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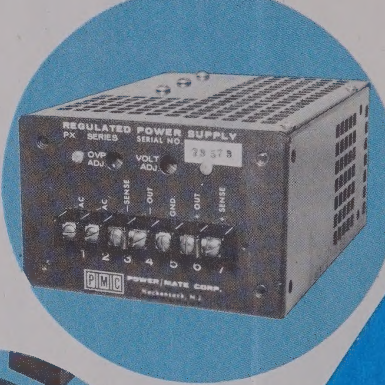
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This issue of EEM is the largest, most complete catalog ever published in the electronics field. The two volumes contain more than 5,000 pages of up-to-date information. New features have been added and you may find it helpful to scan this page as a guide to the easy use of EEM.

1. INDEX OF MANUFACTURERS' CATALOG PAGES

When you need data from particular manufacturers, just look them up alphabetically in the index beginning on page 3 (green pages). More than 700 manufacturers have catalog pages in EEM, and easy reference is given for all these pages in two-number figures. The first number in bold type indicates the volume (1 or 2); the second, the page number. Example: **1**•141 means Vol. 1, page 141.

2. PRODUCT INDEX AND DIRECTORY

All products are indexed by basic type. Each product shows three groups of manufacturers:

1. **Boldface** listings with page references tell you that this manufacturer's catalog pages are right at hand in the white pages.
2. * the asterisk means that this manufacturer has catalog pages in the white section but not on this particular product.
3. Lightface listings, unmarked, means that the manufacturer has submitted a data sheet to verify that they do manufacture this product, but no further data is available in EEM.

New feature You'll find a handy Product Index and Directory in each volume. All product designations are in both volumes, but page references are given only for those products in that volume; you are referred to the other volume when the catalog pages are there.

New feature The letter "D" preceding the listing tells you that the product is available from distributors.

New feature The letter "M" preceding the listing tells you that the product is available in military specifications.

3. TRADE MARK DIRECTORY

If you have just a trade mark, this directory gives you the product it signifies and who makes it. We've black edgemarked the section for easy location. Beginning on page **2**•301 (green pages), there are more than 2500 manufacturers' trade marks listed. Once you have the product and manufacturer, look in the Manufacturers and Sales Offices Directory for complete name and address.

4. MANUFACTURERS' CATALOG PAGES

Here is the greatest collection of detailed catalog pages on electronic products available anywhere. The section is indexed by product category, alphabetically. Manufacturers' catalog pages appear in each product category in alphabetical order. There is a handy guide to the product category in each volume of EEM on the page facing page 1. The great number of catalog pages were divided into the two volumes to facilitate handling.

5. MANUFACTURERS/SALES OFFICES DIRECTORY

Here is all the data on where they are — addresses and phone numbers of main offices, branch offices, local representatives, local distributors plus local contact names and phone numbers.

NEW DATA — Additional data included this year:

a. Minimum order accepted
b. Federal Supply Code (FSC) number
c. Qualified Parts List (QPL) number
d. Individual contacts by name for price data, application information, customer service
e. Free literature offerings
f. Summary of categories of products manufactured by each company
h. Corporate logos or trade marks for easy location of manufacturers. Manufacturers with catalog pages in EEM are indicated by **boldface** listings and page number references.

6. DISTRIBUTOR'S DIRECTORY

Yellow pages, black edgemarked for easy location, contain a geographic listing of electronic distributors offering name, address, phone number and sales manager. This section is to be found in Volume 2 following Manufacturers/Sales Offices Directory.

Your enthusiastic response and usage of EEM has helped make this edition the largest ever. Each year, we try to incorporate new features to make EEM better and easier to use. Your comments and ideas are sincerely welcomed. Please write Editorial Director, United Technical Publications, 645 Stewart Avenue, Garden City, N. Y. 11530.

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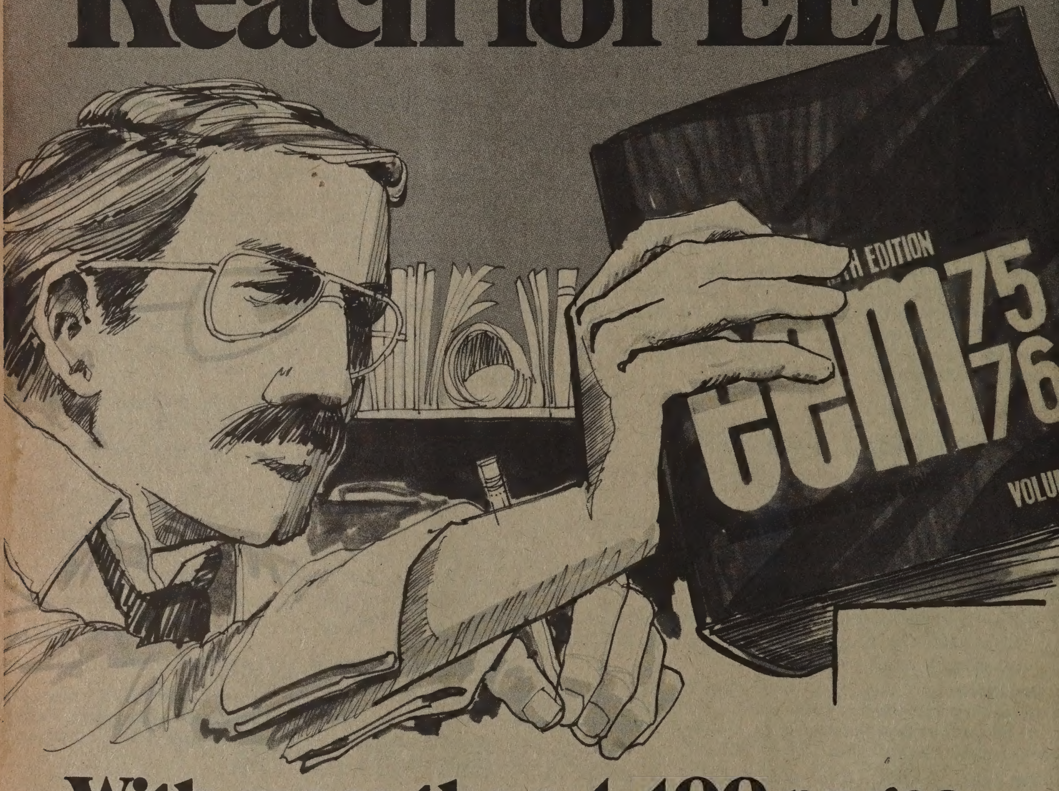

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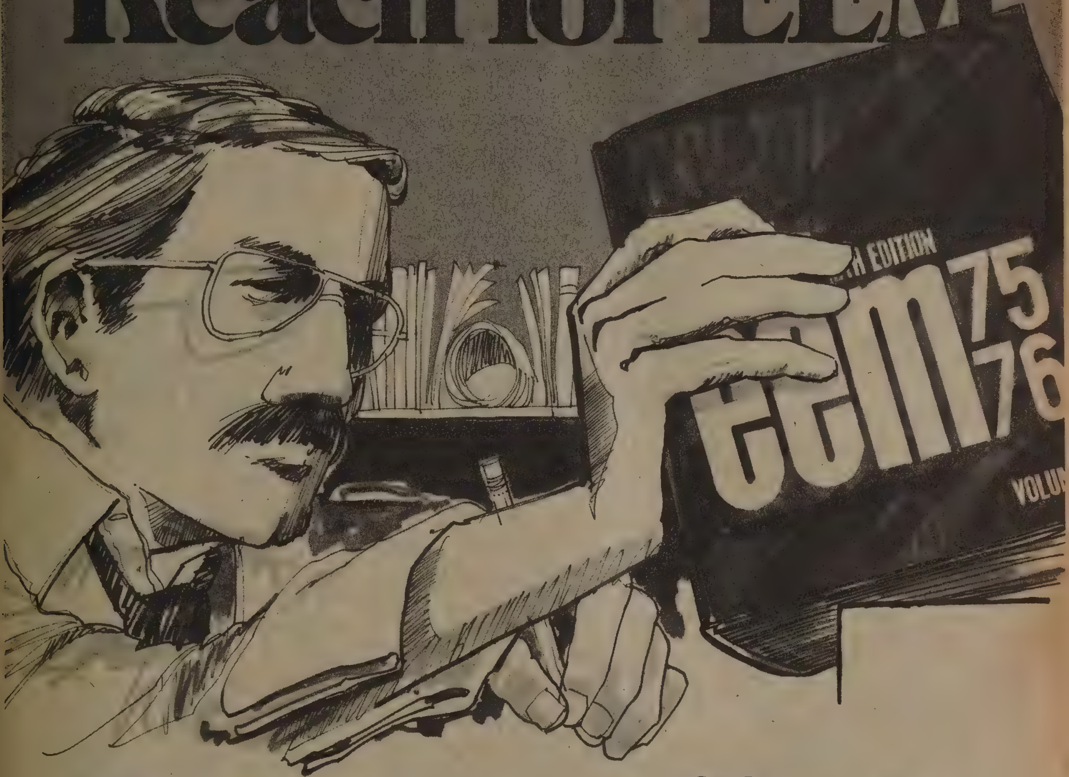

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PRODUCT INDEX AND DIRECTORY

The Product Index and Directory is designed to help locate manufacturers of specific types of electronic products. Products are listed alphabetically with many helpful cross references. The product categories are arranged in the following manner: general product type, specific description. For example, Microwave Generators is listed under Generators, Microwave; Solid State Lamps are found under Lamps, Solid State.

After each Product heading is an alphabetical listing of manufacturers who make that product. Those manufacturers appearing in boldface type with volume and page numbers have catalog data in the white pages of EEM. The volume number appears first, before the bullet, the page number is listed after it. Manufacturers who make the product but who may not have it listed among their catalog pages are in boldface with an asterisk. Manufacturers listed in lightface make the product but have not provided any catalog pages. Those manufacturers marketing the product through distributors have a "D" to the left of their names. Those who manufacture it to meet military specifications have an "M."

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Optical Electronics, Tucson, Ariz.
Optimation, Chatsworth, Cal.
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M Bay Laboratories, Cleveland, Ohio
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Collins Radio, Dallas, Tex.
Control Systems Research, Pittsburgh, Pa.
Datum, Anaheim, Calif.
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M Glentek, Santa Monica, Calif.
Guildline Instrs., Larchmont, N.Y.
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Honeywell, Ft. Washington, Pa.
Incor Instrumentation, West Babylon, N.Y.
D Intech, Santa Clara, Cal.
D Keithley Instruments Inc., Cleveland, Ohio
Leeds & Northrup Co., North Wales, Pa.
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McFadden Elctrns. Co., South Gate, Calif.
Micro Components Corp., Cranston, RI
M Micro-Mo Electronics Inc., Cleveland, Ohio
M Modular Devices, Bohemia, N. Y.
Neff Instrument Corp., Duarte, Cal.
Newport Labs., Santa Ana, Cal.
Nuclear Resch. Corp., Southampton, Pa.
Optical Electronics, Tucson, Ariz.
Optimation, Chatsworth, Cal.
M Perry Amplifier, Brookline, Mass.
Princeton Applied Resch. Corp., Princeton, N.J.
DM RCA Solid State Div., Somerville, N.J.
RIL Elctrns., Southampton, Pa.
Scientific Measurements, Evanston, Ill.
D SGS-ATES Semiconductor, Newtonville, Mass.
Singer Co., State College, Pa.
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D Helm Instr. Co., Toledo, Ohio
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M Modular Devices, Bohemia, N. Y.

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M General Instruments Corp., Hicksville, N.Y. ..... *
M Amplica Inc., Westlake Village, Cal.
Harshaw Chemical Co., Cleveland, Ohio
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Gould, Cleveland, Ohio ...... *
Mini-Systems, North Attleboro, Mass. ...... *
Moxon Inc., Irvine, Cal. ...... *
DM Precision Monolithics Inc., Santa Clara, Cal. .... *
Promemco, Hauppauge, N.Y. ...... *
Teledyne Philbrick, Dedham, Mass. ...... *
B & F Instrs., Corwells Hgts, Pa.
M Bay Laboratories, Cleveland, Ohio
Biocom, Culver City, Cal.
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General Instrument Corp., Hicksville, N.Y.
M Glentek, Santa Monica, Calif.
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D Intech, Santa Clara, Cal.
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D Lithic Systems, Saratoga, Cal.
McKee-Pedersen Instrs., Danville, Calif.
Micro Components Corp., Cranston, RI
M Modular Devices, Bohemia, N. Y.
DM National Semiconductor Corp., Santa Clara, Cal.
Neff Instrument Corp., Duarte, Cal.
D NH Research, Santa Ana, Calif.
Optical Electronics, Tucson, Ariz.
Princeton Applied Resch. Corp., Princeton, N.J.
DM RCA Solid State Div., Somerville, N.J.
Singer Co., State College, Pa.
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Beta Technology, Farmingdale, N.Y.
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D CBS Laboratories, Stamford, Conn.
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D PRD Elctrns., Syosset, N.Y.
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RCA Parts & Accessories, Deptford, N.J.
RIL Elctrns., Southampton, Pa.
Rhode & Schwarz Sls., Fairfield, N.J.
Shure Brothers, Evanston, Ill.
Singer Co., State College, Pa.
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D Ailtech, Farmingdale, N. Y.
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Avantek, Santa Clara, Cal.
BF Elctrns., Solana Beach, Calif.
C-COR Elctrns., State College, Pa.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
E & M Laboratories, Westlake Village, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
Frequency Engrg. Labs., Farmingdale, N.J.
General Instrument Corp., Hicksville, N.Y.
HM Electronics, San Diego, Cal.
HRB-Singer, State College, Pa.
D Keithley Instruments Inc., Cleveland, Ohio
D Lithic Systems, Saratoga, Cal.
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Micro Components Corp., Cranston, RI
Microphase Corp., Cos Cob, Conn.
M Microwave Power Devices, Plainview, N.Y.
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DM National Semiconductor Corp., Santa Clara, Cal.
Optimax, Colmar, Pa.
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M Perry Amplifier, Brookline, Mass.
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D PRD Elctrns., Syosset, N.Y.
Radio Development Lab., Deer Park, NY
DM RCA Solid State Div., Somerville, N.J.
M Required Products, Stanford, Cal.
D R F D, Tampa, Fla.
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Scientific Research Corp., Tampa, Fla.
Special Microwave Devices Oper., Waltham, Mass.
M Technical Research & Mfg., Manchester, N.H.
D Teledyne Semiconductor, Mountain View, Cal.
M Trak Microwave Corporation, Tampa, Fla.
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Tucker Electronics Co., Garland, Tex.
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Promemco, Hauppauge, N.Y. ...... *
Quan-Tech, Randolph Township, N.J. ...... *
Standard Controls, Seattle, Wash. ...... *
M Acromag, Wixom, Mich.
M Amplica Inc., Westlake Village, Cal.
M Avantek, Santa Clara, Cal.
B & F Instrs., Corwells Hgts, Pa.
M Base Ten Systems, Trenton, N.J.
M Bay Laboratories, Cleveland, Ohio
Burr-Brown, Tucson, Ariz.
Continental Rentals Div., Bedford, Mass.
Cycon Corp., Sunnyvale, Cal.
Data, Ft. Collins, Colo.
D Data Translation, Framingham, Mass.
Dynalab Corp., Van Nuys, Cal.
Dynamic Measurements Corp., Winchester, Mass.
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Endevco, San Jaun Capistrano, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
Fogg System Co., Denver, Col.
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General Instrument Corp., Hicksville, N.Y.
General Rand Corp., Edison, N.J.
M Genisco Tech. Corp., Transducers, Compton, Cal.
Harshaw Chemical Co., Cleveland, Ohio
Hawkeye Instrus., Marion, Iowa
D Helm Instr. Co., Toledo, Ohio

Hewlett-Packard Co., Palo Alto, Cal.
S. Himmelstein & Co., Elk Grove Village, Ill.
HM Electronics, San Diego, Cal.
M Hughes Aircraft Co., Torrance, Cal.
Incor Instrumentation, West Babylon, N.Y.
D Intech, Santa Clara, Cal.
Intronics Inc., Newton, Mass.
D Keithley Instruments Inc., Cleveland, Ohio
Leeds & Northrup Co., North Wales, Pa.
McKee-Pedersen Instrs., Danville, Calif.
Micro Components Corp., Cranston, RI
DM National Semiconductor Corp., Santa Clara, Cal.
Neff Instrument Corp., Duarte, Cal.
Newport Labs., Santa Ana, Cal.
Optical Electronics, Tucson, Ariz.
Optimation, Chatsworth, Cal.
D PRD Elctrns., Syosset, N.Y.
Princeton Applied Resch. Corp., Princeton, N.J.
Radio Development Lab., Deer Park, NY
DM RCA Solid State Div., Somerville, N.J.
Sensor Corp., Scottdale, Pa.
Singer Instrumentation, Los Angeles, Cal.
Sprengnether Instr. Co., W.F., St. Louis, Mo.
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D Teledyne Semiconductor, Mountain View, Cal.
D TRW Semiconductor, Lawndale, Cal.
Tucker Electronics Co., Garland, Tex.
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Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y. ... *
DM **General Instruments Corp., Hicksville, N.Y. ... ***
Gould, Cleveland, Ohio ... *
Moxon Inc., Irvine, Cal. ... *
Sprague Products Co., No. Adams, Mass. ... *
DM **Systron Donner, Concord, Cal. ... ***
M Amplica Inc., Westlake Village, Cal.
Burr-Brown, Tucson, Ariz.
M Environmental Communications Inc., Costa Mesa, Cal.
Fogg System Co., Denver, Col.
General Instrument Corp., Hicksville, N.Y.
M Glentek, Santa Monica, Calif.
HRB-Singer, State College, Pa.
M Modular Devices, Bohemia, N. Y.
Optical Electronics, Tucson, Ariz.
Scientific Measurements, Evanston, Ill.
D Taylor Instr. Process Control Div., Rochester, N.Y.
D Teledyne Semiconductor, Mountain View, Cal.
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Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y. ... *
M **General Instruments Corp., Hicksville, N.Y. ... ***
Hope Elctrns., Clifton, N.J. ... *
Quan-Tech, Randolph Township, N.J. ... *
M Acromag, Wixom, Mich.
D Altec Div., Anaheim, Calif.
M Amplica Inc., Westlake Village, Cal.
Burr-Brown, Tucson, Ariz.
M Clifton Precision, Clifton Hgts., Pa.
Collins Radio, Dallas, Tex.
Cross Electronics Inc., Warrendale, Pa.
M Environmental Communications Inc., Costa Mesa, Cal.
D Fairchild Sound Equip., Commack, N.Y.
Fogg System Co., Denver, Col.
General Instrument Corp., Hicksville, N.Y.
M Glentek, Santa Monica, Calif.
Incor Instrumentation, West Babylon, N.Y.
D Intech, Santa Clara, Cal.
D Keithley Instruments Inc., Cleveland, Ohio
M Microwave Power Devices, Plainview, N.Y.
DM Miteg Inc., Hauppauge, N.Y.
M Modular Devices, Bohemia, N. Y.
Neff Instrument Corp., Duarte, Cal.
Newport Labs., Santa Ana, Cal.
M Perry Amplifier, Brookline, Mass.
D PRD Elctrns., Syosset, N.Y.
Singer Co., Little Falls, N.J.
D Spectra Sonics, Ogden, Utah
Tucker Electronics Co., Garland, Tex.

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Aydin Energy Systems, Palo Alto, Cal.
Collins Radio, Dallas, Tex.
M Keltec Florida, Fort Walton Beach, Fla.
M Litton Inds., San Carlos, Calif.
Sperry Microwave Components, Gainesville, Fla.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
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DM **General Instruments Corp., Hicksville, N.Y. ... ***
All Systems, Moorestown, N.J.
M Aertech Industries, Sunnyvale, Cal.
D Altec Div., Anaheim, Calif.
M Amplica Inc., Westlake Village, Cal.
M Avantek, Santa Clara, Cal.
BF Elctrns., Solana Beach, Calif.
D CBS Laboratories, Stamford, Conn.
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
D Fairchild Sound Equip., Commack, N.Y.
General Instrument Corp., Hicksville, N.Y.
D Lithic Systems, Saratoga, Cal.
DM Miteg Inc., Hauppauge, N.Y.
Non Linear Filters, Trumbull, Conn.
Optical Electronics, Tucson, Ariz.
Pasternack Enterprises, Huntington Beach, Cal.
DM Plessey Semiconductors, Santa Ana, Cal.
Scientific Research Corp., Tampa, Fla.
Shure Brothers, Evanston, Ill.
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Dynalab Corp., Van Nuys, Cal.
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Frequency Engrg. Labs., Farmingdale, N.J.
Function Modules, Costa Mesa, Cal.
General Instrument Corp., Hicksville, N.Y.
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McKee-Pedersen Instrs., Danville, Calif.
Microphase Corp., Cos Cob, Conn.
DM Miteg Inc., Hauppauge, N.Y.
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M Perry Amplifier, Brookline, Mass.
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AEL, Colmar, Pa.
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M Amplica Inc., Westlake Village, Cal.
M Avantek, Santa Clara, Cal.
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M Environmental Communications Inc., Costa Mesa, Cal.
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Frequency West, Santa Clara, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
HRB-Singer, State College, Pa.
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M Keltec Florida, Fort Walton Beach, Fla.
Litton Inds., San Carlos, Calif.
M Lorch Devices Inc., Englewood, N.J.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
M Microwave Power Devices, Plainview, N.Y.
Microwave Semiconductor Corp., Somerset, N.J.
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Sperry Microwave Components, Gainesville, Fla.
M Technical Research & Mfg., Manchester, N.H.
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Varian Assocs., Palo Alto, Cal.
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M General Devices, Princeton, N.J.
General Instrument Corp., Hicksville, N.Y.
HGA Elctrns., Mt. Vernon, N.Y.
M Modular Audio Products, Bohemia, N.Y.
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D Russco Electronics Mfg. Inc., Clovis, Cal.
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Special Microwave Devices Oper., Waltham, Mass.
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Sprague Elec. Co., No. Adams, Mass.
Varian Assocs., Palo Alto, Cal.
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General Radio Co., Concord, Mass. .... *
Hope Elctrns., Clifton, N.J. .... *
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AEL, Colmar, Pa.
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M Amplica Inc., Westlake Village, Cal.
Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
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C-COR Elctrns., State College, Pa.
Dynalab Corp., Van Nuys, Cal.
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E & M Laboratories, Westlake Village, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
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General Instrument Corp., Hicksville, N.Y.
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M Lorch Elctrns. Corp., Englewood, N.J.
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M Microwave Power Devices, Plainview, N.Y.
Microwave Semiconductor Corp., Somerset, N.J.
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Mu-Del Elctrns., Silver Spring, Md.
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M Perry Amplifier, Brookline, Mass.
D PRD Elctrns., Syosset, N.Y.
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M Technical Research & Mfg., Manchester, N.H.
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Burr-Brown, Tucson, Ariz.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
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Control Systems Research, Pittsburgh, Pa.
Dynamic Measurements Corp., Winchester, Mass.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
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M Glentek, Santa Monica, Calif.
M Halex, Torrance, Cal.
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D Intech, Santa Clara, Cal.
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Kinetic Tech., Santa Clara, Cal.
Leeds & Northrup Co., North Wales, Pa.
McFadden Elctrns. Co., South Gate, Calif.
McKee-Pedersen Instrs., Danville, Calif.
Micro Components Corp., Cranston, RI
M Modular Devices, Bohemia, N. Y.
DM National Semiconductor Corp., Santa Clara, Cal.
Neff Instrument Corp., Duarte, Cal.
M Optical Electronics, Tucson, Ariz.
Princeton Applied Resch. Corp., Princeton, N.J.
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Dynalab Corp., Van Nuys, Cal.
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Function Modules, Costa Mesa, Cal.
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Control Systems Research, Pittsburgh, Pa.
M Environmental Communications Inc., Costa Mesa, Cal.
General Instrument Corp., Hicksville, N.Y.
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DM National Semiconductor Corp., Santa Clara, Cal.
D NH Research, Santa Ana, Calif.
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D Altec Div., Anaheim, Calif.
M Amplica Inc., Westlake Village, Cal.
Applied Control Co., Fairfield, N.J.
M Avantek, Santa Clara, Cal.
Aydin Energy Systems, Palo Alto, Cal.
Behlman Div., California Instrs., San Diego, Cal
D Bogen Div., Paramus, N.J.
C-COR Elctrns., State College, Pa.
Calico Div., San Diego, Cal.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Control Systems Research, Pittsburgh, Pa.
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M Delta Elctrn. Control, Costa Mesa, Cal.
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D Dracon Industries, Chatsworth, Cal.
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D Lithic Systems, Saratoga, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
McFadden Elctrns. Co., South Gate, Calif.
McKee-Pedersen Instrs., Danville, Calif.
M Microwave Power Devices, Plainview, N.Y.
DM Miteg Inc., Hauppauge, N.Y.
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Transcom Electronics, La Mesa, Cal.
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M Keltec Florida, Fort Walton Beach, Fla.
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M Microwave Power Devices, Plainview, N.Y.
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D TRW Semiconductor, Lawndale, Cal.
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AEL, Colmar, Pa.
D AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
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M Aertech Industries, Sunnyvale, Cal.
Aiken Industries, Gaithersburg, Md.
D Ailtech, Farmingdale, N. Y.
American Astrionics, Costa Mesa, Cal.
M Amplica Inc., Westlake Village, Cal.
D Antenna Corp. of America, Burlington, Iowa
Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
M A.R.F. Products, Boulder, Colo.
Ava Elctrns., Landsdowne, Pa
M Avantek, Santa Clara, Cal.
Aydin Energy Systems, Palo Alto, Cal.
D Barker & Williamson, Bristol, Pa.
The Bendix Corp., Teterboro, N.J.
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D Blonder-Tongue Labs., Old Bridge, N.J.
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D Channel Master Div. Avnet, Ellenville, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
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M Lorch Elctrns. Corp., Englewood, N.J.
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M Microlab/FXR, Livingston, N.J.
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DM RCA Solid State Div., Somerville, N.J.
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D R F D, Tampa, Fla.
D Rodelco, Deer Park, N.Y.
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Singer Co., State College, Pa.
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M Teledyne Mec., Palo Alto, Cal.
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D TRW Semiconductor, Lawndale, Cal.
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D Data Translation, Framingham, Mass.
Datum, Anaheim, Calif.
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E-H Resch. Labs., Oakland, Cal.
Emergency Beacon Corp., New Rochelle, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Function Modules, Costa Mesa, Cal.
General Instrument Corp., Hicksville, N.Y.
Incor Instrumentation, West Babylon, N.Y.
D Intech, Santa Clara, Cal.
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M Avantek, Santa Clara, Cal.
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BF Elctrns., Solana Beach, Calif.
Biocom, Culver City, Cal.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Data-Control Systems, Danbury, Conn.
Dynalab Corp., Van Nuys, Cal.
D Emergency Beacon Corp., New Rochelle, N.Y.
Fogg System Co., Denver, Col.
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Tektronix, Beaverton, Ore.
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D Bacharach Instrument Co., Pittsburgh, Pa.
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British Aircraft Corp. (USA Inc.), Arlington, Va.
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E.I. DuPont de Nemours & Co., Wilmington, Del.
Fisher Sci. Co., Pittsburgh, Pa.
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Meloy Laboratories Inc., Springfield, Va.
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Rhode & Schwarz Sls., Fairfield, N.J.
Rycom Instruments, Raytown, Mo.
Singer Instrumentation, Los Angeles, Cal.
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Electro-Mechanics Co., Austin, Tex.
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M AUL Instrs., Flushng, N.Y.
Collins Radio, Dallas, Tex.
Continental Rentals Div., Bedford, Mass.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Washington, D.C.
Hewlett-Packard Co., Palo Alto, Cal.
Microwave Assocs., Burlington, Mass.
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DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
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D Columbia Resch. Labs., Woodlyn, Pa.
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Edmund Scientific Co., Barrington, N.J.
E.I. DuPont de Nemours & Co., Wilmington, Del.
Electro-Metrics, Amsterdam, N.Y.
Electro-Optical Inds., Santa Barbara, Cal.
Elsytec, Syosset, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
IRD Mechanalysis, Columbus, Ohio
Metrosonics, Rochester, N.Y.
Mine Safety Appliances Co., Pittsburgh, Pa
Nicolet Scientific Corp., Northvale, N.J.
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Elsytec, Syosset, N.Y.
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Harshaw Chemical Co., Cleveland, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
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Rhode & Schwarz Sls., Fairfield, N.J.
Sanders Associates, Nashua, N.H.
D Singer Co., Palo Alto, Cal.
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Advanced Dynamic Instrs. Div., Alexandria, Va.
Applied Systems Corp., St. Clair Shores, Mich.
B & K Instruments, Cleveland, Ohio
Bafco, Warminster, Pa.
D Baganoff Assocs., St. Louis, Mo.
D Bearing Inspection, Santa Fe Springs, Cal.
Continental Rentals Div., Bedford, Mass.
Electrac, Anaheim, Calif.
Electro-Metrics, Amsterdam, N.Y.
Elsytec, Syosset, N.Y.
Endevco, San Jaun Capistrano, Cal.
D Helm Instr. Co., Toledo, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
IRD Mechanalysis, Columbus, Ohio
Lion Precision Corp, Newton, Mass.
Metrix Instrument Co., Houston, Tex.
Nicolet Scientific Corp., Northvale, N.J.
PCB Piezotronics, Depew, N.Y.
Physical Data, Portland, Ore.
Reliance Electric Co., Cleveland, Ohio
Rhode & Schwarz Sls., Fairfield, N.J.
Sensor Corp., Scottdale, Pa.
Tucker Electronics Co., Garland, Tex.
UFAD Corp., Grand Rapids, Mich.
Vibration Instrs. Co., Anaheim, Cal.

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Artisan Elctrns. Corp., Parsippany, N.J.
D Autocon Inds., Minneapolis, Minn.
Automation Displays Inc., Eau Claire, Wisc.
The Bendix Corp., Teterboro, N.J.
Bramco Controls Div., Piqua, Ohio
Clare-Pendar, Post Falls, Idaho
Communications Equipment Co., Indianapolis, Ind.
D Datatron, Santa Ana, Cal.
Engdahl Enterprises, Costa Mesa, Cal.
Hathaway Instruments, Denver, Colo.
Henschel Corp., Amesbury, Mass.
Knowles Elctrns., Franklin Park, Ill.
Major Data Corp., Costa Mesa, Cal.
D Metra Instruments, Mt. View, Cal.
Metric Systems Corp., Ft. Walton Beach, Fla.
D Onan Div-Onan Corp., Minneapolis, Minn.
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M ABA Industries, Pinellas Pk., Fla.
D Alliance Mfg. Co., Alliance, Ohio
D Antenna Corp. of America, Burlington, Iowa
Antenna Research Associates, Beltsville, Md.
D Blonder-Tongue Labs., Old Bridge, N.J.
D Channel Master Div. Avnet, Ellenville, N.Y.
D Cornell-Dubilier Electronics, Newark, N.J.
Datron Systems, Chatsworth, Cal.
D Finney Co., Bedford, Ohio
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
Meltronics Inc., Leeds, Ala.
Tasker Systems, Chatsworth, Cal.
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M Adams-Russell Co., Waltham, Mass.
AEL, Colmar, Pa.
Aiken Industries, Gaithersburg, Md.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Fullerton, Cal.
Hy-Gain Electronics Corp., Lincoln, Neb.
M Sanders Associates, Nashua, N.H.
Torr Labs., Los Angeles, Cal.
M Transco Prods., Venice, Cal.
Trompeter Electronics, Chatsworth, Cal.

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D **GC Electronics, Rockford, Ill.** .... *
AEL, Colmar, Pa.
D Antenna Corp. of America, Burlington, Iowa
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
D Channel Master Div. Avnet, Ellenville, N.Y.
Copperweld Bimetallics, Glassport, PA
M Craig Sys. Corp., Lawrence, Mass.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
Metric Systems Corp., Ft. Walton Beach, Fla.
Microflect Co., Salem, Ore.
Motorola Comms. Div., Schaumburg, Ill.
D Rohn Mfg., Peoria, Ill.
D S & A Electronics, Toledo, Ohio
D Sitco Antennas, Portland, Ore.
Telrex Labs., Asbury Park, N.J.
Titchener, E.H. & Co., Binghamton, N.Y.
D Tri-Ex Tower Corp., Visalia, Calif.
Tucker Electronics Co., Garland, Tex.
Up-Right Scaffolds, Berkeley, Calif.

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M **Aeroflex Labs., Plainview, N.Y.** .... *
Instruments for Industry, Farmingdale, N.Y. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
M Adams-Russell Co., Waltham, Mass.
AEL, Colmar, Pa.
Aircom, Union, N.H.
D Anixter-Mark, Skokie, Ill.
Aviatech Intl. Inc., Holbrook, N.Y.
DM Bayshore Systems Corp., Springfield, Va.
D Bendix Corp., Ft. Lauderdale, Fla.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
M Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
M E-Systems Inc., Dallas, Tex.
Elctrn. Comm., St. Petersburg, Fla.
Emergency Beacon Corp., New Rochelle, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
Lockheed Aircraft Svc., Ont., Cal.
Microwave Prods., Chatsworth, Cal.
M Nurad, Baltimore, Md.
M Premier Microwave, Port Chester, N.Y.
D Rantec Div., Calabasas, Calif.
M Sanders Associates, Nashua, N.H.
Singer Co., State College, Pa.
DM Teledyne Micronetics, San Diego, Calif.
Titchener, E.H. & Co., Binghamton, N.Y.
M Transco Prods., Venice, Cal.
D TRG,, Woburn, Mass.

Antennas, Direction Finding

M **Aeroflex Labs., Plainview, N.Y.** .... *
Instruments for Industry, Farmingdale, N.Y. .... *
M Adams-Russell Co., Waltham, Mass.
AEL, Colmar, Pa.
Andrew Antenna Co. Ltd., Whitby, Ont., Can.
Antenna Research Associates, Beltsville, Md.
Aviatech Intl. Inc., Holbrook, N.Y.
Collins Radio, Dallas, Tex.
Datron Systems, Chatsworth, Cal.
M E-Systems Inc., Dallas, Tex.
Emergency Beacon Corp., New Rochelle, N.Y.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
Hy-Gain Electronics Corp., Lincoln, Neb.
ITT Mackay Marine, Raleigh, N.C.
Lockheed Aircraft Svc., Ont., Cal.
M Nurad, Baltimore, Md.
M Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
Rantec Div., Calabasas, Calif.
Rhode & Schwarz Sls., Fairfield, N.J.
M Sanders Associates, Nashua, N.H.
Singer Co., State College, Pa.
Telrex Labs., Asbury Park, N.J.
Titchener, E.H. & Co., Binghamton, N.Y.
M Transco Prods., Venice, Cal.
D TRG,, Woburn, Mass.

Antennas, Ground Plane

Instruments for Industry, Farmingdale, N.Y. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
AEL, Colmar, Pa.
Antenna Research Associates, Beltsville, Md.
D Cush Craft Corp., Manchester, N.H.
Elctrn. Comm., St. Petersburg, Fla.
D Finney Co., Bedford, Ohio
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
D Kreckman, Herb Co., Cresco, Pa.
M Nurad, Baltimore, Md.
D Premax Prods. Div., Niagara Falls, N.Y.
M Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
D SHAKESPEARE, Columbia, S.C.
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Telrex Labs., Asbury Park, N.J.
Tucker Electronics Co., Garland, Tex.

Antennas, Helical

Instruments for Industry, Farmingdale, N.Y. .... *
AEL, Colmar, Pa.
Andrew Corp., Orland Park, Ill.
Antenna Research Associates, Beltsville, Md.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
M Cubic Corp., San Diego, Cal.
D Cush Craft Corp., Manchester, N.H.
Datron Systems, Chatsworth, Cal.
M E-Systems Inc., Dallas, Tex.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Fullerton, Cal.
DM Hy-Gain Electronics Corp., Lincoln, Neb.
Polyflon Corp., New Rochelle, N.Y.
M Premier Microwave, Port Chester, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D SHAKESPEARE, Columbia, S.C.
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Singer Co., State College, Pa.
Tasker Systems, Chatsworth, Cal.
M Transco Prods., Venice, Cal.
Tucker Electronics Co., Garland, Tex.

Antennas, Log-Periodic

Instruments for Industry, Farmingdale, N.Y. .... *
AEL, Colmar, Pa.
Andrew Corp., Orland Park, Ill.
D Antenna Corp. of America, Burlington, Iowa
Antenna Research Associates, Beltsville, Md.
D Blonder-Tongue Labs., Old Bridge, N.J.
D Channel Master Div. Avnet, Ellenville, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
D Cush Craft Corp., Manchester, N.H.
M E-Systems Inc., Dallas, Tex.
Electro-Mechanics Co., Austin, Tex.
Elctrn. Comm., St. Petersburg, Fla.
D Finney Co., Bedford, Ohio
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
D Jerrold Electronics Corp., Horsham, Pa.
M Nurad, Baltimore, Md.
Rhode & Schwarz Sls., Fairfield, N.J.
D S & A Electronics, Toledo, Ohio
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Telrex Labs., Asbury Park, N.J.

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Shigoto Inds., Ltd., New York, N.Y. .... *
M Adams-Russell Co., Waltham, Mass.
Antenna Research Associates, Beltsville, Md.
D Cush Craft Corp., Manchester, N.H.
Electro-Mechanics Co., Austin, Tex.
Elctrn. Comm., St. Petersburg, Fla.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
ITT Mackay Marine, Raleigh, N.C.
Kinemetrics, San Gabriel, Cal.
McKay Dymek Co., Pomona, Cal.
Radiation Devices Co., Baltimore, Md.
RCA Parts & Accessories, Deptford, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
D S & A Electronics, Toledo, Ohio
DM Saxton Prods., Congers, N.Y.
Singer Co., State College, Pa.
Solar Elctrns. Co., Hollywood, Cal.
Tucker Electronics Co., Garland, Tex.
D Vidaire Electronics Mfg., Freeport, N.Y.

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AEL, Colmar, Pa.
Aircom, Union, N.H.
Andrew Antenna Co. Ltd., Whitby, Ont., Can.
Andrew Corp., Orland Park, Ill.
D Anixter-Mark, Skokie, Ill.
Antenna Research Associates, Beltsville, Md.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Corning Glass Works, Corning, N.Y.
M Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
M E-Systems Inc., Dallas, Tex.
Electro-Mechanics Co., Austin, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Gabriel Elctrns. Inc., Scarborough, Me.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
M ITT Gilfillan Div. of ITT, Van Nuys, Calif.
Maury Microwave Corp., Cucamonga, Calif.
M Microlab/FXR, Livingston, N.J.
Microwave Prods., Chatsworth, Cal.
Narda Microwave Corp., Plainview, N.Y.
M Nurad, Baltimore, Md.
M Premier Microwave, Port Chester, N.Y.
M Radatron Corp., N. Tonawanda, NY
D Rantec Div., Calabasas, Calif.
Rhode & Schwarz Sls., Fairfield, N.J.
D Rohn Mfg., Peoria, Ill.
M Sanders Associates, Nashua, N.H.
Singer Co., State College, Pa.
DM Teledyne Micronetics, San Diego, Calif.
M Transco Prods., Venice, Cal.
D TRG,, Woburn, Mass.
Tucker Electronics Co., Garland, Tex.
Varian Assoc., Beverly, Mass
Varian Electron Tube & Device Grp., San Carlos, Cal.
Waveline, W. Caldwell, N.J.

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Instruments for Industry, Farmingdale, N.Y. ....*
All Systems, Moorestown, N.J.
AEL, Colmar, Pa.
M Airtron, Morris Plains, N.J.
Andrew Antenna Co. Ltd., Whitby, Ont., Can.
Antenna Research Associates, Beltsville, Md.
D Channel Master Div. Avnet, Ellenville, N.Y.
Collins Radio, Dallas, Tex.
M Cubic Corp., San Diego, Cal.
D Cush Craft Corp., Manchester, N.H.
Datron Systems, Chatsworth, Cal.
M E-Systems Inc., Dallas, Tex.
Elctrn. Comm., St. Petersburg, Fla.
D Finney Co., Bedford, Ohio
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
Microwave Prods., Chatsworth, Cal.
M Nurad, Baltimore, Md.
M Premier Microwave, Port Chester, N.Y.
D Rantec Div., Calabasas, Calif.
D S & A Electronics, Toledo, Ohio
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Singer Co., State College, Pa.
D Sitco Antennas, Portland, Ore.

Technical Mat'l., Mamaroneck, N.Y.
M Teledyne Micronetics, San Diego, Calif.
Telrex Labs., Asbury Park, N.J.
M Transco Prods., Venice, Cal.
D TRG,, Woburn, Mass.
D Turner Div., Cedar Rapids, Iowa
D Winegard Co., Burlington, Iowa

Antennas, Rhombic

Instruments for Industry, Farmingdale, N.Y. ....*
GTE Sylvania Inc., Washington, D.C.
M Hy-Gain Electronics Corp., Lincoln, Neb.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Technical Mat'l., Mamaroneck, N.Y.

Antennas, Spiral

Instruments for Industry, Farmingdale, N.Y. ....*
AEL, Colmar, Pa.
M American Chemical Etching, Pacoima, , Cal.
Antenna Research Associates, Beltsville, Md.
D Cush Craft Corp., Manchester, N.H.
M E-Systems Inc., Dallas, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Fullerton, Cal.
M Nurad, Baltimore, Md.
Polyflon Corp., New Rochelle, N.Y.
M Premier Microwave, Port Chester, N.Y.
Singer Co., State College, Pa.
M Teledyne Micronetics, San Diego, Calif.
Telrex Labs., Asbury Park, N.J.
M Transco Prods., Venice, Cal.

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Instruments for Industry, Farmingdale, N.Y. ....*
All Systems, Moorestown, N.J.
M ABA Industries, Pinellas Pk., Fla.
AEL, Colmar, Pa.
Andrew Corp., Orland Park, Ill.
D Anixter-Mark, Skokie, Ill.
Antenna Research Associates, Beltsville, Md.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Collins Radio, Dallas, Tex.
M Cubic Corp., San Diego, Cal.
D Cush Craft Corp., Manchester, N.H.
Datron Systems, Chatsworth, Cal.
M E-Systems Inc., Dallas, Tex.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
M Nurad, Baltimore, Md.
D Rantec Div., Calabasas, Calif.
Tasker Systems, Chatsworth, Cal.
M Teledyne Micronetics, San Diego, Calif.
Telrex Labs., Asbury Park, N.J.
M Transco Prods., Venice, Cal.
D TRG,, Woburn, Mass.

Antennas, Telescopic

D GC Electronics, Rockford, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D All Channel Products Corp., Woodside, N.Y.
Andrew Antenna Co. Ltd., Whitby, Ont., Can.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
D Cush Craft Corp., Manchester, N.H.
D Great Western Aviation, Denver, Colo.
K-W Engineering Works, Menomonee Falls, Wisc.
Materials for Elctrns., Jamaica, N.Y.
Midland International Corp., No. Kansas City, Mo.
D Premax Prods. Div., Niagara Falls, N.Y.
D Sterling Mfg. Co., Cleveland, Ohio
D Tri-Ex Tower Corp., Visalia, Calif.
Tucker Electronics Co., Garland, Tex.
D Workman Electronic Prods., Sarasota, Fla.

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D Anixter-Mark, Skokie, Ill.
D Barker & Williamson, Bristol, Pa.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Communication Assocs., Huntington Station, N.Y.
D Cush Craft Corp., Manchester, N.H.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
D Finney Co., Bedford, Ohio
D Great Western Aviation, Denver, Colo.
Hughes Aircraft Co, Fullerton, Cal.
DM Hy-Gain Electronics Corp., Lincoln, Neb.
ITT Mackay Marine, Raleigh, N.C.
D Midland International Corp., No. Kansas City, Mo.

Motorola Comms. Div., Schaumburg, Ill.
D New-Tronics Corp., Brookpark, Ohio
D Pearce-Simpson, Miami, Fla.
D Premax Prods. Div., Niagara Falls, N.Y.
D Royce Electronics Corp., No. Kansas City, Mo.
D S G C Inc., Bellevue, Wash.
DM SHAKESPEARE, Columbia, S.C.
D Sterling Mfg. Co., Cleveland, Ohio
Tracor, Austin, Tex.
Tucker Electronics Co., Garland, Tex.
D Turner Div., Cedar Rapids, Iowa

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Ross Engineering Corp., Campbell, Cal. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Cutler-Hammer, Milwaukee, Wisc.
Eastern Delta Corp., Fair Lawn, N.J.
Edal Inds., E. Haven, Conn.
Electrons Co., Fairfield, N.J.
DM General Semiconductor Industries, Tempe, Ariz.
Hewlett-Packard Co., Palo Alto, Cal.
Joslyn Elctrn. Sys., Goleta, Cal.
M McG Electronics Inc., Deer Park, N.Y.
D Siemens Corp., Iselin, N.J.
Signalite Div., Neptune, N.J.
Triac Electronics, New York, N.Y.
D Workman Electronic Prods., Sarasota, Fla.

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D GC Electronics, Rockford, Ill. .... *
Ross Engineering Corp., Campbell, Cal. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Antenna Corp. of America, Burlington, Iowa
Ava Elctrns., Landsdowne, Pa
D Channel Master Div. Avnet, Ellenville, N.Y.
M Cush Craft Corp., Manchester, N.H.
Electrons Co., Fairfield, N.J.
D Finney Co., Bedford, Ohio
DM General Semiconductor Industries, Tempe, Ariz.
DM Hy-Gain Electronics Corp., Lincoln, Neb.
Joslyn Elctrn. Sys., Goleta, Cal.
Motorola Comms. Div., Schaumburg, Ill.
D S & A Electronics, Toledo, Ohio
Signalite Div., Neptune, N.J.

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D Allen-Bradley Co., Milwaukee, Wisc. .... *
Applied Research Inc., Port Washington, N.Y. *

Chesterfield Prods. Inc., Saddle Brook, N.J. *
D **Duncan Electronics, Costa Mesa, Cal.** *
General Radio Co., Concord, Mass. *
Kay Elemetrics Corp., Pine Brook, N.J. *
D **Ohmite Mfg. Co., Skokie, Ill.** *
D **Trimm, Libertyville, Ill.** *
Wavetek, San Diego, Cal *
D Altec Div., Anaheim, Calif.
D Davis & Co., J.W., Dallas, Tex.
Elcom Systems, Deer Pk., N.Y.
D Electro-Voice, Buchanan, Mich.
Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
D Fairchild Sound Equip., Commack, N.Y.
General Resistance, Mt. Vernon, N.Y.
Gotham Audio Corp., New York, N.Y.
Incor Instrumentation, West Babylon, N.Y.
D Javex Elctrns., Cherry Valley, Cal.
DM Kings Electronics, Tuckahoe, N.Y.
Knol Enterprise, San Luis Obispo, Cal.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D Shure Brothers, Evanston, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
D Switchcraft, Chicago, Ill.
Tucker Electronics Co., Garland, Tex.
Waters Mfg., Wayland, Mass.
Weinschel Engrg. Co., Gaithersburg, Md.
D Workman Electronic Prods., Sarasota, Fla.

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D Altec Div., Anaheim, Calif.
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M Analog Devices, Resistor Pdt., Rochester, NY
D Blonder-Tongue Labs., Old Bridge, N.J.
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Elcom Systems, Deer Pk., N.Y.
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Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
D Finney Co., Bedford, Ohio
General Resistance, Mt. Vernon, N.Y.
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DM Kings Electronics, Tuckahoe, N.Y.
LRC Inc., Hudson, N.H.
Maury Microwave Corp., Cucamonga, Calif.
M Microlab/FXR, Livingston, N.J.
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D AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
D Ailtech, Farmingdale, N.Y.
Alan Industries Inc., Columbus, Ind.
M Cir-Q-Tel, Kensington, Md.
Elcom Systems, Deer Pk., N.Y.
Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
Jerrold Electronics Corp., Horsham, Pa.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
M Merrimac Inds., West Caldwell, N.J.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
D PRD Elctrns., Syosset, N.Y.
D Regency Electronics, Indianapolis, Ind.
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Special Microwave Devices Oper., Waltham, Mass.
Stettner-Trush Inc., Cazenovia, N.Y.
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General Radio Co., Concord, Mass. *
D **Ohmite Mfg. Co., Skokie, Ill.** *
Systron-Donner Microwave Div., Van Nuys, Cal. *
AEL, Colmar, Pa.
Alan Industries Inc., Columbus, Ind.
Alford Mfg. Co., Winchester, Mass.
D Altec Div., Anaheim, Calif.
M Analog Devices, Resistor Pdt., Rochester, NY
Ava Elctrns., Landsdowne, Pa
D Centralab, Milwaukee, Wisc.
D Channel Master Div. Avnet, Ellenville, N.Y.
Coax Devices Inc., Chelsea, Mass.
Elcom Systems, Deer Pk., N.Y.
Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
General Resistance, Mt. Vernon, N.Y.
Incor Instrumentation, West Babylon, N.Y.
D ITI Electronics, Clifton, N.J.
D Jerrold Electronics Corp., Horsham, Pa.
DM Kings Electronics, Tuckahoe, N.Y.
M Microlab/FXR, Livingston, N.J.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
M Premier Microwave, Port Chester, N.Y.
R L C Elctrns., Mt. Kisco, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Trompeter Electronics, Chatsworth, Cal.
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M Environmental Communications Inc., Costa Mesa, Cal.
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Kilovac Corp., Santa Barbara, Cal. *
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American Microwave Inds., Waltham, Mass.
Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
M LRC Inc., Hudson, N.H.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
D PRD Elctrns., Syosset, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
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M **Kay Elemetrics Corp., Pine Brook, N.J. .... ***
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
AEL, Colmar, Pa.
D AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
Alan Industries Inc., Columbus, Ind.
American Microwave Inds., Waltham, Mass.
DM Anaren Microwave, Syracuse, N.Y.
Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
D Astrolab, Rahway, N.J.
Blonder-Tongue Labs., Old Bridge, N.J.
D Channel Master Div. Avnet, Ellenville, N.Y.
Coaxial Dynamics, Cleveland, Ohio
M Environmental Communications Inc., Costa Mesa, Cal.
D Finney Co., Bedford, Ohio
M GHZ Devices, So. Chelmsford, Mass.
Hewlett-Packard Co., Palo Alto, Cal.
DM Kings Electronics, Tuckahoe, N.Y.
M Lorch Devices Inc., Englewood, N.J.
M LRC Inc., Hudson, N.H.
Motorola Comms. Div., Schaumburg, Ill.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Stettner-Trush Inc., Cazenovia, N.Y.
Trompeter Electronics, Chatsworth, Cal.
Tucker Electronics Co., Garland, Tex.
D United Mineral & Chem. Corp., New York, N.Y.
Waveline, W. Caldwell, N.J.
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Hope Elctrns., Clifton, N.J. .... *
Alan Industries Inc., Columbus, Ind.
Engelmann Microwave, Montville, N.J.
Jerrold Electronics Corp., Horsham, Pa.
Maury Microwave Corp., Cucamonga, Calif.
M Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
M Prémier Microwave, Port Chester, N.Y.
R L C Elctrns., Mt. Kisco, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Telonic Altair, Laguna Beach, Calif.
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General Radio Co., Concord, Mass. .... *
Hope Elctrns., Clifton, N.J. .... *
D **Ohmite Mfg. Co., Skokie, Ill. .... ***
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
AEL, Colmar, Pa.
D Ailtech, Farmingdale, N. Y.
Alan Industries Inc., Columbus, Ind.
D Altec Div., Anaheim, Calif.
American Microwave Inds., Waltham, Mass.
DM Anaren Microwave, Syracuse, N.Y.
D Blonder-Tongue Labs., Old Bridge, N.J.
D Centralab, Milwaukee, Wisc.
Coax Devices Inc., Chelsea, Mass.
Delta-Benco-Cascade LTD., Rexdale, Ont. Can. M9W 1G1
Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
D Fairchild Sound Equip., Commack, N.Y.
Gotham Audio Corp., New York, N.Y.
D Jerrold Electronics Corp., Horsham, Pa.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
M Merrimac Inds., West Caldwell, N.J.
M Microlab/FXR, Livingston, N.J.
Microwave Assocs., Burlington, Mass.
D Microwave Development Labs., Needham Hgts., Mass.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
D PRD Elctrns., Syosset, N.Y.
Precision Electronics, Franklin Park, Ill
M Premier Microwave, Port Chester, N.Y.
R L C Elctrns., Mt. Kisco, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
D Singer Co., Palo Alto, Cal.
Sivers Lab, Corona del Mar, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Telonic Altair, Laguna Beach, Calif.
D TRG., Woburn, Mass.
Tucker Electronics Co., Garland, Tex.
United Mineral & Chem. Corp., New York, N.Y.
Waveline, W. Caldwell, N.J.
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D American Instr. Co., Silver Spring, Md.
Beckman Instrs., (AISSD), Fullerton, Cal.
Brinkmann Instrs., Westbury, N.Y.
DM Cincinnati Sub-Zero Products, Cincinnati, Ohio
Cox & Co., New York, N.Y.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electrovert, Mt. Vernon, N.Y.
Fisher Sci. Co., Pittsburgh, Pa.
D GCA/Precision Scientific, Chicago, Ill.
Guildline Instrs., Larchmont, N.Y.
Hotpack Corp., Phila., Pa.
Leeds & Northrup Co., North Wales, Pa.
Marlow Industries, Garland, Tex.
Plessey Enviromental Sys., San Diego, Cal.
Rosemount Inc., Minneapolis, Minn.
Sargent Welch Sci. Co., Skokie, Ill.
D Standard Environmental Systems, Totowa, N.J.
D Temptronic Corporation, Newton, Mass.
M Tenney Engrg., Union, N.J.

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Shigoto Inds., Ltd., New York, N.Y. .... *
D Acme Battery Corp., Stamford, Conn.
Motorola Comms. Div., Schaumburg, Ill.
Panasonic SPD Div., New York, N.Y.
D Ray-O-Vac Div., Madison, Wisc.
RCA Electronic Comps., Harrison, N.J.

Batteries, Dry, Flashlight, Transistor, etc.

DM **Union Carbide, New York, N.Y. p. 1•1514,1515**
Power, Burnsville, Minn. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Acme Battery Corp., Stamford, Conn.
Carbone Lorraine Industries Corp., Boonton, N.J.
D Mallory Battery, Tarrytown, N.Y.
Motorola Comms. Div., Schaumburg, Ill.
Panasonic SPD Div., New York, N.Y.
D Ray-O-Vac Div., Madison, Wisc.
RCA Electronic Comps., Harrison, N.J.
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Batteries, Gelled-Electrolyte

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D Elpower Corp., Santa Ana, Cal.
Gates Energy Prods., Denver, Colo.
D Globe Union, Milwaukee, Wisc.
D Gould, St. Paul, Minn.
Panasonic SPD Div., New York, N.Y.
D Power-Sonic Corp., Redwood City, Cal.
SGL Batteries Manufacturing Co., Detroit, Mich.
D Teledyne Big Beam, Crystal Lake, Ill.

Batteries, Lead-Acid

DM **Eagle-Picher Inds., Seneca, Mo. .... p. 1•1208**
D **Amperex Electronic Corp., Hicksville, N.Y. ...... ***
Power, Burnsville, Minn. .... *
M Eagle-Picher Industries, Joplin, Mo.
Exide Power Sys. Div., Philadelphia, Pa.
Gates Energy Prods., Denver, Colo.
D Globe Union, Milwaukee, Wisc.
Gould Inc., Trenton, N.J.
Mine Safety Appliances Co., Pittsburgh, Pa
Power-Sonic Corp., Redwood City, Cal.
Ray-O-Vac Div., Madison, Wisc.
SGL Batteries Manufacturing Co., Detroit, Mich.
D Teledyne Big Beam, Crystal Lake, Ill.
D Terado Corp., St. Paul, Minn.
Wisco Div., Racine, Wisc.

Batteries, Lead-Dioxide

DM **Eagle-Picher Inds., Seneca, Mo. .... p. 1•1208**
Power, Burnsville, Minn. .... *
M Eagle-Picher Industries, Joplin, Mo.
Gates Energy Prods., Denver, Colo.
D Globe Union, Milwaukee, Wisc.
SGL Batteries Manufacturing Co., Detroit, Mich.

Batteries, Lithium

D **Eagle-Picher Inds., Seneca, Mo. .... p. 1•1208**
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M Eagle-Picher Industries, Joplin, Mo.
Edmund Scientific Co., Barrington, N.J.
Honeywell, Minneapolis, Minn.
Mallory Battery, Tarrytown, N.Y.
Panasonic SPD Div., New York, N.Y.
Power Conversion Inc., Mt. Vernon, N.Y.

Batteries, Magnesium

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DM **Union Carbide, New York, N.Y. p. 1•1514,1515**
Power, Burnsville, Minn. .... *
Marathon Battery Co., Houston, Tex.

Batteries, Manganese Alkaline

DM **Union Carbide, New York, N.Y. p. 1•1514,1515**
Power, Burnsville, Minn. .... *
D Mallory Battery, Tarrytown, N.Y.
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Panasonic SPD Div., New York, N.Y.
D Ray-O-Vac Div., Madison, Wisc.
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Batteries, Mercury

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D Mallory Battery, Tarrytown, N.Y.
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M Eagle-Picher Industries, Joplin, Mo.
M Edmund Scientific Co., Barrington, N.J.
Exide Power Sys. Div., Philadelphia, Pa.
Gates Energy Prods., Denver, Colo.
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D Gould, St. Paul, Minn.
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Motorola Comms. Div., Schaumburg, Ill.
National Camera Inc., Englewood, Colo.
Panasonic SPD Div., New York, N.Y.
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M Eagle-Picher Industries, Joplin, Mo.

Batteries, Photoflash

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Power, Burnsville, Minn. .... *
D Mallory Battery, Tarrytown, N.Y.
Panasonic SPD Div., New York, N.Y.
D Ray-O-Vac Div., Madison, Wisc.

Batteries, Silver-Cadmium

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Batteries, Silver Oxide

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Power, Burnsville, Minn. .... *
M Eagle-Picher Industries, Joplin, Mo.
Panasonic SPD Div., New York, N.Y.
D Ray-O-Vac Div., Madison, Wisc.
RCA Electronic Comps., Harrison, N.J.

Batteries, Silver-Zinc

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M Atlas Engrg. Corp., W. Hartford, Conn.
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DM Cincinnati Sub-Zero Products, Cincinnati, Ohio
D CVC Products, Rochester, N.Y.
D GCA/Precision Scientific, Chicago, Ill.
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D Hull Corp., Hatboro, Pa.
INRECO, Los Angeles, Cal.
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Bemco, Pacoima, Cal.
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D GCA/Precision Scientific, Chicago, Ill.
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Associated Testing Labs., Burlington, Mass.
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Bemco, Pacoima, Cal.
Benthos, N. Falmouth, Mass.
DM Cincinnati Sub-Zero Products, Cincinnati, Ohio
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M Webber Manufacturing Co., Indianapolis, Ind.

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American Resch. Corp., Farmington, Conn.
Associated Environmental Systems, Lawrence, Mass.
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DM Cincinnati Sub-Zero Products, Cincinnati, Ohio
Cox & Co., New York, N.Y.
Custom Scientific Instrs., Whippany, N.J.
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D GCA/Precision Scientific, Chicago, Ill.
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High Vacuum Equip. Corp., Hingham, Mass.
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Sargent Welch Sci. Co., Skokie, Ill.
Sigma Sys. Corp., San Diego, Calif.
D Standard Environmental Systems, Totowa, N.J.
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DM Cincinnati Sub-Zero Products, Cincinnati, Ohio
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Astrodata Inc., Anaheim, Cal.
M Atlantic Research Coropration, Alexandria, Va
D Autocon Inds., Minneapolis, Minn.
M Base Ten Systems, Trenton, N.J.
DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
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M Cardion Elctrns., Woodbury, N.Y.
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D Codex Corp., Newton, Mass.
Collins Radio, Dallas, Tex.
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Conrac Corp., Fairfield, N.J.
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M General Devices, Princeton, N.J.
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GTE Sylvania Inc., Washington, D.C.
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Dest Data Corp., Sunnyvale, Cal.
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EG&G, Salem, Mass.
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D Dynamic Communications, Riviera Beach, Fla.
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M General Devices, Princeton, N.J.
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Narda Microwave Corp., Plainview, N.Y.
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D Regency Electronics, Indianapolis, Ind.
REPCO Inc., Orlando, Fla.
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M Cardion Elctrns., Woodbury, N.Y.
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D Autocon Inds., Minneapolis, Minn.
M Bendix Corp, Towson, Md.
Bendix Corp., N. Hollywood, Calif.
Beta Technology, Farmingdale, N.Y.
Bramco Controls Div., Piqua, Ohio
M Cardion Elctrns., Woodbury, N.Y.
Coastcom, Concord, Cal.
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GTE Sylvania Inc., Washington, D.C.
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M Bendix Corp, Towson, Md.
Bramco Controls Div., Piqua, Ohio
DM Brelonix, Seattle, Wash
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D Dynamic Communications, Riviera Beach, Fla.
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D Fanon/Courier Corp., Subs., Pasadena, Cal.
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GTE Sylvania Inc., Washington, D.C.
D Intech, Santa Clara, Cal.
ITT Mackay Marine, Raleigh, N.C.
D Kris Inc., Cedarburg, Wisc.
D Linear Systems, Watsonville, Cal.
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D Midland International Corp., No. Kansas City, Mo.
D Mobil Electronics, Anderson, Ind.
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D Royce Electronics Corp., No. Kansas City, Mo.
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Baumker Mfg. Co., Toledo, Ohio
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M Cardion Elctrns., Woodbury, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
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Dynalab Corp., Van Nuys, Cal.
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D Fanon/Courier Corp., Subs., Pasadena, Cal.
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GTE Lenkurt Inc., San Carlos, Calif.

GTE Sylvania Inc.; Washington, D.C.
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D Autocon Inds., Minneapolis, Minn.
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D Baganoff Assocs., St. Louis, Mo.
M Base Ten Systems, Trenton, N.J.
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Biocom, Culver City, Cal.
Bramco Controls Div., Piqua, Ohio
M Cardion Elctrns., Woodbury, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
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Dataproducts Corp., Woodland Hills, Cal.
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GTE Automatic Electric Inc., Northlake, Ill.
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GTE Sylvania Inc., Washington, D.C.
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D ITI Electronics, Clifton, N.J.
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D Phone-Aid Co., Chicago, Ill.
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D Stewart-Warner Microcircuits, Sunnyvale, Cal.
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D Teledyne Semiconductor, Mountain View, Cal.
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DM Anaren Microwave, Syracuse, N.Y.
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
Engelmann Microwave, Montville, N.J.
Frequency Engrg. Labs., Farmingdale, N.J.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
M Merrimac Inds., West Caldwell, N.J.
Sanders Associates, Manchester, N.H.
Struthers-Dunn, Bettendorf, Iowa
Theta Instr. Corp., Fairfield, N.J.
Tucker Electronics Co., Garland, Tex.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.
Vibration Instrs. Co., Anaheim, Cal.

Comparators, Reluctance

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M **General Instruments Corp., Hicksville, N.Y. .....** *
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Applied Control Co., Fairfield, N.J.
Burr-Brown, Tucson, Ariz.
Doric Sci. Corp., San Diego, Calif.
Dynamic Measurements Corp., Winchester, Mass.
Dytro Corp., Hicksville, N.Y.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
Fenwal, Ashland, Mass.
Guildline Instrs., Larchmont, N.Y.
Jerrold Electronics Corp., Horsham, Pa.
Leeds & Northrup Co., North Wales, Pa.
M Lorch Devices Inc., Englewood, N.J.
Luft Instrs., Lincoln, Mass.
DM National Semiconductor Corp., Santa Clara, Cal.
Non-Linear Sys., Del Mar, Cal.
Optical Electronics, Tucson, Ariz.
Pioneer Instrumentation, Cleveland, Ohio
Richard-Lee Co., New Providence, N.J.
Scientific Measurements, Evanston, Ill.
D Siliconix, Santa Clara, Cal
Tektronix, Beaverton, Ore.
D Teledyne Semiconductor, Mountain View, Cal.
Tempo Instrument, Plainview, N.Y.
Zi-Tech Div., Palo Alto, Cal.

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NES, Streamwood, Ill. ...... *
Dest Data Corp., Sunnyvale, Cal.
General Automation, Anaheim, Cal.
Systems Data Inc., Akron, Ohio

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M **Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917**
D **General Magnetics, Bloomfield, N.J. ......** *
DM **Systron Donner, Concord, Cal. ......** *
Systron-Donner Microwave Div., Van Nuys, Cal. ...... *
Yewtec Corporation, Larchmont, N.Y. ...... *
AMF Electical Prods., Alexandria, Va.
M Aviation Elec., Ltd., Montreal, H4L 4x8 Que., Can.
D Baganoff Assocs., St. Louis, Mo.
Datron Systems, Chatsworth, Cal.
Foxboro Co., Foxboro, Mass.
GAP Instr. Corp., Hauppauge, N.Y.
Hughes Aircraft Co, Culver City, Cal.
Leeds & Northrup Co., North Wales, Pa.
Scientific Measurements, Evanston, Ill.
Singer Co., Little Falls, N.J.
Systems Data Inc., Akron, Ohio
M Systron-Donner Inertial Div., Concord, Cal.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Telectro Sys. Corp., Corona, N.Y.

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Promemco, Hauppauge, N.Y. ...... *
Applied Systems Corp., St. Clair Shores, Mich.
Beckman Instrs., (AISSD), Fullerton, Cal.
Burroughs Corp., Pasadena, Cal.
Cipher Data Products, San Diego, Cal.
Digital Equipment Corp., Maynard, Mass.
Diversified Electronics Co., Sunnyvale, Cal.
Four-Phase Systems, Cupertino, Cal,
Hewlett-Packard Co., Palo Alto, Cal.
Microdata Corp., Irvine, Cal.
D Monroe, The Calculator Co., Orange, N.J.
D PCS., Flint, Mich.
Sanders Data Systems, Nashua, N.H.
Texas Instrs. Inc., Houston, Tex.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.
Wang Laboratories, Tewksbury, Mass.

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M **Delco Electronics Div., Kokomo, Ind. ......** *
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Adams-Smith Inc., Needham, Mass.
American Used Computer Corp., Boston, Mass.
Applied Systems Corp., St. Clair Shores, Mich.
B & K Instruments, Cleveland, Ohio
Beckman Instrs., (AISSD), Fullerton, Cal.
M Bendix-Guidance Systems, Teterboro, N.J.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bunker-Ramo Corp., Westlake Village, Cal
Burroughs Corp., Pasadena, Cal.
California Computer Prods., Anaheim, Cal
Collins Radio, Dallas, Tex.
Computer Talk Inc., Idledale, Colo.
Data General Corp., Southboro, Mass.
Data Numerics, Farmingdale, N.Y.
Data Technology Inc., Watertown, Mass.
Datum, Anaheim, Calif.
Design Automation, Lexington, Mass.
Digiac Corp., Smithtown, N.Y.
Digital Computer Controls, Fairfield, N.J.
Digital Equipment Corp., Maynard, Mass.
Digital Scientific, San Diego, Cal.
Dynapar Corp., Gurnee, Ill.
Fairchild Space & Defense Sys. Div., Syosset, N.Y.
Four-Phase Systems, Cupertino, Cal
Foxboro Co., Foxboro, Mass.
G B Instruments Inc., Hollywood, Fla.
General Automation, Anaheim, Cal.
Goodyear Aerospace Corp., Akron, Ohio
GTE Sylvania Inc., Washington, D.C.
Harris Corp., Fort Lauderdale, Fla.
Hewlett-Packard Co., Palo Alto, Cal.
Honeywell, Minneapolis, Minn.
Honeywell Information Systems, Wellsley, Mass.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co, Culver City, Cal.
Instrumentation Tech. Corp., Northridge, Cal.
Intel Corp., Santa Clara, Cal.
D Interdata, Oceanport, N.J.
Leeds & Northrup Co., North Wales, Pa.
Litton Sys., Woodland Hills, Calif.
Lockheed Elctrns. Co., Watchung, N.J.
Major Data Corp., Costa Mesa, Cal.
Metric Systems Corp., Ft. Walton Beach, Fla.
Microdata Corp., Irvine, Cal.
Mohawk OEM Sales, King of Prussia, Pa.
D Mylee Digital Sciences, Maryland Heights, Mo.
DM National Semiconductor Corp., Santa Clara, Cal.
D PCS., Flint, Mich.
Potter Instr. Co., Melville, N.Y.
Research, Minneapolis, Minn.
Robertshaw Controls Co., Richmond, Va
Rolm Corp., Cupertino, Cal.
M Sanders Associates, Nashua, N.H.
Sanders Data Systems, Nashua, N.H.
Scientific Measurements, Evanston, Ill.
Sensor Corp., Scottdale, Pa.
Singer Co., Little Falls, N.J.
Systems Data Inc., Akron, Ohio
D Taylor Instr. Process Control Div., Rochester, N.Y.
Tech Serv., Beltsville, Md
Texas Instrs. Inc., Houston, Tex.
Theta Instr. Corp., Fairfield, N.J.
Uniroyal, New York, N.Y.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.

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DM **Systron Donner, Concord, Cal. ......** *
Systron-Donner Microwave Div., Van Nuys, Cal. ...... *
Applied Digital Data Sys., Hauppauge, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind
Mr. Roger Love, Madison, NJ
Data Numerics, Farmingdale, N.Y.
Dataproducts Corp., Woodland Hills, Cal.
Design Automation, Lexington, Mass.
Hughes Aircraft Co, Culver City, Cal.
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DM Keystone Elctns. Corp., New York, N.Y. *
M Applied Design Co., Tonawanda, N.Y.
Cal-Metex Corp., Inglewood, Cal.
M Craig Sys. Corp., Lawrence, Mass.
Emerson & Cuming, Canton, Mass.
D Estes Engrg. Co., Port Angeles, Wash.
D Heeger Inc., Los Angeles, Cal.
M Kinetron Corp., Asbury Park, N.J.
D Lectro Magnetics, Los Angeles, Cal.
M M Elctrn. Enclosures, Hicksville, N.Y.
D Modpak, Waltham, Mass.
Precision Paper Tube Co., Wheeling, Ill.
D Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
South Shore Metal Prods., Farmingdale, N.Y.
M TA Instrument Case Co., Los Angeles, Cal
Warwick Prods Co., Independence, Ohio

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M Environmental Container Sys., Grants Pass, Ore. p. 1•60
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American Aluminum Co., Mountainside, N.J.
M Applied Design Co., Tonawanda, N.Y.
Astro Dynamics, Burlington, Mass.
Hughes Aircraft Co, Culver City, Cal.
Mann, Henry Inc., Huntingdon Valley, Pa.
M M Elctrn. Enclosures, Hicksville, N.Y.
N L Inds., Granite City, Ill.
NVF Co., Yorklyn, Del.
Parabam, Compton, Cal.
D Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
M TA Instrument Case Co., Los Angeles, Cal
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D Akro-Mils, Akron, Ohio
M Althor Prods., Brooklyn, N.Y.
American Aluminum Co,, Mountainside, N.J.
M Applied Design Co., Tonawanda, N.Y.
DM Bay Prods., Phila., Pa.
Cadillac Plastic & Chemical, Detroit, Mich.
Hughes Aircraft Co, Culver City, Cal.
Mann, Henry Inc., Huntingdon Valley, Pa.
D Metropolitan Wire Corp., Wilkes-Barre, Pa.
M M Elctrn. Enclosures, Hicksville, N.Y.
N L Inds., Granite City, Ill.
NVF Co., Yorklyn, Del.
Panel Controls Corp., Detroit, Mich.
Parabam, Compton, Cal.
D Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
M TA Instrument Case Co., Los Angeles, Cal
DM Thermoelectrics
DM Uniroyal, New York, N.Y.

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Allied Systems Corp., Greensboro, N.C. *
Applied Electro Technology, Santa Ana, Cal. *
Astrosystems, Lake Success, N.Y. *
Dranetz Engrg. Labs., So. Plainfield, N.J. *
Dynage, Bloomfield, Conn. *
D Allen Bradley, Highland Heights, Ohio
D Alnor Instrument Co., Niles, Ill.
D Applied Materials Inc., Santa Clara, Cal.
Applied Systems Corp., St. Clair Shores, Mich.
ARGA Controls, Pasedena, Cal.
Barber-Colman Co., Rockford, Ill.
D Control Products Div., Union, N.J.
Counterscan Systems, Sutton, Neb.
Cross Electronics Inc., Warrendale, Pa.
D CTS Corp., Elkart, Ind.
D CVC Products, Rochester, N.Y.
Datametrics Inc., Wilmington, Mass.
Datawest Corp., Scottsdale, Ariz.
D Delta Design, San Diego, Cal
Digital Equipment Corp., Maynard, Mass.
Eagle Signal, Davenport, Iowa
Electronic Control Systems, Fairmont, W. Va.
Electronic Counters & Controls Inc., Mundelein, Ill.
Foxboro Co., Foxboro, Mass.
Harrel, E. Norwalk, Conn.
Hughes Aircraft Co, Culver City, Cal.
DM Hughes Aircraft Co., Oceanside, Cal.
D Leeds & Northrup Co., North Wales, Pa.
M Lehighton Electronics, Lehighton, Pa
Luft Instrs., Lincoln, Mass.
Marotta Sci. Controls, Boonton, N.J.
Mohawk OEM Sales, King of Prussia, Pa.
DM National Semiconductor Corp., Santa Clara, Cal.
Non-Linear Sys., Del Mar, Cal.
D PCS., Flint, Mich.
D Ragen Data Systems, Farmingdale, N.Y.
Sensotec, Columbus, Ohio
Sigma Instruments, Braintree, Mass.
Standard Logic Inc., Santa Ana, Cal.
Struthers-Dunn, Pitman, N.J.
Systems Data Inc., Akron, Ohio
XINCOM Corp., Chatsworth, Cal.

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Sanders Data Systems, Nashua, N.H.
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M Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917
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Automatic Timing & Controls Co., King of Prussia, Pa.
D Delavan Electronics, Scottsdale, Ariz.
Electron-Machine Corp., Umatilla, Fla.
D Gordon Engineering Corp., Brookfield, Conn.
Lion Precision Corp, Newton, Mass.
Photobell Co., New York, N.Y.
Robertshaw Controls Co., Richmond, Va.

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Applied Control Co., Fairfield, N.J.
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D Autotron, Danville, Ill.
Control Systems Research, Pittsburgh, Pa.
Controlcraft Corp., West Chicago, Ill.
Controltek Inc., Portland, Ore.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Durant Digital Instruments, Watertown, Wisc.
D Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Electron, Bratenahl, Ohio
Electronic Counters & Controls Inc., Mundelein, Ill.
D Ferranti-Packard, Ltd. Elec. Div., Toronto, Can.M6M 4M3
D Gagne Assocs., Binghamton, N.Y.
Howell Inst. Inc., Ft. Worth, Tex.
Jaesic Industries Co., Wixom, Mich.
Luft Instrs., Lincoln, Mass.
D National Sonics, Farmingdale, N.Y.
Nucleus Corp., Madison Hgts., Mich.
D Photobell Co., New York, N.Y.
D Photomation, Mountain View, Cal.
Presin Co., Shelton, Conn.
Redington Counters, Windsor, Conn.
D Scientific Technology, Mountain View, Cal.
D SenSitrol, Albion, Ill.
Sensor Corp., Scottdale, Pa.
D Sigma Instruments, Braintree, Mass.
D Tann Controls Co., Detroit, Mich.
Tenor Co., New Berlin, Wisc.
Tri-Tronics Co., Oak Brook, Ill.
Triac Electronics, New York, N.Y.
Warner Elec. Brake & Clutch Co., S. Beloit, Ill.

Controls, Density

American Electronic Controls, Barrington, N.J.
Automation Prdts., Houston, Tex.
Dolan-Jenner Inds., Melrose, Mass.
Electron-Machine Corp., Umatilla, Fla.
Foxboro Co., Foxboro, Mass.
Heitz, Karl, New York, N.Y.
Luft Instrs., Lincoln, Mass.
D National Sonics, Farmingdale, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
RIL Elctrns., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Triac Electronics, New York, N.Y.

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International Electro-Magnetics, Palatine, Ill. p. 1•16,17
Astrosystems, Lake Success, N.Y. *
Automatic Timing & Controls Co., King of Prussia, Pa.
Columbia Resch. Labs., Woodlyn, Pa.
Data Technology Inc., Watertown, Mass.
D Dynapar Corp., Gurnee, Ill.
Electron-Machine Corp., Umatilla, Fla.
Hughes Aircraft Co., Oceanside, Cal.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Lincoln, Mass.
Schaevitz Engrg., Pennsauken, N.J.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tempo Instrument, Plainview, N.Y.
Theta Instr. Corp., Fairfield, N.J.

Controls, Door Opening & Closing (Industrial)

Gould Inc., Plantsville, Conn. p. 1•1686
D Arrow-Hart, Hartford, Conn. *
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Advanced Devices Lab, Santa Clara, Cal.
A.R.F. Products, Boulder, Colo.
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Innovation Industries Inc., Roswell, N.M.
Instrumentation Tech. Corp., Northridge, Cal.
D Multi-Elmac Co., Novi, Mich.
Pacific Technology, Renton, Wash.
D Perma Power Div., Elmhurst, Ill.
D Photobell Co., New York, N.Y.
D Photomation, Mountain View, Cal.
D Scientific Technology, Mountain View, Cal.
D Sigma Instruments, Braintree, Mass.
D Tann Controls Co., Detroit, Mich.

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D Precision Timer Co., Westbrook, Conn. p. 1•268,269
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D American Instr. Co., Silver Spring, Md.
Analytical Measurements, Chatham, N.J.
Artisan Elctrns. Corp., Parsippany, N.J.
Bafco, Warminster, Pa.
Barber-Colman Co., Rockford, Ill.
Chadwick-Helmuth Co., Monrovia, Calif.
D Control Products Div., Union, N.J.
D Delta Design, San Diego, Cal
Electronic Control Systems, Fairmont, W. Va.
Foxboro Co., Foxboro, Mass.
Honeywell, Ft. Washington, Pa.
Hotpack Corp., Phila., Pa.
Leeds & Northrup Co., North Wales, Pa.
Luft Instrs., Lincoln, Mass.
Non-Linear Sys., Del Mar, Cal.
Nucleus Corp., Madison Hgts., Mich.
OAL Assocs., Westbury, N.Y.
Oven Industries, Mechanicsburg, Pa.
Research, Minneapolis, Minn.
Robicon Corp., Pittsburgh, Pa.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.

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*Company has information in white pages but not on this product

Tech Serv., Beltsville, Md
D Temptronic Corporation, Newton, Mass.
Tenney Engrg., Union, N.J.
Torr Labs., Los Angeles, Cal.
Tucker Electronics Co., Garland, Tex.
D United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.
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CTS Corp., Elkart, Ind.

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American Electronic Controls, Barrington, N.J.
Applied Control Co., Fairfield, N.J.
Beckman Instrs., Cedar Grove, N.J.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., North Wales, Pa.
Mag-Con, New Brighton, Minn.
Robertshaw Controls Co., Richmond, Va.
Tempo Instrument, Plainview, N.Y.
Triac Electronics, New York, N.Y.

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NES, Streamwood, Ill. .... *
Square D Co., Milwaukee, Wisc. .... *
Airmatic/Beckett-Harcum, Wilmington, Ohio
Aitken Communications Inc., Taft, Cal
Applied Materials Inc., Santa Clara, Cal.
Astro Dynamics, Burlington, Mass.
D Autocon Inds., Minneapolis, Minn.
Bendix Corp., N. Hollywood, Calif.
M Brooks Instr. Div., Hatfield, Pa.
Consolidated Controls Corp., Bethel, Conn.
Corning Glass Works, Fluidic Products, Corning, N.Y.
M Dietz, Henry G. Co., Long Island City, N.Y.
Durant Digital Instruments, Watertown, Wisc.
EEMCO Div., Los Angeles, Cal.
Foxboro Co., Foxboro, Mass.
Gems Sensors Div., Farmington, Conn.
General Valve Corp., E. Hanover, N.J.
Harwil Co., Santa Monica, Calif.
D Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Minneapolis, Minn.
D ITT General Controls, Glendale, Cal.
D Lear Siegler, Elyria, Ohio
Leeds & Northrup Co., North Wales, Pa.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Lincoln, Mass.
M Marotta Sci. Controls, Boonton, N.J.
DM Matheson Gas Products, East Rutherford, N.J.
Robertshaw Controls Co., Richmond, Va.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Triac Electronics, New York, N.Y.
Tylan Corp., Torrance, Cal.
D United Elec. Controls Co., Watertown, Mass.
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M Kratos, Pasadena, Cal .... p. 1•253
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NES, Streamwood, Ill. .... *
M Acromag, Wixom, Mich.
Avtron Mfg., Cleveland, Ohio
CTS Corp., Elkart, Ind.
D Electro Corp., Sarasota, Fla.
DM Guardian California, Torrance, Cal.
DM Guardian Electric Co. of Cal., Torrance, Cal.
Hartman Electrical Mfg., Mansfield, Ohio
Leeds & Northrup Co., North Wales, Pa.
Logitek, Farmingdale, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Robicon Corp., Pittsburgh, Pa.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
M Standard Crystal Corp., Monterey Park, Cal.
Tempo Instrument, Plainview, N.Y.

Controls, Gas

NES, Streamwood, Ill. .... *
Air Prods. & Chems., Allentown, Pa.
Airco Industrial Gases, Murray Hill, N.J.
Airmatic/Beckett-Harcum, Wilmington, Ohio
Honeywell, Ft. Washington, Pa.
D ITT General Controls, Glendale, Cal.
Lektra Labs., College Point, N.Y.
Marotta Sci. Controls, Boonton, N.J.
DM Matheson Gas Products, East Rutherford, N.J.
D Singer Co., Philadelphia, Pa.
Triac Electronics, New York, N.Y.
Tylan Corp., Torrance, Cal.
Union Carbide Corp., New York, N.Y.
D United Elec. Controls Co., Watertown, Mass.

Controls, Hardware, Shafts & Accessories—See Shafts; Dials;etc.

Controls, Humidity

M Blue M Electric Co., Blue Island, Ill. p. 1•468,469
NES, Streamwood, Ill. .... *
D American Instr. Co., Silver Spring, Md.
Applied Control Co., Fairfield, N.J.
Barber-Colman Co., Rockford, Ill.
Foxboro Co., Foxboro, Mass.
Harrel, E. Norwalk, Conn.
Honeywell, Ft. Washington, Pa.
Hotpack Corp., Phila., Pa.
D ITT General Controls, Glendale, Cal.
D Lear Siegler, Elyria, Ohio
MKC Electronics, Kansas City, Kans.
PSG Industries Inc., Perkasie, Pa.
Reeve Electronics, Chicago, Ill.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Triac Electronics, New York, N.Y.

Controls, Ignitron Firing

M Autronics Corp., Pasadena, Cal .... p. 1•237
Advanced Kinetics, Costa Mesa, Calif.
D Delta Products, Grand Junction, Colo.
Nucleus Corp., Madison Hgts., Mich.
Research, Minneapolis, Minn.
Triac Electronics, New York, N.Y.

Controls, Joystick

M Aeroflex Labs., Plainview, N.Y. .... *
Bowmar Instr. Corp., Ft. Wayne, Ind.
Marotta Sci. Controls, Boonton, N.J.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Summit Engineering Corp., Bozeman, Mont.

Controls, Lamp Dimming, Flashing

Applied Electro Technology, Santa Ana, Cal. p. 1•1579
M Autronics Corp., Pasadena, Cal .... p. 1•237
Gould Inc., Plantsville, Conn. ....p. 1•1686
K.G.S. Elctrns., Pasadena, Cal. ....p. 1•1238
D Precision Timer Co., Westbrook, Conn. p. 1•268,269
D SGL Waber Electric, Westville, NJ ...... p. 2•356
General Radio Co., Concord, Mass. .... *
International Rectifier Corp., El Segundo, Cal. *
Leach Corp., Los Angeles, Cal. .... *
D Superior Electric Co., Bristol, Conn. .... *
Aerospace Avionics, Bohemia, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
ECC Corp., Euless, Tex.
M Environmental Communications Inc., Costa Mesa, Cal.
Halmar Electronics, Columbus, Ohio
Leviton Mfg. Co., Little Neck, N.Y.
Litton Systems, Mt. Vernon, N.Y.
D Omnetics, Syracuse, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.
S S A C Precision Products Inc., Liverpool, N.Y.
Tempo Instrument, Plainview, N.Y.
Triac Electronics, New York, N.Y.
D Warren G-V Communications, Livingston, N.J.

Controls, Level, Dry Material

M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
D Micro Switch, Freeport, Ill. .... p. 1•2101
NES, Streamwood, Ill. .... *
Amtron Div., Midlothian, Ill.
Automation Prdts., Houston, Tex.
D Autotron, Danville, Ill.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cross Electronics Inc., Warrendale, Pa.
D Delavan Electronics, Scottsdale, Ariz.
M Dietz, Henry G. Co., Long Island City, N.Y.
Innovation Industries Inc., Roswell, N.M.
Mag-Con, New Brighton, Minn.
D National Sonics, Farmingdale, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
PECO Corp., Milpitas, Cal.
Photobell Co., New York, N.Y.
RIL Elctrns., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
D Scientific Technology, Mountain View, Cal.
Skan-A-Matic Corp., Elbridge, N.Y.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Triac Electronics, New York, N.Y.

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Keystone Carbon Co., St. Marys, Pa. p. 1•2317,2318
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Allen-Bradley Co., Milwaukee, Wisc. .... *
Computer Instrs., Hempstead, N.Y. .... *
General Elec. Co., Schenectady, N.Y. .... *
Kessler-Ellis Prods., Atlantic Highlands, N.J. *
NES, Streamwood, Ill. .... *
Square D Co., Milwaukee, Wisc. .... *
Air-O-Tronics Prods., Morrisville, N.Y.
Allis-Chalmers, Milwaukee, Wisc.
D Ametek Controls Division, Feasterville, Pa.
Amtron Div., Midlothian, Ill.
ARGA Controls, Pasedena, Cal.
D Autocon Inds., Minneapolis, Minn.
Automation Prdts., Houston, Tex.
D Autotron, Danville, Ill.
The Bendix Corp., Teterboro, N.J.
M Brooks Instr. Div., Hatfield, Pa.
Conrac Corp., Fairfield, N.J.
Consolidated Controls Corp., Bethel, Conn.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
D Delavan Electronics, Scottsdale, Ariz.
M Dietz, Henry G. Co., Long Island City, N.Y.
EEMCO Div., Los Angeles, Cal.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Foxboro Co., Foxboro, Mass.
D Furnas Elec. Co., Batavia, Ill.
Gagne Assocs., Binghamton, N.Y.
Gems Sensors Div., Farmington, Conn.
General Time Corp., Thomaston, Conn.
Honeywell, Minneapolis, Minn.
Innovation Industries Inc., Roswell, N.M.
Leeds & Northrup Co., North Wales, Pa.
Luft Instrs., Lincoln, Mass.
Madison Laboratories, Madison, Conn
Mag-Con, New Brighton, Minn.
Master Elctrn. Controls, Santa Monica, Cal.
D National Sonics, Farmingdale, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
Omnetics, Syracuse, N.Y.
Oxford Instr. Corp., Annapolis, Md.
PECO Corp., Milpitas, Cal.
Photobell Co., New York, N.Y.
RIL Elctrns., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
D Scientific Technology, Mountain View, Cal.
D SenSitrol, Albion, Ill.
Singer Co., Schiller Park, Ill.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Tempo Instrument, Plainview, N.Y.
Thermometrics, Edison, N.J.
Torr Labs., Los Angeles, Cal.
Triac Electronics, New York, N.Y.
D United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.
D Zi-Tech Div., Palo Alto, Cal.

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D Baldwin Elctrns., Little Rock, Ark. p. 1•144-146
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M Computer Conversions Corp., East Northport, N.Y. ....p. 1•154,155
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D Sealectro Corp., Mamaroneck, N.Y. p. 1•2269
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D **Arrow-Hart, Hartford, Conn.** .... *
Astrosystems, Lake Success, N.Y. .... *
Curtis Industries Inc., Milwaukee, Wisc. .... *
Delco Electronics Div., Kokomo, Ind. .... *
Dynage, Bloomfield, Conn. .... *
General Elec. Co., Schenectady, N.Y. .... *
Hoagland Instr., Dayton, N.J. .... *
International Rectifier Corp., El Segundo, Cal. *
NES, Streamwood, Ill. .... *
D **Ohmite Mfg. Co., Skokie, Ill.** .... *
Square D Co., Milwaukee, Wisc. .... *
D **Superior Electric Co., Bristol, Conn.** .... *
D **Tapeswitch Corp. Amer., Farmingdale, N.Y.** .... *
Varo Semiconductor, Garland, Tex. .... *
Allen Bradley, Highland Heights, Ohio
Ambi-Tech Inds. Inc., Westwood, N.J.
Amtron Div., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Applied Systems Corp., St. Clair Shores, Mich.
Automatic Timing & Controls Co., King of Prussia, Pa.
D Cambridge Thermionic Corp., Cambridge, Mass.
Conrac Corp., Westminister, Cal.
Control Products Corp., Chicago, Ill.
Control Systems Research, Pittsburgh, Pa.
D Control Products Div., Union, N.J.
Controltek Inc., Portland, Ore.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
Data Technology Inc., Watertown, Mass.
Datascan Div., Van Nuys, Ca.
Datex Div., Duarte, Cal.
Durant Digital Instruments, Watertown, Wisc.
D Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
ECC Corp., Euless, Tex.
Electro Corp., Sarasota, Fla.
Electron, Bratenahl, Ohio
D Farrand Controls, Valhalla, N.Y.
D Flight Sys., Mechanicsburg, Pa.
D Furnas Elec. Co., Batavia, Ill.
General Automation, Anaheim, Cal.
D Gordon Engineering Corp., Brookfield, Conn.
Guardian California, Torrance, Cal.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co., Oceanside, Cal.
Icon Corp., Cambridge, Mass.
Instr. & Control Sys., Addison, Ill.
Lion Precision Corp, Newton, Mass.
Litton Systems, Mt. Vernon, N.Y.
D Measurement Sys., Norwalk, Conn.
D NAMCO CONTROLS, Cleveland, Ohio
Payne Engrg. Co., Scott Depot, W. Va.
D PCS., Flint, Mich.
PECO Corp., Milpitas, Cal.
Photobell Co., New York, N.Y.
Proto Matic Co., Cincinnati, Ohio
Robicon Corp., Pittsburgh, Pa.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
D Struthers-Dunn, Pitman, N.J.
Summit Engineering Corp., Bozeman, Mont.
Tempo Instrument, Plainview, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Triac Electronics, New York, N.Y.
Warner Elec. Brake & Clutch Co., S. Beloit, Ill.
Westamp, Santa Monica, Cal.

Controls, Moisture—See Controls, Humidity

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Abacus Controls Inc., Somerville, N.J.
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Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y. .... *
D **Canon U.S.A., Lake Success, N.Y.** .... *
CML-Macarr, Edison, N.J. .... *
General Elec. Co., Schenectady, N.Y. .... *
Gordos/Grisby-Barton, Rolling Meadows, Ill. ...*
Hope Elctrns., Clifton, N.J. .... *
International Rectifier Corp., El Segundo, Cal. *
Leach Corp., Los Angeles, Cal. .... *
D **Ohmite Mfg. Co., Skokie, Ill.** .... *
Square D Co., Milwaukee, Wisc. .... *
M **Unitron Inc., Garland, Tex.** .... *
Varo Semiconductor, Garland, Tex. .... *
Wilmore Elctrns. Co., Durham, N.C. .... *
Allis-Chalmers, Milwaukee, Wisc.
Amtron Div., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
D Autocon Inds., Minneapolis, Minn.
Avtron Mfg., Cleveland, Ohio
B & B Motor & Control, New York, N.Y.
Basler Electric Co., Highland, Ill.
D Cambridge Thermionic Corp., Cambridge, Mass.
Carson Mfg. Co., Indianapolis, Ind.
Control Products Corp., Chicago, Ill.
Control Systems Research, Pittsburgh, Pa.
Cross Electronics Inc., Warrendale, Pa.
Cyberex, Mentor, Ohio
Datron Systems, Chatsworth, Cal.
M Delta Elctrn. Control, Costa Mesa, Cal.
Dynapar Corp., Gurnee, Ill.
Eaton Corp., Cleveland, Ohio
ECC Corp., Euless, Tex.
Electro-Devices, Paterson, N.J.
Electro-Pacific, Goleta, Calif.
D Emerson, Industrial Controls Div., Santa Ana, Cal.
Firing Circuits Inc., Norwalk, Conn.
Foxboro Co., Foxboro, Mass.
D Furnas Elec. Co., Batavia, Ill.
M General Devices, Princeton, N.J.
Gentron Corp., Milwaukee, Wisc.
M Glentek, Santa Monica, Calif.
D GTE Sylvania Inc., Waltham, Mass.
Halmar Electronics, Columbus, Ohio
Hartman Electrical Mfg., Mansfield, Ohio
Honeywell, Ft. Washington, Pa.
Icon Corp., Cambridge, Mass.
Instruments Components Co., Montor, Ohio
Instr. & Control Sys., Addison, Ill.
Kato Engineering Co., Mankato, Minn.
Lear Siegler, Santa Monica, Calif.
Leviton Mfg. Co., Little Neck, N.Y.
Litton Systems, Mt. Vernon, N.Y.
Luft Instrs., Lincoln, Mass.
Mag-Con, New Brighton, Minn.
Magnetics, Div. of Spang Industries, Sandy Lake, Pa.
Marotta Sci. Controls, Boonton, N.J.
Master Elctrn. Controls, Santa Monica, Cal.
D Measurement Sys., Norwalk, Conn.
Meltronics Inc., Leeds, Ala.
Mercer Controls Corp., New York, N.Y.
M Micro-Mo Electronics Inc., Cleveland, Ohio
D Omnetics, Syracuse, N.Y.
Opad Elec. Co., New York, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.
PECO Corp., Milpitas, Cal.
D Power Control Corp., Pittsburgh, Pa.
Quadrastat Controls Corp., Glendale, Cal.
D Reliance Electric Co., Cleveland, Ohio
Research, Minneapolis, Minn.
Research Instrument Co., Garden City, N. Y.
Robicon Corp., Pittsburgh, Pa.
M Sawyer Inds., Arcadia, Cal.
Schaevitz Engrg., Pennsauken, N.J.
Sensor Corp., Scottdale, Pa.
M Sequential Information Systems, Elmsford, N.Y.
Sigma Instruments, Braintree, Mass.
Speed Detectors, Bedford, Ohio
Struthers-Dunn, Bettendorf, Iowa
Teledyne Inet, Gardena, Cal.
Tempo Instrument, Plainview, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Torq Engineered Products, Bedford, Ohio
M Transicoil, Worcester, Pa.
Triac Electronics, New York, N.Y.
Unitron Corp., Ft. Wayne, Ind.
Vectrol, Rockville, Md.
Voltex Co., Farmingdale, N.Y.
Ward Leonard Elec. Co. Inc., Mt. Vernon, N.Y.
DM Welco Inds. Inc., Cincinnati, Ohio
D WER Industrial, Grand Island, N.Y.
West Coast Resch. Corp., Los Angeles, Calif.
Westamp, Santa Monica, Cal.

Controls, Oscillator

Frequency Elctrns., New Hyde Pk., N.Y.
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M **Vectron Labs., Norwalk, Conn.** .... p. 1•420,421
American Time Products, Bulova Watch, Woodside, N.Y. ....*
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ....*
Biddle, James G., Plymouth Meeting, Pa.
CTS Corp., Elkart, Ind.
Meloy Laboratories Inc., Springfield, Va.

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General Radio Co., Concord, Mass. .... *
NES, Streamwood, Ill. ....*
Amtron Div., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Automatic Timing & Controls Co., King of Prussia, Pa.
Automation Devices, Fairview, Pa.
D Autotron, Danville, Ill.
Controlcraft Corp., West Chicago, Ill.
Disc Instruments, Costa Mesa, Ca.
Eagle Signal, Davenport, Iowa
HEI, Chaska, Minn.
D Hughey & Phillips, Burbank, Cal.
Innovation Industries Inc., Roswell, N.M.
M Kates Scientific Instrs., Newton, Mass.
Luft Instrs., Lincoln, Mass.
Master Elctrn. Controls, Santa Monica, Cal.
PECO Corp., Milpitas, Cal.
D Photobell Co., New York, N.Y.
D Photomation, Mountain View, Cal.
DM Power Instrs., Skokie, Ill.
D Ripley Co., Middletown, Conn.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
Sensor Technology, Chatsworth, Cal.
D Sigma Instruments, Braintree, Mass.
Skan-A-Matic Corp., Elbridge, N.Y.
Tri-Tronics Co., Oak Brook, Ill.
Triac Electronics, New York, N.Y.
Warner Elec. Brake & Clutch Co., S. Beloit, Ill.

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M **Computer Conversions Corp., East Northport, N.Y.** ....p. 1•154,155
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D **Superior Electric Co., Bristol, Conn.**
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D **Veeder-Root, Hartford, Conn.** ......p. 1•274,275
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Computer Instrs., Hempstead, N.Y. .... *
Delco Electronics Div., Kokomo, Ind. .... *
NES, Streamwood, Ill. ....*
Vernitech, Deer Pk., N.Y. ....*
M ABA Industries, Pinellas Pk., Fla.
Airmatic/Beckett-Harcum, Wilmington, Ohio
Alessi Industries, Costa Mesa, Cal.
D Ametek Controls Division, Feasterville, Pa.
Amtron Div., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Automatic Timing & Controls Co., King of Prussia, Pa.
Avtron Mfg., Cleveland, Ohio
Barber-Colman Co., Rockford, Ill.
Bendix Corp., N. Hollywood, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
D Cambridge Thermionic Corp., Cambridge, Mass.
Columbia Resch. Labs., Woodlyn, Pa.
Consolidated Controls Corp., Bethel, Conn.
Control Systems Research, Pittsburgh, Pa.

*Company has information in white pages but not on this product

Controltek Inc., Portland, Ore.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Data Technology Inc., Watertown, Mass.
Datex Div., Duarte, Cal.
Datron Systems, Chatsworth, Cal.
Disc Instruments, Costa Mesa, Ca.
D Dynapar Corp., Gurnee, Ill.
D Electro Corp., Sarasota, Fla.
Electronic Counters & Controls Inc., Mundelein, Ill.
D Farrand Controls, Valhalla, N.Y.
Foxboro Co., Foxboro, Mass.
GAP Instr. Corp., Hauppauge, N.Y.
Gems Sensors Div., Farmington, Conn.
D General Scanning, Watertown, Mass.
M Glentek, Santa Monica, Calif.
D Helm Instr. Co., Toledo, Ohio
Honeywell, Minneapolis, Minn.
Hughes Aircraft Co, Culver City, Cal.
Hughes Aircraft Co., Oceanside, Cal.
Icon Corp., Cambridge, Mass.
Instr. & Control Sys., Addison, Ill.
Jordan Controls, Milwaukee, Wisc.
M Lear Siegler, Santa Monica, Calif.
Leeds & Northrup Co., North Wales, Pa.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Lincoln, Mass.
Marotta Sci. Controls, Boonton, N.J.
D Measurement Sys., Norwalk, Conn.
MKC Electronics, Kansas City, Kans.
D National Sonics, Farmingdale, N.Y.
Orbit Instr. Corp., Syosset, N.Y.
PECO Corp., Milpitas, Cal.
Photobell Co., New York, N.Y.
Proto Matic Co., Cincinnati, Ohio
Quadrastat Controls Corp., Glendale, Cal.
D Ragen Data Systems, Farmingdale, N.Y.
Robicon Corp., Pittsburgh, Pa.
Schaevitz Engrg., Pennsauken, N.J.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
M Sequential Information Systems, Elmsford, N.Y.
Sigma Instruments, Braintree, Mass.
M Singer Co., Glendale, Cal.
Skan-A-Matic Corp., Elbridge, N.Y.
Summit Engineering Corp., Bozeman, Mont.
D Tann Controls Co., Detroit, Mich.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Theta Instr. Corp., Fairfield, N.J.
M Transicoil, Worcester, Pa.
D Warner Elec. Brake & Clutch Co., S. Beloit, Ill.
D WER Industrial, Grand Island, N.Y.
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M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
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Square D Co., Milwaukee, Wisc. ....*
Torque Systems, Waltham, Mass. .... *
Airmatic/Beckett-Harcum, Wilmington, Ohio
D Ametek Controls Division, Feasterville, Pa.
ATEC, Houston, Tex.
D Autocon Inds., Minneapolis, Minn.
Automatic Timing & Controls Co., King of Prussia, Pa.
Barber-Colman Co., Rockford, Ill.
Columbus Electric Mfg. Co., Piney Flats, Tenn.
Conrac Corp., Duarte, Cal.
Consolidated Controls Corp., Bethel, Conn.
D Cook Elec. Co., Morton Grove, Ill.
Cutler-Hammer, Milwaukee, Wisc.
D CVC Products, Rochester, N.Y.
M Dietz, Henry G. Co., Long Island City, N.Y.
M Dynamic Controls Corp., S. Windsor, Conn.
D Dynisco, Westwood, Mass.
Foxboro Co., Foxboro, Mass.
D Furnas Elec. Co., Batavia, Ill.
D Gagne Assocs., Binghamton, N.Y.
Harrel, E. Norwalk, Conn.
Honeywell, Minneapolis, Minn.
D Lear Siegler, Elyria, Ohio
Leeds & Northrup Co., North Wales, Pa.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Lincoln, Mass.
M Marotta Sci. Controls, Boonton, N.J.
DM Matheson Gas Products, East Rutherford, N.J.
MKS Instrs., Burlington, Mass.
Non-Linear Sys., Del Mar, Cal.
Robertshaw Controls Co., Richmond, Va.
Robicon Corp., Pittsburgh, Pa.
Schaevitz Engrg., Pennsauken, N.J.
Sensotec, Columbus, Ohio
Sigma Instruments, Braintree, Mass.
D Singer Co., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.
M Tescom Instr. Div., Minneapolis, Minn.
Texas Instruments, Attleboro, Mass.
Triac Electronics, New York, N.Y.
D United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.

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D Precision Timer Co., Westbrook, Conn. p. 1•268
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D Simpson Electric Co., Elgin, Ill. ....*
D Ametek Controls Division, Feasterville, Pa.
Amtron Div., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Automation Prdts., Houston, Tex.
Avtron Mfg., Cleveland, Ohio
Barber-Colman Co., Rockford, Ill.
Bendix Corp., N. Hollywood, Calif.
Control Systems Research, Pittsburgh, Pa.
D Cox & Co., New York, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Durant Digital Instruments, Watertown, Wisc.
Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Elma Engineering, Palo Alto, Cal.
Foxboro Co., Foxboro, Mass.
Guardian California, Torrance, Cal.
Harrel, E. Norwalk, Conn.
Hartman Electrical Mfg., Mansfield, Ohio
D Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Ft. Washington, Pa.
Int'l. Instrs., Orange, Conn.
Ircon Inc., Skokie, Ill.
D ITT General Controls, Glendale, Cal.
Leeds & Northrup Co., North Wales, Pa.
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DM Measurement Sys., Norwalk, Conn.
MKC Electronics, Kansas City, Kans.
D National Sonics, Farmingdale, N.Y.
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M Oven Industries, Mechanicsburg, Pa.
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Research Instrument Co., Garden City, N. Y.
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D Taylor Instr. Process Control Div., Rochester, N.Y.
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D Ametek Controls Division, Feasterville, Pa.
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D Delavan Electronics, Scottsdale, Ariz.
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D Electro Corp., Sarasota, Fla.
D Gagne Assocs., Binghamton, N.Y.
D Gordon Engineering Corp., Brookfield, Conn.
D Helm Instr. Co., Toledo, Ohio
Licon Div., Chicago, Ill.
Lion Precision Corp, Newton, Mass.
D NAMCO CONTROLS, Cleveland, Ohio
D National Sonics, Farmingdale, N.Y.
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D Reed Switch Dev. Co., Greenwich, Conn.
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D Scientific Technology, Mountain View, Cal.
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D Furnas Elec. Co., Batavia, Ill.
General Elec. Co., Lynchburg, Va.
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Hughes Aircraft Co., Oceanside, Cal.
Lakeshore Electric Corp., Bedford, Ohio
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M Marotta Sci. Controls, Boonton, N.J.
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D Multi-Elmac Co., Novi, Mich.
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Cardinal Control Co., Kensington, Conn.
D Furnas Elec. Co., Batavia, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
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Kato Engineering Co., Mankato, Minn.
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PECO Corp., Milpitas, Cal.
M Polyphase Instr. Co., Bridgeport, Pa.
Robicon Corp., Pittsburgh, Pa.
D Scientific Technology, Mountain View, Cal.
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Barber-Colman Co., Rockford, Ill.
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Caig Labs., Westbury, N.Y.
Cal-Power Corp., El Segundo, Calif.
Control Products Corp., Chicago, Ill.
Controltek Inc., Portland, Ore.
Cox & Co., New York, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Datron Systems, Chatsworth, Cal.
D Despatch Oven Co., Minneapolis, Minn.
M Dynamic Controls Corp., S. Windsor, Conn.
Eaton Corp., Cleveland, Ohio
ECC Corp., Euless, Tex.
Electro-Devices, Paterson, N.J.
Electro-Pacific, Goleta, Calif.
Electronic Control Systems, Fairmont, W. Va.
Elma Engineering, Palo Alto, Cal.
Firing Circuits Inc., Norwalk, Conn.
D Flight Sys., Mechanicsburg, Pa.
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M Glentek, Santa Monica, Calif.
Halmar Electronics, Columbus, Ohio
Honeywell, Ft. Washington, Pa.
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D Motorola Semiconductor Prods., Phoenix, Ariz.
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D Power Control Corp., Pittsburgh, Pa.
PSG Industries Inc., Perkasie, Pa.
D Reliance Electric Co., Cleveland, Ohio
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D Vectrol, Rockville, Md.
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D Welco Inds. Inc., Cincinnati, Ohio
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Ohio Semitronics, Columbus, Ohio .... *
M Acromag, Wixom, Mich.
ARGA Controls, Pasadena, Cal.

Cardinal Control Co., Kensington, Conn.
Cross Electronics Inc., Warrendale, Pa.
Cutler-Hammer, Milwaukee, Wisc.
M Dynamic Controls Corp., S. Windsor, Conn.
Dynapar Corp., Gurnee, Ill.
ECC Corp., Euless, Tex.
DM Guardian Electric Co. of Cal., Torrance, Cal.
M Hartman Electrical Mfg., Mansfield, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Culver City, Cal.
Instr. & Control Sys., Addison, Ill.
Int'l. Instrs., Orange, Conn.
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M NH Research, Santa Ana, Calif.
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D Power Control Corp., Pittsburgh, Pa.
Reliance Electric Co., Cleveland, Ohio
Richard-Lee Co., New Providence, N.J.
D SenSitrol, Albion, Ill.
D Tann Controls Co., Detroit, Mich.
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I M C Magnetics, Westbury, N.Y. .... *
M Vernitech, Deer Pk., N.Y. .... *
M ABA Industries, Pinellas Pk., Fla.
B & B Motor & Control, New York, N.Y.
Bafco, Warminster, Pa.
Bendix Corp., N. Hollywood, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Control Systems Research, Pittsburgh, Pa.
Dantronics, St. Paul, Minn
Datron Systems, Chatsworth, Cal.
D Digiac Corp., Smithtown, N.Y.
D Dillon, W.C. & Co., Van Nuys 340, Calif.
Dynapar Corp., Gurnee, Ill.
Honeywell, Ft. Washington, Pa.
Int'l. Instrs., Orange, Conn.
Jordan Controls, Milwaukee, Wisc.
Lear Siegler, Santa Monica, Calif.
Meltronics Inc., Leeds, Ala.
Mercer Controls Corp., New York, N.Y.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
D Ragen Data Systems, Farmingdale, N.Y.
Robicon Corp., Pittsburgh, Pa.
D Scientific Technology, Mountain View, Cal.
M Sequential Information Systems, Elmsford, N.Y.
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M ABA Industries, Pinellas Pk., Fla.
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B & B Motor & Control, New York, N.Y.

D Cambridge Thermionic Corp., Cambridge, Mass.
M Clifton Precision, Clifton Hgts., Pa.
Conrac Corp., Fairfield, N.J.
Controltek Inc., Portland, Ore.
Datron Systems, Chatsworth, Cal.
Dynapar Corp., Gurnee, Ill.
Eastern Air Devices Motor Div., Dover, N.H.
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D Furnas Elec. Co., Batavia, Ill.
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M Glentek, Santa Monica, Calif.
M Harowe Servo Controls, W. Chester, Pa.
Honeywell, Ft. Washington, Pa.
DM Hughes Aircraft Co., Oceanside, Cal.
Icon Corp., Cambridge, Mass.
M IMC Magnetics Corp., Maywood, Cal.
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D PCS., Flint, Mich.
D Power Control Corp., Pittsburgh, Pa.
Proto Matic Co., Cincinnati, Ohio
D Ragen Data Systems, Farmingdale, N.Y.
Sigma Instruments, Braintree, Mass.
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M Acromag, Wixom, Mich.
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D Alnor Instrument Co., Niles, Ill.
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D Ametek Controls Division, Feasterville, Pa.
M Andersen & Assoc., Walther M.A., Tariffville, Conn.
M ARI Inds., Franklin Pk., Ill.
ATEC, Houston, Tex.
Barber-Colman Co., Rockford, Ill.
Barnes Engrg. Co., Stamford, Conn.
Burling Instr. Co., Chatham, N.J.
Caig Labs., Westbury, N.Y.
D Cambridge Thermionic Corp., Cambridge, Mass.
Chatham Controls Corp., Chatham, N.J.
Climatronics Corp., Hauppauge, N.Y.
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D Cox & Co., New York, N.Y.
Cross Electronics Inc., Warrendale, Pa.
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M Dynamic Controls Corp., S. Windsor, Conn.
Eagle Signal, Davenport, Iowa
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Electronic Control Systems, Fairmont, W. Va.
Elma Engineering, Palo Alto, Cal.
D Fenwal, Ashland, Mass.
Foxboro Co., Foxboro, Mass.
D GCA/Precision Scientific, Chicago, Ill.
D General Electric Co., West Lynn, Mass.
M Glentek, Santa Monica, Calif.
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D Helm Instr. Co., Toledo, Ohio
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D LFE Corporation, Waltham, Mass.
Luft Instrs., Lincoln, Mass.
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M Marlow Industries, Garland, Tex.
Master Elctrn. Controls, Santa Monica, Cal.
Micro Devices Corp., Dayton, Ohio
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MKC Electronics, Kansas City, Kans.
D NH Research, Santa Ana, Calif.
Non-Linear Sys., Del Mar, Cal.
M NSI, Instrument Div., Garland, Tex.
Nuclear Resch. Corp., Southampton, Pa.
OAL Assocs., Westbury, N.Y.
M Oven Industries, Mechanicsburg, Pa.
Oxford Instr. Corp., Annapolis, Md.
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D Power Control Corp., Pittsburgh, Pa.
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Research, Minneapolis, Minn.
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Robertshaw Controls Co., Richmond, Va.
Robicon Corp., Pittsburgh, Pa.
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M Sierracin/Thermal Sys., Los Angeles, Cal.
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Texas Instruments, Attleboro, Mass.
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3M Co., St. Paul, Minn.
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Torr Labs., Los Angeles, Cal.
Tracor, Austin, Tex.
Trans-Met Engrg., La Habra, Cal.
Triac Electronics, New York, N.Y.
Tylan Corp., Torrance, Cal.
Ulvac Corp., Fairfield, Conn.
D United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.
Vectrol, Rockville, Md.
D Victory Engrg. Corp., Springfield, N.J.
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D Ametek Controls Division, Feasterville, Pa.
Applied Systems Corp., St. Clair Shores, Mich.
B & B Motor & Control, New York, N.Y.
Computer Terminal Sys., Plainview, N.Y.
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General Time Corp., Thomaston, Conn.
S. Himmelstein & Co., Elk Grove Village, Ill.
Honeywell, Ft. Washington, Pa.
McFadden Elctrns. Co., South Gate, Calif.
Mercer Controls Corp., New York, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.

D PCS., Flint, Mich.
Robicon Corp., Pittsburgh, Pa.
Sensor Corp., Scottdale, Pa.
Sensotec, Columbus, Ohio
Sigma Instruments, Braintree, Mass.
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Vibrac Corp., Chelmsford, Mass.
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Barber-Colman Co., Rockford, Ill.
M Base Ten Systems, Trenton, N.J.
M Bay Laboratories, Cleveland, Ohio
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Burr-Brown, Tucson, Ariz.
D Cambridge Thermionic Corp., Cambridge, Mass.
M Circuit Technology, Farmingdale, N.Y.
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Conrac Corp., Fairfield, N.J.
D Consolidated Controls Corp., Bethel, Conn.
D Control Equip. Corp., Lowell, Mass.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cycon Corp., Sunnyvale, Cal.
Data General Corp., Southboro, Mass.
DataGraphics Corp., San Antonio, Tex.
D Data Translation, Framingham, Mass.
Datametrics Inc., Wilmington, Mass.
Datascan Div., Van Nuys, Ca.
Datawest Corp., Scottsdale, Ariz.
Datum, Anaheim, Calif.
Digital Equipment Corp., Maynard, Mass.
Doric Sci. Corp., San Diego, Calif.

Dynamic Measurements Corp., Winchester, Mass.
E-H Resch. Labs., Oakland, Cal.
Electro-Numerics Corp., Mountain View, Cal.
D EMR Telemetry, Sarasota, Fla.
M Environmental Communications Inc., Costa Mesa, Cal.
Epsco, Westwood, Mass.
Fairchild Space & Defense Sys. Div., Syosset, N.Y.
Fifth Dimension, Princeton, N.J.
Foxboro Co., Foxboro, Mass.
Function Modules, Costa Mesa, Cal.
GAP Instr. Corp., Hauppauge, N.Y.
M General Devices, Princeton, N.J.
General Instrument Corp., Hicksville, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Culver City, Cal.
D Intech, Santa Clara, Cal.
Intronics Inc., Newton, Mass.
Kinetic Systems Corp., Lockport, Ill.
Leeds & Northrup Co., North Wales, Pa.
Lockheed Aircraft Svc., Ont., Cal.
LRC Inc., Hudson, N.H.
D Macrodyne Inc., Schenectady, N.Y.
D Measurement Sys., Norwalk, Conn.
Micro Networks, Worcester, Mass.
DM National Semiconductor Corp., Santa Clara, Cal.
Newport Labs., Santa Ana, Cal.
Non-Linear Sys., Del Mar, Cal.
Optical Electronics, Tucson, Ariz.
D PCS., Flint, Mich.
Perkin-Elmer Corp., Norwalk, Conn.
Princeton Applied Resch. Corp., Princeton, N.J.
D Ragen Data Systems, Farmingdale, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Rolm Corp., Cupertino, Cal.
Scientific Measurements, Evanston, Ill.
D Siliconix, Santa Clara, Cal
Singer Co., State College, Pa.
M Spacetac, Bedford, Mass.
Struthers-Dunn, Bettendorf, Iowa
Tekelec, Oxnard, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
D Tennelec, Oak Ridge, Tenn.
Theta Instr. Corp., Fairfield, N.J.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Tucker Electronics Co., Garland, Tex.
United Systems, Dayton, Ohio
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Palo Alto, Cal.
D Velonex, Display Prods., Santa Clara, Cal.
M Westinghouse Canada Ltd., Hamilton, Ont., Can.
XINCOM Corp., Chatsworth, Cal.

Converters, Analog To Pulse

Astrosystems, Lake Success, N.Y. ..... p. 1•142
M Computer Conversions Corp., East Northport, N.Y. ....p. 1•154,155
M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
Hybrid Systems Corp., Burlington, Mass. p. 1•168,169
North Hills Elctrns., Glen Cove, N.Y. ... p. 1•264
D Precision Timer Co., Westbrook, Conn. p. 1•268
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
M General Microwave Corp., Farmingdale, NY .....*
NES, Streamwood, Ill. ....*
All Systems, Moorestown, N.J.
M Acromag, Wixom, Mich.
Anadex Instrs., Van Nuys, Cal.
Conrac Corp., Fairfield, N.J.
D Control Equip. Corp., Lowell, Mass.
Datum, Anaheim, Calif.
Dynamic Measurements Corp., Winchester, Mass.
Electro-Numerics Corp., Mountain View, Cal.
Foxboro Co., Foxboro, Mass.
General Instrument Corp., Hicksville, N.Y.
Hughes Aircraft Co, Culver City, Cal.
LRC Inc., Hudson, N.H.
DM Measurement Sys., Norwalk, Conn.
Optical Electronics, Tucson, Ariz.
M Power Instrs., Skokie, Ill.
D Ragen Data Systems, Farmingdale, N.Y.
Richard-Lee Co., New Providence, N.J.
Singer Co., State College, Pa.
Struthers-Dunn, Bettendorf, Iowa
D Teledyne Semiconductor, Mountain View, Cal.

Converters, Binary To Decimal

Astrosystems, Lake Success, N.Y. ..... p. 1•142
M Computer Conversions Corp., East Northport, N.Y. ....p. 1•154,155
M Interface Engineering Inc., Stoughton, Mass. p. 1•175
Refac Elctrns./Pinlites, Fairfield, N.J. p. 2•1185

M Vernitech, Deer Pk., N.Y. .... p. 1•220,276
M Analog Devices, Norwood, Mass. .... *
Datel Systems Inc., Canton, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
M General Microwave Corp., Farmingdale, NY ..... *
M Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
Matrix Systems Corp., Chatsworth, Cal. .... *
NES, Streamwood, Ill. .... *
M Base Ten Systems, Trenton, N.J.
D Cambridge Thermionic Corp., Cambridge, Mass.
Conrac Corp., Fairfield, N.J.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Data Technology Inc., Watertown, Mass.
Datametrics Inc., Wilmington, Mass.
Datascan Div., Van Nuys, Ca.
Datum, Anaheim, Calif.
Dynamic Measurements Corp., Winchester, Mass.
M Environmental Communications Inc., Costa Mesa, Cal.
Frederick Electronics Corp., Frederick, Md.
Hughes Aircraft Co, Culver City, Cal.
Instrumentation Tech. Corp., Northridge, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
LSI Computer Systems, Plainview, N.Y.
Metric Systems Corp., Ft. Walton Beach, Fla.
Precision Dynamics Corp., Burbank, Cal.
D Ragen Data Systems, Farmingdale, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Co., Little Falls, N.J.
M Spacetac, Bedford, Mass.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
Struthers-Dunn, Bettendorf, Iowa
Tech Serv., Beltsville, Md
D Teledyne Semiconductor, Mountain View, Cal.
Theta Instr. Corp., Fairfield, N.J.
M Trak Systems, Tampa, Fla.
Wyle Computer Prods., El Segundo, Calif.

Converters, Card To Tape

NES, Streamwood, Ill. .... *
American Used Computer Corp., Boston, Mass.
Datum, Anaheim, Calif.
DEMEK, Shawnee-Mission, Kans.
Instrumentation Tech. Corp., Northridge, Cal.
Lundy Elctrns. & Sys., Glen Head, N.Y.
Mohawk OEM Sales, King of Prussia, Pa.

Converters, CRT Display

Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
M C & A Products, Woodside, N.Y. p. 1•148-151
M Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1170
Hybrid Systems Corp., Burlington, Mass. p. 1•164,165
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
Microtran Co., Valley Stream, N.Y. ... p. 2•1764
M Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471
D Venus Scientific, Farmingdale, N.Y. p. 1•1024,1025
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
NES, Streamwood, Ill. .... *
American Used Computer Corp., Boston, Mass.
Aydin Controls, Ft. Washington, Pa.
Bicron Elctrns. Co., Canaan, Conn.
M Cardion Elctrns., Woodbury, N.Y.
Conrac Div., Covina, Calif.
D Data Translation, Framingham, Mass.
Datum, Anaheim, Calif.
Dynamic Measurements Corp., Winchester, Mass.
EWC, Kenilworth, N.J.
Hughes Aircraft Co, Culver City, Cal.
D Hughes Aircraft Co., Oceanside, Calif.
Information Displays, Mt. Kisco, N.Y.
Intronics Inc., Newton, Mass.
Lundy Elctrns. & Sys., Glen Head, N.Y.
D Princeton Elctrn. Prods., New Brunswick, N.J.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Tektronix, Beaverton, Ore.
M Westinghouse Canada Ltd., Hamilton, Ont., Can.

Converters, D-C to D-C, Less Than 30 VDC Output

M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1043-1045
Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089
M Anadyne, Santa Fe Springs, Cal. p. 1•1108,1109
M Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100
M Autronics Corp., Pasadena, Cal ....p. 1•1113
Bikor Corporation, Harbor City, Cal. p. 1•1122
CEA, San Luis Obispo, Cal. .... p. 1•1125
D Dale Electronics Inc., Columbus, Neb. p. 2•1452
Datel Systems Inc., Canton, Mass. ... p. 1•1166
Dynamic Instr. Corp., Hauppauge, N.Y. p. 1•1177; p. 2•1735
D Endicott Coil Co., Binghamton, N.Y. p. 1•1206
M Freed Transformer Co., Brooklyn, N.Y. p. 1•716,717; p. 2•1738-1747
Hisonic, Olathe, Kan. .... p. 1•1233
M Integrated Circuits, Bellevue, Wash. p. 1•1236
Interelectronics Corp., Congers, N.Y. p. 1•1237
Magnetico, Holtsville, N.Y. .... p. 2•1770
Microtran Co., Valley Stream, N.Y. ... p. 2•1764
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315,1318
MIL Electronics, Lowell, Mass. ....p. 1•1322
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
Power Technology, Little Rock, Ark. p. 1•1338
Reliability Inc., Houston, Tex. p. 1•1428,1429
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
Semiconductor Circuits, Haverhill, Mass. p. 1•1450-1457
M Stevens-Arnold, So. Boston, Mass. p. 1•1476,1477
Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512
M Technipower, Ridgefield, Conn. p. 1•1478,1479
Tecnetics, Boulder, Colo. p. 1•1491-1493,1495,1496
Topaz Electronics, San Diego, Cal. .... p. 1•1504
Wilmore Elctrns. Co., Durham, N.C. p. 1•1536
Analogic Corp., Wakefield, Mass. .... *
Bel Fuse, Jersey City, N.J. .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
Del Electronics Corp., Mt. Vernon, N.Y. .... *
Elctrn. Instr. & Specialty, Stoneham, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
General Magnetics, Bloomfield, N.J. .... *
Hybrid Systems Corp., Burlington, Mass. .... *
NES, Streamwood, Ill. .... *
North Hills Elctrns., Glen Cove, N.Y. .... *
M Torotel Inc., Grandview, Mo. .... *
M Unitron Inc., Garland, Tex. .... *
Acme Electric, Cuba, N.Y.
American Monarch Corp., Minneapolis, Minn.
Astro-Geo-Marine Inc., Oxnard, Cal.
BF Elctrns., Solana Beach, Calif.
Bicron Elctrns. Co., Canaan, Conn.
Burr-Brown, Tucson, Ariz.
D Carter Motor Co., Chicago, Ill.
Compumod, Haverhill, Mass.
Mr. Roger Love, Madison, NJ
Crestronics Inc., Crestline, Cal.
Cyberex, Mentor, Ohio
D Data Translation, Framingham, Mass.
Design Automation, Lexington, Mass.
D Dressen-Barnes Elctrns., Pasadena, Cal.
E-Tronics, Sepulveda, Cal.
M Elasco, Bloomfield, Conn
EMCO High Voltage, Mt. View, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Hughes Aircraft Co, Culver City, Cal.
Instant Instruments Inc., Haverhill, Mass.
Instruments Components Co., Montor, Ohio
Intronics Inc., Newton, Mass.
ITI Electronics, Clifton, N.J.
M Magnetic Circuit Elements, Monterey, Cal.
D Midland International Corp., No. Kansas City, Mo.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
M Peschel Instrs., Cape Coral, Fla.
Pioneer Magnetics, Santa Monica, Cal.
D Power Control Corp., Pittsburgh, Pa.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
M Sawyer Inds., Arcadia, Cal.
Sensor Corp., Scottdale, Pa.
Seven Sciences, Santa Clara, Cal.
M Spacetac, Bedford, Mass.
Standard Logic Inc., Santa Ana, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
M Velonex, Instrument Div., Santa Clara, Cal.
D Vidaire Electronics Mfg., Freeport, N.Y.

Converters, D-C to D-C, 30 to 300 VDC Output

M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1043-1045
M Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
M Anadyne, Santa Fe Springs, Cal. p. 1•1108,1109
M Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100
M Autronics Corp., Pasadena, Cal ....p. 1•1113
D Beckman Instrs., Scottsdale, Ariz. .... p. 2•1128
Bikor Corporation, Harbor City, Cal. p. 1•1122
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
CEA, San Luis Obispo, Cal. .... p. 1•1125
Dynamic Instr. Corp., Hauppauge, N.Y. p. 1•1177; p. 2•1735
D Endicott Coil Co., Binghamton, N.Y. p. 1•1206
Hisonic, Olathe, Kan. .... p. 1•1233
M Integrated Circuits, Bellevue, Wash. p. 1•1236
Interelectronics Corp., Congers, N.Y. p. 1•1237
La Marche Mfg. Co., Des Plaines, Ill. p. 1•1308,1309
Magnetico, Holtsville, N.Y. .... p. 2•1770
Microtran Co., Valley Stream, N.Y. ... p. 2•1764
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315,1318
MIL Electronics, Lowell, Mass. ....p. 1•1323
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
Semiconductor Circuits, Haverhill, Mass. p. 1•1450-1457
DM Sorensen Co., Manchester, N.H. ....p. 1•1433
M Stevens-Arnold, So. Boston, Mass. p. 1•1476,1477
Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512
M Technipower, Ridgefield, Conn. p. 1•1478,1479
Tecnetics, Boulder, Colo. p. 1•1491-1493,1495
Topaz Electronics, San Diego, Cal. .... p. 1•1504
Wilmore Elctrns. Co., Durham, N.C. p. 1•1536
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... *
Bertan Assocs., Hicksville, N.Y. .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
M Del Electronics Corp., Mt. Vernon, N.Y. .... *
Delco Electronics Div., Kokomo, Ind. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
International Rectifier Corp., El Segundo, Cal. *
North Hills Elctrns., Glen Cove, N.Y. .... *
Nova Electric Mfg. Co., Nutley, N.J. .... *
Power Technology, Little Rock, Ark. .... *
M Torotel Inc., Grandview, Mo. .... *
Acme Electric, Cuba, N.Y.
American Monarch Corp., Minneapolis, Minn.
Bicron Elctrns. Co., Canaan, Conn.
D Carter Motor Co., Chicago, Ill.
Mr. Roger Love, Madison, NJ
Controltek Inc., Portland, Ore.
Crestronics Inc., Crestline, Cal.
Cyberex, Mentor, Ohio
Design Automation, Lexington, Mass.
D Dressen-Barnes Elctrns., Pasadena, Cal.
E-Tronics, Sepulveda, Cal.
M Elasco, Bloomfield, Conn
EMCO High Voltage, Mt. View, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Hughes Aircraft Co, Culver City, Cal.
Instant Instruments Inc., Haverhill, Mass.
Intronics Inc., Newton, Mass.
Jaesic Industries Co., Wixom, Mich.
M Magnetic Circuit Elements, Monterey, Cal.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
M Peschel Instrs., Cape Coral, Fla.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
Reich Associates Inc., Plano, Tex
Sensor Corp., Scottdale, Pa.
M Spacetac, Bedford, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Velonex, Instrument Div., Santa Clara, Cal.
D Workman Electronic Prods., Sarasota, Fla.

Converters, D-C to D-C, 300 to 1,000 VDC Output

M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1043

M **Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092**
M **Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100**
M **Autronics Corp., Pasadena, Cal p. 1•1113**
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1122
CEA, San Luis Obispo, Cal. p. 1•1125
CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163
Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1169
D **Endicott Coil Co., Binghamton, N.Y. p. 1•1206**
Hisonic, Olathe, Kan. p. 1•1233
Interelectronics Corp., Congers, N.Y. p. 1•1237
Magnetico, Holtsville, N.Y. p. 2•1770
Microtran Co., Valley Stream, N.Y. p. 2•1764
MIL Electronics, Lowell, Mass. p. 1•1324
Power Designs, Westbury, N.Y. p. 1•1418-1425
M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y. p. 1•1460-1471**
M **Stevens-Arnold, So. Boston, Mass. p. 1•1476,1477**
M **Technipower, Ridgefield, Conn. p. 1•1478,1479**
Tecnetics, Boulder, Colo. p. 1•1492,1493
D **Venus Scientific, Farmingdale, N.Y. p. 1•1024,1025**
Wilmore Elctrns. Co., Durham, N.C. p. 1•537
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. ***
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. *
Industrial Elctrn. Engrs., Van Nuys, Cal. *
International Rectifier Corp., El Segundo, Cal. *
North Hills Elctrns., Glen Cove, N.Y. *
Power Technology, Little Rock, Ark. *
M **Torotel Inc., Grandview, Mo. ***
Bicron Elctrns. Co., Canaan, Conn.
D Carter Motor Co., Chicago, Ill.
Mr. Roger Love, Madison, NJ
Controltek Inc., Portland, Ore.
Crestronics Inc., Crestline, Cal.
M Elasco, Bloomfield, Conn
EMCO High Voltage, Mt. View, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Hughes Aircraft Co, Culver City, Cal.
Intronics Inc., Newton, Mass.
M Magnetic Circuit Elements, Monterey, Cal.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
M Peschel Instrs., Cape Coral, Fla.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Rantec Div., Calabasas, Calif.
Reich Associates Inc., Plano, Tex
M Spacetac, Bedford, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Velonex, Instrument Div., Santa Clara, Cal.

Converters, D-C to D-C, Greater Than 1,000 VDC Output

M **Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092**
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. p. 1•1088,1089**
M **Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100**
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1122
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
M **CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163**
M **Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1169**
D **Endicott Coil Co., Binghamton, N.Y. p. 1•1206**
Hisonic, Olathe, Kan. p. 1•1233
Interelectronics Corp., Congers, N.Y. p. 1•1237
Magnetico, Holtsville, N.Y. p. 2•1770
MIL Electronics, Lowell, Mass. p. 1•1324
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y. p. 1•1460-1471**
M **Stevens-Arnold, So. Boston, Mass. p. 1•1476,1477**
Tecnetics, Boulder, Colo. p. 1•1492,1493
D **Venus Scientific, Farmingdale, N.Y. p. 1•1024,1025**
Wilmore Elctrns. Co., Durham, N.C. p. 1•537
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. *
Industrial Elctrn. Engrs., Van Nuys, Cal. *
International Rectifier Corp., El Segundo, Cal. *
North Hills Elctrns., Glen Cove, N.Y. *
Bicron Elctrns. Co., Canaan, Conn.
Crestronics Inc., Crestline, Cal.
EMCO High Voltage, Mt. View, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Galileo Electro-Optics Corp., Sturbridge, Mass.
Hughes Aircraft Co, Culver City, Cal.
Intronics Inc., Newton, Mass.
M Magnetic Circuit Elements, Monterey, Cal.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
M Peschel Instrs., Cape Coral, Fla.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Reich Associates Inc., Plano, Tex
M Sawyer Inds., Arcadia, Cal.
M Spacetac, Bedford, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Velonex, Instrument Div., Santa Clara, Cal.
Voltek Inc., Beverly Hills, Cal.

Converters, D-C to Frequency (Power)—

See Inverters, D-C to A-C

Converters, D-C to Sine-Cosine

Abacus Controls Inc., Somerville, N.J. p. 1•1026
Astrosystems, Lake Success, N.Y. p. 1•143
M **Computer Conversions Corp., East Northport, N.Y. p. 1•154,155**
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M **Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917**
M **Interface Engineering Inc., Stoughton, Mass. p. 1•175**
Topaz Electronics, San Diego, Cal. p. 1•1504
M **Transmagnetics, Farmingdale, N.Y. p. 1•124**
M **Vernitech, Deer Pk., N.Y. p. 1•220,276**
M **Analog Devices, Norwood, Mass. ***
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. *
M **General Instruments Corp., Hicksville, N.Y. ***
General Magnetics, Bloomfield, N.J. *
All Systems, Moorestown, N.J.
M Control Sciences, Granada Hills, Cal.
E-Tronics, Sepulveda, Cal.
EWC, Kenilworth, N.J.
Intronics Inc., Newton, Mass.
LRC Inc., Hudson, N.H.
Optical Electronics, Tucson, Ariz.
Singer Co., Little Falls, N.J.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
M Welco Inds. Inc., Cincinnati, Ohio

Converters, Digital To Analog

Analogic Corp., Wakefield, Mass. p. 1•130,132,133
M **Arnoux Corp., Santa Barbara, Cal. p. 1•604,605**
Astrosystems, Lake Success, N.Y. p. 1•142
D **Beckman Instrs., Fullerton, Cal. p. 1•881**
C & A Products, Woodside, N.Y. p. 1•148-151
M **Computer Conversions Corp., East Northport, N.Y. p. 1•154,155**
M **Control Technology Co., L.I.C., N.Y. p. 1•1914,1915**
Datel Systems Inc., Canton, Mass. p. 1•156
Dynamic System Elctrns., Santa Barbara, Cal. p. 1•604,605
Electronic Dev. Corp., Boston, Mass. p. 1•672
Elgar Corporation, San Diego, Cal. p. 1•1198
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
M **Hybrid Systems Corp., Burlington, Mass. p. 1•164-167**
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M **Integrated Circuits, Bellevue, Wash. p. 1•891**
M **Inter-Computer Electronics,, Lansdale, Pa. p. 1•173**
M **Interface Engineering Inc., Stoughton, Mass. p. 1•175**
DM **Phoenix Data Inc., Phoenix, Ariz. p. 1•190-193**
Preston Scientific Inc., Anaheim, Cal. p. 1•194-199
RFL Inds., Boonton, N.J. p. 1•122
DM **Sorensen Co., Manchester, N.H. p. 1•1422**
Teledyne Philbrick, Dedham, Mass. p. 1•208-217
M **Vernitech, Deer Pk., N.Y. p. 1•220,276**
M **Analog Devices, Norwood, Mass. ***
D **Data Technology, Santa Ana, Cal. ***
M **General Instruments Corp., Hicksville, N.Y. ***
M **General Microwave Corp., Farmingdale, NY ***
Moxon Inc., Irvine, Cal. *
NES, Streamwood, Ill. *
North Atlantic Inds., Plainview, N.Y. *
DM **Precision Monolithics Inc., Santa Clara, Cal. ***
Burr-Brown, Tucson, Ariz.
D Cambridge Thermionic Corp., Cambridge, Mass.
M Circuit Technology, Farmingdale, N.Y.
Computer Labs, Greensboro, N.C.
Conrac Corp., Fairfield, N.J.
CTS Corp., Elkart, Ind.
Cycon Corp., Sunnyvale, Cal.
D Data Translation, Framingham, Mass.
Datametrics Inc., Wilmington, Mass.
Datawest Corp., Scottsdale, Ariz.
Datex Div., Duarte, Cal.
Datum, Anaheim, Calif.
Digiac Corp., Smithtown, N.Y.
Digital Equipment Corp., Maynard, Mass.
Dynamic Measurements Corp., Winchester, Mass.
E-H Resch. Labs., Oakland, Cal.
D EMR Telemetry, Sarasota, Fla.
M Environmental Communications Inc., Costa Mesa, Cal.
Epsco, Westwood, Mass.
Fairchild Space & Defense Sys. Div., Syosset, N.Y.
Fifth Dimension, Princeton, N.J.
Foxboro Co., Foxboro, Mass.
Function Modules, Costa Mesa, Cal.
GAP Instr. Corp., Hauppauge, N.Y.
M General Devices, Princeton, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Culver City, Cal.
M HyComp Inc., Maynard, Mass.
Information Displays, Mt. Kisco, N.Y.
D Intech, Santa Clara, Cal.
Intronics Inc., Newton, Mass.
Kinetic Systems Corp., Lockport, Ill.
Leeds & Northrup Co., North Wales, Pa.
LRC Inc., Hudson, N.H.
Micro Components Corp., Cranston, RI
Micro Networks, Worcester, Mass.
Microwave Diode Corp., Colebrook, N.H.
DM National Semiconductor Corp., Santa Clara, Cal.
Optical Electronics, Tucson, Ariz.
Perkin-Elmer Corp., Norwalk, Conn.
D Ragen Data Systems, Farmingdale, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Rolm Corp., Cupertino, Cal.
Scientific Measurements, Evanston, Ill.
Singer Co., Little Falls, N.J.
M Spacetac, Bedford, Mass.
Struthers-Dunn, Bettendorf, Iowa
D Teledyne Semiconductor, Mountain View, Cal.
M Trak Systems, Tampa, Fla.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.
Wyle Computer Prods., El Segundo, Calif.
XINCOM Corp., Chatsworth, Cal.

Converters, Digital To Paper Tape

A. D. Data Sys., Rochester, N.Y. p. 1•127
NES, Streamwood, Ill. *
American Used Computer Corp., Boston, Mass.
D Chalco Engrg. Corp., Gardena, Cal.
Cipher Data Products, San Diego, Cal.
D Control Equip. Corp., Lowell, Mass.
DataGraphics Corp., San Antonio, Tex.
Datametrics Inc., Wilmington, Mass.
Datum, Anaheim, Calif.
DEMEK, Shawnee-Mission, Kans.
Instrumentation Tech. Corp., Northridge, Cal.
Mohawk OEM Sales, King of Prussia, Pa.
Struthers-Dunn, Bettendorf, Iowa
Theta Instr. Corp., Fairfield, N.J.

Converters, Digital To Resolver

Astrosystems, Lake Success, N.Y. p. 1•142
M **C & A Products, Woodside, N.Y. p. 1•148-151**
M **Computer Conversions Corp., East Northport, N.Y. p. 1•154,155**
M **Control Technology Co., L.I.C., N.Y. p. 1•1914,1915**
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M **Interface Engineering Inc., Stoughton, Mass. p. 1•174**
M **Natel Engineering Co., Canoga Park, Cal. p. 1•184-187**
M **North Atlantic Inds., Plainview, N.Y. p. 1•188,772**
D **Precision Timer Co., Westbrook, Conn. p. 1•268**
M **Transmagnetics, Farmingdale, N.Y. p. 1•124**
M **Vernitech, Deer Pk., N.Y. p. 1•220,276**
M **Analog Devices, Norwood, Mass. ***
M **General Instruments Corp., Hicksville, N.Y. ***
NES, Streamwood, Ill. *
M Clifton Precision, Clifton Hgts., Pa.

Conrac Corp., Fairfield, N.J.
M Control Sciences, Granada Hills, Cal.
Datametrics Inc., Wilmington, Mass.
Fairchild Space & Defense Sys. Div., Syosset, N.Y.
GAP Instr. Corp., Hauppauge, N.Y.
Oriel Corp. of America, Stamford, Conn.
Perkin-Elmer Corp., Norwalk, Conn.
D Ragen Data Systems, Farmingdale, N.Y.
Singer Co., Little Falls, N.J.
Struthers-Dunn, Bettendorf, Iowa
Theta Instr. Corp., Fairfield, N.J.

Converters, Digital To Synchro

M Applied Microwave, Westwood, Mass. p. 1•901-904
Astrosystems, Lake Success, N.Y. ..... p. 1•142
C & A Products, Woodside, N.Y. p. 1•148-151
M Computer Conversions Corp., East Northport, N.Y. ..... p. 1•154,155
M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Interface Engineering Inc., Stoughton, Mass. p. 1•174
M Natel Engineering Co., Canoga Park, Cal. p. 1•184-187
M North Atlantic Inds., Plainview, N.Y. p. 1•188,772
M Transmagnetics, Farmingdale, N.Y. .....p. 1•124
M Vernitech, Deer Pk., N.Y. ..... p. 1•220,276
M Analog Devices, Norwood, Mass. ..... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Hybrid Systems Corp., Burlington, Mass. ..... *
NES, Streamwood, Ill. ..... *
All Systems, Moorestown, N.J.
M Clifton Precision, Clifton Hgts., Pa.
Conrac Corp., Fairfield, N.J.
M Control Sciences, Granada Hills, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Epsco, Westwood, Mass.
GAP Instr. Corp., Hauppauge, N.Y.
Perkin-Elmer Corp., Norwalk, Conn.
D Ragen Data Systems, Farmingdale, N.Y.
Singer Co., Little Falls, N.J.
Struthers-Dunn, Bettendorf, Iowa
Theta Instr. Corp., Fairfield, N.J.

Converters, Frequency, Logarithmic

Kratos, Pasadena, Cal ..... p. 1•253
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ..... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Yewtec Corporation, Larchmont, N.Y. ..... *
All Systems, Moorestown, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
D Intech, Santa Clara, Cal.

Converters, Frequency Shift Keying

RFL Inds., Boonton, N.J. ..... p. 1•122
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ..... *
All Systems, Moorestown, N.J.
Electrocom Inds., S. Bend, Ind.
Frederick Electronics Corp., Frederick, Md.
Instrumentation Tech. Corp., Northridge, Cal.
Singer - Tele-Signal, Woodbury, N.Y.

Converters, Frequency, Test

Abacus Controls Inc., Somerville, N.J. p. 1•1026
American Vector/TDC, Dayton, N.J. p. 1•1083
Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119
D California Instrs. Co., San Diego, Cal. p. 1•1164
M CML-Macarr, Edison, N.J. .....p. 1•1154-1158
Elgar Corporation, San Diego, Cal. .....p. 1•1198
M Georator Corporation, Manassas, Va. p. 1•1223,1229
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M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
Topaz Electronics, San Diego, Cal. ..... p. 1•1504
Astrosystems, Lake Success, N.Y. ..... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ..... *
Aerospace Avionics, Bohemia, N.Y.
Behlman Div., California Instrs., San Diego, Cal
Calico Div., San Diego, Cal.
Elin Div., San Diego, Cal.
Meloy Laboratories Inc., Springfield, Va.

Converters, Frequency to D-C - Also see Power Supplies A-C Input, D-C Output

Active Control Instrumentation, E. Northport, N.Y. ..... p. 1•228
Advance Conversion Devices Co., Passaic, N. J. p. 1•1085
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D ATR Electronics, St. Paul, Minn. ..... p. 1•1111
M Autronics Corp., Pasadena, Cal .....p. 1•1113
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M CML-Macarr, Edison, N.J. p. 1•1154-1158,1160
M Computer Conversions Corp., East Northport, N.Y. .....p. 1•154,155
M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
Datel Systems Inc., Canton, Mass. ..... p. 1•159
M Georator Corporation, Manassas, Va. p. 1•1223-1225
M Kratos, Pasadena, Cal ..... p. 1•253
Magnetico, Holtsville, N.Y. ..... p. 2•1770
Microtran Co., Valley Stream, N.Y. ... p. 2•1767
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RFL Inds., Boonton, N.J. ..... p. 1•122
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
Teledyne Philbrick, Dedham, Mass. p. 1•208-217
M Transmagnetics, Farmingdale, N.Y. .....p. 1•125
Wilmore Elctrns. Co., Durham, N.C. ....p. 1•537
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. ..... *
Del Electronics Corp., Mt. Vernon, N.Y. ..... *
Delco Electronics Div., Kokomo, Ind. ..... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Hybrid Systems Corp., Burlington, Mass. ..... *
Interelectronics Corp., Congers, N.Y. ..... *
International Rectifier Corp., El Segundo, Cal. *
North Atlantic Inds., Plainview, N.Y. ..... *
M Acromag, Wixom, Mich.
Aerospace Avionics, Bohemia, N.Y.
Airpax Elctrns., Ft. Lauderdale, Fla.
Almond Instrs. Co., Covina, Cal.
Amp Inc., Harrisburg, Pa.
Anadex Instrs., Van Nuys, Cal.
ARGA Controls, Pasedena, Cal.
Avtron Mfg., Cleveland, Ohio
B & F Instrs., Corwells Hgts, Pa.
Basler Electric Co., Highland, Ill.
Bicron Elctrns. Co., Canaan, Conn.
Cal-Power Corp., El Segundo, Calif.
Mr. Roger Love, Madison, NJ
Dynamic Measurements Corp., Winchester, Mass.
Electric Indicator Co., Norwalk, Conn.
D Electro Corp., Sarasota, Fla.
EWC, Kenilworth, N.J.
Foxboro Co., Foxboro, Mass.
GAP Instr. Corp., Hauppauge, N.Y.
Incor Instrumentation, West Babylon, N.Y.
D Intech, Santa Clara, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
Metrix Instrument Co., Houston, Tex.
Pioneer Magnetics, Santa Monica, Cal.
Richard-Lee Co., New Providence, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
M Sawyer Inds., Arcadia, Cal.
Sel-Rex Co. Div. Oxy Metal Industries Corp., Nutley, N.J.
Sensor Corp., Scottdale, Pa.
Singer - Tele-Signal, Woodbury, N.Y.
Teledyne Inet, Gardena, Cal.
Varian Assocs., Palo Alto, Cal.
Vibrac Corp., Chelmsford, Mass.
Vibration Instrs. Co., Anaheim, Cal.

Converters, Graphic To Digital

Astrosystems, Lake Success, N.Y. ..... *
NES, Streamwood, Ill. ..... *
Dest Data Corp., Sunnyvale, Cal.
Hughes Aircraft Co, Culver City, Cal.
Information Displays, Mt. Kisco, N.Y.
Lundy Elctrns. & Sys., Glen Head, N.Y.
D Measurement Sys., Norwalk, Conn.
Sanders Data Systems, Nashua, N.H.

Converters, High-Frequency

American Vector/TDC, Dayton, N.J. p. 1•1083
Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119
Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324
M Georator Corporation, Manassas, Va. p. 1•1223-1227
Magnetico, Holtsville, N.Y. ..... p. 2•1770
M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
Vari-L Co., Denver, Colo. ..... p. 2•1392-1400
Applied Research Inc., Port Washington, N.Y. *
Biometrics Instrument Corp., Garland, Tex. ..... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ..... *
CML-Macarr, Edison, N.J. ..... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Interelectronics Corp., Congers, N.Y. ..... *
M Unitron Inc., Garland, Tex. ..... *
M Aertech Industries, Sunnyvale, Cal.
M Ajax Magnethermic Corp., Warren, Ohio
DM Anaren Microwave, Syracuse, N.Y.
D Blonder-Tongue Labs., Old Bridge, N.J.
Cal-Power Corp., El Segundo, Calif.
Elcom Systems, Deer Pk., N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
D Intech, Santa Clara, Cal.
Jerrold Electronics Corp., Horsham, Pa.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Microphase Corp., Cos Cob, Conn.
DM Miteg Inc., Hauppauge, N.Y.
Mobil Electronics, Anderson, Ind.
Radio Development Lab., Deer Park, NY
Special Microwave Devices Oper., Waltham, Mass.
M Welco Inds. Inc., Cincinnati, Ohio
Westinghouse Elec., Sykesville, Md.

Converters, Low-Frequency

Abacus Controls Inc., Somerville, N.J. p. 1•1026
A L S Electronics Corp., Covina, Cal. p. 1•1087
American Vector/TDC, Dayton, N.J. p. 1•1083
Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119
D California Instrs. Co., San Diego, Cal. p. 1•1164
Elgar Corporation, San Diego, Cal. .....p. 1•1198
M Georator Corporation, Manassas, Va. p. 1•1222,1228,1229
Magnetico, Holtsville, N.Y. ..... p. 2•1770
RFL Inds., Boonton, N.J. ..... p. 1•122
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
M Unitron Inc., Garland, Tex. .....p. 1•1516-1523
Vari-L Co., Denver, Colo. ..... p. 2•1392-1400
Applied Research Inc., Port Washington, N.Y. *
Biometrics Instrument Corp., Garland, Tex. ..... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ..... *
CML-Macarr, Edison, N.J. ..... *
M Del Electronics Corp., Mt. Vernon, N.Y. ..... *
M General Instruments Corp., Hicksville, N.Y. ..... *
General Magnetics, Bloomfield, N.J. ..... *
Interelectronics Corp., Congers, N.Y. ..... *
Nova Electric Mfg. Co., Nutley, N.J. ..... *
AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
Behlman Div., California Instrs., San Diego, Cal
Cal-Power Corp., El Segundo, Calif.
Calico Div., San Diego, Cal.
Elcom Systems, Deer Pk., N.Y.
Elin Div., San Diego, Cal.
Guardian California, Torrance, Cal.
Hughes Aircraft Co, Culver City, Cal.
D Intech, Santa Clara, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Meloy Laboratories Inc., Springfield, Va.
Microphase Corp., Cos Cob, Conn.
D NH Research, Santa Ana, Calif.
M Polyphase Instr. Co., Bridgeport, Pa.
Radio Development Lab., Deer Park, NY
Special Microwave Devices Oper., Waltham, Mass.
D Welco Inds. Inc., Cincinnati, Ohio

Converters, Microwave Frequency

Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324
Greenray Inds., Mechanicsburg, Pa. ..... p. 1•327
M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
Vari-L Co., Denver, Colo. ..... p. 2•1392-1400
Applied Research Inc., Port Washington, N.Y. *
M General Microwave Corp., Farmingdale, NY ..... *
All Systems, Moorestown, N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Ailtech, Farmingdale, N. Y.
M Amplica Inc., Westlake Village, Cal.
DM Anaren Microwave, Syracuse, N.Y.

*Company has information in white pages but not on this product

California Microwave, Sunnyvale, Cal.
Collins Radio, Dallas, Tex.
Elcom Systems, Deer Pk., N.Y.
Electrac, Anaheim, Calif.
Environmental Communications Inc., Costa Mesa, Cal.
Frequency Engrg. Labs., Farmingdale, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Culver City, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Micro-Tel Corp., Baltimore, Md.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
DM Miteg Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
M Premier Microwave, Port Chester, N.Y.
Radio Development Lab., Deer Park, NY
Special Microwave Devices Oper., Waltham, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Beverly, Mass
Varian Data Machines, Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.

Converters, Multiplying, Analog to Digital and Digital to Analog

Dynamic Measurements Corp., Winchester, Mass.

Converters, Paper Tape To Magnetic Tape

NES, Streamwood, Ill. ....*
American Used Computer Corp., Boston, Mass.
D Chalco Engrg. Corp., Gardena, Cal.
D Control Equip. Corp., Lowell, Mass.
Datum, Anaheim, Calif.
Digitronics Corp., Albertson, N.Y.
Dytro Corp., Hicksville, N.Y.
Instrumentation Tech. Corp., Northridge, Cal.
Lundy Elctrns. & Sys., Glen Head, N.Y.
MI2 Data Systems Inc., Columbus, Ohio
Mohawk OEM Sales, King of Prussia, Pa.
Struthers-Dunn, Bettendorf, Iowa

Converters, Paper Tape To Paper Tape

NES, Streamwood, Ill. ....*
American Used Computer Corp., Boston, Mass.
D Chalco Engrg. Corp., Gardena, Cal.
D Control Equip. Corp., Lowell, Mass.
Datum, Anaheim, Calif.
Digitronics Corp., Albertson, N.Y.
Frederick Electronics Corp., Frederick, Md.
Instrumentation Tech. Corp., Northridge, Cal.
Mohawk OEM Sales, King of Prussia, Pa.
Struthers-Dunn, Bettendorf, Iowa

Converters, Phase

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M **Computer Conversions Corp., East Northport, N.Y.** ....p. 1•154,155
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
M **Georator Corporation, Manassas, Va.** p. 1•1222,1223
M **Industrial Control Co., Farmingdale, N.Y.** p. 1•1916,1917
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M **North Atlantic Inds., Plainview, N.Y.** p. 1•188,772
M **Solid State Electronics Corp., Sepulveda, Cal.** p. 1•126
M **Transmagnetics, Farmingdale, N.Y.** .....p. 1•125
Astrosystems, Lake Success, N.Y. .... *
General Elec. Co., Schenectady, N.Y. .... *
D **General Magnetics, Bloomfield, N.J.** .... *
Electrac, Anaheim, Calif.
Guardian California, Torrance, Cal.
D NH Research, Santa Ana, Calif.
Singer Co., State College, Pa.
Special Microwave Devices Oper., Waltham, Mass.
Theta Instr. Corp., Fairfield, N.J.

Converters, Polar To Rectangular Coordinates

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M **Computer Conversions Corp., East Northport, N.Y.** ....p. 1•154,155
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M **Interface Engineering Inc., Stoughton, Mass.** p. 1•174
Natel Engineering Co., Canoga Park, Cal. p. 1•184-187
M **Transmagnetics, Farmingdale, N.Y.** .....p. 1•124
Astrosystems, Lake Success; N.Y. .... *
D **General Magnetics, Bloomfield, N.J.** .... *
Hybrid Systems Corp., Burlington, Mass. .... *
M G B Instruments Inc., Hollywood, Fla.
Metric Systems Corp., Ft. Walton Beach, Fla.
D NH Research, Santa Ana, Calif.
Princeton Elctrn. Prods., New Brunswick, N.J.
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.

Converters, Power Frequency, Electronic

Abacus Controls Inc., Somerville, N.J. p. 1•1026
M **A L S Electronics Corp., Covina, Cal.** p. 1•1087
American Vector/TDC, Dayton, N.J. p. 1•1083
Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
D **California Instrs. Co., San Diego, Cal.** p. 1•1164
M **CML-Macarr, Edison, N.J.** p. 1•1154-1158,1160
M **Control Technology Co., L.I.C., N.Y.** p. 1•1914,1915
M **Eldec Corp., Lynnwood, Wash.** p. 1•1193-1196
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Industrial Test Equip., Port Washington, N.Y. p. 1•1235
M **Mid-Eastern Inds., Scotch Plains, N.J.** p. 1•1315,1318
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Del Electronics Corp., Mt. Vernon, N.Y. .... *
Delco Electronics Div., Kokomo, Ind. .... *
General Elec. Co., Schenectady, N.Y. .... *
Interelectronics Corp., Congers, N.Y. .... *
D **Microtran Co., Valley Stream, N.Y.** .... *
Nova Electric Mfg. Co., Nutley, N.J. .... *
Wilmore Elctrns. Co., Durham, N.C. .... *
AEL, Colmar, Pa.
Aerospace Avionics, Bohemia, N.Y.
Amp Inc., Harrisburg, Pa.
Basler Electric Co., Highland, Ill.
Behlman Div., California Instrs., San Diego, Cal
D B. H. Industries, Los Angeles, Cal
Cal-Power Corp., El Segundo, Calif.
Calico Div., San Diego, Cal.
Components Corp., Denville, N.J.
Mr. Roger Love, Madison, NJ
Cycle-Dyne, Jamaica, N.Y.
M Delta Elctrn. Control, Costa Mesa, Cal.
Electro-Pacific, Goleta, Calif.
Elin Div., San Diego, Cal.
EWC, Kenilworth, N.J.
M International Power Machines Corp., Mesquite, Tex.
Meloy Laboratories Inc., Springfield, Va.
D NH Research, Santa Ana, Calif.
Nucleus Corp., Madison Hgts., Mich.
D Power Control Corp., Pittsburgh, Pa.
Programmed Power, Menlo Park, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Teledyne Inet, Gardena, Cal.
D Terado Corp., St. Paul, Minn.
M Trio Labs, Plainview, N.Y.
Westinghouse Elec., Sykesville, Md.

Converters, Power Frequency, Rotary

M **A L S Electronics Corp., Covina, Cal.** p. 1•1087
M **Anadyne, Santa Fe Springs, Cal.** p. 1•1108,1109
M **Georator Corporation, Manassas, Va.** p. 1•1222-1229
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CML-Macarr, Edison, N.J. .... *
Delco Electronics Div., Kokomo, Ind. .... *
NES, Streamwood, Ill. ....*
M American Electronics, Fullerton, Cal.
D Carter Motor Co., Chicago, Ill.
Control Products Corp., Chicago, Ill.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Microwave Diode Corp., Colebrook, N.H.
Nucleus Corp., Madison Hgts., Mich.
Techsonics, El Prado, N.M.
Teledyne Inet, Gardena, Cal.
Westinghouse Elec., Sykesville, Md.

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Converters, Pulse To Analog

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M **Computer Conversions Corp., East Northport, N.Y.** ....p. 1•154,155
M **Control Technology Co., L.I.C., N.Y.** p. 1•1914,1915
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Hybrid Systems Corp., Burlington, Mass. p. 1•166,167
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
D **Precision Timer Co., Westbrook, Conn.** p. 1•268
M **Solid State Electronics Corp., Sepulveda, Cal.** p. 1•126
M **Transmagnetics, Farmingdale, N.Y.** .....p. 1•124
M **General Instruments Corp., Hicksville, N.Y.** .....*
Inter-Computer Electronics,, Lansdale, Pa. ..... *
NES, Streamwood, Ill. ....*
Airpax Elctrns., Ft. Lauderdale, Fla.
Anadex Instrs., Van Nuys, Cal.
Dynamic Measurements Corp., Winchester, Mass.
E-H Resch. Labs., Oakland, Cal.
Foxboro Co., Foxboro, Mass.
M General Devices, Princeton, N.J.
General Resistance, Mt. Vernon, N.Y.
Hughes Aircraft Co, Culver City, Cal.
Nucleus Corp., Madison Hgts., Mich.
Optical Electronics, Tucson, Ariz.
D Ragen Data Systems, Farmingdale, N.Y.
Sensor Corp., Scottdale, Pa.
Singer Co., State College, Pa.
Struthers-Dunn, Bettendorf, Iowa
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.
West Coast Resch. Corp., Los Angeles, Calif.

Converters, Pulse To Digital

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M **Autronics Corp., Pasadena, Cal** ....p. 1•1113
Chrono-log Corp., Havertown, Pa. ...... p. 1•152
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Hughes Aircraft Co, Culver City, Cal.
DM Hughes Aircraft Co., Carlsbad, Cal.
D Princeton Elctrn. Prods., New Brunswick, N.J.
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Nucleus Corp., Madison Hgts., Mich.
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D Control Equip. Corp., Lowell, Mass.
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Beckman Instrs., Schiller Park, Ill.
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D PCS., Flint, Mich.
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D Stewart-Warner Microcircuits, Sunnyvale, Cal.
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D Dynapar Corp., Gurnee, Ill.
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D Durant Digital Instruments, Watertown, Wisc.
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D Hecon Corp., New Shrewsbury, N.J.
D ITT General Controls, Glendale, Cal.
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Astrodata Inc., Anaheim, Cal.
ATEC, Houston, Tex.
Continental Rentals Div., Bedford, Mass.
D Control Equip. Corp., Lowell, Mass.
Controlcraft Corp., West Chicago, Ill.
Controltek Inc., Portland, Ore.
Counterscan Systems, Sutton, Neb.
D Digilin Inc., Burbank, Cal.
D Durant Digital Instruments, Watertown, Wisc.
Durgin & Brown, Burlington, Vt.
Electronic Counters & Controls Inc., Mundelein, Ill.
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D ITT General Controls, Glendale, Cal.
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D Non-Linear Sys., Del Mar, Cal.
M North American Philips Controls Corp., Cheshire, Conn.
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AEL, Colmar, Pa.
Aiken Industries, Gaithersburg, Md.
Anadex Instrs., Van Nuys, Cal.
M ATEC, Houston, Tex.
D Ballantine Laboratories, Boonton, N.J.
Beckman Instrs., Schiller Park, Ill.
BECO, Salem, Va.
Biddle, James G., Plymouth Meeting, Pa.
Calico Div., San Diego, Cal.
Continental Rentals Div., Bedford, Mass.
Controlcraft Corp., West Chicago, Ill.
Counterscan Systems, Sutton, Neb.
D Dana Labs., Irvine, Calif.
D Dynapar Corp., Gurnee, Ill.
DM EIP, Incorporated, Santa Clara, Cal.
D Eldorado Instrument Co., Concord, Cal.
Electro-Numerics Corp., Mountain View, Cal.
Electronic Counters & Controls Inc., Mundelein, Ill.
HEI, Chaska, Minn.
Hewlett-Packard Co., Palo Alto, Cal.
D ITT General Controls, Glendale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Keltron, Waltham, Mass.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
Micro-Tel Corp., Baltimore, Md.
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Newport Labs., Santa Ana, Cal.
Nucleus Corp., Madison Hgts., Mich.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
Plessey Enviromental Sys., San Diego, Cal.
DM Plessey Semiconductors, Santa Ana, Cal.
M Power Waves Inc., Asbury Park, N.J.
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D Regency Electronics, Indianapolis, Ind.
Rycom Instruments, Raytown, Mo.
Schneider Electronics, Medford, Mass.

Sensor Corp., Scottdale, Pa.
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M Abrams Instr., Lansing, Mich.
D Barker & Williamson, Bristol, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
M Chicago Dynamic Industries, Chicago, Ill.
Durant Digital Instruments, Watertown, Wisc.
Eagle Signal, Davenport, Iowa
Elden Mfg. Co., Chicago, Ill.
Electric Tachometer Corp., Philadelphia, Pa.
ENM, Chicago, Ill.
Foxboro Co., Foxboro, Mass.
D ITT General Controls, Glendale, Cal.
D JPI, Santa Monica, Cal.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
D Machine Components Corp., Plainview, N.Y.
North American Philips Controls Corp., Cheshire, Conn.
Nucleus Corp., Madison Hgts., Mich.
Orbit Instr. Corp., Syosset, N.Y.
PIC Design Division, Ridgefield, Conn.
Presin Co., Shelton, Conn.
D Ragen Data Systems, Farmingdale, N.Y.
Redington Counters, Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Sterling Instr., New Hyde Pk., NY
DM Stock Drive Prods., New Hyde Pk., N.Y.
Techni-Tool, Plymouth Meeting, Pa.
Triac Electronics, New York, N.Y.

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Bausch & Lomb, Rochester, N.Y.
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Harshaw Chemical Co., Cleveland, Ohio
Keltron, Waltham, Mass.
Kinetic Systems Corp., Lockport, Ill.
D Macrodyne Inc., Schenectady, N.Y.
Mine Safety Appliances Co., Pittsburgh, Pa
M Nuclear Resch. Corp., Southampton, Pa.
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D Thermo Sys., St. Paul, Minn.

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Amtron Div., Midlothian, Ill.
Automatic Timing & Controls Co., King of Prussia, Pa.
D Autotron, Danville, Ill.
Controlcraft Corp., West Chicago, Ill.
Disc Instruments, Costa Mesa, Ca.
Dolan-Jenner Inds., Melrose, Mass.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Durant Digital Instruments, Watertown, Wisc.
Durgin & Brown, Burlington, Vt.
D Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Electronic Counters & Controls Inc., Mundelein, Ill.
ENM, Chicago, Ill.
Harrel, E. Norwalk, Conn.
D Hecon Corp., New Shrewsbury, N.J.
Innovation Industries Inc., Roswell, N.M.
Keltron, Waltham, Mass.
Meloy Laboratories Inc., Springfield, Va.
M Nuclear Resch. Corp., Southampton, Pa.
PECO Corp., Milpitas, Cal.
Photobell Co., New York, N.Y.
D Photomation, Mountain View, Cal.
M Power Instrs., Skokie, Ill.
Practical Automation, Shelton, Conn.
Redington Counters, Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
D Scientific Technology, Mountain View, Cal.
Scientifico Scientific Components Co., Newport Beach, Cal.
Sensor Corp., Scottdale, Pa.
Struthers-Dunn, Bettendorf, Iowa
Tech Serv., Beltsville, Md
Tri-Tronics Co., Oak Brook, Ill.
Triac Electronics, New York, N.Y.
D Vorne Inds., Chicago, Ill.
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D **ALCO Electronic Prods., North Andover, Mass. ***
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Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ....*
Weston Instrs., Newark, N.J. ....*
M Abrams Instr., Lansing, Mich.
Amtron Div., Midlothian, Ill.
Anadex Instrs., Van Nuys, Cal.
ATEC, Houston, Tex.
Automatic Timing & Controls Co., King of Prussia, Pa.
B & B Motor & Control, New York, N.Y.
Controlcraft Corp., West Chicago, Ill.
Counterscan Systems, Sutton, Neb.
Data Technology Inc., Watertown, Mass.
Disc Instruments, Costa Mesa, Ca.
D Durant Digital Instruments, Watertown, Wisc.
Durgin & Brown, Burlington, Vt.
D Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Elden Mfg. Co., Chicago, Ill.
D Eldorado Instrument Co., Concord, Cal.
Electronic Counters & Controls Inc., Mundelein, Ill.
ENM, Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Harrel, E. Norwalk, Conn.
D Hecon Corp., New Shrewsbury, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Howell Inst. Inc., Ft. Worth, Tex.
Itek Corp. Meas. Sys. Div., Newton, Mass.
Keltron, Waltham, Mass.
Kinetic Systems Corp., Lockport, Ill.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
Micro Line Div. Bausch & Lomb, Jamestown, N.Y.
MKC Electronics, Kansas City, Kans.
DM National Semiconductor Corp., Santa Clara, Cal.
North American Philips Controls Corp., Cheshire, Conn.
Nu-Metrics, Vanderbilt, Pa.
PECO Corp., Milpitas, Cal.
Presin Co., Shelton, Conn.
Redington Counters, Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Richard-Lee Co., New Providence, N.J.
Sensor Corp., Scottdale, Pa.
Speed Detectors, Bedford, Ohio
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
DM Stock Drive Prods., New Hyde Pk., N.Y.
Struthers-Dunn, Bettendorf, Iowa
D Tennelec, Oak Ridge, Tenn.
Tenor Co., New Berlin, Wisc.
Theta Instr. Corp., Fairfield, N.J.
United Systems, Dayton, Ohio
D Vorne Inds., Chicago, Ill.
D Warner Elec. Brake & Clutch Co., S. Beloit, Ill.
WER Industrial, Grand Island, N.Y.

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Hecon Corp., New Shrewsbury, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
D ITT General Controls, Glendale, Cal.
Tech Serv., Beltsville, Md

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Del Electronics Corp., Mt. Vernon, N.Y. .... *
Kessler-Ellis Prods., Atlantic Highlands, N.J. *
D **Simpson Electric Co., Elgin, Ill. .... ***
Square D Co., Milwaukee, Wisc. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
M Abrams Instr., Lansing, Mich.
Amtron Div., Midlothian, Ill.
Anadex Instrs., Van Nuys, Cal.
ATEC, Houston, Tex.
Automatic Timing & Controls Co., King of Prussia, Pa.
B & B Motor & Control, New York, N.Y.
Beckman Instrs., Schiller Park, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
M Chicago Dynamic Industries, Chicago, Ill.
D Control Equip. Corp., Lowell, Mass.
Controlcraft Corp., West Chicago, Ill.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Data Technology Inc., Watertown, Mass.
Disc Instruments, Costa Mesa, Ca.
Durant Digital Instruments, Watertown, Wisc.
D Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Eldorado Instrument Co., Concord, Cal.
Electro-Numerics Corp., Mountain View, Cal.
Electronic Counters & Controls Inc., Mundelein, Ill.
ENM, Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Gregg Electric Inc., Ontario, Cal.
Haydon Switch & Instr., Waterbury, Conn.
D Hecon Corp., New Shrewsbury, N.J.
HEI, Chaska, Minn.
Itek Corp. Meas. Sys. Div., Newton, Mass.
D ITT General Controls, Glendale, Cal.
Joslyn Elctrn. Sys., Goleta, Cal.
Keltron, Waltham, Mass.
Kinetic Systems Corp., Lockport, Ill.
Non-Linear Sys., Del Mar, Cal.
North American Philips Controls Corp., Cheshire, Conn.
M Nuclear Resch. Corp., Southampton, Pa.
Nucleus Corp., Madison Hgts., Mich.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
Practical Automation, Shelton, Conn.
Presin Co., Shelton, Conn.
Redington Counters, Windsor, Conn.
Richard-Lee Co., New Providence, N.J.
Scientifico Scientific Components Co., Newport Beach, Cal.
Sensor Corp., Scottdale, Pa.
Struthers-Dunn, Bettendorf, Iowa
Sunshine Sci. Instrs., Philadelphia, Pa.
D Tau-Tron Inc., N. Billerica, Mass.
D Tennelec, Oak Ridge, Tenn.
Tenor Co., New Berlin, Wisc.
Theta Instr. Corp., Fairfield, N.J.
Triac Electronics, New York, N.Y.
Velonex, Display Prods., Santa Clara, Cal.
D Vorne Inds., Chicago, Ill.
WER Industrial, Grand Island, N.Y.

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M **Info-Lite Corp., Corona, N.Y. ....p. 2•1159**
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DM **Veeder-Root, Hartford, Conn. ......p. 1•274,275**
Applied Electro Technology, Santa Ana, Cal. ... *
Kessler-Ellis Prods., Atlantic Highlands, N.J. *
NES, Streamwood, Ill. ....*
Shigoto Inds., Ltd., New York, N.Y. .... *
M Abrams Instr., Lansing, Mich.

Anadex Instrs., Van Nuys, Cal.
ATEC, Houston, Tex.
Automatic Timing & Controls Co., King of Prussia, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Controlcraft Corp., West Chicago, Ill.
Disc Instruments, Costa Mesa, Ca.
Durant Digital Instruments, Watertown, Wisc.
D Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Electronic Counters & Controls Inc., Mundelein, Ill.
ENM, Chicago, Ill.
Harrel, E. Norwalk, Conn.
HEI, Chaska, Minn.
D Helm Instr. Co., Toledo, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
D ITT General Controls, Glendale, Cal.
Keltron, Waltham, Mass.
North American Philips Controls Corp., Cheshire, Conn.
Nucleus Corp., Madison Hgts., Mich.
Presin Co., Shelton, Conn.
D Ragen Data Systems, Farmingdale, N.Y.
Redington Counters, Windsor, Conn.
Sensor Corp., Scottdale, Pa.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
Theta Instr. Corp., Fairfield, N.J.
Triac Electronics, New York, N.Y.
United Systems, Dayton, Ohio
WER Industrial, Grand Island, N.Y.

Counters, Variable Time Base

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Kessler-Ellis Prods., Atlantic Highlands, N.J. *
LVC Inds. Inc., Flushing, N.Y. .... *
NES, Streamwood, Ill. .... *
D Alpha Components Corp., El Segundo, Cal.
Anadex Instrs., Van Nuys, Cal.
M ATEC, Houston, Tex.
D Ballantine Laboratories, Boonton, N.J.
Beckman Instrs., Schiller Park, Ill.
Controlcraft Corp., West Chicago, Ill.
EDMAC Associates Inc., East Rochester, N.Y.
Electronic Counters & Controls Inc., Mundelein, Ill.
D Guardian Electric Co. of Cal., Torrance, Cal.
Haydon Switch & Instr., Waterbury, Conn.
D Hecon Corp., New Shrewsbury, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Keltron, Waltham, Mass.
Nucleus Corp., Madison Hgts., Mich.
Sensor Corp., Scottdale, Pa.
Tenor Co., New Berlin, Wisc.
Triac Electronics, New York, N.Y.
United Systems, Dayton, Ohio
WER Industrial, Grand Island, N.Y.

Couplers, Acoustic

Livermore Data Systems, Livermore, Cal.
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M Daico Industries Inc., Compton, Cal. .... *
D GC Electronics, Rockford, Ill. .... *
Heath Co., Benton Harbor, Mich. .... *
D Millen Mfg. Co. Inc., James, Malden, Mass. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
M Adams-Russell Co., Waltham, Mass.
Aerolite Elexs Corp., Union City, N.J.
Aircom, Union, N.H.
DM Anaren Microwave, Syracuse, N.Y.
D Antenna Corp. of America, Burlington, Iowa
Antenna Research Associates, Beltsville, Md.
M A.R.F. Products, Boulder, Colo.
Ava Elctrns., Landsdowne, Pa
D Barker & Williamson, Bristol, Pa.
Beukers Labs., Bohemia, N.Y.
DM Brelonix, Seattle, Wash
D Channel Master Div. Avnet, Ellenville, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Coaxial Dynamics, Cleveland, Ohio
Delta-Benco-Cascade LTD., Rexdale, Ont. Can. M9W 1G1
D Drake Co., R.L., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Elcom Systems, Deer Pk., N.Y.
Gabriel Elctrns. Inc., Scarborough, Me.
D Great Western Aviation, Denver, Colo.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
D Javex Elctrns., Cherry Valley, Cal.
Maury Microwave Corp., Cucamonga, Calif.
M Merrimac Inds., West Caldwell, N.J.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Development Labs., Needham Hgts., Mass.
D Mobil Electronics, Anderson, Ind.
Morey Corp., Downers Grove, Ill.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
National Beryllia Corp., Haskell, N.J.
M Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
RCA Parts & Accessories, Deptford, N.J.
M Resdel Engrg. Corp., Arcadia, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
D Rye Inds., Mamaroneck, N.Y.
D S & A Electronics, Toledo, Ohio
Technical Mat'l., Mamaroneck, N.Y.
Tracor, Austin, Tex.
M Transco Prods., Venice, Cal.
Transcom Electronics, La Mesa, Cal.
TRW Elec. Functions, Camden, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.
D Vidaire Electronics Mfg., Freeport, N.Y.
Waveline, W. Caldwell, N.J.
D Workman Electronic Prods., Sarasota, Fla.

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Couplers, Microwave—See Volume 2

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American Zettler, Irvine, Cal. .... *
Cadillac Plastic & Chemical, Detroit, Mich.
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D Gagne Assocs., Binghamton, N.Y.
M GTI Corporation, Pittsburgh, Pa.
Precision Paper Tube Co., Wheeling, Ill.
Scientific-Atlanta, Tucker, Ga.
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Crayons, Coatings, Pellets, etc., Temperature Indicating

Omega Engrg., Stamford, Conn. p. 1•2324-2327
M Artech Corp., Falls Church, Va.
Gordon, Claud S. Co., Richmond, Ill.
Markal Co., Chicago, Ill.
Tempil Div., So. Plainfield, N.J.
United Mineral & Chem. Corp., New York, N.Y.

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D Cleveland Crystals, Euclid, Ohio
D Crystek Crystals Corp., Ft. Myers, Fla.
CTS Corp., Elkart, Ind.
Harshaw Chemical Co., Cleveland, Ohio
P. R. Hoffman Co., Carlisle, Pa.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
Nihon Dempa Kogyo Co., Ltd., Tokyo, Japan
Piezo Crystal Co., Carlisle, Pa.
M Standard Crystal Corp., Monterey Park, Cal.
Toyo Comm. Equip. Co. Ltd., Kawasaki, Kanagawa, Japan
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Colorado Crystal Corp., Loveland, Colo.
M Crystal Network Prods. Corp., Erie, Pa.
DM Crystek Crystals Corp., Ft. Myers, Fla.
CTS Corp., Elkart, Ind.
Deltronic Crystal Inds., Denville, N.J.
M Erie Frequency Control, Carlisle, Pa.
Julie Research Lab., New York, N.Y.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
D Midland International Corp., No. Kansas City, Mo.
Piezo Crystal Co., Carlisle, Pa.
D Regency Electronics, Indianapolis, Ind.
M Standard Crystal Corp., Monterey Park, Cal.
Standard Logic Inc., Santa Ana, Cal.
Toyo Comm. Equip. Co. Ltd., Kawasaki, Kanagawa, Japan
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DM United States Crystal Corp., Ft. Worth, Tex.

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D McCoy Electronics, Mount Holly Springs, Pa. *
Atomergic Chemetals Co., Carle Place, N.Y.
D Cambridge Thermionic Corp., Cambridge, Mass.
Channel Inds., Santa Barbara, Cal.
D Cleveland Crystals, Euclid, Ohio
Colorado Crystal Corp., Loveland, Colo.
Crystal Technology, Mountain View, Cal
DM Crystek Crystals Corp., Ft. Myers, Fla.
CTS Corp., Elkart, Ind.
Deltronic Crystal Inds., Denville, N.J.
D Ev-Game Inc., Freeport, N.Y.
Edo Western Corp., Salt Lake City, Utah
M Erie Frequency Control, Carlisle, Pa.
Gulton Inds., Fullerton, Cal.
Harshaw Chemical Co., Cleveland, Ohio
Honeywell, Minneapolis, Minn.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
Linden Labs., State College, Pa.
Radio Materials Co., Chicago, Ill.
M Standard Crystal Corp., Monterey Park, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Toyo Comm. Equip. Co. Ltd., Kawasaki, Kanagawa, Japan

Tyco Crystal Products Div., Kansas City, Mo.
DM United States Crystal Corp., Ft. Worth, Tex.

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D McCoy Electronics, Mount Holly Springs, Pa. *
D A E G Telefunken, Englewood Clfs., N.J.
D Aremco Prods., Ossining, N.Y.
Atomergic Chemetals Co., Carle Place, N.Y.
M Bram Metallurgical-Chem. Co., Phila., Pa.
Colorado Crystal Corp., Loveland, Colo.
M Crystal Network Prods. Corp., Erie, Pa.
DM Crystek Crystals Corp., Ft. Myers, Fla.
DM CTS Corp., Elkart, Ind.
M Erie Frequency Control, Carlisle, Pa.
P. R. Hoffman Co., Carlisle, Pa.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
D Optics International, Tenafly, N.J.
D Regency Electronics, Indianapolis, Ind.
D S G C Inc., Bellevue, Wash.
D Siemens Corp., Iselin, N.J.
D Sloan Technology Corp., Santa Barbara, Cal.
M Standard Crystal Corp., Monterey Park, Cal.
Toyo Comm. Equip. Co. Ltd., Kawasaki, Kanagawa, Japan
Tyco Crystal Products Div., Kansas City, Mo.
DM United States Crystal Corp., Ft. Worth, Tex.
M Valpey Corp., Holliston, Mass.

Crystals, Semiconductor(Ingots & Wafers)

Ohio Semitronics, Columbus, Ohio .... p. 1•1848
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Litronix, Cupertino, Cal. .... *
Accumet Engineering Corp., Hudson, Mass.
Atomergic Chemetals Co., Carle Place, N.Y.
D Cleveland Crystals, Euclid, Ohio
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M Eagle-Picher Industries, Joplin, Mo.
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M Solitron Devices, Riviera Beach, Fla.
D Xciton Corp., Latham, N.Y.

Crystals, Yig

M Airtron, Morris Plains, N.J.
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D General Electric Co., West Lynn, Mass.
M Genisco Tech. Corp., Compton, Cal.
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D Leeds & Northrup Co., North Wales, Pa.
D Macrodyne Inc., Schenectady, N.Y.
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Micro Devices Corp., Dayton, Ohio
D NH Research, Santa Ana, Calif.
Pearson Elctrns. Inc., Palo Alto, Cal.
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D NH Research, Santa Ana, Calif.
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M Peschel Instrs., Cape Coral, Fla.
M Sawyer Inds., Arcadia, Cal.
M Trio Labs, Plainview, N.Y.
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D Voltex Co., Farmingdale, N.Y.
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Applied Systems Corp., St. Clair Shores, Mich.
M A.R.F. Products, Boulder, Colo.
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D Autocon Inds., Minneapolis, Minn.
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D Baganoff Assocs., St. Louis, Mo.
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DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
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M Cardion Elctrns., Woodbury, N.Y.
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Doric Sci. Corp., San Diego, Calif.
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M E-Systems Inc., Dallas, Tex.
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D Metra Instruments, Mt. View, Cal.
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QuantaLog, Ann Arbor, Mich
Rhode & Schwarz Sls., Fairfield, N.J.
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Monitor Labs, San Diego, Cal.
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Newport Labs., Santa Ana, Cal.
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D Tennelec, Oak Ridge, Tenn.
Theta Instr. Corp., Fairfield, N.J.
M Trak Systems, Tampa, Fla.
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M Andersen & Assoc., Walther M.A., Tariffville, Conn.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
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M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
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M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
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M Biddle, James G., Plymouth Meeting, Pa.
D Cutler-Hammer Shallcross, Selma, N.C.
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DM Bayshore Systems Corp., Springfield, Va.
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M Cardion Elctrns., Woodbury, N.Y.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
M Environmental Communications Inc., Costa Mesa, Cal.
GTE Sylvania Inc., Washington, D.C.
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DM National Semiconductor Corp., Santa Clara, Cal.
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M Cardion Elctrns., Woodbury, N.Y.
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M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Data-Control Systems, Danbury, Conn.
D EMR Telemetry, Sarasota, Fla.
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M Spacetac, Bedford, Mass.

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Daco Instr. Co., Milford, Conn.
Hotpack Corp., Phila., Pa.
Lear Siegler, Santa Monica, Calif.
Pall Corp., Glen Cove, N.Y.
Pall Trinity Micro Corp., Cortland, N.Y.
Tenney Engrg., Union, N.J.

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Andrew Antenna Co. Ltd., Whitby, Ont., Can.
Cablewave Systems Inc., North Haven, Conn.
D Daco Instr. Co., Milford, Conn.
M Dielectric Comms, Raymond, Maine

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M Columbia Components, Hempstead, N.Y.
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Precision Tube, No. Wales, Pa.
M Teledyne Mec., Palo Alto, Cal.
Times Wire & Cable, Wallingford, Conn.
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D Nytronics Comps. Group Inc., Darlington, S.C. *
M Columbia Components, Hempstead, N.Y.
Computer Devices Corp., Commack, N.Y.
PCA Elctrns., Sepulveda, Cal.
Stanford Applied Engineering, Santa Clara, Cal.
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Computer Devices Corp., Commack, N.Y.
PCA Elctrns., Sepulveda, Cal.
Stanford Applied Engineering, Santa Clara, Cal.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.
D Wiltron Co., Palo Alto, Cal

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M Control Elctrns. Co., Farmingdale, N.Y. .... *
Corning Glass Works, Corning, N.Y. .... *
Amperex Electronic Corp., Slatersville, R.I.
M Andersen & Assoc., Walther M.A., Tariffville, Conn.
Corning Glass Works, Raleigh, N.C.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
M Microsonics, Weymouth, Mass.
M Teledyne Mec., Palo Alto, Cal.

D Television Microtime, Bloomfield, Conn.
M Valpey Corp., Holliston, Mass.

Delay Lines, Liquid

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M Microsonics, Weymouth, Mass.

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D Cambridge Thermionic Corp., Cambridge, Mass.
M Columbia Components, Hempstead, N.Y.
Computer Devices Corp., Commack, N.Y.
M Dietz Design, Belton, Mo.
Rhombus Inds., Torrance, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
TDK Elctrns. Corp., Long Island City, N.Y.
D Television Microtime, Bloomfield, Conn.

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Andersen Labs., Bloomfield, Conn. p. 1•428,429
M Artronic Instr. Co., Silver Spring, Md. p. 1•430,431
Bel Fuse, Jersey City, N.J. ....p. 1•432-442
Bourns Pacific Magnetic Corp., Romoland, Cal. p. 1•443
Caddel-Burns Mfg. Co., Mineola, N. Y. p. 2•382-385
M Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444
M Data Delay Devices, Clifton, N.J. p. 1•445-451,552
M El-Rad Mfg. Co., Chicago, Ill ....p. 2•1773,1774
M ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•452,453
M Hisonic, Olathe, Kan. .... p. 1•565
M Kappa Networks, Carteret, N.J. ...p. 1•461-464
D McGraw-Edison Co., Manchester, N.H. p. 1•661
RCL Electronics Div., Irvington, N.J. p. 1•454-460
Technitrol, Philadelphia, Pa. .... p. 1•466,467
Chesterfield Prods. Inc., Saddle Brook, N.J. .... *
Computer Instrs., Hempstead, N.Y. .... *
Millen Mfg. Co. Inc., James, Malden, Mass. .... *
Nytronics Comps. Group Inc., Darlington, S.C. *
M Torotel Inc., Grandview, Mo. .... *
M BG Electronics, Mount Vernon, N.Y.
M Columbia Components, Hempstead, N.Y.
Computer Devices Corp., Commack, N.Y.
M Dietz Design, Belton, Mo.
M Engineered Components Co., San Luis Obispo, Cal.
Filtron Company, Westbury, N.Y.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
PCA Elctrns., Sepulveda, Cal.
Pulse Engrg., San Diego, Cal
Rhombus Inds., Torrance, Cal.
Stanford Applied Engineering, Santa Clara, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
D Television Microtime, Bloomfield, Conn.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.

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Allen Avionics, Mineola, N.Y. .... p. 1•427
Andersen Labs., Bloomfield, Conn. p. 1•428,429
M Artronic Instr. Co., Silver Spring, Md. p. 1•430,431
Bel Fuse, Jersey City, N.J. ....p. 1•432-442
Bourns Pacific Magnetic Corp., Romoland, Cal. p. 1•443

M Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444
M Data Delay Devices, Clifton, N.J. p. 1•445-451,552
M ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•452,453
M Kappa Networks, Carteret, N.J. .... p. 1•464
D RCL Electronics Div., Irvington, N.J. p. 1•454-460
Accutronics-A Hammond Corp., Geneva, Ill. ... *
Computer Instrs., Hempstead, N.Y. .... *
M Columbia Components, Hempstead, N.Y.
Computer Devices Corp., Commack, N.Y.
Filtron Company, Westbury, N.Y.
PCA Elctrns., Sepulveda, Cal.
Rhombus Inds., Torrance, Cal.
D Television Microtime, Bloomfield, Conn.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.

Delay Lines, Magnetostrictive

Andersen Labs., Bloomfield, Conn. p. 1•428,429
Bourns Pacific Magnetic Corp., Romoland, Cal. p. 1•443
M Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444
M Data Delay Devices, Clifton, N.J. p. 1•445-451,552
RCL Electronics Div., Irvington, N.J. p. 1•454-460
D Baganoff Assocs., St. Louis, Mo.
Computer Devices Corp., Commack, N.Y.
M Microsonics, Weymouth, Mass.
TDK Elctrns. Corp., Long Island City, N.Y.

Delay Lines, Miniature & Subminiature-Also See Specific Types Of Delay Lines

Allen Avionics, Mineola, N.Y. ...... p. 1•426,427
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M Artronic Instr. Co., Silver Spring, Md. p. 1•430,431
Bel Fuse, Jersey City, N.J. ....p. 1•432-442
Bourns Pacific Magnetic Corp., Romoland, Cal. p. 1•443
M Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444
M Damon Corp., Westwood, Mass. p. 1•312,313
M Data Delay Devices, Clifton, N.J. p. 1•445-451,552
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M ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•452,453
M Hisonic, Olathe, Kan. .... p. 1•565
M Kappa Networks, Carteret, N.J. .... p. 1•463
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M Uniform Tubes, Collegeville, Pa. ....p. 2•2065
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Amphenol RF Div., Danbury, Conn. .... *
Computer Instrs., Hempstead, N.Y. .... *
Nytronics Comps. Group Inc., Darlington, S.C. *
M Andersen & Assoc., Walther M.A., Tariffville, Conn.
Cablewave Systems Inc., North Haven, Conn.
M Columbia Components, Hempstead, N.Y.
Computer Devices Corp., Commack, N.Y.
Engineered Components Co., San Luis Obispo, Cal.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
M Microsonics, Weymouth, Mass.
PCA Elctrns., Sepulveda, Cal.
Precision Tube, No. Wales, Pa.
Pulse Engrg., San Diego, Cal
Rhombus Inds., Torrance, Cal.
Stanford Applied Engineering, Santa Clara, Cal.
Tasker Systems, Chatsworth, Cal.
TDK Elctrns. Corp., Long Island City, N.Y.
M Teledyne Mec., Palo Alto, Cal.

Delay Lines, Solid Blank

M Bliley Electric Co., Erie, Pa. ....*
M Control Elctrns. Co., Farmingdale, N.Y. .... *
M Andersen & Assoc., Walther M.A., Tariffville, Conn.
Computer Devices Corp., Commack, N.Y.
M Microsonics, Weymouth, Mass.
Valpey Corp., Holliston, Mass.

Delay Lines, Strip

Andersen Labs., Bloomfield, Conn. p. 1•428,429
Bel Fuse, Jersey City, N.J. ....p. 1•432-442
M Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444

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M **ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•452,453**
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M **Aladdin Elctrns., Nashville, Tenn.** .... *
M **Bliley Electric Co., Erie, Pa.** .... *
M Lorch Devices Inc., Englewood, N.J.
M Microsonics, Weymouth, Mass.
DM Solitron/Microwave, Port Salerno, Fla.

Delay Lines, Trimmer

Andersen Labs., Bloomfield, Conn. p. 1•428,429
Bel Fuse, Jersey City, N.J. .... p. 1•432-442
M **Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444**
M **Data Delay Devices, Clifton, N.J. p. 1•445-451,552**
M **ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•452**
M **Kappa Networks, Carteret, N.J. .... p. 1•463**
Technitrol, Philadelphia, Pa. .... p. 1•466,467
Computer Instrs., Hempstead, N.Y. .... *
M Andersen & Assoc., Walther M.A., Tariffville, Conn.
M Columbia Components, Hempstead, N.Y.
Computer Devices Corp., Commack, N.Y.
M Engineered Components Co., San Luis Obispo, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Universal Ad-Yu Elctrns., Milwaukee, Wisc.

Delay Lines, Ultrasonic

Andersen Labs., Bloomfield, Conn. p. 1•428,429
M **Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444**
M **Damon Corp., Westwood, Mass. p. 1•312,313**
D **McGraw-Edison Co., Manchester, N.H. p. 1•661**
M **Bliley Electric Co., Erie, Pa.** .... *
Corning Glass Works, Corning, N.Y. .... *
M Andersen & Assoc., Walther M.A., Tariffville, Conn.
Beta Technology, Farmingdale, N.Y.
Corning Glass Works, Raleigh, N.C.
Crystal Technology, Mountain View, Cal
M Microsonics, Weymouth, Mass.
TDK Elctrns. Corp., Long Island City, N.Y.
M Teledyne Mec., Palo Alto, Cal.

Delay Lines, Video—See Delay Lines, Ultrasonic

Delay Lines, Waveguide

Andersen Labs., Bloomfield, Conn. p. 1•428,429
M **Uniform Tubes, Collegeville, Pa. .... p. 2•2065**
Aircom, Union, N.H.
Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Culver City, Cal.
Maury Microwave Corp., Cucamonga, Calif.
M Premier Microwave, Port Chester, N.Y.
D TRG,, Woburn, Mass.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.

Delay Lines, Wire

Andersen Labs., Bloomfield, Conn. p. 1•428,429
M **Control Elctrns. Co., Farmingdale, N.Y. p. 1•110,444**
Computer Devices Corp., Commack, N.Y.
Fuji Electrochemical Co., Tokyo, Japan
M Microsonics, Weymouth, Mass.

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M **Artronic Instr. Co., Silver Spring, Md. p. 1•430,431**
M **Autronics Corp., Pasadena, Cal .... p. 1•237**
M **Calex Mgf. Co., Pleasant Hill, Calif. .... p. 1•240**
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
D **Precision Timer Co., Westbrook, Conn. p. 1•268,269**
M **Solid State Electronics Corp., Sepulveda, Cal. p. 1•1816**
D **Aemco Div., Mankato, Minn.** .... *
M **Control Elctrns. Co., Farmingdale, N.Y.** .... *
Hoagland Instr., Dayton, N.J. .... *
Airpot Corp., Norwalk, Conn.
Artisan Elctrns. Corp., Parsippany, N.J.
Automatic Timing & Controls Co., King of Prussia, Pa.
Berkeley Nucleonics, Berkeley, Cal.
D Bristol Saybrook Co., Old Saybrook, Conn.
Bulova Watch Co., Flushing, N.Y.
M Electro-Module, Pomona, Cal.
Fuji Electrochemical Co., Tokyo, Japan
D General Time Corp., Thomaston, Conn.
D Guardian California, Torrance, Cal.
Jay-El Prods., Gardena, Calif.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
PECO Corp., Milpitas, Cal.
Princeton Elctrn. Prods., New Brunswick, N.J.
D Quantrad Corporation, El Segundo, Cal.
D SenSitrol, Albion, Ill.
Sigma Instruments, Braintree, Mass.
D Warren G-V Communications, Livingston, N.J.
D Zenith Controls Inc., Chicago, Ill.

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D **GC Electronics, Rockford, Ill.** .... *
D **Microtran Co., Valley Stream, N.Y.** .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Advanced Kinetics, Costa Mesa, Calif.
Ampex Corp., Redwood City, Cal.
Annis R B Co., Indianapolis, Ind.
D Chemtronics, Hauppauge, N.Y.
Dytro Corp., Hicksville, N.Y.
Eastern Delta Corp., Fair Lawn, N.J.
Edmund Scientific Co., Barrington, N.J.
Ideal Industries Inc., Sycamore, Ill.
Mag-Con, New Brighton, Minn.
Magnos, Incorporated, Harvard, Mass.
Mann, Henry Inc., Huntingdon Valley, Pa.
D Nortronics Co., Minneapolis, Minn.
Permag Corp., Jamaica, N.Y.
D Recoton Corp., Long Island City, N.Y.
D Shester Engineering Co., Culver City, Cal.
D Techni-Tool, Plymouth Meeting, Pa.

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M **Control Technology Co., L.I.C., N.Y. p. 1•1914,1915**
D **General Magnetics, Bloomfield, N.J. p. 1•245-247**
M **Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917**
M **Natel Engineering Co., Canoga Park, Cal. p. 1•184-187**
M **RHG Elctrns. Lab., Deer Park, N.Y. .... p. 2•1389**
M **Solid State Electronics Corp., Sepulveda, Cal. p. 1•126**
M **Transmagnetics, Farmingdale, N.Y. .... p. 1•124**
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M **Analog Devices, Norwood, Mass.** .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
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North Atlantic Inds., Plainview, N.Y. .... *
All Systems, Moorestown, N.J.
D Ametek Controls Division, Feasterville, Pa.
DM Anaren Microwave, Syracuse, N.Y.
D Audiotronics, N. Hollywood, Cal.
Automatic Timing & Controls Co., King of Prussia, Pa.
Biocom, Culver City, Cal.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
M Control Sciences, Granada Hills, Cal.
Data-Control Systems, Danbury, Conn.
D Dynair Elctrns. Inc., San Diego, Calif.
Dynalab Corp., Van Nuys, Cal.
Electrac, Anaheim, Calif.
Environmental Communications Inc., Costa Mesa, Cal.
Feedback, Berkeley Hghts., N.J.
General Resistance, Mt. Vernon, N.Y.
M Glentek, Santa Monica, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
Intronics Inc., Newton, Mass.
D Jerrold Electronics Corp., Horsham, Pa.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
Pasternack Enterprises, Huntington Beach, Cal.
DM Plessey Semiconductors, Santa Ana, Cal.
Radiation Devices Co., Baltimore, Md.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Co., Little Falls, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Telemet Co., Amityville, N.Y.
Theta Instr. Corp., Fairfield, N.J.
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M Watkins-Johnson Co., Palo Alto, Cal.

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M **Computer Conversions Corp., East Northport, N.Y. .... p. 1•154,155**
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M **Transmagnetics, Farmingdale, N.Y. .... p. 1•124**
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Automation Prdts., Houston, Tex.
Beckman Instrs., (AISSD), Fullerton, Cal.
Chemical Etching Equip. & Supply, Alexandria, Va.
COSAR Corp., Garland, Tex.
Gaertner Scientific Corp., Chicago, Ill.
Gamma Scientific Inc., San Diego, Cal.

Deposition Equipment, Vacuum & Accessories-Also See Evaporation Equipment, Electron Beam

NES, Streamwood, Ill. .... *
American Electronic Controls, Barrington, N.J.
Ceramaseal, New Lebanon Center, N.Y.
D CVC Products, Rochester, N.Y.
Edwards High Vacuum, Grand Island, N.Y.
GTE Sylvania Inc., Danvers, Mass.
High Vacuum Equip. Corp., Hingham, Mass.
D Materials Resch. Corp., Orangeburg, N.Y.
D Perkin-Elmer Ultek Inc., Palo Alto, Cal.
Proto Matic Co., Cincinnati, Ohio
D Sloan Technology Corp., Santa Barbara, Cal.
Thin Film Services, Gile, Wisc.
Torr Labs., Los Angeles, Cal.
Ulvac Corp., Fairfield, Conn.
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Bird Electronic Corp., Solon, Ohio .... p. 1•618
M **General Microwave Corp., Farmingdale, NY p. 1•718**
D **Omni Spectra, Farmington, Mich. .... p. 2•724**
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M Aertech Industries, Sunnyvale, Cal.
Alan Industries Inc., Columbus, Ind.
Alford Mfg. Co., Winchester, Mass.
American Microwave Inds., Waltham, Mass.
Coax Devices Inc., Chelsea, Mass.
Collins Radio, Dallas, Tex.
Engelmann Microwave, Montville, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
M Lorch Devices Inc., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
M Omni-Spectra, Tempe, Ariz.
D PRD Elctrns., Syosset, N.Y.
M Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
R L C Elctrns., Mt. Kisco, N.Y.
Singer Co., State College, Pa.
D Sivers Lab, Corona del Mar, Cal.
Telonic Altair, Laguna Beach, Calif.
Waveline, W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Wide Band Engrg. Co. Inc., Phoenix, Ariz.

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Hope Elctrns., Clifton, N.J. .... *
Kay Elemetrics Corp., Pine Brook, N.J. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
Alford Mfg. Co., Winchester, Mass.
American Microwave Inds., Waltham, Mass.
Collins Radio, Dallas, Tex.
M Environmental Communications Inc., Costa Mesa, Cal.

Harshaw Chemical Co., Cleveland, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Jerrold Electronics Corp., Horsham, Pa.
Linden Labs., State College, Pa.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Development Labs., Needham Hgts., Mass.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
M Omni-Spectra, Tempe, Ariz.
D PRD Elctrns., Syosset, N.Y.
Radiation Devices Co., Baltimore, Md.
R L C Elctrns., Mt. Kisco, N.Y.
Sanders Associates, Nashua, N.H.
Singer Co., State College, Pa.
Tucker Electronics Co., Garland, Tex.
Waveline, W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
D Wiltron Co., Palo Alto, Cal

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Applied Fluidics Inc., Westbury, N.Y.
Automation Inds., Danbury, Conn.
Biddle, James G., Plymouth Meeting, Pa.
Branson Cleaning Equip. Co., Shelton, Conn.
Dolan-Jenner Inds., Melrose, Mass.
Dunegan/Endevco, San Juan Capistrano, Cal.
Endevco, San Jaun Capistrano, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
D ITT Industrial & Automation Systems, Plymouth, Mich.
M North American Philips Controls Corp., Cheshire, Conn.
M Peschel Instrs., Cape Coral, Fla.
Photobell Co., New York, N.Y.
Princeton Elctrn. Prods., New Brunswick, N.J.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
Siltec Corp., Menlo Park, Cal.
D Sotcher Measurement, Cupertino, Cal.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Tennelec, Oak Ridge, Tenn.

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D Bell Industries, Compton, Cal. ..... p. 2•370-379
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M General Instruments Corp., Hicksville, N.Y. ..... *
M General Microwave Corp., Farmingdale, NY ..... *
M Nelson Ross Elctrns., Lake Success, N.Y. .... *
Acron Corp., Lakewood, N.J.
Anadex Instrs., Van Nuys, Cal.
Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
M Atlantic Research Coropration, Alexandria, Va
D Blonder-Tongue Labs., Old Bridge, N.J.
Bramco Controls Div., Piqua, Ohio
D Burwen Lab. Inc., Burlington, Mass.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Coaxial Dynamics, Cleveland, Ohio
Data-Control Systems, Danbury, Conn.
M Electro-Module, Pomona, Cal.
Engelmann Microwave, Montville, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
GTE Sylvania Inc., Washington, D.C.
DM Guardian California, Torrance, Cal.
Jerrold Electronics Corp., Horsham, Pa.
D Lithic Systems, Saratoga, Cal.
Logitek, Farmingdale, N.Y.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Microwave/Sys., E. Syracuse, N.Y.
M Norsal Industries, Brentwood, N.Y.
M Omni-Spectra, Tempe, Ariz.
DM Plessey Semiconductors, Santa Ana, Cal.
D PRD Elctrns., Syosset, N.Y.
Programmed Power, Menlo Park, Cal.
Sensor Corp., Scottdale, Pa.
Singer Co., State College, Pa.
Techsonics, El Prado, N.M.
Telonic Altair, Laguna Beach, Calif.
M Tempo Instrument, Plainview, N.Y.

Detectors, Gas Leak

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DM American Gas & Chemicals Co., Ltd., New York, N.Y.
Applied Fluidics Inc., Westbury, N.Y.
D Bacharach Instrument Co., Pittsburgh, Pa.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Datametrics Inc., Wilmington, Mass.
Detoronics Corp., S. El Monte, Cal.
Dukane Corp., St. Charles, Ill.
E.I. DuPont de Nemours & Co., Wilmington, Del.
Figaro Engrg. Inc., Toyonaka City, Osaka, Japan
General Monitors, Costa Mesa, Calif.
Gow-Mac Instr. Co., Madison, N.J.
Gulton Inds., Buena Park, Cal.
Honeywell, Ft. Washington, Pa.
ITI Electronics, Clifton, N.J.
Lion Precision Corp, Newton, Mass.
Mine Safety Appliances Co., Pittsburgh, Pa
MKS Instrs., Burlington, Mass.
Reich Associates Inc., Plano, Tex
DM Shannon Luminous Mat'ls., Hollywood, Cal.
Snap-On-Tools, Kenosha, Wisc.
Statham Instruments, Oxnard, Cal.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Techni-Tool, Plymouth Meeting, Pa.
Techsonics, El Prado, N.M.
M Trio-Tech, of Calif., Burbank, Calif.
Union Carbide Corp., New York, N.Y.
Unitron Corp., Ft. Wayne, Ind.
M Vactronic Lab. Equip., E. Northport, N.Y.
Varian Assocs., Palo Alto, Cal.

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Advanced Devices Lab, Santa Clara, Cal.
Advanced Kinetics, Costa Mesa, Calif.
D A E G Telefunken, Englewood Clfs., N.J.
Barnes Engrg. Co., Stamford, Conn.
Bell & Howell, Bridgeport, Conn.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dolan-Jenner Inds., Melrose, Mass.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
EG & G, Salem, Mass.
EMI Gencom Inc., Plainview, N.Y.
Gamma Scientific Inc., San Diego, Cal.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Harshaw Chemical Co., Cleveland, Ohio
HEI, Chaska, Minn.
Honeywell, Minneapolis, Minn.
Hy-Cal Engineering, Santa Fe Springs, Cal
Industrial Products Div., Orlando, Fla.
Infrared Industries, Waltham, Mass.
Judson Resch. & Mfg. Co., Conshohocken, Pa.
Meret Inc., Santa Monica, Cal.
Mikron Instr. Co., Ridgewood, N.J.
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
Optron, Carrollton, Tex.
Photobell Co., New York, N.Y.
Radiation Devices Co., Baltimore, Md.
Sanders Associates, Nashua, N.H.
Santa Barbara Resch. Ctr., Goleta, Cal.
D Scientific Technology, Mountain View, Cal.
Scientifico Scientific Components Co., Newport Beach, Cal.
Sensor Corp., Scottdale, Pa.
Sensor Technology, Chatsworth, Cal.
Sensors, Ann Arbor, Mich.
Singer Co., State College, Pa.
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Collins Radio, Dallas, Tex.
Engelmann Microwave, Montville, N.J.
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M Norsal Industries, Brentwood, N.Y.
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D Parametric Inds., Winchester, Mass.
D PRD Elctrns., Syosset, N.Y.
M Premier Microwave, Port Chester, N.Y.
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Sensor Corp., Scottdale, Pa.
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D Sivers Lab, Corona del Mar, Cal.
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M Technical Research & Mfg., Manchester, N.H.
D TRG,, Woburn, Mass.
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M Electro-Module, Pomona, Cal.
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M Environmental Communications Inc., Costa Mesa, Cal.
D Guardian California, Torrance, Cal.
D Keithley Instruments Inc., Cleveland, Ohio

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M Lorch Devices Inc., Englewood, N.J.
M Norsal Industries, Brentwood, N.Y.
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D Tennelec, Oak Ridge, Tenn.
Theta Instr. Corp., Fairfield, N.J.
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Universal Ad-Yu Elctrns., Milwaukee, Wisc.
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Galileo Electro-Optics Corp., Sturbridge, Mass.
Gamma Scientific Inc., San Diego, Cal.
Harshaw Chemical Co., Cleveland, Ohio
LFE Corporation, Waltham, Mass.
Meret Inc., Santa Monica, Cal.
Narda Microwave Corp., Plainview, N.Y.
Nuclear Meas. Corp., Indianapolis, Ind.
Sanders Associates, Nashua, N.H.
Sensors, Ann Arbor, Mich.
D Tennelec, Oak Ridge, Tenn.
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Hewlett-Packard Co., Palo Alto, Cal.
Maury Microwave Corp., Cucamonga, Calif.
M Microlab/FXR, Livingston, N.J.
D PRD Elctrns., Syosset, N.Y.
Radiation Devices Co., Baltimore, Md.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Co., State College, Pa.
Telonic Altair, Laguna Beach, Calif.
D TRG,, Woburn, Mass.
Tucker Electronics Co., Garland, Tex.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
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Edison, Instr. Div., W. Orange, N.J.
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Galileo Electro-Optics Corp., Sturbridge, Mass.
Gamma Scientific Inc., San Diego, Cal.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Harshaw Chemical Co., Cleveland, Ohio
Honeywell, Ft. Washington, Pa.
Infrared Industries, Waltham, Mass.
Meret Inc., Santa Monica, Cal.
Sanders Associates, Nashua, N.H.
Sensor Technology, Chatsworth, Cal.
DM Shannon Luminous Mat'ls., Hollywood, Cal.
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D Amperex Elctronic Corp., Slatersville, R.I. .... *
NES, Streamwood, Ill. .... *
Applied Fluidics Inc., Westbury, N.Y.
Datametrics Inc., Wilmington, Mass.
Edwards High Vacuum, Grand Island, N.Y.
E.I. DuPont de Nemours & Co., Wilmington, Del.
EMI Gencom Inc., Plainview, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Cal.
D United Elec. Controls Co., Watertown, Mass.
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M Environmental Communications Inc., Costa Mesa, Cal.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Microphase Corp., Cos Cob, Conn.
M Omni-Spectra, Tempe, Ariz.
DM Plessey Semiconductors, Santa Ana, Cal.
Singer Co., State College, Pa.
Teletron, Pottstown, Pa.
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Rowe Industries, Toledo, Ohio .... *
Applied Control Co., Fairfield, N.J.
Electrical Instr. Svc., Mt. Vernon, N.Y.
M Electro-Module, Pomona, Cal.
Electro Sci. Inds., Portland, Ore.
M Environmental Communications Inc., Costa Mesa, Cal.
DM Guardian California, Torrance, Cal.
D Keithley Instruments Inc., Cleveland, Ohio
Logitek, Farmingdale, N.Y.
Mag-Con, New Brighton, Minn.
Micro Instrument Co., Escondido, Cal.
Non-Linear Sys., Del Mar, Cal.
D Parametric Inds., Winchester, Mass.
PECO Corp., Milpitas, Cal.
Programmed Power, Menlo Park, Cal.
D SenSitrol, Albion, Ill.
Singer Co., State College, Pa.
M Tempo Instrument, Plainview, N.Y.
Triac Electronics, New York, N.Y.
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Electro-Mech Components, So. El Monte, Cal. *
Shigoto Inds., Ltd., New York, N.Y. .... *
GTE Automatic Electric Inc., Northlake, Ill.
D ITT Telecommunications, Corinth, Miss.

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California Computer Prods., Anaheim, Cal
Computer Talk Inc., Idledale, Colo.
Data Technology Inc., Watertown, Mass.
Dest Data Corp., Sunnyvale, Cal.
Gerber Scientific Instr. Co., Hartford, Conn.
Hewlett-Packard Co., Palo Alto, Cal.
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D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
Carter Semiconductor, Syossett, N.Y.
Centralab Semiconductor, El Monte, Cal.
Codi Corporation, Fair Lawn, N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
HEI, Chaska, Minn.
Hewlett-Packard Co., Palo Alto, Cal.
Integrated Photomatrix, Mountainside, N.J.
D ITT Semiconductor, West Palm Beach, Fla.
Meret Inc., Santa Monica, Cal.
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
D National Semiconductor Corp., Santa Clara, Cal.
Optron, Carrollton, Tex.
DM Plessey Semiconductors, Santa Ana, Cal.
Quantrol Elect. Inc., El Paso, Tex.
D RCA, Ind'l. Tube Div., Lancaster, Pa.
Sensor Technology, Chatsworth, Cal.
DM Solitron Devices, Riviera Beach, Fla.
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Edal Inds., E. Haven, Conn.
EMI Gencom Inc., Plainview, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
DM FMC Corporation, Homer City, Pa.
Hewlett-Packard Co., Palo Alto, Cal.
M Hughes Aircraft Co., Torrance, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
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D Motorola Semiconductor Prods., Phoenix, Ariz.
D Parametric Inds., Winchester, Mass.
RCA Electronic Comps., Harrison, N.J.
DM Sarkes Tarzian, Bloomington, Ind.
D Solid State Inc., Bloomfield, N.J.
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Thor Elctrns. Corp., Elizabeth, N.J.

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D TRW Semiconductor, Lawndale, Cal.
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D Teledyne Semiconductor, Mountain View, Cal.
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Varian Electron Tube & Device Grp., San Carlos, Cal.

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D A E G Telefunken, Englewood Clfs., N.J.
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D Hewlett-Packard Co., Palo Alto, Cal.
Infrared Industries, Waltham, Mass.
Meret Inc., Santa Monica, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
OPCOA, Edison, N.J.
Sensor Technology, Chatsworth, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
UPI Semiconductor Div., Patterson, N.J.

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M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
M Aertech Industries, Sunnyvale, Cal.
D Parametric Inds., Winchester, Mass.
UPI Semiconductor Div., Patterson, N.J.
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D A E G Telefunken, Englewood Clfs., N.J.
M Aertech Industries, Sunnyvale, Cal.
D Amperex Electronic Corp., Slatersville, R.I.
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D Cordover & Co., Carl, Hollywood, Fla.
D Dutrex Inds., New York, N.Y.
General Elec., Syracuse, NY
Infrared Industries, Waltham, Mass.
M International Importers, Chicago, Ill.
D ITT Semiconductor, West Palm Beach, Fla.
Kemtron Electron Prods., Newburyport, Mass.
Leico Inds., New York, N.Y.
Microphase Corp., Cos Cob, Conn.
D Norelcom Electronics, Farmingdale, N.Y.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Parametric Inds., Winchester, Mass.
D Semiconductor Technology, College Point, N.Y.
D Siemens Corp., Iselin, N.J.
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General Elec. Co., Schenectady, N.Y. .... *
D NEC America, New York, N.Y. .... *
M Addington Labs, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
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M GHZ Devices, So. Chelmsford, Mass.
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Maxwell Labs., San Diego, Calif.
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Varian Electron Tube & Device Grp., San Carlos, Cal.
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D Amperex Electronic Corp., Slatersville, R.I.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
D Codi Corporation, Fair Lawn, N.J.
Edal Inds., E. Haven, Conn.
D Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
DM FMC Corporation, Homer City, Pa.
General Elec., Syracuse, NY
Maxwell Labs., San Diego, Calif.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Parametric Inds., Winchester, Mass.
Power Physics Corp., Eatontown, N.J.
D RCA Solid State Div., Somerville, N.J.
DM Sarkes Tarzian, Bloomington, Ind.
D Semiconductor Technology, College Point, N.Y.
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Thor Elctrns. Corp., Elizabeth, N.J.
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DM Hewlett-Packard Co., Palo Alto, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Nucleonic Prods., Canoga Pk., Cal.
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Shigoto Inds., Ltd., New York, N.Y. .... *
D Sprague Products Co., No. Adams, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
DM Chicago Miniature Lamp/Drake, Chicago, Ill.
Data Display Products, Los Angeles, Cal.
D Drake Mfg. Co., Harwood Heights, Ill.
Fairchild Semiconductor, Mountain View, Cal.
D General Illumination, Roseville, Minn.
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HEI, Chaska, Minn.
D Hewlett-Packard Co., Palo Alto, Cal.
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Korry Mfg. Co., Seattle, Wash.
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Microwave Assocs., Burlington, Mass.
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
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D National Semiconductor Corp., Santa Clara, Cal.
OPCOA, Edison, N.J.
Optron, Carrollton, Tex.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
Sensor Corp., Scottdale, Pa.
Sensor Technology, Chatsworth, Cal.
D Siemens Corp., Iselin, N.J.
Skan-A-Matic Corp., Elbridge, N.Y.
Sperry Microwave Components, Gainesville, Fla.
Thor Elctrns. Corp., Flizabeth, N.J.
TRG,, Woburn, Mass.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
D Xciton Corp., Latham, N.Y.

Diodes, Limiting

Hewlett-Packard, Palo Alto, Cal.
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D General Elec. Co., Schenectady, N.Y. .... *
M Addington Labs, Sunnyvale, Cal.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Eastern Delta Corp., Fair Lawn, N.J.
Edal Inds., E. Haven, Conn.
General Elec., Syracuse, NY
M GHZ Devices, So. Chelmsford, Mass.
Hewlett-Packard Co., Palo Alto, Cal.
Microphase Corp., Cos Cob, Conn.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Parametric Inds., Winchester, Mass.
Schauer Mfg. Corp., Cincinnati, Ohio
D Semiconductor Technology, College Point, N.Y.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.
UPI Semiconductor Div., Patterson, N.J.
Varian Electron Tube & Device Grp., San Carlos, Cal.

Diodes, Matched Pairs

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D Hewlett-Packard, Palo Alto, Cal.
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D RSM Sensitron Semiconductor, Div. RSM Electron Power, Deer Park, N.Y.
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D Solid State Devices, LaMirada, Cal. ...p. 1•1865
D Westinghouse Elec. Corp., Youngwood, Pa.
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D Amperex Electronic Corp., Hicksville, N.Y. ...... *

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*Company has information in white pages but not on this product

D **General Elec. Co., Schenectady, N.Y. .... ***
International Rectifier Corp., El Segundo, Cal. *
Sprague Products Co., No. Adams, Mass. .... *
M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Amperex Electronic Corp., Slatersville, R.I.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Centralab Semiconductor, El Monte, Cal.
Codi Corporation, Fair Lawn, N.J.
Edal Inds., E. Haven, Conn.
Fairchild Semiconductor, Mountain View, Cal.
DM FMC Corporation, Homer City, Pa.
General Elec., Syracuse, NY
D Hewlett-Packard Co., Palo Alto, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
M Kemtron Electron Prods., Newburyport, Mass.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Parametric Inds., Winchester, Mass.
D Semicoa, Costa Mesa, Cal.
D Semiconductor Technology, College Point, N.Y.
Solid State Inc., Bloomfield, N.J.
DM Solitron Devices, Riviera Beach, Fla.
Sperry Microwave Components, Gainesville, Fla.
Summit Engineering Corp., Bozeman, Mont.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRG,, Woburn, Mass.

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D **General Elec. Co., Schenectady, N.Y. .... ***
D **Hewlett-Packard, Palo Alto, Cal. .... ***
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M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
Carter Semiconductor, Syossett, N.Y.
Codi Corporation, Fair Lawn, N.J.
Edal Inds., E. Haven, Conn.
Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
D Hewlett-Packard Co., Palo Alto, Cal.
Kemtron Electron Prods., Newburyport, Mass.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Parametric Inds., Winchester, Mass.
D Semicoa, Costa Mesa, Cal.
D Semiconductor Technology, College Point, N.Y.
Solid State Inc., Bloomfield, N.J.
DM Solitron Devices, Riviera Beach, Fla.
Summit Engineering Corp., Bozeman, Mont.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

Diodes, Microwave Detector

Amperex Elctronic Corp., Slatersville, R.I. .... *
D **Amperex Electronic Corp., Hicksville, N.Y. ...... ***
D **General Elec. Co., Schenectady, N.Y. .... ***
D **NEC America, New York, N.Y. .... ***
Sprague Products Co., No. Adams, Mass. .... *
M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
M Hughes Aircraft Co., Torrance, Cal.
Kemtron Electron Prods., Newburyport, Mass.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Parametric Inds., Winchester, Mass.
Special Microwave Devices Oper., Waltham, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
UPI Semiconductor Div., Patterson, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Diodes, Microwave Mixer

Amperex Elctronic Corp., Slatersville, R.I. .... *
D **Amperex Electronic Corp., Hicksville, N.Y. ...... ***
D **NEC America, New York, N.Y. .... ***
M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
M Hughes Aircraft Co., Torrance, Cal.
M Kemtron Electron Prods., Newburyport, Mass.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM Parametric Inds., Winchester, Mass.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Microwave Components, Gainesville, Fla.
Thor Elctrns. Corp., Elizabeth, N.J.
D TRG,, Woburn, Mass.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.

Diodes, Noise

M Addington Labs, Sunnyvale, Cal.
D Ailtech, Farmingdale, N. Y.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
Codi Corporation, Fair Lawn, N.J.
M GHZ Devices, So. Chelmsford, Mass.
D Parametric Inds., Winchester, Mass.
Signalite Div., Neptune, N.J.
Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Photoelectric

D **EG&G, Salem, Mass. ....p. 1•1012**
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D **Hewlett-Packard, Palo Alto, Cal.**
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National Semiconductors, Plattsburgh, N.Y.
p. 1•1018,1019
D **Vactec, Maryland Heights, Mo. p. 1•1022,1023**
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
EG & G, Salem, Mass.
D Hewlett-Packard Co., Palo Alto, Cal.
Infrared Industries, Waltham, Mass.
Integrated Photomatrix, Mountainside, N.J.
Meret Inc., Santa Monica, Cal.
Micro Components Corp., Cranston, RI
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
Optron, Carrollton, Tex.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Santa Barbara Resch. Ctr., Goleta, Cal.
Sensor Technology, Chatsworth, Cal.
Skan-A-Matic Corp., Elbridge, N.Y.
Teletron, Pottstown, Pa.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, PIN

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M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
M GHZ Devices, So. Chelmsford, Mass.
DM Hewlett-Packard Co., Palo Alto, Cal.
M Hughes Aircraft Co., Torrance, Cal.
Meret Inc., Santa Monica, Cal.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
Optron, Carrollton, Tex.
RCA Electronic Comps., Harrison, N.J.
Scientifico Scientific Components Co., Newport Beach, Cal.
Sensor Technology, Chatsworth, Cal.
DM Special Microwave Devices Oper., Waltham, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
D Unitrode Corp., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Beverly, Mass
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.

Diodes, Schottky

DM **Hewlett-Packard, Palo Alto, Cal.**
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D **International Rectifier Corp., El Segundo, Cal.**
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D **Varo Semiconductor, Garland, Tex.**
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D **Amperex Electronic Corp., Hicksville, N.Y. ...... ***
D **NEC America, New York, N.Y. .... ***
M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Edal Inds., E. Haven, Conn.
DM Hewlett-Packard Co., Palo Alto, Cal.
M Hughes Aircraft Co., Torrance, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Parametric Inds., Winchester, Mass.
DM Solitron Devices, Riviera Beach, Fla.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Microwave Components, Gainesville, Fla.
Thor Elctrns. Corp., Elizabeth, N.J.
D TRG,, Woburn, Mass.
D TRW Semiconductor, Lawndale, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.

Diodes, Selenium—See Rectifiers, Selenium

Diodes, Silicon

D **Delco Electronics Div., Kokomo, Ind.**
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DM **General Instruments Corp., Hicksville, N.Y.**
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Hamamatsu Corp., Middlesex, N. J.
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International Comps Corp., Melville, N.Y.
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D **International Rectifier Corp., El Segundo, Cal.**
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RSM Sensitron Semiconductor, Div. RSM Electron Power, Deer Park, N.Y.
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Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
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D **Westinghouse Elec. Corp., Youngwood, Pa.**
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D **Amperex Electronic Corp., Hicksville, N.Y. ...... ***
D **GC Electronics, Rockford, Ill. .... ***
D **General Elec. Co., Schenectady, N.Y. .... ***
D **Hewlett-Packard, Palo Alto, Cal. .... ***
Shigoto Inds., Ltd., New York, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
TRW Capacitor Div., Ogallala, Neb. .... *
D **Wagner Elec., Livingston, N.J. .... ***
M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
Alpha Components Corp., El Segundo, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Amperex Electronic Corp., Slatersville, R.I.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Centralab Semiconductor, El Monte, Cal.
D Codi Corporation, Fair Lawn, N.J.
D Cordover & Co., Carl, Hollywood, Fla.
D Dutrex Inds., New York, N.Y.
Edal Inds., E. Haven, Conn.
EG & G, Salem, Mass.
D Elctrn. Devices, Yonkers, N.Y.
D Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
DM FMC Corporation, Homer City, Pa.
General Elec., Syracuse, NY
M GHZ Devices, So. Chelmsford, Mass.
D Hewlett-Packard Co., Palo Alto, Cal.
M Hughes Aircraft Co., Torrance, Cal.
M International Importers, Chicago, Ill.
D ITT Semiconductor, West Palm Beach, Fla.
M Kemtron Electron Prods., Newburyport, Mass.
Meret Inc., Santa Monica, Cal.
Micro Components Corp., Cranston, RI
Microwave Assocs., Burlington, Mass.
Motorola Comms. Div., Schaumburg, Ill.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Norelcom Electronics, Farmingdale, N.Y.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.

D Parametric Inds., Winchester, Mass.
Power Physics Corp., Eatontown, N.J.
DM RCA Solid State Div., Somerville, N.J.
DM Sarkes Tarzian, Bloomington, Ind.
D Semiconductor Technology, College Point, N.Y.
Sensor Technology, Chatsworth, Cal.
D Siemens Corp., Iselin, N.J.
D Solid State Inc., Bloomfield, N.J.
Solitron Devices, San Diego, Cal.
Special Microwave Devices Oper., Waltham, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
Triac Electronics, New York, N.Y.
D TRW Semiconductor, Lawndale, Cal.
D Unitrode Corp., Watertown, Mass.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.
D Workman Electronic Prods., Sarasota, Fla.

Diodes, Step Recovery

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D Westinghouse Elec. Corp., Youngwood, Pa.
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D NEC America, New York, N.Y. .... *
M Addington Labs, Sunnyvale, Cal.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
DM FMC Corporation, Homer City, Pa.
M GHZ Devices, So. Chelmsford, Mass.
Hewlett-Packard Co., Palo Alto, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Parametric Inds., Winchester, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.

Diodes, Switching

DM Hewlett-Packard, Palo Alto, Cal.
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DM RSM Sensitron Semiconductor, Div. RSM Electron Power, Deer Park, N.Y.
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D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
DM Anaren Microwave, Syracuse, N.Y.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Centralab Semiconductor, El Monte, Cal.
D Codi Corporation, Fair Lawn, N.J.
Edal Inds., E. Haven, Conn.
D Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
M GHZ Devices, So. Chelmsford, Mass.
DM Hewlett-Packard Co., Palo Alto, Cal.
Hutson Industries, Dallas, Tex.
D ITT Semiconductor, West Palm Beach, Fla.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Norelcom Electronics, Farmingdale, N.Y.
D Parametric Inds., Winchester, Mass.
D Scientific Technology, Mountain View, Cal.
D Semiconductor Technology, College Point, N.Y.
Signalite Div., Neptune, N.J.
D Solid State Inc., Bloomfield, N.J.
Special Microwave Devices Oper., Waltham, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRG,, Woburn, Mass.
D TRW Semiconductor, Lawndale, Cal.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.

Diodes, Trigger—See Diodes, Avalanche

Diodes, Tunnel

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D General Elec. Co., Schenectady, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
M Aertech Industries, Sunnyvale, Cal.
D Calvert Elctrns., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Parametric Inds., Winchester, Mass.
RCA Electronic Comps., Harrison, N.J.
D Shester Engineering Co., Culver City, Cal.
D Solid State Inc., Bloomfield, N.J.
Special Microwave Devices Oper., Waltham, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
UPI Semiconductor Div., Patterson, N.J.

Diodes, Varactor

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D Amperex Electronic Corp., Hicksville, N.Y. ...... *
D General Elec. Co., Schenectady, N.Y. .... *
D NEC America, New York, N.Y. .... *
M Addington Labs, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
M Aertech Industries, Sunnyvale, Cal.
D Alpha Instr. Inc., Woburn, Mass.
D Calvert Elctrns., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
DM Codi Corporation, Fair Lawn, N.J.
Fairchild Semiconductor, Mountain View, Cal.
Fansteel Inc., N Chicago, Ill.
General Elec., Syracuse, NY
M GHZ Devices, So. Chelmsford, Mass.
M Hughes Aircraft Co., Torrance, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Microwave Assocs., Burlington, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Norelcom Electronics, Farmingdale, N.Y.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Parametric Inds., Winchester, Mass.
D Siemens Corp., Iselin, N.J.
Special Microwave Devices Oper., Waltham, Mass.
DM Teledyne-Crystalonics, Cambridge, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRG,, Woburn, Mass.
D TRW Semiconductor, Lawndale, Cal.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Beverly, Mass
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.
Varian, Solid State West Division, Palo Alto, Cal.

Diodes, Video Detector—See Diodes, Microwave Detector

Diodes, Zener & Stabistors (Forward Reference Diodes)

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D GC Electronics, Rockford, Ill. .... *
D General Elec. Co., Schenectady, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
TRW Capacitor Div., Ogallala, Neb. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Amperex Electronic Corp., Slatersville, R.I.
D Calvert Elctrns., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
D Codi Corporation, Fair Lawn, N.J.
D Cordover & Co., Carl, Hollywood, Fla.
D Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
DM General Semiconductor Industries, Tempe, Ariz.
M International Importers, Chicago, Ill.
D ITT Semiconductor, West Palm Beach, Fla.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D Norelcom Electronics, Farmingdale, N.Y.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Sarkes Tarzian, Bloomington, Ind.
Schauer Mfg. Corp., Cincinnati, Ohio
D Semiconductor Technology, College Point, N.Y.
D Solid State Inc., Bloomfield, N.J.
Solitron Devices, San Diego, Cal.
D Sprague Elec. Co., No. Adams, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
Triac Electronics, New York, N.Y.
D TRW Semiconductor, Lawndale, Cal.
D Unitrode Corp., Watertown, Mass.
UPI Semiconductor Div., Patterson, N.J.
D Workman Electronic Prods., Sarasota, Fla.

Diplexers, Antenna

All Systems, Moorestown, N.J.
M Aertech Industries, Sunnyvale, Cal.
M AIL, Deer Park, N.Y.
Alford Mfg. Co., Winchester, Mass.
DM Bayshore Systems Corp., Springfield, Va.
M Coleman Microwave Co., Lebanon, N.J.
Dynalab Corp., Van Nuys, Cal.
Hughes Aircraft Co, Culver City, Cal.
M Lorch Devices Inc., Englewood, N.J.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
TRW Elec. Functions, Camden, N.J.

Direction Finders

M Adams-Russell Co., Waltham, Mass.
Addington Labs., Santa Clara, Calif.
AEL, Colmar, Pa.
D Bendix Corp., Ft. Lauderdale, Fla.
D Dynair Elctrns. Inc., San Diego, Calif.
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- Microwave Prods., Chatsworth, Cal.
- Mu-Del Elctrns., Silver Spring, Md.
- Murata Corporation of America, Elmsford, N.Y.
- Murata Mfg. Co. Ltd., Kyoto, Japan
- Nihon Dempa Kogyo Co., Ltd., Tokyo, Japan
- M Norsal Industries, Brentwood, N.Y.
- M OPT Inds. Inc., Phillipsburg, N.J.
- Oriel Corp. of America, Stamford, Conn.
- Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
- Physical Electronics Labs., Menlo Park, Cal.
- Piezo Crystal Co., Carlisle, Pa.
- M Polyphase Instr. Co., Bridgeport, Pa.
- M Power Waves Inc., Asbury Park, N.J.
- M Premier Microwave, Port Chester, N.Y.
- Radiation Devices Co., Baltimore, Md.
- R L C Elctrns., Mt. Kisco, N.Y.
- Rhode & Schwarz Sls., Fairfield, N.J.
- Sensotec, Columbus, Ohio
- D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
- Sivers Lab, Corona del Mar, Cal.
- Solar Elctrns. Co., Hollywood, Cal.
- Soshin Elec. Co., Tokyo, Japan
- D Spectra Sonics, Ogden, Utah
- Sprague Elec. Co., No. Adams, Mass.
- Stanford Applied Engineering, Santa Clara, Cal.
- T-F Electronics Inc., Austin, Tex.
- TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
- TDK Elctrns. Corp., Long Island City, N.Y.
- Tektronix, Beaverton, Ore.
- M Teledyne Mec., Palo Alto, Cal.
- M Teledyne Microwave, Mountain View, Cal.
- Telonic Altair, Laguna Beach, Calif.
- Tohoku Metal Inds., Ltd., Tokyo, Japan
- TRG,, Woburn, Mass.
- TRW Elec. Functions, Camden, N.J.
- D TRW/UTC Transformers, New York, N.Y.
- Tucker Electronics Co., Garland, Tex.
- UFAD Corp., Grand Rapids, Mich.
- Universal Ad-Yu Elctrns., Milwaukee, Wisc.
- UTE Microwave, Asbury Park, N.J.
- M Valpey Corp., Holliston, Mass.
- Varian Assocs., Palo Alto, Cal.
- Varian Electron Tube & Device Grp., San Carlos, Cal.
- Varian Palo Alto Microwave Tube Div,, Palo Alto, Cal.
- Varian, Solid State West Division, Palo Alto, Cal.
- Vibration Instrs. Co., Anaheim, Cal.
- M Watkins-Johnson Co., Palo Alto, Cal.
- White Instrs., Austin, Tex.
- Wide Band Engrg. Co. Inc., Phoenix, Ariz.
- DM Yig-Tek Corp., Santa Clara, Cal.

Filters, Band Reject, Band Stop—See Filters, Band, Elimination

Filters, Ceramic

- DM **AVX Ceramics, Myrtle Beach, S.C. p. 1•530,531**
- D **Erie Technological Products, Erie, Pa. p. 1•556**
- M **RF Interonics, Bay Shore, N.Y. ..... p. 1•572,573**
- M **USCC/Centralab, Elec. Div., Los Angeles, Cal. p. 1•594,595**
- M **Vernitron Piezoelectric Div., Bedford, Ohio p. 1•596-599**
- **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... ***
- DM **Sprague Products Co., No. Adams, Mass. .... ***
- Bell Industries, Electronic Components Div., Burbank, Cal.
- Filtron Company, Westbury, N.Y.
- Genisco Technology Corp., Compton, Cal.
- Gulton Inds., Metuchen, N.J.
- Murata Corporation of America, Elmsford, N.Y.
- Murata Mfg. Co. Ltd., Kyoto, Japan
- DM San Fernando Elec. Mfg., San Fernando, Cal.
- Sprague Elec. Co., No. Adams, Mass.
- Star Porcelain Co., Trenton, N.J.
- Stettner-Trush Inc., Cazenovia, N.Y.
- TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
- TDK Elctrns. Corp., Long Island City, N.Y.
- Tohoku Metal Inds., Ltd., Tokyo, Japan
- Viclan, San Diego, Cal.

Filters, Coaxial

- **Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279**
- M **Bird Electronic Corp., Solon, Ohio .... p. 1•618**
- D **Erie Technological Products, Erie, Pa. p. 1•556**
- D **Greenray Inds., Mechanicsburg, Pa. .... p. 1•327**
- **MCL, LaGrange, Ill. .... p. 1•924**
- D **Sealectro Corp., Mamaroneck, N.Y. p. 2•807-810**
- D **Texscan Corp., Indianapolis, Ind. .... p. 1•817**
- **TT Elctrns., Los Angeles, Cal. ...... p. 1•588-591**
- M **USCC/Centralab, Elec. Div., Los Angeles, Cal. p. 1•594,595**
- **General Radio Co., Concord, Mass. .... ***
- **McCoy Electronics, Mount Holly Springs, Pa. ***
- **Systron-Donner Microwave Div., Van Nuys, Cal. .... ***
- Addington Labs., Santa Clara, Calif.
- AEL, Colmar, Pa.
- M Aertech Industries, Sunnyvale, Cal.
- M AIL, Deer Park, N.Y.
- M Cir-Q-Tel, Kensington, Md.
- Coaxial Dynamics, Cleveland, Ohio
- Cornell-Dubilier Electronics, Newark, N.J.
- Dynalab Corp., Van Nuys, Cal.
- D Finney Co., Bedford, Ohio
- Frequency Engrg. Labs., Farmingdale, N.J.
- D Jerrold Electronics Corp., Horsham, Pa.
- M Lorch Elctrns. Corp., Englewood, N.J.
- M Lorch Devices Inc., Englewood, N.J.
- M Lundy Elctrns. & Sys., Glen Head, N.Y.
- Maury Microwave Corp., Cucamonga, Calif.
- M Microlab/FXR, Livingston, N.J.
- Microphase Corp., Cos Cob, Conn.
- D Microwave Development Labs., Needham Hgts., Mass.
- Mu-Del Elctrns., Silver Spring, Md.
- M Norsal Industries, Brentwood, N.Y.
- M Premier Microwave, Port Chester, N.Y.
- R L C Elctrns., Mt. Kisco, N.Y.
- Rhode & Schwarz Sls., Fairfield, N.J.
- D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
- Stettner-Trush Inc., Cazenovia, N.Y.
- M Teledyne Mec., Palo Alto, Cal.
- M Teledyne Microwave, Mountain View, Cal.
- Telonic Altair, Laguna Beach, Calif.
- M Transco Prods., Venice, Cal.
- UTE Microwave, Asbury Park, N.J.
- Varian Assocs., Palo Alto, Cal.
- Varian Electron Tube & Device Grp., San Carlos, Cal.
- Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
- Varian, Solid State West Division, Palo Alto, Cal.
- Waveline, W. Caldwell, N.J.

Filters, Comb

- M **Aladdin Elctrns., Nashville, Tenn. p. 2•1727,1728**
- **Arra Inc., Bay Shore, N.Y. ...... p. 2•1278,1279**
- M **Artronic Instr. Co., Silver Spring, Md. p. 1•430,431**
- M **Axel Elctrns., Jamaica, N.Y. .... p. 1•525**
- **Chesterfield Prods. Inc., Saddle Brook, N.J. p. 1•548**
- **CTS Knights, Sandwich, Ill. .... p. 1•310,311**
- M **Damon Corp., Westwood, Mass. p. 1•312,313**
- M **ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•550,551**
- **Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324**
- **Hertz Filter, Syosset, N.Y. .... p. 1•562,563**
- M **Hughes Aircraft Co., Newport Beach, Cal. p. 1•361**
- **McCoy Electronics, Mount Holly Springs, Pa. p. 1•375**
- M **Monitor Prods., Oceanside, Cal. .... p. 1•395**
- M **Reeves-Hoffman Div., Carlisle, Pa. ..... p. 1•411**
- **Sprague Products Co., No. Adams, Mass. p. 1•587**
- **TMC Systems (Ariz.), Tempe, Ariz. p. 1•418,419**
- **TT Elctrns., Los Angeles, Cal. ...... p. 1•588,590**
- **Vernitron Piezoelectric Div., Bedford, Ohio p. 1•597**
- **Andersen Labs., Bloomfield, Conn. .... ***
- M **Bliley Electric Co., Erie, Pa. .... ***
- **Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... ***
- **Comstron-Seg Multimetrics, Richmond Hill, N.Y. .... ***
- DM **General Instruments Corp., Hicksville, N.Y. ..... ***
- M **Hisonic, Olathe, Kan. .... ***
- **Q-Tech Corp., Los Angeles, Cal. .... ***
- **Systron-Donner Microwave Div., Van Nuys, Cal. .... ***
- Addington Labs., Santa Clara, Calif.
- AEL, Colmar, Pa.
- M AIL, Deer Park, N.Y.
- M American Trans-Coil Corp., Richmond Hill, N.Y.
- M Blackhawk Networks Corp., Janesville, Wisc.
- Cirtech Corp., Leawood, Kans.
- M Coleman Microwave Co., Lebanon, N.J.
- M Crystal Network Prods. Corp., Erie, Pa.
- CTS Corp., Elkart, Ind.
- M Dietz Design, Belton, Mo.
- Dynalab Corp., Van Nuys, Cal.
- Electrocom Inds., S. Bend, Ind.
- M Filtech Corp., Franklin Park, Ill.
- Frequency Engrg. Labs., Farmingdale, N.J.
- M Genisco Tech. Corp., Compton, Cal.
- Kinetic Tech., Santa Clara, Cal.
- K R Electronics, Avenel, N.J.
- M Lorch Elctrns. Corp., Englewood, N.J.
- M Lorch Devices Inc., Englewood, N.J.
- Maury Microwave Corp., Cucamonga, Calif.
- M Microlab/FXR, Livingston, N.J.
- Microphase Corp., Cos Cob, Conn.
- Microsonics, Weymouth, Mass.
- Microwave Development Labs., Needham Hgts., Mass.
- Mu-Del Elctrns., Silver Spring, Md.
- M Norsal Industries, Brentwood, N.Y.
- Piezo Crystal Co., Carlisle, Pa.
- D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
- Sprague Elec. Co., No. Adams, Mass.
- Stanford Applied Engineering, Santa Clara, Cal.
- T-F Electronics Inc., Austin, Tex.
- M Teledyne Microwave, Mountain View, Cal.
- Telonic Altair, Laguna Beach, Calif.
- Varian Assocs., Palo Alto, Cal.
- Vibration Instrs. Co., Anaheim, Cal.
- White Instrs., Austin, Tex.

Filters, Continuously Variable

- **A. P. Circuit Corp., New York, N.Y. ..... p. 1•528**
- M **Axel Elctrns., Jamaica, N.Y. .... p. 1•525**
- **Dynamics Elctrn. Prods., Santa Fe Springs, Cal. p. 1•5**
- **Frequency Devices, Haverhill, Mass. ... p. 1•554**
- **Ithaco, Ithaca, N.Y. .... p. 1•568**
- **Krohn-Hite Corp., Cambridge, Mass. ... p. 1•569**
- **Rockland Sys. Corp., W. Nyack, N.Y. p. 1•416,574,798,799**

D **Texscan Corp., Indianapolis, Ind. .... p. 1•817**
Vari-L Co., Denver, Colo. .... p. 1•600
Applied Research Inc., Port Washington, N.Y. *
Comstron Seg., Richmond Hill, N.Y. .... *
Comstron-Seg Multimetrics, Richmond Hill, N.Y. .... *
DM **General Instruments Corp., Hicksville, N.Y. ..... ***
General Radio Co., Concord, Mass. .... *
Seg Subsidiary, Richmond Hill, N.Y. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
M Aertech Industries, Sunnyvale, Cal.
M AIL, Deer Park, N.Y.
D Altec Div., Anaheim, Calif.
Bafco, Warminster, Pa.
D Burwen Lab. Inc., Burlington, Mass.
M Cir-Q-Tel, Kensington, Md.
Cirtech Corp., Leawood, Kans.
M Coleman Microwave Co., Lebanon, N.J.
M Deltronic Crystal Inds., Denville, N.J.
Dynalab Corp., Van Nuys, Cal.
Fogg System Co., Denver, Col.
Frequency Engrg. Labs., Farmingdale, N.J.
Incor Instrumentation, West Babylon, N.Y.
Kinetic Tech., Santa Clara, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
M Microlab/FXR, Livingston, N.J.
Non Linear Filters, Trumbull, Conn.
M Norsal Industries, Brentwood, N.Y.
Physical Electronics Labs., Menlo Park, Cal.
M Power Waves Inc., Asbury Park, N.J.
M Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
R L C Elctrns., Mt. Kisco, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Special Microwave Devices Oper., Waltham, Mass.
Telonic Altair, Laguna Beach, Calif.
TRW Elec. Functions, Camden, N.J.
Tucker Electronics Co., Garland, Tex.
UFAD Corp., Grand Rapids, Mich.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.
Varian, Solid State West Division, Palo Alto, Cal.
Vibration Instrs. Co., Anaheim, Cal.
DM Yig-Tek Corp., Santa Clara, Cal.

Filters, Crystal (Incl. Monolithic Devices)

Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... p. 1•290,291
CTS Knights, Sandwich, Ill. .... p. 1•310,311
M **Damon Corp., Westwood, Mass. p. 1•312,313**
M **Electronic Research Co., Shawnee Mission, Kans. .... p. 1•317**
Erie Technological Products, Erie, Pa. p. 1•315
Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324,325
M **Hughes Aircraft Co., Newport Beach, Cal. p. 1•361**
D **McCoy Electronics, Mount Holly Springs, Pa. p. 1•367,372-377**
M **Monitor Prods., Oceanside, Cal. .... p. 1•394**
Piezo Technology Inc., Orlando, Fla. p. 1•406,407
Q-Tech Corp., Los Angeles, Cal. ...p. 1•408,409
M **Reeves-Hoffman Div., Carlisle, Pa. ..... p. 1•411**
M **Statek Corp., Orange, Cal. ....p. 1•412,413**
TMC Systems (Ariz.), Tempe, Ariz. p. 1•418,419
TT Elctrns., Los Angeles, Cal. ...... p. 1•589,591
American Time Products, Bulova Watch, Woodside, N.Y. .... *
M **Bliley Electric Co., Erie, Pa. .... ***
Croven, Ltd., Whitby, Ont., Can. .... *
M **Torotel Inc., Grandview, Mo. .... ***
M American Trans-Coil Corp., Richmond Hill, N.Y.
M Blackhawk Networks Corp., Janesville, Wisc.
Cirtech Corp., Leawood, Kans.
Collins Radio, Dallas, Tex.
M Crystal Network Prods. Corp., Erie, Pa.
CTS Corp., Elkart, Ind.
M Dietz Design, Belton, Mo.
Eimac, San Carlos, Calif.
Erie Frequency Control, Carlisle, Pa.
M Filtech Corp., Franklin Park, Ill.
M Genisco Tech. Corp., Compton, Cal.
Information Transfer Industrial, Holcomb, N.Y.
M Microsonics, Weymouth, Mass.
Nihon Dempa Kogyo Co., Ltd., Tokyo, Japan
M OPT Inds. Inc., Phillipsburg, N.J.
Piezo Crystal Co., Carlisle, Pa.
Radiation Devices Co., Baltimore, Md.
Toyo Comm. Equip. Co. Ltd., Kawasaki, Kanagawa, Japan
Tyco Crystal Products Div., Kansas City, Mo.
M Valpey Corp., Holliston, Mass.

Filters, Digital

Rockland Sys. Corp., W. Nyack, N.Y. p. 1•416,574,798,799
Andersen Labs., Bloomfield, Conn. .... *
M **General Instruments Corp., Hicksville, N.Y. ..... ***
McCoy Electronics, Mount Holly Springs, Pa. *
M Dietz Design, Belton, Mo.
Dynalab Corp., Van Nuys, Cal.
Engineered Components Co., San Luis Obispo, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
D Intergrated Microsystems Inc., Mountain View, Cal.
Panelgraphic Corp., Caldwell, N.J.
Varian, Solid State West Division, Palo Alto, Cal.

Filters, EMI/RFI

M **All-Tronics Inc., Westbury, N.Y. p. 1•538-543**
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•526,527**
Amphenol Canada Ltd., Scarborough, (Ont.), Can. .... p. 2•460,461
D **AVX Ceramics, Myrtle Beach, S.C. p. 1•530,531**
M **Axel Elctrns., Jamaica, N.Y. ....p. 1•525**
D **Bell Industries, Compton, Cal. ..... p. 2•370-379**
Caddel-Burns Mfg. Co., Mineola, N. Y. p. 2•382-385
D **Corcom, Chicago, Ill. ....p. 1•546,547**
Electrocube Inc., San Gabriel, Cal. ...... p. 1•553
D **Erie Technological Products, Erie, Pa. p. 1•556**
M **F-Dyne Elctrns., Bridgeport, Conn. p. 2•130-133**
Gudeman Corp., Chicago, Ill. ....p. 2•138
Hopkins Engrg., San Fernando, Cal. p. 1•566,567
Magnetico, Holtsville, N.Y. .... p. 2•1770
M **Potter Co., Wesson, Miss. ....p. 1•570,571**
M **RF Interonics, Bay Shore, N.Y. .....p. 1•572,573**
M **Southern Electronics Co., Burbank, Cal. p. 2•240,241**
D **Spectrum Control, Fairview, Pa. p. 1•575-583**
DM **Sprague Products Co., No. Adams, Mass. p. 1•585-587**
Topaz Electronics, San Diego, Cal. p. 1•593,1506; p. 2•1817
M **USCC/Centralab, Elec. Div., Los Angeles, Cal. p. 1•594,595**
Vari-L Co., Denver, Colo. ....p. 2•1405,1406
M Active & Passive Components, Syosset, N.Y.
Amp Inc., Harrisburg, Pa.
M A.R.F. Products, Boulder, Colo.
D Audio-Vidio Engrg. Co., Merrick, N.Y.
Captor Corp., Tipp City, Ohio
D Cornell-Dubilier Electronics, Newark, N.J.
De Coursey Engrg. Lab., Culver City, Cal.
M DynaMagnetic Engrg, Santa Ana, Cal.
Electro-Mechanics Co., Austin, Tex.
Elmag Corp., Newark, N.J.
Estes Engrg. Co., Port Angeles, Wash.
Evaporated Coatings, Huntingdon Valley, Pa.
Filtron Company, Westbury, N.Y.
DM General Semiconductor Industries, Tempe, Ariz.
Genisco Technology Corp., Compton, Cal.
M Genisco Tech. Corp., Compton, Cal.
Gulton Inds., Metuchen, N.J.
Lundy Elctrns. & Sys., Glen Head, N.Y.
Metavac, Flushing, N.Y.
Research Prods. Corp., Madison, Wisc
M RtroN Corp., Skokie, Ill.
Sanders Associates, Nashua, N.H.
D Siemens Corp., Iselin, N.J.
Simmonds Precision, Norwich, N.Y.
Solar Elctrns. Co., Hollywood, Cal.
DM Sprague Elec. Co., No. Adams, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Tucker Electronics Co., Garland, Tex.
Viclan, San Diego, Cal.
D Vidaire Electronics Mfg., Freeport, N.Y.
M Watkins-Johnson Co., Palo Alto, Cal.

Filters, Equalizer

M **Axel Elctrns., Jamaica, N.Y. ....p. 1•525**
Chesterfield Prods. Inc., Saddle Brook, N.J. p. 1•548
Comstron-Seg Multimetrics, Richmond Hill, N.Y. ....p. 1•544,545,638,639
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
El-Rad Mfg. Co., Chicago, Ill ....p. 2•1773,1774
M **ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•550,551**
Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324
Hertz Filter, Syosset, N.Y. ....p. 1•562,563
M **Hisonic, Olathe, Kan. .... p. 1•565**
Magnetico, Holtsville, N.Y. .... p. 2•1770
M **Reeves-Hoffman Div., Carlisle, Pa. ..... p. 1•411**
Seg Subsidiary, Richmond Hill, N.Y. p. 1•544,545,638,639
TMC Systems (Ariz.), Tempe, Ariz. p. 1•418,419
TT Elctrns., Los Angeles, Cal. ...... p. 1•589,591
Allen Avionics, Mineola, N.Y. .... *
Comstron Seg., Richmond Hill, N.Y. .... *
DM **General Instruments Corp., Hicksville, N.Y. ..... ***
D **McCoy Electronics, Mount Holly Springs, Pa. ***
Microtran Co., Valley Stream, N.Y. .... *
Q-Tech Corp., Los Angeles, Cal. .... *
Sprague Products Co., No. Adams, Mass. .... *
M **Torotel Inc., Grandview, Mo. .... ***
Addington Labs., Santa Clara, Calif.
M AIL, Deer Park, N.Y.
D Altec Div., Anaheim, Calif.
M BG Electronics, Mount Vernon, N.Y.
Bowmar/ALI, Acton, Mass.
Cirtech Corp., Leawood, Kans.
M Dietz Design, Belton, Mo.
Dynalab Corp., Van Nuys, Cal.
M Filtech Corp., Franklin Park, Ill.
D Frazier, Dallas, Tex.
M Genisco Tech. Corp., Compton, Cal.
Kinetic Tech., Santa Clara, Cal.
K R Electronics, Avenel, N.J.
M Lorch Devices Inc., Englewood, N.J.
Microwave Development Labs., Needham Hgts., Mass.
M OPT Inds. Inc., Phillipsburg, N.J.
M Polyphase Instr. Co., Bridgeport, Pa.
D Pulse Techniques, Teaneck, N.J.
D Spectra Sonics, Ogden, Utah
Sprague Elec. Co., No. Adams, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
White Instrs., Austin, Tex.

Filters, Harmonic

M **Axel Elctrns., Jamaica, N.Y. ....p. 1•525**
Chesterfield Prods. Inc., Saddle Brook, N.J. p. 1•548
M **Data Delay Devices, Clifton, N.J. p. 1•445-451,552**
M **ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•550,551**
M **Hisonic, Olathe, Kan. .... p. 1•565**
Magnetico, Holtsville, N.Y. .... p. 2•1770
M **RF Interonics, Bay Shore, N.Y. .....p. 1•572,573**
TT Elctrns., Los Angeles, Cal. ...... p. 1•588-591
Biometrics Instrument Corp., Garland, Tex. ..... *
Comstron Seg., Richmond Hill, N.Y. .... *
Comstron-Seg Multimetrics, Richmond Hill, N.Y. .... *
D **GC Electronics, Rockford, Ill. .... ***
General Radio Co., Concord, Mass. .... *
Microtran Co., Valley Stream, N.Y. .... *
Rockland Sys. Corp., W. Nyack, N.Y. .... *
Seg Subsidiary, Richmond Hill, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
Addington Labs., Santa Clara, Calif.
M BG Electronics, Mount Vernon, N.Y.
Cirtech Corp., Leawood, Kans.
M Coleman Microwave Co., Lebanon, N.J.
M Dietz Design, Belton, Mo.
Dynalab Corp., Van Nuys, Cal.
M Electronic Transformer Corp., Paterson, N.J.
Filtron Company, Westbury, N.Y.
D Finney Co., Bedford, Ohio
Frequency Engrg. Labs., Farmingdale, N.J.
M Genisco Tech. Corp., Compton, Cal.
Kinetic Tech., Santa Clara, Cal.
K R Electronics, Avenel, N.J.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
D Microwave Development Labs., Needham Hgts., Mass.
M OPT Inds. Inc., Phillipsburg, N.J.
M Polyphase Instr. Co., Bridgeport, Pa.
D Sinclair Radio Labs., Concord, Ontario, Can. L4K 1B6
Sprague Elec. Co., No. Adams, Mass.
Telonic Altair, Laguna Beach, Calif.
UFAD Corp., Grand Rapids, Mich.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
Vibration Instrs. Co., Anaheim, Cal.
M Watkins-Johnson Co., Palo Alto, Cal.
White Instrs., Austin, Tex.

Filters, High-Pass

M **Aladdin Elctrns., Nashville, Tenn. p. 2•1727,1728**

Filters, High-Pass (cont'd)

All-Tronics Inc., Westbury, N.Y. p. 1•538-543
Allen Avionics, Mineola, N.Y. .... p. 1•533
A. P. Circuit Corp., New York, N.Y. ..... p. 1•529
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M Axel Elctrns., Jamaica, N.Y. .... p. 1•525
D Beckman Instrs., Fullerton, Cal. .... p. 1•882
D Bell Industries, Compton, Cal. ..... p. 2•370-379
Bird Electronic Corp., Solon, Ohio .... p. 1•618
Caddel-Burns Mfg. Co., Mineola, N. Y. p. 2•382-385
Chesterfield Prods. Inc., Saddle Brook, N.J. p. 1•548
M Damon Corp., Westwood, Mass. p. 1•312,313
M Data Delay Devices, Clifton, N.J. p. 1•445-451,552
Datel Systems Inc., Canton, Mass. ..... p. 1•158
Dynamics Elctrn. Prods., Santa Fe Springs, Cal. p. 1•5
El-Rad Mfg. Co., Chicago, Ill .... p. 2•1773,1774
M Electronic Research Co., Shawnee Mission, Kans. .... p. 1•317
M ESC Elctrns. Corp., Palisades Pk., N.J. p. 1•550,551
M Freed Transformer Co., Brooklyn, N.Y. p. 1•716,717; p. 2•1738-1747
Frequency Devices, Haverhill, Mass. ... p. 1•554
Hertz Filter, Syosset, N.Y. .... p. 1•562,563
M Hisonic, Olathe, Kan. .... p. 1•565
Hopkins Engrg., San Fernando, Cal. p. 1•566,567
M Integrated Circuits, Bellevue, Wash. ... p. 1•891
Ithaco, Ithaca, N.Y. .... p. 1•568
Krohn-Hite Corp., Cambridge, Mass. ... p. 1•569
Magnetico, Holtsville, N.Y. .... p. 2•1770
M Monitor Prods., Oceanside, Cal. .... p. 1•394
Neshaminy Transformer, Furlong, Pa. p. 2•1775,1776
Rental Electronics, Lexington, Mass. p. 1•792-795
M RF Interonics, Bay Shore, N.Y. ..... p. 1•572,573
Rockland Sys. Corp., W. Nyack, N.Y. p. 1•574,798,799
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
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N.Y. Testing Labs., Westbury, N.Y.
Sensor Corp., Scottdale, Pa.
Statham Instruments, Oxnard, Cal.
D Techni-Tool, Plymouth Meeting, Pa.
West Coast Resch. Corp., Los Angeles, Calif.

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D CVC Products, Rochester, N.Y.
Datametrics Inc., Wilmington, Mass.
Edwards High Vacuum, Grand Island, N.Y.
EMI Gencom Inc., Plainview, N.Y.
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DM Matheson Gas Products, East Rutherford, N.J.
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D Perkin-Elmer Ultek Inc., Palo Alto, Cal.
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D Taylor Instr. Process Control Div., Rochester, N.Y.
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Burr-Brown, Tucson, Ariz.
M Circuit Technology, Farmingdale, N.Y.
General Instrument Corp., Hicksville, N.Y.
D Intergrated Microsystems Inc., Mountain View, Cal.
D Lithic Systems, Saratoga, Cal.
Non Linear Filters, Trumbull, Conn.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Adders, Full, Half, Modulo-2 Also see IC's, Arithmetric Logic Units

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
Fairchild Semiconductor, Mountain View, Cal.
General Instr. Corp., Hicksville, N.Y.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Plessey Semiconductors, Santa Ana, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
DM Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Amplifiers, Audio

D Opamp Labs, Los Angeles, Cal. ....**p. 1•10,11**
D Sprague Products Co., No. Adams, Mass. p. 1•1872
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. ..... *
NEC America, New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Amperex Electronic Corp., Slatersville, R.I.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Interdesign Inc., Sunnyvale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
M Modular Audio Products, Bohemia, N.Y.
M Modular Devices, Bohemia, N. Y.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
D Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Siemens Corp., Iselin, N.J.
D Signetics Corp., Sunnyvale, Cal.
Solid State Inc., Bloomfield, N.J.
D Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Amplifiers, Current

CELCO, Mahwah, N.J. .... **p. 1•630**
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Interdesign Inc., Sunnyvale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.

IC's, Amplifiers, Instrumentation

CELCO, Mahwah, N.J. .... **p. 1•630**
DM Precision Monolithics Inc., Santa Clara, Cal. p. 1•893
Sprague Products Co., No. Adams, Mass. p. 1•1872
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
Avantek, Santa Clara, Cal.
Burr-Brown, Tucson, Ariz.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Interdesign Inc., Sunnyvale, Cal.
D Intersil, Cupertino, Cal.
Intronics Inc., Newton, Mass.
D ITT Semiconductor, West Palm Beach, Fla.
Leeds & Northrup Co., North Wales, Pa.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
Sensor Corp., Scottdale, Pa.
D Signetics Corp., Sunnyvale, Cal.
Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Amplifiers, Logarithmic

ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M RHG Elctrns. Lab., Deer Park, N.Y. ....**p. 2•1389**
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Intersil, Cupertino, Cal.
Intronics Inc., Newton, Mass.
Leeds & Northrup Co., North Wales, Pa.
DM Plessey Semiconductors, Santa Ana, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

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ILC Data Device Corp., Bohemia, N.Y. p. 1•171
D Opamp Labs, Los Angeles, Cal. ....**p. 1•10,11**
DM Precision Monolithics Inc., Santa Clara, Cal. p. 1•893
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. ..... *
NEC America, New York, N.Y. .... *
Promemco, Hauppauge, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
Burr-Brown, Tucson, Ariz.
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
DM Intersil, Cupertino, Cal.
Intronics Inc., Newton, Mass.
D ITT Semiconductor, West Palm Beach, Fla.
Leeds & Northrup Co., North Wales, Pa.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Optical Electronics, Tucson, Ariz.
Plessey Semiconductors, Santa Ana, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Siemens Corp., Iselin, N.J.
DM Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Amplifiers, Operational, Micropower

D Beckman Instrs., Fullerton, Cal. ....**p. 1•882**
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. ..... *
NEC America, New York, N.Y. .... *
Burr-Brown, Tucson, Ariz.
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Interdesign Inc., Sunnyvale, Cal.
Intronics Inc., Newton, Mass.
Leeds & Northrup Co., North Wales, Pa.
D Lithic Systems, Saratoga, Cal.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Amplifiers, Opto-Electronic

M General Instruments Corp., Hicksville, N.Y. ..... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
M Environmental Communications Inc., Costa Mesa, Cal.

Integrated Photomatrix, Mountainside, N.J.
Micro Components Corp., Cranston, RI
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D RCA Solid State Div., Somerville, N.J.
Sensor Corp., Scottdale, Pa.
D Siemens Corp., Iselin, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Amplifiers, Radio-Frequency

CELCO, Mahwah, N.J. .... p. 1•630
M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. .....*
D A E G Telefunken, Englewood Clfs., N.J.
M Aertech Industries, Sunnyvale, Cal.
Avantek, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
HRB-Singer, State College, Pa.
Interdesign Inc., Sunnyvale, Cal.
Lansdale Transistor & Elctrns., Andover, Mass.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
DM Plessey Semiconductors, Santa Ana, Cal.
Radio Development Lab., Deer Park, NY
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Amplifiers, Sample-And-Hold—See IC's, Sample And-Hold Circuits

IC's, Amplifiers, Sense Also see IC's, Comparators, Analog

M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Interdesign Inc., Sunnyvale, Cal.
Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
Silicon Systems Inc., Santa Ana, Cal.
Solid State Inc., Bloomfield, N.J.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's AND, AND-OR-Invert Gates—See IC's Logic Circuits

IC's, Arithmetic Logic Units (ALU) Also see IC's, Adders

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
D GC Electronics, Rockford, Ill. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.
Leeds & Northrup Co., North Wales, Pa.
Mostek Corp., Carrollton, Tex.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
DM Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Breadboard Circuits

D Continental Specialties, New Haven, Conn. p. 2•348-351
D Vector Electronic Co., Sylmar, Cal. ..... p. 2•362
Vero Electronics, Hauppauge, N.Y. ..... p. 2•365
D GC Electronics, Rockford, Ill. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
D Cambridge Thermionic Corp., Cambridge, Mass.
D Christiansen Radio Inc., Laguna Beach, Cal.
Douglas Electronics, San Leandro, Cal.
E & L Instruments, Derby, Conn.
M Environmental Communications Inc., Costa Mesa, Cal.
Hughes Aircraft Co, Culver City, Cal.
Interdesign Inc., Sunnyvale, Cal.
D Lithic Systems, Saratoga, Cal.
D National Semiconductor Corp., Santa Clara, Cal.
Proto Matic Co., Cincinnati, Ohio
D Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Buffers—See IC's, Logic Circuits

IC's, Bus Drivers—See IC's, Data Bus Drivers

IC's, Calculator Kits

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
Litronix, Cupertino, Cal. ....p. 2•1178
D A E G Telefunken, Englewood Clfs., N.J.
DM American Microsystems, Santa Clara, Cal.
Electronic Arrays, Mountain View, Cal.
Exetron Corp., Santa Clara, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.
D Intel Corp., Santa Clara, Cal.
Monroe, The Calculator Co., Orange, N.J.
Mos Technology, Norristown, Pa.
D National Semiconductor Corp., Santa Clara, Cal.
Rockwell Int'l., Anaheim, Cal.
D Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Western Digital Corp., Newport Beach, Cal.

IC's, Central Processing Units (CPU)

Exetron Corp., Santa Clara, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D Intel Corp., Santa Clara, Cal.
DM National Semiconductor Corp., Santa Clara, Cal.
D Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Character Generators, Dot-Matrix

DM American Microsystems, Santa Clara, Cal.
M Collins Radio Group, Newport Beach, Calif.
Electronic Arrays, Mountain View, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.
D Intel Corp., Santa Clara, Cal.
Mos Technology, Norristown, Pa.
Mostek Corp., Carrollton, Tex.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Precision Dynamics Corp., Burbank, Cal.
D Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Chroma Amplifiers Demodulators, Signal Processors

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
D Sprague Products Co., No. Adams, Mass. p. 1•1872
M General Instruments Corp., Hicksville, N.Y. .....*
D A E G Telefunken, Englewood Clfs., N.J.
Fairchild Semiconductor, Mountain View, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Signetics Corp., Sunnyvale, Cal.
D Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Clock Drivers

M Beckman Instrs., Fullerton, Cal. ....p. 1•880
M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
M Monitor Prods., Oceanside, Cal. .... p. 1•388
D Sprague Products Co., No. Adams, Mass. p. 1•1872
DM General Instruments Corp., Hicksville, N.Y. .....*
DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
DM American Microsystems, Santa Clara, Cal.
D Amperex Electronic Corp., Slatersville, R.I.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Intergrated Microsystems Inc., Mountain View, Cal.
D Intel Corp., Santa Clara, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Mos Technology, Norristown, Pa.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Code Converters—See IC's, Encoders & Decoders

IC's, Communications Circuits

D Sprague Products Co., No. Adams, Mass. p. 1•1872
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
NEC Microsystems, Ft. Lauderdale, Fla. .... *
D A E G Telefunken, Englewood Clfs., N.J.
DM American Microsystems, Santa Clara, Cal.
M Circuit Technology, Farmingdale, N.Y.
M Collins Radio Group, Newport Beach, Calif.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
D Intergrated Microsystems Inc., Mountain View, Cal.
Interdesign Inc., Sunnyvale, Cal.
D Lithic Systems, Saratoga, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
Solid State Inc., Bloomfield, N.J.
D Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D Western Digital Corp., Newport Beach, Cal.

IC's, Comparators, Analog Also see IC's, Amplifiers, Sense

DM Precision Monolithics Inc., Santa Clara, Cal. p. 1•893
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
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DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
D Intersil, Cupertino, Cal.
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Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Comparators, Digital

M General Instruments Corp., Hicksville, N.Y. .....*
D A E G Telefunken, Englewood Clfs., N.J.

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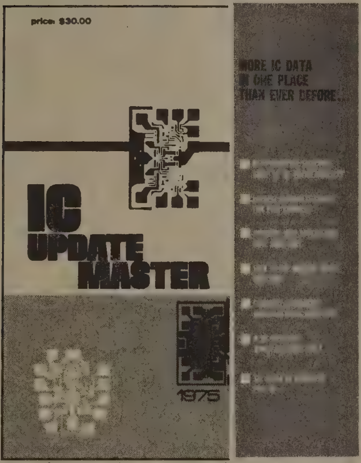

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Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
Sensor Corp., Scottdale, Pa.
DM Signetics Corp., Sunnyvale, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
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Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Converters, Analog-To-Digital

D Beckman Instrs., Fullerton, Cal. ....p. 1•881
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M Analog Devices, Norwood, Mass. .... *
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M General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
A E G Telefunken, Englewood Clfs., N.J.
Burr-Brown, Tucson, Ariz.
M Circuit Technology, Farmingdale, N.Y.
M Collins Radio Group, Newport Beach, Calif.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D Intersil, Cupertino, Cal.
Intronics Inc., Newton, Mass.
Micro Networks, Worcester, Mass.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Ragen Precision Inds., N. Arlington, N.J.
D RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
Solid State Inc., Bloomfield, N.J.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Converters, Binary-To-Binary-Code-Decimal—See IC's, Encoders & Decoders

IC's, Converters, Digital-To-Analog

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M General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
Burr-Brown, Tucson, Ariz.
M Circuit Technology, Farmingdale, N.Y.
M Collins Radio Group, Newport Beach, Calif.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
Intronics Inc., Newton, Mass.
Micro Networks, Worcester, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Converters, Voltage-To-Frequency

M General Instruments Corp., Hicksville, N.Y. ..... *
M Environmental Communications Inc., Costa Mesa, Cal.
Hughes Aircraft Co, Culver City, Cal.
Interdesign Inc., Sunnyvale, Cal.
Intronics Inc., Newton, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor Corp., Santa Clara, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Counters and Adapters

DM Advanced Micro Devices, Sunnyvale, Cal.
DM American Microsystems, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
E & L Instruments, Derby, Conn.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
M LSI Computer Systems, Plainview, N.Y.
Mostek Corp., Carrollton, Tex.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
Sensor Corp., Scottdale, Pa.
DM Signetics Corp., Sunnyvale, Cal.
D Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Current Regulators

D Beckman Instrs., Fullerton, Cal. ....p. 1•880
CELCO, Mahwah, N.J. .... p. 1•630
DM General Instruments Corp., Hicksville, N.Y. ..... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
General Instrument Corp., Hicksville, N.Y.
D Intergrated Microsystems Inc., Mountain View, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D RCA Solid State Div., Somerville, N.J.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Data Bus Drivers

M General Instruments Corp., Hicksville, N.Y. ..... *
Advanced Micro Devices, Sunnyvale, Cal.
Lansdale Transistor & Elctrns., Andover, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
Rockwell Int'l., Anaheim, Cal.
DM Signetics Corp., Sunnyvale, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, D-C Amplifiers

D Beckman Instrs., Fullerton, Cal. ....p. 1•882
M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
Datel Systems Inc., Canton, Mass. ..... p. 1•158
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. ..... *
DM Precision Monolithics Inc., Santa Clara, Cal. .... *
Promemco, Hauppauge, N.Y. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Interdesign Inc., Sunnyvale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Decoders, Decoder/Drivers (All Types)—See IC's, Encoders & Decoders

IC's, Demultiplexers—See IC's, Multiplexers

IC's, Differential Amplifiers—See IC's, Amplifiers, Operational

IC's, Diode Matrices

M Beckman Instrs., Fullerton, Cal. p. 2•1126,1127
Shigoto Inds., Ltd., New York, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D Harris Semiconductor, Melbourne, Fla.
D National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Discriminators, F-M—See IC's, Television, A-M/F-M Sound Circuits

IC's, Display Drivers, 7-Segment, 9-Segment NIXIE, Etc

D Beckman Instrs., Fullerton, Cal. ....p. 1•880
D Beckman Instrs., Scottsdale, Ariz. .... p. 2•1128
CELCO, Mahwah, N.J. .... p. 1•630
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
D Sprague Products Co., No. Adams, Mass. p. 1•1871
M Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
M NEC Microsystems, Ft. Lauderdale, Fla. .... *
D Precision Monolithics Inc., Santa Clara, Cal. .... *
Promemco, Hauppauge, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
DM American Microsystems, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
Mos Technology, Norristown, Pa.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM RCA Solid State Div., Somerville, N.J.
Rockwell Int'l., Anaheim, Cal.
SGS-ATES Semiconductor, Newtonville, Mass.
Signetics Corp., Sunnyvale, Cal.
D Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
D Sprague Elec. Co., No. Adams, Mass.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Encoders & Decoders

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
DM American Microsystems, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
M Collins Radio Group, Newport Beach, Calif.
Electronic Arrays, Mountain View, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D Intel Corp., Santa Clara, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
D Lithic Systems, Saratoga, Cal.
Mos Technology, Norristown, Pa.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.

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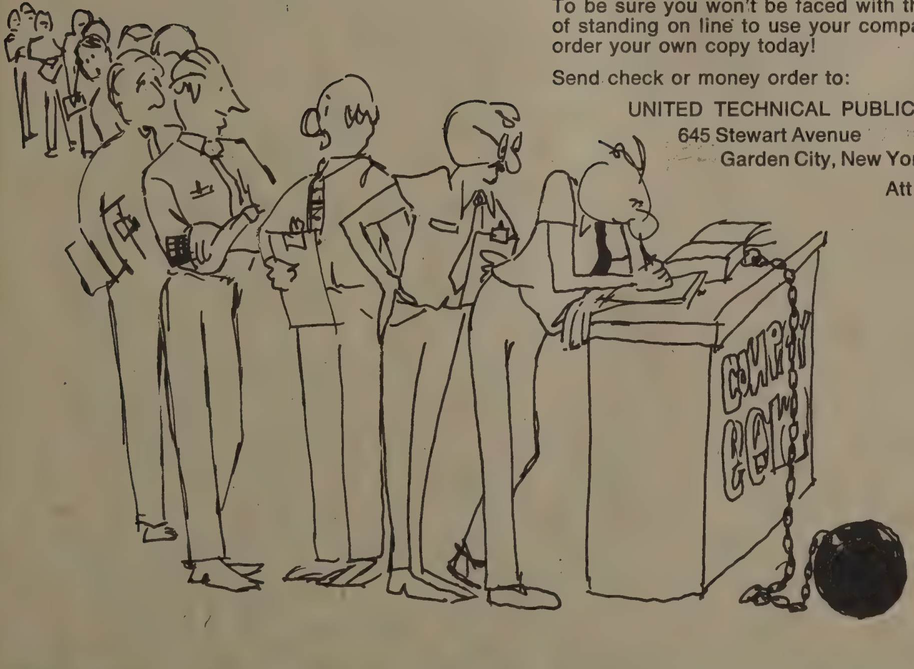

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Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
SGS-ATES Semiconductor, Newtonville, Mass.
D Signetics Corp., Sunnyvale, Cal.
D Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Exclusive OR Gates—See IC's, Logic Circuits

IC's, Expanders—See IC's, Logic Circuits

IC's, Flip-Flops J-K, R-S, R-S-T, Type D, Pulse Triggered, Etc—See IC's, Logic Circuits

IC's, Four-Quadrant Multipliers—See IC's, Multipliers, Analog

IC's, Frequency Dividers—See IC's, Counters

IC's, Frequency-Shift Keyers

Promemco, Hauppauge, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
D Intergrated Microsystems Inc., Mountain View, Cal.
D Lithic Systems, Saratoga, Cal.
D Signetics Corp., Sunnyvale, Cal.

IC's, Frequency Synthesizers

M General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
DM American Microsystems, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
D General Instr. Corp., Hicksville, N.Y.
D Lithic Systems, Saratoga, Cal.
D National Semiconductor Corp., Santa Clara, Cal.
DM Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Function Generators

CELCO, Mahwah, N.J. .... p. 1•630
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D Calvert Elctrns., New York, N.Y.
Energy Elctrn. Products Corp., Los Angeles, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.
Hughes Aircraft Co, Culver City, Cal.
D Intech, Santa Clara, Cal.
Interdesign Inc., Sunnyvale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Signetics Corp., Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Gates—See IC's, Logic Circuits

IC's, Hexidecimal Counters—See IC's, Counters

IC's, High-Voltage (200 V & Over)

M General Instruments Corp., Hicksville, N.Y. ..... *
D Precision Monolithics Inc., Santa Clara, Cal. .... *
Promemco, Hauppauge, N.Y. .... *
M Circuit Technology, Farmingdale, N.Y.
National Semiconductor Corp., Santa Clara, Cal.

IC's, Intermediate-Frequency Amplifiers—See IC's, Amplifiers, Radio-Frequency

IC's, Inverters—See IC's, Logic Circuits

IC's, Keyboard Encoders—See IC's, Encoders & Decoders

IC's, Lamp Drivers—See IC's, Logic Circuits; IC's, Display Drivers

IC's, Latch—See IC's, Logic Circuits

IC's, Level Shifters, Translators—See IC's, Logic Circuits

IC's Line Drivers/Receivers & Line Drivers/Transmitters

ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
Energy Elctrn. Products Corp., Los Angeles, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
D Intergrated Microsystems Inc., Mountain View, Cal.
D Intel Corp., Santa Clara, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Linear Multipliers—See IC's, Multipliers, Analog

IC's, Logic Circuits

D Beckman Instrs., Scottsdale, Ariz. .... p. 2•1128
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
D Sprague Products Co., No. Adams, Mass. p. 1•1872
TRW/Cinch Connectors, Elk Grove Village, Ill. p. 2•896,897
DM General Instruments Corp., Hicksville, N.Y. ..... *
NEC Microsystems, Ft. Lauderdale, Fla. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
DM American Microsystems, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
M Collins Radio Group, Newport Beach, Calif.
E & L Instruments, Derby, Conn.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
Interdesign Inc., Sunnyvale, Cal.
D Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
Ragen Precision Inds., N. Arlington, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
DM Signetics Corp., Sunnyvale, Cal.
D Solid State Scientific, Montgomeryville, Pa.
Sprague Elec. Co., No. Adams, Mass.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Memories

Promemco, Hauppauge, N.Y. .... p. 1•1847
Advanced Memory Sys., Sunnyvale, Cal.
DM Advanced Micro Devices, Sunnyvale, Cal.
DM American Microsystems, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
M Collins Radio Group, Newport Beach, Calif.
Electronic Arrays, Mountain View, Cal.
Electronic Memories & Magnetics Corp., Hawthorne, Cal.
Exetron Corp., Santa Clara, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D Intel Corp., Santa Clara, Cal.
DM Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
Mos Technology, Norristown, Pa.
Mostek Corp., Carrollton, Tex.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Ragen Precision Inds., N. Arlington, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
D RCA Solid State Div., Somerville, N.J.
Rockwell Int'l., Anaheim, Cal.
DM Signetics Corp., Sunnyvale, Cal.
D Solid State Scientific, Montgomeryville, Pa.
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.
D Western Digital Corp., Newport Beach, Cal.

IC's, Microprocessors

Promemco, Hauppauge, N.Y. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
Applied Systems Corp., St. Clair Shores, Mich.
Energy Elctrn. Products Corp., Los Angeles, Cal.
Fairchild Semiconductor, Mountain View, Cal.
Hughes Aircraft Co, Culver City, Cal.
MilerTronics, Greenville, S.C.
Mostek Corp., Carrollton, Tex.
RCA Solid State Div., Somerville, N.J.
Rockwell Int'l., Anaheim, Cal.
Scientific Micro Sys., Mountain View, Cal.
D Western Digital Corp., Newport Beach, Cal.

IC's, Mixers—See IC's, Communications, Circuits

IC's, Modulator/Demodulators, Balanced

M Analog Devices, Norwood, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
Hughes Aircraft Co, Culver City, Cal.
D Intergrated Microsystems Inc., Mountain View, Cal.
Interdesign Inc., Sunnyvale, Cal.
Intronics Inc., Newton, Mass.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
DM Signetics Corp., Sunnyvale, Cal.
Singer - Tele-Signal, Woodbury, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multiplexers, Analog

Datel Systems Inc., Canton, Mass. ..... p. 1•159
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Analog Devices, Norwood, Mass. .... *
Analogic Corp., Wakefield, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Burr-Brown, Tucson, Ariz.
Calvert Elctrns., New York, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Ragen Precision Inds., N. Arlington, N.J.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multiplexers, Digital

Analogic Corp., Wakefield, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D Calvert Elctrns., New York, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.

DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Ragen Precision Inds., N. Arlington, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
DM Signetics Corp., Sunnyvale, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Multipliers, Analog

ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Precision Monolithics Inc., Santa Clara, Cal. .... *
Promemco, Hauppauge, N.Y. .... *
Burr-Brown, Tucson, Ariz.
D Calvert Elctrns., New York, N.Y.
General Instrument Corp., Hicksville, N.Y.
Hughes Aircraft Co, Culver City, Cal.
D Intersil, Cupertino, Cal.
Intronics Inc., Newton, Mass.
Leeds & Northrup Co., North Wales, Pa.
D Lithic Systems, Saratoga, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
D RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multivibrators

M General Instruments Corp., Hicksville, N.Y. ..... *
Sprague Products Co., No. Adams, Mass. .... *
DM Advanced Micro Devices, Sunnyvale, Cal.
D Calvert Elctrns., New York, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
Interdesign Inc., Sunnyvale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
D Lithic Systems, Saratoga, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
DM Signetics Corp., Sunnyvale, Cal.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, NAND, NOR & OR/NOR gates—See IC's, Logic Circuits

IC's, Oscillators

Connor-Winfield Corp., W. Chicago, Ill. p. 1•296-299
M Monitor Prods., Oceanside, Cal. .... **p. 1•388**
Motorola Inc., Franklin Park, Ill. .... **p. 1•398**
M Vectron Labs., Norwalk, Conn. .... **p. 1•420**
M General Instruments Corp., Hicksville, N.Y. ..... *
D Sprague Products Co., No. Adams, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
Exar, Sunnyvale, Cal.
D Intech, Santa Clara, Cal.
Interdesign Inc., Sunnyvale, Cal.
D Intersil, Cupertino, Cal.
D Lithic Systems, Saratoga, Cal.
Mostek Corp., Carrollton, Tex.
D Motorola Semiconductor Prods., Phoenix, Ariz.
M National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
M Spectrum Technology Inc., Goleta, Cal.
Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Parity Generator/Checkers

Calvert Elctrns., New York, N.Y.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Phase Lock Loop Circuits

M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
M General Instruments Corp., Hicksville, N.Y. ..... *
Promemco, Hauppauge, N.Y. .... *
Sprague Products Co., No. Adams, Mass. .... *
D Calvert Elctrns., New York, N.Y.
M Environmental Communications Inc., Costa Mesa, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
Interdesign Inc., Sunnyvale, Cal.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Power Amplifiers (1 W Minimum)

D Beckman Instrs., Fullerton, Cal. .... **p. 1•882**
M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
D Sprague Products Co., No. Adams, Mass. p. 1•1871
DM General Instruments Corp., Hicksville, N.Y. ..... *
D A E G Telefunken, Englewood Clfs., N.J.
Avantek, Santa Clara, Cal.
Burr-Brown, Tucson, Ariz.
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
Energy Elctrn. Products Corp., Los Angeles, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D Lithic Systems, Saratoga, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
D RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Signetics Corp., Sunnyvale, Cal.
Solid State Inc., Bloomfield, N.J.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Power Gates—See IC's, Logic Circuits

IC's, Pulse Shapers—See IC's, Multivibrators

IC's, Receiver/Transmitter, Asynchronous

DM American Microsystems, Santa Clara, Cal.
D General Instr. Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM Signetics Corp., Sunnyvale, Cal.
Sperry Microwave Components, Gainesville, Fla.
D Western Digital Corp., Newport Beach, Cal.

IC's, Receivers, A-M, F-M

M RHG Elctrns. Lab., Deer Park, N.Y. ....**p. 2•1389**
D Sprague Products Co., No. Adams, Mass. p. 1•1872
D A E G Telefunken, Englewood Clfs., N.J.
Fairchild Semiconductor, Mountain View, Cal.
HRB-Singer, State College, Pa.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Siemens Corp., Iselin, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Receivers, Teletype

M General Instruments Corp., Hicksville, N.Y. ..... *
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.

IC's, Relay Drivers—See IC's, Logic Circuits

IC's, Sample-And-Hold Circuits

Datel Systems Inc., Canton, Mass. ..... **p. 1•158**
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
D Amperex Electronic Corp., Slatersville, R.I.
Burr-Brown, Tucson, Ariz.
M Circuit Technology, Farmingdale, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
D Intersil, Cupertino, Cal.
DM National Semiconductor Corp., Santa Clara, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Teledyne-Crystalonics, Cambridge, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Schmitt Triggers—See IC's Logic Circuits

IC's, Shift Registers, Static or Dynamic

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
Litronix, Cupertino, Cal. .... **p. 2•1178**
DM Advanced Micro Devices, Sunnyvale, Cal.
DM American Microsystems, Santa Clara, Cal.
M Collins Radio Group, Newport Beach, Calif.
Electronic Arrays, Mountain View, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D General Instr. Corp., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
D Intel Corp., Santa Clara, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Lansdale Transistor & Elctrns., Andover, Mass.
Mos Technology, Norristown, Pa.
Mostek Corp., Carrollton, Tex.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.

IC's, Subtractors—See IC's, Logic Circuits

IC's, Switches, Analog

M Hughes Aircraft Co., Newport Beach, Cal. p. 1•889
ILC Data Device Corp., Bohemia, N.Y. p. 1•171
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. ..... *
D Sprague Products Co., No. Adams, Mass. .... *
D Waldom Electronics, Chicago, Ill. .... *
D Calvert Elctrns., New York, N.Y.
M Circuit Technology, Farmingdale, N.Y.
M Collins Radio Group, Newport Beach, Calif.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Harris Semiconductor, Melbourne, Fla.
D Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
DM Teledyne-Crystalonics, Cambridge, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Television, A-M/F-M Sound Circuits

D Sprague Products Co., No. Adams, Mass. p. 1•1872
M General Instruments Corp., Hicksville, N.Y. ..... *
Fairchild Semiconductor, Mountain View, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.

*Company has information in white pages but not on this product

Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Siemens Corp., Iselin, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Three-State Logic (TSL)

Fairchild Semiconductor, Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co, Culver City, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Signetics Corp., Sunnyvale, Cal.

IC's, Timers

Connor-Winfield Corp., W. Chicago, Ill. p. 1•299
D Litronix, Cupertino, Cal. .... p. 2•1178
DM General Instruments Corp., Hicksville, N.Y. .....*
D Precision Timer Co., Westbrook, Conn. ....*
Promemco, Hauppauge, N.Y. .... *
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
D Intech, Santa Clara, Cal.
Interdesign Inc., Sunnyvale, Cal.
D Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
LSI Computer Systems, Plainview, N.Y.
Mostek Corp., Carrollton, Tex.
DM National Semiconductor Corp., Santa Clara, Cal.
Optical Electronics, Tucson, Ariz.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
Sensor Corp., Scottdale, Pa.
DM Signetics Corp., Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.

IC's, Transducer, Pressure

Fairchild Semiconductor, Mountain View, Cal.
D National Semiconductor Corp., Santa Clara, Cal.

IC's, Transistor Arrays

Litronix, Cupertino, Cal. .... p. 2•1178
D Sprague Products Co., No. Adams, Mass. p. 1•1870
M Analog Devices, Norwood, Mass. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
DM American Microsystems, Santa Clara, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
DM National Semiconductor Corp., Santa Clara, Cal.
DM Plessey Semiconductors, Santa Ana, Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Siliconix, Santa Clara, Cal
D Sprague Elec. Co., No. Adams, Mass.
D Stewart-Warner Microcircuits, Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.

IC's, Translators, ECL to TTL, ECL to MOS, etc.

DM General Instruments Corp., Hicksville, N.Y. .....*
D A E G Telefunken, Englewood Clfs., N.J.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Intech, Santa Clara, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Signetics Corp., Sunnyvale, Cal.
D Teledyne Semiconductor, Mountain View, Cal.

IC's, Transmitters, Teletype

D A E G Telefunken, Englewood Clfs., N.J.
Fairchild Semiconductor, Mountain View, Cal.
D General Instr. Corp., Hicksville, N.Y.

IC's, Video Amplifiers—See IC's, Amplifiers, Radio-Frequency

IC's, Voltage Regulators

D Beckman Instrs., Fullerton, Cal. ....p. 1•883
Power Monolithics Inc., Corpus Christi, Tex. p. 1•1845
M Analog Devices, Norwood, Mass. .... *
DM General Instruments Corp., Hicksville, N.Y. .....*
Promemco, Hauppauge, N.Y. .... *

M Circuit Technology, Farmingdale, N.Y.
Energy Elctrn. Products Corp., Los Angeles, Cal.
M Environmental Communications Inc., Costa Mesa, Cal.
Exar, Sunnyvale, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Instrument Corp., Hicksville, N.Y.
D Intech, Santa Clara, Cal.
D Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
D Lithic Systems, Saratoga, Cal.
Micro Networks, Worcester, Mass.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Signetics Corp., Sunnyvale, Cal.
D Solitron Devices, San Diego, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Wareform Generators—See IC's, Function Generators

IC's, Wideband Amplifiers—See IC's, Amplifiers, Radio Frequency

IC's, Zero-Voltage Switches

D A E G Telefunken, Englewood Clfs., N.J.
General Instrument Corp., Hicksville, N.Y.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM RCA Solid State Div., Somerville, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.

Integrators, Electronic

M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
Curtis Instrs., Mt. Kisco, N.Y. .... p. 1•643
North Hills Elctrns., Glen Cove, N.Y. ... p. 1•265
M Ohio Semitronics, Columbus, Ohio p. 1•782,783
Plessay Electro-Products, Los Angeles, Cal. p. 1•267
M Analog Devices, Norwood, Mass. .... *
D Esterline Angus, Indianapolis, Ind. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
Gould, Cleveland, Ohio .... *
NES, Streamwood, Ill. ....*
Sprague Products Co., No. Adams, Mass. .... *
DM Systron Donner, Concord, Cal. .... *
Advanced Kinetics, Costa Mesa, Calif.
Brookhaven Instrs. Corp., Austin, Tex.
D Centralab, Milwaukee, Wisc.
M Circuit Technology, Farmingdale, N.Y.
Collins Radio, Dallas, Tex.
D Control Equip. Corp., Lowell, Mass.
Datascan Div., Van Nuys, Ca.
Datron Systems, Chatsworth, Cal.
E-H Resch. Labs., Oakland, Cal.
Elcor Prods. Neotec Elctrns. Inc., Silver Spring, Md.
Electro-Optical Inds., Santa Barbara, Cal.
Environmental Communications Inc., Costa Mesa, Cal.
Fogg System Co., Denver, Col.
Foxboro Co., Foxboro, Mass.
General Instrument Corp., Hicksville, N.Y.
Halmar Electronics, Columbus, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Fullerton, Cal.
Incor Instrumentation, West Babylon, N.Y.
Laboratory Data Control, Riviera Beach, Fla.
LDJ Electronics, Troy, Mich.
National Electronics, Geneva, Ill.
Optical Electronics, Tucson, Ariz.
Princeton Applied Resch. Corp., Princeton, N.J.
Princeton Elctrn. Prods., New Brunswick, N.J.
Richard-Lee Co., New Providence, N.J.
Robertshaw Controls Co., Richmond, Va.
D Taylor Instr. Process Control Div., Rochester, N.Y.
D Vibra-Metrics, E. Haven, Conn.
Walker Scientific, Worcester, Mass.

Integrators, Mechanical & Electro-Mechanical

M Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917
M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
Disc Instruments, Costa Mesa, Ca.
M Transicoil, Worcester, Pa.

Intensifiers, Image

CELCO, Mahwah, N.J. .... p. 1•630
M Varo Electron Devices, Garland, Tex. p. 1•2360
Amperex Elctronic Corp., Slatersville, R.I. ....*

General Elec. Co., Schenectady, N.Y. .... *
Interelectronics Corp., Congers, N.Y. .... *
Galileo Electro-Optics Corp., Sturbridge, Mass.
Hughes Aircraft Co, Culver City, Cal.
DM Hughes Aircraft Co., Carlsbad, Cal.
Litton Inds., San Carlos, Calif.
D Quantrad Corporation, El Segundo, Cal.
D Siemens Corp., Iselin, N.J.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Intercom Systems - Also see Comm. Systems, Selective Paging

Heath Co., Benton Harbor, Mich. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
AEL, Colmar, Pa.
Aiphone USA, Seattle, Wash.
Alaun Engrg., Alhambra, Cal
Alpha Components Corp., El Segundo, Cal.
D Bogen Div., Paramus, N.J.
Communications Equipment Co., Indianapolis, Ind.
D Components Specialties, Hempstead, N.Y.
Dukane Corp., St. Charles, Ill.
D Encom Prods. Co., Oxford, Pa.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
Telephonics, Div, Huntington, N.Y.
D Lear Siegler, Santa Monica, Calif.
D Midland International Corp., No. Kansas City, Mo.
D PASO Sound Products Inc., New York, N.Y.
D R-Columbia Products, Highland Park, Ill.
Ratelco, Seattle, Wash.
D Talk-A-Phone Co., Chicago, Ill.
Tasker Systems, Chatsworth, Cal.
M Telectro Sys. Corp., Corona, N.Y.
D Telex Communications, Minneapolis, Minn.
D Vidaire Electronics Mfg., Freeport, N.Y.
D Wallace S. K. Assocs., Tampa, Fla.

Interferometer Systems

Advanced Kinetics, Costa Mesa, Calif.
Beckman Instrs., (AISSD), Fullerton, Cal.
British Aircraft Corp. (USA Inc.), Arlington, Va.
Bromberg Engineering, Wayland, Mass.
M Cubic Corp., San Diego, Cal.
Dest Data Corp., Sunnyvale, Cal.
Emerson & Cuming, Canton, Mass.
Gaertner Scientific Corp., Chicago, Ill.
Hewlett-Packard Co., Palo Alto, Cal.
Microwave Assocs., Burlington, Mass.
Opto-Metric Tools, Rockleigh, N.J.
Sloan Technology Corp., Santa Barbara, Cal.
Varian Assocs., Palo Alto, Cal.

Intervalometers—See Timers

Inverters, A-C to D-C—See Power Supplies, A-C to D-C

Inverters, D-C to A-C Also see Power Supplies, A-C Output

Abacus Controls Inc., Somerville, N.J. p. 1•1026
M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1046
M Advance Conversion Devices Co., Passaic, N. J. p. 1•1084
M A L S Electronics Corp., Covina, Cal. p. 1•1087
American Time Products, Bulova Watch, Woodside, N.Y. ....p. 1•1124
M Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1102
D ATR Electronics, St. Paul, Minn. p. 1•1110,1111
M Autronics Corp., Pasadena, Cal ....p. 1•1113
Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ....p. 1•1124
CEA, San Luis Obispo, Cal. .... p. 1•1125
M CML-Macarr, Edison, N.J. .... p. 1•1160
Deltec Corp., San Diego, Cal. .... p. 1•1183
Dynamic Instr. Corp., Hauppauge, N.Y. p. 1•1177; p. 2•1735
Elgar Corporation, San Diego, Cal. .....p. 1•1199
Endicott Coil Co., Binghamton, N.Y. p. 1•1206
D Epsco, Addison, Ill. ....p. 1•1200,1201
Era Transpac Corp., Moonachie, N.J. p. 1•1202,1203
Flite-Tronics Co., Burbank, Cal. p. 1•1214,1215
Freed Transformer Co., Brooklyn, N.Y. p. 1•716,717; p. 2•1738-1747
Hisonic, Olathe, Kan. .... p. 1•1233
Industrial Test Equip., Port Washington, N.Y. p. 1•1235
Interelectronics Corp., Congers, N.Y. p. 1•1237

K.G.S. Elctrns., Pasadena, Cal. ....p. 1•1238
La Marche Mfg. Co., Des Plaines, Ill. p. 1•1308,1309
Magnetico, Holtsville, N.Y. .... p. 2•1770
Microtran Co., Valley Stream, N.Y. ... p. 2•1764
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315,1318
Nova Electric Mfg. Co., Nutley, N.J. p. 1•1335,1336
D Powertec, Chatsworth, Cal. .....p. 1•1426,1427
Rental Electronics, Lexington, Mass. p. 1•792-795
M Technipower, Ridgefield, Conn. p. 1•1478,1479
Teledyne Philbrick, Dedham, Mass. p. 1•208-217
Todd Products Corp., Farmingdale, N.Y. p. 1•1502
M Topaz Electronics, San Diego, Cal. .... p. 1•1504
D Triad-Utrad, Huntington, Ind. ...p. 2•1822-1829
M Unitron Inc., Garland, Tex. ....p. 1•1516-1523
Wilmore Elctrns. Co., Durham, N.C. p. 1•538,539
American Vector/TDC, Dayton, N.J. .... *
Del Electronics Corp., Mt. Vernon, N.Y. .... *
Delco Electronics Div., Kokomo, Ind. .... *
D GC Electronics, Rockford, Ill. .... *
M General Instruments Corp., Hicksville, N.Y. ..... *
Heath Co., Benton Harbor, Mich. .... *
International Rectifier Corp., El Segundo, Cal. *
M Rotron, Woodstock, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
M Torotel Inc., Grandview, Mo. .... *
Aaron-Davis Co., Santa Monica, Cal.
Acme Electric, Cuba, N.Y.
Aerospace Avionics, Bohemia, N.Y.
American Monarch Corp., Minneapolis, Minn.
Astro-Geo-Marine Inc., Oxnard, Cal.
M Avionic Instrs. Inc., Rahway, N.J.
M Bendix, Eatontown, N.J.
D B. H. Industries, Los Angeles, Cal
Bicron Elctrns. Co., Canaan, Conn.
Cal-Power Corp., El Segundo, Calif.
D Carter Motor Co., Chicago, Ill.
Mr. Roger Love, Madison, NJ
Controltek Inc., Portland, Ore.
Cyberex, Mentor, Ohio
De Coursey Engrg. Lab., Culver City, Cal.
M Delta Elctrn. Control, Costa Mesa, Cal.
Design Automation, Lexington, Mass.
Dynalab Corp., Van Nuys, Cal.
E-Tronics, Sepulveda, Cal.
M Electro-Module, Pomona, Cal.
Electro-Pacific, Goleta, Calif.
Fuji Electrochemical Co., Tokyo, Japan
Gould Inc., Trenton, N.J.
Hughes Aircraft Co, Culver City, Cal.
Incor Instrumentation, West Babylon, N.Y.
Instr. & Control Sys., Addison, Ill.
M International Power Machines Corp., Mesquite, Tex.
ITT Mackay Marine, Raleigh, N.C.
D JPI, Santa Monica, Cal.
Kelk, George Ltd., Don Mills, Ont., Canada
D Gulton Industries, Plano, Tex
Mag-Con, New Brighton, Minn.
M Magnetic Circuit Elements, Monterey, Cal.
M Modular Devices, Bohemia, N. Y.
Motorola Comms. Div., Schaumburg, Ill.
D New Era Prods., Cleveland, Ohio
North Electric Co., Galion, Ohio
D Nucleonic Prods., Canoga Pk., Cal.
Payne Engrg. Co., Scott Depot, W. Va.
D Power Control Corp., Pittsburgh, Pa.
M Powercube Corp., Waltham, Mass.
Programmed Power, Menlo Park, Cal.
Ratelco, Seattle, Wash.
Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Solidstate Controls, Columbus, Ohio
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Teledyne Inet, Gardena, Cal.
D Terado Corp., St. Paul, Minn.
M Transistor Devices, Cedar Knolls, N.J.
Triac Electronics, New York, N.Y.
M Trio Labs, Plainview, N.Y.
D Tripp-Lite, Chicago, Ill.
Tucker Electronics Co., Garland, Tex.
Warren G-V Communications, Livingston, N.J.
DM Welco Inds. Inc., Cincinnati, Ohio
Westinghouse Elec., Sykesville, Md.

Inverters, D-C to D-C—See Converters, D-C to D-C

Isolators, D-C/D-C Signal

Active Control Instrumentation, E. Northport, N.Y. .... p. 1•228
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
Analog Devices, Norwood, Mass. .... *
Develco, Mountain View, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Hughes Aircraft Co, Culver City, Cal.
Incor Instrumentation, West Babylon, N.Y.

Isolators, Line

D California Instrs. Co., San Diego, Cal. p. 1•1165
CEA, San Luis Obispo, Cal. .... p. 1•1125
Deltec Corp., San Diego, Cal. .... p. 1•1181
Elgar Corporation, San Diego, Cal. .....p. 1•1197
M Georator Corporation, Manassas, Va. p. 1•1222,1228,1229
M Rowe Industries, Toledo, Ohio ..... p. 2•796,797
Topaz Electronics, San Diego, Cal. p. 1•593,1506; p. 2•1817
Allen-Bradley Co., Milwaukee, Wisc. ....*
Dynamic Instr. Corp., Hauppauge, N.Y. .... *
M Acromag, Wixom, Mich.
Cross Electronics Inc., Warrendale, Pa.
Elin Div., San Diego, Cal.
D NH Research, Santa Ana, Calif.
RCA Electronic Comps., Harrison, N.J.
D Stancor/Essex International, Chicago, Ill.

Isolators, Microwave (All Types)—See Volume 2

Isolators, Opto

D Clairex Elctrns. Inc., Mt. Vernon, N.Y. p. 1•1009
DM Hewlett-Packard, Palo Alto, Cal. p. 1•1014,1015; p. 2•1150-1153
Litronix, Cupertino, Cal. p. 2•1174,1177,1179
National Semiconductors, Plattsburgh, N.Y. p. 1•1018,1019
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D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
D National Semiconductor Corp., Santa Clara, Cal.
Optron, Carrollton, Tex.
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D Raytheon Co., Quincy, Mass.
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Carbone Lorraine Industries Corp., Boonton, N.J.
Electronic Systems & Programming Inc., Hawthorne, Cal.
M Jettron Prods., Hanover, N.J.
M Kawecki Beryico Inds., New York, NY
M MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Huntingdon Valley, Pa.
D Matrix Engineering Corp., Gardena, Cal.
Mid-West Metal Prods., Kansas City, Kans.
PIC Design Division, Ridgefield, Conn.
D Program Data Co., Carson, Cal.
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D Techni-Tool, Plymouth Meeting, Pa.
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DM Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
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Texas Instruments, Attleboro, Mass.
TTS, Santa Monica, Cal.
DM Vector General, Woodland Hills, Cal.

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B & K Instruments, Cleveland, Ohio
Christiansen Radio Inc., Laguna Beach, Cal.
Digitech Data Inds., Ridgefield, Conn.
E & L Instruments, Derby, Conn.
M Microlab/FXR, Livingston, N.J.
D Modpak, Waltham, Mass.
DM Multicore Solders, Westbury, N.Y.
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Hewlett-Packard Co., Palo Alto, Cal.
M Microlab/FXR, Livingston, N.J.
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D Bausch & Lomb, Rochester, N.Y.
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GTE Sylvania Inc., Washington, D.C.
Honeywell, Minneapolis, Minn.
Hughes Aircraft Co, Culver City, Cal.
M Hughes Aircraft Co., Torrance, Cal.
Industrial Products Div., Orlando, Fla.
D Javelin Div., Los Angeles, Cal.
Laser Inc., Sturbridge, Mass.
D Macrodyne Inc., Schenectady, N.Y.
Maxwell Labs., San Diego, Calif.
Meret Inc., Santa Monica, Cal.
D Metrologic Instruments, Bellmawr, N.J.
Oriel Corp. of America, Stamford, Conn.
D Quantrad Corporation, El Segundo, Cal.
Quantronix Corp., Smithtown, N.Y.
Raytheon Co., Waltham, Mass.
RCA Electronic Comps., Harrison, N.J.
RCA, Ind'l. Tube Div., Lancaster, Pa.
Reich Associates Inc., Plano, Tex
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D Siemens Corp., Iselin, N.J.
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M Anchor Specialty Mfg. Inc., Teterboro, N.J.
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M International Identifications, Timonium, Md.
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D Bausch & Lomb, Rochester, N.Y.
D Bishop Graphics, Chatsworth, Cal.
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Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Cal.
Corning Glass Works, Corning, N.Y.
M Edmund Scientific Co., Barrington, N.J.
Esco Products, Oak Ridge, NJ
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M Lenox Instr. Co., Philadelphia, Pa.
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Oriel Corp. of America, Stamford, Conn.
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D Photo Research Corp., Burbank, Cal.
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DM General Semiconductor Industries, Tempe, Ariz.
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Hewlett-Packard Co., Palo Alto, Cal.
D Railway Comm., Raytown, Mo.
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Branson Cleaning Equip. Co., Shelton, Conn.
D Chemcut Corp., State College, Pa.
Chemical Etching Equip. & Supply, Alexandria, Va.
Clean Room Prods., Bay Shore, N.Y.
D Cobehn, Fairfield, N.J.
M Cyclo-Tronics, Chicago, Ill.
Electrovert, Mt. Vernon, N.Y.
D Gagne Assocs., Binghamton, N.Y.
Headway Research, Garland, Tex.
Inland Mfg. Co., Omaha, Neb.
D London Chemical Co., Bensenville, Ill.
Mann, Henry Inc., Huntingdon Valley, Pa.
M. P. Odell Co., Cleveland, Ohio
Phillips Mfg. Co., Chicago, Ill.
Research Instrument Co., Garden City, N. Y.
Sara Scientific Co., San Francisco, Calif.
Snap-On-Tools, Kenosha, Wisc.
D Tronic Corp., Belmont, Cal.
D Zenrad Controls Co., Santa Barbara, Ca..

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Elden Mfg. Co., Chicago, Ill.
Eubanks Engrg., Monrovia, Calif.
Kahle Engrg. Co., Union City, N.J.
Solatron Enterprises, Inglewood, Calif.
Stevens, Geo. Mfg. Co., Lincolnwood, Ill.
Techni-Tool, Plymouth Meeting, Pa.

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A. M. W. Corp., Arlington, Mass.
Automation Devices, Fairview, Pa.
DM Black & Webster, Waltham, Mass.
Conrac Corp., Cedar Rapids, Iowa
D Delta Design, San Diego, Cal
Diacon, San Diego, Cal.
Dixon Automation, Torrance, Cal.
Electrovert, Mt. Vernon, N.Y.
Freudenberg, B., New York, N.Y.
Gagne Assocs., Binghamton, N.Y.
Gluco, Monroeville, Pa.
Goodrich Div., Hudsonville, Mich.
M GTI Corporation, Pittsburgh, Pa.
IPT Corp., Sunnyvale, Cal.
Mann, Henry Inc., Huntingdon Valley, Pa.
Penn Engrg. & Mfg. Corp., Doylestown, Pa.
Ragen Precision Inds., N. Arlington, N.J.
D Ramsey Engineering, St. Paul, Minn.
Sensor Corp., Scottdale, Pa.
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Kahle Engrg. Co., Union City, N.J.
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Cycle-Dyne, Jamaica, N.Y.
Reeve Electronics, Chicago, Ill.
Westinghouse Elec., Sykesville, Md.

Machines, Lead Cutting & Forming
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Adtool Corp., Montreal W P Q, Can.
Burndy Corporation, Norwalk, , Conn.
D Eraser Co., Syracuse, N.Y.
Harwil Co., Santa Monica, Calif.
Hollis Engrg., Nashua, N.H.
Mann, Henry Inc., Huntingdon Valley, Pa.
D Marshall Industries, El Monte, Cal.
Pentronix, Lincoln Park, Mich.
Production Devices, San Diego, Cal
RG Enterprises Inc., Scottsdale, Ariz.
Tech. Devices Co., Culver City, Calif.
Universal Instruments Corp., Binghamton, N.Y.

Machines, Marking & Numbering
Acromark Co., Berkeley Hts., N.J.
Adcotech Corp., Sunnyvale, Cal.
Autosplice/Dv Gen Staple, New York City, N.Y.
DM Black & Webster, Waltham, Mass.
D Bostitch, E. Greenwich, R.I.
Brady Co., W. H., Milwaukee, Wis.
Burndy Corporation, Norwalk, , Conn.
Conrac Corp., Westminister, Cal.
Dennison Mfg. Co., Framingham, Mass.
M GTI Corporation, Pittsburgh, Pa.
M International Identifications, Timonium, Md.
IPT Corp., Sunnyvale, Cal.
M Kingsley Mach. Co., Hollywood, Calif.
Laser Inc., Sturbridge, Mass.
Lectroetch, E. Cleveland, Ohio
M Markem Corp., Keene, NH
Matthews & Co., Jas. H., Pittsburgh, Pa.
DM Metalphoto Corp., Cleveland, Ohio
Solatron Enterprises, Inglewood, Calif.
Universal Instruments Corp., Binghamton, N.Y.

Machines, Mask Alignment & Exposure
Sprague Products Co., No. Adams, Mass. ....*
Chemical Etching Equip. & Supply, Alexandria, Va.
GCA/David W. Mann, Burlington, Mass.
Oriel Corp. of America, Stamford, Conn.
Research Devices, Berkeley Heights, N.J.
Sprague Elec. Co., No. Adams, Mass.

Machines, Metallizing, Vacuum—See Deposition Equipment, Vacuum

Machines, Plastic Molding
Adcotech Corp., Sunnyvale, Cal.
Chemical Etching Equip. & Supply, Alexandria, Va.
Di-Acro, Lake City, Minn.
Gluco, Monroeville, Pa.
H.P.M. Div., Mt. Gilead, Ohio
D Hull Corp., Hatboro, Pa.
Mann, Henry Inc., Huntingdon Valley, Pa.

Machines, Plating
Auric Corp., Newark, N.J.
Chemical Etching Equip. & Supply, Alexandria, Va.
Electrovert, Mt. Vernon, N.Y.
Opad Elec. Co., New York, N.Y.
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M Cyclo-Tronics, Chicago, Ill.
Di-Acro, Lake City, Minn.
D Malco, A Microdot Co., Chicago, Ill.
Mann, Henry Inc., Huntingdon Valley, Pa.
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Allied Chemical Corp., Morristown, N.J.
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P. R. Hoffman Co., Carlisle, Pa.
DM Hughes Aircraft Co., Oceanside, Cal.
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IPT Corp., Sunnyvale, Cal.
Kahle Engrg. Co., Union City, N.J.
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Mann, Henry Inc., Huntingdon Valley, Pa.
PSC Technology Inc., Glendale, Cal.
Quantronix Corp., Smithtown, N.Y.
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Research Devices, Berkeley Heights, N.J.
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Systonics, Winchester, Mass.
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Burndy Corporation, Norwalk, , Conn.
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Artos Engrg. Co., New Berlin, Wisc.
Autosplice/Dv Gen Staple, New York City, N.Y.
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Eubanks Engrg., Monrovia, Calif.
D Hykon Mfg. Co., Alliance, Ohio
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Mann, Henry Inc., Huntingdon Valley, Pa.
Nucleus Corp., Madison Hgts., Mich.
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Mag-Con, New Brighton, Minn.
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Honeywell, Minneapolis, Minn.
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Rolm Corp., Cupertino, Cal.
M Spacetac, Bedford, Mass.
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California Computer Prods., Anaheim, Cal
Computer Talk Inc., Idledale, Colo.
Data Disc Inc., Sunnyvale, Cal.
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Datum, Anaheim, Calif.
Digital Dev. Corp., San Diego, Calif.
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D Diva, Eatontown, N.J.
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Datum, Anaheim, Calif.
Digital Equipment Corp., Maynard, Mass.
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Ampex Corp., Redwood City, Cal.
Burroughs Corp., Pasadena, Cal.
California Computer Prods., Anaheim, Cal
Collins Radio, Dallas, Tex.
Computer Operations, Beltsville, Md.
Data Disc Inc., Sunnyvale, Cal.

Data General Corp., Southboro, Mass.
Datacom, Ft. Walton Beach, Fla.
Datum, Anaheim, Calif.
Digital Equipment Corp., Maynerd, Mass.
D Diva, Eatontown, N.J.
Echo Science Corp., Mountain View, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
D Macrodyne Inc., Schenectady, N.Y.
Microdata Corp., Irvine, Cal.
DM Pertec,, Chatsworth, Cal.
DM Raymond Engrg. Inc., Middletown, Conn.
Tohoku Metal Inds., Ltd., Tokyo, Japan
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Hughes Aircraft Co, Culver City, Cal.

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General Instrument Corp., Hicksville, N.Y.
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Hughes Aircraft Co, Culver City, Cal.
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DM National Semiconductor Corp., Santa Clara, Cal.
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M Ideal Precision Meter Co., Brooklyn, N. Y.
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Clarke-Hess Comm., New York, N.Y. p. 1•636,637
D **Data Technology, Santa Ana, Cal.** p. 1•649,650
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
London Co., Westlake, Ohio p. 1•764,765
Marconi Instrs., Northvale, N.J. p. 1•766-771
Sprague Products Co., No. Adams, Mass. p. 1•810
Freed Transformer Co., Brooklyn, N.Y. *
General Radio Co., Concord, Mass. *
Hickok Electrical Instr., Cleveland, Ohio *
NES, Streamwood, Ill. *
D **Simpson Electric Co., Elgin, Ill.** *
DM **Systron-Donner Instr. Div., Concord, Cal.** *
Weston Instrs., Newark, N.J. *
Electro Sci. Inds., Portland, Ore.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
ITT Holub Industries, Sycamore, Ill.
Penn Airborne Prods., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sprague Elec. Co., No. Adams, Mass.
Tektronix, Beaverton, Ore.
Tucker Electronics Co., Garland, Tex.

Meters, Clamp-On
Bell, F.W., Columbus, Ohio p. 1•615
D **Esterline Angus, Indianapolis, Ind.** p. 1•866,867
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
M **Ohio Semitronics, Columbus, Ohio** p. 1•782
D **Simpson Electric Co., Elgin, Ill.** p. 1•805
D **Triplett Corp., Bluffton, Ohio** p. 1•821
D **Arrow-M, Mountainside, N.J.** *
D **Hickok Electrical Instr., Cleveland, Ohio** *
Jonard Industries Corp., Tuckahoe, N.Y. *
NES, Streamwood, Ill. *
D **Weston Instrs., Newark, N.J.** *
M Columbia Electric Mfg. Co., Cleveland, Ohio
Ferranti Elec., Plainview, N.Y.
D General Electric Co., West Lynn, Mass.
Hewlett-Packard Co., Palo Alto, Cal.
ITT Holub Industries, Sycamore, Ill.
D Midland International Corp., No. Kansas City, Mo.
RCA Electronic Comps., Harrison, N.J.
Sticht Co., Herman H., New York, N.Y.
Tucker Electronics Co., Garland, Tex.

Meters, Conductance
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
D **Tekelec Inc., Oxnard, Cal.** p. 1•815
General Radio Co., Concord, Mass. *
NES, Streamwood, Ill. *
Weston Instrs., Newark, N.J. *
Hewlett-Packard Co., Palo Alto, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
Yellow Springs Instrument Co., Yellow Springs, Ohio

Meters, Counting Rate, Nuclear
NES, Streamwood, Ill. *
Weston Instrs., Newark, N.J. *
M Nuclear Resch. Corp., Southampton, Pa.
Nucleus Corp., Madison Hgts., Mich.
NUCOR Corp., Denville, N.J.
Zi-Tech Div., Palo Alto, Cal.

Meters, Decibel Indicating
Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
REI Sales Co., Burlington, Mass. p. 1•796,797
Rental Electronics, Lexington, Mass. p. 1•792-795
Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
D **Triplett Corp., Bluffton, Ohio** p. 1•821
Chesterfield Prods. Inc., Saddle Brook, N.J. *
D **General Radio Co., Concord, Mass.** *
NES, Streamwood, Ill. *
Shigoto Inds., Ltd., New York, N.Y. *
D **Simpson Electric Co., Elgin, Ill.** *
Weston Instrs., Newark, N.J. *
B & K Instruments, Cleveland, Ohio
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Bowmar/ALI, Acton, Mass.
Dixson, Grand Junction, Colo.
Edmund Scientific Co., Barrington, N.J.
Gotham Audio Corp., New York, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
M Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
D Leader Instruments Corp., Plainview, N.Y.
DM Phaostron Instrument, So. Pasadena, Cal.
M Q.V.S., East Orange, N.J.
RCA Electronic Comps., Harrison, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Tracor, Austin, Tex.
Tucker Electronics Co., Garland, Tex.
D Uchida of America Corp., New York, N.Y.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Distortion & Noise
London Co., Westlake, Ohio p. 1•761
Marconi Instrs., Northvale, N.J. p. 1•766-771
Quan-Tech, Randolph Township, N.J. p. 1•787-790
Rental Electronics, Lexington, Mass. p. 1•792-795
D **Simpson Electric Co., Elgin, Ill.** p. 1•805
D **Triplett Corp., Bluffton, Ohio** p. 1•821
Vu-data Corp., San Diego, Cal. p. 1•850
Freed Transformer Co., Brooklyn, N.Y. *
General Radio Co., Concord, Mass. *
D **Weston Instrs., Newark, N.J.** *
M Atlantic Research Coropration, Alexandria, Va
B & K Instruments, Cleveland, Ohio
D Barker & Williamson, Bristol, Pa.
D Becton, Dickinson & Co., Coshocton, Ohio
Bowmar/ALI, Acton, Mass.
Digitech Data Inds., Ridgefield, Conn.
Hewlett-Packard Co., Palo Alto, Cal.
Meguro Electronic Instr. Co., Tokyo, Japan
Rhode & Schwarz Sls., Fairfield, N.J.
Tracor, Austin, Tex.
Tucker Electronics Co., Garland, Tex.
Vibration Instrs. Co., Anaheim, Cal.

Meters, Edge-Wise
D **Beede Electrical Instr. Co., Penacook, N.H.** p. 1•238,612
D **Hoyt Elec. Instr. Works, Belmont, Mass.** p. 1•726,727
D **Larson Instr. Co., Orangeburg, N.Y.** p. 1•757
D **Sheller-Globe Corp., Perkasie, Pa.** p. 1•668,669
D **Triplett Corp., Bluffton, Ohio** p. 1•821
D **GC Electronics, Rockford, Ill.** *
General Elec. Co., Schenectady, N.Y. *
Shigoto Inds., Ltd., New York, N.Y. *
D **Simpson Electric Co., Elgin, Ill.** *
D **Weston Instrs., Newark, N.J.** *
Yewtec Corporation, Larchmont, N.Y. *
Airpax Elctrns., Ft. Lauderdale, Fla.
Electrical Instr. Svc., Mt. Vernon, N.Y.
D General Electric Co., West Lynn, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
D Jewell Electrical Instruments, Manchester, N.H.
D JPI, Santa Monica, Cal.
D LFE Corporation, Waltham, Mass.
Meko Instrument Co., Glendale, Cal.
Mura Corp., Jericho, N.Y.
Non-Linear Sys., Del Mar, Cal.
DM Phaostron Instrument, So. Pasadena, Cal.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Sterling Mfg. Co., Cleveland, Ohio
Sunshine Sci. Instrs., Philadelphia, Pa.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Elapsed Time—See Indicators, Elapsed Time

Meters, Electrometer
ITT Jennings, Instrus. & Systems, San Jose, Cal. p. 1•740,741
M **General Microwave Corp., Farmingdale, NY** *
Jonard Industries Corp., Tuckahoe, N.Y. *
NES, Streamwood, Ill. *
Weston Instrs., Newark, N.J. *
Beckman Instrs., (AISSD), Fullerton, Cal.
Continental Rentals Div., Bedford, Mass.
Corning Glass Works, Medfield, Mass.
D Int'l. Instrs., Orange, Conn.
D Keithley Instruments Inc., Cleveland, Ohio
Nucleus Corp., Madison Hgts., Mich.
Princeton Applied Resch. Corp., Princeton, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Varian Assocs., Palo Alto, Cal.

Meters, Field Strength
Instruments for Industry, Farmingdale, N.Y. p. 1•734
Polarad Elctrn. Instrs., Lake Success, N.Y. p. 1•784,785
Rental Electronics, Lexington, Mass. p. 1•792-795
DM **Systron-Donner Instr. Div., Concord, Cal.** *
Weston Instrs., Newark, N.J. *
Aiken Industries, Gaithersburg, Md.
Annis R B Co., Indianapolis, Ind.
D Blonder-Tongue Labs., Old Bridge, N.J.
D Castle TV Tuner Service, Chicago, Ill.
D Channel Master Div. Avnet, Ellenville, N.Y.
Delta-Benco-Cascade LTD., Rexdale, Ont. Can. M9W 1G1
Electro-Metrics, Amsterdam, N.Y.
D Finney Co., Bedford, Ohio
D Jerrold Electronics Corp., Horsham, Pa.
LDJ Electronics, Troy, Mich.
D Leader Instruments Corp., Plainview, N.Y.

D Midland International Corp., No. Kansas City, Mo.
D Mobil Electronics, Anderson, Ind.
Narda Microwave Corp., Plainview, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sencore, Sioux Falls, S.D.
D Shurite Meters, New Haven, Conn.
Singer Instrumentation, Los Angeles, Cal.
Solar Elctrns. Co., Hollywood, Cal.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
Walker Scientific, Worcester, Mass.

Meters, Fluid Flow

NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Anadex Instrs., Van Nuys, Cal.
D Carolina Medical Elctrns., King, N.C.
Datametrics Inc., Wilmington, Mass.
Hardman Inc., Belleville, N.J.
Lion Precision Corp, Newton, Mass.
NUSonics, Paramus, N.J.
Richard-Lee Co., New Providence, N.J.
Robertshaw Controls Co., Richmond, Va.
D Thermo Sys., St. Paul, Minn.
Tridak, Danbury, Conn.
Tylan Corp., Torrance, Cal.
United Systems, Dayton, Ohio
West Coast Resch. Corp., Los Angeles, Calif.

Meters, Flutter & Wow

Rental Electronics, Lexington, Mass. p. 1•792-795
Weston Instrs., Newark, N.J. .... *
Gotham Audio Corp., New York, N.Y.
M Kenton Engrg. Corp., Skokie, Ill.
D Leader Instruments Corp., Plainview, N.Y.
Meguro Electronic Instr. Co., Tokyo, Japan
RIL Elctrns., Southampton, Pa.
Tucker Electronics Co., Garland, Tex.
Video Research Corporation, Riviera Beach, Fla.

Meters, Flux

EG&G, Salem, Mass. .... **p. 1•1011**
RFL Inds., Boonton, N.J. .... **p. 1•791**
Thomas & Skinner, Indpls., Ind. .... **p. 1•818**
ISC Magnetics Div., Plainview, N.Y. .... *
Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
Electrical Instr. Svc., Mt. Vernon, N.Y.
LDJ Electronics, Troy, Mich.
Magnos, Incorporated, Harvard, Mass.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Walker Scientific, Worcester, Mass.

Meters, F-M Deviation

Kratos, Pasadena, Cal .... **p. 1•750**
London Co., Westlake, Ohio .... **p. 1•760**
Marconi Instrs., Northvale, N.J. p. 1•766-771
Rental Electronics, Lexington, Mass. p. 1•792-795
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
M McGraw-Edison Co., Manchester, N.H. .... *
Weston Instrs., Newark, N.J. .... *
M A.R.F. Products, Boulder, Colo.
Motorola Comms. Div., Schaumburg, Ill.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Instrumentation, Los Angeles, Cal.
Tucker Electronics Co., Garland, Tex.
Video Research Corporation, Riviera Beach, Fla.

Meters, Frequency

M Arnoux Corp., Santa Barbara, Cal. p. 1•604,605
D Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Esterline Angus, Indianapolis, Ind. ...... **p. 1•864**
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324
International Crystal Mfg., Oklahoma City, Okla. .... **p. 1•738**
J-B-T Instrs., New Haven, Conn. p. 1•742-745
M Kratos, Pasadena, Cal .... **p. 1•750**
D Millen Mfg. Co. Inc., James, Malden, Mass. p. 2•1250
D Modutec, Norwalk, Conn. .... **p. 1•773-776**
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
D Yewtec Corporation, Larchmont, N.Y. p. 1•861
American Time Products, Bulova Watch, Woodside, N.Y. .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
General Elec. Co., Schenectady, N.Y. .... *
M General Microwave Corp., Farmingdale, NY ..... *
Hickok Electrical Instr., Cleveland, Ohio .... *
M McGraw-Edison Co., Manchester, N.H. .... *
NES, Streamwood, Ill. .... *
Quan-Tech, Randolph Township, N.J. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Simpson Electric Co., Elgin, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
Anadex Instrs., Van Nuys, Cal.
ARGA Controls, Pasedena, Cal.
Avtron Mfg., Cleveland, Ohio
B & K Instruments, Cleveland, Ohio
Beckman Instrs., Schiller Park, Ill.
DM Biddle, James G., Plymouth Meeting, Pa.
M Coleman Microwave Co., Lebanon, N.J.
D Eldorado Instrument Co., Concord, Cal.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
DM General Electric Co., West Lynn, Mass.
Hathaway Instruments, Denver, Colo.
Hewlett-Packard Co., Palo Alto, Cal.
Leader Instruments Corp., Plainview, N.Y.
M Microlab/FXR, Livingston, N.J.
Motorola Comms. Div., Schaumburg, Ill.
Narda Microwave Corp., Plainview, N.Y.
Newport Labs., Santa Ana, Cal.
Nucleus Corp., Madison Hgts., Mich.
Philips Test & Measuring Instrs., Woodbury, N.Y.
M Power Waves Inc., Asbury Park, N.J.
D PRD Elctrns., Syosset, N.Y.
M Premier Microwave, Port Chester, N.Y.
M Q.V.S., East Orange, N.J.
Richard-Lee Co., New Providence, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Singer Instrumentation, Los Angeles, Cal.
Sivers Lab, Corona del Mar, Cal.
DM Sticht Co., Herman H., New York, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Telesis Laboratory, Chillocothe, Ohio
Tempo Instrument, Plainview, N.Y.
D TRG,, Woburn, Mass.
Tucker Electronics Co., Garland, Tex.
UTE Microwave, Asbury Park, N.J.
Video Research Corporation, Riviera Beach, Fla.
Waveline, W. Caldwell, N.J.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Frequency Deviation

Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324
Kratos, Pasadena, Cal .... **p. 1•750**
Marconi Instrs., Northvale, N.J. p. 1•766-771
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
American Time Products, Bulova Watch, Woodside, N.Y. .... *
Austron, Austin, Tex. .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
M McGraw-Edison Co., Manchester, N.H. .... *
NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Anadex Instrs., Van Nuys, Cal.
ARGA Controls, Pasedena, Cal.
Avtron Mfg., Cleveland, Ohio
Beckman Instrs., Schiller Park, Ill.
Hathaway Instruments, Denver, Colo.
Meguro Electronic Instr. Co., Tokyo, Japan
Microwave/Sys., E. Syracuse, N.Y.
Motorola Comms. Div., Schaumburg, Ill.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Instrumentation, Los Angeles, Cal.
Tracor, Austin, Tex.
Tucker Electronics Co., Garland, Tex.
Video Research Corporation, Riviera Beach, Fla.

Meters, Frequency (Digital)

D California Instrs. Co., San Diego, Cal. p. 1•627
Electronic Research Co., Shawnee Mission, Kans. .... **p. 1•677,681**
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Frequency Elctrns., New Hyde Pk., N.Y. p. 1•324
Heath Co., Benton Harbor, Mich. .... **p. 1•720**
Marconi Instrs., Northvale, N.J. p. 1•766-771
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
American Time Products, Bulova Watch, Woodside, N.Y. .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
General Radio Co., Concord, Mass. .... *
Hickok Electrical Instr., Cleveland, Ohio .... *
M McGraw-Edison Co., Manchester, N.H. .... *
NES, Streamwood, Ill. .... *
North Atlantic Inds., Plainview, N.Y. .... *
Quan-Tech, Randolph Township, N.J. .... *
D Simpson Electric Co., Elgin, Ill. .... *
DM Systron-Donner Instr. Div., Concord, Cal. .... *
D Weston Instrs., Newark, N.J. .... *
Anadex Instrs., Van Nuys, Cal.
Avtron Mfg., Cleveland, Ohio
D Ballantine Laboratories, Boonton, N.J.
Beckman Instrs., Schiller Park, Ill.
Calico Div., San Diego, Cal.
D Dana Labs., Irvine, Calif.
D Eldorado Instrument Co., Concord, Cal.
Electronic Counters & Controls Inc., Mundelein, Ill.
Hewlett-Packard Co., Palo Alto, Cal.
Leader Instruments Corp., Plainview, N.Y.
Meguro Electronic Instr. Co., Tokyo, Japan
Motorola Comms. Div., Schaumburg, Ill.
Newport Labs., Santa Ana, Cal.
Philips Test & Measuring Instrs., Woodbury, N.Y.
Rycom Instruments, Raytown, Mo.
Schneider Electronics, Medford, Mass.
Sensor Corp., Scottdale, Pa.
Sequential Information Systems, Elmsford, N.Y.
Speed Detectors, Bedford, Ohio
Tucker Electronics Co., Garland, Tex.
United Systems, Dayton, Ohio
Valhalla Scientific, San Diego, Cal.
Vibration Instrs. Co., Anaheim, Cal.

Meters, Galvanometer

Electronic Dev. Corp., Boston, Mass. p. 1•671
Esterline Angus, Indianapolis, Ind. ...... **p. 1•866**
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Larson Instr. Co., Orangeburg, N.Y. .... **p. 1•756**
Yewtec Corporation, Larchmont, N.Y. p. 1•861
ISC Magnetics Div., Plainview, N.Y. .... *
NES, Streamwood, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
Weston Instrs., Newark, N.J. .... *
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Coleman Instr. Div., Oak Brook, Ill.
Cutler-Hammer Shallcross, Selma, N.C.
Dixson, Grand Junction, Colo.
Faratron Corp., S. Hackensack, N.J.
Guildline Instrs., Larchmont, N.Y.
Hacker Instrs., Fairfield, N.J.
Hathaway Industries Inc., Tulsa, Okla.
D Keithley Instruments Inc., Cleveland, Ohio
D Leeds & Northrup Co., North Wales, Pa.
Penn Airborne Prods., Southampton, Pa.
M Photron Instrument Co., Cleveland, Ohio
M Q.V.S., East Orange, N.J.
Sensitive Research Instrs., Mt. Vernon, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.

Meters, Gauss

Bell, F.W., Columbus, Ohio .... **p. 1•614**
Rental Electronics, Lexington, Mass. p. 1•792-795
RFL Inds., Boonton, N.J. .... **p. 1•791**
Thomas & Skinner, Indpls., Ind. .... **p. 1•818**
ISC Magnetics Div., Plainview, N.Y. .... *
NES, Streamwood, Ill. .... *
DM Systron-Donner Instr. Div., Concord, Cal. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
Advanced Kinetics, Costa Mesa, Calif.
Annis R B Co., Indianapolis, Ind.
LDJ Electronics, Troy, Mich.
Magnos, Incorporated, Harvard, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tucker Electronics Co., Garland, Tex.
Walker Scientific, Worcester, Mass.

Meters, Grid Dip

D Millen Mfg. Co. Inc., James, Malden, Mass. p. 2•1250
M McGraw-Edison Co., Manchester, N.H. .... *
Weston Instrs., Newark, N.J. .... *
D Leader Instruments Corp., Plainview, N.Y.

Meters, Illuminated Scale

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612
M Kratos, Pasadena, Cal .... **p. 1•750**
D Modutec, Norwalk, Conn. .... **p. 1•773-779**
NES, Streamwood, Ill. .... **p. 1•182,183**
D Triplett Corp., Bluffton, Ohio .... **p. 1•821**
Shigoto Inds., Ltd., New York, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
DM General Electric Co., West Lynn, Mass.
M Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
D Jewell Electrical Instruments, Manchester, N.H.
M Q.V.S., East Orange, N.J.

D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.

Meters, Impedance

Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Marconi Instrs., Northvale, N.J. p. 1•766-771
NES, Streamwood, Ill. ...... p. 1•182,183
RFL Inds., Boonton, N.J. ...... p. 1•791
D **Triplett Corp., Bluffton, Ohio ...... p. 1•821**
M **General Microwave Corp., Farmingdale, NY** ...... *
General Radio Co., Concord, Mass. ...... *
Heath Co., Benton Harbor, Mich. ...... *
Millen Mfg. Co. Inc., James, Malden, Mass. ...... *
Shigoto Inds., Ltd., New York, N.Y. ...... *
DM **Systron-Donner Instr. Div., Concord, Cal.** ...... *
Systron-Donner Microwave Div., Van Nuys, Cal. ...... *
Weston Instrs., Newark, N.J. ...... *
B & K Instruments, Cleveland, Ohio
Bafco, Warminster, Pa.
Electro Sci. Inds., Portland, Ore.
Hewlett-Packard Co., Palo Alto, Cal.
Leader Instruments Corp., Plainview, N.Y.
M Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
D PRD Elctrns., Syosset, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Sennheiser Elctrn. Corp., New York, N.Y.
Tucker Electronics Co., Garland, Tex.

Meters, Inductance

Boonton Electronics Corp., Parsippany, N.J. p. 1•622
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
London Co., Westlake, Ohio ...... p. 1•764,765
Marconi Instrs., Northvale, N.J. p. 1•766-771
Freed Transformer Co., Brooklyn, N.Y. ...... *
General Radio Co., Concord, Mass. ...... *
NES, Streamwood, Ill. ...... *
DM **Systron-Donner Instr. Div., Concord, Cal.** ...... *
Systron-Donner Microwave Div., Van Nuys, Cal. ...... *
Weston Instrs., Newark, N.J. ...... *
Hewlett-Packard Co., Palo Alto, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
Tektronix, Beaverton, Ore.
Tucker Electronics Co., Garland, Tex.

Meters, Kilovolt

Associated Research, Niles, Ill. ...... p. 1•607
D **Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612**
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D **Data Technology, Santa Ana, Cal. p. 1•649,650**
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
M **Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231**
ITT Jennings, Instrus. & Systems, San Jose, Cal. ...... p. 1•740,741
D **ITT Pomona Electronics Div., Pomona, Cal. p. 2•779**
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
M **Kratos, Pasadena, Cal ...... p. 1•750**
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
D **Modutec, Norwalk, Conn. ...... p. 1•773-779**
NES, Streamwood, Ill. ...... p. 1•182,183
M **Ross Engineering Corp., Campbell, Cal. p. 1•1807**
D **Tekelec Inc., Oxnard, Cal. ...... p. 1•815**
D **Triplett Corp., Bluffton, Ohio ...... p. 1•821**
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1527
Yewtec Corporation, Larchmont, N.Y. p. 1•860,861
Scientific Columbus, Columbus, Ohio ...... *
Shigoto Inds., Ltd., New York, N.Y. ...... *
D **Simpson Electric Co., Elgin, Ill.** ...... *
Weston Instrs., Newark, N.J. ...... *
ARGA Controls, Pasedena, Cal.
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Dana Labs., Irvine, Calif.
D Digilin Inc., Burbank, Cal.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electrical Standards Div., N. Hollywood, Cal.
Electro-Numerics Corp., Mountain View, Cal.
DM General Electric Co., West Lynn, Mass.
M Ideal Precision Meter Co., Brooklyn, N. Y.
ITT Holub Industries, Sycamore, Ill.
D Keithley Instruments Inc., Cleveland, Ohio
D Leader Instruments Corp., Plainview, N.Y.
Megavolt, New York, N.Y.
M Q.V.S., East Orange, N.J.
Rutherford Research Prods. Co., Rutherford, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Sterling Mfg. Co., Cleveland, Ohio
Tekelec, Oxnard, Cal.
Westinghouse Elec. Corp., Newark, N.J.
Zi-Tech Div., Palo Alto, Cal.

Meters, Kilowatt

Bird Electronic Corp., Solon, Ohio ...... p. 1•618
Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Esterline Angus, Indianapolis, Ind. ...... p. 1•866
M **Kratos, Pasadena, Cal ...... p. 1•750**
NES, Streamwood, Ill. ...... p. 1•182,183
Ohio Semitronics, Columbus, Ohio p. 1•782,2344-2346
D **Triplett Corp., Bluffton, Ohio ...... p. 1•821**
Yewtec Corporation, Larchmont, N.Y. p. 1•860
General Elec. Co., Schenectady, N.Y. ...... *
Hickok Electrical Instr., Cleveland, Ohio ...... *
Scientific Columbus, Columbus, Ohio ...... *
D **Weston Instrs., Newark, N.J.** ...... *
ARGA Controls, Pasedena, Cal.
Electrical Instr. Svc., Mt. Vernon, N.Y.
DM General Electric Co., West Lynn, Mass.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Laser Energy—See Monitors, Laser Energy

Meters, Light (Non Photographic)

EG&G, Salem, Mass. ...... p. 1•1011
D **Vactec, Maryland Heights, Mo. p. 1•1022,1023**
NES, Streamwood, Ill. ...... *
D **Simpson Electric Co., Elgin, Ill.** ...... *
Weston Instrs., Newark, N.J. ...... *
Yewtec Corporation, Larchmont, N.Y. ...... *
Bell & Howell, Bridgeport, Conn.
Bromberg Engineering, Wayland, Mass.
Corning Glass Works, Medfield, Mass.
EG & G, Salem, Mass.
Gamma Scientific Inc., San Diego, Cal.
D JPI, Santa Monica, Cal.
D Metrologic Instruments, Bellmawr, N.J.
DM Photo Research Corp., Burbank, Cal.
Scientifico Scientific Components Co., Newport Beach, Cal.
D Shurite Meters, New Haven, Conn.
Sticht Co., Herman H., New York, N.Y.
Tektronix, Beaverton, Ore.
Waveline, W. Caldwell, N.J.
Zi-Tech Div., Palo Alto, Cal.

Meters, Megohm

Associated Research, Niles, Ill. ...... p. 1•607
D **California Instrs. Co., San Diego, Cal. p. 1•627**
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D **Data Technology, Santa Ana, Cal. p. 1•649,650**
Freed Transformer Co., Brooklyn, N.Y. p. 1•716,717; p. 2•1738-1747
M **Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231**
ITT Jennings, Instrus. & Systems, San Jose, Cal. ...... p. 1•740,741
London Co., Westlake, Ohio ...... p. 1•764
Ross Engineering Corp., Campbell, Cal. p. 1•1807
D **Tekelec Inc., Oxnard, Cal. ...... p. 1•815**
D **Triplett Corp., Bluffton, Ohio ...... p. 1•821**
Yewtec Corporation, Larchmont, N.Y. p. 1•875
General Radio Co., Concord, Mass. ...... *
Hickok Electrical Instr., Cleveland, Ohio ...... *
NES, Streamwood, Ill. ...... *
Shigoto Inds., Ltd., New York, N.Y. ...... *
D **Simpson Electric Co., Elgin, Ill.** ...... *
Slaughter Co., Ardmore, Okla. ...... *
DM **Systron-Donner Instr. Div., Concord, Cal.** ...... *
D **Weston Instrs., Newark, N.J.** ...... *
Beckman Instrs., Cedar Grove, N.J.
DM Biddle, James G., Plymouth Meeting, Pa.
Calico Div., San Diego, Cal.
D Digilin Inc., Burbank, Cal.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro-Numerics Corp., Mountain View, Cal.
Eltec Instruments Inc., Daytona Beach, Fla.
Hewlett-Packard Co., Palo Alto, Cal.
ITT Holub Industries, Sycamore, Ill.
D Keithley Instruments Inc., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
Non-Linear Sys., Del Mar, Cal.
Penn Airborne Prods., Southampton, Pa.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
M Q.V.S., East Orange, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
M Sticht Co., Herman H., New York, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Uchida of America Corp., New York, N.Y.

Meters, Microampere

D **Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612**
D **Data Technology, Santa Ana, Cal. p. 1•649,650**
Esterline Angus, Indianapolis, Ind. p. 1•864,866
Faria Meter Corp., Uncasville, Conn. ... p. 1•694
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D **Hoyt Elec. Instr. Works, Belmont, Mass. p. 1•726,727**
M **Kratos, Pasadena, Cal ...... p. 1•750**
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
D **Modutec, Norwalk, Conn. ...... p. 1•773-779**
NES, Streamwood, Ill. ...... p. 1•182,183
Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
D **Tekelec Inc., Oxnard, Cal. ...... p. 1•815**
D **Triplett Corp., Bluffton, Ohio ...... p. 1•821**
Weston Instrs., Newark, N.J. p. 2•1116,1117,1119
D **Yewtec Corporation, Larchmont, N.Y. p. 1•861**
General Elec. Co., Schenectady, N.Y. ...... *
Gralex Inds., Farmingdale, N.Y. ...... *
Hickok Electrical Instr., Cleveland, Ohio ...... *
Shigoto Inds., Ltd., New York, N.Y. ...... *
Simpson Electric Co., Elgin, Ill. ...... *
DM **Systron-Donner Instr. Div., Concord, Cal.** ...... *
Systron-Donner Microwave Div., Van Nuys, Cal. ...... *
D Amprobe Instr., Lynbrook, N.Y.
ARGA Controls, Pasedena, Cal.
M AUL Instrs., Flushing, N.Y.
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Biddle, James G., Plymouth Meeting, Pa.
D Digilin Inc., Burbank, Cal.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro-Numerics Corp., Mountain View, Cal.
DM General Electric Co., West Lynn, Mass.
M Ideal Precision Meter Co., Brooklyn, N. Y.
DM Int'l. Instrs., Orange, Conn.
ITT Holub Industries, Sycamore, Ill.
Jewell Electrical Instruments, Manchester, N.H.
D Keithley Instruments Inc., Cleveland, Ohio
D LFE Corporation, Waltham, Mass.
D Midland International Corp., No. Kansas City, Mo.
Mura Corp., Jericho, N.Y.
Newport Labs., Santa Ana, Cal.
DM Phaostron Instrument, So. Pasadena, Cal.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Uchida of America Corp., New York, N.Y.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Micro-Microampere—See Meters, Nanoampere

Meters, Micro-Nanovolt—See Meters, Nanovolt

Meters, Microhm

Associated Research, Niles, Ill. ...... p. 1•607
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
DM **Systron-Donner Corp., Concord, Cal. p. 1•812,813**
DM **Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813**
General Radio Co., Concord, Mass. ...... *
Hickok Electrical Instr., Cleveland, Ohio ...... *
NES, Streamwood, Ill. ...... *
Shigoto Inds., Ltd., New York, N.Y. ...... *
D **Simpson Electric Co., Elgin, Ill.** ...... *
D **Weston Instrs., Newark, N.J.** ...... *
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Dielectric Instr. Corp., Pittsburgh, Pa.
D Digilin Inc., Burbank, Cal.
Electro Sci. Inds., Portland, Ore.
Gotham Audio Corp., New York, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
D Int'l. Instrs., Orange, Conn.
D Keithley Instruments Inc., Cleveland, Ohio

D LFE Corporation, Waltham, Mass.
Mura Corp., Jericho, N.Y.
D Philips Test & Measuring Instrs., Woodbury, N.Y.

Meters, Microvolt

D Data Technology, Santa Ana, Cal. p. 1•649,650
Esterline Angus, Indianapolis, Ind. p. 1•864,866
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
M Kratos, Pasadena, Cal .... p. 1•750
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
M General Microwave Corp., Farmingdale, NY ..... *
Hickok Electrical Instr., Cleveland, Ohio .... *
NES, Streamwood, Ill. .... *
North Atlantic Inds., Plainview, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
ARGA Controls, Pasedena, Cal.
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Biddle, James G., Plymouth Meeting, Pa.
D Consolidated Controls Corp., Bethel, Conn.
Dana Labs., Irvine, Calif.
D Digilin Inc., Burbank, Cal.
Doric Sci. Corp., San Diego, Calif.
Electro-Numerics Corp., Mountain View, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
Hy-Cal Engineering, Santa Fe Springs, Cal
D Int'l. Instrs., Orange, Conn.
D Keithley Instruments Inc., Cleveland, Ohio
D LFE Corporation, Waltham, Mass.
Mura Corp., Jericho, N.Y.
Newport Labs., Santa Ana, Cal.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Sigma Instruments, Braintree, Mass.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
Uchida of America Corp., New York, N.Y.

Meters, Microwave

Bird Electronic Corp., Solon, Ohio .... p. 1•618
M General Microwave Corp., Farmingdale, NY p. 1•718
Polarad Elctrn. Instrs., Lake Success, N.Y. p. 1•784,785
Bendix, Franklin, Ind. .... *
Jonard Industries Corp., Tuckahoe, N.Y. .... *
NES, Streamwood, Ill. .... *
DM Systron-Donner Instr. Div., Concord, Cal. .... *
Frequency Engrg. Labs., Farmingdale, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
M Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
D PRD Elctrns., Syosset, N.Y.
M Premier Microwave, Port Chester, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Sivers Lab, Corona del Mar, Cal.
Tucker Electronics Co., Garland, Tex.
Waveline, W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Milliampere

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612
Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
Esterline Angus, Indianapolis, Ind. p. 1•864,866
Faria Meter Corp., Uncasville, Conn. ... p. 1•694
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D Hoyt Elec. Instr. Works, Belmont, Mass. p. 1•726,727
M Kratos, Pasadena, Cal .... p. 1•750
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
D Modutec, Norwalk, Conn. .... p. 1•773-779
NES, Streamwood, Ill. .... p. 1•182,183
D Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
D Triplett Corp., Bluffton, Ohio .... p. 1•821
D Weston Instrs., Newark, N.J. p. 2•1116,1117,1119
D Yewtec Corporation, Larchmont, N.Y. p. 1•861
General Elec. Co., Schenectady, N.Y. .... *
M General Microwave Corp., Farmingdale, NY ..... *
Gralex Inds., Farmingdale, N.Y. .... *
Hickok Electrical Instr., Cleveland, Ohio .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Simpson Electric Co., Elgin, Ill. .... *
DM Systron-Donner Instr. Div., Concord, Cal. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
Airpax Elctrns., Ft. Lauderdale, Fla.
D Amprobe Instr., Lynbrook, N.Y.
ARGA Controls, Pasedena, Cal.
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Biddle, James G., Plymouth Meeting, Pa.
D Digilin Inc., Burbank, Cal.
Dixson, Grand Junction, Colo.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electrical Standards Div., N. Hollywood, Cal.
Electro-Numerics Corp., Mountain View, Cal.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Honeywell, Ft. Washington, Pa.
M Ideal Precision Meter Co., Brooklyn, N. Y.
DM Int'l. Instrs., Orange, Conn.
D Jewell Electrical Instruments, Manchester, N.H.
D Keithley Instruments Inc., Cleveland, Ohio
D LFE Corporation, Waltham, Mass.
D Midland International Corp., No. Kansas City, Mo.
Mura Corp., Jericho, N.Y.
Newport Labs., Santa Ana, Cal.
DM Phaostron Instrument, So. Pasadena, Cal.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
M Sensitive Research Instrs., Mt. Vernon, N. Y.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Sterling Mfg. Co., Cleveland, Ohio
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
Uchida of America Corp., New York, N.Y.
United Systems, Dayton, Ohio
D Velonex, Display Prods., Santa Clara, Cal.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Milliohm

Associated Research, Niles, Ill. .... p. 1•607
Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
NES, Streamwood, Ill. .... p. 1•182,183
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
Systron-Donner Microwave Div., Van Nuys, Cal. ....p. 1•812,813
D Triplett Corp., Bluffton, Ohio ....p. 1•821
General Radio Co., Concord, Mass. .... *
Hickok Electrical Instr., Cleveland, Ohio .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
D Yewtec Corporation, Larchmont, N.Y. .... *
Biddle, James G., Plymouth Meeting, Pa.
Dana Labs., Irvine, Calif.
D Digilin Inc., Burbank, Cal.
Electro-Numerics Corp., Mountain View, Cal.
Electro Sci. Inds., Portland, Ore.
Hewlett-Packard Co., Palo Alto, Cal.
D Int'l. Instrs., Orange, Conn.
D Keithley Instruments Inc., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sigma Instruments, Braintree, Mass.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.

Meters, Millivolt

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612
Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
D Esterline Angus, Indianapolis, Ind. p. 1•864,866
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Industrial Test Equip., Port Washington, N.Y. p. 1•729
M Kratos, Pasadena, Cal .... p. 1•750
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
Marconi Instrs., Northvale, N.J. p. 1•766-771
D Modutec, Norwalk, Conn. .... p. 1•773-779
NES, Streamwood, Ill. .... p. 1•182,183
Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
Systron-Donner Microwave Div., Van Nuys, Cal. ....p. 1•812,813
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
D Triplett Corp., Bluffton, Ohio .... p. 1•821
D Weston Instrs., Newark, N.J. ....p. 2•1120
M General Microwave Corp., Farmingdale, NY ..... *
Hickok Electrical Instr., Cleveland, Ohio .... *
North Atlantic Inds., Plainview, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Simpson Electric Co., Elgin, Ill. .... *
DM Systron-Donner Instr. Div., Concord, Cal. .... *
D Yewtec Corporation, Larchmont, N.Y. .... *
Airpax Elctrns., Ft. Lauderdale, Fla.
D Amprobe Instr., Lynbrook, N.Y.
ARGA Controls, Pasedena, Cal.
D Ballantine Laboratories, Boonton, N.J.
Barber-Colman Co., Rockford, Ill.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Biddle, James G., Plymouth Meeting, Pa.
Dana Labs., Irvine, Calif.
D Digilin Inc., Burbank, Cal.
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro-Numerics Corp., Mountain View, Cal.
DM General Electric Co., West Lynn, Mass.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Hy-Cal Engineering, Santa Fe Springs, Cal
M Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
D Jewell Electrical Instruments, Manchester, N.H.
D Keithley Instruments Inc., Cleveland, Ohio
D LFE Corporation, Waltham, Mass.
Motorola Comms. Div., Schaumburg, Ill.
Mura Corp., Jericho, N.Y.
Newport Labs., Santa Ana, Cal.
DM Phaostron Instrument, So. Pasadena, Cal.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
M Q.V.S., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
D Velonex, Display Prods., Santa Clara, Cal.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Modulation

Dynamics Elctrn. Prods., Santa Fe Springs, Cal. p. 1•5
M Kratos, Pasadena, Cal .... p. 1•750
London Co., Westlake, Ohio ....p. 1•760
Marconi Instrs., Northvale, N.J. p. 1•766-771
Rental Electronics, Lexington, Mass. p. 1•792-795
NES, Streamwood, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Weston Instrs., Newark, N.J. .... *
ARGA Controls, Pasedena, Cal.
Avtron Mfg., Cleveland, Ohio
Singer Instrumentation, Los Angeles, Cal.
Tucker Electronics Co., Garland, Tex.

Meters, Moving Scale

Jonard Industries Corp., Tuckahoe, N.Y. p. 2•1708
NES, Streamwood, Ill. .... *
D Simpson Electric Co., Elgin, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
Philips Test & Measuring Instrs., Woodbury, N.Y.
M Q.V.S., East Orange, N.J.
D Sigma Instruments, Braintree, Mass.

Meters, Multitester

Associated Research, Niles, Ill. .... p. 1•607
Dynascan Corp., Chicago, Ill. .... p. 1•611
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
International Comps Corp., Melville, N.Y. p. 2•193
Rental Electronics, Lexington, Mass. p. 1•792-795
Simpson Electric Co., Elgin, Ill. .... p. 1•803,804
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
D Triplett Corp., Bluffton, Ohio .... p. 1•821
D GC Electronics, Rockford, Ill. .... *
Heath Co., Benton Harbor, Mich. .... *
NES, Streamwood, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *

D Amprobe Instr., Lynbrook, N.Y.
M AUL Instrs., Flushng, N.Y.
Biddle, James G., Plymouth Meeting, Pa.
D Components Specialties, Hempstead, N.Y.
Doric Sci. Corp., San Diego, Calif.
D Epic, New York, N.Y.
General Rand Corp., Edison, N.J.
D Herald Electronics, Chicago, Ill.
Hewlett-Packard Co., Palo Alto, Cal.
ITT Holub Industries, Sycamore, Ill.
D Keithley Instruments Inc., Cleveland, Ohio
Leader Instruments Corp., Plainview, N.Y.
D Midland International Corp., No. Kansas City, Mo.
D Mura Corp., Jericho, N.Y.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
RCA Electronic Comps., Harrison, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Schauer Mfg. Corp., Cincinnati, Ohio
D Sencore, Sioux Falls, S.D.
D Sotcher Measurement, Cupertino, Cal.
Sticht Co., Herman H., New York, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Uchida of America Corp., New York, N.Y.

Meters, Multitester (Digital)

D California Instrs. Co., San Diego, Cal. p. 1•627
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
D Dynascan Corp., Chicago, Ill. p. 1•611
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D Hickok Electrical Instr., Cleveland, Ohio p. 1•728
REI Sales Co., Burlington, Mass. p. 1•796,797
Rental Electronics, Lexington, Mass. p. 1•792-795
D Simpson Electric Co., Elgin, Ill. p. 1•803
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
D Tekelec Inc., Oxnard, Cal. p. 1•815
Dranetz Engrg. Labs., So. Plainfield, N.J. *
Heath Co., Benton Harbor, Mich. *
NES, Streamwood, Ill. *
D Weston Instrs., Newark, N.J. *
D Ballantine Laboratories, Boonton, N.J.
Calico Div., San Diego, Cal.
M Cubic Corp., San Diego, Cal.
Dana Labs., Irvine, Calif.
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Julie Research Lab., New York, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
Leader Instruments Corp., Plainview, N.Y.
Motorola Comms. Div., Schaumburg, Ill.
NOBEX Div., Burlingame, Cal.
D Non-Linear Sys., Del Mar, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
Schneider Electronics, Medford, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Tektronix, Beaverton, Ore.
Tucker Electronics Co., Garland, Tex.
United Systems, Dayton, Ohio

Meters, Multitester (Potentiometric)

Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
NES, Streamwood, Ill. *
D Simpson Electric Co., Elgin, Ill. *
Biddle, James G., Plymouth Meeting, Pa.
Doric Sci. Corp., San Diego, Calif.
Guildline Instrs., Larchmont, N.Y.
Tucker Electronics Co., Garland, Tex.

Meters, Nanoampere

Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D Tekelec Inc., Oxnard, Cal. p. 1•815
Hickok Electrical Instr., Cleveland, Ohio *
NES, Streamwood, Ill. *
Bromberg Engineering, Wayland, Mass.
Dantronics, St. Paul, Minn
Elcor Prods. Neotec Elctrns. Inc., Silver Spring, Md.
EMI Gencom Inc., Plainview, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
Newport Labs., Santa Ana, Cal.
Philips Test & Measuring Instrs., Woodbury, N.Y.
Tekelec, Oxnard, Cal.

Meters, Nanovolt

Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D Tekelec Inc., Oxnard, Cal. p. 1•815
Hickok Electrical Instr., Cleveland, Ohio *
NES, Streamwood, Ill. *
D Keithley Instruments Inc., Cleveland, Ohio
Philips Test & Measuring Instrs., Woodbury, N.Y.

Meters, Noise-Figure

M Kay Elemetrics Corp., Pine Brook, N.J. p. 1•746-749
Quan-Tech, Randolph Township, N.J. p. 1•787-790
M General Microwave Corp., Farmingdale, NY *
D Triplett Corp., Bluffton, Ohio *
Weston Instrs., Newark, N.J. *
D Ailtech, Farmingdale, N. Y.
B & K Instruments, Cleveland, Ohio
Electro-Metrics, Amsterdam, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
Solatron Enterprises, Inglewood, Calif.
Tucker Electronics Co., Garland, Tex.

Meters, Noise & Sound Level

Esterline Angus, Indianapolis, Ind. p. 1•866
Simpson Electric Co., Elgin, Ill. p. 1•805
Triplett Corp., Bluffton, Ohio p. 1•821
D Becton, Dickinson & Co., Coshocton, Ohio
Edmund Scientific Co., Barrington, N.J.
E.I. DuPont de Nemours & Co., Wilmington, Del.
IRD Mechanalysis, Columbus, Ohio
Metrosonics, Rochester, N.Y.
Mine Safety Appliances Co., Pittsburgh, Pa
D Primo Microphone Inc., Elk Grove Village, Ill.
Tucker Electronics Co., Garland, Tex.

Meters, Null

Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Electronic Dev. Corp., Boston, Mass. p. 1•670
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Industrial Test Equip., Port Washington, N.Y. p. 1•729
M Kratos, Pasadena, Cal p. 1•750
Larson Instr. Co., Orangeburg, N.Y. p. 1•756
D Modutec, Norwalk, Conn. p. 1•773-776
M North Atlantic Inds., Plainview, N.Y. p. 1•188,772
D Triplett Corp., Bluffton, Ohio p. 1•821
Freed Transformer Co., Brooklyn, N.Y. *
M General Microwave Corp., Farmingdale, NY *
General Radio Co., Concord, Mass. *
Shigoto Inds., Ltd., New York, N.Y. *
D Simpson Electric Co., Elgin, Ill. *
Weston Instrs., Newark, N.J. *
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Dixson, Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Electro Sci. Inds., Portland, Ore.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
D Int'l. Instrs., Orange, Conn.
D Jewell Electrical Instruments, Manchester, N.H.
Julie Research Lab., New York, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
D Leeds & Northrup Co., North Wales, Pa.
D LFE Corporation, Waltham, Mass.
McKee-Pedersen Instrs., Danville, Calif.
Micro Instrument Co., Escondido, Cal.
Mura Corp., Jericho, N.Y.
DM Phaostron Instrument, So. Pasadena, Cal.
Philips Test & Measuring Instrs., Woodbury, N.Y.
M Q.V.S., East Orange, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Theta Instr. Corp., Fairfield, N.J.
Tucker Electronics Co., Garland, Tex.
Weinschel Engrg. Co., Gaithersburg, Md.
Zi-Tech Div., Palo Alto, Cal.

Meters, Ohm

Associated Research, Niles, Ill. p. 1•607
D California Instrs. Co., San Diego, Cal. p. 1•627
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
ITT Jennings, Instrus. & Systems, San Jose, Cal. p. 1•740,741
Kratos, Pasadena, Cal p. 1•750
London Co., Westlake, Ohio p. 1•764
NES, Streamwood, Ill. p. 1•182,183
Slaughter Co., Ardmore, Okla. p. 1•807
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
Systron-Donner Microwave Div., Van Nuys, Cal. p. 1•812,813
D Tekelec Inc., Oxnard, Cal. p. 1•815
D Triplett Corp., Bluffton, Ohio p. 1•821
Freed Transformer Co., Brooklyn, N.Y. *
General Radio Co., Concord, Mass. *
Hickok Electrical Instr., Cleveland, Ohio *
Jonard Industries Corp., Tuckahoe, N.Y. *
Shigoto Inds., Ltd., New York, N.Y. *
D Simpson Electric Co., Elgin, Ill. *
Weston Instrs., Newark, N.J. *
D Yewtec Corporation, Larchmont, N.Y. *
D Amprobe Instr., Lynbrook, N.Y.
Beckman Instrs., Cedar Grove, N.J.
D Biddle, James G., Plymouth Meeting, Pa.
D Cutler-Hammer Shallcross, Selma, N.C.
Dana Labs., Irvine, Calif.
D Davidson Elctrn. Dev. Co., Erie, Pa.
D Digilin Inc., Burbank, Cal.
Electro-Numerics Corp., Mountain View, Cal.
Electro Sci. Inds., Portland, Ore.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
D Int'l. Instrs., Orange, Conn.
Julie Research Lab., New York, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
Leader Instruments Corp., Plainview, N.Y.
Meguro Electronic Instr. Co., Tokyo, Japan
Mura Corp., Jericho, N.Y.
National Camera Inc., Englewood, Colo.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
M Q.V.S., East Orange, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
D Sigma Instruments, Braintree, Mass.
Sticht Co., Herman H., New York, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
D Thomas & Betts Co., Elizabeth, N.J.
Tucker Electronics Co., Garland, Tex.
Uchida of America Corp., New York, N.Y.
Valhalla Scientific, San Diego, Cal.

Meters, Panel (D'Arsonval Movement)

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,239,612,613
Faria Meter Corp., Uncasville, Conn. p. 1•694
D Hoyt Elec. Instr. Works, Belmont, Mass. p. 1•726,727
M Kratos, Pasadena, Cal p. 1•750
Larson Instr. Co., Orangeburg, N.Y. p. 1•756
D Modutec, Norwalk, Conn. p. 1•773-776
D Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
D Triplett Corp., Bluffton, Ohio p. 1•821
General Elec. Co., Schenectady, N.Y. *
Hickok Electrical Instr., Cleveland, Ohio *
Shigoto Inds., Ltd., New York, N.Y. *
D Simpson Electric Co., Elgin, Ill. *
D Weston Instrs., Newark, N.J. *
Airpax Elctrns., Ft. Lauderdale, Fla.
ARGA Controls, Pasedena, Cal.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Dixson, Grand Junction, Colo.
Electrical Instr. Svc., Mt. Vernon, N.Y.
D General Electric Co., West Lynn, Mass.
M Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
Jewell Electrical Instruments, Manchester, N.H.
D JPI, Santa Monica, Cal.
D LFE Corporation, Waltham, Mass.
Mura Corp., Jericho, N.Y.
DM Phaostron Instrument, So. Pasadena, Cal.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Panel (Digital)

M Analog Devices, Norwood, Mass. p. 1•606
Analogic Corp., Wakefield, Mass. p. 1•602,603
Berkeley Instruments, Santa Ana, Cal. p. 1•617
C & A Products, Woodside, N.Y. p. 1•148-151
D California Instrs. Co., San Diego, Cal. p. 1•628
D Data Technology, Santa Ana, Cal. p. 1•651
Datel Systems Inc., Canton, Mass. p. 1•648
Electronic Research Co., Shawnee Mission, Kans. p. 1•677,682
Gralex Inds., Farmingdale, N.Y. p. 1•718,719
NES, Streamwood, Ill. p. 1•182,183
D Precision Timer Co., Westbrook, Conn. p. 1•268

DM **Systron-Donner Corp., Concord, Cal. p. 1•812,813**
DM **Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813**
Systron-Donner Microwave Div., Van Nuys, Cal. .... p. 1•812,813
D **Tekelec Inc., Oxnard, Cal. .... p. 1•815**
D **Weston Instrs., Newark, N.J. .... p. 2•1120**
Data Precision Corporation, Wakefield, Mass *
M **General Microwave Corp., Farmingdale, NY** ..... *
Simpson Electric Co., Elgin, Ill. .... *
D Ametek Controls Division, Feasterville, Pa.
Anadex Instrs., Van Nuys, Cal.
Calico Div., San Diego, Cal.
D Consolidated Controls Corp., Bethel, Conn.
D Data Translation, Framingham, Mass.
Datascan Div., Van Nuys, Ca.
D Digilin Inc., Burbank, Cal.
Electro-Numerics Corp., Mountain View, Cal.
Foxboro Co., Foxboro, Mass.
Haydon Switch & Instr., Waterbury, Conn.
D JPI, Santa Monica, Cal.
D LFE Corporation, Waltham, Mass.
Newport Labs., Santa Ana, Cal.
D Non-Linear Sys., Del Mar, Cal.
Philips Test & Measuring Instrs., Woodbury, N.Y.
Schaevitz Engrg., Pennsauken, N.J.
Schneider Electronics, Medford, Mass.
D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
United Systems, Dayton, Ohio
D Velonex, Display Prods., Santa Clara, Cal.

Meters, Peak Power

Bendix, Franklin, Ind. .... p. 2•1280
Bird Electronic Corp., Solon, Ohio .... p. 1•618
Clarke-Hess Comm., New York, N.Y. p. 1•636,637
M **General Microwave Corp., Farmingdale, NY** ..... *
NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Emergency Beacon Corp., New Rochelle, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
Narda Microwave Corp., Plainview, N.Y.
D PRD Elctrns., Syosset, N.Y.
Tucker Electronics Co., Garland, Tex.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Period

Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
General Radio Co., Concord, Mass. .... *
NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Newport Labs., Santa Ana, Cal.
Valhalla Scientific, San Diego, Cal.

Meters, Permeameter

Thomas & Skinner, Indpls., Ind. .... p. 1•818
ISC Magnetics Div., Plainview, N.Y. .... *
Weston Instrs., Newark, N.J. .... *
LDJ Electronics, Troy, Mich.
Sunshine Sci. Instrs., Philadelphia, Pa.
Walker Scientific, Worcester, Mass.

Meters, Phase-Angle

M **Computer Conversions Corp., East Northport, N.Y. .... p. 1•154,155**
M **Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657**
M **Dytronics Co., Columbus, Ohio .... p. 1•658,659**
Esterline Angus, Indianapolis, Ind. p. 1•864,866
Industrial Test Equip., Port Washington, N.Y. p. 1•729
M **Kratos, Pasadena, Cal .... p. 1•750**
Krohn-Hite Corp., Cambridge, Mass. ....p. 1•753
M **North Atlantic Inds., Plainview, N.Y. p. 1•188,772**
Ohio Semitronics, Columbus, Ohio .... p. 1•2345
Rental Electronics, Lexington, Mass. p. 1•792-795
M **Solid State Electronics Corp., Sepulveda, Cal. p. 1•126**
Wavetek, San Diego, Cal .... p. 1•852-859
Chesterfield Prods. Inc., Saddle Brook, N.J. .... *
Comstron Seg., Richmond Hill, N.Y. .... *
Comstron-Seg Multimetrics, Richmond Hill, N.Y. .... *
M **Control Elctrns. Co., Farmingdale, N.Y.** .... *
Seg Subsidiary, Richmond Hill, N.Y. .... *
D **Weston Instrs., Newark, N.J.** .... *
Yewtec Corporation, Larchmont, N.Y. .... *
ARGA Controls, Pasedena, Cal.
Beta Technology, Farmingdale, N.Y.
Collins Radio, Dallas, Tex.
Feedback, Berkeley Hghts., N.J.
D General Electric Co., West Lynn, Mass.
General Rand Corp., Edison, N.J.
Hathaway Instruments, Denver, Colo.
Hewlett-Packard Co., Palo Alto, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Instrumentation, Los Angeles, Cal.
Theta Instr. Corp., Fairfield, N.J.
Tracor, Austin, Tex.
Tucker Electronics Co., Garland, Tex.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.
Vibration Instrs. Co., Anaheim, Cal.
Video Research Corporation, Riviera Beach, Fla.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Phase Vector Volt

Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Industrial Test Equip., Port Washington, N.Y. p. 1•729
Kratos, Pasadena, Cal .... p. 1•750
North Atlantic Inds., Plainview, N.Y. .... *
Weston Instrs., Newark, N.J. .... *
ARGA Controls, Pasedena, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
D NH Research, Santa Ana, Calif.
D PRD Elctrns., Syosset, N.Y.
Princeton Applied Resch. Corp., Princeton, N.J.
Theta Instr. Corp., Fairfield, N.J.
Universal Ad-Yu Elctrns., Milwaukee, Wisc.
D Wiltron Co., Palo Alto, Cal

Meters, Picoampere

London Co., Westlake, Ohio .... p. 1•764
D **Tekelec Inc., Oxnard, Cal. .... p. 1•815**
M **General Microwave Corp., Farmingdale, NY** ..... *
Hickok Electrical Instr., Cleveland, Ohio .... *
NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Bromberg Engineering, Wayland, Mass.
EMI Gencom Inc., Plainview, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
Philips Test & Measuring Instrs., Woodbury, N.Y.
RCA Electronic Comps., Harrison, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.

Meters, Power Factor

Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Esterline Angus, Indianapolis, Ind. ...... p. 1•866
Industrial Test Equip., Port Washington, N.Y. p. 1•729
ITT Jennings, Instrus. & Systems, San Jose, Cal. .... p. 1•740,741
M **Kratos, Pasadena, Cal .... p. 1•750**
NES, Streamwood, Ill. .... *
Ohio Semitronics, Columbus, Ohio .... *
Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
ARGA Controls, Pasedena, Cal.
Beckman Instrs., Cedar Grove, N.J.
Electrical Instr. Svc., Mt. Vernon, N.Y.
DM General Electric Co., West Lynn, Mass.
Micro Instrument Co., Escondido, Cal.
D NH Research, Santa Ana, Calif.
M Q.V.S., East Orange, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tucker Electronics Co., Garland, Tex.

Meters, Power, R-F

M **Bird Electronic Corp., Solon, Ohio .... p. 1•618**
Boonton Electronics Corp., Parsippany, N.J. p. 1•624
M **Electro Impulse, Red Bank, N.J. p. 1•492,662-666**
M **General Microwave Corp., Farmingdale, NY p. 1•718**
REI Sales Co., Burlington, Mass. p. 1•796,797
Rental Electronics, Lexington, Mass. p. 1•792-795
DM **Systron-Donner Corp., Concord, Cal. p. 1•812,813**
DM **Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813**
DM **Systron-Donner, Sunnyvale, Cal. p. 1•812,813**
D **Triplett Corp., Bluffton, Ohio .... p. 1•821**
Bendix, Franklin, Ind. .... *
NES, Streamwood, Ill. .... *
D **Weston Instrs., Newark, N.J.** .... *
Ailtech, City of Industry, Cal.
D Ballantine Laboratories, Boonton, N.J.
M Dielectric Comms, Raymond, Maine
D Drake Co., R.L., Miamisburg, Ohio
Emergency Beacon Corp., New Rochelle, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
D Mobil Electronics, Anderson, Ind.
Narda Microwave Corp., Plainview, N.Y.
D PRD Elctrns., Syosset, N.Y.
Q.V.S., East Orange, N.J.
Reeve Electronics, Chicago, Ill.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Sivers Lab, Corona del Mar, Cal.
Tucker Electronics Co., Garland, Tex.

Meters, Pyrometer

D **Beede Electrical Instr. Co., Penacook, N.H. p. 1•239,613**
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
D **Modutec, Norwalk, Conn. .... p. 1•2319**
NES, Streamwood, Ill. .... p. 1•182,183
Omega Engrg., Stamford, Conn. p. 1•2324-2327
D **Triplett Corp., Bluffton, Ohio .... p. 1•821**
D **Simpson Electric Co., Elgin, Ill.** .... *
Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
DM Alnor Instrument Co., Niles, Ill.
D Amprobe Instr., Lynbrook, N.Y.
Barber-Colman Co., Rockford, Ill.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Caig Labs., Westbury, N.Y.
Edison, Instr. Div., W. Orange, N.J.
Electronic Control Systems, Fairmont, W. Va.
D Epic, New York, N.Y.
D General Electric Co., West Lynn, Mass.
D Int'l. Instrs., Orange, Conn.
Ircon Inc., Skokie, Ill.
Jewell Electrical Instruments, Manchester, N.H.
Leeds & Northrup Co., North Wales, Pa.
D LFE Corporation, Waltham, Mass.
Research Instrument Co., Garden City, N. Y.
Sargent Welch Sci. Co., Skokie, Ill.
Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Thermo Elec. Co., Saddle Brook, N.J.
Trans-Met Engrg., La Habra, Cal.

Meters, Q

Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Marconi Instrs., Northvale, N.J. p. 1•766-771
Rental Electronics, Lexington, Mass. p. 1•792-795
Freed Transformer Co., Brooklyn, N.Y. .... *
Weston Instrs., Newark, N.J. .... *
Hewlett-Packard Co., Palo Alto, Cal.
Meguro Electronic Instr. Co., Tokyo, Japan
Rhode & Schwarz Sls., Fairfield, N.J.
Rutherford Research Prods. Co., Rutherford, N.J.
Telesis Laboratory, Chillocothe, Ohio
Tucker Electronics Co., Garland, Tex.

Meters, Ratio

Data Precision Corporation, Wakefield, Mass p. 1•646,647
D **Data Technology, Santa Ana, Cal. .... p. 1•651**
Esterline Angus, Indianapolis, Ind. ...... p. 1•866
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Ithaco, Ithaca, N.Y. .... p. 1•568
M **North Atlantic Inds., Plainview, N.Y. p. 1•188,772**
Computer Instrs., Hempstead, N.Y. .... *
Freed Transformer Co., Brooklyn, N.Y. .... *
M **General Microwave Corp., Farmingdale, NY** ..... *
NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Bromberg Engineering, Wayland, Mass.
Dana Labs., Irvine, Calif.
Doric Sci. Corp., San Diego, Calif.
Edison, Instr. Div., W. Orange, N.J.
Electro-Numerics Corp., Mountain View, Cal.
Electro Sci. Inds., Portland, Ore.
Hewlett-Packard Co., Palo Alto, Cal.
Newport Labs., Santa Ana, Cal.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Tucker Electronics Co., Garland, Tex.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Recording

Esterline Angus, Indianapolis, Ind. p. 1•864-867
Omega Engrg., Stamford, Conn. p. 1•2324-2327
D **Precision Timer Co., Westbrook, Conn. p. 1•268**
D **Veeder-Root, Hartford, Conn. ...... p. 1•274,275**
Dranetz Engrg. Labs., So. Plainfield, N.J. .... *
General Elec. Co., Schenectady, N.Y. .... *
NES, Streamwood, Ill. .... *
D **Simpson Electric Co., Elgin, Ill.** .... *
Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
D Amprobe Instr., Lynbrook, N.Y.

*Company has information in white pages but not on this product

Annis R B Co., Indianapolis, Ind.
B & K Instruments, Cleveland, Ohio
Barber-Colman Co., Rockford, Ill.
Foxboro Co., Foxboro, Mass.
D General Electric Co., West Lynn, Mass.
Honeywell, Ft. Washington, Pa.
Leeds & Northrup Co., North Wales, Pa.
D LFE Corporation, Waltham, Mass.
Micro Instrument Co., Escondido, Cal.
Robertshaw Controls Co., Richmond, Va.
D Singer Co., Philadelphia, Pa.
Sticht Co., Herman H., New York, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.

Meters, Reflectometer

M Bird Electronic Corp., Solon, Ohio .... p. 1•618
M General Microwave Corp., Farmingdale, NY ..... *
General Radio Co., Concord, Mass. .... *
Weston Instrs., Newark, N.J. .... *
Beckman Instrs., (AISSD), Fullerton, Cal.
Coaxial Dynamics, Cleveland, Ohio
Emergency Beacon Corp., New Rochelle, N.Y.
Gamma Scientific Inc., San Diego, Cal.
Lion Precision Corp, Newton, Mass.
Narda Microwave Corp., Plainview, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Tektronix, Beaverton, Ore.
Waveline, W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, R-F

M Bird Electronic Corp., Solon, Ohio .... p. 1•618
Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
M Electro Impulse, Red Bank, N.J. p. 1•492,662-666
M General Microwave Corp., Farmingdale, NY p. 1•718
ITT Jennings, Instrus. & Systems, San Jose, Cal. ....p. 1•740,741
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
D Modutec, Norwalk, Conn. .... p. 1•773-776
D Triplett Corp., Bluffton, Ohio ....p. 1•821
Bendix, Franklin, Ind. .... *
Weston Instrs., Newark, N.J. .... *
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Coaxial Dynamics, Cleveland, Ohio
M Coleman Microwave Co., Lebanon, N.J.
Emergency Beacon Corp., New Rochelle, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
M Q.V.S., East Orange, N.J.
Reeve Electronics, Chicago, Ill.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Tucker Electronics Co., Garland, Tex.
Uchida of America Corp., New York, N.Y.

Meters, RFI

Instruments for Industry, Farmingdale, N.Y. p. 1•734
Polarad Elctrn. Instrs., Lake Success, N.Y. p. 1•784,785
Rental Electronics, Lexington, Mass. p. 1•792-795
Weston Instrs., Newark, N.J. .... *
Electro-Metrics, Amsterdam, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Instrumentation, Los Angeles, Cal.
Tucker Electronics Co., Garland, Tex.

Meters, S-Unit

NES, Streamwood, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Weston Instrs., Newark, N.J. .... *
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Mura Corp., Jericho, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Shurite Meters, New Haven, Conn.

Meters, Snap-around—See Meters, Clamp-on

Meters, Standing Wave Ratio

M Bird Electronic Corp., Solon, Ohio .... p. 1•618
Kay Elemetrics Corp., Pine Brook, N.J. p. 1•746-749
Rental Electronics, Lexington, Mass. p. 1•792-795
Bendix, Franklin, Ind. .... *
D GC Electronics, Rockford, Ill. .... *
M General Microwave Corp., Farmingdale, NY ..... *
General Radio Co., Concord, Mass. .... *
Millen Mfg. Co. Inc., James, Malden, Mass. .... *
Weston Instrs., Newark, N.J. .... *
Emergency Beacon Corp., New Rochelle, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
D Midland International Corp., No. Kansas City, Mo.

Narda Microwave Corp., Plainview, N.Y.
D PRD Elctrns., Syosset, N.Y.
Radiation Devices Co., Baltimore, Md.
Sivers Lab, Corona del Mar, Cal.
Telonic Altair, Laguna Beach, Calif.
Tucker Electronics Co., Garland, Tex.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Temperature (Contacting)

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•239,613
D Edsyn, Van Nuys, Cal. ....p. 2•1694,1695
Electronic Research Co., Shawnee Mission, Kans. .... p. 1•677,683
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
NES, Streamwood, Ill. .... p. 1•182,183
Omega Engrg., Stamford, Conn. p. 1•2324-2327
D RFL Inds., Boonton, N.J. ....p. 1•2328,2329
D Triplett Corp., Bluffton, Ohio ....p. 1•821
Analogic Corp., Wakefield, Mass. .... *
Connor-Winfield Corp., W. Chicago, Ill. .... *
NL Inds., Muskegon, Mich. .... *
D Simpson Electric Co., Elgin, Ill. .... *
Weston Instrs., Newark, N.J. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
Aerotronic Assocs., Contoocook, N.H.
D Alnor Instrument Co., Niles, Ill.
D Amprobe Instr., Lynbrook, N.Y.
ARGA Controls, Pasedena, Cal.
Barber-Colman Co., Rockford, Ill.
Control Products Corp., Chicago, Ill.
Datametrics Inc., Wilmington, Mass.
D Digilin Inc., Burbank, Cal.
Doric Sci. Corp., San Diego, Calif.
EMI Gencom Inc., Plainview, N.Y.
D General Electric Co., West Lynn, Mass.
H-B Instr. Co., Phila., Pa.
Harrel, E. Norwalk, Conn.
Hawkeye Instrus., Marion, Iowa
Howell Inst. Inc., Ft. Worth, Tex.
Hy-Cal Engineering, Santa Fe Springs, Cal
Ircon Inc., Skokie, Ill.
D LFE Corporation, Waltham, Mass.
Mag-Con, New Brighton, Minn.
Mann, Henry Inc., Huntingdon Valley, Pa.
Newport Labs., Santa Ana, Cal.
Practical Automation, Shelton, Conn.
Relco Prods., Denver, Colo.
Schneider Electronics, Medford, Mass.
Stow Labs., Hudson, Mass.
Trans-Met Engrg., La Habra, Cal.
Uchida of America Corp., New York, N.Y.
United Systems, Dayton, Ohio
D Wahl, Wm. Corp., Los Angeles, Cal.
D Yellow Springs Instrument Co., Yellow Springs, Ohio

Meters, Temperature, Dial-Type (Non-Contacting)—See Pyrometers

Meters, Thermal Transfer

Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
NES, Streamwood, Ill. .... *
Weston Instrs., Newark, N.J. .... *
D Ballantine Laboratories, Boonton, N.J.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Hy-Cal Engineering, Santa Fe Springs, Cal
Julie Research Lab., New York, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Thermo Sys., St. Paul, Minn.

Meters, Time Interval—See Timers, Interval

Meters, Vacuum Tube Volt (VTVM)

Dynascan Corp., Chicago, Ill. .... p. 1•611
Industrial Test Equip., Port Washington, N.Y. p. 1•729
Ross Engineering Corp., Campbell, Cal. p. 1•1807
D Triplett Corp., Bluffton, Ohio ....p. 1•821
Heath Co., Benton Harbor, Mich. .... *
North Atlantic Inds., Plainview, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
Weston Instrs., Newark, N.J. .... *
ARGA Controls, Pasedena, Cal.
D Ballantine Laboratories, Boonton, N.J.
Continental Rentals Div., Bedford, Mass.
Hewlett-Packard Co., Palo Alto, Cal.
D Keithley Instruments Inc., Cleveland, Ohio
Leader Instruments Corp., Plainview, N.Y.
Motorola Comms. Div., Schaumburg, Ill.
RCA Electronic Comps., Harrison, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.

Sunshine Sci. Instrs., Philadelphia, Pa.
Tucker Electronics Co., Garland, Tex.

Meters, VAR

Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Esterline Angus, Indianapolis, Ind. ...... p. 1•866
M Kratos, Pasadena, Cal .... p. 1•750
Ohio Semitronics, Columbus, Ohio .... p. 1•2345
Rental Electronics, Lexington, Mass. p. 1•792-795
Weston Instrs., Newark, N.J. ....p. 2•1118
NES, Streamwood, Ill. .... *
D Simpson Electric Co., Elgin, Ill. .... *
DM General Electric Co., West Lynn, Mass.
Micro Instrument Co., Escondido, Cal.
Transdata Inc., Columbus, Ohio

Meters, Vibration

Unholtz-Dickie Corp., Hamden, Conn. p. 1•851
M Dytronics Co., Columbus, Ohio .... *
General Radio Co., Concord, Mass. .... *
NES, Streamwood, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
Advanced Dynamic Instrs. Div., Alexandria, Va.
B & K Instruments, Cleveland, Ohio
D Biddle, James G., Plymouth Meeting, Pa.
Columbia Resch. Labs., Woodlyn, Pa.
Continental Rentals Div., Bedford, Mass.
Endevco, San Jaun Capistrano, Cal.
D Epic, New York, N.Y.
IRD Mechanalysis, Columbus, Ohio
Larson Aero Dev., Concord, Calif.
Metrix Instrument Co., Houston, Tex.
Reliance Electric Co., Cleveland, Ohio
Robertshaw Controls Co., Richmond, Va.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensor Corp., Scottdale, Pa.
Sprengnether Instr. Co., W.F., St. Louis, Mo.
Tucker Electronics Co., Garland, Tex.
D Vibra-Metrics, E. Haven, Conn.
Vibration Instrs. Co., Anaheim, Cal.

Meters, Volt

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612
Boonton Electronics Corp., Parsippany, N.J. p. 1•625
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Electronic Dev. Corp., Boston, Mass. p. 1•670,671
D Esterline Angus, Indianapolis, Ind. p. 1•864,866
D Faria Meter Corp., Uncasville, Conn. ... p. 1•694
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D GC Electronics, Rockford, Ill. ....p. 2•1696
D Hoyt Elec. Instr. Works, Belmont, Mass. p. 1•726,727
Industrial Test Equip., Port Washington, N.Y. p. 1•729
ITT Jennings, Instrus. & Systems, San Jose, Cal. ....p. 1•740,741
M Kratos, Pasadena, Cal .... p. 1•750
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
Marconi Instrs., Northvale, N.J. p. 1•766-771
D Modutec, Norwalk, Conn. .... p. 1•773-779
NES, Streamwood, Ill. .... p. 1•182,183
M Ross Engineering Corp., Campbell, Cal. p. 1•1807
D Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
D Tekelec Inc., Oxnard, Cal. ....p. 1•815
D Triplett Corp., Bluffton, Ohio ....p. 1•821
D Weston Instrs., Newark, N.J. p. 2•1118-1120
D Yewtec Corporation, Larchmont, N.Y. p. 1•860,861
D ALCO Electronic Prods., North Andover, Mass. *
Clarke-Hess Comm., New York, N.Y. .... *
D General Elec. Co., Schenectady, N.Y. .... *
M General Microwave Corp., Farmingdale, NY ..... *
Gralex Inds., Farmingdale, N.Y. .... *
Hickok Electrical Instr., Cleveland, Ohio .... *
Lambda Elctrns., Melville, N.Y. .... *
M McGraw-Edison Co., Manchester, N.H. .... *
North Atlantic Inds., Plainview, N.Y. .... *
Scientific Columbus, Columbus, Ohio .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Simpson Electric Co., Elgin, Ill. .... *

D Amprobe Instr., Lynbrook, N.Y.
ARGA Controls, Pasedena, Cal.
M AUL Instrs., Flushng, N.Y.
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Biddle, James G., Plymouth Meeting, Pa.
Edmund Scientific Co., Barrington, N.J.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electrical Standards Div., N. Hollywood, Cal.
Electro-Numerics Corp., Mountain View, Cal.
DM General Electric Co., West Lynn, Mass.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
M Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
ITT Holub Industries, Sycamore, Ill.
Jewell Electrical Instruments, Manchester, N.H.
Julie Research Lab., New York, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
Leader Instruments Corp., Plainview, N.Y.
D LFE Corporation, Waltham, Mass.
Meguro Electronic Instr. Co., Tokyo, Japan
Micro Instrument Co., Escondido, Cal.
Motorola Comms. Div., Schaumburg, Ill.
Mura Corp., Jericho, N.Y.
Newport Labs., Santa Ana, Cal.
DM Phaostron Instrument, So. Pasadena, Cal.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
Precision Standards Corp., Santa Ana, Cal.
M Q.V.S., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
Rhode & Schwarz Sls., Fairfield, N.J.
Scientifico Scientific Components Co., Newport Beach, Cal.
M Sensitive Research Instrs., Mt. Vernon, N. Y.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Snap-On-Tools, Kenosha, Wisc.
Sticht Co., Herman H., New York, N.Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
Uchida of America Corp., New York, N.Y.
D Velonex, Display Prods., Santa Clara, Cal.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Volt, Deviation

Berkeley Instruments, Santa Ana, Cal. p. 1•617
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Electronic Dev. Corp., Boston, Mass. p. 1•671
M Kratos, Pasadena, Cal .... p. 1•750
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
NES, Streamwood, Ill. ....*
D Weston Instrs., Newark, N.J. ....*
ARGA Controls, Pasedena, Cal.
Doric Sci. Corp., San Diego, Calif.
General Rand Corp., Edison, N.J.
D Int'l. Instrs., Orange, Conn.
D JPI, Santa Monica, Cal.
D Keithley Instruments Inc., Cleveland, Ohio
Precision Standards Corp., Santa Ana, Cal.
Voltex Co., Farmingdale, N.Y.

Meters, Volt, Differential—See Meters, Volt

Meters, Volt, Digital (DVM) & Accessories

Analogic Corp., Wakefield, Mass. p. 1•602,603
Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
D California Instrs. Co., San Diego, Cal. p. 1•626
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
Datel Systems Inc., Canton, Mass. ..... p. 1•648
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
D Dynascan Corp., Chicago, Ill. .... p. 1•611
M Dytronics Co., Columbus, Ohio p. 1•658,659
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
D Hickok Electrical Instr., Cleveland, Ohio p. 1•728
ITT Jennings, Instrus. & Systems, San Jose, Cal. ....p. 1•740,741
NES, Streamwood, Ill. .... p. 1•182,183
DM Phoenix Data Inc., Phoenix, Ariz. p. 1•190-193
REI Sales Co., Burlington, Mass. p. 1•796,797
M Ross Engineering Corp., Campbell, Cal. p. 1•1807
DM Systron-Donner Corp., Concord, Cal. p. 1•812,813
DM Systron-Donner Instr. Div., Concord, Cal. p. 1•812,813
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
Yewtec Corporation, Larchmont, N.Y. p. 1•860
Electronic Research Co., Shawnee Mission, Kans. ....*
M General Microwave Corp., Farmingdale, NY .....*
Gralex Inds., Farmingdale, N.Y. ....*
Heath Co., Benton Harbor, Mich. ....*
D Simpson Electric Co., Elgin, Ill. ....*
D Weston Instrs., Newark, N.J. ....*
D Ballantine Laboratories, Boonton, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Calico Div., San Diego, Cal.
Continental Rentals Div., Bedford, Mass.
M Dana Labs., Irvine, Calif.
Datascan Div., Van Nuys, Ca.
Doric Sci. Corp., San Diego, Calif.
Dytro Corp., Hicksville, N.Y.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro-Numerics Corp., Mountain View, Cal.
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Howell Inst. Inc., Ft. Worth, Tex.
D JPI, Santa Monica, Cal.
Julie Research Lab., New York, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
Leader Instruments Corp., Plainview, N.Y.
Leeds & Northrup Co., North Wales, Pa.
Motorola Comms. Div., Schaumburg, Ill.
Newport Labs., Santa Ana, Cal.
Non-Linear Sys., Del Mar, Cal.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
Practical Automation, Shelton, Conn.
Rhode & Schwarz Sls., Fairfield, N.J.
Schneider Electronics, Medford, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Tektronix, Beaverton, Ore.
D Thermo Sys., St. Paul, Minn.
Tucker Electronics Co., Garland, Tex.
United Systems, Dayton, Ohio
Valhalla Scientific, San Diego, Cal.
Vidar Autodata Inc., Mt. View, Cal.

Meters, Volt, Frequency Selective

Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Ithaco, Ithaca, N.Y. .... p. 1•568
Kratos, Pasadena, Cal .... p. 1•750
Marconi Instrs., Northvale, N.J. p. 1•766-771
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
Industrial Test Equip., Port Washington, N.Y. *
NES, Streamwood, Ill. ....*
Quan-Tech, Randolph Township, N.J. ....*
D Weston Instrs., Newark, N.J. ....*
ARGA Controls, Pasedena, Cal.
D Blonder-Tongue Labs., Old Bridge, N.J.
D Castle TV Tuner Service, Chicago, Ill.
Hewlett-Packard Co., Palo Alto, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
Railway Comm., Raytown, Mo.
Reliance Electric Co., Cleveland, Ohio
Rhode & Schwarz Sls., Fairfield, N.J.
Tucker Electronics Co., Garland, Tex.

Meters, Volt, Log-Conversion

Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Ithaco, Ithaca, N.Y. .... p. 1•568
Kratos, Pasadena, Cal .... p. 1•750
M General Microwave Corp., Farmingdale, NY .....*
Jonard Industries Corp., Tuckahoe, N.Y. ....*
NES, Streamwood, Ill. ....*
Weston Instrs., Newark, N.J. ....*
D Ballantine Laboratories, Boonton, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
M Q.V.S., East Orange, N.J.

Meters, Volt, Peak

Associated Research, Niles, Ill. .... p. 1•607
D Data Technology, Santa Ana, Cal. p. 1•649,650
M Ross Engineering Corp., Campbell, Cal. p. 1•1807
NES, Streamwood, Ill. ....*
D Weston Instrs., Newark, N.J. ....*
ARGA Controls, Pasedena, Cal.
Continental Rentals Div., Bedford, Mass.
Micro Instrument Co., Escondido, Cal.
Pioneer Instrumentation, Cleveland, Ohio
Sensitive Research Instrs., Mt. Vernon, N. Y.
Tucker Electronics Co., Garland, Tex.

Meters, Volt, Potentiometric

Electronic Dev. Corp., Boston, Mass. p. 1•670
Esterline Angus, Indianapolis, Ind. ...... p. 1•864
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
NES, Streamwood, Ill. ....*
Weston Instrs., Newark, N.J. ....*
Barber-Colman Co., Rockford, Ill.
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
D Leeds & Northrup Co., North Wales, Pa.
Precision Standards Corp., Santa Ana, Cal.
Sensitive Research Instrs., Mt. Vernon, N. Y.

Meters, Volt, R-F

Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
ITT Jennings, Instrus. & Systems, San Jose, Cal. ....p. 1•740,741
Marconi Instrs., Northvale, N.J. p. 1•766-771
M Ross Engineering Corp., Campbell, Cal. p. 1•1807
D Triplett Corp., Bluffton, Ohio .... p. 1•821
M General Microwave Corp., Farmingdale, NY .....*
Simpson Electric Co., Elgin, Ill. ....*
D Weston Instrs., Newark, N.J. ....*
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
D Blonder-Tongue Labs., Old Bridge, N.J.
D Castle TV Tuner Service, Chicago, Ill.
Electrical Instr. Svc., Mt. Vernon, N.Y.
D Jerrold Electronics Corp., Horsham, Pa.
M Q.V.S., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Tucker Electronics Co., Garland, Tex.
Uchida of America Corp., New York, N.Y.
Westinghouse Elec. Corp., Newark, N.J.

Meters, Volt, Sampling

Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
NES, Streamwood, Ill. ....*
D Simpson Electric Co., Elgin, Ill. ....*
Weston Instrs., Newark, N.J. ....*
E-H Resch. Labs., Oakland, Cal.
Micro Instrument Co., Escondido, Cal.

Meters, Volt, True RMS

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612
Boonton Electronics Corp., Parsippany, N.J. p. 1•624,625
Clarke-Hess Comm., New York, N.Y. p. 1•636,637
Data Technology, Santa Ana, Cal. .... p. 1•649
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Industrial Test Equip., Port Washington, N.Y. p. 1•729
ITT Jennings, Instrus. & Systems, San Jose, Cal. ....p. 1•740,741
M Kratos, Pasadena, Cal .... p. 1•750
Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
M Ross Engineering Corp., Campbell, Cal. p. 1•1807
D Triplett Corp., Bluffton, Ohio .... p. 1•821
D Yewtec Corporation, Larchmont, N.Y. p. 1•860
Dranetz Engrg. Labs., So. Plainfield, N.J. ....*
Hickok Electrical Instr., Cleveland, Ohio ....*
NES, Streamwood, Ill. ....*
Shigoto Inds., Ltd., New York, N.Y. ....*
DM Systron-Donner Instr. Div., Concord, Cal. ....*
D Weston Instrs., Newark, N.J. ....*
ARGA Controls, Pasedena, Cal.
D Ballantine Laboratories, Boonton, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electrical Standards Div., N. Hollywood, Cal.
Electro-Numerics Corp., Mountain View, Cal.
Faratron Corp., S. Hackensack, N.J.
DM General Electric Co., West Lynn, Mass.
Julie Research Lab., New York, N.Y.
Leader Instruments Corp., Plainview, N.Y.
Non-Linear Sys., Del Mar, Cal.
Q.V.S., East Orange, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensitive Research Instrs., Mt. Vernon, N. Y.
D Thermo Sys., St. Paul, Minn.
Tucker Electronics Co., Garland, Tex.
UFAD Corp., Grand Rapids, Mich.
Valhalla Scientific, San Diego, Cal.

Meters, Volt-Ohm-Milliampere (VOM)

D Dynascan Corp., Chicago, Ill. .... p. 1•611
D Simpson Electric Co., Elgin, Ill. .... p. 1•802-804
D Tekelec Inc., Oxnard, Cal. .... p. 1•815
D Triplett Corp., Bluffton, Ohio .... p. 1•821
D GC Electronics, Rockford, Ill. ....*
Heath Co., Benton Harbor, Mich. ....*
Jonard Industries Corp., Tuckahoe, N.Y. ....*
NES, Streamwood, Ill. ....*
Shigoto Inds., Ltd., New York, N.Y. ....*
D Weston Instrs., Newark, N.J. ....*

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*Company has information in white pages but not on this product

Meters, Volt-Ohm-Milliampere (VOM) (cont'd)

D Amprobe Instr., Lynbrook, N.Y.
M AUL Instrs., Flushng, N.Y.
D Ballantine Laboratories, Boonton, N.J.
Beckman Instrs., Schiller Park, Ill.
Electrical Instr. Svc., Mt. Vernon, N.Y.
D Finney Co., Bedford, Ohio
General Rand Corp., Edison, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Motorola Comms. Div., Schaumburg, Ill.
D Mura Corp., Jericho, N.Y.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
RCA Electronic Comps., Harrison, N.J.
D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
D Uchida of America Corp., New York, N.Y.
D Vidaire Electronics Mfg., Freeport, N.Y.
D Willco Sales, Mineola, N.Y.
D Workman Electronic Prods., Sarasota, Fla.

Meters, Volt-Ohm-Milliamperes (Vom) Digital

D California Instrs. Co., San Diego, Cal. p. 1•627
Data Precision Corporation, Wakefield, Mass p. 1•646,647
D Data Technology, Santa Ana, Cal. p. 1•649,650
D Dynascan Corp., Chicago, Ill. .... p. 1•611
Simpson Electric Co., Elgin, Ill. .... p. 1•803
Heath Co., Benton Harbor, Mich. .... *
NES, Streamwood, Ill. .... *
Hewlett-Packard Co., Palo Alto, Cal.
D JPI, Santa Monica, Cal.
Julie Research Lab., New York, N.Y.
Non-Linear Sys., Del Mar, Cal.
Tekelec, Oxnard, Cal.
Tucker Electronics Co., Garland, Tex.
United Systems, Dayton, Ohio

Meters, VU

D Beede Electrical Instr. Co., Penacook, N.H. p. 1•238,612
Dynamics Elctrn. Prods., Santa Fe Springs, Cal. p. 1•5
D Modutec, Norwalk, Conn. .... p. 1•773-779
Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
D Triplett Corp., Bluffton, Ohio .... p. 1•821
Vu-data Corp., San Diego, Cal. .... p. 1•850
D Weston Instrs., Newark, N.J. .... p. 2•1119
D GC Electronics, Rockford, Ill. .... *
McGraw-Edison Co., Manchester, N.H. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
D Altec Div., Anaheim, Calif.
Dixson, Grand Junction, Colo.
M Ideal Precision Meter Co., Brooklyn, N. Y.
D Int'l. Instrs., Orange, Conn.
Jewell Electrical Instruments, Manchester, N.H.
Mura Corp., Jericho, N.Y.
DM Phaostron Instrument, So. Pasadena, Cal.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
D Shurite Meters, New Haven, Conn.
D Sigma Instruments, Braintree, Mass.
Sunshine Sci. Instrs., Philadelphia, Pa.
Telesis Laboratory, Chillocothe, Ohio

Meters, Watt

Bird Electronic Corp., Solon, Ohio .... p. 1•618
Boonton Electronics Corp., Parsippany, N.J. p. 1•624
Clarke-Hess Comm., New York, N.Y. p. 1•636,637
M Electro Impulse, Red Bank, N.J. p. 1•492,662-666
Electronic Navigation Inds., Rochester, N.Y. p. 1•674-676
Esterline Angus, Indianapolis, Ind. .... p. 1•866
M General Microwave Corp., Farmingdale, NY p. 1•718
M Kratos, Pasadena, Cal .... p. 1•750
D Larson Instr. Co., Orangeburg, N.Y. .... p. 1•756
Marconi Instrs., Northvale, N.J. p. 1•766-771
NES, Streamwood, Ill. .... p. 1•182,183
Ohio Semitronics, Columbus, Ohio p. 1•782,2344,2345
Scientific Columbus, Columbus, Ohio p. 1•2349
D Triplett Corp., Bluffton, Ohio .... p. 1•821
D Yewtec Corporation, Larchmont, N.Y. p. 1•860
Bendix, Franklin, Ind. .... *
D GC Electronics, Rockford, Ill. .... *
D General Elec. Co., Schenectady, N.Y. .... *
Industrial Test Equip., Port Washington, N.Y. *
ISC Magnetics Div., Plainview, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Simpson Electric Co., Elgin, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
ARGA Controls, Pasedena, Cal.
D Barker & Williamson, Bristol, Pa.
D Barnes & Reinecke, Chicago, Ill.
M Cubic Corp., San Diego, Cal.
Dixson, Grand Junction, Colo.
Dynamic Communications, Riviera Beach, Fla.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Faratron Corp., S. Hackensack, N.J.
General Rand Corp., Edison, N.J.
D Macrodyne Inc., Schenectady, N.Y.
Motorola Comms. Div., Schaumburg, Ill.
D NH Research, Santa Ana, Calif.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
Transdata Inc., Columbus, Ohio
Tucker Electronics Co., Garland, Tex.
Westinghouse Elec. Corp., Newark, N.J.
Zi-Tech Div., Palo Alto, Cal.

Meters, Watt-Hour

Ohio Semitronics, Columbus, Ohio p. 1•782,783
D General Elec. Co., Schenectady, N.Y. .... *
NES, Streamwood, Ill. .... *
D Weston Instrs., Newark, N.J. .... *
Panasonic SPD Div., New York, N.Y.

Meters, Wave

M General Microwave Corp., Farmingdale, NY .... *
D Millen Mfg. Co. Inc., James, Malden, Mass. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
D Weston Instrs., Newark, N.J. .... *
Frequency Engrg. Labs., Farmingdale, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Narda Microwave Corp., Plainview, N.Y.
D PRD Elctrns., Syosset, N.Y.
M Premier Microwave, Port Chester, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Telonic Altair, Laguna Beach, Calif.
Tucker Electronics Co., Garland, Tex.

Meters, Waveguide—See Meters, Microwave

Microcircuit Production Equip.

Qualco, Los Altos, Cal. .... p. 2•791
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Cal.
D CVC Products, Rochester, N.Y.
Electro Sci. Inds., Portland, Ore.
Environmental Communications Inc., Costa Mesa, Cal.
GCA/David W. Mann, Burlington, Mass.
Headway Research, Garland, Tex.
DM Hughes Aircraft Co., Oceanside, Cal.
D Hull Corp., Hatboro, Pa.
IPT Corp., Sunnyvale, Cal.
Materials Resch. Corp., Orangeburg, N.Y.
D Quantrad Corporation, El Segundo, Cal.
Research Instrument Co., Garden City, N. Y.
Sel-Rex Co. Div. Oxy Metal Industries Corp., Nutley, N.J.

Microcircuits—See IC's; Circuits, Hybrid

Microphone Accessories (Including Stands, Holders, Booms)

D Microtran Co., Valley Stream, N.Y. ... p. 2•1763
DM Primo Company Ltd., Tokyo, Japan .... p. 1•30
D GC Electronics, Rockford, Ill. .... *
General Radio Co., Concord, Mass. .... *
M Adec Inc., Fairfield, N.J.
D AKG Div., New York, N.Y.
D Astatic Corp., Conneaut, Ohio
D Atlas Sound Div., Parsippany, N.J.
M Audiosears Corp., Stamford, N.Y.
B & K Instruments, Cleveland, Ohio
D Bogen Div., Paramus, N.J.
Dukane Corp., St. Charles, Ill.
Electro-Voice, Buchanan, Mich.
D Herald Electronics, Chicago, Ill.
D N T-T/Peerless, Leominister, Mass.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
Precision Electronics, Franklin Park, Ill
D Primo Microphone Inc., Elk Grove Village, Ill.
D R-Columbia Products, Highland Park, Ill.
D Sennheiser Elctrn. Corp., New York, N.Y.
D Sescom, Gardena, Cal.
D Shure Brothers, Evanston, Ill.
D Telex Communications, Minneapolis, Minn.
D Turner Div., Cedar Rapids, Iowa

Microphones, Carbon

D GC Electronics, Rockford, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Astatic Corp., Conneaut, Ohio
M Audiosears Corp., Stamford, N.Y.
Aviatech Intl. Inc., Holbrook, N.Y.
Conrac Corp., Cedar Rapids, Iowa
D Electro-Voice, Buchanan, Mich.
Telephonics, Div, Huntington, N.Y.
D Midwest Electronic Industries, Chicago, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D R-Columbia Products, Highland Park, Ill.
Shure Brothers, Evanston, Ill.
D Telex Communications, Minneapolis, Minn.
D Turner Div., Cedar Rapids, Iowa

Microphones, Cardioid

D GC Electronics, Rockford, Ill. .... *
Heath Co., Benton Harbor, Mich. .... *
Primo Company Ltd., Tokyo, Japan .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D AKG Div., New York, N.Y.
D Altec Div., Anaheim, Calif.
D Astatic Corp., Conneaut, Ohio
Audiotronics, N. Hollywood, Cal.
D Bogen Div., Paramus, N.J.
Conrac Corp., Cedar Rapids, Iowa
Dukane Corp., St. Charles, Ill.
Electro-Voice, Buchanan, Mich.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
D Gotham Audio Corp., New York, N.Y.
Knowles Elctrns., Franklin Park, Ill.
D Midland International Corp., No. Kansas City, Mo.
D Mura Corp., Jericho, N.Y.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D PASO Sound Products Inc., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Primo Microphone Inc., Elk Grove Village, Ill.
D R-Columbia Products, Highland Park, Ill.
RCA Corp., Camden, N.J.
D Recoton Corp., Long Island City, N.Y.
D Sennheiser Elctrn. Corp., New York, N.Y.
D Shure Brothers, Evanston, Ill.
D Turner Div., Cedar Rapids, Iowa
University Sound, Anaheim, Cal.
D Vidaire Electronics Mfg., Freeport, N.Y.

Microphones, Ceramic

M Primo Company Ltd., Tokyo, Japan .... p. 1•30
D GC Electronics, Rockford, Ill. .... *
General Radio Co., Concord, Mass. .... *
Heath Co., Benton Harbor, Mich. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Astatic Corp., Conneaut, Ohio
D Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Buchanan, Mich.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
Knowles Elctrns., Franklin Park, Ill.
Linden Labs., State College, Pa.
D Midwest Electronic Industries, Chicago, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Primo Microphone Inc., Elk Grove Village, Ill.
DM Saxton Prods., Congers, N.Y.
D Shure Brothers, Evanston, Ill.
Superex Electronics Corp., Yonkers, N.Y.
D Telex Communications, Minneapolis, Minn.
D Turner Div., Cedar Rapids, Iowa

Microphones, Condenser

DM Primo Company Ltd., Tokyo, Japan .... p. 1•30
D GC Electronics, Rockford, Ill. .... *
General Radio Co., Concord, Mass. .... *
Heath Co., Benton Harbor, Mich. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D AKG Div., New York, N.Y.
D Altec Div., Anaheim, Calif.
B & K Instruments, Cleveland, Ohio
Conrac Corp., Cedar Rapids, Iowa
Dynalab Corp., Van Nuys, Cal.
Electro-Voice, Buchanan, Mich.
D Gotham Audio Corp., New York, N.Y.
D Herald Electronics, Chicago, Ill.
Knowles Elctrns., Franklin Park, Ill.
D Mura Corp., Jericho, N.Y.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Primo Microphone Inc., Elk Grove Village, Ill.
D Sennheiser Elctrn. Corp., New York, N.Y.
Shure Brothers, Evanston, Ill.

Microphones, Crystal

M Primo Company Ltd., Tokyo, Japan .... p. 1•30
D GC Electronics, Rockford, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Astatic Corp., Conneaut, Ohio
Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Cedar Rapids, Iowa
D Midland International Corp., No. Kansas City, Mo.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D R-Columbia Products, Highland Park, Ill.

DM Saxton Prods., Congers, N.Y.
D Vidaire Electronics Mfg., Freeport, N.Y.

Microphones, Dynamic

DM **Primo Company Ltd., Tokyo, Japan** ....p. 1•30
D **GC Electronics, Rockford, Ill.** .... *
Heath Co., Benton Harbor, Mich. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
M Adec Inc., Fairfield, N.J.
D AKG Div., New York, N.Y.
D Altec Div., Anaheim, Calif.
D Astatic Corp., Conneaut, Ohio
M Audiosears Corp., Stamford, N.Y.
Audiotronics, N. Hollywood, Cal.
Aviatech Intl. Inc., Holbrook, N.Y.
D Bogen Div., Paramus, N.J.
Conrac Corp., Cedar Rapids, Iowa
D Ev-Game Inc., Freeport, N.Y.
D Electro-Voice, Buchanan, Mich.
M Gulton Inds., Costa Mesa, Cal.
D Herald Electronics, Chicago, Ill.
M International Importers, Chicago, Ill.
Telephonics, Div, Huntington, N.Y.
Kulite Semiconductor Prod., Ridgefield, N.J.
D Linear Systems, Watsonville, Cal.
D Midland International Corp., No. Kansas City, Mo.
D Midwest Electronic Industries, Chicago, Ill.
Motorola Comms. Div., Schaumburg, Ill.
D Mura Corp., Jericho, N.Y.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D PASO Sound Products Inc., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Primo Microphone Inc., Elk Grove Village, Ill.
D R-Columbia Products, Highland Park, Ill.
RCA Corp., Camden, N.J.
D Recoton Corp., Long Island City, N.Y.
D Rye Inds., Mamaroneck, N.Y.
DM Saxton Prods., Congers, N.Y.
D Sennheiser Elctrn. Corp., New York, N.Y.
D Shure Brothers, Evanston, Ill.
Superex Electronics Corp., Yonkers, N.Y.
D Telex Communications, Minneapolis, Minn.
D Turner Div., Cedar Rapids, Iowa
University Sound, Anaheim, Cal.
D Vidaire Electronics Mfg., Freeport, N.Y.

Microphones, Lavalier

D **GC Electronics, Rockford, Ill.** .... *
Primo Company Ltd., Tokyo, Japan .... *
D AKG Div., New York, N.Y.
D Astatic Corp., Conneaut, Ohio
Dukane Corp., St. Charles, Ill.
Electro-Voice, Buchanan, Mich.
D PASO Sound Products Inc., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Primo Microphone Inc., Elk Grove Village, Ill.
D Sennheiser Elctrn. Corp., New York, N.Y.
D Shure Brothers, Evanston, Ill.
D Turner Div., Cedar Rapids, Iowa
D Vidaire Electronics Mfg., Freeport, N.Y.
D Workman Electronic Prods., Sarasota, Fla.

Microphones, Magnetic

Primo Company Ltd., Tokyo, Japan .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
Audiosears Corp., Stamford, N.Y.
Aviatech Intl. Inc., Holbrook, N.Y.
Conrac Corp., Cedar Rapids, Iowa
Knowles Elctrns., Franklin Park, Ill.
D Primo Microphone Inc., Elk Grove Village, Ill.
D Rye Inds., Mamaroneck, N.Y.
D Sennheiser Elctrn. Corp., New York, N.Y.
D Shure Brothers, Evanston, Ill.
D Workman Electronic Prods., Sarasota, Fla.

Microphones, Omnidirectional

DM **Primo Company Ltd., Tokyo, Japan** ....p. 1•30
D **GC Electronics, Rockford, Ill.** .... *
General Radio Co., Concord, Mass. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D AKG Div., New York, N.Y.
D Astatic Corp., Conneaut, Ohio
B & K Instruments, Cleveland, Ohio
D Columbia Resch. Labs., Woodlyn, Pa.
Electro-Voice, Buchanan, Mich.
Knowles Elctrns., Franklin Park, Ill.
Metrosonics, Rochester, N.Y.
D Midland International Corp., No. Kansas City, Mo.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D PASO Sound Products Inc., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Primo Microphone Inc., Elk Grove Village, Ill.
D Sennheiser Elctrn. Corp., New York, N.Y.
D Sescom, Gardena, Cal.
D Shure Brothers, Evanston, Ill.
D Turner Div., Cedar Rapids, Iowa
D Workman Electronic Prods., Sarasota, Fla.

Microphones, Velocity

D Altec Div., Anaheim, Calif.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
RCA Corp., Camden, N.J.
Shure Brothers, Evanston, Ill.

Microphones, Wireless

DM **Primo Company Ltd., Tokyo, Japan** ....p. 1•30
Shigoto Inds., Ltd., New York, N.Y. .... *
Dukane Corp., St. Charles, Ill.
D Ev-Game Inc., Freeport, N.Y.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
D Mura Corp., Jericho, N.Y.
D PASO Sound Products Inc., New York, N.Y.
D Sennheiser Elctrn. Corp., New York, N.Y.

Microscopes

Jonard Industries Corp., Tuckahoe, N.Y. .... *
American Optical Corp., Buffalo, N.Y.
D Bausch & Lomb, Rochester, N.Y.
Circon Corp., Santa Barbara, Cal.
M Edmund Scientific Co., Barrington, N.J.
Esco Products, Oak Ridge, NJ
Gaertner Scientific Corp., Chicago, Ill.
Gamma Scientific Inc., San Diego, Cal.
D Hacker Instrs., Fairfield, N.J.
Laser Inc., Sturbridge, Mass.
M Lenox Instr. Co., Philadelphia, Pa.
D Olympus Corp. America, New Hyde Park, N.Y.
Opto-Metric Tools, Rockleigh, N.J.
Research Instrument Co., Garden City, N. Y.
Techni-Tool, Plymouth Meeting, Pa.
Tescom Instr. Div., Minneapolis, Minn.
D Titan Tool Supply Co., Buffalo, N.Y.
D Unitron Scientific, Newton Highlands, Mass.

Microscopes, Infrared

Barnes Engrg. Co., Stamford, Conn.
Research Devices, Berkeley Heights, N.J.
Research Instrument Co., Garden City, N. Y.

Microscopes, Measuring

CELCO, Mahwah, N.J. .... p. 1•630
American Optical Corp., Buffalo, N.Y.
Circon Corp., Santa Barbara, Cal.
M Edmund Scientific Co., Barrington, N.J.
Gaertner Scientific Corp., Chicago, Ill.
Hacker Instrs., Fairfield, N.J.
Laser Inc., Sturbridge, Mass.
M Lenox Instr. Co., Philadelphia, Pa.
National Camera Inc., Englewood, Colo.
D Olympus Corp. America, New Hyde Park, N.Y.
Opto-Metric Tools, Rockleigh, N.J.
D Titan Tool Supply Co., Buffalo, N.Y.
D Unitron Scientific, Newton Highlands, Mass.

Microware Comb Generator—See Generators, Microwave

Microwave Integrated Circuits (MIC's)—See Volume 2

Mismatches, Microwave, Precision—See Volume 2

Mixer-Preamplifiers, Microwave—See Volume 2

Mixers, Audio

M **Solid State Electronics Corp., Sepulveda, Cal.** p. 1•126
Vari-L Co., Denver, Colo. .... p. 2•1392-1400
M **General Instruments Corp., Hicksville, N.Y.** ..... *
D Altec Div., Anaheim, Calif.
Ampex Corp., Redwood City, Cal.
D Bogen Div., Paramus, N.J.
Collins Radio, Dallas, Tex.
D Davis & Co., J.W., Dallas, Tex.
Dukane Corp., St. Charles, Ill.
Environmental Communications Inc., Costa Mesa, Cal.
D Fairchild Sound Equip., Commack, N.Y.
D Frazier, Dallas, Tex.
Gotham Audio Corp., New York, N.Y.
D Herald Electronics, Chicago, Ill.
D Lithic Systems, Saratoga, Cal.
D PASO Sound Products Inc., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
D Primo Microphone Inc., Elk Grove Village, Ill.
D Russco Electronics Mfg. Inc., Clovis, Cal.
D Shure Brothers, Evanston, Ill.
D Spectra Sonics, Ogden, Utah
D Switchcraft, Chicago, Ill.
D Vidaire Electronics Mfg., Freeport, N.Y.

Mixers, Microwave—See Volume 2

Mixers, R-F—See Volume 2

Modems—See Modulator/Demodulators, Data

Modulation Transfer Analyzers—See Analyzers, Transfer Function

Modulator/Demodulators, Data

M **Computer Conversions Corp., East Northport, N.Y.** .... p. 1•154,155
M **Control Technology Co., L.I.C., N.Y.** p. 1•1914,1915
General Magnetics, Bloomfield, N.J. p. 1•246,247
Hybrid Systems Corp., Burlington, Mass. p. 1•170
M **Natel Engineering Co., Canoga Park, Cal.** p. 1•184-187
Re-el Circuits, Saddle Brook, N.J. .... p. 1•123
RFL Inds., Boonton, N.J. .... p. 1•122
M **Solid State Electronics Corp., Sepulveda, Cal.** p. 1•126
Vari-L Co., Denver, Colo. .... p. 2•1392-1400
M **Analog Devices, Norwood, Mass.** .... *
M **General Microwave Corp., Farmingdale, NY** ..... *
NES, Streamwood, Ill. .... *
All Systems, Moorestown, N.J.
Almond Instrs. Co., Covina, Cal.
DM Anaren Microwave, Syracuse, N.Y.
Anderson Jacobson, Sunnyvale, Cal.
Beta Technology, Farmingdale, N.Y.
Burroughs Corp., Pasadena, Cal.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Climatronics Corp., Hauppauge, N.Y.
D Codex Corp., Newton, Mass.
Data-Control Systems, Danbury, Conn.
Environmental Communications Inc., Costa Mesa, Cal.
Frederick Electronics Corp., Frederick, Md.
General Instrument Corp., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Honeywell, Minneapolis, Minn.
Hughes Aircraft Co, Culver City, Cal.
International Communications, Miami, Fla.
Livermore Data Systems, Livermore, Cal.
MI2 Data Systems Inc., Columbus, Ohio
Milgo Electronic Corp., Miami, Fla.
Mohawk OEM Sales, King of Prussia, Pa.
D National Semiconductor Corp., Santa Clara, Cal.
Omnitec Corporation, Phoenix, Ariz.
M OPT Inds. Inc., Phillipsburg, N.J.
Rockwell Int'l., Anaheim, Cal.
Sanders Associates, Nashua, N.H.
Singer - Tele-Signal, Woodbury, N.Y.
Tasker Systems, Chatsworth, Cal.
TTS, Santa Monica, Cal.

Modulator/Demodulators, Laser

Fork Standards, West Chicago, Ill. p. 1•320,321
American Time Products, Bulova Watch, Woodside, N.Y. .... *
Andersen Labs., Bloomfield, Conn. .... *
Andersen & Assoc., Walther M.A., Tariffville, Conn.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
Industrial Products Div., Orlando, Fla.
Kappa Scientific Corp., Santa Barbara, Cal.
Quantronix Corp., Smithtown, N.Y.
Radiation Devices Co., Baltimore, Md.
Union Carbide Corp., New York, N.Y.

Modulators, A-M

Clarke-Hess Comm., New York, N.Y. p. 1•636,637
M **Control Technology Co., L.I.C., N.Y.** p. 1•1914,1915
D **General Magnetics, Bloomfield, N.J.** p. 1•246,247
Mini-Circuits Lab., Brooklyn, N.Y. .....p. 2•1291
M **Solid State Electronics Corp., Sepulveda, Cal.** p. 1•126
M **Transmagnetics, Farmingdale, N.Y.** .....p. 1•124
Vari-L Co., Denver, Colo. .... p. 2•1392-1400
M **General Instruments Corp., Hicksville, N.Y.** ..... *
M **General Microwave Corp., Farmingdale, NY** ..... *
Industrial Test Equip., Port Washington, N.Y. *
Millen Mfg. Co. Inc., James, Malden, Mass. .... *
Polarad Elctrn. Instrs., Lake Success, N.Y. ..... *
DM Anaren Microwave, Syracuse, N.Y.
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
Environmental Communications Inc., Costa Mesa, Cal.
Feedback, Berkeley Hghts., N.J.

*Company has information in white pages but not on this product

D Lithic Systems, Saratoga, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Microwave Power Devices, Plainview, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

Modulators, F-M

M Solid State Electronics Corp., Sepulveda, Cal. **p. 1•126**
M General Instruments Corp., Hicksville, N.Y. .....*
Industrial Test Equip., Port Washington, N.Y. *
All Systems, Moorestown, N.J.
Almond Instrs. Co., Covina, Cal.
DM Anaren Microwave, Syracuse, N.Y.
Climatronics Corp., Hauppauge, N.Y.
Data-Control Systems, Danbury, Conn.
Dynalab Corp., Van Nuys, Cal.
D Eimac, San Carlos, Calif.
Environmental Communications Inc., Costa Mesa, Cal.
GTE Lenkurt Inc., San Carlos, Calif.
D Lithic Systems, Saratoga, Cal.
Microwave Power Devices, Plainview, N.Y.
D National Semiconductor Corp., Santa Clara, Cal.
Palomar Engrs., Escondido, Cal.
Plessey Semiconductors, Santa Ana, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.

Modulators, Light

M Philamon, Farmingdale, N.Y. .... p. 1•1020
American Time Products, Bulova Watch, Woodside, N.Y. ....*
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ....*
Cleveland Crystals, Euclid, Ohio
Controlcraft Corp., West Chicago, Ill.
Crystal Technology, Mountain View, Cal
Electro-Optical Inds., Santa Barbara, Cal.
GTE Sylvania Inc., Washington, D.C.
D Scientific Technology, Mountain View, Cal.
Singer Co., State College, Pa.

Modulators, Magnetic

Computer Conversions Corp., East Northport, N.Y. ....p. 1•154,155
General Magnetics, Bloomfield, N.J. ... p. 1•246
M Transmagnetics, Farmingdale, N.Y. .....p. 1•124
Tasker Systems, Chatsworth, Cal.

Modulators, Microwave

Applied Microwave, Westwood, Mass. **p. 1•901-904**
Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
Cober Elctrns., Stamford, Conn. ...p. 1•906,907
M General Microwave Corp., Farmingdale, NY **p. 1•718**
MCL, LaGrange, Ill. .... p. 1•920,921
Vari-L Co., Denver, Colo. .... p. 2•1392-1400
All Systems, Moorestown, N.J.
M Airtron, Morris Plains, N.J.
American Microwave Inds., Waltham, Mass.
DM Anaren Microwave, Syracuse, N.Y.
Aydin Energy Systems, Palo Alto, Cal.
Collins Radio, Dallas, Tex.
D Elctrn. Enterprises, Newark, N.J.
Environmental Communications Inc., Costa Mesa, Cal.
M GHZ Devices, So. Chelmsford, Mass.
GTE Lenkurt Inc., San Carlos, Calif.
M Hughes Aircraft Co., Torrance, Cal.
Hughes Aircraft Co, Fullerton, Cal.
Litton Inds., San Carlos, Calif.
Megavolt, New York, N.Y.
M Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
Microwave Power Devices, Plainview, N.Y.
Narda Microwave Corp., Plainview, N.Y.
M Norsal Industries, Brentwood, N.Y.
M Premier Microwave, Port Chester, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Co., State College, Pa.
Sivers Lab, Corona del Mar, Cal.
M Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
D TRG,, Woburn, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.
M Watkins-Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

Modulators, Phase

M Computer Conversions Corp., East Northport, N.Y. ....p. 1•154,155
M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
General Magnetics, Bloomfield, N.J. .... *
All Systems, Moorestown, N.J.
DM Anaren Microwave, Syracuse, N.Y.
Beta Technology, Farmingdale, N.Y.
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
Elctrn. Comm., St. Petersburg, Fla.
Engelmann Microwave, Montville, N.J.
Environmental Communications Inc., Costa Mesa, Cal.
M GHZ Devices, So. Chelmsford, Mass.
M Glentek, Santa Monica, Calif.
Maxwell Labs., San Diego, Calif.
M Merrimac Inds., West Caldwell, N.J.
Microwave Power Devices, Plainview, N.Y.
Singer Co., State College, Pa.
Special Microwave Devices Oper., Waltham, Mass.
Theta Instr. Corp., Fairfield, N.J.

Modulators, Pulse

Applied Microwave, Westwood, Mass. **p. 1•901-904**
Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
Cober Elctrns., Stamford, Conn. ...p. 1•906,907
M Del Electronics Corp., Mt. Vernon, N.Y. **p. 1•1176**
M General Microwave Corp., Farmingdale, NY **p. 1•718**
MCL, LaGrange, Ill. .... p. 1•920,921
Polarad Elctrn. Instrs., Lake Success, N.Y. **p. 1•784,785**
Vari-L Co., Denver, Colo. .... p. 2•1392-1400
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... *
M General Instruments Corp., Hicksville, N.Y. .....*
Advanced Kinetics, Costa Mesa, Calif.
AEL, Colmar, Pa.
Amp Inc., Harrisburg, Pa.
Aydin Energy Systems, Palo Alto, Cal.
Beta Technology, Farmingdale, N.Y.
D Carco Elctrns., Menlo Park, Calif.
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
D Eimac, San Carlos, Calif.
M GHZ Devices, So. Chelmsford, Mass.
Hughes Aircraft Co, Fullerton, Cal.
Instrument Research Co., Lincoln, Mass.
Litton Inds., San Carlos, Calif.
Maxwell Labs., San Diego, Calif.
Megavolt, New York, N.Y.
Microwave Power Devices, Plainview, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Rantec Div.; Calabasas, Calif.
Singer Co., State College, Pa.
Special Microwave Devices Oper., Waltham, Mass.
Tasker Systems, Chatsworth, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Velonex, Instrument Div., Santa Clara, Cal.

Modulators, R-F

Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
M Del Electronics Corp., Mt. Vernon, N.Y. **p. 1•1176**
M General Microwave Corp., Farmingdale, NY **p. 1•718**
Vari-L Co., Denver, Colo. .... p. 2•1392-1400
M General Instruments Corp., Hicksville, N.Y. .....*
American Microwave Inds., Waltham, Mass.
DM Anaren Microwave, Syracuse, N.Y.
Aydin Energy Systems, Palo Alto, Cal.
Blonder-Tongue Labs., Old Bridge, N.J.
Collins Radio, Dallas, Tex.
D Dynair Elctrns. Inc., San Diego, Calif.
Dynalab Corp., Van Nuys, Cal.
D Eimac, San Carlos, Calif.
Elctrn. Comm., St. Petersburg, Fla.
D Elctrn. Enterprises, Newark, N.J.
Environmental Communications Inc., Costa Mesa, Cal.
M GHZ Devices, So. Chelmsford, Mass.
D Jerrold Electronics Corp., Horsham, Pa.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
M Merrimac Inds., West Caldwell, N.J.
M Microlab/FXR, Livingston, N.J.
Microwave Power Devices, Plainview, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
M Premier Microwave, Port Chester, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
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D Cambridge Thermionic Corp., Cambridge, Mass.
M Columbia Components, Hempstead, N.Y.
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D Data Translation, Framingham, Mass.
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Hughes Aircraft Co, Culver City, Cal.
D Intech, Santa Clara, Cal.
M Kates Scientific Instrs., Newton, Mass.
Microphase Corp., Cos Cob, Conn.
D NAMCO CONTROLS, Cleveland, Ohio
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Environmental Communications Inc., Costa Mesa, Cal.
Frequency Engrg. Labs., Farmingdale, N.J.
DM Guardian Electric Co. of Cal., Torrance, Cal.
Hartman Electrical Mfg., Mansfield, Ohio
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D Simpson Electric Co., Elgin, Ill. *
M Acromag, Wixom, Mich.
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ARGA Controls, Pasedena, Cal.
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M Dynamic Controls Corp., S. Windsor, Conn.
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D Amprobe Instr., Lynbrook, N.Y.
ARGA Controls, Pasedena, Cal.
Barber-Colman Co., Rockford, Ill.
DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
Burling Instr. Co., Chatham, N.J.
M Cardion Elctrns., Woodbury, N.Y.
Chatham Controls Corp., Chatham, N.J.
Climatronics Corp., Hauppauge, N.Y.
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Cox & Co., New York, N.Y.
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D Delta Design, San Diego, Cal
Doric Sci. Corp., San Diego, Calif.
Edison, Instr. Div., W. Orange, N.J.
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Gordon, Claud S. Co., Richmond, Ill.
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D Helm Instr. Co., Toledo, Ohio
Hy-Cal Engineering, Santa Fe Springs, Cal
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D LFE Corporation, Waltham, Mass.
Mag-Con, New Brighton, Minn.
D Metra Instruments, Mt. View, Cal.
Metric Systems Corp., Ft. Walton Beach, Fla.
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Micro Devices Corp., Dayton, Ohio
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Princeton Applied Resch. Corp., Princeton, N.J.
Robertshaw Controls Co., Richmond, Va.
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Trans-Met Engrg., La Habra, Cal.
United Systems, Dayton, Ohio
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M Bay Laboratories, Cleveland, Ohio
D Consolidated Controls Corp., Bethel, Conn.
Doric Sci. Corp., San Diego, Calif.
Gordon, Claud S. Co., Richmond, Ill.
D Helm Instr. Co., Toledo, Ohio
Howell Inst. Inc., Ft. Worth, Tex.

Hy-Cal Engineering, Santa Fe Springs, Cal
Int'l. Instrs., Orange, Conn.
Leeds & Northrup Co., North Wales, Pa.
D LFE Corporation, Waltham, Mass.
Metrix Instrument Co., Houston, Tex.
Narda Microwave Corp., Plainview, N.Y.
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D A E G Telefunken, Englewood Clfs., N.J.
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Beta Technology, Farmingdale, N.Y.
Circon Corp., Santa Barbara, Cal.
Conrac Div., Covina, Calif.
Edo Western Corp., Salt Lake City, Utah
D GBC - Closed Circuit TV, New York, N.Y.
General Electrodynamics Corp., Garland, Tex.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
D Javelin Div., Los Angeles, Cal.
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M Dynamic Controls Corp., S. Windsor, Conn.
Environmental Communications Inc., Costa Mesa, Cal.
DM Guardian Electric Co. of Cal., Torrance, Cal.
Hartman Electrical Mfg., Mansfield, Ohio
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D Keithley Instruments Inc., Cleveland, Ohio
Logitek, Farmingdale, N.Y.
Mag-Con, New Brighton, Minn.
Metrix Instrument Co., Houston, Tex.
Micro Instrument Co., Escondido, Cal.
M Microlab/FXR, Livingston, N.J.
D NH Research, Santa Ana, Calif.
Non-Linear Sys., Del Mar, Cal.
PECO Corp., Milpitas, Cal.
D Power Control Corp., Pittsburgh, Pa.
Power Systems & Controls, Richmond, Va.
Programmed Power, Menlo Park, Cal.
Richard-Lee Co., New Providence, N.J.
Sigma Instruments, Braintree, Mass.
Struthers-Dunn, Bettendorf, Iowa
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M American Electronics, Fullerton, Cal.
EEMCO Div., Los Angeles, Cal.
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Magnetic Metals Co., Camden, N.J.
Reliance Electric Co., Cleveland, Ohio
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CML-Macarr, Edison, N.J. *
D **Electro-Craft Corp., Hopkins, Minn.** *
General Elec. Co., Schenectady, N.Y. *
M Ajax Magnethermic Corp., Warren, Ohio
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M American Electronics, Fullerton, Cal.
Applied Motors Inc., Rockford, Ill.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Kato Engineering Co., Mankato, Minn.
Lear Siegler, Santa Monica, Calif.
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Power Systems & Controls, Richmond, Va.
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TRW/Globe Motors, Dayton, Ohio *
Astro Dynamics, Burlington, Mass.
Brailsford & Co., Rye, N.Y.
Eastern Air Devices Motor Div., Dover, N.H.
EEMCO Div., Los Angeles, Cal.
Haydon Switch & Instr., Waterbury, Conn.
ITT Comps. Grp., N. Andover, Mass.
D Lear Siegler, Elyria, Ohio
D Reliance Electric Co., Cleveland, Ohio
Sigma Instruments, Braintree, Mass.
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Western Gear Corp., City of Industry, Cal

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D **Precision Timer Co., Westbrook, Conn.** *
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Sodeco Div., Elmsford, N.Y. *
TRW/Globe Motors, Dayton, Ohio *
Acrodyne Controls, Janesville, Wisc.
M American Electronics, Fullerton, Cal.
Bowman Electrical Prods. Corp., Chicago, Ill.
D Bristol Saybrook Co., Old Saybrook, Conn.
ECM Motor Co., Schaumburg, Ill.
General Time Corp., Thomaston, Conn.
Hansen Mfg. Co., Princeton, Ind.
Haydon Switch & Instr., Waterbury, Conn.
D Hurst Mfg. Corp., Princeton, Ind.
Ingraham Div., Bristol, Conn.
Mallory Timers, Indpls., Ind.
Molon Motors & Coil Corp., Rolling Meadows, Ill.
DM North American Philips Controls Corp., Cheshire, Conn.
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CML-Macarr, Edison, N.J. *
D **Electro-Craft Corp., Hopkins, Minn.** *
TRW/Globe Motors, Dayton, Ohio *
M American Electronics, Fullerton, Cal.
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
D Carter Motor Co., Chicago, Ill.
Control Systems Research, Pittsburgh, Pa.
D Control Products Div., Union, N.J.
Eaton Corp., Cleveland, Ohio
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
Gentron Corp., Milwaukee, Wisc.
D GTE Sylvania Inc., Waltham, Mass.
Hartman Electrical Mfg., Mansfield, Ohio
Haydon Switch & Instr., Waterbury, Conn.
Honeywell, Ft. Washington, Pa.
D Hurst Mfg. Corp., Princeton, Ind.
M IMC Magnetics Corp., Maywood, Cal.
D Inertial Motors Corp., Doylestown, Pa.
Instr. & Control Sys., Addison, Ill.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Japanese Prods. Corp., Elmsford, N.Y.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
DM North American Philips Controls Corp., Cheshire, Conn.
M Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
D Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Sequential Information Systems, Elmsford, N.Y.
M Servotronics, Buffalo, N.Y.
Sigma Instruments, Braintree, Mass.
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.
Triac Electronics, New York, N.Y.
D Wadsworth Electric Mfg. Co., Covington, Ky.

Motors, Drag Cup

I M C Magnetics, Westbury, N.Y. p. 1•964
M **Rotating Components Div., Plainview, N.Y. p. 1•979**
M **Vernitech, Deer Pk., N.Y. p. 1•999,1920**
M **Aeroflex Labs., Plainview, N.Y.** *
M American Electronics, Fullerton, Cal.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
M Harowe Servo Controls, W. Chester, Pa.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.

Motors, Fractional Horsepower

M **Aeroflex Labs., Plainview, N.Y. p. 1•929-931**
M **Ashland Elec. Prods., L.I.C., N.Y. p. 1•934-937**
D **Bodine Electric Co., Chicago, Ill. p. 1•938**
D **Canon U.S.A., Lake Success, N.Y. p. 1•942**
DM **Cramer Division, Old Saybrook, Conn. p. 1•943**

General Elec. Co., Schenectady, N.Y. p. 1•958,959
Horizons International, Menlo Park, Cal. p. 1•962,963
I M C Magnetics, Westbury, N.Y. .... p. 1•964
Inland Motor Div. Kollmorgen, Rockford, Va. p. 1•968,969
M Magnetic Technology, Canoga Pk., Cal. p. 1•972,973
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M Sierracin/Magnedyne Inc., Carlsbad, Calif. p. 1•983
Torque Systems, Waltham, Mass. p. 1•992,993
M Wertronix Corp., Dayton, Ohio .... p. 1•998
D Electro-Craft Corp., Hopkins, Minn. .... *
D Precision Timer Co., Westbrook, Conn. ....*
M Rotating Components Div., Plainview, N.Y. .....*
Shigoto Inds., Ltd., New York, N.Y. .... *
TRW/Globe Motors, Dayton, Ohio .... *
M Varo, Santa Barbara, Cal. ....*
D Airtrol Corp., Rockton, Ill.
Alliance Mfg. Co., Alliance, Ohio
M American Electronics, Fullerton, Cal.
Ametek/Lamb Electric, Kent, Ohio
Applied Motors Inc., Rockford, Ill.
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
Bowman Electrical Prods. Corp., Chicago, Ill.
D Carter Motor Co., Chicago, Ill.
Control Systems Research, Pittsburgh, Pa.
D Control Products Div., Union, N.J.
Eastern Air Devices Motor Div., Dover, N.H.
Eaton Corp., Cleveland, Ohio
Elden Mfg. Co., Chicago, Ill.
Electric Indicator Co., Norwalk, Conn.
D ECM Motor Co., Schaumburg, Ill.
General Time Corp., Thomaston, Conn.
Hankscraft Co., Reedsburg, Wisc.
M Hathaway Industries Inc., Tulsa, Okla.
Haydon Switch & Instr., Waterbury, Conn.
Howard Industries, Milford, Ill.
D Hurst Mfg. Corp., Princeton, Ind.
Indiana Gen'l. Div., Oglesby, Ill.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
D Japanese Prods. Corp., Elmsford, N.Y.
Jerome Industries Corp., Orange, N.J.
Lear Siegler, Santa Monica, Calif.
Lundy Elctrns. & Sys., Glen Head, N.Y.
Molon Motors & Coil Corp., Rolling Meadows, Ill.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
DM North American Philips Controls Corp., Cheshire, Conn.
D Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Sequential Information Systems, Elmsford, N.Y.
Sigma Instruments, Braintree, Mass.
Singer Co., Little Falls, N.J.
Vibrac Corp., Chelmsford, Mass.
DM Welco Inds. Inc., Cincinnati, Ohio
Western Gear Corp., City of Industry, Cal

Motors, Gearhead

M Ashland Elec. Prods., L.I.C., N.Y. p. 1•934-937
D Bodine Electric Co., Chicago, Ill. .... p. 1•938
D Canon U.S.A., Lake Success, N.Y. ......p. 1•942
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Dale Elctrns., Yankton, S.D. ....p. 2•1452
D Electro-Craft Corp., Hopkins, Minn. .... p. 1•948
General Elec. Co., Schenectady, N.Y. p. 1•958
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M Rotating Components Div., Plainview, N.Y. p. 1•979
Servo-Tek Prods. Co., Hawthorne, N.J. p. 1•980,981
M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
M Wertronix Corp., Dayton, Ohio .... p. 1•998
M Aeroflex Labs., Plainview, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
TRW/Globe Motors, Dayton, Ohio .... *
M Varo, Santa Barbara, Cal. ....*
Alliance Mfg. Co., Alliance, Ohio
M American Electronics, Fullerton, Cal.
Ametek/Lamb Electric, Kent, Ohio
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
D Bristol Saybrook Co., Old Saybrook, Conn.
D Carter Motor Co., Chicago, Ill.
M Clifton Precision, Clifton Hgts., Pa.
M Doerr Electric Corp., Cedarburg, Wisc.
Eastern Air Devices Motor Div., Dover, N.H.
Eaton Corp., Cleveland, Ohio
EEMCO Div., Los Angeles, Cal.
Elden Mfg. Co., Chicago, Ill.
Electric Indicator Co., Norwalk, Conn.
D ECM Motor Co., Schaumburg, Ill.
Hankscraft Co., Reedsburg, Wisc.
Hansen Mfg. Co., Princeton, Ind.
M Harowe Servo Controls, W. Chester, Pa.
M Hathaway Industries Inc., Tulsa, Okla.
Howard Industries, Milford, Ill.
D Hurst Mfg. Corp., Princeton, Ind.
Indiana Gen'l. Div., Oglesby, Ill.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
D Japanese Prods. Corp., Elmsford, N.Y.
Lear Siegler, Santa Monica, Calif.
Meltronics Inc., Leeds, Ala.
M Micro-Mo Electronics Inc., Cleveland, Ohio
Molon Motors & Coil Corp., Rolling Meadows, Ill.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
DM North American Philips Controls Corp., Cheshire, Conn.
M Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
M Sawyer Inds., Arcadia, Cal.
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.
Vibrac Corp., Chelmsford, Mass.
Western Gear Corp., City of Industry, Cal

Motors, Gyro

M Aeroflex Labs., Plainview, N.Y. .... p. 1•929
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M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
M Vernitron Corp., Torrance, Cal. .... p. 1•1924
M American Electronics, Fullerton, Cal.
D Bristol Saybrook Co., Old Saybrook, Conn.
M Clifton Precision, Clifton Hgts., Pa.
EEMCO Div., Los Angeles, Cal.
Lear Siegler, Santa Monica, Calif.
Montevideo Technology Inc., Edina, Minn.
Singer Co., Little Falls, N.J.

Motors, Hysteresis

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D Bodine Electric Co., Chicago, Ill. .... p. 1•938
Dale Elctrns., Yankton, S.D. ....p. 2•1452
I M C Magnetics, Westbury, N.Y. .... p. 1•964
M McLean Engrg. Labs., Princeton Jctn., N.J. p. 1•975
M Rotating Components Div., Plainview, N.Y. p. 1•979
M Sierracin/Magnedyne Inc., Carlsbad, Calif. p. 1•983
M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
M Aeroflex Labs., Plainview, N.Y. .... *
DM Cramer Division, Old Saybrook, Conn. .... *
D Precision Timer Co., Westbrook, Conn. ....*
TRW/Globe Motors, Dayton, Ohio .... *
Aircraft Appliances Eqpt, Brmalea, Ont, Can.
M American Electronics, Fullerton, Cal.
B & B Motor & Control, New York, N.Y.
D Bristol Saybrook Co., Old Saybrook, Conn.
Control Data Corp., Minneapolis, Minn.
Eastern Air Devices Motor Div., Dover, N.H.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
General Time Corp., Thomaston, Conn.
Hansen Mfg. Co., Princeton, Ind.
M Harowe Servo Controls, W. Chester, Pa.
Howard Industries, Milford, Ill.
D Hurst Mfg. Corp., Princeton, Ind.
D Japanese Prods. Corp., Elmsford, N.Y.
D Lear Siegler, Elyria, Ohio
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
DM North American Philips Controls Corp., Cheshire, Conn.
M Sawyer Inds., Arcadia, Cal.
Singer Co., Little Falls, N.J.
DM Stock Drive Prods., New Hyde Pk., N.Y.
M Transicoil, Worcester, Pa.
Western Gear Corp., City of Industry, Cal

Motors, Incremental, Stepping—See Motors, Stepping

Motors, Induction

M Ashland Elec. Prods., L.I.C., N.Y. p. 1•934-937
D Bodine Electric Co., Chicago, Ill. .... p. 1•938
DM Cramer Division, Old Saybrook, Conn. p. 1•943
General Elec. Co., Schenectady, N.Y. p. 1•958,959
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M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
M Aeroflex Labs., Plainview, N.Y. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
TRW/Globe Motors, Dayton, Ohio .... *
M American Electronics, Fullerton, Cal.
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
Bowman Electrical Prods. Corp., Chicago, Ill.
M Clifton Precision, Clifton Hgts., Pa.
M Doerr Electric Corp., Cedarburg, Wisc.
Eastern Air Devices Motor Div., Dover, N.H.
Eaton Corp., Cleveland, Ohio
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
Electric Machinery Mfg. Co., Minneapolis, Minn.
D ECM Motor Co., Schaumburg, Ill.
General Time Corp., Thomaston, Conn.
Haydon Switch & Instr., Waterbury, Conn.
Howard Industries, Milford, Ill.
D Hurst Mfg. Corp., Princeton, Ind.
D Japanese Prods. Corp., Elmsford, N.Y.
Jerome Industries Corp., Orange, N.J.
Kato Engineering Co., Mankato, Minn.
Lear Siegler, Santa Monica, Calif.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
D Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Singer Co., Little Falls, N.J.
Skinner Polynoid Div., New Britain, Conn.
M Transicoil, Worcester, Pa.
DM Welco Inds. Inc., Cincinnati, Ohio
Western Gear Corp., City of Industry, Cal

Motors, Miniature—See Motors, Fractional Hp

Motors, Permanent Magnet

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DM Cramer Division, Old Saybrook, Conn. p. 1•943
D Electro-Craft Corp., Hopkins, Minn. p. 1•947,948
General Elec. Co., Schenectady, N.Y. p. 1•958
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Inland Motor Div. Kollmorgen, Rockford, Va. p. 1•968,969
M Magnetic Technology, Canoga Pk., Cal. p. 1•971-974
M McLean Engrg. Labs., Princeton Jctn., N.J. p. 1•975
D Micro Switch, Freeport, Ill. .... p. 1•2101
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M Rotating Components Div., Plainview, N.Y. p. 1•979
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M Sierracin/Magnedyne Inc., Carlsbad, Calif. p. 1•983
D Superior Electric Co., Bristol, Conn. p. 1•984-987
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M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
M Wertronix Corp., Dayton, Ohio .... p. 1•998
D Precision Timer Co., Westbrook, Conn. ....*
Shigoto Inds., Ltd., New York, N.Y. .... *
Sodeco Div., Elmsford, N.Y. ....*
TRW/Globe Motors, Dayton, Ohio .... *
M Varo, Santa Barbara, Cal. ....*
M American Electronics, Fullerton, Cal.
Ametek/Lamb Electric, Kent, Ohio
Applied Motors Inc., Rockford, Ill.
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
Bowman Electrical Prods. Corp., Chicago, Ill.
D Carter Motor Co., Chicago, Ill.
M Clifton Precision, Clifton Hgts., Pa.
Control Data Corp., Minneapolis, Minn.
Control Systems Research, Pittsburgh, Pa.
D Control Products Div., Union, N.J.
Eastern Air Devices Motor Div., Dover, N.H.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
ECM Motor Co., Schaumburg, Ill.
General Time Corp., Thomaston, Conn.
Hankscraft Co., Reedsburg, Wisc.
M Hathaway Industries Inc., Tulsa, Okla.
Haydon Switch & Instr., Waterbury, Conn.
Howard Industries, Milford, Ill.
D Hurst Mfg. Corp., Princeton, Ind.

M IMC Magnetics Corp., Maywood, Cal.
Indiana Gen'l. Div., Oglesby, Ill.
D Inertial Motors Corp., Doylestown, Pa.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Japanese Prods. Corp., Elmsford, N.Y.
Kato Engineering Co., Mankato, Minn.
D Lear Siegler, Elyria, Ohio
Mallory Timers, Indpls., Ind.
M Micro-Mo Electronics Inc., Cleveland, Ohio
Molon Motors & Coil Corp., Rolling Meadows, Ill.
Montevideo Technology Inc., Edina, Minn.
DM North American Philips Controls Corp., Cheshire, Conn.
M Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Sequential Information Systems, Elmsford, N.Y.
Sigma Instruments, Braintree, Mass.
Singer Co., Schiller Park, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
M Transicoil, Worcester, Pa.
Vibrac Corp., Chelmsford, Mass.
Western Gear Corp., City of Industry, Cal

Motors, Selsyn—See Motors, Synchronous

Motors, Servo

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M Rotating Components Div., Plainview, N.Y. p. 1•979
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TRW/Globe Motors, Dayton, Ohio .... *
M American Electronics, Fullerton, Cal.
Ametek/Lamb Electric, Kent, Ohio
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
The Bendix Corp., Teterboro, N.J.
Bowmar Instr. Corp., Ft. Wayne, Ind.
M Clifton Precision, Clifton Hgts., Pa.
Control Data Corp., Minneapolis, Minn.
Control Systems Research, Pittsburgh, Pa.
Eastern Air Devices Motor Div., Dover, N.H.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
M Harowe Servo Controls, W. Chester, Pa.
Honeywell, Ft. Washington, Pa.
D Hurst Mfg. Corp., Princeton, Ind.
M IMC Magnetics Corp., Maywood, Cal.
Indiana Gen'l. Div., Oglesby, Ill.
D Inertial Motors Corp., Doylestown, Pa.
ITT Comps. Grp., N. Andover, Mass.
Japanese Prods. Corp., Elmsford, N.Y.
Lear Siegler, Santa Monica, Calif.
M Micro-Mo Electronics Inc., Cleveland, Ohio
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
M Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Sequential Information Systems, Elmsford, N.Y.
M Servotronics, Buffalo, N.Y.
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.
Vibrac Corp., Chelmsford, Mass.
Western Gear Corp., City of Industry, Cal
Yaskawa Electric America, Newport Beach, Cal.

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TRW/Globe Motors, Dayton, Ohio .... *
M Varo, Santa Barbara, Cal. .... *
M American Electronics, Fullerton, Cal.
B & B Motor & Control, New York, N.Y.
M Doerr Electric Corp., Cedarburg, Wisc.
Eastern Air Devices Motor Div., Dover, N.H.
Eaton Corp., Cleveland, Ohio
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
Electric Machinery Mfg. Co., Minneapolis, Minn.
D ECM Motor Co., Schaumburg, Ill.
Kato Engineering Co., Mankato, Minn.
D Lear Siegler, Elyria, Ohio
Reliance Electric Co., Cleveland, Ohio
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.
DM Welco Inds. Inc., Cincinnati, Ohio
Western Gear Corp., City of Industry, Cal

Motors, Stepping

M Aeroflex Labs., Plainview, N.Y. .... p. 1•929
D Computer Devices of Calif., Santa Fe Springs, Cal. ....p. 1•940,941
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Ledex Inc., Dayton, Ohio .... p. 1•970
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M Vernitech, Deer Pk., N.Y. .... p. 1•999,1920
General Elec. Co., Schenectady, N.Y. .... *
D Heinemann Elec. Co., Trenton, N.J. ....*
TRW/Globe Motors, Dayton, Ohio .... *
M Abrams Instr., Lansing, Mich.
M American Electronics, Fullerton, Cal.
B & B Motor & Control, New York, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
D Cambridge Thermionic Corp., Cambridge, Mass.
M Clifton Precision, Clifton Hgts., Pa.
Control Data Corp., Minneapolis, Minn.
D Control Products Div., Union, N.J.
Eastern Air Devices Motor Div., Dover, N.H.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
ECM Motor Co., Schaumburg, Ill.
GAP Instr. Corp., Hauppauge, N.Y.
M Harowe Servo Controls, W. Chester, Pa.
Haydon Switch & Instr., Waterbury, Conn.
D Hurst Mfg. Corp., Princeton, Ind.
Icon Corp., Cambridge, Mass.
M IMC Magnetics Corp., Maywood, Cal.
D Japanese Prods. Corp., Elmsford, N.Y.
Molon Motors & Coil Corp., Rolling Meadows, Ill.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
D North American Philips Controls Corp., Cheshire, Conn.
M Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
Plessey Inc., Melville, N.Y.
D Sigma Instruments, Braintree, Mass.
Singer Co., Little Falls, N.J.
M Transicoil, Worcester, Pa.
Warner Elec. Brake & Clutch Co., S. Beloit, Ill.

Motors, Synchronous

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M Aeroflex Labs., Plainview, N.Y. ....*
D Precision Timer Co., Westbrook, Conn. ....*
Sodeco Div., Elmsford, N.Y. ....*
TRW/Globe Motors, Dayton, Ohio .... *
Acrodyne Controls, Janesville, Wisc.
M American Electronics, Fullerton, Cal.
B & B Motor & Control, New York, N.Y.
Barber-Colman Co., Rockford, Ill.
Bowman Electrical Prods. Corp., Chicago, Ill.
M Clifton Precision, Clifton Hgts., Pa.
M Doerr Electric Corp., Cedarburg, Wisc.
Eastern Air Devices Motor Div., Dover, N.H.
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
Electric Machinery Mfg. Co., Minneapolis, Minn.
ECM Motor Co., Schaumburg, Ill.
General Time Corp., Thomaston, Conn.
Hansen Mfg. Co., Princeton, Ind.
M Harowe Servo Controls, W. Chester, Pa.
Haydon Switch & Instr., Waterbury, Conn.
Honeywell, Ft. Washington, Pa.
Howard Industries, Milford, Ill.
D Hurst Mfg. Corp., Princeton, Ind.
M IMC Magnetics Corp., Maywood, Cal.
D Japanese Prods. Corp., Elmsford, N.Y.
Kato Engineering Co., Mankato, Minn.
Kollsman Instr. Co., Syosset, N.Y.
Mallory Timers, Indpls., Ind.
Molon Motors & Coil Corp., Rolling Meadows, Ill.
Montevideo Technology Inc., Edina, Minn.
M MPC Prods. Corp., Chicago, Ill.
DM North American Philips Controls Corp., Cheshire, Conn.
M Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
Reliance Electric Co., Cleveland, Ohio
M Sawyer Inds., Arcadia, Cal.
Sequential Information Systems, Elmsford, N.Y.
Sigma Instruments, Braintree, Mass.
Singer Co., Schiller Park, Ill.
DM Stock Drive Prods., New Hyde Pk., N.Y.
Summit Engineering Corp., Bozeman, Mont.
M Transicoil, Worcester, Pa.
Western Gear Corp., City of Industry, Cal

Motors, Synchronous, Polarized—See Motors, Snychronous

Motors, Timing—See Motors, Clock & Timing

Motors, Torque (Including Torquers)

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Shigoto Inds., Ltd., New York, N.Y. .... *
Vernitech, Deer Pk., N.Y. ....*
B & B Motor & Control, New York, N.Y.
D Carter Motor Co., Chicago, Ill.
M Clifton Precision, Clifton Hgts., Pa.
Control Systems Research, Pittsburgh, Pa.
M Doerr Electric Corp., Cedarburg, Wisc.
Eastern Air Devices Motor Div., Dover, N.H.
Eaton Corp., Cleveland, Ohio
EEMCO Div., Los Angeles, Cal.
Electric Indicator Co., Norwalk, Conn.
D ECM Motor Co., Schaumburg, Ill.
D General Scanning, Watertown, Mass.
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M Omni-Spectra, Tempe, Ariz.
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Bramco Controls Div., Piqua, Ohio
Continental Rentals Div., Bedford, Mass.
Dynalab Corp., Van Nuys, Cal.
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Industrial Test Equip., Port Washington, N.Y. *
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Arvin Frequency Devices, Columbus, Ind.
Bramco Controls Div., Piqua, Ohio
Environmental Communications Inc., Costa Mesa, Cal.
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
Meguro Electronic Instr. Co., Tokyo, Japan
Meloy Laboratories Inc., Springfield, Va.
Nihon Dempa Kogyo Co., Ltd., Tokyo, Japan
Richard-Lee Co., New Providence, N.J.
M Spectrum Technology Inc., Goleta, Cal.
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M **General Instruments Corp., Hicksville, N.Y. ..... ***
D **McCoy Electronics, Mount Holly Springs, Pa. ***
M Addington Labs., Sunnyvale, Cal.
AEL, Colmar, Pa.
Arvin Frequency Devices, Columbus, Ind.
Computer Devices Corp., Commack, N.Y.
Engineered Components Co., San Luis Obispo, Cal.
Gentron Corp., Milwaukee, Wisc.
Narda Microwave Corp., Plainview, N.Y.
M Omni-Spectra, Tempe, Ariz.
Richard-Lee Co., New Providence, N.J.
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Engineered Components Co., San Luis Obispo, Cal.
Environmental Communications Inc., Costa Mesa, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
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American Time Products, Bulova Watch, Woodside, N.Y. .... *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... *
Biddle, James G., Plymouth Meeting, Pa.
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Environmental Communications Inc., Costa Mesa, Cal.
Erie Frequency Control, Carlisle, Pa.
Frequency West, Santa Clara, Cal.
DM Gorman-Redlich Mfg. Co., Athens, Ohio
Kinsekisha Lab. Ltd., Setagaya-ku Tokyo, Japan
Meguro Electronic Instr. Co., Tokyo, Japan
Meloy Laboratories Inc., Springfield, Va.
DM Miteg Inc., Hauppauge, N.Y.
Morey Corp., Downers Grove, Ill.
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D PRD Elctrns., Syosset, N.Y.
D R F D, Tampa, Fla.
Scientific Research Corp., Tampa, Fla.
Singer Co., Palo Alto, Cal.
Sperry Microwave Components, Gainesville, Fla.
M T-F Electronics Inc., Austin, Tex.
M Teledyne Microwave, Mountain View, Cal.
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D **McCoy Electronics, Mount Holly Springs, Pa. ***
Arvin Frequency Devices, Columbus, Ind.
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DM Gorman-Redlich Mfg. Co., Athens, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Meloy Laboratories Inc., Springfield, Va.
D NH Research, Santa Ana, Calif.
Optical Electronics, Tucson, Ariz.
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M T-F Electronics Inc., Austin, Tex.
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Computer Devices Corp., Commack, N.Y.
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Meloy Laboratories Inc., Springfield, Va.
D NH Research, Santa Ana, Calif.
Nihon Dempa Kogyo Co., Ltd., Tokyo, Japan
Richard-Lee Co., New Providence, N.J.
M Spectrum Technology Inc., Goleta, Cal.
M T-F Electronics Inc., Austin, Tex.
D Tau-Tron Inc., N. Billerica, Mass.
Weinschel Engrg. Co., Gaithersburg, Md.

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NES, Streamwood, Ill. .... *
Q-Tech Corp., Los Angeles, Cal. .... *
M Addington Labs., Sunnyvale, Cal.
Adret Corporation, Lancaster, Pa.
Almond Instrs. Co., Covina, Cal.
Arvin Frequency Devices, Columbus, Ind.
Beukers Labs., Bohemia, N.Y.
Biocom, Culver City, Cal.
Bramco Controls Div., Piqua, Ohio
Collins Radio, Dallas, Tex.
CTS Corp., Elkart, Ind.
Data-Control Systems, Danbury, Conn.
M General Devices, Princeton, N.J.
Narda Microwave Corp., Plainview, N.Y.
M Omni-Spectra, Tempe, Ariz.
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D Greenray Inds., Mechanicsburg, Pa. ....p. 1•327
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D Amperex Electronic Corp., Hicksville, N.Y. ......*
Austron, Austin, Tex. ....*
M Bliley Electric Co., Erie, Pa. ....*
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Hewlett-Packard Co., Palo Alto, Cal.
Microphase Corp., Cos Cob, Conn.
M Microsonics, Weymouth, Mass.
D NH Research, Santa Ana, Calif.
Nihon Dempa Kogyo Co., Ltd., Tokyo, Japan
M Omni-Spectra, Tempe, Ariz.
D R F D, Tampa, Fla.
Scientific Research Corp., Tampa, Fla.
M Spectrum Technology Inc., Goleta, Cal.
Sperry Microwave Components, Gainesville, Fla.
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Oscillators, Tuning-Fork Controlled

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Meloy Laboratories Inc., Springfield, Va.
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M Spectrum Technology Inc., Goleta, Cal.
M T-F Electronics Inc., Austin, Tex.
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D Facit-Addo, Secaucus, N.J.
M Mohawk Data Sciences Corp., Utica, N.Y.
Mohawk OEM Sales, King of Prussia, Pa.
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Aldshir Mfg., Tuckahoe, N.Y.
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D Channel Master Div. Avnet, Ellenville, N.Y.
Dukane Corp., St. Charles, Ill.
D Ev-Game Inc., Freeport, N.Y.
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D Herald Electronics, Chicago, Ill.
D Merix Chem. Co., Chicago, Ill.
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D Pageant/M.A. Miller Co., Chinchilla, Pa.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Recoton Corp., Long Island City, N.Y.
D Russco Electronics Mfg. Inc., Clovis, Cal.
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D Microtran Co., Valley Stream, N.Y. .... *
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D Altec Div., Anaheim, Calif.
D Midland International Corp., No. Kansas City, Mo.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Rye Inds., Mamaroneck, N.Y.
DM Saxton Prods., Congers, N.Y.
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D Heyman Mfg. Co., Kenilworth, N.J.
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M Biddle, James G., Plymouth Meeting, Pa.
Brinkmann Instrs., Westbury, N.Y.
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
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Honeywell, Ft. Washington, Pa.
D Leeds & Northrup Co., North Wales, Pa.
M Litton Systems, Mt. Vernon, N.Y.
McKee-Pedersen Instrs., Danville, Calif.
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D Taylor Instr. Process Control Div., Rochester, N.Y.
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M Astro Elctrns., Fullerton, Calif.
Aviation Elec., Ltd., Montreal, H4L 4x8 Que., Can.
Basler Electric Co., Highland, Ill.
M Betatronix, Hauppauge, N.Y.
M Bowmar/TIC, Newbury Park, Calif.
D Electro-Techniques, Oceanside, Cal.
Electronic Control Systems, Fairmont, W. Va.
Honeywell, Ft. Washington, Pa.
Larson Aero Dev., Concord, Calif.
M Litton Systems, Mt. Vernon, N.Y.
M Maurey Instrument Corp., Chicago, Ill.
D Perkin-Elmer Corp., Norwalk, Conn.
Samarius, Derby, Conn.
Waters Mfg., Wayland, Mass.
D Weston Comps. Div., Archbald, Pa.
D Weston Schlumberger, Archbald, Pa.

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D Components Specialties, Hempstead, N.Y.
Computer Products, Ft. Lauderdale, Fla.
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Control Data Corp., Minneapolis, Minn.
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Custom Power, Orange, Cal.
Deltron, N. Wales, Pa.
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D Dormeyer Industries, Chicago, Ill.
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D Dressen-Barnes Elctrns., Pasadena, Cal.
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M Electro-Module, Pomona, Cal.
Electro-Pacific, Goleta, Calif.
Elexon Power Sys., Santa Ana, Cal.
Elma Engineering, Palo Alto, Cal.

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Cal-Power Corp., El Segundo, Calif.
Chemical Etching Equip. & Supply, Alexandria, Va.
Conic Corp., San Diego, Cal.
Continental Rentals Div., Bedford, Mass.
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Dynamod, Little Ferry, N.J.
E & L Instruments, Derby, Conn.
M E-Tronics, Sepulveda, Cal.
M Elasco, Bloomfield, Conn
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M Electro-Module, Pomona, Cal.
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D Elexon Power Sys., Santa Ana, Cal.
Elgin Elctrns., Waterford, PA.
Elma Engineering, Palo Alto, Cal.
EMCO High Voltage, Mt. View, Cal.
EWC, Kenilworth, N.J.
Faratron Corp., S. Hackensack, N.J.
Fuji Electrochemical Co., Tokyo, Japan
General Resistance, Mt. Vernon, N.Y.
Halmar Electronics, Columbus, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Incor Instrumentation, West Babylon, N.Y.
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Julie Research Lab., New York, N.Y.
M Keltec Florida, Fort Walton Beach, Fla.
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Mag-Con, New Brighton, Minn.
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Opad Elec. Co., New York, N.Y.
M OPT Inds. Inc., Phillipsburg, N.J.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.
M Peschel Instrs., Cape Coral, Fla.
Plastic Capacitors, Chicago, Ill.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
D Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
Reich Associates Inc., Plano, Tex
M Required Products, Stanford, Cal.
M Sawyer Inds., Arcadia, Cal.
Schauer Mfg. Corp., Cincinnati, Ohio
Scott Electronics Corp., Orlando, Fla.
Sensor Corp., Scottdale, Pa.
D Shester Engineering Co., Culver City, Cal.
Sola Electric, Elk Grove Village, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Tektronix, Beaverton, Ore.
D Teledyne Big Beam, Crystal Lake, Ill.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Vectrol, Rockville, Md.
Voltex Co., Farmingdale, N.Y.
Wakefield Engrg., Wakefield, Mass.
Walker Scientific, Worcester, Mass.
Warren G-V Communications, Livingston, N.J.
D Willco Sales, Mineola, N.Y.
Xentek, San Marcos, Calif.

Power Supplies, A-C Input, 300 to 1,000 VDC Output

M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1039,1042
M Acopian Corp., Easton, Pa. ....p. 1•1057
M Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089
M Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100
M Autronics Corp., Pasadena, Cal ....p. 1•1113
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1123
CEA, San Luis Obispo, Cal. .... p. 1•1125
CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163
M Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1173
DM Eldec Corp., Lynnwood, Wash. p. 1•1193-1196
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
M Ferrotran Elctrn., New York, N.Y. p. 1•1209-1213
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
M Georator Corporation, Manassas, Va. p. 1•1223-1225
Industrial Test Equip., Port Washington, N.Y. p. 1•1235

- **Kepco, Flushing, N.Y. .... p. 1•1239-1301**
- **La Marche Mfg. Co., Des Plaines, Ill. p. 1•1308,1309**
- **Magnetico, Holtsville, N.Y. .... p. 2•1770**
- M **Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1318**
- **MIL Electronics, Lowell, Mass. .... p. 1•1321**
- D **Millen Mfg. Co. Inc., James, Malden, Mass. p. 2•1251**
- **NJE Corp., Dayton, N.J. .... p. 1•1326-1331**
- **North Hills Elctrns., Glen Cove, N.Y. p. 1•1332**
- **NWL Transformers, Trenton, N.J. ..... p. 2•1325**
- **Power Designs, Westbury, N.Y. p. 1•1418-1425**
- **Power/Mate Corp., Hackensack, N.J. p. 1•1341**
- **Rental Electronics, Lexington, Mass. p. 1•792-795**
- DM **Sorensen Co., Manchester, N.H. p. 1•1439,1440**
- M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471**
- DM **Systron-Donner Corp., Concord, Cal. p. 1•812,813**
- **Systron-Donner Microwave Div., Van Nuys, Cal. .... p. 1•812,813**
- DM **Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512**
- M **Technipower, Ridgefield, Conn. p. 1•1478,1479**
- **Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525**
- **Era Transpac Corp., Moonachie, N.J. .... ***
- **Hamamatsu Corp., Middlesex, N. J. .... ***
- **Industrial Elctrn. Engrs., Van Nuys, Cal. .... ***
- **Interelectronics Corp., Congers, N.Y. .... ***
- **International Rectifier Corp., El Segundo, Cal. ***
- **Lambda Elctrns., Melville, N.Y. .... ***
- **Microtran Co., Valley Stream, N.Y. .... ***
- **Moxon Inc., Irvine, Cal. .... ***
- **Power Technology, Little Rock, Ark. .... ***
- **Tecnetics, Boulder, Colo. .... ***
- **Todd Products Corp., Farmingdale, N.Y. .... ***
- **Topaz Electronics, San Diego, Cal. .... ***
- Aaron-Davis Co., Santa Monica, Cal.
- Acme Electric, Cuba, N.Y.
- D Advanced Power Inc., Anaheim, Cal.
- Almond Instrs. Co., Covina, Cal.
- M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
- Astro-Geo-Marine Inc., Oxnard, Cal.
- M AUL Instrs., Flushng, N.Y.
- Chemical Etching Equip. & Supply, Alexandria, Va.
- Control Data Corp., Minneapolis, Minn.
- Controltek Inc., Portland, Ore.
- Cross Electronics Inc., Warrendale, Pa.
- Custom Power, Orange, Cal.
- M Delta Elctrn. Control, Costa Mesa, Cal.
- M Electro-Module, Pomona, Cal.
- Electro-Pacific, Goleta, Calif.
- Elma Engineering, Palo Alto, Cal.
- EMCO High Voltage, Mt. View, Cal.
- Fuji Electrochemical Co., Tokyo, Japan
- Halmar Electronics, Columbus, Ohio
- Hewlett-Packard Co., Palo Alto, Cal.
- D Keithley Instruments Inc., Cleveland, Ohio
- M Keltec Florida, Fort Walton Beach, Fla.
- Keltron, Waltham, Mass.
- Mag-Con, New Brighton, Minn.
- McKee-Pedersen Instrs., Danville, Calif.
- North Electric Co., Galion, Ohio
- Northeast Scientific Corp., Acton, Mass.
- NUCOR Corp., Denville, N.J.
- Opad Elec. Co., New York, N.Y.
- M OPT Inds. Inc., Phillipsburg, N.J.
- Payne Engrg. Co., Scott Depot, W. Va.
- M Peschel Instrs., Cape Coral, Fla.
- D Plastic Capacitors, Chicago, Ill.
- Power Pac, South Norwalk, Conn.
- M Powercube Corp., Waltham, Mass.
- D Ragen Data Systems, Farmingdale, N.Y.
- Reich Associates Inc., Plano, Tex
- M Sawyer Inds., Arcadia, Cal.
- Scott Electronics Corp., Orlando, Fla.
- Sola Electric, Elk Grove Village, Ill.
- TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
- D Tennelec, Oak Ridge, Tenn.
- M Transistor Devices, Cedar Knolls, N.J.
- M Trio Labs, Plainview, N.Y.
- Tucker Electronics Co., Garland, Tex.
- Vectrol, Rockville, Md.
- Velonex, Instrument Div., Santa Clara, Cal.
- Voltex Co., Farmingdale, N.Y.

Power Supplies, A-C Input, Greater Than 1,000 VDC Output

- M **Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092**
- M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089**
- M **Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100**
- **Associated Research, Niles, Ill. .... p. 1•607**
- M **Autronics Corp., Pasadena, Cal .... p. 1•1113**
- **Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121**
- **Bikor Corporation, Harbor City, Cal. p. 1•1123**
- **Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531**
- M **CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163**
- M **Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1173**
- DM **Eldec Corp., Lynnwood, Wash. p. 1•1193-1196**
- **Electronic Dev. Corp., Boston, Mass. p. 1•670**
- **Electronic Measurements, Neptune, N.J. p. 1•1187-1192**
- **Ferrotran Elctrn., New York, N.Y. p. 1•1209-1213**
- **Fluke Mfg. Co., John, Seattle, Wash. p. 1•695**
- **Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221**
- M **Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231**
- **Industrial Test Equip., Port Washington, N.Y. p. 1•1235**
- **Kepco, Flushing, N.Y. .... p. 1•1239-1301**
- **Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305**
- **Magnetico, Holtsville, N.Y. .... p. 2•1770**
- **MIL Electronics, Lowell, Mass. .... p. 1•1321**
- **Millen Mfg. Co. Inc., James, Malden, Mass. p. 2•1251**
- **NWL Transformers, Trenton, N.J. ..... p. 2•1325**
- **Power Designs, Westbury, N.Y. p. 1•1418-1425**
- **Power Technology, Little Rock, Ark. p. 1•1338**
- **Rental Electronics, Lexington, Mass. p. 1•792-795**
- M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471**
- **Triad-Utrad, Huntington, Ind. ... p. 2•1822-1829**
- **Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525**
- **Venus Scientific, Farmingdale, N.Y. p. 1•1534,1535**
- **American Vector/TDC, Dayton, N.J. .... ***
- M **Axel Elctrns., Jamaica, N.Y. .... ***
- **Cober Elctrns., Stamford, Conn. .... ***
- **Industrial Elctrn. Engrs., Van Nuys, Cal. .... ***
- **Interelectronics Corp., Congers, N.Y. .... ***
- **International Rectifier Corp., El Segundo, Cal. ***
- **ITT Jennings, Instrus. & Systems, San Jose, Cal. .... ***
- M **LOGIMETRICS INC., Plainview, NY .... ***
- **Tecnetics, Boulder, Colo. .... ***
- **Todd Products Corp., Farmingdale, N.Y. .... ***
- Aaron-Davis Co., Santa Monica, Cal.
- Acme Electric, Cuba, N.Y.
- Advanced Kinetics, Costa Mesa, Calif.
- D Advanced Power Inc., Anaheim, Cal.
- Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
- M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
- Astro-Geo-Marine Inc., Oxnard, Cal.
- Beckman Instrs., Cedar Grove, N.J.
- Chemical Etching Equip. & Supply, Alexandria, Va.
- Condenser Products Corp., Brooksville, Fla.
- D CVC Products, Rochester, N.Y.
- Electro-Pacific, Goleta, Calif.
- Elma Engineering, Palo Alto, Cal.
- EMCO High Voltage, Mt. View, Cal.
- Fuji Electrochemical Co., Tokyo, Japan
- Hewlett-Packard Co., Palo Alto, Cal.
- Instrument Research Co., Lincoln, Mass.
- D Keithley Instruments Inc., Cleveland, Ohio
- M Keltec Florida, Fort Walton Beach, Fla.
- Keltron, Waltham, Mass.
- M Lehighton Electronics, Lehighton, Pa
- Megavolt, New York, N.Y.
- M Micron Industries Corp., Stone Park, Ill.
- North Electric Co., Galion, Ohio
- Northeast Scientific Corp., Acton, Mass.
- NUCOR Corp., Denville, N.J.
- Opad Elec. Co., New York, N.Y.
- M Peschel Instrs., Cape Coral, Fla.
- D Plastic Capacitors, Chicago, Ill.
- M Powercube Corp., Waltham, Mass.
- Products for Research, Danvers, Mass.
- Rantec Div., Calabasas, Calif.
- Reich Associates Inc., Plano, Tex
- M Required Products, Stanford, Cal.
- Scott Electronics Corp., Orlando, Fla.
- Sola Electric, Elk Grove Village, Ill.
- TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
- M Teledyne Mec., Palo Alto, Cal.
- D Tennelec, Oak Ridge, Tenn.
- Tucker Electronics Co., Garland, Tex.
- Velonex, Instrument Div., Santa Clara, Cal.
- Voltek Inc., Beverly Hills, Cal.
- Voltex Co., Farmingdale, N.Y.
- Zi-Tech Div., Palo Alto, Cal.

Power Supplies, A-C Output - Also see Inverters; Regulators

- **Abacus Controls Inc., Somerville, N.J. p. 1•1026**
- M **Abbott Transistor Labs, Los Angeles, Cal. p. 1•1046**
- M **Advance Conversion Devices Co., Passaic, N. J. p. 1•1084**
- **Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092**
- M **A L S Electronics Corp., Covina, Cal. p. 1•1087**
- **American Vector/TDC, Dayton, N.J. p. 1•1083**
- M **Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100**
- D **ATR Electronics, St. Paul, Minn. p. 1•1110,1111**
- M **Autronics Corp., Pasadena, Cal .... p. 1•1113**
- **Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119**
- **Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531**
- D **California Instrs. Co., San Diego, Cal. p. 1•1164**
- **Christie Elec., Los Angeles, Cal. .... p. 1•1186**
- M **CML-Macarr, Edison, N.J. .... p. 1•1154-1160**
- M **Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1170**
- **Deltec Corp., San Diego, Cal. .... p. 1•1183**
- **Dynamic Instr. Corp., Hauppauge, N.Y. p. 1•1177; p. 2•1735**
- **Elgar Corporation, San Diego, Cal. ..... p. 1•1198**
- D **Epsco, Addison, Ill. .... p. 1•1200,1201**
- **Era Transpac Corp., Moonachie, N.J. p. 1•1202-1204**
- **Flite-Tronics Co., Burbank, Cal. p. 1•1214,1215**
- **Fluke Mfg. Co., John, Seattle, Wash. p. 1•695**
- **Fork Standards, West Chicago, Ill. p. 1•320,321**
- M **Georator Corporation, Manassas, Va. p. 1•1223,1226**
- **Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231**
- **La Marche Mfg. Co., Des Plaines, Ill. p. 1•1308,1309**
- M **Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1316-1318**
- **NJE Corp., Dayton, N.J. .... p. 1•1326-1331**
- D **Powertec, Chatsworth, Cal. ..... p. 1•1426,1427**
- **Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863**
- DM **Sorensen Co., Manchester, N.H. .... p. 1•1442**
- D **Superior Electric Co., Bristol, Conn. ... p. 1•1443**
- DM **Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512**
- **Topaz Electronics, San Diego, Cal. .... p. 1•1505**
- M **Unitron Inc., Garland, Tex. .... p. 1•1516-1523**
- **Wilmore Elctrns. Co., Durham, N.C. p. 1•538,539**
- **American Time Products, Bulova Watch, Woodside, N.Y. .... ***
- **Bulova Watch Co., Freq Controls Div., Woodside, N.Y. .... ***
- D **GC Electronics, Rockford, Ill. .... ***
- M **General Instruments Corp., Hicksville, N.Y. ..... ***
- **Interelectronics Corp., Congers, N.Y. .... ***
- **International Rectifier Corp., El Segundo, Cal. ***
- **K.G.S. Elctrns., Pasadena, Cal. .... ***
- **Nova Electric Mfg. Co., Nutley, N.J. .... ***
- M **Staco, Dayton, Ohio .... ***
- Acme Electric, Cuba, N.Y.
- American Monarch Corp., Minneapolis, Minn.
- American Power Systems Corp., Worcester, Mass.
- M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
- Astro-Geo-Marine Inc., Oxnard, Cal.
- Basler Electric Co., Highland, Ill.
- M Bendix, Eatontown, N.J.
- Chicago Condenser Corp., Chicago, Ill.
- Conic Corp., San Diego, Cal.
- Cross Electronics Inc., Warrendale, Pa.
- Custom Power, Orange, Cal.
- Cyberex, Mentor, Ohio
- M Delta Elctrn. Control, Costa Mesa, Cal.
- D Dracon Industries, Chatsworth, Cal.
- E-Tronics, Sepulveda, Cal.

Elma Engineering, Palo Alto, Cal.
EWC, Kenilworth, N.J.
Fuji Electrochemical Co., Tokyo, Japan
Halmar Electronics, Columbus, Ohio
Jerome Industries Corp., Orange, N.J.
D JPI, Santa Monica, Cal.
M Keltec Florida, Fort Walton Beach, Fla.
D Linear Systems, Watsonville, Cal.
Megavolt, New York, N.Y.
Modular Power, San Diego, Cal.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
NUCOR Corp., Denville, N.J.
Payne Engrg. Co., Scott Depot, W. Va.
M Peschel Instrs., Cape Coral, Fla.
D Power Control Corp., Pittsburgh, Pa.
D Ragen Data Systems, Farmingdale, N.Y.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
Reich Associates Inc., Plano, Tex
Research, Minneapolis, Minn.
M Sawyer Inds., Arcadia, Cal.
Scott Electronics Corp., Orlando, Fla.
Sola Electric, Elk Grove Village, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Teledyne Inet, Gardena, Cal.
M Transistor Devices, Cedar Knolls, N.J.
Tripp-Lite, Chicago, Ill.
Tucker Electronics Co., Garland, Tex.
Voltek Inc., Beverly Hills, Cal.

Power Supplies, D-C Input, A-C Output—

See Inverters; Regulators

Power Supplies, D-C Input, D-C Output—

See Converters, D-C to D-C

Power Supplies, D-C Output, Current Regulated

ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
Advance Conversion Devices Co., Passaic, N. J. p. 1•1084
M Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089
M Anadyne, Santa Fe Springs, Cal. p. 1•1108,1109
Bikor Corporation, Harbor City, Cal. p. 1•1123
CELCO, Mahwah, N.J. .... p. 1•630
CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163
D Dynascan Corp., Chicago, Ill. .... p. 1•610
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Kepco, Flushing, N.Y. .... p. 1•1239-1301
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
LH Research, Santa Ana, Cal. ...p. 1•1306,1307
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315-1318
Moxon Inc., Irvine, Cal. .... p. 1•752
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
North Hills Elctrns., Glen Cove, N,Y. p. 1•1332,1333
Power Designs, Westbury, N.Y. p. 1•1418-1425
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DM Sorensen Co., Manchester, N.H. p. 1•1439-1441
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Standard Power, Santa Ana, Cal. p. 1•1472-1475
DM Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512
Technipower, Ridgefield, Conn. p. 1•1478,1479
D Tele-Dynamics/Wanlass, Ft. Washington, Pa. p. 1•1480-1489
D Triad-Utrad, Huntington, Ind. ...p. 2•1822-1829
M Analog Devices, Norwood, Mass. .... *
M Arnold Magnetics Corp., Culver City, Cal. .... *
Dynamic Instr. Corp., Hauppauge, N.Y. .... *
M General Instruments Corp., Hicksville, N.Y. .... *
Heath Co., Benton Harbor, Mich. .... *
Hope Elctrns., Clifton, N.J. .... *
MIL Electronics, Lowell, Mass. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
Topaz Electronics, San Diego, Cal. .... *
Acme Electric, Cuba, N.Y.
Adapter/Charger Prdts., Peoria, Ill.
American Power Systems Corp., Worcester, Mass.
Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Astro-Geo-Marine Inc., Oxnard, Cal.
M AUL Instrs., Flushng, N.Y.
Barber Corp., Waynesville, Ohio
Basler Electric Co., Highland, Ill.
D Cambridge Thermionic Corp., Cambridge, Mass.
Cross Electronics Inc., Warrendale, Pa.
Custom Power, Orange, Cal.
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
D Digiac Corp., Smithtown, N.Y.
Disc Instruments, Costa Mesa, Ca.
D Dressen-Barnes Elctrns., Pasadena, Cal.
Dynamic Measurements Corp., Winchester, Mass.
E-Tronics, Sepulveda, Cal.
Electro-Pacific, Goleta, Calif.
D Elexon Power Sys., Santa Ana, Cal.
Elgin Elctrns., Waterford, PA.
Elma Engineering, Palo Alto, Cal.
EMI Gencom Inc., Plainview, N.Y.
Fuji Electrochemical Co., Tokyo, Japan
Galileo Electro-Optics Corp., Sturbridge, Mass.
Halmar Electronics, Columbus, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Incor Instrumentation, West Babylon, N.Y.
Instant Instruments Inc., Haverhill, Mass.
Jerome Industries Corp., Orange, N.J.
Julie Research Lab., New York, N.Y.
D Keithley Instruments Inc., Cleveland, Ohio
D Lectrotech, Chicago, Ill.
D Linear Systems, Watsonville, Cal.
D Metrologic Instruments, Bellmawr, N.J.
D Midland International Corp., No. Kansas City, Mo.
M Modular Audio Products, Bohemia, N.Y.
Modular Power, San Diego, Cal.
Motorola Comms. Div., Schaumburg, Ill.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Northeast Scientific Corp., Acton, Mass.
M NSI, Instrument Div., Garland, Tex.
NUCOR Corp., Denville, N.J.
M OPT Inds. Inc., Phillipsburg, N.J.
Oriel Corp. of America, Stamford, Conn.
Payne Engrg. Co., Scott Depot, W. Va.
M Peschel Instrs., Cape Coral, Fla.
Pioneer Magnetics, Santa Monica, Cal.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
M Sawyer Inds., Arcadia, Cal.
Scott Electronics Corp., Orlando, Fla.
D Sencore, Sioux Falls, S.D.
Sola Electric, Elk Grove Village, Ill.
M Spacetac, Bedford, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Voltek Inc., Beverly Hills, Cal.
Xentek, San Marcos, Calif.

Power Supplies for Arc Lamps

American Vector/TDC, Dayton, N.J. p. 1•1083
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1123
Christie Elec., Los Angeles, Cal. .... p. 1•1186
M CML-Macarr, Edison, N.J. .... p. 1•1160
M Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1176
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315,1318
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
NWL Transformers, Trenton, N.J. .... p. 2•1325
Power/Mate Corp., Hackensack, N.J. p. 1•1341
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
D Eldec Corp., Lynnwood, Wash. .... *
General Elec. Co., Schenectady, N.Y. .... *
Acme Electric, Cuba, N.Y.
Advanced Kinetics, Costa Mesa, Calif.
Amglo Corp., Rosemont, Ill.
Applied Control Co., Fairfield, N.J.
Cross Electronics Inc., Warrendale, Pa.
Dynalab Corp., Van Nuys, Cal.
EG&G, Salem, Mass.
Eimac, San Carlos, Calif.
Electro-Optical Inds., Santa Barbara, Cal.
Gates, Geo. W. & Co., Franklin Sq., N.Y.
Illumination Industries, Sunnyvale, Cal.
Keltron, Waltham, Mass.
Mag-Con, New Brighton, Minn.
Magnetics, Div. of Spang Industries, Sandy Lake, Pa.
Maxwell Labs., San Diego, Calif.
Megavolt, New York, N.Y.
M Micron Industries Corp., Stone Park, Ill.
Opad Elec. Co., New York, N.Y.
Oriel Corp. of America, Stamford, Conn.
M Peschel Instrs., Cape Coral, Fla.
Sola Electric, Elk Grove Village, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
D Union Carbide Corp., New York, N.Y.
U.S. Scientific Instrs., Boston, Mass.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Velonex, Instrument Div., Santa Clara, Cal.

Power Supplies, Bipolar

M Abbott Transistor Labs., Los Angeles, Cal. p. 1•1047,1049,1050
M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1039,1040,1044,1045
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M Acopian Corp., Easton, Pa. .... p. 1•1057
Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089
CEA, San Luis Obispo, Cal. .... p. 1•1125
M Eldec Corp., Lynnwood, Wash. p. 1•1193-1196
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Electrostatics Inc., San Diego, Cal. p. 1•1184,1185
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Kepco, Flushing, N.Y. .... p. 1•1239-1301
Microtran Co., Valley Stream, N.Y. ... p. 2•1767
MIL Electronics, Lowell, Mass. .... p. 1•1320
North Hills Elctrns., Glen Cove, N.Y. p. 1•1332,1333
NWL Transformers, Trenton, N.J. .... p. 2•1325
D Opamp Labs, Los Angeles, Cal. .... p. 1•11
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471
D Standard Power, Santa Ana, Cal. p. 1•1472-1475
Technipower, Ridgefield, Conn. p. 1•1478,1479
Teledyne Philbrick, Dedham, Mass. p. 1•208-217
Torque Systems, Waltham, Mass. p. 1•995-997
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
American Vector/TDC, Dayton, N.J. .... *
M Analog Devices, Norwood, Mass. .... *
Bikor Corporation, Harbor City, Cal. .... *
Cober Elctrns., Stamford, Conn. .... *
Datel Systems Inc., Canton, Mass. .... *
M Del Electronics Corp., Mt. Vernon, N.Y. .... *
M General Instruments Corp., Hicksville, N.Y. .... *
Hybrid Systems Corp., Burlington, Mass. .... *
Interelectronics Corp., Congers, N.Y. .... *
NES, Streamwood, Ill. .... *
Todd Products Corp., Farmingdale, N.Y. .... *
Aaron-Davis Co., Santa Monica, Cal.
Advanced Kinetics, Costa Mesa, Calif.
D Advanced Power Inc., Anaheim, Cal.
American Power Systems Corp., Worcester, Mass.
Berkeley Nucleonics, Berkeley, Cal.
Components Corp., Denville, N.J.
Computer Products, Ft. Lauderdale, Fla.
Deltron, N. Wales, Pa.
M Electro-Module, Pomona, Cal.
Function Modules, Costa Mesa, Cal.

GAP Instr. Corp., Hauppauge, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
Instant Instruments Inc., Haverhill, Mass.
Magnetics, Div. of Spang Industries, Sandy Lake, Pa.
Maxwell Labs., San Diego, Calif.
Megavolt, New York, N.Y.
M Modular Audio Products, Bohemia, N.Y.
DM National Semiconductor Corp., Santa Clara, Cal.
NUCOR Corp., Denville, N.J.
M Peschel Instrs., Cape Coral, Fla.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
D Spectra Sonics, Ogden, Utah
D Teledyne Semiconductor, Mountain View, Cal.
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Velonex, Instrument Div., Santa Clara, Cal.
Voltek Inc., Beverly Hills, Cal.
Walker Scientific, Worcester, Mass.
WORTEK, INC., Tarzana, Cal.
Xentek, San Marcos, Calif.

Power Supplies for CRT's

ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M **Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092**
American Vector/TDC, Dayton, N.J. p. 1•1083
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088,1089**
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1123
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
CELCO, Mahwah, N.J. .... p. 1•630
M **CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163**
M **Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1173**
M **Eldec Corp., Lynnwood, Wash. p. 1•1193-1196**
Erie Technological Products, Erie, Pa. p. 1•1207
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
MIL Electronics, Lowell, Mass. .... p. 1•1324
D **Millen Mfg. Co. Inc., James, Malden, Mass. p. 2•1251**
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471**
D **Standard Power, Santa Ana, Cal. p. 1•1472-1475**
Technipower, Ridgefield, Conn. p. 1•1478,1479
D **Tele-Dynamics/Wanlass, Ft. Washington, Pa. p. 1•1480-1489**
Triad-Utrad, Huntington, Ind. ...p. 2•1822-1829
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
Venus Scientific, Farmingdale, N.Y. p. 1•1024,1025
M **General Instruments Corp., Hicksville, N.Y. ..... ***
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
Interelectronics Corp., Congers, N.Y. .... *
Moxon Inc., Irvine, Cal. .... *
Tecnetics, Boulder, Colo. .... *
Todd Products Corp., Farmingdale, N.Y. .... *
Topaz Electronics, San Diego, Cal. .... *
Aaron-Davis Co., Santa Monica, Cal.
Acme Electric, Cuba, N.Y.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Control Data Corp., Minneapolis, Minn.
EMCO High Voltage, Mt. View, Cal.
EMI Gencom Inc., Plainview, N.Y.
GAP Instr. Corp., Hauppauge, N.Y.
Intronics Inc., Newton, Mass.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
Mag-Con, New Brighton, Minn.
Megavolt, New York, N.Y.
North Electric Co., Galion, Ohio
NUCOR Corp., Denville, N.J.
M Peschel Instrs., Cape Coral, Fla.
Pioneer Magnetics, Santa Monica, Cal.
D Plastic Capacitors, Chicago, Ill.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Reich Associates Inc., Plano, Tex
Scott Electronics Corp., Orlando, Fla.
M Spacetac, Bedford, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Tucker Electronics Co., Garland, Tex.
Velonex, Instrument Div., Santa Clara, Cal.
Voltek Inc., Beverly Hills, Cal.
Xentek, San Marcos, Calif.
Zi-Tech Div., Palo Alto, Cal.

Power Supplies for Computer

M **Abbott Transistor Labs., Los Angeles, Cal. p. 1•1047-1050**
M **Abbott Transistor Labs, Los Angeles, Cal. p. 1•1040,1041**
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M **Acopian Corp., Easton, Pa. .... p. 1•1057**
Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... p. 1•1088**
M **Autronics Corp., Pasadena, Cal .... p. 1•1113**
Bikor Corporation, Harbor City, Cal. p. 1•1123
CEA, San Luis Obispo, Cal. .... p. 1•1125
M **CML-Macarr, Edison, N.J. .... p. 1•1154-1160**
Datel Systems Inc., Canton, Mass. ... p. 1•1167
D **Dynage, Bloomfield, Conn. .... p. 1•1178,1179**
M **Eldec Corp., Lynnwood, Wash. p. 1•1193-1196**
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Electrostatics Inc., San Diego, Cal. p. 1•1184,1185
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
M **Georator Corporation, Manassas, Va. p. 1•1222-1229**
Kepco, Flushing, N.Y. .... p. 1•1239-1301
LH Research, Santa Ana, Cal. ...p. 1•1306,1307
M **Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315-1318**
MIL Electronics, Lowell, Mass. p. 1•1319-1324
Moxon Inc., Irvine, Cal. .... p. 1•752
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
NWL Transformers, Trenton, N.J. ..... p. 2•1325
Power Designs, Westbury, N.Y. p. 1•1418-1425
D **Power/Mate Corp., Hackensack, N.J. p. 1•1341**
D **Power One, Camarillo, Cal. .... p. 1•1414-1417**
DM **Powertec, Chatsworth, Cal. ..... p. 1•1426,1427**
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
DM **Sorensen Co., Manchester, N.H. p. 1•1433-1438**
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471
D **Standard Power, Santa Ana, Cal. p. 1•1472-1475**
DM **Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512**
M **Technipower, Ridgefield, Conn. p. 1•1478,1479**
D **Tele-Dynamics/Wanlass, Ft. Washington, Pa. p. 1•1480-1489**
D **Triad-Utrad, Huntington, Ind. ...p. 2•1822-1829**
D **Venus Scientific, Farmingdale, N.Y. p. 1•1534,1535**
M **General Instruments Corp., Hicksville, N.Y. ..... ***
Hope Elctrns., Clifton, N.J. .... *
Lambda Elctrns., Melville, N.Y. .... *
NES, Streamwood, Ill. .... *
Tecnetics, Boulder, Colo. .... *
Topaz Electronics, San Diego, Cal. .... *
Aaron-Davis Co., Santa Monica, Cal.
Acme Electric, Cuba, N.Y.
D Advanced Power Inc., Anaheim, Cal.
Almond Instrs. Co., Covina, Cal.
American Monarch Corp., Minneapolis, Minn.
American Power Systems Corp., Worcester, Mass.
Astro-Geo-Marine Inc., Oxnard, Cal.
Barber Corp., Waynesville, Ohio
Basler Electric Co., Highland, Ill.
Conic Corp., San Diego, Cal.
Control Data Corp., Minneapolis, Minn.
Custom Power, Orange, Cal.
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
D Dressen-Barnes Elctrns., Pasadena, Cal.
Dynalab Corp., Van Nuys, Cal.
M Dynamic Controls Corp., S. Windsor, Conn.
E-Tronics, Sepulveda, Cal.
D Elasco, Bloomfield, Conn
M Electro-Module, Pomona, Cal.
Electro-Pacific, Goleta, Calif.
Electronic Modules, Pasadena, Cal.
Elexon Power Sys., Santa Ana, Cal.
Elgin Elctrns., Waterford, PA.
EMCO High Voltage, Mt. View, Cal.
D Emerson, Industrial Controls Div., Santa Ana, Cal.
Firing Circuits Inc., Norwalk, Conn.
Fuji Electrochemical Co., Tokyo, Japan
M Hughes Aircraft Co., Oceanside, Cal.
Instant Instruments Inc., Haverhill, Mass.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
Mag-Con, New Brighton, Minn.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
NUCOR Corp., Denville, N.J.
Pioneer Magnetics, Santa Monica, Cal.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
Rantec Div., Calabasas, Calif.
Required Products, Stanford, Cal.
M Sawyer Inds., Arcadia, Cal.
Scott Electronics Corp., Orlando, Fla.
Sola Electric, Elk Grove Village, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
D Willco Sales, Mineola, N.Y.
WORTEK, INC., Tarzana, Cal.
Xentek, San Marcos, Calif.

Power Supplies, Constant Current

ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
Advance Conversion Devices Co., Passaic, N. J. p. 1•1084
M **Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092**
American Vector/TDC, Dayton, N.J. p. 1•1083
Bikor Corporation, Harbor City, Cal. p. 1•1123
M **Calex Mfg. Co., Pleasant Hill, Calif. ... p. 1•1153**
CEA, San Luis Obispo, Cal. .... p. 1•1125
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Industrial Test Equip., Port Washington, N.Y. p. 1•1235
Kepco, Flushing, N.Y. .... p. 1•1239-1301
M **Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315-1317**
MIL Electronics, Lowell, Mass. p. 1•1319-1324
Moxon Inc., Irvine, Cal. .... p. 1•752
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
North Hills Elctrns., Glen Cove, N.Y. p. 1•1332,1333
Power Designs, Westbury, N.Y. p. 1•1418-1425
D **Power/Mate Corp., Hackensack, N.J. p. 1•1341**
DM **Sorensen Co., Manchester, N.H. p. 1•1439-1441**
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. .... p. 1•1460-1471
Standard Power, Santa Ana, Cal. p. 1•1472-1475
DM **Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512**
D **Tele-Dynamics/Wanlass, Ft. Washington, Pa. p. 1•1480-1489**
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa. .... ***
M **Analog Devices, Norwood, Mass. .... ***
Dynamic Instr. Corp., Hauppauge, N.Y. .... *
DM **General Instruments Corp., Hicksville, N.Y. ..... ***
Hope Elctrns., Clifton, N.J. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
Acme Electric, Cuba, N.Y.
Almond Instrs. Co., Covina, Cal.
American Power Systems Corp., Worcester, Mass.
Arenberg Ultrasonic Lab Inc., Jamaica Plain, Mass.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Astro-Geo-Marine Inc., Oxnard, Cal.
M AUL Instrs., Flushng, N.Y.
Basler Electric Co., Highland, Ill.
D Controltek Inc., Portland, Ore.
Cross Electronics Inc., Warrendale, Pa.
Custom Power, Orange, Cal.
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
D Dressen-Barnes Elctrns., Pasadena, Cal.
Dynalab Corp., Van Nuys, Cal.
E-Tronics, Sepulveda, Cal.
M Electro-Module, Pomona, Cal.
Electro-Pacific, Goleta, Calif.
Elma Engineering, Palo Alto, Cal.

Fuji Electrochemical Co., Tokyo, Japan
General Instrument Corp., Hicksville, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
DM Hughes Aircraft Co., Oceanside, Cal.
Incor Instrumentation, West Babylon, N.Y.
Instant Instruments Inc., Haverhill, Mass.
Instruments Components Co., Montor, Ohio
D Keithley Instruments Inc., Cleveland, Ohio
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
M Modular Audio Products, Bohemia, N.Y.
Modular Power, San Diego, Cal.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Northeast Scientific Corp., Acton, Mass.
NUCOR Corp., Denville, N.J.
M Peschel Instrs., Cape Coral, Fla.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
Rantec Div., Calabasas, Calif.
M Sawyer Inds., Arcadia, Cal.
Scott Electronics Corp., Orlando, Fla.
Sola Electric, Elk Grove Village, Ill.
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Voltek Inc., Beverly Hills, Cal.
D WER Industrial, Grand Island, N.Y.
Xentek, San Marcos, Calif.

Power Supplies, Constant Voltage

M **Abbott Transistor Labs., Los Angeles, Cal.** p. 1•1047-1050
M **Abbott Transistor Labs, Los Angeles, Cal.** p. 1•1038-1046
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M **Acopian Corp., Easton, Pa.** p. 1•1057
Advance Conversion Devices Co., Passaic, N. J. p. 1•1084
M **Advanced High Voltage Inc., Van Nuys, Cal.** p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
D **Amphenol Component Mktg. Svc., Broadview, Ill.** p. 2•460,461
M **Arnoux Corp., Santa Barbara, Cal.** p. 1•604,605
M **Autronics Corp., Pasadena, Cal** p. 1•1113
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1123
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
M **CML-Macarr, Edison, N.J.** p. 1•1154-1160
D **Dynage, Bloomfield, Conn.** p. 1•1178,1179
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Electrostatics Inc., San Diego, Cal. p. 1•1184,1185
D **Epsco, Addison, Ill.** p. 1•1200,1201
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Freed Transformer Co., Brooklyn, N.Y. p. 1•716,717; p. 2•1738-1747
Frequency Devices, Haverhill, Mass. p. 1•554
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
M **Georator Corporation, Manassas, Va.** p. 1•1226,1228
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Kepco, Flushing, N.Y. p. 1•1239-1301
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
La Marche Mfg. Co., Des Plaines, Ill. p. 1•1308,1309
LH Research, Santa Ana, Cal. p. 1•1306,1307
Magnetico, Holtsville, N.Y. p. 2•1770
M **Mid-Eastern Inds., Scotch Plains, N.J.** p. 1•1315-1317
MIL Electronics, Lowell, Mass. p. 1•1319-1324
Moxon Inc., Irvine, Cal. p. 1•752
NJE Corp., Dayton, N.J. p. 1•1326-1331
North Hills Elctrns., Glen Cove, N.Y. p. 1•1332,1333
D **Opamp Labs, Los Angeles, Cal.** p. 1•11
Power Designs, Westbury, N.Y. p. 1•1418-1425
D **Power/Mate Corp., Hackensack, N.J.** p. 1•1341
D **Power One, Camarillo, Cal.** p. 1•1414-1417
DM **Powertec, Chatsworth, Cal.** p. 1•1426,1427
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
DM **Sorensen Co., Manchester, N.H.** p. 1•1433-1441
M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y.** p. 1•1460-1471
D **Standard Power, Santa Ana, Cal.** p. 1•1472-1475
DM **Systron Donner Trygon Div., Westbury, N.Y.** p. 1•1507-1512
Technipower, Ridgefield, Conn. p. 1•1478,1479
Tecnetics, Boulder, Colo. p. 1•1491-1494,1496
D **Tele-Dynamics/Wanlass, Ft. Washington, Pa.** p. 1•1480-1489
D **Venus Scientific, Farmingdale, N.Y.** p. 1•1024,1025
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa.** *
M **Analog Devices, Norwood, Mass.** *
Dynamic Instr. Corp., Hauppauge, N.Y. *
General Elec. Co., Schenectady, N.Y. *
DM **General Instruments Corp., Hicksville, N.Y.** *
Hope Elctrns., Clifton, N.J. *
NES, Streamwood, Ill. *
Systron-Donner Microwave Div., Van Nuys, Cal. *
Todd Products Corp., Farmingdale, N.Y. *
Acme Electric, Cuba, N.Y.
D Advanced Power Inc., Anaheim, Cal.
M Almond Instrs. Co., Covina, Cal.
American Monarch Corp., Minneapolis, Minn.
American Power Systems Corp., Worcester, Mass.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Astro-Geo-Marine Inc., Oxnard, Cal.
M AUL Instrs., Flushng, N.Y.
BECO, Salem, Va.
Bendix Corp., Elmira, N.Y.
Conic Corp., San Diego, Cal.
Control Data Corp., Minneapolis, Minn.
Controltek Inc., Portland, Ore.
Cross Electronics Inc., Warrendale, Pa.
Custom Power, Orange, Cal.
Cyberex, Mentor, Ohio
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
Disc Instruments, Costa Mesa, Ca.
D Dressen-Barnes Elctrns., Pasadena, Cal.
Dynalab Corp., Van Nuys, Cal.
E-Tronics, Sepulveda, Cal.
DM Elasco, Bloomfield, Conn
M Electro-Module, Pomona, Cal.
Electro-Pacific, Goleta, Calif.
Elma Engineering, Palo Alto, Cal.
EMCO High Voltage, Mt. View, Cal.
EMI Gencom Inc., Plainview, N.Y.
Fuji Electrochemical Co., Tokyo, Japan
Hewlett-Packard Co., Palo Alto, Cal.
DM Hughes Aircraft Co., Oceanside, Cal.
Incor Instrumentation, West Babylon, N.Y.
Instant Instruments Inc., Haverhill, Mass.
D Keithley Instruments Inc., Cleveland, Ohio
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
M Modular Audio Products, Bohemia, N.Y.
Modular Power, San Diego, Cal.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Northeast Scientific Corp., Acton, Mass.
NUCOR Corp., Denville, N.J.
Opad Elec. Co., New York, N.Y.
M OPT Inds. Inc., Phillipsburg, N.J.
Payne Engrg. Co., Scott Depot, W. Va.
M Peschel Instrs., Cape Coral, Fla.
Pioneer Magnetics, Santa Monica, Cal.
Power Pac, South Norwalk, Conn.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
Required Products, Stanford, Cal.
M Sawyer Inds., Arcadia, Cal.
Scott Electronics Corp., Orlando, Fla.
D Sola Electric, Elk Grove Village, Ill.
D Ten-Tec Inc., Sevierville, Tenn.
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Voltek Inc., Beverly Hills, Cal.
D WER Industrial, Grand Island, N.Y.
D Willco Sales, Mineola, N.Y.
WORTEK, INC., Tarzana, Cal.
Xentek, San Marcos, Calif.

Power Supplies, Constant Voltage/Constant Current

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M **Advanced High Voltage Inc., Van Nuys, Cal.** p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M **Anadyne, Santa Fe Springs, Cal.** p. 1•1108,1109
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
M **Georator Corporation, Manassas, Va.** p. 1•1226,1228
Kepco, Flushing, N.Y. p. 1•1239-1301
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La Marche Mfg. Co., Des Plaines, Ill. p. 1•1308,1309
M **Mid-Eastern Inds., Scotch Plains, N.J.** p. 1•1315-1317
MIL Electronics, Lowell, Mass. p. 1•1319-1324
Moxon Inc., Irvine, Cal. p. 1•752
NJE Corp., Dayton, N.J. p. 1•1326-1331
North Hills Elctrns., Glen Cove, N.Y. p. 1•1333
Power Designs, Westbury, N.Y. p. 1•1418-1425
D **Power/Mate Corp., Hackensack, N.J.** p. 1•1341
Rental Electronics, Lexington, Mass. p. 1•792-795
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
DM **Sorensen Co., Manchester, N.H.** p. 1•1439-1441
M **Spellman High Voltage Elctrns. Corp., Bronx, N.Y.** p. 1•1460-1471
DM **Systron Donner Trygon Div., Westbury, N.Y.** p. 1•1507-1512
Technipower, Ridgefield, Conn. p. 1•1478,1479
D **Tele-Dynamics/Wanlass, Ft. Washington, Pa.** p. 1•1480-1489
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa.** *
M **Analog Devices, Norwood, Mass.** *
Dynamic Instr. Corp., Hauppauge, N.Y. *
M **General Instruments Corp., Hicksville, N.Y.** *
Hope Elctrns., Clifton, N.J. *
Systron-Donner Microwave Div., Van Nuys, Cal. *
Acme Electric, Cuba, N.Y.
Almond Instrs. Co., Covina, Cal.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
M AUL Instrs., Flushng, N.Y.
Barber Corp., Waynesville, Ohio
BECO, Salem, Va.
Burr-Brown, Tucson, Ariz.
Conic Corp., San Diego, Cal.
Cross Electronics Inc., Warrendale, Pa.
Custom Power, Orange, Cal.
Cyberex, Mentor, Ohio
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
M Electro-Module, Pomona, Cal.
Elma Engineering, Palo Alto, Cal.
Fuji Electrochemical Co., Tokyo, Japan
General Instrument Corp., Hicksville, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
Incor Instrumentation, West Babylon, N.Y.
Instant Instruments Inc., Haverhill, Mass.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
North Electric Co., Galion, Ohio
Northeast Scientific Corp., Acton, Mass.
NUCOR Corp., Denville, N.J.
M Peschel Instrs., Cape Coral, Fla.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
Rantec Div., Calabasas, Calif.
Required Products, Stanford, Cal.
M Sawyer Inds., Arcadia, Cal.
Scott Electronics Corp., Orlando, Fla.
Sola Electric, Elk Grove Village, Ill.
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Voltek Inc., Beverly Hills, Cal.
Xentek, San Marcos, Calif.

Power Supplies, Dual Output, Triple Output—See Power Supplies, Multiple Output

Power Supplies, Energy Storage

Abacus Controls Inc., Somerville, N.J. p. 1•1026
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M **Advanced High Voltage Inc., Van Nuys, Cal.** p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa.** p. 1•1088,1089

Power Supplies, Energy Storage (cont'd)

Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1123
Christie Elec., Los Angeles, Cal. ....p. 1•1186
M Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1173
M Eldec Corp., Lynnwood, Wash. p. 1•1193-1196
M Georator Corporation, Manassas, Va. p. 1•1222,1228
M Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315,1318
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
NWL Transformers, Trenton, N.J. ..... p. 2•1325
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. ....p. 1•1460-1471
DM Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512
Technipower, Ridgefield, Conn. p. 1•1478,1479
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
CML-Macarr, Edison, N.J. .... *
Cober Elctrns., Stamford, Conn. .... *
EG&G, Salem, Mass. .... *
Interelectronics Corp., Congers, N.Y. .... *
Moxon Inc., Irvine, Cal. .... *
Power Technology, Little Rock, Ark. .... *
M Ross Engineering Corp., Campbell, Cal. .... *
Todd Products Corp., Farmingdale, N.Y. .... *
Topaz Electronics, San Diego, Cal. .... *
Acme Electric, Cuba, N.Y.
Advanced Kinetics, Costa Mesa, Calif.
Amglo Corp., Rosemont, Ill.
Amp Inc., Harrisburg, Pa.
Aydin Energy Systems, Palo Alto, Cal.
EG & G, Salem, Mass.
M Electro-Module, Pomona, Cal.
Exide Power Sys. Div., Philadelphia, Pa.
Honeywell, Minneapolis, Minn.
Laser Inc., Sturbridge, Mass.
Magnetics, Div. of Spang Industries, Sandy Lake, Pa.
Maxwell Labs., San Diego, Calif.
Megavolt, New York, N.Y.
Opad Elec. Co., New York, N.Y.
M Peschel Instrs., Cape Coral, Fla.
Reich Associates Inc., Plano, Tex
Scott Electronics Corp., Orlando, Fla.
Sel-Rex Co. Div. Oxy Metal Industries Corp., Nutley, N.J.
M Trio Labs, Plainview, N.Y.

Power Supplies High Current (greater than 8 amperes)

Abacus Controls Inc., Somerville, N.J. p. 1•1026
M Abbott Transistor Labs., Los Angeles, Cal. p. 1•1047,1048
M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1038-1045
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
Acopian Corp., Easton, Pa. ....p. 1•1057
American Vector/TDC, Dayton, N.J. p. 1•1083
M Arnold Magnetics Corp., Culver City, Cal. p. 1•1093-1100
D ATR Electronics, St. Paul, Minn. .... p. 1•1111
Autronics Corp., Pasadena, Cal ....p. 1•1113
Bikor Corporation, Harbor City, Cal. p. 1•1122
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
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Christie Elec., Los Angeles, Cal. ....p. 1•1186
M CML-Macarr, Edison, N.J. ....p. 1•1154-1160
M Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1176
Dynage, Bloomfield, Conn. ....p. 1•1179
M Eldec Corp., Lynnwood, Wash. p. 1•1193-1196
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Electrostatics Inc., San Diego, Cal. p. 1•1184,1185
D Epsco, Addison, Ill. ....p. 1•1200,1201
Flite-Tronics Co., Burbank, Cal. p. 1•1214,1215
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
M Georator Corporation, Manassas, Va. p. 1•1222-1229
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Kepco, Flushing, N.Y. ....p. 1•1239-1301
LH Research, Santa Ana, Cal. ...p. 1•1306,1307
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315-1317
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
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D Power/Mate Corp., Hackensack, N.J. p. 1•1341
D Power One, Camarillo, Cal. ...... p. 1•1414,1415
DM Powertec, Chatsworth, Cal. .....p. 1•1426,1427
Rental Electronics, Lexington, Mass. p. 1•792-795
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
Sorensen Co., Manchester, N.H. p. 1•1433-1437,1439-1441
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. ....p. 1•1460-1471
Standard Power, Santa Ana, Cal. p. 1•1472-1475
DM Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512
Tec, Tuscon, Ariz. ....p. 2•1203
M Technipower, Ridgefield, Conn. p. 1•1478,1479
Tecnetics, Boulder, Colo. ....p. 1•1491,1494
Tele-Dynamics/Wanlass, Ft. Washington, Pa. p. 1•1480-1489
Topaz Electronics, San Diego, Cal. .... p. 1•1505
International Rectifier Corp., El Segundo, Cal. *
NES, Streamwood, Ill. .... *
Nova Electric Mfg. Co., Nutley, N.J. .... *
Todd Products Corp., Farmingdale, N.Y. .... *
Accurate Electronics Co., Chicago, Ill.
Acme Electric, Cuba, N.Y.
D Advanced Power Inc., Anaheim, Cal.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Astro-Geo-Marine Inc., Oxnard, Cal.
Conic Corp., San Diego, Cal.
Continental Rentals Div., Bedford, Mass.
Control Data Corp., Minneapolis, Minn.
Controltek Inc., Portland, Ore.
Cross Electronics Inc., Warrendale, Pa.
Cyberex, Mentor, Ohio
Deltron, N. Wales, Pa.
D Dressen-Barnes Elctrns., Pasadena, Cal.
E-Tronics, Sepulveda, Cal.
DM Elasco, Bloomfield, Conn
M Electro-Module, Pomona, Cal.
Elexon Power Sys., Santa Ana, Cal.
Elma Engineering, Palo Alto, Cal.
Fuji Electrochemical Co., Tokyo, Japan
Halmar Electronics, Columbus, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
M Keltec Florida, Fort Walton Beach, Fla.
Modular Power, San Diego, Cal.
Motorola Comms. Div., Schaumburg, Ill.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Opad Elec. Co., New York, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.
M Peschel Instrs., Cape Coral, Fla.
Pioneer Magnetics, Santa Monica, Cal.
Power Pac, South Norwalk, Conn.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
Required Products, Stanford, Cal.
Schauer Mfg. Corp., Cincinnati, Ohio
Scott Electronics Corp., Orlando, Fla.
Sola Electric, Elk Grove Village, Ill.
D Ten-Tec Inc., Sevierville, Tenn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Wakefield Engrg., Wakefield, Mass.
WORTEK, INC., Tarzana, Cal.
Xentek, San Marcos, Calif.

Power Supplies for Integrated Circuits

M Abbott Transistor Labs., Los Angeles, Cal. p. 1•1047-1050
M Abbott Transistor Labs, Los Angeles, Cal. p. 1•1039-1041,1044,1045
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M Acopian Corp., Easton, Pa. ....p. 1•1057
American Vector/TDC, Dayton, N.J. p. 1•1083
M AMP Capitron Div./AMP Inc., Elizabethtown, Pa. ....p. 1•1088,1089
D Amphenol Component Mktg. Svc., Broadview, Ill. ....p. 2•460,461
M Autronics Corp., Pasadena, Cal ....p. 1•1113
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DM Calex Mgf. Co., Pleasant Hill, Calif. p. 1•1153
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D Dynage, Bloomfield, Conn. ...... p. 1•1178,1179
Eldec Corp., Lynnwood, Wash. p. 1•1193-1196
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Electrostatics Inc., San Diego, Cal. p. 1•1184,1185
Ferrotran Elctrn., New York, N.Y. p. 1•1209-1213
Frequency Devices, Haverhill, Mass. ...p. 1•554
M Georator Corporation, Manassas, Va. p. 1•1222-1229
Hope Elctrns., Clifton, N.J. ....p. 1•1234
Kepco, Flushing, N.Y. ....p. 1•1239-1301
LH Research, Santa Ana, Cal. ...p. 1•1306,1307
Magnetico, Holtsville, N.Y. ....p. 2•1770
M Mid-Eastern Inds., Scotch Plains, N.J. p. 1•1315,1316,1318
MIL Electronics, Lowell, Mass. p. 1•1319-1324
NJE Corp., Dayton, N.J. .... p. 1•1326-1331
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D Power/Mate Corp., Hackensack, N.J. p. 1•1341
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DM Powertec, Chatsworth, Cal. .....p. 1•1426,1427
RDI/Reed Devices, Glen Ellyn, Ill. p. 2•792,793
RO Assocs., Menlo Park, Cal. p. 1•1430,1431
Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
Semiconductor Circuits, Haverhill, Mass. p. 1•1444-1457
M Solid State Electronics Corp., Sepulveda, Cal. p. 1•126
DM Sorensen Co., Manchester, N.H. p. 1•1433-1441
D Standard Power, Santa Ana, Cal. p. 1•1472-1475
DM Systron Donner Trygon Div., Westbury, N.Y. p. 1•1507-1512
Technipower, Ridgefield, Conn. p. 1•1478,1479
Tecnetics, Boulder, Colo. .... p. 1•1491-1496
Tele-Dynamics/Wanlass, Ft. Washington, Pa. p. 1•1480-1489
Teledyne Philbrick, Dedham, Mass. p. 1•208-217
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
D ALCO Electronic Prods., North Andover, Mass. *
M Analog Devices, Norwood, Mass. .... *
Christie Elec., Los Angeles, Cal. .... *
Cober Elctrns., Stamford, Conn. .... *
DM General Instruments Corp., Hicksville, N.Y. .... *
Hybrid Systems Corp., Burlington, Mass. .... *
Interelectronics Corp., Congers, N.Y. .... *
Lambda Elctrns., Melville, N.Y. .... *
D Reliability Inc., Houston, Tex. .... *
Systron-Donner Microwave Div., Van Nuys, Cal. .... *
Todd Products Corp., Farmingdale, N.Y. .... *
Topaz Electronics, San Diego, Cal. .... *
Aaron-Davis Co., Santa Monica, Cal.
D Advanced Power Inc., Anaheim, Cal.
M Almond Instrs. Co., Covina, Cal.
American Monarch Corp., Minneapolis, Minn.
American Power Systems Corp., Worcester, Mass.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Astro-Geo-Marine Inc., Oxnard, Cal.
Barber Corp., Waynesville, Ohio
D B. H. Industries, Los Angeles, Cal
Burr-Brown, Tucson, Ariz.
D Cambridge Thermionic Corp., Cambridge, Mass.
Computer Products, Ft. Lauderdale, Fla.
Conic Corp., San Diego, Cal.
Control Data Corp., Minneapolis, Minn.
Controltek Inc., Portland, Ore.
Crestronics Inc., Crestline, Cal.
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
D Dressen-Barnes Elctrns., Pasadena, Cal.
M Dynamic Controls Corp., S. Windsor, Conn.
Dynamod, Little Ferry, N.J.
E & L Instruments, Derby, Conn.
E-Tronics, Sepulveda, Cal.
DM Elasco, Bloomfield, Conn
M Electro-Module, Pomona, Cal.
D Elexon Power Sys., Santa Ana, Cal.
D Fairchild Sound Equip., Commack, N.Y.
Fuji Electrochemical Co., Tokyo, Japan
Function Modules, Costa Mesa, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
Instant Instruments Inc., Haverhill, Mass.

Intronics Inc., Newton, Mass.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
Magnetics, Div. of Spang Industries, Sandy Lake, Pa.
Megavolt, New York, N.Y.
M Modular Audio Products, Bohemia, N.Y.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
NUCOR Corp., Denville, N.J.
M Peschel Instrs., Cape Coral, Fla.
Pioneer Magnetics, Santa Monica, Cal.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
D PRD Elctrns., Syosset, N.Y.
D Rantec Div., Calabasas, Calif.
Required Products, Stanford, Cal.
M Sawyer Inds., Arcadia, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
D Teledyne Semiconductor, Mountain View, Cal.
M Transistor Devices, Cedar Knolls, N.J.
Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
WORTEK, INC., Tarzana, Cal.
Xentek, San Marcos, Calif.

Power Supplies for Klystrons

M **Advanced High Voltage Inc., Van Nuys, Cal.** p. 1•1090-1092
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa.** p. 1•1088
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
Bikor Corporation, Harbor City, Cal. p. 1•1123
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
Ferrotran Elctrn., New York, N.Y. p. 1•1209-1213
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. p. 1•1460-1471
Technipower, Ridgefield, Conn. p. 1•1478,1479
American Vector/TDC, Dayton, N.J. *
M **Axel Elctrns., Jamaica, N.Y.** *
Kilovolt Corp., Hackensack, N.J. *
M AUL Instrs., Flushng, N.Y.
Elma Engineering, Palo Alto, Cal.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
Micro-Now Instr. Co., Chicago, Ill.
Micron Industries Corp., Stone Park, Ill.
Northeast Scientific Corp., Acton, Mass.
M Peschel Instrs., Cape Coral, Fla.
D PRD Elctrns., Syosset, N.Y.
Reich Associates Inc., Plano, Tex
Scott Electronics Corp., Orlando, Fla.
M Transistor Devices, Cedar Knolls, N.J.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
Voltek Inc., Beverly Hills, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

Power Supplies, Lab (Including Metered Units)

ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
Acopian Corp., Easton, Pa. p. 1•1057
Advanced High Voltage Inc., Van Nuys, Cal. p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa.** p. 1•1088
Behlman Engineering Corp., Santa Barbara, Cal. p. 1•1114-1119
Bertan Assocs., Hicksville, N.Y. p. 1•1120,1121
CEA, San Luis Obispo, Cal. p. 1•1125
Christie Elec., Los Angeles, Cal. p. 1•1186
M **CML-Macarr, Edison, N.J.** p. 1•1154-1160
CPS Inc. - Power Supply Grp., Sunnyvale, Cal. p. 1•1162,1163
M **Dal Electronics Corp., Mt. Vernon, N.Y.** p. 1•1168-1173
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
Elgar Corporation, San Diego, Cal. p. 1•1198
D **Epsco, Addison, Ill.** p. 1•1200,1201
Gates Elctrn. Co., Bronx, N.Y. p. 1•1216-1221
M **Georator Corporation, Manassas, Va.** p. 1•1222-1229
M **Hipotronics, Brewster, N.Y.** p. 1•722,723,1230,1231
Hope Elctrns., Clifton, N.J. p. 1•1234
Industrial Test Equip., Port Washington, N.Y. p. 1•1235
Kepco, Flushing, N.Y. p. 1•1239-1301
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
Lambda Elctrns., Melville, N.Y. p. 1•1311
M **Mid-Eastern Inds., Scotch Plains, N.J.** p. 1•1315-1318
NJE Corp., Dayton, N.J. p. 1•1326-1331
NWL Transformers, Trenton, N.J. p. 2•1325
Power Designs, Westbury, N.Y. p. 1•1418-1425
D **Power/Mate Corp., Hackensack, N.J.** p. 1•1341
D **Powertec, Chatsworth, Cal.** p. 1•1426,1427
RFL Inds., Boonton, N.J. p. 1•791
Sanford-Miller Corp., Brooklyn, N.Y. p. 1•1863
DM **Sorensen Co., Manchester, N.H.** p. 1•1439-1441
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. p. 1•1460-1471
DM **Systron-Donner Corp., Concord, Cal.** p. 1•812,813
DM **Systron Donner Trygon Div., Westbury, N.Y.** p. 1•1507-1512
Technipower, Ridgefield, Conn. p. 1•1478,1479
D **Tele-Dynamics/Wanlass, Ft. Washington, Pa.** p. 1•1480-1489
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
Cober Elctrns., Stamford, Conn. *
Datel Systems Inc., Canton, Mass. *
Heath Co., Benton Harbor, Mich. *
Interelectronics Corp., Congers, N.Y. *
Todd Products Corp., Farmingdale, N.Y. *
M **Unitron Inc., Garland, Tex.** *
Wagner Elec., Livingston, N.J. *
Almond Instrs. Co., Covina, Cal.
Alpha Components Corp., El Segundo, Cal.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Astro-Geo-Marine Inc., Oxnard, Cal.
M AUL Instrs., Flushng, N.Y.
Behlman Div., California Instrs., San Diego, Cal
Control Data Corp., Minneapolis, Minn.
Controltek Inc., Portland, Ore.
Deltron, N. Wales, Pa.
D Digiac Corp., Smithtown, N.Y.
D Dressen-Barnes Elctrns., Pasadena, Cal.
Dynalab Corp., Van Nuys, Cal.
Dynamod, Little Ferry, N.J.
M Electro-Module, Pomona, Cal.
Elma Engineering, Palo Alto, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
D Instant Instruments Inc., Haverhill, Mass.
D Keithley Instruments Inc., Cleveland, Ohio
D Lectrotech, Chicago, Ill.
Mag-Con, New Brighton, Minn.
Magnetics, Div. of Spang Industries, Sandy Lake, Pa.
Maxwell Labs., San Diego, Calif.
D Modular Power, San Diego, Cal.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Opad Elec. Co., New York, N.Y.
M Peschel Instrs., Cape Coral, Fla.
PIC Design Division, Ridgefield, Conn.
Plastic Capacitors, Chicago, Ill.
D PRD Elctrns., Syosset, N.Y.
Ratelco, Seattle, Wash.
M Sawyer Inds., Arcadia, Cal.
Sel-Rex Co. Div. Oxy Metal Industries Corp., Nutley, N.J.
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
Tucker Electronics Co., Garland, Tex.
Velonex, Instrument Div., Santa Clara, Cal.
Voltek Inc., Beverly Hills, Cal.
Xentek, San Marcos, Calif.

Power Supplies for Lasers

ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M **Advanced High Voltage Inc., Van Nuys, Cal.** p. 1•1090-1092
American Vector/TDC, Dayton, N.J. p. 1•1083
M **AMP Capitron Div./AMP Inc., Elizabethtown, Pa.** p. 1•1088,1089
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Bikor Corporation, Harbor City, Cal. p. 1•1123
Biometrics Instrument Corp., Garland, Tex. p. 1•1528-1531
CEA, San Luis Obispo, Cal. p. 1•1125
Christie Elec., Los Angeles, Cal. p. 1•1186
M **Dal Electronics Corp., Mt. Vernon, N.Y.** p. 1•1168-1173
Electronic Measurements, Neptune, N.J. p. 1•1187-1192
M **Hipotronics, Brewster, N.Y.** p. 1•722,723,1230,1231
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
MIL Electronics, Lowell, Mass. p. 1•1324
NJE Corp., Dayton, N.J. p. 1•1326-1331
NWL Transformers, Trenton, N.J. p. 2•1325
Power Designs, Westbury, N.Y. p. 1•1418-1425
Power/Mate Corp., Hackensack, N.J. p. 1•1341
Power Technology, Little Rock, Ark. p. 1•1338
Spellman High Voltage Elctrns. Corp., Bronx, N.Y. p. 1•1460-1471
Technipower, Ridgefield, Conn. p. 1•1478,1479
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1524,1525
D **Venus Scientific, Farmingdale, N.Y.** p. 1•1024,1025
Wilmore Elctrns. Co., Durham, N.C. p. 1•537
Cober Elctrns., Stamford, Conn. *
Tecnetics, Boulder, Colo. *
Todd Products Corp., Farmingdale, N.Y. *
Advanced Kinetics, Costa Mesa, Calif.
D Advanced Power Inc., Anaheim, Cal.
Amp Inc., Harrisburg, Pa.
Control Data Corp., Minneapolis, Minn.
Crestronics Inc., Crestline, Cal.
Electro-Pacific, Goleta, Calif.
Elma Engineering, Palo Alto, Cal.
EMCO High Voltage, Mt. View, Cal.
M Hughes Aircraft Co., Torrance, Cal.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
Maxwell Labs., San Diego, Calif.
Megavolt, New York, N.Y.
D Metrologic Instruments, Bellmawr, N.J.
M Micron Industries Corp., Stone Park, Ill.
Northeast Scientific Corp., Acton, Mass.
Opad Elec. Co., New York, N.Y.
M Peschel Instrs., Cape Coral, Fla.
Plastic Capacitors, Chicago, Ill.
Scott Electronics Corp., Orlando, Fla.
Spectra-Physics, Mountain View, Calif.
Union Carbide Corp., New York, N.Y.
Velonex, Instrument Div., Santa Clara, Cal.
Voltek Inc., Beverly Hills, Cal.

Power Supplies, Low Current (Less Than 0.4 Ampere)

M **Abbott Transistor Labs., Los Angeles, Cal.** p. 1•1048-1050
M **Abbott Transistor Labs, Los Angeles, Cal.** p. 1•1038,1042,1043
ACDC Electronics, Oceanside, Cal. p. 1•1027-1036
M **Acopian Corp., Easton, Pa.** p. 1•1057
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D Almond Instrs. Co., Covina, Cal.
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M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
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Barber Corp., Waynesville, Ohio
Burr-Brown, Tucson, Ariz.
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Control Data Corp., Minneapolis, Minn.
Controltek Inc., Portland, Ore.
M Delta Elctrn. Control, Costa Mesa, Cal.
Deltron, N. Wales, Pa.
D Digiac Corp., Smithtown, N.Y.
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Dynamic Measurements Corp., Winchester, Mass.
Dynamod, Little Ferry, N.J.
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Instant Instruments Inc., Haverhill, Mass.
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M Electro-Module, Pomona, Cal.
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M Spacetac, Bedford, Mass.
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D Tennelec, Oak Ridge, Tenn.
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Almond Instrs. Co., Covina, Cal.
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B & F Instrs., Corwells Hgts, Pa.
D B. H. Industries, Los Angeles, Cal
Cal-Power Corp., El Segundo, Calif.
D Cambridge Thermionic Corp., Cambridge, Mass.
Control Data Corp., Minneapolis, Minn.
M Dynamic Controls Corp., S. Windsor, Conn.
E & L Instruments, Derby, Conn.
EG & G, Salem, Mass.
DM Elasco, Bloomfield, Conn
M Electro-Module, Pomona, Cal.
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M Glentek, Santa Monica, Calif.
D Instant Instruments Inc., Haverhill, Mass.
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D NH Research, Santa Ana, Calif.
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Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
M Sawyer Inds., Arcadia, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
M Transistor Devices, Cedar Knolls, N.J.
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Elasco, Bloomfield, Conn
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Hughes Aircraft Co, Culver City, Cal.
Instant Instruments Inc., Haverhill, Mass.
Intronics Inc., Newton, Mass.
M Keltec Florida, Fort Walton Beach, Fla.
Keltron, Waltham, Mass.
Modular Power, San Diego, Cal.
D NH Research, Santa Ana, Calif.

North Electric Co., Galion, Ohio
NUCOR Corp., Denville, N.J.
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Nova Electric Mfg. Co., Nutley, N.J. .... *
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Basler Electric Co., Highland, Ill.
D B. H. Industries, Los Angeles, Cal
Burr-Brown, Tucson, Ariz.
Computer Products, Ft. Lauderdale, Fla.
Conic Corp., San Diego, Cal.
Control Data Corp., Minneapolis, Minn.
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Disc Instruments, Costa Mesa, Ca.
D Dressen-Barnes Elctrns., Pasadena, Cal.
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M Dynamic Controls Corp., S. Windsor, Conn.
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E & L Instruments, Derby, Conn.
M E-Tronics, Sepulveda, Cal.
DM Elasco, Bloomfield, Conn
Elcor Prods. Neotec Elctrns. Inc., Silver Spring, Md.
M Electro-Module, Pomona, Cal.
Electro-Pacific, Goleta, Calif.
D Elexon Power Sys., Santa Ana, Cal.
EMCO High Voltage, Mt. View, Cal.
D Fairchild Sound Equip., Commack, N.Y.
Faratron Corp., S. Hackensack, N.J.
Firing Circuits Inc., Norwalk, Conn.
Function Modules, Costa Mesa, Cal.
General Resistance, Mt. Vernon, N.Y.
Halmar Electronics, Columbus, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
Incor Instrumentation, West Babylon, N.Y.
D Instant Instruments Inc., Haverhill, Mass.
Instruments Components Co., Montor, Ohio
D ITI Electronics, Clifton, N.J.
Kato Engineering Co., Mankato, Minn.
D Keithley Instruments Inc., Cleveland, Ohio
M Keltec Florida, Fort Walton Beach, Fla.
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D Leader Instruments Corp., Plainview, N.Y.
D Lectrotech, Chicago, Ill.
Leeds & Northrup Co., North Wales, Pa.
M Micron Industries Corp., Stone Park, Ill.
M Modular Audio Products, Bohemia, N.Y.
Modular Power, San Diego, Cal.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Northeast Scientific Corp., Acton, Mass.
D Nucleonic Prods., Canoga Pk., Cal.
NUCOR Corp., Denville, N.J.
Oriel Corp. of America, Stamford, Conn.
M Peschel Instrs., Cape Coral, Fla.
Power Pac, South Norwalk, Conn.
M Powercube Corp., Waltham, Mass.
D Ragen Data Systems, Farmingdale, N.Y.
Rantec Div., Calabasas, Calif.
Ratelco, Seattle, Wash.
RCA Electronic Comps., Harrison, N.J.
Reich Associates Inc., Plano, Tex
Required Products, Stanford, Cal.
M Sawyer Inds., Arcadia, Cal.
Schauer Mfg. Corp., Cincinnati, Ohio
Scientifico Scientific Components Co., Newport Beach, Cal.
Scott Electronics Corp., Orlando, Fla.
Sensor Corp., Scottdale, Pa.
D Sola Electric, Elk Grove Village, Ill.
M Spacetac, Bedford, Mass.
Teledyne Inet, Gardena, Cal.
M Teledyne Mec., Palo Alto, Cal.
D Tennelec, Oak Ridge, Tenn.
D Ten-Tec Inc., Sevierville, Tenn.
Trans-Tek, Ellington, Conn.
M Transistor Devices, Cedar Knolls, N.J.
M Trio Labs, Plainview, N.Y.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
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D Advanced Power Inc., Anaheim, Cal.
M Atlantic Research Coropration, Alexandria, Va
Conic Corp., San Diego, Cal.
Cyberex, Mentor, Ohio
Gates Energy Prods., Denver, Colo.
Incor Instrumentation, West Babylon, N.Y.
Instr. & Control Sys., Addison, Ill.
Kato Engineering Co., Mankato, Minn.
M Keltec Florida, Fort Walton Beach, Fla.
North Electric Co., Galion, Ohio
D Onan Div-Onan Corp., Minneapolis, Minn.
Ratelco, Seattle, Wash.
M Sawyer Inds., Arcadia, Cal.
Seven Sciences, Santa Clara, Cal.
D Teledyne Big Beam, Crystal Lake, Ill.
Teledyne Inet, Gardena, Cal.
D Terado Corp., St. Paul, Minn.
M Transistor Devices, Cedar Knolls, N.J.

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M Powercube Corp., Waltham, Mass.
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M Electro-Module, Pomona, Cal.
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M International Power Machines Corp., Mesquite, Tex.
M Keltec Florida, Fort Walton Beach, Fla.
D NH Research, Santa Ana, Calif.
North Electric Co., Galion, Ohio
Pioneer Magnetics, Santa Monica, Cal.
Power Systems & Controls, Richmond, Va.
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D **Reliability Inc., Houston, Tex. ***
Accurate Electronics Co., Chicago, Ill.
Acme Electric, Cuba, N.Y.
D Advanced Power Inc., Anaheim, Cal.
Almond Instrs. Co., Covina, Cal.
D Alpha Components Corp., El Segundo, Cal.
Basler Electric Co., Highland, Ill.
Beckman Instrs., Cedar Grove, N.J.
Control Data Corp., Minneapolis, Minn.
Crestronics Inc., Crestline, Cal.
Cross Electronics Inc., Warrendale, Pa.
Cyberex, Mentor, Ohio
D Dressen-Barnes Elctrns., Pasadena, Cal.
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EMCO High Voltage, Mt. View, Cal.
Instant Instruments Inc., Haverhill, Mass.
Mag-Con, New Brighton, Minn.
Magnos, Incorporated, Harvard, Mass.
Modular Power, San Diego, Cal.
North Electric Co., Galion, Ohio
D Nucleonic Prods., Canoga Pk., Cal.
NUCOR Corp., Denville, N.J.
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D PRD Elctrns., Syosset, N.Y.
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D R F D, Tampa, Fla.
Rhode & Schwarz Sls., Fairfield, N.J.
M Santa Cruz Engrg. Inc., Santa Cruz, Cal.
Singer Co., State College, Pa.
M Technical Research & Mfg., Manchester, N.H.
M Teledyne Micronetics, San Diego, Calif.
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Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Beverly, Mass
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.
Varian, Solid State West Division, Palo Alto, Cal.
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DM Brelonix, Seattle, Wash
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Collins Radio, Dallas, Tex.
Communication Assocs., Huntington Station, N.Y.
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HRB-Singer, State College, Pa.
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Maury Microwave Corp., Cucamonga, Calif.
Micro-Tel Corp., Baltimore, Md.
D Midland International Corp., No. Kansas City, Mo.
Motorola Comms. Div., Schaumburg, Ill.
D Pearce-Simpson, Miami, Fla.
Radiation Devices Co., Baltimore, Md.
D Regency Electronics, Indianapolis, Ind.
M Resdel Engrg. Corp., Arcadia, Cal.
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Collins Radio, Dallas, Tex.
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GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
Midland International Corp., No. Kansas City, Mo.
Rhode & Schwarz Sls., Fairfield, N.J.
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M Watkins-Johnson Co., Palo Alto, Cal.

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Collins Radio, Dallas, Tex.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
Micro-Tel Corp., Baltimore, Md.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Co., State College, Pa.
Sivers Lab, Corona del Mar, Cal.
Tucker Electronics Co., Garland, Tex.
Viable Systems Inc., Needham, Mass.
M Watkins-Johnson Co., Palo Alto, Cal.

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BF Elctrns., Solana Beach, Calif.
Datum, Anaheim, Calif.
Dynalab Corp., Van Nuys, Cal.
Electrac, Anaheim, Calif.
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HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Resdel Engrg. Corp., Arcadia, Cal.
Singer Co., State College, Pa.
Tasker Systems, Chatsworth, Cal.
Tucker Electronics Co., Garland, Tex.
Varian Solid State East Beverly Div., Beverly, Mass.
M Watkins-Johnson Co., Palo Alto, Cal.

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M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
Epsco, Westwood, Mass.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Washington, D.C.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
Microwave/Sys., E. Syracuse, N.Y.
DM Radatron Corp., N. Tonawanda, NY
M Sanders Associates, Nashua, N.H.
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M Bendix Corp, Towson, Md.
DM Brelonix, Seattle, Wash
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Communication Assocs., Huntington Station, N.Y.
M Cubic Corp., San Diego, Cal.
D Drake Co., R.L., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Electrac, Anaheim, Calif.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
Frederick Electronics Corp., Frederick, Md.
GTE Sylvania Inc., Washington, D.C.
HM Electronics, San Diego, Cal.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Culver City, Cal.
ITT Mackay Marine, Raleigh, N.C.
M Lorch Elctrns. Corp., Englewood, N.J.
Micro-Tel Corp., Baltimore, Md.
D Midland International Corp., No. Kansas City, Mo.
Railway Comm., Raytown, Mo.
Rhode & Schwarz Sls., Fairfield, N.J.
D S G C Inc., Bellevue, Wash.
Technical Mat'l., Mamaroneck, N.Y.
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Datum, Anaheim, Calif.
Hughes Aircraft Co, Culver City, Cal.
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D Bogen Div., Paramus, N.J.
Bramco Controls Div., Piqua, Ohio
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Environmental Communications Inc., Costa Mesa, Cal.
GTE Automatic Electric Inc., Northlake, Ill.
Hathaway Instruments, Denver, Colo.
D Regency Electronics, Indianapolis, Ind.
REPCO Inc., Orlando, Fla.
M Resdel Engrg. Corp., Arcadia, Cal.
Singer - Tele-Signal, Woodbury, N.Y.
Viable Systems Inc., Needham, Mass.

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Collins Radio, Dallas, Tex.
Datum, Anaheim, Calif.
D Drake Co., R.L., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro-Metrics, Amsterdam, N.Y.
GTE Sylvania Inc., Washington, D.C.
Hewlett-Packard Co., Palo Alto, Cal.
ITT Mackay Marine, Raleigh, N.C.
Kinemetrics, San Gabriel, Cal.
Micro-Tel Corp., Baltimore, Md.
Railway Comm., Raytown, Mo.
Rhode & Schwarz Sls., Fairfield, N.J.
Singer Co., State College, Pa.
Telstar Electronics Corp., Southold, N.Y.
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D Control Equip. Corp., Lowell, Mass.
Data Specialties, North Brook, Ill.
Datacom, Ft. Walton Beach, Fla.
Datum, Anaheim, Calif.
Dest Data Corp., Sunnyvale, Cal.
Digital Equipment Corp., Maynard, Mass.
Digitronics Corp., Albertson, N.Y.
Echo Science Corp., Mountain View, Cal.
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Four-Phase Systems, Cupertino, Cal
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Hewlett-Packard Co., Palo Alto, Cal.
Hewlett-Packard, San Diego, Cal.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co, Culver City, Cal.
D Intern'l. Computer Prods., Dallas, Tex.
Kinemetrics, San Gabriel, Cal.
Lockheed Aircraft Svc., Ont., Cal.
Memodyne Corp., Newton Upper Falls, Ma.
Metric Systems Corp., Ft. Walton Beach, Fla.
MI2 Data Systems Inc., Columbus, Ohio
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Sycor, Ann Arbor, Mich.
Systems Data Inc., Akron, Ohio
Systems Instrs. Resch., Atlanta, Ga.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Texas Instrs. Inc., Houston, Tex.
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EDMAC Associates Inc., East Rochester, N.Y.
Electric Tachometer Corp., Philadelphia, Pa.
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D General Scanning, Watertown, Mass.
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M Resdel Engrg. Corp., Arcadia, Cal.
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NES, Streamwood, Ill. .... *
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Almond Instrs. Co., Covina, Cal.
American Videonetics Corp., Sunnyvale, Cal.
Ampex Corp., Redwood City, Cal.
Ampro Corp., Willow Grove, Pa.
Applied Data Commun., Santa Ana, Cal.
Audiotronics, N. Hollywood, Cal.
B & K Instruments, Cleveland, Ohio
Bell & Howell Co., Pasadena, Cal.
Burroughs Corp., Pasadena, Cal.
California Computer Prods., Anaheim, Cal
Carolina Medical Elctrns., King, N.C.
D Chalco Engrg. Corp., Gardena, Cal.
Continental Rentals Div., Bedford, Mass.
D Control Equip. Corp., Lowell, Mass.
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Datum, Anaheim, Calif.
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Hecon Corp., New Shrewsbury, N.J.
Heitz, Karl, New York, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
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D Interdata, Oceanport, N.J.
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Lockheed Aircraft Svc., Ont., Cal.
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D Macrodyne Inc., Schenectady, N.Y.
Memodyne Corp., Newton Upper Falls, Ma.
Metric Systems Corp., Ft. Walton Beach, Fla.
MI2 Data Systems Inc., Columbus, Ohio
Midland International Corp., No. Kansas City, Mo.
Mohawk OEM Sales, King of Prussia, Pa.
Newcomb Audio Products Co., Sylmar, Cal.
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Oxford Instr. Corp., Annapolis, Md.
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D Raymond Engrg. Inc., Middletown, Conn.
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D Telex Communications, Minneapolis, Minn.
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Bell & Howell Co., Pasadena, Cal.
D Columbia Resch. Labs., Woodlyn, Pa.
D Control Equip. Corp., Lowell, Mass.
D Emerson, Industrial Controls Div., Santa Ana, Cal.
M Genisco Tech. Corp., Compton, Cal.
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D Amprobe Instr., Lynbrook, N.Y.
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Annis R B Co., Indianapolis, Ind.
Astro-Med, West Warwick, R.I.
Auto Trol Corp., Denver, Colo.
Automatic Timing & Controls Co., King of Prussia, Pa.
B & K Instruments, Cleveland, Ohio
Barber-Colman Co., Rockford, Ill.
Bausch & Lomb, Rochester, N.Y.
Beckman Instrs., (AISSD), Fullerton, Cal.
Beckman Instrs., Cedar Grove, N.J.
BLH Elctrns., Waltham, Mass.
Brinkmann Instrs., Westbury, N.Y.
Coleman Instr. Div., Oak Brook, Ill.
Corning Glass Works, Medfield, Mass.
D Digiac Corp., Smithtown, N.Y.
Edo Western Corp., Salt Lake City, Utah
Electric Tachometer Corp., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
D General Electric Co., West Lynn, Mass.
General Rand Corp., Edison, N.J.
D General Scanning, Watertown, Mass.
Harrel, E. Norwalk, Conn.
Hathaway Industries Inc., Tulsa, Okla.
Hewlett-Packard Co., Palo Alto, Cal.
Hewlett-Packard, San Diego, Cal.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co, Culver City, Cal.
Incor Instrumentation, West Babylon, N.Y.
DM Laboratory Data Control, Riviera Beach, Fla.
D LFE Corporation, Waltham, Mass.
D Linear Instrs. Corp., Irvine, Cal.
McKee-Pedersen Instrs., Danville, Calif.
Metrosonics, Rochester, N.Y.
D Philips Test & Measuring Instrs., Woodbury, N.Y.
M Photron Instrument Co., Cleveland, Ohio
Robertshaw Controls Co., Richmond, Va.
Rhode & Schwarz Sls., Fairfield, N.J.
Sargent Welch Sci. Co., Skokie, Ill.
Sensotec, Columbus, Ohio
D Siemens Corp., Iselin, N.J.
D Sloan Technology Corp., Santa Barbara, Cal.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Tektronix, Beaverton, Ore.
Texas Instrs. Inc., Houston, Tex.
Tracor, Austin, Tex.
Tucker Electronics Co., Garland, Tex.
Westinghouse Elec. Corp., Newark, N.J.
Westronics, Fort Worth, Tex.
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B & K Instruments, Cleveland, Ohio
D Ballantine Laboratories, Boonton, N.J.
Biomation, Cupertino, Cal.
Data Disc Inc., Sunnyvale, Cal.
E-H Resch. Labs., Oakland, Cal.
Echo Science Corp., Mountain View, Cal.
Endevco, San Jaun Capistrano, Cal.
Engdahl Enterprises, Costa Mesa, Cal.
Hathaway Instruments, Denver, Colo.
Hewlett-Packard Co., Palo Alto, Cal.
Incor Instrumentation, West Babylon, N.Y.
D Macrodyne Inc., Schenectady, N.Y.
Micro Instrument Co., Escondido, Cal.
Physical Data, Portland, Ore.
Programmed Power, Menlo Park, Cal.
QuantaLog, Ann Arbor, Mich
Westronics, Fort Worth, Tex.
Zi-Tech Div., Palo Alto, Cal.
Zonic Technical Labs., Cincinnati, Ohio

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General Radio Co., Concord, Mass. .... *
Astro-Med, West Warwick, R.I.
EDMAC Associates Inc., East Rochester, N.Y.
D Epic, New York, N.Y.
Incor Instrumentation, West Babylon, N.Y.
Kinemetrics, San Gabriel, Cal.
Lockheed Aircraft Svc., Ont., Cal.
D Macrodyne Inc., Schenectady, N.Y.
Robertshaw Controls Co., Richmond, Va.
Sprengnether Instr. Co., W.F., St. Louis, Mo.
Westronics, Fort Worth, Tex.
Zonic Technical Labs., Cincinnati, Ohio

Recorders, Video (including Tape & Disc)

American Videonetics Corp., Sunnyvale, Cal.
Ampex Corp., Redwood City, Cal.
Circon Corp., Santa Barbara, Cal.
Data Disc Inc., Sunnyvale, Cal.
Echo Science Corp., Mountain View, Cal.
D GBC - Closed Circuit TV, New York, N.Y.
D Javelin Div., Los Angeles, Cal.
RCA Corp., Camden, N.J.
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DM Guardian California, Torrance, Cal.
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Struthers-Dunn, Pitman, N.J.
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M Branson Corp., Denville, N.J.
Cardinal Control Co., Kensington, Conn.
M Chicago Dynamic Industries, Chicago, Ill.
D Control Products Div., Union, N.J.
D Cornell-Dubilier Electronics, Newark, N.J.
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Hartman Electrical Mfg., Mansfield, Ohio
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D North American Philips Controls, Frederick, Md.
Relay Service Co., Chicago, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
D Siemens Corp., Iselin, N.J.
Sierra Elec., Gardena, Calif.
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D Syracuse Elctrns. Corp., Syracuse, N.Y.
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M Deutsch Relays, East Northport, N.Y.
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M Electronic Specialty Div., Portland, Ore.
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GTE Automatic Electric Inc., Northlake, Ill.
D GTE Sylvania Inc., Waltham, Mass.
Guardian Electric Co., Chicago, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
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D Struthers-Dunn, Pitman, N.J.
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D Triridge Corp., Pittsburgh, Pa.
Trompeter Electronics, Chatsworth, Cal.
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Basler Electric Co., Highland, Ill.
Cardinal Control Co., Kensington, Conn.
Cutler-Hammer, Milwaukee, Wisc.
E-T-A Prods. Co. America, Chicago, Ill.
M Electro-Module, Pomona, Cal.
D Furnas Elec. Co., Batavia, Ill.
DM General Automatic Corp., Bayonne, N.J.
D GTE Sylvania Inc., Waltham, Mass.
Guardian Electric Co., Chicago, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
Logitek, Farmingdale, N.Y.
Relay Specialties Inc., Fair Lawn, N.J.
Sensor Corp., Scottdale, Pa.
D Sigma Instruments, Braintree, Mass.
D Struthers-Dunn, Pitman, N.J.
Teledyne Kinetics, Solana Beach, Cal.
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M Electro-Module, Pomona, Cal.
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DM General Automatic Corp., Bayonne, N.J.
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D Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
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Shigoto Inds., Ltd., New York, N.Y. .... *
Square D Co., Milwaukee, Wisc. .... *
Wabash Relay & Elctrns., Wabash, Ind. .... *
Assembled Products Co., St. Albans, Vt.
M Branson Corp., Denville, N.J.
Cardinal Control Co., Kensington, Conn.
GTE Automatic Electric Inc., Northlake, Ill.
Master Elctrn. Controls, Santa Monica, Cal.
DM North American Philips Controls, Frederick, Md.
Relay Service Co., Chicago, Ill.
D Sigma Instruments, Braintree, Mass.
DM Struthers-Dunn, Pitman, N.J.
Vanguard Relay Corp., Lindenhurst, N.Y.
DM WABCO Aerospace Dept., Pittsburgh, PA.

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Barber-Colman Co., Rockford, Ill.
M Branson Corp., Denville, N.J.
Cardinal Control Co., Kensington, Conn.
D Cook Elec. Co., Morton Grove, Ill.
D Deltrol Controls, Milwaukee, Wisc.
M Deutsch Relays, East Northport, N.Y.
Fifth Dimension, Princeton, N.J.
DM General Automatic Corp., Bayonne, N.J.
GTE Automatic Electric Inc., Northlake, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
ITT Semiconductors-Capacitors, No. Andover, Mass.
Jaidinger Mfg. Co., Chicago, Ill.
North American Philips Controls, Frederick, Md.
M Sigma Instruments, Braintree, Mass.
Torr Labs., Los Angeles, Cal.
Triac Electronics, New York, N.Y.
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D **Ohmite Mfg. Co., Skokie, Ill. ....** *
Shigoto Inds., Ltd., New York, N.Y. .... *
Square D Co., Milwaukee, Wisc. .... *
D Adams & Westlake Co., Elkhart, Ind.
Artisan Elctrns. Corp., Parsippany, N.J.
D Babcock Electronics, Costa Mesa, Cal.
Barber-Colman Co., Rockford, Ill.
Basler Electric Co., Highland, Ill.
Cardinal Control Co., Kensington, Conn.
Cross Electronics Inc., Warrendale, Pa.
Crydom Controls, El Segundo, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Davis Elec. Co., Cape Girardeau, Mo.
D Deltrol Controls, Milwaukee, Wisc.
M Deutsch Relays, East Northport, N.Y.
ECC Corp., Euless, Tex.
Gems Sensors Div., Farmington, Conn.
DM General Automatic Corp., Bayonne, N.J.
DM Guardian California, Torrance, Cal.
Guardian Electric Co., Chicago, Ill.
D H-B Instr. Co., Phila., Pa.
M Hartman Electrical Mfg., Mansfield, Ohio
Honeywell, Ft. Washington, Pa.
ITT Semiconductors-Capacitors, No. Andover, Mass.
King-Seeley Thermos Co., Kendallville, Ind.
Lear Siegler, Santa Monica, Calif.
D Line Electric Co. Unit Esterline Corp., Parsippany, N.J.

North American Philips Controls, Frederick, Md.
Oak Inds. Inc., Crystal Lake, Ill.
Payne Engrg. Co., Scott Depot, W. Va.
D Power Control Corp., Pittsburgh, Pa.
Relay Specialties Inc., Fair Lawn, N.J.
D Sigma Instruments, Braintree, Mass.
D Struthers-Dunn, Pitman, N.J.
Torr Labs., Los Angeles, Cal.
Triac Electronics, New York, N.Y.
Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.
D Ward Leonard Elec. Co. Inc., Mt. Vernon, N.Y.
D Zenith Controls Inc., Chicago, Ill.

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Amp Inc., Harrisburg, Pa.
AMP Special Industries, Valley Forge, Pa.
D Babcock Electronics, Costa Mesa, Cal.
M Branson Corp., Denville, N.J.
Cardinal Control Co., Kensington, Conn.
COSAR Corp., Garland, Tex.
M Deutsch Relays, East Northport, N.Y.
Electronic Specialty Div., Portland, Ore.
GTE Automatic Electric Inc., Northlake, Ill.
Guardian Electric Co., Chicago, Ill.
Hughes Aircraft Co, Culver City, Cal.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Master Elctrn. Controls, Santa Monica, Cal.
D North American Philips Controls, Frederick, Md.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
PSG Industries Inc., Perkasie, Pa.
D Sigma Instruments, Braintree, Mass.
D Struthers-Dunn, Pitman, N.J.
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Cardinal Control Co., Kensington, Conn.
Eagle Signal, Davenport, Iowa
M Electro-Module, Pomona, Cal.
GTE Automatic Electric Inc., Northlake, Ill.
Information Transfer Industrial, Holcomb, N.Y.
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Shigoto Inds., Ltd., New York, N.Y. .... *
Teledyne Relays, Hawthorne, Cal .... *
Wabash Relay & Elctrns., Wabash, Ind. .... *
Acrodyne Controls, Janesville, Wisc.
D Adams & Westlake Co., Elkhart, Ind.
D Babcock Electronics, Costa Mesa, Cal.
Biddle, James G., Plymouth Meeting, Pa.
Component Specialties, Temple City, Cal.
COSAR Corp., Garland, Tex.
Cutler-Hammer, Milwaukee, Wisc.
M Electronic Specialty Div., Portland, Ore.
DM General Automatic Corp., Bayonne, N.J.
GTE Automatic Electric Inc., Northlake, Ill.
Guardian Electric Co., Chicago, Ill.
Information Transfer Industrial, Holcomb, N.Y.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Meko Instrument Co., Glendale, Cal.
MKC Electronics, Kansas City, Kans.
D North American Philips Controls, Frederick, Md.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D QTron Corp., Santa Ana, Cal.
Relay Specialties Inc., Fair Lawn, N.J.
Rhode & Schwarz Sls., Fairfield, N.J.
Sensor Corp., Scottdale, Pa.
D Sigma Instruments, Braintree, Mass.
D Struthers-Dunn, Pitman, N.J.
Torr Labs., Los Angeles, Cal.
M Transco Prods., Venice, Cal.
D Triridge Corp., Pittsburgh, Pa.
Trompeter Electronics, Chatsworth, Cal.
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D Babcock Electronics, Costa Mesa, Cal.
Collins Radio, Dallas, Tex.
COSAR Corp., Garland, Tex.
M Electronic Specialty Div., Portland, Ore.
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Allis-Chalmers, Milwaukee, Wisc.
M Branson Corp., Denville, N.J.
Couch S.H. Div., Boston, Mass.
M Deutsch Relays, East Northport, N.Y.
D Struthers-Dunn, Pitman, N.J.
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Wabash Relay & Elctrns., Wabash, Ind. .... *
D Adams & Westlake Co., Elkhart, Ind.
Artisan Elctrns. Corp., Parsippany, N.J.
D Babcock Electronics, Costa Mesa, Cal.
Barber-Colman Co., Rockford, Ill.
Cardinal Control Co., Kensington, Conn.
Couch S.H. Div., Boston, Mass.
Cutler-Hammer, Milwaukee, Wisc.
M Deutsch Relays, East Northport, N.Y.
Eagle Signal, Davenport, Iowa
Edison, Instr. Div., W. Orange, N.J.
M Electro-Module, Pomona, Cal.
M Electronic Specialty Div., Portland, Ore.
Fifth Dimension, Princeton, N.J.
DM General Automatic Corp., Bayonne, N.J.
H-B Instr. Co., Phila., Pa.
Hartman Electrical Mfg., Mansfield, Ohio
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Jaidinger Mfg. Co., Chicago, Ill.
Larson Aero Dev., Concord, Calif.
D Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
Master Elctrn. Controls, Santa Monica, Cal.
North American Philips Controls, Frederick, Md.
Relay Service Co., Chicago, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
D Sigma Instruments, Braintree, Mass.
Struthers-Dunn, Pitman, N.J.
Triac Electronics, New York, N.Y.
Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.

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*Company has information in white pages but not on this product

DM WABCO Aerospace Dept., Pittsburgh, PA.
D Ward Leonard Elec. Co. Inc., Mt. Vernon, N.Y.
D Zenith Controls Inc., Chicago, Ill.

Relays, Solid-State

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M **General Instruments Corp., Hicksville, N.Y.** ..... *
Hope Elctrns., Clifton, N.J. .... *
International Rectifier Corp., El Segundo, Cal. *
Leach Corp., Los Angeles, Cal. .... *
D **Ohmite Mfg. Co., Skokie, Ill.** .... *
Wabash Relay & Elctrns., Wabash, Ind. .... *
D Adams & Westlake Co., Elkhart, Ind.
Alpha Components Corp., El Segundo, Cal.
D Amtron Div., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Artisan Elctrns. Corp., Parsippany, N.J.
D Babcock Electronics, Costa Mesa, Cal.
Barber-Colman Co., Rockford, Ill.
Basler Electric Co., Highland, Ill.
M Branson Corp., Denville, N.J.
Cardinal Control Co., Kensington, Conn.
Collins Radio, Dallas, Tex.
D Control Products Div., Union, N.J.
Cox & Co., New York, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Crydom Controls, El Segundo, Cal.
Cutler-Hammer, Milwaukee, Wisc.
D Deltrol Controls, Milwaukee, Wisc.
Digitech Data Inds., Ridgefield, Conn.
Eagle Signal, Davenport, Iowa
ECC Corp., Euless, Tex.
Electronic Specialty Div., Portland, Ore.
D Furnas Elec. Co., Batavia, Ill.
Gems Sensors Div., Farmington, Conn.
DM General Automatic Corp., Bayonne, N.J.
General Elec., Syracuse, NY
M Genisco Tech. Corp., Compton, Cal.
Gentron Corp., Milwaukee, Wisc.
DM Guardian California, Torrance, Cal.
DM Guardian Electric Co. of Cal., Torrance, Cal.
Guardian Electric Co., Chicago, Ill.
H-B Instr. Co., Phila., Pa.
Halmar Electronics, Columbus, Ohio
Hartman Electrical Mfg., Mansfield, Ohio
Honeywell, Ft. Washington, Pa.
Instr. & Control Sys., Addison, Ill.
DM Kings Electronics, Tuckahoe, N.Y.
Lear Siegler, Santa Monica, Calif.
D Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
Logitek, Farmingdale, N.Y.
Madison Laboratories, Madison, Conn
Mag-Con, New Brighton, Minn.
Master Elctrn. Controls, Santa Monica, Cal.
MKC Electronics, Kansas City, Kans.
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
North American Philips Controls, Frederick, Md.
Payne Engrg. Co., Scott Depot, W. Va.
PECO Corp., Milpitas, Cal.
PSG Industries Inc., Perkasie, Pa.
Relay Specialties Inc., Fair Lawn, N.J.
Reliance Electric Co., Cleveland, Ohio
Sensor Corp., Scottsdale, Pa.
D Sigma Instruments, Braintree, Mass.
DM Solitron Devices, Riviera Beach, Fla.
S S A C Precision Products Inc., Liverpool, N.Y.
Struthers-Dunn, Pitman, N.J.
D Syracuse Elctrns. Corp., Syracuse, N.Y.
D Tann Controls Co., Detroit, Mich.
D Teledyne-Crystalonics, Cambridge, Mass.
Tempo Instrument, Plainview, N.Y.
M Transco Prods., Venice, Cal.
Triac Electronics, New York, N.Y.
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D Vectrol, Rockville, Md.
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Laser Technology, N. Hollywood, Calif.
D Lithic Systems, Saratoga, Cal.
Macrodata, Woodland Hills, Cal.
Narda Microwave Corp., Plainview, N.Y.
SGS-ATES Semiconductor, Newtonville, Mass.
Silicon Systems Inc., Santa Ana, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
3M Co., St. Paul, Minn.
D Xciton Corp., Latham, N.Y.

Semiconductor Wafer Fabrication, Maskmaking (Tooling)
M **Analog Devices, Norwood, Mass. .... ***
M American Microsystems, Santa Clara, Cal.
Illumination Industries, Sunnyvale, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Quantronix Corp., Smithtown, N.Y.

SGS-ATES Semiconductor, Newtonville, Mass.
D Teledyne Semiconductor, Mountain View, Cal.

Semiconductor Wafer Fabrication, Processing

M Analog Devices, Norwood, Mass. .... *
Accumet Engineering Corp., Hudson, Mass.
M American Microsystems, Santa Clara, Cal.
Applied Materials Inc., Santa Clara, Cal.
Atomergic Chemetals Co., Carle Place, N.Y.
Exetron Corp., Santa Clara, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
LFE Corporation, Waltham, Mass.
Materials Resch. Corp., Orangeburg, N.Y.
Micro Components Corp., Cranston, RI
National Beryllia Corp., Haskell, N.J.
National Electronics, Geneva, Ill.
Philadelphia Quartz Co., Valley Forge, Pa.
Research Devices, Berkeley Heights, N.J.
SGS-ATES Semiconductor, Newtonville, Mass.
Siltec Corp., Menlo Park, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
Union Carbide Corp., New York, N.Y.
D Xciton Corp., Latham, N.Y.

Semiconductor Wafer Fabrication, Testing

Boonton Electronics Corp., Parsippany, N.J. p. 1•623
M Analog Devices, Norwood, Mass. .... *
D GC Electronics, Rockford, Ill. .... *
Alessi Industries, Costa Mesa, Cal.
M American Microsystems, Santa Clara, Cal.
Atomergic Chemetals Co., Carle Place, N.Y.
Exetron Corp., Santa Clara, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
Laser Technology, N. Hollywood, Calif.
D Lithic Systems, Saratoga, Cal.
National Electronics, Geneva, Ill.
Research Devices, Berkeley Heights, N.J.
SGS-ATES Semiconductor, Newtonville, Mass.
Silicon Systems Inc., Santa Ana, Cal.
D Teledyne Semiconductor, Mountain View, Cal.
D Temptronic Corporation, Newton, Mass.
D Transitron Elctrn. Corp., Wakefield, Mass.

Semiconductors—See Diodes; Rectifiers; Transistors

Sensors—See Transducer Listings

Sensors, Light

D International Rectifier Corp., El Segundo, Cal. p. 1•1842,1843
D Litronix, Cupertino, Cal. .... p. 2•1178
Spectronics, Richardson, Tex. .... p. 1•1021
NES, Streamwood, Ill. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Simpson Electric Co., Elgin, Ill. .... *
Eagle Signal, Davenport, Iowa
Electronic Counters & Controls Inc., Mundelein, Ill.
EMI Gencom Inc., Plainview, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Hughes Aircraft Co, Culver City, Cal.
Meloy Laboratories Inc., Springfield, Va.
Meret Inc., Santa Monica, Cal.
Optron, Carrollton, Tex.
Quantrol Elect. Inc., El Paso, Tex.
Sensor Corp., Scottdale, Pa.
Varian Electron Tube & Device Grp., San Carlos, Cal.

Sensors, Temperature—See Bolometers; Thermistors; Transducers

Sequence Controllers—See Controllers, Programmable

Services, Assembly & Fabrication (Including R & D)

Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
M Amphenol Connector Div., SAMS Opers., Chatsworth, Cal. .... p. 2•460,461
M Amphenol Sales Div., Broadview, Ill. p. 2•460,461
Connector Corp., Chicago, Ill. ...... p. 2•657-660
GRM Corp., Medford, N.J. .... p. 1•120
M Interface Engineering Inc., Stoughton, Mass. p. 1•175
D Para-Kote, Marshall, Minn. ...... p. 2•1773,1774
DM SGL Waber Electric, Westville, NJ ...... p. 2•356
Wertronix Corp., Dayton, Ohio .... p. 1•998
M Zero Mfg. Co., Burbank, Cal. .... p. 1•106-109
American Vector/TDC, Dayton, N.J. .... *
M Analog Devices, Norwood, Mass. .... *
EECO, Santa Ana, Cal. .... *
D Elctrn. Molding Corp., Woonsocket, R.I. .... *
Jonard Industries Corp., Tuckahoe, N.Y. .... *
Technitrol, Philadelphia, Pa. .... *
All Systems, Moorestown, N.J.
M ABA Industries, Pinellas Pk., Fla.
M Abrams Instr., Lansing, Mich.
Acesso-Wire, Garnersville, N.Y.
Action Labs Inc., Minneapolis, Minn.
Adcotech Corp., Sunnyvale, Cal.
AEL, Colmar, Pa.
Aerolite Elexs Corp., Union City, N.J.
American Electric Cable Co., Holyoke, Mass.
A. M. W. Corp., Arlington, Mass.
Applied Control Co., Fairfield, N.J.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Associated Spring Corp., Bristol, Conn.
Astro-Geo-Marine Inc., Oxnard, Cal.
Autosplice/Dv Gen Staple, New York City, N.Y.
M Avid Electronics Corp., Baldwin, Pl., N.Y.
Cardinal Control Co., Kensington, Conn.
M Data Numerics, Farmingdale, N.Y.
Dattilo Enterprises, Louisville, Ky.
Detoronics Corp., S. El Monte, Cal.
Diceon Electronics, Irvine, Cal.
Electrocom Inds., S. Bend, Ind.
Electronics One Inc., Atlanta, Ga.
Elgin Elctrns., Waterford, PA.
Environmental Communications Inc., Costa Mesa, Cal.
Estes Engrg. Co., Port Angeles, Wash.
DM Excel Products Co., New Brunswick, N.J.
Form-It Products Inc., Chicago, Ill
Grand Transformers, Grand Haven, Mich.
M Hamilton Technology, Lancaster, Pa.
D Hobson Bros., Chicago, Ill.
Hughes Aircraft Co, Culver City, Cal.
IEC Electronics Corp., E. Rochester, N.Y.
M International Identifications, Timonium, Md.
ITI Electronics, Clifton, N.J.
M Jettron Prods., Hanover, N.J.
M Kates Scientific Instrs., Newton, Mass.
Kentucky Electronics, Owensboro, Ky.
M Kinetron Corp., Asbury Park, N.J.
M Lehighton Electronics, Lehighton, Pa
Mag-Con, New Brighton, Minn.
Matrix Engineering Corp., Gardena, Cal.
M Microdynamics, So. El Monte, Cal.
Mid-West Metal Prods., Kansas City, Kans.
Mobil Electronics, Anderson, Ind.
Molding Technology Inc., Ivyland, Pa.
New Era Prods., Cleveland, Ohio
N.Y. Testing Labs., Westbury, N.Y.
Nucleus Corp., Madison Hgts., Mich.
Paraplegics Mfg., Bensenville, Ill.
Peerless Radio Corp., Lynbrook, N.Y.
Photo Chemical Prods. Cal., Santa Monica, Cal.
P M C Electronics Co., Southampton, Pa
Process & Instrs. Corp., Brooklyn, N.Y.
Proto Matic Co., Cincinnati, Ohio
RCA Service Co., Camden, N.J.
Rye Inds., Mamaroneck, N.Y.
Stanford Applied Engineering, Santa Clara, Cal.
Systems Data Inc., Akron, Ohio
M Teledyne Aerospace Systems, Fairmont, Minn.
Transcom Electronics, La Mesa, Cal.
Ultra Carbon Corp., Bay City, Mich.
D Viking Inds., Chatsworth, Cal.
M Western Microsystems, Santee, Cal.
D Workman Electronic Prods., Sarasota, Fla.

Services, Backplane Wiring

Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
M Amphenol Sales Div., Broadview, Ill. p. 2•460,461
D Bendix Corp., The, Sidney, N.Y. .... p. 2•641
M Interface Engineering Inc., Stoughton, Mass. p. 1•175
Vero Electronics, Hauppauge, N.Y. ..... p. 2•364
American Vector/TDC, Dayton, N.J. .... *
EECO, Santa Ana, Cal. .... *
Technitrol, Philadelphia, Pa. .... *
Action Labs Inc., Minneapolis, Minn.
Adcor Electronic Packaging Corp., New York, N.Y.
M Data Numerics, Farmingdale, N.Y.
DM Excel Products Co., New Brunswick, N.J.
Gary Mfg., New Brunswick, N.J.
G B Instruments Inc., Hollywood, Fla.
Hughes Aircraft Co, Culver City, Cal.
D IFE Div., Rumford, R.I.
M International Identifications, Timonium, Md.
M Lehighton Electronics, Lehighton, Pa
Mid-West Metal Prods., Kansas City, Kans.
Paraplegics Mfg., Bensenville, Ill.
Stanford Applied Engineering, Santa Clara, Cal.

Services, Calibration & Instrument Repair

Fluke Mfg. Co., John, Seattle, Wash. p. 1•695
All Systems, Moorestown, N.J.
AEL, Colmar, Pa.
AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
B & K Instruments, Cleveland, Ohio
The Bendix Corp., Teterboro, N.J.
Biddle, James G., Plymouth Meeting, Pa.
BLH Elctrns., Waltham, Mass.
Columbia Resch. Labs., Woodlyn, Pa.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Electrical Instr. Svc., Mt. Vernon, N.Y.
D Electrical Testing Labs., New York, N.Y.
Foxboro Co., Foxboro, Mass.
M Gen'l. Environments Corp., Morton Grove, Ill.
H-B Instr. Co., Phila., Pa.
Hewlett-Packard Co., Palo Alto, Cal.
Honeywell, Minneapolis, Minn.
Hughes Aircraft Co, Culver City, Cal.
Lear Siegler, Santa Monica, Calif.
Leeds & Northrup Co., North Wales, Pa.
M Lehighton Electronics, Lehighton, Pa
Lockheed Aircraft Svc., Ont., Cal.
Main Electrns., Wichita, Kan.
Maury Microwave Corp., Cucamonga, Calif.
National Camera Inc., Englewood, Colo.
New Era Prods., Cleveland, Ohio
N.Y. Testing Labs., Westbury, N.Y.
Nucleus Corp., Madison Hgts., Mich.
PTS Electronics Inc., Bloomington, Ind
RCA Service Co., Camden, N.J.
Reliance Electric Co., Cleveland, Ohio
Rutherford Research Prods. Co., Rutherford, N.J.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Taylor Instr. Process Control Div., Rochester, N.Y.
Texas Instrs. Inc., Houston, Tex.
Thwing-Albert Instr. Co., Philadelphia, Pa.
D Transducers, Whittier, Ca.
Tucker Electronics Co., Garland, Tex.

Services, Coating (All-Types)

M Rowe Industries, Toledo, Ohio ..... p. 2•796,797
SGL Elctronics, Westville, N.J. .... p. 2•1254
M Zero Mfg. Co., Burbank, Cal. .... p. 1•106-109
M Analog Devices, Norwood, Mass. .... *
Abesto Corp., Bloomfield, N.J.
Adcotech Corp., Sunnyvale, Cal.
Alpha Metals, Jersey City, N.J.
American Chemical Etching, Pacoima, , Cal.
American Lava Corp., Chattanooga, Tenn.
D Aremco Prods., Ossining, N.Y.
M Atlantic Research Coropration, Alexandria, Va
M Chemplast, Wayne, N.J.
Collins Radio, Dallas, Tex.
Evaporated Coatings, Huntingdon Valley, Pa.
Hughes Aircraft Co, Culver City, Cal.
Materials Resch. Corp., Orangeburg, N.Y.
Metavac, Flushing, N.Y.
Mid-West Metal Prods., Kansas City, Kans.
National Beryllia Corp., Haskell, N.J.
Oriel Corp. of America, Stamford, Conn.
Photo Chemical Prods. Cal., Santa Monica, Cal.
M Press-On Prods., Addison, Ill.
SermeTel Teleflex Inc., Limerick, Pa
Thin Film Services, Gile, Wisc.
Union Carbide Corp., New York, N.Y.
M Valpey Corp., Holliston, Mass.
Varian Assocs., Palo Alto, Cal.

Services, Computer-Aided Design (CAD)

EECO, Santa Ana, Cal. .... *
Promemco, Hauppauge, N.Y. .... *
All Systems, Moorestown, N.J.
Adcor Electronic Packaging Corp., New York, N.Y.
Aetna Engrg., Los Angeles, Cal.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Design Automation, Lexington, Mass.
Diceon Electronics, Irvine, Cal.
Exetron Corp., Santa Clara, Cal.
Hughes Aircraft Co, Culver City, Cal.
LSI Computer Systems, Plainview, N.Y.
Silicon Systems Inc., Santa Ana, Cal.

Services, Crimping

Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
Connector Corp., Chicago, Ill. ...... p. 2•657-660
M Rowe Industries, Toledo, Ohio ..... p. 2•796,797
Action Labs Inc., Minneapolis, Minn.
American Electric Cable Co., Holyoke, Mass.
Autosplice/Dv Gen Staple, New York City, N.Y.
Hughes Aircraft Co, Culver City, Cal.
M Manger Elec. Co., Stamford, Conn.

Services Custom Molding, Plastics

Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
M **Amphenol Sales Div., Broadview, Ill. p. 2•460,461**
Connector Corp., Chicago, Ill. ...... p. 2•657-660
Harbison Ind'l. Prods., Levittown, Pa. p. 1•1544
ITT Thermotech, Hopkins, Minn. p. 2•1231,1232
D **Para-Kote, Marshall, Minn. ...... p. 2•1773,1774**
M **Projects Unlimited, Dayton, Ohio .... p. 1•271**
M **Rowe Industries, Toledo, Ohio ..... p. 2•796,797**
Zero Mfg. Co., Burbank, Cal. .... p. 1•106-109
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
Jonard Industries Corp., Tuckahoe, N.Y. .... *
Kurz-Kasch, Wilmington, Ohio .... *
Abesto Corp., Bloomfield, N.J.
Accessories for Electronics, Bayside, N.Y.
M Acme Plastic Products Co., Phoenix, Ariz.
Air Prods. & Chems., Allentown, Pa.
Akron Porcelain Co., Akron, Ohio
American Electric Cable Co., Holyoke, Mass.
M Applied Design Co., Tonawanda, N.Y.
M Atlantic Research Coropration, Alexandria, Va
Caplugs Div., Buffalo, N.Y.
M Chemplast, Wayne, N.J.
Conap, Allegany, N.Y.
Eby Co., Hugh H., Philadelphia, Pa.
Form-It Products Inc., Chicago, Ill
D Gries Reproducer Co., New Rochelle, N.Y.
GTI Corporation, Pittsburgh, Pa.
Gulton Inds., Buena Park, Cal.
D Hobson Bros., Chicago, Ill.
Hughes Aircraft Co, Fullerton, Cal.
Icore Int'l., Sunnyvale, , Cal.
Lear Siegler, Santa Monica, Calif.
Manger Elec. Co., Stamford, Conn.
Minnesota Rubber Co., Minneapolis, Minn.
Molding Technology Inc., Ivyland, Pa.
M Moldtronics, Downers Grove, Ill.
N.Y. Testing Labs., Westbury, N.Y.
NVF Co., Yorklyn, Del.
M Polyflon Corp., New Rochelle, N.Y.
Robinson-Nugent, New Albany, Ind.
Ronor Systems, Cheshire, Conn.
Rostone Corp., Lafayette, Ind.
Rye Inds., Mamaroneck, N.Y.
SGL Plastics, Nazareth, Pa.
Simmons Fastener Corp., Albany, N.Y.
Stanford Applied Engineering, Santa Clara, Cal.
DM Stevens Prods., E. Orange, N.J.
M Teledyne Aerospace Systems, Fairmont, Minn.
Textool Products, Irving, Tex.
M Unit Industries, South Gate, Cal.
Van Norman Molding Co., Bridgeview, Ill.
Vernay Laboratories, Yellow Springs, Ohio
Vlchek Plastics Co., Middlefield, Ohio
Westmoreland Plastics Co., Latrobe, Pa.
Whitso, Schiller Park, Ill.

Services, Decapsulation

Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
D **Amphenol Connector Div., SAMS Opers., Chatsworth, Cal. .... p. 2•460,461**
D Amphenol Comps. Grp. Mktg., Oak Brook, Ill.
Lear Siegler, Santa Monica, Calif.
Research Instrument Co., Garden City, N. Y.

Services, Electrical Measurement & Test

Active Control Instrumentation, E. Northport, N.Y. .... p. 1•229
Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
Amphenol Connector Div., SAMS Opers., Chatsworth, Cal. ....p. 2•460,461
CELCO, Mahwah, N.J. ....p. 1•630,631
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
M **Interface Engineering Inc., Stoughton, Mass. p. 1•175**
Ross Engineering Corp., Campbell, Cal. p. 1•1807
M **Rowe Industries, Toledo, Ohio ... p. 2•798,2054**
M **All-Tronics Inc., Westbury, N.Y.** .... *
M **Analog Devices, Norwood, Mass.** .... *
Hopkins Engrg., San Fernando, Cal. .... *
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal. .... *
Spectrum Control, Fairview, Pa. .... *
Technitrol, Philadelphia, Pa. .... *
All Systems, Moorestown, N.J.
AEL, Colmar, Pa.
AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
Aetna Engrg., Los Angeles, Cal.
Associated Testing Labs., Burlington, Mass.
M Associated Testing Laboratories, Clifton, N.J.
M Atlantic Research Coropration, Alexandria, Va
Ballantine Laboratories, Boonton, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Cardinal Control Co., Kensington, Conn.
Data Numerics, Farmingdale, N.Y.
Detoronics Corp., S. El Monte, Cal.
Dielectric Instr. Corp., Pittsburgh, Pa.
Diceon Electronics, Irvine, Cal.
Electrical Instr. Svc., Mt. Vernon, N.Y.
D Electrical Testing Labs., New York, N.Y.
Environmental Communications Inc., Costa Mesa, Cal.
DM Excel Products Co., New Brunswick, N.J.
M Gen'l. Environments Corp., Morton Grove, Ill.
M Genisco Tech. Corp., Compton, Cal.
Hughes Aircraft Co, Fullerton, Cal.
M Lehighton Electronics, Lehighton, Pa
Lockheed Elctrns. Co., Watchung, N.J.
New Era Prods., Cleveland, Ohio
N.Y. Testing Labs., Westbury, N.Y.
Nucleus Corp., Madison Hgts., Mich.
Peerless Radio Corp., Lynbrook, N.Y.
Proto Matic Co., Cincinnati, Ohio
RCA Service Co., Camden, N.J.
Rutherford Research Prods. Co., Rutherford, N.J.
Sanders Associates, Nashua, N.H.
Sensitive Research Instrs., Mt. Vernon, N. Y.
Sunshine Sci. Instrs., Philadelphia, Pa.
M Technical Research & Mfg., Manchester, N.H.
M Teledyne Micronetics, San Diego, Calif.
Tucker Electronics Co., Garland, Tex.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.

Services, Encapsulation

D **Airflyte Elctrns. Co., Bayonne, N.J. p. 1•932,933**
Amphenol Cadre Div., Endicott, N.Y. p. 2•460,461
Amphenol Connector Div., SAMS Opers., Chatsworth, Cal. ....p. 2•460,461
M **Rowe Industries, Toledo, Ohio ..... p. 2•796,797**
Elctrn. Molding Corp., Woonsocket, R.I. .... *
Endicott Coil Co., Binghamton, N.Y. .... *
Grayhill Inc., LaGrange, Ill. .... *
Action Labs Inc., Minneapolis, Minn.
Adcotech Corp., Sunnyvale, Cal.
AEL, Colmar, Pa.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Bacon Inds., Watertown, Mass.
D Beman Mfg., New Cumberland, Pa.
D Cable Systems & Assembly Co., Everett, Mass.
Eastern Delta Corp., Fair Lawn, N.J.
Electrical Plastics Corp., Long Branch, N.J.
Estes Engrg. Co., Port Angeles, Wash.
H-B Instr. Co., Phila., Pa.
M Hardman Inc., Belleville, N.J.
Hightemp Resins, Stamford, Conn.
Hughes Aircraft Co, Fullerton, Cal.
M Kates Scientific Instrs., Newton, Mass.
Manger Elec. Co., Stamford, Conn.
Molding Technology Inc., Ivyland, Pa.
National Beryllia Corp., Haskell, N.J.
Paraplegics Mfg., Bensenville, Ill.
Research Instrument Co., Garden City, N. Y.
Ronor Systems, Cheshire, Conn.
Semicon Assoc., Lexington, Ky.
M Teledyne Aerospace Systems, Fairmont, Minn.
U.S. Elctrns., Long Branch, N.J.

Services, Environmental Testing

M **Rowe Industries, Toledo, Ohio ..... p. 2•796,797**
M **Analog Devices, Norwood, Mass.** .... *
Grayhill Inc., LaGrange, Ill. .... *
NES, Streamwood, Ill. .... *
M **Torwico Elctrns., Lakewood, N.J.** .... *
M Abrams Instr., Lansing, Mich.
AEL, Colmar, Pa.
Alpha Metals, Jersey City, N.J.
M Ashman Industries (1966) Ltd., Greensville Dundas, Ont., Can.
Associated Testing Labs., Burlington, Mass.
M Associated Testing Laboratories, Clifton, N.J.
M Atlantic Research Coropration, Alexandria, Va
Atlas Engrg. Corp., W. Hartford, Conn.
Atmosphere Controls Prdts., Mt. View, Cal.
D Baganoff Assocs., St. Louis, Mo.
Beckman Instrs., Cedar Grove, N.J.
DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
Burlington Opers. Div., Burlington, Mass.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
DM Datatron, Santa Ana, Cal.
Detoronics Corp., S. El Monte, Cal.
Dow Chemical Co., Midland, Mich.
Eagle-Picher Industries, Joplin, Mo.
EDMAC Associates Inc., East Rochester, N.Y.
E.I. DuPont de Nemours & Co., Wilmington, Del.
D Electrical Testing Labs., New York, N.Y.
Environmental Research Grp., Ann Arbor, Mich.
Fairchild Space & Defense Sys. Div., Syosset, N.Y.
General Elec., Phila., Pa.
M Gen'l. Environments Corp., Morton Grove, Ill.
HRB-Singer, State College, Pa.
Hughes Aircraft Co, Fullerton, Cal.
IRD Mechanalysis, Columbus, Ohio
D Lear Siegler, Elyria, Ohio
Lockheed Aircraft Svc., Ont., Cal.
Lockheed Elctrns. Co., Watchung, N.J.
N.Y. Testing Labs., Westbury, N.Y.
M Preformed Line Products Co., Cleveland, Ohio
M Q.V.S., East Orange, N.J.
RCA Service Co., Camden, N.J.
Sanders Associates, Nashua, N.H.
M Trio-Tech, of Calif., Burbank, Calif.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.

Services, Hermetic Sealing

Alberox Corp., New Bedford, Mass. .... *
Bendix, Franklin, Ind. .... *
Mini-Systems, North Attleboro, Mass. .... *
Associate General Labs., Brookfield, Ill.
Ceramaseal, New Lebanon Center, N.Y.
Connector Inds. of America, Cincinnati, Ohio
Detoronics Corp., S. El Monte, Cal.
Elctrn. Seals, Van Nuys, Cal.
Environmental Communications Inc., Costa Mesa, Cal.
Fansteel Inc., N Chicago, Ill.
Gulton Inds., Buena Park, Cal.
Hermetic Seal Corp., Rosemead, Cal.
Hughes Aircraft Co, Fullerton, Cal.
M Kinetron Corp., Asbury Park, N.J.
Laser Inc., Sturbridge, Mass.
Research Instrument Co., Garden City, N. Y.
D Viking Inds., Chatsworth, Cal.

Services, High Vacuum

Applied Materials Inc., Santa Clara, Cal.
Associated Testing Labs., Burlington, Mass.
M Associated Testing Laboratories, Clifton, N.J.
Bemco, Pacoima, Cal.
D CVC Products, Rochester, N.Y.
Evaporated Coatings, Huntingdon Valley, Pa.
Fredericks Co., Huntington Valley, Pa.
Materials Resch. Corp., Orangeburg, N.Y.
Metavac, Flushing, N.Y.
Micro Line Div. Bausch & Lomb, Jamestown, N.Y.
N.Y. Testing Labs., Westbury, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Cal.
Process & Instrs. Corp., Brooklyn, N.Y.
Statham Instruments, Oxnard, Cal.
Thin Film Services, Gile, Wisc.
Ulvac Corp., Fairfield, Conn.
Varian Assocs., Palo Alto, Cal.
M Western Microsystems, Santee, Cal.

Services, Instrument Design (Industrial)

Active Control Instrumentation, E. Northport, N.Y. .... p. 1•229
D **Precision Timer Co., Westbrook, Conn. p. 1•268,269**
Thomas & Skinner, Indpls., Ind. ... p. 1•818,819
Wertronix Corp., Dayton, Ohio .... p. 1•998
NES, Streamwood, Ill. .... *
Adcotech Corp., Sunnyvale, Cal.
Aetna Engrg., Los Angeles, Cal.
Astro-Geo-Marine Inc., Oxnard, Cal.
Ballantine Laboratories, Boonton, N.J.
Bromberg Engineering, Wayland, Mass.
Brookhaven Instrs. Corp., Austin, Tex.
Cardinal Control Co., Kensington, Conn.
Design Automation, Lexington, Mass.
EDMAC Associates Inc., East Rochester, N.Y.
Electronics One Inc., Atlanta, Ga.
Environmental Communications Inc., Costa Mesa, Cal.
M Lehighton Electronics, Lehighton, Pa
D Macrodyne Inc., Schenectady, N.Y.
Photobell Co., New York, N.Y.
Process & Instrs. Corp., Brooklyn, N.Y.
Sensor Corp., Scottdale, Pa.
Transcom Electronics, La Mesa, Cal.

Services, Metal Etching, Engraving

Hutchinson Industrial Corp., Hutchinson, Minn. p. 1•1542,1543
Zero Mfg. Co., Burbank, Cal. .... p. 1•106-109
M **Analog Devices, Norwood, Mass.** .... *
American Chemical Etching, Pacoima, , Cal.
M Associated Testing Laboratories, Clifton, N.J.
Auric Corp., Newark, N.J.
Buckbee Mears Co., St. Paul, Minn.

Diceon Electronics, Irvine, Cal.
M Etchit, Hopkins, Minn.
DM Excel Products Co., New Brunswick, N.J.
M Hamilton Technology, Lancaster, Pa.
Hughes Aircraft Co, Culver City, Cal.
Kandu Corporation, Arvada, Colo.
Mechanical Engraving Co., Bronx, N.Y.
Micro Line Div. Bausch & Lomb, Jamestown, N.Y.
Peerless Radio Corp., Lynbrook, N.Y.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Plessey Inc., Melville, N.Y.
M Tech-Etch, Hingham, Mass.
Thin Film Services, Gile, Wisc.
D Vemaline Prods. Co., Wyckoff, N.J.

Services, Metal Parts Fabrication

D Bud Radio, Willoughby, Ohio .... p. 1•54,55
Connector Corp., Chicago, Ill. p. 2•657,659,660
Hutchinson Industrial Corp., Hutchinson, Minn. p. 1•1542,1543
Micrite Metal Mfg., Canoga Park, Cal. p. 2•1236-1239
SGL Elctronics, Westville, N.J. ....p. 2•1254
M Zero Mfg. Co., Burbank, Cal. .... p. 1•106-109
Jonard Industries Corp., Tuckahoe, N.Y. .... *
Staver Co., Bay Shore, N.Y. .... *
M Abrams Instr., Lansing, Mich.
Accessories for Electronics, Bayside, N.Y.
Acme Model Engrg. Co., Ridgefield, N.J.
M Advanced Materials Systems, Atteboro, Mass.
AEL, Colmar, Pa.
Aerolite Elexs Corp., Union City, N.J.
A. M. W. Corp., Arlington, Mass.
M Applied Design Co., Tonawanda, N.Y.
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Astro Dynamics, Burlington, Mass.
M Atlantic Research Coropration, Alexandria, Va
M Atlas Fibre Co., Chicago, Ill.
Auto-Swage Products Inc., Shelton, Conn.
M Avid Electronics Corp., Baldwin, Pl., N.Y.
M Bram Metallurgical-Chem. Co., Phila., Pa.
M Braxton Mfg. Co., Watertown, Conn.
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Nucleus Corp., Madison Hgts., Mich.
Overly-Hautz Co., Cleveland, Ohio
Photo Chemical Prods. Cal., Santa Monica, Cal.
Plessey Inc., Melville, N.Y.
M Polyflon Corp., New Rochelle, N.Y.
Process & Instrs. Corp., Brooklyn, N.Y.
PTS Electronics Inc., Bloomington, Ind
M Riester & Thesmacher Co., Cleveland, Ohio
Semicon Assoc., Lexington, Ky.
Servotronics, Buffalo, N.Y.
Sjoberg, C. & Son, Cranston, R.I.
South Shore Metal Prods., Farmingdale, N.Y.
Titchener, E.H. & Co., Binghamton, N.Y.
D Zenrad Controls Co., Santa Barbara, Ca.
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Diceon Electronics, Irvine, Cal.
D Electro-Science Labs., Pennsauken, N. J.
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Hermetic Seal Corp., Rosemead, Cal.
Hughes Aircraft Co, Culver City, Cal.
Materials Resch. Corp., Orangeburg, N.Y.
Metalized Ceramics, Providence, R.I.
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M Servometer Corp., Cedar Grove, N.J.
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Adcotech Corp., Sunnyvale, Cal.
American Electric Cable Co., Holyoke, Mass.
M Atlantic Optical Moulding Co., Dudley, Mass.
M Atlantic Research Coropration, Alexandria, Va
D Beman Mfg., New Cumberland, Pa.
D Cable Systems & Assembly Co., Everett, Mass.
M Chemplast, Wayne, N.J.
Communications Technology Corp., Los Angeles, Cal.
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Form-It Products Inc., Chicago, Ill
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D Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
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Environmental Communications Inc., Costa Mesa, Cal.
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Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Abesto Corp., Bloomfield, N.J.
Accessories for Electronics, Bayside, N.Y.
Ace Plastic Co., Jamacia, N.Y.
M Acme Plastic Products Co., Phoenix, Ariz.
AEL, Colmar, Pa.
Aerolite Elexs Corp., Union City, N.J.
Anchor Plastics, Long Island City, N.Y.
M Anchor Specialty Mfg. Inc., Teterboro, N.J.
Apahouser Corp. of N.E., Watertown, Mass.
M Atlantic Research Coropration, Alexandria, Va
M Atlas Fibre Co., Chicago, Ill.
Atmosphere Controls Prdts., Mt. View, Cal.
Automatic Die Cutting Mch, New York, N.Y.
M Avid Electronics Corp., Baldwin, Pl., N.Y.
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M Chemplast, Wayne, N.J.
M Comco Plastics, Richmond Hill, N.Y.
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Dura Plastics N.Y., Westport, Conn.
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D Mechanical Engraving Co., Bronx, N.Y.
Molding Technology Inc., Ivyland, Pa.
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Polyflon Corp., New Rochelle, N.Y.
PTS Electronics Inc., Bloomington, Ind
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M Auto-Swage Products Inc., Shelton, Conn.
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DM Excel Products Co., New Brunswick, N.J.
Hughes Aircraft Co, Culver City, Cal.
Kawecki Beryico Inds., New York, NY
M Lehighton Electronics, Lehighton, Pa
Plessey Inc., Melville, N.Y.
Polyflon Corp., New Rochelle, N.Y.
D Sifco Metachemical, Independence, Ohio
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Hewlett-Packard Co., Palo Alto, Cal.
Hughes Aircraft Co, Culver City, Cal.
Nucleus Corp., Madison Hgts., Mich.
Rutherford Research Prods. Co., Rutherford, N.J.
Sunshine Sci. Instrs., Philadelphia, Pa.
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Automatic Die Cutting Mch, New York, N.Y.
BECO, Salem, Va.
Bell Co., Trussville, Ala.
D Dura Plastics N.Y., Westport, Conn.
D Electro-Science Labs., Pennsauken, N. J.
Electronics One Inc., Atlanta, Ga.
Elgin Elctrns., Waterford, PA.
DM Excel Products Co., New Brunswick, N.J.
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M Lehighton Electronics, Lehighton, Pa
Mac Panel Co., High Pt., N.C.
D Mechanical Engraving Co., Bronx, N.Y.
Mid-West Metal Prods., Kansas City, Kans.
Mobil Electronics, Anderson, Ind.
Panelgraphic Corp., Caldwell, N.J.
Photo Chemical Prods. Cal., Santa Monica, Cal.
PSG Industries Inc., Perkasie, Pa.
M Riester & Thesmacher Co., Cleveland, Ohio
SGL Graphics, Warminster, Pa.
D Western Coil & Elec. Co., Racine, Wisc.
M Wire Cloth Enterprises, Pittsburgh, Pa.
D Zenrad Controls Co., Santa Barbara, Ca.

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M Torwico Elctrns., Lakewood, N.J. .... *
AEL, Colmar, Pa.
Associated Testing Labs., Burlington, Mass.
M Associated Testing Laboratories, Clifton, N.J.
M Gen'l. Environments Corp., Morton Grove, Ill.
Hughes Aircraft Co, Fullerton, Cal.
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M Art Wire & Stamping Co., Cedar Knolls, N.J.
D Beman Mfg., New Cumberland, Pa.
D Cable Systems & Assembly Co., Everett, Mass.
D Electronic Coil Corp., Plainville, Conn.
Estes Engrg. Co., Port Angeles, Wash.
DM Excel Products Co., New Brunswick, N.J.
Excel Specialty Corp., Chicago, Ill.
Gulton Inds., Buena Park, Cal.
D Hobson Bros., Chicago, Ill.
Hughes Aircraft Co, Fullerton, Cal.
IEC Electronics Corp., E. Rochester, N.Y.
M International Identifications, Timonium, Md.
M Kates Scientific Instrs., Newton, Mass.
M Manger Elec. Co., Stamford, Conn.
Mid-West Metal Prods., Kansas City, Kans.
Neuses, P.K., Rolling Meadows, Ill.
Paraplegics Mfg., Bensenville, Ill.
Phoenix Wire, S. Hero, Vt.
D Ripley Co., Middletown, Conn.
Stellex Industries, Rochester, N. Y.
DM Storm Products Co., Inglewood, Ca.
M Teledyne Aerospace Systems, Fairmont, Minn.
TRW/Holyoke Wire & Cable, South Hadley, Mass.

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All Systems, Moorestown, N.J.
Action Labs Inc., Minneapolis, Minn.
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M Data Numerics, Farmingdale, N.Y.
Gary Mfg., New Brunswick, N.J.
G B Instruments Inc., Hollywood, Fla.
Hughes Aircraft Co, Culver City, Cal.
M International Identifications, Timonium, Md.
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Dest Data Corp., Sunnyvale, Cal.
D Digiac Corp., Smithtown, N.Y.
M Farrand Controls, Valhalla, N.Y.
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M Lear Siegler, Santa Monica, Calif.
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D Ragen Data Systems, Farmingdale, N.Y.
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M Base Ten Systems, Trenton, N.J.
M Bay Laboratories, Cleveland, Ohio
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Columbia Resch. Labs., Woodlyn, Pa.
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Hughes Aircraft Co, Culver City, Cal.
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D Thermo Sys., St. Paul, Minn.
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M Maurey Instrument Corp., Chicago, Ill.
D Nippert Co., Delaware, Ohio
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M Unit Industries, South Gate, Cal.
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Hughes Aircraft Co, Culver City, Cal.
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M Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
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Janel, Stirling, N.J.
Jensen Tools & Alloys, Phoenix, Ariz.
M MacDonald & Co., Glendale, Calif.
D Miller, L.C. Co., Monterey Park, Calif.
Reeve Electronics, Chicago, Ill.
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D Caig Labs., Westbury, N.Y.
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Christiansen Radio Inc., Laguna Beach, Cal.
D Circon Corp., Santa Barbara, Cal.
Electrovert, Mt. Vernon, N.Y.
Enterprise Development Corp, Indianapolis, Ind.
D ESICO, Deep River, Conn.
D Hollis Engrg., Nashua, N.H.
DM Hughes Aircraft Co., Oceanside, Cal.
D ITT Industrial & Automation Systems, Plymouth, Mich.
Janel, Stirling, N.J.
M MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Huntingdon Valley, Pa.
D Matrix Engineering Corp., Gardena, Cal.
OAL Assocs., Westbury, N.Y.
DM Precision Elec. Co., Kezar Falls, Me.
Ragen Precision Inds., N. Arlington, N.J.
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Janel, Stirling, N.J.
Jensen Tools & Alloys, Phoenix, Ariz.
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Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Cal.
D Cooper Group, Apex, N.C.
Electrovert, Mt. Vernon, N.Y.
D Hollis Engrg., Nashua, N.H.
DM Hughes Aircraft Co., Oceanside, Cal.
ITT Industrial & Automation Systems, Plymouth, Mich.
Jensen Tools & Alloys, Phoenix, Ariz.
Kahle Engrg. Co., Union City, N.J.
M MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Huntingdon Valley, Pa.
Motorola Comms. Div., Schaumburg, Ill.
OAL Assocs., Westbury, N.Y.
Research Instrument Co., Garden City, N. Y.
Tech. Devices Co., Culver City, Calif.

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Electrovert, Mt. Vernon, N.Y.
Enterprise Development Corp, Indianapolis, Ind.
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D Components Specialties, Hempstead, N.Y.
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D Davis & Co., J.W., Dallas, Tex.
D Dracon Industries, Chatsworth, Cal.
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D Dynaco Inc., Blackwood, N.J.
D Electro-Voice, Buchanan, Mich.
DM Era Acoustics, Moonachie, N.J.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
D Frazier, Dallas, Tex.
D Herald Electronics, Chicago, Ill.
D Jensen Sound Labs., Schiller Park, Ill.
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D Klipsch & Assocs. Inc., Hope, Ark
D Lear Siegler, Santa Monica, Calif.
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Midland International Corp., No. Kansas City, Mo.
D Minneapolis Speaker Co., Minneapolis, Minn.
Mobil Electronics, Anderson, Ind.
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D Oxford Speaker Co., Chicago, Ill.
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D PASO Sound Products Inc., New York, N.Y.
D Perma Power Div., Elmhurst, Ill.
Precision Electronics, Franklin Park, Ill
D Russco Electronics Mfg. Inc., Clovis, Cal.
Shure Brothers, Evanston, Ill.
D Sonic International Corp., Portland, Ore.
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D Dracon Industries, Chatsworth, Cal.
Dukane Corp., St. Charles, Ill.
Electro-Voice, Buchanan, Mich.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
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D PASO Sound Products Inc., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
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D CTS Corp., Elkart, Ind.
D CTS of Paducah, Paducah, Ky.
D Dracon Industries, Chatsworth, Cal.
Dukane Corp., St. Charles, Ill.
Electro-Voice, Buchanan, Mich.
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Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
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D North American Philips Controls, Frederick, Md.
D Reed Switch Dev. Co., Greenwich, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Risk Inds, George, Kimball, Neb.
Signet Scientific Co., Burbank, Cal.
Sivers Lab, Corona del Mar, Cal.
D Sprague Elec. Co., No. Adams, Mass.
Struthers-Dunn, Pitman, N.J.
D Tann Controls Co., Detroit, Mich.
Torr Labs., Los Angeles, Cal.
Trompeter Electronics, Chatsworth, Cal.

Switches, Matrix—See Switches, Crossbar; Switches, Reed; Boards, Programming

Switches, Mercury Displacement

D **Durakool, Elkhart, Ind. ....p. 1•1639-1643**
D **Micro Switch, Freeport, Ill. .... p. 1•2101**
D **Arrow-Hart, Hartford, Conn. ....***
D Adams & Westlake Co., Elkhart, Ind.
H-B Instr. Co., Phila., Pa.
Leviton Mfg. Co., Little Neck, N.Y.
D Mechanical Enterprises, Silver Spring, Md.
DM Thordarson Meissner, Mt. Carmel, Ill.

Switches, Mercury Wetted Contacts

Coto-Coil Co., Providence, R.I. p. 1•1618-1623
Douglas Randall Div., Pawcatuck, Conn. p. 1•1629
DM **Gordos Corp., Bloomfield, N.J. p. 1•2053,2056**
D **Hamlin Inc., Lake Mills, Wisc. .... p. 1•2058**
Matrix Systems Corp., Chatsworth, Cal. p. 1•1800-1802
D **Micro Switch, Freeport, Ill. .... p. 1•2101**
Aemco Div., Mankato, Minn. ....*
D **Clare & Co., C.P., Chicago, Ill. ....***
NEC America, New York, N.Y. ....*
D Adams & Westlake Co., Elkhart, Ind.
Disc Instruments, Costa Mesa, Ca.
Fifth Dimension, Princeton, N.J.
D H-B Instr. Co., Phila., Pa.

*Company has information in white pages but not on this product

PSG Industries Inc., Perkasie, Pa.
D Reed Switch Dev. Co., Greenwich, Conn.
D Struthers-Dunn, Pitman, N.J.
Trompeter Electronics, Chatsworth, Cal.

Switches, Microwave—See Switches, Coaxial Cable; Switches, Waveguide

Switches, Motor-Driven

D **Airflyte Elctrns. Co., Bayonne, N.J.** p. 1•932,933
Arra Inc., Bay Shore, N.Y. p. 2•1278,1279
D **Electro Switch Corp., Weymouth, Mass.** p. 1•2028,2029
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal. p. 1•2077
M **Janco Corp., Burbank, Cal.** p. 1•2091
M **Precision Mechanisms Corp., Westbury, N.Y.** p. 1•1919
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M **Ross Engineering Corp., Campbell, Cal.** p. 1•1806
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D **Ohmite Mfg. Co., Skokie, Ill.** *
Square D Co., Milwaukee, Wisc. *
Automatic Timing & Controls Co., King of Prussia, Pa.
D Bristol Saybrook Co., Old Saybrook, Conn.
M Chicago Dynamic Industries, Chicago, Ill,
M Cole Instrument Corp., Costa Mesa, Cal.
Consolidated Controls Corp., Bethel, Conn.
D Control Products Div., Union, N.J.
Eagle Signal, Davenport, Iowa
Fifth Dimension, Princeton, N.J.
M General Devices, Princeton, N.J.
Lakeshore Electric Corp., Bedford, Ohio
M Langevin, Costa Mesa, Cal.
Murata Mfg. Co. Ltd., Kyoto, Japan
North American Philips Controls Corp., Cheshire, Conn.
M Oak Inds. Inc., Crystal Lake, Ill.
Signet Scientific Co., Burbank, Cal.
Singer Co., Schiller Park, Ill.
Sivers Lab, Corona del Mar, Cal.
Teledyne Kinetics, Solana Beach, Cal.
Tenor Co., New Berlin, Wisc.
Weinschel Engrg. Co., Gaithersburg, Md.

Switches, Paddle Handle

D **ALCO Electronic Prods., North Andover, Mass.** p. 1•1927
D **Arcolectric Switch Corp., No. Hollywood, Cal.** p. 1•1959
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D **Chicago Switch, Chicago, Ill.** p. 1•1988
D **Micro Switch, Freeport, Ill.** p. 1•2101
D **Tec, Tuscon, Ariz.** p. 2•1203
Shigoto Inds., Ltd., New York, N.Y. *
D **Specialties Mfg. Co., St. Clair Shores, Mich.** *
D **Sprague Products Co., No. Adams, Mass.** *
D American Switch Corp., Gloucester, Mass.

Switches, Photoelectric—See Cells, Photoconductive; Controls, Photoelectric

Switches, Portable Tool Handle

D **Arrow-Hart, Hartford, Conn.** p. 1•1933
D **Specialties Mfg. Co., St. Clair Shores, Mich.** *
D McGill Mfg. Co. Inc., Valparaiso, Ind.

Switches, Power

DM **Amphenol RF Div., Danbury, Conn.** p. 2•460,461
Arra Inc., Bay Shore, N.Y. p. 2•1278,1279
D **Arrow-Hart, Hartford, Conn.** p. 1•1933
D **Cherry Electrical Prods. Corp., Waukegan, Ill.** p. 1•1974-1980
D **Chicago Switch, Chicago, Ill.** p. 1•1988
D **Electro Switch Corp., Weymouth, Mass.** p. 1•2028,2029
D **IEE/Schadow, Eden Prairie, Minn.** p. 1•2068
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal. p. 1•2077-2079
M **Janco Corp., Burbank, Cal.** p. 1•2089
Ledex Inc., Dayton, Ohio p. 1•2092-2096
D **Micro Switch, Freeport, Ill.** p. 1•2101
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M **Ross Engineering Corp., Campbell, Cal.** p. 1•1806
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Stacoswitch, Costa Mesa, Cal. p. 2•1114,1115
Tech Labs., Palisades Pk., N.J. p. 1•2298
D **ALCO Electronic Prods., North Andover, Mass.** *
Allen-Bradley Co., Milwaukee, Wisc. *
Arrow-M, Mountainside, N.J. *
D **CW Industries, Warminster, Pa.** *
ISC Magnetics Div., Plainview, N.Y. *
D **Molex Inc., Lisle, Ill.** *
D **Specialties Mfg. Co., St. Clair Shores, Mich.** *
Square D Co., Milwaukee, Wisc. *
D **Waldom Electronics, Chicago, Ill.** *
D American Switch Corp., Gloucester, Mass.
Birnbach Co., Freeport, N.Y.
D Centralab, Milwaukee, Wisc.
D Compu-Lite Corp., Irvine, Cal.
M Control Switch, Folcroft, Pa.
D CTS Corp., Elkart, Ind.
Cutler-Hammer, Milwaukee, Wisc.
D Cutler-Hammer Shallcross, Selma, N.C.
D Furnas Elec. Co., Batavia, Ill.
D GTE Sylvania Inc., Waltham, Mass.
H-B Instr. Co., Phila., Pa.
Lakeshore Electric Corp., Bedford, Ohio
D Licon Div., Chicago, Ill.
Oak Inds. Inc., Crystal Lake, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.
M Radio Switch, Marlboro, N.J.
Relay Specialties Inc., Fair Lawn, N.J.
D Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
Sierra Elec., Gardena, Calif.
Signet Scientific Co., Burbank, Cal.
D Struthers-Dunn, Pitman, N.J.
D Tann Controls Co., Detroit, Mich.
Teledyne Kinetics, Solana Beach, Cal.
Torr Labs., Los Angeles, Cal.
Triac Electronics, New York, N.Y.
D Wadsworth Electric Mfg. Co., Covington, Ky.

Switches, Pressure

Airflyte Elctrns. Co., Bayonne, N.J. p. 1•932,933
D **Cherry Electrical Prods. Corp., Waukegan, Ill.** p. 1•1974-1980
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M **Kratos, Pasadena, Cal** p. 1•751
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Tapeswitch Corp. Amer., Farmingdale, N.Y. p. 1•2300
Allen-Bradley Co., Milwaukee, Wisc. *
Computer Instrs., Hempstead, N.Y. *
General Elec. Co., Schenectady, N.Y. *
Square D Co., Milwaukee, Wisc. *
Airmatic/Beckett-Harcum, Wilmington, Ohio
Anro Elex Inds. Ltd., Downsview, Ont, Can.
D Aqualarm Inc., Gardena, Cal.
DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
Birnbach Co., Freeport, N.Y.
Bourns, Riverside, Calif.
M Cole Instrument Corp., Costa Mesa, Cal.
Columbus Electric Mfg. Co., Piney Flats, Tenn.
Conrac Corp., Duarte, Cal.
Consolidated Controls Corp., Bethel, Conn.
D Cook Elec. Co., Morton Grove, Ill.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
Datametrics Inc., Wilmington, Mass.
M Dietz, Henry G. Co., Long Island City, N.Y.
M Dynamic Controls Corp., S. Windsor, Conn.
D Furnas Elec. Co., Batavia, Ill.
D Gagne Assocs., Binghamton, N.Y.
M Gulton Inds., Costa Mesa, Cal.
Honeywell, Ft. Washington, Pa.
Korry Mfg. Co., Seattle, Wash.
Lear Siegler, Santa Monica, Calif.
Pall Corp., Glen Cove, N.Y.
Stow Labs., Hudson, Mass.
Texas Instruments, Attleboro, Mass.
D United Elec. Controls Co., Watertown, Mass.

Switches, Printed-Circuit Mountable

D **ALCO Electronic Prods., North Andover, Mass.** p. 1•1926,1927
Arrow-Hart, Hartford, Conn. p. 1•1933
C & K Components, Watertown, Mass. p. 1•1968,1969
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D **Chicago Switch, Chicago, Ill.** p. 1•1988
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M **Janco Corp., Burbank, Cal.** p. 1•2091
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D **Raytheon Co., Burlington, Mass.** p. 1•2284,2285
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D **Tec, Tuscon, Ariz.** p. 2•1203
Vari-L Co., Denver, Colo. p. 2•1405,1406
Analog Devices, Norwood, Mass. *
Arrow-M, Mountainside, N.J. *
D **Illuminated Products Inc., Anaheim, Cal.** *
Shigoto Inds., Ltd., New York, N.Y. *
D **Specialties Mfg. Co., St. Clair Shores, Mich.** *
D **Waldom Electronics, Chicago, Ill.** *
D American Switch Corp., Gloucester, Mass.
D AMP Special Industries, Valley Forge, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
D Burgess Switch Co., Scarborough, Ont., Ont., Can., MIL 4C3
Centralab, Milwaukee, Wisc.
D Compu-Lite Corp., Irvine, Cal.
Controls Research Corp., Santa Ana, Cal.
D Mechanical Enterprises, Silver Spring, Md.
D Molex Products, Downers Grove, Ill.
Oak Inds. Inc., Crystal Lake, Ill.
Risk Inds, George, Kimball, Neb.
D Struthers-Dunn, Pitman, N.J.

Switches, Program

D **Airflyte Elctrns. Co., Bayonne, N.J.** p. 1•932,933
C & A Products, Woodside, N.Y. p. 1•148-151
D **Cherry Electrical Prods. Corp., Waukegan, Ill.** p. 1•1979
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D **IEE/Schadow, Eden Prairie, Minn.** p. 1•2073
Info-Lite Corp., Corona, N.Y. p. 1•2076
D **Interswitch, Burlingame, Cal.** p. 1•2074
Ledex Inc., Dayton, Ohio p. 1•2092-2096
Lineac Corp., Yonkers, N.Y. p. 2•2097
M **LVC Inds. Inc., Flushing, N.Y.** p. 1•2010,2011,2100
M **Precision Mechanisms Corp., Westbury, N.Y.** p. 1•1919
D **Precision Timer Co., Westbrook, Conn.** p. 1•268,269
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D **Sealectro Corp., Mamaroneck, N.Y.** p. 1•2269
Tech Labs., Palisades Pk., N.J. p. 1•2298
D **McGraw-Edison Co., Manchester, N.H.** *
D **Molex Inc., Lisle, Ill.** *
D **Waldom Electronics, Chicago, Ill.** *
Automatic Timing & Controls Co., King of Prussia, Pa.
D Bristol Saybrook Co., Old Saybrook, Conn.
M Cole Instrument Corp., Costa Mesa, Cal.
D Control Products Div., Union, N.J.
D CTS Corp., Elkart, Ind.
Eagle Signal, Davenport, Iowa
M General Devices, Princeton, N.J.
Information Transfer Industrial, Holcomb, N.Y.
M Langevin, Costa Mesa, Cal.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
Master Specialties Co., Costa Mesa, Cal.
D Molex Products, Downers Grove, Ill.
M Raymond Engrg. Inc., Middletown, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
D Siemens Corp., Iselin, N.J.
D Tann Controls Co., Detroit, Mich.
Tenor Co., New Berlin, Wisc.

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Douglas Randall Div., Pawcatuck, Conn. p. 1•1629
D **Hamlin Inc., Lake Mills, Wisc.** p. 1•2059,2060
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D **Micro Switch, Freeport, Ill.** p. 1•2101
D **RDI/Reed Devices, Glen Ellyn, Ill.** p. 2•792,793
D **ALCO Electronic Prods., North Andover, Mass.** *
Allen-Bradley Co., Milwaukee, Wisc. *
D **Daburn Electronics & Cable Corp., Bronx, N.Y.** *
ISC Magnetics Div., Plainview, N.Y. *
Square D Co., Milwaukee, Wisc. *
D **Tapeswitch Corp. Amer., Farmingdale, N.Y.** *
D Adams & Westlake Co., Elkhart, Ind.
Automatic Timing & Controls Co., King of Prussia, Pa.
Birnbach Co., Freeport, N.Y.
D Burgess Switch Co., Scarborough, Ont., Ont., Can., MIL 4C3
Controlcraft Corp., West Chicago, Ill.
Corning Glass Works, Fluidic Products, Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
D Delavan Electronics, Scottsdale, Ariz.
D Denison, R.B., Bedford, Ohio
Dolan-Jenner Inds., Melrose, Mass.
D Electro Corp., Sarasota, Fla.
Electronic Counters & Controls Inc., Mundelein, Ill.
Fifth Dimension, Princeton, N.J.

D Gordon Engineering Corp., Brookfield, Conn.
M Gulton Inds., Costa Mesa, Cal.
D Licon Div., Chicago, Ill.
D NAMCO CONTROLS, Cleveland, Ohio
D North American Philips Controls, Frederick, Md.
PECO Corp., Milpitas, Cal.
Photobell Co., New York, N.Y.
M Raymond Engrg. Inc., Middletown, Conn.
D Reed Switch Dev. Co., Greenwich, Conn.
Risk Inds, George, Kimball, Neb.
D Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottdale, Pa.
Skan-A-Matic Corp., Elbridge, N.Y.
D Tann Controls Co., Detroit, Mich.

Switches, Pushbutton (All Types)

D **ALCO Electronic Prods., North Andover, Mass.** p. 1•1926
American Zettler, Irvine, Cal. ....p. 1•1932
DM **Amphenol RF Div., Danbury, Conn.** p. 2•460,461
D **Arcolectric Switch Corp., No. Hollywood, Cal.** p. 1•1959
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Capitol Machine & Switch Co., Danbury, Conn. p. 1•1970,1971
D **Carlingswitch Inc., W. Hartford, Conn.** p. 1•1972,1973
D **Cherry Electrical Prods. Corp., Waukegan, Ill.** p. 1•1976
D **Chicago Switch, Chicago, Ill.** ....p. 1•1988
D **Dialight, Brooklyn, N.Y.** ....p. 2•1138
DM **Digitran Co., Pasadena, Cal.** ....p. 1•2020
D **Electro-Mech Components, So. El Monte, Cal.** p. 1•2026,2027
Essex Controls Div., Logansport, Ind. p. 1•1681
D **Grayhill Inc., LaGrange, Ill.** ...... p. 1•2034-2052
D **IEE/Schadow, Eden Prairie, Minn.** p. 1•2066-2073
DM **Industrial Elctrn. Engrs., Van Nuys, Cal.** p. 2•1163
D **J-B-T Instrs., New Haven, Conn.** p. 1•2080-2087
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DM **Micro Switch, Freeport, Ill.** .... p. 1•2101
DM **Otto Engrg., Carpentersville, Ill.** p. 1•1545,2267
D **Precision Timer Co., Westbrook, Conn.** p. 1•268
D **Raytheon Co., Burlington, Mass.** ....p. 1•2283
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Seacor, Norwood, N.J. ....p. 1•2270,2271
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DM **Smith Inc., Herman H., Brooklyn, N.Y.** p. 2•881-884
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Stacoswitch, Costa Mesa, Cal. p. 2•1114,1115
T-Bar Inc., Wilton, Conn. .... p. 1•2296
D **Tec, Tuscon, Ariz.** .... p. 2•1201,1203
D **UID Electronics Div., Hollywood, Fla.** p. 1•2306
D **Unimax Switch Corp., Wallingford, Conn.** p. 1•2304
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Arrow-M, Mountainside, N.J. .... *
D **Clare & Co., C.P., Chicago, Ill.** .... *
D **GC Electronics, Rockford, Ill.** .... *
General Elec. Co., Schenectady, N.Y. .... *
ISC Magnetics Div., Plainview, N.Y. ....*
D **Molex Inc., Lisle, Ill.** ....*
D **Specialties Mfg. Co., St. Clair Shores, Mich.** ... *
Square D Co., Milwaukee, Wisc. ....*
D **Tapeswitch Corp. Amer., Farmingdale, N.Y.** .... *
D **Trimm, Libertyville, Ill.** .... *
D **Waldom Electronics, Chicago, Ill.** ....*
D Adalet Mfg. Co., Cleveland, Ohio
Allis-Chalmers, Milwaukee, Wisc.
Amp Inc., Harrisburg, Pa.
Birnbach Co., Freeport, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
D Burgess Switch Co., Scarborough, Ont., Ont., Can., MIL 4C3
M Chicago Dynamic Industries, Chicago, Ill.
D Clare-Pendar, Post Falls, Idaho
M Cole Instrument Corp., Costa Mesa, Cal.
D Compu-Lite Corp., Irvine, Cal.
M Control Prods., E. Hanover, N.J.
DM Control Switch, Folcroft, Pa.
Controls Research Corp., Santa Ana, Cal.
Corning Glass Works, Fluidic Products, Corning, N.Y.
D Cutler-Hammer, Milwaukee, Wisc.
D Cutler-Hammer Shallcross, Selma, N.C.
Durant Digital Instruments, Watertown, Wisc.
D Furnas Elec. Co., Batavia, Ill.
DM General Automatic Corp., Bayonne, N.J.
D General Control Co., Boston, Mass.
D GTE Sylvania Inc., Waltham, Mass.
M Haydon Switch & Instr., Waterbury, Conn.
Honeywell, Ft. Washington, Pa.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Jaidinger Mfg. Co., Chicago, Ill.
M Jay-El Prods., Gardena, Calif.
Key Tronic Corp., Spokane, Wash.
M Korry Mfg. Co., Seattle, Wash.
M Langevin, Costa Mesa, Cal.
Leviton Mfg. Co., Little Neck, N.Y.
D Licon Div., Chicago, Ill.
D Gulton Industries, Plano, Tex
M Machine Components Corp., Plainview, N.Y.
Magic Dot, Minneapolis, Minn.
D Master Specialties Co., Costa Mesa, Cal.
D McGill Mfg. Co. Inc., Valparaiso, Ind.
M Measurement Sys., Norwalk, Conn.
D Mechanical Enterprises, Springfield, Va.
Methode Elctrns., Chicago, Ill.
D Molex Products, Downers Grove, Ill.
D NAMCO CONTROLS, Cleveland, Ohio
D Oak Inds. Inc., Crystal Lake, Ill.
D On-Guard Corp. of America, Carlstadt, NJ
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
Relay Specialties Inc., Fair Lawn, N.J.
Risk Inds, George, Kimball, Neb.
D Robertshaw Controls Co., Columbus, Ohio
DM Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
Sprague Elec. Co., No. Adams, Mass.
Standard Grigsby Inc., Aurora, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
D Switchcraft, Chicago, Ill.
Texas Instruments, Attleboro, Mass.
Thermo Elec. Co., Saddle Brook, N.J.
Universal Relay Corp., New York, N.Y.
Universal Security Instrs., Baltimore, Md.
Wilbrecht Electronics, St. Paul, Minn.
D Workman Electronic Prods., Sarasota, Fla.

Switches, Reed

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Maxi-Switch Co., Minneapolis, Minn. p. 1•2262-2264
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D **ALCO Electronic Prods., North Andover, Mass.** *
Allen-Bradley Co., Milwaukee, Wisc. ....*
Amperex Elctronic Corp., Slatersville, R.I. .... *
D **Amperex Electronic Corp., Hicksville, N.Y.** ...... *
Capitol Machine & Switch Co., Danbury, Conn. *
D **Clare & Co., C.P., Chicago, Ill.** .... *
General Elec. Co., Schenectady, N.Y. .... *
Kessler-Ellis Prods., Atlantic Highlands, N.J. *
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Controls Research Corp., Santa Ana, Cal.
Cutler-Hammer, Milwaukee, Wisc.
D Denison, R.B., Bedford, Ohio
Disc Instruments, Costa Mesa, Ca.
GTE Automatic Electric Inc., Northlake, Ill.
Information Transfer Industrial, Holcomb, N.Y.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Key Tronic Corp., Spokane, Wash.
Madison Laboratories, Madison, Conn
D NAMCO CONTROLS, Cleveland, Ohio
Narda Microwave Corp., Plainview, N.Y.
D On-Guard Corp. of America, Carlstadt, NJ
D Sigma Instruments, Braintree, Mass.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Torr Labs., Los Angeles, Cal.
M Transco Prods., Venice, Cal.
Trompeter Electronics, Chatsworth, Cal.
Universal Security Instrs., Baltimore, Md.
D Wallace S. K. Assocs., Tampa, Fla.

Switches, Reed, Matrix

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Information Transfer Industrial, Holcomb, N.Y.
Risk Inds, George, Kimball, Neb.
Trompeter Electronics, Chatsworth, Cal.
ZEHNTEL, Concord, Cal.

Switches, R-F

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M **General Microwave Corp., Farmingdale, NY** p. 1•718
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DM **Hamlin Inc., Lake Mills, Wisc.** .... *
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M Adams-Russell Co., Waltham, Mass.
Addington Labs., Santa Clara, Calif.
AEL, Colmar, Pa.
Aiken Industries, Gaithersburg, Md.
Alan Industries Inc., Columbus, Ind.
Alaun Engrg., Alhambra, Cal
Alford Mfg. Co., Winchester, Mass.
American Microwave Inds., Waltham, Mass.
Clare-Pendar, Post Falls, Idaho
Coaxial Dynamics, Cleveland, Ohio
M GHZ Devices, So. Chelmsford, Mass.
M Lorch Elctrns. Corp., Englewood, N.J.
LRC Inc., Hudson, N.H.
D Mobil Electronics, Anderson, Ind.
Reeve Electronics, Chicago, Ill.
Standard Grigsby Inc., Aurora, Ill.
Summit Engineering Corp., Bozeman, Mont.
Torr Labs., Los Angeles, Cal.
Trompeter Electronics, Chatsworth, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
M Watkins-Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.
Wide Band Engrg. Co. Inc., Phoenix, Ariz.

Switches, Rocker

D **ALCO Electronic Prods., North Andover, Mass.** p. 1•1927
D **Arcolectric Switch Corp., No. Hollywood, Cal.** p. 1•1959
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D **C & K Components, Watertown, Mass.** p. 1•1968,1969
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M Airpax Elctrns., Cambridge, Md.
Amp Inc., Harrisburg, Pa.
CTS Corp., Elkart, Ind.
D Cutler-Hammer, Milwaukee, Wisc.
Leviton Mfg. Co., Little Neck, N.Y.
D Licon Div., Chicago, Ill.
D McGill Mfg. Co. Inc., Valparaiso, Ind.
D Molex Products, Downers Grove, Ill.

***Company has information in white pages but not on this product**

D Oak Inds. Inc., Crystal Lake, Ill.
D On-Guard Corp. of America, Carlstadt, NJ
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
Relay Specialties Inc., Fair Lawn, N.J.
D Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
Sierra Elec., Gardena, Calif.
Stanford Applied Engineering, Santa Clara, Cal.
Stettner-Trush Inc., Cazenovia, N.Y.
D Switchcraft, Chicago, Ill.
Texas Instruments, Attleboro, Mass.

Switches, Rotary

D **Airflyte Elctrns. Co., Bayonne, N.J. p. 1•932,933**
D **ALCO Electronic Prods., North Andover, Mass. p. 1•1927**
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M **Janco Corp., Burbank, Cal. p. 1•2088-2090**
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Shigoto Inds., Ltd., New York, N.Y. p. 2•2060
DM **Smith Inc., Herman H., Brooklyn, N.Y. p. 2•883**
D **Spectrol Electronics Corp., City of Industry, Cal. p. 2•1681**
Stackpole Components Co., Raleigh, N.C. p. 1•2280
D **Tec, Tuscon, Ariz. p. 2•1203**
Tech Labs., Palisades Pk., N.J. p. 1•2298,2299
Allen-Bradley Co., Milwaukee, Wisc. *
D **Bendix Corp., The, Sidney, N.Y.** *
M **Carter Mfg. Corp., Bolton, Ma.** *
Computer Instrs., Hempstead, N.Y. *
D **GC Electronics, Rockford, Ill.** *
M **General Microwave Corp., Farmingdale, NY** *
DM **Gordos Corp., Bloomfield, N.J.** *
ISC Magnetics Div., Plainview, N.Y. *
D **McGraw-Edison Co., Manchester, N.H.** *
D **Ohmite Mfg. Co., Skokie, Ill.** *
D **Raytheon Co., Burlington, Mass.** *
D **Specialties Mfg. Co., St. Clair Shores, Mich.** *
Sprague Products Co., No. Adams, Mass. *
Square D Co., Milwaukee, Wisc. *
Allis-Chalmers, Milwaukee, Wisc.
Amp Inc., Harrisburg, Pa.
D AMP Special Industries, Valley Forge, Pa.
M Betatronix, Hauppauge, N.Y.
Birnbach Co., Freeport, N.Y.
M Bowmar/TIC, Newbury Park, Calif.
Branson Corp., Denville, N.J.
Carson Mfg. Co., Indianapolis, Ind.
D Centralab, Milwaukee, Wisc.
M Chicago Dynamic Industries, Chicago, Ill.
M Cole Instrument Corp., Costa Mesa, Cal.
DM CTS Corp., Elkart, Ind.
D Cutler-Hammer, Milwaukee, Wisc.
DM Cutler-Hammer Shallcross, Selma, N.C.
D Denison, R.B., Bedford, Ohio
M General Devices, Princeton, N.J.
Honeywell, Ft. Washington, Pa.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
D Javex Elctrns., Cherry Valley, Cal.
Lakeshore Electric Corp., Bedford, Ohio
M Langevin, Costa Mesa, Cal.
Leeds & Northrup Co., North Wales, Pa.
Leviton Mfg. Co., Little Neck, N.Y.
Mag-Con, New Brighton, Minn.
Mallory Controls, Frankfort, Ind.
M Maurey Instrument Corp., Chicago, Ill.
Methode Elctrns., Chicago, Ill.
M Microlab/FXR, Livingston, N.J.
D Microwave Development Labs., Needham Hgts., Mass.
M Minelco, Div. General Time Corp., Thomaston, Conn.
Murata Mfg. Co. Ltd., Kyoto, Japan
North American Philips Controls Corp., Cheshire, Conn.
DM Oak Inds. Inc., Crystal Lake, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
M Radio Switch, Marlboro, N.J.
R L C Elctrns., Mt. Kisco, N.Y.
D Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
Signet Scientific Co., Burbank, Cal.
Sprague Elec. Co., No. Adams, Mass.
M Standard Grigsby Inc., Aurora, Ill.

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D **Arcolectric Switch Corp., No. Hollywood, Cal. p. 1•1959**
Arrow-Hart, Hartford, Conn. p. 1•1933
D **Carlingswitch Inc., W. Hartford, Conn. p. 1•1972,1973**
D **Cherry Electrical Prods. Corp., Waukegan, Ill. p. 1•1979**
D **Chicago Switch, Chicago, Ill. p. 1•1988**
D **CW Industries, Warminster, Pa. p. 1•1967; p. 2•656**
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D **Smith Inc., Herman H., Brooklyn, N.Y. p. 2•880**
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D **Tec, Tuscon, Ariz. p. 2•1203**
D **UID Electronics Div., Hollywood, Fla. p. 1•2306**
D **ALCO Electronic Prods., North Andover, Mass.** *
D **Daburn Electronics & Cable Corp., Bronx, N.Y.** *
D **GC Electronics, Rockford, Ill.** *
D **McGraw-Edison Co., Manchester, N.H.** *
D **Specialties Mfg. Co., St. Clair Shores, Mich.** *
Sprague Products Co., No. Adams, Mass. *
Amp Inc., Harrisburg, Pa.
AMP Special Industries, Valley Forge, Pa.
Birnbach Co., Freeport, N.Y.
Centralab, Milwaukee, Wisc.
M Chicago Dynamic Industries, Chicago, Ill.
D CTS Corp., Elkart, Ind.
D Cutler-Hammer, Milwaukee, Wisc.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Leviton Mfg. Co., Little Neck, N.Y.
D Oak Inds. Inc., Crystal Lake, Ill.
D On-Guard Corp. of America, Carlstadt, NJ
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
D Rye Inds., Mamaroneck, N.Y.
D Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
Signet Scientific Co., Burbank, Cal.
Sprague Elec. Co., No. Adams, Mass.
Standard Grigsby Inc., Aurora, Ill.
D Switchcraft, Chicago, Ill.
Texas Instruments, Attleboro, Mass.
Wilbrecht Electronics, St. Paul, Minn.
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D **Arcolectric Switch Corp., No. Hollywood, Cal. p. 1•1959**
D **Arrow-Hart, Hartford, Conn. p. 1•1933**
D **C & K Components, Watertown, Mass. p. 1•1968,1969**
D **Cherry Electrical Prods. Corp., Waukegan, Ill. p. 1•1974-1979**
D **Chicago Switch, Chicago, Ill. p. 1•1988**
D **Dialight, Brooklyn, N.Y. p. 2•1138**
D **Electro-Mech Components, So. El Monte, Cal. p. 1•2026,2027**
D **Electro Switch Corp., Weymouth, Mass. p. 1•2028,2029**
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M **Industrial Elctrn. Engrs., Van Nuys, Cal. p. 2•1163**
D **J-B-T Instrs., New Haven, Conn. p. 1•2080-2087**
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DM **Micro Switch, Freeport, Ill. p. 1•2101**
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D **Potter & Brumfield, Princeton, Ind. p. 1•1803**
D **Raytheon Co., Burlington, Mass. p. 1•2283**
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D **Specialties Mfg. Co., St. Clair Shores, Mich. p. 1•2277**
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D **Tec, Tuscon, Ariz. p. 2•1201,1203**
D **UID Electronics Div., Hollywood, Fla. p. 1•2306**
DM **Unimax Switch Corp., Wallingford, Conn. p. 1•2304**
Allen-Bradley Co., Milwaukee, Wisc. *
Arrow-M, Mountainside, N.J. *
D **CW Industries, Warminster, Pa.** *
D **GC Electronics, Rockford, Ill.** *
ISC Magnetics Div., Plainview, N.Y. *
Littelfuse, Des Plaines, Ill. *
D **Molex Inc., Lisle, Ill.** *
Sodeco Div., Elmsford, N.Y. *
Sprague Products Co., No. Adams, Mass. *
Square D Co., Milwaukee, Wisc. *
D **Tapeswitch Corp. Amer., Farmingdale, N.Y.** *
D **Waldom Electronics, Chicago, Ill.** *
D American Switch Corp., Gloucester, Mass.
Birnbach Co., Freeport, N.Y.
D Burgess Switch Co., Scarborough, Ont., Ont., Can., MIL 4C3
Centralab, Milwaukee, Wisc.
D Clare-Pendar, Post Falls, Idaho
M Cole Instrument Corp., Costa Mesa, Cal.
Columbus Electric Mfg. Co., Piney Flats, Tenn.
D Components Specialties, Hempstead, N.Y.
D Compu-Lite Corp., Irvine, Cal.
M Control Prods., E. Hanover, N.J.
DM Control Switch, Folcroft, Pa.
D CTS Corp., Elkart, Ind.
D Cutler-Hammer, Milwaukee, Wisc.
DM Cutler-Hammer Shallcross, Selma, N.C.
D Denison, R.B., Bedford, Ohio
GTE Sylvania Inc., Danvers, Mass.
M Haydon Switch & Instr., Waterbury, Conn.
ITT Comps. Grp., N. Andover, Mass.
Jaidinger Mfg. Co., Chicago, Ill.
Key Tronic Corp., Spokane, Wash.
M Langevin, Costa Mesa, Cal.
Leviton Mfg. Co., Little Neck, N.Y.
D Licon Div., Chicago, Ill.
D Machine Components Corp., Plainview, N.Y.
D Master Specialties Co., Costa Mesa, Cal.
D McGill Mfg. Co. Inc., Valparaiso, Ind.
D Molex Products, Downers Grove, Ill.
D Reed Switch Dev. Co., Greenwich, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
D Robertshaw Controls Co., Columbus, Ohio
D Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo, Japan
D Singer Co., Schiller Park, Ill.
Sprague Elec. Co., No. Adams, Mass.
D Switchcraft, Chicago, Ill.
D Tann Controls Co., Detroit, Mich.
Teledyne Kinetics, Solana Beach, Cal.
Texas Instruments, Attleboro, Mass.
Therm-O-Disc, Mansfield, Ohio
Torq Engineered Products, Bedford, Ohio
D United Elec. Controls Co., Watertown, Mass.
Universal Relay Corp., New York, N.Y.

D Wadsworth Electric Mfg. Co., Covington, Ky.
D Workman Electronic Prods., Sarasota, Fla.

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M **Daico Industries Inc., Compton, Cal. p. 2•1281**
D **Dialight, Brooklyn, N.Y. .... p. 2•1138**
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D **Douglas Randall Div., Pawcatuck, Conn. p. 1•1633**
M **General Microwave Corp., Farmingdale, NY p. 1•718**
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D **Tec, Tuscon, Ariz. .... p. 2•1203**
Vari-L Co., Denver, Colo. .... p. 2•1405,1406
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American Time Products, Bulova Watch, Woodside, N.Y. ....*
Amphenol RF Div., Danbury, Conn. ....*
M **Analog Devices, Norwood, Mass. ....***
Applied Research Inc., Port Washington, N.Y. *
Bulova Watch Co., Freq Controls Div., Woodside, N.Y. ....*
D **General Elec. Co., Schenectady, N.Y. ....***
DM **General Instruments Corp., Hicksville, N.Y. .....***
General Magnetics, Bloomfield, N.J. ....*
Hoagland Instr., Dayton, N.J. ....*
D **International Rectifier Corp., El Segundo, Cal. ***
ISC Magnetics Div., Plainview, N.Y. ....*
Leach Corp., Los Angeles, Cal. ....*
Ohmite Mfg. Co., Skokie, Ill. ....*
M Adams-Russell Co., Waltham, Mass.
AEL, Colmar, Pa.
Aiken Industries, Gaithersburg, Md.
Airpax Elctrns., Cambridge, Md.
American Microwave Inds., Waltham, Mass.
Barber Corp., Waynesville, Ohio
Beta Technology, Farmingdale, N.Y.
D Burgess Switch Co., Scarborough, Ont., Ont., Can., MIL 4C3
Centralab, Milwaukee, Wisc.
Coaxial Dynamics, Cleveland, Ohio
M Cole Instrument Corp., Costa Mesa, Cal.
Collins Radio, Dallas, Tex.
D Control Devices Inc., Woburn, Mass.
Controls Research Corp., Santa Ana, Cal.
Counterscan Systems, Sutton. Neb.
D Cutler-Hammer, Milwaukee, Wisc.
Datametrics Inc., Wilmington, Mass.
D Denison, R.B., Bedford, Ohio
D Dynair Elctrns. Inc., San Diego, Calif.
E & M Laboratories, Westlake Village, Cal.
ECC Corp., Euless, Tex.
Engelmann Microwave, Montville, N.J.
Exide Power Sys. Div., Philadelphia, Pa.
Fairchild Semiconductor, Mountain View, Cal.
Fifth Dimension, Princeton, N.J.
Gems Sensors Div., Farmington, Conn.
M General Devices, Princeton, N.J.
M Genisco Tech. Corp., Compton, Cal.
Gentron Corp., Milwaukee, Wisc.
M GHZ Devices, So. Chelmsford, Mass.
GTE Sylvania Inc., Washington, D.C.
Guardian Electric Co., Chicago, Ill.
H-B Instr. Co., Phila., Pa.
Halmar Electronics, Columbus, Ohio
Integrated Photomatrix, Mountainside, N.J.
Jay-El Prods., Gardena, Calif.
Key Tronic Corp., Spokane, Wash.
Leviton Mfg. Co., Little Neck, N.Y.
Licon Div., Chicago, Ill.
M Lorch Elctrns. Corp., Englewood, N.J.
M Lorch Devices Inc., Englewood, N.J.
M LRC Inc., Hudson, N.H.
Mag-Con, New Brighton, Minn.
Magic Dot, Minneapolis, Minn.
Master Specialties Co., Costa Mesa, Cal.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Burlington, Mass.
D Monsanto-Elctrn. Spec. Prods., Palo Alto, Cal.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Brentwood, N.Y.
Payne Engrg. Co., Scott Depot, W. Va.
PECO Corp., Milpitas, Cal.
PSG Industries Inc., Perkasie, Pa.
M Reed Switch Dev. Co., Greenwich, Conn.
Sensor Corp., Scottdale, Pa.
D Siliconix, Santa Clara, Cal
Solidstate Controls, Columbus, Ohio
M Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
S S A C Precision Products Inc., Liverpool, N.Y.
D Struthers-Dunn, Pitman, N.J.
Synchro-Start Products, Skokie, Ill.
D Tann Controls Co., Detroit, Mich.
Tempo Instrument, Plainview, N.Y.
M Transco Prods., Venice, Cal.
Triac Electronics, New York, N.Y.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Solid State East Beverly Div., Beverly, Mass.
M Watkins-Johnson Co., Palo Alto, Cal.
Wide Band Engrg. Co. Inc., Phoenix, Ariz.

Switches, Stack

D **Cherry Electrical Prods. Corp., Waukegan, Ill. p. 1•1979**
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D **Precision Timer Co., Westbrook, Conn. p. 1•268,269**
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Trimm, Libertyville, Ill. .... *
Cardinal Control Co., Kensington, Conn.
General Control Co., Boston, Mass.
Guardian Electric Co., Chicago, Ill.
Jaidinger Mfg. Co., Chicago, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Switchcraft, Chicago, Ill.
Varian Electron Tube & Device Grp., San Carlos, Cal.

Switches, Step Type

D **Airflyte Elctrns. Co., Bayonne, N.J. p. 1•932,933**
D **Clare & Co., C.P., Chicago, Ill. .... p. 1•1615**
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D **Precision Timer Co., Westbrook, Conn. p. 1•268,269**
M **RCL Electronics Div., Irvington, N.J. p. 1•2286-2295**
Schrack Electrical Sales Corp., New York, N.Y. p. 1•1811
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ISC Magnetics Div., Plainview, N.Y. ....*
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal. .... *
D **McGraw-Edison Co., Manchester, N.H. .... ***
Ohmite Mfg. Co., Skokie, Ill. ....*
Barber Corp., Waynesville, Ohio
Centralab, Milwaukee, Wisc.
M Chicago Dynamic Industries, Chicago, Ill.
M Cole Instrument Corp., Costa Mesa, Cal.
D Control Products Div., Union, N.J.
D Denison, R.B., Bedford, Ohio
M Dynamic Controls Corp., S. Windsor, Conn.
Fifth Dimension, Princeton, N.J.
M General Devices, Princeton, N.J.
GTE Automatic Electric Inc., Northlake, Ill.
Guardian Electric Co., Chicago, Ill.
M Langevin, Costa Mesa, Cal.
Leviton Mfg. Co., Little Neck, N.Y.
D Machine Components Corp., Plainview, N.Y.
North American Philips Controls Corp., Cheshire, Conn.
DM Oak Inds. Inc., Crystal Lake, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
R L C Elctrns., Mt. Kisco, N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Tenor Co., New Berlin, Wisc.
Universal Relay Corp., New York, N.Y.

Switches, Tap—See Switches, Rotary

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NL Inds., Muskegon, Mich. ...... p. 1•2322,2323
Allen-Bradley Co., Milwaukee, Wisc. ....*
ISC Magnetics Div., Plainview, N.Y. ....*
D Aqualarm Inc., Gardena, Cal.
Burling Instr. Co., Chatham, N.J.
Chatham Controls Corp., Chatham, N.J.
M Control Prods., E. Hanover, N.J.
Cox & Co., New York, N.Y.
Edison, Instr. Div., W. Orange, N.J.
Electronic Control Systems, Fairmont, W. Va.
D Fenwal, Ashland, Mass.
GTE Sylvania Inc., Danvers, Mass.
Honeywell, Mpls., Minn.
Jaidinger Mfg. Co., Chicago, Ill.
D On-Guard Corp. of America, Carlstadt, NJ
Relay Specialties Inc., Fair Lawn, N.J.
Signet Scientific Co., Burbank, Cal.
Therm-O-Disc, Mansfield, Ohio
DM Torr Labs., Los Angeles, Cal.
Triac Electronics, New York, N.Y.
D United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Beverly, Mass.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Warren G-V Communications, Livingston, N.J.

Switches, Thumbwheel

D **Beckman Instrs., Fullerton, Cal. p. 2•1610,1611**
D **Cherry Electrical Prods. Corp., Waukegan, Ill. p. 1•1982,1983**
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C & K Components, Watertown, Mass. ....*
D **GC Electronics, Rockford, Ill. .... ***
General Elec. Co., Schenectady, N.Y. .... *
ISC Magnetics Div., Plainview, N.Y. ....*
M Airpax Elctrns., Cambridge, Md.
Amp Inc., Harrisburg, Pa.
D AMP Special Industries, Valley Forge, Pa.
M Chicago Dynamic Industries, Chicago, Ill.
M Cole Instrument Corp., Costa Mesa, Cal.
ITT Comps. Grp., N. Andover, Mass.
ITT Semiconductors-Capacitors, No. Andover, Mass.
Leviton Mfg. Co., Little Neck, N.Y.
Master Specialties Co., Costa Mesa, Cal.
Oak Inds. Inc., Crystal Lake, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Stanford Applied Engineering, Santa Clara, Cal.

Switches, Time Delay

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Hoagland Instr., Dayton, N.J. .... *
D Adams & Westlake Co., Elkhart, Ind.
M Airpax Elctrns., Cambridge, Md.
DM Associated Engrg. & Mfg. Corp., Upper Montclair, N.J.
Automatic Timing & Controls Co., King of Prussia, Pa.
D Bristol Saybrook Co., Old Saybrook, Conn.
Bulova Watch Co., Valley Stream, N.Y.
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Microwave Development Labs., Needham Hgts., Mass.
Narda Microwave Corp., Plainview, N.Y.
R L C Elctrns., Mt. Kisco, N.Y.
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DM Kings Electronics, Tuckahoe, N.Y.
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DM Photo Research Corp., Burbank, Cal.
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D Lectrotech, Chicago, Ill.
Nuclear Resch. Corp., Southampton, Pa.
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D Sencore, Sioux Falls, S.D.
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Addison Div. Muirhead, Mountainside, N.J.
Automatic Production Systems Inc., Pennsauken, N.J.
Data Numerics, Farmingdale, N.Y.
D Davidson Elctrn. Dev. Co., Erie, Pa.
Hewlett-Packard Co., Palo Alto, Cal.
D Instrumentation Engrg., Franklin Lakes, N.J.
Julie Research Lab., New York, N.Y.
Non-Linear Sys., Del Mar, Cal.
Optimized Devices Inc., Pleasantville, N.Y.
D Program Data Co., Carson, Cal.
Tektronix, Beaverton, Ore.
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ATEC, Houston, Tex.
Automatic Production Systems Inc., Pennsauken, N.J.
Avtron Mfg., Cleveland, Ohio
The Bendix Corp., Teterboro, N.J.
M Computer Automation, Irvine, Cal.
D Data Test Corp., Concord, Cal.
Datatron, Santa Ana, Cal.
D Davidson Elctrn. Dev. Co., Erie, Pa.
Digital Equipment Corp., Maynard, Mass.
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Hughes Aircraft Co, Culver City, Cal.
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D Instrumentation Engrg., Franklin Lakes, N.J.
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Sensor Corp., Scottdale, Pa.
Siemens Corp.-Computest Products, Cherry Hill, N.J.
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Systems Instrs. Resch., Atlanta, Ga.
D Temptronic Corporation, Newton, Mass.
Teradyne, Boston, Mass.
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M Anchor Specialty Mfg. Inc., Teterboro, N.J.
D Bartlett-Emery Instrument Corp., Ft. Madison, Iowa
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D Control Equip. Corp., Lowell, Mass.
Exide Power Sys. Div., Philadelphia, Pa.
Midland International Corp., No. Kansas City, Mo.
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N.Y. Testing Labs., Westbury, N.Y.
Opad Elec. Co., New York, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
D Philmore Mfg. Co. Inc., Inwood, N.Y.
M Q.V.S., East Orange, N.J.
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Chatsworth Data Corp., Chatsworth, Cal.
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Dillon, W.C. & Co., Van Nuys 340, Calif.
Electronic Systems & Programming Inc., Hawthorne, Cal.
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M Glenair, Glendale, Cal.
GTE Lenkurt Inc., San Carlos, Calif.
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M MacDonald & Co., Glendale, Calif.
Megavolt, New York, N.Y.
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M Trio-Tech, of Calif., Burbank, Calif.
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Beckman Instrs., Cedar Grove, N.J.
D Biddle, James G., Plymouth Meeting, Pa.
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Dielectric Instr. Corp., Pittsburgh, Pa.
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D Japanese Prods. Corp., Elmsford, N.Y.
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D Sotcher Measurement, Cupertino, Cal.
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D **ALCO Electronic Prods., North Andover, Mass.** *
General Radio Co., Concord, Mass. ..... *
NES, Streamwood, Ill. ..... *
Sprague Products Co., No. Adams, Mass. ..... *
Technitrol, Philadelphia, Pa. ..... *
D ADAR Assocs., Burlington, Mass.
Alessi Industries, Costa Mesa, Cal.
Alma, Mountain View, Cal.
ALPHA DATA INCORPORATED, Chatsworth, Cal
Associated Testing Labs., Burlington, Mass.
Beckman Instrs., Schiller Park, Ill.
Bulova Watch Co., Valley Stream, N.Y.
Computer Automation, Irvine, Cal.
Data-Control Systems, Danbury, Conn.
Datatron, Santa Ana, Cal.
Develco, Mountain View, Cal.
Digital Gen'l. Corp., Cleveland, Ohio
E-H Resch. Labs., Oakland, Cal.
Electronics One Inc., Atlanta, Ga.
Fairchild Sys. Technology, San Jose, Cal.
DM Hughes Aircraft Co., Oceanside, Cal.
D Instrumentation Engrg., Franklin Lakes, N.J.
IPT Corp., Sunnyvale, Cal.
Lear Siegler, Santa Monica, Calif.
Macrodata, Woodland Hills, Cal.
Non-Linear Sys., Del Mar, Cal.
Optimized Devices Inc., Pleasantville, N.Y.
D PRD Elctrns., Syosset, N.Y.
Precision Standards Corp., Santa Ana, Cal.
Pylon Co., Attleboro, Mass.
Siemens Corp.-Computest Products, Cherry Hill, N.J.
Singer Co., Little Falls, N.J.
M Sitek, Sunnyvale, Cal.
Sprague Elec. Co., No. Adams, Mass.
Systems Instrs. Resch., Atlanta, Ga.
Telectro Sys. Corp., Corona, N.Y.
Teradyne, Boston, Mass.
Texas Instrs. Inc., Houston, Tex.
DM Trendar, Mountain View, Cal.
M Trio-Tech, of Calif., Burbank, Calif.
XINCOM Corp., Chatsworth, Cal.

Testers, Integrated Circuit (Manual)

Berkeley Instruments, Santa Ana, Cal. p. 1•616
D **Continental Specialties, New Haven, Conn.** p. 2•348-351
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
Quan-Tech, Randolph Township, N.J. p. 1•787-790
D **E-Z-Hook, Arcadia, Cal.** ..... *
General Radio Co., Concord, Mass. ..... *
Sprague Products Co., No. Adams, Mass. ..... *
Alessi Industries, Costa Mesa, Cal.
ALPHA DATA INCORPORATED, Chatsworth, Cal
Applied Control Co., Fairfield, N.J.
Automatic Production Systems Inc., Pennsauken, N.J.
Beckman Instrs., Schiller Park, Ill.
D Cambridge Thermionic Corp., Cambridge, Mass.
D Circon Corp., Santa Barbara, Cal.
Data-Control Systems, Danbury, Conn.
D Data Test Corp., Concord, Cal.
E & L Instruments, Derby, Conn.
Electronics One Inc., Atlanta, Ga.
Fairchild Sys. Technology, San Jose, Cal.
Hughes Aircraft Co., Oceanside, Cal.
IPT Corp., Sunnyvale, Cal.
Jermyn, San Francisco, Cal.
DM Kurz-Kasch, Dayton, Ohio
Macrodata, Woodland Hills, Cal.
Non-Linear Sys., Del Mar, Cal.
D Ostby & Barton Co., Providence, R.I.
Precision Standards Corp., Santa Ana, Cal.
Pylon Co., Attleboro, Mass.
Rhode & Schwarz Sls., Fairfield, N.J.
Siemens Corp.-Computest Products, Cherry Hill, N.J.
M Sitek, Sunnyvale, Cal.
Telectro Sys. Corp., Corona, N.Y.
Teradyne, Boston, Mass.
DM Trendar, Mountain View, Cal.

Testers, Life, Component

M **Blue M Electric Co., Blue Island, Ill.** p. 1•468,469
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
D **Precision Timer Co., Westbrook, Conn.** p. 1•268,269
D ADAR Assocs., Burlington, Mass.
M Aerotronic Assocs., Contoocook, N.H.
Associated Testing Labs., Burlington, Mass.
M Cole Instrument Corp., Costa Mesa, Cal.
Custom Scientific Instrs., Whippany, N.J.
D Delta Design, San Diego, Cal
Megavolt, New York, N.Y.
Rutherford Research Prods. Co., Rutherford, N.J.
Solatron Enterprises, Inglewood, Calif.
Teradyne, Boston, Mass.
Wakefield Engrg., Wakefield, Mass.

Testers, Logic Card

Interface Engineering Inc., Stoughton, Mass. p. 1•175
D **ALCO Electronic Prods., North Andover, Mass.** *
General Radio Co., Concord, Mass. ..... *
NES, Streamwood, Ill. ..... *
DM **Systron Donner, Concord, Cal.** ..... *
D ADAR Assocs., Burlington, Mass.
Automatic Production Systems Inc., Pennsauken, N.J.
M Automation Dynamics, Westwood, N.J.
The Bendix Corp., Teterboro, N.J.
M Computer Automation, Irvine, Cal.
Data Numerics, Farmingdale, N.Y.
D Data Test Corp., Concord, Cal.
Digital Gen'l. Corp., Cleveland, Ohio
Dytro Corp., Hicksville, N.Y.
Electron, Bratenahl, Ohio
Fairchild Sys. Technology, San Jose, Cal.
Fluke Trendar Corp., Mountain View, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
DM Hughes Aircraft Co., Oceanside, Cal.
D Instrumentation Engrg., Franklin Lakes, N.J.
Lundy Elctrns. & Sys., Glen Head, N.Y.
D Macrodyne Inc., Schenectady, N.Y.
Micro Systems, Phoenix, Ariz.
Optimized Devices Inc., Pleasantville, N.Y.
D PRD Elctrns., Syosset, N.Y.
Production Devices, San Diego, Cal
D Program Data Co., Carson, Cal.
Proto Matic Co., Cincinnati, Ohio
Systems Instrs. Resch., Atlanta, Ga.
Teradyne, Boston, Mass.
DM Trendar, Mountain View, Cal.
ZEHNTEL, Concord, Cal.

Testers, Magnetic Core

Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917
DM **Systron Donner, Concord, Cal.** ..... *
Technitrol, Philadelphia, Pa. ..... *
Yewtec Corporation, Larchmont, N.Y. ..... *
D ADAR Assocs., Burlington, Mass.
E-H Resch. Labs., Oakland, Cal.
LDJ Electronics, Troy, Mich.
Magnetic Metals Co., Camden, N.J.
Magnos, Incorporated, Harvard, Mass.
Pioneer Magnetics, Santa Monica, Cal.
Siemens Corp.-Computest Products, Cherry Hill, N.J.
Sunshine Sci. Instrs., Philadelphia, Pa.

Testers, Magnetron

Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
Cober Elctrns., Stamford, Conn. ..... *
Aydin Energy Systems, Palo Alto, Cal.
Megavolt, New York, N.Y.

Testers, Material

Associated Research, Niles, Ill. ..... p. 1•607
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
RFL Inds., Boonton, N.J. ..... p. 1•791
Thomas & Skinner, Indpls., Ind. ..... p. 1•819
NES, Streamwood, Ill. ..... *
Automation Inds., Danbury, Conn.
D Chatillon John & Sons, Kew Gardens, N.Y.
Custom Scientific Instrs., Whippany, N.J.
Dillon, W.C. & Co., Van Nuys 340, Calif.
LDJ Electronics, Troy, Mich.
Magnos, Incorporated, Harvard, Mass.
Megavolt, New York, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
Schaevitz Engrg., Pennsauken, N.J.
Sunshine Sci. Instrs., Philadelphia, Pa.
Thwing-Albert Instr. Co., Philadelphia, Pa.
Walker Scientific, Worcester, Mass.
Western Electronic Systems, Palo Alto, Cal.

Testers, Meter

Electronic Dev. Corp., Boston, Mass. p. 1•670
Jonard Industries Corp., Tuckahoe, N.Y. p. 2•1708
RFL Inds., Boonton, N.J. ..... p. 1•791

Heath Co., Benton Harbor, Mich. .... *
Industrial Test Equip., Port Washington, N.Y. *
NES, Streamwood, Ill. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
M Automation Dynamics, Westwood, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
D JPI, Santa Monica, Cal.
D Keithley Instruments Inc., Cleveland, Ohio
Optimation, Chatsworth, Cal.
Snap-On-Tools, Kenosha, Wisc.
Sunshine Sci. Instrs., Philadelphia, Pa.
Transdata Inc., Columbus, Ohio
ZEHNTEL, Concord, Cal.

Testers, Microwave

Cober Elctrns., Stamford, Conn. ...p. 1•906,907
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
Polarad Elctrn. Instrs., Lake Success, N.Y. p. 1•784,785
M General Microwave Corp., Farmingdale, NY ..... *
General Radio Co., Concord, Mass. .... *
D Ailtech, Farmingdale, N. Y.
M California Microwave, Sunnyvale, Cal.
D Carco Elctrns., Menlo Park, Calif.
Collins Radio, Dallas, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Megavolt, New York, N.Y.
Micro-Tel Corp., Baltimore, Md.
M Microlab/FXR, Livingston, N.J.
D PRD Elctrns., Syosset, N.Y.
D Rantec Div., Calabasas, Calif.
M Santa Cruz Engrg. Inc., Santa Cruz, Cal.
D Singer Co., Palo Alto, Cal.
Waveline, W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
D Wiltron Co., Palo Alto, Cal
ZEHNTEL, Concord, Cal.

Testers, Modem

Marconi Instrs., Northvale, N.J. p. 1•766-771
DM Systron Donner, Concord, Cal. .... *
D Alert Technology, Northbrook, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Bowmar/ALI, Acton, Mass.
Dataprobe, So. Hackensack, N.J.
Hewlett-Packard Co., Palo Alto, Cal.
Hewlett-Packard Corp., Colorado Springs, Colo.
D Instrumentation Engrg., Franklin Lakes, N.J.

Testers, Motor

Slaughter Co., Ardmore, Okla. ....p. 1•809
Scientific Columbus, Columbus, Ohio .... *
Avtron Mfg., Cleveland, Ohio
D Chatillon John & Sons, Kew Gardens, N.Y.
Singer Co., Little Falls, N.J.

Testers, Potentiometer

Computer Instrs., Hempstead, N.Y. .... *
Yewtec Corporation, Larchmont, N.Y. .... *
Barber-Colman Co., Rockford, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Electro Sci. Inds., Portland, Ore.
Freudenberg, B., New York, N.Y.
Litton Systems, Mt. Vernon, N.Y.
Penn Airborne Prods., Southampton, Pa.
Solatron Enterprises, Inglewood, Calif.
D Taylor Instr. Process Control Div., Rochester, N.Y.

Testers, Power Supply

Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1173
Electronic Dev. Corp., Boston, Mass. p. 1•670
Elgar Corporation, San Diego, Cal. ....p. 1•1198
Universal Voltronics Corp., Mt. Kisco, N.Y. p. 1•1526
American Vector/TDC, Dayton, N.J. .... *
Biometrics Instrument Corp., Garland, Tex. .... *
NES, Streamwood, Ill. .... *
M Automation Dynamics, Westwood, N.J.
Biddle, James G., Plymouth Meeting, Pa.
D Instrumentation Engrg., Franklin Lakes, N.J.
Megavolt, New York, N.Y.
Micro Instrument Co., Escondido, Cal.
D NH Research, Santa Ana, Calif.
Optimized Devices Inc., Pleasantville, N.Y.
D Power Control Corp., Pittsburgh, Pa.
D PRD Elctrns., Syosset, N.Y.
M Transistor Devices, Cedar Knolls, N.J.
ZEHNTEL, Concord, Cal.

Testers, Radar

Bird Electronic Corp., Solon, Ohio .... p. 1•618
Cober Elctrns., Stamford, Conn. ...p. 1•906,907
Kilovolt Corp., Hackensack, N.J. p. 1•1302-1305
M General Microwave Corp., Farmingdale, NY ..... *
Aydin Energy Systems, Palo Alto, Cal.
M California Microwave, Sunnyvale, Cal.
Frequency Engrg. Labs., Farmingdale, N.J.
D Instrumentation Engrg., Franklin Lakes, N.J.
Megavolt, New York, N.Y.
M Santa Cruz Engrg. Inc., Santa Cruz, Cal.
Singer Co., Little Falls, N.J.
Tasker Systems, Chatsworth, Cal.

Testers, Ratio Voltage

M North Atlantic Inds., Plainview, N.Y. p. 1•188,772
RFL Inds., Boonton, N.J. ....p. 1•791
NES, Streamwood, Ill. .... *
Biddle, James G., Plymouth Meeting, Pa.
Electro Sci. Inds., Portland, Ore.
General Resistance, Mt. Vernon, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
Julie Research Lab., New York, N.Y.
D NH Research, Santa Ana, Calif.
Teradyne, Boston, Mass.
Weinschel Engrg. Co., Gaithersburg, Md.

Testers, Relay

Clarke-Hess Comm., New York, N.Y. p. 1•636,637
D Jonard Industries Corp., Tuckahoe, N.Y. p. 2•1708
Qualco, Los Altos, Cal. ....p. 2•790
Dranetz Engrg. Labs., So. Plainfield, N.J. .... *
Industrial Test Equip., Port Washington, N.Y. *
Slaughter Co., Ardmore, Okla. .... *
Wabash Relay & Elctrns., Wabash, Ind. .... *
M Anchor Specialty Mfg. Inc., Teterboro, N.J.
Artisan Elctrns. Corp., Parsippany, N.J.
Avtron Mfg., Cleveland, Ohio
D Control Equip. Corp., Lowell, Mass.
Digitech Data Inds., Ridgefield, Conn.
NOBEX Div., Burlingame, Cal.
Non-Linear Sys., Del Mar, Cal.
Optimized Devices Inc., Pleasantville, N.Y.
D Ostby & Barton Co., Providence, R.I.
Sigma Instruments, Braintree, Mass.
Solatron Enterprises, Inglewood, Calif.
Struthers-Dunn, Pitman, N.J.
Sunshine Sci. Instrs., Philadelphia, Pa.
Teradyne, Boston, Mass.
Wilmar Elctrns. Inc., Torrance, Cal.

Testers, Resistivity

Associated Research, Niles, Ill. .... p. 1•607
General Radio Co., Concord, Mass. .... *
NES, Streamwood, Ill. .... *
D Simpson Electric Co., Elgin, Ill. .... *
Alessi Industries, Costa Mesa, Cal.
M Automation Dynamics, Westwood, N.J.
D Biddle, James G., Plymouth Meeting, Pa.
COSAR Corp., Garland, Tex.
D Cutler-Hammer Shallcross, Selma, N.C.
DM Hughes Aircraft Co., Oceanside, Cal.
DM Matheson Gas Products, East Rutherford, N.J.
D Ostby & Barton Co., Providence, R.I.
Penn Airborne Prods., Southampton, Pa.
Rhode & Schwarz Sls., Fairfield, N.J.
Rutherford Research Prods. Co., Rutherford, N.J.
Teradyne, Boston, Mass.

Testers, Resistor

A. D. Data Sys., Rochester, N.Y. .... p. 1•127
Industrial Test Equip., Port Washington, N.Y. p. 1•729
London Co., Westlake, Ohio .... p. 1•763-765
Quan-Tech, Randolph Township, N.J. p. 1•787-790
RFL Inds., Boonton, N.J. .... p. 1•791
General Radio Co., Concord, Mass. .... *
NES, Streamwood, Ill. .... *
Slaughter Co., Ardmore, Okla. .... *
M Anchor Specialty Mfg. Inc., Teterboro, N.J.
Automatic Production Systems Inc., Pennsauken, N.J.
Biddle, James G., Plymouth Meeting, Pa.
D Cutler-Hammer Shallcross, Selma, N.C.
Electro Sci. Inds., Portland, Ore.
Freudenberg, B., New York, N.Y.
General Resistance, Mt. Vernon, N.Y.
IPT Corp., Sunnyvale, Cal.
Luft Instrs., Lincoln, Mass.
Optimized Devices Inc., Pleasantville, N.Y.
Penn Airborne Prods., Southampton, Pa.
M Peschel Instrs., Cape Coral, Fla.
Teradyne, Boston, Mass.

Testers, Servo—See Analyzers, Servo

Testers, Shock

M Blue M Electric Co., Blue Island, Ill. p. 1•468,469
Jan Hardware Mfg. Co., Long Island City, N.Y. p. 2•1093
DM Cincinnati Sub-Zero Products, Cincinnati, Ohio
D CVC Products, Rochester, N.Y.
Larson Aero Dev., Concord, Calif.
Metrix Instrument Co., Houston, Tex.
D Sotcher Measurement, Cupertino, Cal.

Testers, Short-Turn—See Testers, Coil

Testers, Signal Tracing

D Continental Specialties, New Haven, Conn. p. 2•348-351
DIT-MCO INT'L., Kansas City, Mo. ... p. 1•6660
DM Projects Unlimited, Dayton, Ohio .... p. 1•270
D Vaco Products Co., Chicago, Ill. .... p. 2•1715
D Dynascan Corp., Chicago, Ill. .... *
Sprague Products Co., No. Adams, Mass. .... *
DM Systron Donner, Concord, Cal. .... *
Acesso-Wire, Garnersville, N.Y.
Advanced Digital Research, Mountain View, Cal.
Applied Systems Corp., St. Clair Shores, Mich.
M Automation Dynamics, Westwood, N.J.
Barber Corp., Waynesville, Ohio
D Castle TV Tuner Service, Chicago, Ill.
Circon Corp., Santa Barbara, Cal.
Collins Radio, Dallas, Tex.
Computer Automation, Irvine, Cal.
Data Numerics, Farmingdale, N.Y.
EDMAC Associates Inc., East Rochester, N.Y.
Electronics One Inc., Atlanta, Ga.
Everett/Charles, Pomona, Cal.
Fluke Trendar Corp., Mountain View, Cal.
Hughes Aircraft Co., Oceanside, Cal.
IPT Corp., Sunnyvale, Cal.
Jerrold Electronics Corp., Horsham, Pa.
D Macrodyne Inc., Schenectady, N.Y.
D Hunter Tools, El Monte, Calif
National Camera Inc., Englewood, Colo.
Optimized Devices Inc., Pleasantville, N.Y.
D Program Data Co., Carson, Cal.
D PTS Electronics Inc., Bloomington, Ind
Teradyne, Boston, Mass.
DM Trendar, Mountain View, Cal.
D Vidaire Electronics Mfg., Freeport, N.Y.
D Workman Electronic Prods., Sarasota, Fla.
ZEHNTEL, Concord, Cal.

Testers, Solderability

Chemical Etching Equip. & Supply, Alexandria, Va.
Electrovert, Mt. Vernon, N.Y.
M MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Huntingdon Valley, Pa.
DM Multicore Solders, Westbury, N.Y.

Testers, Synchro/Resolver

C & A Products, Woodside, N.Y. p. 1•148-151
M Computer Conversions Corp., East Northport, N.Y. .... p. 1•154,155
M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
M Industrial Control Co., Farmingdale, N.Y. p. 1•1916,1917
M North Atlantic Inds., Plainview, N.Y. p. 1•188,772
Astrosystems, Lake Success, N.Y. .... *
ILC Data Device Corp., Bohemia, N.Y. .... *
The Bendix Corp., Teterboro, N.J.
M Clifton Precision, Clifton Hgts., Pa.
D NH Research, Santa Ana, Calif.
Singer Co., Little Falls, N.J.
Theta Instr. Corp., Fairfield, N.J.

Testers, Telephone - Also see Telephone Channel Test & Simulator Equipment

Frequency Devices, Haverhill, Mass. ...p. 1•554
D Projects Unlimited, Dayton, Ohio .... p. 1•270
Telecommunications Industries, Copiague, N.Y. p. 1•2301
Wavetek, San Diego, Cal .... p. 1•852-859
Comstron Seg., Richmond Hill, N.Y. .... *
Comstron-Seg Multimetrics, Richmond Hill, N.Y. .... *
Dranetz Engrg. Labs., So. Plainfield, N.J. .... *
M McGraw-Edison Co., Manchester, N.H. .... *
NES, Streamwood, Ill. .... *
Seg Subsidiary, Richmond Hill, N.Y. .... *
Acesso-Wire, Garnersville, N.Y.
Advanced Digital Research, Mountain View, Cal.
ATEC, Houston, Tex.
Communications Technology Corp., Los Angeles, Cal.
Hewlett-Packard Co., Palo Alto, Cal.
D Instrumentation Engrg., Franklin Lakes, N.J.
Optimized Devices Inc., Pleasantville, N.Y.
Voice Identification Inc., Somerville, N.J.
D Wiltron Co., Palo Alto, Cal
ZEHNTEL, Concord, Cal.

Testers, Teletypewriter
Re-el Circuits, Saddle Brook, N.J. ....p. 1•204
NES, Streamwood, Ill. .... *
Advanced Digital Research, Mountain View, Cal.
M Atlantic Research Coropration, Alexandria, Va
Dataprobe, So. Hackensack, N.J.
Digitech Data Inds., Ridgefield, Conn.

Testers, Thickness (all types)
American Electronic Controls, Barrington, N.J.
Bicron Elctrns. Co., Canaan, Conn.
Gaertner Scientific Corp., Chicago, Ill.
Neuses, P.K., Rolling Meadows, Ill.
Opto-Metric Tools, Rockleigh, N.J.
Panametrics Inc., Waltham, Mass.
Sloan Technology Corp., Santa Barbara, Cal.
Sunshine Sci. Instrs., Philadelphia, Pa.

Testers, Torque
Jonard Industries Corp., Tuckahoe, N.Y. p. 2•1706
Moxon Inc., Irvine, Cal. .... p. 1•2343
M Aeroflex Labs., Plainview, N.Y. .... *
M Anchor Specialty Mfg. Inc., Teterboro, N.J.
Applied Control Co., Fairfield, N.J.
BLH Elctrns., Waltham, Mass.
D Chatillon John & Sons, Kew Gardens, N.Y.
Dillon, W.C. & Co., Van Nuys 340, Calif.
M Glenair, Glendale, Cal.
S. Himmelstein & Co., Elk Grove Village, Ill.
Information Terminals, Sunnyvale, Cal.
Lebow Associates, Troy, Mich.
McFadden Elctrns. Co., South Gate, Calif.
Owatonna Tool Co., Owatonna, Minn.
M Power Instrs., Skokie, Ill.
Sensor Corp., Scottdale, Pa.
Sunshine Sci. Instrs., Philadelphia, Pa.
D Techni-Tool, Plymouth Meeting, Pa.
Vibrac Corp., Chelmsford, Mass.
Waters Mfg., Wayland, Mass.
West Coast Resch. Corp., Los Angeles, Calif.
Zonic Technical Labs., Cincinnati, Ohio

Testers, Tracking & Erosion Resistance (Insulation)
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
ITT Jennings, Instrus. & Systems, San Jose, Cal. ....p. 1•740,741
Guildline Instrs., Larchmont, N.Y.
Teradyne, Boston, Mass.

Testers, Transistor
Berkeley Instruments, Santa Ana, Cal. p. 1•616
D Dynascan Corp., Chicago, Ill. .... p. 1•608
D Hickok Electrical Instr., Cleveland, Ohio p. 1•728
Quan-Tech, Randolph Township, N.J. p. 1•787-790
D Sprague Products Co., No. Adams, Mass. p. 1•811
D Triplett Corp., Bluffton, Ohio ....p. 1•821
NES, Streamwood, Ill. .... *
Varadyne Industries, Santa Monica, Cal. .... *
AEL, Colmar, Pa.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bulova Watch Co., Valley Stream, N.Y.
Dantronics, St. Paul, Minn
Fairchild Sys. Technology, San Jose, Cal.
IPT Corp., Sunnyvale, Cal.
D Lectrotech, Chicago, Ill.
M MacDonald & Co., Glendale, Calif.
Mastech, Syracuse, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
Precision Standards Corp., Santa Ana, Cal.
D Production Devices, San Diego, Cal
Rhode & Schwarz Sls., Fairfield, N.J.
D Sencore, Sioux Falls, S.D.
Spectra Sonics, Ogden, Utah
Sprague Elec. Co., No. Adams, Mass.
D Telvac Instr. Co., Van Nuys, Cal.
Teradyne, Boston, Mass.
M Trio-Tech, of Calif., Burbank, Calif.
Velonex, Instrument Div., Santa Clara, Cal.
Wakefield Engrg., Wakefield, Mass.
D Workman Electronic Prods., Sarasota, Fla.
Zi-Tech Div., Palo Alto, Cal.

Testers, Transmission & Delay
Dranetz Engrg. Labs., So. Plainfield, N.J. p. 1•652-657
Marconi Instrs., Northvale, N.J. p. 1•766-771
Comstron Seg., Richmond Hill, N.Y. .... *
Comstron-Seg Multimetrics, Richmond Hill, N.Y. .... *
NES, Streamwood, Ill. .... *
Seg Subsidiary, Richmond Hill, N.Y. .... *
DM Systron-Donner Instr. Div., Concord, Cal. .... *
Bowmar/ALI, Acton, Mass.
Digitech Data Inds., Ridgefield, Conn.
Hewlett-Packard Co., Palo Alto, Cal.
International Communications, Miami, Fla.
D International Data Sciences, Providence, R.I.
Milgo Electronic Corp., Miami, Fla.
Railway Comm., Raytown, Mo.
Rantec Div., Calabasas, Calif.
D Tau-Tron Inc., N. Billerica, Mass.
Tektronix, Beaverton, Ore.

Testers, Tube
D Hickok Electrical Instr., Cleveland, Ohio p. 1•728
Telecommunications Industries, Copiague, N.Y. p. 1•2301
Cober Elctrns., Stamford, Conn. .... *
D Dynascan Corp., Chicago, Ill. .... *
American Electronic Controls, Barrington, N.J.
D GTE Sylvania Inc., Seneca Falls, N.Y.
RIL Elctrns., Southampton, Pa.
D Sencore, Sioux Falls, S.D.

Testers, Vibration-Also See Services, Environmental Test
M Kay Elemetrics Corp., Pine Brook, N.J. p. 1•746-749
Unholtz-Dickie Corp., Hamden, Conn. p. 1•471
M Dytronics Co., Columbus, Ohio .... *
General Radio Co., Concord, Mass. .... *
Acoustic Power Systems, Anaheim, Cal.
Advanced Dynamic Instrs. Div., Alexandria, Va.
DM All American Tool & Mfg. Co., Skokie, Ill.
B & K Instruments, Cleveland, Ohio
Bafco, Warminster, Pa.
M Baganoff Assocs., St. Louis, Mo.
Chadwick-Helmuth Co., Monrovia, Calif.
Columbia Resch. Labs., Woodlyn, Pa.
Endevco, San Jaun Capistrano, Cal.
D Epic, New York, N.Y.
D Helm Instr. Co., Toledo, Ohio
Hewlett-Packard Co., Palo Alto, Cal.
IRD Mechanalysis, Columbus, Ohio
Kinemetrics, San Gabriel, Cal.
Metrix Instrument Co., Houston, Tex.
Sunshine Sci. Instrs., Philadelphia, Pa.
Tenney Engrg., Union, N.J.
Torr Labs., Los Angeles, Cal.
D Vibra-Metrics, E. Haven, Conn.
Zonic Technical Labs., Cincinnati, Ohio

Testers, Voltage
Applied Electro Technology, Santa Ana, Cal. p. 1•1578
Associated Research, Niles, Ill. .... p. 1•607
Del Electronics Corp., Mt. Vernon, N.Y. p. 1•1168-1173
Hipotronics, Brewster, N.Y. p. 1•722,723,1230,1231
D Sheller-Globe Corp., Perkasie, Pa. p. 1•668,669
D Simpson Electric Co., Elgin, Ill. .... p. 1•802,803
D Triplett Corp., Bluffton, Ohio ....p. 1•821
D ALCO Electronic Prods., North Andover, Mass. *
D Industrial Devices, Edgewater, N.J. .... *
NES, Streamwood, Ill. ....*
Applied Systems Corp., St. Clair Shores, Mich.
DM Hughes Aircraft Co., Oceanside, Cal.
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BLH Elctrns., Waltham, Mass.
Bourns, Riverside, Calif.
Columbia Resch. Labs., Woodlyn, Pa.
Consolidated Controls Corp., Bethel, Conn.
D Dillon, W.C. & Co., Van Nuys 340, Calif.

D Dynisco, Westwood, Mass.
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M Genisco Tech. Corp., Transducers, Compton, Cal.
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D Interface, Scottsdale, Ariz.
D Kulite Semiconductor Prod., Ridgefield, N.J.
Lebow Associates, Troy, Mich.
DM Measurement Sys., Norwalk, Conn.
Orbit Instr. Corp., Syosset, N.Y.
Sensotec, Columbus, Ohio
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D Transducers, Whittier, Ca.
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D Amprobe Instr., Lynbrook, N.Y.
M ARI Inds., Franklin Pk., Ill.
Aviation Elec., Ltd., Montreal, H4L 4x8 Que., Can.
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Burns Engrg., Minnetonka, Minn.
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Cox & Co., New York, N.Y.
Datametrics Inc., Wilmington, Mass.
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Hy-Cal Engineering, Santa Fe Springs, Cal
D Kulite Semiconductor Prod., Ridgefield, N.J.
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D LFE Corporation, Waltham, Mass.
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DM National Semiconductor Corp., Santa Clara, Cal.
Plessey Enviromental Sys., San Diego, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
Raytek, Mountain View, Cal.
M Relco Prods., Denver, Colo.
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Rodan Ind's., Anaheim, Ca.
Rosemount Inc., Minneapolis, Minn.
Sensotec, Columbus, Ohio
M Sierracin/Thermal Sys., Los Angeles, Cal.
Stow Labs., Hudson, Mass.
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D Taylor Instr. Process Control Div., Rochester, N.Y.
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M Thermometrics, Edison, N.J.
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D Yellow Springs Instrument Co., Yellow Springs, Ohio

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The Bendix Corp., Teterboro, N.J.
BLH Elctrns., Waltham, Mass.
Bourns, Riverside, Calif.
Dillon, W.C. & Co., Van Nuys 340, Calif.
S. Himmelstein & Co., Elk Grove Village, Ill.
Honeywell, Ft. Washington, Pa.
Larson Aero Dev., Concord, Calif.
Lebow Associates, Troy, Mich.
DM Measurement Sys., Norwalk, Conn.
Sensor Corp., Scottsdale, Pa.
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D Transducers, Whittier, Ca.
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D Bendix Corp., Davenport, Iowa
Branson Cleaning Equip. Co., Shelton, Conn.
Channel Inds., Santa Barbara, Cal.
Crystal Technology, Mountain View, Cal
Dukane Corp., St. Charles, Ill.
M Edo Western Corp., Salt Lake City, Utah
Gulton Inds., Metuchen, N.J.
Kidde, Walter & Co., Belleville, N.J.
Linden Labs., State College, Pa.
Murata Mfg. Co. Ltd., Kyoto, Japan
D National Sonics, Farmingdale, N.Y.
Panametrics Inc., Waltham, Mass.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Phillips Mfg. Co., Chicago, Ill.
TDK Elctrns. Corp., Long Island City, N.Y.
M Teledyne Mec., Palo Alto, Cal.
Tohoku Metal Inds., Ltd., Tokyo, Japan
D Ultrasonic Corp., Pipestone, Minn.
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D Electro Corp., Sarasota, Fla.
Engdahl Enterprises, Costa Mesa, Cal.
D Helm Instr. Co., Toledo, Ohio
M Humphrey, San Diego, Calif.
IRD Mechanalysis, Columbus, Ohio
Kinemetrics, San Gabriel, Cal.
Metrix Instrument Co., Houston, Tex.
Montevideo Technology Inc., Edina, Minn.
Pickering & Co., Plainview, N.Y.
Plessey Enviromental Sys., San Diego, Cal.
M Schaevitz Engrg., Pennsauken, N.J.
Sensor Corp., Scottdale, Pa.
Signet Scientific Co., Burbank, Cal.
Sprengnether Instr. Co., W.F., St. Louis, Mo.
M Systron-Donner Inertial Div., Concord, Cal.
D Thermo Sys., St. Paul, Minn.
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M Transicoil, Worcester, Pa.
D Vibra-Metrics, E. Haven, Conn.

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B & K Instruments, Cleveland, Ohio
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Bicron Elctrns. Co., Canaan, Conn.
Biocom, Culver City, Cal.
Channel Inds., Santa Barbara, Cal.
Columbia Resch. Labs., Woodlyn, Pa.
D Electro Corp., Sarasota, Fla.
Electro-Voice, Buchanan, Mich.
M Gulton Inds., Costa Mesa, Cal.
D Helm Instr. Co., Toledo, Ohio
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IRD Mechanalysis, Columbus, Ohio
M Kaman Sciences Corp., Colorado Springs, Colo.
Kinemetrics, San Gabriel, Cal.
Knowles Elctrns., Franklin Park, Ill.
Larson Aero Dev., Concord, Calif.
Linden Labs., State College, Pa.
Lion Precision Corp, Newton, Mass.
Metrix Instrument Co., Houston, Tex.
PCB Piezotronics, Depew, N.Y.
Robertshaw Controls Co., Richmond, Va.
Sensor Corp., Scottdale, Pa.
Sprengnether Instr. Co., W.F., St. Louis, Mo.
M Systron-Donner Inertial Div., Concord, Cal.
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D Semicoa, Costa Mesa, Cal.
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D Amperex Electronic Corp., Slatersville, R.I.
Astro Dynamics, Burlington, Mass.
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Birnbach Co., Freeport, N.Y.
D Calvert Elctrns., New York, N.Y.
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D Cordover & Co., Carl, Hollywood, Fla.
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Fansteel Inc., N Chicago, Ill.
D General Elec., Syracuse; NY
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D Int'l. Elctrn. Resch., Burbank, Cal.
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National Beryllia Corp., Haskell, N.J.
D Norelcom Electronics, Farmingdale, N.Y.
Plessey Ceramic Div., Frenchtown, N.J.
SWS Silicones, Adrian, Mich.
Texas Instruments, Attleboro, Mass.
TOR Corporation, Van Nuys, Cal.
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D TRW/Cinch-Monadnock, An Elctrn. Comps., City of Industry, Cal.
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D Wakefield Engrg., Wakefield, Mass.
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D A E G Telefunken, Englewood Clfs., N.J.
M Ampower Semiconductor Corp., Smithtown, N.Y.
Avantek, Santa Clara, Cal.
DM Communications Transistor Corp., San Carlos, Cal.
Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
DM General Semiconductor Industries, Tempe, Ariz.
Hewlett-Packard Co., Palo Alto, Cal.
Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
DM Kertron, Riviera Beach, Fla.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
Optron, Carrollton, Tex.
D Power Physics Corp., Eatontown, N.J.
M PowerTech, Clifton, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Semicoa, Costa Mesa, Cal.
DM Semiconductor Technology, College Point, N.Y.
D Siliconix, Santa Clara, Cal
Solid State Scientific, Montgomeryville, Pa.
D Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.
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D **General Elec. Co., Schenectady, N.Y. .... ***
D **International Rectifier Corp., El Segundo, Cal. ***
D A E G Telefunken, Englewood Clfs., N.J.
DM Ampower Semiconductor Corp., Smithtown, N.Y.
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DM Kertron, Riviera Beach, Fla.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
D Power Physics Corp., Eatontown, N.J.
M PowerTech, Clifton, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Semicoa, Costa Mesa, Cal.
DM Semiconductor Technology, College Point, N.Y.
D Solid State Inc., Bloomfield, N.J.
DM Solitron Devices, Riviera Beach, Fla.
Sprague Elec. Co., No. Adams, Mass.
D Teledyne Semiconductor, Mountain View, Cal.
D TRW Semiconductor, Lawndale, Cal.
D Unitrode Corp., Watertown, Mass.
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General Elec., Syracuse, NY
D Intersil, Cupertino, Cal.
DM Kertron, Riviera Beach, Fla.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
Power Physics Corp., Eatontown, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
D Semicoa, Costa Mesa, Cal.
DM Semiconductor Technology, College Point, N.Y.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
D Solitron Devices, San Diego, Cal.
D Sprague Elec. Co., No. Adams, Mass.
DM Teledyne-Crystalonics, Cambridge, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
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D Calvert Elctrns., New York, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
D Intersil, Cupertino, Cal.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Norelcom Electronics, Farmingdale, N.Y.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Signetics Corp., Sunnyvale, Cal.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
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D Sprague Elec. Co., No. Adams, Mass.
DM Teledyne-Crystalonics, Cambridge, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
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Fairchild Semiconductor, Mountain View, Cal.
General Elec., Syracuse, NY
HEI, Chaska, Minn.
Optron, Carrollton, Tex.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
DM Plessey Semiconductors, Santa Ana, Cal.
D Semiconductor Technology, College Point, N.Y.
Sensor Technology, Chatsworth, Cal.
D Siliconix, Santa Clara, Cal
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Transistors, Power

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D General Elec. Co., Schenectady, N.Y. .... *
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D Sprague Products Co., No. Adams, Mass. .... *
TRW Capacitor Div., Ogallala, Neb. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Amperex Electronic Corp., Slatersville, R.I.
DM Ampower Semiconductor Corp., Smithtown, N.Y.
D Calvert Elctrns., New York, N.Y.
DM Communications Transistor Corp., San Carlos, Cal.
D Cordover & Co., Carl, Hollywood, Fla.
D Electronic Transistors, Flushing, N.Y.
Energy Elctrn. Products Corp., Los Angeles, Cal.
Fairchild Semiconductor, Mountain View, Cal.
Ferranti Elec., Plainview, N.Y.
General Elec., Syracuse, NY
DM General Semiconductor Industries, Tempe, Ariz.
D Germanium Power Devices, Andover, Mass.
M International Importers, Chicago, Ill.
DM Kertron, Riviera Beach, Fla.
Microwave Semiconductor Corp., Somerset, N.J.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Norelcom Electronics, Farmingdale, N.Y.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Power Physics Corp., Eatontown, N.J.
D PowerTech, Clifton, N.J.
DM RCA Solid State Div., Somerville, N.J.
D Semicoa, Costa Mesa, Cal.
DM Semiconductor Technology, College Point, N.Y.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Siemens Corp., Iselin, N.J.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
DM Solitron Devices, Riviera Beach, Fla.
Special Microwave Devices Oper., Waltham, Mass.
D Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Workman Electronic Prods., Sarasota, Fla.

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D General Elec. Co., Schenectady, N.Y. .... *
Stow Labs., Hudson, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

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M Analog Devices, Norwood, Mass. .... *
D General Elec. Co., Schenectady, N.Y. .... *
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D Amperex Electronic Corp., Slatersville, R.I.
Avantek, Santa Clara, Cal.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
D Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
Ferranti Elec., Plainview, N.Y.
Hewlett-Packard Co., Palo Alto, Cal.
M International Importers, Chicago, Ill.
D ITT Semiconductor, West Palm Beach, Fla.
DM Kertron, Riviera Beach, Fla.
Microwave Semiconductor Corp., Somerset, N.J.
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Plessey Semiconductors, Santa Ana, Cal.
D Power Physics Corp., Eatontown, N.J.
DM RCA Solid State Div., Somerville, N.J.
D Semicoa, Costa Mesa, Cal.
D Semiconductor Technology, College Point, N.Y.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Siemens Corp., Iselin, N.J.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
D Solid State Scientific, Montgomeryville, Pa.
Special Microwave Devices Oper., Waltham, Mass.
Sprague Elec. Co., No. Adams, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
Temtron Elexs, Rosedale, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
D TRW Semiconductor, Lawndale, Cal.
UPI Semiconductor Div., Patterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Workman Electronic Prods., Sarasota, Fla.

Transistors, Switching

DM Delco Electronics Div., Kokomo, Ind. p. 1•1838-1841
D General Instruments Corp., Hicksville, N.Y. p. 1•1844
DM RSM Sensitron Semiconductor, Div. RSM Electron Power, Deer Park, N.Y. p. 1•1852-1855
Solid State Devices, LaMirada, Cal. ...p. 1•1864
D Sprague Products Co., No. Adams, Mass. p. 1•1866-1869
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M Analog Devices, Norwood, Mass. .... *
D General Elec. Co., Schenectady, N.Y. .... *
D International Rectifier Corp., El Segundo, Cal. *
NEC America, New York, N.Y. .... *
TRW Capacitor Div., Ogallala, Neb. .... *
D A E G Telefunken, Englewood Clfs., N.J.
AEL, Colmar, Pa.
D Amperex Electronic Corp., Slatersville, R.I.
DM Ampower Semiconductor Corp., Smithtown, N.Y.
D Calvert Elctrns., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
D Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor, Mountain View, Cal.
Ferranti Elec., Plainview, N.Y.
General Elec., Syracuse, NY
DM General Semiconductor Industries, Tempe, Ariz.
Hewlett-Packard Co., Palo Alto, Cal.
D Intersil, Cupertino, Cal.
D ITT Semiconductor, West Palm Beach, Fla.
DM Kertron, Riviera Beach, Fla.
Micro Components Corp., Cranston, RI
D Motorola Semiconductor Prods., Phoenix, Ariz.
DM National Semiconductor Corp., Santa Clara, Cal.
D Nucleonic Prods., Canoga Pk., Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Power Physics Corp., Eatontown, N.J.
M PowerTech, Clifton, N.J.
DM Raytheon Semiconductor, Mountain View, Cal.
DM RCA Solid State Div., Somerville, N.J.
D Semicoa, Costa Mesa, Cal.
DM Semiconductor Technology, College Point, N.Y.
D SGS-ATES Semiconductor, Newtonville, Mass.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
D Solitron Devices, San Diego, Cal.
D Sprague Elec. Co., No. Adams, Mass.
DM Teledyne-Crystalonics, Cambridge, Mass.
DM Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
D Transitron Elctrn. Corp., Wakefield, Mass.
D TRW Semiconductor, Lawndale, Cal.
D Unitrode Corp., Watertown, Mass.
UPI Semiconductor Div., Patterson, N.J.
D Workman Electronic Prods., Sarasota, Fla.

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D Solid State Devices, LaMirada, Cal. ...p. 1•1865
D General Elec. Co., Schenectady, N.Y. .... *
NEC America, New York, N.Y. .... *
D Sprague Products Co., No. Adams, Mass. .... *
D Calvert Elctrns., New York, N.Y.
General Elec., Syracuse, NY
D Motorola Semiconductor Prods., Phoenix, Ariz.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Semicoa, Costa Mesa, Cal.
D Siliconix, Santa Clara, Cal
D Solid State Inc., Bloomfield, N.J.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
UPI Semiconductor Div., Patterson, N.J.
D Workman Electronic Prods., Sarasota, Fla.

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M Control Technology Co., L.I.C., N.Y. p. 1•1914,1915
NES, Streamwood, Ill. ....*
Beta Technology, Farmingdale, N.Y.
D Control Equip. Corp., Lowell, Mass.
M Cubic Corp., San Diego, Cal.
D Datatron, Santa Ana, Cal.
DEMEK, Shawnee-Mission, Kans.
Hughes Aircraft Co, Culver City, Cal.
Metric Systems Corp., Ft. Walton Beach, Fla.
Mohawk OEM Sales, King of Prussia, Pa.
Singer - Tele-Signal, Woodbury, N.Y.
Theta Instr. Corp., Fairfield, N.J.
M Trak Systems, Tampa, Fla.

Transmission Line, Wire & Cable—See Volume 2

Transmission Systems, Data

RFL Inds., Boonton, N.J. ....p. 1•122
M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
Analog Devices, Norwood, Mass. .... *
NES, Streamwood, Ill. ....*
North Hills Elctrns., Glen Cove, N.Y. .... *
Acurex, Mountain View, Cal.
Applied Systems Corp., St. Clair Shores, Mich.
D Autocon Inds., Minneapolis, Minn.
DM Bendix Corp. Environmtl. Sci., Baltimore, Md.
Beta Technology, Farmingdale, N.Y.
Bramco Controls Div., Piqua, Ohio
M Cardion Elctrns., Woodbury, N.Y.
D Codex Corp., Newton, Mass.
Collins Radio, Dallas, Tex.
M Cubic Corp., San Diego, Cal.
Data-Control Systems, Danbury, Conn.
DEMEK, Shawnee-Mission, Kans.
Dest Data Corp., Sunnyvale, Cal.
Digitronics Corp., Albertson, N.Y.
Galileo Electro-Optics Corp., Sturbridge, Mass.
G B Instruments Inc., Hollywood, Fla.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Hathaway Instruments, Denver, Colo.
Hewlett-Packard Co., Cupertino, Cal.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co, Culver City, Cal.
Hy-Cal Engineering, Santa Fe Springs, Cal
Industrial Products Div., Orlando, Fla.
Lear Siegler, Santa Monica, Calif.
D Leeds & Northrup Co., North Wales, Pa.
Meret Inc., Santa Monica, Cal.
M Mohawk Data Sciences Corp., Utica, N.Y.
Mohawk OEM Sales, King of Prussia, Pa.
Monroe, The Calculator Co., Orange, N.J.
Potter Instr. Co., Melville, N.Y.
RCA Service Co., Camden, N.J.
M Resdel Engrg. Corp., Arcadia, Cal.
Rycom Instruments, Raytown, Mo.
Systems Data Inc., Akron, Ohio
Texas Instrs. Inc., Houston, Tex.
Theta Instr. Corp., Fairfield, N.J.

Transmitters, Beacon

AEROCOM, Miami, Fla.
M A.R.F. Products, Boulder, Colo.
BF Elctrns., Solana Beach, Calif.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Communication Assocs., Huntington Station, N.Y.
D Emergency Beacon Corp., New Rochelle, N.Y.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
ITT Mackay Marine, Raleigh, N.C.
Mobil Electronics, Anderson, Ind.
Pacific Communications, Santa Ana, Cal.
RCA Electronic Comps., Harrison, N.J.
D R F D, Tampa, Fla.

Transmitters, Fixed Frequency

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M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
American Vector/TDC, Dayton, N.J. .... *
AEROCOM, Miami, Fla.
M A.R.F. Products, Boulder, Colo.
D Autocon Inds., Minneapolis, Minn.
Aydin Energy Systems, Palo Alto, Cal.
Beukers Labs., Bohemia, N.Y.
BF Elctrns., Solana Beach, Calif.
D Bogen Div., Paramus, N.J.
DM Brelonix, Seattle, Wash
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Communication Assocs., Huntington Station, N.Y.
D Drake Co., R.L., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Elctrn. Comm., St. Petersburg, Fla.
Farinon Electric, San Carlos, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
HM Electronics, San Diego, Cal.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
IEC Electronics Corp., E. Rochester, N.Y.
ITT Mackay Marine, Raleigh, N.C.
Lundy Elctrns. & Sys., Glen Head, N.Y.
M Microwave Power Devices, Plainview, N.Y.
D Multi-Elmac Co., Novi, Mich.
Pacific Communications, Santa Ana, Cal.
REPCO Inc., Orlando, Fla.
M Resdel Engrg. Corp., Arcadia, Cal.
Rhode & Schwarz Sls., Fairfield, N.J.

*Company has information in white pages but not on this product

Technical Mat'l., Mamaroneck, N.Y.
Transcom Electronics, La Mesa, Cal.
Viable Systems Inc., Needham, Mass.

Transmitters, Fixed Station Comm.

American Vector/TDC, Dayton, N.J. .... *
AEL, Colmar, Pa.
AEROCOM, Miami, Fla.
Aydin Energy Systems, Palo Alto, Cal.
M Bendix Corp, Towson, Md.
D Bogen Div., Paramus, N.J.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Communication Assocs., Huntington Station, N.Y.
D Drake Co., R.L., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
EG&G, Salem, Mass.
Elctrn. Comm., St. Petersburg, Fla.
Farinon Electric, San Carlos, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Fullerton, Cal.
M Hy-Gain Electronics Corp., Lincoln, Neb.
IEC Electronics Corp., E. Rochester, N.Y.
ITT Mackay Marine, Raleigh, N.C.
D Linear Systems, Watsonville, Cal.
M Microwave Power Devices, Plainview, N.Y.
Teaberry Electronics, Indianapolis, Ind.
Technical Mat'l., Mamaroneck, N.Y.
Transcom Electronics, La Mesa, Cal.

Transmitters, Microwave

M Applied Microwave, Westwood, Mass. p. 1•901-904
Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
Cober Elctrns., Stamford, Conn. ...p. 1•906,907
D Greenray Inds., Mechanicsburg, Pa. ....p. 1•327
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M Vega Precision Labs., Vienna, Va. .... p. 1•928
AEL, Colmar, Pa.
Aircom, Union, N.H.
Aydin Energy Systems, Palo Alto, Cal.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
D Conic Corp., San Diego, Cal.
M Cubic Corp., San Diego, Cal.
Dynalab Corp., Van Nuys, Cal.
Elctrn. Comm., St. Petersburg, Fla.
Environmental Communications Inc., Costa Mesa, Cal.
Farinon Electric, San Carlos, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
HM Electronics, San Diego, Cal.
Hughes Aircraft Co, Culver City, Cal.
M Microlab/FXR, Livingston, N.J.
Microwave Assocs., Burlington, Mass.
Microwave Power Devices, Plainview, N.Y.
Narda Microwave Corp., Plainview, N.Y.
M Premier Microwave, Port Chester, N.Y.
M Resdel Engrg. Corp., Arcadia, Cal.
D R F D, Tampa, Fla.
M Teledyne Mec., Palo Alto, Cal.
Transcom Electronics, La Mesa, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Beverly, Mass

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NES, Streamwood, Ill. .... *
Beta Technology, Farmingdale, N.Y.
Bramco Controls Div., Piqua, Ohio
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
Elctrn. Comm., St. Petersburg, Fla.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
Pacific Communications, Santa Ana, Cal.
Singer - Tele-Signal, Woodbury, N.Y.

Transmitters, Pressure & Flow

Computer Instrs., Hempstead, N.Y. p. 1•2340
M Kratos, Pasadena, Cal .... p. 1•751
McGraw-Edison Co., Manchester, N.H. .... *
NES, Streamwood, Ill. .... *
Kulite Semiconductor Prod., Ridgefield, N.J.
Leeds & Northrup Co., North Wales, Pa.
Robertshaw Controls Co., Richmond, Va.
Rosemount Inc., Minneapolis, Minn.
Taylor Instr. Process Control Div., Rochester, N.Y.
D Yellow Springs Instrument Co., Yellow Springs, Ohio

Transmitters, Pulse Code Modulation

Bramco Controls Div., Piqua, Ohio
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
Microwave Power Devices, Plainview, N.Y.
Pacific Communications, Santa Ana, Cal.
D Tau-Tron Inc., N. Billerica, Mass.
Viable Systems Inc., Needham, Mass.

Transmitters, Pulse Phase Modulation

Cober Elctrns., Stamford, Conn. .... *
M McGraw-Edison Co., Manchester, N.H. .... *
Collins Radio, Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Culver City, Cal.
Microwave Power Devices, Plainview, N.Y.

Transmitters, Pulse Time Modulation

D Precision Timer Co., Westbrook, Conn. p. 1•268,269
D Autocon Inds., Minneapolis, Minn.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Fullerton, Cal.
Microwave Power Devices, Plainview, N.Y.
D R F D, Tampa, Fla.
Viable Systems Inc., Needham, Mass.

Transmitters, Radar—See Radar Systems

Transmitters, Single-Sideband

RFL Inds., Boonton, N.J. .... p. 1•122
AEROCOM, Miami, Fla.
M Bendix Corp, Towson, Md.
DM Brelonix, Seattle, Wash
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Communication Assocs., Huntington Station, N.Y.
Design Automation, Lexington, Mass.
D Drake Co., R.L., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
D Fanon/Courier Corp., Subs., Pasadena, Cal.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Washington, D.C.
HM Electronics, San Diego, Cal.
Hughes Aircraft Co, Culver City, Cal.
DM Hy-Gain Electronics Corp., Lincoln, Neb.
ITT Mackay Marine, Raleigh, N.C.
D Linear Systems, Watsonville, Cal.
Microwave Power Devices, Plainview, N.Y.
Rhode & Schwarz Sls., Fairfield, N.J.
D S G C Inc., Bellevue, Wash.
Technical Mat'l., Mamaroneck, N.Y.
D Ten-Tec Inc., Sevierville, Tenn.
Transcom Electronics, La Mesa, Cal.

Transmitters, Telemetry

Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
Re-el Circuits, Saddle Brook, N.J. ....p. 1•123
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M RHG Elctrns. Lab., Deer Park, N.Y. ....p. 2•1389
M Vega Precision Labs., Vienna, Va. .... p. 1•928
D Autocon Inds., Minneapolis, Minn.
Beukers Labs., Bohemia, N.Y.
BF Elctrns., Solana Beach, Calif.
Biocom, Culver City, Cal.
Bramco Controls Div., Piqua, Ohio
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
M Cubic Corp., San Diego, Cal.
Dataprobe, So. Hackensack, N.J.
Dynalab Corp., Van Nuys, Cal.
Elctrn. Comm., St. Petersburg, Fla.
D Emergency Beacon Corp., New Rochelle, N.Y.
D EMR Telemetry, Sarasota, Fla.
Hathaway Instruments, Denver, Colo.
HM Electronics, San Diego, Cal.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co, Culver City, Cal.
Microwave Power Devices, Plainview, N.Y.
Pacific Communications, Santa Ana, Cal.
REPCO Inc., Orlando, Fla.
M Resdel Engrg. Corp., Arcadia, Cal.
D R F D, Tampa, Fla.
D Singer Co., Philadelphia, Pa.
Templine, Gardena, Cal.
Transcom Electronics, La Mesa, Cal.
Viable Systems Inc., Needham, Mass.

Transmitters, Tropospheric Scatter

Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
Cober Elctrns., Stamford, Conn. .... *
Aydin Energy Systems, Palo Alto, Cal.
Collins Radio, Dallas, Tex.
GTE Sylvania Inc., Washington, D.C.
Hughes Aircraft Co, Fullerton, Cal.
M Microwave Power Devices, Plainview, N.Y.

Transmitters, Tone

Re-el Circuits, Saddle Brook, N.J. ....p. 1•123
D Alpha Electronic Services, Stanton, Cal.
D Biddle, James G., Plymouth Meeting, Pa.
Bramco Controls Div., Piqua, Ohio
Dynalab Corp., Van Nuys, Cal.
IEC Electronics Corp., E. Rochester, N.Y.
Microwave Power Devices, Plainview, N.Y.
Mobil Electronics, Anderson, Ind.
D Regency Electronics, Indianapolis, Ind.
REPCO Inc., Orlando, Fla.
Viable Systems Inc., Needham, Mass.

Transmitters, UHF/VHF

Arra Inc., Bay Shore, N.Y. .... p. 2•1278,1279
MCL, LaGrange, Ill. ....p. 1•915
D Johnson Co., E.F., Waseca, Minn. .... *
AEROCOM, Miami, Fla.
D Ailtech, Farmingdale, N. Y.
M A.R.F. Products, Boulder, Colo.
D Bendix Corp., Ft. Lauderdale, Fla.
M Bendix Corp, Towson, Md.
BF Elctrns., Solana Beach, Calif.
M Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio, Dallas, Tex.
Communication Assocs., Huntington Station, N.Y.
Delta-Benco-Cascade LTD., Rexdale, Ont. Can. M9W 1G1
Dynalab Corp., Van Nuys, Cal.
Elctrn. Comm., St. Petersburg, Fla.
D Emergency Beacon Corp., New Rochelle, N.Y.
GTE Sylvania Inc., Washington, D.C.
HM Electronics, San Diego, Cal.
Hughes Aircraft Co, Fullerton, Cal.
Hy-Gain Electronics Corp., Lincoln, Neb.
IEC Electronics Corp., E. Rochester, N.Y.
ITT Mackay Marine, Raleigh, N.C.
D Linear Systems, Watsonville, Cal.
M Microwave Power Devices, Plainview, N.Y.
Mobil Electronics, Anderson, Ind.
D Multi-Elmac Co., Novi, Mich.
Pacific Communications, Santa Ana, Cal.
D Regency Electronics, Indianapolis, Ind.
REPCO Inc., Orlando, Fla.
D Rodelco, Deer Park, N.Y.
Transcom Electronics, La Mesa, Cal.
Viable Systems Inc., Needham, Mass.

Transmitters, ULF/VLF

American Vector/TDC, Dayton, N.J. .... *
DM Bayshore Systems Corp., Springfield, Va.
Collins Radio, Dallas, Tex.
M Delta Elctrn. Control, Costa Mesa, Cal.
Dynalab Corp., Van Nuys, Cal.
GTE Sylvania Inc., Washington, D.C.
Technical Mat'l., Mamaroneck, N.Y.

Transponders

Vega Precision Labs., Vienna, Va. .... p. 1•928
NES, Streamwood, Ill. .... *
AEROCOM, Miami, Fla.
AMF Electical Prods., Alexandria, Va.
M A.R.F. Products, Boulder, Colo.
M Bendix Corp, Towson, Md.
Bramco Controls Div., Piqua, Ohio
D Dynair Elctrns. Inc., San Diego, Calif.
Dynalab Corp., Van Nuys, Cal.
Dynamic Communications, Riviera Beach, Fla.
Epsco, Westwood, Mass.
Hughes Aircraft Co, Culver City, Cal.
Viable Systems Inc., Needham, Mass.

Transports, card

Canon U.S.A., Lake Success, N.Y. .... *

Transports, Tape (all kinds)

Ad-Vance Magnetics, Rochester, Ind. p. 2•1210
Crown International, Elkhart, Ind. ...... p. 1•14
Ampro Corp., Willow Grove, Pa.
Pertec Corp., El Segundo, Cal.

Triacs—See Thyristors

Triggers, SCR—See Controls, SCR

Tubes, Backward Wave

Electro Motive Corp., Melville, New York .... *
International Electronics Corp., Melville, N.Y. *
D Raytheon Co., Burlington, Mass. .... *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
D Siemens Corp., Iselin, N.J.
Sperry Microwave Components, Gainesville, Fla.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.

Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
M Warnecke Electron Tubes, Des Plaines, Ill.
M Watkins-Johnson Co., Palo Alto, Cal.

Tubes, Ballast—See Volume 2

Tubes, Cathode-Ray, Data Storage, TV Picture

Amperex Elctronic Corp., Slatersville, R.I.
p. 1•2350,2351
Ann Arbor Terminals, Ann Arbor, Mich.
p. 1•134
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
Amperex Electronic Corp., Slatersville, R.I.
D Calvert Elctrns., New York, N.Y.
D Channel Master Div. Avnet, Ellenville, N.Y.
Clinton Elctrns. Corp., Rockford, Ill.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
D GTE Sylvania Inc., Waltham, Mass.
DM Hughes Aircraft Co., Carlsbad, Cal.
M International Importers, Chicago, Ill.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Rauland, Melrose Pk., Ill.
Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
M Teltron, Pottstown, Pa.
DM Thomas Elctrns., Wayne, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
M Warnecke Electron Tubes, Des Plaines, Ill.
M Watkins-Johnson Co., Palo Alto, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Cathode-Ray, Instrument Use

D Amperex Elctronic Corp., Slatersville, R.I.
p. 1•2350,2351
Inter-Tech. Grp., Irvington-on-Hudson, N.Y.
p. 1•2356,2357
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
Ferranti Elec., Plainview, N.Y.
DM Hughes Aircraft Co., Carlsbad, Cal.
M International Importers, Chicago, Ill.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
Temtron Elexs, Rosedale, N.Y.
DM Thomas Elctrns., Wayne, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
M Watkins-Johnson Co., Palo Alto, Cal.

Tubes, Cathode-Ray, Multiple Gun

D Amperex Elctronic Corp., Slatersville, R.I.
p. 1•2350,2351
Inter-Tech. Grp., Irvington-on-Hudson, N.Y.
p. 1•2356,2357
Electro Motive Corp., Melville, New York .... *
General Elec. Co., Schenectady, N.Y. .... *
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
International Electronics Corp., Melville, N.Y. *
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
D GTE Sylvania Inc., Seneca Falls, N.Y.
DM Hughes Aircraft Co., Carlsbad, Cal.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
M Teltron, Pottstown, Pa.
DM Thomas Elctrns., Wayne, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Cathode-Ray, Projection

D Amperex Elctronic Corp., Slatersville, R.I.
p. 1•2350,2351
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
DM Hughes Aircraft Co., Carlsbad, Cal.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
RCA Electronic Comps., Harrison, N.J.
D RCA, Ind'l. Tube Div., Lancaster, Pa.
DM Thomas Elctrns., Wayne, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
M Watkins-Johnson Co., Palo Alto, Cal.

Tubes, Cathode-Ray, Scan Conversion

DuMont Electron Tubes & Devices Corp., Clifton, N.J.
General Electrodynamics Corp., Garland, Tex.
DM Hughes Aircraft Co., Oceanside, Cal.
Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
RCA, Ind'l. Tube Div., Lancaster, Pa.
M Teltron, Pottstown, Pa.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
M Warnecke Electron Tubes, Des Plaines, Ill.
M Watkins-Johnson Co., Palo Alto, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Cathode-Ray, Shaped-Beam

Amperex Elctronic Corp., Slatersville, R.I.
p. 1•2350,2351
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
GTE Sylvania Inc., Seneca Falls, N.Y.
DM Hughes Aircraft Co., Carlsbad, Cal.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
Raytheon Co., Quincy, Mass.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
United Page Inc., Paterson, N.J.
M Watkins-Johnson Co., Palo Alto, Cal.

Tubes, Ceramic (Electron)

D Amperex Electronic Corp., Hicksville, N.Y. ...... *
General Elec. Co., Schenectady, N.Y. .... *
DM Raytheon Co., Burlington, Mass. .... *
American Lava Corp., Chattanooga, Tenn.
DM Apollo Corp., Kawasaki, Japan
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
General Electric Co., Cleveland, Ohio
GTE Sylvania Inc., Seneca Falls, N.Y.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
Murata Mfg. Co. Ltd., Kyoto, Japan
Plessey Ceramic Div., Frenchtown, N.J.
RCA Electronic Comps., Harrison, N.J.
RCA, Ind'l. Tube Div., Lancaster, Pa.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.

Tubes, Counting

D Amperex Electronic Corp., Hicksville, N.Y.
p. 1•2352,2353
D Refac Elctrns./Pinlites, Fairfield, N.J. p. 2•1185
Amperex Elctronic Corp., Slatersville, R.I. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
Temtron Elexs, Rosedale, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.

Tubes, Electrometer

D Amperex Electronic Corp., Hicksville, N.Y. ...... *
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

Tubes, Electron Multiplier

Hamamatsu Corp., Middlesex, N. J.
p. 1•2354,2355
Amperex Elctronic Corp., Slatersville, R.I. .... *
D Amperex Electronic Corp., Hicksville, N.Y. ...... *
M Wagner Elec., Livingston, N.J. .... *
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
Galileo Electro-Optics Corp., Sturbridge, Mass.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
D JSH Electronics, Culver City, Cal.
Murata Mfg. Co. Ltd., Kyoto, Japan
RCA Electronic Comps., Harrison, N.J.
M Teltron, Pottstown, Pa.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.

Tubes, Flash

D EG&G, Salem, Mass. ....p. 1•1013
General Radio Co., Concord, Mass. .... *
Amglo Corp., Rosemont, Ill.
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
EG & G, Salem, Mass.
D Great Western Aviation, Denver, Colo.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
D Siemens Corp., Iselin, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
DM Torr Labs., Los Angeles, Cal.
United Page Inc., Paterson, N.J.
U.S. Scientific Instrs., Boston, Mass.

Tubes, Forward Wave

D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
M Litton Inds., San Carlos, Calif.
Sperry Microwave Components, Gainesville, Fla.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
M Warnecke Electron Tubes, Des Plaines, Ill.

Tubes, Gas

M Victoreen Instrument Div., Cleveland, Ohio
p. 2•2358
D Amperex Electronic Corp., Hicksville, N.Y. ...... *
DM Raytheon Co., Burlington, Mass. .... *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
DM Electrons Co., Fairfield, N.J.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
D Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Ignitron

D Amperex Electronic Corp., Hicksville, N.Y.
p. 1•2352,2353
Amperex Elctronic Corp., Slatersville, R.I. .... *
General Elec. Co., Schenectady, N.Y. .... *
International Rectifier Corp., El Segundo, Cal. *
D Raytheon Co., Burlington, Mass. .... *
Advanced Kinetics, Costa Mesa, Calif.
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
D National Electronics, Geneva, Ill.
RCA Electronic Comps., Harrison, N.J.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Triac Electronics, New York, N.Y.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Image Converter

M Varo Electron Devices, Garland, Tex. p. 1•2360
General Elec. Co., Schenectady, N.Y. .... *
Industrial Elctrn. Engrs., Van Nuys, Cal. .... *
D A E G Telefunken, Englewood Clfs., N.J.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
Galileo Electro-Optics Corp., Sturbridge, Mass.
D JSH Electronics, Culver City, Cal.
D Princeton Elctrn. Prods., New Brunswick, N.J.
RCA Electronic Comps., Harrison, N.J.
RCA, Ind'l. Tube Div., Lancaster, Pa.

D Siemens Corp., Iselin, N.J.
M Teltron, Pottstown, Pa.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Indicator—See Volume 2

Tubes, Industrial Power

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
M Victoreen Instrument Div., Cleveland, Ohio p. 2•2358
Amperex Elctronic Corp., Slatersville, R.I. .... *
Electro Motive Corp., Melville, New York .... *
General Elec. Co., Schenectady, N.Y. .... *
International Electronics Corp., Melville, N.Y. *
DM Raytheon Co., Burlington, Mass. .... *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
DM Electrons Co., Fairfield, N.J.
GTE Sylvania Inc., Waltham, Mass.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
D Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Triac Electronics, New York, N.Y.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Klystron

Amperex Elctronic Corp., Slatersville, R.I. .... *
D Amperex Electronic Corp., Hicksville, N.Y. ...... *
General Elec. Co., Schenectady, N.Y. .... *
DM Raytheon Co., Burlington, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
M Litton Inds., San Carlos, Calif.
Motorola Comms. Div., Schaumburg, Ill.
Sperry Microwave Components, Gainesville, Fla.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
D Varian, Solid State West Division, Palo Alto, Cal.

Tubes, Laser

NEC America, New York, N.Y. .... *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
EG & G, Salem, Mass.
M Hughes Aircraft Co., Torrance, Cal.
D Metrologic Instruments, Bellmawr, N.J.
RCA Electronic Comps., Harrison, N.J.
RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Spectra-Physics, Mountain View, Calif.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Union Carbide Corp., New York, N.Y.
United Page Inc., Paterson, N.J.

Tubes, Magnetron

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
Amperex Elctronic Corp., Slatersville, R.I. .... *
Electro Motive Corp., Melville, New York .... *
General Elec. Co., Schenectady, N.Y. .... *
International Electronics Corp., Melville, N.Y. *
DM Raytheon Co., Burlington, Mass. .... *
M Bowmar/TIC, Newbury Park, Calif.
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
M Litton Inds., San Carlos, Calif.
Microwave Assocs., Burlington, Mass.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
RCA Electronic Comps., Harrison, N.J.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
M VTM Microwave, Boulder, Colo.

Tubes, Microwave

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
Amperex Elctronic Corp., Slatersville, R.I. .... *
Electro Motive Corp., Melville, New York .... *
General Elec. Co., Schenectady, N.Y. .... *
International Electronics Corp., Melville, N.Y. *
DM Raytheon Co., Burlington, Mass. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
M Co-Operative Inds., Chester, N.J.
D Dutrex Inds., New York, N.Y.
D Elctrn. Enterprises, Newark, N.J.
M Hughes Aircraft Co., Torrance, Cal.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
M Litton Inds., San Carlos, Calif.
Microwave Assocs., Burlington, Mass.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Sperry Microwave Components, Gainesville, Fla.
M Teledyne Mec., Palo Alto, Cal.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
D Varian, Solid State West Division, Palo Alto, Cal.
Wall A. T. Co., Warwick, R.I.
M Warnecke Electron Tubes, Des Plaines, Ill.
M Watkins-Johnson Co., Palo Alto, Cal.

Tubes, Noise Source

M General Microwave Corp., Farmingdale, NY ..... *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
Sperry Microwave Components, Gainesville, Fla.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
M Watkins-Johnson Co., Palo Alto, Cal.
Waveline, W. Caldwell, N.J.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Photomultiplier

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
EG&G, Salem, Mass. ....p. 1•1011,1012
Hamamatsu Corp., Middlesex, N. J. p. 1•2354,2355
Amperex Elctronic Corp., Slatersville, R.I. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
EMI Gencom Inc., Plainview, N.Y.
Galileo Electro-Optics Corp., Sturbridge, Mass.
Gamma Scientific Inc., San Diego, Cal.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
D JSH Electronics, Culver City, Cal.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
M Teltron, Pottstown, Pa.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.

Tubes, Readout (CRT, Cold-Cathode, Vacuum Fluorescent, Incandescent, etc.)—See Volume 2

Tubes, Receiving

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
International Comps Corp., Melville, N.Y. p. 2•193
Amperex Elctronic Corp., Slatersville, R.I. .... *
Electro Motive Corp., Melville, New York .... *
General Elec. Co., Schenectady, N.Y. .... *
International Electronics Corp., Melville, N.Y. *
D Raytheon Co., Burlington, Mass. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D A E G Telefunken, Englewood Clfs., N.J.
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D GTE Sylvania Inc., Waltham, Mass.
D JSH Electronics, Culver City, Cal.
Motorola Comms. Div., Schaumburg, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
RCA Electronic Comps., Harrison, N.J.
D Siemens Corp., Iselin, N.J.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
Wallace S. K. Assocs., Tampa, Fla.
M Watkins-Johnson Co., Palo Alto, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Rectifying, Gas-Filled

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
Amperex Elctronic Corp., Slatersville, R.I. .... *
General Elec. Co., Schenectady, N.Y. .... *
DM Raytheon Co., Burlington, Mass. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
DM Electrons Co., Fairfield, N.J.
D GTE Sylvania Inc., Seneca Falls, N.Y.
D JSH Electronics, Culver City, Cal.
D National Electronics, Geneva, Ill.
D Raytheon Co., Quincy, Mass.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Rectifying, Vacuum

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
Amperex Elctronic Corp., Slatersville, R.I. .... *
D International Rectifier Corp., El Segundo, Cal. *
DM Raytheon Co., Burlington, Mass. .... *
Shigoto Inds., Ltd., New York, N.Y. .... *
DM Apollo Corp., Kawasaki, Japan
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
D GTE Sylvania Inc., Seneca Falls, N.Y.
D JSH Electronics, Culver City, Cal.
D National Electronics, Geneva, Ill.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Strobe—See Volume 2

Tubes, Switching

D Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353
M Victoreen Instrument Div., Cleveland, Ohio p. 2•2358
Amperex Elctronic Corp., Slatersville, R.I. .... *
M EG&G, Salem, Mass. .... *
D Calvert Elctrns., New York, N.Y.
DuMont Electron Tubes & Devices Corp., Clifton, N.J.
D Dutrex Inds., New York, N.Y.
EG & G, Salem, Mass.
Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.

Tubes, Tv Camera Pickup
Hamamatsu Corp., Middlesex, N. J. p. 1•2354,2355
D **Amperex Elctronic Corp., Slatersville, R.I.** *
General Elec. Co., Schenectady, N.Y. *
NEC America, New York, N.Y. *
D Dutrex Inds., New York, N.Y.
GBC - Closed Circuit TV, New York, N.Y.
General Electrodynamics Corp., Garland, Tex.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
D JSH Electronics, Culver City, Cal.
Motorola Comms. Div., Schaumburg, Ill.
Panasonic, Ind'l. Elctrn. Comps., New York, N.Y.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Teletron, Pottstown, Pa.
M Teltron, Pottstown, Pa.
Temtron Elexs, Rosedale, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Thyratron
D **Amperex Electronic Corp., Hicksville, N.Y. p. 1•2352,2353**
Amperex Elctronic Corp., Slatersville, R.I. *
M **EG&G, Salem, Mass.** *
General Elec. Co., Schenectady, N.Y. *
DM **Raytheon Co., Burlington, Mass.** *
Wagner Elec., Livingston, N.J. *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
EG & G, Salem, Mass.
D Elctrn. Enterprises, Newark, N.J.
DM Electrons Co., Fairfield, N.J.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
D National Electronics, Geneva, Ill.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Electron Tube & Device Grp., San Carlos, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Transmit-Receive (TR)
D **Amperex Electronic Corp., Hicksville, N.Y.** *
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D JSH Electronics, Culver City, Cal.
Microwave Assocs., Burlington, Mass.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
D Varian Electron Tube & Device Grp., San Carlos, Cal.

Tubes, Transmitting
D **Amperex Electronic Corp., Hicksville, N.Y.** *
General Elec. Co., Schenectady, N.Y. *
DM **Raytheon Co., Burlington, Mass.** *
D Apollo Corp., Kawasaki, Japan
D Calvert Elctrns., New York, N.Y.
D Dutrex Inds., New York, N.Y.
D Eimac, San Carlos, Calif.
D Elctrn. Enterprises, Newark, N.J.
ITT Electron Tube, Easton, Pa.
D JSH Electronics, Culver City, Cal.
Litton Inds., San Carlos, Calif.
Motorola Comms. Div., Schaumburg, Ill.
RCA Electronic Comps., Harrison, N.J.
DM RCA, Ind'l. Tube Div., Lancaster, Pa.
D Siemens Corp., Iselin, N.J.
Sperry Microwave Components, Gainesville, Fla.
Temtron Elexs, Rosedale, N.Y.
Thomson-CSF Electron Tubes Inc., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
United Page Inc., Paterson, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Palo Alto Microwave Tube Div., Palo Alto, Cal.
D Varian, Solid State West Division, Palo Alto, Cal.
D Westinghouse Elec. Corp., Elmira, N.Y.

Tubes, Traveling-Wave
DM **Raytheon Co., Burlington, Mass.** *
D A E G Telefunken, Englewood Clfs., N.J.
Hughes Aircraft Co., Torrance, Cal.
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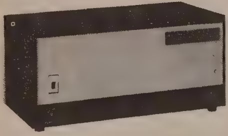
for Laboratory Applications



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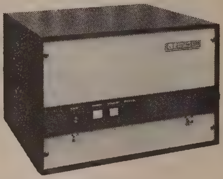
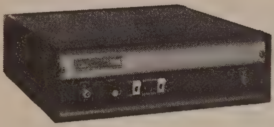
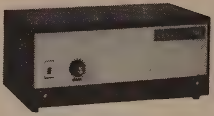


100L



30L

1000L



6HC

10LA

SERIES "L" RF POWER AMPLIFIERS

2L	1-250 MHz, 2 W
2LM1	5-300 MHz, 2 W
6LA	3-150 MHz, 6 W
10LA	1-110 MHz, 10 W
10LB	120-220 MHz, 10 W
30L	1-250 MHz, 30 W
40L	1-240 MHz, 40 W
30LA	1-110 MHz, 30 W
50LA	1-110 MHz, 50 W
60LA	4-150 MHz, 60 W
100LA	1-110 MHz, 100 W
100L	10 kHz-220 MHz, 100 W
100LM8	1-220 MHz, 100 W
100LM9	1-200 MHz, 100 W
500L	10 kHz-220 MHz, 500 W
500LM8	1-220 MHz, 500 W
500LM9	1-200 MHz, 500 W
1000L	10 kHz-220 MHz, 1000 W
1000LM8	1-220 MHz, 1000 W
1000LM9	1-200 MHz, 1000 W
1500 LA	1-150 MHz, 1500 W
5000LA	1-100 MHz, 5000 W

SERIES "H" RF POWER AMPLIFIERS

10HA	225-410 MHz, 10 W
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40A12	20 KHz – 12 MHz, 12 W
50A15	20 KHz – 15 MHz, 50 W
100A15	25 KHz – 15 MHz, 100W

SPECIAL-PURPOSE PRODUCTS

Q-Switch Driver	50 MHz, 65 W, RF Source
615	3-150 MHz, 6 W (OEM)
646	30-50 MHz, 30 W (OEM)
661	3-150 MHz, 6 W (OEM)
691	40-200 MHz, 3.5 W (OEM)

AMPLIFIER RESEARCH

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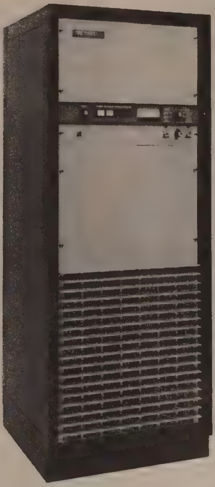
Choose from the FIRST FAMILY of broadband amplifiers.

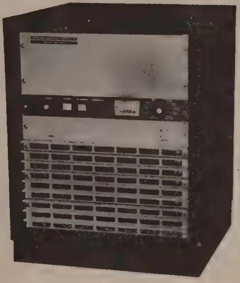
First in design, reliability, capability for lab applications



Model 1000L
10 kHz to 220 MHz

Model 30L
1 to 250 MHz

Model 100L
10 kHz to 220 MHz



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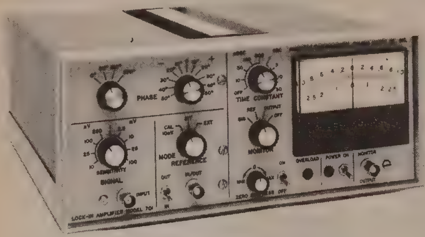
BULOVA Lock-in Amplifier



The Bulova low cost lock-in amplifier operates at any fixed frequency from 5Hz to 20 kHz as selected by changeable plug-in card.

Description

The Model 701 Lock-In Amplifier is a modular unit with each section comprised of an individual plug-in board. It is offered as a completely encased bench instrument, as a panel mounted unit fitting standard racks and in the form of individual models which can be installed at various points in a larger system. Power requirement is less than 10 amps, 50–60Hz, 110V.

Operation

The heart of the lock-in amplifier is the phase sensitive, or synchronous detector. Regardless of how much input and output filtering is used to reduce the noise, the ability to extract a signal from the noise is determined by the dynamic range of the phase sensitive detector.

The signal is fed to the synchronous detector after being amplified by a pre-amplifier and filtered in a post amplifier. Gating of the synchronous detector is accomplished by a reference signal derived from the signal source (external mode) or a reference oscillator (internal mode). The resulting, slowly varying d.c. signal is a function of the amplitude of the incoming signal and its phase with respect to the reference.

Typical Applications

The following is a list of some typical applications. These are by no means all the possible applications, which are limited only by the imagination of the user.

Radiometry (IR, visible, UV) • Spectroscopy • Dual beam optical measurements • Pollution Measurements • Magnetrometry • Amplifier gain, phase shift and transmission measurements • Strain gauge and other transducer measurements • Nuclear magnetic resonance • Hall effect measurements.

Measures very small changes in amplitude at the signal frequency to distinguish and recover weak signals from high background noise.

Available in 3 forms

1. As bench instrument completely encased
2. For panel mounting to fit standard racks
3. As modules for incorporation in larger system.

Function

The Bulova Model 701 Lock-in Amplifier is an instrument which can measure accurately very small changes in the amplitude of a slowly varying signal at the operating frequency, even in the presence of high noise levels where the signal/noise ratio is such that the change would be undetectable by other types of instruments. The Bulova unit was developed as an adjunct to its line of optical scanners and choppers and designed to be low in cost so that it could be applied broadly.

BASIC SPECIFICATIONS

Frequency:	Fixed frequency between 5 Hz, and 20KHz. Determined by a changeable plug-in board.
Sensitivity:	10 microvolts to 100 mv. rms. for full scale output. Sensitivity switch in steps of 1, 2.5, 10.
Signal Amplifier:	Input impedance over 500 megohms shunted by less than 30 Pf. Max. preamplifier gain = 100 Tuned Amplifier "Q" = 10 Max. Overall gain 2.5 x 10^5
Filter Time Constant:	10 ms to 30 seconds, in steps of 1, 3, 10.
Zero Suppress:	Uncalibrated zero suppression of up to ±100% full scale (Calibrated zero suppression optional)
Reference Channel:	Internal — Plug-in Oscillator External — 1 volt–10 volt rms, sine, square or triangular wave (45–50% duty cycle). Filtered by a bandpass amplifier which matches signal channel response. Input impedance = 20 kilohms.
Phase Control:	360° phase adjustment in 4 ranges with a continuously variable phase adjustment of ± 50° in each range.
Monitor:	BNC on front panel. Input, reference and output signal switch selectable. Source impedance—less than 2 kilohms Location—at rear of unit
Power:	115 Vac 50–60Hz less than 10W
Size:	Case model 4-3/4" high x 11-1/16" wide by 11" deep. Rack mounting available.

From Bulova Electronics Division: Frequency Control Components • Crystals • Crystal Oscillators • Monolithic Crystal Filters • Fork Oscillators • DC Servo Amplifiers • 400 Hz Servo Amplifiers • Optical Devices • Choppers and Scanners • Frequency Changers • Inverters • Lock-in Amplifiers

BULOVA AMERICAN TIME PRODUCTS

ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

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DYNAMICS

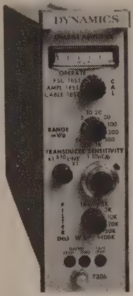
DYNAMICS ELECTRONIC PRODUCTS INC. • 9001 FULLBRIGHT AVE., CHATSWORTH, CALIF. 91311 (213) 998-0121

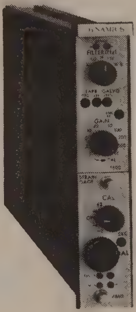
For over a decade Dynamics has been the acknowledged leader in the design and manufacture of instrumentation amplifiers for aerospace, laboratory and industrial applications. A complete range of differential, single-ended and charge amplifiers with various options and extra performance features, such as selectable filters, separate input and output zero controls and strain gauge power supply, are available. Many models have dual isolation 100mA outputs, full scale zero offset controls, galvanometer matching networks and switched or fixed current limiting provisions.

MODEL 7306 CHARGE AMPLIFIER GROUNDED TRANSDUCERS DO NOT CREATE GROUND LOOP

Suited to operate with all types of piezoelectric transducers. Up to 500 kHz bandwidth; low internal noise, excellent for all measurements.

Outstanding features: integral power supply, charge gain of .05 mV/pC to 5000 mV/pC, direct reading charge gain and capability to use Dynamics Model 7819 remote charge converter. Uses a double-shielded power supply to provide power line isolation of 1000 mΩ shunted by less than 0.1pF.





MODEL 7600 UNIVERSAL AMPLIFIER SIGNAL CONDITIONING SYSTEM

Choice of 10 front panel plug-in Signal Conditioning Modules. Amplifier features: gains to 2500; 120 dB CMRR at ±20 Volts; 125 kHz bandwidth; filter; offset control; output level controls; tape; galvo and VCO outputs; and integrated circuits. Ten Signal Conditioning Modules: isolated strain-gage power supply; auto-bridge balance; built-in reference junction and linearization for thermocouples; linear 2, 3, or 4 wire system for RTD's; Servo; Pot; Piezo Resistive; EMF; Carrier Amp; Charge Amp; and Designer's Card for universal system operation.

DYNAMICS
FILTER (Hz)
OFFSET
VARIABLE GAIN
CAL
GAIN
DIFFERENTIAL DC AMPLIFIER
7521

MODEL 7521 50 Volt Common-Mode/Wide Band DC Amplifier

Designed for use in data acquisition systems having common-mode voltage levels up to ±50V. The unit utilizes integrated circuits. Twelve options are offered. Complete compatibility with Dynamics 7514, 7520 and 7525 amplifier line.

DYNAMICS
FILTER (Hz)
VARIABLE GAIN
CAL
ZERO
GAIN
DIFFERENTIAL DC AMPLIFIER
7525

MODEL 7525 Wide Band (DC to 2 MHz) Differential DC Amplifier

Designed to provide maximum speed, performance, and reliability in high speed data acquisition systems. Compatible with all tape recorders for direct recording.

MODEL 6364A Precision "Active" Electronic Filters

Phase matching to within 1° is possible in the Linear Phase mode. Terminal Slopes of 36 dB/Octave are standard with Butterworth and/or Linear Phase characteristics. Four different low-pass frequency multipliers cover the frequency band DC to 1MHz.

MODEL	GAIN RANGE	ACCURACY	OUTPUT	COMMON MODE	FREQUENCY RESPONSE	SLEWING RATE	NOISE	ZERO STABILITY
7202	0.10 to 330 7 steps	±0.1%	±10V,±100mA	—	—3dB above 50kHz	2.0V/μs	1.0mV/RTO	±200μVplus ±5.0μV/°C RTI
7511	1.0 to 1000 7 steps	±0.1%	±10V,±100mA	120dB ±10V	—3dB above 100kHz	2.0V/μs	5.0μV/RTI	±5μV plus ±1.0μV/°C RTI
7521	0.01 to 3300 16 steps	±0.1%	±10V,±100mA	120dB ±50V	—3dB above 75kHz	1.5V/μs	4.0μV/RTI	±2μV plus ±0.4μV/°C RTI
7522	0.01 to 3300 16 steps	±0.1%	±10V,±100mA	120dB ±300V	—3dB above 75kHz	1.5V/μs	6.0μV/RTI	±2μV plus ±0.5μV/°C RTI
7525	1.0 to 1000 10 steps	±0.1%	±10V,±100mA	120dB ±20V	—3dB above 2mHz	2 0V/μs	1.5μV/RTI	±3μV plus ±1.2μV/°C RTI
7306	0.5 to 5000 mV/pC	±1.5%	±10V,±100mA	5mV/V ±50V	—3dB 0.5Hz-125kHz	1.5V/μs	.01pC-20kHz	—

Dynamics Electronic Products is represented throughout the United States and the world. Please see our representative listings in the index.

There is more catalog data available to you at your fingertips than ever before...when you

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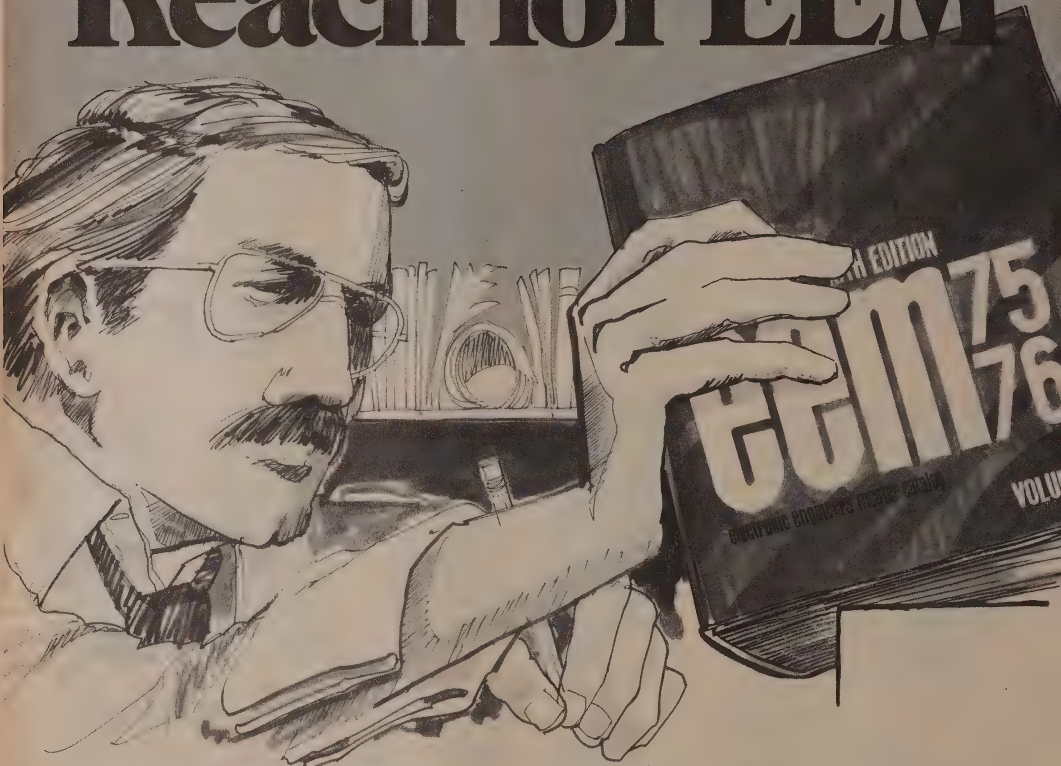
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VOLU

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Ectron
CORPORATION

- Differential DC Amplifiers
- Strain Gage Signal Conditioners
- Thermocouple Signal Conditioners
- Signal Conditioning Systems
- Data Acquisition Systems
- Thermocouple/MV Calibrators

MODEL 314

Miniature airborne amplifier occupies less than one cubic inch. Contains differential amplifier, strain gage excitation and power supply to operate from 28V dc. 20 kHz Bandwidth. Price $450. (Bulletin 2007)

400 ENVIRONMENTAL SERIES

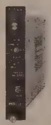
- 100G Shock
- −25 to +71°C
- 0.5 μV/°C Stability
- Thermal Shock Resistant
- Bridge Excitation and Balance
- Thermocouple Conditioning
- RFI protection
- 120 dB CMR ● 100V CMV
- Rack or Stud Mounting
- 12 or 28 V dc Power ● 8 oz's.
- From $330 (Bulletin 2001A)

4000 SERIES, SIGNAL CONDITIONING SYSTEMS

The typical 4000 series system shown below is designed for Airborne or Vehicular service involving moderately high G forces. It includes 14 stable 400 series amplifiers, a monitor meter and monitor selection switch, individual CAL switches, bridge excitation, bridge balance and conditioning.

Other 4000 series systems are designed for operation during shocks up to 100 G's. Features available in these systems include integral VCO's, FET Calibration, Channel ID signals, Rechargeable Battery Pack and others. (See Bulletin 2001A)

500 ECONOMY SERIES



- 1μV/°C
- 114 dB CMR
- Gains X.01 to X2500
- 16 Amps per 3.5″ high rack
- 80 kHz bandwidth
- Filtered output
- 10 ma, 100 ma, dual outputs
- Bridge Bal., Completion, CAL
- From $155
  (Bulletin 2004A or B)

MODEL 540 — Four-channel amplifier for multi-channel data systems such as Model 6000 at right. From $400 (Bulletin 2004B)

600 INDUSTRIAL SERIES

- Strain Gage Conditioning
- Thermocouple Conditioning
- Thermocouple Linearization
- Reference Junctions
- Multifunction Amplifiers
- Bridge Excitation and Bipolar Cal.
- Expanded Scale Operation
- .2 μV/°C Zero Stability
- 120 dB CMR and 300V CMV
- 12V dc, 28V dc or 115V ac power
- From $255 (Bulletin 2005)

700 WIDEBAND SERIES

- 100 kHz Bandwidth
- Manual or Programmable Gain
- Digital Storage
- Local Readout
- 1μV/°C Zero Stability
- .003%/°C Gain T.C.
- .01% Gain Accuracy
- 300V CMV ● 126 dB CMR
- 3-pole filters ● Dual outputs
- From $415 manual gain
- From $775 programmable gain
  (Bulletin 2003A)

6000 SERIES DATA SYSTEMS

All 6000 Series Systems combine per-channel low level amplifiers with a high level multiplexer and a programmable gain amplifier to provide complete multi-channel signal processing in a small, rugged package. When equipped with Model 640 input modules, outstanding performance is provided by the chopper stabilized design which offers extremely low drift and noise and accommodates common mode voltages up to 300 volts dc or peak ac. The systems are capable of scan rates to 20,000 channels per second. Integral A-D converters are optional. Other key features are listed below.

- CMV 300V (higher on special orders)
- CMR 120 dB with 1K unbal.
- 0.5 μV Zero Stability
- .01% Gain Stability
- 3rd order filter, each channel (plug in)
- Sequential or Random Access
- 20 kHz Throughput Rate
- 64 Channels per 5.25″ high enclosure
  (Bulletin 2008)

MODEL 1100 THERMOCOUPLE SIMULATOR CALIBRATOR

Simplifies precise calibration of thermocouple measuring instruments: includes linear DC calibration capability.

THERMOCOUPLE CALIBRATIONS:
Temperature Indicators
Temperature Transmitters
Amplifiers and Linearizers
Temperature Controllers

LINEAR CALIBRATIONS:
DC Digital Voltmeters
Panel Meters
Strip Chart Recorders
Millivoltmeters

FEATURES:
Simulates 4 TC types
Dial Temperature in Degrees
Digital Conformity to NBS 0.1°
Self-Contained Ref. Junction
(Bulletin 2006)

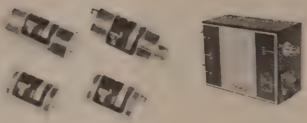
8159 Engineer Road, San Diego, California 92111
Phone (714) 278-0600/TWX 910-335-1259
(See EEM Section 2000)

Specialists in Airborne, Marine and Industrial Instrumentation

Ectron
CORPORATION

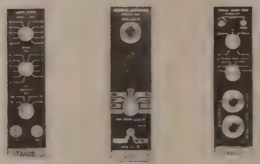
ITHACO
Versatility in AC instrumentation

Low noise AC preamplifiers



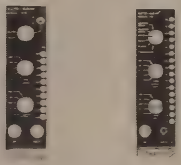
- Preamps for High and Low Impedance Sources
- Frequency Range .001 Hz to 1 MHz
- Gains to 10^5 (100 dB)
- Premium Noise Performance With Minimal Power Drain
- Voltage, Charge and Current Inputs

Instrumentation amplifiers



- Amplifiers for Voltage, Charge, and Strain Gage Inputs
- Single–Ended and Differential; Rack Mountable
- Selectable Frequency Response
- Gains to 100 dB; Frequency Range 1 Hz to 100 kHz

AUTO-GAIN® amplifiers

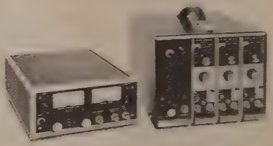


- Computer, Automatic, and Manual Gain Control
- Selectable Frequency Response
- Single–Ended and Differential; Rack Mountable
- Gain Range –10 dB to +80 dB
- Frequence Range 1 Hz to 100 kHz

Hydrophones

- High Sensitivity with Optimum Noise Performance
- Omnidirectional
- All Molded Construction with Built–In Preamp
- Low Sensitivity to Horizontal and Vertical Acceleration
- Frequency Response to Above 100 kHz

Compression-expansion systems



- Record and Recover Wide Dynamic Range Data
- 100 dB Dynamic Range
- Manual, Remote, Computer Controlled Gain
- Compression, Expansion, Normalization

ITHACO also manufactures precision variable electronic filters and lock–in amplifiers. See Sections 2700 and 2900.

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- LOW-NOISE AMPLIFIERS
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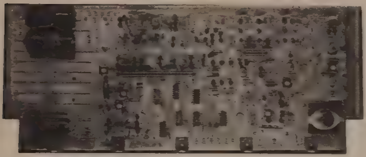
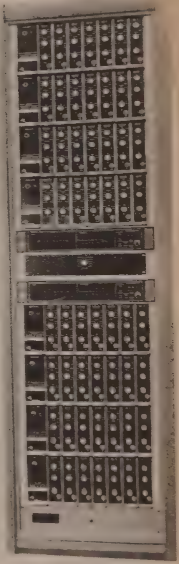
- VOLTAGE AND COMPUTER CONTROLLED AMPLIFIERS
- COMPRESSION & NORMALIZING AMPLIFIERS
- DIGITAL INTERFACE EQUIPMENT
- QUALITY ASSURANCE TO GOOD COMMERCIAL PRACTICES AND CAPABILITIES TO
  - MIL-I-45208A
  - MIL-Q-9858A



CUSTOM SIGNAL CONDITIONING SYSTEMS

- COMPUTER CONTROLLED, AUTOMATIC OR MANUAL OPERATION
- DESIGNED FOR VIBRATION, ACOUSTICS, OR OTHER AC MEASUREMENTS
- PORTABLE OR RACK AND PANEL CONFIGURATIONS



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OPAMP LABS INC.

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AMPLIFIERS

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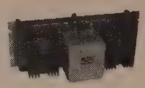
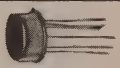
We manufacture over 50 products

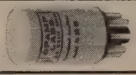
FREE — 50 Industrial & Audio Operational Amplifier Applications

	MODEL 360M Microphone Preamplifier	**MODEL 416** D.C. Thru Audio Operational Power Amplifier	**MODEL 435** Medium Voltage D.C. Operational Amplifier	**MODEL 440** D.C. Thru Audio Operational Power Amplifier	 **MODEL SM-100K** Dual Channel 50 W RMS or Mono 100 W Power Amplifier Kit
POWER REQUIREMENTS	±12v to ±24v @ 30ma or +12v to +50v @ 30ma or −12v to −50v @ 30ma	±12v to ±24v ±12 ma to ±30 ma plus load current	+12v to ±25v ±8 ma to ±15 ma plus load current	±12v to ±36v ±12ma to ±30ma plus load current	115v - 60 Cy. - 1 Phase @ 2.0 Amps
OPERATING TEMPERATURE RANGE (Case)	−20°C to +85°C	−20° to +85°C	−55°C to +85°C	−55°C to +85°C	−20°C to +70°C
INPUT Impedance (Open Loop) Offset Voltage (R_S = 10K) Bias Current Common Mode Voltage Range Equivalent Drift (R_S = 10K) Equivalent Noise Common Mode Rejection Ratio	50, 250, and 600 Ohms −127 DBM Has internal input isolation transformer	20K ±100 mv 0.2 μa Up to ±30v ±0.5 mv/°C 20 μv 80 DB	20K ±20 mv 0.5 μa Up to ±20v ±20 μv/°C 2 μv (−115 dbm) 80 DB	20K ±100mv 0.2 μa Up to ±30v ±0.5 mv/°C 20 μv 80 DB	Per Channel 5K 20 μv
TRANSFER Voltage Gain Unity — Gain BandWidth	Adj.: 30 to 60 DB 20 cy to 20 kc (−3 DB)	650 2 mc	20,000 2 mc	650 2 mc	10 (20 DB) May be changed via Feedback Resistor
OUTPUT Impedance (open loop) Voltage Swing/Load Slewing Rate Full Power Maximum Current Peak Power RMS Power Level Total Harmonic distortion at full power.	10 ohms +14 DBM with ±24v 0.25%	0.5 Ohm Up to ±20v/8 Ohms 5v/μsec D.C. to 20 kc 2 Amps 40w music 10w +40 dbm 0.5%	50 Ohms ±20v/50 Ohms 5v/μsec D.C. to 20 kc ±400 ma 2 w +33 dbm 0.05% @ +24 dbm	0.1 Ohm ±24v/4 Ohms 5v/μs D.C. to 20 kc 7 Amps 100 Watts 50 Watts < 0.5% any supply voltage & power level	0.1 Ohm ±28v/8 Ohms D.C. to 20 kc 5 Amps 100 Watts 50 Watts 0.5%
SIZE	1″ Dia. x 2″ Seated Height	2″ dia. x 3″ Seated height	5-Pin Modified TO-3 Case Mates with 9-Pin Noval Tube Socket	4¾″ x 5½″ x 2⅝″ Seated Height	7″ H x 19″ w Panel—Chassis Plug-in Ampl. and Power Supply
PRICE	$30.00	$30.00	$30.00	$60.00 Model 440 $35.00 Model 440K Kit	Kit $175.00/ea. Wired $255.00/ea.



MODEL 4009
Medium Voltage
D.C. Operational Amplifier

POWER REQUIREMENTS Power Supply Voltage Power Supply Current	±12v ±2.5 ma	±24v ±5 ma	±36v ±8 ma
OPERATING TEMPERATURE RANGE (Case)	−55°C to +125°C	−55°C to +125°C	−55°C to +70°C
INPUT Input Offset Voltage Input Bias Current Input Impedance Input Common Mode Voltage Range Equivalent Input Drift Equivalent Input Noise	< 100 mv 0.2 μa 20 K ±10v < 0.5 mv/°C 2 μv	< 100 mv 0.2 μa 20K ±20v < 0.5 mv/°C 2 μv	< 100 mv 0.2 μa 20K ±30v < 0.5 mv/°C 2 μv
TRANSFER Internal Power Dissipation Open Loop Voltage Gain Unity-Gain Bandwidth Common Mode Rejection Ratio	60 mw 500 30 mc 60 DB	240 mw 650 30 mc 80 DB	600 mw 800 30 mc 80 DB
OUTPUT Output Impedance Output Voltage Swing/Load Output Capacitance Loading Output Slewing Rate Overload Recovery	2.5K ±10v/50K ± 8v/10K ± 3v/ 2K 0.1 μf 10v/μs 5 μs	2.5K ±20v/50K ±15v/10K ± 8v/ 2K 0.1 μf 10v/μs 5 μs	2.5K ±30v/50K ±20v/10K ±10v/ 2K 0.1 μf 10v/μs 5 μs
SIZE	Low Silhouette Modified TO-5 Can	Low Silhouette Modified TO-5 Can	Low Silhouette Modified TO-5 Can
PRICE		$10.00	



MODEL 425
Medium Voltage
D.C. Operational Amplifier

POWER REQUIREMENTS Power Supply Voltage Power Supply Current (Standby)	±12v ±8 ma	±25v ±15 ma
OPERATING TEMPERATURE RANGE (Case)	−20°C to +85°C	−20°C to +85°C
INPUT Input Offset Voltage Input Bias Current Input Impedance (Open Loop) Input Common Mode Voltage Range Equivalent Input Drift (R_S = 10K) Equivalent Input Noise (R_S = 1K)	±20 mv 0.5 μa 20K ±10v ±20 μv/°C 2 μv (−115 dbm)	±20 mv 0.5 μa 20K ±20v ±20 μv/°C 2 μv (−115 dbm)
TRANSFER Internal Power Dissipation Open Loop Voltage Gain Unity-Gain Bandwidth Common Mode Rejection Ratio	200 mw 5,000 2 mc 80 DB	750 mw 20,000 2 mc 80 DB
OUTPUT Output Impedance (Open Loop) Output Voltage Swing/Load Output Slewing Rate Full Power Output	100 Ohms ±10v/1K ±8v/600 Ohms (+16 dbm) ±3v/50 Ohms 5v/μs D.C. to 25 kc	100 Ohms ±20v/1K ±18v/600 Ohms (+24 dbm) ±7v/50 Ohms 5v/μs D.C. to 25 kc
SIZE	1″ Dia. x 1⅝″ Seated Height	1″ Dia. x 1⅝″ Seated Height
PRICE	$25.00	

OPAMP LABS INC.

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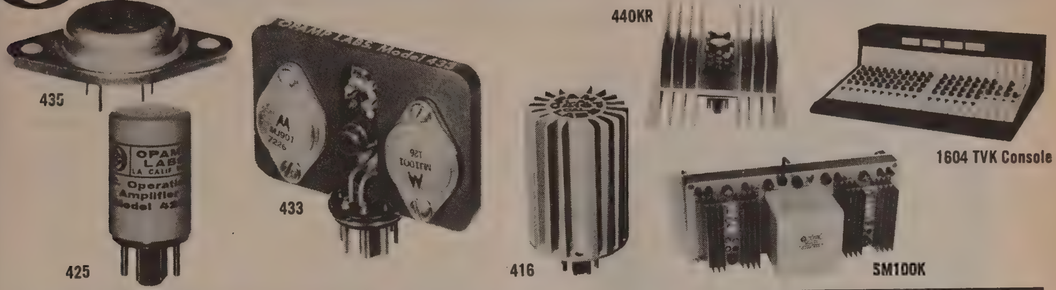
Product Price List F.O.B. Los Angeles, Calif. Jan. 15, 1975
Send for Free Catalog and Application Sheets



MICROPHONE PREAMPLIFIERS

360BM	Low Current	$30
360M	+14 DBM	30
350P	+24 DBM	35

EQUALIZATION AMPLIFIERS

325EQ	Shelf and/or Peak	$30

D.C. POWER AMPLIFIERS (1W TO 100W)

416	10W RMS 2″ Dia. x 3″ H	$30
419	3W RMS 10W PK Audio Prog.	25
420	3W RMS 10W PK Audio Prog.	25
423	4W RMS 16W PK Audio Prog. Repairable	35
432	3W RMS 10W PK Audio Prog.	30
433	4W RMS 16W PK Audio Prog. Repairable	35
434	10W RMS 40W PK Audio Prog. Repairable	35
440KR	50W RMS Kit Repairable	35
440R	50W RMS Wired Repairable	60
440KRS	15W RMS Kit Repairable	35
440RS	15W RMS Wired Repairable	60
SM100K	Stereo or Mono 100W (Total) Kit Repairable	175
SM100	Stereo or Mono 100W (Total) Wired Repairable	255

CONTROLS

101	Input Select	$ 8
102	Input Sel/Pan	8
103	Low Freq. EQ (SW/SW)	25
104	High Freq. EQ (SW/SW)	12
105	Low Freq EQ (SW/5K)	25
105P	Low (Mid-Freq. Peaking) EQ	20
106	High Freq. EQ (SW/5K)	12
106P	High (Mid-Freq. Peaking) EQ	20
107	Echo Send (SW/10K)	8
108F	Conductive-Plastic Mix-Pot	15
110	Automated Processes 600 Mix-Pot	70
130	SW1/SW1 Concentric SP12P SW	6
131	SW2/5K-L Concentric DP12P Switch & 5K Linear Pot	6
132	SW2/10K-A Concentric DP12P Switch & 10K Audio Pot	6
133	SW4/5K-L Concentric 4P12P Switch & 5K Linear Pot	8

CIRCUIT AID

Test Box for Fast Circuit Fabrication

200A	(Use with 4009)	$20
200B	(Use with Octal)	20

PHONO PREAMPLIFIERS

370	RIAA	$30

LIMITERS

325L	1U Sec. Attack Time	$35

OSCILLATORS

AUDIO —		
700	Externally Adjustable	$35
7001	1KC	35
701	10KC	35
BIAS —		
706	60KC	35
710	100KC	35
711	100KC-60KC	35
715	150KC	35

HARDWARE

150	Amp-Conn Bracket for 210	$ 7
151	201 Blank Panel	16
152	201 U-Chassis	16
153	201 Side Plates (PR)	10
154	32 Pin Connector (PR)	10
155	Reverb Unit (Z = 1.5K)	20
156	8 Station Unlighted PB SW	25
157	8 Station Lighted PB SW	50
158	Lever Knob (¼″ Shaft)	2
170B	Micro Switch Blk PB DPDT	10
170R	Micro Switch Red PB DPDT	10
H50	Chassis Panel	50

PC-BOARDS

PC-8	Use with Octal	$ 3
PC-10	4 Buss Summing Board	10
PC-35	Use with 435	20
PC-100SM	Stereo or Mono Amp	15
PC-201	Mic Input Module	10
PC-201LF	Low or High Freq. EQ	$1.50
PC-EQ	Low or High Freq. EQ	1.50
PC-MTR	VU Meter Board	.50
PC-RC	DCPL BRD	2.50

CONSOLES

$200 TO $300/CHANNEL —KIT FORM

		Approx. Price
1004K	(Kit) 10 In, 4 Out	$ 3,000
1604 TVK	(Kit) 16 In, 4 Out TV Audio	5,000
2008/16 RSK	(Kit) 20 In, 8 Out 16 Mixdown Monitor System	12,000

Wired Units are Approx. $160 More per (Input + Output + Monitor) Channel.

MAGNETIC TAPE AMPLIFIERS

320	Record	$35
365	600 Input	35
365L	50 Input	35
380	Hi Z Input	30

D.C. OPERATIONAL AMPLIFIERS

4009	TO-5	$10
415	Wide Band	30
425	General Purpose	25
435	TO-3	30

MIC/LINE INPUT MODULES

201	Duncan Atten.	$200
202	Gliss-Audio Atten.	300
203	Automated Processes Atten.	260
210	Mic Input Panel (10 Channel)	150
211	Meter Switch Panel	35
212	8 PB SW/Panel	50
213A	4 Trans/6 Amp. Bracket	15
213B	4 Trans/12 Amp Bracket	20
213C	30 Amp. and/or X-L Conn. Bracket	20
214	4 Push On-Push Off Buttons	8
218	8 Push On-Push Off Buttons	16
216M	Mic Input Panel-16 Channel	200
216MS	6 Meter/16-4 PB SW Panel	50
216TAC	4 Trans/28 Amp and/or Conn. Bracket	40

POWER SUPPLIES

515P	±15V @ ±50MA Reg.	$25
524P	±24V @ ±40MA Reg.	25
528	±28V @ ± 50MA Unreg.	25
522	±24V @ ±200MA Unreg.	25
525	±24V @ ±1A Unreg.	35
523	±24V @ ±2A Unreg.	40
523R	±24V @ ±1A Reg.	55
526	±24V @ ±4A Unreg.	45
536	±36V @ ±3A Unreg.	45
592K	Power Supply Chassis Kit — Holds 523R & 526 Power Supplies	50
595K	Chassis for 5-523R	50

TRANSFORMERS

T-10K	24DBV 10K C-T/10K C-T Line	$20
T-30	30DBM 150Ω-600Ω/600Ω Line	25
T-40	40DBM 8Ω-16Ω/150Ω-600Ω Line	30

PRESTON

FLOATING DIFFERENTIAL INSTRUMENTATION AMPLIFIERS

Preston's amplifiers deliver precision many times better than any other amplifier! Our "Balanced Precision" 8300 XWB Series have greatly improved performance to overcome the FOUR major sources of instrumentation amplifier errors!

COMMON MODE REJECTION — Preston's CMR of 150 db at DC and 130 db at 60 Hz reduces errors by a factor of 3 to 10 times over the "next best" amplifier!

TEMPERATURE STABILITY — Preston is 2 to 5 times better with a Gain TC of only 10 ppm/°C and Zero Shift of less than 0.1uV/°C RTI!

PUMPOUT CURRENT — 10 times better! Stays under ½ nanoamp over the entire temperature operating range!

OVERLOAD RECOVERY — 10 times as fast! Recovers to within 0.01% in 30 usec!

The 8300 XWB Series gives you many combinations of ACCURACY, LINEARITY and BANDWIDTH from which to choose, and every model has its own integral power supply and mounts in standard RETMA racks.

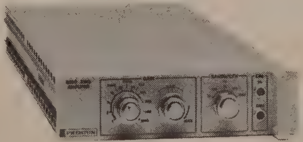
For complete information on the entire line of Preston instrumentation amplifiers, request your copies of our technical literature and our 12 page "Balanced Precision" brochure that shows how to determine the true performance of your instrumentation system.

8300 XWB Series Floating Differential Instrumentation Amplifiers.

Five basic models provide versatility to meet every need, and every model meets all of these performance specifications:

MODEL	A	B	C	D	E
Gain	Ten Steps plus Variable to 2500 X		Ten Steps Fixed to 1000 X		Fixed 1X to 2000 X
Gain Accuracy	±0.01%		±0.1%		±0.01%
Gain Linearity	±0.005%	±0.01%			
Drift (μV/°C)	0.1 μV RTI ±20 μV RTO	0.3 μV RTI ±100 μV RTO			
Bandwidth	Selectable to 100 kHz			Preset up to 100 kHz (max)	

Input Impedance	100 Megohms shunted by less than 0.001 μfd at DC
Input Noise	3 μV (100 kHz bandwidth)
Pumpout Current	Less than 0.2 nanoamps at constant temperature and less than 0.01 nanoamps change/°C
Common Mode Rejection	150 db at DC, 130 db at 60 Hz, 110 db at 400 Hz
Common Mode Voltage	350 Volts maximum peak AC or DC
Bandwidth	DC to 100 kHz
Gain Stability	0.01% (six month term)
Settling Time	30 μsec to within 0.01% of input signal
Long Term Zero Drift	±5 μV RTI, ±1 mV RTO (six month term)
Output Noise	0.2 millivolts peak
Output Capability	±10 volts at 100 ma.

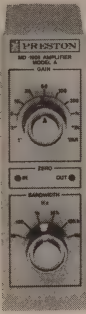


Any of the five models of the 8300 XWB Series Amplifiers can be ordered in this "horizontal" configuration.

PRESTON SCIENTIFIC INCORPORATED 805 East Cerritos Ave., Anaheim, Calif. 92805 Tel : (714) 776-6400 TELEX 65-5321

Instrumentation System Amplifiers
with Programmable Gain and Bandwidth,
Options for Special System Interface,
and Two New Amplifier Instruments.

Programmable Gain and Bandwidth



The Model "A" and "B" versions of the 8300 XWB Series Amplifiers are now available with programmable gain and bandwidth. These remotely controlled amplifiers identified by Model 8300 XWBRC—A and B are ideal for use in instrumentation systems where gain and bandwidth must be rapidly changed to optimize signal amplitude for digitizing purposes and to reduce the RTI noise level by controlling the bandwidth of the output signal.

As many as 10 gain levels between unity and a maximum gain of 2500 can be provided, and up to five different bandwidths in the range from 10 Hz to 100 kHz can also be included —all in the standard amplifier case.

Control of both gain and bandwidth can be accomplished by a 4 bit binary address at standard digital logic levels in fully automated and computer controlled instrumentation systems.

Options for Systems Interfacing.

Where system requirements include special performance features, Preston's instrumentation amplifiers can be delivered with a wide variety of options. For complete information, ask for our 'Amplifier Options' brochure.

1. **Low Pass Filter.** Provides cut-off frequencies as low as 1 Hz.
2. **Four Pole Bessel Filter.** Increases attenuation to 24 db/octave above cut-off frequency.
3. **Dual Output.** For simultaneous use by recorders and indicators.
4. **Triple Output.** For use where the system requires multiple outputs.
5. **Binary Gain Steps.** Eleven steps raise gain from unity to 1024.
6. **Output Coding.** Electrical output signals that indicate gain and bandwidth settings.
7. **Calibrate Relay.** Internal relay switches to 'standard' voltage to periodically calibrate the system.
8. **110 Volt Overload on Input Signal Lines.** Protects amplifier against very high Normal Mode Voltages.
9. **Multiplexer Switch.** External logic signal switches on internal multiplexer circuits for sampling by ADC or digital voltmeter.

New Amplifiers — Available for Delivery in Fall '75

Model AFM Series Amplifier-Filter

Here is a new series of floating differential instrumentation amplifiers specifically designed for use as a high gain or low gain buffer amplifier for real time process control applications or as a pre-amplifier for multiple-channel analog data recorders, strip chart recorders, pen drives and oscillograph galvanometers.

Drift and noise are very low, and accuracy of 0.01% is available over the entire gain range from unity to 2500. Full power bandwidths from DC to 10 kHz is also provided, with a 10 volt p-p output.

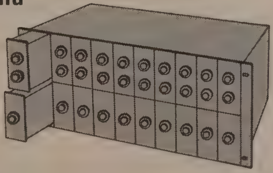
The optional plug-in filter module can be delivered with a customer specified 2, 3, or 4 pole Bessel filter any where in the frequency range from 1 Hz to 10 kHz.

Common Mode Rejection is 150 db at DC, and the maximum Common Mode Voltage is 350 volts peak.

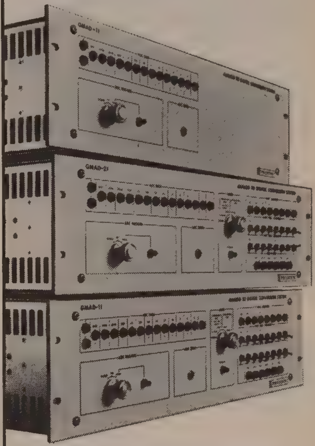
With its smaller size, high performance, unique flexibility and low unit cost, the Model AFM Series Amplifier-Filter is ideal for many analog amplifier applications in research, data acquisition systems and on-line automated production equipment.

1 MHz XWB Series Ultra-Wide-Band Instrumentation Amplifier

A new wide-band amplifier with all the "Balanced Precision" performance of Preston's 8300 XWB Series, but with full power bandwidth of 1 MHz! Designed to meet the growing need for higher frequency response in instrumentation for advanced research and development programs as well as high speed data acquisition systems.



PRESTON Builds the World's Fastest, Most Reliable Analog-to-Digital Converters and Data Acquisition Systems, too!



The GM Series of A-D Conversion Systems includes a full range of resolutions, accuracies and speeds—all the way from 9 bits in 20 usec up to 15 bits in 1 usec!

And every GM Series ADC System can include any type of input amplifier, multiplexers, sample-and-hold amplifiers, and special logic control circuits for custom interfacing with your other data system components.

New Low-Level Amplifier-Multiplexers and Programmable Gain Amplifiers have also been added to the Preston ADC capability, and a full set of plug-in modules that provide a direct interface with your computer is also available.

For more information on the specifications and operating features of these advanced ADCs, look at pages 1•194 and 1•195 of Volume 1 of EEM.

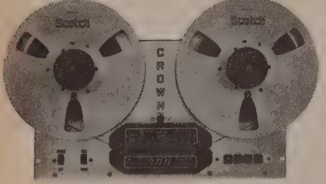
And for information on Preston's data acquisition sub-system components, see the description on pages 1•196 through 1•199 of Volume 1 of EEM.

Then write or call to—

PRESTON SCIENTIFIC INCORPORATED
805 East Cerritos Avenue,
Anaheim, California 92805
Telephone: (714) 776-6400
TELEX 65-5321

PRESTON

crown TAPE TRANSPORTS



SP-700 TRANSPORT

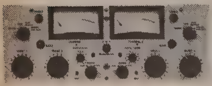
Mechanical interlock mode control • Automatic shut-off in play mode • Hysteresis-synchronous capstan motor • Electro-magnetic braking • 3¾, 7½ ips standard (15 ips optional) • Accepts 10″ NAB reels or 5″ or 7″ EIA reels. Price: $695.

Crown ¼″ magnetic tape transports provide many years of high quality playback and recording for audio recording and test instrumentation. Crown tape machines are three-motor design, and most components are plug-in for easy replacement. Custom design for OEM applications is available. Optional accessories are available for variable speed drive, remote control, multiple microphone inputs. 19″ rack mount. Optional walnut cabinets available. Wow and flutter 0.06% at 15 ips, 0.09% at 7½ ips, 0.18% at 3¾ ips.

SP-800 TRANSPORT

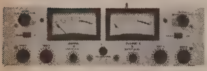
Computer Logic Control for mode selection • Photocell automatic shut-off in all modes • Hysteresis-synchronous capstan motor • Electro-magnetic braking • 3¾, 7½, 15 ips standard • Accepts 10″ reels or 5″ or 7″ EIA reels. Price: $1,095.

crown RECORDER ELECTRONICS



CX SERIES, 2 OR 4 CHANNEL

Plug-in modules for all functions • Built in remote record for no thumps on tape at beginning or end of record mode • Echo controls built in • Front panel bias adjustment • 3-speed equalization • Treble and bass controls with "flat" detent • Available with 600 or 250 ohm balanced 19″ rack mount. Price: $995, 2-channel; $1,995, 4-channel.

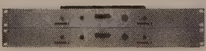


SX SERIES, 2 OR 4 CHANNEL

All circuit functions on four permanently mounted printed circuit cards • Record mode interlock • Rear panel bias adjust • Two speed equalization • Simplified circuitry • External balancing transformers available as accessories. 19″ rack mount. Price: $595, 2-channel; $1,495, 4-channel.

SX MONO

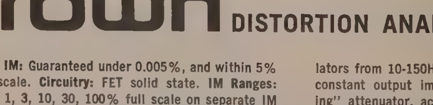
Same as SX • Bridging or 250 ohm balanced rear panel mixing mic inputs • 2 unbalanced mixing line inputs • Balanced and unbalanced line outputs • Headphone output jack. 19″ rack mount. Price: $495.



SP PLAYBACK

SX Type of construction • Play only electronics • 3-speed equalization • Front panel level adjustments • Unbalanced low impedance output • 600 ohm balanced output. 19″ rack mount. Price: $100, 2-channel, $200, 4-channel.

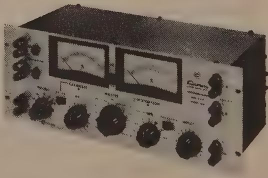
crown VARIABLE SPEED DRIVE



Crown VSD-5A attachment provides pushbutton control for tape transports of 15, 7½, 3¾, 1⅞ and 15/16 ips. Includes variable control to adjust each speed selection +50%, −25%. Adds to series 700 or 800 transports. Includes 19″ rack mount controls with forced air cooling, plus servo-controlled drive system to replace drive motor of transport. **Price:** $850.

crown DISTORTION ANALYZER

Residual IM: Guaranteed under 0.005%, and within 5% of full scale. **Circuitry:** FET solid state. **IM Ranges:** 0.1, 0.3, 1, 3, 10, 30, 100% full scale on separate IM meter. **Sensitivity:** 17mv sensitivity for testing low-level devices; metered, variable LF/HF ratio; internal oscillators 60Hz and 7KHz; provision for external oscillators from 10-150Hz (LF) and 2.5K-20KHz (HF) ranges; constant output impedance. **Plotting:** Master "tracking" attenuator, acting on input and output, permits rapid IM plots of the test device — over a 45db output range in 5db steps. **Price:** $695 rack mount, optional walnut cabinet available.

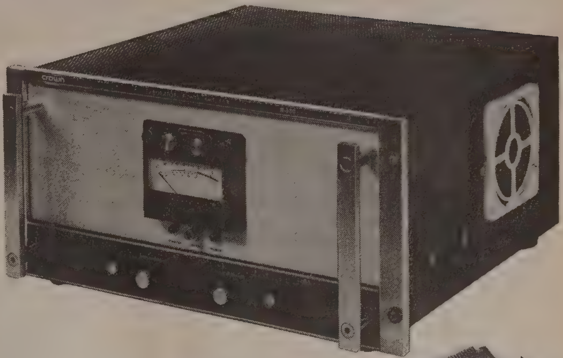


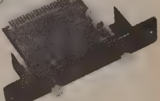
crown INTERNATIONAL
1718 Mishawaka Road, Box 1000, Elkhart, Indiana 46514
(219) 294-5571

WIDEBAND POWER AMPLIFIERS

crown
M-600
SINGLE CHANNEL AMPLIFIER

Power Bandwidth: +1 −0dB, DC-15KHz at 1,000 VA into 4 ohms, DC-20KHz, 600 VA, 8 ohms, maximum power at 2.5 ohms. **IM Distortion:** Under 0.05% from 0.01 VA to 600 VA. **Frequency Response:** ±1dB DC-100KHz at 1 VA into 8 ohms. **Phase Response:** +0° −15°DC-20KHz. **Hum and Noise:** 120dB below full output (20Hz-20KHz). **Slewing Rate:** 16v per micro-second. **DC Output:** 20A MAX at 100v. **Harmonic Distortion:** Less than 0.001% from 20Hz-400Hz, and increasing linearly to 0.05% at 600 VA into 8 ohms. **Output Impedance:** 5.5 milliohms in series with 2.5 μhy, both shunted by 2.7 ohms in parallel with 1 mfd. Safely drives any load including completely reactive loads. **Voltage Gain:** 20 ±1% (26dB) at std. input with gain control fully CW. **Amplifier Output Protection:** Short — mismatch — and open circuit-proof. **Overall Protection:** High line voltage or over temperature results in shutdown of the high power supplies, each of which is fused. Controlled-slewing rate voltage amplifiers protect the amplifier against RF burnouts. Input overload protection is furnished by a resistor at the input of the amplifier to limit current. **Heat Sinking:** A self-contained, forced-air cooling system having a 1900W cooling capacity in 25°C air is employed with a two-speed fan to minimize noise output and dust loading of the input filter at times of low dissipation. **Output Indicator:** Calibrated peak voltage output meter with adjustable hi-lo indicator lights. **Inputs:** Wide choice of input configurations using plug-in modules. **Weight:** 92 lbs.**Dimensions:** 19″ w x 19″ d x 8¾″ h. **Price:** $1,695 rack mount.



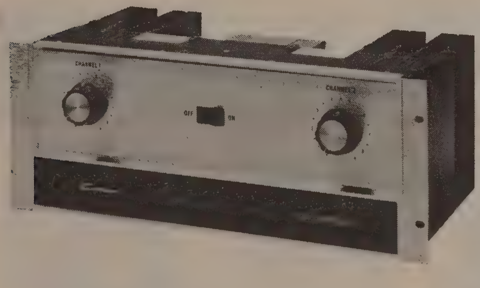


M2000
SINGLE CHANNEL AMPLIFIER

(Not shown, results from the coupling of two M-600 units together through a socket provided on the back of each.)

Power Bandwidth: +1dB-0dB DC-15KHz at 2,000 VA into 8 ohms. Other specifications similar to model M-600. **Weight:** 200 lbs. **Dimensions:** 19″ w x 17½″ h x 19″ d. **Price:** $3,390 rack mount.

crown
DC300A
DUAL-CHANNEL POWER AMPLIFIER



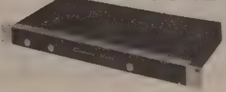
Power Bandwidth: +1dB-0dB, DC-20KHz at 155 VA each channel, 8 ohms. **Bridge Output:** +1dB DC-20KHz at 310 VA, 16 ohms. **IM Distortion:** Under 0.05%, .25 VA to 155 VA, 8 ohms. **Frequency Response:** ±1dB, DC-100KHz 1 VA. **Phase Response:** +0°, −15° DC to 20KHz at 1 VA. **Hum and Noise:** 110dB below 155 VA. **Output Impedance:** Less than 7 milliohms in series with less than 3 microhenries. **Slewing Rate:** 8v per micro-second. **DC Drift:** Under 3mv to 55°C. **Weight:** 55 lbs. **Dimensions:** 19″ w x 9¾″ d x 7″ h. **Price:** $799 rack mount.

crown
D150
DUAL-CHANNEL POWER AMPLIFIER

crown D150A

Power Bandwidth: +1dB-0dB, DC-20KHz at 80 VA, 8 ohms. **Bridge Output:** +1dB-0dB, DC-20KHz at 160 VA, 16 ohms. **IM Distortion:** Under 0.05%, .25 VA to 80 VA, 8 ohms. **Frequency Response:** ±1dB, DC-100KHz 1 VA. **Phase Response:** +0°, −15° DC to 20KHz at 1 VA. **Hum and Noise:** 110dB below 80 VA. **Output Impedance:** Less than 15 milliohms in series with less than 3 microhenries. **Slewing Rate:** 6v per micro-second. **DC Drift:** Under 3mv to 55°C. **Weight:** 24 lbs. **Dimensions:** 17″ w x 9″ d x 5¼″ h. **Price:** $459 rack mount.

crown
D60
DUAL-CHANNEL POWER AMPLIFIER



Power Bandwidth: +1dB-0dB, 35Hz-15KHz at 30 VA, 8 ohms. **Bridge Output:** +1dB-0dB, 20Hz-15KHz at 60 VA, 16 ohms. **IM Distortion:** Under 0.05%, .25 VA to 30 VA, 8 ohms. **Frequency Response:** ±1.2dB 5Hz-100KHz at 1 VA into 8 ohms. **Phase Response:** +10°, −15°, 20Hz-20KHz at 1 VA. **Hum and Noise:** 106dB below 30 VA. **Output Impedance:** Less than 15 milliohms in series with 3 microhenries. **Slewing Rate:** 6v per micro-second. **Voltage Gain:** 20.6 dB. **Weight:** 10 lbs. **Dimensions:** 19″ w x 9¾″ d x 7″ h. **Price:** $269 rack mount.

crown INTERNATIONAL
1718 Mishawaka Road, Box 1000, Elkhart, Indiana 46514
(219) 294-5571

iem®

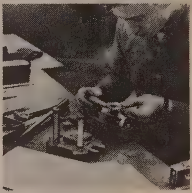
INTERNATIONAL ELECTRO MAGNETICS, inc.
ERIC DRIVE AND CORNELL AVENUE, PALATINE, ILLINOIS 60067 (312) 358-4622

DESIGN & MANUFACTURING CAPABILITIES

Since 1959 IEM, with the same personnel at the same location, and with the same management, has been producing Magnetic Recording Equipment and components for the Industry. It is highly probable that in 1991 we will still be here to serve you! In these uncertain times this type of stability is worth thinking about . . .

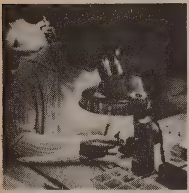
Vertical Milling Line

Vertical Mill with Optics


In-House Die Fabrication

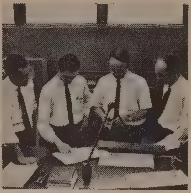
Coil Winding

Pole Pieces Processing


Assembly with Microscope Assist

Resin Compounding

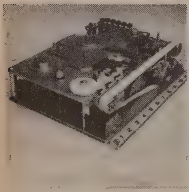
Vapor Deposition

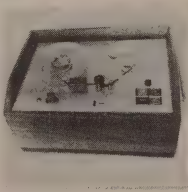

Engineering Conference

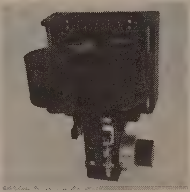
Circuit Design

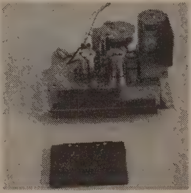
CUSTOM ENGINEERING & SHORT-RUN PRODUCTION

IEM with its "in-house" Engineering and Manufacturing capabilities make us the ideal partners in developing your ideas and bringing them to the pilot run or short-run stage. Below are some of the products we have produced with customer participation.


Magnetic Tape to Braille Translator


Ultra-Low Speed Flux Sensitive Playback System


Computer Output Microfilm Camera


High-Speed Low-Noise Servo Capstan Cassette Tape Deck

Analog Data Transport with Unique Tape Magazine

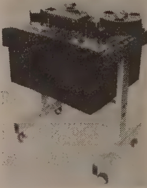
IEM—SYSTEMS AND SUB-SYSTEMS

MAGNETIC TAPE TRANSPORTS

- STUDIO MASTER
- STUDIO ECONOMY
- HIGH-SPEED PLAYBACK
- HIGH-SPEED

SPECIFICATIONS

- UP TO 2" TAPE
- UP TO 240 IPS
- UP TO 24 TRACK
- STANDARD INTERCHANGE HEAD MOUNT



HEAD ASSEMBLIES

- 16 & 24 TRACK
- HI-SPEED DUPLICATING
- FERRITE
- HY-MU 80
- TURRET
- MULTI-FORMAT

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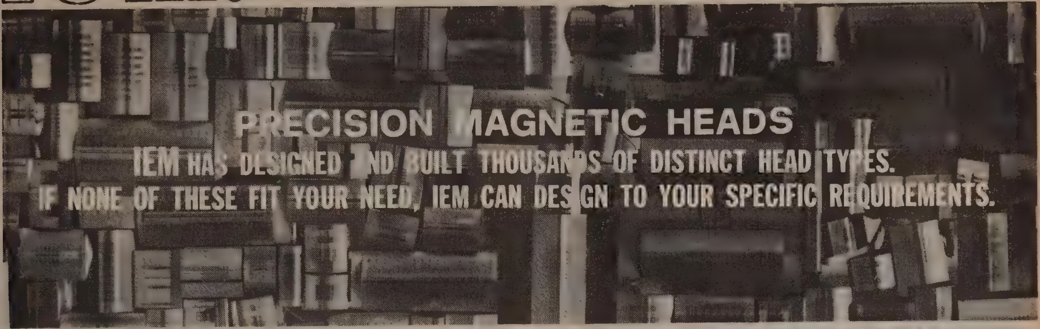
INTERNATIONAL ELECTRO MAGNETICS, inc.

ERIC DRIVE AND CORNELL AVENUE, PALATINE, ILLINOIS 60067 (312) 358-4622



PRECISION MAGNETIC HEADS

IEM HAS DESIGNED AND BUILT THOUSANDS OF DISTINCT HEAD TYPES.
IF NONE OF THESE FIT YOUR NEED, IEM CAN DESIGN TO YOUR SPECIFIC REQUIREMENTS.

Type Designation	Application	No. of Tracks	Track Width	Track Spacing	Inductance @ 1KC	Bias	Output	Tape Speed IPS
R4N5	Record	4	.080	.130	10 mh	3.5 ma @ 100KC	—	15
P4N5	Playback	4	.080	.130	700 mh		1KC 20KC 5.5 mv 12 mv	15
E8N1	Erase	8	.080	.130	1.5 mh	30 ma @ 100KC	—	15
R8N1	Record	8	.070	.130	15 mh	3.5 ma @ 100KC	—	15
P8N1	Playback	8	.070	130	1.2 henry		1KC 5 mv	15
E12L1	Erase	12	.050	.085	100 uh	200 ma @ 60KC	—	15
R12M1	Record	12	.040	.085	3.5 mh	7 ma @ 120KC	—	15
P12M1	Playback	12	.040	.085	800 mh	—	1KC 15KC 3 mv 8 mv	15
R7/14L1	Record	7/7	.050	.070/.140	1.4 mh	3.8 ma @ 375KC	—	60
P7/14L1	Playback	7/7	.044	.070/.140	20 mh		1KC 100KC 0.6 mv 2 mv	30
R16L1	Record	16	.025	.0625	3.6 mh	4.2 ma @ 150KC	—	15
P16L1	Playback	16	.025	.0625	3.8 mh		1KC 0.2 mv	15
E16L1	Erase	16	.030	.0625	0.7 mh	25 ma @ 150 KC	—	15
R16L2	Record	16	.070	.127	3.5/15 mh	6.0/2 ma @ 150KC	—	15
P16L2	Playback	16	.070	.127	3.8/900 mh		0.4/6.0 mv 1Kc	15
E16L2	Erase	16	.080	.127	0.6/1.2 mh	75/50 ma @ 150KC	—	15
E24L2	Erase	24	.050	.084	0.6 mh	75 ma @ 150KC	—	15

- ANALOG
- IRIG
- STUDIO MASTER
- AUDIO

VIDEO

Application	No. of Tracks	Track Width	Gap Shim	Inductance at 1 KC	Saturation Current	Playback	Tape Speed IPS
Video Record	1	.050	100 u in.	67 uh	8 ma		120
	1	.025	100 u in.	100 uh	5 ma		60
Video Playback	1	.050	36 u in.	1.9 mh		1mc .15mv	120
	1	025	20 u in	4.5 mh		1mc 06mv	60

FLUX SENSITIVE

Application	No. of Tracks	Track Width	Track Spacing	Carrier Freq.	Carrier Current	Output Level
Flux Sensitive	1	.250	—	100 KC	80 ma	10 mv
	2	.050	.140	228 KC	40 ma	3 mv
	4	.077	.250	100 KC	80 ma	5 mv
	7	.040	070	228 KC	40 ma	3 mv

COMPUTER

Application	No. of Tracks	Track Width	Track Spacing	Inductance 1 KC	Bit Density BPI	Read Output MV p/P	Saturation Current NRTZ	Tape Speed IPS
Hi Density Read	20	.020	.049	3 mh	900	10 mv		150
Hi Density Write	20	.027	.049	150 uh	900		100 ma	150
Med. Density Read	7	.030	.070	12 mh	556	40 mv		120
Med. Density Write	7	.048	.070	150 uh	556		50 ma	120
Hi Density Read/Write	30	.012	.042	80 mh	800	4.5 mv	3.0 ma	7½
Hi Density Read/Write	4	.025	.062	50 mh	5000	4.0 mv	1.8 ma	7½
Read	9	.040	.055	12 mh	1000	40 mv		120
Write	9	.042	.055	300 uh	1000		100 ma	120

HIGH-SPEED DUPLICATION

SPECIFICATIONS FOR HI-NICKEL ALLOY HEADS

IEM Type	No.	Inductance At 1 KHz	Gap Size	Bias Current		Audio Current	Cross Talk	Head Type
				ma-rms	MHz			
R 1L2	393-3	1.8 mh	.001	10.0	0.5	.001	NA	Full Track ¼"
R 1/2L2	394-2	2.0 mh	.001	8.5	0.5	.0006	NA	Half Track ¼"
R 2L2	395-4	2.5 mh	.001	6 0	0.5	0006	−53 DB	Two Track ¼"
R 2/4L2	408-3	1 8 mh	.0005	5.5	1.0	.0005	−52 DB	4-Track Stereo ¼"
R 4L2	871-2	2.5 mh		5.0	0.5		−50 DB	Quadrophonic ¼"
R 2/8L2	324N	1.8 mh		5.5	1.0		−58 DB	8-Track ¼"
R 4/8L2	691-1	1.5 mh	.0005	6.5	1.0	0005	−50 DB	8-Track Quad ¼"
R 2L15	442-2	2.0 mh	.0003	6 0	0 5	0005	−48 DB	2-Track .150
R 2/4L15	441-13	1.6 mh	.0005	9 0	0.5	.001	−30 DB	2-Track Stereo .150
R 1/2L15	486-1	3 0 mh	0005	4 5	0 5	0005	NA	Half Track .150

SPECIFICATIONS FOR FERRITE HEADS

IEM Type	No.	Inductance At 1 KHz	Gap Size	Bias Current At 1MHz Wavelength		Bias Current At 2 MHz	Audio Current	Cross Talk
				.003 ma	rms .0007			
RF 1L2	393-5	700 uh	.0003	6.2	4.7		.0005	NA
RF 1/2L2	394-3			5.5	4.2		0005	NA
RF 2L2	395-5			5.6	4.1		0005	−56 DB
RF 2/4L2	858-1			4 5	3 5	13 0	0012	−58 DB
RF 4L2	871-1	700 uh		4.5	3.5		0005	−50 DB
RF 2/8L2	324W	1.0 mh	0003	3.8	3 0		0004	−58 DB
RF 4/8L2	852-3	450 uh	00015	6.2	4 7	9.0	0006	−55 DB
RF 2L15	863-1	700 uh		4.6	3.6		0005	−48 DB
RF 2/4L15	441-17	700 uh		4.8	3.8		0005	−35 DB
RF 1/2L15	468-5	700 uh	.00015	4 5	3.6		0005	NA

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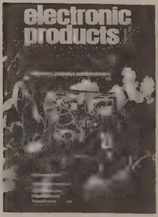

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U.S. AGENCY FOR MAGNETIC COMPONENTS LIMITED

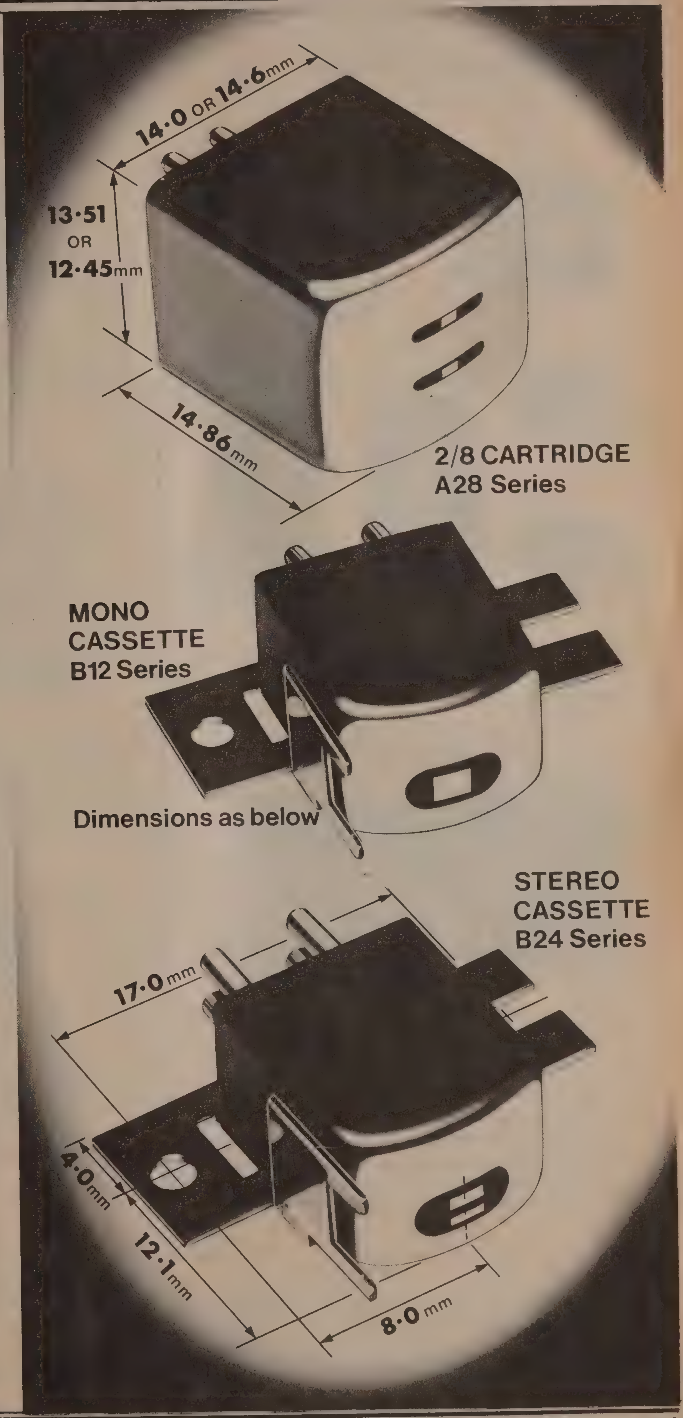
P. O. BOX 23
IRVINGTON, N.Y. 10533
TEL: (914) 591-8822
TWX: 710-564-0802

Cartridge and cassette recording heads

The Inter-Technical Group markets for Magnetic Components Limited, Britain's leading manufacturer of high quality audio recording heads. We offer a range of both mono and stereo heads for use in both cartridge and cassette tape recorders as well as a selection of reel to reel heads.

All MC heads are compatible with existing equipment produced throughout the world.

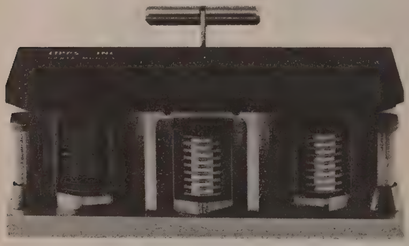
We will be glad to send you specification sheets and prices if you will tell us the categories in which you are interested.


14·0 OR 14·6mm
13·51
OR
12·45mm
14·86mm
2/8 CARTRIDGE
A28 Series
MONO
CASSETTE
B12 Series
Dimensions as below
STEREO
CASSETTE
B24 Series
17·0 mm
4·0mm
12·1mm
8·0 mm

LIPPS..INC MAGNETIC RECORDING HEADS

PROFESSIONAL AUDIO RECORDING HEADS

Illustrated above are only a few of the heads which we produce. Contact us direct for more information and data.



PRE-ALIGNED HEAD ASSEMBLIES

LIPPS . . INC
offers a variety of precision-made head assemblies, complete and ready to mount on your transport. Renew your existing equipment for finer reproduction quality, or update older equipment to accommodate the newer multi-channel recording techniques.

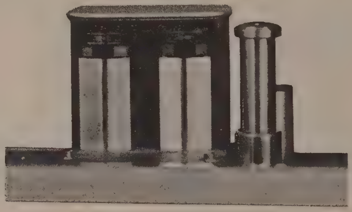
REFURBISHMENT · RELAPPING REPLACEMENT SERVICE

AUDIO · ANALOG · DIGITAL INSTRUMENTATION

Enjoy maximum usage for a fraction of the original cost. Utilize our reconditioning service to obtain maximum use of existing heads.

We will be pleased to furnish prices for special assemblies, including ANALOG and DIGITAL, on request.

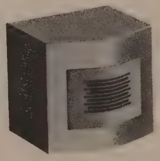
LIPPS . . INC. manufactures a complete line of monaural, stereo and multichannel heads for replacement of original heads in name-brand recorders. Our heads are guaranteed to equal or exceed the requirements of original equipment.



LIPPS . . INC. maintains a complete relapping and replacement service for Ampex and RCA Video Tape Recorder Audio Heads.

Most assemblies are serviced in three to five working days.

EXTENDED LIFE HEAD
Ferrite Core



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magnetic recording heads
1630 euclid street
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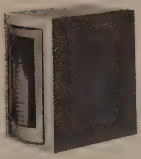
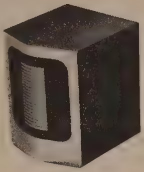
SPECIALIZED PRECISION MAGNETIC RECORDING HEADS

LOGGING · IRIG

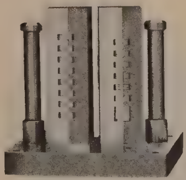


42 TRACK IRIG, 1″

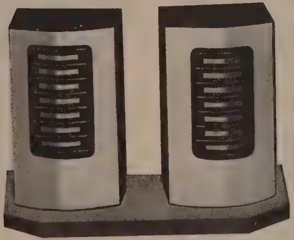


20 TRACK DIGITAL, ½″

INDUSTRIAL or ENVIRONMENTAL



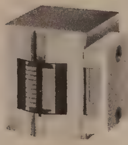
61 CHANNEL ASSEMBLY



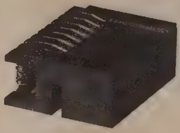
7 or 14 CHANNEL IRIG

When you require more channels on narrower tape widths, single head stacks or special assemblies can be designed and produced utilizing our more than 25 years of head manufacturing experience with tight toleranced multi-channel programs.

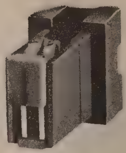
COMMERCIAL DIGITAL SERIES MAGNETIC RECORDING HEADS



7 & 9-CHANNEL IBM COMPATIBLE TAPE HEAD



8-CHANNEL FLYING DISC RECORDING HEAD ASSEMBLY



FLYING DRUM RECORDING HEAD

LIPPS . . INC. is the oldest independent head manufacturer in the United States. We are a production-oriented facility with engineering and development capabilities that enable us to produce metal surfaced and ferrite heads. LIPPS . . INC. produces a complete line of high quality recording heads, mainly for Original Equipment Manufacturers.

Successful performance with Original Equipment Manufacturers has come about as the result of a flexible and strong capacity to produce to customer specifications at competitive prices. Close cooperation between your engineering department and our production staff is our basic policy as an independent manufacturer. Our unique methods have always enabled us to furnish top quality, precision products to our customers at prices more attractive than our competitors. Our techniques are of proprietary design and, therefore, are controlled and protected by in-house processes, some of which are:

> Photolab . . . chemical milling . . . hydrogen annealing . . . transfer molding . . . vacuum depositing . . . complete capability to machine, profile, slice and polish ferrite and ceramic materials . . . complete in-house machine shop.

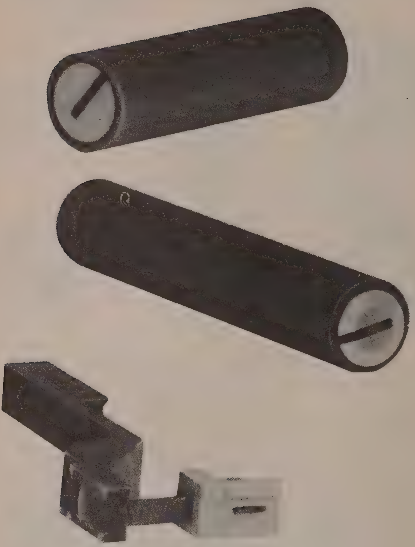
We are manufacturers of custom heads designed for individual requirements. Your specifications will receive immediate attention when sent to us for quotation, and our engineering staff is always available to assist in any way.

We look forward to having the opportunity to manufacture a product built to your exacting requirements at a competitive price.

Robert J. Cross
Vice President and General Manager

LIPPS..INC MAGNETIC RECORDING HEADS

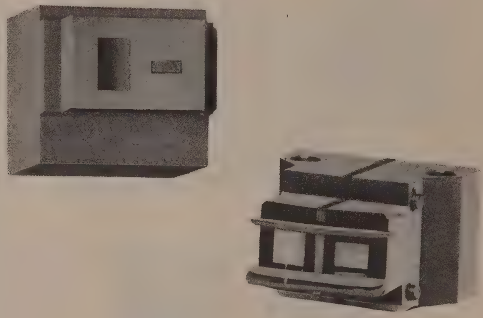
COMMERCIAL AND MILITARY TYPE DRUM HEADS



Fixed and flying drum heads for read and write operations, low and high frequency. Designed specifically for new and direct replacement requirements for drums of six inch to eighteen inch diameter and typical rotational speeds of 1800 RPM and more.

DIGITAL READ/WRITE HEADS FOR CASSETTE & CARTRIDGE

LIPPS . . Incorporated manufactures a complete line of digital single gap read/write heads and dual gap read after write heads for cassette and cartridge application. With single and multi-channel configurations for .150 inch cassette format and ¼ inch format.
Data rates range to 3200 FRPI at tape speeds of up to 50 IPS.



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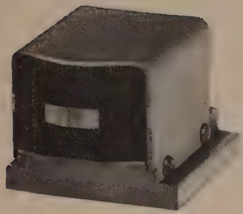
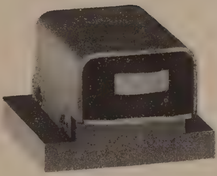
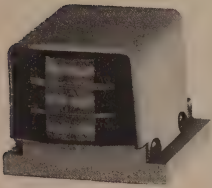
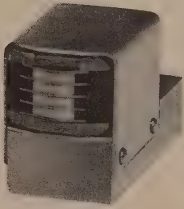
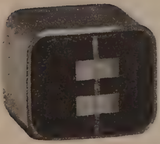
CREDIT CARD READ AND READ/WRITE HEADS







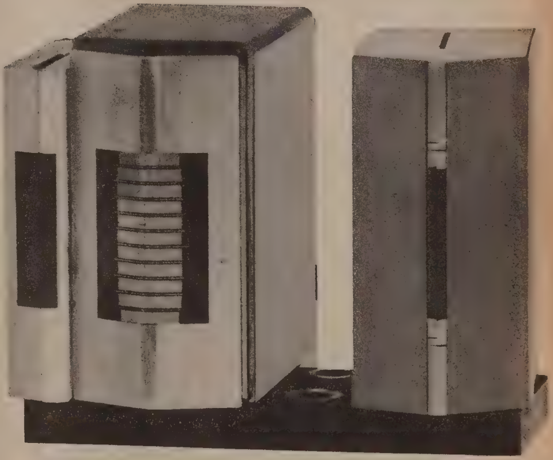




Magnetic stripe card and ticket read and read/write heads with specifications which meets IATA, ANSI, and ABA requirements. These single and multi-track magnetic heads have proven themselves in thousands of hours of actual operation and in measured control tests. The life factor ranks as one of the highest in practical use today. Typical data rates are above 400 FRPI at 15 IPS card speed.

MAGNETIC TAPE CERTIFIERS

LIPPS.. Incorporated has developed a complete line of magnetic tape certifier head assemblies. These assemblies are composed of a full width write head, a multitrack read head and a full width erase head. These designs of certifier head assemblies will accommodate tape speeds above 200 IPS. Applications include certification of tapes for video, computer, and instrumentation (IRIG). Tape width capability ranges from ½ to 2 inch.



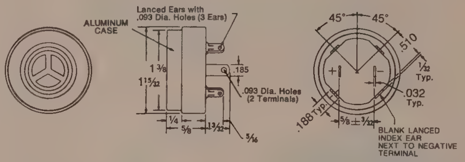
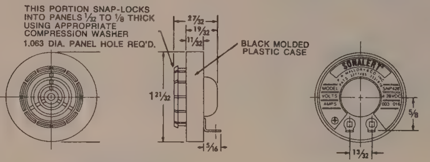
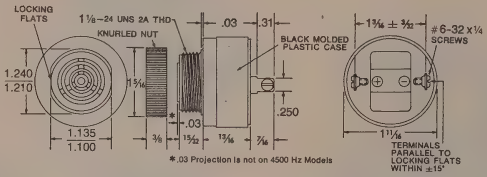
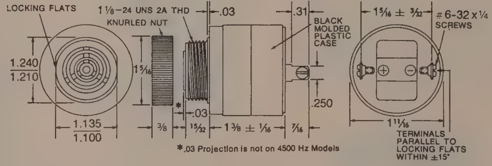
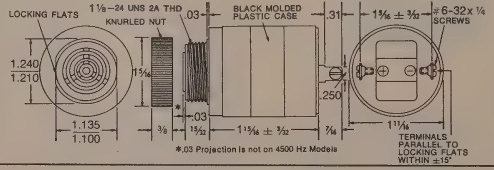
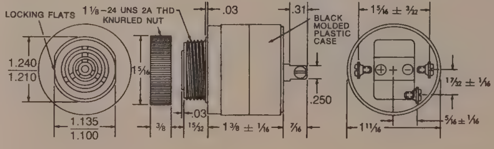
If you're having problems in your current head program contact us, we may have the answer.

We appreciate the opportunity to be of service to you and assure you of a prompt reply to your specifications and assistance with problems.

Robert J. Cross
Vice President and General Manager

SONALERT® Electronic Audible Signals

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PART & MODEL NUMBER	OPERATING VOLTAGE VDC MIN	OPERATING VOLTAGE VDC MAX	TYPICAL OPERATING CURRENT MA @ MIN V	TYPICAL OPERATING CURRENT MA @ MAX V	MINIMUM SOUND LEVEL dBA @ MIN V	MINIMUM SOUND LEVEL dBA @ MAX V	FREQUENCY ±500 (Hz)	NOTES SEE NEXT PAGE	OUTLINE DIMENSIONS FRACTIONS ±1/32 DECIMALS ±.01
SC1.5 SC6 SC12 SC18 SC24	1 4 8 14 20	4 8 15 22 30	4 @ 1.5V 12 @ 6V 14 @ 12V 16 @ 18V 16 @ 24V		60 @ 1.5V 70 @ 6V 70 @ 12V 70 @ 18V 70 @ 24V		3500 3500 3500 3500 3500	D D D D D	 Lanced Ears with .093 Dia. Holes (3 Ears) ALUMINUM CASE 1 3/8 1 15/32 .185 .093 Dia. Holes (2 Terminals) 1/4 5/8 13/32 5/16 45° 45° .510 1/32 Typ. .032 Typ. .188 Typ. 5/8 ± 1/32 BLANK LANCED INDEX EAR NEXT TO NEGATIVE TERMINAL
SNP428	4	28	1.8	14	64	78	2900	E	 THIS PORTION SNAP-LOCKS INTO PANELS 1/32 TO 1/8 THICK USING APPROPRIATE COMPRESSION WASHER 1.063 DIA. PANEL HOLE REQ'D. 27/32 13/32 11/32 BLACK MOLDED PLASTIC CASE 1 21/32 5/16 SONALERT 5/8 13/32
SC628 SC628H SC648 SC648H	6 6 10 10	28 28 48 48	3 3 3 3	14 14 14 14	68 68 68 68	80 80 80 80	2900 4500 2900 4500	F G H I F H I F I F I	 LOCKING FLATS 1 1/8–24 UNS 2A THD KNURLED NUT .03 .31 BLACK MOLDED PLASTIC CASE 1 3/16 ± 3/32 #6-32 x 1/4 SCREWS 1.240 1.210 1 5/16 .250 *.03 1.135 1.100 3/8 15/32 13/16 7/16 1 11/16 TERMINALS PARALLEL TO LOCKING FLATS WITHIN ±15° *.03 Projection Is not on 4500 Hz Models
SC628P SC628HP SC628A SC628AH SC648A SC648AH SC110 SC110H SC250	6 6 6 6 10 10 30 30 60	28 28 28 28 48 48 120 120 250	3 3 3 3 3 3 4 4 4	14 14 14 14 14 14 16 16 16	68 68 68 68 68 68 68 68 68	80 80 80 80 80 80 80 80 80	2900 4500 2900 4500 2900 4500 2900 4500 2900	B F G H I B F I A F H I A F I A F I A F I A F G H I A F I A F I	 LOCKING FLATS 1 1/8–24 UNS 2A THD KNURLED NUT .03 .31 BLACK MOLDED PLASTIC CASE 1 5/16 ± 3/32 #6-32 x 1/4 SCREWS 1.240 1.210 1 5/16 .250 *.03 1.135 1.100 3/8 15/32 1 3/8 ± 1/16 7/16 1 11/16 TERMINALS PARALLEL TO LOCKING FLATS WITHIN ±15° *.03 Projection Is not on 4500 Hz Models
SC628AP SC628AHP SC648AP SC648AHP SC110P SC110HP SC250P SC250HP	6 6 10 10 30 30 60 60	28 28 48 48 120 120 250 250	3 3 3 3 4 4 4 4	14 14 14 14 16 16 16 16	68 68 68 68 68 68 68 68	80 80 80 80 80 80 80 80	2900 4500 2900 4500 2900 4500 2900 4500	A B F A B F A B F A B F A B F A B F A B F A B F	 LOCKING FLATS 1 1/8–24 UNS 2A THD KNURLED NUT .03 BLACK MOLDED PLASTIC CASE .31 1 5/16 ± 3/32 #6-32 x 1/4 SCREWS 1.240 1.210 1 5/16 .250 *.03 1.135 1.100 3/8 15/32 1 15/16 ± 3/32 7/16 1 11/16 TERMINALS PARALLEL TO LOCKING FLATS WITHIN ±15° *.03 Projection Is not on 4500 Hz Models
SC628W	6	28	3	16	68	80	2900	C F H I	 LOCKING FLATS 1 1/8–24 UNS 2A THD KNURLED NUT .03 .31 BLACK MOLDED PLASTIC CASE 1 5/16 ± 3/32 1.240 1.210 1 5/16 .250 .03 1.135 1.100 3/8 15/32 1 3/8 ± 1/16 7/16 1 11/16 17/32 ± 1/16 5/16 ± 1/16

MALLORY

MALLORY CAPACITOR COMPANY
a division of P. R. MALLORY & CO. INC.
Box 372, Indianapolis, Indiana 46206

Electrical and Electronic Components • Timing Devices and Motors • Metallurgical Products • Batteries

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SONALERT® Electronic Audible Signals

GENERAL SPECIFICATIONS AND NOTES

Mallory Sonalert® audible signals produce a unique tone by electronic means. Within the Mallory line of Sonalert® signals, there are three distinctive tone frequencies available. These tones have been selected for their penetrating sound even in the presence of high background noise, yet they are not irritating in a quiet environment.

The Sonalert® signal is ideally suited for portable battery operated equipment because very little electrical power is needed to produce the tone. The low power feature allows the Sonalert® signal to be turned on and off with a low power transistor, S.C.R. or integrated circuit. Construction is completely solid state with no moving parts, no arcing, no R.F. noise and no mechanical wear. For additional information request Bulletin 4-10-02.

EXPLANATION OF "NOTES" COLUMN ON PRECEEDING PAGE.

OPERATING VOLTAGE

Twenty-eight Sonalert® models are available for operation from 1 to 250 VDC and 6 to 250 VAC, 50-400 Hz. Sound starts upon application of voltage and stops when voltage is disconnected.

Note A: Designates models which operate on both AC and DC voltage. These models are non- polar.

SOUND LEVEL

Sound level will vary with applied voltages and is measured as follows:

1. Measurement to be taken only when Sonalert® is emitting sound. This includes pulsing and warbler models.
2. Measured at two (2) feet, free field, not mounted.
3. Measured on "A-Scale" sound level meter: Zero dB = .0002 dynes/CM².

SOUND FREQUENCY

Three sound frequencies are available depending upon model selected. Frequency is fixed for each model and cannot be altered by external means. Standard tolerance is ±500 Hz. Special tolerance for telephone compatibility is +500 −100 Hz on 2900 Hz models only. To specify special tolerance, add "T" after last letter of model number. Example: SC628APT.

PULSING MODELS

Note B: Designates pulsing models which automatically turn off and on at a rate of 2 to 9 Hz depending upon applied voltage.

WARBLER UNIT

Note C: Warbler Model SC628W is to be used with SC628, SC628H, SNP428 to produce two tones alternating at a rate of 2 to 9 Hz depending upon voltage.

MOUNTING METHODS

Note D: Terminals — .032 steel, tin plated with .093 dia. wire hole, will accept standard 3/16" quick disconnect.

Note E: Terminals — .016 brass, hot tin finish with .076 wire hold. Terminal will accept standard ⅛" disconnect.

Note F: Terminals — .032 brass, tin plated, tapped for #6-32 screw. Two #6-32 cadmium or zinc plated steel screws included. Will accept standard ¼" quick disconnect.

INDUSTRY LISTINGS

Note G: Listed as recognized component — Audible Signal Appliances by Underwriters Laboratories Guide Number UCST2, yellow card number S1290.

Note H: Federal Stock Numbers Issued as follows:

Model No.	Federal Stock No.
SC628H	5820 134 5372
SC628P	6350 071 2492
SC628A	6350 912 6310

Note I: Military versions are available which use MIL approved components where applicable. Test documentation is provided. Black anodized aluminum nut is included standard. Olive drab plastic case and olive drab anodized aluminum nut available if specified. Request "Specification for Mallory Sonalert® Signal Military Version" for more information. To specify Military version, add "M" after last digit in part number. Example: SC628MP.

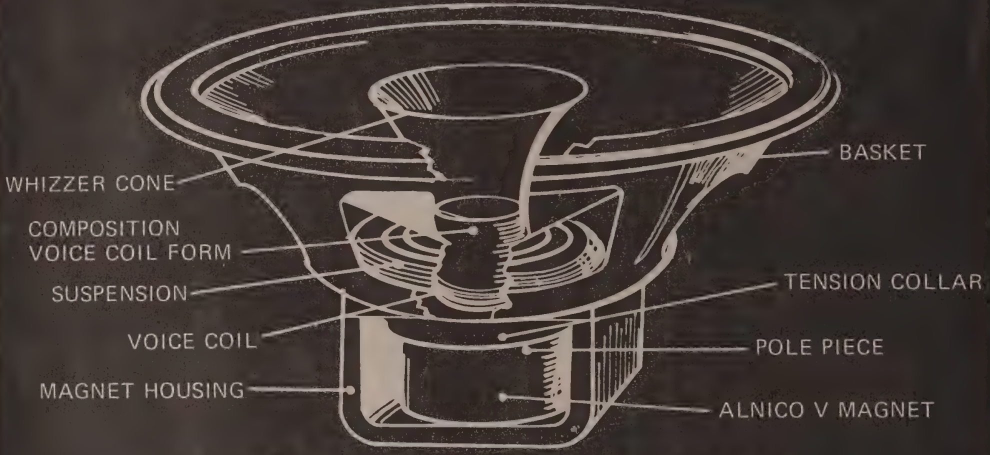
MALLORY

MALLORY CAPACITOR COMPANY
a division of P. R. MALLORY & CO. INC.
Box 372, Indianapolis, Indiana 46206

Electrical and Electronic Components • Timing Devices and Motors • Metallurgical Products • Batteries

SONALERT® is a registered trademark of P. R. Mallory & Co. Inc.

If you can see how to improve this speaker...



we're looking for you.

We're serious.
If you're interested enough in speakers to want to try to improve them, we want to do business with you—because we feel the way you do.

LOOK FOR A BETTER WAY.
Sure, there are ways to improve any speaker—if the sky's the limit on time, size, and cost. But there's the challenge: boost quality and performance, yet stay within design and cost requirements.

THAT'S THE KIND OF CHALLENGE WE LIKE BEST.
That's why we think that the best way to improve the speaker above is to give it an aluminum voice coil form. Why? Low-mass, better heat-resistance, totally moisture-proof. Superior to composition forms in every way.

WE MAKE ALL OUR SPEAKERS THAT WAY.
Whether you order one of more than 160 Oaktron speakers from inventory, or if Oaktron designs and engineers a speaker to your specifications, you'll get the aluminum voice coil form.

The aluminum voice coil form. After more than 20 years in the business of solving speaker problems and almost 60 million speakers, we know it's the best. And we guarantee it.

GUARANTEE: All OAKTRON speakers are 100% inspected and tested and are guaranteed against defects of materials and workmanship for one year from date of purchase, when installed and operated within design specifications. Replacement will be made at no cost when returned to OAKTRON INDUSTRIES, INC.

OAKTRON
INDUSTRIES, INC.

FOR QUOTES AND SAMPLES CALL US TODAY.
NATIONAL SALES: JERRY DISCH, 608/325-2121
INDUSTRIAL: LEN ZIELINSKI, 312/625-2742

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People looking for these speaker applications...

HI FI COMPONENTS • TRANSDUCERS • EXPLOSION & FLAME PROOF • DETECTORS • PUBLIC ADDRESS • WEATHERPROOF • REPLACEMENT • UNDERWATER • DRIVERS • COAXIAL • OPTICAL SCANNERS • INTERCOM • DEPTH SOUNDERS • SYSTEMS • NOISE MASKING • SUBMERGENCE PROOF • ALARM • METAL LOCATORS • HANDI-TALKIES • FREE EDGE • FUNGUS RESISTANT • TWIN CONE • WARNING SYSTEM

looked to us last year.

Oaktron will build any speaker within these design and production capabilities.

SPEAKER SIZES: 1¾″ to 15″ diameter, in round, square, pin-cushion, rectangular and special shapes to design specifications.

VOICE COILS: 5/16″ to 2″ diameter; all wound on heat-dissipating, moisture-proof aluminum forms.

VOICE COIL LAYERS: 2 to 6, single or dual windings.

IMPEDANCE: 1.5 to 200 ohms, or any impedance as specified; multi-impedance taps.

CONNECTORS: Screw post, spade lug, solder eye, or as specified.

ALNICO V MAGNETS: 0.18 oz. to 20.0 oz., in yoke and/or high-energy cup housings.

CERAMIC MAGNETS: 2.35 oz. to 32 oz. Barium ferrite; single and stacked mountings with extended pole piece.

POWER CAPACITIES: ½ to 100 watts, true RMS ratings; 150% transient peak.

CONE MATERIALS: Paper, acrylic or phenolic impregnated cloth, aluminum; moisture-resistant, weather-proof, fire-retardant, and fungus-resistant treatments.

CONE CONSTRUCTION: Butyl rubber, foam rubber, and cloth free-edge surrounds; ½ roll up or down, multiple roll edge; molded, seamed, ribbed, curvilinear, deep, shallow, twin-cone "whizzer."

FREE AIR RESONANCE: Designed to specifications.

BASKETS: Precision formed steel, electrostatically coated in standard and special design shapes: shallow, deep-draw, perforated, solid back; with and without mounting holes and transformer emboss. Front and rear mounting with vinyl gasket ring, clip fasteners.

ENTERTAINMENT SPEAKERS: High response twin-cone, free-edge, musical instrument, woofers, tweeters, mid-range, color TV, co-axial, weather-proof patio speakers; three-way systems; automotive stereo, multi-impedance, and dual voice coil; general and automotive replacement; GM, Ford, and tractor type.

UNDERWATER SPEAKERS: Designed to specifications for deep-submergence, reactive measurement, and underwater communications.

TRANSDUCERS: Displacement, force, pressure, ultrasonic, velocity, and vibration types to design specifications for scientific measurement or continuous use; in sizes and shapes as specified; drivers.

ARCHITECTURAL SOUND: Noise masking, music, paging, public address, dual voice coil, intercom, alarm; interior, exterior, waterproof, weather-and-fungus-resistant, explosion- or flame-proof; architectural enclosures.

ACCESSORIES: Baffles, L-pads, transformers, ceiling rings, mounting brackets.

ALL SPEAKERS MADE IN THE UNITED STATES.

OAKTRON
INDUSTRIES, INC.

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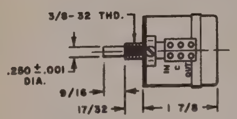
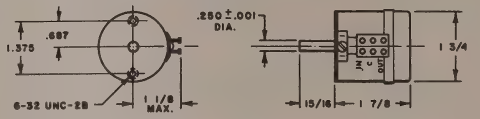
Shallco

PRECISION AUDIO ATTENUATORS

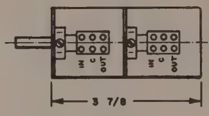
OUTLINE AND MOUNTING DIMENSIONS


3/8-32 THD.
.250 ± .001 DIA.
9/16
17/32
1 7/8
IN
C
OUT

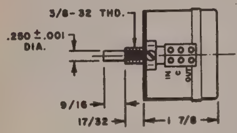
A


1.375
.687
6-32 UNC-2B
1 1/8 MAX.
.250 ± .001 DIA.
15/16
1 7/8
1 3/4
IN
C
OUT

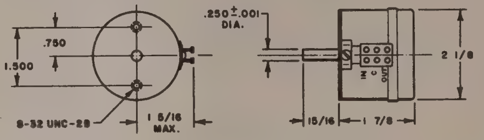
AA



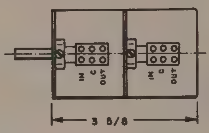
2-A


3/8-32 THD.
.250 ± .001 DIA.
9/16
17/32
1 7/8
IN
C
OUT

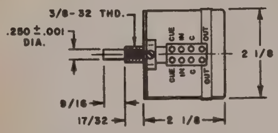
B


.750
1.500
8-32 UNC-2B
1 5/16 MAX.
.250 ± .001 DIA.
15/16
1 7/8
2 1/8
IN
C
OUT

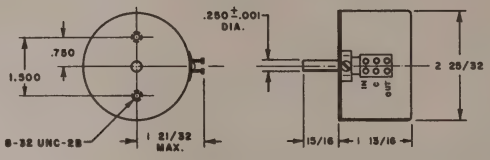
BB



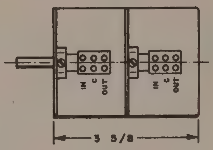
2-B


3/8-32 THD.
.250 ± .001 DIA.
9/16
17/32
2 1/8
2 1/8
CUE
IN
C
OUT

BQ


.750
1.500
8-32 UNC-2B
1 21/32 MAX.
.250 ± .001 DIA.
15/16
1 13/16
2 25/32
IN
C
OUT

D



2-D

DIMENSIONS IN INCHES

T TYPE ATTENUATORS

PRECISION INSTRUMENT AND MEASUREMENT TYPES RESISTOR ACCURACY: ± 1%

TYPE	STEPS	dB/STEP	TAPER	CONTACT SPACING	DETENT	CASE STYLE
P420E-.1B1	20	.1	NO	15°	YES	BB
P420E-.5B1		.5				
P420E-1B1		1				
P420E-1.5B1		1.5				
P420E-2B1		2				
P430C-.1B1	30	.1	NO	11¼°	YES	
P430C-.5B1		.5				
P430C-1B1		1				
P430C-1.5B1		1.5				
P430C-2B1		2				
P445A-.5D1	45	.5	NO	7½°	YES	D
P445A-.75D1		.75				
P445A-1D1		1				

The "T" attenuator circuit provides the features of zero insertion loss (1:1 impedance ratio) and constant input and output impedance for all steps. This device is used in test equipment and for extending the range of volume indicating meters. The Balanced "H" circuit is obtained by ganging together two "T" circuits. Resistor Accuracy: ±5% Standard, ±1% Precision. Cueing available. Specify impedance desired.

REFER TO VOLUMES 1 & 2 FOR SHALLCO RESISTORS AND SWITCHES

Shallco

AUDIO AND R.F. ATTENUATORS

PRECISION BALANCED "H" ATTENUATORS RESISTOR ACCURACY: ± 1%

TYPE	STEPS	dB/STEP	TAPER	CONTACT SPACING	DETENT	CASE STYLE
2-P620E-.1B1	20	.1	NO	15°	YES	2-B
2-P620E-.5B1		.5				
2-P620E-1B1		1				
2-P620E-2B1		2				
2-P630C-.1B1	30	.1	NO	30°	YES	
2-P630C-.5B1		.5				
2-P630C-1B1		1				
2-P630C-2B1		2				
2-P645A-.5D1	45	.5	NO	7½°	YES	2-D
2-P645A-1D1		1				

CODE	B	H	C	K	KU	KG	D	E	EF	F	G
IMPEDANCE	50/50	75/75	125/125	150/150	150/300	150/600	200/200	250/250	250/500	500/500	600/600
INSERTION LOSS, dB	0	0	0	0	7.7	11.4	0	0	7.7	0	0

SPECIAL IMPEDANCES AND dB STEPS AVAILABLE

R.F. ATTENUATORS

SHALLCO R F attenuators provide accurate and convenient insertion of losses in 50 ohm systems. In addition to the types shown, we can provide 75 ohm impedance models both manual and solenoid driven.

POWER RATING	FREQUENCY RANGE	VSWR	INSERTION LOSS	IMPEDANCE
.5 Watt 0 to 10 dB .25 Watt above 10 dB	DC to 1000 MHz	Less than 1.05 at 100 MHz, 1.15 at 500 and 900 MHz	Less than .05 dB at 100 MHz, .1 at 500 MHz, .2 at 900 MHz	50 Ohm

Model*		No. Dials	dB Per Step	Total dB	ATTENUATION ACCURACY VS FREQUENCY			Dimensions (Nominal Inches)	
					0-100 MHz	0-250 MHz	0-900 MHz		
8841	8841RM	4	0.1	111	±1% + .05 dB	±2% + .05 dB	±3% + .05 dB	17⅓ x 5 x 5	19 x 3½ x 2⅝
8831	8831RM	3	0.1	61	±1% + .05 dB	±2% + .05 dB	±3% + .05 dB	17⅓ x 5 x 5	19 x 3½ x 2⅝
8821	8821RM	2	0.1	11	±1% + .05 dB	±2% + .05 dB	±3% + .05 dB	10¼ x 5 x 5	19 x 3½ x 2⅝
8811	8811RM	1	0.1	1	±.05 dB	±.07 dB	±.1 dB	10¼ x 5 x 5	19 x 3½ x 2⅝
8832	8832RM	3	1.0	110	±1% + .05 dB	±2% + .05 dB	±3% + .05 dB	17⅓ x 5 x 5	19 x 3½ x 2⅝
8822	8822RM	2	1.0	60	±1% + .05 dB	±2% + .05 dB	±3% + .05 dB	10¼ x 5 x 5	19 x 3½ x 2⅝
8812	8812RM	1	1.0	10	±.05 dB	±.3 dB	±.4 dB	10¼ x 5 x 5	19 x 3½ x 2⅝
8823	8823RM	2	10.0	100	±1% + .05 dB	±2%	±3%	10¼ x 5 x 5	19 x 3½ x 2⅝
8813	8813RM	1	10.0	50	±1% + .05 dB	±2%	±3%	10¼ x 5 x 5	19 x 3½ x 2⅝
8814	8814RM	1	50.0	50	±1% + .05 dB	±2%	±3%	10¼ x 5 x 5	19 x 3½ x 2⅝

*Bench or Rack Model

SEND FOR CATALOG 102 FOR COMPLETE LISTING

Shallco

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TEL. (919) 934-3135
TWX 510-939-1955

Primo —Leader in the Microphone Field—

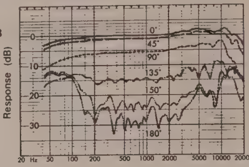
FOR PROFESSIONAL USE MICROPHONE

STUDIO CONDENSER MICROPHONE CMU-503

Professional in every way, the CMU-503 will meet most rigorous studio, broadcast and high-quality PA applications. Self-contained preamp combined with unique circuitry and a high voltage generator, provides such superior characteristics as low 20dB self-noise and 140dB maximum input.

Separate power supply includes level attenuation switch, low frequency response switch, front panel battery removal and battery check.

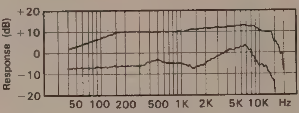
- Frequency Response: 20—18,000 Hz, ±2.5 dB
- Output Impedance: 200 ohms (±15% @ 1,000 Hz)
- Output Level: −72 dB ±1.5 dB

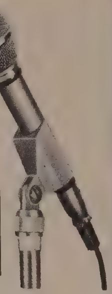


STUDIO UNIDIRECTIONAL DYNAMIC MICROPHONE P-88

Dynamic cardioid microphone designed for studio and broadcast applications. Meets the most stringent PA requirements. Light weight and small size make it the ideal hand-held entertainment microphone. Multiscreen and foam windscreen eliminate wind noise and breath blast. Special smooth finish and unique cable connector reduce mechanical noise considerably. Cardioid cartridges are precision adjusted.

- Frequency Response: 50—15,000 Hz
- Output Impedance: 250 ohms balanced
- Output Level: −76 dB ±3 dB (0 dB = 1 V per microbar)



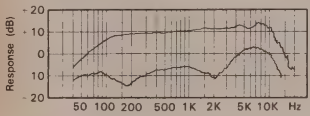


FOR SEMI PROFESSIONAL USE MICROPHONE

UNIDIRECTIONAL DYNAMIC MICROPHONE UD-876M

High quality cardioid dynamic microphone ideally suited for professional vocal, stage and entertainment work. With effective windscreen and breath blast filter. Excellent cardioid pattern reduces unwanted sound pickup from the rear and controls feedback. Convenient built in "ON-OFF". Uses a quality 3-pin standard cable connector.

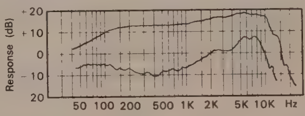
- Frequency Response: 70—14,000 Hz
- Output Impedance: 250 ohms balanced
- Output Level: −76 dB ±3 dB (0 dB = 1 V per microbar)



UNIDIRECTIONAL DYNAMIC MICROPHONE UD-959

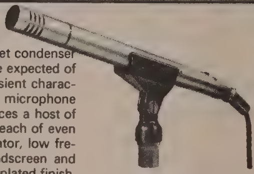
Professional quality vocal and entertainment microphone with a beautiful smooth metal body to reduce handling noise. Extended response is crisp and clean, complimenting any entertainer. Effective built-in windscreen eliminates breaths and wind noise. This rugged performer is designed to withstand the most rigorous entertainment usage.

- Frequency Response: 100—14,000 Hz
- Output Impedance: 250 ohms
- Output Level: −76 dB ±3 dB (0 dB = 1 V per microbar)



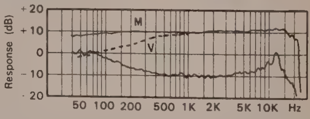
UNIDIRECTIONAL ELECTRET MICROPHONE

EMU-4520

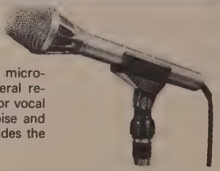


Professional studio and broadcast Electret condenser microphone with the ultrawide response expected of condenser microphones. Excellent transient characteristics make it an ideal studio music microphone for use on all types of instruments. Places a host of professional features with in the price reach of even the smallest studio. With 10dB attenuator, low frequency roll-off switch, removable windscreen and sturdy metal case with smooth long life plated finish.

- Frequency Response: 50—15,000 Hz
- Output Impedance: 200 ohms balanced
- Output Level: −76 dB ±2.5 dB (0 dB = 1 V per microbar)

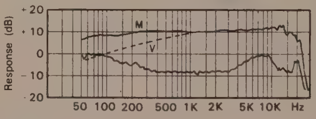


EMU-4516



A good quality cardioid Electret condenser microphone designed for music pickup and general recording. Built-in low frequency roll-switch for vocal use. Effective windscreen reduces wind noise and breath blasts. This excellent performer provides the "condenser" sound at a low price.

- Frequency Response: 70—13,000 Hz
- Output Impedance: 200 ohms
- Output Level: −77 dB ±3 dB (0 dB = 1 V per microbar)



PRIMO MICROPHONE INC.

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60007, U.S.A.
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TELEX: 28-3474 PRIMO MUS ELGR

PRIMO COMPANY LIMITED

6-25-1 MURE, MITAKA-SHI, TOKYO, JAPAN
TEL: 0422-43-3121～9
TELEX: 2822-326 PRIMO J

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UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

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utah replacement speakers

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Deluxe Speakers

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
C4CC	4	Square	2.35	8	5	4 11/16	1 7/16	¾
C6FC	6	Pincushion	5.5	8	7	6 1/8	2 1/8	1¾
C46FC	4 x 6	Oval	5.5	8	7	3 5/8 x 4 5/8	1¾	1¼
C48HC	4 x 8	Oval	6	8	10	3 1/16 x 5 5/8	2 3/16	1¾
C57FC-W	5 x 7	Ov./high frequency cone	5.5	8	10	6 1/8	2 1/8	1¼
C69FC-W	6 x 9	Ov./high frequency cone	5.5	8	10	4 5/8 x 6 9/16	2¾	1½
C10JC-8	10	Round	10	8	12	9 5/8	3 11/16	3

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

These speakers feature special epoxy formulations for bonds stronger than the modern ceramic magnets. Heavy steel parts yield maximum flux density. Plus, durable baked-on finish gives lasting corrosion resistance. (Not recommended for use in color television sets.)

C4CC

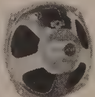
C69FC-W

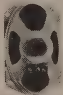
Standard Speakers

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
*SP25Y	2½	Sq./Transistor	.55	3-4	4	2 29/32	1 5/16	¼
*SP3Y	3	Square	.55	3-4	4	3 3/8	1 3/8	¼
*SP35Y	3½	Square	.55	3-4	4	3 31/32	1 9/16	½
*SP4Y-8	4	Sq./Transformer Mtg.	.55	8	4	4 11/16	½	½
*SP4B	4	Sq./Transformer Mtg.	1.00	3-4	5	4 11/16	1 11/16	¾
*SP5Y-8	5	P.C. Transformer Mtg.	.55	8-10	5	4 11/16	1 11/16	½
*SP5B	5	P.C. Transformer Mtg.	1.00	3-4	5	4 11/16	1 7/8	¾
*SP6D	6	P.C. Transformer Mtg.	1.47	3-4	5	6 3/16	2 9/32	¾
*SP6D-8	6	P.C. Transformer Mtg.	1.47	8-10	7	6 3/16	2 9/32	¾
*SP8D	8	P.C. Transformer Mtg.	1.47	3-4	7	7 11/16	2¾	1¼
*SP8D-8	8	P.C. Transformer Mtg.	1.47	8	7	7 11/16	2¾	1¼
SP8J-8	8	Rd./Transformer Mtg.	6.8	8	7	7 11/16	4 1/16	3¼
SP12J-8	12	Rd./Transformer Mtg.	6.8	8	12	11 9/16	5 7/16	4¾
*SP26Y	2 x 6	Oval	.55	3-4	4	1 7/8 x 4¾	1¾	½
*SP53Y	5 x 3	Oval	.55	3-4	4	2 9/16 x 3 9/16	1 19/32	½
*SP53C-8	5 x 3	Oval	1.47	8-10	7	2 9/16 x 3 9/16	2 1/8	½
*SP46D	4 x 6	Oval	1.2	3-4	5	3 5/8 x 4 5/8	1 27/32	¾
*SP46D-8	4 x 6	Oval	1.2	8-10	7	3 5/8 x 4 5/8	1 27/32	¾

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Optional weatherproofing is available on any standard speaker.
*indicates shielded magnet (safe for use in color television sets.)


SP8D


SP35Y

PIN CUSHION (P.C.)

SP12J-8

Executive Aircraft Speakers

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	RMS Power (Watts)	Depth (Inch)	Shipping Wt. (Lbs.)
A52FC	5¼	Pincushion	5.5	3.2	7	2 1/8	1½
A6FC	6	Pincushion	5.5	3.2	7	2¼	1½
A46FC	4 x 6	Oval	5.5	3.2	7	1¾	1¼
A69FC	6 x 9	Oval	5.5	3.2	10	2 1/8	1¾
A5C115	5	Pincushion	1.47	3.2	5	2 3/8	¾
A5C133	5	Pincushion	1.47	3.2	5	2 3/8	¾

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Designed for exceptional performance and long life, these speakers are used in single and twin engine aircraft. Magnet assemblies are heavier than original equipment and maximum speaker depth is only 2 3/8".

utah replacement speakers

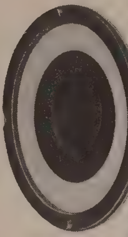
UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

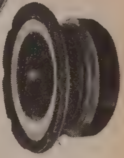
High Compliance Speakers

Model No.	Size (Inch)	Description	Mag. Wt. (Oz.)	Impedance (Ohms)	V. C. Dia. (Inch)	Response (Hz)	RMS Power (Watts)	Mtg. Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
CS5JFC	5	P.C./Cloth Rolls	10	8	¾	65/17,000	10	$4\frac{11}{16}$	2⅛	2
CS5JVC-W	5	Rd/Cloth Rolls/Whizzer	16	8	1	55/17,000	12	$4\frac{11}{16}$	$2\frac{13}{32}$	2¾
CS6JC-W	6	Rd/Cloth Rolls/Whizzer	10	8	1	50/17,000	12	6⅛	2⅝	2
CS8JC-W	8	Rd/Cloth Rolls/Whizzer	10	8	1	30/20,000	12	$7\frac{11}{16}$	3	2¾
CS8JVC-W	8	Rd/Cloth Rolls/Whizzer	16	8	1	28/20,000	15	$7\frac{11}{16}$	$3\frac{3}{16}$	3½
CS10JC-W	10	Rd/Cloth Rolls/Whizzer	10	8	1	30/20,000	15	9⅝	$3\frac{11}{16}$	3
CS12JC-W	12	Rd/Cloth Rolls/Whizzer	10	8	1	28/18,500	15	$11\frac{9}{16}$	$4\frac{7}{16}$	3

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Soft, cloth roll suspension for installation in acoustic suspension or bass reflex speaker cabinets. All high compliance speakers deliver excellent bass and highs.


CS12JC-W


CS5JVC-W

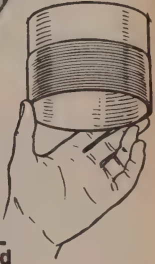
Musical Instrument Speakers

Model No.	Size (Inch)	Description	Mag. Wt. (Oz.)	Impedance (Ohms)	V. C. Dia. (Inch)	Res. Freq. (Hz)	RMS Power (Watts)	Mtg. Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
MH8JC	8	Organ/Guitar	10	8	1	72	15	$7\frac{11}{16}$	3	2¾
MH10JC	10	Organ/Guitar	10	8	1	56	18	9⅝	$3\frac{11}{16}$	3
MH10PC	10	Organ/Guitars/Accordion	20	8	1½	72	35	9⅝	3⅞	5½
MH12JC	12	Organ/Guitar	10	8	1	75	20	$11\frac{9}{16}$	$4\frac{7}{16}$	3¾
MH12PC	12	Organ/Guitars/Accordion	20	8	1½	52	40	$11\frac{9}{16}$	4⅝	6
MH12PXC	12	Organ/Guitars/Accordion	30	8	1½	52	50	$11\frac{9}{16}$	$5\frac{1}{16}$	9
MH12RC	12	Organ/Bass Guitar	40	8	2	48	60	$11\frac{9}{16}$	5⅛	11¼
MH15PXC	15	Organ/Guitars/Accordion	30	8	1½	66	50	$14\frac{9}{16}$	6½	12
MH15RC	15	Organ/Bass Guitar	40	8	2	45	60	$14\frac{9}{16}$	$6\frac{9}{16}$	13½
MH12R3R-A	12	Organ/Bass Guitar	64	8	3	55	75	11¼	6¾	18½
MH15R3R-A	15	Organ/Bass Guitar	64	8	3	55	75	$14\frac{9}{16}$	8⅜	21

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Proven reliable by the nation's leading professionals and musical instrument makers. Voice coils are heat-proofed to sustain extremes of wattage and temperature. Plus, these speakers are unconditionally guaranteed for one year at the power rating specified.

MH12PXC


3", BRUTE FORCE VOICE COIL
Heat-proofed to Withstand 120 Watts

Bass Speakers/Woofers

Model No.	Size (Inch)	Description	Mag. Wt. (Oz.)	Impedance (Ohms)	V. C. Dia. (Inch)	Res. Freq. (Hz)	RMS Power (Watts)	Mtg. Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
W8PC	8	Woofer	20	8	1½	42	30	$7\frac{11}{16}$	3⅛	5
W10PC	10	Woofer	20	8	1½	22	35	9⅝	3⅞	6¼
W12RXC	12	Woofer	30	8	2	28	50	$11\frac{9}{16}$	4⅞	10¼
W15RXC	15	Woofer	30	8	2	20	50	$14\frac{9}{16}$	$6\frac{5}{16}$	12½

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Durable, heat-proofed voice coils and high compliance cloth rolls give deep, high-powered bass tones.

MH15R3R-A

utah replacement speakers

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Midrange Speakers/Horns and Sealed Units

Model No.	Size H x W x D (Inch)	Description	Crossover Freq. (Hz)	Imped-ance (Ohms)	RMS Power (Watts)	Shpg. Wt. (Lbs.)
H-068	10½ x 4 x 11	Horn midrange	—	8	7½	3
H-068-X	10½ x 4 x 11	H-068 & crossover	2,500	8	7½	3
H-068-XC	10½ x 4 x 11	H-068, x'over & control	2,500	8	7½	3
H-458-X	3½ x 8 x 8½	Instrument Horn/x'over	—	8	7½	1½
M5JFC	5" Dia. x 2⅛	5" Sealed-chassis midrange	—	8	10	2
M5JFC-X	5" Dia. x 2⅛	5" Mid. & crossover	2,500	8	10	2
M5JFC-XC	5" Dia. x 2⅛	5" Mid., x'over & control	2,500	8	10	2

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

High efficiency horns or sealed chassis units for dependable operation in 3-way speaker systems.

M5JFC
H-068
H-458-X

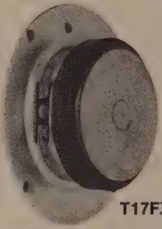
High Frequency Speakers/Tweeters

Model No.	Size (Inch)	Description	Crossover Freq. (Hz)	Imped-ance (Ohms)	RMS Power (Watts)	Shipping Wt. (Lbs.)	Magnet Wt. (Oz.)	Freq. Response (Hz)
T17FXC-1	4¼ x 1¼	Tweeter	—	8	8	¾	5.5	2/20,000
T17CC1	4¼ x 1 1/16	Tweeter	—	8	6	¾	2.35	2/19,000
T3CC4	3 9/16 x 1 3/16	Tweeter	—	8	6	¾	2.35	2/19,000
T3AZ	3 9/16 x 1⅜	Tweeter	—	8	5	¾	.68	2/18,500
H-208	7¼ x 3 x 6⅜	Horn Tweeter	—	8	7½	1¾	2.8	2/17,500
H-208-X	7¼ x 3 x 6⅜	H208/Crossover	5,000	8	7½	1¾	2.8	2/17,500
H-208-XC	7¼ x 3 x 6⅜	H208/Crossover/Control	5,000	8	7½	1¾	2.8	2/17,500

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

High efficiency, horn loaded or cone type tweeters offer brilliant highs from any speaker system.

H-208

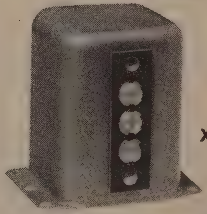

T17FXC-1

Crossover Networks

Model No.	Size (Inch)	Description	Crossover Freq. (Hz)	Shipping Wt. (Lbs.)
X-608	2 3/16 x 2 11/16 x 2 21/32	LC Crossover Network	600	½
X-5008	2 3/16 x 2 11/16 x 2 21/32	LC Crossover Network	5,000	½

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

LC-type crossover networks for 8 ohm systems have 6-db/octave attenuation for smooth frequency transition. X-608 is for 3-way systems, woofer to midrange unit. X-5008 is for 2- or 3-way systems.


X-5008

Speaker System Kit/Woofer, Tweeter, Crossover

Model No.	Kit Description	Response (Hz)	Impedance (Ohms)	RMS Power (Watts)	Shipping Wt. (Lbs.)
WTC8	8" Woofer/3½" Tweeter	40/20,000	8	12	3½

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

These CS8JC-W woofers and TSP35A tweeters have slip-on terminals to speed wiring to the pre-assembled, color-coded wiring harness. Includes crossover capacitor, terminal board and cabinet plans.

WTC8

Build your Own
8" 2-Way Speaker System

utah high fidelity speaker systems

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Utah's complete line of high fidelity speaker systems offer a wide variety of designs, cabinet sizes and styles. Perfectly matched speaker components produce solid bass performance and distinct highs. Plus, the use of advanced materials and existing manufacturing techniques, combined with expert craftsmanship, enable Utah speakers to recreate any musical experience with extreme accuracy.

PV Series Compact Systems (available in pairs only)

Model No.	RMS Power (Watts)	Impedance (Ohms)	Woofer Type	Midrange Type	Tweeter Type	Crossover Frequency (Hz.)	Level Control	Dimension H x W x D	Shipping Wt. (Lbs.)
PV-100	12	8	8″	—	Co-ax Cone	—	—	11 x 17¼ x 6⅝	19
PV-200	12	8	8″	Co-ax Cone	3½″	5,000	—	11 x 17¼ x 6⅝	20
PV-300	12	8	8″	Co-ax Cone	3½″	5,000	—	11 x 17¼ x 6⅝	22

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Walnut/Vinyl Wrapped Systems

Model No.	Frequency Res. (Hz.)	RMS Power (Watts)	Impedance (Ohms)	Woofer Type	Midrange Type	Tweeter Type	Crossover Frequency (Hz.)	Level Control	Dimension H x W x D	Shipping Wt. (Lbs.)
AS-3	40/18,000	15	8	8″	Co-ax Cone	3½″	4,500	—	10½ x 17½ x 8	14
AS-5	40/18,000	20	8	10″	6″	3½″	2,500/5,000	—	12½ x 22 x 9	27
AS-7	35/18,000	40	8	12″	Horn	3½″	2,500/5,000	—	14 x 23 x 10	33

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Oiled Walnut Veneer Systems

Model No.	Frequency Res. (Hz.)	RMS Power (Watts)	Impedance (Ohms)	Woofer Type	Midrange Type	Tweeter Type	Crossover Frequency (Hz.)	Level Control	Dimension H x W x D	Shipping Wt. (Lbs.)
AS2-AX	45/17,500	15	8	8″	—	3½″	5 kHz	—	11¼ x 17¼ x 8¼	20
A70-A	38/18,000	20	8	10″	6″	3½″	2,500/5,000	—	12½ x 22 x 9	28
WD-90	35/18,000	40	8	12″	8″	3½″	2,500/5,000	—	14 x 23 x 10	33
HS1-C	30/19,000	40	8	12″	5″	Horn	2,500/5,000	—	15 x 25¾ x 14	46

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Oiled Walnut Systems/Sculptured Fronts

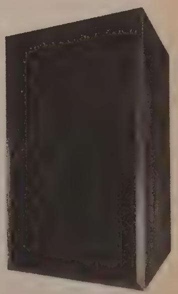
Model No.	Frequency Res. (Hz)	RMS Power (Watts)	Impedance (Ohms)	Woofer Type	Midrange Type	Tweeter Type	Crossover Frequency (Hz.)	Level Control	Dimension H x W x D	Shipping Wt. (Lbs.)
MP-2000	30/20,000	40	8	12″	5″	1″ dome	2,500/5,000	—	15¼ x 24 x 12	42
HS4-B	25/19,500	50	8	12″	horn	1″ dome	2,500/5,000	mid/high	15 x 25¾ x 14	49
MP-3000	20/20,000	60	8	15″	5″	2-1″ dome	2,500/7,000	mid/high	27 x 20½ x 14	70

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

PV300

AS-5

HS1-C



HS4-B

utah cascade high fidelity speakers

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

This series of full-range and woofer models is specially designed for natural sound in custom-built systems. The powerful, flat response of the Cascade series is the result of continuous engineering research and development. Large magnet assemblies and voice coils are featured for high efficiency, power and response. And chemically treated woven fabric suspension maintains high cone compliance.

CD12PC-2

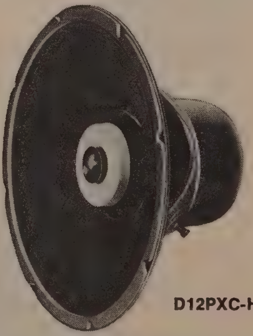
CD8JXC-2

Die Cast Co-Axial Speakers

Model No.	Size (Inch)	Description	Magnet Assy. Wt. (Lbs.)	Impedance (Ohms)	Voice Coil Dia. (Inch)	Response (Hz.)	Res. Freq. (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
CD8JXC-2	8	2-way	2	8	1	39/19,000	55	18	7 11/16	3⅝	4¾
CD8JXC-3	8	3-way	2	8	1	32/20,000	55	18	7 11/16	3⅝	5½
CD8PC-2	8	2-way	4	8	1½	28/17,000	53	30	7 11/16	3⅝	6
CD8PC-3	8	3-way	4	8	1½	28/19,500	53	30	7 11/16	3⅝	6½
CD12PC-H	12	3-way	4	8	1½	23/20,000	25	40	11 9/16	5⅞	13
CD12RC-2	12	2-way	7¾	8	2	18/19,000	25	50	11 9/16	5⅞	16½
CD12RC-H	12	3-way	7¾	8	2	18/20,000	25	50	11 9/16	5⅞	17½
CD12RC-W	12	woofer	7¾	8	2	18/5,000	25	50	11 9/16	5⅞	16½

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

D12P



D12PXC-HF

High Fidelity Speakers

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	Voice Coil Dia. (Inch)	Response (Hz.)	Res. Freq. (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
D12P	12	2-way	21.5	8	1½	30/14,000	62	40	11 9/16	6¼	7½
D15PXC-HF	15	3-way	30	8	1½	30/20,000	40	45	14 9/16	8	13

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Finished in baked-on enamel, these high fidelity replacement speakers include magnet covers, separate treated high frequency cones and finger-tip terminals.

utah trusonic series products

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

The result of years of research and testing, Trusonic speakers are designed to provide clean natural sound. Sand cast magnet structures add as much as 50% flux density compared to conventional assemblies. Mating surfaces are ground for excellent magnet contact resulting in near zero reluctance. And extra-thick, die cast aluminum frames give lasting precision.

Full Range Speakers

Model No.	Size (Inch)	Description	Magnet Assy. Wt. (Lbs.)	Impedance (Ohms)	Voice Coil Dia. (Inch)	Response (Hz.)	Res. Freq. (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
50FR	5	Full range	2	8	1	80/15,000	85	15	4 9/16	1 13/16	3
60FR	6	Full range	2	8	1	45/15,000	40	20	6⅛	2⅝	3
80FR	8	Full range	4.25	8	2	40/15,000	50	25	7 11/16	4	7

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Woofers and Midrange Speakers

Model No.	Size (Inch)	Description	Magnet Assy. Wt. (Lbs.)	Impedance (Ohms)	Voice Coil Dia. (Inch)	Response (Hz.)	Res. Freq. (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
80-W	8	Free cone woofer	4.25	8	2	40/5,000	50	25	7 11/16	4	7
120-W	12	Free cone woofer	9.75	8	2½	20/5,000	30	60	11½	6⅛	15
150-W	15	Free cone woofer	17.5	8	3	20/5,000	20	75	14½	7⅞	25

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Crossover Network

Model No.	Size (Inch)	Description	Shipping Wt. (Lbs.)
5CX	6¼ x 3¾ x 2	500 cycle crossover	3

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

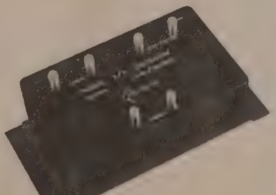
Musical Instrument Speakers

Model No.	Size (Inch)	Description	Magnet Assy. Wt. (Lbs.)	Impedance (Ohms)	Voice Coil Dia. (Inch)	Response (Hz.)	Res. Freq. (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
120-W	12	organ/guitar/accordion	9.75	8	2½	20/5,000	30	60	11.500	6⅛	15
150-W	15	organ/guitar/accordion	17.5	8	3	20/5,000	20	75	14.500 D.	7⅞	25

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

80-FR

80-W


5CX

150W

utah special products

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

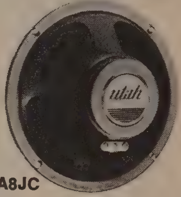
Public Address Speakers

Model No.	Size (Inch)	Description	Mag. Wt. (Oz.)	Imped-ance (Ohms)	V. C. Dia. (Inch)	Response (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
CS5JFC	5	P.C. cloth rolls	10	8	¾	65/17,000	10	4¹¹⁄₁₆	2⅛	2
PA8FC	8	Rd. extra thin	5.5	8	¾	40/15,000	8	7¹¹⁄₁₆	2¾	1 lb., 13 oz.
PA8FC-W	8	Rd. whizzer	5.5	8	¾	40/18,000	8	7¹¹⁄₁₆	2¾	1 lb., 13 oz.
PA8JC	8	Rd.	10.0	8	1	32/15,000	10	7¹¹⁄₁₆	3	2 lb., 13 oz.
PA8JC-W	8	Rd. whizzer	10.0	8	1	32/19,000	12	7¹¹⁄₁₆	3	2 lb., 13 oz.
PA8JC-WCR	8	Rd. cloth rolls/whizzer	10.0	8	1	30/20,000	12	7¹¹⁄₁₆	3	2 lb., 13 oz.
PA8JC-D8W	8	Rd. dual voice coils/whizzer	10.0	8	1	40/14,000	12	7¹¹⁄₁₆	3	2 lb., 13 oz.
PA8JC-3	8	Rd. co-ax 3″ tweeter	10.0	8	1	32/19,500	12	7¹¹⁄₁₆	3	3 lb., 2 oz.
PA12JC	12	Rd.	10.0	8	1	30/12,000	15	11⁹⁄₁₆	4⁷⁄₁₆	3 lb., 13 oz.

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

All public address speakers have transformer mounting facilities, screw terminals and internal dust seals.

PA8JC-WCR



PA8JC

Intercommunication Speakers/45 ohms

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Voice Coil Impedance (Ohms)	RMS Power (Watts)	Depth (Inch)	Shpg. Wt. (Lbs.)
SP4A1	4	square	.68	45	4	1⁹⁄₁₆	¾
SP8FC1	8	pincushion	5.5	45	8	2¾	1¾

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

These sensitive speakers deliver a strong signal to the amplifier when serving as "microphones" in a talk-back system. As many as 11 can be connected in parallel.

Outdoor Speakers/Weather Proof

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	Voice Coil Dia. (Inch)	Response (Hz.)	RMS Power (Watts)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
WP8JC-W	8	whizzer/transformer mount	10	8	1	32/19,000	12	7¹¹⁄₁₆	3	3

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Chemically treated for high humidity areas or outdoor use when mounted in enclosure.

WP8JC-W

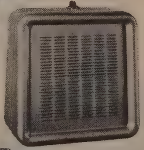
Enclosed Outdoor Speakers/Weather Proof

Model No.	Size (Inch)	Description	Response (Hz.)	Impedance (Ohms)	RMS Power (Watts)	Shipping Wt. (Lbs.)
MOD-4	4⁵⁄₁₆ x 5⁵⁄₁₆ x 2⅜	outdoor speaker	—	8	7	1½
MOD-8	10⅞ x 10⅞ x 5⅜	outdoor speaker	40/15,000	8	12	6¼
HFOD-8	10⅞ x 10⅞ x 5⅜	outdoor speaker	35/19,000	8	15	6¼

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Chemically treated and mounted in a steel case with baked-on finish.

MOD-4



MOD-8

HFOD-8

utah wall baffles

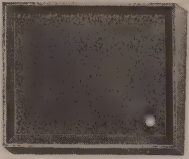
UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Wall Baffles/Transformers & Controls

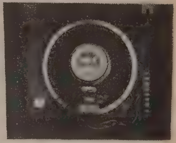
Model No.	Description	RMS Power (Watts)	Shipping Wt. (Lbs.)
UD8-W	baffle only	—	2
UD8A-10W	baffle/speaker/control/transformer	10	5
UD8B-10W	baffle/speaker/control	10	4¾
UD8C-10W	baffle/speaker	10	4¾
UD8D-10W	baffle/speaker/transformer	10	4¾

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Deeply molded walnut grain and fabric grilles are prewired and ready for mounting. Also available: baffle only; baffle, speaker and control only; baffle and speaker only, or; baffle, speaker and transformer only.



UD8A-10W

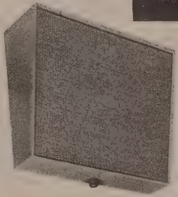


Thin Profile Wall Baffle/Transformers & Controls

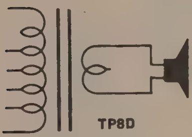
Model No.	PA8ECS Speaker in Baffle, Plus	Size (Inch)	Impedance (Ohms)	Shipping Wt. (Lbs.)
TP8A-W	CV705-WL/control	9½ x 12 x 4	8	4
TP8B-W	control	9½ x 12 x 4	8	3½

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

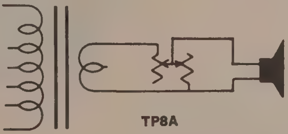
A completely pre-assembled, prewired speaker system.



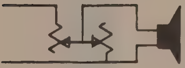
TP8A-W



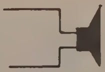
TP8D



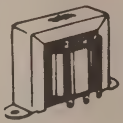
TP8A

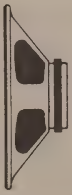


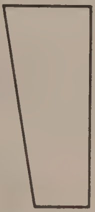
TP8B



TP8C







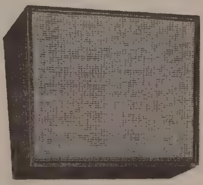
ALL SYSTEMS FEATURE 8", THIN PROFILE SPEAKER

Flat Wall Baffle

Model No.	Size HxWxD (Inch)	Description	Shipping Wt. (Lbs.)
S8-W	9 x 11 x 6	8" flat wall	2
S12-W	13½ x 15⅞ x 7¾	12" flat wall	4

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

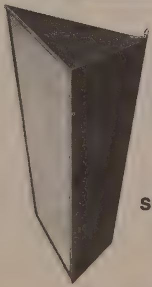
S8-W



Corner Baffle/Sloping

Model No.	Size HxWxD (Inch)	Description	Shipping Wt. (Lbs.)
SS8-W	14 x 15½ x 8⅛	8" sloping corner	3

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.



SS8-W

utah ceiling baffles

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

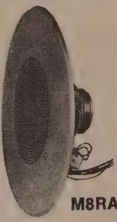
Ceiling Baffle/Prewired Transformer

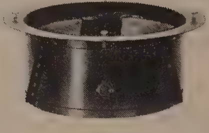
Model Nos.		Mag. Wt. (Oz.)	RMS Power (Watts)	Transformer		Shpg. Wt. (Lbs.)
Brushed Aluminum	White Steel			Type	Volts	
70-8HCW-A	70-8HCW-W	6	10	CV705-WL	70	3½

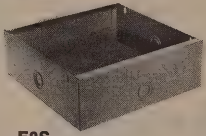
Model No.	Description	Finish	Size	Use With	Shpg. Wt. (Lbs.)
M8RA	Round, Aluminum	Brushed	12¾″ Diameter	E8R, P8R	¾
M8RW	Round, Painted	White	12¾″ Diameter	E8R, P8R	1¼
M8SW	Square, Steel	White	10½″ Square	E8S	1½
E8R	Round Back Box	Anti-Rust	11¾″ O.D. x 4¼″ Deep	(See above)	2½
E8S	Square Back Box	Anti-Rust	9⅝″ Sq. x 3¾″ Deep		3
P8R	Round Plaster Ring	Anti-Rust	13³⁄₁₆″ O.D. x ⁷⁄₁₆″ Deep		½

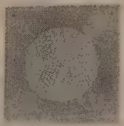
NOTE: E8R has sound deadening compound plus jute pads. E8S has sound deadening only.

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.


M8RA


E8R

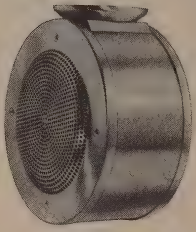

E8S


M8SW

Bi-Directional Baffle

Model No.	Size HxD (Inch)	Description	Shipping Wt. (Lbs.)
M8BD	10 x 5½	Brushed aluminum	2¼

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.


M8BD

6-Speaker Sound Columns

Model No.	Size HxWxD (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	Response (Hz.)	RMS Power (Watts)
SND-2	43⅛ x 8⅛ x 6	6-6″ speakers	6	16	110/12,500	60
SND-3	51 x 11 x 7¾	6-8″ speakers	10	16	50/15,000	80

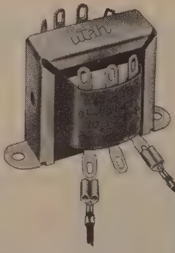
Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

SND-2

Line Transformers

Model No.	Style	Primary Imp./Pwr.	Secdy. Imp. (Ohms)	Max. Power (W)	Core Size	Dimensions			Mtg. Centers	Shpg. Wt. (Lbs.)	Volts
						Ht.	Width	Depth			
CV702WL	A	2/1/.5	8/4	2	⅜ x ⅜	1¼	1½	1¼	1¾	½	70.7
CV704-CT	A	See note above	8	4	⅝ x ⅝	1⅝	2	2⅜	2⅜	¾	70.7
CV705	A	5/2.5/1.25/.62/.31	8/4	5	½ x ⅝	1⅜	1¾	1⅜	2	¾	70.7
CV705WL	A	Same as CV705 but with wire leads instead of lugs									70.7
CV7010	B	10/5/2.5/1.25/.62	16/8/4	10	⅝ x ⅝	2	1⅝	1½	2	¾	70.7
CV7010WL	B	Same as CV7010 but with wire leads instead of lugs									70.7
CV7018	B	18/9/4.5/2.25/1.12	16/8/4	18	¾ x ¾	2⁵⁄₁₆	2	2	2⅜	1¼	70.7
CV252WL	A	2/1/.5	8/4	2	⅜ x ⅜	1¼	1½	1¼	1¾	½	25
CV255	B	5/2.5/1.25/.62/.31	8/4	5	⅝ x ⅝	2	1⅝	1⅝	2	½	25
CV255WL	B	Same as CV255 but with wire leads instead of lugs									25
CV2510	B	10/5/2.5/1.25/.62	16/8/4	10	⅞ x ⅞	2¾	2¼	2⅛	2¾	1¾	25
CV274	A	4, 2, 1, ½, ¼	8	4	½ x ⅝	1⅜	1¹¹⁄₁₆	1⅝	2	½	25/70

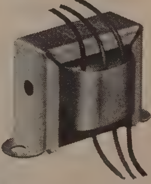
Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.



CV704-CT

STYLE A

STYLE B


TRANSFORMER WITH LEADS

L-Pad Speaker Controls

The same control used in Utah prewired assemblies. 8 watts audio; for 8 ohm speakers. F-5 L-pad control

Heavy duty L-pad for all 8 ohm speakers. 16 watts, 1⅝″ diameter. ⅞″ minimum behind panel. F-10 L-pad control

F-10

utah automotive speakers

UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Deluxe Speakers

Model No.	Size (Inch)	Description	Mag. Wt. (Oz.)	Imped-ance (Ohms)	RMS Power (Watts)	O. D. (Inch)	Mtg. Dia. (Inch)	Depth (Inch)	Shpg. Wt. (Lbs.)
C35EC	3½	Square	3.0	8-10	8	3 7/16 x 4 5/16	3 31/32	1½	¾
C5FC	5	Round	5.5	8-10	7	5	4 11/16	1 13/16	1¾
CS5JFC	5	P.C./Cloth Rolls	10.0	8-10	10	5	4 11/16	2⅛	2
CS5JFC-W	5	P.C./Cloth Rolls/Whizzer	10.0	8-10	10	5	4 11/16	2⅛	2
CS5JVC-W	5	Rd./Cloth Rolls/Whizzer	16.0	8-10	12	5	4 11/16	2 7/16	2¾
C52FC-W	5¼	P.C./Whizzer	5.5	8-10	8	5 9/16	5½	2⅛	1½
C52JC-WFR	5¼	P.C./Foam Rolls/Whizzer	10.0	8-10	10	5 9/16	5½	2⅝	2
CS6JC-W	6	Rd./Cloth Rolls/Whizzer	10.0	8-10	12	6⅝	6 3/16	2⅛	2
C46FC	4 x 6	Oval	5.5	8-10	7	4 3/32 x 6 3/32	3⅝ x 4⅝	1¾	1¼
C57EC-W	5 x 7	Oval/Whizzer	3.0	8-10	8	5 x 7¼	6⅛	2⅛	1¼
C57JC-WCR	5 x 7	Ov./Cloth Rolls/Whizzer	10.0	8-10	10	5 x 7¼	6⅛	2 7/16	2⅛
C58FC-W	5 x 7	Football/Whizzer	5.5	8-10	7	5 x 8 3/16	7 9/16	2¼	1¼
C69FC-MIW	6 x 9	Ov./Whizzer	5.5	10/20/40	10	6⅜ x 9 5/16	4⅝ x 6 9/16	2¾	1½
C69JC-W	6 x 9	Ov./Whizzer	10.0	8-10	15	6⅜ x 9 5/16	4⅝ x 6 9/16	3	2½
C69JC-WCR	6 x 9	Ov./Cloth Rolls/Whizzer	10.0	8-10	15	6⅜ x 9 5/16	4⅝ x 6 9/16	3	2½
C69JC-WCR-48	6 x 9	Ov./Cloth Rolls/Whizzer	10.0	4-8	15	6⅜ x 9 5/16	4⅝ x 6 9/16	3	2½
C69JC-WCRD	6 x 9	Ov./Dual Coil/Whizzer	10.0	8-10	15	6⅜ x 9 5/16	4⅝ x 6 9/16	3	2½
C69JC-CR3	6 x 9	Ov./Cloth Rolls/Co-ax	10.0	8-10	15	6⅜ x 9 5/16	4⅝ x 6 9/16	3	3
C69JVC-WCR	6 x 9	Ov./Cloth Rolls/Whizzer	16.0	8-10	18	6⅜ x 9 5/16	4⅝ x 6 9/16	3 3/16	3¼
C69LXC-WFR	6 x 9	Ov./Foam Rolls/Whizzer	20.0	8-10	30	6 9/32 x 9	4⅝ x 6 9/16	3⅛	5¼
C69LXC-FR3	6 x 9	Ov./Foam Rolls/Co-ax	20.0	8-10	30	6 9/32 x 9	4⅝ x 6 9/16	3⅛	5½
C48HC	4 x 8	Oval	6.0	8-10	10	4 x 8	3 3/16 x 5⅝	2 3/16	1¾
C410-FC-W	4 x 10	Ov./Whizzer	5.5	8-10	8	4 9/32 x 10 1/32	3¼ x 6⅞	2½	2¼
C410JC-WCR	4 x 10	Ov./Cloth Rolls/Whizzer	10.0	8-10	15	4 9/32 x 10 1/32	3¼ x 6⅞	2 11/16	3¼
C410JC-WCRD	4 x 10	Ov./Dual Coil/Whizzer	10.0	8-10	10	4 9/32 x 10 1/32	3¼ x 6⅞	2 11/16	3¼

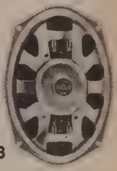
Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

All models feature ceramic magnets and durable baked-on lacquer finish. Ideal for FM radios.

C69LXC-FR3

C52JC-WFR

SP58D-8



SP69D-8

Standard Speakers

Model No.	Size (Inch)	Description	Magnet Wt. (Oz.)	Impedance (Ohms)	RMS Power (Watts)	O.D. (Inch)	Mounting Dia. (Inch)	Depth (Inch)	Shipping Wt. (Lbs.)
SP5B	5	P.C.	1.00	3-4	5	5	4 11/16	1⅞	¾
SP48D-8	4 x 8	Oval	1.20	8-10	6	4 x 8	3 3/16 x 5⅝	2 9/16	1
SP52B-8	5¼	P.C.	1.00	8-10	6	5 5/16	5½	1 31/32	¾
SP60MI	6	P.C.	1.47	10/20/40	6	6 3/16	6 3/16	2¼	¾
SP57D	5 x 7	Oval	1.47	3-4	6	5 x 7¼	6 5/32	2 9/32	1
SP57D-MI	5 x 7	Oval	1.47	10/20/40	6	5 x 7¼	6⅛	2¼	1
SP58D-8	5 x 8	Oval	1.47	8-10	7	5 x 8 3/16	7 9/16	2¼	1
SP69D	6 x 9	Oval	1.47	3-4	7	6⅜ x 9 5/16	4⅝ x 6 9/16	2⅞	1¼
SP69D-8	6 x 9	Oval	1.47	8-10	7	6⅜ x 9 5/16	4⅝ x 6 9/16	2⅞	1¼
SP410CP-8	4 x 10	Oval	1.73	8-10	10	4 9/32 x 10½	3¼ x 6⅞	2 3/16	1¼
SP410CPS-8	4 x 10	Oval	1.73	8-10	10	4 9/32 x 10 1/32	3¼ x 6⅞	2 3/16	1¼
SP410CPS-8A	4 x 10	Oval	1.73	8-10	10	4 9/32 x 10 1/32	3¼ x 6⅞	2 3/16	1¼
SP411E-8	4 x 10	Oval	2.15	8-10	8	4¼ x 11	10 7/16	2⅝	1¼
SP610E-8	6 x 10	Oval	2.15	8-10	8	6⅜ x10 3/16	6 9/16	2⅞	1¼

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

All models have Alnico V magnets and include wiring instructions.

utah automotive speaker kits/accessories

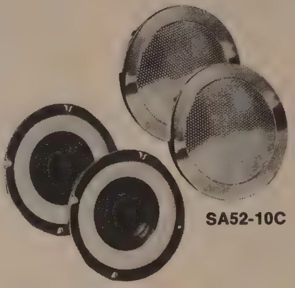
UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Stereo Speaker Kits

Model No.	Speaker Size (Inch)	Description	Mag. Wt. (Oz.)	RMS Power (Watts)	Grille Style	Shpg. Wt. (Lbs.)
SA5-6P	5	Round	6	8	Molded black, square, with silver trim	2¾ lbs.
SA5-10P	5	Round	10	10	Molded black, square, with silver trim	3½ lbs.
SA510-P-48	5	Round	10	10	Molded black, square, with silver trim	3½ lbs.
SA52-6C	5¼	Round	6	8	Round, polished chrome	3 lbs.
SA52-6P	5¼	Round	6	8	Molded black, round, with "padded" front	3 lbs.
SA52-10C	5¼	Round	10	10	Round, polished chrome	4 lbs.
SA52-10P	5¼	Round	10	10	Molded black, round, with "padded" front	4 lbs.
SA52-10P-48	5¼	Round	10	10	Molded black, round, with "padded" front	5 lbs.
SA52-16-C	5¼	Round	16	12	Round, polished chrome	5 lbs.
SA52-16-P	5¼	Round	16	12	Molded black, round, with "padded" front	6 lbs.
SA6-10-P	6	Round	10	10	Molded black, square, with silver trim	5 lbs.
SA69-10N	6 x 9	Oval	10	12	Re-inforced nylon	6 lbs.
SA69-10N/T	6 x 9	Co-ax	10	12	Re-inforced nylon	5 lbs.
SA69-16N	6 x 9	Oval	16	15	Re-inforced nylon	5 lbs.
SA69-20N	6 x 9	Oval	20	30	Re-inforced nylon	5¼ lbs.
SA69-20N/T	6 x 9	Co-ax	20	30	Re-inforced nylon	5½ lbs.

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Everything necessary for complete and easy installation.


SA52-10C

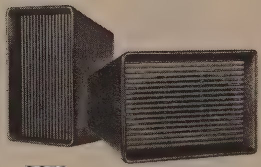
SA6910-N

Speed Mount Stereo Systems

Model No.	Size H x W x D (Inch)	Description	Speaker Size (Inch)	Mag. Wt. (Oz.)	Imped-ance (Ohms)	RMS Power (Watts)	Shpg. Wt. (Lbs.)
SA53	4 x 6		3 x 5	3	8	8	
SA-H30	7 9/16 x 6 9/16 x 2⅞	Molded black/silver trim	5¼	3	8	6	2
SA-H55	7 9/16 x 6 9/16 x 2⅞	Molded black/silver trim	5¼	5.5	8	7	3
SA-H100	7 9/16 x 6 9/16 x 2⅞	Molded black/silver trim	5¼	10	8	10	4¼

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Complete with two enclosed speakers, color-coded wiring, hardware and illustrated instructions.


SA53

Deluxe Rear Deck Kits

Model No.	Size (Inch)	Description	Mag. Wt. (Oz.)	Imped-ance (Ohms)	RMS Power (Watts)	Depth (Inch)	Grille Size (Inch)	Grille Descrip-tion	Shpg. Wt. (Lbs.)
RN69JC-WCR	6 x 9	Ov./Cloth Rolls/Whizzer	10	8-10	12	3	6⅝ x 9½	Nylon/Blk	3¾
RN69JC-CR3	6 x 9	Ov./Cloth Rolls/Co-ax	10	8-10	12	3	6⅝ x 9½	Nylon/Blk	4¼
RN69JVC-WCR	6 x 9	Ov./Cloth Rolls/Whizzer	16	8-10	15	3 3/16	6⅝ x 9½	Nylon/Blk	4½
RN69LXC-WFR	6 x 9	Ov./Foam Rolls/Whizzer	20	8-10	30	3⅛	6⅝ x 9½	Nylon/Blk	5½
RN69LXC-FR3	6 x 9	Ov./Foam Rolls/Co-ax	20	8-10	30	3⅛	6⅝ x 9½	Nylon/Blk	5½
RN410JC-WCR	4 x 10	Ov./Cloth Rolls/Whizzer	10	8-10	12	2 11/16	5⅛ x 11	Nylon/Blk	3¾

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Complete kit, including speakers with massive magnetic structures for beautiful tone and high power.

SA-H100

utah automotive speaker kits/accessories

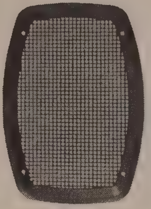
UTAH ELECTRONICS
HUNTINGTON, INDIANA 46750

Grilles for Car Doors and Rear Decks

Model No.	Fits Speaker Size	Grille Size (Inch.)	Description	Finish	Shipping Wt. (Lbs.)
C5P	5	5 7/16 Dia.	Molded	Black	1
2C5P (Pair)	5	5 7/16 Dia.	Molded	Black	1
C5PS	5	5⅜ x 5⅜	Molded	Black	1
2C5PS (Pair)	5	5⅜ x 5⅜	Molded	Black	1
C6PS	6	7⅛ x 7⅛	Molded	Black	1
C57	5 x 7	5½ x 9	Formed Steel	Chrome	1¼
CH57	5 x 7	5½ x 9	Formed Steel	Charcoal	1¼
C69	6 x 9	5½ x 9	Formed Steel	Chrome	1¼
CH69	6 x 9	5½ x 9	Formed Steel	Charcoal	1¼
N69	6 x 9	6⅝ x 9½	Nylon	Black	1½
N410	4 x 10	5⅛ x 11	Nylon	Black	1½

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

A wide choice of quality grilles is available for convenient installation. Includes templates, hardware and instructions.


N69

N410

Rear Deck Speaker Control Kits

Model No.	Description	Comments
RFK-20	20 Ohm Fader	Use with 4-10 Ohm speakers
RFK-100	100 Ohm Fader	Use with 20-40 Ohm speakers

Gap flux density guaranteed to equal or exceed EIA standards for magnet weights listed.

Illustrated wiring instructions and hardware included for easy installation under dash.

SPEAKER CONTROL
FRONT
BOTH
REAR
RKF100

packaging

All raw Utah products are available in these dynamic packages. Their bright, eye-catching colors make them stand out on any shelf or display. Their sturdy construction protects the speakers' delicate moving cones and voice coils, imperative to accurate sound reproduction. Plus, a shrink wrapped inner pack further protects the product from damage and dirt.

utah
12" speaker
utah
8" speaker
utah
5" speaker
utah
6 x 9" speaker

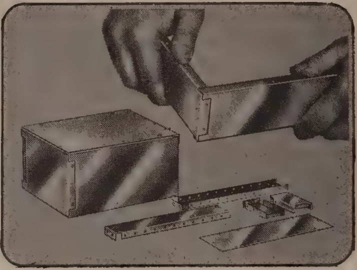
SEEZAK

alpha

THE IDEAL CHASSIS SYSTEM FOR PROTOTYPE AND SHORT RUN APPLICATION

A universal chassis system that offers more than 500 different chassis sizes from a small basic inventory of side rails and panels. All parts of same height are completely interchangeable.

- Easier to work — all mounting can be done from flat panel.
- Complete versatility — all parts of same height, completely interchangeable.
- 10% the storage area of pre-assembled chassis.
- Re-usable.
- Stronger than conventional chassis — heavy gauge aluminum-reinforced covers.



Instead of conventional bulky, difficult-to-work, pre-assembled welded chassis, the SEEZAK system consists of individual front and side rails, and a flat top panel, with optional matching bottom plates and terminal boards.

By means of the patented locking device rails snap together to form a sturdy chassis frame.

The top panel may be firmly fastened to the rails after fabrication, by self-tapping screws (supplied) through the pre-drilled mounting holes on the rails and panel.

Specially designed Phenolic, Fiberglass and Epoxy Glass boards and terminals for SEEZAK chassis available from stock.

CHASSIS PARTS LIST
(For Inventory & Replacement)

To take advantage of the flexibility of the SEEZAK system, order the interchangeable parts on this page to build your chassis inventory.

HOW TO ORDER:
To order parts for a chassis 4″ in width, 7″ in length and 2″ in height, order the following:
1 pr. rails — 2″ high x 4″ wide (R24)
1 pr. rails — 2″ high x 7″ long (R27)
1 panel — 4″ wide x 7″ long (P47)

RAILS

SEEZAK No.	Height-Width	SEEZAK No.	Height-Width
R-12	1″ x 2″	R-217	2″ x 17″
R-13	1″ x 3″	R-33	3″ x 3″
R-14	1″ x 4″	R-34	3″ x 4″
R-15	1″ x 5″	R-35	3″ x 5″
R-16	1″ x 6″	R-36	3″ x 6″
R-17	1″ x 7″	R-37	3″ x 7″
R-18	1″ x 8″	R-38	3″ x 8″
R-19	1″ x 9″	R-39	3″ x 9″
R-110	1″ x 10″	R-310	3″ x 10″
R-111	1″ x 11″	R-311	3″ x 11″
R-112	1″ x 12″	R-312	3″ x 12″
R-113	1″ x 13″	R-313	3″ x 13″
R-114	1″ x 14″	R-314	3″ x 14″
R-115	1″ x 15″	R-315	3″ x 15″
R-116	1″ x 16″	R-316	3″ x 16″
R-117	1″ x 17″	R-317	3″ x 17″
R-22	2″ x 2″	R-44	4″ x 4″
R-23	2″ x 3″	R-45	4″ x 5″
R-24	2″ x 4″	R-46	4″ x 6″
R-25	2″ x 5″	R-47	4″ x 7″
R-26	2″ x 6″	R-48	4″ x 8″
R-27	2″ x 7″	R-49	4″ x 9″
R-28	2″ x 8″	R-410	4″ x 10″
R-29	2″ x 9″	R-411	4″ x 11″
R-210	2″ x 10″	R-412	4″ x 12″
R-211	2″ x 11″	R-413	4″ x 13″
R-212	2″ x 12″	R-414	4″ x 14″
R-213	2″ x 13″	R-415	4″ x 15″
R-214	2″ x 14″	R-416	4″ x 16″
R-215	2″ x 15″	R-417	4″ x 17″
R-216	2″ x 16″		

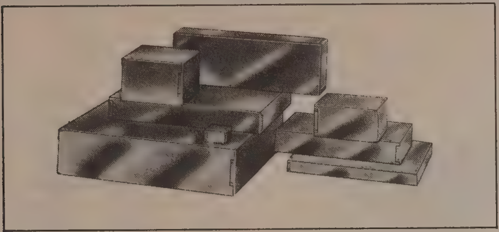
ALL RAILS PACKED WITH MOUNTING SCREWS

PANELS OR PLATES

SEEZAK No.	SEEZAK No.	SEEZAK No.	SEEZAK No.
P-22	P-59	P-715	P-1017
P-23	P-510	P-716	P-1111
P-24	P-511	P-717	P-1112
P-25	P-512	P-88	P-1113
P-26	P-513	P-89	P-1114
P-27	P-514	P-810	P-1115
P-33	P-515	P-811	P-1116
P-34	P-516	P-812	P-1117
P-35	P-517	P-813	P-1212
P-36	P-66	P-814	P-1213
P-37	P-67	P-815	P-1214
P-44	P-68	P-816	P-1215
P-45	P-69	P-817	P-1216
P-46	P-610	P-99	P-1217
P-47	P-611	P-910	P-1313
P-48	P-612	P-911	P-1314
P-49	P-613	P-912	P-1315
P-410	P-614	P-913	P-1316
P-411	P-615	P-914	P-1317
P-412	P-616	P-915	P-1414
P-413	P-617	P-916	P-1415
P-414	P-77	P-917	P-1416
P-415	P-78	P-1010	P-1417
P-416	P-79	P-1011	P-1515
P-417	P-710	P-1012	P-1516
P-55	P-711	P-1013	P-1517
P-56	P-712	P-1014	P-1616
P-57	P-713	P-1015	P-1617
P-58	P-714	P-1016	P-1717

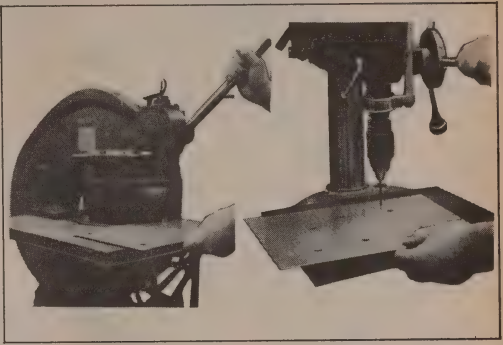
SeeZak chassis from alpha

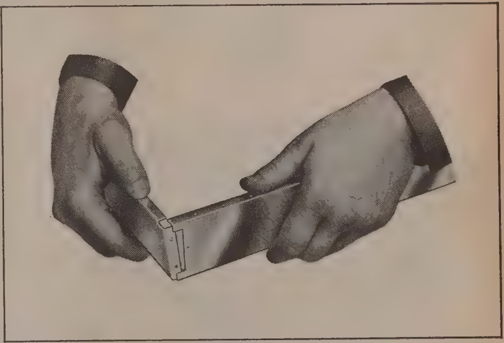
First engineered chassis system designed for prototype and short-run use.

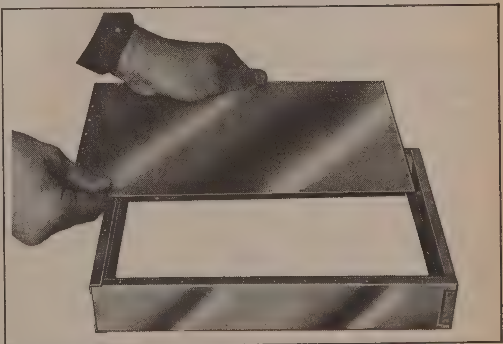


The industry's most complete line of aluminum chassis. 510 sizes from 2" x 2" x 1" to 17" x 17" x 4". Each chassis consists of 4 side rails, matching top paneling and mounting screws. Utilizing the patented SeeZak® chassis locking device.

The many outstanding features of the SeeZak chassis have led to its widespread use in breadboarding, prototype design, and short-run production by leading electronic, aerospace and industrial organizations.







1. EASY TO HOLE-PUNCH, DRILL OR FABRICATE TOP PANEL
It's so much faster and easier to work with a flat panel compared to a bulky, hard-to-fasten-down pre-assembled chassis.

2. CUTS DOWN THE HIGH COST OF ERRORS AND WASTE
Assures accurate chassis layouts.

Hole drilled in wrong position? Last minute layout change? No need to discard a costly complete chassis—simply substitute new top panel. Rails can be reused over and over again.

Drilling and hole punching on flat plate eliminates "oval mounting hole" problem, tool slippage, and errors caused by difficulties in drill and punch positioning.

3. COMPLETE CHASSIS VERSATILITY
A truly universal chassis system, that offers more than 500 different chassis sizes from a small inventory. All parts, of the same height, are completely interchangeable.

For example, two SeeZak chassis frames, a 3" x 6" x 2" and a 4" x 7" x 2" when taken apart, can be recombined to form 6 other chassis frames (3"x4"x2" — 3"x6"x2" — 3"x7"x2" — 4"x6"x2" — 6"x7"x2").

4. SAVES SPACE
Compared to bulky, conventional pre-assembled chassis, takes only 10% the storage area. A complete SeeZak inventory that gives you the parts for 44 chassis can fit into a desk drawer.

5. 510 CHASSIS SIZES
SeeZak offers the largest assortment of chassis and enclosures, plates and panels available—plus a line of matching terminal boards, and specially engineered terminals.

6. REUSABLE—SAVES MONEY
The same chassis rails can be reused over and over again. Simply add inexpensive replacement top panels.

7. STRONGER THAN CONVENTIONAL CHASSIS
Heavy gauge aluminum panels and rails, flanged side rails, reinforced corners, screw-down top and bottom panels, combined to make the SeeZak chassis sturdier and stronger than the conventional welded sheet metal chassis.

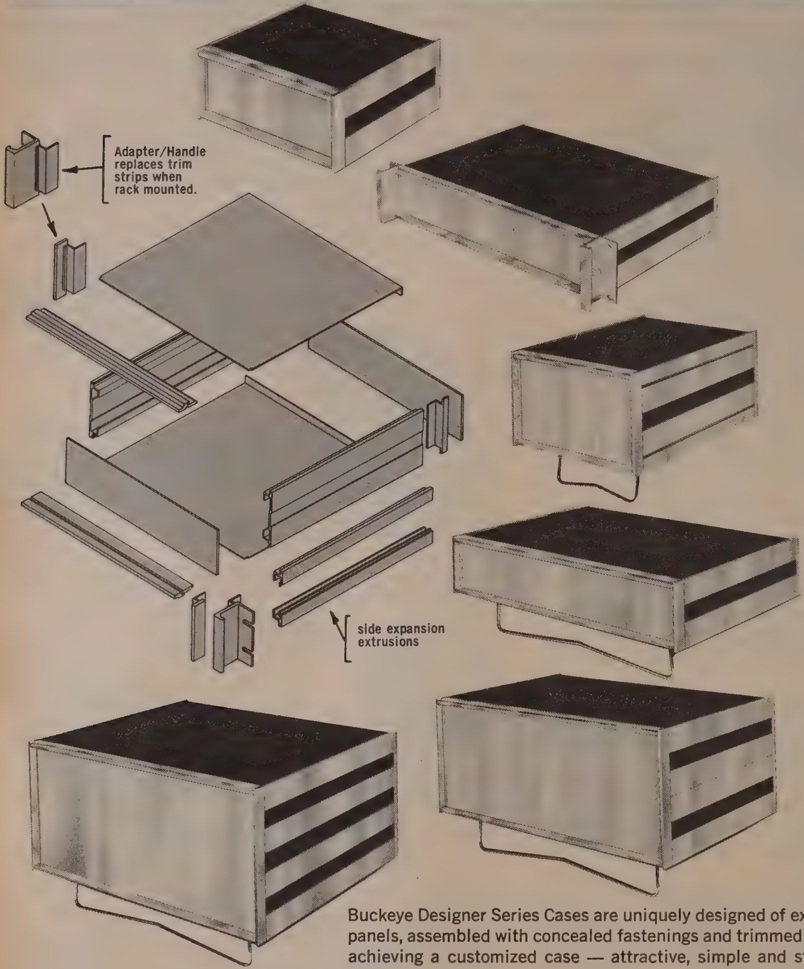
8. REPLACEMENT PANELS, CHASSIS, AND TERMINAL BOARDS AVAILABLE
Instead of the conventional bulky, difficult to work, pre-assembled welded chassis, the SeeZak system consists of individual front and side rails, a flat top panel, with optional matching bottom plates and terminal boards.

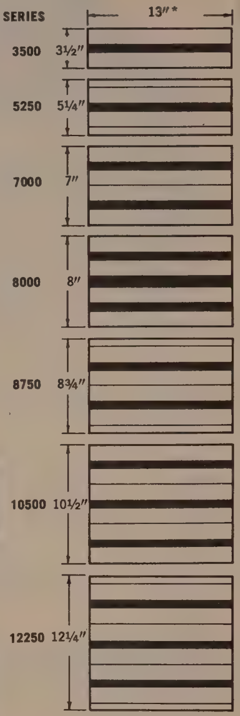
By means of the patented locking device, rails snap together to form a sturdy chassis frame.

The top panel may be firmly fastened to the rails after fabrication by self-tapping screws (supplied through the pre-drilled mounting holes on the rails and panel).

alpha 711 LIDGERWOOD AVENUE • ELIZABETH, NEW JERSEY 07207 • TELEPHONE: (201) 925-8000 • TWX: 710-996-5895

Buckeye DESIGNER SERIES CASES


Adapter/Handle replaces trim strips when rack mounted.
side expansion extrusions



*20″ depth available on 17″ wide cases with no set-up charge.

Buckeye Designer Series Cases are uniquely designed of extruded aluminum shapes and panels, assembled with concealed fastenings and trimmed with suede-type color finishes, achieving a customized case — attractive, simple and strong — at off-the-shelf cost.

EXTERIOR ACCESSORIES

BAILS

RETRACTABLE TILT STANDS

Case Width	Bail Size	Part No.
5.70	3½″	MP 40008-7
8.54	6″	MP 40008-8
11.37	8″	MP 40008-9
17.04	14″	MP 40008-10

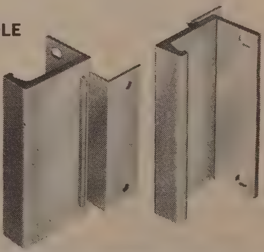
The Buckeye Self-Locking Bail adds extra convenience, completeness and decorative appearance to your instruments. Bright chrome finished 3⁄16″ gracefully curved rod comes complete with four molded feet. The two durable nylon front feet are uniquely designed to snap-lock bail into either a fold-away or elevated position.

RACK MOUNT

RACK ADAPTER AND HANDLE EXTRUSIONS

For Case Model	Part No.
3504	MP 40086-1
5254	MP 40086-2
7004	MP 40086-3
8754	MP 40086-4
10504	MP 40086-5

The Rack Adapter/Handles are especially designed extrusions that replace the standard right and left front trim extrusions for rack mounting the case and thus become a neat appearing, integral part of the unit.



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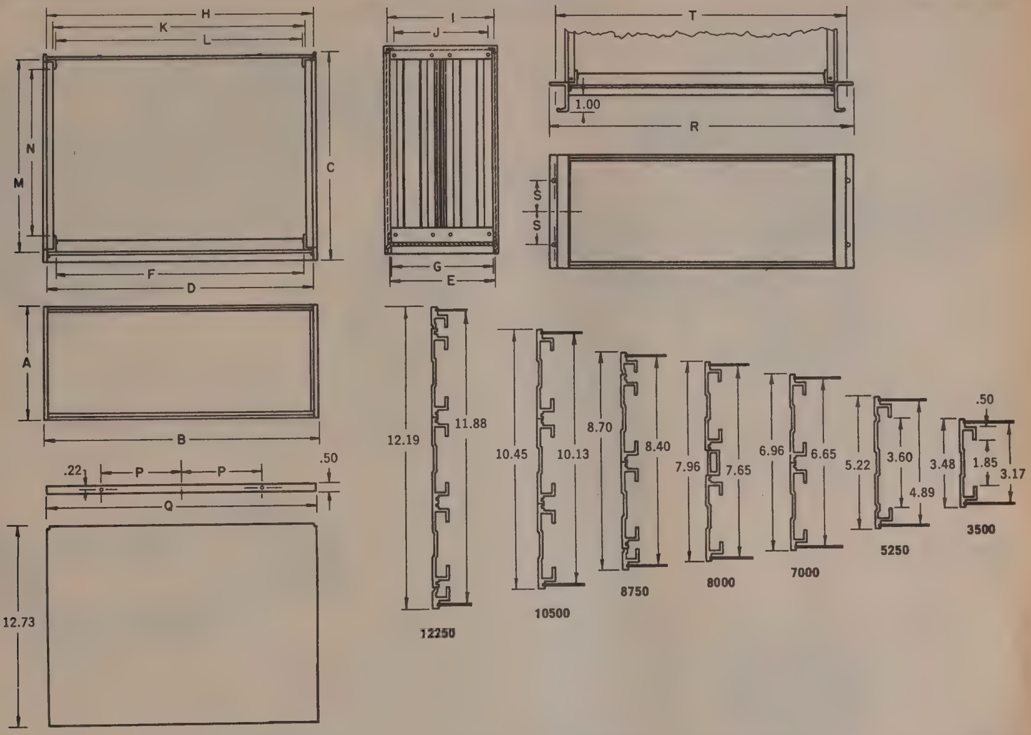
DESIGNER SERIES CASES

Buckeye



Buckeye Cases are designed in industry standard as well as special heights. Stock sizes available are shown in the chart at right. The engineered design excellence of this series permits depth variation, as an option, and an extremely broad range of case sizes to achieve a customized enclosure with standard components.

Buckeye Cases are strong, yet simply constructed with concealed fastenings — attractive, with anodized satin aluminum and colorful suede-finish trim, yet functional for the most sophisticated electronic equipment. Specialized chassis fabrication, piercing and silk-screening can be provided upon request.

Buckeye also manufactures: quality instrument knobs, racks, PCB modular guides, retractable tilt stands and other styles of enclosures.

Model No.	Outside Dimensions			Front Panel				Rear Panel			Inside Dimensions							Mounting Centers	
				Actual		Usable		Actual		Usa.	Width		Depth						
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R*	S*	T*
3501	3.48	5.70	13.00	5.27	2.99	4.25	2.86	5.48	3.08	2.27	4.44	4.09	12.06	10.50	1.50	5.42			
3502	3.48	8.54	13.00	8.11	2.99	7.09	2.86	8.32	3.08	2.27	7.28	6.93	12.06	10.50	2.00	8.26			
3503	3.48	11.37	13.00	10.94	2.99	9.92	2.86	11.15	3.08	2.27	10.11	9.76	12.06	10.50	3.00	11.09			
3504	3.48	17.04	13.00	16.61	2.99	15.59	2.86	16.82	3.08	2.27	15.78	15.43	12.06	10.50	5.00	16.76	19.03	1.50	18.32
5251	5.22	5.70	13.00	5.27	4.73	4.25	4.60	5.48	4.82	3.99	4.44	4.09	12.06	10.50	1.50	5.42			
5252	5.22	8.54	13.00	8.11	4.73	7.09	4.60	8.32	4.82	3.99	7.28	6.93	12.06	10.50	2.00	8.26			
5253	5.22	11.37	13.00	10.94	4.73	9.92	4.60	11.15	4.82	3.99	10.11	9.76	12.06	10.50	3.00	11.09			
5254	5.22	17.04	13.00	16.61	4.73	15.59	4.60	16.82	4.82	3.99	15.78	15.43	12.06	10.50	5.00	16.76	19.03	1.13	18.32
7001	6.96	5.70	13.00	5.27	6.47	4.25	6.34	5.48	6.56	5.75	4.44	4.09	12.06	10.50	1.50	5.42			
7002	6.96	8.54	13.00	8.11	6.47	7.09	6.34	8.32	6.56	5.75	7.28	6.93	12.06	10.50	2.00	8.26			
7003	6.96	11.37	13.00	10.94	6.47	9.92	6.34	11.15	6.56	5.75	10.11	9.76	12.06	10.50	3.00	11.09			
7004	6.96	17.04	13.00	16.61	6.47	15.59	6.34	16.82	6.56	5.75	15.78	15.43	12.06	10.50	5.00	16.76	19.03	2.00	18.32
8001	7.96	5.70	13.00	5.27	7.47	4.25	7.34	5.48	7.56	6.75	4.44	4.09	12.06	10.50	1.50	5.42			
8002	7.96	8.54	13.00	8.11	7.47	7.09	7.34	8.32	7.56	6.75	7.28	6.93	12.06	10.50	2.00	8.26			
8003	7.96	11.37	13.00	10.94	7.47	9.92	7.34	11.15	7.56	6.75	10.11	9.76	12.06	10.50	3.00	11.09			
8004	7.96	17.04	13.00	16.61	7.47	15.59	7.34	16.82	7.56	6.75	15.78	15.43	12.06	10.50	5.00	16.76			
8751	8.70	5.70	13.00	5.27	8.21	4.25	8.08	5.48	8.30	7.50	4.44	4.09	12.06	10.50	1.50	5.42			
8752	8.70	8.54	13.00	8.11	8.21	7.09	8.08	8.32	8.30	7.50	7.28	6.93	12.06	10.50	2.00	8.26			
8753	8.70	11.37	13.00	10.94	8.21	9.92	8.08	11.15	8.30	7.50	10.11	9.76	12.06	10.50	3.00	11.09			
8754	8.70	17.04	13.00	16.61	8.21	15.59	8.08	16.82	8.30	7.50	15.78	15.43	12.06	10.50	5.00	16.76	19.03	2.88	18.32
10501	10.45	5.70	13.00	5.27	9.95	4.25	9.83	5.48	10.05	9.23	4.44	4.09	12.06	10.50	1.50	5.42			
10502	10.45	8.54	13.00	8.11	9.95	7.09	9.83	8.32	10.05	9.23	7.28	6.93	12.06	10.50	2.00	8.26			
10503	10.45	11.37	13.00	10.94	9.95	9.92	9.83	11.15	10.05	9.23	10.11	9.76	12.06	10.50	3.00	11.09			
10504	10.45	17.04	13.00	16.61	9.95	15.59	9.83	16.82	10.05	9.23	15.78	15.43	12.06	10.50	5.00	16.76	19.03	3.75	18.32
12254	12.19	17.04	13.00	16.61	11.69	15.59	11.57	16.82	11.79	10.98	15.78	15.43	12.06	10.50	5.00	16.76	19.03	4.62	18.32

*Dimensions apply when Rack Adapter Handles are added to 17″ wide case. Add Suffix "RM" to Model Number; Example: 3504-RM

20″ DEPTH AVAILABLE ON ALL 17″ WIDE CASES WITH NO SET-UP CHARGE.

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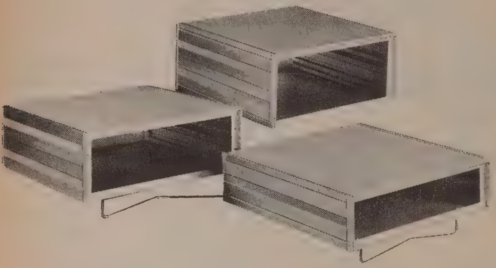
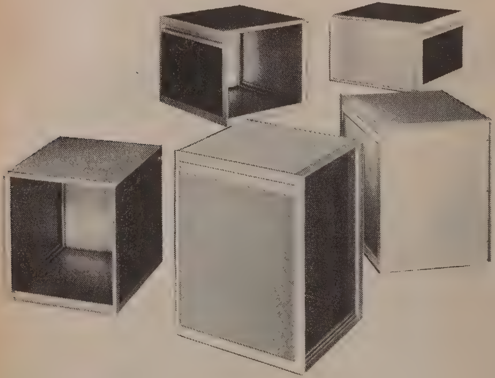
Buckeye ENCLOSURES

FRONT-LOADING CASES



Decorative 19″ cases to house existing instruments in custom fashion at off-the-shelf cabinet cost. Stock units in five sizes from 5¼″ to 12¼″. Durable anodized aluminum trimmed with suede-finish colors. Each case complete with four nylon feet and retractable, self-locking tilt-stand.

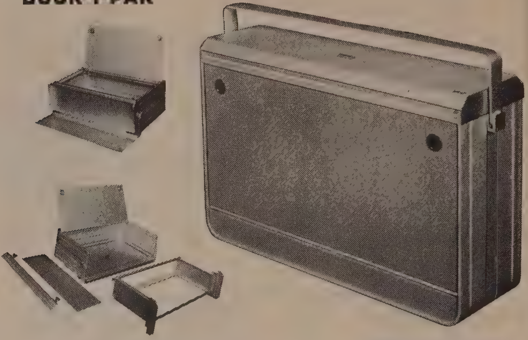
CABINETS



Newest professional - look for instrument enclosures. The strength of the anodized aluminum extrusions and colorful suede-finish panel construction meet the rigid standards to which Buckeye has adhered since 1902.

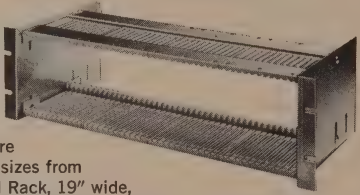
Universal 19″ front panels, with heights 12.25″ to 28″, give packaging versatility at a budget price. All models have integral handles, extrusions with thread-tracks, to mount braces and brackets, and easy access back panels. Slip-in front panel or open-front models available from stock.

BUCK-I-PAK



The first truly portable instrument case designed for travel. Removable chassis for assembly line component installation. Hinged control cover and handle fold neatly underneath. Top access panel opened by flush mounted pushbuttons. Extruded aluminum design with suede-finish colors.
11½″ h. x 18″ w. x 5¼″ d.

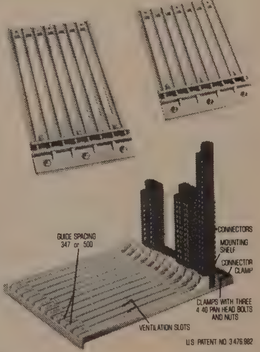
RACKS



The popular Buckeye Racks are available in four sizes from the standard Full Rack, 19″ wide, which accommodates four sets of guides, to the ¼ rack incorporating one set of either 4½″ or 6″ guides. The racks are designed of aluminum support bars connected to flanged end plates to facilitate stacking or mounting into stationary systems. To give maximum versatility, end plates have adjustment slots to accommodate board widths of 2¼″ to 4¾″. A non-adjustable ¼ rack for standard 22 pin edge-type connectors is also available as a stock item.

GUIDES

Buckeye Bord-pak Guides are vented ABS modules with uniquely designed alignment studs on mounting shelf and clamp to provide you with the best time and labor-saving innovation ever offered for packaging modular circuitry. All models have simplified connector assembly feature and are available for 4½″ or 6″ board lengths spaced either .437 or .500 for maximum ventilation.



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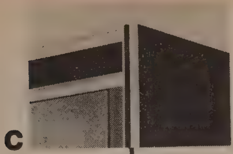
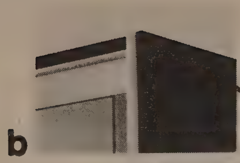
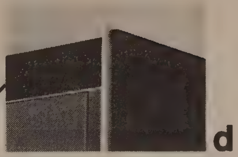






b Ensemble No. 33
Amco Colors Blue with Black Vinyl Inlay.

c Ensemble No. 6
Amco Colors Red and Dark Blue with Black Vinyl Inlay.

d Ensemble No. 31
Amco Colors Chutney and Russet with Walnut Vinyl Inlay.

e Represents a close reproduction of Amco's basic standard colors. There are over 125 professionally developed combinations in Catalog 310-A to assist you in your selection . . . presented in true color reproduction.

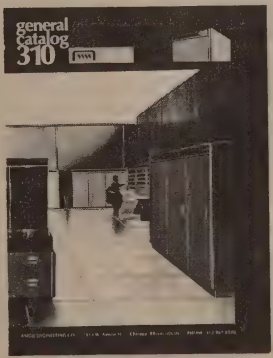
a This Semi-Custom frame is shown utilizing Interface 33 Ensemble 22. Captions b, c & d picture 3 additional variations of Interface 33. Amco Colors Gold and Earth Brown with Brown Leather Vinyl Trim Inlay.

Unprecedented Styling & Versatility

Interface 33—A system of professionally coordinated styling, developed around Amco's basic Modular Frames. These frames being structurally independent of exterior surfaces permitted the accomplishment of this unique and practical Styling System.

Utilizing selections of horizontal aluminum cowling trims with vertical aluminum trims, combined with Vinyl Inlays and virtually unlimited color combinations, one can visualize the infinite possibilities of Interface 33.

To assist in your selections, but certainly not limited to, over 50 professionally developed combinations are presented and may be ordered by Ensemble numbers.



To add to the depth of selection, Amco's two Modular Semi-Custom and Custom systems (offering choice of frame structure) are integrated with Interface 33.

Frame Panel Widths of 19", 24" and 30" and Frame Depths of 18½", 22", 25½" and 30" are all Standard.

All Amco enclosures, accessories and/or components guaranteed 100% against defective material or workmanship for a period of one year from date of purchase.

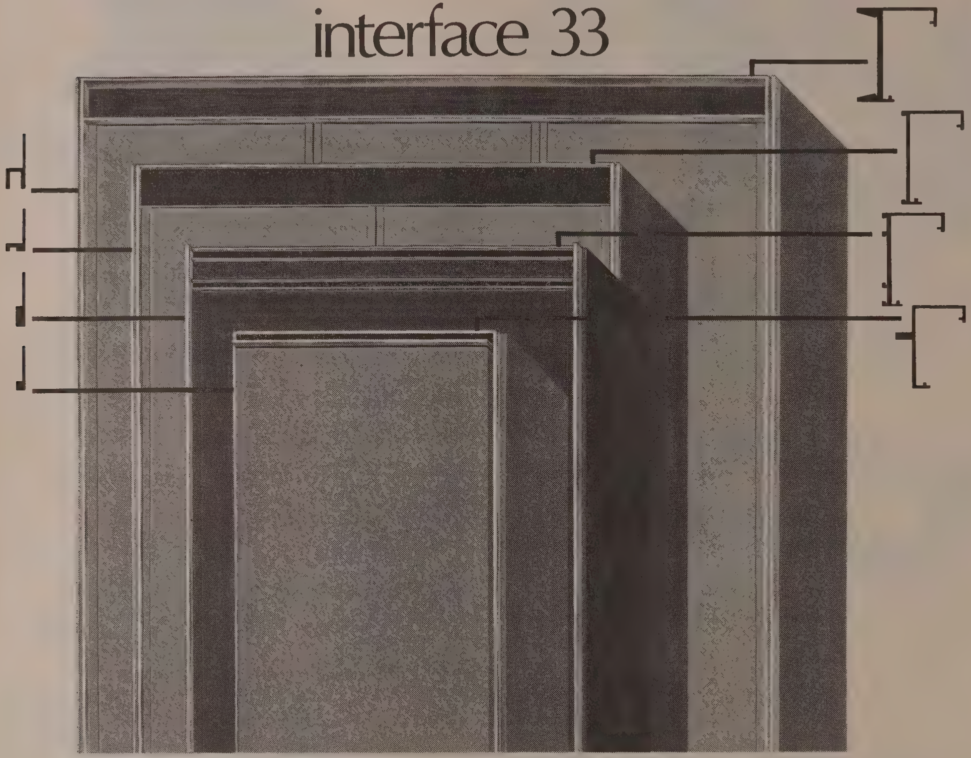
AMCO® *. . . in step with the future . . .*

Amco Engineering Co./7333 W. Ainslie Street/Chicago, Illinois 60656/Phone: 312/867-8500

The Ultimate!

modular consoles with superb styling and function

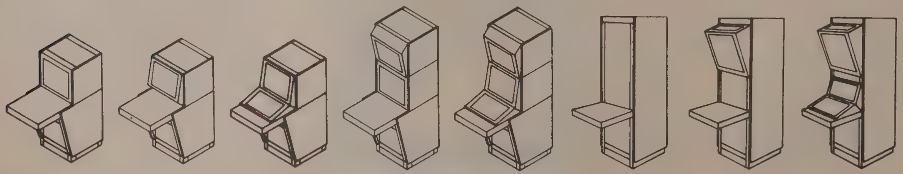
interface 33



Interface 33 is beauty in depth. The custom styling appearance and variety of arrangements provide the *ultimate* compliment to the equipment installed in these consoles.

Standards include a full range of heights, plus selection of depths 22,25½ & 30 inches, and panel widths 19, 24 & 30 inches which may be combined in series mounted consoles. This provides you with economy, custom appearance, and flexibility of arrangement.

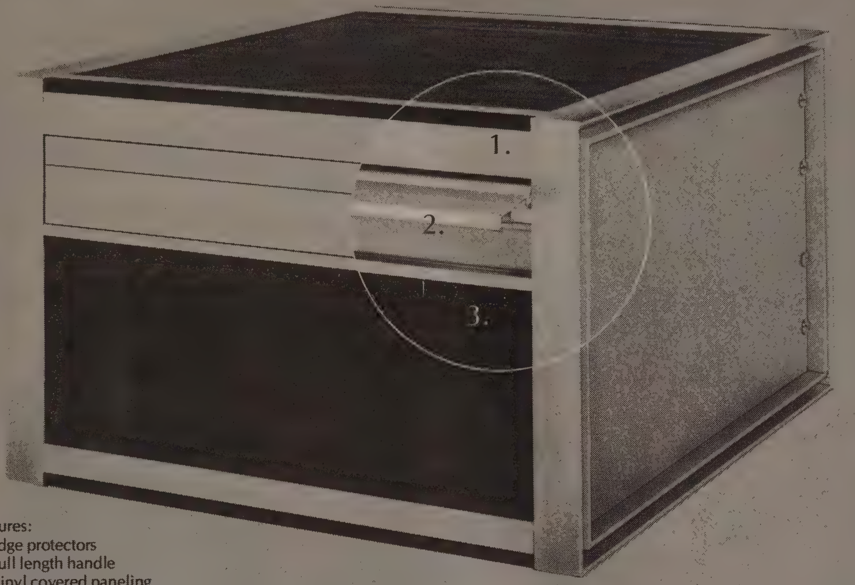
Contact us for your free catalog, color selector guide, and the name of our nearest sales representative and distributor.



AMCO®

Amco Engineering Co./7333 W. Ainslie Street/Chicago, Illinois 60656/Phone: 312/867-8500

A truly beautiful instrument cabinet

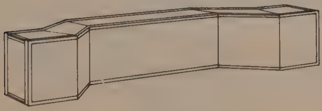


Features:
1. Edge protectors
2. Full length handle
3. Vinyl covered paneling
4. Any pie angle required
5. Panel mounting—horizontal, vertical, or in combination.
6. Economy in size modification—any direction
7. Heavy duty construction

Poly-Dimensional (P/D) Instrument Cabinet (Patents pending)

Cabinet appearance does create a strong impression on customers regarding the quality of the equipment mounted within it. That's why we've stressed design in our new P/D cabinet and backed it up with engineering features, flexibility and quality, making it a truly beautiful cabinet.

Its versatility is fantastic! In addition to the standard sizes, its structural design economically satisfies virtually any desired height, width or depth. Our pie section design allows angular arrangements of any specified degree from 0° on. Its hinged handle is always the full depth of the cabinet for perfectly balanced lifting. And we haven't forgotten the "little" details either, like the edge protectors and vinyl covered paneling. Color selections are available for both paneling and anodized aluminum trim. Our distributors offer immediate delivery on conventional orders, while special sizes and colors require additional time. Contact us for your free catalog 400.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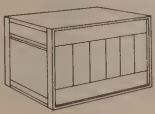
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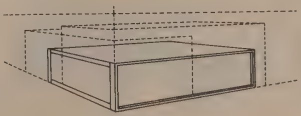
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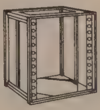
7.

AMCO

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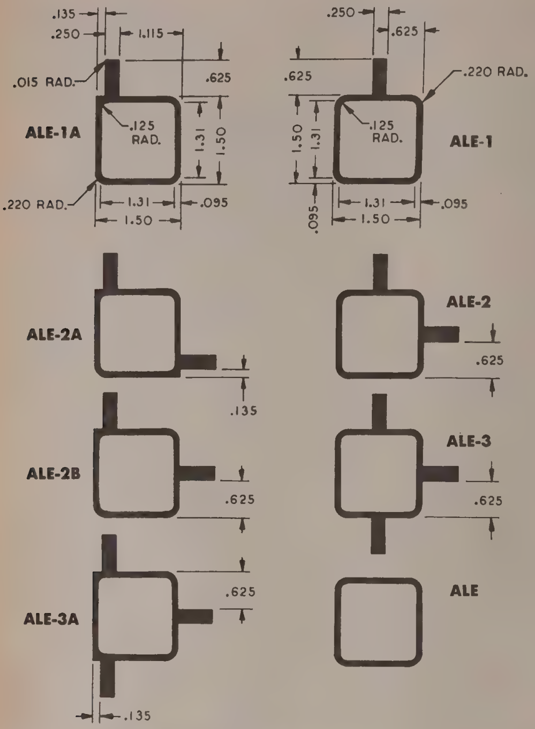
Amco Aluminum Structures


.135
.250
1.115
.015 RAD.
.625
ALE-1A
.125 RAD.
1.31
1.50
.220 RAD.
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.095
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.250
.625
.220 RAD.
.625
1.50
1.31
.125 RAD.
ALE-1
.095
1.31
.095
1.50
ALE-2A
.135
ALE-2
.625
ALE-2B
.625
ALE-3
.625
ALE-3A
.625
.135
ALE

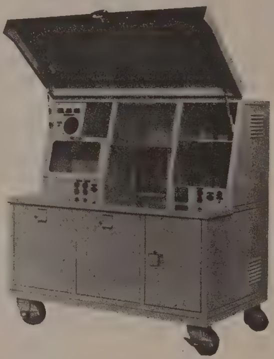
Heavy duty system Cat. 203
Lightweight system Cat. 208

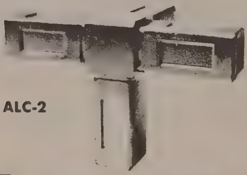
These extremely versatile systems provide both savings in time as well as money on a variety of structures.

Some suggested applications are:

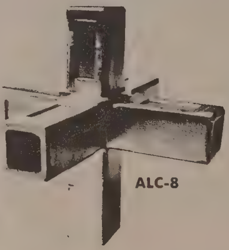
Consoles — racks — weather proof enclosures — shipboard and mobile enclosures — government high shock and vibration requirements — sub-floor platforms — assembly tables — portable field cabinets.

Virtually no size restriction
Angles from 0° to 120°
Single section lengths from 6″ to 20′ for height, width or depth.
High strength alloy 6061-T6

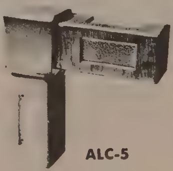




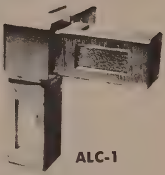
ALC-2



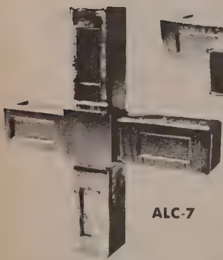
ALC-8



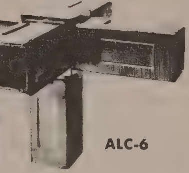
ALC-5



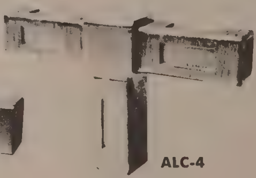
ALC-1



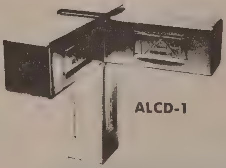
ALC-7



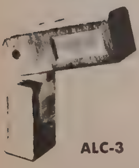
ALC-6



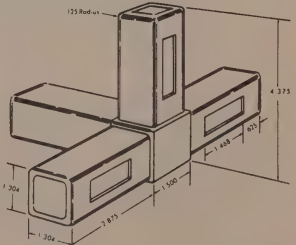
ALC-4



ALCD-1



ALC-3


.125 Radius
4.375
.625
1.468
1.500
1.304
2.875
1.304

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There is more catalog data available to you at your fingertips than ever before...when you

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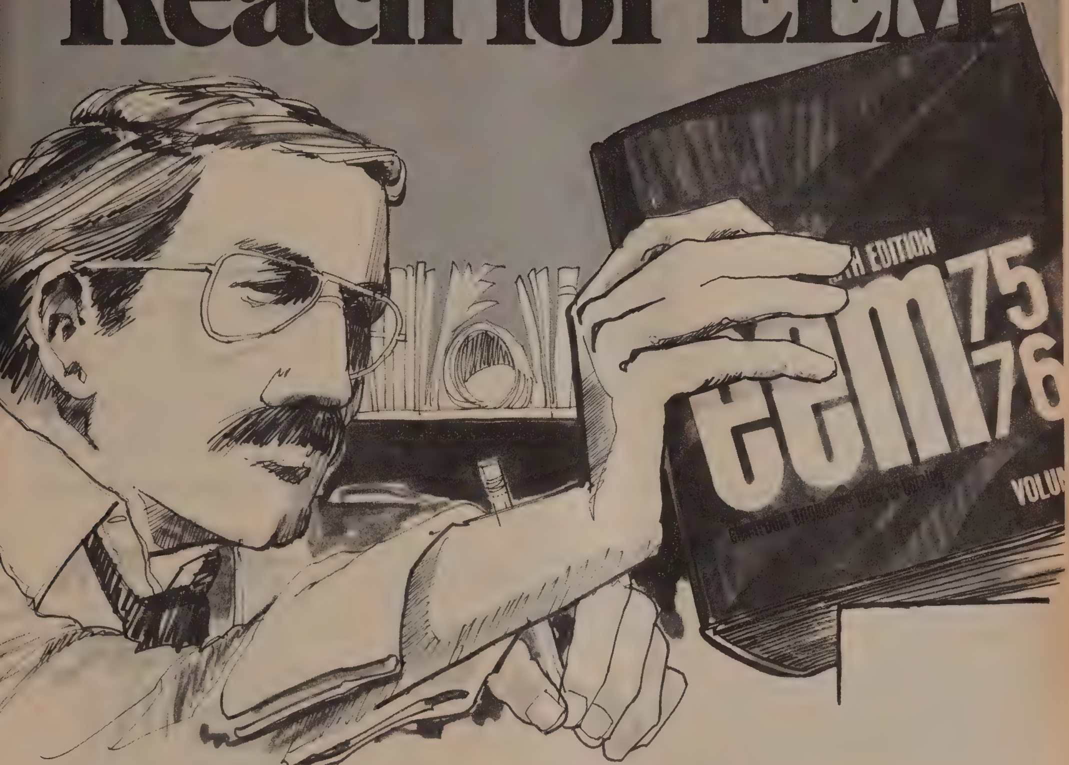

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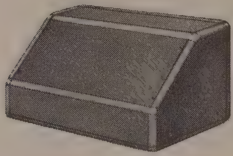
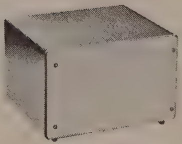
There is a standard Bud Product for nearly every application.

SERIES 2000

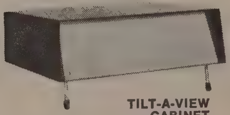


SLOPING FRONT CABINET
MADE FROM STANDARD IMLOK
EXTRUSIONS & CONNECTORS

SERIES 60



CONTOUR CABINET



TILT-A-VIEW CABINET

COMPUCAB

these are only a few of the 3000 Bud products available for immediate delivery.

The Bud Network of Sales Representatives: Contact Them for Additional Information.

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TRINKLE SALES, INC.
Cherry Hill, New Jersey
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WILLGOLD ELECTRONIC SALES CORP.
Rockville Centre, New York
(516) 764-4022

or... We'll alter a standard or create an original

It's your brainchild: That new or redesigned instrument or system. Now to find the cabinet, rack or enclosure to house it.

No problem. Deal with Bud!

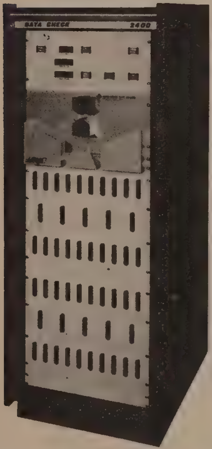
Our special fabrication service is as comprehensive as our standard product line.

A practical and, in many cases, the most economical method of providing a special housing is to alter a standard Bud product to fit your application. That's one approach.

Another is to design an original housing; submitting a quote on a normal production run, then producing a finished quality product. On time!

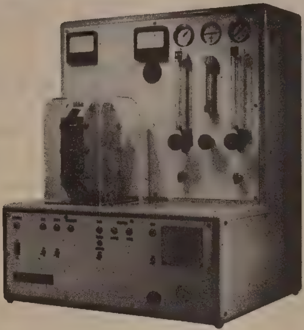
For short runs or pilot models, there's the Bud Imlok system which enables you... or Bud... to design, alter, refine, then build a housing that fits your product and budget to a T.

For further information and quotes on special housings, contact your Bud Representative.

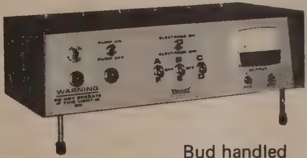


The Bud Series 2000 cabinet rack was altered to house this automatic continuity test system. Standard rack panels were modified to provide required access for testing.

Test stand for determining flow rate of various substances was fabricated from standard Imlok extrusions and connectors. Sheet aluminum panels completed the structure.



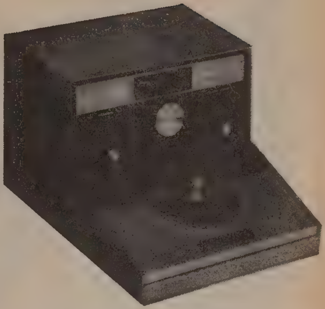
By altering a standard Tilt-A-View cabinet, Bud developed this enclosure for equipment which controls the action of an electrode which disintegrates a predetermined shape or aperature in metal.



Bud handled all silk screening, fabricating and finishing operations.

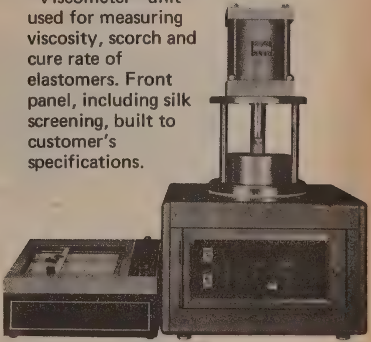
Bud adapted a standard Contour Utility cabinet to house this pulse generator. Front panel was punched to permit installation of switches and controls. Silk screened legends were part of the Bud special fabrication package.

PULSE GENERATOR
REPETITION RATE
WIDTH
SPACING
AMPLITUDE
POLARITY
POS
NEG
SYNC
GND
OUTPUT
WESTBURY, L.I., NEW YORK



This special enclosure, based on the Bud Compucab design, houses an audiometer unit for a system used for the selection and fitting of hearing aids.

Cabinet is an adaptation of the Bud Series 60 cabinet rack and houses a "Viscometer" unit used for measuring viscosity, scorch and cure rate of elastomers. Front panel, including silk screening, built to customer's specifications.



BUD

"The Housing Authority"

BUD RADIO, INC.
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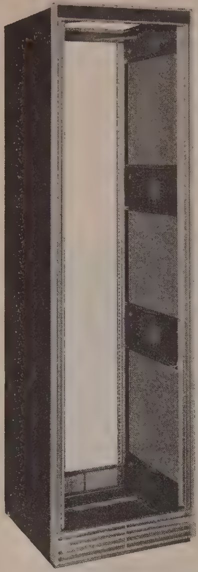
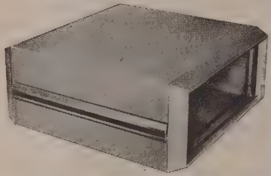
216/946-3200 TWX 810-427-2604

CABTRON
SYSTEMS INC.


RACK CABINET

CONSOLE FRAME


INSTRUMENT CABINET

DESK CABINET AND DESK LEG

HEAVY-DUTY CUSTOM CONFIGURATIONS

standard MODULAR ELECTRONIC CABINETS

Cabtron Systems has a Standard Metal Cabinet for every Electronic requirement featuring many exclusive design features developed over the many years of experience in the Electronic field.

TEN STANDARD STYLES

- Rack Cabinets
- Console Cabinets
- Bench Cabinets
- Bence Turrets
- Desk Turrets
- Instrument Cabinets
- Test Carts
- Production Benchs
- Production Desks
- Desk Cabinets

Cabtron Systems offers the largest selection of functional accessories including air ducts, base or rack blowers, casters, fans, shelves, etc.

Cabtron Systems engineering staff is available to assist you in determining the best application in standard or custom modular cabinetry.

For design assistance or for our complete Cabtron Systems Packaging Manual, write:

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SYSTEMS INC.

200 NORTH ANETS DRIVE
NORTHBROOK, ILLINOIS 60062

CABTRON
SYSTEMS INC.

PDQ → SHIPPED IN TEN DAYS!

* PRICE * DELIVERY * QUALITY

◀ **C-SERIES**

The custom styling of the CABTRON C-Series rack cabinet features modular construction of all components. Frames may be joined in any number with the continuous aluminum top trim and grill creating a one unit appearance.

S-SERIES ▶

The popular styling of the CABTRON S-Series rack cabinet incorporates the same modular construction features as the C-Series cabinets with the exception of the aluminum top trim and grill.

Both series are fabricated of prime 14-gauge steel and feature all-welded construction. Both series will accept the exclusive CABTRON blower system which utilizes the bottom grills for air-intake instead of vertical panel space.

Cabinets are available in four colors: Light Gray, Dark Gray, Sky Blue, and Black.

Call or write CABTRON SYSTEMS, INC. *FOR ADDITIONAL INFORMATION.*

19" PANEL WIDTH H-ASSEMBLY CABINETS

1 — FRAME 2 — SIDE PANELS 2 — SIDE BARS 1 — TOP PANEL LOUVERED 1 — REAR FLUSH DOOR

C-SERIES

CABINET NUMBER	PANEL HEIGHT	CABINET DEPTH	PRICE	
			STYLE 1*	STYLE 2*
AFCB-1961-25H	61¼"	25½"	$327.23	$337.79
AFCB-1970-25H	70"	25½"	$351.70	$361.94
AFCB-1961-30H	61¼"	30¾"	$339.20	$349.76
AFCB-1970-30H	70"	30¾"	$364.27	$374.51

S-SERIES

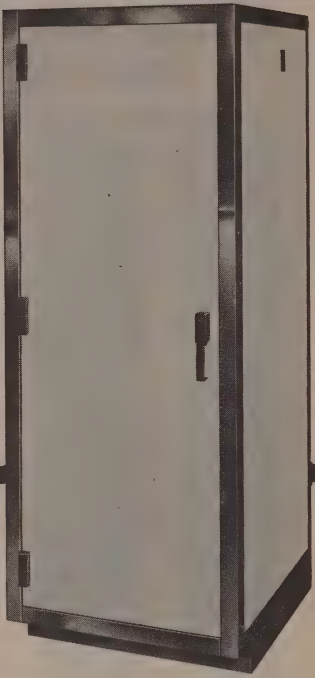
CABINET NUMBER	PANEL HEIGHT	CABINET DEPTH	PRICE
AFSB-1961-25H	61¼"	25½"	$292.24
AFSB-1970-25H	70"	25½"	$313.11
AFSB-1961-30H	61¼"	30¾"	$313.34
AFSB-1970-30H	70"	30¾"	$335.33

*STYLE 1 — Aluminum Trim
*STYLE 2 — Aluminum Trim With Either Black Or Walnut Vinyl Inserts Available. *Please Specify When Ordering.*

CABTRON
SYSTEMS INC.
200 N. Anets Drive, Northbrook, Illinois 60062 (312)498-6090

HEAVY DUTY CABINETS

The EQUIPTO Enclosure System features rugged 14 gauge cold rolled steel multi-formed channel arc welded frames with sway-proof corners, movable side struts, heavier 12 gauge removable Pontoon Bases, 3/16" thick recessable Panel Mounting Angles, 16 gauge sag-proof flush mounted Doors with modern hardware and positive latching, and 16 gauge flush mounted Side Panels. This System of Electronic Cabinets is a proven concept for housing electronic equipment and instrumentation in the most practicable ways possible, with the emphasis on ruggedness, modularity, function and human engineering; Value Engineered to make these Cabinets the Standard to which all others must be compared. The widest selection of Accessories is available to ensure the flexibility and functional advantage to be gained thru the use of EQUIPTO Enclosures.



VERTICAL RACK CABINETS

SLOPED FRONT VERTICAL RACKS

SLOPED FRONT CONSOLES

Special cabinets

In addition to the two great lines of Standard Modular Electronic Cabinets we have shown here, we can take care of any other requirement you may have — from Special Chassis to Special Consoles — built to your design or to ours.

Send us your prints, or let us make a proposal. More than 25 years of engineering, designing, and manufacturing experience in making Hardware for Electronics say that we can do the job.

Special products

Firm, written proposals, with drawings where required, along with price quotations will be made promptly on small or large quantities of Special Cabinets or Special Products, or on modifications to our standard cabinets.

THE
EQUIPTO
ENCLOSURE
SYSTEM

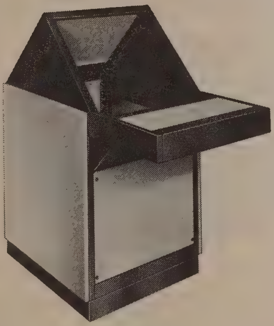
Manufactured by
EQUIPTO ELECTRONICS CORPORATION
435 Woodlawn Avenue • Aurora, Illinois 60507 • Phone 312 897-4691

MEDIUM DUTY CABINETS

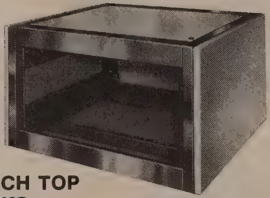
The CHALLENGER® SYSTEM of Modular Electronic Cabinets challenges any other available in its class for economy, versatility, function, and modularity with no sacrifice in the traditional EQUIPTO quality. These Cabinets feature 14 gauge cold rolled steel "U" channel spotwelded frames with 16 gauge side struts, 14 gauge removable bases, 11 gauge recessable Panel Mounting Angles, 16 gauge Flush or Face Mounted Doors with highly functional lift handles and two-point latching, and 16 gauge face mounted Side Panels. New and diversified products demand a more compatible selection of cabinets for housing electronic equipment and instrumentation; the CHALLENGER® SYSTEM meets that demand with a wide variety of cabinet styles and a varied selection of Accessories, all designed to be functional and priced to be competitive.

VERTICAL RACK CABINETS

SLOPED FRONT CONSOLES



LOW PROFILE CONSOLES



BENCH TOP RACKS

When you think of cabinets— contact us!

DOUBLE SLOPE CONSOLES

THE
CHALLENGER® System
OF MODULAR ELECTRONIC CABINETS

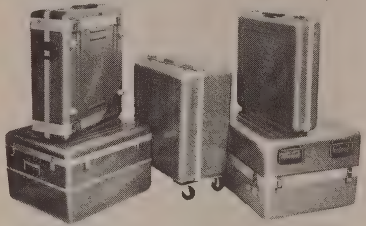
Manufactured by
EQUIPTO ELECTRONICS CORPORATION
435 Woodlawn Avenue • Aurora, Illinois 60507 • Phone 312 897-4691

ECS

DESIGN ALTERNATIVES

FROM THE CASE INNOVATORS

1200 STANDARD SIZES



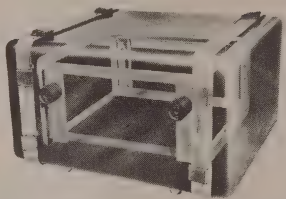
ECS pressure molded fiberglass cases offer durability and performance unequalled by any other case material. For MIL-Spec and commercial applications, check our standard case sizes and features.

- You can order 1200 different case sizes by part number.
- 30 standard colors
- Standard designs include
  - Transit Cases
  - Valise Cases
  - Carrying Cases
  - Wheeled Cases
  - MIL-C-4150 & MIL-T-4734 Cases
  - MIL-T-21200, MIL-T-28800 Transit Cases Combination Cases
- Shock-mounted Cases
- Custom designs for special applications
- Molded or fabricated foam cushions

SEND FOR OUR FREE 80 PAGE CATALOG

STANDARD CASE CATALOG
Environmental Container Systems

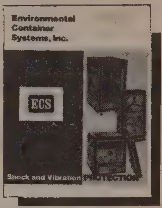
TRANSPORTABLE CABINETS



U.S. PATENT 3,482,895

ECS transportable cabinets are ideal for portable electronic systems. Standard EIA-RETMA dimensions simplify the combining of virtually any group of instruments and accessories.
Typical applications include Military Calibration Systems, Offshore Instrumentation, Flight Line Equipment, Portable Medical and Dental Equipment, Time and Frequency Standards, and Telephone Test Equipment. Seventeen standard sizes can be ordered with rack heights from 5.37 inches to 47.37 inches.

SEND FOR OUR FREE 20 PAGE CATALOG OF CABINETS, OPTIONS AND ACCESSORIES.


Environmental Container Systems, Inc.
ECS
Shock and Vibration PROTECTION

TAPE REEL CASES

ECS manufactures a complete family of carrying cases for storage and transportation of reels of magnetic, instrumentation tape. These cases are available in 2 reel, 4 reel, 6 reel and 10 reel sizes. Cases can be supplied in either dustproof or rainproof styles. Recessed handles, latches and keyed locks are also available. Steel liners for magnetic shielding are optional.
Standard cases fit 600 ft., 1200 ft., and 2400 ft. reels of tape. Tape reels may be edge banded or in plastic canisters.

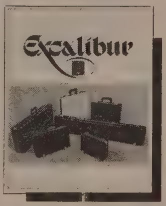
SEND FOR OUR CATALOG "TAPE REEL CASES."

TAPE REEL CASES
Environmental Container Systems, Inc.

SPECIALTY CASES

EXCALIBUR cases have been created to provide the ultimate in portable protection for fine equipment. EXCALIBUR cases are unique: unrivalled in strength, elegant in appearance.
No other material compares with the warm, natural appearance of the fine woolen finish of these cases. The attractive fabric that sets them apart visually is imbedded in layers of clear, pressure molded fiberglass.
EXCALIBUR cases: for the finest instruments, cameras and electronic equipment.

SEND FOR OUR FREE EXCALIBUR CATALOG.



The ECS pressure molding technique maximizes the glass content of the laminate, and this combination of thermosetting resin and molding technique produces cases with a remarkably high strength-to-weight ratio. They are impervious to temperature extremes ranging from – 65°F to 160°F, to shock, vibration, moisture — the foreign environments that can damage valuable equipment.

ECS containers routinely endure the non-rountine, the most hostile environments of man and nature. They are carried from the bottom of the oceans to the top of the world, effectively isolating their diverse cargoes from shock, vibration, moisture, fungus and corrosion. ECS . . . protection from hostile environments.

ECS

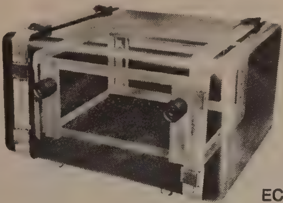
THE CASE INNOVATORS

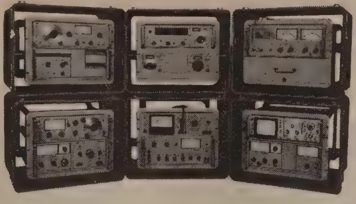
Environmental Container Systems, Inc.

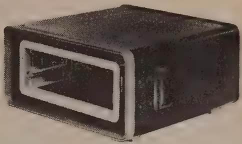
3560 Rogue River Hwy./P.O. Box 188/Grants Pass, Oregon 97526/(503) 476-8871

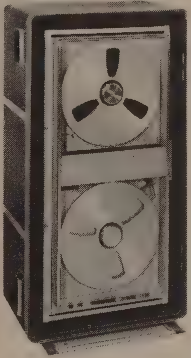
PRIME MOVERS

FROM THE CASE INNOVATORS







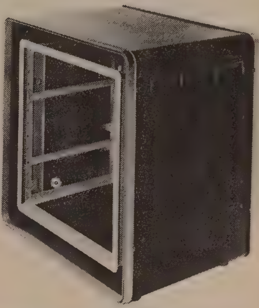


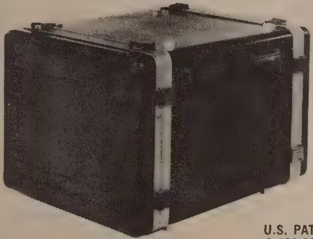
ECS transportable cabinets provide instant portability for your delicate instrumentation.

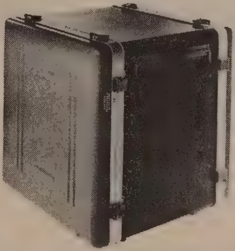
Simply secure your equipment within this shock-mounted case, and it will be protected from rough handling and environmental hazards (rain, salt spray, corrosion, and fungus growth). Remove the front and rear covers using camaction latches, and instrumentation is ready to be operated within the case.

These rugged, pressure-molded fiberglass enclosures have performed outstanding service in many severe applications: Military use in deserts, tropical climates and arctic wastelands. Commercial use as sales demos, for truck and air transportation, for medical electronics to microwave test equipment to cesium beam time standards. The enclosures have withstood drop tests, shock tests, vibration tests and a variety of environmental tests.

SEND FOR OUR FREE 20 PAGE CATALOG OF CABINETS, OPTIONS AND ACCESSORIES.

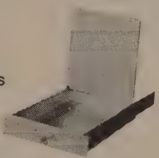






U.S. PATENT
3,482,895

Manuals and accessories can be stored in an ECS rack-mountable, welded and anodized, aluminum drawer. The drawers are available in standard EIA-RETMA rack heights of 3.47 inches (88mm), 5.19 inches (132mm) and 6.97 inches (177mm).



Options include:

001, 002, 003 & 004:	Modified inner rack frames for special applications
005:	Special shock mounts
006 & 007:	Increased front & rear cover depths
008, 009 & 010:	Drawers with ball bearing slides
011 & 012:	Recessed latches & handles
013:	Feet for stacking one case above another
014:	AC Power Strip
015:	Special colors other than desert tan

ECS Part Number	Rack Height	Instrument Capacity		Standard Prices	
		Minimum	Maximum	10 ea.	50 ea.
39-351-0537	5.375	20 lb.	75 lb.	435.00	401.00
39-339-0887	8.875	20 lb.	75 lb.	476.00	440.00
39-338-1062	10.625	30 lb.	130 lb.	493.00	455.00
39-338-1237	12.375	25 lb.	100 lb.	511.00	472.00
39-338-1412	14.125	30 lb.	130 lb.	660.00	609.00
39-338-1587	15.875	30 lb.	130 lb.	669.00	619.00
39-338-1762	17.625	30 lb.	130 lb.	679.00	627.00
39-338-1937	19.375	30 lb.	130 lb.	690.00	638.00
39-350-2112	21.125	50 lb.	250 lb.	690.00	638.00
39-350-2287	22.875	50 lb.	250 lb.	793.00	733.00
39-350-2462	24.625	50 lb.	250 lb.	805.00	743.00
39-350-2637	26.375	50 lb.	250 lb.	814.00	752.00
39-350-2812	28.125	50 lb.	250 lb.	820.00	758.00
39-350-2987	29.875	50 lb.	250 lb.	828.00	765.00
39-350-3162	31.625	50 lb.	250 lb.	849.00	783.00
39-350-3337	33.375	50 lb.	250 lb.	862.00	796.00
39-350-4737	47.375	70 lb.	320 lb.	1510.00	1395.00

Note: OEM discounts available to qualified accounts. Prices subject to change without notice.

THE CASE INNOVATORS

Environmental Container Systems, Inc.

3560 Rogue River Hwy./P.O. Box 188/Grants Pass, Oregon 97526/(503) 476-8871

SECTIONAL

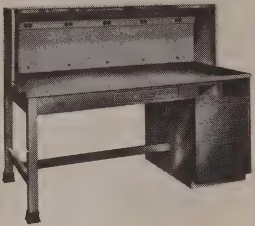
Electronic

LABORATORY TEST FURNITURE

FOR

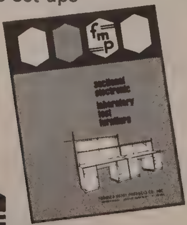
INDUSTRIAL • MILITARY • SCHOOL

APPLICATIONS



Formica's sectional electronic test furniture is designed *by* engineers *for* engineers to provide the utmost in serviceability. Individual prefabricated sections are constructed to afford the greatest possible number of combinations, then factory assembled to suit the exact requirements of your laboratory or classroom. Design features also provide at least 50% more available working area over other types now in use. Made of heavy gauge furniture steel, Formica's rugged construction means many extra years of service even in hard use.

For school purposes, the unusual adaptability of Formica's many specialized turrets and pedestals — whether for single or double set-ups



Write for our new catalog and further specifications.

FORMICA METAL PRODUCTS COMPANY, INC.

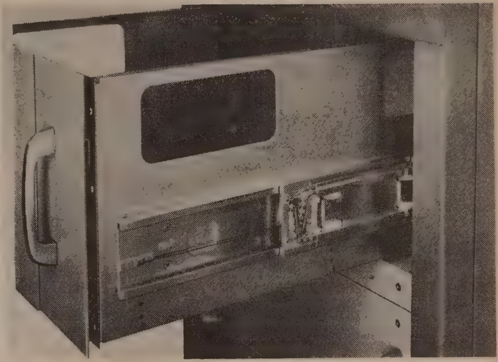
CORPORATION WAY • MEDFORD, MASSACHUSETTS 02155

SLIDES AND ACCESSORIES

chassis Trak®

A COMPLETE LINE OF SLIDES

SOLID BEARING



CIRCULATING BALL BEARING

from Simple to Sophisticated...

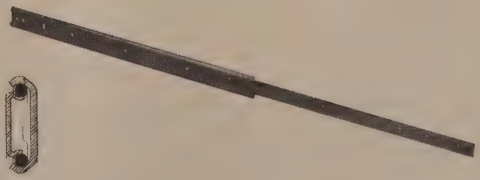
When you're specifying slides, you have many things to consider. You think about type of usage, load-bearing capacity, slide length and travel, slide thickness, type of bearing surface, performance, delivery and cost. Not to mention special optional features such as tilt, detent, lock-out, etc. So it makes sense to go to the single source that carries the most complete line of slides . . . Chassis-Trak.

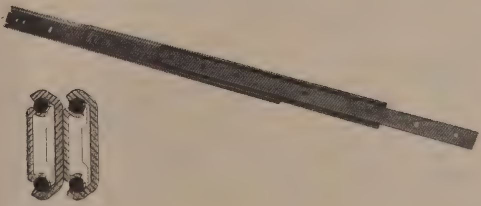
Chassis-Trak slides are available in a wide variety of types, sizes and capacities. Solid Bearing Slides, Linear Ball Bearing Slides, Circulating Ball Bearing Slides, and Bottom Mount Slides are available. Load bearing capacities range from 85# to 1000# per pair.
Simplify your job. Specifiy Chassis-Trak slides. You have a lot to choose from.

X-SERIES / LINEAR BALL BEARING SLIDES

Designed for especially smooth travel and extra long life under maximum loads, these slides are made of cold-rolled steel and operate on carbon steel ball bearings. Available in 2 models, with optional cabinet mount, lock-out, quick-disconnect and recessed mount. **Write for Catalog CT115.**

SERIES	LOAD CAPACITY lbs./pr.	LENGTHS	*TYPICAL PRICE
X-11	100	12″ to 28″	$ 6.92
X-12	250	12″ to 28″	$14.74



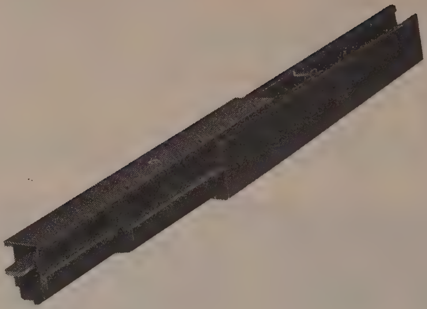


CHASSIS-TRAK

BOTTOM MOUNT SLIDES

Five different models offer load-carrying capacities from 150 lbs./pr. to 1,000 lbs./pr. These slides are made from cold-rolled steel, cadmium plated and irridite dipped, and are available with solid-bearing surfaces or roller bearing, depending on the model. Smooth, easy operation, dependability and long life for heavy-duty applications. **Write for Catalog CT107.**

SERIES	LOAD CAPACITY lbs./pr.	LENGTHS	*TYPICAL PRICE
B-200 (solid)	150	10″ to 24″	$ 16.13
C-386 (roller)	150	12″ to 24″	$ 24.55
D-165 (roller)	400	12″ to 24″	$ 38.85
D-1050 (roller)	1000	22″ to 36″	$117.74

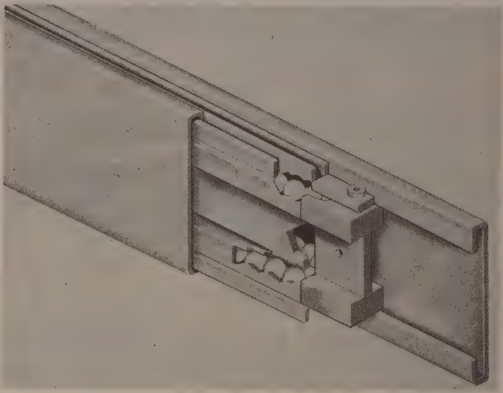


CIRCULATING BALL SLIDES

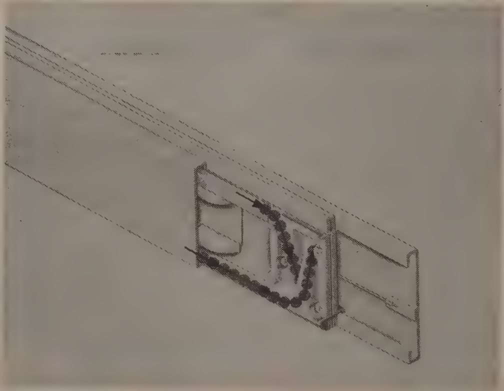
Chassis-Trak circulating ball bearing slides are designed to support weights up to 500 lbs. per pair over considerable lengths. Slides may be side mounted or, optionally, bottom mounted. Military applications (Models D1002 and D1016) furnished with Poxylube® finish and stainless steel balls. Commercial version (D1038 and D1040) is zinc plated with carbon steel balls and utilizes new "cross-over" end cap, allowing minimum thickness of slide to weight ratio. Model D1040 offers synchronized TWO-WAY-TRAVEL allowing load to be moved smoothly in either direction of center. **Write for Catalog CT129.**

SERIES	LOAD CAPACITY	LENGTHS	SPECIAL FEATURE	*TYPICAL PRICE
D-1002	500 lbs.	20″-60″ in 4″ incr.	Mil version	$69.62
D-1016	500 lbs.	20″-60″ in 4″ incr.	Lock-out	$77.87
D-1038	500 lbs.	20″-60″ in 4″ incr.	Comm. version	$40.21
D-1040	500 lbs.	20″-60″ in 4″ incr.	2-way-travel	$47.19

HOW THE CIRCULATING BALL SLIDE WORKS!



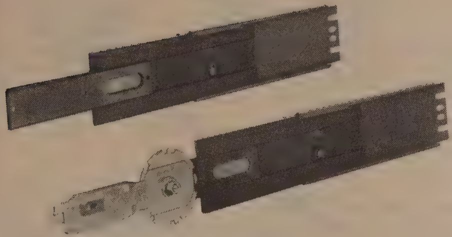
Models D-1002
D-1016



Models D-1038
D-1040

CHASSIS-TRAK

SOLID BEARING SLIDES



A complete line of exceptionally compact, low cost, solid bearing, side mounted, slides for commercial and military application. Permanently lubricated with Poxylube® molybdenum disulfide dry film lubricant to provide smooth sliding action. Chassis-Trak solid bearing slides offer a high degree of immunity to shock and vibration and all slides offer lock-out and quick-disconnect as standard features. Pencil-thin design permits installation of standard 17″ chassis in standard 19″ panel racks. All solid bearing slides are cold-rolled steel except Model D-600 which is lightweight, hard-coated aluminum. **Write for catalog CT104.**

SERIES	LOAD CAPACITY lbs./pr.	LENGTHS	*TYPICAL PRICE
C300	85	10″ to 24″	$ 9.95
C230	125	12″ to 24″	$18.79
D-600	125	10″ to 24″	$31.33
CT	175	10″ to 24″	$27.62
CTR	175	10″ to 24″	$41.72
CTH	275	14″ to 24″	$46.99
CTHR	275	14″ to 24″	$63.47

HOW TO SELECT CHASSIS-TRAK SOLID BEARING SLIDES

Slides are furnished in pairs, with each right and left slide consisting of a stationary section, a corresponding intermediate section and a chassis section. Most solid bearing slides are available with a choice of three stationary sections, determined by the type of mounting, a single intermediate section used for all combinations and a choice of four chassis sections determined by the need for easy access to chassis for servicing.

A Quick-Disconnect system, standard on all Solid Bearing slides, permits the chassis to be removed quickly and easily from the cabinet for servicing when necessary.

AVAILABLE OPTIONS

CABINET SECTIONS

TYPE 1 - CABINET MOUNTING. Designed to fit cabinets or racks having universal RETMA (EIA) hold spacing.

TYPE 2 - STRAP MOUNTING Recommended for use in other than standard installations, or in applications subjected to extreme shock and vibrations.

TYPE 3 - GUSSET MOUNT Permits mounting to front rail only without alignment problems.

CHASSIS SECTIONS

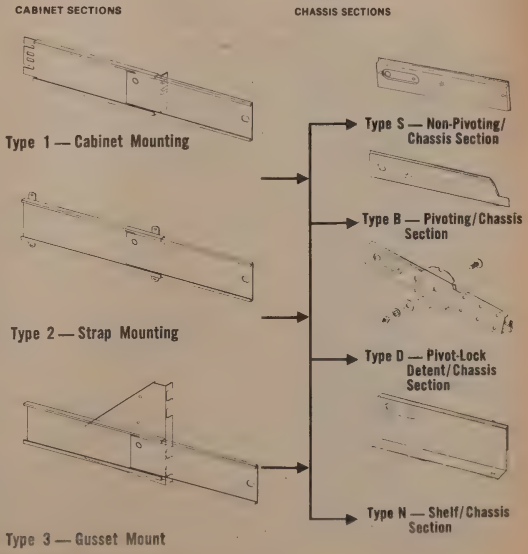
TYPE S - NON-PIVOTING chassis section. Attaches to chassis with side mounting screws.

TYPE B - PIVOTING Chassis section. Chassis pivots up only, for quick access to bottom of chassis.

TYPE D - PIVOT-LOCK DETENT chassis section. Pivots up or down and locks in position with positive detent action. Three, five and seven position detents are available depending on the slide model.

TYPE N - SHELF chassis section. Chassis is supported from the bottom. Used when side mounting screws are not desirable. Series C-300-N furnished with mounting holes for screws. Series C-230, CT and CTH-N are equipped with locating pin so chassis can be quickly lifted off for servicing. Type N chassis section is not available on the D-600 slide.

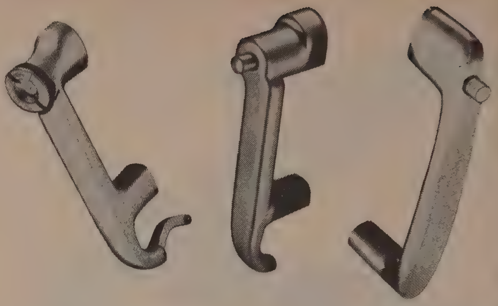
Available Options


CABINET SECTIONS
CHASSIS SECTIONS
Type 1 — Cabinet Mounting
Type 2 — Strap Mounting
Type 3 — Gusset Mount
Type S — Non-Pivoting/Chassis Section
Type B — Pivoting/Chassis Section
Type D — Pivot-Lock Detent/Chassis Section
Type N — Shelf/Chassis Section

H-SERIES HANDLES

H-Series Handles are smooth, modern-looking. Available plain or with a choice of three panel locks . . . Pushbutton, Pawl Type or Keylock. Some models are available with a plunger or trigger-type external control for external pivot control of the slide mechanism. Die-cast aluminum alloy, with a chip resistant finish of baked-on lacquer or dull black enamel. **Write for Catalog CT108.**

MODEL	*TYPICAL PRICE
HO-4	$4.72
HO-7	$6.78
HO-9	$6.78
HO-10	$6.78



KH-SERIES HANDLES

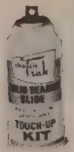
MODEL KHD or KHL	PANEL SIZE	*TYPICAL PRICE
KH-3	3½″	$4.91
KH-5	5¼″	$5.17
KH-7	7″	$5.45
KH-8	8¾″	$5.72
KH-10	10½″	$5.94
KH-12	12¼″	$6.27
KH-14	14″	$6.60

1. All KH handles have threaded stainless steel inserts.
2. End caps are self-extinguishing thermoplastic.
3. Cross member is extruded aluminum, etched and clear anodized.
4. Required mounting hardware furnished.
5. For lengths other than ones listed, contact your local Chassis-Trak Representative or factory.

Write for Catalog CT148

NOTE: Special Lengths — Take next larger size and add $1.10/pair. When ordering specify "D" for Dark Gray or "L" for Light Gray.

CHASSIS-TRAK POXYLUBE® TOUCH-UP KIT



Poxylube®, a molybdenum disulfide, dry film lubricant coating is good for life under normal conditions, but special situations may arise which would make periodic applications desirable. Deeply scratched or damaged chassis slides may be renewed with applications of Poxylube #420. Available in 6 oz. aerosol cans.

*TYPICAL PRICE

Typical prices shown are per pair, in 50 pair quantities, except bottom mount — priced each in quantity of 50 pieces. Includes all mounting hardware except "X"-Series and Circulating Ball Slides. In the case of slides, the price indicates a non-pivoting model. In the case of handles, price indicates a plain handle without lock.

chassis Trak®

CHASSIS-TRAK®

Telex 27-2169
(GENDEVI CO. IND)

P. O. Box 19188, Indianapolis, Indiana 46219 (317) 897-7000
a division of General Devices Company, Inc.

VENT RAK®

ELECTRONIC CABINETS

CHASSIS AND ACCESSORIES

FROM SINGLE UNITS... TO COMPLETE SYSTEMS

SPECIFY VENT-RACK CABINETS

Your systems call for functional packaging. Vent-Rak cabinets provide an enclosure that affords protection, easy access and modern styling. In a compact package. Choose from a complete line of Vent-Rak standard cabinets in almost any size you might need. You can use them as free-standing invidual units or multi-bay installations. You can even specify matching desk-style units. Your system will look like a system should look . . . sleek efficient, reliable.

6000 SERIES

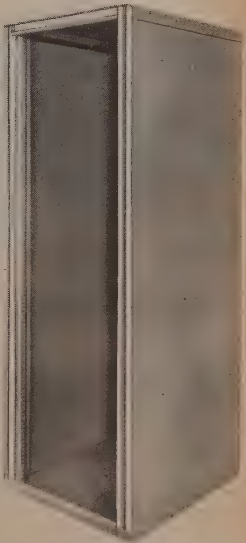
LOW COST/RUGGED COMMERCIAL TYPE CABINET

Available in four standard sizes . . . 24″ deep x 61.25 panel 24 x 70 space 30 x 61.25 and 30″ deep x 70″ panel space, this cabinet is suitable for military, commercial and O.E.M. applications. Special height or depth available on request. Heavy-duty heliarc welded frame with removable side panels for multiple-bay installations. Trim modern styling in two colors, blue or tan. Rear door has attractive handle and magnetic latch. The 6000 Series Cabinet has adjustable rear mounting rails. Optional features such as recessed caster base, special colors, front doors, channel-type mounting rails and writing surface. Competitively priced. Basic prices start at $270.88 in single units. **Write for Catalog VR101.**

3000 SERIES

LIGHT DUTY FOR COMMERCIAL AND MILITARY APPLICATIONS

This light-duty cabinet has non-removable side panels, meets commercial, military and O.E.M. specifications and requirements. Optional aluminum channel trim gives sleek, modern styling. Can be specified in multiple-bay configurations. The 3000 Series Cabinet is available in vertical panel openings from 35.06″ through 84.06″, frame depths from 20″ through 36″. A full selection of available options includes EMI-RFI Shielding, lifting eyes, front door, louvers, Airflo distribution panels, recessed casters, etc. Standard color is textured tan. Basic prices start at $358.05 in single units. **Write for Catalog VR121.**



VENT-RAK

1000 SERIES

HEAVY DUTY FOR ALL COMMERCIAL/ MILITARY APPLICATIONS

The 1000 Series Cabinet is available in vertical panel openings from 14.06″ through 87.56″, frame depths from 18″ through 36″. All heliarc welded steel or aluminum construction, it possesses exceptional strength, yet has outstanding ventilation and accessibility features. Design allows EMI/RFI shielding, as well as custom or multiple-bay configurations to meet or exceed all military and heavy-duty commercial specifications. Standard color is Grey. Options include heavy-duty dolly, side panels hinged at rear and bolted at front, bezels, Airflo distribution panels, blowers, etc. Basic prices start at $464.86 in single units. **Write for Catalog VR116.**

7000 SERIES

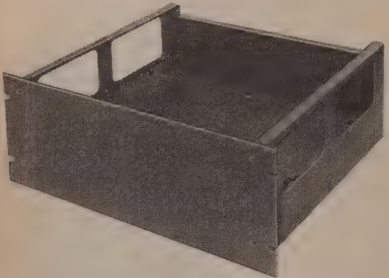
MEDIUM DUTY FOR COMMERCIAL/ MILITARY APPLICATIONS

Designed for accessibility and adaptability, the 7000 Series Cabinet is available in a wide range of sizes. Vertical panel openings from 35.13″ through 84.13″, frame depths from 20″ through 36″. Heavy-duty heliarc welded frame has removable side panels for multiple-bay installations. Top and bottom covers are also removable. Unit has rear door to provide complete accessibility. Adjustable mounting rails and a wide selection of optional accessories provide design flexibility. Standard color is Grey. Basic prices start at $436.15 in single units. **Write for Catalog VR103.**

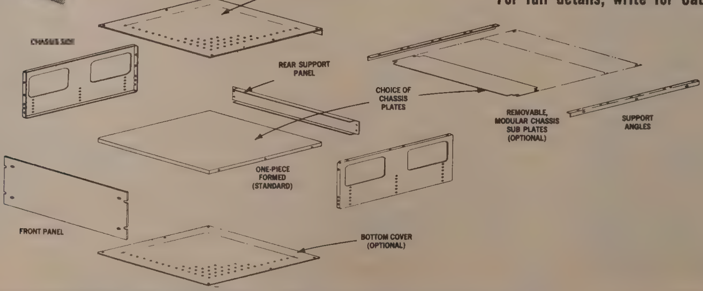
MANY OPTIONS AVAILABLE ON ALL VENT-RAK CABINETS

Starting with the basic cabinet, it is possible to add accessories as required for your specific application. Typical available options include E.M.I./R.F.I. shielding, front door, Airflo distribution panels, louvers, blowers, plugmold, bus bar, cable entry boxes, cutouts, recessed base, caster base, lifting eyes, bezels, removable rear panel, mounting "z"s, writing surfaces, etc. For full details, write for catalog on the particular Series cabinet in which you are interested.

MODULAR ELECTRONIC CHASSIS



Shipped unassembled, with all required mounting hardware, these modular chassis are easy to assemble. The chassis consist of a front panel, pair of chassis sides, rear support panel and a chassis plate. Modular chassis subplates are optional, permitting quick field replacement of individual chassis sections. Standard Vent-Rak chassis are 17″ wide, for a 19″ front panel opening width. A choice of seven heights from 3½″ to 14″ and four chassis depths from 8½″ to 21¼″ offer a wide selection. These chassis have a loading capacity of 100 lbs. per sq. ft. Prices start at $24.92 in single units. **For full details, write for Catalog VR117.**



VENT-RAK

4600 SERIES DESK TOP CONSOLES AND INSTRUMENT CASES

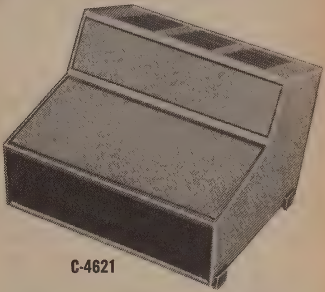
FOR FULL DETAILS, WRITE FOR CATALOG VR143

The 4600 Series Desk Top Consoles incorporate a fresh appearance with distinctive European styling. This series is available in three end panel configurations . . . LARGE (Models C-4610 and C-4611), MEDIUM (Models C-4620 and C-4621) and SMALL (Models C-4630, C-4631 and C-4632). LARGE and MEDIUM can be furnished in standard 19″ or 14¼″ (¾ size) panel opening widths. SMALL is available in standard 19″, 14¼″ (¾ size) and 9½″ (½ size) panel opening widths. Standard front panels meeting Mil Std 189 and EIA RS-310 may be mounted in the 4600 Series Consoles by using optional mounting rails. These consoles are constructed of anodized aluminum end panels and bracing struts with blue, lacquered steel covers.

Consoles are available in kits or as assembled units. Kit prices range from $47.20 to $79.33 per unit in quantities of 10-24 depending on the model selected.

Optional top and bottom front panels of polished bright aluminum complete with all required mounting hardware are available at extra cost.

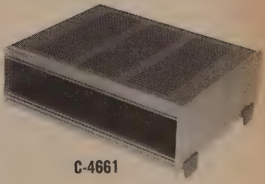
C-4610

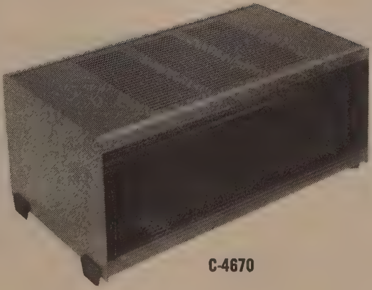

C-4621

C-4632

Sturdy, lightweight Instrument Cases are available in two basic sizes, with panel widths of 9½″, 14½″ or 19″. Clean, modern looking, these cases are recommended for limited production and one-of-a-kind instruments.

Unique and functional system permits mounting chassis directly to the console . . . affording infinite positioning and eliminating unsightly additional holes in the covers. Covers are steel, finished in blue lacquer. Front panels of bright, polished aluminum can be ordered separately. Shipped in kit form, these cases are quickly and easily assembled. Single unit prices range from $61.13 to 66.00, depending on size.


C-4661

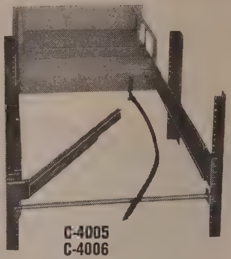

C-4670

ACCESSORIES . . . For full details write for Catalog VR-133.

CABLE RETRACTORS AND CABLE CARRIERS

A complete assortment of Cable Retractors and Cable Carriers to permit power cables to move easily as chassis is opened . . . tuck back out of the way when chassis is in closed position. Model C-4005 and C-4006 Cable Retractors have a spring loaded, telescoping action. Requires only ⅞″ clearance in closed position. Can be used with a pivoting chassis. C-990 Cable Carrier has a three point mounting, providing complete support for unusually heavy or cumbersome cables. With each mounting point hinged, and two telescoping legs, the V configuration will extend up to 30″ or close to only 1½″ behind chassis. Built-in quick disconnect feature. Includes lances for tying cable in place.

D-329 Cable Carrier is cantilever mounted to rear of chassis, unfolding to a maximum of 24″ and folding to only 1½″ behind chassis. Pushbutton disconnect is standard. C-4017 Cable Guide is a simple roller, mounting between rear mounting rails of chassis or rack. Eliminates cable drag during chassis extension. Single screw mount permits infinite vertical positioning. Prices in quantities of 1 to 9 range from $5.23 for C-4017 to $15.90 for C-4006.


C-4005
C-4006

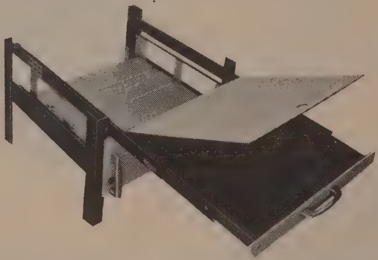
C-990

D-329

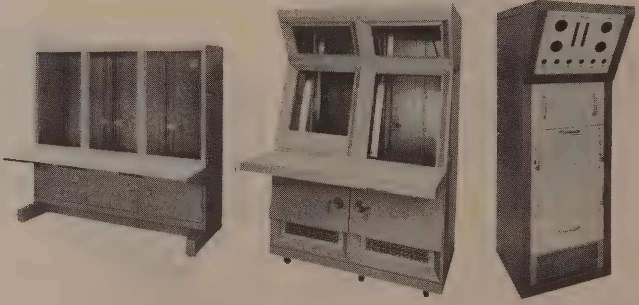
D-4080 RETRACTABLE WRITING SHELF AND STORAGE DRAWER

TWO-IN-ONE . . . DESIGNED FOR YOUR CONVENIENCE

Readily-accessible unit mounts directly to 19″ cabinets and racks . . . anywhere on RETMA, EIA or W-E universal hole pattern. Requires 1¾″ vertical front panel space, retracts flush with other panels. Heavy duty slides will carry a 50# load in extended position. FORMICA writing surface swings up to expose full-width, full-depth storage compartment. Prices start at $49.50 in quantities of 1 to 4.



SPECIAL CABINETS AND MODIFICATIONS TO ORDER



In addition to standard cabinets, Vent-Rak engineers will design and build a custom cabinet to your specfic requirements. Shown above are a few possible configurations. For more information, write, giving us your specfications.

VENT-RAK®

Telex 27-2169
(GENDEVI CO. IND)

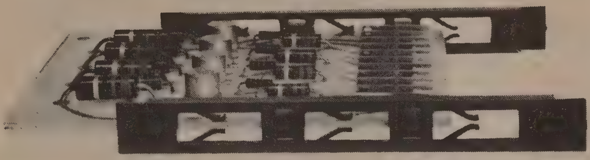
P. O. Box 19188, Indianapolis, Indiana 46219 (317) 897-7000
a division of General Devices Company, Inc.

TAURUS

A Complete Line of P.C. Board Guides

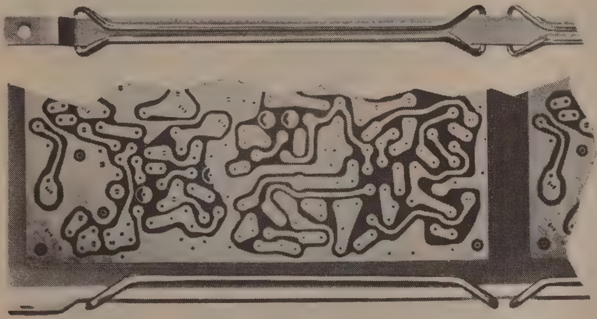
Low Cost • All Designed for Efficient Cooling and High Reliability

All units feature easy mounting; rugged strength, stability, and positive grip; lightweight; shock and vibration resistance; extreme temperature ranges.



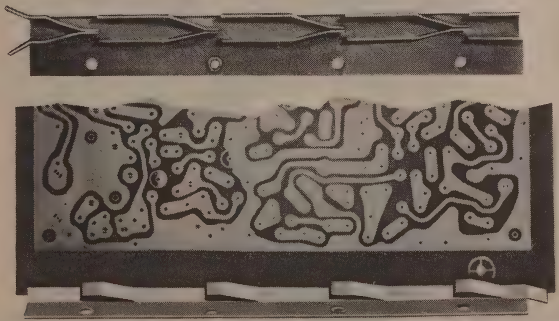
PLASTIC

Four sizes, 2″ to 7″. Snap-in type, Grips cards .050″ to .125″. Polycarbonate plastic. Shaded areas for airflow. Cooling area approx. 85%. Effective grip .093″ to .125″.



STEEL

Grips cards .030″ to .090″ thick. All steel construction. Cadmium plated. Horizontal or vertical mounting. Available in single or multiple wire constructions. Optional center hold downs. Effective grip 2″ and up to any length.



BERYLLIUM COPPER

Spring finger float. Low profile grip .125″. Grips boards .030″ to .125″. Cadmium plated. Five sizes from 2″ to 6″. Optional solid brass inner rail for accurate positioning and solid support. Series 10 features 3-way shock mount and board adjustments from .03″ to .09″.

ALSO A COMPLETE LINE OF
PUNCHED CARD READERS
AND TEFLON TERMINALS

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LAMBERTVILLE, NEW JERSEY 08530
AREA CODE (609) 397-2390

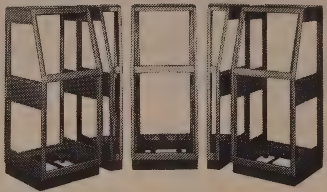
emcor puts it all together

with distinguished modular enclosures

emcor I

the original concept

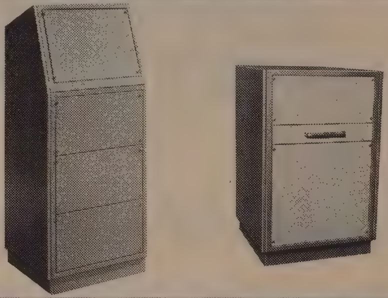
Emcor pioneered the concept of the modular enclosure system for electronic, instrumentation and electro-mechanical applications. The Emcor I series, with hundreds of frames in nine basic configurations, three panel widths, three depths, and literally thousands of components and accessories, offers virtually unlimited design freedom to meet your specific needs at low cost.



emcor II

contemporary classic

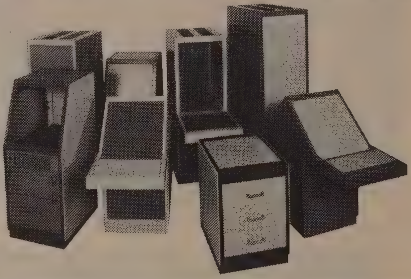
Our top-of-the-line series, with exclusive design and structural features, offers optional modifications to achieve customized individuality. Handsome contemporary styling for the popular square-corner look. Absence of seams in frame construction achieves a picture frame effect. Vertical, corner and instrument frames, including six turret styles with slope fronts from 10° to 80°. And with 11 exciting colors to choose from and combine, custom individuality is assured.



emcor esq

economy with style

Designed to combine the economy of Emcor I with the distinctive styling of Emcor II, the ESQ series is available in nine basic configurations—desk and counter height, extended arm, instrument, turret, and writing top models. Two panel widths — 19″ and 24″; four depths — 18½″, 22″, 25½″ and 30¾″. Hundreds of basic frames and a wide array of components and accessories.



instant emcor

for 3-day shipment

Our "off-the-shelf" series . . . 77 in-stock models from Emcor I, Emcor II and ESQ for shipment within 72 hours after receipt of your order. Vertical frames, slope fronts, desk and counter heights, turrets, low silhouettes, instrument frames, work/writing tops. Plus thousands of components and accessories to meet your equipment housing requirements. That's INSTANT EMCOR—for when time is of the essence.

Ingersoll Products, Division of Borg-Warner Corporation, 1000 W. 120th St., Chicago, Ill. 60643

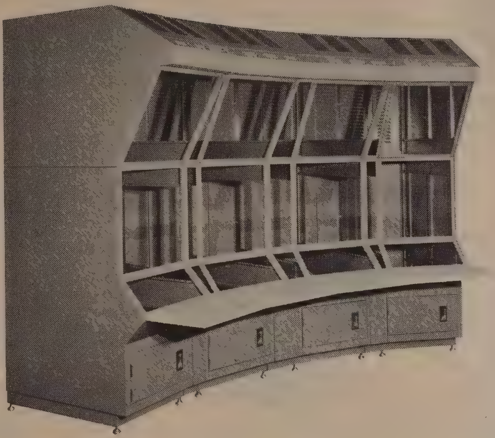
DIVISION OF BORG-WARNER CORPORATION

Ingersoll Products BORG WARNER®

emcor puts it all together with custom cabinetry and computer support furniture

emcor custom

your design or ours



Product identity all your own. That's what you get with Emcor Custom enclosures. Cabinets, racks, consoles, instrument cases, data work stations . . . whatever your custom enclosure need, Emcor has the design, engineering and production capabilities to offer you high styling combined with exceptional quality at attractive pricing.

emcor computer support furniture

Emcor's new, functional design concept in a modular line of terminal work stations and single unit assemblies. Choice of plain, accent edge or inlay laminated top styles. Ten paint colors, nine laminate colors. Basic desk units can be customized with optional pedestals for punched card, instrument or utility storage, cable trough, and molded Plexiglas doors.

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DIV. OF BORG-WARNER CORP.

Ingersoll Products BORG WARNER®

INTERLOK

ONE OF THE **PURDY** GROUP OF COMPANIES

Enclosures & Card Frames

770 AIRPORT BLVD. • BURLINGAME, CA 94010
(415) 348-5625 • TWX 910-374-2353 • TELEX 34-9373

With INTERLOK, quality comes built-in. Finally, here are cabinets and enclosures that offer your electrical and electronic devices a custom appearance. After all, you are interested in displaying your product in the best possible way, and so is INTERLOK.

INTERLOK enclosures are designed for ease of assembly, versatility and rigidity. They are attractive as well as functional. Selecting the proper enclosures and accessories from the wide variety of standard stock items in the INTERLOK system becomes a pleasure, not an engineering chore.

Then, during assembly many unique design features become apparent. Interlocking aluminum extrusions and panels add a custom look to the enclosures. Outside beauty is enhanced by matching color strips that conceal all hardware after assembly. And, speaking of hardware, our workmanship boasts of drilled and tapped holes for machine screws. Sheet metal screws are not for us.

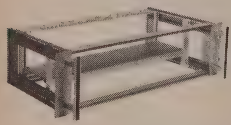
Inside, the enclosures can be subdivided in numerous ways to hold printed circuit boards or other components with access and loading from the front, rear, top and bottom.

INTERLOK not only offers total versatility and beauty in design, but offers all of our products from stock, and through your local electronics distributor. Availability is just one more service from INTERLOK.

The story doesn't stop here. We also have the newest and most exciting control knob available, the all new COLLET KNOB. No more set screws and no more marred front panels; just perfectly aligned control knobs. Interested? Then turn to the knob section in this catalog for the full story.

See if you don't agree that INTERLOK has the answer and the products to back you up no matter what your packaging requirements. Call now for your own "Seeing is Believing" demonstration. Our sales and applications personnel are delighted to show off our products.

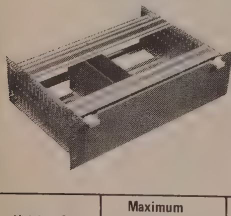
Model 12



INTERLOK Model 12 Lightweight Card Frames have the versatility, strength and customer appeal to satisfy any electrical or electronics packaging requirement. The Model 12 is designed to be used on standard E.I.A. 19-inch racks, and can be stacked, subdivided and ordered in any one of 20 standard sizes. The Model 12 is constructed of extruded, all-aluminum sections and is one of the strongest, most rugged, and most durable card frames available.

Height of Card Frame		PCB Height		Order Numbers for Various Depths			
				7.13" 181 mm	9.50" 241 mm	11.85" 301 mm	16.57" 421 mm
Inches	mm	Inches	mm				
Without Handles							
3.50	88.0	2.19	55.5	12-021	12-022	12-023	12-025
5.25	132.5	3.94	100.0	12-031	12-032	12-033	12-035
7.00	177.0	5.69	144.5	12-041	12-042	12-043	12-045
8.75	221.5	7.49	189.9	12-051	12-052	12-053	12-055
10.50	266.0	9.15	232.4	12-061	12-062	12-063	12-065
With Handles							
3.50	88.0	2.19	55.5	12-121	12-122	12-123	12-125
5.25	132.5	3.94	100.0	12-131	12-132	12-133	12-135
7.00	177.0	5.69	144.5	12-141	12-142	12-143	12-145
8.75	221.5	7.49	189.9	12-151	12-152	12-153	12-155
10.50	266.0	9.15	232.4	12-161	12-162	12-163	12-165

Model 15



INTERLOK Model 15 Universal Card Frame is fully adjustable to accommodate P.C. boards of up to 4.75" high on single height units and up to 10" high on double units. It is designed for standard 19-inch E.I.A. racks and to give you 16.79" (426.7 mm) working width. Four card guides are necessary per card and may be placed as close as .20" (5.08 mm) centers. An optional 2-mm thick anodized aluminum front panel is available.

Height of Card Frame		Maximum PCB Height		Order Numbers for Various Depths		
				7.00" 178.4 mm	9.40" 238.4 mm	11.75" 298.4 mm
Inches	mm	Inches	mm			
Without Handles						
5.25	132.5	4.75	120.65	15-030	15-031	15-032
10.50	266	10.00	254	15-060	15-061	15-062
With Handles						
5.25	132.5	4.75	120.65	15-130	15-131	15-132
10.50	266	10.00	254	15-160	15-161	15-162

Model 30

INTERLOK Model 30 enclosures take the basic card frame idea one step further. The addition of vinyl-clad aluminum covers and side panels give the enclosure a custom appearance. Once the unit is assembled, there is no visible hardware, nothing but clean elegant lines.

Height		PCB Height		Order Numbers for Various Depths			
				7.28" 184.8 mm	9.64" 244.8 mm	12.00" 304.8 mm	16.72" 424.8 mm
Inches	mm	Inches	mm				
19-Inch Wide Rack Mounting Unit Without Handles							
3.50	88	2.19	55.5	30-021	30-022	30-023	30-025
5.25	132.5	3.94	100.0	30-031	30-032	30-033	30-035
7.00	177	5.69	144.5		30-042	30-043	30-045
8.75	221.5	7.49	189.9			30-053	30-055
10.50	266	9.15	232.4		30-062	30-063	30-065
19-Inch Wide Rack Mounting Unit With Handles							
3.50	88	2.19	55.5	30-121	30-122	30-123	30-125
5.25	132.5	3.94	100.0	30-131	30-132	30-133	30-135
7.00	177	5.69	144.5		30-142	30-143	30-145
8.75	221.5	7.49	189.9			30-153	30-155
10.50	266	9.15	232.4		30-162	30-163	30-165
17.20-Inch Wide Unit Without Handles							
3.50	88	2.19	55.5	30-221	30-222	30-223	30-225
5.25	132.5	3.94	100.0	30-231	30-232	30-233	30-235
7.00	177	5.69	144.5		30-242	30-243	30-245
8.75	221.5	7.49	189.9			30-253	30-255
10.50	266	9.15	232.4		30-262	30-263	30-265
13-Inch Wide Unit Without Handles							
3.50	88	2.19	55.5	30-421	30-422	30-423	30-425
5.25	132.5	3.94	100.0	30-431	30-432	30-433	30-435
7.00	177	5.69	144.5		30-442	30-443	30-445
8.75	221.5	7.49	189.9			30-453	30-455
10.50	266	9.15	232.4		30-462	30-463	30-465
9-Inch Wide Unit Without Handles							
3.50	88	2.19	55.5	30-621	30-622	30-623	30-625
5.25	132.5	3.94	100.0	30-631	30-632	30-633	30-635
7.00	177	5.69	144.5		30-642	30-643	30-645
8.75	221.5	7.49	189.9			30-653	30-655
10.50	266	9.15	232.4		30-662	30-663	30-665

INTERLOK

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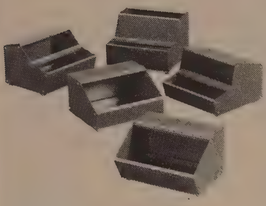
Model 34

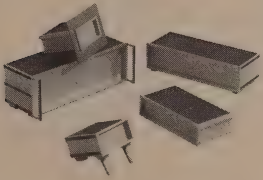


INTERLOK Model 34 Sloped-Top Table Consoles are the perfect answer to your table-top console requirements. They are available in five different styles, each giving you that custom look. The Model 34 is designed to give you the maximum amount of interior room. The aluminum profiles are designed to allow access to the top, front and rear of the unit.

The vinyl-clad panels give your product a look and feel of elegance and customer acceptance. There are also optional front panels available. These are satin-finished clear anodized panels that are 3-mm thick.

	Width		Order Number	Optional Aluminum Front Panels
	Inches	mm		
Type 1	16.50	417.5	34-181	21-381 (2 required)
Type 2	16.50	417.5	34-281	21-381 (2 required)
Type 3	16.50	417.5	34-381	21-581 (1 required)
Type 4	16.50	417.5	34-481	21-581 (1 required)
Type 5	16.50	417.5	34-681	21-381 (1 required) 21-481 (1 required)

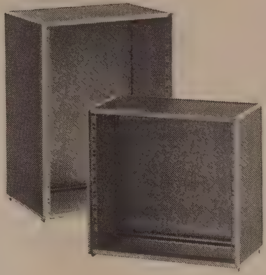
Model 36



INTERLOK Model 36 Enclosures are designed to be used in any number of applications - for bench top or portable instruments, or as a subassembly in a larger unit. The entire assembly is made of lightweight, sturdy, anodized aluminum and the top and bottom panels are blue vinyl-clad aluminum which add that custom look to your product.

Front Panel Dimensions Height x Width		Order Numbers for Various Depths		
Inches	mm	5.75″ 146 mm	10.47″ 266 mm	12.84″ 326 mm
Panel Mounting				
2.83 x 5.67	72 x 144	36-011	36-013	36-014
2.83 x 11.34	72 x 288	36-021	36-023	36-024
2.83 x 17.00	72 x 432	36-031	36-033	36-034
3.78 x 3.78	96 x 96	36-041	36-043	36-044
3.78 x 7.54	96 x 192	36-051	36-053	36-054
3.78 x 15.12	96 x 384	36-061	36-063	36-064
5.67 x 5.67	144 x 144	36-071	36-073	36-074
5.67 x 11.34	144 x 288	36-081	36-083	36-084
5.67 x 17.00	144 x 432	36-091	36-093	36-094
Table Top Without Handles				
2.83 x 5.67	72 x 144	36-111	36-113	36-114
2.83 x 11.34	72 x 288	36-121	36-123	36-124
2.83 x 17.01	72 x 432	36-131	36-133	36-134
3.78 x 7.54	96 x 192	36-151	36-153	36-154
3.78 x 15.12	96 x 384	36-161	36-163	36-164
5.67 x 5.67	144 x 144	36-171	36-173	36-174
5.67 x 11.34	144 x 288	36-181	36-183	36-184
5.67 x 17.00	144 x 432	36-191	36-193	36-194
Table Top With Handles				
3.78 x 3.78	96 x 192	36-251	36-253	36-254
3.78 x 7.54	96 x 384	36-261	36-263	36-264
5.67 x 5.67	144 x 144	36-271	36-273	36-274
5.67 x 11.34	144 x 288	36-281	36-283	36-284
5.67 x 17.00	144 x 432	36-291	36-293	36-294

Model 1500



INTERLOK Model 1500 Cabinets are designed to accommodate one or more standard 19-inch E.I.A. rack mounting units. There are 12 different standard configurations available. All units come with blue vinyl-clad top and side panels, and a 3-mm clear satin-finish aluminum rear panel. All structural members are anodized extruded aluminum.

The Model 1500 is ideal for those applications where looks and strength are both important. From the engineering laboratory to the computer operation, INTERLOK has the right answer to your cabinet needs.

Cabinet Height		Order Numbers for Various Depths		
Inches	mm	8.65″ 220 mm	13.40″ 340 mm	18.10″ 460 mm
7.00	177.00	1500-00	1500-01	1500-02
8.75	221.50	1500-10	1500-11	1500-12
17.50	443.70	1500-20	1500-21	1500-22
26.25	666.00	1500-30	1500-31	1500-32

Model 1520

INTERLOK Model 1520 Equipment Racks are designed to house standard 19-inch rack mounting units. What makes it one step above any other equipment rack is the overall design. It has built-in air ventilation by means of an elevated white formica-like top, leveling feet, and optional blue vinyl-clad aluminum side panels that quickly slide into place. The side panels convert the equipment rack into a custom cabinet suitable for any office surroundings.

Special side rails and vertical adaptors are available to further subdivide the cabinet. The cabinet is easily accessible from all four sides, making repairs much easier.

Overall Height		Usable Mounting Height		Order Number	Optional Vinyl-Clad Panels
Inches	mm	Inches	mm		
42.5	1077	35.0	891	1520-20	1542-40
53.0	1344	45.5	1158	1520-21	1542-41
63.5	1611	56.0	1425	1520-22	1542-42

INTERLOK

ONE OF THE **PURDY** GROUP OF COMPANIES

Enclosures & Card Frames

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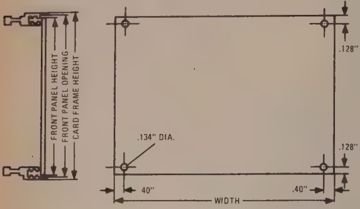
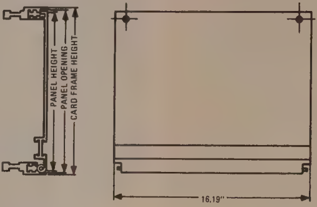
FRONT PANELS

Unhinged (Models 12, 30 and 34)


FRONT PANEL HEIGHT
FRONT PANEL OPENING
CARD FRAME HEIGHT
.128"
.134" DIA.
.128"
.40"
.40"
WIDTH

Hinged (Models 12 and 30)

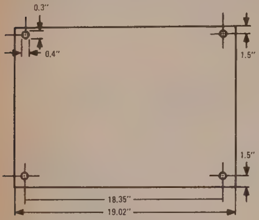

PANEL HEIGHT
PANEL OPENING
CARD FRAME HEIGHT
16.19"

PANEL OPENING = CARD FRAME HEIGHT -.118"
PANEL HEIGHT = CARD FRAME HEIGHT -.138"

FRONT PANELS FOR MODELS 12, 30 AND 34

Height of Enclosure		Std EIA Mtg Spaces	Order Numbers for Various Widths			
			5.39" 137 mm	8.00" 203 mm	12.00" 304.6 mm	16.19" 411.3 mm
Inches	mm					
UNHINGED						
3.50	88.0	2	21-227	21-240	21-260	21-281
5.25	132.5	3	21-327	21-340	21-360	21-381
7.00	177.0	4	21-427	21-440	21-460	21-481
8.75	221.5	5	21-527	21-540	21-560	21-581
10.50	226.0	6	21-627	21-640	21-660	21-681
HINGED						
3.50	88.0	2				25-281
5.25	132.5	3				25-381
7.00	177.0	4				25-481
8.75	221.5	5				25-581
10.50	226.0	6				25-681

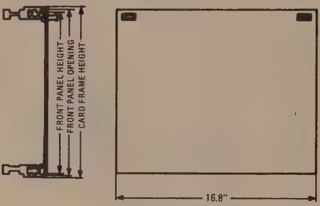
Unhinged (Models 1500 and 1520)


0.3"
0.4"
1.5"
1.5"
18.35"
19.02"

MODELS 1500 AND 1520
FRONT AND REAR PANELS

Height		Std EIA Mtg Spaces	Part Numbers	
Inches	mm		Front Panel 5-mm	Rear Panel 3-mm
7.00	117	4	1506-31	1506-21
8.75	221.5	5	1506-32	1506-22
17.50	443.7	10	1506-37	1506-27
26.25	666	15	1506-38	1506-28

Hinged (Model 15)

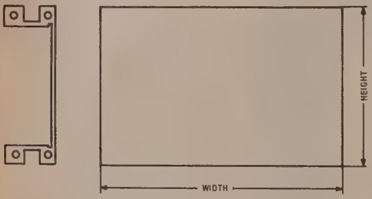

FRONT PANEL HEIGHT
FRONT PANEL OPENING
CARD FRAME HEIGHT
16.8"

MODEL 15
HUNGED FRONT PANELS

Height of Enclosure		Std. EIA Mtg. Spaces	Part Number 16.19" 411.3 mm
Inches	mm		
5.25	132.5	3	27-384
10.50	266	6	27-384 (2 req.)

REAR PANELS

Used on Model 36

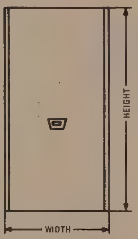

HEIGHT
WIDTH

ADDITIONAL REAR PANELS FOR MODEL 36

Front Panel Dimensions H x W	H x W	Width of Rear Panel		Part Number
Inches	mm	Inches	mm	
2.83 x 5.67	72 x 144	5.04	128	66-354-26
2.83 x 11.34	72 x 288	10.71	272	66-354-27
2.83 x 17.00	72 x 432	16.38	416	66-354-28
3.78 x 3.78	96 x 96	3.15	80	66-355-26
3.78 x 7.56	96 x 192	6.93	176	66-355-27
3.78 x 15.12	96 x 384	14.49	368	66-355-28
5.67 x 5.67	144 x 144	5.04	128	66-356-26
5.67 x 11.34	144 x 288	10.71	272	66-356-27
5.67 x 17.00	144 x 432	16.38	416	66-356-28

SIDE PANELS

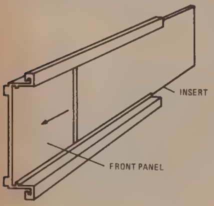
Model 1520


HEIGHT
WIDTH

MODEL 1520
SIDE AND REAR PANELS

Height		Std EIA Mtg Spaces	Part Number
Inches	mm		
35.0	891	20	1542-40
45.0	1158	26	1542-41
56.0	1425	32	1542-42

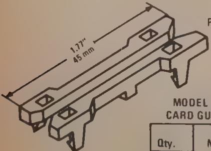
PANEL INSERTS


INSERT
FRONT PANEL

FRONT PANEL INSERTS FOR MODEL 36

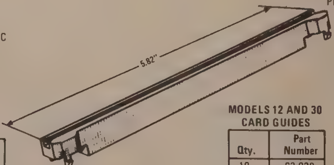
Front Panel Dimensions		Front Panel Insert Dimensions		Part Number
H x W Inches	H x W mm	H x W Inches	H x W mm	
2.83 x 5.67	72 x 144	2.22 x 4.92	56.5 x 125	36-510
2.83 x 11.34	72 x 288	2.22 x 10.59	56.5 x 269	36-520
2.83 x 17.00	72 x 432	2.22 x 16.26	56.5 x 413	36-530
3.78 x 3.78	96 x 96	3.17 x 3.03	80.5 x 77	36-540
3.78 x 7.56	96 x 192	3.17 x 6.42	80.5 x 163	36-550
3.78 x 15.12	96 x 384	3.17 x 14.37	80.5 x 365	36-560
5.67 x 5.67	144 x 144	4.98 x 4.92	126.5 x 125	36-570
5.67 x 11.34	144 x 288	4.98 x 10.59	126.5 x 269	36-580
5.67 x 17.00	144 x 432	4.98 x 16.26	126.5 x 413	36-590

CARD GUIDES


1.77"
45 mm
PLASTIC

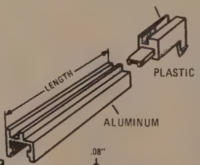
MODEL 15
CARD GUIDES

Qty.	Part Number
100	63-221


PLASTIC
5.82"

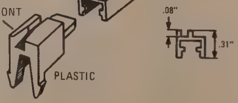
MODELS 12 AND 30
CARD GUIDES

Qty.	Part Number
10	63-028
100	63-029


REAR
PLASTIC
LENGTH
ALUMINUM

MODELS 12 AND 30
VARIABLE GUIDE STRIPS

Length		Part Number
Inches	mm	
4.43	112.5	66-122-20
6.79	172.5	66-122-21
9.15	232.5	66-122-22
11.52	292.5	66-122-23
13.88	352.5	66-122-24


FRONT
PLASTIC
.08"
.31"

MODELS 12 AND 30
FRONT AND REAR
ENTRANCE GUIDES

Qty.	Part Number
50 Pr.	63-030

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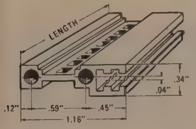
AUXILIARY PROFILES

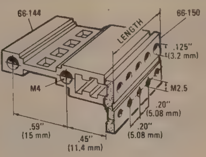
Used on Models 12 and 30

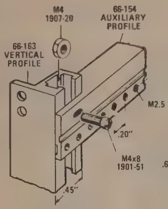

LENGTH
.34"
.04"
.12"
.59"
.45"
1.16"

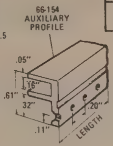
MODELS 12 AND 30
INTERNAL HORIZONTAL PROFILES

Length of Profile		Part Number
Inches	mm	
8.20	208.28	66-144-20
12.20	309.88	66-144-21
16.40	416.56	66-144-22

Used on Models 12 and 30


66-144
66-150
LENGTH
.125"
(3.2 mm)
M4
M2.5
.20"
(5.08 mm)
.59"
(15 mm)
.45"
(11.4 mm)
.20"
(5.08 mm)

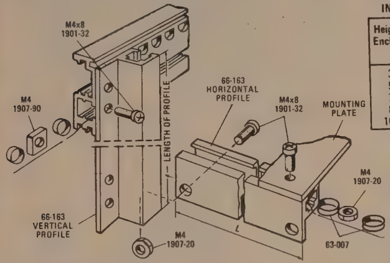

M4
1907-20
66-154
AUXILIARY
PROFILE
66-163
VERTICAL
PROFILE
M2.5
.20"
M4x8
1901-51
.45"


66-154
AUXILIARY
PROFILE
.05"
.16"
.61"
32"
.20"
.11"
LENGTH

MODELS 12 AND 30
UNIVERSAL AUXILIARY PROFILES

Width of Enclosure	Length of Profile		Part Number
	Inches	mm	
19.00	16.20	411.4	66-150-22
19.00	16.36	415.5	66-154-22

Used on Models 12 and 30


M4x8
1901-32
M4
1907-90
66-163
HORIZONTAL
PROFILE
M4x8
1901-32
MOUNTING
PLATE
LENGTH OF PROFILE
M4
1907-20
66-163
VERTICAL
PROFILE
M4
1907-20
L
63-007

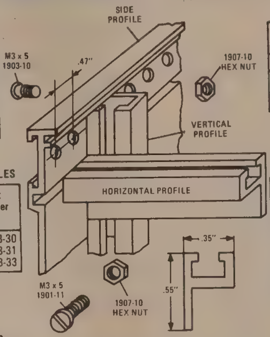
MODELS 12 AND 30
INTERNAL VERTICAL PROFILES

Height of Enclosure	Length of Profile		Part Number
	Inches	mm	
3.50	3.17	80.6	66-163-21
5.25	4.93	125.1	66-163-22
7.00	6.68	169.6	66-163-23
8.75	8.43	214.1	66-163-24
10.50	10.18	258.6	66-163-25

MODELS 12 AND 30
INTERNAL HORIZONTAL PROFILES

Width of Enclosure	Length of Profile		Part Number
	Inches	mm	
8.00	8.06	204.7	66-163-30
12.00	12.06	306.3	66-163-31
19.00	16.25	413	66-163-33

Used on Model 36


SIDE
PROFILE
M3 x 5
1903-10
.47"
1907-10
HEX NUT
VERTICAL
PROFILE
HORIZONTAL PROFILE
.35"
.55"
M3 x 5
1901-11
1907-10
HEX NUT

MODEL 36
INTERNAL VERTICAL PROFILES

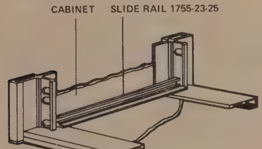
Height of Enclosure		Length of Profile		Part Number
Inches	mm	Inches	mm	
2.83	72	2.28	58	66-166-20
3.78	96	3.23	82	66-166-21
5.67	144	5.04	128	66-166-22

MODEL 36
INTERNAL HORIZONTAL PROFILES

Width of Enclosure		Length of Profile		Part Number
Inches	mm	Inches	mm	
3.78	96	3.07	78	66-166-23
5.67	144	4.96	126	66-166-24
7.56	192	6.85	174	66-166-25
11.34	288	10.63	270	66-166-26
15.12	384	14.41	366	66-166-27
17.00	432	16.30	414	66-166-28

SLIDE RAILS

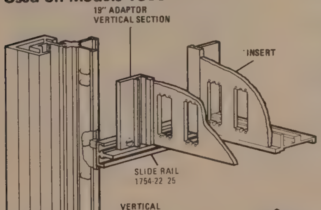
Used on Model 1500


CABINET
SLIDE RAIL 1755-23-25

SLIDE RAILS FOR MODELS 1500 AND 1520

Cabinet Depth		Length		Part Numbers	
Inches	mm	Inches	mm		
8.65	220	8.15	207	1754-23	1755-23
13.40	340	12.90	327	1754-24	1755-24
18.10	460	17.60	447	1754-25	1755-25

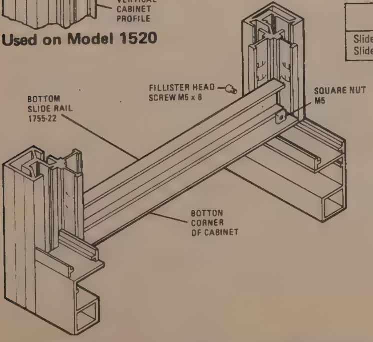
Used on Models 1500 and 1520


19" ADAPTOR
VERTICAL SECTION
INSERT
SLIDE RAIL
1754-22 25
VERTICAL
CABINET
PROFILE

MODELS 1500 AND 1520
VERTICAL ADAPTORS

Equipment Height		Adaptor Length		Part Number
Inches	mm	Inches	mm	
3.5	88.0	3.31	84.0	1755-50
5.25	132.5	5.06	128.5	1755-51
7.00	177.0	6.83	173.0	1755-52
8.75	221.5	8.56	217.5	1755-53

Used on Model 1520

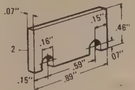

FILLISTER HEAD
SCREW M5 x 8
SQUARE NUT
M5
BOTTOM
SLIDE RAIL
1755-22
BOTTON
CORNER
OF CABINET

SLIDE RAILS FOR MODEL 1520

Description	Part Number
Slide Rails, Std. Mts. (1 Pr)	1754-22
Slide Rails, Corner Mtg. (1 Pr)	1755-22

MOUNTING PLATES

Used on Models 12 and 30

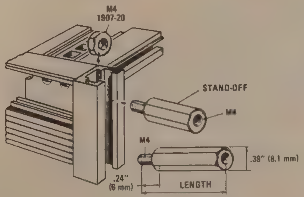

.07"
.15"
.46"
2
.16"
.59"
.07"
.15"
.89"

MOUNTING PLATES

Qty.	Part Number
4	63-026
40	63-027

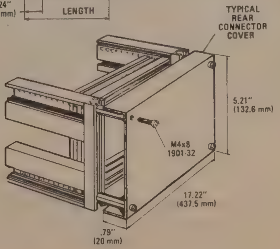
STAND-OFFS

Used on Model 12


M4
1907-20
STAND-OFF
M4
M4
.39" (8.1 mm)
.24"
(6 mm)
LENGTH

STAND-OFFS

Length		Part Number	Qty.
Inches	mm		
1.02	26	63-040	4
1.42	36	63-041	4
1.81	46	63-042	4


TYPICAL
REAR
CONNECTOR
COVER
5.21"
(132.6 mm)
M4x8
1901-32
17.22"
(437.5 mm)
.79"
(20 mm)

OPTIMA
a division of scientific-atlanta inc.

TWX 810-766-3967 Telephone 404-939-6340

enclosures

2166 Mountain Industrial Blvd., Tucker, Ga. 30084

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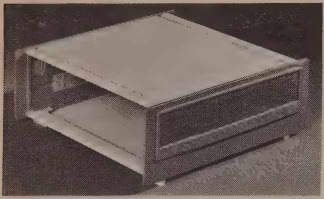
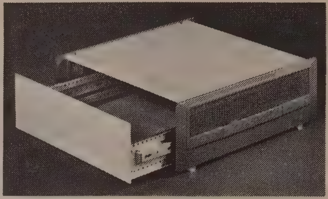
OPTIMAPAK features sculptured side panels of engineering structural foam with a high strength to weight ratio and self-retracting handles. Our most versatile design allows you to order only what your application requires.



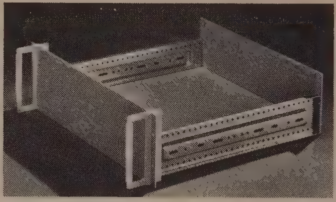
1. OptimaPAK Case
The user may provide his own chassis and panels. Components and subassemblies can be mounted directly to mounting holes provided in the case sides and crossmembers.

Panel Height (in.)	Panel Width 17.40″ Model No.	Panel Width 19.00″ Model No.
3.47	PK-031716H	PK-031916H
5.22	PK-051716H	PK-051916H
6.97	PK-071716H	PK-071916H
8.72	PK-081716H	PK-081916H



2. OptimaPAK Case with Chassis Assembly
This is the complete package—includes a chassis assembly that slides into the front of the case and fastens at the back with four screws.

Panel Width 17.40″ Model No.	Panel Width 19.00″ Model No.
PK-031716HC	PK-031916HC
PK-051716HC	PK-051916HC
PK-071716HC	PK-071916HC
PK-081716HC	PK-081916HC



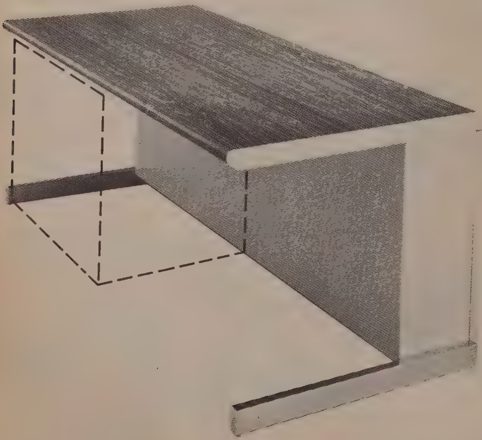
3. Chassis and Rack Adapters
The 17.00″ chassis may be mounted to EIA standard 19″ racks. Includes chassis assembly with front panel painted any Optima color, .063 aluminum bottom shelf and extruded aluminum rack adapter handles.

17.00″ Chassis Width Model No.
CR-031716
CR-051716
CR-071716
CR-081716

NOTE: Panel-to-panel depth in all models = 16.25″

OPTIMADESK...ENDS THE UGLY CABLE TANGLE!

- Spacious storage capacity ends unsightly cable confusion and provides for terminal/equipment mounting and cable routing. An exclusive with OptimaDesk.
- Leg assembly easily adjusts pedestal to operator's comfort level (standard desk height of 28.00″ or keyboard height of 26.25″).
- Color-coordinated cabinets add both rack mounting facilities and compact storage space to your data console.
- Rolled front edge guarantees operator satisfaction and comfort.



Model No.	Description
OD-XX2434	OptimaDesk 24″W x 26″ or 28″H
OD-XX4534	OptimaDesk 45″W x 26″ or 28″H
OD-264534C	OptimaDesk 45″W x 26″H with one cabinet
OD-284534C	OptimaDesk 45″W x 28″H with one cabinet
OD-XX6634	OptimaDesk 66″W x 26″ or 28″H
OD-266634C	OptimaDesk 66″W x 26″H with one cabinet
OD-286634C	OptimaDesk 66″W x 28″H with one cabinet
OD-266634-2C	OptimaDesk 66″W x 26″H with two cabinets
OD-286634-2C	OptimaDesk 66″W x 28″H with two cabinets

OPTIMA
a division of scientific-atlanta inc.

TWX 810-766-3967 Telephone 404-939-6340

enclosures

2166 Mountain Industrial Blvd., Tucker, Ga. 30084

OPTIMA
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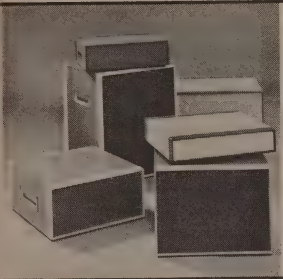
Designed to meet the need of the general electronics industry for high quality enclosures with contemporary styling and commercially oriented design concepts.



Optima Instrument Cases—Beautiful aluminum cabinets designed to house your EIA standard 19″ or 24″ instruments. You may specify smooth, textured, fluted or perforated surfaces.

• long side handle with horizontal stop and spring return, allows two-hand grip • interlock vertical stacking • strong, extruded aluminum frame work.

Instrument cases available

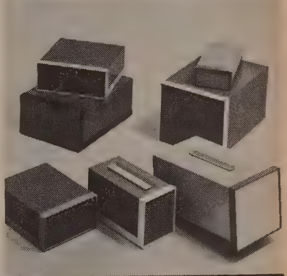
Panel Height (in.)	Panel Width (in.)	Panel-to-Panel Depth (in.)
3.50, 5.25, 7.00, 8.75, 10.50, 12.25, 14.00, 15.75, 17.50,	19 and 24	16.94, 20.56, 24.00, available in all models
19.25, 21.00, 22.75, 24.50, 26.25, 28.00,	19	

Optima small cases available

Panel Height (in.)	Panel Width (in.)	Panel-to-Panel Depth (in.)
2.43 4.18 5.93 7.68 9.43	5.00 7.79 10.57 available in all models	10 14 available in all models

Optima Small Cases—Versatile, lightweight and rugged aluminum cases. Each has one piece cover removable via two screws. Two more screws permit unloading panel and chassis through the front. Panel screws may be omitted.

• Tiltstands • flush, self-retracting handle with trim strip • rack adapters.



Sturdy Optima Racks in aluminum and steel with outstanding options and accessories.

Sloped-Front Racks—Four models (42.12″ and 52.12″ panel height, 19″ panel width and 24″ panel-to-panel depth)

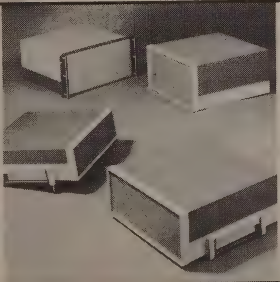
The NEW, economical, all steel "ACTION RACK" is available in 7 panel heights (22.88, 28.12, 35.12, 42.12, 52.62, 61.38, 70.12) for 19″ panel width and 24″ panel-to-panel depth.

Optima Racks available

Panel Height (in.)	Panel Width (in.)	Panel-to Panel (in.)
22.75 28.00 35.00 42.00 52.50 61.25 70.00 77.00	19 and 24 available in all models	20.56 24.00 30.00 available in all models

• key lock doors • louvers • multibay options • stabilizers • casters • chassis slides and angles • drawers • writing surfaces • shelves • blowers

Optima 17—A unique combination of chassis and case. Great access and styling. Available in 4 configurations: (1) Case only with rubber feet (2) Side handle with feet installed (3) Side handle with tilt stand installed (4) with rack adapters. Four panel heights —3½″, 5¼″, 7″, 8¾″. Panel width is 16.09″ and panel-to-panel depth is 16.22″



Optima Consoles—An adaptable system of instrument housing, counter, and storage space. Crafted in aluminum, steel, chrome, and plastic laminates. Available in one-bay (26.5″ w.), two-bay (46.25″ w.), and three-bay (66″ w.) units. 19-inch instrument cases may be mounted above or underslung below. Three overall depths are offered (24″, 30″, 36″)

• Drawers • kick panels • cable troughs • power outlets

- **Dependable Quality**—Materials and workmanship are subjected to a formal quality control program.
- **Competitive Price**—Our price includes complete assembly of components and installation of accessories.
- **Structural integrity**—Optima enclosures do not depend on your equipment for strength and rigidity.
- **Flexibility**—Ease of access and disassembly, dozens of color combinations, and a large selection of accessories help you adapt to specific needs.
- **Customer Service**—Our customer representative is retained to see that you are satisfied. The Optima 5 Program provides quick service for prototype and trade show needs.

Premier Metal Products Co. has specialized in the sheet metal fabrication of electronic enclosures and accessories for over 25 years.

The greater majority of products produced are standard catalog items. Extensive inventories are manufactured and maintained to enable Premier to give quicker service and more competitive pricing consistent with high quality designs engineered into our standard lines.

Modified standard and special designs are manufactured on order. Engineering assistance and quotations are available through our representative organizations and plant engineering department.

Premier products are also available through a nationwide network of Distributors.

Manufacturers of:

- MODULAR ENCLOSURES
- HEAVY DUTY RACKS
- CABINET RELAY RACKS
- INSTRUMENT CASES
- DESK CABINET RACKS
- BLOWERS AND FANS
- SLIDES
- DRAWERS
- SHELVES
- PANELS
- CHASSIS
- UTILITY CASES AND BOXES
- PRINTED CIRCUIT CARD HOLDERS
- HARDWARE

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Phone: (212) 991-6600

theTrimline Series

Modular enclosures providing classic beauty and styling for electronic systems.

PREMIER
Premier
Premier

PREMIER TRIMLINE INSTRUMENT CASES

TIC-031517
Free Standing Unit Convertible
To Rack Mounted Installation

SPECIAL DESIGN SIZE (15⅝″ PANEL WIDTH)

Special design size has been incorporated into the Trimline Instrument Case line which makes the entire case easily adaptable into standard 19″ rack systems. Overall case width accommodates rack adapters to fit cleanly into 19″ rack widths. Overall case height conforms to standard panel heights, requiring no fillers to adjacent panels above or below the Trimline Case. Ideal for bench or test instrumentation that might need transfer into a rack mounted system without requiring a different sized enclosure for each usage.

DISTINCTIVE ELECTRONIC PACKAGING.
HIGH IN QUALITY AND DISTINCTION — MODERATE IN COST.
WELDED CONSTRUCTION THROUGHOUT EXCEPT FOR TRIM.
EIA UNIVERSAL SPACING (⅝″ — ⅝″ — ½″).

Designed to meet engineering and marketing design requirements for OEM electronic products packaging for free standing or rack mounted instrumentation or systems. Cases trimmed front and rear with anodized extruded aluminum and decorative vinyl inlays. Finishes are available in a wide choice of standard Premier colors in either fine grain textures or semi-gloss enamels. Case body #20 gauge cold rolled steel. Panel and accessory mounting channels #16 gauge cold rolled steel. Hand grip mounting channel and stiffener. Top carrying handle supplied with 9½″ panel widths; side hand grips supplied with 15⅝″ and 19″ panel widths. Panel and interior equipment mounting channels are provided with holes on EIA and WE standard spacing to accept #10 Tinnerman speed nuts and screws. Ventilation provisions and other modifications available on request. Provisions for equipment mounting permit the ready use of the following accessories: tilstand, front and rear panels, slides, rack adapters, chassis and shelf support angles, interior mounting matrix panels for components and/or brackets, and access doors with or without locks. Standard finish, smoke blue texture.

Size, Inches		19″ Panel Widths		15⅝″ Panel Widths		9½″ Panel Widths	
Nom. Panel Height	Panel to Panel Depth	Premier No.	Net Each A	Premier No.	Net Each A	Premier No.	Net Each A
3½	13	TIC-031913		TIC-031513		TIC-030913	
5¼	13	TIC-051913		TIC-051513		TIC-050913	
7	13	TIC-071913		TIC-071513		TIC-070913	
8¾	13	TIC-081913		TIC-081513		TIC-080913	
10½	13	TIC-101913		TIC-101513		TIC-100913	
12¼	13	TIC-121913		TIC-121513		TIC-120913	
14	13	TIC-141913		TIC-141513		TIC-140913	
17½	13	TIC-171913		TIC-171513		TIC-170913	
21	13	TIC-211913		TIC-211513		TIC-210913	
24½	13	TIC-241913		TIC-241513		TIC-240913	
28	13	TIC-281913		TIC-281513		TIC-280913	
3½	17	TIC-031917		TIC-031517		TIC-030917	
5¼	17	TIC-051917		TIC-051517		TIC-050917	
7	17	TIC-071917		TIC-071517		TIC-070917	
8¾	17	TIC-081917		TIC-081517		TIC-080917	
10½	17	TIC-101917		TIC-101517		TIC-100917	
12¼	17	TIC-121917		TIC-121517		TIC-120917	
14	17	TIC-141917		TIC-141517		TIC-140917	
17½	17	TIC-171917		TIC-171517		TIC-170917	
21	17	TIC-211917		TIC-211517		TIC-210917	
24½	17	TIC-241917		TIC-241517		TIC-240917	
28	17	TIC-281917		TIC-281517		TIC-280917	
3½	21	TIC-031921		TIC-031521		....	....
5¼	21	TIC-051921		TIC-051521		....	....
7	21	TIC-071921		TIC-071521		....	....
8¾	21	TIC-081921		TIC-081521		....	....
10½	21	TIC-101921		TIC-101521		....	....
12¼	21	TIC-121921		TIC-121521		....	....
14	21	TIC-141921		TIC-141521		....	....
17½	21	TIC-171921		TIC-171521		....	....
21	21	TIC-211921		TIC-211521		....	....
24½	21	TIC-241921		TIC-241521		....	....
28	21	TIC-281921		TIC-281521		....	....

CHASSIS SLIDES FOR TIC CASES (Including complete mounting hardware)

- Ball bearing and Nylon Rollers
- Positive mechanical stop
- Instant disconnect
- Carries 50 lbs. fully extended
- CR steel, zinc plated and clear iridite coating

Premier Number	Slide Length and Extension	Net per Pair A
TFE-50-12	12″	
TFE-50-16	16″	
TFE-50-20	20″	

INDUSTRIAL DISCOUNTS

Minimum order, $25.00

SCHEDULE A ITEMS

Invoice Value	Discount
$ 25.00 to $250.00	Net
250.01 to 500.00	5%
500.01 to 1000.00	10%
1000.01 to 2000.00	15%
2000.01 to 4000.00	20%
4000.01 and up	On Quotation

SCHEDULE B ITEMS

Invoice Value	Discount
$ 25.00 to $200.00	Net
200.01 to 400.00	10%
400.01 to 550.00	15%
550.01 to 700.00	20%
700.01 to 1000.00	25%
1000.01 to 2500.00	30%
2500.01 and up	On Quotation

COLORS AND FINISHES

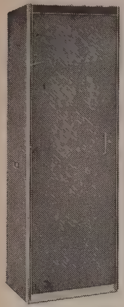
Standard finish on Schedule "B" items are as listed.

Standard Finish on Schedule "A" items are as listed or in any choice of Premier standard colors at no extra charge unless otherwise noted. Specify when ordering. When color is not specified, standard finish will be furnished. PREMIER COLOR CHART AND CHIPS ARE AVAILABLE. Special colors and finishes are available on quotation.

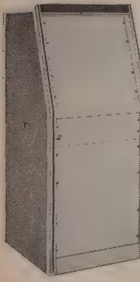
	Premier Finish Number	
Premier Color	Textured "Sandtex"	Semi-Gloss Enamel
Charcoal Gray	561	—
Dark Gray	562	462
Light Gray	563	463
Hammertone Gray	—	464
Bright Blue	551	451
Smoke Blue	552	452
Light Blue	553	—
Charcoal Brown	501	401
Beige Tan	531	431
Shadow Green	541	441
Coral Red	511	—
Autumn Gold	532	—
Black	571	471
White	572	472
Primer, Etching	MIL-SPEC 6889A	#642

See Discount Schedule A or B on Page 2.

PREMIER TRIMLINE SERIES



TVA Series
(Front Door Extra)



TSA Series
(Front Panels Extra)

Trimline series presents trim, classic styling and provides major design requirements for protection, accessibility and cost-saving mounting of electronic equipment. Frame is #14 gauge steel formed uprights, welded to formed one-piece top and base sections. Base has knock outs and cutouts for cables, leads and mounting of concealed casters. Two pairs of #12 gauge steel panel mounting angles, fully adjustable, have EIA spaced 10-32 tapped holes. Screws with nylon washers are furnished. Trim serves as functional decor in system design, made of extruded aluminum with walnut or black grained vinyl inlay, provides extra 1″ deep recess for door mounting and panel area. Vertical trim is ⅝″ wide with 5⁄16″ inlay; horizontal top trim for use with or without front door is 2⅛″ wide with 1 11⁄16″ inlay; 3″ top horizontal trim covers full face of frame top with 2 9⁄16″ inlay. Outside removable, flush side panels are formed of one-piece of #16 gauge steel with welded stiffeners; give quick access to enclosed equipment for inspection and service. Doors formed from one piece of #16 gauge steel with full length welded vertical channel reinforcement; have concealed hinges; are instantly detachable without tools. Fully gasketed doors can be mounted for left or right hand operation and are held closed with full length magnetic stripping. Brushed aluminum handle and locking latch with 2 keys are provided. Standard finish, smoke blue texture. For other colors, refer to chart on page 2. TVA Series Assemblies: Includes frame with trim, 2 pair of adjustable panel mounting angles, 2 outside removable side panels, rear mounted door with handle, lock and keys. Frame includes trim and 2 pair of panel mounting angles. TSA Assemblies: Same as TVA Series above and fixed angles on front sloping panel area. Sloped front 19° from vertical. **To order specify color, trim style and door position (LH or RH).**

VERTICAL ENCLOSURES

Panel Size In. W. x D. x H.	Assemblies		Frames Only		Panels per Pair		Rear Door	
	Premier No.	Net A	Premier No.	Net A	Premier No.	Net A	Premier No.	Net A
19x17x21	TVA-2119-17		TVF-2119-17		TVP-2117		TVD-2119	
19x17x31½	TVA-3119-17		TVF-3119-17		TVP-3117		TVD-3119	
19x17x42	TVA-4219-17		TVF-4219-17		TVP-4217		TVD-4219	
19x17x52½	TVA-5219-17		TVF-5219-17		TVP-5217		TVD-5219	
19x17x61¼	TVA-6119-17		TVF-6119-17		TVP-6117		TVD-6119	
19x17x70	TVA-7019-17		TVF-7019-17		TVP-7017		TVD-7019	
19x17x77	TVA-7719-17		TVF-7719-17		TVP-7717		TVD-7719	
19x23x21	TVA-2119-23		TVF-2119-23		TVP-2123		TVD-2119	
19x23x31½	TVA-3119-23		TVF-3119-23		TVP-3123		TVD-3119	
19x23x42	TVA-4219-23		TVF-4219-23		TVP-4223		TVD-4219	
19x23x52½	TVA-5219-23		TVF-5219-23		TVP-5223		TVD-5219	
19x23x61¼	TVA-6119-23		TVF-6119-23		TVP-6123		TVD-6119	
19x23x70	TVA-7019-23		TVF-7019-23		TVP-7023		TVD-7019	
19x23x77	TVA-7719-23		TVF-7719-23		TVP-7723		TVD-7719	
19x29x21	TVA-2119-29		TVF-2119-29		TVP-2129		TVD-2119	
19x29x31½	TVA-3119-29		TVF-3119-29		TVP-3129		TVD-3119	
19x29x42	TVA-4219-29		TVF-4219-29		TVP-4229		TVD-4219	
19x29x52½	TVA-5219-29		TVF-5219-29		TVP-5229		TVD-5219	
19x29x61¼	TVA-6119-29		TVF-6119-29		TVP-6129		TVD-6119	
19x29x70	TVA-7019-29		TVF-7019-29		TVP-7029		TVD-7019	
19x29x77	TVA-7719-29		TVF-7719-29		TVP-7729		TVD-7719	
24x17x21	TVA-2124-17		TVF-2124-17		TVP-2117		TVD-2124	
24x17x31½	TVA-3124-17		TVF-3124-17		TVP-3117		TVD-3124	
24x17x42	TVA-4224-17		TVF-4224-17		TVP-4217		TVD-4224	
24x17x52½	TVA-5224-17		TVF-5224-17		TVP-5217		TVD-5224	
24x17x61¼	TVA-6124-17		TVF-6124-17		TVP-6117		TVD-6124	
24x17x70	TVA-7024-17		TVF-7024-17		TVP-7017		TVD-7024	
24x17x77	TVA-7724-17		TVF-7724-17		TVP-7717		TVD-7724	
24x23x21	TVA-2124-23		TVF-2124-23		TVP-2123		TVD-2124	
24x23x31½	TVA-3124-23		TVF-3124-23		TVP-3123		TVD-3124	
24x23x42	TVA-4224-23		TVF-4224-23		TVP-4223		TVD-4224	
24x23x52½	TVA-5224-23		TVF-5224-23		TVP-5223		TVD-5224	
24x23x61¼	TVA-6124-23		TVF-6124-23		TVP-6123		TVD-6124	
24x23x70	TVA-7024-23		TVF-7024-23		TVP-7023		TVD-7024	
24x23x77	TVA-7724-23		TVF-7724-23		TVP-7723		TVD-7724	
24x29x21	TVA-2124-29		TVF-2124-29		TVP-2129		TVD-2124	
24x29x31½	TVA-3124-29		TVF-3124-29		TVP-3129		TVD-3124	
24x29x42	TVA-4224-29		TVF-4224-29		TVP-4229		TVD-4224	
24x29x52½	TVA-5224-29		TVF-5224-29		TVP-5229		TVD-5224	
24x29x61¼	TVA-6124-29		TVF-6124-29		TVP-6129		TVD-6124	
24x29x70	TVA-7024-29		TVF-7024-29		TVP-7029		TVD-7024	
24x29x77	TVA-7724-29		TVF-7724-29		TVP-7729		TVD-7724	

SLOPED FRONT ENCLOSURES

Size, Inches W. x D. x H.	Sloped Front Panel Space, In.	Panel to Panel D., In.	Vertical Space, In.		Assemblies		Frames		Panels per Pair		Rear Door	
			Front	Rear	Premier No. TSA-	Net Each A	Premier No. TSF-	Net Each A	Premier No. TSP-	Net Each A	Premier No. TSD-	Net Each A
22x25⅞x47⅝	19x10½	23	19x29¾	19x42	1019-23		1019-23		1023		4219	
22x25⅞x50⅝	19x17½	23	19x26¼	19x42	1719-23		1719-23		1723		4219	
22x31⅞x47⅝	19x10½	29	19x29¾	19x42	1019-29		1019-29		1029		4219	
22x31⅞x50⅝	19x17½	29	19x26¼	19x42	1719-29		1719-29		1729		4219	
27x25⅞x47⅝	24x10½	23	24x29¾	24x42	1024-23		1024-23		1023		4224	
27x25⅞x50⅝	24x17½	23	24x26¼	24x42	1724-23		1724-23		1723		4224	
27x31⅞x47⅝	24x10½	29	24x29¾	24x42	1024-29		1024-29		1029		4224	
27x31⅞x50⅝	24x17½	29	24x26¼	24x42	1724-29		1724-29		1729		4224	

ACCESSORIES

CHASSIS SUPPORT ANGLES

Adjustable #12 gauge steel angles, mount to side legs of panel mounting angles.

Premier Number	To Fit Panel To Panel Rack Depth, In.	Net per Pair A
TCS-17	17	
TCS-23	23	
TCS-29	29	

EQUIPMENT SHELVES

For general use, formed of #16 gauge steel, supported on chassis support angles.

Premier Number	To Fit Rack Size, In., W. x D.	Net Each A
TES-1917	19x17	
TES-1923	19x23	
TES-1929	19x29	
TES-2417	24x17	
TES-2423	24x23	
TES-2429	24x29	

SLIDING DRAWERS

Welded #16 gauge steel drawers are cradle mounted on full extension roller bearings slides with a disconnect feature. Suspension cradle mounts to front panel mounting angles.

Premier Number	For Front Panel Size, In., W.xD.	Net Each A
TDR-319	19x3½	
TDR-719	19x7	
TDR-1019	19x10½	
TDR-324	24x3½	
TDR-724	24x7	
TDR-1024	24x10½	

WRITING SHELVES

Premier Number	Panel Width, In.	Net Each A
TWS-1918	19	
TWS-2418	24	
TWS-319*	19	
TWS-324*	24	

* Sliding shelves.

TURRETS

Mounted to frames or used individually for optimum viewing. EIA spaced holes.

Premier Number	Sloped Panel Size, In., W. x D.	Net Each A
TTU-1-19	19x14	
TTU-1-24	24x14	
TTU-3-19	19x17½	
TTU-3-24	24x17½	

OUTLET BOXES

Premier Number	For Panel Height, In.	Net Each A
OB-142	42	
OB-152	52½	
OB-161	61¼	
OB-170	70	
OB-177	77	

Premier No. TLL-250 Levelling Legs: Set of four legs. Each having 250 lbs. load carrying capacity. Net ....**$13.15** A

See Series PMB Blowers, Cable Retractor, Series CA Casters, SB Series Chassis Slides listed on other Premier pages.

See Discount Schedule A or B on Page 2.

PREMIER MODULAR RACKS

FA SERIES ROUNDED CORNER FRAMES
FOR 19″ AND 24″ PANELS — 22″ & 25½″ DEEP — DESIGNED FOR MULTIPLE INSTALLATIONS

Frame made of 14 gauge steel welded throughout. Tops of front and rear are rounded. Supplied with 2 pair of 12 ga. steel panel mounting angles fully adjustable front to rear. Angles have EIA spaced clearance holes on both legs. 10/32 screws and captive nuts are furnished for panel mounted components. Doors may be mounted front or rear, hinged right or left hand. Knockouts for ganging, holes for caster mounting and combination KOs for cabling on both sides of top and bottom and cutout in base are provided. Top is solid, holes for fans are provided at additional cost. Frames accommodate ball cornered end panels (CEP SERIES). Standard finish, smoke blue texture, for other colors, refer to page 2.

FRAMES — 22″ WIDE

Height, Inches	Panel Space, Inches	22″ Deep Models			25½″ Deep Models		
		Premier No.	Shipping Wt.	Net Each A	Premier No.	Shipping Wt.	Net Each A
48⅝	42 x19	FA-42-22	50 lbs.		FA-42-255	58 lbs.	
59⅛	52½x19	FA-52-22	65 lbs.		FA-52-255	75 lbs.	
67⅞	61¼x19	FA-61-22	80 lbs.		FA-61-255	92 lbs.	
76⅝	70 x19	FA-70-22	100 lbs.		FA-70-255	115 lbs.	
83⅝	77 x19	FA-77-22	110 lbs.		FA-77-255	127 lbs.	

FRAMES — 27″ WIDE

67⅞	61¼x24	FA-2761-22	90 lbs.		FA-2761-255	98 lbs.	
76⅝	70 x24	FA-2770-22	110 lbs.		FA-2770-255	123 lbs.	
83⅝	77 x24	FA-2777-22	120 lbs.		FA-2777-255	135 lbs.	

END PANELS — 1 11/32″ DEEP

Made of one-piece 16 ga. steel; ball cornered. Attach to frame by a bracket on bottom; held securely by two captive screws on top. Supplied blank. Louvers furnished at extra charge. Smoke blue texture finish.

22″ WIDE

Premier Number	Height, In.	Shipping Wt., Lbs.	Net Each A
CEP-42-22	45¼	23	
CEP-52-22	55¾	27	
CEP-61-22	64½	30	
CEP-70-22	73¼	33	
CEP-77-22	80¼	35	

25½″ WIDE

CEP-42-255	45¼	28	
CEP-52-255	55¾	32	
CEP-61-255	64½	35	
CEP-70-255	73¼	38	
CEP-77-255	80¼	40	

DOORS — 13/16″ DEEP

Mount either left or right by rotating 180°; hang on slip-jointed hinges; equipped with locking handle. Made of 16 ga. steel. Supplied blank. Louvers furnished at extra cost. Smoke blue texture finish.

21½″ WIDE

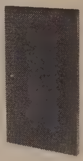
Premier Number	Height, In.	Shipping Wt., Lbs.	Net Each A
DF-42*	45 5/16	20	
DF-52	56 1/16	25	
DF-61	64 13/16	28	
DF-70	73 5/16	31	
DF-77	80 5/16	34	

*Add suffix **-1002** when used with FS-1002 or FS-1004.

26½″ WIDE

DF-2761	64 13/16	34	
DF-2770	73 5/16	38	
DF-2777	80 5/16	41	

FLUSH DOORS — ½″ DEEP



For frames CPF, FS, FA and PRXA. Made of 16 gauge steel. Finished in smoke blue. Mount either left or right hand by rotating 180°. Hinged brackets punched for panel mounting angles on cabinets. Satin chrome plated handle; snap catch.

Premier Number	Size, In. H. x W.	Shipping Wt., Lbs.	Net Each A
CD-17	17½x19	7	
CD-21	21 x19	8	
CD-26	26¼x19	9	
CD-28	28 x19	10	
CD-29	29¾x19	11	
CD-42	42 x19	16	

FS SERIES 10½″ AND 17½″ SLOPED FRONT CONSOLE FRAMES
FOR 19″ AND 24″ PANELS

- Tops of front and rear are rounded
- Designed for multiple installation.
- Made of No. 14 gauge steel.
- Sloped front is 19° from vertical.
- Frame is completely welded thru-out; panel fits into ½″ recess.
- Smoke blue texture finish.
- Supplied with two pairs of adjustable panel mounting angles for vertical openings with EIA spaced clearance holes. 10/32 screws and captive nuts are furnished. Front sloped panel space has fixed mounting angles tapped 10/32 holes on EIA spacing.
- A rectangular cutout is provided in the bottom for leads, etc.
- Holes in bottom accommodate CA-4 (2″) and CA-5 (3″) casters.

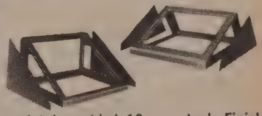
Premier Number	Size, Inches W. x D. x H.	Sloped Front Panel Space, In.	Vertical Space, In.		Shpg. Wt., Lbs.	Net Each
			Front	Rear		
FS-1001	22x22 x50	17½x19	26¼x19	42x19	66	
FS-1002	22x22 x47	10½x19	29¾x19	42x19	64	
FS-1003	27x22 x50	17½x24	26¼x24	42x24	76	
FS-1004	27x22 x47	10½x24	29¾x24	42x24	74	
FS-1001-255	22x25½x50	17½x19	26¼x19	42x19	....	
FS-1002-255	22x25½x47	10½x19	29¾x19	42x19	....	
FS-1003-255	27x25½x50	17½x24	26¼x24	42x24	....	
FS-1004-255	27x25½x47	10½x24	29¾x24	42x24	....	

END PANELS FOR SLOPED FRONT FRAMES

- One-piece No. 16 gauge steel; smoke blue texture finish.
- Ball cornered. 1 11/32″ deep.
- End panels are attached to frame by means of a bracket on the bottom; held securely by two captive screws on top.
- Supplied blank. Louvers furnished at additional charge.

Premier End Panels	Used for Frame	Shipping Wt. Lbs.	Net Each A
CEP-1201LH	Left side FS-1001 & 1003	20	
CEP-1201RH	Right side FS-1001 & 1003	20	
CEP-1202LH	Left side FS-1002 & 1004	18	
CEP-1202RH	Right side FS-1002 & 1004	18	
CEP-1201-255LH	Left side FS-1001- & 1003-255	22	
CEP-1201-255RH	Right side FS-1001- & 1003-255	22	
CEP-1202-255LH	Left side FS-1002- & 1004-255	20	
CEP-1202-255RH	Right side FS-1002- & 1004-255	20	

TURRET WITH FLAT SIDE PANELS



Turrets may be ganged for console assemblies or mounted on any of their three openings to vertical and pedestal frames. All openings drilled and tapped for 10-32 screws on standard EIA spacing in ½″ recess. Frames completely welded 16 ga. steel. Finish available in all Premier standard colors; smoke blue texture supplied unless otherwise specified.

Premier No.	Size, In. W. x H. x D.	Panel Space, In.			Shipping Wt.	Net Each A
		Front	Rear	Bottom		
TUR-1-19	22x 9¾x21	14 x19	7 x19	17½x19	25 lbs.	
TUR-1-24	27x 9¾x21	14 x24	7 x24	17½x24	27 lbs.	
TUR-3-19	22x12¼x17½	17½x19	8¾x19	14 x19	20 lbs.	
TUR-3-24	27x12¼x17½	17½x24	8¾x24	14 x24	22 lbs.	

See Discount Schedule A or B on Page 2.

PREMIER MODULAR RACKS

MODULAR SQUARE CORNERED FRAMES

FOR MULTIPLE INSTALLATIONS 18″ AND 24″ DEEP FOR 19″, 24″ AND 30″ PANELS

Frames accommodate flush side panels (FL Series). Tops of front and rear are square. Made of No. 14 gauge steel, welded throughout. Supplied with two pairs of 12 ga. steel panel mounting angles, fully adjustable front to rear. Angles have EIA spaced clearance holes. 10/32 screws and captive nuts are furnished. Top of frame is solid one piece construction. Frames may be ganged. Lead cutout at bottom. Doors can be mounted to front or rear of frame, and can be mounted left or right hand—knockouts for hinge and handle brackets. Holes for casters — CA-4 (2″), CA-5 (3″), CA-6 (double 2″) and CA-7 (locking 3″). Smoke blue texture.

FRAMES, PANELS AND DOORS

Frames, panels and doors are sold separately. Doors are made of No. 16 ga. steel; mount either left or right hand by rotating 180°. Supplied blank. Louvers available at extra charge. Slip-jointed hinges. Locking handle. Smoke blue texture.

Frame Ht., In.	Panel Space, Inches	Width Inches	18″ Deep Frames			24″ Deep Frames			Doors			
			Premier Number	Shipping Wt. Lbs.	Net Each A	Premier Number	Shipping Wt. Lbs.	Net Each A	Premier Number	Size, Inches W. x H.	Shipping Wt. Lbs.	Net Each A
48⅛	42 x19	22	PRXA-42	48		PRXA-42-24	58		DF-42	21½x45 9/16	20	
58⅝	52½x19	22	PRXA-52	60		PRXA-52-24	72		DF-52	21½x56 1/16	25	
67⅜	61¼x19	22	PRXA-61	70		PRXA-61-24	85		DF-61	21½x64 13/16	28	
76⅛	70 x19	22	PRXA-70	88		PRXA-70-24	108		DF-70	21½x73 9/16	31	
83⅛	77 x19	22	PRXA-77	100		PRXA-77-24	120		DF-77	21½x80 9/16	34	
67⅜	61¼x24	27	PRXA-2761	100		PRXA-2761-24	134		DF-2761	26½x64 13/16	34	
76⅛	70 x24	27	PRXA-2770	104		PRXA-2770-24	140		DF-2770	26½x73 9/16	38	
83⅛	77 x24	27	PRXA-2777	116		PRXA-2777-24	156		DF-2777	26½x80 9/16	41	
67⅜	61¼x30	33	PRXA-3361	122		PRXA-3361-24	162		DF-3361*	32½x64 13/16	40	
76⅛	70 x30	33	PRXA-3370	126		PRXA-3370-24	169		DF-3370*	32½x73 9/16	45	
83⅛	77 x30	33	PRXA-3377	142		PRXA-3377-24	190		DF-3377*	32½x80 9/16	48	

* Double doors with 3-point locking device.

FLUSH SIDE PANELS ½″ DEEP

One-piece, 16-ga. steel. Fits frame side recess; clips on. Smoke blue texture.

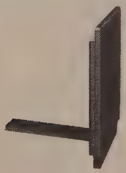
15″ Wide for 18″ Deep Frames

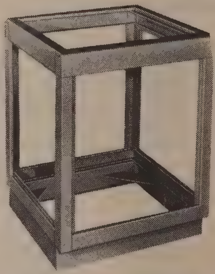
Premier No.	Height In.	To Fit Frame No.	Shipping Wt. Lbs.	Net Each A
FL-42	48	PRXA-42	19	
FL-52	58½	PRXA-52	21	
FL-61	67¼	PRXA-61, 2761, 3361	22	
FL-70	76	PRXA-70, 2770, 3370	25	
FL-77	83	PRXA-77, 2777, 3377	27	

21″ Wide for 24″ Deep Frames

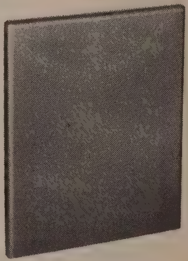
Premier No.	Height In.	To Fit Frame No.	Shipping Wt. Lbs.	Net Each A
FL-42-24	48	PRXA-42-24	21	
FL-52-24	58½	PRXA-52-24	24	
FL-61-24	67¼	PRXA-61-24, 2761-24, 3361-24	27	
FL-70-24	76	PRXA-70-24, 2770-24, 3370-24	30	
FL-77-24	83	PRXA-77-24, 2777-24, 3377-24	33	

END PEDESTAL AND FOOT BRACE FOR DOUBLE UNIT ASSEMBLY





- Made of No. 16 gauge steel.
- Ball cornered.
- Foot Brace mounts to Pedestal Frame CPF Series and End Pedestal PE-901.
- Foot Brace can be mounted between two Pedestal Frames (CPF Series).
- Finished in smoke blue texture.



END PEDESTAL

Premier No.	Shipping Wt.	Net Each A
PE-901	25 lbs.	

FOOT BRACE

Premier No.	Shipping Wt. Lbs.	Used With	Net Each A
FB-801	3	22″ wide work tops	
FB-802	3½	27″ wide work tops	

CPF SERIES ROUNDED PEDESTAL CABINET FRAME

Accommodates ball covered end panel (CEP Series). Designed for multiple installation. Supplied with two pairs of adjustable panel mounting angles for vertical openings with EIA spaced clearance holes. 10/32 screws and captive nuts are furnished. Panels fit into ½″ recess. Two rectangular knockouts supplied on one top cross member to accommodate channels of writing work shelf. Brackets welded in base and punched to accommodate CA-5 (3″) casters and supplied with adapter to accommodate CA-4 (2″) casters. Frame is No. 16 gauge, angles 12 gauge steel. Smoke blue texture.

Premier No.	W.xD., In.	Height *	Height †	Panel Space, In. Front‡	Panel Space, In. Top	Wt., Lbs.	Net Each A
CPF-101	22x22	30″	29½″	21x19	17½x19	45	
CPF-102	22x22	37″	36½″	28x19	17½x19	48	
CPF-101-34	22x34¼	30″	29½″	21x19	29¾x19	54	

* With casters. † Without casters. ‡ And rear.

END PANELS

Made of one-piece 16 gauge steel. Designed for easy installation and access, panels attach to pedestal frame by means of two brackets on bottom; held securely with two captive screws on top. **Finish:** Smoke blue.

Premier No.	W. x H.	Used With	Net A
CEP-401	22″ x26″	CPF-101, -103	
CEP-402	22″ x33″	CPF-102, -104	
CEP-401-34	34¼″x26″	CPF-101-34	
CSS-701*	22″ x23″	CPF-101, -103	
CSS-701-34*	34¼″x23″	CPF-101-34	

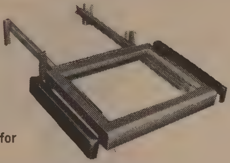
* Short end panel, 1 11/32″ deep. Used only when work top is mounted between two pedestal frames.

See Discount Schedule A or B on Page 2.

PREMIER ENCLOSURE ACCESSORIES

WORK SHELVES AND DRAWERS

WRITING WORK SHELF
FOR CPF, FA AND FS FRAMES



- Made of No. 16 gauge steel.
- Tops, front and rear, are rounded.
- Shipped knocked down.
- Finished in smoke blue texture.
- Supplied with 3½″ x 19″ formed panel.
- Comes complete with channels and brackets for mounting to inside of frames.

FOR SINGLE OR MULTIPLE INSTALLATION — 22″ WIDE, 3″ HIGH

		For 22″ Deep Frames			For 25½″ Deep Frames		
Top Panel Space, In.	Depth In.	Premier No.	Shpg. Lbs.	Net Each A	Premier No.	Shpg. Lbs.	Net Each A
10½x19	15	WW-15-22	11		WW-15-255	12	
14 x19	18½	WW-18-22	12		WW-18-255	13	
17½x19	22	WW-22-22	13		WW-22-255	14	

END PANELS FOR WRITING WORK SHELF

Ball cornered. Fits writing work shelf by two captive screws. One piece of No. 18 gauge steel finished in smoke blue texture.

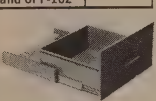
Premier No.	Used With	Shipping, Lbs.	Net Each A
CEP-15	WW-15-22, 15-255	1½	
CEP-18	WW-18-22, 18-255	2	
CEP-22	WW-22-22, 22-255	2½	

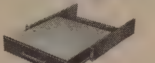
FORMICA WRITING PANELS

Gray linen weave pattern formica is bonded to plywood as top surface. Unfinished formica bonded to bottom surface. 19″ x ½″.

Premier Number	Panel Space, Inches	Fits Into	Net Each A
FWP-1019	10½x19	WW-15-22 and WW-15-255	
FWP-1419	14 x19	WW-18-22 and WW-18-255	
FWP-1719	17½x19	WW-22-22, WW-22-255, WTO-22-22 and top panel of CPF-101 and CPF-102	

SLIDING DRAWERS AND SHELF





Made of No. 16 gauge steel. Mounted on suspension slides, which sustain 46 lbs. Drawer (Fig. A) extends 16 in. from front. Fits CPF Series, FS Series, FA and 24-in deep PRXA Series (when used with other formed panels). Sliding shelf (Fig. B) with gray linen-weave formica (2-C-1) on top surface. Supplied with brackets for mounting to holes of panel mounting angles. Attractive, satin chrome plated handle; light gray finish. Shipped knocked down, with all hardware. For 19-inches wide panel space.

SLIDING DRAWERS (FIG. A)

Premier No.	Panel Size, In.	Drawer Size W. x D. x H., In.	Shipping Wt.	Net Each A
D-1916	10⅜x18⅞	16⅛x16x6	12 lbs.	
D-2016	6⅞x18⅞	16⅛x16x6	22 lbs.	
D-2316	3⅜x18⅞	16⅛x16x2 11/16	16 lbs.	

SLIDING SHELF (FIG. B)

RDS- Premier No.	Panel Size, In.	Shelf Size, In.	Shipping Wt.	Net Each A
RDS-319-22	3⅜x18⅞	16⅛x16⅛	20 lbs.	

SELF-SPRAYING LACQUER
AVAILABLE IN 3 COLORS IN 12 OZ. CANS

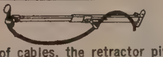
Premier No.	To Match	Net Ea. B
GHL-102	Premier gray hammertone	
SBL-105	Smoke blue enamel	
LGL-106	Light gray enamel	

HEAVY DUTY OUTLET BOXES

Completely wired and ready to use outlet boxes for work benches and internal rack mounting; mount to crosspieces on Premier No. PRXA and FA frames. Have built-in circuit breaker, U-type ground outlets, and soldered connections. Mounting centers, 6″. For heavy-duty applications. Rated at 15 amps, 130 volts continuous duty. Supplied with 6-ft. neoprene cord set with molded plug. Steel case finished in gray hammertone.

Premier No.	Size, Inches L. x W. x D.	No. of Outlets	Fit Racks With	Net Each A
OB-142	39½x1½x1⅛	7	42″ panel space height	
OB-152	50x1½x1⅛	8	52½″ panel space height	
OB-161	56¾x1½x1⅛	9	61¼″ panel space height	
OB-170	65½x1½x1⅛	10	70″ panel space height	
OB-177	72½x1½x1⅛	11	77″ panel space height	

CABLE RETRACTOR
FOR CONTROL OF POWER SUPPLY CABLES



Installed at rear of cabinet for effective control of cables, the retractor pivots and slides on ball bearings under spring tension as chassis is extended maintaining "jam-proof" control

Premier No. PCR-316 — Cable Retractor — Net Each A ....

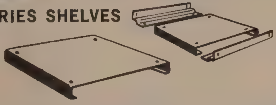
FRONT DOORS

TO FIT STANDARD 19″ DESK RACK CABINETS AND CABINET RELAY RACKS

Constructed of one piece of 16 gauge steel. Cylinder lock and angle bracket incl. All necessary bolts included for easy assembly. 20½″ widex1¼″ deep. Smoke blue texture.

Prem. No.	Door Ht.	Shpg. Lbs.	Net Each A	Prem. No.	Door Ht.	Shpg. Lbs.	Net Each A
FD-300	25¼″	10	$24.15	FD-306	21″	9	
FD-301	31½″	11	27.84	FD-310	36⅞″	13	
FD-302	35″	12	32.46	FD-311	45⅛″	15	
FD-303	12½″	6	18.74	FD-312	61⅜″	20	
FD-304	14″	7	19.64	FD-313	77⅛″	24	
FD-305	17½″	8	21.48				

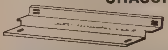
"S" SERIES SHELVES



- Shelf and chassis support angles in position.
- No. 16 gauge steel.
- Light gray finish.

Premier No.	Depth x Width Inches	To Fit Frames W. x D., Inches	Net Each A
S-22-22	20⅜x17½	22x22, FA	
S-27-22	20⅜x22½	27x22, FA	
S-22-255	23⅞x17½	22x25½, FA	
S-27-255	23⅞x22½	27x25½, FA	
S-22-18	16⅜x17½	22x18, PRXA	
S-27-18	16⅜x22½	27x18, PRXA	
S-33-18	16⅜x28½	33x18, PRXA	
S-22-24	22⅜x17½	22x24, PRXA	
S-27-24	22⅜x22½	27x24, PRXA	
S-33-24	22⅜x28½	33x24, PRXA	

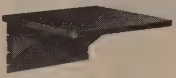
CHASSIS SUPPORT ANGLES



No. 12 gauge steel. Accommodates shelf (S series). Mounts to tapped holes on side legs of panel mounting angles of FA and PRXA series. Light gray finish.

Premier No.	Length, In.	To Fit Frames	Net/Pair A
CSA-16	14⅛	18″ deep FDX, RMX	
CSA-18	16⅛	18″ deep PRXA	
CSA-22	20½	22″ deep FA	
CSA-24	22⅛	24″ deep PRXA	
CSA-255	23⅝	25½″ deep FA	

DESK PANELS



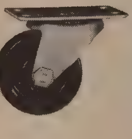
16 gauge steel bolted to standard 10½″x19″ panel. Front corners rounded. 22″ wide Shipped knocked down. Light gray finish.

Premier No. DP-1016 — 16″ deep.
Shipping Weight 20 lbs. ....Net Each A

Premier No. DP-1020 — 20″ deep
Shipping Weight 22 lbs. ....Net Each A

2″ - 3″ - 4″ DIA. CASTERS

Made of non-marking composition wheel with Ball Bearing Swivel Plate. Packed one set of 4 in box with screws for assembly.



Prem. No.	Kind of Wheel	Wheel Size	Overall Height	Cap. per Caster—Lbs.	Net Price A
CA-4	Plaskite	2″ dia. x 13/16″	2 7/16″	80	
CA-5	Rockite	3″ dia. x 1¼″	3 13/16″	225	
CA-6	Soft Rubber	Double 2″ dia. x 1⅝″	2 13/16″	125	
CA-7*	Rockite	3″ dia. x 1¼″	3 13/16″	225	
CA-8†	Rockite	4″ dia. x 1⅝″	5¼″	450	

* Foot operated friction brake for positive locking wheel.
† With roller bearing wheel.

PANEL MOUNTING ANGLES — 1¼″ x 1¼″

Made of #12 Ga. (.104) thick steel punched on E.I.A. spacings (⅝-⅝-½) on both legs. 10-32 screws and captive nuts supplied. Angles with tapped holes available. Smoke blue texture.

Panel Mounting Angles			
Premier No.	Height	Net Price A	To Fit Racks
PMA-212	21″		CPF-101, 103, MSF-21-22 & MSF-21-255
PMA-282	28″		CPF-102, 104, MSF-28-22 & MSF-28-255
PMA-362	36¾″		PRXA, FDX, RMX
PMA-422	42″		FA, PRXA, FS, FDX, RMX
PMA-522	52½″		FA, PRXA
PMA-612	61¼		FA, PRXA, FDX, RMX
PMA-702	70″		FA, PRXA, FDX, RMX
PMA-772	77″		FA, PRXA, FDX, RMX

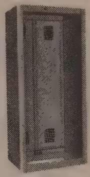
See Discount Schedule A or B on Page 2.

PREMIER HEAVY DUTY RACKS

HEAVY DUTY RACKS
(Solid Side Skin Type)

FOR 19″, 24″ AND 30″ PANELS WITH AND WITHOUT FRONT DOORS 18″ AND 24″ DEEP

Racks are supplied without louvers on side unless specified. Construction of #16 gauge steel with #12 gauge bottom; welded throughout. Supplied with two pairs of 12 ga. steel panel mounting angles, fully adjustable front to rear. Angles have EIA spaced clearance holes. 10/32 screws and captive nuts are furnished. Racks are supplied with or without louvers. Rear doors are hung on sturdy loose-jointed hinges and closed by a chrome handle. A rectangular cutout in bottom is made for leads, etc. Duplex receptacle and outlet box supplied in the back under the door. **Model RMX-7030:** Supplied with double rear doors and 3 point locking devices. **Series FDX:** Supplied with locking handle on front door; panel mounting angles adjustable to any distance from front by channel slides. Base punched to accept casters. **Finish:** Smoke blue texture.



RACKS WITHOUT FRONT DOORS, 18″ DEEP

Premier Number	Size, In. H. x W.	Panel* Ht., In.	Wt.,§ Lbs.	Net Each A
RMX-3619	42⅞x22	36¾	100	
RMX-4219	48⅛x22	42	130	
RMX-6119	67⅜x22	61¼	150	
RMX-7019	76⅛x22	70	170	
RMX-7719	83⅛x22	77	190	

RACKS WITHOUT FRONT DOORS, 24″ DEEP

RMX-3619-24	42⅞x22	36¾	110	
RMX-4219-24	48⅛x22	42	130	
RMX-6119-24	67⅜x22	61¼	175	
RMX-7019-24	76⅛x22	70	200	
RMX-7719-24	83⅛x22	77	225	
RMX-7030	76⅛x33	70†	240	
RMX-2742	48⅛x27	42‡	170	
RMX-2761	67⅜x27	61¼‡	210	
RMX-2770	76⅛x27	70‡	240	
RMX-2777	83⅛x27	77‡	270	

RACKS WITH FRONT DOORS, 18″ DEEP

Premier Number	Size, In. H. x W.	Panel* Ht., In.	Wt.,§ Lbs.	Net Each A
FDX-3619	42⅞x22	36¾	115	
FDX-4219	48⅛x22	42	120	
FDX-6119	67⅜x22	61¼	175	
FDX-7019	76⅛x22	70	200	
FDX-7719	83⅛x22	77	220	

RACKS WITH FRONT DOORS, 24″ DEEP

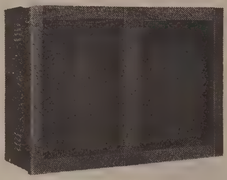
FDX-3619-24	42⅞x22	36¾	125	
FDX-4219-24	48⅛x22	42	150	
FDX-6119-24	67⅜x22	61¼	200	
FDX-7019-24	76⅛x22	70	255	
FDX-7719-24	83⅛x22	77	270	
FDX-2742	48⅛x27	42‡	180	
FDX-2761	67⅜x27	61¼‡	230	
FDX-2770	76⅛x27	70‡	260	
FDX-2777	83⅛x27	77‡	290	

* 19″ wide unless otherwise noted. † 30″ wide. ‡ 24″ wide. § Shipping.

FOR STANDARD 19″ RACK PANELS (KNOCKED DOWN)

MULTIPLE RACK SECTIONS 22″ WIDE X 18″ DEEP

These racks can be joined together to make multiple units by means of a solid center partition which is bolted to the top and bottom. Each multiple section comprises a top, bottom, rear and center partition. When ordering multiple units, specify number of units, such as dobule, triple, quad, etc.



Premier No.	Size, Inches		For Use With	Net Each A
	Overall Height	Panel Space		
MR-3619	41⅞	36¾	R-3619	
MR-4219	47⅛	42	R-4219	
MR-6119	66⅜	61¼	R-6119	
MR-7719	82⅛	77	R-7719	

Example:
One Double R-3619 consists of one R-3619 and one MR-3619
One Triple R-3619 consists of one R-3619 and two MR-3619
One Quad R-3619 consists of one R-3619 and three MR-3619

22″ WIDE X 18″ DEEP

Rounded R Series with front vertical rounded corners. Rigidly constructed of #16 gauge steel. Panel mounting angles are #12 gauge steel welded at front of cabinet to form a ⁵⁄₁₆″ panel recess. Drilled and tapped holes for 10-32 screws on EIA spacing. Panels fit into a ⁵⁄₁₆″ recess so that the edges are not exposed. Rear doors are hung on sturdy slip-jointed hinges, and closed by a chrome handle. Locking handle with two keys available at additional cost. Holes in bottom accommodate casters. Cabinets finished in smoke blue texture. Racks are shipped knocked down with all necessary bolts for easy assembly.

Premier No.	Size, Inches		Shpg. Wt., Lbs.	Net Each A
	Overall Height	Panel Space		
R-3619	41⅞	36¾	80	
R-4219	47⅛	42	90	
R-6119	66⅜	61¼	120	
R-7719	82⅛	77	140	

HEAVY DUTY CHANNEL TYPE

Panels fit into ½″ recess; either flat or formed panels may be used. Top is ventilated by means of grille. Racks can be bolted side by side. Vertical members and top crosspiece are welded together. No projecting screw heads. Smoke blue texture finish.

FOR 19″ WIDE PANELS

Premier No.	Size, Inches H. x W.	Panel Space, Inches	Shpg. Wt., Lbs.	Net Each A
RR-2164	64½x21¹⁄₁₆	61¼x19	85	
RR-2173	73¼x21¹⁄₁₆	70 x19	90	
RR-2180	80¼x21¹⁄₁₆	77 x19	95	

FOR 24″ WIDE PANELS

RR-2664	64½x26¹⁄₁₆	61¼x24	100	
RR-2673	73¼x26¹⁄₁₆	70 x24	105	
RR-2680	80¼x26¹⁄₁₆	77 x24	105	

CHANNEL TYPE

Similar to RR-2100 Series, with 3¼″ channel uprights for medium duty applications. Made of #12 ga. steel and finished in smoke blue texture finish.

Premier No.	Size, Inches H. x W. x D.	Panel Space, Inches	Shpg. Wt., Lbs.	Net Each A
RR-800	39¼x20x18⅜	36¾x19	40	
RR-801	74¼x20x20⅞	71¾x19	55	
RR-802	79¼x20x20⅞	77 x19	60	

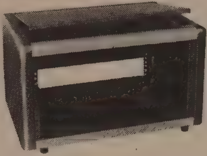
TABLE TYPE

Made of #16 gauge steel; smoke blue texture finish.

Premier No.	Size, Inches H. x W. x D.	Panel Space, Inches	Shpg. Wt., Lbs.	Net Each A
TR-2119	25x21x12	21	17	
TR-2819	32x21x12	28	20	

See Discount Schedule A or B on Page 2.

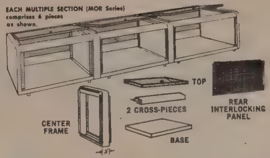
PREMIER DESK CABINETS



DESK CABINETS 15¼″ X 18″ DEEP FOR STANDARD 19″ PANELS SHIPPED KNOCKED DOWN

POR SERIES

Rounded edges, ball cornered at front and rear of tops; assembly screws are not visible externally. Panels fit into ½″ deep recess, vertical members tapped for 10-32 screws on EIA spacing front and rear. Interlocking removable rear panel and top made of perforated metal, held with captive screws. Rear panel has 3½″ opening at bottom for leads, etc., except POR-3, -5, -318, -518. Components may be base mounted before assembly of rack. Supplied with hardware and rubber feet. Made of 16 ga. steel. Finished 2-tone: top cross-piece and base in light gray texture; top panel, rear panel and sides, in smoke blue texture.


EACH MULTIPLE SECTION (MOR Series) comprises 6 pieces as shown.
TOP
REAR INTERLOCKING PANEL
2 CROSS-PIECES
CENTER FRAME
BASE
3″

MOR SERIES

MOR Series Desk Cabinets can be joined together to make multiple units by means of a center frame section which is bolted to the top cross pieces and base. When ordering multiple units specify number of units, such as Double, Triple, etc.

Example: One Double POR-1218 consists of one POR-1218 and one MOR-1218.
One Triple POR-8 consists of one POR-8 and two MOR-8.

Unit shown is one Triple POR-8 which consists of one POR-8 and two MOR-8.

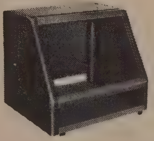
ALL CABINETS ARE 21¾″ WIDE (USE STANDARD 19″ PANELS)

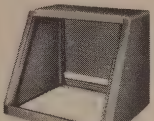
15¼″ Deep			18″ Deep			Size, Inches	
Premier No.	Shpg. Wt., Lbs.	Net Each A	Premier No.	Shpg. Wt., Lbs.	Net Each A	Overall Height	Panel Space
POR-3	18		POR-318	20		5⅞	3½
POR-5	20		POR-518	22		7⅝	5¼
POR-7	22		POR-718	24		9⅜	7
POR-8	24		POR-818	26		11⅛	8¾
POR-10	26		POR-1018	29		12⅞	10½
POR-12	28		POR-1218	31		14⅝	12¼
POR-14	32		POR-1418	35		16⅜	14
POR-17	40		POR-1718	44		19⅞	17½
POR-21	44		POR-2118	48		23⅜	21
POR-26	45		POR-2618	49		28⅝	26¼
POR-31	50		POR-3118	55		33⅞	31½
POR-35	55		POR-3518	60		37⅜	35

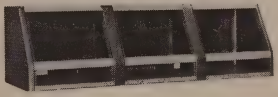
MULTIPLE SECTIONS

15¼″ Deep				18″ Deep	
Premier No.	Shpg. Wt., Lbs.	Net Each A	Premier No.	Shpg. Wt., Lbs.	Net Each A
MOR-3	16		MOR-318	18	
MOR-5	17		MOR-518	19	
MOR-7	18		MOR-718	20	
MOR-8	19		MOR-818	21	
MOR-10	20		MOR-1018	23	
MOR-12	21		MOR-1218	24	
MOR-14	23		MOR-1418	26	
MOR-17	31		MOR-1718	34	
MOR-21	33		MOR-2118	37	
MOR-26	34		MOR-2618	38	
MOR-31	36		MOR-3118	40	
MOR-35	40		MOR-3518	44	

SLOPING INSTRUMENT CABINETS







Ball corner moduler sloping desk top instrument cabinets constructed of 16 ga. steel. Front and rear panel openings recessed ½″ and tapped for 10-32 screws on EIA spacing. Interlocking removable, perforated rear panel fastens with captive screws and furnished with 1¾″ opening at bottom for leads. Assembly screws not visible externally. Shipped knocked down. Provisions are made for mounting to tops of pedestal frames. Top, cross-piece and base finished in light gray texture; rear and side panels finished in smoke blue texture. Also available in all Premier standard colors.

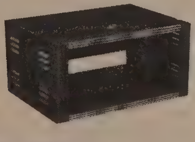
Premier No.	Size, Inches W. x H. x D.	Sloped Panel Space	Front Vertical Panel Space	Rear Panel Space	Slope from Vertical	Bottom Panel Space	Shpg. Wt. Lbs.	Price Net A
CSC-201	21¾x18⅛x18	12¼x19	3½x19	15¾x19	30°	—	35	
CSC-202	21¾x18⅞x18⅞	17½x19	—	15¾x19	25°	15¾x19	40	

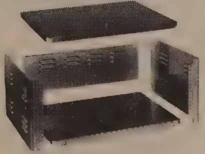
SLOPING INSTRUMENT CABINETS can be joined together to make multiple units by means of a center frame section which is bolted to the top, cross-piece and base. When ordering multiple units specify number of units, such as Double, Triple, etc.

One Triple CSC-201 consists of one CSC-201 and two CMS-301.

MULTIPLE SECTION FOR SLOPING CABINET

Premier No.	Shipping Wt., Lbs.	Net Price A
CMS-301	26	
CMS-302	28	





Constructed of 16 ga. steel. Panel mounting members are recessed ¼″ and tapped for 10-32 screws on EIA spacing. Front trimmed with anodized aluminum at top and bottom. Rounded vertical corners. Top doors equipped with piano hinges and snap catches. Welded gussets at bottoms of rear on Models 170 to 350 for added strength. Knock-down models have no externally visible bolts. DRK Series identical to DCR Series except shipped KD. MDK Series made with solid top and shipped KD. All models finished in smoke blue texture.

DCR AND DRK SERIES

15¼″ Deep Cabinet Racks						Size, Inches		18″ Deep Cabinet Racks		
Welded			Knocked-Down					Welded		
Premier No.	Net Each A	Shpg. Wt., Lbs.	Premier No.	Net Each A	Descr.	Cabinet Height	Avail. Panel Space	Premier No.	Shpg. Wt., Lbs.	Net Each A
DCR-70		22	DRK-70		Door on top only	8¾	7	—	—	
DCR-80		24	DRK-80			10½	8¾	DCR-1880	26	
DCR-100		26	DRK-100			12¼	10½	DCR-18100	29	
DCR-120		28	DRK-120			14	12¼	DCR-18120	31	
DCR-140		32	DRK-140			15¾	14	DCR-18140	35	
DCR-170		40	DRK-170		Door on top and on rear	19¼	17½	DCR-18170	44	
DCR-190		42	DRK-190			21	19¼	DCR-18190	46	
DCR-210		44	DRK-210			22¾	21	DCR-18210	48	
DCR-260		45	DRK-260			28	26¼	DCR-18260	49	
DCR-310		50	DRK-310			33¼	31½	DCR-18310	55	
DCR-350		55	DRK-350			36¾	35	DCR-18350	60	

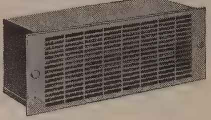
MDK SERIES WITH SOLID TOP

12″ Deep Cabinet Racks					
Knocked-Down					
		Size, Inches			
Premier No.	Descr.	Cabinet Height	Panel Space	Shpg. Wt., Lbs.	Net Each A
MDK-50	With removable rear panel	7	5¼	16	
MDK-70		8¾	7	20	
MDK-80		10½	8¾	21	
MDK-100		12¼	10½	23	
MDK-120		14	12¼	25	
MDK-140		15¾	14	29	
MDK-170	With rear door	19¼	17½	36	
MDK-210		22¾	21	39	
MDK-260		28	26¼	40	
MDK-280		29¾	28	41	

See Discount Schedule A or B on Page 2.

PREMIER BLOWERS-FANS-HANDLES

PREM-O-KOOL PANEL MOUNTED BLOWERS FOR 19″ WIDE PANEL SPACE



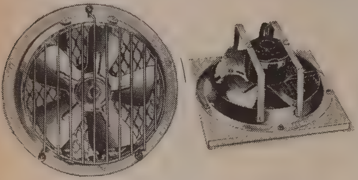
Blowers mount into Standard EIA panel spacing and operate at a low noise level with minimum vibration Supplied with chrome finish grille and permanent type washable filter removable from front, 3′6″ cord and molded male plug. Motors are permanently lubricated, ball bearing, 115v, 50/60 Hz., single phase AC. Units available fit standard 24″ wide panel space. Prices on request.

Premier No.	CFM at 0′ S.P.	Panel Height	Filter Size, Inches	Enclosure Depth	Overall Depth	Motor RPM	Motor Watts	Motor A	Motor Type	Shpg. Wt., Lbs.	Net Each A
PMB-5-150	150	5¼	16⅝x 4⅞x½	6¼	7	3,000	120	1.5	Shaded pole	14	
PMB-5-300	300	5¼	16⅝x 4⅞x½	6¼	7	3,200	86	.9	Split capacitor	15	
PMB-7-360	360	7	16⅝x 6¾x½	8¼	10	1,500	82	1.1	Shaded pole	24	
PMB-7-475	475	7	16⅝x 6¾x½	8¼	10	3,250	180	1.7	Split capacitor	25	
PMB-8-525	525	8¾	16⅝x 8⅜x½	10	11⅝	1,500	180	1.9	Split capacitor	26	
PMB-10-280	820	10½	16⅝x10⅛x½	11½	13	1,500	275	2.8	Split capacitor	35	

PREM-O-KOOL EXHAUST AND INTAKE FANS

Fan and motor assembly shock mounted for minimum noise and vibration. Motors are shaded pole type with permanently lubricated ball bearings, 18″ leads and operate at low temperature rise. Interchangeable accessories are availble for easy mounting with fans.

Exhaust Fans Premier No.	Exhaust Fans CFM	Exhaust Fans Net Each A	Intake Fans Premier No.	Intake Fans CFM	Intake Fans Net Each A	Motor Watts	RPM	Fan Blade Dia., In.	Hole Dia. Req'd., In.
EF-165	165		IF-160	160		20	1650	6½	7⅜
EF-220	220		IF-180	180		25	1550	6½	7⅜
EF-300	300		IF-300	300		65	3000	6½	7⅜
EF-400	400		IF-360	360		46	1460	8	9¼
EF-550	550		IF-540	540		90	1600	9	10⁵⁄₁₆
EF-750	750		IF-740	740		105	1560	10	10⁵⁄₁₆



Cutout and mounting holes for fans can be provided on all Premier racks and cabinets at a slight additional charge.

ACCESSORIES FOR EXHAUST FANS GUARDS

Premier No.	Used with Fan	Dia. In.	Depth In.	Net Each A
GU-6	EF165, 220, 300	6¾	1⅞	
GU-8	EF400	8¼	2³⁄₁₆	
GU-9	EF550	9¼	2⅜	
GU-10	EF750	10¼	2⅜	

GRILLES

GR-6	EF165, 220, 330	8½	—	
GR-8	EF400	10½	—	
GR-9	EF550	11½	—	
GR-10	EF750	12½	—	

SLEEVES

Premier No.	Used with Fan	Dia. In.	Depth In.	Net Each A
SL-6	EF165, 220, 300	8½	1¾	
SL-8	EF400	10½	2	
SL-9	EF500	11½	2⅜	
SL-10	EF750	12½	2⅜	

ACCESSORIES FOR INTAKE FANS — FILTERS

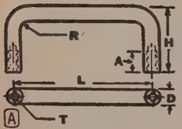
Permanent washable type, ½″ thick.

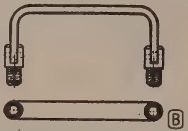
Premier No.	Used with Fan	Size - Sq. In.	Depth In.	Net Each A
FLT-6	IF160, 180, 300	8⅜	—	
FLT-8	IF360	10⅜	—	
FLT-9	IF540	11⅜	—	
FLT-10	IF740	12⅜	—	

FILTER HOLDERS

FH-6	IF160, 180, 300	8⁹⁄₁₆	⅝	
FH-8	IF360	10⁹⁄₁₆	⅝	
FH-9	IF540	11⁹⁄₁₆	⅝	
FH-10	IF740	12⁹⁄₁₆	⅝	

HANDLES FOR INSTRUMENT AND EQUIPMENT HOUSINGS





(A) **HW-16 Series — Material:** Aluminum per QQ-A-325-A. **Finish:** Black anodized per MIL-A-8625 Type II. Also available in semifrost per MIL-A-8625 Type II.

(A) **HW-17 Series — Material:** Brass per QQ-B-626 comp. 22½ hard. **Finish:** Nickel-plate and polish per MIL-QQ-N-290 Type VI. Also available in black oxide finish per MIL-F-495A.

HW-18 — HW-20 SERIES

(A) **HW-18 Series — Material:** Brass per QQ-B-626 comp. 22½ hard. **Finish:** Nickel-plate and polish per MIL-QQ-N-290 Type VI. Also available in black oxide finish per MIL-F-495A.

(A) **HW-19 Series — Material:** Brass per QQ-B-626 comp. 22½ hard. **Finish:** Nickel-plate and polish per MIL-QQ-N-290 Type VI. Also available in black oxide finish per MIL-F-495A.

(A) **HW-20 Series — Material:** Aluminum per QQ-A-325A. Finish: Black anodize per MIL-A-8625 Type II. Also available in semifrost per MIL-A-8625 Type II.

FOLDING ROUND HANDLES

Handle and ferrules are furnished with nylon spacer and roll-pin ⅛″ dia. to hold bow in any given position. Swings 180° to either plane. Size, 4½″ long x ⅜″ dia. x 1¹³⁄₁₆″ high from surface; threaded ⅜″-24 x ½″ long., centered 4″ apart.

(B) **Premier Number HW-21A — Material:** Bow-aluminum MIL spec QQ-A-274. Ferrules MIL spec QQ-A-325A. **Finish:** Nickel-plate and polish MIL-QQ-N-290 Type VI. Net Each ....

(B) **Premier Number HW-22B — Material:** Bow-brass MIL spec QQ-B-626 comp. 22½ hard. Ferrules MIL spec QQ-B-626 comp. 22½ hard. **Finish:** Semifrost per MIL-A-8625 Type II. Net Each ....

(C) METAL FERRULES FOR HANDLES

Premier No.	For Handle Dia.	Material	Finish	Net Ea. A
HW-23AF	¼″	Aluminum	Anodized black	
HW-24BF	¼″	Brass	Nickel-plated, polished	
HW-25BF	⁵⁄₁₆″	Brass	Nickel-plated, polished	

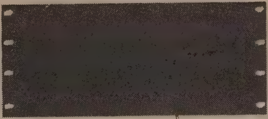
Premier No.	Description	Dimensions, Inches L	H	A	T	D	R	Net Each A
HW-16A1 HW-16A4 HW-16A6	Aluminum, black anodized.	3 4⁹⁄₁₆ 6⁷⁄₁₆	1⁹⁄₃₂ 1½ 1¾	⁹⁄₃₂ ½ ½	10-24 10-24 10-24	⁹⁄₃₂x⅝ oval	½	
HW-17B1 HW-17B4 HW-17B6	Brass, nickel-plate and polish.	3 4⁹⁄₁₆ 6⁷⁄₁₆	1⁹⁄₃₂ 1½ 1¾	⁹⁄₃₂ ½ ½	10-32 10-32 10-32	⁹⁄₃₂x⅝ oval	½	
HW-18B3 HW-18B13 HW-18B14 HW-18B16	Brass, nickel-plate and polish.	3 4⁹⁄₁₆ 6 6⁷⁄₁₆	1⁵⁄₁₆ 1½ 1½ 1¾	⁷⁄₁₆ ⁹⁄₁₆ ⁹⁄₁₆ ⁹⁄₁₆	8-32 10-32 10-32 10-32	⁵⁄₁₆ round	⁵⁄₁₆	
HW-19B1 HW-19B2 HW-19B3 HW-19B4	Brass, nickel-plate and polish.	2 3 4 6	1½ 1½ 1½ 1½	⁹⁄₁₆ ⁹⁄₁₆ ⁹⁄₁₆ ⁹⁄₁₆	8-32 8-32 8-32 8-32	¼ round	¼	
HW-20A1 HW-20A2 HW-20A3 HW-20A4	Aluminum, black anodized.	2 3 4 6	1½ 1½ 1½ 1½	⁹⁄₁₆ ⁹⁄₁₆ ⁹⁄₁₆ ⁹⁄₁₆	8-32 8-32 8-32 8-32	¼ round	¼	

See Discount Schedule A or B on Page 2.

PREMIER PANELS

BLANK RACK PANELS

9½″ — 19″ — 24″ — 30″ WIDTHS



Material:

Steel - #12 Ga. (.104) Cold Rolled
Aluminum - ⅛″ thick —
5005-H36 Alloy
Aluminum - 3⁄16″ thick —
6061-T6 Alloy

FINISHED IN LIGHT GRAY

Available in other finishes at additionali cost. See page 50.

Masked Aluminum Panels:

Made of bright natural aluminum covered on both sides with special self-adhesive paper. Drilling or milling can be done on paper in place, affording complete damage protection. Paper is removed simply by peeling.

Mounting Slots

All panels have closed slots for rigidity with spacing according to E.I.A Standards. Open slots available on special order.

Note: All panels are cut 1⁄32″ less than nominal height.

Modifications Available

- ⅛″ thick Aluminum Panels available in 6061T6 alloy.
- Special finishes, including unfinished.
- Special Heights.

PERFORATED PANELS

- Made of 20 ga. steel with 1⁄16″ diameter holes on 3⁄16″ staggered centers.
- Edges formed on 4 sides.
- Overall depth ½″.
- Each panel has mounting holes on each side.
- Finished in Light Gray enamel.

Panels for TIC Series 15⅝″ and 9½″ widths are available in ⅛″ blank aluminum or masked aluminum.

19″ Wide				24″ Wide		
Premier No.	Shipping Wt., Lbs.	Net Each A	Height	Premier No.	Shipping Wt., Lbs.	Net Each A
PFP-119	1¼		1¾	PFP-124	2¼	
PFP-319	1¾		3½	PFP-324	2¾	
PFP-519	2¼		5¼	PFP-524	3¼	
PFP-719	2¾		7	PFP-724	3¾	
PFP-819	3¾		8¾	PFP-824	4¾	
PFP-1019	4¾		10½	PFP-1024	5¾	
PFP-1219	5¾		12¼	PFP-1224	6¾	
PFP-1419	6¼		14	PFP-1424	7¼	
PFP-1519	6¾		15¾	PFP-1524	7¾	
PFP-1719	7¼		17½			
PFP-1919	7¾		19¼			
PFP-2119	8¾		21			
PFP-2619	10¾		26¼			
PFP-2819	11¾		28			

GRILLE PANELS — 19″ WIDE

Made of No. 12 gauge steel with ⅜″ square perforations. Finished in light gray enamel.

Premier No.	Grille Size	Height, Inches	Shipping Wt., Lbs.	Net Each A
GRP-601	3⅞x13⅜	5¼	2	
GRP-602	3⅞x13⅜	7	2	
GRP-603	5⅞x13⅜	8¾	2½	
GRP-604	3⅞x13⅜*	8¾	2½	
GRP-605	7⅞x13⅜	10½	2½	
GRP-606	5⅞x13⅜*	10½	2½	
GRP-607	7⅞x13⅜*	12¼	3	

* Allows 3½″ space at bottom for chassis mounting.

SIDE HINGED DOOR PANELS — 19″ WIDE

Used for left or right hand opening. Supplied with a quick turn fastener. Full ht. piano hinge welded to panel. Fnish: Light gray enamel.

Premier No.	Height, Inches	Net Each A	Premier No.	Height, Inches	Net Each A
SHP-319	3½		SHP-1019	10½	
SHP-519	5¼		SHP-1219	12¼	
SHP-719	7		SHP-1419	14	
SHP-819	8¾		SHP-2119	21	

BLANK RACK PANELS — 19″ WIDE

Aluminum				Steel		
Premier No.	Shipping Wt., Lbs.	Net Each B	Height	Premier No.	Shipping Wt., Lbs.	Net Each B
ARP-119	½		1¾	RP-119	1	
ARP-319	1		3½	RP-319	2	
ARP-519	1½		5¼	RP-519	3	
ARP-719	2		7	RP-719	4	
ARP-819	2½		8¾	RP-819	5¼	
ARP-1019	3		10½	RP-1019	6¼	
ARP-1219	3½		12¼	RP-1219	7¼	
ARP-1419	4		14	RP-1419	8¼	
ARP-1519	4		15¾	RP-1519	9	
ARP-1719	4¾		17½	RP-1719	10½	
ARP-1919	5		19¼	RP-1919	12	
ARP-2119	6		21	RP-2119	12½	
ARP-2619	7½		26¼	RP-2619	15½	
ARP-3119	8½		31½	RP-3119	19	
ARP-3519	10		35	RP-3519	22	

MASKED ALUMINUM PANELS — 19″ WIDE

Made of bright natural aluminum covered on both sides with special self-adhesive paper. Drilling or milling can be done on paper in place, affording complete damage protection. Paper is removed simply by peeling.

⅛″ Thick				3⁄16″ Thick		
Premier No.	Shipping Wt., Lbs.	Net Each B	Height	Premier No.	Shipping Wt., Lbs.	Net Each A
MAP-119	½		1¾	MAP-119-36	¾	
MAP-319	1		3½	MAP-319-36	1½	
MAP-519	1½		5¼	MAP-519-36	2½	
MAP-719	2		7	MAP-719-36	3	
MAP-819	2½		8¾	MAP-819-36	3¾	
MAP-1019	3		10½	MAP-1019-36	4½	
MAP-1219	3½		12¼	MAP-1219-36	5	
MAP-1419	4		14	MAP-1419-36	6	
MAP-1519	4		15¾	MAP-1519-36	6	
MAP-1719	4¾		17½	MAP-1719-36	7	
MAP-1919	5		19¼	MAP-1919-36	8½	
MAP-2119	6		21	MAP-2119-36	9	
MAP-2619	7½		26¼	MAP-2619-36	11½	
MAP-3119	8½		31½	MAP-3119-36	13½	
MAP-3519	10		35	MAP-3519-36	15	

FORMED PANELS — 19″ WIDE

Blank or louvered panels of one-piece 16 gauge steel with edges formed for ½″ depth. Each panel has only 2 mounting holes on each side. Finish: Light gray.

Premier No.	Height, Inches	Type	Shipping Wt., Lbs.	Net Each A
FP-119	1¾	Blank	1½	
FP-319	3½	Blank	2	
FP-519	5¼	Blank	2½	
FP-719	7	Blank	3	
FP-819	8¾	Blank	4	
FP-1019	10½	Blank	5	
FP-1219	12¼	Blank	6	
FP-1419	14	Blank	6½	
FP-1519	15¾	Blank	7	
FP-1719	17½	Blank	7½	
FP-1919	19¼	Blank	8	
FP-2119	21	Blank	9	
FP-2619	26¼	Blank	11	
FP-2819	28	Blank	12	
FP-4219	42	Blank	18	
FPL-719	7	Louvered	3	
FPL-819	8¾	Louvered	4	
FPL-1019	10½	Louvered	5	
FPL-1219	12¼	Louvered	6	
FPL-1419	14	Louvered	6½	
FPL-1719	17½	Louvered	7½	
FPL-2119	21	Louvered	9	
FPL-2619	26¼	Louvered	11	
FPL-2819	28	Louvered	12	
FPL-4219	42	Louvered	18	

See Discount Schedule A or B on Page 2.

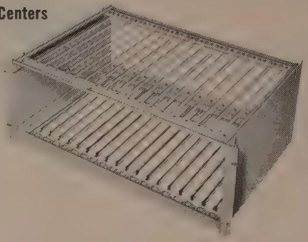
PREMIER

CHASSIS SLIDES-WORK SHELVES DRAWERS

PRINTED CIRCUIT CARD HOLDERS

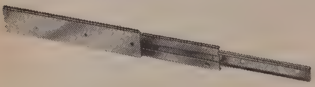
Provides Extensive Adjustability in Accommodating Card Heights and Depths and Connector Mounting Centers

- Units accommodate card widths from 2⅞″ to 8″; card depths to 14½″
- Fit standard 19″ and 24″ wide racks for 5¼″, 7″, 8¾″ panel heights
- 19″ wide frames hold up to 27 cards; 24″ wide frames hold up to 36 cards
- Supplied with two adjustable rear connector panels made of ⅛″ iridited aluminum, having connector mounting holes tapped 4-40 on .200 centers; height fully adjustable
- Frames made of 16 gauge steel and finished in light gray enamel
- Units shipped K.D. with all necessary hardware
- Guide (G Series) sold in packages of 5 pair and ordered as a separate item
- Guides are supplied with push rivets for easy positioning
- Guides made of 14 gauge caustic etched and iridited aluminum as per MIL-C-5541



FOR 19″ WIDE PANEL SPACE					FOR 24″ WIDE PANEL SPACE			Guides — 5 Pair per Package		
Panel Height, Inches	Premier No.	PC Card Height Range, Inches	Net Each A	Overall Depth, Inches	Premier No.	PC Card Height Range, Inches	Net Each A	Premier No.	Length, Inches	Net Ea. A
5¼	PCH-519-6	2⅞ thru 4½		6¼	PCH-524-6	2⅞ thru 4½		G-6	4⅛	
	PCH-519-8			8¼	PCH-524-8			G-8	6⅛	
	PCH-519-10			10	PCH-524-10			G-10	7⅞	
	PCH-519-12			12	PCH-524-12			G-12	9⅞	
	PCH-519-14			14	PCH-524-14			G-14	11⅞	
	PCH-519-16			16	PCH-524-16			G-16	13⅞	
7	PCH-719-6	4⅝ thru 6¼		6¼	PCH-724-6	4⅝ thru 6¼		G-6	4⅛	
	PCH-719-8			8¼	PCH-724-8			G-8	6⅛	
	PCH-719-10			10	PCH-724-10			G-10	7⅞	
	PCH-719-12			12	PCH-724-12			G-12	9⅞	
	PCH-719-14			14	PCH-724-14			G-14	11⅞	
	PCH-719-16			16	PCH-724-16			G-16	13⅞	
8¾	PCH-819-6	6⅜ thru 8		6¼	PCH-824-6	6⅜ thru 8		G-6	4⅛	
	PCH-819-8			8¼	PCH-824-8			G-8	6⅛	
	PCH-819-10			10	PCH-824-10			G-10	7⅞	
	PCH-819-12			12	PCH-824-12			G-12	9⅞	
	PCH-819-14			14	PCH-824-14			G-14	11⅞	
	PCH-819-16			16	PCH-824-16			G-16	13⅞	

BB SERIES 100-LB. SLIDES



Features exclusive Quick Disconnect for immediate chassis removal; 5/16″ horizontal side space adjustable±1/16″; 1⅝″ vertical side space. Uses stainless steel ball bearings, will carry 100 lbs. fully extended; locks in open position. Three telescoping anodized aluminum members; full accessibility for servicing. Mounts to tapped holes of front and rear panel mounting angles. Simple adjustability of chassis slide assembly from outside of frame. Supplied with all hardware.

Premier No.	Slide Length	Travel Length	Depth	Net per Pair A
BB-100-14*	14	13	15¼	
BB-100-16*	16	15	18	
BB-100-20	20	19	22	
BB-100-22*	22	21	24	
BB-100-24	24	23	25½	

* Use slide adapter kit SAK-35.

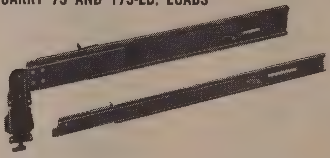
SFE SERIES THIN DRAWER SLIDES

Made of cold rolled steel, zinc plated, with clear iridite track, outer and intermediate channels. Requires ½″ mounting space on each side; positive mechanical stop prevents slide from being over-extended. With large nylon rollers and steel balls.

Premier No.	Slide Length	Travel Length	Net per Pair A
SFE-100-14	14	14	
SFE-100-16	16	16	
SFE-100-20	20	20	
SFE-100-22	22	22	

SOLID BEARING SLIDES

CARRY 75 AND 175-LB. LOADS

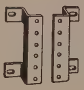


Made from high strength cold rolled steel, zinc plated, chromate treated, coated with molybdenum disulfide lubricant; withstands 100 hours of salt spray. Tilt and non-tile models; exclusive Quick Disconnect for immediate removal of chassis. Three telescoping members, full accessibility for servicing, mounts standard 17″ wide chassis. Horizontal side space: SB-75 Series, .386″, adjustable ±1/32″; SB-175 Series, .398″, adjustable ±1/32″. SB-175-DL Series slides have detent locks that allow chassis to be tilted up or down and locked at 90° for servicing.

Premier No.	Load Rating	Slide Length	Travel Length	Depth	Net per Pair A
SB-75-14*	75 lbs.	14	14½	15¼	
SB-75-16*	75 lbs.	16	14½	18	
SB-75-20	75 lbs.	20	18½	22	
SB-75-22*	75 lbs.	22	22½	24	
SB-75-24	75 lbs.	24	22½	25½	
SB-175-14*	175 lbs.	14	14½	15¼	
SB-175-16*	175 lbs.	16	18½	18	
SB-175-20	175 lbs.	20	22½	22	
SB-175-22*	175 lbs.	22	24	24	
SB-175-24	175 lbs.	24	26½	25½	
SB-175-DL-14*	175 lbs.	14	14½	15¼	
SB-175-DL-16*	175 lbs.	16	18¼	18	
SB-175-DL-20	175 lbs.	20	22¼	22	
SB-175-DL-22*	175 lbs.	22	26¼	24	
SB-175-DL-24	175 lbs.	24	26¼	25½	

*Use slide adapter kit, No. SAK-35, for R, DCR, DRK.

SAK-35 SLIDE ADAPTER KIT

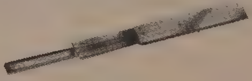


Required for rear mounting on R, DCR, and DRK racks. Mounts to inside rear flange by drilling four holes. Tapped 10-32 on EIA (⅝″-⅝″-½″) spacings. No. 12 gauge steel; gray hammertone finish. Kit includes 2 brackets, four 10-32 screws and keps.

Premier No. SAK-35 — Net Each A ....

50-LB. THREE PIECE SLIDES

- Ball bearings and nylon rollers.
- Carries 50 lbs. fully extended.
- Side mounted — only ½″ width required.
- CR steel, zinc-plated and clear iridite.
- Positive mechanical stop.
- Instant disconnect.

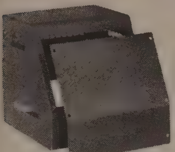


Premier No.	Slide Length and Extension	Net per Pair A
LFE-50-14	14	
LFE-50-16	16	
LFE-50-20	20	
LFE-50-22	22	

See Discount Schedule A or B on Page 2.

PREMIER CHASSIS AND CABINETS

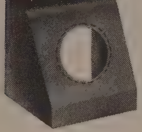
SLOPING FRONT CABINETS



Gray hammertone #20 ga. steel.

Premier No.	H. x W. x D. Size, Inches	Wt., Lbs.	Net Each B
SFC-500	8x 8⅛x 8	6	
SFC-501	8x10⅛x 8	7	
SFC-502	8x14⅛x 8	8	
SFC-503	9x18⅛x 8	10	
SFC-504	18x18⅛x12	14	

2-IN-1 STEEL AND ALUMINUM METER CASES

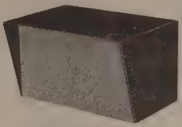


Center hole for 2″ meter increases to 3″ by simply removing a knock-out. Hole dia., 2 3/16″ x 2 13/16″. Supplied with two ½″ dia. knock-outs. No. 20 gauge steel in gray hammertone finish. No. 18 gauge (.040) aluminum natural finish. Size 4 3/16″ x 4 5/16″ x 4 1/16″. Shipping Weight, ¾ lb.

Premier No. SPC-23 — Steel. Net Each B $3.20

Premier No. ASPC-23 —
Aluminum. Net Each B $3.12

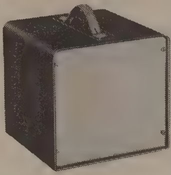
SLOPING COMPACT CASES



Made of two pieces of 20 ga. steel. Top extends beyond front panel. Supplied with necessary screws for assembly. Finished in 2-tone metallic: Outer unit, smoke blue; inner unit, light gray.

Premier No.	Overall Size, In. H. x W. x D.	Net Each B
SCC-3000	6x10x7	
SCC-3001	7x12x8	
SCC-3002	3x 8x5	
SCC-3003	5x 5x5	

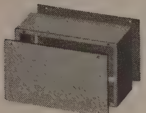
COMPACT CABINETS



Body of 20 gauge steel with .064 aluminum front panel. All have rounded corners on front and rear of top, recessed handle, four rubber feet, and perforated sides. Panel fits into ½″ recess. With assembly hardware. Smoke blue and light gray finish.

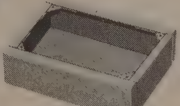
Premier No.	Size, Inches D. x W. x H.	Use Chassis	Wt., Lbs.	Net Each B
CC-2000	8x 6⅛x 8	ACH-426	4	
CC-2001	8x 8⅛x 8	ACH-403	5	
CC-2002	8x10⅛x 8	ACH-404	6	
CC-2003	12x 8⅛x 9	ACH-405	7	
CC-2004	18x11⅛x11	ACH-415	10	
CC-2005	18x14⅛x12	ACH-423	11	

ALUMINUM UTILITY CASES



With flanged edges, spot-welded corners, two removable flat covers. #16 ga. aluminum cases.

BLANK CHASSIS



Constructed from one piece aluminum #18 ga., except those marked *, which are #14 ga. Gussets are spot welded to bottom flanges for additional strength. Flanges are flanged in on four sides and punched for bottom plates.

Premier No.	Size, Inches D. x W. x H.	Weight Lbs.	Net Each B
ACH-400	5½x 9½x1½	½	
ACH-401	5 x10 x3	¾	
ACH-402	6 x14 x3	1	
ACH-403	7 x 7 x2	½	
ACH-404	7 x 9 x2	½	
ACH-405	7 x11 x2	¾	
ACH-406	7 x13 x2	¾	
ACH-407	7 x15 x3	1	
ACH-408	4 x17 x3	1	
ACH-409	7 x17 x3	1½	
ACH-410	8 x17 x2	1⅛	
ACH-411	8 x17 x3	1½	
ACH-412	10 x12 x3	1¼	
ACH-413	10 x14 x3	1¼	
ACH-414	10 x17 x2	1¼	
ACH-415*	10 x17 x3	1⅞	
ACH-416*	10 x17 x4	2	
ACH-417*	11 x17 x2	1¾	
ACH-418*	11 x17 x3	2	
ACH-419*	12 x17 x2	1⅞	
ACH-420*	12 x17 x3	2⅛	
ACH-421*	12 x17 x4	2⅞	
ACH-422*	13 x17 x2	1⅞	
ACH-423*	13 x17 x3	2⅛	
ACH-424*	13 x17 x4	2½	
ACH-425	7 x11 x3	⅞	
ACH-426	5 x 7 x2	¼	
ACH-427	8½x15 x3	1¼	
ACH-428	5 x 7 x3	¼	
ACH-429	5 x13 x3	¾	
ACH-430	8 x12 x3	1	
ACH-431	4 x 6 x2	¼	
ACH-432	4 x 6 x3	¼	
ACH-433	7 x12 x3	⅞	
ACH-434	6 x17 x3	1	
ACH-435*	10 x23 x3	2½	
ACH-436	4 x 6 x1½	¼	
ACH-437	4 x 8 x2	⅜	
ACH-438*	17 x17 x4	3	
ACH-441	8 x10 x2½	1	

ALUMINUM CASES

Natural Aluminum				Gray Hammertone	
Premier No.	Net Ea. B	Size, In. W.xL.xH.	Wt., Lbs.	Premier No.	Net Ea. B
AC-442		4x4x2	½	PAC-442	
AC-453		4x5x3	¾	PAC-453	
AC-564		5x6x4	1	PAC-564	
AC-596		5x9x6	1½	PAC-596	
AC-666		6x6x6	1½	PAC-666	
AC-695		6x9x5	1½	PAC-695	
AC-1276		12x7x6	2¼	PAC-1276	
AC-1597		15x9x7	3½	PAC-1597	

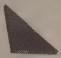
CHASSIS MOUNTING BRACKETS

Light gray finish 16 ga. steel.

Premier No.	For	Wt., Lbs.	Net Pair B
CB-78*	8″ Chassis	1½	
CB-710*	10″ Chassis	1¾	
CB-711*	11″ Chassis	2	
CB-712*	12″ Chassis	2⅛	
CB-713*	13″ Chassis	2¼	
CB-717*	17″ Chassis	3	
CB-810†	10″ Chassis	2⅜	
CB-813†	13″ Chassis	3	

* Notched for 3″ chassis. † Notched for 4″ chassis.

TRIANGULAR CHASSIS MOUNTING BRACKETS

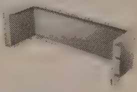


16 gauge steel. Light gray. Sold in pairs.

Premier No.	Height x Depth	Shipping Weight	Net Pair B
TCB-55	5x5	1 lb	
TCB-77	7x7	1 lb.	
TCB-99	9x9	1½ lbs.	

ALUMINUM VERTICAL PANEL CHASSIS

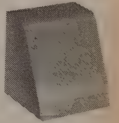
TO FIT 19″ STANDARD RACKS



Made of 14 gauge (.064) aluminum. Flanges are notched for standard rack mounting. All chassis depth are 5 5/32″. Gussets are spot welded in each corner for greater strength. Etched finish.

Premier No.	Height, In.	Shipping Wt., Lbs.	Net Each B
ACH-1200	1¾	¾	
ACH-1201	3½	1¾	
ACH-1202	5¼	1½	
ACH-1203	7	2	
ACH-1204	8¾	2¼	

STEEL AND ALUMINUM SLOPING PANEL CABINETS



Round top corners, sloping front. #20 gauge steel, gray hammertone finish or #18 gauge (.040) aluminum, natural aluminum finish.

Premier No.		Shipping Wt., Lbs.	Size, Inches W. x D. x H.	Net Ea. B
Steel	Aluminum			
SPC-1200	ASPC-1200	¾	4 3/16x4 1/16x4 5/16	
SPC-1201	ASPC-1201	1	5 3/16x4 1/16x4 5/16	
SPC-1202	ASPC-1202	1	6 3/16x4 1/16x4 5/16	
SPC-1203	ASPC-1203	1½	7 3/16x4 1/16x4 5/16	

ALUMINUM MINIATURE CASES

A two-piece case made of No. 16 gauge (.051) aluminum. Natural aluminum finish or gray hammertone.

* 18 ga. (.040).

Aluminum Finish				Gray Hammertone Finish	
Premier No.	Net Ea. B	Size, Inches L. x W. x H.	Shipping Wt., Lbs.	Premier No.	Net Ea. B
AMC-1000*		2¾x2⅛x1⅝	¼	PMC-1000*	
AMC-1001*		3¼x2⅛x1⅝	¼	PMC-1001*	
AMC-1002*		4 x2⅛x1⅝	¼	PMC-1002*	
AMC-1003		4 x2¼x2¼	⅜	PMC-1003	
AMC-1004		5 x2¼x2¼	½	PMC-1004	
AMC-1005		5 x4 x3	½	PMC-1005	
AMC-1006		5¼x3 x2⅛	1	PMC-1006	
AMC-1007		6 x5 x4	¾	PMC-1007	
AMC-1008		7 x5 x3	1⅛	PMC-1008	
AMC-1009		8 x6 x3½	1½	PMC-1009	
AMC-1010		10 x6 x3½	1¾	PMC-1010	
AMC-1011		12 x7 x4	2	PMC-1011	
AMC-1012		17 x5 x4	½	PMC-1012	
AMC-1013		10 x2 x1⅝	¼	PMC-1013	
AMC-1014		12 x2½x2¼	¼	PMC-1014	
AMC-1015		4 x2 x2¾	⅜	PMC-1015	
AMC-1016		4½x2¼x1½	¼	PMC-1016	

See Discount Schedule A or B on Page 2.

STANTRON® MODULAR ELECTRONIC CABINET SYSTEM

Modular Electronic Cabinets

Ball Corner Design

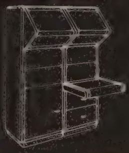
Square Corner Design

or Square Corner Design with Shadow Box Trim

Hundreds of Combinations

For Example:

Like this



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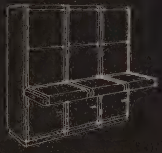

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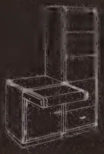

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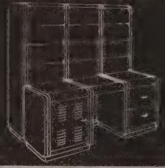
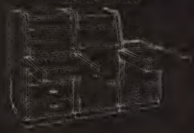


You can Design Your Own Enclosure Package

Like This



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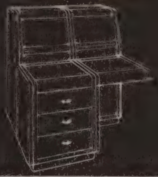

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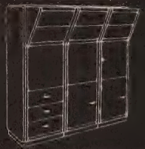
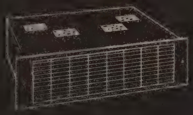
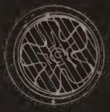


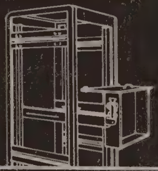
Also Blowers



or Fans



and Slides



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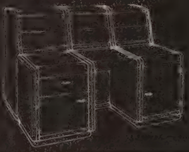

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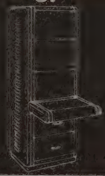

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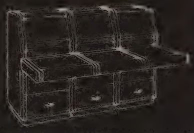

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Write or Phone for Free Catalog

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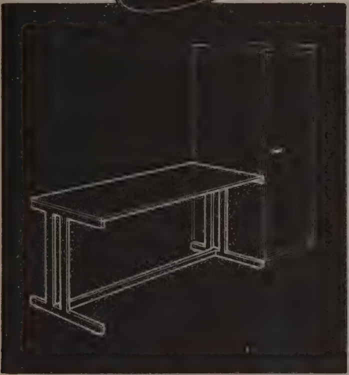
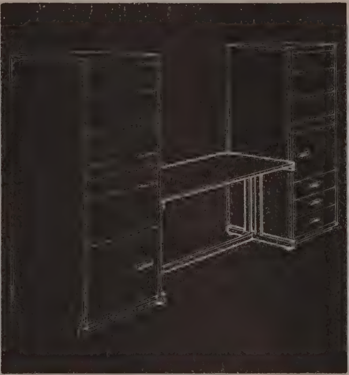
NOW!! THE TOTAL SYSTEM!

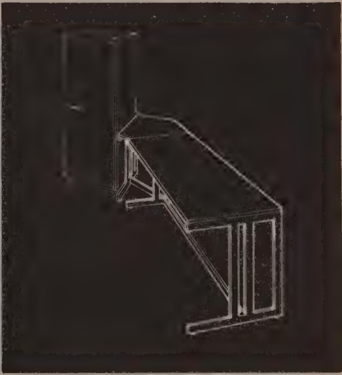
the STANTRON® DATA/TERMINAL DESK SYSTEM

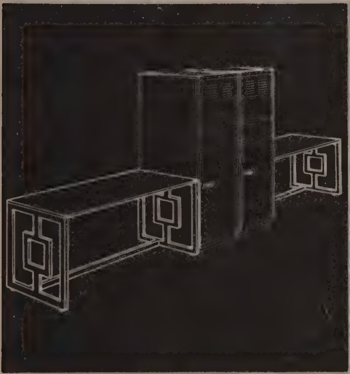
• PLUS •

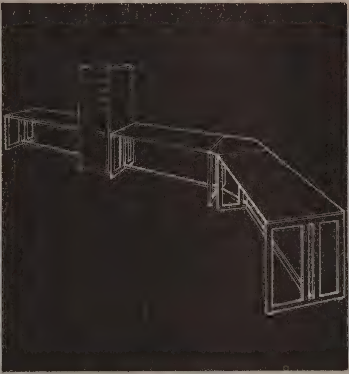
the STANTRON® MODULAR ELECTRONIC CABINETS

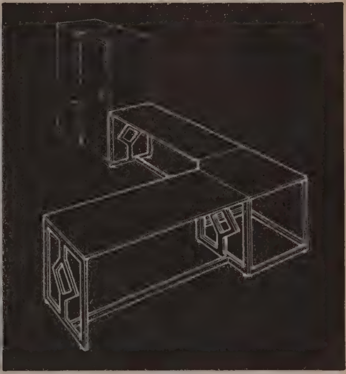


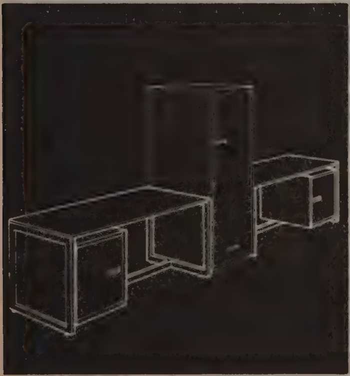


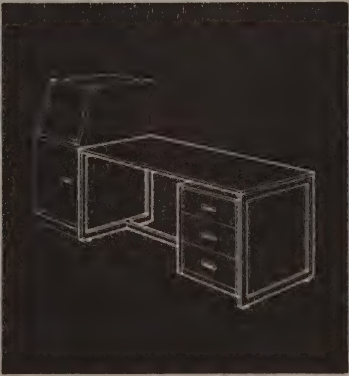












NOW!!

You can design your entire Enclosure/Desk Assembly with Stantron's Data/Terminal Desk System and Modular Cabinet System. Both Systems are dimensionally compatible. Write or phone for free literature and name of nearest representative.

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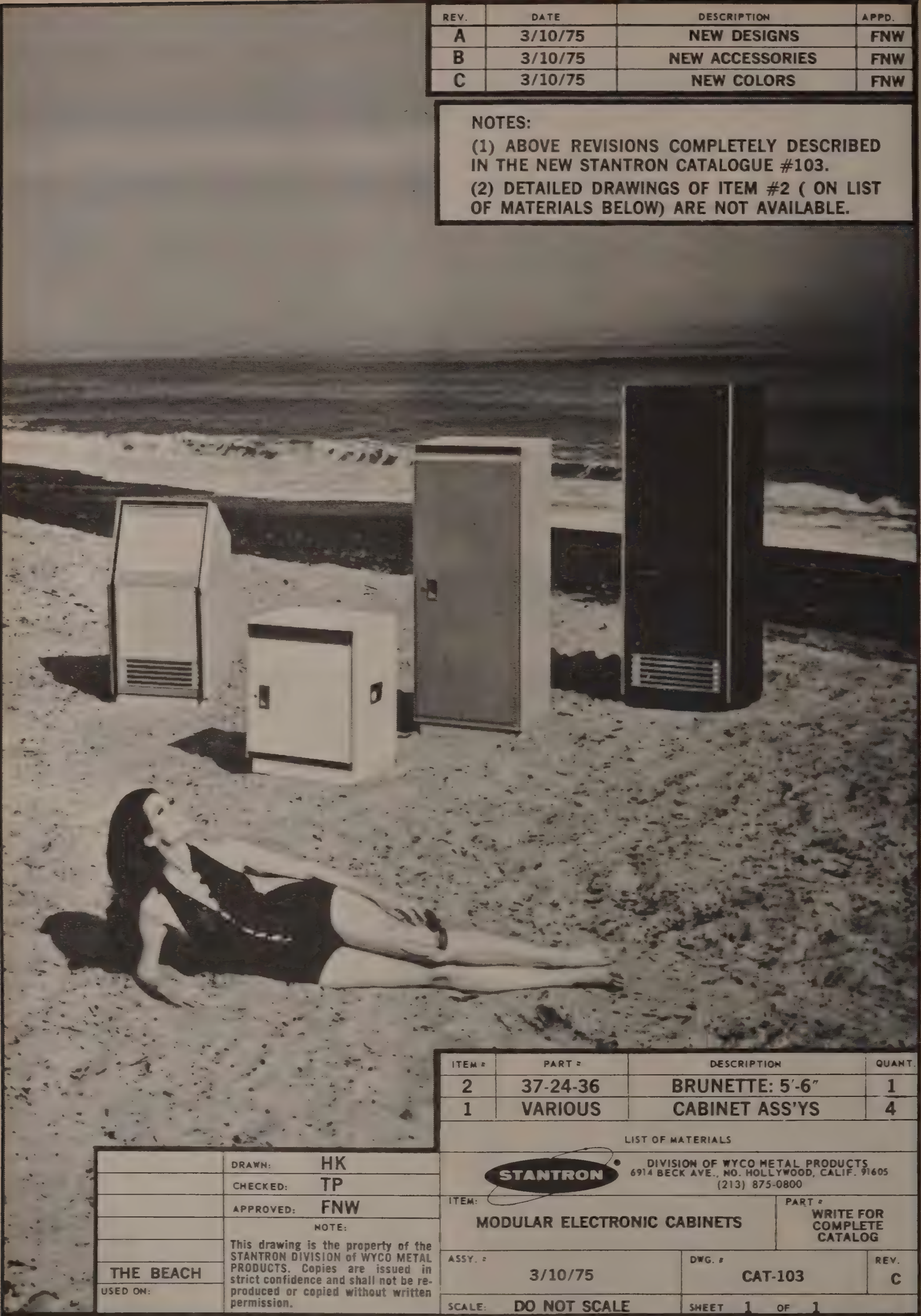
REV.	DATE	DESCRIPTION	APPD.
A	3/10/75	NEW DESIGNS	FNW
B	3/10/75	NEW ACCESSORIES	FNW
C	3/10/75	NEW COLORS	FNW

NOTES:

(1) ABOVE REVISIONS COMPLETELY DESCRIBED IN THE NEW STANTRON CATALOGUE #103.

(2) DETAILED DRAWINGS OF ITEM #2 (ON LIST OF MATERIALS BELOW) ARE NOT AVAILABLE.



ITEM #	PART #	DESCRIPTION	QUANT.
2	37-24-36	BRUNETTE: 5′-6″	1
1	VARIOUS	CABINET ASS'YS	4

LIST OF MATERIALS

STANTRON

DIVISION OF WYCO METAL PRODUCTS
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(213) 875-0800

DRAWN: HK
CHECKED: TP
APPROVED: FNW

NOTE:
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THE BEACH
USED ON:

ITEM: MODULAR ELECTRONIC CABINETS
PART #: WRITE FOR COMPLETE CATALOG
ASSY. #: 3/10/75
DWG. #: CAT-103
REV.: C
SCALE: DO NOT SCALE
SHEET 1 OF 1

REV.	DATE	DESCRIPTION	APPD.
A	3/10/75	NEW DESIGNS	FNW
B	3/10/75	NEW ACCESSORIES	FNW
C	3/10/75	NEW COLORS	FNW

NOTES:

(1) ABOVE REVISIONS COMPLETELY DESCRIBED IN THE NEW STANTRON CATALOGUE #103.

(2) DETAILED DRAWINGS OF ITEM #2 (ON LIST OF MATERIALS BELOW) ARE NOT AVAILABLE.

ITEM #	PART #	DESCRIPTION	QUANT.
2	36-24-36	BLONDE: 5′-5″	1
1	VARIOUS	CABINET ASS'YS	4

LIST OF MATERIALS

STANTRON DIVISION OF WYCO METAL PRODUCTS
6914 BECK AVE., NO. HOLLYWOOD, CALIF. 91605
(213) 875-0800

DRAWN:	HK
CHECKED:	TP
APPROVED:	FNW
USED ON:	THE BEACH

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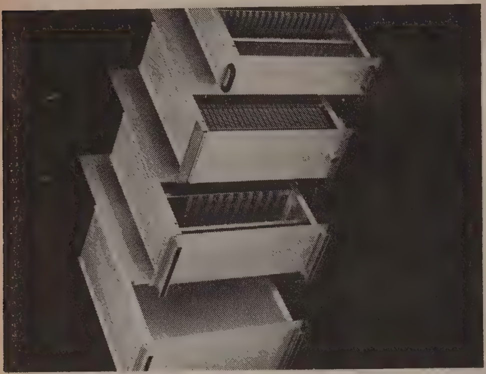
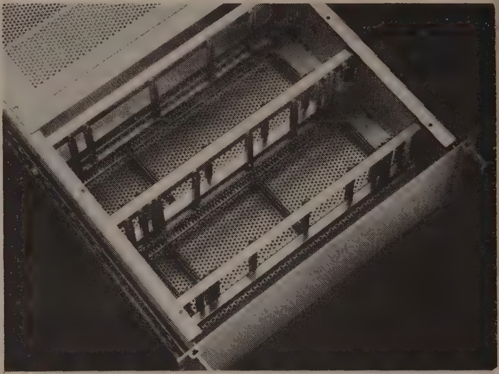
ITEM:	MODULAR ELECTRONIC CABINETS	PART #	WRITE FOR COMPLETE CATALOG
ASSY. #	3/10/75	DWG. #	CAT-103
REV.	C		
SCALE:	DO NOT SCALE	SHEET	1 OF 1

TECHMAR OMNICLOSURE™

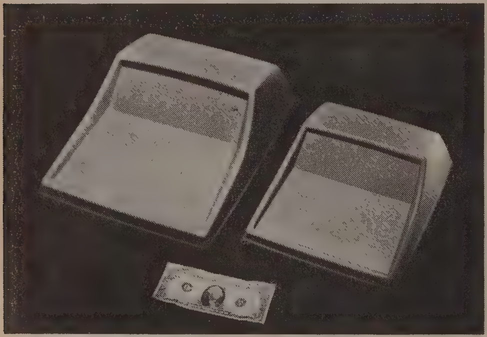
HAS IN STOCK FOR IMMEDIATE SHIPPING ANYWHERE:



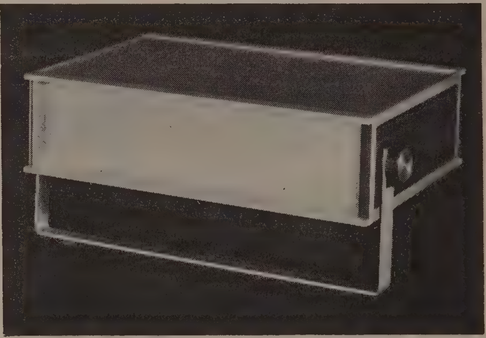
RACK-MOUNTING CHASSIS kits and parts in 7 EIA heights with pre-punched hole patterns for assembling in thousands of configurations; many options and accessories.



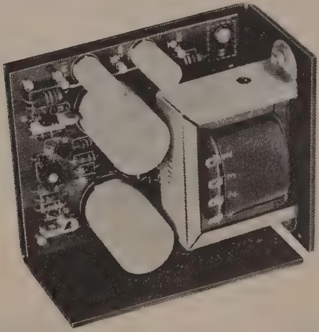
CARD CAGE kits and parts, plated steel guide frames and connector rails, plastic snap-in guides. For assembling in rack-mounting chassis units.



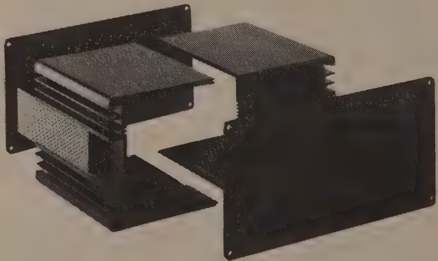
MINI-CONSOLES for enclosing small instruments economically in high style. Textured high-impact thermoplastic. Stocked in 2 sizes, 6 color combinations.



PORTABLE INSTRUMENT ENCLOSURE kits in 54 configurations with optional swing handle/tilt stand, PC card capability, choice of 5 vinyl trims.



POWER SUPPLIES, regulated, AC to DC, single or dual output, open-frame, guaranteed long life in normal or severe environments.



SUBASSEMBLY HOUSINGS, black anodized aluminum, integral card guides. Parts for 45 configurations in stock, 3 x 3 x 4 to 8 x 8 x 4, including 9 with heat sinks.

FREE CATALOG INCLUDES DIMENSIONS AND PRICES.

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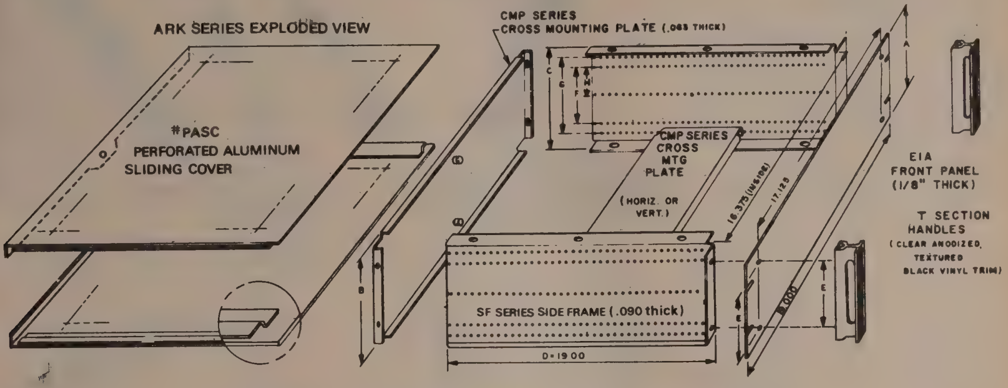
ALL-ALUMINUM RACK-MOUNTING KITS (ARK SERIES)

Besides being your rescue vehicle from a flood of packaging troubles, the ARK series is the third-generation, lighter-weight version of the original prefab chassis system for immediate shipping from factory. Convenient "erector set" hole patterns let you assemble in a mega-number of configurations. Side frames are strengthened by double-bend forming. Kits and parts are stocked in seven EIA heights from 3½" to 14", and are compatible with the earlier RMK series, which is still available. Order the basic ARK kits from the table on this page, and add dash numbers from page 2 to get your choice of options, some of which reduce the kit price by as much as 18%. Or order by part, from the list on page 3. Many interfacing dimensions are shown on the exploded view or table on this page; for other information phone Techmar Applications Engineering at (213) 478-0046.


ARK SERIES EXPLODED VIEW

ORDER ARK SERIES KITS FROM THIS TABLE

KIT NO.	FRONT PANEL HEIGHT "A"	USABLE FRONT PANEL SPACE	FRONT PANEL THICKNESS	CROSS MTG. PLATE HEIGHT "B"	SIDE FRAME HEIGHT "C"	HANDLE HOLES (13⁄64 DIA.) "E"	"F"	HOLE ROW DIMENSIONS "G"	"H"
ARK-3	3.47	16.37 x 3.15	⅛	3.09	3.15	2.00	1½	—	—
ARK-3-3⁄16	3.47	16.37 x 3.15	3⁄16	3.09	3.15	2.00	1½	—	—
ARK-5	5.22	16.37 x 4.90	⅛	4.84	4.90	3.00	3	—	—
ARK-5-3⁄16	5.22	16.37 x 4.90	3⁄16	4.84	4.90	3.00	3	—	—
ARK-7	6.97	16.37 x 6.65	⅛	6.59	6.65	4.56	4	5½	—
ARK-7-3⁄16	6.97	16.37 x 6.65	3⁄16	6.59	6.65	4.56	4	5½	—
ARK-8	8.72	16.37 x 8.40	⅛	8.34	8.40	6.44	4	6	—
ARK-8-3⁄16	8.72	16.37 x 8.40	3⁄16	8.34	8.40	6.44	4	6	—
ARK-10	10.47	16.37 x 10.15	⅛	10.09	10.15	6.44	1	7	—
ARK-10-3⁄16	10.47	16.37 x 10.15	3⁄16	10.09	10.15	6.44	1	7	—
ARK-12	12.22	16.37 x 11.90	⅛	11.84	11.90	9.00	2	8	—
ARK-12-3⁄16	12.22	16.37 x 11.90	3⁄16	11.84	11.90	9.00	2	8	—
ARK-14	13.97	16.37 x 13.65	⅛	13.59	13.65	9.00	6.000	12.000	3.000
ARK-14-3⁄16	13.97	16.37 x 13.65	3⁄16	13.59	13.65	9.00	6.000	12.000	3.000

IN THE WORDS OF OUR CUSTOMERS . . .

"Looks very good and is adequately sturdy." Howard Burch, Stanford Research Institute

"Satisfied with both appearance and engineering." Emory Johnson, Hughes Aircraft, Fullerton, California

"We appreciate very much your fast service." R. Boutvrette, Realtronik Research & Development

"Filled our needs." G. Harry Robinson, Physics International

"Satisfactory in every respect." Leonard W. Rieck, Clevite Ordnance

"Arrived promptly and was everything we expected." Stephen R. Smiriga, Chemistry Dept., University of California, Berkeley

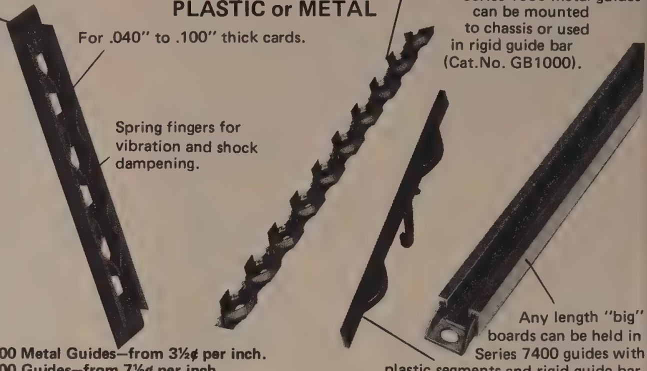
"I am well pleased with the ease of assembly, appearance and general function of the chassis." J. Steffik, FMA, Inc.

"We appreciate the fast, accurate service and deliveries. Don't change. A fine product suits our needs." Jack Grove, Test Equipment Dept., Hughes Aircraft.

"Appearance very good. Well engineered. Versatile." Leonard M. Budzynski, Technical Center, Owens-Illinois

UNITRACK CARD GUIDES

Any p.c. card—large, small, "hot" or to be grounded can be held firmly with the patented spring finger action that *only UNITRACK guides offer.* Vibration and shock dampening are features no other guide offers. The cantilever spring action grips cards from .040" to .100" thick, yet they slide smoothly . . . insertion or extraction. UNITRACK guides are available in standard sizes or in long lengths for customer make up of polycarbonate plastic, phosphor bronze, beryllium copper or plastic or metal in an extruded housing. UNITRACK card guides are accepted for military or commercial applications.



PLASTIC or METAL

Snap in button or hole for quick assembly.

For .040" to .100" thick cards.

Spring fingers for vibration and shock dampening.

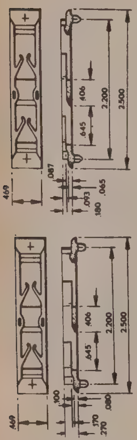
Metal for "hot" boards or grounding.

Series 1000 metal guides can be mounted to chassis or used in rigid guide bar (Cat.No. GB1000).

Any length "big" boards can be held in Series 7400 guides with plastic segments and rigid guide bar.

Prices: Depending on quantity and size.
Standard UNITRACK Guides—14 to 26¢

Series 1000 Metal Guides—from 3½¢ per inch.
Series 4700 Guides—from 7½¢ per inch.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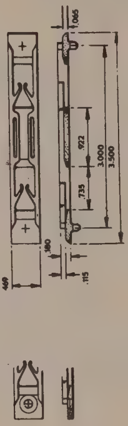
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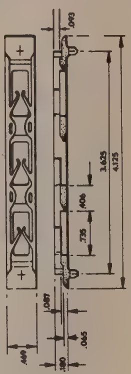
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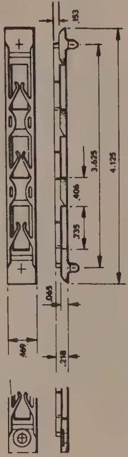
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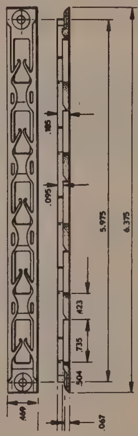
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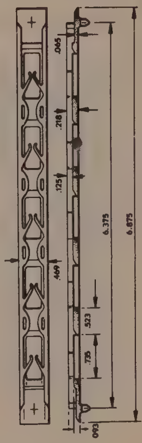
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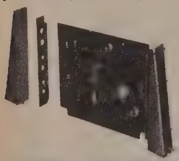
VERSAMOUNT® Brackets

in metal or plastic for mounting p.c. cards, vertically on chassis.



Wherever you need to mount a p.c. card on a chassis, the Versamount provides a firm support bracket. Made in plastic (VM7500) or metal (VM7700) so that grounding can be accomplished. Just drill 2 holes and mount with one screw. **VM7500 Price from 55¢ a pair up. VM7700 Price from 82¢ a pair up.**

PAK-RAK®
(Cat. No. 15625)

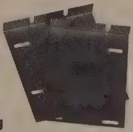
Strong, sturdy in-plant storage rack, test rack or shipping container. An easy to assemble, low-cost container that holds p.c. cards in UNITRACK guides.

Price $5.00 each (UNITRACK guides not included).

UNITRACK CARD RACKS

Low cost, easy-to-assemble, sturdy, rigid racks built to standard EIA sizes for mounting in 19" cabinetry. These racks can be supplied complete, or the individual parts may be ordered separately. Versacage card racks are available in these standard sizes. Specials are also available.

Cat. No.	Card Size	Price
VC-119-450	3½" to 4½" wide, up to 6½" long	$23.00
VC-119-625	4½" to 6¼" wide up to 6½" long	24.00
VC-119-800	6¼" to 8" wide up to 6½" long	25.00
VC-119-975	9¾" wide up to 6½" long	26.00
VC-219-450	3½" to 4½" wide up to 9¼" long	26.50
VC-219-625	4½" to 6¼" wide up to 9¼" long	27.50
VC-219-800	6¼" to 8" wide up to 9¼" long	28.50
VC-219-975	9¾" wide up to 9¼" long	29.50
VC-119-D-450	For two cards 4½" wide up to 6½" long	38.00
VC-219-D-450	For two cards 4½" wide up to 9¼" long	45.00



End Plates

Versacage end plates may be purchased separately. Prices range from $5.00, depending on size and quantity.

HOLDER BARS AND CONNECTOR BARS

Pre-punched bars of rigid aluminum extrusions are available for three card packaging densities . . . .200", .500" or .750" centers.

Pre-punched bars also available for offset connectors.

Price of Connector Bars (Cat. No. CB1702) —from $1.50 ea.

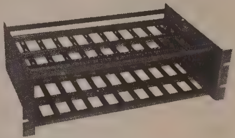
Price of Holder Bars (Cat. No. HB1701) —from $1.50 ea.

Price of Angle Brackets—25¢ ea.

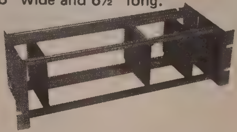
Back Panel Accessories

Versacage End Plates accept special brackets (Cat. No. UB-) so that back panel may be removed or attached in one piece when using wire wrapping connection techniques. Standard and special sizes available.

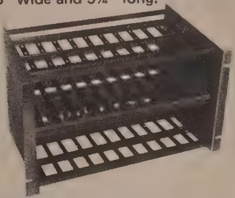
Price: from 75c



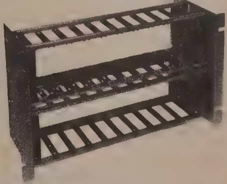
SERIES 119—Sizes for cards 3½" to 8" wide and 6½" long.



SERIES 219—Sizes for cards 3½" to 8" wide and 9¼" long.



SERIES 119-D—Similar to Series 119 but for two rows of cards.



SERIES 219-D—Similar to Series 219 but for two rows of cards.

Heat Dissipators Kooler-Krown®

Provide effective heat dissipation from heat producing power components in standard can packages. Simply push Kooler-Krown on can. Spring action holds Kooler-Krown firmly in place. Large contact area on can provides excellent heat dissipation.

For TO-3 power transistors
Dissipates up to 10 watts @ 100°C
Price 24¢ up CAT. NO. KK 750

For TO-5 power transistors
Dissipates up to 2½ watts @ 100°C
Price 10¢ up. CAT. NO. KK 300

For TO-8 or TO-66 power transistors
Dissipates up to 4 watts @ 100°C
Price 10¢ up. CAT. NO. KK 500

Note: Application of thermal grease slightly increases effectiveness. Also, forced convection will increase effectiveness.

Triac-Kooler™ CAT. NO. TR 60

Packaged triacs can be cooled effectively to add greater life and performance with the Triac-Kooler. It is held firmly to the thermal pad of the triac by a snap-in fastener. The intimate contact to the thermal pad and the large fin area dissipate heat and eliminate damaging heat build up in triacs.

Price 17¢ up (includes fastener).

Note: Application of thermal grease slightly increases effectiveness. Also forced convection will increase effectiveness.

Sales Representatives and Stocking Distributors in major industrial areas.

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UNITRACK®

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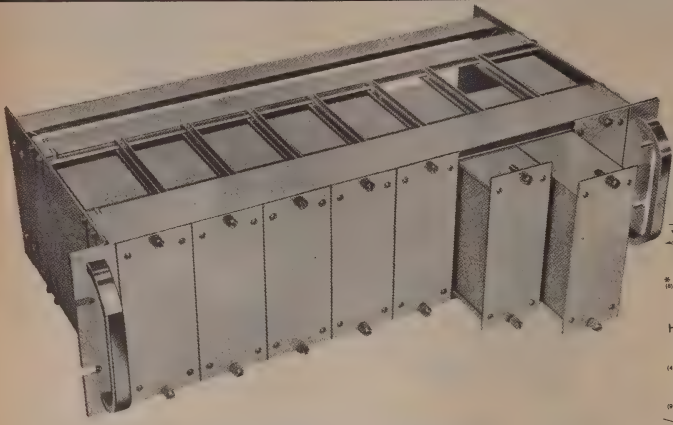
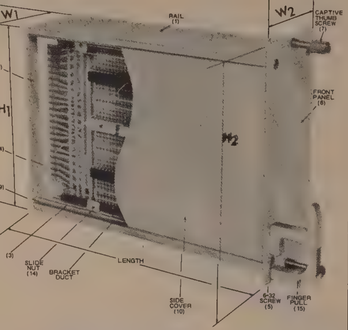
Vector VERSATILE CARD CAGES



CMA3-20 MODULE CAGE
For EFP204-6.6 Modules Only



VECTOR-STRUT MODULE CAGES

These all-aluminum cages for 19 in. rack or table-top mounting with Vector encasements provide sturdy, mechanically excellent housings in which to house electronic assemblies. Units are shipped completely assembled and modules, which are ordered separately, may be plugged in immediately after assembly. Module cages have a finished professional appearance which enhances equipment packaged within. Module guides are preinstalled in the cages for either ten 1.6 in. wide or eight 2 in wide EFP Modules.

Connectors may be mounted to the two rear cross members (T-struts) which come preloaded with required 4/40 steel nuts. Alternately punched metal connector plates may be attached to the rear cross members. In either case the slotted cage side walls and bracket mounts on the cross members provide easy connector position adjustments. All cage parts are satin finished anodized aluminum. Special conductive iridite finish for RFI application available on order. Cages for other size modules and special RFI modules for these cages are available on order.

EFP MODULES

EFP Modules for the accompanying Vector-Strut cages are anodized all-aluminum cases supplied in 1.6 in. and 2 in. wide sizes. They consist of a blank 0.080 in. thick front panel with attachment hardware, blank or "OF" type 0.080 in. thick back panel for protruding circuit card edge fingers, two rear sliding side covers, plus top and bottom rails with 0.075 in. wide grooved inner surface for circuit cards. Two captive 10/32 thumb screws are provided, one of which is a jack screw type to facilitate module insertion/withdrawal in high-insertion-withdrawal-force connectors. Circuit boards or Plugbords are held by the 0.075 in. wide grooves which run the entire length of the top and bottom rails. Lateral card positioning is accomplished with furnished hardware.

Modules are supplied unassembled for user fabrication required, followed by assembly.

56 other Modules are also available in widths including 1", 3", 4.5" and lengths of 4.5" and 11.5". Fully assembled matching cages are also available. Specials to order -- write factory for additional information.

ORDERING INFORMATION

Module Cage No.	Description	Module Size & Circuit Board Accommodated	No. Modules to Order Per Cage	Module Part No. Open Rear Panel Type	Module Part No. Closed Rear Panel Type†
CMA3-16	Assembled Module Cage 5¼"Hx19"W with guides installed for 10 EFP Modules 1.6"Wx6.6"L	1.6"Wx6.6"L for 4½"x6½" Card	10	EFP104-6.6OF	EFP104-6.6
CMA3-20	Assembled Module Cage 5¼"Hx19"W with guides installed for 8 EFP Modules 2"Wx6.6"L	2"Wx6.6"L for 4½"x6½" Card	8	EFP204-6.6OF	EFP204-6.6
CMA4-20	Assembled Module Cage 5¼"Hx19"W with guides installed for 8 EFP Modules 2"Wx9.7"L	2"Wx9.7"L for 4½"x9.6" Card	8	EFP204-9.7OF	EFP204-9.7

†Extra Module Front and Rear Panels Available:

1.6" Modules		2" Modules
FP16-52	-Front-	FP2-52
BP13-6	- Back -	BP17-3

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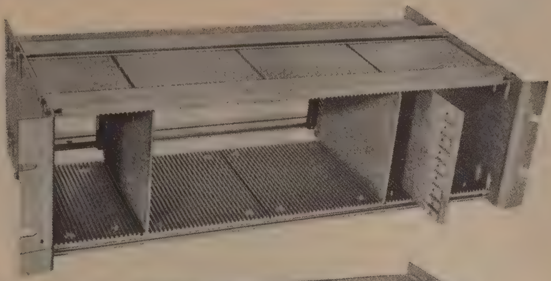
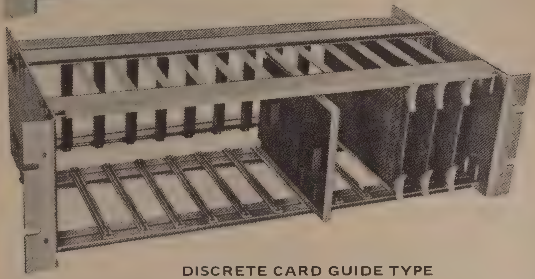
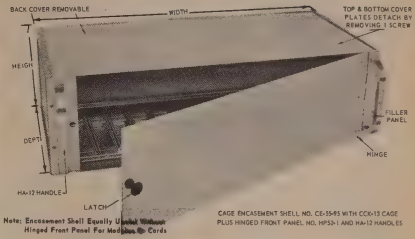
Vector RACK MOUNTABLE CAGES



CONTINUOUS CARD GUIDE TYPE



DISCRETE CARD GUIDE TYPE



Note: Encasement Shell Equally Useful Without Hinged Front Panel For Modules Or Cards

CAGE ENCASEMENT SHELL NO. CE-55-95 WITH CCK-13 CAGE PLUS HINGED FRONT PANEL NO. HP52-1 AND HA-12 HANDLES

ASSEMBLED CARD CAGES

Supplied Fully Assembled - Riveted Card Guides
Connectors Are Easily Positioned Without Hole Drilling
Accommodate Most Popular Card Sizes
Adjustable For Different Card Widths
Ruggedly Handsome - Industrial Quality - Anodized Finish

Two connector mounting struts at rear are bracket mounted and furnished with 21 pairs of captive 4/40 nuts which may be positioned anywhere for fast, easy connector mounting. Heavy aluminum side walls have standard hole pattern for rack mounting, and slots for adjustment to accommodate narrower cards. Card marker strips are included. Ejectors, when used on installed cards, work readily against front cross members.

DISCRETE GUIDE TYPE

Cage supplied with riveted aluminum or plastic card guides for 1/16 in. thick cards attached to heavy extruded aluminum cross members.

CONTINUOUS PLATE TYPE

For maximum card density and position flexibility. Extruded aluminum plates with 0.075 in. wide .100 in. deep grooves on 0.150 in. centers are riveted to heavy aluminum cross pieces.

NEW AND BEAUTIFUL CAGE ENCASEMENTS

The CE Series Cage Encasement Shells provide the finishing touch needed when a portable table-top unit is desired rather than rack mounting. Good accessibility is provided by easily removable top, bottom and rear covers. In addition, the cage can be quickly removed from the encasement shell by removing the screws from the front panel and the top and bottom covers. Supplied in knock-down form consisting of two assembled side panels, plus top, bottom and rear covers and required screws. The hinged front panel is an optional accessory (see below).

HINGED FRONT PANEL – SIDE HINGED

Hinged Front Panels, for card protection and improved appearance, come in easily assembled kit form which includes the hinged panel with latch, striker plate and two filler panels. Panels are of 1/8 in. thick aluminum with a clear anodized finish. All members (except screws) are clear anodized aluminum. (See ordering information on Card Cages for part numbers and dimensions.)

ORDERING INFORMATION

Card Size Range			Discrete Guide Type				Continuous Extruded Metal Plate Type			Card Cage Dimensions			Part No. (Side Hinged Front Panel)	Encasement Dimension			
Width Max.	Min.	Length Max.	No.Cd. Posit.	Spacing	Plastic Guides	Metal Guides	No.Cd. Posit.	Spacing	Part No.	O/A Wdth.	O/A Dpth.	O/A Hght.		Part No.	O/A Wdth.	O/A Dpth.	O/A Hght.
4½"	3"	6½"	21	¾"	CCK13P	CCK13	108	.150	CCK3	19"	9"	5¼"	HP52-1	CE55-95	19"	9.5"	5.5"
4½"	3"	6½"	21	¾"	CCK13AP	CCK13A		None		19"	9"	5¼"	HP52-1	CE55-95	19"	9.5"	5.5"
4½"	3"	9.6"	21	¾"	CCK14P	CCK14	108	.150	CCK4	19"	12"	5¼"	HP52-1	CE55-125	19"	12.5"	5.5"
6¾"	4¾"	9.6"	21	¾"	CCK15P	CCK15	108	.150	CCK5	19"	12"	7"	HP70-1		None		
7.98"	6½"	6½"	21	¾"	CCK16P	CCK16	108	.150	CCK6	19"	9"	8¾"	HP87		None		
7.98"	6½"	9.6"	21	¾"	CCK17P	CCK17	108	.150	CCK7	19"	12"	8¾"	HP87	CE90-125	19"	12.5"	9.0"

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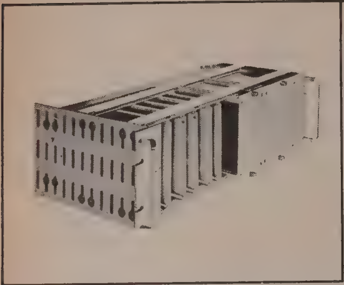
Vector PACKAGING HARDWARE – CAGES



USER-DESIGNED CARD PACKAGING SYSTEMS

All parts of the Vector-Pak packaging system may be purchased separately. The most frequently required parts are listed below.

ALUMINUM CAGE SIDE WALLS

Rows of Slots Multiple Rows Equally Spaced	Part No.	Hgt. A	Dpth. B	Handle Mtg. Holes C	Mounting Slot Dim. D	F
2	SW-34-P-89	3.48	8.97	3.09	—	2.25
3	SW-52-P-89	5.23	8.97	4.25	—	2.25
4	SW-69-P-89	6.98	8.97	3.09	4.00	—
5	SW-87-P-89	8.73	8.97	4.25	5.75	2.25
2	SW-34-P-119	3.48	11.97	3.09	—	2.25
3	SW-52-P-119	5.23	11.97	4.25	—	2.25
4	SW-69-P-119	6.98	11.97	3.09	4.00	—
5	SW-87-P-119	8.73	11.97	4.25	5.75	2.25
3	SW-52-P-156	5.23	15.72	4.25	—	2.25
4	SW-69-P-156	6.98	15.72	3.09	4.00	—
5	SW-87-P-156	8.73	15.72	4.25	5.75	2.25

T-STRUTS (CROSS MEMBERS)

Extruded Aluminum, Anodized Finish
1" wide x .292" thick

These parts are available in 16.85" lgths. for building 19" rack mounting cages and other sizes as listed. Struts listed have 3 T-slots which accept and retain NT4-7 square nuts, SC4-26 or SC4-28 hex head screws.

Part No.	Lgth.	End Insert	Printed Scale	Fastening Method
TS81	8.12	None	No	Brackets or end inserts
TS169	16.85	None	No	Brackets or end inserts
TS169P	16.85	None	Yes	Brackets or end inserts
TS209	20.85	None	No	Brackets or end inserts
TS300	30.00	None	No	Raw Stock

*P type has printed scale with 1/16" markings to facilitate mounting guides and receptacles.

T-Struts may be attached to side walls with 2-way adjustable brackets or with plastic inserts and screws.

BR16 KIT

Consists of 6 brackets and nuts for attaching T-Struts to side walls.

NT6-3 SCREW/INSERT KIT (Pkg. 24)

Includes 24 plastic inserts which slip into T-Strut end slot and engage No. 6 screws supplied as part of kit.

CARD GUIDES

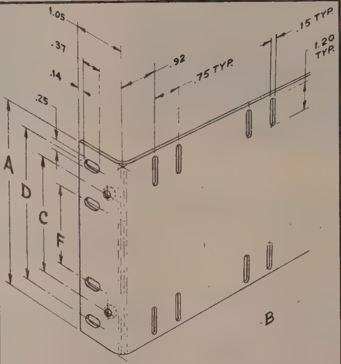
Aluminum, zinc or plastic card guides, 3/8" wide, are supplied drilled and with mounting hardware. Funnel entry in plastic or aluminum as indicated.

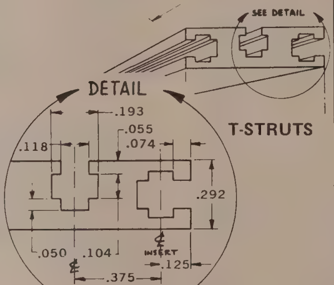
Plastic	Aluminum	Zinc	Lgth.	For Card Lgth.	Pkg. Qty.
BR20-2-HP	BR20-2-H		3.42"	4½"	12
BR20-4-HP	BR20-4-H		4.72"	5"	12
BR20-6-HP		BR20-6-H	5.42"	6½"	12
BR20-8-HP	BR20-8-H		6.82"	8"	12
BR20-10-HP	BR20-10-H		8.52"	9½"	12
BR20-240-P	BR20-240		24.00"	Raw Stk.	2

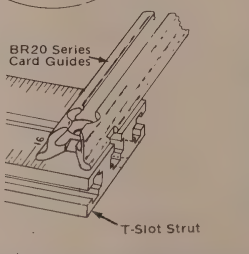
MULTI-PURPOSE CAGE KITS

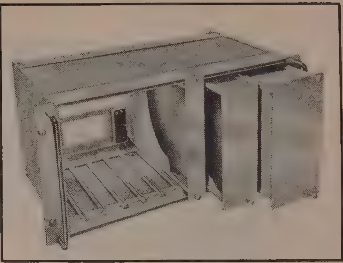
For those applications where pre-assembled units lack the versatility needed due to special size requirements, etc., multi-purpose kits are available. These adjust to all card, module or receptacle size within range. Kits are supplied unassembled and have all required assembly hardware. Major parts include 2 aluminum flanged side walls formed and slotted for standard rack mounting, 6 extruded aluminum T-struts (cross members) with mounting brackets and printed scale marking plus large assortment of required and extra screws, nuts and lock washers. Card guides can be ordered from table below. Special features of these kits are: slotted side walls for maximum mounting versatility--bracket mounting for all cross members (T-struts) for forward-backward positioning.

Kit Part No.	Hght.	Dpth.	Max.Module Height	Max.Card Height
CA-34-HP-89	3.48	8.97	2.85	2.75
CA-52-HP-89	5.23	8.97	4.62	4.50
CA-87-HP-89	8.73	8.97	8.10	8.00
CA-34-HP-119	3.48	11.97	2.85	2.75
CA-52-HP-119	5.23	11.97	4.62	4.50
CA-97-HP-119	8.73	11.97	8.10	8.00
CA-52-HP-156	5.23	15.72	4.62	4.50
CA-87-HP-156	8.73	15.72	8.10	8.00









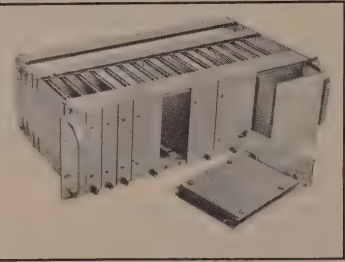
NIM BINS AND MODULES

Vector NIM (Nuclear Instrument Module) bins and modules have been designed to meet specifications of the NIM packaging system. Bins are 8¾"high x 19"wide x 10½"deep and have module guides installed to take standard NIM modules on multiples of 1.35". NIM connectors **or virtually any other flanged connector can readily be mounted on the adjustable bracket mounted cross members(T-struts) at the rear.** Bin standard finish is clear anodized, with iridite available to order.

NIM Modules are 8.70"high x 9.66"long and supplied in widths of 1.33", 2.68" and 4.04". Sliding side covers are standard. "C" types have slotted top and bottom rails with 0.075"wide grooves spaced 0.150" apart for mounting circuit boards where required. "P" types have flat perforated top and bottom rails for ventilation. All models have standard punched back plates for NIM connectors, but unpunched back plates for user punching are available. Standard finish is clear anodized, with iridite available to order.

NIM Bin CN87A	8¾"Hx19"Wx10½"D, without receptacles.

NIM Module No.	Front Panel Hgt.	Front Panel Wdth.	Inside Net Dimen. Hgt.	Inside Net Dimen. Wdth.	Inside Net Dimen. Dpth.
NIM1387A (C or P)	8.714	1.350	7.19	1.00	9.54
NIM2787A (C or P)	8.714	2.704	7.19	2.35	9.54
NIM4087A (C or P)	8.714	4.058	7.19	3.70	9.54



CCM-14A

Universal Card Mount Module System

This unit was inspired by the NIM cage design. It is significantly lower priced and differs substantially in that cards mount to "L"shaped aluminum plates. The module cage is 5¼"Hx19"Wx8.9"D and is supplied completely assembled, except for receptacles and modules, with guides installed at 1" intervals. Sixteen 1" wide card mount modules or a lesser number of any other width or combination of widths totaling 16" of face width may be installed. Almost any P.C. connector may be mounted without hole drilling on the two adjustable rear bracket mounted cross members (T-struts) which are preloaded with 16 pairs of 4/40 nuts.

Module Card Mounts are designed for circuit cards 4½" max. width by 6½" long and have face panel widths of 1", 2", 3" and 4". They consist of brushed anodized aluminum front panel plates with jack screws and brackets for attachment to card mounting plates, which have drilled holes and hardware for mounting circuit cards.

CCM-14A	Fully assembled Cage, except receptacles & modules. For 4½"x6½"cards. Includes front & side plates, mounting hardware for cards.
CM45-65-1	1" wide Front Panel
CM45-65-2	2" wide Front Panel
CM45-65-3	3" wide Front Panel
CM45-65-4	4" wide Front Panel

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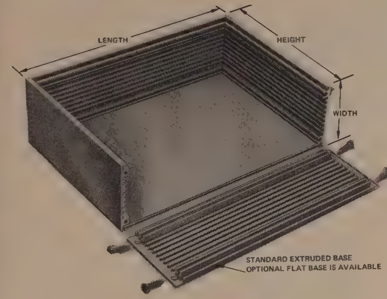
Vector INSTRUMENT CASES & PLUG-INS



MULTI-MOD CASES

Multi-Mod cases offer the user the classic simplicity of extruded aluminum formed into an instrument or component case having both strength and functional beauty. Available in a wide variety of sizes, finishes and colors, all models have a series of interior longitudinal grooves which hold circuit boards, mounting plates, and the sliding side covers which provide easy interior access. Removal of only four screws permits removal of the base plate, sliding side covers, and interior circuit card(s). Decorative extruded aluminum bezels are available for an even more finished front panel appearance. Special sizes and finishes are available to order--write factory.

BRUSHED CLEAR ANODIZED FINISH -- COMPLETELY ASSEMBLED

Optional panel bezels and tilt-up pedestal may be ordered separately.

Part No.	Width	Length	Height	Circuit Card & Side Panel Size	Panel Bezels (Clear Anodize)	Tilt-Up Pedestal
W16-31-31B	1.6	3.10	3.10	2.98x2.98	DB31 (2 pr.)	----
W20-46-31B	2.0	4.61	3.10	4.50x2.98	DB46+DB31	FT35
W20-46-46B	2.0	4.61	4.62	4.50x4.50	DB46 (2 pr.)	FT35
W20-66-46B	2.0	6.61	4.61	6.50x4.50	DB66+DB46	FT35
W30-66-46B	3.0	6.61	4.61	6.50x4.50	DB66+DB46	FT55
W30-86-46B	3.0	8.61	4.61	8.50x4.50	DB86+DB46	FT75
W30-100-46B	3.0	10.00	4.61	9.88x4.50	DB100+DB46	FT75
W45-66-46B	4.5	6.61	4.61	6.50x4.50	DB66+DB46	FT55
W45-86-46B	4.5	8.61	4.61	8.50x4.50	DB86+DB46	FT75
W45-100-46B	4.5	10.00	4.61	9.88x4.50	DB100+DB46	FT75

COLOR ANODIZED OR PAINTED -- COMPLETELY ASSEMBLED WITH CLEAR ANODIZED FRONT PANEL BEZEL

Part No.	Wdth.	Lgth.	Hght.	Circuit Card & Side Panel Size	Finish Frame & Base	Finish Side Panels	Finish Bezel
W20-46-31-1	2.0	4.61	3.10	4.50x2.98	Gold Anodize	Gold Anodize	Clear Anodize
W30-66-46-2	3.0	6.61	4.61	6.50x4.50	Med.Blue Pt.	Beige Paint	Clear Anodize
W45-86-46-2	4.5	8.61	4.61	8.50x4.50	Black Anodize	Blue Anodize	Clear Anodize

Deduct .530" wdth. and .530" lgth. from available front panel area with bezel installed.

PLUG-IN CASES For Building Modular Plug-In Circuits

ROUND CASES listed consist of a mica filled phenolic tube base type plug, either standard 7-pin miniature, 9-pin noval, or 8- or 11-pin octal type, and cover. Some listed models have interior wiring structures for mounting components. Covers, except where noted, attach with furnished screws. Other sizes and "specials" to order – write factory.

Base Plug Type	Part No.	Dia.	Lgth.*	Furnished Internal Structure
7-pin Min.	G2.2-8	5/8"	2"	Center Screw + Insul. Spacer
9-pin Min.	G2.1-8	3/4"	2"	Center Screw + Insul. Spacer
7-pin Min.	G2.2-8	5/8"	2"	None
9-pin Min.	G2.1-8	3/4"	2"	None
7-pin Min.	G2.2-8-4	3/4"	2"	Terminal Wall Strip w/ Terminals
9-pin Min.	G2.1-8-4	3/4"	2"	Terminal Wall Strip w/ Terminals
7-pin Min.	G2.21-8†	5/8"	2"	None
9-pin Min.	G2.11-8†	3/4"	2"	None
8-pin Octal	G2-10	1¼"	2½"	None
8-pin Octal	G2-10-T	1¼"	2½"	Turret w/ 12 Lugs
8-pin Octal	G2-10-4	1¼"	2½"	Terminal Wall Strip w/ Terminals
11-pin Octal	G2-10KF	1¼"	2½"	None

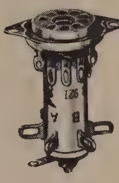
*Does not include plug pins. †Furnished w/o attached screws -- user bonds together.

SQUARE CASES with retainer ring mounted mica filled phenolic plugs. Models listed have 8-pin octal type plugs retainer-ring-mounted in bases to which covers attach with 3 furnished side screws.

Base Plug Type	Part No.	Size (Lgth. Less Plug Pins)	Furnished Internal Structure
8-pin Octal	B-8	1-3/8"sq. x 2" long	None
8-pin Octal	B-10	1-3/8"sq. x 2½" long	None
8-pin Octal	B-10T	1-3/8"sq. x 2½" long	Turret w/ 12 Lugs
8-pin Octal	C-8	2" sq. x 2" long	None
8-pin Octal	C-10	2" sq. x 2½" long	None
8-pin Octal	C-12T	2" sq. x 3" long	Turret w/ 12 Lugs

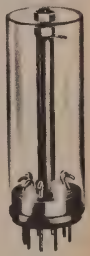
2" SQ. CASES WITH CRIMPED 8-PIN BAKELITE OCTAL PLUGS

Part No.	O/A Lgth.	Available Terminal Cards w/ O/A Hole Pattern & Mtd. Brackets Large Holes (.093) Spaced .265x.265 Phenolic Material	Small Holes (.062) Spaced .1 x .2 Epoxy Glass Mat'l	Micro Holes (.042) Spaced .1 x .1 Epoxy Glass Mat'l
C-8-K1.02	2"	None	None	None
C-10-K1.02	2½"	None	None	None
C-12-K1.02	3"	511	514	514-1P

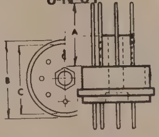


6-N-6T

C-12-K1.02



G2.1-8



TUBE BASE PLUG

G2.2-8-4

TUBE BASE PLUGS

Mica filled phenolic or white glass filled polyimide material for building miniature plug-in units. Plugs match standard tube base sockets and have tinned phosphor bronze pins for soldering components on upper end. Flange on plug body serves as "stop" and bonding point for covers if used. Pins on plug-in side are 17/64" long. Models with recessed knurled nuts are available – write factory.

No. Pins	Mica Filled Phenolic	Polyimide	Type	Center Post	Key Way	Dimensions A	B	C
7	K1.313	——	7-pin Min. St. Pins	No	No	3/16	.620	.575
7	K1.302	——	7-pin Min. St. Pins	No	Yes	17/32	.620	.575
7	K1.334	——	7-pin Min. Hkd.Pins	No	Yes	3/16	.620	.575
9	K1.413	K1.413B	9-pin St. Pins	No	No	3/16	.750	.700
9	K1.402	——	9-pin St. Pins	No	Yes	17/32	.750	.700
9	K1.434	——	9-pin Hkd. Pins	No	Yes	3/16	.750	.700

TURRETS

Post and Socket Types

Compact wiring structures are ideal for mounting discrete components on minimum chassis space. Socket type has ½" dia. phenolic post attached to socket, and one or two rings of tinned lugs for soldering components. Post type mounts with 6-32 screw into recessed knurl nut inside turret, or with protruding 6-32 screw. Many other sizes and types available -- write factory.

Part No.	Mounting Style	Turret Height	No. Term.	No. Rings	Spacing Betw. Rings
8-0-9T	Octal Socket	2"	9	2	1"
10-0-9T	Octal Socket	2½"	9	2	1-3/8"
6-M-9T	7-pin Min. Skt.	1½"	6	1	——
8-M-9T	7-pin Min. Skt.	2"	9	2	1"
6-N-6T	9-pin Min. Skt.	1½"	6	1	——
8-N-9T	9-pin Min. Skt.	2"	9	2	1"
8-12	6-32 Screw/Nut	1-27/32"	12	2	1"
10-12	6-32 Screw/Nut	2"	12	2	1-3/8"
6-H-12	6-32 Knurl Nut	1½"	12	2	7/8"
8-H-12	6-32 Knurl Nut	2"	12	2	1-3/8"

VECTOR ELECTRONIC COMPANY, INC. 12460 Gladstone Avenue, Sylmar CA 91342 Phone (213) 365-9661 TWX 910-496-1539

PRINTED CIRCUIT BOARD
CARD EJECTORS

PACKAGING PROGRESS
BY Bivar

CARD O PULL T.M.

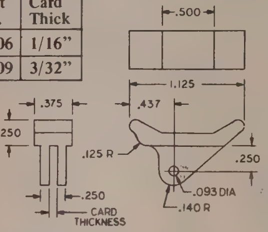
- Protect components, circuitry, connectors, PCB's and system from excessive stress damage.
- Designed for both 1/16" and 3/32" PCB's. Can be used in most systems.
- Aids insertion and extraction of PCB's — eliminates extraction tools.
- Available in locking versions.
- Available from stock.

PC CARD EJECTORS provide safe and easy lever action for extraction and insertion of 1/16" and 3/32" PCBs. Available from stock in 8 standard styles and 2 locking versions for positive retention, CARD-O-PULLs are molded from natural white Nylon per MIL-M-20693 can be supplied in 12 additional colors with hot stamped markings for permanent identification on a custom basis.

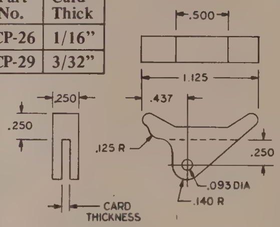
MATERIAL: Natural White Nylon per MIL-M-20693A, Type 4A 3/32" dia. x 1/4" long Spring Pins (furnished with each ejector.)

TOLERANCES: ±.005" per Inch.

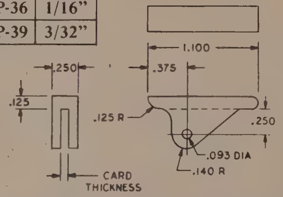
Part No.	Card Thick
CP-06	1/16"
CP-09	3/32"


.500
1.125
.375
.437
.250
.125 R
.250
.093 DIA
.250
.140 R
CARD THICKNESS

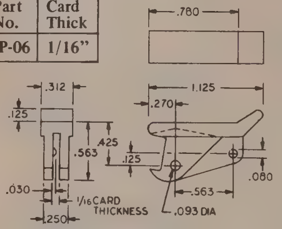
Part No.	Card Thick
CP-26	1/16"
CP-29	3/32"


.500
1.125
.250
.437
.250
.125 R
.250
.093 DIA
.140 R
CARD THICKNESS

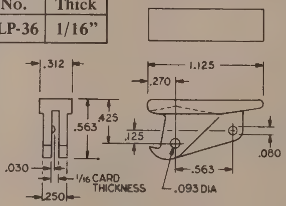
Part No.	Card Thick
CP-36	1/16"
CP-39	3/32"


1.100
.250
.375
.125
.125 R
.250
.093 DIA
.140 R
CARD THICKNESS

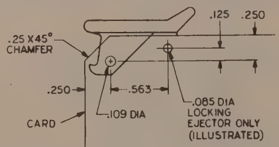
Part No.	Card Thick
LP-06	1/16"


.780
.312
1.125
.270
.125
.425
.563
.125
.080
.030
1/16 CARD THICKNESS
.563
.093 DIA
.250

Part No.	Card Thick
LP-36	1/16"


.312
1.125
.270
.425
.563
.125
.080
.030
1/16 CARD THICKNESS
.563
.093 DIA
.250

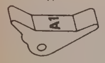
CARD MOUNTING DIMENSIONS


.125
.250
.25 X 45° CHAMFER
.250
.563
CARD
.109 DIA
.085 DIA LOCKING EJECTOR ONLY (ILLUSTRATED)

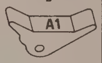
NOTE: 2 Ejectors, mounted on opposing corners, are recommended for cards where width is greater than length.

MARKING: CARD-O-PULLs can be marked numerically, alphabetically or both to code circuit boards. The hot stamping method is used and its durability is accepted by both military and commercial users. Specify size 1 or 2, and style A, B, C or D. See below.

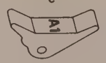
STYLE A



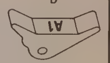
STYLE B



STYLE C



STYLE D



COLOR CODING: CARD-O-PULLs can be colored in a variety of colors to code your circuit board for quick identification.

WHITE (Natural) is standard, unless color is specified.

RED	PINK	BLUE	GRAY
ORANGE	VIOLET	GREEN	BROWN
YELLOW	AQUA	LIME	BLACK

MARKING SIZE:

Size		Approx. Overall Height	No. of Characters Per Inch
1	A16537B245890CDEFGHIJKLMNOPQRSTUVWXYZ	.075	12
2	A16537B245890CDEFGHIJKLMNOPQRSTUVWXYZ	.110	8

		NET PRICE, EACH (INCLUDES MOUNTING PINS)							
PART NO.	CARD THICK.	1–49	50–99	100–499	500–999	1000–2,499	2,500 4,999	5,000 9,999	10,000 24,999
CP-06 CP-26 CP-36	1/16"	$ .39	$ .30	$ .23	$ .21	$ .18	$ .17	$ .16	$ .15
CP-09 CP-29 CP-39	3/32"	.40	.31	.24	.22	.19	.18	.17	.16
LP-06 LP-36	1/16"	.44	.34	.27	.25	.22	.21	.20	.18

MARKING PRICES PER ITEM	25 & Over $.15			
COLORING PRICES PER ITEM	25-99 $.15	100-249 $.12	250-499 $.08	500 & Over $.06

WALDOM ELECTRONICS, INC.

4633 West 53rd St., Chicago, Illinois 60632 • (312) 585-1212 • Telex 25-4604

Complete information and prices on all Bivar products are available. Samples on request. Special sizes to meet your needs.

PACKAGING PROGRESS
BY **Bivar**

ECON-O-GIDE®

SNAP-IN CARD GUIDES

- Rigid reinforced nylon
- 24 Standard lengths, 2½" thru 14" in ½" increments
- Fast, easy installation
- Economical

SNAP-IN CARD GUIDES, available from stock in 24 Standard Lengths, ECON-O-GIDEs provide a wide choice to meet your most challenging design needs. Molded from Reinforced Nylon for strength and rigidity, these inexpensive guides snap into sheet metal with minimum effort and maximum retention. Samples are immediately available upon your request.

SPECIFICATIONS

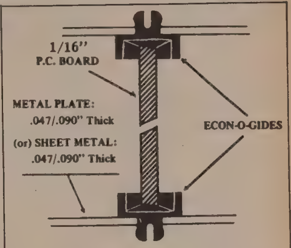
Material: Reinforced Nylon, black

Drawing Tolerances:

Overall Length "L"	: ±1/16
Fractions	: ±1/64
.X	: ±1/64
.XX	: .010
.XXX	: .005

All dimensions in inches.
Code Ident. No. 32559

AVAILABLE IN 24 STANDARD LENGTHS


1/16" P.C. BOARD
METAL PLATE: .047/.090" Thick
(or) SHEET METAL: .047/.090" Thick
ECON-O-GIDES

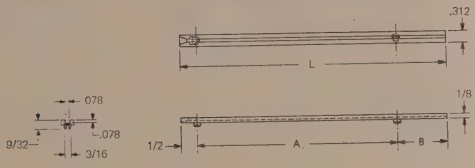
Typical installation of ECON-O-GIDEs

MOUNTING INFORMATION:

SNAP-IN metal plates, .047/.090 thick.
Hole size: .172 dia., +.003, -.001 (11/64 drill)

NOTE: Slotting or elongating of 2nd and 3rd mounting holes is recommended to allow for length variations in molding.

2½" THRU 8" LENGTHS:

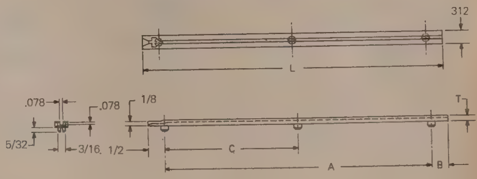


±.010

				NET PRICE EACH					
Part No.	L	A	B	1-49	50-99	100-499	500-999	1,000-2,499	2,500-4,999
E-250	2.5	1-33/64	0.5	$ .25	$ .20	$ .17	$ .14	$ .125	$ .11
E-300	3.0	1-33/64	1.0						
E-350	3.5	1-33/64	1.5						
E-400	4.0	3-1/64	.5	.27	.22	.185	.155	.135	.12
E-450	4.5	3-1/64	1.0						
E-500	5.0	3-1/64	1.5						
E-550	5.5	3-1/64	2.0						
E-600	6.0	5-1/64	0.5	.30	.24	.20	.165	.145	.13
E-650	6.5	5-1/64	1.0						
E-700	7.0	6-1/32	0.5	.38	.30	.26	.215	.19	.165
E-750	7.5	6-1/32	1.0						
E-800	8.0	6-1/32	1.5						

Write for quotations on quantities above 5000.

8½" THRU 14" LENGTHS:



±.010

						NET PRICE EACH					
Part No.	L	A	B	C	T	1-49	50-99	100-499	500-999	1,000-2,499	2,500-4,999
E-850	8.5	7-17/32	.5	3-49/64	.141	$ .44	$ .35	$ .29	$ .245	$ .215	$ .19
E-900	9.0	7-17/32	1.0	3-49/64	.141						
E-950	9.5	7-17/32	1.5	3-49/64	.141						
E-1000	10.0	9-1/32	.5	4-33/64	.141	.50	.40	.345	.29	.255	.225
E-1050	10.5	9-1/32	1.0	4-33/64	.141						
E-1100	11.0	9-1/32	1.5	4-33/64	.141						
E-1150	11.5	10-35/64	.5	5-17/64	.156	.60	.47	.405	.34	.30	.26
E-1200	12.0	10-35/64	1.0	5-17/64	.156						
E-1250	12.5	10-35/64	1.5	5-17/64	.156						
E-1300	13.0	12-3/64	.5	6-1/64	.156	.68	.55	.455	.385	.335	.30
E-1350	13.5	12-3/64	1.0	6-1/64	.156						
E-1400	14.0	12-3/64	1.5	6-1/64	.156						

Write for quotations on quantities above 5000.

PRINTED CIRCUIT BOARD HANDLES

- COMPACT SIZE, EASY MOUNTING
- POSITIVE GRIP
- CHOICE OF COLORS, MARKING

designed for PCB's of any thickness, compact size requires only ⅜" x ¾" area, saving valuable board space. Stocked in natural (white) or 12 colors, features firm grip design and wide handle surface for marking.

WRITE FOR COMPLETE DETAILS AND PRICING ON THESE AND OTHER NEW PACKAGING PRODUCTS FROM . . .

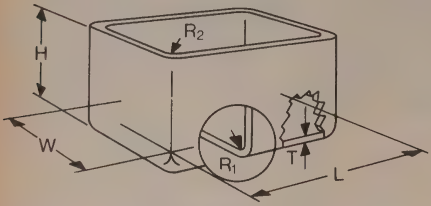
waldom
ELECTRONICS, INC.
4633 West 53rd Street • Chicago, Illinois 60632
(312) 585-1212 — TELEX 25-4604

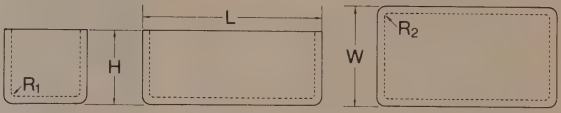
Zero Deep Drawn Aluminum Boxes

ZERO offers 40,000 **standard** deep drawn sizes in rounds, rectangles and squares, available for off-the-shelf delivery in two weeks, A.R.O. This is only a small sample of our standards which can be readily modified for special applications.

ZERO rectangular standard boxes are produced from ZERO-METHOD deep draw tooling that insures close tolerances and a wrinkle-free finish. Available in any height between maximum and minimum shown.

Key to drawing





Note: W and L ARE MEASURED AT POINTS OF TANGENCY. WIDTH, LENGTH AND HEIGHT ARE ALL OUTSIDE DIMENSIONS

W	Width measured at tangency between bottom radius (R_1) and side
L	Length measured at tangency between bottom radius (R_1) and side
H	Height
T	Normal blank thickness (gauge) prior to drawing
R_1	Radius at bottom
R_2	Radius of side (on rectangular boxes and covers)

When ordering give part number and height desired in 1/16's.

EXAMPLE: Z48-80A-48 = A BOX 3″ W. X 5″ L. X 3″ H

Maximum and minimum heights only are listed. Boxes are available in any height to nearest 1/16ths. Decimal or finer fractional heights on special order only.

Thicknesses shown (T) are nominal blank thicknesses prior to drawing. Actual wall thickness is normally 80% or more of nominal blank thickness, but is dependent on depth of draw, number of draws and net blank thickness (a variable within mill tolerances).

Aluminum Association alloy designation and gauge thickness are used throughout this catalog.

OUTSIDE WIDTH W X INCHES	OUTSIDE LENGTH L	OUTSIDE HEIGHT MAX. H INCHES	MIN.	BLANK GAUGE T INCHES	ALLOY	CORNER RADII BOTTOM R1 INSIDE INCHES	SIDE R2 INSIDE	PART NUMBER SPECIFY TRIM HEIGHT
29/32	1-21/32	2-1/8	7/16	.050	1100-0	5/32	1/4	Z14-26
1-5/16	1-7/8	4	9/16	.050	1100-0	1/4	3/16	Z21-30
1-1/2	1-55/64	2-1/2	3/8	.040	1100-0	1/8	1/8	Z24-30
1-1/2	2	2	7/16	.040	1100-0	3/16	3/16	Z24-32
1-5/8	3-3/8	1-7/8	1/2	.032	1100-0	1/4	1/8	Z26-54
1-3/4	2	2	7/16	.025	1100-0	5/32	1/4	Z28-32A
1-3/4	5	4	1/2	.040	1100-0	3/16	3/16	Z28-80
2	2	2-1/4	1/2	.063	1100-0	1/4	1/4	Z32-32A
2	2-1/4	3-3/4	3/8	.040	1100-0	1/8	1/8	Z32-36
2	2-1/2	4-1/2	1/2	.050	6061-0	1/4	1/4	Z32-40B
2	3	3-1/4	1/2	.063	1100-0	1/4	1/4	Z32-48A
2	3	2	7/16	.063	1100-0	3/16	3/16	Z32-48B
2	3-1/2	3	9/16	.050	1100-0	1/4	1/4	Z32-56A
2	4	2	3/8	.063	1100-0	1/8	5/32	Z32-64B
2-1/8	4-1/4	3	1/2	.063	1100-0	1/4	1/8	Z34-68
2-1/4	2-1/4	2-1/2	1/2	.050	1100-0	1/4	1/4	Z36-36
2-1/4	3	3	1/2	.050	1100-0	1/4	1/4	Z36-48
2-1/4	3-3/4	2-3/4	3/8	.040	1100-0	1/8	1/4	Z36-60A
2-1/2	3	2-1/2	1/2	.050	1100-0	1/4	1/4	Z40-48
2-1/2	4	4	1/2	.050	1100-0	1/4	1/4	Z40-64A
3	3	6	1/2	.040	1100-0	1/4	1/4	Z48-48A
3	3-1/2	3-1/4	1/2	.050	1100-0	1/4	1/4	Z48-56A
3	4	2-1/2	3/8	.063	1100-0	1/8	1/8	Z48-64B
3	4-1/2	3	7/16	.063	1100-0	3/16	3/16	Z48-72

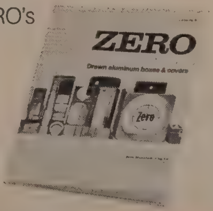
Zero Deep Drawn Aluminum Boxes

OUTSIDE WIDTH W X	OUTSIDE LENGTH L	OUTSIDE HEIGHT MAX.	OUTSIDE HEIGHT MIN.	BLANK GAUGE	ALLOY	CORNER RADII BOTTOM R1 INSIDE	CORNER RADII SIDE R2 INSIDE	PART NUMBER SPECIFY TRIM HEIGHT
INCHES		H INCHES		T INCHES		INCHES		
3	5	3-1/2	1/2	.063	1100-0	1/4	1/4	Z48-80A
3	6-7/8	3	11/16	.080	6061-0	1/4	1/4	Z48-110
3	9	3-1/2	1/2	.063	1100-0	1/4	1/4	Z48-144
3-1/4	5-1/4	5	11/16	.050	1100-0	7/16	5/16	Z52-84A
3-1/4	5-1/4	2-1/2	9/16	.050	1100-0	5/16	5/16	Z52-84B
3-1/2	6	3-1/2	7/16	.050	1100-0	3/16	3/16	Z56-96A
4	4	4	7/8	.063	1100-0	5/16	5/16	Z64-64A
4	6	3-1/2	13/16	.050	1100-0	1/4	7/32	Z64-96A
4	7	6-3/4	7/8	.063	1100-0	5/16	5/16	Z64-112A
4-1/2	6	3-3/8	11/16	.063	1100-0	1/8	5/32	Z72-96
4-7/8	6-1/2	8	7/8	.063	6061-0	11/32	3/16	Z78-104B
5	5	5	7/8	.063	1100-0	5/16	5/16	Z80-80A
5	7	5	7/8	.063	1100-0	5/16	5/16	Z80-112A
5-11/16	10	7	13/16	.063	1100-0	1/4	1/4	Z91-160
6	6	5	7/8	.063	1100-0	5/16	5/16	Z96-96
6	8	6	7/8	.063	1100-0	3/8	5/16	Z96-128A
6	9	6	7/8	.063	1100-0	5/16	5/16	Z96-144
6-1/2	6-1/2	7-1/2	1/2	.063	1100-0	1/4	7/16	Z104-104B
7	9	7	1	.063	6061-0	7/16	7/16	Z112-144A
7	11	7	1-1/16	.063	6061-0	1/2	5/16	Z112-176A
7	12-1/2	5	1/2	.063	3003-0	3/16	3/8	ZT112-200B
8	11	7-1/2	1-7/16	.063	6061-0	7/8	7/8	Z128-176A
8	14	7	1-7/16	.063	6061-0	7/8	7/8	Z128-224
9	9	8	1-1/16	.063	6061-0	1/2	1/2	Z144-144A
9-3/16	13-1/4	9	1-3/16	.063	6061-0	19/32	19/32	Z147-212B
11	18	10	1-5/8	.090	6061-0	1	1	Z176-288A

ROUND HOUSINGS

OUTSIDE DIAMETER INCHES	OUTSIDE HEIGHT (MAX.) H INCHES	BLANK GAUGE T INCHES	ALLOY	BOTTOM RADIUS (INSIDE) INCHES	PART NUMBER SPECIFY TRIM HEIGHT
1-5/8	2-1/2	.032	1100-0	1/16	ZR-26A
2	1-3/4	.032	1100-0	3/16	ZR-32A
3-11/16	2-5/8	.063	6061-0	1/4	ZR-59A
4-21/32	6-1/2	.050	1100-0	9/32	ZR-74
6	6-13/16	.050	1100-0	3/8	ZR-96A

Write or call for ZERO's comprehensive 64-page catalog and design guide.



Zero Manufacturing Co.

ZERO-WEST • 777 Front Street, Burbank, CA 91503
Telephone: (213) 846-4191 • TWX 910-498-2237
Cable: ZEROBOX

ZERO-EAST • 288 Main Street, Monson, MA 01057
Telephone: (413) 267-5561 • TWX 710-354-1450
Cable: ZEROCAN

ZERO-SOUTH • 14501 49th Street North, Clearwater, FL 33520
Telephone: (813) 531-8991 • TWX 810-863-0322

ZERO CENTURION® "ELITE" CARRYING CASES

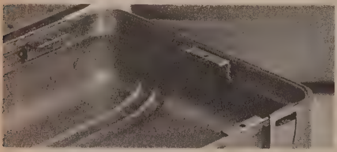
Top-of-the-line protection and appearance for your finest equipment

High strength, light weight and clean simple lines characterize these distinctive cases. Surfaces are seamless and wrinkle-free while satin buffing and anodizing, standard finish for the line, make the most of aluminum's natural good looks.

Zero Centurion cases are dust-proof, weather resistant and odor-proof; and their strength and durability have been proven in actual use around the world. Each is strong enough to stand on, thanks to specially heat treated case shells; yet even the largest (26 x 18 x 9) weighs less than 10 pounds.

NEW FEATURES

Zero has improved the appearance, reliability and versatility of this line. New positive locking latches improve working performance, while adding to the clean styling of each case.



A new, fully gasketed tongue-and-groove closure extrusion, bonded to case shells, offers not only better sealing and better case integrity, but also permits the installation of new adjustable panel mounting brackets (optional) at significant savings over other methods of attaching angles for panel mounting equipment.

DELIVERY

Normal delivery for standard cases and panel mounting brackets is one week after receipt of your order and will be filled from the Zero facility nearest your location. Allow 4 week delivery for cases with foam packs.

100X SERIES

A new standard of excellence

The 100X Series comes completely equipped, ready for installation of your equipment. Available in 13 standard sizes, the dimensions and weights for this line are shown in Table 1.

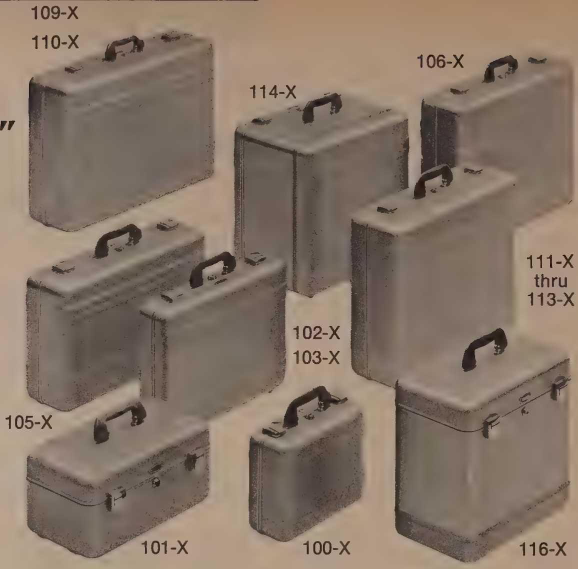


Table 1 Standard Zero Centurion Cases

Model	Width	Length	Height	Height Upper Shell	Height Lower Shell	Material Thickness	Net Weight
100-X	9	12	5	2	3	.040	2 lbs. 7 oz.
101-X	9	16	7¾	2½	5¼	.051	4 lbs. 7 oz.
102-X	13	18	4½	2	2½	.040	4 lbs. 1 oz.
103-X	13	18	6	2½	3½	.040	4 lbs. 4 oz.
105-X	13	21	6½	2¾	3¾	.040	5 lbs. 1 oz.
106-X	17	21	7½	3	4½	.051	7 lbs. 4 oz.
109-X	18	26	8½	3¾	4¾	.051	9 lbs. 9 oz.
110-X	18	26	9	4¼	4¾	.051	9 lbs. 13 oz.
111-X	18	24	7	3	4	.051	8 lbs. 15 oz.
112-X	18	24	8	3½	4½	.051	9 lbs. 6 oz.
113-X	18	24	8½	4	4½	.051	9 lbs. 8 oz.
114-X	17	18	12	2	10	.040	7 lbs. 14 oz.
116-X	9	16	14½	2½	12	.051	5 lbs. 10 oz.

Note: Width and length are outside dimensions; height is an inside dimension.
Lower shell of Model 114-X and 116-X complete with spot welded wrap-around riser section.

ORDERING INFORMATION

(for Standard 100X cases)

Simply order by part number, indicating quantity. If panel support brackets are required, add suffix P and indicate quantity per case.

SAMPLE PART NUMBER

103X - P6

Case Number

Panel Mtg. Brackets and Quantity/Case

Standard foam packs are also available in 2 pound density blue polyurethane, and can be obtained by adding suffix F to case numbers (Example: 103X F). Allow 4 weeks for delivery.

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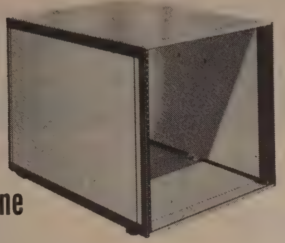
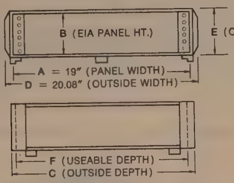
VIP the ZERO versatile instrument packaging system



the vip series 19 line

The VIP Cabinet Line provides an attractive alternative to conventional electronic rack mounts, accepting EIA standard 19″ panels totaling 5¼″ to 28″ height (see table). In addition, multiple VIP Series 19 modules can be stacked vertically for temporary instrument groupings, thanks to a positive-nesting foot design. Individual units may be fitted with tilt stands, chassis slides, fold-away cast handles, or (for the 5¼″ unit only) a self-retracting strap handle. And the VIP Series 19 Line standard units come pre-assembled with or without front and/or rear panels, as you require. The VIP Series 19 Line has removable top and bottom panels.

ORDERING INFORMATION



VIP Cabinet Enclosure System

Standard in pre-assembled form. Cost reduced for kit form.

Dimensions (±0.031″)						Enclosure No.
A	B	C	D	E	F	
19.00	5¼	17.90	20.04	6.03	17.20	190517
19.00	7	17.90	20.04	7.78	17.20	190717
19.00	8¾	17.90	20.04	9.53	17.20	190817
19.00	10½	17.90	20.04	11.28	17.20	191017
19.00	12¼	25.90	20.04	13.03	25.20	191225
19.00	14	25.90	20.04	14.78	25.20	191425
19.00	17½	25.90	20.04	18.28	25.20	191725
19.00	21	25.90	20.04	21.78	25.20	192125
19.00	24½	25.90	20.04	25.28	25.20	192425
19.00	28	25.90	20.04	28.78	25.20	192825

VIP ☐☐☐☐☐☐ — ☐☐ — ☐☐☐☐☐☐

Notes	Configuration	Code
	Plain Side Panels; assembled	1
①	Side Handles; assembled	2
	Kit; Plain Side Panels	3
①	Kit; Side Handles	4

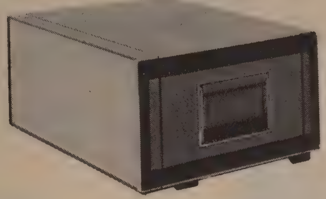
	Color	
②	Blue	1
③	Blue w/Bright Trim	2
②	Brown	3
③	Brown w/Bright Trim	4
⑦	Other (special order only)	5

Notes	Accessories	Code
⑤	Front Panel	F
⑤	Rear Panel	R
④	Chassis Slides (60 lb./pair)	S
	Tilt Stand	T
	Std. Ventilated/Top/ Bottom Panels	X

Example: VIP191225-24-FRT = VIP Series 19 for 12¼″ x 19″ EIA panel; 25.20″ inside depth; fold-away handles; assembled; brown with bright trim; front and rear panels; and tilt stand.

Notes: [1] 3½″ and 5¼″ high units employ dual self-retracting strap handles; 7″ high and over employ fold-away cast handles for 2-man carry. [2] 2-Week delivery. [3] 4-Week delivery. [4] See Zero Catalog P for separable, non-separable and rotational slides, with capacities to 275 lb./pair. [5] Front and rear panels are alodined without color finish to permit secondary operations. [6] Front and rear covers are identical. For one, designate "C"; for two, designate "CC." [7] For special requirements, consult the nearest Zero sales office.

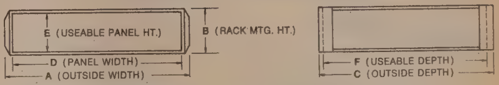
the vip 6-way line



The VIP 6-Way Line, as its name suggests, is more versatile still. The "6-Way" nomenclature derives from this family of features: (1) Vertical Nesting via positive-nesting feet, for temporary groupings; (2) Vertical Interlocking via dove-tail stack-joiner strips and integral grooves, equivalent to rack mounting in less space and without the rack and its limitations; (3) Horizontal Interlocking via dove-tail strips and grooves, for side-by-side mounting of multiple instruments; (4) Rack Mounted via accessory brackets, plus optional chassis or rotation slides, for insertion into the VIP Cabinet units or other EIA Std. racks; (5) Briefcase Portable via cast fold-away handles or self-retracting strap handle, plus optional front/rear dust covers; and (6) Tiltable via an accessory tilt stand, for bench and desk-top use without parallax. It is this extraordinary versatility and the strength of castings, extrusions and heavy-gage aluminum that makes the VIP enclosures worthy of your designs. The VIP 6-Way Line has the unique feature of removable top and bottom panels.

VIP 6-Way standard modules come unassembled in both 17″ and 8½″ outside widths, and are designed for interlocking without gaining width.

ORDERING INFORMATION



VIP 6-Way Enclosure System

Standard in kit form. Extra cost for pre-assembly.

	Dimensions (±0.031″)					Enclosure No.
A	B	C	D	E	F	
16.88	3½	12.70 16.70	15.98 15.98	3.15 3.15	11.07 15.07	170312 170316
16.88	5¼	12.70 16.70	15.98 15.98	4.90 4.90	11.07 15.07	170512 170516
16.88	7	12.70 16.70	15.98 15.98	6.65 6.65	11.07 15.07	170712 170716
16.88	8¾	16.70 22.70	15.98 15.98	8.40 8.40	15.07 21.07	170816 170822
16.88	10½	16.70 22.70	15.98 15.98	10.15 15.15	15.07 21.07	171016 171022
16.88	12¼	16.70 22.70	15.98 15.98	11.90 11.90	15.07 21.07	171216 171222
8.43	3½ 5¼	12.70 12.70	7.52 7.52	3.15 4.90	11.07 11.07	080312 080512

VIP ☐☐☐☐☐☐ — ☐☐ — ☐☐☐☐

Notes	Configuration	Code
	Chassis (no side panels); kit	0
	Plain Side Panels + Feet; kit	1
①	Side Handles + Feet; kit	2
	Assembled Chassis (no side panels)	3
	Assembled; Plain Side Panels + Feet	4
①	Assembled; Side Handles + Feet	5

	Color	
②	Blue	1
③	Blue w/Bright Trim	2
②	Brown	3
③	Brown w/Bright Trim	4
⑦	Other (special order only)	5

Notes	Accessories	Code
	Rack Mtg. Brackets	B
	Rack Mtg. Brackets + Pull Handles	P
⑥	Front or Rear Protective Cover	C
④	Chassis Slides (60 lb./pair)	S
	Horizontal Joiner Strips (pair)	H
	Vertical Joiner Strips (pair)	V
	Tilt Stand	T
	Std. Ventilated/Top/ Bottom Panels	X

Example: VIP170516-21-CCVT = VIP 6-Way enclosure 17″ x 5¼″ x 16.70″ for bench use; strap handles and feet; kit form; blue; stack-joiner strips; both front and rear covers; and tilt stand.

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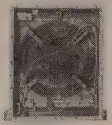
military & commercial

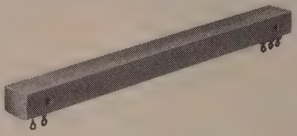
DELAY LINES

WITH OR WITHOUT CIRCUITRY

MAGNETOSTRICTIVE ★ LUMPED CONSTANT ★ ULTRASONIC ★ DISTRIBUTED CONSTANT ★ DISPERSIVE STRIP

MAGNETOSTRICTIVE DELAY LINES — Fixed and variable delays to 10,000 microseconds. Fixed — FMS Series; Variable — VM Series.

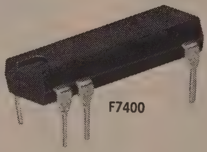




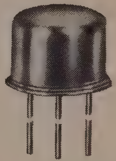
FIXED MAGNETOSTRICTIVE DELAY LINE — Up to 10,000 bits of data for memory storage. Circuitry compatible with all microcircuit logic. Choice of data format: RZ, NRZ or Bipolar.

ULTRASONIC DELAY LINES — Replaces most quartz or glass lines. Offers superior performance, lower attenuation and smaller size at less cost. Frequencies to 30 MHz. Delays to 200 usec and greater.

SUBMINIATURE DELAY LINES



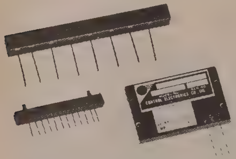
F7400



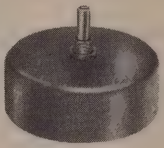
F-TO-5

TO-5 and micrologic packaged delay lines from 0.01 to 0.64 and longer delays. Ideal for timing transistors and other circuit components.

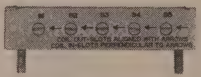
LUMPED CONSTANT DELAY LINES — Many shapes available including miniature types with pin connectors for PC Boards, connector fingers for plug-in units...multi-tapped units...terminal-ended units, etc. Delays from 0.05 usec to 500 usec for standard units. Delay to risetime ratios up to 100:1. Temperature stability to 50 ppm/C°.



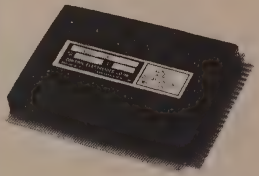
COMPACT FIXED DELAY LINES FOR PC BOARDS — Extremely high density packaging. Typical Unit: 25:1 delay-to-rise-time ratio in a volume of 2 cubic inches.



VARIABLE DELAY LINE Resolution of 1 part in 120. Delay up to 10 usec. 1″ x 3″.

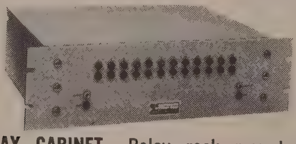


UNIQUE BINARY CODED SECTIONAL DELAY LINE — Uses miniature transfer switches. Also available with terminals for remote switching.



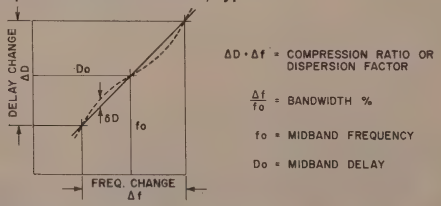
IFF MULTI-TAP DELAY LINES Standard IFF delay lines with taps every 1.45 usec. High density packaging available for airborne transponder use.

AUDIO, HIGH FREQUENCY & DISTRIBUTED CONSTANT DELAY LINES — With unusual circuits, extreme delays, high frequency application, rapid rise times, conforming waveform circuits and corrective circuits. Write for complete details.



AUDIO DELAY CABINET — Relay rack mounted cabinet houses 25 millisecond delay with taps at every ms. Units can be cascaded for longer delays.

DISPERSIVE STRIP DELAY LINES — Delay varies with frequency. A prime application is in Pulse Compression Radar Systems, eliminating large, expensive filter components. Compression ratios of 150:1, typical.



For all your Delay Line requirements, contact:

CONTROL ELECTRONICS COMPANY, INC.
153 Florida Street, Farmingdale, L.I., N.Y. 11735 • (516) 694-0125

short form catalog

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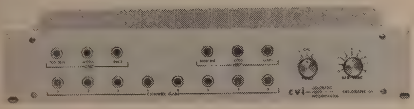
PHONE (303) 444-3972
TWX 910-940-3248 (COLO VIDEO BDR)

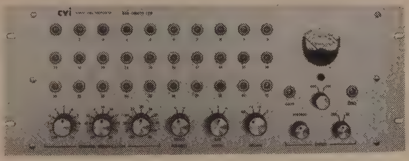
Bar Graph **101**



A device accepting 8 negative going signal inputs and converting these into a vertical "Bar" pattern as seen on the screen of a standard TV monitor. Requires external sync. Rack mount, 3½" high, solid state.

$1250.

Bar Graph **120**



Accepts 30 negative going input signals and produces a horizontal bar display with better than 1% accuracy. Has individual channel markers, zero suppression, decade expansion, and other features. Requires external sync. Rack mount, 7" high, solid state.

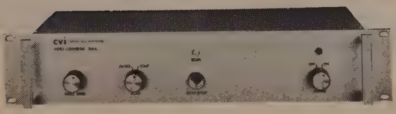
$4200.

Limit Indicator **122**

A device producing 15 separate "high" and 15 separate "low" vertical markers with automatic alarm when video falls outside of predetermined limits. Requires external sync. Rack mount, 5¼" high, solid state.

$3500.

Video Converter **201-A**



A unit which accepts a standard "real time" television input signal and uses high speed sampling to produce a "slow-scan TV" output signal for computer data reduction or other forms of video processing. Conversion accuracy is excellent, with negligible grey scale distortion. Rack mount, 3½" high, solid state.

$1950.

Video Converter **220-A**

Companion unit to the 201-A. Utilizes a magnetic disc memory together with high speed pulse circuits to convert "slow-scan" video or properly formated computer data to standard 525 line TV rates. Has automatic erase and indefinite image storage capabilities. Options include color reproduction and selective record/erase. Rack mount, 7" high, solid state circuitry.

$5000.

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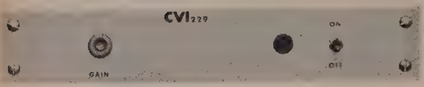
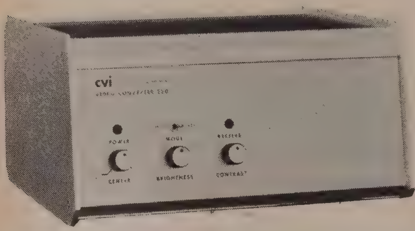


Video Compressor 229

A low cost version of the Model 201A. Output bandwidth is approximately 8 kHz. Either rack mount or table top package. Size 10 x 7 x 1¾″; solid state.

$1000.

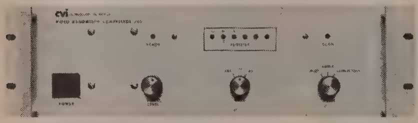


Video Expander 230

A compact version of the 220A, utilizing an 8″ magnetic disc memory. Recommended for lower resolution applications such as signature verification or remote scene monitoring. Size 12½ x 11½ x 6¼″. Table top mounting.

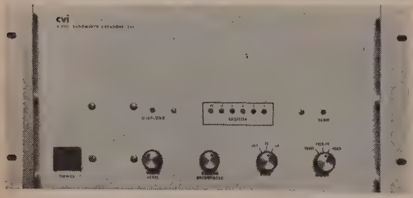
$3000.

Video Compressor 260



This unit accepts standard composite video signals and performs sampling, digitizing, buffering, and slow scan TV conversion operations. Provides outputs for computer use and for direct connection of slow scan signals to voice grade communications circuits. Rack mount, 5¼″ high; solid state.

$3000.



Video Expander 261

A companion device for the 260. Accepts slow scan TV signals and converts to standard TV rates. Uses magnetic disc memory for non-fading image display. Rack mount, 8¾″ high; solid state.

$6000.

Video Digitizer 270

An advanced version of the 260 which provides for directly computer addressable sampling. The 270 allows both computer input of video signals and the redisplay of computer processed information on a standard television monitor by means of photographic time exposures. Various options are available. Rack mount, 5¼″ high; solid state card file construction.

$4000.

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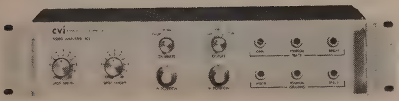
Video Analyser 301

An instrument displaying "vertically line-selected" TV waveforms directly on the screen of a normal TV monitor. 1/1 waveform/picture ratio simplifies identification of individual picture elements. Display also includes an electronic reference grating and H and V markers. Requires external sync. Rack mount, 3½" high; solid state.

$875.

Video Analyser 302



Similar to Model 321, but does not have internal time base or field selection. However, the unit incorporates variable H and V sample widths. Requires external drive pulses. Rack mount, 3½" high; solid state.

$1950.

Sync Stripper 302-2

A utility unit producing sync, horizontal drive, vertical drive, and blanking signals from a standard composite video source. Allows interconnection and synchronization of video devices to camera or tape recorded signals. Size 3 x 5 x 7"; solid state; self powered.

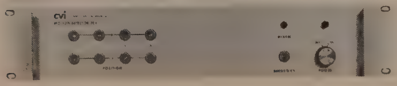
$250.

Raster Generator 302-5

A device containing circuitry to generate very low speed rasters, up to one half hour in duration. Intended for use in recording sampled video information or other low frequency signals in conjunction with a conventional X-Y plotter. Produces pseudo topographical type displays with information vertically deflecting raster lines. Rack mount, 3½" high; solid state.

$950.

Motion Detector 304



A device sampling four independent points in a TV scene and producing an alarm when a change in brightness occurs at any of the sampling points. Operates with standard, composite, video signals. Rack mount, 3½" high, solid state.

$1250.

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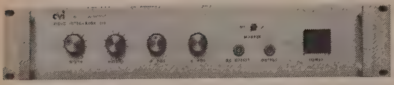
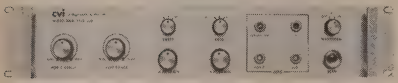
Video Integrator **310**



An instrument producing a D.C. voltage directly proportional to the integral of a video signal falling within a selectable "window" area. Requires external drives. Rack mount, 3½" high; solid state.

$1500.

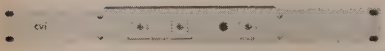
Video Analyser **321**



Laboratory version of the 301. Incorporates additional circuitry to allow chart recording of "line selected video waveforms, X-Y coordinate indication, noise analysis, computer data input, and other features. Requires external sync. Rack mount, 3½" high, solid state.

$2500.

Video Analyser **350**



A low cost instrument for display of TV waveforms directly on a normal monitor screen, eliminating the need for a separate CRT display. Similar to the Model 301 but uses fixed sampling and also features a peak video level detection mode. Rack mount, 1¾" high; solid state.

$400.

Video Plotter **401-A**

An instrument which converts low frequency data to video format with indefinite signal storage via a wide band magnetic disc memory. Features include internal time base, electronic reference grating, multimode recording, grey scale reproduction, and selective erase. Generates own sync. Rack mount, 7" high, solid state circuitry.

$4000.

Video Converter **404B**

A wide band magnetic disc recorder accepting properly formatted computer output signals for conversion to standard 525 line TV rates. Incorporates four separate read/write/erase channels for generation of multiple displays or synthetic color. Also produces H and V timing pulses for synchronization of auxiliary equipment. Rack mount, 8¾" high, solid state circuitry.

$7000.

cvi COLORADO VIDEO INCORPORATED • P.O. BOX 928 • BOULDER, COLORADO 80302 • PHONE (303) 444-3972

Video Converter 404D

A four-channel magnetic disc recorder directly computer addressable for the reconstruction of images in black and white or color TV format.

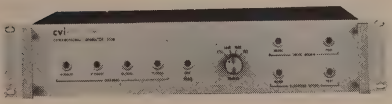
Rack mount, 8¾″ high; solid state card file circuitry.

$7000.

Data Camera 502

A TV camera intended particularly for research or industrial inspection uses. Accepts nearly any 1 inch tube and has various features such as externally controllable sweeps, beam blanking, dynamic gain control, plug-in low pass filters, and very wide range of operating rates. Options include video sampler, shading generator, and digital control of various functions. Camera is three chassis configuration: head, control unit, power supply. Requires external drives, blanking, or deflection voltages.

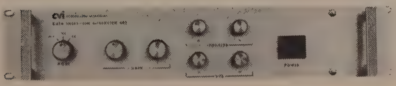
$4000.



Sync Generator 601-B

A unit intended for laboratory use when either standard or nonstandard TV scan rates are required. Uses micrologic binary counters with adjustable feedback paths. Drive and blanking pulses are variable width, but sync is not EIA format. Incorporates dot/bar generator for test purposes. Rack mount, 3½″ high, solid state.

$1025.



Data Insertion Generator 603

Combines the functions of a 2 channel video mixer, special effects generator, and video pointer. Moveable oblong is positionable to any point in TV raster and is variable in size over a wide range. Oblong acts as the internal "key" in special effects mode, and also generates a white "box" outline or solid square for marking purposes. Requires external sync. Rack mount, 3½″ high, solid state.

$1250.

Video Processor 604

An instrument modifying the grey scale of a video input signal by selecting and amplifying a variable width "slice". Also incorporates variable brightness control, sync adding, and external marker adding functions. Requires external sync. Rack mount, 3½″ high; solid state.

$950.

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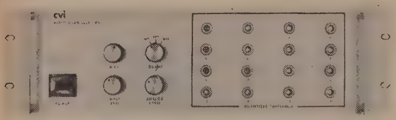
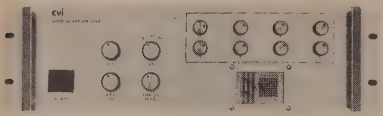


Video Quantizer 606

A device which allows the processing of a video input signal into 16 separate amplitude levels. Operates with tape, camera, or disc inputs and allows radical grey scale alterations or the generation of complex synthetic color signals. Rack mount, 5¼" high, solid state.

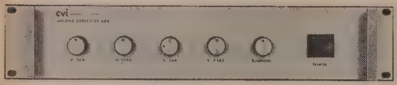
$3500.



Video Quantizer 606A

An eight-channel version of the 606, containing a built-in color coding patch panel and mixing functions. Produces R-G-B outputs and sync. Rack mount, 5¼" high; solid state.

$2500.



Shading Generator 608

Generates H and V sawtooth and parabolic waveforms of variable amplitude and polarity to provide compensation of brightness errors in video input signals. May also be used to drive external dynamic correction circuitry. Requires external sync. Rack mount, 3½" high; solid state.

$950.

Video Pointer 610C

Generates five different oblong and/or cross patterns which are positionable to any location on the TV screen. Oblongs can be changed in size over a range of 10 to 1. Unit may be used for marking purposes or for positional measurements. Requires external drives. Rack mount, 3½" high; solid state.

$1950.

Diameter Analyser 611

This device contains gating, slicing, and counting circuits to provide automatic measurement of the maximum vertical dimension of a target with moderate to high contrast. Both digital and analog output signals are available. Requires external sync. Rack mount, 3½" high; solid state.

$1950.

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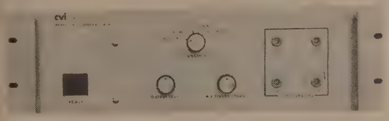
Video Generator 615



A test instrument providing grey scale, grating, dot, window, multiburst, and flat field signals. Multiburst is variable in position for monitor resolution checks, and multiburst frequencies to 20 MHz may be ordered. Requires external drive, blanking, and sync. Rack mount, 5¼" high; solid state.

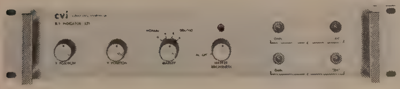
$2000.

X-Y Indicator 620

Generates white cross hairs superimposed over a video input signal. Allows rapid alignment of subject material with a predetermined location when used in conjunction with a standard TV camera and monitor. Accepts composite video on a terminated input and provides composite video out to a standard TV monitor. Size 11 x 8 x 1.65". Mounting: Free standing or rack. Self powered.

$400.

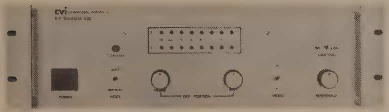
X-Y Indicator 621



An instrument accepting either composite or non-composite video signals and superimposing either a small white dot or set of cross hairs on the video image. Marker may be manually positioned to any location on the raster and two directly proportional DC output signals are generated for analysis of spatial location of subjects. Also contains built-in grating generator for evaluation of input signal quality. Rack mount, 3½" high; solid state.

$1500.

X-Y Digitizer 622



This unit provides 8 bit digital X-Y coordinates of a small white dot that may be manually located anywhere on a standard TV image. Also incorporates automatic tracking of high contrast targets, and stable grating test signal. Operates from composite video. Rack mount, 5¼" high; solid state.

$4500.

Video Detector 630

Provides gating functions combined with high and low video detection circuitry to provide automatic warning when video levels exceed preset limits. May also be operated in a differential mode to provide high sensitivity to small changes in contrast, such as might be produced by spots or hairline cracks. Operates from composite video signals. Standard rack mount, 3½" high; solid state.

$1500.

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A few words about Colorado Video, Incorporated.

CVI specializes in the design and manufacture of instruments utilizing video technology. Particular areas of interest include research laboratory instrumentation, industrial inspection and control, computer input/output of television signals, video metrology, image alteration and synthesis, electronic art, scan conversion, and communications involving the transmission of TV pictures over audio grade circuits.

Colorado Video, Incorporated—3245 Prairie Avenue, Boulder, Colorado USA

CVI instruments are used throughout the world and are available for operation from 50 to 400 Hertz power sources and at various scanning rates. For technical assistance, please contact any of the following:

CVI—Box 928—Boulder CO 80302 USA
303/444-3972—TWX 910-940-3248 COLO VIDEO BDR

CVI Southwest Sales Office—Dallas TX—214/233-5497

Overseas Representatives

Ciclovision S.R.L.
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Buenos Aires, Argentina
(32-2939)

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Kamer Building, 5th Floor
38, Cawasji Patel Street
Bombay-1, India
(253489)

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S-182 51 Djursholm, Sweden
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(383-1039)

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92600 Asnieres, France
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Huntsville, Alabama 35807
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Greensboro, North Carolina 27408
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Williamsburg, Virginia 23185
(804) 245-1786

LD Bevan Company
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Westlake Village, California 91361
(213) 889-3653

Cropley, Inc.
2275 East Arapahoe, #301
Littleton, Colorado 80121
(303) 794-4231

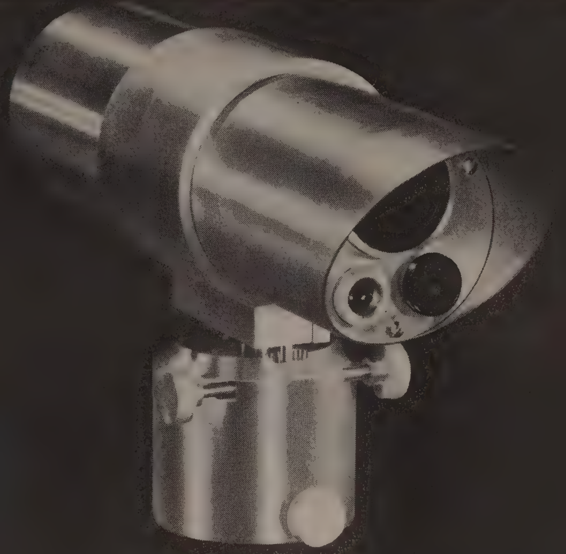
Perspective Measurements
7034 Convoy Court
San Diego, California 92111
(714) 278-8931

Scientific Marketing, Inc.
227 W. Lancaster Ave.
Paoli, Pennsylvania 19301
(215) 647-2021

CVI VIDEO INSTRUMENTS FOR DATA ACQUISITION — PROCESSING — DISPLAY — TRANSMISSION

Laser Communicator

MODEL LC-10



Features

No FCC license required. Single, weather-proof ("O" ring sealed) housing for transmitter, receiver, alignment scope and power supply. Low cost, half the price of a microwave link. One and ten line private telephone models. Data rates of 10K, 100K and 1M bits/second. Range greater than 15 miles. Repeater capability for extended range. Superior security, virtually untappable. Precision pan and tilt base for easy installation. Internal batteries available for portable operation.

Application

Secure high-speed data communications.
High security private telephone.
Telemetry.

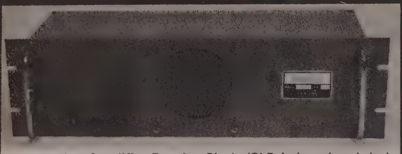
Power Technology Inc.

P. O. Box 4403
Little Rock, Arkansas 72204
(501) 568-1995

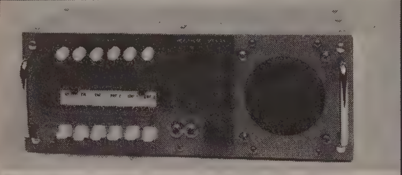
GRM CORP

An Inductotherm Company

TRIANGLE INDUSTRIAL CENTER
MEDFORD, NEW JERSEY 08055
Phone: 609-267-7950



Loudspeaker-Amplifier Panels Single (SLP-4 shown) and dual units available with common or independent AC/DC Integral Power Supplies, or DC inputs. 5-1/4" H X 19" W X 6 " D

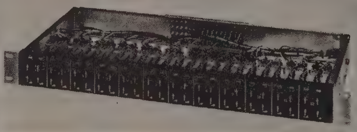


Air Traffic Control Tower Systems•Complete solid state Airport Tower units • FAA, Navy and Air Force approved • Models for 12 VDC, 24 VDC and 48 VDC power • Amplifiers for Tx and Rx circuits.

BURLINGTON COUN
N4845

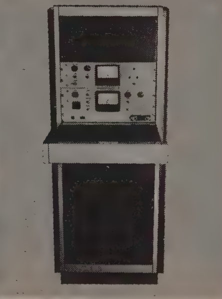
Mobile Air Traffic Control System AN/MRC-131 • Completely self contained • Provides 1 HF, 2 VHF, 2 UHF, 1 FM channels • Three operator positions • Power from motor alternator, 12 V DC battery, and 110/230 VAC rectifier charger • All frequencies in HF, VHF and UHF Air/Ground bands.

Patch and Test Bays Primary (cable), equal level Circuit and DC Patch Bays complete and ready for installation at site. Also, Patch, Test, Fuse and Distribution bays.

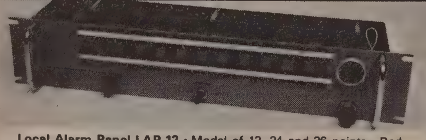


Variable Attenuator Panel - VAP-1230 Provides 12 channels of switchable attenuation from 0 to 30 DB in 2 DB steps, 600 OHMS input and output. 1-3/4" H X 19" W X 9" D. Other impedance and attenuation steps available.

Voice Orderwire Unit TTP-12 • Provides selection 12 channels • Supplied with telephone handset • Adjustable Tx and Rx levels.



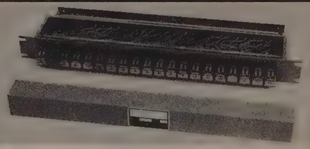
Magnet Charger Model 3 LV • High power for industrial users • 11000 watt seconds peak energy • Automatic 10 operations per minute • Available with Monitor Unit • Variable charging voltage 0-500 volts • Model 1 LV also available.



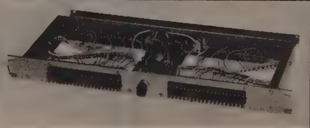
Local Alarm Panel LAP-12 • Model of 12, 24 and 36 points • Red lamp and audible alarm • 110 VAC, 48 VDC and 24 VDC optional power • Solid state construction.

Audio and Digital Patch Panels Miniature and standard telephone jacks in various configurations for telecommunications and computer patch and test facilities available in 2, 4 and 6 wire circuitry for audio; cut key and/or activity indicators for digital.

Supervisory Control, Alarm Systems • Custom designed to your requirements • Up to 256 points control and alarm • Excellent security Double scan with Parity • Computer control and logging available • Single master-multiple remotes • Fully solid state IC construction.



Relay Panel - RP-Y-20 20 Plug in relays in 1-3/4" of panel space for various applications in communications and control field. A wide variety of voltage and contact arrangements available.



Fuse and Alarm Panel 40 fuses in 1-3/4" H. Panel with visual alarm and contact outputs for remoting alarm. FP-40A for 6, 48, 60-80, 120-130 VDC. F P-40B for 6, 12, 24 and 48 VDC applications.

G.R.M. CORPORATION - COMPLETE MANUFACTURING SERVICES FOR OEM PROPRIETARY PRODUCTS

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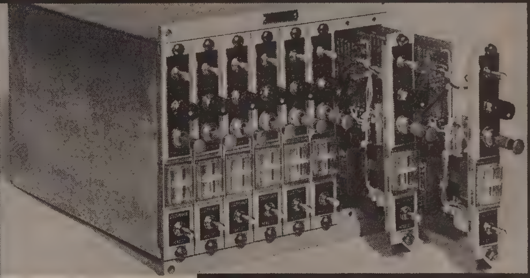
MEDFORD, NEW JERSEY 08055
Phone: 609-267-7950

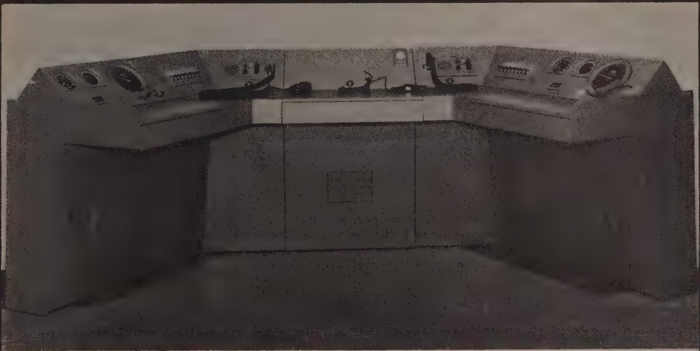
Air Traffic Radio Channel Control Systems 12 VDC, 24 VDC and 48 VDC,—12 and 24 VDC systems include (shown left to right): Jack Unit—audio unit; w/plug-in microphone amplifier/lamp brightner, recorder monitor, and speaker-headphone amplifier modules, — selector unit w/plug-in selector modules — multipin patch panel extender module (foreground). Flight service station selectors, power supply assemblies and supporting test set also shown on this page.

Power Supply Assemblies: Standard models include 12 VDC, 24 VDC and 48 VDC outputs with input @ 115 VAC 50-60 H_z single phase. (Other in/outputs available on request.)

Module Test Sets designed to facilitate organization, direct and depot maintenance levels. The test set provides in/output signals and measurements required to access module performance, used with 12 and 24V radio channel control equipment.



Flight Service Station Selectors provides standard radio channel control functions plus muting and individual volume control features with emergency and locking select and key switch.



Complete Communications Consoles designed to customer specifications, including: air traffic control — flight service stations — police, fire and maintenance dispatcher positions.

Four and Six Channel Main-Standby Transformer Control and Relay Panels — six channel control panel CP-600 shown. Other basic models include RP-600, SSP-400, and RTP-400. These units available in 12, 24 and 48 VDC.

Microphone, Line, Speaker and Mixing Amplifier Assemblies, regulating and non-regulating (6 channel regulating amplifier — AA-6/600B shown)

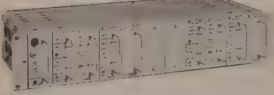
Additional Systems and Equipment:
- Voice frequency signaling and control system (RCAG)
- Voice frequency signaling system (VOR/VORTAC)
- Receiver selector XFMR
- Receiver muting XFMR
- Receiver selector/mixing XFMR
- Radio headset panel
- Receiver selector, 4 channel
- Receiver volume control panel
- Receiver muting panel

G.R.M. CORPORATION - COMPLETE MANUFACTURING SERVICES FOR OEM PROPRIETARY PRODUCTS

COMMUNICATIONS DIVISION RFL Since 1922

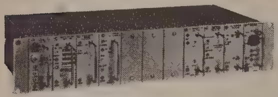
Transmission Terminals For Data, Control, Telephone, Telegraph and Telemetering Applications

AM and FS Voice



The 2056 or 6850 Series single-package design accommodates all tone-channel requirements for any telemetry, control, and telegraphy applications. It permits intermixing AM and FS channels in various combinations of both types of receiver and transmitter. It is available in bandwidths for various speeds of operation. CCITT and Western Electric spacings are also available as standard. Basic modules are common to all applications, with accessory modules providing for special system requirements. All are solid-state, plug-in modules interconnected at the rear of the prewired mounting shelf.

Analog Telemeter



The Model 2203 Variable Frequency Telemeter System operates on an audio FS carrier, modulated at a sub-audio rate of 10 to 30 Hz or by polar current pulsed at 10 to 30 Hz. The modulation frequency is directly proportional to the EMF transmitted and represents the full-scale span of the measured quantity. Received signals are demodulated, and the output voltage or current, which is proportional to the modulated signal, drives potentiometer recorders and DC milliammeters.

Lower frequencies for narrowband transmission and other ranges can be supplied. Any DC input-voltage range of 20mV to 1000mV is standard. Modules for slide-wire operation and for higher input voltages are also available. Output-current span is 2mA standard into 2500 ohms maximum for modulation frequency variation. Outputs up to 50 mA can also be supplied. Accuracies of 1% are guaranteed with a linearity of 0.1%.

The Model 6405 Series High Accuracy Variable Frequency Analog Telemeter System operates at unprecedented accuracies and stability. Typical accuracies, spanning 10 to 30Hz, −2.5 to 0 to +2.5V at 25°C, are 0.02% full span for the transmitter; 0.02% full scale for the receiver. Long-term drift, in six months after 100 hours initial operation, is 0.1% full span for the transmitter; 0.25% full scale for the receiver.

DC voltages or currents are converted into squarewave, sub-audio frequencies for FSK transmission over wire-line, radio-microwave, or carrier-telephone facilities. Interface compatibility covers positive neutral, HTL, CMOS, EIA, DTL/TTL, negative neutral, and dry contact. Squarewaves are reconverted into proportional DC voltages or currents to drive such devices as recorders, indicators, and analog-to-digital converters.

Frequencies may be specified from 5 to 40Hz, calibrated linearly with input voltage requirements between 10mV and 10V.

Data

There is a complete line of RFL Data Modems with rates up to 2400 bps. The modems are usable for all computer, data terminal, and time-sharing operations. Bell compatible modems are available.

Modems for either direct-hardware or acoustical coupling provide interfaces for TTY Models 28, 33, or 35, and operate over two-wire circuits such as a DDD network; or over four-wire circuits such as leased dedicated lines. PC card modems are compact, Originate-Only or Answer-Only units for OEM applications. They operate full duplex and are strappable for half-duplex operation. Digital interfaces for EIA, CCITT, TTL, DTL, and teletype are available.

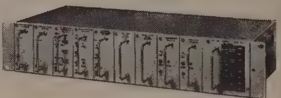
The 6850 Series Voice Frequency Carrier Telegraph (VFCT) provides for a wide variety of data transmission requirements including telegraph, data, speech-plus-data, supervisory control, and alarm. Versatility in chassis arrangement allows for 19-inch rack mounting, single-channel enclosure, or multiple chassis arrangements of twenty-four or more channels; flexibility in digital interfaces provides for either neutral or polar telegraph loops, low-level polar (EIA/CCITT) positive or negative logic, TTL, DTL or CMOS digital interfaces.

Digital Telemeter System

The Model 6291 Digital Telemetry System uses digital logic to monitor and telemeter any information on system status or environmental conditions that can be transduced electrically. It continuously senses, measures, and displays up to eight channels of data on each of up to 19 remote stations, alarming when any parameters are out of preset limits. All remote stations are selectively monitored through one master station, without a computer, by only one operator in attendance. Accuracy of measurement is better than ½% with 3 digit readout.

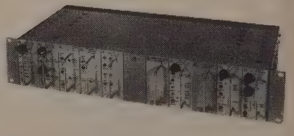
The master repeats all alarms automatically and all displays at command. Readouts are sequential, concurrent, and identical in three digits of applicable units for pinpoint isolation, rapid diagnosis, and immediate correction of all undesirable conditions.

SSB Voice



The Model 2710 SSB Terminal provides single-sideband transmission of voice and data in microwave, static and power line, and radio baseband applications. Two basic configurations are available: 14 channels in the spectrum of 4-60Hz; 12 channels in the spectrum of 60-108Hz. Channels up to 300 kHz are available by dual translation. Channels may be applied singly or in groups without common equipment. Terminals are easy to maintain, with front-panel test points and controls for monitoring and servicing. Complete power line systems including trap coupling capacitors and telephone exchanges can be provided.

Protective Relaying



The Model 3253 Protective Relaying uses audio FS tones to transmit two-function information, trip and guard. Security against false trips is assured through surveillance circuits in the receive channel, which continuously monitors the receive amplifier. Drops greater than 6dB in either signal level cause the circuit to clamp the receive channel in guard position. Similarly, other circuitry clamps the channel in guard if noise levels in a frequency band increase above a preset level.

The Model 6745 Protective Relaying System offers top performance at two-for-one cost through unique design of dual, FS tone channels. Crystal-controlled oscillators with tracking bandpass filters assure stability with minimum time delay, pure sine-wave, continuous-phase outputs. Redundancy and logic circuitry provide security against false trips due to high noise and single component failures.

Self-contained high-pass filters prevent 50-60Hz currents induced on a phone line from overloading system circuits. A signal of −30dBm remains undistorted and unsuppressed even with 40 volts of 60Hz power induced on the line. Advanced design provides dynamic range of 20dB; in-band noise detection; trip-up/trip-down frequency-shift coding; guard-before-trip logic; trip-hold timer; optically isolated transistor-trip input and output; and only three controls to adjust. Trip boost of 10dB is available through strapping options where lines permit.

RFL Industries, Inc.

Communication Div., Boonton, N.J. 07005
Tel: 201-334-3100 / TWX: 710-987-8352
CABLE: RADAIRCO, N.J.

communications

A COMPLETE LINE OF COMPONENTS FOR DATA COMMUNICATIONS SYSTEMS

LINE CONDITIONING & INTERFACE DEVICES

- **C-303** • Dual strappable 0 to 31.75 DB 600 ohm pads
- **C-311** • 600 ohm in/out 30 DB data grade line amplifier
- **C-312** • 2W, 600/10K input speaker amplifier
- **C-314-XX** • Balanced & isolated summing amplifier up to 10 ports
- **C-315-XX** • Balanced & isolated distribution amplifier up to 10 ports

ALARMS — TELETYPE & CARRIER FAULT

- **C-351** • 45 to 200 Baud distortion/open line alarm
- **C-353** • Dual carrier detector/alarm
- **C-354** • Hi/Lo carrier alarm, detects out of tolerance data levels

INTERFACE

- **C-362** • EIA to TTY convertor 20 or 60 ma, two to four wire option
- **C-366** • Neutral to polar, polar to neutral convertor
- **C-368** • Automatic loop current regulator 20ma polar nominal
- **C-369** • Automatic loop current regulator 60ma nominal

CONTROLS & SIGNALLING

- **C-324** • Touch Tone® receiver
- **C-325** • BCD—dial pulse convertor
- **C-370** • Remote supervisory indicator

TELETYPE

- **C-403** • Keyboard programmable automatic answer back
- **C-411** • Regenerative selector magnet driver
- **C-414** • Xtal controlled regenerator
- **C-420** • Hubbing repeater, universal
- **C-431** • Repretory dialer
- **C-440** • Selective calling unit
- **C-470** • Universal bridging monitor interface

COMPUTER INTERFACE

- **C-181** • IBM Selectric interface

TEST EQUIPMENT & SYSTEMS

- **C-391A** • Test message generator
- **C-395** • Line monitor driver (ASCII to Hex translator

CUSTOM DESIGNED & FABRICATED TECHNICAL OPERATIONS CENTERS FOR COMMERCIAL & COMMON CARRIER APPLICATIONS

- TELEPHONE
- TELETYPE
- DATA
- COMPUTER

MODULAR MODEM CHANGE OVER SWITCHES FOR COMPUTER SYSTEMS

RE-EL CIRCUITS INC.

520 VICTOR STREET, SADDLE BROOK, NEW JERSEY TELEPHONE (201) 843-3738

PRODUCTS FOR COMMUNICATION

TRANSMAGNETICS, INC.

210 ADAMS BOULEVARD, FARMINGDALE, NEW YORK 11735
PHONE NO: 516 293-3100 TWX510-224-6420

SOLID STATE SYNCHRO/RESOLVER CONVERTERS

	Input Availability	Output	Static Accuracy	Size
TRACKING SYNCHRO/RESOLVER TO DIGITAL. Series 1651: Miniaturized, fully isolated unit tracks 1440°/Second.	Freq.: 50Hz to 10KHz L-L V_{RMS}: 5 to 90 Ref. V_{RMS}: 10 to 115	14 bits binary parallel TTL, DTL compatible.	±4′	3.125″ x 2.625″ x 0.82″
14 BIT SYNCHRO/RESOLVER TO DIGITAL. Series 1623E: Includes ±5° offset capability. Miniaturized, solid state unit that converts synchro or resolver inputs into binary, BCD or **Both**. Can accept FLUX VALVE inputs.	Freq.: 50Hz to 10KHz L-L V_{RMS}: 5 to 90 Ref. V_{RMS}: 10 to 115	14 bit parallel binary 4 decade BCD, or **Both**. TTL, DTL compatible.	±4′	3.125″ x 2.625″ x 0.82″
ANGLE POSITION INDICATOR, SOLID STATE. Series 2623: Includes ±5° offset capability. Rugged, compact, accurate and economical. Adj. brightness, BDC output available at connector. With or without built-in power supplies. Internal reference available.	Freq.: 50Hz to 10KHz L-L V_{RMS}: 5 to 90 Ref. V_{RMS}: 10 to 115	Readout 359.9, ± 179.9 or 9999. Others available 4 decade BCD avail. at rear connector.	±0.1°	5.5″ x 1.75″ x 5.5″ deep
SYNCHRO/RESOLVER TO LINEAR DC. Series E678-1637: Converts all standard synchro or resolver inputs to linear DC output proportional to the angle. Switching point is non-ambiguous. All models are short circuit proof.	Freq.: 50Hz to 10KHz L-L V_{RMS}: 5 to 90 Ref. V_{RMS}: 10 to 115	**E678:** ±10VDC for angles −180° to +180° **1637:** ±10VDC for angles −89.5° to +89.5°. Other formats available.	6′, 15′, 30′ or 1°	**E678:** 3.625″ x 3.06″ x 0.82″ **1637:** 2.53″ x 3.22″ x 0.82″
SYNCHRO/RESOLVER TO SINE-COSINE DC. Series 655/697: Generates sine and cosine DC outputs proportional to the angle.	Freq.: 60 or 400Hz L-L V_{RMS}: 11.8 or 90 Ref. V_{RMS}: 26 to 115	−10 volts to +10VDC, representing the sine and cosine of the input angle.	±6′	**400Hz:** 1.85″ x .85″ x .82″ **60Hz:** 3.1″ x 1.5″ x .98″
SYNCHRO/RESOLVER TO SINE-COSINE DC (non-variant). Series 655NV: Generates sine and cosine DC outputs proportional to the input angle. Insensitive to synchro reference and line voltage variations.	Freq.: 60 or 400Hz L-L V_{RMS}: 11.8 or 90 Ref. V_{RMS}: 26 or 115	−10 volts to +10VDC, representing the sine and cosine of the input angle.	±6′	3.44″ x 3.19″ x 0.82″
SYNCHRO TO SINE/COSINE DIGITAL. Series 655 NVD:	Freq.: 60 or 400Hz L-L V_{RMS}: 11.8 or 90 Ref. V_{RMS}: 26 or 115	14 lines sine and cosine plus quadrant signs.	5′	PC: 4.5″ x 8″ x 1″
SINE-COSINE TO SYNCHRO DRIVERS. Series B676: Solid state device designed to handle large current surges of TR's. Will drive three 11TR4s to a low null. Overload and short circuit protected.	±10VDC, representing the sine and cosine of the required angle.	L-L V_{RMS}: 11.8 or 90 Ref. V_{RMS}: 26 or 115 Freq.: 60Hz or 400Hz	±10′	P.C. 4.5″ x 8.0″ x 1″
LINEAR DC TO SINE-COSINE DC. Series C670: Converts a D.C. voltage, representing an angle, into two output voltages that are proportional to the sine and cosine of that angle.	±10VDC representing angles from −180° to +180°.	K sin θ and K cos θ K = 10VDC	±10′	3.44″ x 3.19″ x 0.82″
COORDINATE ROTATOR. Series A689: Accepts rectangular inputs (X and Y) and rotates these coordinates through an angle that is proportional to a linear DC input.	$X = R\cos\theta$ $Y = R\sin\theta$ R = ±20 MV to ±10 VDC	$R\sin(\theta+\beta)$ $R\cos(\theta+\beta)$	±10′	3.19″ x 3.44″ x 0.82″
POLAR TO RECTANGULAR. Series A1618: Converts polar coordinates (R, θ) into rectangular (X, Y).	R: ±10VDC θ: ±10VDC	$X = R\cos\theta$ $Y = R\sin\theta$ R = ±20 MV to ±10VDC	±10′	3.19″ x 3.44″ x 0.82″
RECTANGULAR TO POLAR. Series 695: Converts rectangular coordinates (X, Y) into polar (R, θ). Switching point is non-ambiguous.	$X = R\cos\theta$ $Y = R\sin\theta$	$R = \sqrt{X^2 + Y^2}$ $\theta = \tan^{-1}\frac{Y}{X}$	±10′	3.19″ x 3.44″ x 1.78″
DIGITAL-TO-SYNCHRO/RESOLVER. Series 1673: Miniaturized, 2 watts, short circuit proof output.	14 bits parallel, positive Logic, TTL levels binary coded angle.	Synchro or Resolver Freq.: 50Hz to 10KHz L-L V_{RMS}: 5 to 90 Ref.: V_{RMS}: 10 to 115	±4′	3.125″ x 2.625″ x 0.82″
DIGITAL TO SYNCHRO/RESOLVER. Series A1670: High power, solid state device converts a 14 bit digital input into either a 3 wire synchro or 4 wire resolver output. Overload and short circuit protected.	14 bit input representing angles from 0 to 360°.	L-L V_{RMS}: 11.8 or 90 Ref. V_{RMS}: 26 or 115 Freq.: 60Hz or 400Hz	±4′	P.C. 4.5″ x 8″ x 1.0″
ACP TO SINE/COSINE DC (non-variant). Series ACP:	4096 ACP & 1 ARP	±10VDC, representing the sine and cosine of the input angle.	±5′	PC: 4.5″ x 8″ x 1″
DIGITAL TO SINE COSINE DIGITAL. Series 1500:	14 lines representing angles 0 to 360°.	12 bits sine and cosine, also quadrant sign.	±2′	3.0″ x 4″ x 0.4″
DIGITAL TO SINE COSINE DC (non-variant). Series 1501:	14 lines representing angles 0 to 360°.	±10VDC, representing the sine and cosine of the input angle.	±2′ or ±10′	3.125″ x 2.625″ x 0.82″
CONTROL TRANSFORMER, SOLID STATE. Series 1682: Fully transformer isolated unit.	Synchro and 14 bits Natural parallel binary.	±5 volts AC ±12.5°	±4′	3.125″ x 2.625″ x 0.82″
CONTROL DIFFERENTIAL TRANSMITTER, SOLID STATE. Series 1681:	Synchro and 14 bit Natural parallel binary.	6.5 V_{RMS} Sine/Cosine	±4′	3.125″ x 2.625″ x 0.82″
MULTIPLEXED SYNCHRO-TO-DIGITAL. Series MUX: Simple, noise immune, small and inexpensive Modular system, up to 128 channels.	Any combination of Synchros and Resolvers.	14 bits binary parallel 70 μs conversion.	±4′	3.125″ x 2.625″ x 0.82″ + 1.85″ x 0.85″ x 0.82″ per channel
TWO SPEED SYNCHRO-TO-DIGITAL. Accepts either binary or nonbinary gear Ratios from a two speed synchro system.	Freq.: 50Hz to 10KHz L-L V_{RMS}: 5 to 90 Ref. V_{RMS}: 10 to 115	Up to 19 bits binary parallel.		3.125″ x 2.625″ x 0.82″
COMPUTING DEMODULATORS. Series 840, 854: Fully isolated. Proportional phase-sensitive bipolar output.	840: 0 to 5V_{RMS} 854: 0 to 20 V_{RMS} Freq.: 400Hz or 60Hz	0 to ±4.3VDC 0 to ±10VDC	0.1% 0.1%	**840:** 1.63″ x 1.0″ x 1.0″ **854:** 1.63″ x 1.0″ x 1.0″
COMPUTING MODULATORS. Series 1102MP4: Converts DC to proportional Sine wave AC.	±10VDC	0 to 6V_{RMS}	0.1%	2.28″ x 2.03″ x 0.78″

Other frequencies and voltages available. Units available for either 0 to +70°C or −55°C to +85°C operation. Most units are hermetically sealed for extra protection.

TRANSMAGNETICS, INC.

210 ADAMS BOULEVARD, FARMINGDALE, NEW YORK 11735
PHONE NO: 516 293-3100 TWX510-224-6420

TRANSMAGNETICS INC
MODEL- C670

C670 SOLID STATE COMPUTING MODULES

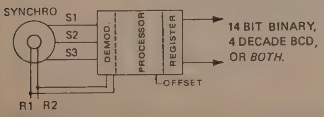
FEATURES:

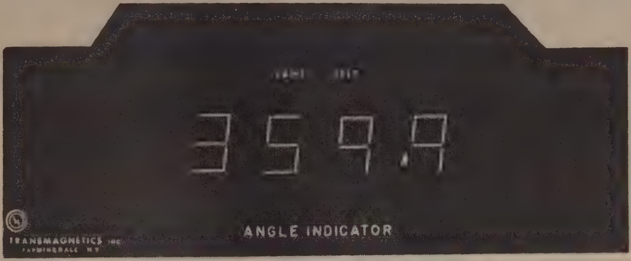
- No calibration, adjustments or warmup.
- Ultra reliable.
- Infinite resolution.
- Factory repairable, hermetically sealed for total protection.
- Designed for P.C. board mounting.
- All models are short circuit proof.
- Meets MIL-STD-202C.

TRANSMAGNETICS INC
FARMINGDALE NEW YORK
MODEL-

SERIES 1623F MINIATURE 14 BIT SYNCHRO or RESOLVER TO DIGITAL CONVERTERS

WITH INTEGRAL ±5° OFFSET CAPABILITY

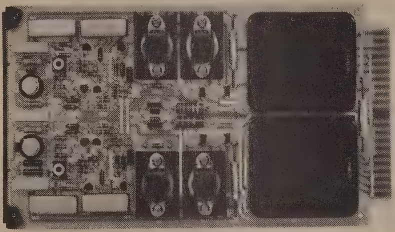

SYNCHRO
S1
S2
S3
DEMOD.
PROCESSOR
REGISTER
14 BIT BINARY,
4 DECADE BCD,
OR BOTH.
OFFSET
R1
R2

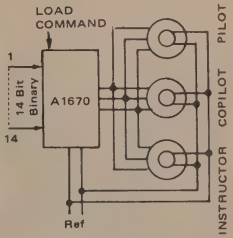

359.9
ANGLE INDICATOR
TRANSMAGNETICS INC
FARMINGDALE N.Y.

SOLID STATE ANGLE POSITION INDICATORS

FEATURES:

- ±0.1° accuracy, total worst case error.
- 2.5 msec. step response for 360° change.
- 120° distortion and glare-free viewing.
- LED or Incandescent readouts.
- Direct Sunlight viewable.
- Readouts replaceable from front.
- Front panel lamp test.
- Only 1¾"H X 5½"W panel space.
- One piece mounting.
- No calibration, adjustments or warmup.
- Internal reference available.
- Leading zero blanking.
- Display dimming.
- Rugged Military Style Connector.
- Humidity proof models available.




LOAD
COMMAND
1
14 Bit
Binary
14
A1670
Ref
PILOT
COPILOT
INSTRUCTOR

SERIES A1670 HIGH POWER DIGITAL TO SYNCHRO/RESOLVER CONVERTERS

FEATURES:

- No external buffers or amplifiers required.
- Capable of driving at least three 11TR4a.
- High accuracy and resolution.
- Short circuit proof output.
- DTL and TTL compatible.
- Low output impedance.
- DC isolated synchros.
- No customer adjustments required.
- Code "M" units meet MIL-STD-202C.

TRANSMAGNETICS

COMPLETE SUBSYSTEM CAPABILITY:

Transmagnetics is well equipped to supply completely wire, rack mounted subsystems that include the D/S converters, power supplies, multiplexing control circuits and other customer specified components.

SOLID STATE ELECTRONICS CORP.

15321 RAYEN STREET
SEPULVEDA, CALIFORNIA 91343
(213) 894-2271

SOLID STATE MODULES

VOLTAGE CONTROLLED OSCILLATORS • FREQUENCY MULTIPLEXERS FM DISCRIMINATORS • FREQUENCY-TO-DC CONVERTERS • OSCILLATORS AMPLIFIERS • PHASE DETECTORS • DC SIGNAL ISOLATORS • INDUSTRIAL APPLICATIONS ANALOG-TO-DIGITAL CONVERTERS • CHOPPERS & ANALOG SWITCHES TELEMETERING, SIGNAL CONDITIONING, DATA ACQUISITION & PROCESSING SPACE, AIRBORNE, MILITARY, GROUND SUPPORT

solid state
electronics co.
MODEL 440
FREQMETER
TM
Sepulveda
Calif.

FIG. 1

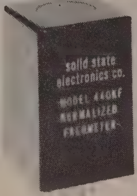


FIG. 2

FIG. 5

FIG. 7

FIG. 4

FIG. 6

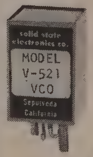


FIG. 8

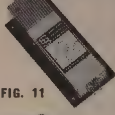


FIG. 11

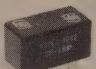


FIG. 9

KILOCYCLES/SECOND

FIG. 3

FIG. 10

OTHER PRODUCTS — SEE EEM SECTION 4500

FREQMETERS, DISCRIMINATORS, PHASEMETERS

Solid state frequency-to-dc converters and discriminators will linearly convert frequency or repetition rate of signals to a proportional dc output. Waveforms can be sine, square, sawtooth or triangular. Standard models are available to cover a wide range from zero to 300 kcps. Expanded scale, differential frequency, under/over frequency and phase detectors are available (meter, meter relay and relay types are also available).

Only the Models 400 to 440 Freqmeters are basic f-dc converters, the output being proportional to the product of frequency and peak input voltage. The 410KF to 440KF are solely frequency dependent (independent of peak input voltage). 450KF to 480KF units require lower drive (millivolts). Series 200VFV are precision F-V or V-F converters.

The 486E is an expanded scale Freqmeter while the 491ME is a mirrored-scale visual panel meter version. The 411 and 421 units are difference Freqmeters. The 401 series FM discriminators are for IRIG channel telemetering. The 471 is a Hi-Lo pass frequency sensitive relay suitable for under/over frequency and speed detection and control.

The 791 Phasemeter is a phase-to-voltage converter. These units have been designed for applications where stability, ruggedness, long life, efficiency and freedom from maintenance are prime requisites. Miniature, stable and rugged designs make these units ideal for military, aerospace, industrial and portable applications. The 801 provides an output frequency that is the absolute difference between 2 input frequencies.

Model-Series	Type	INPUT			OUTPUT						SUPPLY		ENVIRONMENTAL				MECHANICAL		
		Freq. kcps	Volts pk-pk	Z kΩ	Volts DC	Ripple %	Drift %/°C	Z kΩ	Resp. msec	Linear %	V Volt	I ma	Temp. °C	Shock G	Vib. G	Acc. G	Size inches	Wt. grams	Fig.
200VFV	Precision F-V	0-100	10	20	0-±10	0.1	0.0001	0.0001	0.5	0.005	±15	±25	−55 to +85	1K	50	1K	2x2x.5	50	9
400FV	Hi Accuracy F-V	0-100	2-18	40	0-5	1	.005	10	500-0.5	.05	+28	25	−55 to +80	1K	100	1K	1.3x1.3x1.8	115	8
410	Basic Freqmeter	0-0.1	5-18	2	0-5	2	.01	10	500	0.5	−28	1	−55 to +85	5K	100	5K	2x.88 Dia.	60	1
420	Basic Freqmeter	0-1	5-18	2	0-5	2	.01	10	50	0.5	−28	1	−55 to +85	5K	100	5K	1.3x.88 Dia.	38	1
430	Basic Freqmeter	0-10	5-18	2	0-5	2	.01	10	5	0.5	−28	1	−55 to +85	5K	100	5K	1.3x.88 Dia.	38	1
440	Basic Freqmeter	0-100	5-18	2	0-5	2	.01	10	0.5	0.5	−28	1	−55 to +85	5K	100	5K	1x.88 Dia.	30	1
410KF	Normal Freqmeter	0-0.1	2-18	40	0-5	2	.01	10	500	1.0	+28	25	−55 to +80	1K	100	1K	.9x.9x1.3	100	2
420KF	Normal Freqmeter	0-1	2-18	40	0-5	2	.01	10	50	1.0	+28	25	−55 to +80	1K	100	1K	.9x.9x1.3	100	2
430KF	Normal Freqmeter	0-10	2-18	40	0-5	2	.01	10	5	1.0	+28	25	−55 to +80	1K	100	1K	.9x.9x1.3	100	2
440KF	Normal Freqmeter	0-100	2-18	40	0-5	2	.01	10	0.5	1.0	+28	25	−55 to +80	1K	100	1K	.9x.9x1.3	100	2
450KF	Hi Sens Freqmeter	0-0.1	.02-2	1 & 40	0-5	1	.01	10	500	1.0	+28	25	0 to +70	1K	100	1K	.9x.9x1.3	100	2
460KF	Hi Sens Freqmeter	0-1	.02-2	1 & 40	0-5	1	.01	10	50	1.0	+28	25	0 to +70	1K	100	1K	.9x.9x1.3	100	2
470KF	Hi Sens Freqmeter	0-10	.02-2	1 & 40	0-5	1	.01	10	5	1.0	+28	25	0 to +70	1K	100	1K	.9x.9x1.3	100	2
480KF	Hi Sens Freqmeter	0-100	.02-2	1 & 40	0-5	1	.01	10	0.5	1.0	+28	25	0 to +70	1K	100	1K	.9x.9x1.3	100	2
486E	Expanded Freqmeter	.01-300	5-10	40	±5	1	.01	0.1	—	1.0	±15	±25	0 to +70	100	30	200	2.8x2.4x3.8	500	5
490	Differential Freqmeter	0-100	1-20	40	±5	1	0.3	10	0.5	1.0	±15	±35	−20 to +70	50	10	100	2x2.3x3.1	500	5
491ME	Visual Discriminator	.01-300	5-10	40	±5	0	.05	—	—	1.0	+28	40	+10 to +40	—	—	—	4x4.6x4	450	3
411	Differential Freqmeter	.05-50	5-10	0.6	0-5	1	.01	—	500	1.0	±28	25	−55 to +80	50	25	100	1.3x1.3x1.8	115	8
421	Differential Freqmeter	.05-50	5-10	0.6	0-5	1	.01	—	50	1.0	±28	25	−55 to +80	50	25	100	1.3x1.3x1.8	115	8
401	IRIG Discriminator	0.4-80	8-28	50	±5	1	.05	0.1	—	0.5	±15	±75	−55 to +85	50	25	100	2.8x2.4x3.8	500	5
791	Phasemeter	0.3-20	0-10	0.5	±5	1	0.3	3	7	1.0	No	No	−55 to +85	1K	100	1K	.9x.9x1.3	100	2
801	Diff. Freq. Module	.05-50	1-10	0.6	±1	—	—	10	—	—	No	No	−55 to +85	5K	100	5K	.9x.9x1.3	100	2

OSCILLATORS, CONVERTERS, SIGNAL ISOLATORS RELAYS, CHOPPERS, TRANSDUCERS, SUPPLIES

Solid state oscillators and converters are available in many types (MIL-SPEC too). The S-310 is tuneable. Series 300VF Voltage-to-Frequency converters change analog signals to frequency and are matched to our Series 400KF Freqmeters. Series 200VFV are precision F-V or V-F converters. The V-511, MV-515 (20 millivolt input) Voltage Controlled Oscillators (VCO) are designed for IRIG FM telemetering. The V-521 is a micro-version of the V-511 (without bandpass filter). The PCXO-116 is crystal controlled and programmable to 13 frequencies. Use the MA531 to mix several VCO channels. The DCI-177 isolates DC signals eliminating grounding and supply isolation problems with common mode signal rejection.

Model-Series	Type	INPUT		OUTPUT						SUPPLY		ENVIRONMENTAL				MECHANICAL		
		Volts	Z MΩ	Freq. kcps	Wave Form	Volts Min.	Load kΩ	Drift %/°C	Accuracy %	V Volt	I ma	Temp. °C	Shock G	Vib. G	Acc. G	Size inches	Wt. grams	Fig.
200VFV	Precision V-F	0 to ±10	.05	0-100	sin/sq	+15	TTL	.0001	0.005	±15	±25	−55 to +85	1K	50	1K	2x2x.5	50	9
S-310	RC Fix Tuned Oscillator	—	—	.025-1000	sin/sq	1Vrms	100	0.01	0.25	28	7	−20 to +80	500	35	700	1.06x2.25x1.65	50	6
PCXO-116	Xtal Osc. Programmable	—	—	0-1000	square	+2.4	TTL	.001	.001	±5	±11	0 to +70	—	—	—	0.50x0.95x0.47	8	9
310VF	Volt-to-Freq. Converter	0-10	15	0-0.1	pulse	10Vp-p	10	0.05	1	±10	±20	0 to +50	250	25	500	1.31x1.31x1.75	100	5
320VF	Volt-to-Freq. Converter	0-10	15	0-1	pulse	10Vp-p	10	0.05	1	±10	±20	0 to +50	250	25	500	1.31x1.31x1.75	100	5
330VF	Volt-to-Freq. Converter	0-10	15	0-10	pulse	10Vp-p	10	0.05	1	±10	±20	0 to +50	250	25	500	1.31x1.31x1.75	100	5
340VF	Volt-to-Freq. Converter	0-10	15	0-100	pulse	10Vp-p	10	0.05	1	±10	±20	0 to +50	250	25	500	1.31x1.31x1.75	100	5
400VF	Hi Accuracy V-F	0-10	15	0-100	pulse	10Vp-p	10	.01	.25	±10	±20	0 to +50	250	25	500	1.31x1.31x1.75	100	5
V-511	Volt Controlled Oscillator	0-5	0.1	0.3-1000	sine	2Vrms	100	0.003	0.25	+28	7	0 to +80	125	25	200	1.06x2.25x1.66	50	6
MV-515	Volt Controlled Oscillator	0-0.2	0.1	0.3-12	sine	2Vrms	100	0.003	1	±28	±25	0 to +85	125	25	200	1.06x2.25x1.66	50	6
V-521	Volt Controlled Oscillator	0-5	0.1	0.3-12	square	2Vp-p	10	0.003	0.50	+28	+10	0 to +71	500	50	1000	0.75x0.75x1.13	20	8
MA531	Mixer Amplifier	0 to 1	0.1	800	—	2	1	0.02	0.1	28	15	0 to +75	200	30	500	1.06x2.25x1.66	50	6
DCI-177	DC Signal Isolator	0 to ±5	5	0.5	dc	±10	10	0.01	1	28	50	55 to +85	1000	25	500	1.31x1.31x1.75	100	5
DC-2005	Pressure Transducer	PSI	—	—	—	5	10	.04	0.5	28	15	−55 to +100	300	15	300	1.71x2.63x5.25	680	11
NS8000A	Chopper, Xfmr Drive	1-10	.0002	0-1500	square	±10	10	.0001	.001	—	—	−55 to +100	10000	100	5000	0.45x.325 Dia.	2	4
33	Chopper-Relay	±6 to ±15	10	0-3000	square	±5	10	.0001	.001	—	—	−65 to +175	1000	25	500	0.70x0.44 Dia.	2	10
98	Relay, Solid State	6-12	.0006	0-5	square	±20	10	.001	.01	—	—	−55 to +100	1000	25	500	0.84x0.84x0.75	12	9
8001	Relay, Reed	3	.0002	—	—	±28	56	—	—	—	—	−55 to +125	50	25	50	0.90x0.25 Dia.	2	10

Phone, wire or write for specifications and application literature describing above units or consult your microfilm files (VSMF or Thomas Supplementary)

SOLID STATE ELECTRONICS 15321 Rayen Street, Sepulveda, California 91343 • (213) 894-2271

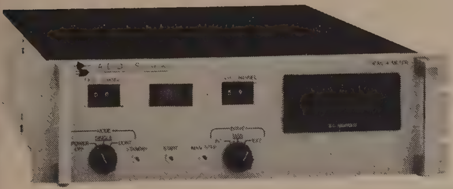
ANALOG DIGITAL DATA SYSTEMS, INC.

830 LINDEN AVENUE • ROCHESTER, N. Y. 14625 • PHONE 716 - 381-2370

DATA ACQUISITION SYSTEMS

DATALOGGING SYSTEMS FROM STOCK UNITS. ASSEMBLED TO CUSTOM REQUIREMENTS

The Dataloggers accept multiple analog signals, from physical transducers, such as thermocouples, strain gauges, and similar devices. These are scanned by a multiplexer and programmer, individually conditioned to the appropriate voltage level; digitized, converted to computer compatible format and recorded.



SERIES 13 SCAN-A-METER

An economical approach to the measurement of Analog Data for either display or Datalogging. Its modular design gives a large number of options for different types of inputs, expansion channels, and output devices.

SERIES M

This datalogger is available with either 10, 100 or 1000 channel multiplexer capability, digitizing and recording in computer compatible magnetic tape. The tape format can be either straight binary or binary coded decimal, 7 or 9 tracks and 200, 556 or 800 b.p.i. The system speed can be from manual push button to 1000 characters/second asychronous or up to 5000 characters/second in the slew mode.

SERIES P

This datalogger is available as the above, but the output is recorded in computer compatible paper tape, such as ASC11. The system speed is 20 characters/second as standard and up to 130 characters/second as options.

SERIES T

This datalogger is available as the above, but with teletype output. The teletype gives both punched paper tape output in the ASC11 code and also a line printer. The teletype includes a keyboard for manual input data and can be used for computer input. Speed is controlled by the teletype at 10 characters/second.

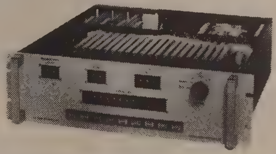
SERIES K

This datalogger is available as above, but with output onto magnetic tape cassettes. The format is compatible with teletype and the cassettes can be read out onto teletype machine or over a datalink to a shared time computer.

MULTIPLEXERS - SERIES - 012

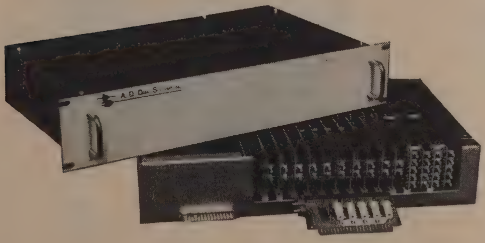
Both reed relay scanners and FET multiplexers from 10 channels to 1000 channels are available as standard. Using a unique modular design, the multiplexers can be built up from a wide range of modules to give 1, 2, 3 or 4 wire switching. Features include low thermal switching, high common mode rejection, switched guard, flying capacitor filtering, and programming.

UNIVERSAL CONTROLLER COUPLERS



These units have been designed to control the overall system and also to serialize parallel data into computer compatible format. The Coupler has plug-in modules to drive output devices such as punched card, paper tape, magnetic tape, teletype and computers. It is also pin board programmable for control functions and computer format, and front panel controls for word length, record length, recycle point and cycle time.

REED RELAY MATRICES



REED RELAY MATRICES

For switching multiple path signals, using reed relays for signal switching and TTL compatible logic for controls.

Each path can be selected in nanoseconds from X, Y and select pulses which latch the control logic and the reed relay switch.

The switched path simulates a 50 ohm impedance coaxial line, terminated in 50 ohm connectors to give minimum signal distortion and crosstalk at frequencies exceeding 10 MHz.

Options include electrical readout of crosspoint selected.

TYPICAL APPLICATIONS

Controlled switching in automatic testing of integrated circuits, printed circuit modules, logic modules.

Routing of R.F. signals, telemetry signals.

Programming video signals.

Computer interface to automatic equipment.

Model 056-003 — 10 x 10 x 1 Matrix with Coax signal connectors.

Model 056-103 — 10 x 10 x 1 Matrix with Coax signal connectors and electrical readout of crosspoint selected.

Model 056-006 — 10 x 10 x 2 Matrix.

Model 056-106 — 10 x 10 x 2 Matrix with crosspoint readout.

Model 056-009 — 10 x 10 x 3 Matrix.

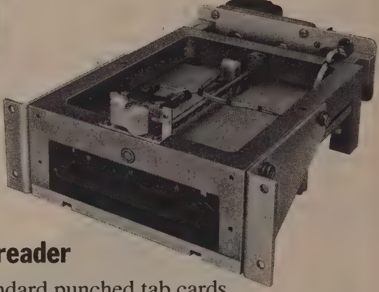
Model 056-109 — 10 x 10 x 3 Matrix with crosspoint readout.

Data entry. AMP fits the product

However you buy them—as complete, ready-to-use units or as individual components—our broad range of data entry products will give you the excellent performance and reliability for which AMP is noted. Typical applications include industrial control and automation, as well as information systems and remote data collection.

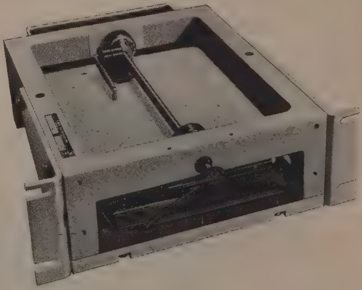
Low-profile magnetic card reader

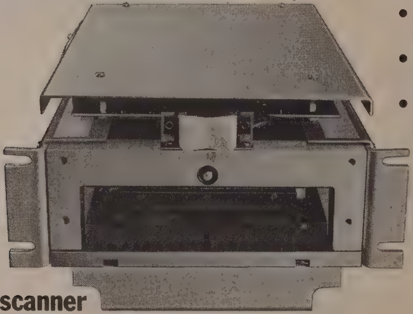
- Simple operation. Cards are inserted and retrieved from same slot.
- Reads ABA track Aiken data at 75 bits/inch.
- No motor required. Mechanical drive eliminates RF generation.
- Low profile. Suitable for use as a stand-alone accessory.
- TTL outputs are compatible with industry standards for design interface.



Tab-card reader

- Reads standard punched tab cards.
- Compact design allows positioning in small panel space.
- Available in bussed-column, matrix and diode-isolated specials.
- Wipe and back-wipe contact operation has high inherent reliability.
- Available in 80-column and 22-column versions—motorized and manually operated.

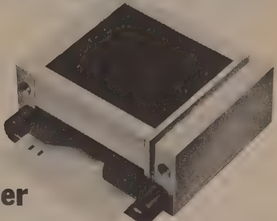




Card reader/scanner

- Senses all 960 hole positions of standard, 80-column card.
- Provides character serial, bit parallel data up to 2000 CPS.
- Offers outputs which are compatible with DTL and TTL.
- Integrated circuitry and solid-state components assure high reliability.
- Equipped with diode-isolated card reader and electronic scanner.

to your application.

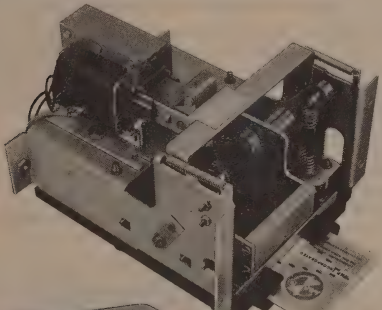


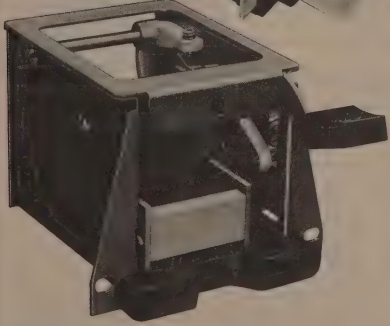
Credit and badge card reader

- Maximum reliability, with proven switch design and a minimum of moving parts.
- Compact, rugged construction. Only two major assemblies for long life in severe environments.
- Low-temperature operation. Suitable for outdoor use to −40° F.
- No external power required. Reader operates with card insertion.
- No maintenance required. Designed to operate throughout life without adjustment or preventive maintenance.

Credit card reader

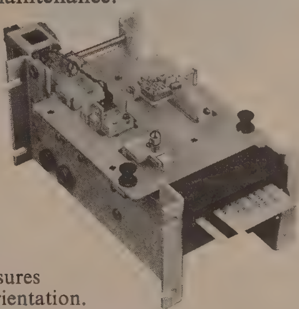
- Reads 15, 20 or 22-column cards.
- Solenoid powered or manually operated versions available.
- Cross matrix available for numeric data, matrix alpha numeric or telephone dial code.





Matrix badge reader

- Reads 10 columns of a 15-column badge; 15 columns of a 20-column badge; and 17 columns of a 22-column badge.
- Small size and low cost adapt to limited space and budget.
- Cross matrix available for numeric data, matrix alpha numeric or telephone dial code.



Magnetic card reader

- Slot design ensures proper card orientation.
- Reads and writes at 210 bits per inch, providing as many as 650 bits across the card.
- Available with dual read head for ABA and IATA tracks.
- Designed for convenient behind-panel mounting.
- Card is returned or captured at users option.

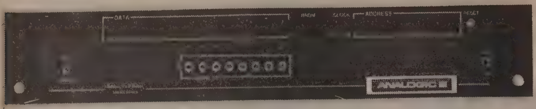
For further information on data entry products call 717-367-1105 or write AMP Capitron Division, Elizabethtown, Pa. 17022.

AMP
INCORPORATED

AMP is a trademark of AMP Incorporated.

COMPLETE DATA ACQUISITION AND CONVERSION SYSTEMS

SERIES AN5400


DATA
ADDRESS
RESET
ANALOGIC

Introducing 12 Important User Features That Guarantee a Better Structured, Better Performing Overall System.

The AN5400 is a multi-channel, analog-to-digital/digital-to-analog data conversion system featuring the uncommon flexibility to handle intermixed high and low level signals — expanded to a virtually unlimited number of channels and providing a generous range of resolutions and speeds.

The system may be field expanded by simply inserting standard Analogic printed circuit cards into sockets provided on the motherboard — or even further by the addition of up to 16 expansion enclosures! The user may select and mix input cards providing *full scale* ranges from 10mVolts to 1000 Volts, or more, single-ended and differential input channels and filters or D/A converters.

Super-Versatile Connectivity

The AN5400 enclosure motherboard accepts up to 18 PC card subsystem modules that connect via rear card edge connectors with the outside world — 16 cards for input and output functions and 2 for computer interface. The motherboard also accepts up to 14 additional cards necessary for address control, functional control and the analog to digital conversion chain — signal conditioning, sample and hold and A/D conversion.

Design Advantages

1. Arbitrarily mixed input/output capabilities — one AN5400 system accommodates all data conversion requirements of a total system.
2. Digital I/O structure accommodates interfaces with all common computers via programmed I/O or DMA — optimized overall system efficiency.
3. True industrial low level capability — can meet NEMA 2500 volt fault protection standards.
4. Highest density — up to 512 A/D channels in a single 5¼" high enclosure.
5. Expansion to systems with up to 8192 channels.

Design Features

Compatibility

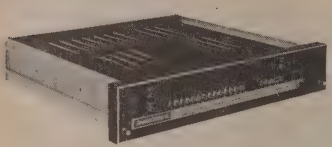
The system is designed to accommodate Analogic's full spectrum of conversion products — A/D's, D/A, Mux's, amplifiers, sample and holds.

Address and Control Structure

Independent address registers for input and output functions provide the capability for

- up to 8192 input channels
- up to 512 output channels
- "full duplex" operation of input and output functions simultaneously
- independent random or sequential operation of inputs and outputs
- selectable display of either address register.

SERIES AN5800



Completely self-contained, wide range of applications, low cost, and proven reliability.

The Series AN5800 family of low-cost modular systems is ideal for data conversion applications — from simple MUX/Buffer/ADC combinations to elaborate A/D-D/A interfaces under computer control. True plug-to-plug compatibility is provided for the standard minicomputer specified. A universal motherboard provides space and interwiring for all the variations and capacities implicit in the general system diagram shown below.

The performance of every AN5800 system is verified by a comprehensive set of computer-programmed test routines, in which every channel, range, level, and functional mode is exercised definitively — validating all key specifications, including accuracy, linearity, monotonicity, and noise. This test program makes it possible to guarantee system performance that is significantly better than that predictable by summing the uncertainties of the individual modules.

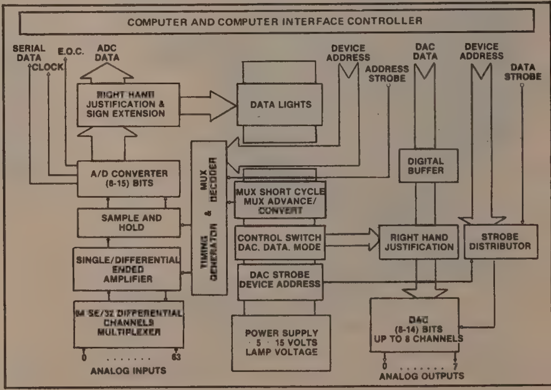
Selected Specifications

Converter resolution — from 8 to 15 bits
Throughput rates — to 200kHz
Differential Systems — CMR 86dB typical @ 60Hz
Crosstalk — 74 dB typical rejection at 1kHz under worse case excitation.
Sample and Hold Aperture plus delay — 40nsec max, ±10nsec uncertainty.

Standard Minicomputer Interfaces

The 5800 interfaces to most minicomputers by means of an interface control card and simple cable connections to a buffered I/O in the computer.

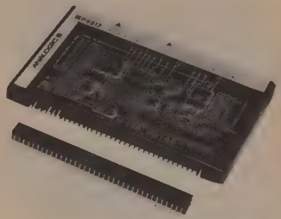
A/D Converter and Recommended Sample & Hold	Throughput Rate in Khz	Overall Accuracy ±%FSR ±1/2LSB
AN2010/AN240	41	.06
2012/240	31	.025
2110/270	200	.05
2112/270	140	.02
2412/240	22	.035
2814/250	10.5	.02
2912/270	100	.025
2914/270	43	.015
2715/270	40	.015
2716/270	38	.015


COMPUTER AND COMPUTER INTERFACE CONTROLLER
SERIAL DATA
CLOCK
E.O.C.
ADC DATA
RIGHT HAND JUSTIFICATION & SIGN EXTENSION
DATA LIGHTS
DEVICE ADDRESS
ADDRESS STROBE
DAC DATA
DEVICE ADDRESS
DATA STROBE
A/D CONVERTER (8-15) BITS
TIMING GENERATOR & MUX DECODER
DIGITAL BUFFER
MUX SHORT CYCLE MUX ADVANCE/ CONVERT
SAMPLE AND HOLD
CONTROL SWITCH DAC. DATA. MODE
RIGHT HAND JUSTIFICATION
STROBE DISTRIBUTOR
SINGLE/DIFFERENTIAL ENDED AMPLIFIER
DAC STROBE DEVICE ADDRESS
64 SE/32 DIFFERENTIAL CHANNELS MULTIPLEXER
0 63
ANALOG INPUTS
POWER SUPPLY ·5 · 15 VOLTS LAMP VOLTAGE
DAC (8-14) BITS UP TO 8 CHANNELS
0 7
ANALOG OUTPUTS

ANALOGIC® Audubon Road ■ Wakefield, Massachusetts 01880 ■ Tel. (617) 246-0300

COMPLETE SUBMINIATURE HIGH SPEED DATA ACQUISITION SYSTEMS

SERIES MP6912



A SINGLE STANDARD PACKAGE— Offering Key Built-in Features that Make it a Genuinely Powerful Total System — So Small it Fits Where Others Won't.

For use within minicomputers and microprocessor systems, the Analogic MP6912 is the smallest, most versatile, completely self-contained modular 16 channel data acquisition system ever offered to the system designer. Despite its remarkably compact construction, this *plug-in*, PC card mountable system provides all the scanning, signal-conditioning, A/D conversion, and programming/control/timing circuitry required for multi-channel high-speed 12-bit data acquisition.

Outstanding Features

- Lowest powered — requires only 1.6 watts.
- Versatile — pin-selectable control of multiplex address mode, input configuration mode, conversion resolution and timing control.
- A completely integrated sub-system — more consistent, accurate, and dependable than assemblies of individual modules.
- Effective electrostatic and electromagnetic shielding, 6 sides, to minimize noise problems.
- Height only 0.375" — fits 0.5" spacing.
- Very high throughput rates — from 100,000 12-bit muxed, sampled conversions/sec to 480,000 single-channel 4-bit conversion/sec.
- Extreme flexibility of input/output/control/format.

Model	Throughput Speed*	S & H Aperture	Throughput Accuracy	Diff Amp CMRR	FS Ranges**
MP6912 — 100kHz	100kHz	<5 ns	Accuracy ±.025% FSR	70db	±10V, ±5V 0 to +10V
MP6912 — 60kHz	60kHz	<5 ns	Quantization Error ±½ LSB Range TC ±12 ppm/°C	DC to lkHz	0 to +5V ±10,24V, ±5.12V
MP6912 — 30kHz	30kHz	<10 ns	Offset TC ±10ppm		0 to 10.24V 0 to 5.12V

*Based on 12-bit resolution, random or sequential non-overlapped addressing.
**All range standard pin selectable.

The MP6912 Has Everything Your System Needs.

1. Built-in complete 12-bit high-speed successive-approximation A/D converter — excellent stability and linearity.
2. Built-in high-speed sample-hold — low aperture uncertainty, for precise sample timing, optimum accuracy.
3. Built-in premium reference with excitation current regulated.
4. Built-in fast, high stability differential buffer amplifier — high CMRR, high impedance for optimum signal conditioning.
5. Built-in digital-output buffer amplifiers-high fan-out, load-isolated, will drive cables.
6. Built-in 16 channel Multiplexer (optionally expandable) for both single-ended and differential inputs.
7. Built-in address register/control logic.
8. Repairable and field supportable.

EXPANSION MODULES TO INCREASE THE RANGE OF THE MP6912

MP6932 Multiplexer Expansion Module

MP6932
ANALOGIC

Contains 32 channels of single-ended or 16 channels of differential multiplexing — with all associated addressing and logic required for expansion. Up to 16 MP6932 modules can be sub-multiplexed into a single MP6912 system, providing 512 single-ended channels or 256 differential channels.

Selected Specifications

Input current (per channel)	<1 na @25°C: 20 na @60°C
Input impedance	>100 Megohms
Input capacitance	<10 pf for off channel <100pf for on channel exclusive of external capacitance.
Input fault current (power off or mux failure)	Internally limited to 20 ma
Channel to channel offset	<100 µv max. <10 µv typical
Multiplexer gain error	.003%
Multiplexer settling time	<3 µsec <8 µsec in conjunction with MP6912

MP6900 PG

Programmable Gain Amplifier/Auto Zero Amplifier

The MP6900PG provides gains of 1, 2, 4 and 8 — enabling the MP6912 to process signals with amplitudes as low as 1.25 volts full scale. This enhances the full 12-bit resolution capability of the A/D converter with 3 additional bits of dynamic range.

The auto zero feature of the MP6900PG automatically compensates for offsets in the programmable gain amplifier, sample and hold amplifier, and in the differential buffer amplifier of the MP6912.

Selected Specifications

Gain of 1, 2, 4 and 8 are programmed through two binary inputs.

Linearity	±.01%
Gain Accuracy	±.01%
Gain Temperature Coefficient	±5ppm/°C
Offset of Programmable Amplifier	adjustable to 0
Settling time at gain of 1 when connected as specified	5 µsec
Settling time at gain of 8	8 µsec
Allowable external load other than that required for the MP6912 system	2 ma

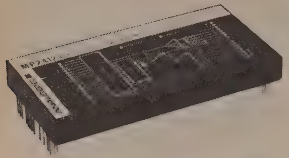
MP6932PG Multiplexer Expander/Programmable Gain Amplifier/Auto Zero Amplifier

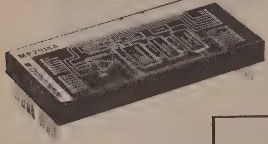
The most comprehensive module in this family of products, the MP6932PG combines multiplexing expansion of 32 single-ended or 16 differential channels with the programmable gain amplifier and the auto zeroing features described above.

Audubon Road ■ Wakefield, Massachusetts 01880 ■ Tel. (617) 246-0300

ANALOGIC®

SUCCESSIVE APPROXIMATION ANALOG-TO-DIGITAL CONVERTERS





DESIGNED FOR EXACT FIT WITH DEMANDING APPLICATIONS

Introduction

Successive approximation type A/D converters are specifically suited to high speed applications. These include multichannel data acquisition systems and conversion of signals with broad band frequency content. Resolutions are available from 8 to 16 binary bits with conversion times from as little as 2 microseconds for 8 bit conversions and 20 microseconds for 16 bit conversions . . . approximately 1000 times faster than integrating type A/D's with comparable resolutions.

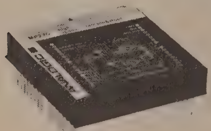
Analogic successive approximation converters feature:

- electrical separation of digital and analog ground for minimization of ground loop-caused errors
- self-contained range and offset adjustments for stable system calibration
- adjustability of integral clock frequency and short cycle capability for best speed/accuracy trade-offs
- pin selectable full scale ranges and output code for versatility and simplicity of ordering and stocking
- built-in buffer amplifier options.

CLASS	TYPE	Resolution		CONVERSION TIME	RELATIVE ACCURACY (of FSR)	Unit Price*
		Binary Bits	Decimal Digits (BCD)			
ECONOMY GENERAL PURPOSE	MP2410	10		20μsec	±0.05%	65(100's)
	MP2412	12		40μsec	±0.012%	75(100's)
HIGH PERFORMANCE GENERAL PURPOSE	MP2010	10		15μsec	±0.05%	159
	MP2012	12	3	24μsec	±0.012%	179
	MP2808	8	2	10μsec	±0.1%	149
	MP2810	10		12μsec	±0.05%	169
	MP2812	12	3	24μsec	±0.012%	199
VERY HIGH SPEED	MP2110	10		5μsec	±0.05%	209
	MP2112	12	3	7μsec	±0.012%	219
	MP2908	8	2	2μsec	±0.1%	295
	MP2910	10		2.5μsec	±0.05%	350
	MP2912	12	3	4μsec	±0.012%	450
HIGH PERFORMANCE GENERAL PURPOSE	MP2813	13		75μsec	±0.005%	250
	MP2814	14		80μsec	±0.005%	295
HIGH RESOLUTION	MP2913A	13		10μsec	±0.005%	510
	MP2914A	14		10μsec	±0.005%	695
ULTRA-HIGH RESOLUTION	AN2715M	15		17μsec	±0.002%	1195
	AN2716M	16		20μsec	±.0015%	1495

*Substantial OEM discounts available

SAMPLE AND HOLD AMPLIFIERS



Features of the Series include:

- low aperture uncertainty
- extremely low feedthrough in the hold mode
- fast acquisition time
- proprietary signal guarded control circuitry to virtually eliminate self-modulation
- storage capacitors selected for minimum dielectric absorption.

Application/ Characteristics	TYPE	Acquisition Time (20V step)	Aperture Uncertainty	Hold Mode Feedthrough	Offset Stability (Hold Mode)
I.C. Unit for Low Cost, High Density	MN245	4 μsec	5nsec nom	-80 dB (with .001 μf hold cap.)	20 μV/°C
Low Cost General Data Acquisition System	MP240	7 μsec (5μs opt.)	1 nsec	-80dB	50 μV/°C
15μV/sec. Droop, high speed	MP250	5 μsec	5nsec nom	-86dB @ 1 mHz	20 μV/°C
High Impedance 15μV/msec. droop	MP255	10 μsec	5nsec nom	-86 dB @ 100kHz	30 μV/°C
Very high speed	MP270	1 μsec	0.2 nsec	-80 dB @ 500 kHz	30 μV/°C

ANALOGIC®

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DUAL SLOPE INTEGRATING ANALOG TO DIGITAL CONVERTERS

A DIFFERENT APPROACH TO SOLVING NEW PROBLEMS

INTRODUCTION

Dual Slope Integrating A/D converters are particularly useful in low to moderate speed applications where moderate to high resolution, excellent differential linearity, inherent noise rejection and monotonicity are required.

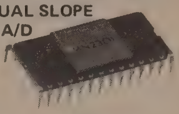
A comparison

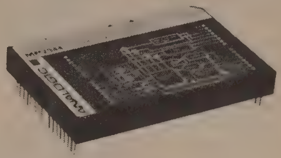
Dual Slope Integrating A/D converters are inherently lower in cost and more reliable than successive approximation converters of equal resolution and accuracy.

Functional Advantages Unique to Many Integrating A/D Converters:

- ☐ Extremely wide dynamic range ratiometric measurements.
- ☐ Total isolation between analog and digital sections.
- ☐ Built-in auto zero for negligible drift and no zero adjustment.
- ☐ Single polarity active reference for bipolar operation, eliminating tracking errors between positive and negative signals.
- ☐ Arithmetic operations and linearization as part of the conversion process.

THE WORLD'S FIRST SINGLE CHIP, AUTO ZERO, DUAL SLOPE INTEGRATING A/D CONVERTER

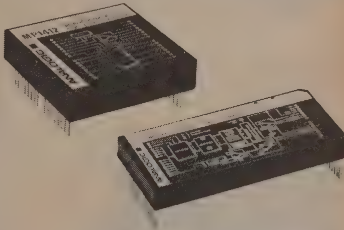




Class	Type	Resolution Binary Bits	 Decimal Digits (BCD)	Signal Integration Time	Relative Accuracy (of FSR)	Unit Price*
Medium Resolution	MN2301	– – –	3½ (plus sign)	100msec nom.	±.05%	$ 24.00 (100's)
	AN2600	12 (incl. sign)	3½ (plus sign)	.3 msec	±0.02%	$129.00
	MP2600	12 (incl. sign)	3½ (plus sign)	.32 msec	±0.02%	$139.00
	AN2313	13 (incl. sign)	3 (plus sign)	5 to 20 msec	±0.05% of rdg.	$199.00
	MP2321	–––	3½ (plus sign)	2 msec	±0.05% of rdg.	$ 99.00
	MP2322	12 (incl. sign)	–––			
High Resolution	AN2317	14 (incl. sign)	4 (plus sign)	41 to 50 msec	±0.005% of rdg.	$249.00
	MP2344	16	4¾ (plus sign)	16-2/3 msec to 100 msec	±1/2 LSB	$200.00

*Substantial OEM discounts are available.

DIGITAL TO ANALOG CONVERTERS



Class	Type	RESOLUTION Binary Bits	MAX. SETTLING TIME (to <½ LSB) (Voltage Mode)	RELATIVE ACCURACY % of FSR	Unit Price*
Economy	MP1410	10	4µsec	0.05%	33 (100's)
	MP1412	12	5µsec	0.012%	39 (100's)
General Purpose	MP1808A	8	5µsec	±0.10%	59
	MP1810A	10	7µsec	±0.04%	69
	MP1812A	12	10µsec	±0.01%	89
High Resolution	MP1814	14	15µsec	±.003%	119
5800 Systems	AN1213B	13	2µsec	±0.005%	295
	AN1214B	14	2µsec	±0.003%	375
	AN1216D	4 BCD digits	2µsec	±0.005%	400
High Speed, High Resolution	MP1913A	13	2µsec	±0.006%	345
	MP1914A	14	3µsec	±0.004%	395
	MP1916A	16	5µsec	±0.002%	485
	MP1916B	4 BCD digits		±0.01%	425
Best State-of-the Art Ultra-Stable	BSOTA	16	<25 µsec	±3ppm	1500

*Substantial OEM discounts are available.

DAC's That Feature Uncompromising Performance — Compatible with Resolution

Analogic digital to analog converters offer a broad range of resolution — from 8 to 16 bits with truly compatible accuracies and stabilities. The models illustrated on these pages are the most completely specified in the industry and guaranteed to meet or exceed their specifications. Worst-case error analysis and 100% high temperature burn-in coupled with 100% documented pre-ship test, ensures the user of reliable and repeatable monotonic and linear performance.

Audubon Road ■ Wakefield, Massachusetts 01880 ■ Tel. (617) 246-0300

ANALOGIC®

ANN ARBOR
TERMINALS, INC

DISPLAY TERMINALS

COMPANY

Ann Arbor is a broad-line manufacturer of CRT display and terminal equipment directed toward the OEM market. Ann Arbor was incorporated in Michigan in 1970, and is wholly owned by its employees. It has delivered over 6000 terminals to date, and is currently delivering at a rate of over 250 terminals per month.

PRODUCTS

Ann Arbor utilizes a building-block approach to its product line. Its products are composed of highly-modular, functionally-partitioned PC boards, each of which is generalized and packed to provide a maximum of function and flexibility. This enables the company to offer an extraordinarily broad line of standard products and options at an economical price.

In addition, this approach enables the company to respond well to "custom" needs. Ann Arbor offers an X-MOD service aimed at the customer's low-volume, minor-change-to-standard-product requirements, and a Q-MOD service aimed at his high-volume, special requirements.

X-MOD SERVICE

Ann Arbor offers its X-MOD service where the customer requires a relatively simple modification to a standard unit and where the quantity required does not economically justify PC redesign, development of production and test fixtures, and preparation of formal product documentation. X-MOD's are accomplished by a technician who orders the closest standard unit from production and modifies it to the customer's requirements.

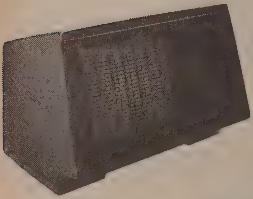
Q-MOD SERVICE

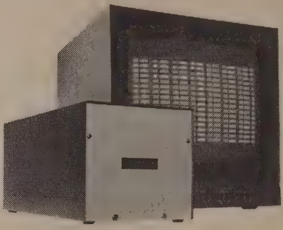
Ann Arbor offers its Q-MOD service where the customer requires major design changes to an existing product, or a completely new design. Q-MOD's are accomplished by a product engineer who develops and documents the product to the customer's specifications, releases it to production, and monitors the early deliveries to assure that the production test and QA procedures are adequate to assure delivery of a reliable, quality product. A non-recurring engineering (NRE) charge is included in Q-MOD quotations to cover these costs.

ORDERING

Ann Arbor's standard product line offers an enormous number of possible combinations of products and options and multiple options. Some combinations are not available. They are not technically viable or operationally practical. Others are available only in quantity. Purchase orders should be based on factory quotation only.

RECEIVE-ONLY (RO) TERMINALS

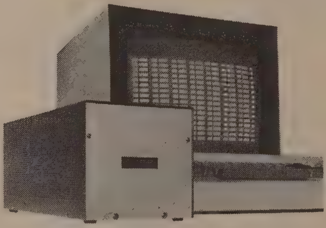




KEYBOARD SEND/RECEIVE (KSR) TERMINALS

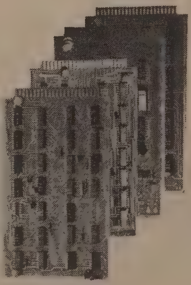
DESIGN III

High-performance desktop model with separable matching keyboard, styled to complement the decor of the most modern surroundings.



SERIES 200

Hard-working, rugged modular concept featuring separately-packaged display electronics, keyboard, and monitor for total versatility in industrial environments.



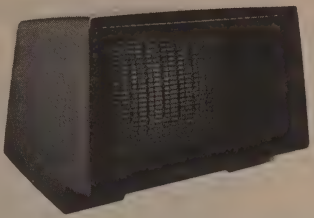
BOARD SETS

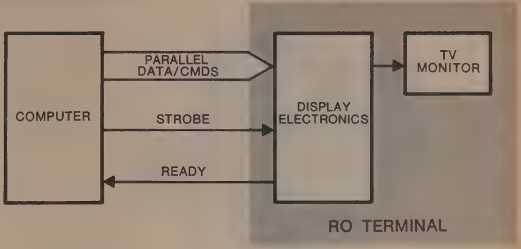
Pre-engineered memory, timing, cursor, and signal conversion functions in easy-to-use PC module form, for the OEM who prefers to package his own terminal electronics.

ANN ARBOR TERMINALS, INC 6107 Jackson Road, Ann Arbor, Michigan 48103 / Tel: (313) 769-0926, TWX: 810-223-6033

ANN ARBOR TERMINALS, INC

RO TERMINALS





RO MODEL	R1632D	R2440D	R2050D	R1680D	R2480D	R4080D
DISPLAY						
No. chars.	512	960	1000	1280	1920	3200
Chars. x lines	32x16	40x24	50x20	80x16	80x24	80x40
SCREEN						
Size (diag.)	14″	14″	14″	14″	14″	14″
Phosphor	P4	P4	P4	P4	P4	P39
Viewing area	10″x8″	10″x8″	10″x8″	10″x8″	10″x8″	10″x8″
CHARACTERS						
Char. set	64	64	96	64	64	96
Char. code	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
Char. case	Upper	Upper	Upper/lower	Upper	Upper	Upper/lower
Dot matrix	5x7 dots	5x7 dots	7x9 dots	5x7 dots	5x7 dots	7x9 dots
Dot field	8x12 dots	8x10 dots	10 x12 dots	8x12 dots	8x10 dots	10x13 dots
Size (nom.)	.18″x.27″	.17″x.23″	.15″x.25″	.09″x.22″	.09″x.22″	.09″x.16″
Cursor	Underline	Underline	Underline	Underline	Underline	Underline

OPERATION

The displayed data is stored in and refreshed from an internal refresh memory. The data remains stored and displayed until changed by the data source. The data is written and the cursor positioned under control of the memory address register. Characters enter at the cursor position. The cursor automatically advances after each character entry. Each entry overwrites the character previously displayed at that position; no other data on the screen is affected. Advance of the cursor past the end of a line automatically advances it to the beginning of the next line. Advance of the cursor past the end of the bottom line advances the cursor to the beginning of the top line (Page display) or all lines move up one, the bottom line clears, and the cursor remains in the bottom line (Roll display).

COMMANDS

Erase screen (clear and home)
Carriage return, line feed
Cursor left, right, up, down, and home
Cursor x-y positioning (absolute cursor address)

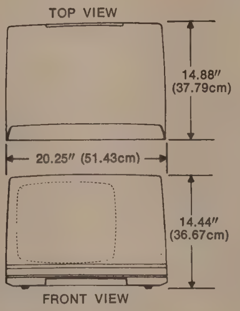
SWITCHES

S1: ROLL/PAGE

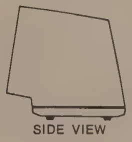
DATA INPUT

7-bit parallel TTL
ASCII-coded
Up to 1600 char/sec asynchronous

PHYSICAL



Weight:
40 lbs.
Power:
105-125 Vac, 60 Hz
Temperature:
10° to 40°C (operating)
−40° to 70°C (storage)
Humidity:
0-95% non-condensing



OPTIONS

Case Options: Series 200, Board Sets

CR/LF Options: Auto LF on CR, New Line, Hold at EOL

Serial Interface: RS232, 20ma, 60ma, TTL Inputs

Baud Rates: 110, 300, 600, 1200, 1800, 2400, 4800, 9600

Baud Controls: Dual, Switched, Keyed, Split

Parity: Even, Odd, Mark, Space

Character Accent: Blink, Dual Intensity, Reverse Video

X-Y Loading

RO Multidrop

Soft-Copy Add-On

External Sync

Export Models

CAUTION: Some combinations of products and options are unavailable. Others are available only in quantity. Orders should be based on factory quotation only.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

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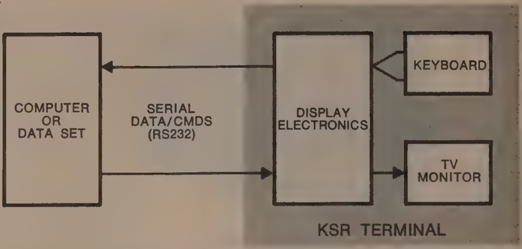
ANN ARBOR TERMINALS, INC

KSR TERMINALS



KSR MODELS	K1632D	K2440D	K2050D	K1680D	K2480D	K4080D
DISPLAY						
No. chars.	512	960	1000	1280	1920	3200
Chars. x lines	32x16	40x24	50x20	80x16	80x24	80x40
SCREEN						
Size (diag.)	14″	14″	14″	14″	14″	14″
Phosphor	P4	P4	P4	P4	P4	P39
Viewing area	10″x8″	10″x8″	10″x8″	10″x8″	10″x8″	10″x8″
CHARACTERS						
Char. set	64	64	96	64	64	96
Char. code	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII
Char. case	Upper	Upper	Upper/lower	Upper	Upper	Upper/lower
Dot matrix	5x7 dots	5x7 dots	7x9 dots	5x7 dots	5x7 dots	7x9 dots
Dot field	8x12 dots	8x10 dots	10 x12 dots	8x12 dots	8x10 dots	10x13 dots
Size (nom.)	.18″x.27″	.17″x.23″	.15″x.25″	.09″x.22″	.09″x.22″	.09″x.16″
Cursor	Underline	Underline	Underline	Underline	Underline	Underline

KEYBOARD

Upper/lower case terminals use the Ann Arbor KB300C Keyboard; upper case only terminals use the KB300B Keyboard. See OPTIONS-KEYBOARDS.

OPERATION

The terminal operates in the same manner as a KSR TTY terminal. As the operator strikes each key, its character code is sent to the computer as an asynchronous serial character at the specified baud rate. If the terminal is set for full-duplex, the computer echoes back the character (or an error message) to the terminal's memory, whereupon it is displayed on the screen. If the computer is not programmed for echo-back, the terminal may be set for half-duplex, whereupon the character is fed back into the terminal's memory as it is transmitted. In either case, the incoming data is stored and displayed as described for the RO terminal.

COMMANDS

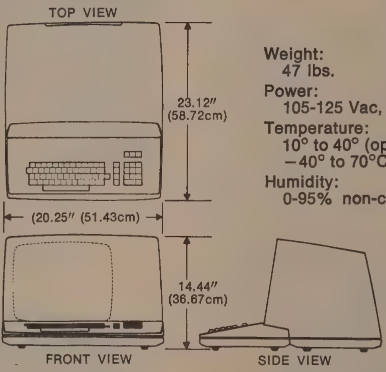
- Erase screen (clear and home)
- Carriage return, line feed
- Cursor left, right, up, down, and home
- Cursor x-y positioning (absolute cursor address)

SWITCHES

S1: ROLL/PAGE
S2: LOCAL/LINE
S3: FULL/HALF DUPLEX

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PHYSICAL



Weight:
47 lbs.
Power:
105-125 Vac, 60 Hz
Temperature:
10° to 40° (operating)
−40° to 70°C (storage)
Humidity:
0-95% non-condensing

DATA INTERFACE

RS232-compatible
ASCII-coded
Up to 9600 baud asynchronous

Parity: Even, Odd, Mark, Space
Character Accent: Blink, Dual Intensity, Reverse Video
Batch Transmit

OPTIONS

Case Options: Series 200, Board Sets
CR/LF Options: Auto LF on CR, Hold at EOL
Interface: RS232, 20ma, 60 ma, TTL
Baud Rates: 110, 300, 600, 1200, 1800, 2400, 4800, 9600
Baud Controls: Dual, Switched, Keyed, Split

Protected Data
Printer Output
Export Models

CAUTION: Some combinations of products and options are unavailable. Others are available only in quantity. Orders should be based on factory quotation only.

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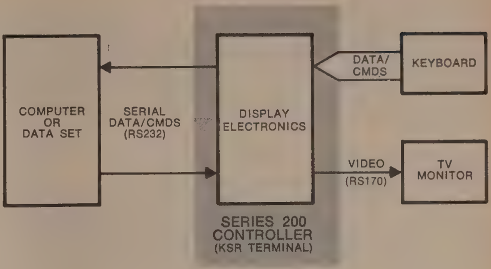
ANN ARBOR TERMINALS, INC

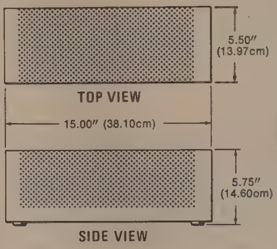
CASE OPTIONS

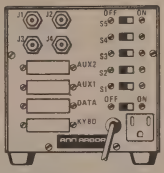
SERIES 200 CASE

All Ann Arbor terminals are available in the Series 200 Controller case. The Series 200 contains the same display electronics as the Design III, packaged for use with free-standing keyboards and monitors. The Series 200 is more rugged and less expensive than the Design III and permits the user greater freedom in tailoring his terminal configuration, keyboard style, and monitor size to his specific application. The Series 200 interface is identical to the Design III, except that a keyboard input connector is added to the KSR units and a video ouput connector to all units. The keyboard input requires 7-bit-parallel ASCII data and a rising-edge strobe at TTL levels. The video output provides R170-compatible composite video capable of driving most commercial TV monitors.


COMPUTER OR DATA SET
SERIAL DATA/CMDS (RS232)
DISPLAY ELECTRONICS
DATA/ CMDS
KEYBOARD
VIDEO (RS170)
TV MONITOR
SERIES 200 CONTROLLER (KSR TERMINAL)

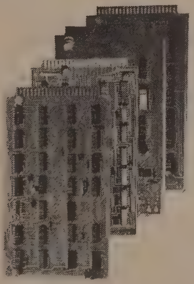
PHYSICAL

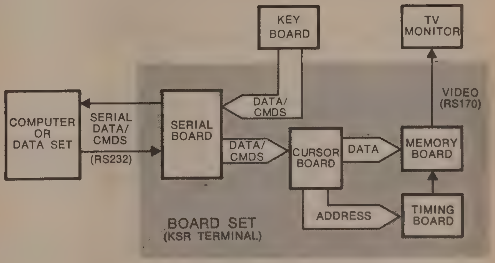

5.50″ (13.97cm)
TOP VIEW
15.00″ (38.10cm)
5.75″ (14.60cm)
SIDE VIEW


J1
J2
J3
J4
OFF
ON
S5
S4
S3
S2
S1
AUX2
AUX1
DATA
KYBD
ANN ARBOR

CONNECTOR PANEL

BOARD SETS




KEY BOARD
TV MONITOR
COMPUTER OR DATA SET
SERIAL DATA/ CMDS (RS232)
SERIAL BOARD
DATA/ CMDS
DATA/ CMDS
CURSOR BOARD
DATA
MEMORY BOARD
VIDEO (RS170)
ADDRESS
TIMING BOARD
BOARD SET (KSR TERMINAL)

All Ann Arbor terminals are available to qualified OEM's as board sets. These are the same printed circuit boards used in the Design III. When interconnected and powered according to documentation supplied, they perform all the functions of the applicable Design III specification. Board sets are supplied in groups of 25 sets minimum of a given model. The typical terminal board set consists of 4 boards: Timing, Memory, Cursor, and Serial. The Timing board generates the raster scan and memory timing for the specified character format, generates the timing for character-addressable memory load, generates the cursor video, and provides for asynchronous input control of memory load. The Memory board stores the full screen of data and generates the composite video for display of the data on the TV monitor. The Cursor board buffers incoming data to memory, holds cursor address, and mechanizes the roll/page and command set operations. The Serial board converts incoming serial data to bit-parallel for the Cursor board, converts bit-parallel keyboard data to serial for transmission, and provides gating for local, half-, and full-duplex operation.

PHYSICAL

Size: 4.5″x8″
Spacing: 0.5″, except Memory 1″
Connector: PC edge-card on 4.5″ end
Mating: Dual 22-pin, 0.156″ c-c
Power: ±5, ±12Vdc, ±2%
Accessories: Power Supply

ANN ARBOR TERMINALS, INC

OPTIONS

CR/LF OPTIONS

Ann Arbor terminals are factory preset to require both CR- and LF-codes to start a new line before end-of-line, and provide automatic wrap-around to new line at end-of-line. The AUTO LF ON CR option enables automatic line-feed on receipt of the CR-code alone. The NEW LINE option enables automatic carriage-return on receipt of the LF-code alone. The HOLD AT EOL option inhibits the automatic wrap-around at end-of-line.

SERIAL INTERFACE OPTIONS

Ann Arbor serial-data terminals are factory configured with an RS232-compatible interface for use with data sets, couplers, and computer TTY channels that are strapped, or strappable, for RS232. Alternatively, they can be configured for current-loop operation, either 20ma or 60ma, for applications requiring direct TTY replacement and/or high noise immunity. For special applications, the terminals can be provided instead with a TTL-logic-level interface.

BAUD RATE OPTIONS

The terminals are factory preset to one of the following baud rates, specified on order: 110, 300, 600, 1200, 1800, 2400, 4800, 9600 baud. The following baud rates are additionally available on some models: 50, 75, 135, 150, 900, 3600, 7200 baud.

BAUD CONTROL OPTIONS

The baud rate is preset by a jumper on the terminal's Serial board. It can be changed in the field by a qualified technician. The following options are offered for applications requiring easier field-selection. DUAL BAUD provides external-switch-selection between two preset baud rates, specified on order. SWITCHED BAUD provides internal switch selection of all available rates. KEYED BAUD provides keyboard selection of all available rates. SPLIT BAUD is offered for applications that require the terminal to send data at one baud rate and receive at another.

PARITY OPTIONS

The terminals are factory preset to generate either Mark or Even parity on outgoing data, depending on model, and to ignore parity on incoming data. The PARITY option permits specification, on order, of Even, Odd, Mark or Space parity on outgoing data, and parity detection on incoming data with errors displayed as a ?-symbol.

CHARACTER ACCENT

This option enables the characters on Ann Arbor terminals to be displayed with visual accents, to highlight or call attention to them, under command (computer or operator) control. Accents vary on individual models but include blink, dual intensity, and reverse video.

EXTERNAL SYNC

This option enables the video from Ann Arbor terminals to be superimposed on ordinary TV picture video. The terminal takes in either picture video or composite sync from the video source and puts out the same signal with the characters on the screen added to it. Controls are provided to add the full-screen of characters, just the bottom line (window), or none at all. A rotate command allows the successive lines on the screen to be rotated into the window. A manual sync control allows the window to be positioned wherever desired in the program output.

SWITCHABLE 0832

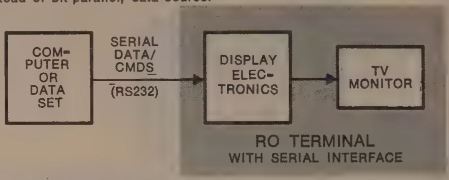
This option enables Ann Arbor 1632 terminals (16 lines x 32 characters) to display, and be operated, as 0832 terminals (8 lines x 32 double-height characters) under command or switch control. The option is particularly applicable to RO's because of the increased viewing range, but can also be applied to KSR's.

EXPORT MODELS

This option enables Ann Arbor terminals to operate to export power and TV standards.

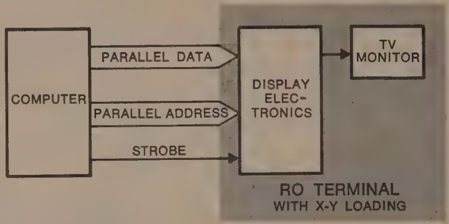
RO SERIAL INTERFACE

This option enables Ann Arbor RO terminals to be written from a bit-serial, instead of bit-parallel, data source.


COMPUTER OR DATA SET
SERIAL DATA/ CMDS (RS232)
DISPLAY ELEC-TRONICS
TV MONITOR
RO TERMINAL WITH SERIAL INTERFACE

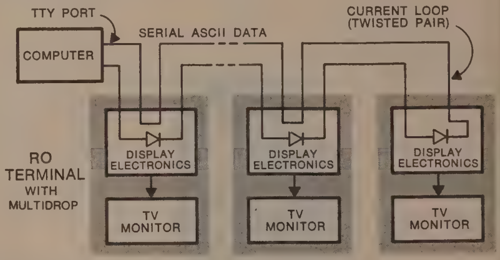
X-Y LOADING

This option enables Ann Arbor RO terminals to be written from a data source that specifies, in parallel, both a character and the x-y position on the screen at which the character is to be displayed.


COMPUTER
PARALLEL DATA
PARALLEL ADDRESS
STROBE
DISPLAY ELEC-TRONICS
TV MONITOR
RO TERMINAL WITH X-Y LOADING

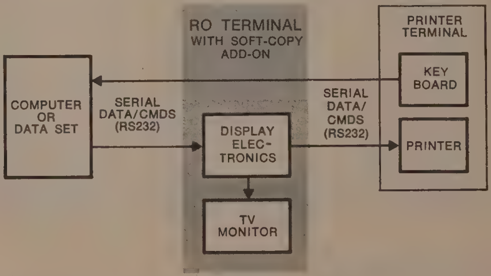
RO MULTIDROP

This option enables up to 64 Ann Arbor RO displays to be remotely addressed and written over a single communications line. The address structure permits selection of one, several, or all of the displays to be written simultaneously.


TTY PORT
COMPUTER
SERIAL ASCII DATA
CURRENT LOOP (TWISTED PAIR)
RO TERMINAL WITH MULTIDROP
DISPLAY ELECTRONICS
TV MONITOR
DISPLAY ELECTRONICS
TV MONITOR
DISPLAY ELECTRONICS
TV MONITOR

SOFT-COPY ADD-ON

This option enables Ann Arbor RO displays to be added to existing computer terminals (TTY's, printer terminals, data-storage terminals, other CRT terminals, etc.) for local, remote, or large-screen viewing of the printout.


RO TERMINAL WITH SOFT-COPY ADD-ON
PRINTER TERMINAL
KEY BOARD
COMPUTER OR DATA SET
SERIAL DATA/CMDS (RS232)
SERIAL DATA/ CMDS (RS232)
DISPLAY ELEC-TRONICS
PRINTER
TV MONITOR

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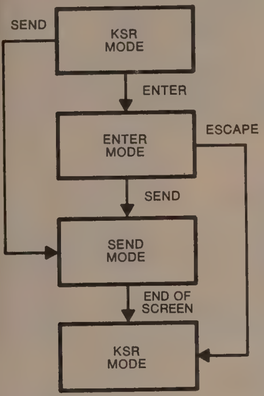
ANN ARBOR
TERMINALS, INC

OPTIONS

BATCH TRANSMIT

This option adds a screen-transmit capability to Ann Arbor KSR terminals. It enables the operator to write to the screen off-line at typing speed, and then transmit the entry to the computer at high-speed. The terminal is normally in KSR mode, full duplex. The terminal is put into ENTER mode on receipt of the Enter code. The terminal goes off-line; the computer can not interrupt. The operator enters data to the screen and, when finished, puts the terminal into SEND mode by entering the Send code. The terminal goes back on-line, transmits the contents of the screen to the computer and returns to KSR mode. Alternatively, when the operator is finished entering data, he may enter the Escape code which puts the terminal directly into KSR mode without transmitting the contents of the screen. In either case, the computer may read (or re-read) the screen at any time in KSR mode by simply sending (or re-sending) the Send code.



Mode	Key-board	Out-going Data Line from	In-coming Data Line
KSR	Active	Kybd	Active
ENTER	Active	Mark	Inactive
SEND	Inactive	Screen	Inactive
KSR	Active	Kybd	Active

PROTECTED DATA

This option adds a form-filling capability to terminals equipped with Batch Transmit option. It features form generation by operator or computer, protected data-entry with tabulation, and compressed data-transmission. The option enables the operator or computer to set up protected fields on the screen. During ENTER mode, these fields are automatically skipped over; the operator cannot affect them. The operator can terminate entry into an unprotected field, and skip to the beginning of the next, by striking a Tab key. The operator can send and the computer may read, the complete screen or only the unprotected portions.

PRINTER OUTPUT

This option adds an RS232-compatible printer output to terminals equipped with the Batch Transmit option. The option enables the data transmitted from the screen to be steered to either the printer or computer under command control (operator or computer).

TRANSMIT CONTROL OPTIONS

These options are available for use with the Batch Transmit option. They permit the insertion of specified delays and/or control characters into the transmitted data stream. CTS CONTROL enables the start of data transmission to be controlled by a clear-to-send (CTS) input signal. START DELAY enables the start of transmission to be controlled by a preset delay. INSERT STX enables insertion of an STX-code as the first character of each data transmission, and an ETX-code as the last character. INSERT CR enables insertion of carriage return and/or line feed codes into the data transmission at the beginning of each line. CR DELAY enables insertion of a preset delay into the data transmission at the beginning of each line, eg., to allow time for a printer carriage return.

MONITORS

Ann Arbor offers a full line of TV monitors for use with its products. Available screen sizes range from 9- to 23-inches in diagonal to satisfy both near and distant viewing requirements.

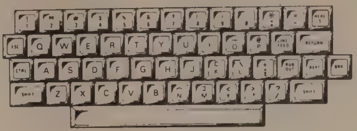
OTHER

Ann Arbor offers a full line of accessories for its products, including mating connectors, video cables, RS232 cables, extender boards, and specialized test equipment.

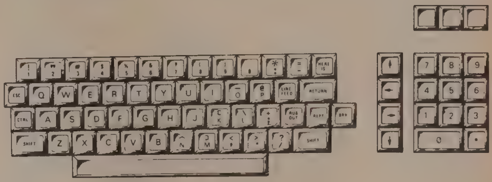
KEYBOARDS

Ann Arbor's keyboards are offered in either of two cases: the Series 200 case, compatible with the Series 200 Controller, or the Series 300 case, compatible with the Design III. Three key layouts (A, B, and C) are available.

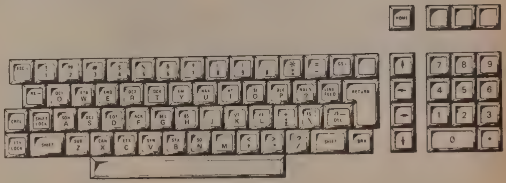
A-LAYOUT



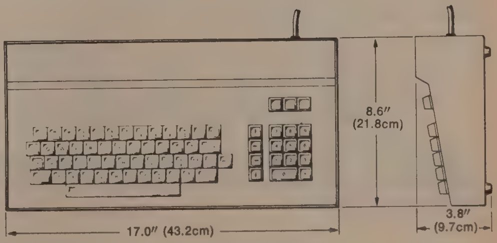
B-LAYOUT



C-LAYOUT



SERIES 200 CASE

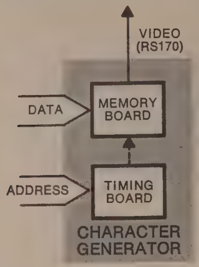


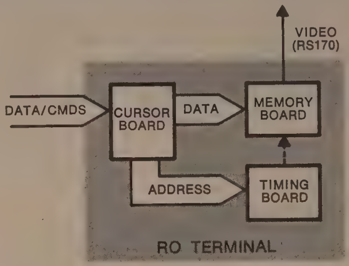
ANN ARBOR TERMINALS, INC 6107 Jackson Road, Ann Arbor, Michigan 48103 / Tel: (313) 769-0926, TWX: 810-223-6033

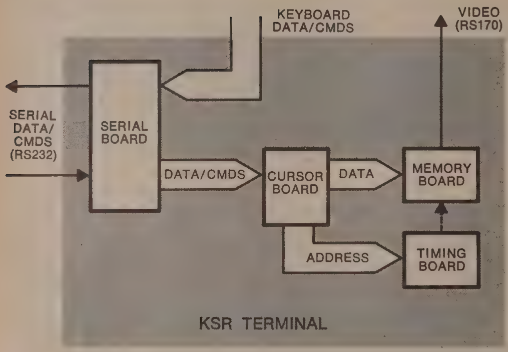
ANN ARBOR TERMINALS, INC

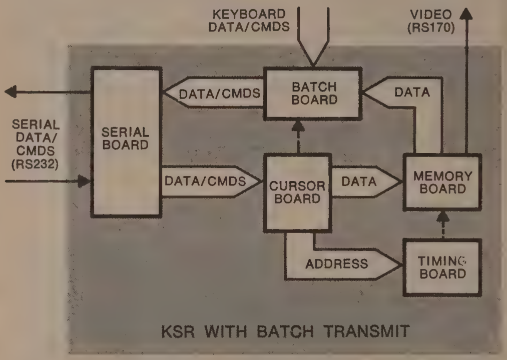
DESIGN MODULARITY

The design modularity of Ann Arbor's product line is illustrated below. It starts with a two-board character generator that displays characters in a specified format on the screen of a TV monitor. With the addition of a Cursor board, the character generator becomes Ann Arbor's standard RO terminal. With the addition of a Serial board (and a keyboard), it becomes Ann Arbor's standard KSR terminal. With the addition of a Batch board, it becomes the top of Ann Arbor's line: a KSR with Batch Transmit. All of the options available at the various stages of progression are the result of alternative strappings and/or stuffings of these PC boards.


VIDEO (RS170)
DATA
MEMORY BOARD
ADDRESS
TIMING BOARD
CHARACTER GENERATOR


VIDEO (RS170)
DATA/CMDS
CURSOR BOARD
DATA
MEMORY BOARD
ADDRESS
TIMING BOARD
RO TERMINAL


KEYBOARD DATA/CMDS
VIDEO (RS170)
SERIAL DATA/ CMDS (RS232)
SERIAL BOARD
DATA/CMDS
CURSOR BOARD
DATA
MEMORY BOARD
ADDRESS
TIMING BOARD
KSR TERMINAL


KEYBOARD DATA/CMDS
VIDEO (RS170)
SERIAL DATA/ CMDS (RS232)
SERIAL BOARD
DATA/CMDS
BATCH BOARD
DATA
DATA/CMDS
CURSOR BOARD
DATA
MEMORY BOARD
ADDRESS
TIMING BOARD
KSR WITH BATCH TRANSMIT

Q-MOD PRODUCTS

Ann Arbor manufactures a number of products, developed to the requirements of specific customers that have not been generalized to be included in its standard product line. A few representative examples are outlined below. If you have a requirement that involves converting digital data into video, the odds are good that Ann Arbor is currently manufacturing something very close to your requirement.

Q101 CONTROLLER The Q101 Controller provides a burst-loaded RO terminal in a Series 200 case, capable of displaying both alphanumerics and full-graphics in black-and-white or in color. Alphanumerics format is 80 characters x 16 lines. Graphics format is 255 dots horizontal x 192 dots vertical. Data input is bit-parallel TTL, 10 Khz to 1 Mhz asynchronous.

Q102 CONTROLLER The Q102 Controller provides two burst-loaded 80 x 16-character alphanumeric RO terminals in a single Series 200 case.

Q801 CONTROLLER The Q801 Controller provides a strip-chart graphics display, with alphanumeric labelling/annotation capability. The graphics data rolls down through the alphanumeric data, from top to bottom on the screen, at rates up to 60 points per second with 8-bit amplitude resolution.

Q1101 CONTROLLER The Q1101 Controller provides the display electronics for a complete 80x24 character alphanumeric RO terminal on a single PC board.

Q2001 CONTROLLER The Q2001 Controller provides the display and control electonics for up to 32 complete data-entry/data-editing terminals. The electronics are packaged, one terminal per PC board, in a 19″ relay rack. The terminal keyboards and monitors can be located up to 300′ from the Controller.

ANN ARBOR TERMINALS, INC

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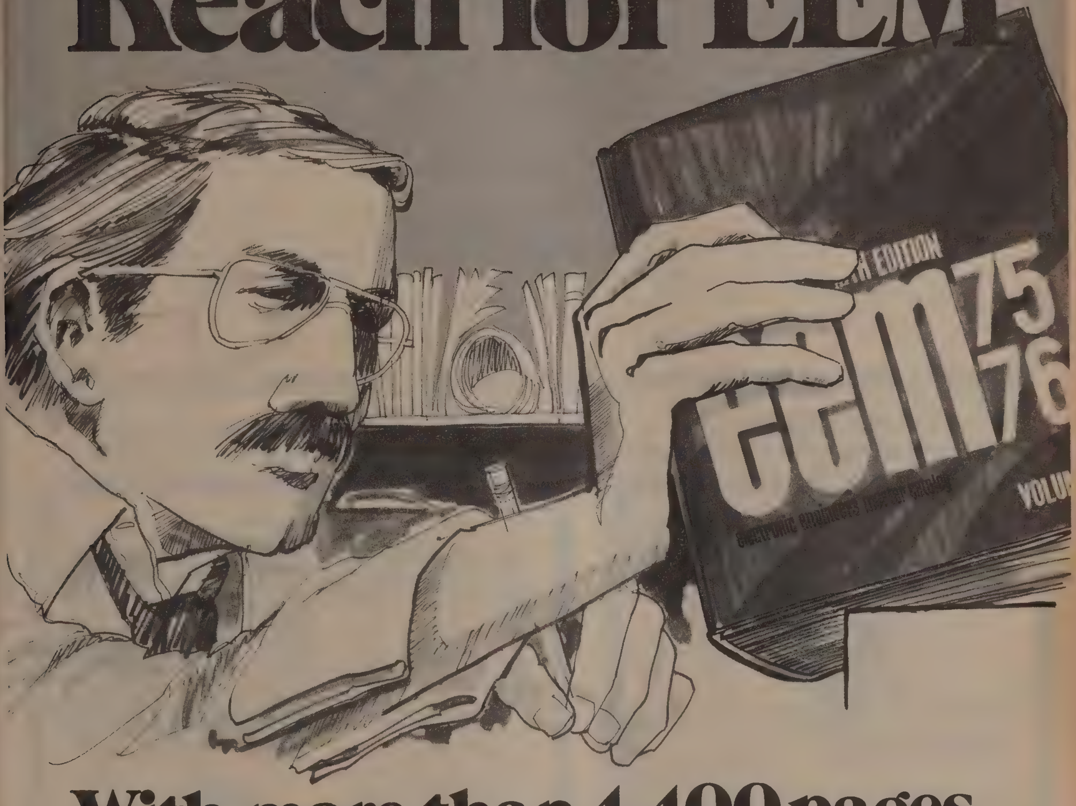

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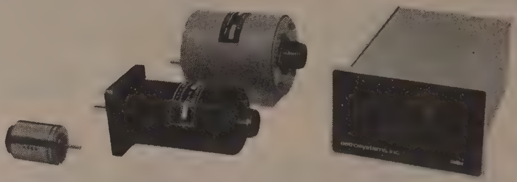
Encoding Systems Electromagnetic Absolute

Rugged, completely-passive magnetic transducers provide absolute position information, with a unique output for each position. Correct information is retained even when power is removed and readings are not affected by electrical noise. Systems offered in a range of full-scale counts from 360 to 100,000 in binary or BCD outputs. All associated electronics provided, including optional visual display. Transducers available in subminiature size or in NEMA housings.



Digital Output Encoders

Type	Code	Full Count	No. of Turns
Single Turn	Binary	10-12 Bits	1
	BCD	360, 1000, 2000, 3600	1
Multi-turn	Binary	16, 17 Bits	64
	BCD	10,000	10
		36,000	36
		100,000	100

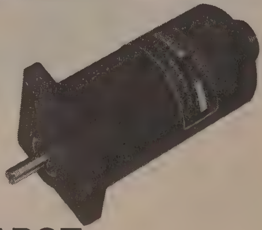
Readout Encoders

Type	Readout Range	No. of Turns
Single Turn	0-999, 0-1999	1
	0-359, 0-3599	1
Multi-turn	0-9999	10
	0-99999	100
	0-35999	36

Differential Encoding Systems

Differential Encoding Systems, consisting of two transducers and an electronics package, measure the angular displacement between two shafts which may be stationary or rotating to accuracies of 0.1°.

Electromagnetic D.C. Rotary Transducers

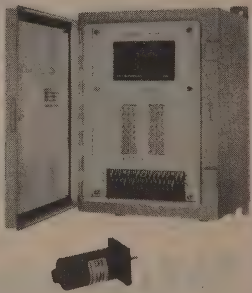


DURAPOT

Wiperless D.C. potentiometers provide high reliability, very low noise level and low starting torque. Unique variable magnetic coupling produces a smooth, continuous D.C. output, proportional to shaft rotation, with a linearity of 0.05% and a deadband of 0.02°. Available in subminiature or heavy-duty NEMA packages. Additional features include: short-circuit proof outputs, up to 20K ohm load and internal or external reference.

Solid State Limit Switches

Replace Rotary Cam-Operated Switches



Permit rapid, remote programming of limits, even while machine is operating, to accuracies of 0.1°. Consisting of a small machine-mounted rotary transducer and a separate electronics control box, they are long-life replacements for cam-operated limit switches. Output signals are highly immune to external noise and are used to provide inputs to programmable controllers or to directly control machine operation. Plug-in keys or thumbwheel switches are used to independently set up to 8 pairs of upper and lower limits.

Ideal Input to Programmable Controllers

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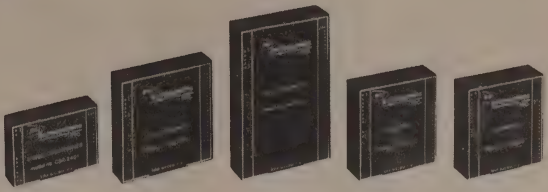
Synchro Conversion



Multi-speed, multiplexed as well as single channel systems. All inputs, including reference, transformer isolated PCB mounting.

Single Speed Modules

Synchro-to-Digital
Convert all standard synchro voltages and frequencies to binary outputs of 8, 10, 12 and 14 bits. BCD outputs of 360, 1000 and 3600 counts.

Synchro-to-DC
Provides DC output from synchro input .1% and .1° resolution and accuracy available.

Digital-to-Synchro
Provides synchro outputs from 12 bit binary input.

Dual Speed

Standard Module Sets accept dual-speed synchro inputs in the following ratios:

1:8, 1:10, 1:16, 1:20, 1:32, 1:36, 2:36, and 1:64. Depending on the input, up to 18 bit binary and various BCD outputs available.

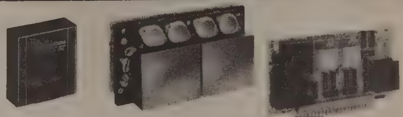
Multiplexing

Convert multiple synchro inputs at high conversion rates. Multiplex mixed voltages and frequencies.

Angle Position Indicators

Completely electronic angle position indicators convert and display standard synchros and resolvers. Available in .01° or .1° accuracy and resolution. BCD outputs available.

High Power Digital to Synchro Converters



Drive all types of torque receivers and/or control transformers. Accept 12 or 13 bit binary information and convert to synchro or resolver information.

Synchro Test Set

SYNCHRO TEST SET

Portable self-contained instrument for rapid in-plant testing of synchros and servos. Displays synchro angles with a resolution of 0.1°. Front panel displays indicate the synchro frequency and voltage as well as the shaft angle.

Standards and Bridges

Standards, Bridges and Decade Ratio Transformers test and simulate synchros, resolvers and servo systems. All units are accurate to 2 arc seconds with resolution from 15° to .0001°

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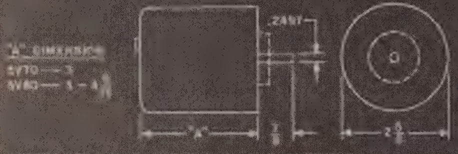
BALDWIN® ENCODERS

A COMPLETE LINE OF LABORATORY TESTED AND FIELD PROVEN OPTICAL ANALOG-TO-DIGITAL ENCODERS

5V70 Series Incremental
5V80 Series Absolute



DOTTED PORTION – LOW TORQUE BEARING ASSEMBLY

Most economical encoders in the Baldwin line.

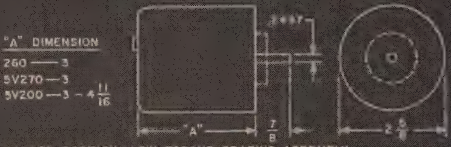
Incremental resolutions to 8000 counts per revolution with zero index available. Photocell, quadrature square wave or direction sensed pulsed outputs. Frequency response to 100 Khz. T^2L compatible.

Absolute resolutions of 0-359, 2^8, 2^9, 10^3 and 2^{10}. Parallel outputs in cyclic binary, natural binary or BCD. Photocell or T^2L compatible signal levels. Reverse count feature is standard. Gating option for sample and hold applications.

All feature single +5V operation, integrated electronics, field replaceable lamp.

Options: low torque bearings, low inertia and metallized disks, thru shaft, side-exit cable and wide operating temperature range.

260 Series Tachometer
5V270 Series Incremental
5V200 Series Absolute



DOTTED PORTION – LOW TORQUE BEARING ASSEMBLY

These popular encoders offer high resolutions and a wide range of operating features in a small size.

Tachometer resolutions to 10,000 counts per revolution with zero index available. Frequency to 1 Mhz.

Incremental resolutions to 20,000 counts per revolution with zero index available. Photocell, quadrature square wave or direction sensed pulsed outputs. Frequency response to 100 Khz. T^2L compatible.

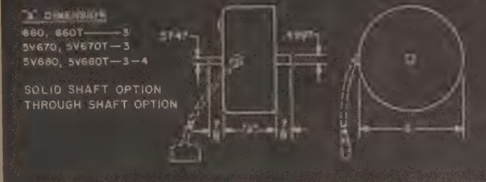
Absolute resolutions of 2^8 thru 2^{14}, 10^3, 0-3599, 10^4. Parallel outputs in cyclic binary, natural binary or BCD. Photocell or T^2L compatible signal levels. Reverse count feature is standard. Gating is optional.

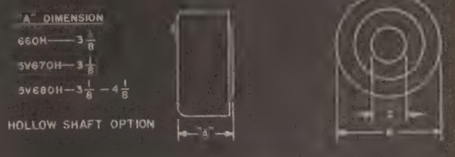
Incremental and absolute encoders feature +5V operation. All have self-contained integrated electronics and easily accessible, single field replaceable lamp.

Options: Ruggedized and low torque bearings, low inertia and metallized disks, side exit cable, wide operating temperature range.

660 Series Tachometer 5V670 Series Incremental

5V680 Series Absolute





Unique in the field of direct reading optical encoders, this group offers a combination of high resolutions, great frequency response and a wide choice of mechanical configurations.

Tachometer resolutions to 24,000 counts per revolution index available. Frequency to 1 Mhz.

Incremental encoders offer resolutions up to 48,000 counts per revolution with or without zero index. Photocell, quadrature square wave or direction sensed pulsed outputs. Frequency response to 100 Khz. T^2L compatible.

Absolute position encoders have standard resolutions of 2^{14} thru 2^{16}, 10^4 and 0-35999. Cyclic binary formats are offered in photocell or square wave output options. Natural binary or natural BCD outputs are other internal electronics options. Gating option is also available for customer sample and hold aplications. Outputs are fully T^2L compatible.

Proprietary circuitry compensates for any changes in photocell levels due to temperature or supply voltage, thereby maintaining original accuracy. Electronic monitor output indicates marginal operation condition or power failure.

Incremental and absolute position encoders in these series feature single +5V operation. All employ integrated circuitry and a field replaceable lamp. Standard single, thru and hollow shaft designs.

Options: Metallized disks, special bearing designs, serial outputs, wide operating temperature range.

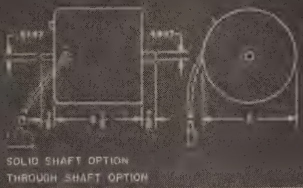
3700 Series Incremental

Most rugged encoder offered in the Baldwin line. Designed expressly for industrial applications.

Encoder is completely sealed against hostile environments. Heavy duty bearings, ½ inch shaft with contacting seal. Solid state, vibration immune light source. Internal integrated electronics with quadrature square wave or direction sensed pulsed outputs from noise rejecting differential line drivers.

Resolutions to 12,700 counts per revolution with zero reference option. Dual inch/metric resolution options have electrically selectable outputs.

690 Series Optical Resolver



This line of Baldwin absolute position encoders uses patented techniques to extend resolutions to 2^{17} thru 2^{20} per revolution while maintaining a 6 inch package diameter.

Internal electronics is integrated circuitry. Outputs are T^2L compatible.

Electronic compensation circuitry maintains accuracy for wide changes in temperature or power supply voltages. Dual detection stations cancel effects of bearing errors.

Solid and thru shafts are standard configurations. Lamps are field replaceable.

Options: Serial outputs, CW shaft rotation for increasing count, wide operating temperature range.

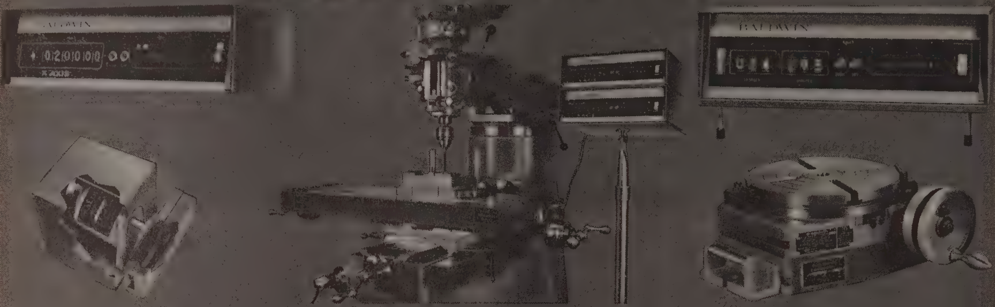
1190 Series Optical Resolver

The 1190 Series with a hollow shaft feature complements the 690 Series optical resolvers. Resolutions of 2^{17} thru 2^{20} are standard.

All features of 690 Series are incorporated in this design. Six inch hollow shaft permits passage of large waveguides or slip ring assemblies.

Construction is all stainless steel for strength and integrity.

ENCODER SYSTEMS



The Baldwin RPR rack and pinion system may be used to upgrade or retrofit mills, lathes, grinders, drills, etc. that would benefit from 1, 2 or 3 axis readout or control.

System consists of 3700 Series incremental encoder with precision pinion, housed rack, anti-backlash encoder mount, BC60 display and interfacing hardware and cables.

System resolution is .0005 in. or .01mm. Enclosed rack is supplied pre-assembled and pre-calibrated.

Designed expressly for the Bridgeport Series I and II Turret Millers, the Baldwin LPR System consists of two linear encoders and two bidirectional counters. All interconnecting cables are supplied.

Completely eliminates lead screw errors, displays true worktable position. Resolution .0005 in. or .01mm., switch selectable. Six digit readout, thru zero counting, floating zero. Preset and zero offset options.

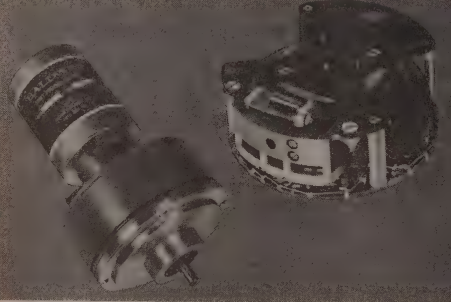
Protective encoder housing is fully enclosed against dirt, oil and coolants, stable chrome coated glass scale, field replaceable lamp. Installed on new or existing machines with no machine modification.

Designed to be mounted on Bridgeport RT12 and RT15 rotary tables, this system incorporates a rotary encoder using proven Baldwin encoder design features and an especially constructed bidirectional counter that displays 0-359° 59.5′.

Displays true angle of table to 0.5′. Operates in three modes - CW, CCW and thru zero for maximum utility. Floating zero, and preset features are standard.

Non-contacting encoder is fully enclosed against dirt, oil, and coolants. Disk is rugged chrome coated glass. Field replaceable lamp.

Installation is at the factory or by qualified personnel.



CUSTOM APPLICATIONS

Baldwin's technical personnel stand ready to assist in applying encoders in custom configurations.

Unusual linear or non-linear codes, special supply voltages, RFI shielding, output interface buffers and parallel/serial converters.

Direct mounting on torque motor drives or low inertia capstan motors.

Compact designs containing 2^{13} bits in a size 11 servo package, multiturn configurations.

Space and military applications requiring high reliability criteria.

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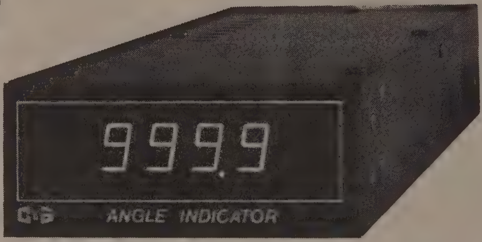
ANGLE INDICATORS SHAFT ENCODERS

MODEL SD150 ANGLE PANEL METER

Model SD150 is a new low cost all solid state digital panel meter accepting either synchro or resolver signals. Completely self-contained, the SD150 derives power from the reference or AC line and displays the output on bright .55 inch planar characters. The conversion process is ratiometric using C & A's phase-tracking technique assuring drift free operation over long time periods. Fully buffered BCD output data is available at the rear connector.



- Input 11.8/90 vrms L-L 60 or 400 Hz. Ref.: 26/115 vrms, transformer isolated
- 359.9 Full Scale standard-custom scale factors to 999.9 F.S. also available
- Guaranteed accuracy ±6 minutes
- Power input 115v/230v ±15% 47-440 Hz.
- Size 1.75"X4.125"X8"
- Leading zero blanking, Lamp-test.

SERIES SE100/SE100R ABSOLUTE SHAFT ANGLE ENCODERS

Series SE100 is a self-contained system for the conversion of absolute shaft position or rotation to direct visual readout and digital output for external use. The low cost reliable electromagnetic transducer is unaffected by industrial environments and can be positioned as far as 200 feet away from the readout.

The readout electronics is completely solid state containing the latest ratiometric conversion techniques guaranteeing long term stability and trouble free operation. Typical applications for the Series SE100 include valve position readout, flow measurement, navigation systems and machine tool positioning systems.

355.9
C·S
SE 100/ABSOLUTE SHAFT ANGLE ENCODER
9999
C·S
ANGLE INDICATOR
SE 100R
ABSOLUTE SHAFT ANGLE ENCODER

- 359.9 Full Scale standard-custom scale factors to 9999 F.S. also available
- Completely self-contained, requires only 115V/230V AC line power
- Encoder is absolute and has a digital output for each mechanical position input
- Correct output is immediately restored after power interruption
- 2 basic accuracies available ±.1°, ±.2°
- Many transducers available (as small as size 5, SAE ARP-461)
- Only six wires max. necessary between transducer and electronic readout
- BCD output data available at rear connector

SHAFT ENCODERS LIMIT SWITCHES

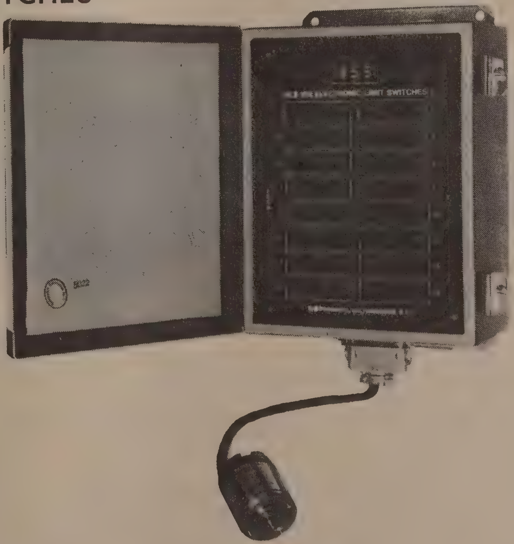
MODEL SE103 ABSOLUTE SHAFT ANGLE ENCODER

Model SE103 is the low cost version of C & A's line of absolute shaft angle encoders. Designed for the budget minded, it can be used in virtually any application requiring mechanical shaft angle measurement.

- 359 Full Scale standard—custom scale factors to 999F.S. also available
- Guaranteed Accuracy ±.5°
- BCD output data available at rear connector
- Low cost reliable electromagnetic transducer
- Completely self-contained, requires only 115v/230vac line power

SERIES DLS103 PROGRAMMABLE LIMIT SWITCHES

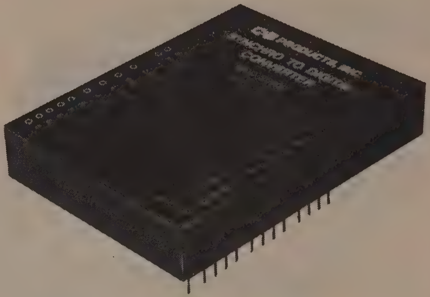
C & A's new line of programmable solid state limit switches are designed to replace electromechanical cam-operated switches. They consist of a rotary transducer connected through a 6-wire cable to a digital programming unit. Advantages include greatly improved reliability, ease of installation and elimination of mechanical wear. They can be remotely set while in operation anywhere from 1° to 359° with an accuracy, resolution and repeatability of 1°. Optional mechanical interfaces are available for many applications.



- 359 Full Scale standard—custom scale factors to 999 F.S. also available
- Completely self contained, requires only 115v/230vac line power
- Choice of single or dual limit switch configuration
- Absolute position system—Settings not affected by electrical noise or power interruptions
- Complete line of rugged low cost electromagnetic transducers available
- Programming unit may be located as far as 200 feet from transducer
- Outputs available as logic levels or relay closures
- Nema 12 enclosure standard, others optional

C&A PRODUCTS, INC.
37-12 58th Street, Woodside, New York, 11377
(212) 779-4303

SYNCHRO/RESOLVER DATA CONVERTERS



SERIES SD300/RD300
SYNCHRO/RESOLVER TO DIGITAL

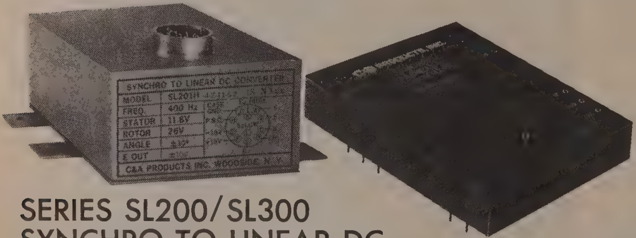
The industry's best buy for the conversion of synchro or resolver signals to digital angle data. Using C & A's proprietary continuous phase-tracking technique, performance is guaranteed in the real world of temperature variations, noise, quadrature, harmonic distortion, amplitude and frequency variations.

- Input: 11.8/90 vrms L-L 60 or 400 Hz. Ref.: 26/115 vrms
- Output: 13 bits Binary (LSB = 2.6 minutes) or 4 decade BCD (LSD = 6 minutes)
- Fully buffered TTL compatible.
- Guaranteed accuracy: ±5.3 minutes (Binary)/ ±.1° (BCD)
- Fast-1 millisecond max. conversion rate
- Transformer isolated, high input impedance to both signal and reference
- One compact module

SERIES DS300/RS300
DIGITAL TO SYNCHRO/RESOLVER

Complementing C & A's line of S/D converters, Series DS300/RS300 accurately convert digital angle data into either three-wire synchro or four-wire resolver signals.

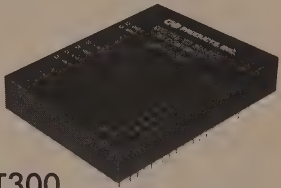
- 14 bits Natural binary angle input
- Guaranteed accuracy ±4 minutes
- Reference and output transformer isolated
- Drives 11.8 or 90 vrms., 60 or 400 Hz., Synchros or Resolvers—2 VA Standard



SERIES SL200/SL300
SYNCHRO TO LINEAR DC

This series converts either synchro or resolver input into a linear DC voltage proportional to the input shaft angle. They utilize the latest ratiometric techniques and are insensitive to input frequency and amplitude variations. Noise and distortion immunity is guaranteed using C & A's minimum delay phase sensitive demodulation techniques. Series SL200 is the hermetically-sealed ruggedized flight-test version.

- Input: 11.8/90 vrms L-L 60 or 400 Hz. Ref.: 26/115 vrms transformer isolated
- Output: ±10v for ±180° input, other scale factors readily available
- Guaranteed accuracy :±6 minutes
- Output is glitch free with infinite resolution
- Fast-1 millisecond max. conversion rate
- Quality components—insuring long term stability

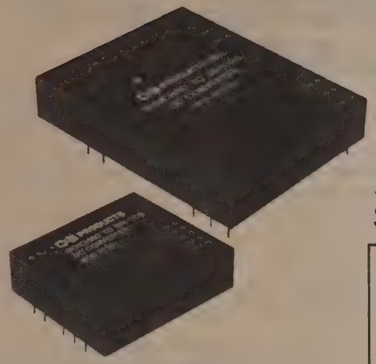


SERIES DT300
DIGITAL TO SIN/COS DC

Rounding off C & A's line of converters is this series which converts digital angle data into a pair of DC voltages proportional to the sine and cosine of the digital angle input. These converters are suitable for applications requiring polar to rectangular conversion or digitally generated radar PPI displays.

- 13 bits Natural binary angle or 4 decade BCD input (359.9FS)
- 10 Sinθ vdc and 10 Cosθ vdc output
- Fast-1 millisecond max. conversion rate
- Guaranteed ±6 minutes accuracy
- Stable internal reference
- Optional-external variable R voltage input

SYNCHRO/RESOLVER DATA CONVERTERS

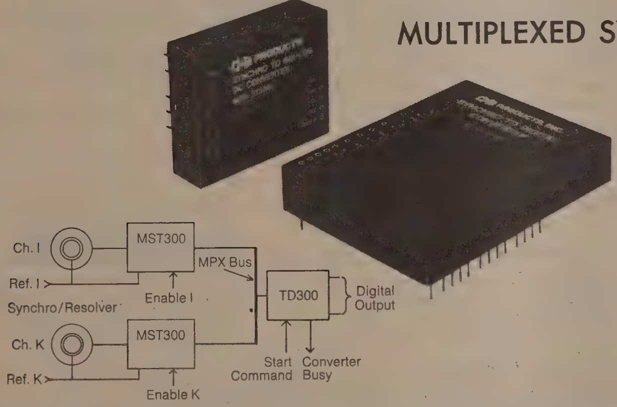


SERIES ST300/ST300A SYNCHRO TO SIN/COS DC

Series ST300/ST300A are miniature low cost modules that transform either a 3-wire synchro or 4-wire resolver input into a pair of DC voltages proportional to the sine and cosine of the transducer shaft angle. Both series use phase sensitive demodulation techniques with special minimum delay filters making them particularly useful in applications requiring accuracy, speed and noise immunity as in radar PPI generation. Series ST300A contains regulators which make output voltage levels independent of synchro/resolver reference voltage variations.

- Input: 11.8/90 vrms L-L 60 or 400 Hz.
  Ref.: 26/115 vrms, transformer isolated.
- Output: 10 Sinθ vdc; 10 Cosθ vdc.
- Guaranteed Accuracy: ±3 minutes (ST300)/±6 minutes (ST300A)
- Dynamic Lag: 5 seconds/rpm
- Conformity: .15% Full Scale
- Regulation: ±.1% for a ±10% line voltage variation (ST300A only)

SERIES MSD300 MULTIPLEXED SYNCHRO TO DIGITAL



A flexible low cost random access system consisting of miniature plug in modules designed for multiplexed synchro/resolver to digital converter applications. Each system requires only one MST300 input module per channel and one TD300 central converter.

- 13 bit Binary or 4 decade BCD output
- Guaranteed accuracy ±5.3 minutes (Binary)/ ±.1° (BCD)
- Conversion rate 1 millisecond/channel max.

ADDITIONAL PRODUCTS

- CUSTOM SYSTEMS
- SIN-COS DC TO SYNCHRO
- POLAR TO RECTANGULAR
- RECTANGULAR TO POLAR

ALL MODULES

- SOLID STATE
- LIGHT WEIGHT
- COMPACT P.C. BOARD MOUNTING
- POWER SUPPLY REVERSAL PROTECTED
- TWO OPERATING TEMPERATURE OPTIONS 0 TO 70°C AND −55 TO +85°C
- MILITARIZED VERSIONS
- OPERATE FROM ±15VDC AND/OR +5VDC
- TRANSFORMER ISOLATED INPUTS, TRANSIENT PROTECTED
- ACCURACY SPECIFIED WORST CASE OVER FULL ENVIRONMENTAL RANGE
- FACTORY REPAIRABLE

Readily available variations of these converters include units with other voltage and frequency ranges and designed to specific mechanical and environmental requirements.

Write or phone for detailed specifications, applications, assistance and evaluation units.

C&A PRODUCTS, INC.
37-12 58th Street, Woodside, New York, 11377 (212) 779-4303

CHRONO-LOG CORPORATION

DIGITAL CLOCKS and CALENDARS

CHRONO-LOG DIGITAL CLOCKS and CALENDARS are used wherever a digital BCD output of real or elapsed time is required, such as in data logging, data transmission, data processing, telemetry, and digital print-out systems. They can also provide outputs for driving remote digital time diplays.

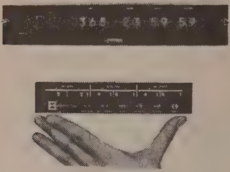
These versatile clocks and calendars provide BCD (8-4-2-1) TTL compatible outputs in parallel or in a character serial (bit parallel) format for ease of interface to bit-limited or character serial input devices.

LOW COST SERIES 70,000 LED CLOCK/CALENDAR

- Time in hours, minutes, seconds
- Month/Day or Day of Year Calendars
- Internal standby battery feature
- Instrument panel or rack mounting

The Series 70,000 Clock/Calendars provide buffered parallel and/or character-serial (bit parallel) TTL compatible BCD outputs of time.

The time base can be line frequency, an external frequency or various internal crystal oscillators. A unique line-sync multivibrator can also be supplied, locked to the line frequency but free-running when line frequency fails. Use of the line-sync multivibrator and internal standby battery provides a low cost unit with power failure operation capability.

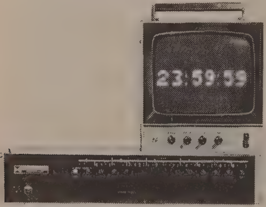


SERIES 30,000 DIGITAL CLOCK

- BCD display, 1¾″ panel
- 0.6″ or 0.8″ NIXIE® type display, 3½″ panel
- Extended time range capability
- BCD output time resolution to 100 microseconds
- Years, Month/Day or Day of Year Calendars
- Internal standby battery feature

The Series 30,000 Clock/Calendars provide time ranges of decimal parts of hours or minutes as well as hours, minutes and seconds, and many other time ranges. BCD output resolutions to the nearest 100 microseconds can be provided.

The clock time base can be line frequency, an external frequency or various internal crystal oscillators. When the standby battery feature is supplied, an external frequency or internal crystal oscillator time base is required.



SERIES 40,000 VIDEO CLOCK
SERIES 60,000 STUDIO CLOCK

- Video output for time display on TV monitors
- Single wire connection to remote displays
- Various time ranges
- Month/Day or Day of Year Calendars
- All displays in absolute synchronism

For systems requiring remote time displays, the Series 40,000 Video Digital Clocks can drive many remote low cost video monitors displaying time with 1″ to 3″ high characters. Only a single wire connection between the remote video monitors is required.

The Series 60,000 Studio Digital Clock provides a small size display of time inserted into your video information for display throughout a studio or laboratory. It is also useful for inserting digital time into video tape recordings.

GENERAL INFORMATION
CLOCKS AND TIME CODE INSTRUMENTS

All units provide buffered and gated BCD parallel outputs with either positive logic (ONE = +5 V.) or negative logic (ONE = 0 V. DC). Most units also provide pulse rate outputs such as 1 pps, 10 pps, 1 ppm, etc.

All units can operate from 115 V or 230 V AC (50-400 Hz) and are available for 19″ rack mounting. In most cases, power failure is displayed on the front panel and an output signal is provided.

Each unit is supplied with all mating connectors and a detailed Instruction Manual. All integrated circuits and LED or NIXIE® type displays are mounted in plug-in sockets for minimization of spare parts requirements and ease of service.

All Digital Clock/Calendars include an interlock circuit which allows the external system to "hold" the time during readout without introducing a timing error.

All Clocks and Time Code Generators are capable of external control for Start/Stop and similar functions.

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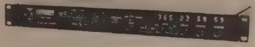
CHRONO-LOG
CORPORATION

TIME CODE INSTRUMENTS

CHRONO-LOG TIME CODE GENERATORS provide serial modulated carrier and DC level shift codes for recording time on analog magnetic tape recorders, oscillographic strip chart recorders, and for transmission to emote locations.

CHRONO-LOG TIME CODE READERS accept the serial modulated carrier time codes from tape recorders or transmission links and provide both a visual display of digital time and BCD parallel outputs for data systems and tape search control systems.



SERIES 9,000 TIME CODE READER
TIME CODE GENERATOR/READER

- Low cost
- Low profile 1¾″ panel height
- IRIG-A, B, E or XR-3 codes
- "On time" update
- LED dot-matrix shaped-character display
- Single or multi-code models

The Generator/Reader time base can be either an external frequency or one of several internal oscillators with stabilities to ±1 x 10^{-7} per week. Semi-automatic synchronization to WWV is provided.

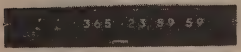
As a Reader, the AGC amplifier accepts inputs in the forward direction at amplitudes from 350 mv. to 5 V peak-to-peak and frequencies from 100 Hz to 100 KHz. In multi-code models, the code format is automatically detected while reading. Buffered TTL compatible parallel BCD outputs are standard, with time resolution to the nearest millisecond available. Code formats can include day-of-year information.

SERIES 4,000 TIME CODE GENERATOR
SERIES 7,000 TIME CODE GENERATOR

- IRIG and NASA Codes
- Oscillographic (Slow) Codes
- LED, NIXIE® or BCD displays
- Single or multi-code models

The Time Code Generator time base can be either an external frequency or one of several internal oscillators with stabilities up to ±1 x 10^{-7} per week. Semi-automatic synchronization to WWV is provided. Options include oscillographic slow codes for recording on graphic recorders. Time Codes can include day of year. The Series 7,000 Time Code Generators are multi-code models providing five (5) code formats simultaneously.

Parallel TTL compatible buffered BCD outputs for hours, minutes, seconds, and days where applicable, are standard.



SERIES 5,000 TIME CODE READER
SERIES 6,000 TIME CODE GENERATOR/READER

- Forward and reverse reading
- IRIG and NASA Codes
- Switch selectable IRIG A, B or E models
- "On-time" update
- 0.6″ or 0.8″ NIXIE® type displays
- Parallel BCD outputs to milliseconds
- Error bypass and digital filtering
- Oscillographic Slow Codes option
- Advance/Retard option

The Series 5,000 Time Code Readers can read in both forward and reverse directions. The AGC amplifier in the Time Code Reader accepts input amplitudes from 350 mv. to 5.0 V peak-to-peak at frequencies from 100 Hz to 100 KHz. An error switch on the front panel allows the Reader to bypass 0, 1, 2, 4, 8 or infinite successive error frames.

The Series 6,000 Generator/Readers combine in a single unit the features of the Series 4,000 Generators and Series 5,000 Readers and are available with or without day-of-the-year calendars.

When used with the Series 8,000 Tape Search Control, the Time Code Generator/Reader functions as a complete Generator and Automatic Tape Search Control System for data retrieval and analysis.

SERIES 8,000
TAPE SEARCH CONTROL

- Fast forward and fast reverse search
- Single cycle or repeat cycle playback
- START/STOP resolutions to 0.1 millisecond depending on code
- Five modes of operation
- Momentary or maintained contact outputs for tape control

The Series 8,000 Automatic Tape Search Control Unit converts a Series 5,000 Reader or Series 6,000 Generator/Reader into an automatic tape playback control unit for searching, editing and data reduction of analog magnetic tape recordings.

The Tape Search Control Unit controls the tape drive to search for desired segments of data at high speed; playback the segment at normal speed; start and activate external data reduction equipment; recycle the tape drive at high speed to replay the desired segment as if it were a tape loop; and stop the tape drive at the end of the desired segment.

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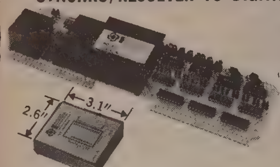
SYNCHRO CONVERTERS/DISPLAYS/ENCODERS

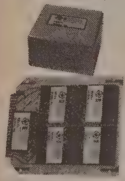
STANDARD LOW COST UNITS TO SATISFY ALMOST ANY SYNCHRO/RESOLVER OR SHAFT INTERFACING REQUIREMENT

SYNCHRO/RESOLVER TO DIGITAL Series SDC40/60



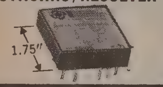
INPUT: 11.8/90 vrms L-L, 60 or 400 Hz. Ref: 26/115 vrms. **OUTPUT:** 14, 12 or 10 bits parallel binary or BCD. **ACCURACY:** ±4, ±6 or ±30 minutes of arc. **PACKAGE:** A) 2.6" x 3.1" x .82"h Module B) 2.6" x 9.25" x .9"h or 4.5" x 6.5" x .75"h repairable PC card.

SYNCHRO/RESOLVER TO LINEAR DC Series SLD200



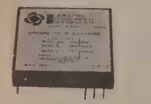
INPUT: 11.8/90 vrms L-L, 60 or 400 Hz. Ref: 26/115 vrms. **OUTPUT:** A) −10 to +10 vdc linear with angles from −180° to +180° B) −10 to +10 vdc linear with angles from −90° to +90° C) 0 to +10 vdc linear with angles from 0° to 360°. **ACCURACY:** ±15, ±30, or ±60 minutes of arc. **PACKAGE:** A) 3.2" x 3.4" x 1.8"h Module B) 4.5" x 6.5" x .75"h repairable PC Card.

SYNCHRO/RESOLVER TO SINE-COSINE DC Series SD100



INPUT: 11.8/90 vrms L-L, 60 or 400 Hz. Ref: 26/115 vrms. **OUTPUT:** ±10 sin θ vdc; ±10 cos θ vdc. **ACCURACY:** ±2 or ±4 minutes of arc. **PACKAGE:** 1.75" x 1.75" x .6"h or 3" x 3" x .625"h Module.

INVARIANT SYNCHRO/RESOLVER TO SINE-COSINE Series SD100 I

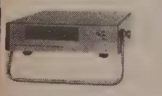


INPUT: 11.8/90 vrms L-L, 60 or 400 Hz. Ref: 26/115 vrms. **OUTPUT:** ±10 sin θ vdc, ±10 cos θ vdc. **ACCURACY:** ±4 minutes of arc. **INVARIANCY:** A ±10% change in the input or reference voltage results in a ±.5% change in the individual DC outputs. **PACKAGE:** 3" x 3" x .625"h Module.

SYNCHRO ANGLE INDICATOR Series AI400

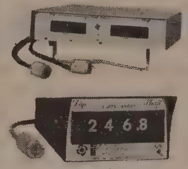
INPUT: 11.8/90 vrms L-L, 60 or 400 Hz. Ref: 26/115 vrms. **OUTPUT:** 5 Digit display and BCD data. **ACCURACY:** ±.1° or ±.05° with .02° resolution. **PACKAGE:** 9.5"w x 1.75"h x 12" Deep — Bench or Rack Mounting.

BINARY ANGLE INDICATOR (BINARY TO BCD) Series BAC100



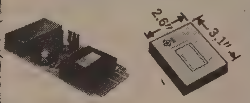
INPUT: Up to 16 bits of parallel binary data, TTL compatable. **OUTPUT:** 5 digit display of angle (0° to 359.99°) OR ANY OTHER SCALE FACTOR DESIRED FROM 0 TO 99999 REPRESENTING ENCODER POSITION, RANGE, PRESSURE, WEIGHT, ETC. **ACCURACY:** ±.01° (±1 lsb). **PACKAGE:** A) 7.0"w x 1.75"h x 8.25" deep — Bench or Rack Mounting B) 4.5" x 6.5" x 1.8"h PC Board requiring +5 vdc at 1 amp C) 2.6" x 3.1" x .82h Module.

SHAFT TO DIGITAL (ENCODERS) Series DS70 & DS100



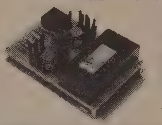
INPUT: Shaft angle position, coupled to "DIGI-SHAFT" system. **OUTPUT:** Four digit display (0° to 359.9°) + BCD data available. **ACCURACY:** ±.1° from shaft position input to digital output. **PICKOFF:** Resolver (Size 15 — 1.4"od x 2.6"L). **PACKAGE:** A) SINGLE AXIS (DS70) — 3.5"h x 8"w x 12.5" deep — Bench/Rack Mount B) DUAL AXIS (DS100) — 3.5"h x 16"w x 12" deep — Bench/Rack Mount.

DIGITAL TO SYNCHRO/RESOLVER Series DSC40/60



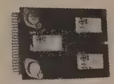
INPUT: 14, 12 or 10 bits parallel binary and 26/115 vrms reference. **OUTPUT:** 11.8/90 vrms. L-L, 60 or 400 Hz capable of driving 1VA, 2VA or 5VA LOADS: (up to 3 T.R.'s). **ACCURACY:** ±4, ±15 or ±30 minutes. **PACKAGE:** A) 2.6" x 3.1" x .82"h Module B) 4½" x 9¼" PC Card with edge connector (5VA units).

DC ANGLE TO SYNCHRO/RESOLVER Series LDS500



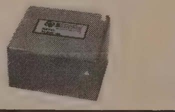
INPUT: ±10 vdc or ±100 vdc representing ±180° of angle. **OUTPUT:** 11.8/90 vrms L-L, 60 or 400 Hz capable of driving up to three size 11 T.R.'s (75 ohms L-L). **ACCURACY:** ±15 or ±30 minutes of arc. **PACKAGE:** (3) repairable 4.5" x 6.5" x 1"h PC Boards stacked with one edge connector.

DC SIN COS TO SYNCHRO DRIVERS Series DCS400



INPUT: ±10 vdc representing sin θ and cos θ. **OUTPUT:** 11.8/90 vrms L-L, 60 or 400 Hz capable of driving up to three size 11 T.R.'s (75 ohms L-L). **ACCURACY:** ±6, ±15, ±30 minutes of arc. **PACKAGE:** A) 4.5" x 6.5" x .8"h repairable PC Card. B) 4.5" x 9.25" x 1"h PC Card.

RECTANGULAR TO POLAR Series RP600



INPUT: R sin θ and R cos θ from 50 mv to 10 vdc. **OUTPUT:** R and θ. **ACCURACY:** θ: ±15 minutes at R = 10, R: ±.1% F.S. **PACKAGE:** 3.2" x 3.4" x 1.8"h Module.

ADDITIONAL PRODUCTS

- Hi Speed Multiplexed Syn to Digital
- Multiplexed Syn to Linear DC
- Digital Sin-Cos to Synchro
- Incremental Encoder Readouts
- Selsyn to Digital/DC
- Polar to Rectangular

ALL SYNCHRO INPUT/OUTPUT UNITS

- Available in 0°C to 70°C or −55°C to +85°C temperature range
- TTL compatable outputs and inputs
- Operate from ±15 v, or ±15 and +5 vdc
- Transformer isolated inputs/outputs
- Solid State construction
- CAN BE MADE FIELD OR FACTORY REPAIRABLE
- Available hermetically sealed and to MIL SPECS (E-5400)
- Delivery: Stock to 4 weeks (small quantity)

SPECIAL UNITS AND PACKAGES AVAILABLE ON REQUEST

Write or phone for detailed specifications, applications assistance and evaluation units.

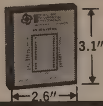
COMPUTER
CONVERSIONS
CORPORATION

6 DUNTON COURT, EAST NORTHPORT, NEW YORK 11731 / (516) 261-3300

SYNCHRO CONVERTERS/DISPLAYS/ENCODERS

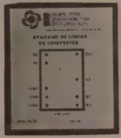
STANDARD LOW COST UNITS TO SATISFY ALMOST ANY SYNCHRO/RESOLVER OR SHAFT INTERFACING REQUIREMENT

SYNCHRO/RESOLVER TO BCD Series SBC



INPUT: 11.8/90vrms L-L, 60 or 400 Hz. Ref. 26/115vrms **OUTPUT:** 3 or 4 decade BCD — scaleable unipolar or bipolar. **ACCURACY:** ±30 or ±6 minutes of arc ±1 LSB. **PACKAGE:** 2.6" x 3.1" x .82" H Module. **OPTIONS:** Choice of Scale factors, Zero offset adjustments (±5%).

SYNCHRO/RESOLVER TO LINEAR DC — (HI-ACCURACY) Series SLD



INPUT: 11.8/90vrms L-L, 60 or 400 Hz., Ref: 26/115vrms. **OUTPUT:** (A) −10 to +10 vdc linear with angles from −180° to +180° (standard) (B) 0 to +10V DC linear with angle from 0° to 360° (special): **ACCURACY:** ±6 minutes of arc at input speeds up to 1440°/sec: **PACKAGE:** (A) 2.6" x 3.1" x .82"H Module; (B) 3.06" x 2.6" x 3.18"H Can.

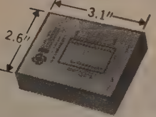
LOW COST ANGLE INDICATOR Series AI540

INPUT: 11.8/90vrms L-L, 60 or 400 Hz, Ref: 26/115vrms +115V 60 Hz power: **OUTPUT:** 4 digit or 3 digit, .5"H LED DISPLAY (unipolar or bipolar). **ACCURACY:** ±6 or ±30 minutes of arc ±1 LSB: **PACKAGE:** (A) 5.5"W x 7.5"L x 2.0"H PANEL MOUNT (DC supplies included): (B) 9½"W x 1¾"H, half rack mounting (DC supplies included. **OPTIONS:** Choice of scale factors, Zero offset adjustment (±5°).

MULTIPLEXED SYNCHRO TO DIGITAL Series MSH

INPUT: 11.8/90vrms L-L, 60 or 400 Hz., Ref: 26/115v rms, up to 128 channels; **OUTPUT:** 12 bit parallel binary or 4 decade BCD (unipolar or bipolar: **ACCURACY:** ±6 minutes of arc ±1 LSB: **PACKAGE:** (A) Central converter — 2.6" x 3.1" x .82"H module, (B) Input Module — 1.5" x 2.0" x .6"H, (C) Transformer Module — 1.5" x 1 3/16" x .6"H (Scott "T" — 400 Hz) +1" x 1" x .8"H (Ref.). **OPTIONS:** (A) choice of scale factor on BCD output, (B) Linear DC output, (C) Systems mounted on PC boards and/or racks.

MULTISPEED SYNCHRO TO DIGITAL Series TSD



INPUT: 11.8-90vrms L-L, 60 or 400 Hz., Ref: 26/115 vrms: **SPEEDS:** 8, 16, 32, 9, 18, and 36: **OUTPUTS:** 16 to 19 bits parallel binary: **ACCURACY:** ±.02, ±.01 or ±.005 degrees: **PACKAGE:** Two or Three 2.6" x 3.1" x .82"H modules. **OPTIONS:** (A) Systems packaged on PC Cards or in racks; (B) 5 digit display.

ABSOLUTE ENCODERS Series DS90

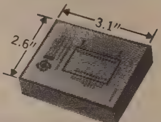
INPUT: Shaft angle position coupled to "DIGI-SHAFT" system: **OUTPUT:** four digit (.5"H) LED display (0 to 9999) +BCD or Parallel binary data (ANY SCALE FACTOR DESIRED): **ACCURACY:** ±1 part in 3600 (single turn) From shaft input to digital output: **PICKOFF:** Resolver (Size 8, 11, or 15): **PACKAGE:** (A) 5.44"W x 7.00" x 1.75"H: (B) Full or half rack: **OPTIONS:** Multi-channels, Zero offset, Presets, DC output, Multi-turn units with 5 digit (99999) output.

TYPICAL UNITS (single Turn)

Pt. No.	Output	Counts/360°
DS90-DB-12	Binary Data	2^{12}
DSR90-36-BC	0-3599 display +BCD data	3600
DSR90-10	0-999 display	1000
DSR90L-25-BC	0 to ±2500 display +BCD data	±2500

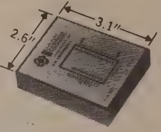
FULL SCALE OUTPUTS OF UP TO 9999 AVAILABLE

SOLID STATE CONTROL TRANSFORMER Series SCT



DIGITAL INPUT ANGLE (ϕ): 14, 12, or 10 bits parallel binary. **SYNCHRO/RESOLVER INPUT ANGLE** (θ): −11.8/90vrms L-L, 60 or 400 Hz. **OUTPUT:** E out=(V ref ±7%) sin (θ-ϕ) Sin wt: **GRADIENT:** .4 or 1vrms/degree. **RANGE:** ±7 or ±12.5 degrees: **ACCURACY:** ±4, ±15, or ±30 minutes of arc. **PACKAGE:** 2.6" x 3.1" x .82"H Module.

SOLID STATE CONTROL DIFFERENTIAL TRANSFORMER Series SCDX

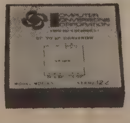


DIGITAL INPUT ANGLE (ϕ): 14, 12, or 10 bits parallel binary. **SYNCHRO/RESOLVER INPUT ANGLE** (θ): 11.8/90vrms L-L, 60 or 400 Hz. **OUTPUT:** (1) 9.2K (ϕ) Sin (θ-ϕ) Sin wt. [7vrms.] (2) 9.2K (ϕ) Cos (θ-ϕ) Sin wt. [7vrms.] **ACCURACY:** ±4, ±15 or ±30 minutes of arc. **PACKAGE:** 2.6" x 3.1" x .82"H.

MODULATORS Series MOD500

INPUT: 0 to ±10 or ±100 VDC and 26V/115Vrms reference: **OUTPUT:** 0 to 7vrms (other voltages available. **ACCURACY:** ±.2% F.S.: **NULL:** ±.1% F.S. **PACKAGE:** 2.6" x 3.1" x .625" Module. **OPTIONS:** Gain+Zero Adjust, external output transformers.

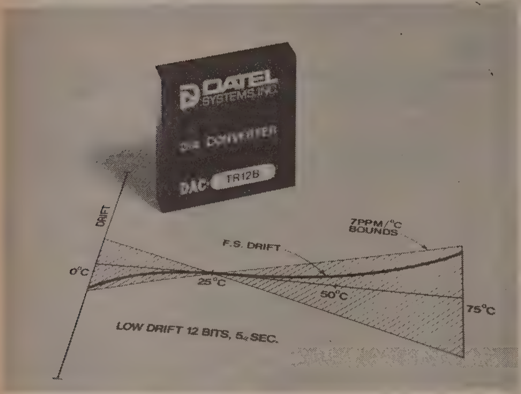
DEMODULATORS Series D400



INPUT: 0 to 5, 10, 25 or 100vrms, 400 to 5000 Hz, 5/26vrms reference. **OUTPUT:** 0 to ±5 or ±10VDC. **ACCURACY:** ±.2, .3 or .5% F.S. **NULL:** ±.1% F.S. **PACKAGE:** (A) 1.75" x 1.75" x .6"H Module. (B) 2.75" x 1.4" x .75"H Module.

COMPUTER CONVERSIONS CORPORATION 6 DUNTON COURT, EAST NORTHPORT, NEW YORK 11731 / (516) 261-3300

MODULAR DIGITAL-TO-ANALOG CONVERTERS



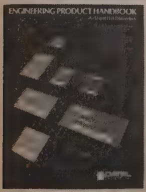
Datel's line of D/A Converter Modules shown below is one of the broadest lines in the industry, offering the user an extremely wide range of performance parameters and prices. Resolutions of 6 through 16 binary bits are offered with either current or voltage outputs and with 2 to 4 digit BCD input coding available. Almost all models can be operated with either unipolar or bipolar outputs by means of external pin connection. All units except the two lowest cost models have internal ultra stable voltage references with exceptionally low temperature coefficients and excellent long term stability. Settling times down to 25 nanoseconds are available for high speed display applications. A series of low power converters which are CMOS compatible are specifically designed for portable and remote instrumentation applications. Both 2 and 4 quadrant multiplying D/A converters with wideband reference inputs are also part of the Datel line. All of these converters are packaged in compact low profile (.375 inch high) cases with dual in-line spacing and are factory repairable.

The rapid selection guide shown below permits quick selection of model series.

RAPID SELECTION GUIDE

CONVERTER TYPE	SERIES	RESOLUTION	INPUT CODES	OUTPUT (Voltage/ Current)	OUTPUT SETTLING TIME*	TEMPERATURE COEFFICIENT	1-9 PRICE
ECONOMY GENERAL PURPOSE	DAC-9	8 Bits	Bin, BCD	Current	500 nsec.	100ppm/°C	$14.95
	DAC-19	8 Bits	Bin, BCD	Both	300 nsec./20 µsec.	50ppm/°C	$29.00
	DAC-29	8 Bits	Bin, BCD	Voltage	5 µsec.	50ppm/°C	$39.00
	DAC-49	10 Bits	Bin, BCD	Both	300 nsec./5 µsec.	50ppm/°C	$49.00
	DAC-69	12 Bits	Bin	Both	300 nsec./20 µsec.	50ppm/°C	$59.00
GENERAL PURPOSE, HIGH PERFORMANCE	DAC-HB	8, 10, 12 Bits	Bin, BCD	Voltage	5 µsec.	30ppm/°C	$65-$89
	DAC-I	8, 10, 12 Bits	Bin, BCD	Current	150 nsec.	15ppm/°C	$69-$89
	DAC-R	8, 10, 12 Bits	Bin, BCD	Voltage	5 µsec.	30ppm/°C	$69-$79
	DAC-TR	8, 10, 12 Bits	Bin, BCD	Voltage	5 µsec.	7ppm/°C	$129-$179
	DAC-V	8, 10, 12 Bits	Bin, BCD	Voltage	1 µsec.	20ppm/°C	$79-$119
	DAC-VR	8, 10, 12 Bits	Bin, BCD	Voltage	1 µsec.	20ppm/°C	$89-$129
HIGH SPEED	DAC-FI	8, 10 Bits	Bin	Current	100 nsec.	30ppm/°C	$89-$109
	DAC-GI	8, 10 Bits	Bin	Current	50 nsec.	30ppm/°C	$99-$119
	DAC-HI	8, 10, 12 Bits	Bin	Current	25 nsec.	15ppm/°C	$99-$129
	DAC-HV	6, 8, 10 Bits	Bin	Voltage	50 nsec.	60ppm/°C	$169-$189
HIGH RESOLUTION	DAC-HR	13, 14, 15, 16 Bits	Bin	Current	1 µsec.	1.5ppm/°C	$249-$299
	DAC-169	16 Bits	Bin, BCD	Both	750 nsec./30 µsec.	10ppm/°C	$109.00
LOW POWER	DAC-CM	8, 10, 12 Bits	Bin	Voltage	25 µsec.	30ppm/°C	$119-$139
MULTIPLYING 2 & 4 QUADRANT	DAC-MI	8, 10, 12 Bits	Bin, BCD	Current	150 nsec.	30ppm/°C	$119-$159
	DAC-MV	8, 10, 12 Bits	Bin, BCD	Voltage	4 µsec.	30ppm/°C	$119-$159

* For series with both current and voltage outputs the current output settling time is shown first.



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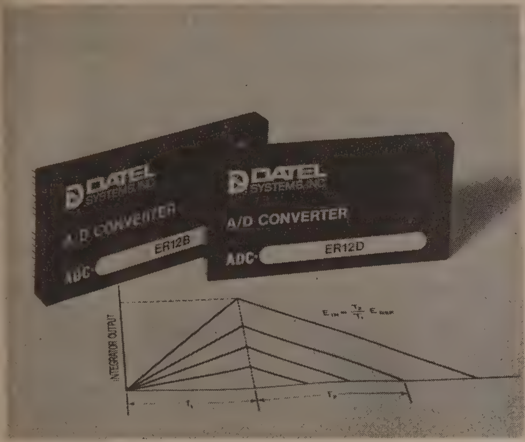
MODULAR ANALOG-TO-DIGITAL CONVERTERS



Datel's A/D Converter product line is an extremely broad offering of different models, giving the user a choice of converter types, specifications, and prices to meet his specific requirements. The conversion methods employed in this line include counter type units for the lowest cost models, successive approximation types used for most of the economy and high performance units, dual slope integrating types used for high noise rejection models, and the parallel and parallel-serial types used for the very fast converters. Resolutions from 4 through 14 bits are offered with conversion times from 40 nanoseconds to 5 milliseconds. Output codes available are binary, BCD, offset binary and two's complement; either unipolar or bipolar inputs can be accepted by external pin connection on most models. Stable compensated voltage reference sources and low T.C. resistor networks result in low temperature coefficients in these converters down to ±10ppm/°C. Most models have parallel data outputs, serial data output, and end of conversion (status) output. A series of low power CMOS converters provides 8, 10, and 12 bit conversion with very low power consumption for portable and remote instrumentation applications. All Datel A/D converters are packaged in compact .375″ to 1.15″ high modules with dual-in-line pin spacing and are factory repairable.

The rapid selection guide shown below permits quick selection of models.

RAPID SELECTION GUIDE

CONVERTER TYPE	SERIES	RESOLUTION	OUTPUT CODES	CONVERSION TIME	TEMPERATURE COEFFICIENT	1-9 PRICE
ECONOMY GENERAL PURPOSE	ADC-Econov.	6 Bits	Bin	50 μsec.	100ppm/°C	$29.95
	ADC-89A	8 Bits	Bin, BCD	100-200 μsec.	50ppm/°C	$69.00
	ADC-D	8, 10, 12 Bits	Bin	50 μsec.	50ppm/°C	$79-$129
	ADC-K	8, 10, 12 Bits	Bin	50 μsec.	30ppm/°C	$109-$139
	ADC-MA	10, 12 Bits	Bin	40 or 20 μsec.	30ppm/°C	$95-$145
GENERAL PURPOSE HIGH PERFORMANCE	ADC-L	8, 10, 12 Bits	Bin, BCD	12-20 μsec.	10ppm/°C	$135-$175
	ADC-M	8, 10, 12 Bits	Bin, BCD	4-13 μsec.	10ppm/°C	$229-$349
	ADC-149	14 Bits	Bin	50 μsec.	15ppm/°C	$239.00
HIGH SPEED	ADC-EH8B	8 Bits	Bin	4.0 or 2.0 μsec.	50ppm/°C	$85-$129
	ADC-EH10B	10 Bits	Bin	4.0 or 2.0 μsec.	40ppm/°C	$149-$189
	ADC-EH12B	12 Bits	Bin	8.0 or 4.0 μsec.	30ppm/°C	$169-$229
	ADC-N	10, 12 Bits	Bin	4.0 μsec.	20ppm/°C	$385-$485
	ADC-P	8, 10 Bits	Bin	2.0 μsec.	20ppm/°C	$420-$430
	ADC-H	4, 6, 8, 10 Bits	Bin	400 nsec.-1.0 μsec.	20ppm/°C	$545-$895
	ADC-G	8, 10 Bits	Bin	800 nsec.-1.0 μsec.	50ppm/°C	$249-$349
	ADC-VH	4, 6, 8 Bits	Bin	100-200 nsec.	50ppm/°C	$795-$895
	ADC-UH	4, 6, 8 Bits	Bin	40-100 nsec.	50ppm/°C	$895-$995
DUAL SLOPE	ADC-E	8, 10, 12 Bits	Bin, BCD	312 μsec.-5 msec.	50ppm/°C	$79-$99
	ADC-ER	8, 10, 12 Bits	Bin, BCD	43-77 msec.	35ppm/°C	$79-$99
LOW POWER CMOS	ADC-CM	8, 10, 12 Bits	Bin	350 μsec.	30ppm/°C	$249-$289

ENGINEERING PRODUCT HANDBOOK
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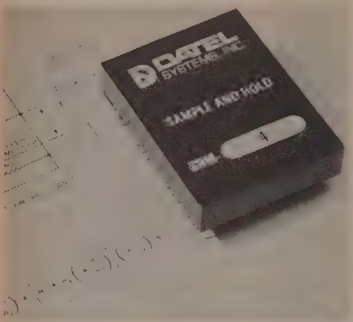
SAMPLE-HOLD MODULES



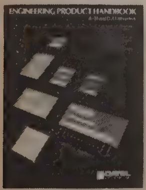
This broad line of sample and hold modules offers the user a wide range of price and performance parameters for data acquisition applications. Sample and holds are also useful in a number of other applications including waveform measurements, sample-data control systems, analog delay, and analog storage. In data conversion applications sample and holds are used to reduce the conversion uncertainty of a time varying signal. By taking a sample of the signal in a very short time the conversion can be performed over a larger time period while the sample and hold is in the hold mode. Datel's line of sample and holds has models which are optimized for different applications such as high speed, high accuracy, low power consumption, and simultaneous sampling. All units feature high linearity, low temperature coefficient, low hold mode feedthru, and low aperture delay times. The control inputs are DTL/TTL compatible with some units also CMOS compatible. All units have a built-in hold mode accuracy adjustment on the side of the module.

SPECIFICATIONS (±25°C)	MODERATE SPEED HIGH ACCURACY SHM-1	HIGH SPEED MODERATE ACCURACY SHM-2	LOWEST COST HIGH ACCURACY SHM-3	HIGH ACCURACY ADJ. APERTURE DELAY SHM-4	VERY LOW POWER CONSUMPTION SHM-CM	ULTRA FAST, 200 PSEC. APER. UNCERT. SHM-UH	INTEGRATED CIRCUIT SHM-IC-I
Accuracy, FS zeroed	±.025% FS	±0.1% FS	±.005% FS	±.005% FS	±.01% FS	——	——
Gain	+1.00	+1.00	+1.00	+1.00	+1.00	+.92 to .98	±1.0
Linearity	±.01% FS	±0.1% FS	±.005% FS	±.005% FS	±.01% FS	±0.5% FS	±.01% FS
Temp. Coefficient	±20 μV/°C	±30 μV/°C	±30 μV/°C	±30 μV/°C	±30 μV/°C	±50 μV/°C	±20 μV/°C
Hold Mode Droop	1 mV/msec.	50 μV/μsec.	20 μV/msec.	20 μV/msec.	1 mV/ nsec.	50 μV/μsec.	50 μV/msec.
Analog Voltage Range	±10V FS[1]	±10V FS	±10V FS	±10V FS	±12V FS	±5V FS	±10V FS
Input Impedance	100 Meg.	200 pF +4Ω[1]	100 Meg.	100 Meg.	1000 Meg.	100 Meg.	100 Meg.
Output Current, Max.	±5 mA	±5 mA	±5 mA	±5 mA	±2 mA	±30 mA	±10 mA
Acquisition Time	5 μsec.	100 nsec.	50 μsec.	7 μsec.	70 μsec.	50 nsec.	4 μsec.
Aperture Delay	50 nsec.	10 nsec.	40 nsec.	40 nsec.	20 nsec.	10 nsec.	50 nsec.
Bandwidth, −3dB	650 kHz	10 MHz	100 kHz	1 MHz	40 kHz	60 MHz	2 MHz
Output Slew Rate	30V/μsec.	30V/μsec.	0.5V/μsec.	5Vμsec.	0.4V/μsec.	500V/μsec.	5V μsec.
Hold Mode Feedthru	−68 dB	−46 dB	−80 dB	−80 dB	−80 dB	−60 dB	−80 dB
Power Requirement	±15VDC @ 20 mA[1]	±15VDC @ 35 mA	+15VDC @ 14 mA −15VDC @ 12 mA	+15VDC @ 14 mA −15VDC @ 12 mA	±15VDC @ 1 mA	±15VDC @ 50 mA +5VDC @ 100 mA	±15VDC @ 5 mA
Temp. Range, Operating	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +70°C	0°C to +75°C
Case Size	2″ x 1″ x .375″	2″ x 1″ x .375″	2″ x 1.5″ x .375″	2″ x 1.5″ x .375″	2″ x 1.5″ x .375″	2″ x 2″ x .375″	TO-116 DIP
Price (1-9)	**$69.00**	**$89.00**	**$49.00**	**$59.00**	**$89.00**	**$349.00**	**$29.00**

WIDEBAND OPERATIONAL AMPLIFIERS

SPECIFICATIONS (25°C)	400 NSEC. SETTLING AM-100 A / B / C	HIGH CAPACITIVE LOAD AM-101 A / B	HIGH SPEED FET FOLLOWER AM-102 A / B	HIGH SLEW RATE AM-103 A / B	±110 VOLT OUTPUT AM-301 A / B	±140 VOLT OUTPUT AM-302 A / B
DC Gain, Rated Load	500,000	500,000	400,000	400,000	1,000,000	1,000,000
Gain Bandwidth Product	18 MHz	7 MHz	45 MHz	45 MHz	7 MHz	7 MHz
Full Power Response	900 kHz	900 kHz	2 MHz	6 MHz	150 kHz	150 kHz
Slew Rate	60V/μsec.	60V/μsec.	140V/μsec.	400V/μsec.	100V/μsec.	100V/μsec.
Setting Time to .01%	0.4 μsec.	1.0 μsec.	0.4 μsec.	0.3 μsec.	2.5 μsec.	2.5 μsec.
Com. Mode Voltage Range	±10V	±10V	±10V	±10V	±50V	±135V
Input Impedance	10^{12} ohms	10^{12} ohms	10^{12} ohms	10^{12} ohms	10^{12} ohms	10^{12} ohms
Common Mode Reject. Ratio	10,000	40,000	40,000	10,000	100,000	100,000
Output Voltage, Min.	±10V	±10V	±10V	±10V	Vcc −10V (±110V Max.)	Vcc −10V (±140V Max.)
Output Current	±20 mA	±20 mA	±20 mA	±20 mA	±20 mA	±20 mA
Capacitive Load	300 pF	5000 pF	300 pF	300 pF	500 pF	500 pF
Offset vs Temp. Max. μV/°C	50 / 25 / 10	40 / 20	40 / 20	40 / 20	50 / 20	50 / 20
Bias Current, pA Max.	100 / 50 / 20	50 / 20	50	50	30	30
Bias Current vs Temp.	2x/10°C	2x/10°C	2x/10°C	2x/10°C	2x/10°C	2x/10°C
Power Requirement	±15VDC @ 13 mA	±15VDC @ 13 mA	±15VDC @ 18 mA	±15VDC @ 18 mA	±60 to 120VDC @ 10 mA	±60 to 150VDC @ 10 mA
Temp. Range, Operating	−25°C to +85°C	−25°C to +85°C	−25°C to +85°C	−25°C to +85°C	−25°C to +85°C	−25°C to +85°C
Case Size	1.12″x1.12″x0.4″	1.12″x1.12″x0.4″	1.12″x1.12″x0.4″	1.12″x1.12″x0.4″	2.4″x1.8″x0.61″	2.4″x1.8″x0.61″
Price (1-9)	**$40 / $45 / $52**	**$46 / $52**	**$49 / $55**	**$49 / $55**	**$75 / $85**	**$90 / $120**

NOTE: [1] For ±10V input and output range a −20VDC negative power supply must be used. With ±15VDC power supply the input and output signal range is −5V to +10V.



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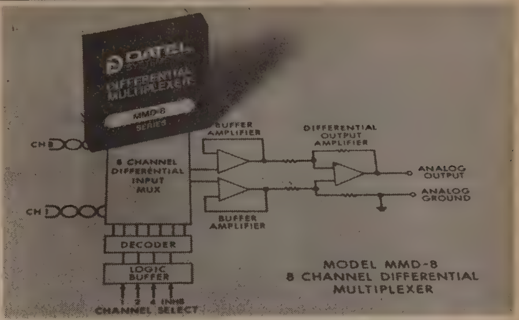
ANALOG MULTIPLEXERS



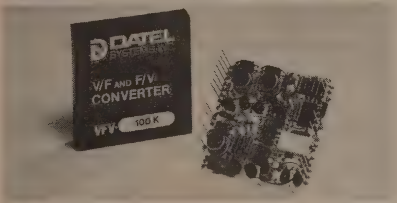
MODEL MMD-8
8 CHANNEL DIFFERENTIAL
MULTIPLEXER

This line of analog multiplexer modules offers a choice of operating features for data acquisition system applications. It includes 8 and 16 channel single ended models and an 8 channel differential model. All units use MOS-FET switches with high speed break-before-make switching and associated driver and logic circuitry. Channel selection is accomplished by parallel binary inputs which are DTL/TTL compatible on all models and also CMOS compatible on the MMD-8 and MM-16. Input and output voltage ranges are ±10 Volts on all models with a transfer accuracy of .01%. Channel sequence rate is 500 kHz on all units.

SPECIFICATIONS (25°C)	8 CHANNEL SINGLE ENDED MM-8	8 CHANNEL DIFFERENTIAL WITH OUTPUT BUFFER MMD-8	16 CHANNEL SINGLE ENDED WITH OUTPUT BUFFER MM-16
PERFORMANCE			
Number of Inputs	8, single ended	8, differential	16, single ended
Analog Voltage Range	±10V FS[1]	±10V FS	±10V FS
Channel ON Resistance	300 ohms	2K ohms	2K ohms
Channel OFF Resistance	100 Meg.	200 Meg.	200 Meg.
Channel OFF Leakage	.03 nA	.03 nA	.03 nA
Channel Selection	4 bit binary DTL/TTL compatible	3 bit binary DTL/TTL/CMOS compatible	4 bit binary DTL/TTL/CMOS compatible
INPUT-OUTPUT ACCURACY	±.01% of FS	±.01% of FS	±.01% of FS
GAIN	+1.00	+1.00	+1.00
SETTLING TIME	1 μsec. to .01%	1 μsec. to .01%	1 μsec. to .01%
CHANNEL SEQUENCE RATE	500 kHz	500 kHz	500 kHz
OUTPUT AMPLIFIERS			
Output Voltage	——	±10V FS @ 10 mA	±10V FS @ 5 mA
Slew Rate	——	100V/μsec.	120V/μsec.
Settling Time, 20V Step.	——	4 μsec to .01%	3 μsec. to .01%
POWER REQUIREMENT	+15VDC @ 3 mA, −15 VDC @ 6 mA +5VDC @ 26 mA	±15VDC @ 20 mA	±15VDC @ 6 mA
TEMPERATURE RANGE, Operating	0°C to +70°C	0°C to +70°C	0°C to +70°C
CASE SIZE	2″ x 1″ x .375″	2″ x 2″ x .375″	2″ x 1.5″ x .375″
PRICE (1-9)	$69.00	$169.00	$129.00

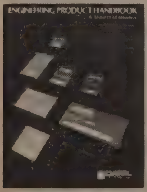
NOTE: [1] Range using −20VDC @ 8 mA negative supply. With ±15VDC supply, range is −5V to +10V.

VOLTAGE TO FREQUENCY CONVERTERS



This new series of converters features universal characteristics permitting use as either a V/F or F/V converter by external pin connection. In addition, by pin connection, voltage inputs of 0 to +10V of 0 to −10V or current inputs of 0 to +1mA or 0 to −1mA may be chosen. The constant width output pulses may be selected to be positive going or negative going with DTL/TTL or CMOS compatibility. These converters use a charge balancing feedback method to generate an output pulse frequency proportional to input voltage or current. This is done with a nonlinearity of only ±.005% maximum for the VFV-10K and ±.05% maximum for the VFV-100K. The linearity holds all the way down to zero input voltage.

SPECIFICATIONS (25°C)	VFV-10K	VFV-100K
Input Voltage Range	0 to +10V or 0 to −10V	
Input Current Range	0 to 1 mA or 0 to −1 mA	
Input Impedance (voltage in)	10K ohms	
Frequency Range	0 to 10 kHz	0 to 100 kHz
Nonlinearity	±.005% max.	±.05% max.
Pulse Width	70 μsec.	7 μsec.
Pulse Polarity	Pos. or Neg. going	Pos. or Neg. going
Output Type	DTL/TTL or CMOS	DTL/TTL or CMOS
Settling Time to .01% (input step)	1 Cycle of new freq.	1 Cycle of new freq.
Gain Temp. Coefficient, Max.	±20 ppm/°C	±200 ppm/°C
Gain vs Time	±100 ppm/day	±100 ppm/day
Input Offset vs Temp., Max.	±10 μV/°C	±10 μV/°C
Input Offset vs Time	±10 μV/day	±10 μV/day
Power Requirement	±15VDC @ 25 mA	±15VDC @ 25 mA
Temperature Range, Operating	0°C to +70°C	0°C to +70°C
Case Size	2″ x 2″ x .375″	2″ x 2″ x .375″
Price (1-9)	$59.00	$79.00



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MINIATURE PANEL-MOUNTING THERMAL PRINTER FOR DPM's

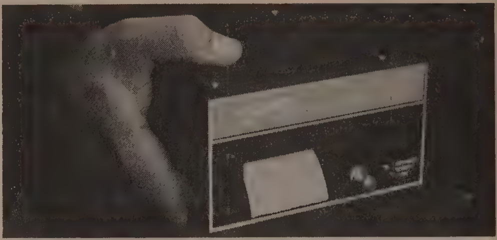
Although specifically designed to mate with Datel's fast growing line of digital panel meters, the DPP-7 is compatible with most BCD output A/D converters and can share the same clock and data bus lines. The unit utilizes a thickfilm thermal printhead to print up to seven columns of BCD input data at a rate of three lines per second maximum.

The DPP-7 accepts six full parallel, four-line BCD (1-2-4-8) digital inputs, and sign, from selectable positive or negative true TTL or DTL logic levels.

The DPP-7 is available as a 5VDC unit with 20W average power consumption (8A pk) and a 115 VAC version with 40W power consumption.

Characters are printed 0.155″ high in seven columns. Format may be sign, selectable left decimal point and then six digits or two identifier digits followed by sign and then four data digits. Print-out is on 1¾″ wide, thermal printing paper which is supplied in 150′ rolls. Only two parts, a linear solenoid and rotary clutch are used to advance the paper.

Front panel, external controls for the DPP-7 include a push-to-print switch which also permits continuous paper advance. In addition, there is an LED pilot lamp to indicate power status.



FEATURES

- Prints seven columns (six numeric and sign) up to 3 lines per second
- Accepts positive or negative true TTL full parallel BCD inputs
- Only 2 moving parts
- Long life, high reliability OEM design
- Last line visible immediately after printing
- 5.25″ W x 2.82″ H x 6.2″ D
- Uses a quiet, inkless 7-segment thermal printhead

SPECIFICATIONS

Print Characters	.155″ H, 7-segment, black on white paper, 10° slant
Maximum Printing Rate	3 lines per second
Print and Paper Advance Cycle	Approximately 330mS
Line Spacing	0.2 inch (5 mm)
Line Density	5 lines per inch
Line Capacity Per Roll	Approximately 9000 lines
Mean Print Head Life	3 million lines

DIGITAL DATA AND CONTROL LINES

(All lines are TTL/DTL logic levels and loading)

Inputs

Data (24 lines): Full parallel BCD
Change Data Polarity
Print and Advance Command: 2 μsec min.
Change Print Polarity
Leading Zero Suppress
Minus Sign
Plus Sign
Decimal Points (6 or 7 lines)
Test: Prints all 8's and decimal points
Change Busy Polarity
Blanked Character: Created by applying 1-1-1-1 to any digit location (may be hard-wired)

Output

Busy: True during print and advance cycle. Data may change 500 nsec after start of busy.
Out of Paper: Switch opening at end of paper roll.

Temperature Ranges

Operating: 0° to +40°C
Storage: −25°C to +60°C

Front Panel

Paper Quantity: Mechanical pointer rides paper roll and coupled to out of paper switch.
Print/Remote/Advance — 3 position toggle switch momentary in top or bottom positions:
Top: Advance (continuous @ 4 lines/sec)
Center: Enable Remote inputs
Bottom: Print 1 line and stop
Ext. inputs enabled

Power Supply

+5VDC: 4 Amps average, 8 Amps pk
AC: 100, 115 or 230VAC, 40 Watts, 47 to 440 Hz. Case Grounded

Connectors:

I/O: (2) 30-pin dual PC edge connectors
Power: ¼″ Spade terminals

Dimensions

Bezel: 5.25″ W x 2.82″ H (134mm x 72mm)
Cutout: 4.50″ W x 2.72″ H (115mm x 69mm)
Depth for connector or fuse clearance:
5V versions: 6.2″ (158mm)
AC versions: 8.7″ (221mm)

ORDERING INFORMATION

PAPER ROLLS
Model 9114, Box of 10 rolls, 150′ per roll — $30

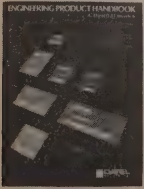
PRICE (1-9, includes connectors) — $475

MODEL NUMBER

DPP-7 ⊤ ⊤

POWER
D = +5VDC
A = 115VAC
J = 110VAC
E = 230VAC

PRINT FORMAT
1 = ±.9.9.9.9.9.9
2 = .9.9 ±.9.9.9.9



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DATEL
SYSTEMS, INC.
1020 TURNPIKE STREET / CANTON, MASS. 02021
TEL. (617) 828-8000 / TWX: 710-348-0135 / TELEX: 924461

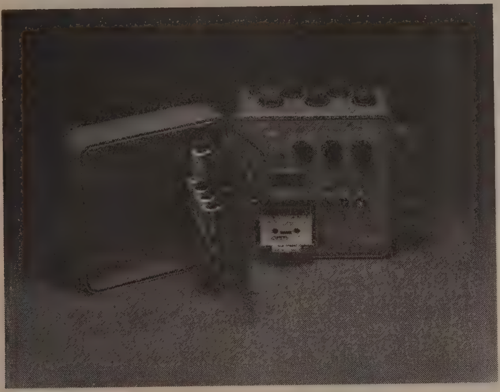
DATA LOGGING SYSTEMS

Datel Systems has a new approach to data logging . . . complete data logging systems in a module. Through the use of CMOS electronics and incremental digital cassette recorders, Datel Systems has significantly reduced the size, power drain and cost over other systems.

Applications for these new data logging modules include oceanography, pollution monitoring, meteorology, seismology and other remote data logging requirements. Datel's recording systems are also ideal for other scientific data acquisition uses, both in the laboratory and in the field.

Cassette readers are available which transcribe the digital data on the cassette to computer compatible media. These readers may be interfaced to produce ½" IBM tape or to teletype, data terminals, acoustic couplers or directly into the computer.

DL-2 — WEATHERPROOF, 64-CHANNEL CASSETTE DATA LOGGING SYSTEM



For remote recording or long term, unattended measurement of any variable, the battery powered DL-2 will record up to 64 channels of analog data on a digital tape cassette. Housed in a sealed, weatherproof, ruggedized metal case, the DL-2 will operate for more than a year on its internal lithium battery supply in temperatures from −20°C to +85°C.

Philips-type digital cassettes with 300′ of tape are used to record data in selectable scan intervals from one second to 30 hours. The number of channels to be scanned is preset on the front panel. In each scan a 40-bit clock word is recorded before each scan. The clock word contains a 36-bit one year digital clock derived from a CMOS oscillator having one-second resolution.

A complete system weighs 20 lbs., with batteries, and measures 12″ H. x 12″ W. x 10″ D. Depending on channel configuration (high level, low level or mixed), input ranges and coding and the type of internal power supply, the DL-2 is priced between $4000 - $5000.

DL-2T — PORTABLE, BATTERY POWERED, WEATHERPROOF TESTER/CALIBRATOR FOR DL-2

Permits on-site exercising of DL-2 and performs a self-check to ensure the accuracy of its tests.

LPS-16 — LOW POWER, CASSETTE DATA MONITORING SYSTEM

DATEL
RELEASE
PUSH

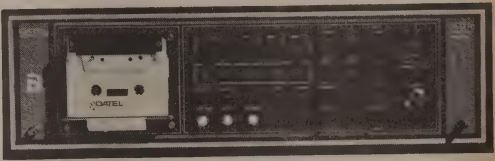
A complete package for recording 16 channel analog data and any number of 16 bit bytes of digital data in serial form. The analog data inputs can be sequentially or randomly multiplexed, converted into digital form, formatted and stored on a standard 300′ Philips tape cassette.

System LPS-16 utilizes CMOS logic throughout, thereby consuming negligible stand-by power (120 microwatts). Only during the actual analog to digital conversion and storage on tape is any appreciable power consumed (960 milliwatts). The system can thus be operated for long periods on battery with low average power.

The LPS-16 weighs only two pounds, exclusive of power source. The 4″ H. x 4½″ W. x 7½″ D. data logging system is priced between $1595 and $1695, depending upon the number of bits and coding, analog input and A/D output format.

CASSETTE READERS

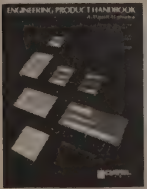
DL-2R — DIGITAL CASSETTE READER AND COMPUTER INTERFACE FOR 64 CHANNEL DL-2 RECORDING SYSTEM



The DL-2R displays digital calendar clock, binary A/D data words, internal octal or external digital header words. Information recorded on tape, such as temperature, pressure, rainfall and wind velocity from external sensors may be transferred directly into a teletypewriter, ½″ tape, mainframe computer or minicomputer data buss using the DL-2R reader. The 19″ wide rack mount unit is priced from $3495 to $4195, depending upon the type of interface.

LPR-16 — CASSETTE TAPE READER/INTERFACE FOR 16 CHANNEL LPS-16 DATA MONITORING SYSTEM

Using the LPR-16, 16 channels of digitized analog data can be fed directly into a minicomputer or mainframe processor or ½″ tape. It will also simultaneously connect directly to a teletypewriter or RS-232C I/O device. The LPR-16 has two side-by-side interface card slots with identical pinout so that two interfaces can be simultaneously connected. The 19″ rack-mount unit is priced from $2095 to $2795, depending on the type of interface required.



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SYSTEMS, INC.

1020 TURNPIKE STREET / CANTON, MASS. 02021
TEL. (617) 828-8000 / TWX: 710-348-0135 / TELEX: 924461

CHECK THIS NEW ECTRON SYSTEM FOR HIGH SPEED DATA ACQUISITION

The 6000 series systems are complete signal processors in a compact, 7-inch high rack mounted package. Each channel has an individual low level amplifier followed by a high level multiplexer, and the system programmable amplifier, sample and hold, and A-D converter. 64-channels are contained within a single chassis and additional increments of 64-channels can be added in slave units. Four pre-amplifiers are packaged on each plug-in module allowing the number of channels within each chassis to be altered in increments of 4-channels.

The basic system is equipped with a 12 bit A-D converter and has a through put rate of 20,000 channels per second. Optionally it can be equipped with A-D converters with higher resolution and/or higher through put rates.

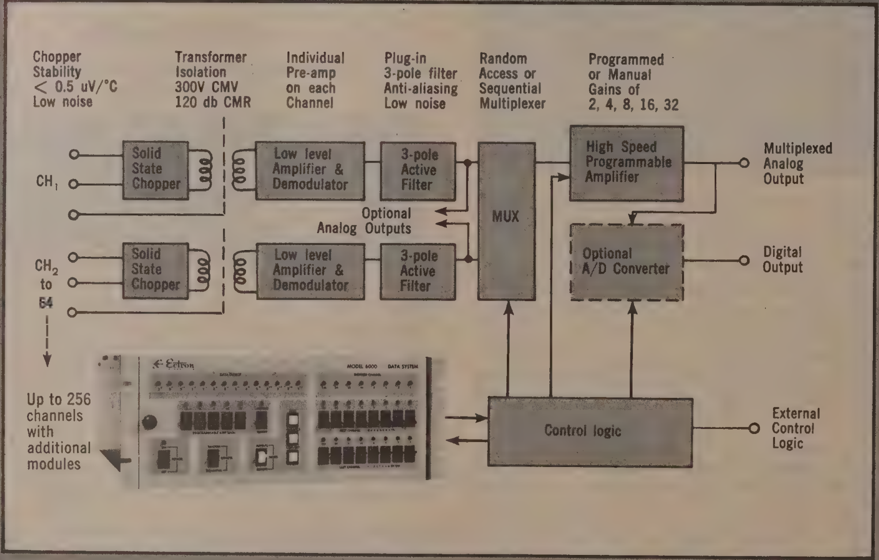
PERFORMANCE ADVANTAGES: With the chopper stabilized pre-amplifier, 1/F noise is very low and dc offset with temperature is less than 0.5 microvolts per °/C. Each channel is equipped with a plug-in three pole filter for anti-aliasing and low output noise. Since it follows the pre-amplifier, it filters both the noise picked up on the input lines and the noise generated by the pre-amplifier. With the optional transformer coupled input amplifier, common mode potentials up to 300 volts dc or peak ac can be accommodated and CMR is in excess of 120 db.

VERSATILITY: All functions and operating modes can be operated under direct computer control, or full manual operation is possible by means of front panel controls. In addition, it is possible to control some functions manually while leaving other selections to the computer.

6000 series systems are available as low level signal processors or can be supplied with complete signal conditioning capability for direct strain gage and thermocouple inputs. This includes strain gage excitation, bridge completion, bridge balance, remote calibration, and thermocouple reference junctions.

All internal circuitry is packaged on plug-in circuit boards which can be removed through the front of the instrument. In addition to convenient servicing, this allows access to optional pre-amplifier gain controls. Pre-amplifier gain can be controlled by a switch on each channel or a low cost plug-in resistor.

KEY FEATURES: • CMV 300 volts, CMR 120db • 0.5 microvolts zero stability • .01% Gain Stability • Plug-in filter • Choice of transformer or direct coupled input pre-amplifier • Choice of interface connectors • Random or sequential access


Chopper Stability < 0.5 uV/°C Low noise
Transformer Isolation 300V CMV 120 db CMR
Individual Pre-amp on each Channel
Plug-in 3-pole filter Anti-aliasing Low noise
Random Access or Sequential Multiplexer
Programmed or Manual Gains of 2, 4, 8, 16, 32
CH1
Solid State Chopper
Low level Amplifier & Demodulator
3-pole Active Filter
MUX
High Speed Programmable Amplifier
Multiplexed Analog Output
Optional Analog Outputs
Optional A/D Converter
Digital Output
CH2 to 64
Solid State Chopper
Low level Amplifier & Demodulator
3-pole Active Filter
Up to 256 channels with additional modules
Ectron
MODEL 6000 DATA SYSTEM
Control logic
External Control Logic

SPECIALISTS IN DC AMPLIFIERS AND SIGNAL CONDITIONING FOR STRAIN GAUGES AND THERMOCOUPLES

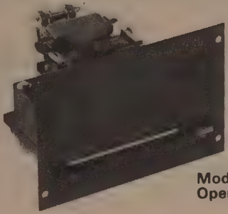
(See EEM Section 1100)

For additional information,
call Jack JaQuay at
714/278-0600

Ectron
CORPORATION
8159 Engineer Road, San Diego, CA 92111

HICKOK

THE HICKOK ELECTRICAL INSTRUMENT CO.
10514 Dupont Avenue • Cleveland, Ohio 44108
(216) 541-8060 • TWX: 810-421-8286


Model 264A-02 Remote Operation Badge Reader

Model 960A Card Reader with Model 80 Scanner

STATIC CARD READERS

- *22-column Badge and 80-column Tab Card Readers*
- *Choice of Wiring and Reset Configurations*
- *Interface Electronic Packages*

264-Bit Output Badge Reader, Model 264A, will read column 1 through 22 of a standard tab card (Media I) or a standard size CR60 plastic badge with Media I punching.

960-Bit Output Card Reader, Model 960A, will read 80 columns of a standard 80-column tab card (Media I).

Choice of output bussing combinations with diode isolation matrices is available for both the badge and card readers to reduce external wiring.

BRIEF SPECIFICATIONS, MODELS 264A, 960A READERS

CONTACTS: Form "A"; hole in card makes contact. Spacing per EIA-RS-292, Media I.
264A: 264 contacts. 12 rows x 22 columns.
960A: 960 contacts. 12 rows x 80 columns.
BADGE SIZE: 2.328 in. x 3.250 in. Thickness: 0.007 in to 0.035 in.
CARD SIZE: Standard Media I tab card. Thickness: 0.007 in to 0.015 in.

PRICES (single quantity):

264A Badge Reader	$220
960A Card Reader	$795

INDUSTRIAL CARD READERS

- *Reliable Performance in Rugged Environments*
- *Interposer Contacts for Error-Free Readings*

Proven success in industrial environments: applications include programmed control of batching and blending processes, automatic storage/retrival and conveyor systems, and automated test equipment, using high current contact closures.

Little maintenance is needed; the self-wiping interposer contact design eliminates periodic dissassembly or cleaning.

Sure, accurate readings result from using the interposer techniques. An interposer (switching mechanism post) slips through a hole in the card when the reader is actuated. Contacts are remote from the card, avoiding misreadings due to contaminants on the card often found in heavy industrial environments.

Additional choices are offered for manual and motor operation, and for form A (switch normally open) and form B (switch normally closed) switching. Blank and preprinted durable vinyl and mylar cards and card punches are available from Hickok.

Set/reject options offer electrical actuation for remote control or manual actuation for economy.

TTL-compatible electronic scanners provide all circuitry for 12-row output in parallel, column serial. The Model 22 Scanner, for the 264A Reader, and the Model 80 Scanner, for the 960A Reader, translate the punched card data into TTL-compatible interfaces. The Scanners have two operating modes: sequential and addressable (random column selection).

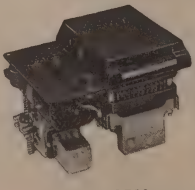
BRIEF SPECIFICATIONS, MODELS 22, 80 SCANNERS

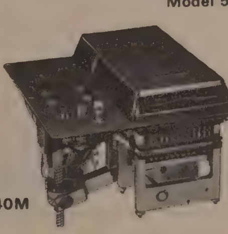
OPERATING MODES: Sequential scan or addressable modes.
LOGIC LEVELS: TTL/DTL levels.
OUTPUTS: 12 data lines; ready; column control; deck position; address; overflow; enable.
INPUTS: 12 row lines; mode selection; inhibit; address; enable; advance; reset; eject (optional 5-volt control).
POWER REQUIREMENTS: 5 volts at 500 milliamperes.

PRICES:

Model 22 Scanner for 22-column 264A Badge Reader	$195
Model 80 Scanner for 80-column 960A Card Reader	$295

Model 50


Model 187M


Model 540M

D/A Converters

General Purpose

Features	Model Number	Resolution Bits	Linearity Error %	Input Code	Full Scale Output	Settling Time Digital	Settling Time Ref
Economy 8& 10 Bits	DAC371-8	8	±0.2	BIN	+2mA	950ns	—
16 Pin DIP Plug-In	DAC371-2-BCD	8	±0.2	BCD	+1.25mA	950ns	—
Current Out	DAC371I-10	10	±0.1	BIN	+4mA	1 µs	—
Voltage Out	DAC371V-8	8	±0.2	OBIN	±5V, +10V	10 µs	—
8& 10 Bits	DAC371V-10	10	±0.1	OBIN	±5V, +10V	10 µs	—
Mini							
12 Bits, Current Out	DAC373I-12	12	±0.025	BIN	+2mA	2 µs	—
Mini	DAC373I-3-BCD	12	±0.05	BCD	+1.2mA	2 µs	—
10-12 Bits	DAC372-10	10	±0.05	BIN, 2's COMP	±5V, +10V	5 µs	—
General Purpose	DAC372-12	12	±0.0125	BIN, 2's COMP	±5V, +10V	5 µs	—
Voltage Out	DAC372-3-BCD	12	±0.05	BCD	+10V	5 µs	—
10-12 Bits	DAC372WB-10	10	±0.05	BIN, 2's COMP	±5V, +10V	950ns	—
Fast Voltage Out	DAC372WB-12	12	±0.0125	BIN, 2's COMP	±5V, +10V	950ns	—
950ns Settling							
10-12 Bits	DAC372I-10	10	±0.05	BIN, OBIN	±1.25mA	300ns	—
Fast Current Out	DAC372I-12	12	±0.0125	BIN, OBIN	±1.25mA	300ns	—
300ns Settling							
12 Bits	DAC395-12C	12	±0.05	BIN, OBIN	±2.5mA, +5mA	50ns	—
Ultra Fast	DAC395-12B	12	±0.025	BIN, OBIN	±2.5mA, +5mA	50ns	—
Current Out	DAC395-12A	12	±0.0125	BIN, OBIN	±2.5mA, +5mA	50ns	—
50ns Settling							
12 Bits	DAC-12QZ/BIN	12	±0.0125	COMP BIN	±2.5V, ±5V, ±10V	5 µs	—
Pin-For-Pin				COMP OBIN			
Replacement	DAC-12QZ/BCD	12	±0.05	COMP BCD	+5V, +10V	5 µs	—

Hybrid IC DAC

Features	Model Number	Resolution Bits	Linearity Error %	Input Code	Full Scale Output	Settling Time Digital	Settling Time Ref
16 Pin DIP	DAC345I-12BP	12	±0.0125	COMP OBIN	±1mA	2 µs	—
Compatible	DAC345I-12UP	12	±0.0125	COMP BIN	−2mA	2 µs	—
Ultra-stable							
Current DAC							
18 Pin DIP	DAC346V-12BP	12	±0.0125	COMP OBIN	±5V, ±10V	5 µs	—
Compatible	DAC346V-12UP	12	±0.0125	COMP BIN	+10V	5 µs	—
Ultra-stable							
Voltage DAC							

SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 AND 4700.

Hybrid Systems CORPORATION Burlington, Massachusetts 01803

(617) 272-1522
TWX 710-332-7584

. . . From Hybrid Systems Corporation

Stability—TC		Power Require. V	Approx. Dimensions (Inches)		
Linearity PPM/°C	Accuracy PPM/°C		Len.	Width	Height
20	100	+15	1.3	0.6	0.5
20	100	+15	1.3	0.6	0.5
20	100	±15	1.4	0.6	0.5
20	100	±15	1.7	1.1	0.4
20	100	±15	1.7	1.1	0.4
20	50	±15	1.7	1.1	0.4
20	50	±15	1.7	1.1	0.4
5	30	±15	2.0	2.0	0.4
5	30	±15	2.0	2.0	0.4
5	30	±15	2.0	2.0	0.4
5	30	±15	2.0	2.0	0.4
5	30	±15	2.0	2.0	0.4
5	30	±15	2.0	2.0	0.4
5	30	±15	2.0	2.0	0.4
15	30	±15	2.0	2.0	0.4
15	30	±15	2.0	2.0	0.4
15	30	±15	2.0	2.0	0.4
10	30	±15, +5	2.0	2.0	0.4
10	30	±15, +5	2.0	2.0	0.4

Stability—TC		Power Require. V	Approx. Dimensions (Inches)		
Linearity PPM/°C	Accuracy PPM/°C		Len.	Width	Height
2	50	±15	0.97	0.5	0.2
2	50	±15	0.97	0.5	0.2
2	20	±15	1.0	0.5	0.2
2	20	±15	1.0	0.5	0.2

SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 and 4700.

Hybrid Systems CORPORATION

Burlington, Massachusetts 01803
(617) 272-1522
TWX 710-332-7584

Digital to Analog Converters

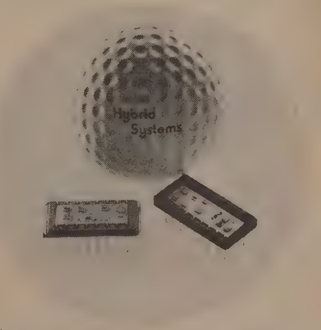
Hybrid Systems is a leading manufacture of D/A converters. Capability includes 8 thru 16 bits resolution; speeds to 50ns; voltage and current switching and tempco to 1PPM/°C. Fixed reference and multiplying D/A's are available in both discrete and thin film hybrid integrated circuit construction for commercial and MIL-STD-883 applications. Hermetically sealed active components and proprietary thin-film nichrome resistor ladder networks are used to assure high reliability and long term stability.

DAC372 Series

HYBRID SYSTEMS CORP.
D/A CONVERTER
DAC 372-12

The DAC372 Series is available in voltage output, high speed current output and high speed voltage output versions. All models have inputs of 12 bits, but are internally adjusted for linearities that conform to resolutions from 8 to 12 bits. Either bipolar 2's complement or unipolar binary operation may be selected by pin interconnection.

DAC345I/346V Series



The DAC345I and DAC346V Series are fully hybridized DIP compatible D/A converters. Utilizing matched monolithic quad current switches and highly stable thin film nichrome resistor networks, these devices maintain accuracy over a wide range of temperature and time. Dynamic laser trimming assures true 12 bit linearity and monotonicity.

D/A Converters

Multiplying

Features	Model Number	Resolution Bits	Linearity Error %	Input Code	Full Scale Output	Reference Input
Ultra Fast	DAC390DWB-10	10	±0.05	BIN	+5mA	0 to +6.2V
2 Quadrant	DAC390DWB-12	12	±0.0125	BIN	+5mA	0 to +6.2V
Fast Reference						
4 Quadrant	DAC316-10	10	±0.05	BIN, 2's COMP	±5V Adj. to ±10V	±10V DC to 100 kHz
AC or DC	DAC316-12	12	±0.0125	BIN, 2's COMP		
Low Feedthrough	DAC316-3-BCD	12	±0.05	BCD		

Special Purpose

Features	Model Number	Resolution Bits	Linearity Error %	Input Code	Full Scale Output	Reference Input
4 Decades BCD	DAC328I-4-BCD	4DEC	±0.01	BCD	+ 2mA	INT.
Economy, 16 Bits	DAC328V-4-BCD	4DEC	±0.01	BCD	−10V	INT.
Compact	DAC328V-16	16	±0.01	BIN	−10V	INT.
High Accuracy	DAC355-14	14	±0.003	BIN, OBIN	+10V, ±5V, and + 2mA	INT.
16 Bits, Low Drift	DAC355-16	16	±0.0015	BIN, OBIN		INT.
10-12 Bits, Indust.	DAC380-10	10	±0.05	BIN	4 to 20mA and 1 to 5mA	INT.
4 to 20mA Output	DAC380-12	12	±0.0125	BIN		INT.

CMOS

Features	Model Number	Resolution Bits	Linearity Error %	Input Code	Full Scale Output	Reference Input
Low Power, 8 Bit 16 Pin DIP Plug In Current Out	DAC385I-8	8	±0.2	BIN	0.5mA	—
Low Pwr., Bipolar	DAC375-10	10	±0.05	BIN, 2's COMP	±5V, +10V	—
Voltage Out	DAC375-12	12	±0.0125	BIN, 2's COMP	±5V, +10V	—

MIL-STD-883

Features	Model Number	Resolution Bits	Linearity Error %	Input Code	Full Scale Output	Reference Input
Economy	DAC365-8	8	±0.2	BIN, OBIN	±10V	±10V, DC to 1kHz
4 Quadrant	DAC365-10	10	±0.05	BIN, OBIN	±10V	
Multiplying	DAC365-12	12	±0.0125	BIN, OBIN	±10V	
Miniature	DAC368-8	8	±0.2	BIN, OBIN	±10V	±10V, DC to 1kHz
4 Quadrant	DAC368-10	10	±0.05	BIN, OBIN	±10V	
Multiplying	DAC368-12	12	±0.0125	BIN, OBIN	±10V	

SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 AND 4700.

Hybrid Systems CORPORATION
Burlington, Massachusetts 01803
(617) 272-1522
TWX 710-332-7584

... From Hybrid Systems Corporation

Settling Time		Stability—TC		Power Require.	Approx. Dimen. (inches)		
Digital	Ref	Linearity PPM/°C	Accuracy PPM/°C	V	L.	W.	H.
50ns	500ns	15	30	±15	2.0	3.0	0.4
50ns	500ns	15	30	±15	2.0	3.0	0.4
2 µs	2 µs	10	25	±15	2.0	3.0	0.4
2 µs	2 µs	10	25	±15	2.0	3.0	0.4
2 µs	2 µs	10	25	±15	2.0	3.0	0.4

Settling Time		Stability—TC		Power Require.	Approx. Dimen. (inches)		
Digital	Ref	Linearity PPM/°C	Accuracy PPM/°C	V	L.	W.	H.
300 µs	—	15	30	±15	2.0	2.0	0.4
20 µs	—	15	30	±15	2.0	2.0	0.4
20 µs	—	15	30	±15	2.0	2.0	0.4
1 µs (I) and 50 µs (V)	—	3	7	±15	2.0	4.0	0.4
	—	3	5	±15	2.0	4.0	0.4
20 µs	—	25	60	±15	2.0	3.0	0.4
20 µs	—	25	60	±15	2.0	3.0	0.4

Settling Time		Stability—TC		Power Require.	Approx. Dimen. (inches)		
Digital	Ref	Linearity PPM/°C	Accuracy PPM/°C	V	L.	W.	H.
1 µs	—	20	200	+12V to +15V (15mW)	1.3	0.6	0.5
50 µs	—	7	30	±15V, 50mW	2.0	2.0	0.4
50 µs	—	7	30	±15V, 50mW	2.0	2.0	0.4

Settling Time		Stability—TC		Power Require.	Approx. Dimen. (inches)		
Digital	Ref	Linearity PPM/°C	Accuracy PPM/°C	V	L.	W.	H.
25 µs	5 µs	2	6	±15	2.0	2.0	0.4
25 µs	5 µs	2	6	±15	2.0	2.0	0.4
25 µs	5 µs	2	6	±15	2.0	2.0	0.4
25 µs	5 µs	2	6	±15	1.5	1.0	0.6
25 µs	5 µs	2	6	±15	1.5	1.0	0.6
25 µs	5 µs	2	6	±15	1.5	1.0	0.6

SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 AND 4700.

Hybrid Systems CORPORATION

Burlington, Massachusetts 01803
(617) 272-1522
TWX 710-332-7584

Digital to Analog Converters

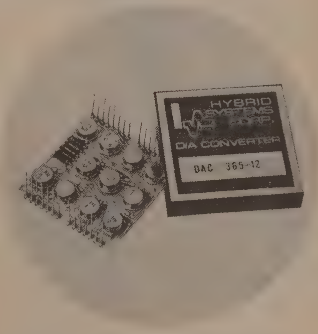
Hybrid Systems is a leading manufacture of D/A converters. Capability includes 8 thru 16 bits resolution; speeds to 50ns; voltage and current switching and tempco to 1PPM/°C. Fixed reference and multiplying D/A's are available in both discrete and thin film hybrid integrated circuit construction for commercial and MIL-STD-883 applications. Hermetically sealed active components and proprietary thin-film nichrome resistor ladder networks are used to assure high reliability and long term stability.

DAC375 Series

HYBRID SYSTEMS CORP.
D/A CONVERTER
DAC 375-12

DAC375 Series requires only 60mW of input power to achieve complete, accurate 12 bit conversion. All models provide 12 bit resolution with linearity of 8, 10 and 12 bits or 3 decade BCD set by precise factory calibration within ±1/2 LSB. All models feature a built-in temperature-compensated reference.

DAC365 Series



The DAC365 Series is a family of ultra-stable 4 quadrant multiplying D/A converters. Advanced hybrid circuit techniques permit these devices to perform accurately over the full MIL temperature range of −55°C to +125°C. All models contain a stable internal reference to accommodate applications that do not require the multiplying feature.

A/D Converters

General Purpose

Features	Model Number	Resolution Bits	Relative Accuracy %	Quantization LSB	Conversion Time	Analog Input V	Tempco	
							Accuracy PPM/°C	Linearity PPM/°C
8 Bit	ADC590-8	8	±0.2	±1/2	200 µs	±5, +10	50	20
Compact	ADC590-2-BCD	8	±0.2	±1/2	100 µs	+10	50	20
2" x 2" x 0.4"	ADC540-8	8	±0.2	±1/2	5 µs	+10, +1	50	20
200 µs to 3 µs	ADC540WB-8	8	±0.2	±1/2	3 µs	+10, +1	50	20
10-12 Bits	ADC550-10-E	10	±0.05	±1/2	30 µs	±5, +10	50	15
General Purpose	ADC550-10-S	10	±0.05	±1/2	30 µs	±5, +10	30	15
30 µs Conversion	ADC550-12-E	12	±0.0125	±1/2	30 µs	±5, +10	50	15
	ADC550-12-S	12	±0.0125	±1/2	30 µs	±5, +10	30	15
10-12 Bits	ADC550-10-LD	10	±0.05	±1/2	30 µs	±5, +10	15	7
Low Drift	ADC550-12-LD	12	±0.0125	±1/2	30 µs	±5, +10	15	7
Fast 30 µs								
Dual Slope	ADC535-3-BCD	3-1/2	±0.05	±1/2	35ms	+10	30	—
3-1/2 Digits	ADC535-3-	3-1/2	±0.05	±1/2	35ms	±5, +10	30	—
+ Sign	BCD-BP	+ Sign						
Excellent Noise	ADC535-12A-E	12	±0.0125	±1/2	35ms	+10	30	—
Rejection								
Pin-for-Pin	ADC-12QZ	12	±0.0125	±1/2	40 µs	+5, +10	30	5
Replacement						±5, ±10		
40 µs Conversion								
8-10 Bits	ADC592-8	8	±0.2	±1/2	800ns	±5, +10	50	30
Ultra Fast	ADC592-10	10	±0.05	±1/2	1 µs	±5, +10	30	20
800ns to 1 µs								
8-12 Bits	ADC591-8	8	±0.2	±1/2	1 µs	±5, +10	50	30
Very Fast	ADC591-10	10	±0.05	±1/2	1.2 µs	±5, +10	30	20
1 µs to 3.5 µs	ADC591-12C	12	±0.05	±1/2	3.5 µs	±5, +10	30	5
	ADC591-12A	12	±0.0125	±1/2	3.5 µs	±5, +10	30	5

CMOS

Features	Model Number	Resolution Bits	Relative Accuracy %	Quantization LSB	Conversion Time	Analog Input V	Tempco	
							Accuracy PPM/°C	Linearity PPM/°C
Low Power	ADC585-12	12	±0.01	±1/2	100ms	0 to +10V @	30	—
12 Bit Accuracy						>10 Meg		
Small Size						±10V @		
						≥400 KΩ		

SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 AND 4700.

Hybrid Systems CORPORATION Burlington, Massachusetts 01803

(617) 272-1522
TWX 710-332-7584

. . . From Hybrid Systems Corporation

Output Codes	Power Require. V	Approx. Dimensions (Inches) Len.	Width	Height
BIN, OBIN	±15, +5	2.0	2.0	0.4
2 DEC BCD	±15, +5	2.0	2.0	0.4
BIN	±15, +5	2.0	2.0	0.4
BIN	±15, +5			
BIN	±15, +5	2.0	4.0	0.4
2's COMP	±15, +5	2.0	4.0	0.4
OBIN	±15, +5	2.0	4.0	0.4
	±15, +5	2.0	4.0	0.4
BIN	±15, +5	2.0	4.0	0.4
2's COMP	±15, +5	2.0	4.0	0.4
OBIN				
3-1/2 DEC BCD	±15, +5	2.0	3.0	0.4
3-1/2 DEC BCD + Sign	±15, +5	2.0	4.0	0.4
BIN	±15, +5	2.0	3.0	0.4
BIN 2's COMP OBIN	±15, +5	2.0	4.0	0.4
BIN	±15, +5	2.0	4.0	0.4
OBIN	±15, +5	2.0	4.0	0.8
BIN	±15, +5	2.0	4.0	0.4
OBIN	±15, +5	2.0	4.0	0.8
	±15, +5	2.0	4.0	0.8
	±15, +5	2.0	4.0	0.8

Output Codes	Power Require. V	Approx. Dimensions (Inches) Len.	Width	Height
BIN OBIN	Single Supply +12V to +15V (30mW)	2.0	2.0	0.4

SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 AND 4700.

Hybrid Systems CORPORATION

Burlington, Massachusetts 01803
(617) 272-1522
TWX 710-332-7584

Analog to Digital Converters

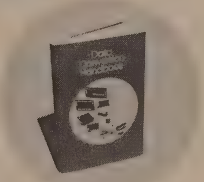
Hybrid Systems manufactures a complete selection of A/D converters with both low cost and superior performance characteristics. Advanced thin film microelectronic techniques and hermetically sealed active components provides superior linearity tempco. Our proprietary thin-film nichrome resistor ladder networks assure far superior tracking and matching characteristics. Capability includes 8 to 12 bits; speeds to 100ns/bit; linearity drift of 2PPM/°C; and successive approximation, digital ramp and dual slope models. CMOS models are also available.

ADC-12QZ

HYBRID SYSTEMS CORP.
ADC-12QZ
A/D CONVERTER

Hybrid Systems low cost, general purpose ADC-12QZ is a direct replacement for Analog Devices' ADC-12 QZ analog-to digital converter. Proprietary precision thin-film nichrome resistor ladder networks are combined with monolithic quad current switches to produce superior tracking and matching characteristics. As a result, Hybrid Systems ADC-12QZ has no missing codes between 0°C and 70°C and maintains a maximum ±1/2LSB linearity error at 25°C.

176 Page Guide to Data Conversion



The Data Conversion Handbook is offered as a guide to design engineers and others who specify and/or use data acquisition products. It is readable, informative . . . because it's written by practitioners. It defines the qualities, specifications and techniques that combine to give D/A and A/D converters their special character.

Chapters include **Digital-To-Analog Converters • Analog-To-Digital Converters • Sample/Holds • Analog Multiplexers / Codes**

Mail $1.50 (for postage and handling) to:
Hybrid Systems Corporation
87 Second Avenue
Burlington, Massachusetts 01803

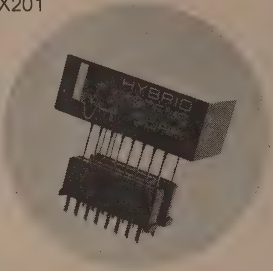
Data Conversion Modules

Multiplexers

- Plugs Into IC Socket
- 8 Channel MOSFET
- ±10 Volt Signal Range
- 250Ω ON Resistance

The MUX201 provides accuracy and high speed in a small package. This 8 channel MOSFET multiplexer will plug into a single 16 pin dual-in-line socket. Units can be combined to provide single ended or differential channels.

MUX201

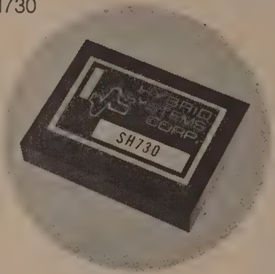


Sample-Holds

- Up To 12 Bit Linearity
- Acquisition Speeds to 200ns
- Aperture Uncertainty to 250ps
- 10mV/s Droop Time

The SH730 sample-hold meets the speed and accuracy requirements of most 12 bit data acquisition systems. The unit incorporates a very fast settling operational amplifier which can be programmed for gains up to 10. The SH730 is complete and ready to use and features an internal high quality holding capacitor. The model is one of a series of economical, high performance sample-holds.

SH730



Operational Amplifiers

- FET Input
- Instrumentation
- Fast Settling, Fast Slewing

A complete series of high performance amplifiers, ranging from FET fast settling operational amplifiers to programmable high accuracy instrumentation types. All units are short circuit protected.

A910A

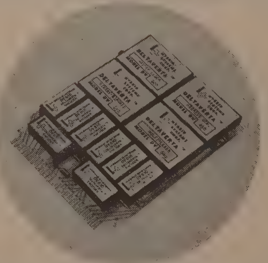
HYBRID
SYSTEMS
CORP.
INSTRUMENTATION
AMPLIFIER
A910A

Deltaverta™ Systems Modules

- Low Cost
- High Accuracy (0.01%)
- CMOS Circuitry
- Multiplexing Flexibility
- System Compatability

The Deltaverta series of system modules are complete and ready to connect. They convert single or multi-channel analog information to a digital signal suitable for transmission over a single line; the original analog data is then reconstructed or converted to digital form at a remote location. These are versatile, low-power, high accuracy, standard modules and subassemblies providing superior performance at prices substantially below any other presently available technique. The Deltaverta product series includes all the modules necessary for the basic functions of data acquisition, transmission, retrieval, and encoding.

8 Channel Multiplex Subassembly



SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 3130 AND 4700.

Hybrid Systems CORPORATION **Burlington, Massachusetts 01803**

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LEADERSHIP

DDC DATA DEVICES DDC DATA DEVICES DDC DATA DEVICES DDC

If you're in data conversion instrumentation ... this valuable reference book is yours absolutely FREE!

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DDC
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DDC's consistent activity in product development provides you with the widest selection of data conversion devices in the industry. This wide selection is fully described in our new catalog—complete with performance characterization, technical specifications and applications notes. With DDC products you can build many different data conversion systems with high performance discrete, hybrid and monolithic...multiplexers...sample-and-holds...A/D and D/A converters...S/D and D/S converters...discrete, hybrid and monolithic, fast slewing and fast settling amplifiers, log/antilog amplifiers and many more.

164 pages of valuable technical data

Look to DDC too, for the finest in lab-quality instrumentation including synchro/resolver angle indicators (for single and multispeed), synchro/resolver angle simulators and shaft angle encoders. Full performance characteristics and specifications are given in our catalog which is yours for the asking. DDC synchro instruments are available in a wide selection of configurations in desk top and half-rack widths 1-3/4" to 3-1/4" high for easy mounting. Accuracies to 0.01°, with bright LED segment display and all solid state.

For detailed information write today for free catalog.

A/D AND D/A CONVERTERS

High speed analog to digital

- Resolution to 12 binary bits
- Accuracies to 0.0125%
- Industrial & Military grades

Video Analog to Digital

- Accuracy/resolution to 9 bits
- Word rates to 100 MHz

Digital to Analog

- Resolution to 14 bits
- Accuracies to 0.0031%
- Settling times to 50 nsecs
- Output currents to 100mA
- Multiplying and universal reference DAC models

SYNCHRO CONVERTERS

Synchro/Resolver-to-Digital

- Up to 20 bit resolution
- Up to ±1' accuracy
- Multispeed in most ratios

Digital-to-Synchro/Resolver

- Up to 16 bit resolution
- Up to ±1' accuracy

Synchro/DC and Sin Cos DC

- 0.1° accuracy, 0.1/°C max drift
- Self calibrating
- Choice of linear range
- Compatibility with simulators

HYBRID MULTIPLEXED SYNCHRO TO DIGITAL CONVERTERS

- Lowest power, smallest size, highest performance converters available
- 100 usec conversion
- To 14 bit resolution
- Accuracy to ±5.3'
- Available in NAFI and SHP module configurations

HYBRID TRACKING S/D AND D/S CONVERTERS

- Lowest power, smallest size, highest performance converters available
- To 20 bits binary
- Accuracy to ±2'
- Full accuracy to 0-1440°/sec

Operating temperature range for our hybrids is —55° to +105°C.

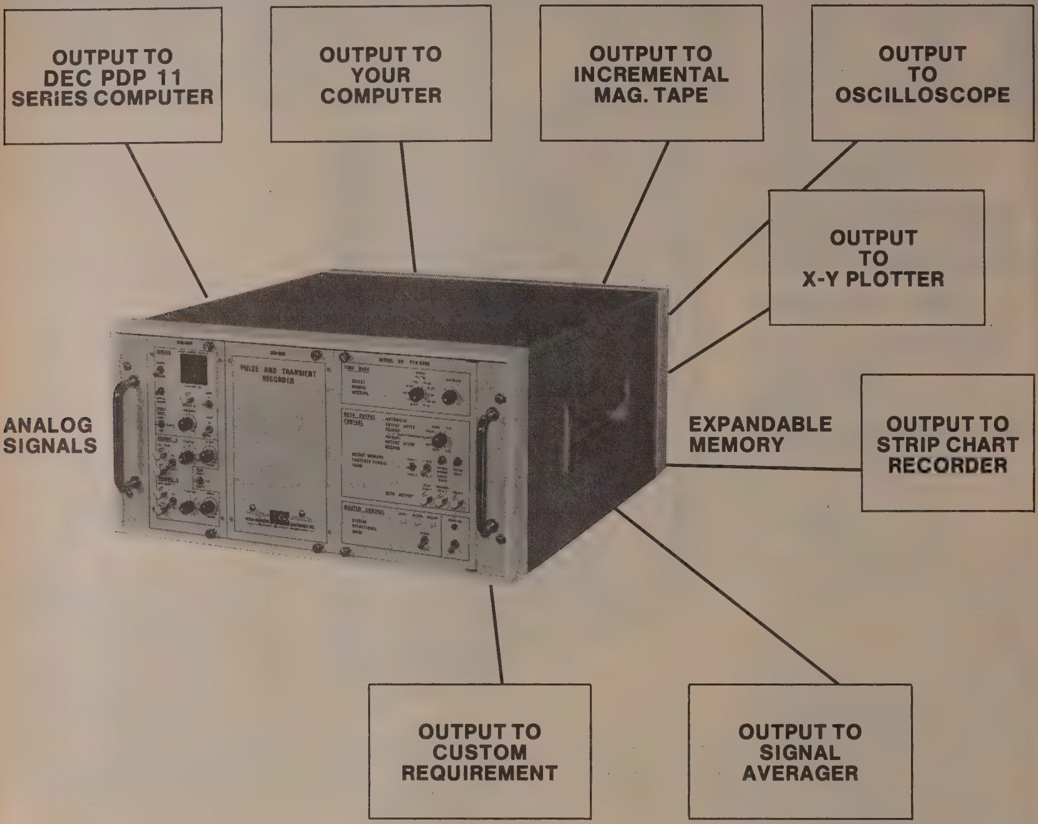
DDC

ILC DATA DEVICE CORPORATION
A Wholly Owned Subsidiary of ILC Industries, Inc.
AIRPORT INTERNATIONAL PLAZA
BOHEMIA, LONG ISLAND, N. Y. 11716 (516) 567-5600
Shaping the future of data conversion.

APPLICATION CENTERS

CALIFORNIA: 2750 Bellflower Blvd., Long Beach 90815 (213) 597-5744
WASHINGTON: 900 So. Washington St., Falls Church, Va. 22046 (703) 536-2212
EUROPE: Belgium: Ave Roger Vandenriessche 51, 1150 Bruxelles Tel 62.01.59
England: The Sanctuary, Oakhill Road, Surbiton, Surrey Tel 01-399-7262

TRANSIENT ANALYZERS & SIGNAL PROCESSING SYSTEMS


OUTPUT TO DEC PDP 11 SERIES COMPUTER
OUTPUT TO YOUR COMPUTER
OUTPUT TO INCREMENTAL MAG. TAPE
OUTPUT TO OSCILLOSCOPE
OUTPUT TO X-Y PLOTTER
ANALOG SIGNALS
EXPANDABLE MEMORY
OUTPUT TO STRIP CHART RECORDER
OUTPUT TO CUSTOM REQUIREMENT
OUTPUT TO SIGNAL AVERAGER
PULSE AND TRANSIENT RECORDER

FEATURES

- Sampling up to 100 MHz with 8-bit resolution
- Interfaces with I/O of all Computers
- Expandable memory blocks of 2816 words
- Records transient waveforms and repetitive signals
- Easily interfaced to TTY, printer, or magnetic tapes
- Complete remote of front-panel controls
- Analog output for oscilloscope, plotter and strip chart recorder
- Sampling interval from 10 nanoseconds to 50 seconds
- X vs Y recording
- Variable pretrigger mode stores data up to total memory capacity for baseline and leading edge of signal analysis

APPLICATIONS

- Laser Processing
- Nuclear Applications
- Medical Applications
- Process Control
- Radar Systems
- Spectral Analysis
- Chemical Analysis
- Electronic and Electrical
- Accelerated Food Processing
- Pollution Monitoring
- X-ray and Gamma Ray Detection
- Alpha, Beta Particle Recording
- Acoustical Analysis

INTER—COMPUTER ELECTRONICS

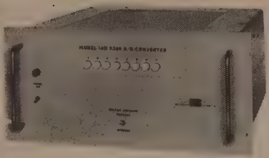
A division of AMERICAN ELECTRONIC LABORATORIES, INC.

P.O. BOX 507, LANSDALE, PA. 19446

HIGH SPEED ANALOG-TO-DIGITAL SYSTEMS

OUTSTANDING FEATURES

- DATA CONVERSION RATES UP TO 400 MEGABITS
- APERTURE TIME ON THE ORDER OF TENTHS OF NANOSECONDS
- WORD SIZES RANGING FROM 4 TO 12 BITS
- WORD CONVERSION RATES FROM 500 kHz TO 100 MHz
- INPUT BANDWIDTH UP TO 100 MHz



GENERAL DESCRIPTION

Inter-Computer Electronics' Analog-to-Digital Converter Systems bring digital signal processing to areas never before thought possible. They are able to link up real world wide bandwidth signals, and translate them into a digital language for the processing requirements of high speed digital computers.

The ultra-high speeds of Inter-Computer Electronics' converters enable them to process digital signals in radar, television, X-ray analyses in multi-channel wideband communication systems and control systems. They offer the capability to convert and communicate digital signals in the speed range of the fourth generation solid-state technology, keeping in step with the computational power of the computer, providing fast and accurate signal processing.

HIGH SPEED ANALOG-TO-DIGITAL MODULES

OUTSTANDING FEATURES

- A/D Encoding Times—4 Nanoseconds/Bit
- Resolution—4 to 12 Bits
- Fastest Encoders Available

The high-speed and ultra high-speed analog-to-digital encoders offer new opportunities for digital signal processing. The modules employ an improved version of the successive approximation, subranging and parallel method of encoding. The modules are available in a format that permits mounting on a printed circuit card or in a shielded case suitable for system use.

Series N modules are a new line of encoder modules using nuclear instrumentation module (NIM) packaging, adding a complete modular capability in configuring the system of your choice.

The design of these converters incorporates all mechanical features for reliable operation at ultra-high speed. Necessary signal terminations, ground planes, and case shieldings are provided for full compatibility with ICE sample and hold modules and D to A converters.

SAMPLE AND HOLD MODULES

Inter-Computer Electronics, sample and hold modules contain an ultra fast analog switch, holding capacitors, and input and output buffer amplifiers. This is a true sample and hold, and is used with Inter-Computer Electronics, high-speed analog-to-digital encoders and converters.

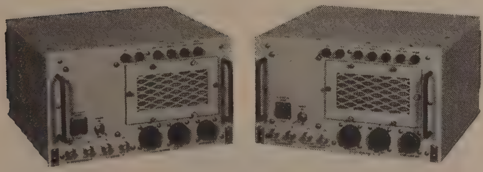
All sample and hold modules are available with long droop capability where a trade-off between long-term hold and repetition rate can be made.

Upon external command, the analog switch is closed and the charging capacitors charged to final value. After this acquisition interval, the charging capacitor is disconnected from the input and holds the value until the next sample pulse.

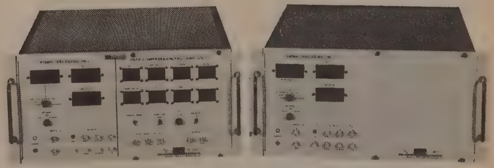
The sample and hold amplifier has a wide range of applications with analog-to-digital converters, data acquistion systems and transient analysis.

The unit is packaged in a shielded case. Appropriate signal terminations, ground planes and layout insure accurate operation in the most severe signal environments.

Custom Signal Processing Systems
Systems for video and radar signal processing.
HIGH speed digital multi plexers/demulti plexers



MUX/DEMUX



RADAR SIGNAL PROCESSING SYSTEM

INTER—COMPUTER ELECTRONICS

A division of AMERICAN ELECTRONIC LABORATORIES, INC.

P.O. BOX 507, LANSDALE, PA. 19446

INTERFACE ENGINEERING INC. (617) 344-7383

ANALOG

SYNCHRO TO DC
- ANGLE
- SINE & COSINE

COORDINATE
- CONVERSION
- TRANSLATION
- ROTATION

Function	Model	Input	Output	Accuracy	Temp. Coeff.	Size	Unit Price
Synchro to Linear DC	SA810-A -B -C	Synchro and Reference	0 to 360° = 0 to +10V	±0.25° ±0.1° ±0.1°	.02°/°C .01°/°C .002°/°C	A A A	210 280 350
Options: — Resolver Input — Bipolar Operation — Expanded Scale — Scaled Output							
Synchro to Sin and Cos DC	SA820	Synchro and Reference	±10 Sin θ (abs) ±10 Cos θ (abs)	±0.15° to ±0.35°	.02°/°C to .002°/°C	B	275 to 480
Synchro to Sin and Cos DC	SA830	Synchro and Reference	±10 Sin θ ±10 Cos θ Scaled from Ref.	±0.1°	.01°/°C to .002°/°C	C	175 to 195
DC Angle to DC Sin and Cos	SA840	0 to 360° = 0 to +10V	±10 Sin θ ±10 Cos θ	±0.1°	.01°/°C	A	235
Polar to Rect. Coordinates	SA850	1) R=0 to +10V 2) θ=0 to +10V	±R Sin θ ±R Cos θ	±0.2°	.01°/°C	B	310
Rectangular to Polar Coord.	SA860	1) R Sin θ 2) R Cos θ	R, 0 to +10V θ, 0 to +10V	±0.2°	.01°/°C	A	310

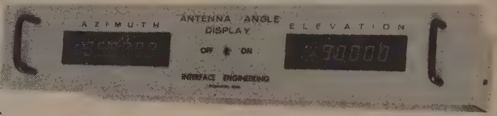
MAINFRAME SUBSYSTEMS

MAINFRAMES are integrated module subsystems optimized by the selection of functions, resolutions, and speeds for the specifics of each application.

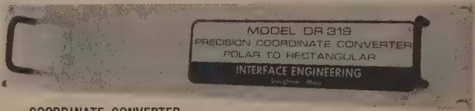
Mainframe subsystems are available as module kits with application instructions for transfer to user PC boards or planes.

Mainframes can accept, convert, display, and deliver angle data in a variety of forms including Binary, Binary Angle, Incremental Angle, Synchro, Resolver, Dual Speed Synchro or Encoder, Scaled BCD Angle, Radar Mils, Degrees-Minutes-Seconds, and Distance in any unit of linear measure.

Typical Mainframes are outlined below. Contact Interface for more information.

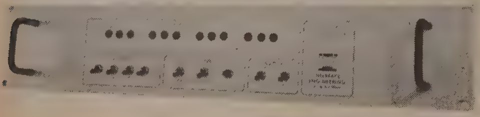


ANTENNA ANGLE DISPLAY

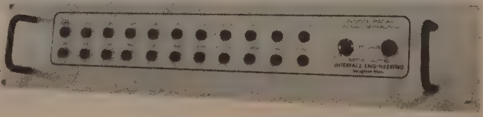


COORDINATE CONVERTER

ANGLE DISPLAYS	**Model** DD135-ACPB DD135-636	**AZ Input** 13 bit ACP 36:1 Synchro	**EL Input** 13 bit ACP 36:1 Synchro	**AZ Display** 359.9° FS 359.997° FS	**EL Display** ±99.9° FS 359.997° FS	**Data Outputs** Binary Angle Binary Angle	 BCD Angle BCD Angle
POSITION CONTROLLERS	**Model** AD143 DD149	**Command** 16 bit Angle 4 digit BCD	**Shaft Position** 36:1 Synchro 13 bit Angle	**Control Output** ±10 VDC = ±10° Incrmtl. Pulse	**Accuracy** ±.01° ±.06°	**Notes** Shortest Path Travel, Displays and Shaped Rate Control	
SYNCHRO INTERFACES	**Model** AD515-94 DS323-94	**Inputs** to 16 Channels 12 bit Angle	**Synchros** 90V 400Hz 90V 400Hz	**Address** Random 4 bit Random 4 bit	**Resolution** 12 bit Angle 12 bit Angle	**Accuracy** ±1 LSB ±½ LSB	**Notes** On/Off Line Bite Off Line Bite
PRECISION COORDINATE CONVERTERS	**Model** DR319 DR155	**Range Input** 5V DC Ramp 16 bit binary	**Angle Input** 12 bit ACP 15 bit Angle	**R Sin θ Out** ±10V ramp FS 18 bits	**R Cos θ Out** ±10V ramp FS 18 bits	**Angle** ±.05° arctan ±.005° arctan	**Range** ±.1% ±.02%
	Model DS327 DD146	**X Input** 12 bit binary 15 bit binary	**Y Input** 12 bit binary 15 bit binary	**Angle Out** 60Hz Synchro 16 bit Angle	**Range Out** 0 to +10 VDC 18 bit binary	**Angle** ±0.1° ±.003°	**Range** ±.05% ±.01%
RADAR REMOTING EQUIPMENT	AD519	**Composite Signal Generator** — Accepts synchro azimuth angle, radar trigger, and radar video — converts angle to digital form and generates composite signal conditioned to modulate wideband RF Link.					
	AD520	**Composite Signal Separator** — Accepts low level composite signal from receiver and synchronizes, conditions, and delivers separate synchro azimuth, radar trigger, and radar video in original form. The unit features 10 MHz video bandwidth and "smoothed" synchro azimuth output with granularity of 0.1°.					
SIMULATORS	DA330 Series	• 47-440 Hz • 11.8 or 90 V • Single or Dual Speed	• 4-6 Decade Angle Control • Accuracies to .002° • Angle Comparator Option	• Static, Sweep and Sector Sweep Modes of Operation • Sweep Rates to 1000 RPM			



MULTICHANNEL SYNCHRO INTERFACE



RADAR REMOTER — SEPARATOR

APPLICATION ASSISTANCE FOR IMMEDIATE SERVICE CALL — (617) 344-7383

INTERFACE ENGINEERING INC.
386 LINDELOF AVE., STOUGHTON, MASS. 02072

INTERFACE ENGINEERING INC.

ANGLE TRANSLATORS

Function	Model	Input	Output	Full Scale	Accuracy	Size	Unit Price	Bulletin
Binary Angle to Scaled BCD Angle	DD107-4A	12 bit θ	4 digit BCD	359.9	±.055°	C	160	570115
	-5A	16 bit θ	5 digit BCD	359.99	±.0055°	C	190	570115
	-6	20 bit θ	6 digit BCD	359.999	±.00055°	A	300	370226
	-7	21 bit θ	7 digit BCD	359.9995	±.00033°	A	330	370226
Binary Angle to Scaled BCD Radar Mils	DD124-4	12 bit θ	4 digit BCD	6399	±0.6	A	110	370630
	-5	16 bit θ	5 digit BCD	6399.9	±0.06	A	150	370630
	-6	20 bit θ	6 digit BCD	6399.99	±0.006	A	190	370630
	-7	21 bit θ	7 digit BCD	6399.995	±0.0033	A	230	370630
BCD Angle to Min. + Sec.	DD132	.999° BCD	4 digit BCD	59′57″	±1 sec.	A	240	371204
Binary Angle to Bipolar Angle	DD117-45	16 bit θ	±16 bit θ	±180°	±0	C	95	370607
	-67	21 bit θ	±21 bit θ	±180°	±0	C	110	370607
Scaled BCD Angle to Binary Angle	DD127-4	4 digit BCD	13 bit θ	359.9 IN	±.06°	A	230	370915
	-5	5 digit BCD	16 bit θ	359.99 IN	±.006°	A	270	370915
Binary Angle to Binary Sine	DD108-A	12 bit θ	16 bit Sine	90°	±.015%	A	320	270928
	-B	15 bit θ	16 bit Sine	90°	±.015%	B	380	270928
Angle to 360° Sine and Cosine	DD109 Controller	1) to 15 bits θ 2) S/C Select	±16 bit S or C from DD108	360°	±.005° Arctan	C	90	271007
Binary Tan to Binary Angle	DD130-A	10 bit Tan θ	16 bit θ	45°	±.0025°	A	360	371105
	-B	13 bit Tan θ	16 bit θ	45°	±.0025°	B	430	371105
Fast Inverse Function	DD137 Controller	16 bit X	f (x)	16 bit	Accuracy of Controlled Function Gen.	A	285	470303
Serial Inverse Function	DD141 Controller	16 bit X (A)	f (x)	16 bit	Accuracy of Controlled Function Gen.	C	120	570210
		28 bit X (B)	f (x)	28 bit		C	160	570210
Fast Binary Multiplier	DD123-12	12 bit A 12 bit B	14 bit AB	14 bit	±½ LSB	A	230	470912
	-16	16 bit A 16 bit B	18 bit AB	18 bit	±½ LSB	A	270	470515
Digital CT Angle Comparator	DD119	1) 16 bit θ 2) 16 bit θ±φ	Shortest Path Sign and φ	16 bit φ	±0	A	125	370815
Digital CDX Angle Rotation	DD118	1) 16 bit θ 2) 16 bit φ	θ + or − φ	16 bit	±0	C	100	370815
Binary Add and Subtract	DD129	A) 15 bit B) 15 bit C) ± Select	A ± B	16 bit	±0	C	115	370726
Universal Complementer	DD112-12	12 bit + Sel.	Direct or Ones or Twos	12 bit + OF	±0	C	70	370918
	-16	16 bit + Sel.		16 bit + OF	±0	C	85	370918
	-20	20 bit + Sel.		20 bit + OF	±0	C	100	370918
36:1 Dual Speed Combiner	DD115A	1X = 7 bit θ 36X = 14 bit θ	Combined Shaft Angle	20 bit	±1 LSB	B	285	471120
1:36 Dual Speed Reducer	DD113-12	12 bit 1X θ	14 bit 36X θ	360° = 10° of main shaft	±0	D	85	471215
		16 bit 1X θ	14 bit 36X θ		±0	D	110	471215
Optically Isolated Serial Data Link	DD128T Transmitter	Accepts 23 bit parallel data and up to 2 MHz clock and transmits serial 24 bit word with parity and gated clock via low cost twisted pair to optically isolated remote receiver which delivers parallel 23 bit data and validity line.				C	165	371115
	DD128R Receiver					C	180	371115
Decimal Panel Display Kits	DD120-3 -4 -5 -6	3 to 6 digit panel display kits containing templates, attractive bezels, polarized lenses, mounting hardware, shield, and PC assembly containing decoder drivers, discretes, and socket mounted .55″ Sperry planar displays. Data input via quick connect ribbon cable. Max. projection .725″ behind panel.					35 + 12 per Digit	371019
Other	Arithmetic operators, dual speed combiners and reducers, miscellaneous units for linearizing and scaling a variety of sensors. Contact IEI for information.							

Notes: 1) Std. Temp. Range: 0 to 70°C
2) DTL/TTL Compatible
3) In Line .020 Pins — PC or wirewrap plane mounting
4) Cases: A = 3″ x 4″ x .4″ C = 2″ x 4″ x .4″
B = 3″ x 4″ x .8″ D = 2″ x 3″ x .4″

DIGITAL

CODE CONVERSION

FORMAT CONVERSION

TRIG FUNCTIONS

COORDINATE CONVERSION

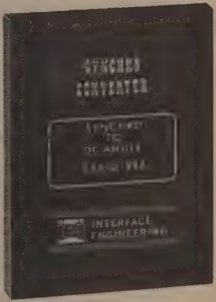
ANGLE OPERATORS

ARITHMETIC OPERATORS

SERIAL-OPTICAL DATA LINKS

DIGITAL SERVOS

PANEL DISPLAYS



APPLICATION ASSISTANCE FOR IMMEDIATE SERVICE CALL — (617) 344-7383

INTERFACE ENGINEERING INC.
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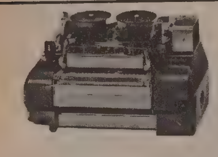
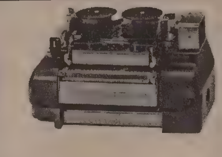
Everything in Fail-Proof Digital Printers


EP-101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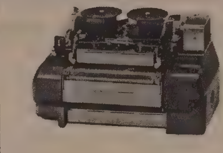
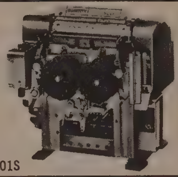
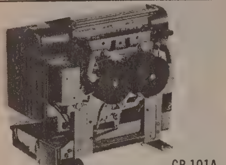
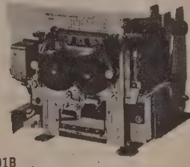
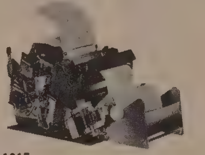
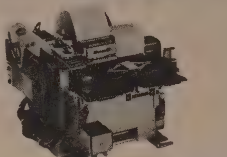

EP-101M

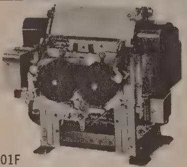

EP-101S

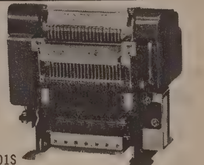

CP-101A


CP-101B


CP-101F


CR-101T


AN-101F


AN-101S

SP-101L

102

To Meet Your Every Need!

MODEL	EP-101	EP-101L	EP-101M	EP-101S	CP-101A	CP-101B	CP-101F	CR-101T	AN-101F	AN-101S	SP-101L	102
Column Capacity	21	19	21	10	19	17	19	Jrnl-10 Recpt-10	21	21	21	18
Character Set	16	16	16	16	16	16	16	16	42	(*)	12	13
Print Rate lines/sec.	2.8	2.3	2.8	2.6	2.6	2.6	2.3	2.6	1.2	2	3.4	2.5
Inking: Ribbon = R Impact Paper = IM	R IM-Opt.	R IM-Opt.	R IM-Opt.	R IM-Opt.	R IM-Opt.	R IM-Opt.	R IM-Opt.	R IM-Opt.	R IM-Opt.	R-Opt. IM	R IM-Opt.	R IM-Opt.
Data Entry: Parallel	P	P	P	P	P	P	P	P	P	P	P	P
Feed: Friction = F Sprocket = Spr	F	F	F	Spr	F	F	F	F	F	F	F	F
Paper: Width- Rolled = RP Fan Fold = FF Card = C	3½" RP or FF	3½" RP	3½" RP	3½" RP or FF	3½" RP + 3½"C	3½" RP +C	3" RP + 3¼"C	Two 1¾" RP	3½" RP or FF	3½" RP	3½"	2½"
Power in VDC	17 ±3	17 ±2	17 ±2	17 ±3	17±2	17 ±2	16 ±2	17 ±2	17 ±2	12^{+2}_{-1}	17 ±2	15 ±2
Size (Height) (Width) (Length)	4" 6½" 5⅜"	6" 6½" 6½"	5¼" 6½" 4"	4" 6½" 5⅜"	5¼" 6½" 4"	5¼" 6½" 4"	7" 7" 15"	6¼" 6½" 4½"	6" 6½" 4½"	5⅜" 6½" 3"	5½" 6½" 5½"	3⅜" 5¾" 4⅞"
Weight in Lbs.	5½"	7¾	5½	5½	8	8	11	6	6¾	5½	5½"	3½
*Suggested Applications:	h, e, k, j, a, d	d (prints logo message with spec. stamp)	q (prints max. char. size of 0.15")	s, n, d	d, c, b, s	d, c, b, s	d, c, b, s	d (prints recpt. & jrnl copies on 2 sep. rolled paper	n, h, f, r, d	o, p, m, l, g	q (prints max. char. size of 0.22")	k, i, d

* Alphameric (Segment)

Applications:
- (a) Automation Monitoring
- (b) Billing Machine
- (c) Cash Dispenser
- (d) Cash Register
- (e) Cash Register (Elec.)
- (f) Computer Output
- (g) CRT Hard Copy
- (h) Data Logger
- (i) Data Logger, Low-Cost
- (j) Digital Voltmeter
- (k) Elec. Calculator
- (l) Emergency Vehicles
- (m) Fire Engines
- (n) Label Printer
- (o) Mobile Communications
- (p) Police Car
- (q) Scale
- (r) Tape Interpretation
- (s) Ticket Printer

Pick a tape for your very own for point-of-sale, test equipment, data logging tickets, calculators, fast food receipts, tolls, etc.

The No. 1 Printers serve the toughest leaders — many years of field-proven experience. Tell us your need — we'll recommend the printer perfect for you — or custom-design it. FAST.

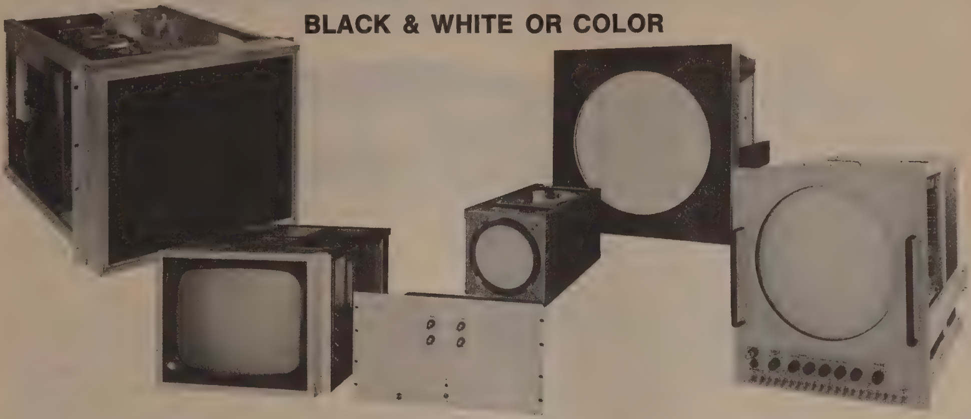
Phone Hans Weck, Sales Manager.

C. Itoh Electronics, Inc.

Systems & Components Division
280 Park Avenue, New York, N.Y. 10017
(212) 573-9467. Telex: WUD 12-5059

COMPUTER GRAPHICS DISPLAYS

BLACK & WHITE OR COLOR



KRATOS is the largest independent manufacturer of computer graphics displays in the United States. Years of engineering effort have resulted in a complete line of units that perform exceptionally well even under adverse conditions. Applications include:

..... Computer-processed radar displays. Available with digitally-generated rotating sweeps, range rings, azimuth heading marker, and special video processing.

..... Video graphics systems for processor-selected raster or graphics displays requiring only XYZ graphics signals, EIA video, and one select line.

..... Simulated cockpit displays with remote CRT featuring minimum panel space and optional brightness to 1000 foot-lamberts.

Multicolor beam penetration displays up to 25-inch diagonal and providing high resolution color graphics are also in production.

HARD COPIERS

Introduction

The model 7000 series Graphics Hard Copiers give you permanent, 8½x11-inch paper copies of information generated by an interactive graphics terminal. The copiers use an electrostatic printer not requiring photosensitive paper, an optics system, and a self-contained X, Y, Z display CRT. The copiers, packaged in attractive cabinets, can operate up to 400 feet from the display controller.

Features of the copiers include outstanding reproduction quality, ease of operation, low maintenance, and lower cost than comparable copiers.

Copier Operation

A copy, under either manual or program control, is made by exposing a coated paper to a photoconductive plate upon which an image is projected. Immediately after this three-second exposure cycle, the CRT image may be changed without affecting the remainder of the copying cycle. This cycle is completed by treating the exposed paper with a toner to make the image visible. The complete copying cycle takes seventeen seconds.

Operator maintenance requires replacing paper rolls (each roll makes 500, 8½ x 11-inch copies), and adding toner after every 250 copies.

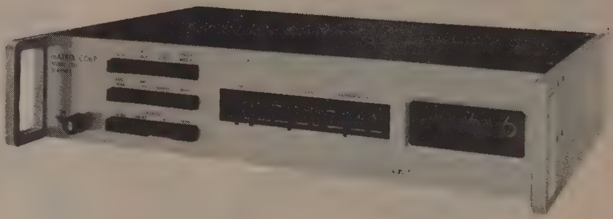
KRATOS

403 S. RAYMOND AVE.
BIN 45
PASADENA, CA 91109
(213) 449-3090
TWX 910-588-3288

Thermocouple and General Instrumentation SCANNERS by MATRIX CORPORATION

General Instrumentation MODEL 1701 SCANNER

- **Random access. Channels controlled by a BCD input to allow programming by external source such as computer.**
- **Sequential scanning with end point selection by front panel digital switches.**



GENERAL: The BCD input is compatible with standard TTL logic. The unit contains BCD output for use on auxiliary equipment. Switches are available in multiples of 10 up to 100 channels in a 3½" cabinet.

CAPACITY: 10 to 100 channels are available in the 3½" master. Slave units with 10 to 200 channels in 3½" cabinets allow expansion to 1000 channels.

SCAN RATE: The scan rate may be as fast as 5 msecs.

INPUT: 1. Level — Standard BCD TTL logic. True equals +5 volts and false equals 0 to +0.5 volts. Unused inputs must have a false level or be terminated in 500 ohms max. 2. BCD enable — A false signal must be applied to enable the input data.

CHANNEL READOUT: Neon numerical indicator lights are provided for a visual indication of the channel selected.

CONTACT RATINGS: 500 volts maximum between conductor and chassis, 350 volts maximum between conductors. Current should not exceed 100 ma for maximum life.

OPTIONS:

A. Manual Digital Switch — The switch can manually select any desired channel from the front panel.

B. Sequential Scan — 1. Advance: Application of a true level will cause the scanner to advance one channel.

2. Reset: Application of a true level will hold the scanner in reset (000) position until true level is removed. Short or open circuit is "false." Positive 5V is true. Input impedance is 10K ohms. 3. Stop or Ctr. Disable: Application of a true level will disenable the advance input or stop any external clock inputs. A false level is required to allow sequential scanning.

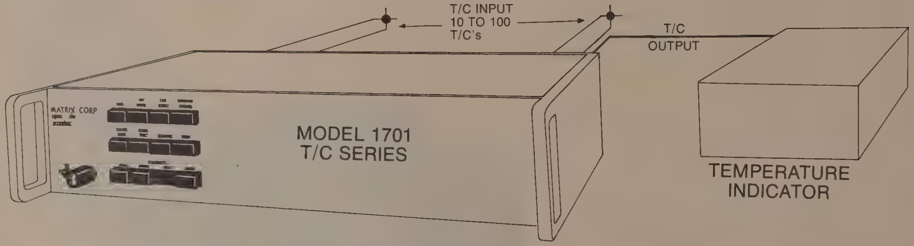
C. Sequential Scan with End Point Selection — Two digital switches are provided on the front panel to manually select the start and the stop channel for sequential scanning.

D. Int. Clock — 1. Rate: Continuously variable from .01 to 10 seconds per channel. 2. Single/Recycle: A front panel switch allows a single scan of all switches or continuous scanning of all switches. 3. Internal/External: Front panel switch selects the internal clock or an external clock input. 4. Start Input: Application of true level at the start input will initiate a scan of all switches only when the scanner is in the 000 condition.

DIMENSIONS: 3½" high x 17" wide x 10" deep.

LITERATURE: Write for Bulletin RS-71.

Thermocouple Scanner MODEL 1701 T/C SERIES



The T/C Series has all the functions of the basic 1701 except it is designed for thermocouple instrumentation. Thermocouples may be connected directly to the scanner. Ice bath, lag boxes or cold junction compensation are NOT REQUIRED, other than for the thermocouple indicator connected to the scanner output. Scanner controls and temperature indicator may be located remotely from the scanner. This reduces the bulk of the thermocouple wiring associated with chemical plant, refineries and similar industrial installations.

MATRIX CORPORATION

520 North 11th Avenue • Beech Grove, Indiana 46107 • Telephone: (317) 786-4601

MFE

KEEWAYDIN DRIVE • SALEM, NEW HAMPSHIRE 03079
TEL. (603) 893-1921 • TWX 710-366-1887 • TELEX 94-7477

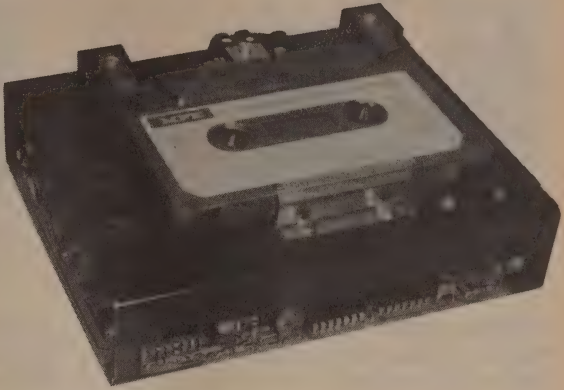
DIGITAL CASSETTE TAPE TRANSPORTS

MODEL 250B

$325.00 EACH IN 100 PIECE QUANTITIES

FEATURES

- Two moving parts
- 15,000 hour MTBF
- Highest data transfer rate
- Widest speed range
- Low power
- Constant tape speed
- Constant tape tension
- Easily interfaced to TTL or DTL logic
- Guaranteed cassette interchangeability
- Error rate less than 1×10^{-7}
- Read-after-write head
- ANSI/ECMA compatible



SPECIFICATIONS

CASSETTE

Any cassette which conforms to the ANSI, ECMA, or ISO standard and with a 1600 FCI clock track on track #2.

MODES OF OPERATION

Continuous.
Incremental (30 increments per second maximum).

RECORDING DENSITY

Up to 1600 FCI.

DATA TRANSFER RATE

Up to 32,000 bits/second standard.

RECORDING METHOD

Single track, bit serial, phase encoded ANSI/ECMA compatible.

TAPE SPEED

Electronically adjustable by user to any speed (with infinite resolution).

*Read/Write:	5-40 ips	(17.8-101.6 cm/sec)
Search:	40-80 ips	(101.6-203.2 cm/sec)
Fast Wind:	80-120 ips	(203.2-304.8 cm/sec)

(less than 30 seconds rewind for 282 feet of tape)

* Lower speed options available.

SPEED CONTROL

Long term speed variation (end to end) < ±1%.
Short term speed variation (bit to bit "jitter") < ±3%.

INTER-RECORD GAP

0.7 inches minimum at 10 inches per second (ANSI Standard), (1.78 centimeters minimum at 25.4 centimeters per second).

CASSETTE STORAGE CAPACITY

2.88×10^6 bits per cassette maximum.

POWER REQUIREMENTS

	Voltage	Standby	Running	Peak (10 msec)
Servo	+5 ±5%	175 mA	600 mA	700 mA (start)
Logic	+5 ±5%	250 mA	260 mA (write)	
Amplifiers	−5 ±5%	230 mA	200 mA	500 mA (stop)

START/STOP PERFORMANCE

Speed: Inches per second)	10	(Proportional at other speeds)
(Centimeters per second)	(25.4)	
Start (milliseconds)	50	
Stop (milliseconds)	30	

(Start time defined as the time from no tape motion to within the short term speed specification.)
(Stop time defined as the time from full speed until tape motion stops.)

INTERFACE

Standard TTL levels.

INTERFACE LINES TO MODEL 250B

Forward Go • Reverse Go • Speed Control One Shot • Reset • Data Input Lines (2) • Power Lines (3)

INTERFACE LINES FROM MODEL 250B

Data Output Lines (3) • Speed Control Clock Track • Cassette Loaded • Write Permit • End of Tape/Beginning of Tape • Busy

DIMENSIONS

With cover — Length 5.92″ x Width 4.85″ x Height 3.12″ (15.04 cm x 12.32 cm x 7.92 cm). Without cover — Length 5.46″ x Width 4.39″ x Height 2.42″ (13.87 cm x 11.15 cm x 6.15 cm).

WEIGHT

Without cover — 1.6 lbs (0.7 Kg). With cover — 2.3 lbs (1 Kg).

ENVIRONMENT

The environmental limits are for the Model 250B transport only. Actual limits depend on the magnetic tape used in the system.

Humidity:

Storage: 0% to 95%, without condensation.
Operating: 10% to 95%, without condensation.

Temperature:

Storage: −55°C to +85°C.
Operating: 0°C to +55°C.

MOUNTING ATTITUDE

No restriction, any attitude.

RECORDING DENSITY

Up to 1600 FCI (flux changes per inch).

MFE

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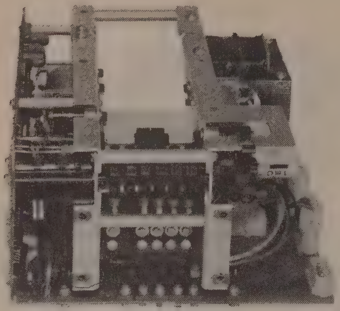
TEL. (603) 893-1921 • TWX 710-366-1887 • TELEX 94-7477

DIGITAL TAPE PRINTERS



- Impact Printer Character Quality
- 6 Column or 12 Column Frames
- Simple Paper Loading
- Narrow Frame
- Absolute Drum Position Optical Encoder
- High Reliability Print Solenoids
- 12 VDC or AC Line Operation
- Floating Decimal Point
- Column Suppression
- TTL/DTL Parallel BCD Inputs
- Low Peak Power

MODELS RP12M and RP6M

Tape Printer Mechanism, Base Price	**$104.00**
Add for Each Active Column	**8.00**

MODELS RP12E and RP6E

Tape Printer with Interface and Drive Electronics	**$240.00**
Add for Each Active Column	**25.00**

CONSULT FACTORY FOR AVAILABLE OPTIONS

SPECIFICATIONS

DATA INPUTS

1-2-4-8 parallel entry BCD, self sourcing, TTL/DTL compatible.

Input Logic Levels: Positive true logic standard "O" state < .8 V. source Z < 200 Ω; "1" state is > 2.5 V and < 5.5 V.

Negative True Logic Inputs: Optional.

CONTROL INPUTS

Print Command: Standard active high. Changes from logic "0" state to logic "1" state. Pulse width 1 microsecond minimum duration direct coupled. Source Z < 40 KΩ to 5 VDC ±5%.

Print Command: Active Low (self sourcing) Available at the rear edge connector. Pulse width 1 microsecond minimum duration direct coupled.

Fast Paper/Ticket Advance: Grounding of rear terminal pin causes paper or ticket to advance at a rate of 13 to 19 lines/second. The feed rate is a direct function of line voltage.

One Line Paper/Ticket Advance: To advance one line without printing present an active low signal of 1 to 8,000 microseconds duration. This is useful to space groups of data or to manually locate a pre-printed parameter and print in front of it on the ticket. If a manual 1 line advance is desired, select option F — operator's devices. A short stroke on the paper feed push button advances 1 line without printout and without a complete drum rotation. The data hold signal will change state after each line advance in the above mode. Single line advance commands must be spaced at least 140 milliseconds apart to allow for the paper to advance. When required, it is possible to count each and every line indexed for positioning the ticket in front of a pre-printed parameter by counting each change of state in the data hold signal. This counting function is not supplied.

PRINTER OUTPUTS

Data Hold Signal: Active Low Standard. Changes from "1" state to "0" state upon receipt of print command or paper/ticket advance command. Automatic return to "1" state upon completion of print cycle or paper/ticket advance step. Open collector (self sourcing).

Data Hold Signal: Active High. Open collector (self sourcing) available on rear edge connector.

Busy/Ready Signal: Use data hold signal for true printer busy/ready feedback.

Ticket Latched Feedback: Models TK11E, and TK5E only. Active low and active high open collector with internal pull-up resistor available on rear edge connector. Change of state upon contact of rear microswitch by leading edge of ticket. When ticket exits past the front microswitch, the signal reverts to its normal state. This signal is used when a totally automatic closed loop operation of the printer is desirable, such as a microprocessor interface. The operator simply inserts the ticket to the point where an optional pilot lamp is turned "on". This lamp is controlled by the ticket latched feedback signal, see option F — operator's devices. From that point on, the microprocessor advances the ticket and commands printouts exactly on pre-printed or pre-assigned spaces on the ticket.

ELECTRICAL SPECIFICATIONS

Print Rate: This is a function of line voltage and of the number of printed characters during one complete drum rotation.

Duty Cycle: Continuous duty 100% at 1 line/second or slower. Intermittent duty 25%, (150 consecutive lines maximum) for faster than 1 line/second print rate.

Column Suppression: Positive true model — all inputs high; negative true model — ground all four inputs.

Overprinting: Change from logic "1" state to logic "0" state — active low. "0" > 2.4 V and < 15 V, "1" < .8 V. Sink < 1 ma (self sourcing). Active high is available as an option. Specify drum position 11 or 12, as required. Maximum number of overprints: Model TK5E: 6 each, Model RP6E: 6 each, Model TK11E: 12 each, Model RP12E: 12 each. Ten overprints maximum per drum position 11 or 12.

MFE

KEEWAYDIN DRIVE • SALEM, NEW HAMPSHIRE 03079
TEL. (603) 893-1921 • TWX 710-366-1887 • TELEX 94-7477

DIGITAL TICKET PRINTERS

MFE
PWR
AUTO
FA
MAN
MFE CORPORATION

- Tab Card Plus 2 Copies
- Accepts Pre-Printed Tickets
- Accurate Line Registration
- Indexing of 28 Lines by 11 Columns
- Adjustable Ticket Insertion Depth
- Half Rack, Full Rack, or Instrument Case
- Inkless Printing
- Printing Mechanism for OEM Applications
- Fast or One Line Paper/Ticket Advance
- Special Character Wheels
- Reliability: One Million Lines of Print
- High Electrical Noise Immunity

MODEL TK11M

Printing Mechanism, Base Price	$208.00
Add for Each Active Column	12.00

MODELS TK11E and TK5E

Ticket Printer with Interface and Drive Electronics	$396.00
Add for Each Active Column	25.00

CONSULT FACTORY FOR AVAILABLE OPTIONS

SPECIFICATIONS (continued)

Power Inputs

10.5 - 14.5 VDC, 12 VDC nominal
90 - 110 VAC 50/60 Hz, 100 VAC nominal ±10%
105 - 129 VAC 50/60 Hz, 117 VAC nominal ±10%
198 - 247 VAC 50/60 Hz, 220 VAC nominal ±10%
210 - 257 VAC 50/60 Hz, 240 VAC nominal ±10%

With the standard OEM units, a power transformer is supplied having taps with lugs for all the above voltages. The exact voltage required must be specified — 12″ color coded leads will be supplied for that voltage, all other lugs will have shrink sleeving. For 12 VDC nominal input voltage 10.5-14.5 VDC range bypass the transformer. An AMP connector is provided for unregulated 12 VDC input.

POWER CONSUMPTION

The peak power required to drive the complete printer with its interface and drive electronics is 5 Amps at 12 VDC, or 60 VA. For those OEM's who buy our mechanism and design their own interface and drive electronics, the following individual peak power requirement chart is useful. Bear in mind that we do not actuate more than one solenoid at a given time.

Function	Peak Current	Voltage	Maximum Duration
Each Print Solenoid	3.6 Amps	12 VDC	17 msec.
Drum Advance Solenoid Actuation	3.6 Amps	12 VDC	17 msec.
One Complete Drum Step			51 msec.
Ticket/Paper Advance Solenoid Actuation	3.6 Amps	12 VDC	17 msec.
One Complete Ticket/Paper Advance Step			51 msec.
Ticket Latch Solenoid Actuation	3.6 Amps	12 VDC	7-10 sec.
Quiescent (Inactive) Power	1.0 Amp	5 VDC	During "Power On"

OPERATING ENVIRONMENT
(mechanical unit only as applicable)

Temperature: OEM models TKE and RPE maximum still air temperature inside customer enclosure 0 to 50°C. Case models ambient temperature of still air outside case 0 to 35°C.

Humidity: 5 to 95% without condensation.

Mounting Position: From horizontal 0 to 90°.

MECHANICAL SPECIFICATIONS

Characters: Standard — .110″ high x .100″ wide., .010″ face, Gorton condensed .110″ high x .065″ wide x .010″ face. Do not combine standard and Gorton condensed characters on the same printer.

Columns: RP6E 1 to 6 columns, RP12E 1 to 12 columns, TK5E 1 to 5 columns, TK11E 1 to 11 columns.

Column Spacing: .275″ between column centers. For ticket printers ask for Ticket Printout Mechanical Outline Drawing.

Line Spacing: Nominal .215″ from the top of each line to the next.

Maximum Variation in Column Spacing: ±.045″ from center line to center line of each wheel.

Maximum Variation in Line Spacing: ±.050 for any one of 20 indexed lines. The customer selects the appropriate line registration tolerance for the exact number of lines to be indexed from the Line Registration Error Curve.

Ticket Insertion Depth: Nominal 6.835″ from leading edge of ticket to top of first line printed. Continuously adjustable on ticket printer from 6.84″ to 3.38″. Specify if non-standard insertion depth calibration is required.

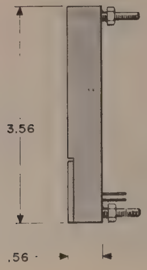
Paper Tape: RP6E 1.68″ x 3.0″ Dia pressure sensitive (PSD-6) 9000 prints/roll. RP12E 3.36″ x 3.0″ Dia pressure sensitive (PSD-12) 9000 prints/roll.

Ticket Dimensions: TK5E or TK11E — 3.250″ wide ±1/64″, 7.875″ long ±1/64″ per MFE Drawing #90062001. TAB card plus 2 copies standard.

Weight: 7 lbs. with AC electronics but less instrument case.

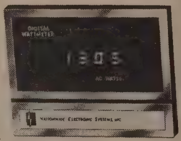
NATIONWIDE ELECTRONIC SYSTEMS, Inc.

First in Electronics through Innovation



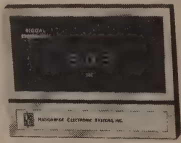
SLIMLINE . . . the *THIN* digital panel instruments

ELECTRICAL MEASUREMENT



Rugged, high-precision instruments for measuring every type of electrical parameter. 3½ digit (1999 count)and 3¾ digit (3100 count) units are available; parallel BCD and all control lines: **VOLTMETERS**, AC & DC millivolts to megavolts, from $199; **AMMETERS** (AC & DC) for scientific laboratories or electrical switchyards, from $208; **OHMMETERS**, electrical resistance as fine as 0.001 ohm; 1.999Ω to 19MΩ, from $230; **WATTMETERS**, AC & DC, display true watts; both high and low frequencies, from only $250; **TRI-SCALE METERS** measure volts, amps, and watts, from $300; **FREQUENCY METERS** accurately measure low and high frequencies from $280; and the **CUSTOM METER** is available with special scaling, linearization, and offsetting to display virtually any electrical signal in the units of measure you want, from $300.

TIME MEASUREMENT



A complete collection of accurate instruments for keeping real or elapsed time. The bright .55″PH light-emitting diode displays are easy to read; remote control inputs and parallel BCD outputs. Their record of performance has made Slimline timing instruments a standard in the industry: **CLOCKS** in 12-hour (AM/PM) or 24-hour (military) format for all types of timekeeping applications; 14 models, including decimal formats, from $204; **CALENDARS** keep the date in month/day or day-of-year (Julian) format; both models are fully automatic, ideal companions for the Slimline clock, from $199; **COUNT-DOWN STOPWATCHES** can be preset to a desired time and will then count down to zero, from $212; and the widest selection of **STOPWATCHES** available anywhere; 59 different models to measure from microseconds to hours, from $200.

PHYSICAL MEASUREMENT

DIGITAL THERMOMETER

A complete selection of instruments to measure all types of physical dimensions and phenomena. If you don't see exactly what you need, our **CUSTOM METER** (listed under Electrical Measurement) will do the job for you. **RTD THERMOMETERS** measure temperature with superb accuracy in either °C or °F with resolution as fine as 0.1°, from $325; **THERMOCOUPLE THERMOMETERS** for all types of industrial temperature measurement, from only $350; **DUAL-SCALE THERMOMETERS** for measuring in either °C or °F; take your pick with the flip of a switch, from only $350; **COUNTERS**, both up & up/down models which accept a wide variety of inputs, including quadrature; available with variable threshold inputs and many other features, from $186; **RELATIVE HUMIDITY METERS** to measure and display humidity automatically, electrically, from $375; **BAROMETERS** to accurately measure atmospheric pressure, from $350; **PRESSURE METERS** for measuring gas or fluid pressures, from $325; **FORCE METERS** for measuring tension or compression, from $325; **VACUUM METERS** to measure and display amount of vacuum in a system, from $350.

DISPLAY & CONTROL

COMPARATOR/CONTROLLER
HIGH
LOW

A wide selection of instruments for remote readout of information, and for the automatic control of equipment based on readings made by measuring instruments: **COMPARATOR/CONTROLLERS** compare data from an instrument against manual preset switches (built in) and activate external equipment when limits are equaled or exceeded; extremely versatile, great for alarm and automation systems, from $122; **REMOTE DISPLAYS** for extra readouts from any Slimline instrument; also for visual display of BCD data buried in a system, from $121; **SUPER REMOTE DISPLAY** does the same job as the regular remote display but has a super-big .75″PH readout for long-distance viewing, from $140; **PRELOADERS**, for automatically preloading a number into the count-down stopwatch or the up/down counter; excellent for automatic monitoring and control systems; from $135.

ALL INSTRUMENTS
BUILT IN U.S.A.

NATIONWIDE ELECTRONIC SYSTEMS, Inc.
1536 Brandy Parkway, Streamwood, IL 60103 • (312) 289-8820

and...to make the SLIMLINES the most POWERFUL line...

PLUG-ON BUSTLES

ASCII TRANSCEIVER Unprecedented power for panel instruments! Plug this module onto your Slimline instrument and you can interrogate and control the instrument with a teletypewriter, computer, etc. A 2-digit ID number (settable in the field) permits selective addressing of 100 units on a single pair of wires. From $180.

DATA ISOLATOR/BUFFER Use this module to isolate the BCD outputs of a Slimline; great for thermocouple systems. Can also be used to buffer the BCD outputs for interface to high-level logic systems. In high noise environments, prevents noise picked up on the BCD cables from feeding back into a system. From $150.

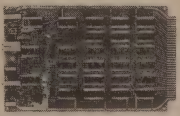
BUS INTERFACE This module lets you turn the parallel BCD outputs of a Slimline instrument on or off; you can hook up to 100 Slimlines onto a single bus using these modules, and then select only one at a time for input to a remote display, printer, computer, etc. Excellent for monitoring and data logging systems. From $160.

POWER SUPPLY Permits operation of a Slimline instrument directly from AC or DC power of higher voltage than standard Slimline requirements. Just plug onto the back of your Slimline and connect to your power source. (For systems using more than one Slimline, large power supplies capable of driving many Slimlines economically are available.) Models available to accept most power standards, from $110.

other products from NES

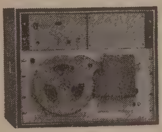
THE COMPACT SERIES

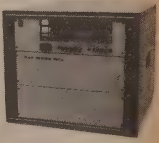
A complete line of high-quality panel instruments with features not available elsewhere. Parallel BCD outputs and remote control inputs are standard: **CALENDAR/CLOCKS** are the smallest in their class; 28 models with day-of-year or month/day calendars (fully automatic), optional internal crystal, from $413; **CLOCKS** are available in all time formats, with optional internal crystal time base, from $270; **EVENT COUNTERS** up to a full six digits with filtered inputs for high noise immunity, from $267; **STOPWATCHES** are available in all time ranges (100 models altogether) to measure from years down to fractions of milliseconds, from $260; and many more.



MOD-U-CARDS

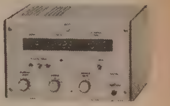
Complete system functions on plug-in cards. These are not limited-function logic cards, but complete building blocks for the system designer who demands conservative design and reliable performance. Include gold-plated connectors, test points, sockets for all I.C.s, and many other features. Over 700 models of circuit cards are available including **CLOCKS** from $183, **CALENDARS** from $194, **CLOCK/THERMOMETERS** from $194, **THERMOCOUPLE LINEARIZERS** from $344, **TOUCH-TONE** and **ROTARY DIAL PULSE DECODERS** from $182, **RELAY SCANNERS** from $148, **DIGITAL MULTIPLEXERS** from $63, **ASCII INPUT/OUTPUT CARDS** from $252, **CODE CONVERTERS** from $120, and many, many more.





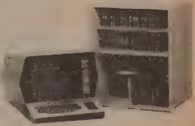
DATA ACQUISTION

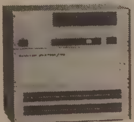
Super tough, super reliable data logging and data acquisition systems built with common-sense engineering for the laboratory or the factory. We have a system to fit any need: the **DIGILOGGER** interfaces any instrument with parallel BCD output directly to a teletypewriter or computer, from $753; **ANALOGGERS** scan several analog inputs and transmit the data in digital format (ASCII) to your teletypewriter or computer; up to 100 inputs, from $2,500; **SAM SYSTEM 1000**, a large data reduction system with up to 1,000 inputs, from $12,000; **PEAK & VALLEY LOGGER**, the digital replacement for the cumbersome strip chart recorder; automatically detects peaks and valleys in the input signal and records the time and amplitude; from $2,700.



COMMUNICATIONS

Rugged equipment designed for the communications field: **TELEPHONE TRAFFIC LOGGER** to monitor up to 40 telephone lines and 256 extensions and automatically record important data on each call; great for cost distribution, traffic pattern analysis, security, and reduction of telephone costs; rotary dial and touch-tone systems available, from $5,000; **CODE CONVERTERS** to change one code into another (and back again); very flexible, can handle ASCII, Baudot, and many other standard codes, plus special codes for data scrambling. Economical uni-directional models are available from $1,500; bi-directional models start at $2,400.





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NATEL ENGINEERING COMPANY, INC.

SYNCHRO CONVERTERS DIGITAL MODULES

NATEL ENGRG CO
SD532
(LSB)
(MSB)

SYNCHRO/DIGITAL
SD532

Natel Engineering Co., synchro converter modules are available for either commercial applications or as fully qualified MIL-GRADE Devices. The devices are free of adjustment or calibration requirements and the use of hybrid technology offers high reliability with it's associated minimal maintenance costs. No adjustments are required for operation.

NATEL ENGINEERING COMPANY
DSC5012
(LSB)
(MSB)

DIGITAL/SYNCHRO
DSC5012

SYNCHRO/DIGITAL Series SD532

- 14 or 15 Bit Resolution
- .03° Accuracy
- Synchro or Resolver Input
- Transformer Isolation
- Hi Speed (10Hz) tracking to full accuracy

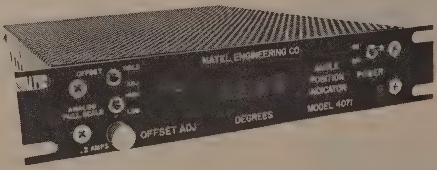
DIGITAL/SYNCHRO Series DSC5012

- 14 to 16 Bit Resolution
- ±4 Arc Min. Accuracy
- 15VA Output Power (optional)
- 100 usec Conversion
- Transformer Isolated Output

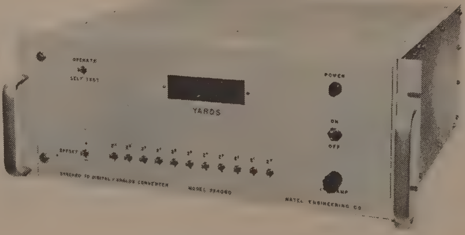
ANGLE POSITION INDICATORS

Natel Synchro/Resolver Angle Indicators Feature:

- LED Display
- Solid-State Design
- Transformer Isolation
- Optional Angle Offset
- BCD Output
- Calibrated in Engineering Units
- 115/230 VAC Operation
- Accuracy: 4071 = ±0.1° (4-Digit Display)
  ±0.03° (5-Digit Display)
  2x4060 = ±0.01° (5-Digit Display)


NATEL ENGINEERING CO
ANGLE POSITION INDICATOR
MODEL 4071
POWER
OFFSET
OFFSET ADJ
DEGREES
.2 AMPS

4071

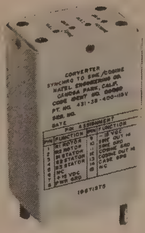

OPERATE
SELF TEST
YARDS
POWER
ON
OFF
OFFSET
NATEL ENGINEERING CO

2x4060 (Multi-Speed Input)

8954 Mason Avenue, Canoga Park, California 91306, Phone (213) 882-9620

NATEL ENGINEERING COMPANY, INC.

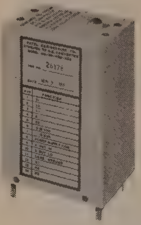
SYNCHRO CONVERTERS DC OUTPUT



SYNCHRO/SINE-COSINE
MODEL 431

FEATURES:

- Transformer Isolation
- ±0.1° Accuracy
- All Solid-State Design
- MIL—Qualifications

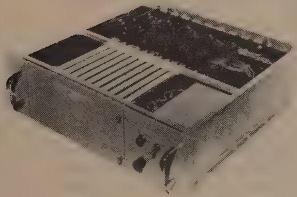


SYNCHRO to LINEAR DC
MODEL 416

The Model 431 Synchro to Sine/Cosine converter is a solid-state device which converts synchro or resolver signals into sine DC and cosine DC voltages. The conversion process maintains an accuracy of ±0.1%, including effects of reference and stator voltage variations (±10%). Designed primarily for radar display systems, the Model 431 is also used in data acquisition or recording systems for simulator control. In contrast to standard single or two-speed electro-mechanical systems, the solid-state 431 provides inputs to display systems completely free of hunting or spoking effects.

The Model 416 Synchro to DC Converter is a solid-state, lightweight unit designed to transform a synchro or resolver input to a linear DC voltage proportional to the input shaft angle. The 416 is designed to serve applications requiring stringent angular accuracies such as servo loops, data acquisition systems and other synchro related systems.

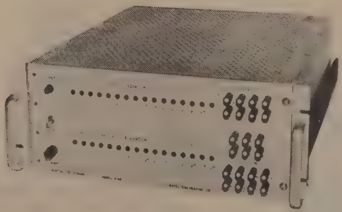
SYNCHRO TRANSMITTERS



SERIES 2066
DC to SYNCHRO

Series 2066 solid-state Synchro Transmitters convert DC sine and cosine input signals to either 3 wire synchro or 4 wire resolver output voltages. They are designed for use in computor control simulator applications. Conversion accuracy is better than ±0.05% and each channel provides power output capability of 7 watts.

Model 4160 Digital to Synchro Converters feature 15 bit resolution and up to 300 watts of output power. They are designed for applications requiring an ability to drive torque receivers out of a 180° false null. The units operate from 115/230 VAC and are available to interface with any synchro or resolver. The 4160 is available in multi-channel configuration.



MODEL 4160

8954 Mason Avenue, Canoga Park, California 91306, Phone (213) 882-9620

TRANSDUCER MEASUREMENT PRODUCTS

For complete information of products listed, request Catalog 575B.

2-WIRE CURRENT TRANSMITTERS . . . 4-20 or 10-50ma

NATEL
HYBRID
2-WIRE XMTR
CT420

DESCRIPTION

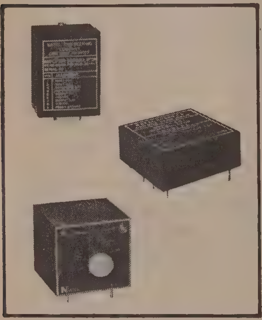
Designed for either integral transducer mounting or PCB installation, these two wire current transducers convert low level thermo couples, strain gages and RTD inputs to 4-20ma or 10-50ma outputs.

Zero and span adjustments are provided plus a proprietary technique to compensate zero shift of the overall transducer/transmitter combnation. Resulting temperature shift is 0.002°/°F.

FEATURES

- Sensitivity — 1mv
- Accuracy — 0.1%
- Zero T.C. — ±.002%/F
- Input Voltage — 10-50 VDC
- Dimensions — 1.75″ dia × 0.6″
  1.5″ sq × 0.6″

PHASE SENSITIVE AMPLIFIER DEMODULATORS



DESCRIPTION

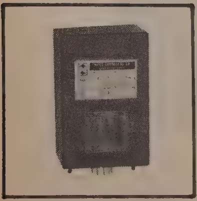
Low level phase sensitive suppressed carrier signals are converted to high level bi-polar dc voltage or current outputs compatible with telemetry systems, recorders or hydraulic servo valves, the amplifier demodulators are packaged as PCB plug-ins, strap down airborne components or multi-range rack mounted units. Gain and null (zero) potentiometers are provided.

Qualified to meet stringent military environments with MTBF's exceeding .25 × 10^6 hours.

FEATURES

- Input — 1mv-10v
- Gain $\frac{DC}{AC}$ — 5000:1
- Output — 0-5, ±2.5, ±10VDC
- Isolation — Input/Output/Ref/Pwr
- Linearity — ±0.05%
- Bandwidth — 20% of Fr
- Ripple — 0.1% p-p
- Quad. Rej. — 52 db

MODULATORS



FEATURES

- Input — 1-100VDC
- Output — 10vrms/1 watt
- Linearity — 0.1%
- Isolation — In/Out/Ref/Pwr
- CMR — 80 db
- Bandwidth — 20% of Fr
- Null — 0.1% p-p
- Distortion — 2%

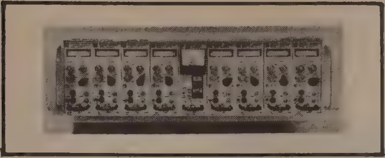
AIRBORNE DC STRAIN GAGE OR THERMOCOUPLE AMPLIFIERS

FEATURES

- Sensitivity — 1mv/v
- Gain — 1000:1
- Output (vdc) — 0-5, ±2.5
- Linearity — 0.1%
- Isolation — In/Out
- CMR — 80 db
- Bandwidth — 10KHz
- Excitation — 5 or 10

For complete information of products listed, request Catalog 575B.

CARRIER DEMODULATOR SYSTEMS



2088
system "N"

DESCRIPTION

Carrier demodulator systems convert low level amplitude modulated suppressed carrier signals, from LVDT, VRT, and/or strain gage transducer inputs operating in "noisy environments" to high level bi-polar dc outputs compatible with recorders, galvanometers and process controllers. Separate or common excitation amplifiers are available.

Using a proprietary "univector"; 360° balancing technique, system operation and calibration are unaffected by cable lengths exceeding 10,000 feet between the transducer and the system.

Model 2088 is a premium measuring system containing separate excitation amplifiers, integral meters, 100ma output current, and solid state overload detector. Options include dual carrier frequency operation, selectable bandwidth response, peak detector output, and remote programming of gain and calibration.

A 19" × 5.25" high rack accommodates eight carrier demodulators plus a master module. System power is 230vrms, 115vrms, 12vdc, or 24vdc. Combination i.e. 115vrms/12vdc is available.

Model 7116 is a general purpose system with 2mv sensitivity and R-C or Univector (360°) balancing plus a reference phase adjustment. A meter located in the master module allows any channel to be selected for balance or operational mode. Four calibration steps and four selectable frequency responses are provided.

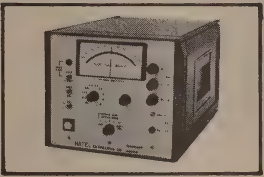
Available as a "mini system", four channels plus a master in a 9.5" wide rack × 5.25" high (see photo), or 10 channels in a 19" × 5.25" high or 20 channels in 8.75" high.

FEATURES

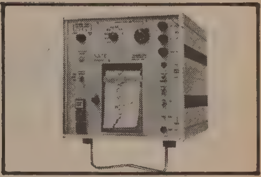
● Sensitivity	0.5mv (50 ustra)
● Accuracy	0.05% FSO
● Gain	5000:1
● Bandwidth	0.5db-25% F_c
● Carrier	0.4-100KHz
● CMR	120db
● Ref. Adj.	420°
● Bal. Adj.	128mv RTI and 420° non-interacting

TRANSDUCER INDICATORS

API 200



DTI 200



RTI200

DESCRIPTION

Indicators are self-contained precision transducer measuring instruments designed for utmost versatility using inter changeable plug-ins. Carrier demodulators plug-ins. Series SC2088 and SC3088 interface with LVDT's, VRT's, strain gage bridge (1, 2 and 4 arm), thermocouple, and potentiometer transducers. Transducer indicators provide a choice of display plus an analog ±10vdc dynamic output @ 10ma or 200ma.

FEATURES

- Sensitivity — 0.5mv
- Gain — 5000:1
- Gain Ranges — 10
- Accuracy — .05%
- Calibration — Shunt Type
- Overload Ind. — Adjustable
- Peak Detector — ±1mv
- Zero Stability — 20uv/°C
- Gain Stability — .002%/°C

OPTIONS

Single, dual, sum and difference inputs

Display in % FSO or engineering units

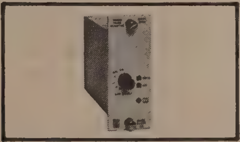
Dual carrier frequency

Multiple frequency response

Calibrated zero suppression

Remote Gain Programming

MODULAR CONDITIONERS



SC7116

SC7116-30

DESCRIPTION

Self-contained signal conditioners precisely convert millivolt transducer signals from strain gages, thermocouples, potentiometers, VRT's and LVDT's to high level bipolar D.C. outputs. Model SC7116 are carrier demodulator conditioners.

Sensitivities range from 0.1V V to 2V V with integral transducer excitation of 5 or 10 volts. Accuracy is ±0.05% of FSO with a choice of 0-5, ±2.5, ±5 or ±10VDC as full scale outputs. Zero stability is ±2mvdc RTO and gain coefficient is 0.002%/°C. Model SC7116-03 shown offers remote programming for both gain and calibration plus an auxiliary peak detector output.

NATEL ENGINEERING CO INC • 8954 MASON AVE • CANOGA PARK CA 91306
TEL (213) 882-9620 TWX 910-494-1959

NORTH ATLANTIC *industries, inc.*

NORTH ATLANTIC
SYNCHRO DATA MODULE
NORTH ATLANTIC
SYNCHRO DATA MODULE

Series 780

D/S & S/D MODULES

The Series 780 low-cost modules are available in a comprehensive selection for most design requirements. All digital input and output data is DTL & TTL compatible. This series also includes single module as well as multi-module converters with size versus maintainability cost being the selection criterion.

Series 780—S/D Modules

14-bit (0.022°) resolution with 4000°/sec data tracking rate and 3 minute ±0.9 LSB accuracy.

Series 780—2 Speed S/D Modules

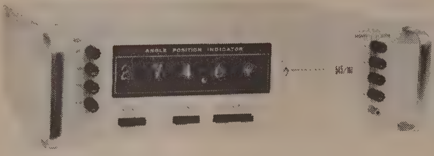
16-bit (0.0055°) resolution with 1000°/second data tracking rate. Typical ratios 36:1, 32:1, 27:1, 16:1, 15:1, 10:1. Accuracy for 36:1 ratio 0.11 minutes ±0.9 LSB.

Series 780—D/S Modules

14-bit (0.022°) resolution and 4 minute ±0.9 LSB accuracy. Power outputs available 1VA and 20VA.

General Features

70°C or 105°C, single or multi-module, 60 or 400Hz data, PC board available for multi-module sets.



Model 545/100

RESOLVER/SYNCHRO-TO-DIGITAL CONVERTERS

These solid-state converters continuously digitize resolver and synchro data at angular velocities up to 20,000°/sec. Continuous tracking is achieved through unique electronic servo techniques. Data frequencies include 60Hz, 400Hz, and higher frequencies in specific models.

Model 545—Automatic Angle Position Indicator

This instrument has .001° resolution and 10-second accuracy for 11.8V, 26V, and 90V line-line at 400Hz. The digital angle is displayed and available as BCD digital output. Other features include programmable or front-panel selection of resolver or synchro input, line-line voltage, and operating mode.

Model 545/100—Automatic Angle Position Indicator

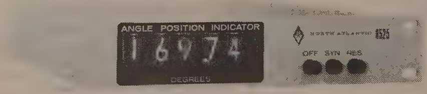
Similar to the Model 545 in overall function, but provided with .01° accuracy and resolution. This instrument accepts both 60 & 400Hz resolver and synchro data.

Model 546/20—Binary S/D Converter

This half-rack R-S/D Converter features 16-bit digital output resolution with 15-bit accuracy for 400Hz resolvers and synchros at line-to-line voltages of 11.8V, 26V and 90V. Front-panel selection of resolver or synchro input, and line-line voltage range.

Model 8525, 8225—Angle Position Indicator

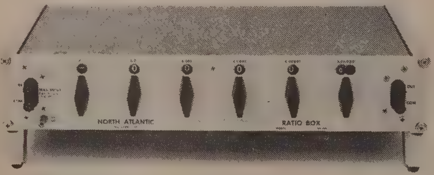
The half-rack 8525 offers 3-minute accuracy and .01° resolution, with 5-decade BCD digital output. Available as a two-channel instrument for any combination of synchro and/or resolver inputs at 11.8V, 26V, or 90V line-line 60Hz or 400Hz. The 8225 is a 4-decade, 6-minute accuracy model.



Model 8525

DIGITAL-TO-RESOLVER/SYNCHRO CONVERTERS— Series 538

These programmable converters are available with 14- to 17-bit single-speed digital input resolution. Analog output is 400Hz resolver/synchro transmitter data at selected line-line voltages with 1-minute accuracy. All models feature output transformer isolation and short-circuit protection. Optional accuracy 40 arc-seconds.



RB-503, RB-504

AC RATIO BOXES

These precision inductive voltage dividers feature high input impedance, low output impedance, and accuracy over a wide frequency band.

Model RB-503, RB-504 AC Ratio Boxes

The RB-503 features 10ppm accuracy from 50Hz to 5KHz, and ratios from 0 to 1.111110. The RB-504 features 1ppm accuracy from 300Hz to 1KHz, and ratios from −0.111110 to +1.111110.

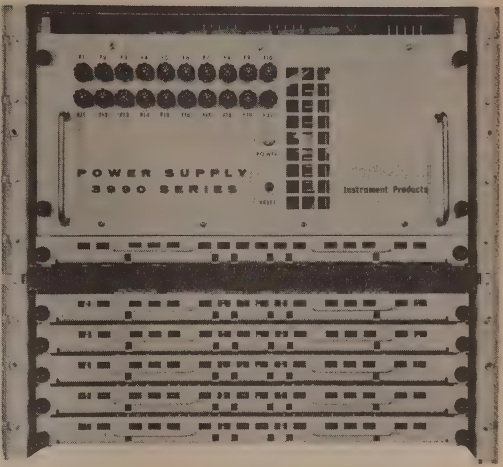
Model RB-503T—Inverting AC Ratio Box

This model features isolated input with full inversion capability. Ratio range ±1.111110 with 10ppm accuracy.

For Phase Angle Voltmeters, Resolver/Synchro Simulators & Bridges and Angle Position Indicators, see our page in the Instruments, Measuring & Test Section, Page 1-772.

REED SCANNERS SWITCHING MATRICES

North Hills



SYSTEMS APPLICATIONS FOR

- Data acquisition.
- Multiple channel recording.
- Calibration.
- Automatic test.
- Communications.
- Process control

3990 GUARDED SWITCHING MATRIX

- Random access two-dimensional reed relay switch matrix.
- Five-digit program command results in interconnection of selected matrix crosspoints. Command, consisting of five parallel BCD (1-2-4-8) characters, identifies up to 10,000 crosspoints and desired action (reset, close or open one, ten, one hundred or all points).
- Ten basic 1 x 10 matrix configurations with associated flip-flop storage (100 crosspoints) per plug-in module. Interconnectable in assorted combinations: 1 x 50, 5 x 10, 1 x 100, etc. Five plug-in modules per chassis.
- Power supply/decode module accommodates up to 2000 crosspoints.

3383/1221 GUARDED SCANNER/PROGRAMMER

- Programmer accepts address from digital programming device (computer, core programmer, tape reader, etc.) and connects desired scanner input channel to a single output. The single output channel may be further programmed through an optional output multiplexer to one of ten possible output locations.
- Number of maximum input channels per scanner: 1000 single-wire, 500 two-wire, 400 three-wire, 200 six-wire channels.
- Programmer maximum capability: 10,000 channels.

Typical reed contact characteristics:

Material:	Di-Met to diffused gold.
Current power rating:	0.5 A maximum, 10 VA.
Breakdown voltage:	300 V rms minimum.
Insulation resistance:	1 x 10^9 ohms.
Thermal emf:	10 microvolts maximum for 30 seconds maximum channel activation.
Switching speed:	3 milliseconds maximum after program command.
Life expectancy:	2 x 10^7 at maximum rating. 5 x 10^7 at half maximum rating. 10 x 10^7 low loads.

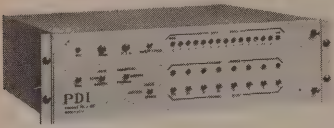
SEE SECTION 4000 FOR NORTH HILLS DIGITAL VOLTAGE AND CURRENT SOURCES

North Hills Electronics, INC.

GLEN COVE, N.Y. 11542 • 516-671-5700

PDI® Analog Data Acquisition Subsystems

6000 SERIES High Level Analog Data Acquisition Systems



Units in the 6000 Series are highly flexible instruments, with many options, that can be matched exactly to the capabilities and characteristics of the control unit or data storage device. Within the 6000 Series there are three subgroups. The subgroups feature high speed, high temperature stability, and low cost. All three groups offer resolution from 8 to 15 binary bits and will accommodate up to 256 single ended or 128 differential inputs in a single chassis. These features combined with single channel, random and sequential address capabilities make the 6000 Series easily adaptable to your system requirements without the need for costly custom engineering. The system comes complete with all necessary power supplies for its operation and requires only 110V AC line power.

FEATURES:

- Multiplexed Thruput Rates to 1MHz
- Temperature Compensation to 10 ppm
- Versatile optional Manual Controls and Indicators
- Choice of Standard Input Voltage Range Options
- Field Expandable to 256 Channels (S.E.)
- Differential or Single Ended Input
- Resolution to 15 Bits
- Input Overvoltage Protection to ±30 Volts
- System Accuracies to 0.01%

3 SUB-SERIES

6900 - Highest Speed

The 6900 group provides the highest thruput rate in the 6000 Series. Resolution of 8 to 15 binary bits is available with multiplexing rates to 1 MHz for an 8 bit model, 400 KHz for a 12 bit model and 220 KHz for a 15 bit model. The 6900 system was designed primarily for applications where the analog input bandwidths are high. Base price: $2,921.00.

Model No.	6908	6910	6912	6913	6914	6915	Notes
No. of Bits (Binary)	8	10	12	13	14	15	
Resolution (1 Part in)	255	1,023	4,095	8,191	16,383	32,767	
Thruput Rate (KHz)	1000	800	400	250	220	220	(1)
Thruput Error (% FSR @ 25°C)	0.4	0.15	0.05	0.03	0.02	0.01	(2)
Input Ranges (STD)	A,B	A,B	A,B,C,D,E	A,B,C,D,E	B,C,D,E	B,C,D,E	(3)

General 6900 Specifications
System T.C.: 0.003% FSR/°C
Aperture Delay: 10 nanoseconds
Aperture Uncertainty: 1 nanosecond

Notes:
(1) Thruput rate for sequential mode or random mode when address is supplied one channel ahead.
(2) Accuracy specification includes all error sources and the quantizing error of ±½ LSB.
(3) Input ranges: A=0 to +5V; B=±5V; C=0 to 10V; D=±10V; E=±10.24V

6700 - Highest Stability

The 6700 group provides the highest thermal stability of the 6000 Series. The overall system temperature coefficient is less than 0.001% FSR/°C or 10PPM. This system was designed specifically for applications where wide temperature variations might be encountered and high accuracy must be maintained. Base price: $2,220.00.

Model No.	6708	6710	6712	6713	6714	6715	Notes
No. of Bits (Binary)	8	10	12	13	14	15	
Resolution (1 part in)	255	1,023	4,095	8,191	16,383	32,767	
Thruput Rate (KHz)	110	90	65	60	20	20	(1)
Thruput Error (% FSR @ 25°C)	0.4	0.1	0.025	0.015	0.01	0.01	(2)
Input Ranges (STD)			A,B,C,D,E			B,C,D,E	(3)

General 6700 Specifications
System T.C.: 0.001% FSR/°C
Aperture Delay: 10 nanoseconds
Aperture Uncertainty: 1 nanosecond

Notes:
(1) Thruput rate for sequential or random mode
(2) Accuracy specification includes all error sources and the quantizing error of ±½ LSB
(3) Input ranges: A=0 to +5V; B=±5V; C=0 to 10V; D=±10V; E=±10.24V

6400 - Lowest Cost

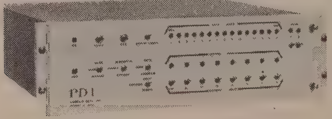
The 6400 offers an attractive compromise between thruput rate, temperature stability, and cost. While the lowest priced group in the 6000 Series, it offers moderate thruput rates and thermal stability. The 6400 group was designed for applications where low cost is a major consideration along with reasonably high performance. Base price: $1,826.00.

Model No.	6408	6410	6412	6413	6414	6415	Notes
Number of Bits (Binary)	8	10	12	13	14	15	
Resolution (1 part in)	255	1,023	4,095	8,191	16,383	32,767	
Thruput rate (KHz)	70	65	50	25	10	4	(1)
Thruput Error (% FSR @ 25°C)	0.4	0.1	0.025	0.015	0.01	0.01	(2)
Input Ranges (STD)			A,B,C,D,E			B,C,D,E	(3)

General 6400 Specifications
System T.C.: 0.002% FSR/°C
Aperture Delay: 50 nanoseconds
Aperture Uncertainty: 10 nanoseconds

Notes:
(1) Thruput rate for sequential or random mode
(2) Accuracy specification includes all error sources and the quantizing error of ±½ LSB
(3) Input Ranges: A=0 to +5V; B=±5V; C=0 to 10V; D=±10V; E=±10.24V

7000 SERIES • Automatic/Programmable Gain Ranging



The 7000 Series offers a unique solution to high speed analog to digital conversion where the input amplitude cannot be predicted in advance of the conversion. Utilizing a high speed, fast settling multi-range amplifier the 7000 Series can switch channels, determine the gain range, and perform a 14 bit A to D conversion in less than 20 microseconds. Five models with thruput rates from 10 KHz to 50 KHz are available. In the Autoranging mode a 14 bit data word is combined with 2 bits of range data for a 16 bit output word. A single chassis will accommodate from 8 to 128 differential channels. Base price: $5,562.00.

Model No.		7115	7215	7315	7415	7515	Notes
Thruput Rate (KHz)		10	20	30	40	50	
Thruput Error (% FSR @ 25°C)							(1)
Full Scale	±10.0	0.01	0.01	0.01	0.01	0.01	
Input	±1.0	0.015	0.02	0.025	0.03	0.035	
Range (Volts)	±0.1	0.02	0.025	0.03	0.04	0.05	

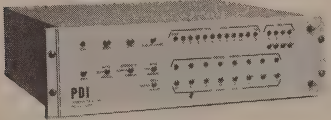
Features:

- Resolution to 15 bits
- Thruput Accuracy to .01%
- Auto or Programmable Gain Ranging
- Four Customer Selected Gain Ranges from 0.1 to 10.0 Volts
- Multiplexed Thruput Rates to 50 KHz

General 7000 Specifications
Input Ranges (Customer Selectable): Any four from ±0.1 to ±10.0 Volts
Input Impedance: 100 megohms (ON or OFF)
CMRR (DC to 60 Hz with 350 ohms source unbalance)
Gain Level: 1 = 80 db; 10 = 100 db; 100 = 120 db
Common Mode and Normal Mode Voltage: ±11 Volts.
Cross Talk Rejection (DC to 1 KHz with 350 ohms source unbalance)
Thruput Rate (KHz): 10 = 110 db; 20 = 104 db; 30 = 98 db; 40 = 92 db; 50 = 86 db
Gain Range Change: 90% of full scale
Thruput T.C.: 0.002% FSR±3 μ volts RTI/°C

Notes:
(1) Thruput error includes all error sources and ±½ LSB in automatic mode. Error is slightly less in programmed mode.

8000 SERIES • Automatic/Programmable Gains to 1024



The 8000 Series features adaptability to almost any input signal currently in use. The system offers automatic or programmed gain selection with 11 binary ranges from ±10 millivolts to ±10.24 volts full scale. In the automatic ranging mode the gain ranges effectively provide the system with a binary floating point capability. The data word (12 binary bits) is combined with the range data (4 binary bits) for a 16 bit output word. The 8000 System will resolve input changes at 5 microvolts on the ±10 millivolt range for an overall analog dynamic range of 132 db. Base price: $3,876.00.

Gain Ranges: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024
Input Ranges: ±10.24, 5.12, 2.56, 1.28, 0.64, 0.32, 0.16, 0.08, 0.04, 0.02, 0.01 Volts
Thruput Error: Less than .05% of the reading on any input over 5 millivolts @ 25°C
Differential CMRR (DC to 60 Hz): 80 db at unity gain and increasing to 120 db at a gain of 1024 with 350 ohms source unbalance
Common Mode and Normal Mode Voltage: ±11 Volts.
* Prices subject to change without notice.

Aperture Time: 50 nanoseconds
System T.C.: 0.001% FSR±1 μ volt RTI/°C
Crosstalk Rejection: Minimum of 100 db, DC to 60 Hz
Input Impedance: 100 megohms (ON or OFF)
Thruput Rates:

Automatic Gain Ranging Mode	
Single Channel	2.5 KHz
Multiplexed Input	1.0 KHz
Programmed Gain Mode	
Fixed Gain, Single Channel	20 KHz
Gain and Channel Switching	1.8 KHz

Features

- Resolution of 12 Bits
- 11 Binary Gain Ranges
- ±10 mv to ±10.24V Input Ranges
- Thruput Rates to 20 KHz
- Auto or Programmable Gains
- System Accuracy of 0.05% of Reading

Subsystem computer interfaces available. Contact factory for quotation.

/PHOENIX DATA, INC.
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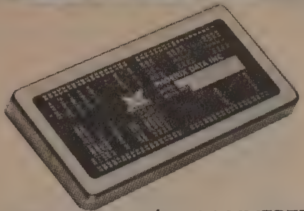
PDI® Analog to Digital Converters



ENCASED A/D CONVERTERS

All 42 units in Phoenix Data's six new series of encased, modular A/D converters — ADC1300 thru ADC1800 — employ the highly reliable and stable voltage switching successive approximation conversion technique. Note these features:

1300 SERIES / Model No.	1308	1309	1310	1311	1312	1313	1314
Conv. Time (μsec.)*	15	20	25	30	40	50	100
Error (%FSR)**	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	20	20	20	20	20	20	20
TC (PPM/°C, 0 to 70°C)***	15	15	15	15	15	10	10
Price 1 to 9	$174.	$185.	$197.	$208.	$219.	$332.	$388.

1400 SERIES / Model No.	1408	1409	1410	1411	1412	1413	1414
Conv. Time (μsec.)*	12	14	17	20	24	35	70
Error (%FSR)**	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	20	20	20	20	20	20	20
TC (PPM/°C, 0 to 70°C)***	15	15	15	15	15	10	10
Price 1 to 9	$180.	$202.	$219.	$230.	$253.	$347.	$422.

1500 SERIES / Model No.	1508	1509	1510	1511	1512	1513	1514
Conv. Time (μsec.)*	8	9	10	12	15	25	35
Error (%FSR)**	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	20	20	20	20	20	4	4
TC (PPM/°C, 0 to 70°C)***	10	10	10	10	10	5	5
Price 1 to 9	$185.	$219.	$242.	$264.	$294.	$366.	$534.

1600 SERIES / Model No.	1608	1609	1610	1611	1612	1613	1614
Conv. Time (μsec.)*	6	7	8	9	10	15	20
Error (%FSR)**	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	20	20	20	20	20	4	4
TC (PPM/°C, 0 to 70°C)***	10	10	10	10	10	5	5
Price 1 to 9	$219.	$253.	$276.	$303.	$332.	$410.	$613.

1700 SERIES / Model No.	1708	1709	1710	1711	1712	1713	1714
Conv. Time (μsec.)*	3.5	4.0	4.5	5.0	6.5	10	15
Error (%FSR)**	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	20	20	20	20	20	4	4
TC (PPM/°C, 0 to 70°C)***	10	10	10	10	10	5	5
Price 1 to 9	$276.	$298.	$332.	$388.	$422.	$545.	$703.

1800 SERIES / Model No.	1808	1809	1810	1811	1812	1813	1814
Conv. Time (μsec.)*	2	2.5	3	3.5	4	8	12
Error (%FSR)**	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	4	4	4	4	4	4	4
TC (PPM/°C, 0 to 70°C)***	10	10	10	10	10	5	5
Price 1 to 9	$332.	$388.	$444.	$500.	$556.	$669.	$781.

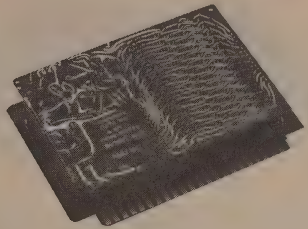
NOTE: All characteristics are available in open-constructed modules. Write for details.

*Total conversion time from trailing edge of TTL/DTL Logic level.

**The conversion error includes all error sources, ±½ LSB and all temperature related errors over the temperature range of 10° to 40°C up to 12 bits and 15° to 35°C for 13 and 14 bit resolution with no adjustments. If an input range other than that specified at time of purchase is selected, the gain and offset may have to be adjusted.

***The temperature coefficient includes all gain, offset, reference, and differential linearity related temperature effects over 0 to 70°C. For extended operating temperature ranges the T.C. degrades by a factor of 2 from +70°C to +125°C and from 0°C to —55°C.

A/D CONVERTERS (PC CARD)



400 SERIES / Model No.	408	409	410	411	412	413	414
Conv. Time (μsec.)	8.0	9.0	10.0	11.0	15.0	35.0	80.0
Error (%FSR)	0.4	0.2	0.1	0.05	0.025	0.015	0.01
Input Z (Kohms)	20	20	20	20	20	20	20
TC (PPM/°C, 0 to 70°)	12 PPM/°C FSR						
Price 1 to 9	$196.	$219.	$242.	$269.	$293.	$347.	$388.

700 SERIES / Model No.	708	709	710	711	712
Conv. Time (μsec.)	3.5	4.0	4.5	5.0	6.5
Error (%FSR)	Up to ±0.025% of Full Range				
Input Z (Kohms)	20	20	20	20	20
TC (PPM/°C, 0 to 70°C)	±10 PPM/°C of Full Range				
Price 1 to 9	$264.	$281.	$310.	$359.	$388.

70 SERIES / Model No.	1270	1370	1470	1570	1670
Conv. Time (μsec.)	13.0	14.0	45.0	250.0	500.0
Error (%FSR)	±0.025	±0.015	±0.01	±0.005	±0.0025
Input Z (Kohms)	20	20	20	20	20
TC (PPM/°C, 0 to 70°C)	±5 PPM/°C				
Price 1 to 9	$332.	$410.	$534.	$815.	$950.

800 SERIES / Model No.	808	809	810	811	812	813	814	815
Conv. Time (μsec.)	2	2.5	3	3.5	4	8	12	35
Error (%FSR)	0.4	0.2	0.1	0.05	0.025	0.015	0.01	0.005
Input Z (Kohms)	4	4	4	4	4	4	4	20
TC (PPM/°C, 0 to 70°C)	15	15	15	15	15	10	10	10
Price 1 to 9	$332.	$376.	$427.	$493.	$579.	$657.	$781.	$950.

900 SERIES / Model No.	908	909	910	911	912
Conv. Time (μsec.)	0.8	0.9	1.	1.5	2.
Error (%FSR)	±0.4	±0.2	±0.1	±0.05	±0.025
Input Z (Kohms)	4	4	4	4	4
TC (PPM/°C, 0 to 70°C)	±20	±20	±20	±20	±20
Price 1 to 9	$759.	$826.	$882.	$1001.	$1116.

1000 SERIES / Model No.	1006	1007	1008
Conv. Time (μsec.)	0.1	0.1	0.1
Error (%FSR)	±1.0%±½LSB	±0.6%±½LSB	±0.3%±½LSB
Input Z (ohms)	50	50	50
TC (PPM/°C, 0 to 70°C)	150	150	150
Price 1 to 9	$3705.	$4208.	$4489.

1100 SERIES / Model No.	1105-60	1105-100	1106-60	1106-100
Conv. Time (μsec.)	0.016	0.010	0.016	0.010
Error (%FSR)	±1.5%±½LSB	±1.5%±½LSB	±1.5%±½LSB	±1.5%±½LSB
Input Z (ohms)	50	50	50	50
Temp. Range (operating)	0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
Price 1 to 9	$3,080.	$6,120.	$5,980.	$11,985.

Military versions available. Contact factory for specifications and quotations.

1200 SERIES / Model No.	1215	1215F
Conv. Time (μsec.)	10	4
Error (%FSR)	0.005	0.0065
Input Z (Mohms)	100	100
TC (PPM/°C, 0 to 70°C)	10	10
Price 1 to 9	$1,118.	$1,678.

Prices subject to change without notice.

/PHOENIX DATA, INC.

3384 W. OSBORN RD. PHOENIX, AZ 85017
Ph. (602) 278-8528, TWX 910-951-1364

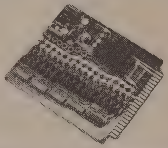
PDI® Encased Digital to Analog Converters – 3000 Series

SPECIFICATIONS EDAC Series 3000 — Encased Digital to Analog Converters

Model	Input Resolution (Note 1)	Full Range Slew & Settling Time (Note 2) (usec.)	Accuracy of FSR (Note 3)	Linearity of FSR	Temperature Coefficient (0°C to 70°C) (Note 4)	Performance	Price 1-9
3012	12 Bits	15	±0.02%	±0.010%	10 ppm/°C	Standard	$179.
3112	12 Bits	15	±0.01%	±0.006%	5 ppm/°C	Precision	219.
3212	12 Bits	1	±0.02%	±0.010%	10 ppm/°C	High Speed	239.
3312	12 Bits	1	±0.01%	±0.008%	5 ppm/°C	Precision & High Speed	279.
3413	13 Bits	15	±0.015%	±0.008%	10 ppm/°C	Standard	228.
3414	14 Bits	17	±0.0125%	±0.007%	10 ppm/°C	Standard	278.
3415	15 Bits	20	±0.010%	±0.006%	10 ppm/°C	Standard	368.
3416	16 Bits	20	±0.007%	±0.004%	10 ppm/°C	Standard	498.
3513	13 Bits	15	±0.010%	±0.006%	5 ppm/°C	Precision	279.
3514	14 Bits	17	±0.007%	±0.004%	5 ppm/°C	Precision	339.
3515	15 Bits	20	±0.005%	±0.003%	5 ppm/°C	Precision	449.
3516	16 Bits	20	±0.003%	±0.0015%	5 ppm/°C	Precision	599.
3613	13 Bits	1.0	±0.015%	±0.008%	10 ppm/°C	High Speed	299.
3614	14 Bits	1.5	±0.0125%	±0.007%	10 ppm/°C	High Speed	359.
3615	15 Bits	2.0	±0.010%	±0.006%	10 ppm/°C	High Speed	479.
3616	16 Bits	3.0	±0.007%	±0.004%	10 ppm/°C	High Speed	639.
3713	13 Bits	2.0	±0.010%	±0.006%	5 ppm/°C	Precision & High Speed	349.
3714	14 Bits	2.5	±0.007%	±0.005%	5 ppm/°C	Precision & High Speed	419.
3715	15 Bits	3.5	±0.006%	±0.004%	5 ppm/°C	Precision & High Speed	559.
3716	16 Bits	4.5	±0.004%	±0.002%	5 ppm/°C	Precision & High Speed	749.

NOTES:
1. Lower resolution units available on request.
2. Conversion time includes settling time to rated accuracy for a full-range step (worse case). See Conversion Timing Diagram.
3. Accuracy figures include all error parameters.
4. Standard operating temperature range is 0°C to 70°C. Extended temperature ranges are available. Also, on special order, units available to 2.5 ppm/°C.
5. For Model Number Coding, see Ordering information.
6. For special configurations or applications, contact your local Phoenix Data, Inc. representative or the factory.
7. The temperature coefficient includes all gain, offset, reference and differential linearity related temperature effects over 0 to 70°C. For extended operating temperature ranges the T.C. degrades by a factor of 2 from +70°C to +90°C and from 0°C to —55°C.

DIGITAL TO ANALOG CONVERTERS — PC Card — including Military and Industrial Types



Model	Input Resolution (Bits)	Full Range Slew & Settling Time (Note 1) (usec.)	Accuracy of FSR (Note 6)	Linearity of FSR	Temperature Coefficient (0°C to 70°C) (Note 7)	Price 1-9
PDAC1270A(2)	12	10	±0.01%	±0.006%	±5 PPM/°C	$ 197.
PDAC1370A	13	10	±0.01%	±0.006%	±5 PPM/°C	253.
PDAC1470A	14	10	±0.01%	±0.006%	±5 PPM/°C	310.
PDAC1570A	15	15	±0.005%	±0.003%	±5 PPM/°C	511.
PDAC1670A	16	15	±0.005%	±0.0015%	±5 PPM/°C	647.
PDAC1270R(3)	12	10	±0.01%	±0.006%	±5 PPM/°C	219.
PDAC1370R	13	10	±0.01%	±0.006%	±5 PPM/°C	276.
PDAC1470R	14	10	±0.01%	±0.006%	±5 PPM/°C	332.
PDAC1570R	15	15	±0.005%	±0.003%	±5 PPM/°C	534.
PDAC1670R	16	15	±0.005%	±0.0015%	±5 PPM/°C	669.
DAC1570G(4)	15	20	±0.005%	±0.002%	±5 PPM/°C	826.
DAC1670	16	20	±0.005%	±0.002%	±5 PPM/°C	953.
DAC1670G-4D(5)	16	20	±0.005%	±0.002%	±5 PPM/°C	1006.
DAC1590G Mil.	15	20	±0.005%	±0.002%	±5 PPM/°C	1792.

NOTES: (1) Faster Settling Times Available. Settling time is to rated accuracy. (2) "A": Without Input Holding Register. (3) "R": With Input Holding Register. (4) "G":Output"Glitch".less than 1 LSB. (5) "4D": Four Decade BCD Code. (6) Accuracy at 25°C including all error sources. (7) Includes all temperature-related errors.

SAMPLE & HOLD 7000 SERIES SPECIFICATIONS

Model No.	Description	Standard Modules 4.5x3"	Standard Modules 4.5x5"	Double Ended Module 3.75x 4.625"	Input Connection Differential	Input Connection Single Ended	Acquisition Time (usec.) Full range step slew & settle to accuracy	Accuracy % FS @ 25°C	TC (PPM/°C) Thruput	Aperture Time Typical (ns)	Short Term Aperture Jitter (ns)	Track To Hold Settle Time (ns)	Input Characteristics (Typical) Impedance @ DC @ 25°C	Input Characteristics (Typical) Bias Current @ 25°C	Output Characteristics Impedance @ 25°C	Output Characteristics Current (Max.)	Price 1 to 9 (Single) Sample & Hold	Price 1 to 9 (Dual) Sample & Hold
7012	Moderate speed.	X				X	13	±0.0125	±2½	30	10	500	1000 Mohms	50 na	0.8 ohm @ DC	5 ma	$ 90.	$140.
7112			X			X	13	±0.0125	±2½	30	10	500					95.	145.
7212	Suitable for ADC's		X		X		15	±0.015	±3½	30	10	500					120.	170.
7312	thru 13 bits.			X		X	13	±0.0125	±2½	30	10	500					100.	158.
7412				X	X		15	±0.015	±3½	30	10	500					125.	209.
7014	Moderate speed.	X				X	15	±0.007	±2½	30	10	600	1000 Mohms	50 na	0.8 ohm @ DC	5 ma	140.	235.
7114			X			X	15	±0.007	±2½	30	10	600					145.	245.
7214	Suitable for ADC's		X		X		17	±0.009	±3½	30	10	600					170.	293.
7314	thru 15 bits			X		X	15	±0.007	±2½	30	10	600					150.	255.
7414				X	X		17	±0.009	±3½	30	10	600					175.	303.
8000 SERIES SPECIFICATIONS																		
8012	Higher speed.	X				X	4	±0.0125	±3.5	30	10	300	1000 Mohms	250 na	0.2 ohm @ DC	5 ma	118.	193.
8112			X			X	4	±0.0125	±3.5	30	10	300					123.	203.
8212	Suitable for ADC's		X		X		5	±0.015	±4.5	30	10	300					186.	324.
8312	thru 13 bits.			X		X	4	±0.0125	±3.5	30	10	300					130.	216.
8412				X	X		5	±0.015	±4.5	30	10	300					191.	333.
8014	Higher speed.	X				X	5	±0.008	±3.5	30	10	400	1000 Mohms	250 na	0.2 ohm @ DC	5 ma	182.	316.
8114			X			X	5	±0.008	±3.5	30	10	400					187.	325.
8214	Suitable for ADC's		X		X		6	±0.01	±4.5	30	10	400					245.	437.
8314	thru 15 bits.			X		X	5	±0.008	±3.5	30	10	400					194.	339.
8414				X	X		6	±0.01	±4.5	30	10	400					250.	447.
9000 SERIES SPECIFICATIONS																		
9010	High speed	X				X	1	±0.025	±10.	20	3	200	500 Mohms	250 na	0.2 ohm @ DC	10 ma	184.	320.
9110	Suitable for ADC's		X			X	1	±0.025	±10.	20	3	200					189.	329.
9210	thru 11 bits		X		X		1.5	±0.035	±12.	20	3	200					250.	447.
9310				X		X	1	±0.025	±10.	20	3	200					194.	339.
9410				X	X		1.5	±0.035	±12.	20	3	200					255.	456.
9012	High speed.	X				X	2	±0.015	±10.	20	3	250	500 Mohms	250 na	0.2 ohm @ DC	10 ma	215.	379.
9112	Suitable for ADC's		X			X	2	±0.015	±10.	20	3	250					220.	389.
9212	thru 13 bits.		X		X		2.5	±0.02	±12.	20	3	250					288.	519.
9312				X		X	2	±0.015	±10.	20	3	250					225.	399.
9412				X	X		2.5	±0.02	±12.	20	3	250					293.	529.
9014	High speed.	X				X	3	±0.01	±7.5	20	3	300	500 Mohms	250 na	0.2 ohm @ DC	10 ma	281.	506.
9114	Suitable for ADC's		X			X	3	±0.01	±7.5	30	3	300					286.	516.
9214	thru 15 bits.		X		X		3.5	±0.0125	±10.	20	3	300					347.	633.
9314				X		X	3	±0.01	±7.5	20	3	300					291.	473.
9414				X	X		3.5	±0.0125	±10.	20	3	300					352.	642.

NOTE 1: 15 bit SAH's require tuning to the individual ADC.
NOTE 2: All SAH's are designed to have a full scale range of ±10V output. That is: a voltage range of +5V input will have a gain of 2.

ENCASED SAMPLE AND HOLD

(2" long x 2" wide x 0.39" high, hot-tin-dipped steel covered module.) Shielded on six sides against RFI and on five sides against EMI. Completely repairable. One SAH per card.

Model	Connection	INPUT Range	INPUT Impedance	Aperture	Accuracy	Settling Time	Output Current	Hold Mode Droop	Price 1 to 9
SAH1	Single ended	+10V to —10V	100 Mohm	50 ns	±0.01% of FS	10us to ±0.01%	±2 ma	2uv/us	$129.
SAH3	Single ended	+10V to —10V	100 Mohm	10 ns	±0.025% of FS	1us to ±0.025%	±5 ma	50uV/us	204.

MULTIPLEXERS. Open or encased modules; Standard 44-pin or double-ended card for back rack insertion. Input ranges to ±10V standard, others optional. Overvoltage protection optional. Single ended or Differential Inputs, Output submultiplexing.

MODEL	DESCRIPTION	PRICE
870S	8 channel Differential or	$253.
1670S	16 channel Single Ended Standard card.	253.

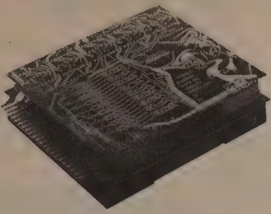
MODEL	DESCRIPTION	PRICE
1670D	16 channel Singled Ended; double ended card.	$265.
870D	8 channel Differential; double ended card.	265.
MUX08	8 channel Single Ended; 2"L x 2"W x 0.39"H encased module.	135.

Prices subject to change without notice.

PHOENIX DATA, INC.

3384 W. OSBORN RD. PHOENIX, AZ 85017
Ph. (602) 278-8528, TWX 910-951-1364

PDI® High Speed Analog to Digital Converters



NEW AND EXCLUSIVE A/D CONVERTER

features:

High Speed: 4 μsec.
High Resolution: 15 Bits
High Accuracy: ±0.0065% of FSR

Phoenix Data's new Model ADC1215F A/D converter is a high-performance design with a total conversion time of 4 microseconds (220,000 conversions per second), a resolution of 15 binary bits (1 part in 32,767), and guaranteed accuracy of ±0.0065% of FSR in addition to complete monotonicity. Analog dynamic range is in excess of 86 db. Model ADC1215F is available in two basic models: single-ended and differential. The ADC1215F utilizes a single fold-back technique in conjunction with successive approximation conversions to achieve an equivalent conversion rate of 267 nanoseconds per bit.

Model ADC1215 is identical with the ADC1215F except that conversion time is 10 microseconds.

ADC1215F SPECIFICATIONS

ENCODING (Digital Quantizing)

Number of Bits	15 binary bits
Accuracy (% of Full Range)	0.0065%
Temperature Coefficient	±10 PPM/°C
Resolution	1 part in 32,767
Conversion Time (Total)	4.0 microseconds

ANALOG INPUT SIGNAL

Standard Full Range	±10V
Connection	Single Ended or Diff. Opt.
Input Impedance	100 Megohm
Overvoltage	±15V, Maximum

CONTROLS, INPUTS AND OUTPUTS

Output Codes	2's Complement and Offset Binary
Logic Levels	TTL/DTL
Data Output Drive	Full TTL capability
Output Data	Stored until updated at end of conversion
Command to Convert	Conversion is initiated on leading edge of positive going pulse.
Busy Output	Goes true at CTC and False at End of Conversion
End of Conversion	Pulse goes true at End of Conversion 100 nanoseconds duration
Overrange	Output goes full scale and overrange bit goes true

ENVIRONMENTAL

Temperature/Operating	0°C to +70°C
Temperature/Storage	—55°C to +100°C
Humidity	0 to 99% Relative, non-condensing

POWER REQUIREMENTS

+15V, ±5% @ 150 MA
—15V, ±5% @ 75 MA
+5V, ±5% @ 900 MA

Base price:

1215 $1,118.
1215F $1,678.

Prices subject to change without notice.

BIT OUT
EOC
STROBE
J1

SPEEDS to 100 MHz

MODEL ADC1105-100 A/D CONVERTER COMBINES

High Speed with (100 million conversions per second)
Exceptional Accuracy (±1.5%±½LSB)

Phoenix Data's new very-high-speed (100 million conversions per second) analog to digital converter is designed to digitize ultra-high-speed analog input signals — including high-speed display and radar signal digitized input — with accuracy of ±1.5%±½LSB.

The new ADC1105-100 also has a resolution of 5-bit binary or 2's complement with a ±2 volt input range. A "system-ready" module only 8"x7.50"x2", it is totally self-contained and incorporates all of the functions necessary to perform 5-bit binary conversions at 100 million per second except for power supply. Model ADC1105-60 is identical with Model ADC1105-100 except that conversions are performed at a rate of 60 million per second.

SPECIFICATIONS

ANALOG INPUT SIGNAL

Accuracy	±1.5%±½LSB
Full Range	±2 volts
Connection	Coaxial, Single Ended
Input Impedance	50 Ohms
Bandwidth, 1dB	50 MHz

CTC (Command to Convert) STROBE

Logic Type	ECL
Input Impedance	50 Ohms
Conversion	Initiated on negative going transition
Pulse Repetition Rate (PRR)	100,000,000/Second
Pulse Duration	Square wave

END OF CONVERSION (EOC)

Pulse	ECL level, rising edge signifies EOC
Width	Same as CTC Strobe Occurs less than 10 nanoseconds after CTC Strobe

DATA OUTPUTS

Code	5-bit Binary and 2's complement with monotonicity
Logic Type	ECL compatible
Drive	50 Ohm lines
Parallel Data Out	Sustained 1 cycle
Output Skew	±1 nanosecond (typical)

POWER REQUIREMENT

+5.2Vdc ± 5% @ 1.2 ampere
—5.2Vdc ± 5% @ 2.5 ampere

PACKAGE	Approx. 8.0" x 7.50" x 2.0"

ENVIRONMENTAL

Temperature	
Operating	0°C to +50°C
Storage	—55°C to +125°C
Humidity	0 to 99% relative, no condensation

Base price:

1105-60 $3,080.
1105-100 $6,120.

/PHOENIX DATA, INC.

3384 W. OSBORN RD. PHOENIX, AZ 85017
Ph. (602) 278-8528, TWX 910-951-1364

PRESTON

ANALOG-TO-DIGITAL CONVERSION SYSTEMS

Here are the world's most reliable Analog-to-Digital Conversion Systems with speed and resolution to meet the needs of every instrumentation and data conversion system.

From the 'world's fastest high resolution ADC'—the GMAD-01—to the new 'low cost' GMAD-4 that can be easily expanded to over 1000 analog input channels at less than $25 per channel, Preston's GM Series of ADCs are delivered with exactly the right amplifiers, multiplexers, controls, indicators and interface features to give your system the ultimate in accuracy, flexibility and efficiency!

And every model in the GM Series comes complete with integral power supplies and interface connectors—ready to install in a standard 19 inch wide rack.

With the GM Series of ADCs, you have a complete selection of low-level and high-level analog amplifiers and multiplexers. This versatile input system is further complemented by a choice of several Sample-and-Hold Amplifiers and special gain scaling buffer amplifiers whose configurations include manual or remote programmed address and automatic gain control capability.

For complete information including detailed specifications, block diagrams, timing charts and examples of overall system performance, call or write Preston Scientific. We'll send you our "Specifying Guide" and include price and delivery information, too!

ANALOG TO DIGITAL CONVERSION SYSTEM

GMAD Series Analog-to-Digital Converters

Five models are included in the GMAD Series to provide an exceptionally wide range of speeds and resolutions.

Resolution	Accuracy (% of F.S. ±½ L.S.B.)	Conversion Time GMAD-01	GMAD-1	GMAD-2	GMAD-3	GMAD-4
14 binary bits + sign	0.010%	*	1.5 μsec	5.0 μsec	10 μsec	20 μsec
13 binary bits + sign	0.015%	*	1.4 μsec	4.5 μsec	9 μsec	19 μsec
12 binary bits + sign	0.025%	0.5 μsec	1.2 μsec	4.0 μsec	8 μsec	18 μsec
11 binary bits + sign	0.05%	0.4 μsec	1.0 μsec	3.5 μsec	7 μsec	17 μsec
10 binary bits + sign	0.1%	0.3 μsec	0.3 μsec	3.0 μsec	*	16 μsec
9 binary bits + sign	0.2%	0.2 μsec	0.2 μsec	2.5 μsec	*	*
8 binary bits + sign	0.4%	0.1 μsec	0.1 μsec	2.0 μsec	*	*
7 binary bits + sign	0.8%	*	0.1 μsec	1.5 μsec	*	*
4-digit BCD and sign	0.01%	*	*	10 μsec	40 μsec	*
3-digit BCD and sign	0.1%	*	*	8 μsec	32 μsec	*

*These configurations not available

Model GMM Multiplexers

Both single-ended and differential input multiplexers provide a common output line isolated from all other signals by 2000 megohms. Easily expandable to over 1000 channels in groups of four, eight or 16, depending on the model number and the GMAD Series in which they are installed.

These specifications are for the Model GMM -1 which is used in the GMAD -1, -2 and -3.

Input Impedance	Greater than 50 Megohms
Switching Time	Less than 1 microsecond
Input Offset Current	Less than 10 nanoamps
Input Voltage	Up to ±10 volts
Crosstalk	Less than ±0.01% for 100 channels
Linearity	±0.01% of Full Scale
Zero Drift	Less than ±0.01% of Full Scale

Model GMSH Sample-and-Hold Amplifiers

For precise time correlation between multiple input signals. Can be used ahead of the multiplexer or between the multiplexer and the ADC to reduce aperture errors and increase timing accuracy.

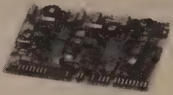
These specifications are for the Model GMSH-10 which can be used in all models of the GMAD Series ADCs.

Gain	Unity
Gain Stability and Linearity	±0.01% of Full Scale
Input Impedance	Greater than 10 Megohms
Noise	Less than 1 mV peak
Hold Delay	100 nanoseconds
Settling Time to 0.01%	Less than 0.5 usec
Droop in Hold Mode	±1 mV after 1 ms
Aperture Error	10 nanoseconds

PRESTON SCIENTIFIC INCORPORATED 805 East Cerritos Ave., Anaheim, Calif. 92805 Tel: (714) 776-6400 TELEX 65-5321

Complete ADC Systems with High-Level and Low-Level Multiplexers, Amplifier-per-Channel Systems With Programmable Gain, and Logic Interface to Computers

Model GMD Amplifier-Multiplexers

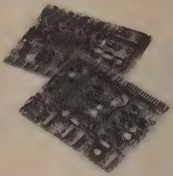


Direct coupled amplifiers with gains selectable from less than unity to gains of over 1000. All models combine wide bandwidths with excellent long-term stability, accuracy, linearity and very low temperature coefficients.

Gain Accuracy	±0.01% of Full Scale
Gain Stability	±0.01% of Full Scale for 6 months
Gain Temp Coeff.	±0.002% per °C
Linearity	±0.01% of Full Scale
Input Impedance	100 Megohms @ Unity gain or greater
Common Mode Rejection	80 db — DC to 60 Hz
Bandwidth	1 MHz
Noise	Less than 1 millivolt
No. of Channels in 5½" high rack	48
Output	Commutated ±10 Volts F.S.

Programmable Gain Amplifiers

Model GMD-PG Amplifiers with Digitally Programmed Gain Control



Accurate control of the gain of the ADC input amplifier can now be determined by external computers and controllers. A standard three-bit binary coded signal is used to set the amplifier gain at precise pre-established levels over a 16-to-1 range. Full 0.01% gain accuracy and stability are assured even at multiplexer rates as high as 1 MHz!

Model GMD-AGC Amplifier with Auto-Ranging Gain Control

For the ultimate in system resolution and accuracy where the input signal level is constantly changing, the Model GMD-AGC Amplifier will automatically establish the optimum amplifier gain in 5 binary steps that cover a 16-to-1 range. With this special amplifier, the output signal will always have an output amplitude above 50% of full scale without exceeding the upper amplitude limits of the analog-to-digital converter!

The gain setting of the amplifier is, in turn, used to generate a three-bit digital signal that is added to the end of the digital ADC output signal so that the data acquisition system will be able to identify the amplifier gain setting for each individual channel!

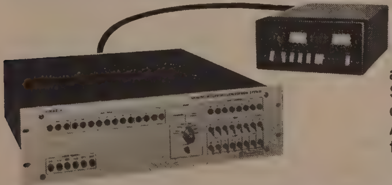
No special programs or controllers are necessary with this automatic gain control system. It's all built into the GMAD System to further simplify equipment requirements and lower system cost.

Logic Interface to Your Computer

Direct interfacing with your computer or controller can now be made an integral part of every GMAD Series A/D Conversion System. Preston can include plug-in logic and control modules that provide the right sequencing and logic levels to match your particular computer program.

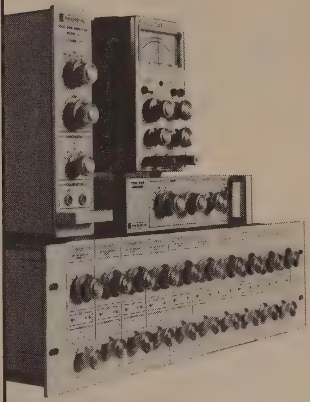
Just let us know the type of computer you plan to interface with our ADC, and we'll provide all the 'hand-shaking' signals you need.

If you're using a DEC PDP-11, HP 2100, Varian V-73, Data General NOVA or other similar computers, we already have the interface system ready to install, and we'll even provide the interconnecting cables!



Save yourself time, trouble and expense. Call or write Preston Scientific for details. We'll make certain you get a complete GMAD ADC System — ready to operate the first day it arrives!

Preston Builds the World's Most Accurate Amplifiers and Data Acquisition Sub-System Components, too!



The "Balanced Precision" performance of Preston's 8300 XWB Series Amplifiers deliver greater accuracy than any other amplifier under all operating conditions!

With improved Common Mode Rejection, Temperature Stability, Overload Recovery and reduced "Pumpout Current," Preston's amplifiers reduce the major sources of instrumentation system errors.

Now the higher performance and system flexibility of these advanced amplifiers has been combined with signal conditioners, multiplexers, analog-to-digital converters, sequencing controls and function indicators to meet the need for improved front-end components in high accuracy, high speed data acquisition systems.

You'll find detailed information on these outstanding amplifiers on Pages 1•12 and 1•13 of Volume 1 of EEM, and a full description of Preston's data acquisition sub-system components on the next four pages.

For specific information on all of Preston's advanced instrumentation equipment, write or call —

PRESTON SCIENTIFIC INCORPORATED
805 East Cerritos Avenue,
Anaheim, California 92805
Telephone: (714) 776-6400
TELEX 65-5321

PRESTON

PRESTON

DATA ACQUISITION SUB-SYSTEMS AND ANALOG FRONT-END COMPONENTS

ANALOG AMPLIFIERS AND MULTIPLEXERS

Low level or high level — single-ended or differential — Preston has the configuration to meet your requirements!

Preston, the leader in high performance A/D converters and precision analog instrumentation amplifiers, is now providing a complete line of sub-system components designed to meet today's most demanding requirements for computer based data acquisition systems.

Preston's low-level and high-level amplifiers and multiplexers provide the accuracy and stability to match the resolution, accuracy and speed of Preston's well-established family of GM Series Analog-to-Digital Conversion Systems.

Preston can now provide everything necessary to complete the 'front-end' sub-system for virtually every type of computer-based data acquisition system. And complete system controls that provide the exact interface your computer needs can be included in any of Preston's ADC and multiplexer systems to make your entire data acquisition system "plug and program compatible" the first day it is installed.

8300 XWB Series Instrumentation Amplifiers

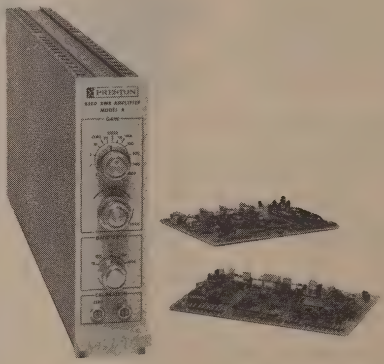
The highest accuracy and stability available today! And every model in the 8300 XWB Series has improved CMR, pumpout current and overload recovery specifications to reduce the biggest sources of data acquisition system errors!

With accuracy as high as 0.01% and linearity to 0.005%, these amplifiers are built to match the resolution of our high accuracy ADCs.

And many models provide infinite isolation with a CMR of 150 db (130 db at 60 Hz) at CMV of 350 volts, plus remotely programmed gain and bandwidth on a per-channel basis to further improve the speed, accuracy and flexibility of your system.

Model GMM High Speed, High Level Multiplexer

A single-ended high speed FET type multiplexer for switching multiple inputs onto a common high level output line. Differential inputs can also be multiplexed with another configuration of this multiplexer.



Model GMD Amplifier-Multiplexers

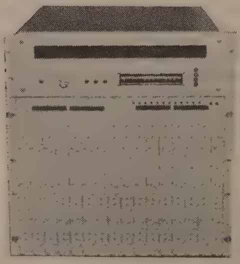
Card mounted for installation in rack-mounted assemblies, these low cost amplifiers are ideal for wide band systems that require high speed multiplexing with amplifier-per-channel performance. Accuracy is 0.01% and the output is ±10 volts full scale with many models available for input signal amplitudes in the range from 10 volts to as low as 10 millivolts full scale. Amplifier output filters down to 2 Hz (−3 db point) are available as options.

Model GMSH Sample-and-Hold Amplifiers

Where precise time correlation between multiple input signals is required, Preston's Sample-and-Hold amplifiers provide exceptionally fast acquisition and aperture times. They can be used ahead of the multiplexers or between the multiplexer and the ADC to reduce aperture errors.

Model LLM Low Level Multiplexer

Preston's latest engineering advance! This low level multiplexer system provides a floating isolated input for the ultimate in performance with low crosstalk, good temperature stability and high accuracy on input levels from 1 millivolt to 10 volts full scale.



The LLM system features also include input data filters (single and multiple pole), remote gain selection on a per-channel basis and operating rates up to 50 kHz in systems with as many as 1024 channels!

The exceptional reliability and accuracy of the Model LLM Low Level Multiplexer makes it ideally suited to replace many types of low performance solid state multiplexers and certain relay and crossbar multiplexing systems.

FOR ADDITIONAL SPECIFICATIONS ON PRESTON AMPLIFIERS, SEE PAGES 1•12 AND 1•13 OF VOLUME 1 OF EEM.

Low Level and High Level Analog Amplifiers and Multiplexers
High Accuracy Analog-To-Digital Converters
Digital-To-Analog Converters • System Controls

ANALOG-TO-DIGITAL CONVERSION SYSTEMS

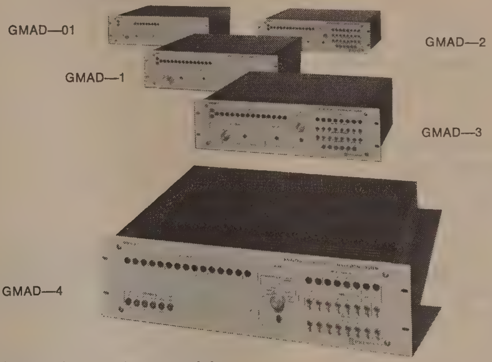
High resolution, ultra fast A/D Converters with 15 bit resolution at 50 KHz to 750 KHz word rates.

GM Series Analog-to-Digital Conversion Systems

Preston's GM Series of ADCs cover the entire range of accuracies, resolutions and conversion speeds. From the GMAD-01 that completes a 9 bit conversion in only 100 nanoseconds to 15 bit models with conversion times that range from 1.5 usec to 20 usec, there's a high reliability GM Series ADC for every data acquisition and data reduction system.

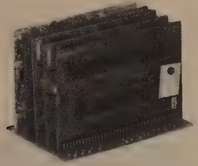
Every GM Series ADC is self contained with its own power supplies, timing and control circuits, multiplexer channel controls, channel and digital conversion indicators, and amplifiers and multiplexers as required —all in complete assemblies ready for rack mounting.

They're all designed for expansion, too, so that as your system requirements change, you can change the type of amplifiers and multiplexers to keep your system up to date.



The heart of every data acquisition system is the accuracy and reliability of the analog-to-digital conversion system, and Preston has earned its reputation for excellence with over 1400 ADCs delivered - most in constant use - and with over 15 years of customer satisfaction and success to prove it!

Digital-to-Analog Converters



Module-mounted multi-channel digital-to-analog converters are also available in the GM Series ADC systems to make the generation of analog data simulation as accurate and reliable as the basic A-D converter.

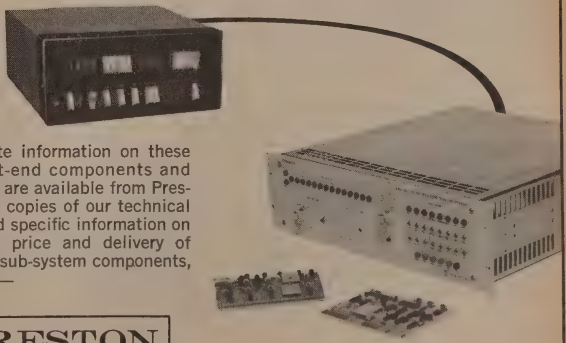
Specifications include 15 bit resolution and accuracy, update rates to 500 KHz and outputs of 10 volts or 100 volts full scale.

These modules are designed to be installed within the standard GM Series chassis, and the outputs are available on rear-panel connectors for easy interfacing with other system components.

System Controls

The GM Series ADCs include internal timing and sequence controls that permit each system to operate independently. Manual controls permit the operator to select any multiplexer channel or any particular portion of the normal multiplexer sequence from 'first' and 'last' channel controls located on the front panel.

Logic control both to and from the system is also provided for 'stop,' 'hold' and 'run' functions, and Preston systems often include control modules that permit direct 'plug-to-plug' interconnection with many standard computers and controllers.



Complete information on these analog front-end components and ADC systems are available from Preston. For your copies of our technical literature and specific information on performance, price and delivery of any of these sub-system components, call or write —

PRESTON

PRESTON SCIENTIFIC INCORPORATED 805 East Cerritos Ave., Anaheim, Calif. 92805 Tel: (714) 776-6400 TELEX 65-5321

FOR ADDITIONAL INFORMATION ON PRESTON A-D CONVERTERS, SEE PAGES 1•194 AND 1•195 OF VOLUME 1 OF EEM.

PRESTON

DATA ACQUISITION SUB-SYSTEMS AND ANALOG FRONT-END COMPONENTS

The modular construction of Preston's analog front-end components and analog-to-digital converters simplifies the design of the optimum sub-system for every application.

With amplifiers and multiplexers to match all input levels, plus a full range of ADCs with speed and accuracy to complement your computer's performance, you can have the 'ideal' data acquisition system 'on-line' in the shortest possible time!

Here's an example of a typical Preston 'front-end' for a 512 channel data acquisition system that includes both high-level and low-level analog inputs, and must interface a 15 bit digital output with a PDP-11 computer:

Analog Signal Amplifiers and Multiplexers

512 analog input channels consisting of:

256 low-level GMD-1000 Amplifier/Multiplexers for analog signals between 10 and 150 millivolts full scale.

240 high-level GMD-10 Amplifier/Multiplexers for analog signals between 500 millivolts and 1 volt full scale.

16 high-level GMD-1 Amplifier/Multiplexers for analog signals of up to 10 volts full scale.

Analog-to-Digital Converter

A GMAD-1 15 bit ADC (14 bits plus sign) that provides 0.010% accuracy at a conversion time of only 1.5 microseconds. Includes operating mode controls and binary output indicators on front panel.

Sample-and-Hold Amplifiers

30 Sample-and-Hold Amplifiers for precise time correlation high accuracy conversion of certain dedicated analog channels between 1.0 and 10 volts full scale.

Multiplexers and Sub-Multiplexers

30 GMM Multiplexers to follow the Sample-and-Hold Amplifiers.

16 GMM Multiplexers for sub-multiplexing the input data channels to minimize analog buss capacity.

Multiplexer Timing and Control Sub-Systems

Internal clock and sequencing circuits for multiplexer addressing. Front panel controls permit independent selection of individual channels and also permit manual selection of 'short-cycle' multiplexer sequencing through 'first' and 'last' channel selection switches.

Computer Interface

This system incorporates a Preston logic-matching hardware type computer interface circuit. The interface logic is from a catalog of available Preston logic interfaces that are compatible with the most widely used 16 bit computers. These plug-in modular circuits provide all the necessary 'hand-shaking' signals between the MUX control system, the ADC and the computer I.O. Buffer (A/D Controller) so that full interfacing of timed channel selection data, start and stop commands and all status signals and digitized data is correctly directed to the computer.

Preston can even supply the interface cable, so that your entire system is ready to go the day it arrives!

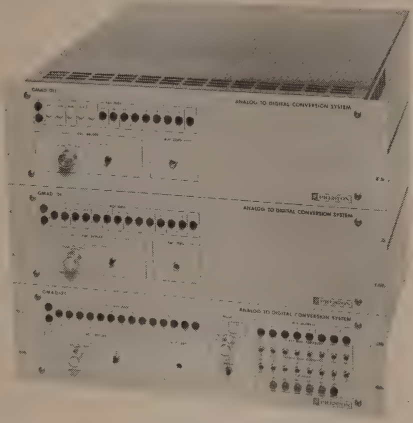
And Preston will work with you to make certain that there is compatibility between the interface hardware and the software drivers that are available from the computer manufacturer's software library.

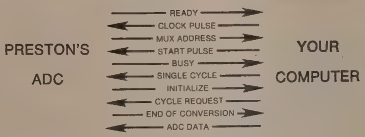
Complete Data Acquisition Sub-Systems with Multi-Level Analog Input Amplifiers and Multiplexers, A/D Converters and Direct Interface to Your Computer System!

Your requirements determine the design of Preston's sub-systems.

With the full line of sub-system components available from Preston, there's never any need for compromising performance. You can select the transducers and signal sources that give you the most accurate and the most reliable performance you can find, and Preston will have an equally accurate and reliable amplifier and multiplexer to handle the signal.

And compatibility of performance in all parts of Preston's sub-systems is assured, too! We've been building the world's most reliable amplifiers and analog-to-digital conversion equipment since 1959, and it's all been designed to fit together and work together — for greater overall accuracy!





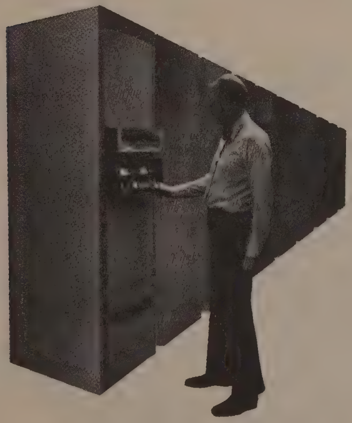
Interfacing with your computer is now easier, too!

If you're using a DEC PDP-11, HP 2100, Varian V-73, Data General NOVA or other similar computers, we already have the interface system ready to install, and we'll even provide the interconnecting cables!

You save time, and eliminate the complex engineering effort that is required to 're-discover' answers to interface problems that we have already solved — and delivered!

Preston has made the investment in computer interface hardware that works with your computer and your software program. Now, when your equipment is delivered, it's ready to be plugged in and put to work!

The largest data acquisition systems are already using Preston's system components:



This computer controlled data acquisition system includes over 500 of Preston's 8300 XWBRC Series Instrumentation Amplifiers and an equal number of 8800 USC Series signal conditioning modules ahead of a high speed 15 bit GMAD-1 Analog-to-Digital Conversion System that includes all the control hardware for interfacing to a 16 bit mini-computer system. The goal of this system is to provide a completely automatic data collection and monitoring capability featuring both software and manual programmed control and providing the ultimate in input-to-output accuracy while operating in a severe common-mode, electrical-noise environment.

This highly sophisticated amplifier-per-channel data acquisition system is to be used in advanced turbine engine compressor development programs for military and commercial aircraft propulsion systems.

For complete information on all of Preston's advanced components for data acquisition systems, examine the more detailed descriptions on amplifiers and ADCs that appear on pages 1•12, 1•13, 1•194 and 1•195 of Volumes 1 of EEM. Then call or write directly to Preston's main office in Anaheim, California. We'll make certain you receive all the information you need.

PRESTON

PRESTON SCIENTIFIC INCORPORATED 805 East Cerritos Ave., Anaheim, Calif. 92805 Tel : (714) 776-6400 TELEX 65-5321

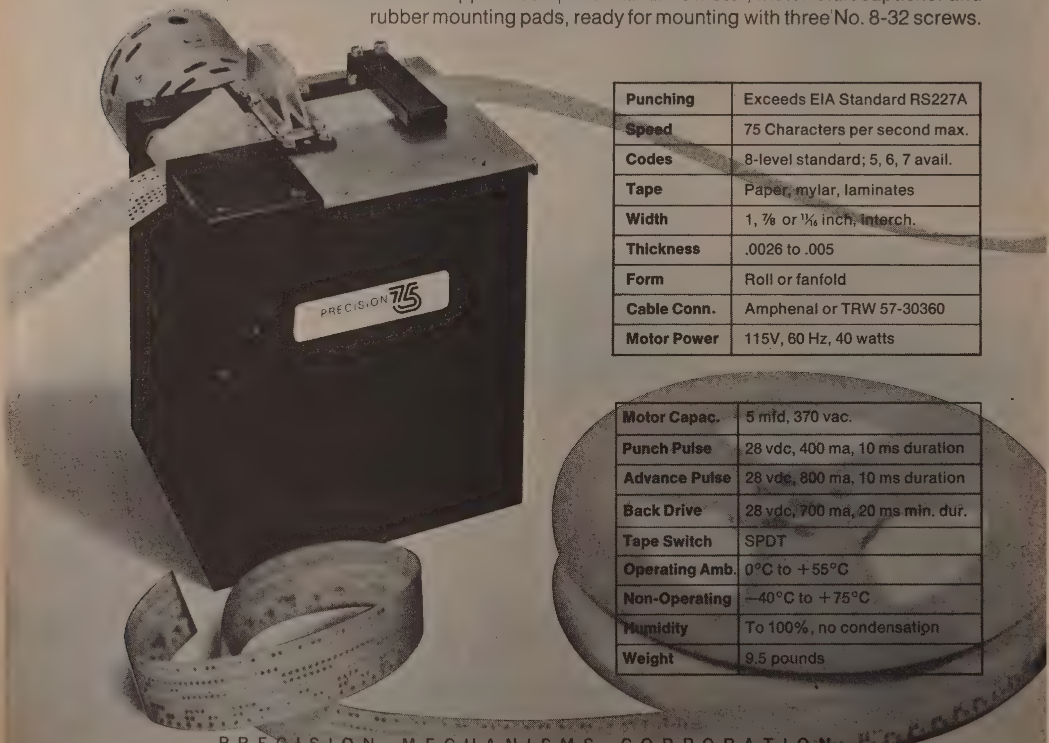
PMC PRECISION 75

The Precision 75 Tape Punch is a 75 character per second tape perforator featuring high reliability, low power requirements and minimal maintenance. It is capable of punching all standard 1, ⅞, and 11/16 inch wide tapes interchangeably.

Its basic elements are motor-powered punch and tape advance drives, an electromagnetic punch selector bank and a reluctance timing pick-off.

Any desired character is punched by applying a 28 vdc pulse to the punch selector bank for each hole of the character. A follow-on pulse activates the tape advance drive which moves the tape into position for the next character. Reference timing for the punch and tape advance pulses is provided by the pick-off.

The Precision 75 is supplied complete with drive motor, motor-start capacitor and rubber mounting pads, ready for mounting with three No. 8-32 screws.



Punching	Exceeds EIA Standard RS227A
Speed	75 Characters per second max.
Codes	8-level standard; 5, 6, 7 avail.
Tape	Paper, mylar, laminates
Width	1, ⅞ or 11/16 inch, interch.
Thickness	.0026 to .005
Form	Roll or fanfold
Cable Conn.	Amphenal or TRW 57-30360
Motor Power	115V, 60 Hz, 40 watts

Motor Capac.	5 mfd, 370 vac.
Punch Pulse	28 vdc, 400 ma, 10 ms duration
Advance Pulse	28 vdc, 800 ma, 10 ms duration
Back Drive	28 vdc, 700 ma, 20 ms min. dur.
Tape Switch	SPDT
Operating Amb.	0°C to +55°C
Non-Operating	−40°C to +75°C
Humidity	To 100%, no condensation
Weight	9.5 pounds

PRECISION MECHANISMS CORPORATION

44 BROOKLYN AVENUE, WESTBURY, L.I., N.Y. • ZIP CODE 11590 • (516) EDgewood 3-5955

PPM, INC.

A subsidiary of TORO

SIGNAL CONDITIONERS

THE SG-11 IS A PLUG-IN MODULE with power supply, balance calibration and monitoring circuits. The power supply circuit offers high temperature and time stability, providing line and load regulation of 0.01%; excitation voltage is adjustable from 0 to 16 volts at 0 to 150 mA. Featured is a self-restoring current limit circuit. All units may be wired for constant-current operation.

The SG-11 has very high isolation to line—under 0.03 pF coupling capacitance from power line to DC output—SG-11 performance approximates battery operation.

All controls are 10 turn potentiometers of very high resolution. Calibration is bipolar single shunt.

Two types of enclosures are available: A 19″ relay rack that permits the mounting of eight units side-by-side and a portable enclosure accepting a single plug-in unit. A plug-in power supply is also available.

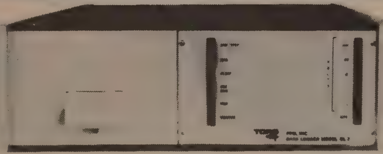
MODEL SG-11 PLUG-IN UNIT (eight shown in rack)	**$187.50**
PORTABLE ENCLOSURE (MODEL SG-11-P as shown)	**$ 39.50**
RELAY-RACK MOUNTING ENCLOSURE (MODEL SG-11-R as shown) with solder terminals only	**$129.00**
RELAY-RACK MOUNTING ENCLOSURE (MODEL SG-11-RC as shown) with MS connectors (mating connectors included)	**$395.00**

THE MODEL SG-16 series (not illustrated) provides lowest-cost strain-gage conditioning. A 20 channel system with common power supply occupies only 5¼ inches of vertical panel space at a total cost of $75 per channel. Amplifier options range from $10 per channel for 10ma galvo drive amplifiers to $100 per channel for low-drift differential amplifiers. Write for Bulletin SG-16.

022
PPM
THERMOCOUPLE MONITORING SYSTEM
MODEL TM-100A

THERMOCOUPLE MONITOR

THE TM 100A SCANS UP TO 100 THERMOCOUPLES, displaying temperature in digital form. A high-low limit circuit compares temperature with preset thumbwheel switches; a lamp matrix displays all out-of-limit channels. Interface provides for auxiliary printout or computer entry of data.



DATA LOGGER

THE MODEL DL-2 IS A COMPLETE DATA ACQUISITION SYSTEM in a compact, portable package. It scans up to 100 differential signals, digitizes them and a thermal printer records their values. Options include floating decimals, internal digital clock, conditioning for thermocouple or strain-gage transducers and punched paper or magnetic tape recording.

Input signals include DC voltage, resistance and frequency. Write for Bulletin DL-2.

Data Logger with 10 Channels	**$2320.00**
Data Logger with 100 Channels	**$3220.00**

PPM
THERMAL DIGITAL PRINTER/TP-10

TP-10

SILENT THERMAL DIGITAL PRINTER

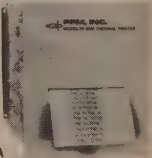
Model TP-10 is a quiet, moderately priced, reliable instrumentation printer with only one moving part. It prints up to 14 columns at 5 lines/second from BCD input signals.

Prints on standard thermal actuated paper . . . excellent legibility.

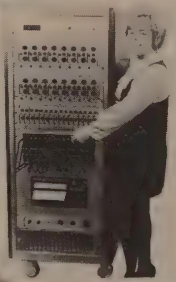
Model TP-10A is a plug-in printer module for OEM applications. All electronics except the power supply are included.

Options for TP-10 include a digital clock card, for recording the time of an event's occurrence, and a digital voltmeter card.

Write or call for prices and Bulletin TP-10.



TP-10A



PPM SYSTEMS

PPM OFFERS CUSTOM SYSTEMS AND SYSTEMS COMPONENTS for data acquisition, process and speed control. PPM Data Acquisition Systems will accept as many as 1000 individual signals; these signals are scanned, digitized and recorded in printed form or on punched or magnetic tape. Alarm outputs are available for signals falling outside of the preset limits. For systems applications we offer several Systems Components, such as: Printers, Scanners, and Digital Clocks.

For comprehensive information, write us or call us collect today.

Bulletin PE-2-4

Prices subject to change without notice.

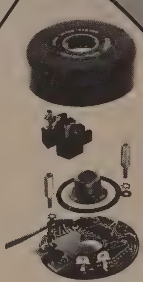
PPM, INC. 32 WEST MONROE STREET • BEDFORD, OHIO 44146 • 216/232-1880

ENCODERS

INCREMENTAL

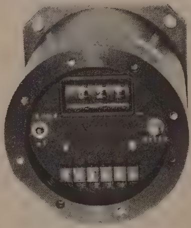
Many configurations from 1 to 20,000 counts. English/Metric available.

MODULAR



For velocity, feedback or positioning applications.

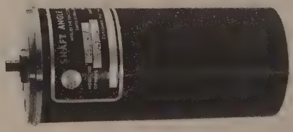
CUSTOM



Will design to meet your applications.

ABSOLUTE

Up to 13 bits— NB or Gray... and 9999 BCD.



ALTITUDE

Will design to fit your Altimeter.

LINEAR

Designed for Disc Memory Files.

RENCO

RENCO CORPORATION

Santa Barbara Research Park
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Goleta, California 93017
Phone(805) 968-1525 TWX 910-334-1180

Our Optical Encoder Handbook will help take the guesswork out of buying encoders.

Need Encoders? Rotary or Linear? Absolute or Incremental? Incandescent Lamps or LED? The objective of this informative handbook is to convey practical knowledge that will assist users to answer these and hundreds of other encoder questions. Renco Corporation offers this handbook—free of charge—to assist you in selecting encoders that are best suited to your particular applications.

Principles of Optical Encoders.
Explains how optical encoders function to generate a digital representation of a motion or a position.

Encoder Design Considerations.
Examines the components and economic variables that are pertinent to the design of optical encoders.

Discs, Codes, and Electronics.
Discusses disc master generation, applicable codes, and electronic output interfaces used in optical encoders.

Understanding Encoder Specifications.
Defines and analyzes typical specification variables, and relates these variables to encoder design considerations.

Optical Encoder Handbook

Renco Corporation

Santa Barbara Research Park
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805/968-1525 TWX 910-334-1180

Incremental and Absolute Encoders.
Explains the functional application and merits of the two approaches.

Linear Encoders.
Discusses the design considerations and functional applications given to this type of encoder.

Modular Encoders and Special Designs.
Explains the economic and performance advantages offered with modular encoders, and the relative merits of specified designs when applicable.

Encoder History and Applications.
Traces the development and usage of non-contact encoders, leading the present-day acceptance of the optical encoder.

Write or call for your copy today.

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RCI/DATA

DATA

- COMMUNICATIONS
- ACQUISITION
- TELEMETRY

MODEM ELIMINATOR

C-596 • Wire Line Modem 9600 BPS to 12,000 ft.
96,000 BPS to 1,000 ft. — from $200.

DIGITAL TELEMETRY & CONTROL SYSTEMS/COMPONENTS

C-210 • Computer to computer link
C-220 • Digital Telemetry — 64 states/one site
C-230 • Digital Telemetry — 18 states/32 sites
C-240 • Security camera controller — remote joystick controlled

COMPUTER SYSTEMS COMPONENTS & SUBSYSTEMS

R1069 • Multiplexer, 32 Channel for PDP-11 computers. DMA in & out. Sync or asyn channels
R1341 • Modem change-over switch, expandable to 32 ports
C- 450 • Anticontention Modem sharing unit — 8 ports
C- 455 • Modem Splitter — 1 to 10 ports
C- 446 • Hi Speed remote line switcher — up to 16 lines, 4 trunks
Flextrix • Reed Relay Switching Matrix, remote or computer controlled

DATA COMM

C-440 • Selective calling units
C-420 • Hubbing repeater
C-470 • Universal bridging monitor — From EIA to 270 volts
C-600 • Series Code Translators — ASCII, Baudot, Hollerith, Selectric
C-380 • Remote Loop Back Module, automatic
C-910 • Voice Order Wire, selective call (Touch Tone®)

TERMINALS

RCI-200 • 15 cps impact printer terminal based on the IBM heavy duty 735 Selectric I/O writer.
RCI-400 • 120 cps impact printer terminal based on the Teletype Corp Mod 40 printer mechanism.

SUPERVISORY CONTROL & MONITOR CENTERS FOR DATA COM USERS

- DATA MODEMS
- TELETYPE
- TELEPHONE
- COMPUTER

RCI/DATA

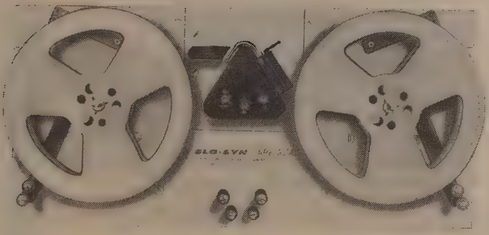
Division of RE-EL Circuits, Inc. 520 Victor Street,
Saddle Brook, N.J. 07662 , (201) 843-3768

SLO-SYN®
PHOTOELECTRIC TAPE READERS

SLO-SYN Photoelectric Tape Readers combine the dependability of photoelectric design with the proved reliability of SLO-SYN stepping motors. There are no detents, ratchets, belts or gears. Models are available to meet high speed as well as low speed applications.

- Bidirectional with two channel pulse input
- Read all opaque and translucent tapes that have a maximum light transmission of 40%. No adjustments needed.
- Simple, full-view loading
- Long, maintenance-free operation
- Standard 19-inch rack mount

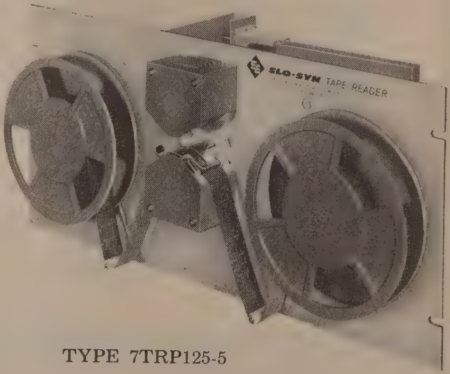
300 CHARACTERS PER SECOND



TYPE 7TRP300

- Reading rate 0 to 300 characters per second asynchronously; 500 characters per second synchronously
- Solid-state LED light source not subject to aging
- TTL, DTL, CMOS compatible with both normal and inverted outputs available
- Integrated circuitry assures reliability
- Reel and fanfold models available

125 CHARACTERS PER SECOND



TYPE 7TRP125-5

- Asynchronous speeds to 125 characters per second
- Normal and inverted outputs
- 5 volt and 15 volt models available
- 5 volt models DTL and TTL compatible
- Models available with or without reeler assembly

Write for complete literature or call Robert Palmer

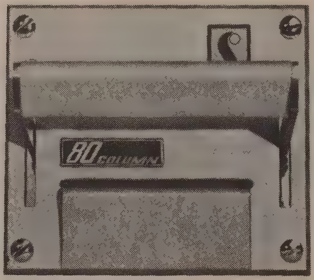
THE SUPERIOR ELECTRIC COMPANY
1000 MIDDLE STREET • BRISTOL, CONN. 06010 • PHONE: (203) 582-9561

SEALECTRO CARD, BADGE & TAB READERS

10 x 10-10 x 12 BADGE READERS

Completely automatic Badge Readers that accept standard IBM and Friden Type Badge cards in 10 x 10 or 10 x 12 formats. Ideal for personnel identification, production control and process control operations.

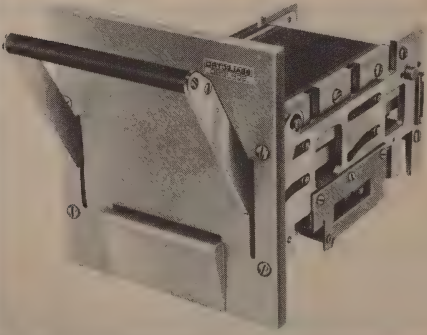
Go/no-go lights immediately indicate if the card is inserted correctly. No contacts actuate until the card is properly inserted. Remote solenoid-operated contacts sense hole patterns and read. Read function is automatically held until feedback from system releases contacts and card is automatically ejected. Flexible output wiring allows bussed or discrete contact interface connections.



12 x 80 CARD READER

The Sealectrocard Card Reader is designed to be completely compatible with all standard 12 x 80 TAB type punched-cards. This unit combines features which provide maximum reliability, convenience and economy in programming. The 12 x 80 Sealectrocard is ideally suited as peripheral equipment for a wide range of computers or as a programming device. Programs consisting of up to 960 bits of information can be read instantly from conventional punched-card formats. Features include:

- Remote contacts with double contact wiping surfaces.
- Positive mechanical lockout if a card is mis-oriented.
- Wide choice terminations.
- Simple, fast operation even by unskilled personnel.



12 x 51 TAB READER

Accepts and reads standard 80 column TAB card, but limits read area to 51 columns, providing 612 bits of information. Ideal for data acquisition in production control and other terminal operations of data processing systems not requiring full 960 point readout.

Completely foolproof. Correct orientation and positioning of card electrically interlocks operating handle eliminating faulty readouts. Card is inserted in insertion slot, handle pulled down to read position, and unit is in operation.

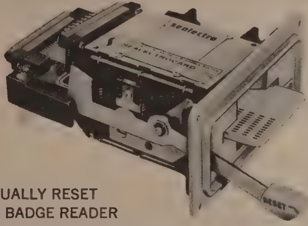
Utilizes same electrical contact assembly as 12 x 80 Reader. Can be bussed vertically or horizontally. It may be used with completely discrete circuitry for each of the 612 points.

SEALECTRO

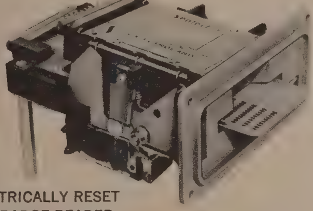
MBR SERIES

Punched Badge Mini-Badge Readers

- A NEW HIGH IN RELIABILITY
- A NEW LOW IN COST
- COMPACT
- MANUAL OR SOLENOID OPERATION
- REMOTE CONTACTS FOR MINIMUM MAINTENANCE
- READS UP TO 12 X 22 FORMAT (264 DATA BITS)
- FULL INTERLOCK FOR BADGE ORIENTATION
- READS PROVEN, RELIABLE, ECONOMICAL HOLLERITH CODE



MANUALLY RESET
MINI BADGE READER



ELECTRICALLY RESET
MINI BADGE READER

At last—the right answer for controlled access, time clock, library, warehouse, parking lot, vending machine, and credit card systems. Reads popular Hollerith code with ultra-reliable, remote switch closures. Dirt, grease, grime — makes no difference. No photo-optics to clean and pamper. No tricky auxiliary electronics. These readers just work and work. And the price is a fraction of what you'd think you would have to pay for this reliability. Positive orientation check eliminates mis-reads. Available in manual or solenoid operation. Models now ready for ID badge or credit-card sizes, with data areas from 10 x 10 to 12 x 22.

Here's the missing link for that data acquisition system you're building or planning—READY RIGHT NOW AND AT THE RIGHT PRICE! Send for complete details . . .

Specifications

Mechanical Specification

Operation: Manual or manual and electrical reset
Number of Columns: 10/12/20/22
Number of Rows: 12
Operating temperature range: +5°C to +55°C
Humidity: 30% to 70% relative
Interlocks: Card fully inserted
Card correctly orientated
Mounting: Front of panel and rear support
Weight: Manual Model: 1 lb.
Electrical reset model: 2 lbs.
*Solenoid Voltage: 24, 110, 230 Volts, 50-60Hz
*Solenoid Power Consumption: 430 V.A. Initial
17 V.A. Final Holding.

*Electrical reset model only.

Contact Specification

Electrical Life: 10^6 operations minimum
Mechanical Life: 10^6 operations minimum
Voltage rating: Up to 50 Volts DC
Current rating (switching): 100 mA (resistive load)
Current rating (static): 250 mA
Loop circuit resistance: Less than 300 m Ohms after 10^6 operations
Overall Size: Manual reset model: 5″ wide x 2.60″ high x 8″ long (including 2″ lever)
Electrical reset model: 5″ wide x 4.13″ high x 6″ long

Badge Specification

Type II (F), Type III (M) or Sealectro Standard (H) Cut Corner Badges.

SEALECTRO

PROGRAMMING DEVICES DIVISION
SEALECTRO®
CORPORATION
MAMARONECK, N. Y. 10543
PHONE: 914 698-5600 TWX: 710-566-1110
Sealectro, West, 3003 Glendale Blvd., Los Angeles, Ca. 90039
Sealectro Ltd., Portsmouth, Hants, England
Sealectro S.A., la Garde 83, France

Operational Amplifiers

TELEDYNE PHILBRICK

Operational Specifications GUARANTEED at 25°C and nominal $\pm V_{CC}$ unless otherwise indicated typical (t).

		Model	Features	Output Range	Open Loop Gain	Frequency Response: Unity Gain	Frequency Response: Full Output	Slew Rate	Settling Time (Typical): to .1%	Settling Time (Typical): to .01%	Input Voltage Range: E_{CM}	Input Voltage Range: DC CMRR	Input Voltage Offset: Initial @ 25°C	Input Voltage Offset: Vs. Temp.	Input Voltage Offset: Vs. Time Typ.
				±V/±mA	dB	MHz	kHz	V/µs	µs	µs	±V	dB	±mV	±µV/°C	±µV/day
GENERAL PURPOSE	FET	1026	High Gain, High Slew Rate	10/5	100	1	100	10	10	—	10	86	Trim pot 1k	50	50
		1026-01												20	50
		1421	Low Noise IC's	10/10	94	1	35(t)	3	—	3	12	72	15	50	10
		1421-01											15	50	10
		1421-02											15	25	10
		1424	Lowest Cost FET IC	10/5	86	1	70(t)	6	—	3	10	70	50	75	50
	Bipolar	1024	20mA Output	10/20	94	2	130	6	5	—	10	86(t)	10	20	10
		1028	High Gain	10/5	108	1	70(t)	6	3	—	10	80	50k pot	20	10
		1319	Guaranteed Low ΔE_{OS}	10/5	94	1(t)	8	0.6(t)	—	—	12	100(t)	5	25	5
		1319-01	Guar. Low I_b, Low ΔE_{OS}										2	15	5
		1339	Uncompensated Low E_{OS}, Low ΔE_{OS} IC's	10/5	84	100(t) GBW @ 100	350(t) @ A=100	34 @ A=100	—	—	11	80	7.5	12	10
		1339-01		10/10	72				—	—	11	80	7.5	5	10
		1339-02		10/10	94				—	—	11	80	3	5	10
HIGH ACCURACY	Guar. Low Noise	1421-24	Low Noise IC's	10/10	94	1	35(t)	3	—	3	12	72	15	25	50
		1421-25													
	Low Voltage Drift	1020	Bipolar Diff. Input Low E_{OS}, ΔE_{OS}, I_b	10/5	106	0.5	5	0.3	—	40	10	100	3	5	5
		1020-01											0.5	1.5	5
		1020-02											0.5	0.5	5
		1020-03											0.5	0.25	5
		1700	Fast Chopper	10/20	160	16	1MHz	100	4 Gtd.	—	—	—	50µV	1	2µV/yr.
		1700-02	Low ΔE_{OS}, 20mA Output										50µV	0.2	2µV/yr.
		1701	Chopper, 5µV/year	12/5	140	1(t)	20	1.2	—	—	—	—	15µV	0.25	5µV/yr.
		1701-01	Lowest ΔE_{OS}, Chopper										15µV	0.1	5µV/yr.
		1703	Low Noise Chopper	10/5	120	1(t)	4.5	0.25	—	—	—	—	40µV	1	5µV/yr.
		1703-01	Lowest I_b Chopper										15µV	0.3	5µV/yr.
		1340	Diff. Input Chopper IC	10/7	174(t)	3(t)	40(t)	2.5(t)	—	—	—	—	20(t)	0.2(t)	5µV/yr.
		1320	Lowest ΔE_{OS} IC	13/10(t)	88	1(t)	10	0.8	—	—	12	80	0.7(t)	2(t)	5
	FET Low Bias Current	1023	Lowest ΔE_{OS} FET 100kHz Full Power 20mA	10/20	100	2	100	6	10	—	10	100 120(t)	0.7	5	20
		1023-01											0.7	2	20
		1425	Low Initial E_{OS} Low I_b IC's	10/5 10/10(t)	100	1	35(t)	3	3	—	12	80	2	50	25
		1425-01											1	20	25
		1425-02											1	10	25
		1426	Low Initial E_{OS} Low ΔE_{OS} IC's	10/5 10/10(t)	100	1	35(t)	3	3	—	12	72	2	50	10
		1426-01									12	80	1	25	10
		1426-02									12	80	1	10	10
		1426-03									12	80	1	5	10
	Electrometer ≤ 1pA Bias Current	1029	0.3pA I_b FET	10/5	100	1	35(t)	3	—	6	10	80	2	50	25
		1029-01	0.1pA I_b FET										2	25	25
		1035	Lowest I_b FET	10/5	100	1	35	3	—	6	2	80	2	25	25
		1035-01											2	15	25
		1702	Lowest I_b Op Amp ±100V CMV	10/5	100	1kHz	40Hz	2.5V/ ms	—	—	100	100	5	30	20
		1702-01											5	10	20
		1429-01	Lowest I_b, Low E_{OS} IC	10/5	92	0.5	35(t)	3	5	—	10	80	1	30	10
		1439	1pA I_b, FET IC	10/5	86	1(t)	70(t)	3(t)	—	—	10	86	30	50	50
	Instrumentation	4253	High CMRR, Low ΔE_{OS}	10/5	CL 1 to 5000	3dB Response A ≤ 1-10, 75 kHz A = 100, 40kHz A = 1000, 5kHz					10	114	1	2	5
		4253-01									10	120	0.5	1	3
WIDEBAND	Guaranteed Fast Settling Precision	1025*	300ns to .01%, 50mA Out.	10/50	100	50	5MHz	500	.075	0.3	10(t)	80(dc)	10	50	50
		1027	1µs to .01%	10/20	100	10	1MHz	60	0.3(t)	1	10	80	15	50	50
		1027-01	1µs to .01%, 15µV/°C										15	15	50
		1030	Fastest Diff. Input	10/20	100	100	5MHz	850(t)	0.13(t)	0.5	10	94	2	25	100
		1430*	Fastest Settling Op Amp	10/50	106	80	5MHz	500	0.1	0.2	15V(dc)	—	2	75	100
	High Slew Rate IC's	1322	Fast Slew IC	10/10	74	20	1.2	80	0.3	3	10	90(t)	10	30(t)	15
		1322-01	Fast Slew, MIL 1322												
		1434	Fast Slew FET IC	10/10	78	20(t)	1	60	0.4	2	10	90(t)	14	75(t)	30(t)
		1434-01	MIL 1434										14	35(t)	30(t)
	High Frequency IC's	1321	High Gain, High Out. IC	20/20(t)	98	100(t)	320	35(t)	0.5	3.5	12	100(t)	5	30(t)	15
		1321-01	MIL 1321												
		1433	High Gain, Low I_b, FET IC	10/10	98	100(t)	250	35(t)	0.8	4	10	90(t)	15(t)	70(t)	30
		1433-01	MIL 1433										15(t)	30(t)	30
HIGH OUTPUT	High Output Voltage	1022	High Gain, CMV (E_O ±140V)	V_{CC}-10/20	120	1	35(t)	30	7	—	V_{CC}-15	106	1	50	100
		1032	Low Cost E_O ±115V	V_{CC}-8/20	100	1	10(t)	6	25	40	V_{CC}-15	94	5	50	100
		1034	Process Control Amp Low ΔE_{OS}	20/22	100	1	35(t)*	6*	5	—	20	86	50k pot	15	25
		1034-01											50k pot	5	25
		1332	High Voltage IC	35/10	100	4(t)	23	5	—	—	35	74	6	20	—
	High Out. Current	1016	Fast, 100mA Out.	V_{CC}-5/100	109	10(t)	1MHz	60	—	1	V_{CC}-5	100	50k pot	20	50
		1017	Low Cost, 125mA Out.	10/125	86	1	15	1	15	—	10	60	6	45	10
	Micropower IC's	1323	Fast, 20mA Out. High A_O & CMRR I_{CC} = 80µA	12/10	106	1(t)	25	10	10	—	11	106	5	10	10
		1323-01											3	10	10
		1323-02											3	10	10

* Inverting Only
(t) Typical

1. Package dimensions
A1 — 1.125 x 1.125 x .04 (inches) 2.9 x 2.9 x 1 (cm)
A4 — 1.125 x 1.125 x 0.6 (inches) 2.9 x 2.9 x 1.4 (cm)
E5 — 1.5 x 1.5 x 0.6 (inches) 3.8 x 3.8 x 1.5 (cm)

TELEDYNE PHILBRICK Allied Drive, Dedham, Mass. 02026 Tel: (617)329-1600 TWX: (710)348-6726

TELEDYNE PHILBRICK

Operational Amplifiers

Input Bias Current		Typical Common Mode Input Impedance	Typical Noise (Referred to Input)						Power Requirement			Oper. Temp. Range	Pkg. Size See Note 1			
Initial @ 25°C	Vs. Temp.		(0.016 to 1.6Hz)		(1.6 to 160Hz)		(160Hz to 16kHz)		±Vcc Nom.	Typ. Range	Icc Quies.					
pA	per °C	Ω	µV p-p	pA p-p	µV RMS	pA RMS	µV RMS	pA RMS	V	V	mA	°C		Model		
50	2x	10^{12}	5	0.2	2.2	1	2.2	2	15	10 to 18	10	−25/85	A1	1026	FET	GENERAL PURPOSE
														1026-01		
20	2x	10^{12}	4	0.5	2	0.5	3	0.2	15	5 to 20	2.8	−25/85	TO-99	1421		
15	2x													1421-01		
10	2x													1421-02		
50	2x	10^{12}	3	0.3	2	0.3	3	0.1	15	—	6	0/70	TO-99	1424		
50nA	0.6nA	50M	7	34	2	22	2	7	15	12 to 18	9	−25/85	A1	1024	Bipolar	
35nA	0.5nA	1000M	1	20	2	14	2	4	15	12 to 18	5	−25/85	A1	1028		
250nA	30pA Offset	100M	1µV RMS(t) 10 Hz to 10 kHz						15	8 to 22	3	0/70	TO-99	1319		
50nA														1319-01		
1000nA	200pA Offset	40M	2µV RMS(t) 10 Hz to 10 kHz						15	12 to 18	7	0/70	TO-99	1339		
100nA														1339-01		
500nA														1339-02		
10	2x	10^{12}	12µVp-p .05Hz to 2kHz Guaranteed						15	5 to 20	2.8	−25/85	TO-99	1421-24	Guar. Low Noise	
			6µVp-p .05Hz to 2kHz Guaranteed											1421-25		
25nA	0.5nA	1000M	2	50	3	6	3	6	15	12 to 18	12	−25/85	A1	1020	Low Voltage Drift	
														1020-01		
														1020-02		
														1020-03		
100	2pA	—	3	6	1	20	2.3	350	15	12 to 18	12	−25/85	E4	1700		
														1700-02		
50	1pA	—	1	5	2	5	5	25	15	8 to 20	3	−25/85	E5	1701		
														1701-01		
50	2pA	—	1	3	2	6	2	—	15	12 to 18	5	0/70	E5A	1703		
50	0.5pA													1703-01		
150(t)	6pA	10^5	—	—	—	—	—	—	15	12 to 20	5	0/75	TO-99	1340		
50nA	0.35nA	10^9(t)	2µV RMS(t) 10Hz to 10kHz						15	3 to 20	3(t)	−55/100	TO-99	1320		
5	2x	10^{12}	1.5	0.1	4	0.2	4	1	15	12 to 18	6	−10/60	A1	1023	FET Low Bias Current	HIGH ACCURACY
2	2x													1023-01		
10	2x	10^{12}	3	0.3	2	0.3	3	0.1	15	12 to 18	2.8	−25/85	TO-99	1425		
5	2x													1425-01		
5	2x													1425-02		
10	2x	10^{12}	4	0.5	2	0.5	3	0.2	15	12 to 18	2.8	−25/85	TO-99	1426		
5	2x													1426-01		
10	2x													1426-02		
10	2x													1426-03		
0.3	2x	10^{13}	2.5	0.4	3	0.05	5	0.03	15	12 to 18	5	0/70	E5A	1029	Electrometer ≤ 1pA Bias Current	
0.1	2x													1029-01		
0.06	2x	10^{13}	2.5	0.4	3	0.05	5	0.03	15	12 to 18	2	0/70	A1	1035		
0.05	2x													1035-01		
0.005	0.0002 pA	10^{14}	10	—	10	—	200	—	15	12 to 18	+13, −8	0/70	E5	1702		
														1702-01		
0.5	2x	10^{13}	10	0.04	6	0.05	8	0.03	15	12 to 18	5	0/70	TO-99	1429-01		
1	2x	10^{13}	3	0.2	2	0.3	3	0.1	15	12 to 18	6	0/70	TO-99	1439		
10	2x	10^{13}	2	0.1	0.3	1	0.7	2	15	12 to 18	16	−40/85	E11	4253	Instrumentation	
														4253-01		
20	2x	10^{12}	15	0.1	0.5	0.1	3	1	15	12 to 18	40	−25/85	E5	1025*	Guaranteed Fast Settling Precision	
50	2x	10^{11}	5	0.5	2	0.2	4	1	15	12 to 18	12	−25/85	A4	1027		
														1027-01		
20	2x	10^{12}	15	0.1	0.5	0.1	3	1	15	12 to 18	20	−25/85	E5	1030		
150(t)	2x	10^{11}(dc)	10	3	9µV RMS 1.6Hz to 1.6MHz				15	10 to 18	50	−25/85	DIP	1430*		
250nA	0.5nA Offset	1000M	1µV RMS 10Hz to 10kHz						15	8 to 20	6	0/75	TO-99	1322	High Slew Rate IC's	WIDEBAND
												−55/125		1322-01		
20	2x	10^{12}	10µV RMS 50Hz to 50 kHz						15	5 to 17	8	0/75	TO-99	1434		
												−55/125		1434-01		
25nA	0.5nA Offset	1000M	1µV RMS 10Hz to 10kHz						15	8 to 22	4	0/70	TO-99	1321	High Frequency IC's	
												−55/125		1321-01		
1(t)	2x	10^{12}	10µV RMS 50Hz to 50 kHz						15	5 to 17	6	0/75	TO-99	1433		
												−55/125		1433-01		
30	2x	10^{12}	25	0.5	8	0.2	5	0.5	120	40 to 150	10	−25/85	G4	1022	High Output Voltage	HIGH OUTPUT
10	2x	10^{12}	4	0.5	2	5µV RMS 5Hz to 50kHz			120	18 to 125	10	−25/85	G4	1032		
50nA	0.2nA	1000M	1	20	2	4	2	10	26	15 to 35	4	−25/85	E11	1034		
														1034-01		
30nA	0.4nA	1000M	—	—	—	—	—	—	40	10 to 50	4.5	0/70	TO-99	1332		
10nA	1nA	1000M	5	100	2	60	0.9	100	15	18 to 28	25	−25/85	G1	1016	High Out. Current	
100nA	3nA	200M	3	220	1	60	1	90	15	12 to 18	15	−25/85	A1	1017		
40nA	0.4nA Offset	200M	10µV RMS 10Hz to 10kHz						15	5.5 to 20	80µA	0/70	TO-99	1323	Micro-power IC's	
20nA												−25/85		1323-01		
20nA												−55/125		1323-02		

E5A — 1.5 x 1.5 x 0.42 (inches) 3.8 x 3.8 x 1.05 (cm)
E4 — 2.8 x 1.3 x 0.625 (inches) 7.1 x 3.3 x 1.6 (cm)
E11 — 2 x 2 x 0.4 (inches) 5 x 5 x 1 (cm)
G1 — 2.7 x 1.5 x 0.75 (inches) 6.9 x 3.8 x 1.9 (cm)
G4 — 2.4 x 1.8 x 0.6 (inches) 6.1 x 4.6 x 0.75 (cm)

TELEDYNE PHILBRICK Allied Drive, Dedham, Mass. 02026 Tel: (617)329-1600 TWX: (710)348-6726

Digital/Analog Converters

TELEDYNE PHILBRICK

	Model	Resolution (bits)	Nonlinearity @ 25°C max.	Input Code Options (T²L/DTL Compatible)	Output Options	Settling Time to % of F.S., max.	Zero Offset
General Purpose Economy	4020	8	±½ LSB	BIN; OBIN	0 to +2 mA; −1 to +1 mA	300 ns to 0.2%	±½ LSB
	4021				0 to −10 V; +5 to −5 V	25 µs to 0.2%	±20 mV
	4022	10	±½ LSB	BIN; OBIN	0 to +2 mA; −1 to +1 mA	300 ns to 0.05%	±½ LSB
	4023				0 to −10 V; +5 to −5 V	25 µs to 0.05%	±15 mV
	4024	12	±½ LSB	BIN; OBIN	0 to +2 mA; −1 to +1 mA	300 ns to 0.01%	±½ LSB
	4025				0 to −10 V; +5 to −5 V	5 µs to 0.01%	±10 mV
	4026	3-digits	±½ LSB	BCD	0 to +1.25 mA	300 ns to 0.01%	±½ LSB
	4027				0 to −10 V	5 µs to 0.01%	±15 mV
	4039QZ	12	±½ LSB	BIN; OBIN	0 to −2 mA; −1 to +1 mA −2.5 V to +2.5 V, ±5 V, ±10 V 0 to +5 V, 0 to +10 V	5 µs to 0.01%	Adj. to zero
General Purpose High Performance	4010	10	±½ LSB	BIN; OBIN	0 to +2 mA; −1 to +1 mA	300 ns to 0.05%	<50 nA @ 70°C
	4011			OBIN	+10 to −10 V	5 µs to 0.05%	±½ LSB
	4004	12	±½ LSB	BIN; OBIN	0 to +2 mA; −1 to +1 mA	300 ns to 0.01%	<50 nA @ 70°C
	4005			OBIN	+10 to −10 V	5 µs to 0.01%	±½ LSB
	4008	3-digits	±½ LSB	BCD	0 to +1.25 mA	300 ns to 0.01%	<50 nA @ 70°C
	4009				0 to −10 V	5 µs to 0.01%	±½ LSB
Ultra Fast	4014	12	±½ LSB [2]	BIN; OBIN	0 to +16 mA; −8 to +8 mA	200 ns to 0.01%	4 µA
	4016	13					
	4060	8	±½ LSB	BIN; OBIN	0 to +10 mA; −5 to +5 mA	40 ns to 0.2%	<¼ LSB
	4061	10			0 to +10 mA; −5 to +5 mA	60 ns to 0.1%	
MIL-Grade Microcircuits	4050	8	±¼ LSB	BIN; OBIN	0 to +3.2 mA; −1.6 to +1.6 mA	0.2 µs to 0.2%	±10 ppm of F.S.
	4051				0 to −10 V; +5 to −5 V [11]	2.5 µs to 0.2%	±20 mV
	4052	10	±¼ LSB	BIN; OBIN	0 to +3.2 mA; +1.6 to −1.6 mA	0.3 µs to 0.05%	±10 ppm of F.S.
	4053				0 to −10 V; +5 to −5 V [11]	2.5 µs to 0.05%	±20 mV
	4054	12	±¼ LSB	BIN; OBIN	0 to +3.2 mA; −1.6 to +1.6 mA	0.5 µs to 0.01%	±10 ppm of F.S.
	4055				0 to −10 V; +5 to −5 V [11]	2.5 µs to 0.01%	±20 mV

	Model	Resolution (bits)	Nonlinearity @ 25°C max.	Input Code (T²L/DTL Compatible)	Output	Output Impedance	Noise (RMS)	Glitches (peak) max.	Overshoot max.	Settling Time/ 10 V Step, max.
Deglitched	4002	14 (incl. sign)	±½ LSB	Mag & Sign BIN	±10 V	0.1 Ω	0.1 mV	±5 mV	±5 mV peak	20 µs [8]
	4015	12	±½ LSB	OBIN; 2 SC	±10 V	0.1 Ω	0.5 mV	±20 mV	25% for <1 V Step	5 µs [10] to 0.01%
	4017	13								

	Model	Resolution (bits)	Nonlinearity @ 25°C max.	Input Code (T²L/DTL Compatible)	Analog Reference Input	Output Impedance min.	F.S. Output max.	Settling Time to ½ LSB	
								Digital	Analog
Multiplying	4028	8	±½ LSB	BIN	±10 V	3 KΩ	±10 V	5 µs	5 µs
	4029	10							
	4070	8	±½ LSB	OBIN	−1 to +10 V	28 KΩ	±10 V	650 ns	750 ns
	4071	10							
	4072	12							

All specifications are typical at 25°C nominal power supply unless otherwise indicated.

1. ABBREVIATIONS
   NA – Not Applicable
   BIN – Binary
   OBIN – Offset Binary
   BCD – Binary Coded Decimal
   2SC – Two's Complement
2. Differential Nonlinearity.
3. Full Scale T.C. using internal feedback resistor.
4. 1 TTL Load equals −1.6 mA max. at V_{IN} = +0.4 V (Lo) and 40 µA max. at 2.4 (Hi).
5. All control inputs, outputs, and data output lines are compatible with standard DTL/TTL levels. Logic state switch '0' is <+0.8 V; logic state switch '1' is >+2.0 V.
6. Operating temperature range for all models, except model 4002 and the MIL-Grade Microcircuits, is 0°C to +70°C with a storage temperature range of −55°C to +100°C. Operating temperature range for model 4002 is +15°C to +45°C.
7. Operating temperature range for the MIL-Grade Microcircuits is −55°C to +125°C with a storage temperature range of −65°C to +155°C. Industrial temperature versions are available. Consult factory for details.

TELEDYNE PHILBRICK Digital/Analog Converters

Philbrick D/A converter modules are self-contained, low-profile units accepting 8 to 14-bit digital inputs and providing either a voltage or current output. With built-in reference, high speed switching, and a fast settling amplifier in voltage models, each converter is fully specified to minimize application difficulties and designed for long-term accuracy and reliability.

Gain TC ppm/°C max.	Stability Zero TC ppm/°C Unipolar/Bipolar max.	Power Requirements	Package Size Inches (Centimeters)
±40	±4/±40 ±20/±40	±15 V @ 15 mA ±15 V @ 20 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±40	±4/±40 ±20/±40	±15 V @ 15 mA ±15 V @ 20 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±30	±4/±18 ±9/±24	±15 V @ 15 mA ±15 V @ 25 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±30	±4/NA ±9/NA	±15 V @ 15 mA ±15 V @ 25 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±30	±50/±100	±15 V @ 30 mA +5 V @ 35 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±20	±3/±15 NA/±20	±15 V @ 15 mA ±15 V @ 25 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±20	±3/±15 NA/±20	±15 V @ 20 mA ±15 V @ 25 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±20	±3/NA ±20/NA	±15 V @ 20 mA ±15 V @ 25 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±30	±15/±15	±15 V @ 150 mA	2 x 5 x 0.4 (5.08 x 12.70 x 1.02)
±25	±3/±10	±15 V @ 35 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±45 [3]	±10/±15 ±25/±30	±15 V @ 15 mA ±15 V @ 20 mA	1.39 x 0.8 x 0.2 (3.53 x 2.03 x 0.51)
±25 [3]	±3/±15 ±15/±25	±15 V @ 15 mA ±15 V @ 20 mA	1.39 x 0.8 x 0.2 (3.53 x 2.03 x 0.51)
±15 [3]	±1/±15 ±10/±15	±15 V @ 15 mA ±15 V @ 20 mA	1.39 x 0.8 x 0.2 (3.53 x 2.03 x 0.51)

TELEDYNE PHILBRICK
4072
high speed
12-bit multiplying
D/A converter
TELEDYNE PHILBRICK
4061
10-bit
high speed current
D/A converter
TELEDYNE PHILBRICK
4022
10-bit current
D/A converter
TELEDYNE PHILBRICK
4039QZ
12-bit
D/A converter
TELEDYNE PHILBRICK
4023
10-bit voltage
D/A converter

Slew Rate	Zero Offset	Gain TC ppm/°C max.	Stability Zero TC ppm/°C max.	Power Requirements	Package Size Inches (Centimeters)
1.8 V/μs	Adj. to 0 V	±7	±3	±15 V @ 35 mA	4.44 x 6.31 x 1.0 [9] (11.28 x 16.03 x 2.54)
8 V/μs	Adj. to 0 V	±30	±15	±15 V @ 150 mA +5 V @ 250 mA	4.44 x 8.13 x 1.0 [9] (11.28 x 20.64 x 2.54)

Zero Offset, max.	Gain TC ppm/°C max.	Stability Zero TC ppm/°C max.	Power Requirements	Package Size Inches (Centimeters)
±2.5 mV	±25	±10	±15 V @ 25 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
±2.4 mV	±90	±60	±15 V @ 50 mA	2.5 x 3 x 0.4 (6.35 x 7.62 x 1.02)
±1 mV	±45	±30	±15 V @ 50 mA	
±1 mV	±15	±15	±15 V @ 50 mA	

8. To 1 LSB of final value, maximum. For a 1 LSB step settling time is 2 μs.
9. Mating connector supplied: Cinch 250-22-30-170.
10. Settling time for a 100 mV step is 200 ns to ±2 mV of final value.
11. Also, +10 V to −10 V; +2.5 V to −2.5 V available.

Analog/Digital Converters

TELEDYNE PHILBRICK

New Products (In Shaded Areas)	Model	Resolution (bits)	Linearity @ 25°C max.	Input Options	Output Code Options (TTL/DTL)	Conversion Time max.	Gain TC ppm/°C max.	Stability Zero TC ppm/°C[1] max.	Input Imped-ance	Power Requirements	Package Size Inches (Centimeters)
TRACKING	4110	8[1]	±¼ LSB	0 to −10 V; ±5 V	BIN; OBIN	125 ns/LSB	±100	±2	4 KΩ	±15 V @ 30 mA +5 V @ 150 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
SUCCESSIVE APPROXIMATION General Purpose Economy	4114	8	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	45 µs	±40	±25	4.5 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4113	10	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	30 µs	±40	±5	5 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4112	12	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	60 µs	±30	±5	5 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4129QZ	12	±½ LSB	±5 V, 0 to +5 V ±10 V, 0 to +10 V	BIN; OBIN; 2SC	24 µs	±30	±5	5 KΩ[4] 10 KΩ	±15 V @ 30 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
Medium Speed	4105	8	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	15 µs	±20	±5	2 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4104	10	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	20 µs	±20	±5	2 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4103	12	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	30 µs	±20	±5	2 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
High Speed	4108	8	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	6 µs	±20	±5	2 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4107	10	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	7 µs	±20	±5	2 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4106	12	±½ LSB	0 to −10 V; ±5 V	BIN; OBIN; 2SC	10 µs	±20	±5	2 KΩ	±15 V @ 50 mA +5 V @ 200 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
Very High Speed High Performance	4130 -10 -20 -30 -40	8	±¼ LSB	0 V to −5 V 0 V to −10 V +5 V to −5 V +10 V to −10 V	BIN BIN OBIN; 2SC OBIN; 2SC	750 ns	±20	±15	500 Ω 1 KΩ 1 KΩ 500 Ω	±15 V @ 35 mA +5V @ 300 mA	2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4131 -10 -20 -30 -40	10	±½ LSB	0 V to −5 V 0 V to −10 V +5 V to −5 V +10 V to −10 V	BIN BIN OBIN; 2SC OBIN; 2SC	1 µs	±20	±10	500 Ω 1 KΩ 1 KΩ 500 Ω	±15 V @ 30 mA +5 V @ 325 mA	Metal Case 2 x 4 x 0.4 (5.08 x 10.16 x 1.02)
	4132 -11 -22	12	±½ LSB	0 V to −2.5 V, ±1.25 V 0 V to −5 V, ±2.5 V 0 V to −10 V, ±5 V 0 V to −20 V, ±10 V	BIN; OBIN; 2SC	3.5 µs	±10	±10	250 Ω 500 Ω 1 KΩ 2 KΩ	±15 V @ 50 mA +5 V @ 325 mA	Metal Case 2 x 4 x 0.4 (5.08 x 10.16 x 0.95)
	4133 -11 -22	12	±½ LSB	0 V to −2.5 V, ±1.25 V 0 V to −5 V, ±2.5 V 0 V to −10 V, ±5 V 0 V to −20 V, ±10 V	BIN; OBIN; 2SC	2.5 µs	±10	±10	250 Ω 500 Ω 1 KΩ 2 KΩ	±15 V @ 50 mA +5 V @ 325 mA	Metal Case 2 x 4 x 0.4 (5.08 x 10.16 x 0.95)
INTEGRATING Economy – Medium Performance	4109	12	±½ LSB	0 to −10 V	BIN	6 ms	±20	±3	100 KΩ	±15 V @ 30 mA +5 V @ 150 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
	4109-10	12	±½ LSB	0 to +10 V	BIN	6 ms	±20	±3	100 KΩ	±15 V @ 30 mA +5 V @ 150 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
	4111	3½ Digit	±½ LSB	0 to −10 V	BCD	2.5 ms[2]	±20	±3	100 KΩ	±15 V @ 30 mA +5 V @ 150 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
	4111-10	3½ Digit	±½ LSB	0 to +10 V	BCD	2.5 ms[2]	±20	±3	100 KΩ	±15 V @ 30 mA +5 V @ 150 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
Ultra Low Cost	4116	8	±½ LSB	0 to +10 V	BIN	6 ms	±250	±5	23 KΩ	±15 V @ 25 mA +5 V @ 140 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
	4116-10 Buffered	8	±½ LSB	0 to +10 V	BIN	6 ms	±250	±5	10^8 Ω	±15 V @ 25 mA +5 V @ 140 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
	4117	2½ Digit	±½ LSB	0 to +10 V	BCD	5 ms	±250	±5	23 K	±15 V @ 25 mA +5 V @ 140 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)
	4117-10 Buffered	2½ Digit	±½ LSB	0 to +10 V	BCD	5 ms	±250	±5	10^8 Ω	±15 V @ 25 mA +5 V @ 140 mA	2 x 3 x 0.4 (5.08 x 7.62 x 1.02)

Specifications Typical @ 25°C unless otherwise specified.

[1] Unipolar Operation.
[2] Includes 100% overrange capability.
[3] ABBREVIATIONS
BIN – Binary
OBIN – Offset Binary
2SC – Two's Complement
BCD – Binary Coded Decimal

[4] Buffered version 4129-10QZ available with $Z_{in} = 10^9$ Ω.
[5] Input Impedance varies with Voltage Range.

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Multiplexers

Philbrick's new line of multiplexers offers two CMOS compatible units, and one buffered version. In a data acquisition system these devices will sequentially switch up to 16 analog inputs to a common output, for digitizing by a single Sample-Hold and ADC. Model 4551, an 8-channel differential, is an ideal choice for switching signals from strain gages, thermocouples, or bridges.

Model Number	Number of Channels	R_{on}	Input Impedance	Buffered Output	Settling Time	Switching Time	Over-voltage Protection	DTL/TTL CMOS Compatible	Power Requirements	Package Size Inches (Centimeters)
4550	16 Single-ended	NA	3 x 10⁸ Ω	Yes	3 μsec max.	**	Yes	DTL/TTL	±15 V @ 75 mW	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
4551	8 Differential	1.5 KΩ	NA	No	NA*	1 μsec	Yes	Yes	±15 V @ 7.5 mW	28 Pin DIP
4552	16 Single-ended	1.5 KΩ	NA	No	NA*	1 μsec	Yes	Yes	±15 V @ 7.5 mW	28 Pin DIP

NA: Not Applicable
*Determined by external circuit
**Included in settling time

Sample-Hold Amplifiers

A Sample-Hold Amplifier is predominently used in front of a Successive Approximation ADC to "Hold" analog data at a constant value during the ADC's conversion.

Philbrick's line of Sample-Hold modules offers a range of price and performance for most data conversion applications and Data Acquisition Systems.

Model Number	Input Impedance	Gain	Error	Slew Rate	Acquisition Time			Sample to Hold Settling Time	Output Droop	Aperture Delay	Aperture Uncertainty	Power Required	Package Size Inches (Centimeters)
				V/μs	μs	step	±% FS	μs to ±% FS		Time nsec	Time nsec		
4853	2 KΩ	−1	±.05	30	1 max. 1.5 max.	10 V 20 V	.01 .01	.3/.01	1 μV/μs max.	10 max.	1 max.	±15 V @ 30 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
4854	10⁹ Ω	+1	±.01	1.5	12 18	10 V 20 V	.01 .01	1.5/.01	50 μV/ms max.	20	2	±15 V @ 13 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
4855	10¹¹ Ω	−1	±.01	150	0.3 max. 0.4 max.	10 V 20 V	.01 .01	.07/.01	25 μV/μs max.	2	0.2	±15 V @ 60 mA	2 x 2 x 0.4 (5.08 x 5.08 x 1.02)
4856	10⁶ Ω	Ext. Adjust		5	4*	10 V	.1	*	*	50	7	±15 V @ 5 mA	14 Pin DIP

*Determined by external capacitor.

High Speed Amplifiers

Model Number	Open Loop Gain	Bias Current	E_{OS} TC	Full Power Frequency
1421	50 k	50 pA	10 μV/°C	50 kHz
1430	500 k	150 pA	25 μV/°C	5 MHz
1434	15 k	20 pA	50 μV/°C	1 MHz
4253	1-5000	10 pA	1 μV/°C	5 kHz

Philbrick's Operational and Instrumentation Amplifiers have specialized performance characteristics to suit most data acquisition systems.

Measuring low level signals in the presence of high common mode voltages is a prime application for the very low drift FET, 4253 Instrumentation Amplifier.

Philbrick also offers Operational Amplifiers for converting current output DAC's to voltage output, signal summation, analog filters, and buffers.

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V/F & F/V Converters

TELEDYNE PHILBRICK

Voltage to Frequency

Full Scale Frequency Out.

New Products (In Shaded Areas)

Frequency	Classification	Model	Input: Signal for Full Scale f Out: Voltage	Input: Signal for Full Scale f Out: Current mA	Circuit SE — Single Ended D — Differential	Offset Current µA/V Nominal Scale Factor	Nominal Impedance KΩ	Over-Range +% Min.	Decades Dynamic Range	Offset Voltage: Initial Untrimmed (adjustable to zero) Max. ±mV	Offset Voltage: Input Coefficient ±ppm/°C Max.	Non Linearity[2]: ±% Full Scale Max.	plus ±% Signal Max.
10 KHz	General Purpose Low Cost	4701	.01 V 10 V	NA	SE	NA	24	10	3½	10	10	.05	—
		4713	.01 V 10 V	NA	SE	NA	23	20	3½	10	10	.1	—
		4721	.02 V 10 V	NA	SE	.35	27	20[1]	3½	20	10	.2	—
	Low Power	4711	.01 V 10 V	NA	SE	NA	92	10	3½	10	10	.05	—
100 KHz	General Purpose	4703	.02 V 10 V	NA	SE	NA	24	10	3½	10	10	.05	—
	Precision Low Drift	4709	10 µV 10 V	.45	SE	42	24	10	6	3	3	.005	.02
		470901	10 µV 10 V	.45	SE	42	24	10	6	3	3	.005	.02
		470902	10 µV 10 V	.45	SE	42	24	10	6	3	3	.005	.02
		470903	10 µV 10 V	.45	SE	42	24	10	6	3	3	.005	.02
1 MHz	Precision	4705	10 µV 10 V	.9	D	70	14	5	6	10	5	.001	.05
		470501	10 µV 10 V	.9	D	70	14	5	6	10	5	.0005	.02
5 MHz	Precision Low Drift	4707	100 µV 10 V	.9	D	70	14	5	5	10	10	.01	.05
		470701	100 µV 10 V	.9	D	70	14	5	5	10	5	.01	.05
		470702	100 µV 10 V	.9	D	70	14	5	5	10	5	.01	.05

Frequency to Voltage

Full Scale Frequency In.

New Products (In Shaded Areas)

Frequency	Classification	Model	Input: Output Voltage Offset Scale Factor µ A per V: Max.	Input: Output Voltage Offset Scale Factor µ A per V: Min.	Input: D — Differential Circuit	Input: Impedance Nominal	Input: Over Range % Min.	Input: Voltage Max.	Input: Decades Dynamic Range	Output Offset Voltage: Initial Input Untrimmed Max. ±mV (adjustable to zero)	Output Offset Voltage: Temp. Coefficient ±ppm/°C Max.	Non Linearity (straight line through O & Fs): ±% Full Scale Max.	plus ±% Signal Max.
10 KHz	General Purpose Low Cost	4702	48	37	D	15 MΩ	10	±15	4	10	5	.03	—
		4714	48	37	D	15 MΩ	10	±15	4	10	10	.1	—
10 KHz	Precision Low Drift	4708	48	37	D	1 MΩ	10	±15	4	5	5	.007	.013
		470801	48	37	D	1 MΩ	10	±15	4	5	5	.005	.01
		470802	48	37	D	1 MΩ	10	±15	4	5	5	.005	.01
		470803	48	37	D	1 MΩ	10	±15	4	5	5	.005	.01
100 KHz	General Purpose	4704	48	37	D	3K Ω	10	±15	4+	10	5	.05	—
		4710	48	37	D	3K Ω	10	±15	4+	10	5	.007	.013
	Precision Low Drift	471001	48	37	D	3K Ω	10	±15	4+	10	5	.005	.01
		471002	48	37	D	3K Ω	10	±15	4+	10	5	.005	.01
		471003	48	37	D	3K Ω	10	±15	4+	10	5	.005	.01
1 MHz	Precision Low Drift	4706	83	45	D	1 MΩ	10	±15	6	10	10	.008	.02
		470601	83	45	D	1 MΩ	10	±15	6	10	10	.005	.01
		470602	83	45	D	1 MΩ	10	±15	6	10	10	.005	.01

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[1] 4½ Decades dynamic range with 33 µf capacitor & 100 Ω connected to current input pin.

TELEDYNE PHILBRICK

V/F & F/V Converters

Output Circuit	Pulse Width	Full Scale Temp. Coefficient	Output Response	Power		Case Dimensions
T^2L Collector or Open Collector (OC)	Min./Max. μsec	±ppm/°C Max.	to .01% for step input 1 to 2 cycles of new f plus μsec	Volts	Current mA	L x W x H inches
T^2L	30/60	100	20	±15	±16	1.5 x 1.5 x .4
T^2L	20/60	150	2	±15	±16	1.5 x 1.5 x .4
OC	20/60	300	20	±15	±18	1.125"x1.125"x .4
T^2L	20/40	100	20	±15	+1.5 −1	1.5 x 1.5 x .4
T^2L	2.4/4.5	150	2	±15	±24	1.5 x 1.5 x .4
T^2L	2.5/4.5	44	2	±15	±18	2 x 2 x .4
T^2L	2.5/4.5	24	2	±15	±18	2 x 2 x .4
T^2L	2.5/4.5	12	2	±15	±18	2 x 2 x .4
T^2L	2.5/4.5	6	2	±15	±18	2 x 2 x .4
T^2L	.2/.5	200	10	±15	±24	2 x 2 x .4
T^2L	.2/.5	200	10	±15	±24	2 x 2 x .4
T^2L	.05/.15	150	10	±15 +5 @	+40-20 +50	3 x 2 x .4
T^2L	.05/.15	80	10	±15 +5 @	+40-20 +50	3 x 2 x .4
T^2L	.05/.15	40	10	±15 +5 @	+40-20 +50	3 x 2 x .4

Output		Input Pulse Width Min.	Full Scale Temp. Coefficient	Output Response	Ripple mV			Power		Case Dimensions
Min. V	Min. mA	μSec for rated accuracy	±ppm/°C Max.	Filter Time Constant μSec	Full Scale	.01 Full Scale	.0001 Full Scale	Volts	mA Max. No Load	L x W x H inches
+10 −10	+20 −5	20	100	240	300	90	20	±15	±12	1.5 x 1.5 x .4
±10	±5	30	150	240				±15	±18	1.5 x 1.5 x .4
±10	+20 −2	25	44	240	200	80	20	±15	±19	1.5 x 1.5 x .4
±10	+20 −2	25	24	240	200	80	20	±15	±19	1.5 x 1.5 x .4
±10	+20 −2	25	12	240	200	80	20	±15	±19	1.5 x 1.5 x .4
±10	+20 −2	25	6	240	200	80	20	±15	±19	1.5 x 1.5 x .4
±10	+20 −5	2.5	150	20	300	100	3	±15	±22	1.5 x 1.5 x .4
±10	+20 −2	2.5	44	20	300	100	3	±15	+22 −23	1.5 x 1.5 x .4
±10	+20 −2	2.5	24	20	300	100	3	±15	+22 −23	1.5 x 1.5 x .4
±10	+20 −2	2.5	12	20	300	100	3	±15	+22 −23	1.5 x 1.5 x .4
±10	+20 −2	2.5	6	20	300	100	3	±15	+22 −23	1.5 x 1.5 x .4
±10	+20 −2	.1	150	2	200	75	2	±15	±36	2 x 2 x .4
±10	+20 −2	.1	80	2	200	75	2	±15	±36	2 x 2 x .4
±10	+20 −2	.1	40	2	200	75	2	±15	±36	2 x 2 x .4

These versatile devices can be used to condition analog data for two wire, long distance transmission. The TTL pulse train output of the V/F converter. All Philbrick V/F and F/V converters feature the high linearity and resolution necessary to ensure precision operation in the most demanding applications.

Signals that must be transmitted in the presence of high common mode voltages can be accomodated by using a photo isolator in combination with the converters. Depending on the isolator chosen, voltages greater than 2,500 volts can be safely handled.

TELEDYNE PHILBRICK
4713
10 kHz V/F converter
TELEDYNE PHILBRICK
4707
5 MHz V/F converter
TELEDYNE PHILBRICK
4708
F/V converter
MADE IN U.S.A.

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[2] Typical non linearities are an order of magnitude better than specified max. Consult Factory.

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Multiplier/Dividers

TELEDYNE PHILBRICK

	High Accuracy			Wideband	General Purpose	Economy
	4454	4455	4456	4457	4450	4452
OUTPUT FUNCTION						
Multiply	XY/10	XY/10	XY/10	XY/10	XY/10	−XY/10
Divide	10Z/X	10Z/X	10Z/X	10Z/X	—	−10Z/Y
ACCURACY, % OF FULL SCALE TRIMMED						
4-Quadrant Operation, max.	±0.5%	0.25%	1%	0.5%	±1%	±2%
2-Quadrant Operation	—	—	—	—	—	±1%
RATED INPUT						
Voltage — All Inputs ±10	±10V	±10V	±10V	±10V	±10V	±10 V
Impedance: X-Input	25kΩ	25kΩ	10kΩ	10kΩ	25kΩ	40kΩ
Y-Input	25kΩ	25kΩ	10kΩ	10kΩ	10MΩ	30kΩ
Z-Input	50kΩ	50kΩ	15kΩ	15kΩ	—	90kΩ
RATED OUTPUT						
Voltage	±10V	±10V	±10V	±10V	±10V	±10V
Current	±5mA	±5mA	±10mA	±10mA	±2mA	±5mA
BANDWIDTH						
−3dB Response, min.	1MHz	1MHz	5MHz	5MHz	1MHz	400kHz
Full Output	50kHz	50kHz	1MHz, min.	2MHz, min.	100kHz	50kHz
1% Amplitude Error	100kHz	100kHz	1MHz	1MHz	—	—
TEMPERATURE STABILITY						
Output Offset, max.	0.5mV/°C	0.2mV/°C	1mV/°C	0.5mV/°C	±3mV/°C	±3mV/°C
TEMPERATURE RANGE	0 to +70°C	0 to +70°C	−25 to +85°C	−25 to +85°	−25 to +85°C	0 to +70°C
POWER REQUIREMENTS						
Voltage	±15V	±15V	±15V	±15V	±15V	±15V
Current	±mA	±5mA	±17mA	±17mA	±12mA	±15mA
CASE SIZE (inches)	1.5 x 1.5 x 0.6	1.5 x 1.5 x 0.6	1.5 x 1.5 x 0.6	1.5 x 1.5 x 0.6	1.125 sq. x 0.4h	1.5 sq. x 0.6h

Specifications are typical at +25°C, nominal supply voltage, unless otherwise indicated.

Logarithmic Amplifiers

	4357/4358	4350/4351	4362/4363	4366/4367
DYNAMIC RANGE				
Current	120dB	120dB	120dB	120dB (Note 1)
Voltage	80dB	80dB	80dB	80dB
ACCURACY — 1% OF READING (Referred to Input)				
1nA to 10nA	1%	1%	1%	1%
10nA to 100µA	1%	0.5%	0.5%	0.5%
100µA to 1mA	1%	1%	1%	1%
TEMPERATURE DRIFT				
Scale Factor				
+10 to +60°C	±0.04%/°C	—	—	±0.04%/°C*
−25 to +85°C	—	±0.04%/°C	±0.04%/°C	—
Offset				
+10 to +60°C	±0.1mV/°C	—	—	±25(I_n1);±30µV/°C (I_n2)*
−25 to +85°C	—	±15mV/°C	±15µV/°C	—
SLOPE				
Fixed	1V/Decade	1, 2, 2/3V/Decade	1, 2, 2/3V/Decade	1V/Decade
Adjustable	Yes	Yes	Yes	Yes
RATED OUTPUT				
Current	Depends on Amplifier	±10mA	±5mA	±5mA
Voltage	Depends on Amplifier	±10V	±10V	±10V
BANDWIDTH (Note 2)				
1nA	80Hz	80Hz	80Hz	1kHz
1.0µA	Depends on Amplifier	70kHz	50kHz	10kHz
10µA	Depends on Amplifier	180kHz	60kHz	20kHz
1mA	Depends on Amplifier	200kHz	80kHz	30kHz
CASE STYLE	A6	G2	G2	G2

* At 0°C to +70°C
Note 1: Five decades (100dB) of log ratio
Note 2: Bandwidth for models 4366/4367 is measured at $I_{ref} = 10\mu A$

	4356
OUTPUT FUNCTIONS	
Sinh^{-1} $\quad K\sinh^{-1}\frac{I_{in}}{2I_r}$	I_{in} = 0 to ±5mA I_r = 1µA ±2%
Log_{10} $\quad 2.3\,K\log_{10}\frac{I_{in}}{I_r}$	I_{in} = 3µA to ±5mA I_r = 1µA ±2%
(K = 1.000)	Adj. with ext. Rf
CONFORMITY (100Hz)	
Sin^{-1} (±0.1µA to ±5mA)	0.5dB
Log (±3µA to ±5mA)	0.5dB
COMPRESSION	40dB
INPUT	
Voltage	±10V
Current	±5mA
OUTPUT	
Voltage	±10V
Current	±5mA
BANDWIDTH	
Large Signal	10kHz
TEMPERATURE STABILITY	
Offset	±2mV/°C
Scale Factor	±0.01%/°C
Reference	±0.1%/°C
TEMPERATURE RANGE	0°C to +70°C
POWER REQUIREMENT	
Voltage	±15V
Current	±7mA
CASE STYLE	E1

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TELEDYNE PHILBRICK

Power Supplies

MODULAR P.C. MOUNTED POWER SUPPLIES

	Model	Output Voltage	Output Current	Regulation, Max. Line	Regulation, Max. Load	Ripple and Noise	Temperature Coefficient, Max.	Case Size inches (centimeters)
5 Volts	2206	+ 5 VDC	+ 500 mA	± 0.10%	± 0.15%	2 mV p-p	± 0.01%/°C	2.5 x 3.5 x 1.0 (6.35 x 8.89 x 2.54)
	2213	+ 5 VDC	+ 1000 mA	± 0.06%	± 0.1%	1 mV p-p	± 0.02%/°C	2.5 x 3.5 x 1.25 (6.35 x 8.89 x 3.18)
	2223	+ 5 VDC	+ 2000 mA	± 0.02%	± 0.05%	1 mV rms	± 0.02%/°C	2.5 x 3.5 x 1.62 (6.35 x 8.89 x 4.12)
±12 Volts	2230	± 12 VDC	± 25 mA	± 0.2%	± 0.2%	2 mV rms	± 0.02%/°C	2.5 x 3.5 x 0.875 (6.35 x 8.89 x 2.22)
	2231	± 12 VDC	± 50 mA	± 0.02%	± 0.02%	0.5 mV rms	± 0.02%/°C	2.5 x 3.5 x 0.875 (6.35 x 8.89 x 2.22)
	2232	± 12 VDC	± 120 mA	± 0.02%	± 0.02%	0.5 mV rms	± 0.02%/°C	2.5 x 3.5 x 0.875 (6.35 x 8.89 x 2.22)
	2235	± 12 VDC	± 240 mA	± 0.02%	± 0.02%	0.5 mV rms	± 0.02%/°C	2.5 x 3.5 x 1.25 (6.35 x 8.89 x 3.18)
±15 Volts	2203	± 15 VDC	± 100 mA	± 0.03%	± 0.03%	1 mV rms	± 0.01/°C	2.5 x 3.5 x 1.0 (6.35 x 8.89 x 2.54)
	2204	± 15 VDC	± 50 mA	± 0.03%	± 0.015%	1 mV rms	± 0.01/°C	2.5 x 3.5 x 1.0 (6.35 x 8.89 x 2.54)
	2208	± 15 VDC	± 100 mA	± 0.03%	± 0.03%	1 mV rms	± 0.01/°C	2.5 x 3.5 x 1.0 (6.35 x 8.89 x 2.54)
	2209	± 15 VDC	± 50 mA	± 0.03%	± 0.015%	1 mV rms	± 0.01/°C	2.5 x 3.5 x 1.0 (6.35 x 8.89 x 2.54)
	2210	± 15 VDC	± 25 mA	± 0.2%	± 0.2%	1 mV rms	± 0.02/°C	2.5 x 3.5 x 0.88 (6.35 x 8.89 x 2.22)
	2211	± 15 VDC	± 50 mA	± 0.1%	± 0.1%	1 mV rms	± 0.015/°C	2.5 x 3.5 x 0.88 (6.35 x 8.89 x 2.22)
	2212	± 15 VDC	± 100 mA	± 0.05%	± 0.1%	1 mV rms	± 0.015/°C	2.5 x 3.5 x 1.0 (6.35 x 8.89 x 2.54)
	2215	± 15 VDC	± 200 mA	± 0.02%	± 0.05%	1 mV rms	± 0.02/°C	2.5 x 3.5 x 1.25 (6.35 x 8.89 x 3.18)
	2218	± 15 VDC	± 350 mA	± 0.02%	± 0.02%	0.5 mV rms	± 0.02/°C	2.5 x 3.5 x 1.62 (6.35 x 8.89 x 4.12)
High Voltage	2216	± 26 VDC	± 45 mA	± 0.05%	± 0.05%	1 mV rms	± 0.02/°C	2.5 x 3.5 x 1.25 (6.35 x 8.89 x 3.18)
	2217	± 120 VDC ± 2%	± 40 mA	± 0.1%	± 0.1%	2 mV rms	± 0.05/°C	2.5 x 3.5 x 2.00 (6.35 x 8.89 x 5.08)
Triple Output	2242	± 15 V ± 5 V	± 100 mA ± 250 mA	± 0.02% ± 0.05%	± 0.03% ± 0.05%	1 mV rms 1 mV rms	± 0.02%/°C ± 0.02%/°C	2.5 x 3.5 x 1.25 (6.35 x 8.89 x 3.18)
	2243	± 15 V ± 5 V	± 100 mA ± 500 mA	± 0.02% ± 0.02%	± 0.03% ± 0.05%	1 mV rms 1 mV rms	± 0.02%/°C ± 0.02%/°C	2.5 x 3.5 x 1.88 (6.35 x 8.89 x 4.77)

2403
2235
2206
2423
2415
2406
2242
2203
2231
2419
2217
2218
2230
TELEDYNE PHILBRICK

CHASSIS MOUNTED POWER SUPPLIES

	Model	Output Voltage	Output Current	Regulation, Max. Line	Regulation, Max. Load	Ripple and Noise	Temperature Coefficient-Max.	Case Size inches (centimeters)
5 Volts	2406	+ 5 VDC	+ 500 mA	± 0.05%	± 0.1%	2 mV rms	0.02%/°C	2.7 x 4 x 1.44 (6.86 x 10.16 x 3.66)
	2413	+ 5 VDC	+ 1000 mA	± 0.05%	± 0.15%	2 mV rms	0.02%/°C	2.7 x 4 x 1.44 (6.86 x 10.16 x 3.66)
	2423	+ 5 VDC	+ 2000 mA	± 0.05%	± 0.15%	2 mV rms	0.02%/°C	2.7 x 4 x 2.0 (6.86 x 10.16 x 5.08)
±12 Volts	2438	± 12 VDC	± 240 mV	± 0.05%	± 0.05%	1 mV rms	0.02%/°C	2.7 x 4 x 1.44 (6.86 x 10.16 x 3.66)
±15 Volts	2403	± 15 VDC	± 100 mA	± 0.05%	± 0.05%	1 mV rms	0.02%/°C	2.7 x 4 x 1.44 (6.86 x 10.16 x 3.66)
	2415	± 15 VDC	± 200 mA	± 0.05%	± 0.05%	1 mV rms	0.02%/°C	2.7 x 4 x 1.44 (6.86 x 10.16 x 3.66)
	2419	± 15 VDC	± 500 mA	± 0.05%	± 0.05%	1 mV rms	0.02%/°C	2.7 x 4 x 2.0 (6.86 x 10.16 x 5.08)

FEATURES

- Small Size (Encapsulated Modules)
- Short Circuit Protection
- Excellent Line and Load Regulation
- 25 mA to 1000 mA Output Current
- No RFI Generated or Transmitted
- Versatile and Trimmable (Models 2203/2204)
- Custom Modifications Available

COMMON SPECIFICATIONS - MODULAR P.C. AND CHASSIS MOUNTED SUPPLIES

Input Voltage - 115 VAC @ 50-400 Hz (For 230 VAC operation add -21 suffix to model number. No extra charge)
Output Accuracy - ±1%
Warm-up Drift - 50 mV
Warm-up Time - 1 hour

DC-to-DC ISOLATED POWER SUPPLIES

Model	Output Voltage	Output Current	Input Voltage	Input Current No Load	Input Current Full Load	Regulation, Max. Line	Regulation, Max. Load	Temperature Coefficient, Max.	Noise: Output Voltage Noise, Max.	Noise: Reflected Input Ripple Current, Max.	Noise: Common Mode Noise Current	Isolation 500 V	Case Size inches (centimeters)
2301	± 15 VDC	± 100 mA	+ 5 VDC	200 mA	1 A	± 0.07%	± 0.07%	0.005%/°C	1 mV rms	3.5% p-p of I_{in}	200 μA p-p	10^9 Ω/80 pF	2 x 2 x 0.375 (5.08 x 5.08 x 0.905)
2302	± 15 VDC	± 150 mA	+ 5 VDC	200 mA	1.38A	± 0.07%	± 0.07%	0.005%/°C	1 mV rms	3.5% p-p of I_{in}	200 μA p-p	10^9 Ω/80 pF	2 x 2 x 0.375 (5.08 x 5.08 x 0.905)
2331	± 15 VDC + 5 VDC	± 165 mA + 750 mA	+ 5 VDC	500 mA	3.48 A	± 0.1% ± 1%	± 0.1% ± 1%	0.015%/°C 0.05%/°C	1 mV rms	3.5 % p-p of I_{in}	500 μA p-p 700 μA p-p	10^9 Ω/150 pF 10^9 Ω/75 pF	2.5 x 3.5 x 0.75 (6.35 x 8.89 x 1.91)

SHORT-CIRCUIT PROTECTION

All Philbrick Power Supplies have short-circuit protection. Models 2203, 2204, 2206, 2208, and 2209 have current fold back protection. All other supplies have current limiting to prevent supply damage up to 72 hours. The DC-to-DC supplies combine current limiting with thermal shut down to prevent supply damage for up to 8 hours at a +71°C ambient temperature.

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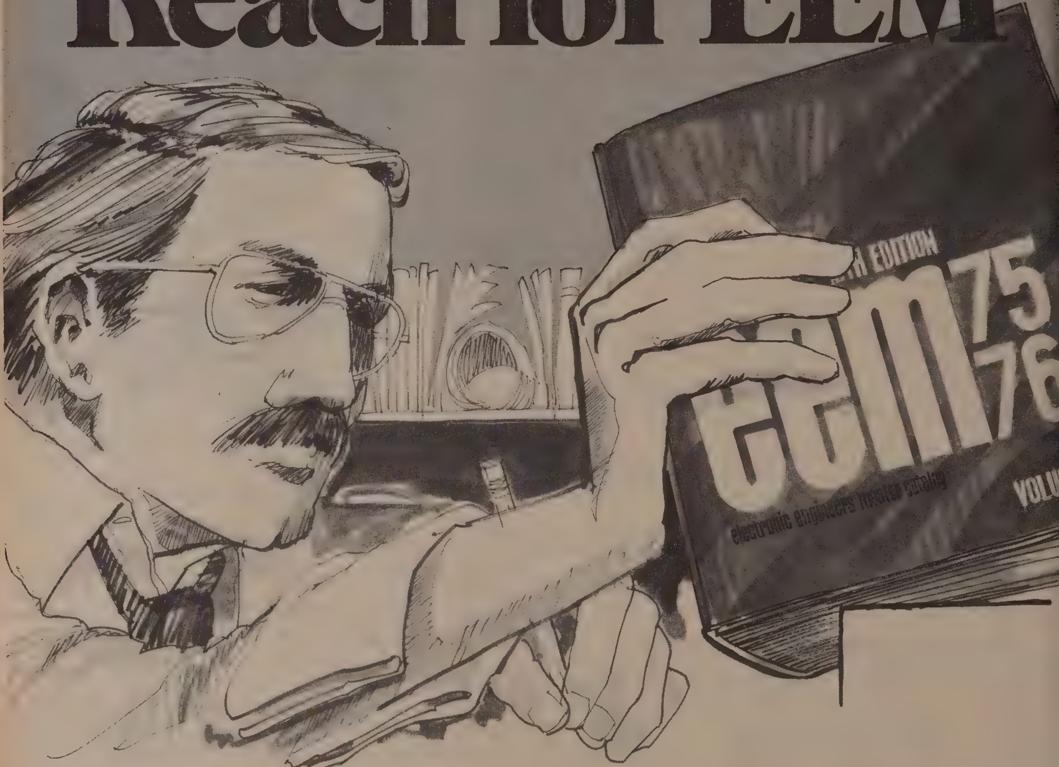
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STANDARD SPECIFICATIONS

Cards—IBM, Rem. Rand or others.

No. of Switches—10 to 960—(Form A, B or C).

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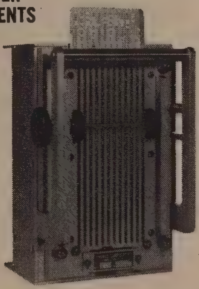
MODEL M-4

NEW!

FULL IBM CARD STATIC READER
SMALLER — MANY IMPROVEMENTS

Reads up to 80 columns, or 960 switches, (complete IBM card). Most compact switching array available. Reads indirectly for maximum reliability. After insertion, punched hole has a closed switch, no hole an open switch. Switch reliability 100,000 cycles. Mechanical reliability 500,000 cycles.

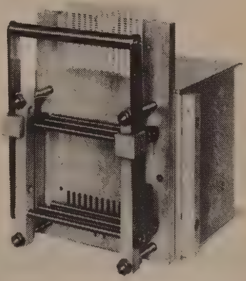


MODEL JM-4

NEW!

SMALLER —
MANY IMPROVEMENTS
STATIC READER
FOR ONE HALF OF
AN IBM CARD

Reads up to 40 columns, or 480 switches, of an IBM card. After insertion, punched hole has a closed switch, no hole an open switch. Switch reliability 100,000 cycles. Mechanical reliability 500,000 cycles.



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MODEL CM-20

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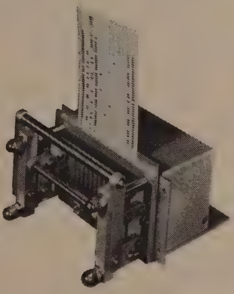
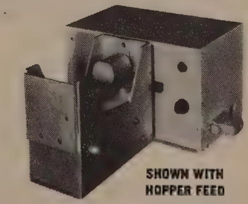


NEW!

MODEL 610-P

SERIAL READER
PHOTO-ELECTRIC



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SYNCHRO/RESOLVER TO DIGITAL CONVERTERS

Hz	L-L Voltage	Resolution	Power Requirements	Size (Inches)	Model No.	Available Options
60	90	14 Bit Binary	±15 VDC; +5V; 115 VAC Ref.	2⅝ x 3⅛ x .82 (plus XFRMR)	VSD-609SM	1. Board Configuration
60	90	0-3599 BCD	±15 VDC; +5V; 115 VAC Ref.	5 x 3¾ x 1	VSD-609SM-D	2. Self Contained Power Supplies
400	11.8	14 Bit Binary	±15 VDC; +5V; 26 VAC Ref.	2⅝ x 3⅛ x .82	VSD-401SM	3. −55°C to +85°C Operating Temperature 4. Serial Output
400	11.8	0-3599 BCD	±15 VDC; +5V; 26 VAC Ref.	5 x 3¾ x 1	VSD-401SM-D	5. ± BCD Output
400	90	14 Bit Binary	±15 VDC; +5V; 115 VAC Ref.	2⅝ x 3⅛ x .82	VSD-409SM	6. Multi-speed Conversion
400	90	0-3599 BCD	±15 VDC; +5V; 115 VAC Ref.	5 x 3¾ x 1	VSD-409SM-D	7. Multi-channel Conversion

ALL VERNITRON CONVERTERS WILL:
1. Operate over 0-70°C range.
2. Have a Digital Interface with DTL or TTL Compatible Logic.
3. Accuracy — ±4 minutes ±1.19
4. Track at 360°/second (400Hz), 180°/second (60Hz).
5. Be repairable in the field; if ever necessary.

DIGITAL TO SYNCHRO/RESOLVER CONVERTERS

Hz	Output Voltage	V.A. Output	Accuracy	Power Requirements	Size (inch)	Model No.	Available Options
60	90	2	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 2*	VDS-609SP-2	1. Modular Configuration
60	90	5	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 1**	VDS-609SP-5	2. Self Contained Power Supplies
400	11.8	2	±1 LSB	±15 VDC; +5 VDC; 26 VAC Ref.	5 x 4 x 2	VDS-401SP-2	3. −55°C to +85°C Operating Temperature
400	11.8	5	±1 LSB	±15 VDC; +5 VDC; 26 VAC Ref.	5 x 4 x 1**	VDS-401SP-5	
400	90	2	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 2*	VDS-409SP-2	4. Serial Input
400	90	5	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 1**	VDS-409SP-5	5. Multi-channel Inputs

ALL VERNITRON CONVERTERS HAVE:
1. 12 Bit parallel binary coded angle input (MSB = 180°, . . .).
2. Digital interface compatible with DTL or TTL logic.
3. Field repairability, if ever necessary.
4. Storage Registers available at no extra cost.

* Transformers to be mounted externally.
** Transformers, power transistors, and heat sinks to be mounted externally. Consult factory for required volume.

SPECIAL CONVERTERS

Type Converter	Part Number	Description
Solid State Synchro Signal Amplifier	VSA-101	Input: 3 Wire Synchro Data, 90V L-L, 60 or 400 Hz; 115V Reference Output: 3 Wire Synchro Data, 90V L-L, 60 or 400 Hz Channels: Two, each completely isolated Accuracy: Plus/Minus 6 minutes of arc Size: Standard 19″ Rack (19″ x 6″ x 20″) Misc.: Self-contained Power Supplies; Short Circuit Protected; Automatic Cutoff of DC Supply if Overload exists; Overload Indicator
Synchro/Resolver to Linear DC Converter	VSDC-401-SP VSDC-409-SP VSDC-609-SP	All parameters identical to those of the Synchro/Resolver to Digital converters, except: 1) Accuracy — ±10′ at room temperature 2) Digital output also available in addition to DC 3) Output 0-10 VDC, 0-5 VDC, 0-±10 VDC, 0-±5 VDC
Synchro/Resolver to Sine-Cosine DC Converter	VSDC-401-SP-A VSDC-409-SP-A VSDC-609-SP-A	All parameters identical to those of the Synchro/Resolver to Digital converters, except: 1) Accuracy — ±10′ of arc at room temperature 2) Output ranges same as Synchro to DC above, except in sine-cosine form
Sine-Cosine DC to Synchro Converter	VDCD-401-SP-A VDCD-409-SP-A VDCD-609-SP-A	All parameters identical to those of the Digital to Synchro/Resolver converters, except: 1) Accuracy — ±10′ of arc at room temperature (Dependent upon load) 2) Input Levels 0-10 VDC, 0-5 VDC, 0-±10 VDC, 0-±5 VDC

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DIVISION OF VERNITRON CORPORATION

SIZE 11 MODIFIED V SCAN BINARY ENCODERS

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VBE11-204	2^8 (256)	1	3	0.835
VBE11-207	2^9 (512)	2	4	1.750
VBE11-210	2^{10} (1,024)	4	4	1.750
VBE11-213	2^{11} (2,048)	8	4	1.750
VBE11-216	2^{12} (4,096)	16	4	1.750
VBE11-219	2^{13} (8,192)	32	4	1.750

Moment of Inertia	5 GM-CM^2
Counts per Turn	256
Operating Speed	200 RPM
Slew Speed	1500 RPM
Torque at +15°C	30 GM-CM
Torque at −55°C	46 GM-CM

SIZE 18 V SCAN BINARY ENCODERS

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VBE18-201	2^7 (128)	1	4	1.125
VBE18-204	2^8 (256)	1	4	1.125
VBE18-207	2^9 (512)	2	6	2.125
VBE18-210	2^{10} (1,024)	4	6	2.125
VBE18-213	2^{11} (2,048)	8	6	2.125
VBE18-216	2^{12} (4,096)	16	6	2.125
VBE18-219	2^{13} (8,192)	32	6	2.125
VBE18-222	2^{14} (16,384)	64	6	2.125
VBE18-225	2^{15} (32,768)	128	9	3.125
VBE18-228	2^{16} (65,536)	256	9	3.125
VBE18-231	2^{17} (131,072)	512	9	3.125
VBE18-234	2^{18} (262,144)	1024	9	3.125
VBE18-237	2^{19} (524,288)	2048	9	3.125

Moment of Inertia	10 GM-CM^2
Counts per Turn	256
(**Exception**: VBE18-201	128)
Operating Speed	200 RPM
Slew Speed	1500 RPM
Torque at +15°C	40 GM-CM
Torque at −55°C	50 GM-CM

SIZE 11 GRAY CODE ENCODERS

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VGE11-403	2^8 (256)	1	3	0.835
VGE11-405	2^9 (512)	8	4	1.750
VGE11-441	2^{10} (1,024)	16	4	1.750
VGE11-442	2^{11} (2,048)	32	4	1.750

Moment of Inertia	10 GM-CM^2
Counte per Turn	64
(**Exception**: VGE11-403	256)
Operating Speed	200 RPM
Slew Speed	1500 RPM
Torque at +15°C	30 GM-CM
Torque at −55°C	46 GM-CM

SIZE 18 GRAY CODE ENCODERS

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VGE18-403	2^8 (256)	1	4	1.125
VGE18-405	2^9 (512)	1	4	1.125
VGE18-441	2^{10} (1,024)	4	6	2.125
VGE18-442	2^{11} (2,048)	8	6	2.125
VGE18-443	2^{12} (4,096)	16	6	2.125
VGE18-444	2^{13} (8,192)	32	6	2.125
VGE18-445	2^{14} (16,384)	64	6	2.125
VGE18-446	2^{15} (32,768)	128	9	3.125
VGE18-447	2^{16} (65,536)	256	9	3.125
VGE18-448	2^{17} (131,072)	512	9	3.125
VGE18-449	2^{18} (262,144)	1024	9	3.125
VGE18-450	2^{19} (524,288)	2048	9	3.125

Moment of Inertia	10 GM-CM^2
Counts per Turn	256
(**Exception**: VGE18-405	512)
Operating Speed	200 RPM
Slew Speed	1000 RPM
Torque at +15°C	40 GM-CM
Torque at −55°C	50 GM-CM

SIZE 31 GRAY CODE ENCODER

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VGE31-407	2^{10} (1,024)	1	12	1.25

Moment of Inertia	50 GM-CM^2
Counts per Turn	1024
Operating Speed	100 RPM
Slew Speed	750 RPM
Torque at +15°C	70 GM-CM
Torque at −55°C	100 GM-CM

SIZE 23 BINARY CODED DECIMAL ENCODERS

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	Counts/ Turn*	"L" Dimension (Inches)
VDE23-301	359	1	8	360	2.00
VDE23-302	3599	9	12	400	3.000
VDE23-303	35999	90	16	400	4.125
VDE23-304	999	2.5	12	400	3.000
VDE23-305	9999	25	12	400	3.000
VDE23-306	99999	250	16	400	4.125
VDE23-307	±1799	9	12	400	3.000
VDE23-308	±17999	90	16	400	4.125
VDE23-309	±17959	180	16	120	4.125
VDE23-310	±179599	540	16	400	4.125
VDE23-311	±899	4.5	12	400	3.000
VDE23-312	±8999	45	12	400	4.125
VDE23-313	±8959	90	12	120	4.125
VDE23-314	±89599	270	16	400	4.125
VDE23-315	±999	5	12	400	3.000
VDE23-316	±9999	50	12	400	4.125

Moment of Inertia	30 GM-CM^2
Operating Speed	200 RPM
Slew Speed	1000 RPM
Torque at +15°C	72 GM-CM
Torque at −55°C	100 GM-CM

*100 and 200 counts per turn available on most units.

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SIZE 18 2P SELF SELECT BINARY ENCODERS

Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VBE18-250	2^7 (128)	1	6	2.375
VBE18-252	2^8 (256)	2	6	3.375
VBE18-254	2^9 (512)	4	9	3.375
VBE18-256	2^{10} (1,024)	8	9	3.375
VBE18-258	2^{11} (2,048)	16	9	3.375
VBE18-260	2^{12} (4,096)	32	9	3.375
VBE18-262	2^{13} (8,192)	64	9	3.375
VBE18-264	2^{14} (16,384)	128	12	4.375
VBE18-266	2^{15} (32,768)	256	12	4.375
VBE18-268	2^{16} (65,536)	512	12	4.375
VBE18-270	2^{17} (131,072)	1024	12	4.375
VBE18-272	2^{18} (262,144)	2048	12	4.375
VBE18-274	2^{19} (524,288)	4096	12	4.375

Moment of Inertia	10 GM-CM²
Counts per Turn	128
Operating Speed	200 RPM
Slew Speed	1000 RPM
Torque at +15°C	40 GM-CM
Torque at −55°C	50 GM-CM

SIZE 23 2P SELF SELECT BINARY ENCODERS

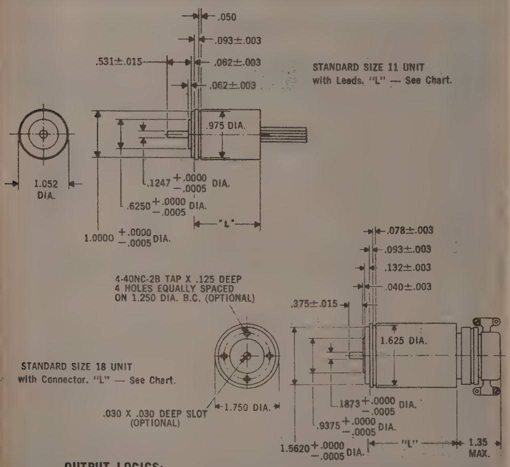
Type No.	Full Count	Revolutions For Full Count	Weight (Oz.)	"L" Dimension (Inches)
VBE23-252	2^8 (256)	1	8	2.00
VBE23-254	2^9 (512)	2	12	2.75
VBE23-256	2^{10} (1,024)	4	12	2.75
VBE23-258	2^{11} (2,048)	8	12	2.75
VBE23-260	2^{12} (4,096)	16	12	2.75
VBE23-262	2^{13} (8,192)	32	12	2.75
VBE23-264	2^{14} (16,384)	64	12	2.75
VBE23-266	2^{15} (32,768)	128	16	3.75
VBE23-268	2^{16} (65,536)	256	16	3.75
VBE23-270	2^{17} (131,072)	512	16	3.75
VBE23-272	2^{18} (262,144)	1024	16	3.75
VBE23-274	2^{19} (524,288)	2048	16	3.75

Moment of Inertia	30 GM-CM²
Counts per Turn	256
Operating Speed	200 RPM
Slew Speed	1000 RPM
Torque at +15°C	72 GM-CM
Torque at −55°C	100 GM-CM

NOTES:

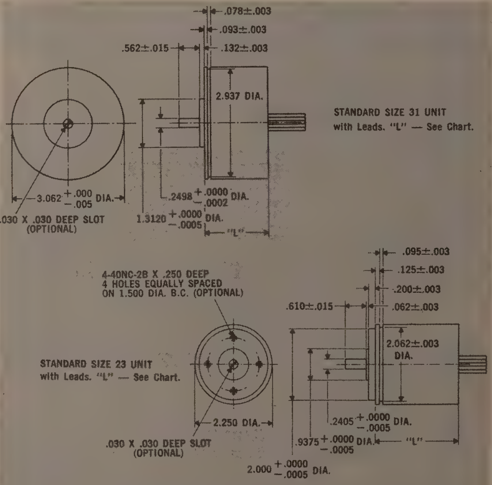
1. Standard units have clockwise rotation for increasing count as viewed from shaft end. Units are available with counter clockwise rotation.
2. Internal isolation diodes available for time-sharing.
3. Operating Temperature: −55°C to +85°C. Units available to +125°C on request.
4. For dimensions of size 18 unit, with connectors, see below.

MECHANICAL CONFIGURATIONS


.050
.093±.003
.531±.015
.062±.003
.062±.003
STANDARD SIZE 11 UNIT with Leads. "L" — See Chart.
.975 DIA.
1.052 DIA.
.1247 +.0000 −.0005 DIA.
.6250 +.0000 −.0005 DIA.
"L"
1.0000 +.0000 −.0005 DIA.
.078±.003
.093±.003
.132±.003
.040±.003
4-40NC-2B TAP X .125 DEEP 4 HOLES EQUALLY SPACED ON 1.250 DIA. B.C. (OPTIONAL)
.375±.015
1.625 DIA.
STANDARD SIZE 18 UNIT with Connector. "L" — See Chart.
.030 X .030 DEEP SLOT (OPTIONAL)
1.750 DIA.
.1873 +.0000 −.0005 DIA.
.9375 +.0000 −.0005 DIA.
1.5620 +.0000 −.0005 DIA.
"L"
1.35 MAX.

OUTPUT LOGICS:

I. Discrete
   A. Positive: Binary 1 = +5 to +15 VDC @ 5ma per bit.
   Binary 0 = Open Circuit.
   B. Negative: Binary 1 = −5 to −15 VDC @ 5ma per bit.
   Binary 0 = Open Circuit.


.078±.003
.093±.003
.562±.015
.132±.003
2.937 DIA.
STANDARD SIZE 31 UNIT with Leads. "L" — See Chart.
3.062 +.000 −.005 DIA.
.030 X .030 DEEP SLOT (OPTIONAL)
.2498 +.0000 −.0002 DIA.
1.3120 +.0000 −.0005 DIA.
"L"
.095±.003
.125±.003
.200±.003
.062±.003
.610±.015
4-40NC-2B X .250 DEEP 4 HOLES EQUALLY SPACED ON 1.500 DIA. B.C. (OPTIONAL)
2.062±.003 DIA.
STANDARD SIZE 23 UNIT with Leads. "L" — See Chart.
2.250 DIA.
.030 X .030 DEEP SLOT (OPTIONAL)
.2405 +.0000 −.0005 DIA.
.9375 +.0000 −.0005 DIA.
"L"
2.000 +.0000 −.0005 DIA.

II. Integrated Circuits
   A. Binary 1 = +5 VDC from DTL type logic.
   Binary 0 = 0 VDC.

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COMMERCIAL AND INDUSTRIAL ENCODERS

ORDERING INFORMATION
(Model Number and Style Number required)
The **Model** Number is: OADC-23/ . . . P/INC
Size 23
Resolution Table 1, 2 or 3 .... P
Incremental .... INC

THE STYLE NUMBER IS:
Style AQIS/5V/UDS 1X/HOUSING/TERMINATION/ SHAFT CONFIGURATION/LITE SOURCE.
Each output channel must be specified .... AQI
Squared outputs (direct cell outputs if blank) .... S
Power supply voltage 5V

OPTIONS
Complementary outputs if specified.
(Normal single ended outputs if blank) .... B
Up-down separator **and** multiplication factor.
(Normal AQ outputs if blank) ...... UDS, 1X, 2X or 4X
Identify type of housing, heavy duty, sealed, etc.
(Normal Housing if blank) .... Housing
Type of electrical termination; leads, connector, etc. .... Termination
Type of shaft configuration, flatted, gear, etc. .... Shaft Configuration
Specify L.E.D. (Tungsten if blank) .... Lite Source

RESOLUTION TABLE #1 SIZE 11

*20 Pulses	*120 Pulses
*64 Pulses	*200 Pulses
*86 Pulses	

RESOLUTION TABLE #2 SIZE 14

256 Pulses

RESOLUTION TABLE #3 SIZE 23

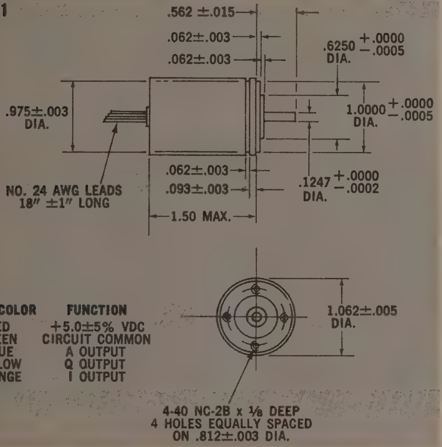
100 Pulses	*500 Pulses
*250 Pulses	*512 Pulses
*256 Pulses	*1000 Pulses
*336 Pulses	*1024 Pulses

RESOLUTION TABLE #4 SIZE 35

100 Pulses	600 Pulses
120 Pulses	625 Pulses
125 Pulses	1000 Pulses
150 Pulses	1200 Pulses
192 Pulses	1250 Pulses
200 Pulses	1500 Pulses
300 Pulses	*2000 Pulses
375 Pulses	*2500 Pulses
500 Pulses	

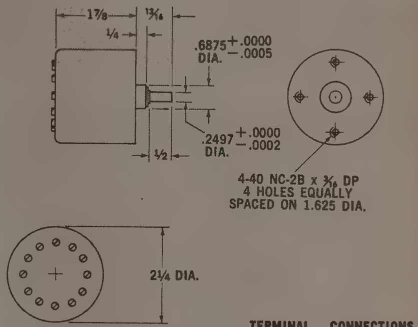
* Indicates Index Optionally available.

FIG. 1


.562 ±.015
.062±.003
.062±.003
.6250 +.0000 −.0005 DIA.
.975±.003 DIA.
1.0000 +.0000 −.0005 DIA.
NO. 24 AWG LEADS 18″ ±1″ LONG
.062±.003
.093±.003
.1247 +.0000 −.0002 DIA.
1.50 MAX.
1.062±.005 DIA.
4-40 NC-2B x ⅛ DEEP 4 HOLES EQUALLY SPACED ON .812±.003 DIA.

WIRE COLOR	FUNCTION
RED	+5.0±5% VDC
GREEN	CIRCUIT COMMON
BLUE	A OUTPUT
YELLOW	Q OUTPUT
ORANGE	I OUTPUT

FIG. 3


1⅞
1³⁄₁₆
¼
.6875 +.0000 −.0005 DIA.
½
.2497 +.0000 −.0002 DIA.
4-40 NC-2B x ³⁄₁₆ DP 4 HOLES EQUALLY SPACED ON 1.625 DIA.
2¼ DIA.

TERMINAL	CONNECTIONS
3	+5.0±5% VDC
5	COMMON
6	A OUTPUT
7	Q OUTPUT
8	INDEX OUTPUT

FIG. 2

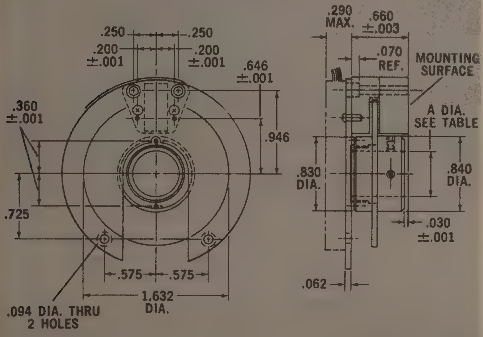
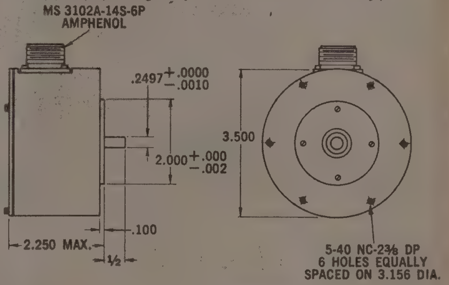

.250
.250
.200 ±.001
.200 ±.001
.646 ±.001
.360 ±.001
.946
.725
.575
.575
1.632 DIA.
.094 DIA. THRU 2 HOLES
.290 MAX.
.660 ±.003
.070 REF.
MOUNTING SURFACE
A DIA. SEE TABLE
.830 DIA.
.840 DIA.
.030 ±.001
.062

FIG. 4 **HEAVY DUTY HOUSING**
(Specify by adding to style callout OADC-23 Series only.)


MS 3102A-14S-6P AMPHENOL
.2497 +.0000 −.0010
2.000 +.000 −.002
3.500
.100
2.250 MAX.
½
5-40 NC-2⅜ DP 6 HOLES EQUALLY SPACED ON 3.156 DIA.

TERM NO.	CONNECTION BASIC ENCODER
PIN A	+5±5% VDC
B	COMMON
C	———
D	A CHANNEL OUT
E	Q CHANNEL OUT
F	INDEX OUT

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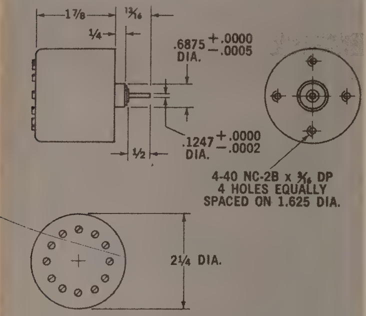
Dia.	Model No. VERNITECH OADC-	Outline Drawing Figure	Resolution (Pulses per Turn) Table #	Starting Torque Oz/In	Moment of Inertia Oz-In²	Maximum Shaft Side-Load	Continuous Loads End	Maximum Count Rate kHz	Maximum Slew Speed RPM	Outputs Available A	Q	I	Standard Power V	MA
1 1/16	11/ . . . P/INC	1	1	.05	.005	1 lb.	1 lb.	50	6000	√	√	√	+5	250
1 1/16	ULT-11/ . . . P/INC	1	1	.0002	.005	ZERO	ZERO	50	6000	√	√	√	+5	250
1 5/16	014/ . . . /INC	2	2	ZERO	.02	N/A	N/A	50	3000	√	√	√	+10	150
2¼	23/ . . . P/INC	3	3	.1	.06	3 lb.	3 lb.	50	3000	√	√	*	+5	250
3½	HD23/ . . . P/INC	4	3	.1	.06	3 lb.	3 lb.	50	3000	√	√	*	+5	250
2¼	ULT-23/ . . . P/INC	5	3	.0002	.06	ZERO	ZERO	50	3000	√	√	*	+5	250
2⅜	23/ . . . P/INC	5A	3	.1	.06	3 lb.	3 lb.	50	3000	√	√	*	+5	250
3½	35/ . . . P/INC	6	4	.5	.55	50 lb.	50 lb.	50	3000	√	√	*	+5	250
3½	SEALED 35/ . . . P/INC	7	4	2.0	.55	50 lb.	50 lb.	50	3000	√	√	*	+5	250

FIG. 5


1⅞
13/16
¼
.6875 +.0000 −.0005 DIA.
.1247 +.0000 −.0002 DIA.
½
4-40 NC-2B x 3/16 DP
4 HOLES EQUALLY SPACED ON 1.625 DIA.
2¼ DIA.

TORQUE: .0002 OZ/IN MAX.

TERMINAL	CONNECTIONS
3	+5.0±5% VDC
5	COMMON
6	A OUTPUT
7	Q OUTPUT
8	INDEX OUTPUT

FIG. 6

PIN DESIGNATION	FUNCTION
A	CASE GROUND
B	+5±5% VDC
C	COMMON
D	I CHANNEL AS AVAIL.
E	A CHANNEL OUTPUT
F	Q CHANNEL OUTPUT

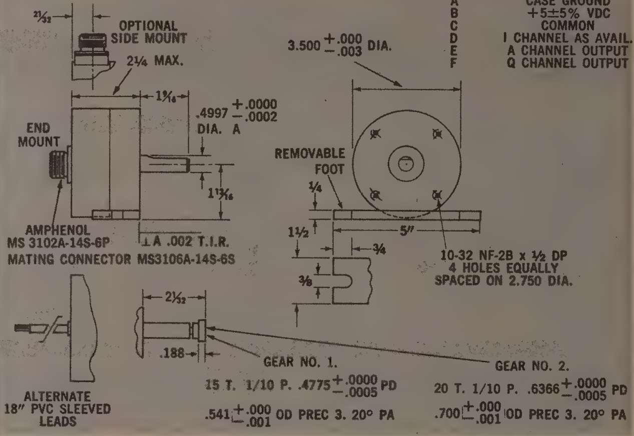

21/32
OPTIONAL SIDE MOUNT
2¼ MAX.
1 9/16
.4997 +.0000 −.0002 DIA. A
END MOUNT
1 13/16
AMPHENOL MS 3102A-14S-6P
⊥ A .002 T.I.R.
MATING CONNECTOR MS3106A-14S-6S
3.500 +.000 −.003 DIA.
REMOVABLE FOOT
¼
1½
5″
¾
⅜
10-32 NF-2B x ½ DP
4 HOLES EQUALLY SPACED ON 2.750 DIA.
2 1/32
.188
ALTERNATE 18″ PVC SLEEVED LEADS
GEAR NO. 1.
15 T. 1/10 P. .4775 +.0000 −.0005 PD
.541 +.000 −.001 OD PREC 3. 20° PA
GEAR NO. 2.
20 T. 1/10 P. .6366 +.0000 −.0005 PD
.700 +.000 −.001 OD PREC 3. 20° PA

FIG. 5A

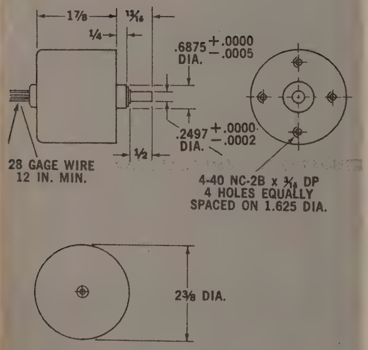
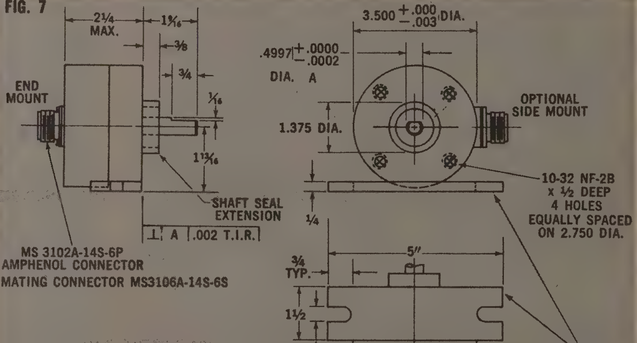

1⅞
13/16
¼
.6875 +.0000 −.0005 DIA.
.2497 +.0000 −.0002 DIA.
½
28 GAGE WIRE 12 IN. MIN.
4-40 NC-2B x 3/16 DP
4 HOLES EQUALLY SPACED ON 1.625 DIA.
2⅜ DIA.

FIG. 7


2¼ MAX.
1 9/16
⅜
¾
1/16
END MOUNT
1 13/16
SHAFT SEAL EXTENSION
⊥ A .002 T.I.R.
MS 3102A-14S-6P AMPHENOL CONNECTOR
MATING CONNECTOR MS3106A-14S-6S
3.500 +.000 −.003 DIA.
.4997 +.0000 −.0002 DIA. A
1.375 DIA.
OPTIONAL SIDE MOUNT
10-32 NF-2B x ½ DEEP 4 HOLES EQUALLY SPACED ON 2.750 DIA.
¼
5″
¾ TYP.
1½
⅜ TYP.
REMOVABLE FOOT

PIN DESIGNATION	FUNCTION
A	CASE GROUND
B	+5±5% VDC
C	COMMON
D	I CHANNEL AS AVAIL.
E	A CHANNEL OUTPUT
F	Q CHANNEL OUTPUT

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VERNITECH

DIVISION OF VERNITRON CORPORATION

OPTICAL ABSOLUTE ENCODER ENVIRONMENTS: #1

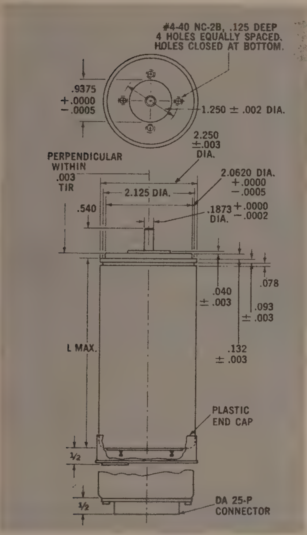
Temp.: 0°C to 70°C.
Humidity: 0 to 95% R.H. non-condensing.
Shock: 5G's 11 ms.
Vibration: 3G's 5 to 500 Hz.
Construction: Dustproof case, stainless shafts and bearings, anodized aluminum body and cover.

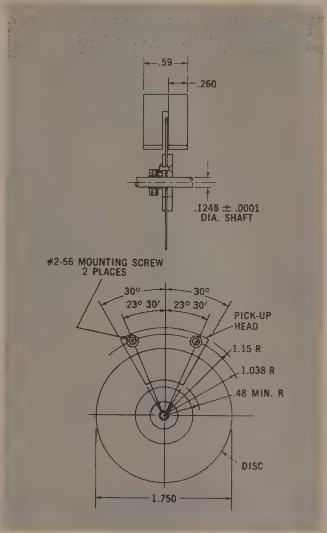
ENCODER ENVIRONMENTS: #2

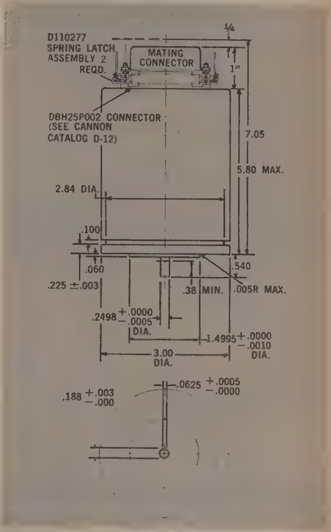
Temp.: 54° to +85°C.
Humidity: No damage to 100%.
Shock: 20G's at 10 ms.
Vibration: 10G's 5 to 500 Hz.

OPTIONS

- 12-15V Operation.
- Open Collector Outputs.
- Built-in Up-Down Separator for Quadrature Encoder.
- Built-in Direction Indication by Voltage Level Output for Quadrature Encoders.
- Reversed Direction for Increasing Count at Extra Cost.
- Differing Resolutions at Extra Cost.
- Terminations by Solder Pin Header or Flat Cannon Connector.
- Modifications to Shaft.
- Protective Housing for Severe Environments, Fluid Spray Submergence, Shaft Side Loads, End Loads Available at Extra Cost.


#4-40 NC-2B, .125 DEEP
4 HOLES EQUALLY SPACED.
HOLES CLOSED AT BOTTOM.
.9375 +.0000 −.0005
1.250 ± .002 DIA.
2.250 ±.003 DIA.
PERPENDICULAR WITHIN .003 TIR
2.0620 DIA. +.0000 −.0005
2.125 DIA.
.540
.1873 +.0000 −.0002 DIA.
.078
.040 ± .003
.093 ± .003
L MAX.
.132 ± .003
PLASTIC END CAP
½
½
DA 25-P CONNECTOR


.59
.260
.1248 ± .0001 DIA. SHAFT
#2-56 MOUNTING SCREW 2 PLACES
30°
30°
23° 30′
23° 30′
PICK-UP HEAD
1.15 R
1.038 R
.48 MIN. R
DISC
1.750


D110277 SPRING LATCH ASSEMBLY 2 REQD.
MATING CONNECTOR
¼
1″
DBH25P002 CONNECTOR (SEE CANNON CATALOG D-12)
7.05
5.80 MAX.
2.84 DIA.
.100
.060
.540
.225 ±.003
.38 MIN.
.005R MAX.
.2498 +.0000 −.0005 DIA.
1.4995 +.0000 −.0010 DIA.
3.00 DIA.
.188 +.003 −.000
.0625 +.0005 −.0000

Size	Model No. VERNITECH — OADC	Output Code Non-Ambibuous	Total Count	Turns Required	Counts per Turn (Note 1)	Least Count Angle (Note 1)
23	23/3/BCDQ(1000)L	BCD	1,000	1	1000/2000	.36°/.18°
23	23/2/BCDQ(200)L	BCD	200	1	200/400	1.8°/.9°
23	23/4/BCDQ(200)L	BCD	10,000	50	200/400	1.8°/.9°
23	23/5/BCDQ(200)L	BCD	100,000	500	200/400	1.8°/.9°
SPECIAL	ALT/500/AAU 32 L.E.D.	ALTITUDE CODE	524	1	525	.667°
7″ DIA.	ULT/1500/BCD-L	BCD	1,500	1	1,500	.233°

Model No. VERNITECH — OADC	Minimum Life	Outline Drawing	Maximum Length	Environment	Light Source
23/3/BCDQ(1000)L	200K HR	1	5.2	1	TUNGSTEN
23/2/BCDQ(200)L	200K HR	1	3.0	1	TUNGSTEN/L.E.D.
23/4/BCDQ(200)L	200K HR	1	5.0	1	TUNGSTEN/L.E.D.
23/5/BCDQ(200)L	200K HR	1	6.5	1	TUNGSTEN
ALT/500/AAU 32 L.E.D.	100K HR	2	¾	2	L.E.D.
ULT/1500/BCD-L	100K HR	3	¾	1	TUNGSTEN

Model No. VERNITECH — OADC	Direction Increasing Count	Maximum Data RPM	Slew RPM	Moment of Inertia Oz/In²	Torque Maximum Oz/In	Output	Sink Current Logical "0" MA	Current @ +5V Supply
23/3/BCDQ(1000)L	CW	180	3,000	.1	.1	TTL	10	400 ma
23/2/BCDQ(200)L	CW	3,000	3,000	.1	.1	TTL	10	350 ma
23/4/BCDQ(200)L	CW	3,000	3,000	.1	.1	TTL	10	350 ma
23/5/BCDQ(200)L	CW	3,000	3,000	.1	.1	TTL	10	450 ma
ALT/500/AAU 32 L.E.D.	CW	10	10	—	ZERO	Hi-Z	N/A	See Note 3
ULT/1500/BCD-L	CW	10	10	—	ZERO	TTL	10	450 ma

Note 1: Units with Q in the Model Number have QUADRATURE OUTPUTS and can double the basic count as well as CONTROL STEPPER FIELD SELECTION.
Note 2: L denotes compatible with TTL/DTL logic.
Note 3: Current from aircraft supply approximately 150 ma.

VERNITECH

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VERNITECH
DIVISION OF VERNITRON CORPORATION

All Vernitech contacting absolute encoders have non-ambiguous outputs whether Binary, 8421 BC Altitude Reporting Code or Gray Code. Many basic patents in the field have been granted to Vernitec over the past 20 years.

Continued development has increased reliability and useful life as requirements evolved makin these encoders suitable for a wide variety of applications from satellites to instrumentation system to process control.

They are current, up to date and being designed into state of the art equipment such as fuel management systems on the DC-10; frequency synthesizers and automatic tuning elements in telecommunication systems.

NOTES

Type of termination affects weight and length overall.

△ Front mount available in 3 configurations, No Major Pilot and Minor Pilot. .625, .500 or .440 DIA.

TP Direction of increasing count controlled by using either one of two leads from slowest changing bit.

☐ Either direction of increasing count available. Must be specified when ordering.

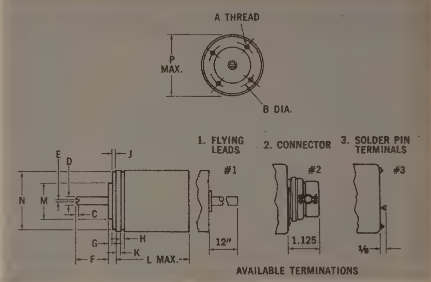
○ Encoder provides both digits and complements. Reverse direction by using either as system digit. Selecting encoder digit causes CCW increasing count; selecting complement; clockwise in the binary series.

★ Dimensions held to +.0000, −.0003.

ORDERING INSTRUCTIONS

Always specify Model Number plus Style Number.
Example: Model ADC 13 BNRY-E/L (from line on matrix) Style S4C — CCW

Teflon Seal	S
Length of Shaft in ⅛ increments	4
Electrical Termination — connector (C) header (H) or flying leads (F)	C
Direction of increasing count looking at shaft end	CCW



AVAILABLE TERMINATIONS

AVAILABLE TERMINATIONS

1. Flying Leads (Teflon Wire)
2. Connector (Both Halves Supplied by Vernitech)
3. Solder Pin Terminals (Header)

BUORD Size	VERNITECH ADC-	Code	Inter-face	Max. MA per Bit	Decode Logic	Output	Full Count	Turns Full Count	Counts per Turn	Least Count Angle Degrees	Dir. Incr. Count	Torque Max. Oz/In	Max. Data RPM	Slew Speed RPM	Moment of Inertia Oz/In²	Life 10⁶ Turns
11△	11/14-BNRY (256) L	BINARY	TTL/DTL	25.0	INT.	DIGIT OR COMP.	16,384	64	256	1.4	CW	.4	54	100	.02	2
11△	11/13-BNRY (256) L	BINARY	TTL/DTL	25.0	INT.	DIGIT OR COMP	8,192	32	256	1.4	CW	.4	54	100	.02	2
11	11/13-BNRY (256)	BINARY	30V	1.5	INT.	DIGIT OR COMP.	8,192	32	256	1.4	CW	.4	54	100	.02	2
11	11/10-GRAY (256)	GRAY	TTL/DTL	3.0	N/A	DIGIT	1,024	4	256	1.4	TP	.4	50	100	.02	2
11	11/10-GRAY (64)	GRAY	TTL/DTL	3.0	N/A	DIGIT	1,024	16	64	5.6	TP	.4	50	100	.02	2
11	11/8-GRAY (256)	GRAY	TTL/DTL	1.0	N/A	DIGIT	256	1	256	1.4	CW	.4	50	100	.02	2
11	11/6-GRAY (64)	GRAY	TTL/DTL	5.0	N/A	COMP.	64	1	64	5.6	CW	.4	25	75	.02	2
11△	11/3-BCD (40)	BCD	TTL/DTL	1.5	INT.	DIGIT	1,000	25	40	9.0	CW	.4	25	75	.02	2
11△	11/6-BCD (40SP)	BCD	TTL/DTL	1.5	INT.	DIGIT	749¾	50	40	9.0	CW	.4	25	75	.02	2
11△	11/3-BCDX (100)	BCD-X	TTL/DTL	2.0	EXT.	LEAD/LAG	1,000	10	100	3.6	CW	.4	25	75	.02	2
11△	11/4-BCDX (100)	BCD-X	TTL/DTL	2.0	EXT.	LEAD/LAG	10,000	100	100	3.6	CW	.4	25	75	.02	2
11△	11/5-BCDX (100)	BCD-X	TTL/DTL	2.0	EXT.	LEAD/LAG	100,000	1,000	100	3.6	CW	.4	25	75	.02	2
11△	11/4-36 BCDX (100)	BCD-X	TTL/DTL	2.0	EXT.	LEAD/LAG	3,600	36	100	3.6	CW	.4	25	75	.02	2
11△	11/5-36 BCDX (100)	BCD-X	TTL/DTL	2.0	EXT.	LEAD/LAG	36,000	360	100	3.6	CW	.4	25	75	.02	2
11	11/ALT-1280 (80)	ALT	30V	5.0	INT.	DIGIT	1,280	16	80	4.5	☐	.4	10	50	.02	2
18	ST-7 BNRY E/L	BINARY	TTL/DTL	25.0	INT.	DIGIT OR COMP.	128	1	128	2.8	*	.8	200	1,500	.075	7.5
18	13 BNRY E/L	BINARY	TTL/DTL	25.0	INT.	DIGIT OR COMP.	8,192	64	128	2.8	*	.8	200	1,500	.075	7.5
18	19 BNRY E/L	BINARY	TTL/DTL	25.0	INT.	DIGIT OR COMP.	524,288	4,096	128	2.8	*	.8	200	1,500	.075	7.5
18	ST-7 BNRY E	BINARY	20V	4.0	INT.	DIGIT OR COMP.	128	1	128	2.8	*	.8	200	1,500	.075	7.5
18	13 BNRY E	BINARY	20V	2.0	INT.	DIGIT OR COMP.	8,192	64	128	2.8	*	.8	200	1,500	.075	7.5
18	19 BNRY E	BINARY	20V	1.5	INT.	DIGIT OR COMP.	524,288	4,096	128	2.8	*	.8	200	1,500	.075	7.5
18	ST 7/8 BNRY XB	BNRY-X	TTL/DTL	2.0	EXT.	LEAD/LAG	2^7 or 2^8	1	128/256	2.8/1.4	CW	.8	200	1,500	.07	5.0
18	13/14 BNRY XB	BNRY-X	TTL/DTL	2.0	EXT.	LEAD/LAG	2^{13} or 2^{14}	64	128/256	2.8/1.4	CW	.8	200	1,500	.07	5.0
18	19/20 BNRY XB	BNRY-X	TTL/DTL	2.0	EXT.	LEAD/LAG	2^{19} or 2^{20}	4,096	128/256	2.8/1.4	CW	.8	200	1,500	.07	5.0
18	18/8 BRAY	GRAY	TTL/DTL	5.0	N/A	COMP.	256	1	256	1.40	CW	.4	50	100	.75	.5
18	ST-8 GRAY	GRAY	TTL/DTL	1.0	N/A	DIGIT	256	1	256	1.4	TP	.8	200	1,500	.7	5.0
23	ST-9 GRAY	GRAY	TTL/DTL	1.0	N/A	DIGIT	512	1	512	0.70	TP	.8	150	1,200	.168	5.0
23	3-36 BCDE (360) L	BCD	TTL/DTL	30.0	INT.	DIGIT	360	1	360	1.0	☐	.8	150	1,000	.172	5.0
23	4-36 BCDE (360) L	BCD	TTL/DTL	30.0	INT.	DIGIT	3,600	10	360	1.0	☐	.8	150	1,000	.172	5.0
23	5-36 BCDE (360) L	BCD	TTL/DTL	30.0	INT.	DIGIT	36,000	100	360	1.0	☐	.8	150	1,000	.172	5.0
23	3-36 BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	360	3.6	100	3.6	☐	.5	150	1,200	.172	1.0
23	4-36 BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	3,600	36	100	3.6	☐	.5	150	1,200	.172	1.0
23	5-36 BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	36,000	360	100	3.6	☐	.5	150	1,200	.172	1.0
23	6-36 BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	360,000	3,600	100	3.6	☐	.75	150	1,200	.172	1.0
23	ST-2 BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	100	1	100	3.6	☐	.5	150	1,200	.172	1.0
23	3-BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	1,000	10	100	3.6	☐	.5	150	1,200	.172	1.0
23	4-BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	10,000	100	100	3.6	☐	.5	150	1,200	.172	1.0
23	5-BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	100,000	1,000	100	3.6	☐	.5	150	1,200	.172	1.0
23	6-BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	1,000,000	10,000	100	3.6	☐	.5	150	1,200	.172	1.0
23	4-LAT BCD	BCD	20V	1.0	INT.	DIGIT OR COMP.	±9,000	3,600	±10	36	☐	.6	150	1,200	.172	1.0
23	5-LNG BCD	BCD	20V	1.0	INT.	DIGIT OR COMP.	±18,000	3,600	±10	36	☐	.6	150	1,200	.172	1.0
31	ST-10 GRAY	GRAY	TTL/DTL	2.0	N/A	DIGIT	1,024	1	1,024	0.35	TP	1.0	90	650	.97	1.0
33	ST-8P BNRY/L	BINARY	20V	4.0	INT.	DIGIT OR COMP.	256	1	256	1.4	☐	1.0	90	650	1.13	1.0
33	ST-9 BNRY/L	BINARY	TTL/DTL	25.0	INT.	DIGIT OR COMP.	512	1	512	0.70	*	1.0	90	650	1.13	1.0
33	ST-36 BCD/L	BCD	TTL/DTL	25.0	INT.	DIGIT OR COMP.	360	1	360	1.0	☐	1.0	90	650	1.13	1.0
33	ST-10 GRAY	GRAY	TTL/DTL	2.0	N/A	DIGIT	1,024	1	1,024	0.35	TP	1.0	90	650	1.13	1.0

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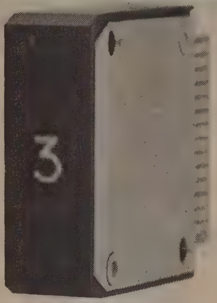
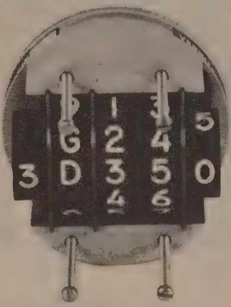


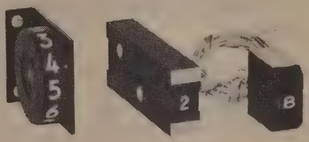
VERNIDEX STANDARD
½ x 1½ x 1½

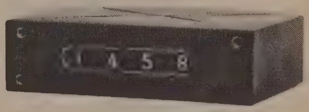


The tiny module that converts digital inputs to an electro-magnetic readout. In addition to standard models listed, Vernitech will manufacture to your specifications.

Part No.	Volts D.C.	No. of Char.	Size of Char.	Pulse Mode	No. of Leads or Term.
06VEA-0022	10	11	.156 x .156	1-1-1-1	12 L
06VBA-0048	10	10	.156 x .156	1-2-1-2	6 T
06VBD-1105 3 Position Flag	10	3	.187 x .187	Return to Flag with Power off	3 T
12VBB-1002	6	10	.281 x .250	Polarity Reversal	6 P/C
12VAC-0015	6	11	.250 x .156	1-1-1-1	12 P/C

Write or phone today for detailed bulletin and stock list.





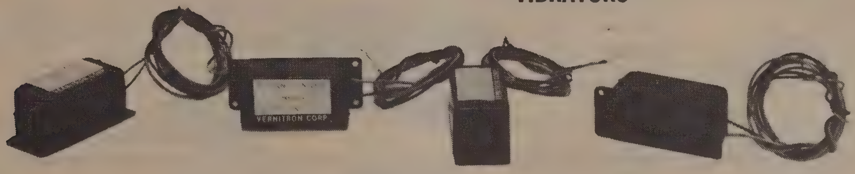
VERNIDEX MINIATURE

Vernitech has fully qualified hermetically sealed units to military specs with regard to:

Altitude	Shock	Fungus	Radio Interference
Temperature	Salt Spray	Explosion	Life
Vibration	Sand/Dust	Acceleration	Fogging

ALL MODELS AVAILABLE WITH FULL LOGIC SELF-CONTAINED—ACCEPTS BCD INPUT

VIBRATORS



The VERNIBRATOR is an electro-mechanical vibrating device originally designed to eliminate stiction from instruments such as altimeters, etc. The Vernitech vibrator produces exceptionally High-G forces over 10,000 hours of failure and maintenance-free operation, while consistently attaining reliable low-voltage operation.

Consult the factory for either standard or custom-made designs.

Part No.	Input Voltage	Input Current	Peak G's	Size (Inches)	Weight
PX 10014	28 VDC	50 ma	.75 - 2.0	1.6 x .67 x .65	28 grams
PX 10018	13-15 VDC	25 ma max. @ 13V	.75 - 2.0	1.6 x .67 x .65	28 grams
PX 10021	21-28 VDC	25 ma @ 21V 30 ma @ 28V	.75 - 2.0	1.0 x .725 x .65	24 grams
PX 10036	14-28 VDC	30 ma max.	.25	.75 x .725 x .65	22 grams

AVAILABLE WITH AND WITHOUT MOUNTING PLATES

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ACTIVE CONTROL INSTRUMENTATION

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MEASUREMENT AND CONTROL

"an advanced line of transducer and sensor instrumentation utilizing state-of-the-art techniques providing high performance economically . . ."

FREQUENCY TRANSDUCER MONITOR

Model 3510 (55-65 Hz)
Model 3511 (380-420 Hz)

Output: 0-1 or 0-5 VDC
Accuracy: 1%
Linearity: .05% center Freq.
Temp.: −20°C to +71°C
Size: 4½″ x 1½″ x 3″

FREQUENCY TRANSDUCER CONTROLLER

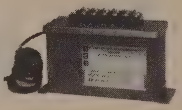
Model 3750 (55-65 Hz)
Model 3751 (380-420 Hz)

Output 1: 0-1 or 0-5 VDC
Output 2: Control - Hi and Lo limits adjustable through entire Range
Accuracy: 1%
Linearity: .05% center Freq.
Temp.: −20°C to +71°C
Size: 6½″ x 1½″ x 3″

A.C. CURRENT CONTROLLER

Model 4015
Thru-Current Ranges:
0-1 Amp 0-10 Amp 0-50 Amp
0-2 Amp 0-20 Amp 0-100 Amp
0-5 Amp

Excitation: 115 or 220 VAC 50-400 Hz
Control Point: .1A to 100A (adjustable)
Repeatability: ±1%
Temp.: −20°C to +71°C
Size: 4½″ x 1½″ x 3″



A.C. CURRENT MONITOR/ CONTROLLER

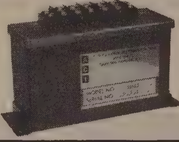
Model 4020 Single Trip Point
Model 4025 Adj. Band Limits

Excitation: 115 or 220 VAC 50-400 Hz
Control Point: (adjustable)
Repeatability: ±1%
Output 1: 0-1 or 0-5 VDC
Output 2: Solid State or Relay
Temp.: −20°C to +71°C
Size: 6½″ x 1½″ x 3″

A.C. VOLTAGE TRANSDUCER MONITOR

Model 9001 (60 Hz)
Model 9002 (400 Hz)

Input: 90-140 VAC
Output: 0-1 or 0-5 VDC
Accuracy: 1%
Response: less than 0.25 Hz
Temp.: −20°C to +71°C
Size: 4½″ x 1½″ x 3″



A.C. VOLTAGE TRANSDUCER CONTROLLER

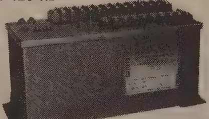
Hi and Lo Control Limits
Model 9601 (60 Hz)
Model 9602 (400 Hz)

Input: 90-140 VAC
Output 1: 0-1 or 0-5 VDC
Output 2: Solid State or Relay
Accuracy: 1%
Response: less than 0.25 Hz
Temp.: −20°C to +71°C
Size: 6½″ x 1½″ x 3″

POWER LINE MONITOR/ CONTROLLER

Model 4301
1φ Voltage and Frequency
Model 4302 (60 Hz or 400 Hz)
3φ Voltage and Frequency

Voltage Band: 100-130 VAC
Freq. Band: 50-70 Hz or 380-420 Hz
Hi-Lo Limits: Adj. to any points within Band
Output Relay: SPDT or 3PDT 10 Amp
Time Delay: 250 MSEC or Adj. Option
Temp.: −20°C to +71°C
Size: 7½″ x 3″ x 3½″



WATTS/POWER FACTOR TRANSDUCER CONTROLLER

Model 9401-9405

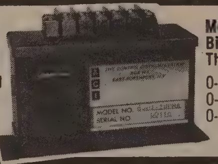
Input: 90-150 & 160-250 VAC 0-500 W to 0-100 kW
Output 1: 0-1 or 0-5 VDC
Output 2: Solid State or Relay
Temp.: −20°C to +71°C
Size: 6½″ x 1½″ x 3″
Thru-Current Ranges:

0-5 Amp	0-50 Amp
0-10 Amp	0-100 Amp
0-20 Amp	0-200 Amp
	0-500 Amp

D.C. CURRENT SENSORS

Thru-Current Ranges:
0-10 MA 0-200 MA 0-5 Amp
0-20 MA 0-500 MA 0-10 Amp
0-50 MA 0-1 Amp 0-20 Amp
0-100 MA 0-2 Amp 0-50 Amp

Model 6001
Excitation: 28 VDC ±4 VDC
Output: 0-5 VDC
Accuracy: 0.5% **PASS-THRU**
Response: 1 MSEC
Temp.: −20°C to +71°C
Size: 4½″ x 1½″ x 3″



Model 6002
Bi-Directional
Thru-Current Ranges:
0-10 MA 0-100 MA 0-1 Amp
0-20 MA 0-200 MA 0-2 Amp
0-50 MA 0-500 MA 0-5 Amp

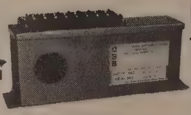
Excitation: ±15 VDC
Output: 0- ±5 VDC
Accuracy: 0.5%
Response: 1 MSEC
Temp.: −20°C to +71°C
Size: 4½″ x 1½″ x 3″

D.C. CURRENT SENSOR

Thru-Current Ranges:
0-10 MA 0-200 MA 0-5 Amp
0-20 MA 0-500 MA 0-10 Amp
0-50 MA 0-1 Amp 0-20 Amp
0-100 MA 0-2 Amp 0-50 Amp
0-100 Amp

Model 6010 D.C. Averaging
Excitation: 115 VAC ±10% 60 Hz
Output: 0-5 VDC **PASS-THRU**
Accuracy: 2%
Response: 0.5 SEC
Temp.: −20°C to +71°C
Size: 6½″ x 1½″ x 3″

50KV → ISOLATION



SENSOR CONTROLLER

Thru-Current Ranges:
0-10 MA 0-200 MA 0-5 Amp
0-20 MA 0-500 MA 0-10 Amp
0-50 MA 0-1 Amp 0-20 Amp
0-100 MA 0-2 Amp 0-50 Amp
0-100 Amp

Model 4550
Excitation: 115 VAC ±10% 60 Hz
Output 1: 0-5 VDC
Output 2: N.O. Relay Cont.
Accuracy: 2%
Response: 20 MSEC
Temp.: −20°C to +71°C
Size: 6½″ x 1½″ x 3″

Telephone or write for individual detail sheets prices and applications assistance.

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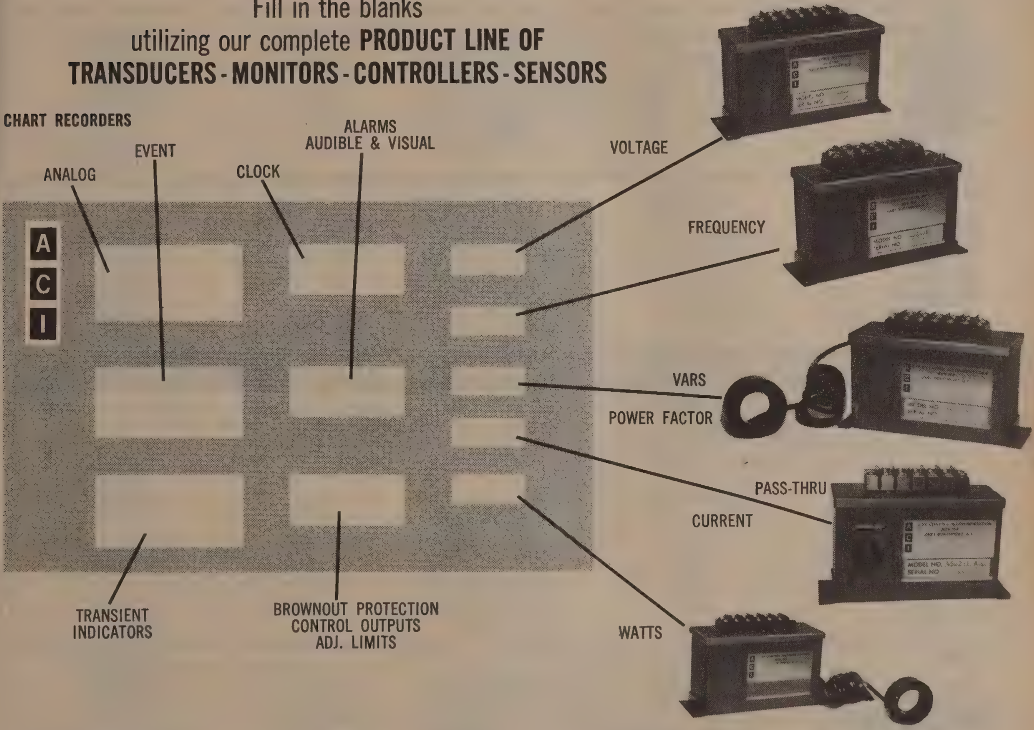
CHART RECORDERS
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then **lease** it from us until you are satisfied that all the functions of your system are satisfied at which time you may exercise your . . .

option to buy without having to pay R&D and design costs or you may purchase the system outright initially.

Some APPLICATIONS

- Aircraft beacon monitors and alarms to meet FAA requirements.
- Computer line fault monitors.
- Transmitting tube-klystron-TWT, etc., isolated DC Current sensing protection.
- UPS (Uninterruptible Power Source) monitoring input and output.
- Systems analysis.
- Custom designed instruments at production prices.
- Remote instrumentation systems.

Telephone or write for individual detail sheets prices and applications assistance.

AAC

American Aerospace Controls Inc.

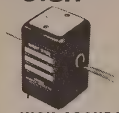
131 VERDI STREET, FARMINGDALE, NEW YORK 11735 ☐ (516) 694-5100

CURRENT, VOLTAGE AND POWER INSTRUMENTATION

CURRENT SENSORS D.C.

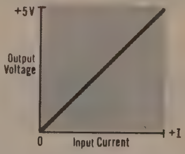
American Aerospace Controls' D.C. current sensors are used for measurement and control applications requiring an accurate high level D.C. output signal proportional to the input current. Most models feature "pass thru hole" construction for the power cable providing complete electrical isolation of the output. Models are available in grades suitable for industrial and military applications.

913A



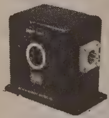
HIGH ACCURACY SMALL SIZE

Current Ranges Amps DC
100
50
20
10



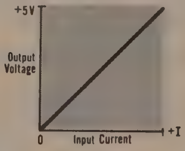
Output Volts	0 to 5 VDC
Response	1 ms
Accuracy	±1% F.S.
Excitation	24-32 VDC
Temp. Coef.	.08% F.S./°C
Size	1⅝ x 1⅝ x 2⅜

902 and 916



HIGH CURRENT RANGES

Current Ranges Amps DC	
902	916
300	1000
200	750
100	500
50	

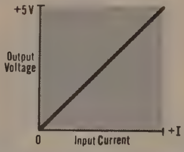


Output Volts	0 to 5 VDC
Response	5 ms
Accuracy	±1% F.S.
Temp. Coef.	.05% F.S./°C
Excitation	24-32 VDC
Size	2³⁄₁₆ x 3¾ x 3¹⁄₁₆

903 and 923

MEDIUM CURRENT RANGES

Current Ranges Amps DC		
903		923
2.0	0.1	50
1.0	0.05	20
0.5	0.02	10
0.2	0.01	5



Output Volts	0 to 5 VDC
Response	50 ms
Accuracy	±1%
Temp. Coef.	.04%/°C
Excitation	24-32 VDC
Size	2 x 2⁹⁄₁₆ x 2⅞

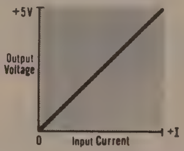
CURRENT SENSORS MOVEABLE JAW TYPE

A complete line of moveable jaw type current sensors are available for D.C., A.C. and combination D.C. and A.C. current measurements. Models cover both military and industrial applications. These transducers are well suited for diagnostic testing of automotive electric circuits. Uses include measurement of starter current, battery drain, and generator-alternator current. Fast response units permit accurate analysis of current wave forms. Output voltage can be indicated on a meter, scope or recorder.

929

HI-ACCURACY MIL-SPECS

Current Ranges Amps. D.C.
0-1000
0-500
0-200
0-100
0-50

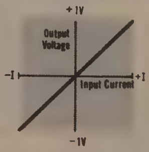


Output	0 to 5 VDC
Accuracy	±1% F.S.
Excitation	28 VDC ±4 VDC
Response	200 μsec
Temp. Range	−55°C to +85°C
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

930

DUAL RANGE FAST RESPONSE BIDIRECTIONAL

Current Ranges Amps. DC	
±1000	±150
± 500	±100
± 400	± 50
± 300	± 30

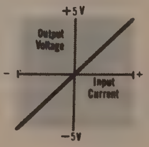


Output Volts	0 to ±1 VDC
Accuracy	±2% F.S.
Response	100 μsec
Excitation	±15 VDC @ 50 MA
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

932

SINGLE RANGE FAST RESPONSE BIDIRECTIONAL

Current Ranges Amps. DC	
±50	±500
±40	±400
±30	±300
±20	±200
±10	±100



Output	0 to ±5 VDC
Accuracy	1% F.S.
Excitation	±15 VDC ±1 VDC
Response	100μ sec
Temp. Range	−20°C to +70°C
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

AAC

American Aerospace Controls Inc.
131 VERDI STREET, FARMINGDALE, NEW YORK 11735 □ (516) 694-5100

CURRENT SENSORS BIDIRECTIONAL

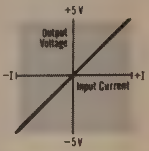
Bidirectional current sensors are used to sense either D.C. currents whose polarity or direction of flow may reverse or A.C. currents within the response capabilities of the device. The electrically isolated output signal duplicates the current wave form. Because of their fast response characteristics, these sensors may be used for pulse measurements and controls.

905

HIGH ACCURACY
HIGH OUTPUT

Current Ranges
Amps D.C.

±5
±2
±1
±0.5
±0.2
±0.1
±0.05



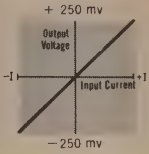
Output	0 to ±5 VDC
Response	50 ms
Accuracy	±1% F.S.
Excitation	±15 VDC
Temp. Coef.	.04% F.S. /°C
Size	2 x 2⁹⁄₁₆ x 2⅞

910

FAST RESPONSE
ECONOMY

Current Ranges
Amps DC or AC Peak

±300
±200
±150
±100
±50
±25



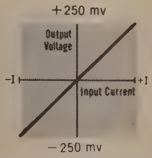
Output Volts	0 to ±250 mv
Response	5 μs
Accuracy	±2% F.S.
Excitation	15 VDC
Temp. Coef.	0.15% F.S. / °C
Size	1 x 1¾ x 2¹⁄₁₆

909

HIGH CURRENT
REMOVABLE YOKE

Current Ranges
Amps DC or AC Peak

±2500
±1500
±1000
±750
±500
±250
±150



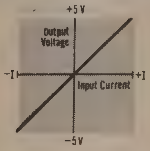
Output Volts	0 to 250 mv
Response	200 μs
Accuracy	±2% F.S.
Temp. Coef.	0.15% F.S. / °C
Excitation	24-32 VDC
Size	1⁹⁄₁₆ x 3¼ x 4⅝

925

HIGH ACCURACY
HIGH OUTPUT

Current Ranges
Amps D.C.

±100
±50
±20
±10



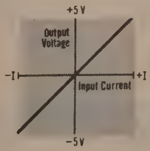
Output	0 to ±5 VDC
Response	50 ms
Accuracy	±1% F.S.
Excitation	±15 VDC
Temp. Coef.	.04% F.S. /°C
Size	2 x 2⁹⁄₁₆ x 2⅞

907

FAST RESPONSE
HIGH OUTPUT

Current Ranges
Amps DC or AC Peak

±150
±100
±50
±25



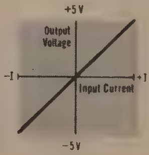
Output Volts	0 to 5 VDC
Response	100 μsec
Accuracy	±2% F.S.
Excitation	±15 VDC
Temp. Coef.	0.15% F.S. / °C
Size	1 x 1¾ x 2¹⁄₁₆

927

MEDIUM CURRENT RANGES
HIGH OUTPUT

Current Ranges
Amps DC or AC Peak

±1000
±750
±500
±300
±250
±200
±150
±100
±50



Output Volts	0 to ±5 VDC
Response	100 micro sec
Accuracy	±2% F.S.
Excitation	±15 VDC
Temp. Coef.	0.15% F.S. / °C
Size	2 x 2⁹⁄₁₆ x 2⅞

AAC

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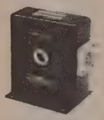
CURRENT SENSORS A.C.

A broad line of "pass thru hole type" A.C. current sensors are available for measurement or control of current at standard line frequencies or over a broad frequency spectrum. The sensors produce a high level D.C. signal output that is electrically isolated from the current line. Power dissipation is negligible and economy models of these sensors may be used as replacements for shunts.

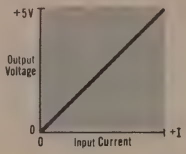
1004



60 TO 400 Hz

Current Ranges
Amps AC rms

100
50
20
10
5
2
1



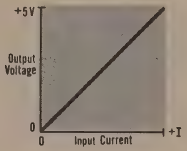
Output Volts	0 to 5 VDC
Response	150 ms
Repeatability	½% F.S.
Accuracy	±2% F.S. Max.
Excitation	Self Excited
Frequency	50 to 400 Hz
Temp. Stability	0.1% F.S. / °C
Size	2 x 2⁹⁄₁₆ x 2⅞

1003AM1 and 1003AM2

60 Hz
ECONOMY

Current Ranges
Amps AC rms

AM1	AM2
100	250
50	200
20	150
10	
5	



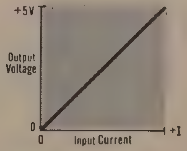
Output Volts	0 to 5 VDC
Response	150 ms
Repeatability	½%
Accuracy	± 2% F.S.
Excitation	Self Excited
Temp. Stability	0.1% F.S./°C
Size (AM1)	1 x 2¹⁄₁₆ x 2
Size (AM2)	1³⁄₁₆ x 2⅞ x 2½

1001

HIGH CURRENT
REMOVABLE YOKE

Current Ranges
Amps AC rms

2500
1500
1000
750
500
250
150

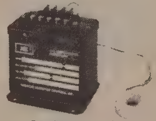


Output Voltage	0 to 5 VDC
Frequency Range	50 Hz to 2000 Hz
Accuracy	±2.5% FS
Temp. Stability	.15% F.S. /°C
Excitation	24-32 VDC
Response	50 ms
Size	1⁹⁄₁₆ x 3¼ x 4⅝

A.C. CURRENT CONTROLLERS

A.C. Current Controllers are adjustable devices that detect a set current level and produce a relay closure or opening when the set current level is exceeded. These ruggedly built industrial control devices utilize a current to voltage "thru hole" toroidal transformer to sense the line current. The (CT) current transformer's output is fed to a control box which contains the signal conditioning circuitry and relay. Uses include overload and underload detection, ground fault monitoring, power failure, etc.

850

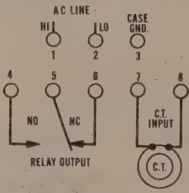


60 Hz
INDUSTRIAL

Settable
Input Current Ranges
Amps 60 Hz

0 to 2
0 to 5
0 to 10
0 to 20
0 to 50
0 to 100

Options
Time Delay — .5 sec. to 5 sec. 400 Hz operation.
Solid state output.



Output	Relay 10 Amp SPDT
Line Voltage	115 VAC or 220 VAC
Line Frequency	50 to 60 Hz
Burden	3 Watts
Set Point	Adjustable 10% to Full Scale
Repeatability	2% F.S.
Reset	Automatic
Response	500 ms

WATT TRANSDUCERS A.C.

A.C. Watt transducers are used for measurement or control of A.C. power. These low insertion devices provide a high level linear D.C. output. Models are available covering real watts (VA times Power Factor) and Volt Amps (VA).

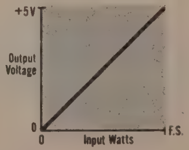
411 and 413

60 Hz
115 and 230 VAC

Kilowatt Ranges
0-1 to 0-100

Current Ranges Amps
0-10 to 0-500

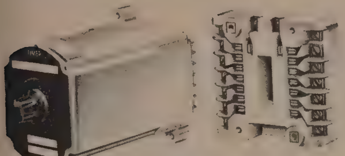
Voltage Ranges VAC
80 to 150 and 160 to 300

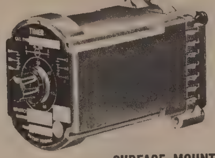


Output 411	0 to 100 mV DC
Output 413	0 to 5V DC
Excitation	Self Excited
Accuracy	2% F.S.
Power Factor	0 to ±1
Response	400 ms
Temp. Coef.	.15% / °C
Size	3⁷⁄₁₆ x 4⅛ x 2⁵⁄₁₆

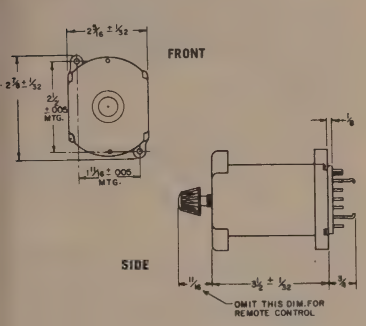
Arrow Hart

INDUSTRIAL MOUNTING TIMERS / TEM SERIES

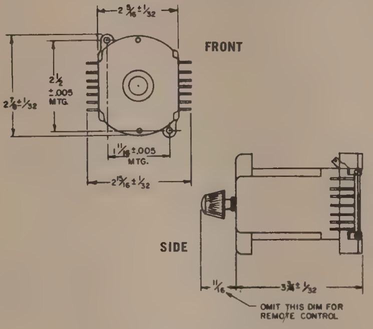

PLUG-IN TYPE


SURFACE MOUNT TYPE

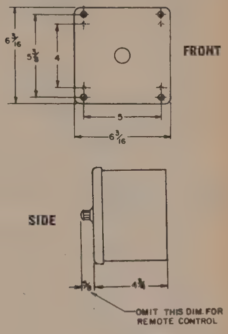
NEMA 1 ENCLOSURE


2 3/16 ± 1/32
FRONT
2 7/8 ± 1/32
2 1/2 ± .005 MTG.
1 11/16 ± .005 MTG.
1/8
SIDE
11/16
3 1/2 ± 1/32
3/4
OMIT THIS DIM. FOR REMOTE CONTROL

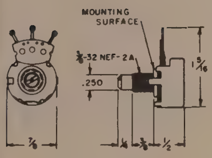
PLUG-IN TYPE


2 3/16 ± 1/32
FRONT
2 1/2 ± .005 MTG.
2 7/8 ± 1/32
1 11/16 ± .005 MTG.
2 15/16 ± 1/32
SIDE
11/16
3 3/4 ± 1/32
OMIT THIS DIM FOR REMOTE CONTROL

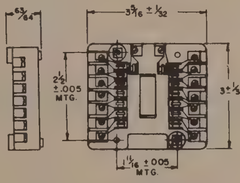
SURFACE MOUNT TYPE


6 3/16
5 3/8
4
FRONT
5
6 3/16
SIDE
7/8
4 1/4
OMIT THIS DIM. FOR REMOTE CONTROL

NEMA 1 ENCLOSURE


MOUNTING SURFACE
3/8-32 NEF-2A
.250
1 3/16
7/8
1/4
3/8
1/2

REMOTE POTENTIOMETER


63/64
3 3/16 ± 1/32
2 1/2 ± .005 MTG.
3 ± 1/32
1 11/16 ± .005 MTG.

MTRS 402

APPROXIMATE DIMENSIONS, NOT SUITABLE FOR CONSTRUCTION

MTRS-402 RECEPTACLE

The MTRS-402 is the basic industrial receptacle built by ARROW-HART exclusively for TEMA series timers and MT series plug-in relays. It is a top quality receptacle made of one-piece molded construction, with flat; stab-in connectors for broad contact surfaces. The back is totally enclosed, eliminating the need for additional insulation when mounting on a panel. Rubber snubbers mounted on the back minimize transmission of vibration to the timer. Screw-type terminal connections are clearly marked by embossed numbers on the molded base. The combination of heavy retaining prongs and mounting screws assures the timer will not vibrate loose under severe conditions.

ELECTRONIC TIME DELAY RELAYS

ARROW-HART offers a line of dependable solid state time delay relays. These combine advantages of solid state circuitry with rugged packaging. Both **delay on energization timers** and **delay on de-energization timers** are available. They are offered in several timing ranges and mounting configurations.

SURFACE MOUNT TYPE

These timers do not require a receptacle and are designated simply by adding an "S" to the catalog types (TEMAS). The relay is front-wired and is equipped with quick-connect terminals.* Rubber snubbers on the base assure firm mounting, and reduced transmission of machine vibration to the timer.

PLUG-IN TYPE

TEM series timers are primarily designed to plug into ARROW-HART's Catalog Number MTRS-402 receptacle. The receptacle is an exceptionally sturdy industrial-type unit of one-piece molded construction. It is equipped with flat stab-in connections having broad contact surfaces to assure positive contact. Screw-type terminal connections are clearly marked for easy identification. Rubber snubbers minimize transmission of machine vibration to the timer.

These timers are designed so that front panel mounting can be obtained. The potentiometer retaining nut secures the timer to panels of 1/16 inch or less.

NEMA 1 FACTORY ASSEMBLED OR KIT

Available factory assembled, including timer, or for field assembly. The field assembly kit includes plug-in receptacle mounted in NEMA 1 enclosure and will accommodate any TEM series timer.

REMOTE TIME ADJUSTMENT

TEM series timers are available with remote time adjustment. When remote control is required, the potentiometer and graduated dial label is packaged unassembled.

DON'T MISS THESE OTHER A-H PRODUCTS IN EEM

Wiring Devices (Connectors)	p. 2•621
Relays	p. 1•1580
Contactors	p. 1•1584
Switches	p. 1•1934

---

*AMP pre-insulated receptacle, series 205, Cat. No. 42727-2 or equivalent may be used on quick connect terminals.

Arrow Hart TIMERS

INDUSTRIAL MOUNTING TIMERS (Continued)

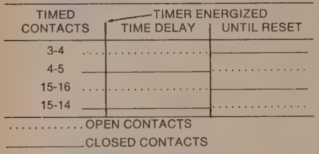
ON-DELAY MODELS

ON-DELAY: Delay on Energization Timers

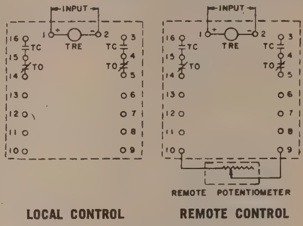
When input voltage is applied, the output contacts will transfer after a pre-selected time delay. Removal of this input voltage will return the contacts immediately to their de-energized state. If an application requires reset before the timer has completed its delay, the timing capacitor may be discharged electronically.

A major advantage is that repeated accuracy is assured on subsequent cycles. A typical application would be one in which the timer was set to time out just after an event, but was reset by the event. If the event didn't occur, the timer would be allowed to time out and sound an alarm, etc.

BASIC MODELS (without Instant Contacts)
TEMA / TEMAS SERIES


TIMED CONTACTS
TIMER ENERGIZED
TIME DELAY
UNTIL RESET
3-4
4-5
15-16
15-14
OPEN CONTACTS
CLOSED CONTACTS

FUNCTION DIAGRAM


INPUT
TRE
TC
TO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
REMOTE POTENTIOMETER
LOCAL CONTROL
REMOTE CONTROL

WIRING DIAGRAM

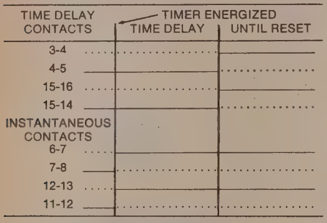
OPERATION

Type TEMA is ON-DELAY time delay relay. When input power is applied, the output contacts will transfer after a pre-selected time delay. This delay is fully adjustable by a potentiometer. Removal of input voltage will return output contacts to their de-energized state. Electronic Discharge which discharges the timing capacitor if relay is reset before timing out is standard.

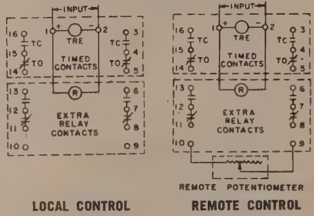
Functional Description — Two Form "C" ON-DELAY Contacts.

1. Adjust potentiometer for required time delay.
2. Apply input voltage to terminals #1 and #2.
3. ON-DELAY contacts transfer after time elapses.
4. Contacts remain transferred until input voltage is removed.

BASIC MODELS (Instant Contacts MODELS)
TEMI / TEMIS SERIES


TIME DELAY CONTACTS
TIMER ENERGIZED
TIME DELAY
UNTIL RESET
3-4
4-5
15-16
15-14
INSTANTANEOUS CONTACTS
6-7
7-8
12-13
11-12

FUNCTION DIAGRAM


INPUT
TRE
TC
TO
TIMED CONTACTS
R
EXTRA RELAY CONTACTS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
REMOTE POTENTIOMETER
LOCAL CONTROL
REMOTE CONTROL

OPERATION

Type TEMI is identical in operation to type TEMA with the exception that there is an extra relay which transfers instantaneously upon application and removal of power.

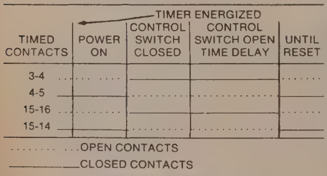
Functional Description—Two Relays—Two Form "C" ON-DELAY Contacts and Two Form "C" Instantaneous Contacts.

1. Adjust potentiometer for required time delay.
2. Apply input voltage to terminals #1 and #2.
3. Instantaneous contacts transfer immediately and ON-DELAY starts for timed contacts.
4. ON-DELAY contacts transfer after time elapses.
5. All contacts remain transferred until input voltage is removed.

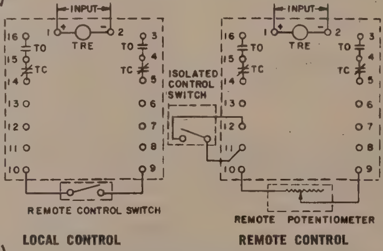
OFF-DELAY: Delay on De-energization Timers

For these timers, input voltage is maintained, and a N.O. isolated input control contact is required. When this contact is closed, the timer relay contacts transfer immediately. When the control contact is opened, the time delay contacts will transfer back to their de-energized state after a preselected time delay.

BASIC MODELS (without Instant Contacts)
TEMR / TEMRS SERIES


TIMER ENERGIZED
TIMED CONTACTS
POWER ON
CONTROL SWITCH CLOSED
CONTROL SWITCH OPEN TIME DELAY
UNTIL RESET
3-4
4-5
15-16
15-14
OPEN CONTACTS
CLOSED CONTACTS

FUNCTION DIAGRAM


INPUT
TRE
TO
TC
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
ISOLATED CONTROL SWITCH
REMOTE CONTROL SWITCH
REMOTE POTENTIOMETER
LOCAL CONTROL
REMOTE CONTROL

WIRING DIAGRAM

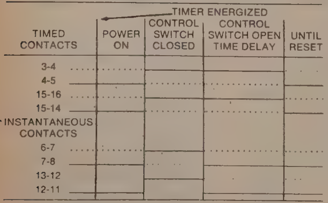
OPERATION

The TEMR is an OFF-Delay time delay relay. Input voltage is maintained and a N.O. isolated contact is used. When the contact is closed, the timer contacts transfer immediately. When the isolated contact is opened, the timer contacts will re-transfer after the OFF-DELAY time elapses.

Functional Description—One Relay—Two Form "C" OFF-DELAY Contacts.

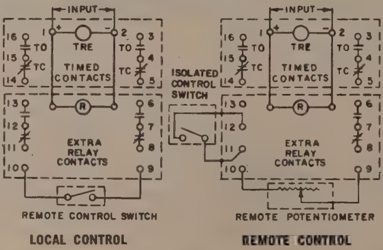
1. Adjust potentiometer for required time delay.
2. Maintain input voltage to terminals #1 and #2.
3. Close isolated control which will transfer contacts immediately.
4. Open isolated control. This begins OFF-DELAY.
5. OFF-DELAY contacts retransfer after time elapses.
6. Repeat steps 3 and 4 to recycle.

BASIC MODELS (Instant Contacts MODELS)
TEMRI / TEMRIS SERIES


TIMER ENERGIZED
TIMED CONTACTS
POWER ON
CONTROL SWITCH CLOSED
CONTROL SWITCH OPEN TIME DELAY
UNTIL RESET
3-4
4-5
15-16
15-14
INSTANTANEOUS CONTACTS
6-7
7-8
13-12
12-11

NOTE Contacts 12-11 and 13-12 not available with remote potentiometer.

FUNCTION DIAGRAM


INPUT
TRE
TO
TC
TIMED CONTACTS
R
EXTRA RELAY CONTACTS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
ISOLATED CONTROL SWITCH
REMOTE CONTROL SWITCH
REMOTE POTENTIOMETER
LOCAL CONTROL
REMOTE CONTROL

OPERATION

Type TEMRI operation is identical to type TEMR except there is an extra relay which pulls in and drops out instantaneously with closure and opening of isolated contact.

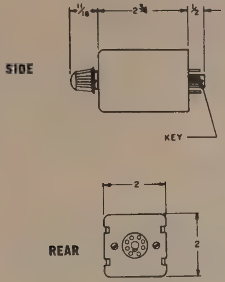
Functional Description—Two Relays—Two Form "C" OFF-DELAY Contacts and Two Form "C" Instantaneous Contacts.

1. Adjust potentiometer for required time delay.
2. Maintain input voltage to terminals #1 and #2.
3. Close isolated control which will transfer timed contacts and instantaneous contacts immediately.
4. Open isolated control. This will re-transfer the instantaneous contacts immediately and begin the OFF-DELAY.
5. OFF-DELAY contacts re-transfer after time elapses.
6. Repeat steps 3 and 4 to recycle.

ARROW-HART INC. / INDUSTRIAL CONTROL PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

Arrow Hart TIMERS

OCTAL BASE TIMERS / TEP SERIES



REMOTE TIME ADJUSTMENT

TEP series timers are available with remote time adjustment. When remote control is required, the potentiometer and graduated dial label is packaged unassembled.

ON-DELAY: Delay on Energization Timers

When input voltage is applied, the output contacts will transfer after a pre-selected time delay. Removal of this input voltage will return the contacts immediately to their de-energized state. If an application requires reset before the timer has completed its delay, the timing capacitor may be discharged electronically.

ELECTRONIC TIME DELAY RELAYS

ARROW-HART offers a line of dependable solid state time delay relays. These combine advantages of solid state circuitry with rugged packaging. Both **delay on energization timers** and **delay on de-energization timers** are available. They are offered in several timing ranges and mounting configurations.

Electronic timers are used most effectively in applications requiring a high degree of timing accuracy, and high cycling rates. However, their competitive cost makes them ideal for any application.

The use of solid state circuits in place of electro-mechanical timing components greatly extends the useful life of timers. They are now capable of millions of operations without failure.

Typical applications include machine tool sequencing, timing functions on automated equipment, and time delays on equipment that requires a warm-up period.

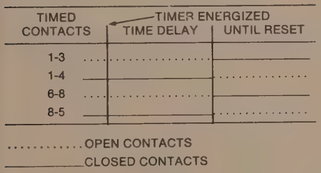
TEP — OCTAL PLUG-IN TYPE

TEP series timers are designed for use with a standard octal socket. The base and center locating pin are of one piece molded nylon construction, which affords greater resistance to breakage. ARROW-HART's method of internally staking and soldering wire leads to the solid connector pins assures connections that are far superior to the standard hollow-pin — blind soldering method. These timers are designed so that front panel mounting can be obtained. The potentiometer retaining nut secures the timer to panels of 1/16 inch or less.

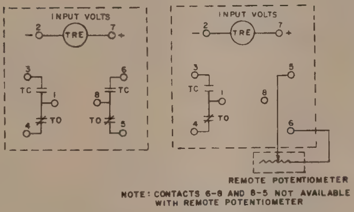
OFF-DELAY: Delay on De-energization Timers

For these timers, input voltage is maintained, and a N.O. isolated input control contact is required. When this contact is closed, the timer relay contacts transfer immediately. When the control contact is opened, the time delay contacts will transfer back to their de-energized state after a preselected time delay.

ON-DELAY MODELS / TEP SERIES



FUNCTION DIAGRAM



NOTE: CONTACTS 6-8 AND 8-5 NOT AVAILABLE WITH REMOTE POTENTIOMETER

LOCAL CONTROL   REMOTE CONTROL

WIRING DIAGRAM

OPERATION

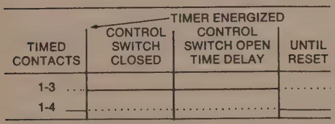
Type TEP relays are ON-DELAY time delay relays. When power is applied, the output contacts will transfer after a pre-selected time delay.

This delay is fully adjustable by a potentiometer. Removal of input voltage will return output contacts to their de-energized state. Electronic Discharge which discharges the timing capacitor if relay is reset before timing out is standard.

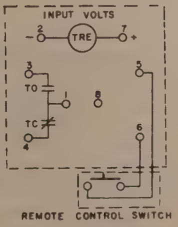
Functional Description—One Relay—Two Form "C" ON-DELAY Contacts.

1. Adjust potentiometer for required time delay.
2. Apply input voltage to terminals #2 and #7.
3. ON-DELAY contacts transfer after time elapses.
4. Contacts remain transferred until input voltage is removed.

OFF-DELAY MODELS / TEPR SERIES



FUNCTION DIAGRAM



LOCAL CONTROL

WIRING DIAGRAM

Remote Control not Available on Type TEPR

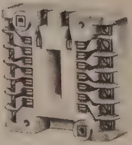
OPERATION

The TEPR is an OFF-DELAY time delay relay. Input voltage is maintained and a N.O. isolated contact is used. When the contact is closed, the timer contacts transfer immediately. When the isolated contact is opened, the timer contacts will re-transfer after the OFF-DELAY time elapses.

Functional Description—One Relay—One Form "C" OFF-DELAY CONTACT.

1. Adjust potentiometer for required time delay.
2. Maintain input voltage to terminals #2 and #7.
3. Close isolated control which will transfer contacts immediately.
4. Open isolated control. This begins OFF-DELAY.
5. OFF-DELAY contacts retransfer after time elapses.
6. Repeat steps 3 and 4 to recycle.

HOW TO ORDER



TIMER
PATENT PENDING

STOCKED CATALOG NUMBERS[3]
INDUSTRIAL MOUNTING / TEM SERIES

OPERATION	CONTACTS Timed	Instantaneous	TIMING RANGE 0.3-60 Sec.	0.1-7 Sec.	0.1-30 Sec.	List[2] Price
110V, 50/60 Hz				CATALOG NO.		
ON-DELAY, times after energization [1]	2PDT 2PDT	— 2PDT	TEMA 111 TEMI 111	TEMA 117 TEMI 117	TEMA 119 TEMI 119	$96 116
OFF-DELAY, times after de-energization [1]	2PDT 2PDT	— 2PDT	TEMR 111 TEMRI 111	TEMR 117 TEMRI 117	— —	108 128
220V, 50/60 Hz						
ON-DELAY OFF-DELAY [1]	2PDT 2PDT	— —	TEMA 121 TEMR 121	— —	— —	96 108

[1] TEMA Series Timers require MTRS-402 receptacle @ $5.60 list. Separate NEMA 1 enclosure is available for mounting any TEMA Series Timer. Receptacle is included. Order Cat. No. 52346 @ $28.00 list.

OCTAL SOCKET MOUNT / TEP SERIES

OPERATION	CONTACTS Timed	Instantaneous	TIMING RANGE 0.3-60 Sec.	0.1-7 Sec.	0.1-30 Sec.	List[2] Price
120V, 50/60 Hz				CATALOG NO.		
ON-DELAY, times after energization	2PDT	—	TEP 111	TEP 117	TEP 119	$72
OFF-DELAY, times after de-energization	2PDT	—	TEPR 111	TEPR 117	—	84

[2] Discount schedules available from your Industrial Distributor, or ARROW-HART Sales Office.
[3] Add Suffix D to catalog number for a timer with remote adjustment. Add Suffix S for a NEMA 1 enclosure; adds $28.00 to list price. Not available on TEP Series. Timers with the D or S option are not stock items.

NON STOCKED TIMERS

A. Select timer type from preceding pages.
B. Add the code number for the desired input voltage.
C. Add the code number for the desired timing range and list price adder if applicable.
D. Add the suffix letter for desired options and list price adder if applicable.

LIST PRICES OF BASIC UNITS

TEMA 1	$ 96.00	TEMRI 1	$128.00
TEMI 1	116.00	TEP 1	72.00
TEMR 1	108.00	TEPR 1	84.00

TEMA ONE — — —

Input Voltage

28 VAC 50/60 Hz	3
28 VDC	4

Timing Range

0.8-180 sec.		3
[4]1.0 sec. to 9 min.	Add $16.00 List	10

Options

D	Remote Time Adjust	
S	[5]NEMA 1 Enclosure	Add $28.00 List

[4] Repeat accuracy of time ranges 6 minutes and over is guaranteed within ±5% of setting. Not available on OFF-DELAY timers, or TEP series.
[5] Not available on TEP series. Includes timer factory-mounted in NEMA 1 enclosure less timer, order #52346 @ $28.00 List.

SPECIFICATIONS

Standard Input Voltage
110V, 50/60 Hz
*220V, 50/60 Hz
24V, 50/60 Hz
28VDC

Timing Ranges
0.1- 7 SEC.
0.1- 30 SEC.
0.3- 60 SEC.
0.8-180 SEC.
**1.0 SEC.-9 MIN.

Reset Time
Standard on or off delay: .1 SEC. MIN.

*Not available on TEMI, TEMRI.
**Not available on TEP Series.

TOTAL POWER CONSUMPTION

Type	Watts Normal	Maximum
TEMA & TEP Series	2	4
TEMA with extra relay	4	7

CONTACT RATINGS — RESISTIVE

Voltage	Ampere Rating† AC	DC
32	10	10
115	10	—
230	5	—

†For higher ratings refer to factory.

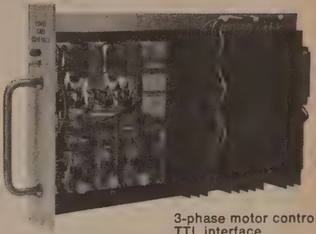
We specialize in engineering and manufacturing

Custom Controls

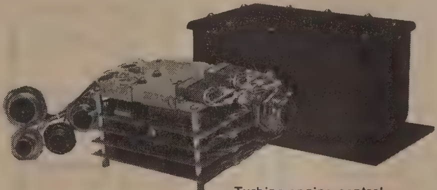
If you're looking for a custom designed solid-state electronic control we would like to talk to you.

Over the past 19 years we've saved countless customers time and effort by applying our design and manufacturing expertise to their control applications. The know-how we have developed during this time has enabled us to produce sophisticated designs to meet military specifications with extreme environments, as well as controls for commercial/industrial applications.

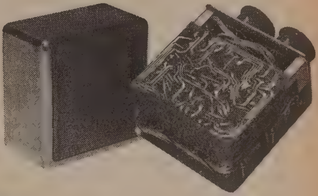
A condensed listing of our general product capabilities is shown below. Call us first the next time you need a custom control. If we can't help you we'll try to tell you who can.



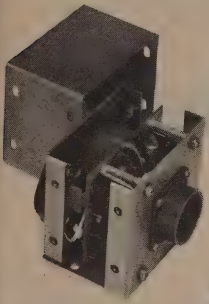
3-phase motor control, TTL interface.



Turbine engine control.



Airborne turbine engine control.



Airborne light dimmer.

Aircraft smoke detector.

Fault current detector.

CONTROLS	Compact solid-state analog and digital units for . . . turbine engine start, run, and shutdown command . . . RPV launch, steering, destruct, and recovery systems . . . electro-mechanical actuator positioning and synchronization.
DETECTORS/SENSORS/ SENSING RELAYS	Voltage, current, frequency, temperature and light-sensing for . . . jet engine speed warnings . . . aircraft cargo smoke detection . . . power phasing . . . over-current protection.
TIMING DEVICES	Time delays from microseconds to hours for . . . missile arming and launching . . . parachute deployment . . . commercial and military system sequencing . . . satellite programming . . . high-noise surroundings.
CONVERTERS/INVERTERS	DC/DC, AC/DC, DC/AC conversion for . . . computer systems . . . geophysical survey equipment . . . integrated circuits . . . radar and sonar power.
FLASHERS/DIMMERS	Solid-state short-circuit-proof flashers and high-efficiency dimmers.
SPECIAL ITEMS	An inventory of proven circuits and packages . . . directly suitable for new applications, or . . . adaptable with slight modifications to fit the most exacting requirements.
POWER SUPPLIES	Multiple and single output units, using high-speed switching, in custom configurations for . . . computer, military, and industrial applications. **See EEM Power Sources Section 4000 for Autronics' Custom Power Supply Capabilities.**

Call us first . . . we'll put our know-how to work for you.

Autronics Corporation

180 North Vinedo Avenue Pasadena, California 91107 (213) 681-3545 TWX (910) 588-1977

BEEDE

Panel Meters
Pyrometers
Control Meter-Relays
Meter Movements

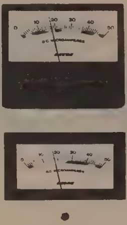
New Beede CERTRAK™ Panel Meters

±1% or ±½% tracking certificate with each meter

Beede is the first panel-meter manufacturer to certify the tracking accuracy of its products. Each Certrak™ meter is shipped with an individually signed certificate of tracking accompanied with a printout of readings taken at every numbered scale division. Certificates of ±1% or ±½% tracking accuracy are available.

New shielded-bar taut-band movement. In conjunction with the new Certrak™ panel meters, Beede announces its new ultra-sensitive shielded-bar taut-band meter movement. All Beede panel meters containing this movement qualify under the Certrak 1% certification program. Sensitivities from 0-10μA to 0-25A are in stock for immediate shipment; stock voltmeters are 0-10mV to 0-300V. Case styles in stock: 3″ and 4″ Designer and Centurion, 6″ Universal (described below).

For complete information, request Bulletin PM-3.



Centurion

Designer

Universal

Other Beede Panel Meters

Centurion Line. 3″ and 4″ durable molded black phenolic with glass window for front-of-panel mounting; 4″ back-of-panel model. Illumination available in 4″ models.

Designer Line. Clear picture-frame design with concave window in 2″, 3″, 4″, and 6″ widths for both front and back-of-panel mounting.

Universal Line. Large, highly visible meter cases in 6″ and 8″ widths for across-the-room reading.

250° Line. Beede's very popular 250° movement for switchboard, automotive, marine applications available as meter movement only (see bottom of next page) or in brass, chrome, or black lacquer case with glass front, 3″ and 6″ diameter.

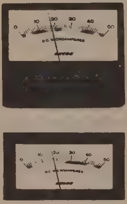
Edgewise Line. 1½″ and 2½″ models for applications demanding minimum panel space.

QA Line. 1½″, 3½″, and 4½″ cases with concave window, lower portion painted or horizontal ribbed.

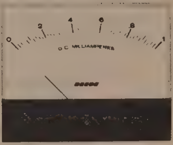
Traditional Line. Available in various rectangular and round phenolic cases.

Clear Front Line. 1″, 2″, 3″, 4″ cases for general-purpose panel-meter applications.

For complete information, request Bulletin PM-2.



Centurion Line



Universal Line

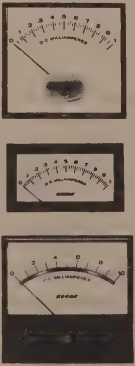
QA Line

Traditional Line

250° Line

Edgewise Line

Clear Front Line



Designer Line

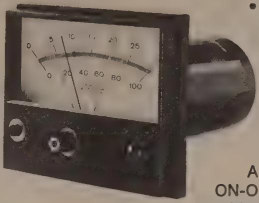
Control Meter-Relays

The Beede non-contacting control-meter relay combines a high-torque d'Arsonval meter with an adjustable photoelectric sensor, switching circuit, and output switch. As the monitored variable passes the adjustable setpoint, an output relay is either energized or de-energized. Either one or two setpoints are available.

Beede's greatly simplified meter-relay design has significantly reduced the number of parts, resulting in price savings up to 50% without a sacrifice of quality features.

Features

- Optical, non-contacting control, continuous indication.
- Standard models available from stock.
- Wide variety of options (power supply, input and output, tamperproof setpoint controls, etc.) for inexpensive customizing.
- Available as single complete unit, or with separate control, or optical element only.
- Inherently fail-safe.
- AC or DC power input.
- Direct-drive set pointers.
- Lamp life in excess of 10 years.
- Meter movement and/or dial custom-designed to your specifications if required.
- Meter permanently free of static influence.
- Attractive, modern "Centurion" case, 3" or 4" wide; 4" model available also for behind-panel mounting.



Specifications

Accuracy ±2% or ±1%.
ON-OFF operation or latching with manual reset.
Output: 5 amp (resistive load) DPDT relay for each setpoint. Solid State Output available.
Standard Deadband is 0.5% nominal.
Power Requirements 105 to 130 Volts AC.
Other AC and DC power inputs available.
Ambient Temperature 40°F to 165°F is standard.

Movements

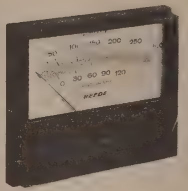
MAG-BAND TAUT BAND, 0-20μA DC minimum range.
MAG-B PIVOT AND JEWEL, 0-200μA DC minimum range.

For complete information, request Bulletin MR-2.

Pyrometers

NEW Optemp™ pyrometer/meter relay. High-impedance input amplifier delivers high-power signal to meter movement, eliminating need for thermocouple lead-length adjustments and permitting the use of lower-cost light-gage t/c extension wire. Rugged high-torque pivot-and-jewel movement with non-contacting optical switching for fast response, inherent noise rejection, continuous indication.

Standard Optemp models suitable for Types J and K t/c's. Six stocked ranges from 0-300°F to 0-2500°F. Single or double setpoint. Case width 3 or 4 in. All models have electrical cold-junction compensation, t/c break protection. Many options available, including integral bridge circuits enabling use of RTD or thermistor sensing of narrow temperature ranges.



Indicating pyrometers—As "prime source for temperature instrumentation," Beede offers, in addition to the controlling pyrometers described at left, a complete range of indicating panel-meter pyrometers in a wide choice of case styles in widths from 2" to 6". Clear-reading mirror scales eliminate parallax error, and may show both Fahrenheit and Centigrade units.

For complete information, request Bulletin T-1.

Meter Movements

Precision d'Arsonval movements as used in the case styles shown above, or available for installation in customer's case.

Shielded-Bar Taut-Band. Maximum sensitivity and freedom from hysteresis, for measuring extremely low microampere ranges.

Mag-Band Taut-Band. Self-shielded, high-torque, excellent balance, no drift.

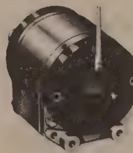
Mag-B Pivot-and-Jewel. Rugged, high-torque self-shielded movement.

250°. A fine, sturdy, self-shielded 250° pivot-and-jewel movement, very popular for process-control applications. Available in a choice of mounting arrangements.

Super-Torque™ 250°. Vehicle, heavy machinery, process applications. Thru-shaft design takes push-on pointers, withstands casual handling by untrained personnel. World's ruggedest 250° movement.

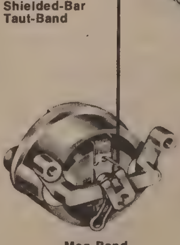
AC Iron-Vane (Repulsion). The preferred movement for making direct measurements of AC voltage and current. Better than d'Arsonval movements for AC panel meters.

Shielded-Bar Taut-Band

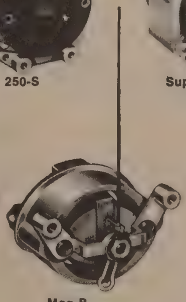


250-S

Super-Torque



Mag-Band Taut-Band



Mag-B Pivot-and-Jewel

AC Iron-Vane

Custom Meter Design

Beede specializes in custom-designed meters to meet exacting customer requirements. And, to top off our in-depth knowledge of our customers' businesses, *we deliver as promised.*

BEEDE

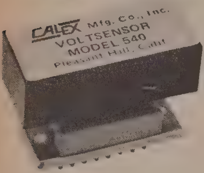
BEEDE ELECTRICAL INSTRUMENT CO., INC
Penacook, N. H. 03301
Phone (603) 753-6362: TWX 710-364-6977.

5908

CALEX

modules for instrumentation in industry

VOLTSENSORS — INSTRUMENTATION AMPS

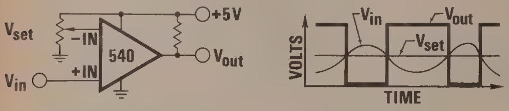

CALEX Mfg. Co., Inc.
VOLTSENSOR
MODEL 540
Pleasant Hill, Calif

model 540
new!

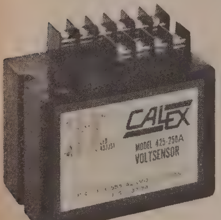
Need to compare dc voltages? The Calex Model 540 VOLTSENSOR is your answer!

- Convenient DIP compatible package . . . can be plugged into any 16 pin DIP socket.
- Wide supply range . . . operate from
  - Single Supply of +5V to +32V or
  - Dual Supply of ±5V to ±16V
- Protected against accidental damage . . .
  - Input Protected to ±100V
  - Output Protected
- Good power-handling capability . . .
  - Output can sink up to 100mA
  - Output load can go to any voltage up to +32V
- Versatile Operation . . .
  - Hysteresis can be externally varied over wide range
  - Module can be connected for latching operation
  - Inputs can be reversed to change logic
  - Output can be connected to sink or source the load current
- Low Cost
  - $19 in 1-9 Quantity

Mounting kits with relays and adjustment pots are also available.

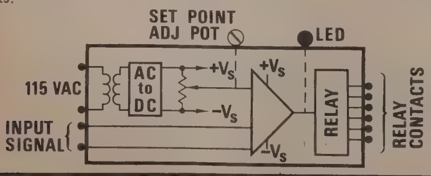

V_{set}
−IN
+IN
540
V_{in}
+5V
V_{out}
VOLTS
V_{in}
V_{out}
V_{set}
TIME

OPERATING THE MODEL 540 FROM SINGLE SUPPLY


CALEX
MODEL 425-250A
VOLTSENSOR

complete voltsensor systems

For process control systems and manufacturing test equipment, here's a complete VOLTSENSOR system in a single package—no external components needed, just connect to 115VAC for power. These modules contain a DC power supply, reference voltage, adjustable set-point, and the output is a DPDT relay. An LED indicator shows output status. The relay changes state as the DC input voltage varies around the set point. Because the unit has its own built-in power supply and the output is a set of relay contacts, you can apply floating inputs with voltages of up to 1500V above the AC line neutral. This isolation makes it feasible to connect ungrounded thermocouples directly to the amplifier inputs.


SET POINT ADJ POT
LED
115 VAC
AC to DC
$+V_S$
$+V_S$
$-V_S$
$-V_S$
INPUT SIGNAL
RELAY
RELAY CONTACTS

model 178
new!

CALEX
INSTRUMENTATION AMPLIFIER
MODEL 178

Order it as a low-cost module, or buy the complete amplifier card for outstanding operating convenience! The PC card has provision for adjusting gain, offset, and CMR.

Just look at these features . . .

- Adjustable gain range of greater than 1 to 1000.
- Drift of less than ±2μV/°C
- Max offset at output of ±1mV over full gain range
- CMR greater than 100dB
- Input offset current less than ±6nA

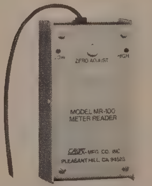
Range of input and output voltage is ±10V and the supply required is ±15V. Prices in unit quantity are . . .

Model 178	Module alone	$59
Model 178/MK278	Module mounted on MK278	$85

function modules

CALEX
MULTIPLIER
MODEL 602K
CALEX MFG. CO. INC
PLEASANT HILL, CALIF

- Analog Multipliers—Model 602
  - Accuracies of ±0.4% to ±0.1%
  - Module on PC card
  - Multiply, Divide, or Square Root
- Active Filters, 4 Pole
  - Low Pass
  - Notch
- Constant-Current Sources—Model 930
  - 1-50mA Range
  - Wide Compliance
- Linesensor—Model 829
  - Monitors 115VAC line and indicates if line voltage is below LO set point or above HI set point.
  - Completely self-contained potted module.


ZERO ADJUST
HIGH
MODEL MR-100
METER READER
CALEX MFG. CO. INC
PLEASANT HILL CA 94523

meter reader

Instrument senses pointer position of any analog meter. Can be used for adding alarm or control functions to existing installations. Photoelectric sensing head is rugged and reliable . . . control box contains all of the necessary electronics. Output is a set of SPDT relay contacts. Comes complete with mounting hardware. Price of the Model MR-100 is $125 each in single quantity.

For further information, send for our 1975 catalog.
CALEX MFG. CO., INC.
3305 Vincent Road, Pleasant Hill, CA 94523, Tel. (415) 932-3911

DIGITAL PANEL INSTRUMENTS

DIGITAL PANEL COUNTER — MODEL DPC-8100

Accepts and displays count rates up to 10 MHz. Gating is by either front panel pushbutton, external logic input or optional crystal timebase.

Front Panel: Six LED decimal digits. Stop, start, reset pushbutton, overrange, gate on, display latched and power fail LED indicators.

Price, including connectors:

All AC models (with non-latched BCD, no low level, no time base)	$299.00
Add for: latchable, gatable BCD	70.00
timebase	65.00
low level input	30.00

DIGITAL STOP CLOCK — MODEL DSC-8200

General purpose count-up timer with six digit LED display. Timebase is either AC line or internal crystal oscillator. Crystal accuracy (initial, at 0° to +50°C, and after one-year aging) — ±10 ppm for each variable.

Front panel controls and indicators: Start, stop and reset pushbuttons. Overrange and power fail LED indicators.

Price, including connectors:

AC models with non-latched BCD	$299.00
+5VDC models with non-latched BCD	269.00
AC models with latchable BCD	369.00
+5VDC models with latchable BCD	339.00

DIGITAL TIME CLOCK — MODEL DTC-8300

Time-of-day with six LED displays in 12 or 24 hour models. May use internal crystal or 50/60 Hz AC line timebase. Crystal accuracy same as Model DSC-8200.

Front panel controls: Set/run pushbutton, Hours set pushbutton, Minute set pushbutton, Push-to-advance digits.

Prices, including connectors:

AC models with non-latched BCD	$299.00
+5VDC models with non-latched BCD	269.00
AC models with latchable BCD	369.00
+5VDC models with latchable BCD	339.00

DIGITAL SET-POINT COMPARATORS — MODELS DDC-8400 AND DLC-8400

Full parallel BCD comparators with (2) six-digit and sign thumbwheel set-point selectors on front panel. Relampable 50,000 hour incandescent indicators lite in various limit modes. Optional relays are available on 2nd internal P.C. board.

Model DDC-8400 — Two separate single-limit comparators in one case. Each has three lights to indicate UNDER/AT LIMIT/OVER status of that input as compared to set-point limits selected. Logic outputs for each light.

Model DLC-8400 — Single BCD input with upper and lower selectable set-point limits. Unit is three-zone (5 lamp) comparator indicating UNDER/BETWEEN LIMITS/OVER or equal to either the HI or LO LIMIT set-point. Logic outputs for each light.

Optional Power Relays: (Control externally patched from lower P.C. board logic outputs.)

Four mechanical contact relays, each with SPDT (Form C) contacts rated at 230VAC, 2 Amps max. resistive.

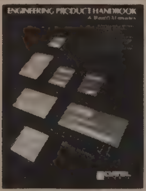
Two opto-isolated solid state relays with zero angle firing, rated at either 115 or 230VAC (specify) at 2 Amps max. resistive or inductive (to handle lamp load surges). Each relay is normally off (Form A) but can be biased to normally on (Form B).

Prices, including connectors:

For Model DDC-8400 or DLC-8400 AC power models, less relays	$399.00
+5VDC power models, less relays	335.00
Add for: Mechanical Contact Relays (4)	75.00
Or: Solid State Relays (2) (Specify 115 or 230VAC)	120.00

SPECIFICATIONS COMMON TO ALL 8000 SERIES

1. **Construction:** Black anodized extruded aluminum case and front bezel.
2. **Case Size:** 5.562" W. x 2.125" H. x 5.467" D. (54 x 141 x 139 mm) (to rear connector).
3. **Mounting Method:** Panel mounting by U-strap through a cutout 2.825" x 5.562" (55.5 mm x 143 mm) with four screwholes.
4. **Power Supply:** Choice of 100, 115, or 230 VAC ±10%, 50 and 60 Hz or +5VDC ±5% (DC) at 2 Amps max. (Logic Noise 50mV max.) AC on spade terminals.
5. **Displays:** (All models except Comparator) Decimal digits are 0.6" High red LED 7-segment type.
6. **Input/Output Connections (excluding AC power connections):** One or two sets of dual 36 pin P.C. board connectors.
7. **Operating Temperature Range:** 0° to +50°C.
8. Full Parallel BCD TTL outputs at rear connector.



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TEL. (617) 828-8000 / TWX: 710-348-0135 / TELEX: 924461

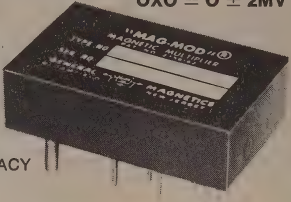
Magnetic Analog Multipliers...

Type # MCM 1351-2

DC X AC = AC Output

Product Accuracy ±½% Of All Theoretical Values Over The Full Military Temperature Range of —55°C To +125°C

OXO = O ± 2MV



OVER TEMPERATURE RANGE OF —55°C TO +125°C NO EXTERNAL TRIM POTENTIOMETERS REQUIRED TO OBTAIN SPECIFIED ACCURACY

FEATURES

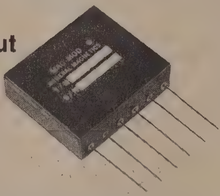
- Product accuracy is specified in % of reading for all output analog voltage product points over the full military temperature range instead of % of full scale error giving superior results for small values.
- Distortion free output AC wave over entire dynamic range regardless of temperature
- Linearity, product accuracy, and zero point virtually unaffected by temperature changes
- Magnetic circuit not sensitive to nuclear radiation
- Analog product accuracy, wave quality and phase stability allow dual multiplier assemblies to be matched in amplitude within 1% of point of each other and 0.1° phase error over the temperature range
- Package size, power supply voltages and electrical specifications may be altered at no extra cost.

SPECIFICATIONS

Transfer equation: E = XY/3
X & Y input signal ranges: 0 to ± 3V Peak
Maximum static and dynamic product error: ½% of point or 2 MVRMS, whichever is greater, over entire temperature range
Maximum zero point (X = 0, Y = 0): 2 MVRMS over entire temperature range
Input impedance: X = 10K; Y = 10K
Full scale output: 3 VRMS
Output impedance: Less than 50 ohms
X input band width: flat, DC to 200 hertz
Y input band width: flat, 20 hertz to 1000 hertz
Operating temperature range: —55°C to +125°C
Storage temperature range: —70°C to +125°C
Zero point drift over temperature range: ± 1MVRMS maximum
DC power: ± 15V unless otherwise required @ 20 ma
Overall dimensions: 1.8" x 1.1" x 0.5"
Weight: Approximately 1 oz.
Case material: High permeability Nickel Alloy
Terminals: Glass to metal hermetic seal pins

Type # MCM 1385-1

DC X AC = AC Output



Product Accuracy 1% Of All Readings Over The Entire Temperature Range.

Low Cost Multiplier

SPECIFICATIONS OVER TEMPERATURE RANGE —55°C to +125°C

Transfer equation: E = XY/10
X & Y input signal ranges: 0 to 10V Peak
Maximum static and dynamic product error: 1% of point or 2MVRMS, whichever is greater.
Maximum zero point (X = 0, Y = 0): 2 MVRMS over entire temperature range.
Input impedance: X = 10K; Y = 10K
Full scale output: 7VRMS
Minimum load resistance for full scale output: 2000 ohms
Output impedance: Less than 50 ohms
X input band width: flat, DC to 10,000 hertz
Y input band width: flat, 20 hertz to 50,000 hertz
Roll off rate: 6db per octave
Operating temperature range: —55°C to +125°C
Storage temperature range: —70°C to +125°C
Zero point drift over temperature range: ±2MVRMS maximum.
DC power: ±15V unless otherwise required at 10ma
Overall dimensions: 1.25" x 1.10" x .35"
Weight: 0.4 oz.
Case material: High permeability Nickel Alloy
Terminals: Glass to metal hermetic seal pins

NOTE: This is not a Hall effect device

Type # MCM 1478-1

New-Precision — ½% of All Output Points (DC to 1000Hz.)

Product Accuracy ±½% Of All Theoretical Output Values Over The Full Military Temperature Range Of —55°C to +125°C

Maximum Output Error for Either
X = O, Y = 10V
Y = O, X = 10V
X = O, Y = O
would be ±2 MV over Entire Temperature Range.

SPECIFICATIONS

Transfer equation: E = XY/10
X & Y input signal ranges: 0 to ±10V Peak
Maximum static and dynamic product error: ½% of point or 2 MVRMS, whichever is greater over temperature range
Maximum zero point (X = 0, Y = 0): 2 MVRMS over entire temperature range
Input impedance: X = 10K; Y = 10K
Full scale output: 10V Peak
Minimum load resistance for full scale output: 2000 ohms
Output impedance: Less than 50 ohms
X input band width: flat, DC to 200 hertz
Y input band width: flat, DC to 1000 hertz
Roll off rate: 6db per octave
Operating temperature range: —55°C to +125°C
Storage temperature range: —70°C to +125°C
Zero point drift over temperature range: ±2 MVRMS maximum
DC power: ±15V unless otherwise required @ 20 ma
Overall dimensions: 1.8" x 1.3" x 0.5"
Weight: approximately 1 oz.
Case material: High permeability Nickel Alloy
Terminals: Glass to metal hermetic seal pins

There is No Substitute for Reliability

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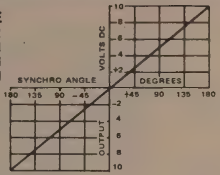
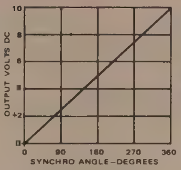
GENERAL MAGNETICS • INC
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

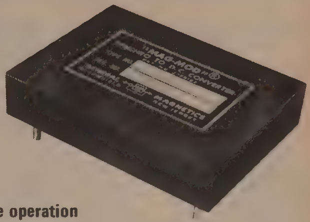
Solid State 3 Wire Synchro To Linear DC Converters...

RESPONSE CURVE
MAC 1422-1
MAC 1449-1
MAC 1458-1
MAC 1459-1



RESPONSE CURVE
MAC 1460-1
MAC 1461-1





FEATURES:

- Develops a DC output voltage linearly proportional to a synchro angle over a ± 180° range.
- Completely solid state with all of the inherent advantages over a mechanical system such as:
  - High reliability (since there are no moving parts)
  - Light weight—6 ozs.
  - Small size
  - All units hermetically sealed
- Wide temperature range operation
- Output short circuit protected
- Three wire inputs isolated from ground
- Package size may be altered at no extra cost
- Units can be altered to accept different line to line voltages or different operating frequencies at no extra cost
- Not affected by reference voltage or power supply variations.

UNIT	MAC 1422-1	MAC 1449-1	MAC 1458-1	MAC 1459-1	MAC 1460-1	MAC 1461-1
TRANSFER EQUATION	±IV/18°	±IV/18°	±IV/18°	±IV/18°	+IV/36°	+IV/36°
ACCURACY (+25°C)	½%	½%	½%	½%	½%	½%
ACCURACY (−25°C-+85°C)	1%	1%	1%	1%	1%	1%
L - L SYNCHRO INPUT (VRMS)	11.8	90	11.8	90	11.8	90
FREQUENCY (Hz)	400	400	60	60	400	400
FULL SCALE OUTPUT	±10V	±10V	±10V	±10V	+10V	+10V
OUTPUT IMPEDANCE	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω
L - L INPUT IMPEDANCE	>10K	>30K	>2K	>10K	>10K	>30K
REFERENCE VOLTAGE (VRMS)	26	115	26	115	26	115
OPERATING TEMP. °C	−25 - +85	−25 - +85	−25 - +85	−25 - +85	−25 - +85	−25 - +85
D.C. SUPPLY	±15V	±15V	±15V	±15V	±15V	±15V
D.C. SUPPLY CURRENT	±75MA	±75MA	±75MA	±75MA	±75MA	±75MA
BANDWIDTH	10Hz	10Hz	OPT.	OPT.	10Hz	10Hz
WEIGHT	6 oz.	6 oz.	6 oz.	8 oz.	6 oz.	6 oz.
SIZE	3.6x2.5x0.6	3.6x2.5x0.6	3.6x3.0x0.6	3.6x3.0x1.0	3.6x2.5x0.6	3.6x2.5x0.6

Precision AC Line Regulators...

Type # MLR-1476-1/TOTAL REGULATION 0.1% MAXIMUM

FEATURES

- Distortion free output sine wave.
- Regulation control better than one order of magnitude superior to commercial AC Voltage Regulators transformer product lines.
- No active filter or tuned resonant circuits employed.
- Regulation virtually indifferent of frequency, line amplitude, temperature or load changes.
- 1 watt output level.
- Extremely small size.
- Isolation between input and output.

SPECIFICATIONS

AC input line voltage: 26vrms ±20% at 400 Hz. ±20%.
Output: 26vrms ±1% for set point range.
Load: 0 to 40 ma.
Total regulation: ±0.1% maximum (any combination line aplitude, frequency, load).
Distortion: Less than 0.5%
Temperature Range: −55°C to +125°C
Size: 2″ x 1.8″ x 0.5″
Output Phase Angle = 0° ±0.1° over entire temperature range and ±20% frequency variations.
Weight: 1 Oz.
Case material: High permeability Nickel Alloy
Terminals: Glass to metal hermetic seal pins

Type # MLR-1476-2

FEATURES

- 0.1% total line and load regulation
- Independent of ±20% frequency fluctuation
- 6.5 watt output
- Small size
- Input and output completely isolated
- Short circuit protected

SPECIFICATIONS

- AC line voltage: 115V ±20% @ 400Hz ±20%
- Line current at full load: 95ma
- Output: 26V ±1% for set point
- Load: 0 to 250 ma
- Total regulation for line, load and frequency changes: ±0.1%
- Distortion: 2%
- Temperature Range: −55°C to +85°C
- Size: 2″ x 4.5″ x 0.9″

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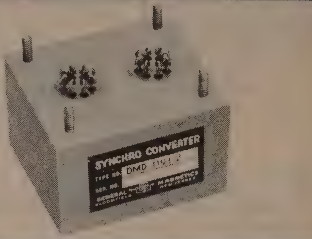
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

Solid State Sine-Cosine Synchro Converters...

This new encapsulated circuit converts a 3-wire synchro input to a pair of d-c outputs proportional to the sine and cosine of the synchro angle.

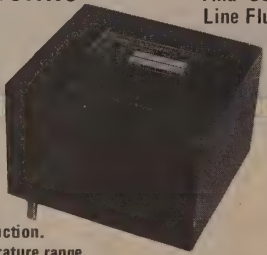
- Complete solid state construction.
- Operates over a wide temperature range.



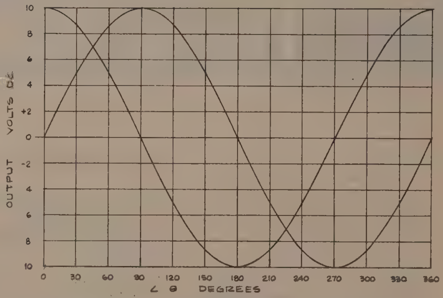
UNIT	DMD 1436-1	DMD 1430-1	DMD 1403-2	DMD 1361-6	DMD 1361-4	DMD 1193-4	DMD 1361-8	DMD 1446-1	DMD 1193-5	DMD 1193-6	DMD 1361-10	DMD 1472-2
L - L SYNCHRO INPUT (VRMS)	11.8	90	95	90	11.8	11.8	11.8	11.8	11.8	11.8	11.8	90
FREQUENCY (Hz)	400	400	60	400	400	400	400	400	400	400	400	60
FULL SCALE OUTPUT (VDC)	±10	±10	±3	±3	±3	±10	±10	±10	±10	±10	±10	±10
OUTPUT IMPEDANCE	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω	<10Ω	<1Ω	<1Ω	<1Ω	<1Ω
L - L INPUT IMPEDANCE	>10K	>30K	>5K	>30K	>5K	>5K	>5K	>5K	>5K	>5K	>5K	>5K
REFERENCE VOLTAGE (VRMS)	26	115	115	115	26	115	26	115	115	115	26	115
ACCURACY SIN/COS (+25°C)	±6MIN	±6MIN	±6MIN	±6MIN	±6MIN	±6MIN	±6MIN	±0.5%	±6MIN	±6MIN	±6MIN	±6MIN
FULL TEMPERATURE RANGE ACCURACY SIN COS	±15MIN	±15MIN	±15MIN	±15MIN	±15MIN	±15MIN	±15MIN	±0.5%	±15MIN	±15MIN	±15MIN	±15MIN
D.C. SUPPLY (VDC)	±15	±15	±15	±15	±15	±15	±15	±15	±15	±15	±15	±15
D.C. SUPPLY CURRENT	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA	<30MA
BANDWIDTH	>10Hz	>10Hz	external set	>20Hz	>5Hz	>10Hz	>10Hz	>10Hz	>2Hz	>40Hz	>5Hz	external set
SIZE	1.1x3.0 x1.1	2.0x2.25 x1.4	1.1x3.0 x1.1	1.5x1.5 x0.6	1.85x0.85 x0.5	2.01x2.25 x1.4	0.85x1.85 x0.5	2x2.25 x1.4	2x2.25 x1.4	2x2.25 x1.4	2.15x1.25 x0.5	1.1x3.0 x1.1
NOTES	—	dual channel unit	—	—	—	dual channel unit	—	dual sine output	dual channel unit	dual channel unit	—	—
TEMPERATURE RANGE	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C

NON VARIANT SOLID-STATE SINE-COSINE SYNCHRO CONVERTER -

Type # DMD 1508-2



This New Encapsulated Circuit Converts A 3 Wire Synchro Input To A Pair Of DC Outputs Proportional To The Sine And Cosine Of The Synchro Angle Independent Of A-C Line Fluctuations



FEATURES:

- Complete solid state construction.
- Operates over a wide temperature range.
- Independent of reference line fluctuations
- Conversion accuracy—6 minutes.
- Reference and synchro inputs isolated from ground

SPECIFICATIONS

- Accuracy: Overall sin/cos conversion accuracy of 6 minutes. Absolute value of sine and cosine outputs accurate to 30 mv.
- Temperature Range: Operating −40°C to +85°C, Storage −55°C to +125°C
- Temperature Coefficient of Accuracy: ±10 seconds/°C on conversion accuracy, ±1 MV °/C on absolute output voltages.
- Synchro Input (Isolated from Ground) 90 V line to line ±5% @ 400 HZ ±5%.
- Synchro Input Impedance: 50 K minimum line to line
- Reference Input (Isolated from Ground): 115 V RMS ±5% @ 400 HZ ±5%
- Reference Impedance: 50 K minimum.
- Output Variation with Reference Changes: ±10 MV maximum for ±5% reference fluctuations.
- DC Power: ±15 VDC ±1% @ 60 MA
- Output: ±10 VDC full scale output on either channel @ 5 MA load (short circuit protected).
- Tracking Speed: Output within specified accuracy when the tracking speed is 20 RPM

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GENERAL MAGNETICS • INC
135 Bloomfield Ave., Bloomfield, New Jersey 07003 · Tel. (201) 743-2700

Solid State Magnetic Demodulators...

FEATURES

- High reference impedance resulting in very small reference power requirements
- Output as high as ±10 v. DC in present units
- Unit operation frequencies: 60 Hz to 100 KHz
- Very low DC offset null voltages (as low as 0.1% of full scale)
- Operation over wide environmental conditions
- Completely solid state—no moving parts
- Signal and reference terminals may be isolated
- Low output impedance
- Small physical size

Demodulator Type Number	DMD-903-1	DMD-931-1	DMD-1012-1	DMD-1013-1	DMD-1017-1	DMD-1023-1	DMD-1025-1	DMD-1040-1	DMD-1028-1
REFERENCE A. Voltage	120 V ±10 V	26 V	115 V	115 V	115 V	30 V-P-P	30 V	115 V	15 V
B. Frequency	60 Hertz	400 Hertz	60	400 Hertz	400 Hertz	55 Hertz	900 Hertz	400 Hertz	50 to 60 Hertz
C. Impedance	15 K	30 K	> 50 K	> 50 K	> 5 K	≈ 2.7 K	≈ 31 K	> 100 K	≈ 5.1 K
SIGNAL A. Voltage Range	0-760 mv	0-12 V	0-1 V	0-10 V	0-10 V	0-5 V	0-0.05 V	0-3.2 V	0-10 V
B. Frequency	60 Hertz	400 Hertz	60 Hertz	400 Hertz	400 Hertz	55 Hertz	900 Hertz	400 Hertz	50 to 60 Hertz
C. Impedance	10 K	> 10 K	10 K ±10%	10 K ±10%	> 10 K	> 10 K	> 3 K	> 3 K	≈ 3 K
OUTPUT A. Maximum Output	±1 V ±5%	±3.6 V ±10%	±0.5 V ±5%	±5 V ±5%	±3 V ±5%	±4 V ±5%	±0.5 V ±10%	±5 V ±5%	±10 V ±5%
B. Load	—	10 K	25 K	5 K	2 K	10 K	1 M	50 K	10 K
C. Linearity	±0.8% fs	±2% A	±1% fs	±1% fs	±1% fs	±1% fs	±1% fs	±1% fs	±1% fs
D. Frequency Response	—	20 cps	—	—	40 Hertz	0.5 Hertz	10 Hertz	—	—
E. Ripple	8.4 mv	< 100 mv	No Filter	No Filter	< 150 mv	< 200 mv	< 10 mv	No Filter	< 400 mv
F. Null	1 mv	< 15 mv	< 10 mv	< 10 mv	< 10 mv	< 10 mv	< 1 mv	< 10 mv	< 15 mv
AMBIENT TEMP. RANGE	—40°F to +120°F	—15°C to +60°C	—30°C to +85°C	—30°C to +85°C	—30°C to +71°C	0°C to +50°C	0°C to +50°C	—30°C to +85°C	—10°C to +55°C
PHYSICAL SIZE	3 x 2⅝ x 4 7/16	2 x 2 x 0.7	1 x 1 x 2.5	1 x 1 x 2.5	1 x 1 x 2.5	0.95 x 1 x 2.5	1 x 1.7 x 0.75	1 x 1 x 2.5	1.9 x 1.25 x 2.9
TERMINAL TYPE	HP PIN	PIN	PIN	PIN	PIN	PIN	HP PIN	PIN	HP
D.C. POWER	No	No	±15 V	±15 V	28 V	±15 V	±15 V	No	±15 V

Demodulator Type Number	DMD-1034-1	DMD-1053-3	DMD-1074-1	DMD-1095-1	DMD-1104-1	DMD 1206-1	DMD 1207-1	DMD 1268-1	DMD 1377-1	DMD 1420-1
REFERENCE A. Voltage	26 V	115 V	115 V ±5%	26 V ±5%	26 V	26 V	26 V	26 V	10 V RMS ±10%	7 V RMS
B. Frequency	400 Hertz	400 Hertz	400 Hertz ±5%	400 Hertz ±5%	800 Hertz	400 Hertz	2 K Hertz	400 Hertz	60 Hertz to 2 K Hertz	100 Hertz
C. Impedance	> 8 K	> 100 K	> 100 K	> 10 K Ω	35 K	> 50 K	> 50 K	> 5 K	> 25 K	> 4 K
SIGNAL A. Voltage Range	0-5 V	0-10 V	0-50 V	0-±6.36 V	0-1 V	0-1 V	0-1 V	0-10 V	0-5 V RMS	0-7 V RMS
B. Frequency	400 Hertz	400 Hertz	400 Hertz	400 Hertz	800 Hertz	400 Hertz	2 K Hertz	400 Hertz	60 Hertz to 2 K Hertz	100 Hertz
C. Impedance	> 10 K	> 100 K	> 1 MEG	> 20 K Ω	> 50 K	> 15 K	> 15 K	> 10 K	> 50 K	> 20 K
OUTPUT A. Maximum Output	±5 V ±5%	±2.5 V ±10%	±50 V ±5%	±5.73 V ±5%	±2.0 V ±5%	1.0 V	1.0 V	±3 V ±5%	2.5 V ±5%	3 V ±5%
B. Load	10 K	10 K	100 K	10 K Ω	10 K Ω	30 K	30 K	2 K	1 Meg	1 Meg
C. Linearity	±1% fs	±1% fs	±1% fs	±1% fs	±1% fs	0.5% fs	0.5% fs	±1% fs	0.2%	0.2%
D. Frequency Response	≈ 100 Hertz	30 Hertz	80 Hertz	—	N.S.	30 Hertz	30 Hertz	40 Hertz	—	—
E. Ripple	< 450 mv	< 125 mv	< 50 mv	No Filter	< 50 mv	< 30 mv	< 10 mv	< 150 mv	No Filter	No Filter
F. Null	< 15 mv	<4 mv	< 100 mv	< 15 mv	< 10 mv	1 mv	1 mv	< 5 mv	< 2 mv	< 3 mv
AMBIENT TEMP. RANGE	0°C to +85°C	—20°C to +50°C	0°C to +65°C	—54°C to +55°C	1200 M	—55°C to +125°C	—55°C to +125°C	—30°C to +71°C	0°C to +70°C	—25°C to +40°C
PHYSICAL SIZE	0.6 x 0.9 x 1.8	1 x 1 x 2.5	2.6 x 1.95 x 2	1.200 x 1.250 x 0.500	1.350 x .600 x .650	0.95 x 1.65 x 0.1	0.95 x 1.3 x 0.1	1 x 1 x 2.5	0.9 x 1.65 x 0.6	1.25 x 1.125 x 0.8
TERMINAL TYPE	PIN	PIN	HP	PIN	PIN	PIN	PIN	PIN	PIN	PIN
D.C. POWER	±15 V	+24-32 V	±15 V ±60 V	±15 V	±15 V	±15 V	± 15 V	+28 V	±15 V DC	±15 V DC

There is No Substitute for Reliability

GM INC.

GENERAL MAGNETICS • INC

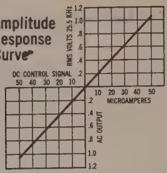
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

'Mag Mod' Micro-miniature Magnetic Modulators...

...Design Analog Computers with Micro Magnetics

Withstands High Intensity Nuclear Radiation

Amplitude Response Curve



Typical Performance Data — Model 748-3

Output distortion as low as 1%

Electrical zero point and gain, repeatability and stability over the entire service life

Extremely broad bandwidth

Carrier frequencies as high as 5 MHz

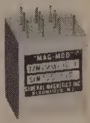
Input signal current resolution better than 0.001 μa

Low milliwatt power consumption

Circuit Isolation—DC to AC Sinusoidal Conversion and Amplification

"MAG MODS" PROVIDE FOUR QUADRANT OPERATION, extreme stability with negligible change of phase, gain and zero position over a wide temperature range. Design is simple, featherweight and rugged—with no vacuum tubes, semiconductors or moving parts to limit life.

MICRO MAGNETIC MODULATORS FEATURE an essentially drift-free circuit with superior phase and gain stability over wide environmental ranges. All the ruggedness, dependability, wide dynamic range and stability that are characteristic of the larger magnetic modulators are engineered into this new magnetic circuit. MICRO "MAG MODS" are shock and vibration proof, provide infinite standby and service life. The micro modulators below are typical; for specifications on other models request literature.



TYPE NUMBER	IMM 987-1	IMM 821-1	IMM 847-1	IMM 1112-1
Reference Carrier Voltage and Frequency	115 V 400 Hz	3 V RMS @ 96 KHz	5 V @ 800 Hz	3.5 V RMS @ 1 MHz
Input Control Signal Range	0 to ±150 μa DC	0 to ±100 μa (DC to 1000 Hz)	0 to ±200 μa DC	0 to ±3 ma DC (DC to 200 KHz)
DC Resistance of Input DC Signal Winding	3 Inputs — 4.5 K each	150 ohms	12.5 K ohms	1000 ohms
AM Phase Reversing AC Output Range	0 to 5 V RMS @ 400 Hz	0 to 0.6 V RMS @ 96 KHz	0 to 1 V RMS @ 800 Hz	0 to 3 V RMS @ 1 MHz
Differential Gain RMS mv. AC Output/ua DC Sig. Input	33 mv RMS/μa DC	6 mv RMS/μa	5 mv RMS/μa DC	1 V RMS/ma DC
AC Output Null (Noise Level) RMS	25 mv RMS	20 mv RMS Max.	5 mv RMS	30 mv RMS
Output Impedance	1.2 K ohms	7.5 K ohms	10 K ohms	3 K ohms
External Load	25 K ohms	100 K ohms	50 K ohms	50 K ohms
Excitation (Carrier Winding) Impedance	200 K ohms	115 ohms	12 K ohms	800 ohms
Zero Point Drift over Temp. Range Referred to DC Input Terminals	±0.2 μa DC	±0.2%	±0.5 μa DC	±0.5%
Hysteresis in Percent of Max. Input DC Signal	±0.2%	±0.2%	±0.4%	±0.5%
% Harmonic Distortion in Output Wave	10%	5%	10%	3%
Temperature Range	—55°C to +80°C	0°C to +100°C	—55°C to +100°C	—55°C to +85°C
Frequency Response	DC to 100 Hz	DC to 1000 Hz	DC to 200 Hz	DC to 200 KHz
Overall Dimensions (in inches)	.550 X .750 X .550	0.562 X 0.40 X .750	1 3/16 X 1 3/16 X 1/2	0.4 X 0.5 X 0.6
Type of Mounting	2-56 Studs	Printed Circuit Board	Printed Circuit Board	Printed Circuit Board 1/10" Grid
Approximate Weight (in ounces)	0.3 ounce	0.12 ounce	0.2 ounce	0.1 ounce

"MAG MODS" conform to MIL-T-27A and MIL-E-5400 Specifications

Prime Components in Solid State Design—The "MAG MOD" family of Magnetic Modulators has proven to be the most reliable module circuit block in aircraft and space vehicle flight control systems developed to date. They are universally accepted and in use in many military and commercial products where reliability is a price factor. Request literature.

There is No Substitute for Reliability

GM INC

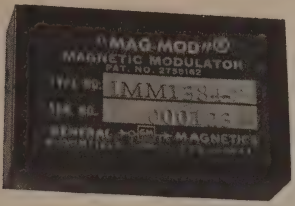
GENERAL MAGNETICS · INC

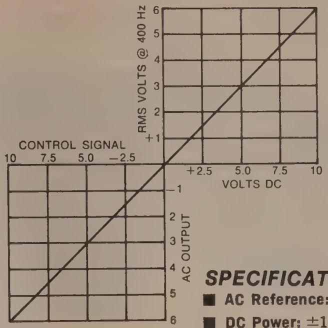
135 Bloomfield Ave., Bloomfield, New Jersey 07003 . Tel. (201) 743-2700

Precision Magnetic Modulator...

Phase, Gain, Zero Point, Null Insensitive to Variations in AC Line, DC Power, Line Frequency, Ambient Temperature

TYPE IMM 1384-2





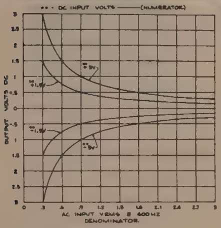
FEATURES:

- Four Quadrant Operation — over 80DB dynamic range per quadrant
- Distortion free output AC wave over entire dynamic range regardless of temperature
- Linearity, and zero point virtually unaffected by temperature changes
- Magnetic circuit not sensitive to nuclear radiation
- All units are hermetically sealed and completely shielded from external electric or magnetic fields
- Gain, linearity, wave quality, and phase stability allow dual modulator assemblies to be matched in amplitude within 1% of point of each other and 0.1° phase error over the temperature range
- Dynamic specifications unaffected by years of continuous operation and storage
- Package size, power supply voltages and electrical specifications may be altered at no extra cost
- Output gain response curve completely independent of AC line variation

SPECIFICATIONS:

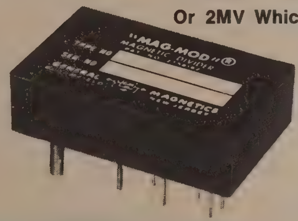
- **AC Reference:** 26 VRMS 400 Hz
- **DC Power:** ±15V at 10 ma
- **Linearity:** 0.1% f.s. or 1 MVRMS whichever is greater
- **Null:** 5 MVRMS maximum
- **Output Range:** 0 to 6 VRMS
- **Load:** 2K ohms minimum
- **Wave Quality:** 0.5% maximum distortion
- **Output Phase Angle:** Zero ° ±0.1° (380-420 Hz)
- **Overall Dimensions:** 1.5 x 1.1 x 0.5 inches
- **Output Isolated**
- **Temperature Range:** —55°C to +100°C
- **Weight:** 1.25 Oz.
- **Case Material:** High permeability nickel alloy
- **Terminals:** Glass to metal hermetic seal pins

Magnetic Analog Divider...



Type # MDM 1355-4 DC ÷ AC = DC Output

Division Accuracy ±1% Of All Theoretical Values Of Quotient Or 2MV Whichever Is Greater, Over A 100:1 Denominator Range



FEATURES

- Linearity, division accuracy and zero point virtually unaffected by temperature changes
- Magnetic circuit not sensitive to nuclear radiation
- Package size, power supply voltages and specifications may be altered at no extra cost
- Accuracy specified in terms of absolute (theoretical point) not full scale
- Wide denominator ranges can be accommodated
- No external trim potentiometers required to obtain specified accuracy.

SPECIFICATIONS

Transfer equation: $E_o = \frac{0.3X}{Y}$

Division accuracy: 1% of all theoretical quotient points or ± 2MV whichever is greater over the temperature range

Input impedance: X = 90K; Y = 50K

Full scale output: 3V DC

X & Y input ranges: X = 0 to ± 3V DC
Y = 0.3V RMS to 3.0V RMS
400 Hz ± 10%

Output impedance: Less than 10 ohms

Bandwidth: 10 Hz at Y = 0.3V RMS

Operating temperature range: —55°C to +125°C

Storage temperature range: —70°C to +125°C

DC power: ± 15V @ 30 ma

AC reference: 6V RMS 400 Hz ± 10%

Overall dimensions: 2.2" x 1.3" x 0.5"

Weight: Approximately 1 oz.

Case material: High permeability Nickel Alloy

Terminals: Glass to metal hermetic seal pins

There is No Substitute for Reliability

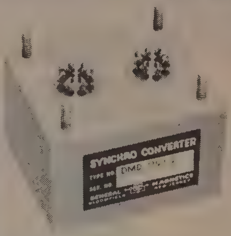
GM INC.

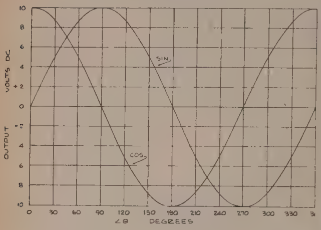
GENERAL MAGNETICS • INC
135 Bloomfield Ave., Bloomfield, New Jersey 07003 . Tel. (201) 743-2700

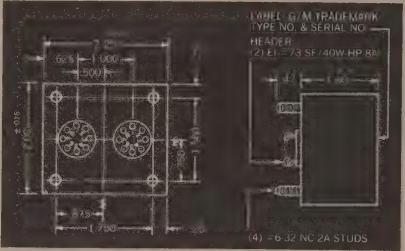
Solid State Sine-Cosine Synchro Converter...

This new encapsulated circuit converts a 3-wire synchro input to a pair of d-c outputs proportional to the sine and cosine of the synchro angle.

- Complete solid state construction.
- Occupies a volume of only 3.2 cu. in. (Single Channel)
- Operates over a wide temperature range.







Typical Specifications
Type DMD 1193-4
Dual Channel Synchro Converter

ACCURACY – Overall conversion accuracy 6 minutes.
AMBIENT TEMPERATURE:
RANGE – Operating –40°C to +100°C
Storage –62°C to –125°C
APPLICATIONS – Analog computers
Flight systems
Fire control
Guided missiles

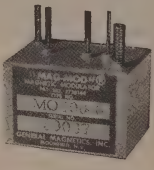
	TERMINAL	FUNCTION	
HEADER A	1	S1	SYNCHRO INPUT #1 11.8 V RMS ±10% L-L 400 Hz ±5% REFERENCE
	2	S3	
	3	S2	
	4	R2	115 V RMS ±5% @ 400 Hz ±5%
	5	R1	
	6	+15 V DC	
	7	DC GROUND	
	8	–15 V DC	
HEADER B	1	S1	SYNCHRO INPUT #2 11.8 U RMS ±10% L-L 400 Hz ±5%
	2	S3	
	3	S2	
	4	SINE	OUTPUT #1 10 V DC FULL SCALE OUTPUT
	5	COSINE	
	6	SINE	OUTPUT #2 10 V DC FULL SCALE OUTPUT
	7	DC GROUND	
	8	COSINE	OUTPUT #2 10 V DC FULL SCALE OUTPUT

DUAL CHANNEL SYNCHRO CONVERTER General Magnetics Model DMD 1193-4 provides two (2) completely independent sine-cosine synchro converter circuits in one package. Overall conversion accuracy is six (6) minutes. Temperature range is —40°C to +100°C.

This new General Magnetics circuit converts a 3 wire synchro input to a pair of d-c outputs proportional to the sine and cosine of the synchro angle. The circuit features complete solid state construction, occupies a volume of only 3.2 cubic inches and operates over a wide temperature range. Overall conversion accuracy defined by the tangent of the angle whose sine and cosine are generated is six (6) minutes. Models are available with both single and dual channel outputs.

Miniature High Stability Sinusoidal Oscillators

G/M Miniature
High Stability
Sinusoidal Oscillator
GMO Series



These high reliability GMO Series Sinusoidal Oscillators provide better than 1% frequency stability at 400 cps over a temperature range of from –55°C. to +95°C. Oscillators of the same series, for operation at any audio frequency from 400 cps up, at temperatures up to +125°C. can be designed to customer specifications. Offering extremely compact design, GMO Series Oscillators are ruggedly constructed to withstand very high shock and vibration.

FEATURES—

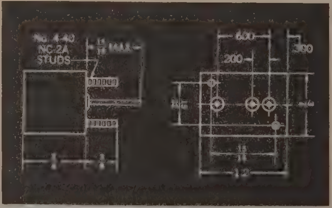
- **High frequency stability with load variation**
- **Extremely long time-period stability**
- **Excellent frequency stability over wide temperature ranges**
- **Low power requirements**
- **Excellent wave form— distortion less than 1%**
- **Can be employed with all printed circuits**
- **Light weight (less than 1 oz.)**
- **Volume less than 1 cubic inch**

SENSITIVITY – Frequency is not significantly affected to ±10% changes in D.C. supply voltage.

PROVIDING THE ULTIMATE IN SOLID STATE DESIGN—General Magnetics Miniaturized High Stability Oscillators offer extremely high shock and vibration resistance. Stability of performance and ruggedized construction make these solid state components the ideal solution for today's applications in increasingly broad operating environments.

GMO SERIES OSCILLATOR 400-6

TEMPERATURE RANGE	**–55°C. to +95°C.**
OUTPUT	**7.0 V. RMS ±5%**
FREQUENCY	**400 cps ±1%**
DISTORTION	**1% (MAX.)**
SUPPLY VOLTAGE	**±15 V.D.C.**



There is No Substitute for Reliability

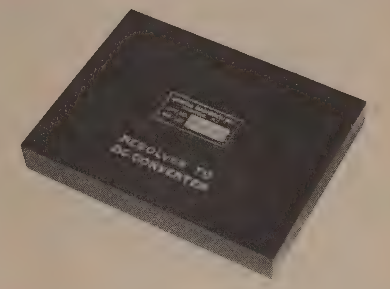
GENERAL MAGNETICS • INC
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

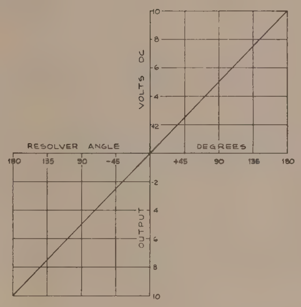
Solid State 4 Wire Resolver To Linear DC Converters...

Type # MACR 1492 (11.8V L-L) Type # MACR 1493 (90V L-L)

FEATURES

- Develops a DC output voltage linearly proportional to a resolver angle over a ± 180° range
- Completely solid state with all of the inherent advantages over a mechanical system such as:
    - High reliability
    - Light weight — 6 ozs.
    - Small size
- All units come in hermetically sealed metal cans
- Four wire inputs isolated from ground and from each other
- Wide temperature range operation (MACR 1492-1 & MACR 1493-1)
- Economical room temperature units available (MACR 1492-2 & MACR 1493-2)
- Package size may be altered at no extra cost
- Output short circuit protected
- Units can be altered to accept different line to line voltages or different operating frequencies
- Not affected by reference voltage or power supply variations





Specifications

Transfer equation: ± 1V/± 18°

Accuracy: 1492-1 } ± 0.5% @ 25°C ± 20°C
1493-1 } ± 1% @ − 25°C to + 85°C
1492-2 } ± 0.5% @ 25°C ± 20°C
1493-2 }

Input voltage: 1492 — 11.8V, 400HZ 4 wire resolver input; 26V, 400HZ reference
1493 — 90V, 400HZ 4 wire resolver input; 115V, 400HZ reference

Operating frequency: 400HZ ± 20%

Input impedance: 10K min.

Full scale output: ± 10V DC (± 180°)

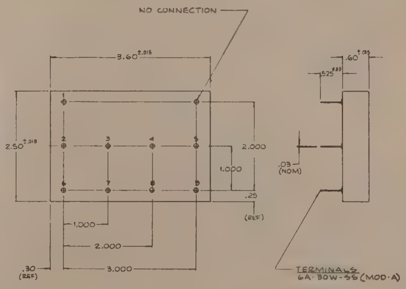
Minimum load resistance for full scale output: 2K

Output impedance: < 1 Ω

Storage temperature range: − 55°C to + 100°C

DC power: ± 15V ± 1% @ 75ma (approximate)

Case material: High permeability nickel alloy



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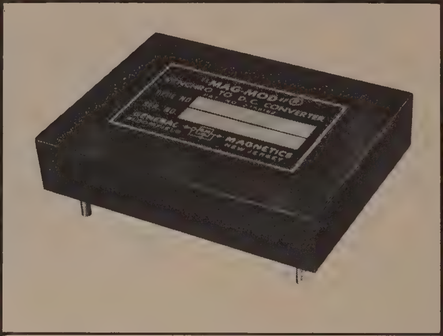
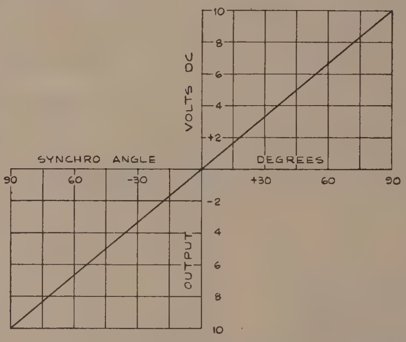
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

Solid State 3 Wire Synchro To Linear DC Converters...

COST SAVING UNITS WITH A CONVERSION RANGE OF 90° FOR APPLICATIONS THAT DO NOT REQUIRE FULL 180° OPERATION

Type # MAC 1487 (11.8V L-L) Type # MAC 1494 (90V L-L)



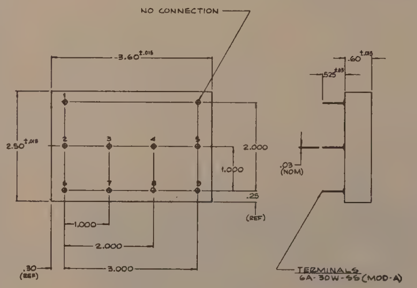


FEATURES

- Develops a DC output voltage linearly proportional to a synchro angle over a ± 90° range
- Completely solid state with all the inherent advantages over a mechanical system such as:
    - High reliability
    - Light weight
    - Small size
- All units come in hermetically sealed metal cans
- Three wire inputs isolated from ground
- Wide temperature range operation (MAC 1487-3; MAC 1494-1)
- Even more cost savings on room temperature units (MAC 1487-4; MAC 1494-2)
- Package size may be altered at no extra cost
- Output short circuit protected
- Units can be altered to meet your exact voltage and operating frequency requirements — in most cases at no extra cost
- Not affected by reference voltage or power supply variations

Specifications

Transfer equation: ± 1V/± 9°
Accuracy: 1487-3 } ± 0.5% @ + 25°C ± 20°C
1494-1 } ± 1% @ − 25°C to + 85°C
1487-4 } ± 0.5% @ + 25°C ± 20°C
1494-2 }
Input voltage: 1487 — 11.8V, 400HZ 3 wire synchro input; 26V, 400HZ reference
1494 — 90V, 400HZ 3 wire synchro input; 115V, 400 HZ reference
Operating frequency: 400HZ ± 20%
Input impedance: 10K minimum line to line
Full scale output: ± 10V DC (± 90°)
Minimum load resistance for full scale output: 2K
Output impedance: < 1Ω
Storage temperature range: − 55°C to + 100°C
DC power: ± 15V ± 1% @ 75ma (approx.)
Case material: High permeability nickel alloy



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GM INC.

GENERAL MAGNETICS • INC
135 Bloomfield Ave., Bloomfield, New Jersey 07003 . Tel. (201) 743-2700

Four Quandrant Sine Function Generator...

GENERAL MAGNETICS, INC.
TYPE NO.
S/N NO.

Model # G1489-1

FEATURES

- Provides a sine function with ½% accuracy over a − 180° to + 180° range
- Excellent temperature stability
- Full scale output of ± 10V DC
- Scale factor adjusted by a DC signal
- Hermetically sealed package

Specifications

DC accuracy: ± 30 min of ARC or 0.5% whichever is greater

DC accuracy over operating temperature range: ± 30 min of ARC or 0.75% whichever is greater

Transfer equation: $E_o = -E \sin \theta$
E represents an external DC voltage in the range of + 2V to + 10V

Input resistance: θ input (pin 6) — 100K ± 10%

Input resistance: E input (pin 4) — 47K ± 10%

Rated output voltage: ± 10V max at 5ma

Output impedance: < 1 Ω

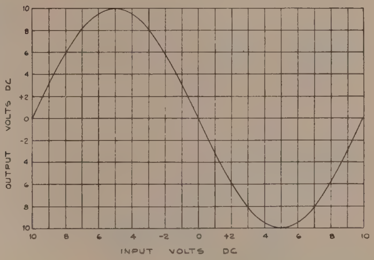
Frequency response:* 400HZ

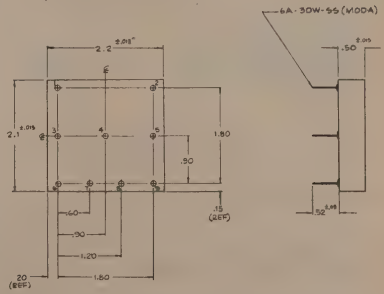
Power requirements: ± 15V DC ± 1% at ± 40ma

Operating temperature range:

MSFG 1489-1	− 40°C to + 100°C
MSFG 1489-2	− 25°C to + 85°C
MSFG 1489-3	0°C to + 70°C
MSFG 1489-4	25°C ± 10°C

*Frequency response is specified for a ± 5V triangular input waveform





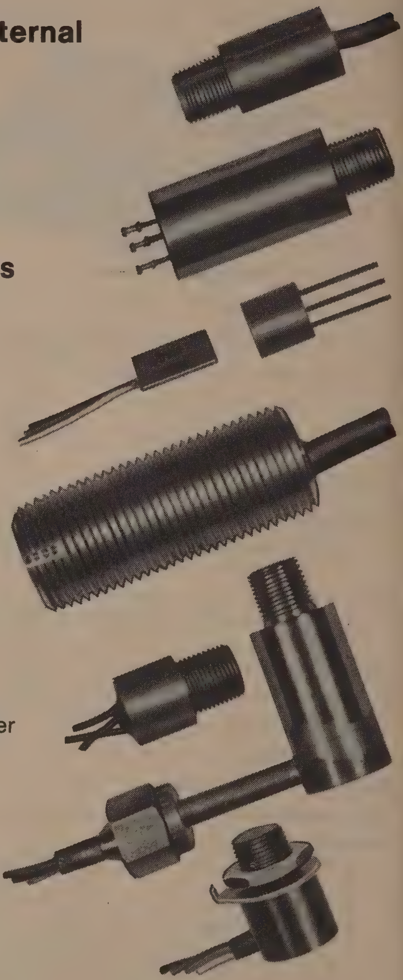
There is No Substitute for Reliability

GENERAL MAGNETICS • INC
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

Speed-Independent Magnetic Pick-ups

Their output voltage amplitudes are totally independent of the rate of change to the external magnetic field. They provide

- True zero speed sensing
- Contactless limit switches
- Translational and rotational velocity, direction and position sensing
- Counting, indexing, and timing functions



Benefits:

- Simplify designs
- Low power consumption
- Rugged enough for engine environments
- Aerospace reliability
- Operate from logic power bus
- Freedom from EMI (no choppers or oscillators)
- Freedom from actuator mechanisms
- Can replace optical systems

Applications:

Computer peripherals—sensing of indexing marks for drive mechanisms in card readers / magnetic tape memories / paper roll drive, and character selection in printers

Transportation—wheel speed sensing (skid-controlled braking) / ignition system timing / vehicle sensing (traffic control)

Industrial — speed, position and limit sensing

Aerospace — wide applications

Other Products:

Solid state Push Button and Toggle Switches / Solid state current sensors / Hall Effect Devices / Magnetoresistors / Fluxmeters / Gaussmeters.

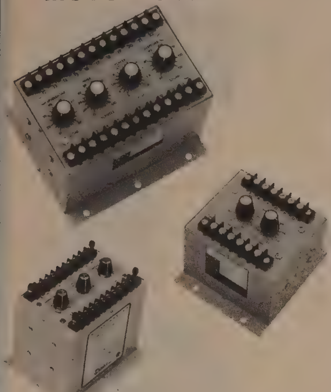
For information and comprehensive technical assistance, contact:

ISC ✱ MAGNETICS

35 South Service Road / Plainview, N.Y. 11803
(516) 293-0115

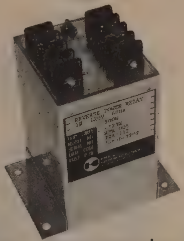
INDUSTRIAL CONTROLS

ELECTRONIC MOTOR CONTROLS



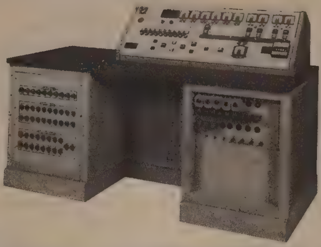
The protection and control of motor-driven equipment is accomplished through true power sensing for maximum effectiveness. Timing and sequencing functions are incorporated as required by the application. Uses include: submergible oil pumps, cryogenic pumps, agitating and settling systems, conveyor systems, refrigeration systems, machine tools, and injection molding equipment.

REVERSE POWER RELAYS



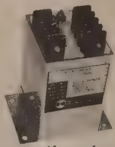
Where two or more generators supply energy to a common bus, reverse power relays provide a means for determining when one of them has stopped producing power and started to consume it. When this occurs, the output of the reverse power relay is used to disconnect the faulty unit from the bus before it can severely overload the units that are still functioning. Rated at 500 watts per phase, there is a model for each type of AC distribution system. With an adjustable time delay and 1500 Vac isolation, input/output/case, these solid state units provide reliable protection.

CONTROL SYSTEMS



KRATOS Process Control Systems satisfy a broad variety of requirements ranging from simple units providing sensing, timing, and sequencing functions to fully computerized control. Applications include: batching of chemicals, concrete, asphalt, rubber, feeds, and explosives; automatic truck loading; food processing; and material handling operations.

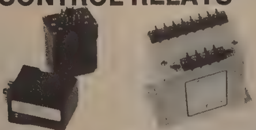
ALARM RELAYS



Alarm relays are protective devices used with any standard transducer output for monitoring AC voltage, current, power, frequency, power factor or such parameters as temperature, pressure, speed, etc. No transducer is needed for inputs of DC current or voltage.

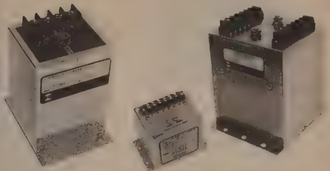
Single and dual limit versions with nine convenient input ranges provide limit detection for a broad spectrum of applications. Repeatability is 0.5% including hysteresis. Programming from 0-120% of full scale may be provided at the unit or remote. Complete input/out/power isolation eliminates grounding problems. All solid state construction is used for stability, reliability, and ruggedness.

CONTROL RELAYS



These units are more complex than the simple Alarm Relays in that they incorporate any required signal conditioning and are integral to a control loop. They are available in single and multiple limit versions.

TRANSDUCERS & TRANSMITTERS



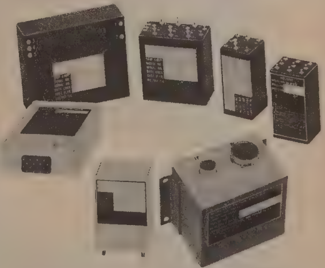
Complete line of power transducers for utility or industrial applications. AC volts, AC amps, Watts, Vars, or Hz inputs produce constant current outputs. No drift. Long term stability. Expanded temperature range. Standard transmitter outputs: 1-5, 4-20, 10-50 ma DC.

POWER MONITORS

This family of protective devices monitors and controls incoming power to any unit, system or equipment for purposes of safe and proper operation.

The Monitors protect equipment or units from low or high voltage, current, or frequency conditions — or monitor proper phase sequencing or loss of phases.

LIMIT DETECTORS/SENSORS
(Special Environment Devices)



These devices, similar in function to the Alarm, Control Relays, and Power Monitors previously described, are units designed and packaged specifically for use in extreme environment operation such as in Aviation, Military or rugged Industrial applications.

Hermetic sealing, special packaging, capability of operation through wide temperature extremes, and higher accuracies are features of this line of control devices. Full MIL Spec designs are available as well as designs to meet rugged Industrial requirements such as explosion-proofing.

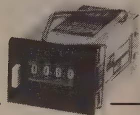
KRATOS

403 S. RAYMOND AVE.
BIN 45
PASADENA, CA 91109
(213) 449-3090
TWX 910-588-3288

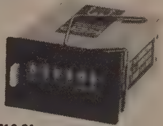
ADDING-TOTALIZING COUNTERS

These high performance totalizing counters are designed for long life - 250 million counts - and accuracy even at speeds up to 50 counts/sec. They can be supplied for any voltage in 5 mounting styles with many options.

M13.21
3 digit push button
4 digit w/o reset
Electric reset now available.
4 mounting styles available.



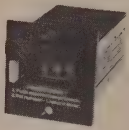
E14.21
4 digit with push button reset
Electrical reset optional



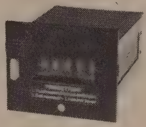
E16.21
5 or 6 digit with PB Reset
Electrical reset optional
5 or 6 digit with no reset

E17.10
7 or 8 digit w/o reset

PREDETERMING COUNTERS

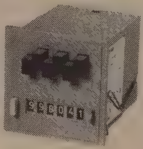


EVS13.11

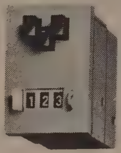


EVS15.13

These two predetermining counters count down from the manually preset number to operate a built-in SPDT switch as the number wheels pass from all zeros to all 9's. Manual or optional electrical or automatic reset returns wheels to preset number and counter is ready to start again. Numbers are preset by holding in reset button, lifting locking bar and indexing up number wheels to preset position with small rod supplied or by built in pushbuttons.



MVS16.21
New 6 digit predetermining subtracting counter features large staggered buttons for easy preset . . . manual and electrical reset . . . plug-in socket box mount allows easy mating with M16 counter.



MVS13.21
New 3 digit predetermining counter. Identical functionally to 6 digit unit on left, but is narrower to take up less panel space. All mounting options available, also manual and electrical reset. Any voltage, AC or DC at speeds up to 50 counts per second.

HOW TO ORDER

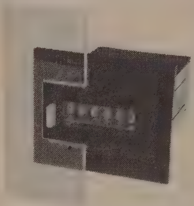
The basic catalog number i.e. M13, E14 through E18 plus EVS13, 15 and 25 followed by:

1st NUMBER E16.31
- 0- Small faceplate rear mounting
- 1- Large faceplate panel mounting with 2 screws
- 2&3 Flanged faceplate spring clip (See M13.21) or snap in (See E14.31).
- 5- Mount with no screws showing Behind the panel mounting

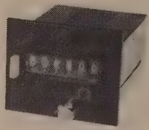
2nd NUMBER E16.31
- 0- No Reset at all (See E17.10)
- 1- Manual Reset Push Button
- 2- Electrical reset only
- 3. Manual & Electrical reset

FOLLOWED BY:
Count Speed Required: 10, 25, 40, 50, 75 per second & Voltage Required.

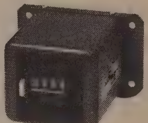
Some Optional Features



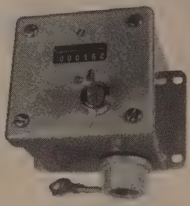
Behind panel mounting available on E16 or EVS15.



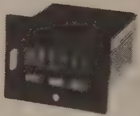
Spade key reset to prevent against unauthorized reset.



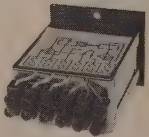
E14.61 Surface Mounting Option



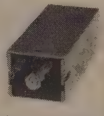
Nema 4 Water-tight & weather proof. Nema 7 explosion proof also available.



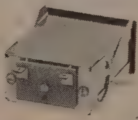
Special number wheels read out in time, money and reverse colors.



Standard insulated screw terminals on all E series counters.



Quick Disconnect terminals or solder terminals are standard on the M13 option on E series.



.187 x .20 quick connect terminals may be supplied. For other type terminals contact the factory.

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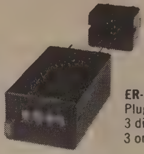
IMMEDIATE DELIVERY ON ALL ITEMS Pneumatic Counters Available **PLEASE CALL US COLLECT FOR ASSISTANCE**

Low Cost / Moderate Performance MINIATURE COUNTERS

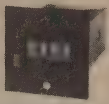
These counters serve in applications where count speeds up to 20 per second and life to 50 million are required. Electrical reset is not available.

ER-404-01
Rear mounted
type ER
3 digits with reset
3 or 4 digits w/o reset

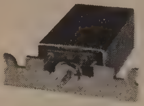
ER-313-01
3 digits with reset
3 or 4 digits w/o reset



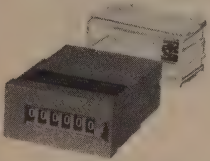
ER-404-01P
Plug-in rear connections
3 digits with reset
3 or 4 digits w/o reset



ER-414-01
Frame size 4
4 digits with reset
5 or 6 digit w/o reset



Rear View



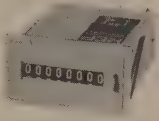
M16.01
With plug-in socket box

HOW TO ORDER

ER SERIES DESIGNATION

1st Digit	#3 Handles 3 digits with reset - 4 digit w/o reset #4 Handles 4 digits with reset - 5 or 6 digits w/o reset #6 Handles 5 and 6 digits with reset #7 Handles 7 digits without reset
2nd Digit -	Mounting Style 0-Stud Mount at rear 1-Panel Mount with 2 screws 2-Spring Clip Mount - No Screws
3rd Digit -	Number of digits required on counter
4th Digit -	Is always 0
5th Digit -	0-No Reset 1-Reset
6th Digit -	P denotes Plug-in Mounting

IMMEDIATE DELIVERY ON ALL ITEMS.
PLEASE CALL US COLLECT FOR ASSISTANCE.

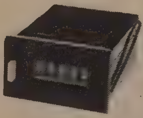


M18.20
8 digit non-reset
spring clip mount

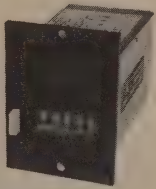
All models at any voltage are in stock for quick delivery.

ADD SUBTRACT COUNTERS

These rugged units have proved extremely reliable for differential counting - they are all in stock for fast delivery.



ED15.21
Available with or without
manual or electric reset.
Count speed 10, 25, 40/sec.



ED25.11
Provides zero switch output
with or w/o manual resets

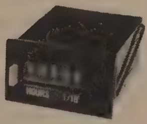
EDVS25.11
Add subtract predetermining.
Output switch point may be
changed in the field.

EDA 15
Add subtract counter. Provides
10 line or BCD electrical
read out.

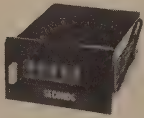
ELAPSED TIME METERS

Accurate long life and attractive styling are features of these units.

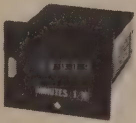
Type B2 for 110 or 220VAC.
60 HZ or 50 HZ. Attractive
rear mounting. Hours only.



ETH15.21
110V 60 HZ with or without
electrical and manual reset.
Available in hours or minutes



EZ16.21
Stop clock reads seconds and
10ths directly from 50 or 60
HZ line.



ETMVS15.11
Predetermining Elapsed Time
Counter: Operates SPDT switch
as numbers pass from 00000 to
9999. AC or DC models. Hrs., Min., or Secs.

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IMMEDIATE DELIVERY ON ALL ITEMS

Pneumatic Counters Available

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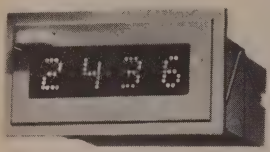
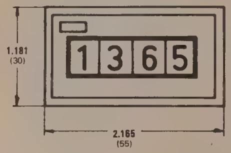
NEW

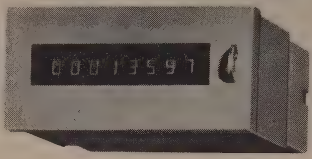
ELECTRONIC COUNTERS

The All New "L" Series Totalizer . . . large display, great flexibility, small size, smallest price*

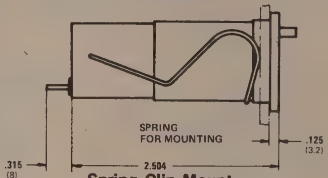


L104.23

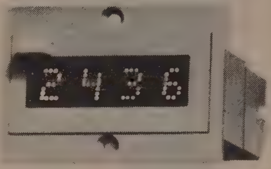




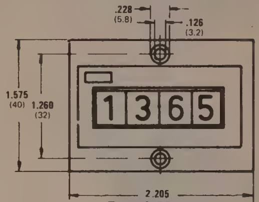
L108.00



Spring Clip Mount



L104.11



Panel Mount

**12 VDC, $40 O.E.M. quantity*

These new compact electronic counters utilize the latest c/MOS circuits to eliminate sensitivity to line transcients, reduce power requirements, and insure long life reliability. Built on 25 x 50 mm internationally recognized frame size for electro-mechanical counters they are interchangeable mounting wise with our new M Series counters. Large bright .160 or .300 inch high LED display, with optional decimal point insures good readability. Counters come in 4, 5, 6, 7, or 8 digit models. 60 counts per second maximum. For faster speeds and adding and subtracting capability, see the K and SC series.

MOUNTING

Two types of mounting are illustrated above. Type 104.23 panel mount uses a spring wire to hold the counter in the panel. No other hardware is required. A very neat, clean appearance results.

Type 104.13 panel mount uses two 4-40 screws for mounting.

TECHNICAL DATA

Reset . . .
Manual pushbutton or remote using normally opened contact.

Operating Voltage . . .
6, 12, 24 vdc or built in 110 vac.

Power Consumption . . .
25 mils at 9 volts.

Display Size . . .
LED 4 digits = .330" high
5, 6, 7, 8 digits = LED .160" high.

Ambient . . .
—20C+ 55C

Count Speed . . .
60 cps maximum. For faster speeds, see the K or SC series.

Min. Pulse Duration . . .
10 m/s mechanical.

Input Requirements . . .
N/O Switch closure 10 m/s or greater.

HOW TO ORDER

Basic catalog number is L10 followed by number of digits. EX. L108 = 8 digits.	
1st number thereafter **MOUNTING:** panel = 1 spring = 2 *Ex. L108.23*	2nd number thereafter **RESET:** panel = 1 remote = 2 both = 3

KESSLER-ELLIS PRODUCTS
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IMMEDIATE DELIVERY ON ALL ITEMS **Pneumatic Counters Available** **PLEASE CALL US COLLECT FOR ASSISTANCE**

TACHOMETERS, TOTALIZERS, TIMERS

The SC Series — for high speeds, BCD output, memory, battery standby circuitry, a .250" display, and built in power supply. The series that is ideal for totalizing events, recording precise elapsed time, monitoring rate, or comparing speeds of two variables.

SECONDS
8 3 9 6 5.2
RESET
KEP

Type SCTS

These timers use the 60HZ line frequency to count seconds, tenths, minutes or any combination hereof. A crystal oscillator variation counts 100ths of seconds.

8 3 9 6 5 2
RESET
KEP

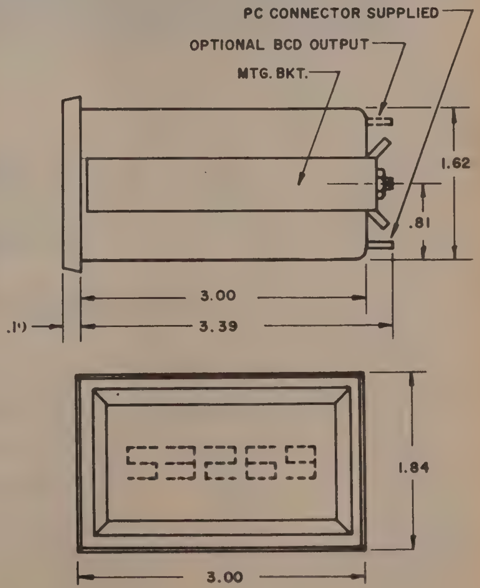
Type SC16

Model SC is a totally solid state, easily applied, ultra reliable, electronic counter. It will totalize pulses produced by mechanical or solid state switch closures with absolute accuracy and indefinite life.

3 9 x100
RESET
KEP

Type SCRS

These counters utilize a one second RC time base to display the pulses received in one second during the next second Readout is typically shown in feet per minute, gallons per second, RPM, or inches per second. The lens can be marked accordingly.



KESSLER-ELLIS PRODUCTS

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IMMEDIATE DELIVERY ON ALL ITEMS **Pneumatic Counters Available** **PLEASE CALL US COLLECT FOR ASSISTANCE**

ELECTRONIC PREDETERMINING COUNTERS

EL-4

The EL and SCP series are designed for batch counting and timing in industrial environments where constant resetting, high speeds and reliability are required. The SCP series offers a 10 amp 2 PDT relay output or a 9 amp triac output while the EL offers triac output only. Both have adjustable output times and are programable for many special applications. Both have built-in 110 VAC power supplies and are engineered to operate smoothly and the most rugged industrial environments. Both may be equipped with a built-in time base for pre-determining units of time before functioning. EL unit measures 2.56 x 2.95 x 3.94 deep. SCP Series measures 1.65 x 5.28 x 6.50 deep.

672
0 0 5 6 8 0
RESET
KEP

SCP-16

Ask for KEP Input Devices for all your counting requirements

MODULATED PULSED LED PHOTOELECTRIC DRIVERS

PHOTOELECTRIC AND MECHANICAL SHAFT ENCODERS

8 CHANNEL ANTI-COINCIDENCE COUNT SUMMATORS

ELECTRONIC PULSERS

KEP **KESSLER-ELLIS PRODUCTS**
121 FIRST AVE. ATLANTIC HIGHLANDS, N.J. 07716 (201) 291 - 0501

IMMEDIATE DELIVERY ON ALL ITEMS

PLEASE CALL US COLLECT FOR ASSISTANCE

MECHANICAL COUNTERS

Model KS Mechanical Stroke Counter 3, 4 and 5 Digit Models and Model KR Revolution Counter 5 Digits.

KSTC-R3

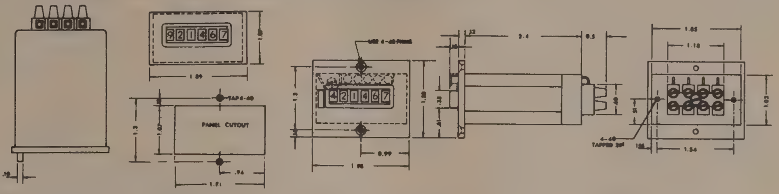
KSTC-R5

KSTC-R4

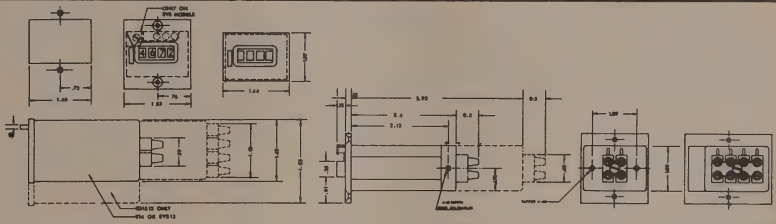
KR-R5

KS series stroke counters provide long, trouble free operation even in harsh oily and dusty atmospheres. The counters are supplied with a removable lever and spring combination used in most reciprocating applications. Models are available with either right or left hand shaft extension.
The Model KR is a small but rugged revolution counter with the unique feature of adding regardless of the direction of rotation on the in-put shaft. It is available in either right or left hand drive. Count life is 50 million minimum with a rated maximum speed of 600 rpm.

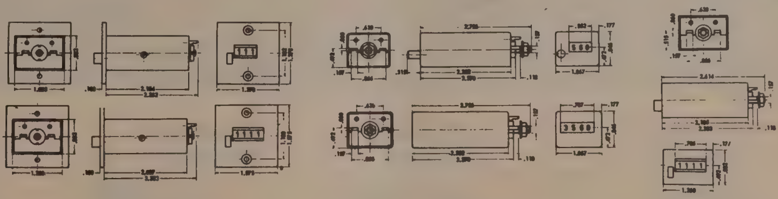
(E16, EVS15, ED15)



(E14, EVS13, ED15.13)



(ER3, ER4m13)



LIST OF REPRESENTATIVES

Los Angeles:	Van Gott Associates	213/285-2418
Chicago:	Lincoln-Hodges	312/297-3810
San Francisco	Bill Berry	415/343-2773
Denver:	Ken Palmer	303/255-9961
Boston:	Gilway Sales	617/331-5212
Detroit	Pitcher-Poulin	313/582-5450
New Jersey:	Robert L. Dalton	201/291-0500
Washington:	H.R. Siebar	301/589-9110
Cleveland:	Ed Bock Associates	216/331-5212
Atlanta	Electro Mech	404/256-4414
Philadelphia:	W. Reeves	215/566-6709
Houston:	Wm. Carey Associates	713/460-1111
Dallas:	Wm. Carey Associates	713/460-1111

KEP

KESSLER-ELLIS PRODUCTS
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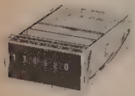
IMMEDIATE DELIVERY ON ALL ITEMS Pneumatic Counters Available PLEASE CALL US COLLECT FOR ASSISTANCE

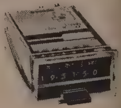
Guide to Sodeco impulse counters

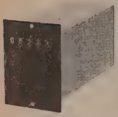
★ The Sodeco R-Series: Up to 200,000,000 counts and speeds to 60 ips

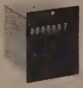
Inside their rugged, clear packages, Sodeco's new R-series impulse counters pack many times the life of any other counter on the market. The most advanced counters you can buy, they're Swiss-engineered for greater precision, quieter operation, no missed counts. Instead of all the usual rattles, vibration and wear associated with standard ratchet mechanisms, our special escapement mechanism keeps them working better longer. Compact plug-in modules with power consumption as low as 0.8W are compatible with the most advanced solid state instruments and systems. Standard ± 15% voltage tolerances and a capacity for operating with a wide variance of pulse waveforms provide a maximum safety margin. For more details on R-Series counters check the asterisked items in the application categories below.

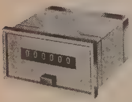
Totalizing Counters

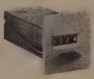










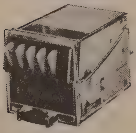


Number of Digits	Counting Speeds (ips)	Type of Reset	Typical Dimensions	Model/Style	Ask for Bulletin No.
3, 4, 5, 6, 8	10, 35, 60	None, Manual, Electric	w — 1.11" h — 0.95" d — 2.76"	★ RG Series	601
6 (models available from 1/10 sec. to hours)	1/10 sec.	None, Manual, Electric	w — 1.11" h — 0.95" d — 2.70"	★ RT Series	1001
5	10	None	w — 1.10" h — 0.81" d — 4.49"	TT-11	223
3, 4, 5, 6, 7, 8,	10, 25, 50	None, Manual (toggle)	w — 1.65" h — 1.22" d — 4.42"	TCe Series	201
4, 5, 6	10, 25, 50	Electric	w — 1.37" h — 2.36" d — 4.42"	TCeF Series	201
4, 5, 6, 7	10, 25	None, Manual	w — 1.38" h — 2.05" d — 1.73"	TCeB Series	212
6, 7	10	None, Manual, Electric, Both	w — 5.67" h — 2.84" d — 4.30"	EP Series	15602
4, 6 Low Budget:	10	None, Manual	w — 1.65" h — 1.73" d — 3.00"	RE Series	14501

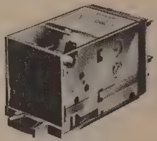
NOTE: Standard Voltages are 12, 24, 110 VDC, 110 VAC throughout. Special voltages available on request.

Other Counters

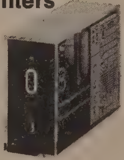
Predetermining Counters ★



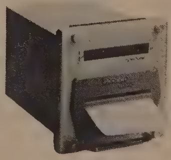
Add/Subtract Counters ★



Single Digit Counters



Printing Counters



SODECO
A Division of
LANDIS & GYR

4 Westchester Plaza, Elmsford, New York 10523 • Phone: (914) 592-4400 TWX: (710) 567-1219 Telex: 137345
In Canada: 2063 Chartier Street, Dorval 760, Quebec • Phone: (514) 631-9069 Telex: 0525398

The Sodeco electronic predetermining counter type KE

Totally modern in MOS/LSI technology, fully flexible in use—the Sodeco KE counts up and down at speeds up to 1 MHz. 5-digit LED-type display has characters 7.5 mm (.30 in.) high, display can be frozen without disturbing incoming count. Features include TTL-compatible inputs and outputs, battery-backup capability in case of power failure. Also has double pre-determining feature. Fast-mounting case meets DIN standards, has 72 x 72 mm (2.83 in. x 2.83 in.) front panel dimension. Power is 5VDC ± 5%. The input voltage is adjustable from 5 to 48VDC.

For more information and technical data, contact: SODECO, a Division of Landis & Gyr, 4 Westchester Plaza, Elmsford, N.Y. 10523; phone (914) 592-4400.

SODECO
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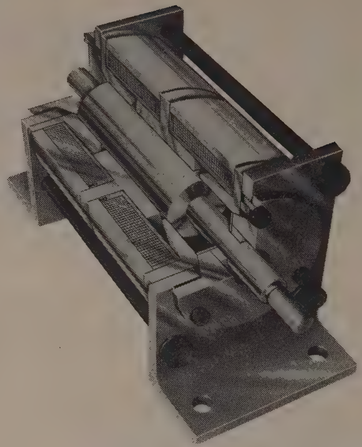
LANDIS & GYR

ELECTRO PROPORTIONAL SOLENOIDS AND CONTROL SYSTEMS



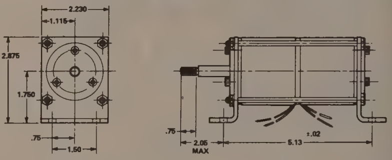
FOR PRECISE POSITIONING

New . . . Ledex linear electro proportional solenoid that can move loads over a ½ inch range and produce up to fifty pounds force at continuous duty. The Ledex E.P. solenoid is designed for rugged use, yet its low profile and compact size combine accuracy, high force, and fast response for the most precise applications.

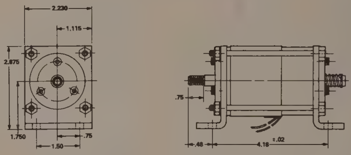
DESIGN BENEFITS

1. Only one moving part, the armature, typically provides 10,000,000 trouble-free cycles.
2. Maintenance free, no periodic lubrication necessary.
3. The only wear points are two bearings mounted in the bearing housings. Bearing assembly is easily replaced with an Allen wrench. No need to disturb the alignment of the unit.
4. Threaded shaft for load attachment allows secure and precise mechanical positioning.
5. Distinctive quality appearance and excellent environmental protection is provided by the electroless nickel plated case and anodized mounting brackets.
6. Designed to operate in temperatures from −40°C to +80°C.

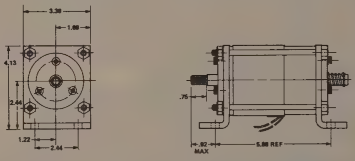
LB-22



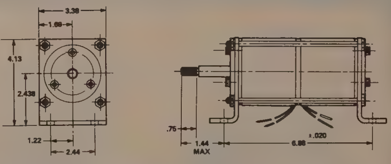
LU-22



LU-33



LB-33



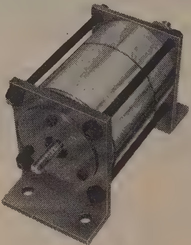
18 STANDARD MODELS

The E.P. solenoids are available in both unidirectional (single coil) or bidirectional (dual coil) models. Both provide precise positioning and load control. Bidirectional units utilize electromechanical forces in both directions to accomplish this. Unidirectional units utilize electromechanical force from a single coil working against a balanced return spring or opposing load.

MODELS LU-22 AND LU-33

Unidirectional EP Solenoid Force Chart for Closed Loop Systems

Design Stroke of Unit	Net Force at Continuous Duty	
	LU-22	LU-33
.125	6 lbs.	22 lbs.
.250	5	18
.375	3	13
.500	2.5	8



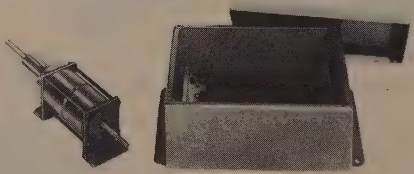
MODELS LB-22 AND LB-33

Bidirectional EP Solenoid Force Chart for Closed Loop Systems

Design Stroke of Unit	Net Force at Continuous Duty	
	LB-22	LB-33
.125	14 lbs.	50 lbs.
.250	11	40
.375	8	30
.500	5	20

COMPLETE CONTROLLER PACKAGES FOR SYSTEMS

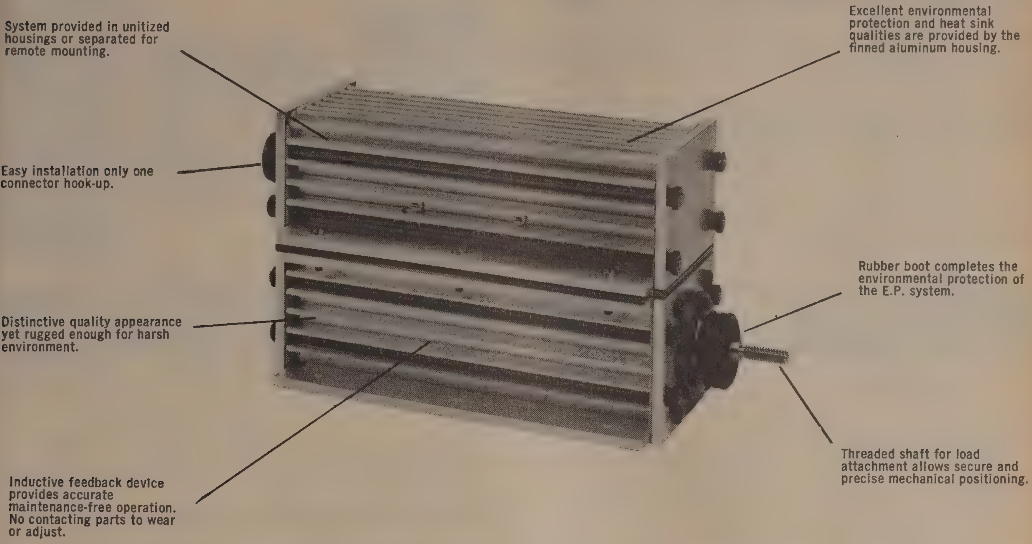
Standard closed loop controllers are in stock for use with both unidirectional and bidirectional electro proportional solenoids. Ledex controllers are easily modified through compensation networks to accommodate various types of load and performance requirements. These controllers are all factory pre-tested and calibrated for optimum system performance. Standard controllers operate on 22 to 38 Volts D.C. Standard oil tight JIC enclosures for harsh environments are available.



LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

LEDEX

EP-505 PROPORTIONAL POSITIONING WITH 5% SYSTEM ACCURACY


System provided in unitized housings or separated for remote mounting.
Excellent environmental protection and heat sink qualities are provided by the finned aluminum housing.
Easy installation only one connector hook-up.
Rubber boot completes the environmental protection of the E.P. system.
Distinctive quality appearance yet rugged enough for harsh environment.
Threaded shaft for load attachment allows secure and precise mechanical positioning.
Inductive feedback device provides accurate maintenance-free operation. No contacting parts to wear or adjust.

CLOSED LOOP SYSTEMS IN ENVIRONMENTALLY PROTECTED HOUSINGS

Complete closed loop systems, using inductive feedback devices, provide five percent positioning accuracy. Since this type of feedback relies on an inductive field without contacting parts, it is maintenance free for the life of the system.

The controller, using pulse width modulated (PWM) techniques for high efficiency, provides error signals which drive to EPS.

The E.P. Solenoid, feedback electronics and controller are mounted in a finned aluminum enclosure for use in harsh environments. If desired, the controller can be provided in a separate housing for remote mounting.

The stock five percent system is designed for either 12 or 28 VDC operation. The Ledex E.P. systems provide closed loop servo performance, but at a fraction of the cost of a comparable servo system.

5% SYSTEM SPECIFICATIONS

(Unit design stroke .5 inches)

	Uni Directional	Bi Directional
Net Output Force @ Cont. Duty	2½ lbs.	5 lbs.
Positioning Accuracy (With load change from 0 to Cont. Duty Force)	±.025″	±.025″
Linearity as % of Full Stroke (No Load)	±5%	±5%
System Sensitivity (No Load)	4V/inch	4V/inch
Steady State Response at −6 DB (System compensated for No Load)	2Hz Min.	5Hz Min.
Transient Response (Typical)	200 ms	150 ms

Test Conditions:

Power Supply V_{cc} = 26 VDC
Temperature T_A = 25°C

NOTE: 1. Standard systems are supplied with electrical feedback compensation for force only load. Ledex can supply systems compensated for mass and/or friction loads.

System Electrical Input Requirements

Input Supply Voltage: 11 to 13 VDC @ 8 Amps Cont. 16 Amp Peak
25 to 29 VDC @ 4 Amps Cont. 8 Amp Peak
Input Command: 3 to 5 VDC (.5″ stroke unit) or 4V/inch
Input Impedance: 10K Minimum

LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

PROCESS CONTROL MODULES

ELECTRONIC INTEGRATORS

Compute time-integral of sensor outputs; output pulses drive external or self-contained 24 V electro-mechanical totalizing counters (8 W max.). Full-scale output pulse rate field-settable with high resolution between 100 and 50,000 counts/hour.

Model No.	Input	Output
IV-100-X*	Process control currents	No count for less than min. current
IV-110	0 to 10 V	No count for -V
IV-200	−10 V to +10 V	Dual outputs for up-down counter
IV-201	−10 V to +10 V	Count ignores input polarity
IV-300	−10 V to +10 V	Integral counter display

* -1 = 1-5 mA, -2 = 4-20 mA, -3 = 10-50 mA.

ALARMS / SWITCHES

Trip when input parameters (frequency, speed, dc voltage, dc current) cross preset limits. Provide both electrical signal and Form C relay contact closure for alarm and on-off control applications.

- Gold-alloy relay contacts for switching dry circuit to 1A loads.
- No relay chatter.
- Fail-safe for power and signal interruption.
- Adjustable hysteresis.

FREQUENCY/SPEED MODELS SERIES FM-10

Accept arbitrary waveform frequency information from speed transducers, generators, etc., 0.1 to 200 V peak input level; 0.1 MΩ input impedance; respond in two cycles of input frequency. Full-scale trip frequency field-settable with high resolution between 40 and 10,000 Hz.

Model No.	No. of Preset Limit Frequencies	Trip Indication When Input Frequency Is
FM-10	1	Below limit
FM-11	1	Above limit
FM-12	2	Outside range between limits
FM-13	2	Below low and above high limit

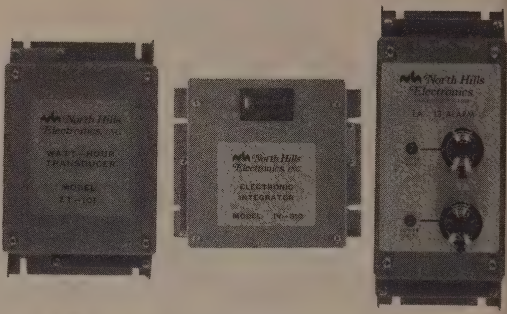
VOLTAGE/CURRENT MODELS LA-10

Accept mV, V, process control current inputs. Trip level set by Kelvin-Varley divider in steps of 10% and 0 to 10% continuous vernier. Alarm status indicated by LED monitor light. Single-ended or differential input. Instrumentation-type high stability input amplifier for very high input impedance and common mode rejection.

Model No.	Set Points	Alarm Indication When Input Level Is
LA-11	1	Above limit
LA-12	1	Below limit
LA-13	2	Below low and above high limit

Standard full-scales: mV = 50, 100, 500
V = 1, 5, 10
mA = 5, 10, 20, 50

North Hills



ISOLATED TRANSMITTERS

Convert various input parameters to process control current outputs. Input, output, power source are dc-isolated from one another.

- Outputs 1-5, 4-20, 10-50 mA at 0 to 30 V load voltage.
- 0.1% accuracy.
- Fast response.
- Wide range offset and span adjustments with high resolution.

VOLTAGE/CURRENT MODELS VX-10

Accept mV, V, process control currents.

Model designation: VX-10-X-Y, where

X = Input code:
1 = 1-5 mA, 2 = 4-20 mA, 3 = 10-50 mA
050 = 50 mV, 110 = 100 mV, 150 = 500 mA
210 = 1 V, 250 = 5 V, 310 = 10 V

Y = Output code:
1 = 1-5 mA, 2 = 4-20 mA, 3 = 10-50 mA

WATT-HOUR TRANSDUCER

MODEL ET-101

The ET-101 Watt-Hour Transducer produces an output pulse for a given watt-hour energy input sample. When accumulated in a suitable external counter, the total count is proportional to the total watt-hour energy use.

INPUTS — Voltage Input: Zero to 10 volts DC full scale. **Current Input:** Drop across 100 mV shunt selected for desired full scale operation.

OUTPUT SIGNAL — Pulse train, isolated from both inputs, whose rate is proportional to the instantaneous product of voltage and current. **Amplitude:** 5 volts. **Pulsewidth:** 2 μsec.

FULL SCALE COUNTING RATE — 50 x V x I counts/kWhr.

North Hills Electronics, INC. | *GLEN COVE, N.Y. 11542 • 516-671-5700*

CONVERTERS

North Hills

VOLTAGE-TO-FREQUENCY

Complete line of Voltage-to-Frequency Converters for
- A/D conversion.
- Telemetering.
- Electronic integration.
- Process control applications.

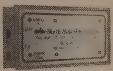
All have one-cycle response, excellent linearity down to zero frequency, low TC.

FIXED RANGE SERIES DF-10, DF-12, AND LOW COST DF-20

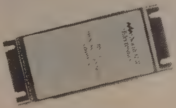
12 models cover full-scale output frequencies from 25 to 100,000 Hz. 0 to 10 V input; >100 MΩ input impedance; 0.02% linearity; zero and full-scale trimmers.

North Hills Electronics, Inc.
V/F CONVERTER
DF-20-210

Model DF-20
2.5 x 1.9x 1.0 in.



Model DF-10
3.5 x 1.82 x 1 in.
±15 Vdc powered



Model DF-12
3.5 x 8.5 x 2.3 in.
Ac-line powered

DF-10 Model No.	DF-12 Model No.	DF-20-Model No.	Freq. Range (Hz)
DF-10-025	DF-12-025	DF-20-025	0-25
DF-10-050	DF-12-050	DF-20-050	0-50
DF-10-110	DF-12-110	DF-20-110	0-100
DF-10-125	DF-12-125	DF-20-125	0-250
DF-10-150	DF-12-150	DF-20-150	0-500
DF-10-210	DF-12-210	DF-20-210	0-1000
DF-10-225	DF-12-225	DF-20-225	0-2500
DF-10-250	DF-12-250	DF-20-250	0-5000
DF-10-310	DF-12-310	DF-20-310	0-10,000
DF-10-325	DF-12-325	DF-20-325	0-25,000
DF-10-350	DF-12-350	DF-20-350	0-50,000
DF-10-410	DF-12-410	DF-20-410	0-100,000

WIDE-RANGE SERIES DF-100

Ac-line operated models with built-in regulated dc supplies; Uni- and bi-polar inputs; 0.02% linearity. Full-scale output frequency field-settable over 250:1 range with high resolution. X represents input level code, Y denotes full-scale frequency range.

Model No.	Input	Output
DF-100-X-Y	0 to +V, Process control currents	Frequency
DF-110-X-Y	−V to +V	Frequency and logic output indicating polarity
DF-120-X-Y	−V to +V	Separate frequencies for + and − inputs

X, Y	Input		Full-scale Freq. Range (Hz)
	Level	Impedance	
1	0 to 10 V	>100 MΩ	0.4 - 100
2	1 to 5 mA	1000 Ω	4 - 1000
3	4 to 20 mA	250 Ω	40 - 10,000
4	10 to 50 mA	100 Ω	400 - 100,000

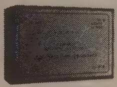
FREQUENCY-TO-VOLTAGE

Line of high-performance Frequency-to-Voltage Converters for
- Tachometry.
- Frequency monitoring.
- Telemetering.
- Control application.

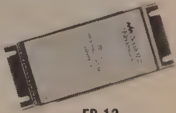
All feature ripple-free outputs and excellent linearity.

STANDARD SERIES FD-10, FD-12, AND LOW COST FD-20

12 models cover full-scale input frequencies from 25 to 100,000 Hz. 0.1 to 100 V peak input; 0.1 MΩ input impedance; 0 to 10 V output; 0.02% linearity; negligible ripple; fast response.



FD-10
3.5 x 2.3 x 1 in.
±15 Vdc powered

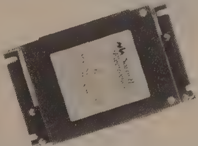


FD-12
3.5 x 8.5 x 2.3 in.
Ac-line powered

FD-10 Model No.	FD-12 Model No.	FD-20 Model No.	Freq. Range (kHz)
FD-10-025	FD-12-025	FD-20-025	0-0.025
FD-10-070	FD-12-070	FD-20-070	0-0.070
FD-10-110	FD-12-110	FD-20-110	0-0.1
FD-10-125	FD-12-125	FD-20-125	0-0.25
FD-10-150	FD-12-150	FD-20-150	0-0.5
FD-10-210	FD-12-210	FD-20-210	0-1
FD-10-225	FD-12-225	FD-20-225	0-2.5
FD-10-250	FD-12-250	FD-20-250	0-5
FD-10-310	FD-12-310	FD-20-310	0-10
FD-10-325	FD-12-325	FD-20-325	0-25
FD-10-350	FD-12-350	FD-20-350	0-50
FD-10-410	FD-12-410	FD-20-410	0-100

ULTRA-FAST RESPONSE SERIES FD-51

Ac-line operated modules with built-in regulated dc power supplies. Cover 10:1 frequency ranges and are particularly suited for instrumentation at low frequencies when very fast response, negligible ripple, and a high degree of linearity are required. Applications include cycle-to-cycle line frequency monitoring, FM demodulation, speed run-down tests on rotating devices. Also have outputs proportional to period of input frequency.

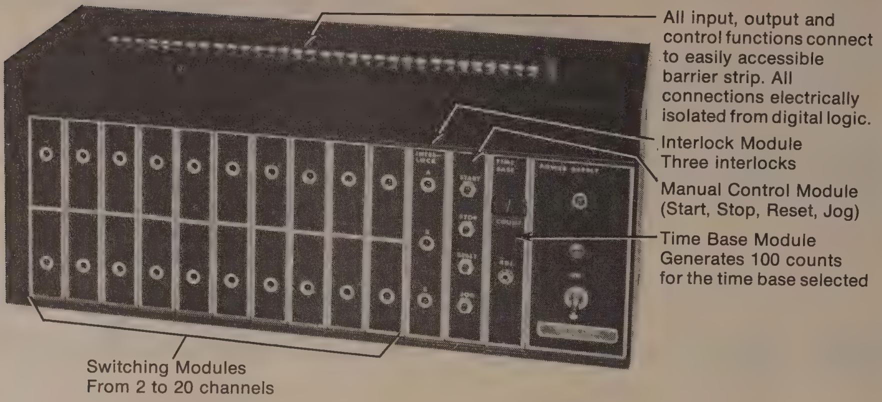


Input: 1 to 200 V peak; input impedance: 0.1 megohm; output: 1 to 10 V; linearity: 0.02%; negligible ripple.

Model No.	Frequency Range (Hz)
FD-51-110	10 to 100
FD-51-150	50 to 500
FD-51-210	100 to 1000
FD-51-230	300 to 3000
FD-51-110-1	50 to 70
FD-51-150-1	330 to 470

North Hills Electronics, INC. | GLEN COVE, N.Y. 11542 • 516-671-5700

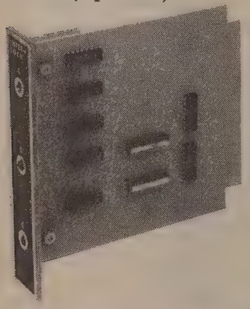
The Quantachron V Timer-Programmer by MATRIX CORPORATION


All input, output and control functions connect to easily accessible barrier strip. All connections electrically isolated from digital logic.
Interlock Module
Three interlocks
Manual Control Module
(Start, Stop, Reset, Jog)
Time Base Module
Generates 100 counts for the time base selected
Switching Modules
From 2 to 20 channels

A solid state "cam" timer-programmer with plug-in modules for easier maintenance and less down time.

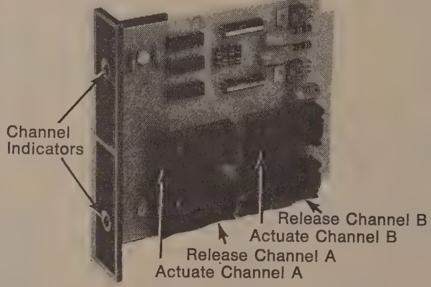
FEATURES: Field proven • All solid state high level logic • Triac output switching • Up to 20 channels per unit • Programmed by digital switches • Easy to maintain • Plug-in modules • Select only the number of channels and functions needed • Rack mounted, bench mount or enclosure mount • Digital display of count • Manual or remote control • Dimensions 16" wide x 6¾" high x 6" deep.

Interlock Module
(Optional)



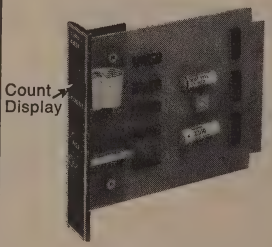
The interlock module allows three independent external contacts (normally open) to interupt the count sequence and prevent an actuation of three output channels until the interlock is re-established. Indicators on the module show which of the three interlocks are open. When the interlock is re-established, the channel actuates and the count continues until the cycle is complete or another channel with an "open" interlock is reached.

Switching Module
(2 channels per module)


Channel Indicators
Release Channel B
Actuate Channel B
Release Channel A
Actuate Channel A

This module receives the count code generated by the TIME BASE MODULE and compares it to the "Activate" and "Release" code programmed by the digital switches. Each module has two independent channels. Programming is done by setting the digital switches (by thumb or screwdriver) to the desired actuate and release times. When activated a triac, conservatively rated at 1 amp, is turned ON. A front panel indicator (LED) also is lit to show the channel is energized. All output circuits electrically isolated from logic. Select only the number of channels for the application. Modules can be added later if expansion is required.

Time Base Module


Count Display

The time base module generates 100 coded steps for the time base selected. The time base can be adjusted from 0.5 to 1000 seconds. The count is displayed by a front panel digital indicator (00 to 99). The 100 steps are converted into a code acted upon by the switching modules. Accuracy of the time base is 1% of the time cycle.

MATRIX CORPORATION

520 North 11th Avenue • Beech Grove, Indiana 46107 • Telephone: (317) 786-4601

E-CELL (TM) COMPONENTS

First in Micro-Coulometry

- *Timing: Seconds to Months*
- *Integration: 1 to near ∞ events*
- *Non-Volatile Memory*
- *Low Cost*

① WHAT IS AN E-CELL DEVICE?

An E-CELL device is a new kind of circuit element that looks like a discrete electronic component but does the work of a complete electro-mechanical assembly. Its main functional part is a center "working" electrode, which is surrounded by an electrolyte. The unit's metallic container also serves as the second ("reservoir") electrode. Functionally, an E-CELL unit is a reversible micro-coulometer. By plating the "working" electrode, it converts electrical **current-time integrals (up to several thousand milliampere-sec.** into equivalent integrals of a mass of metal. Exactly one atom is transferred for each electron impressed on the E-CELL unit. Power drain is normally in the microwatt region. If the "working" electrode is then deplated at a known current, the deplating time will be proportional to the original integral. When a known mass is given as part of the initial condition (i.e. is preplated on the "working" electrode), this same process generates a precise time interval. The unit abruptly changes from a low-resistance to a high-resistance circuit element when its "working" electrode is completely deplated.

② HOW DO YOU USE AN E-CELL DEVICE?

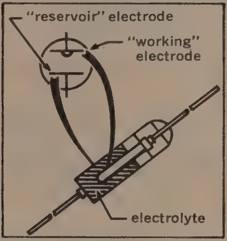
An E-CELL device has two generic functions: integration and timing. In both areas, the device is characterized by: electrical stability; small size; insensitivity to the physical environment; compatibility with the low current and voltage levels of modern circuitry; and the ability to operate over an extremely broad time domain. Compared to conventional mechanical and electro-mechanical devices which perform similar functions, an E-CELL device is much lower in cost.

For integration applications, an uncharged E-CELL unit accepts d-c, periodic, or random inputs in any waveshape — and stores the integral of these on the "working" electrode. To read out the stored value, the mass transfer process is reversed. The measured time to reach the point of the abrupt voltage swing, multiplied by the read-out current, gives a precise value which represents a total count of the stimuli presented to the unit. The Model 500 EDR Digital Readout Instrument provides a convenient means of making these measurements.

Operation in the timing mode is essentially the same as that for integration. The E-CELL unit is pre-charged with a known mass of plating material. In operation, this mass is transferred to the "reservoir" electrode (container) at a constant known rate determined by the current value used. When the "working" electrode has been deplated, an abrupt voltage swing signals that the pre-set time has elapsed. This signal is normally used as a bias transition with semiconductor devices.

③ APPLICATIONS

The scope of applications is as broad as counting and timing functions themselves. We have a repertoire of many convenient, economical circuit designs that have been proven in actual field use. Our experienced applications specialists will help you apply E-CELL coulometric techniques to your particular problems. Representative applications: **REPETITIVE TIMING AND CONTROL** Repeat cycle timing for domestic and industrial appliances. **PULSE COUNTING AND MEMORY** Adding and subtracting pulses. Counting events for vending machines, traffic, etc. Confidential memory for security devices. **CURRENT-TIME INTEGRATION** Battery charging controls. Environmental monitoring. Data accumulation. Laboratory integration in physics, chemistry, meteorology, etc. **USE-TIME MEASUREMENT** End-of-life, elapsed time, and warranty indication. Use-accounting for office, automotive, or industrial machines. **TIMING** Ordnance, safing and arming devices. Sonobuoy scuttling. Long delays (months).



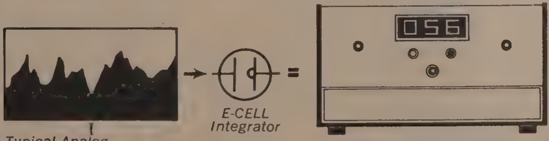
E-CELL Device and Circuit Symbol

E-CELL INTEGRATING AND TIMING COMPONENTS

Type (Actual Size)	Charge µa-hr	Application	Range Accuracy	Physical Characteristics
Series 560	None	Integrating	10-1000 µa-hr ±4%	Single anode with axial leads. Current range up to 2000 µa. Temperature range −40°C to +85°C. (See Bulletin 500 for additional information.)
	60-3000	Timing	0.1 to 3000 hr. ±4%	
Series 550	None	Integrating	10-1000 µa-hr ±4%	Single anode, plug-in type. Current range up to 2000 µa. Temperature range −40°C to +85°C. (See Bulletin 500 for additional information.)
	60-3000	Timing	0.1 to 3000 hr. ±4%	

E-CELL Timing Components with other pre-charges are available on special order.

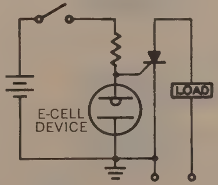
Specifications subject to change without notice.



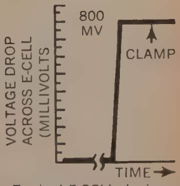
Typical Analog Input Signal

E-CELL Integrator

Model 500 EDR E-CELL Digital Readout Instrument



Typical circuit using E-CELL components.



Typical E-CELL device voltage rise.

E-CELL components and instruments are protected by one or more of the following U.S. patents: 2,744,217; 3,387,288; 3,423,642; 3,423,643; 3,423,644; 3,423,648. Other U.S. and foreign patents pending.

For additional technical information and applications notes, contact:

PLESSEY ELECTRO-PRODUCTS

subsidiary of PLESSEY INCORPORATED
3860 Centinela Ave., Los Angeles, Calif. 90066
Tel: (213) 390-3585 • TWX: 910-343-6483

PRECISION TIMER COMPANY, INC.

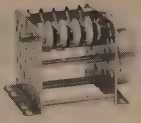
(203) 399-6253

13 WESTBROOK INDUSTRIAL PARK • WESTBROOK, CONN. 06498

	Distrib. Stock No.	Factory Pt. No.	Time	List 1-4	5-9	10-24	25-49	50-99	100-249	250-499
DRM DELAY RELAY Transfers switch at end of set time period. Resets on removal of power to motor. 15A SPDT Switch. 5W 120V 60 Hz synch. motor. U/L and CSA listed. Includes Bezel and Dial, Hdwe., and Instructions. 2¾" Bezel, 3"H x 2¼"W x 2¼"D. 12 oz. 		DRM- 6S - 12S - 18S - 25S - 40S - 75S -150S -300S	6 sec. 12 sec. 18 sec. 25 sec. 40 sec. 75 sec. 150 sec. 300 sec.	$15.50	$14.43	$13.47	$12.72	$11.97	$11.87	$11.76
DPB DELAY RELAY Transfers switch at end of set time period. Resets and commences new cycle by pushing button. 15A SPDT switch. 3W 120V 60 Hz synch. motor. U/L and CSA listed. Includes Bezel and Dial, Hdwe., and Instructions. 2¾" Bezel, 3"H x 2¼"W x 2¼"D. 12 oz. 		DPB- 5S -15S -30S -60S - 5M -15M -30M -60M - 5H -15H -30H	5 sec. 15 sec. 30 sec. 60 sec. 5 min. 15 min. 30 min. 60 min. 5 hrs. 15 hrs. 30 hrs.	15.15	14.11	13.17	12.44	11.70	11.60	11.50
INM INTERVAL TIMER Timer is set manually and runs back down to transfer switch at "zero." 15A SPDT switch. 3W 120V 60 Hz synch. motor. U/L and CSA listed. Includes Hdwe. and Instructions. ¼" shaft wil accept any low cost pointer-knob. Or order separately our "FKT" Front End Kit consisting of Bezel and Dial. 2¾" Bezel, 3"H x 2¼"W x 2¼"D. 12 oz. 		INM- 5S -15S -30S -60S - 5M -15M -30M -60M - 5H -15H -30H	5 sec. 15 sec. 30 sec. 60 sec. 5 min. 15 min. 30 min. 60 min. 5 hrs. 15 hrs. 30 hrs.	8.80	8.20	7.65	7.22	6.80	6.74	6.68
		FKT- 5 -15 -30 -60	5 Div. 15 Div. 30 Div. 60 Div.	2.16	2.01	1.88	1.77	1.67	1.65	1.64
IPB INTERVAL TIMER Yields one exact fixed cycle each time button is pushed. 15A SPDT switch. 3W 120V 60 Hz motor. U/L and CSA listed. Includes Hdwe. and Instructions. ¾" button with 1" protective ferrule. 3"H x 2¼"W x 2¼"D. 12 oz. 		IPB- 5S -15S -30S -60S - 5M -15M -30M -60M	5 sec. 15 sec. 30 sec. 60 sec. 5 min. 15 min. 30 min. 60 min.	10.57	9.84	9.19	8.68	8.16	8.09	8.02
PER PERCENT TIMER Provides adjustable percentage of "ON" and "OFF" time within each fixed cycle. 15A SPDT switch. 3W 120V 60 Hz synch. 2¾" Bezel, 3"H x 2¼"W x 2¼"D. 12 oz. 		PER-15S -30S -60S - 5M -15M	15 sec. 30 sec. 60 sec. 5 min. 15 min.	16.41	15.28	14.26	13.47	12.68	12.57	12.45
HOURS METER — AC — NON-RESET Records elapsed time while 3W 120V 60 Hz synch. motor is energized. 2¾" sq. Bezel, 2½" diam. body. Hdwe. included. Wt. 12 oz. U/L and CSA. 		SN-200-1 -2 -3 -4 -5 -6 -7 -8	9999.9 sec. 99999 sec. 999.99 min. 9999.9 min. 99999 min. 999.99 hrs. 9999.9 hrs. 99999 hrs.	12.75	11.87	11.08	10.46	9.84	9.76	9.67
HOURS METER — AC — RESETTABLE Records elapsed time while 3W 120V 60 Hz synch. motor is energized. Resets with pushbutton. 2¾" sq. Bezel, 2½" diam. body. Hdwe. included. Wt. 12 oz. U/L and CSA listed. 		SR-240-1 -2 -3 -4 -5 -6 -7 -8	999.9 sec. 9999 sec. 99.99 min. 999.9 min. 9999 min. 99.99 hrs. 999.9 hrs. 9999 hrs.	25.74	23.96	22.37	21.12	19.88	19.70	19.53
HOURS METER — DC — NON-RESET Operates off any DC from 4 to 50 Volts. Polarity protected. Welded plastic case provides full enclosure. 2⅞" diam. Bezel. Very low power draw. U/L listed. 2⅞" Bezel. 2" diam. body. Wt. 12 oz. 		DC-260-7	9999.9 hrs.	26.74	24.89	23.23	21.94	20.65	20.47	20.28

PROGRAM TIMER
(REPEAT CYCLE TIMER)

TYPE 115
1-2-3 Poles



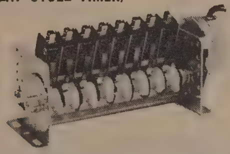
TYPE 130
4-5-6 Poles

Repeats continuously a preset program of ON/OFF switch operations. Or may be wired for single-revolution-and-stop operation. Cams are fully adjustable. 15A SPDT switches. 3W 120V 60 Hz motor. U/L and CSA listed. Approx. 3″W x 3″H. 8-16 oz. Instructions included.

No. of Poles	Distrib. Stock No.	Factory Pt. No.	Time Per Cycle	List 1-4	5-9	10-24	25-49	50-99	100-249	250-499
1		1151- 6S -15S -30S -60S - 6M -15M -30M -60M	6 sec. 15 sec. 30 sec. 60 sec. 6 min. 15 min. 30 min. 60 min.	$12.73	$11.88	$11.09	$10.47	$9.84	$9.75	$9.66
2		1152- 6S -15S -30S -60S - 6M -15M -30M -60M	6 sec. 15 sec. 30 sec. 60 sec. 6 min. 15 min. 30 min. 60 min.	14.24	13.26	12.37	11.69	11.00	10.90	10.80
3		1153- 6S -15S -30S -60S - 6M -15M -30M -60M	6 sec. 15 sec. 30 sec. 60 sec. 6 min. 15 min. 30 min. 60 min.	18.23	16.97	15.84	14.96	14.08	13.95	13.83
4		1304- 6S -15S -30S -60S - 6M -15M -30M -60M	6 sec. 15 sec. 30 sec. 60 sec. 6 min. 15 min. 30 min. 60 min.	22.56	21.01	19.61	18.52	17.43	17.27	17.12
5		1305- 6S -15S -30S -60S - 6M -15M -30M -60M	6 sec. 15 sec. 30 sec. 60 sec. 6 min. 15 min. 30 min. 60 min.	26.56	24.73	23.08	21.80	20.52	20.34	20.15
6		1306- 6S -15S -30S -60S - 6M -15M -30M -60M	6 sec. 15 sec. 30 sec. 60 sec. 6 min. 15 min. 30 min. 60 min.	30.57	28.46	26.56	25.09	23.61	23.40	23.19

PRECISION TIMER CO., INC.

PROGRAM TIMER — SERIES D-150
(REPEAT CYCLE TIMER)



	Distrib. Stock No.	Factory Pt. No.	No. of Poles	List 1-4	5-9	10-24	25-49	50-99	100-249	250-499
FRAME		D-150-2	2	$12.02	$11.29	$10.44	$9.86	$9.28	$9.20	$9.12
		-3	3	16.30	15.17	14.16	13.37	12.59	12.47	12.37
		-4	4	21.07	19.61	18.30	17.29	16.27	16.12	15.99
		-6	6	27.79	26.34	24.58	23.21	21.85	21.65	21.47
		-8	8	36.25	33.75	31.50	29.75	28.00	27.75	27.50
		-10	10	44.87	41.77	38.98	36.82	34.65	34.33	34.04
		-12	12	56.32	52.43	48.93	46.22	43.50	43.11	42.73
		-16	16	78.04	72.66	67.81	64.04	60.28	59.74	59.21
ANY MOTOR	— SEE CHART —		—	6.00	5.59	5.22	4.93	4.64	4.60	4.55
ANY GEAR	— SEE CHART —		—	1.45	1.35	1.26	1.19	1.12	1.11	1.10
DIAL KIT		KTD-150	—	1.32	1.23	1.15	1.08	1.02	1.01	1.00

Repeats continuously a preset program of ON/OFF switch operations, or may be wired for single-revolution-and-stop operation. Cams are fully adjustable. 15A SPDT switches are field replaceable. 3W 120V 60 Hz motors are interchangeable and include pinion on output shaft. 2½″W x 3″H. Wt. 12-24 oz. U/L and CSA listed. Features broad selection of number of poles and of speeds from shelf stock. (Inquire as to many other models, types, and speeds from Factory Stock.) Instructions included.

Order Frame of desired number of poles.

Order Motor and order Change Gear from Speed Selection Chart below, to obtain desired Time per Camshaft Revolution. (Hundreds of other speeds available on request from Factory Stock.)

Order additional Motors and Gears if you plan to experiment at various speeds.

Order Dial Kit for your convenience in adjusting timing of cams.

— SPEED SELECTION CHART —

Time for each Camshaft Revolution

MOTORS:

GEARS:

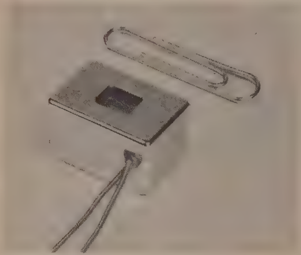
			M-20	M-5	M-1	M-1/3	M-1/12	M-1/60	M-1/180	M-1/720	Distr. Stock No. Motor Pt. No.
Distrib. Stock No.	Factory Pt. No.	No. of Teeth	20 RPM	5 RPM	1 RPM	1/3 RPM	1/12 RPM	1/60 RPM	1/180 RPM	1/720 RPM	Motor Speed
	G-16	16	4 sec.	16 sec.	80 sec.	4 min.	16 min.	80 min.	4 hrs.	16 hrs.	
	-20	20	5 sec.	20 sec.	100 sec.	5 min.	20 min.	100 min.	5 hrs.	20 hrs.	
	-24	24	6 sec.	24 sec.	120 sec.	6 min.	24 min.	120 min.	6 hrs.	24 hrs.	
	-28	28	7 sec.	28 sec.	140 sec.	7 min.	28 min.	140 min.	7 hrs.	28 hrs.	
	-32	32	8 sec.	32 sec.	160 sec.	8 min.	32 min.	160 min.	8 hrs.	32 hrs.	
	-36	36	9 sec.	36 sec.	180 sec.	9 min.	36 min.	180 min.	9 hrs.	36 hrs.	
	-40	40	10 sec.	40 sec.	200 sec.	10 min.	40 min.	200 min.	10 hrs.	40 hrs.	
	-44	44	11 sec.	44 sec.	220 sec.	11 min.	44 min.	220 min.	11 hrs.	44 hrs.	
	-48	48	12 sec.	48 sec.	240 sec.	12 min.	48 min.	240 min.	12 hrs.	48 hrs.	
	-52	52	13 sec.	52 sec.	260 sec.	13 min.	52 min.	260 min.	13 hrs.	52 hrs.	
	-56	56	14 sec.	56 sec.	280 sec.	14 min.	56 min.	280 min.	14 hrs.	56 hrs.	
	-60	60	15 sec.	60 sec.	300 sec.	15 min.	60 min.	300 min.	15 hrs.	60 hrs.	

PRECISION TIMER CO., INC. / WESTBROOK, CONNECTICUT 06498 / (203) 399-6253

projects® unlimited Audio Indicators

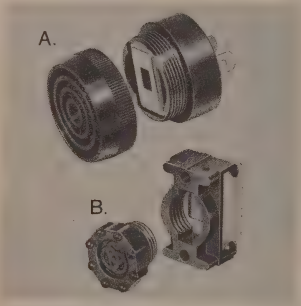
Solid state. No moving contacts. No arcing or RF noise. Low current drain. Built for long, dependable service.

Miniature solid state audio indicators



AI-100 series. Nickel plated, steel encased. Emits 76 dB tone @ 400 Hz. Maximum current 30 mA. Four models. AI-101 (3 vdc). AI-103W (3 vdc) with third wire collector output. AI-105 (5 vdc—shown at right) and AI-112 (12 vdc). Weight ¼ ounce (7 grams). Dimensions: .91″ L. x .47″ H. x .61″ W. (23 x 12 x 15.6 mm).

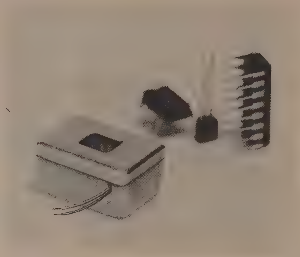
Plastic panel mounts for AI-100 series



(A) PM-100 fits 1⅛″ (28.5 mm) diameter opening in panels to ⅛″ (3.2 mm) thick. Terminals accept .250″ (6.4 mm) disconnects, screws or solder.

(B) PM-101 fits ½″ (12.7 mm) diameter opening in panels to ⅛″ (3.2 mm) thick. Mounts with bezel, screws or adhesive.

5-Volt audio indicators for IC's and logic circuits

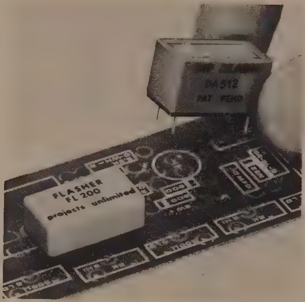


AI-105. 5 vdc. Draws 30 mA. Steel encased. Weighs only 7 grams. Ideal for compact, highly reliable warning or alarm system. Installs with panel mounts or tape.

The 2-pin audio indicator for PC boards and wave soldering

AI-400. 1.625″ (41.3 mm) diameter x ½″ (12.7 mm) high (38 x 13 mm). Emits approximately 70 dB tone at 2900 Hz. 3 to 15 vdc. Designed with 2 pins for PC board mounting and wave soldering. 10-20 mA. current consumption.

DIP-ALARM™ solid state audio indicators



DA-500 series. First miniature solid state indicator of its kind. Plugs in 16 pin DIP socket or mounts directly to PC board. Three models. DA-503 (3 vdc), DA-505 (5 vdc) and DA-512 (12 vdc) all with collector output available. Weight 3.5 grams. Dimensions: .90″ L. x .50″ H. x .50″ W. (22.9 x 12.7 x 12.7 mm). 76 dB at 400 Hz.

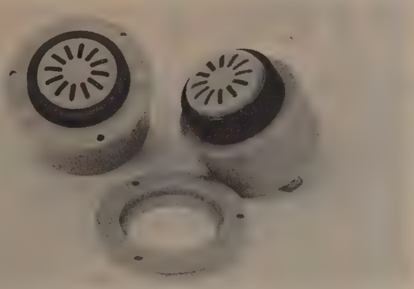
DIP-FLASH® solid state pulser

DIP-FLASH™
FL 200
projects unlimited

FL-200 series. Interrupts or pulses loads up to 200 mA, 5 to 15 vdc, at 90 cycles per minute. Fits standard 16 pin DIP socket or PC board. Ideal companion to AI and DA series audio indicators and LED's. Weight 2.5 grams. Dimensions: .90″ L. x .35″ H. x .50″ W. (22.9 x 8.0 x 12.7 mm).

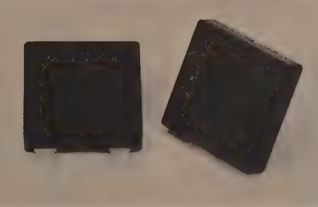
for every requirement

New panel mounted solid state audio indicators



AI-300 series. All are light gray, have .250″ (6.4 mm) fast-on terminals, fit 1⅛″ (28.5 mm) openings, have adapter ring for 1½″ (38.1 mm) to 1⅝″ (41.3 mm) holes. Depth required behind panel is 1″ (25.4 mm). AI-320 piezo crystal units produce approximately 80 dB @ 2900 Hz. 5 to 15 vdc. 10-20 mA. 28 gm. AI-330 pure tone audio indicator 80 dB @ 800 Hz. (special frequencies can be supplied on large quantity orders). 5 to 15 vdc. 40 mA. AI-340 has adjustable pure tone from 400 to 1000 Hz. Otherwise similar to AI-330. AI-350 for use with external oscillating circuits. 8 Ohms impedance.

Pulsing or continuous audio indicators

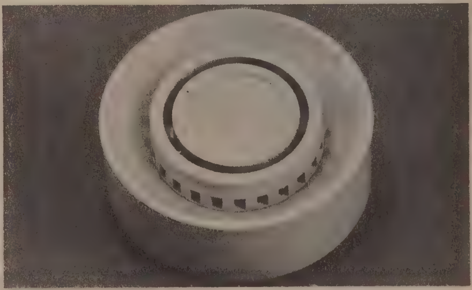


X-10. Piezo crystal. Emits approximately 90 dB at 3300 Hz. 10 mA. 3 to 7 vdc and 7 to 20 vdc. Dimensions: 1⅝″ square x 5/16″ high. (40 x 40 x 8 mm). Available with pins for PC mounting, fast-ons or wire. Choose continuous or pulsing model which is ⅝″ (16 mm) high. Excellent for computer terminals, etc. Weight 12 grams.

Wall or panel mount solid state audio indicators

X-40. White. Piezo crystal. 95 dB at 2700 Hz. 10 mA. Available in continuous, plus continuous and slow pulsing. Mounts with screws to wall or panel. Use wires or pins. 4⅛″ L. x 7/16″ H. x 2⅜″ W. (80 x 10 x 60 mm). Weight 35 grams.

Wall or panel mount solid state audio indicators



X-50. White. Piezo crystal. 110 dB at 2700 Hz. Excellent for fire alarms, burglar alarms, etc. Choose solid tone, or fast or slow pulsing, or all three. Mounts with screws. 3½″ diameter x 1½″ high (90 x 36 mm). Weight 41 grams.

Other products and services . . .

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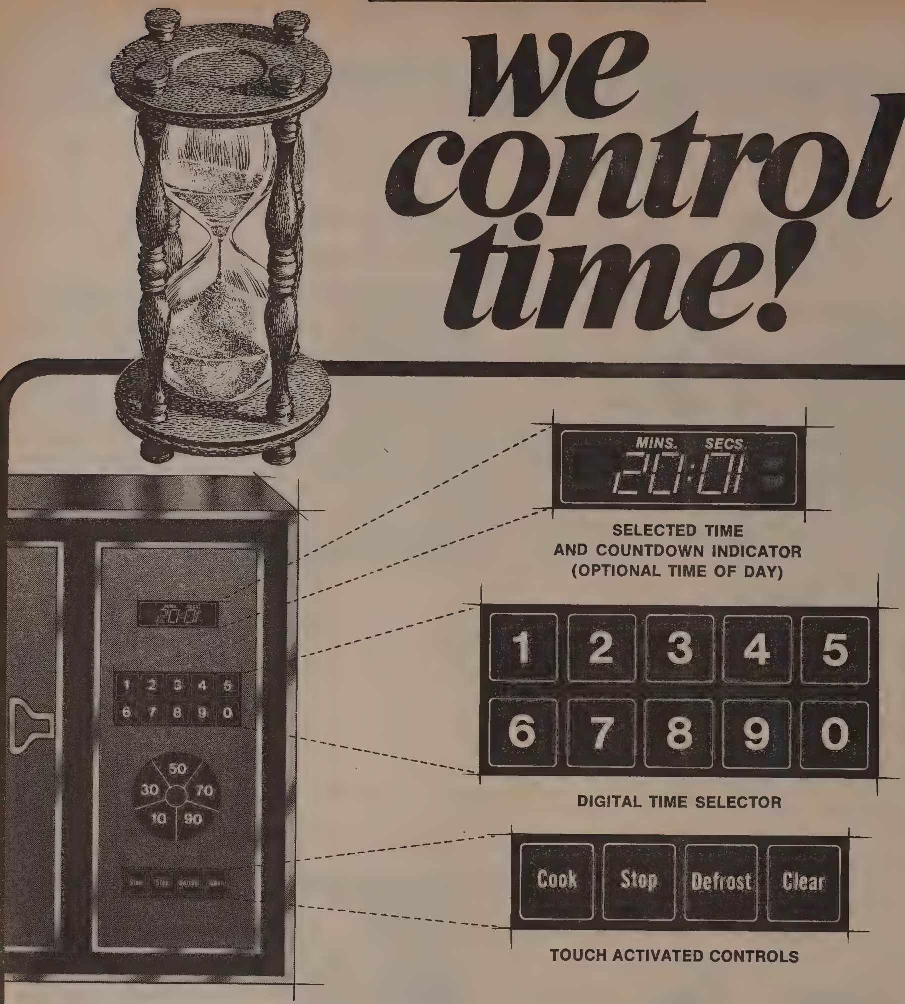
we control time!


MINS. SECS.
20:01
SELECTED TIME AND COUNTDOWN INDICATOR (OPTIONAL TIME OF DAY)
1 2 3 4 5
6 7 8 9 0
DIGITAL TIME SELECTOR
50 30 70 10 90
Cook Stop Defrost Clear
TOUCH ACTIVATED CONTROLS

Microwave ovens, conventional ovens, dishwashers, washing machines, dryers, water softeners or wherever programmed or sequential events must be controlled, REGMO DATA can make your timing controls more accurate, more reliable, more advanced and, most importantly, we can make your appliance more saleable.

This new "Touch Timer" concept is just another excellent example of our innovative design, economically-engineered using the latest in state-of-the-art techniques . . .

Desirable features include:

- **Solid-state reliability**
- **High density packaging**
- **Digital display**
- **Timing range:** 1 second to 100 minutes (hours or days)
- **Time of day** (optional)
- **Accuracy:** Well within 1% over the entire specified time range
- **Operating voltage:** 95V to 130V A.C.
- **Output:** Currents in excess of 25 amps

No wonder America's leading microwave manufacturers have incorporated our patented Timing Controls into their appliances.

REGMO DATA is prepared to think creatively for you . . .

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6992 Oxford St., Mpls., MN 55426

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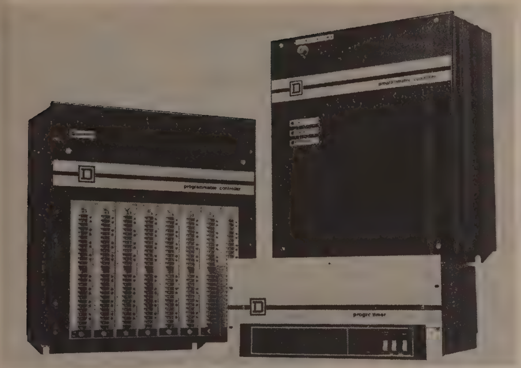
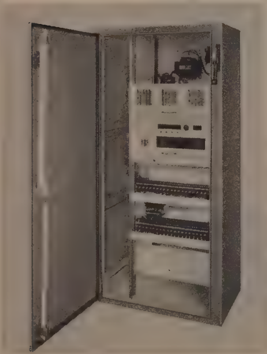
Complete control systems capability.

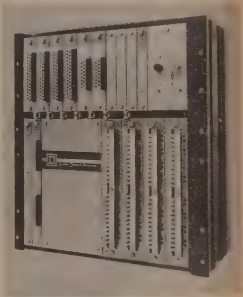


The new Class 8881 Programmable Controller is a solid state controller that is truly *programmable*. It delivers maximum flexibility at minimum cost for complex systems. The hardware permits memory loading using a single step programming technique called BLIP (Base Language Input Programming). This technique makes possible communication with the controller in the specific language of your particular industry. Memory capacity is expandable up to 16.000 words. The controller will accommodate up to 2.048 inputs and/or outputs in any combination in increments of 16. The Programmable Controller from Square D is adaptable to most applications, is suited for industrial environments and is extremely dependable.



The Program Sequence Controller—an economical solid state controller applicable for machines or processes which operate in a definite sequence. Programming is quick and easy—inputs and outputs are separately programmed at each step by simply inserting diode pins in matrix boards (no special programming equipment needed). Features include modular expandability of the number of inputs, outputs and steps. Also included are visual diagnostic aids. Options are available which permit programming time delays in any step, rearranging the step sequence, and handling some non-sequential operations. This pre-packaged controller, available in a NEMA 12 enclosure, is ready for immediate installation.

NORPAK® Solid State Control is the ideal logic control in industrial environments. NORPAK logic functions are available in two forms—Encapsulated or Plug-in. The Encapsulated version is suited to environmental extremes. It withstands shock, vibration, dust and corrosive fumes. Plug-in NORPAK components are suited to less hostile atmospheres and feature the ease of plug-in maintenance. Both forms, when properly applied, are virtually immune to electrical noise.



The Ladder Diagram Processor is a small, economical programmable controller designed to replace control systems using up to 32 relays. It can handle up to 32 inputs, 32 outputs, and up to 120 lines of relay ladder diagram. And the cost is comparable to hard-wired, electro-mechanical relay systems. Light Emitting Diode status indicators on all inputs, outputs, relay equivalents, and lines of the ladder diagram provide continuous monitoring of the control system. This means your plant electricians can work with the LDP by using the same relay control techniques they've developed over the years.

For specific engineering data on Programmable Controllers, Plug-in and Encapsulated Solid State Logic or Program Sequence Controllers, contact your nearby Square D field office. Or write Square D Company, Dept. SA-711, Milwaukee, Wisconsin 53201.

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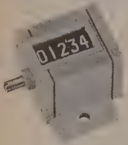
Small Square Case Mechanical Counter



Series 7458. Mech. totalizing. Nonreset. Low-friction design. Tamperproof. 5 to 7 figures, 3/16″ high. Direct, revolution, ratchet, rotary ratchet drives. Speed to 1000 cpm. For vending machines, elapsed time indicators, office machines.

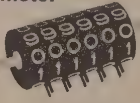
Small Reset Mechanical Counter

Series 7272. Totalizing. Knob reset (or nonreset). Rugged, long life. 4 or 5 figures, 3/16″ high. Speed to 1000 cpm. Ratchet or revolution drive.

Medium Size Mechanical Counter

Series 7428. Totalizing. Reset or nonreset. Easy-to-read figures, .270″ high. Speed to 2000 cpm. 3 to 8 figures. Direct, revolution, or rotary ratchet drives. Also with right angle drive and various gear ratios (Series 7434).

Veedometer

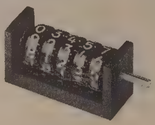


Series 1771. Mech. totalizing. Compact — yet with big figures. Low cost. Direct drive. Reset or nonreset. Speed to 5000 cpm. For OEM applications: elapsed time indicators, water meters, mileage odometers, etc.

Precision Digital Timer

Series 7665. Extremely accurate digital control timer. Controls time to 59 minutes, 55 seconds. Large .375″ high figures. Subtracts from manually set digital time. Actuates SPDT and bell at zero. Ideal for automatic time control of home appliances, laboratory instruments, medical equipment, and production processes.

Veederline/Varicounter

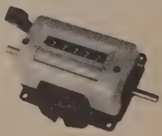


Series 1996. Mechanical totalizing. Direct drive, nonreset. Open frame. Many varieties. 3-7 figures, 3/16″ or 1/4″ high. Dual or tandem models available. Speed to 25,000 cpm.

Visicounter

Series 1667. Mech. totalizing. Reset. Heavy duty. 6 figures, .345″ high. Speed to 5000 cpm. Ratchet, revolution, or geared drive. Also with right angle drive (Series 1953).

Hi-Speed Quick Reset Predetermining Counter

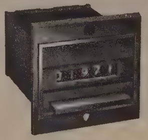


Series 7283. Finest all-mech. ctr. Speed to 6000 cpm. Count life 500,000,000! Reset life 1,000,000 guaranteed! Adjustable preset. Counts and opens switch. Reset restores counter to preset number. Rotary/ratchet drive. With panel mtg./electric reset (7601 Series) totalizing only (7298 Series).

Digi-Master II Predetermining Counter

Series 7129. Electronic preset counter. 4 digits, LED display, 1 or 2 presets. Output is SPDT 10A relay. Inputs are V-R photohead, switch, customer-supplied pulse, rotary pulse generator or Model 6144 magnetic sensor. Auto reset, manual and remote.

Low Cost Electric Counter with or without Bar Reset

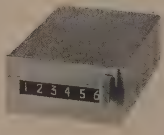


Series 7437/38. Low cost totalizer. 5, 6, 7 figs. nonreset. 5 figs. reset. 5/32″ high. Several mtg. versions. In 12, 24v-dc, 24, 15 or 230v-ac. UL and CSA recognized.

General Purpose Electric Counter

Series 7443. General purpose totalizing ctr. w/ac coil — no rectifier burnout. 6 figs. 3/16″ high, ac and dc voltages. Several mountings. UL, CSA recognized.

Hi-Speed Electric Counter



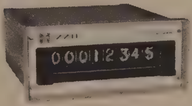
Series 7440. Electric reset. Compact. Speeds to 3000 cpm. Pawl or plug-in. Programmed mechanism ensures reliable reset. Manual, elec. reset or nonreset.

Total Capability from VEEDER-ROOT

Hi-Performance Predetermining Electric Counter

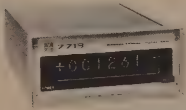
Series 7441. Interlock on preset number. Preset buttons change preset number. Programmed reset mechanism. Manual or elec. reset.

Unidirectional Totalizer



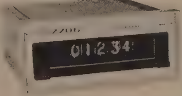
Series 7711. Electronic 4 or 6 digits. Inputs: V-R photohead. Optional: contact closure, incremental encoders, pulse or sine wave.

Bidirectional Totalizer



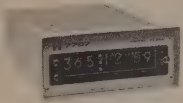
Series 7713. Electronic. 4 or 6 digits with ± sign. Std. input Model 1848 Encoder. Other inputs optional. Utilizes DTL/TTL microcircuits.

Time Base Counter



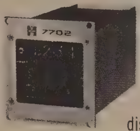
Series 7706. Electronic time base ctr. 3½" high. 2 to 5 digits with speeds to 500kHz. Displays events/time. Standard input: V/R photoheads. Options are contact closure, incremental encoders, pulse or sine wave. Static display.

Digital Clock



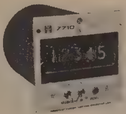
Series 7707 Monitors/displays real time through one year. 7 decades: 2 for minutes, 2 for hours, 3 for day of year. Solid state. Shows year in 1 to 365 days (1 to 366 for leap year). 12 hour am/pm or 24 hour models available. Latched BCD data and timing pulse output standard. Batteries and standby circuitry optional.

Predetermining Counter



Series 7702. Electronic preset ctr. 2 to 4 digits with one preset. With or without display. Standard inputs are contact closure, V/R photohead, or D.C. pulse — depends on model. Output is 2A. triac. Auto reset without loss of counts. Variable hold time on output. Panel mount.

Elapsed Time Indicator



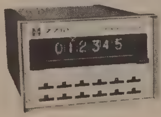
Series 7710. Electronic stopwatch measures/displays elapsed time. 5½ digits, quartz crystal oscillator accurate to 0.0005% of reading. Reset button stops/returns display to zero. Accepts signals from electromechanical and electronic devices. Triac output.

Digital Printer

Series 7480. Reliability/versatility at low cost. Prints on paper tape, cards, or oversize forms. Stores, displays and prints BCD data. Up to 10 columns. Up to 16 numerals and symbols per column.

The Total Capability Company

Unidirectional Preset Counter



Series 7712. Electronic preset ctr. 2 to 6 digits. One or two presets standard. Others available. SPDT output relays. Standard input: V/R photoheads. Options are contact closure, incremental encoders, pulse or sine wave.

Bidirectional Preset Counter

Series 7714. Electronic bidirectional preset ctr. 2 to 6 digits with ± sign. Available in multi-row presets. 5¼" high. High speed with auto reset or latch and hold. SPDT output relays. Standard input is Model 1848 Encoder. Other inputs optional.

Remote Ticket Printer

Series 7690. Low cost counter and printer in one package. The "simple" printing machine. Prints up to 7 copies clearly on tickets and carbon packs. Has optional LED display for unit totalizing and 7-figure accumulative totalizer. Start/print switch also actuates interlock relay that permits remote motor control. Reliable heavy duty print mechanism.

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We have hundreds more. Or make it to your specs – an individual device or a complete package. Contact nearest V-R sales office listed in Yellow Pages and Thomas Register. Or write V-R, 70 Sargeant St., Hartford, Conn. 06102. Or call (203) 527-7201.

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Hartford, Conn. 06102 — (203) 527-7201 A VEEDER INDUSTRIES COMPANY

VERNITECH

DIVISION OF VERNITRON CORPORATION

NOW AVAILABLE FOR THE FIRST TIME, REPAIRABLE AND NON-REPAIRABLE SYNCHRO CONVERTER MODULES, PLUS CONVERTERS IN BOARD CONFIGURATION.

SYNCHRO/RESOLVER TO DIGITAL CONVERTERS

Hz	L-L Voltage	Resolution	Power Requirements	Size (Inches)	Model No.	Available Options
60	90	14 Bit Binary	±15 VDC; +5V; 115 VAC Ref.	2⅝ x 3⅛ x .82 (plus XFRMR)	VSD-609SM	1. Board Configuration
60	90	0-3599 BCD	±15 VDC; +5V; 115 VAC Ref.	5 x 3¾ x 1	VSD-609SM-D	2. Self Contained Power Supplies
400	11.8	14 Bit Binary	±15 VDC; +5V; 26 VAC Ref.	2⅝ x 3⅛ x .82	VSD-401SM	3. −55°C to +85°C Operating Temperature
400	11.8	0-3599 BCD	±15 VDC; +5V; 26 VAC Ref.	5 x 3¾ x 1	VSD-401SM-D	4. Serial Output 5. ± BCD Output
400	90	14 Bit Binary	±15 VDC; +5V; 115 VAC Ref.	2⅝ x 3⅛ x .82	VSD-409SM	6. Multi-speed Conversion
400	90	0-3599 BCD	±15 VDC; +5V; 115 VAC Ref.	5 x 3¾ x 1	VSD-409SM-D	7. Multi-channel Conversion

ALL VERNITRON CONVERTERS WILL:

1. Operate over 0-70°C range.
2. Have a Digital Interface with DTL or TTL Compatible Logic.
3. Accuracy — ±4 minutes ±1.19
4. Track at 360°/second (400Hz), 180°/second (60Hz).
5. Be repairable in the field, if ever necessary.

DIGITAL TO SYNCHRO/RESOLVER CONVERTERS

Hz	Output Voltage	V.A. Output	Accuracy	Power Requirements	Size (inch)	Model No.	Available Options
60	90	2	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 2*	VDS-609SP-2	1. Modular Configuration
60	90	5	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 1**	VDS-609SP-5	2. Self Contained Power Supplies
400	11.8	2	±1 LSB	±15 VDC; +5 VDC; 26 VAC Ref.	5 x 4 x 2	VDS-401SP-2	3. −55°C to +85°C Operating Temperature
400	11.8	5	±1 LSB	±15 VDC; +5 VDC; 26 VAC Ref.	5 x 4 x 1**	VDS-401SP-5	
400	90	2	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 2*	VDS-409SP-2	4. Serial Input
400	90	5	±1 LSB	±15 VDC; +5 VDC; 115 VAC Ref.	5 x 4 x 1**	VDS-409SP-5	5. Multi-channel Inputs

ALL VERNITRON CONVERTERS HAVE:

1. 12 Bit parallel binary coded angle input (MSB = 180°, . . .).
2. Digital interface compatible with DTL or TTL logic.
3. Field repairability, if ever necessary.
4. Storage Registers available at no extra cost.

* Transformers to be mounted externally.

** Transformers, power transistors, and heat sinks to be mounted externally. Consult factory for required volume.

SPECIAL CONVERTERS

Type Converter	Part Number	Description
Solid State Synchro Signal Amplifier	VSA-101	Input: 3 Wire Synchro Data, 90V L-L, 60 or 400 Hz; 115V Reference Output: 3 Wire Synchro Data, 90V L-L, 60 or 400 Hz Channels: Two, each completely isolated Accuracy: Plus/Minus 6 minutes of arc Size: Standard 19″ Rack (19″ x 6″ x 20″) Misc.: Self-contained Power Supplies; Short Circuit Protected; Automatic Cutoff of DC Supply if Overload exists; Overload Indicator
Synchro/Resolver to Linear DC Converter	VSDC-401-SP VSDC-409-SP VSDC-609-SP	All parameters identical to those of the Synchro/Resolver to Digital converters, except: 1) Accuracy — ±10′ at room temperature 2) Digital output also available in addition to DC 3) Output 0-10 VDC, 0-5 VDC, 0-±10 VDC, 0-±5 VDC
Synchro/Resolver to Sine-Cosine DC Converter	VSDC-401-SP-A VSDC-409-SP-A VSDC-609-SP-A	All parameters identical to those of the Synchro/Resolver to Digital converters, except: 1) Accuracy — ±10′ of arc at room temperature 2) Output ranges same as Synchro to DC above, except in sine-cosine form
Sine-Cosine DC to Synchro Converter	VDCD-401-SP-A VDCD-409-SP-A VDCD-609-SP-A	All parameters identical to those of the Digital to Synchro/Resolver converters, except: 1) Accuracy — ±10′ of arc at room temperature (Dependent upon load) 2) Input Levels 0-10 VDC, 0-5 VDC, 0-±10 VDC, 0-±5 VDC

STILL OTHER PACKAGES AVAILABLE AT VERNITECH:

DC TO SYNCHRO • STANDARD SERVO PACKAGES • SUB-SYSTEMS, WITH DISPLAYS AND POWER SUPPLIES
DIGITAL TO SHAFT POSITION CONVERTERS • UP-DOWN COUNTING SERVO PACKAGES • TORQSYN-ENCODER PACKAGES

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DIVISION OF VERNITRON CORPORATION
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for

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Problems with VISIBILITY?
Problems with LIFE?
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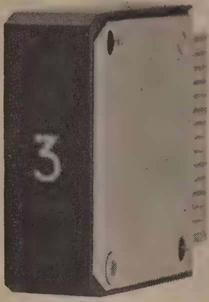
Call VERNITECH (516) 586-5100 for selection from the widest available range of RELIABLE electro-magnetic readouts

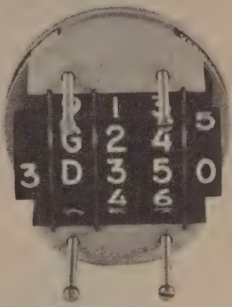
The tiny module that converts digital inputs to an electro-magnetic readout. In addition to standard models listed, Vernitech will manufacture to your specifications.

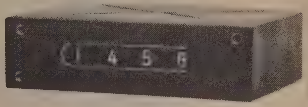
Part No.	Volts D.C.	No. of Char.	Size of Char.	Pulse Mode	No. of Leads or Term.
06VEA-0022	10	11	.156 x .156	1-1-1-1	12 L
06VBA-0048	10	10	.156 x .156	1-2-1-2	6 T
06VBD-1105 3 Position Flag	10	3	.187 x .187	Return to Flag with Power off	3 T
12VBB-1002	6	10	.281 x .250	Polarity Reversal	6 P/C
12VAC-0015	6	11	.250 x .156	1-1-1-1	12 P/C

Write or phone today for detailed bulletin and stock list.



VERNIDEX STANDARD
½ x 1½ x 1½





VERNIDEX MINIATURE

Vernitech has fully qualified hermetically sealed units to military specs with regard to:

Altitude	Shock	Fungus	Radio Interference
Temperature	Salt Spray	Explosion	Life
Vibration	Sand/Dust	Acceleration	Fogging

ALL MODELS AVAILABLE WITH FULL LOGIC SELF-CONTAINED—ACCEPTS BCD INPUT

VIBRATORS

VERNITRON CORP.

The VERNIBRATOR is an electro-mechanical vibrating device originally designed to eliminate stiction from instruments such as altimeters, etc. The Vernitech vibrator produces exceptionally High-G forces over 10,000 hours of failure and maintenance-free operation, while consistently attaining reliable low-voltage operation.

Consult the factory for either standard or custom-made designs.

Part No.	Input Voltage	Input Current	Peak G's	Size (Inches)	Weight
PX 10014	28 VDC	50 ma	.75 - 2.0	1.6 x .67 x .65	28 grams
PX 10018	13-15 VDC	25 ma max. @ 13V	.75 - 2.0	1.6 x .67 x .65	28 grams
PX 10021	21-28 VDC	25 ma @ 21V 30 ma @ 28V	.75 - 2.0	1.0 x .725 x .65	24 grams
PX 10036	14-28 VDC	30 ma max.	.25	.75 x .725 x .65	22 grams

AVAILABLE WITH AND WITHOUT MOUNTING PLATES

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DIVISION OF VERNITRON CORPORATION
300 Marcus Boulevard, Deer Park, New York 11729 / (516) 586-5100, TWX: 510-227-6079

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VARO

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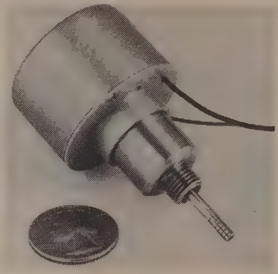
Varo actuators combine a variety of custom designed mechanical devices such as: gearboxes, brakes, clutches, governors and torque limiters. Control circuitry can be supplied for your application.

We also supply high-temperature and high-pressure solenoid valves for missile servo systems, aircraft air-conditioning and fuel control systems.

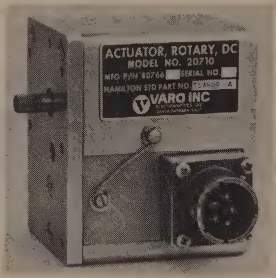
The units shown below represent a few of the types commonly designed and manufactured. We may have an existing design that will meet your requirements. Call or write Department 420 VARO INC EK DIVISION.

20707 MOTOR



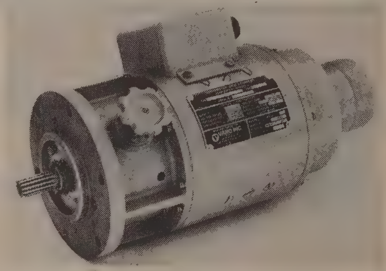
Direct Current PM Motor Electronically Governed to Provide Speed Regulation of ± 0.5 Percent.

20710 ACTUATOR



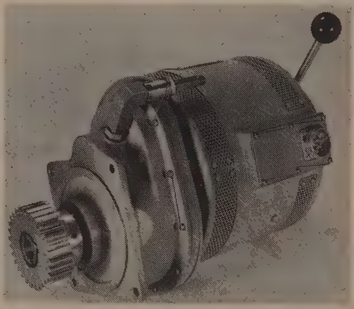
30 IN-LB at 6°/SEC DC Servoactuator Utilized for High Response, Reversing Pulse Width Modulated Servo Systems.

20693 SERVOMOTOR



Linear Torque DC Servomotor Rated at 3.24 FT-LB at 2000 RPM, Equipped with Tachometer, Electromagnetic Brake and Manual Drive.

20590 ACTUATOR



2 H.P., 60 HZ, 115/208V Continuous Duty

VARO

VARO INC ELECTROKINETICS DIVISION, Department 420
P.O. Box 1500, 402 East Gutierrez
Santa Barbara, CA 93102

Telephone:
(805) 963-2055

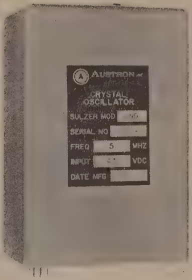
SERIES 1100 CRYSTAL OSCILLATORS

HIGH STABILITY OVEN-CONTROLLED

MODEL 1150

The Model 1150 is a very rugged, high precision, crystal oscillator specifically designed for use in satellite navigation systems or other applications which demand a precise time base frequency reference.

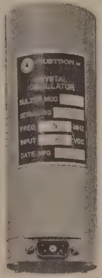
Frequency:	5 MHz
Output:	1 vrms sine wave
Aging:	5 X 10^{-11}/day ultimate aging
Input Voltage:	27 VDC ±10%
Input Power:	2.5 watts operating
Size:	2⅜" X 3-3/16" X 5"
Weight:	2 lbs max


AUSTRON
CRYSTAL OSCILLATOR
SULZER MOD
SERIAL NO
FREQ
5
MHZ
INPUT
VDC
DATE MFG

MODEL 1115

The Model 1115 is specifically designed for use in undersea equipment or other applications where high stability and minimal power consumption are of prime importance.

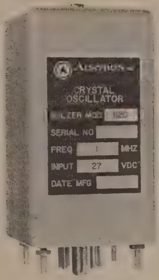
Frequency:	5 MHz
Output:	1 vrms sine wave
Aging:	1 X 10^{-9}/day ultimate aging
Input Voltage:	12 to 15 VDC ±5%
Input Power:	150 mw @ 25°C (typical)
Size:	2" diameter X 5½" length
Weight:	12 ounces


AUSTRON
CRYSTAL OSCILLATOR
SULZER MOD
SERIAL NO
FREQ
5
MHZ
INPUT
VDC
DATE MFG

MODEL 1120

The Model 1120 is a compact, rugged crystal oscillator specifically designed for use in counters, synthesizers and communications equipment.

Frequency:	1 MHz, 5 MHz or 10 MHz
Output:	1 vrms sine wave
Aging:	1 X 10^{-9}/day ultimate aging
Input Voltage:	12v to 27v DC
Power Consumption:	3 watts operating (typical)
Size:	2¼" X 2⅛" X 4"
Weight:	9 ounces


AUSTRON
CRYSTAL OSCILLATOR
SULZER MOD
1120
SERIAL NO
FREQ
1
MHZ
INPUT
27
VDC
DATE MFG

MODEL 1100

The Model 1100 is high stability crystal oscillator combining precision performance specifications with small size for applications where available space is at a premium.

Frequency:	5 MHz
Output:	1 vrms sine wave
Aging:	1 X 10^{-9}/day ultimate aging
Input Voltage:	12 VDC to 27 VDC
Input Power:	2 watts operating (typical)
Size:	1¼" X 1¾" X 3¼"
Weight:	7 ounces

AUSTRON
CRYSTAL OSCILLATOR
SULZER MOD
1100
SERIAL NO
FREQ
5
MHZ
INPUT
27
VDC
DATE MFG

AUSTRON

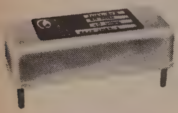
1915 KRAMER LANE
AUSTIN, TEXAS 78758
TELEPHONE (512) 836-3523

CRYSTALS/OSCILLATORS/CRYSTAL FILTERS

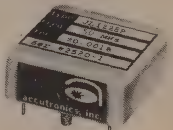
OSCILLATORS

1 Hz to 250 MHz

ANALOG ENGINEERS — We haven't forgotten you. Accutronics has not devoted all its engineering talents to digital devices which are compatible with TTL, ECL, MECL and COS/MOS logic. In our standard product line we carry a complete line of SINE WAVE oscillators from 1 Hz to 250 MHz. Space does not permit us to depict all of our units, but if you review the units below, more than likely you will find one which is GREAT for your ANALOG application.

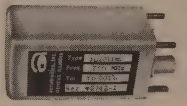


SERIES 100

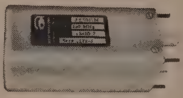


SERIES 110

SERIES 140



SERIES 150

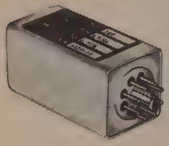


SERIES 165

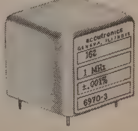
PARAMETER (1)	SERIES 100	SERIES 110	SERIES 140	SERIES 150	SERIES 165 (3)
Frequency Range	15 KHz / 1 MHz	10 MHz / 250 MHz	1 Hz / 1 MHz	1 MHz / 250 MHz	1 MHz / 150 MHz
Supply Voltage	+12 VDC	+12 VDC	+12 VDC	+12 VDC	+12 / +28 VDC
Distortion	<5%	<10%	<5%	<10%	—
Output Voltage	1 VRMS ±30%	>.5 VRMS	1 VRMS ±30%	>.5 VRMS	>.17 VRMS
Load	10 KΩ	50 Ω	10 KΩ	50 Ω	50 Ω
−55°C to +75°C (2)	±.025%	±.005%	±.025%	±.005%	—
0 to +60°C (2)	±.005%	±.001%	±.005%	±.001%	±1 x 10^{-7}
+15°C to +35°C (2)	±.002%	±.0005%	±.002%	±.0005%	—
Current Drain	<50 ma	<30 ma @ 10 MHz <60 ma @ 250 MHz	<175 ma @ 1 Hz <50 ma @ 1 MHz	<50 ma @ 1 MHz <35 ma @ 250 MHz	15W @ turn-on: 6W @ 25°C Following 1 Hour Warmup
Size	1.5 x 3.1 x 1.0	1.5 x 1.5 x 1.5	1.5 x 1.5 x 3.0	1.5 x 1.5 x 2.0	2.0 x 2.0 x 4.5

(1) These are typical specifications — please consult factory for more details. (2) Frequency tolerance versus temperature.
(3) Special oven series — please consult factory.

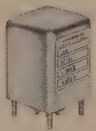
LOW CURRENT DRAIN GROUP



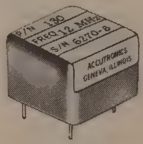
SERIES 160/160A



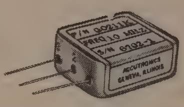
SERIES 162



SERIES 164



SERIES 130



SERIES 60A

PARAMETER (1)	SERIES 160	SERIES 160A	SERIES 162	SERIES 164	SERIES 130	SERIES 60A
Frequency Range	300 Hz / 10 KHz	300 Hz / 10 KHz	60 Hz / 1 MHz	60 Hz / 1 MHz	6 MHz / 150 MHz	5 MHz / 30 MHz
Supply Voltage	+12 VDC	+28 VDC	+12 VDC	+12 VDC	+12 VDC	+5 VDC
Distortion	<5%	<5%	<5%	<5%	<10%	<10%
Output Voltage	>1 VRMS	>3 VRMS	1 VRMS ±30%	1 VRMS ±30%	>.15 VRMS	>.35 VRMS
Load	10 KΩ	10 KΩ	10 KΩ	10 KΩ	50 Ω	1 KΩ
−55°C to +75°C (2)	—	—	±.005%	±.005%	±.005%	—
0 to +60°C (2)	±.01%	±.01%	±.001%	±.001%	±.002%	±.01%
+15°C to +35°C (2)	—	—	±.0005%	±.0005%	±.001%	—
Current Drain	<15 ma	<30 ma	<15 ma	<15 ma	<40 ma	<20 ma
Size	1.5 x 1.5 x 3.0	1.5 x 1.5 x 3.0	1.5 x 1.5 x 1.37	1.5 x 1.5 x 2.0	1.0 x 1.0 x .75	1.0 x 1.125 x .5

(1) These are typical specifications — please consult factory for more details. (2) Frequency tolerance versus temperature.

INTERESTED? — Call Gerald DeWar at (312) 232-2600, and he will be glad to fill you in on all the details and send you our new catalog.

"THE PRODUCTION SPECIALISTS with short run capabilities"

SURE, anyone can build one oscillator or maybe two! But when it comes to that production need — We OFFER: P.C.B. capabilities, automatic insertion equipment, low cost and deliveries consistent with your needs.

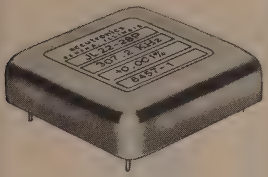
accutronics
A HAMMOND CORPORATION COMPANY

628 North St. Geneva, Illinois
Area Code 312 232-2600
TWX: 910-237-1680 CBL: AKUTRONX

OSCILLATORS

1 Hz to 150 MHz

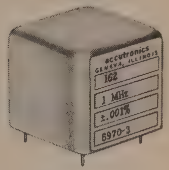
DIGITAL DESIGN ENGINEERS — YES! In conjunction with our line of sinewave oscillators, we are still producing all types of digital units. We can offer you compatibility with COS/MOS, TTL, DTL and other logic functions. We package these units in any one of the configurations shown in our line of sinewave standards. FOR EXAMPLE: Review the specifications on our Series 90 and 162 below, more than likely they will fill your application requirements.



SERIES 90

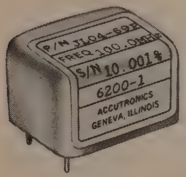
PARAMETER (1)	SERIES 90	SERIES 162
Frequency Range	20 Hz / 6 MHz	1 Hz / 1 MHz
Supply Voltage	+5 VDC	+20 VDC
Rise/Fall Time	<50 ns / <25 ns	<250 ns / <200 ns
Source Voltage	>2.4V	+15V min. @ 10 MOS Loads
Sink Voltage	<.4V	+.1V max. @ 10 MOS Loads
Load	TTL / DTL	MOS Logic
−55°C to +75°C (2)	±.005%	±.005%
0 to +60°C (2)	±.001%	±.001%
+15°C to +35°C (2)	±.0005%	±.0005%
Current Drain	<60 ma @ 23 Hz	<5 ma @ 1 Hz
Symmetry	50 / 50 ±1%	50 / 50 ±1%
Size	2.0 x 2.0 x .500	1.5 x 1.5 x .625

(1) These are typical specifications — please consult factory for more details.
(2) Frequency tolerance versus temperature.

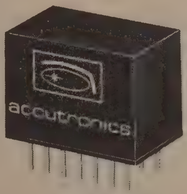


SERIES 162

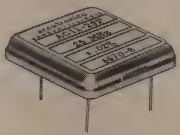
PERHAPS your application requires something more exotic in packaging techniques, WHY NOT TRY our Series 90A, 80, 50 or 40? The ultimates in discrete "state of the art technology."



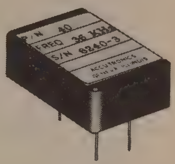
SERIES 90A



SERIES 80



SERIES 50



SERIES 40

PARAMETER (1)	SERIES 90A	SERIES 80	SERIES 50	SERIES 40
Frequency Range	6 MHz / 50 MHz	250 KHz / 30 MHz	3 MHz / 30 MHz	32 KHz / 85 KHz
Supply Voltage	+5 VDC	+5 VDC	+5 VDC	+5 VDC to +15 VDC
Rise/Fall Time	<15 ns / <10 ns	<50 ns	<25 ns / <20 ns	<150 ns
Source Voltage	>2.4V	>2.4V	>2.4V	>2.4V
Sink Voltage	<.4V	<.4V	<.4V	<.4V
Load	TTL or DTL	TTL (10)	TTL / DTL	TTL / DTL
−55°C to +75°C (2)	±.005%	—	±.015%	—
0 to 60°C (2)	±.001%	±.005%	±.005%	±.015%
+15°C to +35°C (2)	±.0005%	—	±.001%	—
Current Drain	<30 ma	<100 ma @ 250 KHz	<30 ma	<10 ma
Symmetry	50 / 50 ±1%	50 / 50 ±20%	50 / 50 ±15%	50 / 50 ±10%
Size	1.0 x 1.250 x .500	.495 x .800 x .590	1.5 x 1.5 x .325	1.0 x 1.5 x .500

(1) These are typical specifications — please consult factory for more details. (2) Frequency tolerance versus temperature.

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ERIE/PENNSYLVANIA 16512
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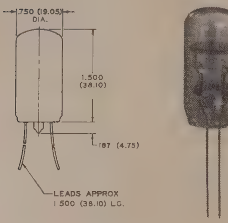
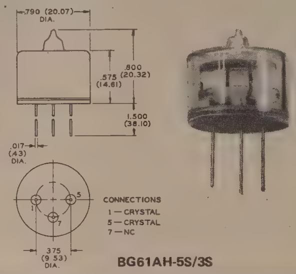
Ultra High Stability Glass Units

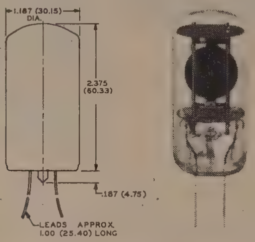
THIS IS AN OUTSTANDING GROUP OF CRYSTAL UNITS INCORPORATING THE ADVANCED TECHNOLOGY AND CRAFTSMANSHIP THAT HAS MADE BLILEY FAMOUS FOR QUALITY WITHOUT COMPROMISE. EXCEPTIONALLY LOW AGING AND HIGH Q CHARACTERISTICS PROVIDE PRECISION REFERENCE FOR SNYTHESIZERS AND SYSTEM CLOCKS.



BG61AH-5



BG61AH-5S/3S



BG93A

BLILEY TYPE	FREQ. RANGE	MODE	NOM. FREQ. TOL.	MAX. EFFECTIVE RESISTANCE (OHMS)	MAX. T.C.	T.P. RANGE	SHORT TERM STABILITY	SHOCK	VIBRATION	DRIVE LEVEL	AVERAGE Q
BG61AH-5S	5 MHz	A_5	±1 ppm @ T.P.	140/ser. res. 185/par. res. 32 pF	$<1 \times 10^{-7}$/°C @ optimum operating temp. ± 0.5°C	+70°C to +85°C	After restart: $<1 \times 10^{-9}$/ 24 hrs. $<5 \times 10^{-10}$/ 72 hrs.	50 G Freq. change $< \pm 1 \times 10^{-8}$	10-200 Hz 10 G Freq. change $< \pm 1 \times 10^{-8}$	70 μ A ±20%	2.5×10^6
BG61AH-5	5 MHz	A_5	±1 ppm @ T.P.	140/ser. res. 185/par. res. 32 pF	$<1 \times 10^{-7}$/°C @ optimum operating temp. ±0.5°C	+70°C to +85°C	1×10^{-9}/ 24 hrs. with temp. control within .01°C	50 G Freq. change $< \pm 1 \times 10^{-8}$	10-200 Hz 10 G Freq. change $< \pm 1 \times 10^{-8}$	70 μ A ±20%	2.5×10^6
BG61AH-3S	3.8–6.0 MHz	A_3	±4 ppm @ T.P.	50/ser. res. 65/par. res. 32 pF	$<1 \times 10^{-7}$/°C @ optimum operating temp. ±0.5°C	+70° to +80°C	After restart: $<3 \times 10^{-9}$/ 24 hrs. $<1 \times 10^{-9}$/ 72 hrs.	50 G Freq. change $< \pm 2 \times 10^{-8}$	10-200 Hz 10 G Freq. change $< \pm 2 \times 10^{-8}$	100 μ A max.	1.5×10^6
BG93A	1–5 MHz	A_f	±5 ppm @ T.P.	See chart below *	2×10^{-7}/°C (within T.P. ±1°C)	+60° to +85°C	—	30 G Freq. change $< \pm 1 \times 10^{-7}$	10-200 Hz 10 G Freq. change $< \pm 1 \times 10^{-7}$	2 mW max.	1.5×10^6

AGING CHARACTERISTICS

BG61AH-5S	BG61AH-5	BG61AH-3S	BG93A
5×10^{-10}/day after 3 days. 7×10^{-10}/wk. after 30 days. Based on continuous operation @ specified drive level and temp. stability within 0.005°C.	2×10^{-9}/wk. @ specified drive level and temp. stability within 0.005°C.	2×10^{-9}/day after 3 days. 1×10^{-9}/day after 1 wk. 2×10^{-9}/wk. after 30 days. Based on continuous operation @ specified drive level and temp. stability within 0.005°C.	2×10^{-8}/wk. (After 1 wk. & temp. within .01°C of T.P.)

*MAX ESR VALUES

FREQ. RANGE	ESR (OHMS)
1–1.9 MHz	25
2–2.9 MHz	40
3–3.9 MHz	25
4–5 MHz	20

ADDITIONAL PARAMETER DATA

BLILEY TYPE	L (INDUCTANCE)	C_m (MOTIONAL)	C_o (SHUNT)
BG61AH-5S	9.2 H	.00011 pF	4.3 pF
BG61AH-5	9.2 H	.00011 pF	4.3 pF
BG61AH-3S	2.0 H	.0005 pF	3.0 pF

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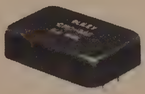
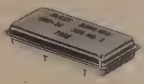
Crystal Clock Oscillators

BLILEY OFFERS A COMPLETE LINE OF CRYSTAL CLOCK OSCILLATORS BACKED UP BY TOP TECHNOLOGY IN THE FIELD OF CRYSTAL CONTROLLED DEVICES. A WIDE CHOICE OF MODELS IS AVAILABLE WITH EITHER SINE WAVE OR LOGIC OUTPUT TO DRIVE TTL CIRCUITRY. SELECTION OF THE CLOCK OSCILLATOR THAT IS BEST FOR YOUR APPLICATION IS DICTATED BY THE SIZE AND PERFORMANCE PARAMETERS AS WELL AS ECONOMIC CONSIDERATIONS. ALL MODELS HAVE BEEN DESIGNED WITH PRIMARY EMPHASIS ON QUALITY.

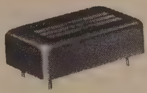
CMO-8



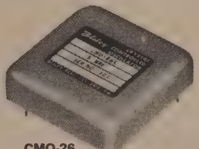
CMO-32C



CKO-31



CMO-3



CMO-26

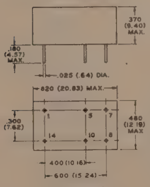
SPECIFICATION GUIDELINES

- MODEL CMO-8 IS SMALLEST SIZE. MODEL CMO-32C HAS LOWEST PRICE.
- MODELS CMO-8, CMO-32C, CKO-31 MOUNT IN STANDARD 14 PIN DIP SOCKETS, OR DIRECTLY ON PC BOARDS.
- ALL STANDARD MODELS ARE DESIGNED FOR OPERATION ON +5VDC WITH TTL LOGIC OUTPUT. CMOS LOGIC OUTPUT IS AVAILABLE AS A CUSTOM OPTION.
- MODEL CKO-31 IS COLDWELD SEALED.
- MODEL CMO-26 IS HERMETICALLY SEALED. ELECTRICAL OR MECHANICAL TRIM ARE AVAILABLE AS CUSTOM OPTION.

MODEL	FREQUENCY RANGE	TEMPERATURE RANGE			LOGIC OUTPUT
		0° TO +50°C OVERALL FREQ. TOL.	0° TO +70°C OVERALL FREQ. TOL.	−20° TO +70°C OVERALL FREQ. TOL.	
CMO-8	1 – 25 MHz	±.0025%	±.005%	±.01%	TTL
CMO-32C	1 – 25 MHz	±.0025%	±.005%	±.01%	TTL
CKO-31	300 kHz – 25 MHz	±.0025%	±.005%	±.01%	TTL

MODEL	FREQUENCY RANGE	TEMPERATURE RANGE				OUTPUT
		0° TO +50°C OVERALL FREQ. TOL.	0° TO +70°C OVERALL FREQ. TOL.	−20° TO +70°C OVERALL FREQ. TOL.	−40° TO +70°C OVERALL FREQ. TOL.	
CMO-3	20 kHz – 50 kHz	±.003%	±.005%	±.007%	±.012%	TTL Logic
	50 kHz – 25 MHz	±.001%	±.0012%	±.0015%	±.002%	TTL Logic
	3 MHz – 150 MHz	±.001%	±.0012%	±.0015%	±.002%	Sine Wave
CMO-26	50 Hz – 4 kHz	±.004%	±.006%	±.008%	±.01%	TTL Logic
	1 kHz – 50 kHz	±.003%	±.005%	±.007%	±.008%	TTL Logic
	50 kHz – 25 MHz	±.001%	±.0012%	±.0015%	±.002%	TTL Logic
	800 kHz – 150 MHz	±.001%	±.0012%	±.0015%	±.002%	Sine Wave

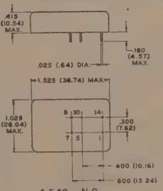
CMO-8



.370 (9.40) MAX.
.180 (4.57) MAX.
.025 (.64) DIA.
.820 (20.83) MAX.
.300 (7.62)
1
5
7
14
10
8
.480 (12.19) MAX
.400 (10.16)
.600 (15.24)

1,5,10 – N.C.
7 – GROUND
8 – OUTPUT
14 – +5Vdc

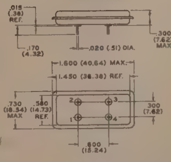
CMO-32C



.415 (10.54) MAX.
.180 (4.57) MAX.
.025 (.64) DIA.
1.525 (38.74) MAX.
1.025 (26.04) MAX.
8
10
14
7
5
1
.300 (7.62)
.400 (10.16)
.600 (15.24)

1,5,10 – N.C.
7 – COMMON
8 – OUTPUT
14 – +5Vdc

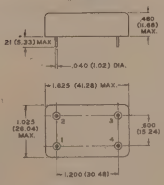
CKO-31



.015 (.38) REF.
.170 (4.32)
.020 (.51) DIA.
.300 (7.62) MAX.
1.600 (40.64) MAX.
1.450 (36.38) REF.
.730 (18.54) MAX
.580 (14.73) REF.
2
3
1
4
.300 (7.62)
.600 (15.24)

1 – NEG. OSC.
2 – N.C.
3 – +5Vdc
4 – OUTPUT

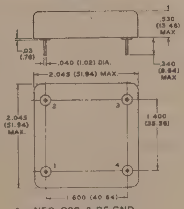
CMO-3



.460 (11.68) MAX.
.21 (5.33) MAX
.040 (1.02) DIA.
1.625 (41.28) MAX.
1.025 (26.04) MAX.
2
3
1
4
.600 (15.24)
1.200 (30.48)

1 – NEG. OSC. & RF GND.
2 – N.C.
3 – +5Vdc
4 – OUTPUT

CMO-26



.530 (13.46) MAX
.03 (.76)
.040 (1.02) DIA.
.340 (8.64) MAX
2.045 (51.94) MAX.
2.045 (51.94) MAX.
2
3
1
4
1.400 (35.56)
1.600 (40.64)

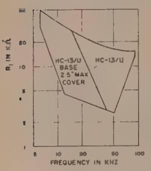
1 – NEG. OSC. & RF GND.
2 – VOLTAGE CONTROL OR N.C.
3 – +5Vdc
4 – OUTPUT

QUARTZ CRYSTALS • PACKAGED CRYSTAL OSCILLATORS • CRYSTAL FILTERS • SOLID ULTRASONIC DELAY LINES • CRYSTAL AND COMPONENT OVENS

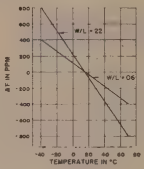
BULOVA ® Crystals 1 kHz

H (+5° *Flexural*)

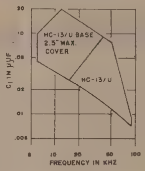
+5° X CUT (FLEXURE), RANGE OF R_1 VS FREQUENCY



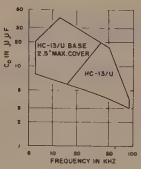
+5° X CUT (FLEXURE MODE) ΔF IN PPM VS ΔT (°C)



+5° X CUT (FLEXURE), RANGE OF C_1 VS. FREQUENCY

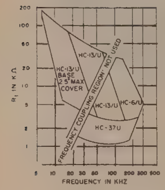


+5° X CUT (FLEXURE), RANGE OF C_o VS FREQUENCY

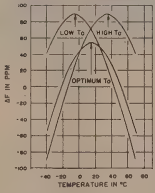


NT

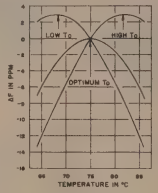
NT CUT, RANGE OF R_1 VS FREQUENCY



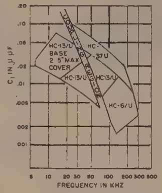
NT CUT, ΔF IN PPM OVER EXTENDED TEMPERATURE RANGE
To = ZERO TEMPERATURE COEFFICIENT POINT



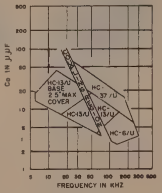
NT CUT, ΔT VS ΔT (°C) FOR OVEN REGULATED UNITS
To = ZERO TEMPERATURE COEFFICIENT POINT



NT CUT, RANGE OF C_1 VS FREQUENCY

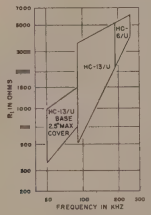


NT CUT, RANGE OF Co VS FREQUENCY

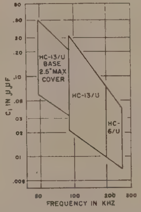


E (+5° *Extensional*)

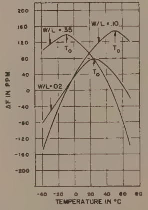
+5° X CUT RANGE OF R_1 VS. FREQUENCY



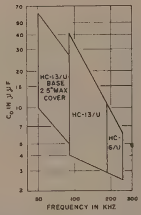
+5° X CUT, RANGE OF C_1 VS. FREQUENCY



+5° X CUT, ΔT IN PPM VS. ΔT (°C)
T_0 = ZERO TEMPERATURE COEFFICIENT POINT

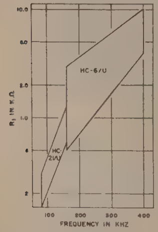


+5° X CUT, RANGE OF C_o VS FREQUENCY

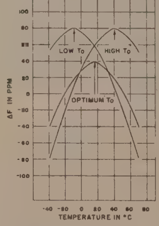


DT

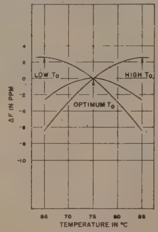
DT CUT, RANGE OF R_1 VS. FREQUENCY



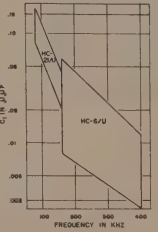
DT CUT, ΔF IN PPM VS ΔT (°C)
T_0 = ZERO TEMPERATURE COEFFICIENT POINT



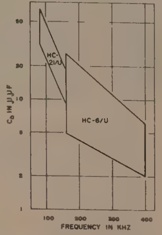
ΔF VS ΔT (°C) FOR OVEN REGULATED CRYSTAL UNITS
(T_0 = ZERO TEMPERATURE COEFFICIENT POINT).



DT CUT, RANGE OF C_1 VS. FREQUENCY

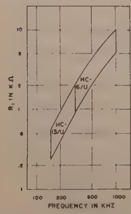


DT CUT, RANGE OF Co VS FREQUENCY

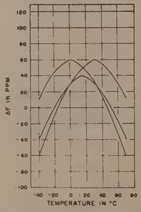


DT Bar

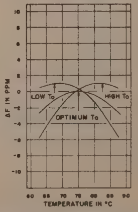
DT BAR CUT, RANGE OF R_1 VS FREQUENCY



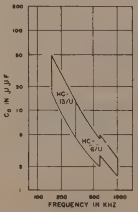
DT BAR CUT, ΔF IN PPM VS. ΔT (°C)
To = ZERO TEMPERATURE COEFFICIENT POINT



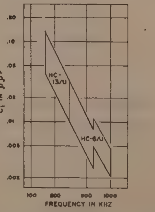
DT BAR CUT, ΔF IN PPM VS. ΔT (°C)
FOR OVEN REGULATED UNITS



DT BAR CUT, RANGE OF C_o VS FREQUENCY



DT BAR CUT, RANGE OF C_1 VS. FREQUENCY



to 1000 kHz

Cuts: JT • H (+5° Flexural) • NT E (+5° Extensional) D • DT Bar

The Bulova crystals for the lower frequency ranges—1kHz to 1 MHz—include units specifically suited for filter and for oscillator applications. The ST, DT and DT Bar cuts are equally suitable for either use. The H (+5° Extensional) and E (+5° Flexural) are primarily used in filter applications, while the NT is usually used as an oscillator.

The various holders available for specific frequency ranges are listed, by cuts, in the accompanying table. The illustrations below show the basic configurations and list the most pertinent dimensions, keyed to the dimensional drawings.

Bulova has been a major supplier of crystals for more than 25 years, during which it has acquired a wealth of experience. Engineering assistance is available. You are invited to call early in your planning.

Typical Performance

		E	DT	DT Bar	JT	H	NT
Temp. Range	-40° +85°C (MIL)	±.015%	±.01%	±.01%	±.02%	±.1%	±.01%
	-10° +60°C (Com.)	±.008%	±.005%	±.005%	±.01%	±.05%	±.005%
Drive Level	in Milliwatts	1	1	1	.1	.1	.1
Freq. Stability	P.P.M./mo.						
Coldweld		0.5	0.1	0.1	0.5	0.5	0.1
Solder Seal		2.0	1.0	1.0	2.0	1.0	1.0

SOLDER SEALED

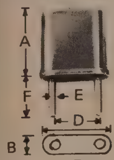


Fig. 1

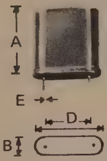


Fig. 2

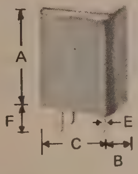


Fig. 3

Bulova No.	Fig. No.	A	B	C	D	E	F
70	1	.775	.335	.575	.486	.050	.238
71	1	1.775 to 3.050	.345	.750	.486	.050	.238
73	1	1.5	.345	.750	.486	.050	.238
75	1	.650	.232	.562	.283	.040	.238
78	2	.775	.352	.757	.486	.030 wire	
90	3	2.025	1.187	1.594	.812/.500	.156	.625

COLDWELD

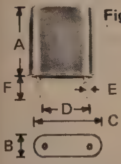


Fig. 4

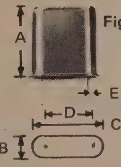


Fig. 5

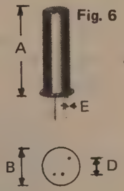


Fig. 6

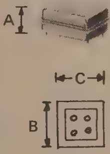


Fig. 7

Bulova No.	Fig. No.	A	B	C	D	E	F
113	4	.775	.352	.757	.486	.050	.238
115	6	.250	.360	–	.200	.030 wire	–
116	6	.600	.360	–	.200	.030 wire	–
117	6	1.00	.360	–	.200	.030 wire	–
118	6	1.50	.360	–	.200	.030 wire	–
122	6	.600	.620	–	.281	.030 wire	–
124	6	1.50	.620	–	.281	.030 wire	–
130	7	.430	.760	.760	–	.030	.250
131	7	.430	.760	1.70	–	.030	.250

HOLDERS

Cuts	Frequency Range, kHz	Bulova No.	Mil No.	Seal[2]
JT	1-15	71	HC-13/U	S
	3-15	73	HC-13/U	S
	4-15	124	HC-37/U(1.5")	C
	4-15	118	HC-35/U(1.5")	C
	4-15	131	HC-41/U	C
	10-15	122	HC-37/U(.6")	C
	10-15	117	HC-35/U(.6")	C
H +5° Flexure Mode	10-90	71	HC-13/U(1")	S
	15-90	73	HC-13/U	S
	15-90	124	HC-37/U(1.5")	C
	15-90	118	HC-35/U(1.5")	C
	15-90	131	HC-41/U	C
	45-90	117	HC-35/U(1")	C
	45-90	122	HC-37/U(.6")	C
NT	8-200	71	HC-13/U	S
	15-200	73	HC-13/U	S
	20-200	124	HC-37/U(1½")	C
	20-200	118	HC-35/U(1½")	C
	20-200	131	HC-41/U	C
	45-200	117	HC-35/U(1")	C
	45-200	122	HC-37/U(.6")	C
	85-200	70	HC-6/U	S
	85-200	78	HC-33/U	S
	85-200	113	HC-36/U	C
E +5° Extensional Mode	50-300	71	HC-13/U (1.75 to 3.50)	S
	85-300	73	HC-13/U	S
	100-300	118	HC-35/U(1½)	C
	100-300	131	HC-41/U	C
	162-300	117	HC-35(1")	C
	185-300	70	HC-6/U	S
	185-300	78	HC-33/U	S
	235-300	113	HC-36/U	C
	240-300	130	HC-39/U	C
DT	80-400	90	HC-21/U	S
	150-400	70	HC-6/U	S
	150-400	78	HC-33/U	S
	200-400	113	HC-36/U	C
	200-400	130	HC-39/U	C
	325-400	116	HC-35/U(.6")	C
DT Bar	150-1000	73	HC-13/U	S
	180-1000	131	HC-41/U	C
	250-1000	122	HC-37/U(.6")	C
	285-1000	70	HC-6/U	S
	285-1000	78	HC-33/U	S
	300-1000	113	HC-36/U	C
	300-1000	130	HC-39/U	C
	440-1000	75	HC-32/U	S
	450-1000	116	HC-35/U(.6"	C
	800-1050	115	HC-35/U	C

Notes 1. *Numbers in parentheses after MIL type number indicates height or height range of modified can. For configuration and dimensions see illustrations.*

2. *Seals. "S" = solder sealed, "C" = coldweld.*

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ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

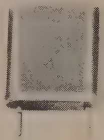
61-20 WOODSIDE AVENUE
WOODSIDE, N. Y. 11377 • 212 335-6000

BULOVA® AT Cut Quartz

SOLDER SEALED

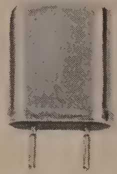
Bulova No. 70 MIL No. HC-6/U
Frequency Range 1-35 MHz

A	.775
B	.352
C	.757
D	.486
E	.050
F	.238



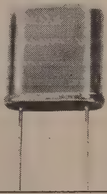
Bulova No. 75 MIL No. HC-32/U
Frequency 2-35 MHZ

A	.650
B	.232
C	.562
D	.283
E	.040
F	238



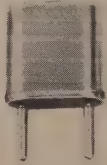
Bulova No. 78 MIL No. HC-33/U
Frequency 1-35 MHZ

A	.775
B	.352
C	.757
D	.486
Leads, wire	.030



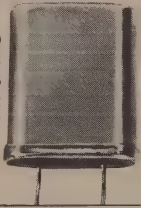
Bulova No. 79 MIL No. HC-17/U
Frequency 1-35 MHz

A	.775
B	.352
C	.757
D	.486
E	.093
F	.238



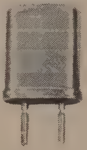
Bulova No. 80 MIL No. HC-18/U
Frequency 3-35 MHz

A	.530
B	.183
C	.435
D	.192
Leads, wire	.017



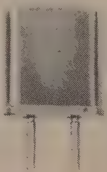
Bulova No. 83 MIL No. HC-25/U
Frequency 3-35 MHz

A	.530
B	.183
C	.435
D	.192
E	.040
F	.238



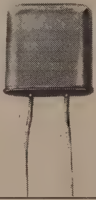
Bulova No. 91 MIL No. HC-11A/U
Frequency 1-35 MHz

A	1.282
B	.460
C	1.170
D	.500
E	.125
F	.640
G	.093



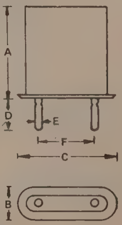
Bulova No. 92
Frequency 20-35 Hz

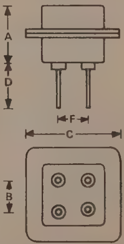
A	.299
B	.100
C	.299
D	.112
Leads, wire	.017

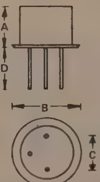


Bulova No. 95
Frequency 2-35 MHZ

A	.650
B	.232
C	.562
D	.283
Leads, wire	.017







COLDWELDS

Bulova No. 110 MIL No. HC-43/U
Frequency 3-35 MHz

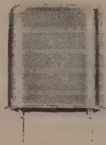
A	.530
B	.183
C	.435
D	.192
Leads, wire	.017

Bulova No. 111 MIL No. HC-24/U
Frequency 3-35 MHz

A	.530
B	.183
C	.435
D	.192
E	.040
F	.238

Bulova No. 113 MIL No. HC-36/U
Frequency 1-35 MHz

A	.775
B	.352
C	.757
D	.486
E	.050
F	.238



Bulova No. 115 MIL No. HC-35/U
Frequency 9-35 MHz

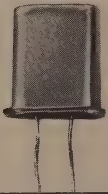
A	.265
B	.410
C	.200
Leads, wire	.017

Bulova No. 120 MIL No. HC-37/U
Frequency 2-35 MHz

A	.260
B	.620
C	.200
Leads, wire	.030

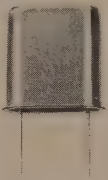
Bulova No. 121
Frequency 20-35 Hz

A	.310
B	.130
C	.323
D	.112
Leads, wire	.017



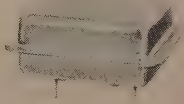
Bulova No. 112 MIL No. HC-47/U
Frequency 1-35

A	.775
B	.352
C	.757
D	.486
Leads, wire	.030



Bulova No. 130 MIL No. HC-39/U
Frequency 1-35 MHz

A	.430	D	–
B	.760	E	.030
C	.760	F	.250



GLASS

Bulova No. 77 MIL No. HC-27/U
Frequency 1-35 MHz

A	.775
B	.352
C	.757
D	.486
E	.050
F	.238

Crystals for Fundamental Frequencies – 1 to 35 MHz

Bulova has produced hundreds of thousands of crystals for filter applications. These have covered virtually the complete spectrum for quartz resonators and can be supplied in small lots as well as production quantities. A wide variety of packages are available in both coldweld and solder seal. Crystal Q's in excess of 1 x 10^6 can be supplied in some ranges and spurious mode suppression from 20 db to 65 db depending on the parameters required can be achieved.

TYPICAL PERFORMANCE

Typical performance available for the fundamental frequencies is:

Frequency tolerance: as tight as ± .002% from ±55° to +105°C, .0003% from −10°C to +60°C with reference to +25°C

Frequency Stability: Aging, 5 parts in 10^6/30 days to 4 parts 10^8/30 depending upon package, frequency and temperature

Drive Level: 0.01mW to 10mW

TEMPERATURE vs FREQUENCY

Figure 1

AT CUT, ΔF IN PPM vs. ΔT°C

Typical Coefficients, Non-ovenized Applications

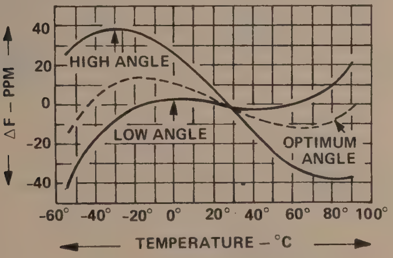
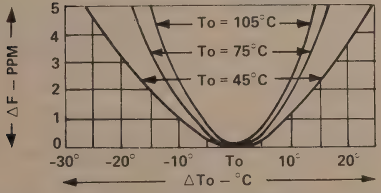


Figure 2

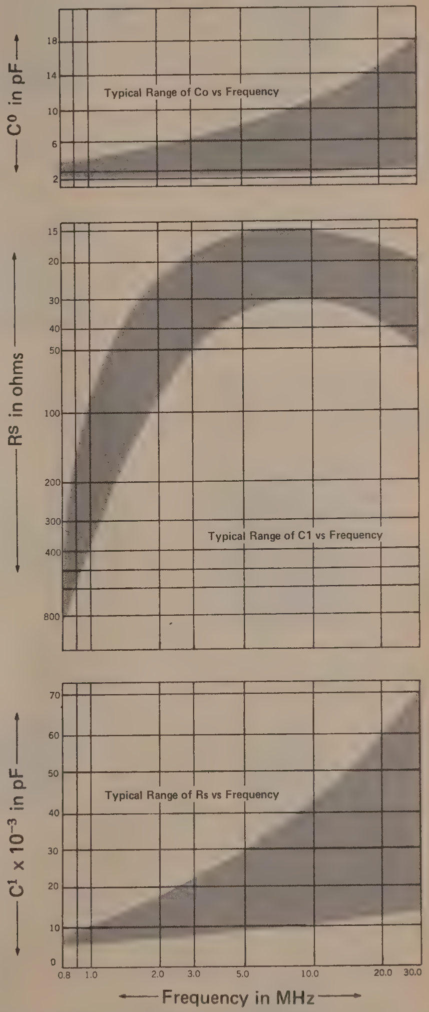
AT CUT, ΔF vs. To FOR OVEN UNITS

To = Zero Temperature Coefficient Point



FUNDAMENTAL MODE PARAMETERS

Ranges of C^0, C^1 & R^s vs. Frequency



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BULOVA FREQUENCY CONTROL PRODUCTS

ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

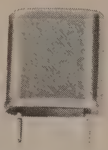
61-20 WOODSIDE AVENUE
WOODSIDE, N. Y. 11377 • 212 335-6000

BULOVA® AT Cut Quartz

SOLDER SEALED—10 to 150 MHz

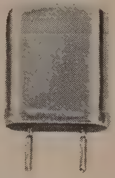
Bulova No. 70 MIL No. HC-6/U

A	.775
B	.352
C	.757
D	.486
E	.050
F	.238



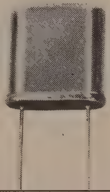
Bulova No. 75 MIL No. HC-32/U

A	.650
B	.232
C	.562
D	.283
E	.040
F	.238



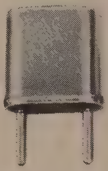
Bulova No. 78 MIL No. HC-33/U

A	.775
B	.352
C	.757
D	.486
Leads, wire	.030



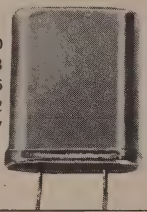
Bulova No. 79 MIL No. HC-17/U

A	.775
B	.352
C	.757
D	.486
E	.093
F	.238



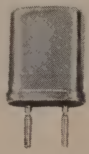
Bulova No. 80 MIL No. HC-18/U

A	.530
B	.183
C	.435
D	.192
Leads, wire	.017



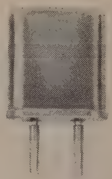
Bulova No. 83 MIL No. HC-25/U

A	.530
B	.183
C	.435
D	.192
E	.040
F	.238



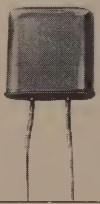
Bulova No. 91 MIL No. HC-11A/U

A	1.282
B	.460
C	1.170
D	.500
E	.125
F	.640
G	.093



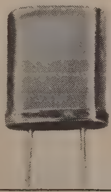
Bulova No. 92

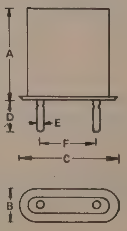
A	.299
B	.100
C	.299
D	.112
Leads, wire	.017

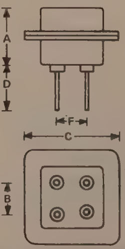


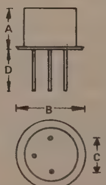
Bulova No. 95

A	.650
B	.232
C	.562
D	.283
Leads, wire	.017





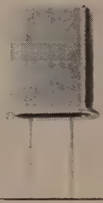




COLDWELD—10 to 150 MHz

Bulova No. 110 MIL No. HC-43/U

A	.530
B	.183
C	.435
D	.192
Leads, wire	.017

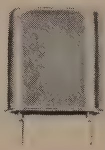


Bulova No. 111 MIL No. HC-24/U

A	.530
B	.183
C	.435
D	.192
E	.040
F	.238

Bulova No. 113 MIL No. HC-36/U

A	.775
B	.352
C	.757
D	.486
E	.050
F	.238



Bulova No. 115 MIL No. HC-35/U

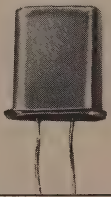
A	.265
B	.410
C	.200
Leads, wire	.017

Bulova No. 120 MIL No. HC-37/U

A	.260
B	.620
C	.200
Leads, wire	.030

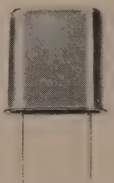
Bulova No. 121

A	.310
B	.130
C	.323
D	.112
Leads, wire	.017



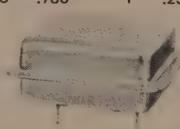
Bulova No. 112 MIL No. HC-47/U

A	.775
B	.352
C	.757
D	.486
Leads, wire	.030



Bulova No. 130 MIL No. HC-39/U

A	.430	D	–
B	.760	E	.030
C	.760	F	.250



GLASS

Bulova No. 77 MIL No. HC-27/U

A	.775
B	.352
C	.757
D	.486
E	.050
F	.238

Crystals for Overtone Frequencies - 10 to 150 MHz

For more than 25 years Bulova has been a major supplier of crystals for MIL Spec, general industrial and special applications. These latter include: matched sets for filter and high stability oscillator applications, radiation hardened units and packaging to withstand high shock.

Engineering assistant is available.
You are invited to call early in your planning.

TYPICAL PERFORMANCE

Typical performance available for the overtone frequencies is:

Frequency Tolerance: as tight as ±.002% from -55°C to + 105°C with reference to +25°C

Frequency Stability: Aging, 5 in 10^6/30 days to 1 in 10^7/30 days depending upon packaging, frequency and temperature

Drive Level: 0.01mW to 2mW

TEMPERATURE vs FREQUENCY

Figure 1

AT CUT, ΔF IN PPM vs. ΔT°C
Typical Coefficients, Non-ovenized Applications

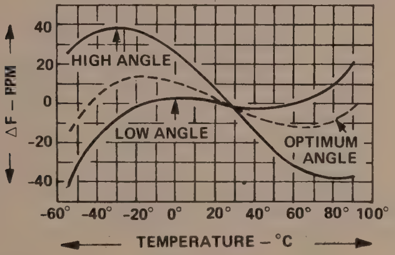
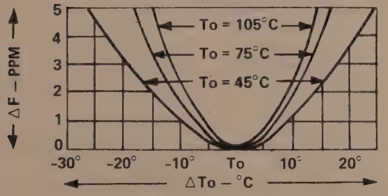


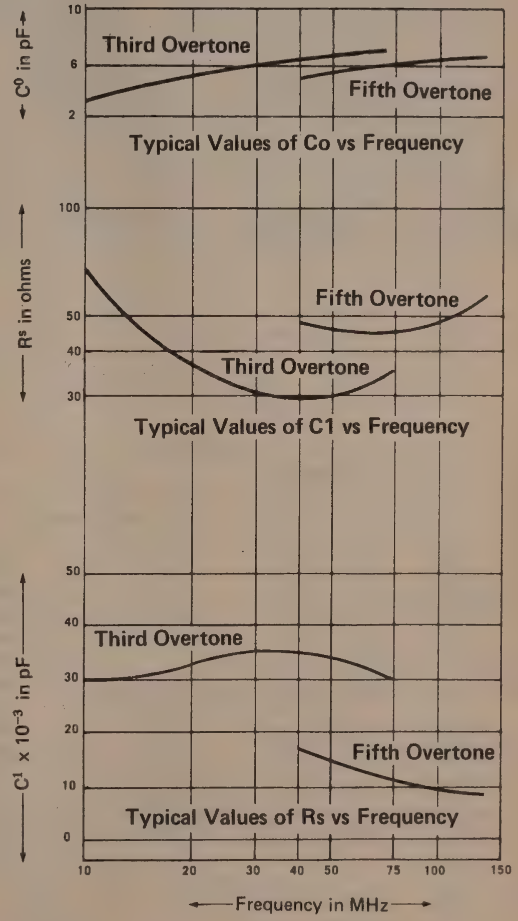
Figure 2

AT CUT, ΔF vs. To FOR OVEN UNITS
To = Zero Temperature Coefficient Point



OVERTONE MODE PARAMETERS

Ranges of C^0, C^1 & R^s vs. Frequency



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ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

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BULOVA Monolithic

STANDARD BULOVA HOLDERS—Dimensions in Inches and Frequencies in MHz

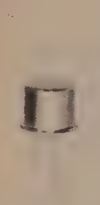
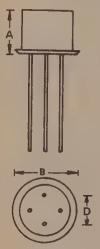


FIGURE 1



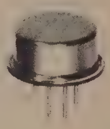
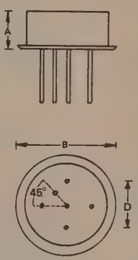


FIGURE 2



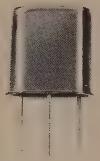


FIGURE 3

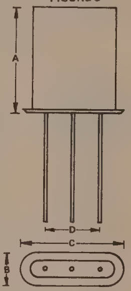
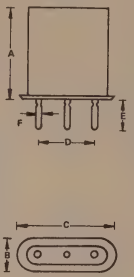


FIGURE 4



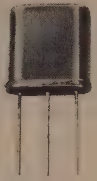
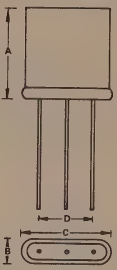


FIGURE 5



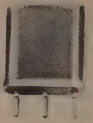
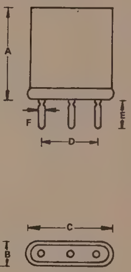


FIGURE 6



Coldwelds

K1W 12–180
FIG. 1
A .265
B .410
leads, .018
wire

K2P 5–180
FIG. 2
A .260
B .560
C .281
D .030

K3P 1–180
FIG. 2
A .445
B .750
C .281
D .030

K6W 10–180
FIG. 3
A .530
B .183
C .435
D .192
leads, .018
wire

K6P 10–180
FIG. 4
A .530
B .183
C .435
D .192
E .040
F .238

K9W 15–180
FIG. 3
A .318
B .117
C .305
D .112
leads, .014
wire

K7W 5–180
FIG. 3
A .775
B .352
C .757
D .486
leads, .030
wire

K7P 5–180
FIG. 4
A .775
B .352
C .757
D .486
E .050
F .238

Solder Sealed

S6W–
FIG. 5
-1 10–180
A .530
-2 12–180
A .460
-3 14–180
A .425
-4 15–180
A .360
-5 20–180
A .312
-6 35–180
A .250
B .183
C .435
D .192
leads, .018
wire

S6P–
FIG. 6
-1 10–180
A .530
-2 12–180
A .460
-3 14–180
A .425
-4 15–180
A .360
-5 20–180
A .312
-6 35–180
A .250
B .183
C .435
D .192
E .040
F .238

S7W 1–180
FIG. 5
A .775
B .352
C .757
D .486
leads, .030
wire

S7P 1–180
FIG. 6
A .775
B .352
C .757
D .486
E .050
F .248

S8W–
FIG. 5
-1 2–180
A .650
-2 4–180
A .585
B .237
C .565
D .275
leads, .018
wire

S8P–
FIG. 6
-1 2–180
A .650
-2 4–186
A .585
B .237
C .565
D .275
E .040
F .248

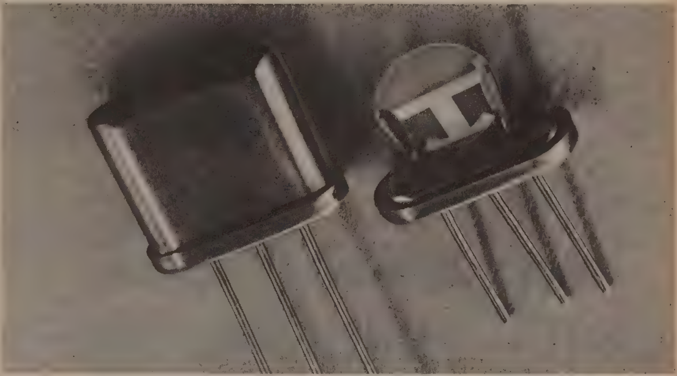
S9W 15–180
FIG. 5
A .318
B .117
C .305
D .112
leads, .014
wire

S10W 5–180
FIG. 5
A .540
B .183
C .565
D .275
leads, .018
wire

S10P 5–180
FIG. 6
A .540
B .183
C .565
D .275
E .040
F .248

Crystal Filters–1 to 185 MHz

for Fundamental and Overtone Modes

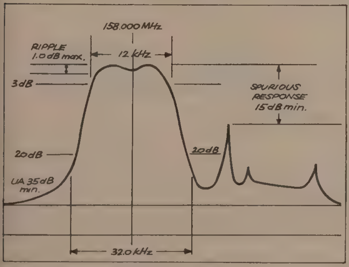


Monolithic crystal filters offered by Bulova cover the range from approximately 1MHz to 180MHz, extending from the fundamental into the seventh overtone. Included are relatively simple 2-pole devices and more complex, multipole units—up to 10-pole response. Performance characteristics of some representative units are illustrated in the accompanying table.

Modern filter synthesis techniques are used to produce multiple units either as cascaded 2-pole devices which are electrically coupled, or by acoustically coupling resonators on a single quartz wafer. The illustrations opposite show the various holders available, their dimensions and the frequency range they cover. Both coldwelded and solder sealed types are included.

Monolithic crystal filters for frequencies lower than those listed or higher than the indicated 180MHz can be provided. Engineering assistance is available and your inquiry early in your program is welcomed.

TYPICAL ELECTRICAL PERFORMANCE



2-POLE 158.000 MHz MONOLITHIC FILTER

Representative Units Monolithic Fillers

Fo MHz	Overtone Order	3dB Band width (min.) kHz	30dB Band width (max.) kHz	Spurious dB (min.)	Ultimate Atten. (min.)	Insertion Loss dB(max.)	Ripple dB (max.)	Source Load Ohms
2 Pole Response								
7.146	1	14.0	80	15	45	3.0	0.5	5400
9.400	1	2.8	15	25	45	3.0	0.5	1100
15.000	1	20.0	110	15	45	3.0	0.5	4700
20.000	1	42.0	220	20	45	3.0	0.5	3800
21.400	1	28.0	155	20	45	3.0	0.5	2300
30.000	1	75.0	400	20	45	3.0	0.5	3000
59.300	3	20.0	110	20	40	4.0	0.5	3800
70.000	3	20.0	110	20	40	4.0	0.5	2600
90.000	3	21.0	115	20	40	4.0	0.5	3700
105.000	5	24.0	135	15	40	4.0	0.5	4600
146.880	5	16.0	90	15	35	4.0	1.0	3200
158.000	5	12.0	65	15	35	4.0	1.0	3000
180.000	7	11.0	60	15	35	5.0	1.0	3200
4 Pole Response								
5.000	1	2.0	7	40	50	4.0	1.0	4280
18.600	1	30.0	125	35	50	4.0	1.0	3500
21.400	1	25.0	90	40	50	4.0	1.0	2300
6 Pole Response								
59.300	3	20.0	50	40	60	5.0	1.0	4600
70.000	3	20.0	50	40	60	5.0	1.0	2800
8 Pole Response								
25.5	1	70.0	140	60	65	5.0	1.5	3600
30.1	1	70.0	140	60	65	5.0	1.5	3300

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BULOVA fcp

BULOVA FREQUENCY CONTROL PRODUCTS

ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

61-20 WOODSIDE AVENUE
WOODSIDE, N. Y. 11377 • 212 335-6000

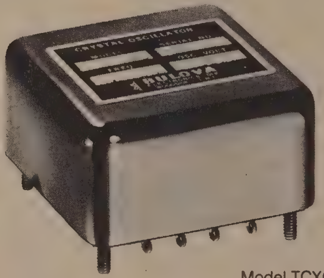
BULOVA® Crystal Oscillators

Bulova offers a full line of both Military and Industrial crystal oscillators—provides a total capability from custom engineering to volume production, using the latest automatic test equipment. Bulova's full line of crystal oscillators includes • high stability crystal oscillators • temperature compensated crystal oscillators (TCXO) • computer clock oscillators

State-of-the-Art TCXO's With Frequency Stability of ±2pp10^7 from −40 to +75°C

And just check these other features:

- Components derated for long life and high reliability
- Meet MIL-E-5400, MIL-E-4970 and MIL-E-16400 environmental specifications
- Buffer and Output amplifiers
- Hermetically sealed
- Self-contained voltage regulator
- Low power consumption
- Small size, only 2″ x 2″ x 1″, weighs only 5 ozs.



Model TCXO-2

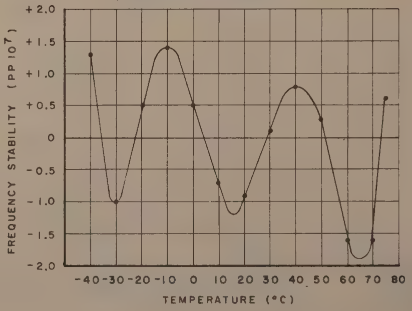
The Bulova Model TCXO-2 is a temperature compensated crystal oscillator employing a voltage variable capacitance diode and thermistor network to maintain frequency stability over wide temperature ranges without the use of an oven. This unit has been designed for use in applications where power, space and weight restrictions preclude the use of oven for temperature stabilization, yet which require exceptional stability.

BASIC SPECIFICATIONS

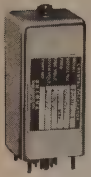
Frequency Range:	3 to 5MHz
Frequency Stability	
Temperature:	±2pp10^7 maximum over the temperature range of −40°C to +75°C
Voltage:	±5pp10^8 maximum for a supply variation of ±5%
Load:	±1pp10^8 for a load variation of ±10%
Frequency Aging:	±1/10^8 per week at 60°C
Output Voltage:	125 millivolts RMS into 50 ohms
Input Power:	12vDC ±5% at 50 milliwatts maximum
Size:	2″ x 2″ x 1″
Weight:	5.0 oz.

Frequency Stability vs Temperature

(Measured Performance)



HIGH STABILITY CRYSTAL OSCILLATORS

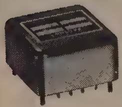


PCOXO

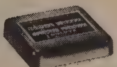
The high frequency stability of these oscillators results from housing a high precision crystal and an oscillator circuit with AGC to maintain low constant crystal drive in a stable DC proportional control oven.

	MILITARY		INDUSTRIAL	
MODEL	**PCOXO-101**	**PCOXO-106**	**PCOXO-3**	**PCOXO-5**
Frequency Range	1.0 to 10MHz	30 to 100 MHz	1.0 to 10MHz	1.0, 3.0 or 5.0MHz
Temp. Range	−55°C to +70°C	−55°C to +70°	0°C to +60°C	0°C to +60°C
Stability				
Temp. Range	±1PP10^8	±5PP10^7	4PP10^{10}/°C	2PP10^{10}/°C
Aging per day	1PP10^9	5PP10^8	5PP10^9	5PP10^{10}
Line Voltage ±10°	±5PP10^9	±5PP10^7	±5PP10^9	±5PP10^9
Load ±10%	±1PP10^9	±5PP10^7	±1PP10^9	±1PP10^8
Warm-up at +25°C after 1 hr.	±3PP10^8	±1PP10^7	±3PP10^8	±3PP10^6
Output	.5VRMS (min)	1 MW (Min)	1VRMS (min)	1VRMS (min)
Load	50 ohms	50 ohms	1K ohms	1K ohms
Input Voltage	+28VDC	+28VDC	+28VDC	+28VDC
Turn on Power	18W	18W	12W	12W
Power at 25°C	4.5W (Typ)	4.5W (Typ)	4.2W (Typ)	4.2W (Typ)
Size	2″ x 2″ x 4″	2″ x 2″ x 4″	2″ x 2″ x 4″	2″ x 2″ x 4″

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS



TCXO-2
TCXO-50

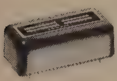


TCXO-1
TCXO-100

Bulova temperature compensated crystal oscillators employ a computer selected and optimized variable capacitance diode and thermistor compensation network to maintain frequency stability over wide temperature ranges, without the use of an oven.

	MILITARY		INDUSTRIAL	
MODEL	**TCXO-1**	**TCXO-2**	**TCXO-50**	**TCXO-100**
Frequency Range	3MHz to 12MHz	3, 4 or 5MHz	1MHz to 12MHz	1MHz to 12MHz
Frequency Adjustment Range	±3PPM	±0.3PPM	±3PPM	±3PPM
Frequency Stability	±1PPM over Temp. Range of −40°C to +70°C	±0.2PPM over Temp. Range of −40°C to +75°C	±0.5PPM over Temp. Range of 0°C to +60°C	±2.5PPM over Temp. Range of 0°C to 60°C
Aging Rate per yr.	±1PP10^6	±1PP10^6	±1PP10^6	±1PP10^6
Power Input	12VDC ±2% at 150mw	12VDC ±5% at 50mw	12 and 5 VDC	12 and 5 VDC
Output	1VP-P into 1K ohm	125 mv RMS into 50 ohms	T^{2}L	T^{2}L
Size	2″ x 2″ x 0.5″	2″ x 2″ x 1″	2″ x 2″ x 1″	2″ x 2″ x 0.5″
Weight	3 oz.	5 oz.	5 oz.	3 oz.

COMPUTER CLOCK OSCILLATORS



XO-140
XO-14

XO-304
XO-302

These computer clock oscillators feature crystal stability, printed circuit board mounting and outputs directly compatible with DTL or TTL loads. 14 pin dual in-line configuration.

	MILITARY		INDUSTRIAL	
MODEL	**XO-140**	**XO-304**	**XO-14**	**XO-302**
Frequency Range	8KHz to 1MHz	4MHz to 25MHz	8KHz to 1MHz	4MHz to 25MHz
Temp. Range	−40°C to +70°C	−55°C to +85°C	0°C to +60°C	0°C to +60°C
Frequency Stability	±120PPM over Temp. Range	±50PPM over Temp. Range	±65PPM over Temp. Range	±25PPM over Temp. Range
Input Voltage	+5VDC	+5VDC	+5VDC	+5VDC
Output	Logic Zero: 0 to .4V Logic One: 2.6 to 5V	Logic Zero: 0 to .4V Logic One: 2.6 to 5V	Logic Zero: 0 to .4V Logic One: 2.6 to 5V	Logic Zero: 0 to .4V Logic One: 2.6 to 5V
Size	1″ x 2″ x .5″	.8″ x .5″ x .4″	1″ x 2″ x .5″	.8″ x .5″ x .4″

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ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

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BULOVA®

Crystals for Digital Watches

Actual Size

Advanced manufacturing techniques for high volume production are enabling Bulova's Electronics Division to make crystal packages for digital watch modules which offer superior performance while remaining competitively priced. Initial application of these new crystals was in Bulova's own Accuquartz® Digital watches.

Standard units have a frequency of 32,768 Hz. They are designed for application in both LED and LCD watches. Other frequencies can be provided in comparable low cost packages.

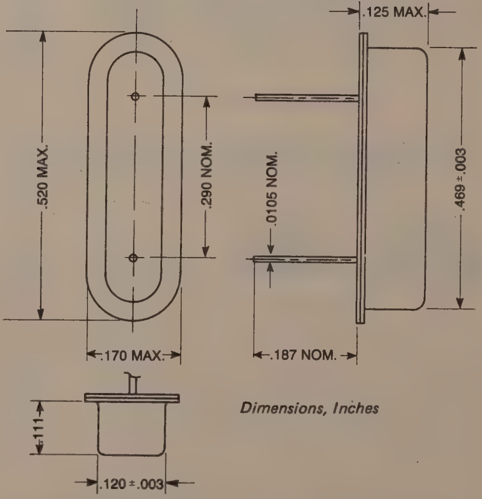
Standard Frequency: 32,768 Hz

Basic Specifications

Model Number	WA-32-10-20A
Crystal Plate	XY' Flexure
Frequency^1	32,768 Hz
Adjustment Tolerance^2 @ 10 pf or as req.	± 30 ppm
Drive Level, max.	10 μW
Series resistance, max.	20 K Ω
Q Factor	>50K
Turnover Temperature	29°C ± 4°C
Frequency Stability 24°C-34°C	3 ppm max.
Shock	3000g .25 ms
Aging After 2 Weeks	1 x 10^{-8}/Day, max.
Aging After 1 Year	1 x 10^{-9}/Day, typ
Operating Temp. Range	-10°C to +60°C

Notes:

1. *Available at other frequencies*
2. *Also available at 20 and 25 ppm*



Dimensions, Inches

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BULOVA FREQUENCY CONTROL PRODUCTS

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61-20 WOODSIDE AVENUE
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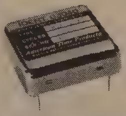
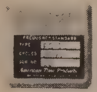
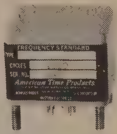
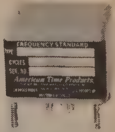
BULOVA® Low Frequency Oscillators/Resonators

1.5 Hr./Period to 1 MHz

Single and Multiple Frequencies Hermetically Sealed
(Also available in 5, 10, 20 and up to 500 VA typical packages)

Whatever your requirements for tuning forks or crystal oscillators, Bulova has either the product available or the inherent capability to meet your need. Reliability, accuracy and size criteria can be quickly met, with appreciable savings in engineering time and production costs.

PRECISION OSCILLATORS

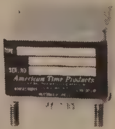
	MICROPOWER	P.C. BOARD	CYLINDRICAL	SIMULTANEOUS MULTIPLE OUTPUTS	WIDE RANGE MODULAR
					
Model	FS 200	FS 11 FS 11-1 FS 11-F	FS 27	FS 300 or FS 400	FS 32 FS 32-1 FS 32-F
Frequency, Hz	360 to 1000 Hz	400 Hz to 50 kHz	360 to 1300 Hz	60,120,240,480 50,100,200,400	240 Hz to 100 kHz
Frequency Accuracy	up to ±.01%	up to ±.02%	up to ±.002%	up to ±.002%	up to ±.002%
Temperature Range	FOR SOME ACCURACIES AS MUCH AS −65°C to + 125°C				
Input	1.5 V DC at 6 to 20 microamps	STANDARD 28 V DC (AVAILABLE 3 to 40 V DC)			
Output	0.1 volt	sine, square wave or compatible with logic			
Load	500 K ohms	10 K OHMS TO 500 K OHMS OR LOGIC CIRCUITRY			
Size	1-5/16″ x 1-5/16″ x 3/8″	1-1/2″ x 1-1/2″ x 3/8″	23/32″ x 3″	1-1/2″ x 1-1/2″ x 1-3/16″	1-1/2″ x 1-1/2″ x 1-3/16″
Weight	1 ounce	1½ ounces	2 ounces	2-1/2 ounces	2-1/2 ounces

RESONATORS

The forks used in the precision oscillator packages also are available as discrete components without driver circuits. Accuracy is comparable to that given in the table.

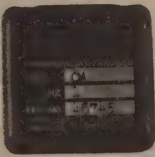
MODEL TCG

Extremely accurate master oscillator with single or multiple outputs and any combination of pre-set closures or timing functions.



Pre-coded oscillator, accuracy to ±.002%

VERY LOW FREQUENCY OSCILLATORS 1.5 Hr/Period to 25kHz



Models:
- OA1, CMOS Compatible
- OA2, DTL & TTL Compatible
- OA3, Resistor Loading

Typical Temperature Accuracy
- 15° to 35° C, ± 0.02%
- 0° to 65° C, ± 0.1%
- −55° to 85° C, 0.2%

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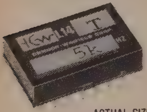
CONNOR-WINFIELD CORPORATION

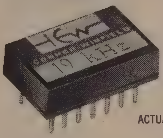
WEST CHICAGO, ILLINOIS 60185 U.S.A. • PHONE (312) 231-5270

SMOS & CMOS COMPATIBLE CRYSTAL OSCILLATORS—.03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

SMOS CMOS Output**		Type	Model	Frequency Tolerance‡	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current ***	Package
Low Power SMOS Square-wave	Standard SMOS Output (Silicon on Sapphire)	Xtal	S121-MSA thru Y	See Table A at top of Next Page	50 KHz to 20 MHz	±100 ppm for Model S121, S120, C121, C120	Any fixed voltage, 5 to 15VDC ±5%	≤1 MA at 5VDC ≤5 MA at 15VDC	1.6" L (4.06 cm) x 1.2" W (3.04 cm) x 0.4" H (1.01 cm) .03" (.07 cm) Diameter Gold Plated Pins
			S120-MSA thru Y					≤5 MA at 5VDC ≤15 MA at 15VDC	
Low Power CMOS Square-wave	Standard CMOS Output		C121-MSA thru Y		.0001 Hz to 10 MHz			≤1 MA at 5VDC ≤5 MA at 15VDC	
			C120-MSA thru Y					≤5 MA at 5VDC ≤15 MA at 15VDC	
		RC	C117-MS	See Table C Next Page	1 Hz to 20 kHz	Standard ±2%		<1 MA to 7 MA	
		Xtal	L24R-2K thru Y	See Table A Next Page	500 Hz to 4 MHz Binary Multiples	Optional ±10 ppm		3 MA to 15 MA Depending On Supply Voltage	24 Pin DIP 1.25" L (3.17 cm) x 0.8" W (2.03 cm) x .43" H (1.09 cm) .02" (.05 cm) Diameter Gold Plated Pins

DIP CRYSTAL & SOLID STATE OSCILLATORS—PLUG INTO SINGLE IC SOCKET


ACTUAL SIZE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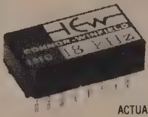
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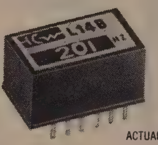
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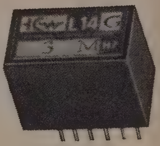

DIP XTAL AND RC Output**		Type	Model*	Frequency‡ Tolerance	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current ***	Package
TTL Pulse	Negative pulse, duration 60 μ or less Amplitude 2.4Vp ±1Vp into a 2KΩ load	RC	L14A L13A	±1.0% 0° to +50°C	100 Hz to 50 KHz	External ±2% Standard	5VDC ±5%	1 MA to 5 MA	14 Pin DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.17" H (0.43 cm)
			L16A	±0.1% +20°C to +40°C ±0.25 0° to +50°C					16 Pin DIP 0.89" L (2.26 cm) x 0.49" W (1.24 cm) x 0.22" H (0.55 cm)
			L14T	±1% 0°C to +50°C		External +0% −2% Standard		4 MA Max.	14 Pin DIP Same as L14A, L13A Above
TTL Square	Logic zero <0.4V, I_{sink} = 16ma Logic one >2.4V into 200Ω to 2KΩ load Duty cycle 50%, † risetime <50ns Amplitude stability ±5% with fixed supply voltage	RC	L14Q L13Q	Same as L14A	50 Hz to 20 KHz	External		20 MA to 50 MA	14 Pin DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.44" H (1.12 cm)
			L14R L13R	Same as L16A					
		Xtal	L14C L13C	±.001% 0° to +50°C	1 Hz to 25 MHz	Optional ±30 ppm		5 MA to 150 MA	14 Pin DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.35" H (0.89 cm), 0.44" (1.12 cm) or 0.57" (1.45 cm) depending on frequency
			L14D L13D	±.0025% 0° to +65°C	.1 Hz to 60 MHz				
			L14E L13E	±.005% −25°C to +75°C					
Sine	Amplitude $3V_{rms} \pm 1V_{rms}$ into a 10KΩ load (can drive 1KΩ) Harmonic distortion <5% Amplitude stability ±5% with fixed supply voltage	RC	L14B L13B	Same as L14A	1 KHz to 20 KHz	External ±2% Standard		15 MA to 50 MA	14 Pin DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.57" H (1.45 cm)
			L14N L13N	Same as L16A					
		Xtal	L14F L13F	±.001% 0° to +50°C	100 KHz to 60 MHz	Optional ±30 ppm		35 MA to 150 MA	14 Pin DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.75" H (1.91 cm)
			L14G L13G	±.0025% 0° to +65°C					
			L14I • L13I	.005% −25°C to +75°C					
			L84F L83F	±.001% 0°C to +50°C	20 KHz to <100 KHz				14 Pin DIP 1.2" L (3.04 cm) x 0.8" W (2.03 cm) x 0.48" H (1.22 cm)
			L84G L83G	±.0025% 0°C to +65°C					
			L84I L83I	±.005% −25°C to +75°C					

†>10 MHz.

*Use Model L14- or L84- for .023" (.06 cm) pins; use Model L13- or L83- for .017" (.04 cm) square pins.

**Tighter amplitude tolerance available on square wave outputs except with 5V supply and on sinewave outputs except for frequency >100 KHz and/or supply voltage <10V.

***Supply current depends on frequency.

‡Temperature range can be shifted ±50°C within the range of −55°C to +125°C for crystal oscillators, and ±10°C for RC oscillators.

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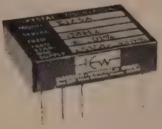
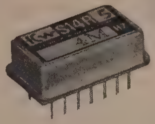
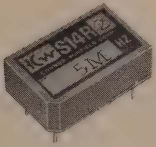


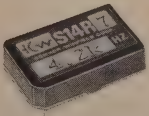


LOW COST OSCILLATORS— FLAT PACKAGE AND LOW PROFILE DIP

CMOS & TTL	DIP AND FLAT PACKAGE Output**	Type	Model	Frequency Tolerance	Fixed Frequencies Available	Temperature Range‡	Supply Voltage	Supply Current ***	Frequency Adjust	Package
TTL Pulse	Negative Pulse, Amplitude −2.4Vp ±1 Vpp into a 2KΩ load.	RC	S14R7	+0%-2% Accuracy ±5% Stability	100 Hz to 50kHz	0°C to +50°C	5Vdc ±5%	1 MA to 5 MA	External Resistance	‡3 pm DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.17" H (0.43 cm) for 14 pin socket
Low Power CMOS Output	Standard CMOS Output	Ceramic	C130MS	See Table C next page	24.4 Hz to 250 KHz	See Table C next page	Any fixed voltage between 5 and 15 VDC ±5%	<1 to 7 MA	Screw adjust ±2% of standard	1.5" (3.8 cm) Square x 0.5" (1.27 cm) H†
		Xtal	C122MS	±.01%	100 Hz to 1 MHz	−25°C to +75°C		<1 to 5 MA	Optional ±10 ppm	
	30/70 duty cycle, 85% of supply voltage amplitude into a 10KΩ load		S14R2	±.01%	4 MHz to 20 MHz	−25°C to +75°C	Any fixed voltage between 3 and 15VDC ±5%	<1 to 5 MA		‡14 Pin DIP .78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.3" H (.76 cm)
			S14R1				5VDC ±20%			
ECL, TTL Square Wave	Logic zero ≤0.4V, I_{sink} = 16ma Logic one ≥2.4V into 200Ω to 2KΩ load Duty cycle 30/70 or better, risetime <50ns & fall time ≤ Amplitude stability ±5% with fixed supply voltage 180° phase out		E120A	±.01% 200 KHz to <2 MHz ±.005%, 2 MHz t2—MHz		0°C to +70°C	5VDC or −5.2VDC ±10%	25 MA to 50 MA Internal Loading, 10 TTL Gates Logic 1≤2.4V Logic 0≥0.5V 5 ECL Gates Complimentary Outputs		1.6" (4.06 cm) L x 1.2" (3.04 cm) W x 0.4" (1.01 cm) H†
			E125A	±.02%, 200 KHz to <2 MHz ±.01%, 2 MHz to 20 MHz		−55°C to +125°C				

†.03" (.07 cm) diameter gold plated pins. ‡.02" (.05 cm) diameter gold plated pins.



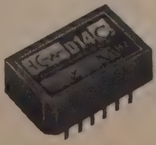


ACTUAL SIZE

LOW PROFILE DIP CRYSTAL OSCILLATORS— PLUG INTO SINGLE IC SOCKET—Also see Model S14R1 below

COMPACT	UNITS Output	Type	Model	Frequency Tolerance	Fixed Frequencies Available	Temperature Range‡	Supply Voltage	Supply Current ***	Package to Fit Standard 14 Pin DIP Socket
TTL Square Wave	Logic zero ≤0.4V, I_{sink} = 16ma Logic one ≥2.4V into 200Ω to 2KΩ load Duty cycle, 50% ±1% <10 MHz 50% ±10% >10 MHz, risetime <50ns Amplitude stability ±5%	Xtal	D14C	±.005%	1 MHz to 20 MHz	0°C to +50°C	5VDC ±5%	5 MA to 40 MA	3 Pin DIP 0.78" L (1.98 cm) x 0.49" W (1.24 cm) x 0.3" H (0.76 cm) Pins .017" (0.4 cm) square
			D14D	±.0075%		0°C to +65°C			
			D14E	±.01%	4 MHz to 20 MHz	−25°C to +75°C			
	Same as above except duty cycle 50% ±10%		S14R5						14 Pin DIP 0.2" H (.51 cm) x 49" W (1.24 cm) x 78" L (1.98 cm)

**Tighter amplitude tolerance available on square wave outputs except with 5V supply and on sinewave outputs except for frequency >100 KHz and/or supply voltage <10V.
***Supply current depends on frequency.
‡Temperature range can be shifted ±50°C within the range of −55°C to +125°C for crystal oscillators, and ±10°C for RC oscillators.



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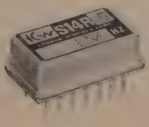

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VCXO — .03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

VCXO	Output**	Model*	Frequency Tolerance‡	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current ***	Package
TTL Square OR Low Power CMOS Square or Sine	Logic zero <0.4V, I_{sink} = 16ma Logic one >2.4V into 200Ω to 2KΩ load Duty cycle 50%, risetime <50ns Amplitude stability ±5% with fixed supply voltage OR 0.6 to 9.5V with a 10V supply into a 600Ω to 15KΩ load Amplitude stability ±5% with fixed supply voltage†	V220A	±.001% +20°C to +40°C	1 KHz to 10 MHz	40ppm/V or 20 ppm/V* 0 to 4VDC with 5V supply 0 to 10VDC with 12V supply	5VDC ±1% for TTL or Any fixed voltage 8 to 15VDC ±1%	<1 MA to 20 MA	2" square (5.08 cm) x 0.6" H (1.52 cm)
		V220B	±.0025% 0°C to +50°C					
		V220C	±.005% 0°C to +65°C					
		V220D	±.0075% −25°C to +50°C					

TCXO — .03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

FLAT PACK	Output**	Model*	Frequency Tolerance‡	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current ***	Package
TTL Square Low Power CMOS Square or Sine	Logic zero <0.4V, I_{sink} = 16ma Logic one >2.4V into 200Ω to 2KΩ load Duty cycle 50%, risetime <50ns Amplitude stability ±5% with fixed supply voltage OR 0.6 to 9.5V with a 10V supply into a 600Ωto 15KΩ load square also Amplitude stability ±5% with fixed supply voltage†	C12A	±.000055% +25°C to +35°C	.0001 Hz to 20 MHz	±30 ppm	5VDC ±1% for TTL OR Any fixed voltage 8 to 15VDC ±1%	10 MA to 75 MA OR <1 MA to 50 MA	1.75" square (4.45 cm) x 0.4" H (1.02 cm) or 0.5" H (1.27 cm) depending on frequency
		C12B	±.00015% 0° to +50°C ±1 ppm at 25°C					
		C12C	±.00025% −25°C to +65°C ±1 ppm at 25°C					

FLAT PACKAGE PC BOARD MOUNT CRYSTAL & SOLID STATE OSCILLATORS

.03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

FLAT PACK	Output**	Type	Model	Frequency Tolerance‡	Fixed Frequencies Available	Fre-quency Adjust	Supply Voltage	Supply Current ***	Packages
TTL Pulse	Negative pulse, duration 20 to 100 μs Amplitude 2Vp ±1Vp into 1KΩ load (4Vp in 10KΩ) Amplitude stability ±5% with fixed supply voltage	RC	L79A	Table C	1 Hz to 50 KHz	Screw Adjust ±2% Standard	5VDC ±5%	1 MA to 5 MA	1.2" L (3.04 cm) x 0.8" W (2.03 cm) x 0.48" H (1.23 cm)
Pulse	Negative pulse, duration 20 to 100 μs Amplitude 10Vp ±1Vp into a 10KΩ load Amplitude stability ±5% with fixed supply voltage		L80A				12VDC ±5%		
Square	Amplitude 10Vp ±2Vp into a 10KΩ load Duty cycle 50% Amplitude stability ±5% with fixed supply voltage		L118A		1 Hz to 20 KHz			10 MA to 25 MA	1.6" L (4.06 cm) x 1.2" W (3.04 cm) x 0.4" H (1.01 cm)
TTL Square	Logic zero <0.4V$_{sink}$ 16ma Logic one >2.4V into 200Ω to 2KΩ load Duty cycle 50%, risetime <50ns Amplitude stability ±5% with fixed supply voltage		L117A				5VDC ±5%	20 MA to 50 MA	
		Xtal	IC5A1 thru J1	Table A	.00005 Hz to 400 KHz	Optional	5VDC ±10%	<10 MA to 150 MA	
Sine			IC5K1 thru Y1		400 KHz to 60 MHz		5VDC ±5%	5 MA to 35 MA	
	Amplitude 3V$_{rms}$ ±1V$_{rms}$ into a 10KΩ load Harmonic distortion <5% Amplitude stability ±5% with fixed supply voltage	Xtal	IC5A2 thru J2	Table B	20 Hz to 500 KHz	Optional	5VDC ±10%	15 MA to 100 MA	2" square (5.08 cm) x 0.6" H (1.52 cm)
		RC	L199B	Table C	50 Hz to 20 KHz	Screw Adjust ±2% Standard	5VDC ±5%	20 MA to 50 MA	
	Amplitude 5V$_{rms}$ ±2V$_{rms}$ into a 10KΩ load Harmonic distortion <5% Amplitude stability ±5% with fixed supply voltage†	Xtal	L220A thru J	Table B	50 Hz to 500 KHz	Optional	12VDC ±10%	15 MA to 100 MA	
		RC	L200B	Table C	50 Hz to 20 KHz	Screw Adjust ±2% Standard	12VDC ±5%	10 MA to 25 MA	

ALSO SEE TCXO AND VCXO

†For tighter amplitude stability, see table below.

*NOTE: for TTL output, place prefix "I" in front of model number.

***Supply current depends on freqnency.

**Tighter amplitude tolerance available on square wave outputs except with 5V supply and on sinewave outputs except for frequency >100 KHz and/or supply voltage <10V.

‡Temperature range can be shifted ±50°C within the range of −55°C to +125°C for crystal oscillators, and ±10°C for RC oscillators.

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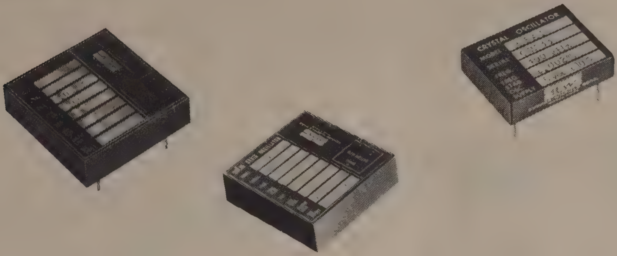

AC VOLTAGE REFERENCE

PACKAGE DIMENSIONS: 2" (5.08 cm) SQUARE x 0.6" (1.52 cm) HIGH TERMINATION
.03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

Model	Type	Amplitude Stability‡	Total Harmonic Distortion	Output Amplitude	Supply Voltage	Fixed Frequencies Available	Frequency Accuracy or Tolerance
L200BD	RC	±5%, 0°C to +50°C	<1%	Sinewave 5Vrms ± 2Vrms into a 10KΩ load (amplitude adjust available as option) (other amplitudes and loads available as option) Square Wave also available	Any fixed voltage from 12VDC to 15VDC, and 20VDC to 32VDC with ±5% regulation	100 Hz to 20 KHz	See Table C
L220-D	Xtal					100 Hz to 600 KHz	See Table D below
L200BV	RC	±0.25%, 0°C to +50°C	<5%			100 Hz to 10 KHz	See Table C
L220-V	Xtal						See Table D below
L200BR	RC		<1%				See Table C
L220-R	Xtal						See Table D below
L204BV	RC	±0.1%, +20°C to +40°C	<5%				See Table C
L224-V	Xtal						See Table D below
L204BR	RC		<1%				See Table C
L224-R	Xtal						See Table D below

TABLE A (SEE CHARTS BELOW)

Model	Frequency Tolerance	Temp. Range Degrees C‡
L24R2K, C120MSK, IC5K1	±.001%	+20 to +40
C120MSA, IC5A1	±.002%	+20 to +40
L24R2N, C120MSN, IC5N1	±.0025%	+10 to +40
L24R2R, L120MSR, IC5R1	±.0025%	0 to +50
L24R2S, C120MSS, IC5S1	±.003%	0 to +50
L24R2T, C120MST, IC5T1	±.003%	0 to +65
L24R2U, C120MSU, IC5U1	±.004%	0 to +65
L24R2X, C120MSX, LC5X1	±.004%	−25 to +50
C120MSB, IC5B1	±.005%	0 to +50

TABLE A (continued)

Model	Frequency Tolerance	Temp. Range Degrees C‡
C120MSC, IC5C1	±.005%	0 to +65
L24R2Y, C120MSY, IC5Y1	±.005%	−25 to +65
C120MSD, IC5D1	±.01%	0 to +65
C120MSE, IC5E1	±.01%	−25 to +75
C120MSF, IC5F1	±.02%	−25 to +75
C120MSG, IC5G1	±.02%	−55 to +75
C120MSH, IC5H1	±.05%	−55 to +75
C120MSJ, IC5J1	±.05%	−55 to +125

TABLE B (SEE CHARTS BELOW)

Model	Frequency Tolerance	Temp. Range Degrees C‡
IC5A2, L220A	±.002%	+20 to +40
IC5B2, L220B	±.005%	0 to +50
IC5C2, L220C	±.005%	0 to +65
IC5D2, L220D	±.01%	0 to +65
IC5E2, L220E	±.01%	−25 to +75
IC5F2, L220F	±.02%	−25 to +75
IC5G2, L220G	±.02%	−55 to +75
IC5H2, L220H	±.05%	−55 to +75
IC5J2, L220J	±.05%	−55 to +125

TABLE D (SEE CHART ABOVE)

Model	Frequency Tolerance‡
L220-D, L220-V, L220-R, L224-V, L224-R	
L220KD, L220KV, L220KR, L224KV, L224KR	±.001%, +20°C to +40°C
L220ND, L220NV, L220NR, L224NV, L224NR	±.0025%, +10°C to +40°C
L220RD, L220RV, L220RR, L224RV, L224RR	±.0025%, 0°C to +50°C
L220SD, L220SV, L220SR, L224SV, L224SR	±.003%, 0°C to +50°C
L220BD, L220BV, L220BR, L224BV, L224BR	±.005%, 0°C to +50°C

‡Temperature range can be shifted ±50°C within the range of −55°C to +125°C for crystal oscillators, and ±10°C for RC oscillators.

TABLE C (SEE CHARTS BELOW)

Frequency Tolerance	Temp. Range Degrees C‡
±0.05%	+15 to +35
±0.1%	0 to +50
±0.25%	0 to +65
±0.5%	−25 to +65

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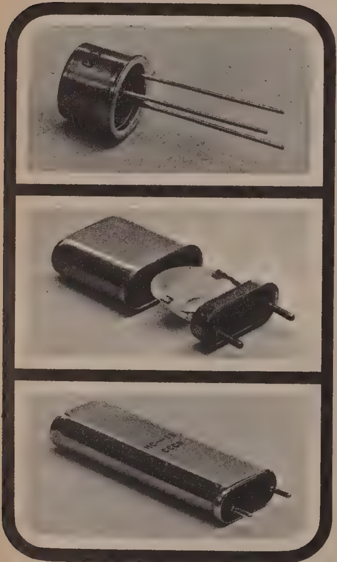

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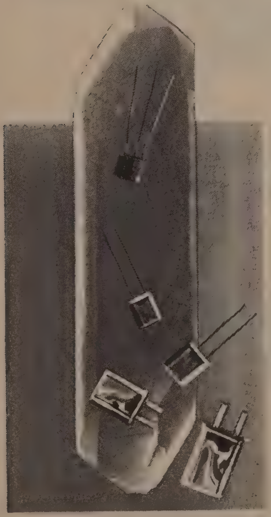

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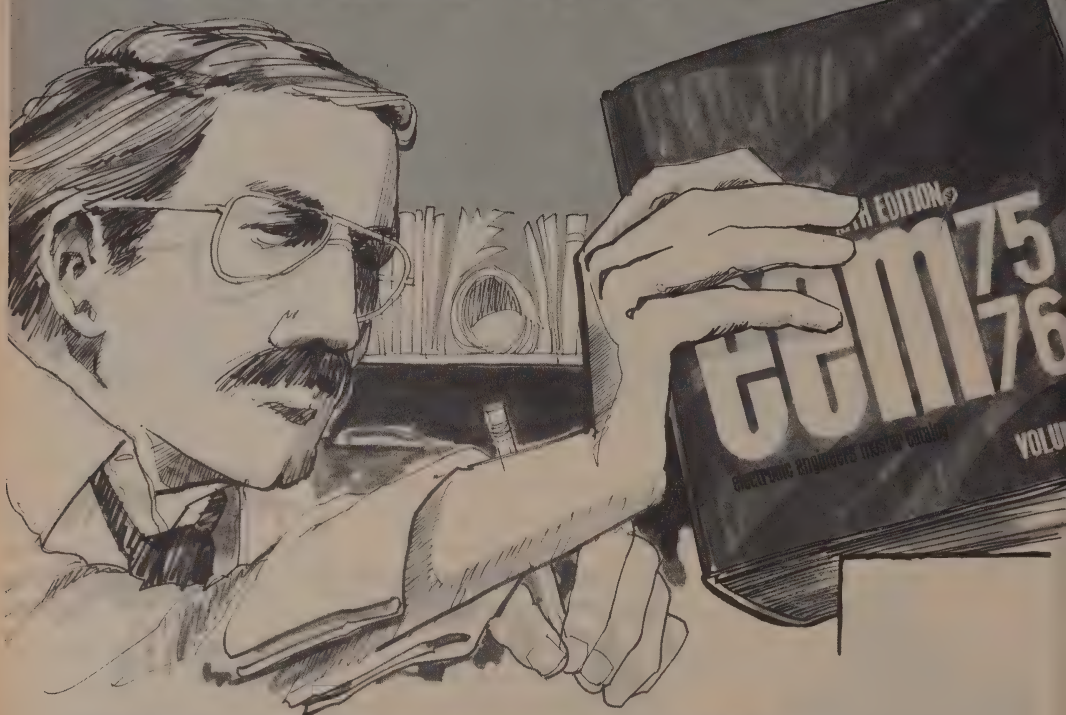
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Data shown in the table and graphs applies to typical crystal designs. CTS Knights will, at no additional cost, design a crystal for your specific oscillator requirements. When ordering a crystal, the following minimal specifications must be given: 1. Frequency, 2. Calibration Tolerance at 25°C. (or Oven temperature), 3. Mode (Fundamental or Overtone), 4. Load Capacitance, 5. Holder.

CTS Knights is QPL approved on the following Military Crystal types:

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CR-19A/U
CR-52A/U
CR-54A/U
CR-55A/U
CR-56A/U
CR-58A/U
CR-60A/U
CR-64A/U
CR-67A/U
CR-72A/U
CR-75A/U
CR-76A/U
CR-77A/U
CR-78A/U
CR-79A/U
CR-80A/U
CR-81A/U
CR-82A/U
CR-83A/U
CR-89A/U
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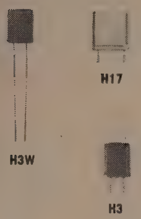
CR-117A/U
CR-139A/U
CR-140A/U
CR-141A/U
CR-157A/U



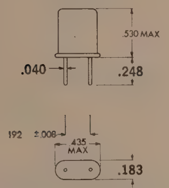
CTS Holder	Frequency Range	Calibration Tolerance @ 25°C*	Stability Over Temp. Range†	Temp. Range‡	Unwanted Modes	Drive	Modes	Dimensional Outline
H3/H3W	4-10 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	10 mw	FUND.	FIG. 1
H3/H3W	10-25 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	5 mw	FUND.	FIG. 1
H3/H3W	17-52 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	2 mw	3RD	FIG. 1
H3/H3W	40-125 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	2 mw	5TH	FIG. 1
H3/H3W	110-154 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	2 mw	7TH	FIG. 1
H5/H5W	1.8-5 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	10 mw	FUND.	FIG. 2
H17/H17W	1-10 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	10 mw	FUND.	FIG. 3
H17/H17W	10-25 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	5 mw	FUND.	FIG. 3
H17/H17W	20-60 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	2 mw	3RD	FIG. 3
H17/H17W	60-75 MHz	±.002%	±.002%	−30 to +70°C	−6db min.	2 mw	5TH	FIG. 3

* Calibration tolerances of ±.001% through .01% are available.
† Stability over temperature measured from frequency at 25°C.
‡ Temperature ranges of −55°C to +105°C, −30°C to +60°C, 0 to 70°C and 0 to 50°C are available.
Frequencies above 154 MHz are available, contact CTS Knights, Incorporated.

OUTLINE DRAWINGS

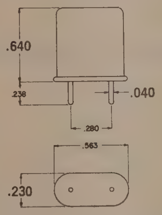
Dimensions shown are maximum unless otherwise noted.

Fig. 1 H3 (HC 25/u)



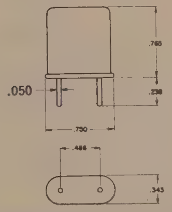
H3W (HC 18/u) 1.5″ Leads .017″ Dia.

Fig. 2 H5 (HC 32/u)



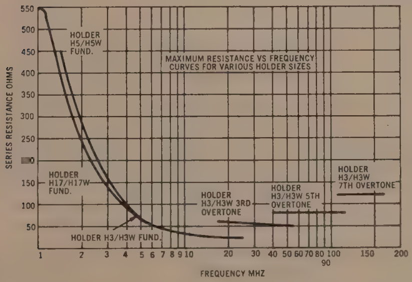
H5W 1.5″ Leads .030″ Dia.

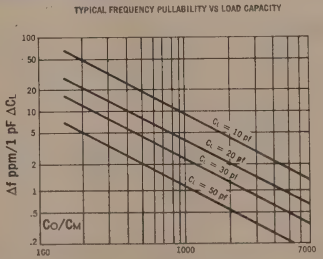
Fig. 3 H17 (HC 6/u)



H17W (HC 33/u) 1.5″ Leads .030″ Dia.

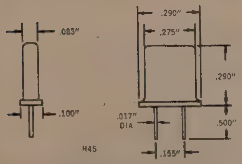
PERFORMANCE CURVES





TYPICAL Co/Cm RATIOS

Freq.	Co/Cm
FUNDAMENTAL	
1.0 - 1.399 MHz	310
3.4 - 1 5 MHz	275
1.5 - 25 MHz	225
3RD OVERTONE	
17 - 29 999 MHz	2100
30 - 54 MHz	2250
5TH OVERTONE	
40 - 90 MHz	6500



MICRO MINIATURE CRYSTALS

For applications such as pocket pager radios where minimal size is a must.

CTS Holder	Frequency Range	Mode	Dimensional Outline
H45	12.5-26 MHz	FUND.	FIG. 3A
H45	40-78 MHz	3RD	FIG. 3A
H45	70-130 MHz	5TH	FIG. 3A
H45	100-180 MHz	7TH	FIG. 3A

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SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA
SPECIALISTS IN FREQUENCY MANAGEMENT

CRYSTALS

HIGH STABILITY PRECISION COLDWELD CRYSTALS 1 MHz — 150 MHz

K5W

K17

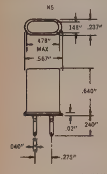
K3

CTS Holder	Frequency Range	Calibration Tolerance @ 25°C	Aging	Stability Over Temp. Range	Temp. Range	Drive	Mode	Dimensional Outline
K3/K3W	8-25 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	FUND.	FIG. 4
K3/K3W	24-75 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	3RD	FIG. 4
K3/K3W	40-125 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	5TH	FIG. 4
K5/K5W	3-25 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	FUND.	FIG. 5
K17/K17W	1-10 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	FUND.	FIG. 6
K17/K17W	4-30 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	OVERTONE	FIG. 6
K17/K17W	4.5-6.5 MHz	±2x10⁻⁶	1x10⁻⁹/day 1.5x10⁻⁷/yr.	*	Oven	.1 mw	3RD	FIG. 6
K17/K17W	4.8-6.5 MHz	±2x10⁻⁶	1x10⁻¹⁰/day 1.5x10⁻⁸/yr.	*	Oven	.1 mw	5TH	FIG. 6
T05	12-25 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	FUND.	FIG. 7
T05	36-150 MHz	±10x10⁻⁶	1x10⁻⁸/day 1.5x10⁻⁶/yr.	±25x10⁻⁶	−55 to +105°C	.1 mw	OVERTONE	FIG. 7
K39	1-20 MHz	±10x10⁻⁶	5x10⁻⁸/day 2.5x10⁻⁶/yr.	±25x10⁻⁶	0 to +70°C	2 mw	FUND.	FIG. 8

* Special High-Stability oven types for use in highly stable proportional control ovens.

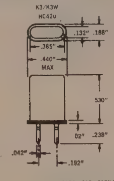
OUTLINE DRAWINGS

Dimensions shown are maximum unless otherwise noted.



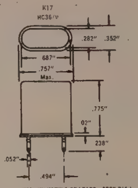
(FIG. 5W K5W 1.0″ LEADS, .020″ DIA.)

Fig. 5



(FIG. 4W K3W 1.5″ LEADS, .016/.019″ DIA.)

Fig. 4



(FIG. 6W K17W 1.0″ LEADS, .030″ DIA.)

Fig. 6

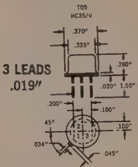


Fig. 7

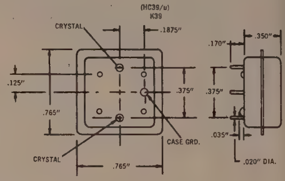
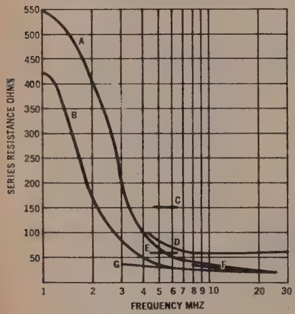
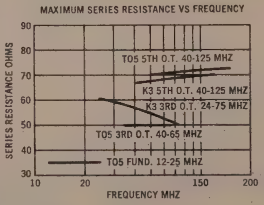


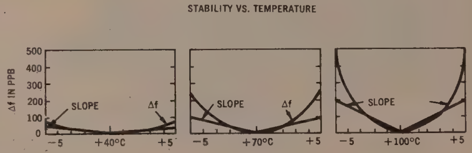
Fig. 8

PERFORMANCE CURVES





Legend
A—K39 1-20 MHz
B—K17 1-10 MHz
C—K17 4.8-6.5 MHz
D—K17 4-30 MHz
E—K17 4.5-6.5 MHz
F—K3 8-20 MHz
G—K5 3-25 MHz



$\frac{\Delta f}{f} = 3\text{ppb}/{}^\circ C^2 \Delta T^2$

Slope = 6ppb/°CΔT

$\frac{\Delta f}{f} = 10\text{ppb}/{}^\circ C^2 \Delta T^2$

Slope = 20ppb/°CΔT

$\frac{\Delta f}{f} = 20\text{ppb}/{}^\circ C^2 \Delta T^2$

Slope = 40ppb/°CΔT

NOTE: Curves assume no thermal shock due to oven cycling.

WATCH AND CLOCK CRYSTALS

CTS Holder	Size (Inches)	Frequency	Cal. Tol. @ 27°C*	Turning Point	Operating Temp. Range	Stability VS. Time	Typical Series Resistance†	Load Cap.	Stability VS. Temp. Δf/f‡	Drive Level	Dimensional Outline
TPEX-3	.565x.145 x.150	32.768 KHz	±40x10⁻⁶	27°C ±7°C	−10 to +60°C	±5x10⁻⁶/yr.	28K Ohms	10-25 Pf	.0437 ppm/(Δ°C)²	1 uw.	Fig. 9
TX4	.492x.070 x.119	32.768 KHz	±40x10⁻⁶	27°C ±7°C	−10 to +60°C	±5x10⁻⁶/yr.	20K Ohms	10-25 Pf	.04 ppm/(Δ°C)²	1 uw.	Fig. 10
K17W	.757x.352 x.775	180 to 330 KHz	±40x10⁻⁶	27°C ±15°C	−10 to +60°C	±5x10⁻⁶/yr.	500 Ohms	Series to 20 Pf	.02 ppm/(Δ°C)²	.05 mw.	Fig. 6W except leads are .5″

* ±30x10⁻⁶ to ±100x10⁻⁶ tolerances available.
† Resistances shown are typical values at series resonance.
‡ Δ°C with reference to Turning Point Temp.

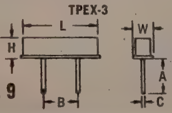


Fig. 9

Dim.	Inch	MM.
L	.565	14.351
W	.145	3.683
H	.150	3.810
A	.250	6.350
B	.250	6.350
C	.019	.483

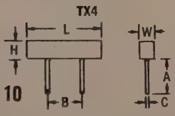


Fig. 10

Dim.	Inch	MM.
L	.495	12.573
W	.075	1.905
H	.125	3.175
A	.425	10.795
B	.250	6.350
C	.005	.127

CTS KNIGHTS, INC., 400E Reimann Avenue, Sandwich, Illinois 60548 • Telephone (815) 786-8411 • TWX 910-642-0860 Cable CTS

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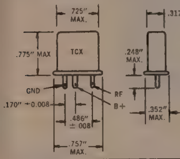
SPECIALISTS IN FREQUENCY MANAGEMENT

CRYSTALS & CRYSTAL OSCILLATORS

TEMPERATURE COMPENSATED CRYSTALS (TCX)

The temperature compensated crystal (TCX) is designed to give good stability over a broad temperature range at a minimum of cost. Typical applications are land mobile and radio telephone equipment that require a stability of ±5 ppm over an ambient temperature range of −30°C to +60°C. The TCX is easily furnished in a variety of frequencies. Extremely low power consumption makes the TCX ideal for portable applications.



725″ MAX.
.317″ MAX.
.775″ MAX
TCX
.248″ MAX.
GND
RF
B+
.170″ ±0.008
.486″ ±.008
.352″ MAX.
.757″ MAX.

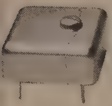
CTS Holder	Frequency Range	Calib. Tol. @ 25°C	Temperature Range	Stability vs. Temp.*	Input Voltage	Drive	Load Cap.	Dimesional Outline
H17	6-25 MHz	±10x10^{-6}	−30° to +60°C	±5x10^{-6}	+9 VDC	Less than 5 mw	32 pf	FIG. 12

* Other stabilities available. Contact factory.

† Input voltage ±5%. Regulated ±1% over temperature.

TEMPERATURE COMPENSATED OSCILLATORS (TCXO)

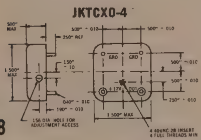
Low power requirements, high stability and excellent environmental capability characterize CTS Knights' temperature compensated crystal oscillators. CTS Knights has many years experience in developing economical TCXO designs for instrument and communications applications. Stabilities as high as ±5 x 10^{-7} over a wide temperature range are practical. CTS Knights can supply all TCXO designs with sine wave or TTL compatible output. Special designs available.



JKTCXO-8

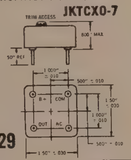
Model	Series	Frequency Range	Size (Inches)	Supply Voltage	Stability VS. Operating Temp.	Stability VS. Time	Output	Dimensional Outline
JKTCXO-4 JKTCXO-4 JKTCXO-4	——— Option 1 Option 2	6-20 MHz	1.50 SQ. x.50	12 VDC @ 16 MA	±1x10^{-5} −55 to +85°C ±1x10^{-6} 0 to +50°C ±5x10^{-6} −20 to +70°C	±5x10^{-6}/yr.	TTL Logic 0:.5 V Max. Logic 1:2.5 V Min.	FIG. 28
JKTCXO-7 JKTCXO-7 JKTCXO-7	974-1000 974-2000 974-3000	3-10 MHz	1.50 SQ. x.800	12 VDC @ 10 MA	±5x10^{-7} +15 to +70°C ±1x10^{-6} 0 to +70°C ±5x10^{-6} −40 to +70°C	±1x10^{-6}/yr.	TTL Logic 0:.5 V Max. Logic 1:2.5 V Min.	FIG. 29
JKTCXO-8 JKTCXO-8 JKTCXO-8 JKTCXO-8	972-1000 972-2000 972-3000 972-4000	25 KHz-20 MHz	2.00 x.625	12 VDC @ 10 MA	±1x10^{-6} −40 to +70°C ±2x10^{-6} −40 to +70°C ±5x10^{-6} −40 to +70°C ±2x10^{-6} −55 to +85°C	±1x10^{-6}/yr.	TTL Logic 0:.5 V Max. Logic 1:2.5 V Min.	FIG. 30

All dimensions are maximum unless otherwise noted.



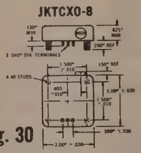
JKTCXO-4
500″ MAX
500″ ± 010
250″ REF
1 500″ MAX
150″ ± 10
GRD
GRD
+12V
OUT
500″ ± 010
250″ ± 010
040″ ± 010
190″ ± 010
1 500″ MAX
156 DIA HOLE FOR ADJUSTMENT ACCESS
4 40UNC 2B INSERT 4 FULL THREADS MIN

Fig. 28



TRIM ACCESS
JKTCXO-7
800″ MAX
50″ REF
1 000″ ± 010
500″ ± 010
B+
COM
OUT
NC
1 50″ ± 030
1 000″ ± 010
500″ ± 010
1 50″ ± 030

Fig. 29



JKTCXO-8
130″ MIN
625″ MAX
250″ REF
3 040″ DIA TERMINALS
1 500″ ± 010
150″ REF
4 40 STUDS
400 ±010″
2.00″ ± .030
1 500″ ±.010
500″ ±.030
2.00″ ± .030

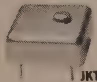
Fig. 30

OPTIONS

Option A: 4-40 inserts are available in lieu of the 4-40 studs.

Option B: Case available with 4 .040 dia. mounting terminals in lieu of the 4 4-40 studs and trim access centered. Connections to the oscillator are to the 4 .040 terminals.

VOLTAGE CONTROLLED CRYSTAL OSCILLATORS

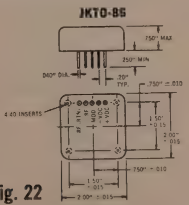


JKTO-86

Voltage controlled oscillators can be supplied by CTS Knights for various stability versus temperature requirements by adding oven control or temperature compensating circuitry. Contact CTS Knights for special requirements.

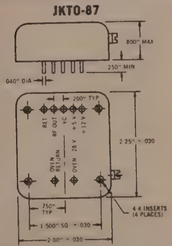
Model	Frequency Range	Size (Inches)	Oscillator Input	Oven Input	Modulation Input	Modulation Deviation	Modulation Linearity	Stability VS. Temp.	Dimensional Outline
JKTO-86	5-30 MHz	2.0 SQ. x.750	12 VDC ±1	None	±3 VP.P., DC to 20 KHz	±1000 PPM	±10%	0 to +50°C ±100x10^{-6}	FIG. 22
JKTO-87	10-27 MHz	2.0 SQ. x.800	+12 & +5 VDC	+28 VDC	±3 VP.P., DC to 20 KHz	±1000 PPM	±5%	−40 to +70°C ±10x10^{-6}	FIG. 23
JKTO-87	10-27 MHz	Same as Above Except Stability Versus Temperature:						0 to +55°C ±5x10^{-6}	FIG. 23

All dimensions are maximum unless otherwise noted.



JKTO-86
750″ MAX
250″ MIN
040″ DIA.
.20″ TYP.
.750″ ±.010
4 40 INSERTS
RF .RTN.
RF
MOD
−VDC
+VDC
1 50″ ± 0 15
2 00″ ± 015
750″ ± 010
1 50″ ± 015
2 00″ ± 015

Fig. 22



JKTO-87
800″ MAX
250″ MIN
040″ DIA
200″ TYP
RET
RF OUT
VC
+5 V
+12 V
OVEN RETURN
OVEN 28 V
2 25″ ± 030
750″ TYP
4 4 INSERTS (4 PLACES)
1 500″ SQ ± 030
2 00″ ± 030

Fig. 23

CTS KNIGHTS, INC.

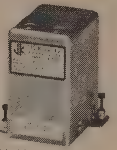
SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

SPECIALISTS IN FREQUENCY MANAGEMENT

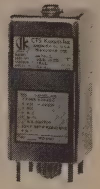
CRYSTAL OSCILLATORS

HIGH STABILITY OVENIZED CRYSTAL OSCILLATORS

CTS Knights ovenized oscillators are available in thermostatically controlled models as well as proportional control models. A variety of design options is available to the user, including very high stability, low power, small size and sine wave or square wave (TTL or CMOS) output. Contact CTS Knights for your special requirements.



JKTO-83



JKTO-41

Model	Frequency Range	Size (Inches)	Oscillator Input	Oven Input	Temperature Control	Stability VS. Time†	Stability VS. Temp.	Output	Dimensional Outline
JKTO-9	20 KHz- 10 MHz	1.313 O.D. x 1.047	+28 VDC	+28 V DC/AC 20 W.	Thermostat	±1x10^{-7}/day	−40 to +55°C ±1x10^{-6}	Sine Wave 1 Volt ±10% 10 K Ohm Load	FIG. 13
JKTO-22	4- 100 MHz	1.578x1.875 x4.422 HT	+28 VDC	+28 V DC/AC 115 VAC 11 W.	Thermostat	±2x10^{-7}/day	−40 to +70°C ±7.5x10^{-7}	Sine Wave 1 Volt RMS 5 K Ohm Load	FIG. 14
JKTO-25	60 Hz- 4 MHz	2.219 SQ. x4.37	* +28 VDC & 5 VDC	+28 V DC/AC 22 W.	Thermostat	±2.5x10^{-7}/day	−40 to +70°C ±7.5x10^{-7}	TTL Compatible	FIG. 15
JKTO-30	1- 4 MHz	2.0 SQ. x4.0	+28 VDC	+28 VDC or 115 VAC 10 W. Max.	Proportional	±1x10^{-8}/day	−10 to +55°C ±5x10^{-8}	Sine Wave 1 Volt RMS 500 Ohm Load	FIG. 16
JKTO-30	4- 10 MHz	2.0 SQ. x4.0	+12 to +28 VDC	+28 VDC or 115 VAC 10 W. Max.	Proportional	±1x10^{-8}/day	−10 to +55°C ±5x10^{-8}	Sine Wave 1 Volt RMS 500 Ohm Load	FIG. 16
JKTO-41	1- 10 MHz	2.0 SQ. x4.25	+28 VDC	+28 VDC 10 W. Max.	Proportional	±2x10^{-9}/day	−40 to +70°C ±3x10^{-8}	Sine Wave .316 Volt Min. 50 Ohm Load	FIG. 17
JKTO-41	10- 100 MHz	2.0 SQ. x4.25	+28 VDC	+28 VDC 10 W. Max.	Proportional	±5x10^{-9}/day	−25 to +65°C ±5x10^{-8}	Sine Wave .316 Volt Min. 50 Ohm Load	FIG. 17
JKTO-49	1- 5 MHz	2.0 SQ. x4.25	+28 VDC	+28 VDC 10 W. Max.	Double Oven Proportional	±2x10^{-9}/day	−40 to +65°C ±5x10^{-9}	Sine Wave .316 Volt Min. 50 Ohm Load	FIG. 17
JKTO-51	1- 2 MHz	1.844x2.0 x3.436	+28 VDC	+28 VDC 10 W. Max.	Proportional	±1x10^{-8}/day	−55 to +75°C ±5x10^{-8}	Sine Wave 1 Volt RMS 10K Ohm Load	FIG. 18
JKTO-56	4- 6 MHz	2.0 SQ. x4.0	+12 VDC	+24 VDC 5 W. Max.	Proportional	±2.5x10^{-7}/day	−10 to +60°C ±1x10^{-8}	Sine Wave .224 Volt Min. 50 Ohm Load	FIG. 19
				Same As Above Except		±1x10^{-6}/day	−10 to +60°C ±5x10^{-8}		
JKTO-66	5 MHz	7x19 Panel	(115 VAC Power Supply)		Double Oven Proportional	±5x10^{-10}/day	0 to 50°C ±2x10^{-9}	Sine Wave 1 Volt Min. 50 Ohm Load	Std. Rack Mtg.
JKTO-83	1- 6 MHz	2.437 x2 x3.187	±30 VDC	±30 VDC 6.5 W. Max.	Double Oven Proportional	±1x10^{-9}/day	−55 to +70°C ±1x10^{-8}	Sine Wave 1 Volt Min. 50 Ohm Load	FIG. 20
JKTO-88-1	1- 10 MHz	2.0x2.25 x.800	5 V & 12 VDC	+28 VDC 10 W. Max.	Proportional	±5x10^{-9}/day	−25 to +65°C ±1x10^{-7}	TTL Syn. ±15% Fan Out 5	FIG. 21
-2	10- 30 MHz	2.0x2.25 x.800	5 V & 12 VDC	+28 VDC 10 W. Max.	Proportional	±2x10^{-8}/day	−25 to +65°C ±2x10^{-7}	TTL Syn. ±15% Fan Out 5	FIG. 21

* Must have 28 VDC oscillator and 5 VDC binary supply.

† At a constant temperature.

OUTLINE DRAWINGS

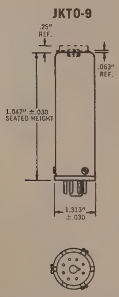

JKTO-9
.25" REF.
.063" REF.
1.047" ±.030 SEATED HEIGHT
1.313" ±.030

Fig. 13

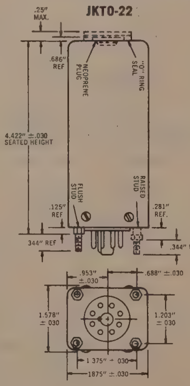

.25" MAX.
JKTO-22
.686" REF
NEOPRENE PLUG
"O" RING SEAL
4.422" ±.030 SEATED HEIGHT
FLUSH STUD
RAISED STUD
.125" REF
.281" REF.
344" REF
.344" REF
.953" ±.030
.688" ±.030
1.578" ± 030
1.203" ± 030
1 375" ± 030
1875" ±.030

Fig. 14

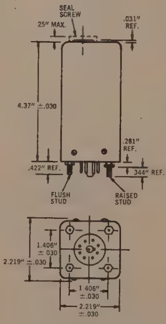

JKTO-25
SEAL SCREW
25" MAX.
.031" REF.
4.37" ±.030
.281" REF.
.422" REF.
344" REF.
FLUSH STUD
RAISED STUD
1.406" ± 030
2.219" ±.030
1 406" ±.030
2.219" ±.030

Fig. 15

HIGH STABILITY OVENIZED CRYSTAL OSCILLATORS (Continued)

JKTO-30

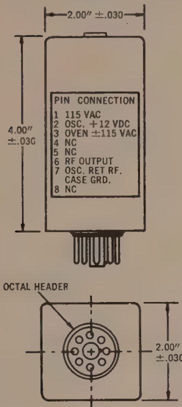

2.00″ ±.030
4.00″ ±.030
PIN CONNECTION
1 115 VAC
2 OSC. +12 VDC
3 OVEN ±115 VAC
4 NC
5 NC
6 RF OUTPUT
7 OSC. RET RF. CASE GRD.
8 NC
OCTAL HEADER
2.00″ ±.030

Fig. 16

JKTO-47
JKTO-49

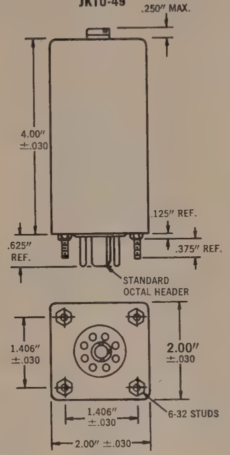

.250″ MAX.
4.00″ ±.030
.125″ REF.
.625″ REF.
.375″ REF.
STANDARD OCTAL HEADER
1.406″ ±.030
2.00″ ±.030
1.406″ ±.030
6-32 STUDS
2.00″ ±.030

Fig. 17

JKTO-51

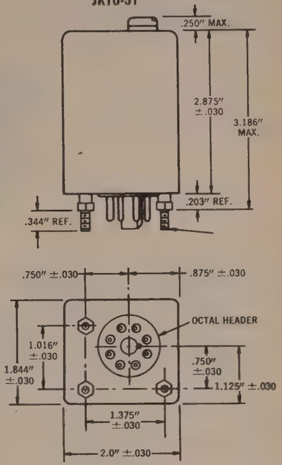

.250″ MAX.
2.875″ ±.030
3.186″ MAX.
.203″ REF.
.344″ REF.
.750″ ±.030
.875″ ±.030
OCTAL HEADER
1.016″ ±.030
1.844″ ±.030
.750″ ±.030
1.125″ ±.030
1.375″ ±.030
2.0″ ±.030

Fig. 18

TO-56

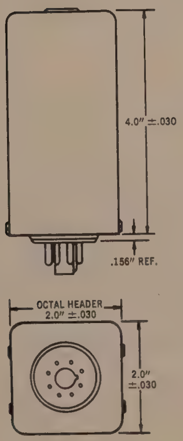

4.0″ ±.030
.156″ REF.
OCTAL HEADER
2.0″ ±.030
2.0″ ±.030

Fig. 19

JKTO-83

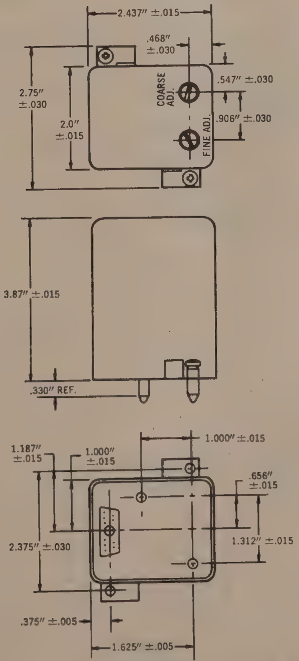

2.437″ ±.015
.468″ ±.030
2.75″ ±.030
2.0″ ±.015
COARSE ADJ.
.547″ ±.030
.906″ ±.030
FINE ADJ.
3.87″ ±.015
.330″ REF.
1.000″ ±.015
1.187″ ±.015
1.000″ ±.015
.656″ ±.015
1.312″ ±.015
2.375″ ±.030
.375″ ±.005
1.625″ ±.005

Fig. 20

JKTO-88

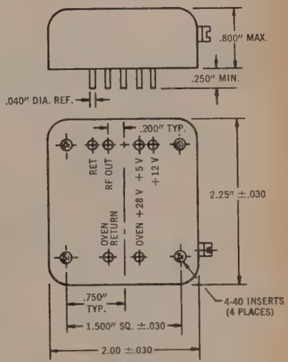

.800″ MAX.
.250″ MIN.
.040″ DIA. REF.
.200″ TYP.
RET
RF OUT
+5 V
+12 V
OVEN RETURN
OVEN +28 V
2.25″ ±.030
4-40 INSERTS (4 PLACES)
.750″ TYP.
1.500″ SQ. ±.030
2.00 ±.030

Fig. 21

CTS KNIGHTS, INC.

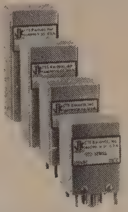
SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

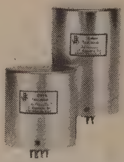
SPECIALISTS IN FREQUENCY MANAGEMENT

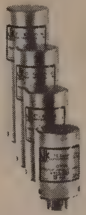
OVENS

OVENS

Precise control and reliability are the main features of CTS Knights ovens. Snap-action thermostats known for their long life are used on every thermostat design. Hermetically sealed, double insulated thermostats are used on 115 V models and are optional on others. Contact CTS Knights for special cavity and internal component mounting requirements.







Series	Temperature Control	External Dim. (Max.)	Cavity Size	Calibration Temperature	Oven Temp. Cycling @ 25°C Ambient	Max. Oven Temp. Change VS. Ambient*	Voltage	Mounting	Dimensional Outline
905	Thermostat	1.299 O.D. x1.718 H.	1.03 I.D. x.860	+65 to 85°C ±2.5°C	±.1°	1°C from −55°C	6.3 V to 28 V AC/DC 115 VAC	Octal Plug-in	FIG. 31
906	Thermostat	1.299 O.D. x2.468 H.	1.03 I.D. x1.609	+65 to 85°C ±2.5°C	±.1°	1°C from −55°C	6.3 V to 28 V AC/DC 115 VAC	Octal Plug-in	FIG. 31
918	Thermostat	2.360 O.D. x2.360 H.	1.687 I.D. x2.50	+65 to 85°C ±3°C	±.1°	2°C from −55°C	24-28 V AC/DC 115 VAC	Octal Plug-in	FIG. 32
919	Thermostat	2.360 O.D. x4.562 H.	1.687 I.D. x3.50	+65 to 85°C ±3°C	±.1°	2°C from −55°C	24-28 V AC/DC 115 VAC	Octal Plug-in	FIG. 32
923	Proportional Control	2.0 SQ. x1.0 H.	1.50 SQ. x.453	+60 to 100°C ±2°C	±.015°C	.5°C from −40°C	24-32 VDC	Octal Plug-in	FIG. 33
947	Thermostat	3.187 O.D. x3.50 H.	2.468 I.D. x2.406	+65 to 85°C ±3°C	±.1°	2°C from 0°C	28 V AC/DC 115 VAC	Octal Plug-in	FIG. 34
948	Thermostat	3.187 O.D. x4.875 H.	2.468 I.D. x3.843	+65 to 85°C	±.1°	2°C from 0°C	28 V AC/DC 115 VAC	Octal Plug-in	FIG. 34
952/ 955	Thermostat	1.639 O.D. x2.28 H. to 4.531 H.	1.031 I.D. .875 to 3.098	+65 to 85°C	±.025°C	.15°C from 40°C	28 VDC	Octal Plug-in	FIG. 35

* Stability from temperature shown to within 10°C of oven temperature.

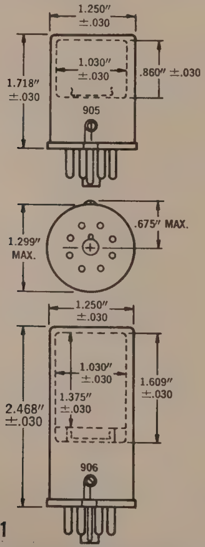

1.250″ ±.030
1.030″ ±.030
.860″ ±.030
1.718″ ±.030
905
1.299″ MAX.
.675″ MAX.
1.250″ ±.030
1.030″ ±.030
1.609″ ±.030
1.375″ ±.030
2.468″ ±.030
906

Fig. 31

918 & 919

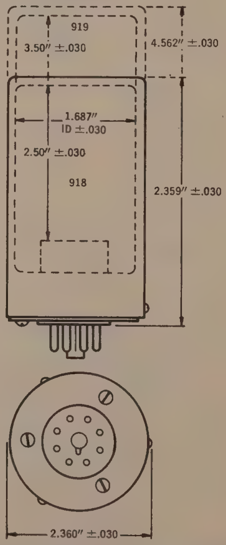

919
3.50″ ±.030
4.562″ ±.030
1.687″ ID ±.030
2.50″ ±.030
918
2.359″ ±.030
2.360″ ±.030

Fig. 32

923

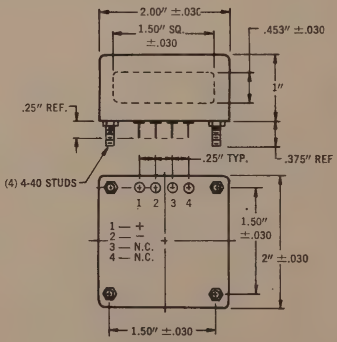

2.00″ ±.030
1.50″ SQ. ±.030
.453″ ±.030
1″
.25″ REF.
.25″ TYP.
.375″ REF
(4) 4-40 STUDS
1 2 3 4
1 — +
2 — −
3 — N.C.
4 — N.C.
1.50″ ±.030
2″ ±.030
1.50″ ±.030

Fig. 33

CTS KNIGHTS, INC.
SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA
SPECIALISTS IN FREQUENCY MANAGEMENT

OVENS & CRYSTAL CLOCK OSCILLATORS

OVENS (Continued)

Fig. 34

947 & 948

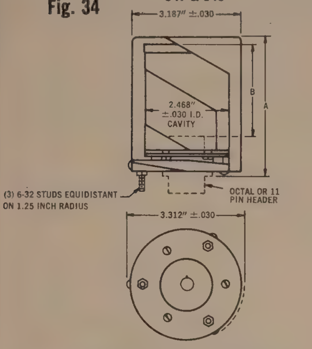
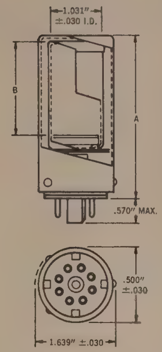
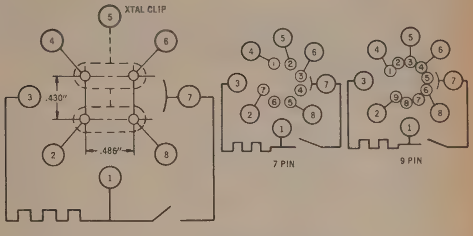

3.187" ±.030
2.468" ±.030 I.D. CAVITY
B
A
(3) 6-32 STUDS EQUIDISTANT ON 1.25 INCH RADIUS
OCTAL OR 11 PIN HEADER
3.312" ±.030

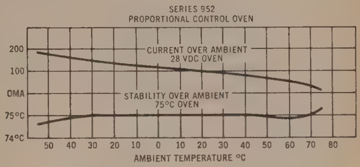
Fig. 35

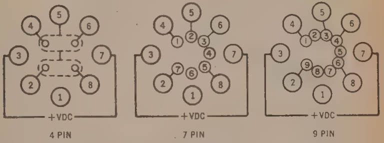
953/955


1.031" ±.030 I.D.
B
A
.570" MAX.
.500" ±.030
1.639" ±.030

905/906 SERIES


XTAL CLIP
5
4
6
3
.430"
7
.486"
2
8
1
7 PIN
9 PIN




+VDC
4 PIN
7 PIN
9 PIN

Model	Internal Socket	Seated HT "A"	Internal HT Above Socket "B"
947	None	3.50" ±.030	2.406" ±.030
	7 Pin	3.50" ±.030	1.812" ±.030
	8 Pin	3.50" ±.030	1.718" ±.030
	9 Pin	3.50" ±.030	1.812" ±.030
948	None	4.875" ±.030	3.843" ±.030
	7 Pin	4.875" ±.030	3.375" ±.030
	8 Pin	4.875" ±.030	3.156" ±.030
	9 Pin	4.875" ±.030	3.375" ±.030

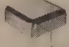
Model	"A" Seated Height	"B" Over Int. Socket
952	2.281" ±.030	.875" ±.030
953	3.031" ±.030	1.625" ±.030
954	4.031" ±.030	2.578" ±.030
955	4.531" ±.030	3.078" ±.030

CRYSTAL CLOCK OSCILLATORS

CTS Knights' crystal clock oscillators provide a highly reliable timing function for military and commercial digital applications. All CTS crystal clocks have hermetically sealed crystals. The discrete packaged units such as the JKTO-77 and 78 are useful in applications where size is not a problem. The JKTO-79 series cold-weld sealed hybrid oscillators are ideal for applications where size must be reduced to a minimum while maintaining reliability. The most economical hybrid clock oscillator in the CTS line is the JKTO-80. Contact CTS for special frequencies or output requirements.

JKTO-78

JKTO-79



JKTC-77

Model	Frequency Range	SIZE (Inches)	Supply Voltage	Stability VS. Operating Temperature		Cal. Tol. @ 25°C	Output	Mounting	Dimensional Outline
JKTO-77	5-20 MHz	1.00 SQ.x.375	+5 VDC	±.01%	−55° to 125°C	±50x10-6	TTL	P.C. Board	FIG. 24
JKTO-78	50-50,000 KHz	1.500 SQ.x.420	+5 VDC	±.01%	−55° to 125°C	±50x10-6	TTL	P.C. Board	FIG. 25
JKTO-79B	8-26 MHz	TO-8 Holder	+5 VDC	±25x10-6	0° to 70°C	±20x10-6	TTL	P.C. Board	FIG. 26
JKTO-79B	Same as above except stability:			±100x10-6	−55° to 125°C				
JKTO-79C	25-8000 KHz	TO-8 Holder	+5 VDC	±25x10-6	0° to 70°C	±20x10-6	TTL	P.C. Board	FIG. 26
JKTO-79C	Same as above except stability:			±100x10-6	−55° to 125°C				
JKTO-79S	8-20 MHz	TO-8 Holder	+5 VDC	±25x10-6	0° to 70°C	±20x10-6	SINE	P.C. Board	FIG. 26
JKTO-79S	Same as above except stability:			±100x10-6	−55° to 125°C				
JKTO-80	5-26 MHz	14-Pin DIP .8x.8x.31	±5 VDC	±25x10-6	0° to 70°C	±25x10-6	TTL	P.C. Board	FIG. 27

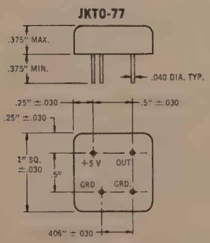

JKTO-77
.375" MAX.
.375" MIN.
.040 DIA. TYP.
.25" ±.030
.25" ±.030
.5" ±.030
1" SQ. ±.030
.5"
+5 V
OUT
GRD
GRD
.406" ± .030

Fig. 24

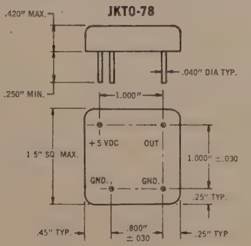

JKTO-78
.420" MAX.
.040" DIA TYP.
.250" MIN.
1.000"
1.5" SQ. MAX.
+5 VDC
OUT
1.000" ±.030
GND.
GND.
.25" TYP.
.45" TYP.
.800" ±.030
.25" TYP

Fig. 25

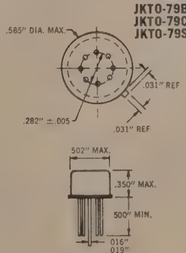

JKTO-79B
JKTO-79C
JKTO-79S
.565" DIA. MAX.
.031" REF
.282" ±.005
.031" REF
.502" MAX.
.350" MAX.
.500" MIN.
.016"
.019"

Fig. 26

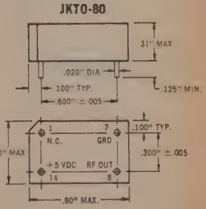

JKTO-80
.31" MAX
.020" DIA
.100" TYP.
.125" MIN.
.600" ±.005
.100" TYP.
1
7
N.C.
GRD
.50" MAX
.300" ±.005
+5 VDC
RF OUT
14
8
.80" MAX.

Fig. 27

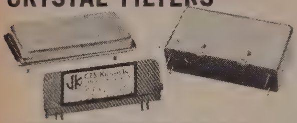
CTS KNIGHTS, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

SPECIALISTS IN FREQUENCY MANAGEMENT

CRYSTAL FILTERS

CRYSTAL FILTERS



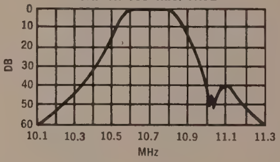
High quality CTS Knights crystal filters are used in FM receivers, narrow band FM transceivers, single sideband transceivers, land mobile radios and military communications equipment. CTS Knights' computer filter analysis assures the customer of getting the most economical filter for his application. Contact CTS Knights to discuss your specific filter requirements.

Type	Frequency	3 db BW	Shape Factor†	Ult. Atten.	I.L.	Z In/Out*	Poles	Operating Temperature	Dimensional Drawing
JKF-4W-15S	10.7 MHz	240 KHz	4.25/1 (50/3 db)	50 db	5.0 db Max.	500	4	−30° to +65°C	FIG. 40
961-7000	9-25 MHz	10-30 KHz	1.8/1 (60/3 db)	100 db	4.0 db Max.	1K-8K	8	−30° to +65°C	FIG. 41
961-2000	9-25 MHz	10-30 KHz	2.3/1 (60/3 db)	90 db	3.0 db Max.	1K-8K	6	−30° to +65°C	FIG. 41
961-2500	9-25 MHz	10-30 KHz	4/1 (60/3 db)	70 db	2.0 db Max.	1K-8K	4	−30° to +65°C	FIG. 41
961-8000	9-30 MHz	10-30 KHz	1.8/1 (60/3 db)	100 db	4.0 db Max.	1K-8K	8	−30° to +65°C	FIG. 42
	OPTION	10-30 KHz	2.3/1 (60/3 db)	90 db	3.0 db Max.	1K-8K	6	−30° to +65°C	FIG. 42
	OPTION	10-30 KHz	4/1 (60/3 db)	70 db	2.0 db Max.	1K-8K	4	−30° to +65°C	FIG. 42
961-9000	9-25 MHz	10-30 KHz	1.8/1 (60/3 db)	90 db	4.0 db Max.	1K-8K	8	−30° to +65°C	FIG. 43
	OPTION	10-30 KHz	2.31/ (60/3 db)	80 db	3.0 db Max.	1K-8K	6	−30° to +65°C	FIG. 43
	OPTION	10-30 KHz	4/1 (60/3 db)	70 db	2.0 db Max.	1K-8K	4	−30° to +65°C	FIG. 43

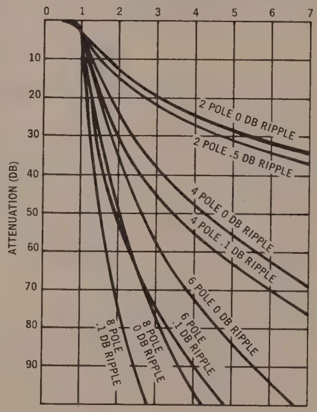
†Theorical Limit

* Natural Termination: $Z = 1.2 \frac{BW3}{2\pi fc^2 \text{ cm}}$
Except for JKF-4W-15S

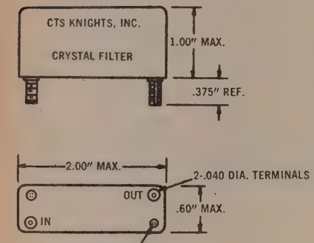
JKF-4W-155 RESPONSE



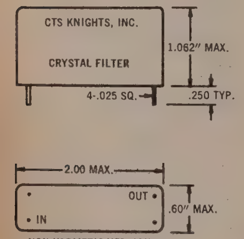
SHAPE FACTOR FOR MONOLITHIC CRYSTAL FILTERS



JKF-4W-15S


CTS KNIGHTS, INC.
CRYSTAL FILTER
1.00″ MAX.
.375″ REF.
2.00″ MAX.
2-.040 DIA. TERMINALS
OUT
IN
.60″ MAX.
2-#4-40 STUDS

HERMETIC SEALED VERSION
FOR MILITARY OR INDUSTRIAL USE


CTS KNIGHTS, INC.
CRYSTAL FILTER
1.062″ MAX.
4-.025 SQ.
.250 TYP.
2.00 MAX.
OUT
IN
.60″ MAX.

NON-HERMETIC VERSION
FOR CONSUMER PRODUCTS

Fig. 40

961-8000 SERIES

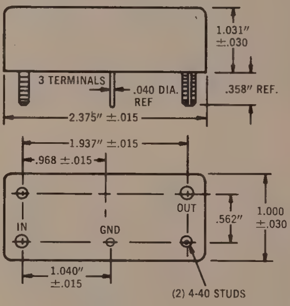

1.031″
±.030
3 TERMINALS
.040 DIA.
REF
.358″ REF.
2.375″ ±.015
1.937″ ±.015
.968 ±.015
OUT
IN
GND
.562″
1.000
±.030
1.040″
±.015
(2) 4-40 STUDS

Fig. 42

961-7000 SERIES

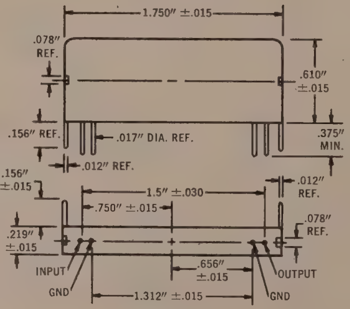

1.750″ ±.015
.078″
REF.
.610″
±.015
.156″ REF.
.017″ DIA. REF.
.375″
MIN.
.012″ REF.
.156″
±.015
1.5″ ±.030
.012″
REF.
.750″ ±.015
.078″
REF.
.219″
±.015
INPUT
GND
.656″
±.015
OUTPUT
GND
1.312″ ±.015

Fig. 41

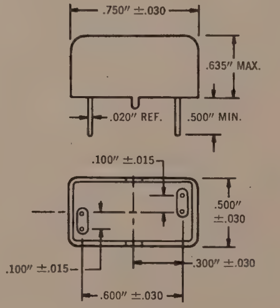

.750″ ±.030
.635″ MAX.
.020″ REF.
.500″ MIN.
.100″ ±.015
.500″
±.030
.100″ ±.015
.300″ ±.030
.600″ ±.030

Fig. 43

CTS KNIGHTS, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

SPECIALISTS IN FREQUENCY MANAGEMENT

CRYSTAL FILTERS & DISCRIMINATORS

MONOLITHIC CRYSTAL FILTERS

CTS Knights is a leader in the high volume production of monolithic crystal filters. We have the capability to design and manufacture monolithic crystal filters to fulfill your specific requirement. Our experienced engineering staff will assist you in tailoring monolithic crystal filters that can be combined to form 4, 6, or 8 pole filters. This building block approach allows you to take advantage of the low cost and small size of the monolithic crystal filter, and also gives the overall advantage of building your own filter in-house.

CTS Holder	Frequency Range	F1 - F2	Bandwidth 3 db	Load	Poles	Shape Factor	Dimensional Outline
H3W3	10-15 MHz	5 thru 35 KHz	7-40 KHz	Note 1	2	5.5-1 (30-3 db)	FIG. 38
H3T3	15-23 MHz	10 thru 45 KHz	14-60 KHz	Note 1	2	5.5-1 (30-3 db)	FIG. 39

Note 1: Terminating Resistance $= 1.2 \frac{BW3}{2 f^2 C_m}$

C_m = Motional Capacitance

BW3 = Bandwidth at 3 db.

OUTLINE DRAWINGS

H3W3

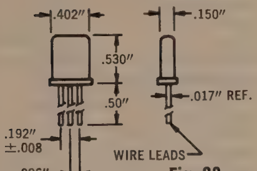


Fig. 38

H3T3

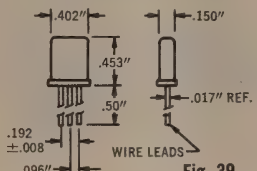
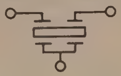
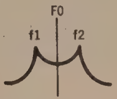


Fig. 39





CRYSTAL DISCRIMINATORS

CTS Knights crystal discriminators offer excellent cross-over stability, low distortion and small size. The 964-2000 Series offers a built-in hybrid microcircuit that produces full limiting with 5 mv to 2 v input. Crystal discriminators are used in FM detection and phaselock loop applications.

Series	Size	Frequency	% of Freq. BW	Stability VS. Temperature	Linearity	Input Voltage	Sensitivity	Output Z	Dimensional Drawing
964-1000	1.0″ SQ.x.500″	18-25 MHz	.05% to .25% of f	$\pm 3\times10^{-5}$ −20° to 85°C	1 to 5%	2 V into 50 ohms	3.0 V/BW P-P	100 K	FIG. 36
964-2000*	1.0″ SQ.x.500″	10-25 MHz	.05% to .25% of f	$\pm 3\times10^{-5}$ −20° to 85°C	1 to 5%	5 MV to 2 V into 50 ohms	4.0 V/BW P-P	100 K	FIG. 37

* +15 VDC supply required for hybrid amplifier and limiter.

964-1000

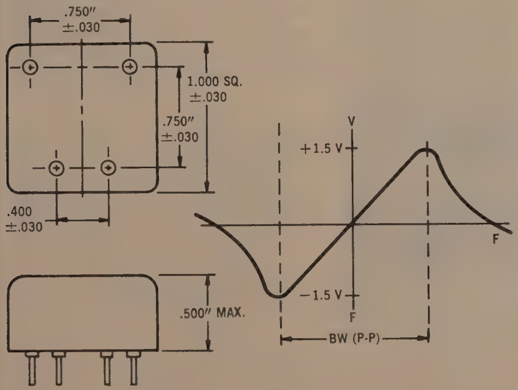


Fig. 36

964-2000

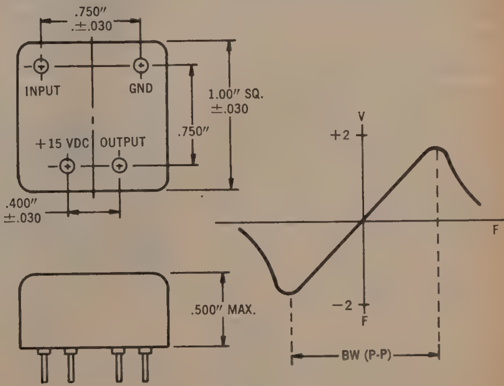


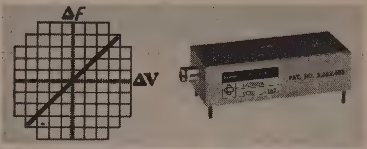
Fig. 37

CRYSTALS/OSCILLATORS/CRYSTAL FILTERS

DAMON...*THE FORM FACTOR SPECIALISTS*

VCXO's — 1 KHz to 500 MHz

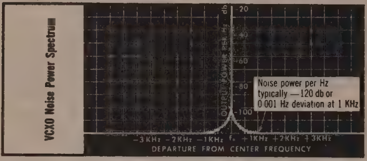
Damon VCXO's provide high stability over a broad range of center frequencies. An optional square wave or pulse output signal compatible with I. C. logic circuits is available.



Center Frequency	1 KHz to 500 MHz
Deviation	.01% to 0.5% of Center Frequency
Linearity	1% to 5% of Peak Deviation
Frequency Stability	determined by Peak Deviation and Operating Temp.
Modulation Rates	DC to 200 KHz

Low Noise VCXO's

Damon low noise miniaturized VCXO's are all solid state quartz crystal stable oscillators whose frequencies can be varied linearly by an external DC or AC modulating signal. Only a source of power and control signal are required . . . no auxiliary compensating circuitry.



TYPICAL CHARACTERISTICS:

Center Frequency	10.000 MHz ±1 KHz
Deviation	±10 KHz
Linearity	±1%
Modulation Rate	Flat to 4 KHz
Output Power	>1 MW

Gaussian Crystal Filters

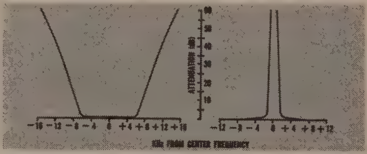
Gaussian Crystal Filters of either conventional or monolithic design. Useful in FM communications or radar systems where flat time delay is required. In a coherent pulsed radar, it can minimize return-pulse overshoot. Eliminates ringing problems in swept spectrum analysis. Available in 2 to 8 pole designs.

DAMON
CRYSTAL FILTER
6272A
334

Center Frequency	
Conventional	10 KHz - 35 MHz
Monolithic	3 - 30 MHz
3 dB Bandwidth	100 Hz - 30 KHz
Shape Factor, 30 dB to 3 dB	3:1 to 7:1
Ringing, Pulse or Impulse	25 - 50 dB down
Phase Linearity	±2%
No. of Poles	
Conventional	2-8
Monolithic	2 - 4
Volume	
Conventional	1 - 6 cu. in.
Monolithic	0.016 - 0.4 cu. in.

Band-Pass/Reject Crystal Filters

A wide variety of conventional crystal filters are produced at Damon. Standards designs such as Butterworth, Chebyshev, Gaussian, Bessel, and Legendre, as well as custom tailored designs are available.

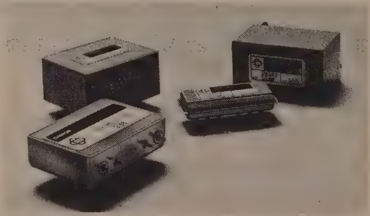


RANGE OF PARAMETERS:

Center Frequency	10 KHz - 75 MHz
Bandwidth	.01% - 3% of C. F.
Shape Factor	down to 1.2:1
Differential Phase Shift	±2°
Group Delay Uniformity	±5%

Surface-Wave Delay Lines

With signal transfer *across* the surface instead of through the body (a state-of-the-art development), the new Surface-Wave concept results in substantially smaller packages, lower cost in production quantities and superior performance over a 20 MHz to 200 MHz range.



RANGE OF PARAMETERS:

Frequency Range	20 MHz - 200 MHz
Time Delay Range	0.5 microsecs. - 10 microsecs.
Bandwidth at —3 dB	3% - 30% of center frequency
Insertion Loss	10 - 20 dB
Spurious Responses	25 - 30 dB below desired response
Environment	Full military temp., shock, vibration available
Typical Size	Less than one cubic inch

Monolithic Crystal Filters

Damon Monolithic Filters utilize a single quartz plate for multiple resonators and the coupling medium between them. Advantages over conventional crystal filters include smaller size, superior stability, and lower cost. Available in a wide variety of computer-assisted designs from Chebyshev to Gaussian characteristics and from 2 to 8 poles.

Center Frequency	2.5 - 30 MHz
3 dB Bandwidth	0.3 - 30 KHz
No. of Coupled Resonators	2-6
Insertion Loss	1 - 6 dB
Ripple	0.5 dB max
Terminations	50 ohms to 20 kilohms
Size	TO-5, TO-8, or Flat-Pack

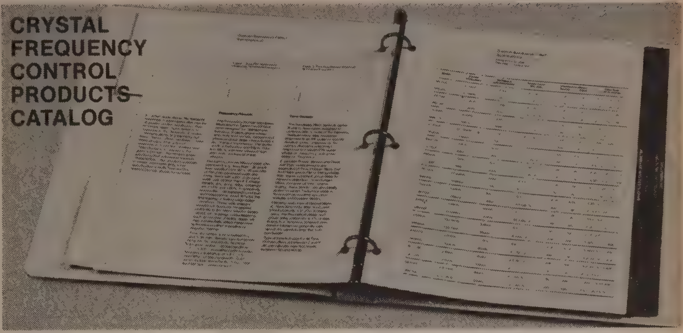
Write for technical bulletins.

DAMON/ELECTRONICS DIVISION
80 WILSON WAY, WESTWOOD, MASS. 02090, TEL: (617) 449-0800

Attention RF Systems Engineers

A new catalog available from Damon provides applications information, design considerations and detailed tables showing design capabilities, parameter ranges and trade-off relationships for crystal filters and discriminators. Additional information on VCXO's and delay lines is also provided.

Yours Free. Simply photocopy and fill out the questionnaire below and send to Damon/ Electronics Division.



Gentlemen,

I have occasion to use or specify crystal frequency control devices. Please send your Crystal Filter and VCXO Catalogs. Add my name to your mailing list for information on future product developments.

Name Title

Company Phone

Street

City State Zip

JOB RESPONSIBILITY
(Check One Only)

- A. ☐ Executive Engineering Management (Chief Engineer, V.P., Director of Engineering, Div. Eng. Mgr.)
- B. ☐ Executive Management Other Than Engineering (President, V.P., Owner, Partner)
- C. ☐ Supervisory Management (Project, Program or Department direction, such as Department Head, Project Manager, Project Engineer)
- D. ☐ Senior Staff (Design Engineer, Research Engineer, Physicist, Scientist)
- E. ☐ Line (Engineering Aide, Technician, Draftsman, etc.)
- F. ☐ Sales management
- G. ☐ Purchasing
- H. ☐ Other (specify)

PRIMARY PRODUCT INTEREST

- A. ☐ Crystal Filters (discrete)
- B. ☐ Crystal Filters (monolithic)
- C. ☐ Crystal Oscillators. Voltage controlled or Temp. Compensated
- D. ☐ Delay Lines (Surface Wave)
- E. ☐ Crystal Discriminators
- F. ☐ Crystal Controlled Frequency Synthesis or Analysis Devices

MAJOR JOB FUNCTION
(Check One Only)

- A. ☐ Overall Project Direction
- B. ☐ Circuit Design/Development
- C. ☐ Research & Development
- D. ☐ System Design
- E. ☐ Standards Laboratory & Test Equipment (Selection & Application of instrumentation for use as reference or calibration in lab or production line)
- F. ☐ Production Test
- G. ☐ Services or Support (Q.C., Reliability, Component Engineering, etc.)
- H. ☐ Other (specify)

ESTIMATED USAGE THIS YEAR OF PRODUCTS CHECKED ABOVE
(Reply Optional)

- A. ☐ Over $100,000
- B. ☐ $50,000—$100,000
- C. ☐ $25,000—$50,000
- D. ☐ $10,000—$25,000
- E. ☐ $5,000—$10,000
- F. ☐ $2,500—$5,000
- G. ☐ Under $2,500

YOUR INDUSTRY OR PRODUCT
(Check One Only)

- A. ☐ Computers, data processing, or peripheral equipment
- B. ☐ Test, measurement, or instrumentation equipment
- C. ☐ Industrial control, Machine control, or Process control equipment
- D. ☐ Biochemical or Medical Instrumentation
- E. ☐ Oceanographic equipment or Systems
- F. ☐ Consumer Electronic equipment
- G. ☐ Aircraft, Missiles, Space, or Ground support equipment
- H. ☐ Electronic or Electro-mechanical components
- I. ☐ Sub-assemblies (modules, circuit packages, logic boards, etc.)
- J. ☐ Government agency or Military
- K. ☐ Independent R&D Lab or Consultants
- L. ☐ Educational Institutions
- M. ☐ Others (specify)

DAMON
ELECTRONICS DIVISION 80 WILSON WAY, WESTWOOD, MASS. 02090 TEL. (617) 449-0800

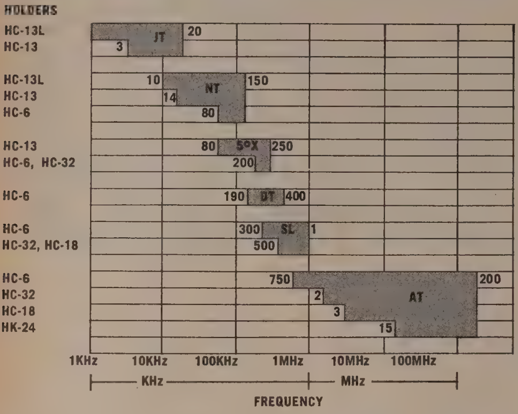
FOR DAMON USE: Identification Code ________ **Territory Code** ________

ERIE FREQUENCY CONTROL

Division of Erie Technological Products, Inc.
499 LINCOLN STREET / CARLISLE, PENNSYLVANIA 17013
TELEPHONE(717) 249-2232 / TELEX 084-2328

QUARTZ CRYSTALS

MAJOR CRYSTAL TYPES—FREQUENCY vs. HOLDERS



Erie Frequency Control manufactures crystal cuts capable of handling the entire frequency spectrum from 1 KHz to 200 MHz. The chart above shows the type cut, and the holder into which the crystal can be placed. Specifications for crystals vary widely with regard to the equipment in which they are being used. Erie manufactures to Military CR types and is qualified on the QPL list for some frequencies. It also manufactures crystals specifically to the customer's own specifications. Erie welcomes the opportunity to quote on any type of crystal in solder seal or cold weld holders.

JT CRYSTALS

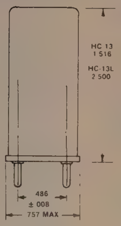
PERFORMANCE SUMMARY

General — A length thickness flexure type crystal, manufactured by Duplexing two 5° x cut crystals into one bar.

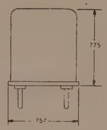
Frequency Range	400 Hz - 3 KHz	3 KHz - 20 KHz
Holder Type	HC 13 Long	HC 13/U
Height	2½″	1½″
Seal	Solder	Solder
Type Coldweld	Not Available	CW 13

Nominal Frequency Tolerance	±.015% −40°C to +70°C
Best Frequency Tolerance	±.010% −40°C to +70°C
Zero Temperature Coefficient	25°C
Resistance	See graph
Q Range	25000
Aging	≤ 1 x 10⁶/day initial and ≤ 2 x 10⁷/day after 3 months.

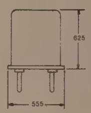
CRYSTAL HOLDERS



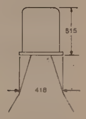
HC-13
1 KHz - 250 KHz
PIN DIA. .050
SPACING .486
THICKNESS .350



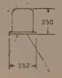
HC-6
80 KHz - 200 MHz
PIN DIA. .050
SPACING .486
THICKNESS .350



HC-32
200 KHz - 1 MHz
2 MHz - 200 MHz
PIN DIA. .040
THICKNESS .225
SPACING .275



Variations in lead length, diameter, ground pins and mounting available in all holder sizes upon request.



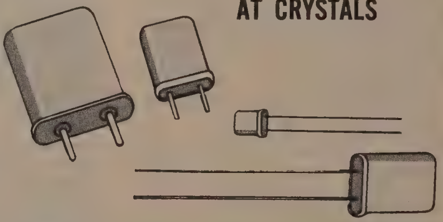
HC-25/HC-18
500 KHz - 1 MHz
3 MHz - 200 MHz
LEAD DIA. .017
SPACING .192
THICKNESS .166

HK-24
15 MHz - 200 MHz
LEAD DIA. .015
SPACING .080
THICKNESS .124

PERFORMANCE SUMMARY

General — A Thickness — shear type crystal, manufactured by controlled lapping of miniature substrates to exact thickness dimensions.

AT CRYSTALS



Frequency Range	750 KHz	2 MHz	3 MHz	15 MHz
	200 MHz	200 MHz	200 MHz	200 MHz
Holder Type			HC-18	
	HC-6	HC-32	HC-25	HK-24
Height	.775″	.625″	.515″	.250″
Seal	Solder	Solder	Solder	Solder
Type Coldweld			HC-25C.W.	
	HC-6C.W.	N/A	HC-18C.W.	N/A

Nominal Frequency Tolerance	±.005% from −55°C to +105°C
Best Frequency Tolerance	±.0025% from −55°C to +105°C ±.0005% from − 5°C to + 60°C
Zero Temperature Coefficient	Per customer spec between +25°C and +100°C
Q Range	50 K to 500 K (function of frequency range)
Aging	≤ 2 x 10⁻⁸/day initial ≤ 5 x 10⁻⁹/day after 3 months

ERIE

ERIE FREQUENCY CONTROL

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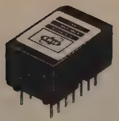
CRYSTAL OSCILLATORS

STANDARD AND CUSTOM DESIGNS

TTL DIP PACKAGE CRYSTAL OSCILLATORS

New low cost Oscillator for computers, data communications and timing circuitry.



20A01111

Frequency Range: 4 to 20 MHz

Size: .375″ H. x .78″ L. x .49″ W.

Stability: ±0.01

Input Voltage: +5 Vdc

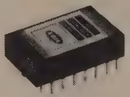
Power: 15 ma

Output: TTL Comp.

Temp. Range: 0°C to 60°C

Source Max. Impedance: 10 ± j 10Ω

TTL DIP PACKAGE CRYSTAL OSCILLATORS WITH HERMETICALLY SEALED CRYSTAL



20A01046

Size: .20″ H. x .78″ L. x .49″ W.

Frequency: 15 MHz to 25 MHz

Input Voltage: +5 Vdc ±5%

Wave Form: Square
RT & FT ≤ 7.5 NS
0 State .4 ma max. @ 20 ma Sink
1 State 2.4 V min. @ −500 μa Source

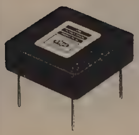
Stability: ±25 PPM over Temperature Range

Setting Accuracy: ±100 PPM @ 25°C ±3°C

Temperature Range: 0°C to 70°C

CMOS COMPATIBLE CRYSTAL OSCILLATORS

For time reference, computer clock, marker generator and transceivers.



20A01089

Size: .312″ H. x 1.0″ L. x 1.0″ W.

Frequency: .01 Hz to 5 MHz

Input Voltage: 3 to 15 Vdc

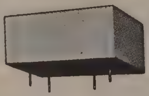
Input Cur.: @ 6 Vdc & freq. @ 3 MHz—1 ma max.

Output: CMOS Compatible

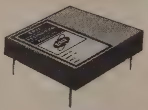
Stability vs. Temperature:
±25 ppm — 0°C to +70°C
±50 ppm — −55°C to +125°C
±5 ppm — 0°C to +50°C

Setting Accuracy: ±100 ppm @ 25°C
For frequencies below 3.00 MHz, the package increases 1.5″ sq. x .40″ H.

LOW COST TTL CRYSTAL OSCILLATORS



20A0183



20A01084

Frequency Range: 3 MHz to 15 MHz

Input Voltage: +5 Vdc ±5%

Input Current: 20 ma max.

Setting Tolerance: ±20 PPM

Frequency vs. Temp.: ±50 PPM over 0°C to 70°C

Frequency vs. VCC: ≤ ±1 PPM / ±5%

Frequency vs. RL: ≤ ±1 PPM / ±10%

Aging:
±10 PPM first 30 days / ±5 PPM/yr. thereafter

Wave Form: TTL compatible logic "1" 2.4 V min. "0" .4 V max.

Symmetry: 50/50 ±10%

Rise & Fall Time: 20 Nanosec. max.

Fanout: 10 7400/5400 Series

Material: Diallyl phthalate glass filled

- **True F-M**
- **Supply Regulation**
- **Oscillator Buffering**
- **Linearization**
- **Small Size**
- **Low Cost**
- **Aging Adjust.**

20V01021 VCXO

Frequency: 40 KHz to 80 MHz

Power: +12 Vdc @ 20 ma max.

Output: 1 mw or logic

Stability:
±0.005% 0°C to +50°C

Deviation: ±0.05%

FM Linearity: 3% max.

Response: ±3 db DC to
20 KHz 0 db ref. @ 1 KHz

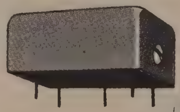
- **Low Power**
- **High Stability**
- **Small Size**
- **Low Cost**
- **Voltage Control Option**
- **Machined Aluminum Cavity**

Frequency: 1 MHz to 10 MHz

Stability:
±5 x 10^{-9}/24 hours
±1 x 10^{-8} 0 to 70°C

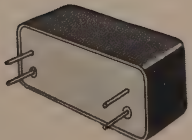
Power: +12 Vdc @ 3 Watts max.
@ 0°C

Size: 1.5″ x 1.5″ x 3″ Long



20B01020

CRYSTAL FILTERS



Erie offers a complete line of crystal Bandpass and Reject Filters. Modern computerized designs are available to synthesize any of the following types: Butterworth, Chebyshev Elliptic Function, Bessel Function and Gaussian. 1-10 pole designs are standard with higher order types available. Comb set, multiple channel or BW and matched sets are also readily available. Units are rugged, compact and most can be designed to meet the environmental requirements of Mil-F-18327.

Center Frequency:
1 KHz to 50 MHz

Bandwidth:
.005% to 10%

Shape Factor:
As steep as 1/1.4
(6 db/60 db)

Ripple:
Generally less than 0.5 db

Insertion Loss:
Usually less than 3.0 db

Ultimate Attenuation:
100 db Max.

Max. Operating Temperature:
−55°C to +125°C

Erie manufactures a long line of high stability, high reliability frequency sources utilized in military and space work and other high technology areas. As these units are custom, we welcome your inquiries and specifications.

FOR OSCILLATORS AND FILTERS. CHECK ERIE'S CAPABILITIES, PRICES, DELIVERIES

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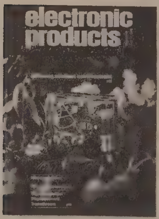

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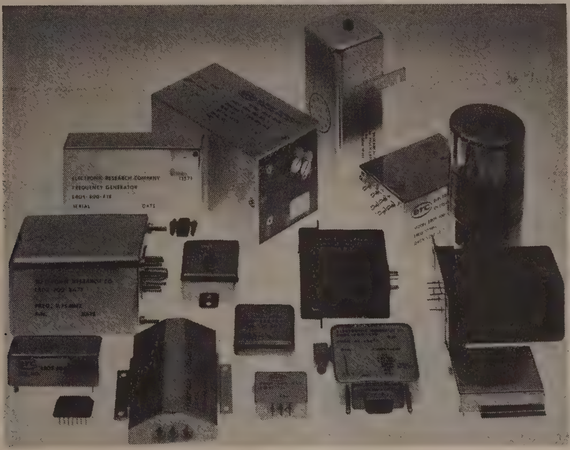
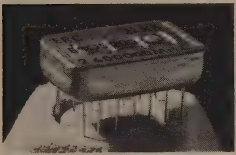
erc Crystal Oscillators, Crystals, Filters



Crystal Oscillators — 1 Hz to 300 MHz

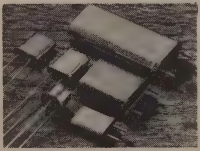
Wide variety of crystal oscillators manufactured by ERC includes TCXO's, VCXO's, TCVCXO's, Precision Standards and Hybrid Oscillators. TCXO's are available with frequency stability vs. temperature of ±0.5 PPM over an ambient temperature range of −30°C to +70°C. Crystal oscillators utilizing DC proportional controlled ovens are available with aging as low as 5 x 10^{-10}/day. Discuss your special requirements such as phase noise, output parameters, power, size, and applicable mil. specs with our engineers.



Hybrid Crystal Oscillators
In .200″ High Dip Packages

Standard Features:

- FREQUENCY: 30 KHz to 25 MHz
- OPERATING TEMPERATURE RANGE: −55°C to +125°C
- PACKAGE SIZE: 14 Pin DIP, .500″ (12.7 mm) X .800″ (20.3 mm) X .200″ (5.1 mm)
- SQUARE WAVE OUTPUT: Compatible with 10 T^2L loads
  - "0" = +0.4 Vdc maximum (+0.2 Vdc typical)
  - "1" = +2.4 Vdc minimum (+3 Vdc typical)
- HERMETICALLY SEALED: Permits use in harsh, high-humidity environments
- STANDARD PIN CONNECTIONS: As a 5400 Series Gate
- CAN BE TESTED TO MIL-STD-883



Crystals, Coldweld — Metal Can

Complete frequency range from 2 KHz to 200 MHz with QPL approval on Military crystals to Mil-C-3098F. Precision coldweld crystals are available for applications needing superior long term aging, maximum reliability and crystal Q. Improved process techniques provide for production of tight tolerance temperature crystals for use in Temperature Compensated Crystal Oscillators.

Filters — Complete Design Capability

Crystal Filters: 2 KHz to 100 MHz; Bandpass, Sideband, Rejection, Linear Phase, Discriminators.

Electronic Research Co.
a textron Division
7618 Wedd
Overland Park, Kansas 66204
Mail to P.O. Box 913
Shawnee Mission, Kansas 66201
TWX: 910-749-6477
Telephone: (913) 631-6700

W H FERWALT, INC.

LAPWAI, IDAHO 83540
PHONE: (208). 843-2281

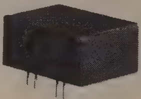
PRECISION OSCILLATORS

.0005 Hz TO 75 MHz

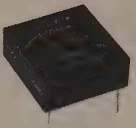
OVEN & NON-OVEN • VOLTAGE CONTROLLED
CRYSTAL CONTROLLED • LC & RC • PHASE LOCK
TEMPERATURE COMPENSATED DRIVES INTEGRATED CKTS
CMOS TTL DTL RTL ECL & OTHERS

GENERAL CHARACTERISTICS AVAILABLE—

- Square-wave or Sine-wave output
- Manual trim or preset to ±.001% or better
- Supply voltages to suit customer requirements
- Internal dividing and gate control
- Special logic gating or memory
- Shock and vibration specifications
- Mil approved parts when req'd

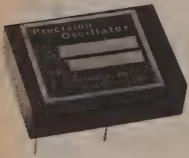


PKG STYLE G
I.C. plug-in
Encapsulated
.78" x 1.125" x .5"
(GX: .75" x 1.5" x .5")

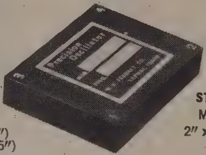


PKG STYLE J
Printed ckt mount
Encapsulated
1.25" x 1.25" x .5"
(JX: 1.25" x 1.25" x .32")

PKG STYLE D
Octal plug-in
2.0" x 2.250" x 3.313"
(DX: 2.234" Sq. x 3.7")

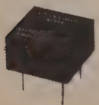


PKG STYLE A
Printed ckt mount
Encapsulated
1.5" x 2.0" x .56"
(AX: Without mtg. hole)
(AC: 7 pin plug-in; stud mt.)



PKG STYLE B
Printed ckt mount
Encapsulated
1.9" x 2.5" x .5"
(BY: 1.9" x 2.5" x 1.0")
(BZ: 1.9" x 2.5" x .375")

STYLE BM
Metal can
2" x 2.5" x .5"



PKG STYLE H
Printed ckt mount
Encapsulated
.875" x .875" x .5"

OSCILLATOR 4MHz
W. H. FERWALT, INC.
LAPWAI, IDAHO

PKG STYLE F & Q
Printed ckt mount
Encapsulated
F: 1.0" x 1.25" x .5"
Q: 2" x 2" x .6"

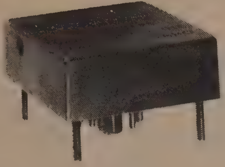
PKG STYLE K
I.C. 14 pin D.I.P.
.485" x .78" x .45"
(KX: .485" x .78" x .57")

Model Series	Frequency Range	Stability	Temperature Range	PK-to-PK Output	Load	Supply Voltage	Pkg. Style	1-9 Price Range[4]
CRYSTAL CONTROLLED OSCILLATORS—NO OVEN REQUIRED								
X0128	7.5KHz to 85KHz	±.02%	0°C to +70°C	6.7V Sine	10K ohms	+15V	Q	$158 to $168
X062	4KHz to 16MHz	±.01 to ±.025%[4]	−20°C to +70°C	5V Square	1.5K ohms	+12V	AX	$49 to $77
X0110	4MHz to 10MHz	±.01%	0°C to +70°C	4V Square	10 TTL	+5V	F	$34 to $44
X0111	250KHz to 3.99MHz	±.01%	0°C to +70°C	4V Square	10 TTL	+5V	J	$36 to $50
X0112	63Hz to 249KHz	±.01%	0°C to +70°C	4V Square	10 TTL	+5V	AX	$43 to $70
X0120	30Hz to 20MHz	±.01%	0°C to +70°C	4V Square	9 TTL	+5V	K or KX[4]	$62 to $165
X0123	7.5KHz to 60KHz	±.01%	0°C to +50°C	1.5V Sine	10K ohms	+5V	A	$120.79
X0100	.005Hz to 3MHz	±.007%	−40°C to +85°C[2]	12V Square[5]	50 CMOS[5]	+12V	A	$71 to $148
X096	10MHz to 16MHz	±.005%	0°C to +70°C	1V Square	3 ECL	−5V	JX	$62.07
X032	12.5KHz to 5.99MHz	±.003 to ±.01%[4]	0°C to +75°C[2]	4V Square[3]	25 DTL	+5V	A	$72 to $106
X032C	6MHz to 40MHz	±.003%	0°C to +75°C[2]	4V Square[3]	9 TTL	+5V	A	$82 to $97
X033	.001Hz to 30MHz	±.003%	0°C to +75°C[2]	4V Square[3]	9 DTL/TTL	+5V	B	$74 to $190
X082	190KHz to 30MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	F	$58 to $78
X094	190KHz to 16MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	H	$65 to $84
X0181	12Hz to 12.49KHz	±.003%	0°C to +75°C[2]	4V Square	1 TTL	+5V	GX	$126 to $149
X081	12.5KHz to 199KHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	GX	$98 to $116
X071	200KHz to 20MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	G	$70 to $88
X081	20.1MHz to 30MHz	±.003%	0°C to +75°C[2]	4V Square	9 DTL/TTL	+5V	GX	$78.05
X045	1MHz to 5MHz	±.001%	+10°C to +50°C	.63V Sine	50 ohms	+15V	AC	$109.20
OVEN CONTROLLED CRYSTAL OSCILLATORS—OVEN VOLTAGES: 115VAC, 28VDC, or OTHERS								
PGX147	1MHz to 6MHz	±.01PPM[1]	−20°C to +55°C	2.8V Sine	500 ohms	+25V	DX	$372.00
PGX50	65KHz to 30MHz	±.1PPM	0°C to +50°C	3V Sine	1K ohms	+28V	D	$208 to $282
PGX63	1Hz to 30MHz	±.1PPM	0°C to +50°C	3V Square[3]	1.5K ohms	+12V	D	$208 to $330
PGX99	1MHz to 5MHz	±.5PPM	−55°C to +80°C	8V Sine	470K ohms	+27V	—	$212.50
LC AND RC OSCILLATORS								
LC035	70KHz to 5MHz	±.5%	0°C to +85°C	2V Sine	10K ohms	+12V	A	$34.90
LC01028	733KHz to 5MHz	±1%	−50°C to +100°C	2V Sine	1K ohms	+12V	J	$51.21
PS057	10Hz to 40KHz	±1%/±2%[4]	0°C to +50°C	6V Sine	10K ohms	+12V	A	$39 to $46
RC036A	1Hz to 1MHz	±2%	−20°C to +85°C	4V Square[3]	9 DTL/TTL	+5V	A	$34 to $59
RC036B	1Hz to 1MHz	±1%	0°C to +75°C	4V Square[3]	9 DTL/TTL	+5V	A	$32 to $52
UJ039A	.1Hz to 100Hz	±2%	0°C to +50°C	3V Square	1.5K ohms	+12V	A	$25.50
RC0109	1Hz to 1MHz	±1%	0°C to +50°C	2.5V Sine	600 ohms	+15V	B	$62 to $83
SINE WAVE OPTIONS—ADD "S" VERSION TO MODEL NUMBER (MAY REQUIRE LARGER PACKAGE[4])								
S11/12[4]	10KHz to 40MHz	5% Distortion	0°C to +75°C	1 mw into 50 ohms		+12V	May be Combined with Oscillator Voltage[4]	Add $20
S13	5Hz to 100KHz	5% Distortion	−55°C to +75°C	1.75V RMS into 600 ohms		+15V		Add $25
S14	10KHz to 1MHz	3% Distortion	−55°C to +125°C	2V pk-to-pk into 10K ohms		None		Add $15
S17	20Hz to 200KHz	5% Distortion	0°C to +50°C	3V pk-to-pk into 10K ohms		+5V		Add $20
S18	5Hz to 100KHz	3% Distortion	−55°C to +75°C	2.5V pk-to-pk into 600 ohms		+15V		Add $25
S19/20[4]	10KHz to 40MHz	5% Distortion	0°C to +75°C	2mv into 50 ohms		+15V		Add $20
S21	20Hz to 200KHz	5% Distortion	0°C to +50°C	3V RMS into 10K ohms		+15V		Add $25
S23	10KHz to 1MHz	1% Distortion	0°C to +75°C	8V pk-to-pk into 10K ohms		+12V		Add $30
S24	100KHz to 15MHz	5% Distortion	0°C to +75°C	.5V RMS into 5K ohms		None		Add $20

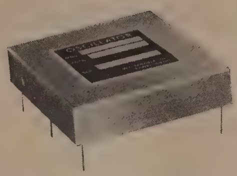
[1] $\pm 5 \times 10^{-10}$ short term stability.
[3] Sine wave options listed above.
[2] For ±.01% over −55°C to +125°C add "A" to Model Number (Price increases).
[4] Depending on frequency.
[5] TTL option available.

W. H. FERWALT, INC.

HWY. 95 & WEBB ROAD LAPWAI, IDAHO 83540 PHONE (208) 843 2281



PKG STYLE L
Octal plug-in
Stud mount
Metal can
2″ x 2″ x .75″



PKG STYLE M, N, & O
Printed ckt mount
Encapsulated metal can
M: 2.5″ x 2.5″ x .625″
N: 2″ x 2″ x .75″
O: 2″ x 2.5″ x .75″ (stud mount)

PKG STYLE P
Special plug-in
Encapsulated metal can
.7″ x 1.3″ x 1.7″

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

Model Series	Frequency Range	Stability	Temperature Range	Aging at Const. Temp.	PK-to-PK Output	Load	Supply Voltage	Pkg. Style	1-9 Price Range[4]
TCX0101	.0075Hz to 10MHz	±1PPM	0°C to +50°C	±2/10^8 per day[1]	12V Square[5]	50 CMOS[5]	+12V	B	$165 to $222
TCX0101A	.0075Hz to 10MHz	±5PPM	−55°C to +75°C	±2/10^8 per day[1]	12V Square[5]	50 CMOS[5]	+12V	B	$203 to $315
TCX01013	4KHz to 17MHz	±2PPM	−18°C to +55°C	±2/10^8 per day[1]	4V Square	9 DTL/TTL	+5V	B	$194 to $243
TCX034	.0005Hz to 40MHz	±1PPM	0°C to +50°C	±2/10^8 per day[1]	4V Square[3]	9 DTL/TTL	+5V	B	$171 to $216
TCX056	100KHz to 30MHz	±1PPM	0°C to +50°C	±2/10^8 per day[1]	4V Square[3]	9 DTL/TTL	+5V	A	$182 to $210
TCX01133	2MHz to 10MHz	±.6PPM	0°C to +30°C	±1PPM per year	12V Square[5]	50 CMOS[5]	+12V	B	$190.00
TCX0146	4MHz to 10MHz	±.5PPM	0°C to +70°C	±1/10^8 per day	1V Sine	1K ohm	+10V	P	$198.80
TCX0138	2MHz to 6MHz	±.2PPM	+10°C to +55°C	±1/10^8 per day	4V Sine	500 ohms	±9V	L	$386.95
TCX0130	1MHz to 10MHz	±.1PPM	+10°C to +50°C	±1PPM per year	4V Square[3]	9 TTL	±9V	M	$238 to $259

These are only a few of our many TCXO combinaitons — Let us quote to your specs.

TEMPERATURE COMPENSATED VOLTAGE CONTROLLED CRYSTAL OSCILLATORS

Model Series	Center Frequency Range	Deviation	Input[8]	Linearity	Stability	Temperature Range	PK-to-PK Output	Load	Supply Voltage	Pkg. Style	1-9 Price Range[4]
TCVCX0151	1Hz to 10MHz	±20PPM	+3V to −3V	±10%	±1PPM	0°C to +50°C	12V Square	50CMOS	+12V	B	$199 to $243
TCVCX0144	125KHz to 30MHz	±20PPM	+2.7V to −2.7V	±15%	±1PPM	−40°C to +71°C	4V Square	9 TTL	±9V	O	$259 to $284
TCVCX0149	30MHz to 50MHz	±25PPM	+2.5V to −2.5V	±5%	±2PPM	−40°C to +70°C	1V Sine	50 ohms	+6V & +14V	—	$313.50
TCVCX0129	1MHz to 10MHz	±25PPM	+3V to −3V	±5%	±.1PPM	+10°C to +50°C	4V Square[3]	9 TTL	±9V	M	$259 to $279
TCVCX0143	30KHz to 10MHz	±1PPM	+10V to 0V	±5%	±.1PPM	0°C to +50°C	10V Square	50CMOS	+10V	N	$235 to $244

VOLTAGE CONTROLLED OSCILLATORS — CRYSTAL AND NON-CRYSTAL TYPES

Model Series	Center Frequency Range	Minimum Deviation	Input[8]	Linearity	Stability	Temperature Range	PK-to-PK Output	Load	Voltage Supply	Pkg. Style	1-9 Price Range[4]
VC0115	60Hz to 50KHz[6]	0 to 100%	0V to +10V	±.1%F.S.	±.1%F.S.	+15°C to +55°C	4V Square	10 TTL	±15V	B	$120 to $124
VC0114	300Hz to 10KHz	±60%	+1.5V to +9V	±10%	±5%	+10°C to +44°C	3V Sine	125 ohms	+6V	B	$178.70
VC0137	1Hz to 30MHz	±10%	−5V to +5V	±10%	±.5%	0°C to +50°C	4V Square[3]	9 TTL	+5V	B	$107 to $184
VC047	1Hz to 75MHz	±10%	0V to −7V	±10%	±3%	0°C to +75°C	4V Square[3]	9 TTL	+5V	B	$82 to $159
VC068	5Hz to 15KHz	±10%	0V to −7V	±1%	±.5%	0°C to +75°C	4V Square[3]	9 TTL	+15V	B	$73 to $94
VC01019	.5MHz to 5MHz	±2%	+5V to −5V	±5% to ±10%[4]	±.5%	+55°F to +95°F	4V Square	5 TTL	+12V	A	$83.88
VC01160	100KHz to 30MHz	±1.25%	−5V to +5V	±5%	±.5%	0°C to +50°C	.8V Sine	50 ohms	+12V	BM	$147 to $162
VCX01095B	35MHz to 85MHz	±0.03%	−5V to +5V	±5%	±.01%	−40°C to +90°C	1V Square	3 ECL	+5V & −5.2V	BY	$507.66
VCX0103	1Hz to 20MHz	±.01% to ±10%	±3V or 0V to +6V	±5% to ±10%	±.0001% to ±1%	0°C to +50°C	4V Square[3]	5 TTL	+5V	BY	$257 to $380
VCX0255	1Hz to 40MHz	±.005%	0V to +6V	±5%	±.003%	0°C to +75°C	4V Square[3]	9 TTL	+5V	B	$99 to $176

CRYSTAL AND RC CONTROLLED TIMERS — CYCLE TYPE WITH PUSH BUTTON RESET

Model Series	Time Intervals	Accuracy	Temperature Range	Output	Load	Supply Voltage	Size	1-9 Price Range[4]
TMX271B	15-30-60 Min.	±30 Sec. per day	−30°F to +130°F	SPDT Contacts	.5 Amp.	+7.5V	7″ x 4″ x 2½″	$229.00
TMX83	15-30-60 Min.	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+7.5V	7″ x 4″ x 2½″	$355.00
TMX83A	5-15-30 Min.	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+7.5V	7″ x 4″ x 2½″	$363.00
TMX183A	5-15-30 Min.	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+8.3V	7″ x 4″ x 2½″	$363.00
TMX145	5-15-30-60 Min.[7]	±3 Sec. per Mo.	+14°F to +120°F	SPDT Contacts	.5 Amp.	+7.5V	5.6″ x 3.1″ x 1.53″	$390.00
TMC37	5 to 30 Sec. Adj.	±10%	+20°F to +150°F	SPST Contacts	5 Amp.	6V or 12V	4″ x 2¼″ x 2¼″	$51.94

[1] 1 PPM per year option available.

[3] See page 1 for sine wave options. S11/12/19/20 not available for voltage control ranges greater than ±1%.

[4] Depending on frequency.

[5] TTL option available.

[6] Full scale frequency.

[7] Includes LED display.

[8] For minimum frequency to maximum frequency.

W. H. FERWALT, INC.

HWY 95 & WEBB ROAD LAPWAI, IDAHO 83540 PHONE (208) [illegible]

OSCILLATORS

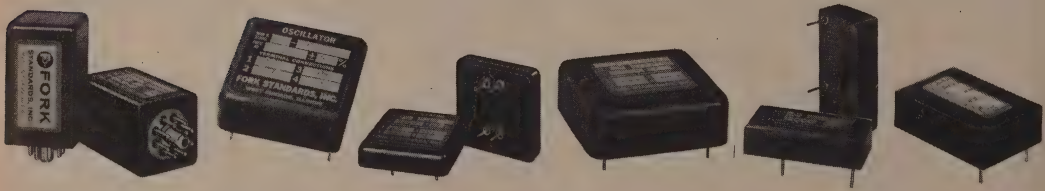
CRYSTALS AND TUNING FORKS

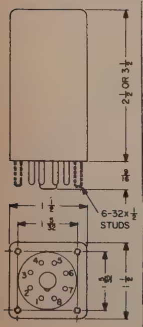
Fork Standards oscillators are either crystal or tuning fork stabilized depending upon the frequency and accuracy desired.

Oscillators such as Model S have been designed and manufactured to meet applicable military specifications MIL-E-5400 and MIL-E-16400. Most other models can be supplied to meet the same or similar specifications. Our inspection system is based upon MIL-I-45208A.

Consult us for special design and application aid. Our oscillators are available with a variety of frequency, stability, output, supply voltage and package combinations.

Model	Accuracy/ Temp. Limits	Sine Wave Output Frequency Range	Waveform Options	Square Wave Output Frequency Range	Waveform Options	Supply VDC	Wt. Oz.
G (tuning fork)	2A-3J	25-15000Hz	AA, AC, AT, DT	Below 1-15000Hz	B, BL, BN	5 or 12	4-7
GQ (crystal)	4A-8C	25Hz-40MHz	AA, AC, AT, DT	Below 1Hz-20MHz	BL, BN	5 or 12	4-7
UQ (crystal)	4A-8C	3000Hz-40MHz	AA	Below 1Hz-20MHz	BL, BN	5 to 15	1.75
BQ (crystal)	4A-8C	25Hz-40MHz	AA, AC, AT, DT	Below 1Hz-20MHz	BL, BN	5 to 15	3
FO (tuning fork)	2A-3J	1000-15000Hz	AA	.001-250Hz .6″h	B, BL, BN	5 or 12	1.5
				250-15000Hz .4″h	B, BL, BN	5 or 12	1.5
FT (tuning fork)	2A-2F	NA	NA	1000-10000Hz	B	5	1
LO (tuning fork)	2A-3J	NA	NA	1000-15000Hz	B, BL	5 or 12	.66
LQ (crystal)	4A-8C	NA	NA	60Hz-20MHz	BL, BN	5 or 12	.66
AQ (crystal)	4A-6N	NA	NA	1-20MHz	BL	5	1
		NA	NA	.18-1MHz	BL	5	1
EQ1 (crystal)	4A-7J	NA	NA	60Hz-20MHz	BL	5	.5
EQ2 (crystal)	4A-6J	NA	NA	3.5-20MHz	BL	5	.5
P (tuning fork)	2A-3J	.5-15000Hz	AA, AC, AT, DT	Below 1-15000Hz	B, BL, BN	5 or 12	3.5
PQ (crystal)	4A-7J	.5-40MHz	AA, AC, AT, DT	Below 1-20MHz	BL, BN	5 or 12	3.5
DQ (oven)	9A-10N	NA	NA	60Hz-20MHz	BL	Consult Factory	7
S (tuning fork)	2A-3J	25-15000Hz	AA, AC, AT, DT	Below 1-15000Hz	B, BL, BN	5 or 12	4-7
SQ (crystal)	4A-8C	25Hz-40MHz	AA, AC, AT, DT	Below 1-20MHz	BL, BN	5 or 12	4-7


FORK STANDARDS, INC.
OSCILLATOR
TERMINAL CONNECTIONS
FORK STANDARDS, INC.


G, GQ General Purpose Plug-in
2 1/2 OR 3 1/2
9/16
6-32x1/2 STUDS
1 1/2
1 5/32
1 5/32
1 1/2
1
2
3
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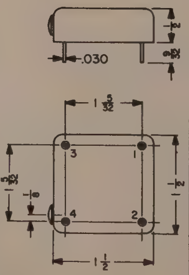
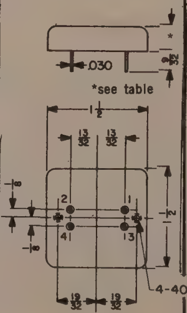
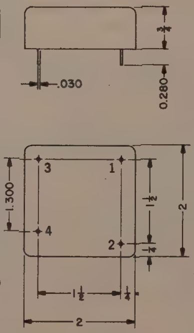
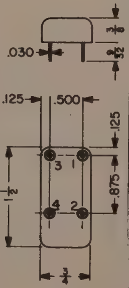
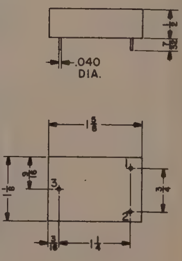

UQ Compact Crystal P.C.B. Mount
1/2
.030
9/32
1 5/32
3
1
4
2
5/32
1/8
1/2
1 1/2


FO Compact Low Frequency
FT Economy Low Frequency
*
.030
9/32
*see table
1 1/2
13/32
13/32
2
1
4
13
1/8
1/8
1/2
4-40
19/32
19/32


B, BQ Low Frequency Sine Wave
3/4
.030
0.280
1.300
3
1
4
2
1 1/2
1/4
2
1 1/2
1/4
2


LO, LQ Miniature
3/8
.030
9/32
.125
.500
.125
3
1
4
2
.875
1 1/2
3/4


AQ Economy High Frequency
1/2
7/32
.040 DIA.
1 5/8
1 1/8
9/16
3
2
3/4
3/16
1 1/4

FSI/FORK STANDARDS, INC. / 211 MAIN STREET, WEST CHICAGO, ILLINOIS 60185 / (312) 231-3511

FSI/Fork Standard Inc.

PRECISE FREQUENCY SOURCES FOR YOUR EVERY APPLICATION

SPECIFYING FSI OSCILLATORS

FSI specification numbers completely describe the oscillator. This number is made up of a code designating model, accuracy / temperature class, output waveform and supply, respectively. These codes are obtained through selections from the following charts and tabulations.

STANDARD OUTPUT WAVEFORMS OPTIONS

SQUARE WAVE:

B: Output amplitude ⅔ supply voltage, minimum, 10K ohms load.

BN: Output amplitude ⅔ supply voltage, minimum, 50/50 symmetry; CMOS compatible.

BL: Five volt logic; TTL compatible, fan-out of 10.

Complementary and multiple outputs of all the above are available.

SINE WAVE:

AA: RMS voltage output ¼ supply, minimum, into 10K ohms resistive load. Harmonic distortion 1 to 10%, depending on customer requirements.

AC: Like AA except capacitor isolated output.

AT: Like AA except transformer isolated output.

DT: Output 1 mW into 600 ohms, transformer isolated.

ACCURACY/TEMPERATURE CLASS

Accuracy %	+15°C to +35°C	0°C to +65°C	−25°C to +65°C	−40°C to +65°C	−55°C to +85°C
.1	2A	2C	2F	3N	3J
.05	3A	3C	3F	4N	5J
.01	4A	4C	4F	5N	6J
.005	5A	5C	5F	6N	7J
.0025	6A	6C	6F	7N	*
.001	7A	7C	7F	8N	*
.0005	8A	8C	8F	9N	*
.0001	9A	9C	9F	10N	*
.00001	10A	10C	*	*	*

*Special oven unit. Consult factory. ☐ Tuning fork oscillator.
▨ Crystal oscillator. ▩ Ovenized crystal oscillator.

ORDERING

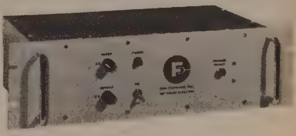
Use the following code scheme to specify FSI oscillators.

EXAMPLE:

G - 3C - 4K - BL - 5

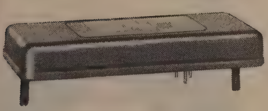
5 = 5 VDC Power Supply
BL = TTL Compatible Drive, Output
4K = 4 kHz Output Frequency
3C = .05% Accuracy, 0-65°C Temperature Range
G = Model G Case

POWER INVERTERS

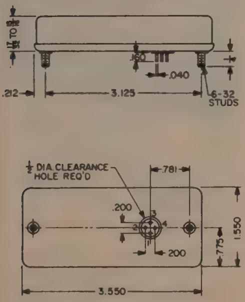


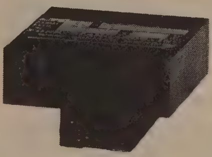
RMLA-75

FSI manufactures a line of power inverters that provide a stable source of alternating current suitable for driving chart or stepper motors. Frequency sources are available with accuracies of from .1% to .005% and temperature ranges from room to 0°C to 65°C depending upon choice of oscillator. Power capability is from 2 VA to 75 VA dependent on inverter requirements. Input power may be obtained from batteries or unstabilized 60 Hz, 115 to 130 line. Contact the factory for additional information regarding your particular application.

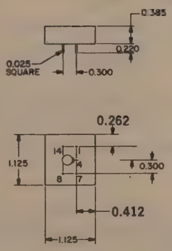


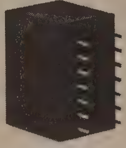
P, PQ Sine Wave, Below 60 Hz, Stud Mount



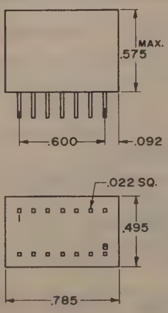


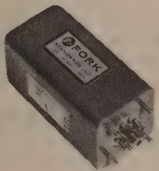
EQ1 DIP Package, Mid Frequency



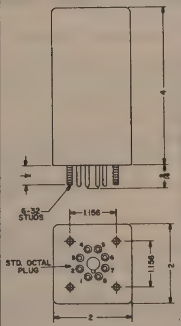


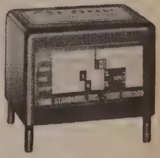
EQ2 DIP Package, High Frequency



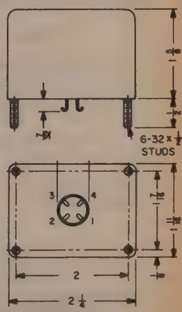


D, DQ Oven Stabilized





S Rugged Military



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encoders • decoders oscillators

FROM

Frequency Devices INC.

TONE ENCODERS FOR DUAL-TONE MULTIFREQUENCY (DTMF) APPLICATIONS

Model 510, 511, 520 Encoders

Model 510 Touch Tone* Encoder is a complete T²L Compatible Dual Touch Tone* Encoder in a 2.4 cu. in. low profile (.4″) module. It features self contained decode logic to select the frequencies of its two low distortion oscillators and output gating logic to gate either or both of the oscillators outputs.

Specifications include: Low distortion outputs (< 1%) — Touch Tone* frequencies (±1%) (Osc. 1 — 697Hz, 770Hz, 852Hz, 941Hz: Osc. 2 — 1209Hz, 1334Hz, 1446Hz, 1633Hz). Gating isolation > 60dB — Low impedance output (10Ω).

Other models with Trunk Tone frequencies or customer specified frequencies are also available.

Tone decoder modules featuring two pole pair bandpass filters and level detection circuitry with T²L compatible logic outputs are available.

Model 511 Tone Encoder, a complete TTL Compatible Dual Tone Encoder offering a signal amplitude of high tones 3dB greater than that of low tones.

Model 520 Tone Encoder, a complete, low-cost TTL compatible tone encoder for use with external switching and touch pads.

APPLICATIONS

- CONSUMER CREDIT
- TRAVEL & ENTERTAINMENT
- MANUFACTURING FACILITIES
- TRANSPORTATION SYSTEMS
- FACSIMILE TRANSMISSION
- DATA COLLECTION
- UTILITY CONTROL

TONE DECODERS FOR DUAL-TONE MULTIFREQUENCY (DTMF) APPLICATIONS

Model 550-1 (Low Frequency) & Model 550-2 (High Frequency) Tone Detector Modules

The Model 550-1 and 550-2 Tone Detector modules are a complete, easy to use, adjustment free, high performance tone decoding system. They detect and decode standard Bell System Touch Tone* with relative amplitudes of ±10dB and absolute amplitude in the range from —30dBm to 0dBm. Detection and hold times have been designed to achieve non-ambiguous decoding of 40 ms on and 40 ms off tone bursts. Outputs may be interfaced with CMOS and T²L logic.

Model 540 Band Separation Filter

The Model #540 Band Separation Filter attenuates the dial tone frequencies (by > 30dB) and the out of band portions of the voice spectrum. It also separates the high and low tone bands.

SINEWAVE OSCILLATORS LOW COST—HIGH PERFORMANCE—LOW DISTORTION

Fixed Frequency Models 400 — Tuneable Models 440

Modular fixed frequency and tuneable oscillators featuring low distortion quadrature (90° ±.1°) buffered outputs with amplitude tracking to better than 100 ppm/°C. Fixed frequency models available from 1Hz to 20KHz (externally adjustable ±10%) and Tuneable models externally variable over 1000:1 range.

Low frequency drift (0.01%/°C) — Low Noise (−85dB). Amplitude externally adjustable over 20dB range (with resistor or voltage).

An amplitude control module to maintain 100 ppm amplitude accuracy and stability is also available.

Model 450

The 450 Series features 0.1dB amplitude stability, 0.1% distortion, 1 to 20V p-p adjustable, 100Hz to 10KHz range, 1% accuracy (adj. ±5%) and .02%/°C stability.

Frequency Devices INC.

FREQUENCY DEVICES INC. ALSO CARRIES A BROAD LINE OF ACTIVE FIXED FREQUENCY, TUNEABLE AND PROGRAMMABLE FILTERS.

Frequency Devices, Inc., 25 Locust St., Haverhill, MA 01830 / (617) 374-0761 / TWX 710-347-0314

*Registered trademark of AT&T.

MICRO-MINIATURIZED MIC PRODUCTS

Specification Guide

One-call service from Tek-wave, the largest micro-miniaturized product manufacturer producing connectors and circuit frames for hermetic and non-hermetic applications, as well as devices, hardware, substrates and circuits.

CALL OUR CUSTOMER SERVICE HOTLINE

1. Describe your product or component needs
2. Tell us your application and requirements
3. We'll match your needs, offer assistance and quote immediately

(516) 328-0100

FOR IMMEDIATE RESPONSE, COMPETITIVE PRICES, FAST SHIPMENT

CIRCUIT FRAMES

FOR HERMETIC AND NON-HERMETIC APPLICATIONS

- Standard and custom configurations
- All materials: aluminum, brass, copper, Kovar, etc.
- Compliance with applicable MIL SPECS
- Sizes from ½″ x ½″ to 6″ x 10″; 1 to 6 ports
- High reliability, low VSWR, excellent electrical performance
- Variety of sealing methods available
- Connectors and all hardware included
- Full line of hermetic circuit modules

LAUNCHERS, TRANSITIONS AND CONNECTORS

FOR HERMETIC AND NON-HERMETIC APPLICATIONS

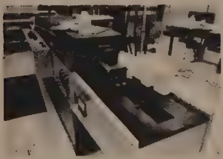
- All sizes and configurations: 3 and 7mm/SMA, 14mm
- Standard and custom designs
- Lots of different mounting methods offered
- High reliability, low VSWR, excellent electrical performance
- Many metals and finishes available
- Impedance, GPS, frequency ranges, etc. matched to your needs

METALLIZED SUBSTRATES AND CIRCUITS

- All materials including ceramics, alumina, BeO and glass
- Any size or shape—up to 4″ x 4″
- Any combination chrome-copper-gold metallization; both sides and edges metallized
- Close tolerances—±.001 on thickness and camber standard

RESISTIVE PRODUCTS

- Sizes from .025″ W x .050″ L x .010″ T to .100″ W x .200″ L x .025″ T
- Resistive values from 5 ohms to 250 ohms
- Terminations and attenuators offered to our specs or yours



CUSTOM METALLIZING CAPABILITIES

- Metallizing and circuits on BeO, AL_2O_3, glass and ceramics
- Microcircuit and macro screen printing for special applications
- New development applications for beryllium oxide
- Prototyping and short production of solid state device packages

For literature about any Tek-wave product or capability, write or call:

TEK-WAVE, INC.

A division of:

FREQUENCY ELECTRONICS, INC.

3 Delaware Drive, New Hyde Park, New York 11040

INSTRUMENTS

- DISCIPLINED TIME FREQUENCY STANDARDS
- HIGH STABILITY FREQUENCY STANDARDS
- FREQUENCY STANDARD CARRYING CASES
- DIGITAL PHASE COMPARATORS
- FREQUENCY ERROR ANALYZERS
- DISTRIBUTION AMPLIFIERS
- VIDEO DISTRIBUTION AMPLIFIERS
- RF SWITCHOVERS
- PASSIVE COMBINERS
- DIGITAL CLOCKS
- C/KT RATIOMETERS
- MICROWAVE FREQUENCY MULTIPLIERS
- IF NOISE GENERATORS
- HIGH FREQUENCY AMPLIFIERS
- UHF DOWN-CONVERTERS
- UHF UP-CONVERTERS

SYSTEMS

- TIME & FREQUENCY CONTROL SYSTEMS
- UHF SYNTHESIZERS
- FREQUENCY GENERATORS
- COHERENT MICROWAVE SYNTHESIZERS

CRYSTAL FILTERS AND DISCRIMINATORS

- NARROW BAND CRYSTAL FILTERS
- INTERMEDIATE WIDE BAND CRYSTAL FILTERS
- BAND REJECT CRYSTAL FILTERS
- SINGLE SIDE BAND CRYSTAL FILTERS
- DISCRIMINATORS

FREQUENCY

INSTRUMENTS

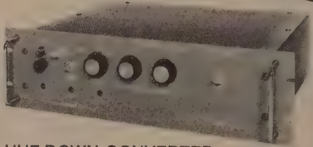
IMPROVED FREQUENCY STANDARD

HIGH STABILITY FREQUENCY STANDARD

DISTRIBUTION AMPLIFIER

DISCIPLINED TIME FREQUENCY STANDARD

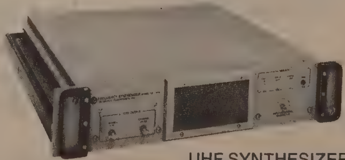
HIGH LEVEL IF NOISE GENERATOR



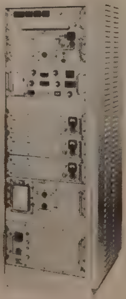
UHF DOWN-CONVERTER

SYSTEMS

FREQUENCY STABILIZATION EQUIPMENT



UHF SYNTHESIZER

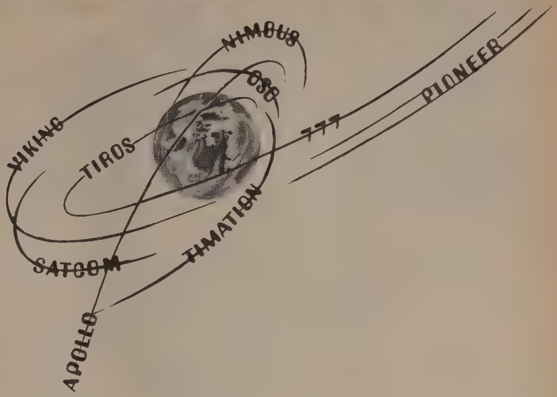


FREQUENCY-TIME STANDARD SET

FREQUENCY ELECTRONICS, INC. 3 Delaware Drive, New Hyde Park, New York 11040 • 516 328-0100

SCILLATORS

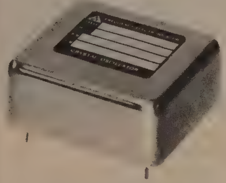
- VENIZED CRYSTAL OSCILLATORS
- VENIZED VOLTAGE CONTROLLED CRYSTAL OSCILLATORS
- TEMPERATURE COMPENSATED VOLTAGE CONTROLLED CRYSTAL OSCILLATORS
- TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS
- NON-OVENIZED CRYSTAL OSCILLATORS
- LC VOLTAGE CONTROLLED OSCILLATORS
- PRECISION LOW POWER OSCILLATORS
- HIGH STABILITY PROPORTIONAL OVENS
- CUSTOM ENGINEERED OSCILLATORS



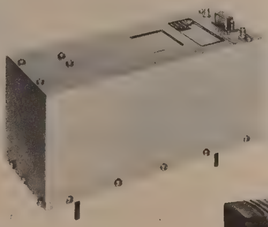
ELECTRONICS, INC.

for Space-Qualified Hardware

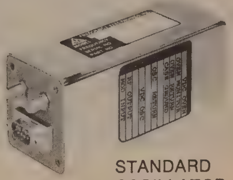
OSCILLATORS



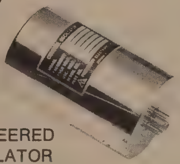
VOLTAGE CONTROLLED CRYSTAL OSCILLATOR



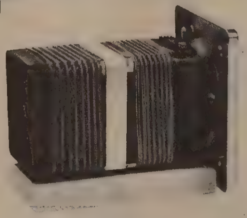
SATELLITE CRYSTAL OSCILLATOR



STANDARD OSCILLATOR



CUSTOM ENGINEERED OSCILLATOR

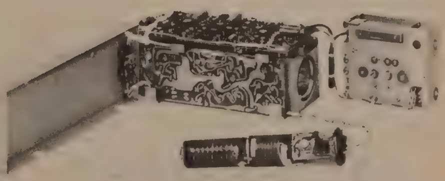


HIGH STABILITY PROPORTIONAL OVEN

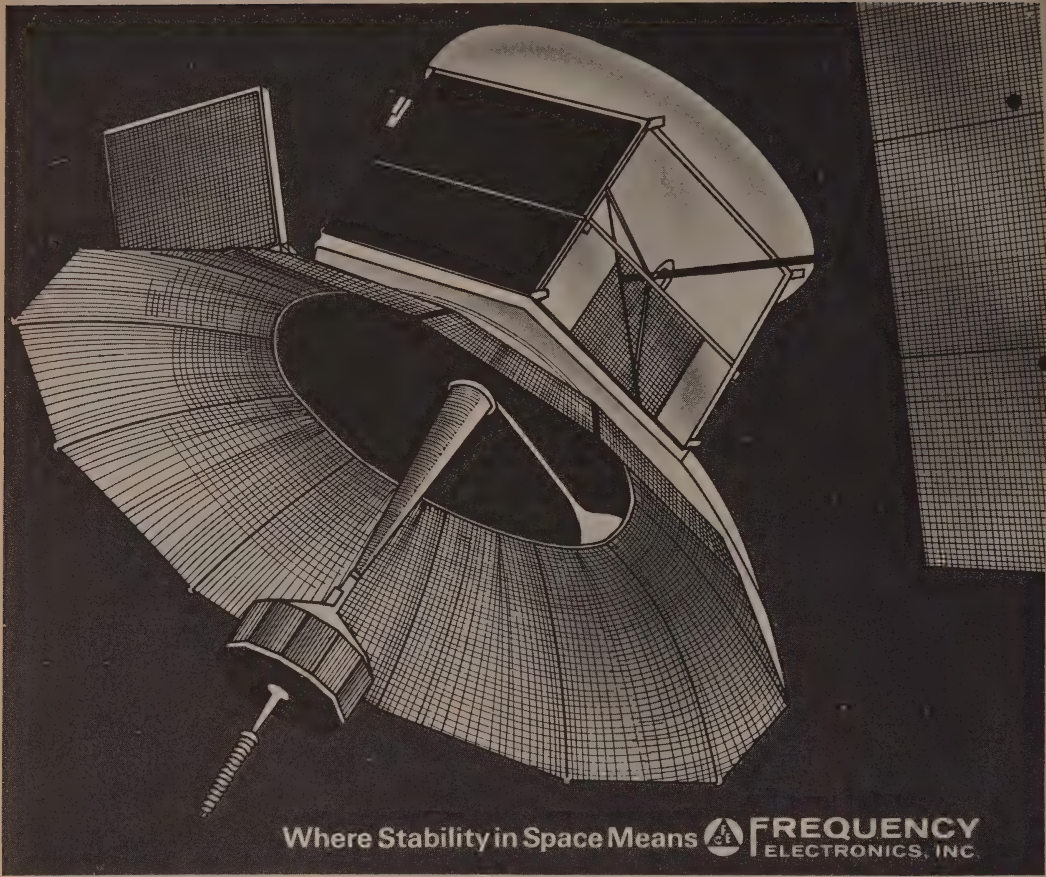
STANDARD OSCILLATOR

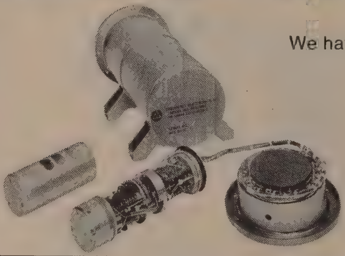
CRYSTAL FILTERS AND DISCRIMINATORS

HIGH RELIABILITY PRODUCTS



Many of These Products are Space-Qualified Hi-Rel.


Where Stability in Space Means
FREQUENCY
ELECTRONICS, INC.



Shown here is
an exploded view
of a typical
space-qualified
Frequency Standard.

Time and Frequency is our unique dimension . . .
We have contributed with High Stability and Reliability to:

- FLEET-SATCOM
- Manned Space Shuttle
- Apollo-Soyuz
- HEAO (High Energy Astronomical Observatory)
- Timation Satellite
- VIKING Mars Space Probe
- PIONEER Jupiter Probe

SPECIFICATIONS

PARAMETER	VALUE
Nominal Output Frequency	5.0 MHz
Short Term Frequency Stability	
0.1 second integration time	3×10^{11}
1 millisecond integration time	2×10^{9}
24 hour stability within any 10°F temperature change within the range of 0°F and +110°F	$\pm 1 \times 10^{11}$/24 hrs.
24 hour stability within any 25°F temperature change within the range of 0°F and ±110°F	$\pm 2.5 \times 10^{11}$

PARAMETER	VALUE
Long term frequency (life) stability over environments	$\pm 1 \times 10^{7}$/5 years
Frequency change due to orientation	1.2×10^{9}/g
Frequency change due to magnetic fields	5×10^{11}/gauss
DC Power Consumption	2.5 W maximum (run) 4.0 W maximum (start)
Weight	40 ounces maximum
Size	4" diameter x 7¹¹⁄₁₆" length

FREQUENCY ELECTRONICS, INC. 3 Delaware Drive, New Hyde Park, New York 11040 (516) 328-0100

DISCIPLINED TIME FREQUENCY STANDARD • FREQUENCY STANDARDS • PHASE COMPARATORS • FREQUENCY ERROR ANALYZERS • DISTRIBUTION AMPLIFIERS
TIME & FREQUENCY CONTROL SYSTEMS • PRECISION QUARTZ CRYSTAL OSCILLATORS • CRYSTAL FILTERS & DISCRIMINATORS

Greenray Industries, Inc.

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ORDERING INFORMATION

FEDERAL SUPPLY CODE NO. 16681
DUNS NO. 300-3290

ORDERING INFORMATION REQUIRED:

1. Model number.
2. Output frequency desired (or range, etc.).
3. Quantity required.
4. Any special modifications desired.

PRICES:

EVERY PAGE LISTS PRICES. We make every effort to keep prices as accurate as possible. However, we reserve the right to change prices without written notice.

Prices for "production quantities" vary from 30% to 80% discount for a few hundred units (depending on quantity, model and frequency). We would be happy to submit quotations at any time.

PRICES— OVERSEAS SHIPMENTS:

Prices are shown in U.S. dollars and may be higher for all overseas purchases.

TERMS:

Net-30 days. F.O.B. Mechanicsburg, Pa.

WARRANTY:

We guarantee all OSCILLATORS we manufacture to be free of any defects and to operate within specifications for one year from date of shipment. If an OSCILLATOR should become defective within this period and has not been subject to misuse, it will be repaired free of charge. Opening an OSCILLATOR case, of course, voids this warranty.

MILITARY SPECIFICATIONS:

Components used in practically all OSCILLATORS in this catalog are of the Military approved type and the construction of the OSCILLATORS is based on General Military Specifications.

QUALITY CONTROL:

We have a fully implemented Quality Control system as a separate department and our system includes complete compliance to and exceeding MIL-I-45208A (Inspection system requirements) and MIL-C-45662 (Calibration system requirements).

LIABILITY:

GREENRAY INDUSTRIES, INC. assumes no responsibility for consequential damages of any nature and the customer by his acceptance of equipment or components thereof, or parts thereof, assumes all liability for its use or misuse.

GENERAL INFORMATION ON OSCILLATORS

HARMONICS

Products of the output frequency. Unless otherwise stated all harmonics of the output frequency will be −20 dB minimum.

SUB-HARMONICS

Products due to the multiplication of the basic OSCILLATOR frequency. Unless otherwise stated all sub-harmonics of the output frequency will be −20 dB minimum.

SPURIOUS

Unrelated frequencies present at the output. Unless otherwise stated all spurious will be −40 dB minimum.

AGING

As an OSCILLATOR operates, its components will "settle in" and the frequency generally drifts high with time. Most major aging or frequency drift will occur during the first month of operation of any OSCILLATOR.

LONG TERM AGING specifications, (unless otherwise noted), will be met after a 24 hour stabilization period. (MIL-C-3098E, Paragraph 4.7.14).

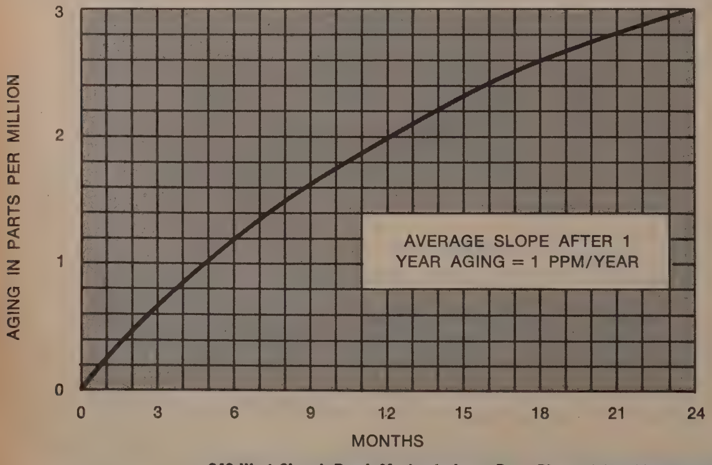
FREQUENCY DEVIATION vs. FREQUENCY OUTPUT CHART

	1 x 10^{-10}	1 x 10^{-9}	.01 PPM 1 x 10^{-8} .000001%	.1 PPM 1 x 10^{-7} .00001%	1 PPM 1 x 10^{-6} .0001%	5 PPM 5 x 10^{-6} .0005%	10 PPM 1 x 10^{-5} .001%	100 PPM 1 x 10^{-4} .01%	1000 PPM 1 x 10^{-3} .1%	10,000 PPM 1 x 10^{-2} 1%
1 kHz			.00001 Hz	.0001 Hz	.001 Hz	.005 Hz	.01 Hz	.1 Hz	1 Hz	10 Hz
500 kHz			.005 Hz	.05 Hz	.5 Hz	2.5 Hz	5 Hz	50 Hz	500 Hz	5 kHz
1 MHz			.01 Hz	.1 Hz	1 Hz	5 Hz	10 Hz	100 Hz	1 kHz	10 kHz
10 MHz		.01 Hz	.1 Hz	1 Hz	10 Hz	50 Hz	100 Hz	1 kHz	10 kHz	100 kHz
50 MHz		.05 Hz	.5 Hz	5 Hz	50 Hz	250 Hz	500 Hz	5 kHz	50 kHz	500 kHz
100 MHz	.01 Hz	.1 Hz	1 Hz	10 Hz	100 Hz	500 Hz	1 kHz	10 kHz	100 kHz	1 MHz
500 MHz	.05 Hz	.5 Hz	5 Hz	50 Hz	500 Hz	2500 Hz	5 kHz	50 kHz	500 kHz	5 MHz
1 GHz	.1 Hz	1 Hz	10 Hz	100 Hz	1000 Hz	5 kHz	10 kHz	100 kHz	1 MHz	10 MHz

EXAMPLE: (from the chart above)
An oscillator which holds ±1 x 10^{-7} frequency stability at 1 MHz will hold ±.1 Hz.

AGING CHART
CRYSTAL CONTROLLED SOURCES

TYPICAL CRYSTAL DRIFT vs. TIME IN MONTHS WITH TEMPERATURE HELD CONSTANT



The chart at left shows typical aging characteristics which can be expected for crystal controlled frequency sources manufactured by Greenray Industries, Inc. after one week's prior aging.

Please note that the chart should be used for estimating aging rate only, and does not represent a warranty on the part of Greenray Industries, Inc.

In cases where there is a maximum aging specification, this requirement should be designated. (Oscillators can be provided with aging rates of less than 1 PPM per year on special order.)

Greenray Industries, Inc.

SHORT TERM STABILITY

Short term frequency stability can be measured in two domains, Time or Frequency. The frequency domain is measured by spectrum analysis and time domain is measured by gated frequency counter techniques. At Greenray Industries both measurement techniques are used; as shown below.

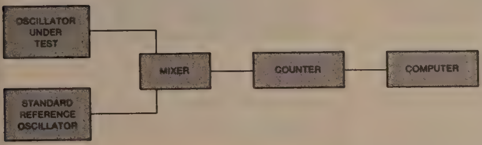
The way in which short term stability is specified is often confusing to both the customer and the vendor. In an effort to reduce this confusion Greenray Industries suggests the following methods to specify short term stability.

1. TIME DOMAIN: Specify $\frac{\Delta f}{f}$ in powers of 10 per time.

   For example: ±2.5 x 10^{9} per 100 milliseconds.
2. FREQUENCY DOMAIN: Specify single sideband spectral density of phase fluctuations at specific fourier frequencies in a particular bandwidth.

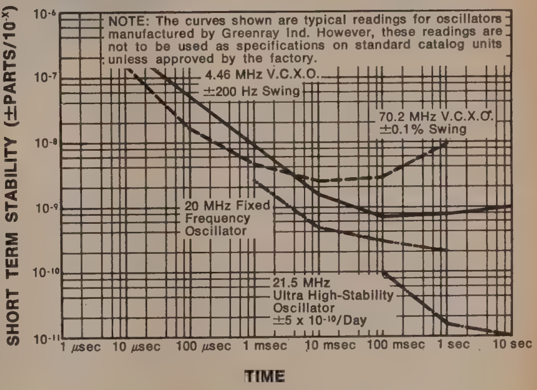
   For example: In a 1 Hz bandwidth, single sideband phase spectral density relative to the carrier is −116 db at 100 Hz from the carrier. (also see Page 1•346)

BLOCK DIAGRAM FOR TIME DOMAIN MEASUREMENTS

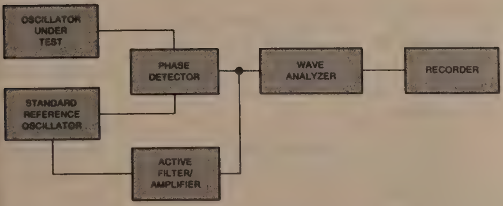


From the above test set-up we obtain the required data to compute the $\frac{\Delta f}{f}$ in the required time period.

SHORT TERM STABILITY IN THE TIME DOMAIN


NOTE: The curves shown are typical readings for oscillators manufactured by Greenray Ind. However, these readings are not to be used as specifications on standard catalog units unless approved by the factory.

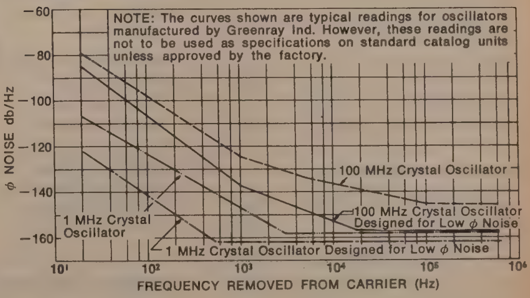
BLOCK DIAGRAM FOR FREQUENCY DOMAIN MEASUREMENTS



From the above test set-up we obtain the required data to compute the single sideband phase spectral density relative to the carrier at a particular frequency from the carrier in the desired bandwidth.

TYPICAL SINGLE SIDE-BAND PHASE SPECTRAL DENSITY MEASURED RELATIVE TO THE CARRIER IN A 1 Hz BANDWIDTH

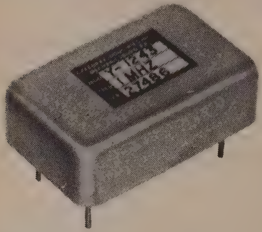
FIXED FREQUENCY CRYSTAL OSCILLATORS


NOTE: The curves shown are typical readings for oscillators manufactured by Greenray Ind. However, these readings are not to be used as specifications on standard catalog units unless approved by the factory.

Greenray Industries, Inc.

CRYSTAL OSCILLATORS

100 KHz to 20 MHz SINE or SQUARE WAVE MODEL Y-1243 & Y-1245 LOW COST



SPECIFICATIONS:

Frequency Range: 100 kHz to 20 MHz

Frequency Stability Over Temperature Range: ±.02% (100 kHz to 800 kHz)
±.01% (800.1 kHz to 20 MHz)

Temperature Range:
0°C to +70°C (Model Y-1243)
−40°C to +85°C (Model Y-1245)

Output:
Square wave version: 50/50 ±20% to drive ≤10 TTL loads. 0 ±.4V to +2.4V min.
Sine wave version: .23V RMS sine wave into a 50 ohm load (Harmonic Distortion: less than 20%)
ECL version: Requires −5.2V DC ±1% input voltage. Output waveform and levels will drive ≤5 standard ECL gates.

Input Voltage:
+5V DC ±.25V (Model Y-1243)
+5V DC ±.5V (Model Y-1245)

Input Current: 60 ma. maximum

Size: 2.02 x 1.0 x .53″ (L-W-H)
51.3 x 25.4 x 13.5 mm

Printed Circuit Board Mounting

Hermetically Sealed

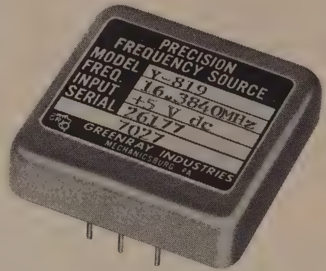
Designed for Low Cost, High Volume Production Requirements

FREQUENCY RANGE	PRICE: 1-3 units Y-1243	Y-1245
100 kHz to 800 kHz	$87.00 ea.	$97.00 ea.
800.1 kHz to 20 MHz	79.00 ea.	89.00 ea.

ORDERING INFORMATION:

1. Specify exact frequency desired.
2. Specify Model Y-1243 or Y-1245 for sine wave output.
3. Specify Model Y-1243Q or Y-1245Q for TTL output (same price).
4. Specify Model Y-1243U or Y-1245U for ECL output (same price).

1 Hz to 100 MHz SQUARE WAVE MODEL Y-819



SPECIFICATIONS:

Frequency Range: 1 Hz to 100 MHz

Frequency Stability Over Temperature Range: ±.005%

Temperature Range: 0°C to +70°C

Output Voltage: 0 ±.4V to +2.4V min.

Output: Square wave 50/50 ±10% to drive ≤10 TTL loads

Input Voltage: +5V DC ±.25V

Input Current: 350 ma. maximum

Size:
2x2x.5″, 50.8x50.8x12.7 mm (L-W-H) (frequencies above 70 kHz)
2.56x2.94x.5″, 65.02x74.68x12.7 mm (L-W-H) (frequencies below 69.9 kHz)

Hermetically Sealed

Mounting:
3 PC Pins and 2 (6-32) threaded studs

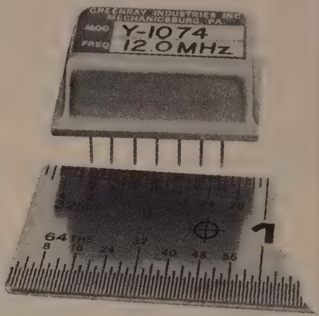
Designed for Low Cost Commercial Applications

FREQUENCY RANGE	PRICE: 1-3 units
1 Hz to 19.9 Hz	$249.00 each
20 Hz to 299 Hz	219.00 each
300 Hz to 4.49 kHz	186.00 each
4.5 kHz to 69.9 kHz	153.00 each
70 kHz to 999 kHz	120.00 each
1.0 MHz to 19.99 MHz	87.00 each
20.0 MHz to 50 MHz	120.00 each
50.1 MHz to 100 MHz	153.00 each

ORDERING INFORMATION:

Specify Model Y-819 and exact output frequency desired.

5 MHz to 25 MHz SQUARE WAVE MODEL Y-1054 & Y-1074 DUAL-IN-LINE MOUNTING



SPECIFICATIONS:

Frequency Range: 5 MHz to 25 MHz

Frequency Stability Over Temperature Range: ±.005% 0°C to +70°C
±.01% −55°C to +125°C

Temperature Ranges:
0°C to +70°C (Model Y-1074)
−55°C to +125°C (Model Y-1054)

Output: Square wave 50/50 ±20% to drive ≤10 TTL loads

Output Voltage: 0 ±.4V to +2.4V min.

Input Voltage: +5V DC ±.25V (Y-1074)
+5V DC ±.50V (Y-1054)

Input Current: 70 ma. maximum

Size: .90 x .56 x .35″ (L-W-H)
22.86 x 14.22 x 8.89 mm (L-W-H)

Plugs into Standard 14 Pin Dual-In-Line Socket

Hermetically Sealed Metal Can (for maximum shielding)

	PRICE: 1-3 units
Model Y-1054	$120.00 each
Model Y-1074	87.00 each

ORDERING INFORMATION:

1. Specify Model Y-1074 for operation over 0°C to +70°C.
2. Specify Model Y-1054 for operation over −55°C to +125°C.
3. Specify exact output frequency desired.

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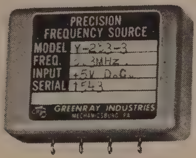
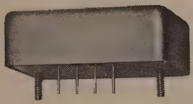
Greenray Industries, Inc.

CRYSTAL OSCILLATORS

70 KHz to 100 MHz SQUARE WAVE MODEL Y-283-3A & Y-283-3AG71.


PRECISION
FREQUENCY SOURCE
MODEL
FREQ.
INPUT
SERIAL
GREENRAY INDUSTRIES
MECHANICSBURG, PA

MODEL Y-283-3A



MODEL Y-283-3AG71

SPECIFICATIONS:

Frequency Range: 70 kHz to 100 MHz

Frequency Stability Over Temperature Range:
70 kHz to 999 kHz output: ±.025%
1 MHz to 100 MHz: ±.005%

Output: Square wave 50/50 ±10% to drive ≤10 TTL loads

Output Voltage:
70 kHz to 50 MHz:
0 ±.2V to V_{cc} −1V ±1V
50.1 MHz to 100 MHz:
0 ±.4V to +2.4V minimum

Output Load: Will drive any popular type of micrologic such as T^2L, DTL, RTL, etc.

Temperature Range: −55°C to +90°C

Input Voltage: +5V DC ±.25V (V_{cc})

Input Current: 150 ma. maximum

Size: 2.25 x 1.62 x .75″ (L-W-H)
57.15 x 41.15 x 19.05 mm

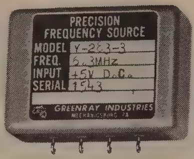
Hermetically Sealed

FREQUENCY RANGE	PRICE: 1-3 units
70 kHz to 999 kHz	$157.00 each
1 MHz to 9.99 MHz	149.00 each
10 MHz to 20 MHz	157.00 each
20.1 MHz to 50 MHz	175.00 each
50.1 MHz to 100 MHz	195.00 each

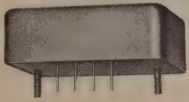
ORDERING INFORMATION:

Specify Model Y-283-3A or Y-283-3AG71 and exact output frequency desired.

50.1 MHz to 150 MHz ECL OUTPUT MODEL Y-283-3D & Y-283-3DG71


PRECISION
FREQUENCY SOURCE
MODEL
FREQ.
INPUT
SERIAL
GREENRAY INDUSTRIES
MECHANICSBURG, PA

MODEL Y-283-3D



MODEL Y-283-3DG71

SPECIFICATIONS:

Frequency Range: 50.1 MHz to 150 MHz

Frequency Stability Over Temperature Range: ±.005%

Output: Compatible to ECL

Output Voltage and Load: Determined by ECL 1023 Gate

Temperature Range: −55°C to +90°C

Input Voltage: −5.2V DC ±1%

Input Current: 75 ma. maximum

Size: 2.25 x 1.62 x .75″ (L-W-H)
57.15 x 41.15 x 19.05 mm

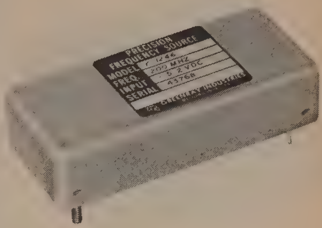
Hermetically Sealed

FREQUENCY RANGE:	PRICE: 1-3 units
50.1 to 60 MHz	$210.00 each
60.1 to 150 MHz	249.00 each

ORDERING INFORMATION:

Specify Model Y-283-3D or Y-283-3DG71 and exact output frequency desired.

150.1 MHz to 300 MHz ECL OUTPUT MODEL Y-1246


PRECISION
FREQUENCY SOURCE
MODEL
FREQ.
INPUT
SERIAL
GREENRAY INDUSTRIES

SPECIFICATIONS:

Frequency Range: 150.1 MHz to 300 MHz

Frequency Stability Over Temperature Range: ±.005%

Temperature Range: −55°C to +90°C

Output: To drive ≤10 ECL gates

Input Voltage: −5.2V DC ±1%

Input Current: 25 ma. maximum

Size: 1.62 x 3.75 x .88″ (W-L-H)
41.15 x 95.25 x 22.35 mm

PC Board Mounting

Hermetically Sealed

PRICE: 1-3 units — $298.00 each

ORDERING INFORMATION:

Specify Model Y-1246 and exact output frequency desired.

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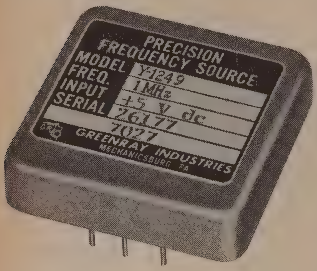
Greenray Industries, Inc.

CRYSTAL OSCILLATORS

100 KHz to 2.5 MHz PULSE OUTPUT

MODEL Y-1249 & Y-1250



SPECIFICATIONS:

Frequency Range: 100 kHz to 2.5 MHz

Frequency Stability Over Temperature Range: ±.02% (100 kHz to 800 kHz)
±.01% (800 kHz to 2.5 MHz)

Temperature Ranges:
0°C to +70°C (Model Y-1249)
−40°C to +85°C (Model Y-1250)

Output Voltage: 0 ±.4V to +2.4V min.

Output:
Square wave to drive ≤10 TTL loads

Pulse Characteristics: (Factory set)
Positive pulse width, 40 nsec. minimum, 9 μsec maximum
Set tolerance of pulse width: ±10%

Duty Cycle Limits: 10/90% to 90/10%

Pulse Width Stability: ±.02%/°C

Input Voltage:
+5V DC ±.25V (Model Y-1249)
+5V DC ±.5V (Model Y-1250)

Input Current: 110 ma. maximum

Size: 2.0 x 2.0 x .53″ (L-W-H)
50.8 x 50.8 x 13.46 mm

PC Board Mounting

Hermetically Sealed

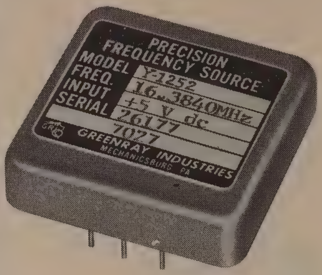
FREQUENCY RANGE:	**PRICE: 1-3 units** **Y-1249**	**Y-1250**
100 kHz-800 kHz	$152.00 ea.	$162.00 ea.
800 kHz-2.5 MHz	145.00 ea.	155.00 ea.

ORDERING INFORMATION:

1. Specify Model Y-1249 for operation over 0°C to +70°C
2. Specify Model Y-1250 for operation over −40°C to +85°C.
3. Specify exact output frequency and pulse characteristics desired.

100 Hz to 3 MHz CMOS OUTPUT

MODEL Y-1252



SPECIFICATIONS:

Frequency Range: 100 Hz to 3 MHz

Frequency Stability Over Temperature Range: ±.005% (for higher stability see Model T-686, Page 1•338)

Temperature Range: −40°C to +85°C

Output:
Square wave to drive ≤50 CMOS gates
50/50 ±2% (100 Hz to 1 MHz)
50/50 ±10% (1.01 MHz to 3 MHz)

Input Voltage: +5V DC to +15V DC

Input Current: 10 ma. maximum

Size: 2.0 x 2.0 x .53″ (L-W-H)
50.8 x 50.8 x 13.46 mm

Mounting:
PC Pins and 2 (6-32) threaded studs

Hermetically Sealed

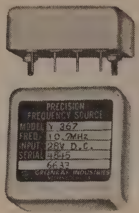
FREQUENCY RANGE:	**PRICE: 1-3 units**
100 Hz to 62.5 kHz	$149.00 each
62.51 kHz to 3 MHz	185.00 each

ORDERING INFORMATION:

Specify Model Y-1252 and exact output frequency desired.

800 Hz to 150 MHz SINE WAVE

MODEL Y-367



SPECIFICATIONS:

Frequency Range: 800 Hz to 150 MHz

Frequency Stability Over Temperature Range:
800 Hz to 900 kHz, ±.015%
900.1 kHz to 150 MHz, ±.005%

Temperature Range: −40°C to +70°C

Input Voltage: +28V DC ±10% (also available with other input voltages)

Input Current: 35 ma. maximum

Output:
Sine wave, Harmonics −20 dB min.

Output Voltage: 1V RMS minimum into a 1000 ohm load for units 50 MHz and below. .22V RMS (1 milliwatt) minimum into a 50 ohm load for units 50.1 MHz and above

Hermetically Sealed

Size:
800 Hz to 2.99 kHz
2.56 x 2.94 x .88″
65.02 x 74.68 x 22.35 mm (L-W-H)
3.0 kHz to 150 MHz
2 x 2 x .75″
50.80 x 50.80 x 19.05 mm (L-W-H)

FREQUENCY RANGE:	**PRICE: 1-3 units**
800 Hz to 2.99 kHz	$185.00 each
3.0 kHz to 9.99 kHz	175.00 each
10.0 kHz to 14.99 kHz	155.00 each
15.0 kHz to 44.99 kHz	145.00 each
45.0 to 99.99 kHz	125.00 each
100.0 kHz to 999.9 kHz	119.00 each
1.00 MHz to 20.0 MHz	119.00 each
20.1 MHz to 50.0 MHz	125.00 each
50.1 MHz to 75.0 MHz	129.00 each
75.1 MHz to 100.0 MHz	139.00 each
100.1 MHz to 150 MHz	175.00 each

ORDERING INFORMATION:

1. Specify Model Y-367 and exact output frequency desired.
2. If 50 ohm output at 1 mw minimum is desired, (below 50 MHz), add the letter "L" after the Model Number and $20 to the price. (Example: Model Y-367L.)
3. If alternate case style is desired add G66 to Model Number. Same price as standard Model Y-367.

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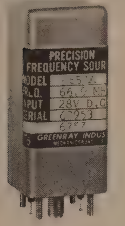
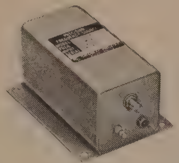
Greenray Industries, Inc.

CRYSTAL OSCILLATORS

12 MHz to 600 MHz SINE WAVE MODEL Y-657A



MODEL Y-657A



MODEL Y-657G6

SPECIFICATIONS:

Frequency Range: 12 MHz to 600 MHz

Frequency Stability Over Temperature Range: ±.005% (for higher stability see Model T-316, Page 1•338)

Temperature Range: −40°C to +70°C

Output: 1 mw minimum into a 50 ohm load (10 mw or 20 mw available)

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB min.

Input Voltage: +28V DC ±2%

Input Current: 75 ma. maximum

Sizes: 1.5 x 1.5 x 3.75″ (W-L-H)
(See Note) (Y-657A)
2.3 x 3.75 x 1.6″ (W-L-H)
(See Note) (Y-657G6)

Flange or Stud Mounting

Connector: SMA, Filtercon for +28V DC

Solder Sealed

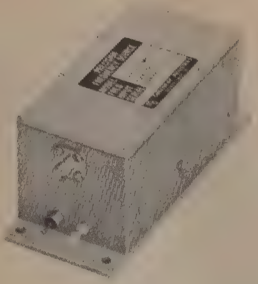
FREQUENCY RANGE	PRICE: 1-3 units
12 MHz to 20 MHz	$153.00 each
20.1 MHz to 50 MHz	159.00 each
50.1 MHz to 75 MHz	164.00 each
75.1 MHz to 100 MHz	175.00 each
100.1 MHz to 150 MHz	215.00 each
150.1 MHz to 300 MHz	286.00 each
300.1 MHz to 600 MHz	413.00 each

ORDERING INFORMATION:

1. Specify exact output frequency desired.
2. Specify Model Y-657A for stud mounting or Model Y-657G6 for flange mounting.
3. For all harmonics and sub-harmonics −40 dB minimum, add $30.00 to price and an "X" after Model No. (Example: Model Y-657AX).
4. For 10 mw output add "J" after Model No. For 20 mw output add "K" after Model No. (Example: Model Y-657AJ or Y-657AXK.)
   Price: 12 MHz to 150 MHz: Add $40.00 for 10 mw and $80.00 for 20 mw.
   150.1 MHz to 600 MHz: Add $80.00 for 10 mw and $160.00 for 20 mw.

NOTE: Units above 150 MHz will have a
2 x 2 x 4″ (W-L-H) case size. (Y-657A)
3 x 4 x 2.1″ (W-L-H) case size (Y-657G6)

1 MHz to 110 MHz SINE WAVE MODEL YH-980 ULTRA-LOW PHASE NOISE



SPECIFICATIONS:

Frequency Range: 1 MHz to 100 MHz

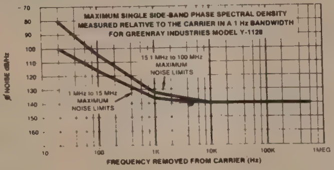
Frequency Stability Over Temperature Range: ±.005%

Temperature Range: 0°C to +50°C

Output Power: 10 milliwatts minimum into a 50 ohm load

Output:
Sine wave, Harmonics −40 dB min.

Phase Spectral Density: Maximum noise levels shown on chart below



Noise Levels Are Typically 6 to 10 db Lower Than Shown Above

Input Voltage: +28V DC ±2%

Input Current: 50 ma. maximum

Size: 4.0 x 2.0 x 2.0″ (L-W-H)
101.6 x 50.8 x 50.8 mm

Mounting:
Flanges, add 1″ to length for flanges

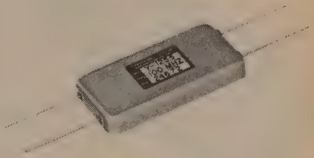
Connector: SMA Filtercon for +28V DC

FREQUENCY RANGE:	PRICE: 1-3 units
1 MHz to 15.0 MHz	$445.00 each
15.1 MHz to 100 MHz	399.00 each

ORDERING INFORMATION:

Specify Model Y-1128 and exact output frequency desired.

10 MHz to 150 MHz SINE WAVE MODEL Y-1255 STRIP-LINE MOUNTING



SPECIFICATIONS:

Frequency Range: 10 MHz to 150 MHz

Frequency Stability Over Temperature Range: ±.003%

Temperature Range: 0°C to +50°C

Output Power:
+5 dBm minimum into a 50 ohm load

Output:
Sine wave, Harmonics −40 dB min.

Input Voltage: +12V DC ±2%

Input Current: 20 ma. maximum

Size: 2.02 x 1.0 x .26″ (L-W-H)
51.3 x 25.4 x 6.6 mm

Strip-line Mounting

Hermetically Sealed

FREQUENCY RANGE:	PRICE: 1-3 units
10 MHz to 20 MHz	$249.00 each
20.1 MHz to 75 MHz	269.00 each
75.1 MHz to 150 MHz	298.00 each

ORDERING INFORMATION:

Specify Model Y-1255 and exact output frequency desired.

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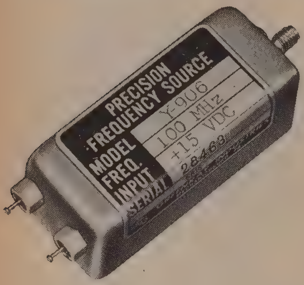
Greenray Industries, Inc.

CRYSTAL OSCILLATORS

4 MHz to 150 MHz SINE WAVE MODEL Y-906 100 MILLIWATTS OUTPUT



SPECIFICATIONS:

Frequency Range: 4 MHz to 150 MHz

Frequency Stability Over Temperature Range: ±.003%

Temperature Range: 0°C to +70°C

Output Power: 100 milliwatts minimum into a 50 ohm load

Output:
Sine wave, Harmonics −20 dB min.

Input Voltage: +15V DC ±2%

Input Current: 125 ma. maximum

Size: 2.38 x 1 x 1″ (L-W-H)
60.45 x 25.4 x 25.4 mm

Mounting: 2 (6-32) threaded studs

Connector: SMA; Filtercons for +15V DC

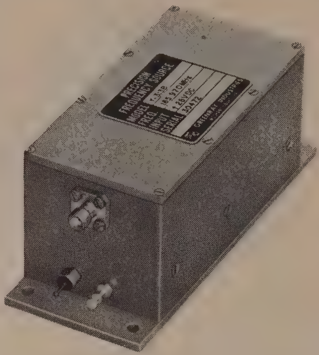
Solder Sealed

FREQUENCY RANGE:	PRICE: 1-3 units
4 MHz to 25 MHz	$274.00 each
25.1 MHz to 90 MHz	299.00 each
90.1 MHz to 150 MHz	328.00 each

ORDERING INFORMATION:

Specify Model Y-906 and exact output frequency desired.

1 MHz to 600 MHz SINE WAVE MODEL Y-313B UP TO 1 WATT OUTPUT



SPECIFICATIONS:

Frequency Range: 1 MHz to 600 MHz

Frequency Stability Over Temperature Range: ±.005%

Temperature Range: 0°C to +50°C

Output Power: Up to 1 (ONE) WATT minimum into a 50 ohm load (see below)

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum

Input Voltage: +28V DC ±2%

Input Current: 175 ma. maximum

Size: 4.0 x 2.0 x 2.0″ (L-W-H)
101.6 x 50.8 x 50.8 mm

Connector: SMA; Filtercons for +28V DC

Mounting Flange: Add 1″ to length for flanges

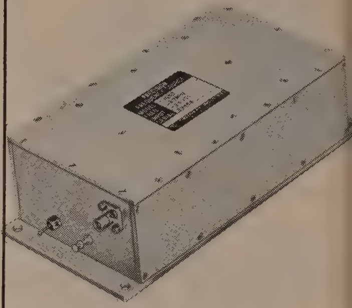
No Additional Heat Sinking Required

FREQ. RANGE (MHz)	MINIMUM OUTPUT POWER	PRICE: 1-3 units
1-30	1 Watt	$345.00 each
30.1-60	800 Milliwatts	390.00 each
60.1-90	600 Milliwatts	445.00 each
90.1-180	400 Milliwatts	525.00 each
180.1-275	200 Milliwatts	575.00 each
275.1-350	100 Milliwatts	655.00 each
350.1-600	50 Milliwatts	695.00 each

ORDERING INFORMATION:

Specify Model Y-313B and exact output frequency desired.

150 MHz to 600 MHz SINE WAVE MODEL Y-1065A UP TO 4 WATTS OUTPUT



SPECIFICATIONS:

Frequency Range: 150 MHz to 600 MHz

Frequency Stability Over Temperature Range: ±.002%

Temperature Range: 0°C to +50°C

Output Power: 1 watt minimum (Model Y-1065A) or 4 watts minimum (Model Y-1065AE) into a 50 ohm load (VSWR 1.5:1 maximum)

Output: Sine wave, Harmonics and Sub-Harmonics −26 dB minimum

Input Voltage: +28V DC ±2%

Input Current:
Model Y-1065A: 400 ma. maximum
Model Y-1065AE: 650 ma. maximum

Connector: SMA; Filtercons for +28V DC

Size: 3.0 x 6.0 x 2.0″ (L-W-H)
76.2 x 152.4 x 50.8 mm

Mounting Flange: Add 1″ to length for flanges

No Additional Heat Sinking Required

FREQ. RANGE (MHz)	1 W Output Model Y-1065A Price: 1-3 units	4 W Output Model Y-1065AE Price: 1-3 units
150-300	$849.00 ea.	$949.00 ea.
300.1-600	952.00 ea.	1152.00 ea.

ORDERING INFORMATION:

1. Specify exact output frequency desired.
2. Specify Model Y-1065A for 1 watt output.
3. Specify Model Y-1065AE for 4 watts output.

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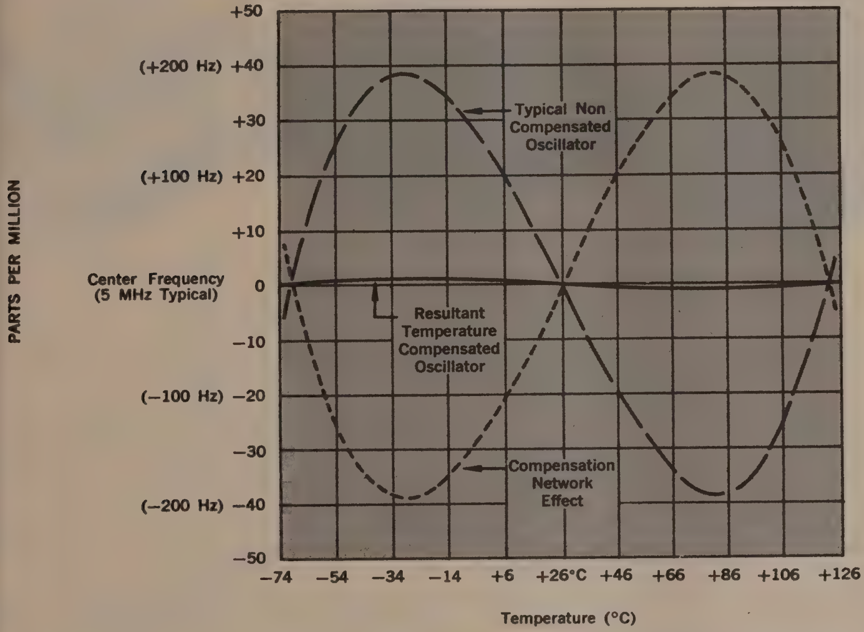
TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

There are many applications which require that a crystal oscillator exhibit a very tight frequency stability over a wide temperature range. Units of this type in the past have always required ovens in order to hold the crystal and other components at a constant temperature. This is because a crystal will change its output frequency with a change in temperature. In addition, other components in the oscillator circuit will also tend to affect the output frequency with a change in temperature.



The chart above shows the output frequency **versus temperature of a typical 5 MHz crystal oscillator**

The chart above shows the output frequency versus temperature of a typical 5 MHz crystal oscillator which has not been temperature compensated. (This is shown by the long dashes.) It is necessary to design a temperature compensation network which exhibits an effect on frequency which is opposite that effect offered by the crystal. (This is shown by the short dashes.) If perfect compensation is created, a straight line would result where there would be no change in frequency with a change in temperature. The resultant line is represented on the chart above by the solid line through the center.

In most cases, temperature compensation is achieved by first designing a voltage controlled oscillator and second, using a thermistor network consisting of 1 to 4 thermistors with varying slope characteristics which control the output frequency of the oscillator as the temperature changes.

Greenray Industries, Inc. is presently manufacturing many versions used for portable single side band communications equipment, portable test equipment, and electronic aircraft and missile control equipment. Other applications include where very high temperature operation may be occasionally encountered and the use of an oven operating at constant high temperature would cause decreased component reliability. TCXO's are used wherever instantaneous warmup and low power consumption are needed.

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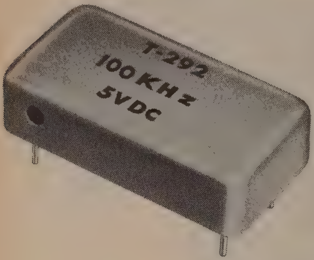
Greenray Industries, Inc.

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

10 KHz to 199 KHz SQUARE WAVE MODEL T-292



SPECIFICATIONS:

Frequency Range: 10 kHz to 199 kHz

Frequency Stability:
- $\pm 4 \times 10^{-6}$ over the temperature range
- $\pm 1 \times 10^{-6}$ over a ±5°C range
- $\pm 1 \times 10^{-9}$ averaged for one second at a constant temperature

Temperature Range: 0°C to +50°C

Frequency Adjustment to Compensate for Long Term Aging

Output: Square wave 50/50 ±1% to drive ≤10 TTL loads

Output Voltage: 0 ±.25V to +5 ±.5V

Input Voltage: +5V DC ±.5V

Input Current: 74 ma. nominal

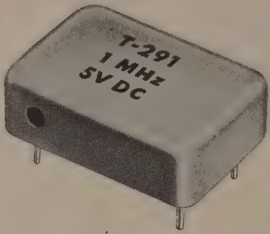
Size: 1.0 x 2.02 x .53″ (L-W-H)
25.4 x 51.3 x 13.5 mm

PRICE: 1-3 units — $285.00 each

ORDERING INFORMATION:

Specify Model T-292 and exact output frequency desired.

200 KHz to 2.99 MHz SQUARE WAVE MODEL T-291



SPECIFICATIONS:

Frequency Range: 200 kHz to 2.99 MHz

Frequency Stability:
- $\pm 4 \times 10^{-6}$ over the temperature range
- $\pm 1 \times 10^{-6}$ over a ±5°C range
- $\pm 1 \times 10^{-9}$ averaged for one second at a constant temperature

Temperature Range: 0°C to +50°C

Frequency Adjustment to Compensate for Long Term Aging

Output: Square wave 50/50 ±1% to drive ≤10 TTL loads

Output Voltage: 0 ±.25V to +5 ±.5V

Input Voltage: +5V DC ±.5V

Input Current: 42 ma. nominal

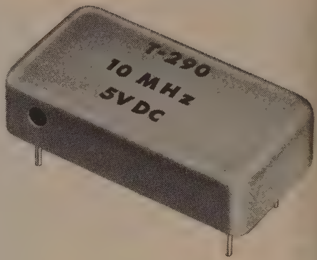
Size: 1.0 x 1.6 x .53″ (L-W-H)
25.4 x 40.6 x 13.5 mm

PRICE: 1-3 units — $245.00 each

ORDERING INFORMATION:

Specify Model T-291 and exact output frequency desired.

3 MHz to 60 MHz SQUARE WAVE MODEL T-290



SPECIFICATIONS:

Frequency Range: 3 MHz to 60 MHz

Frequency Stability:
- $\pm 4 \times 10^{-6}$ over the temperature range
- $\pm 1 \times 10^{-6}$ over a ±5°C range
- $\pm 1 \times 10^{-9}$ averaged for one second at a constant temperature

Temperature Range: 0°C to +50°C

Frequency Adjustment to Compensate for Long Term Aging

Output: Square wave 50/50 ±10% to drive ≤10 TTL loads

Output Voltage: 0 ±.25 to +3.5V min.

Input Voltage: +5V DC ±.5V

Input Current: 20 ma. nominal

Size: 1.0 x 2.02 x .53″ (L-W-H)
25.4 x 51.3 x 13.5 mm

PRICE: 1-3 units — $185.00 each

ORDERING INFORMATION:

Specify Model T-290 and exact output frequency desired.

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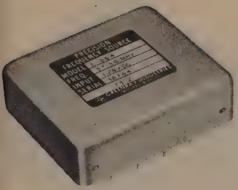
Greenray Industries, Inc.

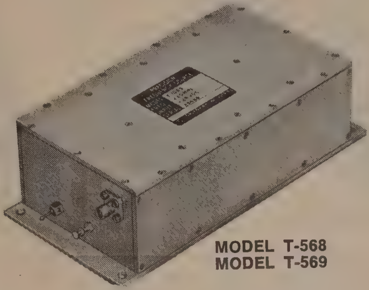
TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

3 MHz to 600 MHz
SINE or SQUARE WAVE
MODEL T-563, T-564, T-565, T-566, T-567, T-568 & T-569



MODEL T-563
MODEL T-564
MODEL T-565
MODEL T-566

MODEL T-567



MODEL T-568
MODEL T-569

SPECIFICATIONS:

Frequency Range: 3 MHz to 600 MHz

Frequency Stability Over Temperature Range: $\pm 5 \times 10^{-7}$ or $\pm 1 \times 10^{-6}$

Temperature Range: 0°C to 50°C or −30°C to +70°C

Aging: $\pm 2 \times 10^{-6}$ per year at +25°C after 30 days of operation

Output Power: 1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum*

Input Voltage: +28V DC ±2%

Input Current: 30 ma. to 150 ma. (depending on output frequency)

Frequency Adjust to Compensate for Aging

Connector: Below 75 MHz, PC Pins, Above 75 MHz, SMA; Filtercons for +28V DC

*If square wave output to drive ≤10 TTL loads is desired (below 75 MHz) add the letter "Q" after the model number. (Example: T-564Q). Same price.

Frequency Range and Case Size (L-W-H)	Tolerance Over Temperature Range	Temperature Range	Model Number	Price 1-3 units (each)
3 MHz to 20 MHz	±.0001%	0°C to +50°C	T-563	$259.00
	±.0001%	−30°C to +70°C	T-563-1	299.00
2 x 2 x .75″	±.00005%	0°C to +50°C	T-563-2	339.00
50.8 x 50.8 x 19.0 mm	±.00005%	−30°C to +70°C	T-563-3	395.00
20.01 to 75 MHz 2 x 2 x .75″	±.0001%	0°C to +50°C	T-564	295.00
50.8 x 50.8 x 19.0 mm	±.0001%	−30°C to +70°C	T-564-1	349.00
75.01 to 150 MHz	±.0001%	0°C to +50°C	T-565	385.00
2.56 x 2.94 x .88″	±.0001%	−30°C to +70°C	T-565-1	449.00
150.01 to 225 MHz	±.0001%	0°C to +50°C	T-566	449.00
2.56 x 2.94 x .88″	±.0001%	−30°C to +70°C	T-566-1	535.00
225.01 to 300 MHz	±.0001%	0°C to +50°C	T-567	520.00
2 x 4 x 2″	±.0001%	−30°C to +70°C	T-567-1	615.00
300.01 to 450 MHz	±.0001%	0°C to +50°C	T-568	630.00
2 x 5 x 2″	±.0001%	−30°C to +70°C	T-568-1	750.00
450.01 to 600 MHz	±.0001%	0°C to +50°C	T-569	765.00
3 x 6 x 2″	±.0001%	−30°C to +70°C	T-569-1	910.00

ORDERING INFORMATION:

Specify Model and exact output frequency desired.

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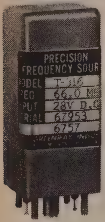
Greenray Industries, Inc.

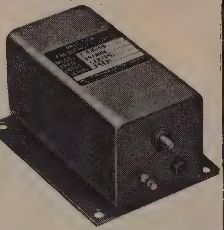
TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

12 MHz to 600 MHz SINE WAVE

MODEL T-316



MODEL T-316



MODEL T-316G6

SPECIFICATIONS:

Frequency Range: 12 MHz to 600 MHz

Frequency Stability Over Temperature Range: ±.0005% (for lower stability see Model Y-657, Page 7)

Temperature Range: −10°C to +60°C

Output Power: 1 mw minimum into 50 ohm load (10 mw or 20 mw available)

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum

Input Voltage: +28V DC ±2%

Input Current: 75 ma. maximum

Size:
1.5 x 1.5 x 3.75″ (L-W-H) (Model T-316)
2.3 x 3.75 x 1.6″ (L-W-H) (Model T-316G6)

NOTE: Units above 150 MHz will have a 2 x 2 x 4″ (L-W-H) case size. (Model T-316), 3 x 4 x 2.1″ (L-W-H) (Model T-316G6)

Connector: SMA; Filtercons for +28V DC

FREQUENCY RANGE

	Price: 1-3 units
12 MHz to 20 MHz	$197.00 each
20.1 MHz to 50 MHz	215.00 each
50.1 MHz to 75 MHz	215.00 each
75.1 MHz to 100 MHz	237.00 each
100.1 MHz to 150 MHz	263.00 each
150.1 MHz to 300 MHz	299.00 each
300.1 MHz to 600 MHz	459.00 each

ORDERING INFORMATION:

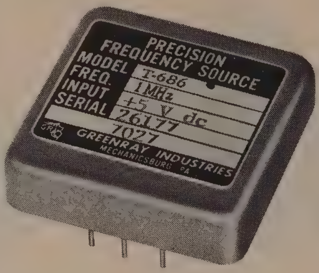
1. Specify Model T-316 or T-316G6 and exact output frequency desired.
2. For all Harmonics and Sub-Harmonics −40 dB minimum, add $30.00 to price and an "X" after Model No.
3. For 10 mw output add "J" after the Model No. For 20 mw output add "K" after the Model No. (Example: Model T-316J or T-316XK)

PRICE:

12 MHz to 150 MHz add $40.00 for 10 mw and $80.00 for 20 mw.
150.1 MHz to 600 MHz add $80.00 for 10 mw and $160.00 for 20 mw.

100 Hz to 3 MHz CMOS OUTPUT

MODEL T-686



SPECIFICATIONS:

Frequency Range: 100 Hz to 3 MHz

Frequency Stability Over Temperature Range: ±1 x 10^{-6} (for lower stability see Model Y-1252, Page 1•332)

Temperature Range: +20°C to +45°C

Output:
Square wave to drive ≤50 CMOS gates
50/50 ±2% (100 Hz to 1 MHz)
50/50 ±10% (1.01 MHz to 3 MHz)

Input Voltage: +12V DC ±2%

Input Current: 10 ma. maximum

Size: 2.0 x 2.0 x .53″ (L-W-H)
50.8 x 50.8 x 13.46 mm

Mounting:
PC Pins and 2 (6-32) threaded studs

Hermetically Sealed

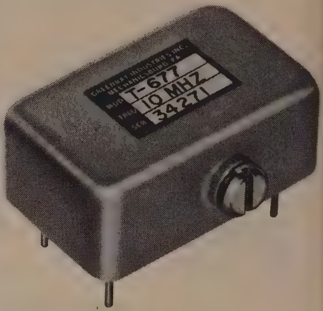
FREQUENCY RANGE:	PRICE: 1-3 units
100 Hz to 62.5 kHz	$145.00 each
62.51 kHz to 3 MHz	195.00 each

ORDERING INFORMATION:

Specify Model T-686 and exact output frequency desired.

5 MHz to 20 MHz SINE WAVE

MODEL T-677



SPECIFICATIONS:

Frequency Range: 5 MHz to 20 MHz

Frequency Stability Over Temperature Range: ±5 x 10^{-6}

Temperature Range: 0°C to +50°C

Output Voltage:
1.0V RMS minimum in a 1500 ohm load

Output:
Sine wave, Harmonics −20 dB min.

Input Voltage: +5V DC ±5%

Input Current: 10 ma. maximum

Size: 1.6 x 1.25 x .63″ (L-W-H)
40.6 x 31.8 x 16.0 mm

Frequency Adjustment to Compensate for Aging

Printed Circuit Board Mounting

O-ring Seal

PRICE: 1-3 units — $175.00 each

ORDERING INFORMATION:

Specify Model T-677 and exact output frequency desired.

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Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

Frequency range from 1 Hz to 600 MHz.

Oven types have a frequency adjustment through a hole in the unit to set the OSCILLATOR exactly on frequency and to compensate for long-term aging.

SEE CRYSTAL AGING CHART ON PAGE 1•328

The stabilities shown on the specifications in this section are given as "per 24 hours" whether noted or not. Most OSCILLATORS with ovens are pre-aged in our plant until the stability shown on the specification sheet can be held over the 24 hour period. Complete aging of any high stability OSCILLATOR takes about one month and is usually done in the customer's equipment. For this reason, it is best to re-adjust the frequency at the end of one month of operation and at the end of 4 to 6 months of operation.

Greenray Industries, Inc. presently uses only proportional type oven controllers because of their superiority over the snap-action thermostat type. The fact that they do not place switching transients on signal and power lines, and their greater reliability are assets to their use.

The proportional oven controller consists of precision resistors and thermistors in a bridge configuration feeding an integrated circuit op-amp. This output drives a power transistor in series with the oven heater which maintains the oven cavity temperature at the point where the thermistor-resistor bridge maintains balance. With this method it is common to maintain cavity temperature stabilities of ±.2°C over a wide ambient temperature range.

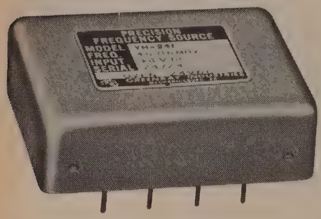
The lowest ambient temperature for which the oven must maintain temperature control, governs the amount of input power required. The lower the ambient the greater the input power necessary. The highest ambient temperature determines the set temperature of the oven, which is typically 15°C above the ambient. A typical cavity temperature would be +65°C for an oscillator specified over an ambient temperature range of 0°C to +50°C or +85°C for an ambient temperature range of 0°C to +70°C. Many variations are possible with proportional oven control; for example, low power types and fast warm-up types. The use of a wide range of input voltages is also possible. For DC, the range is +5V to +40V with +24V and +28V being the most common. For AC operation, 6.3V to 115V is possible. Greenray Industries, Inc. is able to supply snap-action thermostat oven units as replacement units for those presently in use.

OSCILLATORS with proportional ovens, do not use thermostats and therefore, do not exhibit the thermal cycling and associated frequency cycling caused by thermostat control. The short-term stability of these units exceeds ±1 x 10^{-9} per minute, per second, and per millisecond. Where noise or spurious level must be kept below −40 db, the proportional oven control types are recommended.

Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

1 Hz to 75 MHz SQUARE WAVE
MODEL YH-991
$\pm 5 \times 10^{-8}$/DAY
FAST WARM-UP



SPECIFICATIONS:

Frequency Range: 1 Hz to 75 MHz

Frequency Stability Over Temperature: $\pm 1 \times 10^{-6}$

Temperature Range: 0°C to +50°C

Maximum Aging Rate: $\pm 5 \times 10^{-8}$/24 hrs. at constant ambient after 30 days of aging

Input Voltages: +20V DC to +28V DC for proportional oven. Maximum turn-on power: 20 watts, 3 watts after 1 minute. Average power at 0°C: approx. 1 watt +5V DC ±2% for oscillator

Maximum Warm-up Time: 5 minutes

Output Voltage: 0 ±.4V to +2.4V min.

Output: Square wave 50/50 ±10% to drive ≤10 TTL loads

Size: 2.56 x 2.94 x .88″ (L-W-H)
65.02 x 74.68 x 22.35 mm

Printed Circuit Board Mounting

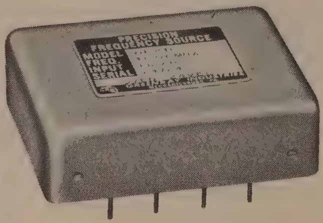
Proportional Oven Control

FREQUENCY RANGE	Price: 1-3 units
1 Hz to 19.9 Hz	$429.50 each
20 Hz to 299 Hz	399.50 each
300 Hz to 4.49 kHz	369.50 each
4.5 kHz to 69.9 kHz	339.50 each
70 kHz to 999 kHz	309.50 each
1.0 MHz to 19.99 MHz	279.50 each
20.0 MHz to 50 MHz	309.50 each
50.1 MHz to 100 MHz	339.50 each

ORDERING INFORMATION:

Specify Model YH-991 and exact output frequency desired.

40 KHz to 150 MHz SINE WAVE
MODEL YH-841
$\pm 5 \times 10^{-8}$/DAY
FAST WARM-UP



SPECIFICATIONS:

Frequency Range: 40 kHz to 150 MHz

Frequency Stability Over Temperature: $\pm 1 \times 10^{-6}$

Temperature Range: 0°C to +50°C

Maximum Aging Rate: $\pm 5 \times 10^{-8}$/24 hrs. at constant ambient after 30 days of aging

Input Voltages: +20V DC to +28V DC for proportional oven. Maximum turn-on power: 20 watts, 3 watts after 1 minute. Average power at 0°C: approx. 1 watt. +12V DC ±2% for oscillator

Maximum Warm-up Time: 5 minutes

Output Power: 1 mw minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Size: 2.56 x 2.94 x .88″ (L-W-H)
65.02 x 74.68 x 22.35 mm

Printed Circuit Board Mounting

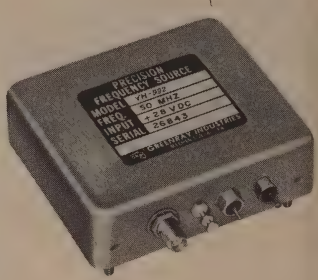
Proportional Oven Control

FREQUENCY RANGE	Price: 1-3 units
40 kHz to 650 kHz	$359.00 each
650.1 kHz to 10 MHz	299.00 each
10.01 MHz to 25 MHz	259.00 each
25.01 MHz to 75 MHz	279.00 each
75.01 MHz to 150 MHz	299.00 each

ORDERING INFORMATION:

Specify Model YH-841 and exact output frequency desired.

20 MHz to 150 MHz SINE WAVE
MODEL YH-992
$\pm 5 \times 10^{-8}$/DAY
FAST WARM-UP



SPECIFICATIONS:

Frequency Range: 20 MHz to 150 MHz

Frequency Stability Over Temperature: $\pm 1 \times 10^{-6}$

Temperature Range: 0°C to +50°C

Maximum Aging Rate: $\pm 5 \times 10^{-8}$/24 hrs. at constant ambient after 30 days of aging

Input Voltages: +20V DC to +28V DC for proportional oven. Maximum turn-on power: 20 watts, 3 watts after 1 minute. Average power at 0°C: approx. 1 watt. +12V DC ±2% for oscillator

Maximum Warm-up Time: 5 minutes

Output Power:
1 mw minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Size: 2.56 x 2.94 x .88″ (L-W-H)
65.02 x 74.68 x 22.35 mm

Connector: SMA; Filtercons for +12V DC and +20V to +28V DC

Proportional Oven Control

FREQUENCY RANGE	Price: 1-3 units
20 MHz to 25 MHz	$295.00 each
25.01 MHz to 75 MHz	315.00 each
75.01 MHz to 150 MHz	335.00 each

ORDERING INFORMATION:

Specify Model YH-992 and exact output frequency desired.

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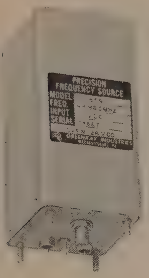
Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

12 MHz to 600 MHz SINE WAVE MODEL YH-859 FAST WARM-UP



SPECIFICATIONS:

Frequency Range: 12 MHz to 600 MHz

Frequency Stability Over Temperature Range: $\pm 1 \times 10^{-6}$

Temperature Range: 0°C to +50°C

Maximum Aging Rate: $\pm 2 \times 10^{-6}$/year after 30 days of aging

Maximum Warm-up Time: 5 minutes

Input Voltage: +28V DC. Maximum turn-on power: 20 watts, 3 watts after 1 minute. Average power at 0°C: approx. 1 watt

Output Power: 1 mw minimum into a 50 ohm load (10 mw or 20 mw available)

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum

Size: 2.0 x 2.0 x 4.0" (L-W-H)
50.8 x 50.8 x 101.6 mm

Connector: SMA; Filtercons for +28V DC

Solder Sealed

Proportional Oven Control

FREQUENCY RANGE	Price: 1-3 units
12 MHz to 20 MHz	$259.00 each
20.1 MHz to 50 MHz	275.00 each
50.1 MHz to 75 MHz	285.00 each
75.1 MHz to 100 MHz	295.00 each
100.1 MHz to 150 MHz	325.00 each
150.1 MHz to 300 MHz	399.00 each
300.1 MHz to 600 MHz	525.00 each

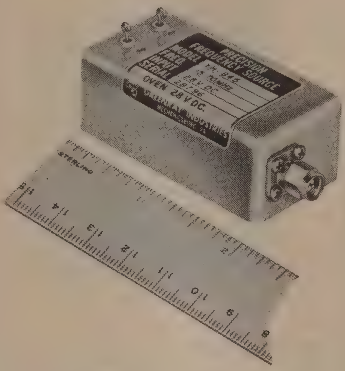
ORDERING INFORMATION:

1. Specify Model YH-859 and exact output frequency desired.
2. For all Harmonics −40 dB minimum, add $30.00 to price and an "X" after Model No. (Example: Model YH-859X).
3. For 10 mw output add "J" after the Model No. For 20 mw output add "K" after the Model No. (Example: Model YH-859J or YH-859XK).

PRICE:

12 MHz to 150 MHz: add $40.00 for 10 mw and $80.00 for 20 mw.
150.1 MHz to 600 MHz: add $80.00 for 10 mw and $160.00 for 20 mw.

10 MHz to 80 MHz SINE WAVE MODEL YH-845 LOW INPUT POWER



SPECIFICATIONS:

Frequency Range: 10 MHz to 80 MHz

Frequency Stability Over Temperature Range and Per Day: $\pm 1 \times 10^{-7}$

Temperature Range: 0°C to +70°C

Maximum Aging Rate: $\pm 5 \times 10^{-8}$/24 hrs. at constant ambient after 30 days of aging

Output Power:
1 mw minimum into a 50 ohm load

Output: Sine wave, Harmonics −26 dB min.; Spurious −50 dB min.

Input Voltage:
+28V DC ±1%

Input Current: 170 ma. maximum

Size: 2.84 x 1.41 x 1.00" (L-W-H)
72.14 x 35.81 x 25.4 mm

Connector: SMA, solder terminal for +28V DC

Frequency Adjustment to Compensate for Aging

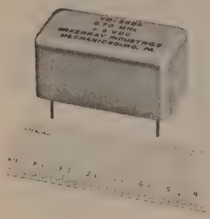
Proportional Oven Control

PRICE: 1-3 units — $659.00 each

ORDERING INFORMATION:

Specify Model YH-845 and exact output frequency desired.

5 MHz to 10 MHz SQUARE WAVE MODEL YH-650A LOW POWER FAST WARM-UP



SPECIFICATIONS:

Frequency Range: 5 MHz to 10 MHz

Frequency Stability:
Over temp. range: $\pm 5 \times 10^{-8}$
Time—24 hours: $\pm 1.0 \times 10^{-8}$ after 30 days aging
Year: $\pm 3 \times 10^{-6}$ after 30 days aging
Second: $\pm 1 \times 10^{-10}$

Temperature Range: 0°C to +50°C

Setting Tolerance: ±10 ppm (no freq. adj.)

Output: Square wave, Rise time and Fall time less than 10 nsec.

Output Voltage: 0 ±.25V to 4V ±1V DC

Input Voltage:
+5V DC ±.25V DC ±1% regulation

Input Current: 400 ma. maximum

Warm-up Time: 10 minutes maximum

Weight: 1.2 oz. maximum

Size 1.0 x 2.05 x 1.0" (L-W-H)
25.4 x 52.07 x 25.4 mm

Mounting: 4 P-C Pins

Oven Controlled

Hermetically Sealed

PRICE: 1-3 units — $550.00 each

ORDERING INFORMATION:

Specify Model YH-650A and exact output frequency desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

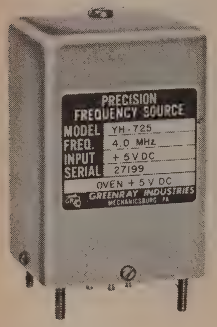
Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

1 MHz to 50 MHz SQUARE WAVE

MODEL YH-725

±1 x 10^{-8}/DAY


PRECISION
FREQUENCY SOURCE
MODEL YH-725
FREQ. 4.0 MHz
INPUT +5 V DC
SERIAL 27199
OVEN +5 V DC
GREENRAY INDUSTRIES
MECHANICSBURG, PA.

SPECIFICATIONS:

Frequency Range: 1 MHz to 50 MHz

Frequency Stability:
±1 x 10^{-8}/day at fixed ambient after 30 days of aging
±5 x 10^{-8} over temperature range

Temperature Range: 0°C to +50°C

Output: Square wave, 50/50 ±10% to drive ≤10 TTL loads

Output Voltage: 0 ±.2V to +4V ±1V

Maximum Rise and Fall Time: 15 nanoseconds

Input Voltage: +5V DC ±.25V for oscillator and proportional oven

Input Current: Oven 850 ma. maximum; Oscillator 50 ma. maximum

Size: 2.0 x 2.0 x 3.0″ (L-W-H)
50.8 x 50.8 x 76.2 mm

Frequency Adjustment to Compensate for Aging

Proportional Oven Control

Connector: 8 Pin turret lug header

PRICE: 1-3 units — $425.00 each

ORDERING INFORMATION:

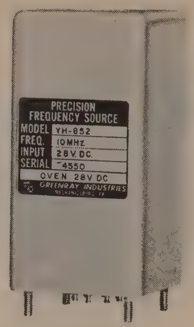
Specify Model YH-725 and exact output frequency desired.

Note: +28V DC oven option available — Specify Model YH-725C, same price. (Oscillator operates on +5V DC, oven on +28V DC)

16 KHz to 70 MHz SINE WAVE

MODEL YH-852

±1 x 10^{-8}/DAY


PRECISION
FREQUENCY SOURCE
MODEL YH-852
FREQ. 10 MHz
INPUT 28 V DC
SERIAL 4550
OVEN 28V DC
GREENRAY INDUSTRIES

SPECIFICATIONS:

Frequency Range: 16 KHz to 70 MHz

Frequency Stability Over Temperature Range: ±5 x 10^{-8}

Temperature Range: 0°C to +50°C

Aging Rates at Constant Ambient After 30 Days of Aging:
16 kHz to 20 MHz: ±1 x 10^{-8}/24 hrs.
20.1 MHz to 70 MHz: ±5 x 10^{-8}/24 hrs.
All frequencies: ±5 x 10^{-10}/second

Output Voltage: 1V RMS minimum into a 1K ohm load (below 20 MHz) or .22V RMS minimum into a 50 ohm load (above 20 MHz)

Output: Sine wave, Harmonics −26 dB minimum; Spurious −60 dB minimum

Input: 28V DC ±2% for oscillator; 28V DC ±10% for oven

Input Current:
Oven: 650 ma. maximum
Oscillator: 50 ma. maximum

Connector: 8 Pin turret lug header

Proportional Oven Control

Size: 2.0 x 2.0 x 4.0″ (L-W-H)
50.8 x 50.8 x 101.6 mm

FREQUENCY RANGE:	**PRICE: 1-3 units**
16 kHz to 999 kHz	$489.00 each
1 MHz to 70 MHz	439.00 each

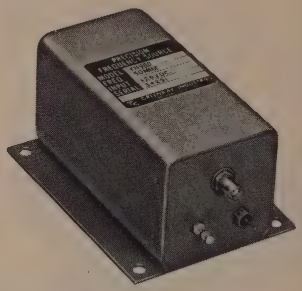
ORDERING INFORMATION:

Specify Model YH-852 and exact output frequency desired.

1 MHz to 110 MHz SINE WAVE

MODEL YH-980

ULTRA-LOW PHASE NOISE


PRECISION
FREQUENCY SOURCE
MODEL
FREQ.
INPUT
SERIAL
GREENRAY INDUSTRIES

SPECIFICATIONS:

Frequency Range: 1 MHz to 110 MHz

Frequency Stability:
±1 x 10^{-7}/day at fixed ambient after 30 days of aging
±1 x 10^{-7} over temperature range

Temperature Range: 0°C to +50°C

Output Power:
10 mw minimum into a 50 ohm load

Output:
Sine wave, Harmonics −40 dB min.

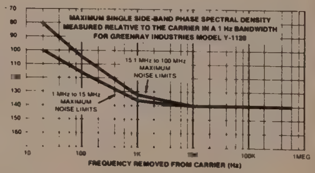
Input Voltage: +28V DC ±2%

Input Current: 550 ma. maximum

Size: 2.0 x 4.0 x 2.0″ (L-W-H)
50.8 x 101.6 x 50.8 mm

Connector: SMA; Filtercons for +28V DC

Frequency Adjustment to Compensate for Aging



FREQUENCY RANGE:	**PRICE: 1-3 units**
1 MHz to 15.0 MHz	$595.00 each
15.01 MHz to 110 MHz	549.00 each

ORDERING INFORMATION:

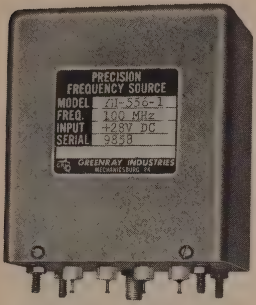
Specify Model YH-980 and exact output frequency desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

1 MHz to 10 MHz
SINE WAVE
MODEL YH-556-1
±1 x 10^{-8}/DAY


PRECISION
FREQUENCY SOURCE
MODEL YH-556-1
FREQ. 100 MHz
INPUT +28V DC
SERIAL 9858
GREENRAY INDUSTRIES
MECHANICSBURG, PA.

SPECIFICATIONS:

Frequency Range: 1 MHz to 10 MHz

Frequency Stability:
- ±1 x 10^{-8}/24 hours
- ±2 x 10^{-6}/year after 30 days of operation
- ±1 x 10^{-9}/second
- ±5 x 10^{-8} over temperature range

Temperature Range: +10°C to +50°C

Output Power:
1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Input Current:
Oven: 600 ma. maximum
Oscillator: 40 ma. maximum

Connector: SMA; Filtercons for +28V DC

Frequency Adjustment to Compensate for Aging

Proportional Oven Control

Size: 1.94 x 2.97 x 3.5″ (L-W-H)
49.28 x 75.44 x 88.90 mm

PRICE: 1-3 units — $425.00 each

ORDERING INFORMATION:

Specify Model YH-556-1 and exact output frequency desired.

10.1 MHz to 75 MHz
SINE WAVE
MODEL YH-556-1
±5 x 10^{-8}/DAY

PRECISION
FREQUENCY SOURCE
MODEL YH-556-1
FREQ. 100 MHz
INPUT +28V DC
SERIAL 9858
GREENRAY INDUSTRIES
MECHANICSBURG, PA.

SPECIFICATIONS:

Frequency Range: 10.1 MHz to 75 MHz

Frequency Stability:
- ±5 x 10^{-8}/24 hours
- ±2 x 10^{-6}/year after 30 days of operation
- ±1 x 10^{-9}/second
- ±5 x 10^{-8} over temperature range

Temperature Range: +10°C to +50°C

Output Power:
1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Input Current:
Oven: 600 ma. maximum
Oscillator: 40 ma. maximum

Connector: SMA; Filtercons for +28V DC

Frequency Adjustment to Compensate for Aging

Proportional Oven Control

Size: 1.94 x 2.97 x 3.5″ (L-W-H)
49.28 x 75.44 x 88.90 mm

PRICE: 1-3 units — $425.00 each

ORDERING INFORMATION:

Specify Model YH-556-1 and exact output frequency desired.

75.1 MHz to 120 MHz
SINE WAVE
MODEL YH-556-1
±1 x 10^{-7}/DAY

PRECISION
FREQUENCY SOURCE
MODEL YH-556-1
FREQ. 100 MHz
INPUT +28V DC
SERIAL 9858
GREENRAY INDUSTRIES
MECHANICSBURG, PA.

SPECIFICATIONS:

Frequency Range: 75.1 MHz to 120 MHz

Frequency Stability:
- ±1 x 10^{-7}/24 hours
- ±2 x 10^{-6}/year after 30 days of operation
- ±1 x 10^{-9}/second
- ±5 x 10^{-8} over temperature range

Temperature Range: +10°C to +50°C

Output Power:
1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Input Current:
Oven: 600 ma. maximum
Oscillator: 40 ma. maximum

Connector: SMA; Filtercons for +28V DC

Frequency Adjustment to Compensate for Aging

Proportional Oven Control

Size: 1.94 x 2.97 x 3.5″ (L-W-H)
49.28 x 75.44 x 88.90 mm

PRICE: 1-3 units — $425.00 each

ORDERING INFORMATION:

Specify Model YH-556-1 and exact output frequency desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

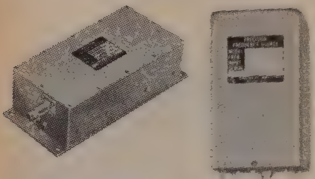
Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

40 MHz to 600 MHz SINE or SQUARE WAVE

MODEL YH-278A

$\pm 1 \times 10^{-8}$/DAY



SPECIFICATIONS:

Frequency Range: 40 MHz to 600 MHz

Frequency Stability:
- $\pm 1 \times 10^{-9}$ per 70 milliseconds
- $\pm 1 \times 10^{-9}$ per second
- $\pm 1 \times 10^{-8}$ per 24 hours after 15 days of aging
- $\pm 5 \times 10^{-8}$ per week after 30 days of aging
- $\pm 5 \times 10^{-8}$ over temperature range

Temperature Range: +20°C to +50°C

Output Power:
10 milliwatts min. into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −26 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Input Current: 750 ma. maximum

Connector: BNC; Filtercons for +28V DC

Proportional Oven Control

Size: 40 MHz to 160 MHz:
2.75 x 2.75 x 4.62″ (L-W-H)
69.85 x 69.85 x 117.35 mm
160.1 MHz to 600 MHz:
6.0 x 3.0 x 2.0″ (L-W-H)
152.40 x 76.20 x 50.8 mm
(add 1″ to length for flanges)

FREQUENCY RANGE:	PRICE: 1-3 units
40 MHz to 160 MHz	$575.00 each
160.1 MHz to 320 MHz	750.00 each
320.1 MHz to 600 MHz	925.00 each

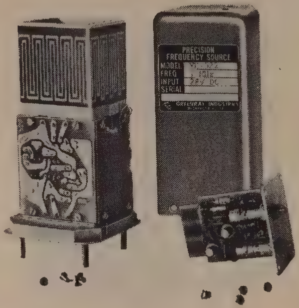
ORDERING INFORMATION:

1. Specify Model YH-278A and exact output frequency desired.
2. If square wave output to drive ≤10 TTL loads is desired (below 100 MHz) add the letter "Q" after the Model No. (Example: YH-278AQ). Requires additional +5V DC ±.25V input voltage (same price).
3. If square wave output to drive ECL is desired (below 300 MHz) add the letter "U" after the Model No. (Example: YH-278AU). Requires additional −5.2V DC ±10% input voltage. Output wave form and levels will drive ≤5 standard ECL gates (same price).

1 MHz to 20 MHz SINE or SQUARE WAVE

MODEL YH-522-1W

$\pm 1 \times 10^{-9}$/DAY



SPECIFICATIONS:

Frequency Range: 1 MHz to 20 MHz

Frequency Stability:
- $\pm 1 \times 10^{-9}$/day after 30 days of aging
- $\pm 1 \times 10^{-10}$/minute
- $\pm 1 \times 10^{-8}$ over temperature range

Output Voltage:
1 VRMS minimum into a 1000 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Temperature Range: 0°C to +55°C

Input Voltage: +28V DC ±1%

Input Current: 650 ma. maximum

Frequency Adjustment: 2 adjustments for resolution of better than $\pm 1 \times 10^{-9}$

Size: 2.13 x 2.13 x 4.25″ (L-W-H)
54.10 x 54.10 x 107.95 mm

Cast Aluminum Oven Cavity for Maximum Stability

Connector: 8 Pin turret lug header

PRICE: 1-3 units — $535.00 each

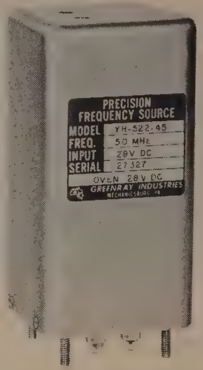
ORDERING INFORMATION:

1. Specify Model YH-522-1W and exact output frequency desired.
2. If square wave output to drive ≤10 TTL loads is desired (below 100 MHz) add the letter "Q" after the Model No. (Example: YH-522-1WQ). Requires additional +5V DC ±.25V input voltage (same price).
3. To specify an octal plug-in rather than turret lug header, specify Model YH-522-1 instead of Model YH-522-1W (same price).

20.1 MHz to 120 MHz SINE WAVE

MODEL YH-522-45

$\pm 1 \times 10^{-8}$/DAY



SPECIFICATIONS:

Frequency Range: 20.1 MHz to 120 MHz

Frequency Stability at Fixed Ambient:
- $\pm 5 \times 10^{-8}$/week after 30 days of aging
- $\pm 1 \times 10^{-9}$/70 milliseconds
- $\pm 1 \times 10^{-9}$/second
- $\pm 1 \times 10^{-8}$/24 hours after 15 days aging

Frequency Stability Over Temperature Range: $\pm 5 \times 10^{-8}$

Temperature Range: 0°C to +50°C

Output Power
1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Input Current: 650 ma. maximum

Size: 2.13 x 2.13 x 4.25″ (L-W-H)
54.10 x 54.10 x 107.95 mm

Connector: SMA; Filtercons for +28V DC

PRICE: 1-3 units — $579.00 each

ORDERING INFORMATION:

Specify Model YH-522-45 and exact output frequency desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

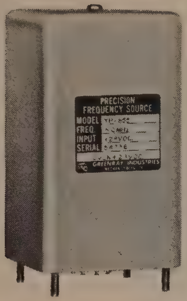
HIGH STABILITY CRYSTAL OSCILLATORS

1 MHz to 10 MHz SINE WAVE

MODEL YH-855

FREQUENCY STANDARD

±1 x 10^{-9}/DAY



SPECIFICATIONS:

Frequency Range: 1 MHz to 10 MHz

Frequency Stability:
±5 x 10^{-9} over temperature range
±1 x 10^{-9}/day after 72 hours stabilization period at constant ambient after 30 days of aging

Temperature Range: +20°C to +55°C

Output Voltage:
1V RMS minimum into a 1000 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Input Current: 1 amp maximum

Size: 2.75 x 2.75 x 4.62″ (L-W-H)
69.85 x 69.85 x 117.35 mm

Connector: 8 Pin turret lug header

Proportional Oven Control

PRICE: 1-3 units — $759.00 each

ORDERING INFORMATION:

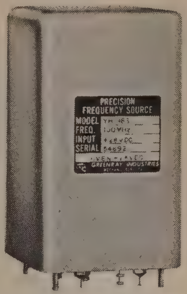
1. Specify Model YH-855 and exact output frequency desired.
2. For 1 mw minimum into a 50 ohm load, suffix Model No. with L (Example YH-855L) and add $25.00 to price.

80 MHz to 120 MHz SINE WAVE

MODEL YH-986

FREQUENCY STANDARD

±1 x 10^{-9}/DAY



SPECIFICATIONS:

Frequency Range: 80 MHz to 120 MHz

Frequency Stability:
±5 x 10^{-8} over temperature range
±1 x 10^{-9}/day at a constant ambient after 30 days of aging

Temperature Range: +10°C to +40°C

Output Power:
10 mw minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+24V DC ±2% at 800 ma. maximum
−24V DC ±2% at 50 ma. maximum

Size: 2.75 x 2.75 x 4.63″ (L-W-H)
69.85 x 69.85 x 117.60 mm

Connector: SMA; Filtercons for +24V DC and −24V DC

SSB Phase Noise in a 1 Hz Bandwidth*

20 Hz	−68 dB	10 kHz	−125 dB
100 Hz	−90 dB	100 kHz	−130 dB
1 kHz	−118 dB	500 kHz	- 130 dB

*Typical readings 6 to 10 dB better.

Ideal for Input Standard of Phase Locked Microwave Sources

PRICE: 1-3 units — $865.00 each

ORDERING INFORMATION:

Specify Model YH-986 and exact output frequency desired.

1 MHz to 20 MHz SINE WAVE

MODEL YH-989

±5 x 10^{-9}/DAY

RACK MOUNT

PRECISION FREQUENCY SOURCE

SPECIFICATIONS:

Frequency Range: 1 MHz to 20 MHz

Frequency Stability:
±1 x 10^{-8} over temperature range
±5 x 10^{-9}/day at a constant ambient after 30 days of aging

Temperature Range: −30°C to +60°C

Output Voltage:
1V RMS minimum into a 50 ohm load

Output: Sine wave, Harmonics −40 dB minimum; Spurious −60 dB minimum

Input Voltage: 105 to 125V AC, 47-63 Hz

Size: 19.0 x 6.0 x 3.5″ (L-H-D)
482.6 x 152.4 x 88.9 mm

Connector: BNC

Option 1: Oscillator only, no power supply or panel assembly. Requires +12V DC ±2% at 2.5 amps maximum
Size: 6.3 x 3.0 x 4.0″ (L-W-H)
160.0 x 76.20 x 101.6 mm
Specify Model YH-989A

PRICE: 1-3 units
Model YH-989 — $1135.00 each
Model YH-989A — 845.00 each

ORDERING INFORMATION:

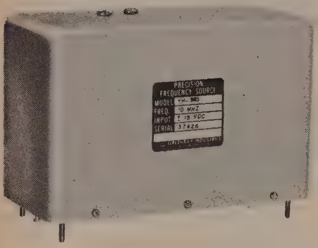
Specify Model No. and exact output frequency desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

HIGH STABILITY CRYSTAL OSCILLATORS

5 MHz to 25 MHz
SINE WAVE
MODEL YH-983
FREQUENCY STANDARD
±5 x 10^{-10}/DAY



SPECIFICATIONS:

Frequency Range: 5 MHz to 25 MHz

Frequency Stability:
- ±5 x 10^{-10}/day at fixed ambient after 30 days of aging
- ±1 x 10^{-8} over temperature range

Temperature Range: −25°C to +60°C

Output Power:
1 mw minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −40 dB minimum; Spurious −60 dB minimum

Input Voltages: + and −15V DC ±2%

Input Current: 1.2 amps maximum

Connector:
BNC; Filtercons for + and −15V DC

Proportional Oven Control

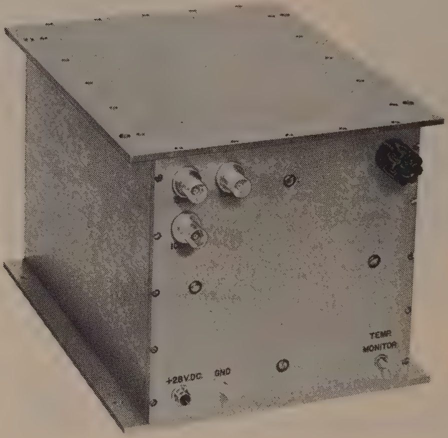
Size: 6.08 x 2.86 x 3.81″ (L-W-H)
154.43 x 72.64 x 96.77 mm

PRICE: 1-3 units — $1275.00 each

ORDERING INFORMATION:

Specify Model YH-983 and exact output frequency desired.

100 KHz, 1 MHz & 5 MHz
SINE WAVE
MODEL YH-823
EXCELLENT LABORATORY STANDARD
VERY LOW PHASE NOISE



SPECIFICATIONS:

Output Frequencies: 100 kHz, 1 MHz and 5 MHz

Long Term Stability: ±1 x 10^{-10} per day at a constant ambient after 30 days of aging
±5 x 10^{-11} per day at a constant ambient after 6 months

Short Term Stability: (Time Domain) 5 x 10^{-12} per second
1.5 x 10^{-11} per 100 milliseconds
1.5 x 10^{-10} per 10 milliseconds

(Frequency Domain) single sideband
20 Hz from Carrier: −130 dB
100 Hz from Carrier: −135 dB
1000 Hz from Carrier: −140 dB

NOTE: Measurement Bandwidth: 1 Hz

Temperature Range: +15°C to +40°C

Output Power: 1 mw minimum into a 50 ohm load (each output)

Output: Sine wave, Harmonics −40 dB minimum, Spurious −60 dB minimum

Input Voltage: +28V DC ±1%

Input Current: 2.0 amps maximum at turn-on

Size: 6.5 x 8.0 x 5.5″ (L-W-H), 165.1 x 203.2 x 139.7 mm

Connectors: 3 BNC's, Filtercon on +28V DC

Double Proportional Oven for High Stability

PRICE: 1-3 units — $2475.00 each

ORDERING INFORMATION: Specify Model YH-823

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

VOLTAGE CONTROLLED OSCILLATORS

TYPES:

I. R-C (RESISTANCE PLUS CAPACITANCE) OSCILLATORS

Recommended where:

a. Frequencies between 1 Hz and 100 kHz are required.
b. Very wide frequency swing is required (between ±10% and ±100%).
c. Frequency stabilities better than .5% are not required.
d. Linearity up to ±.1% is desired.
e. Smallest size possible is required.

II. L-C (INDUCTANCE PLUS CAPACITANCE) OSCILLATORS

Recommended where:

a. Frequencies between 50 Hz and 200 MHz are required.
b. Medium frequency swing is required (±1% to ±20%).
c. Frequency stabilities up to .05% are required.
d. Linearity up to ±.5% is desired.

III. CRYSTAL OSCILLATORS (VCXO)

Recommended where:

a. Frequencies between 1 Hz and 600 MHz. (Lower output frequencies have built-in dividers.)
b. Very narrow frequency swing is required from ±.001% to ±.1%.
c. Frequency stabilities from ±.000001% to ±.1% are required.
d. Linearities between ±.5% and ±10% are required.

Rate of Modulation: Most VCXO's can be supplied for modulation rates up to 100 kHz. However, if the oscillator is to be modulated at a rate faster than 10 kHz, please specify modulation rate when placing order.

Types of Modulation Voltage: Inputs may be DC, pulsating DC or AC. It is best to specify the type of modulation voltage when placing an order.

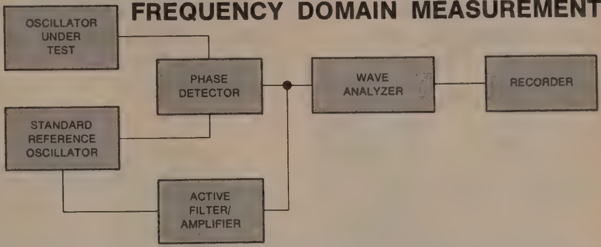
LINEARITY:

Linearity is a function of the percentage of graphic error versus the amount of frequency shift.

In the chart, an example of perfect straight-line linearity is shown by line "A." If the specifications for an oscillator called for a linearity of ±5% and the actual amount of shift of an oscillator was 800 Hz total (as shown) the curve of output frequency versus the actual plotted value for a given voltage input could vary ±40 Hz (800 Hz x ±5% = ±40 Hz). This is shown by lines "B" and "C." A typical curve of a voltage controlled oscillator holding a linearity of ±5% is shown by line "D."

Although non-linear, the voltage versus frequency change always exhibits a smooth curve.

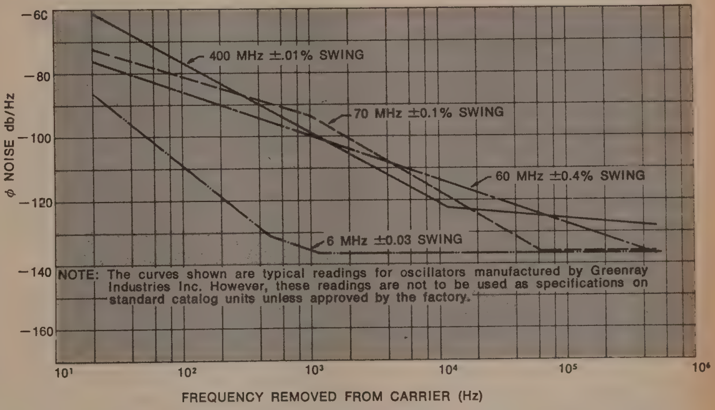
BLOCK DIAGRAM FOR FREQUENCY DOMAIN MEASUREMENTS



From the above test set-up we obtain the required data to compute the single sideband phase spectral density relative to the carrier at a particular frequency from the carrier in the desired bandwidth.

TYPICAL SINGLE SIDE-BAND PHASE SPECTRAL DENSITY MEASURED RELATIVE TO THE CARRIER IN A 1 Hz BANDWIDTH

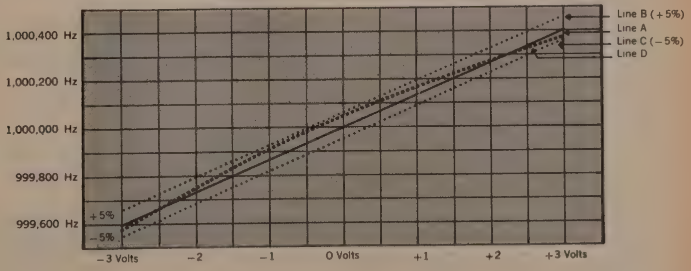
VOLTAGE CONTROLLED CRYSTAL OSCILLATORS



NOTE: The curves shown are typical readings for oscillators manufactured by Greenray Industries Inc. However, these readings are not to be used as specifications on standard catalog units unless approved by the factory.

This chart is accurate for both voltage controlled crystal oscillators and temperature compensated, voltage controlled crystal oscillators.

See Page 1•329 for measurement information and other graphs.



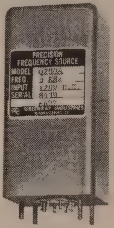
NOTE: Re-adjusting the center frequency to compensate for component aging does not appreciably change the shape of the linearity curve.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

VOLTAGE CONTROLLED OSCILLATORS

20 Hz to 50 KHz SINE, SQUARE OR PULSE OUTPUT
MODEL Q-200A
R-C V.C.O.
WIDE BAND



SPECIFICATIONS:

Center Frequency Range: 20 Hz to 50 kHz

Frequency Swing Range: ±10% or ±30% (other ranges available on request)

Frequency Stability:
±.5% over the temperature range of 0°C to +50°C
±2% over the temperature range of −40°C to +60°C

Output Voltage: −10V peak-to-peak minimum into a 1000 ohm load (negative going pulse) AC coupled

Output Wave Form: Pulse, less than 1 µsec rise time. Pulse width, 1 to 20 µsec depending on frequency

Input Voltage: +28V DC ±2%

Input Current: 50 ma. maximum

Size: 2.0 x 2.0 x 4.0″ (L-W-H)
50.8 x 50.8 x 101.6 mm

Control Voltage: 0 to +10V DC. This oscillator has two adjustments on top. One to adjust for the low frequency end at 0 volts input and the other to adjust to the high frequency end at +10V DC. This oscillator will then be on frequency at +5V DC input.

Positive Slope

Linearity: Better than ±2%

Modulation Input Impedance: 600 ohms

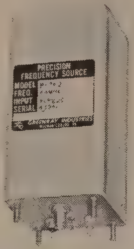
Hermetically Sealed

PRICE: 1-3 units — $299.00 each

ORDERING INFORMATION:

1. Specify exact center frequency desired.
2. Specify Model Q-200A for ±10% swing.
3. Specify Model Q-200B for ±30% swing.
4. Sine wave output is available on Model Q-200A only. For sine wave output (10% maximum harmonic distortion), specify Model Q-200AS. **Price: 1-3 units** — $395.00 each. Sine wave output: 1V RMS minimum into a 1000 ohm load.
5. Square wave output is available on either Model Q-200A or Q-200B. For square wave output specify Model Q-200AQ or Q-200BQ. **Price: 1-3 units** — $345.00 each.
   Square wave output suitable to drive ≤10 TTL loads.

1 KHz to 200 MHz SINE WAVE
MODEL P-360
L-C V.C.O.



SPECIFICATIONS:

Center Frequency Range:
1 kHz to 200 MHz

Frequency Swing Ranges:
±1%, ±5%, ±10%, ±20%

Frequency Stability Over Temperature Range: ±.20% with ±1% swing
±.25% with ±5% swing
±.30% with ±10% swing
±.40% with ±20% swing

Temperature Range: 0°C to +50°C

Output Power:
1 milliwatt minimum into a 50 ohm load, 20 MHz to 200 MHz
1V RMS minimum into a 1000 ohm load, 1 kHz to 19.99 MHz

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB; Spurious −60 dB

Input Voltage: +28V DC ±1%

Input Current: 100 ma. maximum

Control Voltage: 0 to ±3V (DC coupled)

Negative Slope

Maximum Modulation Rate:
1%* of output frequency

Modulation Input Impedance: 1000 ohms

Size: 2.0 x 2.0 x 4.0″ (L-W-H)
50.8 x 50.8 x 101.6 mm

Linearity: ±5% or better

Connector: SMA; Filtercons for +28V DC

Center Frequency Adjustment to Compensate for Aging

Solder Sealed

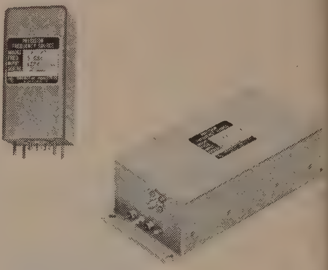
*Consult factory for faster modulation rates.

FREQUENCY RANGE:	PRICE: 1-3 units Percent Swing ±1% or ±5%	±10%	±20%
1 KHz-99.99 kHz	$489	—	—
100 kHz-19.99 MHz	385	$435	$485
20 MHz-100 MHz	395	445	495
100 MHz-200 MHz	445	495	—

ORDERING INFORMATION:

1. Specify Model P-360A for ±1% swing.
2. Specify Model P-360B for ±5% swing.
3. Specify Model P-360C for ±10% swing.
4. Specify Model P-360D for ±20% swing.
5. Specify exact center freq. desired.

100 KHz to 200 MHz SINE WAVE
MODEL PH-229 & PH-230
L-C V.C.O.



SPECIFICATIONS:

Center Frequency Range:
100 kHz to 200 MHz

Frequency Swing Range: ±2% or ±10%

Temperature Range: 0°C to +50°C

Output Power:
1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB; Spurious −60 dB minimum

Input Voltage:
+28V DC ±2% for oscillator and oven

Size: 2 x 2 x 4″ high (up to 50 MHz)
50.8 x 50.8 x 101.6 mm
3 x 6 x 2″ high (above 50 MHz)
76.2 x 152.4 x 50.8 mm

Center Frequency Adjustment to Compensate for Aging

Proportional Oven Control

Control Voltage: May be DC coupled or AC coupled with the FM modulation rate up to 15 kHz.* A variable DC bias of 0 to ±3V DC may be used rather than an AC input to set the frequency at a fixed input.

Negative Slope

Linearity: ±5% or better

Modulation Input Impedance: 1000 ohms

Non-Hermetically Sealed

Input Current: 650 ma. maximum

*Consult factory for higher modulation rates.

Stabilities

Model	Per Hour	Per Day & Over Temp.
PH-229	±.01%	±.02%
PH-230	±.001%	±.02%

FREQUENCY RANGE:	PRICE: 1-3 units
Model PH-229	
100 kHz to 50 MHz	$585.00
50.1 MHz to 200 MHz	785.00
Model PH-230	
100 kHz to 50 MHz	845.00
50.1 MHz to 200 MHz	995.00

ORDERING INFORMATION:

1. Specify Model PH-229 for ±10% swing.
2. Specify Model PH-230 for ±2% swing.
3. Specify exact center freq. desired.

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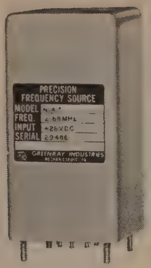
Greenray Industries, Inc.

VOLTAGE CONTROLLED OSCILLATORS

1 KHz to 3.99 MHz
SINE WAVE
MODEL N-415
V.C.X.O.



SPECIFICATIONS:

Center Frequency Range:
1 kHz to 3.99 MHz

Frequency Swing Ranges:
±.01%, ±.03%, ±.05%, ±.1%
(other ranges available on request)

Frequency Stability Over Temperature Range:
±.002% with ±.01% swing
±.003% with ±.03% swing
±.004% with ±.05% swing
±.005% with ±.10% swing

Temperature Range: 0°C to +50°C

Output Voltage:
1V RMS minimum into a 1000 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage:
+28V DC ±1% and +5V DC ±5%

Input Current:
50 ma. maximum at +28V DC
200 ma. maximum at +5V DC

Control Voltage: 0 to ±3V (DC coupled with a maximum modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Connector: 8 Pin turret lug header

Size: 2.0 x 2.0 x 4.0″ (L-W-H)
50.8 x 50.8 x 101.6 mm

Linearity: ±5% or better

Negative Slope

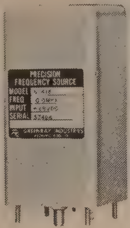
Center Frequency Adjustment to Compensate for Aging

FREQUENCY RANGE	Price: 1-3 units
1 kHz to 15.99 kHz	$545.00 each
16 kHz to 249.9 kHz	515.00 each
250 kHz to 3.99 MHz	485.00 each

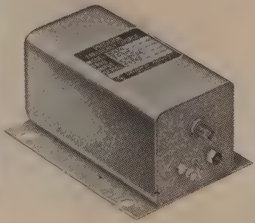
ORDERING INFORMATION:

1. Specify Model N-415A for ±.01% swing.
2. Specify Model N-415B for ±.03% swing.
3. Specify Model N-415C for ±.05% swing.
4. Specify Model N-415D for ±.10% swing.
5. Specify exact center freq. desired.

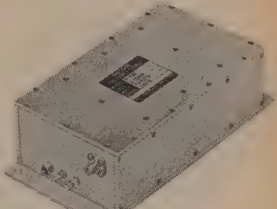
4 MHz to 600 MHz
SINE WAVE
MODEL N-418, N-420 & N-423
V.C.X.O.



MODEL N-418



MODEL N-420



MODEL N-423

SPECIFICATIONS:

Center Frequency Range: 4 MHz to 600 MHz

Frequency Swing Ranges:
±.01%, ±.03%, ±.05% or ±.10% (other ranges available on request)

Frequency Stability Over Temperature Range:
±.002% with ±.01% swing
±.003% with ±.03% swing
±.004% with ±.05% swing
±.005% with ±.10% swing

Temperature Range: O°C to +50°C

Output Power: 1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB min.; Spurious −60 dB min.

Input Voltage: +28V DC ±1%

Input Current: Model N-418: 50 ma. maximum
Model N-420: 75 ma. maximum
Model N-423: 150 ma. maximum

Control Voltage: 0 to ±3V (DC coupled with a maximum modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Linearity: ±5% or better

Negative Slope

Center Frequency Adjustment to Compensate for Aging

Connector: SMA; Filtercon for +28V DC

Frequency Range	Case Size (L-W-H)	Model No.	Price (1-3 units)
4 MHz to 24.9 MHz	2.0 x 2.0 x 4.0″	N-418	$385.00 each
25 MHz to 49.9 MHz	50.8 x 50.8 x 101.6 mm	N-418	435.00 each
50 MHz to 74.9 MHz		N-418	485.00 each
75 MHz to 149.9 MHz	4.0 x 2.0 x 2.0″* 101.6 x 50.8 x 50.8 mm	N-420	635.00 each
150 MHz to 299.9 MHz	5 x 3.0 x 2.0″* 127.0 x 76.2 x 50.8 mm	N-420	735.00 each
300 MHz to 600 MHz	6.0 x 3.0 x 2.0″* 152.4 x 76.2 x 50.8 mm	N-423	835.00 each

*NOTE: Add 1″ (25.4 mm) to length for flanges.

ORDERING INFORMATION:

1. Specify exact center frequency desired.
2. Suffix Model Number with "A" for ±.01% swing.
3. Suffix Model Number with "B" for ±.03% swing.
4. Suffix Model Number with "C" for ±.05% swing.
5. Suffix Model Number with "D" for ±.10% swing.

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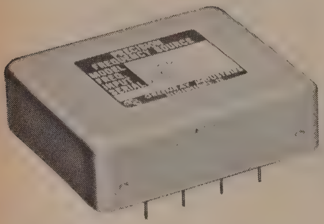
Greenray Industries, Inc.

VOLTAGE CONTROLLED OSCILLATORS

1 KHz to 25 MHz
SQUARE WAVE
MODEL N-412
V.C.X.O.



SPECIFICATIONS:

Center Frequency Range:
1 kHz to 25 MHz

Frequency Swing Ranges:
±.01%, ±.03%, ±.05%, ±.10%
(other ranges available on request)

Frequency Stability Over Temperature
Range: ±.002% with ±.01% swing
±.003% with ±.03% swing
±.004% with ±.05% swing
±.005% with ±.10% swing

Temperature Range: 0°C to +50°C

Output Voltage: 0 ±.4V to +2.4V min.

Output: Square wave, 50/50 ±10% to drive ≤10 TTL loads

Input Voltage: +5V DC ±5%

Input Current: 200 ma. maximum

Control Voltage: 0 to ±3V (DC coupled with a max. modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Size: 2.56 x 2.94 x .88″ (L-W-H)
65.02 x 74.68 x 22.35 mm

Linearity: ±5% or better

Negative Slope

Center Frequency Adjustment to Compensate for Aging

PC Board Mounting

Solder Sealed

FREQUENCY RANGE	**Price: 1-3 units**
1 kHz to 15.99 kHz	$510.00 each
16 kHz to 249.9 kHz	485.00 each
250 kHz to 3.99 MHz	460.00 each
4 MHz to 25 MHz	435.00 each

ORDERING INFORMATION:

1. Specify Model N-412A for ±.01% swing.
2. Specify Model N-412B for ±.03% swing.
3. Specify Model N-412C for ±.05% swing.
4. Specify Model N-412D for ±.10% swing.
5. Specify exact center freq. desired.

4 MHz to 75 MHz
SINE WAVE
MODEL N-471
V.C.X.O.

PRECISION
FREQUENCY SOURCE
MODEL N-471
FREQ. 50 MHZ
INPUT +28 VDC
SERIAL 26843
GREENRAY INDUSTRIES

SPECIFICATIONS:

Frequency Range: 4 MHz to 75 MHz

Frequency Swing Ranges:
±.01%, ±.03%, ±.05%, ±.1%
(other ranges available on request)

Frequency Stability Over Temperature
Range: ±.002% with ±.01% swing
±.003% with ±.03% swing
±.004% with ±.05% swing
±.005% with ±.10% swing

Temperature Range: 0°C to +50°C

Output Power: 1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +28V DC ±1%

Input Current: 50 ma. maximum

Control Voltage: 0 to ±3V (DC coupled with a max. modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Size: 2.56 x 2.94 x .88″ (W-L-H)
65.02 x 74.67 x 22.35 mm

Connector: SMA; Filtercons for +28V DC

Linearity: ±5% or better

Negative Slope

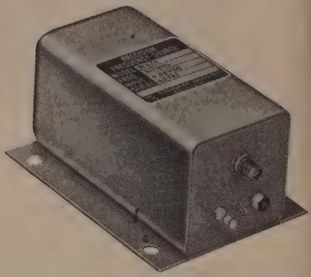
Center Frequency Adjustment to Compensate for Aging

FREQUENCY RANGE:	**PRICE: 1-3 units**
4 MHz to 24.9 MHz	$385.00 each
25 MHz to 49.9 MHz	435.00 each
50 MHz to 74.9 MHz	485.00 each

ORDERING INFORMATION:

1. Specify Model N-471A for ±.01% swing.
2. Specify Model N-471B for ±.03% swing.
3. Specify Model N-471C for ±.05% swing.
4. Specify Model N-471D for ±.10% swing.
5. Specify exact center freq. desired.

40 MHz to 75 MHz
SINE WAVE
MODEL N-474
V.C.X.O.
LOW PHASE NOISE



SPECIFICATIONS:

Frequency Range: 40 MHz to 75 MHz

Frequency Swing Range:
±.003% or ±.005%

Frequency Stability Over Temperature
Range: ±.002% with ±.003% swing
±.003% with ±.005% swing

Temperature Range: 0°C to +50°C

Output Power +10 dBm minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +28V DC ±2%

Input Current: 50 ma. maximum

Control Voltage: 0 to ±5V (DC coupled with a max. modulation rate of 3 kHz)

Modulation Input Impedance: 1000 ohms

Size: 4.0 x 2.0 x 2.0″ (L-W-H)
101.6 x 50.8 x 50.8 mm

Linearity: ±5% or better

Connector: SMA; Filtercons for +28V DC

Negative Slope

SSB Phase Noise in a 1 Hz Bandwidth*
20 Hz −72 dB 10 kHz −134 dB
100 Hz −93 dB 100 kHz −140 dB
1 kHz −124 dB
*Typical readings 6 to 10 dB better.

PRICE: 1-3 units — $575.00 each

ORDERING INFORMATION:

1. Specify Model N-474A for ±.003% swing.
2. Specify Model N-474B for ±.005% swing.
3. Specify exact center frequency desired.

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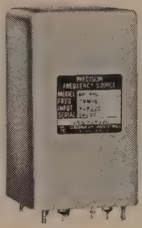
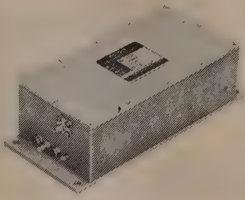
Greenray Industries, Inc.

VOLTAGE CONTROLLED OSCILLATORS

1 MHz to 600 MHz
SINE WAVE
MODEL NH-437, NH-440, NH-443
OVENIZED V.C.X.O.

MODEL NH-437


MODEL NH-440


MODEL NH-443

SPECIFICATIONS:

Center Frequency Range: 1 MHz to 600 MHz

Frequency Swing Ranges:
±.01%, ±.03%, ±.05% or ±.10% (other ranges available on request)

Frequency Stability Over Temperature Range:
±4 x 10^{-7} with ±.01% swing
±6 x 10^{-7} with ±.03% swing
±8 x 10^{-7} with ±.05% swing
±10 x 10^{-7} with ±.10% swing

Temperature Range: 0°C to +50°C

Output Power: 1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB min.; Spurious −60 dB min.

Input Voltage: +28V DC ±1%

Input Current: 650 ma. maximum

Control Voltage: 0 to ±3V (DC coupled with a maximum modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Linearity: ±5% or better

Negative Slope

Center Frequency Adjustment to Compensate for Aging

Connector: SMA; Filtercons for +28V DC

Proportional Oven Control

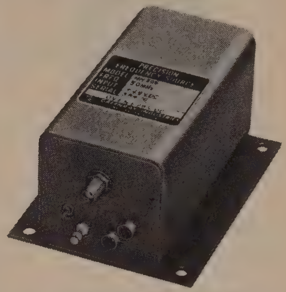
Frequency Range	Case Size (L-W-H)	Model No.	Price (1-3 units)
1 MHz to 3.9 MHz	2.0 x 4.0 x 2.0″* 50.8 x 101.6 x 50.8 mm	NH-437	$635.00 each
4 MHz to 24.9 MHz		NH-437	585.00 each
25 MHz to 74.9 MHz		NH-437	685.00 each
75 MHz to 149.9 MHz	2.75 x 2.75 x 4.62″ 69.8 x 69.8 x 117.3 mm	NH-440	835.00 each
150 MHz to 299.9 MHz		NH-440	935.00 each
300 MHz to 600 MHz	6.0 x 3.0 x 2.0″* 152.4 x 76.2 x 50.8 mm	NH-443	1035.00 each

*NOTE: Add 1″ (25.4 mm) to length for flanges.

ORDERING INFORMATION:

1. Specify exact center frequency desired.
2. Suffix Model Number with "A" for ±.01% swing.
3. Suffix Model Number with "B" for ±.03% swing.
4. Suffix Model Number with "C" for ±.05% swing.
5. Suffix Model Number with "D" for ±.10% swing.

40 MHz to 120 MHz
SINE WAVE
MODEL NH-500
OVENIZED V.C.X.O.
LOW PHASE NOISE



SPECIFICATIONS:

Frequency Range: 40 MHz to 120 MHz

Frequency Swing Range:
±.003% or ±.005%

Frequency Stability Over Temperature Range: ±3 x 10^{-7} with ±.003% swing
±5 x 10^{-7} with ±.005% swing

Temperature Range: 0°C to +50°C

Output Power: +10 dBm minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +28V DC ±2%

Input Current: 600 ma. maximum

Control Voltage: 0 to ±5V (DC coupled with a max. modulation rate of 3 kHz)

Modulation Input Impedance: 1000 ohms

Size: 4.0 x 2.0 x 2.0″ (L-W-H)
101.6 x 50.8 x 50.8 mm

Linearity: ±5% or better

Connector: SMA; Filtercons for +28V DC

Negative Slope

SSB Phase Noise in a 1 Hz Bandwidth*
20 Hz −72 dB
100 Hz −93 dB
1 kHz −124 dB
10 kHz −134 dB
100 kHz −140 dB
*Typical readings 6 to 10 dB better.

PRICE: 1-3 units — $775.00 each

ORDERING INFORMATION:

1. Specify Model NH-500A for ±.003% swing.
2. Specify Model NH-500B for ±.005% swing.
3. Specify exact center frequency desired.

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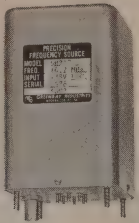
Greenray Industries, Inc.

VOLTAGE CONTROLLED OSCILLATORS

500 KHz to 100 MHz*
SINE WAVE
MODEL SH-219
WIDE-BAND OVENIZED V.C.X.O.



SPECIFICATIONS:

Center Frequency Range: 500 kHz to 100 MHz*

Frequency Swing Ranges: ±.25%, ±.5%, ±1% (other ranges available on request)

Frequency Stability Over Temperature Range: ±.001% for ±.25% swing
±.0025% for ±.5% swing
±.005% for ±1% swing

Temperature Range: 0°C to +50°C

Output Power: 1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum

Input: +28V DC ±2% for oscillator, +28V DC ±5% for oven

Input Current: 850 ma. maximum

Size: 2.75 x 2.75 x 4.62″ (L-W-H)
69.85 x 69.85 x 117.39 mm

Center Frequency Adjustment to Compensate for Aging

Control Voltage: 0 to ±3V (DC coupled with a max. modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Positive Slope

Connector: BNC; 8 Pin turret lug header for +28V DC

Proportional Oven Control

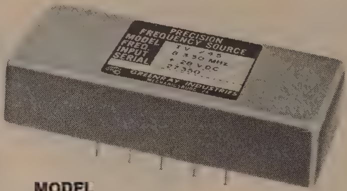
*For higher frequencies (up to 600 MHz) use in conjunction with XA-100 Series frequency multipliers Page 1•360.

FREQUENCY RANGE:	PRICE: 1-3 units
500 kHz to 3 MHz	$1180.00 each
3.01 MHz to 10.00 MHz	1375.00 each
1.01 MHz to 25 MHz	1500.00 each
25.1 MHz to 100 MHz	1695.00 each

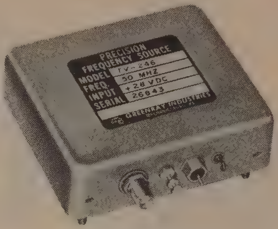
ORDERING INFORMATION:

1. Specify exact center freq. desired.
2. Specify Model SH-219A for ±.25% frequency swing.
3. Specify Model SH-219B for ±.5% frequency swing.
4. Specify Model SH-219C for ±1% frequency swing.

4 MHz to 70 MHz
SINE WAVE
MODEL TV-245 & TV-246
TEMPERATURE COMPENSATED V.C.X.O.
HIGH STABILITY



MODEL TV-245



MODEL TV-246

SPECIFICATIONS:

Center Frequency Range: Model TV-245: 4 MHz to 19.9 MHz
Model TV-246: 20 MHz to 70 MHz

Frequency Swing Range: ±.005% to ±.1%

Frequency Stability Over Temperature Range: ±.00025% to ±.005%

Temperature Range: 0°C to +50°C

Output Power: Model TV-245: 1V RMS minimum into a 1000 ohm load
Model TV-246: 1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB min.; Spurious −60 dB min.

Input Voltage: +28V DC ±2%

Input Current: 60 ma. maximum

Control Voltage: 0 to ±3V (DC coupled with a maximum modulation rate of 15 kHz)

Modulation Input Impedance: 1000 ohms

Linearity: ±5% or better

Negative Slope

Connector: Model TV-245: PC Pins Model TV-246: SMA; Filtercons for +28V DC

Size: Model TV-245: 3.75 x 1.63 x .88″ (L-W-H)
Model TV-246: 2.94 x 2.56 x .88″ (L-W-H)

Center Frequency Adjustment to Compensate for Aging

Swing	Stability Over Temperature	Model Number
±.005%	±.00025%	TV-245A-2 or TV-246A-2
±.01%	±.0005%	TV-245B-2 or TV-246B-2
±.03%	±.0015%	TV-245C-2 or TV-246C-2
±.05%	±.0025%	TV-245D-2 or TV-246D-2
±.08%	±.0040%	TV-245E-2 or TV-246E-2
±.10%	±.0050%	TV-245F-2 or TV-246F-2

FREQUENCY RANGE	MODEL NUMBER	PRICE: 1-3 Units
4 MHz to 19.9 MHz	TV-245	$550.00 each
20 MHz to 70 MHz	TV-246	620.00 each

ORDERING INFORMATION:

1. Order appropriate model number for the swing and temperature stability desired.
2. Specify exact center frequency desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

L—C OSCILLATORS

Recommended where:

Stabilities of ±.2% to ±2%, (without oven), over a wide temperature range are required.

Shock and/or vibration specifications are too high to allow use of crystals (please specify).

Relatively low cost is desired.

Wide range, stable, frequency shift is required. (Variable capacitor or variable inductor type.)

CONVERSION TABLES

CENTIGRADE TO FAHRENHEIT

C.	F.	C.	F.	C.	F.	C.	F.	C.	F.
−60	−76.0	−1	+30.2	31	87.8	63	145.4	95	203.0
−50	−58.0	0	32.0	32	89.6	64	147.2	96	204.8
−40	−40.0	+1	33.8	33	91.4	65	149.0	97	206.6
−30	−22.0	2	35.6	34	93.2	66	150.8	98	208.4
−29	−20.2	3	37.4	35	95.0	67	152.6	99	210.2
−28	−18.4	4	39.2	36	96.8	68	154.4	100	212.0
−27	−16.6	5	41.0	37	98.6	69	156.2	105	221.0
−26	−14.8	6	42.8	38	100.4	70	158.0	110	230.0
−25	−13.0	7	44.6	39	102.2	71	159.8	115	239.0
−24	−11.2	8	46.4	40	104.0	72	161.6	120	248.0
−23	− 9.4	9	48.2	41	105.8	73	163.4	125	257.0
−22	− 7.6	10	50.0	42	107.6	74	165.2	130	266.0
−21	− 5.8	11	51.8	43	109.4	75	167.0	135	275.0
−20	− 4.0	12	53.6	44	111.2	76	168.8	140	284.0
−19	− 2.2	13	55.4	45	113.0	77	170.6	145	293.0
−18	− 0.4	14	57.2	46	114.8	78	172.4	150	302.0
−17	+1.4	15	59.0	47	116.6	79	174.2	155	311.0
−16	3.2	16	60.8	48	118.4	80	176.0	160	320.0
−15	5.0	17	62.6	49	120.2	81	177.8	165	329.0
−14	6.8	18	64.4	50	122.0	82	179.6	170	338.0
−13	8.6	19	66.2	51	123.8	83	181.4	175	347.0
−12	10.4	20	68.0	52	125.6	84	183.2	180	356.0
−11	12.2	21	69.8	53	127.4	85	185.0	185	365.0
−10	14.0	22	71.6	54	129.2	86	186.8	190	374.0
−9	15.8	23	73.4	55	131.0	87	188.6	195	383.0
−8	17.6	24	75.2	56	132.8	88	190.4	200	392.0
−7	19.4	25	77.0	57	134.6	89	192.2		
−6	21.2	26	78.8	58	136.4	90	194.0		
−5	23.0	27	80.6	59	138.2	91	195.8		
−4	24.8	28	82.4	60	140.0	92	197.6		
−3	26.6	29	84.2	61	141.8	93	199.4		
−2	28.4	30	86.0	62	143.6	94	201.2		

Formula:

$^{\circ}C = (F - 32)\,5/9$

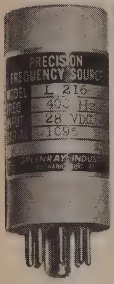
$^{\circ}F = 9/5\,(C) + 32$

$^{\circ}K = {}^{\circ}C + 273$

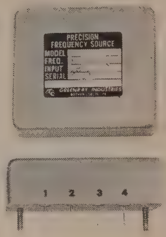
Greenray Industries, Inc.

L—C OSCILLATORS

100 Hz to 1 MHz SINE WAVE MODEL L-216 & L-217


PRECISION
FREQUENCY SOURCE
MODEL L 216
FREQ 400 Hz
INPUT 28 VDC
SERIAL 1C95
GREENRAY INDUS

MODEL L-216


PRECISION
FREQUENCY SOURCE
MODEL
FREQ.
INPUT
SERIAL
GREENRAY INDUSTRIES
1 2 3 4

MODEL L-217

SPECIFICATIONS:

Frequency Range: 100 Hz to 1 MHz

Available With External Frequency Adjustment at No Extra Cost

Frequency Stability Over Temperature Range: ±0.5%

Temperature Range: −40°C to +70°C

Output: 1.5V RMS minimum into a 4700 ohm load

Output: Sine wave, 5% maximum Harmonic distortion

Input: +28V DC ±1V DC

Input Current: 25 ma. maximum

External Frequency Adjustment is accomplished by using a 0 to 10,000 ohm variable or fixed resistor to be supplied by the customer. This allows oscillator to be set exactly on frequency.

Hermetically Sealed

Withstands Extreme Shock and Vibration

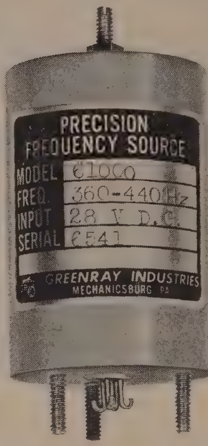
Size:
L-216: 1.5 dia. x 3.31" high, 38.1 x 84.1 mm (Below 499 Hz)
1.25 dia. x 2.56" high, 31.8 x 65.0 mm (Above 500 Hz)
L-217: 2.56 x 2.94 x .88" (L-W-H), 65.0 x 74.7 x 22.4 mm

PRICE: 1-3 units — $107.00 each

ORDERING INFORMATION:

1. Specify exact output frequency desired.
2. If external frequency adjustment is desired, add the letter "Z" after the Model No. (Example: L-216Z or L-217Z.) (Same price.)

400 Hz to 10 MHz SINE WAVE MODEL 61000 ±10% ADJUSTMENT RANGE


PRECISION
FREQUENCY SOURCE
MODEL 61000
FREQ. 360-440 Hz
INPUT 28 V D.C.
SERIAL 6541
GREENRAY INDUSTRIES
MECHANICSBURG PA

SPECIFICATIONS:

Center Frequency Range:
400 Hz to 10 MHz

Frequency Stability:
±0.3% over temperature range
±.05% at any fixed ambient

Temperature Range: −30°C to +65°C

Input Voltage: +28V DC ±10%

Input Current: 30 ma. maximum

Output: Sine wave, less than 10% maximum Harmonic distortion

Output Voltage: 1.5V RMS minimum into any load between 5000 ohms to 2 Megohms

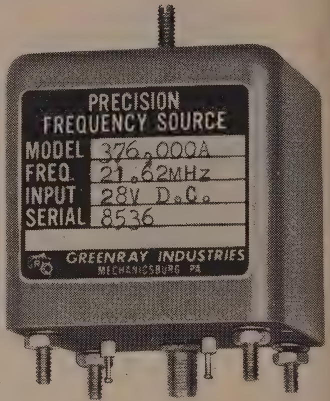
Size: 1.5 dia. x 3.68" high, 38.1 x 93.5 mm

PRICE: 1-3 units — $140.00 each

ORDERING INFORMATION:

Specify Model 61000 and exact center frequency desired.

10 MHz to 250 MHz SINE WAVE MODEL 376000A ±10% ADJUSTMENT RANGE


PRECISION
FREQUENCY SOURCE
MODEL 376,000A
FREQ. 21.62MHz
INPUT 28V D.C.
SERIAL 8536
GREENRAY INDUSTRIES
MECHANICSBURG PA

SPECIFICATIONS:

Center Frequency Range:
10 MHz to 250 MHz

Frequency Stability:
±0.3% over temperature range
±.05% at any fixed ambient

Temperature Range: −30°C to +65°C

Input Voltage: +28V DC ±2%

Input Current: 30 ma. maximum

Output:
Sine wave, Harmonics −20 dB min.

Output Voltage:
1 milliwatt minimum into a 50 ohm load

Size: 2.0 x 2.0 x 2.0" (L-W-H)
50.8 x 50.8 x 50.8 mm

PRICE: 1-3 units — $229.00 each

NOTE: Most of the lower frequency oscillators of this Model have the slug on top for frequency adjustment as shown in the picture.

On most of the higher frequency oscillators no slug is used and the frequency is adjusted through a hole in the top of the unit.

ORDERING INFORMATION:
Specify Model 376000A and exact center frequency desired.

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Greenray Industries, Inc.

MULTIPLE FREQUENCY OSCILLATORS

These oscillators are widely used where a large number of output frequencies are required from one unit, which can be selected with:

a. An internal or external rotary switch.
b. External TTL gate (logical "1" -on; logical "0" -off).
c. External BCD codes; 01, 00, etc.

This offers an excellent cost reduction over using several single fixed frequency oscillators.

Uses include multiple channel communications equipment, test equipment, and synthesizers.

We can supply many other varieties to your specifications and frequency requirements than those shown in this catalog section.

Call or write for a fast quotation on your exact requirements for multiple output, programmable sources, or phase locked loops.

Technical personnel are always available to discuss your requirements.

PHONE: (717) 766-0223 TWX NO. 510-650-4939

COMPONENTS AND SUB-SYSTEMS

FOR RADAR, TELEMETRY, SURFACE & SPACE COMMUNICATIONS, RADIO ASTRONOMY & ELECTRONIC COUNTERMEASURES

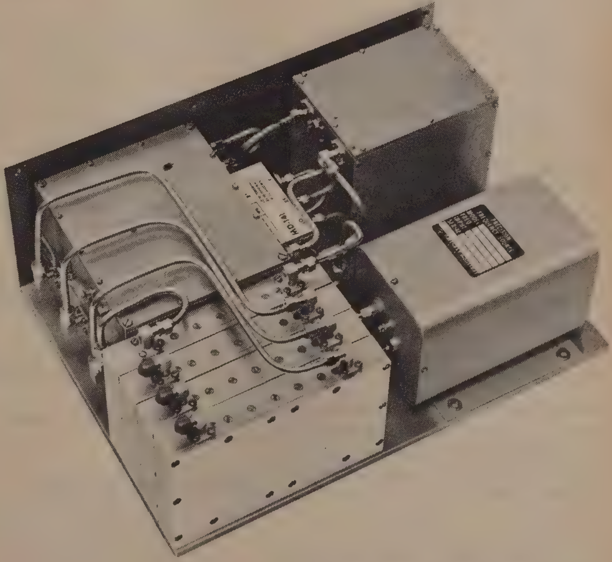
SUBSYSTEM CAPABILITY

Over 15 years of experience as a leading supplier of components with an in-depth knowledge in the area of systems design uniquely qualifies Greenray Industries, Inc., to fill your subsystem requirements.

Let Greenray Industries' building block techniques and expertise in the solution of interface problems enhance your system performance and reliability in the following areas:

Frequency Synthesis using the following techniques:

- — phase lock
- — digital
- — crystal switching
- — harmonic multiplication



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GRI Greenray Industries, Inc.

MULTIPLE FREQUENCY OSCILLATORS

1 MHz to 50 MHz
SINE WAVE
MODEL M-400
1 to 12 CHANNELS

SPECIFICATIONS:

Frequency Range: 1 MHz to 50 MHz

Frequency Stability Over Temperature Range: ±.005%

Temperature Range: −40°C to +70°C

Output:
Sine wave, Harmonics −20 dB min.

Output Power:
1 milliwatt min. into a 50 ohm load

Input Voltage: +28V DC ±2%

Input Current: 25 ma. maximum

Size: 2.56 x 2.94 x 3.06″ (L-W-H)
65.02 x 74.68 x 77.72 mm

Mounting: 4 threaded inserts

Connector: 8 Pin turret lug header

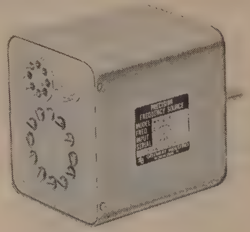
Non-Hermetically Sealed

PRICE: 1-3 units — $645.00 each
10 channels

ORDERING INFORMATION:

1. Specify Model M-400
2. State number of channels and exact output frequencies desired.
3. Subtract $10.00 from price for each channel under 10.
4. Add $40.00 to price for each channel over 10.
5. For separate Frequency trim adjustment on each channel add the latter "Y" after Model No. and $25 per channel.

5 MHz to 90 MHz
SINE WAVE
MODEL MH-211A
2 to 12 CHANNELS
HIGH STABILITY



SPECIFICATIONS:

Frequency Range: 5 MHz to 90 MHz over any 25% bandwidth.
(Note: Wider bandwidths and other frequency ranges can be supplied on special order)

Frequency Stability Over Temperature Range: $\pm 5 \times 10^{-7}$

Temperature Range: +10°C to +50°C

Short Term Stability:
$\pm 5 \times 10^{-9}$ per 15 milliseconds

Long Term Stability:
$\pm 1 \times 10^{-7}$ per day at constant ambient

Output Power:
1 milliwatt min. into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +28V DC ±2%

Input Current: 600 ma. maximum

Automatic Gain Control is Incorporated for Minimum Aging

Size: 3.32 x 3.88 x 4.0″ (L-W-H)
84.33 x 98.55 x 101.60 mm

Connector: BNC; 8 Pin turret lug header for +28V DC

Mounting: 4 threaded inserts

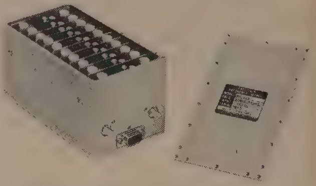
Separate Frequency Adjustment for Each Channel

PRICE: 1-3 units — $990.00 each
10 channels

ORDERING INFORMATION:

1. Specify Model MH-211A.
2. State number of channels and exact output frequencies desired.
3. Subtract $20 for each channel under 10.
4. Add $40 for each channel over 10.

12 MHz to 125 MHz
SINE WAVE
MODEL MH-278
4 to 10 CHANNELS
HIGH STABILITY



SPECIFICATIONS:

Frequency Range: 4 to 10 channels in the range of 12 MHz to 125 MHz

Frequency Stability Over Temperature Range: $\pm 1 \times 10^{-6}$

Temperature Range: 0°C to +50°C

Output:
5 mw minimum into a 50 ohm load (primary)
0.5 mw minimum into a 50 ohm load (monitor)

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +28V DC ±2%

Input Current: 2 amps at turn-on, 500 ma. at +25°C

No Intermodulation Between Channels; Only One Channel is Active at a Time

Switching Time: Less than 20 milliseconds (output frequency accuracy: ±10 ppm)

Switching Code:
4 wire BCD. (Example: Channel 5 requires a code of 0101.)
Logic "0" = 0 ±.4V, Logic "1" = +2.4 to +5.5V

Size: 6.04 x 3.25 x 3.25″ (L-W-H)
153.42 x 82.55 x 82.55 mm

Connectors:
Cannon DEM-9P-A-106 and 2-SMA

Each Channel Incorporates a Center Frequency Adjustment

PRICE: 1-3 units — $1090.00 each
4 channels

ORDERING INFORMATION:

1. Specify Model MH-278.
2. Specify number of channels and exact output frequencies desired.
3. Add $165.00 per channel for each channel over 4.
4. Additional plug-in boards: $195.00 ea.

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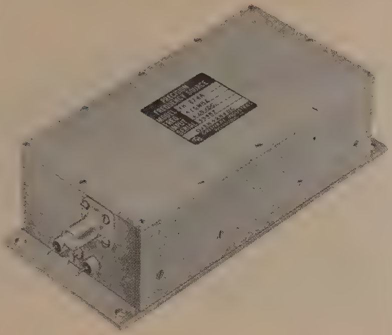
MULTIPLE FREQUENCY OSCILLATORS

10 MHz to 150 MHz
SINE WAVE
MODEL YL-221
PHASE LOCKED FREQUENCY SOURCE



SPECIFICATIONS:

Input Frequency: 5 MHz

Input Power: 0 dbm minimum into a 50 ohm load

Output Frequency:
Model YL-221A: 10 MHz to 80 MHz at the following frequency multiples of 5 MHz: X2, X4, X5, X8, X10 and X16
Model YL-221B: 10 MHz to 150 MHz at integer frequency multiples at 5 MHz not included above

Input Power: 0 dBm minimum into a 50 ohm load

Output: Sine wave, Harmonics and Sub-Harmonics −40 dB min.; Spurious −60 dB min.

Input Voltages: +28V DC ±2% and +5V DC ±2%

Input Current: 650 ma. maximum at +28V DC 50 ma. maximum at +5V DC

Temperature Range: 0°C to +50°C

Connector: 2-SMA, (input and output); Filtercons for +28V DC and +5V DC

Size: Model YL-221A: 6.0 x 3.0 x 3.0″* (L-W-H), 152.4 x 76.2 x 76.2 mm
Model YL-221B: 6.0 x 6.0 x 3.0″* (L-W-H), 152.4 x 152.4 x 76.2 mm
*Add 1″ (25.4 mm) to length for flanges.

PRICE: 1-3 units — Model YL-221A: From $550.00 each
Model YL-221B: From 950.00 each

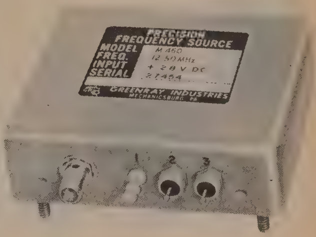
OPTIONS AVAILABLE:

Output frequencies that are non integer multiples of 5 MHz that can be expressed as: $\frac{n}{m}$ x 5 MHz; where "n" and "m" are integers (Example: 51.167 MHz)

ORDERING INFORMATION:

Consult factory for a quotation to your exact requirements.

10 MHz to 150 MHz
SINE WAVE
MODEL M-460
TWO CHANNELS ELECTRONIC SWITCHING



SPECIFICATIONS:

Frequency Range: 10 MHz to 150 MHz

Frequency Stability Over Temperature Range: ±.003%

Temperature Range: 0°C to +50°C

Output Power:
0 dBm minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +12V DC ±2%

Input Current: 75 ma. maximum

Size: 2.56 x 2.94 x .88″ (W-L-H)
65.02 x 74.68 x 22.35 mm

Any Two Frequencies may be Selected in the Range of 1 MHz to 150 MHz
Example: F1 = 14 MHz
F2 = 132.6 MHz

Output F1 is selected by applying 0V to the control pin.

Output F2 is selected by applying +5V to the control pin.

Switching Time: Less than 10 msec.

Isolation: Infinite (only one oscillator is active at a time)

Connector: SMA; Filtercons for +12V DC

PRICE: 1-3 units — $490.00 each

ORDERING INFORMATION:

Specify Model M-460 and exact output frequencies desired.

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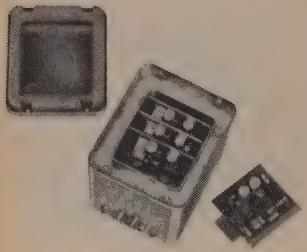
GRI **Greenray Industries, Inc.**

MULTIPLE FREQUENCY OSCILLATORS

1 MHz to 150 MHz
SINE WAVE
MODEL MH-260 & M-405
4 CHANNELS
PLUG-IN BOARDS



SPECIFICATIONS:

Frequency Range:
4 channels of any frequency in the range of 1 MHz to 150 MHz

Stability Over Temperature Range:
Model MH-260: ±2 x 10^{-6}
Model M-405: ±2 x 10^{-5}

Temperature Range: 0°C to +50°C

Output Power:
1 milliwatt minimum into a 50 ohm load

Output: Sine wave, Harmonics −20 dB minimum; Spurious −60 dB minimum

Input Voltage: +28V DC ±2%

Input Current:
Model MH-260: 800 ma. maximum
Model M-405: 50 ma. maximum

Frequency Selection: Desired Frequency is selected by applying +28V DC to the proper input terminal. This unit is designed to operate one channel only at a given time

Size: 3.5 x 4 x 4″ (L-W-H)
88.9 x 101.6 x 101.6 mm

Mounting: 4 threaded inserts

Connector: SMA; Filtercons for +28V DC

Frequency Adjustment: Each channel has a separate frequency adjustment

PRICE: 1-3 units

Model MH-260	$970.00 each
Model M-405	750.00 each
Additional Plug-in Boards (specify frequency)	195.00 each

ORDERING INFORMATION:

1. Specify Model MH-260 or Model M-405.
2. Specify the 4 frequencies desired.

5 MHz to 100 MHz
SINE WAVE
MODEL M-457
LOW PHASE NOISE FREQUENCY SYNTHESIZER
30% BANDWIDTH

PHASE LOCK
STEPPABLE FREQUENCY SYNTHESIZER
MODEL-M-457
GREENRAY INDUSTRIES, INC.
MECHANICSBURG, PENNA.
POWER

SPECIFICATIONS:

Frequency Range: 5 MHz to 100 MHz over any 30% bandwidth

Frequency Stability: Phase locked to external 5 MHz frequency standard (requires 0 dbm minimum into a 50 ohm load)

Temperature Range: −40°C to +50°C

Output Power: +10 dBm minimum into a 50 ohm load

Output: Sine wave, Harmonics and Spurious −50 dB minimum

Input Voltage: 105-125V AC 55-65 Hz

Minimum Channel Spacing: 50 kHz to 500 kHz (depending on frequency range)

Connector: TNC

Size: 19.0 x 5.25 x 17.0″ (L-H-D) (rack mounting), 482.60 x 133.35 x 431.80 mm

Typical Phase Noise at 75 MHz

SSB Phase Noise in a 1 Hz Bandwidth*

30 Hz	−86 dB	100 kHz	−108 dB
100 Hz	−86 dB	300 kHz	−124 dB
1 kHz	−90 dB	600 kHz	−124 dB
10 kHz	−91 dB		

*Typical readings 6 to 10 dB better.

PRICE: 1-3 units — from $2500.00 each

OPTIONS AVAILABLE:

1. +28V DC input voltage
2. Internal frequency standard
3. Wider bandwidth
4. Narrower channel spacing
5. Militarized versions

ORDERING INFORMATION:

Consult factory for a quotation to your exact requirements.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

Greenray Industries, Inc.

AMPLIFIERS AND MULTIPLIER/AMPLIFIERS

Greenray Industries, Inc. manufactures a complete line of power amplifiers. All of the units shown in this section operate Class "C." Therefore, the output power will not vary linearly with the input power. In applications where Class "A" or "B" is required we will be happy to provide a quotation on your exact requirements. Where requirements for amplifiers and multipliers with outputs above 600 MHz exist write or call for our latest microwave catalog.

CAUTION: (For amplifiers with more than 250 milliwatts rated output.)

Operating power amplifiers without a 50 ohm load can cause severe damage (even if only for a few seconds). This also voids our one year warranty.

We highly recommend an Isolator be used in series with the output line to eliminate this hazard.

When load VSWR exceeds 1.5:1 an output isolator is required.

VOLTAGE POLARITY: All amplifiers are protected against accidental input voltage polarity reversal. All units operate from positive supply, with negative ground.

OUTPUT POWER INTO A 50 OHM LOAD

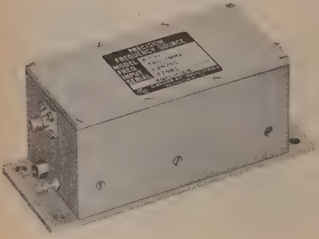
dbm	Milliwatts	dbm	Milliwatts	dbm	Milliwatts
−40	.00010	+6	3.981	+21	125.9
−35	.00032	+7	5.012	+22	158.5
−30	.00100	+8	6.310	+23	199.5
−25	.00316	+9	7.943	+24	251.2
−20	.01000	+10	10.00	+25	316.2
−15	.03162	+11	12.59	+26	398.1
−10	.1000	+12	15.85	+27	501.2
−5	.3162	+13	19.95	+28	631.0
−3.01	.5000	+14	25.12	+29	794.3
−0.0	1.000	+15	31.62	+30	1.0 Watt
+1	1.259	+16	39.81	+35	3.162 Watts
+2	1.585	+17	50.12	+36.98	5.0 Watts
+3	1.995	+18	63.10	+40	10.0 Watts
+4	2.512	+19	79.43	+45	31.62 Watts
+5	3.162	+20	100.0	+50	100. Watts

Greenray Industries, Inc.

MULTIPLIER/AMPLIFIERS

10 MHz to 600 MHz 1 WATT OUTPUT AMPLIFIER

MODEL A-100



SPECIFICATIONS:

Frequency Range: 10 MHz to 600 MHz

Bandwidth: ±1%

Input Power: 1 milliwatt minimum

Output Power: 1 watt minimum

Input and Output Impedance: 50 ohms

Load VSWR: 1.5:1 maximum

Harmonics: −20 dB minimum

Class C Operation

Temperature Range: 0°C to +50°C

Input Voltage: +28V DC ±2%

Input Current: 300 ma. maximum

Connectors: 2-SMA (input and output); Filtercons for +28V DC

Size: 4.0 x 2.0 x 2.0″ (L-W-H)
101.6 x 50.8 x 50.8 mm

NOTE: Add 1″ (25.4 mm) to length for flanges.

FREQUENCY RANGE:	PRICE: 1-3 units
10 MHz to 100 MHz	$380.00 each
100.1 MHz to 300 MHz	460.00 each
300.1 MHz to 600 MHz	540.00 each

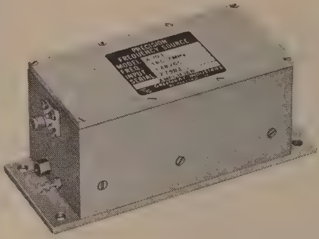
ORDERING INFORMATION:

Specify Model A-100 and exact center frequency desired.

Higher Power Units Up To 100 Watts Are Available Or We Will Custom Build To Your Requirements. Call Us!

10 MHz to 600 MHz 100 mw OUTPUT AMPLIFIER

MODEL A-103



SPECIFICATIONS:

Frequency Range: 10 MHz to 600 MHz

Bandwidth: ±1%

Input Power: 1 milliwatt minimum

Output Power: 100 milliwatts minimum

Input and Output Impedance: 50 ohms

Load VSWR: 1.5:1 maximum

Harmonics: −20 dB minimum

Class C Operation

Temperature Range: 0°C to +50°C

Input Voltage: +28V DC ±2%

Input Current: 150 ma. maximum

Connectors: 2-SMA (input and output); Filtercons for +28V DC

Size: 4.0 x 2.0 x 2.0″ (L-W-H)
101.6 x 50.8 x 50.8 mm

NOTE: Add 1″ (25.4 mm) to length for flanges.

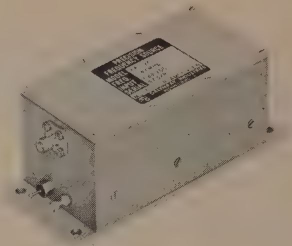
FREQUENCY RANGE:	PRICE: 1-3 units
10 MHz to 100 MHz	$240.00 each
100.1 MHz to 300 MHz	300.00 each
300.1 MHz to 600 MHz	380.00 each

ORDERING INFORMATION:

Specify Model A-103 and exact center frequency desired.

2 MHz to 600 MHz X2/X3/X4/X6 MULTIPLIER

MODEL XA-100, XA-101, XA-102 & XA-103



SPECIFICATIONS:

Output Frequency: 2 MHz to 600 MHz

Input Frequency Range: 1 MHz to 300 MHz

Multiplication: X2 Specify Model XA-100
X3 Specify Model XA-101
X4 Specify Model XA-102
X6 Specify Model XA-103

Input Power: 1 milliwatt minimum

Output Power: 5 milliwatts minimum

Class C Operation

Bandwidth: ±1%

Input and Output Impedance: 50 ohms

Output: Sine wave, Harmonics and Sub-Harmonics −20 dB minimum

Input Voltage: +28V DC

Input Current: 75 ma. maximum

Connectors: 2-SMA (input and output); Filtercons for +28V DC

Size: 4 x 2 x 2″ (L-W-H)
101.6 x 50.8 x 50.8 mm

NOTE: Add 1″ (25.4 mm) to length for flanges.

Harmonics and Sub-Harmonics −40 dB Suffix Model No. with "X" and add $40 to price. (Example: Model XA-100X.)

Harmonic and Sub-Harmonics rejection to −60 dB is available, consult factory.

MODEL NO.	PRICE: 1-3 units
XA-100	$280.00 each
XA-101	330.00 each
XA-102	370.00 each
XA-103	420.00 each

ORDERING INFORMATION:

Specify Model No. and exact input and output frequencies desired.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510-650-4939

HUGHES
FREQUENCY CONTROL DEVICES

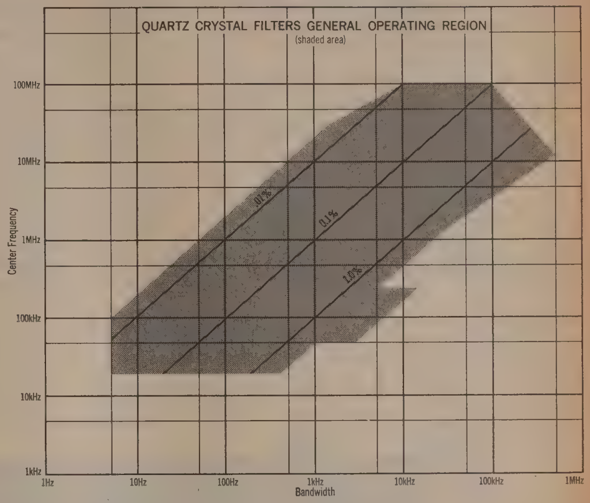
CRYSTAL FILTERS

As the nation's leading supplier of precision crystal filters, Hughes offers years of technical experience backed by the industry's most advanced production and test facilities. Thousands of Hughes crystal filters are currently in use in missiles, space vehicles, radar systems and communications equipment. Available in various frequencies, sizes and environmental standards, Hughes filter types include bandpass, single sideband, band rejection, contiguous comb doppler and thin-film monolithic.

Bandpass & Single Sideband Filters. Narrow passbands, steep shape factors and low insertion losses are characteristic of all Hughes bandpass and single sideband filters. General specifications include:

Center Frequency Range	250kHz to 100MHz
Fractional Bandwidth Range	0.002% to 6%
Shape Factor (60 db/3 db ratio)	As low as 1.15 to 1
Insertion Loss	Down to 0.1 db
Passband Ripple	Down to ±0.1 db

Note: Refer to the General Operating Regions Chart (right) to determine producible design combinations of bandwidth and center frequency.

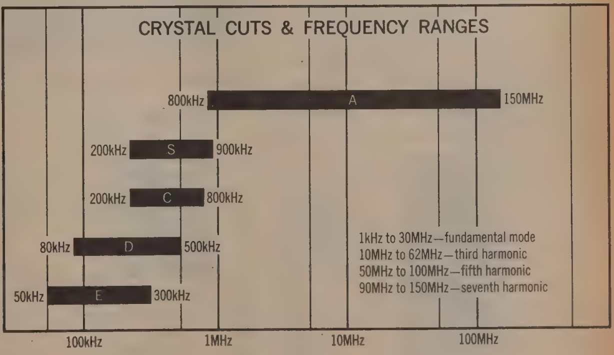


QUARTZ CRYSTALS

Hughes supplies a full range of low and high frequency quartz crystals from 250kHz up to 150MHz. Both standard and custom units in prototype or production quantities can be supplied for a variety of precision, frequency control applications.

Military Standard Crystals. Manufactured to MIL-C-3098E, Hughes military standard quartz crystal units are offered in a full range of low and high frequencies.

Coldweld Sealed Crystals. For applications requiring exceptionally high reliability and long term frequency stability, Hughes employs the Coldweld process for hermetically sealing the crystal enclosure. Only pressure is used in welding the cover to the base, thereby eliminating all possibility of contamination from fluxes, sparking or heating. Hughes Coldweld quartz crystals are available in 250kHz to 150MHz frequencies and in TO-5, HC-6 or HC-18 Coldweld holders.



Hughes is the country's leading supplier of precision crystal filters and related frequency control devices. A partial list of major programs using these products includes BMEWS, Apollo, Pioneer, Syncom, Surveyor, Mauler, Hawk, Minuteman, Talos, Phoenix and Standard Missile. A staff of competent engineers backed by the industry's most advanced quality control and test facilities, stands ready to handle your toughest assignment. Call collect or contact your nearest Hughes representative for assistance.

Hughes Aircraft Company
Microelectronic Products Division
500 Superior Avenue, Department E5
Newport Beach, California 92663
Telephone (714) 548-0671
TWX 910-596-1374

HUGHES
HUGHES AIRCRAFT COMPANY
MICROELECTRONIC
PRODUCTS DIVISION

INTERNATIONAL

Low Frequency Crystals

70 KHz – 999 KHz

On this page we present our four most popular crystal mountings and the data for the crystals available in these mountings according to the various frequency ranges.

mode of oscillation
70-184 KHz Length shear 5°X
185-599 KHz Edge shear CT & DT
600-999 KHz shear AT

shunt capacitance 7 pf (Max.)
70-200 KHz 10000- 7000 ohms
200-500 KHz 6500-11000 ohms
800-999 KHz 625 ohms

drive (Max.)
70-499 KHz 2 milliwatts
500-999 KHz 10 milliwatts

REMEMBER: Just any crystal and just any oscillator will not combine to produce designated spot frequencies.

DESCRIPTION AND DATA: All of these crystals are of the plated, wire-mounted type. Low drift AT-cut blanks are used in these units above 600 KHz, and low drift CT cut blanks are used in units below 600 KHz; any crystal can be supplied for operation with or without an oven.

TYPE SPECIFICATIONS

1. **General Purpose** (GP) crystals will be calibrated to within ±.02% of frequency when operated into the customers specified fundamental load capacitance only (32 pf will be used when none is specified). **GP crystals 500-999 KHz will hold temperature tolerance of ±.005% from —30° to 60°C and ±.02% for frequencies below 500 KHz.**
2. **Commercial Standard** (CS) crystals will be calibrated as noted below, as specified for operation in customers load. CS crystals will hold temperature tolerance ±.003% —30° to 60°C above 500 KHz and ±.02% below 500 KHz.

CIRCUIT: As specified by customer. Crystals are available for all major two-way equipment and in most cases the necessary correlation data is on file. Where circuit is not specified, the crystal will be calibrated for operation into a load capacitance of 32 mmf.

The CS series of crystal units is available to commercial or military specifications demanding tight frequency tolerance, long term stability and low frequency response.

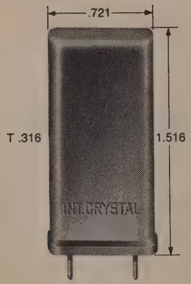
WHEN ORDERING — SPECIFY THE FOLLOWING FOR EACH CRYSTAL

- **A.** Crystal frequency
- **B.** Type GP or CS
- **C.** Calibration temperature (Room temperature or over 60°C)
- **D.** Holder (see below)
- **E.** Circuit load and correlation data.

Note: For GP specify 10, 20 or 32 pf. Do not specify equipment types in the case of GP crystals. These are made only to 10, 20 or 32 pf load. When circuilt load is not specified crystals will be correlated for a 32 pf load.

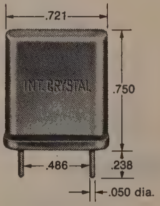
FREQUENCY	TYPE					
	GENERAL PURPOSE (1)		COMMERCIAL STANDARD (2)			
	Calibration Tolerance As Noted		Calibration Tolerance As Noted			
70- 99 KHz	.02%	$21.00	.01%	$22.50		
100-199 KHz	.02%	13.50	.01%	15.50	.005%	$17.50
200-599 KHz	.02%	13.50	.01%	15.50	.005%	17.50
600-849 KHz	.01%	37.50	.0025%	39.50		
850-999 KHz	.01%	13.50	.0025%	15.50		

F-13



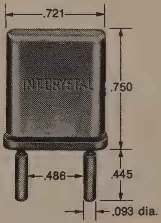
70 KHz-160 KHz
HC-13/U
(70-99 KHz 2.5" height)

F-605



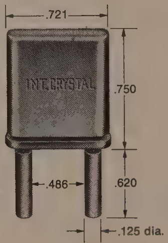
HC-6/U
T .316 max

F-609



HC-17/U
T .316 max

F-612



T .316 max

HOW TO ORDER:

MAIL: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Okla. 73102
PHONE: Area Code 405 236-3741
CABLE: INCRYSTAL
WESTERN UNION TELEX: 747-147
BELL SYSTEM TWX: 910-831-3177

INTERNATIONAL
CRYSTAL MFG. CO., INC.
10 NO. LEE • OKLA. CITY, OKLA. 73102

INTERNATIONAL

Medium Frequency Crystals

1,000 KHz – 22,000 KHz

FUNDAMENTAL TYPE

TYPE SPECIFICATIONS

1. **GENERAL PURPOSE** (GP) crystals will be calibrated to within ±.01% of frequency when operated into 10, 20 or 32 pf load capacitance only (32 pf will be used when none is specified.)
   GP crystals will hold temperature tolerance of ±.005% from —30° to 60°C.
2. **COMMERCIAL STANDARD** (CS) crystals will be calibrated to either .0025% or .001% as specified for operation in customer's load. CS crystal will hold temperature tolerance ±.003% —30° to 60°C.
3. A calibration tolerance of ±.001 (or special) can only be obtained when a definite circuit load capacitance and drive level are specified. Where a definite load capacitance is not specified and correlation is required from a copy of the intended circuit a tolerance of ±.01%, should be expected.
4. **HIGH ACCURACY** (HA) crystals are for use in circuits where tolerances better than ±.002% —30° to 60°C are required. Tolerances of .0005% over the range —30° to 60°C will require circuit compensation. Without compensation the range will be limited to —10° to 60°C. Compensators are not included with the crystals and tolerance is for crystals only and does not allow for any change in circuit parameters over the temperature range.

mode of oscillation
1,000-22,000 KHz Shear AT

resistance

1,000- 1,499 KHz	490 ohms
1,500- 1,999 KHz	375 ohms
2,000- 2,999 KHz	270 ohms
3,000- 3,999 KHz	150 ohms
4,000-22,000 KHz	75 to 25 ohms

Shunt capacitance 7 pf (max.)
7 pf (Max.)

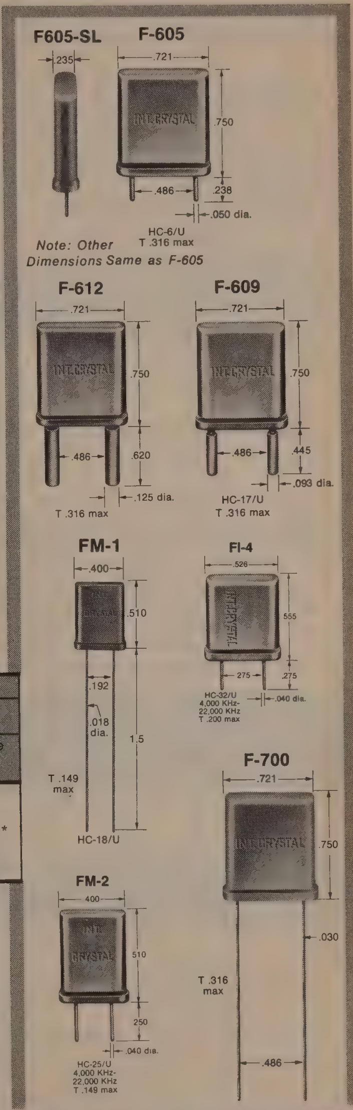
drive (max.)

1,000- 9,999 KHz	10 milliwatts
10,000-22,000 KHz	4 milliwatts

*Available 2,000-2,999 KHz

**FM Holder Available 6,000 to 22,000 KHz

FREQUENCY	TYPE				
	GENERAL PURPOSE(1)	COMMERCIAL STANDARD(2)		HIGH ACCURACY(4)	
	Calibration Tolerance .01%	Calibration Tolerance .0025%	Calibration Tolerance .001% / CS – 1 Special(3)	Temperature Tolerance —10° to +60° .002%	Temperature Tolerance —10° to +60° .0005%
1,000- 1,499 KHz	$8.50	$10.50	$12.50		
1,500- 2,999 KHz	6.40	7.40	8.50	$ 8.50*	
3,000-10,999 KHz	4.90	5.50	6.50	6.75	$10.00**
11,000-19,999 KHz	6.40	7.40	8.50	8.50	10.00
20,000-22,000 KHz	8.50	10.50	11.50	11.50	13.00


F605-SL
.235
F-605
.721
INTERCRYSTAL
.750
.486
.238
.050 dia.
HC-6/U
T .316 max
Note: Other Dimensions Same as F-605
F-612
.721
INTERCRYSTAL
.750
.486
.620
.125 dia.
T .316 max
F-609
.721
INTERCRYSTAL
.750
.486
.445
.093 dia.
HC-17/U
T .316 max
FM-1
.400
INT CRYSTAL
.510
.192
.018 dia.
1.5
T .149 max
HC-18/U
FI-4
.526
INTERCRYSTAL
555
275
.275
.040 dia.
HC-32/U
4,000 KHz-22,000 KHz
T .200 max
F-700
.721
INTERCRYSTAL
.750
.030
T .316 max
.486
FM-2
400
INT CRYSTAL
510
250
.040 dia.
HC-25/U
4,000 KHz-22,000 KHz
T .149 max

WHEN ORDERING — SPECIFY THE FOLLOWING FOR EACH CRYSTAL

A. Crystal frequency
B. Type — GP, CS, or HA
C. Calibration tolerance — .0025% or .001% / Special (not required for GP as this type is supplied only in .01%).
D. Calibration temperature (room temperature or over 60°C, 75°C, 85°C.
E. Holder (see below)
F. Circuit load and correlation data
Note: For GP specify 10, 20 or 32 pf. Do not specify equipment types in the case of GP crystals. These are made only to 10, 20 or 32 pf load. When not specified crystals will be correlated for a 32 pf load.

HOW TO ORDER:

MAIL: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Okla. 73102
PHONE: Area Code 405 236-3741
CABLE: INCRYSTAL
WESTERN UNION TELEX: 747-147
BELL SYSTEM TWX: 910-831-3177

INTERNATIONAL
CRYSTAL MFG. CO., INC.
10 NO. LEE • OKLA. CITY, OKLA. 73102

INTERNATIONAL

High Frequency Crystals

10 MHz – 160 MHz

Crystals for use in military equipment can be supplied to conform to specifications of MIL-C-3098E

MODE OF OSCILLATION

10- 60 MHz	Shear third mechanical overtone AT
61-100 MHz	Shear fifth mechanical overtone AT
111-140 MHz	Shear seventh mechanical overtone AT
141-160 MHz	Shear ninth mechanical overtone AT
Shunt Capacitance	7 pf (Max.)

RESISTANCE (Max.)

10- 14.9 MHz	60 ohms
15- 60 MHz	40 ohms
60-110 MHz	60 ohms
110-140 MHz	80 ohms
140-160 MHz	100 ohms
Drive (Max.)	2 milliwatts

TYPE SPECIFICATIONS

1. **General Purpose** (GP) crystals will be calibrated to within ±.01% of frequency when operated into the customer's specified circuit load only. When none is specified series resonance will be used.
   GP overtone crystals will hold temperature tolerance of ±.005% from —30° to 60°C.
2. **Commercial Standard** (CS) crystals will be calibrated to either .0025% or .001% as specified for operation in customer's load. CS crystal will hold temperature ±.003% —30° to 60°C.
3. A calibration tolerance of ±.001% (or special) can only be obtained when a definite circuit load and drive level are specified. Where a definite load is not specified and correlation is required from a copy of the intended circuit a tolerance of .01% should be expected.
4. **High Accuracy** (HA) crystals are for use in circuits where tolerances better than ±.002% —30° to 60°C are required. Tolerances of .0005% over the range —30° to 60°C will require circuit compensation. Without compensation the range will be limited to —10° to 60°C. Compensators are not included with the crystals and tolerance is for crystals only and does not allow for any change in circuit parameters over the temperature range.

FREQUENCY	MHz	TYPE				
		General Purpose(1)	Commercial Standard(2)		High Accuracy (3) (4)	
		Calibration Tolerance	Calibration Tolerance	(3) CS-1	Temperature Tolerance —10° to +60°	
		.01%	.0025%	.001%/special	.002%	.0005%
15- 66	(3rd)	$ 5.40	$ 7.40	$ 8.25	$9.75	$12.00
61- 79	(5th)	6.30	11.50	12.25		
80-110	(5th)	8.50	15.25	16.25		
111-160	(7th)	10.15	15.25	16.25		
140-160	(9th)	15.25	18.25	19.25		

WHEN ORDERING — SPECIFY THE FOLLOWING FOR EACH CRYSTAL

A. Crystal frequency

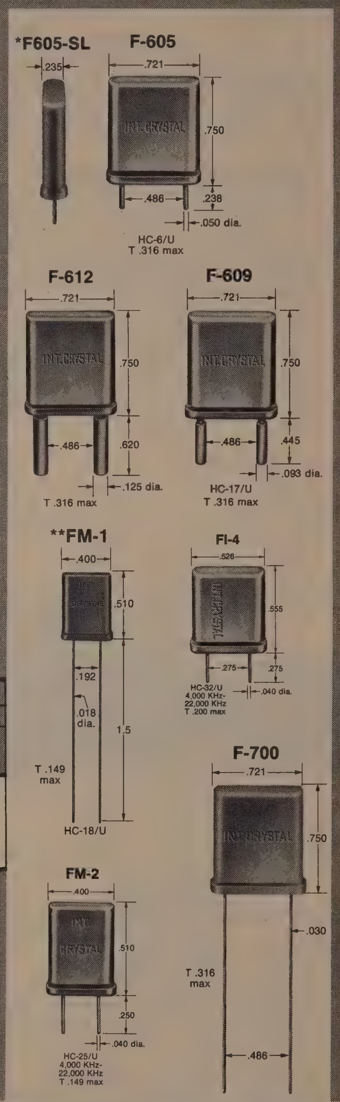
B. Type — GP, CS, or HA

C. Calibration tolerance — .0025% or .001% / Special (not required for GP as this type is supplied only in .01%)

D. Calibration temperature — Room temperature or oven 85°C

E. Holder (see above)

F. Circuit load and correlation data — normal series resonate or anti-resonate
Note: Do not specify equipment types in the case of GP crystals.


*F605-SL
.235
F-605
.721
INT.CRYSTAL
.750
.486
.238
.050 dia.
HC-6/U
T .316 max
F-612
.721
INT.CRYSTAL
.750
.486
.620
.125 dia.
T .316 max
F-609
.721
INT.CRYSTAL
.750
.486
.445
.093 dia.
HC-17/U
T .316 max
**FM-1
.400
.510
.192
.018 dia.
1.5
T .149 max
HC-18/U
FI-4
.526
INT.CRYSTAL
.555
.275
.275
.040 dia.
HC-32/U
4,000 KHz-
22,000 KHz
T .200 max
F-700
.721
INT.CRYSTAL
.750
.030
T .316 max
.486
FM-2
.400
INT. CRYSTAL
.510
.250
.040 dia.
HC-25/U
4,000 KHz-
22,000 KHz
T .149 max

*Other dimensions same as F-605
**Not supplied below 15 MHz
†Available in FM-1 and FM-2 holder only above 20 MHz

HOW TO ORDER:

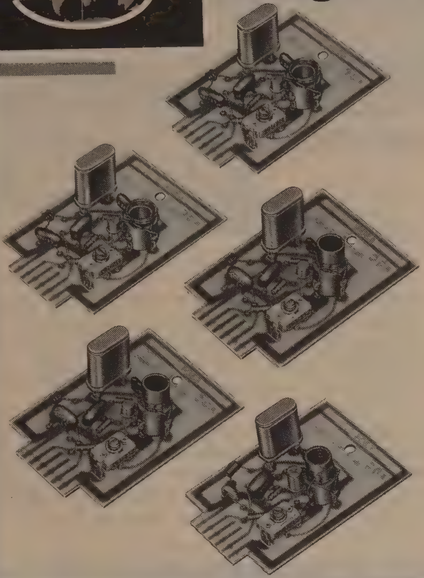
MAIL: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Okla. 73102
PHONE: Area Code 405 236-3741
CABLE: INCRYSTAL
WESTERN UNION TELEX: 747-147
BELL SYSTEM TWX: 910-831-3177

INTERNATIONAL
CRYSTAL MFG. CO., INC.
10 NO. LEE • OKLA. CITY, OKLA. 73102

INTERNATIONAL

Plug-in Transistor Oscillators

direct crystal control to 160 MHz

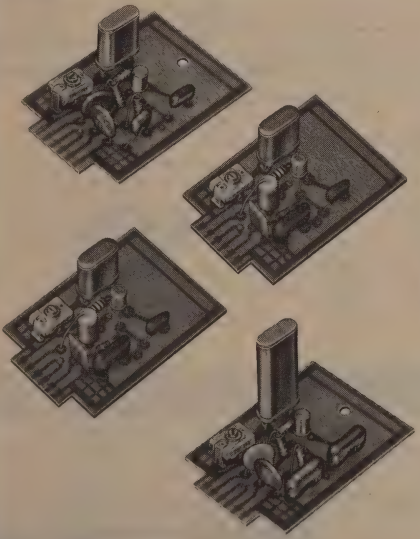


HIGH FREQUENCY (20 MHz — 160 MHz)

- Signal Generators For Receiver Alignment
- Quick-Change Plug-In Oscillators

Five transistor oscillators covering 20 MHz - 160 MHz. Standard 77°F calibration tolerance ±.0025%. The frequency tolerance is ±.0035%. Oscillator output is .2 volts (min.) across 51 ohms. Power requirement: 9 vdc @ 10 ma. max.

Oscillator Type	Oscillator Range	Temperature Tol. —40°F to 150°F	Oscillator (Less Crystal) Price
OT-124	20- 40 MHz	±.0035%	$7.00
OT-146	40- 60 MHz	±.0035%	7.00
OT-161	60-100 MHz	±.0035%	7.00
OT-1140	100-140 MHz	±.0035%	7.00
OT-1160	125-160 MHz	±.0035%	7.00



LOW FREQUENCY (70 KHz — 20,000 KHz)

- Band Edge Markers
- Frequency Markers For Oscilloscopes
- Portable Signal Standards
- Accessory Cases

Four transistor oscillators covering 70 KHz - 20,000 KHz. Trimmer capacitor for zeroing crystal. When oscillator is ordered with crystal the standard will be ±.0025%. Oscillator output is 1 volt (min.) across 470 ohms. Power requirement: 9 vdc @ 10 ma. max.

Oscillator Type	Oscillator Range	Temperature Tol. —40°F to +150°F	Oscillator (Less Crystal) Price
OT-11	70-150KHz	±.015%	$7.00
OT-12A	150-400KHz	200-600KHz±.01%	7.00
OT-12	400-5,000KHz	600-5,000KHz±.0035%	7.00
OT-13	2,000-12,000KHz	±.0035%	7.00
OT-14	10,000-20,000KHz	±.0035%	7.00

HOW TO ORDER:

MAIL: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Okla. 73102
PHONE: Area Code 405 236-3741
CABLE: INCRYSTAL
WESTERN UNION TELEX: 747-147
BELL SYSTEM TWX: 910-831-3177

INTERNATIONAL
CRYSTAL MFG. CO., INC.
10 NO. LEE • OKLA. CITY OKLA. 73102

INTERNATIONAL

Oscillators–Amplifiers

BROADBAND AMPLIFIER

MODEL 150-299

14 DB GAIN — 10 to 1,000 MHz

BROADBAND AMPLIFIER
150-299
10 to 1000 MHz
OUTPUT
INPUT
+20vdc

International's inline amplifier provides 14 db gain flat within 1 db over a range of 10 to 1,000 MHz. Impedance 50 phms. Requires 20 VDC @ 50 ma. For increased gain additional amplifier may be added. Uses BNC type terminals.

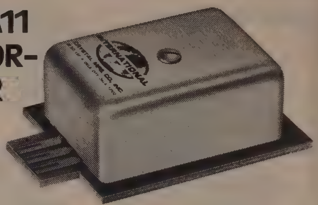
SPECIFICATIONS

Range 10 to 1,000 MHz
Impedance 50 ohms
DC Input* 20 VDC 50 ma
Gain** 14 db
Flatness ±1db (Ref. 500 MHz)
Operating Temperatures −25 to +70°C
Noise Figure 9 db
VSWR Output 2.0
Output capability for −60 db near intermodulation distortion 100 MV

*Will operate 12 to 24 VDC with some loss characteristics.
**May cascade for additional gain with consideration of noise and flatness.

PRICE $40.00

OA10 & OA11 OSCILLATOR-AMPLIFIER



OA series of "oscillator-amplifier" units provide signal sources where greater power output is required. Available with either 50 ohm or 10K ohm output impedance over the frequency range of 6 MHz to 60 MHz. The OA-10 has a tuned output and the OA-11 has a broadband untuned output. Standard input voltage in 9 VDC. *Modification −01 provides for operation from 30 VDC. †Two temperature tolerances are available over the range −10°C to + 60°C. Specify frequency when ordering. Output into 50 ohms, 1 volt/rms min. for OA-10.

TYPE	†ACCURACY	PRICE
OA–10*	.002%	$50.00
OA–10*	.0005%	$65.00
OA–11*	.002%	$50.00
OA–11*	.0005%	$65.00

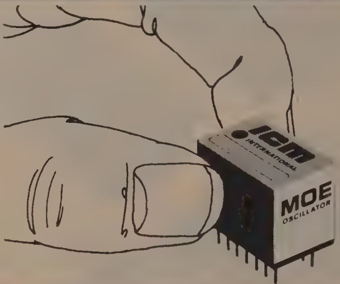
*Mod–01 30 VDC operation add $15.00

MOE CRYSTAL OSCILLATOR

elements provide a complete controlled signal source from 600 KHz to 60 MHz

The MOE series is designed for direct plug-in to a standard dip socket. The miniature oscillator element in a complete source, crystal controlled, in an integrated circuit 14 pin dual-in-line package with a height of .6 inches, width .5 inches and length .8 inches.

Oscillators are grouped by frequency and temperature stability thus giving the user a selection of the overall accuracy desired. Operating voltage 6 vdc.



SPECIFICATIONS

DC Input	6 VDC @ 10ma max
RF Output	−10 dbm (periodic)
Output Impedance	Low, 100 ohms
Freq. Stability (−10°C to +60°C)	MOE −5 ±.002% MOE −10 ±.0005%
Calibration	±1ppm at 25°C

TYPE	CRYSTAL RANGE	OVERALL ACCURACY	25°C TOLERANCE	PRICE
MOE–5	6MHz to 60MHz	+ .002% −10° to +60°C	Zero Trimmer	$35.00
MOE–10	6MHz to 60MHz	+ .0005% −10° to +60°C	Zero Trimmer	$50.00

HOW TO ORDER:

MAIL: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Okla. 73102
PHONE: Area Code 405 236-3741
CABLE: INCRYSTAL
WESTERN UNION TELEX: 747-147
BELL SYSTEM TWX: 910-831-3177

INTERNATIONAL
CRYSTAL MFG. CO., INC.
10 NO LEE • OKLA CITY, OKLA 73102

McCOY ELECTRONICS COMPANY

a subsidiary of **OAK Industries Inc.**

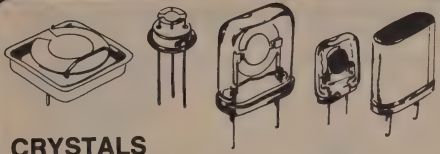
MT. HOLLY SPRINGS, PA. 17065 • 717-486-3411 - TWX: 510-650-3548

Nearly a quarter century of dedication to **Quartz Crystals, Filters,** and **Oscillators** has earned McCoy Electronics Company the foremost reputation for performance. McCoy's achievements have provided the base for extensive domestic sales representation and worldwide distribution. The versatility of design and capability in McCoy's precision components has placed them in the vanguard of not only the commercial and industrial crystal market, but also NASA's aerospace programs and computer systems for communication and defense, thus exemplifying the esteem accorded the McCoy product line.

McCoy customer service has grown in unison with the rapidly expanding McCoy technology. An additional plant facility now supplements the present vast engineering, manufacturing, and distribution capability—the foundation of the McCoy Company reputation. The unequaled versatility of custom manufacturing and resultant customer confidence are enhanced with ever increasing efficiency by our computer assisted design capability. Laboratory trial and error efforts are eliminated through the accurate analyses and directions provided by the computer.

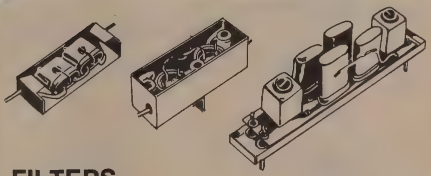
The McCoy name has been synonymous with quality in the crystal industry for more than two decades. Our catalog contains crystals, filters, and oscillators continually proven to be the ultimate in performance critique. The various components listed herein are supported by PC Board, chemical milling, and other photo-fabrication capabilities, and represent only a small cross section of products and services offered. Our many years of experience assure each customer that the industry's finest skills are at his command.

"ADVANCING CRYSTAL TECHNOLOGY FOR TWO DECADES"



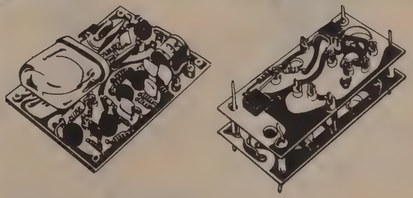
CRYSTALS

McCoy's leadership in crystal design and production permits precision blanks from 700 Hz to 250 MHz to be cut, angles controlled to within ±15", and fundamental frequencies lapped to 45 MHz. Thousands of electrode masks, permitting maximum latitude in controlling motional parameters, give range and depth to McCoy's crystal capabilities.



FILTERS

Crystal filters from 1KHz to 250MHz are designed by computer assistance to exacting specifications. Monolithic filters, with spurious mode suppression capabilities, offer an infinite variety of designs for custom application.



OSCILLATORS

The precision standard, oven, temperature compensated (TCXO) and voltage controlled (VCXO) crystal oscillators each feature a matched McCoy crystal. Coupled with the McCoy expertise in manufacturing smooth discontinuity-free crystals, these oscillators offer unequaled performance when tailored to blend with the equipment or system needs.

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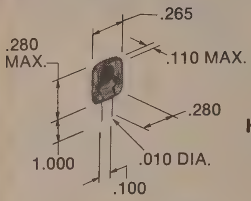
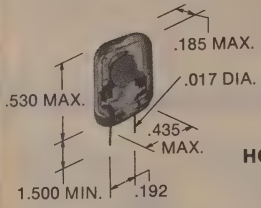
McCOY CRYSTALS

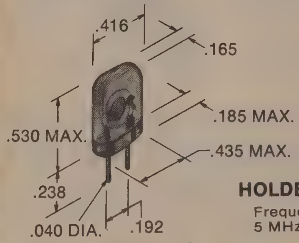
PRECISION GLASS CRYSTALS


.265
.280 MAX.
.110 MAX.
.280
1.000
.010 DIA.
.100

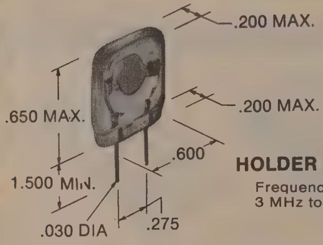
HOLDER SERIES MM
Frequency Range:
10 MHz to 250 MHz


.185 MAX.
.017 DIA.
.530 MAX.
.435 MAX.
1.500 MIN.
.192

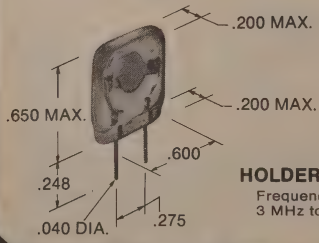
HOLDER SERIES G-20
Frequency Range:
5 MHz to 100 MHz


.416
.165
.185 MAX.
.530 MAX.
.435 MAX.
.238
.040 DIA.
.192

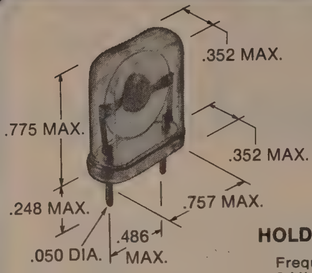
HOLDER SERIES G-21
Frequency Range:
5 MHz to 100 MHz


.200 MAX.
.650 MAX.
.200 MAX.
.600
1.500 MIN.
.030 DIA
.275

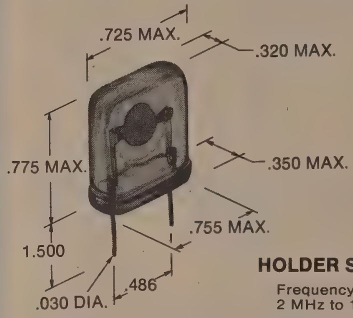
HOLDER SERIES G-30
Frequency Range:
3 MHz to 100 MHz


.200 MAX.
.650 MAX.
.200 MAX.
.600
.248
.040 DIA.
.275

HOLDER SERIES G-31
Frequency Range:
3 MHz to 100 MHz

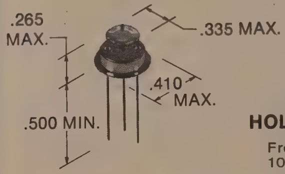

.352 MAX.
.775 MAX.
.352 MAX.
.248 MAX.
.757 MAX.
.486 MAX.
.050 DIA.

HOLDER SERIES G-1
Frequency Range:
2 MHz to 100 MHz

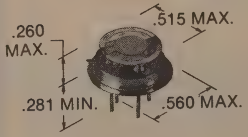

.725 MAX.
.320 MAX.
.775 MAX.
.350 MAX.
.755 MAX.
1.500
.486
.030 DIA.

HOLDER SERIES G-4
Frequency Range:
2 MHz to 100 MHz

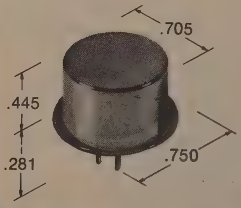
COLD WELD CRYSTALS


.265 MAX.
.335 MAX.
.410 MAX.
.500 MIN.

HOLDER SERIES W-6
Frequency Range:
10 MHz to 250 MHz


.515 MAX.
.260 MAX.
.281 MIN.
.560 MAX.

HOLDER SERIES W-7
Frequency Range:
3 MHz to 250 MHz


.705
.445
.281
.750

HOLDER SERIES W-8
Frequency Range:
0.8 MHz to 250 MHz

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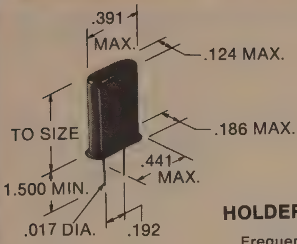
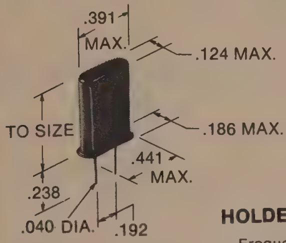

.391
MAX.
.124 MAX.
TO SIZE
.186 MAX.
.441
MAX.
1.500 MIN.
.017 DIA.
.192

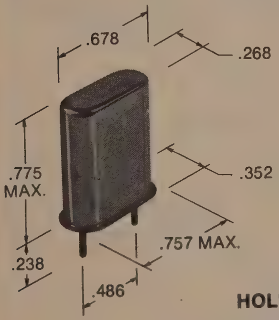
HOLDER SERIES W-20

Frequency Range:
2.9 MHz to 250 MHz


.391
MAX.
.124 MAX.
TO SIZE
.186 MAX.
.441
MAX.
.238
.040 DIA.
.192

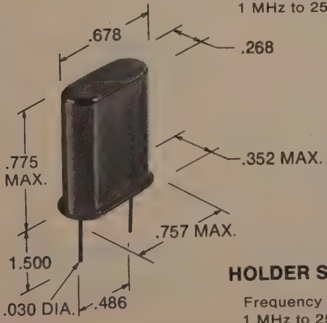
HOLDER SERIES W-21

Frequency Range:
2.9 MHz to 250 MHz


.678
.268
.352
.775
MAX.
.757 MAX.
.238
.486

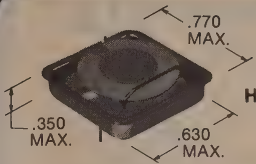
HOLDER SERIES W-1

Frequency Range:
1 MHz to 250 MHz


.678
.268
.352 MAX.
.775
MAX.
.757 MAX.
1.500
.030 DIA.
.486

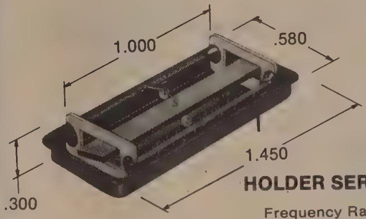
HOLDER SERIES W-4

Frequency Range:
1 MHz to 250 MHz


.770
MAX.
.350
MAX.
.630
MAX.

HOLDER SERIES W-10

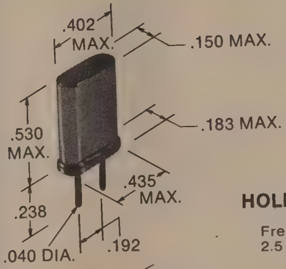
Frequency Range:
1 MHz to 250 MHz


1.000
.580
1.450
.300

HOLDER SERIES W-11

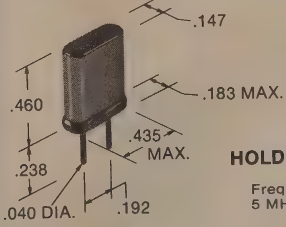
Frequency Range:
3KHz to 700 KHz

SOLDER SEAL CRYSTALS


.402
MAX.
.150 MAX.
.183 MAX.
.530
MAX.
.435
MAX.
.238
.040 DIA.
.192

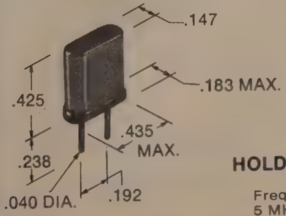
HOLDER SERIES M-21

Frequency Range:
2.5 MHz to 250 MHz


.147
.183 MAX.
.460
.435
MAX.
.238
.040 DIA.
.192

HOLDER SERIES M-21A

Frequency Range:
5 MHz to 250 MHz


.147
.183 MAX.
.425
.435
MAX.
.238
.040 DIA.
.192

HOLDER SERIES M-21B

Frequency Range:
5 MHz to 250 MHz

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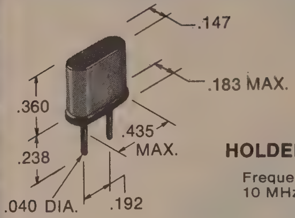
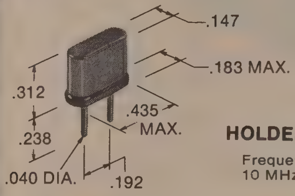
McCOY CRYSTALS

SOLDER SEAL CRYSTALS


.147
.183 MAX.
.360
.238
.435 MAX.
.040 DIA.
.192

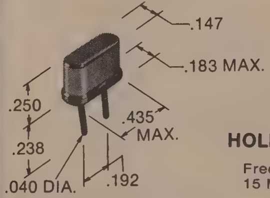
HOLDER SERIES M-21C

Frequency Range:
10 MHz to 250 MHz


.147
.183 MAX.
.312
.238
.435 MAX.
.040 DIA.
.192

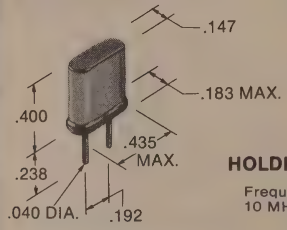
HOLDER SERIES M-21D

Frequency Range:
10 MHz to 250 MHz


.147
.183 MAX.
.250
.238
.435 MAX.
.040 DIA.
.192

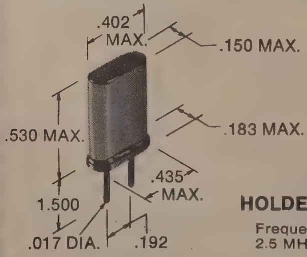
HOLDER SERIES M-21E

Frequency Range:
15 MHz to 250 MHz


.147
.183 MAX.
.400
.238
.435 MAX.
.040 DIA.
.192

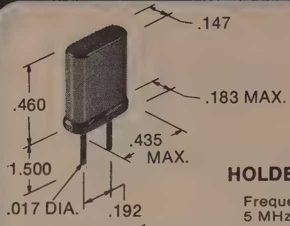
HOLDER SERIES M-21F

Frequency Range:
10 MHz to 250 MHz


.402 MAX.
.150 MAX.
.530 MAX.
.183 MAX.
.435 MAX.
1.500
.017 DIA.
.192

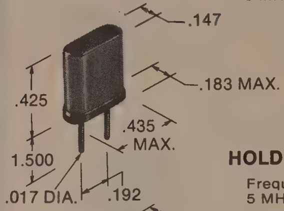
HOLDER SERIES M-20

Frequency Range:
2.5 MHz to 250 MHz


.147
.183 MAX.
.460
.435 MAX.
1.500
.017 DIA.
.192

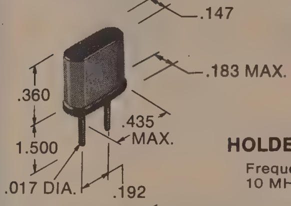
HOLDER SERIES M-20A

Frequency Range:
5 MHz to 250 MHz


.147
.183 MAX.
.425
.435 MAX.
1.500
.017 DIA.
.192

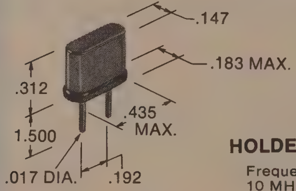
HOLDER SERIES M-20B

Frequency Range:
5 MHz to 250 MHz


.147
.183 MAX.
.360
.435 MAX.
1.500
.017 DIA.
.192

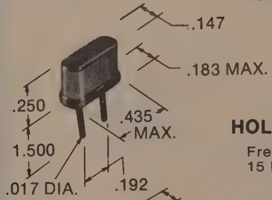
HOLDER SERIES M-20C

Frequency Range:
10 MHz to 250 MHz


.147
.183 MAX.
.312
.435 MAX.
1.500
.017 DIA.
.192

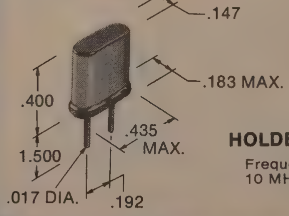
HOLDER SERIES M-20D

Frequency Range:
10 MHz to 250 MHz


.147
.183 MAX.
.250
.435 MAX.
1.500
.017 DIA.
.192

HOLDER SERIES M-20E

Frequency Range:
15 MHz to 250 MHz


.147
.183 MAX.
.400
.435 MAX.
1.500
.017 DIA.
.192

HOLDER SERIES M-20F

Frequency Range:
10 MHz to 250 MHz

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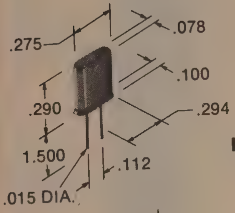
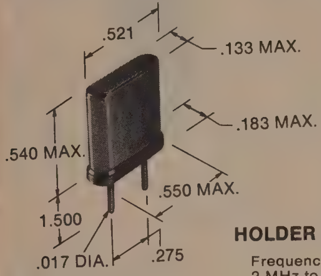
SOLDER SEAL CRYSTALS


.275
.078
.100
.290
.294
1.500
.112
.015 DIA.

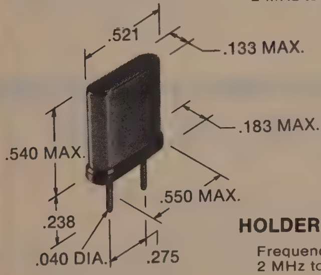
HOLDER SERIES M-60

Frequency Range:
12.5 MHz to 250 MHz


.521
.133 MAX.
.183 MAX.
.540 MAX.
.550 MAX.
1.500
.017 DIA.
.275

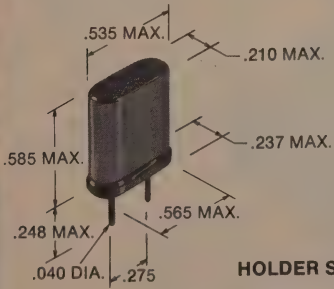
HOLDER SERIES M-40

Frequency Range:
2 MHz to 250 MHz


.521
.133 MAX.
.183 MAX.
.540 MAX.
.550 MAX.
.238
.040 DIA.
.275

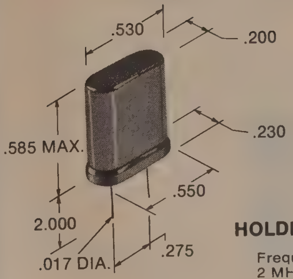
HOLDER SERIES M-41

Frequency Range:
2 MHz to 250 MHz


.535 MAX.
.210 MAX.
.237 MAX.
.585 MAX.
.565 MAX.
.248 MAX.
.040 DIA.
.275

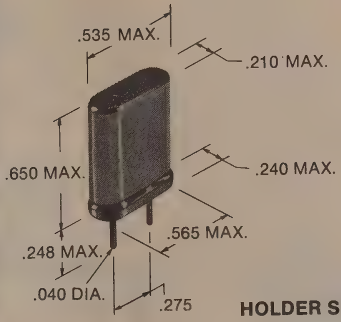
HOLDER SERIES M-27

Frequency Range:
2 MHz to 250 MHz


.530
.200
.230
.585 MAX.
.550
2.000
.275
.017 DIA.

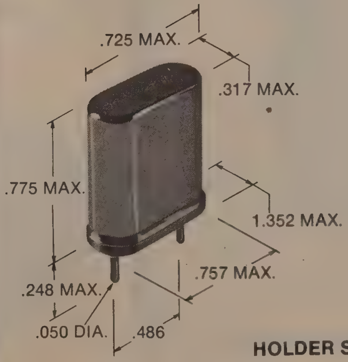
HOLDER SERIES M-28

Frequency Range:
2 MHz to 250 MHz


.535 MAX.
.210 MAX.
.240 MAX.
.650 MAX.
.565 MAX.
.248 MAX.
.040 DIA.
.275

HOLDER SERIES M-25

Frequency Range:
2 MHz to 250 MHz


.725 MAX.
.317 MAX.
.775 MAX.
1.352 MAX.
.757 MAX.
.248 MAX.
.050 DIA.
.486

HOLDER SERIES M-1

Frequency Range:
0.7 MHz to 250 MHz

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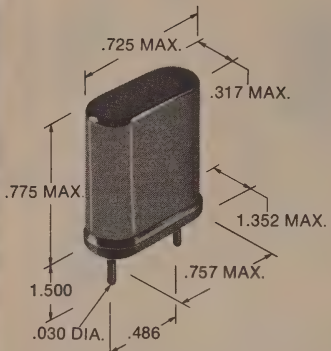
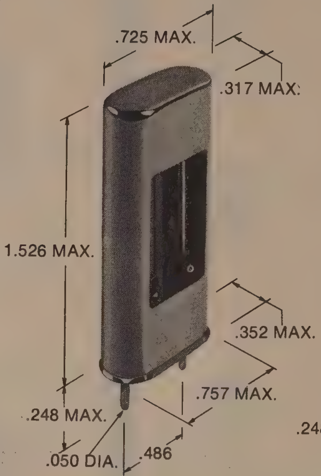
McCOY CRYSTALS

SOLDER SEAL CRYSTALS


.725 MAX.
.317 MAX.
.775 MAX.
1.352 MAX.
.757 MAX.
1.500
.030 DIA.
.486

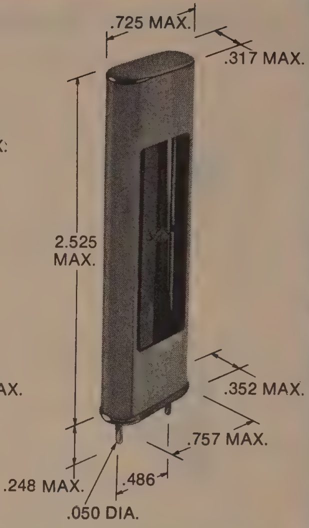
HOLDER SERIES M-4

Frequency Range:
0.7 MHz to 250 MHz


.725 MAX.
.317 MAX.
1.526 MAX.
.352 MAX.
.757 MAX.
.248 MAX.
.050 DIA.
.486

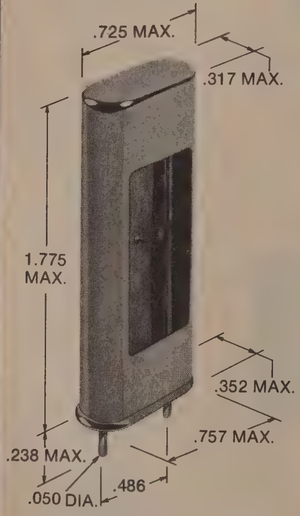
HOLDER SERIES M-22

Frequency Range:
4 Hz to 15 KHz


.725 MAX.
.317 MAX.
2.525 MAX.
.352 MAX.
.757 MAX.
.248 MAX.
.486
.050 DIA.

HOLDER SERIES M-22A

Frequency Range:
700 Hz to 1.5 KHz

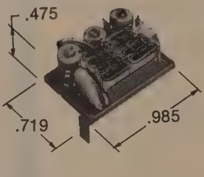

.725 MAX.
.317 MAX.
1.775 MAX.
.352 MAX.
.757 MAX.
.238 MAX.
.486
.050 DIA.

HOLDER SERIES M-22B

Frequency Range:
1.5 Hz to 4 KHz

McCOY CRYSTAL FILTERS

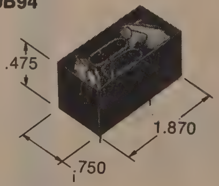
Filter
MODEL 80B36
F_0 57.836 MHz



SPECIFICATIONS

Package FM 3965
3db BW ±25 KHz min.
45db BW 140 KHz max.
Insertion Loss: 6db max. @ RT, 7db over temp.
Ripple: 1db max. @ RT, 2db over temp.
Temperature Range: −54° to +100° C
Source/Load Impedance: 50 Ω
Shock: MIL-F-18327, Method I
Vibration: MIL-STD-202, Method 204B, Test Condition A
Spurious Response Attenuation:
35db min. from 58.036 to 58.236 MHz
45db min. from 10 to 57.766 MHz and 58.236 to 150 MHz

Filter
MODEL 20B94
F_0 17.000 MHz


.475
1.870
.750

SPECIFICATIONS

Package FM 2856
3db BW ±115 KHz min.
40db BW ±400 KHz max.
Insertion Loss: 4db max.
Ripple: ±1db max.
Temperature Range: −55° to +105° C
Source/Load Impedance: 50 Ω

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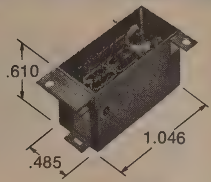
McCOY CRYSTAL FILTERS

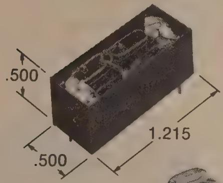
Filter
MODEL 2B164
F_o 30.000 MHz



SPECIFICATIONS

Package FM 3389
3db BW ±31.8 KHz min.
6db BW ±34.5 KHz min.
60db BW ±57 KHz max.
Insertion Loss: 3db max.
Ripple: 1db max. over ±25 KHz
Ultimate Attenuation: 60db min.
Temperature Range: −55° to +105° C
Source Impedance: 2000 Ω
Load Impedance: 50 Ω

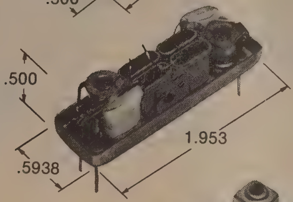
Filter
MODEL 20B91
F_o 75.000 MHz



SPECIFICATIONS

Package FM 2562
.5db BW ±3.1 KHz min.
50db BW 50 KHz max.
Insertion Loss: 2db max.
Ripple: 1db max.
Ultimate Attenuation: 60db min.
Source/Load Impedance: 500 Ω

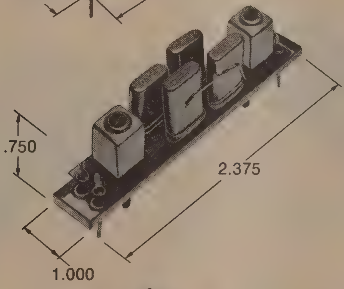
Filter
MODEL 246B5
F_o 48.2510 MHz



SPECIFICATIONS

Package FM 2895-1
1db BW 7.0 ±1.0 KHz
30db BW ±8.0 KHz max.
Insertion Loss: 5db max.
Ripple: 1db max.
Attenuation: from 46-50db 30db
Temperature Range: −40° to +70° C
Source/Load Impedance: 50 Ω
Shock: MIL-STD-202, Method 213, Test Condition J, except 30G^S 11ms.
Vibration: MIL-STD-202, Method 204, Test Condition C, except 23″ DA 5-29 Hz, 10G^S 29-2000Hz

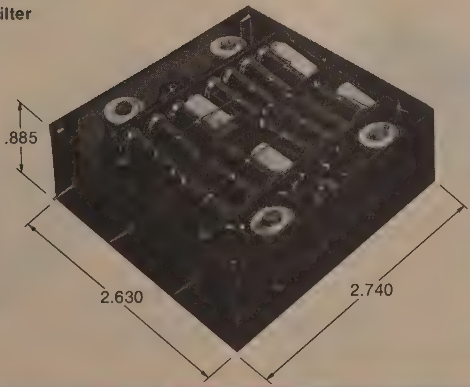
Filter
MODEL 53B20
F_o 455.000 KHz



SPECIFICATIONS

Package FM 3361
3db BW ±150 KHz min.
60db BW ±925 KHz max.
Transmission Loss: 14db max.
Ripple: 3db max.
Ultimate Attenuation: 60db min.
Temperature Range: −40° to +85° C
Transfer Impedance: 6500 Ω ±20%

Single Sideband Filter
MODEL 20B110
F_o 1.750 MHz



SPECIFICATIONS

Package FM 2871
BW min. @ 1db F_o +295Hz to F_o +3100Hz
BW max. @60db F_o −125Hz to F_o +3975Hz
Insertion Loss: 5db max.
Ripple: 1db max. over 1db BW
Temperature Range: −40° to +70° C
Intermodulation Distortion Levels: At least 65db below two equal level (100mv.) signals, F_o +900Hz and F_o +2800Hz, applied simultaneously
Source/Load Impedance: 500 Ω
Shock: MIL-STD-202, Method 205, Test Conditions set forth in para 4.8.11.1 of MIL-F-39025
Vibration: MIL-STD-202, Method 204A, Test Condition A
Carrier Attenuation: @ F_o 40db min.
Differential Delay: 400 ms. max. over the band defined from F_o +800 Hz to F_o +3050 Hz

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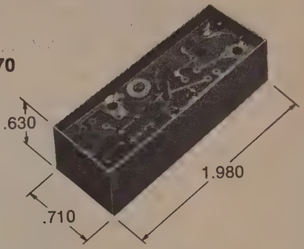
McCOY CRYSTAL FILTERS

Filter
MODEL 2B270
F_o 20.000 MHz

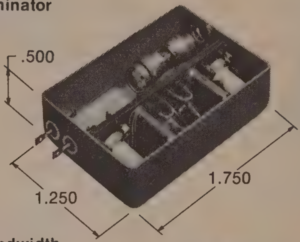


Unique design for airborne communications features immediate identification of failure mode of any defective component.

SPECIFICATIONS

Package FM 6392
6db BW ±10 KHz min.
60db BW ±15 KHz max.
Insertion Loss: 4db max.
Ripple: 2db max.
Ultimate Attenuation: 90db
Temperature Range: −40° to +85° C
Source/Load Impedance: 1800 Ω
Shock: 50G^S 11ms
Vibration: 10G^S 10-500 Hz

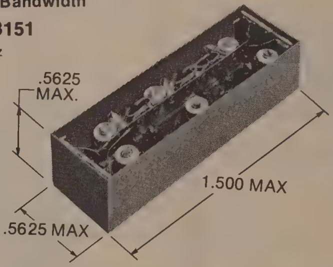
Crystal Discriminator
MODEL 6D1
F_o 11.000 MHz



SPECIFICATIONS

Package D1007
Peak-Peak BW: ±20 KHz
Linear BW: ±15 KHz
Linearity: ±3%
Sensitivity: .75 v/KHz
Driver Source Impedance: 1000 Ω
Discriminator Load Impedance: 75000 Ω
Drive Level: 3VRMS @ F_o
Temperature Range: +10° to +50° C

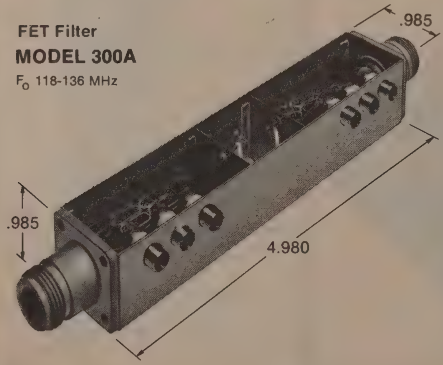
Filter,
Switchable Bandwidth
MODEL 2B151
F_o 30.000 MHz



SPECIFICATIONS

Package FM 2871
Bandwidth A:
  6db ±22.5 KHz min.
  60db 90 KHz max.
Bandwidth B:
  6db ±40 KHz min.
  60db 160 KHz max.
Insertion Loss: 4db max.
Ripple:
  1db max. @ +25° C
  2db max. −55° to +105° C
Ultimate Attenuation: 80db min. F_o
  Bandwidth A
    ±112.5 KHz to ±30 MHz
  Bandwidth B
    ±200 KHz to ±30 MHz
Temperature Range: −55° to +105° C
Source/Load Impedance: 50 Ω
Shock: 15G^S per MIL-STD-202, Method 202
Vibration: MIL-STD-202, Method 201, Test Condition B
Switching Voltage:
  Fixed: +12VDC
  BW A: +24VDC ±1VDC
  BW B: +1VDC ±0.5VDC

FET Filter
MODEL 300A
F_o 118-136 MHz



Eliminates adjacent channel interference and contains amplifier with built in power supply.

SPECIFICATIONS

Package FM 3976
6db BW ±12 KHz min.
60db BW ±35 KHz max.
90db BW ±75 KHz max.
Insertion Loss: 1db max.
Ripple: 2db max.
Ultimate Attenuation: 90db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 50 Ω
External Supply Required: 10V ±10%

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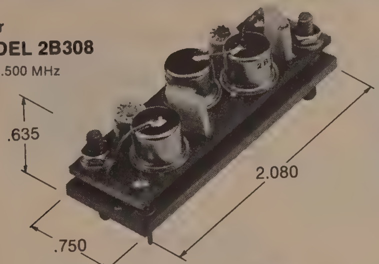
McCOY CRYSTAL FILTERS

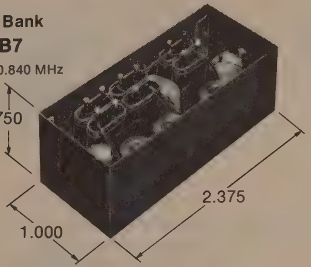
Filter
MODEL 2B308
F_o 25.500 MHz



SPECIFICATIONS

Package FM 7055
6db BW ±34.5 KHz min.
60db BW ±80 KHz max.
Insertion Loss: 5db max.
Ripple: 1db max.
Temperature Range: −55° to +71° C
Source/Load Impedance: 2700 Ω
Shock: 50G^S 11ms
Vibration: 5-500 Hz 10G^S

Filter Comb Bank
MODEL 31B7
F_o 10.000 to 10.840 MHz

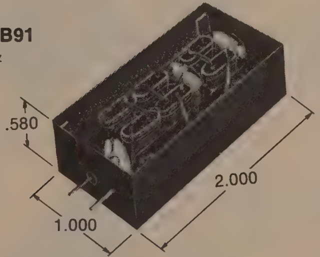


Bank of 15 filters operates from common source and offers 60:6db SF of 2:1

SPECIFICATIONS

Package FM 3318
6db BW ±19 KHz min.
60db BW ±38 KHz max.
Insertion Loss: 16db max.
Ripple: 1db max.
Temperature Range: 0° to +60° C
Source/Load Impedance: 50 Ω
Phase Linearity:
±3° over 50% of the 6db BW
±8° over 80% of the 6db BW

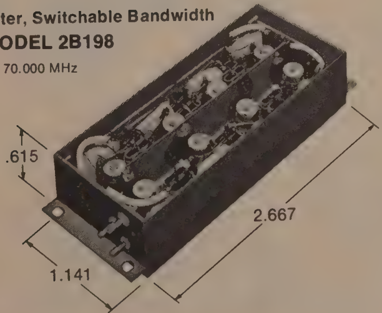
Filter
MODEL 2B91
F_o 9.000 MHz



SPECIFICATIONS

Package FM 2561
3db BW ±6 KHz min. ±7 KHz max.
60db BW 51 KHz max.
Insertion Loss: 6db max.
Ripple: 1db max.
Ultimate Attenuation: 60db min.
Temperature Range: −40° to +70° C
Source Impedance: 450 Ω
Load Impedance: 50 Ω

Filter, Switchable Bandwidth
MODEL 2B198
Fo 70.000 MHz



One of the most innovative creations of the McCoy engineering staff, the switchable dual bandwidth filter is ideal for multi-mode airborne communication systems.

SPECIFICATIONS

Package FM 6360
Bandwidth A:
3db ±35 KHz min.
60db 170 KHz
Bandwidth B:
6db ±19 KHz min.
60db 90 KHz
Insertion Loss: 8db max. (both BWs)
Ripple:
Bandwidth A
1.5db max.
Bandwidth B
1.0db max.
Ultimate Attenuation: from ±200 KHz to ±20 MHz from F_o 80db min.
Temperature Range: −55° to +95° C
Source/Load Impedance: 50 Ω
Shock: 50G^S per MIL-STD-202, Method 202
Vibration: MIL-STD-202, Method 204, Test Condition A
Spurious Response Attenuation: 80db min.
Phase Linearity, BW A only: ±3° over 70% of 3db BW, and ±8° over 90% of 3db BW
Switching Voltage:
Bias Voltage to pin 5: 12VDC
BW A obtained by applying to pin 6: 0-1VDC
BW B obtained by applying to pin 6: 24VDC
Filter will sustain no damage with .5VRMS applied to input.

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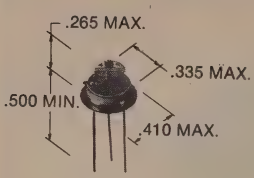
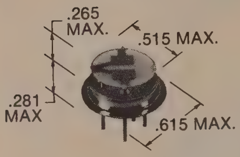
McCOY MONOLITHIC FILTERS



Monolithic Filter
MODEL 48Q2
F_o 156.000 MHz

This illustrates McCoy's high frequency technology in a high performance cold weld seal holder. Rugged and small.

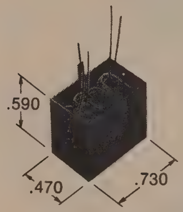
SPECIFICATIONS
Package W-6
3db BW ±7.5 KHz min.
30db BW 54 KHz max.
Insertion Loss: 1db max.
Ripple: .5db max.
Ultimate Attenuation: 40db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 1500 Ω



Monolithic Filter
MODEL 2Q5
F_o 9.900 MHz

Economical, highly reliable, and rugged - features a cold weld seal.

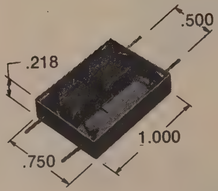
SPECIFICATIONS
Package W-7
3db BW ±400 Hz min.
25db BW 10 KHz max.
40db BW 80 KHz max.
Insertion Loss: 6db max.
Ripple: 1db max.
Temperature Range: −55° to +85° C
Source/Load Impedance: 75 Ω ±10%
Shock: MIL-STD-202, Method 205, Test Condition B
Vibration: MIL-STD-202, Method 204, Test Condition A
Spurious Responses: Within ±80 KHz of 9.9 MHz shall be 40db min.



Monolithic Filter
MODEL 48Q6
F_o 30.000 MHz

Eight (8) pole filter utilizes McCoy's miniature crystals - underscores McCoy's innovative capability in micro-electronics applications.

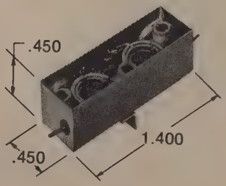
SPECIFICATIONS
Package FM 7027
3db BW ±15 KHz min.
60db BW 60 KHz max.
Insertion Loss: 4db max.
Ripple: 1db max.
Ultimate Attenuation: 70db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 1500 Ω



Monolithic Filter
MODEL 48Q8
F_o 22.800 MHz

Less than 0.2 cubic inches, this four pole filter offers maximum performance in efficient layout.

SPECIFICATIONS
Package FM 2893
3db BW ±25 KHz min.
40db BW 120 KHz max.
Insertion Loss: 1db max.
Ripple: .5db max.
Ultimate Attenuation: 60db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 2700 Ω



Monolithic Filter
MODEL 2Q1
F_o 109.350 MHz

Designed for highly reliable, sophisticated, surveillance aircraft, this filter meets exacting electrical and environmental requirements.

SPECIFICATIONS
Package FM 3922
.5db BW ±3 KHz
3db BW 15 KHz min.
20db BW 70 KHz max.
Insertion Loss: 6db max.
Ripple: .5db max.
Ultimate Attenuation: 60db min.
Temperature Range: −55° to +85° C
Intermodulation Distortion: Third or higher order products of a 2 tone signal of 0.1v per tone, measured at the output terminals, do not exceed a level of 50db below each reference tone. Tones are 109.351 and 109.549 MHz.
Source/Load Impedance: 200 Ω
Shock: 15G^S, MIL-STD-202, Method 202
Vibration: MIL-STD-202, Method 204, Test Condition A

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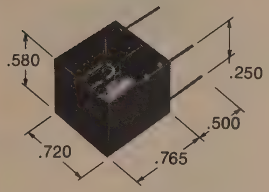
McCOY MONOLITHIC FILTERS



Monolithic Filter

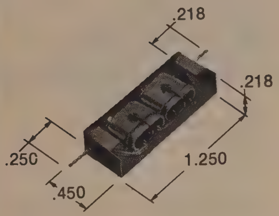
MODEL 48Q5

F_o 75.000 MHz

Popular center frequency range utilizes McCoy's experience in high frequency crystal spurious mode control techniques.

SPECIFICATIONS

Package FM 1058
3db BW ±17.5 KHz min.
30db BW 105 KHz max.
Insertion Loss: 2db max.
Ripple: .5db max.
Ultimate Attenuation: 50db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 75 Ω



Monolithic Filter

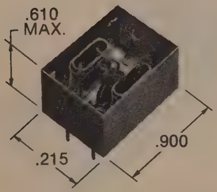
MODEL 48Q3

F_o 11.500 MHz

Quality four pole space saver for miniaturized applications.

SPECIFICATIONS

Package FM 2885
3db BW ±10.5 KHz min.
40db BW 59 KHz max.
Insertion Loss: 2.5db max.
Ripple: 1db max.
Ultimate Attenuation: 60db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 2700 Ω



Monolithic Filter

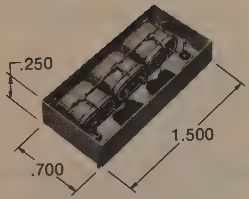
MODEL 12Q11

F_o 21.400 MHz

Small, lightweight four pole filter ideally suited for miniature airborne transceivers.

SPECIFICATIONS

Package FM 7045
6db BW 32 KHz min.
30db BW 72 KHz max.
Insertion Loss: 6db max.
Ripple: 2db max.
Ultimate Attenuation: 70db min.
Temperature Range: −18° to +38° C
Source/Load Impedance: 2200 Ω
Spurious Response Attenuation: 30db min.



Monolithic Filter

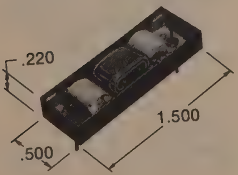
MODEL 2Q4

F_o 24.500 MHz

Features top performance in low profile package and efficient mechanical layout.

SPECIFICATIONS

Package M-20C
6db BW ±10 KHz min.
40db BW ±22 KHz max.
Insertion Loss: 4db max.
Ripple: 1.5db max.
Ultimate Attenuation: 80db min.
Temperature Range: −30° to +70° C
Source/Load Impedance: 1500 Ω
Shock: MIL-STD-202, Method 201
Vibration: MIL-STD-202, Method 205



Monolithic Filters

MODELS 20Q4
1 through 16

F_o 11.000 - 15.000 MHz

Compact filter with termination matched to customer's requirement.

SPECIFICATIONS

Package FM 3919
3db BW ±7 KHz min.
10db BW 32 KHz max.
20db BW 50 KHz max.
Insertion Loss: 2db max.
Ripple: ±1db max.
Ultimate Attenuation: 30db min.
Temperature Range: −40° to +70° C
Source/Load Impedance: 50 Ω
Spurious Response Attenuation: 15db min.

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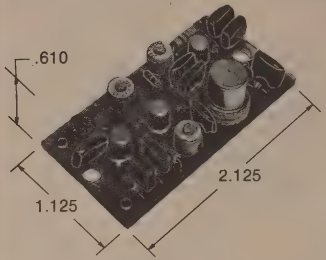
McCOY CRYSTAL OSCILLATORS



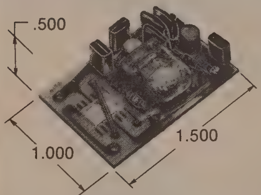
Crystal Controlled Oscillator

MODEL MC308X1

Multi-frequency crystal oscillator designed to allow the user to change frequency by inserting a new crystal and performing a simple retuning process.

SPECIFICATIONS

Frequency Range: 80 MHz to 110 MHz
Frequency Stability vs. Temperature Range (typical choices):
±20 PPM over −20° to +60° C from RT value
±50 PPM over −55° to +85° C from RT value
±100 PPM over −55° to +85° C from RT value
Frequency @RT: Resolution of less than 1 PPM
Input Voltage: +12VDC ±2%
Input Current: 15ma. max.
Output:
7mw. min. into a 50Ω Load, sine wave, (−20° to +60° C)
5mw. min. into a 50Ω Load, sine wave, (−55° to +85° C)
Weight: 2 ounces max.
Mounting: Direct to printed circuit board using 4 wire leads
Package Volume: 1.63 cubic inches nominal
Crystal Type Used: TO-5 (McCoy Type W-6)



NOTE: Where height is critical, order MODEL MC210A1 which is the same as MC209A1 except height of .360 max.

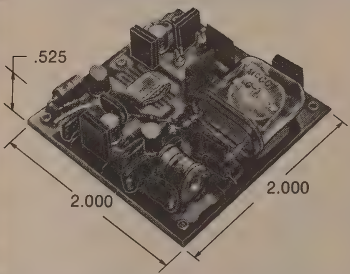
Crystal Controlled Oscillator

MODEL MC209A1

An offshoot of our MC109A1, the MC209A1 is utilized where an extra logic is required, thus obtaining lower output frequencies. It uses all MIL-approved parts where required on government work.

SPECIFICATIONS

Frequency Range: 1.8 KHz to 650 KHz
Frequency Stability vs. Temperature Range (suggested values only):
1.8 KHz to 12 KHz
±150 PPM over −55° to +105° C
± 70 PPM over 0° to +50° C
12 KHz to 650 KHz
± 50 PPM over −55° to +105° C
±100 PPM over −55° to +105° C
± 30 PPM over 0° to +50° C
Input Voltage: +5VDC ±5%
Output: Logic
Seal: Hermetic
Weight: 1.5 ounces max.
Mounting: Direct PC Mount



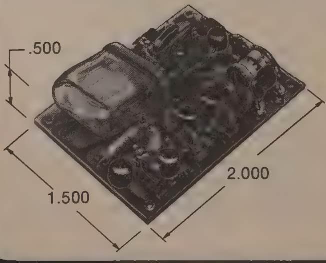
Temperature Compensated Crystal Oscillator

MODEL MC163X2

TCXO Work-horse of the product line covers a wide frequency range of TTL/DTL compatible outputs and can provide outside trim capability.

SPECIFICATIONS

Frequency Range: 8.0 KHz to 28.0 MHz
Frequency Tolerance vs. Temperature Range (typical choices):
±0.5 PPM over −30° to +60° C
±1.0 PPM over −40° to +70° C
±5.0 PPM over −55° to +105° C
Input Voltage: +12VDC ±2% and +5VDC ±5%
Output: TTL/DTL Compatible
Seal: Hermetic
Mounting: Direct printed circuit board using 5 ea. wire leads
Outside Trim: Available on request



Temperature Compensated Crystal Oscillator

MODEL MC380A2

High Stabilities achieved with a single +5VDC input instead of 2 separate inputs.

SPECIFICATIONS

Frequency Range: 187.5 KHz to 25 MHz
Frequency Stability:
±0.5 PPM
±1.0 PPM
±2.0 PPM
±5.0 PPM
Temperature Range:
0° to +50° C
−10° to +70° C
−30° to +70° C
−40° to +85° C
Input Voltage: +5VDC ±1%
Output: TTL/DTL Compatible
Seal: Hermetic
Outside Trim: Available on request (5 PPM total pull)

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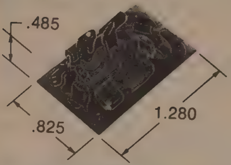
McCOY CRYSTAL OSCILLATORS



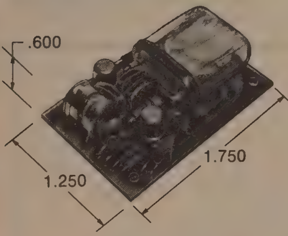
Standard Oscillator

MODEL MC205A1

Compact, rugged unit offers excellent stability for computer applications where performance and reliability are important.

SPECIFICATIONS

Frequency Range: 25 to 50 MHz
Stability: ±20 PPM over 0° to +95° C
Accuracy: @RT ±10 PPM
Input Voltage: +5VDC ±10%
Output: Compatible with TTL and DTL Logic
Seal: Hermetic
Package Size: 1.28 x .825 x .485



Standard Oscillator

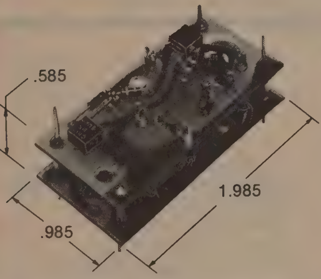
MODEL MC350X1

Versatile, economical crystal oscillator for PC board applications offering frequency trim adjustment and square wave output.

SPECIFICATIONS

Frequency Range: 188 KHz to 25 MHz
Frequency Stability: ±50 PPM
Temperature Range: −55° to +105° C
Frequency Accuracy at 25° C:
 *Units with Trim - ±1 PPM
 *Units without Trim - ±5 PPM
Input Voltage: +5VDC ±5%
Output: Compatible with TTL and DTL Logic
Seal: Hermetic
Weight: Less than 3 ounces
Package Size: 1.25 x 1.75 x .600
Volume: 1.312 cubic inches

*The frequency trim adjustment is optional and should be specified when required.



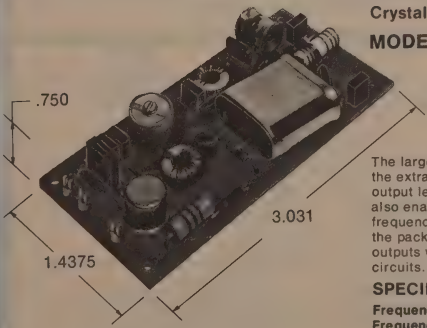
Temperature Compensated Crystal Oscillator

MODEL MC302X2

TCXO designed to provide sine wave outputs up to 85 MHz with minimum package volume.

SPECIFICATIONS

Frequency Range: 12 MHz to 85 MHz
Frequency Tolerance vs. Temperature Range (choose one):
 ±1.0 PPM over −10° to +60° C
 ±5 PPM over −20° to +70° C
 ±10 PPM over −55° to +105° C
Input Voltage: +12VDC ±5%
Output Waveform: sine
Output Power: Typically 5 mw. into a 60 Ω Load
Seal: Hermetic
Weight: Less than 3 ounces
Mounting: Direct to printed circuit board with wire leads out major surface. Also available with studs out major surface and wire leads out side of unit (MC301X2).
Current Drain: 25ma. max.



Crystal Controlled Oscillator

MODEL MC501C1

The larger size of this model allows the extra circuitry to obtain higher output levels (as high as 20mw.). It also enables the use of M-22 lower frequency crystal units to be placed in the package for lower frequency outputs without the use of divider circuits.

SPECIFICATIONS

Frequency Range: 940 Hz to 160 MHz
Frequency Stability:
 940 Hz to 10 KHz: ±.02%
 10 KHz to 700 KHz: ±.015%
 700 KHz to 160 MHz: ±.005%
Temperature Range: −55° to +85° C
Input Voltage:
 940 Hz to 700 KHz = +5VDC to +28VDC
 700 KHz to 160 MHz = +10VDC to +28VDC
Output Levels:
 940 Hz to 150 KHz: Up to 3VRMS into a 1000 Ω Load with <1% distortion
 150 KHz to 700 KHz: Typically 1VRMS into a 1000 Ω Load
 700 KHz to 160 MHz: Up to 20mw. depending on frequency selection
Output Waveform: sine or square
Seal: Hermetic
Mounting & Termination: Many different versions are available using studs, inserts, solder terminals, and RF connectors
Outside Trim: Available on request

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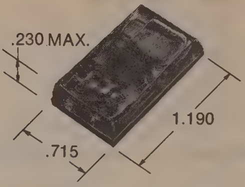
McCOY CRYSTAL OSCILLATORS



Crystal Controlled Oscillator
MODEL MC1000A1

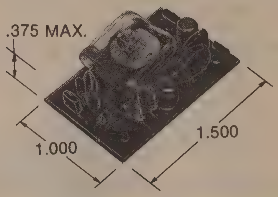
Thick Film, low profile oscillator designed to satisfy small volume designs which must have minimum seated height on printed circuit board or dual-in-line socket.

SPECIFICATIONS

Frequency Range: 188 KHz to 50 MHz

Frequency Tolerance and Temperature Range (customer choice):
±50 PPM over −55° to +105° C
±50 PPM over −40° to +85° C
±50 PPM over 0° to +75° C

Input Voltage: +5VDC ±5%
Output: TTL/DTL Compatible
Seal: Hermetic
Mounting: Printed circuit board or direct plug into a dual-in-line socket
Package Volume: 0.196 cubic inches



Crystal Controlled Oscillator
MODEL MC262X1

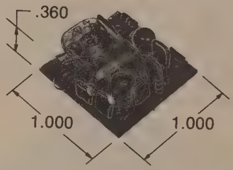
Similar to our MODEL MC110A1, the MC262X1 is used where G-30 or M-28 crystal units are required, due to frequency or low aging rate requirement. It is also used in high shock and vibration requirements and high reliability applications.

SPECIFICATIONS

Frequency Range: 180 KHz to 30 MHz

Frequency Stability vs. Temperature Range (suggested values only):
± 50 PPM over −55° to +105° C
±100 PPM over −55° to +105° C
± 30 PPM over −55° to +105° C
± 50 PPM over 0° to +70° C
± 10 PPM over 0° to +50° C

Input Voltage: +5VDC ±5%
Output: TTL/DTL Compatible
Seal: Hermetic
Weight: 2 ounces max.
Mounting: Direct PC Mount
Current Drain: 10ma. to 50ma. depending on frequency



Crystal Controlled Oscillator
MODEL MC110A1

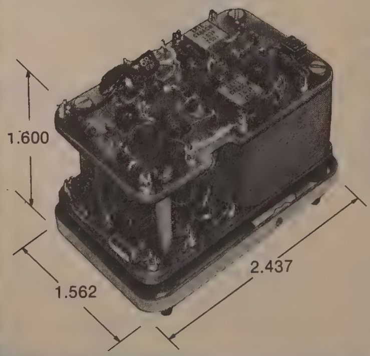
Relatively low cost crystal controlled oscillator designed for commercial or military equipment. Use where space is a problem and height is of prime consideration.

SPECIFICATIONS

Frequency Range: 30 KHz to 55 MHz

Frequency Tolerance vs. Temperature Range (suggested valves only):
30 KHz to 650 KHz
±100 PPM over −55° to +85° C
± 65 PPM over −40° to +70° C
± 50 PPM over 0° to +75° C
650 KHz to 30 MHz
± 70 PPM over −55° to +125° C
± 50 PPM over −55° to +105° C
±100 PPM over −55° to +105° C
30 MHz to 50 MHz
± 50 PPM over −40° to +85° C
± 50 PPM over 0° to +75° C
±100 PPM over −55° to +105° C

Input Voltage: +5VDC ±5% at 10ma. to 50 ma. depending on frequency
Output: TTL/DTL Compatible
Seal: Hermetic
Weight: 1 ounce max.
Mounting: Direct PC Mount
NOTE: Where all MIL-Parts must be used, specify MODEL MC109A1 which is same as MC110A1 except .500 max. height.



Oven Controlled Crystal Oscillator
MODEL MC645X4

Small, stable oven used where the upper ambient must be as high as +90° C.

SPECIFICATIONS

Frequency Range: 2.0 to 25 MHz
Frequency Stability: ±10 PPM over the temperature range
Temperature Range: −55° to +90° C
Input Voltage:
Oscillator: +16VDC ±5%
Oven: +18VDC to +35VDC (select value)

Output Waveshape: sine or square
Output Voltage: 4VP-P ±3db into a 10,000 Ω Load
Outside Trim: Yes, to better than 0.1 PPM of nameplate frequency
Oven Control: Proportional Type Solid State
Oven Power:
6 watts max. at −55° C turn-on and +28VDC input
3.5 watts max. steady state at −55° C and +28VDC input
Warm-up time: 10 minutes at −55° C (unit will be within frequency tolerance over the temperature range.

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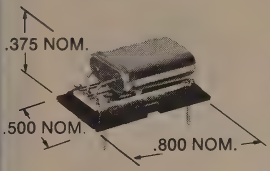
McCOY CRYSTAL OSCILLATORS



Miniature Dip Crystal Clock Oscillator

701/702 SERIES

SPECIFICATIONS

Size:
MC 701A1 -4 Pin Dip Plastic Pkg.
MC 702A1 -14 Pin Dip Plastic Pkg.

Pin Conn:
MC 701A1/MC 702A2 Pin #1 NC
Pin #7 GND
Pin #8 RF Output
Pin #14 +5VDC

Frequency Range:
156 KHz to 25 MHz

Frequency Stability Over Temp:
± 20 PPM, +15 °C to +34 °C
± 50 PPM, 0 °C to +70 °C
± 60 PPM, -40 °C to +85 °C
± 70 PPM, -55 °C to +105 °C

Frequency Calibration @ +25 °C:
± 25 PPM
± 10 PPM (Optional @ Prem.)

Frequency Stability vs. B+ (5.0 VDC) ± 10%:
± 2.0 PPM

Frequency Stability vs. A Load, 1 to 10 Loads:
± 2.0 PPM

Aging vs. Time:
± 5 PPM, 1st Yr. ± 3 PPM/Yr. For Subsequent Yrs.

Symmetry:
40% to 60% Typ., 35% to 65% max.

Risetime:
(.5V to 2.4V): 10 to 25 nsec Value Related to Output Frequency

Fall Time:
(2.4 to .5V): 10 to 25 nsec Value Related to Frequency

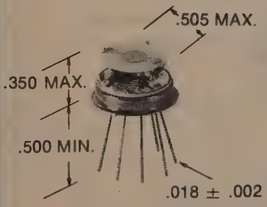
Fanout:
1 to 10^{2}T L Loads
(1 sink = 16.0 ma. max., 1 source = 4 ma. max.)

Output Voltage:
Logic "1": 2.4V min.
Logic "0": 0.4V max.

Input:
+5VDC. ± 10%
2.5 MHz to 25 MHz, 15 ma. typ. (25 ma. max.)
625 KHz to 2.5 MHz, 30 ma. typ. (50 ma. max.)
156 KHz to 625 KHz, 40 ma. typ. (65 ma. max.)

Features: MC701A1:
Utilizes 4 pins to facilitate mounting on PC board solder operation.

MC702A1:
Utilizes 14 Pins for mounting in 14 pin dip socket for maximum engagement under shock and vibration conditions.



Miniature Crystal Clock Oscillator

708 SERIES

SPECIFICATIONS

Frequency Range:
Binary Output: 250 KHz to 4.0 MHz
Straight Thru: 4.0 MHz to 50.0 MHz

Frequency Stability:
± 35 PPM, 0 °C to +75 °C
± 50 PPM, -40 °C to +85 °C
± 70 PPM, -55 °C to +105 °C

Frequency Calibration @ 25° C:
± 15 PPM, 250 KHz to 20 MHz
± 25 PPM, 20 MHz to 50 MHz

Aging @ +25°C:
± 10 PPM, max., 1st Yr.
± 5 PPM, max., Per For Successive Yrs.

Input Power @ +5VDC, ± 5%:
55ma. max., 35ma typ., from 250 KHz to 4.0 MHz
20ma. max., 14ma typ., from 4.0 MHz to 50.0 MHz

Output:
T^{2}L/DTL Compatible

Fan Out:
10T^{2}L Loads, from 250 KHz to 4.0 MHz
6T^{2}L Loads, from 4.0 MHz to 50.0 MHz

Logic Levels:
Logic "0":0.4V max.
Logic "1":2.4V min.

Duty Cycle: Logic "1" @ 1.5V Level:
45% to 55% from 250 KC to 4.0 MHz (Binary)
40% to 60% from 4.0 MHz to 30.0 MHz
35% to 65% from 30.0 MHz to 50.0 MHz

Seal: Cold Weld
Leak Rate: 1 x 10^{-8} ATM CC/SEC

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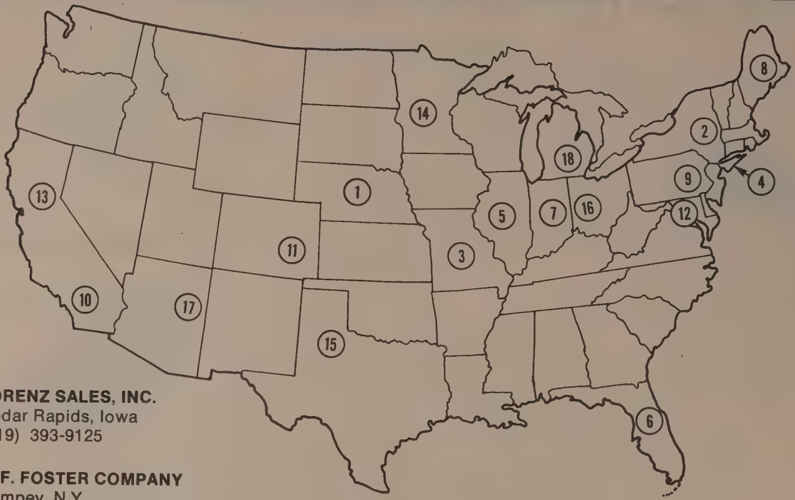
McCOY SALES REPRESENTATIVES



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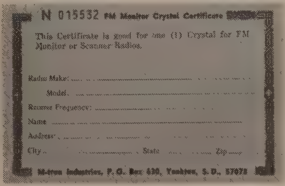

N 015532 FM Monitor Crystal Certificate

This Certificate is good for one (1) Crystal for FM Monitor or Scanner Radios.

Radio Make:

Model.

Receive Frequency:

Name

Address

City | State | Zip

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Military/Precision

- QPL approvals to MIL-C-3098
- Hermetically sealed cold-weld and subminiature enclosures
- Computer design program guarantees fast delivery of sample designs

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Because of its strict quality control and testing programs,
MF Electronics guarantees that every MF Crystal Oscillator
you purchase will meet or exceed your specifications.
Each oscillator is carefully checked and tested under worst-case conditions
to insure it will function properly for a full year under normal operating conditions.
The individual performance parameters are recorded
and available for study years after the production date.
Because we take care to make them better and test them better,
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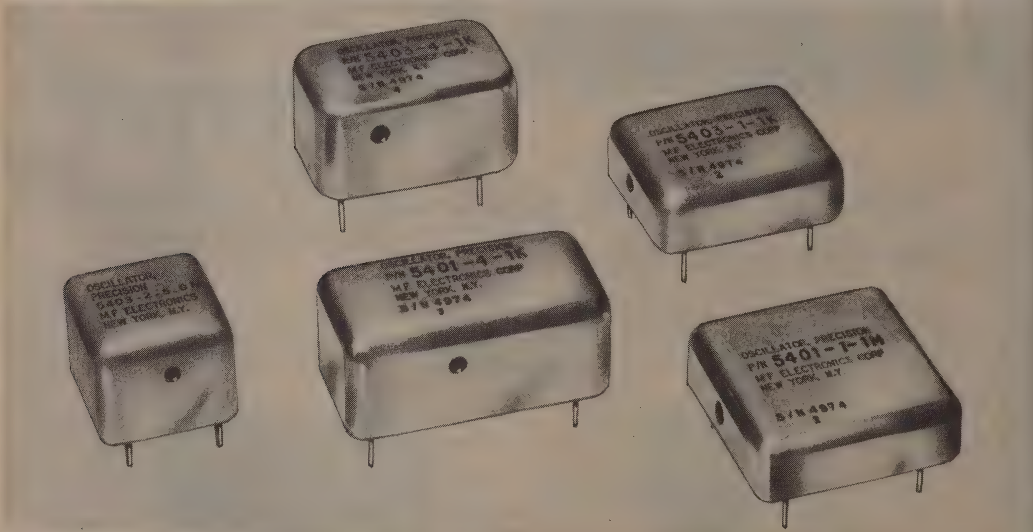
MF GUARANTEED CRYSTAL OSCILLATORS (TCXO and XO) • 1 Hz - 20 MHz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P/N 5403-4-1K
MF ELECTRONICS CORP
NEW YORK, N.Y.
S/N 4974
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OSCILLATOR, PRECISION
P/N 5401-1-1M
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NEW YORK, N.Y.
S/N 4974

The frequency input voltage characteristics of the 5401 series has been improved to the point that specific frequency accuracy is a complete tolerance, including all effects of temperature, input voltage and initial accuracy.

All unit frequencies are screwdriver adjustable, and there is a choice of 2 case sizes for each set of frequency/stability specifications to match your PC board mounting requirements. Commonly requested frequencies are in stock and available for immediate delivery.

Series 5401 and 5403 oscillators are metal cased, with superior frequency characteristics to the smaller DIP types. Operating from standard 5 volts power, they are used in TTL logic and have a drive capacity of 10 TTL loads. Both series can drive CMOS at 5 volts up to 4 MHz.

The 5401 series differs from the 5403 in that all 5401's are individually temperature compensated with a guaranteed frequency stability of ± 1 ppm at temperatures from 0° to 65° C, while the frequency stability of the 5403's is ± 10 ppm.

MF ELECTRONICS CORP.
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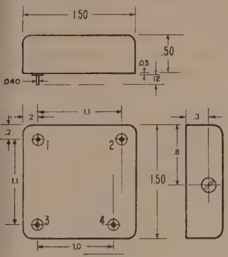
SERIES 5401

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS (TCXO) • 1 Hz - 20 MHz

	5401-1, 2	5401-3, 4
Frequency range	As specified from 250 KHz to 20 MHz	As specified from 1 Hz to 249 KHz
Input Current, Maximum	50 ma	100 ma

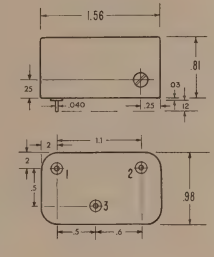
	MINIMUM	TYPICAL	MAXIMUM	
Input Voltage	4.75	5.00	5.25	Volt
Frequency Screwdriver Adjustment	±5	±10		ppm
Frequency Stability with Temperature from 0 to 65°C		±0.4	±0.8	ppm
Frequency Stability with Input Voltage from 4.75 to 5.25 volts		±0.1	±0.2	ppm
Ageing, per month, after 60 days		±0.2		ppm
Output Fan Out			10	TTL loads
Symmetry, at 1.5 volts	40/60		60/40	
Rise Time, 0.8 to 2.4 volts 1 Hz to 10 MHz Over 10 MHz to 20 MHz		 7 2.5	 20 5	 ns ns
Fall Time, 2.4 to 0.8 volts 1 Hz to 10 MHz Over 10 MHz to 20 MHz		 4 2	 20 5	 ns ns

SPECIFICATIONS, SERIES 5401



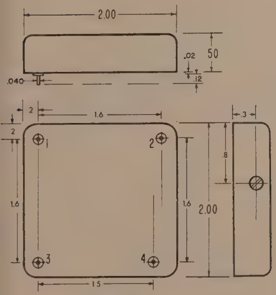
150
.50
.03
.12
.040
2
1.1
.3
.2
.8
1.1
1.50
1
2
3
4
1.0

5401-1



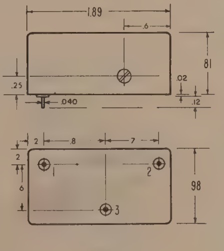
1.56
.81
.25
.03
.040
.25
.12
2
1.1
2
.5
1
2
3
98
.5
.6

5401- 2



2.00
.02
50
.12
.040
2
1.6
.3
2
.8
1.6
1.6
2.00
1
2
3
4
1.5

5401-3



1.89
.6
.81
.25
.02
.040
.12
2
.8
.7
2
6
1
2
3
98

5401-4

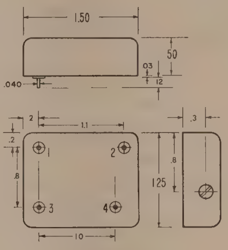
SERIES 5403

CRYSTAL OSCILLATORS (XO) • 1 Hz - 20 MHz

	5403-1, 2	5403-3, 4
Frequency range	As specified from 250 KHz to 20 MHz	As specified from 1 Hz to 249 KHz
Input Current, Maximum	50 ma	100 ma

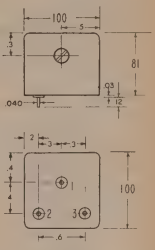
	MINIMUM	TYPICAL	MAXIMUM	
Input Voltage	4.75	5.00	5.25	Volt
Frequency Screwdriver Adjustment	±5	±10		ppm
Frequency Stability with Temperature from 0 to 65°C		±7	±10	ppm
Frequency Stability with Input Voltage from 4.75 to 5.25 volts		±0.3	±1	ppm
Ageing, per month, after 60 days		±0.2		ppm
Output Fan Out			10	TTL loads
Symmetry, at 1.5 volts	40/60		60/40	
Rise Time, 0.8 to 2.4 volts 1 Hz to 10 MHz Over 10 MHz to 20 MHz		 7 2.5	 20 5	 ns ns
Fall Time, 2.4 to 0.8 volts 1 Hz to 10 MHz Over 10 MHz to 20 MHz		 4 2	 20 5	 ns ns

SPECIFICATIONS, SERIES 5403



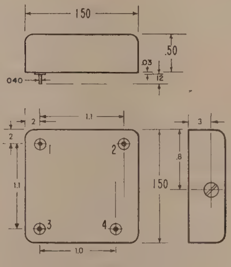
1.50
50
.03
.12
.040
2
1.1
.3
.2
.8
.8
125
1
2
3
4
1.0

5403-1



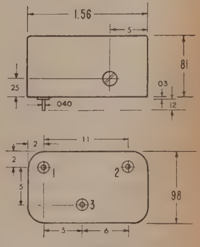
100
.5
.3
81
.03
.12
.040
2
.3
.3
.4
.4
100
1
2
3
.6

5403-2



150
.50
.03
.12
040
2
1.1
3
2
.8
1.1
150
1
2
3
4
1.0

5403-3



1.56
.5
81
25
03
040
.12
2
11
2
.5
1
2
3
98
.5
.6

5403-4

AVAILABLE IN CMOS LOGIC

HOW TO ORDER:

For Part Number...Add case style and frequency to the Series
For example:
Series 5401, Flatpack case, 10 MHz frequency

5401 — 1 — 10 M

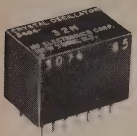
Series 5403, Compact case, 153.6 KHz frequency

5403 — 2 — 153.6K

MF ELECTRONICS CORP.
118 EAST 25th STREET, NEW YORK, N.Y. 10010 • (212) 674-5360 • TWX: 710-581-4109

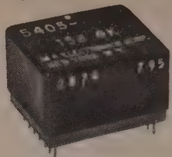
MF GUARANTEED

PLUG-IN CRYSTAL OSCILLATORS • 80 KHz-65 MH



SERIES 5404
5-65 MHz

SERIES 5405
80 KHz-4.99 MHz



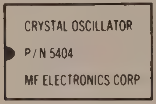
Series 5404 crystal oscillators generate a specified frequency from 5 to 65 MHz with an accuracy of ±.005% over a 0 to 65° C temperature range. The 5405 series generates a specified frequency from 80 KHz to 4.99 MHz, with an accuracy of ±.02%. Operating from +5 volts, they deliver outputs for DTL/TTL, and with the use of filters, can provide sine waves. Both units can drive 10 TTL loads. The outstanding aspect of both units is their ability to be plugged directly into sockets. The higher frequency 5404 takes only the socket space of one IC DIP package. The 5405, which generates the lower frequencies, is approximately twice the size of 5404, and occupies the space of two DIP packages, fitting directly into two DIP sockets which are spaced 0.5″ apart. Both units will mate into the Augat High Density Packaging panels (8136).

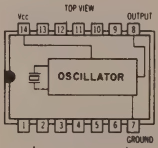
Common frequencies for the 5405 are 80K, 100K, 200K, 1M and 2 MHz. Common frequencies for the 5404 are 4, 4.9152, 5, 6, 8, 10, 16, 16.384, 20, 24, 30, 32, 40 and 50 MHz.

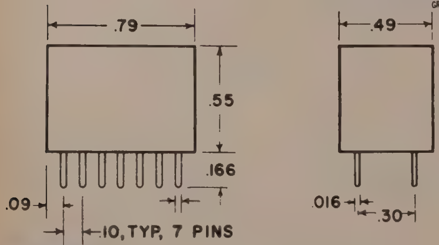
Note: For new designs, use series 5406 instead of the 5404.

SPECIFICATIONS

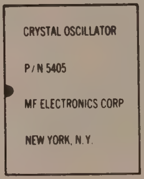
	MINIMUM	TYPICAL	MAXIMUM	
Input Voltage	4.75	5.0	5.25	volt
Input Frequency	As specified from 5 to 65 MHz			
Temperature of Operation	0 to 65° C			
Input Current 4 MHz to 10 MHz		20	40	ma.
Input Current Above 10 MHz to 65 MHz		25	50	ma.
Frequency Accuracy (All Conditions)	.005			%
Waveform Symmetry, measured at 1.5 v	40/60		60/40	
Rise Time, 4 MHz to 10 MHz, 0.8 to 2.4 volts		7	20	ns.
Fall Time, 4 MHz to 10 MHz, 2.4 to 0.8 volts		4	20	ns.
Rise Time over 10 MHz to 19.9999 MHz, 0.8 to 2.4 v		3.5	15	ns.
Fall Time over 10 MHz to 19.9999 MHz, 2.4 to 0.8 v		3	10	ns.
Rise Time from 20 MHz to 65 MHz, 0.8 to 2.4 volts		2.5	5	ns.
Fall Time from 20 MHz to 65 MHz, 2.4 to 0.8 volts		2	5	ns.

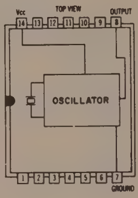

CRYSTAL OSCILLATOR
P/N 5404
MF ELECTRONICS CORP

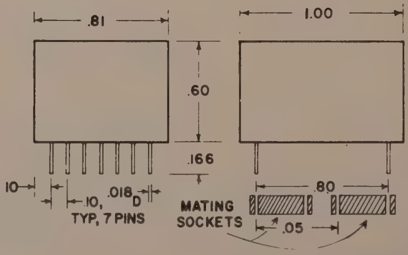

TOP VIEW
Vcc
OUTPUT
14
13
12
11
10
9
8
OSCILLATOR
1
2
3
4
5
6
7
GROUND


.79
.55
.166
.09
.10, TYP, 7 PINS
.49
.016
.30

	MINIMUM	TYPICAL	MAXIMUM	
Input Voltage	4.75	5.0	5.25	volt
Input Frequency	As specified from 80 K to 4.99 MHz			
Temperature of Operation	0 to 65 C			
Input Current 20 MHz to 60 MHz		20	40	ma.
Frequency Accuracy (All Conditions)		.02		%
Waveform Symmetry, measured at 1.5 V	40/60		60/40	
Rise Time		7	20	ns.
Fall Time		4	20	ns.


CRYSTAL OSCILLATOR
P/N 5405
MF ELECTRONICS CORP
NEW YORK, N.Y.


Vcc
TOP VIEW
OUTPUT
14
13
12
11
10
9
8
OSCILLATOR
1
2
3
4
5
6
7
GROUND


.81
.60
.166
10
.10, TYP, 7 PINS
.018 D
1.00
.80
MATING SOCKETS
.05

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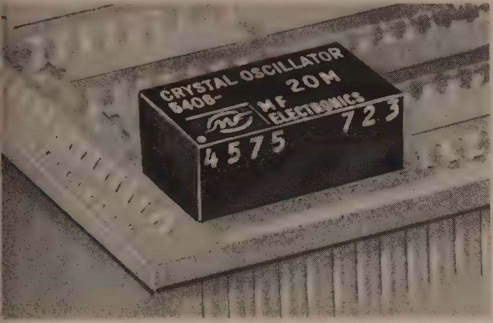
SERIES 5406 / 5407 4-65 MHz

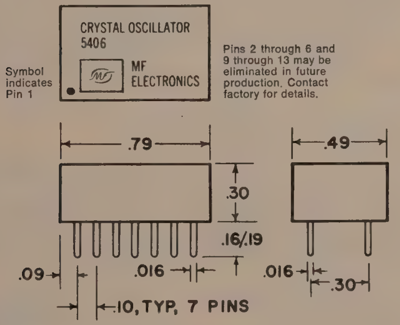

CRYSTAL OSCILLATOR
5406-
20M
MF
ELECTRONICS
4575
723

5406 SERIES

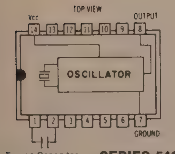
The 5406 oscillator module is in the frequency range of 4 to 50 MHz and is socket-pluggable or may be soldered into a printed circuit board. Operating from +5 volts, it delivers output for DTL/TTL, and with the use of filters can provide sine waves.

5407 SERIES

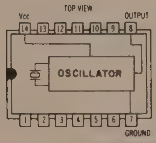
The 5407 is a controllable-frequency version of the 5406. The exact frequency can be achieved by the tuning of an external capacitor between pins 1 and 2. The adjustable range is at least ±20 ppm when the external capacitor is varied from 0 (open) to 32 pf.


CRYSTAL OSCILLATOR
5406
MF
ELECTRONICS
Symbol indicates Pin 1
.79
.49
.30
.16/.19
.09
.016
.016
.30
.10, TYP, 7 PINS

Pins 2 through 6 and 9 through 13 may be eliminated in future production. Contact factory for details.


TOP VIEW
Vcc
OUTPUT
14
13
12
11
10
9
8
OSCILLATOR
1
2
3
4
5
6
7
GROUND
Tuning Capacitor

SERIES 5407


TOP VIEW
Vcc
OUTPUT
14
13
12
11
10
9
8
OSCILLATOR
1
2
3
4
5
6
7
GROUND

SERIES 5406

The 5406 / 5407 crystal oscillators generate a fixed frequency over a temperature range of 0 to 65°C and –55 to +125°C, depending on dash number, for clock logic or communication frequency generation. For military uses, refer to parts 5408, 5409, 5420 and 5421.

All 5406 / 5407 units fan-out 10 TTL loads. From 4 to 10 MHz, logic is standard TTL; above 10 to 19.9 MHz, logic is high speed TTL. From 20 to 65 MHz, logic is Shottky TTL.

Series	Temperature of Operation	Frequency Accuracy, All Conditions
5406 / 5407	0 to +65°C	±.005% (±50 ppm)
5406-1 / 5407-1	0 to +65°C	±.0025%
5406-2 / 5407-2	–55 to +65°C	±.005%
5406-3 / 5407-3	0 to +85°C	±.005%
5406-4 / 5407-4	0 to +125°C	±.0075%
5406-5 / 5407-5	–55 to +85°C	±.005%
5406-6 / 5407-6	–55 to +125°C	±.0075%

SPECIFICATION OVER ALL TEMPERATURES, FULL LOAD

	MINIMUM	TYPICAL	MAXIMUM	
Input Voltage	4.75	5.0	5.25	volt
Input Frequency	As Specified from 4 to 65 MHz			
Input Current 4 MHz to 10 MHz		20	40	ma.
Input Current Above 10 MHz to 65 MHz		25	50	ma.
Frequency Accuracy (All Conditions)	See Preceding Table			
Waveform Symmetry, measured at 1.5 v	40/60		60/40	
Rise Time, 4 MHz to 10 MHz, 0.8 to 2.4 volts		7	20	ns.
Fall Time, 4 MHz to 10 MHz, 2.4 to 0.8 volts		4	20	ns.
Rise Time over 10 MHz to 19.9999 MHz, 0.8 to 2.4 v		3.5	15	ns.
Fall Time over 10 MHz to 19.9999 MHz, 2.4 to 0.8 v		3	10	ns.
Rise Time from 20 MHz to 65 MHz, 0.8 to 2.4 volts		2.5	5	ns.
Fall Time from 20 MHz to 65 MHz, 2.4 to 0.8 volts		2	5	ns.

AVAILABLE IN CMOS LOGIC

HOW TO ORDER:

For Part Number . . . Add frequency to the Series

For example:

Series 5404, ±50 ppm, 0 to 65°C 10 MHz frequency
→ **5404 - 10M**

Series 5406-5, ±50 ppm, –55 to +85°C 4.096 MHz frequency
→ **5406-5 - 4.096M**

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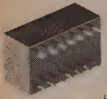
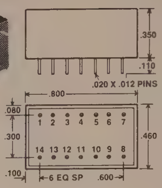
TTL LOGIC CLOCK OSCILLATORS

HERMETICALLY SEALED OR DIALLYL PHTHALATE PACKAGES

Monitor expands its line of TTL logic crystal-controlled oscillators by adding new economy models and offering a wider range of frequencies, stabilities, temperature ranges and availability. There's single and multiple output units for DIP and circuit board mounting. And standard frequencies are available for fast shipment. With delivery like this you don't have to maintain a costly inventory.

968, 969 SERIES / 1-20MHz / MULTIPLE OUTPUT / TTL LOGIC CLOCK OSCILLATORS / DIP 14-PIN PLUG-IN





Frequency Range:	1-20MHz basic frequency (fo)
*Standard Frequencies,	1.0, 2.0, 4.0, 8.0 and **16.0MHz in same unit 1.25, 2.5, 5.0, 10.0 and **20.0MHz in same unit **basic frequency
Stability:	±.005%, 0 to 70°C
Nominal Calibration:	±.005%, @ 25°C ±5°C
Output:	"0" = +.5V Max., "1" = 2.7V Min.
Input:	+5VDC, 35MA
Operating Temp. Range:	0 to 70°C
Leads:	.020" x .012"
Material:	Dialiyl Phthalate

PIN CONNECTIONS:

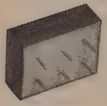
	968	969
1.	+5VDC	fo ÷ 2
2.	fo ÷ 8	Gnd.
3.	+5VDC	Gnd.
4.	+5VDC	N/C
5.	fo ÷ 2	+5VDC
6.	fo ÷ 2	TP
7.	Common	fo
8.	fo	fo ÷ 8
9.	fo ÷ 4	fo ÷ 4
10.	+5VDC	Gnd.
11.	+5VDC	fo ÷ 16
12.	fo ÷ 16	fo ÷ 2
13.	+5VDC	TP
14.	+5VDC	fo

PRICING

Series	1	5	10	50	100	ESTIMATES		
						500	1000	5000
968	90.00	45.00	33.75	22.50	18.00	15.75	13.50	10 12
969	80.00	40.00	30.00	20.00	16.00	14.00	12.00	9.00

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

900 SERIES: DIP PLUG-IN: 50Hz — 125MHz



DIP plug-in
TO-116 compatible

SPECIFICATIONS / PRICING

Series	Frequency Range	Output	OSC Input VDC	Typical OSC Current Drain MA	Dimension (Inches) L W H	* Typical Stability (0° - 60°C)	1	5	10	50	100	Estimates		
												500	1000	5000
900	50 HZ - 7.9 KHZ	"0" = + .4V Max. "1" = + 2.4V Min.	5 ± 10%	150	2.0x1.0x.5	±100 PPM	124.00	62.00	46.50	31.00	20.15	17.05	15.50	12.40
905	8 KHZ - 999 KHZ			90	•	±60 PPM	112.00	56.00	42.00	28.00	18.20	15.40	14.00	11.20
910	1 MHZ - 10 MHZ			50	1.0x.75x.5	±30 PPM	86.00	43.00	32.25	21.50	13.98	11.82	10.75	8.60
915	10 MHZ - 25 MHZ						90.00	45.00	33.75	22.50	14.62	12.38	11.25	9.00
920	25 MHZ - 75 MHZ						96.00	48.00	36.00	24.00	15.60	13.20	12.00	9.60
925	75 MHZ - 125 MHZ						98.00	49.00	36.75	24.50	15.92	13.48	12.25	9.80
930	1 MHZ - 10 MHZ			50	1.0x.75x.350	±30 PPM	98.00	49.00	36.75	24.50	15.92	13.48	12.25	9.80
935	10 MHZ - 25 MHZ			50	1.0x.75x.350	±30 PPM	102.00	51.00	58.25	25.50	16.58	14.02	12.75	10.20
940	25 MHZ - 75 MHZ			70	1.0x.75x.350	±30 PPM	106.00	53.00	39.75	26.50	17.22	14.58	13.25	10.60
945	75 MHZ - 125 MHZ			70	1.0x.75x.350	±30 PPM	110.00	55.00	41.25	27.50	17.88	15.12	13.75	11.00

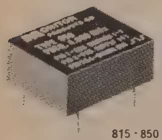
*Nominal Calibration: ±50 PPM @ 25°C
Full Ambient Devices Available at Additional Cost

• 905 Series: 8-50 KHZ 1.75"x1.0"x.5"
50-999 KHZ 1.5" x1.0"x.5"

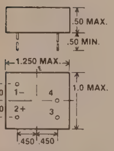
*STANDARD DELIVERY: 1 MHZ, 2 MHZ, 4 MHZ, 5 MHZ, 10 MHZ, 20 MHZ.

All of the above are available as full ambient mil certified devices. Write for specification drawings and pricing.

800 SERIES / LOW PROFILE / 225KHz-24.99MHz / TTL LOGIC ECONOMY CLOCK OSCILLATORS



815 - 850



1. NEGATIVE COMMON 3. SIGNAL OUT
2. POSITIVE SUPPLY 4. SIGNAL OUT

SPECIFICATIONS / PRICING

Series	Frequency Range	Output	OSC Input VDC	Typical OSC Current Drain MA	Dimension (Inches) L W H	* Typical Stability (0° - 60°C)	1	5	10	50	100	Estimates		
												500	1000	5000
805	50 HZ - 900 KHZ	"0" = + .4V Max. "1" = + 2.4V Min.	5 ± 10%	150	1.5x1.5x.750	±30 PPM	98.00	49.00	36.75	24.50	15.92	13.48	12.25	9.80
810	16 KHZ - 80 KHZ			30	1.87x1.25x.5	±80 PPM	90.00	45.00	33.75	22.50	14.62	12.38	11.25	9.00
815	10 KHZ - 80 KHZ			75	1.25x1.0x.5	±60 PPM	88.00	44.00	33.00	22.00	14.30	12.10	11.00	8.80
820	80 KHZ - 900 KHZ			15		±60 PPM	86.00	43.00	32.25	21.50	13.98	11.82	10.75	8.60
830	900 KHZ - 1.5 MHZ			25		±30 PPM	70.00	35.00	26.25	17.50	11.38	9.62	8.75	6.95
840	1.5 MHZ - 3.5 MHZ			15			51.00	25.50	19.12	12.75	8.28	7.01	6.38	5.10
845	3.5 MHZ - 10.0 MHZ						59.00	29.50	22.12	14.75	9.59	8.11	7.38	5.90
850	10.0 MHZ - 40.0 MHZ						68.00	34.00	25.50	17.00	11.05	9.35	8.50	6.80

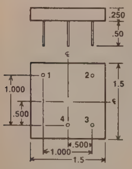
*Nominal Calibration: ±50 PPM @ 25°C
Available to −55°C as type 750 series.

*STANDARD DELIVERY: 50 Hz, 60 Hz, 400 Hz, 1 KHz, 10 KHz, 100 KHz, 500 KHz, 1 MHz, 2.0 MHz, 4.0 MHz, 5.0 MHz, 10 MHz, 20 MHz.

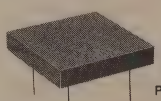
MONITOR HAS HUNDREDS OF OTHER FREQUENCIES AVAILABLE FOR 72 HOUR DELIVERY. CHECK WITH US FOR YOUR REQUIREMENT.

SPECIFICATIONS / PRICING

Series	Frequency Range	*Standard Frequency	Output	Input (VDC)	Stability (0° - 60°C)	1	5	10	50	100	Estimates		
											500	1000	5000
861	225 KHZ - 999 KHZ	—	"0" = + .4V Max. "1" = + 2.4V Min.	+5V ± 10%, 40 MA	±.005% Nominal Calibration: ±.005% @ 25°C	90.00	45.00	33.75	22.50	14.62	12.38	11.25	9.00
862	1 MHZ - 3.999 MHZ	1, 2 MHZ		+5V ± 10%, 25 MA		76.00	38.00	28.50	19.00	12.35	10.45	9.50	7.60
863	4 MHZ - 15.99 MHZ	4, 5, 10 MHZ		+5V ± 10%, 20 MA		66.00	33.00	24.75	16.50	10.72	9.08	8.25	6.60
864	16 MHZ - 24.99 MHZ	—		+5V ± 10%, 20 MA		72.00	36.00	77.00	18.00	11.70	9.90	9.00	7.20



861-864



OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

PIN CONNECTIONS:
1. +5V (Supply)
2. Common (−)
3. Output
4. Output (Compl.)

Leads: .025" Dia. gold Dumet
Material: Diallyl Phthalate

750 SERIES: FULL AMBIENT DIGITAL CLOCKS 50Hz — 40MHz

All of the above 800 Series is available in extreme environment military specification configurations as the 750 Series. Call factory for pricing and delivery.

Specifications and pricing subject to change without notice.

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

48 Years of Frequency Control Know-How

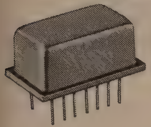
TTL LOGIC CLOCK OSCILLATORS

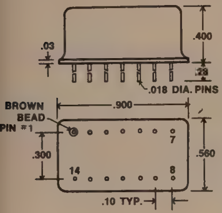
2 NEW OSCILLATORS

Monitor's two new crystal-controlled clock oscillators offer excellent stability in a wide selection of frequencies. The subminiature hermetically sealed GO Series is also available to withstand extreme environments.

GO SERIES / SUBMINIATURE HERMETICALLY SEALED / TTL LOGIC CLOCK OSCILLATORS 218 KHz — 20 MHz / 14-PIN DIP COMPATIBLE

NEW HERMETICALLY SEALED





SPECIFICATIONS — PRICING

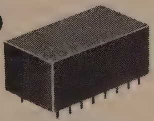
Series	Frequency Range	OSC Input VDC	Current Drain MA (Max.)	1	5	10	50	100	Estimates 500	Estimates 1000	Estimates 5000
G20	16.001 - 20 MHz	5±10%	35	115.00	57.50	43.12	28.75	18.69	15.81	14.38	11.50
G01	7.5 - 16 MHz		35	110.00	55.00	41.25	27.50	17.88	15.12	13.75	11.00
G02	3.5 - 7.499 MHz		25	95.00	47.50	35.62	23.75	15.44	13.06	11.88	9.50
G03	1.75 - 3.5 MHz		35	98.00	49.00	36.75	24.50	15.92	13.48	12.25	9.80
G04	875 KHz - 1.75 MHz		35	104.00	52.00	39.00	26.00	16.90	14.30	13.00	10.40
G05	450 - 875 KHz		50	108.00	54.00	40.50	27.00	17.55	14.85	13.50	10.80
G06	218 - 450 KHz		50	112.00	56.00	42.00	28.00	18.20	15.40	14.00	11.20
G30	16.001 - 20 MHz		35	135.00	69.00	51.50	34.75	22.90	19.85	17.00	15.70
G07	7.5 - 16 MHz		35	130.00	65.00	48.75	32.50	21.12	17.88	16.25	13.00
G08	3.5 - 7.499 MHz		25	115.00	57.50	43.12	28.75	18.69	15.81	14.38	11.50
G09	1.75 - 3.5 MHz		35	118.00	59.00	44.25	29.50	19.18	16.22	14.75	11.80
G10	875 KHz - 1.75 MHz		35	124.00	62.00	46.50	31.00	20.15	17.05	15.50	12.40
G11	450 - 875 KHz		50	128.00	64.00	48.00	32.00	20.80	17.60	16.00	12.80
G12	218 - 450 KHz		50	132.00	66.00	49.50	33.00	21.45	18.15	16.50	13.20

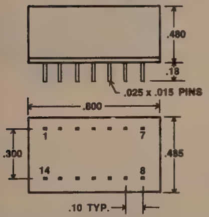
Typical Stability: G01 - G06, ±100 PPM, 0° - 70°C / G07-G12, ±100 PPM, −55°C to +125°C (closer stabilities available)
Set Tolerance: ±50 PPM at +25°C ±5°C (closer stabilities available)
Output: Symmetry 60/40 (when measured between the 1.4V point)
Amplitude: V_{ol} = 0.4V max., V_{oh} = +2.4V min.
Rise/Fall Time: 20 nanoseconds nominal (V_{ol} to V_{oh})
Output Reference: Common pin No. 7
Load: Up to 10 TTL gates (1.6 MA each)

Pin Connections: 7 common, 8 output, 14 +5 V input. All other pins may be internally connected and cannot be used as external tie points.
Connector: TO-116 pin pattern
Material: Nickel silver
Mounting: DIP socket
Environmental: (G07 - G12 only)
Shock: Mil-Std-202D method 213, test condition A
Vibration: Mil-Std-202D method 201, 10G's from 10Hz - 500 Hz
Immersion: Mil-Std-202D method 104A, test condition A
Acceleration: Mil-Std-202D method 212A, test condition A

FO SERIES / 218 KHz — 20 MHz / TTL LOGIC CLOCK OSCILLATORS / 14-PIN DIP PLUG-IN

NEW





SPECIFICATIONS — PRICING

Series	Frequency Range	OSC Input VDC	Current Drain MA (Max.)	1	5	10	50	100	Estimates 500	Estimates 1000	Estimates 5000
F20	16.001 - 20 MHz	5 ± 10%	35	73.00	36.50	27.38	18.25	11.86	10.04	9.12	7.30
F01	7.5 - 16 MHz		35	67.00	33.50	25.12	16.75	10.89	9.21	8.38	6.70
F02	3.5 - 7.499 MHz		25	59.00	29.50	22.00	14.75	9.59	8.11	7.38	5.90
F03*	1.75 - 3.5 MHz		35	63.00	31.50	23.62	15.75	10.24	8.66	7.88	6.30
F04*	875 KHz - 1.75 MHz		35	65.00	32.50	24.38	16.25	10.56	8.94	8.12	6.50
F05	450 - 875 KHz		50	69.00	34.50	25.88	17.25	11.21	9.49	8.62	6.90
F06	218 - 450 KHz		50	73.00	36.50	27.38	18.25	11.86	10.04	9.12	7.30

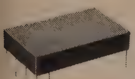
*Dual complementary output standard.

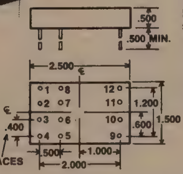
Typical Stability (0° - 70°C): ±100PPM (closer stabilities available)
Set Tolerance: ±100PPM at +25°C ±5°C (closer stabilities available)
Output: Symmetry 60/40 (when measured between the 1.4V point)
Amplitude: V_{ol} = 0.4V max., V_{oh} = +2.4V min.
Rise/Fall Time: 20 nanoseconds nominal (V_{ol} to V_{oh})

Output Reference: Common pin No. 7
Load: Up to 10 TTL gates (1.6 MA each)
Pin Connections: 7 common, 8 output, 14 +5 V input. All other pins may be internally connected and cannot be used as external tie points.
Connector: TO-116 pin pattern
Material: Diallyl Phthalate
Mounting: DIP socket

COMPUTER TERMINAL CLOCKS

for telecommunications and Modem applications





The SO-3631A is a reference clock oscillator designed specifically for the telecommunications and Modem user. A unique design provides 16 standard baud rates in one package. The mode of operation is selectable with one external connection. See chart below.

Output Pin	Pin 10 to Com.; Pin 11 Open		Pin 11 to Com.; Pin 10 Open	
	Baud Rate	Freq. (KHz)	Baud Rate	Freq. (KHz)
1	100	1.600	110	1.760
2	150	2.400	165	2.640
3	300	4.800	330	5.280
4	600	9.600	660	10.560
5	1200	19.20	1320	21.120
6	2400	38.40	2640	42.240
7	4800	76.80	5280	84.480
8	9600	153.60	10560	168.960

	1	5	10	50	100	500	1000	5000
Prices:	164.00	82.00	61.50	30.75	26.65	22.50*	20.50*	16.40*

*Estimated

Stability: ±50PPM, 0 to 75°C
Nominal Calibration: ± 30PPM at 25°C
Output: "0" = .5V Max.
"1" = 2.7V Min.
Rise/Fall Time: 15 nanoseconds typical.
Load: Max. of 10 TTL gates per output.
Material: Diallyl Phthalate
Pin Connections:
Pin 9: +5V supply. 10: 100 baud rate (See table). 11: 110 baud rate. 12: — common
Leads: No. 22AWG, .025″ dia. gold plated Dumet
Other baud rates available on special order.

Specifications and pricing subject to change without notice.

MONITOR PC

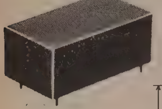
MONITOR PRODUCTS COMPANY, INC.
3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

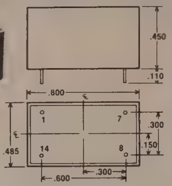
48 Years of Frequency Control Know-How

CMOS LOGIC CLOCK OSCILLATORS

Monitor has CMOS! Monitor's new CMOS logic crystal-controlled oscillators are precision clocks with single and multiple outputs for today's CMOS logic applications. The units are complete and ready to plug into a DIP socket or circuit board. Why build them yourself when Monitor can supply standard frequencies at these low prices? And each unit is backed by 48 years of frequency control know-how.

978A SERIES / 3-10MHz / CMOS LOGIC CLOCK OSCILLATORS / 14-PIN DIP COMPATIBLE





Frequency Range:	3-10MHz
*Standard Frequencies:	4.194304MHz (1Hz binary multiple) 3.932160MHz (60Hz binary multiple) 4.096MHz (1MHz binary multiple)
Stability:	±.005%, −40 to +85°C
Normal Calibration:	±.01% @ 25°C ±5°C
Output:	"0" = +.5V Max., "1" = 80% of supply voltage min.
Input:	10-15VDC, 3.0 MA Max.
Operating Temp. Range:	−40 to +85°C
Leads:	.019" dia. gold Dumet pins in 14-pin DIP compatible configuration
Material:	Diallyl Phthalate

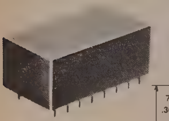
PIN CONNECTIONS:
1. Output
7. Common
8. Output
14. + Supply Voltage

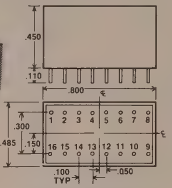
PRICING

Quantity	Price	Quantity	Price Estimate
1	76.00	500	13 30
5	38.00	1000	11.40
10	28.50	5000	8.66
50	19.00		
100	15.20		

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

979A SERIES / 3-9MHz / MULTIPLE OUTPUT / CMOS LOGIC CLOCK OSCILLATORS / DIP 16-PIN PLUG-IN





FREQUENCY RANGE:

Up to 13 outputs in a single package. Output frequencies depend on crystal frequency (fo) selected between 3 and 9MHz. See example below and Pin Connections.

*Standard Frequency: 4.096MHz

EXAMPLE OF OUTPUT FREQUENCIES AVAILABLE USING A CRYSTAL FREQUENCY (fo) OF 4.096 MHZ

PIN	FREQUENCY	PIN	FREQUENCY
10	4.096 MHZ	13	16 KHZ
9	2.048 MHZ	12	8 KHZ
7	256 KHZ	14	4 KHZ
5	128 KHZ	15	2 KHZ
4	64 KHZ	1	1 KHZ
6	32 KHZ	2	500 HZ
		3	250 HZ

Stability:	±.005%, −40 to +85°C
Nominal Calibration:	±.005% @ 25°C ±5°C and 12VDC
Output:	"0" = +.5V Max. "1" = 90% of supply voltage min.
Input:	+10V to +15V, 5 MA Max. (Depends on Frequency)
Operating Temp. Range:	−40 to +85°C
Leads:	.020" x .012"
Material:	Diallyl Phthalate

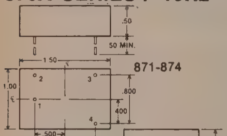
PRICING

Quantity	Price	Quantity	Price Estimate
1	90.00	500	16.75
5	45.00	1000	13.60
10	33.75	5000	10.12
50	22.50		
100	18.00		

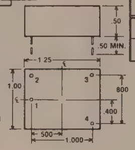
OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

PIN CONNECTIONS
1. Fo ÷ 4096
2. Fo ÷ 8192
3. Fo ÷ 16,384
4. Fo ÷ 64
5. Fo ÷ 32
6. Fo ÷ 128
7. Fo ÷ 16
8. Common
9. Fo ÷ 2
10. Fo (Xtal Freq.)
11. Common to pin 8
12. Fo ÷ 512
13. Fo ÷ 256
14. Fo ÷ 1024
15. Fo ÷ 2048
16. + Supply Voltage

870A SERIES / 10Hz - 10MHz / CMOS LOGIC CLOCK OSCILLATORS / PCB MOUNTING



871-874



877, 879

SPECIFICATIONS / PRICING

Series	Frequency Range	*Standard Frequency	Output	Input	†Stability (0° - 60°C)	1	5	10	50	100	Estimates 500	Estimates 1000	Estimates 5000
871A	10 HZ - 149.9 HZ	10, 60 HZ	"0"=+.5V Max. "1"=90% of Supply V Min.	10-15V, 10MA	±.01%	104.00	52.00	39.00	26.00	20.80	18.20	15.60	11.70
872A	150 HZ - 499.9 KHZ	—		10-15V, 10MA	±.005%	100.00	50.00	37.50	25.00	20.00	17.50	15.00	11.26
873A	500 KHZ - 1.99 MHZ	1 MHZ		10-15V, 10MA	±.005%	92.00	46.00	34.50	23.00	18.40	16.10	13.80	10.35
874A	2.0 MHZ - 5.0 MHZ	5 MHZ		10-15V, 10MA	±.005%	84.00	42.00	31.00	21.00	16.80	14.70	12.60	9.46
877A	100 KHZ - 700 KHZ	100 KHZ	"0"=+.5V Max. "1"=80% of Supply V	10-15V, <5MA	±.01% -25 to +75°C	82.00	41.00	30.75	20.50	16.40	14.35	12.30	9.22
879A	2.0 MHZ - 10.0 MHZ	5, 10 MHZ		10-15V, <10MA	±.005% -25 to +75°C	78.00	39.00	29.25	19.00	16.60	13.65	11.70	8.78

Operating Temperature Range:
871-874, 0-60°C
877, 879, —25 to +75°C

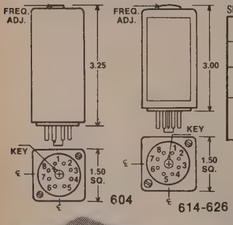
† Nominal Calibration : 871-874 & 879, ±.005% @ 25°C ±5°C
877, ±.01% at 25°C, ±5°C

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

Leads: .025" Dia. gold Dumet
Material: Diallyl Phthalate

PIN CONNECTIONS
1. N/C
2. Common
3. Output
4. + Supply Voltage

PRECISION FREQUENCY STANDARDS



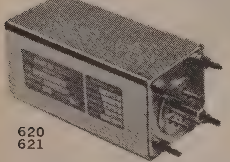
SPECIFICATIONS / PRICING

Type	Standard Frequency	Input Osc.	Input Oven	Stability (Long Term)	Temperature Stability/Range		1	5	10	50	100	Estimates 500	Estimates 1000	Estimates 5000
604	1-10 MHZ	24-30V, 25 MA	115VAC, 7 watts	$\pm 3 \times 10^{-9}$/Day @ 1MHZ	$\pm 2 \times 10^{-9}$/°C	-25 to +55°C	157.00	141.00	91.70	72.05	65.50	59.00	58.00	54.50
614	1 MHZ	5V± 10%, 15 MA	12-15V, 3 watts	$\pm 5 \times 10^{-9}$/Day	$\pm 5 \times 10^{-9}$/°C	-25 to +55°C	132.00	93.50	77.00	60.50	55.00	46.00	43.00	39.80
624 625 626	1 MHZ 5 MHZ 10 MHZ		24-30V, 80 MA	$\pm 7 \times 10^{-9}$/Day	$\pm 5 \times 10^{-9}$/°C	0 to 55°C	118.00	83.30	68.60	53.90	49.00	43.00	38.50	36.00

Material: Gold anodized aluminum

PIN CONNECTIONS
1. 115VAC
2. +5V Supply
3. N/C
4. (Pos.) 12-15V Supply
5. (Neg.) 12-15V Supply
6. 115VAC
7. Signal Output
8. Osc./Oven Common

Other frequencies, stabilities and temperature ranges available on special order.



620
621

Type	Frequency	Stability	Output	Oven Control	Dimensions (Inches) L x W x H	Connector
620	1 KHz-70 MHz	Parts in 10^{-7} per day	TTL or sine wave	Solid state mercury	2.0x2.0x4.5	Octal or multiple choices available
621	1 KHz-70 MHz	Parts in 10^{-9} per day	TTL or sine wave	Proportional	2.0x2.0x4.5	Octal or multiple choices available
627	1-5 MHz	±3 parts in 10^{-9} per °C ambient	Sine wave	Proportional	1.75x1.75x3.375	7-Pin Noval

Specifications and pricing subject to change without notice.

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

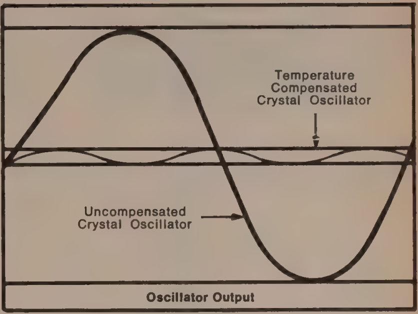
3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

48 Years of Frequency Control Know-How

TCXO TEMPERATURE COMPENSATED OSCILLATORS

Monitor Products, Temperature Compensated Crystal Oscillators assure precise frequency control, in the smallest possible package. The frequency stability vs. temperature range of each TCXO is individually optimized by use of the unique Monitor Products Computer Program. Elimination of oven control requirements greatly enhances reliability while providing high stability with extremely low current drain and zero warm up time. A full range of previously established designs are available including either Sinewave, DTL, TTL, or CMOS compatible outputs. Our TCXO's and TC/VCXO's are widely used in Industrial, Military or Spacebourne environments where high density packaging, low current drain, and maximum reliability are required. Some of our more popular designs available to satisfy your exact needs are listed herein. Please contact us for assistance in fully defining your TCXO or TC/VCXO requirements.

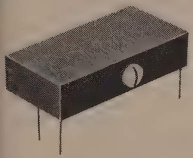
Monitor Products Company recently acquired the entire Frequency Devices product line of Arvin Industries. All drawings, test equipment and design information regarding previous **Arvin devices** have been integrated with the Monitor Product line. We are confident that this expansion of Monitor's capability assures our ability to fulfill your requirements exactly, whether TCXO or TC/VCXO

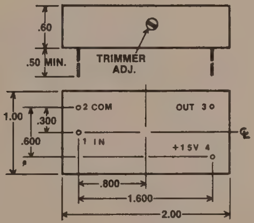

Temperature Compensated Crystal Oscillator
Uncompensated Crystal Oscillator
Oscillator Output

TC/VCXOs

Monitor's TC/VCXOs provide all the many advantages of Monitor Products TCXO's combined with a unique frequency versus voltage control capability. Total deviation of up to 1000 ppm at rates from DC to 20 KHz are available depending on center frequency and temperature range specified. Typical linearity is 5% to 10% of best straight line. Center frequency stabilities to ±1 ppm are available depending on frequency and temperature range. Slightly derated stability versus temperature designs are available to 150 MHz. Full complement of optional wave shapes available include square wave TTL, Sinewave and MOS/C-MOS. A detailed quotation is available upon receipt of your specific requirements. Please contact the factory direct.

E01-E06 SERIES TC/VCXO





Monitor TCXO Series E01 thru E06 are specifically designed for volume commercial or industrial applications. Automatic preselection of required network components is accomplished by use of unique mass production fixtures and a powerful digital computer program. This series is the lowest priced TC/VCXO design available in full production within the industry. Standard negative slope VCO control of ±20 ppm for ∓1V input variation. May be used as TCXO without input to pin 1.

SPECIFICATIONS PRICING

Series	Frequency Range	Stability (0° - 60°C)	Output		Input (VDC)	1	5	10	50	100	Estimates		
											500	1000	5000
E01	3 - 10 MHz	± 5 PPM	TTL	"0" = + .4V Max. "1" = +2.4V Min. 10 TTL Load	+10 to +15V ±5%, 20 MA	140.00	117.00	94.00	63.00	47.50	38.50	35.00	30.00
E02		± 1 PPM			+10 to +15V ±2%, 20 MA	185.00	155.00	124.00	84.00	63.00	49.50	46.25	39.25
E03		± 5 PPM	SINE WAVE	0 dbm Min. 50 ohms	+10 to +15V ±5%, 20 MA	148.00	124.00	99.00	67.00	50.50	39.50	37.00	31.50
E04		± 1 PPM			+10 to +15V ±2%, 20 MA	193.00	161.00	129.00	87.00	66.00	51.50	48.50	41.00
E05		± 5 PPM	CMOS	"0" = +.5V Max. "1" = 80% of Supply V Min.	+10 to +15V±5%, 10 MA	159.00	132.50	106.00	72.00	54.00	42.50	39.75	33.75
E06		± 1 PPM			+10 to +15V±2%, 10 MA	208.00	174.00	139.00	94.00	70.75	55.50	52.00	44.00

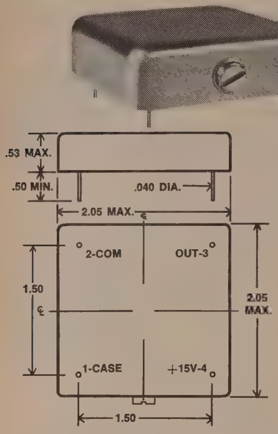
Specifications and pricing subject to change without notice.

MONITOR PRODUCTS COMPANY, INC.
3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

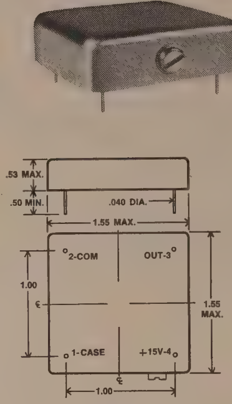
48 Years of Frequency Control Know-How

TCXO TEMPERATURE COMPENSATED OSCILLATORS

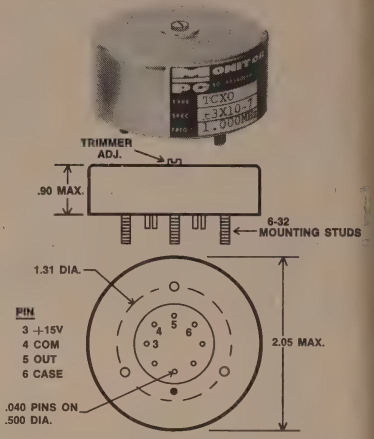
E07-E90 SERIES TCXOs



E07-E42



E43-E78



E79-E90

Monitor hermetically sealed E07 through E90 Series temperature compensated crystal oscillators are designed specifically for applications where extremely low input power is available and minimum or near zero warm-up time is required. E07 through E42 are typical of the more popular configurations currently in volume production. Series E43 through E78 represent state of the art subminiaturization of discrete component TCXO designs. Series E79 through E90 were designed specifically for personalized Telecommunications Systems and Military Man-Pac Radio Communication applications. Square configuration available with mounting studs and/or side egress terminals.

SELECTED SERIES/3-20 MHz FREQUENCY RANGE*

SPECIFICATIONS

PRICING

Series	Temperature Range	Stability	Output		Input (VDC)	1	5	10	50	100	Estimates		
											500	1000	5000
E15	0 to 60° C	± 5 PPM	SINE WAVE	0 dbm Min. 50 ohms	+10 to +15V± 5%, 20 MA	208.00	173.50	139.00	94.00	70.75	55.50	52.00	44.00
E27	0 to 60° C	± 1 PPM				232.00	193.50	155.00	105.00	78.75	62.00	58.00	49.00
E10	−20 to +70° C	± 1 PPM				244.00	203.50	163.00	110.00	83.00	65.00	61.00	52.00
E19	0 to 60° C	± 5 PPM	TTL	"0" = +.4V Max. "1" = +2.4V Min. 10 TTL Loads	+10 to +15V± 5%, 20 MA	192.00	160.00	128.00	87.00	65.00	51.50	48.00	41.00
E20	−20 to +70° C	± 5 PPM				204.00	170.00	136.00	92.00	69.50	54.50	51.00	43.00
E22	−20 to +70° C	± 1 PPM				228.00	190.00	152.00	103.00	77.50	61.00	57.00	48.00
E31	0 to 60° C	± 5 PPM	CMOS	"0" = +.5V Max "1" = 80% of supply V Min.	+10 to +15V ± 5%, 10 MA	200.00	167.00	134.00	90.00	68.00	53.50	50.40	42.50
E32	−20 to +70° C	± 5 PPM				212.00	177.00	142.00	96.00	72.00	56.50	53.00	45.00
E34	−20 to +70° C	± 1 PPM				236.00	197.00	158.00	107.00	80.50	63.00	59.00	50.00
E43	0 to 60° C	± 5 PPM	SINE WAVE	0 dbm Min. 50 ohms	+10 to +15V ± 5%, 20 MA	260.00	216.75	173.75	117.50	88.50	69.50	65.00	55.00
E45	0 to 60° C	± 1 PPM				290.00	241.75	193.75	131.25	98.50	77.50	72.50	61.25
E46	−20 to +70° C	± 1 PPM				305.00	255.50	203.75	137.50	103.75	81.25	76.25	65.00
E55	0 to 60° C	± 5 PPM	TTL	"0" = +.4V Max. "1" = +2.4V Min. 10 TTL Loads	+10 to +15V ± 5%, 20 MA	240.00	200.00	160.00	108.75	81.25	65.50	60.00	51.25
E56	−20 to +70° C	± 5 PPM				255.00	212.50	170.00	115.00	87.00	68.00	63.75	53.75
E58	−20 to +70° C	± 1 PPM				285.00	237.50	190.00	128.75	96.75	76.25	71.25	60.00
E67	0 to 60° C	± 5 PPM	CMOS	"0" = +.5V Max "1" = 80% of supply V Min.	+10 to +15V ± 5%, 10 MA	250.00	208.75	167.50	112.50	85.00	66.75	62.50	53.00
E68	−20 to +70° C	± 5 PPM				265.00	221.25	177.50	120.00	90.00	70.75	66.25	56.25
E70	−20 to +70° C	± 1 PPM				295.00	246.25	197.50	133.75	100.75	78.75	73.75	62.50

*Frequencies as low as 1 MHz and above 20 MHz available on request in some configurations.

Specifications and pricing subject to change without notice.

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

48 Years of Frequency Control Know-How

OVENS/CRYSTAL & COMPONENT

For over a quarter century Monitor has been solving oven problems for the electronics industry. 25 years of design experience and several hundred models are available. Why settle for less?

1192

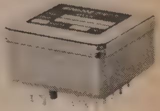
510
512
1145
1152
1176

547
581

530
531
1156

583

555
556


1169

HIGH RELIABILITY, SOLID STATE MERCURY CONTROLLED OVENS/ONE YEAR WARRANTY

To meet the increasing demands for closer long-term stabilities and better overall performance in extreme environments, Monitor offers its new line of proven design Solid State Mercury controlled ovens.

Oven Type	Cavity Accommodates	Stability °C		Heater Voltage	Watts	Std. Set Temp. ±2°C	Outside Dimensions L x W x H (Inches)	Cavity Dimensions L x W x H (Inches)	Warm-Up (Minutes)		Oper. Temp. Range	Connector
		Constant Ambient	Per °C Ambient Change						25C	-55°C		
512	MC-4 Crystal or Component	± .01	.005	115VAC 28VDC	15	75° C	1.437x1.875x4	.81 x 1.34 x 2	15	25	-55 to +70° C	Octal
530	Components	± .02	.007	115VAC	15	75° C	2.26x2.1x3.42	1.75x1.35x2.37	12	20	-55 to +65° C	Octal/Hooks
531	Components 1.75" x 2" x .031" Board	± .02	.007	28VDC	8	75° C	2.26x2.1x3.42	1.75x1.35x2.37	15	—	0 to +65° C	Octal/Hooks
581	KX-18 Crystal or Component	± .03	.02	28VDC 115VAC	5 max	75° C	1.2 x .4 x 1.4	.5 x .18 x .5	8	15	-55 to + 70° C	Wire Leads
583	KX-6 Crystal or Component	± .03	.01	28VDC 115VAC	5 max	75° C	1.281x.687x1.422	.770x.366x.967	8	15	-55 to + 70° C	Hooks/ Wire Leads
1145	Components	± .01	.005	115VAC	15	65° C	1.43x1.87x3.25	.81x1.34x2.22	15	25	-55 to +60° C	9-pin Noval
1152	Two Type HC6/U Crystals	± .01	.005	115VAC	15	75° C	1.43x1.87x2.75	.81x1.34x1.47	13	22	-55 to + 70° C	Octal
1156	Components	± .02	.007	115VAC	8	60° C	2.26x2.1x3.42	1.75x1.35x2.37	15	—	0 to + 55° C	11-pin Octal
1176	Components	± .01	.005	115VAC	15	75° C	1.43x1.87x2.75	.81x1.34x1.47	15	25	-55 to + 70° C	Octal
1192	Components	± .02	.008	115VAC	15	60° C	4.2x3.8x1.95	3.06x1.220x2.43	17	28	-30 to + 55° C	Octal/Pins
1169	8 MC-18 Crystals	± .02	.008	12VDC	10	65° C	1.88x1.76x.90	1.25x.85x.73	17	28	0 to +55° C	Wire Leads

PROPORTIONAL CONTROL OVENS

Monitor manufactures a complete line of 12 VDC to 28 VDC and 115 VAC proportional control ovens. Similar models as shown above and many other special proportional control ovens are available. Send us your requirements.

MECHANICAL THERMOSTAT OVENS

For applications where lower cost is an important factor and where long-term stability and aging are not critical, Monitor offers its standard line of mechanical thermostat controlled ovens.

Oven Type	Cavity Accommodates	Stability °C		Heater Voltage	Watts	Std. Set Temp. ±2°C	Outside Dimensions L x W x H (Inches)	Cavity Dimensions L x W x H (Inches)	Warm-Up (Minutes)		Oper. Temp. Range	Connector
		Constant Ambient	Per °C Ambient Change						25C	-55°C		
510	1 MC13A 1 MC6A 1 MC4D	± .2	.01	115	15	75° C	1.87x1.43x4	1.2 x 7 x 1.9	15	25	-55 to + 70° C	Octal
547	1 MC18B	± 1	.08	6.3 115	8	75° C	1.2 x .4 x 1.4	.5 x .18 x .5	6	10	-55 to + 70° C	Wire Leads
556	Components	± 1	.04	6.3 115	8 15	75° C	1.37 dia. x 2.0	.96 dia. x 1.05	10	15	0 to +70°C, 8w -55 to +70°C,15w	15-pin F/P

PRICING

Oven Type	1	2	3-4	5	10	25	50	100
512	97.20	87.20	77.20	65.60	53.90	46.25	42.50	38.75
530	157.00	147.00	137.00	116.50	95.90	82.25	75.25	68.50
531	157.00	147.00	137.00	116.50	95.90	82.25	75.25	68.50
581	99.20	89.20	79.20	67.60	55.90	48.25	44.50	40.75
583	102.20	92.20	82.20	70.60	58.90	51.25	47.50	43.75
1145	97.20	87.20	77.20	65.60	53.90	46.25	42.50	38.75
1152	97.20	87.20	77.20	65.60	53.90	46.25	42.50	38.75
1156	171.90	160.50	149.00	126.70	104.30	89.40	81.95	74.50
1176	102.20	92.20	82.20	70.60	58.90	51.25	47.50	43.75
1192	136.00	126.50	118.50	108.50	92.25	75.90	65.10	59.70
1169	170.40	159.30	148.20	125.95	103.75	88.90	81.50	74.10
510	98.50	88.00	78.50	66.75	54.95	47.10	43.20	39.25
547	94.00	84.20	73.20	61.60	49.90	43.25	39.50	35.75
556	128.10	122.90	111.40	94.70	78.00	66.85	61.25	55.70

Specifications and pricing subject to change without notice.

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

48 Years of Frequency Control Know-How

FILTERS/CRYSTAL & LC

UTILIZING THE "INITIAL FILTER ANALYSIS CONCEPT"

As one of the nation's leading suppliers of LC and quartz crystal filters, Monitor is able to meet your **Total Filter Needs.**

We cover the frequency spectrum from audio to 30 MHz, **without restriction** to bandwidth.

Monitor combines many years of engineering experience, with its computer-aided design facility, to better satisfy customer requirements.

Our **"Initial Filter Analysis Concept"** can save you time and money when specifying crystal and LC filters.

We can assist you at the quoting-stage to arrive at the optimum network.

With the "Initial Filter Analysis," the customer receives a computer analysis in plot and tabloid form, ending in recommendations and a summary. An example of computer-graphic analysis is shown below.

The crystal is the heart of the crystal filter and our 48 years of experience and capabilities in the production of quartz crystals is well known.

Monitor primarily designs to custom requirements, but has developed standard filter designs which are available on short notice.

Figure 1. Amplitude and delay Response

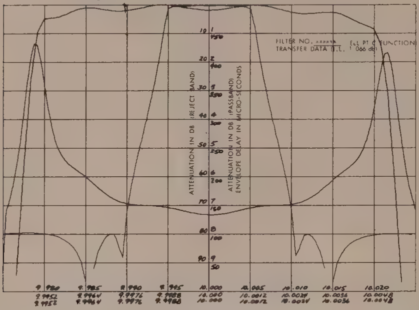
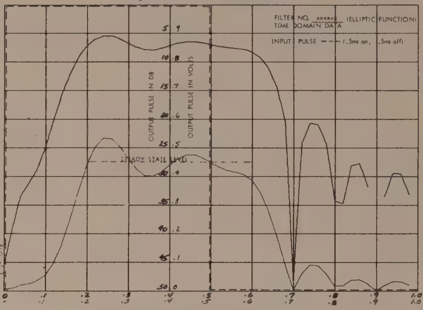
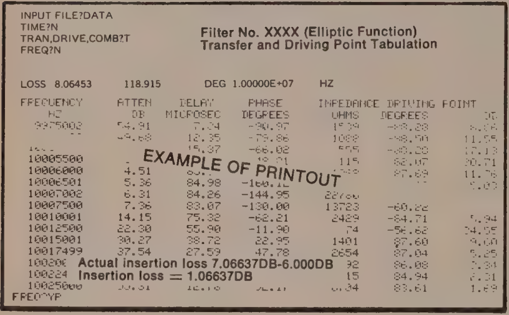


Figure 2. Pulse Response





```
INPUT FILE?DATA
TIME?N
TRAN,DRIVE,COMB?T
FREQ?N
```

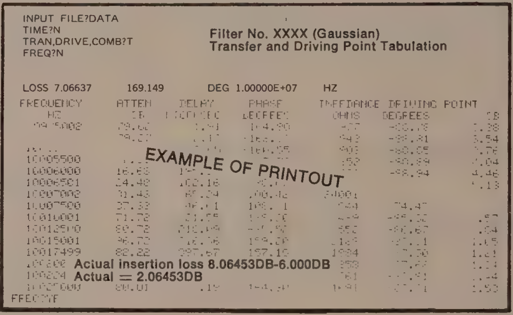
Filter No. XXXX (Elliptic Function)
Transfer and Driving Point Tabulation

```
LOSS  8.06453      118.915       DEG  1.00000E+07      HZ

FREQUENCY        ATTEN     DELAY        PHASE       IMPEDANCE DRIVING POINT
   HZ              DB    MICROSEC      DEGREES         OHMS     DEGREES        DB
 9975002         54.91       7.24       -90.97         [illegible]  [illegible]  [illegible]
 [illegible]     49.68      12.35       -79.86         1088      -48.50      11.55
 [illegible]  [illegible]   15.37       -66.02          555      -80.20      17.13
 10005500     [illegible] [illegible] [illegible]       115       82.07      20.71
 10006000         4.51  [illegible] [illegible]   [illegible]     87.69      11.76
 10006501         5.36      84.98   [illegible]   [illegible] [illegible]  [illegible]
 10007002         6.31      84.26      -144.95    [illegible]
 10007500         7.36      83.07      -130.00        13723      -60.22
 10010001        14.15      75.32       -62.21         2429      -84.71       5.94
 10012500        22.30      55.90       -11.90           74      -56.62      24.55
 10015001        30.27      38.72        22.95         1401       87.60       9.00
 10017499        37.54      27.59        47.78         2654       87.04       5.25
 [illegible]                                             92       86.08       [illegible]
 100224                                                  15       84.94       [illegible]
 10025000     [illegible] [illegible] [illegible]      [illegible] 83.61       1.69
FREQ?YP
```

EXAMPLE OF PRINTOUT

Actual insertion loss 7.06637DB-6.000DB
Insertion loss = 1.06637DB



```
INPUT FILE?DATA
TIME?N
TRAN,DRIVE,COMB?T
FREQ?N
```

Filter No. XXXX (Gaussian)
Transfer and Driving Point Tabulation

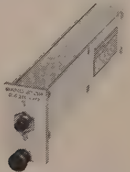
```
LOSS 7.06637       169.149       DEG  1.00000E+07      HZ

FREQUENCY        ATTEN     DELAY        PHASE       IMPEDANCE DRIVING POINT
   HZ              DB   [illegible]   DEGREES          OHMS     DEGREES        DB
 [illegible]  [illegible] [illegible] [illegible]  [illegible] [illegible]  [illegible]
 10005500     [illegible] [illegible] [illegible]  [illegible] [illegible]   [illegible]
 10006000     [illegible] [illegible] [illegible]  [illegible]   -98.94       4.46
 10006501     [illegible]    102.16  [illegible]                              [illegible]
 10007002         31.43  [illegible] [illegible]   [illegible]
 10007500     [illegible] [illegible] [illegible]  [illegible]    74.47
 10010001         71.72  [illegible] [illegible]   [illegible] [illegible]   [illegible]
 10012500     [illegible] [illegible] [illegible]  [illegible] [illegible]   [illegible]
 10015001     [illegible] [illegible]      159.20  [illegible] [illegible]   [illegible]
 10017499         82.22  [illegible]       157.10       1984  [illegible]   [illegible]
 [illegible]                                       [illegible] [illegible]  [illegible]
 [illegible]                                       [illegible] [illegible]  [illegible]
 [illegible]  [illegible]       .19  [illegible]   [illegible] [illegible]  [illegible]
FREQ?YF
```

EXAMPLE OF PRINTOUT

Actual insertion loss 8.06453DB-6.000DB
Actual = 2.06453DB

CCIR FILTERS: MULTI-CHANNEL TRANSMISSION SYSTEMS



Complete sets of low-pass and high-pass, band-pass and band-stop filters, designed to conform to the CCIR recommendations A, B and C.

Low pass	(8 KHz - 12.5 MHz) LC filters.
High pass	(8 KHz - 12.5 MHz) LC filters.
Band pass	(8 KHz - 105 KHz) LC filters. (105 KHz - 12:5 MHz) crystal filters.
Band stop	(8 KHz - 12.5 MHz) LC and crystal filters.

DIAGNOSTIC FILTERS FOR DYNAMIC ANALYSIS:

Center frequency 100 KHz, 300 KHz.

Standard impedances 3 K ohms.

High reliability, solid-state temperature controlled.

Package size: 4.2" x 2.0" x 3.9".

Available with octal plug or straight pin terminals.

In addition we supply filters of 2:1 shape factor with the following bandwidths. 100 Hz, 200 Hz, 400 Hz, 500 Hz, 700 Hz, 800 Hz, 1000 Hz.

Part No.	3 db-BW (Hz)	60/3 db SF	Insertion Loss (db)
SF-5001-1	1.5	4:1	10.0
SF-5001-2	2.0	4:1	10.0
SF-5001-3	5.0	4:1	6.0
SF-5001-4	10.0	4:1	5.5
SF-5013	10.0	2:1	5.5
SF-5001-5	20.0	4:1	4.0
SF-5004-1	20.0	2:1	4.0
SF-5004-2*	50.0	2:1	3.0
SF-5004-3*	75.0	2:1	2.0

*Also available phase match to ±5 degrees.

Specifications and pricing subject to change without notice.

MONITOR
PC

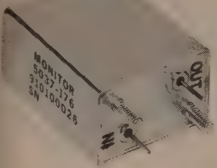
MONITOR PRODUCTS COMPANY, INC.
3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

48 Years of Frequency Control Know-How

FILTERS/CRYSTAL & LC

UTILIZING THE "INITIAL FILTER ANALYSIS CONCEPT"

COMB-FILTER SETS

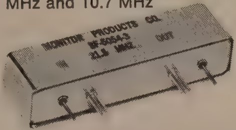


168 KHz through 264 KHz, spaced 4 KHz
1 db bandwidth = 200 Hz
30 db bandwidth = 1800 Hz
Zin = 27 K ohms, Zo = 6.8 K ohms
Amplitude matched to within 0.4 db from 0°C to 45°C to within 0.7 db from —20°C to +65°C
Size: 1.39" x .859" x 1.75 "

Monitor also designs and manufactures complete sets of contiguous comb filters up to 25 MHz.

VERY NARROW BANDWIDTH FILTERS

AT 21.5 MHz, 21.4 MHz and 10.7 MHz



These filters contain overtone crystals to provide low insertion loss and greater stability.

Less than 0.5 db ripple, Zin = Zo = 50 ohms

Part No.	3 db-BW (KHz)	70 db BW (KHz)	Insertion Loss (db)
SF-5058-1	8	28	2.0
SF-5058-2	4	14	2.5
SF-5058-3	2,8	10	3.0

MULTIPLEX FILTERS

Monitor manufactures multiplex filters in the following frequency ranges. Send us your requirements for a prompt evaluation and quotation.

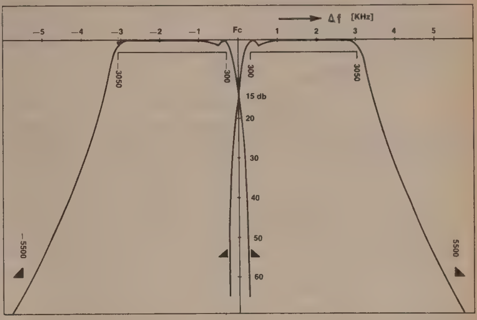
64 - 108 KHz, 4 KHz spacing.
148 - 192 KHz, 4 KHz spacing.
Typical bandwidth at 1 db is 3250 Hz.
Typical bandwidth at 55 db is 4750 Hz.

SINGLE SIDE BAND FILTERS

Monitor manufactures a complete range of single side band filters available at all major IF frequencies.

A typical filter curve is shown below.

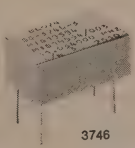
Send us your requirements for a prompt evaluation and quotation.



How to Order Filters. Specify the following:

1. Centerfrequency and tolerance.
2. 1, 2, 3, or 6 db bandwidth.
3. 20, 40, 60, etc. bandwidth if symmetric. Corresponding frequencies if assymmetric.
4. Ultimate attenuation and frequency range.
5. Insertion loss and tolerance or max. ins. loss.
6. Max. passband — ripple.
7. Input and output impedance and tolerance.
8. Operating and storage temperature.
9. Drive level.
10. Can dimensions, mounting and terminal location.
11. Phase magnitude, linearity if applicable.
12. Delay magnitude and differential delay if applicable.
13. Environmental requirement if applicable. Shock, vibration, temperature cycling, leakage, insulation resistance, etc.

E. R. (HI-REL) TTL LOGIC CLOCK OSCILLATORS



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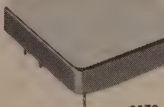
3528



3372

Monitor has available many hermetically sealed digital clock oscillators using established reliability components and employing our Approved Quality Assurance Programs. These units have been successfully produced for missile, space and extreme military environments, including the latest weapons systems and avionics.

The devices listed below are typical of some of the high volume systems now in production. We welcome the opportunity to review your specific E. R. requirements.

Series	Frequency Range	Output	Input VDC	Stability	Dimensions (In.) H W L	Original Application
3372	15-24 MHz	TTL	+5 ±10%	±100 ppm —30 to +100°C	1.5x1.5x3.75	Difar
3432	15-24 MHz	TTL	+5 ±10%	±100 ppm —54 to +125°C	1.0x1.0x.450	F-14 AN/AQS-
3440	2.5-10 MHz	TTL	+5 ±10%	±60 ppm —54 to +125°C	1.0x1.0x.350	F-15 AN/AQS-
3480	163 KHz - 1 MHz	TTL	+5 ±10%	±100 ppm —54 to +125°C	1.25x1.0x.265	AN/ALR 54
3528	1-5 MHz	TTL	+5 ±10%	±70 ppm —54 to +125°C	1.0x1.0x.375	AN/BQS-
3746	10-20 MHz	TTL	+5 ±10%	±40 ppm —40 to +70°C	1.26x.76x.250	AN/2SQ73

Specifications and pricing subject to change without notice.

MONITOR PC

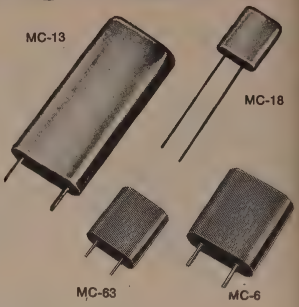
MONITOR PRODUCTS COMPANY, INC.
3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

48 Years of Frequency Control Know-How

STANDARD QUARTZ CRYSTALS

for commercial and military applications

"Supplying the electronics industry with quality crystals for 48 years."



This page provides engineering data and product data on the six different crystal cuts that Monitor Products normally manufactures. In ordering units referenced under Mil-C-3098, complete ordering information is not necessary (order by frequency and CR number) since the specifications are referenced under the CR type and the units will be built to those specifications. In high reliability requirements* and those not covered under Mil-C-3098 (note below), Monitor will provide engineering design and product data under each cut to help the design engineer determine the type of quartz resonator needed. A copy of this crystal handbook is available on request.

INFORMATION REQUIRED WHEN ORDERING CRYSTALS

1. Mode of operation of the crystal unit.
2. Drive level at which the crystal unit is being operated.
3. Temperature deviations that exist in the environment in which the crystal is operating.
4. Maximum equivalent impedance or resistance of the crystal for satisfactory circuit operations.

Special units can be procured to meet Mil-E-5400, Mil-E-5272, and other more severe environmental specs up to 30 G's to 2,000 cycles.

METHOD OF TESTING

In order to insure correlation between Monitor and the customer, the following test sets or equivalents are used by Monitor for both manufacture and testing (1KHz to 1MHz; T/S-710/TSM), (1MHz to 15MHz fundamental; T/S-330/TSM), (15MHz to 140MHz, T/S-683/TSM).

*SEE MONITOR'S HIGH RELIABILITY KOLDWELD CRYSTAL PAGE.

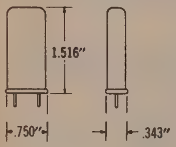
WHEN ORDERING CRYSTALS FOR USE IN CLOCK OSCILLATORS CONSULT MONITOR'S OSCILLATOR PAGES FOR COMPLETE SPECIFICATIONS ON PRE-TESTED MODULES FOR COST SAVINGS UP TO 50%.

SPECIFICATIONS | PRICING (MINIMUM ORDER: $ 50.00 LOT)

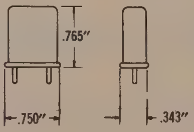
	Cut Type	Nominal Freq. TCL Available #STD 0-60° C	Series Resistance Range In Ohms	Typical L in henries	Typical C_0 in pf	Typical C_1 in pf	Average Capacity Ratio	Recommended Drive Level In mw	2	10	100	Estimates 500	Estimates 1000	Estimates 5000
MC-13 SERIES														
16-100 KHz	NT	±.020%	5-100 K	1000	7.0	.007	900	.05	36.00	17.00	9.90	8.50	8.10	7.70
90-200 KHz	E	±.020%	.4-5K	30	8.0	.050	130	.10	22.00	10.50	6.10	4.90	4.25	3.75
MC-6 SERIES														
90-200 KHz	NT	±.020%	5-50 K	270	6.0	.006	900	.05	36.00	17.00	9.90	8.50	8.10	7.70
200-250 KHz	E	±.020%	1-5 K	25	3.0	.020	130	.10	19.00	9.50	5.50	4.40	3.85	3.45
200-500 KHz	DT	±.010%	1-8 K	30	3.0	.007	350	.10	20.00	9.70	5.65	4.50	3.95	3.55
300-700 KHz	DD	±.010%	1-5 K	10	4.0	.010	350	.10	20.00	9.70	5.65	4.50	3.95	3.55
400-900 KHz	CT	±.020%	1-8 K	8	4.0	.009	400	.10	20.00	9.70	5.65	4.50	3.95	3.55
1.5-3.0 MHz	AT	±.005%	10-300	.45	4.0	.010	300	.05	20.00	7.90	4.95	2.50	2.10	1.90
3-10 MHz	AT	±.005%	3-80	–	5.0	–	–	.05	15.00	6.50	4.00	2.25	1.80	1.50
MC-18 SERIES														
3-11.9 MHz	AT	±.005%	3-50	.03	4.0	.015	300	.05	18.00	6.90	4.25	2.40	2.00	1.70
12-20.9 MHz	AT	±.005%	3-80	–	5.0	.020	250	.05	16.00	6.25	3.85	Available on Request		
21-25 MHz (Fund.)	AT	±.005%	3-80	–	5.0	.020	250	.05	29.00	12.50	7.90	6.90	6.40	6.10
25-60 MHz (3rd.)	AT	±.005%	3-80	–	5.0	–	–	.05	16.50	6.30	3.90	Available on Request		
60-120 MHz (5th.)	AT	±.005%	3-80	–	5.0	–	–	.05	22.00	10.50	6.10	Available on Request		
120-180 MHz (7th.)	AT	±.005%	3-80	–	5.0	–	–	.05	29.00	12.50	7.90	6.90	6.40	6.10
MC-63 SERIES														
2-8 MHz	AT	±.005%	3-300	–	4.0	.015	300	.05	22.00	10.50	6.10	4.90	4.25	3.75

DIMENSIONS, MOUNTING AND MECHANICAL DATA

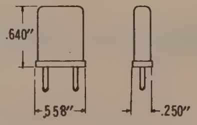
MC-13A, C



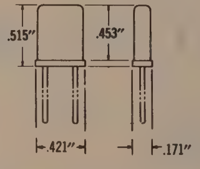
MC-6A, C



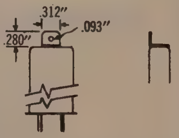
MC-63B



MC-18A, B



BKL BRACKET
Printed Circuit Board
Mounting for
MC-6C, MC-13C



Monitor Type	Military Type	Weight (Grams) Nominal	Volume (Cubic Inch) Nominal	Holder Material	Base Material	Lead Material	Tab Material	Pin Length Nominal	Pin Size Nominal Dia.	Pin Spacing Nominal
MC-6A	HC-6/U	4.00	.178	nickel silver	steel tin dipped	52 alloy	–	.238	.050	.486
MC-6C	HC-33/U	4.40	.178	nickel silver	steel tin dipped	52 alloy	–	1.50	.030 wire leads	.486
MC-18A	HC-18/U	.77	.034	nickel silver	steel tin dipped	kovar	–	1.50	.017 wires	.192
MC-18B	HC-25/U	1.30	.034	nickel silver	steel tin dipped	kovar	–	.238	.040	.192
MC-13A	HC-13/U	6.60	.350	Same as MC-6A except 1.5" height						
MC-13C	–	7.00	.350	Same as MC-6C except 1.5" height						
MC-63B	HC-32/U except wire leads	1.50	.080	nickel silver	steel tin dipped	kovar	–	1.50	.017 dia. wire leads	.275

All above information should be considered approximations with a standard quartz blank inside can.

Specifications and pricing subject to change without notice.

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

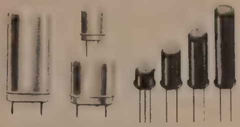
48 Years of Frequency Control Know-How

KOLDWELD STABILITY RELIABILITY CRYSTALS

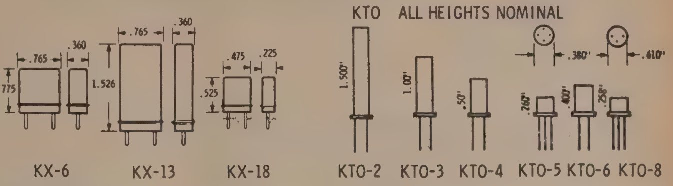
Monitor's KTO Series Frequency Control Crystals are an extension of Monitor's capability in applying KOLDWELD techniques to crystal packaging. These high reliability, low aging crystals offer precision frequency control in a subminiature package (TO-5 transistor package). The KX type crystals conform to the dimensions and requirements of standard military type HC holders and are ideally suited to extreme environments. The KX type can be used as replacements for standard HC-6, HC-18 and HC-13 mil-spec units.

Monitor also manufactures a complete line of crystals (HC-6/U, HC-18/U, HC-13/U, HC-25/U) to MIL-C-3098 (4 KHz-200 MHz). See opposite page.

Write for our crystal specification handbook.



KOLDWELD CRYSTALS



SPECIFICATIONS

PRICING

	Cut Type	Nominal Freq. TCL* Available #STD	Series Resistance Range in Ohms	Typical L in henries	Typical C_0 in pf	Typical C_1 in pf	Average Capacity Ratio	Recommended Drive Level In mw	Aging Typical x 10^8 per Day After:			2	10	100	500	1000
									1 Wk.	5 Wks.	10 Wks.					
KX-13 SERIES																
16-100 KHz	NT	6	5-100 K	1000	7.0	.007	900	.05	40	–	7	67.32	31.79	18.70	14.96	13.09
90-200 KHz	E	7	.4-5 K	30	8.0	.050	130	.10	50	–	8	41.31	19.50	11.47	9.18	8.03
KX-6 SERIES																
90-200 KHz	NT	6	5-50 K	270	6.0	.006	900	.05	40	–	7	68.85	32.51	19.12	15.30	13.38
200-250 KHz	E	7	1-5 K	25	3.0	.020	130	.10	60	–	9	37.47	17.69	10.41	8.32	7.28
200-500 KHz	DT	5	1-8 K	30	3.0	.007	350	.10	50	30	9	37.47	17.69	10.41	8.32	7.28
300-700 KHz	DD	3	1-5 K	10	4.0	.010	350	.10	50	–	8	37.47	17.69	10.41	8.32	7.28
400-900 KHz	CT	9	1-8 K	8	4.0	.009	400	.10	50	–	8	37.47	17.69	10.41	8.32	7.28
1.5-3.0 MHz	AT	4	10-300	.45	4.0	.010	300	.05	5	1	.4	31.46	12.58	7.86	7.08	6.68
3-10 MHz	AT	4	3-80	–	5.0	–	*	.05	7	2	.6	19.56	7.82	4.89	4.40	4.15
KX-18 SERIES																
5-11.9 MHz	AT	4	3-50	.03	4.0	.015	300	.05	7	3	.6	23.22	9.28	5.80	5.22	4.93
12-20.9 MHz	AT	4	3-80	–	5.0	.020	250	.05	7	3	.8	21.60	8.64	5.40	4.86	4.59
21-25 MHz	AT	4	3-80	–	5.0	.020	250	.05	7	3	.8	46.68	18.67	11.67	10.50	9.91
25-60 MHz (3rd)	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	23.22	9.28	5.80	5.22	4.93
60-120 MHz (5th)	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	28.62	11.44	7.15	6.43	6.08
120-180 MHz (7th)	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	43.20	17.28	10.80	9.72	9.18
KTO-2 SERIES																
16-100 KHz	NT	6	5-80 K	800	8.0	.009	900	.05	50	30	9	67.32	31.79	18.70	14.96	13.09
KTO-3 SERIES																
60-200 KHz	NT	6	5-60 K	550	7.0	.007	900	.05	50	30	9	68.85	32.51	19.12	15.30	13.38
120-350 KHz	E	7	.5-5 K	10	8.0	.070	130	.10	50	30	9	41.31	19.50	11.47	9.18	8.30
325-600 KHz	DD	3	.2-5 K	25	4.0	.009	450	.10	50	–	8	33.06	15.61	9.18	7.34	6.42
KTO-4 SERIES																
350-455 KHz	E	7	1-5 K	16	2.0	.015	130	.10	50	30	9	33.06	15.61	9.18	7.34	6.42
600-700 KHz	DD	2	.5-5 K	9	3.0	.017	450	.10	50	–	8	33.06	15.61	9.18	7.34	6.42
KTO-5 SERIES																
455-524 KHz	E	9	1-5 K	7	2.0	.015	130	.10	60	40	9	39.69	18.74	11.02	8.82	7.71
525-649 KHz	DT	7	1-10 K	12	2.0	.005	400	.10	60	40	9	39.69	18.74	11.02	8.82	7.71
650-1000 KHz	CT	9	1-8 K	8	2.0	.005	400	.10	60	–	9	39.69	18.74	11.02	8.82	7.71
9-11.9 MHz	AT	4	3-40	.025	5.0	.016	300	.05	7	3	.6	22.36	8.94	5.59	5.03	4.75
12-20.9 MHz	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	31.36	12.54	7.84	7.06	6.66
21-25 MHz	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	45.08	18.03	11.27	10.14	9.58
25-60 MHz (3rd)	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	31.36	12.54	7.84	7.06	6.66
60-120 MHz (5th)	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	40.18	16.07	10.04	9.04	8.54
120-180 MHz (7th)	AT	4	3-80	–	5.0	–	*	.05	7	3	.8	45.08	18.03	11.27	10.14	9.58
KTO-8 SERIES																
2-8 MHz	AT	4	3-300	–	4.0	.015	300	.05	5	1	.5	31.36	12.54	7.84	7.06	6.66

***STANDARD** (All values average)

1. ±.0025 —55°C to /105°C or ±.002% oven calibration
2. ±.015% —40°C to /70°C or ±.002% oven calibration
3. ±.08% —40°C to +70°C or ±.002% oven calibration
4. ±.005% —55°C to /105°C or ±.002% oven calibration
5. ±.01% —40°C to +70°C or ±.002% oven calibration
6. ±.012% —40°C to /70°C or ±.002% oven calibration
7. ±.02% —40°C to +70°C or ±.002% oven calibration
8. ±.025% —40°C to /70°C or ±.002% oven calibration
9. ±.03% —40°C to /70°C or ±.002% oven calibration

Capacity Ratio — AT Fund. — 300 3rd — 3000 5th — 8000

ENVIRONMENTAL: Monitor's Koldweld units meet the following environmental specifications.

LEAKAGE: 1 x 10^{-8} CC of Helium
INSULATION RESISTANCE: 500 Meg Ohm MIL-STD-202, Method 302
MOISTURE RESISTANCE: MIL-STD-202, Method 106 and MIL-C-3098
SALT SPRAY: MIL-STD-202, Method 104B
IMMERSION: 500 Meg Ohm MIL-STD-202, Method 104B
VIBRATION: (Specify one)

1. MIL-C-3098 (10G's 55 cps)
2. MIL-STD-202 Method 204A (10G's 500 cps)
3. MIL-STD-202 Method 204B (15G's 2,000 cps)
4. MIL-STD-202 Method 204D (20G's 2,000 cps)
5. Special 30G's to 3,000 cps
6. Normal Handling

SHOCK: (Specify one)

1. MIL-STD-202 Method 202B (100G's, 11 ms)
2. MIL-C-3098 4. 7. 7. 2 Method B
3. Normal Handling

ACCELERATION: (Specify one)

1. MIL-STD-202 Method 212A (100G's)
2. Normal Handling

Specifications and pricing subject to change without notice.

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

3018 SAN LUIS REY ROAD / OCEANSIDE, CALIFORNIA 92054 / (714) 433-4510

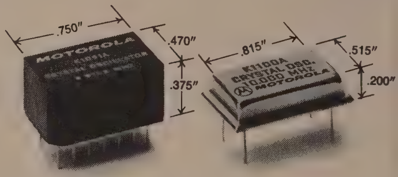
48 Years of Frequency Control Know-How

Microprocessor Clocks

SPECIFICATION	K1117A	MC6871A
Designed specifically to drive:	**Intel 8080 CPU**	**Motorola MC6800 MPU**
Frequency:	2.000 MHz	500 kHz or 1,000 MHz
Frequency Stability: (Inclusive of calibration tolerance at 25° C, operating temperature, input voltage change, load change, aging, shock, and vibration.)	±0.01%	±0.01%
Operating temperature range:	0° C to + 70° C	0° C to + 70° C
Input Voltage	VDD + 12V VCC + 5V VSS GND	+5V
Logic Outputs	ø1, ø2 NMOS ø1, ø2 TTL	ø1, ø2 NMOS ø1, ø2 TTL
Interrupt Capability	No	Yes
Dimensions:	1.34″ L x .84″ W x .20″ seated Height (34,1 x 21,34 x 5.08mm)	

The MC6871A and the K1117A are designed to provide the critical 2-phase, non-overlapping waveforms required by the specific microprocessor. Crystal, oscillator, NMOS drivers and necessary waveshaping circuitry are packaged by hybrid thick-film IC technology into one dual-in-line module that cuts your component count and board space.

Integrated Circuit Crystal Clock Oscillators



SPECIFICATION	K1091A	K1100A	K1114A	K1115A	K1116A
Frequency Range:	4 MHz to 20 MHz	250 kHz to 30 MHz	250 kHz to 20 MHz		
Frequency Stability: (Inclusive of calibration tolerance at 25° C, operating temperature, input voltage change, load change, aging, shock, and vibration.)	±0.01%	±0.01%	±0.05%	±0.1%	±1.0%
Temperature Range Operating: Storage:	0° C to + 70° C −55° C to +125° C	0° C to +70° C −55° C to +125° C	0° C to +70° C −55° C to +125° C		
Input Voltage: Input Current (typical):	+5V dc ±10% 60 mA	+5V ±0.5V 105 mA (250—1,000 kHz) 90 mA (1—4 MHz) 30 mA (4—9 MHz) 60 mA (9—30 MHz)	+5V ±0.5V 105 mA (250—1,000 kHz) 90 mA (1—4 MHz) 30 mA (4—9 MHz) 60 mA (9—20 MHz)		
Output: Square Wave: Rise & Fall Time: Levels: Symmetry: Fan Out:	TTL Compatible 10 nsec maximum "0" = 0.4V, "1" = 3.0V 60/40 duty cycle worst case 1 to 10 gates, 1.6 mA/gate	TTL Compatible 15 nsec Maximum (.25 to 9 MHz) 10 nsec Maximum (9 to 30 MHz) "0" = 0.4V, "1" = 2.4V 60/40% at 1.4V dc level 1 to 10 gates, 1.6 mA/gate	TTL Compatible 15 nsec Maximum (.25 to 9 MHz) 10 nsec Maximum (9 to 20 MHz) "0" = 0.4V, "1" = 2.4V 60/40% at 1.4V dc level 1 to 10 gates, 1.6 mA/gate		
Environmental Shock:	Withstand 40 G's for 11 ms, 3 mutually perpendicular planes	1,000 G's for 0.35 ms, ½ sine wave, 3 shocks each plane	1,000 G's for 0.35 ms, ½ sine wave, 3 shocks each plane		
Vibration:	5—55 Hz, 0.06″ double amplitude 15 minutes each plane	10—55 Hz, 0.060″ Double amplitude; 55 Hz—2 kHz, 35 G's 12 hours duration	10—55 Hz, 0.060″ Double amplitude; 55 Hz—2 kHz, 35 G's 12 hours duration		

MOTOROLA INC.
COMPONENT PRODUCTS DEPT.

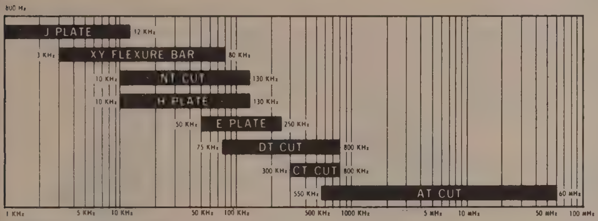
2553 N. Edgington, Franklin Park, Illinois 60131
Phone: (312) 451-1000

NEL FREQUENCY CONTROL DEVICES

OUR COMPANY

Northern Engineering Laboratories was founded in 1954 in recognition of the need for a reliable source of high quality, low frequency quartz resonators for advanced and sophisticated requirements as well as conventional applications. Our excellent record of delivery and customer service has contributed to a steady growth through three previous plant locations to our present modern air-conditioned building. Since the main structure was completed in 1961, two additions have been made, doubling the total area. Our product lines of quartz crystals, temperature control ovens and packaged oscillators have continually expanded and improved.

OUR PRODUCT



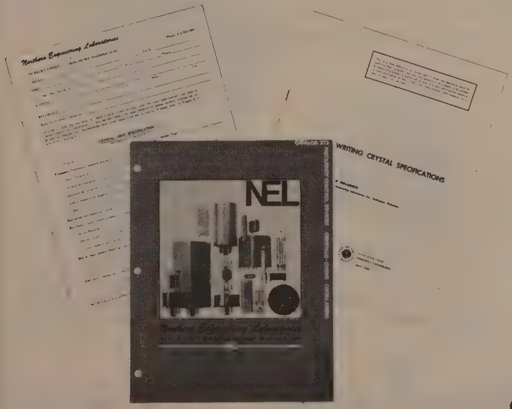
Leadership in the design and manufacture of low frequency crystals enables us to provide the widest variety in choosing the proper crystal for your application. Dependable quality and producible specifications help you to keep your production schedules. Complete spectrum coverage from under 1 KHz to over 50 MHz means one source that can handle most applications. For technical information, see our catalog.

CRYSTALS
OVENS
OSCILLATORS

Crystal and component ovens that employ dynamic thermal design and utilize the best components and construction techniques. Either standard or custom designs to provide optimum performance for your application. Contact us for details.

Northern Engineering offers a complete line of Digital, Card & Temperature Controlled Oscillators.

OUR SERVICE


Northern Engineering Laboratories
WRITING CRYSTAL SPECIFICATIONS
NEL

Complete application assistance followed by prompt, dependable delivery of reliable frequency control devices will help ensure the success of your product. Contacting our sales representative or factory will bring a rapid, useful response. The value of our service is enhanced by allowing us to work with you early in the design stage.

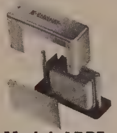
Write for new 20 page technical brochure and pamphlet on "Writing Crystal Specifications."

Northern Engineering Laboratories . . . INC.
357 Beloit Street, Burlington, Wisconsin 53105 Phone: Area Code 414 763-3591
Please contact us with your needs.

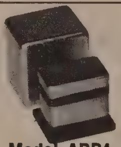
ovens

PROPORTIONAL CONTROL CRYSTAL OVENS

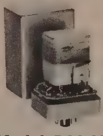
New technology in circuit design now provides low cost proportional control crystal ovens. High reliability, low sustaining power consumption and noiseless operation. A representative few of many available models are shown. Available in standard temperatures and voltages.



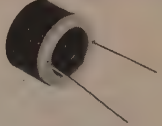
Model ADP5
A side access oven for 5 HC-6/U crystals. For AC/DC operation. Wire leads for circuit board mounting.



Model ADP4
For 4 HC-6/U crystals, has center shield. For AC/DC operation. Wire leads for circuit board mounting.



Model PC2-20
A precision oven for 2 HC-6/U crystals or components. Octal base. 115 VAC. Models for DC voltages available.



Model T05P
For T05 crystal, Transistor or I.C. 5, 12 or 24 VDC. A wide range of temperature models.

PROPORTIONAL CONTROL COMPONENT OVENS

Ovenaire offers a complete line of component ovens, from PCB mount mini-ovens for solid state and IC designs to large cavity area ovens for more sophisticated systems. A few of many available standard designs are shown. Custom design capabilities to meet most exacting requirements.

Model CO-1142
Cavity area 2 13/16″ x 4″ x 13/16″ high. 24V DC. Temperature +60°C to +85°C, factory set.

Model CO-1139
Cavity area 2½″ x 4½″ x 1¼″ high. 12V DC. Temperature +60°C to +85°C, factory set.

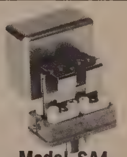
Model CO-1128
Cavity area 2½″ x 2½″ x ⅝″ high. 28V DC or 115V AC. Temperature +60°C to +85°C factory set.

Model CO-1090
Cavity area 2 47/64″ x 2 21/64″ x 1 3/32″ high. 28V DC or 115V AC. Temperature +60°C to +85°C factory set.

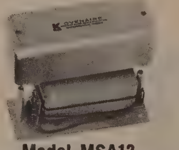
THERMOSTAT CONTROL OVENS

For more than a decade, Ovenaire has been recognized as the leader in thermostat controlled ovens. This proud reputation continues with a full line of crystal and component ovens featuring the reliable snap action thermostat.

Model SA2
For 2 HC-6/U crystals. Fast warmup, low power. 6 to 28V AC/DC. All standard temperatures.



Model SA4
For 4 HC-6/U crystals. Fast warmup, low power. 6 to 28V AC/DC. All standard temperatures.



Model MSA12
For 12 HC-25/U crystals. Minimal cycling. Circuit board mount. Standard, AC/DC voltages and temperatures.

Model SA12
For 12 HC-6/U crystals. Wire leads or terminals. Standard AC/DC voltages and temperatures.

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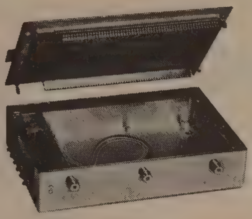
temperature control devices

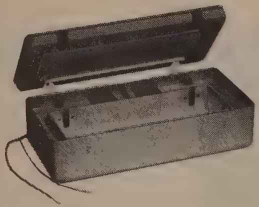
HIGH STABILITY, LARGE CAVITY COMPONENT OVENS

State of the Art Temperature regulation and temperature indicators have been built into these component oven designs. These models feature fast warm-up, temperature setting, high stability over a wide ambient range with a wide variety of thermal loading, and temperature indicating outputs. These ovens are available with either military or commercial grade control components, with special materials and finishes and custom tailored to interface with your application.



Model CO1178

A high stability oven designed with all MIL-STD components. Available with temperature indicator in addition to secondary control to provide optimum MTBF. Cavity 3.4″ x 4.5″ x .8″. 24 VDC, 65°C.



Model CO1195

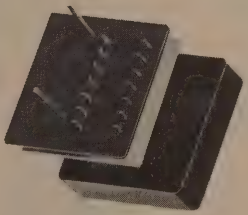
Fast warm-up with large thermal load using semi-rigid coax for electrical hookup. Outstanding performance over wide ambient range. Cavity 2.0″ x 6.2″ x 1.0″. 28 VDC, 87°C.

Model CO2001

A printed circuit board mounted oven with high stability and feed-thru terminals for direct electrical inter-connection. Cavity 2.75″ x 3.94″ x .79″. 24 VDC, 70°C.

MINIATURE CRYSTAL & COMPONENT OVENS

Great versatility and accessibility at low cost. Literally covering all needs for temperature control. This blanket design has been generated for applications that require easy access and at low cost by comparison with totally enclosed ovens. No sacrifice need be made in temperature stability if the oven is tailored to the given thermal loading. Ideally suited for printed circuit board and existing surface mounted devices.

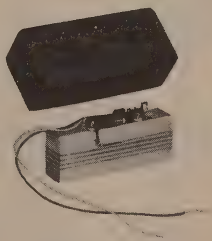


Model PC1-25

Mini-module, component or I.C. oven for printed circuit mounting. Capacity 14 or 16 DIP I.C. or .375″ x .875″ x .156″ component cavity. Overall size .312″ x 1″ x 1″. 12 VDC, 65°C.

Model PCL1-27

Printed circuit board mounted crystal oven. Capacity one HC-18/U, HC-25/U, HC-42/U or HC-43/U crystal. Overall size .750″ dia. x .562″. 15 VDC, 50°C.



Model PCL12-10

Multiple crystal or component oven enclosure for socket or printed circuit board mounting. 12 HC-25/U or HC-18/U crystals. Overall size 1.0″ x 1.25″ x 3.0″. 12 VDC, 75°C.

All Models are available with temperature and voltage options and a variety of configurations for electrical interface as required.

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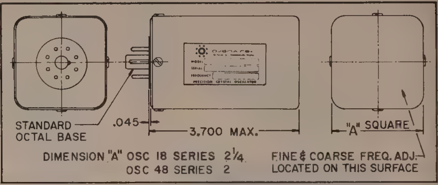
frequency control devices

Ovenaire has the capabilities, experience and production techniques to meet the most exacting crystal oscillator requirements. From high precision military requirements to volume production for competitively priced systems. Select a standard design series from the tables on these pages or contact us for special requirements.

OSC 18 SERIES

HIGH STABILITY CRYSTAL OSCILLATORS



FEATURING:

- Precision Glass Enclosed Crystals
- High Gain DC Proportional Oven
- Low Power — 3 Watts at +25° C
- Designed for Hi-Impact Shock
- Now in 6th Year of Production
- Unbeaten for Price and Performance

Options —
Logic Output, VCXO Control,
Supply Voltage:
+12 VDC, +15 VDC, +28 VDC

STABILITY CLASS		HIGH PRECISION	PRECISION	HIGH	HIGH	EXTENDED FREQUENCY
FREQ. RANGE		1 or 3 MHz	1 MHz	0.5 to 2 MHz	1 to 5 MHz	5 to 30 MHz
PART NO.		OSC 18-6	OSC 18-2	OSC 18-1	OSC 18-5	OSC 18-7
OUTPUT		1 VOLT RMS MINIMUM SINE WAVE INTO 500 OHMS				0.7v RMS INTO 50 Ω
STABILITY	LONG TERM	1x10⁻⁸/WK	3x10⁻⁹/DAY	7x10⁻⁹ PER DAY		3.5x10⁻⁶/YR
	SHORT TERM	2x10⁻¹⁰RMS	±5x10⁻¹⁰P-P	5x10⁻¹⁰RMS	±5x10⁻⁹P-P	——
	AMBIENT	0 to +55°C <1x10⁻⁸	−20 to +55°C 2x10⁻¹⁰/°C	−20 to +55°C 1x10⁻⁹/°C	−20 to +65°C <5x10⁻⁷	−20 to +65°C 5x10⁻⁹/°C
	VOLTAGE	5x10⁻¹⁰/1%	5x10⁻¹⁰/1%	5x10⁻⁹/1%	2x10⁻⁸/1%	3x10⁻⁸/1%
	LOAD	5x10⁻¹⁰/1%	1x10⁻⁹/1%	2x10⁻⁹/1%	2x10⁻⁸/5%	5x10⁻⁸/5%
WARM-UP FROM +25°C		1x10⁻⁷ IN < 20 MIN	1x10⁻⁷ IN < 30 MIN	2x10⁻⁷ IN < 30 MIN	5x10⁻⁷ IN < 30 MIN	5x10⁻⁷ IN < 20 MIN
FREQ. ADJUSTMENT		COARSE AND FINE PISTON TRIMMERS		SINGLE PISTON TRIMMER		
INPUT POWER		24 VDC WITH 10 WATTS MAXIMUM DURING WARM-UP				

Technical data subject to change

PRINTED CIRCUIT MOUNT CRYSTAL OSCILLATORS 1MHz to 150MHz

FREQUENCY RANGE (MHz)		1 to 6	>6 to 10	>10 to 25	>25 to 60	>60 to 150
TOLERANCE		±0.001%			±.0012%	±.0015%
TEMP. RANGE		0°C to +60°C				
SERIES NO.	LOGIC	OSC 51-1-1	OSC 51-1-2	OSC 51-1-3	OSC 51-1-4	——
	SINE	OSC 51-2-1	OSC 51-2-2	OSC 52-2-1	OSC 52-2-2	OSC 52-2-3
LOGIC	SUPPLY VOLTAGE	+5V DC ±5%				
	SYMMETRY	50/50 ±20%	50/50 ±20%	50/50 ±20%	50/50 ±30%	——
	LOGIC HIGH	3VP @3Ma	3VP @3Ma	3VP @5Ma	3VP @5Ma	——
	LOGIC LOW	±0.4V @5Ma				——
	RISE TIME	<50 NS	<15 NS	<10 NS	<5 NS	——
	FALL TIME	<50 NS	<15 NS	<10 NS	<4 NS	——
	CONFIGURATION	FIGURE 1				——
	HEIGHT DIM A	.625	.50			——
SINE	SUPPLY VOLTAGE	+12V DC ±5%				
	OUTPUT VOLTAGE	1 VRMs ±30%		+10 DBM ±3db		
	LOAD	1 KΩ Resistive		50Ω Resistive		
	HARMONIC LEVEL	−30 DB		−25 DB		
	CONFIGURATION	FIGURE 1		FIGURE 2		
	HEIGHT DIM A	.625	.50	1.00		

ORDERING INFORMATION
Specify Series Number and Desired Frequency
Example: 8.3 MHz Logic Unit would be OSC 51-1-2 (8.3 MHz)

● EXTENDED CAPABILITY

- LOGIC LEVELS TO 60 MHz
- SINE COVERAGE TO 150 MHz
- FAST PROTOTYPE SERVICE
- LOW COST
- SMALL SIZE
- RELIABLE

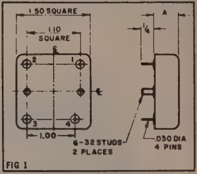


FIG 1

Pin Connections
PIN 1 +VSUP PIN 3 OVDC
PIN 2 OVDC PIN 4 OUTPUT

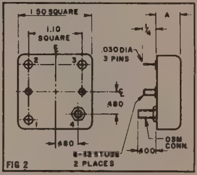


FIG 2

Pin Connections
PIN 1 +VSUP PIN 3 OVDC
PIN 2 OVDC OSM OUTPUT

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OVEN STABILIZED OSCILLATOR SERIES

Ovenaire produces many types of ovenized crystal oscillators to meet widely varying performance needs. Your ovenized oscillator requirement can be customized from one of these proportionately controlled standards.

Available in sine and square wave output.

FIG. 1

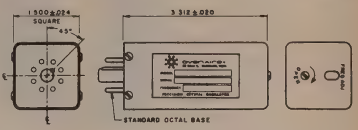

1 500±.024 SQUARE
45°
3 312±.020
STANDARD OCTAL BASE
FREQ ADJ

FIG. 2

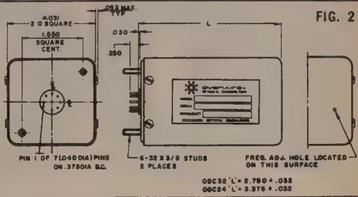

±.031
2 0 SQUARE
.063 MAX. TYP
1.550 SQUARE CENT.
.030
.250
L
PIN 1 OF 7(.040 DIA) PINS ON .375DIA B.C.
6-32 X 3/8 STUDS 2 PLACES
FREQ. ADJ. HOLE LOCATED ON THIS SURFACE
OSC32 'L' = 2.750 ± .032
OSC24 'L' = 3.375 ± .032

FIG. 3

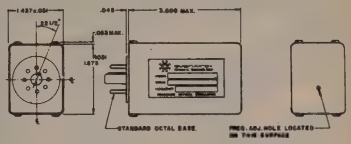
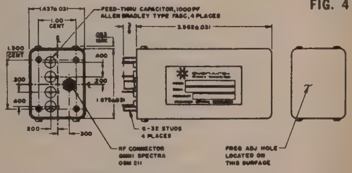

1.437±.031
22 1/2°
.048
3.600 MAX.
.063 MAX.
±.031
1.875
STANDARD OCTAL BASE
FREQ. ADJ. HOLE LOCATED ON THIS SURFACE

FIG. 4


1.437±.031
1.00 CENT
FEED-THRU CAPACITOR, 1000PF ALLEN BRADLEY TYPE FASC, 4 PLACES
3.562±.031
.063 MAX
1.300 CENT
.400
.300
.200
.400
1.875±.031
200
300
6-32 STUDS 4 PLACES
RF CONNECTOR OMNI SPECTRA OSM 211
FREQ ADJ HOLE LOCATED ON THIS SURFACE

SERIES		OSC 11	OSC 24	OSC 32	OSC 29	OSC 70
MAJOR FEATURE		AC or DC SMALL SIZE	FAST WARM-UP	LOW OVEN POWER	EXTENDED FREQ. COMPACT SIZE	
FREQUENCY		1 to 22 MHz	1 to 10 MHz	2 to 10 MHz	5 to 25 MHz	22 to 150 MHz
OUTPUT		1 VOLT RMS INTO 500 OHMS			1v RMS 300 Ω	+10 dbM 50 Ω
OPTIONAL OUTPUT		LOGIC	LOGIC	LOGIC	LOGIC	NONE
AMBIENT RANGE °C		−20° to +60°	−30° to +55°	0° to +55°	−20° to +60°	−10° to +60°
AMBIENT STABILITY		$5x10^{-9}$/°C	$5x10^{-10}$/°C	$1x10^{-9}$/°C	$1x10^{-8}$/°C	$2x10^{-8}$/°C
WARM-UP FROM 0°C		$\pm1x10^{-6}$ IN 30 MIN	$\pm5x10^{-7}$ IN 5 MIN	$\pm5x10^{-7}$ IN 45 MIN	$\pm1x10^{-6}$ IN 30 MIN	$\pm1x10^{-6}$ IN 30 MIN
POWER	COLD START	10 to 15W	25 WATTS	3.6 WATTS	8 WATTS	8 WATTS
	STEADY STATE +25°	APPROX. 3.5W	2 WATTS	1 WATT	APPROX 2.5 WATTS	
	SUPPLY VOLTAGE	115V AC 24V DC	24V DC	24V DC	28V DC	28V DC
OSCILLATOR SUPPLY		12 to 24V DC	24V DC	24V DC	15V DC	15V DC
TRIM RANGE		MECHANICAL AND/OR ELECTRICAL TRIM AVAILABLE				
SIZE		FIG 1	FIG 2	FIG 2	FIG 3	FIG 3 or FIG 4

TCXO SERIES

Logic Compatible Output –

Supply Voltage +12 VDC. (+5 VDC to +20 VDC Optional)
Size: OSC 27-5 SERIES 2.0 SQ x .600 OSC 37 –SERIES 1.75 SQ x .750

PART NO.	OSC 27-5-1	OSC 27-5-2	OSC 27-5-3	OSC 37-1-1	OSC 37-2-1	OSC 37-3-1	OSC 37-1-2	OSC 37-2-2
FREQUENCY	2 to 12 MHz	2 to 12 MHz	2 to 5 MHz	1 to 5 MHz	5.01 to 10 MHz	1 to 5 MHz		5.01 to 10 MHz
AMBIENT RANGE	0°C to +55°C			0°C to +55°C		−5° to +60°C	−10° to +65°C	
AMBIENT STABILITY	$\pm1x10^{-6}$	$\pm5x10^{-7}$	$\pm3x10^{-7}$	$\pm2x10^{-6}$ REF +25°C		$\pm1x10^{-6}$ REF +25°C	$\pm1.5x10^{-6}$ REF +25°C	
AGING RATE	$1x10^{-6}$/YR		$5x10^{-7}$/YR	$1x10^{-6}$/YR	$2.5x10^{-6}$/YR	$1x10^{-6}$/YR		$2.5x10^{-6}$/YR
TRIM RANGE	$\pm6x10^{-6}$ MIN			$\pm5x10^{-6}$	$\pm8x10^{-6}$	$\pm4x10^{-6}$	$\pm5x10^{-6}$	$\pm8x10^{-6}$

VCXO SERIES

AVAILABLE IN VARIOUS PHYSICAL CONFIGURATIONS

- Frequency Range 5 to 50 MHz
- ±0.005% to ±0.03% Deviation
- ±100 PPM to 0.2 PPM Stabilities
- Low Distortion F.M. Oscillators
- Oven and Non-Oven Models
- Compact Size

Technical data subject to change

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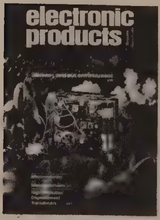

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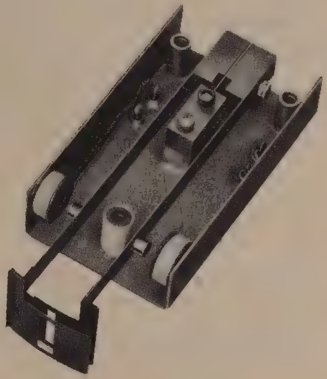
FORK OSCILLATORS

Output frequencies from 1.0 to 20,000 Hz. Absolute frequency accuracies from ±.10% to ±.001%. Operating temperature ranges up to from −55°C to +100°C depending upon accuracy. Wide choice of DC inputs from 5 to 28 volts and output waveshapes such as logic-clock, square or sine. Full MIL shock and vibration environmental capability, hermetically-sealed designs. Also ultra low current versions, miniature sizes, specials to suit either your performance or packaging requirements.

FORK OPTICAL MODULATORS

Frequencies from 40 to 1,000 Hz...for modulating or chopping either light or energy beams. May often be used to replace motor driven choppers, offering weight and power savings plus no need to lubricate. Particular design and construction provides exceptional fork balance and high resistance to shock and vibration for most MIL specs. Tine ends may be fitted with shutters, lenses, or mirrors to suit your special requirements, various drive circuits available.



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Still smaller oscillators, a greater selection of fork optical modulators, and new optical scanning devices.

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MONOLITHIC CRYSTAL FILTERS

If you need crystal filters, chances are your best bet is a monolithic — for cost, for size, for performance. If you need monolithics, you need PTI — the oldest and largest supplier. And monolithics are our principal product — not a sideline.

STANDARD MODELS

For low cost, take our 10.7 MHz and 21.4 MHz integrated crystal filters. All models are available off-the-shelf. All feature tandem monolithic construction for minimum size and high stopband performance. Our 10.7's and 21.4's are available in upright, flatpack, p.c. assemblies or sets of monolithic units for assembly on your own board.

Guide to Standard 10.7 MHz Models

13 kHz Bandwidth	15 kHz Bandwidth	30 kHz Bandwidth	No. Poles (Resonators)	Dimensions WxLxH
2194F	2195F	2196F	2	.185x.432x.45
1463	1464	1465	4	.47x.59x.60
1466	1467	1468	4	.63x.89x.23
1469	1470	1471	6	.47x.59x.60
1472	1473	1474	6	.63x1.32x.23
1475	1476	1477	8	.50x.75x.60
1478	1479	1480	8	.63x1.75x.23
1433	1434	1435	8	1.02x2.39x.52

Models 1433 - 35 interchange with commonly used conventional crystal filters.
Standard European configurations are also available.

Guide to Standard 21.4 MHz Models

13kHz Bandwidth	15 kHz Bandwidth	30 kHz Bandwidth	No. Poles (Resonators)	Maximum Dimensions WxLxH (in.)
2249F	2250F	2251F	2	.185x.432x.45
1617	1618	1619	4	.47x.59x.60
1620	1621	1622	4	.63x.89x.23
1623	1624	1625	6	.47x.59x.60
1626	1627	1628	6	.63x 1.32x.23
1629	1630	1631	8	.50x.75x.60
1632	1633	1634	8	.63x 1.75x.23

PTI also offers standard models at many other popular frequencies including 5.26, 6.46, 8.0, 16.9, 20.0, 30.0, 32.0, 75 and 156 MHz.

CUSTOM MODELS

The same cost saving techniques of PTI standard integrated crystal filters can be applied to your high volume custom requirements in I-F filtering, spectrum clean-up, parametric up-conversion and front-end filtering, just to name a few. PTI engineers will work with you from start to finish to meet your specific requirements from 5 to 300 MHz. They'll be glad to discuss performance characteristics, packaging and cost. Prototypes are usually available within 4 to 6 weeks. Specification forms are yours for the asking. Write or call. If you have questions about monolithics, we've got the answers.

PTi

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Orlando, Florida 32804
305-425-1574
TWX 810-850-4136

The standard in monolithic crystal filters

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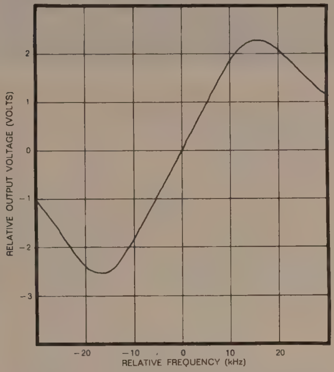
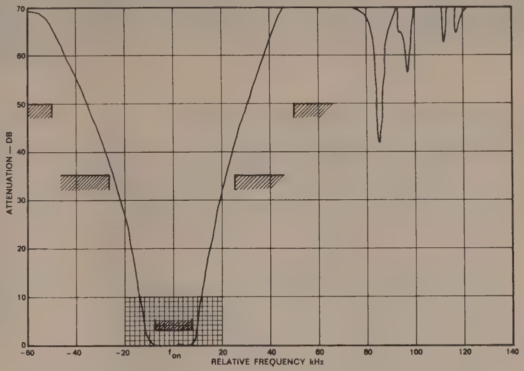
MONOLITHIC CRYSTAL DISCRIMINATOR



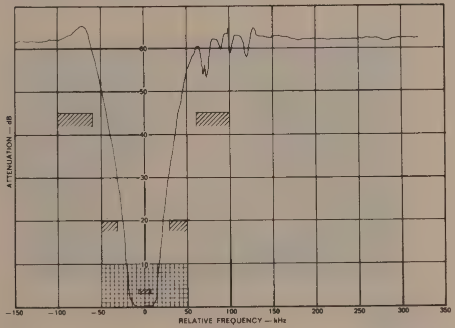
Model 2283F, at 10.7 MHz, offers 1% total harmonic distortion and 800 mV of recovered audio when used with a CA3089E quadrature detector. Model 2378F offers similar performance at 21.4 MHz. Data sheets available on request.

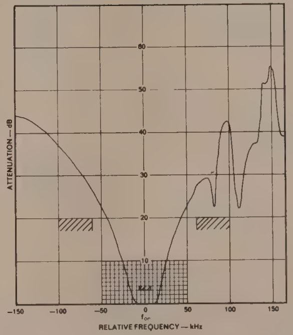
A 45 MHz SPECIAL



Our new 45 MHz Model 4371F is a 4-pole monolithic crystal filter offering maximum performance in a single HC-18 envelope. Designed for first IF use in new generation 900 MHz mobile receivers. Attenuation is 3dB max. over ± 7.5 kHz. Data sheet available on request.

FRONT-END FILTERS





These two-pole and four-pole monolithic crystal filters are designed especially for use as front-end filters for VHF low-band and high-band land mobile radios. All models are suitable for field or factory installation. They are matched to 50 ohms and fitted with phono-jacks (2-pole models) or BNC connectors (4-pole models). Two-pole models offer alternate channel rejection of 20dB min. and ultimate attenuation of 30dB. Four-pole models offer adjacent and alternate channel rejection of 20 and 45 dB (high-band) or 15 and 40 dB (low-band).

Case dimensions: l - 2.39 w - 1.02 h - 1.07

Other case styles available on special order. For OEM applications the monolithic elements can be supplied individually.

Piezo Technology Inc.
2400 Diversified Way
Orlando, Florida 32804
305-425-1574
TWX 810-850-4136

The standard in monolithic crystal filters

Q-Tech Corporation

PIONEERS IN HYBRID TECHNOLOGY
STATE OF THE ART DEVELOPMENT

TTL & CMOS CLOCK OSCILLATORS

Q-TECH CLOCK OSCILLATORS

are the result of long and extensive development which has joined the semiconductor, hybrid and crystal techniques. Units are now available in miniature low profile packages with a wide range of capabilities.

The units are capable of producing the high stability temperature and aging characteristics associated with AT cut quartz crystals. This stability is achieved over the entire wide frequency range.

ADDITIONAL CHARACTERISTICS

	TTL	CMOS
Power Supply:	5.0 Volts ±10%	5.0 to 15.0 Volts (Specify)
Symmetry:	60/40% or better above 6.0MHz 50/50% below 6.0MHz (available up to 12.5MHz)	50/50
Rise and Fall Times:	Less than 10 nanoseconds at 10.0MHz	75 nanoseconds max. V_{dd} 5.0 Volts 80 nanoseconds max. V_{dd} 10.0 Volts
Level (Output):	"1" 2.8 Volts Min. "0" .4 Volts Max.	CMOS "1" V_{dd} (less .01V) "0" 0.01 Volts
Power Consumption:		See Page 4

GENERAL (TTL & C-MOS):

Stability Versus	10% Change in Input:	2 PPM (.0002%)
	20% Change in Load	1 PPM (.0001%)
Aging:		5 PPM (.0005%) Max (30 Days) or 10 PPM

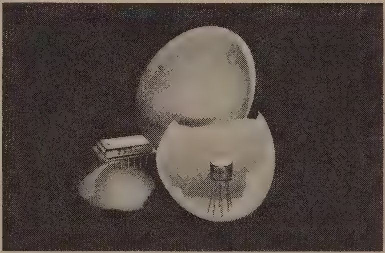
OTHER HYBRID FREQUENCY CONTROL DEVICES

Other HYBRID FREQUENCY CONTROL devices are offered on a custom basis. Consult the factory for units with VCXO characteristics, gated output, multiple frequency output, or custom logic. Units ordered to −3 stability (±.0005% 0° to 50°C) require an external tuning capacitor. This tolerance can only be met when the nominal frequency is within ±.0001% at 25°C. This tuning capacitor is necessary to adjust the unit's nominal frequency to ±.0001% at 25°C. The tuning capacitor (nominally 32 pf) is connected between two designated internal tie points.

FREQUENCY VERSUS TEMPERATURE OPTION

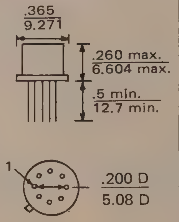
1 ±.01% /2 ±.005% /3* ±.0005%	0 to 50°C
4 ±.005%	0 to 70°C
5 ±.0025%	−20 to +70°C
6 ±.005%	−55 to +105°C
7 ±.003% /9 ±.005% /10 ±.01%	−55 to +125°C
8 SPECIAL	

*Requires Tuning Capacitor



MOUNTING AND CONNECTIONS
Upper dimension is inches
Lower dimension is millimeters

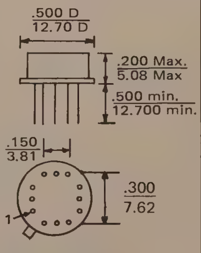
QT1



1,2&6 Tie Points
4 Ground
5 Output
8 V_{cc}

Figure 1.

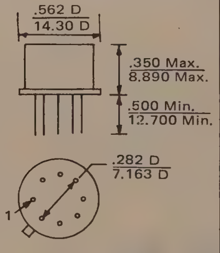
QT2



3,9&10 Tie Points
5 Output
6 Ground
12 V_{cc}

Figure 2.

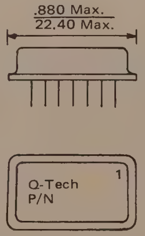
QT3



2,6&7 Tie Points
4 Ground
5 Output
8 V_{cc}

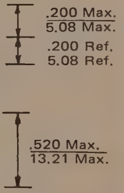
Figure 3.

QT4



3,10,12&14 Tie Points
4 V_{cc}
5 Output
7 Ground

QT6



4,10&11 Tie Points
7 Ground
8 Output
14 V_{cc}

Figure 4.

Q-Tech Corporation

PIONEERS IN HYBRID TECHNOLOGY
STATE OF THE ART DEVELOPMENT

TTL & CMOS CLOCK OSCILLATORS

C-MOS CLOCK OSCILLATORS:

Frequencies available in the C-MOS line of oscillators are limited presently to 10.0 MHz. This frequency limit is also related to input voltage. It is essential, therefore, when ordering a C-MOS unit to specify the input voltage.

Power requirements of C-MOS units are related to both frequency and input voltage. Most of the power is dissipated within the crystal oscillator portion of the device, and buffering, division, or other logic requirements within the unit contribute little to the total power consumption.

The graph below shows a family of curves that demonstrate the above. One curve shows reliable frequency versus voltage operation (solid line) while three other curves show power versus frequency at 15.0 Volts, 10.0 Volts, and 5.0 Volt levels. These curves are derived from Q-Tech's normal approach of utilizing "AT" cut crystals within the 3.0 to 10.0 MHz spectrum to produce the frequency or logic functions required.

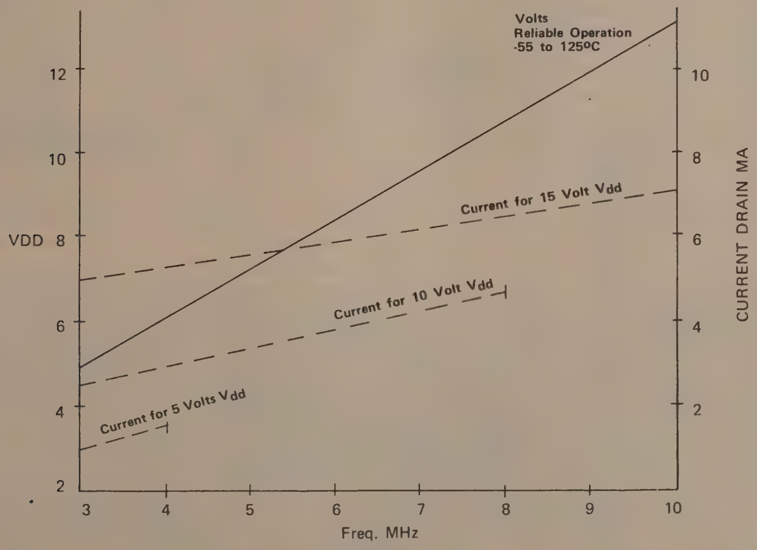
Custom units of lower power operate from a low frequency crystal source and may operate from a much lower voltage. Information on these devices can be obtained by calling the Q-Tech sales or application engineering department. As the state of the art of available C-MOS devices improves, we will have available higher frequency units at lower voltages. Consult the factory for your custom requirements.

FREQUENCY RANGES AVAILABLE

Package Size	C-MOS Frequency Range	TTL Frequency Range
QT1	50 KHz to 10MHz	50KHz to 30MHz
QT2 or QT3	300Hz to 10MHz	1KHz to 25MHz
QT4 or QT6	1Hz to 10MHz	1Hz to 25MHz

QUALITY CONFORMANCE & RELIABILITY ASSURANCE:

Q-Tech's facilities are qualified to Mil-I-45208 and are well equipped to perform the screening, quality conformance and reliability assurance requirements of Mil-M-38510A and Mil-Std-883. Personnel at Q-Tech are fully conversant with and experienced in performing these screening and O.A. requirements.



POWER CONSIDERATIONS FOR Q-TECH C-MOS CRYSTAL OSCILLATORS

REEVES-HOFFMAN

Described are typical units of commonly used types. Descriptive data, including measured capabilities, furnished on request. If your need concerns types and parameters not shown, please contact our plant.

Available with special C_0, C_1, and L_1 for filter applications • temperature coefficients to your specifications • pre-aging to guarantee stability of high precision units • special designs for high shock and vibration. All units meet mil-3098 requirements. Special high precision units, with aging characteristics up to 2×10^{-11} per day, are available in standard frequencies of 1, 2.5 and 5 MHz.

CRYSTALS

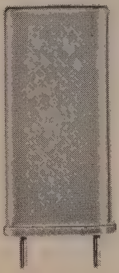
Frequency Range	Frequency Tolerance/Temperature Range			Holder Size (Military)*
	−55°C to +105°C	−40°C to +85°C	0°C to +50°C	
.85 to 50 kHz	±0.02%	±0.015%	±0.01%	HC-6, HC-13, HC-14
1 to 14 kHz	±0.02%	±0.015%	±0.01%	HC-13
14 to 150 kHz	±0.015%	±0.010%	±0.008%	HC-6, HC-13, HC-14, HC-17
90 to 300 kHz	±0.025%	±0.018%	±0.01%	HC-6, HC-13, HC-17
200 to 500 kHz	±0.012%	±0.008%	±0.003%	HC-6, HC-14, HC-17, HC-21(**)
200 to 800 kHz	±0.009%	±0.005%	±0.003%	HC-6, HC-13, HC-14, HC-17
250 to 800 kHz	±0.018%	±0.015%	±0.008%	HC-6, HC-14, HC-17
500 to 1,400 kHz	±0.005%	±0.004%	±0.0025%	HC-6, HC-14, HC-17
1.4 to 20 MHz	±0.004%	±0.004%	±0.002%	HC-6, HC-14, HC-17, 511, 512
10 to 200 MHz	±0.004%	±0.003%	±0.002%	HC-6, HC-13, HC-14, HC-17, HC-18

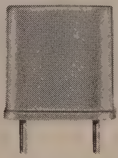
* All units listed are also available in T-5 ½ glass holder.

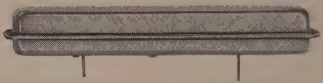
** Also available in T-9 glass bulb.

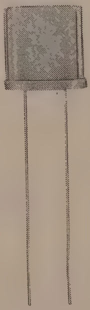
QUARTZ CRYSTAL HOLDERS

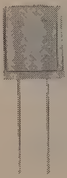
CW—Coldweld
SS—Solderseal

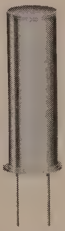

RH-13 (SS)

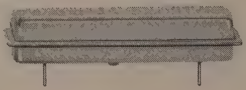

RH-6 (SS)

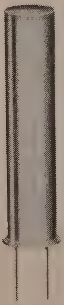

E-1 (CW)

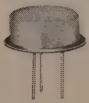

RH-512 (SS)

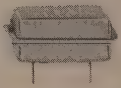

RH-18 (SS)

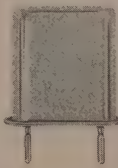

A-3 (CW)

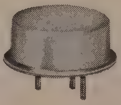

E-2 (CW)

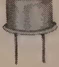

A-2 (CW)


B-5 (CW)


E-3 (CW)


DA (CW)


C (CW)


A-5 (CW)

Illustrations show actual sizes

REEVES-HOFFMAN
DIVISION OF DCA
400 WEST NORTH STREET, CARLISLE, PA. 17013

REEVES-HOFFMAN CRYSTAL FILTERS

Note: The frequencies and bandwidths indicated are not to be considered production limitations. Variations of these filters can be made over the frequency range of approximately 10 kHz to 30 MHz (or higher).

BAND PASS

Center Frequency	3 dB Bandwidth	Shape Factor	Impedance (Ohms)	Size (in.) (L x W x H)
8 kHz	4 Hz	50:1 @ 40 dB	600	1.82 x 1.5 x 5.0
100 kHz	2 Hz	4:1 @ 60 dB	3K	4.25 x 2.0 x 3.82
250 kHz	100 Hz	3:1 @ 60 dB	8K	2.0 x 2.0 x 3.5
455 kHz	200 Hz	10:1 @ 60 dB	2K	3.5 x 1.5 x 2.0
700 kHz	1000 Hz	10:1 @ 80 dB	2.5K	1.5 x 1.5 x 3.5
1.75 MHz	400 Hz	5:1 @ 60 dB	1K	1.0 x 1.5 x 1.5
1.75 MHz	110 Hz	2:1 @ 60 dB	200	3.75 x 1.75 x 1.25
3.0 MHz	400 Hz	6:1 @ 60 dB	5K	3.0 x 2.0 x 1.5
4.0 MHz	1200 Hz	10:1 @ 70 dB	50	3.5 x 1.5 x 1.5
* 9.0 MHz	5400 Hz	2:1 @ 60 dB	470	1.5 x .75 x .32
*10.7 MHz	2700 Hz	2:1 @ 60 dB	470	1.5 x .75 x .32
*10.7 MHz	13 kHz	2:1 @ 60 dB	470	1.5 x .75 x .32
10.7 MHz	800 Hz	1.5:1 @ 60 dB	600	2.0 x 2.0 x 1.0
11.5 MHz	120 kHz	4:1 @ 40 dB	2K	1.5 x 1.5 x 1.0
20.0 MHz	30 kHz	1.7:1 @ 60 dB	1K	1.5 x 1.5 x 1.0
*25.0 MHz	26 kHz	3:1 @ 50 dB	2K	1.75 x .70 x .50
30.0 MHz	25 kHz	3:1 @ 60 dB	2K	1.5 x 1.5 x 1.0

* "MINILITH," Reeves-Hoffman monolithic design.
† Reeves-Hoffman "Hi-Fidelity" SSB design.

SINGLE SIDE BAND

Center Frequency	3 dB Passband	Min. Attenuation	Insertion Loss	Passband Variation	Impedance (Ohms)
250 kHz	−230 to −7730 Hz	60 dB	6.0 dB	3 dB max.	3K
250 kHz	+240 to +7740 Hz	60 dB	6.0 dB	3 dB max.	3K
1750 kHz	−350 to −3040 Hz	70 dB	6.0 dB	1.5 dB	3K
1750 kHz	+350 to +3040 Hz	70 dB	6.0 dB	1.5 dB	3K
†1743.71 kHz	−3255 to −5935 Hz	70 dB	3.0 dB	.5 dB	220
†1750.00 kHz	−255 to −3035 Hz	70 dB	3.0 dB	.5 dB	220
†1750.00 kHz	+255 to +3035 Hz	70 dB	3.0 dB	.5 dB	220
†1756.29 kHz	+3255 to +5935 Hz	70 dB	3.0 dB	.5 dB	220
* 9.0 MHz	(6 dB) +500 to +3000 Hz	60 dB	3.0 dB	1.5 dB	470
* 9.0 MHz	(6 dB) −500 to −3000 Hz	60 dB	3.0 dB	1.5 dB	470
*10.7 MHz	+500 to +3200 Hz	60 dB	2.0 dB	2.0 dB	470
*10.7 MHz	−500 to −3200 Hz	60 dB	2.0 dB	2.0 dB	470

REEVES-HOFFMAN CRYSTAL OSCILLATORS

Note: Parameters shown are not production limitations. Custom designing is available from 1 Hz to 200 MHz. Stability, aging, output voltage, waveform, and environment to your specifications.

Frequency	Aging	Output	Supply Voltage	Temp. Range	Size in.) (L x W x H)
60 Hz	3 x 10^{-8}/day	1v, rms	12v, ac	10°C to 60°C	4 x 4.7 x 4.9
400 Hz	25 x 10^{-6}/yr.	sq. wave	24v, dc	−32°C to +52°C	1.75 x 1.75 x 4.33
100.000 kHz	3 x 10^{-8}/day	1v, rms	28v, dc	−40°C to +70°C	1.88 x 1.44 x 3
90-650 kHz	25 x 10^{-6}/yr.	1v, rms	30v, dc	−30°C to +55°C	1.290 dia. x 4.062
1000.000 kHz	1 x 10^{-9}/day	1v, rms	28v, dc	0°C to 65°C	2 x 2 x 4.75
2500.000 kHz	2 x 10^{-11}/day	100 kc 1.0 mc 5.0 mc 1v, rms	24v, dc	0°C to 40°C	Rack mount 5¼″ panel
5000.000 kHz	1 x 10^{-8}/wk	55mv	12v, dc and 26v, dc	0°C to 60°C	8.5 x 5 x 5

STATEK

STATEK

LOW FREQUENCY
QUARTZ CRYSTALS
MODELS SX-1H & SX-1V

FEATURES
- 10 kHz to 250 kHz
- Hermetically sealed TO-5 can
- Twenty SX-1 stock frequencies
- Low cost
- Minimal aging

APPLICATIONS

SX-1H CRYSTAL used in series resonant oscillator circuits (two inverters)

SX-1V CRYSTAL for parallel resonant (Pierce) oscillator circuits (single inverter)

SX Crystal
in TO-5 Can

SPECIFICATION SUMMARY*

		SX-1 SERIES			
Frequency Range (kHz)		10.0-30.0	30.0-50.0	50.0-100.0	100.0-250.0
Calibration Tolerance at 25°C	Calibration A	± 0.01%	± 0.01%	± 0.02%	± 0.02%
	Calibration B	± 0.03%	± 0.03%	± 0.05%	± 0.05%
Frequency (1) Variation (%)	0-70°C	+.0065 to −.025	+.0095 to −.03	+.013 to −.035	+.0075 to −.032
	−40 +85°C	+.008 to −.036	+.015 to −.043	+.022 to −.05	+.009 to −.044
Series Resistance (MΩ)	SX-1H	4.0-1.0	1.0-0.8	0.8-0.4	0.4-0.15
	SX-1V	0.9-0.25	0.25-0.2	0.2-0.1	0.10-0.03
Q	SX-1H	3,500-7,500	7,500-11,000	11,000-14,000	14,000-22,000
	SX-1V	17,000-32,000	32,000-42,000	42,000-58,000	58,000-70,000
Motional Capacitance fF		1.3-0.60	0.60-0.45	0.45-0.25	0.25-0.30
Maximum Drive Current (μA rms)		0.5	0.5	0.5	0.5
First Year Aging at 25°C(ppm)		10	10	10	10
Shock and Operating Vibration		1000 g, 1 ms, ½ sinewave; 11.6 g RMS, 100-1000 Hz, random (MIL-STD-202D, 1D)			
Stock Frequencies (kHz)(2)		10.0, 12.8, 15.36, 16.0, 16.384, 17.476, 18.641, 19.2, 20.48, 24.576, 28.16, 30.72, 31.5, 32.768, 36.864, 38.4, 40.96, 60.0, 76.8, 100.0, 153.6. (240.00, SX-1H only)			

*Specifications are typical unless otherwise indicated. Subject to change without notice.

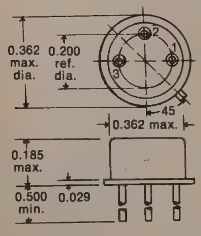
(1) Does not include calibration error.
(2) Stock frequencies are established by demand. Contact Statek for current stock frequency list.

PRICING SUMMARY*

	QUANTITIES						
	1-24	25-49	50-99	100-249	250-499	500-999	1000-2499
SX-1H, Stock Frequencies, Calibration A	$ 4.30	$ 3.70	$3.20	$2.87	$2.50	$2.20	$2.00
SX-1H, Stock Frequencies, Calibration B	$ 3.70	$ 3.10	$2.79	$2.44	$2.15	$1.90	$1.70
SX-1H, Non-Stock Frequencies, Calibration A	$11.30	$ 8.00	$6.30	$4.90	$3.60	$2.85	$2.20
SX-1H, Non-Stock Frequencies, Calibration B	$ 9.60	$ 6.90	$5.40	$4.15	$3.05	$2.40	$1.87
SX-1V, Stock Frequencies, Calibration A	$ 5.40	$ 4.60	$4.00	$3.59	$3.12	$2.80	$2.50
SX-1V, Stock Frequencies, Calibration B	$ 4.30	$ 3.70	$ 3.20	$2.87	$2.50	$2.20	$2.00
SX-1V, Non-Stock Frequencies, Calibration A	$14.00	$10.00	$7.90	$6.20	$4.50	$3.50	$2.75
SX-1V, Non-Stock Frequencies, Calibration B	$11.30	$ 8.00	$6.30	$4.90	$3.60	$2.85	$2.20

*Prices subject to change without notice.

Minimum order stock frequencies, $30.00; non-stock frequency minimum order, $200.00.
Prices are significantly lower for 10,000 or more units.

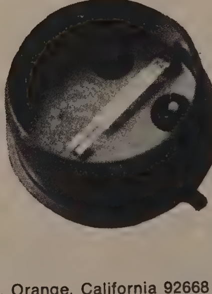


TO-5 TOP VIEW

SX-1V, SX-1H

Pin	Connection
1	Input
2	Output
3	Gnd.

1. All metal parts are gold plated.
2. Leads are 0.019 dia. (max.)
3. All dimensions in inches.



TO-5 can with
top removed.

STATEK CORPORATION
1233 Alvarez Avenue, Orange, California 92668
Tel. (714) 639-7810 TELEX 65-5430

STATEK

STATEK

WATCH & TIME KEEPING
QUARTZ CRYSTALS
MODEL WX-2CF

FEATURES
- Lowest cost
- Higest accuracy; ±5ppm
- Smallest size
- Very rugged
- Laser tuned
- Low aging

DESCRIPTION
Rugged Tuning Fork Designs, Semi Conductor Manufacturing Techniques And Automatic Laser Beam Tuning Used For Low Cost, High Volume Production.

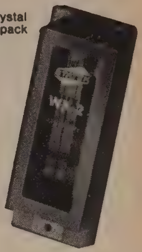
APPLICATIONS
Any time keeping function from the smallest ladies watch to standard electrically powered timers.

SPECIFICATIONS

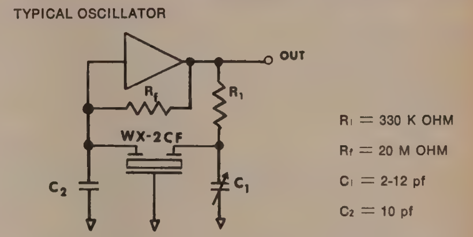
Frequency Tolerance (Specified oscillator, at 25°C)	32,768 Hz ±5ppm
Series Resistance, R_m	350 K OHM typical 500 K OHM maximum
Motional Capacitance, C_m	0.22 fF typical
Geometric Capacitance, C_g	2.0 pf typical
Shunt Capacitance, C_s	0.15 pf typical
Q	65,000 typical 45,000 minimum
Drive Level	1.5 µa PP maximum
Turning Point, T_o	20°C ±5°C
Temperature Coefficient, K	-0.04 ppm/°C^2
Aging (first year, at 25°C)	1 ppm typical 3 ppm maximum
Shock (3000 g, for 0.2 msec.)	3 ppm max. shift
Vibration (20g RMS, 10 to 1000 Hz)	1 ppm max. shift

APPLICATIONS INFORMATION
Calibration Frequency

Since Statek supplies crystals calibrated within 5 ppm, it is essential that the frequency offset of the circuit and watch module be well defined. This can best be achieved by measuring the frequency of reference Statek crystals in the circuit of intended use. Tuning production units in accordance with the reference oscillator and crystal has proven to be more effective than specifying a load capacitance.



WX Crystal in Flatpack

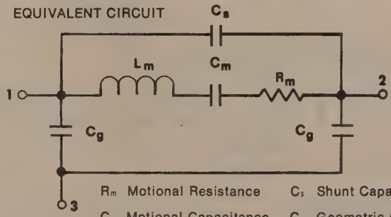


R_1 = 330 K OHM

R_f = 20 M OHM

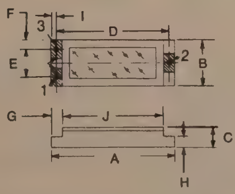
C_1 = 2-12 pf

C_2 = 10 pf



R_m	Motional Resistance	C_s	Shunt Capacitance
C_m	Motional Capacitance	C_g	Geometric Capacitance
L_m	Motional Inductance		

FLATPACK TOP VIEW



TERMINALS
1. CRYSTAL (tuning)
2. CRYSTAL
3. GROUND

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	10.14	10.39	0.399	0.409
B	3.81	4.06	0.150	0.160
C	1.52	1.78	0.060	0.070
D	9.12	9.37	0.359	0.369
E	2.41	2.67	0.095	0.105
F	0.56	0.81	0.022	0.032
G	0.88	1.13	0.034	0.045
H	0.79	1.04	0.031	0.041
I	0.38	0.64	0.015	0.025
J	8.18	8.43	0.322	0.332
Holes	0.31	0.41	0.012	0.016
Pad Length	1.40	1.65	0.055	0.065

STATEK CORPORATION 1233 Alvarez Avenue, Orange, California 92668
Tel. (714) 639-7810 TELEX 65-5430

STATEK

STATEK

LOW FREQUENCY

CRYSTAL OSCILLATORS

MODEL SQXO-2

FEATURES

- Oscillator frequency range — 10 kHz to 250 kHz
- Extremely small size
- Low milliamps current consumption
- Wide operating temperature range
- Withstands high shock and vibration levels
- CMOS and TTL compatible

DESCRIPTION

Subminiature • Thin Film Hybrid • Stable • Rugged • Buffered Square Wave Output

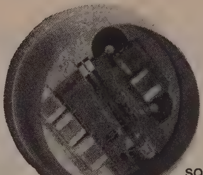
APPLICATIONS

SQXO OSCILLATORS contain • SX-1H crystal • chip transistors. These series resonant circuits drive TTL and CMOS loads.

SPECIFICATION SUMMARY*

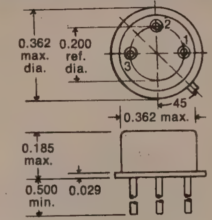
	SQXO-2
Calibration Voltage	5± 0.5 VDC
Supply Voltage Range	Depends on freq. & temp. range
Current (typical, at Calibration Voltage into 10 pf and 10 MΩ load)	0.50 mA at 10 kHz to 2.0 mA at 250 kHz
Frequency Ranges	10 kHz to 250 kHz
Stock Frequencies**	10.0, 12.8, 15.36, 16.0, 16.384, 19.2, 32.768 & 100.0 kHz
Standard Frequency (Calibration A) at 25°C	± 0.01% from 10 to 50 kHz and ± 0.02% from 50 to 250 kHz
Frequency Stability over Temperature Range	Approximates SX-1 Crystal Characteristics
Operating Temperature	0 to 70°C, (C) −40 to + 85°C (I) −55 to + 125°C (M)
Shock and Operating Vibration***	1000 g, 1 Ms, ½ Sinewave; 11.6 g RMS, 100-1000 Hz, random (MIL-STD-202D, 1D)

*Specifications subject to change without notice.
**Stock frequencies are established by demand. Contact Statek for current frequency list.
***Improved shock and vibration specifications available.



SQXO-2 Oscillator in TO-5 Can

TO-5 TOP VIEW



SQXO-2

Pin	Connection
1	+ Supply
2	Output
3	Gnd.

1. All metal parts are gold plated.
2. Leads are 0.019 dia. (max.)
3. All dimensions in inches.

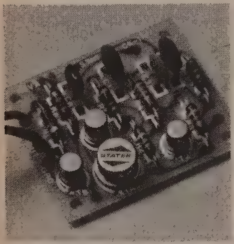
PRICING SUMMARY*

QUANTITY	SQXO-2(1) STOCK FREQ. (TO-5 CAN)	SQXO-2(1,2) NON-STOCK FREQ. (TO-5 CAN)
1- 4	$39.00	–
5-24	$29.00	$49.00
25-49	$23.50	$38.00
50-99	$23.50	$28.00
100	$19.50	$21.50

*Prices subject to change without notice.
(1) Prices shown are for Calibration A, 0 to 70°C units. Pricing for Units with different temperature and calibration ranges may be obtained from Statek.
(2) A minimum order of 5 units is required for non-stock frequency SQXO-2 oscillators.

CRYSTAL OSCILLATOR KITS – MODELS CK-1H & CK-1V

COMPLETE LOW FREQUENCY CRYSTAL OSCILLATOR KITS (actual size)



NOTE: Models CK-1H and CK-1V Kits **do not** include integrated circuits, resistors, capacitors or wiring.

THE CK-1H AND CK-1V OSCILLATOR KITS CAN BE USED FOR:

- Oscillator breadboards
- Low volume production oscillators
- Reference oscillators for frequency correlation

DESCRIPTION

The CK-1V kit utilizes a Pierce (single inverter) oscillator circuit and contains five SX-1V crystals. The CK-1H kit utilizes a series circuit (two inverters) and contains six SX-1H crystals. The frequency calibration is ±0.01% for all frequencies except 240 kHz which is ±.02%. The table below lists the frequencies included in the kits.

Frequency	Applications
10,000 kHz	Decimal Time Base
15,360 kHz	60 Hz Time Base
19,200 kHz	Modem Clock
32,768 kHz	Seconds Timer
100,000 kHz	Decimal Time Base
240,000 kHz	Motor Speed Control

Both kits have an etched and drilled circuit board. The Model CK-1H Kit circuit uses three low cost transistors. The Model CK-1V Kit uses a CMOS 4007A Dual Complementary Pair Plus Inverter.

DOCUMENTATION

The circuit documentation supplied with each kit consists of:

- Circuit schematics with a table of component values for different oscillator frequencies.
- A physical layout of the oscillator
- A parts list for various oscillator frequencies

Description of circuit operation, layout characteristics and mounting provisions are also included.

The kits are priced at $27.00 each in single quantity.

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Tel. (714) 639-7810 TELEX 65-5430

STATEK

HIGH PERFORMANCE HYBRID
CRYSTAL OSCILLATORS &
MODELS LQXO-1 & LQXO-2
CRYSTAL CONTROLLED TIMERS
MODELS DQXO-1 & DQXO-2

STATEK

FEATURES

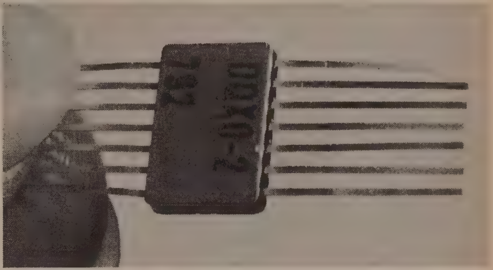
- LQ Series — 10 kHz to 250 kHz
- DQ — divided outputs to 1 cycle per day
- Microamp current consumption
- TO-5 or Flatpak

DESCRIPTION

Rugged Tuning Fork Designs, Semi Conductor Manufacturing Techniques And Automatic Laser Beam Tuning Used For Low Cost, High Volume Production.

APPLICATIONS

LQXO-1 — 5 volt oscillator
LQXO-2 — 12 volt oscillator
DQXO-1 — 5 volt timer (oscillator & divider)
DQXO-2 — 12 volt times (oscillator & divider)

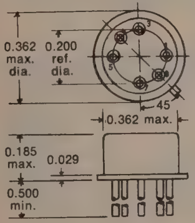


SPECIFICATION SUMMARY*

	LQXO-1, -1F	LQXO-2, -2F	DQXO-1, -1F	DQXO-2, -2F
Calibration Voltage	5± 0.5 VDC	12± 1 VDC	5± 0.5 VDC	12± 1 VDC
Supply Voltage Range	4 to 9 VDC	9 to 15 VDC	4 to 9 VDC	9 to 15 VDC
Current (typical, at Calibration Voltage into 10 pf and 10 MΩ load)	20 μA at 10 kHz to 80 μA at 200 kHz	60 μA at 10 kHz to 220 μA at 200 kHz	2 to 10 μA increase over corresponding LQXO design	
Frequency Ranges	10 kHz to 200 kHz		Standard Version to 1 Hz, Long Period to 1 pulse/day	
Stock Frequencies**	16.0, 16.384 & 32.768 kHz		1 Hz	1 Hz
Standard Frequency (Calibration A) at 25°C	± 0.01% from 10 to 50 kHz and ± 0.02% from 50 to 250 kHz			
Frequency Stability over Temperature Range	Approximates SX-1 Crystal Characteristics			
Operating Temperature	−40 to +85°C or −55 to +100°C			
Shock and Operating Vibration***	1000 g, 1 Ms, ½ Sinewave; 11.6 g RMS, 100-1000 Hz, random (MIL-STD-202D, 1D)			

*Specifications subject to change without notice.
**Stock frequencies are established by demand. Contact Statek for current frequency list.
***Improved shock and vibration specifications available.

TO-5 TOP VIEW



Pin Conn.

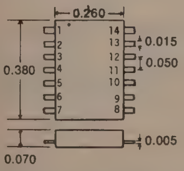
LQXO	
1	Out
3	Vdd
4	Gnd
5-8	NC

DQXO	
1	Out
3	Vdd
4	Gnd
5	NC
7	Osc
8	Reset

LEADS ARE 0.019" DIA. (MAX.)

1. All dimensions are in inches.
2. No tolerance given.
3. All metal parts are gold plated
4. Hermétically sealed packages weigh less than 1 gram.

FLATPACK TOP VIEW



Pin Conn.

LQXO	
1	Gnd
3	Vdd
7	Out
Others	NC

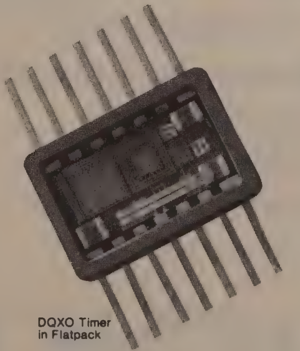
DQXO	
1	Gnd
3	Vdd
5	Out
6	Reset
7	Osc
Others	NC

¼" x 3/8" flatpack for LQXO-1F, 2F and standard DQXO-1F, 2F.
3/8" x 3/8" flatpack for long period DQXO-1F, 2F.

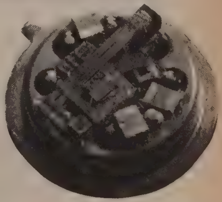
PRICING SUMMARY*

QUANTITY	LQXO-1, -2$^{(1)}$ OSCILLATOR (TO-5 CAN)	DXQO-1, -2$^{(1)}$ STD. TIMER (TO-5 CAN)	DQXO-1F, -2F$^{(1)}$ LONG PER. TIMER (FLATPACK)
1- 4	$150.00	$170.00	$275.00
5- 9	$135.00	$155.00	$250.00
10-24	$120.00	$140.00	$225.00
50-99	$ 90.00	$100.00	$168.00
100	$ 69.00	$ 79.00	$140.00

*Prices subject to change without notice.
(1) Prices for flatpack configurations available upon request. A minimum order of 4 units is required for non-stock frequency CMOS oscillators and timers.



DQXO Timer in Flatpack



LQXO Oscillator in TO-5 Can

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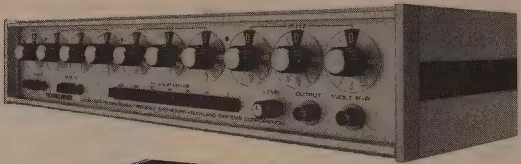
CRYSTALS/OSCILLATORS/CRYSTAL FILTERS

for the BE$T in...
FREQUENCY SYNTHESIZERS

DC to 2 MHz Range

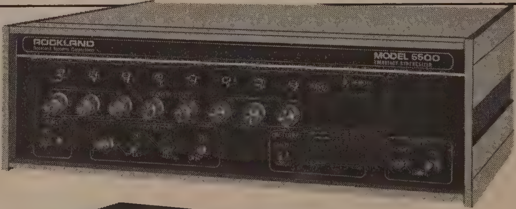


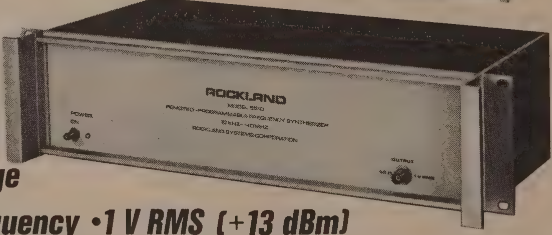
Model 5100
Local and remote programming
for laboratory and systems applications

Model 5110
Remote programming only. (for O.E.M.
and other "hands-off" applications)

- *DC to 2 MHz Range*
- *0.001 Hz Resolution throughout range*
- *1.5 Microsecond Programming Speed*
- *Full Programmability* BINARY OR BCD
- *No Switching Transients*
- *Direct Digital Techniques* NO MIXING OR PHASE LOCKING
- *High Spectral Purity* —70dB SPURIOUS —55dB HARMONIC
- *High Stability* $\pm2\text{x}10^{-8}$/°C STANDARD $\pm2\text{x}10^{-10}$/°C OPTIONAL

10 KHz to 39.999999 MHz





New! **Model 5500**
Precise, stable frequency source
for fine resolution HF applications.
Local and remote programming

New! **Model 5510**
Remote programming only. (for O.E.M.
and other "hands-off" applications)

- *10 KHz to 39.999999 MHz Range*
- *1 Hz Resolution throughout range*
- *LED Display of Programmed Frequency*
- *Full Programmability & Fast Switching* —1 MS TYPICAL
- *High Spectral Purity:* SPURIOUS: >60 dB down PHASE NOISE: —55 dB HARMONIC: —30 dB
- *High Stability:* $\pm2\text{x}10^{-8}$/°C STANDARD $\pm2\text{x}10^{-10}$/°C OPTIONAL
- *1 V RMS (+13 dBm)*
- *Amplitude Modulation:* 0-95%, 400 Hz, 1 KHz, EXTERNAL
- *Auxiliary TTL Square-wave Output*
- *ASCII, Calculator and Minicomputer Interface Options*

ROCKLAND

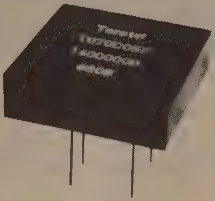
Rockland Systems Corporation 230 W. Nyack Road, West Nyack, New York • (914) 623-6666 • TWX 710-575-2631

TOROTEL INC.

13402 SOUTH 71 HIGHWAY, GRANDVIEW, MO. 64030
PHONE: (816) 761-6314 TWX 910-777-7037

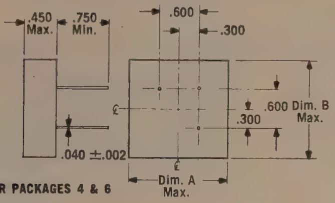
CRYSTAL CONTROLLED CLOCK OSCILLATORS

- Available in Plastic Package or Hermetic Seal
- Excellent Rise/Fall Time, Square Wave
- Compatible with T^{2}L Logic
- Minimum Power Required, All Solid State
- Economically Priced for Industrial Applications

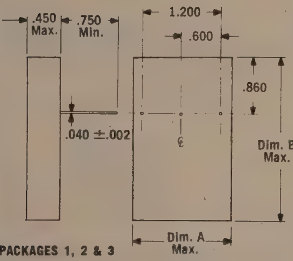


POWER REQUIREMENTS

Operating Voltage .... 3.5 to 5.5 VDC
Nominal Current .... 6 ma, 0.1 MHz to 2.5 MHz
25 ma, 2.5 MHz and up
Special Order for other Operating Voltage
T^{2}L Logic Output:
1 = 2.4 Volts Minimum 0 = 0.4 Volts Maximum
Fanout = 5, 10 T.T.L. Loads Max.
Duty Cycle .... 50% ±10% at 1.4 Volts
Rise/Fall Time .... Measured from 0.4 to 2.4 Volts
10 nanoseconds .... 2.5 MHz and up
25 nanoseconds .... 0.1 MHz to 2.5 MHz



FOR PACKAGES 4 & 6



FOR PACKAGES 1, 2 & 3

TOROTEL OSCILLATOR PART NUMBER

TXXX X XX X X — (Frequency)

Temp. Range in C°	No.
10°- 40°	040
0°- 50°	*050
−10°- 60°	*060
−20°- 70°	*070
−30°- 80°	ᵀ 080
−40°- 90°	ᵀ 090
−55°-105°	ᵀ 105

Freq. Tol. Over Temp. Range	No.
±10 PPM	*ᵀA
±50 PPM	C
±100 PPM	D
±200 PPM	E
±500 PPM	F
±20 PPM	ᵀ J
±70 PPM	L

T.T.L. Output	No.
5	05
10	10

Package Type	No.
Encapsulated	E
Hermetic Seal	H

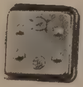
Package Size Dim. A	Package Size Dim. B	No.
1.505	3.260	1
1.505	2.510	2
1.505	1.505	3
1.505	1.505	4
1.005	1.005	6

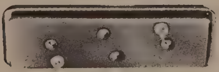
Frequency Range	Package No.
0.1 Hz- 25 Hz	1
25 Hz-6,250 Hz	2
6,250 Hz- 100 KHz	3
100 KHz- 25 MHz	4
10 MHz- 20 MHz	6

When Ordering:
Do not mix Columns with an *
Do not mix Columns with a ᵀ

Example Order: T070D10E4-10,000,000
Torotel Oscillator, −20°C to +70°C, ±100 PPM, 10 T.T.L. Fanout, Encapsulated, Size 4, 10 MHz

QUARTZ CRYSTALS





Frequencies from 68 KHz to 75 MHz manufactured to the highest tolerances and hermetically sealed with the latest methods.

Resistance weld sealing is available at no extra cost in the HC-6/U, HC-18/U, HC-25/U and HC-33/U standard holders. This process uses an electrical weld to seal the crystal unit in a helium-nitrogen atmosphere. Solder balls and aging due to flux contamination are completely eliminated.

QPL-3098

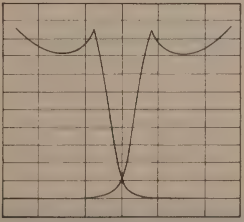
In house laboratory facilities can perform testing to MIL-C-3098F. Many standard types are QPL approved and custom designs are available on request.

CRYSTAL FILTERS

Crystal filters from 10 KHz to 30 MHz are computer designed for maximum performance. Custom designs are considered a challenge. Contact Torotel's engineering staff for assistance.

WE SPECIALIZE IN THESE TYPES OF PASSIVE NETWORKS:

BAND PASS
BAND REJECT
LOW PASS
HIGH PASS
LINEAR PHASE
PHASE EQUALIZER
AMPLITUDE EQUALIZER
DELAY LINES
IN THE FREQUENCY RANGES FROM DC TO 35 MHz



FOR APPLICATIONS INVOLVING:

DATA MODEMS
RF COMMUNICATIONS
AVIONICS
TELEGRAPH
INSTRUMENTATION TELEMETRY
FSK
SINGLE SIDEBAND

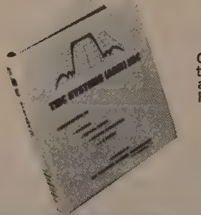
SEE OTHER TOROTEL PAGES

T.M.C. SYSTEMS (ARIZ.) INC.
930 W. 23rd ST. • TEMPE, ARIZONA 85281
PHONE (602) 967-7874
TWX 910-950-1943

This is a partial listing of available designs. Modified or Custom designs are available for your specific application. Contact our factory directly for technical or sales assistance.

Center Frequency	Passband	Stopband Bandwidth	Case Size in Inches	Insertion Loss (dB)	Source & Load Z (Ω)	Part Number
10.000 KHz	75 Hz USB	250 Hz at 40 dB	1.5 x 4 x 3	10	1K	FIL-0228
16.000 KHz	40 Hz	2 KHz at 30 dB	2 x 2 x .80	4.5	600	FIL-0055
19.275 KHz	217 Hz	1120 Hz at 20 dB	1.75 x 1.75 x 3.5	10	10K	FIL-0030
27.700 KHz	50 Hz	250 Hz at 50 dB	2.25 x 4 x 1.5	1	12K x 10K	FIL-0244
61.150 KHz	600 Hz	2300 Hz at 70 dB	1 x 2 x 3.5	4	1.8K-8.2K	FIL-0273
100.000 KHz	10 Hz	120 Hz at 40 dB	1.25 x 1 x 1.75	5	1500	FIL-0283
100.000 KHz	250 Hz	1 KHz at 60 dB	2 x 3.5 x .75	3	330	FIL-0099
100.000 KHz	2790 Hz USB	4790 Hz at 70 dB	2.5 x 3.5 x 2	3	330	FIL-0095
100.000 KHz	2790 Hz LSB	4790 Hz at 70 dB	2.5 x 3.5 x 2	3	330	FIL-0097
125.000 KHz	±10 Hz at 3 dB	3 Hz at 50 dB notch	2 x 6 x 2.5	3	1K	FIL-0131
250.000 KHz	400 Hz at 1 dB	30 Hz at 30 dB notch	2.9 x 2 x 2.5	2	12K	FIL-0008
250.000 KHz	2780 Hz USB	3500 Hz at 60 dB	1.875 x 2.75 x .65	4	500	FIL-0127
455.000 KHz	300 Hz at 6 dB	1700 Hz at 60 dB	.5 x 2.75 x .76	14	100K	FIL-0063
455.000 KHz	Dual 6 dB 100 Hz & 1000 Hz	1 KHz & 5 KHz Dual 60 dB	1.45 x 3.5 x 1	4 & 7	2.5K	FIL-0100
455.000 KHz	10 KHz at 6 dB	50 KHz at 60 dB	1 x 3.5 x 1	8	500-2K	FIL-0274
500.000 KHz	2 KHz at 6 dB	5 KHz at 40 dB	.6 x 4.66 x 1.5	7	50-500	FIL-0317
500.000 KHz	6 KHz at 6 dB	35 KHz at 60 dB	1 x 1 x 3.5	8	2K	FIL-0345
500.000 KHz	12 KHz at 6 dB	30 KHz at 60 dB	1 x 1 x 3.5	8	2K	FIL-0344
500.000 KHz	22 KHz at 6 dB	75 KHz at 60 dB	1 x 1 x 3.5	8	2K	FIL-0343
1.000 MHz	900 Hz at 6 dB	24 KHz at 50 dB	1 x 2.8 x 1.07	3	50K	FIL-0043
1.250 MHz	12 KHz at 6 dB	72 KHz at 60 dB	.8 x 1.25 x 3.5	10	500	FIL-0366
1.600 MHz	750 Hz at 6 dB	4 KHz at 60 dB	1 x 2.8 x 1.07	6	9K	FIL-0031
1.600 MHz	2800 Hz at 6 dB	15.2 KHz at 60 dB	1 x 2.8 x 1.07	6	9K	FIL-0005
1.750 MHz	2750 Hz USB	6 KHz at 60 dB	1 x 1.12 x 3.38	3	3.3K-500	FIL-0107
1.750 MHz	2750 Hz LSB	6 KHz at 60 dB	1 x 1.12 x 3.38	3	3.3K-500	FIL-0108
2.500 MHz	12 KHz	72 KHz at 60 dB	.8 x 1.25 x 3.5	10	500	FIL-0367
5.000 MHz	12 KHz	72 KHz at 60 dB	.8 x 2.5 x 1.25	10	500	FIL-0368
5.000 MHz	50 KHz	250 KHz at 50 dB	1 x 2.37 x 1.03	8	50	FIL-0377
5.750 MHz	3000 Hz at 3 dB	450 Hz at 60 dB notch	1 x 3.5 x 1	2	50	FIL-0230
6.290 MHz	500 Hz	20 KHz at 60 dB	.625 x 2⅛ x .750	6	470	FIL-0044
6.400 MHz	8000 Hz	20 KHz at 60 dB	.825 x 3 x .562	3	2.8K-150	FIL-0003
8.242 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0134
10.000 MHz	6300 Hz	63 KHz at 40 dB	1 x 1.77 x .88	6	50-500	FIL-0039
10.000 MHz	36 KHz	160 KHz at 60 dB	1 x 2.5 x 1	3	100	FIL-0035
10.125 MHz	40 KHz	80 KHz at 50 dB	.7 x 2.2 x .7	4	50	FIL-0375
10.700 MHz	70 KHz	140 KHz at 60 dB	1.31 x 2.35 x .782	8	50	FIL-0231
11.500 MHz	50 KHz	450 KHz at 60 dB	½ x 1.27 x .718	4	1K	FIL-0288
12.300 MHz	3200 Hz	52 KHz at 20 dB	.93 x 1.68 x .75	2	470	FIL-0113
13.418 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0295
15.542 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0296
16.533 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0314
21.400 MHz	20 KHz	40 KHz at 60 dB	1.2 x .6 x .4	3	700	FIL-0511
21.400 MHz	40 KHz	80 KHz at 60 dB	1.2 x .6 x .4	2	1400	FIL-0512
21.400 MHz	60 KHz	120 KHz at 60 dB	1.2 x .6 x .4	1	2100	FIL-0513
21.953 MHz	1600 Hz	20 KHz at 50 dB	1 x 1.5 x .875	5	2K	FIL-0028

If you need Custom Designs at Standard Prices — you need the experience of TMC working for you. Our Computerized Techniques provide you with Optimum Designs and Rapid Response at Cost Savings.



Complete sales and technical information available, contact Factory direct.

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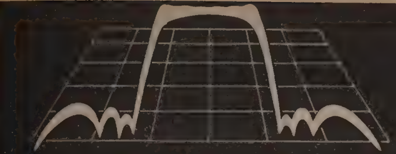

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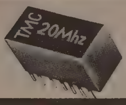
EQ-264
FILTER
FL-0351
FX-264

MINIATURIZED CRYSTAL OSCILLATOR



MINIATURIZED 8 POLE CRYSTAL FILTER

TMC SYSTEMS
FIL-02016-00
6808
60
50
40
30
20
10
ATTENUATION IN db.

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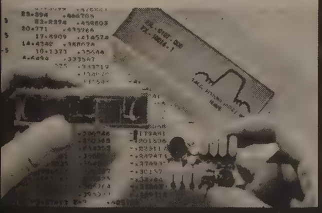
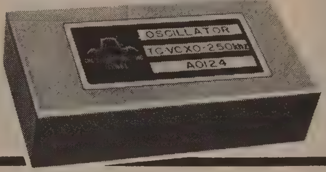
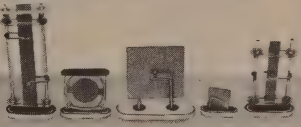


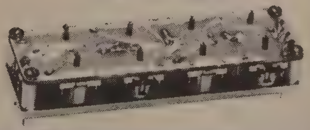
TEMPERATURE COMPENSATED VOLTAGE CONTROLLED CRYSTAL OSCILLATOR:



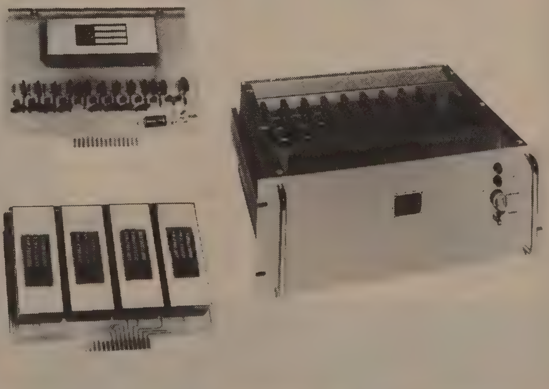
10 KHz TO 60 MHz STANDARD OR CUSTOM CRYSTAL RESONATORS



LC BANDPASS FILTERS



COMB FILTER ASSEMBLY 32 CHANNELS



A Subsidiary of **THE TECHNICAL MATERIEL CORPORATION**

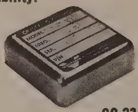
TTL Clock Oscillators

Model:	CO-231	CO-231L	CO-232	CO-235	CO-238	CO-239
Frequency:	1 Hz-100 MHz	200 KHz-30 MHz	3 MHz-30 MHz	20 KHz-30 MHz	3 MHz-100 MHz	4 MHz-100 MHz
Output:	Drives 10 TTL loads. "0" level of 0.4V max, sink 16 ma, "1" level of 2.4V min. source 2 ma					
Input:	5 VDC	5 VDC	5 VDC	5 VDC	5 VDC	5 VDC
Size:	1½"x1½"x½"	1½"x1½"x0.3"	1"x1"x½"	1½"x1½"x½" DIP compatible	0.5"x0.8"x0.35" DIP compatible	1.4"x0.8"x0.225" DIP compatible
Accuracy (at 25°C):	CO-231: ±.001% *CO-231T: ±.0001%	CO-231LA: ±.005% CO-231LB: ±.001%	CO-232: ±.001% *CO-232T: ±.0001%	CO-235: ±.001% *CO-235T: ±.0001%	CO-238A: ±.005% CO-238B: ±.001%	CO-239A: ±.005% CO-239B: ±.001%

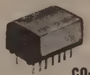
*Models with "T" suffix include tuning adjustment with settability better than ±0.0001%

Stability:

Standard: 0°C to + 70°C: ±.0025%
—1 Option: −55°C to + 85°C: ±.005% (−40°C to +85°C for CO-231-1 below 8 KHz)
—2 Option: —55°C to +125°C: ±.005%
—3 Option: 0°C to + 50°C: ±.0003% (N/A for CO-231 below 8 KHz, CO-238 below 4 MHz)
—4 Option: 0°C to + 50°C: ±.0001% (only for CO-231 in 3-20 MHz range)
—5 Option: 0°C to + 50°C: ±.0005%
—6 Option: 0°C to + 50°C: ±.001%
—8 Option: 0°C to + 70°C: ±.01% (includes initial accuracy)
—Y Option: Aging improved from 5 ppm/year typical to 1 ppm/year


CO-231

Other Options:
- Other stability specifications
- Other mechanical configurations
- Fully solder sealed units
- Ruggedized types for high shock and vibration


CO-238

CMOS Clock Osc.

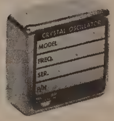
	CO-236	CO-636	CO-536
Model:	.01 Hz thru 10 MHz	3 MHz thru 10 MHz	100 Hz thru 10 MHz
Frequency:	CMOS compatible	CMOS compatible	CMOS compatible
Output:	5-15 VDC to 6 MHz	5-15 VDC to 6 MHz	5-15 VDC to 6 MHz
Input:	1-2 ma typical <2 MHz	3-5 ma typical at 10V	1-2 ma typical <2 MHz
Size:	1½"x1½"x½"	0.5"x0.8"x0.42" DIP compatible	1½"x1½"x½" DIP compatible
Accuracy (at 25°C):	CO-236: ± .001% *CO-236T: ±.0001% *includes tuning adjust	CO-636A: ±.005% CO-636B: ±.001%	CO-536: ± .001% *CO-536T: ±.0001% *includes tuning adjust

Stability: Standard: 0/+ 70°C: ±.0025%
—1 Option: −40/+ 85°C: ±.005%
—2 Option: −55/+125°C: ±.005%
—3 Option: 0/+ 50°C: ±.0003% (3-10 MHz only)
—4 Option: 0/+ 50°C: ±.0001% (only CO-236, 3-10 MHz)
—5 Option: 0/+ 50°C: ±.0005%
—6 Option: 0/+ 50°C: ±.001%
—8 Option: 0/+ 70°C: ±.01% (includes accuracy)
—Y Option: Aging improved from 5 to 1 ppm/year (CO-236, CO-536 only)

ECL Clock Osc.

Model: CO-233ME
Frequency: 4 MHz thru 200 MHz
Output: ECL compatible
Input: −5.2 VDC @ 30-60 ma
Size: 1½"x1½"x⅝"
Accuracy (at 25°C): CO-233ME: ± .001%
*CO-233MET: ±.0001%
*includes tuning adjustment

Stability:
Standard: 0/+ 70°C: ±.0025%
**—1 Option: −55/+ 85°C: ±.005%
**—2 Option: −55/+125°C: ±.005%
**—3 Option: 0/+ 50°C: ±.0003%
—5 Option: 0/+ 50°C: ±.0005%
—6 Option: 0/+ 50°C: ±.001%
—8 Option: 0/+ 70°C: ±.01%

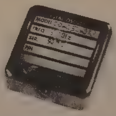


**—1, —2, —3 and T options only available to 125 MHz.

TCXOs (Temperature Compensated Crystal Oscillators)

	CO-251 SERIES	CO-252 SERIES	CO-254 VHF SERIES
Temperature Stability:	CO-251: 0/+50°C: ±1x10^{-6} CO-251A: 0/+50°C: ±5x10^{-7} CO-251B: +15/+35°C: ±2x10^{-7} CO-251C: 0/+65°C: ±1x10^{-6}	CO-252-3: 0/+50°C: ±2x10^{-7} CO-252-3A: 0/+50°C: ±1x10^{-7} CO-252: −20/+70°C: ±1x10^{-6} CO-252A: −20/+70°C: ±5x10^{-7} CO-252-4: −55/+85°C: ±5x10^{-6} CO-252-4B: −55/+85°C: ±2x10^{-6} CO-252-4A: −55/+85°C: ±1x10^{-6}	CO-254-1: 0/+50°C: ±1x10^{-6} CO-254-2: 0/+50°C: ±5x10^{-7} CO-254-3: 0/+50°C: ±2x10^{-7} CO-254: −20/+70°C: ±1x10^{-6} CO-254A: −20/+70°C: ±5x10^{-7} CO-254-4: −55/+85°C: ±5x10^{-6} CO-254-4B: −55/+85°C: ±2x10^{-6}
Frequency:	1, 2, 3, 4, 5 or 10 MHz std (any frequency, 60 Hz to 20 MHz optional)	1, 2, 3, 4, 5 or 10 MHz std (any frequency, 60 Hz to 20 MHz optional)	50 or 100 MHz std (any frequency, 20+ MHz to 140 MHz optional)
Output:	TTL, sine or CMOS	sine, TTL or CMOS	sine, ECL or TTL
Input:	Any specified voltage in 5-32 VDC range; current as low as 4 ma for some types		
Aging Rate:	1x10^{-6}/year	1x10^{-6}/year	2x10^{-6}/year
Size:	2"x2"x¾", printed circuit board mounting, (chassis mount with rf connector optional)		

Options include:
- Other stability characteristics.
- Other mechanical configurations.
- Voltage frequency control (TC/VCXO)



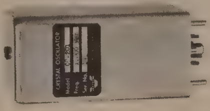
VECTRON

VECTRON

FOR PRICE, DELIVERY OR

Oven Controlled Crystal Oscillators

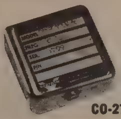
	SINGLE OVEN					DOUBLE OVEN		
Model:	CO-204	CO-201	CO-217	CO-216	CO-214	CO-244V	CO-246-1	FS-323
Aging Rate:	1x10^{-9}/day	1x10^{-8}/day	1x10^{-9}/day	3x10^{-9}/day	1x10^{-8}/day	1x10^{-9}/day	1x10^{-10}/day	1x10^{-10}/day
Temperature:	0°C to +50°C: ±5x10^{-9} −20°C to +70°C: ±1x10^{-8} −55°C to +85°C: optional		Standard: 0°C to +50°C: ±5x10^{-8} —1 Option: 0°C to +50°C: ±1x10^{-8} −20°C to +70°C: ±3x10^{-8}			0°C to +50°C: ±1x10^{-9} −55°C to +70°C: optional	0°C to +50°C: ±5x10^{-10} −55°C to +60°C: optional	0°C to +50°C: ±5x10^{-10}
Frequency:	1, 5 or 10 MHz standard (broad range of frequencies available)		1, 5 or 10 MHz standard (broad range of frequencies available)			1, 5 or 10 MHz std. (broad range of frequencies available)	1 MHz or 5 MHz std. (other freq. available)	100 KHz, 1 MHz & 5 MHz simultaneous
Output:	1 vrms/50 ohms (TTL output optional)		1 vrms/500 ohms (TTL or 50 ohm output optional)			1 vrms/500 ohms (TTL output optional)	1 vrms/50 ohms	1 vrms/50 ohms
Input:	24 VDC standard (5-32 VDC optional)		24 VDC standard (5-32 VDC optional)			24 VDC standard (5-32 VDC opt.)	24 VDC standard (15-32 VDC opt.)	115/230 VAC battery optional
Size:	2"x2"x4"		2"x2"x3"			2¼"x2¼"x4¼"	3"x3"x5½"	19" rack panel, 3½" h



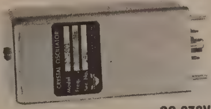
VCXOs (Voltage Controlled Crystal Oscillators)

	LINEAR APPLICATIONS				PHASE LOCK APPLICATIONS	
Model:	CO-271V	CO-275V	CO-272V	CO-273V	CO-233V	CO-231V
Frequency:	2-20 MHz	20-100 MHz	2-100 MHz	0.5-4 MHz	10-200 MHz	3-20 MHz
	(Higher and lower frequencies optionally available)					
Deviation:	±.1%	±.1%	±.1%	±.5%	*±30 ppm (wider deviation optional)	
	(Wider and narrower deviation optionally available)					
Linearity:	±1%	±1%	±1%	±1%	±20% (smooth monotonic characteristic)	
	(For ±5% linearity, resulting in reduced cost, add "N" to Model No.)					
Stability: (0-50°C)	A: ± .01% B: ±.001%	A: ± .01% B: ±.001%	±.0001%	±.025%	*±10 ppm	*±10 ppm
Output:	sine/logic	sine/logic	sine/logic	sine/logic	sine	TTL
Oven Control:	No oven	No oven	Proportional	No oven	No oven	No oven
Size:	2"x2"x¾"	2"x3"x¾"	2"x2"x4"	2"x3"x¾"	1½"x1½"x⅝"	1½"x1½"x½"

*Capable of correcting to specified center frequency over 0-50°C for 5-10 years



CO-271V



CO-272V

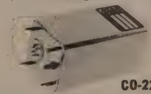
CO-231V

VHF Crystal Osc.

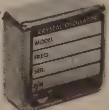
	OVEN CONTROLLED		NON-OVEN
	CO-229	CO-226	CO-233
Frequency:	25-400 MHz	25-400 MHz	5-350 MHz
***Aging:**	1x10^{-8}/day	1x10^{-7}/day	5-10 ppm/year
Temperature:	0°C to +50°C: ±5x10^{-8} −55°C to +85°C: optional		0/+ 50°C: ±.002% std. 0/+ 50°C: ±.0003% opt. −55/+125°C: ±.005% opt.
Output:	0.5 vrms/50Ω (+7 dBm) +13 dBm optional to 200 MHz ECL/TTL optional to 100 MHz		0.5 vrms/50Ω (+7 dBm) +13 dBm optional to 200 MHz ECL optional to 200 MHz
Input:	24 VDC standard (15-32 VDC optional)		15 VDC standard (12-32 VDC optional)
Size:	2"x2"x3" or 4"		1½"x1½"x⅝"

For intermediate stability please see CO-254 VHF Series in TCXO section.

*Improved aging to 1x10^{-9}/day available optionally.



CO-229



NOTES

1. Many models and frequencies are available with off-the-shelf delivery.
2. When ordering a standard product, please specify model, frequency and any desired option.
3. While Vectron offers a broad line of standard products, we are equipped to handle "specials" expeditiously and economically.

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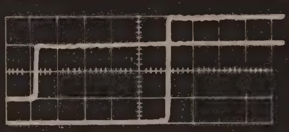
SERIES "HF", "HR" & "VHR" LUMPED CONSTANT DELAY LINES

HIGHEST $\frac{\text{TIME DELAY}}{\text{RISE TIME}}$ RATIO EVER BUILT!

These Delay Lines have the highest ratio of time delay to rise time that has ever been built in a Lumped Constant Line. Unlike other types of high ratio lines, the Lumped Constant Delay Line has a passband from D.C. to its cutoff frequency and maintains a constant delay over these frequencies. These lines are also unique in that they offer relatively low insertion loss. The units are characterized by tight time delay tolerances, low pulse distortion, excellent phase linearity and good temperature stability.



1 MICROSECOND PER DIVISION

For laboratory use, any time delays from 10 microseconds to 100 microseconds can be built into variable decade instruments with ratios of over 100/1. These units could have a resolution of up to 1/5000 of the total delay.

NEW MINIATURIZED SERIES "HF" HIGH FREQUENCY

The "HF" Series in most cases will serve as more than adequate electrical replacement for coaxial cable. The inconvenience of handling and storing cable will thus be eliminated.

Standard impedances of 50 and 75 ohms are available. Part numbers shown are for 50 ohms. For 75 ohms, substitute Z075 in place of Z050.

Time delays are shown in microseconds. Rise times are shown in nanoseconds in the "HF" tables below, and in microseconds in the "HR" and "VHR" tables on the following page. Bandwidths are shown in megahertz.

Units are normally supplied with BNC connectors. Tapped lines and time delays other than those listed can be supplied.

50/1 RATIO
Attenuation 9db Max. Size: 1¼"x4"x7½".

PART NO.	Time Delay µs	Rise Time NS	Bandwidth 3db MHz
050HF00P25Z050	*.25	5.0	72.00
050HF00P50Z050	*.50	10.0	36.00
050HF00P75Z050	.75	15.0	24.00
050HF01P00Z050	1.00	20.0	18.00
050HF01P25Z050	1.25	25.0	14.40
050HF01P50Z050	1.50	30.0	12.00
050HF01P75Z050	1.75	35.0	10.28
050HF02P00Z050	2.00	40.0	9.00
050HF02P25Z050	2.25	45.0	8.00
050HF02P50Z050	2.50	50.0	7.20
050HF02P75Z050	2.75	55.0	6.54
050HF03P00Z050	3.00	60.0	6.00
050HF03P25Z050	3.25	65.0	5.53
050HF03P50Z050	3.50	70.0	5.14
050HF03P75Z050	3.75	75.0	4.80
050HF04P00Z050	4.00	80.0	4.50
050HF04P25Z050	4.25	85.0	4.23
050HF04P50Z050	4.50	90.0	4.00
050HF04P75Z050	4.75	95.0	3.78
050HF05P00Z050	5.00	100.0	3.60
050HF05P50Z050	5.50	110.0	3.27
050HF06P00Z050	6.00	120.0	3.00
050HF06P50Z050	6.50	130.0	2.76
050HF07P00Z050	7.00	140.0	2.57
050HF07P50Z050	7.50	150.0	2.40
050HF08P00Z050	8.00	160.0	2.25
050HF08P50Z050	8.50	170.0	2.11
050HF09P00Z050	9.00	180.0	2.00
050HF09P50Z050	9.50	190.0	1.89
050HF10P00Z050	10.00	200.0	1.80

75/1 RATIO
Attenuation 12db Max. Size: 2½"x4"x7½".

PART NO.	Time Delay µs	Rise Time NS	Bandwidth 3db MHz
075HF00P50Z050	*.50	6.7	54.00
075HF00P75Z050	*.75	10.0	36.00
075HF01P00Z050	1.00	13.3	27.00
075HF01P25Z050	1.25	16.6	21.60
075HF01P50Z050	1.50	20.0	18.00
075HF01P75Z050	1.75	23.3	15.43
075HF02P00Z050	2.00	26.6	13.50
075HF02P25Z050	2.25	30.0	12.00
075HF02P50Z050	2.50	33.3	10.80
075HF02P75Z050	2.75	36.6	9.81
075HF03P00Z050	3.00	40.0	9.00
075HF03P25Z050	3.25	43.3	8.31
075HF03P50Z050	3.50	46.6	7.71
075HF03P75Z050	3.75	50.0	7.20
075HF04P00Z050	4.00	53.3	6.75
075HF04P25Z050	4.25	56.6	6.35
075HF04P50Z050	4.50	60.0	6.00
075HF04P75Z050	4.75	63.3	5.68
075HF05P00Z050	5.00	66.6	5.40
075HF05P50Z050	5.50	73.3	4.90
075HF06P00Z050	6.00	80.0	4.50
075HF06P50Z050	6.50	86.6	4.15
075HF07P00Z050	7.00	93.3	3.85
075HF07P50Z050	7.50	100.0	3.60
075HF08P00Z050	8.00	107.0	3.36
075HF08P50Z050	8.50	113.0	3.18
075HF09P00Z050	9.00	120.0	3.00
075HF09P50Z050	9.50	127.0	2.83
075HF10P00Z050	10.00	133.0	2.70

100/1 RATIO
Attenuation 15db Max. Size: 2½"x4"x7½".

PART NO.	Time Delay µs	Rise Time NS	Bandwidth 3db MHz
100HF01P00Z050	*1.00	10.0	36.00
100HF01P25Z050	1.25	12.5	28.80
100HF01P50Z050	1.50	15.0	24.00
100HF01P75Z050	1.75	17.5	20.57
100HF02P00Z050	2.00	20.0	18.00
100HF02P25Z050	2.25	22.5	16.00
100HF02P50Z050	2.50	25.0	14.40
100HF02P75Z050	2.75	27.5	13.09
100HF03P00Z050	3.00	30.0	12.00
100HF03P25Z050	3.25	32.5	11.07
100HF03P50Z050	3.50	35.0	10.28
100HF03P75Z050	3.75	37.5	9.60
100HF04P00Z050	4.00	40.0	9.00
100HF04P25Z050	4.25	42.5	8.47
100HF04P50Z050	4.50	45.0	8.00
100HF04P75Z050	4.75	47.5	7.57
100HF05P00Z050	5.00	50.0	7.20
100HF05P50Z050	5.50	55.0	6.54
100HF06P00Z050	6.00	60.0	6.00
100HF06P50Z050	6.50	65.0	5.53
100HF07P00Z050	7.00	70.0	5.14
100HF07P50Z050	7.50	75.0	4.80
100HF08P00Z050	8.00	80.0	4.50
100HF08P50Z050	8.50	85.0	4.23
100HF09P00Z050	9.00	90.0	4.00
100HF09P50Z050	9.50	95.0	3.78
100HF10P00Z050	10.00	100.0	3.60

TO ORDER SPECIFY PART NUMBER

*50 OHMS ONLY

SERIES "HR"

SERIES "VHR"

While the Lines listed below are standard, time delays in-between tabulated values can be manufactured. Units are hermetically sealed in metal cans. Four studs are provided for mounting. Input and output BNC Connectors are supplied as standard. Hermetic seal terminals can be substituted on special requests.

100/1 RATIO

Impedance 50 Ohms. Attenuation 10db Max. Size: 2½x4½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
100HR015P0Z050	15	.150	2.400
100HR020P0Z050	20	.200	1.800
100HR025P0Z050	25	.250	1.440
100HR030P0Z050	30	.300	1.200
100HR035P0Z050	35	.350	1.030
100HR040P0Z050	40	.400	.900
100HR045P0Z050	45	.450	.800
100HR050P0Z050	50	.500	.720

Impedance 75 Ohms. Attenuation 10db Max. Size:3½x4½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
100HR055P0Z075	55	.550	.655
100HR060P0Z075	60	.600	.600
100HR063P0Z075	63	.630	.572
100HR065P0Z075	65	.650	.554
100HR070P0Z075	70	.700	.514
100HR075P0Z075	75	.750	.480

Impedance 100 Ohms. Attenuation 14db Max. Size:3½x4½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
100HR080P0Z100	80	.800	.450
100HR085P0Z100	85	.850	.424
100HR090P0Z100	90	.900	.400
100HR100P0Z100	100	1.000	.360
100HR150P0Z100	150	1.500	.240

Impedance 250 Ohms. Attenuation 20db Max. Size:3½x4½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
100HR200P0Z250	200	2.000	.180
100HR250P0Z250	250	2.500	.144
100HR300P0Z250	300	3.000	.120
100HR350P0Z250	350	3.500	.103
100HR400P0Z250	400	4.000	.090
100HR450P0Z250	450	4.500	.080
100HR500P0Z250	500	5.000	.072

130/1 RATIO

Impedance 50 Ohms. Attenuation 11db Max. Size: 3½x4½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
130HR005P0Z050	5	.039	9.360
130HR010P0Z050	10	.077	4.680
130HR015P0Z050	15	.116	3.110
130HR020P0Z050	20	.154	2.340
130HR025P0Z050	25	.193	1.860
130HR030P0Z050	30	.232	1.550
130HR035P0Z050	35	.271	1.330
130HR040P0Z050	40	.308	1.170
130HR045P0Z050	45	.348	1.030
130HR050P0Z050	50	.387	.930
130HR055P0Z050	55	.423	.851

Impedance 75 Ohms. Attenuation 12db Max. Size: 3½x6½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
130HR060P0Z075	60	.462	.780
130HR063P0Z075	63	.485	.742
130HR065P0Z075	65	.500	.720
130HR070P0Z075	70	.538	.669
130HR075P0Z075	75	.577	.624
130HR080P0Z075	80	.615	.585
130HR085P0Z075	85	.654	.551

Impedance 100 Ohms. Attenuation 16db Max. Size:3½x6½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
130HR090P0Z100	90	.693	.520
130HR095P0Z100	95	.731	.492
130HR100P0Z100	100	.769	.468
130HR150P0Z100	150	1.150	.312
130HR200P0Z100	200	1.540	.234
130HR250P0Z100	250	1.930	.187

Impedance 250 Ohms. Attenuation 20db Max. Size:3½x6½x12".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3 db MHz
130HR300P0Z250	300	2.310	.156
130HR350P0Z250	350	2.690	.134
130HR400P0Z250	400	3.080	.117
130HR450P0Z250	450	3.460	.104
130HR500P0Z250	500	3.850	.094

150/1 RATIO

Impedance 50 Ohms. Attenuation 16db Max. Size: 3½x6½x16".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3db MHz
150HV005P0Z050	5	.033	10.810
150HV006P0Z050	6	.040	9.000
150HV007P0Z050	7	.047	7.720
150HV008P0Z050	8	.053	6.750
150HV009P0Z050	9	.060	6.000
150HV010P0Z050	10	.067	5.370
150HV015P0Z050	15	.100	3.600
150HV020P0Z050	20	.133	2.710
150HV025P0Z050	25	.167	2.160
150HV030P0Z050	30	.200	1.800
150HV035P0Z050	35	.233	1.550
150HV040P0Z050	40	.267	1.350
150HV045P0Z050	45	.300	1.200
150HV050P0Z050	50	.333	1.080
150HV055P0Z050	55	.367	.980
150HV060P0Z050	60	.400	.900
150HV063P0Z050	63	.420	.850
150HV065P0Z050	65	.433	.830
150HV070P0Z050	70	.467	.770
150HV075P0Z050	75	.500	.720
150HV080P0Z050	80	.533	.675
150HV085P0Z050	85	.567	.635
150HV090P0Z050	90	.600	.600
150HV095P0Z050	95	.633	.569

Impedance 100 Ohms. Attenuation 18db Max. Size:3½x6½x16".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3db MHz
150HV100P0Z100	100	.667	.540
150HV150P0Z100	150	1.000	.360
150HV200P0Z100	200	1.330	.270
150HV250P0Z100	250	1.670	.216

Impedance 250 Ohms. Attenuation 20db Max. Size:3½x6½x16".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3db MHz
150HV300P0Z250	300	2.000	.180
150HV350P0Z250	350	2.330	.154
150HV400P0Z250	400	2.670	.135
150HV450P0Z250	450	3.000	.120
150HV500P0Z250	500	3.330	.108

200/1 RATIO

Impedance 50 Ohms. Attenuation 18db Max. Size: 3½x6½x16".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3db MHz
200HV010P0Z050	10	.050	7.200
200HV015P0Z050	15	.075	4.800
200HV020P0Z050	20	.100	3.600
200HV025P0Z050	25	.125	2.880
200HV030P0Z050	30	.150	2.400
200HV035P0Z050	35	.175	2.060
200HV040P0Z050	40	.200	1.800
200HV045P0Z050	45	.225	1.600
200HV050P0Z050	50	.250	1.440
200HV055P0Z050	55	.275	1.310
200HV060P0Z050	60	.300	1.200
200HV063P0Z050	63	.315	1.140
200HV065P0Z050	65	.325	1.110
200HV070P0Z050	70	.350	1.030
200HV075P0Z050	75	.375	.960

250/1 RATIO

Impedance 50 Ohms. Attenuation 20db Max. Size: 3½x6½x16".

PART NO.	Time Delay µs	Rise Time µs	Bandwidth 3db MHz
250HV020P0Z050	20	.080	4.500
250HV025P0Z050	25	.100	3.600
250HV030P0Z050	30	.120	3.000
250HV035P0Z050	35	.140	2.570
250HV040P0Z050	40	.160	2.250
250HV045P0Z050	45	.180	2.000
250HV050P0Z050	50	.200	1.800
250HV060P0Z050	60	.240	1.500
250HV063P0Z050	63	.252	1.430
250HV065P0Z050	65	.260	1.380
250HV070P0Z050	70	.280	1.290
250HV080P0Z050	80	.320	1.130
250HV090P0Z050	90	.360	1.000
250HV100P0Z050	100	.400	.900

TO ORDER SPECIFY PART NUMBER

ALLEN AVIONICS, INC.
224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: 516-248-8080 OR 516-747-5450

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FILTERS
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SPIRADEL®* THE MOST COMPACT
Highest Time Delay to Rise Time Ratio DISTRIBUTED DELAY LINE

FOR IMMEDIATE DELIVERY!

SPIRADEL is a small diameter, distributed constant fixed delay line, featuring higher delay to rise time ratio and excellent pulse fidelity. Its new shape offers greater package design versatility than most other delay lines available, and the entire unit is encapsulated for maximum environmental protection.

SPIRADEL covers a delay range of 20 to 6000 nanoseconds. Any delay within this range may be selected.

Time delay to rise time ratios range up to 30 to 1. Any impedance from 50 to 1000 ohms is available. Standard delay tolerance is 5%, although tighter tolerances can be held.

SPIRADEL is designed for operation from −55°C up to +105°C. Temperature coefficient over this range is 150 parts/million/°C. Bandwidth is from DC to frequency f = .35/rise time.

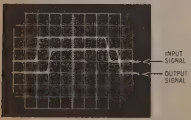
TO ORDER SPECIFY PART NUMBER

STANDARD HEIGHT OF ALL UNITS: 7/16″

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Band-width Minimum (MHz)	Diam. Inches
IMPEDANCE 50 OHMS				
SP0050Z050	50	10.0	35.0	1.60
SP0100Z050	100	13.0	26.9	2.00
SP0150Z050	150	14.0	25.0	2.50
SP0200Z050	200	16.0	21.9	2.50
SP0250Z050	250	19.0	18.4	3.25
SP0300Z050	300	21.0	16.7	3.25
SP0350Z050	350	24.0	14.5	3.25
SP0400Z050	400	27.0	12.9	3.75
SP0450Z050	450	28.0	12.5	3.75
SP0500Z050	500	29.0	12.0	3.75
IMPEDANCE 75 OHMS				
SP0025Z075	25	4.5	77.7	1.20
SP0050Z075	50	6.0	58.3	1.20
SP0100Z075	100	9.5	36.8	1.60
SP0150Z075	150	11.5	30.4	2.00
SP0200Z075	200	13.0	26.9	2.00
SP0250Z075	250	14.0	25.0	2.50
SP0300Z075	300	16.0	21.8	2.50
SP0350Z075	350	18.0	19.4	2.50
SP0400Z075	400	20.0	17.5	3.25
SP0450Z075	450	21.9	15.9	3.25
SP0500Z075	500	24.0	14.5	3.25
SP0550Z075	550	26.0	13.4	3.75
SP0600Z075	600	28.0	12.5	3.75
SP0650Z075	650	30.0	11.6	3.75
SP0700Z075	700	32.0	10.9	3.75
IMPEDANCE 100 OHMS				
SP0050Z100	50	7.3	47.9	1.20
SP0060Z100	60	7.5	46.6	1.20
SP0070Z100	70	7.7	45.4	1.20
SP0080Z100	80	8.2	42.6	1.20
SP0090Z100	90	9.1	38.4	1.20
SP0100Z100	100	10.0	35.0	1.60
SP0150Z100	150	12.5	28.0	1.60
SP0200Z100	200	14.0	25.0	2.00
SP0250Z100	250	16.0	21.8	2.00
SP0300Z100	300	18.0	19.4	2.50
SP0350Z100	350	20.0	17.5	2.50
SP0400Z100	400	22.0	15.9	2.50
SP0450Z100	450	24.5	14.2	2.50
SP0500Z100	500	27.0	12.9	3.25
SP0550Z100	550	29.5	11.8	3.25
SP0600Z100	600	31.0	11.2	3.25
SP0650Z100	650	32.5	10.7	3.25
SP0700Z100	700	34.0	10.2	3.25
SP0750Z100	750	36.0	9.7	3.75
SP0800Z100	800	38.0	9.2	3.75
SP0850Z100	850	39.5	8.8	3.75
SP0900Z100	900	41.0	8.5	3.75
SP0950Z100	950	42.5	8.3	3.75
SP1000Z100	1000	44.0	7.9	3.75

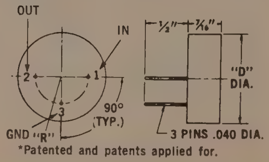
Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Band-width Minimum (MHz)	Diam. Inches
IMPEDANCE 150 OHMS				
SP0020Z150	20	5.0	70.0	1.20
SP0030Z150	30	6.5	53.8	1.20
SP0040Z150	40	7.5	46.6	1.20
SP0050Z150	50	7.7	45.4	1.20
SP0060Z150	60	7.9	44.3	1.20
SP0070Z150	70	8.0	43.7	1.20
SP0080Z150	80	8.2	42.6	1.20
SP0090Z150	90	8.5	41.1	1.20
SP0100Z150	100	9.0	38.8	1.20
SP0150Z150	150	12.0	29.1	1.60
SP0200Z150	200	14.0	25.0	1.60
SP0250Z150	250	15.0	23.3	2.00
SP0300Z150	300	17.5	20.0	2.00
SP0350Z150	350	19.0	18.4	2.00
SP0400Z150	400	20.0	17.5	2.00
SP0450Z150	450	22.0	15.9	2.50
SP0500Z150	500	24.0	14.5	2.50
SP0550Z150	550	25.6	13.6	2.50
SP0600Z150	600	27.0	12.9	2.50
SP0650Z150	650	28.6	12.2	2.50
SP0700Z150	700	30.0	11.6	2.50
SP0750Z150	750	31.6	11.0	3.25
SP0800Z150	800	33.0	10.6	3.25
SP0850Z150	850	34.5	10.1	3.25
SP0900Z150	900	36.0	9.4	3.25
SP0950Z150	950	38.0	9.2	3.25
SP1000Z150	1000	40.0	8.7	3.25
IMPEDANCE 325 OHMS				
SP0100Z325	100	12.0	29.2	1.20
SP0150Z325	150	14.0	25.0	1.20
SP0200Z325	200	17.0	20.6	1.20
SP0250Z325	250	19.0	18.4	1.60
SP0300Z325	300	21.0	16.7	1.60
SP0350Z325	350	23.0	15.3	1.60
SP0400Z325	400	24.0	14.6	1.60
SP0450Z325	450	26.0	13.5	2.00
SP0500Z325	500	28.0	12.5	2.00
SP0550Z325	550	29.0	12.1	2.00
SP0600Z325	600	31.0	11.3	2.00
SP0650Z325	650	33.0	10.6	2.50
SP0700Z325	700	34.0	10.3	2.50
SP0750Z325	750	35.0	10.0	2.50
SP0800Z325	800	37.0	9.5	2.50
SP0850Z325	850	39.0	9.0	2.50
SP0900Z325	900	41.0	8.5	2.50
SP0950Z325	950	43.0	8.1	2.50
SP1000Z325	1000	45.0	7.8	2.50
SP1100Z325	1100	49.0	7.1	3.25
SP1200Z325	1200	52.0	6.7	3.25
SP1300Z325	1300	55.0	6.3	3.25
SP1400Z325	1400	59.0	5.9	3.25
SP1500Z325	1500	62.0	5.6	3.25

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Band-width Minimum (MHz)	Diam. Inches
IMPEDANCE 500 OHMS				
SP0300Z500	300	33.0	10.6	1.20
SP0400Z500	400	40.0	8.7	1.60
SP0500Z500	500	44.0	7.9	1.60
SP0600Z500	600	50.0	7.0	1.60
SP0700Z500	700	55.0	6.3	2.00
SP0800Z500	800	57.0	6.1	2.00
SP0900Z500	900	60.0	5.8	2.00
SP1000Z500	1000	66.0	5.3	2.00
SP1500Z500	1500	87.0	4.0	2.50
SP2000Z500	2000	110.0	3.1	2.50
SP2500Z500	2500	120.0	2.9	3.25
SP3000Z500	3000	137.0	2.5	3.25
SP3500Z500	3500	154.0	2.2	3.25
SP4000Z500	4000	165.0	2.1	3.25
IMPEDANCE 600 OHMS				
SP0400Z600	400	46.0	7.6	1.20
SP0500Z600	500	48.0	7.2	1.60
SP0600Z600	600	54.0	6.4	1.60
SP0700Z600	700	58.0	6.0	1.60
SP0800Z600	800	60.0	5.8	1.60
SP0900Z600	900	65.0	5.3	2.00
SP1000Z600	1000	70.0	5.0	2.00
SP1500Z600	1500	85.0	4.1	2.50
SP2000Z600	2000	100.0	3.5	2.50
SP2500Z600	2500	115.0	3.0	2.50
SP3000Z600	3000	125.0	2.8	3.25
SP3500Z600	3500	140.0	2.5	3.25
SP4000Z600	4000	150.0	2.3	3.25
SP4500Z600	4500	165.0	2.1	3.75
SP5000Z600	5000	170.0	2.0	3.75
SP5500Z600	5500	185.0	1.8	3.75
SP6000Z600	6000	200.0	1.7	3.75
IMPEDANCE 1000 OHMS				
SP0500Z01K	500	58.0	6.0	1.20
SP0600Z01K	600	63.0	5.5	1.20
SP0700Z01K	700	72.0	4.8	1.20
SP0800Z01K	800	80.0	4.3	1.20
SP0900Z01K	900	87.0	4.0	1.60
SP1000Z01K	1000	95.0	3.6	1.60
SP1500Z01K	1500	116.0	3.0	1.60
SP2000Z01K	2000	126.0	2.7	2.00
SP2500Z01K	2500	147.0	2.3	2.00
SP3000Z01K	3000	158.0	2.2	2.00
SP3500Z01K	3500	182.0	1.9	2.50
SP4000Z01K	4000	203.0	1.7	2.50
SP4500Z01K	4500	220.0	1.5	2.50
SP5000Z01K	5000	240.0	1.4	3.25



Actual oscilloscope presentation photo of input and output pulses of 100 ns. Spiradel, illustrating excellent pulse fidelity.

"D"	"R"
1.20″	.400″
1.60″	.600″
2.00″	.800″
2.50″	1.050″
3.25″	1.425″
3.75″	1.675″



*Patented and patents applied for.

ALLEN AVIONICS, INC.

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"TAPPED" SPIRADEL®* FOR IMMEDIATE DELIVERY!

HIGHEST TIME DELAY TO RISE TIME RATIOS FOR COMPARATIVE SIZE AT LOWEST COST

TAPPED SPIRADEL covers a delay range from 20 to 1500 nanoseconds. Any delay within this range may be selected. Total delay tolerance is ±5%. Standard units are tapped at increments of 10% of their total delay. Delay tolerance at all taps is 10% or 2 nanoseconds (whichever is greater). Operation is from −55°C up to +105°C. Bandwidth is from DC to frequency f = .35/rise time.

STANDARD HEIGHT OF ALL UNITS: 7/16"

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Band-width Minimum (MHz)	Diam. Inches
IMPEDANCE 50 OHMS				
ST0050Z050	50	12.0	30.0	2.00
ST0100Z050	100	15.0	24.0	2.50
ST0150Z050	150	17.0	21.2	3.25
ST0200Z050	200	21.0	16.6	3.25
ST0250Z050	250	24.0	14.5	3.75
ST0300Z50	300	27.0	12.9	3.75
ST0350Z050	350	30.0	11.6	3.75
ST0400Z050	400	33.0	10.6	3.75
IMPEDANCE 75 OHMS				
ST0025Z075	25	6.0	60.0	1.60
ST0050Z075	50	9.0	40.0	1.60
ST0100Z075	100	12.0	30.0	2.00
ST0150Z075	150	15.0	24.0	2.50
ST0200Z075	200	17.0	21.2	2.50
ST0250Z075	250	21.0	16.7	3.25
ST0300Z075	300	24.5	14.2	3.25
ST0350Z075	350	28.0	12.5	3.25
ST0400Z075	400	31.0	11.2	3.75
ST0450Z075	450	33.0	10.6	3.75
ST0500Z075	500	36.0	9.7	3.75
IMPEDANCE 100 OHMS				
ST0050Z100	50	10.3	33.9	1.60
ST0060Z100	60	10.5	33.3	1.60
ST0070Z100	70	10.7	32.7	1.60
ST0080Z100	80	11.2	31.2	1.60
ST0090Z100	90	12.1	28.9	1.60
ST0100Z100	100	13.0	26.9	2.00
ST0150Z100	150	15.0	23.3	2.00
ST0200Z100	200	17.0	20.5	2.50
ST0250Z100	250	20.0	17.5	2.50
ST0300Z100	300	22.0	15.9	3.25
ST0350Z100	350	25.0	14.0	3.25
ST0400Z100	400	27.0	12.9	3.25
ST0450Z100	450	30.0	11.6	3.25
ST0500Z100	500	33.0	10.6	3.75
ST0550Z100	550	35.2	9.9	3.75
ST0600Z100	600	38.2	9.1	3.75
ST0650Z100	650	41.0	8.5	3.75
ST0700Z100	700	44.0	7.9	3.75
ST0750Z100	750	46.0	7.6	3.75
ST0800Z100	800	47.0	7.4	3.75

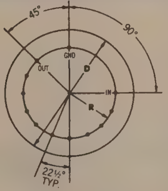
Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Band-width Minimum (MHz)	Diam. Inches
IMPEDANCE 150 OHMS				
ST0020Z150	20	6.0	58.3	1.60
ST0030Z150	30	8.0	43.7	1.60
ST0040Z150	40	9.0	38.8	1.60
ST0050Z150	50	9.5	36.8	1.60
ST0060Z150	60	10.0	35.0	1.60
ST0070Z150	70	10.5	33.3	1.60
ST0080Z150	80	11.0	31.8	1.60
ST0090Z150	90	11.5	30.4	1.60
ST0100Z150	100	12.0	29.1	1.60
ST0150Z150	150	15.0	23.3	2.00
ST0200Z150	200	17.0	20.5	2.00
ST0250Z150	250	19.0	18.4	2.50
ST0300Z150	300	21.0	16.6	2.50
ST0350Z150	350	23.0	15.2	2.50
ST0400Z150	400	25.0	14.0	2.50
ST0450Z150	450	27.0	12.9	3.25
ST0500Z150	500	29.0	12.0	3.25
ST0550Z150	550	31.0	11.2	3.25
ST0600Z150	600	33.0	10.6	3.25
ST0650Z150	650	35.0	10.0	3.25
ST0700Z150	700	37.0	9.4	3.25
ST0750Z150	750	40.0	8.7	3.75
ST0800Z150	800	41.9	8.3	3.75
ST0850Z150	850	44.0	7.9	3.75
ST0900Z150	900	46.0	7.6	3.75
ST0950Z150	950	48.0	7.2	3.75
ST1000Z150	1000	50.0	7.0	3.75

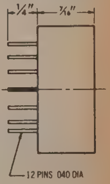
Tap values are multiples of 10% of above delays.

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Band-width Minimum (MHz)	Diam. Inches
IMPEDANCE 325 OHMS				
ST0100Z325	100	16.0	21.8	1.60
ST0150Z325	150	20.0	17.5	1.60
ST0200Z325	200	24.0	14.5	1.60
ST0250Z325	250	25.0	14.0	2.00
ST0300Z325	300	26.0	13.4	2.00
ST0350Z325	350	28.0	12.5	2.00
ST0400Z325	400	31.0	11.2	2.00
ST0450Z325	450	33.0	10.6	2.50
ST0500Z325	500	35.0	10.0	2.50
ST0550Z325	550	36.0	9.7	2.50
ST0600Z325	600	37.0	9.4	2.50
ST0650Z325	650	39.0	8.9	3.25
ST0700Z325	700	41.0	8.5	3.25
ST0750Z325	750	43.0	8.1	3.25
ST0800Z325	800	44.0	7.9	3.25
ST0850Z325	850	46.0	7.6	3.25
ST0900Z325	900	48.0	7.2	3.25
ST0950Z325	950	50.0	7.0	3.25
ST1000Z325	1000	52.0	6.7	3.25
ST1100Z325	1100	56.0	6.2	3.75
ST1200Z325	1200	59.0	5.9	3.75
ST1300Z325	1300	62.0	5.6	3.75
ST1400Z325	1400	66.0	5.3	3.75
ST1500Z325	1500	69.0	5.0	3.75

TO ORDER SPECIFY PART NUMBER

"D"	"R"
1.20"	.400"
1.60"	.600"
2.00"	.800"
2.50"	1.050"
3.25"	1.425"
3.75"	1.675"



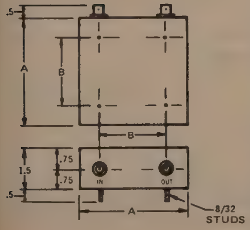


* Patented and patents applied for.

"HI-RATIO" SPIRADEL®*

HIGHEST TIME DELAY TO RISE TIME RATIO IN SPIRADEL FAMILY

TO ORDER SPECIFY PART NUMBER



"HI-RATIO" SPIRADEL offers the same excellent electrical specifications for which the standard Spiradel is so well known.

These Delay Lines are packaged in metal cans and are usually supplied with two B.N.C. connectors. Four 8/32 mounting studs are provided.

The units are available in 100 ohm impedances with time delays from 1.5 to 5.5 microseconds.

Standard Delay Tolerance: 5%

TIME DELAY/RISE TIME — 40/1 RATIO ATTENUATION 10 DB MAXIMUM

Part Number	Time Delay (Nanoseconds)	Rise Time (Nanoseconds)	3 db Bandwidth in Megahertz	Size (Inches)
40SH1500Z100	1500	37.5	9.60	A — 4.5 B — 3.0
40SH2000Z100	2000	50.0	7.20	
40SH2500Z100	2500	62.5	5.70	
40SH3000Z100	3000	75.0	4.80	A — 5.5 B — 4.0
40SH3500Z100	3500	87.5	4.11	
40SH4000Z100	4000	100.0	3.60	
40SH4500Z100	4500	112.5	3.20	A — 6.5 B — 5.0
40SH5000Z100	5000	125.0	2.80	
40SH5500Z100	5500	137.5	2.62	

TIME DELAY/RISE TIME — 50/1 RATIO ATTENUATION 12 DB MAXIMUM

Part Number	Time Delay (Nanoseconds)	Rise Time (Nanoseconds)	3 db Bandwidth in Megahertz	Size (Inches)
50SH2500Z100	2500	50.0	7.20	A — 4.5 B — 3.0
50SH3000Z100	3000	60.0	6.00	A — 5.5 B — 4.0
50SH3500Z100	3500	70.0	5.14	
50SH4000Z100	4000	80.0	4.50	
50SH4500Z100	4500	90.0	4.00	A — 6.5 B — 5.0
50SH5000Z100	5000	100.0	3.60	
50SH5500Z100	5500	110.0	3.27	

ALLEN AVIONICS, INC.

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DUAL-IN-LINE "MINI" SPIRADEL®* FOR IMMEDIATE DELIVERY!

FEATURES EXCELLENT PULSE FIDELITY

EXCEPTIONALLY FINE PHASE LINEARITY OVER WIDE FREQUENCY RANGE

- Designed for operation from −55°C up to +105°C. Units exhibit a change of less than 175 parts/million/°C over this entire temperature range.
- Designed for dual-in-line mounting. Compatible with integrated circuits.
- Maximum attenuation for all delays: 7%.

TO ORDER SPECIFY PART NUMBER

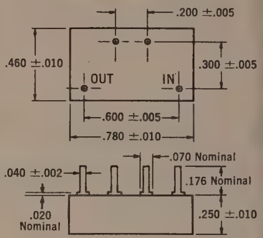
Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds)	Bandwidth Megahertz	Impedance (Ohms)
MN005Z125	5	2.0	180.0	125
MN010Z125	10	2.5	144.0	125
MN020Z200	20	4.0	90.0	200
MN030Z250	30	6.0	60.0	250
MN040Z300	40	8.0	45.0	300
MN050Z350	50	10.0	36.0	350
MN060Z400	60	12.0	30.0	400
MN070Z400	70	14.0	25.7	400
MN080Z475	80	16.0	22.5	475
MN090Z500	90	18.0	20.0	500
MN100Z500	100	20.0	18.0	500
MN125Z500	125	25.0	14.4	500
MN150Z01K	150	30.0	12.0	1000
MN175Z01K	175	35.0	10.2	1000
MN200Z01K	200	40.0	9.0	1000

STANDARD DELAY TOLERANCE 10% (5% ON SPECIAL ORDERS)

UP TO 5 UNITS can be connected in series to achieve longer delays providing the delays and impedances of each unit are the same. The total rise time of the series combination can be determined by the following formula:

$$Tr = \frac{Td}{50} + Tr_1$$

Where
Tr = Total Rise Time
Td = Total Time Delay
Tr_1 = Rise Time of Individual Unit



*Patented and patents applied for.

DUAL-IN-LINE "MIDI" SPIRADEL®*

THE WORLD'S LOWEST COST DELAY LINE HAVING TIME DELAY TO RISE TIME GREATER THAN 5/1

"MIDI" SPIRADEL offers the same excellent pulse fidelity and phase linearity as the Standard Spiradel. Its low silhouette and dual-in-line mounting permit packaging with semiconductor and comparable components. In high volume use, the unit's low cost is competitive with all types of active devices with no sacrifice in stability and reliability. While units listed are standard-stocked, other delays and impedances are available on special order. Standard Delay Tolerance 10%. (5% on special order.)

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Bandwidth Minimum (MHz)
IMPEDANCE 100 OHMS Maximum Attenuation 5%			
MD005Z100	5	2.0	180.0
MD010Z100	10	2.5	144.0
MD015Z100	15	3.0	120.0
MD020Z100	20	4.0	90.0
MD025Z100	25	5.0	72.0
MD030Z100	30	6.0	60.0
MD040Z100	40	7.5	48.0
MD050Z100	50	9.0	40.0
IMPEDANCE 175 Ohms Maximum Attenuation 8%			
MD060Z175	60	11.0	32.7
MD070Z175	70	12.0	30.0
MD080Z175	80	13.0	27.7
MD090Z175	90	14.0	25.7
MD100Z175	100	15.0	24.0

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds) Maximum	Bandwidth Minimum (MHz)
IMPEDANCE 500 OHMS Maximum Attenuation 20%			
MD125Z500	125	25.0	14.4
MD150Z500	150	29.0	12.1
MD175Z500	175	32.0	11.3
MD200Z500	200	35.0	10.3
MD250Z500	250	40.0	9.0
IMPEDANCE 1000 OHMS Maximum Attenuation 20%			
MD300Z01K	300	60.0	6.0
MD350Z01K	350	67.0	5.4
MD400Z01K	400	74.0	4.9
MD450Z01K	450	78.0	4.6
MD500Z01K	500	81.0	4.4
MD550Z01K	550	83.0	4.3
MD600Z01K	600	85.0	4.2

TO ORDER SPECIFY PART NUMBER

Epoxy Encapsulated. Temperature Coefficient: Less than 200 PPM/°C from −55°C to +105°C.

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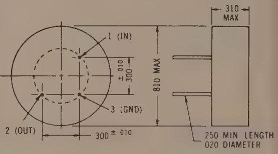
400NS
3



"LC DIP"

THE WORLD'S SMALLEST DUAL-IN-LINE 14 PIN TAPPED LUMPED CONSTANT DELAY LINE

Part Number	Time Delay (Nano-seconds)	Rise Time (Nano-seconds)	Bandwidth (MHz)	Impedance (Ohms)	Maximum Attenuation (%)	Refer to Drawing
LC010Z100B	10	2.5	144.0	100	4	1
LC020Z100A	20	4.0	90.0	100	5	1
LC025Z100A	25	5.0	72.0	100	5	1
LC030Z100A	30	6.0	60.0	100	6	1
LC040Z100A	40	8.0	45.0	100	7	1
LC050Z100A	50	10.0	36.0	100	8	1
LC100Z100A	100	20.0	18.0	100	12	1
LC150Z100A	150	30.0	12.0	100	15	1
LC200Z100A	200	40.0	9.0	100	23	1
LC250Z100A	250	50.0	7.2	100	30	1
LCL250Z050A	250	50.0	7.2	50	35	2
LCL500Z100A	500	100.0	3.6	100	35	2
LCL500Z050A	500	100.0	3.6	50	40	2
LCL750Z050A	750	150.0	2.4	50	40	2
LCL01KZ050A	1000	200.0	1.8	50	45	2

THE "LC DIP" offers the ultimate in high density packaging and tapping capabilities. These units are excellent for high frequency applications. The availability of 10 equal delay increments and the dual-in-line packaging along with its low silhouette make for compatibility with semiconductor and other assemblies where circuit board height must be held to a minimum. This makes the "LC DIP" extremely adaptable for the computer and allied industries.

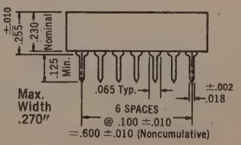
Delay Tolerance:
±5% or 4 ns (whichever is greater) for delays of 250 ns or less.
±5% or 20 ns (whichever is greater) for delays of over 250 ns.

Working Voltage: 50 volts DC.

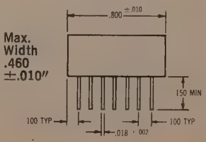
Construction: Epoxy encapsulated.

TO ORDER SPECIFY PART NUMBER

DRAWING 1 (LC)



DRAWING 2 (LCL)



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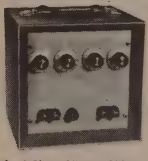
ATTENTION: COMMUNICATIONS, VIDEO TRANSMISSION & RECORDING INDUSTRIES

LUMPED CONSTANT DECADE DELAY LINES TYPE "D"

Type "D" Variable Decade Delay Units are engineered to provide variable time delays with absolute stability for accurate triggering and excellent reproduction of the input pulse. These lumped constant delay lines are completely passive. All models have a minimum of 1000 to 1 resolution and consist of three or more decade switches. Any delay output of Type "D" decade delay unit is the summation of individual lines. It is not the result of a tapped line. This feature is an important factor in eliminating undesirable reflections in the output pulse. Accuracy at any delay exceeding 1% of the unit's total delay is within 3%. These units have a characteristic impedance of 500 ohms in and out. While the units listed are standard, other delays and impedances can be manufactured to specifications.

TO ORDER SPECIFY PART NUMBER

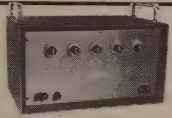


Cabinet Size: 8"w. x 8"h. x 7"d.

Part No.	Maximum Time Delay In Microseconds	Resolution In Microseconds	Rise Time @ Max. Delay In Microseconds	Band-width Kilohertz	Attenuation In db
D11	11.1	.01	.45	800.00	3
D21	21.1	.01	.85	424.00	5
D41	41.1	.01	1.65	218.00	5
DD41	41.1	.01	.83	434.00	5
D61	61.1	.01	2.45	147.00	6
DD61	61.1	.01	1.23	293.00	6
D1C	111.1	.01	4.45	81.00	3
DD1C	111.1	.01	2.23	161.00	8

Cabinet Size: 14"w. x 8"h. x 10"d.

Part No.	Maximum Time Delay In Microseconds	Resolution In Microseconds	Rise Time @ Max. Delay In Microseconds	Band-width Kilohertz	Attenuation In db
D2C	211.1	.01	8.45	42.60	3
DD2C	211.1	.01	4.23	85.10	3
D4C	411.1	.01	16.45	21.90	3
DD4C	411.1	.01	8.23	43.70	6
D6C	611.1	.01	24.45	14.70	3
DD6C	611.1	.01	12.23	29.40	6
D1K	1111.1	.01	40.45	8.89	3
DD1K	1111.1	.01	20.23	17.80	8
D2K	2111	.1	84.50	4.26	5
D4K	4111	.1	164.50	2.18	6
D6K	6111	.1	244.50	1.47	8
D11K	11,111	.1	444.50	.80	11
D21K	21,111	1	844.50	.42	11



Cabinet Size: 17"w. x 9½"h. x 11½"d.

Part No.	Maximum Time Delay In Microseconds	Resolution In Microseconds	Rise Time @ Max. Delay In Microseconds	Band-width Kilohertz	Attenuation In db
DD2K	2111	.1	42.25	8.52	5
DD4K	4111	.1	82.25	4.37	6
DD6K	6111	.1	122.25	2.94	8
DD11K	11,111	.1	222.25	1.61	11
DD21K	21,111	1	422.25	.85	11
DD41K	41,111	1	822.25	.43	12
DD61K	61,111	1	1222.25	.29	12

PULSE & VIDEO DELAY LINE TYPE AV-397

These delay lines are designed to be used with any 75 ohm system for either pulse or video delay. Although intended primarily for equalizing the delays in various lengths of coaxial cable, the line can be used wherever any delay from .025 μs. to 2.075 μs. is needed. The delay is changed by adding individual lines of various delays to give the desired total delay.

Each type AV-397 delay line consists of seven individual delay lines each having its own input and output terminals. Each of these seven lines may be used individually or collectively. By connecting the output of one to the input of another, 83 different time delays are available in .025 μs steps from .025 μs to 2.075 μs. The delay of each individual line is marked between its input and output terminals. The total time delay is the sum of the delays of the individual lines that are connected.

Maximum Delay: 2.075 microseconds ±3% variable in .025 microsecond steps from .025 microseconds to 2.075 microseconds.
Time Delay of Individual Lines: 1, .5, .2, .2, .1, .05, .025 microseconds.
Rise Time for Entire Line: .06 microseconds maximum.
Frequency Response: 3 db down at 5 MHz for 2.075 microseconds delay.
Distortion: 2% maximum with .2 microsecond input pulse.
Impedance: 75 ohms ±5%.
Temperature Coefficient: 50 parts/million/°C from −55°C to 105°C.
Attenuation: 7% maximum for 2.075 microsecond delay.
Mechanical: Hermetically sealed in a steel can 2" x 2½" x 5½", painted gray with black identification markings, and using 10/32 x ½ inch studs spaced on 1½" x 2" centers for mounting.

ALSO AVAILABLE: Model 75-2 — A switch variable version of the above Pulse & Video Delay Line.

TV LINE EQUALIZER TYPE AV-535

The Allen Avionic's AV-535 Equalizer is designed to compensate for losses in RG-11/U (75 ohm) cable and its equivalents. The unit is capable of equalizing 50 to 300 feet in 50 foot increments.

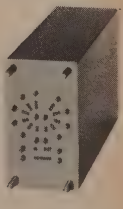
Terminals on mounting surface are so arranged to provide for simplified strapping for compensation of different cable lengths. All units are foamed and hermetically sealed in steel cans.

Size: 2 x 3½ x 5 inches (not including mounting stud length).
Mounting Centers: 1½ x 3 inches.
Stud Size: 8/32 x ½ inch long.

Impedance: 75 ohms ±2 ohms to 8 MHz.
Attenuation of Cable Plus Equalizer: 3 db.
Attenuation of equalizer alone is as shown in the following table:

Feet	0.1 MHz	2 MHz	4 MHz	8 MHz
50	2.97 db	2.86 db	2.79 db	2.67 db
100	2.93	2.68	2.53	2.27
150	2.90	2.51	2.28	1.88
200	2.86	2.35	2.03	1.52
250	2.82	2.19	1.82	1.21
300	2.78	2.02	1.58	0.86

Tolerance: ±.07 db.



TYPES "N", "A", "B", "L" DELAY LINES

TYPES "N" & "A"

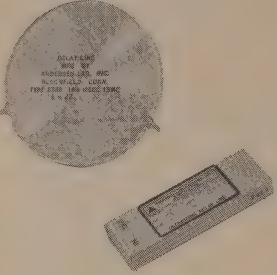
TYPE "B"

TYPE "L"

Type	Time Delay	Impedance	Time Delay To Rise Time Ratio	Size
N	20, 30, 40, 50, 60, 70, 80, 90, 100 ns.	100 Ω	3.5 to 1	⅝" x ⅝" x .450"
A	0.1, 0.2, 0.3, 0.4, 0.5 μs.	500 Ω	3.5 to 1	⅝" x ⅝" x .450"
	0.5, 0.6, 0.7, 0.8, 0.9, 1.0 μs.	1000 Ω		
B	5, 10, 15 μs.	1000 Ω	5 to 1	½" x 1⅜" x 3⅛"
L	25, 75, 200, 250 μs.	250 Ω	5 to 1	2½" x 4½" x .8"
	50, 150, 400, 500 μs.	500 Ω		
	100, 300, 800, 1000 μs.	1000 Ω		

ULTRASONIC DELAY DEVICES

QUARTZ AND GLASS DELAY LINES



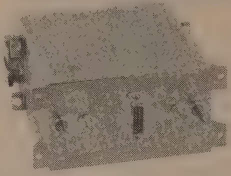
QUARTZ DELAY LINES for signal processing and storage applications. Offered with delays from 1 microsecond to 4.8 milliseconds; center frequencies from 5 to 100 MHz.

GLASS LINES for analog and digital storage in computer and teleproduction applications. Built to custom specifications in delays from 2 to 250 microseconds; center frequencies from 5 to 30 MHz.

MAGNETOSTRICTIVE DELAY LINES

MAGNETOSTRICTIVE DELAY LINES for computer memory buffer storage and video display applications. Operate over wide range of environmental conditions with excellent delay time stability. High storage capacity, rugged, reliable, low cost. Available with TTL compatible electronics; typical storage of 16,666 bits with 8.333 millisecond delay at 2 MHz bit rate. Delay range: 10 microseconds to 10 milliseconds at frequencies to 3 MHz.

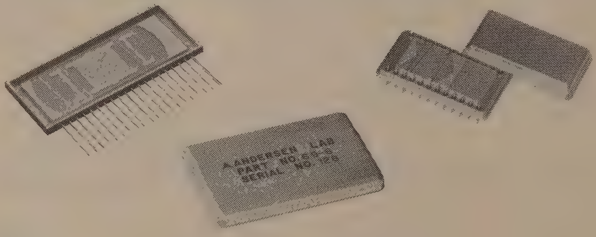
DISPERSIVE DELAY LINES



DISPERSIVE METAL STRIP DELAY LINES for pulse compression radar. Linear change of delay with frequency. Dispersive delays from 1 to 1,000 microseconds; dispersive bandwidths from 0.1 to 6 MHz. Time-bandwidth products to 150.

IMCON REFLECTION-MODE DISPERSIVE DELAY LINES for scanning spectrum analysis, pulse compression radar and compressive receivers. High time-bandwidth product, high dynamic range and low sidelobe level. Dispersive delays from 1 to 1,200 microseconds; bandwidths from 0.1 to 15 MHz. Time-bandwidth products to 10,000.

SURFACE ACOUSTIC WAVE DEVICES



Surface Wave devices for radar, communication, telemetry, and frequency domain filtering systems. Reliable, compact. Planar processing manufacturing techniques permit low cost, high volume production. Compliant with military specifications.

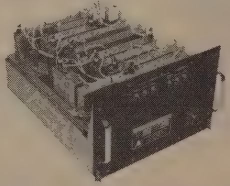
LINEAR PHASE BANDPASS FILTERS: center frequencies from 10 to 300 MHz; bandwidths from 1 to 40%; shape factors as low as 1.2

PHASE CODED DELAY LINES: any bi-phase or quadri-phase code can be specified. Center frequencies to 200 MHz; bandwidths to 50 MHz; up to 127 chips.

NON-DISPERSIVE AND TAPPED DELAY LINES: center frequencies from 10 to 200 MHz; bandwidths up to 60 MHz; time delays to 60 microseconds. Typical insertion loss of 6 to 40 dB. One or up to 60 taps available.

DISPERSIVE DELAY LINES: center frequencies to 300 MHz; bandwidths up to 40%. Sidelobe levels from 30 to 40 dB.

SUB-SYSTEMS



PULSE EXPANSION-COMPRESSION EQUIPMENT: complete sub-systems including dispersive delay lines and all necessary electronics to perform pulse expansion, pulse compression, and sidelobe suppression.

UNITY GAIN DELAY CHANNELS: complete sub-systems containing dispersive or non-dispersive delay lines with electronics as needed to satisfy specified gain, amplitude, and phase requirements.

VIDEO DELAY MODULE: for drop-out compensators, vertical aperture correctors, comb filters, video disc systems; contains circuitry to pass base-band NTSC or PAL video. Available in 1H, 2H and 1/2H configurations.

ANDERSEN LABORATORIES, INC.

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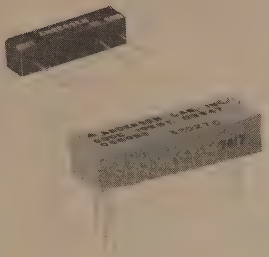
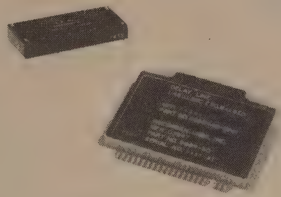
ELECTROMAGNETIC DELAY LINES

DISTRIBUTED DELAY LINES



Fixed and variable DISTRIBUTED CONSTANT DELAY LINES for video, commercial and military applications. Reliable, low-cost performance with excellent pulse fidelity and high delay to rise time ratios. Small size; for chassis or printed circuit board assembly. Conform with most mil specs. Delay ranges from 10 nanoseconds to 1 microsecond. Impedance from 500 to 2,000 ohms. Available in tapped or untapped versions.

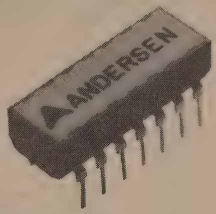
LUMPED CONSTANT DELAY LINES



FIXED AND VARIABLE LC DELAY LINES for use in commercial, video, and military applications. Available in a wide range of delays and performance characteristics to meet the most stringent requirements.

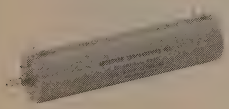
ENCODER-DECODER LC DELAY LINES for use in aircraft identification systems, transponders, and navigational aids. A multi-tapped LC delay line with low loss, light weight, for use under extreme environmental conditions such as specified by MIL STD 202B.

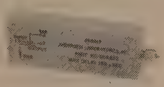
MINIATURE DELAY LINES



Low cost DUAL-IN-LINE and SINGLE-IN-LINE DELAY LINES for computer applications. Compatible with most integrated circuit series. 14 or 16 pin configurations; other pin arrangements and variable delays available. Delay ranges from 5 to 1000 nanoseconds. Delay to rise time ratio approximately 4 to 7. Available in untapped or tapped versions with typical tap spacings of 10% of total delay.

ELECTRICALLY VARIABLE DELAY LINES



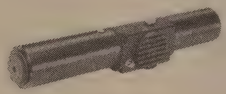


ELECTRICALLY VARIABLE DELAY LINES for controlling precise delays with high resolution and fast response time. Time constants of control circuit designed for specified response. Control is manually operated or automatically adjusted by feedback or servo mechanisms. Withstand extreme environmental controls. Nominal delays from 0.1 to 3 microseconds, with ±20% variation. Bandwidths to 50 MHz.

ACOUSTO-OPTIC PRODUCTS

by Datalight, Inc.

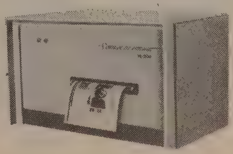
ACOUSTO-OPTIC COMPONENTS



ACOUSTO-OPTIC MODULATOR for high power Argon laser. Rise time, 50 nanoseconds; laser power level, 15 watts; multi-line contrast ratio, 10:1; single line contrast ratio, 1,000:1.

Other MODULATORS and BEAM DEFLECTORS for 3,000 to 10,600A° wavelengths. Complete line of Q-SWITCHES for NdYag lasers.

GRAPHICS RECORDER



Reliable laser-powered recording system for recording with facsimile equipment, scan converters or computer data sources to produce photographic quality hard copy with a dry process. Analog or digital interface; asynchronous operation. Records 8½ x 11" page on 3M dry silver paper in 10 seconds with resolution of 200 lines-per-inch and 16 shades of grey.

LASER RECORDING SYSTEMS

Custom LASER RECORDING SYSTEMS for OEM applications in computer output, facsimile, high speed non-impact printing, phototypesetting and laser plate making. Typical recording speed: 16mm frame, .04 sec.; 8½ x 11" page, 10 sec.; 17 x 22" newspaper page, 60 sec.

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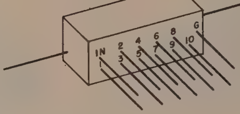
**ARTRONIC
INSTRUMENT
COMPANY**

MILITARY GRADE DELAY LINES

10 Tap TYPE 26

Total Delay (μsec)	Type 26A Impedance (ohms)	Type 26B Impedance (ohms)
0.01	50	
0.02	50	
0.025	50	100
0.05	50	200
0.1	50	400
0.2	50	600
0.25	50	1000
0.3	60	1000
0.4	80	1000
0.5	100	1000
0.6	120	1500
0.8	160	2000
1.0	200	2500
1.5	300	2500
2	400	2500
2.5	500	2500
3	600	2500
4	800	2500
5	1000	2500
6		2000
8		2000
10		2000

Other values of delay and impedance also available



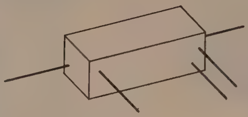
SPECIFICATIONS

Dimensions: 0.5 x 0.56 x 1.56″
Tap Spacing: 1/10 total delay
Rise Time: 15%-20% total delay
Delay Tolerance: 3% or 1 nsec
Thermal Coeff. Delay: 50-150 ppm/°C
Working Voltage: 400 v, DC or pulse
Test Voltage: 800 vDC
Temperature Range: −65°C to 125°C
Environmental: MIL-STD-202
Leads: #22 AWG tinned solid wire, 1¼″ long
Attenuation, for total delay:

0-1 μsec:	1 db max
1-8 μsec:	2 db max
10 μsec:	2.5 db

Ordering Information: Part numbers are given by designating first the type number and letter, and then the total delay, e.g., 26B-0.25.

TYPE 26



SPECIFICATIONS

Weldable leads—Internal shield
Dimensions: 0.5 x 0.5 x 1.56″
Rise Time: 15%-20% of delay
Delay Tolerance: 3% or 1 nsec
Taps: None (see below)
Thermal Coeff. of Delay: 50 to 150 ppm/°C
Working Voltage: 400 v, DC or pulse
Test Voltage: 800 vDC
Temperature Range: −65°C to 125°C
Environmental: MIL-STD-202
Leads: #24 AWG gold dumet, 1½″ long
Attenuation: 1.5 db max
Internal Shield: minimizes cross-coupling when more than one delay line per board is used
Other values of delay and impedance can also be furnished, as well as taps in specified positions.

Part Number	Delay (μsec)	Impedance (ohms)
26K-0.02	0.02	50
26K-0.05	0.05	125
26P-0.1	0.1	400
26K-0.12	0.12	100
26P-0.12	0.12	500
26K-0.125	0.125	375
26K-0.15	0.15	425
26J-0.2	0.2	50
26K-0.2	0.2	500
26P-0.2	0.2	800
26K-0.25	0.25	650
26K-0.27	0.27	700
26K-0.28	0.28	700
26K-0.3	0.3	750
26P-0.3	0.3	1300
26K-0.4	0.4	1000
26T-0.5	0.5	1000
26K-0.5	0.5	1400
26K-0.61	0.61	1500
26J-0.7	0.7	500
26K-0.7	0.7	1750
26K-0.75	0.75	1800
26J-1.0	1.0	500
26Q-1.0	1.0	1000
26K-1.0	1.0	2500
26K-1.1	1.1	2700
26R-1.1	1.1	2000
26K-1.2	1.2	3000
26K-1.5	1.5	2400
26K-1.6	1.6	2600
26K-1.7	1.7	2700
26K-2	2	2500
26K-2.25	2.25	2250
26K-2.5	2.5	3125
26R-2.5	2.5	2000
26K-3	3	2500
26K-3.3	3.3	2700
26K-3.5	3.5	2900
26K-4	4	2500
26K-4.5	4.5	2800
26K-5	5	2500
26K-5.5	5.5	2750
26K-6	6	2000
26P-6	6	2500
26K-6.5	6.5	2600
26K-7	7	2800
26K-8	8	3000

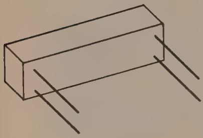
APPLICATION INFORMATION

Most of the delay lines on this page were developed for space-flight use in scientific satellites and planetary probes. Thousands of them have been supplied over the last 12 years to NASA installations and contractors without a single reported failure or malfunction; in fact, without a single return for any reason. The design and construction methods used are our own, and to our knowledge are unique in the industry.

These designs and off-shoots in almost endless variety have been used in the whole gamut of aerospace and naval electronic equipment and instruments. Our file of modifications and custom designs is so large that special customer requirements can usually be satisfied with an existing design, at little or no increase in cost over a standard item. Among the variations included are special delay times, impedance levels, tap positions, case configurations, etc.; also closer tolerances on delay or impedance, lower temperature coefficients, higher delay to rise time ratios, etc. Recently there has been considerable interest in very low attenuation figures: 0.1 db max for 200 nsec, or 0.7 db max for 100 μsec delay, to give two examples.

CALL OUR ENGINEERS FOR DETAILS

TYPE 42



Part Number	Delay (μsec)	Impedance (ohms)
42-0.01	0.01	50
42-0.02	0.02	50
42-0.025	0.025	50
42-0.05	0.05	50
42-0.1	0.1	50
42-0.2	0.2	100
42-0.25	0.25	100
42-0.3	0.3	150
42-0.4	0.4	200
42-0.5	0.5	200
42-0.6	0.6	300
42-0.8	0.8	400
42-1.0	1.0	500
42-1.5	1.5	750
42-2	2	1000
42-2.5	2.5	1000
42-3	3	1250

TYPE 42 SPECIFICATIONS

Dimensions: 0.3 x 0.35 x 1.4″
Rise Time: 18%-22% of delay
Delay Tolerance: 3% or 1 nsec
Taps: None
Thermal Coeff. of Delay: 50 to 100 ppm/°C
Working Voltage: 300 v, DC or pulse
Test Voltage: 600 vDC
Temperature Range: −65°C to 125°C
Environmental: MIL-STD-202
Leads: #22 AWG tinned copper, 1½″ long
Attenuation:

0-0.8 μsec:	0.5 db max
1-3 μsec:	1.2 db max

Other values of delay and impedance can also be furnished

OTHER SERIES

SERIES W: 0.4 x 2.05 x 4.4″, same performance and type of construction as Series N, max T/Z is 0.03 μsec/ohm

TYPE 228: 20-Tap 227 (22 p.c. pins ¼″ long in 227 lead face)

TYPE 227T: A tapered 227 with sine-function tap spacing

TYPE 226: 0.4″ height off the board 227

TYPE 266: 0.4″ height off the board 26

TYPE 266F: Foam-encapsulated 266

TYPE 22: 10-Tap 20% rise time, similar to 227

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ARTRONIC
INSTRUMENT
COMPANY

MILITARY GRADE

DELAY LINES

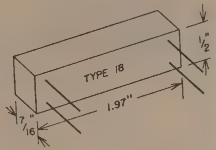
TYPE 18

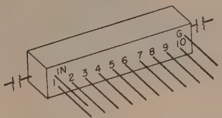
RISE TIMES

Type 18Q: 12% of delay (Table at far right)

Type 18H, 18L: 20% to 25% of delay time

Delay (μsec)	Type 18H Impedance (ohms)	Type 18L Impedance (ohms)
0.05	125	62
0.1	250	62
0.2	500	50
0.25	625	62
0.3	750	75
0.4	1000	100
0.5	1250	125
0.6	1500	150
0.7	1750	175
0.75	1875	188
0.8	2000	200
0.9	2250	225
1.0	2500	250
1.5	1875	375
2.0	2500	500
2.5	3125	625
3	1875	750
4	2500	1000
5	3125	1250
6	1500	
7	1750	
8	2000	
9	2250	
10	2500	





TYPE 18 AND TYPE 227

Delay Tolerance: 3% or 1 nsec
Thermal Coefficient of Delay: 0.005%/°C to 0.01%/°C
Test Voltage: 800 VDC
Temperature Range: −65°C to 125°C
Ordering Information: Part Numbers are given by designating first the type number and then the delay, e.g., 227-0.75. Other values of delay and impedance can also be furnished.

TYPE 227

10 Taps, equally spaced
Rise Time: 10% of total delay time
Dimensions: 1/2" x 9/16" x 2 1/2" (lead face is 9/16" wide)
Leads: #22 AWG tinned solid wire, 1 1/4" long

Leads on end faces are spare ground leads to provide added mounting rigidity. They may be clipped off if not needed, since a third ground lead is provided on the long face.

Delay (μsec)	TYPE 18Q Impedance (ohms)	TYPE 227 Impedance (ohms)
0.01		50
0.02	50	50
0.025	50	50
0.05	50	50
0.1	100	50
0.2	100	50
0.25	100	50
0.3	200	50
0.4	200	50
0.5	200	50
0.6	200	100
0.8	200	100
1.0	200	100
1.5	500	200
2	500	200
2.5	500	250
3	1000	500
4	1000	500
5	1000	500
6	1500	1000
8	2000	1000
10	2500	1000
12	2500	1200
15	3000	1500
20	4000	2000
25		2500

PRECISION, RUGGEDNESS, RELIABILITY

These four series of military grade delay lines are encapsulated in an epoxy casting resin, which is poured under vacuum and cured to a solid, void-free block of high-temperature plastic. All components and wires are solidly supported against shock and vibration and completely protected from moisture and salt spray. All four series meet the requirements of MIL-STD-202.

The remarkable performance and stability of these very compact delay lines is due to the extraordinary care taken in the design and manufacturing processes. Phase characteristics are individually adjusted for optimum pulse performance, to give fast-rising, noise-free output pulses with minimum overshoot and distortion. A complete system of inspections and tests at every stage of construction and assembly assures the utmost in quality and reliability.

OTHER TYPES AND CUSTOM DESIGNS ALSO AVAILABLE

SERIES L 10 Taps

Rise Time: 7% to 8% of Total Delay

ARTRONIC INSTRUMENT CO.
SILVER SPRING, MD.

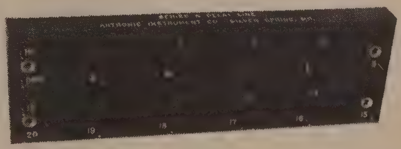
Size: 1/2" x 1.5" x 2.9"
Mounting: Two 6-32 tapped inserts

BANDWIDTHS IN MHz

Delay (μsec)	Characteristic Impedance (Ohms)				
	50	200	500	1,000	2,000
0.1	110				
0.2	58	58			
0.3	39	39			
0.4	29	29			
0.5	23	23	23		
0.6	19	19	19		
0.7	16	16	16		
0.8		14	14		
0.9		13	13		
1.0		11	11	11	
2.0		5.8	5.8	5.8	5.8
3.0		3.9	3.9	3.9	3.9
4.0			2.9	2.9	2.9
5.0			2.3	2.3	2.3
6 0			1.9	1.9	1.9
7 0			1.6	1.6	1.6
8.0				1.4	1.4
10				1.1	1.1
15				0.7	0.7
20					0.6
25					0.5
30					0.4

SERIES N 20 Taps

Rise Time: 3% to 4% of Total Delay



Size: 1/2" x 2" x 6.4"

Mounting: Four 6-32 Tapped Inserts

SERIES L AND SERIES N

Delay Tolerance: 2%
Delay Temp. Coeff.: 0.003%/°C to 0.01%/°C
Test Voltage: 800 vDC
Working Voltage: 400 vDC max
Pulse Voltage: 400 v peak max
Temperature Range: −65°C to 125°C
Connections: 22 gauge pins, 3/16" long

Designed to plug into printed wiring boards for dip-soldering into place, these high-performance units are readily adaptable to other types of circuit construction, since the 22 gauge pins may be easily formed to fit lugs or terminal posts. The pins are laid out on the standard 0.1" printed circuit grid.

Careful control of the attenuation characteristic and the provision of special phase-compensating circuits result in superlative pulse performance. The tables give the cut-off frequencies of the delay lines which are available in each series. Part Numbers: Give series, impedance, and delay; e.g., N-1000-40.

BANDWIDTHS IN MHz

Delay (μsec)	Characteristic Impedance (Ohms)				
	50	200	500	1,000	2,000
1	39	39			
1.5	26	26			
2	19	19			
2.5	15	15	15		
3		13	13		
4		9.7	9.7		
5		7.8	7.8	7.8	
6		6.5	6.5	6.5	
8		4.8	4.8	4.8	
10		3.9	3.9	3.9	3.9
12			3.2	3.2	3.2
15			2.6	2.6	2.6
20			1.9	1.9	1.9
25			1.5	1.5	1.5
30				1.3	1.3
40				0.9	0.9
50				0.7	0.7
75					0 5
100					0.4

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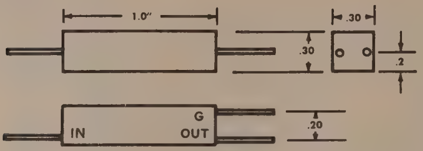
bel defining a degree of excellence

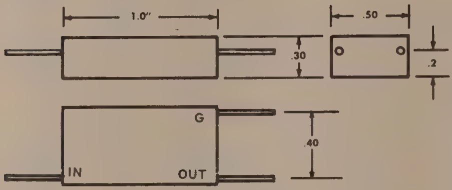
DELAY LINES

A


1.0"
.30
.30
.2
G
IN
OUT
.20

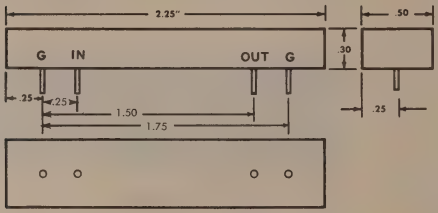
Lead Dia. = .032

B


1.0"
.30
.50
.2
G
IN
OUT
.40

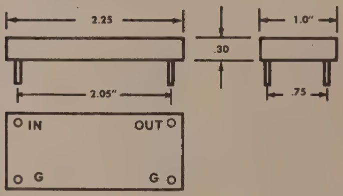
Lead Dia. = .032

C


2.25"
.50
.30
G
IN
OUT
G
.25
.25
1.50
1.75
.25

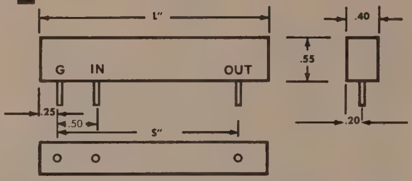
Lead Dia. = .032

D


2.25
.30
1.0"
2.05"
.75
IN
OUT
G
G

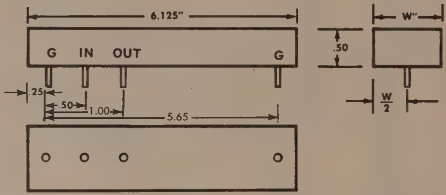
Lead Dia. = .032

E


L"
.40
G
IN
OUT
.55
.25
.50
S"
.20

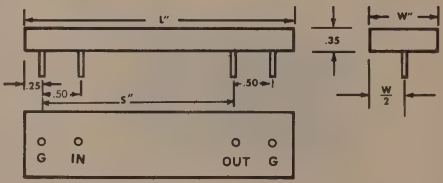
Lead Dia. = .032

F


6.125"
W"
G
IN
OUT
G
.50
.25
.50
1.00
5.65
W/2

Lead Dia. = .032

G


L"
.35
W"
.25
.50
S"
.50
W/2
G
IN
OUT
G

Lead Dia. = .032

The condensed version of our catalog items are listed here showing the most widely used sizes and types available for prompt shipment. Space prohibits the full listing of the many specials and the variations available.

CAUTION: Before finalizing your design, it is highly recommended you contact our Engineering Staff for their expert guidance, founded on our vast experience and up-to-date technology — a phone call can save you valuable time and money.

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NANOSECONDS

Part Number — Impedance ±10%				DELAY TIME ±5% nsec	RISE TIME nsec 93Ω	CON-FIGU-RATION	LEAD SPACING "S" INCHES	LENGTH "L" INCHES	WIDTH "W" INCHES
93Ω	200Ω	500Ω	1000Ω						
0420-0001-93	0420-0001-02	0420-0001-05	0420-0001-10	1	4.0	A	—	1.0	.3
0420-0002-93	0420-0002-02	0420-0002-05	0420-0002-10	2	4.0	A	—	1.0	.3
0420-0003-93	0420-0003-02	0420-0003-05	0420-0003-10	3	4.0	A	—	1.0	.3
0420-0004-93	0420-0004-02	0420-0004-05	0420-0004-10	4	4.0	A	—	1.0	.3
0420-0005-93	0420-0005-02	0420-0005-05	0420-0005-10	5	4.0	A	—	1.0	.3
0420-0010-93	0420-0010-02	0420-0010-05	0420-0010-10	10	4.0	A	—	1.0	.3
0420-0015-93	0420-0015-02	0420-0015-05	0420-0015-10	15	4.0	B	—	1.0	.5
0420-0020-93	0420-0020-02	0420-0020-05	0420-0020-10	20	4.0	B	—	1.0	.5
0420-0025-93	0420-0025-02	0420-0025-05	0420-0025-10	25	5.0	C	—	2.25	.5
0420-0030-93	0420-0030-02	0420-0030-05	0420-0030-10	30	6.0	C	—	2.25	.5
0420-0035-93	0420-0035-02	0420-0035-05	0420-0035-10	35	7.0	C	—	2.25	.5
0420-0040-93	0420-0040-02	0420-0040-05	0420-0040-10	40	8.0	C	—	2.25	.5
0420-0045-93	0420-0045-02	0420-0045-05	0420-0045-10	45	9.0	C	—	2.25	.5
0420-0050-93	0420-0050-02	0420-0050-05	0420-0050-10	50	9.0	C	—	2.25	.5
0420-0055-93	0420-0055-02	0420-0055-05	0420-0055-10	55	10.0	D	—	2.25	1.0
0420-0060-93	0420-0060-02	0420-0060-05	0420-0060-10	60	10.0	D	—	2.25	1.0
0420-0065-93	0420-0065-02	0420-0065-05	0420-0065-10	65	11.0	D	—	2.25	1.0
0420-0070-93	0420-0070-02	0420-0070-05	0420-0070-10	70	12.0	D	—	2.25	1.0
0420-0075-93	0420-0075-02	0420-0075-05	0420-0075-10	75	12.0	D	—	2.25	1.0
0420-0080-93	0420-0080-02	0420-0080-05	0420-0080-10	80	13.0	D	—	2.25	1.0
0420-0085-93	0420-0085-02	0420-0085-05	0420-0085-10	85	13.0	D	—	2.25	1.0
0420-0090-93	0420-0090-02	0420-0090-05	0420-0090-10	90	14.0	D	—	2.25	1.0
0420-0095-93	0420-0095-02	0420-0095-05	0420-0095-10	95	14.0	D	—	2.25	1.0
0420-0100-93	0420-0100-02	0420-0100-05	0420-0100-10	100	15.0	D	—	2.25	1.0
0420-0125-93	—	—	—	125	15.0	G	2	3.00	.75
—	0420-0125-02	—	—	125	18.0	G	2.8	3.8	.625
—	—	0420-0125-05	0420-0125-10	125	30.0	E	1.20	1.8	.4
0420-0150-93	—	—	—	150	15.0	G	2	3.0	1.0
—	0420-0150-02	—	—	150	20.0	G	2.8	3.8	.625
—	—	0420-0150-05	0420-0150-10	150	27.0	E	1.20	1.8	.4
0420-0175-93	—	—	—	175	20.0	G	2	3.0	1.0
—	0420-0175-02	—	—	175	20.0	G	2.8	3.8	.625
—	—	0420-0175-05	0420-0175-10	175	30.0	E	1.20	1.8	.4
0420-0200-93	—	—	—	200	20.0	G	2	3.0	1.0
—	0420-0200-02	—	—	200	20.0	G	2.8	3.8	.625
—	—	0420-0200-05	0420-0200-10	200	35.0	E	1.20	1.8	.4
0420-0250-93	—	—	—	250	32.0	G	2	3.0	1.0
—	0420-0250-02	—	—	250	35.0	G	2.8	3.8	.625
—	—	0420-0250-05	0420-0250-10	250	40.0	E	1.20	1.8	.4
0420-0300-93	—	—	—	300	40.0	G	5.125	6.125	1.5
—	0420-0300-02	—	—	300	40.0	G	2.8	3.8	.925
—	—	0420-0300-05	0420-0300-10	300	45.0	E	2.20	3.0	.4
0420-0400-93	—	—	—	400	45.0	G	5.125	6.125	1.5
—	0420-0400-02	—	—	400	45.0	G	2.8	3.8	.925
—	—	0420-0400-05	0420-0400-10	400	55.0	E	2.20	3.0	.4
0420-0500-93	—	—	—	500	65.0	G	5.125	6.125	1.5
—	0420-0500-02	—	—	500	65.0	G	2.8	3.8	.925
—	—	0420-0500-05	0420-0500-10	500	70.0	E	2.20	3.0	.4
—	0420-0600-02	—	—	600	75.0	G	2.8	3.8	1.5
—	—	0420-0600-05	0420-0600-10	600	75.0	E	2.20	3.9	.4
—	0420-0700-02	—	—	700	85.0	G	5.125	6.125	.8
—	—	0420-0700-05	0420-0700-10	700	85.0	E	2.20	3.9	.4
—	0420-0800-02	—	—	800	85.0	G	5.125	6.125	.8
—	—	0420-0800-05	0420-0800-10	800	95.0	E	3.40	4.25	.4
—	0420-0900-02	—	—	900	95.0	G	5.125	6.125	.8
—	—	0420-0900-05	0420-0900-10	900	100.0	E	4.40	5.25	.4
—	0420-1000-02	—	—	1000	110.0	G	5.125	6.125	.8
—	—	0420-1000-05	0420-1000-10	1000	110.0	E	4.40	5.25	.4
—	0420-1500-02	—	—	1500	150.0	F	—	6.125	2.0
—	—	0420-1500-05	0420-1500-10	1500	150.0	F	—	6.125	.8
—	0420-2000-02	—	—	2000	200.0	F	—	6.125	2.0
—	—	0420-2000-05	0420-2000-10	2000	200.0	F	—	6.125	.8
—	0420-2500-02	—	—	2500	250.0	F	—	6.125	2.0
—	—	0420-2500-05	0420-2500-10	2500	250.0	F	—	6.125	.8
—	0420-3000-02	—	—	3000	300.0	F	—	6.125	2.0
—	—	0420-3000-05	0420-3000-10	3000	300.0	F	—	6.125	1.2
—	0420-3500-02	—	—	3500	350.0	F	—	6.125	3.0
—	—	0420-3500-05	0420-3500-10	3500	350.0	F	—	6.125	1.2
—	0420-4000-02	—	—	4000	400.0	F	—	6.125	3.0
—	—	0420-4000-05	0420-4000-10	4000	400.0	F	—	6.125	2.0
—	0420-4500-02	—	—	4500	450.0	F	—	6.125	3.0
—	—	0420-4500-05	0420-4500-10	4500	450.0	F	—	6.125	2.0
—	0420-5000-02	—	—	5000	500.0	F	—	6.125	3.0
—	—	0420-5000-05	0420-5000-10	5000	500.0	F	—	6.125	2.0

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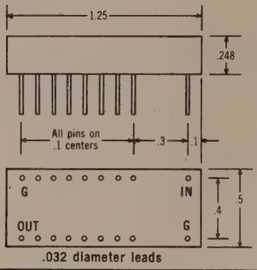
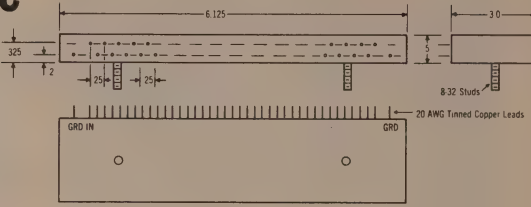
TAPPED DELAY LINES

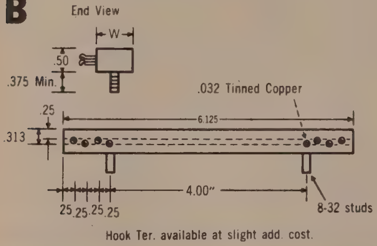
A


1.25
.248
All pins on .1 centers
.3
.1
G
IN
OUT
G
.4
.5
.032 diameter leads

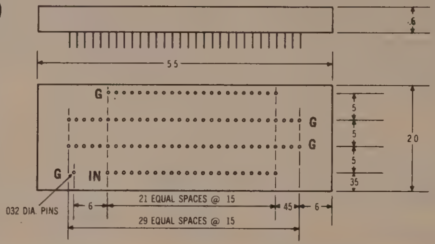
C


6.125
3.0
325
2
5
25
25
8-32 Studs
20 AWG Tinned Copper Leads
GRD IN
GRD

B


End View
W
.50
.375 Min.
.032 Tinned Copper
.25
6.125
.313
4.00″
25 .25 .25 .25
8-32 studs
Hook Ter. available at slight add. cost.

D


.6
5.5
G
G
G
G
IN
5
5
5
35
2.0
.032 DIA. PINS
6
21 EQUAL SPACES @ .15
45
6
29 EQUAL SPACES @ .15

Part No.	Delay nsec	Tr nsec	No. of Taps	Delay/Tap nsec	Impedance	Width "	Style
0414-0155-01	15	5	15	1	100 ∼	½	A
0414-0155-02	15	5	15	1	200 ∼	½	A
0414-0155-03	15	5	15	1	500 ∼	½	A
0414-0131-01	100	15	20	5	500 ∼	.8	B
0414-0447-01	200	25	20	10	500 ∼	.8	B
0414-0448-01	300	35	20	15	500 ∼	.8	B
0414-0449-01	400	45	20	20	500 ∼	.8	B
0414-0131-02	500	55	20	25	500 ∼	.8	B
0414-0450-01	600	60	20	30	500 ∼	.8	B
0414-0451-01	700	70	20	35	500 ∼	.8	B
0414-0452-01	800	80	20	40	500 ∼	.8	B
0414-0453-01	900	90	20	45	500 ∼	.8	B
0414-0131-03	1000	100	20	50	500 ∼	.8	B
0404-0454-01	1000	30	100	10	100 ∼	2.0	D
0414-0455-01	2000	200	20	100	500 ∼	.8	B
0404-0456-01	3000	300	20	150	500 ∼	.8	B
0404-0457-01	4000	400	20	200	500 ∼	.8	B
0404-0458-01	5000	500	20	250	500 ∼	.8	B
0404-0459-01	7500	750	20	375	500 ∼	1.5	B
0404-0460-01	10,000	1000	20	500	500 ∼	1.5	B
0404-0461-01	12,500	750	25	500	500 ∼	3	C
0404-0462-01	15,000	900	30	500	500 ∼	3	C
0404-0463-01	17,500	1100	35	500	500 ∼	3	C
0404-0464-01	20,000	1200	40	500	500 ∼	3	C

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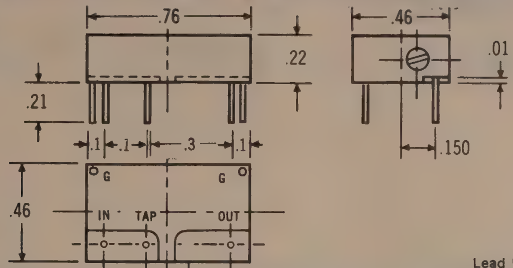
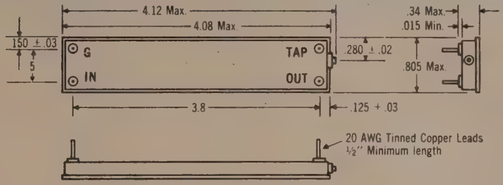
DUAL-IN-LINE VARIABLE DELAY LINES

DV Series


.76
.46
.22
.01
.21
.1
.1
.3
.1
.150
.46
G
G
IN
TAP
OUT
Lead Dia. = .020

BEL introduces the first variable delay line compatible with IC Dual-In-Line packaging featuring: • Hermetic Seal-O-Ring construction • Precious metal contacts • Resolution — MIN 2% (for high reliability performance)

NV Series
PV Series

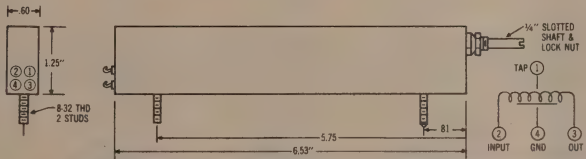

4.12 Max.
4.08 Max.
.34 Max.
.015 Min.
.150 ± .03
.5
G
TAP
IN
OUT
.280 ± .02
.805 Max.
3.8
.125 + .03
20 AWG Tinned Copper Leads
½" Minimum length

VARIABLES

These precision hermetically sealed variables are available in a wide range of delays and impedances. Both may be provided with various mounting and terminal configurations to suit most applications.

NV Series in Metal Case
PV Series in Epoxy Case

CV Series
LV Series


.60
1.25"
② ①
④ ③
8-32 THD
2 STUDS
¼" SLOTTED
SHAFT &
LOCK NUT
TAP ①
② INPUT
④ GND
③ OUT
5.75
.81
6.53"

VARIABLES

These precision hermetically sealed variables are available in a wide range of delays and impedances. Both may be provided with various mounting and terminal configurations to suit most applications.

Part Number	Td Range	Rise Time	Impedance ±10%	Style
0430-0040-05	0-40 nsec	15 nsec	500 Ω	NV
0430-0050-02	0-50 nsec	12 nsec	200 Ω	
0430-0150-10	0-150 nsec	55 nsec	1000 Ω	
0430-0250-05	0-250 nsec	60 nsec	500 Ω	
0430-0250-04	0-250 nsec	55 nsec	400 Ω	
0433-0040-05	0-40 nsec	10 nsec	500 Ω	PV
0433-0050-02	0-50 nsec	10 nsec	200 Ω	
0433-0150-10	0-150 nsec	45 nsec	1000 Ω	
0433-0250-05	0-250 nsec	45 nsec	500 Ω	
0433-0250-04	0-250 nsec	45 nsec	400 Ω	
0431-0450-10	0-450 nsec	70 nsec	1000 Ω	CV
0431-0500-10	0-500 nsec	75 nsec	1000 Ω	
0431-0700-05	0-700 nsec	110 nsec	500 Ω	
0431-0750-05	0-750 nsec	110 nsec	500 Ω	
0431-1000-05	0-1000 nsec	135 nsec	500 Ω	
0448-0005-01	0-5 nsec	5 nsec	100 Ω	DV
0448-0020-02	0-20 nsec	15 nsec	200 Ω	
0448-0030-03	0-30 nsec	20 nsec	350 Ω	
0448-0040-05	0-40 nsec	25 nsec	500 Ω	
0432-0250-01	0-250 nsec	35 nsec	100 Ω	LV

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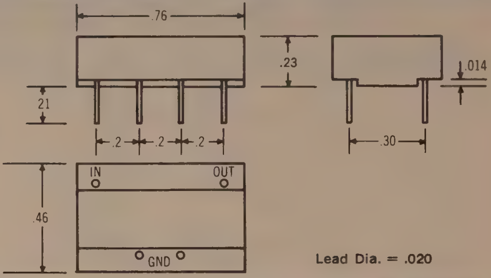
DUAL-IN-LINE DELAY LINES

- Delays from 1-1000 nanoseconds.
- Band Width to 60 mhz.
- Impedance 50 to 1000 ohms.
- Resistive Terminations if desired.
- Tapped Delay Lines available.
- Several separate lines in one case.
- Contact Bel Engineering for special applications.



Lead Dia. = .020

Time Delay nsec ±5%*	Impedance ±10%					
	50Ω	75Ω	100Ω	200Ω	500Ω	1000Ω
5	0440-0005-50 Tr =5	0440-0005-75 Tr = 5	0440-0005-01 Tr = 5	0440-0005-02 Tr = 6	0440-0005-05 Tr = 6	0440-0005-10 Tr = 6
10	0440-0010-50 Tr = 5	0440-0010-75 Tr = 6	0440-0010-01 Tr = 6	0440-0010-02 Tr = 7	0440-0010-05 Tr = 7	0440-0010-10 Tr = 7
15	0440-0015-50 Tr = 8	0440-0015-75 Tr = 8	0440-0015-01 Tr = 8	0440-0015-02 Tr = 8	0440-0015-05 Tr = 8	0440-0015-10 Tr = 8
20	0444-0020-50 Tr = 10	0440-0020-75 Tr = 10	0440-0020-01 Tr = 10	0440-0020-02 Tr = 10	0440-0020-05 Tr = 10	0440-0020-10 Tr = 10
30	0444-0030-50 Tr = 12	0440-0030-75 Tr = 15	0440-0030-01 Tr = 18	0440-0030-02 Tr = 12	0440-0030-05 Tr = 10	0440-0030-10 Tr = 15
40	0444-0040-50 Tr = 17	0444-0040-75 Tr = 20	0440-0040-01 Tr = 18	0440-0040-02 Tr = 20	0440-0040-05 Tr = 15	0440-0040-10 Tr = 20
50	0444-0050-50 Tr = 18	0444-0050-75 Tr = 20	0440-0050-01 Tr = 20	0440-0050-02 Tr = 20	0440-0050-05 Tr = 18	0440-0050-10 Tr = 30
60	0444-0060-50 Tr = 23	0444-0060-75 Tr = 20	0444-0060-01 Tr = 18	0440-0060-02 Tr = 20	0440-0060-05 Tr = 22	0440-0060-10 Tr = 35
70	0444-0070-50 Tr = 23	0444-0070-75 Tr = 22	0444-0070-01 Tr = 19	0440-0070-02 Tr = 22	0440-0070-05 Tr = 25	0440-0070-10 Tr = 35
80	0444-0080-50 Tr = 28	0444-0080-75 Tr = 22	0444-0080-01 Tr = 19	0440-0080-02 Tr = 25	0440-0080-05 Tr = 30	0440-0080-10 Tr = 40
90	0444-0090-50 Tr = 30	0444-0090-75 Tr = 23	0444-0090-01 Tr = 20	0440-0090-02 Tr = 26	0440-0090-05 Tr = 33	0440-0090-10 Tr = 45
100	0444-0100-50 Tr = 35	0444-0100-75 Tr = 23	0444-0100-01 Tr = 20	0440-0100-02 Tr = 28	0440-0100-05 Tr = 35	0440-0100-10 Tr = 50
125	0444-0125-50 Tr = 45	0444-0125-75 Tr = 40	0444-0125-01 Tr = 22	0444-0125-02 Tr = 30	0440-0125-05 Tr = 37	0440-0125-10 Tr = 55
150	0444-0150-50 Tr = 50	0444-0150-75 Tr = 35	0444-0150-01 Tr = 27	0444-0150-02 Tr = 30	0440-0150-05 Tr = 40	0444-0150-10 Tr = 60
200	0444-0200-50 Tr = 55	0444-0200-75 Tr = 50	0444-0200-01 Tr = 37	0444-0200-02 Tr = 40	0444-0200-05 Tr = 40	0444-0200-10 Tr = 60
300			0444-0300-01 Tr = 57	0444-0300-02 Tr = 60	0444-0300-05 Tr = 55	0444-0300-10 Tr = 60
400				0444-0400-02 Tr = 60	0444-0400-05 Tr = 65	0444-0400-10 Tr = 70
500				0444-0500-02 Tr = 110	0444-0500-05 Tr = 95	0444-0500-10 Tr = 95
600				0444-0600-02 Tr = 110	0444-0600-05 Tr = 100	0444-0600-10 Tr = 125
700				0444-0700-02 Tr = 120	0444-0700-05 Tr = 110	0444-0700-10 Tr = 120
800					0444-0800-05 Tr = 120	0444-0800-10 Tr = 125
900					0444-0900-05 Tr = 135	0444-0900-10 Tr = 135
1000					0444-1000-05 Tr = 150	0444-1000-10 Tr = 150

* or 1 nsec (whichever is greater)

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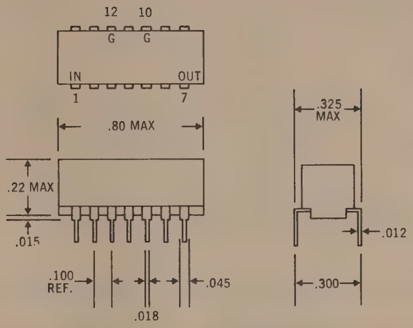
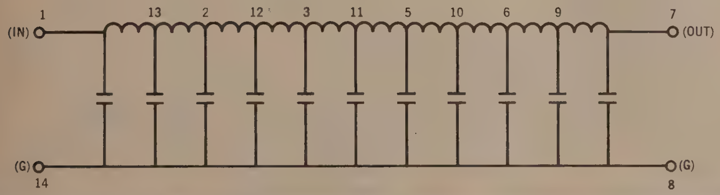
DIP DELAY LINES

- Built to conform to MIL-D-23859.
- Temperature Range −55°C to +125°C.
- Temperature Coefficient 100 ppm/°C or less.
- Will meet most stringent MIL requirements.
- Low attenuation.
- Excellent pulse fidelity.
- Compatible with TTL and other logic modes.
- Other delays available upon request.
- Contact Bel Engineering for special applications.



*Height of 1000Ω units is .3 max.

Time Delay nsec ±5%	Impedance ±10%					
	50Ω	75Ω	100Ω	200Ω	500Ω	1000Ω*
50	0445-0050-50 Tr = 10	0445-0050-75 Tr = 20	0445-0050-01 Tr = 10	0445-0050-02 Tr = 10	0445-0050-05 Tr = 30	0445-0050-10 Tr = 30
100	0445-0100-50 Tr = 20	0445-0100-75 Tr = 23	0445-0100-01 Tr = 20	0445-0100-02 Tr = 20	0445-0100-05 Tr = 40	0445-0100-10 Tr = 50
150	0445-0150-50 Tr = 30	0445-0150-75 Tr = 35	0445-0150-01 Tr = 25	0445-0150-02 Tr = 30	0445-0150-05 Tr = 45	0445-0150-10 Tr = 50
200	0445-0200-50 Tr = 40	0445-0200-75 Tr = 50	0445-0200-01 Tr = 35	0445-0200-02 Tr = 40	0445-0200-05 Tr = 45	0445-0200-10 Tr = 50



10 EQUALLY SPACED TAPS

CUSTOM PIN LAYOUT AVAILABLE UPON REQUEST

Total Delay nsec ±5%	Tap Delay	Distortion ± Max %	Impedance ±10%		
			50Ω	100Ω	200Ω
50	5 ±2 nsec	10	0446-0050-50 Tr = 10	0446-0050-01 Tr = 10	0446-0050-02 Tr = 10
100	10 ±3 nsec	10	0446-0100-50 Tr = 20	0446-0100-01 Tr = 20	0446-0100-02 Tr = 20
200	20 ±3 nsec	10	0446-0200-50 Tr = 40	0446-0200-01 Tr = 35	0446-0200-02 Tr = 40

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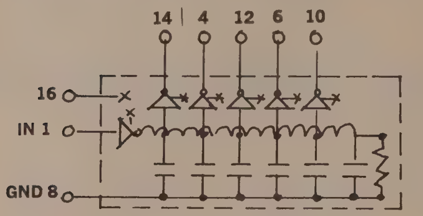
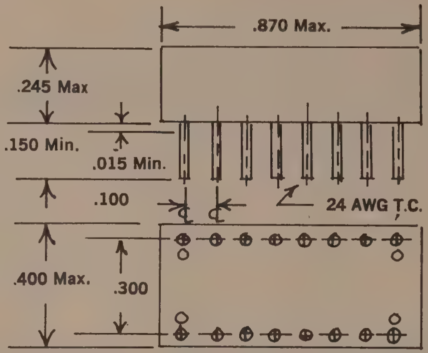
DIGITAL DELAY LINE SERIES 447

Bel Fuse Digital Delay Line Series 447 features five equally tapped delay lines with total delays of 50 to 500 nanoseconds. The lines are compatible with TTL and DTL circuits. Either Logic "1" or Logic "0" inputs are accepted. Cascading of units causes no undesirable reflections. The .870 x .400 x .260 dimensions, with standard Dip Pin-Out permits dense packaging on your circuit board. Delay tolerances for total delay is 5%. Tap tolerances are ±3nsec or 10% whichever is greater. Operating temperature is 0°-70°C. Special designs upon request.



PIN
1—Input
14—20% Delay
4—40% Delay
12—60% Delay

PIN
6—80% Delay
10—100% Delay
8—Ground
16—Vcc



Part Number	Td (1)	Td/Tap (1)	No. Taps	Tr (2)
0447-0050-01	50 Ns.	10 Ns.	5	4 Ns.
0447-0100-01	100 Ns.	20 Ns.	5	4 Ns.
0447-0250-01	250 Ns.	50 Ns.	5	4 Ns.

(1) Measured at 1.5 Volt Level, Leading Edge (2) Measured from 0.75V to 2.4V

Supply Voltage Vcc	4.5 to 5.5 Volts
Logic 1 Input Current	50 Microamps Max.
Logic 0 Input Current	2 Milliamps Max.
Logic 1 Output Voltage	2.6 Volts Min.
Logic 0 Output Voltage	.5 Volts Max.

All Measurements Made at VCC = 5.0 Volts @ 25°C

INPUT TEST CONDITIONS

Pulse Voltage	3.2 Volts
Rise Time	3.0 Nsec.
Input Current	60 ma
Pulse Width	Min. of 40% Delay

DRIVE CAPABILITIES

Logic 0 Output	10 TTL Loads/Tap Max. (20 TTL loads/Unit Max.)
Logic 1 Output	10 TTL Loads/Unit Max.

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GENERAL CHARACTERISTIC OF CATALOG ITEMS AND CONSIDERATIONS FOR SPECIFYING DELAY LINES

Wherever possible, it is suggested that standard catalog items be used. When this is not possible, the following factors should be considered.

CONSIDERATIONS:

1. Delay Time
2. Rise Time
3. Attenuation
4. Impedance
5. Distortion
6. Temperature Coefficient
7. Package Design

Of these seven parameters, rise time, delay time and attenuation are closely related and have a major effect on the complexity and cost of a delay line.

Rise time of catalog items are specified as a maximum. The Td:Tr ratio is probably the most important factor in determining the cost of a delay line, since it determines the number of sections required. To overspecify this ratio is costly.

The increase in the number of sections can grow at a rate of 2 to 4 times the Td:Tr ratio. As the sections increase, their individual section efficiency decreases. To compensate for this, more complex section designs are required and consequently the costs increase.

Since input pulse width may considerably affect the design of a delay line, this parameter should always be given. As a rule of thumb, the width of the input pulse should be at least two times the required delay line rise time to avoid added attenuation or special design.

Normally, rise time measurements are made from 10% to 90% of the leading edge of the delayed pulse; however, in some applications, the rise time between two other intermediate amplitude levels on the leading edge may be more pertinent to circuit requirements. When this is the case, rise time may be specified as being read between the 20% to 80% points, etc. All catalog item rise times are specified between the 10% and 90% points.

Attenuations typically are from .2 to 3db depending on delay and compactness of the line. Special core materials are available for extremely low attenuation. Bel Fuse can generally, lower the attenuation simply by increasing case size slightly. This has a negligible effect on cost. Attenuation is generally specified as a maximum. Generally, as the attenuation in a delay line is decreased, the complexity and cost increase. With input pulse characteristics which obey our rule of thumb, the attenuation of the output pulse is dependent mainly on the individual inductor design.

The maximum input amplitude will be limited by the dielectric strength of the capacitors or the saturation point of the inductors. The problem of inductor saturation, however, occurs more often with relatively long delay lines. A more serious consideration is the size of the overall package. It is well to remember that lower voltage capacitors can be obtained in smaller sizes than the higher voltage capacitors. Working voltage is specified as a minimum. Catalog items with a prefix 0430, 0431, 0433, 0440, and 0448 are rated at 100 volts operating. All other catalog prefix numbers are rated at 50 volts operating.

GENERAL CHARACTERISTIC OF CATALOG ITEMS AND CONSIDERATIONS FOR SPECIFYING DELAY LINES

(continued)

Bel Fuse produces delay lines with impedances ranging from 50 to 2000 ohms. Impedances from 20 to 10,000 ohms are available on special order. The easiest and most straight-forward impedance parameters are between 50 and 500 ohms. Typical tolerances are 3%, 5% and 10%. All catalog items are specified at ±10% for impedance.

Distortions typically run 10%. Bel Fuse can supply delay lines with distortions as low as 2%. It should be remembered that distortions are input rise time dependent; i.e., a delay line which exhibits a distortion of ±10% with a 3ns input rise time may show only ±5% distortion with a 10ns input risetime. If distortion is to be reduced on a given line, cost will increase.

Bel Fuse delay lines are available with delays as low as 1 nanosecond (1 x 10^{-9} sec. and as high as 50 microseconds (1 x 10^{-6}). Normal delay tolerance is ±5%. A tolerance tighter than ±5% will, of course, increase the unit price. Tapped delay lines, listed in the catalog have a delay tolerances tap to tap of less than ±10%.

Bel Fuse can also provide delay line packages consisting of several increments with one common ground, and the input/output taps of each increment brought out for external connection.

Another major factor affecting delay line costs is the temperature coefficient (TC). The more economical design is achieved when TC for the delay line is ±50 PPM/°C or higher. An operating range of —25° to +85°C is suggested for all catalog part numbers with a prefix of 0414, 0420, 0430, 0431, 0433, 0440 and 0448. An operating range of —55°C to +125°C is suggested for part numbers with a prefix of 0404, 0432, 0444, 0445. Catalog part numbers prefixed 0404, 0432, 0444, 0445, and 0046 have a TC of 50 PPM/°C. Catalog part numbers prefixed 0414, 0420, 0430, 0431, 0440, 0448 have a TC of 100 PPM/°C.

The final factor that should be considered in specifying delay lines is package design. The physical lead configuration of a delay line is almost the same as its schematic configuration. For minimum costs, the package design and pin designation should correspond to the basic internal layout of the delay line circuit board design. If the printed circuit board design establishes a tangled pattern for terminal locations, the package complexity may increase substantially and drive costs up.

If possible, size should be suggested in limits rather than in a fixed dimension, so that Bel Fuse might select a standard package, resulting therefore in a lower cost.

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APPLICATION OF BEL FUSE PRECISION DELAY LINES IN DATA PROCESSING EQUIPMENT

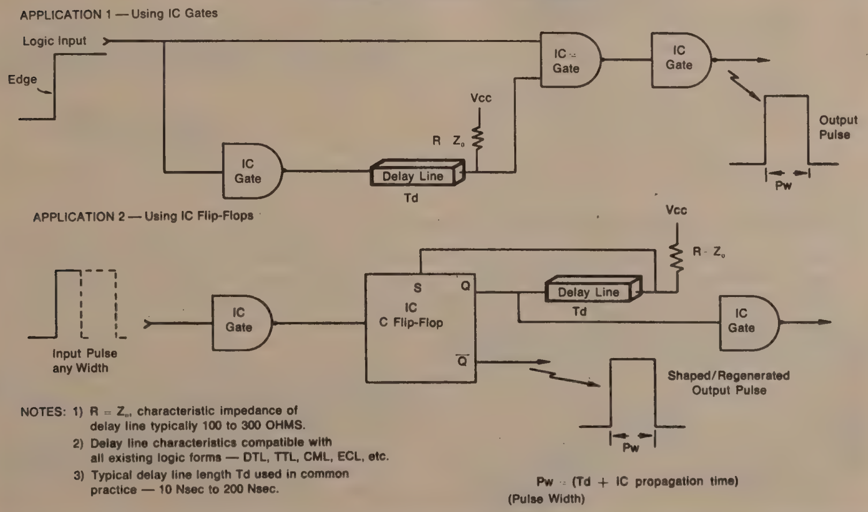
PULSE SHAPING/CLOCK PULSE GENERATION

The operation and application of high speed integrated circuitry with logic propagation times in the range from 2nsec to 20nsec requires the conversion of logic edges to pulses and the generation of accurately controlled clock pulses. BEL FUSE'S distributed parameter and lumped constant delay lines allow these functions to be performed in close proximity to the actual logic circuits and in the same packaging technology employed by the logic circuit set. BEL FUSE'S DIP delay lines can be automatically inserted into circuit boards along with integrated circuit DIP logic circuits.

In large scale third generation computer systems clock pulses are distributed to many different points within the data processing hardware over large distances. Pulse degradation due to attenuation, logic skew, spurius noise, etc, can cause intermittent system operation. BEL FUSE delay lines in conjunction with logic gates and/or flip-flops permit efficient means of local clock pulse REgeneration which contributes greatly to the preservation of the integrity of logic system.

Figure 1 shows two application methods of the use of BELFUSE delay lines for pulse shaping and clock pulse generation.

PULSE SHAPING/CLOCK PULSE GENERATION
THRU USE OF PRECISION DELAY LINES


APPLICATION 1 — Using IC Gates
Logic Input
Edge
IC Gate
IC Gate
IC Gate
Vcc
R Z₀
Delay Line
Td
Output Pulse
Pw
APPLICATION 2 — Using IC Flip-Flops
Vcc
R - Z₀
Input Pulse any Width
IC Gate
S
Q
IC
C Flip-Flop
Q̄
Delay Line
Td
IC Gate
Shaped/Regenerated Output Pulse
Pw
Pw = (Td + IC propagation time)
(Pulse Width)

NOTES:
1) R = Z_0, characteristic impedance of delay line typically 100 to 300 OHMS.
2) Delay line characteristics compatible with all existing logic forms — DTL, TTL, CML, ECL, etc.
3) Typical delay line length Td used in common practice — 10 Nsec to 200 Nsec.

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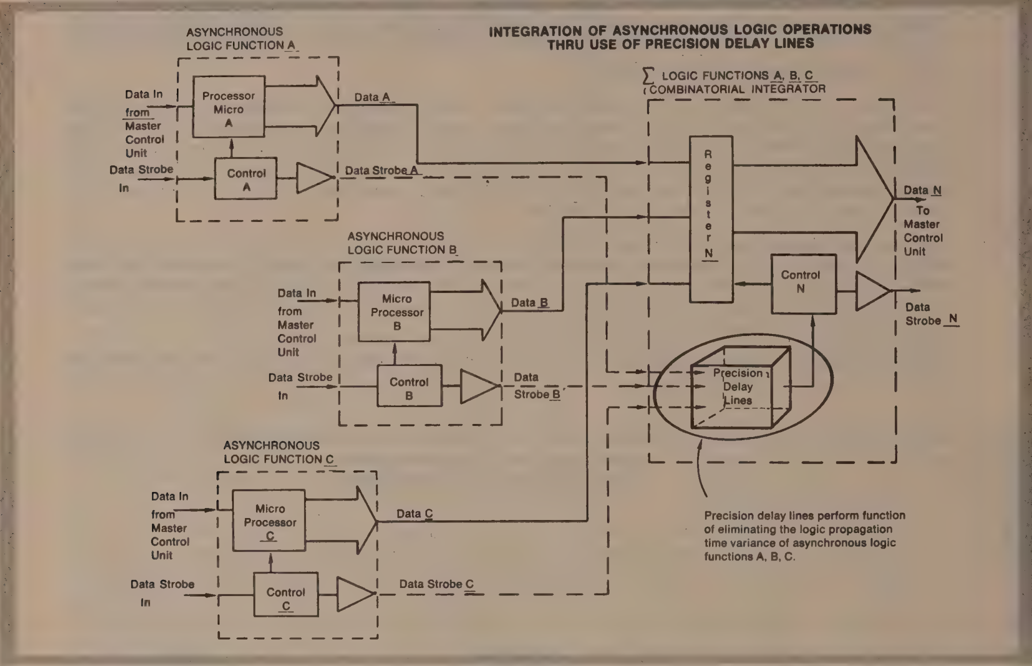

INTEGRATION OF ASYNCHRONOUS LOGIC OPERATIONS
THRU USE OF PRECISION DELAY LINES
ASYNCHRONOUS LOGIC FUNCTION A
Data In from Master Control Unit
Processor Micro A
Data Strobe In
Control A
Data A
Data Strobe A
ASYNCHRONOUS LOGIC FUNCTION B
Data In from Master Control Unit
Micro Processor B
Data Strobe In
Control B
Data B
Data Strobe B
ASYNCHRONOUS LOGIC FUNCTION C
Data In from Master Control Unit
Micro Processor C
Data Strobe In
Control C
Data C
Data Strobe C
∑ LOGIC FUNCTIONS A, B, C
(COMBINATORIAL INTEGRATOR
Register N
Control N
Precision Delay Lines
Data N
To Master Control Unit
Data Strobe N
Precision delay lines perform function of eliminating the logic propagation time variance of asynchronous logic functions A, B, C.

INTEGRATION OF ASYNCHRONOUS LOGIC OPERATIONS

A parallel processing techniques utilizing several different and independent operation logic function units can be a very efficient approach. Typically the functional units are under the control of one master control unit. The master control unit dispatches data and/or commands to be processed to several function units simultaneously. The resultant overlapping of processing operations results in significant improvement in overall system operation and thruput as compared to sequential processing techniques.

Due to the fact that the independent, asynchronous logic function unit response times differ from each other and in fact are variable in some cases, a problem arises when the master control unit samples their processed outputs because their outputs are available at different times.

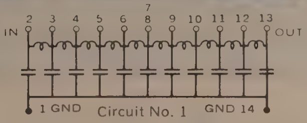
Precision BEL FUSE delay lines can be employed to compensate for the various response times of the asynchronous logic units so that on a precision timing basis the combined results are made available for sampling by the master control unit and a data skew problem is eliminated.

Figure 2 is a functional block diagram of a typical parallel processing system employing precision BEL FUSE delay lines as a response time variance compensation device.

BOURNS
MAGNETICS DIVISION

DELAY LINES

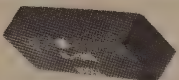
DUAL-IN-LINE DELAY LINES



Circuit No. 1

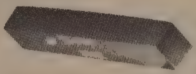
Catalog Number	Imped. Z₀ (Ω) ±10%	Total Delay (ns±5%)	No. of Taps	Delay Per Tap (ns±3ns)	Rise Time (ns Max.)	Total Delay Rise Time Ratio (Min.)	Distortion (% Max.)	Attenuation (% Max.)
DL-1101	50	50	10	5(±2ns)	8.5	6	10	2.5
DL-1102*	50	100	10	10	17	6	10	7
DL-1103*	50	125	10	12.5	21	6	10	7.5
DL-1104	100	50	10	5(±2ns)	8.5	6	10	2.5
DL-1105	100	100	10	10	17	6	10	9
DL-1106*	100	125	10	12.5	21	6	10	13
DL-1107*	100	150	10	15	25	6	10	15

STANDARD DELAY LINES, SERIES DL-1300



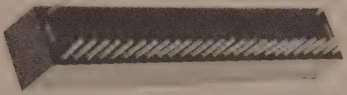
Catalog Number	Imped. Z₀ (Ω) ±10%	Total Delay (ns ±5%)	No. of Taps	Delay Per Tap (ns±3ns)	Rise Time (ns Max.)	Total Delay Rise Time Ratio (Min.)	Distortion (% Max.)	Attenuation (% Max.)	Case Style
DL-1301	100	50	10	5(±2ns)	8.5	6	10	2	DP-1
DL-1302	100	100	10	10	17	6	10	3.5	DP-1
DL-1303	100	125	10	12.5	21	6	10	5	DP-1
DL-1304	100	150	10	15	25	6	10	5	DP-2
DL-1305	100	200	10	20	34	6	10	8	DP-2
DL-1306	100	250	10	25	42	6	10	10	DP-2

SPECIAL DELAY LINES, SERIES DL-1500



Catalog Number	Imped. Z₀ (Ω) ±10%	Total Delay (ns±5%)	No. of Taps	Delay Per Tap (ns±2ns)	Rise Time (ns Max.)	Total Delay Rise Time Ratio (Min.)	Distortion (% Max.)	Attenuation (% Max.)
DL-1501	50	50	10	5(±2ns)	5.5	9	10	2
DL-1502	50	100	10	10	11	9	10	5
DL-1503	50	125	10	12.5	13.8	9	10	6
DL-1504	50	150	10	15	16.5	9	10	8
DL-1505	50	200	10	20	22	9	10	12
DL-1506	100	50	10	5(±2ns)	5.5	9	10	3
DL-1507	100	100	10	10	11	9	10	3
DL-1508	100	125	10	12.5	13.8	9	10	9
DL-1509	100	150	10	15	16.5	9	10	14

SPECIAL DELAY LINES, SERIES DL-1600



Catalog Number	Imped. Z₀ (Ω) ±10%	Total Delay (ns±5%)	No. of Taps	Delay Per Tap (ns±2ns)	Rise Time (ns Max.)	Total Delay Rise Time Ratio (Min.)	Distortion (% Max.)	Attenuation (% Max.)
DL-1601	100	125	25	5	11.9	10.5	10	4.5
DL-1602	100	200	25	8	19	10.5	12	7
DL-1603	100	250	25	10	23.8	10.5	12	9

FIGURE 1

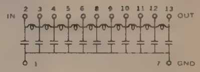


FIGURE 2

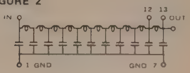
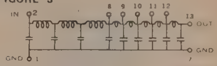
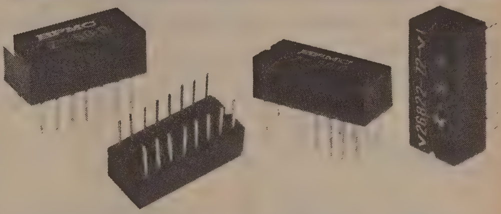


FIGURE 3



Catalog Number	Imped. Z₀ (Ω) ±10%	Total Delay (ns ±5%)	No. of Taps	Delay Per Tap (ns)	Rise Time (ns Max.)	Total Delay Rise Time Ratio (Min.)	Distortion (% Max.)	Attenuation (% Max.)	Case Style
DL-1201	50	50	10	5.0	8.5	6	12	2.5	1
DL-1202	100	43	2	4.3(End)	8.5	5	12	1	2
DL-1203	100	25	5	1.0(End)	7.5	3.3	12	1	3

PROGRAMMABLE DELAY LINES

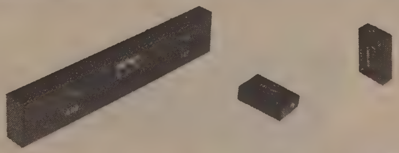


Catalog Part No. — DL-1220	1-3	4-6	8-10	11-13
Delay Per Section (ns):	5.0	5.0	5.0	5.0
Delay Tolerance (ns):	±0.5	±0.5	±0.5	±0.5
Max. Rise Time (ns):	3.4	3.4	3.4	3.4
Impedance (Zo) (Ω) ±5%:	50	50	50	50
Max. DCR (Ω):	0.1	0.1	0.1	0.1

Catalog Part No. — DL-1221	2-15	3-14	4-13	5-12	All Sections Combined
Delay Per Section (ns):	2	4	6	8	20
Delay Tolerance (ns):	±0.3	±0.35	±0.4	±0.45	±0.9
Max. Output Rise and Fall Times in ns —20% —80%:	2.4	2.4	2.4	2.4	3.4
Impedance (Zo) in Ω ±10%:	92	92	92	92	92
Max. Crosstalk %:	12	12	12	12	12
Max. DCR (Ω):	0.25	0.5	0.75	1.0	2.5

Terminating Resistors: (6-11 & 7-10) = 42Ω ±5%

ADJUSTABLE DELAY LINES



Catalog Part No.	Imped. Z₀(Ω) +10%	Delay ns	Rise Time ns Max.	Distortion +% Max.	DCR Ohms Max.
DL-8402	500	250	60	10	30
DL-8101	500	40	26	10	20
DL-8401	300	80	15	10	30

HIGH RELIABILITY • MIL SPEC • COMMERCIAL • INDUSTRIAL • MICRO AND STANDARD SIZE MAGNETIC COMPONENTS

BOURNS
MAGNETICS DIVISION

28151 HIGHWAY 74, ROMOLAND, CA. 92380 PHONE: 714 657-5195 TELEX: 67-6446 *military & commercial*

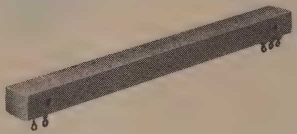
DELAY LINES

WITH OR WITHOUT CIRCUITRY

MAGNETOSTRICTIVE ★ LUMPED CONSTANT ★ ULTRASONIC ★ DISTRIBUTED CONSTANT ★ DISPERSIVE STRIP

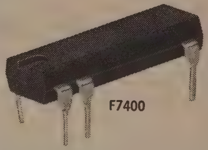
MAGNETOSTRICTIVE DELAY LINES — Fixed and variable delays to 10,000 microseconds. Fixed — FMS Series; Variable — VM Series.

FIXED MAGNETOSTRICTIVE DELAY LINE — Up to 10,000 bits of data for memory storage. Circuitry compatible with all microcircuit logic. Choice of data format: RZ, NRZ or Bipolar.

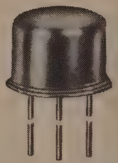


ULTRASONIC DELAY LINES — Replaces most quartz or glass lines. Offers superior performance, lower attenuation and smaller size at less cost. Frequencies to 30 MHz. Delays to 200 usec and greater.

SUBMINIATURE DELAY LINES



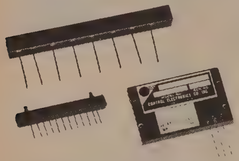
F7400



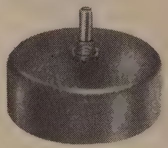
F-TO-5

TO-5 and micrologic packaged delay lines from 0.01 to 0.64 and longer delays. Ideal for timing transistors and other circuit components.

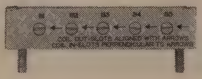
LUMPED CONSTANT DELAY LINES — Many shapes available including miniature types with pin connectors for PC Boards, connector fingers for plug-in units...multi-tapped units...terminal-ended units, etc. Delays from 0.05 usec to 500 usec for standard units. Delay to risetime ratios up to 100:1. Temperature stability to 50 ppm/C°.



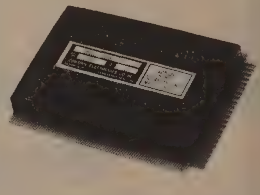
COMPACT FIXED DELAY LINES FOR PC BOARDS — Extremely high density packaging. Typical Unit: 25:1 delay-to-rise-time ratio in a volume of 2 cubic inches.



VARIABLE DELAY LINE
Resolution of 1 part in 120. Delay up to 10 usec. 1″ x 3″.

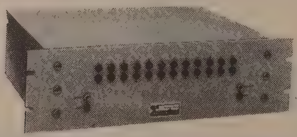


UNIQUE BINARY CODED SECTIONAL DELAY LINE — Uses miniature transfer switches. Also available with terminals for remote switching.



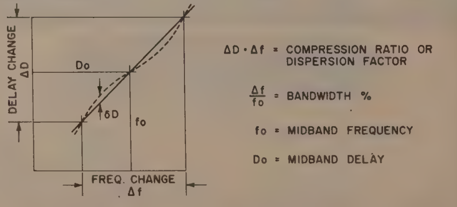
IFF MULTI-TAP DELAY LINES
Standard IFF delay lines with taps every 1.45 usec. High density packaging available for airborne transponder use.

AUDIO, HIGH FREQUENCY & DISTRIBUTED CONSTANT DELAY LINES — With unusual circuits, extreme delays, high frequency application, rapid rise times, conforming waveform circuits and corrective circuits. Write for complete details.



AUDIO DELAY CABINET — Relay rack mounted cabinet houses 25 millisecond delay with taps at every ms. Units can be cascaded for longer delays.

DISPERSIVE STRIP DELAY LINES — Delay varies with frequency. A prime application is in Pulse Compression Radar Systems, eliminating large, expensive filter components. Compression ratios of 150:1, typical.



For all your Delay Line requirements, contact:

CONTROL ELECTRONICS COMPANY, INC.
153 Florida Street, Farmingdale, L.I., N.Y. 11735 · (516) 694-0125

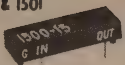
DATA DELAY DEVICES
[illegible]
SHORT FORM CATALOG

DUAL-IN-LINE DELAY LINES SERIES 1500 & 1501

SPECIFICATIONS

- Taps available
- Td/Tr ≥ 3/I and 2/I series 1501 & 1500 respectively
- Withstanding voltage – 100 vdc for series 1500; 50 vdc for series 1501
- Longer cases available for longer delays

STOCKED



PART NO.	Td (NS)	Ro (ohms)	H (INS)	PART NO	Td (NS)	Ro (ohms)	H (INS)	PART NO	Td (NS)	Ro (ohms)	H (INS)
1500-1	10	125	3/16	1500 8	10	250	1/8	1500 15	20	280	1/8
1500-2	10	150	↓	1500-9	20	250	↓	1500 16	30	280	↓
1500-3	15	200	↓	1500 10	25	250	↓	1500 17	10	300	↓
1500-4	15	220	↓	1500 11	15	270	3/16	1500 18	20	300	↓
1500 5	25	220	↓	1500 12	25	270	↓	1500 19	30	300	↓
1500-6	10	240	1/8	1500 13	35	270	↓	1500 20	40	300	↓
1500 7	15	240	↓	1500 14	10	280	1/8	1500 21	50	300	↓

PART NO.	Td (NS)	Ro (ohms)	H (INS)	PART NO	Td (NS)	Ro (ohms)	H (INS)	PART NO	Td (NS)	Ro (ohms)	H (INS)
1501-1	10	100	1/8	1501-21	30	300	1/8	1501-41	10	400	1/8
1501-2	20	100	↓	1501 22	40	300	↓	1501-42	20	400	↓
1501-3	30	100	↓	1501-23	50	300	3/16	1501-43	30	400	↓
1501-4	10	150	↓	1501 24	60	300	↓	1501-44	40	400	3/16
1501-5	20	150	↓	1501-25	70	300	↓	1501-45	50	400	↓
1501-6	30	150	↓	1501 26	80	300	↓	1501-46	60	400	↓
1501-7	40	150	↓	1501 27	90	300	↓	1501-47	70	400	↓
1501-8	10	200	↓	1501-28	100	300	↓	1501-48	80	400	↓
1501-9	20	200	↓	1501-29	120	300	↓	1501-49	90	400	↓
1501-10	30	200	↓	1501-30	140	300	↓	1501-50	100	400	↓
1501-11	40	200	↓	1501 31	10	350	1/8	1501-51	110	400	↓
1501-12	50	200	↓	1501 32	20	350	↓	1501-52	20	500	↓
1501-13	60	200	↓	1501-33	30	350	↓	1501 53	30	500	↓
1501-14	10	250	↓	1501 34	40	350	3/16	1501-54	40	500	↓
1501-15	20	250	↓	1501-35	50	350	↓	1501-55	50	500	↓
1501 16	30	250	↓	1501-36	60	350	↓	1501-56	60	500	↓
1501 17	40	250	↓	1501-37	70	350	↓	1501-57	70	500	↓
1501-18	50	250	↓	1501-38	80	350	↓	1501-58	80	500	↓
1501-19	10	300	↓	1501-39	90	350	↓	1501-59	90	500	↓
1501-20	20	300	↓	1501-40	100	350	↓				

DUAL-IN-LINE DELAY LINES SERIES 1502

SPECIFICATIONS

STOCKED

- Standard 14 lead I.C. case
- Case Height – 3/16 in.
- 50 vdc withstanding voltage
- Td/tr ≥ 3/1
- Impedance 100 to 500 ohms
- Taps available
- Pin Connections – No. 1 - IN; No. 5 - OUT; No. 8 - GND.

PART NO.	Td (NS)	Ro (ohm)	PART No.	Td (NS)	Ro (ohms)	PART NO.	Td (NS)	Ro (ohms)	PART NO.	Td (NS)	Ro (ohms)
1502-1	5	100	1502-15	20	200	1502-29	100	250	1502-43	40	350
1502-2	10	100	1502-16	30	200	1502-30	5	300	1502-44	50	350
1502-3	15	100	1502-17	40	200	1502-31	10	300	1502-45	80	350
1502-4	20	100	1502-18	80	200	1502-32	15	300	1502-46	100	350
1502-5	40	100	1502-19	80	200	1502-33	20	300	1502-47	10	400
1502-6	5	150	1502-20	5	250	1502-34	20	300	1502-48	20	400
1502-7	10	150	1502-21	10	250	1502-35	40	300	1502-49	30	400
1502-8	15	150	1502-22	15	250	1502-36	50	300	1502-50	40	400
1502-9	20	150	1502-23	20	250	1502-37	60	300	1502-51	10	500
1502-10	30	150	1502-24	30	250	1502-38	80	300	1502-52	20	500
1502-11	50	150	1502-25	40	250	1502-39	100	300	1502-53	30	500
1502-12	5	200	1502-26	50	250	1502-40	10	350			
1502-13	10	200	1502-27	60	250	1502-41	20	350			
1502-14	15	200	1502-28	80	250	1502-42	30	350			

DUAL-IN-LINE DELAY LINES SERIES 1504

SPECIFICATIONS

STOCKED

DATA DELAY DEVICES

- Delay – (see table)
- Delay accuracy – ±5% (other tolerances on request)
- Delay Taps – Available on request
- Impedances (See table, others on request)
- Impedance Accuracy – ±10% (other tolerances on request)
- Rise Time – 20% of total time delay
- Operating voltage – 50 Vdc. Min.
- Temperature Coefficient – 100 PPM/°C
- Environment – Meets or exceeds MIL-D-23859C.

PART NO	TOTAL DELAY (NS)	Imp (Ω)	Rdc (Ω)	PART NO	TOTAL DELAY (NS)	Imp (Ω)	Rdc (Ω)	PART NO.	TOTAL DELAY (NS)	Imp (Ω)	Rdc (Ω)
1504 20A	20	50	1.0	1504 160C	160	200	5.0	1504 450E	450	300	14.0
1504 25A	25	50	1.0	1504 180C	180	200	5.5	1504-600E	600	300	17.0
1504 30A	30	50	1.2	1504 240C	240	200	6.0	1504-40F	40	400	2.0
1504 40A	40	50	1.5	1504 300C	300	200	7.0	1504-80F	80	400	5.0
1504 45A	45	50	1.5	1504 400C	400	200	8.0	1504 120F	120	400	6.0
1504 60A	60	50	1.5	1504 25D	25	250	2.0	1504 160F	160	400	7.0
1504 75A	75	50	1.8	1504 50D	50	250	2.5	1504 200F	200	400	8.0
1504 100A	100	50	2.0	1504 75D	75	250	3.5	1504 240F	240	400	12
1504 10B	10	100	1.0	1504 100D	100	250	4.5	1504 320F	320	400	13
1504 20B	20	100	1.5	1504 125D	125	250	5.0	1504 360F	360	400	15
1504 30B	30	100	1.5	1504 150D	150	250	5.5	1504-480F	480	400	18
1504 40B	40	100	1.8	[illegible]	200	250	6.3	1504 600F	600	400	20
1504 50B	50	100	2.0	1504 225D	225	250	7.0	1504 800F	800	400	23
1504 60B	60	100	2.0	1504 300D	300	250	8.0	1504 50G	50	500	3.0
1504 80B	80	100	2.2	1504 375D	375	250	8.4	1504 100G	100	500	6.0
1504 90B	90	100	2.4	1504 500D	500	250	12.5	1504 150G	150	500	8.0
1504 120B	120	100	2.8	1504 30E	30	300	2.0	1504 200G	200	500	11
1504 150B	150	100	3.0	1504 60E	60	300	2.0	1504 250G	250	500	13
1504 200B	200	100	4.0	1504 90E	90	300	3.0	1504 300G	300	500	16
1504 20C	20	200	2.0	1504 120E	120	300	5.0	1504 400G	400	500	18
1504 40C	40	200	2.0	1504 150E	150	300	6.0	1504-450G	450	500	20
1504 60C	60	200	2.5	1504 180E	180	300	7.0	1504 600G	600	500	22
1504 80C	80	200	3.0	1504 240E	240	300	7.5	1504 750G	750	500	24
1504 100C	100	200	4.0	1504 270E	270	300	8.0	1504 1000G	1000	500	30
1504 120C	120	200	4.5	1504 360E	360	300	11.0				

DIP-TAPPED DELAY LINE SERIES 1517

SPECIFICATIONS

5 TAPS

STOCKED

- Delay accuracy – ± 5% (others on request).
- No. taps – 5 Equally spaced taps.
- Taps accuracy – ± 5% of tap delay.
- Impedance tolerance – ± 10% (others on request).
- Rise-Time ≤ 30% of time delay.
- Withstanding voltage – 50 Vdc. Min.
- Temperature coefficient – 100 PPM/°C.
- Environment – Meets or exceeds MIL-D-23859C.
- Overall case height – 0.280 inches.

PART NO	TOTAL DELAY (NS)	Imp. (Ω)	Rdc (Ω)	PART NO	TOTAL DELAY (NS)	Imp. (Ω)	Rdc (Ω)	PART NO.	TOTAL DELAY (NS)	Imp. (Ω)	Rdc (Ω)
1517 10A	10	50	0.6	1517-80C	80	200	2.5	1517-20F	20	400	1.0
1517-15A	15	50	0.6	1517-90C	90	200	2.7	1517-40F	40	400	2.5
1517-20A	20	50	0.7	1517 120C	120	200	3.0	1517-60F	60	400	3.0
1517-30A	30	50	0.7	1517 150C	150	200	3.5	1517-80F	80	400	3.5
1517-40A	40	50	0.9	1517-25D	25	250	1.2	1517 100F	100	400	4.0
1517-5B	5	100	0.5	1517-37D	37	250	1.7	1517-120F	120	400	6.0
1517 10B	10	100	0.7	1517 50D	50	750	2.2	1517 160F	160	400	6.5
1517 15B	15	100	0.7	1517-60D	60	250	2.5	1517 180F	180	400	7.5
1517-20B	20	100	0.9	1517-75D	75	250	2.7	1517-240F	240	400	9.0
1517-25B	25	100	1.0	1517 100D	100	250	3.1	1517 300F	300	400	10.0
1517-30B	30	100	1.0	1517 150D	150	250	4.0	1517-25G	25	500	1.5
1517-40B	40	100	1.1	1517-15E	15	300	1.0	1517-50G	50	500	3.0
1517-50B	50	100	1.2	1517-30E	30	300	1.0	1517 75G	75	500	4.0
1517-60B	60	100	1.4	1517-50E	50	300	1.5	1517 100G	100	500	5.5
1517 75B	75	100	1.5	1517-60E	60	300	2.5	1517-125G	125	500	6.5
1517 10C	10	200	1.0	1517 75E	75	300	3.0	1517 150G	150	500	8.0
1517 20C	20	200	1.0	1517 90E	90	300	3.5	1517 200G	200	500	9.0
1517-30C	30	200	1.2	1517-120E	120	300	3.7	1517-225G	225	500	10.0
1517-40C	40	200	1.5	1517 130E	130	300	4.0	1517-300G	300	500	11.0
[illegible]	50	200	2.0	1517 180E	180	300	5.5				
1517-60C	60	200	2.2	1517 220E	220	300	7.0				

DIP-TAPPED DELAY LINE SERIES 1519

SPECIFICATIONS

10 TAPS

DATA DELAY DEVICES

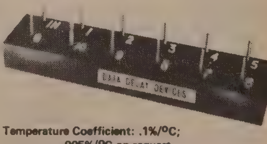
STOCKED

- Delay accuracy – ±5% (others on request).
- No. taps – 10 Equally spaced taps.
- Taps accuracy – ±5% of tap delay.
- Impedance tolerance – ±10% (others on request).
- Rise-Time – 20% of time delay.
- Withstanding voltage – 50 Vdc. Min.
- Temperature coefficient – 100 PPM/°C.
- Environment – Meets or exceeds MIL-D-23859C.
- Overall case height – 0.280 inches.

PART NO	TOTAL DELAY (NS)	Imp (Ω)	Rdc (Ω)	PART NO	TOTAL DELAY (NS)	Imp (Ω)	Rdc (Ω)	PART NO	TOTAL DELAY (NS)	Imp (Ω)	Rdc (Ω)
1519 20A	20	50	1.0	1519-120C	120	200	4.5	1519-450E	450	300	14.0
1519 25A	25	50	1.0	1519-160C	160	200	5.0	1519-600E	600	300	17.0
1519 30A	30	50	1.2	1519-180C	180	200	5.5	1519-40F	40	400	2.0
1519-40A	40	50	1.5	1519-240C	240	200	6.0	1519-80F	80	400	5.0
1519-45A	45	50	1.5	1519-300C	300	200	7.0	1519-120F	120	400	6.0
1519 50A	50	50	1.5	1519-400C	400	200	8.0	1519-160F	160	400	7.0
1519-60A	60	50	1.5	1519-25D	25	250	2.0	1519-200F	200	400	8.0
1519 75A	75	50	1.8	1519-50D	50	250	2.5	1519-240F	240	400	12
1519 100A	100	50	2.0	1519 75D	75	250	3.5	1519 320F	320	400	13
1519-10B	10	100	1.0	1519-100D	100	250	4.5	1519 360F	360	400	15
1519-20B	20	100	1.5	1519-125D	125	250	5.0	1519-480F	480	400	18
1519 30B	30	100	1.5	1519-150D	150	250	5.5	1519-600F	600	400	20
1519 40B	40	100	1.8	1519-200D	200	250	6.3	1519-800F	800	400	23
1519 50B	50	100	2.0	1519-225D	225	250	7.0	1519-50G	50	500	3.0
1519 60B	60	100	2.0	1519-300D	300	250	8.0	1519-100G	100	500	6.0
1519-80B	80	100	2.2	1519-375D	375	250	8.4	1519-150G	150	500	8.0
1519-90B	90	100	2.4	1519-500D	500	250	12.5	1519-200G	200	500	11
1519 100B	100	100	2.8	1519-30E	30	300	2.0	1519-250G	250	500	13
1519 120B	120	100	2.8	1519-60E	60	300	2.0	1519-300G	300	500	16
1519 150B	150	100	3.0	1519-90E	90	300	3.0	1519-400G	400	500	18
1519 200B	200	100	4.0	1519-120E	120	300	5.0	1519-450G	450	500	20
1519-20C	20	200	2.0	1519-150E	150	300	6.0	1519-600G	600	500	22
1519-40C	40	200	2.0	1519-180E	180	300	7.0	1519-750G	750	500	24
1519-60C	60	200	2.5	1519-240E	240	300	7.5	1519-1000G	1000	500	30
1519-80C	80	200	3.0	1519-270E	270	300	8.0				
1519-100C	100	200	4.0	1519-360E	360	300	11.0				

TAPPED DELAY LINES

SERIES 8000

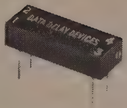


SPECIFICATIONS

Delay Accuracy: ± 2%
No. Taps: 10
Terminals: Printed-circuit type, spaced 0.2 inches
Impedance accuracy: ± 5%
Distortion: ± 5%
Temperature: – 55° C to 125° C
Temperature Coefficient: .1%/°C; .005%/°C on request
D.C. Working voltage: 200 vdc
Case: epoxy encapsulated

PART NO.	DELAY (μs)	RISE-TIME (μs)	IMP. (OHMS)	PART NO.	DELAY (μs)	RISE-TIME (μs)	IMP. (OHMS)
8000-02-100	.2	.04	100	8000-20-300	2.0	.4	300
8000-03-100	.3	.06	100	8000-25-300	2.5	.5	300
8000-05-100	.5	.1	100	8000-10-500	1.0	.2	500
8000-03-150	.3	.06	150	8000-20-500	2.0	.4	500
8000-05-150	.5	.1	150	8000-30-500	3.0	.6	500
8000-10-150	1.0	.2	150	8000-40-500	4.0	.8	500
8000-01-200	.1	.02	200	8000-10-1000	1.0	.2	1000
8000-05-200	.5	.1	200	8000-20-1000	2.0	.4	1000
8000-10-200	1.0	.2	200	8000-30-1000	3.0	.6	1000
8000-15-200	1.5	.3	200	8000-40-1000	4.0	.8	1000
8000-10-300	1.0	.2	300	8000-50-1000	5.0	1.0	1000
8000-15-300	1.5	.3	300	8000-60-1000	6.0	1.2	1000

TRIM-DIP DELAY LINES SERIES 1503



SPECIFICATIONS

- Continuously variable delay
- Multi-turn adjusting screw (40 turns approx.)
- Delay (see table)
- Impedance (see table)
- Rise-time (see table)
- Withstanding voltage – 50 Vdc
- Temperature Coefficient – 100 PPM/°C
- #20 gauge leads
- Resolution – .12NS approx.

STOCKED

PART NO	Td (NS)	Imp. (Ω)	Rdc (Ω)	Tr (NS)	PART NO.	Td (NS)	Imp. (Ω)	Rdc (Ω)	Tr (NS)	PART NO.	Td (NS)	Imp. (Ω)	Rdc (Ω)	Tr (NS)
1503-15A	15	50	.7	3	1503-30B	30	100	2.	6	1503-60C	60	200	8	12
1503-25A	25	50	.8	5	1503-50B	50	100	3.	10	1503-100C	100	200	14	20
1503-30A	30	50	1.	6	1503-60B	60	100	4.	12	1503-20D	20	250	5	4
1503 40A	40	50	1.5	8	1503-80B	80	100	5.	16	1503-20E	20	300	5	4
1503-50A	50	50	1.7	10	1503-100B	100	100	6	20	1503-30F	30	350	8	6
1503-60A	60	50	2.	12	1503-120B	120	100	8	24	1503-25G	25	400	8	5
1503-80A	80	50	3.	16	1503-160B	160	100	10	32	1503-40H	40	500	12	8
1503-100A	100	50	3.5	20	1503-200B	200	100	14	40					
1503-15B	15	100	1.	3	1503-30C	30	200	4	6					

TRIM-DIP DELAY LINES SERIES 1503J

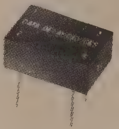
DATA DELAY DEVICES
OUT TAP

SPECIFICATIONS: Same as 1503, except adjusting screw has 60 turns approximately

STOCKED

PART NO.	Td (NS)	Imp. (Ω)	Tr (NS)	Rdc (Ω)	PART NO.	Td (NS)	Imp. (Ω)	Tr (NS)	Rdc (Ω)
1503J-150A	150	50	22	5	1503J-30E	30	300	5	7
1503J-250B	250	100	38	21	1503J-40F	40	350	6	10
1503J-130C	130	200	20	21	1503J-35G	35	400	6	10
1503J-30D	30	250	5	7	1503J-60H	60	500	9	18

MINI TRIM DELAY LINES SERIES 1509



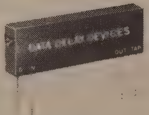
SPECIFICATIONS

- Low cost unit
- Fits standard DIP sockets
- Continuously variable
- 20 Turns approx.
- Resolution – .15 NS
- Withstanding voltage – 100 Vdc
- Temperature coefficient – 200 PPM/°C
- #22 gauge leads

PART NO.	Td (NS)	IMPEDANCE (Ω)	TR (NS)	Rdc (Ω)
1509-05B	5	100	3	.4
1509-20C	20	200	8	1.0
1509-30F	30	400	10	7.0
1509-40H	40	500	15	13.0

STOCKED

MINI TRIM DELAY LINES SERIES 1509J



SPECIFICATIONS: Same as 1509, except adjusting screw has 60 turns approx.

PART NO.	Td (NS)	Imp. (Ω)	Rdc (Ω)	Tr (NS)
1509J-10B	10	100	.8	4
1509J-40C	40	200	1.5	9
1509J-40E	40	300	6.0	9
1509J-75F	75	400	12	16
1509J-80H	80	500	20	16

STOCKED

COMPUTER DELAY LINES SERIES 1000

SPECIFICATIONS

TEMPERATURE RANGE: -55°C to +125°C. DISTORTION: 5% Max. DC WORKING VOLTAGE: 200 VDC. CASE EPOXY. SIZE L x .45 x .33 max.

PART NO	DELAY ±2%	RISE TIME	RES D C. OHMS	IMP OHMS 10%	LENGTH MAX. (IN)	PART NO.	DELAY ±2%	RISE TIME	RES. D.C. OHMS	IMP. OHMS 10%	LENGTH MAX. (IN)
1000 25A	25ns	20ns	3.5	500	2	1000-400A	400ns	50ns	75	900	3
1000-50A	50ns	22ns	6	500	2	1000-450A	450ns	56ns	87	900	3
1000 100A	100ns	24ns	14	500	2	1000 500A	500ns	60ns	92	900	3
1000-125A	125ns	25ns	13.5	500	2	1000-600A	600ns	66ns	110	900	5.25
1000-200A	200ns	35ns	36	900	2	1000-700A	700ns	74ns	130	900	5.25
1000-225A	225ns	37ns	42	900	2	1000 800A	800ns	85ns	148	900	5 25
1000 250A	250ns	40ns	48	900	2	1000-900A	900ns	98ns	165	900	5.25
1000 300A	300ns	45ns	55	900	2						

HIGH DENSITY DELAY LINES SERIES 100

SPECIFICATIONS

TIME DELAY: 0-35 μs DELAY ACCURACY: ± 3%. RISE TIME: 3% of time delay. IMPEDANCE: up to 4000 ohms. PHASE RESPONSE: 1% up to 3db. FREQUENCY RESPONSE: up to 10 MC. ATTENUATION: Less than 0.1 db/μs TEMPERATURE COEFFICIENT: 1000 PPM/°C.

$\frac{\text{DELAY}}{\text{RISE-TIME}} = 30/1$

PART NO.	DELAY (US)	IMPEDANCE (OHMS)	PART NO.	DELAY (US)	IMPEDANCE (OHMS)	PART NO.	DELAY (US)	IMPEDANCE (OHMS)
100A-525A	5.25	075	100A-700E	7.00	400	100A-700G	7 00	600
100A-350B	3.50	100	100A-1050E	10.50	400	100A-1400G	14.00	600
100A-700B	7.00	100	100A 1400E	14 00	400	100A-2100G	21 00	600
100A-350C	3.50	150	100A-2100E	21.00	400	100A 2800G	28.00	600
100A-700C	7.00	150	100A 2800E	28.00	400	100A 3500G	35.00	600
100A-1050C	10.50	150	100A 700F	7.00	500	100A-700H	7 00	1000
100A-350D	3.50	200	100A-1050F	10.50	500	100A 1050H	10 50	1000
100A-700D	7.00	200	100A 1400F	14.00	500	100A 1400H	14 00	1000
100A-1050D	10.50	200	100A-2100F	21.00	500	100A 2100H	21 00	1000
100A 1400D	14 00	200	100A-2800F	28.00	500	100A 2800H	28 00	1000
			100A 3500F	35.00	500			

$\frac{\text{DELAY}}{\text{RISE-TIME}} = 20/1$

PART NO	BELAY (US)	IMPEDANCE (OHMS)	PART NO.	DELAY (US)	IMPEDANCE (OHMS)	PART NO	DELAY (US)	IMPEDANCE (OHMS)
100B-300A	3.00	075	100B-400E	4.00	400	100B 2000F	20.00	500
100B-200B	2.00	100	100B-600E	6.00	400	100B-200G	2.00	600
100B-400B	4.00	100	100B-800E	8.00	400	100B-400G	4.00	600
100B-200C	2.00	150	100B-1200E	12.00	400	100B-800G	8.00	600
100B-400C	4.00	150	100B-1600E	16.00	400	100B-1200G	12.00	600
100B-600C	6.00	150	100B-200F	2.00	500	100B 1600G	16.00	600
100B-200D	2.00	200	100B-400F	4.00	500	100B-2000G	20.00	600
100B-400D	4.00	200	100B-600F	6.00	500	100B-600H	6.00	1000
100B-600D	6.00	200	100B-800F	8.00	500	100B-800H	8.00	1000
100B-800D	8.00	200	100B-1200F	12.00	500	100B 1200H	12.00	1000
100B-200E	2.00	400	100B-1600F	16.00	500	100B 1600H	16 00	1000

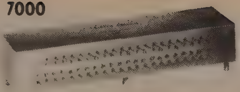
$\frac{\text{DELAY}}{\text{RISE-TIME}} = 10/1$

PART NO	DELAY (US)	IMPEDANCE (OHMS)	PART NO	DELAY (US)	IMPEDANCE (OHMS)	PART NO	DELAY (US)	IMPEDANCE (OHMS)
100C 150A	1 50	075	100C 100F	1.00	500	100C-400H	4.00	1000
100C 100B	1 00	100	100C-200F	2 00	500	100C-600H	6.00	1000
100C-200B	2 00	100	100C-300F	3.00	500	100C 800H	8.00	1000
100C 100C	1 00	150	100C-400F	4 00	500	100C-030J	0 30	1500
100C 200C	2 00	150	100C-600F	6.00	500	100C-060J	0.60	1500
100C 300C	3 00	150	100C 800F	8.00	500	100C-100J	1.00	1500
100C 050D	0.50	200	100C-1000F	10.00	500	100C-200J	2.00	1500
100C 100D	1 00	200	100C-050G	0.50	600	100C 300J	3.00	1500
100C 200D	2 00	200	100C 100G	1.00	600	100C-400J	4.00	1500
100C 300D	3.00	200	100C 200G	2.00	600	100C-040K	0.40	2000
100C 400D	4 00	200	100C-400G	4.00	600	100C-080K	0.80	2000
100C-050E	0.50	400	100C-600G	6.00	600	100C-100K	1.00	2000
100C 100E	1 00	400	100C-800G	8.00	600	100C-200K	2.00	2000
100C-200E	2.00	400	100C-1000G	10.00	600	100C-300K	3.00	2000
100C-300E	3 00	400	100C-020H	0.20	1000	100C 200M	2.00	3000
100C-400E	4 00	400	100C-040H	0.40	1000	100C-200R	2 00	4000
100C 600E	6.00	400	100C-080H	0.80	1000			
100C-800E	8 00	400	100C-100H	1.00	1000			
100C-020F	0 20	500	100C 200H	2.00	1000			
100C 050F	0.50	500	100C-300H	3.00	1000			

$\frac{\text{DELAY}}{\text{RISE TIME}} = 7/1$

PART NO.	DELAY (US)	IMPEDANCE (OHMS)	PART NO.	DELAY (US)	IMPEDANCE (OHMS)	PART NO.	DELAY (US)	IMPEDANCE (OHMS)
100D-075A	0.75	075	100D-050F	0.50	500	100D-200H	2.00	1000
100D 050B	0.50	100	100D 100F	1.00	500	100D 300H	3.00	1000
100D-100B	1.00	100	100D-150F	1 50	500	100D 400H	4.00	1000
100D-050C	0.50	150	100D-200F	2.00	500	100D-015J	0.15	1500
100D-100C	1.00	150	100D-300F	3.00	500	100D-030J	0.30	1500
100D-150C	1.50	150	100D-400F	4.00	500	100D-050J	0.50	1500
100D-025D	0.25	200	100D-500F	5.00	500	100D-100J	1.00	1500
100D 050D	0.50	200	100D-025G	0.25	600	100D-150J	1.50	1500
100D 100D	1.00	200	100D-050G	0.50	600	100D-200J	2.00	1500
100D-150D	1.50	200	100D-100G	1.00	600	100D-020K	0.20	2000
100D-200D	2.00	200	100D-200G	2.00	600	100D-040K	0.40	2000
100D 025E	0.25	400	100D-300G	3.00	600	100D-050K	0.50	2000
100D-050E	0.50	400	100D-400G	4.00	600	100D-100K	1.00	2000
100D-100E	1.00	400	100D 500G	5.00	600	100D-150K	1.50	2000
100D-150E	1 50	400	100D-010H	0.10	1000	100D-100M	1.00	3000
100D-200E	2 00	400	100D-020H	0.20	1000	100D-100P	1.00	4000
100D-300E	3.00	400	100D-040H	0.40	1000			
100D-400E	4.00	400	100D 050H	0.50	1000			
100D-010F	0.10	500	100D-100H	1.00	1000			
100D-025F	0.25	500	100D 150H	1.50	1000			

AUDIO DELAY LINES SERIES 7000

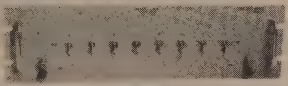


SPECIFICATIONS

TOTAL DELAY: See table. TAP DELAY: Normal IN and OUT (100 taps can be accommodated). DELAY ACCURACY: ± 3% (± ½% on request). IMPEDANCE: 200 to 10,000 ohms. ± 5%. ATTENUATION: 6 db or better. PHASE RESPONSE: ± 1% over bandwidth. TEMPERATURE RANGE: -55°C to +125°C. TEMPERATURE COEF.: ± 50 PPM/°C (± 15 PPM/°C on request). WORKING VOLT.: 200 WVDC (400 WVDC on request). CASE: Vertically sealed metal. SIZE: 5.75 x 3 x 2 (14.6 x 7.67 x 5.10 cm). MOUNTING: 4 - 10 - 32 x .25 studs, spaced 3.5 x 2. TERMINALS: Glass-to-metal or press-fit.

PART NO	DELAY (μs)	RISE TIME (μs)	BW (KHZ)	IMPEDANCE (Ω)	PART NO.	DELAY (μs)	RISE-TIME (μs)	BW (KHZ)	IMPEDANCE (Ω)
7000 100A	100	4	0 80	500	7000 800B	800	32	0-10	1000
7000 100B	100	4	0-80	1000	7000 1000A	1000	40	0-8	500
7000 200A	200	8	0-40	500	7000 1000B	1000	40	0-8	1000
7000 200B	200	8	0 40	1000	7000 2000A	2000	80	0-4	500
7000 400A	400	16	0 20	500	7000 2000B	2000	80	0-4	1000
7000 400B	400	16	0-20	1000	7000 4000A	4000	160	0-2	500
7000 800A	800	32	0 10	500	7000 4000B	4000	160	0-2	1000

STEP VARIABLE DELAY LINES SERIES 510,511,1510,1511



DESCRIPTION

L-C networks in tandem, with precise delay increments and low attenuation. Use as delay syntesizers for evaluation of Worst-Case design analysis; as time delay standards and Phase measuring devices. Meets Military specifications. Type 510 and 511 use a single 10 positions switch.

SPECIFICATIONS

ACCURACY: ± 2% of setting. ATTENUATION and *TIME DELAY see table. *RISE TIME: 2% of time delay or less. TEMPERATURE COEFFICIENT: ± 50 PPM/°C. DISTORTION: Less than 3% for pulse signals on most types. Essentially no harmonic distortion for sine wave signals. SIZE: 8 x 3.5 x 4.5 (20.32 x 8.89 x 11.43 cm) Max. for type 510 and 511. 16.75 x 5.25 x 5.5 (41.54 x 13.33 x 13.97 cm) Max. for type 1510 and 1511 (Rack-Mount Panel available on request).

*other can be provided on request.

RISE TIME = 2% IMPEDANCE = 600 ⌒				RISE TIME = 2% IMPEDANCE = 1000 ⌒			
PART NO	Total Delay (us)	Delay Step (us)	Attn db	PART NO.	Total Delay (us)	Delay Step (us)	Attn db
510-A	10 0	1 0	1	511-A	10.0	1.0	.6
510-B	25 0	2.5	1.5	511-B	25.0	2.5	1.0
510-C	50 0	5 0	2.0	511-C	50.0	5.0	1.5
510-D	100.00	10 0	3.5	511-D	100.0	10.0	2.5
510-E	500.00	50.0	4 0	511-E	500.0	50.0	3.0
510-F	1,000.00	100.00	4.5	511-F	1,000.00	100.0	4.0
1510-A	11 0	1	1	1511-A	11.0	.1	.6
1510-B	110.0	1	3.5	1511-B	110.0	1	2.5
1510-C	1,100 0	10	4	1511-C	1,100.0	10	4.0
				1511-D	11,000	100	6.0

CONTINUOUSLY VARIABLE DELAY LINES SERIES 500

SPECIFICATIONS

DELAY VARIATION: 0 to 10 shaft rev. ACCURACY: ± 3% or better. BANDWIDTH: f(3db)=.35/TR. IMPEDANCE TOLERANCE: ± 10% or better. OPERATING TEMPERATURE: -60°C to +125°C. TEMPERATURE COEFFICIENT: 50 PPM/°C for type 500. 170 PPM/°C for type 501. CASE: plastic. DIMENSION: 6.5 x 1.56 x 1.12 (16.5 x 3.96 x 2.85 cm). SHAFT: .25 dia. (.635 cm). MOUNTING: 2 - 6 - 32 centered on 1.56 side, spaced 6.25.

PART NO.	IMP. (Ω)	DELAY (μs)	TR (μs)	ATT. (db)	RES. (ns)	PART NO.	IMP. (Ω)	DELAY (μs)	TR (μs)	ATT. (db)	RES. (ns)
500-A	75	1.25	.12	1.5	2.5	500-F	250	0.50	.05	.5	1.0
500-A1	75	1.50	.15	1.5	3.0	500-F1	250	1.00	.10	2	1.2
500-B	100	1.00	.10	1.0	2.0	500-G	300	0.60	.06	1.2	.6
500-B1	100	1.50	.15	1.5	3.0	500-G1	300	1.25	.12	3	1.0
500-B2	100	2.00	.20	4	2	500-J	450	0.90	.09	2	.7
500-C	120	0.90	.09	1.0	2	501-A	220	0.15	.025	.25	.4
500-C1	120	1.75	.17	3	1.8	501-B	370	0.25	.040	.50	.5
500-D	150	0.62	.060	.9	1.3	501-C	400	0.35	045	.50	.45
500-D1	150	1.50	.15	1.5	3	501-D	440	0.60	.060	.5	.6
500-D2	150	2.50	.25	9	2.0	501-E	540	0.70	.080	.6	.7
500-D3	150	2.75	.27	9	2.2	501-F	630	1.10	.10	1	.7
500-E	200	2.00	.20	6	1.6						

CONTINUOUSLY VARIABLE DELAY LINES

SERIES 600

PART NO.	Ro (ohms)	Td (US)*	Tr (US)	RES (NS)	ATT (db)
601-1	50	3.50	.25	1.8	1.5
601-2	55	1.67	.15	2.0	.8
601 3	66	4.00	40	3.2	1.5
601 4	75	2.44	.18	1.8	1.2
601 5	75	4.30	.40	3.0	1.7
601 6	82	1.20	.10	1.5	.5
601 7	95	2.82	.26	2.2	1.4
601 8	100	1 74	12	1.8	1.0
601 9	110	83	.08	1.1	5
601 10	110	3.00	.30	2.1	1.6
601 11	133	2.0	.15	1.6	1.0
601 12	150	.60	.06	.8	.5
601 13	150	1.21	.09	1.8	.7
601 14	160	2.1	.19	1.5	1.2
601-15	186	1.41	.14	1.1	1.2
601-16	200	.87	.06	1.8	.5
601-17	220	1.52	.13	1.3	1.1
601 18	260	1.01	10	1.0	1.1
601-19	305	1.09	.1	.8	1.0

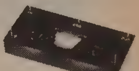
FEATURES

- Continuqusly variable
- High resolution, 0.15 Ns
- Long delay, 4.3 US
- One turn delay adjustment
- Low attenuation
- High fidelity of pulse reproduction

PART NO.	Ro (ohms)	Td (US)	Tr (US)	RES (NS)	ATT (db)
602 1	436	.25	.025	.2	.15
602-2	460	.31	.030	.28	.15
602-3	520	.49	038	.33	.3
602 4	636	.59	.057	40	.5
602 5	720	.74	.072	.55	1.0

ELECTRICALLY VARIABLE DELAY LINES

SERIES 300



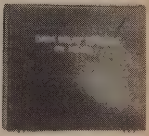
SPECIFICATIONS

DELAY VARIATION: 30% or more of total delay. DELAY TRACKING: ± 4%, ± 1% if control signal is sawtooth. DELAY/VOLTAGE LINEARITY: Normally non-linear. FREQUENCY RESPONSE: 5 MHz. Max. DELAY/RISE TIME RATIO: 10/1 (other to specification). MAXIMUM CURRENT: 50 MA. IMPEDANCE VARIATION: Less than 4%. VOLTAGE SWING: 0-20V max. ATTENUATION: Less than 2db over the voltage swing. SIZE 5 x 1.25 x 1.25 (12.7 x 3.17 x 3.17 cm) max. CASE TYPE: Epoxy. TERMINALS: #18 gauge pins, .25 long.

PART NO.	DELAY CHANGE (μs)	MAX DELAY (μs)	MIN DELAY (μs)	VOLTAGE RANGE	IMPEDANCE (Ω)	MAX RISE TIME (μs)
300-A	10	33	23	20	150	4 1
300-B	4.8	21	16 2	20	220	2 8
300-C	3.2	15	11 8	20	300	2.0
300-D	2.0	10	8	20	250	1 3
300-E	1 6	7	5 4	20	150	.91
300-F	1.0	4.5	3.5	20	85	.67

MAGNETOSTRICTIVE DELAY LINES

SERIES MS



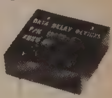
FEATURES

- Less than 1¢ per BIT
- T.C. less than 1 PPM/°C
- TTL compatible
- .1MW per BIT
- RZ, NRZ, BIPOLAR RECORDING
- Electronic circuitry to suit your application

PART NO	STORAGE (BITS)	DELAY (us)	SIZE (INCHES)	SIZE (M.M.)
MS 101	4,300	3,450	7.70 x 7.00 x .75	195.58 x 177.80 x 19.06
MS 102	6,250	5,000	9.00 x 8.00 x .75	228.60 x 203.20 x 19.06
MS-103	11,000	8,340	10.00 x 9.10 x 1.00	254.00 x 231.14 x 25.40
MS-104	12,500	10,000	14.50 x 10.50 x .83	368.30 x 266.70 x 21.08
MS-105	22,000	8,340	14.50 x 10.50 x 1.00	368.30 x 266.70 x 25.40
MS-106	22,000	16,700	14.50 x 10.50 x 1.00	368.30 x 266.70 x 25.40

The above P/N's are only a partial list of delay line available. Custom designs can be supplied with or without electronics. Our engineering department is at your service.

LOW FREQUENCY OSCILLATORS SERIES LFO 10



SPECIFICATIONS

OPEN-CIRCUIT VOLTAGE: 1.5 VRMS. FREQUENCY ACCURACY ± 0.1% or ± 1HZ (whichever is greater). POWER. +12 VDC, 0.5 MA. DISTORTION: Less than 1%. OUTPUT LOADING: 1 Meg-Ohm Min. (if less specify). TEMPERATURE COEFF.. 0.016%/°C (others on request). TEMPERATURE RANGE: -25°C to +85°C. ENCAPSULATION: Epoxy resin. TERMINALS: (4) No. 18 gauge pins, 1.10 x 1.10 spacing. SIZE: 1.5 x 1.5 x .5 (3.81 x 3.81 x 1.27 cm).

PART NO	FREQ (HZ)	PART NO	FREQ (HZ)	PART NO	FREQ (HZ)
LF010-A	1,000	LF010-H	7,000	LF010-P	14,000
LF010-B	1,600	LF010-J	8,000	LF010-Q	15,000
LF010-C	2,000	LF010-K	9,000	LF010-R	16,000
LF010-D	3,000	LF010-L	10,000	LF010-S	17,000
LF010-E	4,000	LF010-M	11,000	LF010-T	18,000
LF010-F	5,000	LF010-N	12,000	LF010-U	19,000
LF010-G	6,000	LF010-O	13.00	LF010 V	20,000

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

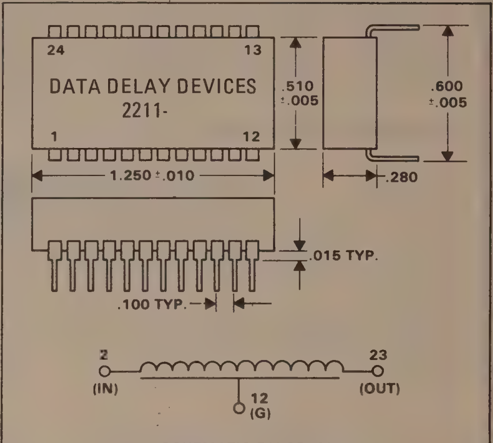
DATA DELAY DEVICES

[illegible] AVE., CLIFTON, N.J. 07011 Tel. [illegible]

DUAL-IN-LINE DELAY LINES
TD/TR=10/1

SERIES:
2211

DATA DELAY DEVICES



SCHEMATIC DIAGRAM

SPECIFICATIONS

- Standard 24 pins DIP.
- TTL and DTL compatible.
- Td/Tr = 10/1
- Delay tolerance: +5% or 1NS whichever
- is greater.
- Temperature coefficient: 100PPM/°C.
- Temperature range: −55°C to +125°C.
- Dielectric breakdown: 50 Vdc.
- Meets or exceeds MIL-D-23859.
- Epoxy encapsulated.

PART NO.	IMP. (Ω)	TOTAL DELAY (NS)	RISE-TIME (NS)	Rdc (Ω)	PART NO.	IMP. (Ω)	TOTAL DELAY (NS)	RISE-TIME (NS)	Rdc (Ω)	PART NO.	IMP. (Ω)	TOTAL DELAY (NS)	RISE-TIME (NS)	Rdc (Ω)
2211-50A	50	50	5	2.0	2211-120C	200	120	12	5.0	2211-600D	250	600	60	16.0
2211-60A	50	60	6	2.4	2211-200C	200	200	20	8.0	2211-750D	250	750	75	18.0
2211-80A	50	80	8	3.0	2211-300C	200	300	30	10.0	2211-200G	500	200	20	12.0
2211-100A	50	100	10	3.2	2211-400C	200	400	40	12.0	2211-300G	500	300	30	16.0
2211-150A	50	150	15	3.6	2211-500C	200	500	50	13.0	2211-400G	500	400	40	22.0
2211-50B	100	50	5	3.0	2211-600C	200	600	60	14.0	2211-500G	500	500	50	26.0
2211-60B	100	60	6	3.0	2211-50D	250	50	5	4.0	2211-600G	500	600	60	32.0
2211-80B	100	80	8	3.6	2211-100D	250	100	10	5.0	2211-800G	500	800	80	36.0
2211-100B	100	100	10	4.0	2211-150D	250	150	15	7.0	2211-1000G	500	1000	100	40.0
2211-150B	100	150	15	4.2	2211-200D	250	200	20	9.0	2211-1200G	500	1200	120	44.0
2211-200B	100	200	20	4.6	2211-250D	250	250	25	10.0	2211-1500G	500	1500	150	48.0
2211-300B	100	300	30	6.0	2211-300D	250	300	30	11.0					
2211-40C	200	40	4	4.0	2211-400D	250	400	40	13.0					
2211-80C	200	80	8	4.0	2211-500D	250	500	50	14.0					

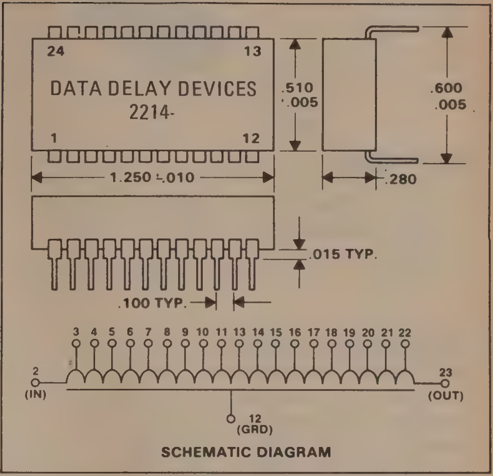
DATA DELAY DEVICES

253 CROOKS AVE., CLIFTON, N.J. 07011 Tel. (201) 772 1106

DUAL-IN-LINE DELAY LINE 20 TAPS

SERIES: 2214

DATA DELAY DEVICES



SCHEMATIC DIAGRAM

SPECIFICATIONS

- 20 Equally spaced taps.
- TTL and DTL compatible
- Td / Tr = 10 / 1
- Delay tolerance: ±5% or INS whichever is greater.
- Tap tolerance: ±5% or INS whichever is greater.
- Temperature coefficient: 100 PPM / °C.
- Temperature range: −55°C to +125°C.
- Dielectric breakdown: 50 Vdc.
- Meets or exceeds MIL-D-23859.
- Epoxy encapsulated.

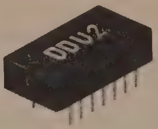
PART NO.	IMP. (Ω)	TOTAL DELAY (NS)	TAP INCREMENT (NS)	RISE TIME (NS)	Rdc (Ω)	PART NO.	IMP. (Ω)	TOTAL DELAY (NS)	TAP INCREMENT (NS)	RISE-TIME (NS)	Rdc (Ω)
2214-50A	50	50	2.5	5	2.0	2214-800C	200	800	40	80	16.0
2214-60A	50	60	3.0	6	2.4	2214-50D	250	50	2.5	5	4.0
2214-80A	50	80	4.0	8	3.0	2214-100D	250	100	5	10	5.0
2214-100A	50	100	5.0	10	3.2	2214-150D	250	150	7.5	15	7.0
2214-150A	50	150	7.5	15	3.6	2214-200D	250	200	10	20	9.0
2214-200A	50	200	10.0	20	4.0	2214-250D	250	250	12.5	25	10.0
2214-50B	100	50	2.5	5	3.0	2214-300D	250	300	15	30	11.0
2214-60B	100	60	3.0	6	3.0	2214-400D	250	400	20	40	13.0
2214-80B	100	80	4.0	8	3.6	2214-500D	250	500	25	50	14.0
2214-100B	100	100	5	10	4.0	2214-600D	250	600	30	60	16.0
2214-150B	100	150	7.5	15	4.2	2214-800D	250	800	40	80	18.0
2214-200B	100	200	10	20	4.6	2214-1000D	250	1000	50	100	25.0
2214-300B	100	300	15	30	6.0	2214-200G	500	200	10	20	12.0
2214-400B	100	400	20	40	8.0	2214-300G	500	300	15	30	16.0
2214-40C	200	40	2	4	4.0	2214-400G	500	400	20	40	22.0
2214-80C	200	80	4	8	4.0	2214-500G	500	500	25	50	26.0
2214-120C	200	120	6	12	5.0	2214-600G	500	600	30	60	32.0
2214-200C	200	200	10	20	8.0	2214-800G	500	800	40	80	36.0
2214-300C	200	300	15	30	10.0	2214-1000G	500	1000	50	100	40.0
2214-400C	200	400	20	40	12.0	2214-1200G	500	1200	60	120	44.0
2214-500C	200	500	25	50	13.0	2214-1500G	500	1500	75	150	48.0
2214-600C	200	600	30	60	14.0						

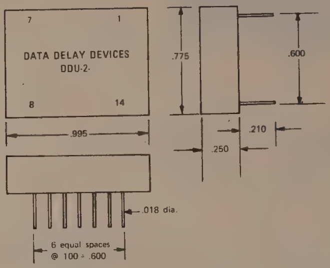
DATA DELAY DEVICES

253 CROOKS AVE., CLIFTON, N.J. 07011 Tel. (201) 772-1106

DIGITAL DELAY UNIT
LOW PROFILE

SERIES:
DDU-2



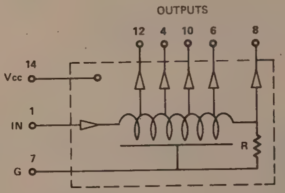


FEATURES

- Completely interfaced for TTL and DTL application.
- No external components required.
- P. C. board space economy achieved.
- Low profile.

SPECIFICATIONS

- **Delay tolerance:** ±5% or better.
- **Rise-Time:** 4 NS typically.
- **Temperature coefficient:** 100 PPM/°C.
- **Temperature range:** −55°C to +125°C.
- **Supply voltage:** 4.5 to 5.5 Vdc.
- **Logic 1 input current:** 50 ua max.
- **Logic 0 input current:** −2 ma max.
- **Logic 1 V out:** 2.5 V min.
- **Logic 0 V out:** 0.5 V max.
- **Logic 1 Fan-out:** 20/tap max.
- **Logic 0 Fan-out:** 10/tap max.



SCHEMATIC DIAGRAM FOR 5 DELAYS OUTPUT

SINGLE DELAY OUTPUT (NS)	
PART NO.	DELAY@ PIN # 8
DDU-2-1010	10
DDU-2-1020	20
DDU-2-1030	30
DDU-2-1040	40
DDU-2-1050	50
DDU-2-1060	60
DDU-2-1080	80
DDU-2-1100	100

2 DELAYS OUTPUT (NS)		
PART NO.	DELAY@ PIN # 10	DELAY@ PIN # 8
DDU-2-2020	10	20
DDU-2-2040	20	40
DDU-2-2050	25	50
DDU-2-2060	30	60
DDU-2-2080	40	80
DDU-2-2100	50	100
DDU-2-2150	75	150
DDU-2-2200	100	200

5 DELAYS OUTPUT (NS)					
PART NO.	DELAY@ PIN # 12	DELAY@ PIN # 4	DELAY@ PIN # 10	DELAY@ PIN # 6	DELAY@ PIN # 8
DDU-2-5050	10	20	30	40	50
DDU-2-5100	20	40	60	80	100
DDU-2-5150	30	60	90	120	150
DDU-2-5200	40	80	120	160	200
DDU-2-5250	50	100	150	200	250
DDU-2-5300	60	120	180	240	300
DDU-2-5400	80	160	240	320	400
DDU-2-5500	100	200	300	400	500

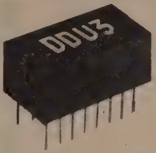
DATA DELAY DEVICES
253 CROOKS AVE., CLIFTON, N.J. 07011 Tel. (201) 772-1106

DIGITAL DELAY UNIT

STANDARD 16 PINS DIP

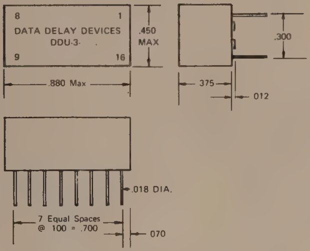
SERIES:

DDU-3



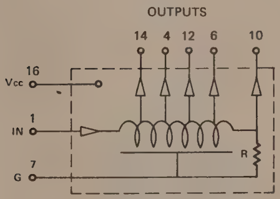
FEATURES

- Completely interfaced for TTL and DTL applications.
- No external components required.
- Fits standard 16 pins DIP sockets.
- P. C. board space economy achieved.



SPECIFICATIONS

- **Delay tolerance:** ±5% or better.
- **Rise-time:** 4 NS typically.
- **Temperature coefficient:** 100 PPM/°C.
- **Temperature range:** −55°C to +125°C.
- **Supply voltage:** 4.5 to 5.5 Vdc.
- **Logic 1 input current:** 50 ua max.
- **Logic 0 input current:** −2 ma. max.
- **Logic 1 V out:** 2.5 V min.
- **Logic 0 V out:** 0.5 V max.
- **Logic 1 Fan-out:** 20/tap max.
- **Logic 0 Fan-out:** 10/tap max.



SCHEMATIC DIAGRAM FOR 5 DELAYS OUTPUT

SINGLE DELAY OUTPUT (NS)	
PART NO.	DELAY @ PIN # 10
DDU-3-1010	10
DDU-3-1020	20
DDU-3-1030	30
DDU-3-1040	40
DDU-3-1050	50
DDU-3-1060	60
DDU-3-1080	80
DDU-3-1100	100
DDU-3-1150	150
DDU-3-1200	200
DDU-3-1300	300
DDU-3-1400	400
DDU-3-1500	500

2 DELAYS OUTPUT (NS)		
PART NO.	DELAY @ PIN # 12	DELAY @ PIN # 10
DDU-3-2020	10	20
DDU-3-2040	20	40
DDU-3-2050	25	50
DDU-3-2060	30	60
DDU-3-2080	40	80
DDU-3-2100	50	100
DDU-3-2150	75	150
DDU-3-2200	100	200
DDU-3-2300	150	300
DDU-3-2400	200	400
DDU-3-2500	250	500

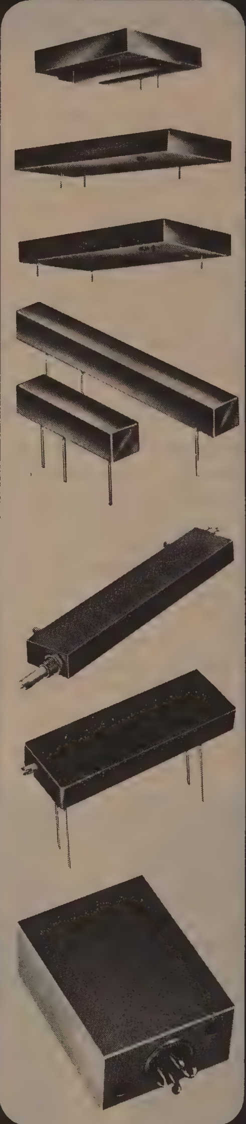
5 DELAYS OUTPUT (NS)					
PART NO.	DELAY @ PIN # 14	DELAY @ PIN # 4	DELAY @ PIN # 12	DELAY @ PIN # 6	DELAY @ PIN # 10
DDU-3-5050	10	20	30	40	50
DDU-3-5100	20	40	60	80	100
DDU-3-5150	30	60	90	120	150
DDU-3-5200	40	80	120	160	200
DDU-3-5250	50	100	150	200	250
DDU-3-5300	60	120	180	240	300
DDU-3-5400	80	160	240	320	400
DDU-3-5500	100	200	300	400	500

DATA DELAY DEVICES

253 CROOKS AVE., CLIFTON, N.J. 07011
Tel (201) 772-1106

ESC The World's Leading Producer of Electromagnetic DELAY LINES

DUAL-IN-LINE DELAY LINES	EC Series: From delay (T) of 5 ns and rise time (tr) of 2.5 ns to T = 25 ns and tr = 10 ns, Impedance (Z) = 200, 300, 400 or 500 Ω Size: .66 x .250 x .250 EP Series: From T = 20 ns to 50 ns, tr = 5 ns to 12.5 ns, Z = 200, 300, 400 or 500 Ω Size: .46 x .76 x .25 EL Series: From T = 50 ns to 100 ns, tr = 8.5 ns to 17 ns, Z = 200, 300, 400 or 500 Ω Size: .46 x 1.40 x .25 *Request Bulletin — ECPL* D Series: (Low temp. coeff. of Delay Types) From 20 ns to 100 ns, T/tr = 3.3, Z = 100 Ω or 200 Ω Size: .46 x .76 x .25 E Series: (Low temp coeff. of Delay) From 50 ns to 500 ns, T/tr = 6, Z =100 Ω or 200 Ω Size: .46 x 1.4 x .25 F Series: (Low temp. coeff. of Delay) From 100 ns to 1000 ns, T/tr = 10,Z = 100 Ω or 200 Ω Size: 1.0 x 1.5 x .25 *Request Bulletin — DEF*
DISTRIBUTED CONSTANT DELAY LINES	Delays from 20 ns to 1100 ns, tr from less than 20 ns to 120 ns depending upon delay. Impedance from 100 to 1800 Ω. *Request Bulletin — DC*
SUB-MINIATURE NANOSEC DELAY LINES	SM Series: T = 10 ns to 50 ns at Z = 100 and 200 Ω; T = 100 ns to 300 ns at Z = 500 Ω T/tr = 3.5 average; Size = 1 x .32 x 32; T = 50 ns to 120 ns at Z=100 and 200 Ω and T = 400 ns to 1200 ns at Z = 500 T/tr = 5 to 10; Size 2 x .32 x .32 *Request Bulletin-SM*
TAPPED DELAY LINES	Delays of 100 ns to 1000 ns; tapped in 10 or 20 equal increments tr = 10 ns for T = 100 ns to 55 ns for T = 1000 ns, Z from 50 Ω to 200 Ω; Size 1 x 3 x .35 for 100 and 200 ns delay; 1.25 x 5 x .35 for longer delays. *Request Bulletin-T*
PROGRAMMABLE DELAY LINES	Adjustable constant Impedance lines with increments arranged in binary order; resolution is the smallest increment. Total delay from 125 ns to 1000 ns with resolution of 5 to 40 ns; tr = 10 ns to 80 ns; Z = 100, 200 or 500 Ω Size: .875 x 3.0 x .45 *Request Bulletin — PR*
STANDARD MIL TYPE LUMPED CONSTANT DELAY LINES	Chassis mounting, steel enclosures, delays range from 1.0 µsec to 50 µsec, Impedance 50 Ω to 2000 Ω; T/tr from 10 to 50. Specs per MIL-D-23859 Slash sheets. *Request Bulletin — MIL*
CONTINUOUSLY VARIABLE DELAY LINES	400 Series: T = 100 ns to 700 ns; tr = 30 to 95 ns; Z = 100 to 1500 Ω Metal encased, Size: 6 17/32 x .66 x 1 1/4 500 Series: T = 1.0 to 12.0 µsec; tr = .15 to 1.9 µsec; Z = 75 to 1000 Ω Metal encased, Size: 7 1/4 x 1 x 1 5/8 *Request Bulletin-400/500* 700 Series: T = .125 to 1.5 µsec, tr = .03 to .1 µsec, Z = 75 Ω to 1800 Ω Metal encased, Size: 4.5 x .5 x 1.51 800 Series: T = 10 to 280 ns; T/tr = 4 for size 2.25 x .75 x .35 and T/tr = 7 for 4 x .75 x .35, P.C.B. mounting, Epoxy enclosure. ("Trimline" TM) 900 Series: Size: .76 x .46 x .25 for T = 5, 10 and 20 ns with T/tr = 2 to 2.5 for T = 30, 40 and 50 ns with T/tr = 3.3 Size is 1.5 x .46 x .25 Z is 200 and 300 Ω Epoxy enclosure for P.C.B. mounting. ("Mini-Trimline" TM) *Request Bulletin — 700/800/900*
HIGH DENSITY PC MOUNTING DELAY LINES	For delays of .5 µsec to 10.0 µsec with T/tr from 18 to 29 Size is 2 x 2 x .4. For delays of 15 µsec to 30 µsec with T/tr = 40 Size is 2.75 x 4.2 x .65.Z varies from 50 Ω at shorter delays to 500 Ω for longer delays. *Request Bulletin — PC*
EXTENDED DELAY/RISE TIME DELAY LINES	Delay/Rise time from 100 to 250; T = 10 µsec to 100 µsec; Z from 75 Ω to 250 Ω. Volume is 91 to 294 cu. in. depending upon T/tr. *Request Bulletin-HP*
MILLSECOND DELAY LINES	Delays from .1 msec to 5 msec; T/tr = 25, 33 and 50; Z = 500, 1000 and 2000 Ω; Volume is from 40 to 162 cu. in., hermetically sealed metal cased construction. *Request Bulletin — MS*



The lines described above represent only a small segment of our total design capability. ESC also designs and manufactures, typically . .

VIDEO	Fixed programmable and mechanically-variable delay lines for the TV broadcast industry, including video cable simulators and voltage variable delay lines.	**SONAR**	Delay lines used in beam forming systems. These units are manufactured to precision tolerances and are supplied in matched sets or groups.
HI-REL	Proven design, manufacturing capabilities, and facilities encompassing all quality levels dictated by MIL-I-45208 and MIL-Q-9858A.	**ATC**	Precision tapped delay lines for Air Traffic Control systems of all types, IFF, Beacon Systems, Tacan, Vortac, etc.

ESC ELECTRONICS CORPORATION
534 BERGEN BOULEVARD ● PALISADES PARK, N.J. 07650
PHONE (201) 947-0400 ● TWX 710-991-9780

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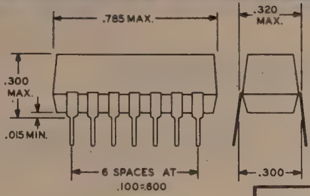
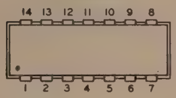
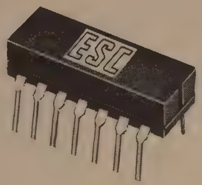
The World's Leading Producer of Electromagnetic DELAY LINES

ESC

DIP DELAY LINES







Request Bulletin-DIP

SPECIFICATIONS:

- Operating Temperature.......... -55°C to + 125°C
- Temperature Coefficient......... 50 ppm/°C max
- Attenuation.................... 1 db max
- Distortion...................... 10% max
- Dielectric Strength............. 50 VDC

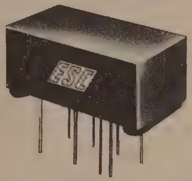
IMPEDANCE ± 10% →				50	75	93	100	200
Time Delay (nsec)± 5%	Rise Time (nsec)	No. of Taps	Delay per Tap (nsec) non-cumulative	MODEL NO.				
10 ± 1 ns	1.7	10	1.0 ± .5		7P10	9P10	1P10	
20	3.3	10	2.0 ± .5	5P20	7P20	9P20	1P20	2P20
30	5.0	10	3.0 ± 1	5P30	7P30	9P30	1P30	2P30
40	6.5	10	4.0 ± 1	5P40	7P40	9P40	1P40	2P40
50	8.0	10	5.0 ± 1	5P50	7P50	9P50	1P50	2P50
100	16	10	10 ± 1.5	5P100	7P100	9P100	1P100	2P100
150	25	10	15 ± 1.5				1P150	
200	35	10	20 ± 2				1P200	

IMPEDANCE ± 10% →				300	400	500
Time Delay ± 5%	Rise Time (nsec)Max	No. of Taps	Delay per Tap ± 5%	MODEL NO.		
300	75	5	60	3P300	4P300	5P300
400	100	5	80	3P400	4P400	5P400
500	125	5	100	3P500	4P500	5P500
600	150	5	120	3P600	4P600	5P600
800	200	5	160	3P800	4P800	5P800
1000	250	5	200	3P1000	4P1000	

DIGITAL DELAY LINES

Compatible with 14 Pin DIP Size: .46" W x .46" H x 1.0" L

MODEL	Time Delay (nsec) ①	Delay per Tap (nsec) ①	No. of Taps	Rise Time (max) ①
9H50	50	10	5	2
9H100	100	20	5	2
9H250	250	50	5	3



Request Bulletin-DDL

CUSTOM DELAY LINES

MODEL	DESCRIPTION
54-67	**29 μs High Density Package** for DME applications provides a maximum rise time of 2 μs at a 400 ohm impedance. Attenuation is 2 db and size is 3 x 1½ x ¼.
81-64	**1213 μs Dual Polarity Balanced Delay Line.** Delay accuracy is ±1% and the nominal impedance is 1100 ohms. It features a low attenuation of 1 db max and the maximum operating frequency is DC to 6 Khz.
62-45	**Sonar Precision Tapped Delay Line of 566 μs** used for beam forming. Tolerance on delays is ±0.5% and operating frequency range is 700 to 2500 Hz. The attenuation of 35 db is controlled to within ±0.2 db.
81-59	**5000 μs Delay Line** with rise time of 70 μs in only 125 cu. inches. Impedance is 1000 ohms; attenuation 12 db max.
55-27	**High Delay-Bandwidth product** of 95 for a delay of 31.52 μs is feature of this item. Impedance is 75 ohms and attenuation is 20 db. Delay linearity from DC to 0.5 Mhz is ± 40 ns, .5 Mhz to 1 Mhz is ± 60 ns and from 1 Mhz to 3 Mhz is ± 100 ns. Size 8 x 5 x 16.

MODEL	DESCRIPTION
75-06	**Miniature Mechanically Variable Delay Line** features highest performance. The maximum time delay is 50 ns and a maximum rise time is 5 ns. The impedance is 50 ohms and package dimensions are 2.5 x .7 x .35.
75-45	**Electrically Variable Delay Line** has a nominal delay of 3.1 μs and is electrically variable from 2.55 to 3.6 μs. The bandwidth is suitable for processing television video signals up to 7 Mhz. Peak to peak ripple is less than .2 db and the average goup delay is 25 ns maximum.
62-40 62-41	**Non-Linear Precision Matched** multiple section delay lines with delay varying parabolically with frequency and delay-matched between sections and any combination of sections to within .25%. Delays cover ranges of 100 to 400 μs.
14A89	**Programmable Line** consisting of 4 sections of 750, 80, 40 and 20 ns, delay linearity up to 6 Mhz is ± 8 ns and from 6 Mhz to 8 Mhz is ±16 ns. Impedance is 150 ohms and size is 8 x 2½ x ½.

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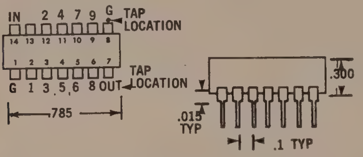
AMF

RCL Electronics

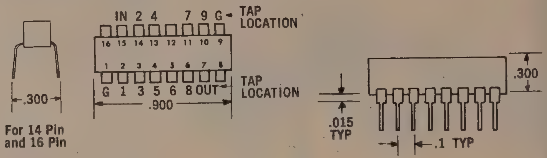
DUAL IN-LINE PACKAGES

- Compatible with TTL circuits
- Total Delay Tolerance = ±5% or 1 nsec, whichever is greater
- Impedance Tolerance = ±10%
- Temperature Coefficient of Delay 70 ppm/°C ±30 ppm/°C
- Tap Interval Tolerance = ±10% or 1 nsec, whichever is greater
- Operating Temperature Range = −55°C to +125°C
- Voltage Rating = 50 wvdc
- Td/Tr Ratio = 5/1 (24 pin = 10/1)
- Economically priced
- Epoxy encapsulated
- Exceeds applicable portions of MIL-D-23859
- Low distortion
- Low attenuation

14 PIN DIP DELAY LINE SERIES L-21

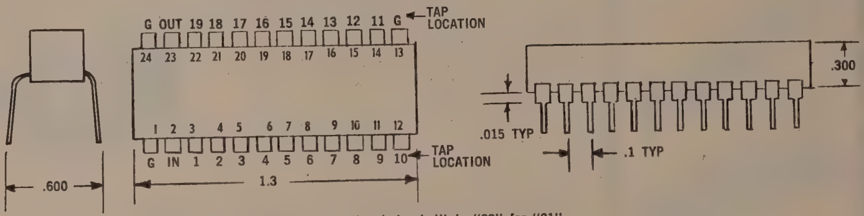

IN 2 4 7 9 G
TAP LOCATION
14 13 12 11 10 9 8
1 2 3 4 5 6 7
G 1 3 5 6 8 OUT
TAP LOCATION
.785
.300
.015 TYP
.1 TYP

16 PIN DIP DELAY LINE SERIES L-22


.300
For 14 Pin and 16 Pin
IN 2 4 7 9 G
TAP LOCATION
16 15 14 13 12 11 10 9
1 2 3 4 5 6 7 8
G 1 3 5 6 8 OUT
TAP LOCATION
.900
.300
.015 TYP
.1 TYP

NOTE: Available in case heights of .220 or .187 for automatic machine insertion.

24 PIN DIP DELAY LINE SERIES L-23


G OUT 19 18 17 16 15 14 13 12 11 G
TAP LOCATION
24 23 22 21 20 19 18 17 16 15 14 13
1 2 3 4 5 6 7 8 9 10 11 12
G IN 1 2 3 4 5 6 7 8 9 10
TAP LOCATION
.600
1.3
.300
.015 TYP
.1 TYP

To order Series L-22 use chart below but substitute "22" for "21"

Part No.	Impedance (ohms)	Total Delay (nsec.)	Tap Intervals (nsec.)	Rise Time (nsec.)	Maximum Attenuation (db)
L-21-10	50	40	4	8	1 db
L-21-11	50	50	5	10	1 db
L-21-12	50	60	6	12	1 db
L-21-13	50	70	7	14	1 db
L-21-14	50	80	8	16	1 db
L-21-15	50	90	9	18	1 db
L-21-16	50	100	10	20	1 db
L-21-17	50	125	12.5	25	1 db
L-21-18	50	150	15	30	1 db
L-21-19	50	175	17.5	35	1 db
L-21-20	50	200	20	40	1 db
L-21-21	100	50	5	10	1 db
L-21-22	100	60	6	12	1 db
L-21-23	100	70	7	14	1 db
L-21-24	100	80	8	16	1 db
L-21-25	100	90	9	18	1 db
L-21-26	100	100	10	20	1 db
L-21-27	100	125	12.5	25	1 db
L-21-28	100	150	15	30	1 db
L-21-29	100	200	20	40	1 db
L-21-30	100	300	30	60	1 db
L-21-31	200	50	5	10	1 db
L-21-32	200	60	6	12	1 db
L-21-33	200	70	7	14	1 db
L-21-34	200	80	8	16	1 db
L-21-35	200	90	9	18	1 db
L-21-36	200	100	10	20	1 db
L-21-37	200	125	12.5	25	1 db
L-21-38	200	150	15	30	1 db
L-21-39	200	200	20	40	1 db
L-21-40	200	300	30	60	1 db
L-21-41	500	50	5	10	1 db
L-21-42	500	60	6	12	1 db
L-21-43	500	70	7	14	1 db
L-21-44	500	80	8	16	1 db
L-21-45	500	90	9	18	1 db
L-21-46	500	100	10	20	1 db
L-21-47	500	125	12.5	25	1 db
L-21-48	500	150	15	30	1 db
L-21-49	500	200	20	40	1 db
L-21-50	500	300	30	60	1 db

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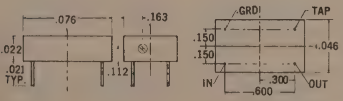
DUAL IN-LINE PACKAGES

TO ORDER 24 PIN (SERIES L-23—USE CHART BELOW)

Part No.	Impedance (ohms)	Total Delay (nsec.)	Tap Intervals (nsec.)	Rise Time (nsec.)	Max. Attenuation (db)
L-23-10	75	100	5	10	1 db
L-23-11	75	150	7.5	15	1 db
L-23-12	75	200	10.0	20	1 db
L-23-13	75	250	12.5	25	1 db
L-23-14	100	100	5	10	1 db
L-23-15	100	150	7.5	15	1 db
L-23-16	100	200	10.0	20	1 db
L-23-17	100	250	12.5	25	1 db
L-23-18	100	300	15	30	1 db
L-23-19	100	350	17.5	35	1 db
L-23-20	200	200	10	20	1 db
L-23-21	200	250	12.5	25	1 db
L-23-22	200	300	15	30	1 db
L-23-23	200	350	17.5	35	1 db
L-23-24	200	400	20	40	1 db
L-23-25	200	500	25	50	1 db
L-23-26	200	600	30	60	1 db
L-23-27	200	700	35	70	1 db
L-23-28	350	350	17.5	35	1 db
L-23-29	350	400	20	40	1 db
L-23-30	350	450	22.5	45	1 db
L-23-31	350	500	25	50	1 db
L-23-32	350	600	30	60	1 db
L-23-33	350	700	35	70	1 db
L-23-34	350	800	40	80	1 db
L-23-35	350	900	45	90	1 db
L-23-36	350	1000	50	100	1 db
L-23-37	350	1100	55	110	1 db
L-23-38	350	1200	60	120	1 db
L-23-39	500	500	25	50	1 db
L-23-40	500	600	30	60	1 db
L-23-41	500	700	35	70	1 db
L-23-42	500	800	40	80	1 db
L-23-43	500	900	45	90	1 db
L-23-44	500	1000	50	100	1 db
L-23-45	500	1500	75	150	1 db

VARIABLE DELAY "DUAL IN-LINES" DIP SERIES L-61



RCL offers for the first time, a variable delay line in a Dual In-Line package.

- Hermetically sealed construction
- Precious metal contacts
- Resolution: 2% for highest possible reliability performance

Delay lines meet applicable portion of MIL-D-23859.

Short run production facilities can produce prototype quantities in exceptionally short lead time.

TYPICAL EXAMPLES:

RCL Type No.	Delay Range (Max. nsec.)	Rise Time (nsec.)	Impedance ohms (±10%)
L-61-10	0-5	5	100
L-61-11	0-20	15	200
L-61-12	0-30	20	350
L-61-13	0-40	25	500

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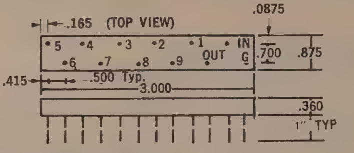
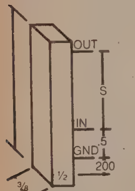
LUMPED CONSTANT DELAY LINES EPOXY ENCAPSULATED



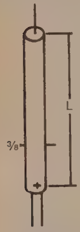
RCL Part No.	Delay nsec.*	Rise Time nsec. (max.)	Impedance Ohms (±10%)	Output Distortion % (max.)	Attenuation % (max.)	Working Voltage (max.)	External Taps
L-24-10	50	7	100	10	10	100	Every 5 nsec.
L-24-11	100	12	100	10	10	100	Every 10 nsec.
L-24-12	200	20	100	10	10	100	Every 20 nsec.
L-24-13	250	25	100	10	10	100	Every 25 nsec.
L-24-14	300	30	100	10	10	100	Every 30 nsec.
L-24-15	400	40	100	10	10	100	Every 40 nsec.
L-24-16	500	50	100	10	10	100	Every 50 nsec.

* ±1 nsec or 10%, whichever is greater on total delay or taps, referred to input.
Other designs on request.

DISTRIBUTED CONSTANT DELAY LINES
Series
L-07 & L-08



Printed Board Type

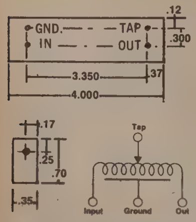


Cylindrical Type

Part No. Printed Board	Part No. Cylindrical Type	Delay µsec. †	Impedance ohms‡	Rise Time µsec.	Attenuation db	Printed Board "L"	"S"
L-07-10	L-08-10	.1	500	.055	1.5 db/µsec. or .25 db whichever is greater	2¼"	.7
L-07-11	L-08-11	.2		.075		2¼"	.7
L-07-12	L-08-12	.3		.080		2¼"	.7
L-07-13	L-08-13	.4		.085		2¾"	1.3
L-07-14	L-08-14	.5		.085		3¼"	1.7
L-07-15	L-08-15	.6		.10		3¾"	2.3
L-07-16	L-08-16	.7		.105		4"	2.5
L-07-17	L-08-17	.8		.120		4½"	2.9
L-07-18	L-08-18	.9		.125		5"	3.5
L-07-19	L-08-19	1.0		.130		5½"	3.9
L-07-20	L-08-20	1.1		.135		5¾"	4.3
L-07-21	L-08-21	1.2		.14		6¼"	4.7
L-07-22	L-08-22	.1	1000	.06	1.8 db/µsec. or .25 db whichever is greater	2¼"	.7
L-07-23	L-08-23	.2		.065		2¼"	.7
L-07-24	L-08-24	.3		.075		2¾"	1.3
L-07-25	L-08-25	.4		.085		3¼"	1.7
L-07-26	L-08-26	.5		.09		3¾"	2.3
L-07-27	L-08-27	.6		.095		4"	2.5
L-07-28	L-08-28	.7		.100		4½"	2.9
L-07-29	L-08-29	.8		.105		5"	3.5
L-07-30	L-08-30	.9		.110		5½"	3.9
L-07-31	L-08-31	1.0		.120		6"	4.5
L-07-32	L-08-32	1.1		.130		6½"	4.9
L-07-33	L-08-33	.1	1200	.06	1.8 db/µsec. or .25 db whichever is greater	2¼"	.7
L-07-34	L-08-34	.2		.075		2¼"	.7
L-07-35	L-08-35	.3		.08		2¾"	1.3
L-07-36	L-08-36	.4		.085		3¼"	1.7
L-07-37	L-08-37	.5		.09		4"	2.5
L-07-38	L-08-38	.6		.095		4½"	2.9
L-07-39	L-08-39	.7		.100		5¼"	3.7
L-07-40	L-08-40	.8		.110		5¾"	4.3
L-07-41	L-08-41	.9		.120		6½"	4.9
L-07-42	L-08-42	1.0		.130		6½"	4.9

When ordering, lead length should be specified (½" nominal).

VARIABLE DELAY LINES — Series L-62

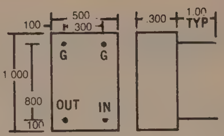


For applications which require adjustable delay time in the operating circuitry. The units are sealed against moisture and contamination. The adjusting shaft is equipped with a watertight "O" ring seal.

10 Turn Adjustment

RCL Part No.	Delay Range nsec.	Impedance ohms	Rise Time Max. nsec.
L-62-10	10-250	1000	40
L-62-11	10-200	200	40
L-62-12	0-300	750	60
L-62-14	5-80	300	20
L-62-15	10-250	500	60

For other variable delay lines consult our Engineering Department.

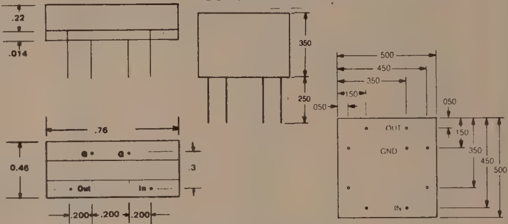


MINIATURE DELAY LINES Series L-04

RCL Part No.	Delay nsec. (±5%)	Rise Time nsec.	Impedance ohms (±10%)	Distortion %	Attenuation %	Working Voltage (max.)
L-04-10	20	3	100	10	10	100
L-04-11	25	4	100	10	10	100
L-04-12	40	6	100	10	10	100
L-04-13	50	8	100	10	10	100
L-04-14	75	12	100	10	10	100
L-04-15	100	20	100	10	10	100

Other tolerances on request.

SUBMINIATURE DELAY LINES Series L-05 & L-06



TYPICAL EXAMPLES:

RCL Part No.	Delay nsec.*	Rise Time nsec.	Impedance† ohms (±10%)
L-05-10	25	10	100
L-05-11	50	20	100
L-05-12	100	46	100
L-05-13	200	80	100
L-05-14	30	16	200
L-05-15	50	18	200
L-05-16	200	80	200
L-05-17	50	20	500
L-05-18	200	80	500
L-05-19	100	46	1000
L-05-20	500	200	1000
L-06-10	4	2.5	50
L-06-11	16	3	50
L-06-12	20	4	50

Distortion: 10% all-encompassing

Attenuation: 10%

Working Voltage: 100V

Temperature Coefficient: 70 ppm/°C max. −55° to +125°C

Mil Spec: Meets or exceeds all applicable sections of MIL-D-23859.

In addition to the above examples of Delays, many others are available on request.

* ±1 nsec. or ±10%, whichever is greater.
† Other impedances available.
Other tolerances on request.

RCL SPECIAL VIDEO DELAY LINES (RCL SERIES VL)

Designed to equalize and/or synchronize color television signals. These lines are especially designed to fulfill existing stringent specifications in regard to frequency and phase response within the color television frequency band 405, 525 and 621 line color video systems.

Specialized design feature and test instrumentation are applied. The visual display of frequency and phase response using sophisticated test equipment makes it possible to manufacture video delay lines to precise performance specifications.

These lines are used in color TV cameras and recorders. In addition, similar delay lines are used for studio work, to either replace or equalize bulky cable lengths. These cable replacements are normally 75 ohm lines with either standard terminals or BNC coaxial plugs.

Precise loss pads are also available for 75 ohm lines equipped with BNC plug and jacks for easy coupling between cables and delay lines. Test specifications are either expressed in Amplitude and Delay ripple response, or T Pulse response for a specified k factor.

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AUDIO DELAY LINES
RCL Series L1100

RCL Audio Delay Lines are custom designed and manufactured to the most stringent specifications. The electrical performance, due to advanced design techniques, classical and synthesis network theories, insures the ultimate in precision performance.

ENGINEERING FEATURE:
Envelope delay of better than 0.1% in the mid-frequency region, and 0.2% in the 6 db fall off. The frequency characteristic is maximally flat with 0.1% frequency ripple.

Typical Delay range up to 10 milliseconds

Typical Delay-Bandwidth product up to 30

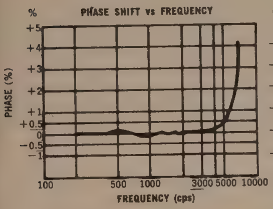
Typical Impedance 500 ohms to 1,000 ohms

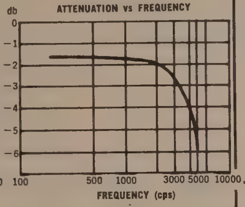
Typical Attenuation 0.001 to 0.003 per microsecond

Units are normally housed in standard rack type mounting cabinets.

A typical example of electrical performance for a delay line of 5 milliseconds is indicated in the following graphs:

Any tap spacings available upon request.





ELECTRICAL VARIABLE DELAY LINES

Voltage and Current Type

The Electrical Variable Delay Line (EVDL) is basically a Lumped Constant Delay Line (LCDL) with the same design approach as outlined for LCDL's.

The capacitive or inductive element is voltage or current sensitive, respectively.

Normally EVDL are defined by an inherent Center delay at a specified Bias input and a % deviation of Delay from Center.

Modern EVDL's are generally voltage controlled, with infinite resolution, and excellent frequency and phase response over the specified delay variation.

EVDL's are used as Vernier devices, either manually or automatically adjustable, also as phase modulator of fast response.

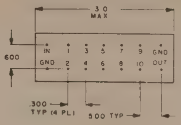
The precision performance of the voltage controlled EVDL makes it a reliable device for tape compensation in color television recorders.

Carrier frequencies: Up to 70 MHz and phase modulation of up to 1 MHz, for automatic adjustments of Delay of quartz or glass delay lines, due to temperature variation. Expensive temperature compensators can be avoided.

Control voltage inputs: Either single or push-pull, low or high impedance.

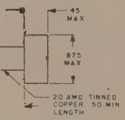
Carrier voltage inputs from 50 to 1000 ohms impedance.

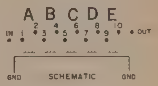
MODULAR DELAY LINES
Series L-44
Multiple Discreet Delay Lines in a Single Package



SPECIFICATIONS:

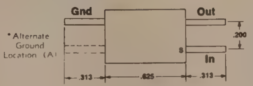
- Operating Temperature: −55°C to +125°C
- Attenuation: 1 db
- Distortion: ±10%
- Temperature Coefficient: 100 ppm/°C
- Dielectric Strength: 100 VDC
- Delay Tolerance: ±5% or ±3 nsec, whichever is greater.
- Impedance: ±10%

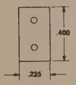


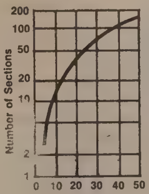


Part No.	Ohms Impedance	Time Delays (nsec.) A	B	C	D	E	Total	Total (nsec.) Rise Time
L-44-10	100	50	40	20	10	5	125	10
L-44-11	100	100	80	40	20	10	250	20
L-44-12	100	200	160	80	40	20	500	50
L-44-13	100	400	320	160	80	40	1000	80
L-44-14	200	50	40	20	10	5	125	10
L-44-15	200	100	80	40	20	10	250	20
L-44-16	200	200	160	80	40	20	500	50
L-44-17	200	400	320	160	80	40	1000	80
L-44-18	500	100	80	40	20	10	250	20
L-44-19	500	400	320	160	80	40	1000	80

ECONOLINE DELAY LINES
Series L-09







Lumped Constant, Econoline Modules are designed primarily for computer applications where large quantities of low cost time delays are required. Eleven different time delay values between 10 and 200 nanoseconds are available in this new modular form. Each module unit is a single time delay section. The required total delay and delay to rise time ratio can be obtained by simply interconnecting a number of modules. The accompanying chart shows how to select the proper module values.

Econoline Delay Line Modules are also ideal for prototypes and breadboard circuits. Single modules can be connected together on a circuit board with taps available at each connection point, if needed.

Econoline Delay Line Modules should be used in applications where pulse distortion and tolerance are not critical. They provide a convenient low cost time delay for commercial and industrial usage.

SELECTION CHART

The chart above can be used to determine the number of modules required to provide a desired delay and rise time.

1. Determine the delay to rise time ratio by dividing the desired time delay by the desired rise time.
2. Using the chart determine the number of sections required for this T_d/T_r.
3. Divide this number of sections by the total delay to determine the delay per section.

Total delay is the sum of the individual section delays. It can be trimmed to the desired value by selecting the proper value of the last module.

RCL Part No.	Delay nsec. (±10%)	Impedance ohms (±10%)	Attenuation db (max.)	Working Volt. (max.)
L-09-10	10	500	1	100
L-09-11	20	500	1	100
L-09-12	30	500	1	100
L-09-13	40	500	1	100
L-09-14	50	500	1	100
L-09-15	60	500	1	100
L-09-16	70	500	1	100
L-09-17	80	500	1	100
L-09-18	90	500	1	100
L-09-19	100	500	1	100
L-09-20	200	500	1	100

ORDERING INFORMATION

* For relocating ground terminal to Position A use Suffix -1

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ENGINEERING AND MANUFACTURING CAPABILITY

RCL Electronics designs and manufactures lumped constant, distributed constant and variable delay lines. We pride ourselves on the quality of our product, the extent and quality of our test equipment and the high caliber of our engineering staff. All of these capabilities have only one purpose—to provide you with the finest delay lines available at the lowest price consistent with quality. Our staff and facilities are always available to help you. The first and most important step in selecting a delay line might well be a call to RCL Electronics for an engineer-to-engineer discussion of your delay line requirements. Our engineering staff includes some of the most experienced delay line engineers in the industry. They will promptly tell you what's available in delay lines to solve your problem.

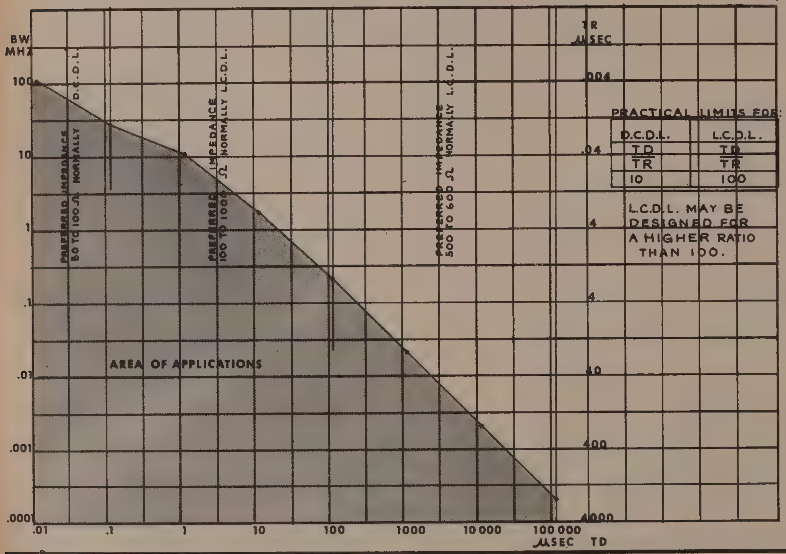
Quality Assurance

Stringent process controls are enforced at RCL to insure the highest quality levels and maximum reliability of all delay lines. A quality assurance department performs continual in-process inspection and monitors all final testing operations. Periodic checks are made on environmental specifications and material analyses. A comprehensive study is made of all failures and field problems to insure maximum product quality consistent with cost. RCL has participated in many high-reliability military programs in their quality assurance department.

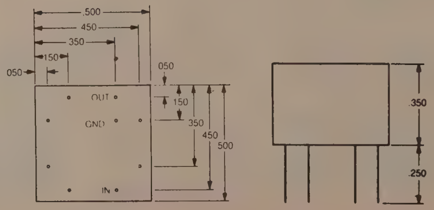
CUSTOM DELAY LINES

When one of the standard RCL delay lines will not meet your specific requirements a custom delay line can be designed for your application. For example, practically any kind of AUDIO and VIDEO delay lines are available, manufactured to the customer's specifications. When considering the specifications for your custom delay it is recommended that you call on an RCL engineer for his advice and recommendations. RCL employs the most experienced delay line engineers in the industry and his advice could result in your obtaining a better unit at less cost. When required, a detailed laboratory report accompanies prototype custom delay lines. Oscillograms of the actual delay line under test and the exact test procedure are part of the report. With the aid of the oscillograms a customer has concrete evidence for comparing his test results with the RCL report.

PRACTICAL LIMITS OF ELECTRO MAGNETIC DELAY LINES



SERIES L-06



Distortion: 10% all-encompassing.
Attenuation: 10%.
Working Voltage: 100 V.
Temperature Coefficient: 70 PPM/°C max. −55°C to +125°C.
Mil Spec: Meets or exceeds all applicable sections of MIL-D-23859.
In addition to the above examples of Delays, many others are available on request.

RCL PART NO.	DELAY NSEC	RISE TIME NSEC.	IMPEDANCE OHMS (±10%)
L-06-10	4	2.5	50
L-06-11	16	3	50
L-06-12	20	4	50

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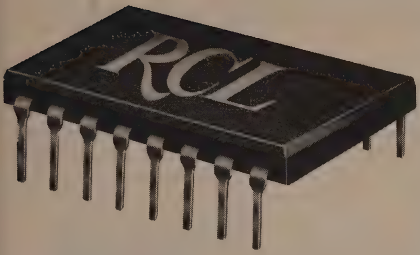
delay line driver



RCL Part No. DLD

A device that replaces circuitry, which often must be introduced to drive delay lines ... New from RCL.

Totally compatible with TTL logic, the devices are designed to drive delay lines with characteristic impedances of 50 to 350 ohms.

Operating temperature range is - 40°C + 85°C. Storage temperature range is - 25°C to + 125°C.

With switch characteristics at full load, using 50 ohms, 125 nsec delay line, rise time to logic "1" is 9 nsec, and fall time to logic "0" is 5 nsec. Propagation delay to logic "1" level is 9 nsec.

Input Signal Characteristics At +25°C

INPUT VOLTAGE		INPUT CURRENT
Threshold Level		Threshold Level
LOGIC "1"	+2.0 Vmin.	1.5 ma max.
LOGIC "0"	+0.8 Vmin.	-2.6 ma max.

Input Pulse Characteristics:

Pulse width is 30 ns min. (50% points)
Risetime and falltime is 20 ns max.

Output at +25°C

Load is 50 ohms paralleled by 120 pf

Voltage at full load:
Logic "1" is +3.2 V nominal
Logic "0" is +0.080 V nominal
Current capabilities: Source and sink is 120 ma

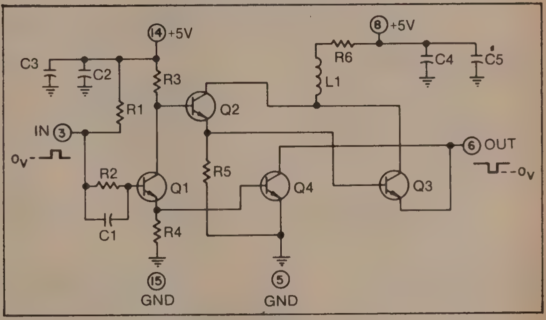
Switching Characteristics At Full Load

	LOGIC "1"	LOGIC "0"
Rise Time	9ns	5ns
Propogation Delay	9ns	5ns

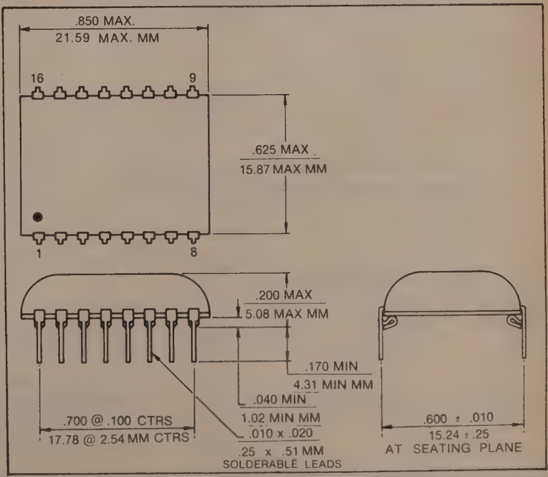
Power at +25°C

VCC is +5.0 V + 0.5 V
Power is 85 mw with no load and 110 mw loaded
(50% duty cycle, max load)

SCHEMATIC


⑭ +5V
⑧ +5V
C3
C2
R3
R6
C4
C5
L1
R1
Q2
IN ③
0V
⑥ OUT
0V
R2
Q1
R5
Q4
Q3
C1
R4
⑮ GND
⑤ GND

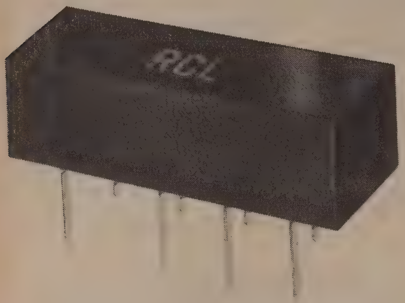
OUTLINE DRAWING


.850 MAX.
21.59 MAX. MM
16
9
1
8
.625 MAX
15.87 MAX MM
.200 MAX
5.08 MAX MM
.170 MIN
4.31 MIN MM
.040 MIN
1.02 MIN MM
.010 x .020
.25 x .51 MM
SOLDERABLE LEADS
.700 @ .100 CTRS
17.78 @ 2.54 MM CTRS
.600 ± .010
15.24 ± .25
AT SEATING PLANE

AMF
RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

"plug-in" digital delay modules



RCL "Plug-In" Digital Delay Modules provide the precise timing features of a Delay Line in a device which can be easily used with the DTL and TTL families. Considerable space savings and flexibility are achieved over the use of conventional components.

△ FAST RISE TIME - INDEPENDENT OF DELAY

△ DTL and TTL COMPATIBLE
△ 5 TAPPED DELAYS
△ HIGH FAN OUT CAPABILITY

△ 50ns, 100ns, 250ns DELAYS
△ 16 PIN DIP PATTERN
△ IN STOCK

SPECIFICATIONS

Supply Voltage Vcc	+4.5 to 5.5 V DC
Logic "1" Input Current	50μ a Max.
Logic "0" Input Current	-2ma Max.
Logic "1" V out	2.4 V Min.
Logic "0" V out	0.4 V Max.

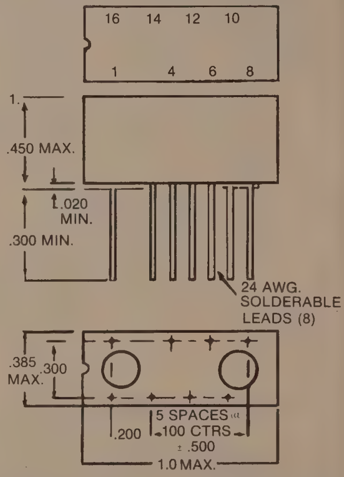
Drive Capabilities:

Logic "0" Output	10 TTL Loads/Tap Max. (20 TTL Loads/Unit Max.)
Logic "1" Output	20 TTL Loads/Unit Max.

RCL No.	Delay Time (a)	Delay/Tap (b)	No/Taps	Rise Time²
L13-01	50ns	10ns	5	4ns
L13-02	100ns	20ns	5	4ns
L13-03	250ns	50ns	5	4ns

All Measurements Made at Vcc=5.0V @ 25° C
(a) Measured at 1.5v Level, Leading Edge
(b) Measured from 0.75v to 2.4v.

PIN CONNECTIONS



1 Input
14 20% Delay
4 40% Delay
12 60% Delay
10 Output
8 Ground
16 Vcc

INPUT TEST CONDITIONS

Pulse Voltage	3.2V	Input Current	60ma TYP
Rise Time	3ns	Pulse Width	Min. of 40% of Delay

SEE OUR PAGE ON
DUAL-IN-LINE OPTION BLOCKS PAGE 1•465

Kappa
NETWORKS INC

DESIGNERS AND MANUFACTURERS
ELECTROMAGNETIC

DELAY LINES

FROM STOCK / CATALOGUE ORDER / CUSTOM

- FIXED OR VARIABLE
- DUAL-IN-LINE TO RACK MOUNTING
- MILITARY OR COMMERCIAL

INSTANT SERVICE

DIAL TOLL-FREE
800-631-5653

PHONE OR WRITE FOR FREE CATALOGUE AND DATA SHEETS

KAPPA NETWORKS, INC. / 165 Roosevelt Ave, Carteret, New Jersey 07008
TELEPHONE: (201) 541-1600

KAPPA NETWORKS, INC.

165 ROOSEVELT AVENUE / CARTERET, NEW JERSEY 07008 / TEL: (201) 541-1600

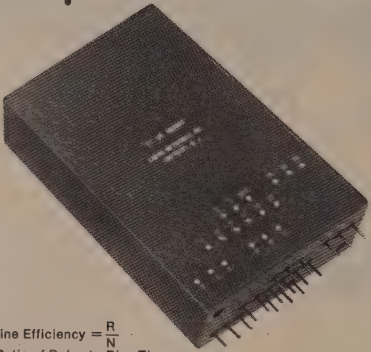
PRECISION SONAR DELAY LINES / SERIES A

The basic design of this series incorporates unsymmetrical Pierce sections with precisely controlled equalization. These sections consist of closely matched high Q inductors and precision tolerance capacitors to assure unsurpassed performance.

SPECIFICATIONS

Delay Range: from 500 μsec to 10^6 μsec ±1%
Delay Linearity: available to within ±0.05%
Bandwidth: 70 KHz maximum
Dielectric Strength: 100 VDC
Operating Temperature: −55°C to +125°C
Temperature Stability: under 50 ppm/°C

SUPER-η* DELAY LINES / SERIES H



*η = Delay Line Efficiency = $\frac{R}{N}$
where R = Ratio of Delay-to-Rise-Time
N = Required number of LC sections

SUPER-η LINES embody a new design principle providing the highest efficiency yet obtainable in lumped constant delay lines. Use of network synthesis techniques** rather than conventional m-derived methods result in sharply improved delay line efficiency. Compared to ordinary delay lines of the same delay-to-rise-time ratio, **Super-η** LINES use far fewer LC sections. For this reason these newly-developed lines provide such outstanding advantages as:

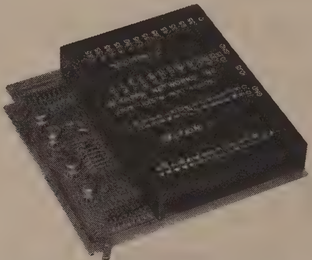
- Greater Inherent Reliability
- Smaller Package Size
- Appreciable Cost Reduction

**KAPPA Technical Report #TR-101

SPECIFICATIONS

Delay Range: 0.5 μsec to 500 μsec ±5%
Delay-to-Rise-Time Ratio: as required, up to 150
Delay Linearity: ±1%
Bandwidth: 70 MHz maximum
Distortion: ±10% maximum
Dielectric Strength: as required
Operating Temperature: −55°C to +125°C
Temperature Stability: 50 ppm/°C

TRANSPONDER LINES / TACAN LINES / DME LINES / SERIES C



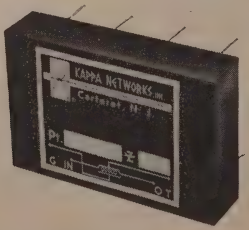
Designed to meet the requirements of MIL-D-23859 and to withstand the most rigorous military environments.

- Tap Selecion to Precise Tolerances
- Compact Packaging
- Used in Air and Ground Measuring and Signalling Equipment

SPECIFICATIONS

Tap-Spacing: as required
Tap Tolerance: as required
Delay-to-Rise-Time Ratio: 100 maximum
Delay Linearity: ±0.5%
Attenuation: from 1.5 to 6 db
Distortion: as required, to 1%
Dielectric Strength: as required
Operating Temperature: −55°C to +125°C
Temperature Stability: 50 ppm/°C or less

LOW DISTORTION LINES / SERIES D



Used primarily in precision instrumentation where high bandwidth and low distortion are critical considerations.

SPECIFICATIONS

Delay-to-Rise-Time Ratio: 50 maximum
Bandwidth: 50 MHz maximum
Dielectric Strength: as required
Operating Temperature: −55°C to +125°C
Temperature Stability: 50 ppm/°C
Distortion at Output: 2% maximum
Distortion at Taps: less than 5% at any tap
Distortion Limit: as low as 0.1% if required
Delay Range: up to 100 μsec
Standard Tolerances: ±1% on Delays ±5% on Impedance

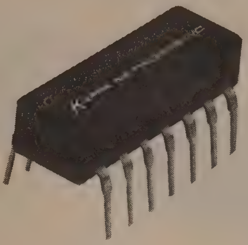
KAPPA NETWORKS, INC.

165 ROOSEVELT AVENUE / CARTERET, NEW JERSEY 07008 / TEL: (201) 541-1600

DUAL IN LINE / DELAY LINE SERIES DP

This series widely used in computer, radar and timing applications.

- Available with Tapped Delay Increments
- Plug into Standard Dual-in-Line Sockets or P.C. Board
- Manufactured and Tested to MIL-D-23859



SPECIFICATIONS

Delay Range: to 1000 nanoseconds
Distortion: 10%
Operating Temperature: −55°C to +125°C
Temperature Stability: 50 ppm/°C
Dielectric Strength: 100 VDC

MINIATURE NANOSECOND DELAY LINE SERIES KM

This series of lumped constant design, incorporates an advanced technique of packaging, to offer high figure of merit in small volume.

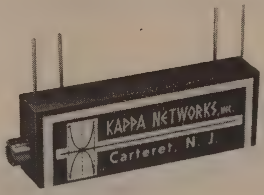
KAPPA NETWORKS, INC.

SPECIFICATIONS

Operating Temperature: −55°C to +125°C
Temperature Coefficient: 50 ppm/°C
Attenuation: 0.5 db maximum
Dielectric Strength: 100 VDC
Distortion (typical): ±10%
Meets MIL-D-23859

MINIATURE CONTINUOUSLY VARIABLE DELAY TRIMMERS SERIES TT

This Series is the smallest of its kind and is immediately available from stock. Intermittent-free operation is assured by KAPPA's unique contact design.



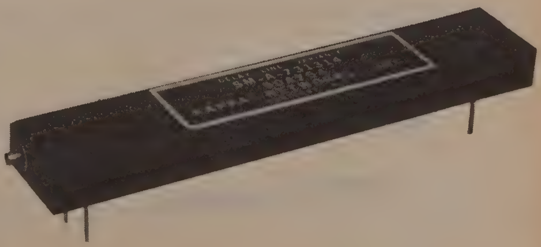
SPECIFICATIONS

Size: ¼ cubic inch
Delay Range: up to 120 nanoseconds
Resolution: −25 nanoseconds or less
Delay-to-Rise-Time Ratio: 4/1
Bandwidth To: 70 MHz
Attenuation: .25 db maximum
Distortion: ±15% maximum
Dielectric Strength: 100 VDC
Operating Temperature: −55°C to +125°C
Temperature Stability: 200 ppm/°C

MINITRIM DELAY LINE SERIES MT

This series available in both distributed and lumped constant design.

- Ideal for P.C. Board Insertion
- Wide Range of Delay
- KAPPA Minitrim Delay Lines are Designed for Circuits Requiring Precise Delay Adjustments



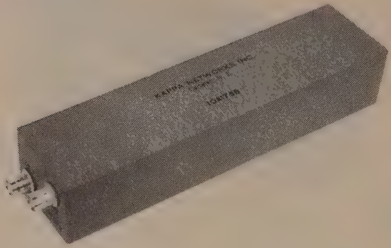
SPECIFICATIONS

Delay Range: up to 300 nanoseconds
Resolution: less than 1 nanoseconds
Attenuation: less than .5 db
Dielectric Strength: as required
Operation Temperature: −55°C to +125°C

KAPPA NETWORKS, INC.

165 ROOSEVELT AVENUE / CARTERET, NEW JERSEY 07008 / TEL: (201) 541-1600

VIDEO BROADCAST DELAY LINES SERIES BC



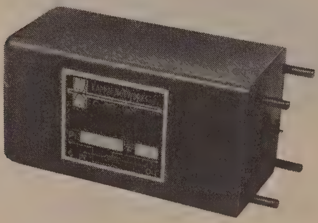
KAPPA Video Broadcast Delay Lines yield a greater delay-bandwidth from fewer components than conventional units, and their performance more nearly approaches constant delay at all transmitted frequencies than do conventional (m-derived) delay lines.

This performance has established their wide acceptance for use in the most demanding color television applications of American and European Systems.

SPECIFICATIONS

Delay Range: to 10 μsec
Impedance: 75 ohms ±2%
Linear Delay Bandwidth: to 14 MHz, Delays to 1 μsec
7 MHz, Delays to 5 μsec
5 MHz, Delays to 10 μsec

STANDARD LUMPED CONSTANT DELAY LINES SERIES LC



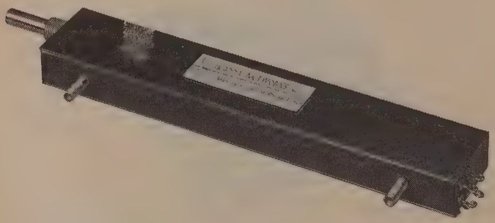
Most standard KAPPA Lumped Constant Delay Lines utilize either the highly efficient Golay or unsymmetrical Pierce designs. Equalization is precisely calculated and realized, fully accounting for variations in magnetic core permeability, distributed capacity and other variables. The resulting units exhibit the specified delay linearity tolerance to frequencies beyond the 3 db passband.

SPECIFICATIONS

Delay: 50 nanoseconds to 1 second*
Impedance: 20 ohms to 50 K ohms
Delay-to-Rise-Time Ratio: 150 maximum
Delay Linearity: ±0.5%
Bandwidth: DC to 250 MHz*
Distortion: ±10% or as required
Operating Temperature: −55°C to +125°C
Temperature Stability: 50 ppm/°C

*Subject to a limit on delay X bandwidth

CONTINUOUSLY VARIABLE DELAY LINES SERIES K



This series offer continuously variable delay lines of lumped constant design. Incorporating special contact feature for intermittent free variation.

SPECIFICATIONS

Delay Range: to 2.0 μsec
Resolutions: 1/1000 of total delay or 1 nanosecond whichever is greater
Delay-to-Rise-Time Ratio: up to 10:1
Attenuation: under 1.5 db
Dielectric Strength: as required
Operating Temperature: −55°C to +125°C
Temperature Coefficient Delay: 50 ppm/°C

STANDARD DISTRIBUTED CONSTANT DELAY LINES SERIES DC

These Delay Lines offer limited delay-rise-time ratio and small volume at lowest cost.

- Available for P.C. Board Insertion
- Short Delivery Cycle

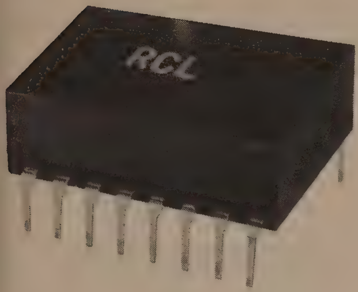
SPECIFICATIONS

Delay Range: up to 3 μsec ±5%
Relay-to-Rise-Time Ratio: 11 maximum
Bandwidth: 30 MHz maximum
Distortion: ±5% typical, ±10% maximum
Dielectric Strength: as required
Operating Temperature: −55°C to +125°C
Temperature Stability: 200 ppm/°C maximum

AMF
RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

dual-in-line option blocks

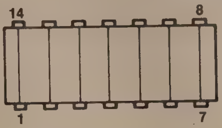


For Micro Programming

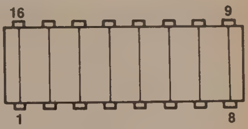
Designed to be used for bussing or micro programming, such as code conversion and rate multiplication. The units can also be used as shorting modules for test fixture compensation.

- Δ 14 & 16 pin packages
- Δ Custom configurations are available
- Δ Shorting pattern may be modified by simply cutting off individual leads
- Δ Allows shorting of multiple arrangements of pins for various circuit applications on circuit boards using a standard DIP spacing.
- Δ May be used for bussing or micro programming, such as code conversion and rate multiplication.
- Δ Can be used as shorting modules for test fixture compensation.

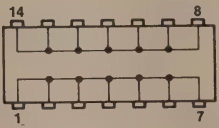
SCHEMATIC



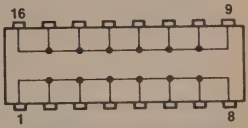
RCL Part No. L-17-01



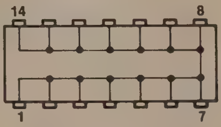
RCL Part No. L-18-01



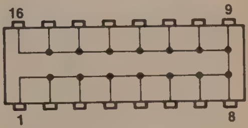
RCL Part No. L-17-02



RCL Part No. L-18-02

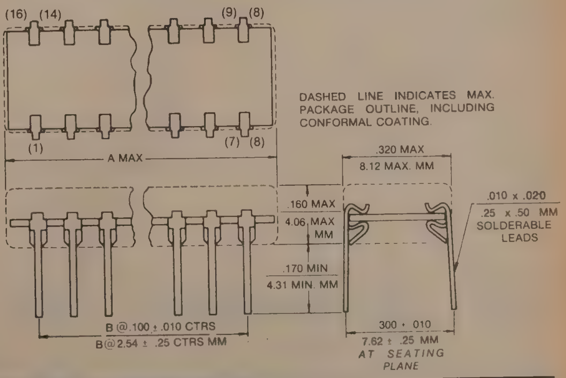


RCL Part No. L-17-03



RCL Part No. L-18-03

OUTLINE DRAWING


(16)
(14)
(9)
(8)
(1)
(7)
(8)
A MAX
.320 MAX
8.12 MAX. MM
.160 MAX
4.06 MAX MM
.170 MIN
4.31 MIN. MM
.010 x .020
.25 x .50 MM
SOLDERABLE LEADS
B @ .100 ± .010 CTRS
B @ 2.54 ± .25 CTRS MM
.300 ± .010
7.62 ± .25 MM
AT SEATING PLANE

DASHED LINE INDICATES MAX. PACKAGE OUTLINE, INCLUDING CONFORMAL COATING.

STYLE	DIMENSIONS			
	A		B	
	INCHES	MM	INCHES	MM
16 PIN DIP	.860	21.84	.700	17.78
14 PIN DIP	.760	19.30	.600	15.24

Technitrol, Inc.

DUAL-IN-LINE, LOW PROFILE MINIATURE LUMPED — CONSTANT DELAY LINES

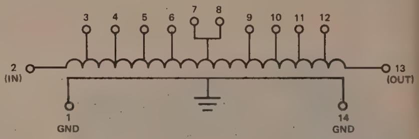
Part No.	Delay* (NS)	Rise Time (NS-Max.)	Impedance (Ohms) ±10%	Att. (% Max.)	DCR (Ohms Max.)	Tap Delay (NS-Max.)
LB10F1	20	3.1	50	2.5	1.0	2.0
LB10G1	25	3.5	50	2.5	1.0	2.5
LB10K1	50	7.5	50	3.5	1.5	5.0
LB10M1	100	17.0	50	5.5	2.5	10.0
LF10D1	10	2.2	100	1.5	1.0	1.0
LF10E1	12.5	2.5	100	1.5	1.0	1.25
LF10F1	20	3.3	100	2.0	1.5	2.0
LF10G1	25	3.7	100	2.0	1.5	2.5
LF10K1	50	8.4	100	3.0	2.5	5.0
LF10M1	100	17.0	100	5.0	5.0	10.0
LF10P1	200	38.0	100	12.0	11.5	20.0
LJ10D1	10	2.6	200	1.0	1.5	1.0
LJ10E1	12.5	2.6	200	1.0	1.5	1.25
LJ10G1	25	5.0	200	1.5	2.5	2.5
LJ10K1	80	10.0	200	2.5	5.0	5.0
LJ10M1	100	22.0	200	6.0	11.5	10.0

*Tolerances on T_D: ±5% or ±2 NS W.I.G.

DISTORTION: Pre-Pulse ±10% Max.
Pulse ±10% Max.

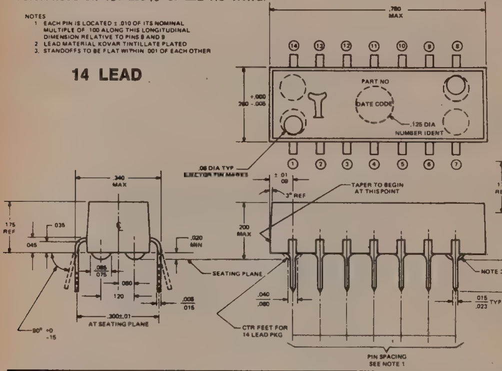
INSULATION RESISTANCE: 10K megohms at 100 VDC

HIPOT: 100 VDC


3
4
5
6
7
8
9
10
11
12
2 (IN)
13 (OUT)
1 GND
14 GND

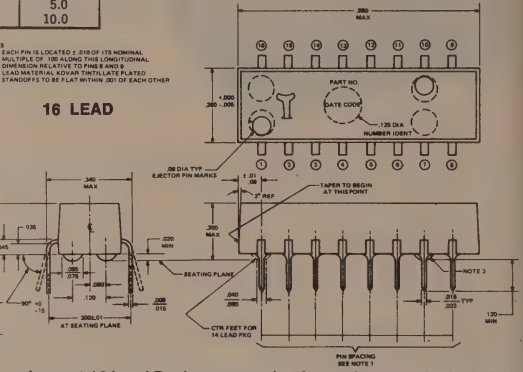
NOTES
1. EACH PIN IS LOCATED ± .010 OF ITS NOMINAL MULTIPLE OF .100 ALONG THIS LONGITUDINAL DIMENSION RELATIVE TO PINS 8 AND 9
2. LEAD MATERIAL KOVAR TINTILLATE PLATED
3. STANDOFFS TO BE FLAT WITHIN .001 OF EACH OTHER

14 LEAD


.780 MAX
PART NO
DATE CODE
.125 DIA NUMBER IDENT
+.000 .280 -.005
.08 DIA TYP EJECTOR PIN MARKS
.340 MAX
± .01 .08
3° REF
TAPER TO BEGIN AT THIS POINT
.175 REF
.035
.045
.200 MAX
.020 MIN
SEATING PLANE
.085 .075
.080
.120
.008 .015
.300±.01 AT SEATING PLANE
90° +0 -15
.040 .080
CTR FEET FOR 14 LEAD PKG
NOTE 3
.015 .023 TYP
.120 MIN
PIN SPACING SEE NOTE 1

NOTES
1. EACH PIN IS LOCATED ± .010 OF ITS NOMINAL MULTIPLE OF .100 ALONG THIS LONGITUDINAL DIMENSION RELATIVE TO PINS 8 AND 9
2. LEAD MATERIAL KOVAR TINTILLATE PLATED
3. STANDOFFS TO BE FLAT WITHIN .001 OF EACH OTHER

16 LEAD


.880 MAX
PART NO.
DATE CODE
.125 DIA NUMBER IDENT
+.000 .280 -.005
.08 DIA TYP EJECTOR PIN MARKS
.340 MAX
± .01 .08
3° REF
TAPER TO BEGIN AT THIS POINT
.175 REF
.035
.045
.200 MAX
.020 MIN
SEATING PLANE
.085 .075
.080
.120
.008 .015
.300±.01 AT SEATING PLANE
90° +0 -15
.040 .080
CTR FEET FOR 14 LEAD PKG
NOTE 3
.015 .023 TYP
.120 MIN
PIN SPACING SEE NOTE 1

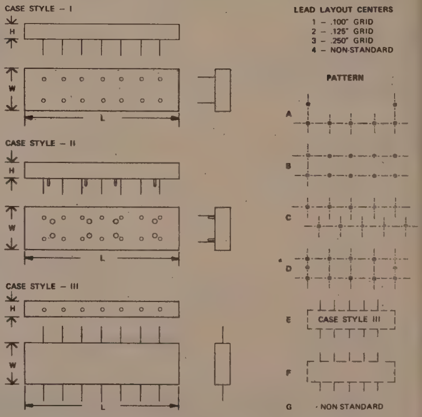
In most 16 Lead Packages, terminating resistor can be included.
Internally-Welded Construction is used on Coils and Resistors.

STANDARD DELAY LINES

Part No.	Delay (NS)	Impedance (Ohms)	Rise Time (NS)	Taps No.	Taps Value	Case L	Case W	Case H	Case Style	Case Lead Layout
L500U801C	800±5%	50±10%	40[1]	80 —	10NS	8.00	1.19	.35	I	4-D
L500K301B	300±5%	50±5Ω	35	24 —	12.5NS	2.70	.75	.35	I	1-B
L950T102A	1000±5%	95±5Ω	60	40 —	25NS	5.80	1.25	.44	I[2]	4-B
L930A140A	14±5%	93±10%	8	Programmable 2, 4, 6, 8NS		.73	.48	.37	II	2-A
L930E101C	100±5%	93±5%	15	20 —	5NS	3.24	.865	.37	II	2-A
L930F131B	125±5%	93±10%	20	Programmable 5, 10, 20, 40, 50NS		1.54	.865	.37	II	2-D
L101K301A	300±10NS	100±5%	30	24 —	12.5NS	4.25	.875	.36	I	1-B
L101K601A	600±20NS	100±5%	60	24 —	25NS	4.25	.875	.37	I	1-B
L101E151A	156±5%	100±5%	30	24 —	6.5NS	4.25	.875	.36	I	1-B
L101K181A	180±5%	100±5%	23	24 —	7.5NS	4.25	.875	.36	I	1-B
L101K151A	156±5%	100±5%	21	24 —	6.5NS	4.25	.875	.36	I	1-B
L101D251B	250±5%	100±5%	68	10 —	25NS	3.24	.865	.37	II	3-C
L101K301C	300±10NS	100±5%	30	24 —	12.5NS	4.25	.875	.385	I[3]	1-B
L101W501A	500±5%	100±5%	30	100 —	5NS	4.51	3.00	.50	I[4]	1-G[5]
L101D501A	500±5%	100±5%	88	10 —	50NS	3.24	.865	.36	III	3-E
L101D251A	250±5%	100±5%	68	10 —	25NS	3.24	.865	.36	III	3-E
L101K501A	500±3%	100±10%	50	20 —	25NS	4.6	1.0	.30	I	1-C
L321K341A	342±20NS	320—	34	TAP #1 = 9 —	180NS 18NS	3.25	.875	.365	I	1-A
L321J181A	180±15NS	320—	20	10 —	18NS	3.25	.875	.365	I	1-A
L321K251A	250±12NS	320—	25	10 —	25NS	3.25	.875	.365	I	1-A
L331K281B	275±25NS	330±10%	27.5	11 —	25NS	3.25	.875	.312	I	1-D
L501D501A	500±5%	500±5%	90	10 —	50NS	3.24	.865	.36	III	3-E

NOTES:

[1] Measured at 10-50% points.
[2] With — two #4-40 metal inserts.
[3] With — two #4-40 metal inserts and non-standard feet.
[4] With non-standard feet.
[5] With five rows of leads, spaced 0.5″ apart.


CASE STYLE – I
H
W
L
CASE STYLE – II
CASE STYLE – III
LEAD LAYOUT CENTERS
1 – .100″ GRID
2 – .125″ GRID
3 – .250″ GRID
4 – NON-STANDARD
PATTERN
A
B
C
D
E
CASE STYLE III
F
G
· NON STANDARD

CASE STYLES AND LEAD LAYOUT

Technitrol, Inc.
1952 E. Allegheny Avenue
Philadelphia, Pa. 19134
(215) 426-9105

Specialists in pulse transformers and completely transfer molded, welded DIP delay lines under 3/16″ high — to 250 ns.

Technitrol, Inc.

TTL DELAY MODULE

TTL Delay Modules are designed to be used directly with super high speed TTL, standard TTL and DTL logic circuits. They provide many timing applications without any or minimum interface.

TTL Delay Modules can be cascaded to get any combination of delay without derating output rise time (T_R+ or T_R-). Delay to rise time ratio (T_D/T_R) of individual modules is very high (approximately 50:1) and improves with cascading modules. Output rise times of each module are independent of input rise times up to 50 nsec. Each module can handle input pulse widths as low as 15 nsec, (with ≤ 2.5 nsec, input rise times).

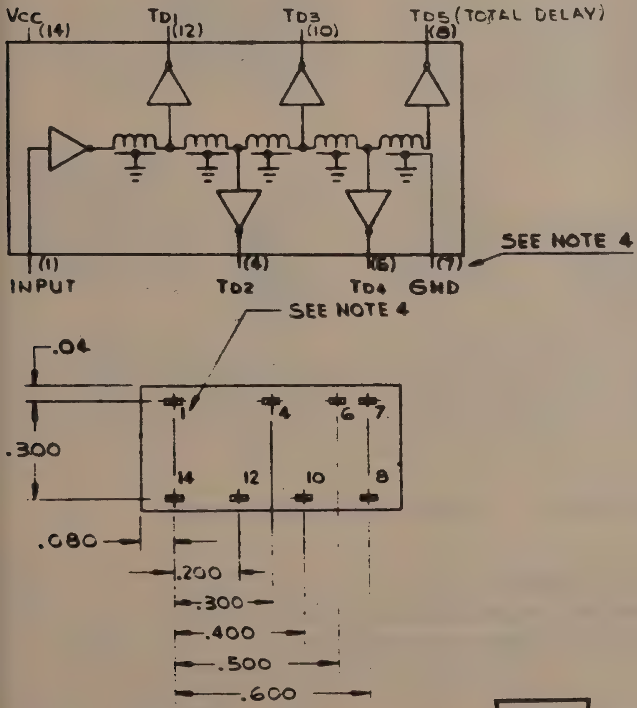
TTL Delay Modules are encapsulated by transfer molding. They are pin compatible with 74 Series TTL/SSI 14 Lead DIP Circuits. MIL version available for −55°C to +125°C operation.

Delay Characteristics @ Vcc = 5.0 volts, 25°C, No Load.

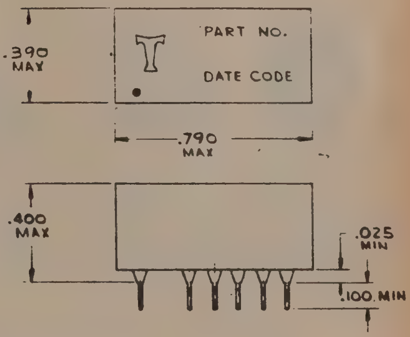
			Nanoseconds			All Taps	
Part No.	T_D1	T_D2	T_D3	T_D4	T_D5	T_R+ &	T_R-
TTLDL025	5.0±1.5	10.0±1.5	15.0±1.5	20.0±1.5	25.0±1.5	≤1.0	≤1.0 nsec.
TTLDL050	10.0±1.5	20.0±1.5	30.0±1.5	40.0±2.0	50.0±2.5	≤1.0	≤1.0 nsec.
TTLDL100	20.0±1.5	40.0±2.0	60.0±3.0	80.0±4.0	100.0±5.0	≤2.0	≤2.0 nsec.
TTLDL250	50.0±2.5	100.0±5.0	150.0±7.5	200.0±10.0	250.0±12.5	≤2.0	≤5.0 nsec.
TTLDL500	100.0±5.0	200.0±10.0	300.0±15.0	400.0±20.0	500.0±25.0	≤2.0	≤9.0 nsec.

T_D — Time between +1.5 volt points on input and output voltage wave forms either low to high or high to low.
T_R — Time between +0.8 volt and +2.0 volt points on output wave form either low to high or high to low.

CONNECTION DIAGRAM



NOTES:
1. Material Leads: Solderable Plated Kovar.
2. Leads: .011±.003 Thk. x .018±.003 Wide.
3. Case Material: Epoxy, Color Black.
4. Number for Reference Only (on Dwg.).



Specialists in pulse transformers and completely transfer molded, welded DIP delay lines under 3/16" high — to 250 ns.

Technitrol, Inc.
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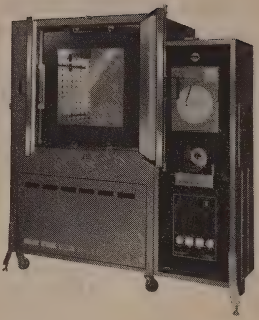
CONSTANT TEMPERATURE

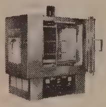


TEMPERATURE/HUMIDITY CHAMBERS

Full-Range Chamber illustrated typifies entire line. Maximum capability cabinets perform all current MIL humidity tests. Dual wet and dry bulb POWER-O-MATIC 60® Proportioning Control Systems assure absolute stability and reliability. Horizontal mechanical convection units feature programming, separate monitoring recorder, and built-in overtemperature protection. Range: −18°C. to +93°C. (±½°C.). Meets MIL-202D, Method 106C, Step 7A; automatically performs −10°C. dip without changing cams. Maintains R.H. ±½%. Chamber sizes: 5.8, 11, 27 and 64 cu. ft.

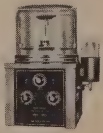
ALSO . . .

Full-Range Single Steady-State Chambers, new −38°C. Extended Range Cabinets, new +150°C. Steady-State Cabinets plus those described below. Acknowledged as the finest units of their kind ever built.



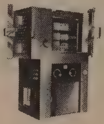
AIR-COOLED TEMPERATURE/ HUMIDITY CABINETS

Unique design lets air do the work, not costly conditioned water! The most accurate, reliable and economical chamber for long-term steady-state high temperature/humidity testing. Meets MIL-202D, Method 103D, Condition D — continuous operation for 56 days. Sizes to 10 cu. ft.



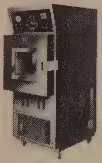
JAR TYPE CHAMBERS

Conduct many tests at once at lowest cost. Patented VAPOR-TEMP® design uses inverted Pyrex glass jar as work chamber, eliminating cost of expensive alloy cabinet. Controls humidity: 20%-98% (±1%); dry bulb: ambient to +77°C. (±½°C.). Also mechanically refrigerated models.



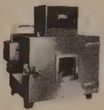
TESTONIC CONSTANT TEMPERATURE CABINETS

Versatile 0°C. to +204°C. (+400°F.) range, patented POWER-O-MATIC 60 Control and exclusive Versa-Kold Mechanical Refrigeration offer remarkable performance at a fraction of the cost of expensive wide-range chambers. Four sizes to 24 cu. ft.



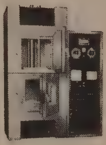
VERSA-RANGE® REFRIGERATED TEST CHAMBERS

Two versatile ranges: −73°C. to +204°C. and −40°C. to +93°C. Five chamber sizes—3 to 64 cu. ft. Patented POWER-O-MATIC 60 Control for incomparably reliable performance. Also −40°C. and −85°C. chest type units. Overtemperature protection.



STABIL-THERM® LN_2 CHAMBERS

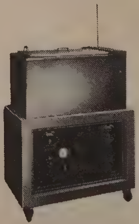
Front or top opening models. −185°C. to +200°C. with solid-state instrumentation. Similar units with CO_2 as coolant have −73°C. to +300°C. range. Quality construction throughout, including overtemperature protection.



THERMAL SHOCK TEST CHAMBERS

Dual Cabinets for MIL-STD-202D and 883; 3-Stage Cabinets for MIL-STD-202D, Method 102A, Preferred Conditions C and D; Versa-Whirl Baths for MIL-STD-883, Method 1011, Conditions A to F. Latter available as an integrated, automated facility.

CONSTANT TEMPERATURE BATHS — WATER, OIL, REFRIGERATED



FOR MIL SPEC TESTING . . .

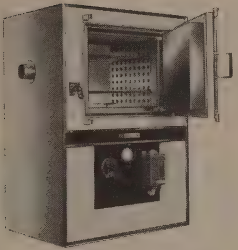
EXACTING CALIBRATION PROCEDURES . . .

MEETING STRINGENT IN-HOUSE SPECS

® BLUE M

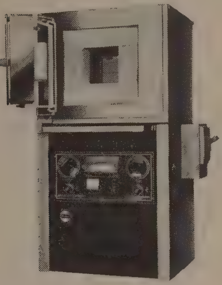
CONTROLLED EQUIPMENT

TYPICAL EXAMPLES OF AMERICA'S FINEST, MOST COMPLETE LINES OF OVENS AND FURNACES



FRICTION-AIRE™ — THE PATENTED ELECTRIC OVENS WITH *NO* HEATING ELEMENTS . . . NOW WITH 3 MODELS U.L. LISTED FOR CLASS 1, GROUP D SERVICE!

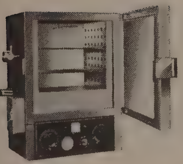
Air turbulence is the only source of heat . . . non-electric POWER-O-MATIC 90™ Control provides superb ±0.5°C. proportional performance. U.L. Listed models have 15°C. above ambient to +150°C. (+302°F.) range — remain well under +215°C. under any operating conditions. Other models built to N.E. Code recommended practices for Class 1, Group D locations . . . others engineered for general-purpose applications of a critical nature. Also Class A and Batch. Various sizes . . . temperatures to +260°C. (+500°F.). You can't buy a safer chamber!



HIGH TEMPERATURE CHAMBERS — OVENS TO +704°C. (+1300°F.); FURNACES TO +1650°C. (+3000°F.)

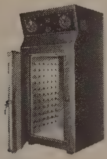
Ultra-Temp Ovens — gravity and mechanical, bench and floor — with ranges to +704°C. (+1300°F.) feature new patented POWER-O-MATIC 80™ Solid-State Proportioning Control for true straight-line performance. Available with a variety of options including programming. Other models with commercial solid-state instrumentation for less critical work.

Complete line of Furnaces includes new models — like Globar® illustrated — with POWER-O-MATIC 80 Control for proportional performance at elevated temperatures. Also Tube, Box Type Muffle and Industrial. All high temperature chambers have built-in overtemperature protection.



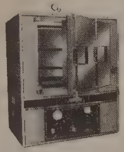
BURN-IN
AND
OVENS
LIFE-TEST

Variety of sizes and types with temperatures to +316°C. (+600°F.). New High-Powered Life-Test Oven is designed for extended tests, yet high K.W. rating and one-pass air-flow system also provides fast run-up and pull-down rates. All models have Blue M's own patented controls for superior performance and overtemperature protection for safety.



BATCH
OVENS

Dozens of models . . . sizes to 96 cu. ft. . . . temperatures to +400°C. (+750°F.). Available with POWER-O-MATIC 60 Control for precise work — or with less sophisticated instrumentation for less demanding performance. Options include programming, roll-in racks, timers, rear doors and many others. Also new Class A ovens meeting recommendations of NFPA Bulletin 86A. Built-in overtemperature protection.



INERT
GAS OVENS

Complete line includes simple units with manual gas control on up to fully automated chambers with programming. Bench and floor models. Temperatures to +593°C. (+1100°F.). All have patented Blue M control systems matched to the capabilities of the chamber for fine performance. Overtemperature protection standard. Properly applied, these units quickly pay for themselves in gas savings alone.

Complete selection ranging from small, inexpensive water baths for laboratory use on up to large, semi-custom units for pinpoint testing of exotic components and parts. Most feature Blue M's patented, fully automatic MAGNI-WHIRL® agitation — the built-in system which obsoletes old-fashioned, space-wasting circulating methods and mechanical stirrers. Blue M control systems — including POWER-O-MATIC 60 — are standard on most models.

FOR FULL DETAILS ON THESE PRODUCTS AND FOR INFORMATION ON OUR COMPLETE CONTROLLED TEMPERATURE CAPABILITY — INCLUDING CUSTOM-ENGINEERING — CONTACT YOUR NEAREST BLUE M BRANCH OFFICE OR WRITE US DIRECT. YOUR INQUIRY WILL RECEIVE OUR PROMPT ATTENTION.

BLUE M ENGINEERING
A Sales and Service Branch of Blue M Electric Company
CORPORATE HEADQUARTERS: BLUE ISLAND, ILLINOIS 60406

TELEDYNE GEOTECH

TELEDYNE GEOTECH DOES ALL!

DESIGNS / MANUFACTURES

Sensors for – meteorology
geophysics
intrusion detection
Magnetic tape recorders
Signal conditioners / processors
Industrial data acquisition and control equipment
Microprocessor control units.

PROVIDES

Systems for – pipeline automation
compressor stations
meteorological profile towers
automatic weather stations
outdoor intrusion detection
Software / hardware

SERVICES

Installation
Startups
Software support and maintenance
Data reduction
Training

For over 35 years, Teledyne Geotech has been intensely involved in such diverse fields as meteorology, seismology, outdoor intrusion detection, and pipeline automation. Through the years they have paced the industry in design and development of instruments and systems unique to these fields.

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P.O. Box 28277, Dallas, Tex. 75228
Phone: (214) 271-2561
Telex: 73-2394

also TELEDYNE GEOTECH
P.O. Box 334, Alexandria, Va. 22313
Phone: (703) 836-3882
Telex: 89-9424

ENVIRONMENTAL TEST EQUIPMENT

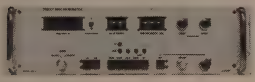
VIBRATION TEST SYSTEMS

Unholtz-Dickie produces vibration test systems for all test applications. Sine force ratings range from 50 to 20,000 pounds. The table below lists these systems, with pertinent technical data. Special systems, including those with multiple shakers are also available.

Every Unholtz-Dickie system includes a safe, reliable, proven solid state power amplifier, and features reliable air cooling of the shaker armature. Systems engineering of each system element assures maximum performance and utilization, with simplified operation.

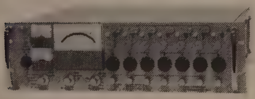
SYSTEM PERFORMANCE				SHAKER	
FORCE (lbs)		STROKE (inches, DA)	MAX. SINE PAYLOAD (lbs) at 20g	ARMATURE WEIGHT (lbs)	TABLE DIA (inches)
Sine (pk)	Random (rms)				
50	—	0.5	1.8	0.69	2
50	—	1.0	1.9	0.55	drive rod
150	—	4.0	5.2	2.25	drive rod
250	125	1.5	9.7	2.75	3.5
300	180	1.5	12.2	2.75	3.5
500	300	1.0	19.7	5.3	4.5
1,000	—	6.0	39	11	drive rod
1,200	600	1.0	46	14	5.75
1,200	600	1.0	40	20	8
1,700	850	1.0	65	20	8
3,000	2,200	1.0	134	16	5.75
3,000	2,200	1.0	128	22	8
3,800	2,200	1.0	162	28	8
6,000	3,000	1.0	264	36	12
6,000	4,500	1.0	264	36	12
8,000	4,000	1.0	310	90	16
12,000	6,000	1.0	510	90	16
12,000	8,000	1.0	505	100	16
17,500	12,000	1.0	780	95	16
17,500	15,000	1.0	780	95	16
19,500	14,000	1.0	880	95	16
20,000	18,000	1.0	905	95	16

ACCESSORY INSTRUMENTS



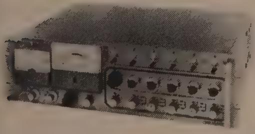
Model OSC-1

Sweep sine generator uses digital circuitry to generate output signal. Features presettable time of sweep, number of sweeps, and digital frequency counter with 0.1 Hz resolution displayed each second.



Model SP-7

Servo-programmer features acceleration, velocity or displacement control in any sequence in up to 7 independent automatic program segments as a function of frequency — log d-c output for record of test.

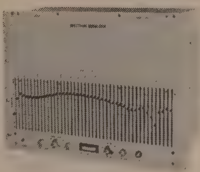


Model ACS-6

Acceleration Control Selector automatically switches to the highest (or lowest) acceleration input. Accepts six sine acceleration signals, and gates to the output whichever signal reaches its preset limit.

Model MAC-8

Multifunction Averaging Control features eight individually selectable data channels for control to the average signal level. Can be used for sine or random vibration testing.



Model E109B

Spectrum Equalizer featuring 45 active filters with individual, rectilinear motion attenuation controls. Convenient equalization can be performed using this unit in conjunction with a real time analyzer.

Accelerometers

A full line of piezoelectric accelerometers for general purpose vibration testing and for special applications. Various models are optimized to provide features such as subminiature size, high sensitivity, high frequency operation, and normalized 10 pC/g sensitivity.

manufacturers of shaker systems, advanced instruments and accelerometers

UNHOLTZ-DICKIE CORPORATION

3000 WHITNEY AVE./HAMDEN, CONN. 06518/(203) 288-3358

FAN SELECTION GUIDE

BUNKER RAMO AMPHENOL

Step 1 . . . Determine your heat load.

Since almost all of the electrical power input to your system is dissipated as heat, you then have a close approximation to the amount of heat to be removed in watts.

Step 2 . . . Calculate the necessary air flow to remove that heat.

$$CFM = \frac{W}{\Delta T} \times 3.16$$

W-is the heat load in watts that you determined above.

ΔT-is an acceptable difference between average outlet temperature and average intake temperature. A good rule of thumb is 18° F (or 10°).

Step 3 . . . Estimate the resistance to air flow.

This is very difficult to do precisely but a ballpark estimate can be obtained by estimating the static pressure drops through air passages and adding them up. The most restricted area is the most significant.

Static pressure drop (inches of H_2O) $= [\frac{V}{4000}]^2$.

$$V = \frac{CFM}{\text{Area (sq. ft.)}}$$

Step 4 . . . Now that you have a rough idea of the fan performance curve required, you can narrow your choice by considering the following trade-offs:

Trade-Off 1 . . . Life vs. price.

Fan life (which is essentially bearing life) depends greatly on the demands of the application and, in particular, the ambient temperature. The life of sleeve bearing fans which use oil as a lubricant are adversely affected by heat which thins the oil and inhibits its lubricating properties. Sleeve bearing fans should not be used above 55°C; for these applications, ball bearing fans (AMPHENOL SERIES 760) would be needed to give acceptable life. Since ball bearing fans are lubricated with grease, which does not lose its lubricating properties with increases in temperature, the life of ball bearing fans is not dependant on temperature within its specified rating (typically a maximum of 70°C with 100°C capability on special models). In most applications a ball bearing fan will last twice as long as a sleeve bearing fan (typically ten years). If you lease or maintain your equipment then the extra dollars spent would be recovered in lower long run costs.

Trade-Off 2 . . . Air delivery vs. noise

A low noise fan is achieved by reducing rotational speed and hence CFM. What is most often overlooked is that available static pressure is a function of the square of the speed so that when speed is reduced by one half the resulting static pressure is only ¼th of that produced by the full speed fan!

Trade-Off 3 . . . Size

Because of their low cost and excellent cooling performance, the Brute models would be an excellent choice for many applications but they do require more space. However, good fan application practice requires at least a half impeller diameter between fan and components to allow the conversion of air velocity into static pressure. The extra room for the Brute model should then be available. For really tight applications the 760 Series offers models 4-½ inches square and 3-⅝ inches square that are only 1 inch thin.

AXIAL FANS

BUNKER RAMO AMPHENOL

Series 760 Axial Fans

Amphenol now offers an alternative source of supply for cooling fans through its Component Marketing Service subsidiary. This broad line is made by an experienced, innovative manufacturer — and is capable of second sourcing most industry standard models. Thin fans for high density packaging applications and high pressure and flow fans for unusually tough cooling problems are evidenced of technical ingenuity. Amphenol fans are known for high quality construction featuring ball bearings, aluminum frame and lightweight rotors. They offer longer operating life at competitive prices. The efficient aerodynamic design of the impeller assures highest pressure and flow for their size.

Models are illustrated in order of cooling capacity. Those models marked "stock" are available in production quantities from Broadview, Illinois. Limited quantities of other models may be available for evaluation. Detailed catalog describing entire line is available on request.

INTERCHANGEABILITY CHART

Amphenol	Rotron	IMC	Pamotor
760-125XR-182-11115	Sentinal 747 Muffin M747 Centaur CT3A/B2	Boxer BS/WS2107FL	4500 Series 4600 Series
760-125XR-181-11220	Sentinal 756 Muffin M756 CT3A/B52	Boxer BS/WS2107FL-3	4550 Series 4650 Series
760-125XL-182-11115	Whisper	HiFi Boxer BS/WS2107FL-9	4800 Series
760-125XL-181-11220	Whisper	HiFi Boxer BS/WS2107FL-10	4850 Series
760-122VF-182-11115	Major MA2B4	——	7500 Series
760-122VF-181-11220	Major MA77B4	——	7550 Series
760-126LF-182-11115	Sprite SP2A2	PeeWee Boxer PBS/PWS2107FL	8500 Series
760-126LF-181-11220	Sprite SP2A3	PeeWee Boxer PBS/PWS2107FL-3	8550 Series

Series 760 Axial Fan — Model 126

760 126 is interchangeable with other 3⅛ in. size fans. The "knee" of the pressure/flow curve is about 10% better than other fans of this size extending the range of applications for the 126. We'll deliver more air at working pressures above .075 in. of water than any other fan of this size.

CHARACTERISTICS

Electrical connection: 2-12 inch long #22GA stranded wires.

Mounting: Double square flange and mounting holes.

Insulation and finish: See general catalog for specification codes.

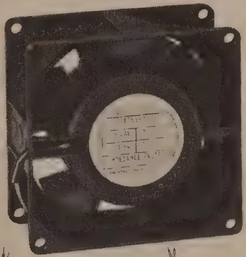
Temperature range: Code 11 construction −40°C to +70°C.

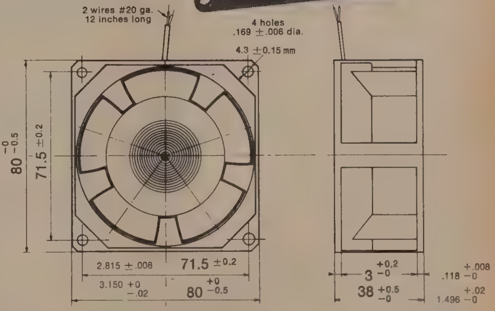
Locked rotor protection: Impedance protected.

HOW-TO-ORDER

EXAMPLE: 760 126 182 11115

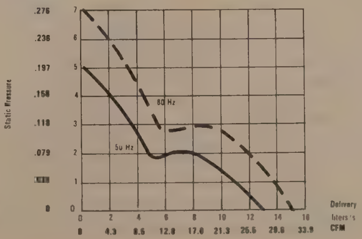
Series
Impeller Type
Motor Type
Special Characteristic
  1 = Plug/Solder Terminal
  2 = Flying Leads
Voltage
Insulation and Finish Specification Code
UL Recognition
  81 = 220 Vac Construction
  82 = 115 Vac Construction

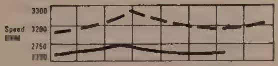




Model Number		Freq. Hz	Voltage V	Phase	RPM	For Maximum Delivery	
						Power Input (w)	Line Current ma
126 LF	182	50/50	115	1	2700/3200	11/8	130/100
	181		220			14/10	90/70

PERFORMANCE CURVE 760 126





FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

TUBE AXIAL FANS

BUNKER RAMO AMPHENOL

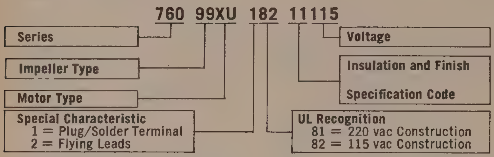
Series 760 99

Extremely small width fan. Six-bladed impeller. 400 Hz model with permanent capacitor. Model 760 99 XU01 is UL recognized under the Component Recognition Program (File E53047). Accessories: Finger-guard for all models (Part No. 760 9901-43). Plug and cable for 50/60 Hz models (Part No. 760 9601-05).

CHARACTERISTICS

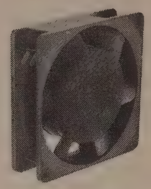
Electrical connection: Furnished with plug/solder terminals or flying leads. 400 Hz version furnished flying leads only. Leads are 200 mm or 7¾ inches long.
Weight: 13.0 oz. max.

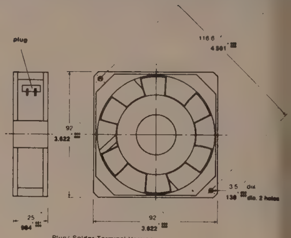
HOW-TO-ORDER EXAMPLE:


760 99XU 182 11115

- Series
- Impeller Type
- Motor Type
- Special Characteristic
  - 1 = Plug/Solder Terminal
  - 2 = Flying Leads
- Voltage
- Insulation and Finish
- Specification Code
- UL Recognition
  - 81 = 220 vac Construction
  - 82 = 115 vac Construction

DIMENSIONS



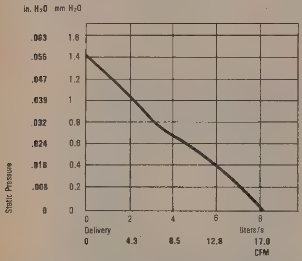


Plug/ Solder Terminal Version

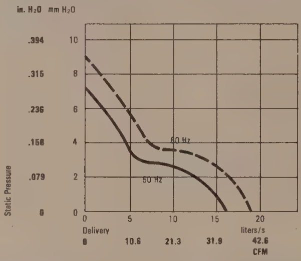
NOMINAL PERFORMANCE

Model Number	Frequency (Hz)	Voltage (v)	Capacitor Required (uF)	R.P.M.	For Maximum Delivery	
					Power Input - (w)	Line Current (ma)
760 99XM (Stock)	50/60	115 220	—	1450/1500	3.1/2.7	35/31 18/16
760 99XU (Stock)	50/60	115 220	—	2750/3300	14/11	150/130 80/65
760 99XV	400	115 200	0.47 0.15	5500	14	145 85

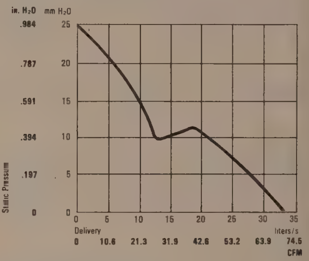
PERFORMANCE CURVE 760 99XM



PERFORMANCE CURVE 760 99XU



PERFORMANCE CURVE 760 99XV



Speech Interference Levels: 25 db (760 99XM), 50 Hz = 33 db, 60 Hz = 37 db (760 99XU, 57 db (760 99XU)

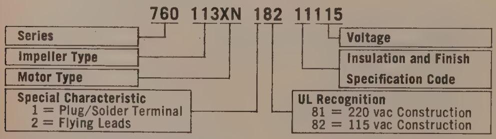
Series 760 113

Designed to produce long life performance even in high temperature applications. Six-bladed impeller 50/60 Hz model is impedance protected. Model 760 113XN 1 is UL recognized under the Component Recognition Program (File E53047). Accessories: Finger-guard for all models (Part No. 760 9901 43). Plug and cord for 50/60 Hz model (Part No. 760 9601 05).

CHARACTERISTICS

Electrical connection: Furnished with plug/solder terminals or flying leads. 400 Hz version furnished with flying leads only. Leads are 200 mm or 7¾ inches long.
Weight: 18.3 oz. max.

HOW-TO-ORDER EXAMPLE:

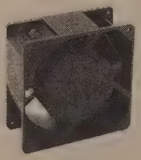

760 113XN 182 11115

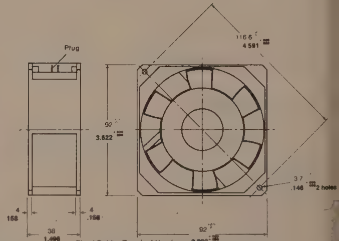
- Series
- Impeller Type
- Motor Type
- Special Characteristic
  - 1 = Plug/Solder Terminal
  - 2 = Flying Leads
- Voltage
- Insulation and Finish
- Specification Code
- UL Recognition
  - 81 = 220 vac Construction
  - 82 = 115 vac Construction

NOMINAL PERFORMANCE

Model Number	Frequency (Hz)	Voltage (v)	Capacitor Required (uF)	R.P.M.	For Maximum Delivery	
					Power Input - (w)	Line Current (ma)
760 113XN (Stock)	50/60	115 220	—	2800/3250	13/12	175/145 90/75
760 113XP	400	115 200	0.69 0.22	5500	19	200 110

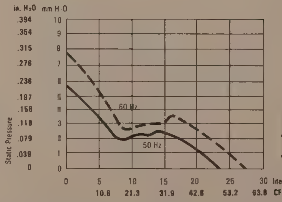
DIMENSIONS



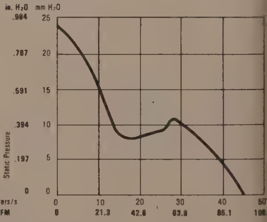


Plug/ Solder Terminal Version

PERFORMANCE CURVE 760 113XN



PERFORMANCE CURVE 760 113XP



Speech Interference Levels: 50 Hz = 36 db; 60 Hz = 40 db (760 113XN), 53 db (760 113XP)

FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

TUBE AXIAL FANS

BUNKER RAMO AMPHENOL

Series 760 98

Same extremely thin design as the 760 99 but capable of delivering better flow rate. Six-bladed impeller. 50/60 Hz models are impedance protected. Model 760 98XH 01 is UL recognized under the Component Recognition Program (File E53047). Accessories: Finger-guard for all models (760 9601 43), filter for all models (760 96 302), filter for 400 Hz models (760 96 125), plug and cable for 50/60 Hz models (760 9601 05).

CHARACTERISTICS

Electrical connection: 50/60 Hz fans furnished with plug/solder terminals or flying leads. 400 Hz version furnished with flying leads only. Leads are 200 mm or 7¾ inches long.

Weight: 12.7 oz. max.

HOW-TO-ORDER EXAMPLE:

760 98XH 182 11115

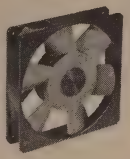
- 760 — Series
- 98X — Impeller Type
- H — Motor Type
- 1 — Special Characteristic
  - 1 = Plug/Solder Terminal
  - 2 = Flying Leads
- 82 — UL Recognition
  - 81 = 220 vac Construction
  - 82 = 115 vac Construction
- 1111 — Insulation and Finish Specification Code
- 5 — Voltage

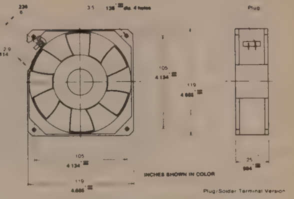
NOMINAL PERFORMANCE

Model Number	Frequency (Hz)	Voltage (v)	Capacitor Required (uF)	R.P.M.	For Maximum Delivery Power Input - (w)	For Maximum Delivery Line Current (ma)
760 98XH (Stock)	50/60	115 220	—	2600/3000	14/12	170/140 85/70
760 98XJ	400	115 200	1 0.32	5500	30	310 180

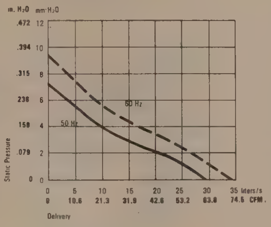
Speech Interference Levels: 50 Hz = 38 db; 60 Hz = 44 db (760 98XH), 62 db (760 98XJ)

DIMENSIONS

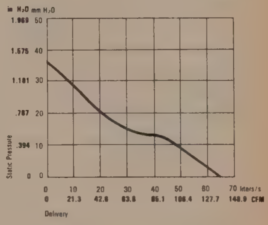




PERFORMANCE CURVE 760 98XH



PERFORMANCE CURVE 760 98XJ



Series 760 125

760 125 Designed for applications requiring maximum cooling performance. Delivers as much air at .15 inches H_2O as two 100 CFM 4$^{11}/_{16}$ inch fans. Interchangeable with 96 series. Models 760 125XL 181, 760 125XL 182, 760 125XR 181 and 760 125XR 182 are UL recognized under the Component Recognition Program (File E53047).

CHARACTERISTICS

Electrical connection: 50/60 Hz fans furnished with plug/solder terminals.

Temperature range: Code eleven construction −40°C to +70°C.

Weight: 19.4 oz. max.

HOW-TO-ORDER EXAMPLE

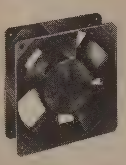
760 125XL 182 11115

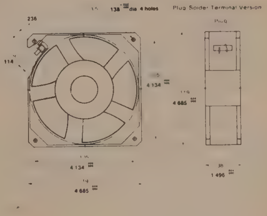
- 760 — Series
- 125X — Impeller Type
- L — Motor Type
- 1 — Special Characteristic
  - 1 = Plug/Solder Terminal
- 82 — UL Recognition
  - 81 = 220 vac Construction
  - 82 = 115 vac Construction
- 1111 — Insulation and Finish Specification Code
- 5 — Voltage

NOMINAL PERFORMANCE

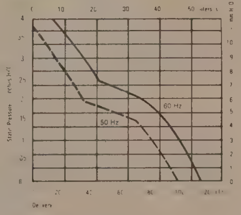
Model Number	Frequency (Hz)	Voltage (v)	Capacitor Required (uF)	R.P.M.	For Maximum Delivery Power Input - (w)	For Maximum Delivery Line Current (ma)
760 125XL 182 (Stock)	50/60	115	—	1550/1650	11/9	135/115
760 125XL 181 (Stock)		220				70/60
760 125XR 182 (Stock)	50/60	115	—	2750/3250	18/15	260/200
760 125XR 181 (Stock)		220				135/105
760 125XT (Stock)	400	115 200	0.15 0.05	3300	16	145 85
760 125XS (Stock)		115 200	1.47 0.47	5500	41	415 240

DIMENSIONS



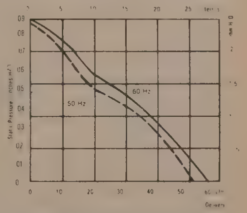


PERFORMANCE CURVE 760 125XR



Speech Interference Level:
50 Hz = 37 db;
60 Hz = 40 db (760 125XR)

PERFORMANCE CURVE 760 125XL



Speech Interference Level:
50 Hz = 26 db;
60 Hz = 29 db (760 125XL)

FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

TUBE AXIAL FANS

BUNKER RAMO AMPHENOL

Series 760 120/121

Designed to provide maximum performance, with flow rates of 260 CFM at pressures of up to .7 in. of H_2O, in a minimum package size of 6 in. x 1½ in.Seven-bladed impeller. Capacitor furnished with 760 120 VZ 02 is UL recognized under the Component Recognition Program (File E53047). Accessories: Fingerguard (Part No. 760 120 01-43), Filters for 760 120 VZ models (Part Nos. 760 120-400, 760 120-700 and 760 120-720). Filters for 760 121 models on request, Plug and cable for 760 120 VZ 02 (Part No. 9601-05).

CHARACTERISTICS

Electrical connection: 50/60 Hz fans furnished with plug/solder terminals or flying leads. 400 Hz version furnished with flying leads only. Leads are 200 mm or 7¾ inches long.

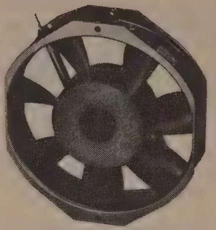
Weight: 28.2 oz. max.

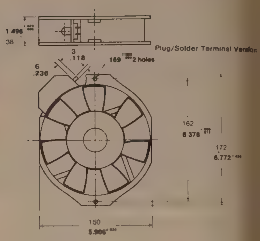
HOW-TO-ORDER EXAMPLE:

760 120VZ 282 11115

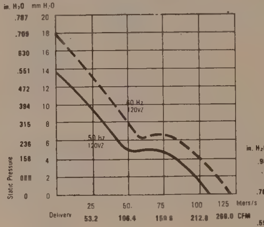
- Series
- Impeller Type
- Motor Type
- Special Characteristic
  - 1 = Flying Leads
  - 2 = Plug/Solder Terminal with Capacitor
- UL Recognition
  - 81 = 220 vac Construction
  - 82 = 115 vac Construction
- Insulation and Finish Specification Code
- Voltage

DIMENSIONS

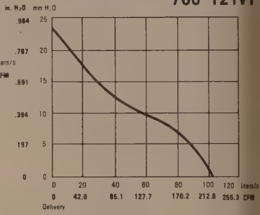




PERFORMANCE CURVES 760 120VZ, VR



PERFORMANCE CURVE 760 121VY



NOMINAL PERFORMANCE

Model Number	Frequency (Hz)	Voltage (v)	Capacitor Required (uF)	R.P.M.	For Maximum Delivery Power Input - (w)	For Maximum Delivery Line Current (ma)
760 120VZ (Stock)	50	115 220	3.2 1	2700	40 42	340 190
(Stock)	60	115 220	3.2 1	3100	—	350 195
760 121VY	400	115 200	0.32 1	3750	39	410 345

Speech Interference Levels: 50 Hz = 54 db; 60 Hz = 57 db (760120VZ); 55 db (760 120VY)

Series 760 122

760 122 Shaded pole motor version of our 120 Series. Delivers nearly equivalent cooling performance. Interchangeable with our 120 Series and other manufacturers' 6 inch fans. Designed for UL recognition.

CHARACTERISTICS

Electrical Connection: 50/60 Hz fans provided with plug/solder terminals; flying leads on request.

Temperature: Code 11 construction, −40°C to +70°C.

Material: Housing — die cast aluminum.
Impeller — glass filled polycarbonate; SE-1.

Locked Rotor Protection: Line Voltage Switch.

Weight: 41 oz. max.

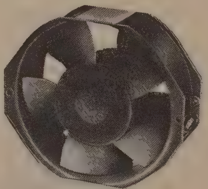
HOW-TO-ORDER EXAMPLE

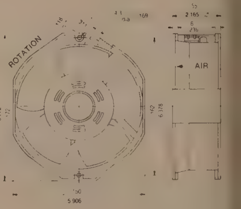
760 122VF 182 11115

- Series
- Impeller Type
- Motor Type
- Special Characteristic
  - 1 = Plug/Solder Terminal
  - 2 = Flying Leads
- UL Recognition
  - 81 = 220 vac Construction
  - 82 = 115 vac Construction
- Insulation and Finish Specification Code
- Voltage

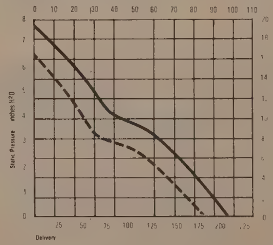
Model Number	Freq. (Hz)	Volt (v)	R.P.M.	For Maximum Delivery Power Input (w)	For Maximum Delivery Line Current ma	Locked Rotor Current ma
760 122VF 182 Stock 760 122VF 181 Stock	50/60	115 220	2750/3200	42/38	580/490 320/270	970/780 540/430

DIMENSIONS





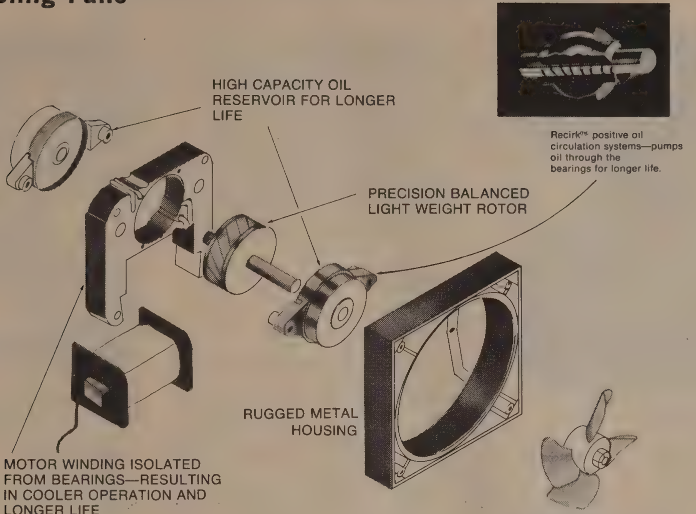
PERFORMANCE CURVE 760 122VF



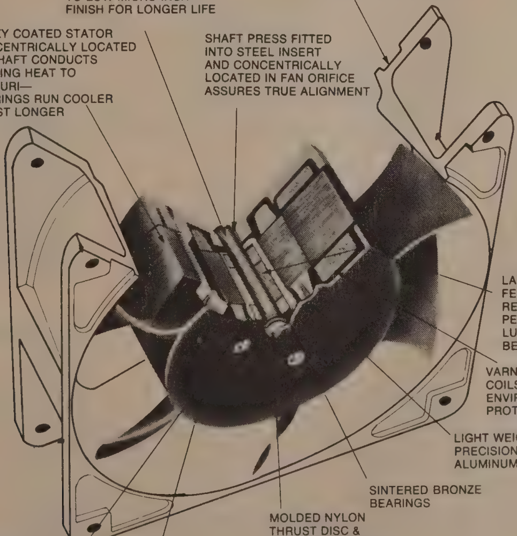
Speech Interference Level:
50 Hz = 47 db; 60 Hz = 50 db

FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

Compare the Built-in Quality of Series 390 Cooling Fans


HIGH CAPACITY OIL RESERVOIR FOR LONGER LIFE
PRECISION BALANCED LIGHT WEIGHT ROTOR
RUGGED METAL HOUSING
MOTOR WINDING ISOLATED FROM BEARINGS—RESULTING IN COOLER OPERATION AND LONGER LIFE
SE-0 RATED TOUGH POLYCARBONATE

Recirk™ positive oil circulation systems—pumps oil through the bearings for longer life.


HEAT TREATED STEEL SHAFT GROUND AND POLISHED TO LOW MICRO-INCH FINISH FOR LONGER LIFE
RUGGED DIE CAST ZAMAC VENTURI—RIGID ONE PIECE CONSTRUCTION—NO BREAKAGE PROBLEMS
EPOXY COATED STATOR CONCENTRICALLY LOCATED TO SHAFT CONDUCTS WINDING HEAT TO VENTURI—BEARINGS RUN COOLER & LAST LONGER
SHAFT PRESS FITTED INTO STEEL INSERT AND CONCENTRICALLY LOCATED IN FAN ORIFICE ASSURES TRUE ALIGNMENT
LARGE FELT OIL RESERVOIR PERMANENTLY LUBRICATES BEARINGS
VARNISH IMPREGNATED COILS FOR ENVIRONMENTAL PROTECTION
LIGHT WEIGHT DIE CAST PRECISION BALANCED ALUMINUM ROTOR
SINTERED BRONZE BEARINGS
MOLDED NYLON THRUST DISC & END PLAY WASHERS MINIMIZE POSITION SENSITIVITY
PRECISION MOLDED "O" RING OIL SEAL PREVENTS OIL LEAKAGE
TOUGH MOLDED GLASS FILLED LEXAN FAN BLADE—CONCENTRICALLY LOCATED ON ROTOR

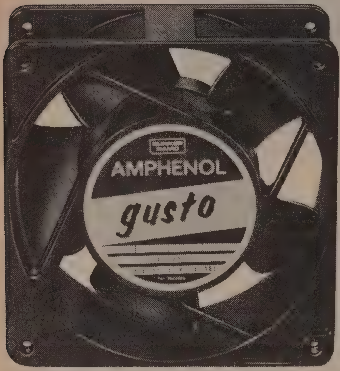
UL RECOGNIZED

FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

AXIAL FANS

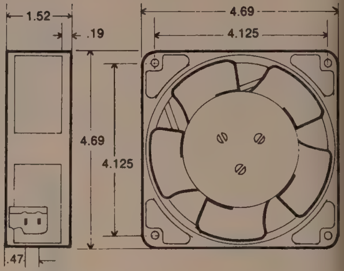
BUNKER RAMO AMPHENOL

Axial Fan Series 390 *gusto*



The Gusto series offers off-the-shelf delivery of the most popular fan size. Gusto fans are interchangeable with all other 4½ inch fans in terms of both performance and dimensions. Quality construction throughout — durable heat sinking metal frame, tough lexan impeller, lightweight non-position sensitive rotor and large sealed oil reservoir sleeve bearing system assure maximum reliability and life for a sleeve bearing design.

Typical life is in excess of five years depending on the application. UL recognized under File No. E53047. Available in low noise, standard and high performance versions. See Pages 000000 for accessories.



CHARACTERISTICS

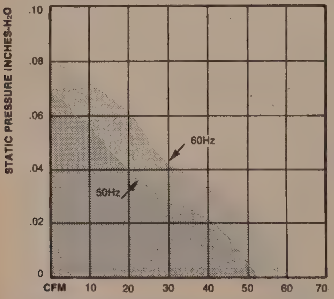
Temperature Range
−30°C to 55°C
Materials
Housing: Zamac III zinc alloy black paint finish
Impeller: Lexan SE-0 rated
Locked Rotor Protection
Impedance protected

Life Expectancy
Better than 5 years
Winding Insulation Class
F
Electrical Connection
Two .110 inch wide quick disconnect terminals suitable for soldering or cord

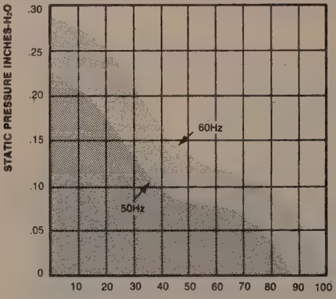
NOMINAL PERFORMANCE

Model	Free Delivery CFM	Voltage Volts	Line Current Amps	Power Watts	Locked Rotor Current Amps	Speed RPM	Winding Rise °C	Noise SIL db	Weight oz
390-457A1-10	60	115 60Hz	.20	16	.24	2000	29	24	30
390-458A1-11	100	115 60Hz	.30	20	.37	3000	18	33	30
390-458A2-12	84	220 50Hz	.20	26	.28	2700	39	30	
390-459A1-13	110	115 60Hz	.33	24	.43	3100	18	40	30
390-459A2-14	88	220 50Hz	.30	40	.40	2800	34	35	

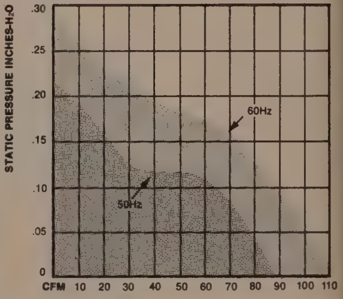
PERFORMANCE CURVE 457A1



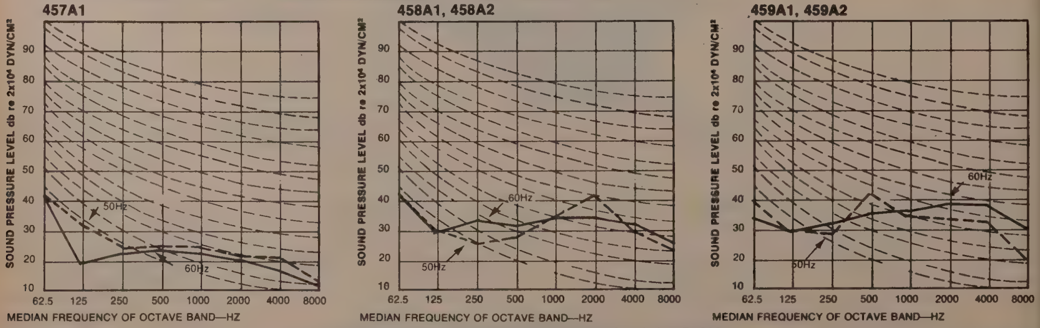
PERFORMANCE CURVE 458A1, 458A2



PERFORMANCE CURVE 459A1, 459A2



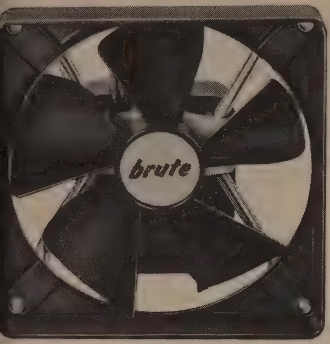
ACOUSTICAL CHARACTERISTICS TEST METHOD: MICROPHONE 3 FT. AND 45° FROM INTAKE SIDE.

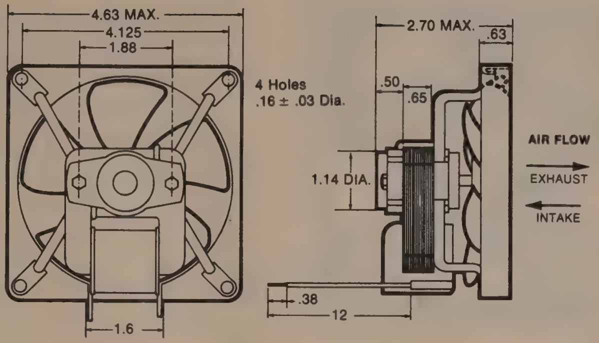

457A1
458A1, 458A2
459A1, 459A2

AXIAL FANS

BUNKER RAMO AMPHENOL

Axial Fan Series 390 brute



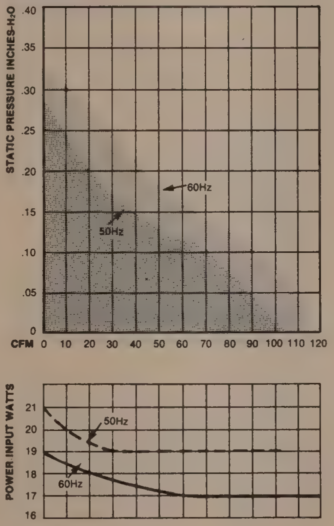


Designed to minimize your cooling fan costs without compromising performance! The Brute exhaust model delivers a full 117 cfm at free delivery! Operating life exceeds that of concentric motor designs because the winding heat is kept away from the lifetime lubricated self-aligning bearings which incorporate the Recirk™ positive oil circulation system. The rugged metal frame mounts on conventional 4⅛ inch centers. UL recognized, CSA listed. The powerful two pole shaded pole motor is impedance protected. See Page 0000 for optional finger guard and filters. Leads are built-in.

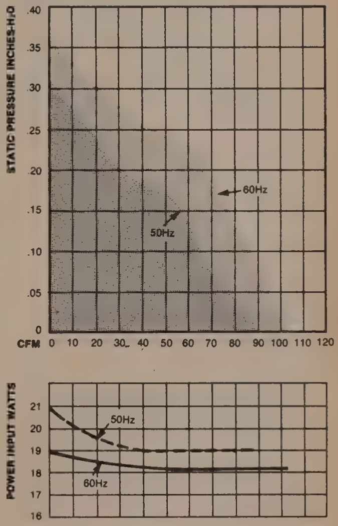
CHARACTERISTICS

Temperature Range
−30°C to 55°C
Materials
Venturi: Die cast zinc alloy painted black
Struts: 3⁄16 diameter aluminum
Impeller and Bobbin: 94V-0 rated plastic
Locked Rotor Protection
Impedance protected
Life Expectancy
Better than 7 years
Winding Insulation Class
B
Electrical Connection
Two 12 inch #18GA tinned stranded wires ⅜ end strip, 105°C PVC insulated

PERFORMANCE CURVE 2329, 2331 —EXHAUST



PERFORMANCE CURVE 2330, 2332 —INTAKE



NOMINAL PERFORMANCE

Model	Frequency (Hz)	Volts (v)	Phase	Speed RPM	CFM Free Air	Maximum Delivery		Motor Temperature		Weight (oz)
						Power Input (w)	Line Current ma	(°C)	Rise ▪ (°F)	
390-451A1-2329 Exhaust	60 50	115 115	1 1	2810 2630	117 103	17 19	295 370	22 35	72 95	24 24
390-451A2-2331 Exhaust	60 50	220 220	1 1	2780 2580	117 103	17 19	160 205	22 34	72 93	24 24
390-450A1-2330 Intake	60 50	115 115	1 1	2730 2570	103 89	17 19	300 370	20 26	68 79	24 24
390-450A2-2332 Intake	60 50	220 220	1 1	2690 2550	103 89	17 19	160 205	20 32	68 90	24 24

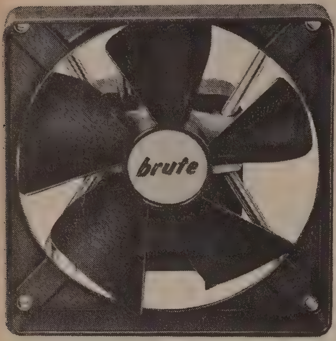
▪ Temperature rise is measured at maximum power absorbtion point within range of normal usage.

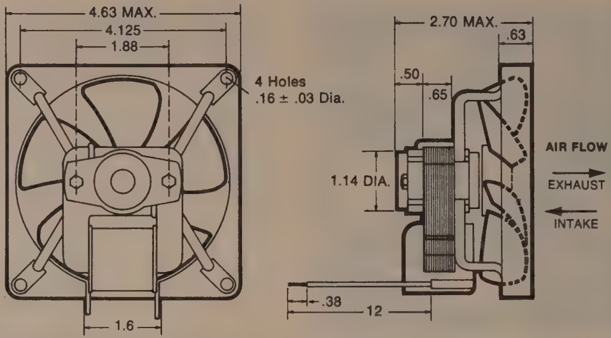
FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

AXIAL FANS

BUNKER RAMO AMPHENOL

Axial Fan Series 390 DEMI brute



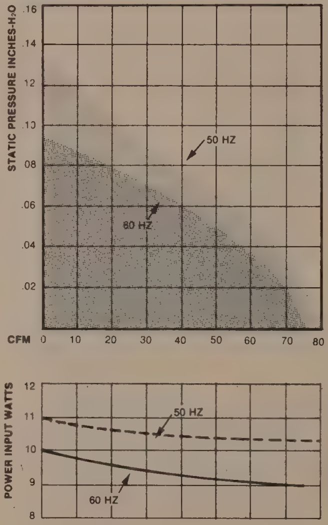


The designers choice where low noise is the prime consideration. The Demi Brute exhaust model delivers 70 cfm at an SIL of only 31 db. The Recirk™ oil circulation system eliminates the bearing wear problems that occur in slow speed concentric motor designs. Convenient 4⅛ inch mounting centers on durable metal frame allows ready substitution for your present fan. UL recognized, CSA listed. Impedance protected during locked rotor condition.

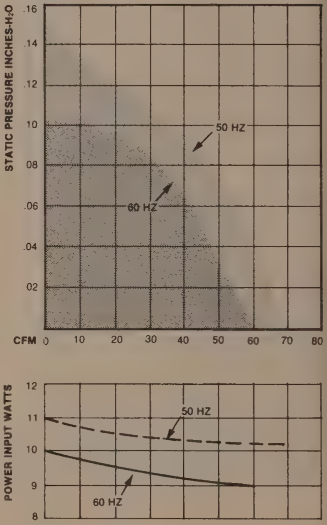
CHARACTERISTICS

Temperature Range
−30°C to 55°C
Materials
Venturi: Die cast zinc alloy painted black
Struts: 3⁄16 diameter aluminum
Impeller and Bobbin: 94V-0 rated plastic
Locked Rotor Protection
Impedance protected
Life Expectancy
Better than 7 years
Winding Insulation Class
B
Electrical Connection
Two 12 inch #18GA tinned stranded wires ⅜ end strip, 105°C PVC insulated

PERFORMANCE CURVE 2333, 2335 —EXHAUST



PERFORMANCE CURVE 2334, 2336 —INTAKE



NOMINAL PERFORMANCE

Model	Frequency (Hz)	Volts (v)	Phase	Speed RPM	CFM Free Air	Maximum Delivery		Motor Temperature		Weight (oz)
						Power Input (w)	Line Current ma	(°C)	Rise ■ (°F)	
390-453A1-2333	60	115	1	1520	70	10	155	23	74	17
Exhaust	50	115	1	1830	60	11	183	33	92	17
390-453A2-2335	60	220	1	1480	74	9	75	23	74	17
Exhaust	50	220	1	1820	80	10	90	30	86	17
390-452A1-2334	60	115	1	1450	58	10	155	20	68	17
Intake	50	115	1	1760	50	11	185	24	75	17
390-452A2-2336	60	220	1	1430	62	9	75	20	68	17
Intake	50	220	1	1720	71	10	90	25	77	17

■ Temperature rise is measured at maximum power absorbtion point within range of normal usage.

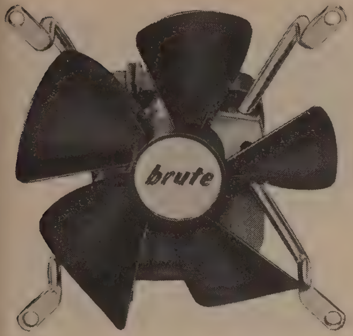
FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

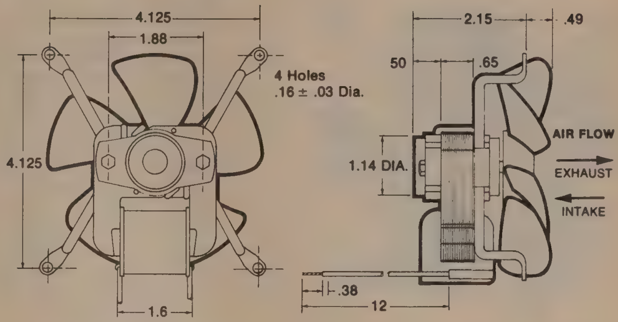
AXIAL FANS

BUNKER RAMO AMPHENOL

Axial Fan Series 390

BARE BONES brute



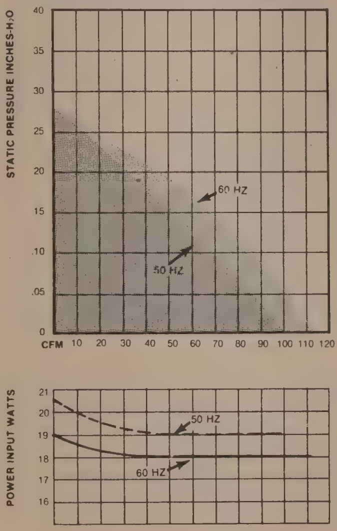


Allows the designer to save even more money by utilizing the mounting panel as a venturi. When mounted in a 4⅜ inch diameter hole in a ⅛ thick panel, the Bare Bones Brute produces a very respectable performance curve. May also be used to move free air for stirring or spot cooling applications at minimal cost. The Recirk™ positive oil circulation system gives life expectancies of 7 years in typical applications.

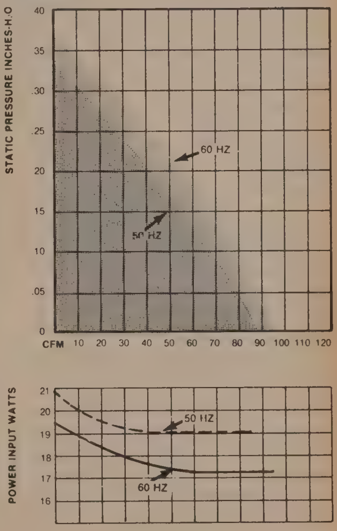
CHARACTERISTICS

Temperature Range
−30°C to 55°C
Materials
Venturi: Die cast zinc alloy painted black
Struts: 3⁄16 diameter aluminum
Impeller and Bobbin: 94V-0 rated plastic
Locked Rotor Protection
Impedance protected
Life Expectancy
Better than 7 years
Winding Insulation Class
B
Electrical Connection
Two 12 inch #18GA tinned stranded wires ⅜ end strip, 105°C PVC insulated

PERFORMANCE CURVE 2337, 2339
— EXHAUST



PERFORMANCE CURVE 2338, 2340
— INTAKE



NOMINAL PERFORMANCE

Model	Frequency (Hz)	Volts (v)	Phase	Speed RPM	CFM* Free Air	Maximum Delivery Power Input (w)	Maximum Delivery Line Current ma	Motor Temperature (°C)	Motor Temperature Rise ▪ (°F)	Weight (oz)
390-451B1-2337	60	115	1	2760	112	18	300	22	72	20
Exhaust	50	115	1	2580	98	19	365	35	95	20
390-451B2-2339	60	220	1	2660	111	17	160	21	70	20
Exhaust	50	220	1	2560	96	19	205	32	90	20
390-450B1-2338	60	115	1	2730	95	18	300	20	68	20
Intake	50	115	1	2570	85	20	380	26	79	20
390-450B2-2340	60	220	1	2720	93	17	160	21	70	20
Intake	50	220	1	2560	82	19	205	30	86	20

▪ Temperature rise is measured at maximum power absorbtion point within range of normal usage.

*Air flow measured using a ⅛'' thick 4⅜ dia. sharp edge orifice.

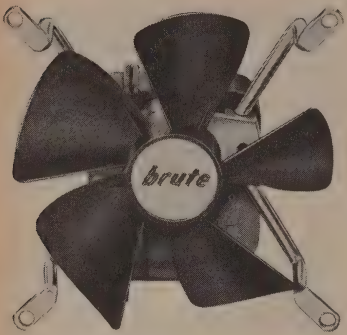
FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

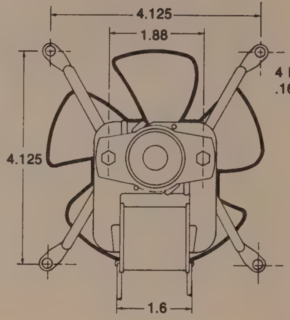
AXIAL FANS

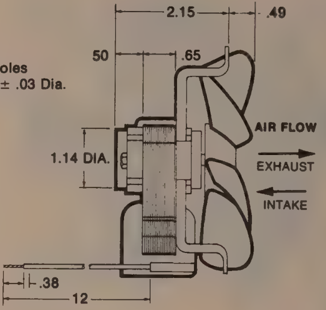
BUNKER RAMO AMPHENOL

Axial Fan Series 390

BARE BONES
DEMI *brute*





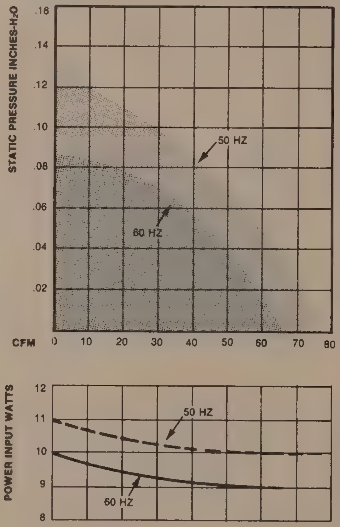


Low noise version — only 31 db SIL when mounted in panel orifice. Performance curves equivalent to Demi Brute. Offers cost saving potential through the use of a panel venturi. May also be used for air stirring or spot cooling applications at minimal cost. Same 7 year life expectancy as Brute models. UL recognized, CSA listed.

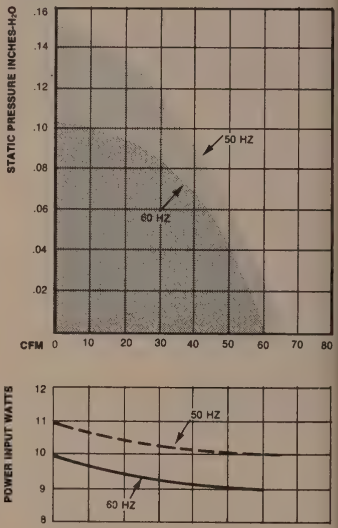
CHARACTERISTICS

Temperature Range
−30°C to 55°C
Materials
Venturi: Die cast zinc alloy painted black
Struts: 3/16 diameter aluminum
Impeller and Bobbin: 94V-0 rated plastic
Locked Rotor Protection
Impedance protected
Life Expectancy
Better than 7 years
Winding Insulation Class
B
Electrical Connection
Two 12 inch #18GA tinned stranded wires 3/8 end strip, 105°C PVC insulated

PERFORMANCE CURVE 2341, 2343
— EXHAUST



PERFORMANCE CURVE 2342, 2344
— INTAKE



NOMINAL PERFORMANCE

Model	Frequency (Hz)	Volts (v)	Phase	Speed RPM	CFM* Free Air	Maximum Delivery		Motor Temperature		Weight (oz)
						Power Input (w)	Line Current ma	(°C)	Rise ■ (°F)	
390-453B1-2341 Exhaust	60 50	115 115	1 1	1430 1750	66 75	10 11	150 175	23 30	74 86	13 13
390-453B2-2343 Exhaust	60 50	220 220	1 1	1430 1770	66 75	9 10	75 85	24 30	75 86	13 13
390-452B1-2342 Intake	60 50	115 115	1 1	1480 1770	60 65	10 11	150 175	20 25	68 77	13 13
390-452B2-2344 Intake	60 50	220 220	1 1	1440 1720	60 65	9 1085	75 90	20 25	68 77	13 13

■ Temperature rise is measured at maximum power absorbtion point within range of normal usage.

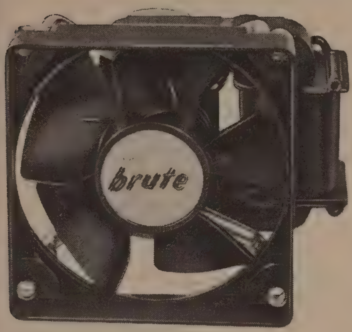
*Air flow measured using a 1/8″ thick 4 3/8 dia. sharp edge orifice.

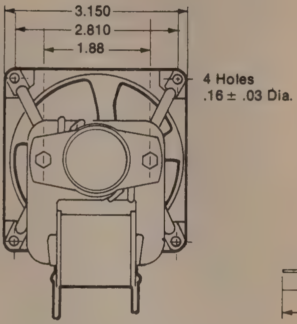
FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

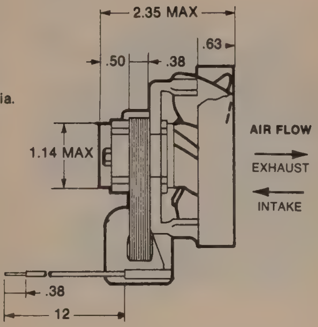
AXIAL FANS

BUNKER RAMO AMPHENOL

Axial Fan Series 390 MINI *brute*





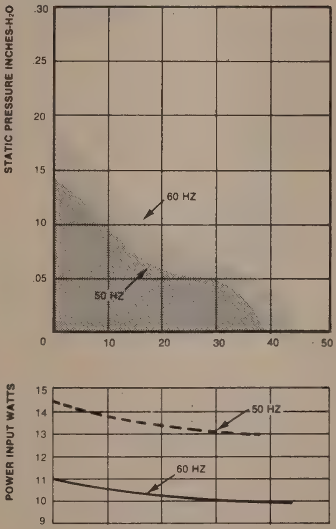


High cooling performance in a very compact package! Mini-Brute mounts on the same centers as popular 3⅛ inch square fans but delivers an amazing 45 cfm at free air. Same long life Recirk™ bearing system as larger Brute fans. Can be mounted within 3½ inch panel heights. UL, CSA listed, See Pg. 1•485 for finger guards.

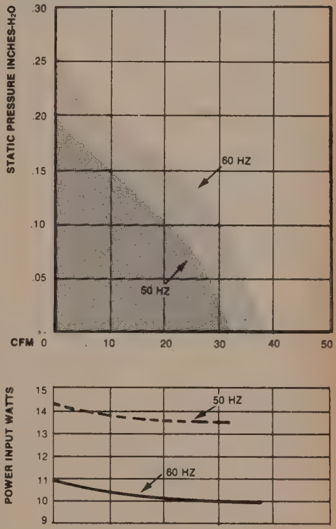
CHARACTERISTICS

Temperature Range
−30°C to 55°C
Materials
Venturi: Die cast zinc alloy painted black
Struts: 3⁄16 diameter aluminum
Impeller and Bobbin: 94V-0 rated plastic
Locked Rotor Protection
Impedance protected
Life Expectancy
Better than 7 years
Winding Insulation Class
B
Electrical Connection
Two 12 inch #18GA tinned stranded wires ⅜ end strip, 105°C PVC insulated

PERFORMANCE CURVE 2345, 2347 — EXHAUST



PERFORMANCE CURVE 2346, 2348 — INTAKE



NOMINAL PERFORMANCE

Model	Frequency (Hz)	Volts (v)	Phase	Speed RPM	CFM Free Air	Maximum Delivery Power Input (w)	Maximum Delivery Line Current ma	Motor Temperature (°C)	Motor Temperature Rise ■ (°F)	Weight (oz)
390-301A1-2345	60	115	1	3170	45	10	215	19	66	16
Exhaust	50	115	1	2740	38	13	325	42	103	16
390-301A2-2347	60	220	1	3200	45	10	105	19	66	16
Exhaust	50	220	1	2750	38	13	165	40	104	16
390-300A1-2346	60	115	1	3130	38	10	220	16	61	16
Intake	50	115	1	2700	33	14	330	38	101	16
390-300A2-2348	60	220	1	3170	38	9	105	16	61	16
Intake	50	220	1	2740	38	13	160	34	93	16

■ Temperature rise is measured at maximum power absorbtion point within range of normal usage.

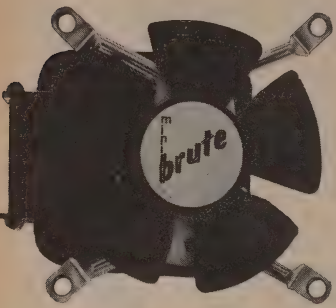
FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

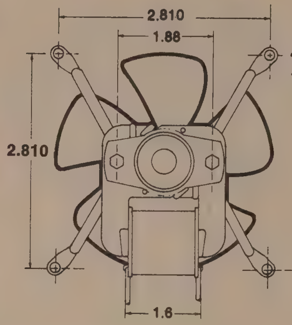
AXIAL FANS

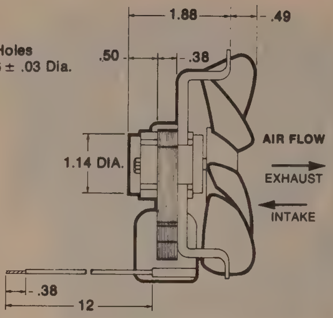
BUNKER RAMO AMPHENOL

Axial Fan Series 390

BARE BONES
MINI *brute*





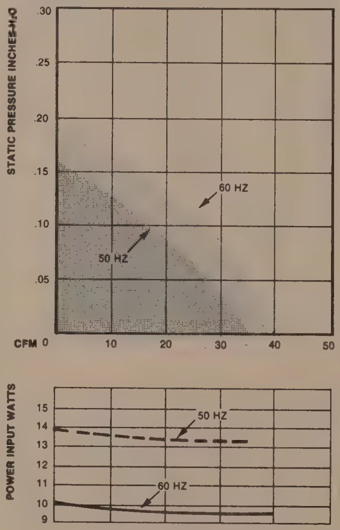


Allows additional savings where a venturi can be incorporated as part of the design or where just an air stirring device is needed. UL and CSA listed. Same long life Recirk™ bearing system as larger Brute models.

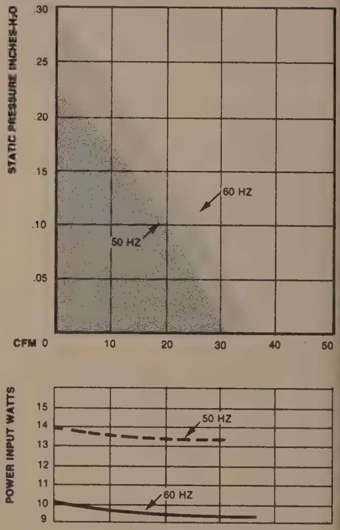
CHARACTERISTICS

Temperature Range
−30°C to 55°C
Materials
Venturi: Die cast zinc alloy painted black
Struts: 3⁄16 diameter aluminum
Impeller and Bobbin: 94V-0 rated plastic
Locked Rotor Protection
Impedance protected
Life Expectancy
Better than 7 years
Winding Insulation Class
B
Electrical Connection
Two 12 inch #18GA tinned stranded wires 3⁄8 end strip, 105°C PVC insulated

PERFORMANCE CURVE 2349, 2351
—EXHAUST



PERFORMANCE CURVE 2350, 2352
—INTAKE



NOMINAL PERFORMANCE

Model	Frequency (Hz)	Volts (v)	Phase	Speed RPM	CFM* Free Air	Maximum Delivery		Motor Temperature		Weight (oz)
						Power Input (w)	Line Current ma	(°C)	Rise ■ (°F)	
390-301B1-2349 Exhaust	60 50	115 115	1 1	3120 2710	40 35	10 14	215 325	23 46	74 116	14 14
390-301B2-2351 Exhaust	60 50	220 220	1 1	3160 2730	40 35	9 12	105 160	21 45	70 113	14 14
390-300B1-2350 Intake	60 50	115 115	1 1	3120 2700	36 30	10 14	220 330	18 42	64 108	14 14
390-300B2-2352 Intake	60 50	220 220	1 1	3180 2740	34 30	9 12	105 160	16 33	61 91	14 14

■ Temperature rise is measured at maximum power absorbtion point within range of normal usage.

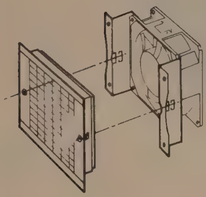
*Air flow measured using a 1⁄8'' thick 3 1/16 dia. sharp edge orifice.

FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

AXIAL FAN ACCESSORIES CROSS-REFERENCE & INDEX

BUNKER RAMO AMPHENOL

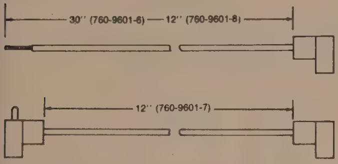
Filters



760-100-45

For all 4½ inch square fans; prevents coarse materials from entering unit. Filter mounts easily to the body of the fan by use of attached spring clips. Wire mesh screen is held in place by a pair of quick-release screws.

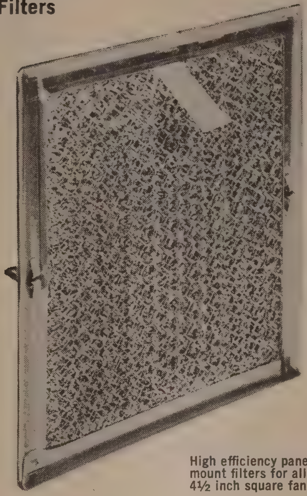
Cords for Gusto Fans



UL approved #18GA wire molded terminal ⅜ inch end stripped.

760-9601-6 — 30″ long
760-9601-7 — 12″ jumper for multiple connection
760-9601-8 — 12″ long

Filters

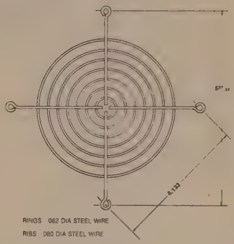


High efficiency panel mount filters for all 4½ inch square fans.

Filter P/N	Size	Mounting Hole Centers
760-100-45	5¹¹⁄₁₆ x 5¹¹⁄₁₆ x ¼	5³⁄₁₆ ±¹⁄₁₆

Finger Guards

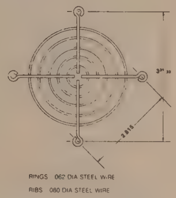
760-9601-43



Fits all 4½ inch square fans. Meets UL spacing requirements.

Bright zinc finish over steel wire.

760-12601-43



Fits all 3⅛ inch square fans. Meets UL spacing requirements.

Bright zinc finish over steel wire.

Cross Reference & Index

Page Number		AMPHENOL MODEL						
		390 SERIES						
Gusto	Brute	Gusto	Brute Exhaust	Brute Intake	760 SERIES*	ROTRON MODEL	IMC MODEL	PAMOTOR MODEL
4, 5	6, 7	458A1	451A1	450A1	125XR-182-11115	M747 or MU2A/B1	WS2107F/L	4500 4500P
4, 5	6, 7	458A2	451A2	450A2	125XR-181-11220	M756 or MU3A/B2	WS2107F/L-3	4550 4550P
4, 5	8, 9	457A1	453A1	452A1	125XL-182-11115	M745 or WR2A1	WS2107F/L-2	4800
4, 5	6, 7	459A1	451A1	450A1	125XR-182-11115	CT3A/B2	WS2107F/L-110	4600
					125XR-182-11115 125XR-181-11220	S747 S756	BS2107F/L BS2107F/L-3	4606 4656
	10, 11		451B1 451B2	450B1 450B2		MU2A2 MU3A2		4700 4750
	10, 11		451B1 451B2	450B1 450B2		SKR2 SKR3		
	14, 15		301A1	300A1	126LF-182-11115	SP2A2/SU2A1	PWS2107F/L	8500
	16, 17		301A2	300A2	126LF-181-11220	SP2A3	PWS2107F/L-3	8550
18, 19			ACCESSORIES					

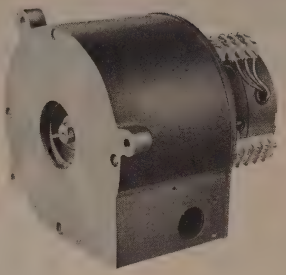
*Described in 760 Series catalog. Call your CMS Rep or Distributor for a copy.

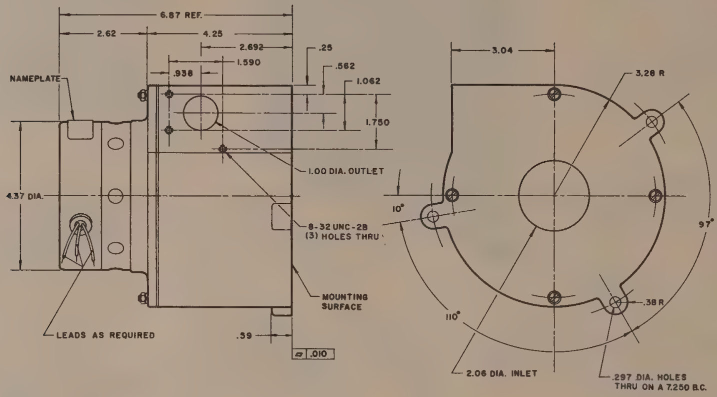
FOR LOCAL SOURCE OF SUPPLY SEE EEM VOL. 2 PAGE 462

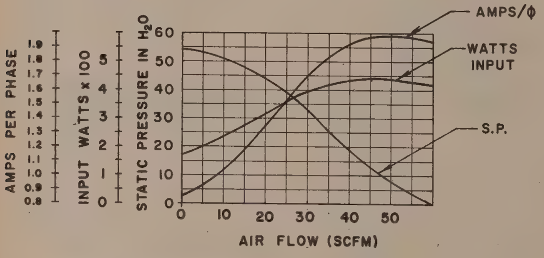
AEP MOTORS

IN PHASE WITH INDUSTRY

stage centrifugal blowers




6.87 REF.
2.62
4.25
2.692
1.590
.938
.25
.562
1.062
1.750
NAMEPLATE
4.37 DIA.
1.00 DIA. OUTLET
8-32 UNC-2B (3) HOLES THRU
MOUNTING SURFACE
LEADS AS REQUIRED
.59
.010
3.04
3.28 R
10°
97°
110°
.38 R
2.06 DIA. INLET
.297 DIA. HOLES THRU ON A 7.250 B.C.



Voltage: 115 or 208 volts A.C.
Frequency: 400 HZ
Phase: one, two or three

Ashland's reputation for consistent excellence is exemplified in this line of stage centrifugal blowers.

These self-contained direct drive blowers are driven by Ashland motors and contain long life, sealed ball bearings designed to withstand vacuum or pressure under the most adverse ambient conditions.

Available in one to six stage configurations with zero C.F.M. at 75 inches static pressure and 60 C.F.M. at zero static pressure.

ASHLAND ELECTRIC PRODUCTS INC.

32-02 QUEENS BLVD., LONG ISLAND CITY, N. Y. 11101 • PHONE (212) 392-4010

AEP MOTORS

model "A" centrifugal blower

**AVAILABLE IN — 115/208 VAC, OR 208-220/440 VAC
60 Hz OR 50/60 Hz, SINGLE PHASE OR THREE PHASE,
SLEEVE OR BALL BEARING, RESILIENT OR RIGID BASE MOTORS.**

All blowers are shipped with 12 O'clock blast which may be changed in the field to any of the 4 positions shown. Special positions can be supplied on order.

ROTATION — Model A blowers are available with either CW or CCW rotation. CCW rotation will always be shipped unless CW rotation is specified. The rotation cannot be changed in the field. Rotation is determined by viewing the blower wheel from the drive side of the housing.

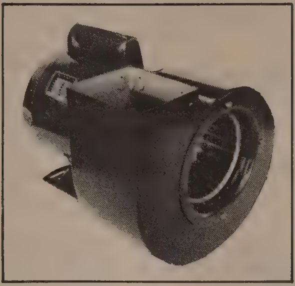
MOTOR — NEMA frame designs manufactured by General Electric* are supplied with the Model A blowers. They are rated at 40°C, open — drip proof with integral resilient mounting.

THERMAL PROTECTION — is not provided due to the nature of the application and a desire for cost reduction. Thermal protectors (Automatic or manual) may be purchased from G.E. distributors and can be easily installed in the field.

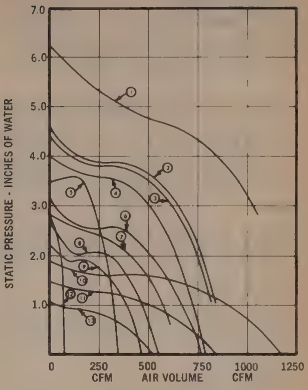
LUBRICATION — all angle, sleeve bearing, General Electric motors require a minimum of Service. Lubrication instructions are shown on a terminal box coverplate.

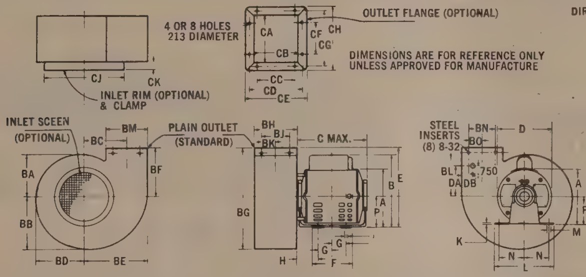
WARRANTY — Ashland's standard one year warranty applies to all materials and workmanship of the blower. The motors are warranteed by G.E. for 13 months from date of manufacture. They can be serviced at any local G.E. service station.

*Or equivalent

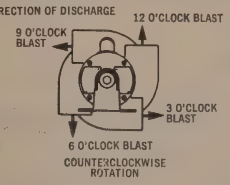


PERFORMANCE CHARACTERISTICS





DIMENSIONS ARE FOR REFERENCE ONLY UNLESS APPROVED FOR MANUFACTURE



SIZE DIMENSIONS WILL BE SUPPLIED UPON REQUEST

MECHANICAL SPECIFICATIONS FOR MODEL "A" BLOWERS

ASHLAND			MOTOR DATA					MOTOR DIMENSIONS					MOTOR MOUNTING DIMENSIONS									INLET FLANGE	
PART NUMBER	Air Curve No.	RPM	Nema Frame Size	Nom. H.P.	Full Load Watts	Full Load Amps	Start Amps	A	B	C	D	E	F	G	H	J	K	L	M	N	P	CJ	CK
								NOM	NOM	NOM	NOM	NOM	NOM	±.005	MAX	NOM	NOM	±.[illegible]	±.015	NOM	±.03	NOM	NOM
A-7231	1	3450	56	1	1600	16.5	70	6.74	8.84	10.16	6.42	9.41	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	10	¾
A-7020X	2	3450	56	1	1140	13.4	70	6.74	8.84	10.16	6.42	8.44	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	8½	¾
A-6030	3	3450	56	1	1140	13.4	70	6.74	8.84	10.16	6.42	8.44	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	8½	¾
A-6025	4	3450	56	1	1140	13.4	70	6.74	8.84	10.16	6.42	8.44	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	8½	¾
A-6020X	5	3450	48	⅓	640	6.8	28	5.83	7.31	8.13	5.61	7.07	3½	1⅜	2.35	11/32	.112	5⅝	.705	2.12	3.00	8½	¾
A-5035	6	3450	56	¾	940	11.2	55	6.74	8.22	9.16	6.42	7.69	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	6½	⅝
A-5030	7	3450	48	½	680	7.0	38	5.83	7.31	8.53	5.61	7.19	3½	1⅜	2.35	11/32	.112	5⅝	.705	2.12	3.00	6½	⅝
A-4735	8	3450	48	½	635	7.0	38	5.83	7.31	8.53	5.61	6.41	3½	1⅜	2.35	11/32	.112	5⅝	.705	2.12	3.00	6¼	¾
A-4730	9	3450	48	⅓	600	6.8	28	5.83	7.31	8.13	5.61	6.41	3½	1⅜	2.35	11/32	.112	5⅝	.705	2.12	3.00	6¼	¾
A-7241B	10	1725	56	¾	825	10.8	59	6.74	8.84	9.64	6.42	9.41	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	10	¾
A-7232B	11	1725	56	½	710	7.8	44	6.74	8.84	9.16	6.42	9.41	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	10	¾
◆ A-6010X-3	12	3450	48	⅛	200	2.6	20	5.83	None	7.50	5.61	7.50	3½	1⅜	2.50	11/32	.112	5⅝	.718	2.12	3.00	8½	¾
A-6031B	13	1725	56	⅓	320	5.6	28	6.74	8.22	8.26	6.42	8.44	4¼	1½	2.90	11/32	.125	6½	.895	2.44	3.50	8½	¾

ASHLAND	DIMENSIONS - BLOWER HOUSING & OUTLET														DIMENSIONS-OUTLET FLANGE								SWITCH ⊕		Weight
PART NUMBER	BA	BB	BC	BD	BE	BF	BG	BH	BJ	BK	BL	BM	BN	BO	CA	CB	CC	CD	CE	CF	CG	CH	DA	DB	
	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM	±1/32	±1/32	NOM	NOM	±1/32	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM	NOM	
A-7231	5 5/32	7 5/16	5⅝	6¼	8 13/32	5 15/16	13¼	5 1/16	3 9/16	1 25/32	5 7/16	5 9/16	4 1/16	2 1/32	5⅜	4 15/16	4⅜	5⅞	6 9/16	4⅞	6⅜	7 1/16	4 13/32	1	39
A-7020X	4⅛	5⅞	4½	5	6¾	4 31/32	10 27/32	4⅜	2⅞	1 7/16	4 15/32	4½	3	1½	4 5/16	4¼	3 11/16	5 3/16	5⅞	3 13/16	5 5/16	6	3 7/16	1	35
A-6030	4⅛	5⅞	4½	5	6¾	4 31/32	10 27/32	4⅜	2⅞	1 7/16	4 15/32	4½	3	1½	4 5/16	4¼	3 11/16	5 3/16	5⅞	3 13/16	5 5/16	6	3 7/16	1	35
A-6025	4⅛	5⅞	4½	5	6¾	4 31/32	10 27/32	3 27/32	2 11/32	1 11/64	4 15/32	4½	3	1½	4 5/16	3 23/32	3 5/32	4 21/32	5 11/32	3 13/16	5 5/16	6	3 7/16	1	35
A-6020X	3 29/32	4 17/32	4 9/32	4 7/32	5 27/64	4 3/32	8⅝	3 3/32	1 19/32	51/64	3 19/32	2 9/32	25/32	25/64	2⅛	3	see note	3 29/32	4 19/32	see note	3 3/32	3 25/32	2 21/32	53/64	23
A-5035	3 15/32	4 29/32	3¾	4 3/16	5⅝	4 7/32	9⅛	4 27/32	3 11/32	1 43/64	3 23/32	3 13/16	2 5/16	1 5/32	3⅝	4 23/32	4 5/32	5 21/32	6 11/32	3⅛	4⅝	5 5/16	2 11/16	1	33
A-5030	3 15/32	4 29/32	3¾	4 3/16	5⅝	4 7/32	9⅛	4 5/32	2 21/32	1 21/64	3 23/32	3 13/16	2 5/16	1 5/32	3⅝	4 1/32	3 15/32	4 31/32	5 21/32	3⅛	4⅝	5 5/16	2 11/16	1	25
A-4735	3 1/16	4⅜	3 5/16	3 23/32	5	3 7/16	7 13/16	4 27/32	3 11/32	1 43/64	3 1/16	3 11/32	1 27/32	59/64	3 3/16	4¾	4 5/32	5 21/32	6 11/32	2 21/32	4 5/32	4 27/32	1 29/32	1	24
A-4730	3 1/16	4⅜	3 5/16	3 23/32	5	3 7/16	7 13/16	4 5/32	2 21/32	1 21/64	3 1/16	3 11/32	1 27/32	59/64	3 3/16	4 1/16	3 15/32	4 31/32	5 21/32	2 21/32	4 5/32	4 27/32	1 29/32	1	22
A-7241B	5 5/32	7 5/16	5⅝	6¼	8 13/32	5 15/16	13¼	6 21/32	5 5/32	2 37/64	5 7/16	5 9/16	4 1/16	2 1/32	5⅜	6 17/32	5 31/32	7 15/32	8 5/32	4⅞	6⅜	7 1/16	4 13/32	1	40
A-7232B	5 5/32	7 5/16	5⅝	6¼	8 13/32	5 15/16	13¼	5⅝	4⅛	2 1/16	5 7/16	5 9/16	4 1/16	2 1/32	5⅜	5½	4 15/16	6 7/16	7⅛	4⅞	6⅜	7 1/16	4 13/32	1	37
◆ A-6010X-3	3 29/32	4 17/32	4 9/32	4 7/32	5 27/64	4¼	8 25/32	2¼	1⅛	9/16	3⅞	2¼	25/32	25/64	2⅛	2 5/32	see note	3 1/16	4 19/32	see note	3 3/32	3 25/32			17
A-6031B	4⅛	5⅞	4½	5	6¾	4 31/32	10 27/32	5 1/16	3 9/16	1 25/32	4 15/32	4½	3	1½	4 5/16	4 15/16	4⅜	5⅞	6 9/16	3 13/16	5 5/16	6	3 7/16	1	30

NOTE: Four holes only — one hole centered on each side of flange.

◆ 115 Volt, Split Phase, Solid Base Only.

⊕ Blowers are shipped with air interlock capped.

BORG WARNER
Borg-Warner Thermoelectrics
DEPARTMENT OF BORG-WARNER CORPORATION WOLF AND ALGONQUIN ROADS, DES PLAINES, ILLINOIS 60018, PHONE 312/827-3131

THERMOELECTRIC COOLERS

INTRODUCTION TO THERMOELECTRIC PRODUCTS

Thermoelectric cooling units have many unique advantages over other types of coolers in their application area.

SIZE

They can be tailored to fit the application by easy addition or subtraction of modules to fill the need accurately and avoid waste.

POWER INPUT

Due to tailored modular construction, power requirements can be reduced to a minimum. Power is provided through a single pair of leads.

RELIABILITY

There are no parts that wear or clog, and no delicate moving parts. Gases, corrosive liquids or chemicals that will leak or dissipate with age are also eliminated. These features result in greatly reduced maintenance requirements.

LOGISTICS

There are no requirements at the load for pumping refrigerant or for a source of coolant such as liquid nitrogen to be added during operation of the system.

REMOTE CONTROL

The unit and heat sink are required in the cooling area; the power supply and most other control equipment can be mounted and operated remotely.

COOLING RANGE

Thermoelectric coolers are capable of operating from any heat-sink temperature from +100°C to −100°C.

TEMPERATURE CONTROL

Simple electronic control schemes allow control within a fraction of a degree of desired load temperatures above or below ambient.

HEAT SINKS

The design of the heat sink or heat exchanger is a very important aspect of a good thermoelectric system.

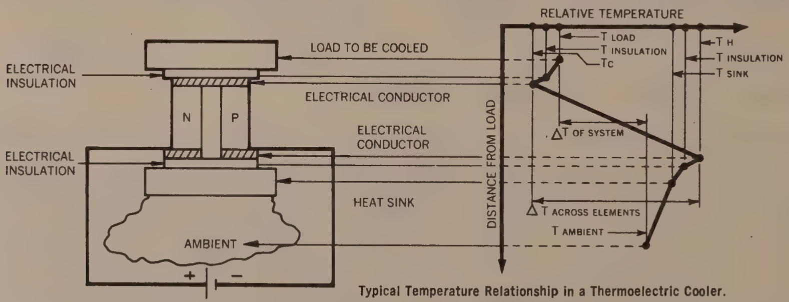
The figure below illustrates the steady-state temperature profile across a typical thermoelectric device from the load side to the ambient.

The total steady-state heat which must be rejected by the heat sink to the ambient may be expressed as follows:

heat rejected (Q_s) = heat absorbed from load (Q_e) +
power input ($V \cdot I$) + heat leakage (Q_1)

If the heat sink is not capable of rejecting the required Q_s from a given system, the temperature of the entire system will rise and the load temperature will increase. If the thermoelectric current is increased to maintain the load temperature, the COP tends to decrease. Thus, a good heat sink contributes to improved COP.

Energy may be transferred to or from the thermoelectric system by three basic modes: conduction, convection, and radiation. The values Q_e and Q_1 may easily be estimated; their total along with the power input gives Q_s, the energy the hot-junction must dissipate.



Typical Temperature Relationship in a Thermoelectric Cooler.

TIME TO COOL OR HEAT VARIOUS MATERIALS

The figure below shows the heat transfer required to cool or heat a given weight of known material in one hour without a change of state. When a change of state occurs (freezing, melting or vaporizing) the additional heating or cooling capacity required can be estimated by multiplying the weight of the given material by the appropriate latent heat. The equation plotted in the Figure at the right is:

$$Q \, \Delta t = m \, Cp \, \Delta T \qquad (2)$$

ΔT — required temperature change (°F)
Cp — average specific heat (BTU/lb-°F)
m — weight of material (lbs)
Δt — time interval
Q — heat removed or supplied (BTU/hr)

Using this formula, it is easy to design a photographic bath for processing film rapidly. The bath consists of 2 lbs of water in a 1 lb stainless steel container. The bath must be cooled from 110°F to 60°F in 1 hour. How much heat must be removed?

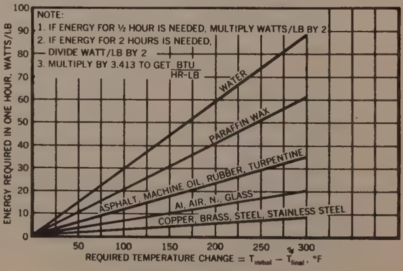
The temperature change is (110-60) = 50°F.

Enter Figure below on the horizontal axis at 50°F. Move vertically to the stainless steel and water curves and read on the vertical axis:

15 watts/lb × 2 lbs of water = 30 watts
1.6 watts/lb × 1 lb of stainless = 1.6 watts

Thus, for 1 hr, 31.6 watts are required.

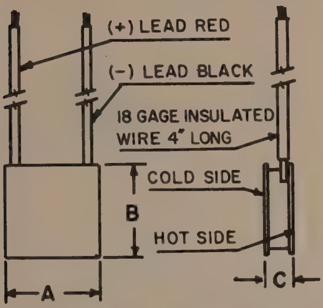
The time provided by this graph is based on a constant heat transfer during the one hour period. Actually, a thermoelectric cooler would not pump heat at a constant level due to change in ΔT and this should be taken into account in a design. An effective heat pumping capacity of a thermoelectric cooler can be estimated as the heat pumping capacity at a temperature difference equal to one-half of the final operating ΔT (usually, initial ΔT = 0). Borg-Warner can provide assistance in more accurate transient design.

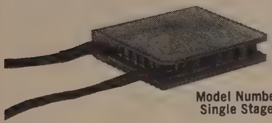


Energy to be Added or Removed Thermoelectrically in One Hour for Various Materials.

STANDARD THERMOELECTRIC DEVICES

SINGLE STAGE MODULE SPECIFICATION CHART — T_H 27°C IN VACUUM

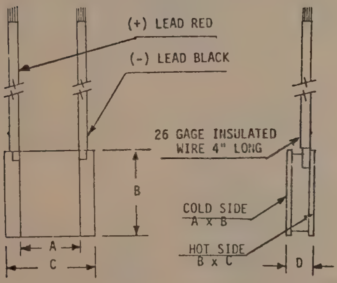


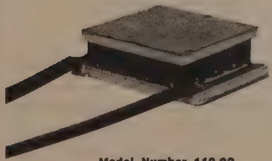


Model Number 920-31
Single Stage Module

MODULE NUMBER	MAX ΔT $Q_C = 0$ ΔT - °C	MAX Q_C $\Delta T = 0$ Q_C - WATTS	MAX CURRENT AMPS	MAX VOLTAGE VOLTS	DIM. A	DIM. B	DIM. C
920-3	66	1.8	8.5	0.34	0.26	0.51	0.22
920-7	66	4.3	8.5	0.80	0.51	0.51	0.22
920-11	66	6.7	8.5	1.24	0.51	0.78	0.22
920-15	66	9.2	8.5	1.70	0.51	1.10	0.22
920-31	66	19.0	8.5	3.50	1.20	1.20	0.22
930-3	66	0.8	3.7	0.36	0.34	0.17	0.21
930-7	66	1.8	3.7	0.84	0.34	0.34	0.21
930-11	66	2.9	3.7	1.30	0.34	0.51	0.21
930-17	66	4.5	3.7	2.00	0.51	0.51	0.21
930-35	66	9.4	3.7	4.20	0.51	1.10	0.21
930-71	66	19.0	3.7	8.50	1.20	1.20	0.21
940-3	66	2.9	14.0	0.34	0.26	0.51	0.18
940-7	66	6.8	14.0	0.80	0.51	0.51	0.18
940-11	66	10.6	14.0	1.24	0.51	0.78	0.18
940-15	66	14.5	14.0	1.70	0.51	1.10	0.18
940-31	66	30.0	14.0	3.50	1.20	1.20	0.18
950-3	66	1.3	6.0	0.36	0.34	0.17	0.17
950-7	66	3.0	6.0	0.84	0.34	0.34	0.17
950-11	66	4.6	6.0	1.30	0.34	0.51	0.17
950-17	66	7.2	6.0	2.00	0.51	0.51	0.17
950-35	66	14.8	6.0	4.20	0.51	1.10	0.17
950-71	66	30.0	6.0	8.50	1.20	1.20	0.17

MINI MODULE SPECIFICATION CHART — T_H 27°C IN VACUUM





Model Number 110-32
Mini Module

MINI MODULE NUMBER	MAX ΔT $Q_C = 0$ ΔT - °C	MAX Q_C $\Delta T = 0$ Q_C - WATTS	MAX CURRENT AMPS	MAX VOLTAGE VOLTS	DIM. A	DIM. B	DIM C	DIM. D
110-4	64	0.24	1.1	0.5	0.08	0.16	0.14	0.13
110-8	64	0.49	1.1	1.0	0.16	0.16	0.22	0.13
110-12	64	0.73	1.1	1.5	0.16	0.24	0.22	0.13
110-18	64	1.10	1.1	2.2	0.24	0.24	0.30	0.13
110-32	64	1.95	1.1	4.0	0.32	0.32	0.38	0.13
120-4	64	0.30	1.4	0.5	0.08	0.16	0.14	0.12
120-8	64	0.61	1.4	1.0	0.16	0.16	0.22	0.12
120-12	64	0.92	1.4	1.5	0.16	0.24	0.22	0.12
120-18	64	1.35	1.4	2.2	0.24	0.24	0.30	0.12
120-32	64	2.40	1.4	4.0	0.32	0.32	0.38	0.12
130-4	64	0.42	1.9	0.5	0.09	0.18	0.15	0.12
130-8	64	0.84	1.9	1.0	0.18	0.18	0.24	0.12
130-12	64	1.25	1.9	1.5	0.18	0.27	0.24	0.12
130-18	64	1.90	1.9	2.2	0.27	0.27	0.33	0.12
130-32	64	3.35	1.9	4.0	0.36	0.36	0.42	0.12

Standard coolers will withstand ambient temperatures of 110°C. Special coolers are available at premium prices that will withstand ambient temperatures of 160°C. For high temperature applications consult the factory.

BORG WARNER

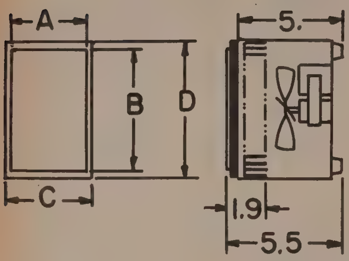
Borg-Warner Thermoelectrics

DEPARTMENT OF BORG-WARNER CORPORATION WOLF AND ALGONQUIN ROADS, DES PLAINES, ILLINOIS 60018 • PHONE (312) 827-3131

THERMOELECTRIC HEAT PUMPS

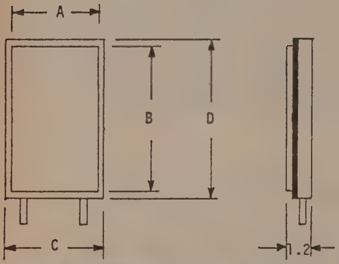
BORG WARNER

HEAT PUMP SPECIFICATION CHART T_H 77°F IN DRY AIR — AIR COOLED HEAT SINK

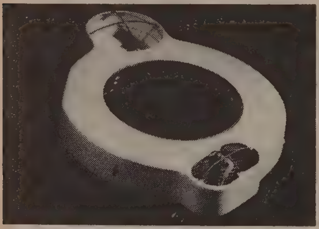


HEAT PUMP NUMBER	930AHP-1	920AHP-2	920AHP-4	930AHP-6	930AHP-9
MAX HEAT PUMPING WITH COLD PLATE SUPPRESSED TO 77°F AMBIENT (WATTS))	15	30	60	90	135
MIN. COLD PLATE TEMPERATURE OPERATING IN 77°F AMBIENT (°F)	−10	−10	−10	−10	−10
INPUT POWER AMPS	3.6	8.4	8.4	7.2	10.8
INPUT POWER VOLTS	9	7	14	28	28
DIMENSION A	1.5	1.5	3.8	3.8	6.0
DIMENSION B	2.0	3.8	3.8	6.0	6.0
DIMENSION C	4.1	4.1	4.1	4.1	6.6
DIMENSION D	4.1	4.1	4.1	6.6	6.6
POWER SUPPLY REQUIRED	PS-101	PS-102	PS-103	PS-104	PS-104

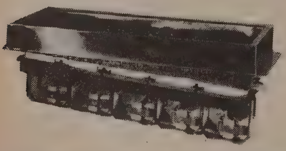
HEAT PUMP SPECIFICATION CHART T_H 77°F IN DRY AIR — LIQUID COOLED HEAT SINK



HEAT PUMP NUMBER	950LHP-1	940LHP-2	940LHP-4	950LHP-6	950LHP-9
MAX HEAT PUMPING WITH COLD PLATE SUPPRESSED TO 77°F AMBIENT (WATTS))	20	50	100	150	225
MIN. COLD PLATE TEMPERATURE OPERATING IN 77°F AMBIENT (°F)	−20	−20	−20	−20	−20
INPUT POWER AMPS	6	14	14	12	18
INPUT POWER VOLTS	9	7	14	28	28
DIMENSION A	1.5	1.5	3.8	3.8	6.0
DIMENSION B	2.0	3.8	3.8	6.0	6.0
DIMENSION C	4.1	4.1	4.1	4.1	6.6
DIMENSION D	4.1	4.1	4.1	6.6	6.6
POWER SUPPLY REQUIRED	PS-101	PS-102	PS-103	PS-104	PS-104



Ring type cooler to stabilize the inertial navigation system at 40°C and pump 280 watts with an input power of 338 watts.



This system cools one gallon of chemical solution to 40°F below ambient with 850 watts of input power. Load capability 450 watts at 0 ΔT.

TEMPERATURE CONTROLLERS FOR POWER SUPPLIES

TC-101	Set Point Relay Controlled Accuracy ±3°C	Heat and Cool
TC-102	Set Point Proportional Accuracy ±1°C	Cool only
TC-104	Set Point Proportional Accuracy ±1°C	Heat and Cool

Other Borg-Warner Thermoelectric Heat Pumps are available that will operate with larger or smaller heat pumping capacities and current input voltage. Power supplies, on/off temperature controllers with set point, and proportional reverse controllers are available to fit these pumps. Please contact factory for further information.

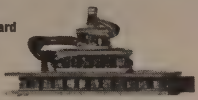
BORG WARNER

Borg-Warner Thermoelectrics

DEPARTMENT OF BORG-WARNER CORPORATION   WOLF AND ALGONQUIN ROADS, DES PLAINES, ILLINOIS 60018 • PHONE (312) 827-3131

CASCADED THERMOELECTRIC COOLERS

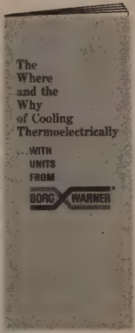
Model Number 954-70-16-4-1 Standard Four Stage Cascade



Special 145°K Eight Stage High Performance Cascade

Model Number 134BW-63-31-15-7 Low Power 193°K Cascaded Cooler

Model Number 936BW-65-32-17-8-4-2 Low Power 170°K Cascaded Cooler



The Where and the Why of Cooling Thermoelectrically

...WITH UNITS FROM BORG WARNER

Write on company letterhead for your free copy

The principles, applications, and design possibilities of thermoelectric cooling are discussed in this booklet.

STANDARD

2 - 5 Stages
From T_H 27°C
To T_C 180°K

Over 7000 Optimized Cascade Designs Using Partial Standard Borg-Warner Thermoelectric Modules.

- — Customer Design at Standard Cooler Prices
- — Lowest Price Per Watt of Heat Pumped
- — Quick Delivery, Usually one Week ARO

HIGH PERFORMANCE

2 - 14 Stages
From T_H 27°C
To T_C 130°K

Individual Computer Aided Cascade Design Using Standard or High Performance Thermoelectronic Materials.

- — Higest Heat Pumping Capability
- — Lowest Temperatures
- — Lowest Power Input

STANDARD LOW POWER INFRARED DETECTOR COOLERS

	MODEL NO. 134BW-63-31-15-7	MODEL NO. 936BW-65-32-17-8-4-2
T_H	300°K	300°K
T_C	193°K	170°K
Q_T	43 mw	52 mw
Q_{active}	25 mw	25 mw
P	2 w at 6 v	10 w at 6 v
Cold Plate Size	0.18″ x 0.18″ min.	0.17″ x 0.17″ min.
Base Size	0.46″ x 0.76″	0.94″ x 1.03″
Height	0.63″	1.27″

DELIVERY FROM STOCK

Cascaded Thermoelectric Coolers are available at premium prices that will withstand ambients or bake-out temperatures of 150°C.

CUSTOM DESIGN

Engineering back-up is available for designs to meet customer specifications.

APPLICATION OF THERMOELECTRIC PRODUCTS

Cold traps for vacuum chambers
Crystals
Discrete silicon components
Inertial guidance systems
Infrared detectors
Integrated circuits
Lasers
Masers
Nuclear radiation detectors
Parametric amplifiers
Constant temperature chambers
Environment chambers
Integrated circuit test chambers
Temperature baths
Display cabinets
Ice cube makers
Photo developing solution coolers
Photomultiplier tubes
Vidicon tubes
Cold probes
Dew point hygrometers
Microscope cold plates
Mobile drug coolers
Surgical instrument-coolers
Test tube coolers

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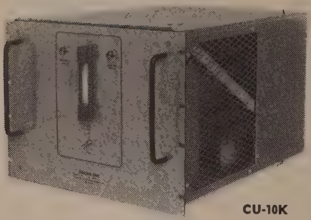
COOLING UNITS

HEAT EXCHANGE-REFRIGERATING

Electro
IMPULSE, INC.



CU-10K

Heat exchange cooling units are useful whenever it is desirable to prevent runaway heat conditions. Heat is absorbed by a circulating coolant liquid, then exhausted into the ambient by forced air passing through a radiator.

Use this series when coolant temperature can be allowed to rise above ambient.

CU SERIES

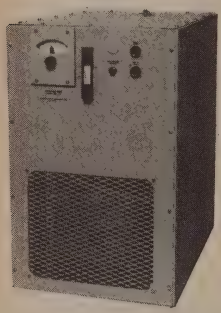
WATER-TO-WATER UNITS ARE NOW AVAILABLE

Model	Cap Watts (BTU/Hr)	(1) Temp. Rise (Water)	Cool-ant Flow	Max. Press.	Std. Op Volt	Size LxWxH	Wt.
CU-500	500 (1700 BTU)	10/500 w	.5	30	115-1-60	10x14x20	60
CU-5000	5000 (17,000 BTU)	5/KW	1	50	115-1-60	23x17 7/16 x14	75
CU-10,000	10,000 (34100)	4/KW	2	50	115-1-60	22x17½ x18	95
CU-20K	20,000 (68,000 BTU)	1.25/KW	5	60	208/230 1-60	33½x21½ x30	175
CU-50K	50,000 (170,000 BTU)	0.5/KW	12	60	208/230-3-60	40x40x40	250
CU-100K	100,000 (341,000 BTU)	0.3/KW	20	60	208/230-3-60	64x96x68	400

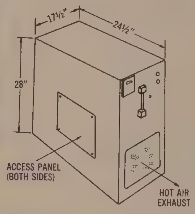
(1) Measured coolant rise above ambient per °F per unit watts indicated at rated flow using water.

Optional Equipment Available: Flow switch, Thermometers, Thermostat, Flowmeter, Heater and Water De-ionizer.

RU SERIES



RU-75



Models from this series are required when coolant temperatures must be below ambient. Using refrigeration, they can provide temperatures to 0 degrees C and below, while removing up to 9000 watts of heat.

These units are ideal for remote applications. Coolant temperatures are low, flow rate is steady, and the final heat sink can be in a location which will not cause overloading of air-conditioning equipment.

Special options can provide temperature control of ±0.15 degree F, while combinations of refrigeration and heating can hold temperatures at any point above ambient.

Model	Amb. 70°F Capacity Watts Water @ 65°F	Amb. 90°F Capacity Watts Water @ 65°F	(1) Cool-ant Flow	Max. Press.	Std. Op Voltage	Size LxWxH	Wt.
RU-6	370	325	.5	30	115-1-60	24½x14x11	90
RU-12.5	900	780	.5	35	115-1-60	34x18x14	150
RU-25	1180	1050	1	50	115-1-60	23x13½x22	200
RU-50	1780	1560	1	50	115-1-60	17x17x15½	220
RU-75	2600	2300	1	50	115-1-60	24⅝x17¾x 28¼	230
RU-100	3350	2900	3	60	208/220-1-60	24⅝x17¾x 28¼	230
RU-200	4630	4130	3	60	208/220-1-60	26⅛x18¾x 36¾	240
RU-300	7100	6100	4	60	208/230-3-60	32x18x36	300
RU-400	11,000	9000	5	60	208/230-3-60	32½x18x36⅜	390

(1) Recommended min. flows — other flow rates available.

Optional Equipment Available: Thermometer, Thermostat, Flow Meter, Heater.

RACK COOLER

This series is designed for air, rather than liquid cooling. A sealed volume of air is cooled by a refrigeration system and continually re-circulated within the enclosure. Cool sensitive rack-mounted electronic equipment, or use duct work and manifolds for extensive cooling of radar or other electronic control consoles and cabinets.

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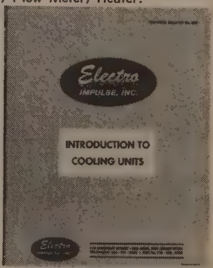

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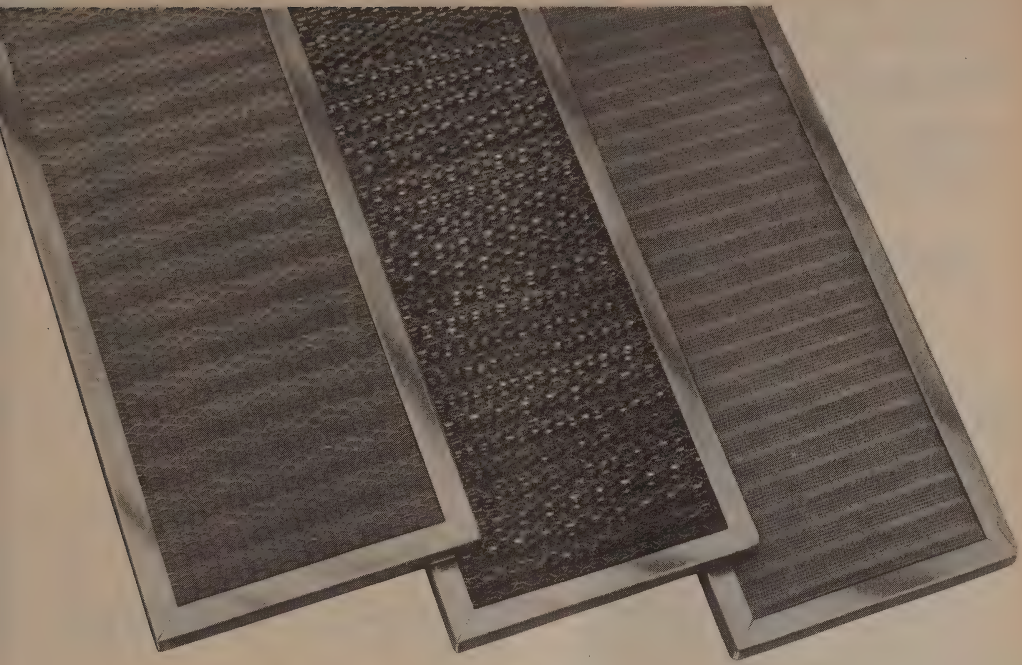
SEE OUR OTHER PRODUCTS ON PAGE 1•662 THRU 1•666

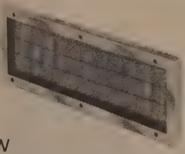


EVANS air filters

for Electronic Cabinet Application

. . . used on Computers . . . Card Readers . . . Tape Transports . . . Transceivers . . . Power Supply Units . . . both large and small cabinetry. Evans Air filters are permanent. Rigid. Aluminum. Made to withstand the brutal abuse of military field conditions. Frames have mitered corners for smooth, close tolerance fit. Die cut, expanded aluminum grids are criss crossed and precision fitted into each filter. Patented Brillo Lock design gives more air delivery with positive cleaning results.

Tolerance:	± 1/32″
Velocity:	200 to 900 FPM
Efficiency:	75% AFI Test
Finishes:	Available in chemical film finish to meet requirements of MIL-C-5541 . . . MIL-F-14072 . . . MIL-A-8625
Sizes:	Filter of 1/2″ or 3/4″ dimension. Made to a maximum area 400 sq. inches . . . with maximum length 25″ on one side without special bracing. For complete information write or call.

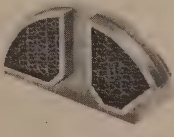


LOW
RESISTANCE FILTER

Special serts permit fastening solidly to blower unit. Made for air drop equipment.

LOUVERED FILTERS

For outside application. Louvers protect filter media from water, ice, snow.



HEAVY DUTY UNIT

For rugged military use. Extra rigid frame made from .063 aluminum.

The George Evans Corporation

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We make centrifugal blowers, propeller fans, vaneaxial and tubeaxial airmovers...

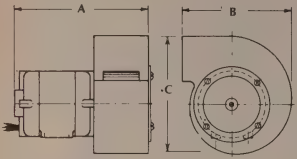

Figure A

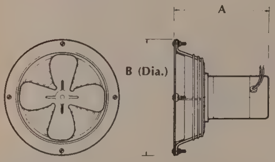

Figure B

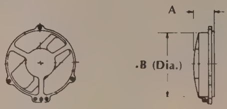

Figure C

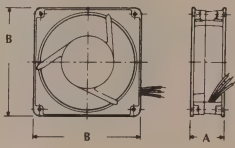

Figure D

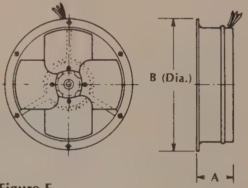

Figure E

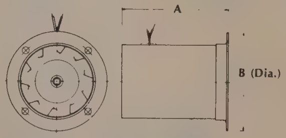

Figure F

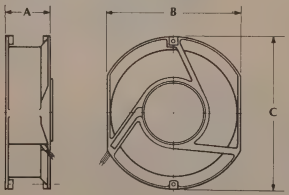

Figure G

to meet your most demanding cooling requirements. Slim-profile IMCool tubeaxials, compact (4-11/16″ to a side) Boxers and MiniBoxers in Mil-Spec, 400 Hz and variable frequency versions, propeller fans and centrifugal blowers for intake or exhaust, against back pressure, and in harsh environments. Also, high performance vaneaxials from miniature IMCube (1″ cube) to 14.5-inch diameter sizes, automatic air density/speed compensating "Hi-Slip" models for high altitude applications. Air deliveries from 6.5 to 3500 cfm.

Select from the thousand or more catalog designs, a sampling of which appear below, or we will custom design to your exact specifications . . . new systems, evolving systems, exasperating parameters, it's all in a days work for our Applications Engineering Section.

CENTRIFUGAL BLOWERS

Model No.	Air Delivery (cfm)	Voltage (VAC)	Frequency (Hz)	Speed (rpm)	Figure No.	Dimensions (inches)		
						A	B	C
1696	6.3	115	400	10,500	A	2 51/64	1 59/64	1 61/64
1836	20.0	200	400	11,000	A	2 3/8	2 53/64	2 25/32
1736	48.0	12	DC	10,000	A	4 5/16	5 17/32	5 7/16
1311	215.0	208	60	3300	A	7 17/32	7 1/4	7 7/8
2142	160.0	28	DC	6500	A	6 15/16	5 9/64	5 1/2
1598	600.0	200	400	3100	A	11 5/16	9 9/32	10 3/8
2133-2	650.0	115	60	3100	A	11 5/16	9 9/32	10 3/8
1796	1750.0	220	60	3200	A	12 1/2	13 17/64	14 21/32
PROPELLER FANS								
804	18.0	115	400	18,000	B	1 3/4	1 1/2	—
2315	32.0	115	60	3400	B	2 13/16	4 1/4	—
5-2	78.0	115	60	3400	B	3 3/8	5 3/8	—
6	160.0	200	400	7000	B	3 5/8	5 3/8	—
2304	360.0	115	400	10,000	B	4 53/64	6 3/16	—
1164	730.0	115	60	3350	B	6 7/16	10	—
2255	980.0	115	DC	4000	B	7 1/2	10	—
1999	1300.0	115	60	3200	B	9 1/2	12	—
2523	240.0	208	400	3400	G	2	5 29/32	6 3/4
2516	240.0	115	400	3400	G	2	5 29/32	6 3/4
VANEAXIAL FANS								
BC703V	6.5	26	400	23,000	F	1	1	—
BC1307V-13	50.0	115	400	17,000	F	2 1/8	2	—
BT1610V-5	128.0	200	400	21,500	F	4 1/2	4 1/2	—
BT1615V-1	260.0	200	400	22,500	F	4 1/4	4 9/64	—
BT2220V	280.0	200	400	23,000	F	4 53/64	5	—
BT2922V-3	375.0	200	400	21,000	F	6	5 1/2	—
BT3815V-1	700.0	115	400	5500	F	7	8	—
BT3830V-1	2250.0	200	60	3300	F	10	12 1/2	—
TUBEAXIAL FANS								
1840	50	115	400	12,500	C	7/8	3 25/32	—
1873	73	115	400	5600	D	1 1/2	3 5/8	—
1554	130	115	400	3400	D	1 1/2	4 11/16	—
1908	265	115	400	7000	D	1 1/2	4 11/16	—
1602	270	208	60	3300	E	2 15/32	7 3/64	—
2311	625	208	60	3400	E	3 11/16	11	—
2034	710	200	400	2000	E	3 1/2	10	—
2290	1600	208	60	2700	E	3 3/4	12 1/4	—

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Want more data on our airmover lines? Request the handbook to fit your needs. There's our Centrifugal Blower Catalog #EB1, Vaneaxial Catalog #EV1R, and The Fan Catalog featuring propeller and tubeaxial designs, it's #EF1R. Each manual contains comprehensive theory and applications information as well.

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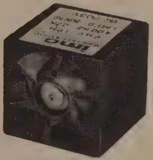
IMC FAN FACTS

LARGE

or small...



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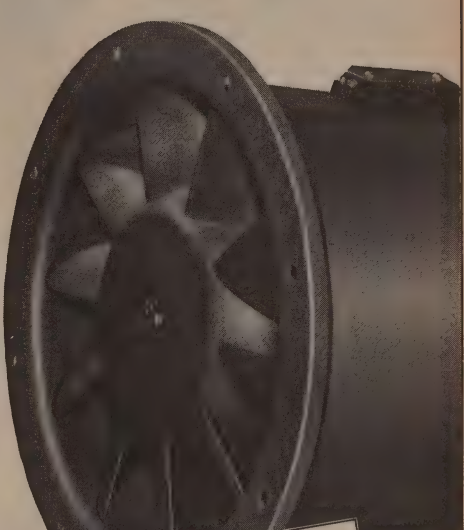
DC OR 60 HZ OR 400 HZ



When your space is at a premium and performance requirements are 6 CFM up to 12,000 CFM, count on an **IMC VANEAXIAL** fan for highest efficiency. Send for information regarding Turboslot® units using boundary layer control for high performance at lower speeds than conventional Vaneaxial fans. For immediate service please call Gene Egan, V.P. Sales — (516) 334-7070 or write:

NEW...

IMC units are also available with **IMCom Brushless DC Motor** drives. Features Electromagnetic Commutation, a new, uncomplicated, rugged and reliable control method.

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IMC FAN FACTS

Our well-built airmovers are rugged and reliable

Standard **Boxer** fans, rugged ball and new **Grand Prix** sleeve bearing types, both rated at more than 10 years operating life. **Super Boxer** for exceptional output at high back pressure. Versatile **DC Boxer** accepts DC and converts it to drive the unit's AC motor, eliminates brush wear, RF noise and other common DC motor problems. Miniature **PeWee Boxer**, delivering the highest cooling punch of any fan its size.

These reliable performers feature Boxer's sturdy all-metal construction, compact design for ease and flexibility of installation, and patented long-life bearing systems, as do **MiniBoxers, Tandem Boxers, Hi-Fi Boxers** and the new **Fulmar** fans. There's also the slim-profile **Condor** (3½″ thin by 10″ dia.) with air delivery to 575 cfm, and quality proven **IMCair** fans and centrifugal blowers. They are all distributor stocked for immediate availability.

If you'd like complete specifications and performance parameters for our full line of airmovers, send for 20 page catalog No. ND4R-5. It's available from **IMC Magnetics Corp., New Hampshire Division. Tel. (603) 332-5300.**

Bearing (m/n prefix)		Model No.	Air Delivery (cfm)	Volts (VAC)	Figure No.	Dimensions A	B	C
BOXER FANS – BALL(BS), SLEEVE(WS) BEARING MODELS								
BS	WS	2107FL	115	115	A	1½	4 11/16	4 11/16
X	X	2107FL-2	70	115	A	1½	4 11/16	4 11/16
X	X	2107FL-3	115	220	A	1½	4 11/16	4 11/16
X	X	2107FL-6	115	220/240	A	1½	4 11/16	4 11/16
X	X	2107FL-7	115	115/230	A	1½	4 11/16	4 11/16
MIL-TYPE BOXER FANS								
X		2107F-0-1	115	115	A	1½	4 11/16	4 11/16
X		2107F-2-1	70	115	A	1½	4 11/16	4 11/16
X		2107F-6-1	115	230	A	1½	4 11/16	4 11/16
SUPER BOXER FANS								
X	X	2107F-110	117	115	A	1½	4 11/16	4 11/16
X	X	2107FL-310	117	220/240	A	1½	4 11/16	4 11/16
HI-FI BOXER FANS (low noise)								
	X	2107FL-9	50	115	A	1½	4 11/16	4 11/16
	X	2107FL-10	50	220/240	A	1½	4 11/16	4 11/16
DC BOXER FANS								
X	X	2107F-12	95-118	12-16†	B	1½	5 11/16	4 11/16
X	X	2107F-24	97-110	22-26†	B	1½	5 11/16	4 11/16
X	X	2107F-30	110-120	28-32†	B	1½	5 11/16	4 11/16
X	X	2107F-36	100-114	34-38†	B	1½	5 11/16	4 11/16
TANDEM BOXER FANS								
TBS		2107FL	125	105/125	A	3	4 11/16	4 11/16
X		2107FL-6	125	220/240	A	3	4 11/16	4 11/16
MINIBOXER FANS								
MBS	MWS	*	**	*	C	1½	3⅝	3⅝
PEWEE BOXER FANS								
PBS	PWS	2107FL	36	115	C	1.665	3.125	3.125
CONDOR FANS (Ball bearing – only)								
		00, 01, 02	450	115	D	3½	10	–
		10, 11, 12	575	115	D	3½	10	–
		20, 21,22	575	230	D	3½	10	–
IMCair FANS								
Sleeve		FE6, FI6	225	115	E	4⅝	8⅛	–
Ball		FE8, FI8	485	115	E	5 29/32	10	–
IMCair BLOWERS (Sleeve bearing – only)								
		B2	24	115	F	4 21/32	3 7/16	3 15/16
		B3	87	115	F	5 15/16	5 15/16	5½
FULMAR FANS								
		10, 11, 12	240	115	G	2	5 29/32	6¾
		20, 21, 22	240	230	G	2	5 29/32	6¾

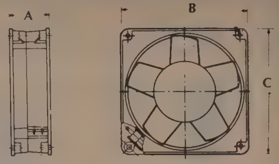

Figure A

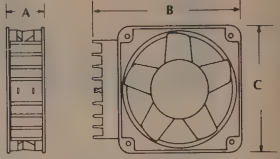

Figure B

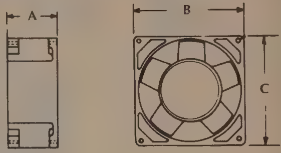

Figure C

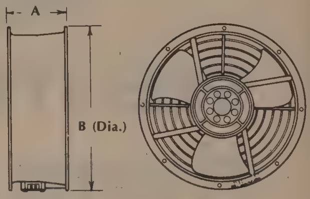

Figure D

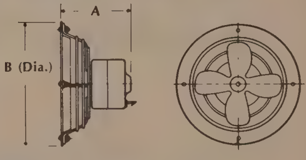

Figure E

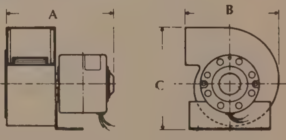

Figure F

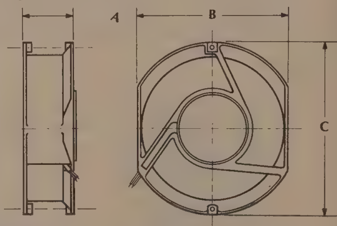

Figure G

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†DC voltage ratings (VDC).

*Identical to standard Boxer and Mil-Type models.

**MBS/MWS2107F-2 rated at 31 cfm, all other models rated at 46 cfm.

U.L. approved models. All Boxer and MiniBoxer (except Mil-Types), Super Boxer (BS/WS2107F-310), Tandem Boxer (TBS2107F), DC Boxer (WS2107F-9), Condor and IMCair (FE6, FI6) fans are optionally available in Underwriters Laboratories, Inc. approved versions. Yellow card component recognition #E36707.

IMC MAGNETICS CORP.
NEW HAMPSHIRE DIVISION
ROUTE 16B, ROCHESTER, NEW HAMPSHIRE 03867

IMC FAN FACTS

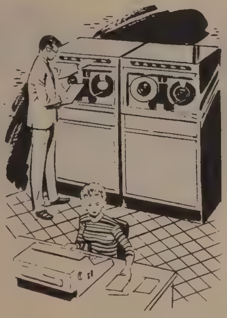
ALL 50/60 HZ AIRMOVERS

Here's a fan with high performance for low-profile cooling

The IMC Pe Wee Boxer fan delivers the highest available air flow for any unit of its size — up to 36 cubic feet of air per minute. The answer for cooling radio transmitters, tape decks, power suppliers, 3″ high relay rack panels etc. Well built for long life — varied designs.

3⅛″ square by 1.665″ deep.

PE WEE BOXER FAN



Our standard Boxer Fan is rugged and reliable

Here's a compact* whose whirlwind delivers 70 to 115 cubic feet of air per minute. The Boxer can convert to a variety of uses — has long life and saves time and money.

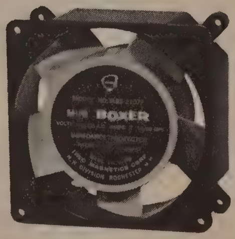
BOXER FAN
IMPEDANCE PROTECTED

* 4¹¹⁄₁₆″ square by 1½″ deep.

STANDARD BOXER FAN

IMC's MINI has a MAXI

When it comes to applications, our Mini Boxer fan can meet a maximum of uses — ranging from the busy ring of the supermarket cash register to the soothing melodies of a modern tape deck. Variations of this model include the Ball Bearing, G.P. Sleeve Bearing, Skeleton and Mil Type Miniboxers — all with similar low profile applications.



3⅝″ Sq. by 1½″ deep

MINI BOXER FAN

Literature on request!
For immediate service
please call Fred Taylor,
Sales Manager at
(603) 332-5300 or write.

imc

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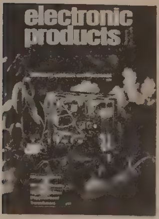

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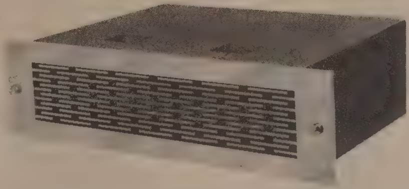
The Originators and Leaders in Packaged Cooling Equipment

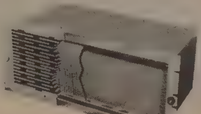
RACK–MOUNTED BLOWERS

Over 100 models available in any panel width. Heights from 3½" to 12¼". Airflows to 1000 CFM. Pressurize systems with cool, filtered air. Prevent dust from entering systems. Standard EIA notching. Quick, easy mounting. No cutting. No filing. Also Packaged Fans for pressurizing or evacuating. Four sizes. Airflows from 275 to 120 CFM. All units available to Commercial, Military or EMI Shielded Specifications.



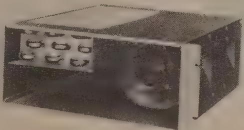
MODEL	NO	CFM	PANEL* HEIGHTS	MOTOR**		REMARKS
				RPM	AMPS OR WATTS	
2EB300	12	150	3½ & 5¼	2900	70W	FOR LIMITED SPACE
2EB3500	12	290	3½ & 5¼	3200	175W	HIGH PRESSURE-LIMITED SPACE
2EB408	16	300	5¼ & 7	1500	60W	QUIET OPERATION
2EB412	16	350	5¼ & 7	3000	200W	HIGH PRESSURE & VELOCITY
2EB508	16	325 & 475	7 & 8¾	1250-1600	0.8/0.6 amps	DUAL SPEED-LOW VELOCITY
2EB512	16	500	7 & 8¾	1700	130W	LARGE VOL. HIGH VELOCITY
2EB610	16	450 & 750	8¾ & 10½	1100-1500	1.6-1.3amps	DUAL SPEED-LARGE VOL.-LOW VEL.
2EB612	16	800	8¾ & 10½	1650	220W	HIGH VOLUME-HIGH VELOCITY
1EB800G	1	1000	10½	1100	240W	LOW NOISE-HIGH CFM
2EB412	20	500 & 700	5¼-7-8¾	3000	200W	SIDE DISCHARGE DUCT BLOWER
P1E350	6	350 or 675	5¼	3000	200W	PONTOON BASE BLOWER
4EB300	2	250	5¼ X 14⅝D	Two 3100	80W	MULTI-EXHAUST BLOWER
4EB424	2	450	7 X 19½D	Two 1700	70W	MULTI-EXHAUST BLOWER
ID300M	4	75	5¼	3000	40W	HALF PANEL WIDTH
IE2200	1	150	3½	3150	80W	SLOT BLOWER
IEB710	9	180 to 515	1¾-3½-5¼-7	1600	900W	SIDEWINDER

*ALL MODELS ARE 19" WIDTH EXCEPT ID300A (HALF PANEL) **ALL MOTORS ARE 115V 50 60 NZ UL APPROVED
UNITS ALSO AVAILABLE TO OTHER RACK WIDTHS AND FOR RECESSED INSTALLATION



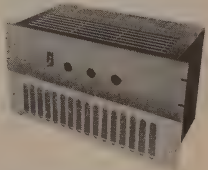
EMI—SHIELDED UNITS

All packaged blowers available with an EMI shield and wave guide media built into the airstream. Cuts signal leakage inward or outward.



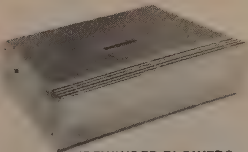
HEAT EXCHANGERS

Maintain cabinet temperature at 80°F maximum with 1 KW heat dissipation. Air recirculates in rack and is cooled by exchanger in blower case.



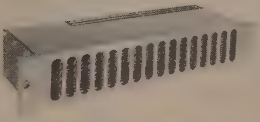
HEATER—COOLERS

For unheated field installations. Maintains an even 65°F with surrounding air as low as 10°F.



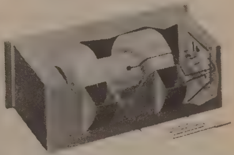
SIDEWINDER BLOWERS

More air. More pressure. Less space. Delivers 180, 350 or 515 CFM in a 17" wide airstream.



SLOT BLOWERS

Ideal for jam-packed circuitry. Delivers 150 CFM from a 3½" panel. Quiet.



SOLID STATE TEMPERATURE CONTROLLERS

Cuts noise level. Modulates blower speed. Keeps operating between 80-90°F. Costs less than air conditioning.

Also a broad line of accessory equipment including grilles, controls, etc.

McLEAN ENGINEERING LABORATORIES

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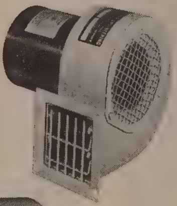
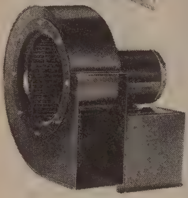
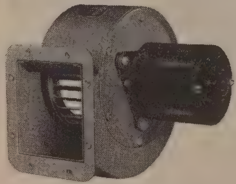
mc lean®

Single and Dual Centrifugal Blowers
Filter Grille Panels





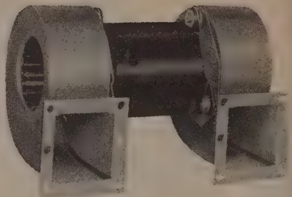


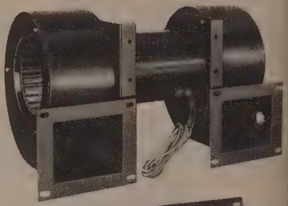
SINGLE CENTRIFUGAL BLOWERS—McLean does have a large selection of single centrifugal blowers engineered to meet a wide variety of CFM output and pressure characteristics. Inlet duct flanges, exhaust outlet flanges and protective screens are available. CW and CCW rotations can be supplied. Each motor has been specifically designed for the application, bearings are properly loaded, double shielded and permanently lubricated. Motor and wheels are balanced to precision tolerances assuring vibration-free operation. All motors are UL approved. These blowers may be operated in any shaft position.

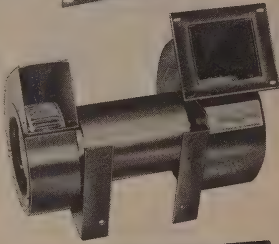
CFM output ranges from 50 to 2000 CFM with static pressures from 0″ to 3.0″ SP. Motors can be supplied for any AC frequency or power.

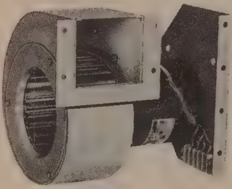
DUAL CENTRIFUGAL BLOWERS—There is an extensive variety of McLean Dual Centrifugal Blowers offering a wide choice of static pressure and output characteristics. Wheel diameters range from 3″ to 12″. Motors can be supplied for any AC frequency or power, single or three phase. Each motor has been specifically designed for the application, bearings are properly loaded, double shielded and permanently lubricated. Motors and wheels are balanced to precision tolerances assuring vibration-free operation. All motors are UL approved.

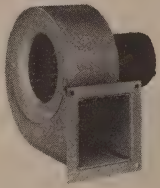
Exhaust outlet flanges, inlet duct flanges, protective screens and various types of mounting flanges and supports are available.

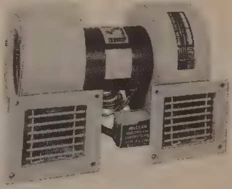


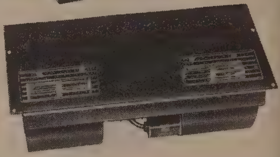




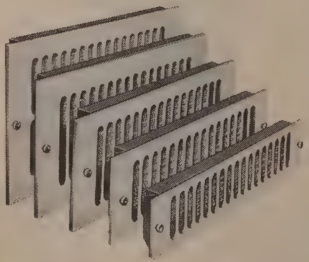




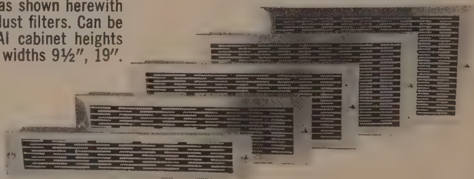




FILTER GRILLE PANELS



Filter Grille Panels are for use in electronic cabinets where louvered area is needed to permit adequate ventilation. These panels may be used as an air inlet or air outlet. They are available with two different grille designs as shown herewith and are complete with dust filters. Can be supplied in standard EAI cabinet heights from 3½″ x 10½″ and widths 9½″, 19″. 24″ and 30″.



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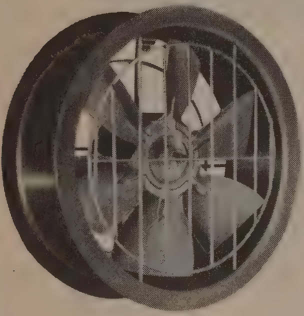
FANS — Venturi, Orifice, Panel-Mounted

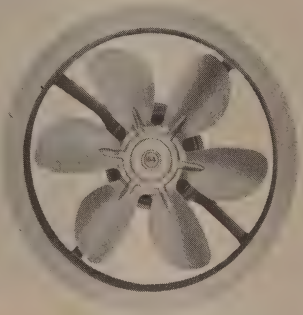
VENTURI-MOUNTED



MODEL 1VB80

A 420 cfm self-contained unit that mounts against top, bottom, or side of rack. Mounts for airflow in either direction . . . no need to stock two models for push or pull. Venturi is black anodized aluminum 3⅞″ deep. Motor: 1600 rpm; 60 watt, 115 volt, 50/60 Hz; shaded pole; stainless steel shaft; double-shielded ball bearings; permanently lubricated; fungus, moisture, and corrosion resistant. Installs fast and easy — just bolt flush to rack opening and fan is ready to go.

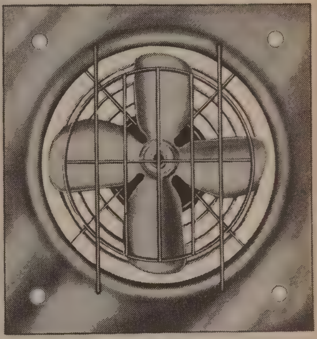
ORIFICE-MOUNTED



SERIES 1NB65

Rugged, self-contained. Strong, lightweight, axial flow aluminum for maximum pressure. Mounts easily on top, bottom or side of rack. Deep-pitched, accurately-balanced blades are quiet and vibrationless. No welds, joints, or rivets to break. Motors: 115 volts, 50/60 Hz; shaded pole, stainless steel shaft. The INB65 Series is 3000 rpm, 60 watts, airflow either direction. The 1NB80 Series is 1600 rpm, 55 watts air flow either direction. cfm's are 275, 300 or 395. Dimensions: 4″ deep x 8½″ dia. or 4¾″ deep x 10¼″ dia.

PANEL-MOUNTED



SERIES 1PB65

Low-cost, long-life, self-contained fans ready to mount, shaft in any position, for vertical or horizontal operation, inside or outside rack. May be installed flat against mounting surface in a round or square opening with a minimum of installation time and effort. Propeller protected with heavy wire guard welded flush in bell mouth orifice plate. Motor side also protected by heavy cadmium-plated guard. Air delivery 280 cfm. Motor: 3100 rpm, 70 watt, 115 volt, 50/60 Hz, permanent lube. Dimensions: 10″ square panel on 9″ centers, $4\frac{23}{32}$″ deep.

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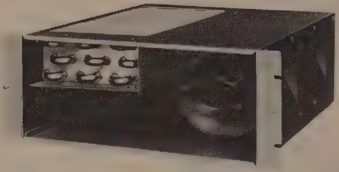
Heat Exchangers • Heat Pipes

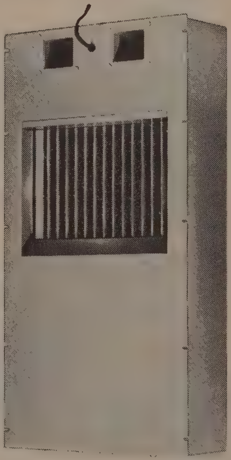
HEAT EXCHANGERS

McLean Heat Exchanger models are designed to meet individual specifications and applications. Air is recirculated within the electronic enclosure and cooled by a heat exchanger installed within the blower case. The systems do not use room ambient air nor do they exhaust hot interior cabinet air into the room atmosphere. These heat exchangers are highly reliable with a more accurate interior cabinet temperature control. Especially recommended in critical applications involving a harsh environment surrounding the electronic installation.



HEAT PIPE HEAT EXCHANGERS

Model HPI is an air-to-air system utilizing the most advanced method of heat transfer now in use. The heat pipe is a super thermal conductor, transmitting heat by the evaporation and condensation of a working fluid sealed in the pipe. Ambient air is cooled and recirculated without introducing outside air. Ambient air is used only to cool the heat pipe and is not induced into the cabinet. Model shown will remove 1 KW of heat and will maintain a stable interior temperature differential of 16°F above ambient.



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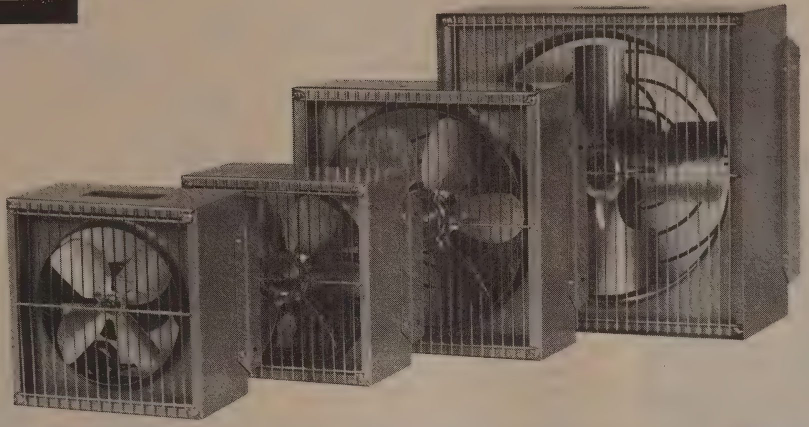
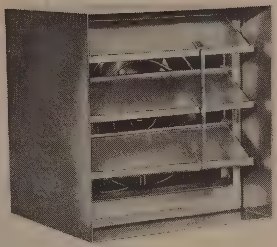
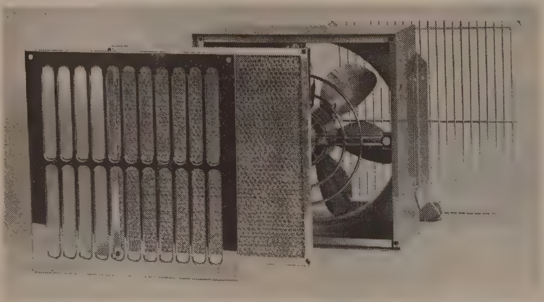
Reversible Filter Box Propeller Fans



MODEL 1RB65 MODEL 1RB80 MODEL 1RB100 MODEL 1RB120



MODEL LA120



Extra Equipment: Stainless Steel Grille, Permanent Washable Filter, Heavy Gauge Propeller Guard.

Efficient, versatile, and compact line of mechanically-reversible fans with a wide range of CFM capacities and flexibility of mounting arrangements. May be used to pressurize or evacuate electronic cabinets. Can be supplied with guards, dust filters and decorative air inlet grilles. All UL approved.

Model 1RB65 delivers 275 cfm, 3100 rpm 4½" deep x 8⅞" square

Model 1RB80 delivers 450 cfm, 1650 rpm 4½" deep x 8⅞" square

Model 1RB100 delivers 725 cfm, 1600 rpm 4½" deep x 12⅛" square

Model 1RB120 delivers 1200 cfm, 1450 rpm 4½" deep x 15⅛" square

Model LA120 Back Draft Damper is used in conjunction with Model 1RB120. Louvers automatically open when power is applied and close when power is off. May be used in horizontal or vertical positions.

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PAMOTOR

ONE OF THE **PURDY** GROUP OF COMPANIES
770 AIRPORT BLVD. • BURLINGAME, CA 94010
(415) 347-1203 • TWX 910-374-2353 • TELEX 34-9373

Premium Grade Fans

PAMOTOR offers a premium grade fan line for the most critical of applications. Guaranteed to be the most reliable fans available, the PENTAFLOW ™ series is covered by a special 5-year warranty.

Every model in the PENTAFLOW ™ series incorporates seven basic points of superiority designed into them: lightweight, durable all-metal construction . . . low noise level . . . low operating temperature . . . optimized shape factor . . . minimum electromagnetic field . . . low true cost . . . and high reliability.

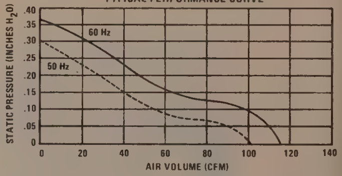
FEATURES
- 5-Year warranty
- All-metal construction
- UL recognized - Yellow Card E41168
- Special moisture resistant finish

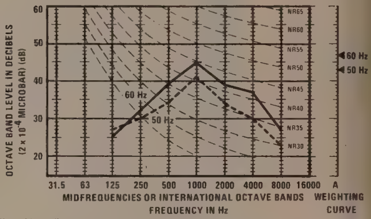
MODEL 4500P
Size: 4.68" Square x 1.50" Depth
115 cfm

PENTAFLOW
PAMOTOR

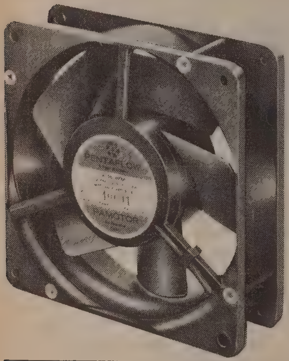
Characteristic	Model 4500P
Bearing System	Sleeve, Broached Sintered Iron
Voltage	115 VAC
Frequency	50/60 Hz
Input Power	20 watts
Air Flow	115 cfm
Speed	2950 rpm
Weight	20 ounces
Noise Level (SIL)	31.5 dB

TYPICAL PERFORMANCE CURVE



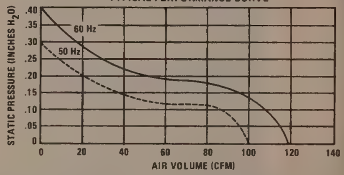


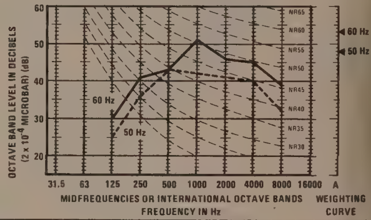
MODEL 4600P
Size: 4.68" Square x 1.50" Depth
120 cfm



Characteristic	Model 4600P
Bearing System	Sleeve, Broached Sintered Iron
Voltage	115 VAC
Frequency	50/60 Hz
Input Power	20 watts
Air Flow	120 cfm
Speed	3100 rpm
Weight	21 ounces
Noise Level (SIL)	37.5

TYPICAL PERFORMANCE CURVE



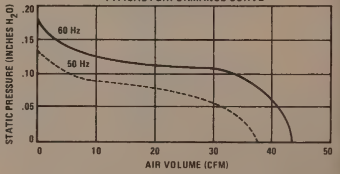


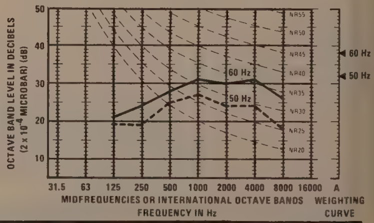
MODEL 8500P
Size: 3.13" Square x 1.50" Depth
43 cfm

PENTAFLOW
21000

Characteristic	Model 8500P
Bearing System	Sleeve, Broached Sintered Iron
Voltage	115 VAC
Frequency	50/60 Hz
Input Power	13 watts
Air Flow	43 cfm
Speed	3200 rpm
Weight	18 ounces
Noise Level (SIL)	22.3 dB

TYPICAL PERFORMANCE CURVE





DC Fans

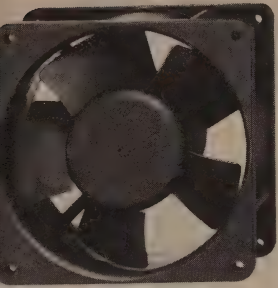
PAMOTOR
ONE OF THE PURDY GROUP OF COMPANIES
770 AIRPORT BLVD. • BURLINGAME, CA 94010
(415) 347-1203 • TWX 910-374-2353 • TELEX 34-9373

FEATURES
- Out-performs equivalent sized AC fans
- Polarity protected
- No external inverter required
- Fully self-contained
- Reliable all-metal construction
- Input power - 20% of that required in AC units

PAMOTOR has introduced the first self-contained DC cooling fan that does not require an external voltage inverter. This new design concept eliminates many of the inherent reliability and RF noise problems associated with using AC motors in a DC environment.

The new PAMOTOR DC fans are available in three configurations: two axial fans and one radial blower. All of the units are designed to meet U/L, C.S.A. and I.E.C. requirements.

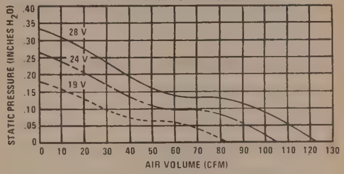
MODEL 4110
Size: 4.68" Square x 1.50" Depth
122 CFM

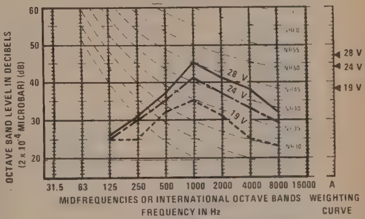


U.S. Patent No. 3-873-897

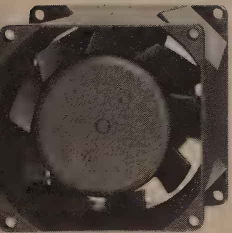
Characteristic	Model 4110	
	24 VDC	28 VDC
Bearing System	Ball Bearing	Ball Bearing
Voltage	19 - 28 VDC	19 - 28 VDC
Input Power	4.1 watts	5.9 watts
Input Current	170 mA	210 mA
Air Flow	82 cfm	122 cfm
Speed	2225 rpm	3175 rpm
Weight	21 ounces	21 ounces
Noise Level (SIL)	28 dB	35.6 dB

TYPICAL PERFORMANCE CURVE





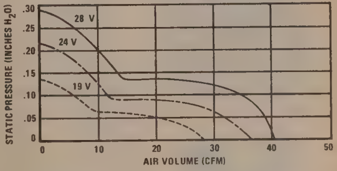
MODEL 8110
Size: 3.13" Square x 1.50" Depth
41 CFM

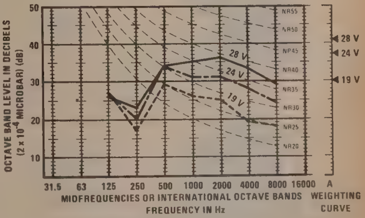


U.S. Patent No. 3-873-897

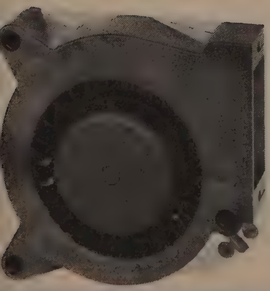
Characteristic	Model 8110	
	24 VDC	28 VDC
Bearing System	Ball Bearing	Ball Bearing
Voltage	19 - 28 VDC	19 - 28 VDC
Input Power	2.8 watts	4.0 watts
Input Current	115 mA	140 mA
Air Flow	28 cfm	41 cfm
Speed	2620 rpm	3700 rpm
Weight	19 ounces	19 ounces
Noise Level (SIL)	23 dB	30.8 dB

TYPICAL PERFORMANCE CURVE





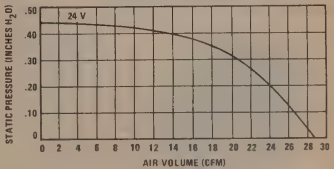
MODEL RL90-18/10
Size: 4.75" Square x 1.46" Depth
29 CFM

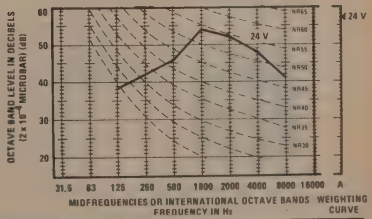


U.S. Patent No. 3-873-897

Characteristic	Model RL90-18/10
Bearing System	Ball Bearing
Voltage	19 - 28 VDC
Input Power	4.1 watts
Input Current	170 mA
Air Flow	29 CFM
Speed	2225 rpm
Weight	20 ounces
Noise Level (SIL)	42.7 dB
Maximum Back Pressure	.45 inch H_2O

TYPICAL PERFORMANCE CURVE





PAMOTOR

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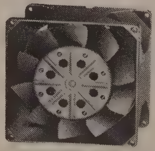
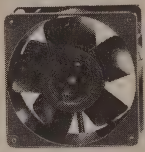
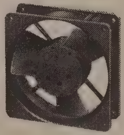
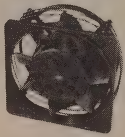
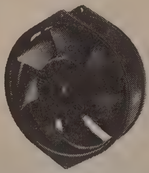
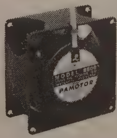
770 AIRPORT BLVD. • BURLINGAME, CA 94010
(415) 347-1203 • TWX 910-374-2353 • TELEX 34-9373

Shaded-Pole Type Fans

FEATURES

- Available through local distribution
- Reliable all-metal construction
- Designed to meet C.S.A. and I.E.C. requirements
- UL recognized - Yellow Card E41168
- Proven reliability
- High performance
- Quality construction
- Advanced engineering

WRITE FOR YOUR FREE SET OF BROCHURES ON HOW TO SELECT THE OPTIMUM FAN

	Model	Noise Level (SIL)	Air Flow (CFM)	Max. Back Pres. (H_2O)	Volts (AC) 50/60 Hz	Dimensions
	2500S	37.5 dB	100	.58	115	4.45″ Square x 1.97″ Depth
	2550S	37.5 dB	100	.58	220	4.45″ Square x 1.97″ Depth
	4500C	31.5 dB	115	.37	115	4.68″ Square x 1.50″ Depth
	4506A *	34.3 dB	115	.37	115	4.68″ Square x 1.50″ Depth
	4550C	31.5 dB	115	.37	220	4.68″ Square x 1.50″ Depth
	4556	34.3 dB	115	.37	220	4.68″ Square x 1.50″ Depth
	4600	37.5 dB	120	.40	115	4.68″ Square x 1.50″ Depth
	4650	37.5 dB	120	.40	220	4.68″ Square x 1.50″ Depth
	4800A	22.5 dB	70	.11	115	4.68″ Square x 1.50″ Depth
	5500S	37 dB	140	.49	115	4.68″ Square x 2.17″ Depth
	5550S	37 dB	140	.49	220	4.68″ Square x 2.17″ Depth
	7500S	42 dB	250	.69	115	6″ Diameter x 2.17″ Depth
	7506 *	42 dB	250	.69	115	6″ Diameter x 2.17″ Depth
	7550S	36.8 dB	250	.69	220	6″ Diameter x 2.17″ Depth
	7556 *	36.8 dB	250	.69	220	6″ Diameter x 2.17″ Depth
	7900S	50 dB	220	.45	115	6″ Diameter x 1.50″ Depth
	7950S	50 dB	250	.45	220	6″ Diameter x 1.50″ Depth
	8500C	22.3 dB	43	.18	115	3.13″ Square x 1.50″ Depth
	8506 *	22.9 dB	43	.18	115	3.13″ Square x 1.50″ Depth
	8550C	22.3 dB	43	.18	220	3.13″ Square x 1.50″ Depth
	8556 *	24.2 dB	43	.18	220	3.13″ Square x 1.50″ Depth

*High-temperature ball bearing models.

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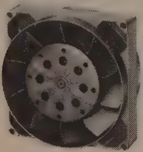
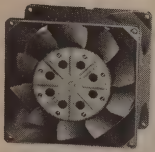
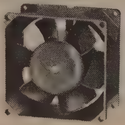
Induction Type Fans

FEATURES

- Available through local distribution
- Reliable all-metal construction
- Designed to meet C.S.A. and I.E.C. requirements
- UL recognized Yellow Card E41168
- Proven reliability
- High performance
- Quality construction
- Advanced engineering

CAPACITORS FOR INDUCTION-TYPE FANS

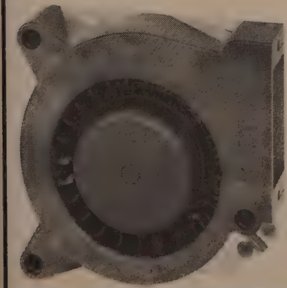
Part Number	Capacitance mfd	For Models
1005	4.0	2000, 3000
1005G	4.0	2000, 3000
1006	2.0	1300, 2050
1009	1.0	3050
1009G	1.0	3050
1010	0.5	2110
1011	5.6	900

	Model	Noise Level (SIL)	Air Flow (CFM)	Max. Back Pres. (H_2O)	Volts (AC) 50/60 Hz	Dimensions
	900	16.8 dB	34	.09	115	3.13″ Dia x 1.50″ Depth
	1300	37.6 dB	120	.41	220	4.45″ Square x 1.97″ Depth
	2000 2050 2110 *	37.5 dB 37.5 dB 44.9 dB	130 130 125	.59 .59 .55	115 220 115	4.45″ Square x 1.97″ Depth 4.45″ Square x 1.97″ Depth 4.45″ Square x 1.97″ Depth
	3000 3050	29.3 dB 29.3 dB	65 65	.18 .18	115 220	3.46″ Square x 1.97″ Depth 3.46″ Square x 1.97″ Depth

*400 Hz

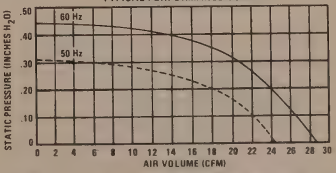
Radial Blowers

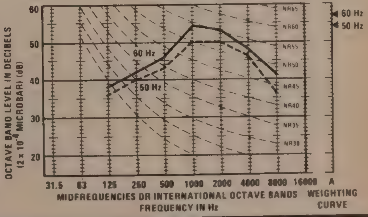
MODEL RL90-18/00
MODEL RL90-18/50
Size: 4.75″ Square x 1.46″ Depth
29 cfm



Characteristic	Model RL90-18/00	Model RL90-18/50
Bearing System	Sleeve, Broached Sintered Iron	Sleeve, Broached Sintered Iron
Voltage	115 VAC	220 VAC
Frequency	50/60 Hz	50/60 Hz
Input Power	21 watts	19 watts
Air Flow	29 cfm	29 cfm
Speed	2700 rpm	2600 rpm
Weight	20 ounces	20 ounces
Noise Level (SIL)	42.7 dB	42.7 dB

TYPICAL PERFORMANCE CURVE





What follows will give you an idea of what we can offer you in standard centrifugal, axial, tube axial, and transverse blowers.

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

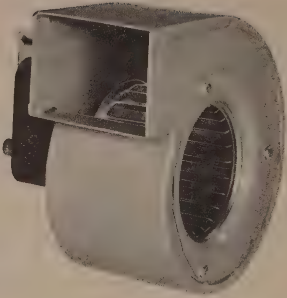
The models on the following pages sum up our selection of ready-to-go standard blowers. They're the substance behind our statement that we have an unmatched choice . . . in size and variety.

We also have extensive production facilities that are strategically situated from the East to the West Coast in North America, as well as throughout Western Europe and Australia. Our inventory is a good guarantee that you won't grow old waiting for deliveries.

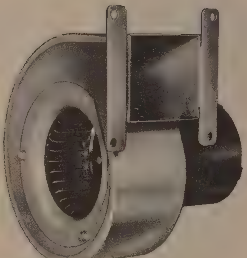
After all, we've been in this air-moving business for fifty-odd years. So we know what service is all about. Many of the products presented here are available directly from our nationwide stocking distributors.

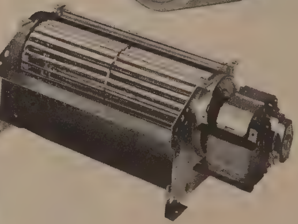
The best way for us to get started together is for you to ask for literature that contains complete specs and data on our complete standard blower line. Write or phone Torin Corporation, Torrington, Ct. 06790 . . . 203-482-4422. Make your choices, and we'll zap off literature or samples to you immediately.

See how easy we make it to solve air-moving problems?



Torin TA450
Model A30122
Volt 115
Hz 50/60
impedance protected





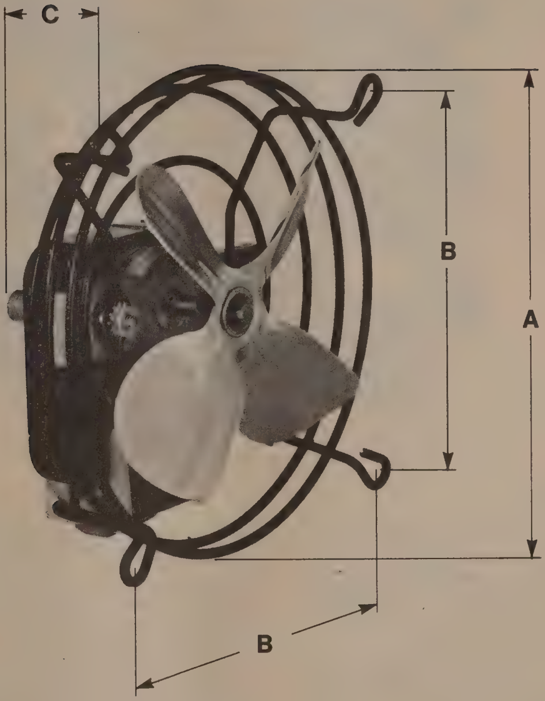
Standard Axials

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

Torin Standard Axials offer a wide range of air and pressure delivery. They provide a low-cost answer for many cooling applications. The impeller design is the result of a great many years of application and design experience. It is a one-piece construction that exhibits a high degree of aerodynamic design in its blade configuration.

The motors are manufactured by Torin's wholly owned subsidiary Cole Dynamics.



Axial Specifications

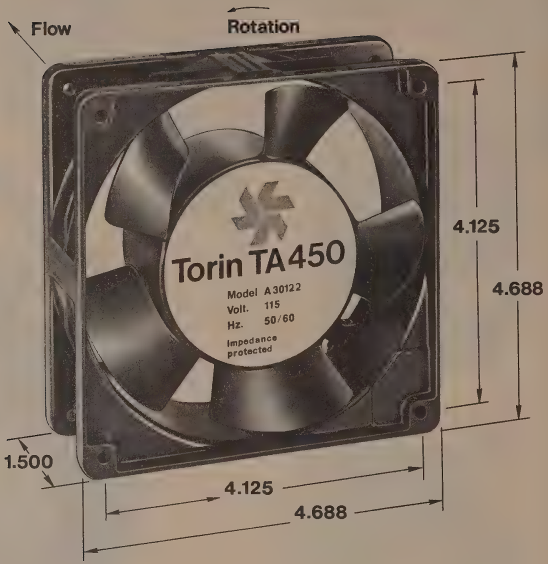
Unit	A	B	C	Performance CFM at zero static pressure
AX 2021-28350-1	3.53	3.18	2.85	8.2
AX 2035-28350-2	3.53	3.18	2.85	12
AX 3027-28350-3	3.53	3.18	2.85	32.5
AX 4029-28350-4	5.03	4.18	2.85	73
AX 4043-28350-5	5.03	4.18	3.23	92.5
AX 4527-28350-6	5.03	4.18	3.23	103
AX 5020-28352-1	6.52	5.31	3.22	125
AX 5027-28352-2	6.52	5.31	3.66	182
AX 6021-28352-3	6.52	5.31	3.66	238
AX 6030-28352-4	6.52	5.31	3.66	270

Standard TA450 Tube Axial

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

The TA450 is a small tube-axial blower with an integral motor. It was designed to reflect improvements over competitive units and the needs of customers as revealed by our market survey. The TA450 is utilized primarily in computers, business machines and electronic equipment. Its size and characteristics also make it applicable to many other uses.



Elements

Housing: One-piece zinc die casting which provides strength and acts as a heat sink in dissipating heat from the motor. Finish is plain or black paint.

Motor: Shaded pole designed as an integral part of the unit. Motors are impedance protected.

Bearing system: The unit is available with either sleeve or ball bearings.

Sleeve Bearings: A sintered bronze bearing impregnated with high-quality oil (23% volume). Hydrodynamic pumping and pressure at the front end of an air-tight system causes oil to move along the shaft to provide a constant film of lubricant.

Ball Bearings: Double-shielded ABEC-3 electric motor quality bearings, press fitted into the rotor laminations.

Life expectancy: Because of the lubricant reserve and low loss design, you can expect long bearing life. Actual life in any given case will depend upon operating conditions, including temperature, duty cycle, vibration and contamination levels. A normal expectancy for nominal indoor ambient conditions would be 20,000 hours life.

UL and CSA approval on units.

Models

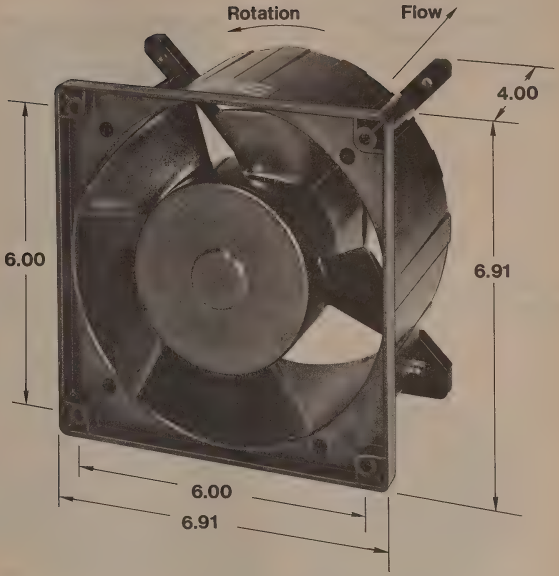
Model No.	Voltage	Frequency	Phase	Bearing Type	Performance CFM at zero static pressure
A30108	115	50/60	1	Sleeve	106
A28678	230	50/60	1	Sleeve	106
A30122	115	50/60	1	Ball	106
A30135	230	50/60	1	Ball	106

Standard TA700 Tube Axial

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

The TA700 is a tube-axial unit developed to produce greater air delivery than any other blower of its size and type. It was designed specifically for applications that demand a large volume of air working against moderate static pressure, such as densely-packaged relay racks in communications equipment and printed-circuit card chassis in computers. The TA700's construction is rugged, yet not heavy. It outperforms competitive units in air flow, power consumption and quietness of operation.



Elements

Impeller: Lexan polycarbonate black plastic injection molded. Airfoil shape for optimum air performance with low noise.

Note: Lexan polycarbonate has U.L. rating 94V-O for flammability. It has high-impact strength, dimensional stability, heat resistance, and excellent environmental resistance to maintain these properties over a long life.

Housing: Lexan polycarbonate black plastic injection molded. Housing ribbed for additional strength and rigidity.

Motor mounting: Aluminum die cast with four radial motor support struts, semi-elliptically shaped to lessen noise. The entire bracket operates as a heat sink to hold temperature rise to a minimum. Air ventilating holes are also provided.

Motor: Shaded pole, thermally protected, developed to use less current and lower draw than any other blower motor of similar size and performance.

Two double shielded ball bearings.

Life expectancy: Because of the lubricant reserve and low loss design, you can expect long bearing life. Actual life an any given case will depend upon operating conditions, including temperature, duty cycle, vibration and contamination levels. A normal expectancy for nominal indoor ambient conditions would be 20,000 hours life.

UL and CSA approval on units.

Models

Model No.	Voltage	Hz.	Phase	Performance CFM at zero static pressure
A30050	115V	50/60	1	380
A30056	230V	50/60	1	380

TA450 & TA700 Accessories

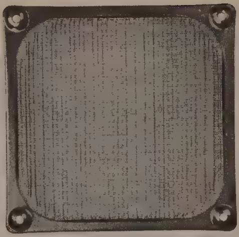
Products designed for use on Torin tube axial units.

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

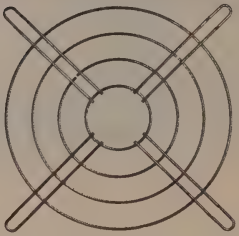
Filter: for use with TA450 tube axial unit. Designed to attach directly to the TA450 unit. Matched filter and fan insure proper operation and easy assembly.

Part number 30208

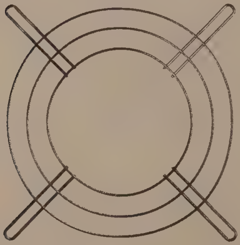


Guards protect personnel or object from coming in contact with rotary fan.

Part number 30181 for TA450



Part number 30204 for TA700



Cord assembly for use on both TA450 and TA700

Part number 30225

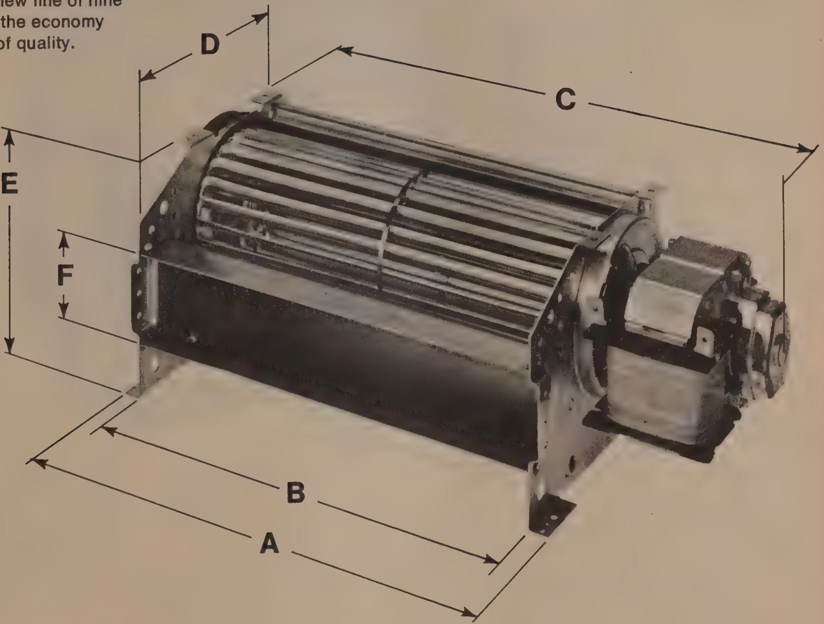
Standard Transverse Flow

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

Because of their configuration, Transverse Flow Blowers occupy minimum height and depth. Utilizing the entire width of the impeller blades, they take air in across the entire width of impeller and discharge it at that width. They deliver a wide band of uniformly distributed air at a plane defined by the discharge of the specially-designed housing.

There is a definite price advantage in the utilization of this new line of nine standard models, but the economy involves no sacrifice of quality.



Specifications

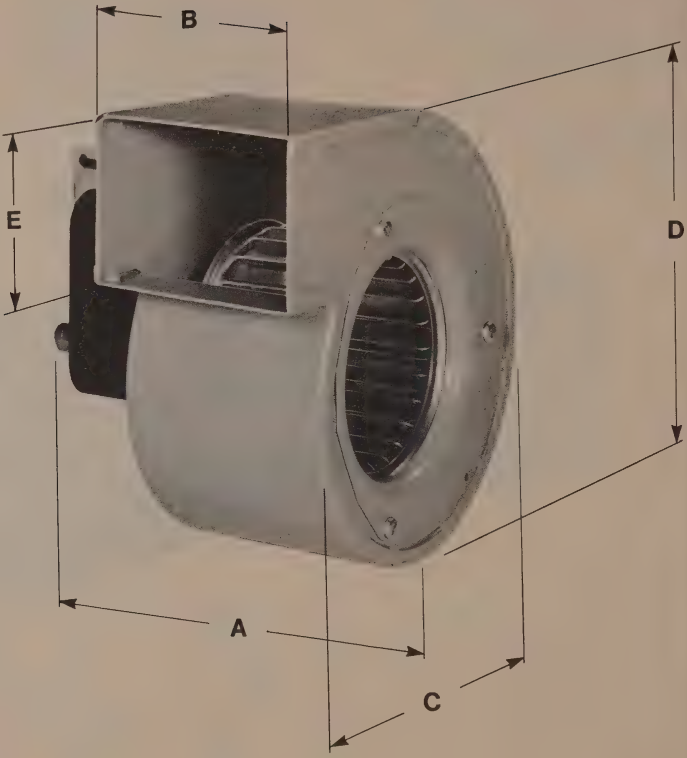
Unit	A	B	C	D	E	F	Performance CFM at zero static pressure
SEL 236-28206	5.11	4.49	7.29	4.33	3.54	1.38	53
SEL 236-28207	7.47	6.85	10.15	4.33	3.54	1.38	68
SEL 236-28208	7.47	6.85	10.35	4.33	3.54	1.38	73
SEL 236-28209	9.92	9.28	12.77	4.33	3.54	1.38	82.5
SEL 236-28210	9.92	9.28	12.97	4.33	3.54	1.38	111
SEL 236-28211	—	18.66	23.62	4.57	3.58	1.38	171
SEL 236-28213	—	7.24	10.12	3.78	3.27	1.42	81
SEL 236-28214	—	7.24	10.12	3.78	3.27	1.42	74
Double unit, motor in center							
SEL 236-2812	—	—	24.00	4.57	4.09	1.38	165

Standard Centrifugals

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares

Torin Standard Centrifugals feature the most widely used air impeller in air moving history. The continuous blade strip Airotor wheel. This wheel, developed by Torin engineers over twenty five years ago, and improved by usage gained from experience is the standard of the industry. Strong, efficient, rattle free; a forward curved wheel produced to close tolerances of trueness and balance that guarantees you years of trouble free air delivery.

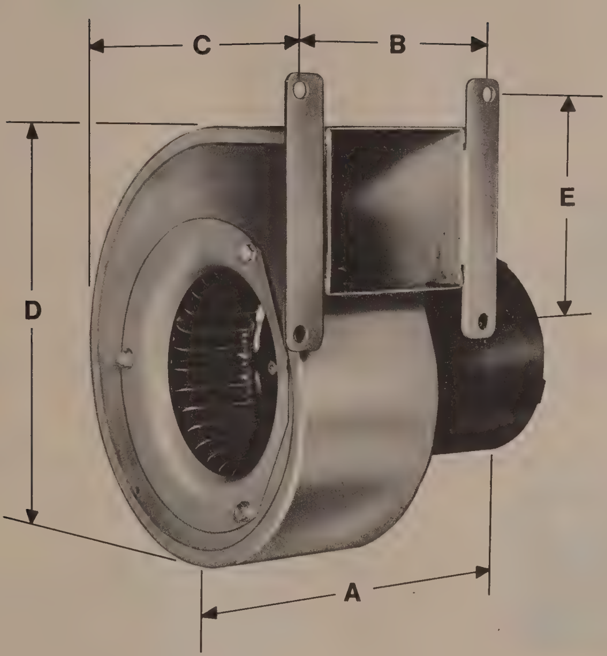


Specifications

Unit	A	B	C	D	E	Performance CFM at zero static pressure
SC 216-28316-1	3.40	1.75	4.69	5.39	1.93	29
SC 216-28316-2	4.34	2.25	4.69	5.39	1.93	44.5
SC 300-28316-3	3.88	1.75	4.69	5.39	1.93	41.5
SC 300-28316-4	4.84	2.75	4.69	5.39	1.93	61
SC 300-28316-5	4.84	2.75	4.69	5.39	1.93	64
SC 326-28317-1	3.88	1.75	5.91	6.79	1.93	68.5
SC 326-28317-2	4.84	2.75	5.91	6.79	1.93	102.5
Small snap lock housing style						
SC 116-28323-1	2.87	1.25	3.19	3.73	1.49	5.6
SC 200-28323-2	2.87	1.25	3.19	3.73	1.49	12.6

Torin

Torin Corporation
United States: Torrington, Conn.
Van Nuys, Calif.
Rochester, Ind./Elgin, Ill.
Canada: Oakville, Ont.
England: Swindon, Wilts
Belgium: Nivelles
Australia: Sydney
Spain: Alcalá de Henares



Specifications

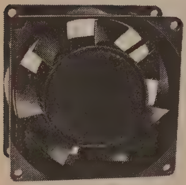
Unit	A	B	C	D	E	Performance CFM at zero static pressure
SC 326-28962	6.33	3.75	6.44	6.85	3.45	120
SC 400-28963	8.31	4.25	6.44	6.85	3.45	235
SC 400-28964	8.81	4.75	7.17	7.68	3.45	239
SC 416-28965	7.82	4.50	7.17	7.68	3.45	159
SC 424-28966	8.35	4.75	7.17	7.68	3.45	285
SC 424-28967	8.32	5.00	7.83	8.52	3.45	190
Plastic housing & wheel						
SC 306-28361	6.00	2.75	5.44	5.83	2.18	98

Rotron® Fans and Blowers

Long recognized as the leader in the design and manufacture of air moving devices for cooling and flushing electronic equipment, Rotron offers fans and blowers for virtually every need. Quality standards are the highest in the industry. And costs to the customer are among the lowest. If you do not find the product you need in the following pages, or need help in selecting an air mover to meet your requirements, contact your Rotron representative, distributor, or field office today.

Why settle for less when the best costs no more?

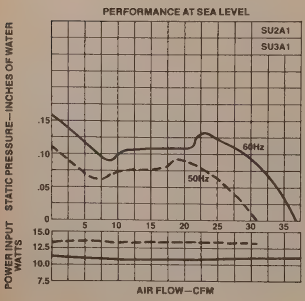
ROTRON INC., Woodstock, N. Y. 12498 ☐ 914•679-2401 ☐ TWX 510-247-9033
Pacific Div., Burbank, Cal. 91506, 213•849-7871 • Rotron B.V., Breda, Netherlands, Tel: 79311, Telex: 844-54074



Sprite® Fan

A smaller size fan that delivers relatively high pressures at close-to-maximum air delivery.

- 36 cfm free air delivery, with 25 cfm at .12 inches H_2O
- ideal where space is at a premium, just 3.13″ square x 1.64″ depth
- withstands ambients from -28°C to 60°C
- outperforms larger, conventional fans in many applications
- extremely quiet, with only 35 dB noise level
- UL Yellow Card Recognized
- up to 5 years maintenance-free life
- comes with terminals (standard) or lead wires



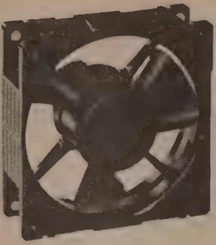
Model No.	Part No.	Volts	Hz	Watts	CFM
SU2A1*	028064	115	50/60	10	37
SU3A1*	028067	230	50/60	10	37

*with leads

For complete information, see Catalog Sheet COM 030

Rotron® Fans and Blowers

ROTRON INCORPORATED



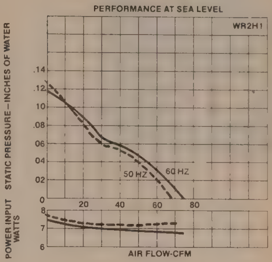
Whisper® Fan

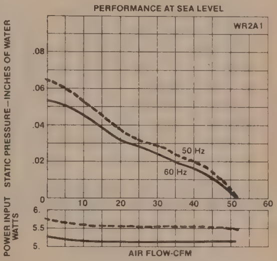
The quiet one - for efficient cooling where low acoustical disturbance is a must.

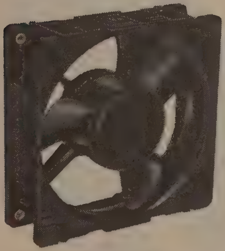
- just 18 dB at full 52 cfm free air delivery
- available in skeleton or venturi version
- ideal for cooling TV cameras, public address and sound systems, tape recorders, hi-fi equipment, TV receivers, and ham radio gear
- essentially a low-speed Muffin, with all its long life advantages
- 4.68" square x 1.50" depth. Weighs 17.2 oz.
- UL Yellow Card Recognized

Model No.	Part No.	Volts	Hz	Watts	CFM
WR2A1	027117	115	50/60	7	52
WR2H1	027119	115	50/60	7	75

For complete information, see Catalog Sheet COM 050



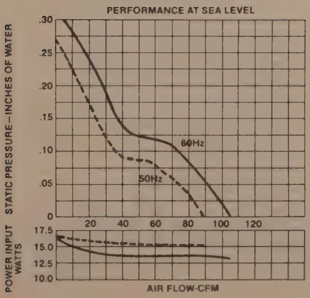




Muffin® Fan

***The* dependable, low cost fan for all commercial cooling applications.**

- 105 cfm free air delivery
- 10 years continuous duty at 70°F. without relubrication
- only 4.68" square x 1.50" depth
- proved by the millions in thousands of applications
- rated for ambients from −18°C to 70°C
- venturi or skeleton version
- low 40 dB noise level
- available with ball bearings
- UL Yellow Card Recognized
- weighs just 17.2 oz.



Model No.	Part No.	Bearing	Volts	Hz	Watts	CFM
MU2A1	028021	sleeve	115	50/60	14	105
MU2A2*	028022					
MU2B1	028027	ball	115	50/60	14	105
MU2B2*	028028					
MU3A1	028023	sleeve	230	50/60	14	105
MU3A2*	028024					
MU3B1	028029	ball	230	50/60	14	105
MU3B2*	028030					

*Skeleton version

For complete information, see Catalog Sheet COM 040

ROTRON INCORPORATED

Rotron® Fans and Blowers

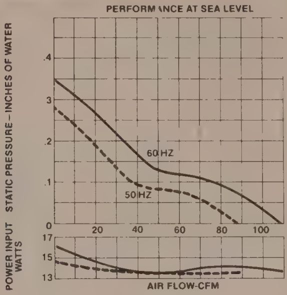
Sentinel® Fan

An especially rugged fan for severe application conditions, including temperature and shock.

- 105 cfm free air delivery
- stainless steel ball bearings
- withstands ambients up to 100°C
- meets MIL E-4970A
- sturdy glass-filled phenolic venturi block
- low NC-40 noise level
- 4.68″ square x 1.50″ depth
- weighs 16 oz.
- venturi or skeleton version
- UL Yellow Card Recognized

Model No.	Part No.	Volts	Hz	Watts	CFM
S747	020128	115	50/60	14	105
S756	020146	230	50/60	14	105

For complete information, see Catalog Sheet COM 060



Caravel® Fan

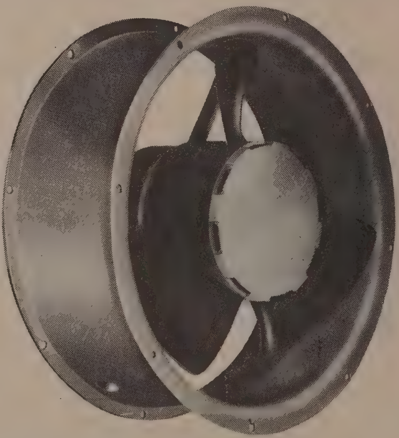
Maximum air volume, from a narrow fan, for flushing large racks and cabinets.

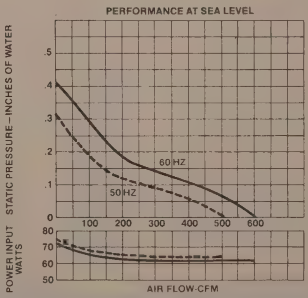
- full 590 cfm free air delivery
- measures just 10″ diameter x 3.50″ depth
- sealed ball bearings for long, quiet, maintenance-free life
- for ambients from −30°C to 60°C
- acoustical rating as low as NC-45
- weight 4.4 lbs.
- UL Yellow Card Recognized and C S A listed

Model No.*	Part No.	Volts	Hz	Watts	CFM
CL2L2	020188	115	50/60	61	590
CL2T2	020189	115	50/60	61	590
CL3L2	020190	230	50/60	61	590
CL3T2	020191	230	50/60	61	590

*T = with terminals, L = with leads

For complete information, see Catalog Sheet COM 110





Rotron® Fans and Blowers

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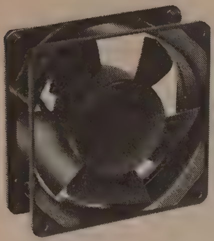
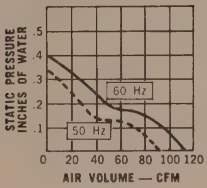


Centaur® Fan

The highest performance in air and pressure delivery for a fan of its size.

- 115 cfm at free air delivery
- withstands ambients from −40°C to 70°C
- 5+ years continuous duty at 21°C
- UL Yellow Card Recognized
- Low NC-47 noise level
- 4.68 x 1.50″ depth allows interchange with Muffin, Sentinel, or Whisper
- weighs 19 oz.



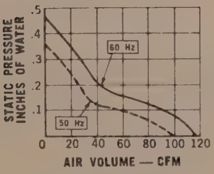
Model No.	Part No.	Bearings	Volts	Hz	Watts	CFM
CR2A1	028076	sleeve	115	50/60	16	115
CR52A1	028082	sleeve	230	50/60	16	115

For complete information, see Catalog Sheet COM 070

Spartan Fan

The MIL SPEC version of the famous MUFFIN.

- 115 cfm free air delivery (132 cfm for 400 Hz model)
- unusually high pressure characteristics (up to .5″ hg)
- dimensionally interchangeable with Muffin® fan 4.68″ square x 1.50″ depth
- double shielded stainless steel ball bearings
- lubricated for life
- highly efficient multi-slot motor
- withstands ambients from −54°C to 125°C
- venturi, spiders, and hub are single aluminum casting for shock and vibration resistance
- meets all applicable mil specs for ground and shipboard use



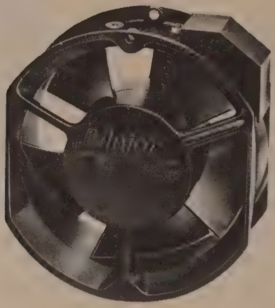
Motor Series	Volts	Hz	Watts	CFM
682YS	115	50/60	13	117
810DS	115	400	13	135

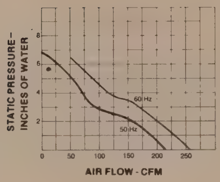
Type SL with leads, Type ST with terminals

For complete information, see Catalog Sheet MIL 070

ROTRON INCORPORATED

Rotron® Fans and Blowers





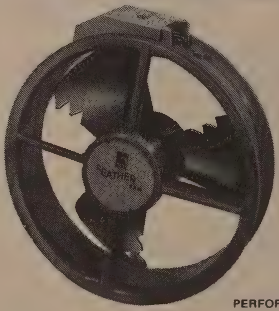
Major® Fan

Newest Rotron tubeaxial fan: a rugged peak performer offering exceptionally high pressures for densely packed spaces.

- unusually high pressure building capacity in 100-200 CFM range
- shallow 2″ depth permits application in tightest spaces
- efficient, permanent split capacitor motor prevents over-heating, down-time
- extremely low noise level ideal for computer room environments
- Major's unique housing design facilitates multiple fan installation
- withstands ambients up to 70°C.
- long life bearings — permanently lubricated
- U.L. yellow card recognition

Model No.	Part No.	Volts	Hz	Watts	CFM
MA2B4	026551	115	50/60	34	260
MA77B4	026553	230	50/60	28	260

For complete information, see Catalog Sheet COM 080



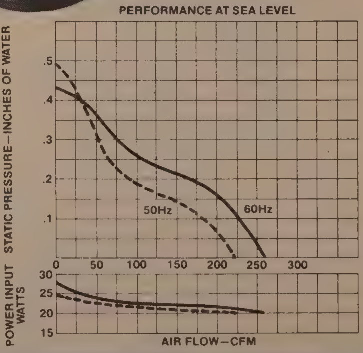
Feather® Fan

High volume air performance where space is severely limited, particularly in depth.

- 270 cfm free air delivery
- 7″ diameter and just 2.47″ depth
- exclusive new Feathered Edge™ blade is extra quiet at free delivery—NC-48
- pre-lubricated stainless steel ball bearings
- withstands ambients from −54°C to +65°C
- multi-slot induction motor, capacitor provided
- UL Yellow Card Recognized

Model No.	Part No.	Volts	Hz	Watts	CFM	Thermal Protector
FF103	026161	115	50/60	20	270	No
FF113	026165	115	50/60	20	270	Yes
FF203	026162	230	50/60	20	270	No
FF213	026166	230	50/60	20	270	Yes

For complete information, see Catalog Sheet COM 090



Rotron® Fans and Blowers

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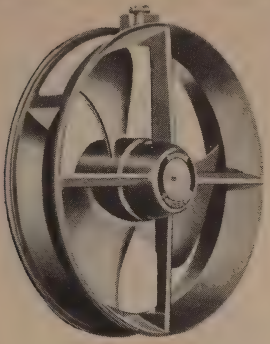
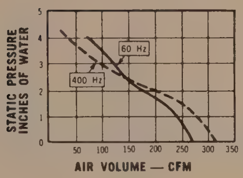


Saucer® Fan

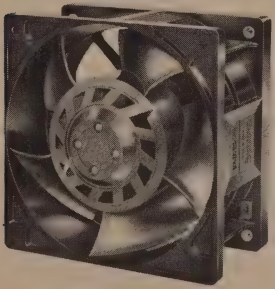
High volume and high pressure both, from a minimum of fan space.

- 275 cfm free air delivery
- generates pressures of over .5" H_2O
- driving motor entirely within hub for minimum depth - 2.50", dia. 7"
- pre-lubricated stainless steel ball bearings
- for ambients from —54°C to 125°C
- clamping rings at venturi ends for easy mounting
- meets all applicable military specifications



Motor Series	Volts	Hz	Watts	CFM
340ZS	115	50/60	25	275

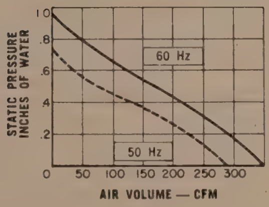
For complete information, see Catalog Sheet MIL 080



Tarzan® Fan

High air volume and pressure combined, for tightly packed cabinets and chassis.

- 340 cfm free air delivery
- patented design gives pressures approaching centrifugal blowers
- unusually high 0.9" H_2O pressure at cut-off
- tough phenolic venturi, die cast aluminum spiders
- double shielded ball bearings
- 3-4 year maintenance-free life at 49°C
- withstands ambients from —18°C to 55°C
- UL Yellow Card Recognized
- 6.91 square x 4.34" depth



Model	Volts	Hz	Watts	CFM
TN3A2 TN3C2	115	50/60	85	340
TN3A3 TN3C3	230	50/60	85	340

*A with terminals, C with leads

For complete information, see Catalog Sheet COM 120

ROTRON INCORPORATED

Rotron® Fans and Blowers

Aximax® 1, 2, & 3

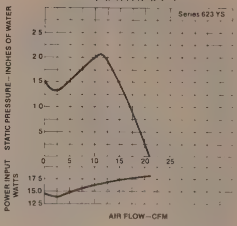
Family of miniature, high-performance air movers for air-borne and other critical space/weight/performance applications.

- free air delivery from 7 cfm to 160 cfm
- optional Altivar® motors automatically increase speed with altitude
- life expectancies from 10,000 hours up at 72°C
- withstands ambients up to 125°C
- sizes: 1.50" x 1.50", 2" x 1.50", and 3" x 2.38"
- weight 4 oz., 4½ oz., and 14 oz. respectively
- meet all applicable military specifications

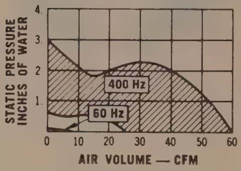
Models for 115 VAC, 1 phase, 400 Hz; 200 VAC, 3 phase, 400 Hz, and 115 VAC 1 phase, 60 Hz (except Aximax 1)

For complete information, see Catalog Sheets,
Aximax 1 - MIL 020
Aximax2, Aximax 3-MIL 040, MIL 030

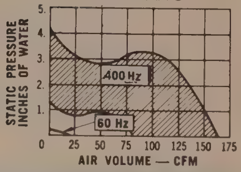
AXIMAX 1

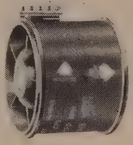


AXIMAX 2



AXIMAX 3





PROPIMAX 3B
PROPIMAX 2
PROPIMAX 3

Propimax® 2, 3, & 3B

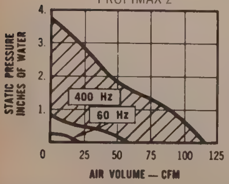
Large-volume and high-pressure air movers for airborne equipment.

- free air delivery from 22 cfm to 190 cfm
- offer pressures as high as 7" H_2O at cut-off
- optional Altivar® motors automatically increase speed with altitude
- life expectancies of 10,000 hours at 14.7 psia and 72°C
- withstand ambients up to 125°C
- size/weight: 3.25" x 1.50" and 6.5 oz., for Propimax 3.75" x 2" and 15.2 oz. for Propimax 3 & 3B
- meet all applicable military specifications

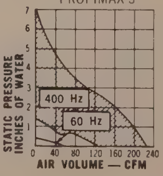
Models for 115 VAC, 1 phase, 400 Hz; 200 VAC, 3 phase, 400 Hz; 115 VAC, 1 phase, 60 Hz

For complete information, see Catalog Sheets,
Propimax 2 - MIL 050 Propimax 3 & 3B - MIL 060

PROPIMAX 2



PROPIMAX 3



Rotron® Fans and Blowers

® ROTRON
INCORPORATED

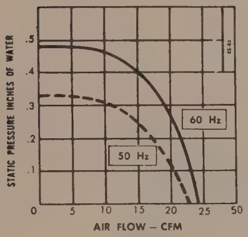
Biscuit® Blower

The only air moving device that fits inside a 1¾" rack panel mounted instrument.

- 25 cfm free air delivery
- 4.75" square and only 1.56" depth
- built around famous Muffin fan features
- delivers sufficient pressure for tightly packaged equipment
- 10 year life expectancy at room ambients
- withstands ambients from −18°C to 72°C
- low NC-42 noise level
- UL Yellow Card Recognized

Model No.	Part No.	Volts	Hz	Watts	CFM
BT2A1	025447	115	50/60	16	25
BT3A1	025449	230	50/60	17	25

For complete information, see Catalog Sheet COM 130

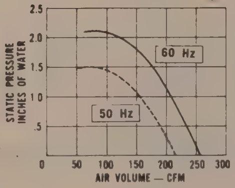


Centrimax® Blower

Compact, efficient and versatile blower for use where system impedance is relatively high.

- over 3" of static water pressure at 50-300 cfm available with CX33A
- motor completely integrated with impeller design
- oversize double-shielded ball bearings, lubricated for life
- adjustable blast direction - housing rotates 360°
- installs in any attitude, from any of three mounting surfaces
- accepts standard, readily available round ducting
- housing of flame retardant polyester, won't bend or rust
- operates from −20°C to 55°C

For complete information, see Catalog Sheet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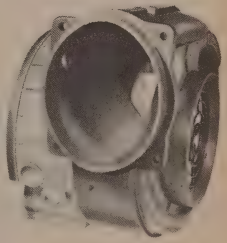
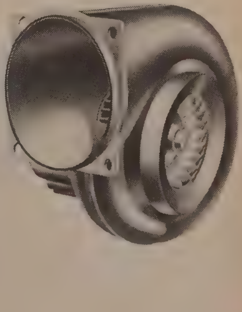
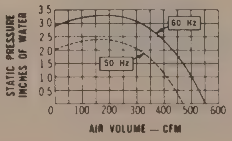





CX33

ROTRON INCORPORATED

Rotron® Fans and Blowers

Spiral® Blowers

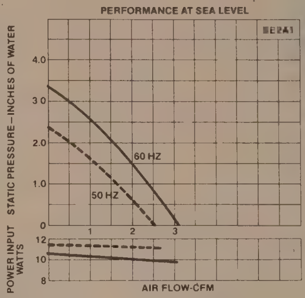
Spiral Blowers are revolutionary new motor/blower packages that develop unusually high positive or negative air pressure with low-to-moderate air volume. There are no sliding seals or vanes. No brushes or commutators to wear or cause RF interference. Extra wide, lubricated-for-life ball bearings provide the only contacting surfaces.

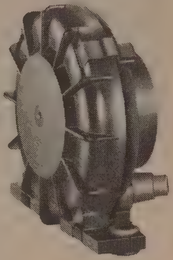
Mini-Spiral®

The advantages of spiral blowers in an ultra-compact high-performance unit.

- suction as high as 3 inches H_2O at shut-off
- compact 4.16″ diameter x 1.81″ depth
- fully encapsulated stator for protection against environment
- double shielded, stainless steel ball bearings
- maintenance-free life of six years
- low 10 watt power consumption
- UL Yellow Card Recognition
- weight only 17 oz.

For complete information, see Catalog Sheet COM 140



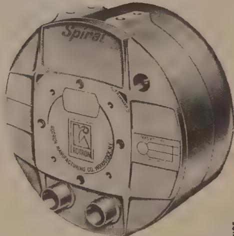


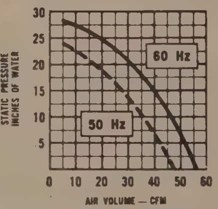
Spiral® Simplex

Reliable, economical, versatile source of high pressure, high vacuum.

- pressures up to 30″ wg, air flow to 55 cfm
- compact 10″ diameter x 5.87″ depth
- high strength die-cast aluminum housing
- for ambients to 55°C at normal 5 to 15 cfm, higher as air flow is increased
- optional trimmer valves at inlet and outlet allow precise adjustment for system requirements
- optional accessories include filters, pressure gauge clamps, thermal protector, and terminal box
- weight 21.9 lbs.

For complete information, see Catalog Sheet HIP 020

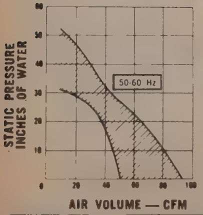




Spiral® Duplex

Two independent air sources from a single compact unit.

- pressures/vacuums 2 psig, pre-set to requirements at the plant
- air delivery up to 94 cfm
- oil free air - no possible contamination
- low 3300 rpm speed for quiet and long life
- mounts in any attitude, with four ¼-20 holes in two locations
- economically priced
- weight 36 lbs.



For complete information, see Catalog Sheet HIP 020

Axel

Must You Meet MIL-STD 461?

Here's where EXPERIENCE counts!

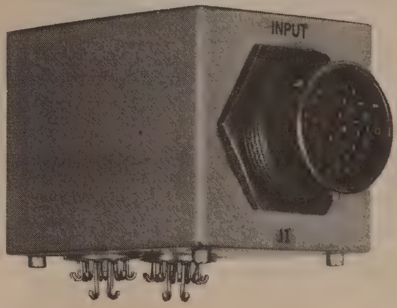
AXEL computer-aided designed filters will enable your system to meet the exacting requirements of MIL-STD 461 and MIL-F-15733.

Initial system analysis is our specialty.

AXEL ELECTRONICS is a highly experienced organization specializing in the design and production of standard and custom built filters.

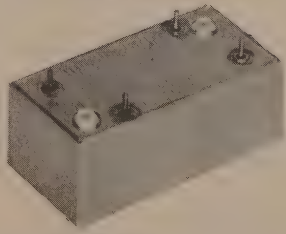
We offer a complete line of high quality, long life, high performance filters from low signal level devices to very high power line filters including special multi-circuit packages.

A total filter design service is available backed by a complete QC monitored manufacturing facility to meet your most stringent requirements.



OUR EXPERIENCE INCLUDES:

- Active and Passive Electric Wave Filters (MIL-F-18327)
- Low Pass - High Pass - Band Pass - Band Reject Filters
- Constant Delay Filters
- Delay Equalizers
- Signal Line Filters
- Transmission Line Filters



Ask for our complete catalog and
Look to the Leader in Filter Technology . . .

Axel

AXEL ELECTRONICS, INC.
A UNIT OF GENERAL SIGNAL CORPORATION
134-20B Jamaica Avenue, Jamaica, N.Y. 11418
(212) AX 1-3900 • TWX: 710-582-2618

Our complete service includes applications engineering and fast prototype delivery. Send us your specifications and/or applications and we'll do the rest.

Want a low-pass RFI/EMI filter with small size? See AMP.

Shown approximately twice actual size.

You'll find exactly the one you're looking for among a wide variety of rugged, single-piece, center-conductor RFI/EMI low-pass filters with solder or bolt-in mountings.

Features.

- Three sizes (standard, miniature and subminiature) suitable for a wide variety of applications.
- Standard or low-capacitance versions accommodate a wide range of cutoff frequencies.
- High insertion loss performance versus size.
- Rugged, single-piece construction offers excellent resistance to shock and vibration.

Environmental and physical specifications.

Salt Spray: MIL-STD-202, Method 101, Cond. A; 96 hrs. (salt solution 20%)
Temperature Cycling: MIL-STD-202, Method 102. Cond. D; except −55°C to +125°C
Immersion Test: MIL-STD-202, Method 104, Cond. A
Barometric Pressure: MIL-STD-202, Method 105, Cond. B
Moisture Resistance: MIL-STD-202, Method 106; 50 VDC applied
Vibration: MIL-STD-202, Method 204, Cond. D
Resistance to Soldering Heat: MIL-STD-202, Method 210, Cond. B
Shock: MIL-STD-202, Method 213, Cond. C
Terminal Strength: MIL-STD-202, Method 211, Cond. A 5 lb. pull test
Temperature range: −55°C to +125°C, without voltage derating.
Note. The following military standards and specifications are applicable to all series filters. MIL-STD-202, MIL-STD-220, and MIL-F-15733

Electrical specifications.

Standard-size 4000 pf filters (Series 55).

Maximum voltage rating (to +125°C, 60-400 Hz): 200 VDC; 125 VAC.
Maximum current rating: 15A (load); .5A (RF).
Minimum capacitance (either terminal-to case): 4000 pf @ 1 KHz (rms) @ +25°C.
Dielectric withstanding voltage (either terminal-to case): 500 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
3 db @ 2 MHz 50 db @ 100 MHz
10 db @ 10 MHz 90 db @ 300 MHz to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals (except filter P/N 859550-3): .002 ohms @ +25°C.

Miniature 3000 pf filters (Series 25).

Maximum voltage rating (to +125°C, 60-400 Hz): 125 VDC; 85 VAC.
Maximum current rating: 15A (load); .3A (RF).
Minimum capacitance (either terminal-to case): 3000 pf @ 1 KHz (rms) @ +25°C.
Dielectric withstanding voltage (either terminal-to case): 375 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
10 db @ 10 MHz 55 db @ 300 MHz
30 db @ 100 MHz 65 db @ 500 MHz to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals: .002 ohms @ +25°C.

Subminiature 1500 pf filters (Series 25).

Maximum voltage rating (to +125°C, 60-400 Hz): 125 VDC; 85 VAC.
Maximum current rating: 15A (load); .3A (RF).
Minimum capacitance (either terminal-to case): 1500 pf @ 1 KHz (rms) @ +25°C.
Dielectric withstanding voltage: (either terminal-to case): 375 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
5 db @ 10 MHz 40 db @ 500 MHz
20 db @ 100 MHz 50 db @ 1000 MHz to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals: .002 ohms @ +25°C.

Standard-size, low-capacitance filters (Series 45).

Maximum voltage rating (to +125°C, 60-400 Hz): 200 VDC; 125 VAC.
Maximum current rating: 15A (load); .5A (RF).
Maximum capacitance (either terminal-to case):
300 pf @ 1 KHz (rms) @ +25°C;
390 pf @ 1 KHz (rms) @ +125°C.
Dielectric withstanding voltage: (either terminal-to case): 500 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
3 db @ 25 MHz 45 db @ 1 GHz
35 db @ 500 MHz 70 db @ 5 to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals (except filter P/N 859604): .002 ohms @ +25°C.

Miniature low-capacitance filters (Series 15).

Maximum voltage rating (to +125°C, 60-400 Hz):
125 VDC; 85 VAC.
Maximum current rating: 15A (load); .3A (RF).
Maximum capacitance (either terminal-to case):
225 pf @ 1 KHz (rms) @ +25°C;
280 pf @ 1 KHz (rms) @ +125°C.
Dielectric withstanding voltage (either terminal-to case):
375 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
3 db @ 50 MHz
25 db @ 500 MHz
35 db @ 1.0 GHz
55 db @ 5.0 to 18 GHz.
Minimum insulation resistance (either terminal-to case):
500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals:
.002 ohms @ +25°C.

Subminiature low-capacitance filters (Series 15).

Maximum voltage rating (to +125°C, 60-400 Hz):
125 VDC; 85 VAC.
Maximum current rating: 15A (load); .3A (RF).
Maximum capacitance (either terminal-to case):
130 pf @ 1 KHz (rms) @ +25°C;
170 pf @ 1 KHz (rms) @ +125°C.
Dielectric withstanding voltage (either terminal-to case):
375 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220):
3 db @ 150 MHz
16 db @ 1.0 GHz
35 db @ 5.0 GHz
42 db @ 10 GHz to 18 GHz
Maximum insulation resistance (either terminal-to case):
500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals:
.002 ohms @ +25°C.

Mechanical specifications.

Standard-size filters (Series 55 & 45).

Series 55 Part No.	Series 45 Part No.	Weight in grams	Suggested mounting hole diameter	**Recommended Mounting Torque in.-lbs.	Thread size
859550-1	859604-1	.50	.140	—	—
*859550-2	*859604-2	.35	.125	—	—
859550-3	859604-3	.25	.125	—	—
859550-4	859604-4	.35	.125	—	—
859550-5	859604-5	.45	.125	—	—
859551-1	—	2.00	.203	5.0-6.0	10-32 UNF-2A
*859551-2	—	2.00	.203		10-32 UNF-2A
859552-1	859606-1	.35	.094	—	—
*859552-2	*859606-2	.35	.094	—	—
859555-1	859605-1	1.5	.177	5.0-6.0	8-32 UNC-2A
*859555-2	*859605-2	1.5	.177		8-32 UNC-2A
859554-1	—	2.70	.228	5.0-6.0	12-32 UNEF-2A
*859554-2	—	2.70	.228		12-32 UNEF-2A

NOTES:
All threaded versions supplied with lock washer and nut.
*These part numbers have a turret head terminal, .060" dia. by .030".
**Refer to AMP Capitron Division for additional information regarding mounting specifications.

AMP INCORPORATED

For more information, write AMP Capitron Division, Elizabethtown, Pa. 17022.
Note: Data subject to change without notice. AMP is a trademark of AMP Incorporated.

Miniature filters (Series 25 and 15).

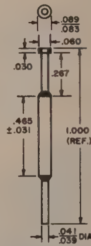
Series 25 Part No.	Series 15 Part No.	Weight in grams	Suggested mounting hole diameter	**Recommended Mounting Torque in.-lbs.	Thread size
859249-1	859603-1	1.2	.177	4.0-5.0	8-32 UNC-2A
*859249-2	*859603-2	1.2	.177		8-32 UNC-2A
1-859249-1	859603-3	.3	.125	—	—
*1-859249-2	*859603-4	.3	.125	—	—
1-859249-3	859603-5	.4	.125	—	—
2-859249-1	859603-6	.25	.094	—	—
*2-859249-2	*859603-7	.25	.094	—	—

NOTES:
All threaded versions supplied with lock washer and nut.
*These part numbers have a turret head terminal, .060" x .030".
**Refer to AMP Capitron Division for additional information regarding mounting specifications.

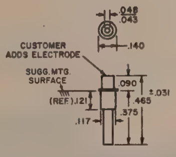
Subminiature filters (Series 25 and 15).

Series 25 Part No.	Series 15 Part No.	Weight in grams	Suggested mounting hole diameter	*Recommended Mounting Torque in. lbs.	Thread size
859259-2	859602-1	.40	8-32 UNC-2A Thread	4.0-5.0	8-32 UNC-2A
859259-3	859602-3	.20	.125	—	—
859259-4	859602-5	.15	.094	—	—
859259-6	859602-2	.40	8-32 UNC-2A Thread	4.0-5.0	8-32 UNC-2A
859259-8	859602-4	.20	.125	—	—

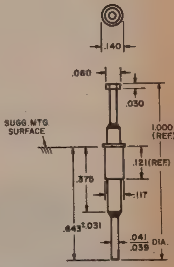
NOTES:
*Refer to AMP Capitron Division for additional information regarding mounting specifications.


.089
.083
.060
.030
.267
.465 ±.031
1.000 (REF.)
.041 .039 DIA.

859552-2
859606-2


.048
.043
.140
CUSTOMER ADDS ELECTRODE
SUGG. MTG. SURFACE
.090
±.031
(REF.) .121
.465
.375
.117

859550-3
859604-3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.060
.030
SUGG. MTG. SURFACE
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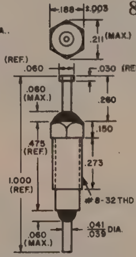
.121 (REF.)
.375
.117
.643 ±.031
.041 .039 DIA.

859550-2
859604-2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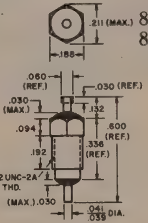
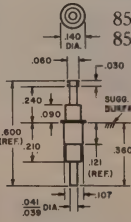
.211 (MAX.)
(REF.) .060
.030 (REF.)
.060 (MAX.)
.260
.150
.475 (REF.)
.273
1.000 (REF.)
#8-32 THD
.060 (MAX.)
.041 .039 DIA.

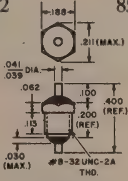
859555-2
859605-2


.211 (MAX.)
.188
.060 (REF.)
.030 (REF.)
.030 (MAX.)
.132
.094
.600 (REF.)
.336 (REF.)
.192
#8-32 UNC-2A THD.
(MAX.) .030
.041 .039 DIA.

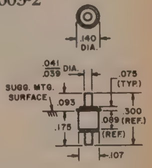
859249-2
859603-2


.140 DIA.
.060
.030
.240
.090
SUGG. MTG. SURFACE
.600 (REF.)
.210
.360
.121 (REF.)
.107
.041 .039 DIA.

1-859249-2
859603-4


.188
.211 (MAX.)
.041 .039 DIA.
.062
.100
.400 (REF.)
.200 (REF.)
.113
.030 (MAX.)
#8-32 UNC-2A THD.

859259-2
859602-1


.140 DIA.
.041 .039 DIA.
.075 (TYP.)
SUGG. MTG. SURFACE
.093
.300
.089 (REF.)
.175
(REF.)
.107

859259-3
859602-3

FIXED FREQUENCY FILTERS

A.P. Circuit Active Filters are available in Standard Modules. Low-Pass, High-Pass, Band-Pass or Band-Reject.

Filters Feature: High Input, Low Output Impedance, O Insertion Loss. Most Units in Plastic Cases, Copper Shielded. Custom Modular Designs.

Signal Conditioning Units assembled to customer specifications from Standard Modules Fig. P.

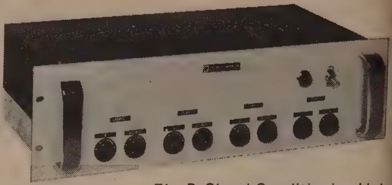


Fig. P. Signal Conditioning Unit

Model	FUNCTION				Standard Frequency Range	Fig.	
	Low Pass	High Pass	Band Pass	Band Reject			
APH 4		✓			1 Hz–10KHz *	G	24Db/Octave
APH 8		✓			1 Hz–10KHz *	H	48Db/Octave
APL 4	✓				1 Hz–10KHz *	G	24Db/Octave
APL 8	✓				1 Hz–10KHz *	H	48Db/Octave
APB 8			✓		1 Hz–10KHz *	H	24Db/Octave
APN -				✓	30Hz–20KHz *	I	Adjustable Q
APN - 60				✓	60Hz	I	Adjustable Q
APN - 60 PC				✓	60 Hz	K	Adjustable Q

"NEW" BAND PASS FILTER FOR MODEMS:

APT			✓		1K–100KHz *	L	Double Tuned

* HIGHER OR LOWER FREQUENCIES UPON REQUEST

NEW

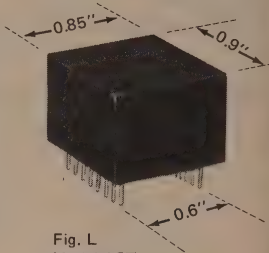


Fig. L
Model APT
Modem Band Pass Filter

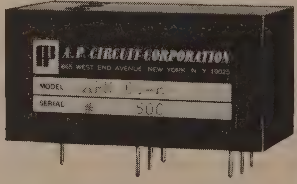


Fig. K
P.C. Mounted Notch Filter
(Band Reject)

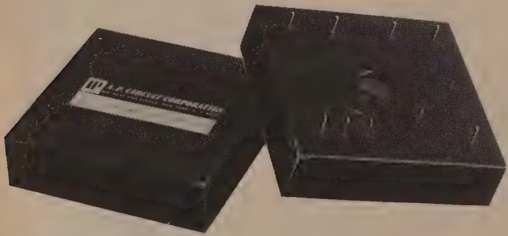


Fig. H
8 Pole Filter

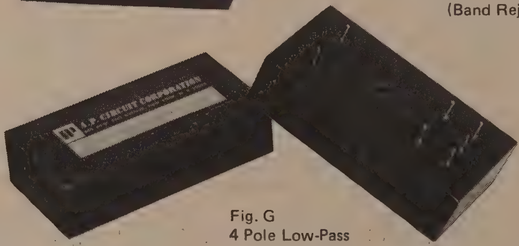


Fig. G
4 Pole Low-Pass
or High-Pass

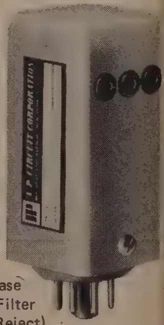


Fig. I
Octal Base
Notch Filter
(Band-Reject)

Send For Detailed Literature.
Application Notes

A.P. CIRCUIT CORPORATION

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VARIABLE FREQUENCY FILTERS

Analyze your requirements with our variable frequency instruments and select our low cost fixed frequency modules accordingly.

Units Feature: Low Noise, Hight Input, Low Output Impedance
0 Db Insertion Loss, 24 Db/Octave Slope,
NEW: Single Decade: Low Pass to 5 MHz

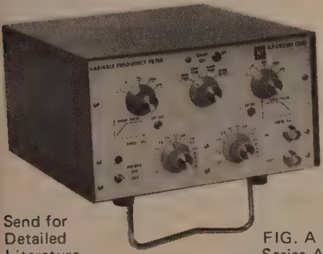
Dual Channel Rack Mount

	FUNCTION						SWING (R.M.S. VOLTS)			
Model	Low Pass	High Pass	Band Pass	Band Reject	Tuning Range	Upper 3 DB Frequency	Battery	A. C.	Fig.	
APVL-43-5	√				0.02Hz–2KHz		4	8	B	240Db/Octave
APVL-44-5	√				0.2Hz–20KHz		4	8	B	
APVL-1	√				1Decade		4	8	B	
APVH-43-5		√			0.02Hz–2KHz	250KHz	4	8	B	
APVH-44-5		√			0.02Hz–20KHz	250KHz	4	8	B	
APVH-1		√			1 Decade		4	8	B	
APVLH-41-5	√	√			0.2Hz–20KHz	250KHz	4	8	B	
APVLH-44-5	√	√			0.0Hz–20KHz	250KHz	4	8	B	
AP 200-1			√		1 Decade		4	8	A	
AP 240-5			√		0.02Hz–2KHz		4	8	A	
AP 250-5			√		0.2Hz–20KHz		4	8	A	
AP 255-5	√	√	√	√	0.2Hz–20KHz	250KHz	4	8	A	
AP 260-5	√	√	√	√	0.1Hz–10KHz	250KHz	4	8	A	
AP 265-5	√	√	√	√	0.02Hz–2KHz	250KHz	4	8	A	
AP 280-5 *	√	√	√	√	2.0Hz–200KHz	2MHz		5	A	
AP 220-5 *	√	√	√	√	20Hz–2MHz	8MHz		3	A	

* AC Supply only

"NEW": BAND–PASS, BAND REJECT (SPIKE–NOTCH)
SINGLE KNOB FREQUENCY SWEEPING FILTER
VARIABLE Q (BANDWIDTH) AND ADJUSTABLE PREAMPLIFICATION

AP 301			√		0.1–10KHz			12	F	Variable
AP 401			√	√	0.1–10KHz			12	F	Q(2-100)



Send for Detailed Literature

FIG. A
Series AP200
High-Pass, Low-Pass
Band-Pass, Band-Reject

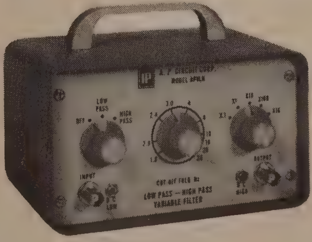


FIG. B
Series APVLH
High Pass, Low-Pass

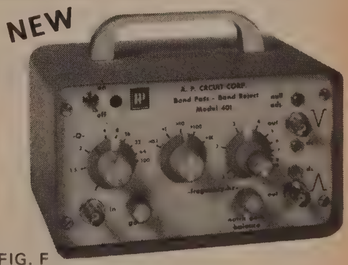


FIG. F
Model 401, Frequency Sweeping
Band-Pass; Band-Reject

A.P. CIRCUIT CORPORATION
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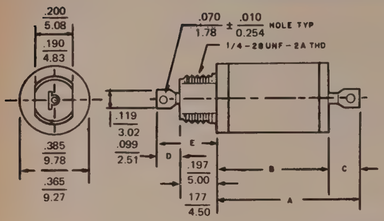
AVX: The Insiders.

SUBMINIATURE CERAMIC FILTERS



BROADBAND MINIATURE LOW PASS EMI FILTERS — L NETWORKS .375/9.53 DIAMETER

L9 Working Voltage 100VDC −55°C to +125°C

Part Number	Max. DC Current (amps)	Max. DC Resistance (ohms)	Peak Transient Voltage	Min. I.R. Megohms	Minimum Insertion Loss db Full Load						
					30 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
AFL2C1111T	0.25	0.4	500	1000	6	34	43	58	70	70	70
AFL211111T	1.0	0.2	500	1000		30	38	57	70	70	70
AFL231111T	3.0	0.05	500	1000		24	30	48	70	70	70
AFL251111T	5.0	0.03	500	1000		20	28	38	70	70	70
AFL261111T	10.0	0.007	500	1000		18	27	36	54	70	70

OPERATING TEMPERATURE RANGE:	−55°C to +125°C
FLASH TEST VOLTAGE:	2 times rated 50 Ma charging current max.
LIFE TEST VOLTAGE:	1.4 times rated voltage @ V 125°C and 1000 hours
INSERTION LOSS:	Measured in 50 ohm system per MIL-STD-220A full load
TORQUE:	10 lbs. inch. max.
HOUSING (HERMETICALLY SEALED):	Tin plated brass or steel can be supplied with silver (S) or gold (G) plating. Change letter T at the end of the part no. to S or G for desired finish
MARKING:	AVX Ceramics part no. and identification, voltage current, circuitry and Date Code

BROADBAND MINIATURE LOW PASS EMI FILTERS Pi NETWORK .375/9.53 DIAMETER

Pi6 Working Voltage 100VDC −55°C to +125°C

Part Number	Max. DC Current (amps)	Max. DC Resistance (ohms)	Peak Transient Voltage	Min. I.R. Megohms	Minimum Insertion Loss db Full Load						
					30 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
AFP2C1111T	0.25	0.4	500	1000		58	70	70	70	70	70
AFP211111T	1.0	0.2	500	1000		47	66	70	70	70	70
AFP231111T	3.0	0.05	500	1000		36	55	70	70	70	70
AFP251111T	5.0	0.03	500	1000		14	42	64	70	70	70
AFP261111T	10.0	0.007	500	1000		22	28	40	70	70	70

BROADBAND MINIATURE LOW PASS EMI FILTERS — T NETWORKS .375/9.53 DIAMETER

T6 Working Voltage 100VDC −55°C to +125°C

Part Number	Max. DC Current (amps)	Max. DC Resistance (ohms)	Peak Transient Voltage	Min. I.R. Megohms	Minimum Insertion Loss db Full Load						
					30 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
AFT2C1311T	.25	.8	400	1000	20	54	70	70	70	70	70
AFT211311T	1.0	.4	400	1000		30	60	70	70	70	70
AFT231311T	3.0	.1	400	1000		12	40	67	70	70	70
AFT251311T	5.0	.06	400	1000			20	50	70	70	70

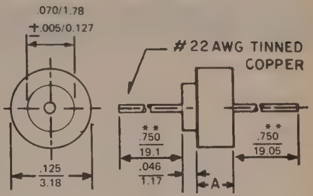
THESE PRODUCTS AVAILABLE FROM AVX CERAMICS FRANCHISED DISTRIBUTORS

AVX Corporation Filter Division, 10441 Roselle St., San Diego, Calif. 92121, Tel: (714) 453-6610

AVX: The Insiders.

SUBMINIATURE CERAMIC FILTERS (CONT'D)

EYELET-TYPE BROADBAND LOW PASS EMI FILTERS — C NETWORK



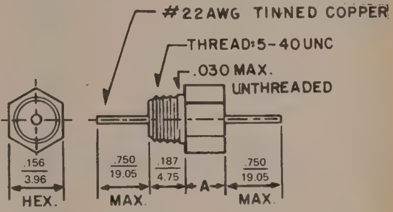
13.18 Diameter — Eyelet 8 Amp

Working Voltage over the temperature range of −55°C to +125°C

Part Number	A	Cap GMV MFD	Working Voltage DC	Min. Insertion Loss dB 30 KHZ	50 KHZ	100 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
6EC41T-2	.115/2.92	.007	200		1	7	11	17	27	45	50	65
6EC83T-1	.187/4.75	.18	50*			1	5	11	21	38	45	65
6EC83T-2	.115/2.92	.09	50*			2	6	12	22	40	45	65
6EC11T-1	.187/4.75	.1	50					6	16	34	45	65
6EC11T-2	.115/2.92	.05	50					6	16	34	45	65
6EC21T-1	.187/4.75	.05	100						10	28	40	60
6EC21T-2	.115/2.92	.025	100						10	28	40	60
6EC31T-1	.187/4.75	.026	150						4	22	40	60
6EC31T-2	.115/2.92	.013	150						4	22	35	60
6EC41T-1	.187/4.75	.014	200							16	35	60

*Working voltage −55°C to +85°C 50VDC, −55°C to +125°C 28VDC

AVheX BROADBAND MINIATURE LOW PASS EMI FILTERS — C AND Pi NETWORKS



5/32 Hex. 13.96

8 Amps C Network

Working Voltage over the temperature range of −55°C to +125°C

Part Number	A	Cap GMV MFD	Working Voltage DC	Min. Insertion Loss dB 30 KHZ	50 KHZ	100 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
1HC41T-2	.130/3.30	.015	200	3	8	14	18	24	34	52	60	65
1HC83T-1	.230/5.84	.40	50*		2	8	12	18	28	46	55	65
1HC83T-2	.130/3.30	.20	50*		2	8	12	18	28	46	55	65
1HC11T-1	.230/5.84	.20	50			2	6	12	22	40	50	65
1HC11T-2	.130/3.30	.10	50			3	7	13	23	42	50	65
1HC21T-1	.230/5.84	.12	100					7	17	36	45	65
1HC21T-2	.130/3.30	.06	100					7	17	36	45	65
1HC31T-1	.230/5.84	.06	150						11	31	40	60
1HC31T-2	.130/3.30	.03	150						11	31	40	60
1HC41T-1	.230/5.84	.03	200						5	25	35	55

*Working voltage −55°C to +85°C 50VDC, −55°C to +125°C 28VDC

OPERATING TEMPERATURE RANGE:	−55°C to +125°C
INSULATION RESISTANCE:	1000 megohms minimum
FLASH TEST VOLTAGE:	2 times rated 50 Ma charging current max.
LIFE TEST VOLTAGE:	1.4 times rated voltage @ 125°C and 1000 hours
INSERTION LOSS:	Measured in 50 ohm system per MIL-STD-220A full load
TORQUE:	10 lbs. inch max.
HOUSING (HERMETICALLY SEALED):	Tin plated brass or steel can be supplied with silver (S) or gold (G) plating. Change letter T at the end of the part no. to S or G for desired finish
MARKING:	AVX Ceramics part no. and identification

THIS IS ONLY A REPRESENTATIVE LISTING OF AVX'S WIDE LINE OF FILTERS. FOR COMPLETE INFORMATION REQUEST AVX CATALOG FC-74.

THESE PRODUCTS AVAILABLE FROM AVX CERAMICS FRANCHISED DISTRIBUTORS

AVX Corporation Filter Division, 10441 Roselle St., San Diego, Calif. 92121, Tel: (714) 453-6610

ALLEN AVIONICS, INC.

224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: (516) 248-8080 OR (516) 747-5450

SEE OUR PAGES UNDER
DELAY LINES
SECTION 2350
WRITE FOR CATALOG

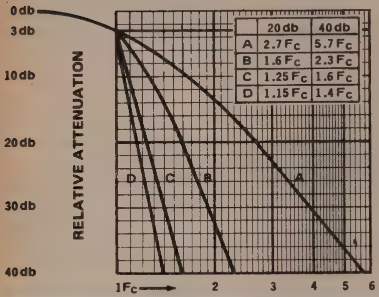
CUSTOM-BUILT L-C FILTERS

LOWPASS

PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 3 DAYS

TYPES: BUTTERWORTH, TCHEBYCHEFF & ELLIPTIC FUNCTION

The lowpass filters listed below are typical units that we build. We do manufacture lowpass filters with any cut-off frequency between 200Hz and 400MHz.



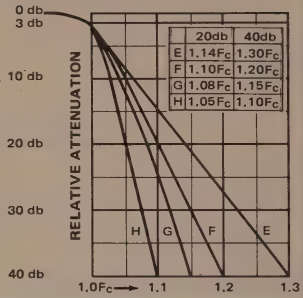
SIZE (INCHES)

Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

J — 1.00 x .750 x .500
K — 1.50 x 1.000 x .800
L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250
O — 5.00 x 1.500 x 1.250
P — 6.00 x 1.500 x 1.250
Q — 7.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

S — 1.25 x .875 x .625
U — 2.00 x 1.125 x .750
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375



CURVES A, B, C & D — ½ db MAXIMUM RIPPLE — 1 db MAXIMUM INSERTION LOSS
CURVES E, F, G & H — 1 db MAXIMUM RIPPLE — 2 db MAXIMUM INSERTION LOSS

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
200Hz	500-2K	A, B	Z
400Hz	500-3K	A	X
		B	Y
		C, D, E	Z
1KHz	200-10K	A	X
		B	Y
		C, D, E, F	Z
2.5KHz	200-20K	A	X
		B	Y
		C, D, E, F, G	Z
5KHz	150-20K	A	X
		B, C, D, E	Y
		F, G	Z
7.5KHz	150-20K	A	X
		B, C, D, E	Y
		F, G	Z
10KHz	150-10K	A	U
		B	X
		C, D, E	Y
		F, G	Z
25KHz	150-10K	A	U
		B	X
		C, D, E, F	Y
		G	Z
50KHz	150-10K	A	U
		B	W
		C, D	X
		E, F	Y
		G, H	Z
75KHz	150-10K	A	S
		B	U
		C	W
		D, E	X
		F	Y
		G, H	Z
100KHz	50-10K	A	S
		B	U
		C, D	W
		E	X
		F, G	Y
		H	Z
250KHz	50-5K	A	S
		B	U
		C, D	W
		E	X
		F, G	Y
		H	Z

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
500KHz	50-5K	A	S
		B	U
		C, D	W
		E	X
		F, G	Y
		H	Z
750KHz	50-1K	A	S
		B	U
		C, D	W
		E	X
		F, G	Y
		H	Z
1MHz	50-500	A	S
		B, C	U
		D	W
		E, F	X
		G, H	Y
2MHz	50-500	A	S
		B, C	U
		D	W
		E, F	X
		G, H	Y
3MHz	50-500	A	S
		B, C	U
		D	W
		E, F	X
		G, H	Y
4MHz	50-200	A	S
		B, C	U
		D	W
		E, F, G	X
		H	Y
5MHz	50-100	A, B	S
		C	U
		D	W
		E, F, G	X
		H	Y
6MHz	50-100	A, B	K
		C, D, E	L
		F, G	M
		H	N
7MHz	50-100	A, B	K
		C, D, E	L
		F, G	M
		H	N
8MHz	50-100	A, B, C	K
		D, E, F	L
		G, H	M
9MHz	50-100	A, B, C	K
		D, E, F	L
		G, H	M

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
10MHz	50-100	A	J
		B, C, D, E	K
		F	L
		G, H	M
15MHz	50-100	A	J
		B, C, D	K
		E	L
		F, G, H	M
20MHz	50-100	A	J
		B, C, D	K
		E	L
		F, G	M
		H	N
25MHz	50-100	A	J
		B, C, D	K
		E	L
		F, G	M
		H	N
30MHz	50	A	J
		B, C, D	K
		E, F	M
		G	N
		H	O
40MHz	50	A	K
		B, C	L
		D, E	M
		F	N
		G	O
		H	P
50MHz	50	A	K
		B, C	L
		D, E	M
		F	N
		G	P
		H	Q
*75MHz	50	A, B	L
		C, D	M
		E	O
		F, G	P
*100MHz	50	A	L
		B, C, D	M
		E	O
		F, G	P
*150MHz to *200MHz	50	A	L
		B, C	M

* 1 db MAX. RIPPLE

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WRITE FOR CATALOG

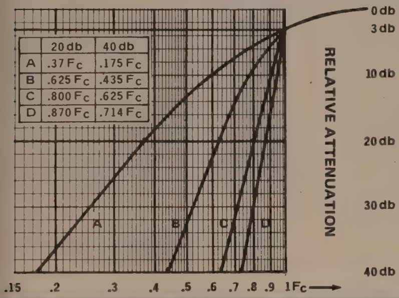
CUSTOM-BUILT L-C FILTERS

HIGHPASS

PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 3 DAYS

TYPES: BUTTERWORTH, TCHEBYCHEFF & ELLIPTIC FUNCTION

The highpass filters listed below are typical units that we build. We do manufacture highpass filters with any cut-off frequency between 200Hz and 75MHz.



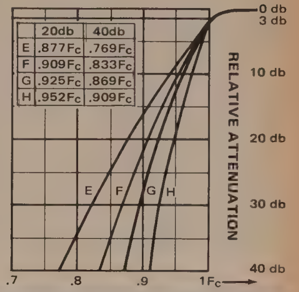
SIZE (INCHES)

Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

J — 1.00 x .750 x .500
K — 1.50 x 1.000 x .800
L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250
O — 5.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

R — .80 x .460 x .345
S — 1.25 x .875 x .625
U — 2.00 x 1.125 x .750
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375



CURVES A, B, C & D — ½ db MAXIMUM RIPPLE — 1 db MAXIMUM INSERTION LOSS
CURVES E, F, G & H — 1 db MAXIMUM RIPPLE — 2 db MAXIMUM INSERTION LOSS

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
400Hz	1K-3K	A	X
		B	Y
		C, D, E	Z
1KHz	500-10K	A	X
		B	Y
		C, D, E, F	Z
2.5KHz	50-20K	A	X
		B	Y
		C, D, E, F, G	Z
5KHz	150-20K	A	W
		B	X
		C, D, E	Y
		F, G	Z
7.5KHz	150-20K	A	W
		B	X
		C, D, E	Y
		F, G	Z
10KHz	150-10K	A	W
		B	X
		C, D, E	Y
		F, G	Z
25KHz	150-10K	A	W
		B	X
		C, D, E, F	Y
		G	Z
50KHz	150-10K	A	W
		B	X
		C, D, E, F	Y
		G, H	Z
75KHz	150-10K	A	U
		B	W
		C, D, E	X
		F, G	Y
		H	Z
100KHz	50-10K	A	U
		B	W
		C, D, E	X
		F, G	Y
		H	Z
250KHz	50-5K	A	S
		B	U
		C, D	W
		E	X
		F, G	Y
		H	Z

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
500KHz	50-5K	A	S
		B, C	U
		D	W
		E	X
		F, G	Y
		H	Z
750KHz	50-1K	A	S
		B, C	U
		D	W
		E	X
		F, G	Y
		H	Z
1MHz	50-1K	A	S
		B, C	U
		D	W
		E, F	X
		G	Y
		H	O
2MHz	50-200	A, B	S
		C, D	U
		E, F	X
		G	Y
		H	O
3MHz	50-200	A, B	S
		C, D	U
		E, F	X
		G	Y
		H	O
4MHz	50-200	A	R
		B	S
		C, D	U
		E, F	X
		G	N
		H	O
5MHz	50-100	A	R
		B	S
		C, D	U
		E, F	X
		G	N
		H	O
6MHz	50-100	A	J
		B, C, D	K
		E, F	X
		G	N
		H	O
7MHz	50-100	A	J
		B, C, D	K
		E	X
		F	M
		G	N
		H	O

Cut-Off (F_c) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
8MHz	50-100	A	J
		B, C, D	K
		E	X
		F	M
		G	N
		H	O
9MHz	50-100	A	J
		B, C, D	K
		E	X
		F	M
		G, H	N
10MHz	50-100	A	J
		B, C, D	K
		E	X
		F	M
		G, H	N
15MHz	50-100	A	J
		B, C, D	K
		E	X
		F, G	M
		H	N
20MHz	50	A	J
		B, C, D	K
		E	L
		F, G	M
		H	N
25MHz	50	A	J
		B, C, D	K
		E, F	M
		G, H	N
30MHz	50	A	J
		B, C, D	K
		E, F	M
		G	N
35MHz	50	A, B	L
		C, D, E, F	M
		G	N
40MHz	50	A, B	L
		C, D, E, F	M
45MHz	50	E	M
		F	N
50MHz	50	A, B	L
		C, D, E	M
		F	N
75MHz	50	A	L
		B, C	M
		D	N

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DELAY LINES
SECTION 2350
WRITE FOR CATALOG

CUSTOM-BUILT L-C FILTERS LINEAR PHASE LOWPASS

LINEAR PHASE LOWPASS FILTERS

Types:
Bessel, Gaussian, Equal Phase Ripple and Transitional (Gaussian to 6 db).

Frequency Range:
400Hz to 50MHz.

Impedance Range:
50 ohms to 20K ohms.

Low Delay and Phase Distortion in Passband.

Very Low Pulse Distortion (Low Overshoot).

Construction:
Epoxy encapsulated or sealed in metal can.

DELIVERY: PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 3 DAYS

The lowpass filters listed below are typical units that we build. We do manufacture linear phase lowpass filters with any cut-off frequency between 1KHz and 50MHz.

SIZE (INCHES)

Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

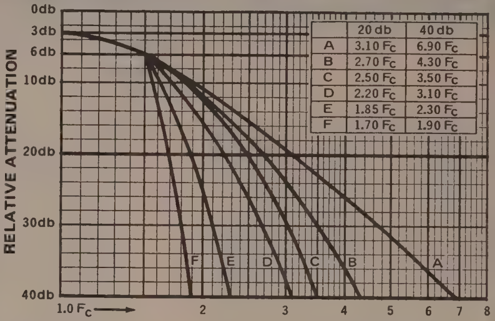
K — 1.50 x 1.000 x .800
L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

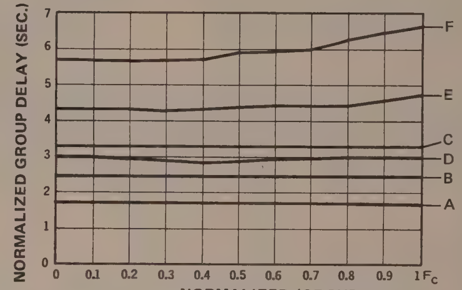
U — 2.00 x 1.125 x .750
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375

The graph at right illustrates ideal delay characteristics.
Consult table below for typical realizable values.

Shape Factor	Max. Phase Distortion	Maximum Overshoot	Typical Delay Variation
A	±2°	1.5%	3%
B	±2°	1.5%	3%
C	±2°	1.5%	3%
D	±3°	3%	8%
E	±7°	6%	13%
F	±12°	9%	17%



	20 db	40 db
A	3.10 Fc	6.90 Fc
B	2.70 Fc	4.30 Fc
C	2.50 Fc	3.50 Fc
D	2.20 Fc	3.10 Fc
E	1.85 Fc	2.30 Fc
F	1.70 Fc	1.90 Fc



$$\text{GROUP DELAY} = \frac{\text{NORMALIZED (GROUP DELAY)}}{2\pi F_c \text{ (Hz)}}$$

½ db MAXIMUM RIPPLE — 1 db MAXIMUM INSERTION LOSS

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size Range
1KHz	500-10K	A	X
	500-10K	B	Y, Z
	500-10K	C	Z
	500-10K	D	Y
	500-10K	E	Y, Z
	500-10K	F	Z
5KHz	50-20K	A	X
	50-20K	B	Y, Z
	50-15K	C	Y, Z
	50-20K	D	Y
	50-20K	E	Y, Z
	50-10K	F	Z
10KHz	50-10K	A	W, X
	50-10K	B	X, Y
	50-10K	C	X, Y
	50-10K	D	W, X
	50-10K	E	X, Y
	50-10K	F	Y, Z
50KHz	50-10K	A	W, X
	50-10K	B	X
	50-5K	C	X, Y
	50-10K	D	W, X
	50-10K	E	X, Y
	50-10K	F	X, Y
100KHz	50-10K	A	U, W
	50-5K	B	W, X
	50-5K	C	X, Y
	50-10K	D	W, X
	50-10K	E	X
	50-10K	F	X, Y
500KHz	50-3K	A	U, W
	50-3K	B	W
	50-1K	C	W, X
	50-5K	D	W
	50-5K	E	W, X
	50-5K	F	X, Y
750KHz	50-2.5K	A	U, W
	50-2.5K	B	W, X
	50-1K	C	X, Y
	50-5K	D	U, W
	50-5K	E	W, X
	50-5K	F	X
1MHz	50-500	A	L
	50-500	B	M
	50-500	C	M
	50-500	D	W
	50-500	E	W, X
	50-500	F	X
2MHz	50-500	A	L
	50-500	B	M
	50-500	C	M
	50-500	D	W
	50-500	E	W, X
	50-500	F	W, X
3MHz	50-500	A	L
	50-500	B	M
	50-400	C	M
	50-500	D	L
	50-500	E	M
	50-500	F	M
4MHz	50-500	A	L
	50-500	B	M
	50-200	C	M
	50-500	D	L
	50-500	E	M
	50-500	F	M
5MHz	50-500	A	L
	50-500	B	M
	50-200	C	M
	50-500	D	L
	50-500	E	M
	50-500	F	M
7.5MHz	50-500	A	K
	50-250	B	L
	50-100	C	M
	50-500	D	L
	50-500	E	M
	50-500	F	M
10MHz	50-100	A	K
	50-100	B	L
	50-100	C	M
	50-100	D	L
	50-100	E	M
	50-100	F	M
20MHz	50-100	A	K
	50-100	B	L
	50-100	D	L
	50-100	E	M
	50-100	F	N
30MHz	50-100	A	K
	50-100	B	L
	50-100	D	L
	50-100	E	M
	50-100	F	N
40MHz	50	A	K
	50	B	L
	50	D	L
	50	E	M
	50	F	M
50MHz	50	A	K
	50	D	L
	50	E	M
	50	F	M

ALLEN AVIONICS, INC.
224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: 516-248-8080 OR 516-747-5450

CUSTOM-BUILT L-C FILTERS LINEAR PHASE BANDPASS

SEE OUR PAGES UNDER
DELAY LINES
SECTION 2350
WRITE FOR CATALOG

LINEAR PHASE BANDPASS FILTERS

Type:
Gaussian-type offering unusual excellence in fast cut-off and low delay variation characteristics.

Frequency Range:
1KHz to 25MHz.

Impedance Range:
50 ohms to 10K ohms.

Exceptionally fine phase linearity combined with good impulse response.

Construction: Epoxy encapsulated or sealed in metal can.

DELIVERY: PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 3 DAYS

The linear phase bandpass filters listed below are typical units that we build. We do manufacture linear phase bandpass filters with any center frequency between 1KHz and 25MHz.

SIZE (INCHES)

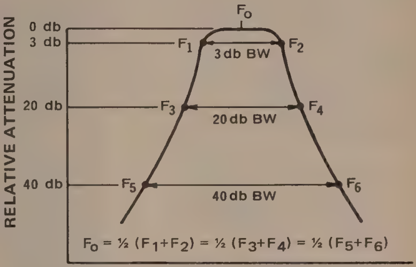
Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375

Maximum Phase Distortion over 3 db Passband	Typical Delay Variation over 3 db Passband
±3°	5%



$F_0 = \frac{1}{2}(F_1+F_2) = \frac{1}{2}(F_3+F_4) = \frac{1}{2}(F_5+F_6)$

Percent (%) Bandwidth	20db BW / 3db BW	40db BW / 3db BW	D
30	2.60	4.85	14.62
40	2.58	4.80	10.89
50	2.56	4.70	8.65
60	2.53	4.60	7.14
70	2.51	4.50	6.04

APPROXIMATE PASSBAND DELAY $= \frac{D}{2\pi F_0}$

1 db MAXIMUM RIPPLE — 2 db MAXIMUM INSERTION LOSS

Center Frequency (F_0)	Percent Band-width	Impedance Range (Ohms)	Size
1KHz	30	500-2.5K	Y, Z
	40	500-3K	Y, Z
	50	500-3.5K	Y, Z
	60	500-4K	Y, Z
	70	500-5K	Y, Z
5KHz	30	500-5K	Y, Z
	40	500-7K	Y, Z
	50	500-8K	Y, Z
	60	500-9K	Y, Z
	70	500-10K	Y, Z
10KHz	30	500-7K	X, Y, Z
	40	500-10K	X, Y, Z
	50	500-10K	X, Y, Z
	60	500-10K	X, Y, Z
	70	250-10K	X, Y, Z
25KHz	30	250-5K	X, Y
	40	250-5K	X, Y
	50	200-5K	X, Y
	60	200-6K	X, Y
	70	200-7.5K	X, Y
50KHz	30	100-1K	W, X
	40	100-2K	W, X
	50	100-3K	W, X
	60	100-4K	W, X
	70	50-5K	W, X
75KHz	30	100-1K	W, X
	40	50-1.5K	W, X
	50	50-2K	W, X
	60	50-2.5K	W, X
	70	50-2.5K	W, X
100KHz	30	50-1K	W, X
	40	50-1K	W, X
	50	50-1.5K	W, X
	60	50-2K	W, X
	70	50-2K	W, X
200KHz	30	50-1K	L, M, X
	40	50-1K	L, M, X
	50	50-1.5K	L, M, X
	60	50-1.5K	L, M, X
	70	50-1.5K	L, M, X
300KHz	30	50-1K	L, M
	40	50-1K	L, M
	50	50-1K	L, M
	60	50-1K	L, M
	70	50-1K	L, M, N
400KHz	30	50-500	L, M, N
	40	50-500	L, M
	50	50-500	L, M
	60	50-750	L, M, N
	70	50-1K	L, M, N
500KHz	30	50-250	L, M, N
	40	50-350	L, M
	50	50-500	L, M
	60	50-500	L, M
	70	50-500	L, M
750KHz	30	50-250	L, M, N
	40	50-350	L, M, N
	50	50-500	L, M, N
	60	50-500	L, M, N
	70	50-500	L, M, N
1MHz	30	50-100	L, M
	40	50-150	L, M
	50	50-300	L, M, N
	60	50-500	L, M, N
	70	50-500	L, M, N
2MHz	30	50-100	L, M
	40	50-150	L, M
	50	50-500	L, M, N
	60	50-500	L, M, N
	70	50-500	L, M, N
3MHz	30	50-100	L, M, N
	40	50-150	L, M, N
	50	50-250	L, M, N
	60	50-300	L, M, N
	70	50-500	L, M, N
4MHz	30	50-100	L, M
	40	50-150	L, M
	50	50-150	L, M
	60	50-150	L, M
	70	50-200	L, M
5MHz	30	50-75	M, N
	40	50-100	M, N
	50	50-100	L, M
	60	50-100	L, M
	70	50-200	L, M
7.5MHz	30	50-75	M, N
	40	50-100	L, M
	50	50-100	L, M
	60	50-100	L, M
	70	50-150	L, M
10MHz	30	50-75	L, M
	40	50-100	L, M
	50	50-100	L, M
	60	50-100	M, N
	70	50-150	M, N
15MHz	30	50	M, N
	40	50-75	M, N
	50	50-75	M, N
	60	50-75	M, N
	70	50-100	N
20MHz	40	50	N
	50	50	N
	60	50	N
	70	50	N
25MHz	60	50	N
	70	50	N

ALLEN AVIONICS, INC.

224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: 516-248-8080 OR 516-747-5450

SEE OUR PAGES UNDER
DELAY LINES
SECTION 2350
WRITE FOR CATALOG

CUSTOM-BUILT L-C FILTERS

BANDPASS

BANDPASS FILTERS

Types:
Butterworth, Tchebycheff, and Elliptic Function.

Frequency Range:
400Hz to 150MHz.

Impedance Range:
50 ohms to 10K ohms.

Construction: Epoxy encapsulated or sealed in metal can.

DELIVERY: PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 3 DAYS

The bandpass filters listed below and on following page are typical units that we build. We do manufacture bandpass filters with any center frequency between 200Hz and 150MHz.

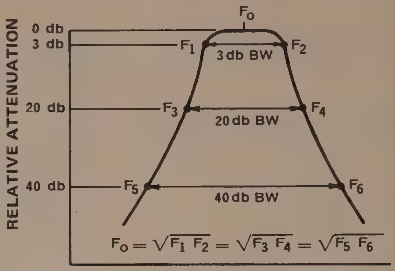
SIZE (INCHES)

Sealed in Metal Can. Printed Circuit Terminals, End Terminals or Connectors available where applicable:

L —2.00 x 1.625 x 1.125
M —3.00 x 1.625 x 1.125
N —4.00 x 1.500 x 1.250
O —5.00 x 1.500 x 1.250
P —6.00 x 1.500 x 1.250
Q —7.00 x 1.500 x 1.250
NN—4.00 x 4.000 x 1.250
OO—5.00 x 4.000 x 1.250

Encapsulated in Epoxy Container:

V —1.75 x 1.750 x .875
W —2.50 x 1.125 x .750
X —3.00 x 1.500 x 1.000
Y —4.00 x 1.500 x 1.125
Z —4.50 x 2.500 x 1.375



$$F_o = \sqrt{F_1 F_2} = \sqrt{F_3 F_4} = \sqrt{F_5 F_6}$$

Shape Factor	20db BW / 3db BW	40db BW / 3db BW
A	2.70	5.70
A_1	2.00	4.00
B	1.60	2.50
B_1	1.50	2.10
C	1.45	1.85
D	1.30	1.55
E	1.20	1.45

1 db MAXIMUM RIPPLE

Center Frequency (F_o)	Q Range F_o / 3 db BW	Shape Factor	Impedance Range (Ohms)	Insertion Loss	Size
400Hz	1-5	A	1K-5K	2-6 db	Y
	1-5	A_1	1K-5K	3-7 db	Z
1KHz	1-10	A	1K-5K	2-6 db	Y
	1-8	A_1	1K-5K	2-6 db	Z
	1-5	B	1K-5K	4-8 db	Z
5KHz	1-10	A	500-10K	1-4 db	Y, Z
	10-25	A	500-10K	3-7 db	X, Y, Z
	1-10	A_1	500-10K	1-5 db	X, Y, Z
	10-25	A_1	500-10K	4-8 db	Y, Z
	1-10	B	500-10K	2-6 db	Y, Z
	1-5	B_1	500-10K	3-7 db	Y, Z
	1-5	C	1K	3-7 db	Z
10KHz	1-10	A	100-10K	1-4 db	X, Y
	10-25	A	100-10K	2-5 db	X, Y, Z
	25-50	A	100-10K	3-7 db	Y, Z
	1-10	A_1	100-10K	1-4 db	X, Y, Z
	10-25	A_1	100-10K	2-5 db	X, Y, Z
	25-40	A_1	100-10K	3-7 db	Y, Z
	1-10	B	100-10K	1-5 db	X, Y, Z
	10-25	B	100-10K	3-8 db	Y, Z
	1-10	B_1	100-10K	1-4 db	X, Y, Z
	10-20	B_1	100-10K	3-7 db	Y, Z
	1-10	C	100-5K	2-6 db	Y, Z
	10-15	C	100-500	3-7 db	Z
	1-10	D	500	3-7 db	Z
	1-5	E	500	4-8 db	Z
25KHz	1-10	A	100-10K	1-4 db	X, Y, Z
	10-25	A	100-10K	2-5 db	X, Y, Z
	25-50	A	100-10K	3-8 db	Y, Z
	1-10	A_1	100-10K	1-4 db	X, Y, Z
	10-25	A_1	100-10K	2-5 db	X, Y, Z
	25-50	A_1	100-5K	3-8 db	Y, Z
	1-10	B	100-10K	1-4 db	X, Y, Z
	10-25	B	100-10K	3-7 db	Y, Z
	25-40	B	100-5K	3-8 db	Z
	1-10	B_1	100-10K	1-4 db	X, Y, Z
	10-25	B_1	100-10K	2-6 db	X, Y, Z
	25-35	B_1	100-500	3-8 db	Z
	1-10	C	100-5K	3-7 db	X, Y, Z
	10-25	C	100-500	4-8 db	Y, Z
	1-10	D	100-500	3-7 db	Z
	1-5	E	100-500	4-8 db	Z

Center Frequency (F_o)	Q Range F_o / 3 db BW	Shape Factor	Impedance Range (Ohms)	Insertion Loss	Size
50KHz	1-10	A	100-5K	1-4 db	W, X, Y
	10-25	A	100-5K	2-5 db	X, Y, Z
	25-50	A	100-5K	3-8 db	Y, Z
	1-10	A_1	100-5K	2-5 db	X, Y, Z
	10-25	A_1	100-5K	3-6 db	X, Y, Z
	25-50	A_1	100-5K	4-8 db	Y, Z
	1-10	B	100-5K	2-5 db	X, Y, Z
	10-25	B	100-5K	3-6 db	Y, Z
	25-30	B	100-500	4-8 db	Z
	1-10	B_1	100-5K	2-5 db	X, Y, Z
	10-25	B_1	100-5K	3-6 db	X, Y, Z
	25-30	B_1	100-500	3-8 db	Z
	1-10	C	100-5K	2-5 db	X, Y, Z
	10-18	C	100-250	4-8 db	Y, Z
	1-10	D	100-500	3-7 db	Z
	1-5	E	100-500	4-8 db	Z
100KHz	1-10	A	100-5K	1-4 db	W, X, Y
	10-25	A	100-5K	2-5 db	X, Y
	25-50	A	100-5K	3-8 db	Y, Z
	1-10	A_1	100-5K	2-5 db	X, Y, Z
	10-25	A_1	100-5K	3-6 db	X, Y, Z
	25-45	A_1	50-100	3-8 db	Y, Z
	1-10	B	100-5K	2-5 db	X, Y, Z
	10-25	B	50-5K	3-6 db	Y, Z
	25-35	B	50-150	3-8 db	Z
	1-10	B_1	100-5K	2-5 db	X, Y, Z
	10-25	B_1	100-5K	3-6 db	X, Y, Z
	25-30	B_1	50-100	3-8 db	Z
	1-10	C	50-5K	2-5 db	X, Y, Z
	10-20	C	50-100	4-8 db	Y, Z
	1-10	D	50-100	3-7 db	Z
	10-12	D	50-100	4-8 db	Z
	1-8	E	50-100	4-8 db	Z
200KHz	1-10	A	50-5K	1-4 db	V, W, X
	10-25	A	50-5K	2-5 db	W, X, Y
	25-50	A	50-5K	3-8 db	Y, Z
	10-25	A_1	50-5K	2-5 db	X, Y, Z
	10-25	A_1	50-5K	3-6 db	X, Y
	25-35	A_1	50-5K	3-8 db	Y, Z
	1-10	B	50-5K	2-5 db	X, Y
	10-25	B	50-5K	3-6 db	X, Y, Z
	25-30	B	50-100	3-8 db	Y, Z
	1-10	B_1	50-5K	2-5 db	X, Y, Z
	10-25	B_1	50-5K	3-6 db	Y, Z
	25-30	B_1	50-100	3-8 db	Y, Z
	1-10	C	50-5K	2-5 db	X, Y, Z
	10-18	C	50-100	4-8 db	Y, Z
	1-10	D	50-100	3-7 db	Y, Z
	10-12	D	50-100	4-8 db	Z
	1-8	E	50-100	4-8 db	Z

ALLEN AVIONICS, INC.

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CUSTOM-BUILT L-C FILTERS **BANDPASS**

CONTINUED FROM PREVIOUS PAGE

1 db MAXIMUM RIPPLE (Cont'd)

Center Frequency (F_o)	Q Range F_o / 3 db BW	Shape Factor	Impedance Range (Ohms)	Insertion Loss	Size
300KHz	1-10	A	50-5K	1-4 db	V, W, X
	10-25	A	50-5K	2-5 db	W, X, Y
	25-50	A	50-5K	3-8 db	Y, Z
	1-10	A_1	50-5K	2-5 db	X, Y
	10-25	A_1	50-5K	3-6 db	X, Y
	25-40	A_1	50-5K	3-8 db	Y, Z
	1-10	B	50-5K	2-5 db	X, Y
	10-25	B	50-5K	3-6 db	X, Y, Z
	25-30	B	50-100	3-8 db	Y, Z
	1-10	B_1	50-5K	2-5 db	X, Y, Z
	10-25	B_1	50-5K	3-6 db	Y, Z
	1-10	C	50-2K	2-5 db	X, Y, Z
	10-12	C	50-100	4-8 db	Y, Z
	1-10	D	50-100	3-7 db	Y, Z
	1-6	E	50-100	4-8 db	Z
400KHz	1-10	A	50-5K	1-4 db	V, W, X
	10-25	A	50-5K	2-5 db	W, X, Y
	25-50	A	50-5K	3-8 db	Y, Z
	1-10	A_1	50-5K	2-5 db	X, Y
	10-25	A_1	50-5K	3-6 db	X, Y
	25-40	A_1	50-2K	3-8 db	Y, Z
	1-10	B	50-5K	2-5 db	X, Y
	10-25	B	50-5K	3-6 db	X, Y, Z
	1-10	B_1	50-5K	2-5 db	X, Y, Z
	10-25	B_1	50-5K	3-6 db	Y, Z
	1-10	C	50-2K	2-5 db	X, Y, Z
	10-12	C	50-100	4-8 db	Y, Z
	1-10	D	50-100	3-7 db	Y, Z
	1-6	E	50-100	4-8 db	Z
500KHz	1-10	A	50-5K	1-4 db	V, W, X
	10-25	A	50-5K	2-5 db	W, X, Y
	25-50	A	50-5K	3-8 db	Y, Z
	1-10	A_1	50-5K	2-5 db	X, Y
	10-25	A_1	50-5K	3-6 db	X, Y
	25-40	A_1	50-2K	3-8 db	Y, Z
	1-10	B	50-5K	2-5 db	X, Y
	10-25	B	50-5K	3-6 db	X, Y, Z
	1-10	B_1	50-5K	2-5 db	X, Y, Z
	10-25	B_1	50-5K	3-6 db	Y, Z
	1-10	C	50-2K	2-5 db	X, Y, Z
	10-12	C	50-100	4-8 db	Y, Z
	1-8	D	50-100	3-7 db	Y, Z
	1-5	E	50-100	4-8 db	Z
1MHz	1-10	A	50-5K	1-4 db	V, W, X
	10-25	A	50-500	2-5 db	W, X, Y
	25-40	A	50-200	3-8 db	M, N, O
	1-10	A_1	50-2K	1-4 db	X, Y
	10-25	A_1	50-200	2-5 db	X, Y
	25-40	A_1	50-100	3-7 db	M, N
	1-10	B	50-5K	2-5 db	X, Y
	10-20	B	50-100	3-6 db	M, N, O
	1-10	B_1	50-5K	2-5 db	X, Y
	10-20	B_1	50-100	3-6 db	M, N, O
	1-5	C	50-100	2-5 db	M, N, O
	5-10	C	50-100	3-6 db	O, P, NN
	1-8	D	50	3-7 db	NN
	1-5	E	50	3-7 db	NN
3MHz	1-10	A	50-500	1-4 db	L, M, N
	10-25	A	50-200	2-5 db	M, N, O
	25-40	A	50-100	3-8 db	M, N, O
	1-10	A_1	50-500	1-4 db	L, M, N
	10-25	A_1	50-200	2-5 db	M, N, O
	25-35	A_1	50-100	3-7 db	M, N, O
	1-10	B	50-500	2-5 db	M, N, O
	10-15	B	50-200	3-6 db	N, O, P
	1-10	B_1	50-200	2-5 db	M, N, O
	10-15	B_1	50-100	3-6 db	N, O, P
	1-5	C	50-100	2-5 db	M, N, O
	5-10	C	50-100	3-6 db	N, O, P
	1-5	D	50	3-7 db	P, NN
	1-3	E	50	3-7 db	P, NN

Center Frequency (F_o)	Q Range F_o / 3 db BW	Shape Factor	Impedance Range (Ohms)	Insertion Loss	Size
5MHz	1-10	A	50-100	1-4 db	L, M, N
	10-25	A	50	2-5 db	M, N, O
	25-35	A	50	3-8 db	M, N, O
	1-10	A_1	50-100	1-4 db	L, M, N
	10-25	A_1	50	2-5 db	M, N, O
	25-30	A_1	50	3-7 db	M, N, O
	1-10	B	50-100	2-5 db	M, N, O
	10-15	B	50	3-6 db	N, O, P
	1-10	B_1	50-100	2-5 db	M, N, O
	10-12	B_1	50	3-6 db	N, O, P
	1-5	C	50	2-5 db	M, N, O
	5-10	C	50	3-6 db	N, O, P
	1-5	D	50	3-7 db	P, NN
	1-3	E	50	3-7 db	P, NN
10MHz	1-10	A	50	1-4 db	M, N, O
	10-25	A	50	2-5 db	M, N, O
	25-35	A	50	3-8 db	M, N, O
	1-10	A_1	50	1-4 db	N, O, P
	10-25	A_1	50	2-5 db	N, O, P
	25-30	A_1	50	3-8 db	N, O, P
	1-10	B	50	2-5 db	N, O, P
	10-18	B	50	3-6 db	O, P, Q
	1-10	B_1	50	2-5 db	O, P, Q
	10-18	B_1	50	3-6 db	O, P, Q
	1-10	C	50	2-5 db	O, P, Q
	10-12	C	50	3-8 db	P, Q, NN
	1-8	D	50	3-7 db	Q, NN, OO
	1-6	E	50	3-7 db	Q, NN, OO
15MHz	1-10	A	50	1-4 db	M, N, O
	10-25	A	50	2-5 db	M, N, O
	25-30	A	50	3-8 db	M, N, O
	1-10	A_1	50	1-4 db	M, N, O
	10-25	A_1	50	2-5 db	N, O, P
	25-30	A_1	50	3-8 db	N, O, P
	1-10	B	50	2-5 db	N, O, P
	10-15	B	50	3-6 db	N, O, P
	1-10	B_1	50	2-5 db	N, O, P
	10-15	B_1	50	3-7 db	O, P, Q
	1-10	C	50	2-5 db	P, Q, NN
	1-5	D	50	3-7 db	Q, NN, OO
	1-3	E	50	3-7 db	Q, NN, OO
20MHz	1-10	A	50	1-4 db	M, N, O
	10-25	A	50	2-5 db	M, N, O
	25-30	A	50	3-8 db	M, N, O
	1-10	A_1	50	1-4 db	M, N, O
	10-25	A_1	50	2-5 db	N, O, P
	25-30	A_1	50	3-8 db	N, O, P
	1-10	B	50	2-5 db	N, O, P
	10-15	B	50	3-6 db	N, O, P
	1-10	B_1	50	2-5 db	N, O, P
	10-15	B_1	50	3-6 db	O, P, Q
	1-10	C	50	2-5 db	P, Q, NN
	1-5	D	50	3-7 db	Q, NN, OO
	1-3	E	50	3-7 db	Q, NN, OO
30MHz	1-10	A	50	2-5 db	M, N, O
	10-25	A	50	3-8 db	M, N, O
	1-10	A_1	50	2-5 db	M, N, O
	10-25	A_1	50	3-8 db	N, O, P
	1-10	B	50	2-6 db	N, O, P
	10-12	B	50	3-8 db	N, O, P
	1-10	B_1	50	2-6 db	O, P, Q
	10-12	B_1	50	3-8 db	O, P, Q
	1-6	C	50	3-7 db	P, Q, NN
	1-3	D	50	3-7 db	Q, NN, OO
40MHz	1-10	A	50	2-5 db	M, N, O
	10-25	A	50	3-8 db	M, N, O
	1-10	A_1	50	2-5 db	M, N, O
	10-25	A_1	50	3-8 db	N, O, P
	1-10	B	50	2-6 db	N, O, P
	10-12	B	50	3-8 db	N, O, P
	1-10	B_1	50	2-6 db	O, P, Q
	10-12	B_1	50	3-8 db	O, P, Q
	1-6	C	50	3-8 db	P, Q, NN
	1-3	D	50	3-7 db	Q, NN, OO

All-tronics, inc.

RADIO INTERFERENCE
FILTERS

FOLLOW THESE EASY STEPS

1. DETERMINE CURRENT AND VOLTAGE OF CIRCUIT WHERE THIS FILTER WILL BE USED.
2. OBTAIN BASIC PART NUMBER FROM TABLE BELOW BASED ON SUPPRESSION REQUIREMENTS.
3. SELECT MOUNTING STYLE AND TERMINAL TYPE FROM FACING PAGE.
4. BUILD UP PART NUMBER THIS WAY →

70 D 6.3 G P 11

BASIC PART NUMBER — MOUNTING STYLE — TERMINAL TYPE

RECTANGULAR TYPES EFFECTIVE TO 400 MEGAHERTZ

Amperes	Case Size			0-70 Volts DC Series		400 VDC/150 VAC 0-70 Hertz Series		150 VAC 50-1000 Hertz Series		600 VDC/250 VAC 0-70 Hertz Series		250 VAC 50-1000 Hertz Series	
	a	b	c	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db
0.40	1⅛	1	11/16	70D0.4E	48	400D0.4E	24	400A0.4E	24	*	*	*	*
	1¾	1¼	⅞	70D0.4F	60	400D0.4F	47	400A0.4F	47	600D0.4F	42	600A0.4F	42
	2	1¾	1⅛	70D0.4G	90	400D0.4G	90	400A0.4G	90	600D0.4G	90	600A0.4G	90
0.63	1⅛	1	11/16	70D0.6E	48	*	*	*	*	*	*	*	*
	1¾	1¼	⅞	70D0.6F	56	400D0.6F	40	400A0.6F	40	600D0.6F	35	600A0.6F	35
	2	1¾	1⅛	70D0.6G	90	400D0.6G	85	400A0.6G	92	600D0.6G	83	600A0.6G	87
1.0	1⅛	1	11/16	70D1.0E	47	*	*	*	*	*	*	*	*
	1¾	1¼	⅞	70D1.0F	53	400D1.0F	30	400A1.0F	30	600D1.0F	30	600A1.0F	30
	2	1¾	1⅛	70D1.0G	87	400D1.0G	74	400A1.0G	87	600D1.0G	75	600A1.0G	80
2.5	2	1¾	1⅛	70D2.5G	75	400D2.5G	57	400A2.5G	60	600D2.5G	59	600A2.5G	64
	2	2	1¼	70D2.5H	80	400D2.5H	63	400A2.5H	67	600D2.5H	69	600A2.5H	70
4.0	2	1¾	1⅛	70D4.0G	72	400D4.0G	48	400A4.0G	52	600D4.0G	50	600A4.0G	52
	2	2	1¼	70D4.0H	82	400D4.0H	68	400A4.0H	68	600D4.0H	62	600A4.0H	62
6.3	2	1¾	1⅛	70D6.3G	72	400D6.3G	43	400A6.3G	45	600D6.3G	44	600A6.3G	47
	2	2	1¼	70D6.3H	80	400D6.3H	60	400A6.3H	60	600D6.3H	55	600A6.3H	55
	3 1/16	2⅞	1⅝	*	*	400D6.3J	88	400A6.3J	90	600D6.3J	75	600A6.3J	75
10	2	1¾	1⅛	70D10G	60	400D10G	40	400A10G	43	600D10G	27	600A10G	30
	2	2	1¼	70D10H	72	400D10H	50	400A10H	54	600D10H	35	600A10H	35
	3 1/16	2⅞	1⅝	70D10J	90	400D10J	72	400A10J	75	600D10J	63	600A10J	66
16	3 1/16	2⅞	1⅝	70D16J	77	400D16J	65	400A16J	65	600D16J	49	600A16J	55
25	3 1/16	2⅞	1⅝	70D25J	70	400D25J	55	400A25J	55	600D25J	44	600A25J	48
	3 1/16	2⅞	2⅛	70D25K	84	400D25K	60	400A25K	65	600D25K	55	600A25K	60
40	3 1/16	2⅞	1⅝	70D40J	50	400D40J	20	400A40J	23	600D40J	35	600A40J	35
	3 1/16	2⅞	2⅛	70D40K	75	400D40K	50	400A40K	50	600D40K	45	600A40K	45
63	3 1/16	2⅞	1⅝	70D63J	50	400D63J	19	400A63J	22	600D63J	35	600A63J	35
	3 1/16	2⅞	2⅛	70D63K	55	400D63K	50	400A63K	50	600D63K	40	600A63K	45
	3½	3½	2½	70D63L	80	400D63L	60	400A63L	60	600D63L	45	600A63L	54
100	3 1/16	2⅞	2⅛	70D100K	55	400D100K	50	400A100K	50	600D100K	40	600A100K	45
	3½	3½	2½	70D100L	60	400D100L	55	400A100L	55	600D100L	45	600A100L	50

TUBULAR TYPES EFFECTIVE TO 10 GIGAHERTZ

Amperes	Case Size		0-70 Volts DC Series		400 VDC/150 VAC 0-500 Hertz Series		600 VDC/150 VAC 0-500 Hertz Series	
	Dia.	Length	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db
1.0	1	2½	70R1.0M	75	400R1.0M	70	600R1.0M	55
	1	4	70R1.0P	90	400R1.0P	85	600R1.0P	70
2.5	1	2½	70R2.5M	75	400R2.5M	60	*	*
	1	4	70R2.5P	88	400R2.5P	70	600R2.5P	55
	1⅜	4⅛	*	*	400R2.5R	90	600R2.5R	75
4.0	1	4	70R4.0P	75	400R4.0P	65	600R4.0P	45
	1⅜	4⅛	70R4.0R	90	400R4.0R	85	600R4.0R	70
6.3	1	4	70R6.3P	70	*	*	*	*
	1⅜	4⅛	70R6.3R	85	400R6.3R	65	600R6.3R	45
	1½	4⅜	*	*	400R6.3S	90	600R6.3S	75
10	1	4	70R10P	60	*	*	*	*
	1⅜	4⅛	70R10R	80	400R10R	65	600R10R	45
	1½	4⅜	*	*	400R10S	80	600R10S	60
16	1⅜	4⅛	70R16R	70	400R16R	55	600R16R	35
	1½	4⅜	70R16S	85	400R16S	70	600R16S	50
20	1½	4⅜	70R20S	70	400R20S	60	600R20S	40

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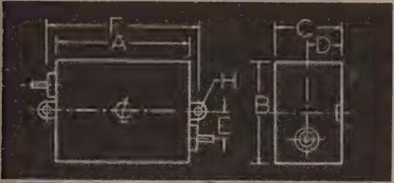
RADIO INTERFERENCE FILTERS

STYLES & DIMENSIONS STANDARD MOUNTING

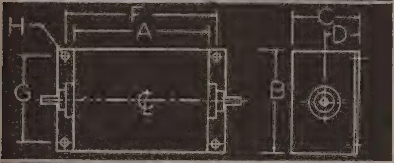
RECTANGULAR



IF BASIC PART NUMBER ENDS WITH THIS LETTER

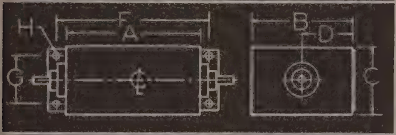
STYLE P DIMENSIONS ARE

	A	B	C	D	E	F	H
E	1 1/8	1	11/16	11/32	1/4	1 7/16	5/32
F	1 3/4	1 1/4	7/8	7/16	1/4	2 1/8	3/16
G	2	1 3/4	1 1/8	9/16	1/2	2 3/8	3/16
H	2	2	1 1/4	5/8	5/8	2 3/8	3/16



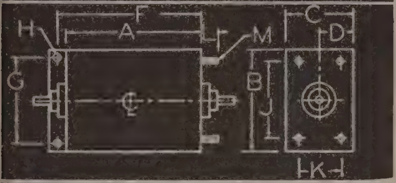
STYLE P DIMENSIONS ARE

	A	B	C	D	F	G	H
J	3 1/16	2 7/8	1 5/8	13/16	3 5/8	2 1/8	.195
K	3 1/16	2 7/8	2 1/8	1 1/16	3 5/8	2 1/8	.195
L	3 1/2	3 1/2	2 1/2	1 1/4	4 1/2	2	.195



STYLE R DIMENSIONS ARE

	A	B	C	D	F	G	H
J	3 1/16	2 7/8	1 5/8	1 7/16	3 5/8	7/8	.195
K	3 1/16	2 7/8	2 1/8	1 7/16	3 5/8	1 3/8	.195
L	3 1/2	3 1/2	2 1/2	1 3/4	4 1/2	1 3/4	.195

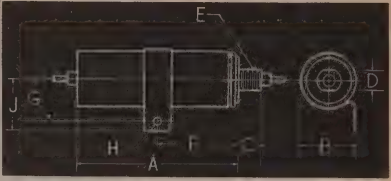


STYLE S DIMENSIONS ARE

	A	B	C	D	F
J	3 1/16	2 7/8	1 5/8	13/16	3 3/8
K	3 1/16	2 7/8	2 1/8	1 1/16	3 3/8
L	3 1/2	3 1/2	2 1/2	1 1/4	4

	G	H	J	K	L	M
J	2 1/8	.195	2	7/8	15/32	10-32
K	2 1/8	.195	2	1 3/8	15/32	10-32
L	2	.195	2 1/4	1 3/4	15/32	10-32

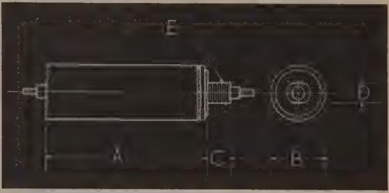
TUBULAR



IF BASIC PART NUMBER ENDS WITH THIS LETTER

STYLE L DIMENSIONS ARE

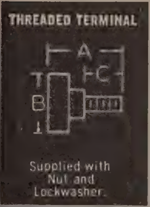
	A	B	C	D	E	F	G	H	J
M	2 1/2	1	7/16	3/8	7/16-20NF	1 1/4	3/4	.156	15/16
P	4	1	7/16	3/8	7/16-20NF	2	3/4	.156	15/16
R	4 1/8	1 3/8	5/8	17/32	5/8-24NF	2 1/16	1	.195	1 1/4
S	4 3/8	1 1/2	5/8	17/32	5/8-24NF	2 3/16	1 1/8	.195	1 3/8

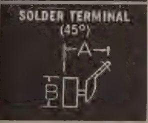


STYLE M DIMENSIONS ARE

	A	B	C	D	E
M	2 1/2	1	7/16	3/8	7/16-20NF
P	4	1	7/16	3/8	7/16-20NF
R	4 1/8	1 3/8	5/8	17/32	5/8-24NF
S	4 3/8	1 1/2	5/8	17/32	5/8-24NF

TERMINALS





IF BASIC PART NUMBER ENDS WITH ONE OF THESE LETTERS

USE TERMINAL TYPE

FOR THIS CURRENT RANGE

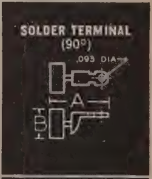
		Amp	Thread Size	A	B	C
EFGHMP	10	0-2.5	4-40	1/2	5/16	3/16
FGHRS	11	0-10	6-32	5/8	7/16	9/32
FGHJRS	12	0-16	8-32	5/8	7/16	5/16
JKL	13	4-25	10-32	13/16	1	5/16
JKL	14	10-63	1/4-20	1	1	3/8
JKL	15	25-100	3/8-16	1 1/4	1 1/2	9/16
EFGHJ	16	0-16	—	13/32	5/16	—

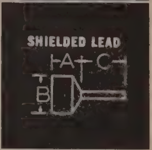
IF BASIC PART NUMBER ENDS WITH ONE OF THESE LETTERS

USE TERMINAL TYPE

FOR THIS CURRENT RANGE

		Amp	Thread Size	A	B	C
EFGHJMP	17	0-16	—	1/2	5/16	—
RS	31	0-20	—	1/2	15/32	—
EFGH	19	0-2.5	—	5/16	5/16	12
EFGH	22	0-2.5	—	5/16	5/16	36
FGHRS	24	2.5-16	—	5/16	13/32	11
FGHRS	26	2.5-16	—	5/16	13/32	36
MP	28	0-4	—	5/16	5/16	12
MP	30	0-4	—	5/16	5/16	32





RFI/EMI TESTING LABORATORY • FCC • MILITARY • RTCA

All-Tronics also maintains a complete RFI/EMI Testing Laboratory. The combination of large modern RFI shielded rooms, the latest in interference testing instrumentation, and top level know-how provide a complete testing service that is capable of covering all of the latest requirements of FCC, Military, Commercial and foreign interference specifications. The laboratory is an approved FCC testing lab specializing in Part 15 and Part 18 compliance testing and consulting. The military interference testing capabilities include testing to specifications such as MIL-STD-220A, MIL-STD-461A, MIL-STD-6181D, MIL-STD-826A and MIL-I-16910C.

In addition to RFI/EMI interference levels caused by your equipment, All-Tronics can also perform susceptibility testing to determine the effects of RFI/EMI emissions on your product. Along with FCC and Military interference testing, All-Tronics also performs interference tests specifically prepared by the Radio Technical Commission for Aeronautics for the commercial aviation industry. In the commercial power field, All-Tronics has and is capable of performing site surveys on power lines, power stations and sub-stations. Test plans per MIL-STD-831 and consultation on test methods for your products are also available.

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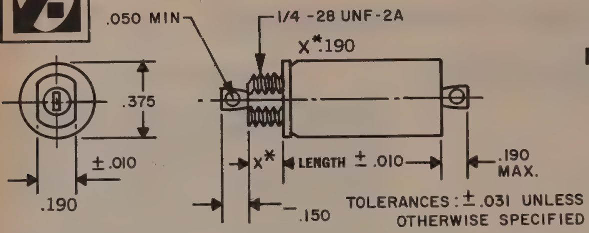
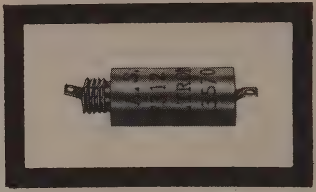
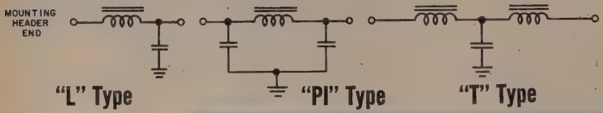
CERAMIC FEED-THRU SUBMINIATURE FILTERS







MINIMUM INSERTION LOSS IN DECIBELS MIL-STD 220A (FULL LOAD)

	TYPE	CURRENT RATING	MAXIMUM RESISTANCE	SIZE DIA. & LGTH.	CIRCUIT	30 KHz	50 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1000 MHz
"PI" Type • "T" Type 50 VDC	50V0.25P	0.25A	1.2 ohms	.375x.540	PI	15	30	55	75	80	80	80
	50V1.0P	1.0A	0.32 ohms	.375x.540	PI	5	15	40	60	80	80	80
	50V3.0P	3.0A	0.06 ohms	.375x.540	PI	—	—	15	40	75	80	80
	50V5.0P	5.0A	0.04 ohms	.375x.540	PI	—	—	2	25	65	80	80
	50V2.0T	2.0A	0.18 ohms	.375x.975	T	9	12	20	30	42	80	80
	50V5.0T	5.0A	0.04 ohms	.375x1.140	T	9	12	20	30	42	80	80
"L" Type 50 VDC	50V0.6L	60MA	70 ohms	.375x.540	L	44	—	70	70	70	70	70
	50V0.15L	150MA	12 ohms	.375x.540	L	24	—	52	64	70	70	70
	50V0.25L	250MA	4 ohms	.375x.540	L	18	—	42	56	70	70	70
	50V0.30L	300MA	2.3 ohms	.375x.540	L	16	—	35	44	62	70	70
	50V0.45L	450MA	1.2 ohms	.375x.540	L	15	—	31	37	55	70	70
	50V10.0L	10A	.01 ohms	.375x.540	L	15	—	28	33	44	64	70
"PI" Type 100 VDC "T" Type	100V0.5P	0.5A	.5 ohms	.375x.590	PI	13	33	65	80	80	80	80
	100V1.0P	1.0A	.25 ohms	.375x.590	PI	5	26	56	73	80	80	80
	100V2.0P	2.0A	.07 ohms	.375x.590	PI	5	17	45	64	80	80	80
	100V3.0P	3.0A	.07 ohms	.375x.590	PI	5	12	35	57	80	80	80
	100V5.0P	5.0A	.015 ohms	.375x.590	PI	—	—	12	44	79	80	80
	100V10.0P	10.0A	.01 ohms	.375x.975	PI	—	—	—	27	67	80	80
	100V0.5T	0.5A	1.0 ohms	.375x.975	T	10	19	42	60	80	80	80
	100V1.0T	1.0A	.3 ohms	.375x.975	T	10	15	32	43	71	80	80
	100V2.0T	2.0A	.15 ohms	.375x.975	T	5	10	25	34	60	80	80
	100V3.0T	3.0A	.15 ohms	.375x.975	T	5	10	24	33	52	80	80
	100V5.0T	5.0A	.02 ohms	.375x.975	T	8	12	22	28	42	80	80
	100V10.0T	10.0A	.01 ohms	.375x.975	T	—	12	24	30	39	63	80
"L" Type 100 VDC	100V0.5L	0.5A	.55 ohms	.375x.540	L	13	18	33	44	64	70	70
	100V1.0L	1.0A	.25 ohms	.375x.540	L	10	15	27	36	57	70	70
	100V2.0L	2.0A	.07 ohms	.375x.540	L	10	14	24	31	48	70	70
	100V3.0L	3.0A	.07 ohms	.375x.540	L	10	14	24	31	44	70	70
	100V5.0L	5.0A	.015 ohms	.375x.540	L	6	11	20	27	38	68	70
	100V10.0L	10.0A	.01 ohms	.375x.540	L	10	15	26	29	38	66	70
"PI" Type "T" Type 115 VAC 0-400 Hz 200 VDC	200V0.5P	0.5A	.5 ohms	.375x.870	PI	—	13	46	62	80	80	80
	200V1.0P	1.0A	.25 ohms	.375x.870	PI	—	3	35	53	80	80	80
	200V2.0P	2.0A	.07 ohms	.375x.870	PI	—	—	16	42	76	80	80
	200V3.0P	3.0A	.07 ohms	.375x.870	PI	—	—	—	28	64	80	80
	200V5.0P	5.0A	.015 ohms	.375x.870	PI	—	—	—	12	58	80	80
	200V10.0P	10.0A	.01 ohms	.375x.975	PI	—	—	—	—	48	80	80
	200V0.5T	0.5A	1.0 ohms	.375x.975	T	—	20	32	48	78	80	80
	200V1.0T	1.0A	.3 ohms	.375x.975	T	—	5	22	34	60	80	80
	200V2.0T	2.0A	.15 ohms	.375x.975	T	—	5	13	22	42	80	80
	200V3.0T	3.0A	.15 ohms	.375x.975	T	—	5	11	18	34	80	80
	200V5.0T	5.0A	.02 ohms	.375x.975	T	—	—	13	19	31	74	80
	200V10.0T	10.0A	.01 ohms	.375x.975	T	—	—	15	20	30	56	80
"L" Type 115 VAC 0-400 Hz • 200 VDC	200V0.5L	0.5A	.55 ohms	.375x.690	L	2	10	23	35	54	70	70
	200V1.0L	1.0A	.25 ohms	.375x.690	L	2	5	18	26	46	70	70
	200V2.0L	2.0A	.07 ohms	.375x.690	L	2	6	15	22	36	70	70
	200V3.0L	3.0A	.07 ohms	.375x.690	L	2	6	15	20	33	67	70
	200V5.0L	5.0A	.015 ohms	.375x.690	L	2	5	15	21	32	60	70
	200V10.0L	10.0A	.01 ohms	.375x.690	L	2	7	17	21	33	56	70

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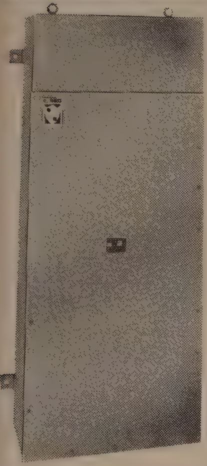
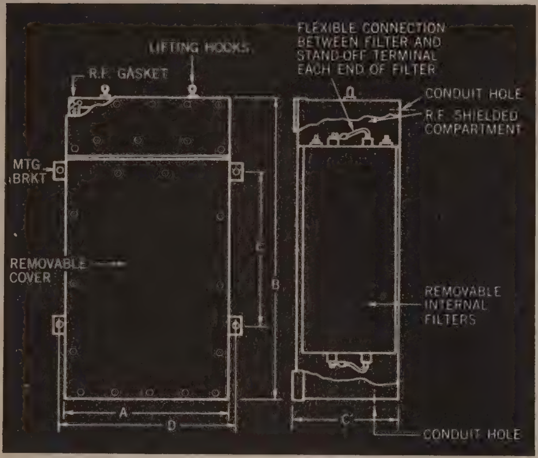
ALL-TRONICS

RADIO INTERFERENCE FILTERS

5 TO 200 AMP. CIRCUITS

PLF-H SERIES • PLF-R SERIES




LIFTING HOOKS
R.F. GASKET
FLEXIBLE CONNECTION BETWEEN FILTER AND STAND-OFF TERMINAL EACH END OF FILTER
CONDUIT HOLE
R.F. SHIELDED COMPARTMENT
MTG BRKT
REMOVABLE COVER
C
B
REMOVABLE INTERNAL FILTERS
A
D
C'
CONDUIT HOLE

MEASURED IN A 50Ω SYSTEM PER MIL-STD-220A

FOR PLF-H SERIES —
INSERTION LOSS: 100 db from 14KHz to 10GHz measured in accordance with MIL-STD-220A, load condition.

ALSO MEASURED UNDER FULL LOAD CONDITION FROM 14KHz TO 20MHz WITH EXTENDED RANGE BUFFER NETWORKS.

FOR PLF-R SERIES —
INSERTION LOSS: 100 db from 14KHz to 10GHz measured in accordance with MIL-STD-220A, load condition.

FEATURES:

- EXTREME RELIABILITY: Special features specifically developed for secure communications areas, shielded rooms, etc., in continuous service for years without failure.
- FIELD REPLACEABILITY: Each individual phase filter is easily replaceable in field without the use of any special tools.
- LEAKPROOF: Each individual phase filter, completely hermetically sealed and leakproof.
- INDESTRUCTIBLE TERMINALS: Terminal assemblies are made of indestructible alumina ceramic.
- FLEXIBLE LEADS: Flexible leads to the electrical connection preventing possibility of damage to terminals.
- NO FIRE OR EXPLOSIVE HAZARD: Non-flammable impregnant used wherever applicable.
- MAXIMUM VOLTAGE DROP: 2 volts.
- MAXIMUM OPERATING TEMPERATURE: 85°C.
- OVERLOAD SAFETY: 140% of rated current for 15 minutes in compliance with MIL-F-15733E. Short term current capability in excess of 10 times rating without damage.

For Architects' & Engineers' Specifications,
Request Catalog AR-73

GENERAL

The filter herein described shall be designed for filtering of radio frequency interference and to meet the requirements of Military Specifications MIL-F-15733, where applicable. These filters may be used with other electrical devices to enable the devices to meet the requirements of MIL-I-26600, MIL-I-16910, MIL-I-6181, MIL-I-11748, MIL-STD-461, 462, 463, FED-STD-222, and FCC Specification Part 18. Also, DCA specifications and others developed for special equipment and systems applications.

ELECTRICAL

INSERTION LOSS: The filter shall provide an insertion loss of 100 db minimum over its indicated frequency range when measured in accordance with applicable MIL-STD-220A, full load condition, by a government approved laboratory.

For PLF-H Series — Insertion loss: 100db from 14KHz to 10GHz measured in accordance with MIL-STD-220A, load condition. ALSO MEASURED UNDER FULL LOAD CONDITIONS FROM 14KHz TO 20MHz WITH EXTENDED RANGE BUFFER NETWORKS.

For PLF-R Series — Attenuation: 100db from 14KHz to 10GHz measured in accordance with MIL-STD-220A, load condition.

CURRENT RATING: The filters shall be capable of withstanding 140% of rated current overload for 15 minutes without any deterioration.

VOLTAGE: The filters shall be capable of operating continuously at full-rated voltage and of withstanding an over-voltage test of twice the rated voltage for one minute. Maximum voltage drop shall not exceed 2 volts when measured in accordance with MIL-F-15733E. Maximum operating temperature: 85°C.

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ALL-TRONICS

FILTERS (EXCLUDING CRYSTAL)

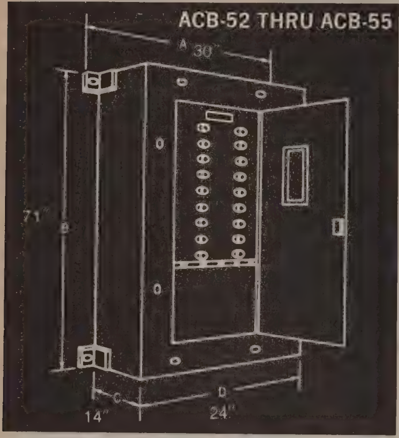
RADIO INTERFERENCE POWER LINE FILTERS

RF FILTERED & SHIELDED
CIRCUIT BREAKER
PANELBOARDS

ACB-50 SERIES • ACB-10 SERIES

INSERTION LOSS: 100db from 14KHz to 10GHz in accordance with MIL-STD-220A, load condition.

ACB-50 SERIES SPECIAL: ALSO MEASURED UNDER FULL LOAD CONDITION FROM 14 KHz TO 20 MHz WITH EXTENDED RANGE BUFFER NETWORKS.



ACB-50 SERIES: IAW DCA CIR300-175-1 CHANGE 5

FEATURES:

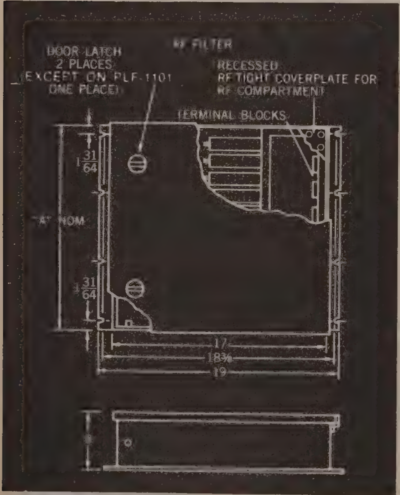
Designed to prevent undesired emanation of intelligence from secure communication installations by conducted or radiated RF energy.

The most important feature is that the circuit breaker panelboard is completely RF shielded even when the front door of the cabinet is open. RF integrity is maintained by mounting the RF Filters in an internal shielded compartment with RF gasketing of a corrosion resistant metal assuring proper RF contact between the filters and the shield wall.

The circuit breaker actuator mechanisms are designed so that their RF shielding effectiveness will be maintained for the life of the panelboard. Each circuit breaker toggle is operated by a wave-guide assembly in order to maintain the shielding effectiveness of the operating mechanism.

For Architects' & Engineers' Specifications, Request Catalog AR-73

PLF-1100 SERIES SECURE COMMUNICATIONS & SIGNAL LINE FILTERS


DOOR LATCH 2 PLACES (EXCEPT ON PLF-1101 ONE PLACE)
RF FILTER
RECESSED RF TIGHT COVERPLATE FOR RF COMPARTMENT
TERMINAL BLOCKS
1 31/64
"A" NOM
1 31/64
17
18¾
19

FILTER MODULE CASES

These cases will accommodate any of the following tubular filter types in any desired combination: PLF-1110, PLF-1111, PLF-1112, PLF-1113, PLF-1114, PLF-1115.

Request Catalog AR-73

These ALL-TRONIC filters are used in teletype, communication and telephone lines in conjunction with shielded and controlled facilities to achieve secure communication standards such as those required for DCA RED/BLACK ENGINEERING — INSTALLATION CRITERIA (U) per Specification DCA CIR C175-6A; DCA ENSP-422-5C, DCA C 300-175-1; and BuShips Inst. 011120.12C.

The ALL-TRONIC low-pass filters, meet or exceed the insertion loss characteristics, and all other requirements, of the above specifications. All units are hermetically sealed and housed in plated metal cases provided with mounting flanges and/or threaded necks for convenient mounting. Terminals are of compression-type glass, solder sealed. Duty cycle is continuous for all units. When installed on a shield-room wall, the filters remove spurious high-frequency energy, while providing a continuous RF-tight shield for the filtered signal. ALL-TRONIC also supplies assemblies of any combination of filters, completely pre-wired to terminal strips and enclosed in an RF-tight cabinet.

All-tronics, inc.

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ALL-TRONICS

RADIO INTERFERENCE POWER LINE FILTERS

PLF-2300 series • PLF-2100 series • PLF-1900 series

RFI / EMI FILTERS FOR 25 • 30 • 50 • 100 • 150 • 200 AMP CIRCUITS

At 277 VAC Line-to-Ground or 480 VAC Line-to-Line • 0-60 Hz

(0-400Hz Available in 1900 & 2100 Series)

SINGLE PHASE FILTER WITH WIRING CHAMBERS FOR DIRECT INSTALLATION

INSERTION LOSS:

PLF-2300 Series — 100 db from 14 KHz to 10 GHz in accordance with MIL-STD-220A, load condition.

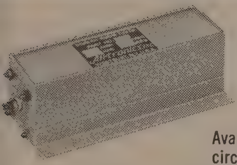
PLF-2100 Series — 100 db from 100 KHz to 10 GHz in accordance with MIL-STD-220A.

PLF-1900 Series — Effective range from 100 KHz to 1 GHz.

For Architects' & Engineers' Specifications, Request Catalog AR-73

PLF-1700 series • PLF-1500 series

RFI / EMI FILTERS



5-10-15 AMP CIRCUITS

At 130 VAC Line-to-Ground

0-400 Hz

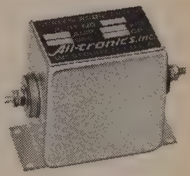
Available in single, dual and/or triple circuits in each current rating. Insertion loss when measured in accordance with MIL-STD-220A provides 50 db at 14 KHz and 100 db at 90 KHz out to 1 GHz.

5 • 10 • 15 • 25 • 50 • 75 • 100•200•300 AMP CIRCUITS

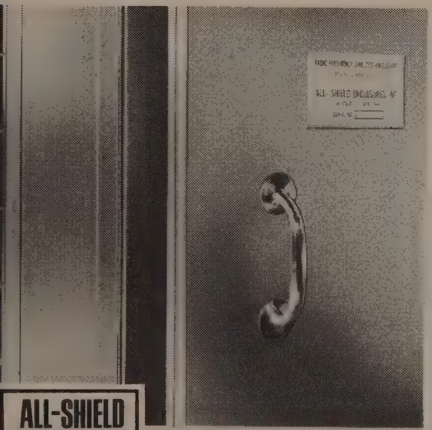
at 250 VAC Line-to-Ground IN BOTH 0-60 Hz & 0-400 Hz Series

(0-400Hz Series to 100 AMPS. only)

Reliable, low-cost, hermetically sealed filters providing insertion loss with effective range from 150 KHz to 150 MHz.



RFI/EMI AND EMP SHIELDED ENCLOSURES



Featuring the NEW Patented

NO-LATCH DOOR DESIGN

•

ALL ACCESSORIES AND FULL DETAILS DESCRIBED IN ALL-SHIELD CATALOG SE-2

ALL-SHIELD ENCLOSURES, INC.

All-shield designs, manufactures and installs a complete line of pre-fabricated, copper mesh and welded steel RF enclosures for medical, laboratory, electronics and governmental agencies. **All-shield** enclosures are designed to specifications 65-5 and 65-6 and also to the performance levels required by critical governmental agencies. **All-shield** produces a superior line of light weight doors. Both automatic and manual required by the discriminating user. The manual door in addition to light weight and meeting performance levels of 65-5 requires no elaborate latching devices to achieve attenuation. The automatic door uses an electric single point latch to eliminate the hand operation. Of importance, the manual door weighs approximately 100 lbs.; total weight of the door and frame approximately 275 lbs.; with the electrical operation the total weight is approximately 295 lbs. **All-shield** thru the application of materials and designs offer a new state of the art in enclosure design at lowered cost.

ALL-SHIELD

All-tronics, inc.

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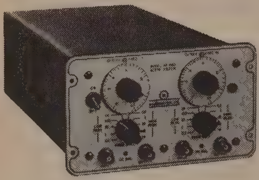
COMSTRON·SEG MULTIMETRICS DIVISION ACTIVE FILTERS

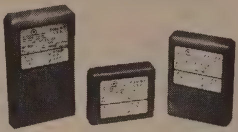
TUNABLE & FIXED 0.001Hz to 2MHz



SERIES AF-100, AF-200

20Hz to 2MHz, 0.2Hz to 20kHz; tunable; ruggedly built, low cost package. Designed for a wide range of applications.

- Top performance and versatility
- Individual channels are independent High or Low Pass Butterworth Filters
- Interconnected channels are Band Pass, Band Reject or have sharpened attenuation slopes
- Selectable Time Domain response for optimum transient (pulse) behavior
- All units rack mountable
- Quick delivery!



Fixed frequency, mini-sized modules. Low, high, band pass, band reject and notch functions, Butterworth, Chebyschev and elliptic responses. Frequencies from 0.001Hz to 100kHz. Other frequencies, response characteristics and pole configurations available.

SERIES AF-850A

35Hz to 3500Hz; ±1% accuracy; tunable; ideal for notched noise measurements and waveform analysis. Fully compatible with telephone channel transmission measuring techniques and equipment.

SERIES AF-400

0.001Hz to 99.9kHz; digital switch tuning; superb accuracy and stability. 115/230VAC or battery operated.

MODEL	AF-110	AF-120	AF-210	AF-220	AF-410	AF-420	AF-410L	AF-420L	AF-850A
FREQ. RANGE, Hz	20 to 2M		0.2 to 20K		0.01 to 99.9K		0.001 to 9.99K		35 to 3.5K
ACCURACY	±5%		±5%		±2%		±2%		±1%
CHANNELS	1	2	1	2	1	2	1	2	1
TUNING	CONTINUOUS				DIGITAL SWITCH				CONTINUOUS
SLOPE, db/Octave	24 (48 – 2 CHANNELS IN SERIES)								N/A
FUNCTIONS	HP, LP	HP, LP BP, BR	HP, LP	HP, LP BP, BR	HP, LP BYPASS	HP, LP BP, BR BYPASS	HP, LP BYPASS	HP, LP BP, BR BYPASS	BP, BR, BYPASS, GAIN

PASSIVE FILTERS AND NETWORKS — AUDIO FREQUENCY TO VHF
FOR APPLICATIONS ENGINEERING ASSISTANCE **CALL 212-441-4240**

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120-30 Jamaica Avenue ▪ Richmond Hill ▪ New York 11418 ▪ Tel: 212-441-4240 Telex: 146337
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COMSTRON·SEG FILTERS & EQUALIZERS

before you buy any filter or equalizer check our design-delivery-price...

- Datacom
- Telecom
- Eye Pattern
- Hilbert Transform
- Linear Phase
- High Pass
- Low Pass
- Band Pass
- Band Reject
- Matched
- Delay Equalized
- Amplitude Equalized
- Time Domain
- FDM
- Optimum
- Thompson
- Butterworth
- Chebyschev
- Cauer
- Bessel
- Elliptic
- Legendre
- Channel Simulation

COMSTRON■SEG's on-time delivery of "impossible" filters, from engineering conception to mathematical synthesis, through quality oriented production, satisfies our most demanding customers.

Whatever your needs . . . from spectral shaping and phase correction to time-domain synthesis . . . you can rely on the filter experts at COMSTRON■SEG. Computer-optimized custom designs from DC to 120MHz with sharp roll offs or phase correction or narrow bandwidths, all in production quantities with competitive pricing. NAME IT AND COMSTRON■SEG WILL DELIVER IT ON SCHEDULE!

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RFI Powerline Filters

S, V & W SERIES* These filters combine line-to-ground RFI filters with additional circuitry to reduce low frequency line-to-line noise. They are designed to protect equipment from malfunctions due to conducted line interference coming into the equipment from the line (susceptibility). They also provide needed noise suppression to allow most equipment to meet VDE, CISPR and CSA specifications for conducted emission. They are particularly effective when applied in equipment using switching type power supplies, SCR and T²L circuits. **NEW**

H SERIES* These filters are designed for use in health care equipment and are recognized under UL 544 specification. Model 6H1 is suited for patient care equipment. Models 6H4 & 6H9 are suited for non-patient equipment (equipment that is intended for use where contact with the patient is unlikely). **NEW**

B SERIES* These filters are general purpose types—effectively providing RFI control of line to ground noise in a small size at lowest cost. They are available in a broad selection of current ratings and termination styles.

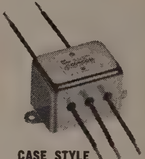
EF SERIES* Now VDE approved. These filters incorporate the special IEC (International Electrotechnical Commission) power line connector. This connector has 4 mm minimum pin spacing and complies with all current and proposed requirements for use with industrial and test equipment in the European market where a detachable power cord is part of the equipment design. The EF series features extremely low leakage current; meets IEC, BSI, VDE, CSA and ASA requirements for data processing equipment. Minimum insertion loss 2.0 MHz to 5.0 MHz 50 DB.

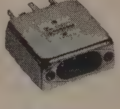
K SERIES* These filters are similar to the B Series but have the added feature of being extremely effective in the control of line to line as well as line to ground RFI interference. The K Series is particularly suited where pulsed, continuous and/or intermittent RFI interference is present and should be used where line to line interference protection is required.

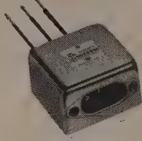
R SERIES* These filters are dual T section RFI powerline filters and provide premium performance at moderate cost. They are well suited for low impedance loads where noisy RFI environments are present. At frequencies as low as 150 KHz, the R Series has an insertion loss as high as 45 DB. They control pulsed, continuous and/or intermittent interference. The R Series provides extremely low leakage current without deterioration of insertion loss characteristics.

CASE STYLE B1, K1, H1

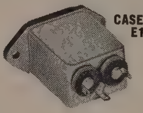
CASE STYLE B2, K2

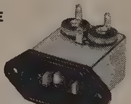

CASE STYLE B3, K3


CASE STYLE B4, K4

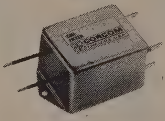

CASE STYLE B5, K5

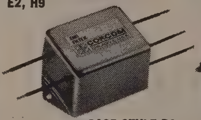
CASE STYLE B6, K6

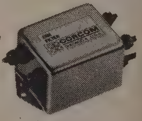

CASE STYLE E1, H4


CASE STYLE E2, H9

CASE STYLE R1, S1, V1, W1

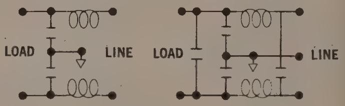

CASE STYLE R2


CASE STYLE R3

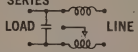

CASE STYLE R6

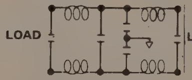
FILTER ELECTRICAL SCHEMATICS

B SERIES EF SERIES J SERIES K SERIES



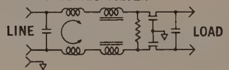
H SERIES



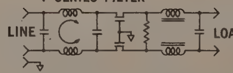


R SERIES

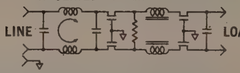
S SERIES FILTER



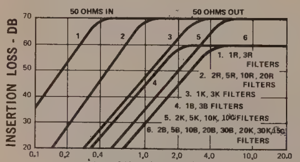
V SERIES FILTER



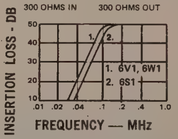
W SERIES FILTER



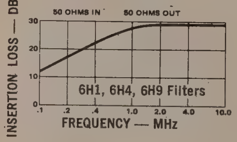
TYPICAL INSERTION LOSS VS FREQUENCY TEST PER MIL STD. 220



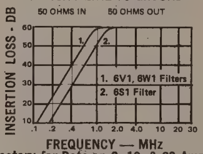
TYPICAL LINE-TO-LINE



Contact Factory for Data on 3, 10, & 20 Amp Models.



TYPICAL LINE-TO-GROUND



Contact Factory for Data on 3, 10, & 20 Amp Models.

Specifications	B, K Series	EF, J Series	R Series	H Series	S, V, W Series
Rated Voltage	115/250 VAC	115/250 VAC	115/250 VAC	115/250 VAC	115/250 VAC
Maximum Leakage Current, Each Line to Ground @ 115 VAC 60 Hz	.5 mA	.25 mA	.5 mA	2 μA	Less than 1.5 mA**
Capacitance Line to Ground Max.	10,000 pfd	5000 pfd	10,000 pfd	zero	
Operating Frequency	50-400 Hz	50-400 Hz	50-400 Hz	50-400 Hz	50-60 Hz
High Pot Test	2250 VDC	2250 VDC	2250 VDC	2500 VAC	2250 VDC

*115 VAC ONLY **@ 250 V, 60 Hz

2635 NORTH KILDARE AVENUE
CHICAGO, ILLINOIS 60639
(312) 384-7400 • TWX 910-221-5308

*** THESE FILTERS ARE RECOGNIZED UNDER THE COMPONENTS PROGRAM OF UNDERWRITERS LABORATORIES INC.**

corcom

RFI Powerline Filters

SERIES B FILTERS*
GENERAL PURPOSE TYPE WITH TWO "L" SECTIONS

Model No.	Case Style	Size L x W x H (Inches)	Maximum Line Current (Amps)	List Price
1B1	B1	2.50 x 2.25 x .65	1	$6.44
1B2	B2	2.50 x 1.56 x .65	1	6.55
1B3	B3	2.50 x .94 x .65	1	6.66
1B4	B4	2.00 x 2.50 x .75	1	7.37
1B5	B5	2.00 x 1.85 x .75	1	7.48
2B1	B1	2.50 x 2.25 x .65	2	5.83
2B2	B2	2.50 x 1.56 x .65	2	5.89
2B3	B3	2.50 x .94 x .65	2	5.94
2B4	B4	2.00 x 2.50 x .75	2	6.66
2B5	B5	2.00 x 1.85 x .75	2	6.77
3B1	B1	2.50 x 2.60 x .75	3	6.66
3B2	B2	2.50 x 1.94 x .75	3	6.77
3B3	B3	2.50 x 1.31 x .75	3	7.04
3B4	B4	2.00 x 2.75 x .75	3	7.65
3B5	B5	2.00 x 2.06 x .75	3	7.77
5B1	B1	2.50 x 2.60 x .75	5	5.94
5B2	B2	2.50 x 1.94 x .75	5	6.11
5B3	B3	2.50 x 1.31 x .75	5	6.27
5B4	B4	2.00 x 2.75 x .75	5	6.93
5B5	B5	2.00 x 2.06 x .75	5	7.04
10B1	B1	2.50 x 2.60 x 1.13	10	6.55
10B2	B2	2.50 x 1.94 x 1.13	10	6.66
10B3	B3	2.50 x 1.31 x 1.13	10	6.77
10B4	B4	2.00 x 2.75 x 1.13	10	7.48
10B5	B5	2.00 x 2.16 x 1.13	10	7.65
10B6	B6	2.50 x 2.57 x 1.13	10	7.98
20B1	B1	2.78 x 3.35 x 1.13	20	11.00
20B6	B6	2.78 x 3.38 x 1.13	20	12.38
30B6	B6	4.12 x 5.13 x 1.50	30	22.00

SERIES EF FILTERS*
INTERNATIONAL TYPE WITH IEC CONNECTOR — VDE APPROVED

Model No.	Case Style	Size L x W x H (Inches)	Maximum Line Current (Amps)	List Price
1EF1	E1	1.97 x 1.97 x .79	1	$10.73
3EF1	E1	1.97 x 1.97 x .79	3	9.90
6EF1	E1	1.97 x 1.97 x .79	6	9.08
1EF2	E2	1.97 x 1.55 x 1.31	1	10.73
3EF2	E2	1.97 x 1.55 x 1.31	3	9.90
6EF2	E2	1.97 x 1.55 x 1.31	6	9.08

SERIES H FILTERS*
LOW LEAKAGE CURRENT FILTERS FOR HEALTH CARE EQUIPMENT—U.L. 544

Model No.	Case Style	Size L x W x H (Inches)	Maximum Line Current (Amps)	List Price
6H1	H1	2.50 x 2.25 x .65	6	$7.15
6H4	H4	1.97 x 1.97 x .79	6	9.95
6H9	H9	1.97 x 1.55 x 1.31	6	9.95

SERIES K FILTERS*
FOR LINE TO LINE & LINE TO GROUND NOISE SUPPRESSION

Model No.	Case Style	Size L x W x H (Inches)	Maximum Line Current (Amps)	List Price
1K1	K1	2.78 x 3.13 x .875	1	$7.54
1K2	K2	2.78 x 2.47 x .875	1	7.65
1K3	K3	2.78 x 1.81 x .875	1	7.76
1K4	K4	2.00 x 2.75 x .875	1	8.47
1K5	K5	2.00 x 2.06 x .875	1	8.58
2K1	K1	2.78 x 3.13 x .875	2	6.93
2K2	K2	2.78 x 2.47 x .875	2	6.99
2K3	K3	2.78 x 1.81 x .875	2	7.04
2K4	K4	2.00 x 2.75 x .875	2	7.76
2K5	K5	2.00 x 2.06 x .875	2	7.87
3K1	K1	2.78 x 3.13 x 1.13	3	7.76
3K2	K2	2.78 x 2.47 x 1.13	3	7.87
3K3	K3	2.78 x 1.81 x 1.13	3	8.14
3K4	K4	2.00 x 2.75 x 1.13	3	8.75
3K5	K5	2.00 x 2.06 x 1.13	3	8.86
5K1	K1	2.78 x 3.13 x 1.13	5	7.04
5K2	K2	2.78 x 2.47 x 1.13	5	7.21
5K3	K3	2.78 x 1.81 x 1.13	5	7.37
5K4	K4	2.00 x 2.75 x 1.13	5	8.03
5K5	K5	2.00 x 2.06 x 1.13	5	8.14
10K1	K1	2.78 x 3.38 x 1.13	10	7.65
10K2	K2	2.78 x 2.72 x 1.13	10	7.76
10K3	K3	2.78 x 2.06 x 1.13	10	7.87
10K6	K6	2.78 x 3.25 x 1.13	10	9.08
20K1	K1	3.32 x 3.38 x 1.50	20	11.75
20K6	K6	3.32 x 3.38 x 1.55	20	13.15
30K6	K6	5.13 x 4.12 x 1.50	30	23.00

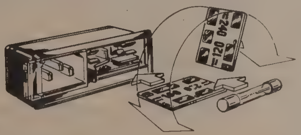
SERIES R FILTERS*
FOR PREMIUM PERFORMANCE WITH TWO "T" SECTIONS

Model No.	Case Style	Size L x W x H (Inches)	Maximum Line Current (Amps)	List Price
1R1	R1	3.38 x 1.75 x 1.13	1	$11.88
1R2	R2	3.06 x 1.75 x 1.13	1	11.99
1R3	R3	2.75 x 1.75 x 1.13	1	12.10
2R1	R1	3.38 x 1.75 x 1.13	2	11.28
2R2	R2	3.06 x 1.75 x 1.13	2	11.39
2R3	R3	2.75 x 1.75 x 1.13	2	11.50
3R1	R1	3.88 x 2.00 x 1.13	3	12.10
3R2	R2	3.56 x 2.00 x 1.13	3	12.21
3R3	R3	3.32 x 2.00 x 1.13	3	12.43
5R1	R1	3.88 x 2.00 x 1.13	5	11.39
5R2	R2	3.56 x 2.00 x 1.13	5	11.50
5R3	R3	3.32 x 2.00 x 1.13	5	11.72
10R1	R1	3.88 x 2.00 x 1.50	10	11.99
10R2	R2	3.56 x 2.00 x 1.50	10	12.10
10R3	R3	3.32 x 2.00 x 1.50	10	12.21
10R6	R6	3.75 x 2.00 x 1.50	10	13.31
20R1	R1	3.88 x 2.00 x 1.50	20	25.03
20R6	R6	5.13 x 4.12 x 1.50	20	26.40

SERIES S, V & W FILTERS*
FOR EQUIPMENT USING SWITCHING TYPE POWER SUPPLIES

Model No.	Case Style	Size L x W x H (Inches)	Maximum Line Current (Amps)	List Price
3S1	S1	3.60 x 2.00 x 1.50	3	$11.66
6S1	S1	3.60 x 2.00 x 1.50	6	10.90
10S1	S1	3.60 x 2.00 x 1.50	10	11.55
20S1	S1	4.12 x 5.13 x 1.50	20	26.07
3V1	V1	3.60 x 2.00 x 1.50	3	12.76
6V1	V1	3.60 x 2.00 x 1.50	6	12.00
10V1	V1	3.60 x 2.00 x 1.50	10	12.65
20V1	V1	4.12 x 5.13 x 1.50	20	27.17
3W1	W1	3.60 x 2.00 x 1.50	3	13.86
6W1	W1	3.60 x 2.00 x 1.50	6	12.95
10W1	W1	3.60 x 2.00 x 1.50	10	13.75
20W1	W1	5.13 x 4.12 x 1.50	20	28.27

THE VS & F VOLTAGE SELECTING & FUSED CONNECTOR



Available to the industry for the first time in one unit a voltage selector switch, a connector and a fuse. The VS & F allows equipment to operate anywhere in the world. FOUR OPERATING VOLTAGES — The VS & F and a simple transformer modification allows the equipment to operate at 100, 120, 220 or 240 volts 50-400 Hz. Voltage selection is made with a unique voltage selector card. EASY INSTALLATION — Only one rectangular cut-out is required for easy snap in mounting. BUILT-IN SAFETY — The fuse and voltage selector card are enclosed behind a see-thru cover which cannot be moved until the power cord is removed from the equipment. UL & IEC — The VS & F has an IEC approved connector, UL SE-01 fire retardant polyester housing and complies with UL and IEC requirements. RFI FILTER — Available with RFI filter (see EF Series specifications for electrical data.) Minimum insertion loss at .5 MHz is 24 DB, at 2.0 MHz to 5.0 MHz 50 DB.

Model	Price
Model 6J1 (unfiltered style)	**$ 5.95** List Price
Model 6J4 (filtered style)	**$10.95** List Price

corcom
2635 NORTH KILDARE AVENUE
CHICAGO, ILLINOIS 60639
(312) 384-7400 • TWX 910-221-5308

* THESE FILTERS ARE RECOGNIZED UNDER THE COMPONENTS PROGRAM OF UNDERWRITERS LABORATORIES INC.

LC filters

Chesterfield Products Inc
Chesterfield Products Inc
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Chesterfield Products Inc

LOW PASS
HIGH PASS
BAND PASS
BAND STOP
EQUALIZERS
ROOFING
FILTERS

GUARANTEED TECHNICAL PERFORMANCE

- FAST QUOTATIONS
- FAST DELIVERY
- LOW PRICES

LC filters from 10 Hz to 50 MHz designed to commercial or Mil Specs. Our competent staff of filter engineers has made us a top rated supplier in the instrumentations, Communications, Telemetering, and Computer fields.

Call or write and let us know your filter requirements. No order too small. If you need one or one thousand units, *we will be happy to quote.*

CP Chesterfield Products/inc.
SADDLE BROOK, NEW JERSEY 07662

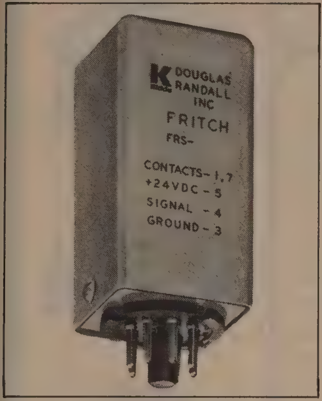
511- B Victor Street, Saddle Brook, New Jersey 07662 : 201/845-6886

Douglas Randall TONE CONTROLS

DIVISION OF WALTER KIDDE & COMPANY, INC. • 6 PAWCATUCK AVE., PAWCATUCK, CONN. 02891 • (203) 599-1750

Kidde

FRITCH® — Frequency Responsive Switch



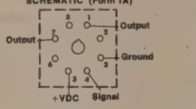
The FRITCH® is a sensitive, rapid tone detector combining solid state circuitry with a Reed Relay output. Two basic types are made:

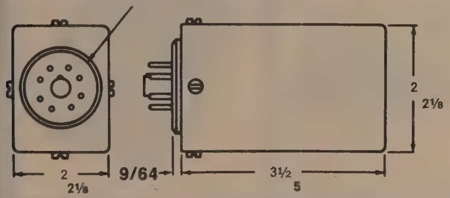
Type I — Used where only one frequency is present.

Type II — Used where several frequencies are present.

DOUBLE TONE FRITCHes detect two frequencies. They are prefiltered to operate in the presence of several frequencies and can incorporate optional time delays to minimize the effect of spurious signals. They are ideal for detecting touch tone pairs over telephone lines.

SCHEMATIC (Form 1A)





BOLD DIMENSIONS ARE FOR DOUBLE TONE FRITCH

LIGHT DIMENSIONS ARE FOR SINGLE TONE FRITCH

Specifications

FREQUENCY RANGE: 7 Hz to 100 KHz.

BANDWIDTH: Must Operate: ±2% fo. May Operate ±5% fo.

NORMAL CHANNEL SPACING: 11%.

INPUT SIGNAL LEVEL: 5 VRMS, 1 VRMS or 0.7 VRMS (odbm). Special to .050 V.

INPUT IMPEDANCE: 25,000 ohms typical.

RESPONSE TIME: To 75 pulses per second depending on frequency.

DC POWER INPUT: 12 V or 24 VDC ±10% (other voltages available).

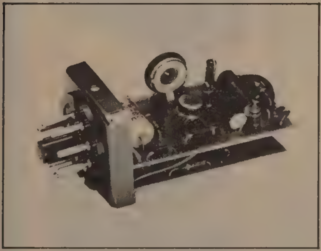
OUTPUT CONTACTS: Form 1A, 2A, 1B, 2B, 1C or 1A1B. Solid state output optional.

CONTACT RATING: Form A or B — 10 W, 0.5 A or 250 VDC Max. Form C — 3 W, 0.25 A or 28 VDC Max.

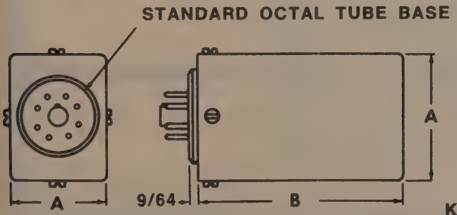
ENVIRONMENTAL LIMITS: Shock: 50 g; Vibration: 35 g; Temperature: −0°C to +50°C.

® Registered trademark of Douglas Randall Frequency Responsive switch. (Patent 3584275)

Oscillators

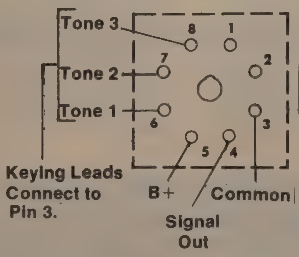


Douglas Randall Oscillators are solid state RC devices. The oscillator circuit operates continuously. The output stage is gated to a low impedance driver circuit, insuring extremely rapid signal response and freedom from frequency shift due to keying. Keying is accomplished by connecting the proper terminal to the power supply common (see schematic). The oscillators have reverse polarity protection incorporated in the unit to protect them if improperly connected. Single, double and triple tone versions are available in standard octal plug housings. They are also available for P.C. Mounting.



Dimension Single Tone	Double or Triple Tone
A — 1½	A — 2
B — 2¾	B — 3½

SCHEMATIC



Specifications

DC POWER INPUT: 12 V or 24 VDC ±10% (other voltages available).

LOAD IMPEDANCE: 600 ohms.

OUTPUT SIGNAL: Standard, 1 V RMS.

DISTORTION: 1%.

RESPONSE TIME: 50 Microseconds.

DECAY TIME: 50 Microseconds.

FREQUENCY RANGE: ±1%: 0°C to 40°C. ±1.5%: −20° to +65°.

ESC LC FILTERS

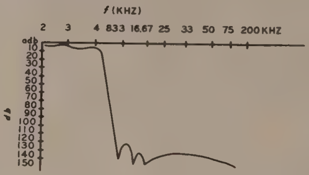
DC to 100 Mhz

- Low Pass
- Band Reject
- RC
- Phase Matched
- High Rel
- High Pass
- Wideband
- Linear Phase
- Attenuation Matched
- Comb
- Band Pass
- Audio
- Constant Group Delay
- Low Transient Response
- Attenuation Equalizers

SONAR FILTERS IN PHASE AND AMPLITUDE MATCHED SETS

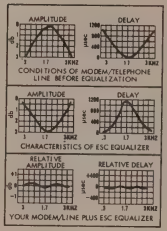
Linear phase bandpass and lowpass filters, with phase and amplitude matched passbands. Matching can be accomplished for any number of channels; generally three filters made a set, but as many as 900 have been phase and amplitude matched. ESC produces filters for Sonobuoys and audio comb analyzers.

HIGH ATTENUATION 140 db AIRCRAFT RADIO LOW PASS FILTERS



ESC is the leading manufacturer of high attenuation filters. These filters provide more than 140 db attenuation of harmonic frequencies in the audio band and have controlled minimum phase shift. Size is only 1.2 x 1.0 x .58.

ESC EQUALIZERS



ESC produces custom designed equalizers for group delay and amplitude distortion. In particular, ESC produces custom designed compromise equalizers for modem manufacturers to correct for transmission line and modem produced amplitude and phase (delay) distortion. Equalization allows modem sets to be used at highest possible rates with minimum distortion. Contact ESC for your specific requirement.

FILTERS FOR THE TELEPHONE INDUSTRY

ESC has a full line of 1010 Hz Band reject filters. Low profile versions for standard telephone testing production equipment. Available in 600 Ω and 900 Ω balanced and unbalanced versions to "Western Electric" specifications.

2600 Hz Band reject filters available to standard "Bell" specifications or in miniaturized version with height approximately ½". Low cost for standard "SF" Signalling equipment.

ESC TELEPHONE LINE SIMULATORS

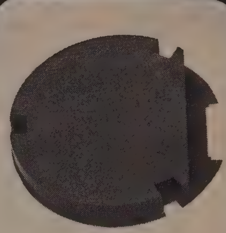
They provide voice-band data systems users with nominal worst case conditions of amplitude and envelope delay of Bell Telephone voice bandwidth data channel 3002 and C1, C2 and C4 conditioning.

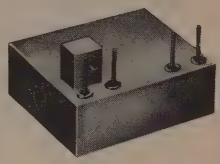
BROAD BAND VIDEO TRANSFORMERS

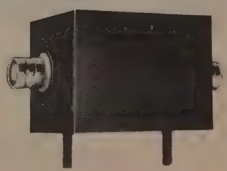
Series of extended wide band transformers covering frequency ranges up to 8 Mhz. Applications include impedance matching, interstage coupling, phase inversion, and elimination of ground loop problems encountered in video transmission. See photo and write for more details.

ULTRA SHARP HIGH SPEED DATA MODEM FILTERS

ESC produces a series of lowpass, bandpass and band suppression filters in 60 Khz to 108 Khz range for use in high speed (150 Kbps) data modems. Filters have very sharp attenuation characteristics, low group delay distortion and more than 60 db intermodulation distortion and are made in compact sizes for PC board capability.







The filters described above represent only a small segment of our total capability. ESC also designs and manufactures, typically . . .

VIDEO	Fixed programmable and mechanically-variable delay lines for the TV croadcast industry, including video cable simulators and voltage variable delay lines.
HI-REL	Proven design, manufacturing capabilities, and facilities encompassing all quality levels dictated by MIL-I-45208 and MIL-Q-9858A.
SONAR	Delay lines used in beam forming systems. These units are manufactured to precision tolerances and are supplied in matched sets or groups.
ATC	Precision tapped delay lines for Air Traffic Control systems of all types, IFF, Beacon Systems, Tacan, Vortac, etc.

ESC ELECTRONICS CORPORATION
534 BERGEN BOULEVARD ● PALISADES PARK, N.J. 07650
PHONE: (201) 947-0400 ● TWX 710-991-9780

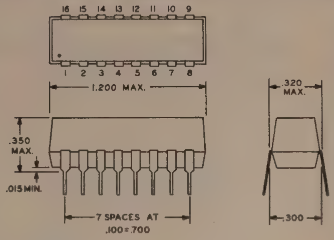
TOLL FREE
800-631-0853
(except N.J.)

LC FILTERS

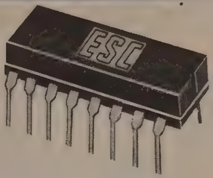
DC to 100 Mhz

ESC

DIP LOW PASS FILTER SERIES



PIN 1 – IN
PIN 8 – OUT
PINS 9 & 16 – GND



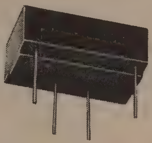
SPECIFICATIONS:

- Insertion Loss: less than .5 db at .1 Fc
- Ripple: less than 1 db in Passband to Fc
- Attenuation: less than 3 db to Fc
  greater than 50 db at 3 Fc
- Operating Temp: – 55°C to + 125°C
- Built to conform to applicable portions of MIL-F-18327
- Mounting: Standard 16 Pin configuration
- For other filter types in DIP configuration contact plant

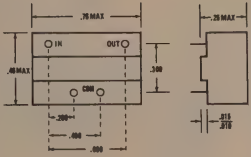
CUT-OFF FREQUENCY Fc	IMPEDANCE Z IN/OUT ➧	75 Ω	100 Ω	200 Ω	250 Ω	500 Ω	1000 Ω
200 KHz				2 DIP-200	2 DIP-250	2 DIP-500	2 DIP-1000
400 KHz			4 DIP-100	4 DIP-200	4 DIP-250	4 DIP-500	4 DIP-1000
500 KHz			5 DIP-100	5 DIP-200	5 DIP-250	5 DIP-500	5 DIP-1000
800 KHz		8 DIP-75	8 DIP-100	8 DIP-200	8 DIP-250	8 DIP-500	8 DIP-1000
1 MHz		10 DIP-75	10 DIP-100	10 DIP-200	10 DIP-250	10 DIP-500	10 DIP-1000

Request Bulletin — DIP-F

ESC DUAL-IN-LINE DIF FILTERS



Five series of filters, three lowpass and two highpass. As example DIF-L39 lowpass series is listed below. Also available is linear phase series DIF-LP, lowpass series DIF-L20, highpass series DIF-H20 and DIF-H39. Full specifications for attenuation and typical characteristics such as phase shift, group delay and pulse response are presented in catalog. A bandpass filter can be formed by tandem connection of a lowpass and highpass (minimum bandwidth is one octave).



DIF-L39 SERIES STANDARD PART NUMBERS

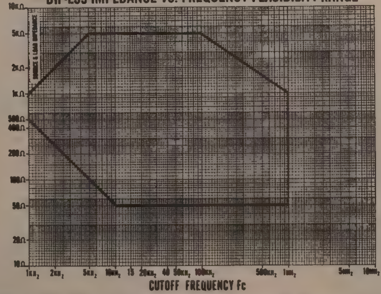
CUTOFF FREQUENCY Fc	IMPEDANCE Z IN/OUT ▷	50 Ω	100 Ω	200 Ω	500 Ω	1000 Ω	2000 Ω	5000 Ω
1KH,					DIF-L39-31	DIF-L39-41		
2					DIF-L39-32			
2 5				DIF-L39-21		DIF-L39-42	DIF-L39-50	
5			DIF-L39-11	DIF-L39-22	DIF-L39-33	DIF-L39-43	DIF-L39-51	DIF-L39-57
10KH,		DIF-L39-1	DIF-L39-12		DIF-L39-34	DIF-L39-44		DIF-L39-58
12.5				DIF-L39-23			DIF-L39-52	
20		DIF-L39-2			DIF-L39-35			DIF-L39-59
25			DIF-L39-13	DIF-L39-24		DIF-L39-45	DIF-L39-53	
50		DIF-L39-3	DIF-L39-14	DIF-L39-25	DIF-L39-36	DIF-L39-46	DIF-L39-54	DIF-L39-60
100KH,		DIF-L39-4	DIF-L39-15		DIF-L39-37	DIF-L39-47		DIF-L39-61
125				DIF-L39-26			DIF-L39-55	
200		DIF-L39-5			DIF-L39-38			
250			DIF-L39-16	DIF-L39-27		DIF-L39-48	DIF-L39-56	
500		DIF-L33-6	DIF-L39-17	DIF-L39-28	DIF-L39-39	DIF-L39-49		
1MH,		DIF-L39-7	DIF-L39-18		DIF-L39-40			

SPECIFICATIONS:

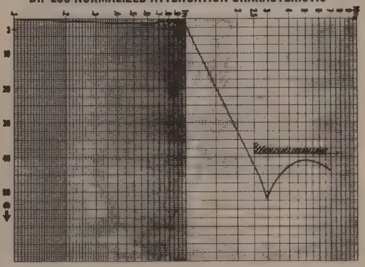
INSERTION LOSS	<.5 db at .1Fc
RIPPLE	<±1 db in Passband (to Fc)
ATTENUATION	<3 db to Fc >39 db at 2.5 Fc & higher frequencies

DIF L39 ➡

DIF-L39 IMPEDANCE VS. FREQUENCY FEASIBILITY RANGE



DIF-L39 NORMALIZED ATTENUATION CHARACTERISTIC



Request Bulletin — DIF

ESC ELECTRONICS CORPORATION
534 BERGEN BOULEVARD ● PALISADES PARK, N.J. 07650
PHONE: (201) 947-0400 ● TWX 710-991-9780

TOLL FREE
800-631-0853
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Looking for Electromagnetic Delay Lines? See our Ad in Section 2350. EEM

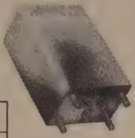
DATA DELAY DEVICES

[illegible] AVE. CLIFTON N.J. 07011 Tel. (201) 772-1106

SHORT FORM CATALOG

STANDARD LINE & INTERSTAGE FILTER SERIES 1120

FEATURES



- Hermetically sealed, metal case.
- Meet or exceed MIL-18327C
- Customized units available on request.

HIGH – PASS

PART NO.	PASS-BAND (<6db) HZ & ABOVE	STOP BAND MIN. db @ HZ	IMP. IN / OUT	CASE NO.
1120H-40A	40	33 26.5 42 20.0	600	3
1120H-200A	200	38 133 42 100	600	3
1120H-300A	300	40 200 50 150	600	3
1120H-500A	500	40 333 50 250	600	3
1120H-1000A	1000	40 667 50 500	600	3
1120H-50E	50	33 33 42 25	10K	3
1120H-100E	100	38 66.7 42 50.0	10K	3
1120H-200E	200	38 133 42 100	10K	3
1120H-300E	300	38 200 42 150	10K	3
1120H-400E	400	38 267 42 200	10K	3
1120H-500E	500	38 330 42 250	10K	3
1120H-800E	800	38 533 42 400	10K	3
1120H-1000E	1000	38 667 42 500	10K	3
1120H-2000E	2000	38 1330 42 1000	10K	3
1120H-3000E	3000	38 2000 42 1500	10K	3

LOW – PASS

PART NO.	PASS-BAND(<6db) HZ & BELOW	STOP BAND MIN. db @ HZ	IMP. IN / OUT	CASE NO.
1120L-200E	200	30 300 40 330	10K	1
1120L-300E	300	30 450 40 495	10K	1
1120L-500E	500	30 750 40 830	10K	1
1120L-600E	600	30 900 40 990	10K	1
1120L-1000E	1000	30 1500 40 1660	10K	1
1120L-3000E	3000	30 4500 40 4950	10K	1

BAND – PASS) (HIGH QUALITY)

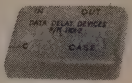
PART NO.	fc (HZ)	PASS-BAND (.1db)	STOP-BAND MIN. db	@ HZ	IMP. IN/OUT	CASE NO.
1120BP-1,500P	1,500	1,000 - 2,000 Hz.	40	60 - 4,000 Hz.	2,000	4
1120BP-2,700P	2,700	1,400 - 5,500 Hz.	40	400 - 9,000 Hz.	2,000	4
1120BP-3,000P	3,000	2,000 - 4,000 Hz	40	400 - 7,000 Hz.	2,000	4
1120BP-3,300P	3,300	500 - 20,000 Hz	40	60 - 40,000 Hz.	2,000	4
1120BP-5,000P	5,000	500 - 50,000 Hz	40	60 - 100,000 Hz.	2,000	4
1120BP-6,000P	6,000	4,000 - 8,000 Hz	40	400 - 15,000 Hz.	2,000	4
1120BP-11,000P	11,000	8,000 - 16,000 Hz	40	400 - 32,000 Hz.	2,000	4

BAND – PASS

PART NO.	fc (HZ)	PASS-BAND (2db)	STOP-BAND MIN. db	@ HZ	IMP. IN/OUT	CASE NO.
1120BP-230E	230	175 - 285	27	87 - 570	10K	3
1120BP-340E	340	285 - 395	36	140 - 800	10K	2
1120BP-450E	450	395 - 505	36	195 - 1000	10K	2
1120BP-1050E	1050	995 - 1105	30	750 - 1500	10K	3

CASE NO.	CASE DEMENSIONS					
	L.	W.	H.	STUDS	CUT-OUT	MOUNTING DIM.
3	1-11/16	1-3/16	2-1/2	6 - 32 x 3/8	3/4" Dia.	1-1/4 x 3/4
2	1-11/16	1-3/16	1-5/8	6 - 32 x 3/8	3/4" Dia.	1-1/4 x 3/4
1	1.00	1.00	1-11/32	4 - 40 x 3/8	SEE BASE SKETCH	
4	2-3/16	1-13/16	2-9/16	6 - 32 x 3/8	3/4" Dia.	1-1/2 x 1-1/8

LOW PROFILE FILTERS SERIES 1100



MIL SPECS	These filters meet MIL-F-18327C specs. Grade 6, Class R, Life X.
CASE	Metal flat case to reduce hum pick-up.
PINS	Straight pins for PC mounting.
NOTE	Filters with other requirements than shown can be supplied. Our technical staff is ready to give you prompt service.

LOW-PASS

PART NO.	Imp. IN/OUT	PASS-BAND (1db)	PASS-BAND (3db)	STOP-BAND	CASE NO.
1101-1	10K	DC to 460Hz	600Hz	40db above 750Hz	1
1101-2	600	DC to 3KHz	3.4KHz	40db above 4.2KHz	1
1101-3	10K	DC to 4.4KHz	5KHz	43db above 6.3KHz	2
1101-4	1K	DC to 9KHz	10KHz	43db above 12.8KHz	1
1101-5	600	DC to 15KHz	18KHz	43db above 23KHz	1
1101-6	600	DC to 43KHz	50KHz	43db above 64KHz	2

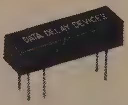
HIGH-PASS

PART NO.	Imp. IN/OUT	PASS-BAND (1db)	PASS-BAND (3db)	STOP-BAND	CASE NO.
1102-1	10K	300Hz & above	200Hz	40db below 140Hz	1
1102-2	10K	600Hz & above	400Hz	40db below 280Hz	1
1102-3	10K	1.2KHz & above	800Hz	40db below 560Hz	1
1102-4	10K	3KHz & above	2KHz	40db below 1.4KHz	2
1102-5	10K	6KHz & above	4KHz	40db below 2.8KHz	2

BROAD BAND-PASS

PART NO.	Imp. IN/OUT	PASS-BAND	STOP-BAND (36db) BELOW	STOP-BAND (36db) ABOVE	CASE NO.
1103-1	10K	1KHz to 2KHz	0.5KHz	4KHz	3
1103-2	10K	2KHz to 4KHz	1KHz	8KHz	3
1103-3	10K	4KHz to 8KHz	2KHz	16KHz	3
1103-4	10K	10KHz to 20KHz	5KHz	40KHz	4

ACTIVE FILTERS



SPECIFICATIONS

- **Transfer characteristics** – Butterworth, Bessel, Tchebyshev.
- **Gain in pass-band** – 0 db ±.2db
- **Cut-off frequency accuracy** – ±2% @ – 3 db
- **Maximum imput voltage** – 10 volts peak.
- **Supply voltage** – ±15 volts min., ±18 volts max.
- **DC drift** – 20uV/°C typical.
- **Temperature range** – 0°C to 70°C (standard), -55°C to 125°C (on request).
- **Temperature/Coefficient** – .03%/°C. better on request.

fc	LOW PASS 24 db/OCT.	HIGH-PASS 24 db/OCT.	BAND-PASS 24 db/OCT.	BAND-REJECT 24 db/OCT.
10 HZ	32 BU24-00010	34 BU24-00010	46 BU24-00010-00100	63 BU24-00010-00100
100 HZ	32 BU24-00100	34 BU24-00100	46 BU24-00100-01000	63 BU24-00100-01000
1000 HZ	32 BU24-01000	34 BU24-01000	46 BU24-01000-10,000	63 BU24-01000-10,000
10,000 HZ	32 BU24-10,000	34 BU24-10,000	46 BU24-10,000-15,000	63 BU24-10,000-15,000
20,000 HZ	32 BU24-20,000	34 BU24-20,000	46 BU24-15,000-20,000	63 BU24-15,000-20,000

NOTE: The above table gives only a small number of designs available. Many other designs are available on request.

TO ORDER OTHER ACTIVE FILTERS NOT LISTED ON ABOVE TABLE USE THE FOLLOWING PROCEDURE:

PART NO. 32	BU	24	01000-00000
32-LOW PASS 34-HIGH PASS 46 BAND PASS 63-BAND REJECT	BU-BUTTERWORTH BE BESSEL CH-TCHEBYSHEV	06 6 db/OCT. 12-12 db/OCT 18-18 db/OCT 24-24 db/OCT 36-36 dh/OCT 48 48 dh/OCT	CUT-OFF FREQUENCIES in HZ

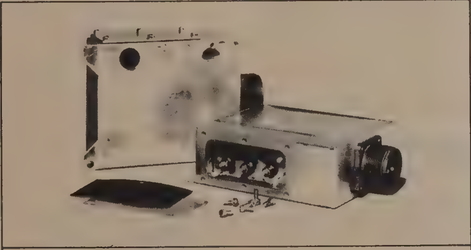
electrocube filters

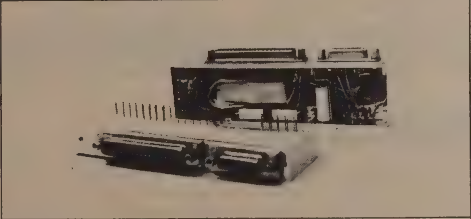
Electrocube has developed literally thousands of EMI filters, to meet the rigorous specialized requirements of military, aerospace and commercial applications. Company designs are found on Saturn and Apollo LEM space vehicles, Minutemen and Titan missiles, C-5A and other current aircraft, and on computers and UL listed commercial equipment.

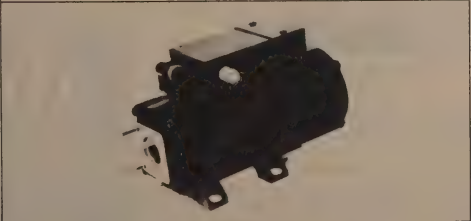
Filters have been designed with current carrying capacities from 0.1 to 500 amps, voltages to 5000 VDC and 600 VAC, and for DC to 1000 Hz and intermittent or continuous duty. Single and multicircuit configurations are also offered, including L, Pi (also with feed-through capacitors) and T. Models include low pass, high reject, noise, interstage and line, screen room, and heavy duty industrial filters.

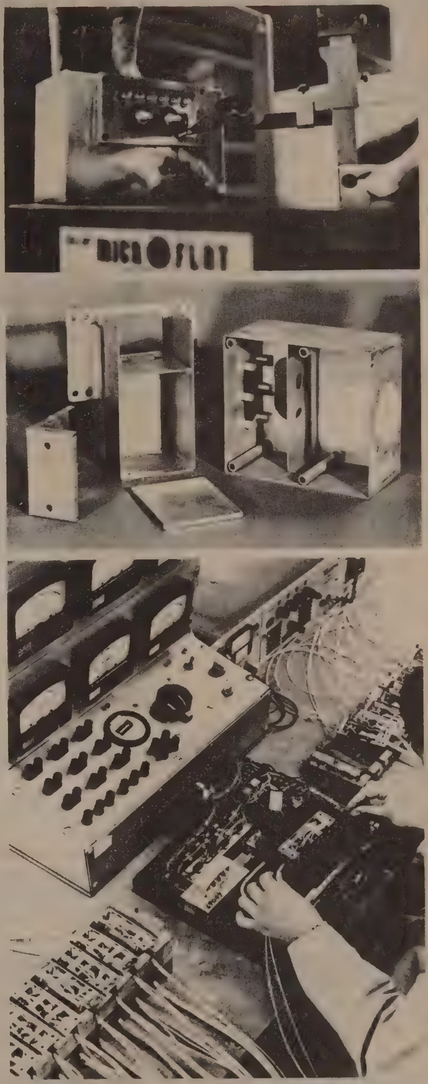
The important factor of packaging is also a prime consideration. Conformance to customer specified space, mounting, terminal and environmental requirements are met, and manufacturing tolerances of ±0.005 on mounting surfaces and ±0.015 on case dimensions can be provided. Case interiors are usually completely encapsulated for electrical isolation and environmental protection.

Electrocube maintains an experienced engineering group and complete in-house facilities for the production and testing of EMI filters. An extensive inventory of existing designs provides the benefits of standardization to non-standard filter design and production. Assistance is also offered during initial system design phases in the definition and resolution of filter requirements.









electrocube

1710 South Del Mar Avenue
San Gabriel, California 91776
Telephone: (213) 283-0511
TWX: 910-589-1609

active filters FROM Frequency Devices INC.

FIXED FREQUENCY ACTIVE FILTERS—SERIES 700

High performance Active Filters offer Bessel, Butterworth, and Tchebyscheff transfer functions in 2-, 4-, 6-, and 8-pole designs. Low pass, high pass, bandpass, and band reject models available.

Wide Frequency Range: .001Hz to 20KHz.

Low Drift: $\Delta f_c < 0.05\%/°C$; Offset Drift: $30\mu V/°C$.

Z_{in} to 1MΩ; $Z_{out} = 1\Omega$; Insertion Loss = .02dB; Noise = 50μVrms.

RESISTIVE TUNEABLE ACTIVE FILTERS—SERIES 730, 740, 760, 780

730 & 740 Series Lowpass: Four and six pole filters with externally tuneable cutoff frequency. Various models are tuneable over 20:1, 50:1, 200:1 or 500:1 frequency ranges via external tuning resistors. Bessel and Butterworth responses in the frequency range from .001Hz to 50KHz. 780 Series Bandpass/Band Reject: Provides adjustable Q of 0.5 to > 100 with 1000:1 tuning. 50 to 60dB notch is trimmable to 60 to 80dB.

760 Series Bandpass: Two pole-pair Butterworth characteristics with Q of 5 or 10 and 1000:1 tuning. Various models cover the range 0.05 to 20KHz.

APPLICATIONS

- A to D Pre-Filtering
- Geophysical and Meteorological Data Reduction
- Noise Reduction
- Contiguous Comb Filter
- Demodulation Filter
- Phase Lock Control
- Vibration Analysis
- Voltage to Frequency Conversion
- Time Delay Filters
- Test Instrumentation
- RMS Measurements
- Harmonic Analysis
- Noise Reduction
- Waveform Purifier

VOLTAGE TUNEABLE ACTIVE FILTERS—SERIES 300

Versatile two-pole active filters are tuneable over a 20:1 frequency range by application of a control voltage. Simultaneous low, high, and bandpass outputs are provided. Operational without external components, but gain or Q may be varied with a single resistor.

Linear tuning (1%), $Z_{in} = 100K\Omega$; $Z_{out} = 10\Omega$; Insertion Low = 0.2dB.

UNIVERSAL VOLTAGE TUNEABLE NOW AVAILABLE: MODEL 320

- Spectrum Analysis
- Adaptive/Tracking Filter
- Frequency/Phase Locked Loops
- Automatic Test Instrumentation
- Sinewave VCO with Quadrature Outputs
- Bandwidth Control

PROGRAMMABLE FILTERS—744 SERIES & FC103

Butterworth and Bessel Lowpass Filters have BCD and Binary programmable corner frequencies. 500:1 and 1000:1 tuning with 80dB floors and 100dB dynamic range. Five models cover the frequency range from 0.1 to 50KHz. FC102: The almost instrument filter card. User need only interface signal & power. Corner frequency is selected via pencil point switches. Excellent choice for breadboard and laboratory applications.

FC103/104: Universal Remote Programming Card System allows TTL control of filters and oscillators.

- Programmable Test Equipment
- Anti-Aliasing
- Programmable Time Delay
- Computer Controlled Signal Processing
- Automated Measurements
- Tracking Sampled Data Systems

MODEM FILTERS—530 SERIES

Low cost/high performance modem filters for FSK modems. Switchable bandpass filters for transmitting and receiving applications where switching from 1 carrier frequency to another is desirable.

- Telephone Test Equip.
- Data Transmission

WEIGHTING FILTERS—580 SERIES

Ideal for telephone communications and test equipment. Includes "C Message" "Notch", "A Message" and other weighting functions.

PRECISION SINEWAVE OSCILLATORS, TONE DECODERS & ENCODERS ALSO AVAILABLE

FAST DELIVERY— 2 weeks on tuneable filters / 2-4 weeks on fixed frequency filters

Frequency Devices, Inc., 25 Locust St., Haverhill, MA 01830/ (617) 374-0761/ TWX 710-347-0314

Frequency Devices INC.

encoders • decoders oscillators

FROM

Frequency Devices INC.

TONE ENCODERS FOR DUAL-TONE MULTIFREQUENCY (DTMF) APPLICATIONS

Model 510, 511, 520 Encoders

Model 510 Touch Tone* Encoder is a complete T^2L Compatible Dual Touch Tone* Encoder in a 2.4 cu. in. low profile (.4″) module. It features self contained decode logic to select the frequencies of its two low distortion oscillators and output gating logic to gate either or both of the oscillators outputs.

Specifications include: Low distortion outputs (< 1%) — Touch Tone* frequencies (±1%) (Osc. 1 — 697Hz, 770Hz, 852Hz, 941Hz: Osc. 2 — 1209Hz, 1334Hz, 1446Hz, 1633Hz). Gating isolation > 60dB — Low impedance output (10Ω).

Other models with Trunk Tone frequencies or customer specified frequencies are also available.

Tone decoder modules featuring two pole pair bandpass filters and level detection circuitry with T^2L compatible logic outputs are available.

Model 511 Tone Encoder, a complete TTL Compatible Dual Tone Encoder offering a signal amplitude of high tones 3dB greater than that of low tones.

Model 520 Tone Encoder, a complete, low-cost TTL compatible tone encoder for use with external switching and touch pads.

TONE DECODERS FOR DUAL-TONE MULTIFREQUENCY (DTMF) APPLICATIONS

Model 550-1 (Low Frequency) & Model 550-2 (High Frequency) Tone Detector Modules

The Model 550-1 and 550-2 Tone Detector modules are a complete, easy to use, adjustment free, high performance tone decoding system. They detect and decode standard Bell System Touch Tone* with relative amplitudes of ±10dB and absolute amplitude in the range from —30dBm to 0dBm. Detection and hold times have been designed to achieve non-ambiguous decoding of 40 ms on and 40 ms off tone bursts. Outputs may be interfaced with CMOS and T^2L logic.

Model 540 Band Separation Filter

The Model #540 Band Separation Filter attenuates the dial tone frequencies (by > 30dB) and the out of band portions of the voice spectrum. It also separates the high and low tone bands.

SINEWAVE OSCILLATORS LOW COST—HIGH PERFORMANCE—LOW DISTORTION

Fixed Frequency Models 400 — Tuneable Models 440

Modular fixed frequency and tuneable oscillators featuring low distortion quadrature (90° ±.1°) buffered outputs with amplitude tracking to better than 100 ppm/°C. Fixed frequency models available from 1Hz to 20KHz (externally adjustable ±10%) and Tuneable models externally variable over 1000:1 range.

Low frequency drift (0.01%/°C) — Low Noise (−85dB). Amplitude externally adjustable over 20dB range (with resistor or voltage).

An amplitude control module to maintain 100 ppm amplitude accuracy and stability is also available.

Model 450

The 450 Series features 0.1dB amplitude stability, 0.1% distortion, 1 to 20V p-p adjustable, 100Hz to 10KHz range, 1% accuracy (adj. ±5%) and .02%/°C stability.

APPLICATIONS

- CONSUMER CREDIT
- TRAVEL & ENTERTAINMENT
- MANUFACTURING FACILITIES
- TRANSPORTATION SYSTEMS
- FACSIMILE TRANSMISSION
- DATA COLLECTION
- UTILITY CONTROL

Frequency Devices INC.

FREQUENCY DEVICES INC. ALSO CARRIES A BROAD LINE OF ACTIVE FIXED FREQUENCY, TUNEABLE AND PROGRAMMABLE FILTERS.

Frequency Devices, Inc., 25 Locust St., Haverhill, MA 01830 / (617) 374-0761 / TWX 710-347-0314

*Registered trademark of AT&T.

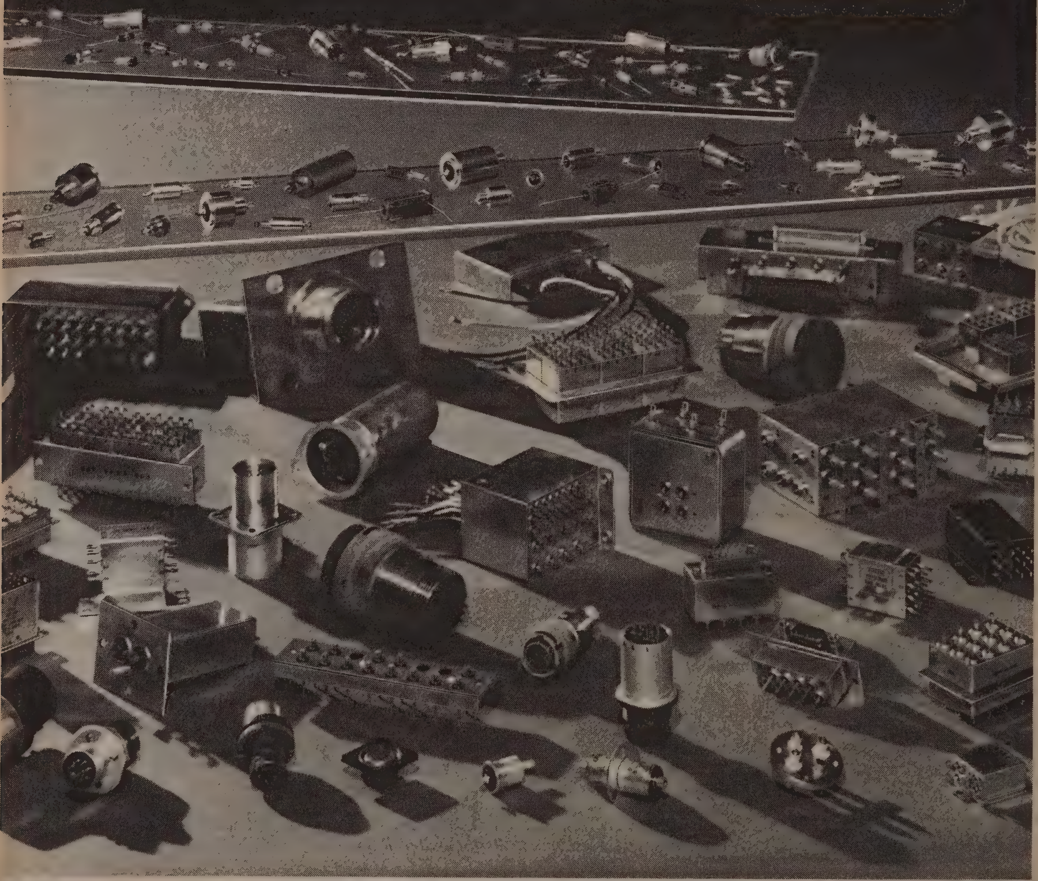
EMI FILTER
CAPITAL OF THE WORLD

**FROM CERAMIC POWDER TO MIL-APPROVED TEST LAB...
ERIE HAS IT ALL, UNDER ONE ROOF**

Only one company can deliver your total EMI Ceramic Filter needs . . . ERIE. We've been applying sophisticated ceramic and related technologies to developing superior filters for 35 years. Today ERIE has, by far, the broadest line of subminiature EMI Filters in the world. From tiny high frequency filters to broad band filters to custom filter assemblies, ERIE offers the ultimate in quality. And you get single-source responsibility too, for we build the complete filter in a plant devoted exclusively to the design and manufacture of EMI Filters. So come to ERIE for your filter needs. We'll put a team to work on your particular application. Aerospace. Communications. Avionics. Industrial Equipment. Whatever the market, we can help eliminate electromagnetic "noise" and emissions. In the meantime, write for our complete catalog . . . EMI Filters or call 613/392-2581.

ERIE TECHNOLOGICAL PRODUCTS, INC.
Erie, Pennsylvania 16512

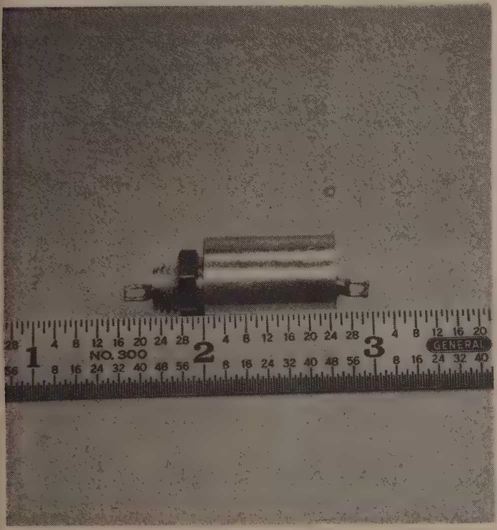
ERIE



THE GUDEMAN CORPORATION

capacitors and EMI filters
340 WEST HURON STREET ▪ CHICAGO ILLINOIS 60610 ▪ 312 337 7400 ▪ TWX 910 221 3863

EMI and RFI FILTERS polycarbonate dielectric L type miniature filters



polycarbonate dielectric versus ceramic is ultimately superior for A/C applications

The **Gudeman Corporation** manufactures a full line of military and commercial EMI and RFI filters to meet the needs of most custom requirements.

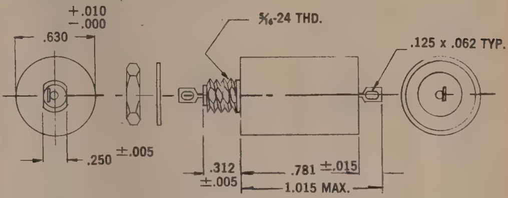
Military types are designed to meet or exceed the applicable requirements of MIL-F-15733E. Commercial types to Underwriters Laboratories requirements or the customers individual specifications.

In addition to the popular tubular and bathtub style case configurations, the **Gudeman Corporation** offers case styles and mounting means custom designed to take full advantage of the volume and form factor available for that "special application."

ENGINEERING SERVICES
Please feel free to consult our application engineering department without obligation, for assistance on any problem relating to the design, use or application of low pass filters.

TESTING SERVICES
The **Gudeman Corporation** has complete facilities for testing equipment for radiated or conducted EMI to FCC regulations, at a very low cost.

polycarbonate dielectric L type miniature filter



specifications 64L6- /64RL6-* series

115 VAC 0-400 Hz, 250 VDC
500 VDC Dielectric Withstanding Voltage
1000 Megohm Minimum @ 250 VDC Insulation Resistance
−55°C to +105°C Operating Temperature
Meets or exceeds all applicable requirements of MIL-F-15733
*R in part number denotes capacitor at threaded end.

Dash No.	Current (amps)	Insertion Loss (DB) MIL-STD-220A, Full Load					
		30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1000 MHz
-06	.06	20	50	60	70	70	70
-1	1		30	42	60	70	70
-2	2		22	30	50	70	70
-3	3		20	25	45	65	70
-5	5		15	22	35	60	70
-10	10		12	20	30	50	70

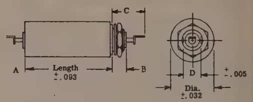
NOTE: Other currents (amps) and configurations (π & T) available upon request. Other tube sizes (.41 o.d.) available.

THE GUDEMAN CORPORATION
capacitors and EMI filters
340 WEST HURON STREET ▪ CHICAGO ILLINOIS 60610 ▪ 312 337 7400 ▪ TWX 910 221 3863

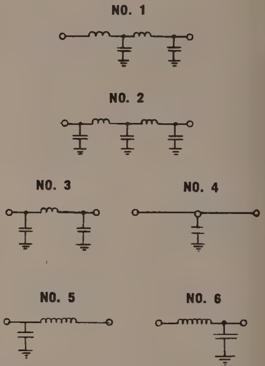
tubular broadband low pass filters series 100

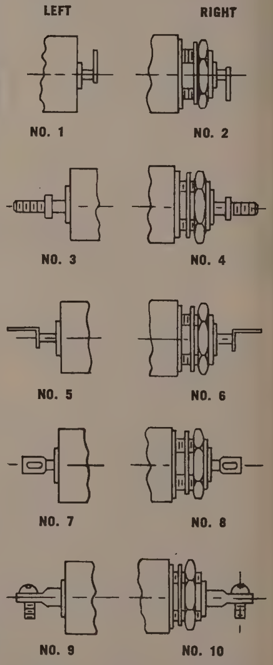
Part Number	Current in Amps	Voltage Rating			Circuit Number	Amb. Temp. −55°C to	Max. Alt. in Feet	Terminal Dimension				
		DC	AC	Line Freq.				Thd. Size	A	B	C	D
100-1101	.1	600	220	0-400 Hz	3	125°C	60,000	5⁄16-24	.171	.500	.796	NA
100-1100	.25	500	115	0-400 Hz	1	85°C	60,000	5⁄16-32	.171	.500	.796	NA
100-1102	.25	500	115	0-400 Hz	1	85°C	60,000	5⁄16-32	.171	.500	.796	NA
100-1205	.3	300	130	0-400 Hz	3	85°C	50,000	5⁄16-24	.171	.343	.640	.250
100-1155	.3	300	130	0-400 Hz	1	85°C	50,000	¼-28	.218	.250	.406	.201
100-1138	.5	400	125	0-400 Hz	2	85°C	50,000	5⁄16-24	.328	.281	.640	.250
100-1183	.5	150	—	—	3	125°C	80,000	5⁄16-24	.281	.281	.640	NA
100-1165	.5	150	—	—	3	125°C	80,000	Shielded	.172	NA	6.000	NA
100-1163	.5	400	125	0-400 Hz	3	85°C	65,000	½-28	.312	.250	.562	.437
100-1121	.5	125	—	—	3	85°C	80,000	½-28	.469	.375	.875	.437
100-1108	1	500	125	0-400 Hz	3	100°C	60,000	½-28	.375	.437	.812	.437
100-1113	1	400	125	0-400 Hz	3	85°C	60,000	½-28	.171	.375	.546	.437
100-1122	1	100	—	—	3	85°C	80,000	½-28	.375	.375	.750	.437
100-1227	1	600	250	0- 60 Hz	3	125°C	60,000	7⁄16-20	.375	.438	.843	.375
100-1132	1.2	400	125	0-400 Hz	3	85°C	70,000	5⁄16-24	.125	.281	.406	.250
100-1106	1.5	400	115	0-400 Hz	2	125°C	60,000	¼-20	.156	.250	.406	.201
100-1180	1.5	100	—	—	3	100°C	70,000	½-28	.171	.375	.546	.437
100-1287	1.5	300	125	0-400 Hz	3	85°C	80,000	5⁄16-24	.312	.281	.578	.250
100-1118	2	50	—	—	6	85°C	70,000	5⁄16-24	.125	.500	.687	NA
100-1104	2	100	—	—	3	100°C	70,000	7⁄16-20	.484	.437	.921	.375
100-1116	2	400	115	0-400 Hz	3	95°C	60,000	7⁄16-20	.187	.312	.547	.375
100-1179	2	100	—	—	3	85°C	80,000	5⁄16-24	.218	.281	.703	NA
100-1181	2	100	—	—	3	100°C	70,000	⅝-24	.375	.375	.718	.530
100-1193	2	100	—	—	6	85°C	70,000	5⁄16-24	.218	.281	.765	.250
100-1164	2	100	—	—	6	85°C	80,000	5⁄16-24	.172	.281	4.000	NA
100-1141	3	400	125	0-400 Hz	3	85°C	50,000	¾-20	.375	.500	1.015	.655
100-1264	3.5	400	115	0-1200 Hz	3	85°C	80,000	7⁄16-20	.375	.312	.687	.375
100-1182	3.5	400	115	0-400 Hz	3	100°C	70,000	⅝-24	.187	.312	.530	.530
100-1154	5	400	125	0-400 Hz	3	85°C	60,000	⅝-24	.375	.375	.750	.531
100-1162	5	600	250	0-400 Hz	3	85°C	65,000	7⁄16-20	.218	.437	.687	.375
100-1107	10	500	125	0-400 Hz	3	100°C	60,000	⅝-24	.375	.375	.750	.530
100-1198	10	600	250	0- 60 Hz	3	85°C	60,000	⅝-24	.218	.375	.603	.530
100-1114	10	400	125	0-400 Hz	3	85°C	60,000	7⁄16-20	.187	.437	.703	.375
100-1178	10	600	220	0- 60 Hz	3	85°C	70,000	¾-20	.187	.562	.750	.655
100-1202	10	400	125	0-400 Hz	3	85°C	70,000	⅝-24	.375	.375	.562	.535
100-1161	10	600	250	0-400 Hz	3	85°C	65,000	⅝-24	.218	.671	1.000	.520
100-1190	10	400	120	0-400 Hz	3	85°C	70,000	¾-20	.687	.325	1.062	.655
100-1159	10	600	240	0- 60 Hz	3	85°C	70,000	⅝-24	.375	.375	.750	.515
100-1144	10	400	125	0-400 Hz	3	85°C	60,000	¾-20	.375	.375	.750	.655
100-1268	15	200	—	—	3	85°C	60,000	7⁄16-20	.375	.430	.750	.375
100-1189	15	—	440	0- 60 Hz	3	85°C	60,000	1⅛-18	.437	.562	1.000	1.055
100-1177	15	600	220	0- 60 Hz	3	85°C	60,000	¾-20	.437	.562	1.000	.655
100-1103	20	400	115	0-400 Hz	3	85°C	60,000	¾-20	.437	.375	.812	.655
100-1229	20	400	125	0- 60 Hz	3	85°C	60,000	¾-20	.437	.375	.812	.655
100-1176	20	400	125	0-400 Hz	3	85°C	60,000	¾-20	.437	.375	.812	.655
100-1130	30	600	250	0- 60 Hz	3	125°C	60,000	1⅛-18	.781	.562	1.343	1.046
100-1225	30	600	250	0- 60 Hz	3	125°C	60,000	1⅛-18	.781	.562	1.343	1.046
100-1158	30	400	125	0-400 Hz	3	85°C	60,000	¾-20	.812	.375	1.187	.655
100-1152	50	400	125	0- 40 Hz	3	85°C	50,000	1⅛-18	.875	.500	1.375	1.055
100-1146	100	400	220	0- 60 Hz	4	85°C	60,000	1⅛-18	.750	.500	1.250	1.055

Part Number	Terminal Pull	Body Size		Terminals		Typical Insertion Loss in Decibels*							Max.† V. Drop
		Length	Dia.	Left	Right	.15 MHz	.5 MHz	1.0 MHz	10 MHz	100 MHz	400 MHz	1000 MHz	
100-1101	2.5	1.125	.500	1	8	10	50	75	75	75	75	75	.5
100-1100	2.5	1.437	.562	1	8	60	75	85	85	85	85	85	.5
100-1102	2.5	1.750	.562	1	8	60	75	85	85	85	85	85	.5
100-1205	2.5	1.375	.562	1	8	55	80	80	80	75	75	75	.5
100-1155	2.5	1.250	.670	1	2	55	80	82	82	75	75	75	.5
100-1138	2.5	1.937	.671	5	8	60	82	90	90	85	80	75	.5
100-1183	2.5	1.390	.562	1	8	45	70	90	100	100	82	80	.5
100-1165	NA	1.500	.562	1	Shielded	45	70	95	100	100	82	80	.5
100-1163	2.5	2.812	1.000	7	2	85	102	102	102	102	95	90	.5
100-1121	2.5	2.125	.656	5	6	65	90	95	95	90	90	90	.5
100-1108	2.5	2.562	1.031	5	6	60	78	80	80	80	80	80	.5
100-1113	2.5	2.531	.875	1	2	65	85	105	105	105	100	90	.5
100-1122	2.5	2.469	1.000	5	6	75	100	95	80	80	80	80	.5
100-1227	2.5	2.750	1.000	5	6	60	90	95	75	75	75	75	.5
100-1132	2.5	1.937	.671	1	2	55	70	85	85	90	80	70	1
100-1106	2.5	2.060	.670	1	2	50	85	100	120	120	95	85	.5
100-1180	2.5	2.078	.437	5	6	50	85	100	115	100	90	80	.5
100-1287	2.5	1.251	.562	1	8	20	32	48	70	60	60	60	.5
100-1118	2.5	1.125	.500	1	8	—	—	5	30	40	40	40	.5
100-1104	3	2.125	.750	3	4	40	80	80	80	80	80	80	.5
100-1116	3	2.000	.875	1	2	57	89	113	107	80	91	80	.5
100-1179	3	1.187	.562	1	8	20	40	49	70	70	70	70	.5
100-1181	3	1.250	.875	5	6	25	40	52	56	68	78	75	.5
100-1193	3	1.187	.562	1	8	20	40	60	75	60	60	60	.5
100-1164	3	1.187	.562	1	Shielded	20	40	49	70	60	60	60	.5
100-1141	3	2.250	1.250	1	6	55	68	78	78	78	78	78	.5
100-1264	3	2.656	1.000	5	6	60	74	80	80	79	78	75	.5
100-1182	3	2.218	1.187	1	2	45	75	92	98	80	58	50	.5
100-1154	5	3.250	1.250	5	6	50	70	90	90	90	80	70	.5
100-1162	5	3.500	1.250	1	2	60	88	102	102	102	95	90	.5
100-1107	5	3.500	1.469	7	8	60	83	83	83	83	83	83	.5
100-1198	5	3.750	1.453	1	2	60	95	99	108	110	100	91	.5
100-1114	5	2.312	1.125	1	2	55	72	90	90	90	90	80	.5
100-1178	5	3.750	1.500	1	2	60	80	100	100	100	100	90	.5
100-1202	5	3.406	1.312	5	2	50	78	90	90	88	81	75	.5
100-1161	5	3.796	1.500	1	2	60	98	101	105	105	102	95	.5
100-1190	5	3.875	1.250	9	10	55	70	80	80	80	80	80	.5
100-1159	5	3.625	1.453	7	8	45	65	81	75	80	80	80	.5
100-1144	5	3.725	1.500	5	6	55	70	80	80	80	80	80	.5
100-1268	5	2.060	.750	5	6	35	48	60	80	90	88	80	.75
100-1189	5	4.937	2.000	9	10	55	72	72	72	72	72	72	.75
100-1177	5	3.843	1.500	9	10	60	82	105	105	105	90	85	.75
100-1103	5	3.593	1.500	9	10	55	80	80	80	80	80	85	.75
100-1229	5	4.125	1.500	9	10	60	70	80	80	80	80	80	.75
100-1176	5	4.000	1.500	9	10	60	85	110	110	110	80	80	.75
100-1130	5	4.062	2.000	9	10	60	75	80	80	80	80	75	1
100-1225	5	4.062	2.000	9	10	60	75	80	80	80	80	75	1
100-1158	5	3.625	1.500	3	4	60	82	82	82	82	82	82	1
100-1152	5	4.250	2.234	3	4	50	68	70	70	70	70	50	1
100-1146	5	4.937	2.000	3	4	25	48	50	60	60	60	60	1



Circuit Configuration





† Voltage drop: Difference between input to output voltage of filter at rated voltage, current and frequency, if AC.

* Per MIL-STD-220

THE GUDEMAN CORPORATION
capacitors and EMI filters
340 WEST HURON STREET ▪ CHICAGO ILLINOIS 60610 ▪ 312 337 7400 ▪ TWX 910 221 3863

bathtub broadband low pass filters

series 100

Case Styles

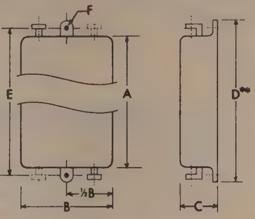


FIG. 1

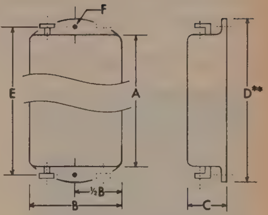


FIG. 2

Part Number	Current in Amps	Voltage Rating AC	Voltage Rating DC	Voltage Rating Freq.	Circuit No.	Amb. Temp. —55°C to	Alt. Feet Max.	Dimensions* A	Dimensions* B	Dimensions* C	Dimensions* D†	Dimensions* E	Dimensions* F
100-1808	1.0	50	100	60 Hz	2	100°C	80,000	1 1/8	1	11/16	1 21/32	1 7/16	.141
100-1657	2	115	400	0-400 Hz	2	125°C	80,000	1 3/4	1 1/4	1 1/8	2 3/4	2 1/8	.187
100-1810	2.25	125	300	0-400 Hz	2	65°C	50,000	1 3/4	1 1/4	1	2 1/2	2 1/8	.187
100-1814	3	125	400	0-400 Hz	2	85°C	50,000	2	2	7/8	3 19/32	2 23/64	.187
100-1605	5	125	400	0-400 Hz	2	85°C	60,000	2	2	1 1/2	2 29/32	2 3/8	.187
100-1564	5	—	300	0-400 Hz	4	85°C	60,000	1 3/4	1 1/4	1	2 1/8	2 3/8	.187
100-1817	10	125	400	0-400 Hz	2	85°C	60,000	2	2	1 1/2	2 3/8	3 19/32	.187
100-1791	12	125	300	0-400 Hz	2	65°C	60,000	2	2	1 1/4	2 25/32	2 3/8	.187
100-1818	15	125	400	0-400 Hz	2	85°C	60,000	2 1/2	2	1 1/2	4 3/32	2 15/16	.187
100-1819	30	125	400	0-400 Hz	2	85°C	80,000	3 1/4	2 1/4	2 1/8	4 31/32	3 7/8	.187
100-1812	50	—	100	0-400 Hz	2	85°C	80,000	2 7/8	2 1/4	1 7/8	4 19/32	3 1/2	.187
100-1813	50	125	400	0-400 Hz	2	85°C	80,000	3 5/16	2 1/4	2 1/8	5 1/32	3 15/16	.187
100-1807	2 x .5	125	300	0-400 Hz	2	65°C	50,000	2 1/16	1 1/4	1 1/8	2 3/4	2 25/64	.187
100-1514	2 x 1	125	400	0-400 Hz	1	85°C	60,000	1 3/4	1 1/4	1	2 1/2	2 1/8	.187
100-1811	2 x 1	50	100	60 Hz	2	85°C	70,000	1 13/16	1 1/4	3/4	2 1/2	2 1/8	.187
100-1596	2 x 1	—	300	0-400 Hz	1	85°C	60,000	1 3/4	1	7/8	2 1/2	2 1/8	.187
100-1336	2A AC 2A DC	125	400	0-400 Hz	2	85°C	60,000	1 3/4	1 1/4	1	2 1/2	2 1/8	.187
100-1007	2 x 2	125	400	0-400 Hz	1	85°C	60,000	2	1 3/4	3/4	2 3/4	2 3/8	.187
100-1654-1	2 x 3	125	400	0-400 Hz	2	85°C	50,000	2	2	1 1/8	3	2 3/8	.187
100-1393	2 x 4	125	400	0-400 Hz	1	125°C	80,000	2	2	1 1/2	3	2 3/8	.187
100-1761	2 x 5	125	400	0-400 Hz	2	125°C	50,000	2 1/8	2 1/8	1	2 7/8	2 1/2	.172
100-1415	2 x 7.5	125	400	60 Hz	2	85°C	60,000	2 1/2	2	1 1/2	2 15/16	3 1/2	.187
100-1500	2 x 7.5	125	400	0-400 Hz	1	85°C	40,000	2 1/2	2	1 1/2	2 15/16	3 1/2	.187
100-1805	2 x 10	125	300	60 Hz	1	85°C	60,000	2	2	1 1/4	2 3/8	2 3/4	.187

* Tolerance ±1/16
† D Dimension represents the Greatest Overall Dim. and may be measured from terminal to terminal

Circuit Configuration*

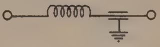


FIG. 1

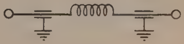


FIG. 2

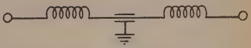


FIG. 3

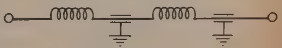


FIG. 4

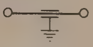


FIG. 5

Part Number	Case Style	Terminals Fig.	Terminals No. of Terms	Typical Insertion Loss in Decibels** .15 MHz	.5 MHz	1.0 MHz	10 MHz	100 MHz	400 MHz	1000 MHz	Voltage Drop Max.‡
100-1808	1	3	2	40	70	70	60	40	35	30	.5
100-1809	1	6	1 Shielded	40	50	60	70	80	80	80	.75
100-1810	1	5	2	60	80	85	75	65	60	55	.5
100-1814	1	1	2	50	60	60	60	60	60	60	.5
100-1605	2	1	2	65	85	100	100	100	100	100	.5
100-1564	1	1	2	25	70	80	80	60	50	40	.5
100-1817	1	6	2	50	60	60	60	60	60	60	.5
100-1807	1	5	2	60	80	85	75	65	60	55	.5
100-1818	1	6	2	40	50	60	60	60	60	60	.5
100-1819	1	6	2	50	60	60	60	60	60	60	.5
100-1812	1	6	2	50	60	60	60	60	60	60	.5
100-1813	1	6	2	50	60	60	60	60	60	60	.5
100-1807	1	5	4	60	80	85	75	65	60	55	.5
100-1514	1	3	4	25	45	55	55	50	45	40	.5
100-1811	1	3	4	45	75	85	75	65	60	55	.5
100-1596	1	1	4	12	32	45	45	40	37	30	.5
100-1336	1	1	4 AC DC	25 35	55 65	70 80	70 80	60 70	65 75	50 60	.5 .5
100-1007	1	4	4	10	25	40	40	30	25	20	.5
100-1654-1	1	2	4	65	85	80	65	55	60	60	.5
100-1393	1	1	4	25	45	60	60	50	45	40	.5
100-1761	2	2	4	40	70	80	80	75	65	60	.5
100-1415	2	1	4	60	60	60	60	60	48	20	.5
100-1500	2	1	4	30	55	65	65	55	40	35	.5
100-1805	2	3	4	20	30	40	60	50	40	35	.5

** Per MIL-STD-220
‡ Voltage drop: Difference between input and output voltage of filter at rated voltage, current and frequency, if AC.

Terminal Configuration

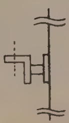


FIG. 1

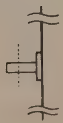


FIG. 2

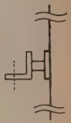


FIG. 3

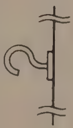


FIG. 4

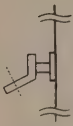


FIG. 5

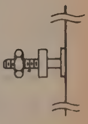


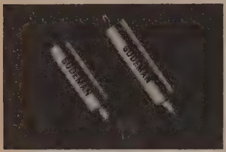
FIG. 6

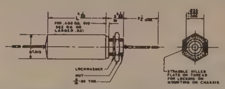
THE GUDEMAN CORPORATION
capacitors and EMI filters
340 WEST HURON STREET ▪ CHICAGO ILLINOIS 60610 ▪ 312 337 7400 ▪ TWX 910 221 3863

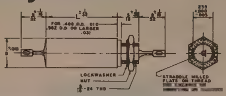
miniature feed-thru filters • paper dielectric — hermetically sealed

Gudeman impregnant #257

series 271 and 272




FOR .400 DIA. .010
.562 OD OR LARGER .031
LOCKWASHER
NUT
¼-28 THD.
STRADDLE MILLED FLATS ON THREAD FOR LOCKING OR MOUNTING ON CHASSIS



Mfd.	Size L ±1/32	 D ±.015	Catalog Number 85°C	 125°C
100 VDC				
.01	¾	.400	271B103NF	272B103NF
.047	¾	.400	271B473NF	272B473NF
.1	⅞	.400	271B104NF	272B104NF
.22	1⅜	.400	271B224NF	272B224NF
.33	1⅛	.562	271B334NF	271B334NF
.47	1⅜	.562	271B474NF	272B474NF
.68	1⅞	.562	271B684NF	272B684NF
1.00	1⅞	.670	271B105NF	272B105NF
200 VDC				
.01	¾	.400	271C103NF	272C103NF
.047	⅜	.400	271C473NF	272C473NF
.1	1⅛	.400	271C104NF	272C104NF
.22	1⅛	.562	271C224NF	272C224NF
.33	1⅝	.562	271C334NF	272C334NF
.47	1⅞	.562	271C474NF	272C474NF
.68	1⅞	.670	271C684NF	272C684NF
1.00	2⅛	.750	271C105NF	272C105NF
300 VDC				
.01	¾	.400	271Z103NF	272Z103NF
.047	1⅛	.400	271Z473NF	272Z473NF
.1	1⅜	.400	271Z104NF	272Z104NF
.22	1⅜	.562	271Z224NF	272Z224NF
.33	1⅞	.562	271Z334NF	272Z334NF
.47	1⅞	.670	271Z474NF	272Z474NF
.68	2⅛	.750	271Z684NF	272Z684NF
400 VDC				
.01	¾	.400	271E103NF	272E103NF
.047	1⅜	.400	271E473NF	272E473NF
.1	1⅛	.562	271E104NF	272E104NF
.22	1⅞	.562	271E224NF	272E224NF
.33	1⅞	.670	271E334NF	272E334NF
.47	2⅛	.750	271E474NF	272E474NF
.68	2⅜	.750	271E684NF	272E684NF
600 VDC				
.01	¾	.400	271F103NF	272F103NF
.047	1⅜	.400	271F473NF	272F473NF
.1	1⅜	.562	271F104NF	272F104NF
.22	1⅞	.670	271F224NF	272F224NF
.33	2⅛	.750	271F334NF	272F334NF
.47	2⅜	.750	271F474NF	272F474NF

Mfd.	Size L ±1/32	 D ±.015	Catalog Number 85°C	 125°C
100 VDC				
.01	¾	.400	271B103NFT	272B103NFT
.047	¾	.400	271B473NFT	272B473NFT
.1	⅞	.400	271B104NFT	272B104NFT
.22	1⅜	.400	271B224NFT	272B224NFT
.33	1⅛	.562	271B334NFT	272B334NFT
.47	1⅜	.562	271B474NFT	272B474NFT
.68	1⅞	.562	271B684NFT	272B684NFT
1.00	1⅞	.670	271B105NFT	272B105NFT
200 VDC				
.01	¾	.400	271C103NFT	272C103NFT
.047	⅞	.400	271C473NFT	272C473NFT
.1	1⅛	.400	271C104NFT	272C104NFT
.22	1⅛	.562	271C224NFT	272C224NFT
.33	1⅝	.562	271C334NFT	272C334NFT
.47	1⅞	.562	271C474NFT	272C474NFT
.68	1⅞	.670	271C684NFT	272C684NFT
1.00	2⅛	.750	271C105NFT	272C105NFT
300 VDC				
.01	¾	.400	271Z103NFT	272Z103NFT
.047	1⅛	.400	271Z473NFT	272Z473NFT
.1	1⅜	.400	271Z104NFT	272Z104NFT
.22	1⅜	.562	271Z224NFT	272Z224NFT
.33	1⅞	.562	271Z334NFT	272Z334NFT
.47	1⅞	.670	271Z474NFT	272Z474NFT
.68	2⅛	.750	271Z684NFT	272Z684NFT
400 VDC				
.01	¾	.400	271E103NFT	272E103NFT
.047	1⅜	.400	271E473NFT	272E473NFT
.1	1⅛	.562	271E104NFT	272E104NFT
.22	1⅞	.562	271E224NFT	272E224NFT
.33	1⅞	.670	271E334NFT	272E334NFT
.47	2⅛	.750	271E474NFT	272E474NFT
.68	2⅜	.750	271E684NFT	272E684NFT
600 VDC				
.01	¾	.400	271F103NFT	272F103NFT
.047	1⅜	.400	271F473NFT	272F473NFT
.1	1⅜	.562	271F104NFT	272F104NFT
.22	1⅞	.670	271F224NFT	272F224NFT
.33	2⅛	.750	271F334NFT	272F334NFT
.47	2⅜	.750	271F474NFT	272F474NFT

specifications

TEST VOLTAGE
Shall withstand a DC voltage equal to twice rated DC voltage or a 60 cycle AC voltage equal to twice the recommended AC voltage rating for two minutes maximum when applied between case and either terminal.

LIFE TEST
Shall withstand an accelerated life test for 250 hours with an applied DC voltage as follows:
At 85°C 271 Type 140% Rated DC voltage.
At 125°C 272 Type 140% Rated DC voltage for filters of .05 watt-second or less, 120% for greater than .05 watt-second.
One failure in 12 permitted.

POWER FACTOR
The power factor shall not be more than 1% when measured at or referred to a frequency of 1,000 cycles at 25°C.

INSULATION RESISTANCE
The insulation resistance when measured at a potential of 100 Volts DC and an electrification time of two minutes shall be as follows:
At 25°C 20,000 megohm-mfd. or 30,000 megohms, whichever is less.
At 85°C 100 megohm-mfd. or 1,000 megohms, whichever is less.
At 125°C 10 megohms-mfd. or 100 megohms, whichever is less.

ENVIRONMENTAL REQUIREMENTS
Designed to meet the applicable environmental requirements of specification MIL-C-25A for characteristics E (Type 271) and K (Type 272).

TYPE DESIGNATION
271 E 104 NF T
T — **TERMINAL STYLE** (Absence of Letter T designates wire Terminal)
NF — **THREADED NECK WITH STRADDLE MILLED FLATS**
104 — **CAPACITANCE**
E — **VOLTAGE**
271 — **COMPONENT AND TEMPERATURE RANGE**

COMPONENT AND TEMPERATURE RANGE
The Gudeman Feed-Thru Filter is designed as a three-terminal component. Types 271 and 272 are paper dielectric filters impregnated with Gudeman impregnant #257 which are designed to operate within the temperature range as follows:
Type 271 −55°C to +°85C
Type 272 −55°C to +125°C

VOLTAGE TABLE

DC Working Voltage	Symbol
100	B
200	C
300	Z
400	E
600	F

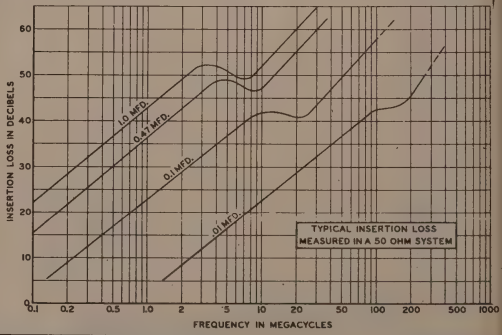
AC VOLTAGE RATING
The Gudeman 272 Type may be operated up to 85°C as follows:
The 300 VDC units may be used at 150 Volts AC from 60 to 400 cycles.
The 600 Volt units may be used at 300 Volts AC from 60 to 400 cycles.

CAPACITANCE
The nominal capacitance value in micro-micro-farads is expressed by a three-digit number in the type designation. The first two digits are the first two digits of the capacitance value. The last digit designates the number of zeros which follows the first two digits.

CURRENT RATING
The 271 and 272 Feed-Thru Filters are designed for a maximum permissible current rating of 5 amperes DC or equivalent.

CAPACITANCE TOLERANCE
The 271 and 272 Types are available in a standard capacitance tolerance of ±20%.

SPECIAL CAPACITANCE VALUES
Non-Standard Capacitance Values are available upon special request.



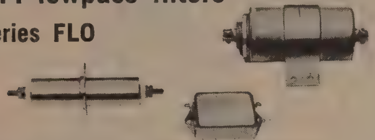
THE GUDEMAN CORPORATION

capacitors and EMI filters

340 WEST HURON STREET ■ CHICAGO ILLINOIS 60610 ■ 312 337 7400 ■ TWX 910 221 3863

RFI lowpass filters

series FLO



RADIO INTERFERENCE FILTERS

The FLO (filter, lowpass) series is a select group of most commonly used filter types. The Gudeman Company has tabulated this series in order that the engineer can pick a standard "off the shelf" item for quick delivery. The tabulated insertion loss represent minimum performance when measured in a 50 ohm system in accordance with Military Standard MIL-STD-220.

case styles

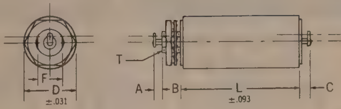


FIG. 1

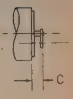


FIG. 1A

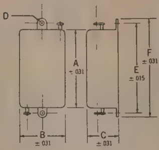


FIG. 2

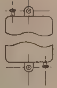


FIG. 2A

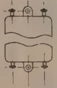


FIG. 2B

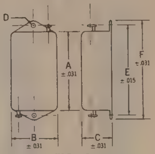


FIG. 3

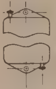


FIG. 3A

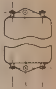


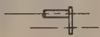
FIG. 3B

TUBULAR RADIO INTERFERENCE FILTERS

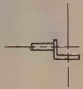
Gudeman Part No.	Rated Current (Amperes)	Working Voltage			Maximum D.C. Rest. (Ohms)	Maximum Temperature (°C)	Maximum Altitude (Feet)	Fig. No.	Case Dimensions	
									Diameter "D"	Length "L"
FLO-613	.3	130 VAC	60 Hz	300 VDC	5.0	85	50K	1	.670	1.250
FLO-701	.45	150 VAC	60 Hz	400 VDC	5.0	85	50K	1	.670	1.375
FLO-175-4	.5	50 VAC	60 Hz	100 VDC	2.0	85	70K	1	.670	1.250
FLO-164-3	1.0	125 VAC	0-400 Hz	500 VDC	.7	85	50K	1A	1.000	2.500
FLO-214-1	1.0	250 VAC	60 Hz	600 VDC	.5	125	50K	1	1.000	2.687
FLO-231-1	1.2	115 VAC	400 Hz	300 VDC	1.0	85	50K	1	.670	1.625
FLO-175-1	2.5	115 VAC	0-1000 Hz	300 VDC	.2	85	60K	1	1.000	2.000
FLO-214-2	3.0	250 VAC	60 Hz	600 VDC	.12	125	50K	1	1.125	3.500
FLO-217-1	3.2	115 VAC	400 Hz	300 VDC	.03	85	40K	1	.484	.812
FLO-155-2	5.0	125 VAC	0-400 Hz	500 VDC	.075	85	60K	1A	1.250	3.281
FLO-143-4	5.0	130 VAC	0-1000 Hz	400 VDC	.066	105	60K	1	1.125	2.562
FLO-214-3	5.0	250 VAC	60 Hz	600 VDC	.07	125	50K	1	1.250	3.438
FLO-143-5	7.0	130 VAC	0-1000 Hz	400 VDC	.06	105	60K	1	1.125	2.562
FLO-717	8.0	50 VAC	60 Hz	100 VDC	.024	85	80K	1	1.500	3.375
FLO-175-6	10.0	50 VAC	60 Hz	100 VDC	.02	85	80K	1	1.125	2.562
FLO-165-4	10.0	125 VAC	0-400 Hz	500 VDC	.025	85	50K	1A	1.375	3.406
FLO-214-4	10.0	250 VAC	60 Hz	600 VDC	.025	125	50K	1	1.500	3.750
FLO-166-2	20	125 VAC	0-400 Hz	500 VDC	.006	85	60K	1	1.500	4.000
FLO-214-5	20	250 VAC	60 Hz	600 VDC	.01	125	40K	1	1.750	4.875
FLO-214-7	30	250 VAC	60 Hz	600 VDC	.006	125	50K	1	2.250	4.000
FLO-214-6	50	250 VAC	60 Hz	600 VDC	.0025	125	50K	1	2.250	4.500

Gudeman Part No.	Terminal		Terminal Dimension				
	Left	Right	Thd. Size "T"	Flats "F"	"A"	"B"	"C"
FLO-613	1	1	¼-28	.206/.196	.188	.250	.188
FLO-701	1	1	¼-28	.206/.196	.188	.250	.188
FLO-175-4	1	1	¼-28	.206/.196	.188	.250	.188
FLO-164-3	3	1	½-28	.442/.437	.375	.375	.250
FLO-214-1	1	1	7/16-20	.380/.365	.218	.438	.218
FLO-231-1	1	1	¼-28	.206/.196	.125	.250	.156
FLO-175-1	1	1	7/16-20	.380/.365	.375	.438	.250
FLO-214-2	1	1	7/16-20	.380/.365	.188	.438	.218
FLO-217-1	1	1	¼-28	.206/.196	.125	.250	.125
FLO-155-2	3	3	⅝-24	.536/.531	.344	.375	.375
FLO-143-4	3	1	7/16-20	.380/.365	.281	.438	.218
FLO-214-3	1	1	7/16-20	.380/.365	.250	.438	.281
FLO-143-5	3	1	7/16-20	.380/.365	.218	.438	.218
FLO-717	2	2	¾-20	.665/.650	.562	.375	.531
FLO-175-6	1	1	7/16-20	.380/.365	.375	.438	.250
FLO-165-4	2	3	⅝-24	.536/.520	.438	.375	.343
FLO-214-4	1	1	⅝-24	.536/.520	.218	.438	.218
FLO-166-2	5	5	¾-20	.665/.650	.750	.375	.750
FLO-214-5	5	5	1″-14	.930/.915	.437	.500	.531
FLO-214-7	5	5	1⅛-18	1.070/1.055	.625	.562	.750
FLO-214-6	5	5	1⅛-18	1.070/1.055	.625	.562	.750

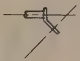
terminal configurations



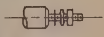
No. 1



No. 2



No. 3



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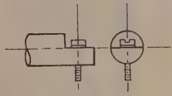


No. 5

minimum attenuation in decibels

TUBULAR RADIO INTERFERENCE FILTERS

Gudeman Part No.	Frequency in Megacycles						
	.15	.6	1.0	10	100	400	1,000
FLO-613	45	80	80	80	62	62	62
FLO-701	50	78	80	70	50	50	50
FLO-175-4	40	80	80	80	56	43	35
FLO-164-3	45	75	80	80	75	75	*
FLO-214-1	60	74	80	80	80	80	80
FLO-231-1	30	68	80	78	62	56	50
FLO-175-1	40	80	80	80	56	43	35
FLO-214-2	60	74	80	80	80	80	80
FLO-217-1	*	*	*	5	60	85	85
FLO-155-2	52	85	85	85	80	70	60
FLO-143-4	55	80	80	80	58	46	38
FLO-214-3	60	74	80	80	80	80	80
FLO-143-5	55	80	80	80	58	46	38
FLO-717	74	80	80	80	80	80	80
FLO-175-6	40	80	80	80	56	43	35
FLO-165-4	55	80	80	80	80	80	*
FLO-214-4	60	74	80	80	80	80	80
FLO-166-2	50	85	85	85	80	65	*
FLO-214-5	60	74	80	80	80	80	80
FLO-214-7	60	74	80	80	80	80	80
FLO-214-6	60	74	80	80	80	80	80

RECTANGULAR RADIO INTERFERENCE FILTERS

Gudeman Part No.	Rated Current (Amperes)	Working Voltage			Maximum D.C. Rest. (Ohms)	Maximum Temperature (°C)	Maximum Altitude (Feet)	Fig. No.
FLO-198-2	1.0	50 VAC	60 Hz	100 VDC	.30	100	80K	2
FLO-300-15	1.0	115 VAC	60 Hz	200 VDC	.20	85	80K	2A
FLO-704	2.0	230 VAC	0-60 Hz	500 VDC	.65	125	50K	3A
FLO-276-1	2.25	125 VAC	0-400 Hz	300 VDC	.20	65	50K	2A
FLO-275-1	12.0	125 VAC	0-400 Hz	300 VDC	.02	65	60K	2
FLO-277-1	2 x .5	125 VAC	400- Hz	300 VDC	4.0	65	50K	2B
FLO-168-1	2 x 1.0	50 VAC	60 Hz	100 VDC	.20	85	70K	2B
FLO-705	2 x 5.0	125 VAC	0-400 Hz	300 VDC	.05	125	50K	3B
FLO-716	2 x 10.0	120 AC	0-60 Hz	300 VDC	.025	85	60K	3B

Gudeman Part No.	Case Dimensions						Terminals	
	"A"	"B"	"C"	"D"	"E"	"F"	Top	Bottom
FLO-198-2	1⅛	1	11/16	.141	1 7/16	1 23/32	1	1
FLO-300-15	1¾	1¼	¾	.187	2⅛	2½	4	4
FLO-704	2½	2	⅞	.187	2 15/16	3 5/16	2	2
FLO-276-1	1¾	1¼	1	.187	2⅛	2½	3	3
FLO-275-1	2	2	1¼	.187	2⅜	2 25/32	3	3
FLO-277-1	2 1/16	1¼	1⅛	.187	2 25/64	2¾	3	3
FLO-168-1	1 13/16	1¼	¾	.187	2⅛	2½	3	3
FLO-705	2⅛	2⅛	1	.172	2½	2⅞	2	2
FLO-716	2	2	1¼	.187	2⅜	2¾	1	1

RECTANGULAR RADIO INTERFERENCE FILTERS

Gudeman Part No.	Frequency in Megacycles						
	.15	.6	1.0	10	100	400	1,000
FLO-277-1	60	60	60	40	*	*	*
FLO-198-2	40	70	70	50	30	25	*
FLO-300-15	50	50	50	50	*	*	*
FLO-168-1	45	78	80	80	70	50	*
FLO-704	45	85	85	80	80	*	*
FLO-276-1	75	80	80	65	*	*	*
FLO-705	40	70	90	90	90	*	*
FLO-716	10	25	30	60	*	*	*
FLO-275-1	70	90	90	70	50	*	*

* Attenuation not defined at these frequencies. All measurements made in a 50 ohm system per MIL-STD-220.

HERTZ FILTERS

BAND PASS FILTERS CUSTOM DESIGNED TO FILL YOUR NEEDS

LC FILTERS

- **HIGH PASS**
- **LOW PASS**
- **BAND PASS**
- **PASSIVE**
- **BAND REJECT**

EXCELLENCY IN DESIGN

UNIFORMITY IN PRODUCTION

Hertz filters are currently being utilized in major military programs where maximum reliability and performance are required.

PARTIAL LIST OF HERTZ FILTERS

(all filters in accordance with MIL-F-18327)

BAND PASS PART NO.	PASS BAND	STOP BAND	Z_o	I.L.@CF	SIZE
BP-7907-1	3db(150-300)Hz	60db(50-850)Hz	600	1db	2 x 2¼ x 4
BP-7907-2	3db(300-900)Hz	60db(110-1700)Hz	600	1db	2 x 2¼ x 4
BP-7907-3	3db(600-1200)Hz	60db(210-3400)Hz	600	1db	2 x 2¼ x 4
BP-7907-4	3db(1.2-2.4)KHz	60db(.43-6.8)KHz	600	1db	2 x 2¼ x 4
BP-7907-5	3db(2.4-4.8)KHz	60db(.85-13.5)KHz	600	1db	2 x 2¼ x 4
BP-7907-6	3db(4.8-9.6)KHz	60db(1.7-27)KHz	600	1db	2 x 2¼ x 4
BP-7907-7	3db(8.9-11.2)KHz	60db(3.1-32)KHz	600	1db	2 x 2 x 3
BP-7996-1	3db(825-1,175)Hz	40db(650-1,350)Hz	30K	3db	1 x 2¼ x 4½
BP-8004-10	3db(8-26)KHz	30db(4-30)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-8004-11	3db(19.5-33.5)KHz	30db(16.5-36.5)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-8004-12	3db(26.25-40.25)KHz	30db(23.25-43.25)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-8004-13	3db(32.6-52.6)KHz	30db(27.6-57.6)KHz	10K/2K	2db	1⅜ x 1⅝ x 2¾
BP-7897-1	3db(37.5-40.5)KHz	30db(34.5-43.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-2	3db(40.5-43.5)KHz	30db(37.5-46.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-3	3db(43.5-46.5)KHz	30db(40.5-49.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-4	3db(46.5-49.5)KHz	30db(43.5-52.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-5	3db(49.5-52.5)KHz	30db(46.5-55.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-6	3db(52.5-55.5)KHz	30db(49.5-58.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-7	3db(55.5-58.5)KHz	30db(52.5-61.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-8	3db(58.5-61.5)KHz	30db(55.5-64.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-9	3db(61.5-64.5)KHz	30db(58.5-67.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-10	3db(64.5-67.5)KHz	30db(61.5-70.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-11	3db(67.5-70.5)KHz	30db(64.5-73.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-12	3db(70.5-73.5)KHz	30db(67.5-76.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-13	3db(73.5-76.5)KHz	30db(70.5-79.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-14	3db(76.5-79.5)KHz	30db(73.5-82.5)KHz	10K/1K	4db	1¼ x 1¼ x 2
BP-7897-15	3db(79.5-82.5)KHz	30db(76.5-85.5)KHz	10K/1K	4db	1¼ x 1¼ x 2

LOW PASS PART NO.	PASS BAND	STOP BAND	Z_o	SIZE
LP-7907-1	4db@300Hz, 1db@225Hz	60db@850Hz	600	2 x 2 x 3
LP-7907-2	4db@600Hz, 1db@450Hz	60db@1700Hz	600	2 x 2 x 3
LP-7907-3	4db@1.2KHz, 1db@.9KHz	60db@3.4KHz	600	2 x 2 x 3
LP-7907-4	4db@2.4KHz, 1db@1.8KHz	60db@6.8KHz	600	2 x 2 x 3
LP-7907-5	4db@4.8KHz, 1db@3.6KHz	60db@13.5KHz	600	2 x 2 x 3
LP-7907-6	4db@9.6KHz, 1db@7.2KHz	60db@27KHz	600	2 x 2 x 3
LP-7907-7	4db@11.2Hz, 1db@10KHz	60db@32KHz	600	1⅜ x 1⅝ x 2¾
LP-7996-1	5db@1,175Hz, 2db@1,000Hz	40db@650Hz	30K	1⅜ x 1⅝ x 2¾
LP-8004 10	5db@26KHz, 1db@17KHz	30db@30KHz	10K/2K	1¼ x 1¼ x 2
LP-8004-11	5db@33.5KHz, 1db@26.5KHz	30db@36.5KHz	10K/2K	1¼ x 1¼ x 2
LP-8004-12	5db@40.25KHz, 1db@33.25KHz	30db@43.25KHz	10K/2K	1¼ x 1¼ x 2
LP-8004-13	5db@52.6KHz, 1db@42.6KHz	30db@57.6KHz	10K/2K	1¼ x 1¼ x 2

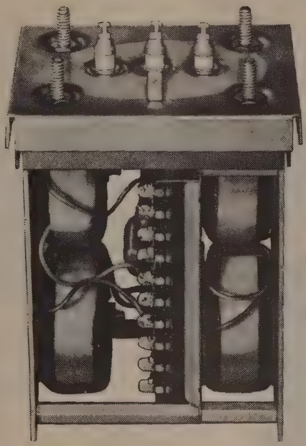
PART NO. HIGH PASS	PASS BAND	STOP BAND	Z_o	SIZE
HP-7907-1	4db@150Hz, 1db@225Hz	60db@50Hz	600	2 x 2 x 3
HP-7907-2	4db@300Hz, 1db@450Hz	60db@110Hz	600	2 x 2 x 3
HP-7907-3	4db@600Hz, 1db@900Hz	60db@210Hz	600	2 x 2 x 3
HP-7907-4	4db@1.2KHz, 1db@1.8KHz	60db@.43KHz	600	2 x 2 x 3
HP-7907-5	4db@2.4Hz, 1db@3.6KHz	60db@.85KHz	600	2 x 2 x 3
HP-7907-6	4db@4.8Hz, 1db@7.2KHz	60db@1.7KHz	600	2 x 2 x 3
HP-7907-7	4db@8.9KHz, 1db@10KHz	60db@3.1KHz	600	1⅜ x 1⅝ x 2¾
HP-7996-1	5db@825Hz, 2db@1,000Hz	40db@1,350Hz	30K	1⅜ x 1⅝ x 2¾
HP-8004-10	5db@8KHz, 1db@17KHz	30db@4KHz	10K/2K	1¼ x 1¼ x 2
HP-8004-11	5db@19.5KHz, 1db@26.5KHz	30db@16.5KHz	10K/2K	1¼ x 1¼ x 2
HP-8004-12	5db@26.25KHz, 1db@33.25KHz	30db@23.25KHz	10K/2K	1¼ x 1¼ x 2
HP-8004-13	5db@32.6KHz, 1db@42.6KHz	30db@27.6KHz	10K/2K	1¼ x 1¼ x 2

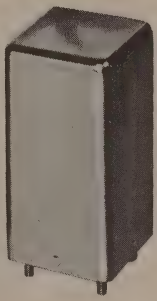
HERTZ

HERTZ FILTER CORPORATION
3 AERIAL WAY • SYOSSET, NEW YORK 11791
TELEPHONE (516) 822-4770

HERTZ FILTERS

BAND PASS FILTERS CUSTOM DESIGNED TO FILL YOUR NEEDS

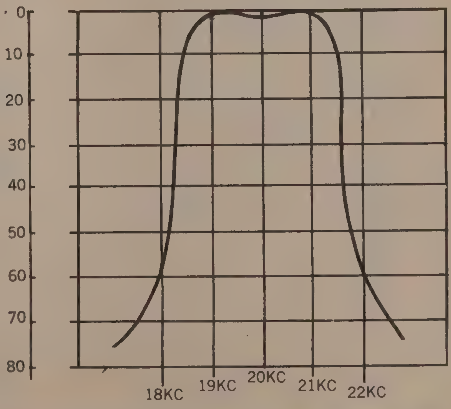




Hertz Filter Corporations' engineering department is made up entirely of specialists in the field of custom design of band pass filters. They are all fully experienced and prepared to help you solve your filter problems. Call or write Hertz for reliable service and prompt delivery.

FEATURES

1. Filters, Band Pass, Passive
2. Center Frequencies — 50 Hz to 50 Meg Hz
3. Shape factors — better than 2.0 for ratios of 60 db to 3 db
4. Bandwidth to center frequency ratio — up to 10%
5. Phase linearity — within 10° through passband
6. Low passband insertion loss
7. Better than 80 db attenuation 50% above and below center frequency
8. Input and output impedances as required
9. Low input and output impedances in stop band
10. Low passband ripple
11. L, C, and R elements only



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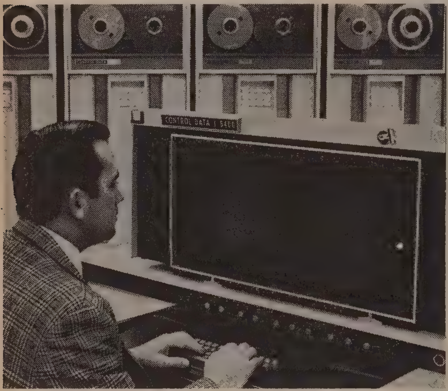
TELEPHONE (516) 822-4770

hisonic inc.

249 N. TROOST • OLATHE, KANSAS 66061
PHONE: 913-782-0012
TELEX: 4-2562

CUSTOM FILTERS

Low, band or high pass and band stop filters with optimum amplitude and/or delay characteristics can be supplied to your special requirements and MIL-F-18327 Construction utilizes precision inductors and high quality capacitors of special films or silvered mica, according to frequency and space requirements. Operating frequencies range to 100 MHZ. Temperature stabilization for both amplitude and frequency can be effected. Mechanical styles may be epoxy encapsulated or hermetically sealed metal in sizes from 0.2 to 200 cu. in.



To keep pace with the most sophisticated technologies of network design, Hisonic engineers have direct in-plant access to the tremendous capabilities of large late-generation computers. The Hisonic staff includes specialists with up to 25 years experience in precision inductor and filter network design. It also includes advanced mathematicians with backgrounds of program development, who are able to achieve design excellence not otherwise attainable.

FR6RX22YY
HISONIC 20-0320-00
OUT
GND
IN
151.5 TO 171.5 KHZ, 3DB MAX.
SOURCE AND LOAD: 1.2K OHMS
6817

EXAMPLE CUSTOM FILTERS

BAND PASS

P/N		Pass Band db @ BW	Stop Band db @ BW	Impedance	Size
20-0340-xx	Series;f_0 .8-7.5KHZ	.15@1.0f_0	25@1.75f_0	2.7K/2.7K	1.3x3.0x1.0H
20-0450-xx	Series;f_0 4.5-7.1KHZ	4.0@98HZ	26@258HZ	600/600	1.5x3.6x1.0H
20-0521-12	f_0 9960HZ;IL .4db	1.0@1460HZ	35@4000HZ	2K/500	2.5x2.5x.7H
20-0501-10	f_0 30KHZ;IL .5db	.25@20KHZ	40@+30KHZ −24.7KHZ	4.7K/4.7K	1.4x2.0x.6H
20-0481-11	f_0 40KHZ;IL .5db	3.0@24KHZ	30@+50KHZ −27KHZ	4.7K/4.7K	1.1x1.9x.6H
20-0177-10	f_0 142KHZ;IL 20db	3.0@3.0KHZ	70@20KHZ	5K/470	1.8x2.0x.9H
20-0299-10	f_0 155KHZ;IL 3db	1.2@56.6KHZ	40@+120KHZ −80KHZ	1K/1K	1.3x1.4x.8H
20-0410-xx	Series;f_0 200-500KHZ	3.0@.10f_0	60@.85f_0	1K/1K	1.3x2.8x1.1H
20-0466-10	f_0 5.5MHZ;IL 4db	.5@40KHZ	40@980KHZ 65@1980KHZ	600/600	1.0x2.3x.7H
20-0527-10	f_0 10MHZ;IL 5db	.3@320KHZ	45@4.0MHZ	600/600	1.3x1.8x.9H
20-0459-10	f_0 11.8MHZ;IL 4db	2.0@1.0MHZ	50@+1.0MHZ −1.6MHZ	50/50	.6x3.2x1.0H
20-0539-10	f_0 30MHZ;IL 8db	.3@.64MHZ	20@3.2MHZ 30@6.2MHZ	500/500	1.4x2.0x.6H

LOW & HIGH PASS & BAND SUPPRESSION

P/N	Description	db@Abs.Freq.			Size
20-0212-10	200HZ Low Pass	3@185HZ	60@430HZ	1K/1K	1.0x1.7x1.5H
20-0388-xx	IRIG TELEM VCO LP f_0 Range 4-70KHZ	1@1.07f_0	20@1.8f_0 36@2.8f_0	Source 18K Load 47K	.5x.8x.8H
20-0350-10	High Atten. LP	3@500HZ	105@1000HZ	1K/100K	.6x3.5x1.0H
20-0519-10	Voice Low Pass	5@2500HZ	40@4000HZ	600/600	1.3x1.8x.9H
20-0342-10	Voice Low Pass	1@3000HZ	40@3400HZ	600/600	1.5x4.0x1.1H
20-0475-10	Voice Low Pass	3@3500HZ	40@4500HZ	600/600	2.0x2.0x.5H
20-0414-10	Low Pass	.4@24.5KHZ	61@40KHZ	1K/1K	1.0x2.0x.5H
20-0399-10	Low Pass	.25@25KHZ	65@50KHZ	10K/10K	1.0x1.0x1.1H
20-0280-01	Instrumentation LP	3@500KHZ	18/Octave	75/75	1.3x1.3x1.0H
-02	W/BNC Connectors	3@1.2MHZ	18/Octave	75/75	1.3x1.3x1.0H
20-0529-10	Video Range LP	1@4MHZ	40@5.5MHZ	200/200	1.3x2.0x.5H
20-0489-10	300HZ High Pass	3@300HZ	20@250HZ	200/6K	1.0x1.5x.5H
20-0473-00	Balanced High Pass	.5@1400HZ	50@750HZ	600/600	Field Test Case
20-0325-10	Speech+Tone Suppress	3@1.0&1.6KHZ	40@1.2−1.3KHZ	600/600	2.8x3.0x1.0H
20-0460-10	Band Suppression	.3@552&667KHZ	50@605−609KHZ	75/75	1.4x2.0x2.0H
20-0159-11	Band Suppression	.3@7.4&9 8MHZ	50@8.47−8.56MHZ	75/75	1.4x2.0x2 0H

DUAL FUNCTION FILTERS & SPECIAL NETWORKS

P/N	Description	Characteristics	Impedance	Size
20-0488-13	Isolated LPF &Video range XFMR	.6db@1.5MHZ,14db@2.5MHZ 3db .1 to 5 MHZ	200/200 200/200	.8x.8x.4H
20-0343-10	Common input voice LP & Signal BP Filter	1db@3KHZ,35db@3.4KHZ $f_0$3.4KHZ,6db@150HZ BW	600/600 Com/50K	2.5x4.0x1.1H
20-0232-10	Common input Voice LP & Signal BP Filter	1db@3.4KHZ,35db@3.8KHZ f_0 3.8KHZ,2db@20HZ BW	600/600 Com/50K	2.5x4.0x1.1H
20-0486-10	90/150HZ Glide/Slope Dual BP Filter	.25db@85−95HZ,20DB@50&150HZ .25db@142−158HZ;20DB@90&250HZ	1K/10K Com/10K	2.3x2.4x1.7H
20-0405-10	Isolated Dual Dis- symetrical BP Filter	3db2.1−2.5KHZ,30db@3.7KHZ 3db3.7−4.1KHZ,30db@2.8KHZ	1K/10K 1K/10K	1.6x1.9x.8H
20-0217-10	Common Input, Dual Narrow BP Filter	f_0 269KHZ,55db@63KHZ BW f_0 331KHZ,55db@75KHZ BW	1K/10K Com/10K	2.0x4.0x.7H
20-0463-11	Twin Tee RC Network	56db min @ 130 HZ	82/5M	1.6x1.6x.6H
20-0463-12	Twin Tee RC Network	56db min @ 140 HZ	82/5M	1.6x1.6x.6H
20-0412-11	Audio Delay Equalizer	90 us correction@2KHZ;Bal.Imp.	600/600	.9x1.3x1.0H
20-0478-10	Phase Shift Network	160±5 degrees 3−90KHZ	50/2K/2K	1.4x2.3x1.4H

hisonic inc.

OTHER PRODUCTS: Precision Inductors • Transformers & Reactors • Tuned Circuits • Amp/Phase Equalizers • Lumped Constant Delay Lines

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249 N. TROOST • OLATHE, KANSAS 66061
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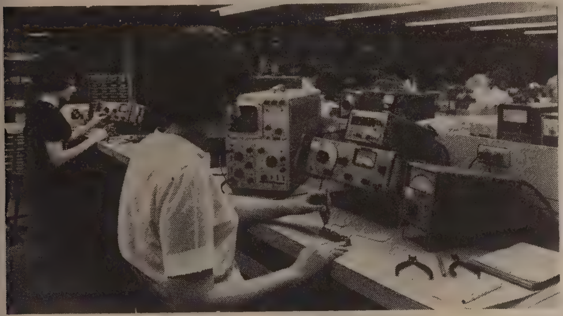
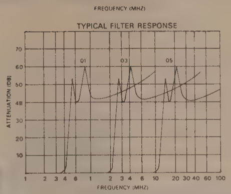
STANDARD FILTERS

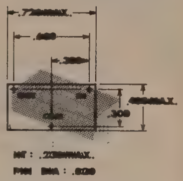
FOR HIGHEST SELECTIVITY

Standard filters are computer designed by modern network methods for minimum stop to pass band ratios. Applications are those requiring optimum utilization of frequency spectrum.



Technicians adjust critical response of special band pass filters utilizing adjustable ferrite core inductors. Modern precision test equipment is employed in association with MIL I 45208 Quality Control procedures.



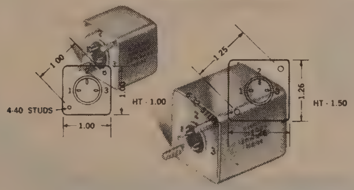


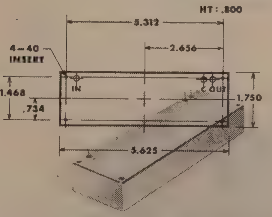
MINIATURE SERIES 540 LOW PASS

ELECTRICAL SPECIFICATIONS

- IMPEDANCE: 100 ohms standard.
- INSERTION LOSS: 5db max. at .1Fc.
- RESPONSE:
  3DB max. at Fc
  40DB min. at 1.5 Fc
- SIGNAL LEVEL: Max. power in mw = 10
- OTHER IMPEDANCES AND FREQUENCIES: Write for data sheet.
- TEMPERATURE RANGE: −55 to +105°C
- STANDARD CUTOFF FREQUENCIES:

Fc (MHZ)	HISONIC PART NUMBER
.40	20-0550-01
1.0	20-0550-02
2.0	20-0550-03
5.0	20-0550-04
10.0	20-0550-05
20.0	20-0550-06





SERIES 68 LOW PASS

SPECIFICATIONS:

Relative Attenuation
3 db ± .5 @ fc
20 db min @ 1.3 fc
40 db min @ 1.5 fc

Insertion loss—1 db max

Terminations
Input—10K ohms
Output—10K ohms

Physical Specifications
Case Hermetically Sealed Steel
Size (330 to 900 cps)
1.26"x1.26"x1.5" High
Mounting: two 6-32 studs
spaced 1.25"
Size (1050 to 13000 cps)
1"x1"x1" High
Mounting: two 4-40 studs
spaced 1"
Terminals—3 solder type

fc cps	Part No.
330	68-01
450	68-02
600	68-03
660	68-04
790	68-05
900	68-06
1050	68-07
1200	68-08
1600	68-09
2100	68-10
3000	68-11
3300	68-12
4000	68-13
4500	68-14
5250	68-15
6000	68-16
8000	68-17
10500	68-18
11500	68-19
13000	68-20

SERIES 430 FSK TONE CHANNEL BAND PASS

(170HZ spacing)

SPECIFICATIONS:

Relative Attenuation
(Receive Filters)
3 db max at ± 42.5 cps
20 db min at ± 85 cps
38 db min at ± 128 cps
(Transmit Filters)
3 db max at ± 42.5 cps
15 db min at ± 85 cps
30 db min at ± 128 cps

Insertion Loss—6 db max

Terminations
Input: 600 ohms
(inputs all channels may
be operated in parallel)
Output: Receive 50K ohms
Transmit 600 ohms

Freq.	Receiver No.	Trans. No.
425	430-01	430-21
595	430-02	430-22
765	430-03	430-23
935	430-04	430-24
1105	430-05	430-25
1275	430-06	430-26
1445	430-07	430-27
1615	430-08	430-28
1785	430-09	430-29
1955	430-10	430-30
2125	430-11	430-31
2295	430-12	430-32
2465	430-13	430-33
2635	430-14	430-34
2805	430-15	430-35
2975	430-16	430-36
3145	430-17	430-37
3315	430-18	430-38

In addition to series listed, other tone channel series with spacings from 85 to 500 c/s are available.

hisonic inc.

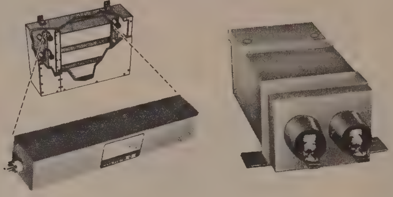
OTHER PRODUCTS: Precision Inductors • Transformers & Reactors • Tuned Circuits • Amp/Phase Equalizers • Lumped Constant Delay Lines

HOPKINS ENGINEERING CO.

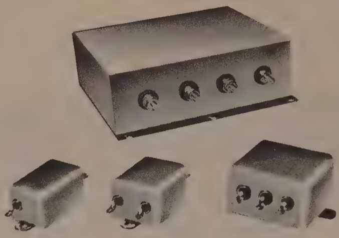
EMI/RFI FILTERS

12900 Foothill Blvd., San Fernando, California 91342 • Phone: (213) 361-8961 • TWX: 910-496-1531

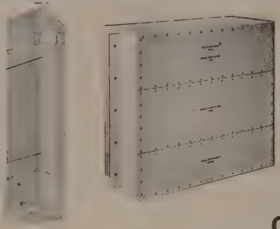
HEAVY DUTY POWER-LINE FILTERS



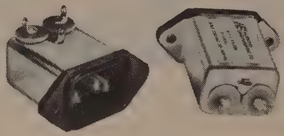
DATA PROCESSING FILTERS



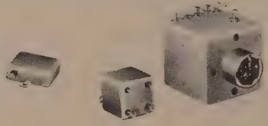
COMMUNICATION FILTERS



UNIVERSAL RFI/EMI FILTERS



CUSTOM FILTERS



FACILITIES CAPABILITY

Hopkins Engineering Company is a leading manufacturer of RFI/EMI filters. It was founded in 1945 and offers engineering design and manufacturing expertise in solving electromagnetic interference problems.

MANUFACTURING

A wide variety of filter designs are manufactured in our modern fully equipped 30,000 square foot factory. Quality is built into every Hopkins filter by skilled production personnel and an efficient prototype department offers prompt delivery of new designs. Hopkins has manufactured products to the most exacting military programs for over 25 years.

ENGINEERING

Hopkins' engineers have developed thousands of filter designs to meet a variety of military and industrial RFI/EMI suppression requirements. This versatility coupled with the latest filter design techniques and use of computer assisted design programs allows our engineers to develop filters of optimized circuitry, performance, reliability, and cost.

QUALITY ASSURANCE

A policy of rigid quality control practices are employed. Quality materials and high workmanship standards insures a product that meets or exceeds specification requirements. Our quality assurance department maintains established procedures to control the quality and reliability objectives of the customer and Hopkins Engineering Company.

HOPKINS ENGINEERING CO.

EMI/RFI FILTERS

12900 Foothill Blvd., San Fernando, California 91342 • Phone: (213) 361-8691 • TWX: 910-496-1531

HEAVY DUTY POWER LINE FILTERS

Tailored for heavy duty, high current and attenuation applications, Hopkins Engineering power line filters offer optimum long term dependable performance. Available with current ratings over 200 amperes and 100 db attenuation, these filters are available for military, industrial, institutional solid room and secure communication applications. They can be provided with shock hazard discharge devices in single and multi-filter shielded cabinets.

COMMUNICATION FILTERS

The communication filters provide optimum long term dependable performance in secure communications and noisy "real world" installations such as telephone, teletype, carrier current, and data phone computer line equipment or systems. Many of these filters are readily available to the customer.

CUSTOM FILTERS

As a recognized leader in the design and production of special custom filters, Hopkins has supplied many unique filtered designs. They meet a variety of sophisticated, complex, and multi-circuit applications associated with high reliability military/aerospace equipment in addition to electronic instrumentation and industrial control systems.

DATA PROCESSING FILTERS

Hopkins offers many different filters expressly designed for the suppression of RFI/EMI interference detrimental to data processing equipment. A selection of UL recognized filters are available in many current ratings and insertion loss characteristics. The data processing filters are designed to meet UL, VDE, and CSA specifications.

UNIVERSAL RFI/EMI FILTER

The universal 3-6 amp RFI/EMI power line filter provides a high degree of noise suppression in a compact assembly incorporating an IEC (International Electromechanical Commission) power line connector. It is designed to meet the filtering needs in a wide variety of applications at a low cost. Some examples include industrial controls, electronic instrumentation, data processing, and medical health care systems. Many other applications are possible where UL, VDE, and CSA requirements are imposed.

ENGINEERING CATALOGUE AVAILABLE UPON REQUEST

EMI/EMC ENGINEERING SERVICES

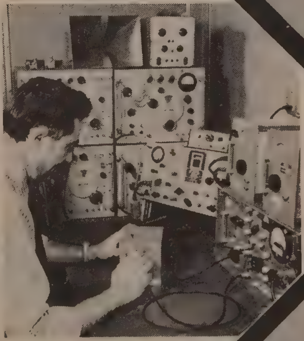
Hopkins maintains a complete electromagnetic engineering service for the evaluation and qualification of systems, sub-systems, and FCC certification programs. The engineering staff is available to write control plans, test plans, and consult in the design of equipment to assure compliance to EMI/EMC specifications.

LABORATORY FACILITIES

Hopkins EMI shielded laboratory test facilities are equipped with the latest instrumentation to diagnose, redesign and qualify equipment over the frequency range of 30Hz to 10GHz. Tests are conducted routinely to MIL-STD-461A, VDE, and CSA specifications.

FIELD SERVICES

Hopkins' engineers and equipment are available to perform tests of evaluation and validation at the customer's location. Engineering consultation may be provided that is prior or separate from the testing services.



ITHACO

Variable electronic filters

STANDARD FEATURES

- Frequency Response – Butterworth and Bessel
- Insertion Loss – 1%
- Frequency Accuracy – ±1%
- Phase Accuracy – ±2°
- Output Level – 20V p–p
- Noise – Less than 50μV
- Input Impedance – 20MΩ
- Output Impedance – 50Ω

OPTIONS

- Battery Operation
- Remote Preamplifiers
- Filter Gain

MODIFICATIONS

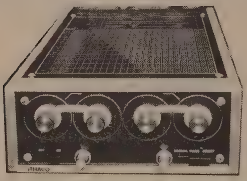
- Special Frequency Ranges
- Special Frequency Steps
- Special Frequency Responses

SERIES 4110
Multi channel electronic filters

4 and 7 Channel Mounting Cases

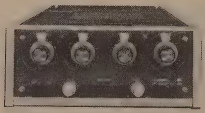
- Filter Functions – High-Pass, Low-Pass, Band Pass
- Frequency Range – .01 Hz – 1 MHz
- Frequency Steps – 1/10 Decade (1/3 Octave)

SERIES 4210
Laboratory filters



- Filter Functions – High-Pass, Low-Pass, Band Pass, Band Reject
- Frequency Range – .01 Hz – 1 MHz
- Frequency Steps – 1/10 Decade (1/3 Octave)
- Filter information for all settings are printed on top of the instrument

SERIES 4251
Laboratory filters



- Filter Functions – High-Pass, Low-Pass
- Frequency Range – .01 Hz – 111 kHz
- Frequency Resolution – 3 Digit
- Normalized Frequency, phase and pulse response curves are printed on top of the instrument

ITHACO also manufactures a complete line of AC amplifiers, preamplifiers and custom engineered instruments and systems. See Section 1100. For lock–in amplifiers, see Section 2900.

ITHACO Inc 735 West Clinton Street, Ithaca, New York 14850
Phone 607–272–7640 TWX 510–255–9307

ITHACO

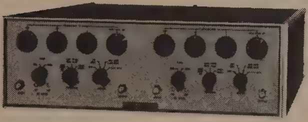
Variable Electronic Filters

ALL MODELS PROVIDE: • Butterworth or Low Q Response • 0 dB Insertion Loss • High Input—Low Output Impedance • Low Noise • Floating Operation • Wide Dynamic Range **SOME MODELS INCLUDE:** • Battery Operation • 20 dB Gain

Digital Tuned—High Pass, Low Pass

Model	Frequency Range	Atten. Slope dB/oct.	Price
3320	0.001Hz to 100kHz	24	$ 775*
3321	0.01Hz to 100kHz	24	$ 670*
3340	0.001Hz to 100kHz	48	$1175*
3341	0.01Hz to 100kHz	48	$1075*

*Battery option add $100.00

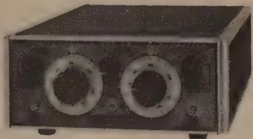


Digital Tuned—Band Pass, Band Reject High Pass, Low Pass

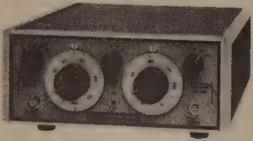
Model	Frequency Range	Atten. Slope dB/oct.	Price
3322	0.001Hz to 100kHz	24/48	$1490*
3323	0.01Hz to 100kHz	24/48	$1290*
3342	0.001Hz to 100kHz	48/96	$2125*
3343	0.01Hz to 100kHz	48/96	$1900*

*Battery option add $200.00

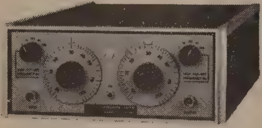
MODEL 3750 $995*
Band Pass, Band Reject
High Pass, Low Pass
0.02Hz to 20kHz
6, 12, 18, 24 dB/octave slope
*Battery option add $200.00



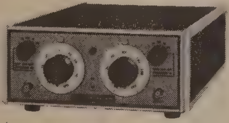
MODEL 3700 $625*
Band Pass
0.2Hz to 20kHz
24 dB/octave slope
*Battery option add $100.00



MODEL 3550 $695
Band Pass, Band Reject
High Pass, Low Pass
2Hz to 200kHz
24 dB/octave slope

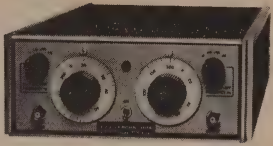


MODEL 3100 $695
Band Pass
10Hz to 1MHz
24 dB/octave slope

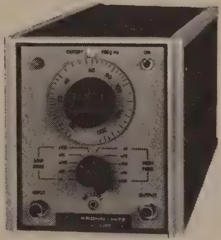


MODEL 3103 $725
Band Pass
10Hz to 3MHz
24 dB/octave slope

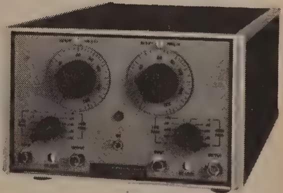
MODEL 3103-4 $725
18 dB/octave slope



MODEL 3500 $525
Band Pass
20Hz to 200kHz
24 dB/octave slope



MODEL 3200 $495
High Pass, Low Pass
20Hz to 2MHz
24 dB/octave slope



MODEL 3202 $895
Band Pass, Band Reject
High Pass, Low Pass
20Hz to 2MHz
24/48 dB/octave slope

Refer to Section 2900 for information on other Krohn-Hite products: Function Generators and Oscillators, Programmable Signal Sources, Phasemeters.

KH KROHN-HITE CORPORATION

Avon Industrial Park, Avon, Massachusetts 02322 • (617) 580-1660

ALES OFFICES: ALA, Huntsville (205) 534-9771; ARIZ., Scottsdale (602) 947-7841; CAL., San Jose (408) 292-3220, Inglewood (213) 674-6850; COLO., Denver (303) 750-1222; ONN., Glastonbury (203) 633-0777; FLA., Orlando (305) 894-4401; HAWAII, Honolulu (808) 941-1574; ILL., Des Plaines (312) 298-3600; IND., Indianapolis (317) 244-2456; MASS., exington (617) 861-8620; MICH., Detroit (313) 526-8800; MINN., Minneapolis (612) 884-4336; MO., St. Louis (314) 423-1234; N.C., Burlington (919) 227-3639; N.J., Haddonfield 609) 795-1700; N.M., Albuquerque (505) 299-7658; N.Y., E. Syracuse (315) 437-6666, Rochester (716) 328-2230, Vestal (607) 785-9947, Elmont (516) 488-2100; OHIO, Cleveland (216) 61-5440, Dayton (513) 426-5551; PA., Pittsburgh (412) 371-9449; TEX., Houston (713) 688-9971, Richardson (214) 231-2573; VA., Alexandria (703) 354-1222; WASH., Bellevue (206) 24-4035; CANADA, Montreal, Quebec (514) 636-0525, Toronto, Ontario (416) 499-5544, Stittsville, Ontario (613) 836-3990, Vancouver, British Columbia (604) 278-2009, Halifax, ova Scotia (902) 434-3402.

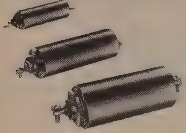
THE POTTER COMPANY

STANDARD EMI & UL RECOGNIZED FILTERS

for Data Processing & Military Applications

GENERAL PURPOSE & UL RECOGNIZED FILTERS

.5 thru 50 amps.
Pi, L and T Sections.
50, 200, 400, 600 VDC.
125 and 250 VAC-400 Hz.
Feed thru construction.
60 DB @ 150 KHz at full rated load.



Current Amps	Part Number	A Diam.	B Length	C Thread Length	D Threads	E	F	G	Fig.
125 VOLTS AC - 400 Hz / 400 VOLTS DC									
1.0	5004-7043	1.0	2 15/16	.312	7/16-20	.390	.375	.375	1
2.5	5004-7046	1.0	3¼	.312	7/16-20	.390	.375	.375	1
5.0	5004-7049	1¼	2¾	.375	¾-20	.484	.484	.656	1
10.0	5004-7052	1¼	3 15/16	.375	¾-20	.484	.484	.656	1
15.0	5004-7055	1½	3⅝	.375	¾-20	.750	.750	.656	2
20.0	5004-7058	1¾	3⅞	.437	¾-20	.750	.750	.656	2
30.0	5004-7061	2	4½	.562	1⅛-18	.750	.750	1.046	2
50.0	5004-7064	2¼	5	.562	1⅛-18	.875	.812	1.046	3
250 VOLTS AC - 400 Hz / 600 VOLTS DC — UL RECOGNIZED									
1.0	5004-7044	1.0	3 11/16	.312	½-28	.330	.330	.375	1
2.5	5004-7047	1.0	4	.312	½-28	.330	.330	.375	1
5.0	5004-7050	1¼	3¼	.375	¾-20	.484	.484	.656	1
10.0	5004-7053	1½	3⅞	.375	¾-20	.484	.484	.656	1
15.0	5004-7056	1½	4⅛	.375	¾-20	.750	.750	.656	2
20.0	5004-7059	1¾	4⅜	.437	¾-20	.750	.750	.656	2
30.0	5004-7062	2	4⅞	.562	1⅛-18	.750	.750	1.046	2
50.0	5004-7065	2¼	5¼	.562	1⅛-18	.875	.812	1.046	3

MECH. DIM.

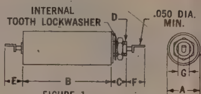


FIGURE 1

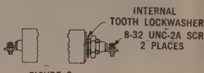


FIGURE 2

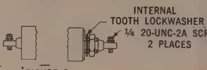
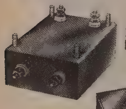


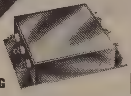
FIGURE 3

GENERAL PURPOSE RECTANGULAR FILTERS

10 thru 50 amps.
Pi, L and LL Sections.
2 and 3 circuit versions.
120/208 and 250/440 VAC.
60 DB @ 150 KHz at full rated load.



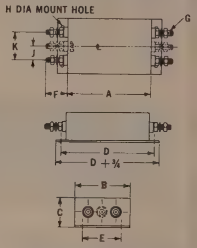
BULKHEAD MOUNTING



FLAT MOUNTING

Current Amps	Part Number		A Length	B Width	C Depth	D	E	F	G	H	J	K
	Military Style	Industrial Style										
120/208 VOLTS AC / 400 VOLTS DC												
2 x 10	5004-7033	5004-6980	4½	3	1½	5¼	2	¾	8-32	.196	¾	1½
3 x 10	5003-4328	5003-4358	4½	4½	1½	5¼	3½	¾	8-32	.196	1¼	2½
2 x 15	5004-7034	5004-6979	4½	3¼	2	5¼	2	¾	10-32	.196	¾	1½
3 x 15	5003-4329	5003-4359	5¼	4½	2	6	3½	¾	10-32	.196	1¼	2½
2 x 25	5004-7036	5004-6977	5	3½	2½	5¾	2	⅞	¼-20	.196	¾	1½
3 x 25	5003-4331	5003-4361	5½	5½	2½	6¼	4½	⅞	¼-20	.196	1¾	3½
2 x 50	5004-7037	5004-6975	6½	4	4	7¼	3	1	5/16-24	.196	¾	1½
3 x 50	5003-4333	5003-4363	7	6	4	7¾	5	1	5/16-24	.196	1¾	3½
250/440 VOLTS AC / 600 VOLTS DC												
2 x 10	5004-6899	5004-6898	5	3	1½	5¾	2	¾	8-32	.196	¾	1½
3 x 10	5003-4417	5003-4418	5½	4½	1½	6¼	3½	¾	8-32	.196	1¼	2½
2 x 15	5004-7035	5004-6978	5	3½	2	5¾	2	¾	10-32	.196	¾	1½
3 x 15	5003-4330	5003-4360	5½	5½	2	6¼	4½	¾	10-32	.196	1¾	3½
2 x 25	5004-6988	5004-6976	5½	3½	2½	6¼	2	⅞	¼-20	.196	¾	1½
3 x 25	5003-4332	5003-4362	6	5½	2½	6¾	4½	⅞	¼-20	.196	1¾	3½
2 x 50	5004-7038	5004-6974	7	4	4	7¾	3	1	5/16-24	.196	¾	1½
3 x 50	5003-4334	5003-4364	7½	7	4	8¼	6	1	5/16-24	.196	2¼	4½

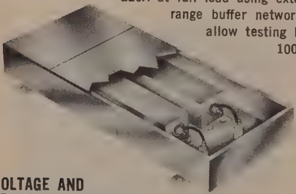
FLAT MOUNTING STYLE



FULL LINE ALSO AVAILABLE IN BULKHEAD MOUNTING CONFIGURATIONS.

POWER LINE FILTERS — NEW!

Power Line Filters yield 100 DB attenuation from 14 KHz thru 10 GHz when tested in accordance with MIL-STD-220A at full load using extended range buffer networks to allow testing below 100 KHz.



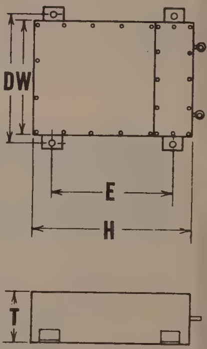
*VOLTAGE AND FREQUENCY RATINGS

Code	Voltage	Frequency
A	100 VDC	Non Polar
B	125/240 VAC	60 Hz, 400 VDC
C	277/480 VAC	60 Hz, 600 VDC
D	125/208 VAC	400 Hz, 400 VDC
E	220/440 VAC	400 Hz, 600 VDC

Part number must be followed by a letter denoting the voltage rating.

FILTER PANELS

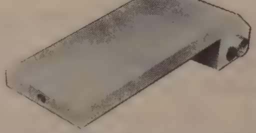
Part Number	H	W	T	D	E	Approx. Weight
5100-2x15*	42	16	5	18.5	36	95#
5100-3x15*	42	32	5	33.5	36	160#
5100-4x15*	42	32	5	33.5	36	180#
5100-2x25*	48	18	6	19.5	36	135#
5100-3x25*	48	34	6	35.5	36	205#
5100-4x25*	48	34	6	35.5	36	235#
5100-2x30*	48	18	6	19.5	36	135#
5100-3x30*	48	34	6	35.5	36	205#
5100-4x30*	48	34	6	35.5	36	235#
5100-2x50*	48	18	6	19.5	36	175#
5100-3x50*	48	34	6	35.5	36	265#
5100-4x50*	48	34	6	35.5	36	315#
5100-2x75*	60	18	11	19.5	48	315#
5100-3x75*	60	40	11	41.5	48	515#
5100-4x75*	60	40	11	41.5	48	595#
5100-2x100*	60	18	11	19.5	48	335#
5100-3x100*	60	40	11	41.5	48	545#
5100-4x100*	60	40	11	41.5	48	635#
5100-2x150*	60	18	11	19.5	48	355#
5100-3x150*	60	40	11	41.5	48	575#
5100-4x150*	60	40	11	41.5	48	675#
5100-2x200*	60	18	11	19.5	48	415#
5100-3x200*	60	40	11	41.5	48	635#
5100-4x200*	60	40	11	41.5	48	760#

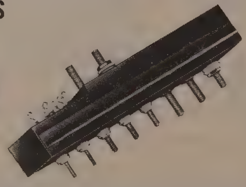


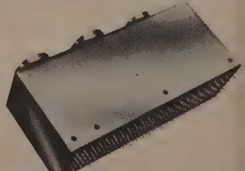
A HALF-CENTURY OF LEADERSHIP

With over 50 years of experience, and 40,000 square feet of prime production facilities, The Potter Company is a leader in the design and manufacture of EMI filters, and layer wound film capacitors. Please send for complete catalog data.

POTTER EMI CUSTOM FILTERS







THE POTTER COMPANY

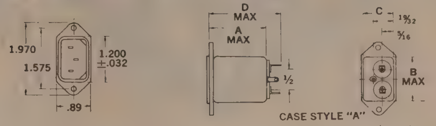
P.O. BOX 337, NORTH HIGHWAY 51
WESSON, MISSISSIPPI 39191 (601) 643-2216
A Division of Pemcor, Inc.

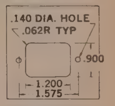
THE POTTER COMPANY

UL RECOGNIZED EMI FILTERS FOR

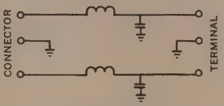
Data Processing, Industrial Control, Medical and Instrumentation Applications

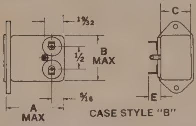
CASE STYLE A
CASE STYLE B

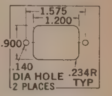

1.970
1.575
1.200 ±.032
.89
D MAX
A MAX
½
C
19/32
5/16
B MAX
CASE STYLE "A"


.140 DIA. HOLE
.062R TYP
.900
1.200
1.575
PANEL CUT OUT "A"

- Max. leakage current each line to ground .25 ma @ 125 VAC 60 Hz .5 ma @ 250 AC 60 Hz
- Test Voltage 2100 VDC


CONNECTOR
TERMINAL
"L" CKT.

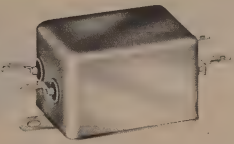

19/32
½
B MAX
5/16
A MAX
C
E
CASE STYLE "B"

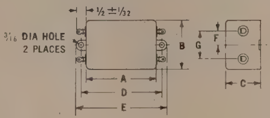

1.575
1.200
.900
.140 DIA HOLE 2 PLACES
.234R TYP
PANEL CUT OUT "B"

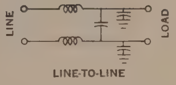
INTERNATIONAL SERIES 125/250 VAC / 0-60 Hz

Part Number	Current Amps	Case Style	A Length	B Width	C Depth	D	E	Insertion Loss
5004-6620	2 x 1	A	1.55	1.175	13/16	1.97	—	35 DB @ .5 MHz, 50 DB @ 2 MHz
5004-6608	2 x 3	A	1.55	1.175	13/16	1.97	—	30 DB @ .5 MHz, 50 DB @ 2 MHz
5004-6607	2 x 6	A	1.55	1.175	13/16	1.97	—	27 DB @ .5 MHz, 50 DB @ 5 MHz
5004-6621	2 x 1	B	1.55	1.175	13/16	—	7/16	35 DB @ .5 MHz, 50 DB @ 2 MHz
5004-6622	2 x 3	B	1.55	1.175	13/16	—	7/16	30 DB @ .5 MHz, 50 DB @ 2 MHz
5004-6614	2 x 6	B	1.55	1.175	13/16	—	7/16	27 DB @ .5 MHz, 50 DB @ 5 MHz

- Max. Leakage Current Each Line to Ground 5 ma Max. @ 125/250 VAC
- Test Voltage 1278 VDC




½ ± 1/32
3/16 DIA HOLE 2 PLACES
A
D
E
B
G
F
C

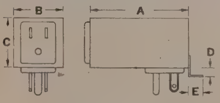


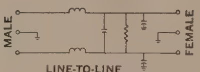
LINE-TO-LINE

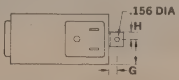
BATHTUB STYLES

Part Number	Current Amps	AC 0-60 Hz Voltage	A Length	B Width	C Depth	D	E	F	G	Insertion Loss
5004-6966	2 x 1.0	125	1¾	1¼	1⅛	2⅛	2½	5/16	⅝	30 DB @ .15 MHz - 100 MHz
5004-6965	2 x 2.5	125	2	1¾	⅞	2⅜	2¾	½	1	30 DB @ .15 MHz - 100 MHz
5004-6095	2 x 3.0	250	1¾	1¼	1⅛	2⅛	2½	9/32	9/16	26 DB @ .15 MHz, 59 DB @ 4 MHz
5004-6964	2 x 5.0	125	2	1¾	1⅛	2⅜	2¾	½	1	30 DB @ .15 MHz - 100 MHz
5004-6963	2 x 7.5	125	2	2	1¼	2⅜	2¾	½	1	30 DB @ .15 MHz - 100 MHz
5004-6962	2 x 10	125	2	2	1½	2⅜	2¾	½	1	30 DB @ .15 MHz - 100 MHz

Ideal for Retrofitting EMI Field Problem




MALE
FEMALE
LINE-TO-LINE

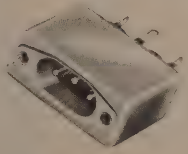


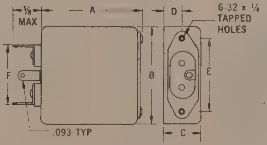
PLUG-IN STYLES 125 VAC / 0-60 Hz

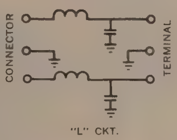
Part Number	Current Amps	A Length	B Width	C Depth	D	E	F	G	H	Insertion Loss
5004-6518	2	3.00	1.50	1.50	.25	.40	.75	.25	.22	50 DB @ .15 MHz, 65 DB @ 1 MHz, 45 DB @ 20 MHz

Custom Designs Available upto 10 Amps in Case Size Shown Above

- Max. Leakage Current Each Line to Ground .5 ma @ 125 VAC 60 Hz 1 ma @ 250 AC 60 Hz
- Test Voltage 2100 VDC




⅝ MAX
A
D
6-32 x ¼ TAPPED HOLES
F
B
E
.093 TYP
C


CONNECTOR
TERMINAL
"L" CKT.

PLUG-IN STYLES 125/250 VAC / 0-60 Hz

Part Number	Current Amps	A Length	B Width	C Depth	D	E	F	Insertion Loss
5004-6485	2 x 2	1⅞	2	¾	⅜	1½	1⅜	14 DB @ .15 MHz, 30 DB @ 1 MHz, 60 DB @ 20 MHz
5004-6486	2 x 5	2⅛	2	¾	⅜	1½	1⅜	14 DB @ .15 MHz, 30 DB @ 1 MHz, 60 DB @ 20 MHz
5004-6487	2 x 10	2⅛	2	1	⅜	1½	1⅜	14 DB @ .15 MHz, 30 DB @ 1 MHz, 60 DB @ 20 MHz

THE POTTER COMPANY

P.O. BOX 337, NORTH HIGHWAY 51
WESSON, MISSISSIPPI 39191 (601) 643-2216
A Division of Pemcor, Inc.

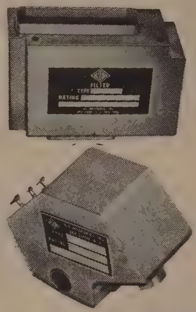
...the nation's leading filter supplier offers a complete range of RFI/EMC filters...

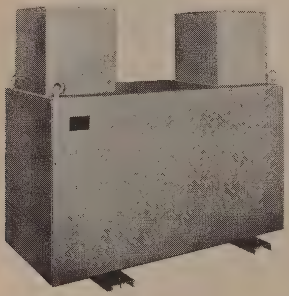
RFI offers the most complete range of products in the industry. Sophisticated, complex, multi-circuit filter assemblies, or simple feedthru capacitors—we make them all.

These are just a few of the more than 10,000 different filter designs by RF INTERONICS for specific customer requirements. For detailed information concerning standard and custom-engineered parts contact our sales department.

Multi-circuit filter packages

Designed to provide the equipment manufacturer with the most economical package from the standpoint of size, weight, and cost. Packages can include the input power connector and considerably simplify equipment construction and wiring.



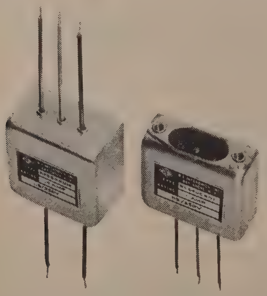


High Power Filter Units

Current and voltage ratings up to 2000 amperes and 20,000 volts. Designed to provide the performance required by high powered ground installations, such as computer facilities, shielded test laboratories, radar installations and similar, high performance applications.

Cylindrical filters to Mil-F-15733E

RF Interonics has more QPL listed parts than any other supplier in the industry — Now qualified on more than 150 different filters, including subminiature "MICRO-FILTER®" units corresponding to military styles FL10, 11, 12, 13 14 and 15, and standard cylindrical types, covered by requirements for styles FL22, 24, 81, 82, 83 and 84 of the military specification.

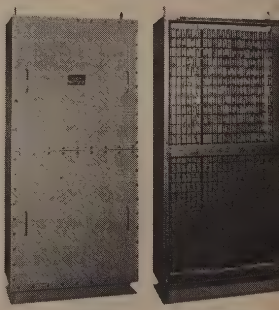


UL Listed Parts

RFI's line of filters includes parts recognized under the components listing program of Underwriters' Laboratories, Inc. These filters are designed for use in Data Processing Equipment, and similar applications.

Communications and Signal Line Filters

RF Interonics manufactures a wide range of filters with various pass band and impedance characteristics, suitable for use in communication, signal or telephone line applications. Filters are available as single or dual circuit units, or in multi-circuit shielded cabinets.



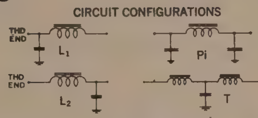
RF INTERONICS

100-E Pine Aire Drive, Bay Shore, Long Island, New York 11706 / (516) 231-6400 / TWX 510-227-6233

Here are only a few
of the more than 10,000
different filter designs
by RF INTERONICS for
specific customer requirements.
For detailed information
concerning standard and
custom-engineered parts —
contact our sales department.

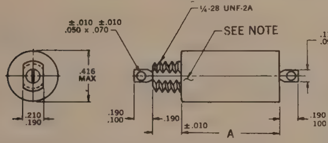
MILITARY STYLES

FL 13 per Mil-F-15733/25 and FL 14 per Mil-F-15733/26



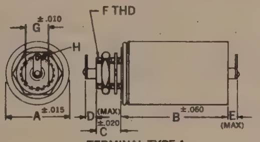
NOTE: THE CASE SHALL BE MARKED AT THE THREADED END OF FILTER, WITH THE SYMBOL "C" OR THE SYMBOL "L", AS FOLLOWS:

CIRCUIT	SYMBOL
L_1	C
L_2	L

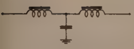


M15733/25 DASH NO.	RFI PART NO.	CKT	RATING AMP	RATING DC VOLTS	A MAX.	MAX VOLT. DROP	75 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz
							MINIMUM INSERTION LOSS IN DECIBELS MIL-STD-220A (FULL LOAD)					
0001	RF5004-1	L_1	1.0	100	.743	.250	15	23	34	55	70	70
0002	RF5004-2	P_i	1.0	100	.793	.250	16	33	52	80	80	70
0003	RF5004-3	L_2	1.0	100	.738	.250	15	23	34	55	70	70
0004	RF5004-4	P_i	3.0	100	.793	.150	6	1	34	68	80	70
0005	RF5004-5	L_1	5.0	100	.743	.075	11	17	23	35	69	70
0006	RF5004-6	P_i	5.0	100	.793	.075	11	14	17	57	80	70
0007	RF5004-7	T	4.0	100	1.345	.250	16	22	28	43	80	70
0008	RF5004-8	L_2	5.0	100	.738	.075	11	17	23	35	69	70
0009	RF5004-9	L_1	.25	100	.743	.325	24	35	47	68	70	70
0010	RF5004-10	P_i	.25	100	.793	.375	31	48	66	80	80	70
0011	RF5004-11	L_2	.25	100	.738	.375	24	35	47	68	70	70
0012	RF5004-12	T	2.0	100	1.179	.20	16	22	31	55	80	70

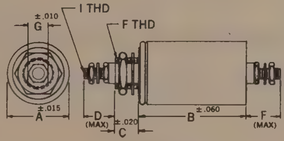
T CIRCUIT POWER FILTERS for Mil-Std-461 and similar applications



TERMINAL TYPE 1



CIRCUIT DIAGRAM

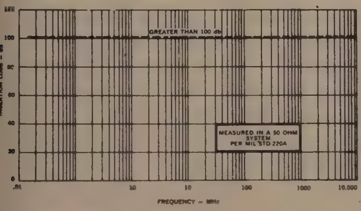


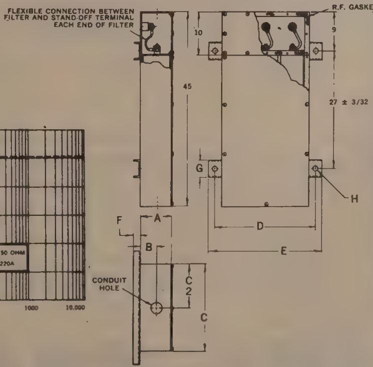
TERMINAL TYPE 2

RATING		PART NO.	A	B	C	D	E	F	G	H	I	TERMINAL TYPE
100VDC	0.5A	RF6124	1.00	2.25	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	1A	RF6125	1.00	2.87	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	3A	RF6126	1.25	4.19	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	5A	RF6127	1.50	3.88	.50	.69	.69	¾-20	.656		8-32	2
	10A	RF6128	2.25	3.88	.56	.69	.69	1⅛-18	1.065		8-32	2
	20A	RF6129	1.50	4.00	.50	.69	.69	¾-20	.656		8-32	2
	30A	RF6130	2.25	4.75	.56	.81	.81	1⅛-18	1.065		10-32	2
	50A	RF6131	2.25	5.50	.56	.88	.88	1⅛-18	1.065		¼-20	2
115VAC 0-400 Hz 400VDC	0.5A	RF6132	1.00	3.00	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	1A	RF6133	1.13	3.87	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	3A	RF6134	1.50	3.75	.50	.69	.69	¾-20	.656		8-32	2
	5A	RF6135	1.50	4.38	.50	.69	.69	¾-20	.656		8-32	2
	10A	RF6136	2.25	5.31	.56	.69	.69	1⅛-18	1.065		8-32	2
	20A	RF6137	1.75	5.00	.50	.69	.69	¾-20	.656		8-32	2
	30A	RF6138	2.25	5.50	.56	.81	.81	1⅛-18	1.065		10-32	2
	50A	RF6139	2.25	6.50	.56	.88	.88	1⅛-18	1.065		¼-20	2
250VAC 0-400 Hz 600VDC	0.5A	RF6140	1.13	3.56	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	1A	RF6141	1.25	4.25	.44	.25	.25	7/16-20	.370	3/32 x 3/16		1
	3A	RF6142	1.75	4.50	.50	.69	.69	¾-20	.656		8-32	2
	5A	RF6143	1.75	5.75	.50	.69	.69	¾-20	.656		8-32	2
	10A	RF6144	2.25	5.75	.56	.69	.69	1⅛-18	1.065		8-32	2
	20A	RF6145	2.25	5.50	.56	.69	.69	1⅛-18	1.065		8-32	2

POWER LINE FILTER ASSEMBLIES

for shielded rooms and secure areas




FLEXIBLE CONNECTION BETWEEN FILTER AND STAND-OFF TERMINAL EACH END OF FILTER
R.F. GASKET
10
9
45
27 ± 3/32
G
H
D
E
F
A
B
C/2
C
CONDUIT HOLE

RFI PART NO.	CURRENT RATING (AMPERES)	A	B	C	D	E	CONDUIT HOLE	F	G	H	APPROX. WT. (LBS.)
RF3300-1	2x25	7	4	13	15	17	1⅜	1½	3	⅝	155
RF3300-2	3x25	7	4	18	20	22	1½	1½	3	⅝	180
RF3300-3	4x25	7	4	23	25	27	1½	1½	.3	⅝	240
RF3300-4	2x50	7	4	13	15	17	1¾	1½	3	⅝	155
RF3300-5	3x50	7	4	18	20	22	2	1½	3	⅝	180
RF3300-6	4x50	7	4	23	25	27	2	1½	3	⅝	240
RF3300-7	2x75	12	8	15	18	21	2	1¾	4	1	280
RF3300-8	3x75	12	8	20	23	26	2½	1¾	4	1	340
RF3300-9	4x75	12	8	26	29	32	2½	1¾	4	1	410
RF3300-10	2x100	12	8	15	18	21	2	1¾	4	1	280
RF3300-11	3x100	12	8	20	23	26	2½	1¾	4	1	340
RF3300-12	4x100	12	8	26	29	32	2½	1¾	4	1	410
RF3300-13	2x150	18	14	15	18	21	2½	1¾	4	1	380
RF3300-15	3x150	18	14	20	23	26	3	1¾	4	1	500
RF3300-15	4x150	18	14	26	29	32	3	1¾	4	1	650
RF3300-16	2x200	18	14	15	18	21	3	1¾	4	1	380
RF3300-17	3x200	18	14	20	23	26	3	1¾	4	1	500
RF3300-18	4x200	18	14	26	29	32	3	1¾	4	1	650

ALL FILTERS ARE RATED FOR A MAXIMUM OF 277 VAC LINE TO GROUND, 480 VAC LINE TO LINE AT POWER LINE FREQUENCIES FROM 0 TO 400 Hz.

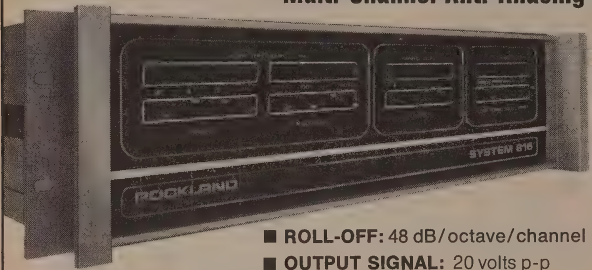
RF INTERONICS

100-E Pine Aire Drive, Bay Shore, Long Island, New York 11706 / (516) 231-6400 / TWX 510-227-6233

for the BE$T in...
ANALOG FILTERS

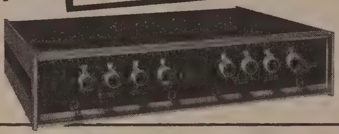
- **HI** PERFORMANCE/ **LO** COST
- **WIDE RANGE**—CUT-OFF FREQUENCIES FROM 0.001 Hz to 1.1 MHz
- **DIGITAL TUNING**—INSTANT RESETTABILITY
- **FLEXIBILITY:** **Modes:** Low pass, high pass, band pass, band reject, notch.
  Roll-Offs: 24, 48, & 96 dB/octave
  Responses: Butterworth, Bessel, Linear Phase, RC
  Passband Gains: 0, 20 dB
- **REMOTE PROGRAMMABILITY**—*A ROCKLAND EXCLUSIVE!*

Multi-Channel Anti-Aliasing Filter: System 816



- **ROLL-OFF:** 48 dB/octave/channel
- **OUTPUT SIGNAL:** 20 volts p-p
- **PASSBAND GAIN:** 0 dB
- **IMPEDANCES:** 1 Meg input, 50 ohm output
- **DYNAMIC RANGE:** 80 dB
- **FOR AUTOMATED DATA ACQUISITION AND SIGNAL ANALYSIS SYSTEMS**
- **DIRECT INTERFACE WITH COMPUTER, PROGRAMMER OR SWITCH CLOSURES**
- **PLUG-IN CARDS PROVIDE UP TO 16 INDEPENDENT FILTER CHANNELS IN 5¼″ HIGH PANEL**
- **LOCAL, REMOTE, AND ON-CARD PROGRAMMING OF CUTOFF FREQUENCY**
- **CUTOFF FREQUENCY RANGE:** 01 Hz to 150 KHz
- **FUNCTIONS:** Low pass, high pass, bandpass, band reject
- **RESPONSES:** Butterworth and Bessel

New! Higher Performance, Lower Cost!

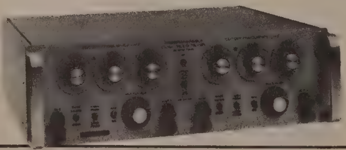


DUAL HI/LO: Models 452 and 852

Frequency Range: 0.01 Hz to 111 KHz
Roll-Off: 24 dB/octave/channel (452) 48 dB/octave/channel (852)
(Cascading channels doubles roll-off)
Responses: Butterworth, Linear Phase
Passband Gains: Selectable 0, 20 dB.

VARIABLE ANALOG: Models 1100 and 1200

Frequency Range: 10 Hz to 1.1 MHz **Roll-Off:** 24 dB /octave
Responses: Butterworth and Bessel **Passband Gain:** 0 dB.



PROGRAMMABLE DUAL HI/LO: Series 1500

Frequency Range: 0.001 Hz to 111 KHz
Roll-Off: 24 dB/octave/channel (Cascading channels doubles roll-off)
Passband Gain: 0, 20 dB. **Responses:** Butterworth, RC.
Programming: Local and/or Remote of all Functions
Programming options: 02; 1-2-4-8 BCD positive logic,
03; 1-2-2-4 BCD positive logic.

ROCKLAND

Rockland Systems Corporation 230 W. Nyack Road, West Nyack, N.Y. 10994 • (914) 623-6666 • TWX 710-575-2631

STERLING
TRANSFORMER

STANDARD INTERSTAGE AND LINE TRANSISTOR AND TUBE APPLICATIONS *filters*

Hermetically Sealed – Manufactured to MIL-F-18327B Available in Other Frequencies

LOW PASS

INTERSTAGE

LI units have a loss of approximately 3 db at cutoff frequency, and an attenuation of 35 db at 1.5 cutoff frequency. Input and output 10,000 ohms. LI units are MIL type FR4RX11YY.

Part No.	Frequency	Case Size	Net Price
LI-60	60 cps	A	72.00
LI-100	100 cps	A	72.00
LI-200	200 cps	B	72.00
LI-400	400 cps	B	72.00
LI-500	500 cps	B	72.00
LI-800	800 cps	B	72.00
LI-1,000	1,000 cps	B	72.00
LI-1,500	1,500 cps	B	72.00
LI-2,000	2,000 cps	B	72.00
LI-2,500	2,500 cps	B	72.00
LI-3,000	3,000 cps	B	72.00
LI-4,000	4,000 cps	B	72.00
LI-5,000	5,000 cps	B	72.00
LI-10,000	10,000 cps	B	72.00

LINE

LL units have a loss of approximately 3 db at cutoff frequency, and an attenuation of 35 db at 1.5 cutoff frequency. Input and output 500/600 ohms. LL units are MIL type FR4RX11YY.

Part No.	Frequency	Case Size	Net Price
LL-600	600 cps	A	72.00
LL-1,000	1,000 cps	A	72.00
LL-1,500	1,500 cps	A	72.00
LL-2,000	2,000 cps	A	72.00
LL-2,500	2,500 cps	A	72.00
LL-4,000	4,000 cps	A	72.00
LL-8,000	8,000 cps	A	72.00
LL-10,000	10,000 cps	A	72.00
LL-12,000	12,000 cps	A	72.00

HIGH PASS

INTERSTAGE

HI units have a loss of less than 6 db at cutoff frequency, and an attenuation of 35 db at .67 cutoff frequency. Input and output 10,000 ohms. HI units are MIL type FR4RX33YY.

Part No.	Frequency	Case Size	Net Price
HI-100	100 cps	A	72.00
HI-200	200 cps	A	72.00
HI-300	300 cps	A	72.00
HI-400	400 cps	A	72.00
HI-500	500 cps	A	72.00
HI-800	800 cps	A	72.00
HI-1,000	1,000 cps	A	72.00
HI-2,000	2,000 cps	A	72.00
HI-3,000	3,000 cps	A	72.00

LINE

HL units have a loss of less than 6 db at cutoff frequency, and an attenuation of 35 db at .67 cutoff frequency. Input and output 500/600 ohms. HL units are MIL type FR4RX33YY.

Part No.	Frequency	Case Size	Net Price
HL-200	200 cps	A	80.00
HL-300	300 cps	A	80.00
HL-500	500 cps	A	80.00
HL-1,000	1,000 cps	A	80.00

FOR WIDE BAND PASS FILTERS THE LI & HI OR LL & HL MAY BE CONNECTED IN SERIES.

BAND PASS

INTERSTAGE

BI units have 2:1 voltage gain. They are sharply peaked, having approximately 2 db attenuation at plus or minus 3% from center frequency and attenuation greater than 40 db at 1/2 and twice center frequency. Input 10,000 ohms, output to grid. BI units are MIL type FR4RX22YY.

Part No.	Frequency	Case Size	Net Price
BI-50	50 cps	A	72.00
BI-60	60 cps	A	72.00
BI-100	100 cps	A	72.00
BI-120	120 cps	B	72.00
BI-200	200 cps	B	72.00
BI-240	240 cps	B	72.00
BI-400	400 cps	B	72.00
BI-500	500 cps	B	72.00
BI-750	750 cps	B	72.00
BI-800	800 cps	B	72.00
BI-1,000	1,000 cps	B	72.00
BI-1,500	1,500 cps	B	72.00
BI-2,000	2,000 cps	B	72.00
BI-3,000	3,000 cps	B	72.00
BI-4,000	4,000 cps	B	72.00
BI-5,000	5,000 cps	B	72.00
BI-10,000	10,000 cps	B	72.00

LINE

BL units have 9:1 voltage gain. They are sharply peaked, having approximately 2 db attenuation at plus or minus 3% from center frequency and attenuation greater than 40 db at 1/2 and twice center frequency. Input 500/600 ohms, output to grid. BL units are MIL type FR4RX22YY.

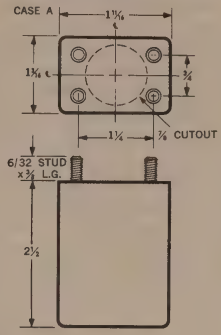
Part No.	Frequency	Case Size	Net Price
BL-400	400 cps	B	72.00
BL-1,000	1,000 cps	B	72.00

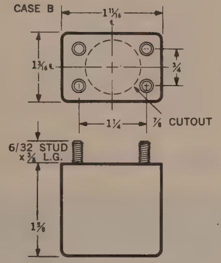
TRANSISTOR INTERSTAGE

They are sharply peaked, having approximately 2 db attenuation at plus or minus 3% from center frequency and attenuation greater than 40 db at 1/2 and twice center frequency. Input 10,000 ohms, output 10,000 ohms. BIT units are MIL type FR4RX22YY.

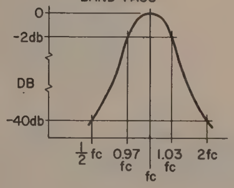
Part No.	Frequency	Case Size	Net Price
BIT-60	60 cps	A	80.00
BIT-100	100 cps	A	80.00
BIT-120	120 cps	B	80.00

CASE DETAIL

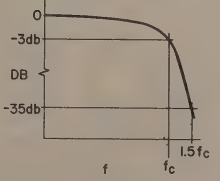




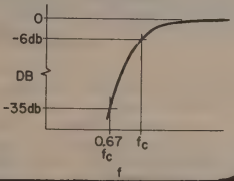
BAND PASS



LOW PASS



HIGH PASS



STERLING TRANSFORMER CORP.

SPECTRUM CONTROL INC.

SPECTRUM CONTROL . . . The company was founded upon the basic philosophy of encompassing literally the spectrum of services in the EMI/EMC technology . . . services offered within reasonable cost structures.

Today, Spectrum Control facilities must rate among the most efficient in the industry. Advanced test equipment, shielded test rooms and a fully experienced engineering staff combined with a broad range of electronic components qualifies Spectrum as a unique source for total program management of electromagnetic interference.

Your EMI/EMC problem in electronic or electromechanical equipment can be assumed in total by Spectrum engineers . . . including testing, planning and control, from the initial stages to final resolution of the problem. At the outset an EMC control plan is formulated. This involves in-depth analysis of engineering drawings, circuitry, specifications and the equipment. Next, Spectrum provides consulting service to assist compliance with the control plan. EMI testing to the latest applicable specifications are conducted at your plant site by a team of experienced Spectrum engineers; or, if more convenient, specific equipment and apparatus can be brought directly to our test facilities.

As the problem is pinpointed, Spectrum Control has the total facilities to affect satisfactory, economical solution. Corrective action may involve circuit changes, packaging changes . . . or require EMI Filters, gaskets, metal shields or other types of hardware. Whatever is required, Spectrum Control is equipped with qualified personnel, plant facilities and a broad range of reasonably priced components to help resolve your EMI/EMC problems.

INDUSTRIAL CONSUMER APPLICATIONS

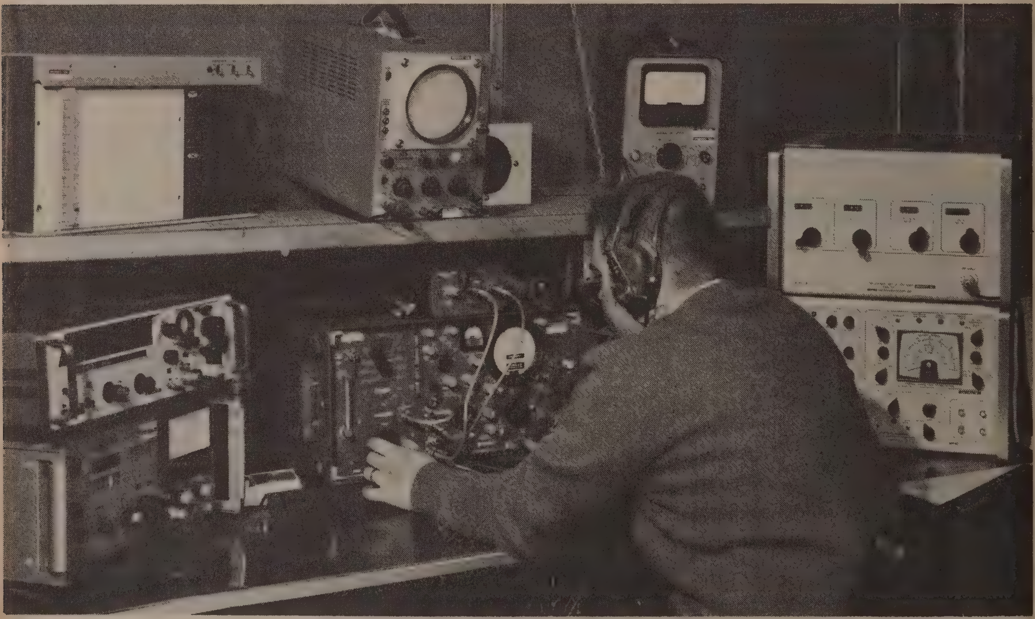
A rapidly increasing number of industrial and consumer products, equipment and systems are potential sources of electromagnetic interference. Spectrum Control specializes in air navigation and avionics, microwave ovens, control circuits, power supplies, electrical instruments, electric motor noise suppression . . . just about any application where EMI impairs optimum performance.

MILITARY APPLICATIONS

Today's powerful communications systems, radar systems and other high performance systems demand the ultimate in electromagnetic compatibility. Spectrum Control offers one of the best equipped, independent test facilities in the United States. Spectrum is capable of performing to the following applicable specifications:

MIL-STD-461/462
MIL-STD-826
MIL-I-6181
MIL-I-26600
MIL-I-16910
FCC-Part 15
FCC-Part 18

EMC Planning, Control and Testing . . . a total approach to electromagnetic compatibility!



Spectrum EMI Components available now from these authorized distributors:

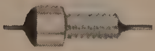
HALL-MARK ELECTRONICS	(215) 355-7300
METUCHEN CAPACITOR	(201) 442-0500
ROSE ELECTRONICS	(415) 697-0224

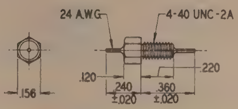
SPECTRUM CONTROL INC.
152 EAST MAIN ST., FAIRVIEW, PENNSYLVANIA 16415
PH. (814) 474-5593 TWX 510-699-6848

EMI/RFI SUPPRESSION FILTERS

THREAD BUSHING
RESIN SEAL

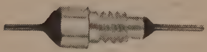
SPECTRUM CONTROL

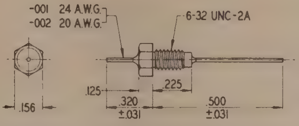



24 A.W.G.
4-40 UNC-2A
TOL. ± .015
.220
.120
.156
.240 ±.020
.360 ±.020

TEST SPECIFICATION: SCI 51000

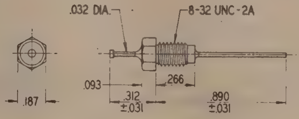
Spectrum Control N°	Rated IDC	Working Volts +85°C	Working Volts +125°C	DCR Max.	Refer Cap ----	Insertion Loss DB 1 MHz	10 MHz	100 MHz	200 MHz	1 GHz	10 GHz
51-729-303	10 amps	200 VDC	100 VDC	.01	.0015 MFD	—	5	42	60	65	65
51-729-304	10 amps	200 VDC	100 VDC	.01	.022 MFD	20	30	50	55	65	65




-001 24 A.W.G.
-002 20 A.W.G.
6-32 UNC-2A
TOL. ± .015
.125
.225
.156
.320 ±.031
.500 ±.031

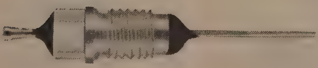
TEST SPECIFICATION: SCI 51000

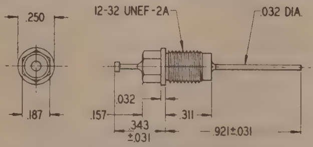
Spectrum Control N°	Rated IDC	Working Volts +85°C	Working Volts +125°C	DCR Max.	Refer Cap ----	Insertion Loss DB 1 MHz	10 MHz	100 MHz	200 MHz	1 GHz	10 GHz
51-726-001	3 amps	200 VDC	100 VDC	.01	.001 MFD	—	3	40	50	70	70
51-726-002	10 amps	200 VDC	100 VDC	.01	.022 MFD	10	28	50	60	70	70


TOL. ± .015
.032 DIA.
8-32 UNC-2A
.093
.266
.187
.312 ±.031
.890 ±.031

TEST SPECIFICATION: SCI 51000

Spectrum Control N°	Rated IDC	Working Volts +85°C	Working Volts +125°C	DCR Max.	Refer Cap ----	Insertion Loss DB 1 MHz	10 MHz	100 MHz	200 MHz	1 GHz	10 GHz
51-712-001	10 amps	200 VDC	100 VDC	.01	.0015 MFD	—	5	42	45	70	70
51-712-003	10 amps	200 VDC	100 VDC	.01	.022 MFD	10	30	50	55	70	70




.250
12-32 UNEF-2A
.032 DIA.
TOL. ± .015
.032
.187
.157
.311
.343 ±.031
.921±.031

TEST SPECIFICATION: SCI 51000

Spectrum Control N°	Rated IDC	Working Volts +85°C	Working Volts +125°C	DCR Max.	Refer Cap ----	Insertion Loss DB 100 KHz	1 MHz	10 MHz	100 MHz	200 MHz	1 GHz	10 GHz
51-714-001	10 amps	350 VDC	200 VDC	.01	.0015	—	—	5	45	50	70	70
51-714-002	10 amps	200 VDC	100 VDC	.01	.0050	—	5	20	60	60	70	70
51-714-007	10 amps	200 VDC	100 VDC	.01	—	—	12	30	50	60	70	70
51-714-017	10 amps	200 VDC	100 VDC	.01	—	6	16	60	65	70	70	70

SPECTRUM CONTROL INC.

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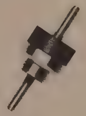
EMI/RFI SUPPRESSION FILTERS

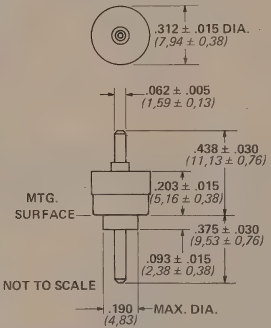
RESIN SEAL
THREAD BUSHING

SPECTRUM CONTROL

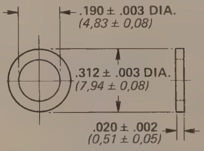
Specifications	Type FCS-C	Type SMFB-A4	Type SMFO-1 Type SMFB-A1	Type SMFB-A2 Type SMFO-2
				
Attenuation See explanation below table.	25 dB @ 25°C 20 dB @ 85°C	50 dB @ 25°C 45 dB @ 125°C	35 dB @ 25°C 35 dB @ 125°C	60 dB @ 25°C 50 dB @ 85°C
Operating Temperature Range	−55°C to +85°C	−55°C to +125°C	−55°C to +125°C	−55°C to +85°C
DC Working Voltage Includes summation of the DC and lower level AC peak voltages.	500 Volts	500 Volts	200 Volts	200 Volts
Feed-Thru Current DC and/or low frequency AC RMS.	25 Amperes	10 Amperes	10 Amperes	10 Amperes
Capacitance (pF) Minimum values at 25°C, 0.5 to 2.5 volts RMS, at 1 KHz.	1000	2500	1300	5500
Feed-Thru Terminal Resistance	0.01 Ohm Maximum			

Attenuation: Minimum attenuation values from 100 MHz to 10 GHz, when measured with an input 50 ohm series resistor (except FCS-C which is determined without 50 ohm series resistor), and at 0 volts DC and 0 amperes DC.

Type FCS-C

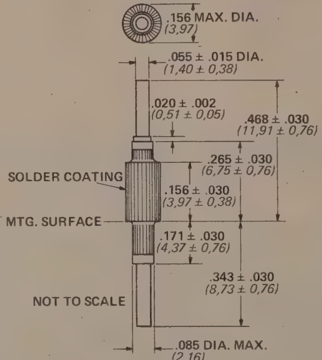

.312 ± .015 DIA.
(7,94 ± 0,38)
.062 ± .005
(1,59 ± 0,13)
.438 ± .030
(11,13 ± 0,76)
.203 ± .015
(5,16 ± 0,38)
MTG. SURFACE
.375 ± .030
(9,53 ± 0,76)
.093 ± .015
(2,38 ± 0,38)
NOT TO SCALE
.190 MAX. DIA.
(4,83)

RECOMMENDED MTG. HOLE .191 MIN. DIA. (4,85)

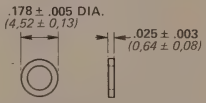

.190 ± .003 DIA.
(4,83 ± 0,08)
.312 ± .003 DIA.
(7,94 ± 0,08)
.020 ± .002
(0,51 ± 0,05)

SOLDER WASHER M-6447

Types SMFO-1, SMFO-2

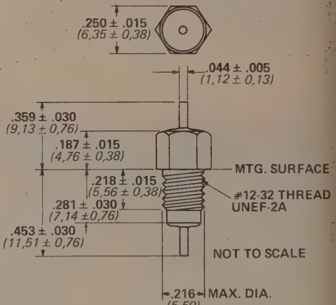

.156 MAX. DIA.
(3,97)
.055 ± .015 DIA.
(1,40 ± 0,38)
.020 ± .002
(0,51 ± 0,05)
.468 ± .030
(11,91 ± 0,76)
.265 ± .030
(6,75 ± 0,76)
SOLDER COATING
.156 ± .030
(3,97 ± 0,38)
MTG. SURFACE
.171 ± .030
(4,37 ± 0,76)
.343 ± .030
(8,73 ± 0,76)
NOT TO SCALE
.085 DIA. MAX.
(2,16)

RECOMMENDED MTG. HOLE .093 DIA. (2,38)

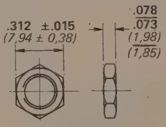

.178 ± .005 DIA.
(4,52 ± 0,13)
.025 ± .003
(0,64 ± 0,08)

SOLDER WASHER M-6446

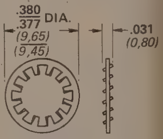
Types SMFB-A1, SMFB-A2, SMFB-A4


.250 ± .015
(6,35 ± 0,38)
.044 ± .005
(1,12 ± 0,13)
.359 ± .030
(9,13 ± 0,76)
.187 ± .015
(4,76 ± 0,38)
MTG. SURFACE
.218 ± .015
(5,56 ± 0,38)
#12-32 THREAD UNEF-2A
.281 ± .030
(7,14 ±0,76)
.453 ± .030
(11,51 ± 0,76)
NOT TO SCALE
.216 MAX. DIA.
(5,50)

RECOMMENDED MTG. HOLE .228 DIA. (5,79)


.312 ±.015
(7,94 ± 0,38)
.078/.073
(1,98)/(1,85)

NUT M-6377


.380/.377 DIA.
(9,65)/(9,45)
.031
(0,80)

LOCK WASHER M-6351

Allen Bradley Type Number	Spectrum Control Inventory Code Number
FCS-C	51-722-001 51-722-022 with solder mounting washer
SMFB-A1	51-719-022 with nut and lockwasher
SMFB-A2	51-719-021 with nut and lockwasher
SMFB-A4	51-719-011 with nut and lockwasher
SMFO-1	51-723-303 51-723-304 with solder mounting washer
SMFO-2	51-723-301 51-723-302 with solder mounting washer

SPECTRUM ACQUIRES ALLEN BRADLEY LINE

In May of 1973, Spectrum Control, Inc. and Allen Bradley Company entered into a long term agreement whereby Spectrum Control acquired all patents, technology and machinery to manufacture the Allen Bradley line of filters and capacitors. These devices can be ordered by the Allen Bradley part number or by the Spectrum Control inventory code number.

SPECTRUM CONTROL INC.

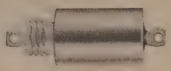
152 EAST MAIN STREET, FAIRVIEW, PA. 16415
PHONE (814) 474-5593

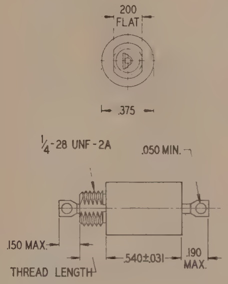
EMI/RFI SUPPRESSION FILTERS

HERMETIC SEAL

50VDC +85°C L SECTION 28VDC +125°C

Spectrum Control Nº	A Thread Length	Inductor Location	Rated Current	DCR Max.	Insertion Loss DB 30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz
51-353-007	.187	THREAD END	60 ma.	70	44	70	70	70	70	70
51-353-086	.312									
51-353-094	.187	TOP END								
51-353-102	.312									
51-353-006	.187	THREAD END	150 ma.	12	24	52	64	70	70	70
51-353-087	.312									
51-353-095	.187	TOP END								
51-353-103	.312									
51-353-005	.187	THREAD END	250 ma.	4	18	42	56	70	70	70
51-353-088	.312									
51-353-096	.187	TOP END								
51-353-104	.312									
51-353-004	.187	THREAD END	300 mg.	2.3	16	35	44	62	70	70
51-353-089	.312									
51-353-097	.187	TOP END								
51-353-105	.312									
51-353-003	.187	THREAD END	450 mg.	1.2	15	31	37	55	70	70
51-353-090	.312									
51-353-098	.187	TOP END								
51-353-106	.312									
51-353-033	.187	THREAD END	1 amp.	.25	15	33	44	70	70	70
51-353-091	.312									
51-353-099	.187	TOP END								
51-353-107	.312									
51-353-035	.187	THREAD END	5 amps	.015	15	28	33	46	70	70
51-353-092	.312									
51-353-100	.187	TOP END								
51-353-108	.312									
51-353-001	.187	THREAD END	10 amps	.01	15	28	33	44	64	70
51-353-093	.312									
51-353-101	.187	TOP END								
51-353-109	.312									

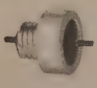



200
FLAT
.375
¼-28 UNF-2A
.050 MIN.
.150 MAX.
THREAD LENGTH
.540±.031
.190 MAX.

100VDC +85°C L SECTIONS 125VAC +125°C

51-717 Style
See Fig. 1

51-359 Style
See Fig. 2



51-344 Style
See Fig. 3

Spectrum Control Nº	Rated I_{DC}	Working Volts +85°C	Working Volts +125°C	DCR Max.	Refer Cap - - - -	Insertion Loss DB 30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz
51-717-001	15 amps	100 VDC	50 VDC	.01	1.4 MFD	15	28	33	44	60	70
51-717-007	15 amps	125 VAC	125 VAC	.01	.015 ±20%	—	—	—	10	30	70
51-359-001	15 amps	100 VDC	50 VDC	.01	1.4 MFD	15	28	33	44	60	70
51-359-007	15 amps	125 VAC	125 VAC	.01	.015 ±20%	—	—	—	10	30	70
51-344-006	15 amps	100 VDC	50 VDC	.01	1.4 MFD	15	28	33	44	60	70

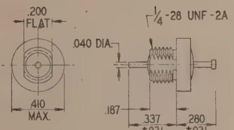

.200
FLAT
.040 DIA.
¼-28 UNF-2A
.410
MAX.
.187
.337 ±.031
.280 ±.031

Fig. 1

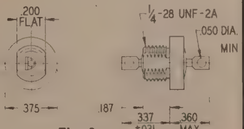

.200
FLAT
¼-28 UNF-2A
.050 DIA. MIN
.375
.187
.337 ±.031
.360 MAX

Fig. 2

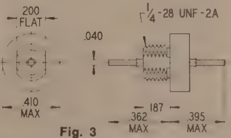

.200
FLAT
¼-28 UNF-2A
.040
.410
MAX
.187
.362 MAX
.395 MAX

Fig. 3

SPECTRUM CONTROL

SPECTRUM CONTROL INC.

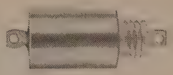
152 EAST MAIN STREET, FAIRVIEW, PA. 16415

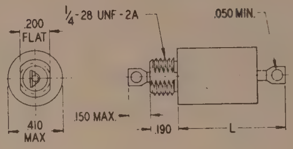
PHONE (814) 474-5593

EMI/RFI SUPPRESSION FILTERS

SPECTRUM CONTROL

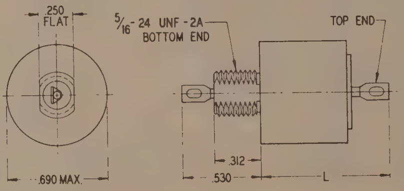
125VAC +125°C L, Pi, T 0-400 HERTZ





Spectrum Control Nº	Rated IDC	Filter Circuit and Inductor	Length L +.015 −.090	DCR Max.	Insertion Loss DB 75 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1 GHz
51-353-110	1 amp L	Inductor Top	.728	.25	8	17	29	50	70	70
51-353-111		Inductor Bottom								
51-353-112	3 amp L	Inductor Top	.728	.05	8	13	20	35	70	70
51-353-113		Inductor Bottom								
51-353-114	5 amp L	Inductor Top	.728	.015	8	12	20	30	62	70
51-353-115		Inductor Bottom								
51-353-315	.5 amp	Pi	.778	.6	15	33	50	80	80	80
51-353-316	1 amp	Pi	.778	.25	—	20	40	70	80	80
51-353-317	3 amp	Pi	.778	.05	—	—	20	55	80	80
51-351-601	2 amp	T	1.164	—	5	11	18	33	70	70

240VAC +125°C L, Pi, T 0-400 HERTZ



Spectrum Control Nº	Rated IDC	Filter Circuit and Inductor	Length "L"	DCR Max.	Insertion Loss DB 50 KHz	100 KHz	150 KHz	1 MHz	10 MHz	1 GHz
51-320-023	1 amp	Inductor Bottom	1.006	.21	13	24	30	60	70	70
51-320-024		Inductor Top								
51-320-025	3 amp	Inductor Bottom	1.006	.03	9	14	19	45	70	70
51-320-026		Inductor Top								
51-320-027	5 amp	Inductor Bottom	1.006	.007	9	14	19	37	70	70
51-320-028		Inductor Top								
51-323-005	10 amp	Inductor Bottom	1.006	.0075	5	10	14	30	53	70
51-323-001		Inductor Top								
51-322-012	20 amp	Inductor Bottom	1.738	.0075	4	6	19	35	55	70
51-322-013		Inductor Top								
51-321-317	1 amp	Pi	1.738	.21	23	43	53	80	80	80
51-321-318	3 amp	Pi	1.738	.03	—	15	31	80	80	80
51-321-319	5 amp	Pi	1.738	.02	—	—	17	75	80	80
51-321-612	4 amp	T	1.738	.0013	8	14	18	40	70	70

SPECTRUM CONTROL INC.

152 EAST MAIN STREET, FAIRVIEW, PA. 16415
PHONE (814) 474-5593

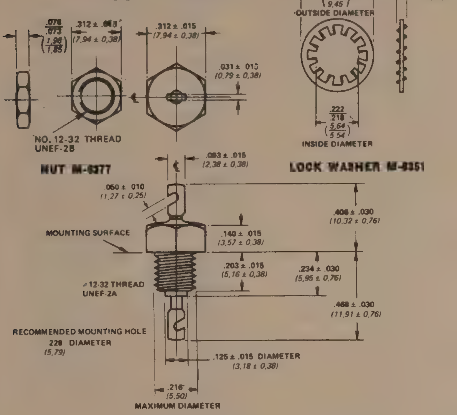
FEED-THRU CERAMIC CAPACITORS

500VDC −55°C
to +85°C

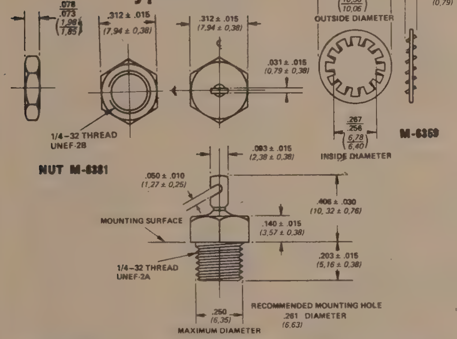
SPECTRUM ACQUIRES ALLEN BRADLEY LINE

In May of 1973, Spectrum Control, Inc. and Allen Bradley Company entered into a long term agreement whereby Spectrum Control acquired all patents, technology and machinery to manufacture the Allen Bradley line of filters and capacitors. These devices can be ordered by the Allen Bradley part number or by the Spectrum Control inventory code number.

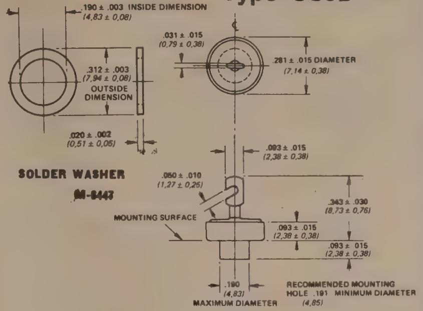
Type FB2B


.380 / .372 (9,65 / 9,45) OUTSIDE DIAMETER
.031 (0,79)
.078 / .073 (1,98 / 1,85)
.312 ± .015 (7,94 ± 0,38)
.312 ± .015 (7,94 ± 0,38)
.031 ± .015 (0,79 ± 0,38)
NO. 12-32 THREAD UNEF-2B
.222 / .218 (5,64 / 5,54) INSIDE DIAMETER
NUT M-6377
LOCK WASHER M-6351
.093 ± .015 (2,38 ± 0,38)
.050 ± .010 (1,27 ± 0,25)
.406 ± .030 (10,32 ± 0,76)
MOUNTING SURFACE
.140 ± .015 (3,57 ± 0,38)
.203 ± .015 (5,16 ± 0,38)
.234 ± .030 (5,95 ± 0,76)
12-32 THREAD UNEF-2A
.468 ± .030 (11,91 ± 0,76)
RECOMMENDED MOUNTING HOLE .228 DIAMETER (5,79)
.125 ± .015 DIAMETER (3,18 ± 0,38)
.216 (5,50) MAXIMUM DIAMETER

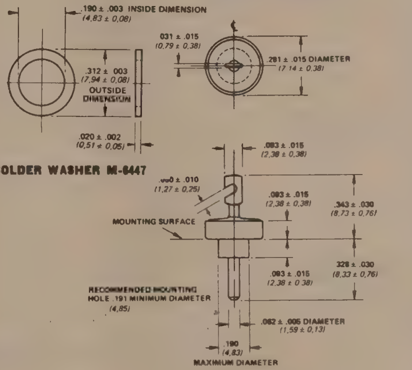
Type SB3A


.078 / .073 (1,98 / 1,85)
.312 ± .015 (7,94 ± 0,38)
.312 ± .015 (7,94 ± 0,38)
.031 ± .015 (0,79 ± 0,38)
.408 / .396 (10,36 / 10,06) OUTSIDE DIAMETER
.031 (0,79)
1/4–32 THREAD UNEF-2B
.267 / .256 (6,78 / 6,40) INSIDE DIAMETER
M-6359
NUT M-6381
.093 ± .015 (2,38 ± 0,38)
.050 ± .010 (1,27 ± 0,25)
.406 ± .030 (10, 32 ± 0,76)
MOUNTING SURFACE
.140 ± .015 (3,57 ± 0,38)
.203 ± .015 (5,16 ± 0,38)
1/4–32 THREAD UNEF-2A
RECOMMENDED MOUNTING HOLE .261 DIAMETER (6,63)
.250 (6,35) MAXIMUM DIAMETER

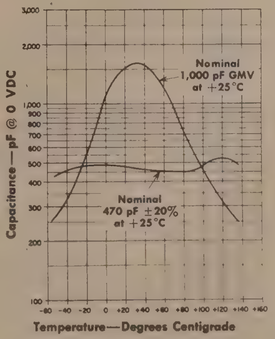
Type SS5D


.190 ± .003 INSIDE DIMENSION (4,83 ± 0,08)
.031 ± .015 (0,79 ± 0,38)
.281 ± .015 DIAMETER (7,14 ± 0,38)
.312 ± .003 (7,94 ± 0,08) OUTSIDE DIMENSION
.020 ± .002 (0,51 ± 0,05)
SOLDER WASHER M-6447
.093 ± .015 (2,38 ± 0,38)
.050 ± .010 (1,27 ± 0,25)
.343 ± .030 (8,73 ± 0,76)
MOUNTING SURFACE
.093 ± .015 (2,38 ± 0,38)
.093 ± .015 (2,38 ± 0,38)
.190 (4,83) MAXIMUM DIAMETER
RECOMMENDED MOUNTING HOLE .191 MINIMUM DIAMETER (4,85)

Type FA5C


.190 ± .003 INSIDE DIMENSION (4,83 ± 0,08)
.031 ± .015 (0,79 ± 0,38)
.281 ± .015 DIAMETER (7,14 ± 0,38)
.312 ± .003 (7,94 ± 0,08) OUTSIDE DIMENSION
.020 ± .002 (0,51 ± 0,05)
SOLDER WASHER M-6447
.093 ± .015 (2,38 ± 0,38)
.050 ± .010 (1,27 ± 0,25)
.093 ± .015 (2,38 ± 0,38)
.343 ± .030 (8,73 ± 0,76)
MOUNTING SURFACE
.093 ± .015 (2,38 ± 0,38)
.328 ± .030 (8,33 ± 0,76)
RECOMMENDED MOUNTING HOLE .191 MINIMUM DIAMETER (4,85)
.062 ± .005 DIAMETER (1,59 ± 0,13)
.190 (4,83) MAXIMUM DIAMETER

Spectrum Control P/N	Allen Bradley P/N	Tolerance %	Capacitance pf	Hardware Supplied
54-794-002-101M	FA5C-1012	20	100	M6447 Solder Preform
54-794-002-471M	FA5C-4712	20	470	
54-794-002-102P	FA5C-102W	GMV	1000	
54-804-002-101M	FB2B-1012	20	100	Nut M6377 Washer M6351
54-804-002-471M	FB2B-4712	20	470	
54-804-002-102P	FB2B-102W	GMV	1000	
54-803-002-101M	SS5D-1012	20	100	M6474 Solder Preform
54-803-002-471M	SS5D-4712	20	470	
54-803-002-102P	SS5D-102W	GMV	1000	
54-807-002-101M	SB3A-1012	20	100	Nut M6381 Washer M6359
54-807-002-471M	SB3A-4712	20	470	
54-807-002-102P	SB3A-102W	GMV	1000	



SPECTRUM CONTROL

SPECTRUM CONTROL INC.

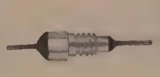
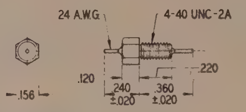
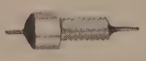
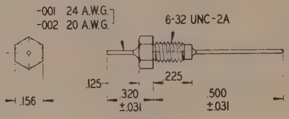
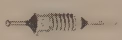
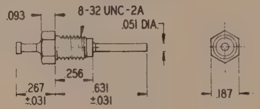
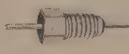
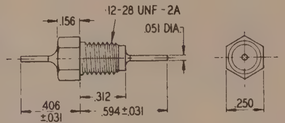
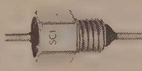
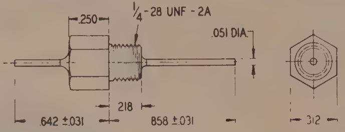
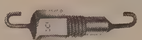
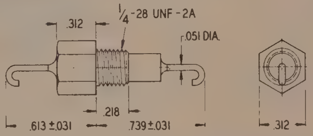
152 EAST MAIN STREET, FAIRVIEW, PA. 16415 PHONE (814) 474-5593

FEED-THRU CERAMIC CAPACITORS

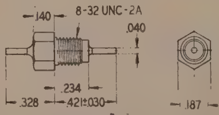
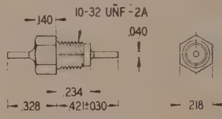
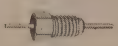
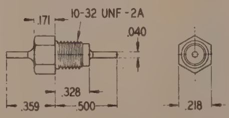
RESIN SEAL

SPECTRUM CONTROL

SPECTRUM ACQUIRES ALLEN BRADLEY LINE In May of 1973, Spectrum Control, Inc. and Allen Bradley Company entered into a long term agreement whereby Spectrum Control acquired all patents, technology and machinery to manufacture the Allen Bradley line of filters and capacitors. These devices can be ordered by the Allen Bradley part number or by the Spectrum Control inventory code number.

		Working Voltage		Catalog Values Picofarad	Ordering Number
		+85°C	+125°C		
	 24 A.W.G. 4-40 UNC-2A .220 .120 .240 ±.020 .360 ±.020 .156	200 200 200 200	100 100 100 100	10 100 500 22000	54-790-001-100M 54-790-001-101M 54-790-001-501Z 54-790-001-223Z
	 -001 24 A.W.G. -002 20 A.W.G. 6-32 UNC-2A .125 .225 .320 ±.031 .500 ±.031 .156	200 200 200 200 200	100 100 100 100 100	10 100 500 1000 22000	54-779-001-100M 54-779-001-101M 54-779-001-501P 54-779-001-102P 54-779-001-223Z
	 .093 8-32 UNC-2A .051 DIA. .256 .267 ±.031 .631 ±.031 .187	200 200 200 200	100 100 100 100	10 100 1000 3000	54-713-001-100M 54-713-001-101M 54-713-001-102Z 54-713-001-302Z
	 .156 12-28 UNF-2A .051 DIA. .312 .406 ±.031 .594±.031 .250	500 500 500	250 250 250	500 1000 39000	54-743-001-501M 54-743-001-102Z 54-743-001-393Z
	 .250 1/4-28 UNF-2A .051 DIA. .218 .642 ±.031 .858 ±.031 .312	500 500 500	250 250 250	1000 1500 3000	54-721-001-102Z 54-721-001-152Z 54-721-001-302Z
	 .312 1/4-28 UNF-2A .051 DIA. .218 .613±.031 .739±.031 .312	500 500 500	250 250 250	1000 1500 10000	54-752-001-102Z 54-752-001-152Z 54-752-001-103Z

MULTI-LAYER FEED-THRU CAPACITORS

		Working Voltage		Catalog Values Picofarad	Ordering Number
		+85°C	+125°C		
	 .140 8-32 UNC-2A .040 .234 .328 .421±.030 .187	100	100	50000	54-785-005-503P
	 .140 10-32 UNF-2A .040 .234 .328 .421±.030 .218	50	50	.3 MFD	54-786-013-304Z
	 .171 10-32 UNF-2A .040 .328 .359 .500 .218	50 50	50 50	.5 MFD 1.0 MFD	54-786-021-504Z 54-786-014-105Z

SPECTRUM CONTROL INC.

152 EAST MAIN STREET, FAIRVIEW, PA. 16415

PHONE (814) 474-5593

EMI/RFI SUPPRESSION FILTERS

Listed below are the decodings from Mil-F-15733 to Spectrum part number. These filters can be ordered by the Spectrum or Mil number. A copy of this Mil specification and the slash sheets are available through normal channels at Naval Publications, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. Spectrum Control is QPL'd on all dash numbers under slash sheets shown and will become qualified under all new slash sheets.

MIL-F-15733

Military Designation	Spectrum Part Number
M15733/23-0001	51-390-001
M15733/23-0002	51-390-002
M15733/23-0003	51-390-003
M15733/23-0004	51-390-004
M15733/23-0005	51-353-316
M15733/23-0006	51-353-317
M15733/23-0007	51-390-005
M15733/23-0008	51-390-006
M15733/23-0009	51-390-007
M15733/23-0010	51-390-008
M15733/23-0011	51-353-318
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M15733/23-0018	51-353-321
M15733/23-0019	51-390-013
M15733/23-0020	51-390-014
M15733/23-0021	51-390-015
M15733/23-0022	51-390-016
M15733/23-0023	51-353-322
M15733/23-0024	51-353-323
M15733/23-0025	51-390-017
M15733/23-0026	51-390-018
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M15733/24-0004	51-385-026
M15733/24-0005	51-353-066
M15733/24-0006	51-353-067
M15733/24-0007	51-385-027
M15733/24-0008	51-385-028

Military Designation	Spectrum Part Number
M15733/24-0009	51-353-068
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M15733/24-0011	51-353-070
M15733/24-0012	51-353-071
M15733/24-0013	51-353-072
M15733/24-0014	51-353-073
M15733/24-0015	51-353-074
M15733/24-0016	51-353-075
M15733/24-0017	51-385-029
M15733/24-0018	51-385-030
M15733/24-0019	51-385-031
M15733/24-0020	51-385-032
M15733/24-0021	51-385-033
M15733/24-0022	51-385-034
M15733/24-0023	51-385-035
M15733/24-0024	51-385-036
M15733/25-0001	51-353-052
M15733/25-0002	51-311-308
M15733/25-0003	51-353-053
M15733/25-0004	51-311-309
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M15733/25-0010	51-311-311
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M15733/27-0020	51-320-020
M15733/27-0021	51-323-315
M15733/27-0022	51-321-315
M15733/27-0023	51-321-609
M15733/28B-0001	51-712-014
M15733/28B-0002	51-712-028
M15733/32-0001	52-304-006
M15733/33-0001	51-707-006
M15733/33-0002	51-707-007
M15733/34B-0001	51-322-016

Military Designation	Spectrum Part Number
M15733/34B-0002	51-322-017
M15733/34B-0003	51-311-327
M15733/34B-0004	51-321-328
M15733/34B-0005	51-321-329
M15733/34B-0006	51-321-330
M15733/34B-0007	51-353-207
M15733/34B-0008	51-353-208
M15733/34B-0009	51-321-334
M15733/35-0001	51-719-017
M15733/35-0002	51-719-018
M15733/36-0001	51-702-012
M15733/36-0002	51-702-013
M15733/37-0001	51-703-004
M15733/38A-0001	51-343-018
M15733/38A-0002	51-343-028
M15733/39B-0001	51-353-148
M15733/39B-0002	51-353-149
M15733/39B-0003	51-353-150
M15733/39B-0004	51-353-151
M15733/39B-0005	51-353-152
M15733/39B-0006	51-353-153
M15733/39B-0007	51-353-154
M15733/39B-0008	51-353-155
M15733/39B-0009	51-353-156
M15733/39B-0010	51-353-157
M15733/39B-0011	51-353-344
M15733/39B-0012	51-353-345
M15733/39B-0013	51-353-223
M15733/40-0001	51-704-002
M15733/43A-0001	51-719-023
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M15733/44B-0001	51-744-003
M15733/44B-0002	51-744-005
M15733/44B-0003	51-744-006
M15733/46-0001	51-709-004
M15733/47B-0001	51-714-023
M15733/47B-0002	51-714-024
M15733/47B-0003	51-714-032
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M15733/48A-0001	51-385-038
M15733/48A-0002	51-385-040
M15733/49-0001	51-344-011
M15733/50B-0001	51-713-007
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M15733/54B-0011	51-353-357
M15733/54B-0012	51-353-358
M15733/54B-0013	51-353-359
M15733/54B-0014	51-353-360
M15733/54B-0015	51-353-227
M15733/54B-0016	51-353-228
M15733/56-0001	51-431-804
M15733/56-0002	51-431-805
M15733/57-0001	51-353-226

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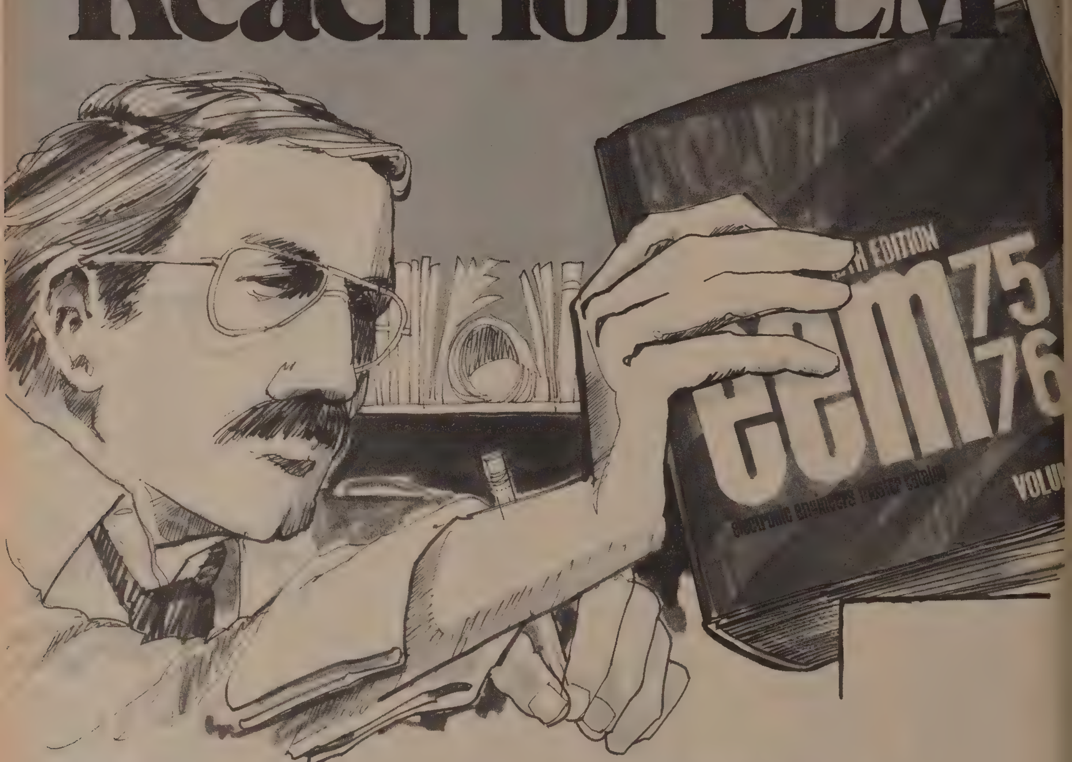
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SPRAGUE FILTERS

HYPASS® CAPACITORS

SPRAGUE
HYPASS
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HYPASS

- Exclusive Sprague 3-terminal Network Feed-thru Capacitors
- Bypass V-H-F Currents Where Ordinary Capacitors are Ineffective
- Suppress TVI from Short-wave Transmitters, Diathermy Machines, Electronic Heating Apparatus, etc.
- Eliminate Line-conducted Interference from Neighboring TV Sets
- Install Leads in Series with Circuit Being Filtered and Ground the Case

µF	Amps.	WVDC	Dia. x Length	Cat. No.
.5	40	50	1 x 1 13/16	*48P18
.5	60	50	1 x 1 13/16	*48P100
.25	20	200	3/4 x 1 13/16	*48P10
.25	20	200	3/4 x 1 13/16	*†80P5
.5	20	200	1 x 1 13/16	*48P14
.1	20	250 (VAC)	11/16 x 1 13/16	*48P9
.1	20	400	11/16 x 1 13/16	*48P6
.1	20	400	11/16 x 1 13/16	*†80P1
.002	15	600	1/4 x 1 3/8	46P12
.005	15	600	1/4 x 1 5/8	46P8
.01	20	600	7/16 x 1 1/4	47P6
.02	20	600	7/16 x 1 1/2	47P8
.1	20	600	11/16 x 1 13/16	*48P8
.1	20	600	11/16 x 1 13/16	*†80P3
.25	20	600	1 x 1 13/16	*48P12
.5	20	600	1 x 2 1/4	*48P16
.005	20	1000	7/16 x 1 1/4	47P12
.01	20	1000	7/16 x 1 1/2	47P13
.005	20	2500	1 x 1 9/16	47P14
.01	20	2500	1 x 1 9/16	47P15
.002	20	5000	1 x 1 9/16	47P16

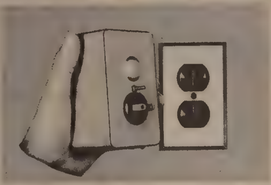
CALL YOUR SPRAGUE INDUSTRIAL DISTRIBUTOR FOR CURRENT PRICES

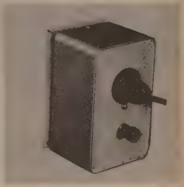
*Has female screw terminals

†Bulkhead mounting

TYPE F-400

MIRACLE FILTEROL®





A LINE FILTER THAT REALLY WORKS

- Effectively Suppresses Radio Interference by Filtering Power Lines of Receivers and Appliances
- Maximum Noise Eliminating Efficiency because of Practically Zero Length of Ground Lead
- Plugs into Standard Duplex Wall Outlet — Captive Screw Fastens Filterol F-400 to Outlet for Safe, Secure Mounting
- Direct Wall-Mounting Provides Neat Installation — No Unsightly Cord — Receiver or Appliance Plugs into Standard Outlet on Face of F-400
- Will Also Operate at Slightly Reduced Efficiency in Older Homes where Wiring is of Knob and Tube or 2-Conductor Non-Metallic Sheathed Cable Type by Using the External Grounding Post Provided for this Purpose
- Handsomely Finished in Tan Hammerloid Baked Enamel
- Rated at 5 Amperes, 125 Volts AC or DC

CALL YOUR SPRAGUE INDUSTRIAL DISTRIBUTOR FOR CURRENT PRICES

TYPE IF FILTERS

IF-15
IF-11
IF-21
IF-S1
IF-37

IF-15—TRIPLE-SECTION FILTER for small motor-operated devices such as fans, drills, etc. designed to prevent shocks from discharge of filter capacitors.

IF-11—DUAL HIGH-CAPACITY FILTER designed for use on motors over 1 hp up to 220 volts ac-dc. Also used on high-current arcing devices.

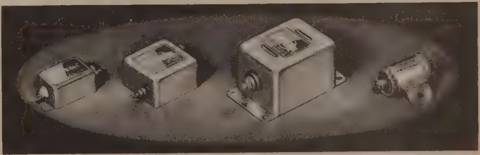
IF-21—COMPACT DUAL FILTER for use on fractional horsepower motors with case grounded to motor frame. Also used across line terminals of motors.

IF-S1—SINGLE SECTION 2-LEAD FILTER for use across make-and-break contacts, such as thermostats, circuit breakers, etc.

IF-37—3-SECTION DELTA-CONNECTED FILTER especially designed for fluorescent fixtures and governor-type motors. Underwriters' Labs., Inc. listed.

Cat. No.	Volts AC or DC	Dia. x Length
IF-15	220	1 x 2 3/16
IF-11	220	1 3/8 x 5 1/4
IF-21	220	1 x 2 3/16
IF-S1	220	3/4 x 2 1/16
IF-37	220	1 x 2"

FILTEROL® FILTERS



Filterol Types 1, 2, and 3— Designed for connection in series with power supply lines to interference-producing devices . . . A 3-terminal network with the case as one terminal . . . The selected filter should have a rating higher than the continuous operating current of the offending device . . . A single Filterol connected to the high side of the line is usually sufficient . . . In severe cases a Filterol in each leg of the power line may be necessary . . . For three or four-wire systems, a Filterol in each wire is necessary.

Filterol Type 4— A new, exclusive Sprague development incorporating a Sprague HYPASS® Capacitor . . . Provides exceptionally high attenuation at frequencies above 5 megacycles . . . Intended for small devices with continuous current ratings up to 20 amperes.

Cat. No.	Amps.	Volts AC or DC	Size
Filterol 1	1	115	7/8 x 1 1/4 x 1 3/4
Filterol 2	10	115	1 1/8 x 2 x 2
Filterol 3	35	115	1 7/8 x 2 7/8 x 3 1/8
Filterol 4	20	115	1" dia. x 1 13/16" long

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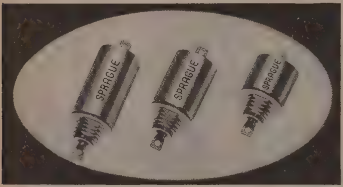
SPRAGUE FILTERS



SUBMINIATURE EMI FILTERS

- The broadest line of subminiature interference control components available.
- Small size and high performance make them well suited for high-density packaging in a wide variety of applications, including power and control lines.
- Hermetically sealed with glass-to-metal seals in corrosion resistant metal cases.
- Low terminal-to-terminal d-c resistance. Especially desirable in low-voltage circuitry where any reduction in power supply voltage is critical.
- Threaded-neck construction is ideal where leads being filtered pass through chassis or bulkhead.
- For complete technical data, refer to Sprague Engineering Bulletins 8132 and 8132.1.

Circuit Type	Current (Amperes)	Voltage Rating			Max. D-C Resistance (Ohms)	Size Dia. x Length	Min. Full Load Insertion Loss (dB)						Catalog Number
		A-C@125 C	D-C@85 C	D-C@125 C;			30 kHz	150 kHz	300 kHz	1 MHz	10 MHz	1 GHz	
feed-thru	15	—	50	30	—	.400 x .210	16	30	36	46	50	60	15JX2529
feed-thru	10	—	100	50	0.01	.400 x .250	10	24	30	40	50	60	7JX2503
feed-thru	5 7	125, 400 Hz 125, 60 Hz	—	—	0.01	.400 x .250	—	15	21	31	48	60	5JX3502
L	0.1	—	100	50	1.7	.400 x .440	19	47	60	70	70	70	1JX2603
L	0.5	—	100	50	0.35	.400 x .440	15	37	49	70	70	70	1JX2623
L	5	—	100	50	0.01	.400 x .440	11	24	30	40	70	70	5JX2693
L	0.1	—	100	50	1.7	.400 x .440	19	47	60	70	70	70	1JX2608
L	0.5	—	100	50	0.35	.400 x .440	15	37	49	70	70	70	1JX2628
L	5	—	100	50	0.01	.400 x .440	11	24	30	40	70	70	5JX2698
Pi	0.5	—	100	50	0.35	.400 x .540	24	68	80	80	80	80	1JX2713
Pi	1	—	100	50	0.14	.400 x .540	—	54	71	80	80	80	1JX2718
Pi	2	—	100	50	0.06	.400 x .540	—	47	65	80	80	80	2JX2723
Pi	5	—	100	50	0.01	.400 x .540	—	18	47	80	80	80	5JX2732
L	0.1	125, 400 Hz	250	150	1.7	.400 x .440	10	38	51	60	60	60	1JX3601
L	0.5	125, 400 Hz	250	150	0.35	.400 x .440	4	27	36	57	60	60	1JX3603
L	4 5	125, 400 Hz 125, 60 Hz	250	150	0.01	.400 x .440	4	15	21	32	57	60	5JX3623
L	0.1	125, 400 Hz	250	150	1.7	.400 x .440	10	38	51	60	60	60	1JX3606
L	0.5	125, 400 Hz	250	150	0.35	.400 x .440	4	27	36	57	60	60	1JX3608
L	4 5	125, 400 Hz 125, 60 Hz	250	150	0.01	.400 x .440	4	15	21	32	57	60	5JX3613
Pi	0.5	125, 400 Hz	250	150	0.35	.400 x .540	—	47	64	70	70	70	1JX3703
Pi	1.5	125, 400 Hz	250	150	0.06	.400 x .540	—	20	44	70	70	70	2JX3705
Pi	3.5 5	125, 400 Hz 125, 60 Hz	250	150	0.01	.400 x .540	—	—	—	58	70	70	5JX3709

RADIO INTERFERENCE FILTERS

FOR AIRCRAFT APPLICATIONS

- Exact replacements for filters needed to control radio interference caused by noise-producing devices in aircraft as well as ground equipment.
- Constructed to meet the high quality standards demanded by the aircraft industry.
- Hermetically-sealed terminals. Corrosion-resistant metal cases.

Current (Amperes)	Volts A-C	Volts D-C	D-C Surge	Operating Temperature	Size L. x W. x H.	Unit in Photo	Catalog Number
0.5	—	50	75V	65C	1¾ x 1¼ x 1⅛	F	18005A
0.5	—	50	75V	65C	2½ x 2 x 1⅛	D	1JX700A
2	125, 400 Hz	—	250V	125C	1¼ x ¾ x ¾	E	JN10-358
5	115, 400 Hz	—	900V	85C	2½ x 2 x 1¾	B	10S1034A
5	—	28	50V	125C	2⅞ x 2¼ x 1 13/16	C	JN10-2002B1
3 x 20	115, 400 Hz	—	1000V	85C	10¾ x 5 x 2½	A	10S1033

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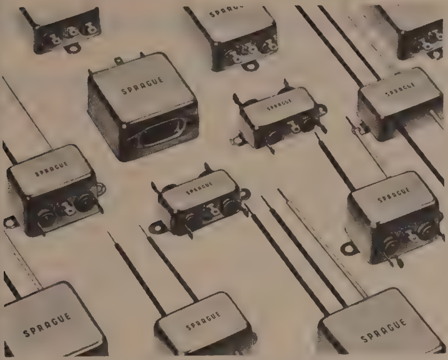
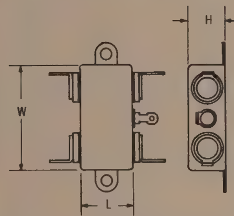
SPRAGUE CAPACITORS

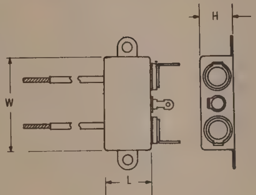
SERIES JX5100 GENERAL PURPOSE INTERFERENCE FILTERS



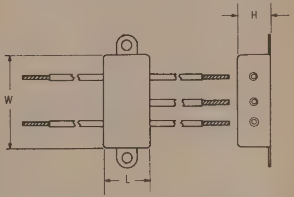
- Designed for wide variety of applications . . . particularly useful in desk top computers, office machines, medical electronics, industrial controls, other high quality instruments.
- U.L. recognized for operation at 125 or 250 volts a-c.
- Ideal for eliminating broadcast band and high-frequency interference. Also useful into the VHF range and in microwave oven applications.
- May be used at any combination of voltage and frequency up to and including the max. of 250 volts a-c, 60 Hz, at full rated current.
- Max. leakage current is 0.5mA at 125V, 60 Hz and 1.0mA at 250V, 60 Hz.
- Will withstand a 2100 volt d-c dielectric strength test.
- Style AA and AB filters furnished with combination terminals which accept so-called "quick-connect" connectors and may also be used as soldering lugs.
- For complete technical data, refer to latest issue of Sprague Engineering Bulletin 8210.11.



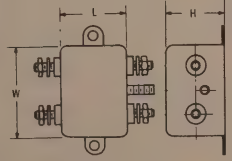
STYLE AA



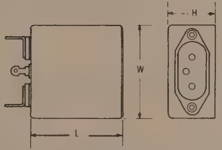
STYLE AB



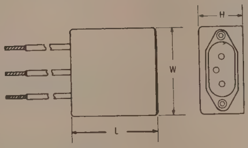
STYLE AC



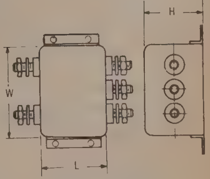
STYLE AD



STYLE BA



STYLE BB



STYLE DD

Max. Current (Amperes)	Style	Dimensions In Inches L. x W. x H.	Cat. Number
1	AA	.940 x 1.750 x .650	1JX5101A
	AB	.940 x 1.750 x .650	1JX5101B
	AC	.940 x 1.750 x .650	1JX5101C
	BA	1.850 x 2.000 x .750	1JX5101D
	BB	1.850 x 2.000 x .750	1JX5101E
2	AA	.940 x 1.750 x .650	2JX5102A
	AB	.940 x 1.750 x .650	2JX5102B
	AC	.940 x 1.750 x .650	2JX5102C
	BA	1.850 x 2.000 x .750	2JX5102D
	BB	1.850 x 2.000 x .750	2JX5102E
3	AA	1.330 x 1.750 x .750	3JX5103A
	AB	1.330 x 1.750 x .750	3JX5103B
	AC	1.330 x 1.750 x .750	3JX5103C
	BA	2.090 x 2.000 x .750	3JX5103D
	BB	2.090 x 2.000 x .750	3JX5103E
5	AA	1.330 x 1.750 x .750	5JX5104A
	AB	1.330 x 1.750 x .750	5JX5104B
	AC	1.330 x 1.750 x .750	5JX5104C
	BA	2.090 x 2.000 x .750	5JX5104D
	BB	2.090 x 2.000 x .750	5JX5104E
10	AA	1.330 x 1.750 x 1.130	10JX5105A
	AB	1.330 x 1.750 x 1.130	10JX5105B
	AC	1.330 x 1.750 x 1.130	10JX5105C
	BA	2.090 x 2.000 x 1.130	10JX5105D
	BB	2.090 x 2.000 x 1.130	10JX5105E
	AD	1.250 x 1.750 x 1.130	10JX5105F
20	AA	2.060 x 2.000 x 1.130	20JX5106A
	AD	2.060 x 2.000 x 1.130	20JX5106B
30	DD	3.870 x 3.310 x 1.500	30JX5107A

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TTE *miniature* FILTERS

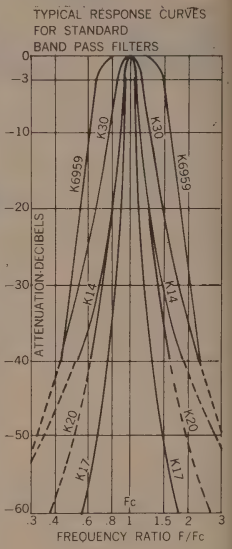
Lowpass
1K/1K ohm
A1971

THESE PAGES CATALOG OVER 1,000,000 STANDARD FILTER TYPES — SPECIFY ANY COMBINATION OF FREQUENCY, SOURCE AND LOAD OHMS WITHIN THE MIN-MAX RANGES

These pages give complete electrical and mechanical information for ordering standard filters.

BANDPASS FILTERS FOR ANY CENTER FREQUENCY FROM 30Hz TO 100MHz (Specials from 10Hz upward)

Series	F_c Center Freq. Range Min.	Max.	Bandwidth @ −3db	Stopband Attenuation	Source, Ohms Min.	Max.	Load, Ohms Min.	Max.	Case No.
K10	500Hz	9.9KHz	±1%F_c	30db at .92F_c & 1.1F_c & 40db at .86F_c & 1.2F_c	1K	500K	1K	500K	4
K10A	10KHz	100MHz	±1%F_c		50	10K	50	10K	3 or 11
K11B	500Hz	9.9KHz	±1%F_c	30db at .94F_c & 1.06F_c & 40db at .93F_c & 1.1F_c	1K	500K	1K	500K	4
K11D	10KHz	100MHz	±1%F_c		50	10K	50	10K	3 or 12
K12A	500Hz	9.9KHz	±2%F_c	30db at .92F_c & 1.1F_c	1K	10K	1K	10K	4
K12C	10KHz	100MHz	±2%F_c	30db at .92F_c & 1.1F_c	50	10K	50	10K	3 or 12
K13	30Hz	99Hz	±5%F_c	60db at .5F_c & 2F_c	1K	500K	1K	500K	5
K14A	100Hz	100KHz	±5%F_c	40db at .5F_c & 2F_c	500	10K	100	1 Meg	3
K14B	300Hz	999Hz	±5%F_c	35db at .5F_c & 2F_c	700	15K	700	15K	11
K14C	1KHz	99KHz	±5%F_c	43db at .5F_c & 2F_c	1K	1K	1K	10K	10
K14D	100KHz	100MHz	±5%F_c	43db at .5F_c & 2F_c	50	100	50	100	10
K17	100Hz	10KHz	±5%F_c	60db at .5F_c & 2F_c	500	10K	100	1 Meg	4
K17A	300Hz	999Hz	±5%F_c	50db at .5F_c & 2F_c	500	15K	500	30K	12
K17B	1KHz	99KHz	±5%F_c	50db at .5F_c & 2F_c	100	50K	100	100K	11
K17C	100KHz	100MHz	±5%F_c	60db at .5F_c & 2F_c	50	300	50	300	11
K18	10KHz	100KHz	±5%F_c	60db at .5F_c & 2F_c	100	100K	100	500K	3
K20	100Hz	3.9KHz	±7.5%F_c	40db at .57F_c & 1.75F_c	500	10K	500	10K	4
K20C	250Hz	99KHz	±7.5%F_c	35db at .5F_c & 2F_c	1K	10K	1K	10K	11
K20D	100KHz	100MHz	±7.5%F_c	40db at .67F_c & 1.5F_c	50	300	50	300	11
K21B	1KHz	100KHz	±7.5%F_c	40db at .6F_c & 1.67F_c	500	10K	500	10K	3
K30	100Hz	3.9KHz	±15%F_c	40db at .4F_c & 2.5F_c	500	10K	500	10K	4
K30C	150Hz	99KHz	±15%F_c	25db at .45F_c & 2.2F_c	1K	10K	1K	10K	11
K30D	100KHz	100MHz	±15%F_c	40db at .5F_c & 2F_c	50	300	50	300	11
K31B	1KHz	100KHz	±15%F_c	40db at .45F_c & 2.2F_c	500	10K	500	10K	3



The bandwidth for any of the above filters can be increased or decreased to specification.

WIDE BAND FILTERS: Bandwidths of ±16% or greater can be obtained by ordering TTE standard High pass and Low pass filter sections as a composite network. Select numbers from the Series H and J listings on the next page which give the desired attenuation slopes and combine these numbers. For example to obtain a slope of 40db at 0.65 of the lower freq. cut-off, F_{c1}, (High pass section) and 40db at 1.6 of the upper freq. cut-off, F_{c2}, (Low pass section) use H69B and J59B. Specify the two as K6959. **The high pass series number is first, followed by the low pass number.** Types with dissymmetrical attenuation slopes can be combined. Also specify the three db down cut-off frequencies F_{c1} and F_{c2} and impedance. The price is the sum of the HP and LP section prices.

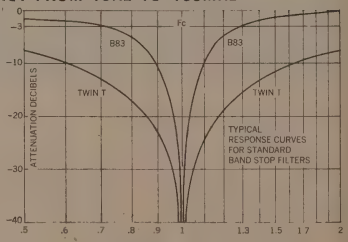
Telemetering: Refer to series K20, K21B, K30 or K31B. TO ORDER specify IRIG Channel number, source and load impedances.

TO ORDER BANDPASS FILTERS — Specify (1) TTE Series No., (2) minus 3db frequencies, (3) source impedance, (4) load impedance. **PRICES** $33 to $72.

INSERTION LOSSES for bandpass types between equal terminations are from 0.5 to 6db depending upon bandwidth, frequency and size. K10 and K11 types have about 10 db, and K12 types about 5db flat loss. **SPECIALS** are available for center frequencies from 10Hz upward and 40db to 3db bandwidth ratios as sharp as 1.2:1. **TO ORDER** Specials, also specify (5) bandwidth and (6) stop band attenuation required.

BAND REJECT STANDARD FILTERS FOR ANY CENTER FREQUENCY FROM 10Hz TO 100MHz

Series	F_c, Center Freq. Range Min.	Max.	Bandwidth −3db	Attenuation	Impedance Ohms Min.	Max.	Circuit	Case No.
B83	10Hz	1MHz	.77F_c & 1.3F_c	50db Notch	50	1 Meg.	L-C	4
D	10Hz	100KHz	.25F_c & 4 F_c	50db Notch	SEE ORDERING INSTRUCTIONS BELOW		Twin-T	2
F	10Hz	100KHz	.25F_c & 4 F_c	60db Notch			Twin-T	2
R20	100Hz	3999Hz	$BW_{3db}/BW_{40db} \leq 5$ For $BW_{40db} \geq 10\%F_c$		10K	50K	L-C	4 or 13
R30	4KHz	100MHz			50	10K	L-C	4 or 13



FREQUENCY RATIO F/Fc

TO ORDER BAND REJECT FILTERS — Specify (1) TTE Series No. or Letter, (2) center frequency, (3) source impedance, (4) load impedance. For Series R20 and R30 specify 40db bandwidth. Twin-T prices and cases apply to all filters using capacitor values from 0.1 MFD to 500 pF. $C = 1/8.85FHz\ (R_{source}R_{load})^{1/2}$. C is in farads. Filters with null frequencies as low as 1Hz are available. Terminations are regarded as resistive unless otherwise specified. **PRICES** $17 to $45.

TT ELECTRONICS INC. 2214 SO. BARRY AVE. / LOS ANGELES, CALIF. 90064 / (213) 478-8224

TTE *miniature* FILTERS

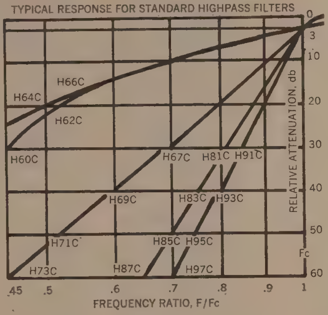
ELECTRONICS, INC.
TTE
Bandpass
1K/1K
ohms
300
KI
B1971

1-2 WEEK DELIVERY FOR STANDARD AND NEAR STANDARD TYPES
ALL GROUPS AVAILABLE IN FLAT PC MOUNTING CASES

HIGH PASS

STANDARD FILTERS FOR ANY CUT-OFF FREQ. FROM 75Hz TO 100MHz

Series	Min. Attn. db	Cut-off Ratio F/Fc
H60C	30	.45
H62C	40	.35
H64C	50	.25
H66C	60	.15
H67C	30	.70
H69C	40	.60
H71C	50	.52
H73C	60	.45
H81C	30	.81
H83C	40	.75
H85C	50	.70
H87C	60	.65
H91C	30	.85
H93C	40	.80
H95C	50	.75
H97C	60	.70

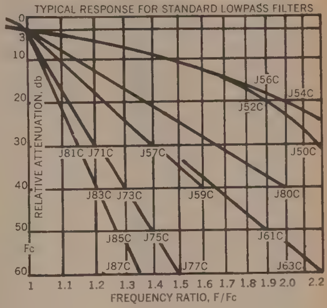


TO ORDER specify (1) TTE Series No., (2) minus 3db freq., (3) impedance, (4) Case No. **SPECIALS** are available for cut-off frequencies down to 40Hz and above 100MHz. **PRICES** $26 to $65.

LOW PASS

STANDARD FILTERS FOR ANY CUT-OFF FREQ. FROM 75Hz TO 100MHz
(*And from 10Hz to 74Hz)

Series	Min. Attn. db	Cut-off Ratio F/Fc
J50C	30	2.2
J52C	40	3.0
J54C	50	4.0
J56C	60	5.5
J57C	30	1.4
J59C	40	1.6
J61C	50	1.9
J63C	60	2.2
J71C	30	1.2
J73C	40	1.3
J75C	50	1.4
J77C	60	1.5
J81C	30	1.15
J83C	40	1.20
J85C	50	1.27
J87C	60	1.35
*J80C	40	2.0



TO ORDER specify (1) TTE Series No., (2) minus 3db freq., (3) impedance, (4) Case No. **SPECIALS** are available for cut-off frequencies down to 3Hz and above 100MHz. **PRICES** $26 to $65.

PHASE LINEARITY is reasonable. Some types are used for pulse transmission.

CASE SIZES FOR HIGHPASS AND LOWPASS FILTERS

J50C THRU J63C
H60C THRU H73C
PC CASE 12 11
75Hz 200Hz 500Hz 1KHz 2KHz 50KHz 100KHz 100MHz
STD. CASE 5 4 3 2

J71C THRU J87C
H81C THRU H97C
PC CASE 15 12
100Hz 200Hz 1KHz 5KHz 10KHz 100KHz 100MHz
STD. CASE 5 4 3

J80C, CASE 4

SOURCE AND LOAD impedances are equal and resistive for standard HP and LP filters. The insertion loss is less than 0.5db for ±10% matching. Typical Passband flatness within ±0.2db.

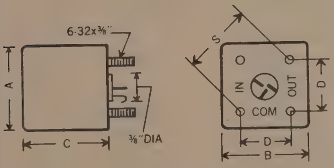
SPECIALS for other impedances and unequal terminations are available. Units with cut-off ratios as sharp as 1.06 (0.94 Highpass) are available.

IMPEDANCE GUIDE — HIGH PASS AND LOW PASS TYPES

Fc −3db 10Hz 50Hz 100Hz 500Hz 5KHz 10KHz 100KHz 500KHz 1MHz 5MHz 100MHz
Z MINΩ 10K 10K 5K 1K 500 100 50 50 50 50
Z MaxΩ 15K 39K 39K 39K 20K 3K 3K 1K 300 75

CASE DIMENSIONS AND MOUNTING INFORMATION FOR ALL FILTERS

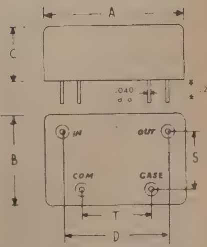
STANDARD CHASSIS TYPE



CASE	A	B	C	D	S	T	Mounting
STANDARD CHASSIS TYPE							
1	.75	.75	1.38	—	.56	—	(2)4-40 x ⅜
2	1.19	1.19	1.25	.75	—	—	(4)6-32 x ⅜
3	1.31	1.31	1.75	—	1.25	—	(2)6-32 x ⅜
4	1.63	1.63	2.38	1.19	—	—	(4)6-32 x ⅜
5	1.94	1.81	2.44	1.38/ 1.25	—	—	(4)6-32 x ⅜
FLAT PC BOARD TYPE							
10	1.27	1.27	.50	.90	.90	.60	PC PINS
11	1.88	1.44	.50	1.5	1.0	1.0	PC PINS
12	2.00	2.00	.50	1.5	1.5	1.0	PC PINS
13	2.00	2.00	.75	1.5	1.5	1.0	PC PINS
15	2.96	1.93	.50	2.4	1.4	2.0	PC PINS
16	2.96	1.93	.75	2.4	1.4	2.0	PC PINS

BNC AND SMA CONNECTORS ARE AVAILABLE.

FLAT CASES PC BOARD TYPE



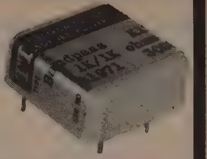
From 500KHz upward flat case "Com" is connected to case.

NOTES: TTE Filters are epoxy encased within hermetically sealed steel cases. The case finish is copper plate per MIL-C-14550 under fused tin per MIL-T-10727A. The maximum power output without de-tuning is 10 to 20 milliwatts for most low frequency types. K10 and K12 types are tested at 100mV and B83 types at .77V output for all imped. levels. Terminations are regarded as resistive unless otherwise specified.

TTE COVERS THE RANGE—
VLF-LF-MF-HF-VHF-UHF
LC — CRYSTAL — POWER NETWORKS

TT ELECTRONICS
INC. 2214 SO. BARRY AVE. / LOS ANGELES, CALIF. 90064 / (213) 478-8224

TTE *miniature* FILTERS



1-2 WEEK DELIVERY FOR STANDARD AND NEAR STANDARD TYPES
ALL GROUPS AVAILABLE IN FLAT PC MOUNTING CASES

BANDPASS FILTERS — these are typical modified standard types

Model Number	Center Frequency	Band-Width, %	−3db Frequencies	Stopband Attenuation and Frequency	Source & Load Ohms	Case Number
K1007	17.6Hz	88.0	11.5 & 27.0Hz	16.5db @ 6.9 & 54.0Hz	39k/39k	5
K6959	28.2Hz	112	16.0 & 50.0Hz	40db @ 10.4 & 80.0Hz	39k/39k	6†
K6959	33.3Hz	144	16.0 & 64.0Hz	40db @ 10.4 & 102.4Hz	39k/39k	6†
K9982	38.7Hz	142	20.0 & 75.0Hz	40db @ 10.0 & 150Hz	39k/39k	6†
K6050	56.5Hz	248	20.0 & 160Hz	30db @ 9.0 & 352Hz	3k/3k	11
K9990	118Hz	110	70.0 & 200Hz	40db @ 35.0 & 400Hz	39k/39k	6†
K6050	187Hz	134	100 & 350Hz	30db @ 45.0 & 770Hz	15k/15k	12
K7783	252Hz	69.5	180 & 355Hz	60db @ 90.0 & 710Hz	10k/10k	HU3†
K8536	315Hz	2.5	311.1 & 318.9Hz	30db @ 289.8 & 346.5Hz	1k/1k	5
K9735	400Hz	15.0	370 & 430Hz	30db @ 280 & 518Hz	1k/1k	6†
K1023	400Hz	15.0	370 & 430Hz	60db @ 275 & 585Hz	1k/1k	HU3†
K7892	501Hz	71.0	355 & 710Hz	60db @ 177.5 & 1420Hz	10k/10k	HU3†
K9749	560Hz	15.0	518 & 602Hz	30db @ 430 & 675Hz	1k/1k	6†
K7817	590Hz	30.1	502 & 698Hz	30db @ 400 & 945Hz	10k/10k	15
K3400	697Hz	5.0	680 & 715Hz	40db @ 627 & 767Hz	600/600	EA†
K8777	708Hz	692	100 & 5000Hz	60db @ 65.0 & 7500Hz	10k/10k	5
K9743	730Hz	15.0	675 & 785Hz	30db @ 602 & 888Hz	1k/1k	6†
K6050	756Hz	172	350 & 1650Hz	30db @ 157.5 & 3630Hz	15k/15k	11
K9762	960Hz	15.0	888 & 1032Hz	30db @ 785 & 1202Hz	1k/1k	6†
K6373	980Hz	297	300 & 3200Hz	60db @ 150 & 6400Hz	2k/2k	5
K7827	1000Hz	21.0	896 & 1105Hz	30db @ 760 & 1345Hz	10k/10k	12
K7901	1000Hz	70.0	710 & 1410Hz	60db @ 355 & 2820Hz	10k/10k	HU3†
K8542	1120Hz	98.3	700 & 1800Hz	30db @ 300 & 3000Hz	1k/1k	15
K8777	1180Hz	110	700 & 2000Hz	60db @ 455 & 3000Hz	1k/1k	6†
K9779	1300Hz	15.0	1202 & 1572Hz	30db @ 1032 & 1572Hz	1k/1k	5
K9041	1500Hz	13.3	1400 & 1600Hz	40db @ 600 & 2400Hz	10k/10k	13
K8956	1600Hz	2.5	1580 & 1620Hz	30db @ 1472 & 1760Hz	10k/10k	4
K9783	1700Hz	15.0	1572 & 1828Hz	30db @ 1398 & 2127Hz	1k/1k	5
K7919	1980Hz	71.0	1410 & 2820Hz	60db @ 705 & 5640Hz	10k/10k	12
K4717	2000Hz	14.0	1860 & 2140Hz	50db @ 1400 & 2500Hz	10k/10k	5
K7848	2100Hz	11.5	1980 & 2221Hz	30db @ 1670 & 2820Hz	10k/10k	12
K3413	2250Hz	5.0	2194 & 2307Hz	40db @ 1958 & 2542Hz	600/600	4
K6050	2280Hz	65.8	1650 & 3150Hz	30db @ 742.5 & 6930Hz	15k/15k	11
K9795	2300Hz	15.0	2127 & 2473Hz	30db @ 1828 & 2775Hz	1k/1k	5
K8821	2400Hz	12.5	2250 & 2550Hz	50db @ 1200 & 4800Hz	10k/10k	11
K7927	2408Hz	116	2820 & 5630Hz	60db @ 1410 & 11260Hz	10k/10k	12
K9058	2500Hz	8.0	2400 & 2600Hz	40db @ 1600 & 3400Hz	10k/10k	13
K8870	2600Hz	3.9	2550 & 2650Hz	30db @ 2390 & 2860Hz	1k/1k	4
K7363	2610Hz	123	200 & 3400Hz	60db @ 100 & 6800Hz	5k/10k	4
K8777	2820Hz	71.0	2000 & 4000Hz	60db @ 1340 & 6000Hz	1k/1k	15
K7859	2900Hz	8.96	2770 & 3030Hz	30db @ 2300 & 3900Hz	10k/10k	12
K2525	2960Hz	29.6	2500 & 3500Hz	40db @ 2000 & 4300Hz	10k/10k	4
K9806	3000Hz	15.0	2775 & 3225Hz	30db @ 2473 & 3607Hz	1k/1k	5
K6622	3500Hz	4.3	3425 & 3575Hz	30db @ 2870 & 4270Hz	10k/10k	3
K9062	3500Hz	5.72	3400 & 3600Hz	40db @ 2600 & 7000Hz	10k/10k	13
K3397	3540Hz	56.6	500 & 2500Hz	60db @ 50.0 & 5000Hz	50/5000	6†
K1031	3890Hz	15.0	3600 & 4200Hz	40db @ 3200 & 4600Hz	1k/1k	HU3†
K8716	4000Hz	3.75	3925 & 4075Hz	30db @ 3680 & 4400Hz	10k/10k	10
K6656	4000Hz	100	2000 & 6000Hz	60db @ 380 & 31800Hz	20k/20k	4
K4723	4500Hz	6.20	4150 & 4850Hz	50db @ 3900 & 5100Hz	10k/10k	5
K8179	4500Hz	26.7	3900 & 5700Hz	40db @ 3530 & 5570Hz	10k/10k	15
K9975	5000Hz	20.0	4750 & 5250Hz	40db @ 3200 & 8200Hz	1k/1k	3
K8020	5500Hz	2.5	5431 & 5569Hz	40db @ 2750 & 11000Hz	50k/50k	4
K8013	6500Hz	2.5	6419 & 6581Hz	40db @ 3250 & 13000Hz	50k/50k	4
K8373	6690Hz	127	500 & 9000Hz	40db @ 395 & 11700Hz	500/500	5
K8860	7350Hz	20.0	6615 & 8085Hz	40db @ 3770 & 14700Hz	10k/10k	3
K8282	7500Hz	2.60	7400 & 7600Hz	30db @ 6768 & 8391Hz	100k/100k	4
K7765	7590Hz	271	2500 & 23000Hz	60db @ 1250 & 46000Hz	3k/3k	11
K8595	7750Hz	2.58	7650 & 7850Hz	50db @ 3875 & 15.5KHz	100k/100k	4
K7931	7950Hz	72.5	5630 & 11300Hz	60db @ 2815 & 22600Hz	10k/10k	12
K8934	8000Hz	2.50	7900 & 8100Hz	30db @ 7360 & 8800Hz	10k/10k	4
K8576	8000Hz	12.5	7500 & 8500Hz	50db @ 4000 & 16000Hz	100k/100k	4
K8587	8250Hz	2.43	8150 & 8350KHz	50db @ 4125 & 16500Hz	100K/100K	4
K7378	9770Hz	48.1	7700 & 12400Hz	60db @ 5.16 & 18.6KHz	2k/2k	12
K9572	10.0KHz	5.0	9.75 & 10.25KHz	40db @ 9.4 & 10.7KHz	1k/1k	5
K9560	10.0KHz	20.0	9.0 & 11.0KHz	40db @ 6.0 & 16.0KHz	10k/10k	11
K8325	11.5KHz	8.7	11.0 & 12.0KHz	60db @ 5.75 & 23.0KHz	1k/1k	3
K1035	14.4KHz	15.0	13.4 & 15.6KHz	40db @ 10.9 & 19.0KHz	1k/1k	HU3†
K6057	14.75KHz	202	6.0 & 36.0KHz	30db @ 2.70 & 50.4KHz	2k/2k	12
K9360	16.0KHz	2.5	15.8 & 16.2KHz	60db @ 10.46 & 32.14KHz	10k/10k	4
K5523	20.0KHz	5.0	19.5 & 20.5KHz	30db @ 18.0 & 22.0KHz	5k/5k	11
K6057	20.0KHz	150	10.0 & 40.0KHz	30db @ 4.50 & 56.0KHz	2k/2k	12
K6050	22.3KHz	179.5	10.0 & 50.0KHz	30db @ 4.50 & 110KHz	1k/1k	11
K5535	25.0KHz	4.0	24.5 & 25.5KHz	30db @ 20.0 & 31.2KHz	5k/5k	11
K8228	26.8KHz	48.3	20.0 & 36.0KHz	40db @ 18.0 & 70.0KHz	10k/10k	5
K9170	28.2KHz	7100	.400 & 2000KHz	18db @ .200 & 4000KHz	300/300	11
K8890	40.0KHz	2.5	39.5 & 40.5KHz	30db @ 36.8 & 44.0KHz	2k/2k	13
K8231	40.5KHz	33.3	34.3 & 47.8KHz	40db @ 20.3 & 81.0KHz	500/10k	3
K875Y	56.0KHz	10.72	53.0 & 59.0KHz	50db @ 50.0 & 62.0KHz	1k/1k	HU3†
K8754	56.0KHz	17.8	51.0 & 61.0KHz	40db @ 44.0 & 68.0KHz	1k/1k	15
K6057	58.2KHz	193	45.0 & 75.0KHz	30db @ 20.25 & 105KHz	2k/2k	12
K12-4	60.0KHz	4.0	58.8 & 61.2KHz	30db @ 55.5 & 65.0KHz	10k/10k	12
K876Y	64.0KHz	9.38	61.0 & 67.0KHz	20db @ 58.0 & 70.0KHz	1k/1k	HU3†
K8769	64.0KHz	15.6	59.0 & 69.0KHz	40db @ 53.0 & 75.0KHz	1k/1k	15
K8358	80.0KHz	25.0	70.0 & 90.0KHz	36db @ 40.0 & 160KHz	500/500	11
K7363	90.0KHz	68.2	57.6 & 129.0KHz	60db @ 28.8 & 258KHz	100/100	12
K873Y	95.0KHz	6.32	92.0 & 98.0KHz	20db @ 89.0 & 101KHz	1k/1k	HU3†
K8733	95.0KHz	9.5	90.0 & 100.0KHz	40db @ 82.5 & 109.0KHz	1k/1k	15
K18-3	100.0KHz	3.0	98.5 & 101.5KHz	60db @ 50.0 & 200KHz	600/600	3
K8560	100.0KHz	9.0	95.5 & 104.5KHz	60db @ 50.0 & 200KHz	300/300	3

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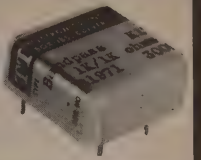
TTE *miniature* FILTERS



1-2 WEEK DELIVERY FOR STANDARD AND NEAR STANDARD TYPES
ALL GROUPS AVAILABLE IN FLAT PC MOUNTING CASES

BANDPASS FILTERS — these are typical modified standard types

Model Number	Center Frequency	Band-Width, %	−3db Frequency	Stopband Attenuation and Frequency	Source & Load Ohms	Case Number
K874Y	103.0KHz	5.73	100.0 & 106.0KHz	20db @ 97.0 & 109KHz	1k/1k	HU3†
K8336	110.0KHz	18.2	100.0 & 120.0KHz	36db @ 55.0 & 220KHz	500/500	11
K7943	130.0KHz	4.8	126.91 & 133.14KHz	35db @ 117.0 & 143KHz	1k/1k	HU3†
K8777	136.0KHz	31.0	40.0 & 460.0KHz	60db @ 26.0 & 690KHz	500/500	15
K8347	150.0KHz	13.3	140.0 & 160.0KHz	36db @ 75.0 & 300KHz	500/500	11
K9454	156.3KHz	1.5	155.44 & 157.02KHz	30db @ 152.59 & 160.51KHz	1k/1k	13
K9686	200.0KHz	10.0	190.00 & 210.0KHz	60db @ 100 & 400KHz	50/50	KK9†
K9787	245.0KHz	41.0	200.0 & 300.0KHz	60db @ 146 & 400KHz	3k/3k	5
K8777	262.0KHz	208	105.0 & 650.0KHz	60db @ 70.5 & 975KHz	50/50	15
K5585	300.0KHz	4.3	294.0 & 307.0KHz	40db @ 265 & 350KHz	500/500	11
K8373	332.0KHz	301	100.0 & 1100KHz	40db @ .075 & 1.43MHz	50/50	HU3†
K1005	512.0KHz	3.9	502.0 & 522.0KHz	40db @ 372 & 712KHz	50/50	11
K8090	625.0KHz	24.0	550.0 & 700.0KHz	40db @ 312.5 & 1250KHz	50/300	11
K9891	1.2MHz	4.0	1.18 & 1.22MHz	30db @ 1.05 & 1.4MHz	50/50	BT6†
K9217	1.25MHz	3.2	1.23 & 1.27MHz	50db @ .8485 & 2.45MHz	50/50	11
K9626	1.25MHz	10.0	1.19 & 1.31MHz	43db @ .62 & 2.3MHz	100/100	10
K8839	1.55MHz	5.0	1.511 & 1.589MHz	60db @ .775 & 1.589MHz	100/100	11
K8171	1.66MHz	42.1	1.35 & 2.05MHz	30db @ 1.12 & 2.42MHz	50/50	15
K8161	3.5MHz	3.49	2.9 & 4.1MHz	40db @ 1.75 & 7.0MHz	50/250	11
K1011	3.98MHz	7.3	3.76 & 4.05MHz	40db @ 3.0 & 5.0MHz	50/50	11
K9877	4.0MHz	3.6	3.93 & 4.07MHz	40db @ 3.2 & 5.2MHz	50/50	BT6†
K9861	5.6MHz	2.6	5.53 & 5.67MHz	40db @ 4.6 & 7.0MHz	50/50	BT6†
K9264	6.0MHz	16.7	5.54 & 6.54MHz	40db @ 4.0 & 9.15MHz	50/50	11
K9699	6.3MHz	10.0	5.985 & 6.615MHz	60db @ 3.15 & 12.6MHz	50/50	BT6†
K9278	12.07MHz	16.5	11.075 & 13.075MHz	40db @ 7.15 & 17.8MHz	50/50	11
K1039	12.3MHz	21.0	11.5 & 14.1MHz	40db @ 8.96 & 16.64MHz	50/50	15
K7363	14.1MHz	15.0	10.0 & 20.0MHz	60db @ 5.0 & 40.0MHz	50/50	15
K1040	15.36MHz	17.5	14.02 & 16.71MHz	40db @ 11.5 & 19.2MHz	50/50	15
K9701	17.0MHz	10.0	16.15 & 17.85MHz	60db @ 8.5 & 34.0MHz	50/50	BT6†
K1041	17.9MHz	15.0	16.5 & 19.2MHz	40db @ 13.9 & 22.0MHz	50/50	15
K1041	17.92MHz	15.0	16.57 & 19.27MHz	40db @ 13.9 & 21.9MHz	50/50	15
K1006	18.0MHz	2.8	17.8 & 18.3MHz	40db @ 16.0 & 20.0MHz	50/50	11
K9710	18.95MHz	10.0	18.0 & 19.9MHz	60db @ 9.5 & 37.9MHz	50/50	BT6†
K9722	29.5MHz	10.0	28.0 & 31.0MHz	60db @ 14.7 & 59.0MHz	50/50	BT6†
K9857	30.0MHz	2.5	29.62 & 30.38MHz	30db @ 27.6 & 33.0MHz	50/50	12
K1009	30.0MHz	4.0	29.4 & 30.6MHz	30db @ 27.0 & 33.0MHz	50/50	11
K9636	34.5MHz	10.0	32.77 & 36.23MHz	60db @ 17.3 & 69.0MHz	50/50	BT6†
K7363	35.0MHz	57.0	25.0 & 45.0MHz	60db @ 12.5 & 90.0MHz	50/50	HU3†
K9647	37.0MHz	10.0	35.15 & 38.85MHz	60db @ 18.5 & 74.0MHz	50/50	BT6†
K9652	38.95MHz	10.0	37.0 & 40.9MHz	60db @ 19.5 & 78.0MHz	50/50	BT6†
K9660	39.5MHz	10.0	37.5 & 41.5MHz	60db @ 19.75 & 79.0MHz	50/50	BT6†
K1014	40.0MHz	2.0	39.6 & 40.4MHz	40db @ 35.0 & 47.0MHz	50/50	BT6†
K9673	44.5MHz	10.0	42.3 & 46.7MHz	60db @ 22.3 & 89.0MHz	50/50	BT6†
K9501	45.75MHz	2.8	45.25 & 46.25MHz	30db @ 43.0 & 49.0MHz	50/50	11
K1013	45.75MHz	6.56	44.25 & 47.25MHz	60db @ 25.6 & 56.5MHz	50/50	11
K9490	45.75MHz	26.2	39.75 & 51.75MHz	40db @ 22.9 & 91.5MHz	50/50	11
K8037	60.0MHz	6.67	58.0 & 62.0MHz	15db @ 54.7 & 64.8MHz	50/50	BT5†
K6050	63.2MHz	95.0	40.0 & 100.0MHz	30db @ 18.0 & 220MHz	50/50	11
K9531	70.0MHz	2.0	69.3 & 70.7MHz	30db @ 64.0 & 77.0MHz	50/50	BT6†
K9412	70.0MHz	6.43	67.4 & 72.3MHz	30db @ 63.1 & 78.6MHz	50/50	BT6†
K9019	70.0MHz	9.15	66.8 & 73.2MHz	43db @ 35.0 & 140MHz	50/50	10
K7363	70.0MHz	59.7	50.0 & 90.0MHz	60db @ 25.0 & 90.0MHz	50/50	HU3†
K1049	75.0MHz	20.0	67.5 & 82.5MHz	60db @ 37.5 & 150MHz	50/50	HU3†,‡

LOWPASS — modified standard filters

Model Number	−3db Frequency	Stopband Attenuation and Frequency	Source & Load Ohms	Case Number
J6062	10Hz	60db @ 20Hz	15k/15k	6†
J501	30Hz	30db @ 66Hz	10k/10k	10
J5009	80Hz	60db @ 160Hz	39k/39k	BT4†
J5616	200Hz	20db @ 329Hz	10k/10k	12
J6828	300Hz	40db @ 530Hz	10k/10k	10
J6886	2100Hz	40db @ 2500Hz	5k/5k	15
J6540	2500Hz	40db @ 2650Hz	600/600	HU3†
J6125	3400Hz	40db @ 4000Hz	600/600	HU3†
J6551	3800Hz	40db @ 4028Hz	600/600	5
J6607	4000Hz	40db @ 4240Hz	600/600	HU3†
J6359	4960Hz	40db @ 5257Hz	600/600	5
J6813	9000Hz	40db @ 28.8KHz	50/50	11
J6747	15.0KHz	40db @ 16.5KHz	600/600	HU3†
J6836	15.0KHz	40db @ 17.0KHz	600/600	15
J6680	1.2MHz	60db @ 1.8MHz	50/50	12
J6340	1.5MHz	60db @ 2.34MHz	300/300	12
J6691	2.4MHz	60db @ 3.6MHz	50/50	12
J6709	6.0MHz	60db @ 9.0MHz	50/50	12
J6715	12.0MHz	60db @ 18.0MHz	50/50	12
J6453	40.0MHz	40db @ 51.0MHz	50/50	KK6†,‡
J6937	80.0MHz	40db @ 130MHz	50/50	KK6†,‡

HIGHPASS — modified standard filters

Model Number	−3db Frequency	Stopband Attenuation and Frequency	Source & Load Ohms	Case Number
H2363	32Hz	35db @ 26Hz	600/600	6†
H1984	38Hz	30db @ 25Hz	600/600	5
H901	42Hz	40db @ 35Hz	600/100k	GB†
H2469	80Hz	40db @ 63Hz	600/600	6†
H2415	100Hz	30db @ 50Hz	600/600	5
H2341	500Hz	50db @ 250Hz	600/600	4
H2314	600Hz	40db @ 390Hz	10k/10k	11
H2358	665Hz	60db @ 400Hz	10k/10k	15
H2422	1950Hz	40db @ 1570Hz	5k/5k	15
H1440	3500Hz	30db @ 3300Hz	600/600	5
H1401	4800Hz	40db @ 3790Hz	10k/10k	12
H1920	10KHz	60db @ 1.9KHz	10k/10k	2
H2320	1.54MHz	60db @ 1.0MHz	75/75	BT6†

BAND REJECT — modified standard filters

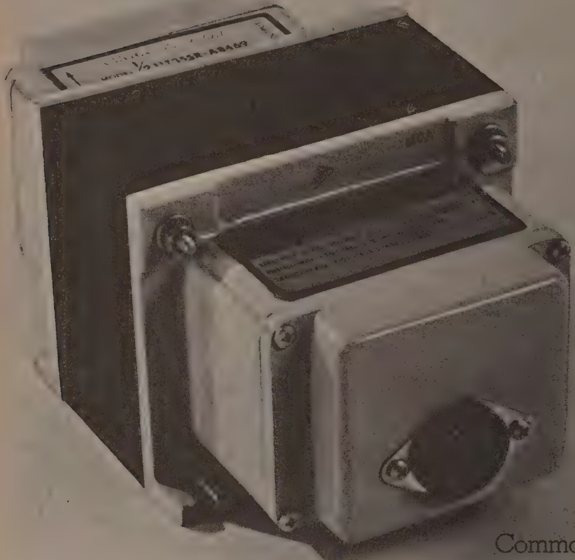
Model Number	Center Frequency	−3db Frequency	Stopband Attenuation and Frequency	Source & Load Ohms	Case Number
BA-16	60Hz	15.0 & 240Hz	40db notch @ 60Hz	250k/1MEG	1
R30-6	8100Hz	7833 & 8333Hz	40db @ 8033 & 8133Hz	600/600	4
R1332	512KHz	446 & 584KHz	40db @ 495.0 & 527.7Hz	75/75	BT6†

†**CASE DIMENSIONS: CASE KK6,** 3.4″ x 6.8″ x 2.75″ high; **CASE 6,** 2.32″ x 2.06″ x 2.5″ high; **CASE EA,** 1.94″ x 1.81″ x 2.75″ high; **CASE GB,** 2.75″ x 2.38″ x 2.82″ high; **CASE HU3,** 2.96″ x 1.93″ x .75″ high; **CASE BT4,** 2.0″ x 2.0″ x 1.25″ high; **CASE KK9,** 2.0″ x 2.0″ x 1.0″ high; **CASE BT6,** 2.0″ x 2.0″ x 0.75″ high; **CASE BT5,** 1.5″ x 1.5″ x 0.75″ high.

‡**POWER RATING:** K968, 1 Watt; K1049, 5 Watts; J645 & J693, 1 KW.

TT ELECTRONICS INC. 2214 SO. BARRY AVE. / LOS ANGELES, CALIF. 90064 / (213) 478-8224

Topaz Ultra-Isolation Transformers will solve your power line noise problems. We guarantee it.



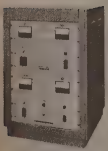
Pete Jorgensen, Magnetics Production Manager at Topaz, was asked recently why the performance of Topaz Ultra-Isolation Transformers is so exceptional. He answered by saying, "Because we have people who have been winding and shielding transformers for 10 years, and they do it unusually well."

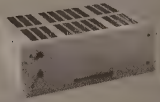
Topaz Ultra-Isolation Transformers protect electronic equipment from noisy power lines and protect clean power lines from noise-generating equipment. The unique Topaz box shielding techniques and the meticulous care taken during manufacturing guarantee the effectiveness of Topaz transformers.

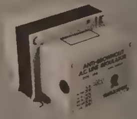
Common-mode noise is attenuated by more than 1,000,000 to 1. Effective capacitance between windings is less than 0.0005 picofarads.

So if power line noise is your problem, write or phone. We'll prove that Topaz Ultra-Isolation Transformers will solve your problem. We guarantee it — or your money back.

Or your money back.







Other Products • Uninterruptible Power Systems • Inverters • Frequency Changers • AC Line Regulators

Topaz is also a major supplier of **custom** power conversion equipment. Contact us.

TOPAZ
ELECTRONICS 3855 Ruffin Road, San Diego, California 92123 • Phone: (714) 279-0831. TWX (910) 335-1526

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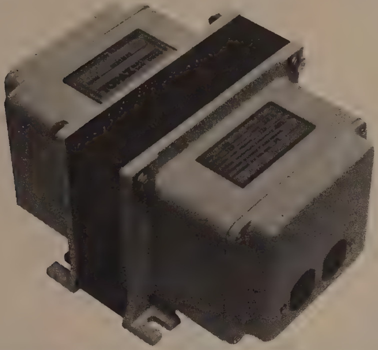
page 4

ULTRA-ISOLATION TRANSFORMERS

For eliminating power line noise problems associated with sensitive equipment



TOPAZ ULTRA - ISOLATION TRANSFORMERS are available in single-phase and three-phase versions, from 125 VA to 45,000 VA, and in step-up and step-down configurations, some with provisions for use on several different power line voltages. They are especially designed for these applications:

1. For isolating sensitive instrumentation from noisy power lines.
2. For isolating sensitive power lines from noisy equipment.
3. For isolating noisy equipment from noise-sensitive equipment when both share the same AC power source.
4. For maximum attenuation of common-mode noise (noise between ground and power lines).
5. For excellent attenuation of transverse-mode noise (line-to-line output noise) caused by common-mode noise at the input.
6. For completion of electrostatic guarding of equipment which is protected by an electrostatic shield.
7. For applications in which leakage currents must be kept below critical low levels.

TYPICAL SPECIFICATIONS

Common-Mode Noise Rejection:
.005 pF—greater than 125 dB
.001 pF—greater than 140 dB
.0005pF—greater than 146 dB

Common-Mode to Transverse-Mode Noise Rejection:
Greater than 125 dB at 1 kHz

Electromagnetic Noise:
Less than 0.1 gauss (-20 dB) at 18 in. radius

Standard Voltage Ratings:
120 (for 110, 115, 120 V lines*)
240 (for 208, 220, 230, 240 V lines*)
480 (for 360 440, 480 V lines*)
*Maximum current = VA rating ÷ Nominal Voltage Rating

Operating Voltages:
To 110% of nominal

Operating Frequency:
57 to 63 Hz

Featuring. . .
- Excellent Common-Mode Noise Rejection
- Very Low Leakage Current
- Unique Box-Shielded Design
- Single-Phase and Three-Phase Models
- 50Hz, 60Hz and 400Hz Models
- Money-Back Guarantee

STANDARD 60 Hz SINGLE-PHASE STOCK MODELS

	MODEL NUMBER GUARANTEED EFFECTIVE CAPACITANCE							
Power Rating	≤ .005 pF	≤ .001 pF	≤ .0005 pF	Primary VAC (Nominal)	Secondary VAC (Nominal)	Terminations	Wt. (Lbs.)	Price Each
125 VA	1/811T25SR			120	120	Receptacle	11	$ 75
125		1/811T21SR		120	120	Receptacle	11	105
125			1/811T35SR	120	120	Receptacle	11	140
125	1/811T25ST			120	120	Terminals	10	75
125		1/811T21ST		120	120	Terminals	10	105
125			1/811T35ST	120	120	Terminals	10	140
500 VA	1/211T25SR			120	120	Receptacle	18	120
500		1/211T21SR		120	120	Receptacle	18	155
500			1/211T35SR	120	120	Receptacle	18	205
500	1/211T25ST			120	120	Terminals	17	120
500		1/211T21ST		120	120	Terminals	17	155
500			1/211T35ST	120	120	Terminals	17	205
1.0 kVA	0111T25SR			120	120	Duplex	32	200
1.0	0131T25SR			240	120	Duplex	32	200
1.0	0111T25ST			120	120	Terminals	30	200
1.0	0131T25ST			240	120	Terminals	30	200
1.0	0133T25ST			240	240	Terminals	30	200
1.0	0155T25FT			125/250■	115/230	Terminals	67	500
1.0	0111T25FT			120	120	Terminals	67	425
1.0		0111T21SR		120	120	Duplex	32	250
1.0		0131T21SR		240	120	Duplex	32	250
1.0		0111T21ST		120	120	Terminals	30	250
1.0		0131T21ST		240	120	Terminals	30	250
1.0		0133T21ST		240	240	Terminals	30	250
1.0		0155T21FT		125/250■	115/230	Terminals	67	625
1.0		0111T21FT		120	120	Terminals	67	510
1.0			0111T35SR	120	120	Duplex	32	335
1.0			0131T35SR	240	120	Duplex	32	335
1.0			0111T35ST	120	120	Terminals	30	335
1.0			0131T35ST	240	120	Terminals	30	335
1.0			0133T35ST	240	240	Terminals	30	335
1.0			0155T35FT	125/250■	115/230	Terminals	67	830
1.0			0111T35FT	120	120	Terminals	67	710

	MODEL NUMBER GUARANTEED EFFECTIVE CAPACITANCE							
Power Rating	≤ .005 pF	≤ .001 pF	≤ .0005 pF	Primary VAC (Nominal)	Secondary VAC (Nominal)	Terminations	Wt. (Lbs.)	Price Each
2.5 kVA	0211T25SR			120	120	Duplex	45	305
2.5	0231T25SR			240	120	Duplex	45	305
2.5		0211T21SR		120	120	Duplex	45	380
2.5		0231T21SR		240	120	Duplex	45	380
2.5			0211T35SR	120	120	Duplex	45	510
2.5			0231T35SR	240	120	Duplex	45	510
2.5	0211T25ST			120	120	Terminals	44	305
2.5	0231T25ST			240	120	Terminals	44	305
2.5	0233T25ST			240	240	Terminals	44	305
2.5		0211T21ST		120	120	Terminals	44	380
2.5		0231T21ST		240	120	Terminals	44	380
2.5		0233T21ST		240	240	Terminals	44	380
2.5			0211T35ST	120	120	Terminals	44	510
2.5			0231T35ST	240	120	Terminals	44	510
2.5			0233T35ST	240	240	Terminals	44	510
5.0 kVA	0511T25FT			120	120	Terminals	111	565
5.0	0511T25ST			120	120	Terminals	66	460
5.0	0531T25ST			240	120	Terminals	66	460
5.0	0533T25ST			240	240	Terminals	66	460
5.0	0541T25ST			480	120	Terminals	66	460
5.0		0511T21FT		120	120	Terminals	111	710
5.0		0511T21ST		120	120	Terminals	66	575
5.0		0531T21ST		240	120	Terminals	66	575
5.0		0533T21ST		240	240	Terminals	66	575
5.0		0541T21ST		480	120	Terminals	66	575
5.0			0511T35FT	120	120	Terminals	111	945
5.0			0511T35ST	120	120	Terminals	66	770
5.0			0531T35ST	240	120	Terminals	66	770
5.0			0533T35ST	240	240	Terminals	66	770
5.0			0541T35ST	480	120	Terminals	[illegible]6	770
10 kVA	1033T25ST			240	240	Terminals	164	820
10		1033T21ST		240	240	Terminals	164	1045
10			1033T35ST	240	240	Terminals	164	1390
10	1065T25BT			240/480	120/240	Conduit	222	1430
10		1065T21BT		240/480	120/240	Conduit	222	1800
10			1065T35BT	240/480	120/240	Conduit	222	2490
15 kVA	1533T25ST			240	240	Terminals	203	995
15		1533T21ST		240	240	Terminals	203	1245
15			1533T35ST	240	240	Terminals	203	1660
15	1565T25BT			240/480	120/240	Conduit	269	1640
15		1565T21BT		240/480	120/240	Conduit	269	2050
15			1565T35BT	240/480	120/240	Conduit	269	2730
20 kVA	2065T25BT			240/480	120/240	Conduit	332	1840
20		2065T21BT		240/480	120/240	Conduit	332	2300
20			2065T35BT	240/480	120/240	Conduit	332	3050

■Consists of (2) 125 coils with taps at 102, 110, and 118 volts

The models listed above are generally in stock; hundreds of other models are available on short notice.

LG 25
March 1975
Supersedes LG 19

TOPAZ SOLUTIONS TO POWER PROBLEMS
ELECTRONICS
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CERAMOLITHIC®

U.S. Capacitor Corporations' monolithic ceramic EMI/RFI filters have evolved in phase with solid state technology. Increasingly higher frequencies in tiny LSI environments make tough demands on designers: better attenuation, in state-of-the-art sizes and at affordable prices.

We've met these challenges at USCC/Centralab by accelerating the filter evolution through research in dielectrics and high-productivity manufacturing techniques.

Here's what today and tomorrow look like.

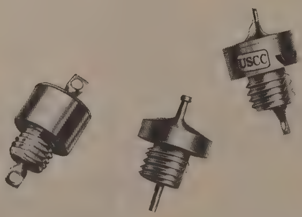
The latest and smallest filters available from USCC – 9900 Series feed-throughs. Better than 70db insertion loss at 10 GHz. Used all the way from medical electronics to CATV.

MIL-STD-461 filters – the smallest ever offered for this use. For any relatively low source and load impedance job, the highest insertion loss at low frequencies.

Also tomorrow's filters today – CASELESS. USCC now offers another step in CERAMOLITHIC® technology – a dielectric that serves as its own outer case – with obvious economics.

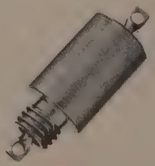
"BUTTON" SERIES

- Epoxy or hermetically sealed;
- 50, 100, 200, 300 VDC and 115 VAC 0-400 Hz;
- 15 amps DC; L section
- .187″ or .312″ thread lengths



MINIATURE 1000 and 2000 SERIES

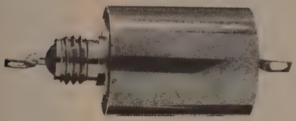
- 50, 100, 200, 300 VDC and 115 VAC 0-400 Hz;
- .06 to 10 amps DC; Pi, L and T sections;
- .187″ or .312″ thread lengths



EMI/RFI FILTERS

MINIATURE 1400 and 2400 SERIES

- 125 VAC and 230 VAC 0-40 Hz;
- .1 to 10 amps DC;
- Pi, L and T sections



SUBMINIATURE 3000 SERIES

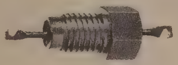
- 3112: 100 VDC; 10 amps; L section
- 3223: 200 VDC; 10 amps; Pi section
- 3300: 50, 100 and 200 VDC; 10 amps;
- Pi and Multi-sections
- 3500: 100, 200 and 500 VDC; 25 amps; Pi section

FEED-THRU CAPACITOR FILTERS 9900 SERIES

- 50, 100, 200 WVDC
- 10 amps DC
- 100 pF to 5000 pF

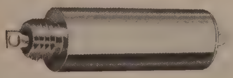
FEED-THRU CAPACITOR FILTER 9000 SERIES

- 50, 100, 200, 300, 500 VDC and 115 VAC 0-400 Hz;
- 10 and 25 amps DC;
- 100 pF to 1.5 Mfd.



MIL-STD-461 FILTER

- Designed for MIL-STD-461 applications;
- 50, 100, 300 VDC and 115 VAC 0-400 Hz;
- .1 to 10 amps DC;
- 5 element inductor fed.



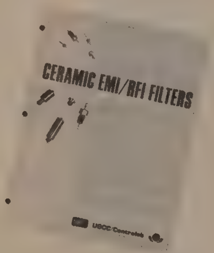
CASELESS EMI/RFI FILTERS

UF and US Series Feed-Thru and Standoff Styles

- 50, 100, 200 WVDC
- 5 amps DC
- 1000 to 5000 pF; 0.01 to 0.05 Mfd.

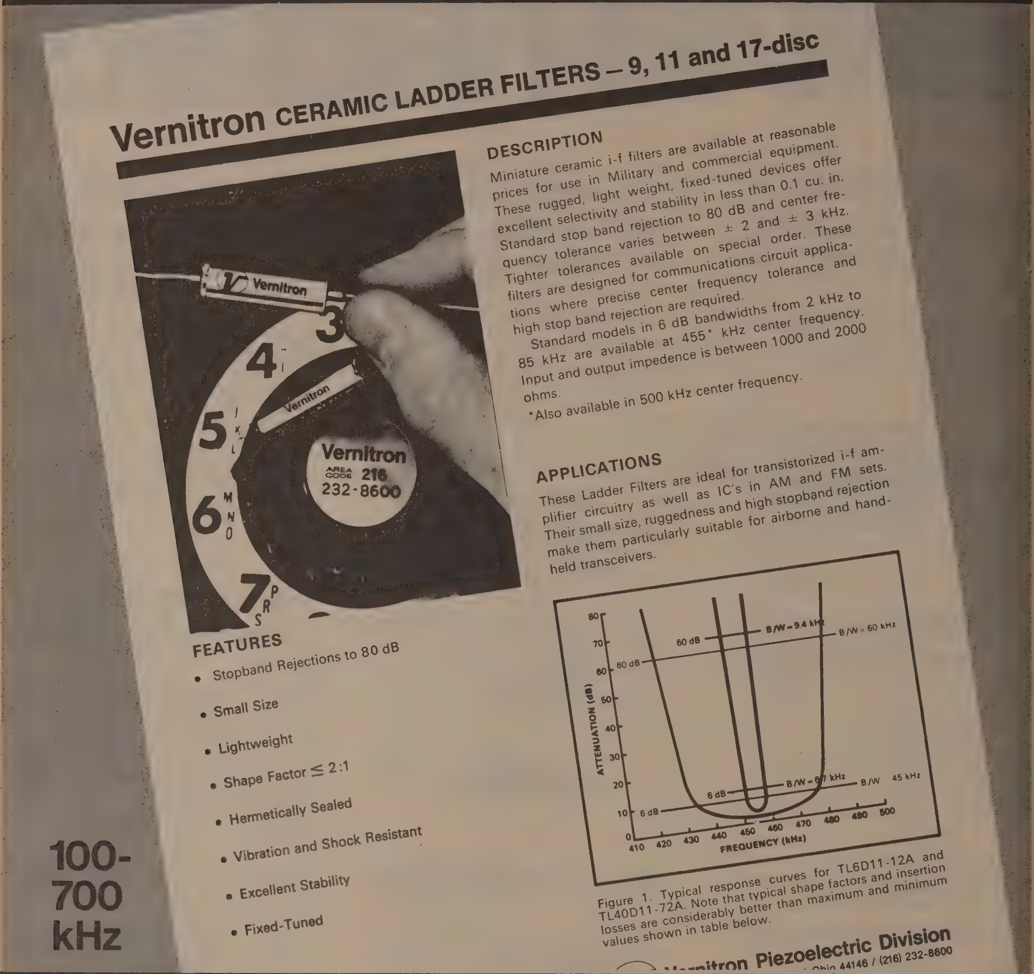
CUSTOM DESIGN AND PROTOTYPES.

USCC offers you complete custom design assistance for non-standard filters, including prototype manufacturing and testing services. Call (213) 240-4880 for applications engineering support, or write for your new 1975 EMI/RFI filters catalog.



USCC **USCC/Centralab**
Electronics Division ■ Globe-Union Inc.
4561 Colorado Boulevard ■ Los Angeles, Ca. 90039
(213) 240-4880

from **Vernitron** (the ceramic filters people)



Vernitron CERAMIC LADDER FILTERS – 9, 11 and 17-disc

DESCRIPTION

Miniature ceramic i-f filters are available at reasonable prices for use in Military and commercial equipment. These rugged, light weight, fixed-tuned devices offer excellent selectivity and stability in less than 0.1 cu. in. Standard stop band rejection to 80 dB and center frequency tolerance varies between ± 2 and ± 3 kHz. Tighter tolerances available on special order. These filters are designed for communications circuit applications where precise center frequency tolerance and high stop band rejection are required.

Standard models in 6 dB bandwidths from 2 kHz to 85 kHz are available at 455* kHz center frequency. Input and output impedence is between 1000 and 2000 ohms.

*Also available in 500 kHz center frequency.

APPLICATIONS

These Ladder Filters are ideal for transistorized i-f amplifier circuitry as well as IC's in AM and FM sets. Their small size, ruggedness and high stopband rejection make them particularly suitable for airborne and handheld transceivers.

Figure 1. Typical response curves for TL6D11-12A and TL40D11-72A. Note that typical shape factors and insertion losses are considerably better than maximum and minimum values shown in table below.

FEATURES

- Stopband Rejections to 80 dB
- Small Size
- Lightweight
- Shape Factor ≤ 2:1
- Hermetically Sealed
- Vibration and Shock Resistant
- Excellent Stability
- Fixed-Tuned

nitron Piezoelectric Division
Ohio 44146 / (216) 232-8600

100-700 kHz

GENERAL SPECIFICATIONS

Center Frequency 455 or 500 kHz (capability from 100-700 kHz)

Stopband Rejection 9-disc — 50 dB; 11-disc — 60 dB; 17-disc — 80 dB

Stability +0.2%/5 yrs; within ±0.2%/ —40° to +85° C.

Ripple Bandwidth Dependent, 1 to 3dB

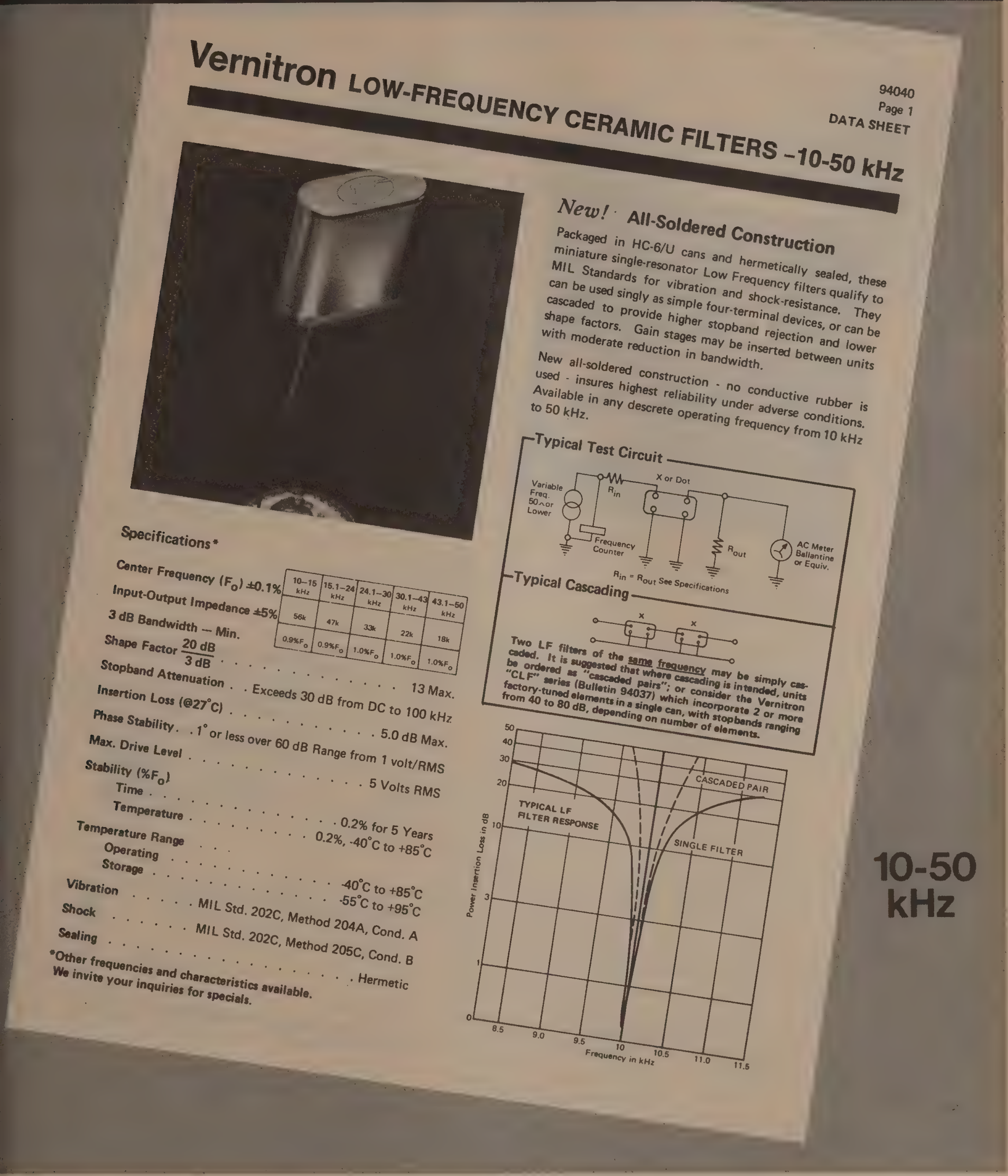
Operating Range —40° to +85° C.

Environmental Meets MIL Std. 202B

	9-DISC — 50 dB STOPBAND			11-DISC — 60 dB STOPBAND			17-DISC — 80 dB STOPBAND		
TYPICAL MODELS	TL-10D9 20A	TL-16D9 32A	TL-20D9 38A	TL-6D11 12A	TL-16D11 32A	TL-30D11 57A	TL-2D 5A	TL-16D 25A	TL-30D 45A
BANDWIDTH/6dB @27°C /60dB	10 20	16 32	20 38	6 12	16 32	30 57	5 5	16 25	30 45
SHAPE FACTOR	2.0:1	2.0:1	1.9:1	2.0:1	2.0:1	1.9:1	2.5:1	1.6:1	1.5:1
INSERTION LOSS (dB)	4	5	5	6	5	5	10	5	5
IN/OUT IMPEDANCE (OHMS)	2000	1000	1000	2000	1000	1000	2500	1500	1200

Vernitron Piezoelectric Division
232 Forbes Road / Bedford, Ohio 44146 / (216) 232-8600

from **Vernitron** (the ceramic filters people)



94040
Page 1
DATA SHEET

Vernitron LOW-FREQUENCY CERAMIC FILTERS –10-50 kHz

New! · All-Soldered Construction

Packaged in HC-6/U cans and hermetically sealed, these miniature single-resonator Low Frequency filters qualify to MIL Standards for vibration and shock-resistance. They can be used singly as simple four-terminal devices, or can be cascaded to provide higher stopband rejection and lower shape factors. Gain stages may be inserted between units with moderate reduction in bandwidth.

New all-soldered construction - no conductive rubber is used - insures highest reliability under adverse conditions. Available in any descrete operating frequency from 10 kHz to 50 kHz.

Typical Test Circuit

Variable Freq. 50⌃or Lower
R_{in}
X or Dot
Frequency Counter
R_{out}
AC Meter Ballantine or Equiv.

$R_{in} = R_{out}$ See Specifications

Typical Cascading

Two LF filters of the same frequency may be simply cascaded. It is suggested that where cascading is intended, units be ordered as "cascaded pairs"; or consider the Vernitron "CLF" series (Bulletin 94037) which incorporate 2 or more factory-tuned elements in a single can, with stopbands ranging from 40 to 80 dB, depending on number of elements.

TYPICAL LF FILTER RESPONSE
CASCADED PAIR
SINGLE FILTER
Power Insertion Loss in dB
50
40
30
20
10
3
1
0
8.5
9.0
9.5
10
10.5
11.0
11.5
Frequency in kHz

Specifications*

Center Frequency (F_o) ±0.1%	10–15 kHz	15.1–24 kHz	24.1–30 kHz	30.1–43 kHz	43.1–50 kHz
Input-Output Impedance ±5%	56k	47k	33k	22k	18k
3 dB Bandwidth — Min.	0.9%F_o	0.9%F_o	1.0%F_o	1.0%F_o	1.0%F_o

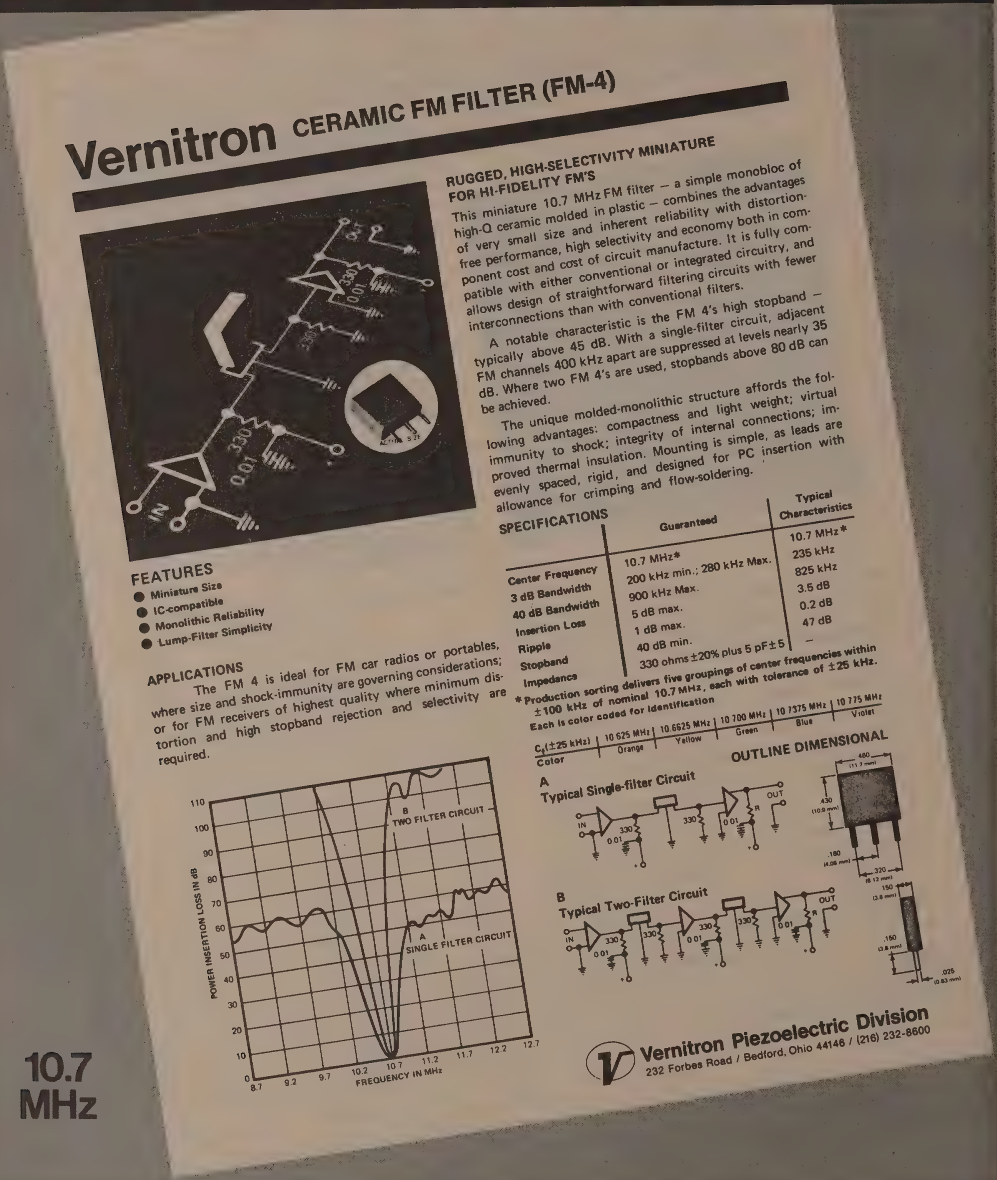
Shape Factor $\frac{20\text{ dB}}{3\text{ dB}}$ . . . . 13 Max.
Stopband Attenuation . . Exceeds 30 dB from DC to 100 kHz
Insertion Loss (@27°C) . . . . 5.0 dB Max.
Phase Stability . . 1° or less over 60 dB Range from 1 volt/RMS
Max. Drive Level . . . . 5 Volts RMS
Stability (%F_o)
  Time . . . . 0.2% for 5 Years
  Temperature . . . . 0.2%, -40°C to +85°C
Temperature Range
  Operating . . . . -40°C to +85°C
  Storage . . . . -55°C to +95°C
Vibration . . . . . MIL Std. 202C, Method 204A, Cond. A
Shock . . . . . . MIL Std. 202C, Method 205C, Cond. B
Sealing . . . . Hermetic

*Other frequencies and characteristics available. We invite your inquiries for specials.

10-50 kHz

Vernitron Piezoelectric Division
232 Forbes Road / Bedford, Ohio 44146 / (216) 232-8600

from **Vernitron** (the ceramic filters people)



Vernitron CERAMIC FM FILTER (FM-4)

RUGGED, HIGH-SELECTIVITY MINIATURE FOR HI-FIDELITY FM'S

This miniature 10.7 MHz FM filter — a simple monobloc of high-Q ceramic molded in plastic — combines the advantages of very small size and inherent reliability with distortion-free performance, high selectivity and economy both in component cost and cost of circuit manufacture. It is fully compatible with either conventional or integrated circuitry, and allows design of straightforward filtering circuits with fewer interconnections than with conventional filters.

A notable characteristic is the FM 4's high stopband — typically above 45 dB. With a single-filter circuit, adjacent FM channels 400 kHz apart are suppressed at levels nearly 35 dB. Where two FM 4's are used, stopbands above 80 dB can be achieved.

The unique molded-monolithic structure affords the following advantages: compactness and light weight; virtual immunity to shock; integrity of internal connections; improved thermal insulation. Mounting is simple, as leads are evenly spaced, rigid, and designed for PC insertion with allowance for crimping and flow-soldering.

FEATURES

- Miniature Size
- IC-compatible
- Monolithic Reliability
- Lump-Filter Simplicity

APPLICATIONS

The FM 4 is ideal for FM car radios or portables, where size and shock-immunity are governing considerations; or for FM receivers of highest quality where minimum distortion and high stopband rejection and selectivity are required.

SPECIFICATIONS

	Guaranteed	Typical Characteristics
Center Frequency	10.7 MHz*	10.7 MHz*
3 dB Bandwidth	200 kHz min.; 280 kHz Max.	235 kHz
40 dB Bandwidth	900 kHz Max.	825 kHz
Insertion Loss	5 dB max.	3.5 dB
Ripple	1 dB max.	0.2 dB
Stopband	40 dB min.	47 dB
Impedance	330 ohms ±20% plus 5 pF±5	—

* Production sorting delivers five groupings of center frequencies within ±100 kHz of nominal 10.7 MHz, each with tolerance of ±25 kHz. Each is color coded for identification

C_f(±25 kHz)	10.625 MHz	10.6625 MHz	10.700 MHz	10.7375 MHz	10.775 MHz
Color	Orange	Yellow	Green	Blue	Violet

OUTLINE DIMENSIONAL

A
Typical Single-filter Circuit

B
Typical Two-Filter Circuit

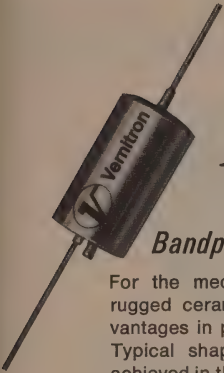
Vernitron Piezoelectric Division
232 Forbes Road / Bedford, Ohio 44146 / (216) 232-8600

10.7 MHz

Vernitron Piezoelectric Division
232 Forbes Road / Bedford, Ohio 44146 / (216) 232-8600

from **Vernitron** (the ceramic filters people)

NEW for '75



LADDER FILTERS

Series LTL

100 to 270 kHz

Bandpass capabilities 1 to 10%

For the medium-frequency range, these rugged ceramic bandpass filters offer advantages in price and size over LC filters. Typical shape factors of 2.0 to 1 are achieved in this unique ladder design.

Ideal for navigation and instrumentation applications.

Any Operating Frequency Between 100 kHz and 270 kHz.

SEND FOR BULLETIN 94043

Ceramic Filter

455 kHz

LOW-COST MINIATURES

For today's compact COMM receivers

VTL Ladder Filters

For OEM or service replacement without board modification in transceivers, receivers, pagers or scanners. Stopband to 60 db. No transformer required. Encapsulated. Mates with IC circuitry.

BULLETIN 94042

TAF Series

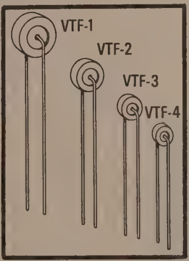
Compact, encapsulated 3-resonator filter gives close to 50 db rejection and greatest design flexibility. Designed for volume assembly, flow-soldering. IC compatible.

BULLETIN 94039

RESONATORS FOR OSCILLATOR CONTROL

Series VTF

175 to 600 kHz



Series VTF-1/175-249 kHz
Series VTF-2/250-346 kHz
Series VTF-3/347-435 kHz
Series VTF-4/436-600 kHz

Applications: Digital clock generators, oscillator elements, frequency-selective bypass elements, coupling elements, bandpass filters, notch filters, data transmission.

GENERAL SPECIFICATIONS

Resonant Frequency Tolerance	1.0% to 2.0% dependent on frequency
Temperature Stability	0.2% of resonant frequency
Operating Range	—20°C to +60°C.
Resonant Impedance	Less than 20 ohms

SEND FOR BULLETIN 94044

SPECIAL PURPOSE MINIATURE FM FILTERS

-10.7 MHz

Automotive applications

Controlled 3 dB bandwidth of 170—230 kHz, 45 dB attenuation. Special attention to symmetry at ±200 and ±400 kHz adjacent frequencies.

BULLETIN 94045

Selected center frequencies

Specially sorted versions of Vernitron's unique FM-4. Available in the following center frequencies: 10.62 MHz, 10.66 MHz, 10.70 MHz, 10.73 MHz, 10.77 MHz. Ideal for crystal-controlled IF strips. Perfect for SCA applications.

BULLETIN 94033

Digital applications

A new ultra narrowband FM filter. 3 dB bandwidth is 50—60 KHz at 10.7 MHz. The ultimate for digital-tuned IF receiver applications.

BULLETIN 94046

Vernitron Piezoelectric Division
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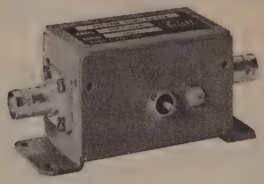
VARACTOR TUNED FILTERS

Z-MATCH



VTF-1

CONSTANT PERCENTAGE BANDWIDTH TWO POLE TCHEBYSCHEFF RESPONSE HIGH RATE FULL OCTAVE TUNING FROM 1.5-55 VOLTS

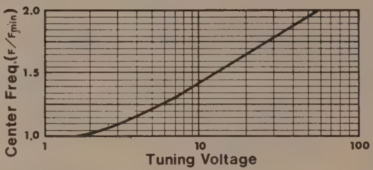
- **LESS THAN 100 MICRO SECONDS TO TUNE THE FULL OCTAVE**
- **2.5 dB INSERTION LOSS**
- **6% BANDWIDTH**
- **+20 dBm 3rd ORDER INTERCEPT POINT**

P.C. PACKAGE AVAILABLE FOR THE VF-200. CONSULT FACTORY SALES FOR DETAILS.

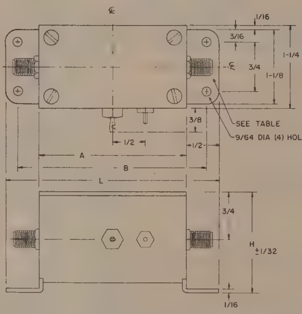
HIGHER AND LOWER OCTAVE RANGES AVAILABLE DOWN TO 2 MHz AND UP TO 800 MHz.

NARROWER BANDWIDTH AVAILABLE DOWN TO 3% BANDWIDTH WITH ACCOMPANYING HIGHER MIDBAND INSERTION LOSS. CONTACT FACTORY SALES FOR DETAILS.

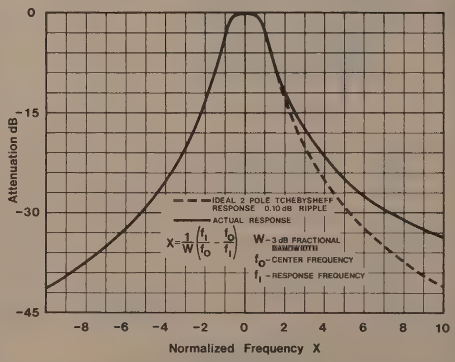
HIGHER ORDER TCHEBYSCHEFF AND BUTTERWORTH RESPONSE CHARACTERISTICS AVAILABLE ON SPECIAL ORDER WITH ACCOMPANYING HIGHER INSERTION LOSS. CONTACT FACTORY SALES FOR DETAILS.



VTF-2



DIMENSION TABLE					
CASE No.	A DIM.	B DIM.	L DIM	H DIM.	CONNECTORS
CD-1	3-3/8	4	4-3/8	1-23/32	BNC
CD-2	2-1/4	2-7/8	3-1/4	1-15/32	BNC
CD-3	2-1/4	2-7/8	3-1/4	1-15/32	SMA



VTF-3

MODEL NO.	TUNING RANGE	BANDWIDTH AT F MAX. (MHz)	MAX. INSERTION LOSS (dB)	MIN. THIRD ORDER INTERCEPT POINT (dBm)	PACKAGE	MODEL* PRICE
VF-25	25-50 MHz	3 MHz	2.5 dB	+20	CD1	—
VF-50	50-100 MHz	6 MHz	2.5 dB	+20	CD2	—
VF-100	100-200 MHz	12 MHz	2.5 dB	+20	CD3	—
VF-200	200-400 MHz	24 MHz	2.5 dB	+20	CD3	—

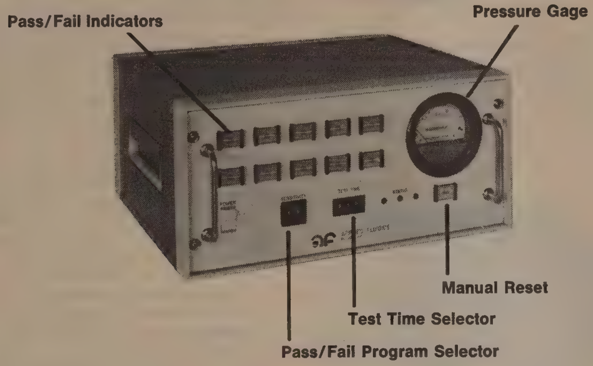
*SUBJECT TO CHANGE WITHOUT NOTICE. CONTACT FACTORY SALES.

VARI-L CO., INC. • 3883 MONACO PARKWAY • DENVER, COLORADO 80207 • (303) 321-1511 • TWX 910-931-0590

AFI | CENTURY SERIES ELECTRONIC LEAK DETECTION SYSTEMS

for 100% in-line inspection of open or sealed containers

ELECTRONICS CONSOLE



DESCRIPTION

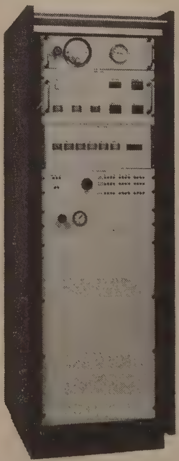
AFI's Century Series Electronic Leak Detection System the ELD-100, for **open** containers, and the ELD-200, for **sealed** containers, are ultra sensitive high speed, solid state systems capable of 100% in-line inspection of virtually any type containers.

The leak detection system consists of two units: a test station which receives the containers to be tested, and an Electronic Console.

The electronic console includes; a data processor which analyzes the test data and determines whether the container under test is to be passed or rejected, a data display panel to visually display pass/fail information, and control logic, for activation and control of the test station, and accept-reject mechanisms.

TYPICAL APPLICATIONS

Plastic containers of any size from 2 cc up
Plastic or steel containers 3 to 55 gallons
Aerosol cans and liners
Drug vials cc's to several litres
Blister packs
Portion packs
Foil packs
Glass bottles
Hot water tanks
Automotive parts
Virtually any closed volume



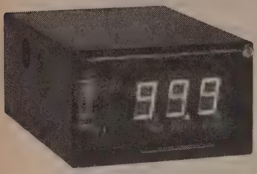
FEATURES

- Modular construction
- Single or multi station high speed system
- Sequential, or parallel testing
- Detect leaks from holes as small as 0.001″-0.006″
- Ultra sensitive ELD systems available to detect leaks in the low micron range
- Manually programmable pass/fail criteria for optimum reject rates
- Built-in multiplexing capability for high speed on-line testing
- Completely automatic, including start of test, end of test, and rejection
- Visual pass/fail indication
- Adaptable to overstress testing
- Optional automatic control logic for assembly line controllers
- Remote data terminal for remote data display and/or printout
- Remote Control System could be programmed and Q.C. data displayed in a Quality or Production Control Office
- Time Shared Systems — several production lines could be tested from a central control system

applied fluidics inc.

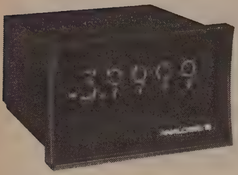
770 Main St., Westbury, N.Y. 11590 (516) 334-8742

LINE POWERED DIGITAL PANEL INSTRUMENTS



AN2531 Biomedical grade, high reliability at low cost, meeting U.S. and CSA standards. For display only of selected unipolar 3 digit values with non-blinking up-dates at 1 to 4 second rate.

AN2532 3½ digit system grade bipolar unit, with parallel BCD standard. Can measure on command with only 3.3 msec. aperture, to 100 conversions/second.



AN2544 Premier grade, ±40,000 count—industry's most stable accurate and versatile DPI. Features include ±300 volt floating front end, precise signal integration for highest possible NMRR at line frequency and standard latched buffered parallel BCD outputs.

AN2537 Parallel buffered BCD outputs—ideal for printer drive in a bipolar 3½ digit DPI at the lowest price. Adjustable offset and user-set sensitivity for flexibility in special instrumentation and system applications.

Featuring Superior Accuracy, Linearity, Stability, Superior Reliability

The Series AN2500 features DPI modules with resolution ranging from 3 digit to 4¾ digit. These units include units that are cost-optimized for simple, direct view applications as well as more comprehensive models designed to interact with more complex control systems.

Most Analogic DPI's are available in versions to accommodate all normally encountered line voltages throughout the world. Several are equipped with universal tapped transformers.

Features

- LED, Planar gas discharge and Nixie displays available.
- Widest line in the industry — smallest, lowest price, best performance.
- Proprietary dual slope technique — provides inherent noise rejection.
- Programmable decimal points.
- Superior accuracy, linearity, stability.
- Polarity symbols standard in most models.
- Many with ratiometric capability.
- Isolated BCD standard or optionally available.
- Differential front end.
- Ultra low power.

Cutout Dimensions

C = 1.772" x 3.622" (45mm x 92mm)
D = .62" x .80" (15.74mm x 20.3mm)
E = 2.03" x 3.53" (51.56mm x 89.66mm)

Model	Full Scale Display/Resolution, Digits	Accuracy with Resp. to Reading (±1 count)	Input Config.	CMV Resp. to Line/CMRR	Displays	BCD's	Cut-out	Price Units/ 100's*
AN2531	999 3 digit	.1%	Hi-Z S.E.	1500V RMS >80dB	Beckman .55"	Not Available	D	95/77
AN2538	±1999 Bipolar 3½ digit	.05%	Hi-Z Diff.	600V p-pAC >100dB	LED	Optional SER/ Parallel/Bit	C	89/72
AN2533	±1999 Bipolar 3½ digit	.05%	Hi-Z Balanced Symetrical Diff.	±1000V p-pAC >80dB	Beckman/.55" LED ½"	Optional Parallel (AN401,2,3)	C	109/85
AN2532	±1999 Bipolar 3½ digit	.05%	Hi-Z Balanced Symetrical Diff.	600V p-pAC >70dB	Beckman/.55" Nixie	Std. Parallel	E	139/111
AN2537	±1999 Bipolar 3½ digit	.05%	Hi-Z Balanced Symetrical Diff.	±1000V p-pAC >80dB	Beckman/.55" LED ½"	Std. Parallel Buffered	C	119/95
AN2553	±3999 Bipolar 3½ digit	.05%	Hi-Z Balanced Diff.	±1000Vp-pAC Up to 160dB	Beckman/.55" LED ½"	Optional Parallel (AN401,2,3)	C	119/94
AN2534	±3999 Bipolar 3¾ digit	.05%	Hi-Z Balanced Symetrical Diff.	600Vp-pAC >70dB	Beckman/.55" Nixie	Std. Parallel	E	208/166
AN2544	±39999 Bipolar 4¾ digit	.01%	Hi-Z Floating	600Vp-pAC >100dB	Nixie	Std. Parallel	E	370/286

*Substantial OEM discounts available

ANALOGIC® Audubon Road ■ Wakefield, Massachusetts 01880 ■ Tel. (617) 246-0300

LOGIC POWERED DPI'S FOR SYSTEMS APPLICATIONS

Introduction

Logic powered digital panel instruments may have specific advantages over line powered models in applications where 5 volt power is readily available.

Since they require no line transformer or 60Hz power source filtering, they are usually more compact and have less internal power supply dissipation.

A specific Series AN2500 advantage over many logic powered devices of other manufacture is our differential input design that eliminates a significant source of error caused by IR voltage drops in the logic power return.

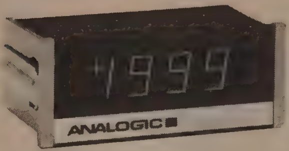
In addition, Series AN2500 is the only logic powered line of DPI's offering the choice of the bright ½" gas discharge style of display, in addition to LED Display.

Featuring

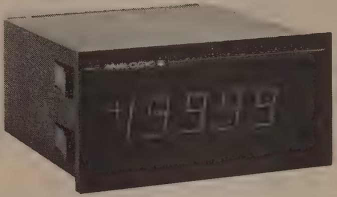
☐ Differential or floating front ends.
☐ Choice of display.
☐ Backed by the most extensive reliability standards and procedures to guarantee dependable performance.

Design Features

- New Reliability Standards, procedures & performance
- Extremely small case sizes
- Gas discharge and LED displays available
- Fully floating and isolated front end on AN2530 models
- Most units offer optional ratiometric capability
- Auto zero, dual slope on most units
- Metal cases standard or optionally available
- Heavy power line filter for minimizing RFI



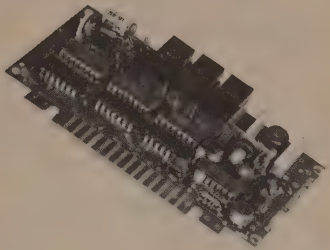
AN2535 Proven design, auto zero, 3½ digit featuring bright Beckman displays in extremely compact case. For portable instrumentation and systems applications. Differential input insures maintenance of specified accuracy for total system. BCD output standard.



AN2545 A premier grade auto zero ±20,000 count unit requiring only 1.2 watts, including its bright .55" Beckman display, this unit is ideal for wide dynamic range portable instruments. For working with certain transducers, the optional four wire ratio capability is particularly appropriate.

Cutout Dimensions

A = 1.750" x .750" (44.45mm x 19.05mm)
B = 3.250" x 1.280" (82.6mm x 32.5mm)
C = 1.772" x 3.622" (45mm x 92mm)



AN2330-L An extremely versatile Digital Panel Instrument. It is a selected unipolar 1000 count logic powered DPM laid out on a single P.C. card for behind the panel mounting. Electrically identical to the AN2530-L, it shares its features — including a truly floating front end, user set sensitivity, least significant digit sensitivity of 1, 2, 5, or 10 and standard BCD outputs. In addition, the AN2330-L has provisions for solder tab wiring and internal placement of the parts and jumpers of the AN86

AN2530 Low cost universal 3 digit model providing truly floating high impedance front end, user set sensitivity, LED or .55" Beckman display in the smallest case size. Ideal for portable instruments and system applications. BCD output standard.

999
ANALOGIC

MODEL	Full Scale Display Resolution Digits	Accuracy with respect to reading (±1 count)	Input Configuration	CMV With respect to 5V RTN CMRR @ 60Hz	Display	BCD's	Cut-out	Price Unit/ 100's*
AN2330L AN2530L AN2530S	999 3 digits counted by 1,2,5,10	0.2%	Hi-Z Isolated, floating selected unipolar	±300V 100dB	.3" LED .3" LED .55" Beckman	Full parallel Std.	A B B	89/64 89/64 99/71
AN2535 AN2536	±1999 bipolar 3½ digit	.05%	Hi-Z Diff.	2V (200mV range) .25V (2V range) >70dB	.55" Beckman	Full parallel Std.	B C	129/99 129/89
AN2545	±19999 bipolar 4½ digit	.01%	Hi-Z Diff.	.25V >70dB	.55" Beckman	Serial by digit, parallel by bit Std.	C	189/139

*Substantial OEM discounts available.

Audubon Road ■ Wakefield, Massachusetts 01880 ■ Tel. (617) 246-0300

ANALOGIC®

AERO

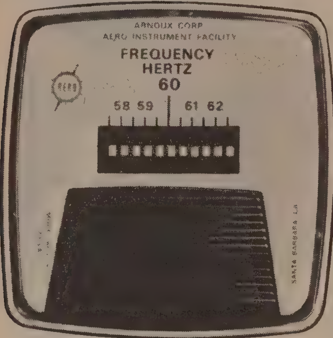
FREQUENCY METERS

OVER 25 YEARS OF CONTINUOUS PRODUCTION

VIBRATING REED METERS

The AERO Instrument Facility of Arnoux Corporation produces over 1000 different types and styles of Vibrating Reed Frequency Meters, with a proved history of usage spanning over 25 years. Unsurpassed for high performance and quality construction, all AERO Frequency Meters provide the inherent advantages of great accuracy (with 0.3% at 72°F, and within 0.1% on special order); long term stability (±75 ppm per degree F. from -60° to +180°); low power consumption; self-checking characteristics; high reliability; and extreme ruggedness. No adjustments are ever required on Vibrating Reed Frequency Meters. AERO meters are available with . . . . .

- **1.5 inch to 3.5 inch Round Cases**
- **Bakelite and Metal Construction**
- **Hermetic Sealing**
- **1 Reed to 11 Reeds**
- **Center Frequencies from 20 Hz to 400 Hz**
- **Voltages from 24 Vrms to 220 Vrms**
- **Running Time Indicators**
- **Combination Meters**

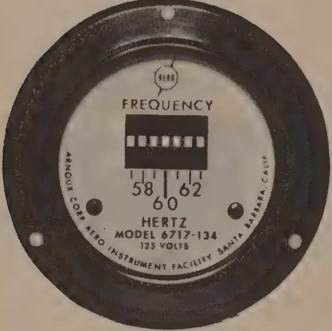


3.5 Inch Full View Meters

MODEL* NO.	CENTER FREQUENCY	FREQUENCY RANGE	NUMBER OF REEDS	REED INTERVAL	PRICE PER UNIT 1-24	25-49	50-99
2810.183	[50 Hz 60 Hz	48 to 52 Hz 58 to 62 Hz]	10	1 Cycle	37.21	24.93	20.47
4059-183	400 Hz	380 to 420 Hz	9	5 Cycles	42.11	28.21	23.16
5D31-183	50 Hz	47.5 to 52.5 Hz	11	½ Cycle	37.03	24.81	20.37
5717-183	50 Hz	47 to 53 Hz	7	1 Cycle	34.55	23.15	19.00
6D31-183	60 Hz	57.5 to 62.5 Hz	11	½ Cycle	37.03	24.81	20.37
6511-183	60 Hz	55 to 65 Hz	11	1 Cycle	37.03	24.81	20.37
6717-183	60 Hz	57 to 63 Hz	7	1 Cycle	34.55	23.15	19.00
6815-183	60 Hz	58 to 62 Hz	5	1 Cycle	32.55	21.81	17.90

Mounting Data. Three equally-spaced mounting studs (No. 8-32) are permanently affixed to rear of meter face panel, on 3.16" diameter (single studs at top center). Meter case requires 2.18" diameter hole. Total depth from rear of face panel is 2.50", including two No. 10-32 electrical connection studs. Meter face panel is 3.50" square and approximately 0.4" deep.

*Model numbers specify non-hermetically sealed metal cases; 0.3% accuracy; standard voltage of 117 Vrms; and input resistance of 10,000 ohms.



3.5 Inch Round Meters

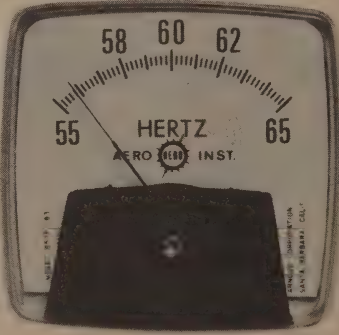
MODEL* NO.	CENTER FREQUENCY	FREQUENCY RANGE	NUMBER OF REEDS	REED INTERVAL	PRICE PER UNIT 1-24	25-49	50-99
2810-134	[50 Hz 60 Hz	48 to 52 Hz 58 to 62 Hz]	10	1 Cycle	33.58	22.50	18.47
4059-134	400 Hz	380 to 420 Hz	9	5 Cycles	38.48	25.78	21.16
5D31-134	50 Hz	47.5 to 52.5 Hz	11	½ Cycle	33.40	22.38	18.37
5717-134	50 Hz	47 to 53 Hz	7	1 Cycle	30.92	20.72	17.01
6D31-134	60 Hz	57.5 to 62.5 Hz	11	½ Cycle	33.40	22.38	18.37
6511-134	60 Hz	55 to 65 Hz	11	1 Cycle	33.40	22.38	18.37
6717-134	60 Hz	57 to 63 Hz	7	1 Cycle	30.92	20.72	17.01
6815-134	60 Hz	58 to 62 Hz	5	1 Cycle	28.92	19.38	15.91

Mounting Data. Three equally-spaced mounting holes are through meter face panel on 3.16" diameter (single hole at top center). Holes accept No. 8-32 mounting hardware (supplied). Meter case requires 2.69" diameter hole. Total depth from rear of face panel is 2.31", including two No. 6-32 electrical connection studs. Meter face panel is 3.50" diameter and approximately 0.2" deep.

*Model numbers specify non-hermetically sealed bakelite cases; 0.3% accuracy; standard voltage of 117 Vrms; and input resistance of 10,000 ohms.

POINTER TYPE METERS

AERO's new line of Pointer-Type Meters feature advanced microminiature circuits for performing frequency-to-DC conversion with remarkable linearity and stability. These circuit innovations have now made pointer-type meters both economical and practical for production. Pointer-Type Meters are presently available in three frequency ranges, with accuracy and stability as great as 0.3 Hz in the 45 to 65 Hz ranges. The input voltage for all units is 115 ±15Vac, with power consumption approximately 2 watts. Operating temperature range is 0° to 150°F.



MODEL NO.	FREQUENCY RANGE	ACCURACY & STABILITY	PRICE PER UNIT 1-24	25-49	50-99
557P-183	45-55 Hz	0.3 Hz	58.69	42.55	36.67
657P-183	55-65 Hz	0.3 Hz	58.69	42.55	36.67
407P-183	380-420 Hz	2.0 Hz	58.69	42.55	36.67

Mounting Data
(Same as for 3.5 Inch Full View Meters. See above.)

All prices are net, FOB Factory, 9-30-74, subject to change.

Larger quantity prices on request.

Write for Our Catalog for Complete Data on Other Models and Styles of Aero Frequency Meters

AERO INSTRUMENT FACILITY OF ARNOUX CORPORATION

35 ANACAPA STREET
SANTA BARBARA, CALIFORNIA 93101
PHONE (805) 963-3476

ARNOUX CORPORATION

POWER SUPPLIES

METALLIC TYPE

MAGNETICALLY REGULATED INSTRUMENT SUPPLIES

The precision-regulated, ac-to-dc power converters described here are among a great many types Arnoux Corporation has developed and marketed for airborne, missile, and ground-support equipment applications. Of solid-state design for reliable long-life duty, these converters have no moving parts or tubes. The units are stabilized over a wide range of input voltage (115 ±15 vac) and temperature (typically, from −65°F to +160°F). Detailed specifications on all units are available on request.

Designed for use in 400-cycle systems, these power converters are either magnetic-amplifier or transistor regulated. The magnetic types are dual regulated with ferroresonant or standard transformer input regulator and magnetic-amplifier output regulator. The transistorized models have a single, fast-response, output regulator that produces exceptional dynamic characteristics.

These units can be used wherever there is a requirement for precision power sources with fast response, low line current distortion, compactness, and reliability. Arnoux's power converters are particularly suited for operation or test in missile and aircraft flight systems, for checkout and control of ground-support equipment, and for transducer excitation or voltage standards work.

Producing from 5 vdc to 500 vdc with corresponding current variations, this series offers the user a wide selection of output voltages.

Electrical Characteristics
Magnetic Types with Ferroresonant Input

Static Regulation: for a line variation of ±15 volts under a full-rated load, static regulation in the output is within ±0.2%. Typical values are from ±0.05 to ±0.1%. For frequency changes of ±5%, regulation is less than ±0.15%. Typical values are from ±0.1 to ±0.25%. For load variation, typical values are regulation of less than 0.05% for a change of from 20% of rated load to full load; less than 0.1% for a load change of from 0 to 100%.

Dynamic Regulation: a 10% instantaneous change in line voltage results in less than 3% maximum change in output voltage, with a 95% recovery within 15 msec. For a load change of 10%, the instantaneous output-voltage excursion is 3%, with a 95% recovery within 100 msec.

POWER CONVERTERS

PRECISION AC-TO-DC TYPES/EXCITATION: 115 ± 15 VAC, 400 ± 20 CPS

• — MAGNETIC AMPLIFIER REGULATED, FERRORESONANT INPUT

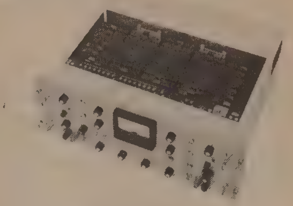
	Output		Regulation			Dimensions[a]					
			Line								
Model	Voltage DC	Current	Voltage, %	Freq, %	20-100% of Load, %	Ripple, % Rms	Length, In.	Width, In.	Height, In.	Weight, Lb	Ambient Temperature Range, °F
5S10-7 •	5	1 amp	±0.05	±0.1	±0.05	0.1	7.00	3.00	2.50	4.5	−65 to +160
5S30 •	5	3 amp	±0.1	±0.2	±0.05	0.1	9.00	3.00	3.00	6.5	−65 to +160
6.3S20 •	6.3	2 amp	±0.1	±0.25	±0.05	0.1	9.00	3.00	3.00	6.5	−65 to +160
6.3S50 •	6.3	5 amp	±0.1	±0.2	±0.05	0.1	7.00	5.00	4.00	12	−65 to +160
6.3S100 •	6.3	10 amp	±0.1	±0.2	±0.05	3.0	7.00	5.00	4.00	12	−65 to +160

[a] Excluding mounting flanges and connectors.

ARNOUX

TELEMETRY DECOMMUTATION SYSTEMS

Arnoux's unmatched reputation for the finest in Telemetry Decommutation Systems and components is exemplified by the Telemetry Commutation Simulator Model TCS-2.



Arnoux Corporation has developed a precision commutator simulator for use in ground station checkout and calibration. Because of the inherent accuracy and stability of the Arnoux TCS-2, it can satisfactorily perform two functions: that of a laboratory standard for decommutator evaluation and that of an operational commutator simulator for decommutator adjustment and calibration.

Basically, the TCS-2 generates PAM and PDM wave trains, which exactly simulate the signals developed by both IRIG and nonstandard telemetry commutation systems. Among the outstanding features, providing universal application, are a PAM nonreturn-to-zero output, a commutation-rate change from 2 to 10,000 pulses per second, and a wide degree of flexibility in channel-data output.

Operational simplicity and ease are illustrated by the front-panel controls. For example, the pulse-monitor meter directly displays pulse rate, PAM duty cycle, and PDM pulse widths. This capability is unique in the Arnoux unit among all existing simulators. Both zero and full scale reference channels may be switch selected to any place in the frame.

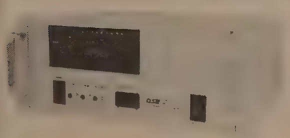
AN ARNOUX ASSOCIATED COMPANY

DSE DYNAMIC SYSTEM ELECTRONICS

35 ANACAPA STREET • SANTA BARBARA, CALIFORNIA 93101 • PHONE (805) 963-3476

ANALOG MULTIPLEXERS & A/D CONVERTERS

Dynamic System Electronics manufactures a full line of Analog Multiplexers and Analog-to-Digital Converters.



855 SERIES
High-level analog system

The 855 Series Analog Subsystem is used to generate digital representations of analog voltages and is normally incorporated in systems monitoring such sources as strain gauges, radar systems, thermocouples, accelerometers, pressure sensing transducers, medical devices, and numerous other sources of analog information.

DSE's 855 Analog to Digital Subsystems offer the following features:

- Conversion rates up to 100K samples/sec.
- Up to 128 differential (256 single ended) channels
- High accuracy
- Common Model Voltage Limit 12 volt (either line to ground)
- Input signals ±10 volts
- Up to 17 output bits and complement
- All solid-state

SPECIFICATIONS

OPERATION

Analog Inputs			Up to 128 differential Up to 256 single ended
Conversion Rate (sample/sec.)	No Bit	With S&H	Without S&H
	12	80K	100K
	13	73K	93K
	14	68K	88K
	15	63K	83K
	17	58K	78K

Resolution	
Binary	Up to 15 bits
BCD	Up to 17 bits
Accuracy (0 - 50°C)	
Full Scale Accuracy	±.01% ±½ LSB
Full Scale Linearity	±.01%
Temperature Effect/Full Scale Coefficient	±.001%/°C
Common Mode Rejection	
DC	80 db
60 Hz	60 db
Common Mode Voltage Limit	12V (either line with respect to ground)
S & H Aperture Time	50 nanoseconds, max.
S & H Hold Time	100 μs. for hold droop of less than 1 mv

INPUTS

Analog Voltage (standard)	±10 volts
Input Impedance	
OFF or ON	100 megohms all channels
Source Impedance	1000 ohms, max.
Input Over-voltage — Each Channel	
Standard	±30 volts
Optional	±100 volts
Common Mode Impedance	
Resistive	100 megohms
Capacitive	100 pfd
Input Logic	TTL compatible

OUTPUTS

Parallel Data Output	Up to 17 bits and complement
Binary, BCD or Decimal Display	
Output Logic	TTL compatible

PHYSICAL PARAMETERS

Dimensions	7″ x 19″ x 17″
Shipping Weight	50 lbs., max.

860 SERIES
Low-level analog system

The 860 Subsystem provides a true low-level, high-speed gain ranging capability. It accepts up to 96 differential inputs, automatically selects the gain, and converts this data into a binary output.

DSE's 860 Gain Ranging Subsystems offer the following features:

- Automatic Gain-Ranging
- Effective Dynamic Range of 24 bits
- Up to 96 differential channels
- Input signals from ±10 mv to ±10V
- Up to 13 bit +4 bit gain output
- All solid-state

SPECIFICATIONS

OPERATION

Number of Channels	Up to 96 (differential)
Automatic Gain Ranging	11 ranges
Voltage Range	±10 mv to ±10.24V
Conversion Rate	
Auto	0.83 kHz (max.)
Programmed	1.7 kHz
Resolution	13 bit
Accuracy (0-50°C)	±0.06% of full scale (at selected gain)
Common Mode Rejection	
DC	120 db
60 cps	100 db
Max. Common Mode Voltage	±12V (with 10 mv signal)

INPUTS

Input Impedance	
Scan On	10 megohms (min.)
Scan Off (includes Power Off)	100 megohms (min.)
Common Mode Impedance	
Resistive	1000 megohms
Capacitive	20 pfd (max.)
Source Unbalance	1000 ohms
Cross Talk	±0.02% (max.)
Max. Differential Input	±15V
Max. Voltage from either input to ground (Signal + Common Mode)	±12V
Input Logic	TTL Compatible

OUTPUTS

Parallel Output (including sign)	13 bits binary + complement 4 bits gain
Output Logic	TTL Compatible

PHYSICAL PARAMETERS

Dimensions	7″ x 19″ x 17″
Shipping Weight	50 lbs., max.

Your DPM Search Ends Here

AC power or 5VDC. 2½, 3, 3½, or 4½ digit resolution. Numitron, LED, or Beckman display. And all priced right. A complete range of DPM's including the only true RMS AC reading DPM. All backed by Analog Devices' worldwide sales and service organization. Decide on the right DPM from the capsule selection guide below and call or write for complete details including our Designers' Guide to Digital Panel Meters.

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East: 617/329-4700; Midwest: 312/894-3300; Texas 214/231-5094; West Coast: 213/595-1783. (Also, check our complete sales office listing elsewhere in this directory.)

Modular Instrumentation Division
Analog Devices, Inc.
Norwood, MA 02062

ANALOG DEVICES

If you don't see what you need in the table, give us a call anyway. Tables grow old, ideas don't.

CAPSULE SELECTION GUIDE TO DIGITAL PANEL METERS

Model		AD2001	AD2002	AD2003	AD2004	AD2006	AD2008	AD2009	AD2010	AD2011
Resolution (digits) and Range	2½		●							
	3									●
	3½	●		●		●		●	●	
	4½				●		●			
Input Type	Single-Ended	●	●					●	●	
	Differential			●	●	●				
	Floating				●		●			●
	Unipolar		●							
	Bipolar	●		●	●	●	●	●	●	●[4]
Display	Numitron	●	●	●						
	LED				●				●	
	Beckman					●	●	●		●
Data Outputs	Parallel BCD	●	●[1]			●		●		●
	Parallel BCD, Latched			●	●		●[3]		●	
Power	+5VDC	●	●	●	●	●[2]			●	
	AC Line					●	●	●		●
Connector	PC Card	●		●[2]		●[2]	●	●	●	●
	Multipin		●	●	●	●				
Applications	Low Cost Analog Replacement		●						●	
	General Purpose	●		●		●		●	●	
	Instrumentation Amp Input			●		●	●			
	High Noise Immunity			●	●	●	●		●	●
	Off Ground Measurements				●	●	●			●
	Ratiometric Measurements					●	●		●	
	High Visibility Display (>8-10′ & high ambient light)	●	●	●		●	●	●		●
	Extremely Rugged Display				●				●	
	True RMS Measurements									●
Price (Unit Quantity)		$142	$93	$156	$314	$177	$295	$140	$148	$295

[1] With DP option, solder pads for power and inputs only, standard.
[2] Optional.
[3] Optional: count output with polarity also available.
[4] Measures true-rms valued AC voltage.

ASSOCIATED RESEARCH, INC

INSULATION TESTING INSTRUMENTS

Insulation Resistance Testers

Ranges from 100 to 10 million megohms at test potentials to 10 KV.

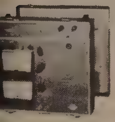
The MEG-CHEK® megohmmeter provides a wide selection of battery and line-powered instruments for accurate insulation resistance measurements of circuits, components, cables, motors, etc. They are direct reading and push button operated requiring no cranking or leveling.

Select from 17 models ranging from pocket-size to portable 10 KV with variable voltage. Some models combine megohm with ohm and AC-DC volt scales in one instrument. Five popular models are:

Model	DC Test Voltage	Max. Megohms	Features	Price
2001	500	100	Pocket-size	$ 99
2201	500	200	Includes 2K ohm and six AC-DC volt scales	225
2211	1000	2000	200 K ohm range	290
2850	500/50	10 Million	Constant test voltage through 6 decades	345
2955	0-2,500	50,000	Adjustable test voltage	945

Request MEG-CHEK Megohmmeter Bulletins by model number.

Portable DC HYPOTS® to 200 KV



Output of the several portable DC HYPOTS is continuously variable from 0 to maximum with the voltage metered directly in the output. Leakage current measurements are on four range meters reading down to as low as 0.05 microamps. Features: 2% metering ccuracies, electronic circuit protection, by-pass nd metered return terminals, grounded steel cases, ilicon rectifiers, plug-in high voltage leads, etc.

Model	Output Voltage	Output Current	Price
5205	0-5 KV	2.0	$ 550
5212	0-10 KV	2.0	675
5220	0-15 KV	2.0	735
5471	0-50 KV	5.0	2450
5321	0-100 KV	5.0	3115

Request Portable DC HYPOT Bulletins

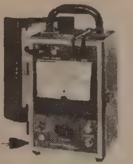
Two 60-page Testing Manuals available

Each contains bulletins, specs, application data and prices on instruments. For a free copy write on your company letterhead for either:

Manual 2900–test instruments for electronic equipment and systems (as illustrated above).

Manual D-62–test instruments for HV cables, generators and utility equipment (as illustrated on back of this sheet).

A-C HYPOT Jrs... to 10 KV, limited current



Portable a-c dielectric strength testers providing outputs continuously variable from 0-1500 V up to 10,000 V a-c. Use of neon breakdown and leakage current indicators in conjunction with collapsing field-type high voltage transformers assures rapid and safe production testing.

The leakage current indicator is adjustable from 0.3 to 3 ma. A 4½" kilovoltmeter provides high accuracy. Short-circuit current cannot exceed 18 ma.

Three popular models are:

Model	Output Voltage	Price
411	0-2,500	$225
404	0-4,000	235
422	0-10,000	355

HYPOT Jr. Automatic "Squawker" Models

Available with output voltages from 0-1500 volts to 0-6000 volts a-c. Similar to the standard HYPOT Jr. models but include an audible signal unit and external control terminals.

DC and Combined AC/DC HYPOT Jrs.

offer same features as described above, plus test potentials to 5 KV.

Request AC & DC HYPOT Jr. Bulletins.

Insulating Materials Testers

A full range of testers for solid and liquid insulating materials to 100 KV and higher is available. Due to the rapid progress of insulating materials and testing techniques, new equipment is added whenever required to meet ASTM, MIL and Federal test specifications.

Model 4501 Materials Testing HYPOT 0-35 KV at 2 KVA

This popular model meets dielectric strength testing requirements of Specification D-149, ASTM Standards on Electrical Insulation Materials. Output continuously variable from 0-35 KV a-c at 2 KVA (intermittent rating). Magnetic breaker trips when specimen breaks down. Output termination in jacks at center of the lucite cabinet top accepts the interchangeable ARI materials testing fixtures. Optional features: interlocked clear lucite test cage and selection of ARI plug-in materials testing fixtures, automatic rate of rise, dual sensitivity circuit breaker, etc.

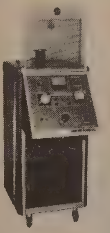
Request Insulation Materials Tester Bulletin

High Voltage Test Equipment to 500 KV AC and 1,000 KV DC

A full range of instruments for extra high voltage dielectric strength testing. AC or DC potentials at capacities of up to 150 KVA or more. Control and measurement features include: automatic rate of voltage rise, memory circuit to record breakdown voltage, output current metering, separate low voltage control and high voltage test cabinets and many others.

ARI has over 30 years experience in the design and manufacture of heavy duty very high voltage test equipment. All instruments are ruggedly constructed and fully tested in our own high voltage laboratory.

Corona Testing Equipment



New instruments detect, display and measure corona caused by voids, surface or other conditions in the insulation sample or the equipment under test.

Instruments include: specially constructed corona-free HYPOT test set, a pickup network to extract the true corona signal and the corona detection display module. Detector also incorporates a calibrator to make quantitative corona measurements down to 0.1 picocoulombs.

These modules are available as individual units or as a complete integrated instrument. Standard models with test potentials of 10 to 100 KV AC include these two popular models:

Model	Output KV	KVA Capacity	Cabinet Style	Price
4074	10	0.25	Bench	$2250
4309	35	1.0	Console	3950

Request Bulletin 4-1.9.

Mobile HYPOTS . . . to 150 KV DC

Heavy-duty mobile test sets for determining insulation leakage and dielectric strength of cables, bushings, switch-gear, transformers, motors and generators.

Outputs continuously variable from 0 to 45 KV and on up to 150 KV, with ratings of 2.5, 5, 10 ma. at full voltage.

Features include: 4½" kilovoltmeter connected directly across the high voltage output; three-range 4½" microammeter electronically protected against overload; zero return interlock; connector for remote safety interlock; fast-acting magnetic circuit breaker in output to protect high voltage circuits and external load; thermal overload breaker to protect input circuits; long-life silicon high voltage rectifiers; metered return and bypass return terminals for measurement of load (leakage) or bypass (guard) currents.

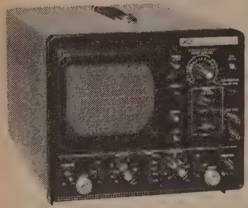
Request Mobile DC HYPOT Bulletin 5-1.16.

ASSOCIATED RESEARCH, INC.

6125 W. HOWARD ST.. CHICAGO. ILL. 60648 • (312) 647-7850

B+K PRECISION Quality Oscilloscopes

NEW! MODEL 1472 DUAL-TRACE, 15 MHZ TRIGGERED SWEEP OSCILLOSCOPE



Another outstanding oscilloscope from B & K – Precision. Bandwidth of 15 MHz is more than ample for the vast majority of applications in the lab, industry, on the service bench. Dual display of waveforms for quick, positive comparison. Triggered and automatic sweep. In AUTO mode, sweep is obtained without input signal. Six operating modes: CH A, CH B, Dual (A & B), with CHOPPED mode selected automatically for sweep speeds of 1 mSEC or slower, and ALTERNATE mode automatically selected for all faster speeds. TV-H and TV-V positions on sweep selector switch provided by sync separator circuitry.

SPECIFICATIONS

VERTICAL AMPLIFIERS (CH. A and B)

Sensitivity: 10 mV/cm to 20 V/cm, ± 5%, divided into 11 calibrated ranges, variable between ranges. **Response:** DC, DC to 15 MHz; AC, 2 Hz to 15 MHZ (-3 dB). **Risetime:** Less than 24 nanoseconds.

SWEEP SYSTEM

Type: Triggered and automatic. **Sweep Time:** 0.5 µSEC/cm to 500 mSEC/cm (±5%), divided into 19 ranges: 1, 2, 5 sequence; concentric sweep vernier control. **Magnification:** 5 times at all speeds; maximum sweep speed becomes 0.1 µSEC/cm.

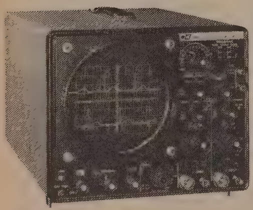
HORIZONTAL AMPLIFIER

Sensitivity: 10 mV/cm. **Response:** DC to 1 MHz (-3 dB).

OTHER SPECIFICATIONS

Calibration Voltage: 1 kHz, square wave of 1.0 V, peak-to-peak (±5%).
Intensity Modulation: 20 V peak-to-peak, minimum.
Size: 7-7/8 x 9-7/8 x 14-5/8".
Shpg. wt.: 26 lbs.
Stand: With tilt stand for eye-level viewing.
Probes: 2 required (see listing on next page).
B & K-Precision Model 1472 .... **Net: $595.00**

MODEL 1470 DUAL-TRACE, 10 MHZ TRIGGERED SWEEP OSCILLOSCOPE



Compare inputs, outputs. Six operating modes.

Features dual display of waveforms, their sum or difference, for fast, easy comparison. Its speed in checking inputs and outputs of video amplifiers is unsurpassed; same is true for checking the burst into and out of gate amplifiers. Has both triggered and automatic sweep; TV sync separator circuit for TV-H and TV-V; six operating modes, including alternate and chopped displays; large 5" screen with illuminated scale; bezel accepts standard camera mounting bracket. An extremely versatile scope with a wide range of applications. 100% solid state, except for CRT. Size: 9x10x7". For 105-125 VAC, 50-60 Hz. Complete with tilt stand for convenient viewing and Mylar vector overlay for Vectorscope function. Shpg. wt., 28 lbs.
B & K-Precision Model 1470. Less probes (2 required). . . Net: $580.00

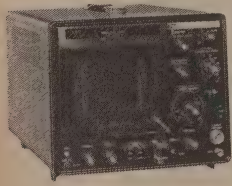
Model 1470 Specifications

VERTICAL AMPLIFIERS (Ch. 1 and 2)
Sensitivity: 10 mV/cm to 20 V/cm, ±5%, divided into 11 calibrated ranges. Concentric variable control between ranges. **Response:** DC, DC to 10 MHz; AC, 2 Hz to 10 MHz (-3 dB). **Operating Modes:** CH. 1 only; CH. 2 only; ALT; CHOPPED; ADD; CH. 2 invert. **Chopping Frequency:** 140 kHz.

SWEEP SYSTEM:
Type: Triggered and automatic. **Sweep Time:** 1 µSEC to .1 SEC/cm (±5%) in 16 steps (1, 2, 5 sequence); concentric variable control between ranges. **Magnification:** 5 times at all speeds.

HORIZONTAL AMPLIFIER
Sensitivity: 30 mV/cm. **Response:** DC to 800 kHz (-3 dB).

Model 1465 with Exclusive CALI-BRAIN®

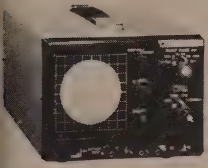


CALI-BRAIN—another B & K first! Special CRT screen has 2 scales, one on each side; selecting your vertical attenuator range automatically lights up the correct scale and produces a digital readout of full scale volts above the screen. To read peak-to-peak volts faster and more accurately, here's all you do: (1) Get pattern on screen; (2) pull out CALI-BRAIN knob (vertical position control); this collapses the horizontal sweep and shifts the resulting vertical line to the proper scale; (3) position the compressed waveform on the base line; (4) read the peak-to-peak volts directly off the screen! 100% solid-state. 10 MHz bandwidth, triggered sweep, automatic sync. With tilt stand. 9x10x17". For 105-125 VAC, 50-60 Hz. Shipg. wt., 27 lbs.
B & K - Precision Model 1465. Less probe. .... Net: $428.00

Model 1460 Triggered Sweep Deluxe Oscilloscope

Fully automatic triggered sweep. View the entire composite TV signal or any portion thereof, including the VITS and "back porch" of the horizontal sync pulse—all in perfect sync. Special sync separator circuit operates in all 19 triggered sweep positions, including TV-H and TV-V positions; switch back and forth from 2 horizontal lines to 2 vertical fields—with no other adjustments! DC to 10 MHz bandwidth; 10 millivolts/cm sensitivity displays smallest signal levels. DC amplifier. Has 1, 2,5 steps on calibrated vertical attenuator. Front-panel Vectorscope capability. Mylar vector overlay and tilt stand. Size, 9x10x17". For 105-125 VAC, 50-60 Hz. Shpg. wt., 27 lbs.
B & K - Precision Model 1460. Less probe............ Net: $450.00

Scopes & Transistor Testers B+K PRECISION



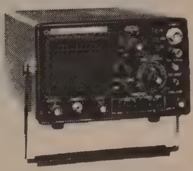
Model 1403 3" All-Purpose Mini-Scope

Here's a fine general-purpose oscilloscope: a 3", solid-state, highly reliable, rugged "Mini-Scope" that's so compact and portable, you'll take it with you wherever you go! Perfect for freeing more expensive scopes from such "menial" tasks as monitor-ng, etc. Trace is sharp and bright. DC amplifiers on both vertical and orizontal axes; direct-deflection terminals for waveforms up to 150MHz.

SPECIFICATIONS

Sensitivity: 20 mV/cm. **Response:** DC,DC to 2 MHz; AC, 2Hz to 2 MHz both -3dB). **Max. Input:** 600 V p-p. **Input Impedance:** 1 megohm/30 pF. **Sweep:** Recurrent. **Time Base Ranges:** 10-100 Hz, 100 Hz-1 kHz, 1-10 Hz, 10-100 kHz; continuously variable between ranges. **Sync:** Internal nd negative. **Size:** 5 1/4 x 7-3/8 x 11 1/4. **Power Requirements:** 117/234 VAC, 50-60 Hz; 15 watts; 3-wire AC cord. With leads, spare fuse. Wt., 11 bs.

& K-Precision Model 1403 .... Net: $189.00



Model 1431 3" Triggered Sweep Scope

A compact 3" scope with exceptional capabilities: triggered sweep, automatic sync, DC to 10 MHz bandwidth. Small size leaves lots of room on bench for auxiliary equipment—makes it easy to handle and store the 1431. Has TV-H and TV-V positions on sweep selector. Very sensitive—displays smallest signal levels in transistor and IC circuits and positive sync. Also displays high frequency signals such as TV color burst. Fast writing speeds of up to 0.1 microsecond per division. All solid state. Weighs only 8½ lbs.

SPECIFICATIONS

Sensitivity: 10 mV/DIV to 20 V/DIV; 11 calibrated positions. **Response:** DC, DC to 2 MHz; AC, 2 Hz to 10 MHz. **Sweep:** Automatic and triggered. Sweep time, 0.5 μSEC/cm. **Size:** 4-3/4 x 7-7/8 x 12-7/8". For 105-125 VAC, 50-60 Hz. Has 3-wire cord. Less probe; see probe listings above. Shpg. wt., 11 lbs.

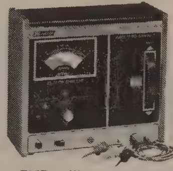
B & K-Precision Model 1431 .... Net: $399.00

Model 501-A Curve Tracer for Analyzing Solid-State Devices

- Pin-points BAD devices in-circuit

The 501-A is to solid-state devices what the mutual conductance tube tester is to vacuum tubes. It's the best way to analyze semiconductors: by displaying their curves on the screen of an auxiliary scope. Measures gain (beta); leakage, breakdown voltage (non-destructive), output admittance, etc. Tests J-FET's, MOS-FET's, signal and power bipolar transitors, UJT's, diodes, Triacs, SCR's, diodes. Electronic current limiting—no IR drops to affect curves. With FP-3 probe for in-circuit testing. 4x10x9½". For 105-125 VAC, 60 Hz.

B & K - Precision Model 501-A. Shpg. wt., 6 lbs....... Net: $163.00



NEW! Model 520 Transistor Tester

Here's the answer to those transistor-testing jobs! "Human-engineered" front panel—less reference to manual is required with the 520 than with any other transistor tester. **In-Circuit Tests:** GOOD/BAD test for PNP and NPN devices; F.E.T.'s and SCR's. Automatically identifies: NPN or PNP; silicon or germanium. **Out-of-Circuit Tests:** GOOD/BAD test for PNP and NPN transistors; F.E.T.'s, SCR's; leakage, IDSS. Identifies NPN or PNP; silicon or germanium. Measures reverse leakage from 0.1uA to 5 mA. **Other Features:** "GOOD" indication by audible tone, in or out of circuit. Gain test switch automatically identifies base or gate lead for good transistors or F.E.T.'s. No charts needed for leakage tests—dial scale calibrated for different types of devices. Actually determines presence of GAIN in circuit—unlike testers which only measure phase inversion or diode front-to-back ratios. Size: 8x7x3 1/2". For 105-1250 VAC, 50-60 Hz. with FP-5 probe. Shpg. wt., 7 lbs.

B & K-Precision Model 520 .... Net: $150.00

SCOPE PROBES AND CASES

Probes for B & K-Precision Oscilloscopes

The following probes are for use with B & K—Precision scope Models 1431, 1440, 1460, 1465, 1470 and 1472.

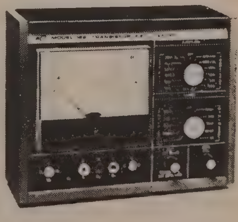
MODEL PR-20 PROBE. Combination 10:1/DIRECT probe, with spring-loaded clip-on tip. Input impedance: Low-capacity, 10:1, 10 megohms/18 pF; DIRECT, 1 megohm/120 pF. Net: $20.00

MODEL PR-24 PROBE. Combination probe as above, but with wider frequency band-width to especially accommodate the wider band-width of the Model 1472 scope. Net: $28.00

MODEL PR-153 PROBE. Demodulator probe for viewing RF and IF modulation waveforms on B & K—Precision scopes. Net: $35.00.

Cases for Scopes and HV-40 Probe

odel No.	For	Net Each
LC-14	Model 1403 scope	$10.00
LC-31	Model 1431 scope	10.00
LC-70	Models 1460, 1465, 1470 and 1472 scopes	25.00
LC-32	Model HV-40 probe tester	12.00



Model 162 Transistor/ F.E.T. Tester

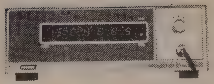
Reliable, fast, low-cost way to check transistors and F.E.T.'s in- and out-of-circuit. Easy to operate. Go-No Go tests tell you instantly if device is defective. Tests: Diodes, Unijunctions, SCR's, Triacs, etc. Checks gates of dual-gate F.E.T.'s separately. Measures: $I_{CBO}/I_{CES}/I_{CEO}/I_{GSS}$/Beta/Gm. 4½" meter. Size, 7¼x9x4" D. With batteries and leads. Shpg. wt., 6¾ lbs.

B & K - Precision Model 162 .... Net: $128.00

Model HV-40 High-Voltage Probe

Measures up to 40,000 volts with 2% accuracy. Tracking accuracy, ±2% of full-scale. Reading accuracy, ±2% at 25 KV. 1.75" probe tip. Shpg. wt., 1½ lbs. .... Net: $35.00

B+K PRECISION Power Supplies & Generators



New! Model 1801 Frequency Counter

High-quality, lightweight, auto-ranging frequency counter for measurements in the range of 20 Hz to 40 MHz. Crystal-controlled 10 MHz internal time base with stability of ±0.1 PPM (±1 Hz). Has 6-digit display plus 3 L.E.D.'s for indicating "kHz", "MHz" or overrange. Excellent for lab or field use. Frequency range: 20 Hz to 40 MHz guaranteed, 10 Hz to 60 Hz typical. Function switch selects "1 SEC" for reading to the closest Hz, or "AUTO" for maximum resolution without overranging. Accuracy, ± time base accuracy, ± 1 count. Resolution, 1 Hz. Input impedance, 1 megohm, shunted by 25 pF. Diode-protected. Maximum input: 200 V to 500 Hz, derate linearly to 100 V @ 1 kHz; 100 V from 1 kHz to 5 MHz, derate linearly to 50 B at 40 MHz (all voltage values = peak AC + DC). Sine wave sensitivity: 30 mV RMS guaranteed, 15 mV RMS typical, over full range. Size, 2-3/4 x 8½ x 10" D. For 105-130 VAC, 60 Hz; 25 watts max. With combination tilt stand/handle.

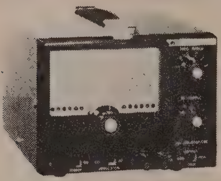
B & K–Precision Model 1801 .... Net: $230.00

Model 1601 0-50 VDC Regulated Power Supply

Provides 0-50 VDC, continuously variable, over full range, with a single control. Also, 0-2 amperes. Simplified current setting: does not require application of short circuit to output terminals. To set current, no short-circuiting of output terminals is necessary. Fail-safe overload protection automatically shuts power supply down whenever current exceeds the preset level, and overload indicator on the front panel lights up. STANDBY switch disconnects load for safe, quick adjustments without disturbing settings. Regulation: load, .05% typical; line, .02% typical. Ripple: 5 mV p-p max. Size: 14-1/8 x 3-7/8 x 10". For 105-125 VAC, 50-60 Hz. Complete with leads and instructions. Shpg. wt., 13 lbs.

B & K-Precision Model 1601 .... Net: $175.00

MODEL 1602 0-400 VDC SUPPLY. Fully regulated, continuously variable output over full range–with a single control. Also: 0-200 mA, fully regulated; 0-100 VDC bias @ 2 mA; 6.3/12.6 VAC @ 3.5 A. Same size as Model 1601. Shpg. wt., 13 lbs. Net: $185.00



Model 2050 RF Signal Generator

Rugged, versatile, accurate RF signal generator. Built to withstand the rigors of continuous portable use, yet it's very compact and weighs. only 5 pounds! All solid-state circuitry uses F.E.T.'s in RF and audio oscillator stages for greater stability and maximum linearity of modulated signals. A single, special-design PC boards holds 90% of the components, assuring highest frequency stability. Zener-regulated power supply is internally fuse-protected. RF output is isolated for maximum protection against external voltage sources. Provides 100 kHz to 30 MHz in 6 bands, with 1.5% accuracy. Outputs: RF, modulated RF (400 Hz) and externally modulated RF. Attenuator: Combination HIGH-LOW switch, plus continuously variable RF output control for approximately 20 dB change. Size: 6-1/8x71/2x9-3/4"D. For 117/234 VAC, 50-60 Hz. Has 3-wire grounded line cord. Shpg. wt., 7 lbs.

B & K-Precision Model 2050 .... Net $107.00

Model 3050 Sine/ Square Wave Generator

Versatile audio frequency generator with circuitry based on the Wien bridge oscillator. Ideal as signal source for phase and time measurements; for characteristic measurements using square waves; as low-distortion source for AF measurements. All solid state; extremely high stability with ±10% line voltage variations. Outputs: 4 ranges, 20 Hz to 200 kHz. Accuracy, ±(3% + 2Hz). Sine wave o.p.: 10 V RMS, ±10% @ 1 kHz. Sq. wave o.p.: 10 V p-p or better. Rise/fall time: 0.5 μSEC or less.

Other Specs: Frequency drift, less than 0.5%. Output level variation, less than 0.5 dB. (Both with 10% line voltage variation.) Size, 7-3/4x9-5/8x6" H. Net wt., 6¼ lbs. Factory-set for 117VAC, 50/60Hz; can be converted to 230VAC and 100VAC. With leads.

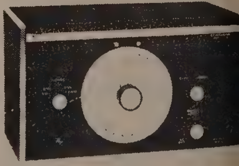
B & K - Precision Model 3050 .... Net: $133.00

Model E200D RF Signal Generator

Features 100% silicon transistor circuitry and zener-regulated power supply for accuracy, stability and long life. Six individually shielded step attenuators plus variable fine output level control with calibrated meter provide widest range of outputs with known signal levels. Full shielding eliminates spurious radiation even at outputs of 1μV. Internal crystal calibrator for accuracy of better than 0.1%. Has 200μA d'Arsonval meter for accurate monitoring and setting of RF carrier and modulation levels. Crystal calibrator provides audible zero-beat through built-in speaker. Can be used as crystal-calibrated marker. 100kHz to 54MHz on fundamentals and 54 to 216MHz on harmonics. Outputs: Unmodulated RF; modulated RF; externally modulated RF; 400 Hz audio. For trap, bandpass coil alignment; FM/AM receiver alignment; stage-by-stage amplifier gain tests; signal tracing. 100-130 VAC, 50-60 Hz. 16 lbs.

B & K-Precision Model E200D .... Net: $229.00

Model E310B Sine/ Square Wave Generator



Latest version of the industry standard. For service shops testing hi-fi equipment; for schools, labs, industry. Now features 100% solid-state circuitry; F.E.T. in oscillator, all-silicon transistors. Fully shielded–no signal spill-over to other equipment. Extended ranges: Sine Wave: 20 Hz to 2 MHz. Square Wave: 20 Hz to 200 kHz. Constant-voltage output over each band and from band-to-band. Features step attenuation of both sine and square wave outputs. Ideal fo amplifier, P.A. testing; loudspeaker resonance tests; input/output impedance measurements; modulation of RF signal generators; synchronizing pulse generators; stage-by-stage amplifier gain tests; alignment o broadcast receiver IF and RF stages, etc. Size: 12-3/4x7¼x8"D. Shpg wt., 9½ lbs.

B & K–Precision Model E310B .... Net $153.0

Industry Standard Meters

B+K PRECISION

Model 280 3-Digit Hand-Held Digital Multimeter

The first full-feature 3-digit multimeter at an analog price! Features resolution down to 1mV, 1μA, 0.1Ω. Bright 0.3″ non-blinking display; automatic decimal point and polarity. Positive out-of-range indication—all 3 digits of display flash. Has high-low power ohms ranges to measure resistances in solid-state circuits. Input impedance, 10 megs. RANGES: DC/AC voltage, 0-1000mV, 10V, 100V, 1000V; DC accuracy ±1% of read-ng, (1000V, ±2% of reading); AC accuracy, ±2% of reading, 1000V, ±3% of reading). DC/AC current, 0-1000 μA, 10mA, 00mA, 1000mA; accuracy ±2% of reading, ±1% F.S. (1000mA, ±3% of reading). Ohms, 0-100, 1K, 10K, 100K, 1meg, 10 megs; ccuracy, ±2% of reading, ±1% F.S. (10 megs, ±3% of reading). Dverload protection: DC/AC volts, diode and series current limit re-istance; DC/AC current, fuse and diode; ohms, internal to 135VAC. ize, 4-3/8x6-3/8x2″. Uses 4 "C" cells (not supplied) or optional AC dapter/charger. With leads, less carrying case. Shpg. wt., 3 lb.

&K-Precision Model 280 .... Net: $99.95

Model 120P 20,000 Ohms-Per-Volt Volt-Ohm-Milliammeter

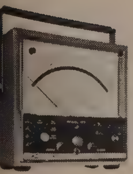
- Resettable electronic overload protection
- .25V and 50 μA DC ranges

Highly accurate, versatile, rugged VOM–one of the most popular in the business. Resettable electronic overload protection prevents accidental destruction of instrument, shunts, multipliers, meter. Protects all ranges except 0-ampere bus bar range. Meter movement is a precision, taut-band, elf-shielding annular type–withstands shock and vibration encountered n heavy day-in and day-out use. RANGES: DCV, 0.25V to 1000V; ccuracy, ±2%, F.S. DC current, 50 uA to 10 A; ±1.5% F.S. on 50 uA ange; 2% on other ranges. ACV, 2.5 to 1000V RMS; accuracy, ±3% F.S. requency response: 0-50 VAC, ±1 dB to 100 kHz; 250 VAC, ±1 dB to 0 kHz. Resistance: Rx1, x100x10,000; center scale, 12 ohms. Also read B. Size, 5-1/8x7x3-1/8" D. Complete with leads and batteries. Shpg. t., 4 lbs.

& K–Precision Model 120P .... Net: $96.00

ODEL LC-12 CASE. For 120P VOM .... Net: $9.00

Model 177 Vacuum Tube Voltmeter



- DC supply for ohms ranges–no ohms battery needed
- 11 megohms input impedance

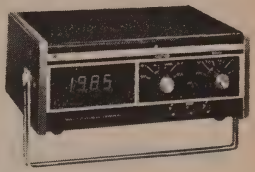
Highly versatile, rugged, "old-stand-by" vacuum tube voltmeter, with built-in DC supply – no ohms battery required. Has 30 ranges: DC/AC/RMS volts; resistance. Separate peak-to-peak and RMS scales. Special calibration on low AC ranges. Reads 0.5V to 1500VDC; 1.5V to 1500VAC. Large 7", mirrored, 100-microamp meter. Input esistance, 11 megohms. Accuracy, 3% on DC, 5% on AC. Supplied with &K PR-43 DC/AC/Ohms test probe, with switch. 7-1/8x7¼x3-5/8". hpg. wt., 8 lbs.

& K-Precision Model 177 .... Net: $107.00

V-1A RF PROBE. Extends freq. range to 250 MHz. 1 lb. Net: $ 13.50

V-2A HIGH-VOLTAGE PROBE. Extends DCV range to 0,000 volts. Wt., 1 lb. .... Net: $ 19.50

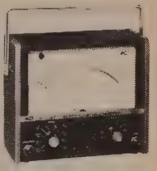
Model 282 3½-Digit Digital Multimeter



The Model 282 VOM features a 3½-digit display, 0.5% accuracy on DC and automatic polarity. Also has 100% overrange capability on all ranges and positive out-of-range indication: first digit shows "1" and remaining digits blank out completely.. Automatic decimal point positioning. 1 mV resolution. Input impedance, 10 megohms, all ranges. RANGES: DC and AC volts, 1-1000 V. Accuracy on DC, ±0.5% of reading, ±1% of reading, ±1 digit, 1, 10, 100 V ranges; 1000 V range, 1.5%; all ±1 digit. DC current, 1-1000 mA. Frequency response: ACV and AC current, 50-200 Hz. Resistance, 100 ohms to 10 megohms. Accuracy, ±1% of reading, ±1 digit, all ranges except 1000V, ±2%. Overload protection: To 250V on ohms; to 3 amps on shunts; to 1500V on volts. Size, 3½x7x9". For 105-125 VAC, 50-60 Hz. 3-wire grounded line cord. With PR-21 probe and leads. Shpg. wt., 5 lbs.

B & K–Precision Model 282 .... Net: $200.00

Model 290 F.E.T. 75-Range Electronic Multimeter



- Hi-Lo power ohms ranges
- 7" meter with 100° scale arc

One of the most versatile multimeters ever designed–75 ranges in all. Hi-Lo power ohms ranges for critical semiconductor circuit testing. 50 mV full-scale sensitivity on both AC and DC. 50 microamp current range. Rx0.1 ohm range with 1 ohm center scale. 15 megohms input impedance for minimum circuit loading. Uses 0.5% precision multipliers. Zener-regulated power supplies. Full protection for meter, F.E.T. input, circuits. RANGES: DCV, 50-1500 V; accuracy, ± 1.5% F.S. ACV, 50-1500V RMS; 10 peak-to-peak ranges; accuracy, ± 3% F.S. through 150 V range; ±5%, 500V, 1500 V ranges. Frequency response: To 150 V range, ±0.5 dB, 20 Hz to 500 kHz; ±3 dB, 5 Hz to 750 kHz. DC current, 50 uA to 1.5A; accuracy, ±3% F.S., except ±4% on 1.5A range. AC current, 50 uA to 1.5A; accuracy, ±4% F.S. except 5% on 50 uA and 1.5A ranges. Resistance: 8 Lo-Power ranges and 7 Hi-Power ranges. Meter has 100 uA movement and mirrored scale. Size, 7¼x8x3-5/8" D. For 105-125 VAC, 50-60 Hz. Shpg. wt., 6 lbs.

B & K-Precision Model 290 .... Net: $151.00

Model 277 F.E.T. Electronic Multimeter

- Lo-Power and Hi-Power ohms ranges for checking semiconductor, IC circuits
- 1μA DC current range
- 1V AC/DC volts scale

Has 7 low-power and 7 high-power ohms ranges – valuable when checking ohms in semi-conductor or IC circuits, 36 additional ranges for measuring AC and DC volts, dC current and dB. Has 1 microamp DC current range for sensitive semiconductor leakage testing. Also has .1 volt AC/DC volts scale, for measuring transitor bias. Reads to 1kV, DC and AC. 100% solid state. FET input, current and resistance circuits overload-protected. 4½" meter has 50μA movement, mirrored scale. Size, 7½x7-7/8x3-5/8". With PR-21 probe; has switchable 100K ohm isolating resistor. Less batteries. Requires 1 "D" cell and 1 NEDA 1604 cell. Shpg. wt. 5 lbs.

B & K-Precision Model 277 .... Net: $102.00

MODEL LC-27 CASE. For 277 VOM .... Net: $11.00

BEEDE

Panel Meters
Pyrometers
Control Meter-Relays
Meter Movements

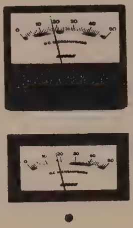
New Beede CERTRAK™ Panel Meters

±1% or ±½% tracking certificate with each meter

Beede is the first panel-meter manufacturer to certify the tracking accuracy of its products. Each Certrak™ meter is shipped with an individually signed certificate of tracking accompanied with a printout of readings taken at every numbered scale division. Certificates of ±1% or ±½% tracking accuracy are available.

New shielded-bar taut-band movement. In conjunction with the new Certrak™ panel meters, Beede announces its new ultra-sensitive shielded-bar taut-band meter movement. All Beede panel meters containing this movement qualify under the Certrak 1% certification program. Sensitivities from 0-10μA to 0-25A are in stock for immediate shipment; stock voltmeters are 0-10mV to 0-300V. Case styles in stock: 3″ and 4″ Designer and Centurion, 6″ Universal (described below).

For complete information, request Bulletin PM-3.


Centurion

Designer

Universal

Other Beede Panel Meters

Centurion Line. 3″ and 4″ durable molded black phenolic with glass window for front-of-panel mounting; 4″ back-of-panel model. Illumination available in 4″ models.

Designer Line. Clear picture-frame design with concave window in 2″, 3″, 4″, and 6″ widths for both front and back-of-panel mounting.

Universal Line. Large, highly visible meter cases in 6″ and 8″ widths for across-the-room reading.

250° Line. Beede's very popular 250° movement for switchboard, automotive, marine applications available as meter movement only (see bottom of next page) or in brass, chrome, or black lacquer case with glass front, 3″ and 6″ diameter.

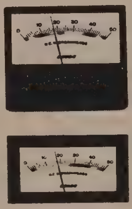
Edgewise Line. 1½″ and 2½″ models for applications demanding minimum panel space.

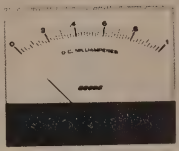
QA Line. 1½″, 3½″, and 4½″ cases with concave window, lower portion painted or horizontal ribbed.

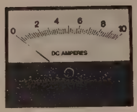
Traditional Line. Available in various rectangular and round phenolic cases.

Clear Front Line. 1″, 2″, 3″, 4″ cases for general-purpose panel-meter applications.

For complete information, request Bulletin PM-2.


Centurion Line

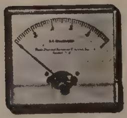

Universal Line

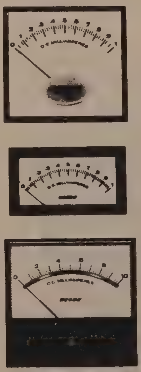

QA Line

Traditional Line

250° Line

Edgewise Line


Clear Front Line


Designer Line

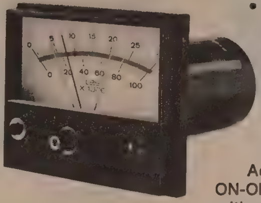
Control Meter-Relays

The Beede non-contacting control-meter relay combines a high-torque d'Arsonval meter with an adjustable photoelectric sensor, switching circuit, and output switch. As the monitored variable passes the adjustable setpoint, an output relay is either energized or de-energized. Either one or two setpoints are available.

Beede's greatly simplified meter-relay design has significantly reduced the number of parts, resulting in price savings up to 50% without a sacrifice of quality features.

Features

- Optical, non-contacting control, continuous indication.
- Standard models available from stock.
- Wide variety of options (power supply, input and output, tamperproof setpoint controls, etc.) for inexpensive customizing.
- Available as single complete unit, or with separate control, or optical element only.
- Inherently fail-safe.
- AC or DC power input.
- Direct-drive set pointers.
- Lamp life in excess of 10 years.
- Meter movement and/or dial custom-designed to your specifications if required.
- Meter permanently free of static influence.
- Attractive, modern "Centurion" case, 3" or 4" wide; 4" model available also for behind-panel mounting.



Specifications

Accuracy ±2% or ±1%.
ON-OFF operation or latching with manual reset.

Output: 5 amp (resistive load) DPDT relay for each setpoint. Solid State Output available.
Standard Deadband is 0.5% nominal.
Power Requirements 105 to 130 Volts AC.
Other AC and DC power inputs available.
Ambient Temperature 40°F to 165°F is standard.

Movements

MAG-BAND TAUT BAND, 0-20μA DC minimum range.
MAG-B PIVOT AND JEWEL, 0-200μA DC minimum range.

For complete information, request Bulletin MR-2.

Pyrometers

NEW Optemp™ pyrometer/meter relay. High-impedance input amplifier delivers high-power signal to meter movement, eliminating need for thermocouple lead-length adjustments and permitting the use of lower-cost light-gage t/c extension wire. Rugged high-torque pivot-and-jewel movement with non-contacting optical switching for fast response, inherent noise rejection, continuous indication.

Standard Optemp models suitable for Types J and K t/c's. Six stocked ranges from 0-300°F to 0-2500°F. Single or double setpoint. Case width 3 or 4 in. All models have electrical cold-junction compensation, t/c break protection. Many options available, including integral bridge circuits enabling use of RTD or thermistor sensing of narrow temperature ranges.

Indicating pyrometers—As "prime source for temperature instrumentation," Beede offers, in addition to the controlling pyrometers described at left, a complete range of indicating panel-meter pyrometers in a wide choice of case styles in widths from 2" to 6". Clear-reading mirror scales eliminate parallax error, and may show both Fahrenheit and Centigrade units.
For complete information, request Bulletin T-1.

Meter Movements

Precision d'Arsonval movements as used in the case styles shown above, or available for installation in customer's case.

Shielded-Bar Taut-Band. Maximum sensitivity and freedom from hysteresis, for measuring extremely low microampere ranges.

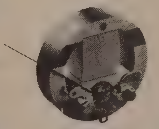
Mag-Band Taut-Band. Self-shielded, high-torque, excellent balance, no drift.

Mag-B Pivot-and-Jewel. Rugged, high-torque self-shielded movement.

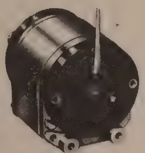
250°. A fine, sturdy, self-shielded 250° pivot-and-jewel movement, very popular for process-control applications. Available in a choice of mounting arrangements.

Super-Torque™ 250°. Vehicle, heavy machinery, process applications. Thru-shaft design takes push-on pointers, withstands casual handling by untrained personnel. World's ruggedest 250° movement.

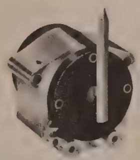
AC Iron-Vane (Repulsion). The preferred movement for making direct measurements of AC voltage and current. Better than d'Arsonval movements for AC panel meters.



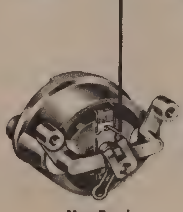
Shielded-Bar
Taut-Band



250-S



Super-Torque



Mag-Band
Taut-Band

Mag-B
Pivot-and-Jewel

AC Iron-Vane

Custom Meter Design

Beede specializes in custom-designed meters to meet exacting customer requirements. And, to top off our in-depth knowledge of our customers' businesses, *we deliver as promised.*

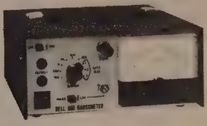
BEEDE

BEEDE ELECTRICAL INSTRUMENT CO., INC
Penacook, N. H. 03301
Phone (603) 753-6362: TWX 710-364-6977.

5908

F W BELL INC.

HALL EFFECT GAUSSMETERS



600

640

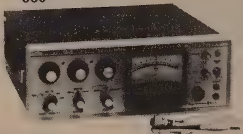
FEATURES

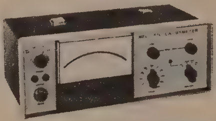
- 0.1% BUILT IN CALIBRATION ACCURACY
- HIGH ACCURACY
- AC AND DC MAGNETIC FIELD MEASUREMENTS
- MILLIGAUSS TO 100 KILOGAUSS RANGE
- EXCELLENT REPEATABILITY
- STABILITY TO 100 PPM/°C

APPLICATIONS

magnet processing
thickness measurement
mass spectrometer
field monitoring
magnetic ink
magnet testing
magnetic field feedback control
manufacturing Q A

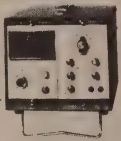
660





610

811



DESCRIPTION

Bell Gaussmeters are high quality instruments designed to accurately measure magnetic flux density. Twenty-eight models and one-hundred ten standard field probes meet the demanding requirements of most applications. Accuracies range from ±0.2% FS to ±4% FS. Dynamic ranges are from 0.1 Gauss FS to 100,000 Gauss FS. Outputs are proportional voltages, visual meter indications and BCD.

Bell gaussmeters provide four magnetic field measurement modes. They provide direct measurement of absolute magnetic field density, differential measurement of the difference in magnetic field density at two probe locations, incremental field measurements using an expanded scale, and summation measurements.

GAUSSMETER PROBES

There are 110 different probe models for each gaussmeter model. Each probe is a precision solid-state magnetic field sensor built into a rugged package for accurate, repeatable, stable, field measurements. Models are available for transverse, axial, differential, two-axis, and three-axis measurements with a variety of field ranges, field sensitivities, and physical configurations for each. Calibrated extension cables and high sensitivity magna-probes are also available.

This complete line of Bell gaussmeter probes is a major advantage of Bell magnetic measuring equipment over other manufacturers' equipment. The wide range of gaussmeters and probe combinations meet the demanding electrical and mechanical requirements of virtually all applications.

model	ranges	accuracy	frequency response	output voltage
811 digital gaussmeter	4 ranges, 10 to 100,000 gauss FS	±0.2% FS to 100 kg	dc to 400 Hz	BCD 1 Volt dc FS
810 field monitor	4 ranges, 10 to 100,000 gauss FS	±0.2% FS to 100 kg	dc to 400 Hz	1 Volt dc FS
660 digital gaussmeter	6 ranges, 1 to 100,000 gauss FS	±0.25% FS to 10 kg ±0.5% FS to 30 kg	static and slowly varying	1 Volt dc FS
640 incremental gaussmeter	12 ranges, .1 to 30,000 gauss FS	±0.25% of reading	dc to 400 Hz	1 Volt dc FS 5 Volts dc FS
620 precalibrated gaussmeter	12 ranges, .1 to 30,000 gauss FS	±0.25% of reading	dc to 400 Hz	1 Volt dc FS
615 digital gaussmeter	5 ranges, 10 to 100,000 gauss FS	±0.5% FS	dc to 400 Hz	100 mV dc FS BCD
610 self-calibrated gaussmeter	11 ranges, 1 to 100,000 gauss FS	±0.5% FS	dc to 400 Hz	100 mV dc FS
600 general purpose gaussmeter	6 ranges, 100 to 30,000 gauss FS	±4% FS to 30 kg plus cal. error	dc to 5 kHz	1 volt dc FS

ORDERING INFORMATION

Contact F. W. Bell, Inc. for application assistance. Product assistance and technical literature are available. If standard models are not available, F. W. Bell, Inc. can design for your special electrical and physical requirements.

Member of ALLEGHANY LUDLUM INDUSTRIES, INC.

F W BELL INC.

A Subsidiary of
The Arnold Engineering Company

4949 Freeway Drive E.
Columbus, Ohio 43229
Phone: (614) 888-7501
TWX: 810-337-2851

For other Bell products turn to pages 1•2338, 1•2339

The Gaussmeter People

DC AND AC CURRENT SENSORS

DESCRIPTION

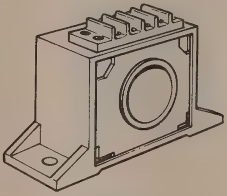
FW Bell current sensors are designed to meet the challenging requirements of many different current measurement applications. The sensors are compact non-contact Hall effect devices. The measured current full-scale range may be from *(several amperes)* full-scale to in excess of 40 kA.

The Bell current sensors operate on the principle of Ampere's Law. This principle says that the closed-line integral of magnetic field is equal to the current through the line aperature. Thus, the Bell current sensors function by sensing the magnetic field surrounding a current carrying conductor.

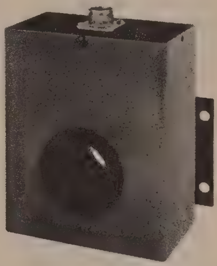
Features:

- Fast responding
- Non-contact operation
- Output voltage isolated from input
- Very low insertion impedance
- Clamp-on feature saves time when making measurements
- Economical
- Minimal distortion from adjacent conductors
- Compact
- Amplified and non-amplified models available

Clamp-on current probe



ID-5001 M



IA-5020 P

Permanent Mount Models

model	rated current	rated output	accuracy	temperature range	response time
1A-5001 Z	600 A dc	6 V dc	± 1% RO	−20°C to +70°C	< 50 μs
1A-5002 Z	800 A dc	8 V dc	± 1% RO	−20°C to +70°C	< 50 μs
1A-5021 P	1000 A dc	10 V dc	±0.5% RO	−30°C to +75°C	<150 μs
1A-5020 P	2000 A dc	10 V dc	±0.5% RO	−30°C to +75°C	<150 μs
ID-5001 M	350 A ac/dc	.25 mV/At	±2% RO	−40°C to −100°C	<100 μs

Clamp-on Current Probe

Sensing dc & ac current in automobiles, computers, aircraft, motors, etc.

range	accuracy	temperature range	output
0-500 A peak	±3% of reading	−20°C to +65°C	35 mV/100A, 1V/100A

Various other models available. Contact factory for your specific requirements.

ORDERING INFORMATION

Contact F. W. Bell, Inc. for application assistance. Product assistance and technical literature are available. If standard models are not available, F. W. Bell, Inc. can design for your special electrical and physical requirements.

For other Bell products turn to pages 1•2338, 1•2339

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Columbus, Ohio 43229
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TWX: 810-337-2851

FREQUENCY COUNTERS—SEMICONDUCTOR TESTERS—PRINTERS—LINE NOISE GENERATORS

PROGRAMMABLE COUNTER-TIMER Model 6401

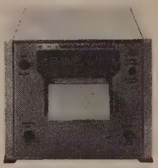
Actually two counters in one, the Model 6401 allows frequency ratio and time interval measurements between 2 signal sources. It features field-replaceable ICs, trigger point monitor lamps and burst frequence measurements. A choice of 3 standard oscillators is offered, with the "O" oscillator standard, and the "L" and "N" oscillators optional. Priced from $1310.00.

INDUSTRIAL COUNTERS AND CONTROLLERS Models 6220A, 6235B and 6240B

Model 6220A is a dual preset controller which is ideal for programming external functions at two separate predetermined count limits. Model 6235B is a direct-count laboratory 5MHz IC counter for industrial use. Auxiliary input-output connector provides external control for remote synchronization. Model 6240B is a direct-count 10MHz 2-channel laboratory IC counter-timer. Measures frequence (0 to 10MHz) period and time interval plus ratio and stability. Priced from $995.00.

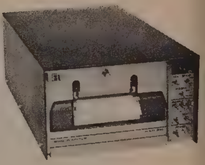
DIGITAL PRINTER MODEL 1454

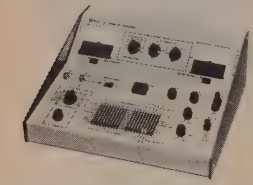
21-column digital printer accepts data in BCD or ten live decimal codes. It features flexible input format, BCD column expansion capability, portability and decimal point, column suppression, and red/black print control. Input levels can be specified at IC levels or transistor levels. Replacement IC is socket-connected and instantly changeable. Priced from $1,155.

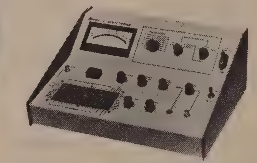


TAPE PRINTER Model 2000B

Features 21-column-BCD, self-reversing ink ribbon, black/red printout, 3 lines per second and floating decimal points. 2 right-hand columns provide 32 different special characters for data identification. Other 19 columns each have 5 special characters plus numbers 0 through 9 and decimal points. Model will record data from digital panel meters, voltmeters, counters, etc. Priced from $995.



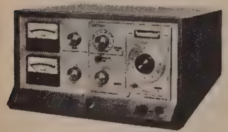




DIGITAL/LINEAR IC TESTERS Models 998 and 999

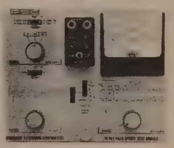
Model 998 is a precision linear integrated circuit tester which checks all important DC parameters including input offset voltage and range, input and bias current, open loop gain, power dissipation and other voltage and current measurements. Model 999 is a digital integrated circuit tester which checks RTL, RCTL, DTL, modified DTL, TTL, LPDTL, CML, and ECL IC's for all important DC parameters. It accepts most types of digital IC packages. Priced from $595.

PSC *A MEMBER OF BERKELEY'S FAMILY*



Model 70 SEMICONDUCTOR TEST SET

Plug-in test modules provide the low-cost Model 70 with the scope and capabilities of a much more expensive test system. The basic unit contains power supplies and metering circuitry for setting u bias conditions. Interchangeable modules slide into and connect within the chassis. $875.00

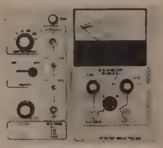


TEST MODULE 10-FET

Measures all basic FET parameters. Types include JFET, D/E, MOS FET. Covers a wide range of test parameters. $975.00

TEST MODULE 10-RF-1

Gives direct read-out of hfe from 3 MHz to 30 MHz. Accuracy is + 10% maximum error. $890.00



TEST MODULE 10-A

Direct read-out of the DC Beta, 0 to 1000. Low duty cycle permits testing up to 30 amps of collector current. $895

TEST MODULE 10-AC-1

Internal 1000-cycle oscillator and tuned voltmeter provide direct read-out of seven hybrid parameters. $695

TEST MODULE 10-B

Direct read-out of saturation voltages at normal operating conditions. Pulsed base current permits up to 30 amps of collector current. $795

TEST MODULE 10-CD

Module-within-a-module design uses 2 plug-ins to the test module itself; one for breakdown voltage; the other for extremely low-leakage measurement. $895

TEST MODULE 10-E

Plug-in program cards provide varied test modes for multi-parameter testing. Six cards are available including breakdown, leakage and saturation tests. $725

TEST MODULE 10-L

Direct read-out of transistor pulsed breakdown in the Latch-Up or Sustained voltage region. Low, variable duty cycle permits measuring high peak currents with nominal junction heating. $875

TEST MODULE 10-Z

Internal 1000-cycle oscillator and tuned voltmeter provide accurate reading of dynamic impedances from 10 to 1000 ohms. Direct read-out. $575

LINE NOISE GENERATOR — MODELS 3020 AND 3021

These instruments offer a controlled method of generating line noise. Inexpensive, they serve a dual purpose: generating a controlled line transient similar to rectifier or SCR noise on the AC line, as well as measuring line noise up to one kilowatt peak. They also generate noise pulses to simulate power line interference up to 10 kilowatt peak power. Noise amplitude and phase position are continuously adjustable from 0 to 600 volts. Pulse rise time is 0.5 microsecond or better. A sweep mode is provided for scanning the noise pulse over the full 360° of line cycle. Model 3020 is priced at $995. Model 3021, which has a special variable pulse rate control, is priced at $1,095.

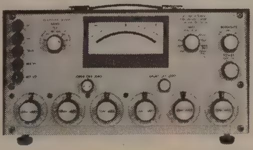
PINHOLE COUNTER — MODEL 6250

Model 6250 Pinhole Counter/Controller provides a 4-decade (5-decade optional) Accumulator, a 3-decade (4-decade optional) Preset Controller and an end-of-coil Reset. It counts number of pinholes in pre-selected length of steel coil or sheet and then, on command, delivers data to Model 1454-21 Digital Printer. Model 6250Counter/Controller combines with Model 1454-21 Printer to provide an accurate system. Model 6250 priced at $1,175. Model 1454-21 Digital Printer is $1,155.

EARLY-WARNING, SHUT-DOWN SYSTEM
MODEL MPS-10B

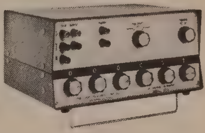
Designed initially as an early warning and shutdown system for motor-pump units used in secondary oil field recovery operations, Model MPS-10B is also ideal for countless other uses. Features monitoring of 8 temperatures, 2 pressures and a vibration switch. Model first alerts operator to trouble, then shuts down equipment. First-out feature pinpoints initial source of trouble. Provides digital readout of temperatures and pressures. Has reset button and manual override switches. Extreme setpoint accuracy. Priced at $1,750.

DIFFERENTIAL VOLTMETERS — MODELS 1000 AND 1002



Provides DC accuracy of 0.002% of reading. Internally guarded input. Input ranges: 1000, 100, 10, 1.0V AC and DC with 10% overranging. 10 microvolt, full scale null detector provides means for zero check. Ratio measurements attainable through 3-position REFERENCE CONTROL (positive, negative, external). Short and open circuit zero functions provided. Six-digit Kelvin Varley Voltage Divider provides resolution of 1 part per million. Model 1000 uses DC only, priced at $1,025. Model 1002 uses AC or DC, priced at $1,450.

DC VOLTAGE CALIBRATORS — MODELS 462 AND 472A

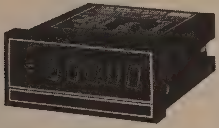


The PSC Model 472A is an adjustable precision DC calibrator, 0-11 volts DC with two ranges. An output current of 20 milliamperes can be drawn on the 11-volt range, a 100:1 precision divider provides a simultaneous output of 0 to 110 millivolts at 10 ohm output resistance. Better than 0.05 microvolts resolution. Operational stability assured through stable zener reference, silicon oil-filled, wire-wound resistors and high gain, wide-band amplifier. Short circuit proof. Model 472 features greater precision, priced at $895. Model 462 priced at $695.

A MEMBER OF BERKELEY'S FAMILY

DIGITAL PANEL METERS

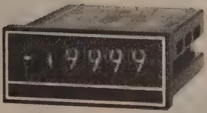
MODEL 386



Model 386 is representative of the Electro Numeric, Inc., line of Digital Panel Meters. It uses the passive integration, dual slope, analog-to-digital conversion technique which provides excellent long-term stability, accuracy, temperature stability, linearity, noise rejection, and jitter-free performance. It features 4-3/4 digits, a full 50,000 count resolution, is pin-compatible with 4-1/2 digit models. The positive true BCD code that is applied to the decoders is also available at the rear of the meter, and can be used for data logging. Model 386 is available with the Beckman display, and is competitively priced.

BECKMAN

Cold cathode, neon-gas-filled. Orange color. 7 segment address format, rugged. 170V excitation. Single-plane display with no gaps.



NIXIE

Cold cathode, neon-gas-filled. Orange color. 10 line decimal address format. Rugged. 170V excitation. Easier to read when display changing.

NUMITRON

Incandescent. 7 segment address format. Bright, white color changeable with filters. Needs only 5V excitation. Single plane display with wider viewing angle.

Model 300 series Digital Panel Meters are available in 3-1/2, 3-3/4, 4-1/2 and 4-3/4 digits. They all feature standard BCD outputs, non-blinking displays, polarity indications and overload indications. Meter retains the last reading indefinitely while "hold" line on the BCD output connector is shorted to common. The meters in the Model 300 series can be mounted either through or behind the front panel. All models in this series are competitively priced.

Some prices slightly higher outside U.S.A.

BERKELEY
INSTRUMENTS
INC.

1701 Reynolds, Santa Ana, Ca. 92705/(714) 556-0623

BIRD *Quality Instruments for RF Power Measurement*

50 ohms nominal

THRULINE® RF DIRECTIONAL WATTMETERS

MODEL	CONNECTORS	PLUG-IN ELEMENTS FREQUENCY (MHz)	 POWER RANGES (Watts)	U.S. PRICE
43	QC (1)	For CW, FM and TV (black level)		$100
4311(Battery)	QC (1)	For Peak, Pulse. SSB, AM, TV, CW and FM		450
4314 (AC/DC)	QC (1)	For Peak, Pulse, SSB, AM, TV, CW and FM		475
Order one or more elements with your Thruline Wattmeter to suit your frequency and power ranges.		2-30	50, 100, 250, 500, 1000, 2500, 5000	35 each
		25-60, 50-125, 100-250, 200-500, 400-1000	5, 10, 25, 50, 100, 250, 500, 1000	32 each
	Elements, low power (1, 2.5W) narrow band			50
	Elements, 950-1260MHz (1, 2.5, 5, 10, 25, etc. to 5000W)			75
	Elements, high frequency to 2300MHz (1, 2.5, 5, 10,25W)			75
	Elements, peak only to 10kW, 25-1000MHz in five bands			75
	CC-1 Cowhide Carrying Case for 43, 4311			20
	EC-1 Element Case for 12 spares			12
4310	QC (1)	For Peak, Pulse, SSB, AM and TV		249
		Elements (4310) Choices from 50W-10kW, 2-1260MHz		50
4330	QC (1)	Milliwatt version of Model 43 (200/800mW)		145
	Elements (4330) 60-2300MHz in narrow bands, 60-950/950-2300			60/80
4370	QC (1)	25-520MHz	1-500W	475
4371	QC (1)	25-520MHz	1-1000W	950
4111	UHF, N, BNC	25-175MHz Mini-Monitor® Pocket Meter	150/15W	135
4112	N, UHF, BNC	2- 30MHz	200/20W	135
4113	N, UHF, BNC	2- 30MHz	1000/100W	135
4114	N, UHF, BNC	400-512MHz	50/5W	135
4115	N. UHF, BNC	100-225MHz	50/5W	135
4501	⅞ EIA Fl.	Rigid Line Wattmeter		135
	Uses Elements listed for Model 43			see above
4712	1⅝ EIA Fl.	Rigid Line Wattmeter		206
		Elements (4712) Choices from 25W-25kW 2-1000MHz		50
460	3⅛ EIA Fl.	Rigid Line Wattmeter		235
4805	3⅛ Unfl.	Rigid Line Wattmeter		166
		Elements (460, 4805) Choices from 1-100kW, 2-1000MHz		50
4902	6⅛ EIA Fl.	Rigid Line Wattmeter		600
		Elements (4902) Choices from 2.5-250kW, 2-1000MHz		50
4521	QC (1)	Panel-mounted, one meter-one socket		115
4522	QC (1)	Panel-mounted, one meter-two sockets		160
4526	QC (1)	Panel-mounted, two meters-two sockets		200
3122	QC (1)	Special meter: simultaneous forward/ reflected power and VSWR, panel mtd. two sockets.		250
		These four models use Elements listed for Model 43		see above
4320/21		Amplifiers for adding PEAK READ to CW Thrulines		300

WATTCHER® RF POWER MONITOR/ALARM

MODEL		U.S. PRICE
3127/28	Fwd/refl. Wattmeter. Has alarm or Xmitter shut-off with high VSWR. Requires Line Section, Elements, etc. Choices from 0.45 to 2300MHz, 1W to 250kW.	$ 425

TERMALINE® HI-POWER RF CALORIMETERS

MODEL	POWER	FREQ. (GHz)	VSWR @ 1GHz	ACCURACY	U.S. PRICE
6020/23	1kW	dc-3.5	1.1	±1.3% to ±3%	$ 895
6070/71	5kW	dc-2	1.1	±1.5% to ±3%	1275
6032	10kW	dc-1.4	1.1	±1.5% to ±3%	1850
6042/6542	15kW	dc-1.5	1.1	± 1% to ±2%	2350
6052/6552	25kW	dc-1.5	1.1	± 1% to ±2%	2950
6062/6562	50kW	dc-1.5	1.1	± .5% to ±1.5%	3550

TERMALINE® RF ABSORPTION WATTMETERS

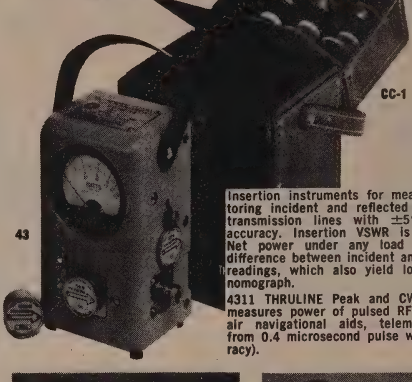
MODEL	POWER SCALES	FREQUENCY (MHz)	CON-NECTOR	U.S. PRICE
6254	25, 50, 100, 250, 500mW, 1 or 2W	30-500	BNC/F	$ 140
611 †	0-15/60W	30-500	N/F	190
61 †	0-.5/80W (19 choices)	30-500	N/F	220
6154	0-5/15/50/150W	25-1000	N/F	265
67 †	0-25/100/500W	30-500	QC (1)	360
694	0-1000W	2-30	QC (1)	400
6835	0-120/600/1200W	30-500	QC (1)	550
Water-cooled:				
67C †	0-100/500/2500W	30-500	QC (1)	400
† Special calibration 500-1000MHz available at time of order.				25

COAXWITCH® COAXIAL SELECTOR SWITCHES

MODEL	FUNCTION	U.S. PRICE	MODEL	FUNCTION	U.S. PRICE
7422	1P2T	$85	718	1P8T	$100
7441	1P3T	85	7181	1P10T	135
7431	1P4T	85	72-2	2P2T	90
74	1P6T	85	72-R	2P-Rev	90

4111-14

460


CC-1

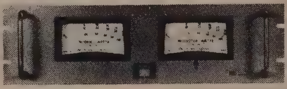
43

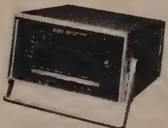
Insertion instruments for measuring and monitoring incident and reflected power in coaxial transmission lines with ±5% of full scale accuracy. Insertion VSWR is less than 1.05. Net power under any load condition is the difference between incident and reflected power readings, which also yield load VSWR from a nomograph.

4311 THRULINE Peak and CW Wattmeter also measures power of pulsed RF systems such as air navigational aids, telemetry, radar, etc. from 0.4 microsecond pulse width (±8% accuracy).

3122 VSWR + Wattmeter

4521 Panel-mounted "43" type


3127
3128

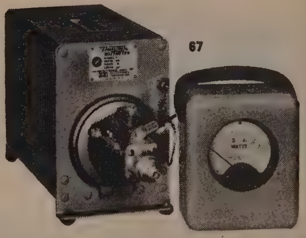

NEW
4371 Digital Multirange Broadband Wattmeter, self-contained elements.
(Analog version: Model 4370)

6254

6154

Direct reading instruments for absorbing and measuring RF power. The load section of the TERMALINE Wattmeter serves as a dummy load. The indicating meter is calibrated to read RF power directly in watts with ±5% of full scale accuracy (to 500 MHz).

74


67

COAXIAL RF FILTERS

Custom engineered or field-proven designs. High rejection attenuation filters available with Low-pass cut-off from 16 to 2700MHz (about fifty designs at 400MHz). Hi-pass cut-off frequencies from 30 to 1000MHz, Band-pass as narrow as 5% of center frequency. Sizes from ¼ cubic inches, with subminiature connectors, to 3⅛" line.

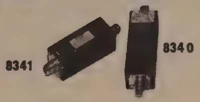
50 ohms nominal

BIRD *Quality Instruments for RF Power Measurement*

8164
8160
8166
8080
80BNCM
8010
80M
8053

TERMALINE RF Coaxial Load Resistors for accurate, non-radiating termination of 50-ohm RF coaxial transmission lines are designed for use in permanent installations, development testing and trouble shooting of transmitters, intermediate components, power tubes, and accessories.

82A
8135
8321
81B
8141
8323
80A
8130



No external water supply is needed for the new 10kW Self-Cooling MODULOAD® RF Load Resistor Module. In a scant three cubic feet of space, the integral heat-exchanger permits continuous 10kW dissipation in 5° to 45°C ambients (−20° to +20°C with anti-freeze).

6770 Dolly with 8763 Load and 480 Wattmeter

TERMALINE® RF COAXIAL LOAD RESISTORS

Air Cooled, Dry Dielectric

MODEL	POWER	FREQ.	VSWR @ 1GHz	CONNECTOR	U.S. PRICE
8010, 8011	2W	0-4GHz	1.04	N/F, N/M	$ 25
8015, 8016	2W	0-4GHz	1.04	TNC/M, TNC/F	27
80F, 80M	5W	0-4GHz	1.1	N/F, N/M	25
80CF, 80CM	5W	0-4GHz	1.1	C/F, C/M	30
80 BNC/F, -/M	5W	0-4GHz	1.1	BNC/F, BNC/M	30
8052, 8053	10W	0-4GHz	1.1	N/F, N/M	35
8080	25W	0-3.5GHz	1.1	QC (3)	45
8085	50W	0-3.5GHz	1.1	QC (3)	65
8071 Miniload®	100W*	0-2GHz	1.1	SM A/F	125
8160	100W	0-2.5GHz	1.1	QC (3)	115
8164	100W	0-2.5GHz	1.1	QC (1)	105
8166	150W	0-2.5GHz	1.1	QC (1)	120
8072 Miniload®	300W*	0-2.5GHz	1.1	SQC (1)	150

* When bolted to heat sink.

Air Cooled, Liquid Dielectric

MODEL	POWER	FREQ.	VSWR @ 1GHz	CONNECTOR	U.S. PRICE
80A	20W	0-3.5GHz	1.1	N/F	30
8130	50W	0-4GHz	1.1	QC (1)	50
81B	80W	0-4GHz	1.1	N/F	70
8135	150W	0-4GHz	1.1	QC (1)	75
8141	250W	0-2.5GHz	1.1	QC (1)	110
8201	500W	0-2.5GHz	1.1	QC (1)	165
82A	500W	0-3.5GHz	1.1	QC (1)	185
8401	600W	0-3GHz	1.1	QC (1)	169
8251	1000W	0-2.5GHz	1.1	QC (2)	280
8833	1000W	0-2.5GHz	1.1	QC (2)	365
8890**	2500W	0-1.5GHz	1.1	QC (2)	460
8891**	2500W	0-1.5GHz	1.1	3⅛ EIA Fl.	485
8892**	2500W	0-1.5GHz	1.1	1⅝ EIA Fl.	470
8898-510	7500W	0-1.5GHz	1.1	3⅛ Unfl.	950
** BA-88 Blower for doubling power (intermittent duty)					275
** Overtemperature Thermoswitch					30

Water Cooled, Air Dielectric

MODEL	POWER	FREQ.	VSWR @ 1GHz	CONNECTOR	U.S. PRICE
8710	1kW	0-3.5GHz	1.1	N/M or F	$ 200
8720	5kW	0-2GHz	1.1	1⅝ EIA Fl.	325
8736	10kW	0-1.4GHz	1.1	1⅝ EIA Fl.	950
8742/8542	15kW	0-1.5GHz	1.1	3⅛ EIA Fl.	1400
8752/8552	25kW	0-1.5GHz	1.1	3⅛ EIA Fl.	2000
8762/8562	50kW	0-1.5GHz	1.1	3⅛ EIA Fl.	2600
6770 Dolly for mounting 10kW to 50kW Loads.					125

MODULOAD® Self-Cooled Load Systems

MODEL	POWER	FREQ.	VSWR @ 1GHz	CONNECTOR	U.S. PRICE
8632	10kW	0-1.4GHz	1.1	3⅛ EIA Fl.	2350
8641/2	20kW	0-1.3GHz	1.1	3⅛ EIA Fl.	3300
8651/2	40kW	0-1.3GHz	1.1	3⅛ EIA Fl.	5200

TENULINE® ATTENUATORS

MODEL	POWER	FREQUENCY	VSWR	ATTEN.	CONNECTOR	U.S. PRICE
8340-060, -100, -200	25W	0-500MHz to 1000MHz	1.1 1.15	6dB 10, 20dB	QC (1) in, (1) out	$ 83
8341-060, -100, -200	*40W	0-500MHz to 1000MHz	1.1 1.15	6dB 10, 20dB	QC (1) in, (1) out	78
8343-060 -100, -200	100W	0-500MHz to 1000MHz	1.1 1.15	6dB 10, 20dB	QC (1) in, (1) out	165
8321	50W	0-500MHz	1.1	30dB	QC (1) in, (1) out	145
8323	100W	0-500MHz	1.1	30dB	QC (1) in, (1) out	165
8322	200W	0-500MHz	1.1	30dB	QC (1) in, (1) out	225
8325	500W	0-500MHz	1.1	30dB	QC (1) in, (1) out	400
8327**	1000W	0-500MHz	1.1	30dB	QC (2) in, (1) out	500
8329**	2000W	0-500MHz	1.1	30dB	QC (2) in, (1) out	600
BA-88 Blower for 4000W int. duty (8329).					—	275

* When bolted to heat sink. ** Overtemperature Thermoswitch 30

QC-TYPE CONNECTORS (Quick Change) Adaptable to particular TERMALINE, THRULINE, and TENULINE units, these connectors may be quickly changed in the field. Connector types available are: Female or male BNC, TNC, N, C, SC, HN, LC, UHF, LT, ⅞″ and 1⅝″ EIA Flanged.

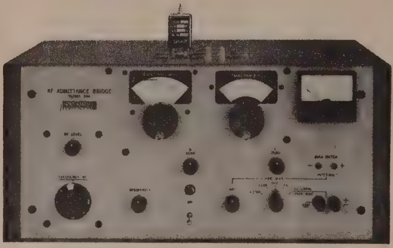
Prices are subject to changes without notice. F.O.B. Cleveland, Ohio. Normally supplied: (1) Female N, (2) Female LC, (3) Male N.

OTHER BIRD INSTRUMENTS THRULINE® RF DIRECTIONAL POWER SENSORS • SENTRILINE® FILTER-COUPLERS COAXIAL RF FILTERS • NEW: VSWR/WATTMETERS •

BIRD
ELECTRONIC CORPORATION
30303 Aurora Road / Cleveland (Solon), Ohio 44139 / Phone (216) 248-1200
TWX: 810-427-2687 / Cable: BIRDELEC

RF Admittance Bridges – 1 MHz to 100 MHz
Model 33 Series

These bridges measure two-terminal parallel capacitance and conductance at 1, 5, 10, 20, 30, 50, and 100 MHz. Other frequencies between 1 and 100 MHz can be provided to special order. Good resolution of low conductance values makes loss measurements possible on many high Q diodes, varactors, and capacitors. The bridge balances accurately with the low test levels required for measurements on most solid state devices. Internal and external dc bias is standard.



SPECIFICATIONS

Model 33A/1

Capacitance: 0-150 pF (30 pF at 100 MHz); resolution, 0.02 pF; basic accuracy, ±0.3%.
Conductance: 0-25 mS; resolution, 0.5 μS or better; basic accuracy, ±2%.

Model 33B/1

Capacitance: 0-150 pF (30 pF at 100 MHz); resolution, 0.02 pF; basic accuracy, ±0.3%.
Conductance: 0-5 mS; resolution, 0.1 μS or better; basic accuracy, ±2%.

Model 33C/1

Capacitance: 0-15 pF; resolution, 0.002 pF; basic accuracy, ±1%.
Conductance: 0-25 mS; resolution, 0.5 μS or better; basic accuracy, ±2%.

Model 33D/1

Capacitance: 0-15 pF; resolution, 0.002 pF; basic accuracy, ±1%.
Conductance: 0-5 mS; resolution, 0.1 μS or better; basic accuracy, ±2%.

Capacitance Range Extensions: Accessories available for measuring higher values of capacitance at frequencies up to 30 MHz for Model 33A/1 and to 20 MHz for Model 33B/1.

Capacitance Bridge – 5 kHz to 500 kHz
Model 75C

The Model 75C is a precise, high resolution bridge which makes measurements of capacitance, conductance, and parallel resistance from 5 kHz to 500 kHz.

Three-terminal remote measurements may be made via shielded cables without incurring errors resulting from stray capacitance from either side of the test to ground. The standard arm of the bridge is also accessible through front panel BNC connectors, permitting use of external balancing capacitors for differential measurements.

A special version, Model 75C-S23, additionally allows the application of externally supplied dc bias up to ±400 V with fusing at 10 mA. It also provides for connection of external ac or dc null detectors to increase balance sensitivity.

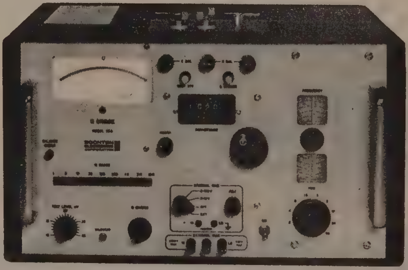
SPECIFICATIONS

Capacitance: 0 to 1000 pF; basic accuracy, ±0.25%; resolution, 0.0002 pF max.
Conductance: 0 to 1000 μS; basic accuracy, ±10%; resolution, 0.001 μS max.
Test Signal: Internally supplied; continuously adjustable in frequency from 5 kHz to 500 kHz; level adjustable from 1 mV to 3 V rms.
DC Bias:
Model 75C: Internal only; –5 to +110 V, adjustable.
Model 75C-S23: Internal; –5 V to +110 V, adjustable. External; to ±400 V.

Q Bridge – 100 kHz to 50 MHz
Model 35A

This unusual, non-resonant, three-terminal bridge measures capacitance and its Q directly over a wide frequency range to Q values as high as 10,000. The low test signal level may be set by a calibrated front panel control, and complete facilities for dc biasing the test component are provided. Measurements of a variety of capacitors and solid state devices such as high Q varactors, diodes, and ceramic and monolithic capacitors are now possible.

Q standards are available to support the accuracy of the bridge. The complete set of six allows Q values of 500, 1500 and 5000 to be checked at 1 MHz, a Q of 1500 to be checked at 20 MHz, and Q's of 500 and 1500 to be checked at 50 MHz.



SPECIFICATIONS

Q: 5 to 10,000; accuracy, generally ±10% to ±30%.
Capacitance: 20 to 1000 pF; accuracy, generally ±0.5% to ±2%.
Test Signal: Frequency, 100 kHz to 50 MHz; level, 10-30 mV rms.
Range Extensions: 2 to 20 pF; 200 to 10,000 pF.
DC Bias: Internal, 0-100 V; external 0-200 V.

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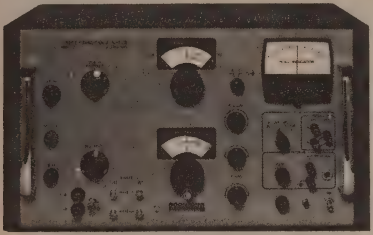
Capacitance Bridge—1 MHz
Model 75D

This bridge provides 3-terminal measurements of capacitance and conductance allowing remote connection without errors due to stray capacitance to ground. An adapter for 2-terminal grounded measurements is available. Inductance is read by conversion from equivalent capacitance measurement. The null detector is extremely sensitive yet shows balance direction from the most extreme off-range setting. An additional differential detector mode allows capacitance or inductance sorting of components. Internal and external dc bias.

The main capacitance dial consists of a "counter" dial that works in conjunction with a 40:1 vernier dial. This arrangement provides both ease of scanning and great accuracy of fine adjustment. Thus each range, including the lowest 0.1 pF fs range, is spread over 5000 divisions.

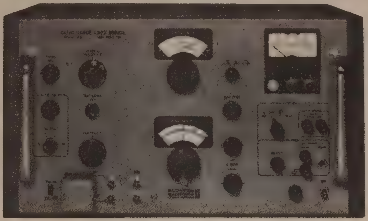


SPECIFICATIONS

Capacitance: 0 to 1000 pF; basic accuracy, ±0.25%; resolution, 0.00005 pF max.
Conductance: 0 to 1000 μS; basic accuracy ±5%; resolution, 0.01 μS max.
Inductance: 25 μH to 25 mH; basic accuracy, ±0.25%.
Test Signal: 1 MHz; level adjustable from 1 mV to 250 mV.
Dual external DC Bias: HI to GND and/or LO to GND; differential, ±400 V max.
Internal DC Bias: HI to LO; −6 to +150 V.

Capacitance Limit Bridge—1 MHz
Model 77B

Performs automatic, high-speed dual or single limit tests, or conventional manual measurements of capacitance or inductance. In automatic mode, test is insensitive to specimen loss. "High", "Low", or "Go" test decisions are indicated by front panel lamps as well as by continuity closures for actuation of material handling equipment. 3-terminal arrangement permits remote measurements at the end of coaxial cables without incurring error due to cable capacitance to ground. Nominal capacitance values are set by the main capacitance balance dial in conjunction with its multiplier switch. A multi-turn control and range switch are used to program the desired tolerance. Operates with low test level. Built-in dc bias supply; provision for external bias.



SPECIFICATIONS

Capacitance: Automatic, 0 to 1000 pF with 0.001 pF resolution max.; Manual, 0.0001 pF resolution max.; basic accuracy, ±0.25%.
Inductance: Manual or automatic, 25 μH to 25 mH; basic accuracy, ±0.25%.
Tolerance Limits: ±0.0005 pF to ±200 pF; basic accuracy, ±0.25% of limit setting.
Test Time: Approx. 50 ms.
Conductance: (Manual only) 0 to 1000 μS; basic accuracy, ±5%; resolution, 0.01 μS max.
Test Signal: 1 MHz, 250 mV to 15 mV rms for automatic mode, to 1 mV rms for manual.
Decision Output: Green, red, and amber panel lamps; continuity contacts.
DC Bias: Internal, −6V to +150 V; external, to ±400 V.

Automatic 1 MHz Capacitance Bridge
Model 76A

The new Model 76A combines established precision bridge techniques with an automatic balancing system and internal computing facilities. It makes fully automatic and programmable 1 MHz parallel capacitance and conductance measurements. The bridge will also compute and display equivalent series capacitance, series resistance, dissipation, and Q of the test. Any capacitance measurement can be internally stored and subsequent measurements displayed as a change in capacitance or as a percentage change in capacitance versus the stored value. Independent ranging of capacitance and loss can be manually selected or autoranged. An entry mode allows double-duty operation of panel buttons. In this mode the user can digitally program and display dc bias voltage, digitally program into storage a reference capacitance value for deviation measurements, and command automatic zero offset correction and test cable length correction. Test level is adjustable over a 5 to 200 mV range. Versatile data interfacing options are available.

SPECIFICATIONS

Capacitance: 0-2000 pF in 4 ranges
0-1.999 pF, 0-19.999 pF, 0-199.99 pF, 0-1999.9 pF.
Basic Accuracy: ±(0.1% rdg + 1 digit).
Conductance: 0-2000 μS in 4 ranges
0-1.999 μS, 0-19.99 μS, 0-199.9 μS, 0-1999 μS.
Basic Accuracy: ±(2% rdg + 1 digit).
Test Frequency: 1 MHz.
Test Level: 5-200 mV, adjustable.
Test Time: < 100 ms, C > 2 pF, G > 2 μS.
Display: Dual digital readout, decimal points, units, mode, active ranges.
Display Modes: C_p, C_s, ΔC, $\Delta\%$, G, R_p, R_s, D, Q.
Autoranging: Standard.
Trigger Modes: Continuous (1 per sec), manual, external.
Remote Programming: Standard, TTL.
Data Output Options: ASCII Bus, parallel BCD, or BCD serial by bit, isolated.
DC Bias: Internal, 0 to 100 V bipolar; external to ±200 V.

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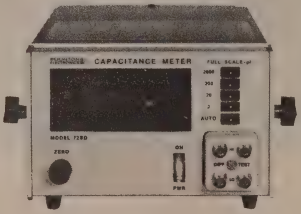
Capacitance Meters – 1 MHz
Model 72 Series

The Model 72 Series of solid-state capacitance meters provide rapid, accurate, three-terminal measurements of capacitance, particularly of semiconductor devices because of the low test level employed (15 mV rms), and the provision for application of dc bias to the test.

The phase-sensitive detection system allows the capacitance of even low Q devices (as low as Q = 1) to be measured with little reduction in accuracy. Range switching is accomplished by a combination of logic-controlled reed relays and diodes. Range selection is by front panel switch or remote TTL inputs.

Both models provide a highly linear, high-speed, dc analog voltage output corresponding to the meter or display indication. In addition, the 72BD has BCD outputs, TTL compatible. Autoranging of this model is standard.

Adapters are supplied for coaxial-cable connection to a remote test fixture, and for direct attachment of wire-lead components.



CAPACITANCE METER
FULL SCALE-pF
CAPACITANCE
MODEL 72B
ZERO
ON
PWR
DIFF
TEST

SPECIFICATIONS

Digital Model 72BD

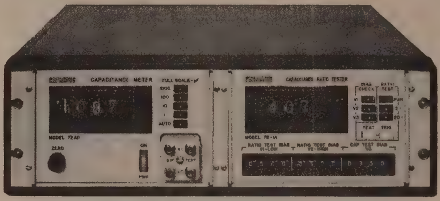
Capacitance Ranges: 2.000, 20.00, 200.0, 2000 pF fs.
Basic Accuracy: ±(0.25% rdg +0.2% fs).
Display: LED-type, 4 digits.
Data Outputs: Serial by digit, TTL.
Commands: Range (4 lines); manual disable; autorange enable; encode hold, encode trigger; TTL.
DC Output: 2 V for fs all ranges; linearity ±(0.1% rdg +0.005% fs). Response time < 2 ms.
Test Signal: 1 MHz, 15 mV rms.
DC Bias: External ±600 V max.
Autoranging: Standard, 100 ms per range.
Options: 100 mV test level, BCD serial/parallel converter.

Analog Model 72B

Capacitance Ranges: 1, 3, 10, 30, 100, 300, 1000, 3000 pF fs.
Basic Accuracy: ±(0.5% rdg + 0.5% fs).
Resolution: 0.5% fs for each range.
Meter: 4½ inch taut-band type.
Commands: Range (8 lines); manual disable; TTL.
DC Output: 1 V for fs (1 series ranges); 3 V for fs (3 series ranges); linearity, ±(0.1% rdg +0.01% fs); response time <1 ms.
Test Signal: 1 MHz, 15 mV rms.
DC Bias: External ±600 V max.
Option: 100 mV test level.

Capacitance Ratio Meter
Model 172A

Measures capacitance ratio and capacitance value at accurately preset bias levels. Within 0.5 s results are displayed on two 3½ digit readouts. All functions, ranges and bias voltages are externally programmable. BCD outputs are provided for ratio and capacitance.

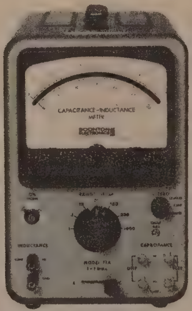


SPECIFICATIONS

Capacitance Ranges: 1.999, 19.99, 199.9, 1999 pF fs.
Ratio Ranges: 1.999:1 and 19.99:1 fs.
Ratio Accuracy: (Ratio/20)% +0.025 (C_r/C_2)% ±1 digit
Where: C_r = full scale of the capacitance range on which the higher capacitance (C_1) is measured.
C_2 = smaller capacitance valued measured.
Test Signal: 1 MHz, 15 mV rms.
Displays: Nixie-type, 3½ digits.
Measurement time: < 500 ms.
DC Bias:
Full Scale: 1.999, 19.99, 199.9 volts.
Accuracy: ±(0.03% rdg +100 μV).

Capacitance/Inductance Meter – 1 MHz
Model 71A

Quick, convenient, direct reading, 3-terminal measurements of capacitance and 2-terminal measurements of inductance at 1 MHz. Operates with low test signal level, permitting semiconductor tests. Provision for dc bias. Linear dc output proportional to capacitance or inductance reading for display on dvm, x-y plotter, etc.



SPECIFICATIONS

Capacitance: 1 pF to 1000 pF fs in 7 ranges; basic accuracy, ± (0.5% rdg. + 0.5% fs); resolution, 0.25% fs, Q > 3.
Inductance: 1 μH to 1 mH fs in 7 ranges; basic accuracy, ±0.5% rdg ±0.5% fs.
Test Signal: 1 MHz; 15 mV rms for C, < 1 mV for L.
DC Bias: External ±200 V; (±600 V to special order).
DC Analog Output: 0 to 100 mV or 300 mV fs depending on range numerics; response time < 10 ms; (1 ms to special order).

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C/V Plotting Systems
Model 179 Series

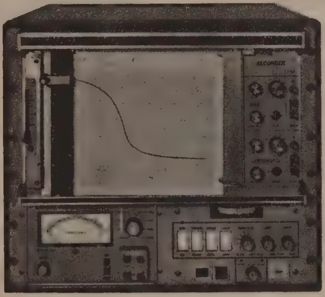
Model 179B is a 1 MHz capacitance measuring and recording system which automatically traces capacitance/voltage data on removable pen-recorded X-Y plots. It is designed primarily for recording C/V data on MOS wafers and varactor diodes. Properties of the metal-insulator-semiconductor (MIS) structure, such as doping profiles, impurity concentrations, spatial variations, etc., may readily be obtained. With varactors, the system provides graphic measurements of capacitance, capacitance ratio, and tracking characteristics. Normal and inverted ramp voltages, together with single and dual ramp functions, are available. Automatic or step, linear or log modes may be selected.

Two ramp voltage ranges of 0-20 V and 0-200 V at speeds from 0.5 V/sec. to 25 V/sec. are provided.

Model 179D is a 179B plus a module that allows connection of up to nine separate test inputs. Any one of the nine may be selected for plotting while a soak voltage of up to ±100 V dc is impressed on the other eight channels.

To plot C/V characteristics at other than room temperature the 179B or 179D can be operated in conjunction with a "hot-chuck" system (available from other manufacturers.) Typically the chuck is heated or cooled by a fluid passed to it through flexible pipes from a control unit. Wafers are placed on the chuck which acts as the mounting surface beneath a prober.

Oversize cabinets are available to accommodate the "hot chuck" control unit.



Capacitance Classification Systems
Model 170 Series

The 170 Series is designed to control component handling equipment for high-speed testing of capacitors.

The Series is based on two control units: one for high-accept-low limit testing, and one for up to eight accept zones plus high and low reject limits for multi-category sorting. Either control unit can be combined with a 1 kHz or 1 MHz capacitance measurement module to form a complete system. If the 1 kHz module is chosen, additional sorting can be done according to a pre-set dissipation limit.

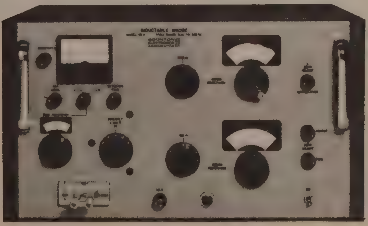
The 1 kHz module measures capacitance from 10 pF to 10 μF and DF from 0.001 to 0.1. The 1 MHz module measures capacitance from 0.1 pF to 1000 pF. Accuracy is typically 0.25% of reading. Each has an analog meter for measurement readout.

Nominal capacitance values, tolerances or categories in ±%, and maximum 1 kHz dissipation factor are programmed on the front panel of either control unit. Decisions are displayed by panel lights and mercury wetted relay closures provide electrical outputs for connection to a mechanical component handler. Limit decisions are made within 70 ms, multi-category decisions within 70 to 150 ms.

The 170 Series can be operated in either a continuous or a manual mode. In the continuous mode, the interrogation of the unknown and display of test results are on a free-running basis. In the manual mode, a test and display cycle is performed each time a start test signal is received; the display remains clamped until the completion of the succeeding triggered cycle.

Inductance Bridges
Model 63

These unique bridges provide direct-reading measurements of series inductance down to unusually low values with fractional percentage accuracy over broad frequency ranges. Series resistance is also directly measured. Each bridge is complete with built-in oscillator and detector. Test current does not change during balance.



SPECIFICATIONS

Model 63H

Inductance: 0.2 nH to 110 mH; basic accuracy ±0.25%.
Series Resistance: 0.2 mΩ to 11 kΩ; basic accuracy ±3%.
Test Signal: Frequency, 5 to 500 kHz; level, 3 V rms max.

Model 63L

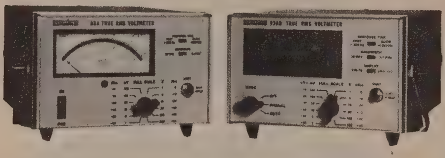
Inductance: 20 nH to 11 H; basic accuracy ±0.25%.
Series Resistance: 10 mΩ to 110 kΩ; basic accuracy ±3%.
Test Signal: Frequency, 0.4 to 40 kHz; level, 5.5 V rms max.

Model 63M

Inductance: 2 nH to 1.1 H; basic accuracy ±0.25%.
Series Resistance: 2 mΩ to 110 kΩ; basic accuracy, ±3%.
Test Signal: Frequency, 1 to 100 kHz; level, 5.5 V rms max.

True RMS Voltmeters
Model 93

The Boonton 93A and 93AD voltmeters are true rms responding instruments that use backward diodes as balanced, low-level, square-law detectors. An all solid-state chopper amplifier and unique operational square-root circuitry convert the squared function to a high-level dc proportional to rms. This dc voltage is available at rear terminals for rms converter applications, and is displayed on an analog meter in the case of the 93A or on a 3½ digit LED display for the 93AD. The 93A and 93AD both cover twelve ac voltage ranges from 1 mV to 300 V full-scale. The 1 mV full-scale range provides unmatched sensitivity to measure the low rms level of noise and of low duty cycle pulse trains. Both rms voltmeters feature a full 10 Hz to 20 MHz frequency range usable down to the lowest voltage range. A three dB bandwidth of 30 MHz assures accurate rms measurements of complex voltages with significant high frequency energy components, such as narrow pulses and wideband noise. The 93A meter is calibrated with dBm as well as voltage scales. The 93AD has, as standard, an edge-mounted dBm analog meter in addition to the digital display; an optional dB display provides readings directly in dB with 0.01 dB resolution.



SPECIFICATIONS

Analog Model 93A

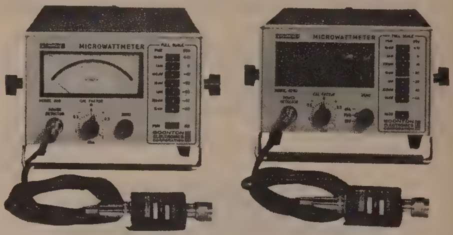
Voltage Range: 1 mV to 300 V fs, in 12 ranges.
dBm Range: –68 dBm to +52 dBm (600 Ω ref.).
Selectable Frequency Range: 10 Hz to 20 MHz or 10 Hz to 100 kHz.
Basic Accuracy: ±1% fs or ±2% rdg, whichever is better.
Indicator: 4½" taut-band meter; scales 0-3, 0-10 and dBm.
Response Time: Fast; 1 sec. Slow; 4 sec.
Crest Factor: 6 at full scale; 18 at down scale.
Input: *Impedance:* 2 MΩ, < 25 pF.
Equivalent noise: < 35 μV.
DC Output: +10 V for fs.
Remote Control: All functions and ranges commanded with TTL input.
Options:
Rear signal input.
50 Ω dBm reference.
75 Ω dBm reference.
Accessory: 93-1A High-Z probe; 10 MΩ,< 11.5 pF, attenuation 10x.

Digital Model 93AD

Voltage Range: 1 mV to 300 V rms fs, in 12 ranges.
dB Range: 120 dB; resolution, 0.01 dB (optional).
Selectable Frequency Range: 10 Hz to 20 MHz or 10 Hz to 100 kHz.
Basic Accuracy: ±(1% rdg + 1 count) for voltage.
±0.3 dB for dB option.
Display: 3½ digit LED display (4 digits for dBm). Decimal point, units (V, mV, dB), under- and over-range, polarity (dBm only) also indicated. Analog edgemeter, scaled over 12 dB range.
Response Time: Fast; 1 sec. Slow; 4 sec.
Crest Factor: 6 at full scale; 18 at down scale.
Input: *Impedance:* 1 MΩ, < 25 pF.
Equivalent noise: < 35 μV.
Outputs: BCD (serial) digits, binary range and mode information.
DC Output: 10 V for fs.
Remote Control: All functions and ranges commanded with TTL input.
Options:
Autoranging.
Rear signal-input.
50 Ω dBm display.
75 Ω dBm display.
600 Ω dBm display.
BCD serial/parallel converter
Accessory: 93-1A High-Z probe; 10 MΩ, < 11.5 pF, attenuation 10x.

RF Microwattmeters
Model 42

Models 42B, 42BB, and 42BD are analog, analog-battery, and digital versions of the rf microwattmeter. They are exceptionally stable and sensitive units which cover a 70 dB dynamic range measuring power down to 1 nanowatt and withstanding cw overloads to 0.3 watts. Power detectors may be operated many hundreds of feet away from the power meters without deterioration of accuracy or stability. Drift problems common in other types of power meter are virtually eliminated. Three coaxial 50 Ω power detectors cover frequency ranges of 200 kHz to 7 GHz, 200 kHz to 12.4 GHz and 200 kHz to 18 GHz. In addition,a 75 Ω unit covers from 200 kHz to 1 GHz for CATV applications. Analog models are scaled in power and dBm. The digital model has an LED display that uses 3½ digits for power and 4 digits for dBm (0.01 dB resolution). Unique applications are field alignment of microwave antennas and long term power alarm monitoring in satellite communications systems.



SPECIFICATIONS

Digital Model 42BD

Power Range: 10 nW fs to 10 mW fs.
Frequency Range: 200 kHz to 18 GHz.
Accuracy: Overall, instrument and detector.
±(0.2 dB + 1 digit) to ±(0.8 dB + 1 digit) depending on power range and frequency.
Stability: <1 nanowatt/hour at 25°C
Temperature Effect: 0.007 dB/ °C typ.
Indicator: 3½ digit LED display for power, 4 digit for dBm option.
Data Outputs: BCD (serial) digits, binary coded range, overrange, underrange, encode complete, TTL.
Remote Control: Input range, encode hold and trigger, manual disable, dBm and autorange commanded by TTL inputs.
DC Output: 10 V fs proportional to power.
Major Options: Autoranging, dBm display, BCD serial/parallel converter.

Analog Model 42B

Power Range: 10 nW fs to 10 mW fs.
Frequency Range: 200 kHz to 18 GHz.
Accuracy: Overall instrument and detector.
±(0.2 dB + 0.5% fs) to ±(0.8 dB + 1.0% fs) depending on power range and frequency.
Stability: <1 nanowatt/hour at 25°C
Temperature: Effect: 0.007 dB/ °C typ.
Indicator: 4½ inch taut band meter calibrated power and dBm.
Remote Control: Input range and manual disable commanded by TTL inputs.
DC Output: 10 V fs proportional to power.
Major Options: Meter scale and dc output linear with dBm. Rear input.

Analog Battery Model 42BB

Specifications same as 42B. Sealed lead-acid rechargeable 6 hour battery.

Power Detectors

41-4A	200 kHz – 7 GHz, 50 Ω input	Connector: Precision type "N" standard, APC-7 optional
41-4B	200 kHz – 12.4 GHz, 50 Ω input	
41-4C	200 kHz – 1 GHz, 75 Ω input	
41-4E	200 kHz – 18 GHz, 50 Ω input	

BOONTON

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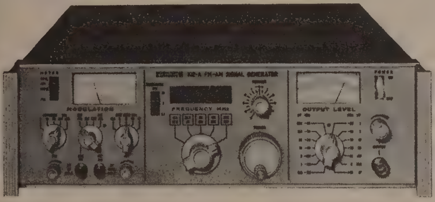
FM/AM Signal Generator – 4.3 to 520 MHz
Model 102A

The 102A FM/AM Signal Generator is a well shielded, low noise source from 4.3 to 520 MHz that is both stable in frequency and accurate in level. Warmup time for most purposes is only 15 minutes and weight has been shrunk to 30 lbs. The front panel is designed to be easy to use and understand and all specifications are located on the top of the instrument for convenient reference. An adjustable "feel" main tuning drive brings smoothness and ease to narrow-band receiver setting.

Some of the main features are an excellent residual FMspecification, 100 Hz resolution on a 6 digit frequency display, individual metering of modulation and RF output, true peak monitoring of AM level and FM deviation, 0-300 kHz internal FM deviation on all bands and external FM deviations as wide as 2 MHz p-p even at the lowest carrier frequency.

Special options are available for NAV/COM applications.



SPECIFICATIONS:

FREQUENCY –
Ranges: 4.3-37.5, 32.5-65, 65-130, 130-260, 260-520 MHz
Accuracy: ±(100 Hz + 5 ppm).
Stability: Typically < 2 ppm/10 min. after 1 hour.
(Stable ambient conditions.)
Residual FM: Bands 2-5, < 0.25 ppm peak (20 Hz to 15 kHz); band 1, < 20 Hz peak.
Display: Six digit LED; resolution 100 Hz, 1 kHz and 10 kHz.

RF OUTPUT –
Power Level: −130 dBm to +13 dBm.
Attenuator: 13 steps, 10 dB/step, plus variable 13 dB.
Accuracy: ±2 dB max.
Leveling: ±0.5 dB.
Spurious Output: > 30 dB down.
Impedance: 50 Ω; VSWR < 1.5:1.

FREQUENCY MODULATION –
Deviation: 0 to 300 kHz in five ranges.
Accuracy: ±10% fs.
Bandwidth: DC to 200 kHz.
Distortion: Bands 3, 4, 5: < 1% THD at 100 kHz peak dev.
Bands 1, 2: < 2% THD at 100 kHz peak dev.

AMPLITUDE MODULATION –
Percent: 0 to 100.
Calibrated Ranges: 30%, 100% fs.
Bandwidth: DC to 20 kHz.
Distortion (at 1 kHz rate): < 1% THD at 30% AM;
< 2% THD at 70% AM (typically < 3% THD at 90% AM).

INTERNAL MODULATION –
Frequencies: 400 Hz, 1, 3, 10, 19 kHz
Accuracy: ±3%
Distortion: 0.3%

MAJOR OPTIONS:
Ext. clock input, special modulation frequencies, NAV/COM version, fused rf output, accessory frequency doubler.

RF Millivoltmeters
Model 92

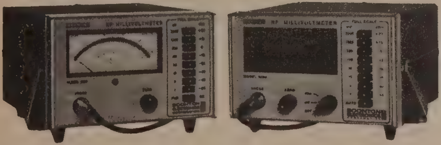
Available in three versions, these rf millivoltmeters offer the best choice for sensitive, wide-band, accurate rf voltage measurements.

a) Model 92B, a programmable analog version, has a large mirrored scale meter with linear 0-3 and 0-10 voltage ranges, a dBm scale (1 mW into 50Ω) and dc output.

b) Model 92BD, a programmable LED digital version, has 4 digit display, serial BCD data outputs, dc output, optional dB display (0.01 dB resolution) and autoranging.

c) Model 92C, a low cost analog version, saves by eliminating programming, dc output, the lowest voltage range (1 mV fs) and working to a more modest accuracy specification.

All models are supplied with rf probe, 50 Ω BNC adapter and probe tip. Many optional accessories extend their capability for other measurements.



SPECIFICATIONS
Analog Model 92B

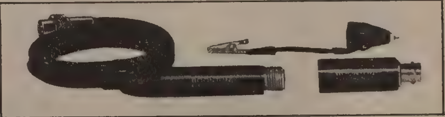
Voltage Range: 200 μV to 3 V (300 V up to 700 MHz with divider). Useful indications down to 100 μV.
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 1% fs).
Indicator: 4½" taut-band meter; scales 0-3, 0-10 and dBm.
Remote Control: All functions and ranges commanded by TTL inputs.
DC Output: 10 V fs.
Options: Many scale variations, other dB references, rear input.

Digital Model 92BD

Voltage Range: 200 μV to 3 V (300 V up to 700 MHz with divider).
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 1% fs).
Display: 4 digit LED, reads 1000 fs for "10" ranges and 3000 fs for "3" ranges. Small analog meter to right of display is scaled in dBm.
Data Outputs: BCD (serial) digits, binary coded range information. Overrange, underrange, encode complete.
Remote Control: All functions and ranges commanded with TTL inputs.
DC Output: 10 V fs.
Options: Autoranging, digital dBm readout (0.01 dB resolution), other dB references, rear input, BCD serial/parallel converter

Model 92C

Voltage Range: 500 μV to 3 V (300 V up to 700 MHz with divider).
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 2% fs).
Indicator: 4½" taut-band meter; scales, 0-3, 0-10 and dBm.



FURNISHED ACCESSORIES

BOONTON

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DIGITAL MULTIMETERS MULTIMETER/COUNTERS

5½ Digit Multimeters

CIMRON
DMM 50

DMM 50

- 20 readings/second with 60 dB NMR
- 1 μ volt sensitivity on DC
- 10 μ volt sensitivity on AC
- 1 milliohm sensitivity on ohms
- AC-true RMS or averaging
- Auto zero
- Parallel and serial Data outputs
- Remote Control

CIMRON
DMM 51
DIGITAL MULTIMETER

DMM 51

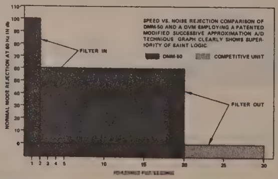
- 1 μ volt sensitivity on DC
- 1 μ volt sensitivity on ratio
- 10 μ volt sensitivity on AC
- 1 milliohm sensitivity on ohms
- AC-true RMS or averaging
- 4-wire bipolar ratio option
- Isolated data outputs
- Full input protection

MODEL DMM 50 5½ DIGIT MULTIMETER

The DMM 50 meets the need for high speed and high accuracy in the presence of normal and common mode noise. Its high accuracy fulfills the requirements of a data acquisition system meter while its low price matches the cost-conscious considerations of routine bench applications.

The DMM 50 employs "SAINT" logic which is a blend of successive approximation (SA) logic and integration (INT) logic. The "SA" provides the high speed and accuracy and the "INT" provides the inherent noise rejection. The result is 20 readings/second with 60 dB of noise rejection.

The basic DMM 50 provides DC volts and DC/DC ratio with 1 μ volt sensitivity. Prior to each measurement, the unit is automatically zeroed providing essentially drift free operation. To increase the capability of the DMM 50 a long list of options are available. These may be added in the field or ordered with the instrument. Among these options are: AC volts, average or true RMS responding; Ohms with 1 milliohm sensitivity; current shunts; high voltage probe; remote control; and data outputs which are addressable in both paralled and serial-character. The flexibility of the data outputs make the DMM 50 equally compatible with computers or printers. Special interfaces are available.



MODEL DMM 51 5½ DIGIT MULTIMETER

The DMM 51 is the best price vs. performance 5½ digit meter available. It is the first 5½ digit autoranging full capability, multimeter to break the established price barrier. Maximum use of LSI technology coupled with practical engineering design has resulted in the lowest possible parts count and a substantial reduction in hand soldered connections. The result is a lower cost highly reliable instrument with accuracy and stability second to none. The basic unit provides DC volts and DC/DC 3-wire ratio capability with sensitivity of 1 μ volt. In addition the functions of AC volts (averaging), Ohms with sensitivity of 1 milliohm, and AC/DC ratio may be added. If the requirement is for true RMS AC, it may be substituted for the averaging type at additional cost. The Ohms function is protected against inadvertent application of voltages of up to ±300 volts DC or peak AC on all ranges. The open circuit voltage of the Ohms converter is limited to less than 5 volts so that voltage sensitive devices such as integrated circuits may be measured without damage to the device. The autozero circuitry of the DMM 51 insures drift free operation.

Other options are: 4-wire bipolar ratio; current shunts; high voltage probe; and data outputs.

The DMM 51 uses an aesthetically pleasing gas discharge planar display that permits easy viewing from a 130° angle. Unlike the narrow band spectral response of red LED displays, the wide band orange of the DMM 51 display minimizes eye fatigue and delivers a large bright numeral that can be seen from a long distance even in high ambient light levels.

An exclusive Cimron servicing convenience is a step-by-step calibration procedure imprinted on the underside of the top cover. Since accurate calibration cannot be made without a shield, access ports are provided through all shields with proper identification.

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DIGITAL MULTIMETERS MULTIMETER / COUNTERS

MODEL DMM 40
4½ DIGIT AUTORANGING MULTIMETER

The DMM 40 is equally at home in bench or systems applications. It provides the measurement functions of DC and AC volts, DC and AC current and resistance with a resolution of 0.005% due to the 100% overrange capability. The autoranging and auto-zero features of the DMM 40 increase productivity by eliminating the need to manually range the instrument and the need to frequently zero the input.

The unique input circuitry of the DMM 40 protects the instrument from misapplication. The most common failure of digital multimeters is the result of applying voltage to the input when the unit is in the resistance measuring mode. The DMM 40 is protected against inputs of up to ±300 volts DC or peak AC on any range when the resistance mode is selected. Input protection in the current mode is provided by means of a self-resetting thermal switch. Optional, plug-in, accessories include isolated data outputs, high voltage probe, additional current ranges, and battery pack.

MODEL DMM 42
4½ DIGIT AUTORANGING MULTIMETER

The basic DMM 42 provides 6 automatically selected ranges of DC volts, with sensitivity of 1 μ volt and resolution of 0.005%, as well as data outputs and remote control. Through the use of plug-in options, the measurement capability may be increased to include 9 automatically selected ranges of resistance and/or 4 ranges of AC volts. The resistance function covers a range of 0.1 milliohm to 200 megohms and is a true 4-wire configuration. The AC volts option affords the choice of either average or true RMS responding converters. Full input protection and auto zero is provided on all functions and all ranges. When combined with a scanner and a recording device, the DMM 42 provides the answer to the requirement for a versatile, wide range, automatic, low-cost, data acquisition system.

In that remote control is a standard feature of the DMM 42, an option is offered which affords finger tip control of functions, range, and trigger control. This command module option may be located in a position which is convenient to the operator eliminating the need to reach across work areas to select ranges and functions. Considerable savings in time and the reduction of industrial accidents, through the use of this option, effects large cost savings while increasing productivity. Additional options include current shunts, and high voltage probe.

DSM 44
AUTORANGING 4½ DIGIT SYSTEMS METER

This truly unique instrument provides flexibility of programming such that it will take 20-30 readings per second including range and/or function changes. Competitive units which claim similar speeds are generally limited to 1 or 2 readings per second when range and/or function changes are required. To simplify programming the DSM 44 automatically performs many tasks which must be programmed externally on other units. An example of this is the automatically programmed settling times (i.e., on AC at 400 Hz and above, the time from application of signal and program to full accuracy display is equal to or less than 150 milliseconds).

Another user oriented feature of the DSM 44 is its false program protection. If an incompatible range and function or a function that is not installed is programmed, the DSM 44 will go into a self-protect mode and indicate both on the front panel and in the output data that the misprogram has occurred.

The basic DSM 44 measures DC volts and DC/DC ratio. To increase its capability various options are offered including AC volts (average or true RMS responding), resistance, 4-wire bipolar ratio, parallel, serial or binary data outputs, parallel or serial remote control, current shunts, and high voltage probe.

4½ Digit Multimeters

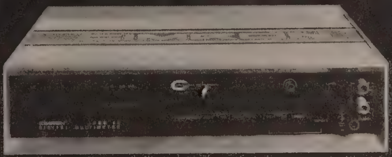
CIMRON DMM 40 DIGITAL MULTIMETER

DMM 40

- 5 functions, 20 ranges, autoranging
- Input protected, auto zero circuitry
- High noise rejection
- 10 μ volt sensitivity
- AC and DC current
- Optional battery pack
- Optional data outputs

DMM 42

- 6 ranges of DC volts
- 9 ranges of resistance, 0.1 mΩ-200 MΩ
- AC-true RMS or averaging
- Autorange — all functions
- Data outputs, remote control, standard
- 1 μ volt sensitivity, auto zero
- Input protected



DSM 44

- 20-30 readings per second
- Full input protection
- Unique high speed programming
- Unique false program protection
- AC/AC ratio
- Auto zero circuitry
- Parallel, serial and binary outputs
- 5 ranges of DC volts and DC/DC ratio
- Averaging or true RMS AC volts
- Resistance measurements
- Fully systems oriented

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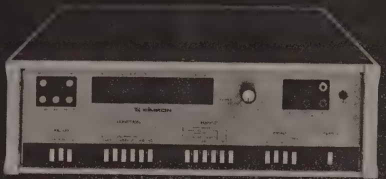
DIGITAL MULTIMETERS MULTIMETER / COUNTERS

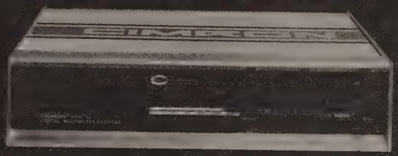
4½ Digit Multimeter
(High Speed)



6653A

- 1000 readings per second
- ± 1 digit accuracy
- DC volts and DC ratio
- AC true RMS or averaging
- Ohms/millivolt option
- Sample and hold option
- 6 print options
- Remotely programmable

4½ Digit Multimeter/Counters



DMC 45

- 6 functions — 32 ranges
- 5 ranges AC and DC volts
- 6 ranges resistance
- 6 ranges frequency, 10 Hz to 20 MHz
- 5 ranges AC and DC current
- 300% overrange
- Optional data outputs
- Optional battery pack — 8 or 16 hrs.

8421

- 4 functions — 17 ranges
- Frequency to 10 MHz
- 4 ranges AC and DC volts
- 5 ranges resistance
- Autorange all functions
- Auto zero
- Optional data outputs

MODEL 6653A
4½ DIGIT MULTIMETER

The 6653A is ideally suited for high speed data acquisition applications. Capable of reading rates of up to 1000 per second, this unit enjoys broad application in high speed data gathering and waveform digitizing applications. When equipped with its Sample-and-Hold option, digitizing of transient signals and peak values may be effected.

The high sampling rate of the 6653A is achieved through the use of an advanced linear amplifier with unusually short settling time and an IC successive approximation logic design.

Features of the standard 6653A are: DC volts and DC/DC ratio; 3 position filter, 6 month accuracy of ±1 digit, out-of-range indication, variable sampling rate and automatic polarity indication. The input signal leads are floating and isolated from the case, power line ground and print output. Options include: AC volts, averaging or True RMS; Ohms/millivolts; automatic ranging; remote control; and isolated data outputs.

The remote control option permits remote selection of all controls on the front panel including function, range, decimal location, sensitivity, filter, printout, energizing of external reference and energizing auto-desensitizing and trigger rate when the instrument is in Repetitive Mode. When in remote control, front panel controls are locked out, thus preventing the loss of data due to inadvertent operation of a front panel control.

MODEL DMC 45
4½ DIGIT MANUAL RANGING MULTIMETER/COUNTER

The low-cost DMC 45 combines all of the most useful measurement functions in a single compact unit. This state-of-the-art instrument has a multifunction input cable which afford the operator an error-free method of making fast precision measurements in a variety of applications. With 300% overranging capability, the DMC 45 provides resolution of 0.0025%. With 40,000 count capability, it is an extremely efficient production test instrument due to the fewer number of range selections required of the operator.

The basic DMC 45 provides functional capability of DC and AC volts, DC and AC current, resistance and frequency counting from 10 Hz to 20 MHz with resolution of 0.01 Hz on the lowest range. Through the use of a phase lock system on the two lower ranges, the need for a 10 or 100 second time base, required by other counters when measuring frequencies below 100 Hz, is eliminated. The phase lock system provides low frequency capability through a direct counting function rather than a computation based on the period of the input signal.

This 32 range multimeter may be expanded, through options, to include high voltage probe, battery operation and data outputs. Battery operation of up to 8 hours or 16 hours is available as an option.

MODEL 8421
4½ DIGIT AUTORANGING MULTIMETER/COUNTER

The 8421 combines many of the features of the DMC 45 with the convenience of automatic range selection — even on frequency measurements. This 4 function, 17 range instrument provides measurement capability of DC and AC volts, resistance and frequency to 10 MHz. With 100% overranging. The 8421 provides resolution of 0.005%. The unit is fully input protected and performs an automatic zero correction prior to each measurement. When equipped with its optional data outputs, the 8421 is ideally suited to laboratory, production, quality control, and field applications, both as a bench instrument and as a systems component. Other options to the 8421 include current shunts and a high voltage probe.

California Instruments' single-board construction techniques contribute to its ability for delivering maximum capability together with simplified calibration and ease of maintenance at a competitive price.

Exceptional AC measurement performance is obtained through the use of a wideband, fast settling time AC converter.

The measurement of frequency is accomplished through the use of our exclusive circuit technique known as SYNCHRO-COUNT, on which Patent No. 369745 has been issued.

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DIGITAL MULTIMETERS MULTIMETER / COUNTERS

MODEL NUMBERS	DMM 50	DMM 51	DMM 40	DMM 42	DSM 44	6653A	DMC 45	8421
Number of Digits	5½	5½	4½	4½	4½	4½	4¾	4½
Overrange %	20	20	100	100	100	10	300	100
Readings/Sec.	20	3⅓	4	2½	20-30	1000	2	3
Range Change	Auto/Man/Rem	Auto/Man	Auto/Man	Auto/Man/Rem	Auto/Man/Rem	Auto/Man/Rem	Man	Auto/Man
Frequency	—	—	—	—	—	—	Std	Std
Ranges (6)	—	—	—	—	—	—	100 Hz-20 mHz	10 KHz-10 MHz
Sensitivity	—	—	—	—	—	—	.01 Hz	1Hz
DC Volts	Std	Std	Std	Std	Std	Std	Std	Std
Ranges	5	5	5	6	5	6	5	4
Sensitivity	1 µV	1 µV	10 µV	1 µV	10 µV	1 µV	10 µV	100 µV
Accuracy	.002% Rdg	.002% Rdg	.01% Rdg	.01% Rdg	.01% Rdg	.01% Rdg	.01% Rdg	.01% Rdg
AC Volts — Averaging	Opt	Opt	Std	Opt	Opt	Opt	Std	Std
AC Volts — RMS	Opt	Opt	—	Opt	Opt	Opt	—	—
Ranges	4	4	5	4	4	4	5	4
Sensitivity	10 µV	10 µV	10 µV	100 µV	100 µV	100 µV	10 µV	100 µV
Accuracy	.05% Rdg	.05% Rdg	.1% Rdg	.1% Rdg	.1% Rdg	.1% Rdg	.1% Rdg	.1% Rdg
Resistance	Opt	Opt	Std	Opt	Opt	Opt	Std	Std
Ranges	6	6	6	9	7	5	6	5
Sensitivity	1 mOhm	1 mOhm	.01 Ohm	.1 mOhm	1 mOhm	.1 Ohm	.01 Ohm	.1 Ohm
Accuracy	.003% Rdg	.003% Rdg	.05% Rdg	.01% Rdg	.01% Rdg	.02% Rdg	.02% Rdg	.02% Rdg
Ratio DC/DC 3-Wire	Std	Std	—	—	Std	Std	—	—
Ratio DC/DC 4-Wire	—	Opt	—	—	Opt	—	—	—
Ranges	—	5	—	—	5	6	—	—
AC/AC Ratio	—	—	—	—	Opt	—	—	—
Sensitivity	1 µV	1 µV	—	—	10 µV	1 µV	—	—
Ratio AC/DC	Opt	Opt	—	—	Opt	Opt	—	—
Current AC and DC	Opt	Opt	Std	Opt	Opt	Opt	Std	Opt
Ranges	5	5	2	6	6	6	5	5
Data Output	Opt	Opt	Opt	Std	Opt	Opt	Opt	Opt
Remote Control	Opt	—	—	Std	Opt	Opt	—	—
Battery Operation	—	—	Opt	—	—	—	Opt	—
Basic Unit Less Options	$1395	$795	$695	$695	$895	$1740	$695	$895

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AUTOMATICALLY COMPUTE PHYSICAL AND ELECTRICAL PHENOMANAE

WITH THE NEW CP70 INSTRUMENT ORIENTED

CALCULATING PROCESSOR

- Interfaces with instruments, computers, process control equipment, data systems and peripherals
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- Automatic limit comparisons of computed values
- Accepts up to 3 full 6 digit inputs, plus polarity and range

With the hardwired program approach, the CP 70 is as easy to interface and control as a digital multimeter. Like digital multimeters, which require a simple control command or press of a button, the CP 70 will execute computational tasks with the same ease of control. The two main advantages offered by the CP 70 over similar devices are price and simplicity of interface and operation. Unlike programmable calculators and mini-computers, the user or system designer requires no knowledge of software or programming. Further, there is no need for de-bugging of programs or for software loading devices such as teletypes or high speed tape readers.

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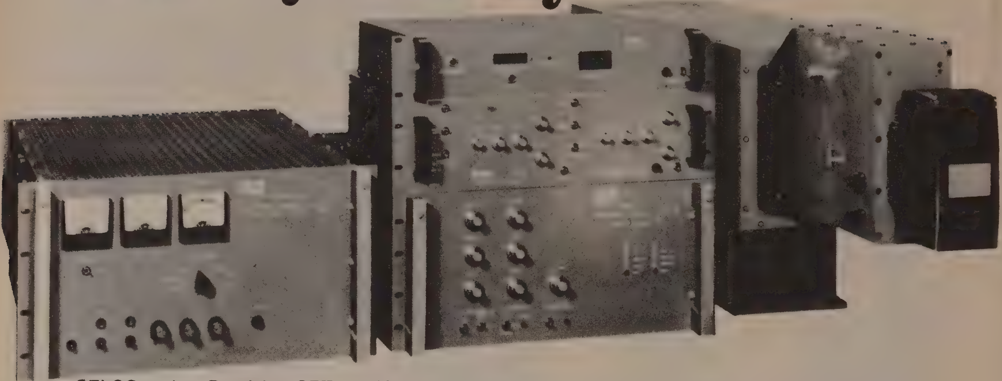
The "Above-Average" Sub-System by Celco



CELCO makes Precision CRT Displays for your "above-average" CRT requirements.

Need a CRT spot-size as small as 0.00065"? This standard CELCO 5" CRT display is being used for Satellite Photography. They needed the best they could get. You can get performance like that too with CELCO's DS5-065 Precision CRT Display.

A CELCO DS5-08 with 0.1% linearity, and spot size of 0.0008" is being used by another CELCO customer for Nuclear Photography Film Recording. Special features include programmable Raster Generators, and triple-layer and articulated shielding for ambient fields from earth's field and from dc to RF fields.

Fingerprint Scanning is the job of CELCO's DS5-10 Optical Character Recognition System for one of our customers. They needed that wide 2.5 MHz deflection bandwidth for high-speed scanning of vast amounts of data. And the DS5-10 has a settling time of 10 microseconds to 0.1% large signal, and 350 nanoseconds to 0.02% small signal settling time. Spot-size is 0.001".

One CELCO customer is using our 5" Color Display System for color separation and color photo scanning. One display does all that!

If your *needs* are "above-average" but your budget is *below*-average, CELCO also makes a 5" Precision CRT Display System especially for you that's ideal for your Low-Cost Film-Scan applications. Or if your display needs are larger, CELCO makes standard precision 7" and 9" CRT displays.

Our DS5-075 provides NASA with a 0.00075" spot-size for their Viking Orbiter and Viking Lander satellite photography. They needed 0.01% repeatability too. And they got it. From CELCO.

Two different customers with "above-average" display needs are using CELCO CRT Display Systems for Astronomy Research. One is an observatory; they're keeping their eye on the Sun. The other is recording their Stellar Observations with a CELCO CRT Display System.

High-speed map making is the task of another CELCO customer using a CELCO precision display for topographical projects.

CELCO displays are helping a leading Oil Company in their oil explorations. While another CELCO display is being used in Eye Research.

Maps and satellites, eyeballs and oilwells. All "above-average" display requirements. If your needs are ABOVE-AVERAGE, you need a CELCO "above-average" Precision CRT Display System.

(Don't you think so too?)

Call CELCO for your "above-average" CRT Display System.

UPLAND CA 714-982-0215
MAHWAH NJ 201-327-1123

(average is so . . . ho-hum to us.)

Celco

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1150 E. Eighth Street, Upland, CA 91786
70 Constantine Drive, Mahwah, NJ 07430

CELCO makes "Above-Average" YOKES for "Above-Average" CRT Displays

Need a deflected CRT spot as small as 0.00065"? CELCO's HDQ High-Resolution Deflectron for Satellite Photography Readout was the choice of one of our customers for their "Above-Average" display requirements. You can get performance like that with a CELCO YOKE optimized on your CRT for your "Above-Average" display. (measured with a CELCO CRT Spot Analyzer.)

Or YOUR "Above-Average" display may require fast Zero-approach settling time, as required in a Fingerprint Scanning job where CELCO HDN Deflectrons are specified to recover to 0.01% in 25 us.

Wide Bandwidth to provide several hundred nanosecond step response was part of this customer's display requirement too. (A CELCO RDA-1260 Deflection Amplifier did the driving.)

Precision Linearity on the final film plane or work surface, in Integrated Circuit Mask-Generator Displays enables producers of LSI technology to make low-cost computers for all of us. CELCO Special Deflectrons and Linearity Correctors LC123 are being used by several equipment builders for their "Above-Average" displays.

For PEPR, a system for reading Bubble Chamber photographs, developed by a few individuals at MIT and refined and expanded by others at leading universities throughout the world, CELCO was asked to provide special Low Residual Yokes for their project. CELCO produced their HD Deflectron with special 0.003% residual, and GFJ irrotational Focus Coils to help achieve the performance of these "Above-Average" displays.

CELCO DAPP2N-7 Amplifiers drive the Dynamic Focus Coil; a CELCO DAPP2N-5 Amplifier was selected by another PEPR group to drive the CELCO B1700 Di-Quadrupole which produced the rotating high-resolution scanning line!

"Above-Average" Recording Storage Tube displays with 1$\frac{7}{16}$" neck scan converters and storage tubes need CELCO QY and QD Recording Storage Tube Yokes.

The QY Yoke, matched with a CELCO QF Focus Coil, or the QD Yoke matched with CELCO's Low-Residual AFH Focus Coil helps guarantee the success of your "Above-Average" Storage Tube application. For 1⅛" neck Storage Tubes, we recommend our QYT and FQT Yokes and Focus Coils.

CELCO electronics and magnetics were integrated into a CELCO "DS" Special Display System for Oil Exploration and Data Reduction where "Above-Average" Linearity, Spot Growth, Zero-approach, Bandwidth, and Residual performances were required. Our customer decided to use CELCO's unique display experience to achieve his "Above-Average" display.

In "Above-Average" Direct-View displays, 0.00065" spot size is not needed since it is not discernible by the naked eye. But on LARGE screens, small errors of recovery, spot growth, residual, linearity, deflection defocussing and astigmatism are readily apparent. This is due to the wide deflection angles, large electron beam bundles in the yoke field, long throw distances from yoke to screen electron-gun and focus field aberrations.

CELCO "Above-Average" deflection yokes, focus coils, beam-centerings and aligners, astigmatic correctors, and pincushion correctors applied to your specific requirement will help you produce YOUR "Above-Average" Direct-View Display. CELCO YB, YA, and Hi-Q Yokes are used in Large-Screen, Direct-View airborn radar displays to take advantage of their fast dynamic response characteristics. Use them in YOUR "Above-Average" display.

For improved system performance in High-resolution displays use CELCO Beam Centering and Flooding Coils, and also for convenient location of adjustment controls.

CELCO LC, KC, JC, or MC coils for ⅞", 1$\frac{7}{16}$", or 2" CRT necks produce uniform confined magnetic fields to minimize distortion of the useful electron beam.

- CELCO Immersion Optics, for Vidicon, Storage, Image Orthicon, Image Dissector and Intensifier coil assemblies provide for deflection, focus, and alignment of your "Above-Average" applications.
- CELCO WV is a High-resolution Vidicon Assembly. Ruggedized, it was used on cameras in Tyros, Nimbus, Ranger, Venus-Mercury and other Space applications.
- CELCO CV Yoke Assemblies enhance the performance of 1" silicon storage tubes. CELCO DV Image Dissector coils are designed for digitizing with precision at high speeds and high resolution.
- CELCO IO coils for Image Orthicon and SEC tubes are designed for ground-based Orbiting Astronomical Observatory Readouts or rocket-borne research.
- CELCO Lens Assemblies, Type NU with Static and Dynamic Focus Coil, and Static and Dynamic Astigmatic Correctors are used on Film Recording Systems, Flying Spot Scanners, Optical Character Recognition Systems, and Computer-On-Microfilm (COM) to keep spots round and small.
- CELCO type HFH Certified performance Focus Coils are designed to provide Low Residual and Low Astigmatism and are used in conjunction with CELCO Yokes to minimize spot size and change in focus current. CELCO recommends Type HFL Focus Coils for general purpose, high quality CRT displays.
- CELCO Focus Coils are the choice for such "Above-Average" missions as the Ground Receiving Stations for many U.S. Space Probes into the Solar System, as well as for ERTS orbiters.
- CELCO DH Mini-Yokes measure 1.2" OD, weigh in at 3 oz., and are designed for ⅞" CRT necks and 50° deflection angle. 50° deflection angle on ⅞" CRT necks is obtained with CELCO's MY Mini-Yoke; 1⅞" OD, ¾" oz.
- The CELCO Type SD Low-L Deflectrons are Computer-designed and tested Yokes for ⅞" to 1$\frac{7}{16}$" CRT neck diameter, and provide to 90° deflection angles . . . (sort of a "yoke designer's YOKE).
- CELCO CRT Mounts, coil positioners, holders and magentic shields will enable you to get everything together to achieve your "Above-Average" display.
- CELCO C1, C2, C3, C4, etc. mounts are designed to hold CRT and coils of your choice. PB1, PB2, etc. are CELCO Yoke and Focus Coil positioners to enable you to precision-position the yoke and focus fields around the electron beam for optimum performance.

REMEMBER CELCO YOKES, whether you want to send a man to the moon, a probe to Jupiter or Mars, investigate chromosomes or trophoblast for cancer research, or build a large format scanner to generate typesetting masters, X-Ray enhancement, or data digitization.

Call CELCO for the "Above-Average" YOKE you need for YOUR "Above-Average" CRT Display System. (average is so . . . ho-hum to us.)

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4 ways IC Update Master can solve the problem of device selection.

Smaller companies often offer special performance devices. How would you find a company making a device you need?

Go to the Master. Section 2 is a product guide to the entire IC industry. It allows you to survey all devices, their key operational characteristics, and the companies who supply each one.

You want to call for information on TI's MOS memories . . . What city would you call for information.

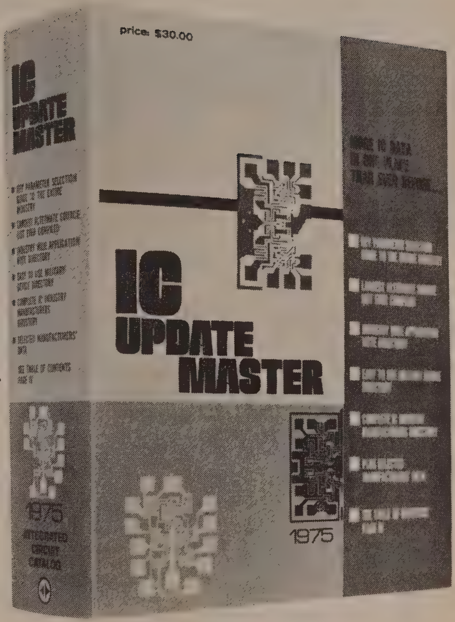
Go to the Master. Section 7 is a comprehensive telephone directory of the entire IC Industry. Page 7-37 lists Texas Instruments and the extension number for product information on MOS. It also contains a phone listing for TI sales offices and distributors throughout the country.

Motorola makes an MCM 4004 device . . . where would you look to find an alternate source for an MCM 4004?

Go to the Master. Section 3 is an industry wide cross reference. It contains over 14,000 cross references. Page 3-20 lists five other companies and their part numbers for pin-for-pin replacements of an MCM 4004.

Got a design problem . . . could an application note help?

Go to the Master. Section 5 is a comprehensive guide to the many IC application notes available. It lists the devices covered, describes each note and tells who publishes each one.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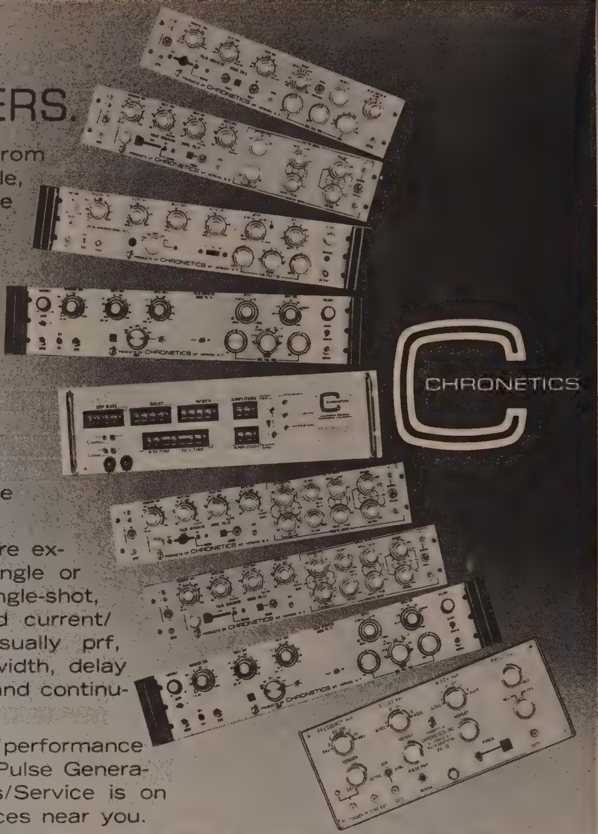
THE *PLUS* PULSERS.

Advanced Pulse Generators from CHRONETICS: The most versatile, sophisticated, high performance pulsers in the field. State of the art circuit design, meticulous construction for reliable quality. Performance and flexibility second to none. Thirteen standard models for virtually every need.

Repetition rates from 0.1 Hz to 100 MHz, output amplitudes from 0 to ±100 volts or ±2A, rise/fall-times of less than 2 ns, wide dynamic ranges, high duty cycles, bipolar outputs, etc. are all available on standard instruments.

Chronetics' Pulse Generators are exceptionally flexible. All provide single or double pulses of either polarity, single-shot, pulse bursts. Bipolar outputs and current/voltage modes are available. Usually prf, amplitude, risetime and falltime, width, delay and DC-offset are independently and continuously variable.

"Total Pulse Control" and price/performance engineering make CHRONETICS' Pulse Generators the best buys in the field. Sales/Service is on a world-wide basis with field offices near you.



CHRONETICS Advanced Pulse Generators

MODEL	CLOCK PRF	AMPLITUDE[2]	Z OUT	RISE/FALL TIME	PULSE DURATION	PULSE DELAY	DUTY CYCLE (MAX)	DC OFFSET
PG-10	0.1 Hz-50 MHz	5 mV-10V + or −	50 ohms or 1K, min.	< 5 ns	15 ns-1 sec	15 ns-1 sec	To 100%	± 2V ± 40 mA
PG-11A	<10 Hz->50 MHz	0-15V + or −	8 ohms	<5 ns	15 ns-10 ms	20 ns-10 ms	85%	
PG-12	0.1 Hz-50 MHz	100 mV-10V + or −	50 ohms	< 5 ns-1 sec[4]	10 ns-1 sec	15 ns-1 sec	To 100%	± 10V
PG-13B	1 Hz-25 MHz	100 mV-100V + or −	50 ohms or 1K, min.	<10 ns-50 ms[4]	10 ns-500 ms[5]	15 ns-500 ms	10% @ 2A 50% @ 1A 100% @ < 0.5A	±5V ±100 mA
PG-14	1 Hz-50 MHz	100 mV-20V + or −	50 ohms or 10K, min.	2 ns-50 ms[4]	<5 ns-500 ms	10 ns-500 ms	To 100%	±5V ±100 mA
PG-16	1 Hz-100 MHz	100 mV-20V + or −	50 ohms or 10K, min.	2 ns-50 ms[4]	< 5 ns-500 ms[5]	10 ns-500 ms	To 100%	±5V ±100 mA
PG-32A	0.1 Hz-10 MHz 20 MHz Max.[1]	20 mV-20V[3] + and − 2 Channels	50 ohms or 500 ohms	5 ns-1 sec[4]	< 30 ns-1 sec[5]	50 ns-1 sec	To 100%	To 10V To 400 mA
1012P[6]	10 Hz-9.99 MHz 20 MHz Max.[1]	0-9.9V[2] + or −	50 ohms	5 ns-9.9 ms[4]	40 ns-9.9 ms	25 ns-9.99 ms	85%	±9.9V

1 Effective PRF in double pulse mode
2 Max. Range into 50-ohm loads
3 Separate or combined (bipolar) channels; same polarity on Special Order
4 Variable linearly -Separate control of Rise and Fall Times
5 Independent control Pulse 1/Pulse 2 (double pulse mode)
6 Fully programmable

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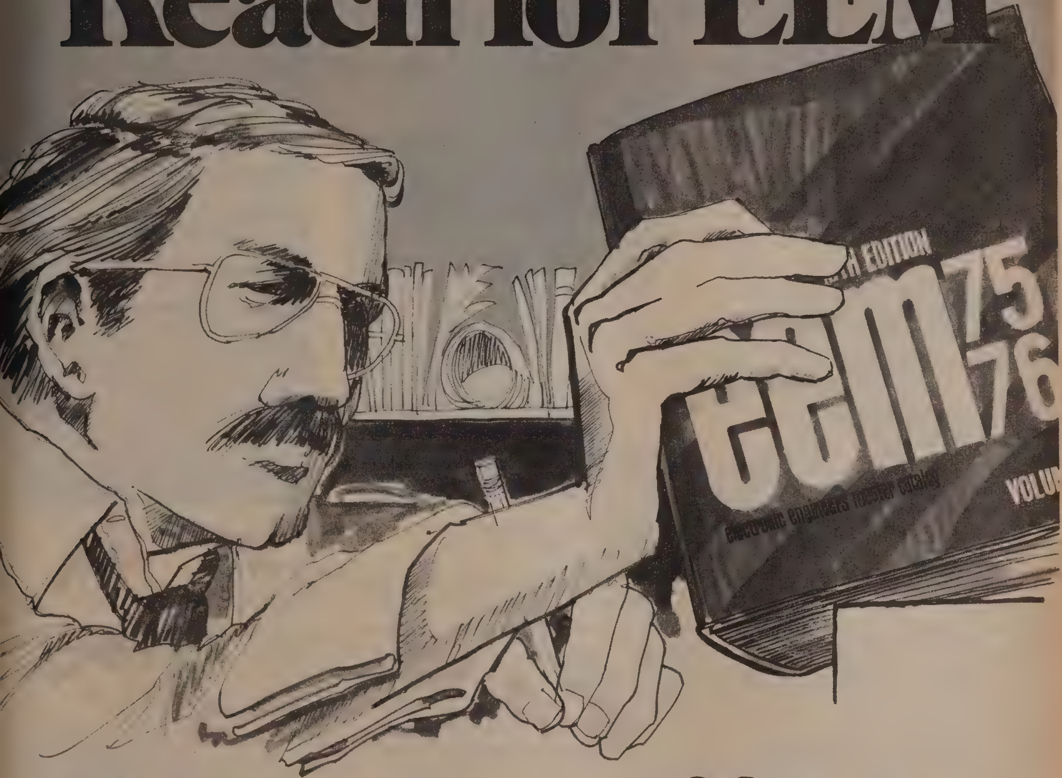
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VERSATILE
ECONOMICAL
Model 925

automatic relay tester

LARGE CAPACITY/ PRACTICAL FIXTURING

Basic machine can test 6PDT, 2 coil relays in any one of five identical test positions. Four wire connections to all elements except case and coil(s). "Zero Insertion" sockets available for DIP and most 200 mil spacing pin type relays. Standard connectors available for "In house" fixturing.

HARD COPY FAILURE MESSAGES

Upon a test failure the system produces a "Failure Message" which indicates the Test failed, the Test Position, and whether the Test was failed HIGH or LOW. "Continue" button causes the test sequence to restart.

AMPLE INDICATORS and CONTROLS

Indicator Lamps show:
- The Test in Progress
- The Test Position being investigated
- PASS or FAIL results of each Test.

Switches allow:
- Incrementing Test Positions
- Choosing the "Single Test" mode
- Resetting any Test at any time
- Overriding the programed dwell time with a minimum dwell time of 1 second.

Panel Meter holds:
- The last Coil or Contact resistance reading.

WIDE RANGE OF TESTS

Coil and Contact Resistance. Pick-up and Dropout Voltages. Operate, Release, and Bounce Times. Four different High Potential Insulation Resistance Tests. Latch up Test. Make-Before-Break and Break-Before-Make Tests.

EASY TO PROGRAM and/or OPERATE

Complete program written in minutes. Programs in simple English. Operates in "Single Test" or continuous Tape controlled Modes. Easily programed to sequence through test positions without operator intervention. One short Tape loop can contain a complete Test Sequence.

WIDE RANGE OF PROGRAMMABLE TEST VOLTAGES, CURRENTS and TIMES

Coil Voltages:
0.1V to 75 V, 0 to 250 mA.

Contact Resistance Test Currents:
10 to 2,000 mA.

High Potentials: 50 to 1,500 V.

Time Intervals:
100μsec to 100 milliseconds.

"High Pot" Dwell Times:
1 to 100 seconds.

HIGH THROUGHPUT

Testing time per relay depends upon the number of tests performed and with High Potential tests upon the dwell times chosen. Running 13 tests per relay and allowing 5 seconds dwell time for all "High Pot" tests will allow a yearly rate (single shift) of at least 80,000 DPDT relays. Except for the dwell times the typical time per test is 2-2.5 seconds.

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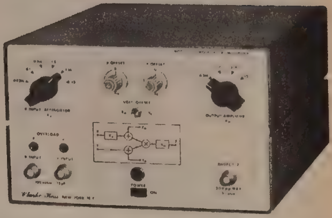
unique instrumentation



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Ready to use as a *suppressed carrier modulator*, as an *instantaneous wattmeter*, as a gain *controlled amplifier*, as a high quality *AM modulator*. Amplifier — 3 dB bandwidth above 6 MHz. Difference in channel delays under 2 nsec. Total "feedthrough" at 2 MHz less than 40 dB. dc coupled, low dc drift. Price $520.00

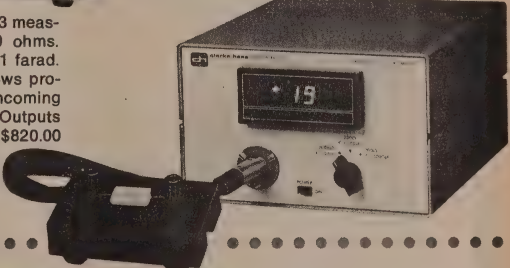
Model 235 **WIDEBAND WATTMETER**

20Hz — 20 kHz; 2W — 20kW. Full scale up to 31 A/630 V. down to 100 mA/20 V. Accuracy 1%, any connection. Power Factors 0-1. Easy to connect and to read. BCD output available. Various range combinations available: 6 to 600 V, 10 mA to 31 Amperes. Price $2495.00

Model 273 **DIGITAL ESR METER**

The industry standard for 100 kHz ESR measurements. The Model 273 measures Equivalent Series Resistance values from 1 milliohm to 20 ohms. Handles any type of capacitance with values from 5,000 pF up to 1 farad. In use by the world's leading capacitor users. The Model 273 allows production line monitoring in capacitor manufacture and 100% incoming inspection for capacitor users with critical loss requirements. BCD Outputs Standard. Price $820.00

Model 273 also measures internal impedance of *Batteries*, contact resistance of *Relays*, and the effective loss term in *Networks*.



function generators

All function generators with sine, square, and triangular waveshapes, Tone Burst, Phase Lock Synchronization, Wide Range low distortion VCF and/or FM. All extend down to 1 mHz with "Low Frequency Expand Switch". All generators have sine wave distortions below 46 dB and extremely flat sine wave amplitude vs frequency characteristics. Most units sweep to twice the upper dial frequency. All generators have 50 ohm output, 60 dB of output range.

Model 743 **TONE BURST, PHASE LOCK SYNC.**

Dial Controlled 1 Hz to 2 MHz. Low distortion FM or VCG. Price $385.00

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Dial Controlled 3 Hz to 3 MHz. Balanced 600 ohm output. Price $415.00

Model 745 **THUMBWHEEL SWITCH CONTROLLED**

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Model 748 **DIAL CONTROLLED 1 Hz to 2 MHz.**

High quality, low distortion AM or suppressed carrier modulation or detection. Price $535.00

Model 750 **DIAL CONTROLLED 1 Hz to 2 MHz.**

Internal ramp generator with sweep times from 1 msec to 200 seconds. Price $495.00

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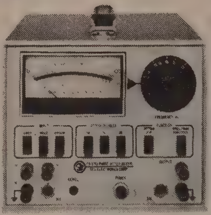
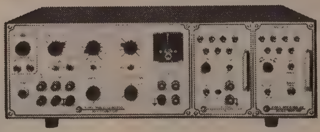
COMSTRON·SEG TELEPHONE CHANNEL TEST AND SIMULATION EQUIPMENT

PHASE JITTER METER


FA-1743

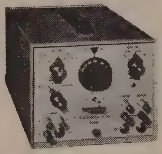
- Measures peak-to-peak phase jitter from 0° to 100°
- Unique BUILT-IN SPECTRUM ANALYZER for instant determination of jitter frequencies and their contribution to total phase jitter, even in the presence of large amounts of broadband noise.
- Accepts carrier frequencies from 800 to 1800Hz
- Simplified operation — no level set or frequency adjustment required
- Rugged, portable — for field and laboratory use

PHASE JITTER SIMULATOR


FA-1564 A

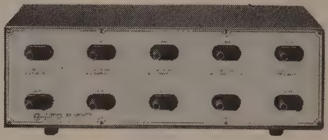
- Simulates normally encountered active telephone channel impairments such as phase jitter, phase hits, harmonic distortion, broadband and impulse noise and frequency translation
- Simulates phase jitter; 0 to 45° peak-to-peak; jitter frequencies, 20 to 300Hz
- Use for developing, testing and evaluating data-com equipment

TUNABLE BAND PASS AND BAND REJECT FILTER


AF-850A

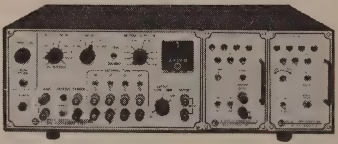
- Telephone channel filter tunable from 35Hz to 3500Hz
- Use for notched noise measurements and waveform analysis; 3.5Hz and 35Hz bandwidth
- Fully compatible with telephone channel transmission measuring techniques and equipment
- 0dB, 10dB, 20dB, 30dB gain and by-pass functions
- Generates reference signal at Fc of notch and bandpass

TELEPHONE DATA LINE SIMULATOR


Model LSCC-( )

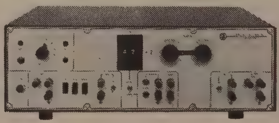
- Contains up to 5 data line simulators
- Industry standard telephone line simulator
- Simulates nominal worst case attenuation and delay, per Bell, CCITT, and DCS schedules
- Simulates 3002, C1, C2, C4 and DCS-S3
- Controlled out-of-band characteristics
- Also available: C-Message Weighting, F1A Weighting, Telephoto 1 and 2, etc.

DROPOUT SIMULATOR


FA-1955 A

- Simulates data-channel dropout; adjustable duration from 1 ms to 10 seconds and depth from —3dB to greater than —50dB
- Simulates additive broadband and impulse noise, SFI tones and out-of-band signals
- Operates in band limited mode, with SEG Telephone Data Line Simulators, or in broadband metallic mode

DIGITAL DELAY (ECHO) GENERATOR


FA-1755

- Simulates data channel delay and/or echo
- Delay to 100 ms* in 1 ms steps
- Stores 99 ms* of transient input data and continuously regenerates it for analysis or utilization as additional channel impairment
- Bandwidth 200Hz to 3.4kHz delay-corrected to 50usec
- Echo adjustable to 49dB in 1dB steps

*Up to 2 seconds available

FOR APPLICATIONS ENGINFERING ASSISTANCE CALL 212-441-3200

COMSTRON·SEG

120-30 Jamaica Avenue ▪ Richmond Hill ▪ New York 11418 ▪ Tel: 212-441-3200 Telex: 146337

FREQUENCY SYNTHESIZERS ▪ CUSTOM FILTERS ▪ TUNABLE FILTERS ▪ TELEPHONE TEST & SIMULATION EQUIPMENT

Comstron 1013 the new synthesizer . . . an extraordinary signal source at an ordinary price!

RMS
2
4
6
8
VOLTS
COMSTRON
COMSTRON FREQUENCY SYNTHESIZER

$1595
0.1Hz to 13MHz

the performance says . . . it's the utmost in synthesizers! the price says . . . use it everywhere — on the bench, in the lab, in your system.

COMSTRON MODEL 1013 FREQUENCY SYNTHESIZER
0.1Hz to 13MHz WITH FULL 5+ DIGIT ACCURACY AND PROGRAMMABILITY

Now you can have the precision and versatility of a synthesizer at the price of an ordinary oscillator.

Here's the synthesizer that gives you full 5+ digit crystal accuracy (no accuracy stealing verniers), clean signals, automatic leveling, and high output power.

The new 1013 is the only synthesizer using COMSTRON's Direct Programming Differential Synthesis Technique (patent pending) that gives uncompromising precision and high speed programmability. It all adds up to a cost-performance breakthrough with unmatched reliability and data handling capability . . . your guarantee of performance with integrity.

SPECIFICATIONS

Range

Frequency Range:
0.1Hz to 13MHz in 5 ranges

Accuracy

Frequency Accuracy:
Full 5+ digits, ±0.001% of setting for 6 months, 0°C to 55°C

Frequency Stability:
Full 5+ digits, long term is ± 10 ppm of setting per year at ambient

Purity

Phase Noise:
Signal to phase noise (integrated); Greater than 40dB in a 30kHz band excluding ± 1Hz, centered on carrier 10MHz range, greater than 60dB, 1MHz range and below

Harmonic Distortion:
−40dB 1 MHz to 13MHz
−50dB 0.1Hz to 1MHz

Spurious:
Greater than 60dB below selected output level or less than −110dBm/50 ohm, whichever is greater

Amplitude:
Maximum 6Vrms open circuit
3Vrms (+23dBm) into 50 ohms

Output Impedance:
50 ohms

Amplitude Control:
Attenuator; +20 to −30dB in 10dB steps
Continuous control: +3 to −15dB
Meter indication in volts and dBm

Square Wave Output:
Positive going square wave TTL compatible

Options

Option 001	Programming—Parallel BCD, field installed
Option 002	Programming—ASCII, Isolated, field installed
Option 003	Ultra-Stable Reference Oscillator, field installed
Model 101	Micro-machine for programmed frequency hopping, sweeping and searching. Uses Model 1013 display and is programmed directly from the Model 1013

COMSTRON·SEG

ASK FOR NEW FULL COLOR BROCHURE FOR COMPLETE DETAILS OR CALL COMSTRON FOR A DEMONSTRATION . . . TODAY.

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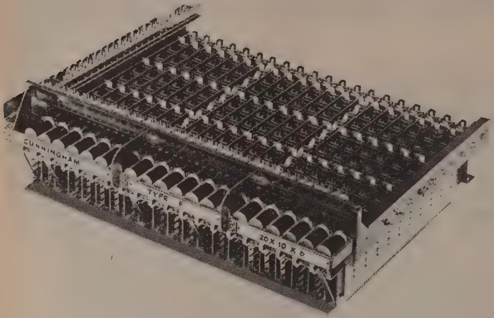
FREQUENCY SYNTHESIZERS ▪ CUSTOM FILTERS ▪ TUNABLE FILTERS ▪ TELEPHONE TEST & SIMULATION EQUIPMENT

crossbar matrix switches



Cunningham crossbar switches have a minimum operating life of 20 million operations per crosspoint, due largely to their gold-alloy, self-wiping contacts. These, together with the beryllium-copper coordinate conductors, provide extremely low path resistance and minimal EMF. Insulation resistance is very high, while induced noise is virtually nonexistent. The crossbar actually covers a wider frequency band than any other comparable switching device, and handles low-level to high-power signals. Matrix switches from ten to three hundred 6 wire crosspoints.

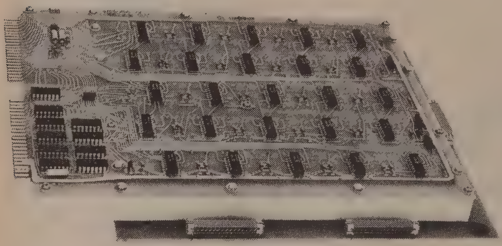
The Type A crossbar is a broadband group-to-group signal routing switch with coordinate actuation of the crosspoints.

The Type F crossbar is a coordinately actuated group-to-one matrix with the capability of connecting any one of a number of inputs to a single output or vice-versa.

The Type P crossbar is a broadband frequency group-to-group signal routing switch with direct actuator coils positioned above each crosspoint.

The Type T crossbar is a group-to-one switch that is ideal for handling low-level (microvolt) signals. Direct actuator coils are mounted above each crosspoint.

reed matrix switches



Two reed matrix models are available for high and intermediate frequencies. They are supplied in the 5x10 (50 crosspoint) configuration only. Crosspoints are interconnected to form a group-to-group switching matrix.

The high frequency (HF) model is a single-pole matrix for switching signals up to 60 MHZ. The multilayer signal board provides shielded signal paths with 50 ohm characteristic impedance. Input and output are through subminiature coaxial connectors. The coaxial cable shields are all tied together through the connector shells to a common ground. Only the center conductor is switched.

The intermediate frequency (IF) model can have one, two, or three poles at each crosspoint and can handle signals from DC to 4 MHz. Multipin connectors are used for input and output signal connections. For general purpose switching applications where the signal frequencies do not need the heavy shielding of the H.F. model.

for applications assistance call (716) 624-2000

SPECIFICATION	TYPICAL CROSSBAR MATRIX	TYPICAL REED MATRIX
Minimum Life:	2x10⁷ operations per crosspoint.	10⁸ operations per crosspoint.
Current Rating:	Switch 100 mA @ 50 VDC, carry 1.0 A.	Switch 100 MA @ 12 VDC, carry 1.0 A.
Contact Material:	Gold alloy 0.005″ thick.	Rhodium plated.
Contact Resistance:	Less than 30 milliohms.	Less than 300 milliohms.
Contact Stability:	Better than ±5 milliohms.	Better than ±150 milliohms.
Longest Path Resistance:	Less than 400 milliohms—in 30x10 matrix.	Less than 300 milliohms—in 5x10 matrix.
Thermal EMF's:	Less than 0.1 microvolt per °C.	Less than 1.0 microvolt per °C.
Insulation Resistance:	Greater than 100,000 megohms @ 45% R.H.	Greater than 100,000 megohms @ 45% R.H.
Breakdown Voltage:	1000 VAC, rms @ 60 Hz, 1500 VDC between conductors and frame or across open contacts at humidity below 45% R.H.	500 VDC between conductors or to ground, 250 VDC across open contacts at humidity below 45% R.H.
Frequency Range:	To 10 MHz w/—50 db cross-talk and 60 db isolation.	HF Series—to 50 MHz w/—60 db crosstalk and 60 db isolation. IF Series—to 4 MHz w/—60 db crosstalk and 60 db isolation.
Operate Time:	Less than 30 millisec.	Less than 4 millisec.
Release Time:	Less than 10 millisec.	Less than 2 millisec.
Contact Bounce:	Less than 400 microsec on make, not measurable on break.	Less than 100 microsec on make, not measurable on break.
Induced Noise:	Less than 5.0 millivolt.	Less than 100 microvolt.

Cunningham Corporation

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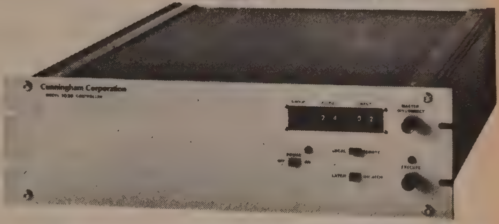
matrix controller

The 1020 Controller interfaces a switch matrix to any 16 bit address device. Crosspoint connections can be programmed to latch or unlatch as required. CMOS logic is used to insure high noise immunity and low power consumption. Both local and remote control are featured. This standard interface component facilitates a wide variety of matrix applications as in automated testing or telemetry switching.



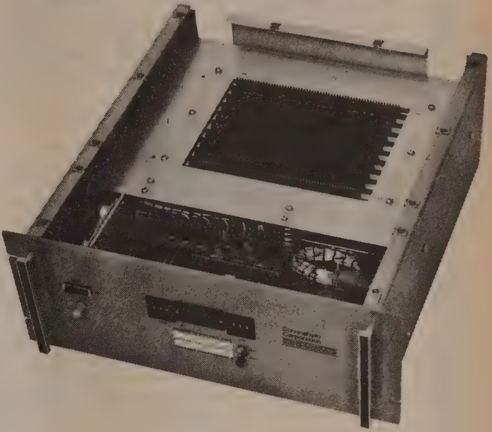
for applications assistance call (716) 624-2000

data acquisition scanners

Cunningham has developed two versions of the 2000 Series scanner for sequentially or randomly reading a number of instrument-level signals. One of these uses a crossbar while the other uses SC-10 reed cards for switching. The crossbar matrix switch is ideal for extremely low signal levels (Microvolts). The reed cards are best applied where scanning speeds exceed 50 channels per second.

Control, logic, and interfacing for both versions are performed by integrated circuitry to ensure compatibility with peripheral instruments. All levels are DTL and TTL compatible and each input represents only one standard load. Each output can accommodate 10 standard loads.

Front panel controls include single channel random access, single scan, continuous scan, scan limit switches, and single channel advance. A three-digit display shows which channel is being sampled, Either scanner can be remotely controlled, in which case the unnecessary controls may be omitted from the front panel.



SPECIFICATION 2000 SERIES	REED SCANNER	CROSSBAR SCANNER
Number of data channels	10-100 three-wire in increments of ten channel per plug in scanner card	600 one-wire, 300 two-wire, 200 three-wire, 100 six-wire
Contact resistance	< 100 milliohms	< 50 milliohms
Contact stability at maximum ratings over life	± 2.0 Ohms	±10 milliohms
Initial data path resistance	< 300 milliohms	< 250 milliohms
Thermal EMF's +25°C — +50°C	< 1.0 microvolts/ °C	< 0.1 microvolts/ °C
Open contact capacitance	0.2 pf	0.3 pf
Contact ratings resistive loads	500 milliamps at 200 VDC	100 milliamps at 50 VDC
Open contact breakdown voltage	250 VDC	1500 VDC
Insulation resistance at 95% R.H.	100,000 Megohms	100,000 Megohms
Scan rate	to 200 ch./Sec.	to 40 ch./Sec.
Contact bounce	< 500 microseconds	< 400 microseconds
Contact dwell time at maximum speed	> 2.3 milliseconds	> 7 milliseconds
Expected life at rated loads	10 Million closures/ch.	20 Million closures/ch.
Logic levels	Logic "1" = 4.0 ±1.0 Volts Logic "0" = 0.4 ±0.4 Volts	Logic "1" = 4.0 ±1.0 Volts Logic "0" = 0.4 ±0.4 Volts
Power consumption	45 Watts	50 Watts
Operating temperature range	0°C to 70°C	0°C to 60°C
Signal input connectors*	1 Winchester 50 Pin/Card	20 Cunningham SP-1173
Signal output connectors*	Winchester 4 Pin	20 Pin
Control connectors*	56 Pin	56 Pin
Dimensions	3.5" High, 22" Deep, 19" Wide - front panel	7" High, 22" Deep, 19" Wide-front panel
Weight	21 Lbs.	30 Lbs.
Weight - Packed for shipment	36 Lbs.	45 Lbs.
Contact material	Rhodium plate	Solid gold — .005 in. thick.

* Mating connectors are supplied.

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CURTIS

AMPERE HOUR METERS, STATE-OF-CHARGE INDICATORS and CHARGE CONTROLLERS

The 920 Series of "Fuel" Gauges, Ampere Hour Meters and Controllers was originally developed for a variety of special space and military applications. Versions of these units are employed on such critical applications as the Trieste II, the Lunar Rover Vehicle, and special military applications. Numbers of units are serving as special instrumentation on experimental electric traction vehicles.

The Curtis 920 Series is a family of precision, bi-polar ampere hour integrators, offered in a variety of functional packages which, in their simplest configuration . . . **continuously display the energy level of rechargeable batteries.**

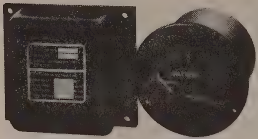
And in other package configurations, also . . . **control the charge cycle and . . . provide low level alarm or lockout signals.**

WHAT THEY DO

• Permit maximum performance and efficiency in battery operated equipment and systems • Extend battery life by eliminating abusive overcharge and deep discharge • Prevent unexpected work stoppages by providing continuous display of work life left in battery • Automatically measure actual ampere hours removed during discharge and replaced during recharge • Control battery charge without expensive charging controls.

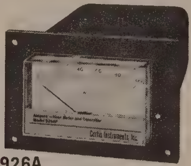
WHAT THEY FEATURE

• Accurate continuous display of state-of-charge • Actual ampere hour measurement • Charger control based on actual state-of-charge • No maintenance—all solid state • Low cost • Completely automatic operation.



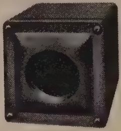
MODEL 925E ELECTRIC VEHICLE FUEL GAUGE

Designed specifically for use in electric powered vehicles, the 925E provides a continuous reading of remaining battery capacity to the operator. Automatically resets as batteries are recharged. Requires no maintenance or periodic calibration.



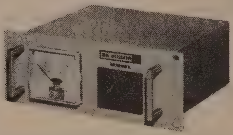
MODEL 926A AMPERE HOUR METER AND CHARGE CONTROLLER

Designed for large rechargeable stationary battery systems, the 926A is available for rack or bulkhead mounting with integral or remote meter. High and low level detectors and an adjustable charge/discharge ratio to compensate for battery losses are standard. Plug-in printed circuit card construction permits a wide range of options (extra contacts, signal conditioning, power conditioning, etc.) to be easily incorporated for custom applications. Used in systems where extremely high discharge rates and asymmetric charge/discharge ratios are encountered. For a more complete description, call or write for the 926A data sheet.



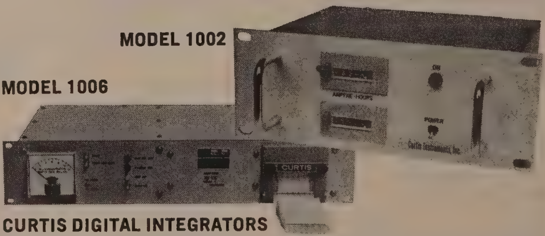
MODEL 928 AMPERE HOUR METER AND CHARGE CONTROLLER

Used in heavy industrial traction or stationary applications, the 928 features an adjustable capacity range and charge/discharge ratio as well as a wide operating voltage range. Simple, convenient controls permit rapid adjustment of operating parameters making the 928 compatible with most battery systems. Requires no maintenance or periodic calibration. Can be used in conjunction with battery and battery chargers as ampere hour meter and charge controller. Call or write for the 928 data sheet.



MODEL 1004 AMPERE HOUR METER WITH DIGITAL REGISTER

The Model 1004 answers the need for a continuously recording ampere hour meter that is powered directly from the DC voltage of the power source. It has no drift, and non volatile storage. Ampere hours are displayed in the first decade in vernier analog form while a six digit counter provides the digital readout. Available with integral shunt in a complete range of currents.



MODEL 1002

MODEL 1006

CURTIS DIGITAL INTEGRATORS

For applications where the unique features of the infinite memory, analog output bipolar integrating elements are not required. Curtis has developed several series of electronic integrators. The 1002 series of Ampere Hour Meters and Current Time Integrators are enjoying growing acceptance for precious metal and other electroplating requirements. The 1002 is available in a wide range of ampere hours and various counter configurations.

The 1006 is a printing integrator designed to integrate outputs of the Philips SO_2 detector and other transducers for environmental monitoring, and automatically print, on 15 minute to 4 hour intervals, the integral in PPM/Hr with real time identifier.

For additional information and full specifications, write:

CURTIS INSTRUMENTS, INC. 207 Kisco Avenue, Mt. Kisco, N.Y. 10549 • Tel. (914) 666-2971
TWX 710-571-2163

CURTIS

ANALOG ELAPSED TIME INDICATORS

...Smallest size, lowest cost, AC or DC, any voltage

How they work — The patented Curtis Ampere Hour Meter is basically a mercury microcoulometer fabricated from precision bore, glass capillary tubing filled with two columns of mercury separated by a small electrolyte gap. Application of pure or pulsed DC signals to electrodes inserted in the mercury causes mercury at the anode to be electrochemically transferred across the gap to the cathode at a time rate proportional to the current. The gap moves along the tube length as a function of the current-time integral. A constant-current supply provides a precision timing device.

TYPICAL APPLICATIONS

Warranty — Low-cost meters for warranty of equipment based on both actual usage, and calendar period.

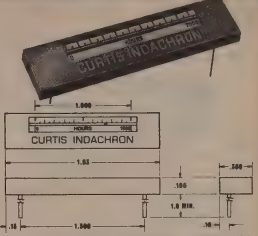
Reliability Engineering — Provides mean-time-to-failure or sub-system replacement time without costly, unreliable logging.

Test Equipment Utilization & Calibration — Provides calibration on actual hours of use with savings up to 50% compared to calendar-basis programs. Substantial savings in capital investments can be realized with accurate utilization data on test instruments, tools and equipment.

Curtis Instruments, Inc.
200 Kisco Avenue, Mount Kisco, N.Y. 10549
(914) 666-2971 • TWX 710-571-2163

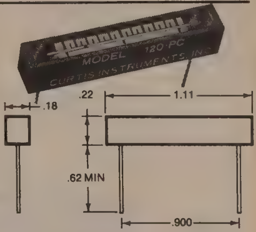
L Series Curtis Indachron™

Used on OEM equipment as a very low-cost means of validating warranties and for P.M. scheduling. Under $2.00 each in production quantities. AC and DC Models. Various time scales and electrical ratings. Can be mounted on printed circuit cards or direct to chassis with adhesive strips.



120-PC Series

Radial leads for installation directly on printed circuit cards for "mean-time-to-failure" or preventative maintenance scheduling. Can be instrumented from available DC voltages for any time scale by use of series resistor. Full scale of .65 inches = 4.16 milliamp-hours.



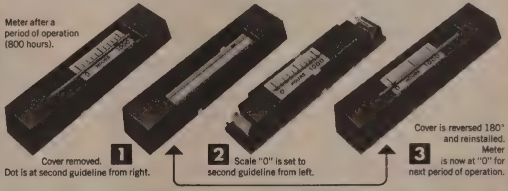
620 PC, 620N Series, MIL Type

The Curtis MIL type analog timers are made in two configurations. The 620N Series meet MS90386, and are now available in 5V and 15V, as well as 28V DC and 115V AC models. The 5V and 15V units directly answer the long felt need for an elapsed time meter than can be powered **directly** from voltages available within the box, precluding the necessity of special wiring for the ETI. The units also provide dramatic economies over the older electromechanical types. The 28V DC version provides for internal regulation over the complete aircraft power range, and the 115V AC device is truly insensitive to variation in line frequency.

The 620 PC Series meets the MS-3311 (AS) and was specifically designed for repairable modules and subassemblies, is very low cost and installs directly on PC boards.

CP-3 Series

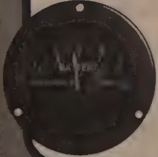
New low cost monitor for P/M scheduling and other applications requiring a simple means of reset to zero in the field. AC or DC. Scales for any type of scheduling.


Meter after a period of operation (800 hours).
Cover removed. Dot is at second guideline from right.
1
2
Scale "0" is set to second guideline from left.
3
Cover is reversed 180° and reinstalled. Meter is now at "0" for next period of operation.

ANALOG COUNTERS

When operated by well defined pulses such as digital logic signals, any Curtis INDACHRON™ can be calibrated to provide direct indication of accumulated number of pulses with virtually any full scale reading. They can be used to count the number of lines, copies, characters, or other operating functions of computer peripherals, office or communication equipment.

CURTIS INFINITE MEMORY INTEGRATORS



Battery "Fuel" Gauges

Meter displays % of discharge (amp-hrs. remaining in rechargeable battery systems). Typical of applications for Curtis 925 Millivolt Integrator.

Ampere Hour Meter and Controller Model 926-A

For large rechargeable stationary battery systems. High and low level detectors. Adjustable charge/discharge ratio to compensate for battery losses.

Powered from battery system. Available in panel and bulkhead mountings. Also model for remote panel meter display.

1006 Pollution Monitor

A new automatic integrator, with cyclic printout of the integral of the output of any pollution monitor. Records total quantities of emission, and substantially replaces manual data reduction.

DANA EXACT ®

Function Generators

NEW!!

510 SERIES

LOW COST 10 MHz FUNCTION GENERATORS
- Low Cost Instruments
- .001 to 11 MHz Frequency Range
- Sine, Square, Triangle, VCF Generators
- Positive and Negative Ramp or Pulse Outputs
- Linear and Logarithmic Sweepers
- Select Start and Stop Frequency
- 80 db Attenuation, Variable DC Offset, Sync, Trigger
- 20 V P-P Open Circuit 10 V P-P Into 50 Ohms

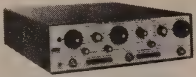
120 SERIES

FUNCTION GENERATORS
- Low Cost and Precision Units
- 3 MHz and 5 MHz Generators
- VCF Generators
- Dual Output Instruments
- Linear and Logarithmic Sweepers
- AM/FM Generator
- 20 V P-P Open Circuit 10 V P-P Into 50 Ohms
- Variable DC Offset

NEW!!
196A

190 SERIES

FUNCTION GENERATORS
- Low Cost
- 200 KHz and 1 MHz Units
- VCF Generators
- Sweep and Pulse Capability
- 600Ω and 50Ω Output Impedance
- Battery Powered Units
- 20 V P-P Open Circuit Output
- Stocked Locally



NEW!!
7059

7000 SERIES

PRECISION 10 MHz FUNCTION GENERATORS
- 0.0001 Hz to 11 MHz Frequency Range
- Sine, Square, Triangle, Ramp, Pulse, ± Sine, ± Square, ± Triangle, ± Ramp, ± Pulse
- Voltage Controlled Frequency 1000:1
- Linear and Logarithmic Sweepers
- 80 db Attenuation, 10 db Steps, 20 db Variable
- AM (External Input), 360° Phase Lock (Model 7056)
- Variable DC Offset, Gate and Trigger Modes
- 30 V P-P Open Circuit 15 V P-P Into 50 Ohms
- Ramp Hold, Variable Phase Start/Stop, Pulse and Burst Modes Featured on Some Models

7200 SERIES

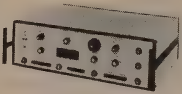
PRECISION 20 MHz FUNCTION GENERATORS
- 0.0001 Hz to 20 MHz Frequency Range
- Sine, Square, Triangle, Ramp, Pulse, ± Sine, ± Square, ± Triangle, ± Ramp, ± Pulse
- Voltage Controlled Frequency 1000:1
- Linear and Logarithmic Sweepers
- 80 db Attenuation, 10 db Steps, 20 db Variable
- Variable DC Offset
- 30 V P-P Open Circuit 15 V P-P Into 50 Ohms (Except Model 7260)
- Gate and Triggered Mode, Triggered Sweep, Ramp Hold, Variable Phase Start/Stop, Pulse and Burst Modes Featured on Some Models

Frequency Synthesizers

800 SERIES

FREQUENCY SYNTHESIZERS
- 1 Hz to 20 MHz (.01 Hz Optional)
- 10 PPM Stability
- All Plug-in Card Construction
- Constant Dial Resolution Over Extremely Broad Band
- Optional BCD or ASCII Frequency Programming (Amplitude Programming 802 Only)
- 0 dbm to +13 dbm (801) and −69.99 dbm to +26.99 dbm (802) Into 50 Ohms
- 0.05 dbm Amplitude Accuracy (Leveled Output — 802)

Digitally Synthesized Generators



330 SERIES

DIGITALLY SYNTHESIZED WAVEFORM GENERATORS
- 336 Materials Testing Generator
  0.000001 Hz to 1 KHz, Dual Rate Ramp
  Select: First Rate, Break Point, Hold Time, Second Rate
- 337 Digital Variable Phase Generator
  0.00001 Hz to 50 KHz
  0.2° Phase Lead Setability from 0.0° to 359.8°
- Gate and Trigger Modes
- 20 V P-P Open Circuit 10 V P-P Into 50Ω

Programmable Generators

600 SERIES

PROGRAMMABLE FUNCTION GENERATORS
- 0.001 Hz to 1 MHz
- Front Panel or Remote Programming
- Sine, Square, Triangle, Ramp, Pulse
- 1 mV P-P to 9.99 V P-P Into 50 Ohms
- BCD Programming Standard
- 0.5 mSec Programming Time
- Voltage Controlled Frequency 1000:1
- 1.66 MHz and 15.99 V P-P (Remote Only)

Waveform Synthesizers

200 SERIES

COMPLEX WAVEFORM SYNTHESIZERS
- Plug-in Programmer (40 Knob or Screwdriver Adjustment)
- Digital and Analog Waveforms
- 40 Increments — Fixed or Selectable
- 1 μSec to 1 Sec per Increment
- Variable Width and Variable Slope
- 20 V P-P Open Circuit, 10 V P-P Into 50 Ohms
- 60 db Attenuation, 20 db Steps, 20 db Variable
- Variable DC Offset, Gate and Trigger Modes

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electronics, inc.

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(503) 648-6661 TWX 910-460-8811

DANA **EXACT** ®

Instrument Comparison Chart

Model	Frequency	Maximum Output Amplitude	⎍	⋀⋁	∿	⟋	⎍⎽	Gate Trig	VCF	Int Sweep	Var DC Offset	Var Sym	Remarks	Price
120	0.1Hz-3MHz	10V P-P 50Ω 20V P-P, Open	●	●	●						±10V			$350
122			●	●	●				●				50Ω and 600Ω Bal	$490
123			●	●	●				●				VCF Gen	$395
124	0.1Hz-5MHz		●	●	●		●	●	●	●			Dual Generator	$695
125			●	●	●		●	●	●	●			Lin/Log Dual Gen	$795
126	0.1Hz-3MHz		●	●	●	●	●	●	●	●		Opt	Dual Generator	$590
127			●	●	●	●	●	●	●	●			Digital Freq. Dial	$695
128			●	●	●	●	●	●	●	●			Ramp Hold-Lin/Log	$790
129	0.1Hz-5MHz		●	●	●		●	●	●	●			AM/FM Dual Gen	$795
170	DC-200KHz	50V P-P, 50Ω 100V P-P, OPEN	X5 Amplifier—50Ω and 600Ω Output											$395
180	1000 SEC-1µSEC•	5V P, 50Ω 10V P OPEN		●		●	●	●			±10V	●	Dual Ramp	$845
190	0.1Hz-1MHz	10V P-P, 600Ω 20V P-P, Open	●	●	●	●	●		●			●	Variable DC offset	$245
191			●	●	●	●	●		●			●	Battery Powered	$350
192		10V P-P, 50Ω	●	●	●	●	●		●			●	50Ω Output	$295
195	2Hz-200KHz	1V RMS, Open	●	●	●				●	●			Battery Powered	149.50
196 A	0.1Hz-1MHz	10V P-P, 50Ω 20V P-P, OPEN	●	●	●	●	●		●	●	±10V	●	Dual Generator 50Ω Output	$350
201	1 SEC-1µSEC/STEP	10V P-P,50Ω 20V P-P, OPEN	Infinite Waveform Synthesizer- Requires programmer (see catalog)										40 Steps (Fixed)	$1695
202													0-40 Steps Sel.	$2195
336	0.000001Hz-1KHz	10V P-P, 50Ω	●	●	●	●	●	Materials Testing Generator					Dual Slope Ramp	$1495
337	0.00001Hz-50KHz	20V P-P, OPEN	●	●	●	●		●	●		±10V		Var. Phase	$2495
513	.001Hz-11MHz	10V P-P, 50Ω 20V P-P, OPEN	●	●	●				●		±10V		Low cost 11MHz	$525
516			●	●	●	●	●	●	●	●			Dual Generator	$695
517			●	●	●	●	●	●	●	●			Log Swp, 11MHz	$795
605	0.001Hz-1.66MHz	15.99V P-P, 50Ω	●	●	●	●	●	●	●	Programmable			Programmable	$1450
606													Remote only	$1250
801	0.01Hz-20MHz	1V RMS, 50Ω	Frequency Synthesizer										10ppm stability	$2195
802		5V RMS, 50Ω	.001% frequency accuracy										BCD or ASCII	$2995
7030	0.0001Hz-11MHz	15V P-P, 50Ω 30V P-P, OPEN	●	●	●	●	●		●		±15V	●	11MHz	$595
7050			●	●	●	●	●	●	●			●	Gate/Trigger	$795
7056			●	●	●	●	●	●	●			●	AM/Phase Lock	$1090
7059			●	●	●	●	●	●	●	●			Calib. Pulse Control	$895
7060			●	●	●	●	●	●	●	●		Opt	Dual Generator	$995
7071			●	●	●	●	●	●	●	●		Opt	Ramp Hold-Lin/Log	$1095
7230	0.0001Hz-20MHz		●	●	●	●	●		●			●	20MHz	$795
7260		10V p-p, 50Ω	●	●	●	●	●	●	●	●	±10V		Dual Generator	$995
7271		15V p-p, 50Ω	●	●	●	●	●	●	●	●	±15V		RampHold-Lin/Log	$1145

OPTIONS:

- • Check with Exact's Local representative in your area or contact Exact electronics for information and prices of options for each instrument.

Subsidiary of Dana Electronics, Inc.

DANA **EXACT** ®
electronics, inc.

BOX 160, HILLSBORO, OREGON 97123
(503) 648-6661 TWX 910-460-8811

DMM
Price/Performance Leaders

Data Precision offers from a single source a complete line of 3-1/2, 4-1/2, and 5-1/2 digit multimeters. An instrument for every job — in the lab, in the plant or in the field. Data Precision offers you a complete choice from a wide line of instruments that have set the price/performance standards in the industry for years.

Model 3500
5-1/2 Digit
$995.00

Including:

- Autoranging Throughout
- BCD Output
- Remote Range & Trigger
- Triphasic™ Auto Zero
- 20% Overrange
- DCV, 1μv to 1000 volts
- ACV, 1μv to 700 volts
- Resistance, 1mΩ to 12MΩ
- Ratio
- 1/2 inch Planar Display
- Isopolar™ High Stability Reference
- Ratiohmic™ Resistance Method, 2 and 4 wire
- 1,000 MΩ Input Impedance through 10 VDC

Model 1450
4-1/2 Digit
$325.00

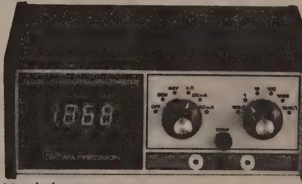
Big, Bright 1/2 inch planar display. 5 Functions — 21 Ranges — 100% overrange. 6 month DC accuracy of ±0.02% of Reading, ±0.01% f.s.

One year warranty, Certificate of Conformance, Test Documentation, instruction manual and probes provided with all instruments.

Model 2440
4-1/2 Digit
$675.00

By far the most, accurate autoranging *full* function 4½ digit multimeter available. It has DCV accuracy of ±0.007% rdg. ±1 LSD/6 months, autoranging and autozeroing, remote ranging and triggering and isolated BCD output, all included in one basic price. Full function, includes Ratio, 4 wire ohms, and 100 KHz AC frequency response.

Model 134
3-1/2 Digit
$199.00 with isolation and standard probes
$189.00 with standard probe



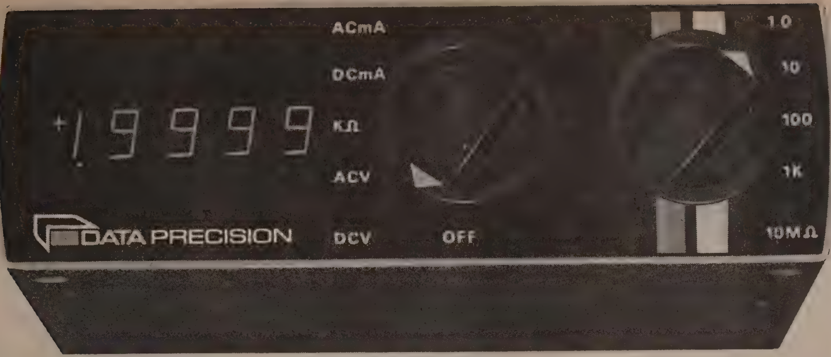
Model 134 measures DC and AC volts, DC and AC current and resistance through a total of 22 range scales. Basic accuracy of ±0.2% reading ±0.2% f.s. with auto-polarity, auto-decimal positioning and 100% overrange.

DATA PRECISION

Data Precision Corporation
Audubon Road
Wakefield, MA 01880 U.S.A.

For a demonstration, contact your local representative listed below:

AL		(205) 533-5896
AZ		(602) 994-9519
CA	(N)	(408) 733-8690
CA	(S)	(714) 540-7160
CO		(303) 449-5294
CT		(203) 526-7647
FL	(S)	(305) 525-9767
FL	(N)	(813) 294-5815
GA		(404) 457-7117
HI		(808) 262-6286
IL		(312) 593-0282
IN		(317) 293-9827
MA		(617) 273-0198
MD		(301) 792-8661
MI		(313) 482-1229
MN		(612) 781-1611
MO	(W)	(816) 737-0066
MO	(E)	(314) 731-2331
NC		(919) 787-5818
NJ	(S)	(215) 925-8711
NJ	(N)	(201) 863-5660
NM		(505) 265-6471
NY	(N)	(315) 446-0220
NY	(S)	(516) 482-3500
OH	(N)	(216) 725-4560
OH	(S)	(513) 433-8171
OR		(503) 238-0001
TX	(N)	(214) 234-4137
TX	(S)	(713) 461-4487
UT		(801) 268-3181
WA		(206) 763-2210
CAN	(E)	(416) 275-2270
CAN	(E)	(514) 695-9787



SHOWN ACTUAL SIZE

MODEL 245

PORTABLE POCKET-SIZE MULTIMETER

$295.00
COMPLETE

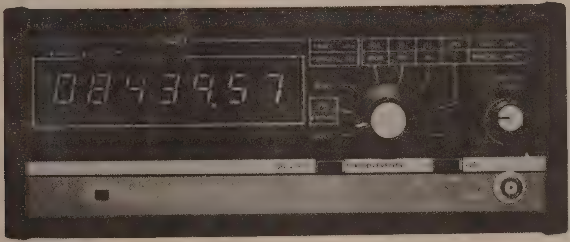
PERFORMANCE: .005% RESOLUTION, .05% BASIC ACCURACY FOR 6 MONTHS, MEASURES DCV, ACV, DC AND AC CURRENT, AND RESISTANCE WITH 100% OVERRANGING.

DC Volts, 1 volt to 1000 volts full scale, 100 μV resolution.
AC Volts, 1 volt to 500 volts RMS full scale, 100 μV resolution, 30HZ-50kHZ.
DC Current, 1 ma to 1A f.s., 1 μA resolution.
AC Current, 1 ma to 1A f.s., 1 μA resolution, 30 HZ-50kHZ.
Resistance, 1 KΩ-10MΩ full scale, 100 milliohms resolution.
Calibration guaranteed 6 months minimum.

PRICE: $295 COMPLETE
Includes rechargeable battery module, line cord/recharger, fused input probes, carrying case and strap, complete software and test documentation, full Data Precision calibration Instruction Manual and separate Operator's Manual, and one year warranty.

USABILITY: IDEAL FOR LAB, PRODUCTION OR FIELD USE.
Truly portable, pocket size 1¾" × 3½" × 5½" packaged in a rugged impact resistant case, rechargeable 6 hour battery for in-spec operation.

MULTIFUNCTION COUNTER



Measures: Frequency, Period, Period Average, Total Events, Elapsed Time.

Designed to compete directly with counter/timers costing 2 to 3 times more, Model 5740 makes absolutely no compromises in the area of performance.

Every element — every component — has been "value-optimized" to keep its exceptional range, sensitivity, accuracy and resolution within your budget.

It's a remarkable instrument, made more remarkable by its price. $295.00

MODEL 5740

7 DIGITS, 100 MHz, MULTIFUNCTION COUNTER

$295.00

SPECIFICATIONS: Sinewaves, Square Waves, Pulses, Pulse Pairs, Complex Waves

- Frequency
  5 Hz to 100 MHz; 10 ms/100 ms/1 sec. /10 sec. gate times, resolution to 0.1 Hz
- Period
  ½ microsecond to 0.2 sec.
- Period Average
  10, 100 and 1000 periods
- Total Events
  0 to 9,999,999 (unlimited with "overflow" indicator)
- Elapsed Time
  0 to 99,999.99 sec (27.8 hrs.)

FEATURES:
- Sensitivity
  10 mV from 5 Hz to 20 MHz rising linearly to a high frequency sensitivity of 50 mV RMS at 100 MHz
- 100 MHz Bandwidth
- 250 Volts RMS input capability
- Low Component Count
- Wide Signal Tolerances
- Gate/Overflow Indicators
- Trigger Level Front Panel Adjustable
- x1 and x20 Attenuator

OPTIONS:
- Remote Start/Stop
- 50 ohm Input Termination
- External Clock Input
- BCD Interface and Logic Control

For a demonstration contact your local Data Precision Representative

DATA PRECISION

Data Precision Corporation, Audubon Road, Wakefield, MA 01880 (617) 246-1600

DIGITAL PANEL METERS

-1.999
DATEL
SYSTEMS, INC.

FEATURES

- 3 to 4¾ Digits
- 5VDC or AC Powered
- Bright Red LED Displays
- Differential Inputs
- Optical Isolation Option
- 3″W x 1.75″H x 2.25″D
- Internal or External Triggering

Datel's fast growing line of digital panel meters now includes AC line or 5 volt powered models with a wide variety of performance specifications, options, and prices. They are low cost, high quality devices with conservative design, computer grade components, and superior workmanship for a wide margin of safety resulting in reliable operation. These DPM's feature bright LED displays and are housed in a rugged, black lexan case.

They are simple to install and are complete, requiring only external connection of programming wires, signal input, and 5VDC power. Any parameter that can be converted into a voltage can be displayed, and decimal point location can be programmed externally so that input voltage scaling can be used. The meters can also be computer interfaced using the 12 line parallel BCD outputs. In addition, they have external digital outputs for Overrange, Polarity, Overflow, and End of Conversion (Busy). External inputs include Start Conversion, Lamp Test, and Decimal Point.
The modular construction used in these panel meters permits simple servicing should this be necessary. By removing the snap-on front bezel and 4 mounting screws the meter can slide out of its mounting case from the front panel of an instrument, saving opening the instrument case. This operation takes less than a minute. Once removed, trouble shooting can be accomplished through board substitution, and servicing can be completed within five minutes. The meter can be calibrated using Zero, Full Scale, and Balance adjustment potentiometers behind the front panel bezel. A number of useful options is available on several of the models including floating differential inputs with up to ±300 volts common mode voltage. This is achieved by floating the analog front end of the meter by means of optical isolation. With this option these meters become operationally equivalent to an analog panel meter in its ability to float to any voltage level.

DM-2115: New this year, the DM-2115 is the world's smallest AC-powered DPM using 100, 115 or 230VAC, 47 to 440 Hz. A portable version of the DM-2115 uses +5VDC at 400mA max.
DM-3000: This low cost 3 digit meter has a single ended input with unipolar operation reading 0 to +.999 volts. It has 100ppm/°C temperature stability and very fast warm up time.
DM-2100: This low cost 3½ digit model has differential inputs with up to 200 reading per second. Temperature stability is 50ppm/°C. Two bipolar voltage ranges are offered, ±199.9mV and ±1.999 volts.
DM-4000, DM-4300: These two high-resolution DPM's feature ratiometric operation, autozeroing and optional optoisolation. The DM-4000 even has large .43″H displays.
DM-2000AR: This auto ranging meter automatically switches itself over three input ranges to give a total measurement range of 106dB. Its conversion time is 33 milliseconds giving up to 30 readings per second. The standard model has a single ended input. An optical isolation option gives differential inputs with ±100V common mode range.

SPECIFICATIONS (25°C)	MINIATURE AC POWERED DM-2115	3 DIGIT LOW COST DM-3000	3½ DIGIT LOW COST DM-2100	MINIATURE 4½, 4¾ DIGIT DM-4000, DM-4300	3½ DIGIT AUTO RANGING DM-2000AR
INPUT					
Input Voltage Range	±1.999V	0 to +.999V, +9.99V, +99.9V	±199.9 mV ±1.999 mV	±1.9999V, ±3.9999V ±50V	±.1999V ±1.999V ±19.99V
Overvoltage Protection	±50V	±50V	±15V		±100V
Input Impedance	100 Meg. min.	100 Meg.	100 Meg[2]	100 Meg. min.	1 Meg.
Input Bias Current	3 nA	100 nA	20 nA[2]	100 pA max.	2 nA
Input Configuration	Differential	Single ended	Differential	Single ended floating	Single ended[1]
Input Polarity	Bipolar, automatic	Unipolar	Bipolar, automatic	Bipolar, automatic	Bipolar, automatic
Common Mode Rejection	70 dB @ 60 Hz	——	70 dB @ 60 Hz	120 dB @ 60 Hz	——[1]
Common Mode Voltage	±3V to logic gnd.	——	±2V	±300V to logic gnd.	——[1]
PERFORMANCE					
Accuracy	±.05% Reading ±1 Digit	±.01% Reading ±1 Digit	±.05% Reading ±1 Digit	±.01% Reading ±1 Digit	±0.1% FS ±1 Digit
Resolution	1 mV	1 mV	100 µV or 1 mV	100 µV	100 µV
Temperature Coefficient	±50 ppm/°C max.	±100 ppm/°C	±50 ppm/°C	±15 ppm/°C max.	100 ppm/°C
Conversions per Second	0 to 40	0 to 250	0 to 200	0 to 5 (DM-4000), 0 to 3.3 (DM-4300)	0 to 30
Warm-up Time (to spec. acc.)	5 min.	Essentially zero	5 min.	15 min.	15 min.
DISPLAY					
Number of Digits	3½	3	3½	4½ (DM-4000), 4¾ (DM-4300)	3½
Digit Height	.43 inches (11mm)	.43 inches (11mm)	.3 inches (8mm)	.43″ (DM-4000), .3″ (DM-4300)	.3 inches (8mm)
Overflow	Flashes bars and zeroes	Display blanked	Displays "OF"	Center bars	Displays "OF"
Decimal Point Selection	External connection	External connection	External connection	External connection	Automatic
OUTPUTS	BCD 12 line (optional) Overrange Polarity Overflow End of conversion	BCD 12 line Overflow End of conversion	BCD 12 line Overrange Polarity Overflow End of conversion	BCD 16 line (optional) Overrange Polarity Overflow End of conversion ±Reference	BCD 12 line Overrange Polarity Overflow End of conversion Decimal point — 3 lines Internal start
OPTIONS	BCD (add $16.)	Crystal clock ($10.) +10V or +100V in ($10.)	——	BCD (add $20.) 50 or 60 Hz synch select (no charge)	Optical Isolation with Differential Inputs ($49.)
POWER REQUIREMENT	AC line or +5V, 2W max.	+5VDC @ 800 mA	+5VDC @ 750 mA	+5VDC @ 600 mA max.	+5VDC @ 1A max.
TEMPERATURE RANGE, Operating	0 to +50°C	0°C to 50°C	0°C to +50°C	0 to +50°C	0°C to +50°C
BULLETIN NUMBER	MAC-T10503	M3KAL15408	M2KET05501	M4K-L10504, M43-L10504	MARCT05504
PRICE (1-9)	**$129 (5V), $159 (AC)**	**$99.00**	**$129.00**	**$219 (DM-4000), $235 (DM-4300)**	**$169.00**

NOTES: [1]The optical isolation option has floating inputs and the following specifications: ±100V common mode range and 70 dB common mode rejection at 60 Hz.
[2]A 1 nA input bias current option with 1000 Megohm input impedance is listed at the bottom of the table.

ENGINEERING PRODUCT HANDBOOK
DATEL

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data technology

DIGITAL PANEL METERS

These digital panel meters (DPM's) are designed with quality, reliable components and assembled with the finest workmanship to provide accurate, stable performance for a wide variety of applications.

DATA TECHNOLOGY offers the greatest selection of DPM's to fit your exact applications requirements: 3, 3½, 4, 4½ digit; AC or DC powered; AC or DC inputs; single ended or differential inputs; ratiometric operation; BCD output; Beckman planar discharge or LED displays; external control features; auto-zero circuitry, etc.

In addition to these standard features, a variety of modifications; customized lenses and bezels, read rate modifications, special scaling, signal conditioning adapter plates, and special internal components are available.

Digital DC Line Monitor
Model 1301-04 (3½ + digits/3000 counts)

The 1301 is the first low-cost, off-the-shelf digital line monitor with 100mV resolution. It can be calibrated for any frequency and voltage within its range with greater repeatability than traditional designs. The 3,000 count model 1301-04 will measure line voltages directly. BCD drive for five TTL load is standard and can be used for driving alerting devices when overvoltage or undervoltage conditions are detected.

Model 3362 - 6000 count DPM with Ratio option

The 3362 is a ±6000 count DPM that provides 4-digit resolution for 60% of the range. It offers great versatility, with (±0.1 % rdg. + 0.04% FS) accuracy for 90 days.

Analog features: an optional ratio measurement capability. The Unislope^{tm} converter assures significant noise rejection with a 6dB-per-octave input filter and 100dB of common mode rejection at 60Hz. Low input bias current (7nA max at 23°C) prevents excessive offset errors.

Digital features: BCD data (optional), read on command/hold on command and display and polarity inhibits. All digital lines are TTL compatible. Any decimal point may be illuminated with a ground to the corresponding input.

Conversion time is 24 msecs max. The internally controlled repetitive read rate, factory set at about four readings/sec, may be increased up to 8 readings/sec via an external shunt resistor.

Low cost DPM
Model 3312 (3½ digits)

These new DPMs give you the most readable readout up front, but far fewer parts in back. Exclusive Unislope^{tm} circuitry reduces parts by 30% giving you a cooler, tougher, more reliable DPM. And, you get BCD drive for five TTL loads at no extra cost.

Compare these specs: Common mode rejection of 80dB (with no filtering) at 50-60 Hz with 1k in series. Accuracy is ±0.1% of reading, ±1 digit. Input resistance is 1000mΩ for 200mV and 2V ranges. Model 3312 withstands 200V pk-pk at any range.

High accuracy high resolution DPM
Model 4312 (3½ digits)
Model 4412 (4½ digits)

100 pico amp input bias current, 1000 megohm input impedance and 250 volt minimum input protection, built-in transformer power supply with extra high voltage line transient suppression, a wide operating temperature range and the new wide angle, easy to read displays are a few of the features of these panel instruments.

Complete digital input and output signals are standard. "print," "hold" overrange, overvoltage and polarity signals are all DTL and TTL compatible for easy interfacing with most system applications.

The "auto-zero" input amplifier on the model 4412 and the special "sync" circuits that lock the dual slope integration A-to-D converter to the line frequency both contribute to the improved noise immunity and overall accuracy.

DC Powered 3½ digit DPM
Model 5312

The most accurate 3½ digit DPM available today. Differential input, LED readout, LSI design, and tool free installation are all standard features of the 5312. Optional ratio operation and/or buffered BCD outputs are available. The 5312 is also available with AC for those applications where line operation is necessary. Specifications include 1.5nA bias current, 1nA offset current, common mode rejection to 80db with 1 K source unbalance, and 2.5 watts power drain.

DC Powered 4½ digit DPM
Model 5412

Accuracy: 0.1% R; 20,000 count DPM. Available with either +5VDC or 100, 115 or 230Vac power. LSI analog chip provides highest accuracy, lowest cost state-of-the-art design. Ratiometric operation and buffered BCD output optionally available.

MODEL	1301-04	3312	3362	4312	5312	4412	5412
DIGITS	3½	3½	3½	3½	3½	4½	4½
COUNTS	3000	2000	6000	2000	2000	20,000	20,000
RANGES (Voltage)	1	4	3	5	4	4	4
FULL SCALE	299.9 VAC	200.0 mV–200.0V	600.0mV–60.00V	200.0mV–1000V	200.0mV–200.0V	200.00mV–200.00V	200.00mV–200.00V
ACCURACY (%R)	±0.1%	±0.1%	±0.08%	±0.1%	±0.05%	±0.02%	±0.01%
INPUT IMPEDANCE	1MΩ	10^9Ω	10^9Ω	10^9Ω	10^9Ω	10^9Ω	10^9Ω
BIAS CURRENT (Typ)	70nA	70nA	1.5nA	100pA	70nA	100pA	5nA
INPUT	AC	Single Ended	Single Ended	Single Ended FET	Differential	Single Ended FET	Differential
RATIO	No	No	OPTIONAL	No	OPTIONAL	OPTIONAL	OPTIONAL
BCD OUTPUT	STD	STD	OPTIONAL	STD	OPTIONAL	STD	OPTIONAL
POWER *	AC	AC	AC	AC	+5VDC or AC	AC	5VDC or AC
PRICE, 100 Quantity	$129.00	$99.00	$145.00	$125.00	$91.00	$244.00	$189.00

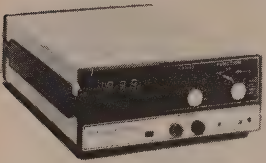
*100, 115, 220 VAC Available no charge.

DATA TECHNOLOGY CORP. 2700 S. FAIRVIEW RD. SANTA ANA, CALIFORNIA U.S.A. 92704 TEL (714) 546 7160 TWX 910 595 1570
designers and manufacturers of multimeters, panel meters, [illegible] frequency synthesizers, conversion products and [illegible]

data technology

3½ DIGITAL MULTIMETERS

All 3½ digit Digital Multimeters by Data Technology offer extra benefits to their owners. Each model has special features which make it unique. All are versatile, low cost, rugged, quality engineered instruments designed to fit your measurement requirements. All use standard parts for ease of replacement; and most feature the high- impact plastic case that can be disassembled in five seconds for calibration / service.



MODEL 20 DMM with CAPACITANCE $199.00

A 3½ DMM for bench applications. Measures
DC VOLTS: 1mV – 1000V; AC VOLTS: 1mV – 200V;
OHMS: 1Ω – megΩ; CAPACITANCE: 2pF – 2µF.

MODEL 30 MOST ACCURATE 3½ DMM $299.00

5000 counts (400% overrange) means better accuracy, more resolution than any other 3½ DMM. Battery option can be added at any time.
DC VOLTS: 100µV – 1000V; AC VOLTS: 100µV – 1000V;
OHMS: 100mΩ – 50megΩ; DC CURRENT: 100nA – 3A;
AC CURRENT: 100nA – 3A.

MODEL 31 TRUE RMS 6000-COUNTS $375.00

All the above features of the Model 30 plus true RMS measurement of AC VOLTS and CURRENT over the frequency range of 25Hz – 20KHz.

MODEL 21
HANDHELD DMM $229.00

A battery powered small size DMM with versatility.
DC VOLTS: 1mV – 1000V;
AC VOLTS: 1mV – 800V;
OHMS: 1Ω – 2megΩ;
CAPACITANCE: 2pF – 2µF.

MODEL		20	21	30	31
DC VOLTS	Ranges	4	4	5	5
	Resolution	1mV	1 mV	100µV	100µV
	* Accuracy	±(.1%R + .05%FS)	±(.1%R + .05%FS)	±(.15%R + .04%FS)	±(.04%R + .04%FS)
AC VOLTS	Ranges	4	4	5	5
	Resolution	1mV	1 mV	100µV	100µV
	*Accuracy	±(.5%R + .1%FS)	±(.5%R + .1%FS)	±(.5%R + .05%FS)	±(.5%R + .1%FS)
	Frequency	50Hz – 500Hz	50Hz – 500Hz	40Hz – 5KHz	25Hz – 20KHz
	Method	Average Responding	Average Responding	Average Responding	True RMS
OHMS	Ranges	4	4	6	6
	Resolution	1Ω	1Ω	100mΩ	100mΩ
	*Accuracy	±(.15%R + .05%FS)	±(.15%R + .05%FS)	±(.15%R + .06%FS)	±(.12%R + .04%FS)
DC CURRENT	Ranges	—	—	5	5
	Resolution	—	—	100nA	100nA
	*Accuracy	—	—	±(.3%R + .05%FS)	±(.2%R + .06%FS)
AC CURRENT	Ranges	—	—	5	5
	Resolution	—	—	100nA	100nA
	*Accuracy	—	—	±(7%R + .1%FS)	±(.5%R + .07%FS)
	Frequency	—	—	45Hz - 5KHz	25Hz 20KHz
	Method	—	—	Average Responding	True RMS
CAPACITANCE	Ranges	4	4	—	—
	Resolution	1pF	1 pF	—	—
	*Accuracy	±(.15%R + .05%FS)	±(.15%R + .05%FS)	—	—
FULL SCALE COUNTS		2000	2000	5000	6000
DISPLAY		.33" Beckman	.27" LED	33" Beckman	.33" LED
BATTERY POWER		No	Standard	Optional	Optional
PRICE		$199.00	$229.00	$299.00	$375.00

* Basic Accuracy 23° ±5°C 90 Days

DATA TECHNOLOGY CORP 2700 S FAIRVIEW RD, SANTA ANA CALIFORNIA U.S.A 92704 TEL (714) 546 7160 TWX 910 595 1570
designers and manufacturers of multimeters, panel meters, pH meters, strip chart recorders, frequency synthesizers, conversion products and logic cards

data technology

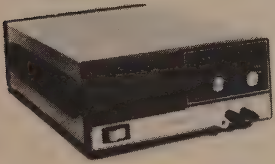
4½ DIGITAL MULTIMETERS

Data Technology's family of 4½ digit Digital Multimeters offer the highest performance at the lowest cost available. Yet each instrument has features which make it unique for specific applications. The Model 40 is designed as a

Data Technology's family of 4½ digit Digital Multimeters offer the highest performance at the lowest cost available. Yet each instrument has features which make it unique for specific applications. The Model 40 is designed as a general purpose bench multimeter; the Model 41 provides full multimeter capabilities plus BCD output for systems applications; and the Model 45 will operate from either internal batteries or AC line power for portable field requirements. All feature high resolution and accuracies, use standard parts, and utilizes Data Technology's unique case design. The instruments can be disassembled in five seconds for calibration/repair, but still provide the protection necessary for even the most rugged environment.

MODEL 40 **Lowest Cost, High Performance** **$399.00**

High resolution bench instrument, 100% overrange, high input impedance, 14 ranges.
DC VOLTS: 10µV – 1200V; AC VOLTS: 10µV – 1000V; OHMS: 100mΩ – 20MΩ ; DC CURRENT: 10nA – 2A; AC CURRENT: 10nA – 1A.



MODEL 41 **Most Versatile Systems Instrument** **$595.00**

BCD output, 25 ranges, high accuracy, bright .5" display, 150 msec conversion time.
DC VOLTS: 10µV – 1200V; AC VOLTS: 10µV – 1000V; OHMS: 100mΩ – 20MΩ ; DC CURRENT: 10nA – 2A; AC CURRENT: 10nA – 1A.

MODEL 45
General Purpose, High Accuracy DMM
$499.00

Compact, portable instrument, AC or optional battery power, 26 ranges of measurement.
DC Volts: 10µV–1200V;
AC Volts: 10µV–1000V;
OHMS: 10mΩ–10megΩ;
DC Current: 10nA–1A;
AC Current: 10nA–1A.

MODEL		40	41	45
DC VOLTS	Ranges	5	5	5
	Resolution	10µV	10µV	10µV
	*Accuracy	±(.06%R + .02%FS)	±(.02%R + .05%FS)	±(.02$R + .01%FS)
AC VOLTS	Ranges	4	5	5
	Resolution	100µV	10µV	10µV
	*Accuracy	±(.4%R + .05%FS)	±(.4%R + .05%FS)	±(.4%R + .03%FS)
	Frequency	50Hz 5KHz	50Hz - 5KHz	40Hz 10KHz
OHMS	Ranges	5	5	6
	Resolution	100mΩ	100mΩ	10mΩ
	*Accuracy	±(.04%R + .03%FS)	±(.04%R + .03%FS)	±(.05%R + .01%FS)
DC CURRENT	Ranges	—	5	5
	Resolution	—	10nA	10nA
	*Accuracy	—	±(.04%R + .005%FS)	±(.05%R + .01%FS)
AC CURRENT	Ranges	—	5	5
	Resolution	—	10nA	10nA
	*Accuracy	—	±(.05%R + .02%FS)	±(.5%R + .03%FS)
	Frequency	—	50Hz – 5KHz	40Hz - 10KHz
FULL SCALE COUNTS		20,000	20,000	12,000
DISPLAY		.515 Beckman	515 Beckman	.33 LED
BATTERY POWER		No	No	Optional
BCD OUTPUT		No	Standard	No
IC SOCKETS		Optional	Optional	Optional
·PRICE		$399.00	$595.00	$499.00

* Basic Accuracy 23°±1°C 90 Days

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designers and manufacturers of multimeters, panel meters, pH meters, strip chart recorders, frequency synthesizers, conversion products and logic cards

DRANETZ

ENGINEERING LABORATORIES INCORPORATED

SOUTH PLAINFIELD, NEW JERSEY 07080 • TEL: (201) 755-7080 • TWX: 710-997-9553

SERIES 305

SUPER PERFORMANCE PHASEMETERS AND GAIN/PHASEMETERS*

305 Series Phasemeters provide the highest available accuracy, along with many operational features. Designed for the calibration laboratory, the design engineer's bench, the production line and automatic test systems, the 305 is the most widely accepted phasemeter in industrial, and governmental organizations.

FEATURES

- No hands 86 dB dynamic range
- Automatic or programmable operation and calibration
- Highest accuracy — to 0.03°
- Repeatability better than 0.01°
- Rejects harmonics and noise
- Wide frequency range — 1 Hz to 11 MHz

FLEXIBILITY THROUGH PLUG-IN CONCEPT

The plug-in concept of the 305 offers a wide selection of characteristics. Three standard mainframes and nine plug-ins are complemented by a variety of options, such as programmability, high speed and auto-calibration. Special modifications are also available. In addition, modular construction throughout provides maintainability at both component and P.C. card levels for ease and speed of servicing.

WIDE FREQUENCY RANGE

The basic mainframe provides a direct frequency coverage of 2 Hz to 700 kHz with high accuracy. By the use of frequency converting plug-ins such as the 305-PA-3005, standard units can handle frequencies up to 11 MHz. Special units can be provided for higher frequency.

NO HANDS OPERATION

The Series 305 Phasemeters require no controls or adjustments by the operator. These units are also equipped with several significant automatic features. These include automatic selection of angle range, automatic sensing of leading or lagging angle, automatic selection of the output time constants, and automatic setting of AC gains.

HIGHEST ACCURACY

Accuracy to better than ±0.03° is attained with precision mainframes and carefully designed plug-ins. Mainframes exhibit precise zero crossing detection, angle-to-DC conversion linearity to approximately ±0.01° and outstanding DC stability. Plug-ins are designed for accurate conversion of sine wave (also square wave) inputs to square waves through carefully controlled amplifier circuitry, use of gain autoranging, and harmonic filters where necessary.

INSENSITIVITY TO INPUT LEVEL

Series 305 plug-ins are available with a guaranteed accuracy of better than ±0.05° even with independent input level variations of 60 dB. Typical accuracy can approach ±0.03° as shown on the following page.

NON-AMBIGUOUS ANGLE READINGS

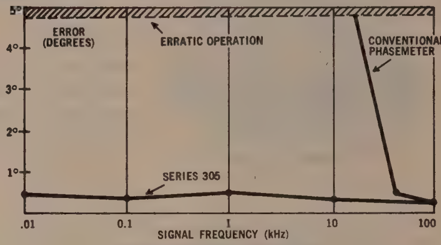
Two phase angle ranges in the 305 eliminate the ambiguity or "dead zone" error inherent in all other phasemeters (usually at 0°/360° or −180°/+180°). An automatic system switches to the 0°/360° range for angles near 180° and to the −180°/+180° range for angles near 0°. Unique guard bands prevent dead zones near switching points.

REPEATABILITY, STABILITY, AUTOCALIBRATE

Repeatability of the 305 is better than ±0.005°; temperature coefficient is ±0.001°/°C; and DC output drift is better than ±0.05° over any 30 day period. The autocalibrate feature eliminates virtually all DC errors in digital panel readout and BCD rear panel outputs.

NOISE IMMUNITY

Unique patented circuitry minimizes noise errors and makes possible accurate phase measurements under noise levels where other phasemeters become completely useless. The accompanying curve compares the phase error of the model 305 with that of a conventional phasemeter with broad band noise in both channels.



PHASE READING ERROR VS SIGNAL FREQ.
FOR GAUSSIAN NOISE (FLAT TO 5 MHz)
IN BOTH CHANNELS FOR S/N = 10

PROGRAMMABLE OPERATION

Standard mainframes are provided with rear connections for over-riding the automatic time constant and angle range selectors by relay contact closures. Options are provided for control by DTL and TTL logic.

DIGITAL READOUT

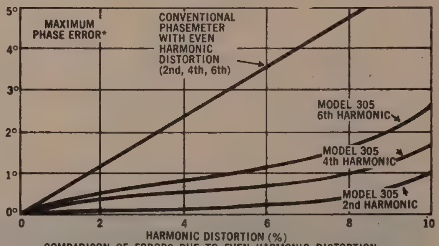
In addition to analog DC output, standard mainframes are available with up to 5 digit panel readouts (i.e., 0.00° to ±180.00° and 0.00° to +360.00°) and BCD outputs for each digit. Autocalibrate feature eliminates virtually all meter drift and scaling errors.

RAPID PHASE NULLING

For production testing of filters and other networks, an additional analog deviation-panel meter (305D) provides an easy means of adjusting a test angle to any accurate value. Presetting can be done in seconds without any other equipment. The precision digital panel meter monitors actual test angle continuously.

ABILITY TO REDUCE HARMONICS

The 305 is designed to reduce significantly the errors due to even harmonic distortion without the use of filters. The accompanying curve compares the error due to even harmonic distortion (maximized for worst case harmonic angle) on conventional phasemeters and on the model 305. (Odd harmonics in-phase with fundamental contribute no error.)



COMPARISON OF ERRORS DUE TO EVEN HARMONIC DISTORTION
(* For worst case phase relationship between harmonic and fundamental)

*Manufactured under U.S. Pat. No. 3,725,781

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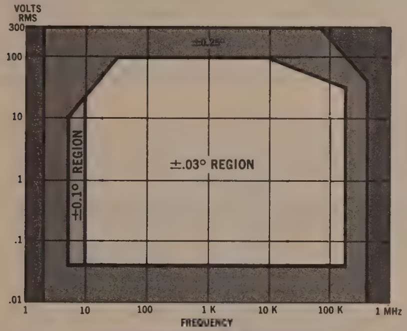
SERIES 305

HIGH PERFORMANCE PLUG-INS

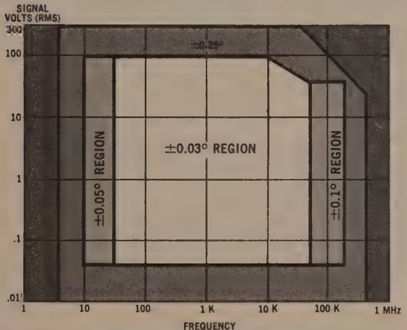
The variety of plug-ins available provides unlimited flexibility for the Series 305 Phasemeters in meeting many phase measurement problems. In addition to an expanding line of standard plug-ins, custom units can be designed for special needs.

305-PA-3001 AUTORANGING PLUG-IN

This plug-in features high accuracy over a broad range of input levels and frequencies. Autoranging of gain in each channel assures high accuracy (±0.05° guaranteed) over a dynamic range of 60 dB (50 mV to 50 V rms) for independent levels of inputs, with a useful range of 90 dB (10 mV to 300 V rms). This plug-in covers the range from 2 Hz to 700 kHz, with its highest accuracy in the 50 Hz to 50 kHz range. The curves shown illustrate typical accuracies as a function of level and frequency. The 305-PA-3001 also features compatibility with Textronix probes and includes front panel lamps to indicate when either input signal is below 50 mV or above 50 V rms.



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001
FOR EQUAL SIGNAL INPUTS



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001
FOR UNEQUAL INPUTS — REF. 0.3 VOLTS RMS

While the above accuracies apply to sine wave inputs, this instrument can also be used for square wave and amplitude modulated signals.

305-PA-3002 SINGLE RANGE PLUG-IN

The 305-PA-3002 is similar to the model 305-PA-3001 except that it does not include autoranging or limit indicator lamps. For sine wave inputs the standard unit is designed for guaranteed ±0.05° accuracy (typically ±0.03°) over independent signal levels of 50 mV to 500 mV rms, with a slight reduction in accuracy from 10 mV to 3 V rms. Other level ranges can be supplied on special order; Tektronix probes can be used for high input levels. This plug-in is useful for sine wave, square wave and amplitude modulated signals.

305-PA-3005 HIGH FREQUENCY PLUG-IN

This high frequency plug-in is designed for high accuracy to 11 MHz. Using a self tracking oscillator, the input signals are converted to 40 kHz for precision measurement by the mainframe. Input attenuators (50 ohms) are provided with 10 dB steps, to cover a range of 1 mV to 3 V rms in either channel. Front panel lamps indicate when input levels are out of range or when level controls are improperly set. The self tracking oscillator can be controlled by channel A signal or by a third independent signal.

305-PA-3007 PROGRAMMABLE AND AUTORANGING PLUG-IN

This programmable plug-in features all of the characteristics of the model 305-PA-3001. In addition it includes increased input gain to achieve operation down to 1 mV rms. The unit can be operated either in an automatic or programmable mode. Without rear connections, the plug-in operates automatically as a 305-PA-3001; however, by utilizing rear connectors, the internal autoranging can be over-ridden and additional internal gain can also be inserted. Programming is available by DTL and TTL logic.

305-PA-3008 SINGLE FREQUENCY PLUG-IN

The 305-PA-3008 is a special purpose plug-in designed for precision calibration of 50 Hz, 60 Hz and 400 Hz power line equipment such as wattmeters, phase detectors and watt hour meters. This instrument can measure phase difference between two voltages, two currents or between a voltage and a current. The unit covers a voltage range of 25 V to 250 V rms and a current range of 0.1 to 5 A rms. The basic plug-in covers the frequency range of 50 Hz to 500 Hz. Plug-in filters, available for 50 Hz, 60 Hz and 400 Hz, assure reduction of second harmonic by at least 40 dB and higher harmonics by at least 50 dB. A front panel zero control provides adjustment for high accuracy (±0.1°) at any single frequency.

305-PA-3009 WIDE BAND NETWORK ANALYZER PLUG-IN (GAIN/PHASE/AMPLITUDE)

This plug-in measures the voltage amplitude of each signal input (in volts or dBV, selectable by operator), the phase difference between inputs, and the amplitude ratio of inputs. Featuring auto-ranging of gain in both channels, it requires no manual setting of gains for any measurement. Simultaneous DC outputs on mainframe are proportional to all four fuctions. A front panel switch selects the measuring mode for digital panel readout — channel A voltage, channel B voltage, phase difference, or amplitude ratio. Lamps on the front panel of the plug-in indicate the proper decade multiplier. The 305-PA-3009A is designed for extending the low frequency range.

305-PA-3010 SPECIAL PURPOSE PLUG-IN

This plug-in is typical of special purpose plug-ins which can be supplied to meet unique problems. Having high input impedance, it is equipped with closely matched low pass filters to pass 125 Hz signals while rejecting 400 Hz signals, solving problems in many types of servo control systems. Similar units can be readily designed for other special voltage and frequency applications.

305-PA-3015 PROGRAMMABLE PLUG-IN

Intended for use in automatic test systems, this plug-in has two selectable filters for harmonic rejection and selectable gains to handle inputs from 50 mV to 50 V rms. Filter (or filter out) selection as well as gain switching is accomplished by contact closures across terminals on the rear of the main frame.

PRECISION TRANSFORMER ISOLATION NETWORKS

Dranetz TR 3100 series networks are available for input voltage isolation with minimum phase error and flat gain response. For use with balanced or signal ended sources, these units are equipped with internal preamplifiers to produce outputs in the 30 mV to 3 V rms range (for use with 305 Series Phasemeters) for input levels from 50 mV to 500 V rms. These transformer units are packaged for direct plug-in into the input BNC's of the phasemeter, and draw B+ power from the front panel accessory connector of the phasemeter plug-in. Size: 2¾" x 2¾" x 2". Input: banana jack. Output: BNC.

Model TR___	Zin	Com. Mode Rej: >60 dB for frequency	Range for ±0.1° typical shift	Range for ±0.3° typical shift	Gain ±2%
3101	1 megΩ 70 pF	Below 1 kHz	20-400 V rms 50 Hz-20 kHz	5-400 V rms 10 Hz-25 kHz	x 0.01
3102	100 kΩ 70 pF	Below 10 kHz	2-40 V rms 50 Hz-20 kHz	0.5-40 V rms 10 Hz-25 kHz	x 0.1
3103	10 kΩ 70 pF	Below 25 kHz	0.2-4 V rms 50 Hz-20 kHz	0.05-4 V rms 10 Hz-25 kHz	x 1.0

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SERIES 305
HIGH PERFORMANCE PHASEMETERS

MAINFRAME SPECIFICATIONS

Frequency Range: 2 Hz to 11 MHz (see plug-in data)

Angle Ranges: 0.00° to ±180.00° or 0.00° to +360.00° manually or automatically selected. End-of-range measurement errors are prevented by 15° automatic guard zones.

Analog Output

Range: −1.8000 to +3.6000 Vdc corresponding to measured angle; 10.0 mVdc per degree

Accuracy: See plug-in specifications

Output Impedance: 100 ohms

DC Resolution: Infinite

Linearity: Approx. ±0.01°

Repeatability: Better than ±0.005°

Time Constants: Automatically selected; 10 ms for frequency >5 kHz, 50 ms >500 Hz, 350 ms >50 Hz, 700 ms >2 Hz (Note: 4.6 time constants to respond to better than 99% of step change).

Warm-up Drift: Approx. 0.05° after first minute.

Long Term Drift: Typically less than ±0.05° per month

Temp. Coefficient: Approx. ±0.001°/°C

Recommended Output Devices: Recorders, DVM's, A-D Converters, Printers

Self Check: Front panel switches; dc outputs correspond to −180.00°, 0.00°, +180.00° and +360.00°

Error Rejection: False triggers due to high frequency noise are locked out for signal to noise ratios better than 10:1. Errors and fluctuations due to waveform dissymmetry or low frequency noise reduced by at least 10 to 1.

Harmonic Rejection: Worst case errors due to even harmonic distortion reduced by approximately 5:1 without filters. Odd harmonics in-phase with fundamental contribute no error.

Operator Adjustments: None.

Operating Temp. Range: 0° to +50°C

Grounding: Independent grounds for signal, chassis, and power line. (For safety, chassis and power line grounds connected at factory.)

Remote Programmability (standard on all mainframes): By rear connector pins. Over-ride by contact closure of automatic time constant selection and angle range. Factory installed wiring from rear connector to plug-in for use with programmable plug-ins.

Modular Construction: Circuits on removable plug-in cards, extenders supplied for ease in servicing.

Size: 3½" high, 16" deep, 19" rack/portable package.

Weight: 20 lbs; shipping 30 lbs.

Power: 115/230 V, 50-400 Hz, <0.75 A (specify voltage and frequency when ordering).

Plug-In Accommodation: Accepts 305-PA-(   ) plug-ins. Mainframes and plug-ins are interchangeable.

ANGLE PRESENTATION

	Model 305	Model 305B	Model 305C	Model 305D
DIGITAL				
Display	None	4 digit plus sign	5 digit plus sign	
Angle Ranges	Not Applicable	0.0° to ±180.0° and 0.0° to +360.0°	0.00° to ±180.00° and 0.00° to +360.00°	
Resolution	NA	0.1°	0.01°	
BCD Output	None	BCD coded (1248), 4 lines per digit plus polarity line; TTL/DTL compatible (<0.8 V to > +2.4 V dc). Read and hold on command, and data ready features available on rear connector.		
Warm-up Time	NA	30 minutes (1 minute with option 107)		
Zero & FS Controls	NA	Front panel for FS & 0 (no adjustments with option 107)		
ANALOG				
DC Output	10.0 mV/°; 0.0000 V to 3.6000 V and −1.8000 V to +1.8000 V corresponding to 0.00° to 360.00° and −180.00° to +180.00°; infinite resolution.			
DC Offset	None			Continuously adjustable angle offset. Analog panel meter and DC output indicate deviation from offset.

OPTIONS

#101 Rear connectors for signal and reference inputs, BNC(4)

#102 Full mainframe programmability; includes self check, angle range and time constant selection, DTL and TTL compatible.

#103 High speed analog output response. Time to respond to within 99% of step change: 1 ms for frequency >5 kHz, 10 ms >500 Hz, 100 ms >50 Hz, 1 second >5 Hz. (Temp. stability ±0.01°/°C)

#107 Automatic calibration checks and automatically readjusts digital readout and BCD output circuits and at 0° and 360° to reduce readout errors to ±0.01°. This option available only on 305C .

COMBINED PLUG-IN AND MAINFRAME SPECIFICATIONS

MODEL	FREQUENCY RANGE	INPUT LEVELS (independent)	INPUT Z	ACCURACY(2) WITH INDEPENDENT LEVELS UNLESS OTHERWISE INDICATED Analog output accuracy: As specified below. Digital phase accuracv: For model 305C, same as analog accuracy. For model 305B, add ±0.15° digital readout error to analog accuracy specified.
305-PA-3001 Auto Ranging Plug-in	2 Hz to 700 kHz	10 mV to 300 V rms up to 10 kHz and to 50 V rms up to 700 kHz; can be extended to 40 kV rms with Textronix probes. Each channel has automatic gain ranging, and lamps which indicate when level is below 50 mV and above 50 V rms.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 50 V rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 50 V rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3002 Single Range Plug-in	2 Hz to 700 kHz	10 mV to 3 V rms(1); can be extended to 3 kV rms with Textronix probes. Other ranges available on request.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 500 mV rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 500 mV rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3005 High Frequency Plug-in	200 kHz to 11 MHz	1 mV to 3 V rms; manual level controls in 10 dB steps. Lamps indicate when inputs are out of range or when level controls are improperly set.	50 ohms	Broadband with equal inputs above 10 mV rms: ±0.4° from 200 kHz to 4 MHz; ±1° from 4 MHz to 11 MHz. With independent levels above 10 mV rms: ±1° up to 4 MHz and ±2° up to 11 MHz. Single frequency — above 10 mV rms: ±0.3° at any frequency from 200 kHz to 11 MHz at any fixed levels.
305-PA-3007 Programmable and Auto-Ranging Plug-in	2 Hz to 700 kHz	Auto-ranging: similar to levels of 305-PA-3001. Programmable: over-rides autoranging; extends low levels to 1 mV rms; DTL, TTL logic; program connector in rear of mainframe.	1 megohm shunted with 40 pF	Same as 305-PA-3001 for levels above 10 mV rms; typically ±0.35° from 50 Hz to 50 kHz for levels below 10 mV rms.
305-PA-3008 Power Freq. Plug-in	50-500 Hz without filters. 50 Hz, 60 Hz and 400 Hz L.P. filters available(3)	25 V to 250 V rms; 0.1 A to 5 A rms. Inputs are transformer isolated.	100 k ohm (voltage) 1 Ω max. (current)	At any single frequency, with filter set: ±0.1°, 25 V to 250 V rms, or 0.1 A to 5 A rms.
305-PA-3009 Network Analyzer (Gain/Phase/Amplitude)	5 Hz to 700 kHz (Note: 305-PA-3009A operates to 1 Hz with 305 mod. 14)	10 mV to 40 V rms. Each channel has automatic gain ranging. Direct reading of phase angle, amplitude ratio and level of each input. Compatible with Tektronix probes.	1 megohm shunted with 40 pF	Phase: ±0.1° from 40 mV to 40 V rms from 50 Hz to 50 kHz; typically ±0.25° at all other levels from 5 Hz to 500 kHz. Voltage Amplitude: above 40 mV (channel A or B): ±2% reading ±0.03% FS, 50 Hz to 50 kHz; ±5% reading ±0.03% FS, 100 kHz to 500 kHz.(5) Ratio: ±0.5 dB, 50 Hz to 50 kHz; ±1 dB, 50 kHz to 500 kHz.(5)
305-PA-3010 Special Purpose Plug-in (with filter)	For use at 125 ±10 Hz; matched filters in both channels reject higher frequencies	500 mV to 5 V rms. Other ranges available on request.	1 megohm shunted with 40 pF	±0.1°, 500 mV to 5V rms; ±0.25°, 100 mV to 500 mV rms.
305-PA-3015 Selectable Filter Plug-in	5 Hz to 500 kHz without filters; uses 2 of type 305-PA-3008-( ) filters (3); filter selection programmable	Ranges of 50-500 mV rms, 0.5 to 5 V rms, and 5-50 V rms selectable by remote contact closures.	1 megohm shunted with 40 pF	With filters, ±0.1° at fixed frequencies over all levels; without filters ±0.1° from 50 Hz to 50 kHz at all levels (typically ±0.03°), typically ±.25°, 5 Hz to 500 kHz.

(1) Can be provided for other voltage levels.

(2) For sinusoidal signal; can be used for square wave inputs over limited frequency range; can be used for amplitude modulated signals up to 97% modulation, depending upon model, level and frequency.

(3) 50 Hz filter, P/N 305-PA-3008-50; 60 Hz filter, P/N 305-PA-3008-60; 400 Hz filter, P/N 305-PA-3008-400. (Other frequencies available on request.)

(4) Available for use with 305-PA-3001, -3002, -3007 and -3010. Specify when ordering plug-in.

(5) For higher accuracy below 50 Hz, specify Model 305-PA-3009A.

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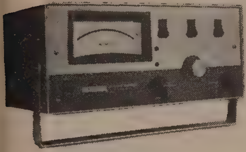
SERIES 301 LOW COST PHASEMETERS



FEATURES:

- 70 dB input level range
- 1° accuracy, 0.1° resolution
- 5 Hz to 0.5 MHz frequency range
- 0° to 360° phase range
- 0 to 3.6 Vdc analog output

Series 301 Phasemeters are low cost, direct-reading instruments for measurement of the phase difference between two sinusoidal signals.

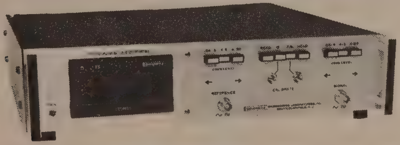
Phase angle is indicated by a large taut band meter with mirror scales of 0 to 36, 0 to 90, 0 to 180, and 0 to 360 degrees. The 70 dB input range of the 301 is achieved without range switching. Operating controls include an input reversal switch and an "Add 180°" switch which allows the operator to avoid the 0°/360° discontinuity. Model 301A also produces a DC voltage output proportional to angle.

SPECIFICATIONS

Frequency Range: 5 Hz to 500 kHz
Input Impedance: 100 KΩ
Absolute Accuracy (independent input levels):
±1°, 45 Hz to 40 kHz, inputs > 200 mV
±1.5°, 7 Hz to 100 kHz, inputs > 200 mV
±2°, 5 to 7 Hz and 100 to 200 kHz
1° additional for each additional 100 kHz
Minimum Input Levels: 1 V rms, 5 Hz to 30 Hz
300 mV rms to 50 mV rms, 30 Hz to 200 Hz
50 mV rms, 200 Hz to 50 kHz
50 mV rms to 500 mV rms, 50 kHz to 500 kHz
Maximum Input Levels: 160 V rms
Panel Meter:
6″ taut band movement; 0.5% fs linearity (add to accuracy)
Rectangular Wave Output: 1.5 V p-p, 5 nsec rise time
DC Output (Model 301A or 301AR only):
0 to +3.6 Vdc for 0 to 360°; Z out less than 50Ω
AC Power Input: 115/230 V, 50 to 400 Hz, 0.4 Amps rms
Case: 7″ x 16½″ x 11½″. For 19″ rack mount specify option R
Weight: 18 lbs.; shipping, 27 lbs.

SERIES 331

HIGH ACCURACY ECONOMY PHASEMETERS



- Accuracy to 0.05°, resolution to 0.01°
- Frequency range 2 Hz to 700 kHz
- Analog output and 4 or 5 digit panel readouts
- Input 0.05 to 220 V rms
- Accepts sine, square and other waveforms in either channel

The Dranetz 331 Series Phasemeters feature high accuracy over a broad amplitude and frequency range. Front panel controls (equipped with LO/HI indicators) are used to select proper voltage ranges, as well as to check and adjust calibration. The 331 incorporates several of the important features of the Superperformance 305 Series, including elimination of 0°/360° ambiguity and reduction of sensitivity to noise and even harmonics. The 331 is designed for calibrating equipment, for testing subassemblies and for general laboratory work.

SPECIFICATIONS

CHARACTERISTICS	331B	331C
Frequency Range:	2 Hz to 500 kHz	
Accuracy: Sine Wave:	±0.1° ±1 digit from 50 Hz to 50 kHz, ±0.2° per 100 kHz to 500 kHz and ±0.2° ±1 digit at 5 Hz.	±0.05° from 50 Hz to 50 kHz; ±0.2° from 10 Hz to 100 kHz; add ±0.2° per 100 kHz above 100 kHz.
Square Wave:	±0.1° ±1 digit from 10 Hz to 20 kHz; ±.5° per 100 kHz above 20 kHz	±0.05° from 10 Hz to 5 kHz; ±0.1° to 20 kHz; ±0.5° per 100 kHz above 20 kHz.
Angle Ranges:	000.0° to 360.0° or −180.0° to +180.0° automatic or selectable.	
Display:	Beckman (Sperry) 0.6″ 4 digit for ranges above.	Beckman (Sperry) 0.6″ 5 digit for ranges above.
Drift (30 day period):		
Sine Wave:	None	
Square Wave:	None	
DC Drift:	0.1°	
Repeatability (DC):	Better than 0.1°.	Better than 0.01° after readjusting 0 and FS.
Temperature Coefficient:	0.01°/°C independent of other conditions.	
Input Signal Amplitudes:	0.05 to 220 Volts rms in 3 ranges (0.05-0.5, 0.4-5, 4-220; can be extended with Tektronix probes.	
Input Impedance:	1 megohm shunted by 50 pF nominal	
Response Time:	700 milliseconds	
Maximum DC Component:	±200 volts; can be extended with probes	
Analog Output:	0.0000 to 3.600 V and −1.8000 to +1.8000 V DC, +10.00 mV DC/degree phase; output impedance less than 100 ohms.	
Ambient Temperature	0°C to 45°C	
Panel Controls and Adjustments:	3 range input level pushbuttons each channel; read-hold; power; 0° cal and 360° cal adjustments.	
Connectors:	BNC, both input channels, rear and front; PC rear for analog output.	
Power Requirements:	105-125 or 210-250 volts, 50/60 Hz, 70 watts.	
Dimensions:	3½″ high x 16″ deep, 19″ rack/portable package, 18 lbs. (7 kg) net wt., 25 lbs. (10 kg) shipping.	
Option:	#101: BCD output, TTL/DTL, 8421	#101: BCD output, TTL/DTL, 8421

DRANETZ

ENGINEERING LABORATORIES INCORPORATED

SOUTH PLAINFIELD, NEW JERSEY 07080 • TEL: (201) 755-7080 • TWX: 710-997-9553

SERIES 325

POWER SYSTEM POLYMETER / DUAL MEASURE OF VOLTAGE, CURRENT, TIME, FREQUENCY

FEATURES

- Simultaneous measurement and display of two selectable parameters.
- Display of continuous, triggered or maximum readings.
- Full isolation of all inputs.
- Precision measurement of time interval in seconds or cycles.
- Large 0.6″ digital display.
- Precision frequency measurement optional.
- Portable for field use.
- A field instrument with laboratory accuracy.

The Series 325 is specifically designed for measuring key parameters in electric power systems. Simultaneous measurements of Voltage and Current, 2 Currents, 2 Voltages, Current and Time, and Voltage and Time may be made. Readings may be taken on a continuous basis, or the meter may be triggered to "freeze" readings at a specific time. Time may be measured either in seconds or cycles of the power line frequency. Timing and trigger inputs may be actuated from type A or B dry contacts or by AC or DC voltages. Special circuits assure positive triggering on first contact and prevent simultaneous start/stop conditions. Options and adapters are available for DC current, DC voltage, fast frequency measurement, low pass filters and BCD outputs.

APPLICATIONS

- Ideal for electric utility use.
- Testing of trip points on overcurrent, overvoltage, undercurrent, undervoltage, and underfrequency relays.
- With Model 314 Phase Angle Meter, ideal for impedance relays.
- Precision measurement of frequency.

SPECIFICATIONS

Frequency Range: 47-450 Hz. (25 Hz available on request.)

AC Voltage: 15 mV to 1000 V RMS, 1.5, 15, 150, 1000 V FS, transformer isolated, 5000 ohms per volt.

AC Current: 1.5 mA to 100 A RMS, 0.15, 1.5, 15, 100 A FS, transformer isolated, .001 ohms insertion resistance.

Time Interval (2 ranges): 0 to 999.99 seconds in .001 second increments. 0 to 9999.9 cycles in 0.1 cycle increments.

Trigger Inputs: (Start and Stop) Contact closure, DC step voltage change, or AC input.

Accuracies: V, I, ±0.3% reading ±0.03% FS; Time, ±0.003% reading ± last digit.

Out of Range: Display blinks when level is too high.

Measurement Modes: Continuous, triggered, and "hold maximum."

Dielectric Test: 4250 V RMS to ground from V and I terminals. 1600 V RMS to ground from trigger terminals. (Per ANSI-C39.5.) Also meets SWC test.

Power Supply: 95 to 140 or 190 to 280 V RMS, 47 to 450 Hz, 20 watts, International Universal type connector.

Operating Temp. Range: 0°F. to 125°F.

Case: Portable, weatherproof, with cover 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D); without cover 11″L x 7″W x 7″D (Panel 11″ x 7″).

Weight: 10 pounds. (Shipping weight, approximately 17 pounds.)

OPTIONAL FEATURES

Option 101: Fast frequency measurement capability — 0.1 sec. meas. time, 0.01 Hz resolution; 1 sec., .001 Hz resolution; accuracy ±0.002 Hz ± resolution.

Option 102: Low pass filters for removing effects of harmonics from measurements.

Option 103: BCD outputs suitable for driving printers for recording measured data. DTL/TTL compatible.

Option 105: True RMS detection.

Option 106: Panel mount.

Option 107: Panel mount with remote display.

Option 108: Accessory power for 325-PA-( ) adapters.

Option 109: Dry contacts corresponding to START/STOP times (available only when Option 108 is chosen.)

325-PA-1001: DC Current Adapter.

325-PA-1002: DC Voltage Adapter.

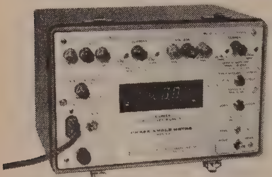
325-PA-1003: Contact Opening Trigger Adapter.

325-PA-1004: Adjustable Threshold Trigger Adapter.

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 325

SERIES 314

POWER SYSTEM PHASEMETER / FOR ACCURATE & RAPID MEASUREMENT OF PHASE IN ELECTRIC POWER SYSTEMS



FEATURES

- Universal Current-Voltage Inputs, V-V, I-I, V-I
- Portable
- Immune to Harmonics
- Independent of Frequency Changes
- Digital Readout — "No Hands" Simplicity
- Accuracy ±0.5°, Resolution ±0.1°
- Independent of Input Levels
- Complete input isolation

APPLICATIONS

- Testing and Adjustment of Protective Relays
- Measuring Load Current Phase Angles — Measuring Power Factor
- Testing Polyphase Balance
- Determining Power Flow in Interconnected Systems
- Minimizing Circulating Reactive Currents
- Synchronizing Multiple Sources

Accurate, precise and rapid phase measurement is an essential technique in the setup, operation, and maintenance of modern power systems, subsystems, and the control and protection circuits used in them. The value of a phase meter in such applications is directly proportional to the speed, convenience, and validity with which it indicates the phase angles it measures. With the introduction of the Dranetz Model 314, virtually all of the limitations and error sources of electromechanical meters have been removed, and the overall accuracy of this class of phase measurements has been increased by more than a full order of magnitude. The basic accuracy of ±0.5° specified for the Model 314 is actually **maintained, without degradation,** over the wide ranges of frequency variation, voltage/current level, and harmonic content for which the instrument is rated. Furthermore, the direct-reading **digital** presentation of phase, to four-place resolution (0.1° increments) requires no interpretation or interpolation, and is not subject to reading errors or parallax. **The phase angle you see is the phase angle that exists — to within ±0.5°,** without correction or uncertainty.

SPECIFICATIONS

ELECTRICAL

Range: 000.0° to 360.0°, Direct-reading

Frequency Range: 47-53, 57-63 Hz (specify at time of ordering)

Input Current Range: (both input circuits) .015-50 A rms

Input Voltage Range: (both input circuits) 0.3 to 600 V rms

Current-Input Impedance: Approx. 2 or 20 milliohms

Display: Four digits, non-flickering, 0.6″ numerals

Resolution: 0.1°

Accuracy: ±0.5°

Burden:

Voltage: 1.8 VA max. at 600 V rms input

Current: Approx. 2.5 VA at 50 A rms input

Interaction Between Inputs: None

Errors Due to Harmonic Distortion: None for harmonic distortion up to 30%, any harmonic

Errors Due to Offground Inputs or Reversal: None

Overload:

Voltage: 100% overload for 1 minute

Current: 100 A rms for 1 minute

Dielectric Test: Up to 2200 Volts rms between inputs and ground (ANSI-C39.5)

Self-Check: Provided for 000.0°. Full scale (360.0°) is autocalibrated internally

Power Required: 115/230 V, 50-60 Hz, 20 Watts

MECHANICAL AND ENVIRONMENTAL

Case: Portable weatherproof carrying case with cover 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D). Without cover 11″L x 7″W x 7″D. (Panel 11″ x 7″)

Operating Temperature Range: 10°F to 110°F

Weight: 10 pounds approx. (shipping wt. approx. 17 pounds)

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 314A

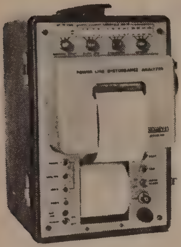
DRANETZ

ENGINEERING LABORATORIES INCORPORATED

SOUTH PLAINFIELD, NEW JERSEY 07080 • TEL: (201) 755-7080 • TWX: 710-997-9553

SERIES 606

POWER LINE DISTURBANCE ANALYZER/RECORDER



- For 115/230/460 V rms, 1 and 3 phase systems.
- Monitors, classifies, times and prints out line disturbances.
- Immediate and day-end printouts.
- Operates on command or disturbance — no wasted paper.
- For portable or permanent installation.
- 4 hour internal carry over power.

The 606 is designed specifically for monitoring power mains connected to computers, process control systems, hospital equipment and data communications devices, which are particularly susceptible to line transients, level changes or other disturbances. Using a digital microprocessor, the 606 classifies each disturbance into IMPULSE, CYCLE-TO-CYCLE CHANGE or SLOW RMS CHANGE. When preset thresholds are exceeded, the instrument prints out time, classification, magnitude, duration and channel designation. Data is also accumulated for overflow and day-end printout. The instrument is designed for both temporary pre-installation use and for permanent monitoring.

SPECIFICATIONS

Input Voltage Ranges: 115, 230, 460 V rms ±50%, all transformer isolated, Zin > 100 kΩ

Number of Inputs: Model 606-1, 1 input; Model 606-3, 3 inputs (3ϕ or separate circuits)

Test Modes:

AVG+ or AVG−: Increase or decrease in steady state rms, averaged over 10 sec

SURGE or SAG: Increase or decrease in cycle-to-cycle rms value

IMPULSE: 0-peak value of impulse having duration 0.5-100 microsec (excluding sine wave)

ACCUMULATED COUNT: Summation of disturbance data in memory (includes time, HI AVG+, LO AVG−, HI SURGE and number of HITS, LO SAG and number of HITS, HI IMPULSE and number of HITS)

Printing Modes:

AVG+ or AVG−: Prints time, AVG+ or AVG−, rms VALUE, CHAN., when exceeding threshold of 2, 5, 10, 15 V rms*

SURGE or SAG: Prints time, SURGE or SAG, rms VALUE, CHAN. and duration (cycles) when exceeding threshold of 2, 5, 10, 15 V rms*

IMPULSE: Prints time, IMPULSE, 0-pk VALUE & CHAN. when exceeding threshold of 50, 100, 200, 400 V and 0-pk.

SUPPLY DOWN or UP: Prints POWER DOWN or POWER ON and TIME

STORED DISTURBANCES: Stores data on disturbances during printing. Prints out when printer clears

ACCUMULATED COUNT: (Short Term) Overflow of data entering printer. Prints out automatically

DAILY ACCUMULATED COUNT: End-of-day print out. Prints number of day and ACCUMULATED COUNT

TEST: Prints time and ACCUMULATED COUNT

RESET: Prints time and ACCUMULATED COUNT, resets memory

PRINT OFF: Prints PRINT OFF, disables printer, all data goes into accumulator

Accuracy: AVG+ or AVG−: ±1% reading; SURGE/SAG: 1% reading; IMPULSE: 5% of reading to 10X threshold pk (or 4000 volts, whichever limits first)

Clock: Indicates real time in hours, minutes, seconds, crystal controlled. During power off, operates on internal batteries (4 hours). Clock resets from front panel buttons

Printer: 17 character, alpha-numeric, thermal, paper 2¼″ wide, prints 1 line/sec

Supply Power: 90 to 140 V, 47-450 Hz, 1ϕ, 0.5A

Case: Portable, aluminum, weatherproof, removable cover, equipped with carrying handle and feet

Size (with cover): 11″H x 7″W x 9½″D; net weight, 15 lbs.

Options: Opt. 101 (606-3 only),freq. disturbance; Opt. 102, meas. freq. 50 Hz nominal; opt. 103 (606-3), meas. freq. 400 Hz nom.

*These values for 115 V input; multiply by X2 or X4 for 230 V rms or 460 V rms.

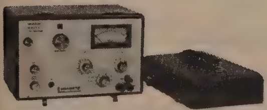
MODEL 910 UNINTERRUPTIBLE POWER SUPPLY: Model 606 operates normally during all above line disturbances as well as during complete line interruptions up to 50 millisec. For line interruptions up to 4 hours, unit prints power down and power return times, maintains clock operation and retains accumulated data in memory. For complete operation during power shutdown up to 2 hours, use Dranetz Model 910 uninterruptible power supply.

CHARACTERISTICS: Input, 60 to 180 Vrms, DC to 800 Hz; output, 105 to 125 Vrms, 60 Hz, 1A; carry over time, 2 hours; size, 11″ x 7″ x 9½″.

FOR FULL INFORMATION WRITE FOR BULLETIN 606

SERIES 602

FREQUENCY SELECTIVE VOLTMETER



- Broad range — 2 kHz to 350 kHz.
- High selectivity — spurious signals down more than 50 dB.
- Battery powered — long life.
- Excellent for K and N carrier systems.
- Meets W.E. KS-15538-L5A

The Dranetz Model 602 Frequency Selective Voltmeter is a low power transistorized instrument for the measurement of carrier signals hidden among other multiple signals. The instrument uses a frequency selective detector based on heterodyning to cover a broad frequency range, and uses a crystal oscillator for frequency and level calibration. The instrument has both high impedance and bridging inputs for 135 or 600 ohms (balanced or unbalanced).

SPECIFICATIONS

Frequency Range: 2-350 kHz

Input Levels:

Full Scale Ranges: −60 to +20 dBm, 5 dB/step

Sensitivity: −70 to +22 dBm

Selectivity: Spurious output down more than 50 dB

Accuracy:

Level: 135 ohm input, ±.25 dB
600 ohm input, ±.5 dB

Calibrator: ±.25 dB at 35 kHz ±250 Hz

Frequency: ±1 kHz or ±500 Hz

Frequency Response: ±1 dB ref 25 kHz

Meter Bandwidth: Nominal 500 Hz at −3 dB, 1000 Hz at −60 dB

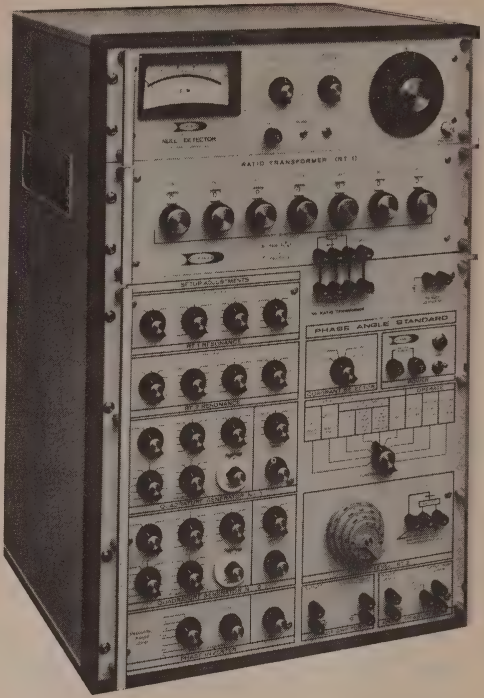
Audio Bandwidth: Nominal 2.5 kHz at −6 dB, 8 kHz at −60 dB

Internal Noise: At least 20 dB below full scale

Battery Drain: 80 mA nominal

Size: 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D) with cover; panel 7″ x 11″

Weight: Net 10 lbs., shipping 15 lbs.


NULL DETECTOR
RATIO TRANSFORMER (RT 1)
SETUP ADJUSTMENTS
RT 1 RESONANCE
RT 2 RESONANCE
PHASE ANGLE STANDARD
QUADRANT SELECTOR
QUADRATURE GENERATOR No. 1
QUADRATURE GENERATOR No. 2
PHASE INVERTER

DYTRONICS

MODEL 311/RT-1/717S PRIMARY PHASE ANGLE STANDARD

- 0.015° ACCURACY
- FREQUENCY RANGE 30 Hz to 10,000 Hz
- SELF-CALIBRATING
- SHIFT OR MEASURE PHASE ANGLE
- MAXIMUM 125 VOLT OUTPUT
- 12 MICRODEGREES RESOLUTION

Dytronics has pioneered in the development of an original technique for the measurement of phase angle. This measurement method has been recognized as an authentic "PRIMARY" technique. Measurements are dependent only upon fundamental concepts, and not upon secondary considerations. The measurement methods that have been developed by Dytronics have resulted in absolutely unmatched performance. Hundreds of our Phase Angle Standards that employ this exclusive "PRIMARY" technique are in use throughout the world.

The only authentic PRIMARY PHASE ANGLE STANDARDS

SETUP ADJUSTMENTS
RT 1 RESONANCE
RT 2 RESONANCE
QUADRANT SELECTOR
312 PHASE ANGLE STANDARD
QUADRATURE GENERATOR NO. 1
QUADRATURE GENERATOR NO. 2
PHASE INVERTER

MODEL 312 PRIMARY PHASE ANGLE STANDARD

- 0.02° ACCURACY
- FREQUENCY RANGE 4 kHz to 500 kHz
- SELF-CALIBRATING
- SHIFT OR MEASURE PHASE ANGLE
- MAXIMUM 15 VOLT OUTPUT
- 12 MILLIDEGREES RESOLUTION

Model Number	Frequency Range	Accuracy	Measure Phase?	Shift Phase?	0° to 360° Coverage without Ambiguity?
302	1 Hz-100 kHz	±0.5°	Yes	Yes	Yes
311/RT-1/717S	30 Hz-10 kHz	±0.015°	Yes	Yes	Yes
312	4 kHz-500 kHz	±0.02°	Yes	Yes	Yes
342	400 Hz	±0.1°	Yes	Yes	Yes
400K	400 Hz	±0.05°	No	Yes	No
401/401P	400 Hz	±0.01°	No	Yes	No
411	1 Hz-100 kHz	±0.1°	No	Yes	Yes
412	.01 Hz-1 kHz	±0.1°	No	Yes	Yes

SEE OUR CATALOG FOR A COMPLETE LIST OF MODELS AND SPECIFICATIONS

DYTRONICS COMPANY, INC.
4800 EVANSWOOD DRIVE, COLUMBUS, OHIO 43229
Telephone (614) 885-3303

MODEL 411
PHASE ANGLE GENERATOR

DYTRONICS

- DIRECT READOUT IN PHASE ANGLE
- FREQUENCY RANGE 1Hz to 100 kHz
- 0° to 360° PHASE COVERAGE
- CONSTANT OUTPUT VOLTAGE WITH VARYING PHASE ANGLE
- 0.1° ACCURACY
- EXCELLENT STABILITY
- RAPID OPERATION

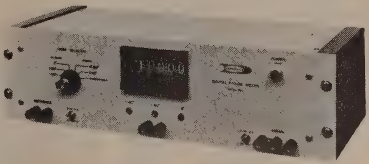
PHASE ANGLE GENERATOR
MODEL 411
PHASE ANGLE
FREQUENCY ADJUST
METER NULL
POWER
INPUT
FREQUENCY RANGE
FUNCTION
OUTPUT

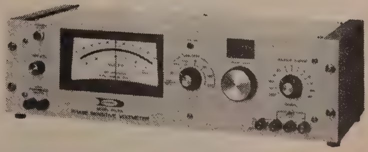
The Model 411 finds a variety of applications for general laboratory and production use. Some specific applications are:

- CALIBRATION OF PHASE METERS
- DELAY DISTORTION MEASUREMENTS
- MEASUREMENTS OF PHASE ANGLE
- TESTING OF TRANSFORMERS
- LABORATORY STANDARD
- SERVO DESIGN APPLICATIONS
- CALIBRATION OF NAVIGATION TESTING INSTRUMENTS
- CALIBRATION OF WATT METERS

Model 224 "hands-off" Digital Phase Meter

Hands-Off Phase Angle Measurements using new "Linear Mode Concept" 0.1° Accuracy 0.01° Resolution





Model Number	Frequency Range	Accuracy	Internal Filters	Outputs	0° to 360° Coverage without Ambiguity?
222	20 Hz-100 kHz	±0.1°	No	DC	Yes
224	20 Hz-100 kHz	±0.1°	No	DC-BCD	Yes
244/RS	400 Hz	±1.0°	Yes	DC	Yes
250B	4 Frequency	±1.0°	Yes	DC	Yes

SEE OUR CATALOG FOR A COMPLETE LIST OF MODELS AND SPECIFICATIONS

MODEL RT-501

HIGH-FREQUENCY DECADE VOLTAGE DIVIDER

- OPERATION UP TO 500 kHz
- ±0.0005% ACCURACY AT 5 kHz; ±0.09% ACCURACY AT 500 kHz
- LESS THAN 1 OHM OUTPUT IMPEDANCE
- 1 PPM RESOLUTION

HIGH-FREQUENCY RATIO TRANSFORMER

Dytronics offers an array of instrumentation for the measurement and generation of phase angle. This successful and advanced measurement technique pioneered by Dytronics is recognized as the finest throughout the world. See our catalog for complete information or contact Dytronics Company, Inc. 4800 Evanswood Drive, Columbus, Ohio 43229, Telephone (614) 885-3303.

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4800 EVANSWOOD DRIVE, COLUMBUS, OHIO 43229
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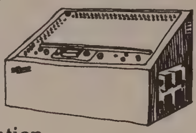
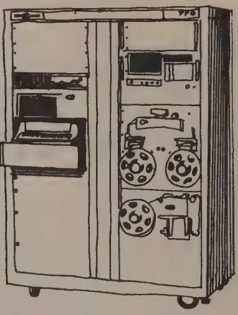
DIT~MCO:
THE DIFFERENCE IN TESTING!

FOR TWO DECADES, THE SINGLE SOURCE MANUFACTURER OF FIXTURE/WIRE-CIRCUIT ANALYZER TEST EQUIPMENT AND SYSTEMS . . . THAT WORK!


200

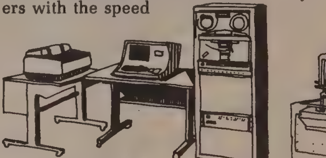
Twenty years ago, in 1954 our first wiring analyzer, the DIT-MCO model 200, was purchased by Goodyear Aircraft of Akron, Ohio. At that time the 200 was a real innovation. Through the years technological advancements in the aerospace, computer, and communications industries have demanded more sophisticated and versatile circuit analysis test equipment.


770

DIT-MCO has met the test!

We have remained the only company in the industry whose sole business is the design and manufacture of automatic test systems, computer controlled analyzers and systems, and fixturing devices. From the first rather simple model 200 (still operative after 20 years) we've come a long way.

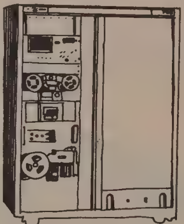
Our variety of test equipment includes:

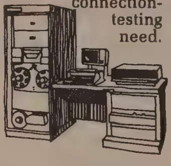

823

The 700 SERIES: Random access analyzers with the speed and reliability you want at the price you want to pay.

The 730 SERIES: A step-up . . . faster test speeds, greater terminal capacity, expanded versatility.

The 770 SERIES: Tape-programmed random-access wire-circuit analyzers with the speed and available instrumentation to meet almost every conceivable connection-testing need.


700


810B

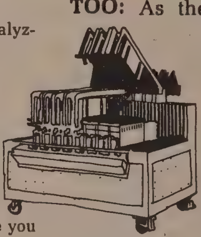
SYSTEM 803: A high speed random-access circuit analyzer combining the field proven capabilities of DIT-MCO test systems with the flexibility and capacity of computerization.

SYSTEM 810B: A multichannel real-time, on line multi-programmed controller and program library for automatic wire-circuit test equipment AND numerically controlled production test equipment.

SYSTEM 823: Computer controlled, ultra high speed wiring analyzer particularly applicable where UUT terminal capacities are high. Revolutionary new switching eliminates massive adaptor cable systems.

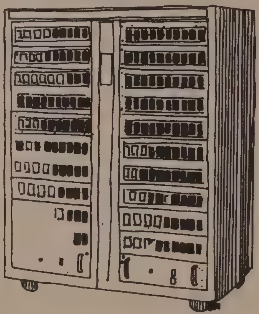
SWITCHING: A choice . . . reed, bar relay, EQA, or solid state to give you optimum speed/reliability combinations.

FIXTURING: Multi-layer board fixtures, spring pin and cam card fixtures, special custom access fixtures, and fixture/analyzer systems.


Fixture

AND CUSTOMER SERVICE TOO: As the largest exclusive manufacturer of automatic circuit test systems, we have demonstrated our ability to fully support all of our systems . . . in the past, now, and in the future.

For over 20 years DIT-MCO has been the acknowledged pioneer and leader in the field of circuit testing.


Switching

What's happening in circuit testing still happens best at DIT-MCO. Let our representatives show you how DIT-MCO equipment relates to your test needs. Call or write our nearest office. There is a DIFFERENCE in testing and DIT-MCO is IT!

DIT MCO

DIT-MCO INTERNATIONAL

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European Technical Representative ● RADIX HOUSE ● Central Trading Estate ● Staines, Middlesex, TW 18-4XA ●
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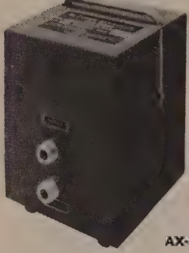
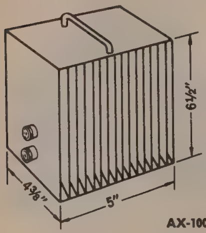
ATTENUATORS

AX SERIES ATTENUATORS



AX-100-20

- Oil-filled Self-Cooling.
- 50 ohm impedance.
- VSWR 1.1:1 to 500 MHz (1.15:1 for AX-500).
- Frequency Range DC-500 MHz, usable to 1 GHz.
- Stock values of attenuation are 3, 6, 10, 20, 30 db.



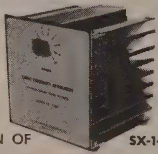
AX-100-20

Model*	Max. Power Watts	Accuracy	Attenuation Specify
AX-100	100	±0.5 db to 500 MHz	3, 6, 10 20,30 db
AX-500	500		

* Choose Stock Attenuation Value.

ALSO AVAILABLE

SX SERIES STEP ATTENUATORS



SX-1-100

INSTANT SELECTION OF ATTENUATION LEVEL FOR HIGH POWER RF APPLICATIONS

DUMMY LOADS

WL SERIES WAVEGUIDE WATER LOADS

WL-112

- Calibration resistor precisely located in coolant flow path permits calibration of load using 60 Hz line power (WLT Models).
- Quick-connect couplings on coolant connections guarantee safe, sure and convenient operation.
- Extremely low RF radiation.
- Optional equipment includes closely coupled Thermopiles, Output Meters reading directly in watts, and Flow meters.
- Water is both the lossy material and the coolant for these loads.

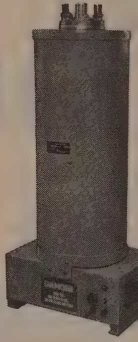
WLT-284

WAVEGUIDE LOADS

Model	EIA Desig.	Frequency Range GHz	VSWR Max.	Power Rating Average
WL-650	L	1.12-1.70	1.2	40KW
WL-430	LS	1.70-2.60	1.2	30KW
WL-340	340	2.20-3.30	Special Order Only	
WL-284	S	2.60-3.95	1.15	25KW
WL-187	C	3.95-5.85	1.15	10KW
WL-159	159	4.90-7.05	Special Order Only	
WL-137	XN	5.85-8.20	1.15	5KW
WL-112	XB	7.05-10.0	1.15	3KW
WL-90	X	8.20-12.4	1.15	2KW
WL-62	KU	12.4-18.00	1.15	1KW
WL-42	K	18.00-26.5	1.15	500W
WL-28	V	26.5-40.0	1.15	500W

For Loads with Thermopiles, add T to designation. Example: WLT-284 (For use with Calorimeters).

DPTC-FM SERIES FM BAND DRY LOADS



DPTC-10KFM

Model	Average Power	Connector	VSWR
DPTC-10KFM	10KW	3⅛	1.2:1
DPTC-20KFM	20KW	3⅛	1.2:1
*DPTC-30KFM	30KW	3⅛	1.2:1
*DPTC-40KFM	40KW	3⅛	1.1:1
DPTC-50KFM	50KW	6⅛	1.2:1
DPTC-75KFM	75KW	6⅛	1.25:1

* Special Order Only.

Specifications: Model DPTC-10KFM

Power Rating: 10,000 watts
Duty: Continuous
Frequency: 85-110 MHz
VSWR: 1.2:1
Weight: 37 pounds
Connector: 3⅛ standard
Power Required: 115 VAC 60 Hz standard
Ambient Temp. Range: −40° to 52°C
Dimensions: 38 h x 11 d x 16" w.

The new Electro Impulse Dry FM Band Termination will save the costs of water or expensive installations for other types of loads.

Consisting of a practically indestructible resistive element in a stream of forced ambient air, the DPTC-10KFM will operate silently for just a few pennies a year . . . **and we guarantee it for 2!**

APPLICATION: Highly dependable Termination for FM Transmitters. Requires only 115 VAC, 30 watts power.

UNIQUE WARRANTY

"This Termination is Unconditionally Guaranteed against defects in parts or workmanship for a period of 25 months, provided it is operated within recommended parameters."

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Electro IMPULSE, INC.

116 CHESTNUT STREET • RED BANK, NEW JERSEY 07701
TELEPHONE: 201 - 741-0404

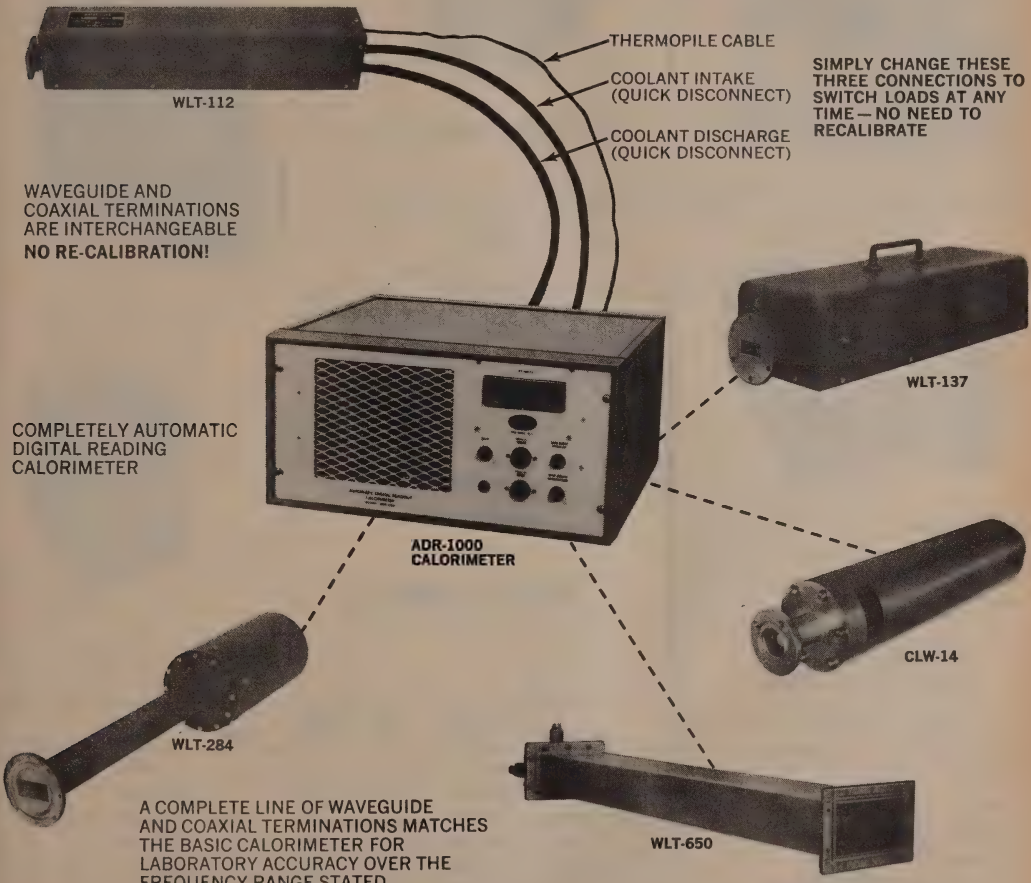
SEE OUR OTHER PRODUCTS ON PAGE 1•492

Electro IMPULSE, INC.

CALORIMETERS

The Complete Calibration Lab

COMPLETE SYSTEMS TO 10,000 WATTS AVERAGE POWER DC to 40 GHz with 1% ACCURACY


WLT-112
THERMOPILE CABLE
COOLANT INTAKE (QUICK DISCONNECT)
COOLANT DISCHARGE (QUICK DISCONNECT)
WLT-137
ADR-1000 CALORIMETER
CLW-14
WLT-284
WLT-650

SIMPLY CHANGE THESE THREE CONNECTIONS TO SWITCH LOADS AT ANY TIME—NO NEED TO RECALIBRATE

WAVEGUIDE AND COAXIAL TERMINATIONS ARE INTERCHANGEABLE
NO RE-CALIBRATION!

COMPLETELY AUTOMATIC DIGITAL READING CALORIMETER

A COMPLETE LINE OF WAVEGUIDE AND COAXIAL TERMINATIONS MATCHES THE BASIC CALORIMETER FOR LABORATORY ACCURACY OVER THE FREQUENCY RANGE STATED

ALL FACTORY CALIBRATION TRACEABLE TO NATIONAL BUREAU OF STANDARDS

Each system is complete with 1% ADR Calorimeter, 10 foot Hoses and Loads as ordered. Consult factory for further details and a quotation.

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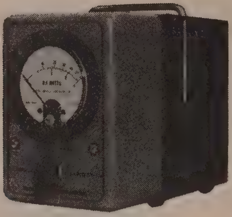
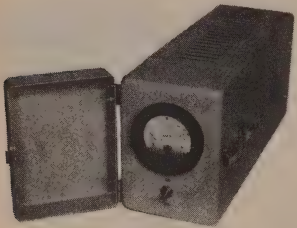
PM SERIES
TERMINATION-TYPE
RF POWER METERS



PM-10A

Full Scale Ranges	15 & 60 watts
Insertion VSWR	1:1:1
Accuracy (to 500 MHz)	±5%
Frequency Range MHz	.2-1000



DPM-3

Full Scale Ranges	50 & 150 watts
Insertion VSWR	1.1:1
Accuracy (to 500 MHz)	±5%
Frequency Range MHz	.2-1000

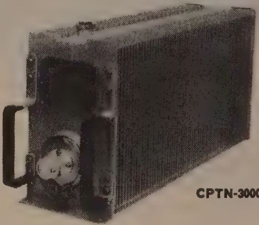
RUGGED, ACCURATE, SIMPLE TO CALIBRATE!

- Direct reading — no calibration charts.
- Calibrate anywhere — use line frequency standard.
- Portable — no power required.
- Detachable Load Resistor can be used as a Termination in a remote location.
- 50 ohms impedance — other impedances available.
- Type "N" Connector supplied — other types available upon request.

CPTN SERIES
COAXIAL DUMMY LOADS

CPTN-500

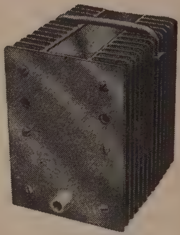
- No external power required.
- Up to 5,000 watts average power.
- Frequency range DC-3500 MHz.



CPTN-3000

- Rhomic Antenna Terminations also available.
- Oil filled termination cooled by convection — almost completely maintenance free.
- Units may be pulsed.
- Standard impedance is 50 ohms. Units can be furnished with 72, 300 or 600 ohms impedance. Request quotation from factory on special units.

THESE TERMINATIONS
ARE BACKED BY
A UNIQUE
25 MONTH WARRANTY



CPTN-100

Model	Frequency Range MHz	Connector Type	Average Power Watts	VSWR	Size HxWxD	Weight
CPTN-50	DC-1000	N	50	1.1	6.5x4.4x5	7
CPTN-100	DC-1000	N	100	1.1	6.5x4.4x5	7
CPTNS-100	DC-3500	N	100	1.25	6.5x4.4x5	7
CPTN-500	DC-1000	N	500	1.1	9.6x6x16	16
CPTNS-500	DC-3500	N	500	1.25	9.6x6x16	16
CPTN-1500	DC-1000	LC	1500	1.15	11x6.4x24.3	32
CPTN-3000	DC-1000	LC	3000*	1.15	11x6.4x24.3	32

* 2500 watts continuous.

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DUMMY LOADS

DACT SERIES CONVECTION COOLED

UNIQUE 25-MONTH WARRANTY!

DACT-14
10,000 WATTS

ABSOLUTELY NO MAINTENANCE!

NO POWER REQUIREMENT!

Power Ratings Available:
1000, 3000, 5000, 10,000, 15,000, 20,000, 25,000 watts.

VSWR:
1.15:1 (on most models).

Frequency Range:
Standard to 30 MHz —
Models available to 55 MHz.

Impedance:
50 ohms standard. 72, 300, 600 ohms available at extra cost.

Maximum Ambient Temperature:
52°C. No minimum!

Mounting Orientation:
Non-critical.

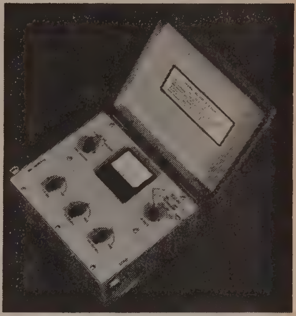
UNITS MAY BE PULSED

IN LINE RF DIRECTIONAL WATTMETER

NEW

MODEL DW-1000

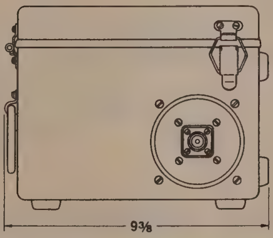
BROADBAND — 2-800 MHz
WIDE RANGE — 1-1000 Watts
HIGH ACCURACY — ±5% Fs

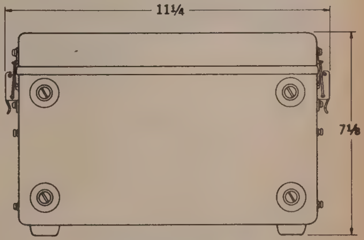


- NO PLUG-IN ELEMENTS
- RUGGED, INTEGRAL CARRYING CASE
- ALL SWITCHING ON FRONT PANEL

SPECIFICATIONS

*Forward Power Ranges	10, 50, 100, 500, 1000 watts
Reflected Power Ranges	10, 50, 100, 500 watts
Frequency Range	2 MHz to 800 MHz
Insertion VSWR	1.1:1 maximum
Impedance	50 ohms nominal
Directivity	17 db minimum; 25 db maximum
Accuracy	±5% of full scale
Connectors	Type N Female (Type C, BNC special)
Equivalent Transmission Line Length	22.4 Cm
Size	Lg 11¼ (28.5 Cm) 7⅛ (18.1 Cm) 9⅜ (23.8 Cm)
Weight	8¼ lbs. (3.7 Kg)





*Power Scales: 2-30 MHz: 50W, 100W, 500W, 1000W
30-80 MHz: 10W, 50W, 100W, 500W

WRITE FOR CATALOG #800 FOR OTHER ELECTRO IMPULSE PRODUCTS

- CALORIMETERS
- ATTENUATORS
- COOLING UNITS
- BALUNS
- POWER METERS
- WAVEGUIDE LOADS
- COMPLETE LINE OF TERMINATIONS

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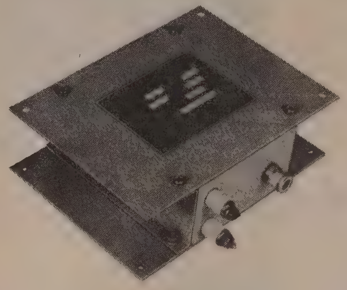
Electro IMPULSE, INC.

DRY BALUNS

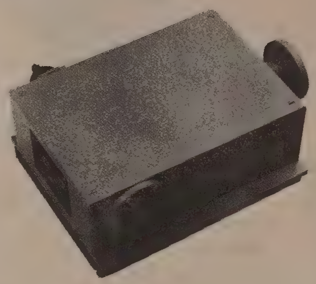
BROADBAND RF MATCHING TRANSFORMERS

POWER RATINGS—
RECEIVING UP TO 25,000
WATTS AVERAGE POWER

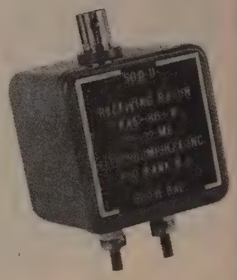
POWER ADDERS
POWER SPLITTERS
HYBRIDS
ALSO AVAILABLE



1000 WATTS



10,000 WATTS



RECEIVE

EXPLANATION OF MODEL NUMBERS:

BA5-60-1

UNBALANCED INPUT IMPEDANCE OHMS x 10
AVERAGE POWER x 1000
OUTPUT IMPEDANCE OHMS x 10

THESE BALUNS
ARE BACKED BY
A UNIQUE
25 MONTH WARRANTY

GENERAL SPECIFICATIONS:

Frequency Range Capability	**100 kHz-100 MHz**
Standard Frequency Range	4-30 MHz*
Maximum Insertion VSWR	1.2:1 (Typically 1.1:1)
Maximum Load VSWR	2.5:1
Efficiency	> 97%
Insertion Loss	< 0.15 db
Ambient Temperature Range	−40°F. to +132°F.
Phase Balance	Better than ±5%
Peak Power (Based on Average)	2 times average

* Lower prices quoted for more limited frequency band widths.

PLEASE CALL US FOR FAST PRICE & DELIVERY INFORMATION

EVERY BALUN IS INDIVIDUALLY, FULLY TESTED BEFORE DELIVERY

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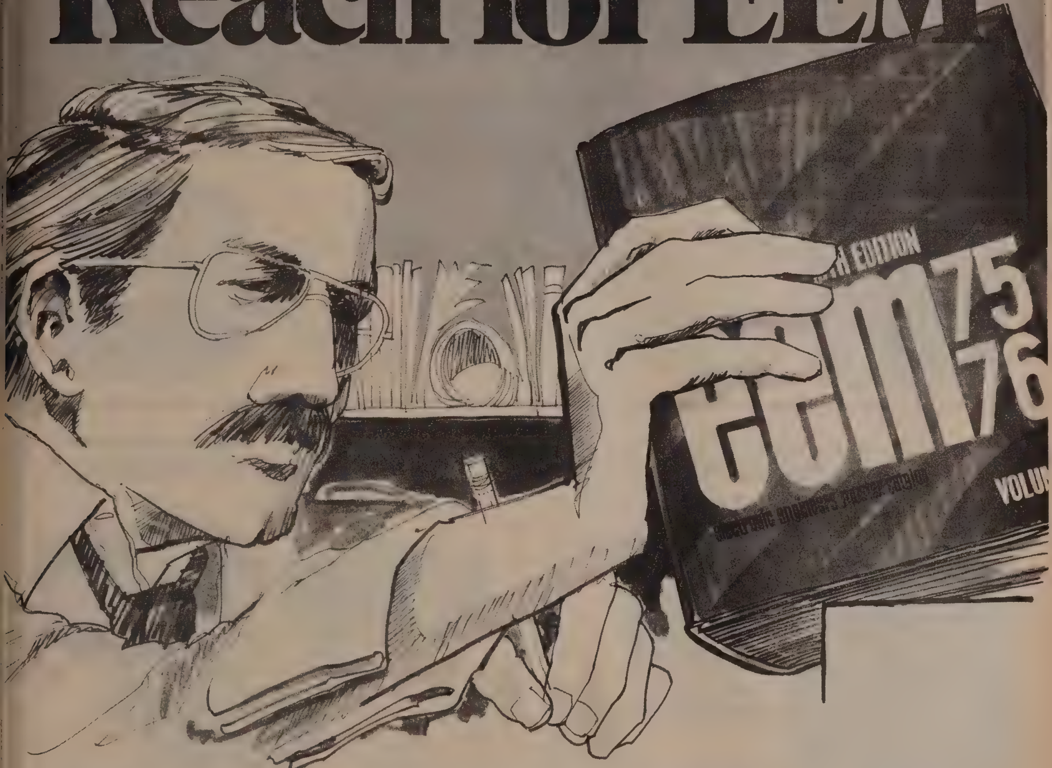
There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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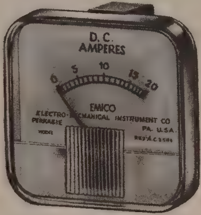
HIGH TORK PRECISION METERS

PRODUCED IN VOLUME AT COMPETITIVE PRICES

EMICO is your dependable VOLUME source for 100% American-made AC and DC meters for a wide range of applications in the electronics, automotive, appliance, test equipment and process industries. Select any standard model or have EMICO design and engineer a meter to your exact requirements, including a custom dial face with special scale, trademark, name or colors. Send for a complete catalog of standard models or mail drawings and specifications for a prompt quotation on a custom meter.

- Voltmeters
- Ammeters
- Millivoltmeters
- Milliameters
- Microammeters
- DB meters
- VU meters
- Circuit indicators
- Voltage testers
- Induction meters



PANEL METERS WITH METAL OR PLASTIC BEZELS

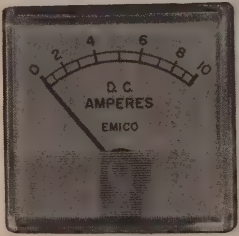
Plastic Bezel Meter
Model 42—2$\frac{5}{16}$″ square
Model 44—2$\frac{13}{16}$″ square

Metal Bezel Meter
Model 72—2¼″ square
Model 74—2¾″ square

Featuring the unique EMICO High-Tork movement, these versatile meters are available as AC or DC ammeters, voltmeters and milliammeters. All AC meters have 5% accuracy; DC meters available with 3% or 5% accuracy. These meters can be mounted into a 2 1-16″ diameter panel hole.

0
10
20
30
D.C.
VOLTS
EMICO

THE CHARGE INDICATOR WITH A MODERN LOOK BUT AN OLD-FASHIONED PRICE



Plastic Face Meters

50 Series all approximately 2⅜″ square

The eye-catching appearance, durability, and low price tag have made these meters especially popular. The one shown above (Model 53) is ideal for battery charger applications. Features attractive, clear molded plastic bezel and easy-to-read scale that can be customized. Specific models available as DC ammeters, voltmeters and milliammeters with 3% or 5% accuracy. AC model accurate to 5% of full scale.

Send for detailed product data sheets, today.

SHELLER-GLOBE CORPORATION
ELECTRO-MECHANICAL INSTRUMENT DIVISION
P. O. Box 216 Perkasie, Pa. 18944
Phone: (215) 249-9330 TWX: 510-665-9583

HOW TO GIVE YOUR PRODUCTS AN EDGE

Edge-Reading Indicator
Model 12 1¼″ x $\frac{5}{16}$″

DC MILLIAMPERES
0
1
2
3
4
5

Edge-Reading Meter
Model 13 1$\frac{13}{16}$″ x ¾″

You can engineer added sales appeal into your product by giving it the EMICO edge—either Model 12 or the slightly larger Model 13. Both feature a clear molded plastic front and case plus excellent readability. Model 12, primarily a current indicating device, is available in DC ranges from 0-500 microamperes through 0-50 milliamperes. Model 13 can be supplied as a 0-500 microampes DC meter, as well as an AC or DC ammeter, voltmeter and milliammeter. Either 3% or 5% accuracy is available on DC meters, depending upon the sensitivity. All AC meters have a 5% accuracy rating.

Send for detailed product data sheets, today.

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THE EMICO TOUGH GUYS . . . METERS FOR DIFFICULT ENVIRONMENTS

4-20 MA. DC
0
20
40
60
80
100
EMICO®

Tough Guy in All Weather

Model 35W—3½" dia.

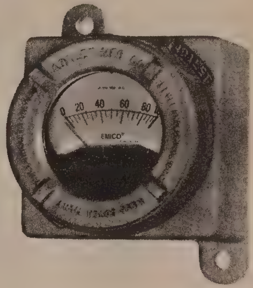
Designed for difficult environmental conditions, this intrinsically safe, rugged sealed meter is mountable anywhere with standard electrical fittings. Pressure tested under water in its polycarbonate housing. Magnetic shield standard. Concealed zero adjustment protects suppressed ranges. Independent five point calibration scale.

Send for detailed product brochure, today.

Tough Guy in Explosive Situations

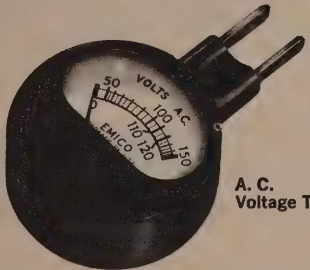
Model 35EP—5" x 7¼"

Designed for use in hazardous locations, this meter features UL listed sparkless, rustless aluminum housing. Magnetic shield standard. Concealed zero adjustment protects suppressed ranges. Independent five point calibration scale. Four alternate, field changeable, 90 degree mounting positions of meter eliminate extra plugged connection taps and allow positioning of housing for entrance of conduit from top, sides or bottom.



Send for detailed product bulletin, today.

JUST PLUG-IN FOR ACCURATE READING OF A.C. VOLTAGE



A. C. Voltage Tester

This handy pocket-size plug-in meter provides an instant accurate check of line voltage or fluctuation in the 0-150 volt range. Essential tool for electricians and electrical appliance servicemen, it's a well-appreciated accessory or premium offer for manufacturers of electrical products. Precision mechanism (5% accuracy) with damped meter movement. Convenient 90 degree swivel prongs for ease of reading from any position. UL listed.

Send for further information, today.

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Phone: (215) 249-9330 TWX: 510-665-9583

TINY INDICATORS KEEP A BIG EYE ON D.C. CIRCUITS

PAT PENDING

Flag

PAT PENDING

Pointer

Model 802—approx. ½" square

Rugged, dependable, and extra low in cost, these micro-miniature circuit indicators:

- **Monitor on-off conditions**
- **Indicate battery-charge conditions**
- **Indicate circuit-operating conditions**

Less than 2 milliwatts required to move flag or pointer. Overload capacity is 15 times current rating without burn-out or calibration shift. All models are packaged in a high-impact, clear plastic case and are available either with wire leads or plug-in jacks for ease of installation.

Send for detailed product bulletin, today.

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AC & DC voltage and current calibrators

General purpose and special purpose standard, sources and references

LOW IMPEDANCE DC MILLIVOLT STANDARD

DC CALIBRATION REFERENCE STANDARD

DC VOLTAGE STANDARDS

Applications for Production Line QC, Field Service Calibration Laboratories. Ideal as a Reference/Source/Supply for design and development labs. Simulator for thermocouples and transducers.

MODELS	MV 100/H	MV 105/H	MV 106/H	MV 115/H	MV 116/H	330D	VS 1030	E 100E
Bulletin	(#25)	(#25)	(#25)	(#25)	(#25)	(#20)	(#22)	(#23)
DC Volts (ranges)	± 11 V ±100 mV	± 11 V ±100 mV	± 11 V ±100 mV ± 10 mV	±11 V ± 1 V	± 11 V ± 1 V ±100 mV	±311 V ± 31 V ± 3 V ±300 mV	±1111 V ± 111 V ± 11 V	± 11 V ±100 mV
Resolution (1 ppm)	10 μV 0.1 μV	10 μV 0.1 μV	10 μV 100 nV 10 nV	10 μV 1 μV	10 μV 1 μV 100 nV	100 μV 10 μV 1 μV 0.1 μV	1 mV 100 μV 10 μV	100 μV 1 μV
Iout	50 mA	50 mA	50 mA	50 mA	50 mA	100 mA	10 mA	75 mA
Accuracy	±0.005% of setting	±0.005% of setting	±0.005% of setting	±0.005% of setting	±0.005% of setting	±0.003% of setting	±0.005% of setting	±0.01% of setting
Price	$875	$895	$995	$895	$995	$1195	$1500	$675

Option: DIFFERENTIAL VOLTMETER (ΔVM) OPTION "G" (Bulletin 26)

Available in all "MV" models and 1030. (Not available in 330D or E100)

For potentiometric and differential measurements: from 0.5μV to 1000 V dc.

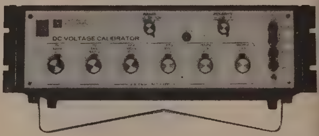
Accuracies: from ±0.005% to ±0.002%. Factory installed.

Price $235.

DC CURRENT AND VOLTAGE STANDARD – MODEL CR 103 H (Bulletin 31)

Short-circuit and open-circuit protected. 30 second warm-up. Automatic zero.

	Current Mode	Voltage Mode
DC Ranges	±110 mA ± 11 mA	± 11 V ±110 mV
Resolution (1 ppm)	100 nA 10 nA	1 μV 0.1 μV
Compliance	100 V	50 mA
Accuracy	0.01% of setting	± 0.005% of setting
Price	$1495	



AC VOLTAGE STANDARD – MODEL AC 1000 D/B (Bulletin 41)

Completely solid state. Highly stable. 60 second warm-up. Low output impedance.

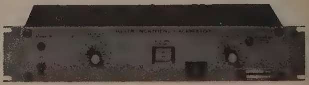
Vac rms ranges	1000 V, 1 V, 100 mV, 10 mV
Accuracy	0.025%
Burden	50 VA (2A max.)
Frequency Range	50 Hz to 5 kHz

5 internal frequencies 50 Hz, 60 Hz, 400 Hz, 1 kHz plus optional frequency and unlimited number of frequencies attained by use of external oscillator via front panel terminals.

Distortion	.5%
Weight	45 lbs.
Price	$3250

Option Model IC-15 – Meter increment calibration – Bulletin 42

AC VOLTAGE STANDARD

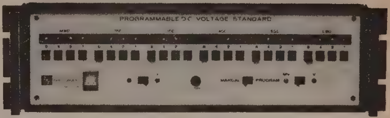


DIGITALLY PROGRAMABLE STANDARD (High Speed) — MODEL 501 H (Bulletin 51)

Switching and settling time: 50 µS. BCD programing 8421 or ASC II. Binary. TTL compatable. High accuracy with NBS traceability. Options and accessories provide wide flexibility.

Applications: High speed programable calibration. Data logging and process control system checking i.e., input simulation of thermocouples and transducers and reference for differential tests.

	MAIN FRAME MODEL 501 H	100 mV RANGE OPTION D	RANGING AMPLIFIER p/n RA – 3
Output	10.0000 Vdc	100.000 mVdc	100 V & 200 Vdc
Resolution	100 µV (10 ppm)	1 µV (10 ppm)	1 mV & 2 mV
w/Option B	10 µV (1 ppm)	0.1 µV (1 ppm)	100 µV & 200 µV
Accuracy	±(0.005% of setting	+0.0005% of range + 5 µV)	
		±(0.01% of setting + 0.0005% of range)	
Speed	50 microseconds		500 µS
Noise	0.0005% of range & 5 µV		0.0005% of range
Current	50 mA	into 400 KΩ	15 mA
Price	$1485	$165.	$950



OPTIONS

Option B Additional Resolution – 10 V Range: 10.00000 Vdc, 10 µV (1 ppm). 100 mV Range: 100.0000 m Vdc, 0.1 µV (1 ppm).
Option C Ready Signal – Output signal indicating "ready" state.
Option J Bipolar Operation – Programable positive and negative output voltage control.
Option K Negative Logic – Logic "0" ≡+2 V (min), Logic 1 ≡0.8 V (max).
Option L Binary Code – Accepts straight binary code.
Option M Control Panel – Manual controls for program check and instrument check. A single switch controls the manual/program mode. Program lines do not have to be disconnected for manual operation.

ACCESSORIES

p/n MR-1 memory register or buffer storage.
p/n MR-2 serial-to-parallel converter with storage.
p/n CM-1 CMOS Compatable Logic
p/N IS-40 Opto – Isolation

DIFFERENTIAL VOLTMETER (ΔVM) AND CALIBRATOR — MODEL 2902 (Bulletin 21)

The model 2902 is a high accuracy ΔVM for potentiometric and differential DC voltage measurements. Also, it is a highly stable and accurate reference/source/standard.

	MEASURE MODE		OUTPUT MODE
Ranges	1000V, 100V, 10V, 100mVdc	**Ranges**	100V, 10V, 1V, 100mVdc
Sensitivity	1000V, 100V, 10V, 1V, 100mV, 10mV, 1mV, 100µV, 10µV	**Resolution**	100µV, 10µV, 1µV, 100mV
		Stability	±0.0005%
Maximum sensitivity	0.5µV/division	**Current**	50 to 100mA
Zin	00 At null; 10 MΩ of null.	**Accuracy**	0.002% of setting
Accuracy	±0.002% of setting.	**Price**	$1495.00

DC VOLTAGE CALIBRATOR

RACK MOUNTING ASSEMBLY p/n RK-01 (Bulletin 26)

Complete with rack-style handles. Available for all models. **Price $20**

Electronic Development Corp.
11 Hamlin Street, Boston, MA 02127 (617) 268-9696

All EDC instruments are traceable to the U.S. National Bureau of Standards. Certification supplied with each instrument. / All instruments available under GSA Contract / Export prices slightly higher / Line (Mains) power: 115 Vac, [illegible] Hz or 220 Vac, 50 Hz / Instruments available for [illegible] evaluation. Contact your local sales representative or the main plant.

EDC

ELECTRONIC
DEVELOPMENT
CORPORATION

High Speed
Programable D.C. Voltage Calibrator

PROGRAMMABLE D.C. VOLTAGE STANDARD
MSD
2SD
3SD
4SD
5SD
8 4 2 1 8 4 2 1 8 4 2 1
ELECTRONIC DEVELOPMENT CORPORATION
Boston, Mass
ON
OFF
MANUAL
PROGRAM

Model 501 — Series H

OUTPUT SPECIFICATIONS

Output Voltages: Unipolar (Bipolar see Option J)
10.0000 V dc
and 100.000 mV dc – See Option D

Resolution: 10 ppm (1 ppm – See Option B)
10 V Range: 100 μV or 10 μV
100 mV Range: 1 μV or 0.1 μV

Accuracy:
±(0.005% of setting + 0.0005% of range + 5 μV)

The reference is built into the instrument. It is a selected, aged zener diode that is temperature compensated.

The accuracy is based on the "Limit of Error" (or "Worst Case") Method. All other specifications noted hereafter, which effect accuracy, e.g., line load, temperature, drift are **included in the accuracy statement.** Thus, all other specifications listed are NON-ADDITIVE.*

Settling Time:
50μ seconds to 0.005% of programed voltage. Including polarity change.

Stability: *(Non-Additive)
24 hrs: ±0.001%; 90 days: ±0.0025%; 6 mos: ±0.005%

Ripple & Noise: (0.0005% of range + 5 μV) RMS
in a band pass of 0.8 Hz to 100 kHz. No random spikes.

Output Current: 10 V range: 50 mA; 100 mV range: EMF into 400kΩ load.

Note: The rated accuracy of the 100 mV range applies when the R_L is 400kΩ or higher. (See: "Output Impedance")

eg: Where Z_o = 20 Ω and R_L = 400kΩ
∴ IR error = 0.005% of programmed value.

Output Impedance:
10 V range = 0.03Ω; 100 mV range = 20Ω (constant).

Regulation: (*Non-Additive)
Line & Load = ±0.001%

Protection:
Short-circuit and overload protection with front panel indicator.
Standby/Ready signal to programer – See Option C.

Isolation:
Power transformer primary to analog output: 2.5 x 10^4 megohms, 300 pf. Control logic to analog output: with opto-Isolators p/n IS-40: 10^9 Ω, 130 pf, 500 Vdc.

Temp. Coef.: *(Non-Additive)
Ambient: ±0.0005%/°C. Operating Limit: ±0.001%/°C.

PROGRAMMING:

Standard TTL, DTL and CMOS optional.
Code: Binary Coded Decimal.
Logic: Positive.
Negative logic - see Option K
Logic swing: Logic "0" ≡ 0.8V (max.)
Logic "1" ≡ +2V (min.)
Input loading factor: 1 TTL standard load per bit.
Logic lines: 5 decade model ≡ 20 lines.
6 decade model ≡ 24 lines.
Options: Bipolar control: add 1 line.
Std by/ready: add 1 line.
Memory: add 1 line.
Ranging Amplifier: add 2 lines.

MECHANICAL SPECIFICATIONS.

Power Requirements:

105 to 125 Vac; 50-60 Hz, 10 watts
(220 VAC power – See option 220)

Temperature:

Calibration Temperature: 23°C ± 1°C
Ambient Temperature: 20°C to 30°C
Operating Limit: 10°C to 50°C
Storage Temperature: -40°C to 85°C

Dimensions:

W* 16.9 x H 5.2 x D 14.2 in.;
W* 42.9 x H 13.3 x D 36.2 cm.
*With rack mount accessory RK-01: W = 19.1 in.; 48.5 cm.

Weight:

12.5 lbs.; 5.7 kg. Shipping wt: 16.5 lbs.; 7.5 kg. (approx)

Warranty: 6 months includes accuracy and stability.

OPTIONS:

Additional Resolution: LSD$_2$ Option B $110

A sixth, programable decade may be added which provides resolution of 1 ppm. 10μV on 10V range; 0.1μV on 100mV range. 4 additional programing lines are required.

Stand-by/Ready signal: Option C $ 55

Output signal indicates the status of the calibrator.
Logic "0" = "Ready"
Logic "1" = "Standby"
1 additional line (output) is required.

100 Millivolt Range: Option D $165

Outputs from 1 μV to 100 mV dc. This is in addition to the 10 V range. All options and specifications do apply.
1 additional programing line is required.

Bipolar Operation: Option J $165

Programable positive or negative output control.
Logic "0" = Positive (+) output
Logic "1" = Negative (-) output
1 additional programing line (bit line) is required.

Negative Programming Logic: Option K $110

Logic "0" = +2 V (min.) Logic "1" = 0.8 V (max.)

Straight Binary Entry: Option L $ 55

Five decade instruments only (Option B not available).

Manual Control Panel with Display: Option M $330

The manual control assembly is factory installed and becomes part of the front panel. Each control bit may be manual programed for calibration and program check-out. A switch controls the manual/automatic mode. The bit light display is operative in both the manual and the automatic modes.

ACCESSORIES

Mating Connectors: (supplied with the instrument)

Program input:	Part # MP-0156-25-SP-2	(2 required)
Analog output:	Part # 3106A-14S 6P	(1 required)

Rack Mounting Brackets, with handles: part # RK-01

Memory Register: Part #MR-1 $220

This eliminates the requirement to "hold up" the bit lines in order to sustain the programed voltage output. The register will respond only to the strobe command. Thus, the programer may be used for other functions while the calibrator voltage is maintained.
Construction: Plug-in P.C. board.

Serial-to-Parallel Converter: Part #MR-2 $440

This accessory permits a program format that is parallel by bit and serial by digit. The number of bit lines is 9. Memory function is included.
Construction: Plug-in P.C. board.

CMOS Compatible Input: Part #CM-1 $165

When ordering specify, "family" and voltage swing.

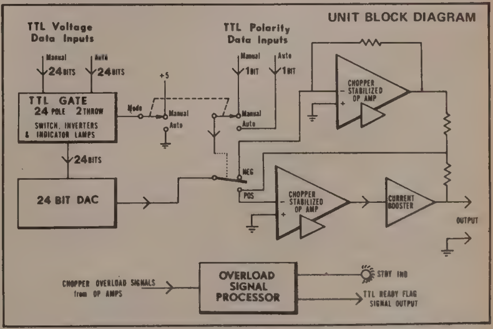
Programable Ranging Amplifier: Model RA-3 $950

This is an additional chassis, which is operated in conjunction with the Model 501 H, to provide programable dc voltage outputs up to 200 V f.s.
(For complete specifications see Bulletin 33, pg 4)

Opto-Isolation: Part #IS-40 $225

The opto-isolators provide the maximum isolation between the logic circuit and the analog output. $10^9 \Omega$, 130 pf, 500 Vdc. Many applications do not require this high degree of isolation. The opto-isolators are conveniently mounted in a plug-in PC board. Therefore, the opto-isolators may be installed, in the field, when and if the need arises.

MODEL 501 Series H $1485


UNIT BLOCK DIAGRAM
TTL Voltage Data Inputs
Manual
Auto
24 BITS
24 BITS
TTL GATE 24 POLE 2 THROW SWITCH, INVERTERS & INDICATOR LAMPS
Mode
+5
Manual
Auto
TTL Polarity Data Inputs
Manual
Auto
1 BIT
1 BIT
Manual
Auto
24 BITS
24 BIT DAC
NEG
POS
CHOPPER STABILIZED OP AMP
CHOPPER STABILIZED OP AMP
CURRENT BOOSTER
OUTPUT
CHOPPER OVERLOAD SIGNALS from OP AMPS
OVERLOAD SIGNAL PROCESSOR
STBY IND
TTL READY FLAG SIGNAL OUTPUT

ENI... the world leader

MODEL 1140L RF POWER AMPLIFIER
OVERLOAD OVERHEAT
REDUCE DRIVE
POWER
OVERLOAD RESET
INPUT
OUTPUT
CAUTION LETHAL VOLTAGE
ON
INPUT
1 VOLT MAXIMUM
60 dB 20 KHZ 10 MHZ
OUTPUT
CAUTION RF VOLTAGE
A.
B.
C.
D.

A. 1.4 KILOWATT/1140L

- **9 KHz to 250 KHz**
- **All solid state**
- **Linear output**
- **Failsafe**
- **Driven by any signal source**
- **Weighs less than 45 lbs.**
- **Works from 115 volt outlet**

The ENI 1140L is a revolutionary development in high power solid state amplifiers. The 1140L is designed for high power RF heating, Ultrasonics and high power laboratory applications. Optional matching transformers will deliver full power to any load impedance from 3 ohms to 800 ohms balanced or unbalanced.

B. 40 WATT/240L

- **20 kHz to 10 MHz coverage**
- **Up to 150 watts CW & pulse output**
- **Works into any load impedance**

Extraordinary performance in a wide range of transducer drive applications. Deliver up to 150 watts into any load regardless of its impedance. Compatible with all signal and function generators, the 240L is a high quality laboratory instrument for ultrasonics, biological research and electro-optic modulation.

C. 20 WATT/320L

- **250 kHz to 110 MHz coverage**
- **50 dB ± 1 dB gain**
- **Less than 5 Nanosec rise time**

This low distortion unit is an outstanding performer in NMR/ENDOR spectroscopy and for laser modulation. Constant forward power is available regardless of load impedance.

D. 50 WATT/350L

- **250 kHz to 105 MHz**
- **50 dB ± 1.5 dB gain**
- **More than 100V RMS into high impedance load**

Portable and lightweight, this unit is rugged enough for field operation and powerful enough for use in AM, FM, SSB, and Data Communication Systems.

NEW 300 WATT/A-300

- **300 KHz to 35 MHz**
- **55dB ± 1dB gain**
- **Up to 500 Watts pulse and CW**

Highest power in a portable package. Top quality signal transmission in AM, SSB, and Pulse Communication Systems. Cannot be damaged by mistuned antenna.

WRITE FOR OUR CATALOGUE: ENI, 3000 WINTON ROAD SOUTH,
Call (716) 473-6900 or TELEX 97-8283 ENI ROC

in solid state RF power amplifiers

E.
H.
I.
G.
I.
F.
J.
503L RF POWER AMPLIFIER
2.5 WATTS LINEAR OUTPUT
POWER
INPUT
1 V MAX
40 dB
2-500 MHz
OUTPUT

E. 100 WATT/3100L
- 250 kHz to 105 MHz
- Up to 180 watts pulse
- Operates from 115/230V
- AC single phase line
- Driven by any signal generator

Designed to replace bulkier tube amplifiers, the model 3100L will provide reliable and maintenance free operation for NMR, ultrasonics and communications applications.

F. 2.7 WATT/403L
- 150 kHz to 250 MHz coverage
- 37 dB ± 1.5 dB gain
- 2.5 Nanosec pulse rise time

The extended frequency coverage of this compact power amplifier along with its ability to work into any load make it ideal for general laboratory work as well as signal distribution.

G. 5 WATT/406L
- 150 kHz to 250 MHz coverage
- 40 dB ± 1.5 dB gain
- 9 dB noise figure

This high reliability unit will withstand 20 dB of overdrive for all load conditions, including short and open circuits. Widely used in CATV and in-plant TV distribution systems.

H. 20 WATT/420L
- 150 kHz to 250 MHz coverage
- 45 dB ± 1.5 dB gain
- Class A linearity

The widest band solid state power amplifier available at its 20 watt power level, the ENI 420L is a truly state-of-the-art instrument. As a drive source for high resolution acousto-optic modulators and deflectors the Model 420L is invaluable.

ROCHESTER, NEW YORK 14623

I. 3 WATT/500P & 500L
- Flat 27 dB gain
- 8 dB noise figure
- 500 L has AC power supply
- 2 MHz to 500 MHz usable coverage
- Thin film hybrid construction
- 500 P requires 24 VDC at 0.3 AMP

These compact units can deliver more than 300 milliwatts from 1.7 MHz to 560 MHz at low distortion. A thin film microelectronic circuit is the heart of these general utility laboratory amplifiers. Extremely wide band response at a very modest price.

J. 3 WATT/503L
- Flat 40 dB gain
- Class A linearity
- More than 3 watts of linear power
- 1.8 to 510 MHz frequency coverage

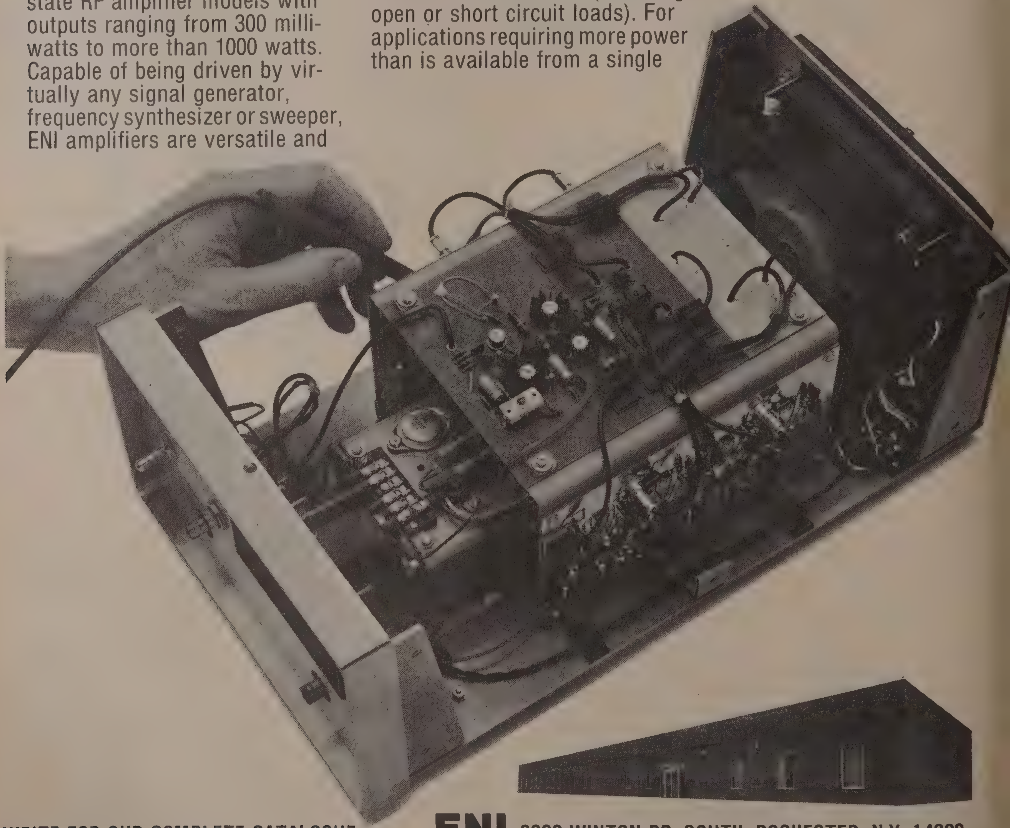
Three watts of power from 1.8 MHz to 510 MHz when driven by any laboratory signal generator. As a general purpose laboratory instrument and for wideband pulse systems the 503L is an exceptional unit.

Creative hands solving amplifier application problems worldwide.

THE COMPANY ENI's dedication to engineering excellence in the manufacture of RF power amplifiers has resulted in a growing list of more than 1,000 customers throughout the world. With over 55 field sales offices worldwide we can provide service and/or consultation that no other company offers ie; if we can't repair your unit in 5 days, we'll loan you a new one; 10 day free evaluation of our products, engineering assistance on applications problems is free, just call or write.

THE PRODUCTS Covering the frequency spectrum of 9 kHz to 1 GHz, ENI offers a full line of solid state RF amplifier models with outputs ranging from 300 milliwatts to more than 1000 watts. Capable of being driven by virtually any signal generator, frequency synthesizer or sweeper, ENI amplifiers are versatile and flexible sources of power for a wide variety of applications. Completely broadband and untuned, these highly linear units will amplify inputs of AM, FM, SSB, TV and pulse modulations with minimum distortion. Although all power amplifiers will deliver their rated power output to a matched load, only ENI power amplifiers will deliver their rated power to any load regardless of match. ENI units are designed to internally absorb reflected power from a mismatched load. Unconditional stability and failsafe design mean that the user need never fear damage or oscillation due to severe load conditions (including open or short circuit loads). For applications requiring more power than is available from a single unit, ENI Power Multicouplers permit the power addition of up t four amplifiers. Whether used a a laboratory instrument or for a OEM application, ENI can provid the right unit to suit your requirements.

THE GUARANTEE Free 10 Day evaluation of all products; 1 Ye Warranty (all parts and labor); Authorized factory service avai able in U.S.A., Europe, and Asia 100 percent inspection, 100 percent burn-in of all complete units.



WRITE FOR OUR COMPLETE CATALOGUE. **ENI** 3000 WINTON RD. SOUTH, ROCHESTER, N.Y. 14623

erc Digital Instruments

STANDARD FEATURES

- BCD Outputs
- Reliable LED Displays
- Rugged, All-Aluminum Enclosures
- 115 Vac, 50-400 Hz Power, Standard; most available with 220 Vac 50-400 Hz, 5 Vdc, or 10-30 Vdc Power Supplies
- Remote Control Inputs
- "All 8's" Power Failure Indicator w/Clocks, Counters and Stopwatches
- All Connectors and Mounting Hardware Supplied
- Complete Family of System Building Blocks

SELECTED OPTIONS

Options listed are those most frequently ordered. Dozens of other standard options are available to adapt ERC's digital instruments for special applications. Data sheets with complete specs, option lists, and prices are available for each series of instruments.

PRICES

FOB Overland Park, Kansas. Terms: Net 30 days. ERC reserves the right to change prices without notice. All orders subject to acceptance.

DELIVERY

Small quantity, stock to four weeks ARO. Larger quantity, request quotation.

WARRANTY

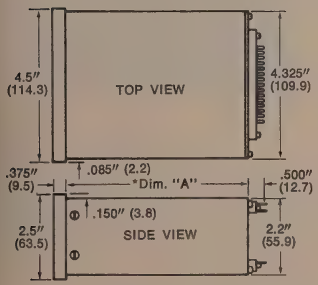
Electronic Research Company warrants instruments of its manufacture to be free from defects in material and workmanship for one year (12 months) from the date of original purchase. Any instrument found to be defective during this period may be returned, transportation prepaid, to the factory for repair or, at our option, replacement without charge.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons or which have had the serial number altered, effaced or removed. This warranty is in lieu of all other warranties whether expressed or implied.

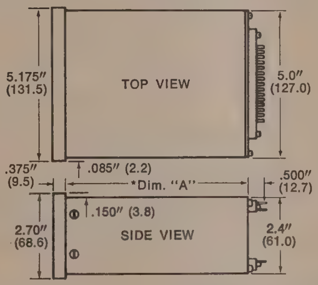
The instrument will be returned to the customer unrepaired unless the nature of the defect and the name and phone number of a person to contact is noted with the unit. Equipment returned should be forwarded directly to Electronic Research Company, attention: Instrument Repair Department.

CASE DIMENSIONS

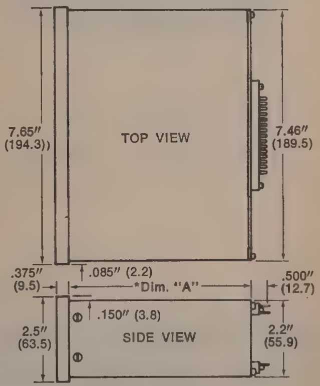
CASE SIZE I


4.5″
(114.3)
TOP VIEW
4.325″
(109.9)
.375″
(9.5)
.085″ (2.2)
*Dim. "A"
.500″
(12.7)
.150″ (3.8)
2.5″
(63.5)
SIDE VIEW
2.2″
(55.9)

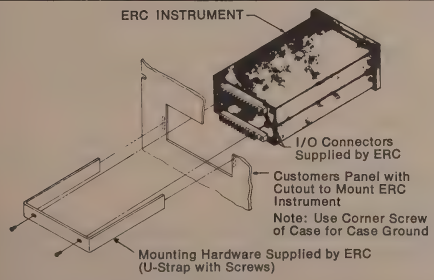
CASE SIZE II


5.175″
(131.5)
TOP VIEW
5.0″
(127.0)
.375″
(9.5)
.085″ (2.2)
*Dim. "A"
.500″
(12.7)
.150″ (3.8)
2.70″
(68.6)
SIDE VIEW
2.4″
(61.0)

CASE SIZE III


7.65″
(194.3))
TOP VIEW
7.46″
(189.5)
.375″
(9.5)
.085″ (2.2)
*Dim. "A"
.500″
(12.7)
.150″ (3.8)
2.5″
(63.5)
SIDE VIEW
2.2″
(55.9)

Millimeter equivalents shown in parentheses.


ERC INSTRUMENT
I/O Connectors
Supplied by ERC
Customers Panel with
Cutout to Mount ERC
Instrument
Note: Use Corner Screw
of Case for Case Ground
Mounting Hardware Supplied by ERC
(U-Strap with Screws)

INSTRUMENT MOUNTING DETAIL

CASE SIZE I

Panel Cutout Size: 4.375″ (111.1) x 2.250″ (57.2)

*Dimension A is 5.250″ (133.4) unless specified otherwise for a particular instrument.

CASE SIZE II

Panel Cutout Size: 5.063″ (128.6) x 2.469″ (62.7)

*Dimension A is 6.375″ (161.9) unless specified otherwise for a particular instrument.

CASE SIZE III

Panel Cutout Size: 7.575″ (192.4) x 2.250″ (57.2)

*Dimension A is 7.375″ (187.3) unless specified otherwise for a particular instrument.

Electronic Research Co.
a textron Division

7618 Wedd
Overland Park, Kansas 66204

Mail to P.O. Box 913
Shawnee Mission, Kansas 66201

TWX: 910-749-6477
Telephone: (913) 631-6700

erc Clocks and Timers

Model 2200 Precision Timer

erc
0 0.1 3 0
PRECISION TIMER
START STOP TIMING

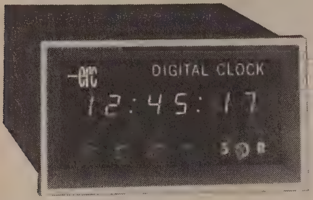
Features
- Wide timing range . . . 1 μsec to 999.99 secs
- Crystal-controlled oscillator for timing accuracy
- Time Selection by front panel switches
- Manual or electronic (remote) control with timer override (STOP) input
- TTL and relay outputs permit use in a wide range of timing applications

Price $249.0

Dimensions
Case Size II except Case Depth (Dim. A) is 7.250″ (184.2 mm).

Typical Applications
Use as timebase with ERC Series 2300 Counter allows scaling to read ou directly in RPM or other engineering units.
Accurate interval timing for process or laboratory control.
Control up to 28 Watts directly with internal relay.

Series 2400A Digital Clocks



Features
- 6-digit LED displays
- Available with Crystal or 60 Hz time base
- TTL-compatible BCD outputs
- Programmable time mark output available
- Battery backup capability

Models/Prices

Model No.	Time Base	Interval	Price
2401A	Crystal	12 Hr.	$353.00
2402A	Crystal	24 Hr.	353.00
2412A	60 Hz	24 Hr.	313.00

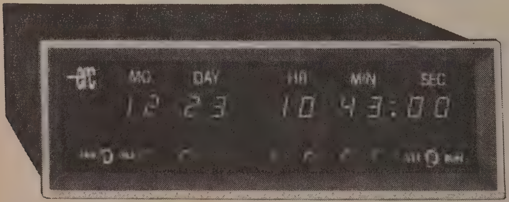
Selected Options

-01	Buffered, latchable, BCD outputs. Case Depth (Dim. A) is 7.250″ (184.2 mm)	add $40.0
-20	5 Vdc operation only	no charg
-22	220 Vac operation only	no charg
-26	No ERC logo	add $10.0
-28	Blank lens (no legends or logos)	add $ 5.0

Dimensions Case Size I

Typical Applications
Time-of-day display and systems use. One pps and 10 pps TTL outputs are useful for sequencing and timing. BCD outputs interface with printer for recordin time of printout of other system parameters. Uninterruptible timing is provide by use of Series 5200 Battery Backup System.

Series 2440A/2450A Calendar Clocks



Features
- LED displays
- Buffered, latchable, TTL-level BCD outputs
- Day-of-year or Month-day versions available
- Available with Crystal or 60 Hz time base
- Programmable time mark output (Models 2450A-2456A only)
- Battery backup capability

Dimensions Case Size III

Models/Prices

Month-day Models				Day-of-year Models			
Model No.	Display	Time Base	Price	Model No.	Display	Time Base	Price
*2450A	12 Hr.	60 Hz	$535.00	*2440A	12 Hr.	60 Hz	$495.00
2451A	24 Hr.	60 Hz	535.00	2441A	24 Hr.	60 Hz	495.00
*2455A	12 Hr.	Crystal	565.00	*2445A	12 Hr.	Crystal	535.00
2456A	24 Hr.	Crystal	565.00	2446A	24 Hr.	Crystal	535.00

*12 Hr. Clocks have AM/PM LED indicator.

Selected Options

-20	5 Vdc operation only	no charg
-22	220 Vac operation only	no charg
-26	No ERC logo	add $10.0

Typical Applications
Date and time-of-day display and systems use. One pps an 10 pps TTL outputs are useful for sequencing and timing BCD outputs interface with printer for recording time of print out of other system parameters. Uninterruptible timing provided by use of Series 5200 Battery Backup System.

Electronic Research Co.
a textron Division

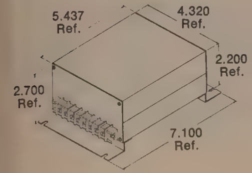
7618 Wedd
Overland Park, Kansas 66204

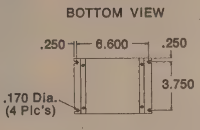
Mail to P.O. Box 913
Shawnee Mission, Kansas 66201

TWX: 910-749-6477
Telephone: (913) 631-6700

ERC Clocks and Timers

Battery Backup System for Series 2400A, 2440A and 2450A Clocks





Mounting Dimensions

Features
- No loss of clock logic during power outages
- Automatic switchover
- 8, 16, or 24 hour operation
- Keeps batteries charged between power outages

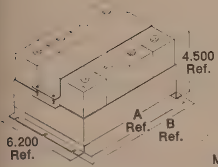
Model 5200 Battery Charger/Switchover Unit

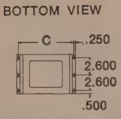
Price $125.00

Series 5210 Battery Pack

Models/Prices

Model	No. of Batteries	Discharge Time	Charge Time	Dimensions A	Dimensions B	Dimensions C	Price
5212	2	8 Hrs.	12 Hrs.	4.1″ (104.1 mm)	5.1″ (129.5 mm)	4.6″ (116.8 mm)	$ 77.00
5214	4	16 Hrs.	24 Hrs.	8.1″ (205.7 mm)	9.1″ (231.1 mm)	8.6″ (218.4 mm)	119.00
5216	6	24 Hrs.	36 Hrs.	12.1″ (307.3 mm)	13.1″ (332.7 mm)	12.6″ (320.0 mm)	165.00





Mounting Dimensions

Series 2600 Digital Stopwatches/Time Interval Meters

SECONDS
59.31
START
STOP
RESET

Features
- 3 to 6 digit LED displays
- Parallel BCD outputs
- Crystal or 60 Hz time bases available
- Front-panel or remote-control operation

Dimensions Case Size I

Models/Prices

60 Hz Time Base			Crystal Time Base		
Model No.	**Display**	**Price**	**Model No.**	**Display**	**Price**
2631	99.9 seconds	$218.00	2610	999 seconds	$250.00
2632	9:59 min/sec		2611	99.9 seconds	
2634	99.9 minutes		2612	9.99 seconds	
			2613	.999 seconds	
			2614	9:59 min/sec	
			2615	99.9 minutes	
			2616	9.99 minutes	
			2651	99.9 milliseconds	
			2652	9.99 milliseconds	
			2653	.999 milliseconds	

Note: To add digits to basic unit see options -31, -32, -33.

Examples:	
Needed 99.99 seconds	Select a 2612-31.
Needed 999.9 minutes	Select a 2634-31.
Needed 999.999 seconds	Select a 2613-33.

Selected Options

-01	Buffered, latchable BCD outputs. Case Depth (Dim. A) is 7.250″ (184.2 mm)	add $40.00
-05	Stored display. Holds last reading until next reading is complete. Includes buffered and latched BCD outputs. Case Depth (Dim. A) is 7.250″ (184.2 mm)	add $40.00
-10	Delete front panel switches, remote control operation only	no charge
-12	10-30 Vdc operation only	add $60.00
-15	Bench Mount w/line cord	add $40.00
-18	Reset switch only	add $10.00
-20	5 Vdc operation only	no charge
-22	220 Vac operation only	no charge
-26	No ERC logo	add $10.00
-31	Add 1 digit to the left of display	add $25.00
-32	Add 2 digits to the left of display	add $50.00
-33	Add 3 digits to the left of display	add $75.00

Note: Count-down models are available. Contact the factory for details.

Typical Applications

Remote control inputs facilitate accurate time interval measurement in a wide variety of applications.

An ERC Series 2600 Stopwatch and a Series 2500 single-limit BCD Tracking Comparator make a presettable precision timing system.

Mission Clock (not shown)

Features
- External time preset input
- External control line for count direction
- Crystal time base
- Polarity indication
- Thru zero operation
- ±99:59:59 Hr/Min/Sec display

Model 2690A $371.00

Dimensions Case Size II

erc Counters

Preset Counter-Comparators

erc
COMPARATOR
LO
HI
+00395

Features

- Serial TTL pulse-train inputs
- "HI" and "LO" limit LED indicators plus "IN" LED indicators for dual-limit models
- Logic and relay outputs facilitate a variety of interface applications
- TTL compatibility

Models/Prices/Dimensions

Model No.	Number of Digits	Case Size	Price
Single Limit Models			
2504-01	4	I	$200.00
2505-01	5	I	215.00
2506-01	6	II	230.00
2507-01	7	II	245.00
Dual Limit Model			
2524-01	4	II	$290.00

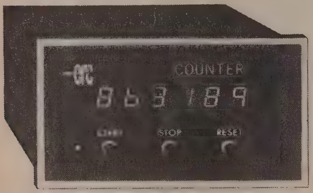
Selected Options

-02	Auto-Reset	add $25.00
-20	5 Vdc operation only	no charge
-26	No ERC logo	add $10.00

Typical Applications

A Series 2500 Preset Counter-Comparator with the Auto-Reset option is a complete batching system.

Series 2300 Totalizing Counters



Features

- 3 to 6 digit LED displays
- TTL-compatible BCD outputs
- TTL or contact closure inputs or Low-level input (10 mV rms min.)
- Rugged all-aluminum enclosures
- Schmitt-trigger input (Models 2324 and 2326 only)

Models/Prices/Dimensions

Model No.	No. of Digits	Input Type	Max. Count Rate	Case Size	Price
Unidirectional Counters					
2303A	3	TTL or Contact Closure	10 MHz	I	$216.00
2304A	4	TTL or Contact Closure	10 MHz	I	252.00
2305A	5	TTL or Contact Closure	10 MHz	I	283.00
2306A	6	TTL or Contact Closure	10 MHz	I	316.00
2306B	6	Low-level sine wave	10 KHz	I	335.00
*2324	4	TTL or Contact Closure and low-level sine wave	50 KHz	II	260.00
*2326	6	TTL or Contact Closure and low-level sine wave	50 KHz	II	300.00
Bidirectional Counters					
2313A	3½	TTL or Contact Closure	100 KHz	I	$245.00
2314A	4½	TTL or Contact Closure	100 KHz	I	278.00
2315A	5½	TTL or Contact Closure	100 KHz	I	315.00
2316A	6½	TTL or Contact Closure	100 KHz	I	351.00
2316B	6½	Low-level sine wave	10 KHz	I	371.00
2317A-04	7½	TTL or Contact Closure	100 KHz	II	436.00
2317B-04	7½	Low-level sine wave	10 KHz	II	456.00

*Series 2320 Industrial Counters have buffered and latched BCD outputs standard. Case Dept (Dim. A) is 7.250″ (184.2 mm).

Selected Options

-01	Buffered, latchable, BCD outputs. Case Depth (Dim. A) is 7.250″ (184.2 mm). (Standard on Models 2324 and 2326)	add $40.0
-03	Quadrature input logic. Count input is two signals approximately 90 degrees out of phase. Direction of count is determined by which signal leads or lags (Models 2313-2317 only)	add $50.0
-04	Presettable inputs, bidirectional models only. Case Size II	add $50.0
-10	No switches	no charg
-12	10-30 Vdc operation only	add $60.0
-18	Reset switch only	add $10.0
-20	5 Vdc operation only	no charg
-22	220 Vac operation only	no charg
-26	No ERC logo	add $10.0
-28	Blank lens (no legends or logos)	add $ 5.0

Typical Applications

Series 2300 Counters find wide application in batching and counting systems BCD outputs interface with a printer for automatic recording or with an ERC Series 2500 Comparator for preset limit control. A bidirectional counter and dual-limit comparator can control a closed loop system.

Electronic Research Co.
a textron Division
7618 Wedd
Overland Park, Kansas 66204
Mail to P.O. Box 913
Shawnee Mission, Kansas 66201
TWX: 910-749-6477
Telephone: (913) 631-6700

ERC Counters

Series 2800 Digital Presets

PRESET
1 0 0 0 0 1

Features

- Thumbwheel-switch preset selection
- TTL-compatible, buss-oriented BCD outputs (preset units can be selected remotely)

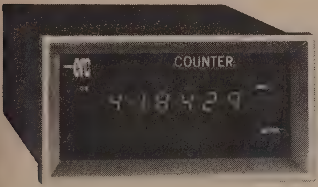
Models/Prices/Dimensions

Model No.	Digits	Case Size	Price
2804-01	±9999	I	$145.00
2806-01	±999999	II	165.00

Typical Applications

Generate BCD numbers for Series 2300 Presettable Counters and Series 2600 Time Interval Meters or to remotely select limits for Series 2500-03 Comparators.

Series 2700A Frequency Meters/Tachometers



Features

- Crystal time base
- 10 Hz to 20 MHz operation
- 4 and 6 digit LED displays
- Eight selectable time bases — 1, 10, 100 and 600 msecs and 1, 6, 10 and 60 sec.
- Accepts sine and square wave inputs
- 100 mV rms sensitivity
- Auto-reset insures accuracy of first reading
- Decimal point position externally selectable

Models/Prices

Model No.	Display	Price
2704A	9999	$340.00
2706A	999999	380.00

Selected Options

-01	Free-running gate; counter continuously gates without input signal present	add $15.00
-03	Front panel controls including mode select switch, sensitivity pot., and BNC input connector	add $40.00
-15	Bench Mount w/line cord	add $40.00
-22	220 Vac operation only	no charge
-26	No ERC logo	add $10.00
-28	Blank lens (no legends or logos)	add $ 5.00
-38	TTL input only	less $20.00

Dimensions Case Size II

Typical Applications

Used with ERC Series 2500 BCD Tracking Comparator, the Series 2700 Counter can display and control speed or events-per-unit-time.

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Overland Park, Kansas 66204

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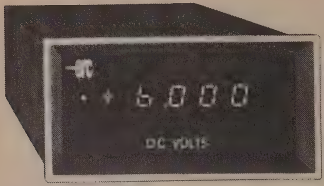
Telephone: (913) 631-6700

erc Voltmeters

Series 3500 Digital Panel Voltmeters w/5999 Count Full Scale



Features

- Optically-isolated BCD outputs
- Models available for 115 Vac or 220 Vac, 50-400 Hz; 5 Vdc; 10-30 Vdc; 20-60 Vdc
- Accuracy ±0.015% R, ±0.015% F.S., ±1 digit
- Auto Polarity
- Reliable LED displays
- Readout scaling capability
- Decimal point position externally selectable

Models

Model No.	Full Scale	Resolution	Input Resistance	Input Protection (Max. Signal Volt.)	Input Bias
3500	599.9 mV	100 µV	100 Megohms	130 Vac (RMS)	3 nA
3501	5.999 V	1 mV	1000 Megohms	130 Vac (RMS)	3 nA
3502	59.99 V	10 mV	1 Megohm	600 Vac (RMS)	0.3 nA

Price	All Models	$273.00

Selected Options

-12	10-30 Vdc operation only	add $50.00
-14	20-60 Vdc operation only	add $50.00
-15	Bench Mount w/line cord	add $40.00
-20	5 Vdc operation only	less $16.00
-22	220 Vac operation only	no charge
-26	No ERC logo	add $10.00
-28	Blank lens (no legends or logos)	add $ 5.00

Dimensions Case Size II, except Case Depth (Dim. A) is 7.250″ (184.2 mm).

Typical Applications

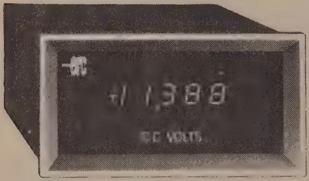
Use to convert output of transducer to BCD form. Then use ERC Series 2500 Comparator for control.

Interface with line printer. Use ERC Series 2400 Clock for periodic print command for automatic recording system.

Use external time base to scale voltmeter to read out in engineering units (RPM, pounds, gallons, etc.).

Many applications in automatic testing.

Series 4000 Digital Panel Voltmeters



Features

- TTL-compatible parallel BCD outputs
- Auto Polarity
- Stored LED displays
- Remote conversion controls
- Input isolated from BCD outputs

Models

Model No.	Full Scale	Resolution	Input Z	Accuracy @ 25°C ± 1°C	Input Protection (Max. Signal Volt.)
4010	199.99 mVdc	10 µV	100 Meg	0.01%R±0.02%F.S.	100 V
4000	1.9999 Vdc	100 µV	100 Meg	0.01%R±0.01%F.S.	100 V
4001	19.999 Vdc	1 mV	1 Meg	0.01%R±0.01%F.S.	500 V
4002	199.99 Vdc	10 mV	1 Meg	0.01%R±0.01%F.S.	500 V
4003	999.9 Vdc	100 mV	1 Meg	0.01%R±0.01%F.S.	1200 V

Price	All Models	$450.00

Selected Options

-15	Bench Mount w/line cord	add $40.00
-22	220 Vac operation only	no charge
-26	No ERC logo	add $10.00
-28	Blank lens (no legends or logos)	add $ 5.00

Dimensions Case Size I except Case Depth (Dim. A) is 7.250″ (184.2 mm).

Typical Applications

Use to convert output of transducer to BCD form and use ERC Series 2500 Comparator for control.

Interface with printer. Use Series 2400 Clock for periodic print command for automatic recording system.

Many applications in automatic testing.

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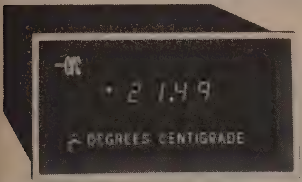
erc Temperature Indicators

Series 9300 Temperature Indicators



Features
- Temperature range of −60°C to +160°C
- Probe certification traceable to NBS
- Resolution to 0.01 degree
- Overall system is accurate to ±0.5°C
- TTL compatible, parallel BCD outputs
- Analog recorder output, 10 mV/°

Models/Prices

Model No.	Measurement Range	Resolution	Price
9300C	−60.00°C to +160.00°C	0.01°C	$645.00
9300F	−76.00°F to +199.99°F	0.01°F	645.00
9301F	−76.0°F to +320.0°F	0.1°F	645.00
9330C	−60.0°C to +160.0°C	0.1°C	600.00
9330F	−76.0°F to +199.9°F	0.1°F	600.00
9331F	−76°F to +320°F	1°F	600.00

Silicon Sensor Probes For use with Series 9300 Temperature Indicators

Probe No.	Description	Price
P-100	½″ Dia. Disc Surface Probe	$45.00
P-101	3/16″ Dia., General Purpose, Tubular, 10″ Long w/⅛″ NPT Pipe Fitting	55.00
P-102	3/16″ Dia., General Purpose, Tubular, 10″ Long	50.00
P-103A	⅛″ Dia., General Purpose, Bead, 0.4″ Long	45.00

Selected Options

-04	10 Probe Input w/selector switch	add $75.00
-15	Bench Mount Case w/line cord	add $40.00

Dimensions Case Size II except Case Depth (Dim. A) is 7.250″ (184.2 mm).

Typical Applications

BCD outputs allow interface with a line printer for automatic recording systems or use with ERC BCD Tracking Comparator for temperature control. Analog output allows use of stripchart recorder.

Series 9500 Thermocouple Indicators

erc
+1492
DEGREES FAHRENHEIT

Features
- 1 degree resolution
- Digital thermocouple linearization
- Grounded or floating T/C operation
- 500 Vdc input/output isolation
- TTL compatible, parallel BCD outputs
- Cold-reference junction compensation
- Large 0.6″ high LED display

Models/Prices

Model No.	Temp. Range	T/C Type	Price
9500KF	0-1999°F	K	$695.00
9500JF	0-1600°F	J	695.00
9500KC	0-1371°C	K	695.00
9500JC	0-1200°C	J	695.00

Note: T/C Type J is Iron-Constantan
T/C Type K is Chromel-Alumel

Selected Options

-15	Bench Mount Case w/line cord	add $40.00
-22	220 Vac operation only	no charge
-26	No ERC logo	add $10.00

Dimensions Case Size II except Case Depth (Dim. A) is 7.250″ (184.2 mm).

Typical Applications

BCD outputs facilitate application in automatic temperature control and recording systems.

erc Companion Instruments

Parallel BCD Tracking Comparators

erc
COMPARATOR
LO
IN
HI
-3924+0298

Features

- Accepts Parallel BCD data
- "HI" and "LO" limit LED indicators plus "IN" LED indicator for dual-limit models
- Logic and relay outputs facilitate variety of interface applications
- TTL compatibility
- Series 2550 single-limit models compare on external command (strobe)

Models/Prices/Dimensions

Model No.	Number of Digits	Case Size	Price
Single-Limit Models			
2513	3	I	$200.00
2514	4	I	215.00
2515	5	I	230.00
*2554	4	I	205.00
*2555	5	I	215.00
*2556	6	I	225.00
*2557	7	I	235.00
Dual-Limit Models			
2543	3	II	$275.00
2544	4	II	310.00

*Units compare on external command (strobe).

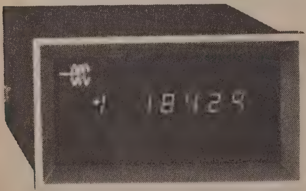
Selected Options

-03 Remote control limit selection. Limits can be set by front-panel thumbwheel switches or by external BCD program commands.... add $50.00
-20 5 Vdc operation only .... no charge
-22 220 Vac operation only .... no charge
-26 No ERC logo .... add $10.00

Typical Applications

A dual-limit comparator used with a DPM, temperature indicator, or any meter which has stored BCD outputs can be used to preset high and low alarm points. The single-limit comparator may be used if only one present alarm point is needed.

Series 2900 Remote Displays



Features

- Accepts parallel BCD input
- 4½- and 5½-digit LED displays, 0.43" high
- Latchable, TTL-compatible BCD inputs
- 115 Vac, 50-400 Hz operation

Models/Prices/Dimensions

Model No.	Display	Case Size	Price
2904-01	±19999	I	$180.00
2905-01	±199999	I	190.00

Typical Applications

Use for remote display of BCD data from any ERC digital instrument or paralle BCD source of 5½ digits or less. Remote display will interface with an absolute encoder for visual display of angular position.

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ELGENCO INCORPORATED

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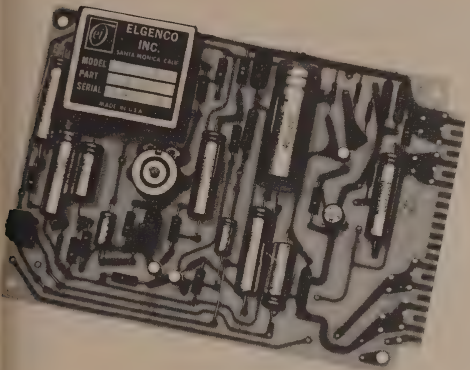
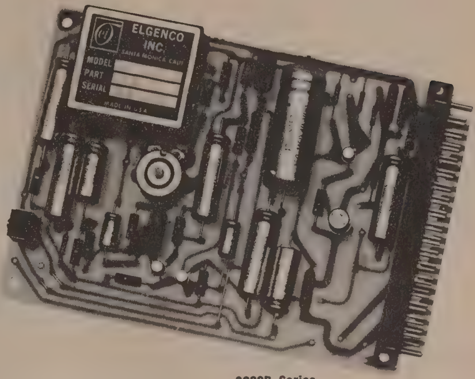
1550 EUCLID STREET • SANTA MONICA, CALIFORNIA 90404 • (213) 451-1635

SERIES 3600 FIXED RANGE • NOISE GENERATOR CARDS



3600A Series



3600B Series

SPECIFICATIONS

FREQUENCY RANGE: The frequency band may be any combination of the listed low and high frequencies.

Lower Frequency: 10, 20, 50, or 200 Hz, 5 kHz.

Upper Frequency: 20, 50, 100, 200, or 500 kHz; 1, 2, 3, or 5 mHz.

SPECTRAL UNIFORMITY: Spectral uniformities are available as:

Upper Frequency	Spectral Uniformity
20 kHz to 500 kHz	±0.5, ±1.0, ±2.0 or ±3.0db
1 mHz to 3 mHz	±1.0, ±2.0, or ±3.0db
5 mHz	±2.0 or ±3.0db

As a rule of thumb, the roll off above the specified upper frequency gives a 3db point about twice the specified upper frequency. Roll off above 3db point approaches 12db per octave.

OUTPUT IMPEDANCE:

20 kHz to 500 kHz units	600 ohms
1 to 5 mHz units	200 ohms

POWER REQUIREMENTS:

	3600A Series or 3600B Series	Low Current Option 3600A or 3600B	3600C Series
Power supply voltage required	−30 VDC ±1%	−30 VDC ±1%	−24 VDC ±1%
Approximate current	50 ma	30 ma	37 ma
Output level	0 to 3.0 VRMS	0 to 1.5 VRMS	0 to 2.2 VRMS

Note: The 3600B series units are the same as the 3600A series except the 3600B series have a test point and Elco 00-7023-035-000-001 connector mounted on the PCB.

The 3600A and 3600C units mate with a Cinch 250-22-30-170, Elco 00-6007-022-940-022 connector or equivalent.

SPECIFICATIONS COMMON TO ALL UNITS:

Amplitude Probability Distribution: Gaussian.

Peak to RMS Capability: Minimum dynamic ranges 3.5 to 1 at specified maximum level. Increases with lower output levels.

Maximum Load: 900 ohms minus output impedance.

Operating Temperature Range: 0 to 50°C.

Size: 4½ x 6½ x ⅞ inches.

Weight: 7 oz.

PRICING: (See price list on facing page)

Base Price: 3600A, 3600C and 3600A or C with reduced current option (specify on order).

Base price plus $18.00: 3600B or 3600B with reduced current option (specify on order).

OPTIONS:

Other than specified frequency; add $10.00 each per frequency per board.

Steel shield plate, ¼-inch off conductor side of PCB; add $6.00 each.

Other than specified output impedance; add $5.00 each.

To operate on other power supply voltages, voltage difference must be 30-volts for 3600A or 3600B and 24-volts for 3600C. Specify on order; "Decoupled option for operation on ________ power supply," and add to price as:

Quantity Per Order	Add Each	Quantity Per Order	Add Each
1	$15.00	25-49	$2.50
2	10.00	50-99	2.00
3	7.50	100-249	1.95
4	6.00	250-499	1.90
5-9	5.00	500 up	1.85

DISCOUNT: Quantity discounts apply as:

Quantity	Discount	Quality	Discount
1-4	List	20-49	13%
5-9	5%	50-99	17%
10-19	10%	100	20%

MODEL 3609A POWER SUPPLY CARD

Size: 4½″ x 6½″ x 2 1/16″.

Input: 115/230 volts ± 10/20 volts, 50 to 1000 Hz.

Supplies power for up to 2 noise generator cards or up to 4 noise generator cards with reduced current option. Price: **$90.00**

MATING CONNECTOR: Mating Elco Connector; Elgenco, Inc. part numbers 7521-1122, for 3600A, 3600C and 3609A is available at $7.85 each.

ELGENCO INCORPORATED
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1550 EUCLID STREET • SANTA MONICA, CALIFORNIA 90404 • (213) 451-1635

SERIES 1600 • ENCAPSULATED NOISE SOURCE MODULES • 10Hz TO 5MHz

ELGENCO
INC.
SANTA MONICA CALIF.
MODEL
PART
SERIAL
MADE IN U.S.A.

SPECIFICATIONS IN RECOMMENDED CIRCUIT:

The 1600 series provide a low level wide band output. A portion of this wide band is specified to a certain flatness; uniformity. The 3 or 5 millivolt output is for the whole band extending to 5 mHz. Specifications are for 25°C unless specified otherwise.

SPECTRAL DENSITY UNIFORMITY: Available with uniformity to ±½db, ±1db, ±2db, or ±3db and many frequency ranges within 10 Hz to 5 mHz. See price list for complete list of standards.

SPECTRAL DENSITY: Approximately 2 $\mu v/\sqrt{\ }$ Hz .

RMS OUTPUT LEVEL: 1602A series 3 mv; 1603A, 1606A, and 1607A series 5 mv.

OUTPUT IMPEDANCE: Approx 20 ohms.

AMPLITUDE PROBABILITY DISTRIBUTION: Gaussian.

OPERATING TEMPERATURE RANGE: 0 to 50°C.

POWER REQUIREMENTS: −30 volts dc ±1% at approximately 3.5 ma.
Note: external passive components are required to properly install unit.

MOUNTING: .032″ Printed Circuit Leads.

Size: 11/16″ H x 1 51/64″ W x 1 37/64″ D.

WEIGHT: Approx 1.5 oz.

SERIES 3600/1600 PRICES

Frequency Band	Flatness	SERIES 3600 CARDS Model No.	SERIES 3600 CARDS Price	SERIES 1600 MODULES Model No.	SERIES 1600 MODULES Price
200 Hz to 20 kHz	±½db	3606A-52224	$314.00	1606A-52224	$255.00
50 Hz to 20 kHz	±½db	-55124	$324.00	-55124	$265.00
20 Hz to 20 kHz	±½db	-52124	$344.00	-52124	$285.00
10 Hz to 20 kHz	±½db	-51124	$379.00	-51124	$305.00
200 Hz to 50 kHz	±½db	3606A-52254	$334.00	1606A-52254	$275.00
50 Hz to 50 kHz	±½db	55154	$344.00	-55154	$285.00
20 Hz to 50 kHz	±½db	-52154	$364.00	-52154	$305.00
10 Hz to 50 kHz	±½db	-51154	$399.00	-51154	$330.00
200 Hz to 100 kHz	±½db	3606A-52215	$354.00	1606A-52215	$295.00
50 Hz to 100 kHz	±½db	-55115	$364.00	-55115	$305.00
20 Hz to 100 kHz	±½db	-52115	$384.00	-52115	$325.00
10 Hz to 100 kHz	±½db	-51115	$419.00	-51115	$350.00
200 Hz to 200 kHz	±½db	3606A-52225	$369.00	1606A-52225	$310.00
50 Hz to 200 kHz	±½db	-55125	$379.00	-55125	$320.00
20 Hz to 200 kHz	±½db	-52125	$399.00	-52125	$340.00
10 Hz to 200 kHz	±½db	-51125	$434.00	-51125	$360.00
200 Hz to 500 kHz	±½db	3606A-52255	$389.00	1606A-52255	$330.00
50 Hz to 500 kHz	±½db	-55155	$399.00	-55155	$340.00
20 Hz to 500 kHz	±½db	-52155	$419.00	-52155	$360.00
10 Hz to 500 kHz	±½db	-51155	$454.00	-51155	$385.00
200 Hz to 20 kHz	±1db	3602A-12224	$189.00	1602A-12224	$130.00
50 Hz to 20 kHz	±1db	-15124	$199.00	-15124	$140.00
20 Hz to 20 kHz	±1db	-12124	$219.00	-12124	$160.00
10 Hz to 20 kHz	±1db	-11124	$254.00	-11124	$185.00
200 Hz to 50 kHz	±1db	3602A-12254	$209.00	1602A-12254	$150.00
50 Hz to 50 kHz	±1db	-15154	$219.00	-15154	$160.00
20 Hz to 50 kHz	±1db	-12154	$239.00	-12154	$180.00
10 Hz to 50 kHz	±1db	-11154	$274.00	-11154	$205.00
200 Hz to 100 kHz	±1db	3603A-12215	$229.00	1603A-12215	$170.00
50 Hz to 100 kHz	±1db	-15115	$239.00	-15115	$180.00
20 Hz to 100 kHz	±1db	-12115	$259.00	-12115	$200.00
10 Hz to 100 kHz	±1db	-11115	$294.00	-11115	$225.00
200 Hz to 200 kHz	±1db	3603A-12225	$244.00	1603A-12225	$185.00
50 Hz to 200 kHz	±1db	-15125	$254.00	-15125	$195.00
20 Hz to 200 kHz	±1db	-12125	$274.00	-12125	$215.00
10 Hz to 200 kHz	±1db	-11125	$309.00	-11125	$240.00
200 Hz to 500 kHz	±1db	3603A-12255	$264.00	1603A-12255	$205.00
50 Hz to 500 kHz	±1db	-15155	$274.00	-15155	$215.00
20 Hz to 500 kHz	±1db	-12155	$294.00	-12155	$235.00
10 Hz to 500 kHz	±1db	-11155	$329.00	-11155	$260.00
200 Hz to 50 kHz	±2db	3602A-22254	$189.00	1602A-22254	$130.00
50 Hz to 50 kHz	±2db	-25154	$199.00	-25154	$140.00
20 Hz to 50 kHz	±2db	-22154	$219.00	-22154	$160.00
10 Hz to 50 kHz	±2db	-21154	$254.00	-21154	$185.00
200 Hz to 100 kHz	±2db	3602A-22215	$194.00	1602A-22215	$135.00
50 Hz to 100 kHz	±2db	-25115	$204.00	-25115	$145.00
20 Hz to 100 kHz	±2db	-22115	$224.00	-22115	$165.00
10 Hz to 100 kHz	±2db	-21115	$259.00	21115	$190.00
200 Hz to 200 kHz	±2db	3602A-22225	$214.00	1602A-22225	$155.00
50 Hz to 200 kHz	±2db	-25125	$224.00	-25125	$165.00
20 Hz to 200 kHz	±2db	-22125	$244.00	-22125	$185.00
10 Hz to 200 kHz	±2db	-21125	$279.00	-21125	$210.00
200 Hz to 500 kHz	±2db	3602A-22255	$229.00	1602A-22255	$170.00
50 Hz to 500 kHz	±2db	-25155	$239.00	-25155	$180.00
20 Hz to 500 kHz	±2db	-22155	$259.00	-22155	$200.00
10 Hz to 500 kHz	±2db	-21155	$299.00	-21155	$225.00
200 Hz to 500 kHz	±3db	3602A-32255	$189.00	1602A-32255	$130.00
50 Hz to 500 kHz	±3db	-35155	$199.00	-35155	$140.00
20 Hz to 500 kHz	±3db	-32155	$229.00	-32155	$160.00
10 Hz to 500 kHz	±3db	-31155	$254.00	-31155	$185.00
5 kHz to 1 mHz	±1db	3607A-15316	$380.00	1607A-15316	$311.00
5 kHz to 2 mHz	±1db	-15326	$470.00	-15326	$401.00
5 kHz to 3 mHz	±1db	-15336	$570.00	-15336	$501.00
5 kHz to 1 mHz	±2db	3607A-25316	$290.00	1607A-25316	$221.00
5 kHz to 2 mHz	±2db	-25326	$365.00	-25326	$296.00
5 kHz to 3 mHz	±2db	-25336	$445.00	-25336	$376.00
5 kHz to 5 mHz	±2db	-25356	$605.00	-25356	$536.00
5 kHz to 1 mHz	±3db	3607A-35316	$230.00	1607A-35316	$161.00
5 kHz to 2 mHz	±3db	-35326	$290.00	-35326	$221.00
5 kHz to 3 mHz	±3db	-35336	$360.00	-35336	$291.00
5 kHz to 5 mHz	±3db	-35356	$495.00	-35356	$426.00

NOTE: A SERIES TO OPERATE ON −30VDC
C SERIES TO OPERATE ON −24VDC, PRICE SAME AS (A) SERIES

TO EXTEND 3607A LOW FREQUENCY ADD AS FOLLOWS:

200 Hz add $30.00
50 Hz add $40.00
20 Hz add $60.00
10 Hz add $95.00

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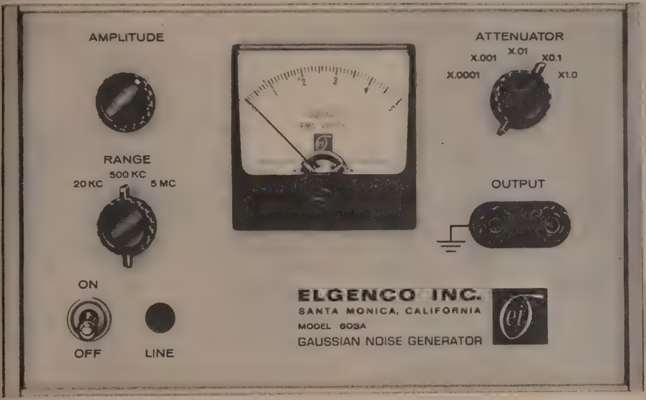
MODELS 602A-200/602A-1390/603A • ALL SOLID STATE NOISE GENERATORS 5 Hz TO 5 MHz



SPECIFICATIONS:

These specs are unique to the Series 602A-200, 602A-1390, 603A introduced on this page.

FREQUENCY RANGES: 5 Hz to 20 kHz, 5 Hz to 500 kHz, 5 Hz to 5 mHz.

AMPLITUDE PROBABILITY DISTRIBUTION: Gaussian.

OUTPUT SPECTRUM:

Accuracy	602A-1390	602A-200	603A
20 Hz to 20 kHz	±1 db	±1 db	—
20 Hz to 500 kHz	±3 db	±2.5 db	—
500 kHz to 5 mHz	±8 db	±5 db	—
10 Hz to 500 kHz	—	—	±1 db
500 mHz to 5 mHz	—	—	±3 db

RMS OUTPUT LEVEL: (Minimum value of maximum open circuit output).

20 kHz range	3 volts	3 volts	3 volts
500 kHz range	2 volts	2.5 volts	3 volts
5 mHz range	1 volt	2.0 volts	3 volts

OUTPUT IMPEDANCE:

	900 ohms ±10%	200 ohms ±10%	200 ohms ±10%

MAXIMUM LOAD: (on direct output)

	no limit	700 ohms	700 ohms

OUTPUT STEP ATTENUATOR: Five positions: X1.0, X0.1, X.01, X.001, and X.0001; calibrated to work into open circuit. Accuracy:

to 100 kHz	±3%	±3%	—
to 500 kHz	—	—	±3%
to 5 mHz	±10%	±10%	±5%
Output Impedance	200 ohms —	200 ohms ±1%	200 ohms ±1%

SPECTRAL DENSITY: Approximate spectral density (mv √ Hz) for 1 volt RMS output.

20 kHz band	5.0	5.0	5.0
500 kHz band	1.2	1.2	1.2
5 mHz band	0.6	0.4	0.4

PRICE

	$515.00	$625.00	$785.00

SPECIFICATIONS • ALSO COMMON TO SERIES 624A

These specs are common to the Series 602A-200, 602A-1390, 603A introduced on this page and the Series 624A on facing page.

DYNAMIC RANGE: 3.5 to 1 peak to RMS at 3 volts RMS open circuit; 5 to 1 at 2.1 volts RMS. Dynamic range is inversly proportional to output level as set by front panel amplitude control.

OUTPUT METER: Rectifier type meter circuit reads proportional to average value, calibrated to read RMS value of Gaussian Noise; 0-5 volts RMS scale.

OPERATING TEMPERATURE RANGE: 0 to 50°C.

POWER SUPPLY: Built-in highly regulated dc supply.

POWER REQUIREMENTS: 115/230 volts ±10/20 volts, 50 to 1,000 Hertz ac; approximately 5 watts. A rechargeable battery option is available. Battery is recharged by operating unit on ac line.

DIMENSIONS: 5¼″ high x 8⅝″ wide x 11″ deep.

RACK MOUNT: A rack mounting adapter kit is available for rack mounting two units side by side. Also available is a rack mounting adapter kit for rack mounting one unit. One or two units use 5¼″ x 19″ of rack panel space with adapter kit. Full rack width cabinet option for one unit is available. Size of unit with this option is 5¼″ high x 17″ wide x 11″ deep and comes with rack mounting hardware.

SHIPPING WEIGHT: Approximately 12 lbs.

OPTIONS AVAILABLE: Full rack width cabinet with mounting hardware option; rechargeable battery option; BNC output terminal on rear panel option.

ACCESSORIES AVAILABLE: Dual adapter kit and rack mounting hardware; single unit adapter kit with rack mounting hardware and front and rear dummy panels; rechargeable battery adapter kit.

OPTIONS & ACCESSORIES FOR MODELS 602A/603A/610A & SERIES 624A

Adapter kit, single unit rack mounting (mounts one unit in rack, includes blank panel to make dual unit) Part No. 8804-0002	$95.00
Adapter kit, dual unit and rack mounting hardware (mounts two units side by side) Part No. 8804-0001	$15.00
Full rack width cabinet and rack mounting hardware option	add $60.00
Pink filters, Part No. 8890-0015	$73.00
Rechargeable battery option	add $255.00
Rechargeable battery kit	$265.00

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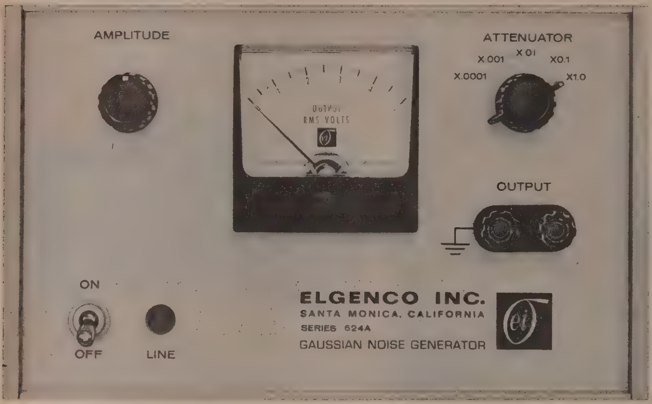
SERIES 624A FIXED RANGE • ALL SOLID STATE NOISE GENERATORS



SPECIFICATIONS • ALSO SEE FACING PAGE

FREQUENCY RANGES: See price list for a partial list of frequency ranges available.

RMS OUTPUT LEVEL: (Minimum value of maximum open circuit output) 3 volts.

OUTPUT IMPEDANCE: 200 ohms ±10%.

MAXIMUM LOAD: (on direct output) 700 ohms.

OUTPUT STEP ATTENUATOR: Five positions: X1.0, X0.1, X.01, X.001, and X.0001; calibrated to work into open circuit.
Accuracy: ±3%
Output Impedance: 200 ohms

SPECTRAL DENSITY: Approximate spectral density (mv√ Hz) for 1 volt RMS output.

Accuracy	mv	Accuracy	mv
20 kHz band	5.0	200 kHz band	1.6
50 kHz band	3.1	500 kHz band	1.0
100 kHz band	2.2		

AMPLITUDE PROBABILITY DISTRIBUTION: Gaussian.

SPECIFICATIONS FOR SERIES 624A

624A-11124	10 Hz to 20 kHz, ±1db	$560.00
-12124	20 Hz to 20 kHz, ±1db	$515.00
-15124	50 Hz to 20 kHz, ±1db	$505.00
-12224	200 Hz to 20 kHz, ±1db	$495.00
624A-11154	10 Hz to 50 kHz, ±1db	$580.00
-12154	20 Hz to 50 kHz, ±1db	$545.00
-15154	50 Hz to 50 kHz, ±1db	$525.00
-12254	200 Hz to 50 kHz, ±1db	$515.00
624A-11115	10 Hz to 100 kHz, ±1db	$600.00
-12115	20 Hz to 100 kHz, ±1db	$565.00
-15115	50 Hz to 100 kHz, ±1db	$545.00
-12215	200 Hz to 100 kHz, ±1db	$535.00
624A-11125	10 Hz to 200 kHz, ±1db	$650.00
-12125	20 Hz to 200 kHz, ±1db	$615.00
-15125	50 Hz to 200 kHz, ±1db	$595.00
-12225	200 Hz to 200 kHz, ±1db	$585.00

SPECIFICATIONS FOR SERIES 624A (Cont'd)

624A-11155	10 Hz to 500 kHz, ±1db	$670.00
-12155	20 Hz to 500 kHz, ±1db	$635.00
-15155	50 Hz to 500 kHz, ±1db	$615.00
-12255	200 Hz to 500 kHz, ±1db	$605.00
624A-21154	10 Hz to 50 kHz, ±2db	$560.00
-22154	20 Hz to 50 kHz, ±2db	$525.00
-25154	50 Hz to 50 kHz, ±2db	$505.00
-22254	200 Hz to 50 kHz, ±2db	$595.00
624A-21115	10 Hz to 100 kHz, ±2db	$565.00
-22115	20 Hz to 100 kHz, ±2db	$530.00
-25115	50 Hz to 100 kHz, ±2db	$510.00
-22215	200 Hz to 100 kHz, ±2db	$500.00
624A-21125	10 Hz to 200 kHz, ±2db	$580.00
-22125	20 Hz to 200 kHz, ±2db	$550.00
-25125	50 Hz to 200 kHz, ±2db	$530.00
-22225	200 Hz to 200 kHz, ±2db	$520.00
624A-21155	10 Hz to 500 kHz, ±2db	$600.00
-22155	20 Hz to 500 kHz, ±2db	$565.00
-25155	50 Hz to 500 kHz, ±2db	$545.00
-22255	200 Hz to 500 kHz, ±2db	$535.00
624A-31155	10 Hz to 500 kHz, ±3db	$560.00
-32155	20 Hz to 500 kHz, ±3db	$525.00
-35155	50 Hz to 500 kHz, ±3db	$505.00
-32255	200 Hz to 500 kHz, ±3db	$495.00
624A-51124	10 Hz to 20 kHz, ±½db	$685.00
-52124	20 Hz to 20 kHz, ±½db	$650.00
-55124	50 Hz to 20 kHz, ±½db	$630.00
-52224	200 Hz to 20 kHz, ±½db	$620.00
624A-51154	10 Hz to 50 kHz, ±½db	$700.00
-52154	20 Hz to 50 kHz, ±½db	$650.00
-55154	50 Hz to 50 kHz, ±½db	$630.00
-52254	200 Hz to 50 kHz, ±½db	$620.00
624A-51115	10 Hz to 100 kHz, ±½db	$725.00
-52115	20 Hz to 100 kHz, ±½db	$690.00
-55115	50 Hz to 100 kHz, ±½db	$670.00
-52215	200 Hz to 100 kHz, ±½db	$660.00
624A-51125	10 Hz to 200 kHz, ±½db	$775.00
-52125	20 Hz to 200 kHz, ±½db	$740.00
-55125	50 Hz to 200 kHz, ±½db	$720.00
-52225	200 Hz to 200 kHz, ±½db	$710.00
624A-51155	10 Hz to 500 kHz, ±½db	$795.00
-52155	20 Hz to 500 kHz, ±½db	$760.00
-55155	50 Hz to 500 kHz, ±½db	$740.00
-52255	200 Hz to 500 kHz, ±½db	$730.00

Model 602A with full rack width mounting option

Models 602A and 610A combined by dual unit adapter kit.

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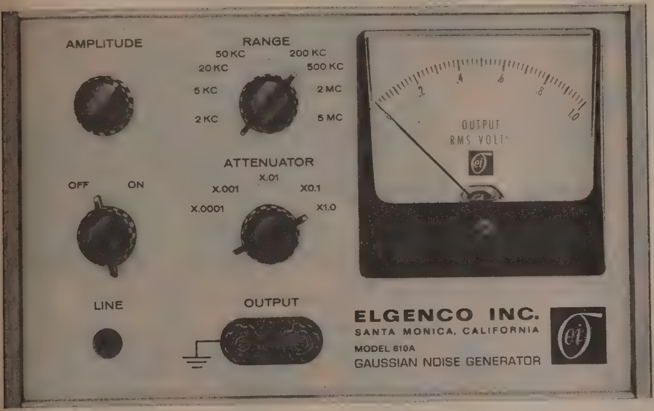
MODEL 610A • ALL SOLID STATE NOISE GENERATOR • 5Hz TO 5MHz



SPECIFICATIONS

FREQUENCY RANGES: Eight ranges selectably by front panel switch; 5 Hz to 2 kHz, 5 Hz to 5 kHz, 5 Hz to 20 kHz, 5 Hz to 50 kHz, 5 Hz to 200 kHz, 5 Hz to 500 kHz, 5 Hz to 2 mHz, and 5 Hz to 5 mHz.

OUTPUT SPECTRUM: Uniform to ±0.5 db from 10 Hz to 500 kHz and ±2.0 db from 500 kHz to 5 mHz.

OUTPUT LEVEL: 0 to 1 volt RMS, adjustable by front panel amplitude control. A dynamic range of 5 to 1 peak to RMS value is provided.

OUTPUT STEP ATTENUATOR: Five positions; X1.0, X0.1, X.01, X.001, X.0001. Accuracy ±0.1 db to 500 kHz; ±0.25 db to 5 mHz.

SPECTRAL DENSITY: Approximate spectral density for 1 volt RMS output.

Band	volts/√ Hz	Band	volts/√ Hz
2 kHz	1.75×10^{-2}	200 kHz	1.75×10^{-3}
5 kHz	1.1×10^{-2}	500 kHz	1.1×10^{-3}
20 kHz	5.5×10^{-3}	2 mHz	5.5×10^{-4}
50 kHz	3.5×10^{-3}	5 mHz	3×10^{-4}

AMPLITUDE PROBABILITY DISTRIBUTION: Symmetrical Gaussian Distribution all ranges.

OUTPUT METER: Meter reads 0 to 1 volt RMS. Accuracy ±2% of full scale to 2 mHz; ±5% to 5 mHz.

MAXIMUM LOAD: 500 ohms on direct output.

OUTPUT IMPEDANCE: Approximately 50 ohms direct output. Step attenuated output 50 ohms ±1%.

POWER SUPPLY: Built-in highly regulated dc supply.

POWER REQUIREMENTS: 115/230 volts ±10/20 volts, 50 to 1,000 Hertz ac; approximately 7 watts. A rechargeable power option is available. Battery is recharged by operating unit on ac line.

DIMENSIONS: 5¼″ high x 8⅝″ wide x 11″ deep.

RACK MOUNT: A rack mounting adapter kit is available for rack mounting two units side by side. Also available is a rack mounting adapter kit for rack mounting one unit. One or two units use 5¼″ x 19″ of rack panel space with adapter kit. Full rack width cabinet option for one unit is available. Size of unit with this option is 5¼″ high x 17″ wide x 11″ deep and comes with rack mounting hardware.

SHIPPING WEIGHT: Approximately 14 lbs.

PRICE: $1,565.00

MODELS 632A/631A • ALL SOLID STATE NOISE GENERATOR

Model 632A Dual Output DC to 400 Hz and 5 Hz to 40 kHz **$2,995**

LOW FREQUENCY OUTPUT

AMPLITUDE PROBABILITY DISTRIBUTION: Gaussian ±1.0%.
OUTPUT SPECTRUM: Uniform ±0.1 db from DC to 350 Hz.

MAXIMUM OUTPUT: 1.0 volts rms. A dynamic range of 5 to 1 peak to rms value is provided.

MAXIMUM SPECTRAL DENSITY: Approx. 1.5×10^{-3} volts²/Hz.

OUTPUT MEAN: Less than 5 mv.

OUTPUT IMPEDANCE: Approximately 1,000 ohms.

HIGH FREQUENCY OUTPUT

AMPLITUDE PROBABILITY DISTRIBUTION: Gaussian ±2%.

OUTPUT SPECTRUM: Uniform ±0.5 db from 10 to 35,000 Hz.

MAXIMUM OUTPUT: 1.0 volts rms. A dynamic range of 5 to 1 peak to rms values is provided.

MAXIMUM SPECTRAL DENSITY: Approx. 2×10^{-5} volts²/Hz.

OUTPUT MEAN: Less than 1 mv.

OUTPUT IMPEDANCE: Approximately 100 ohms.

NOISE REGULATOR: rms output level continuously stabilized against a reference voltage.

OVERLOAD INDICATOR: Panel overload indicator lights when input noise level to regulator is out of regulation range.

POWER: 115/230 volts ±10/20 volts, 50 to 1,000 Hertz ac.

DIMENSIONS: 5¼″ high x 17″ wide x 11″ deep. 19″ wide with rack mounting flanges mounted (supplied).

Model 631A 5 Hz to 40 kHz **$1,995**

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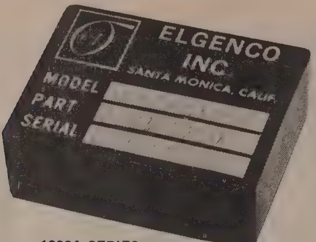
SERIES 1800 • NOISE SOURCE MODULES • 10KHz TO 100MHz



1800A SERIES

ELGENCO
INC.
SANTA MONICA, CALIF.
MODEL
PART
SERIAL

1800B SERIES

SPECIFICATIONS

The 1800 Series provides a low level wide band output. A portion of this band is specified to a certain flatness; uniformity. The approximate 6 mv open circuit output is for the whole band. The 1800B Series modules are the same as the 1800A series except the output is via a SMA connector. Specifications are for 25°C unless specified otherwise.

SPECTRAL DENSITY UNIFORMITY: Available with uniformity of ±0.5 db, ±1 db, ±2 db, ±3 db and ±4 db for many frequency ranges between lower frequencies of 10 kHz and 2 mHz and upper frequencies of 20 mHz, 30 mHz, 45 mHz, 50 mHz, 70 mHz, 80 mHz and 100 mHz.

SPECTRAL DENSITY: Approximately 0.3 μV per root Hz into 50 ohms.

RMS OUTPUT LEVEL: Approximately 3 mv rms into 50 ohms; 6 mv rms open circuit.

OUTPUT IMPEDANCE: Approximately 50 ohms.

AMPLITUDE PROBABILITY DISTRIBUTION: Gaussian.

OPERATING TEMPERATURE RANGE: 0 to 50°C.

POWER REQUIREMENTS: Model 1815, −15 VDC; Model 1818, −18 VDC; Model 1820, −20 VDC; Model 1822, −22 VDC; Model 1824, −24 VDC (well regulated power is required); current approximately 25 ma. Note: No external components are needed to properly install unit.

MOUNTING: .032″ printed circuit leads.

SIZE: 1.60 x 1.30 x 0.65 inches.

WEIGHT: Approximately 1 oz.

PRICING:

Base Price: 1818A.
Base Price plus $10.00: 1820A, 1822A and 1824A.
Base Price plus $10.00: 1818B.
Base Price plus $20.00: 1820B, 1822B and 1824B.
Base Price plus $20.00: 1815A.
Base Price plus $30.00: 1815B.

SERIES 1800 PRICES

Model No.	Frequency Band	Price
1818A-31427	10 kHz to 20 mHz, ±3 db	$169.00
-21427	10 kHz to 20 mHz, ±2 db	$199.00
-11427	10 kHz to 20 mHz, ±1 db	$309.00
-51427	10 kHz to 20 mHz, ±0.5 db	$429.00
1818A-31437	10 kHz to 30 mHz, ±3 db	$179.00
-21437	10 kHz to 30 mHz, ±2 db	$209.00
-11437	10 kHz to 30 mHz, ±1 db	$329.00
-51437	10 kHz to 30 mHz, ±0.5 db	$479.00
1818A-31447	10 kHz to 45 mHz, ±3 db	$209.00
-21447	10 kHz to 45 mHz, ±2 db	$259.00
-11447	10 kHz to 45 mHz, ±1 db	$429.00
-51447	10 kHz to 45 mHz, ±0.5 db	$609.00
1818A-31457	10 kHz to 50 mHz, ±3 db	$259.00
-21457	10 kHz to 50 mHz, ±2 db	$329.00
-11457	10 kHz to 50 mHz, ±1 db	$479.00
-51457	10 kHz to 50 mHz, ±0.5 db	$729.00
1818A-41477	10 kHz to 70 mHz, ±4 db	$259.00
-31477	10 kHz to 70 mHz, ±3 db	$279.00
-21477	10 kHz to 70 mHz, ±2 db	$349.00
-11477	10 kHz to 70 mHz, ±1 db	$529.00
1818A-41487	10 kHz to 80 mHz, ±4 db	$279.00
-31487	10 kHz to 80 mHz, ±3 db	$299.00
-21487	10 kHz to 80 mHz, ±2 db	$379.00
-11487	10 kHz to 80 mHz, ±1 db	$579.00
1818A-41418	10 kHz to 100 mHz, ±4 db	$309.00
-31418	10 kHz to 100 mHz, ±3 db	$329.00
-21418	10 kHz to 100 mHz, ±2 db	$429.00
-11418	10 kHz to 100 mHz, ±1 db	$719.00

Note: 1815 Series not available in 80 mHz and 100 mHz units.

Model No.	Frequency Band	Price
1818A-32627	2 mHz to 20 mHz, ±3 db	$119.00
-22627	2 mHz to 20 mHz, ±2 db	$149.00
-12627	2 mHz to 20 mHz, ±1 db	$259.00
-52627	2 mHz to 20 mHz, ±0.5 db	$329.00
1818A-32637	2 mHz to 30 mHz, ±3 db	$129.00
-22637	2 mHz to 30 mHz, ±2 db	$159.00
-12637	2 mHz to 30 mHz, ±1 db	$279.00
-52637	2 mHz to 30 mHz, ±0.5 db	$379.00
1818A-32647	2 mHz to 45 mHz, ±3 db	$159.00
-22647	2 mHz to 45 mHz, ±2 db	$209.00
-12647	2 mHz to 45 mHz, ±1 db	$379.00
-52647	2 mHz to 45 mHz, ±0.5 db	$509.00
1818A-32657	2 mHz to 50 mHz, ±3 db	$209.00
-22657	2 mHz to 50 mHz, ±2 db	$279.00
-12657	2 mHz to 50 mHz, ±1 db	$429.00
-52657	2 mHz to 50 mHz, ±0.5 db	$629.00
1818A-42677	2 mHz to 70 mHz, ±4 db	$209.00
-32677	2 mHz to 70 mHz, ±3 db	$229.00
-22677	2 mHz to 70 mHz, ±2 db	$299.00
-12677	2 mHz to 70 mHz, ±1 db	$479.00
1818A-42687	2 mHz to 80 mHz, ±4 db	$229.00
-32687	2 mHz to 80 mHz, ±3 db	$249.00
-22687	2 mHz to 80 mHz, ±2 db	$329.00
-12687	2 mHz to 80 mHz, ±1 db	$529.00
1818A-42618	2 mHz to 100 mHz, ±4 db	$259.00
-32618	2 mHz to 100 mHz, ±3 db	$279.00
-22618	2 mHz to 100 mHz, ±2 db	$379.00
-12618	2 mHz to 100 mHz, ±1 db	$669.00

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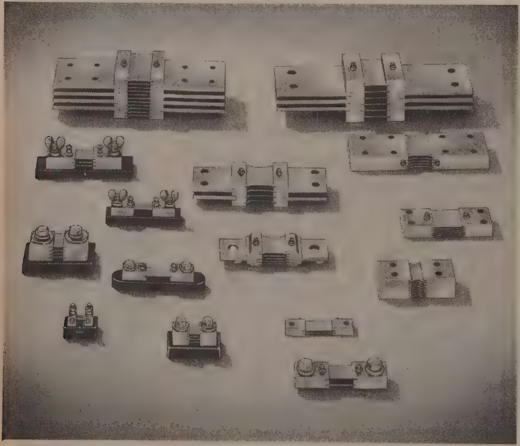

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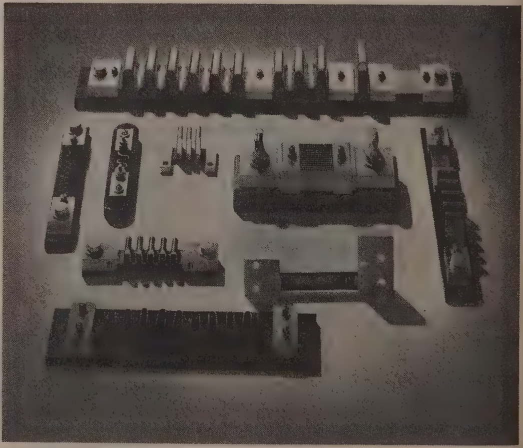

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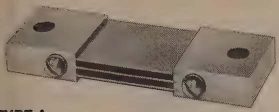
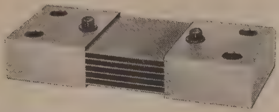
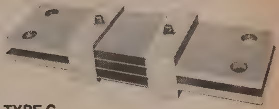


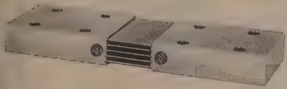
TYPE A
50 MV 15 through 600 amperes
100 MV 50 through 600 amperes



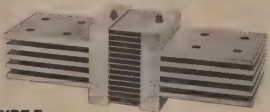
TYPE B
50 MV 300 through 1200 amperes
100 MV 300 through 1200 amperes



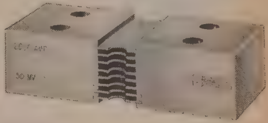
TYPE C
50 MV 1000 through 2000 amperes
100 MV 1000 through 2000 amperes



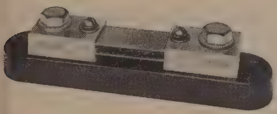
TYPE E
50 MV 1500 through 2000 amperes
100 MV 1500 through 2000 amperes



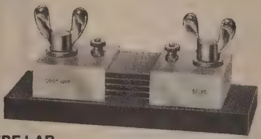
TYPE F
50 MV 2500 through 30000 amperes
100 MV 2500 through 10000 amperes



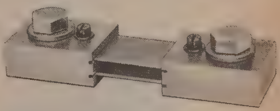
TYPE FL
50 MV 1000 through 3000 amperes



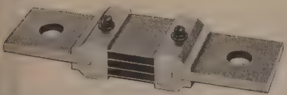
TYPE HA
50 MV 1 through 500 amperes
100 MV 1 through 500 amperes



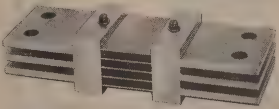
TYPE LAB
50 MV 15 through 1000 amperes
100 MV 15 through 1000 amperes



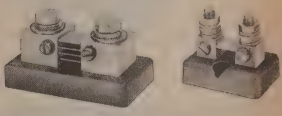
TYPE TRW-50
50 MV 100 through 600 amperes



TYPE W
50 MV 300 through 1000 amperes
100 MV 120 through 500 amperes



TYPE WT
50 MV 1000 through 10000 amperes
100 MV 600 through 6000 amperes



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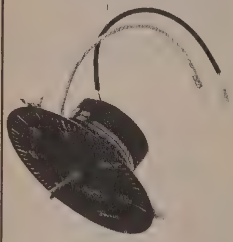

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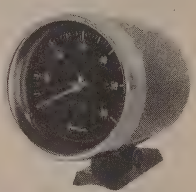

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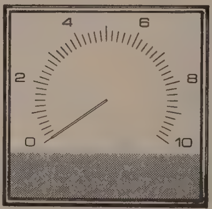

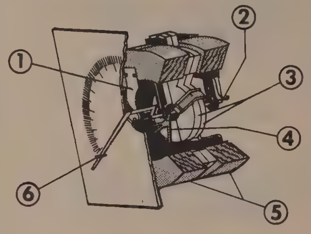

1. Tension member assures constant band tension while absorbing shock and vibration to prevent band breakage.

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3. Pole piece design assures uniform flux density from 0 to 250° deflection for better tracking.

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HOW TO ORDER

ORDER BY MODEL NUMBER

When ordering, please specify the complete instrument model number and nomenclature. For example, "Model 8600A Digital Multimeter." Unless otherwise specified, factory installed options are designated by a 2-digit number preceded by a dash. The suffix "K" denotes the option is field installable. The complete option designation should include the model number as shown in the following example:

Instrument	Option	Order by
8600A Digital Multimeter	Rechargeable Battery Pack -01	8600A-01 Digital Multimeter

WHERE TO SEND YOUR ORDER

Orders should be made out to **John Fluke Mfg. Co., Inc.** or its subsidiaries and sent in care of your local **Fluke** representative (see list of representatives) or directly as follows:

Electronic Counters	**John Fluke Mfg. Co., LTD.** P.O. Box 1094 Buffalo, New York 14210
Logic Test Equipment	**Fluke Trendar Corporation** 500 Clyde Avenue Mountain View, CA 94040
All Other Orders	**John Fluke Mfg. Co., Inc.** P.O. Box 43210 Mountlake Terrace, WA 98043

SHIPPING METHODS

Shipments are made directly from the factory. Unless specifically requested otherwise, express or truck transportation is used, whichever is least expensive and most serviceable to you. Small items may be sent via parcel post. Air freight, air express, or parcel post will be used when specified on your order.

TERMS

U.S. and Canada terms are 30 days net. Unless credit has already been established, shipments will be made C.O.D. or on receipt of cash in advance. Terms for orders from other countries are irrevocable letter of credit or cash in advance unless other terms have been previously arranged.

PRICES

Unless otherwise specified, all prices are in U.S. funds and are subject to change without notice. See last page this section for price list.

QUOTATIONS AND PRO FORMA INVOICES

Upon request quotations or pro forma invoices will be furnished to you by your local **Fluke** sales representative or by **John Fluke Mfg. Co., Inc., John Fluke Mfg. Co., LTD or Fluke Trendar Corporation.**

TECHNICAL ASSISTANCE

Demonstration of a particular instrument may be conveniently arranged with the local **Fluke** representative. Technical assistance in selecting equipment and preparing orders is available from engineering personnel at these local offices supplemented by a highly qualified staff of application engineers at the factory.

WARRANTY

All **Fluke** instruments are warranted against defective materials and workmanship for one year.

SERVICE

Fluke authorized service centers are located throughout the world. **Fluke** Technical Centers are placed strategically throughout North America.

All **Fluke** instruments repaired by these facilities will be returned to the customer calibrated within the parameters listed in the original specification for that instrument and warranted for 60 days after repair.

Arrangements should be made with your local repair agency before sending equipment for repair or calibration.

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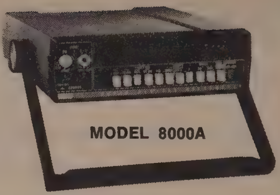

MODEL 8000A

DIGITAL MULTIMETERS AND VOLTMETERS
FOR BENCH APPLICATIONS

3½ DIGIT DMM'S
THE 8000A FAMILY OF MULTIMETERS

The highly successful Fluke 8000A Digital Multimeter brought a new standard of excellence to the low cost field. Today, with expanded capability, the 8000A brings that standard to increased measurement capability through the addition of new options and accessories.

Choose from many options including rechargeable battery power, digital printer output plus the new low ohms and high current options. High voltage and RF probes and a clamp-on ac current probe highlight the list of 8000A accessories.

The latest development in the 8000A family include a mA-sec DMM and a DMM with analog display, both now available as standard Fluke instruments.

BASIC SPECIFICATIONS

	DC Volts	AC Volts	DC Current	AC Current	Ohms
Range	0.2-1200 V	0.2-1200 V	200 μA-2 A	200 μA-2 A	200 Ω-20 MΩ
Resolution	100 μV	100 μV	100 nA	100 nA	0.1 Ω
Accuracy[1]	(0.1 +1)	(1 +2)	(0.3 +1)	(1 +2)	(0.1 +1)

[1] Accuracy for 1 year, ±(% Input + No. of Digits), 15°C to 35°C

OPTIONS
RECHARGEABLE BATTERY PACK — 8000A-01

The rechargeable battery pack is entirely self-contained within the 8000A package. It is supplied with standard "D" sized nickel-cadmium batteries which provide, under normal conditions, 1000 discharge-charge cycles of operation. The battery pack will provide a minimum of eight hours operation, with recharge requiring less than 14 hours. Recharging is automatic whenever unit is plugged in and does not affect normal bench operation.

DATA OUTPUT — 8000A-02

The data output option provides parallel, buffered BCD data of the digital readout, polarity and overload. It is suitable for driving a digital printer or providing input to systems. The non-isolated buffered output will sink up to 10 mA of current and has a 15 kΩ pull-up resistor.

HIGH CURRENT — 8000A-05

8000A-05

The Fluke 8000A-05 Digital Multimeter offers extended current measurement capabilities to 20 amps with the -05, line, and -015, battery, options.

All of the specifications for the basic 8000A apply to the 8000A-05, -015 plus the following current specifications:

Range (DC)	10.00 A (1 min. operation 10 A to 20 A)
Accuracy (DC)	10 A Range ±(0.5% or reading +1 digit)
Range (AC)	10.00 A (1 min. operation 10 A to 20 A)
Accuracy (AC)	10 A Range 45 Hz to 3 kHz ±(1% of reading +2 digits)

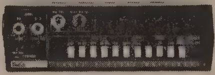
LO OHMS — 8000A-06

8000A-06

The Model 8000A-06 features 0.001Ω resolution and 2 ohm and 20 ohm resistance ranges. The instrument includes a front panel lead resistance cancellation control assuring the user that his measurement of the unknown R does not include the resistance in his test leads. All basic 8000A specs apply plus the following:

Range	1.999 Ω, 19.99 Ω
Accuracy (1 yr, 15°C-35°C)	1.999 Ω range ±(1% of rdg +2 dig) 19.99 Ω range ±(0.5% of rdg +2 dig)

SPECIALS
MODEL 8000A/MAS



8000A/MAS

The 8000A/mAS (or Mass Meter) calibrates x-ray tubes by directly measuring current as a function of time. Addition of mA-sec function has extended overall measuring capability to 31 ranges of ac/dc volts and current, resistance and mAS.

Ranges	2000, 200, 20, 2 mA sec and 200 μA sec.
Accuracy	±(1% of input +1 digit)

MODEL 8000A/MTR

8000A/MTR

The Fluke Model 8000A/MTR is similar to the Model 8000A but also includes an analog panel meter and rechargeable batteries.

This instrument provides 26 ranges including five ranges each of ac and dc voltage, five ranges each of ac and dc current and six ranges of resistance. The analog panel meter included in the unit is invaluable for peaking or dipping measurements. The panel meter also serves to monitor battery level.

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4½, 5½ DIGIT DMM'S

The new Fluke 8600A and 8800A automatic digital multimeters head the list of 4½ and 5½ digit DMM's offering new standards of convenience and performance.

They're multimeters with everything you want built-in to meet the widest possible applications of bench, field and laboratory.

All Fluke DMM's Feature:
- **Fully Guarded Input.**
- **Overload Protection.**
- **High Accuracy.**
- **Complete Line of Accessories.**

SPECIFICATIONS

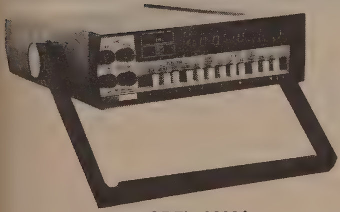
	8600A	8800A	8350A	8100B	8120A	8125A
DC Volts Range Resolution (DC) Accuracy (90 days)[1]	0.2-1200 V 10 μV (0.02 +0.008)	0.2-1200 V 1 μV (0.01 +0.0015)	0.1-1100 V 1 μV (0.01 +0.002)	1-1200 V 100 μV (0.05 +0.01)	0.1-1200 V 10 μV (0.02 +0.01)	1-1200 V 100 μV (0.01 +0.01)
AC Volts Range Accuracy (90 days)[1]	0.2-1200 V (0.2 +0.015)	2-1200 V (0.1 +0.005)	1-1100 V (0.1 +0.03)	1-1200 V (0.2 +0.05)	0.1-1200 V (0.2 +0.05)	1-1200 V (0.2 +0.05)
DC Current Range Accuracy (90 days)[1]	200 μA-2 A (0.1 +0.01)	— —	— —	— —	100 μA-1.2 A (0.1 +0.02)	— —
AC Current Range Accuracy (90 days)[1]	200 μA-2 A (0.3 +0.08)	— —	— —	— —	100 μA-1.2 A (0.3 +0.05)	— —
Ohms Range Accuracy (90 days)[1]	200 Ω-20 MΩ (0.1 +0.005)	200 Ω-20 MΩ (0.01 +0.0015)	1 K-12 MΩ (0.01 +0.002)	1 K-12 MΩ (0.1 +0.02)	1 K-12 MΩ (0.05 +0.01)	1 K-12 MΩ (0.02 +0.01)

[1] Accuracy ±(% Input +% Range), 25°C ±5°C except 15°C to 35°C for Models 8600A, 8100B, 8120A.

MODEL 8350A

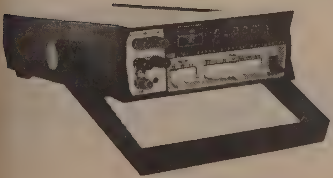
MODEL 8350A

The Fluke 8350A offers you maximum performance and quality in a 5½-digit multimeter. Included in the standard 8350A multimeter is the ability to measure accurately dc volts from 1 microvolt to 1100 volts, ac volts from 10 microvolts to 1100 volts rms, and resistance from 10 milliohms to 12 megohms. These measurements are made with full-scale 120,000-count resolution, and accuracies up to 0.005%. Autoranging and autopolarity are standard.


MODEL 8600A

MODEL 8600A

Newest Fluke 4½-digit DMM includes a 4½-digit LED readout featuring five ranges of dc volts, five ranges of ac volts, five ranges of dc current, five ranges of ac current and six ranges of resistance. With 26 ranges, the instrument offers more measure power than any other instrument available. **Autorange** and **autozero** are standard. Options include Battery Pack (8600A-01) and Isolated Data Output (8600A-02).


MODEL 8800A

MODEL 8800A

This extraordinary 5½-digit DVM offers a basic dc accuracy of 0.005% with full autoranging. There are fifteen ranges which include five dc, four ac, and six resistance. Complete isolated four terminal ohms measurements are provided on all ranges. Separate current and voltage inputs are available to provide the ultimate in ohms accuracy by eliminating errors caused by input lead resistance. LED readout is bright and readable. Features Isolated Data Output option 8800A-02.

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DIGITAL MULTIMETERS AND VOLTMETERS
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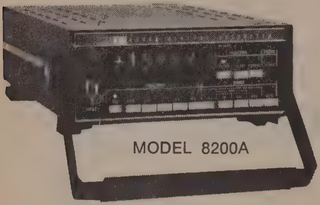

MODEL 8200A

MODEL 8200A

The Model 8200A four range dc DVM easily expands into a 400 readings per second systems multimeter by installing a family of plug-in options. Standard features of the basic instrument include 60% overrange, switched filter for assured broadband noise rejection, all push button selection, autoranging, automatic polarity selection and display as well as full guarding.

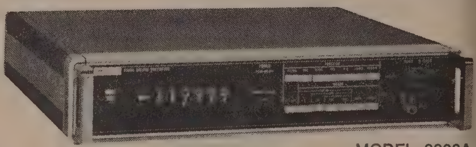
Multimeter options include 2 ranges of dc millivolts, 4 ranges of True RMS ac volts or 4 ranges of average responding ac volts, 6 resistance ranges and an isolated external reference-ratio input. System options are Data Output Unit or Printer Output Unit and Remote Control Unit. All options may be added in the field by the user at any time.

SPECIFICATIONS

	DC Volts	AC Volts	Ohms
Range	0.01-1200 V	1-1000 V	100 Ω-16 MΩ
Accuracy[1]	(0.01 +0.01)	(0.1 +0.02)	(0.01 +0.01)
Resolution	100 μV	100 mV	10 mΩ

OPTIONS

AC Volts	Milli-volts	Ohms	DC-DC Ratio	AC-AC Ratio	Data Out	Rem. Cont.
-01[2] -09[2]	-02	-03	-04	—	-07 -06[6]	-08


MODEL 8300A

MODEL 8300A

The 8300A is a versatile digital voltmeter with five full decades of digits plus a 6th digit for 20% overrange. Its mainframe will accept options in any sequence for expansion from a bench DVM into a bench or systems multimeter.

The basic instrument offers 3 ranges of DC voltage measuring capability including autorange, autopolarity, and switchable active filtering. In addition, the 8300A-10 option offers 5 ranges of dc volts, and the 8300A-02 option offers 5 ranges of dc volts and 5 ranges of ohms measurements. Other analog options include ac volts and dc-dc ratio. Systems options include Data Output and Remote Control.

SPECIFICATIONS

	DC Volts	AC Volts	Ohms
Range	0.1-1200 V	1-1000V	1 K-12 MΩ
Accuracy[1]	(0.01 +0.002)	(0.1 +0.03)	(0.01 +0.002)
Resolution	1 μV	10 μV	10 mΩ

OPTIONS

AC Volts	Milli-volts	Ohms	DC-DC Ratio	AC-AC Ratio	Data Out	Rem. Cont.
-01	-02	-02	-05	—	-03	-04

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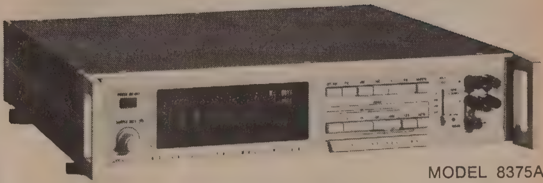
DIGITAL MULTIMETERS AND VOLTMETERS FOR SYSTEMS APPLICATIONS



MODEL 8375A

MODEL 8375A

The 8375A offers unusual capability in a 5½ digit multimeter. At a very low cost, its standard configuration combines highly accurate measurement of dc volts, true-rms ac volts and broad ranges of resistance, together with a unique self-test feature that permits rapid check-out of all measurement functions. In addition, a powerful set of systems-oriented options are available, all of which can be easily installed in any desired sequence in the field, including Data Output, Remote Control and DC Reference.

SPECIFICATIONS

	DC Volts	AC Volts	Ohms
Range	0.1-1100 V	1-1100 V	10 Ω-12 MΩ
Accuracy[1]	(0.005 +0.001)	(0.1 +0.02)	(0.01 +0.002)
Resolution	1 μV	10 μV	100 μΩ

OPTIONS

AC Volts	Milli-volts	Ohms	DC-DC Ratio	AC-AC Ratio	Data Out	Rem. Cont.
Note 3, 4	Note 3	Note 3	-05	—	-03	-04

MODEL 8400A

MODEL 8400A

The 8400A's outstanding accuracy is complemented by numerous and versatile functional capabilities. DC voltages are measured on five ranges with resolution to 1 microvolt. Overrange is 20% on all ranges except on the ±1,000 V range. 1100 V can be applied to any range without damaging the unit.

The basic DVM accepts a family of rugged plug-in option cards for AC Volts, Resistance DC/DC Ratio, AC/AC Ratio, True RMS Volts, Data Output and Remote Control.

SPECIFICATIONS

	DC Volts	AC Volts	Ohms
Range	0.1-1100 V	1-1100 V	10 Ω-12 MΩ
Accuracy[1]	(0.004 +0.001)	(0.05 +0.005)	(0.01 +0.002)
Resolution	1 μV	10 μV	100 μΩ

OPTIONS

AC Volts	Milli-volts	Ohms	DC-DC Ratio	AC-AC Ratio	Data Out	Rem. Cont.
-01[2] -09[2]	Note 3	-02	-05	-06	-03	-04

NOTES:

[1] Accuracy 90 days, ±(% Input + % Range), 25°C ±5°C

[2] -01 denotes avg. responding, -09 True RMS

[3] Included in basic instrument

[4] Includes True RMS Volts

[5] Optional 1 μV

[6] Printer Output

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ELECTRONIC COUNTERS

1900A MULTI-COUNTER

GENERAL

Display:
6-digit LED, leading zero suppression, annunciation and overflow.

Automatic Features:
AUTORANGING: In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds, to eliminate redundant up range/down range commands. This allows measurements to be made on signals containing large amounts of FM and PM.

AUTORESET: A new measurement sequence is started every time a front panel button is activated.

INPUT CHARACTERISTICS

Sensitivity:
25 mV, typically 15 mV rms sine wave, 5 Hz to 80 MHz.

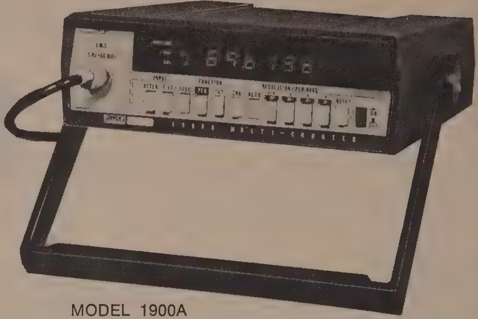
Impedance:
1 MΩ shunted by less than 30 pf.

OPERATING RANGES

Frequency:
5 Hz to 80 MHz. Four manually selected gate times provide resolution of 100 Hz to 0.1 Hz.

Period:
5 Hz to 1 MHz single and multiple period averages provide resolution of 100 ns to 100 ps.

Totalize:
1 count to 999999 counts.



MODEL 1900A

TIMEBASE CHARACTERISTICS

Aging Rate:
$<\pm 5 \times 10^{-7}$month.

Temperature:
$<\pm 5 \times 10^{-6}$ 0°C to 50°C.
$<\pm 2 \times 10^{-6}$ (typical) 20°C to 30°C.

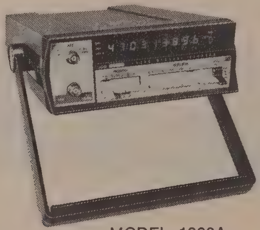
OPTIONS

1900A-01 — Rechargeable Battery.
1900A-02 — Data Output.

1920A TELECOMMUNICATIONS COUNTER

GENERAL

- **9-Digit LED Display, Leading Zero Suppression, Annunciation and Overflow.**
- **Burst Mode Measures Frequency of RF Bursts**
- **Optional Resolution Multiplier Multiplies Audio Tone Signals by 1000, Providing Resolution of 0.001 Hz in 1 Sec.**



MODEL 1920A

FREQUENCY RANGE

Direct:
5 Hz to 125 MHz with AGC.

Prescaled:
50 MHz to 520 MHz with AGC.
50 MHz to 1000 MHz (option -13).
50 MHz to 1250 MHz (option -14).

SENSITIVITY

Direct:
15 mV up to 100MHz decreasing to 25 mV at 125 MHz.

Prescaled:
15 mV to 520 and 1000 MHz decreasing to 30 mV at 1250 MHz.

GATE TIMES

Direct:
1 ms, 10 ms, 0.1 s, 1.0 s, 10 s.

Prescaled:
4 ms, 40 ms, 0.4 s, 4.0 s, 40 s (520 MHz).
8 ms, 80 ms, 0.8 s, 8.0 s, 80 s (1000 and 1250 MHz).

TIMEBASE CHARACTERISTICS

Aging Rate (per month):
$\pm 3 \times 10^{-7}$.

Temperature Stability:
$\pm 2 \times 10^{-6}$ 0°C to 50°C.
$\pm 5 \times 10^{-7}$ 20°C to 30°C.

OPTIONS

1920A-01 — Rechargeable Battery
1920A-02 — Data Output
1920A-04 — TCXO $\pm 3 \times 10^{-7}$
1920A-06 — Resolution Multiplier
1920A-13 — 1000 MHz Prescaler
1920A-14 — 1250 MHz Prescaler

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ELECTRONIC COUNTERS

1953A PROGRAMMABLE UNIVERSAL COUNTER/TIMER

GENERAL

- **9-Digit LED Display, Leading Zero Suppression, Annunciation and Overflow.**
- **Measures Frequency, Period(s), Ratios, Time Interval and Gateable Totals. Variable Trigger Level Controls with Status Indicators. Scope marker output. TCXO Timebase.**
- **Options Include Prescaled Inputs to 1250 MHz, Full Remote Programming, Oven Stabilized Timebase.**

FREQUENCY MEASUREMENTS

Range:
DC to 125 MHz (dc coupled).
5 Hz to 125 MHz (ac coupled).

Gate Time:
0.1 ms to 10 s in 6 decade steps.

PERIOD MEASUREMENTS

Range:
DC to 25 MHz (dc coupled).
5 Hz to 25 MHz (ac coupled).

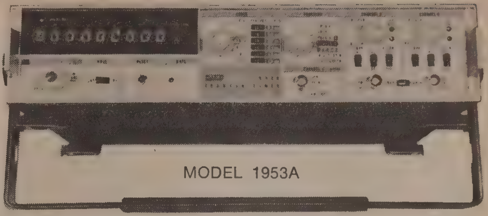
Periods Averaged:
1 period to 10^5 periods.

Frequency Counted:
10 MHz.

Resolution:
1 ps at 10^5 periods to 0.1 μs at 1 period.

TIMEBASE CHARACTERISTICS

	Standard	-04 Option	-10 Option
Aging Rate (constant temp.)	$<\pm 3\times10^{-7}$/mo.	$<\pm 3\times10^{-7}$/mo.	$<\pm 1\times10^{-7}$/mo.
Temp. Stability: 20°C - 30°C	$\pm 5\times10^{-7}$ typ.	$\pm 2\times10^{-7}$ typ.	$\pm 3\times10^{-9}$ typ.
0°C - 50°C	$<\pm 2\times10^{-6}$	$<\pm 5\times10^{-7}$	$<\pm 1\times10^{-8}$


MODEL 1953A

TIME INTERVAL MEASUREMENT

Range:
0.1 μs to 10^7 s.

Input:
Channels A and B; common or separate.

Resolution:
0.1 μs to 10 ms in 6 decade steps.

SENSITIVITY

Channel A or B:
A Channel: 30 mV rms from dc to 75 MHz decreasing to 50 mV at 125 MHz.
B Channel: 30 mV rms from dc to 25 MHz.

Channel C (Prescaled):
15 mV from 50 MHz to 520 MHz (AGC) (option -07).
15 mV from 50 MHz to 1000 MHz (options -13 or -14), decreasing to 30 mV at 1250 MHz (option -14 only).

OPTIONS

1953A-02 — Data Output
1953A-04 — Superior TCXO
1953A-05 — Timebase Multiplier
1953A-07 — 520 MHz Prescaler
1953A-10 — Oven-Stabilized Timebase
1953A-11 — Basic Remote Programming
1953A-12 — Full Remote Programming
1953A-13 — 1000 MHz Prescaler
1953A-14 — 1250 MHz Prescaler
1953A-16 — Rear Input

1952B UNIVERSAL COUNTER/TIMER (SIMILAR IN APPEARANCE TO 1953A)

GENERAL

- **6-Digit LED Display with Leading Zero Suppression, Annunciation and Overflow.**
- **Measures Frequency, Period(s), Ratios, Time Interval and Gateable Totals.**
- **DC Coupled Amplifiers to 80 MHz.**
- **Variable Trigger Level Controls with Status Indicators, Scope Marker Output.**

FREQUENCY MEASUREMENTS

Range:
DC to 80 MHz (dc coupled).
5 Hz to 80 MHz (ac coupled).

Gate Time:
0.1 ms to 10 s in 6 decade steps.

PERIOD MEASUREMENTS

Range:
DC to 10 MHz (dc coupled).
5 Hz to 10 MHz (ac coupled).

Periods Averaged:
1 period to 10^5 periods.

Frequency Counted:
100 kHz.

Resolution:
0.1 ns at 10^5 periods to 10 μs at 1 period.

TIMEBASE CHARACTERISTICS

Frequency:
10 MHz.

Temperature Stability:
$<\pm 5 \times 10^{-6}$, 0°C to 50°C.
$<\pm 2 \times 10^{-6}$ (typical), 20° to 30°C.

Aging Rate:
(constant $<\pm 5 \times 10^{-7}$ month temp.)

TIME INTERVAL MEASUREMENT

Range:
0.1 μs to 10^4 s.

Input:
Channels A and B, common or separate

Resolution:
0.1 μs to 10 ms in 6 decade steps.

SENSITIVITY

Channel A or B Sinewave:
A Channel: 50 mV rms from DC to 50 MHz, decreasing to 75 mV rms at 80 MHz.
B Channel: 50 mV rms from DC to 10 MHz.

Channel A or B Pulse:
A Channel: 150 mV pulse amplitude with minimum pulse width of 20 ns.
B Channel: 150 mV pulse amplitude with minimum pulse width of 50 ns.

OPTIONS

1952B-03 — TCXO $\pm 2 \times 10^{-6}$ 0°C to 50°C
1952B-17 — 7th LED Digit
1952B-18 — 7th and 8th LED Digit
1952B-19 — Information Pak (Gate Out, Clock Out, External Reset).

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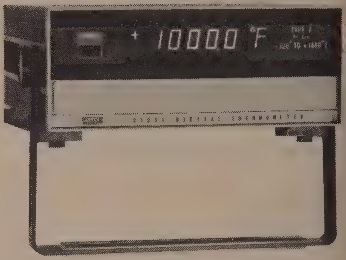
DIGITAL THERMOMETERS

TEMPERATURE MEASUREMENT WITH FLUKE THERMOMETERS

The 2100A Digital Thermometer is not just a single instrument, it is a whole series of instruments designed to satisfy a wide variety of temperature measuring applications. Its versatility ranges from a systems instrument capable of monitoring up to 100 different thermocouples and outputing the data to a digital recorder or computer, to a fully portable battery operated instrument able to take measurements from any type of thermocouple as well as having two direct mV ranges. All of this with a resolution of 0.1 degrees.

Four basic instruments make up the series. Since many of the parts are common, instruments can easily be converted from one type to another.

All of the instruments can be ordered for operation with any of the standard types of thermocouples; J, K, E, T, R, S, and will measure the usable temperature span of each thermocouple without the need for range changing. For example, with a K couple, the temperature range is −320°F to +2400°F and for an R couple, the temperature range is 0°F to 3200°F. The resolution is 0.1°C for all types of thermocouples and 0.1°F for the J, K, E, and T, and 0.2°F for the R and S thermocouples. A unique feature of the design is that the linearizing data for all six types of thermocouples is contained in a single ROM of 4K bits which allows the user to easily change from one type of couple to another. The curve of each thermocouple is subdivided into 64 straight line segments which gives the 2100A digital thermometer excellent conformity to standard NBS Thermocouple Tables.

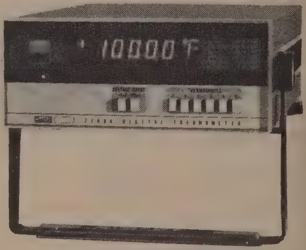


MODEL 2100A-03

MODEL 2100A-03

DIGITAL THERMOMETER FOR ONE TYPE OF THERMOCOUPLE

The 2100A-03 is used to measure the temperature of a single thermocouple of a predetermined type. The complete temperature span of each thermocouple is covered and the reading is displayed in either degrees Celsius or degrees Fahrenheit.



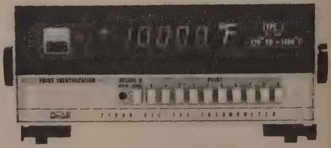
MODEL 2100A-06

MODEL 2100A-06

DIGITAL THERMOMETER FOR SIX TYPES OF THERMOCOUPLES

This is the same basic unit as the 2100A-03 but with the addition of 8 select switches on front panel. Any one of the six available thermocouple types can be selected by means of the switches, but only one type of thermocouple can be connected at one time. Two additional ranges for dc voltages of 40 mV and 400 mV are provided.

These ranges have a resolution of 1 µV and 10 µV respectively and have a noise level of less than 0.5 µV peak to peak.



MODEL 2100A-10

MODEL 2100A-10

DIGITAL THERMOMETER FOR TEN THERMOCOUPLES OF THE SAME TYPE

This is the same basic unit as the 2100A-03 but with the addition of 11 manual switches on front panel. This allows up to 10 thermocouples (all of the same type) to be connected to the rear of the instrument and then switched, one at a time, into the measuring instrument. An error of 0.1°F or 0.1°C is added to the existing errors in the 2100A-03 specifications. A separate switch on the front panel isolates this bank of ten switches from external inputs when the 2150A is used. Channel identity of the selected thermocouple is available when the DOU is fitted.

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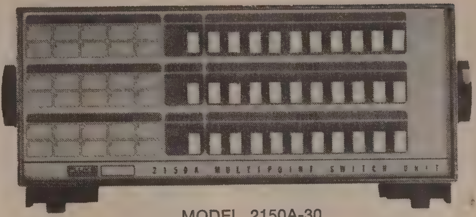
DIGITAL THERMOMETERS

MODEL 2150A

The 2150A is a multi-point switch unit. It consists of up to three sets of ten point-select push button switches and can be used with any of the three measuring instruments. Up to 30 thermocouples can be connected to each unit and units can be connected in series to allow up to 100 points to be monitored by one measuring instrument.

The following units are available:

2150A-10 — Ten point selector switch unit.
2150-20 — Twenty point selector switch unit.
2150A-30 — Thirty point selector switch unit.


MODEL 2150A-30

SPECIFICATIONS

	2100A-03	2100A-06	2100A-10
Type of Temperature Sensor	Thermocouple	Thermocouple	Thermocouple
Temperature Range (Dependent on thermocouple type)	−320°F to +3200°F −200°C to +1760°C	−320°F to +3200°F −200°C to +1760°C	−320°F to +3200°F −200°C to +1760°C
Temperature Resolution & Repeatability	0.1°F or C(1)	0.1°F or C(1)	0.1°F or C(1)
Thermocouple Types	J, K, T, E, R, S	J, K, T, E, R, S	J, K, T, E, R, S
Number of Thermocouple types	1 (Choose from above)	All 6	1 (Choose from above)
Number of Thermocouple inputs	1	1	10
Accuracy 90 days J, K, T, E	< ± .015% rdg ± .55°F (.35°C)	< ± .015% rdg ± .55°F (.35°C)	< ± .015% rdg ± .65°F (.45°C)
Accuracy 90 days R, S	< ± .015% rdg ± 1.0°F (0.6°C)	< ± .015% rdg ± 1.0°F (0.6°C)	< ± .015% rdg ± 1.1°F (0.7°C)
DC Voltage ranges	—	400mV, 40mV	—
DC Voltage resolution	—	10µV, 1µV	—

(1) 0.2°F or 0.1°C for type R and S thermocouples.

OPTIONS

*2100A-01 — Rechargeable Battery Pack for 2100A
2100A-02 — Data Output Unit for 2100A
2100A-04 — Recorder Output
* Option -01, -02 and -04 are mutually exclusive

ACCESSORIES

2010A-7017 — Interface Kit to Fluke 2010A Printer from 2100A-03 and 2100A-06
2010A-7018 — Interface Kit to Fluke 2010A Printer from 2100A-10
P20J — Thermocouple Probe - J Type
P20K — Thermocouple Probe - K Type
P20T — Thermocouple Probe - T Type

ORDERING GUIDE

2100A- ☐ - ☐ - ☐ **Example: 2100A-** 10 - KF - 02

Basic Unit
Thermocouple Type and/or Measurement Units
Other Options

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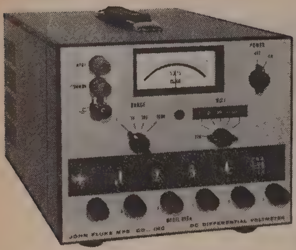
DIFFERENTIAL VOLTMETERS



MODEL 895A

DC AND AC/DC DIFFERENTIAL VOLTMETERS

Model	Input Range	% of Input Accuracy DC	AC[1]	Frequency Range	Max Full Scale Sensitivity	Max Meter Resolution
885AB	0-1100V	±0.0025		—	100μV	1μV
891A[2]	0-1100V	±0.01		—	1mV	10μV
895A[2]	0-1100V	±0.0025		—	100μV	1μV
883AB	0-1100V	±0.005	±0.1	20Hz-5KHz	100μV	1μV
887AB	0-1100V	±0.0025	±0.05	30Hz-5KHz	100μV	1μV
893A[2], AR[3]	0-1100V	±0.01	±0.05	50Hz-10KHz	1mV	10μV

AB and -01 models are combination line and battery-powered.

1. Reduced accuracy over wider frequency range.
2. Infinite input resistance to 1100 volts D.C.
3. Model 893AR is rack configuration, 3½" high at no extra cost.

MODEL 931B

TRUE RMS DIFFERENTIAL VOLTMETER — MODEL 931B

Voltage Range:
Differential Mode: 0.01 to 1100V RMS in 5 ranges
Direct Mode: 0.003 to 1100V RMS in 11 ranges

Crest Factor: (Differential Mode) 10, 1500 volts peak

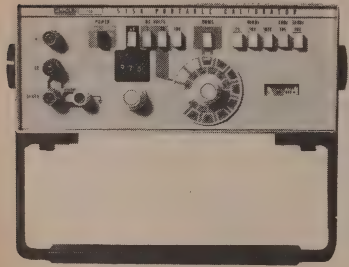
Input Power: 115/230V AC, 50-440 Hz

Input Impedance: 1 megohm shunted by less than 8 pF

Accuracy:
Differential Mode: ± (0.05% of reading + 0.005% of range) from 30Hz to 50KHz. Reduced Accuracy specifications from 1 Hz to 1MHz.
Direct Mode: ±3% of end scale

Price:
931B $1095.
931B-01 $1195.

CALIBRATORS



MODEL 515A

PORTABLE CALIBRATOR — MODEL 515A FEATURES

- **0.003% DC Accuracy for 1 Year.**
- **AC Volts, DC Volts and Ohms.**
- **Single Set of Output Terminals for All Functions.**
- **Built-in Rechargeable Battery Pack.**
- **Color-Coded Controls.**
- **DC Volts — 0 to 999 μV, 1 V, 10 V, 100 V.**
- **AC Volts — 1 V, 10 V, 100 V.**
- **Ohms — 10 Ω through 10 MΩ in Decades.**

MODEL 343A

DVM CALIBRATORS

Model	Output Voltage	Current Output	Accuracy	Regulation Line-Load	Stability % per mo.	Ripple (rms)	Resolution PPM of range
341A	0 to 1111.110V	25 mA	±0.005%	0.0005%	±0.003%	100μV	1 ppm
343A	0 to 1111.110V	25 mA	±0.002%	0.0005%	±0.0015%	50μV	0.1 ppm

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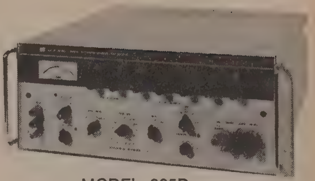
CALIBRATORS

DC VOLTAGE AND CURRENT CALIBRATORS

VOLTAGE STANDARDS

Model	Voltage	Current	Regulation %		Stability %	Calibration Accuracy	Max. Ripple RMS
			Line	Load			
332B	0-1111	0-50mA	0.0002	0.0002	0.002/year	0.002%	20-40μV
332D	0-1111	0-50mA	0.0002	0.0002	0.0014/year	0.001%	20-40μV
335A[1]	0-1111	0-50mA	0.0002	0.0002	0.002/year	0.002%	20-40μV
335D	0-1111	0-50mA	0.0002	0.0002	0.0014/year	0.001%	20-40μV



MODEL 335D

(Models 335A and 335D are also, respectively, 20 ppm and 10 ppm differential voltmeters and nine range, high input impedance galvanometers)

VOLTAGE/CURRENT CALIBRATOR

Model	Output Voltage	Current Output	Accuracy	% Regulation Line-Load	Stability % per mo.	Ripple (rms)
382A[1]	0-50 V	0-2 A	±0.01%	0.0005	±0.005%	50 μV
382A[2]	0-50 V	0-2 A	±0.02%	0.0005- 0.0001	±0.005%	0.002% of range

[1] Voltage mode [2] Current mode

MODEL 382A

PROGRAMMABLE VOLTAGE/CURRENT CALIBRATOR

Model 3330B	Constant Voltage Mode	Constant Current Mode
Voltage Range	10, 100 1000 V	—
Max. Current	100 mA 50 mA	—
Current Range	—	1, 10 100 mA
Compliance Voltage	—	1000 V 500 V
Accuracy, 90 days, 23°C ±1°C	±0.003%	±0.006%
Regulation Line-Load	5 PPM of ouput	5 PPM of range
Stability PPM of Output	15 PPM per mo.	30 PPM per mo.

MODEL 3330B

PRECISION AC CALIBRATION SYSTEM

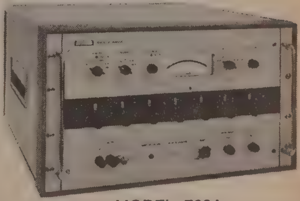
MODEL 5200A

- **1 mV to 1000V.**
- **Midband Accuracy ± (0.02% +0.002%).**
- **Fully Guarded.**
- **Distortion and Noise ± (0.04%).**
- **Phase Locking Input.**
- **Fully Programmable.**
- **90° Quadrature Output.**

MODEL 5200A and 5205A

AC/DC METER CALIBRATOR — MODEL 760A

Model 760A	DC Voltage & Current	AC Voltage & Current
Voltage Range	0.001V to 1000V in 0.1 mV steps	0.001V to 1000V in 0.1 mV steps
Voltage Accuracy	±(0.1% of setting + 25μV) Also ±0.33% at 1 mV, 3 mV, and 10 mV.	±(0.2% of setting + 25μV) Also ±0.33% at 1 mV, 3 mV and 10 mV.
Current Range	1μA to 10A in 1μA steps	1μA to 10A in 1μA steps
Current Accuracy	±(0.1% of setting + 0.01μA)	±(0.25% of setting + 0.025μA)
Frequency	—	60Hz and 400Hz (60Hz phase locked to power line)
Resistance: Range Accuracy Resolution	0 to 10 megohms ±(0.1% of setting + 0.5 ohm) 1 ohm	



MODEL 760A

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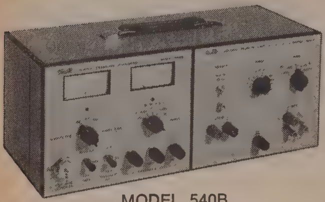
AC AND DC STANDARDS

REFERENCE AND TRANSFER STANDARDS



MODEL 540B

THERMAL TRANSFER STANDARD — MODEL 540B

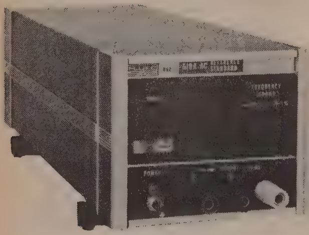
SPECIFICATIONS

Voltage Range	0.5 to 1000 V in 14 ranges.
Galvanometer Resolution	0.0012% of input/scale div. at rated input.
Accuracy	(% of input.)

Range	Frequency	AC/DC Difference
All except 1000V	5Hz-50KHz	±0.01%
1000V	5Hz-20KHz	±0.02%
1000V	20KHz-50KHz	±0.04%
	50KHZ-1MHz	±0.1%

CURRENT TRANSFER ACCESSORIES

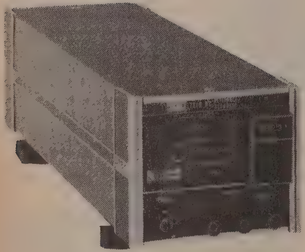
Accessories for the Model 540B are Thermal Converters (A55). Current Shunts (A40). Coaxial Cable Kits (A55-110), and Storage Cases (C41 and C55).



MODEL 510A

AC REFERENCE STANDARD — MODEL 510A

The Fluke 510A is a precision ac voltage source which can be used as a calibration standard or as a fixed frequency source for test applications. An output voltage of 10 volts rms and a current of 10 ma rms to an accuracy of ±0.01% for 30 days and ±0.02% for 90 days are featured. Any fixed frequency output from 50 Hz to 100 kHz is available. Total harmonic distortion is less than 0.005%. The 510A can be calibrated with dc. An optional rechargeable battery pack provides up to 16 hours of operation without ac line power.



MODEL 731B

DC REFERENCE STANDARD — MODEL 731B

The Fluke Model 731B DC Reference Standard is a solid state versatile instrument providing standard cell accuracy, but utilizes the excellent performance capabilities of the latest solid state technology. The instrument furnishes a variety of precision voltages with switched output ranges including 1.0; 1.018 + ΔE; 1.019 + ΔE; 10.0; and ΔE volts. Delta E (ΔE) provides a variable output of 0 through 999 μV which is either added to the voltage of a standard cell transfer or may be used directly as a low level source stable dc voltage.

Output Voltage	10.000 V, 1.000 V, 1.018 + ΔE, 1.019 + ΔE, ΔE.
Output Accuracy	30 days 10 ppm, 90 days 15 ppm, 1 year 3 ppm.
Transfer Accuracy	2 ppm between standard cells. 3 ppm between standard cells and 1V output. 5 ppm between standard cells and 10 V output.
ΔE Resolution	1 μV.

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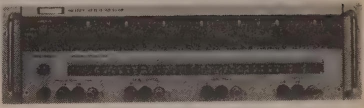
AC AND DC STANDARDS

RATIO MEASUREMENT INSTRUMENTS

KELVIN-VARLEY DIVIDER—MODEL 720A

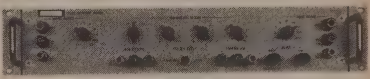
Input Resistence	Linearity	Resolution	Max. Input	Voltage Max. Pwr.	TC of Linearity
100K ohm ± 0.005%	±0.1 ppm of input	0.1 ppm of input	1100V	11 watts	±0.1 ppm of input per/°C



MODEL 720A

REFERENCE VOLTAGE DIVIDER—MODEL 750A

Input Voltage Ranges	Output Voltage Ranges	Divider Current	TC of Output	Accuracy	Stability
1.1, 5, 10, 50, 100, 500, 1000, 1100V DC	0.1, 0.5, 1.1, 5, 10, 50, 100, 500, 1000, 1100V DC	1 mA	±1ppm/°C over operating range	±0.001%	±0.001% per year

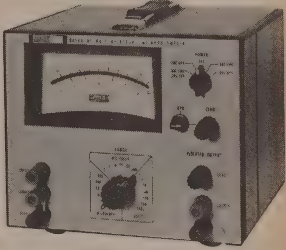


MODEL 750A

LEAD COMPENSATOR — MODEL 721A

4000: 1 Max. Ratio Resistance. 0.1 milliohm resolution. 1500 V Max. Divider voltage. 150 milliohms maximum allowable lead resistance.

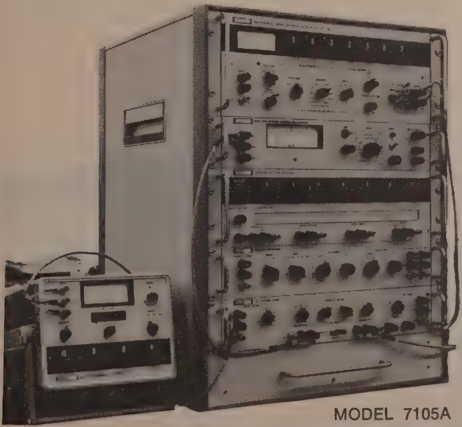
NULL DETECTOR — MICROVOLTMETER



MODEL 845AB

MODEL 845AB AND 845AR

Input Ranges	1μV to 1000 VDC in 19 end-scale ranges
Accuracy	±2% end scale + 0.1 μV)
Input Resistance	100 megohms on 300 mV range and above 10 megohms on 100 mV range and below
Input Power	845AB rechargeable battery or 115/230 VAC ±10%, 50-440 Hz, 845AR 115/230 VAC ± 10%, 50-440 Hz



MODEL 7105A

CALIBRATION SYSTEM

MODEL 7105A

DC VOLTAGE AND RATIO CALIBRATION SYSTEMS

FEATURES

- 5 PPM Accuracy
- Traceable to NBS.
- 0.1 PPM Resolution and Ratio Accuracy.
- Self-Calibrating.
- All System Instruments are Fluke Solid State.
- Functional Enclosure for Self-Contained Operation.

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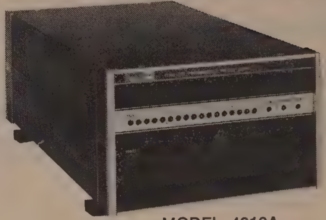
PROGRAMMABLE POWER SOURCES

MODEL 4250A



MODEL 4210A

SPECIFICATIONS

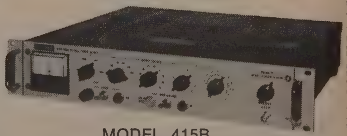
Model/Program Type	4210A BCD	4216A Binary	4250A BCD	4265A Binary	4270A BCD	4275A Binary
Output Voltage	±10V	±16V	±10V, ±65V	±16V, ±65V	±32V, ±110V	±10V, ±110V
Output Current	100mA		1A		500mA	
Settling Time to .01% Accuracy	30µs		100µs		110µs	
Ripple & noise	300 µV rms		500µV rms on low range 100mV pk 65V range		500µV on low range 1.2mV on high range	
Programming Noise	50mV peak		50mV pk on low range 1mV pk 65V range		500mV pk on low range 100mV pk on high range	
Stability	±(10 ppm of setting + 20µV) per 24 hours ±(30 ppm of setting + 60µV) per 90 days		Low Volt Range: ±(10 ppm of setting + 40µV) per 24 hours ±(30 ppm of setting + 70 µV) per 90 days 4250A, High Range: ±(30 ppm of setting + 490µV) per 90 days 4265A, High Range: ±(30 ppm of setting + 210µV) per 90 days		Same as 4250A	Low Volt Range: ±(30 ppm of setting + 105 µV) High Volt Range: ±(30 ppm of setting + 370 µV)

OPTIONS

External Reference	4210A-03	4216A-03	4250A-03	4265A-03	4270A-03	4275A-03
Current Limit*	—	—	4250A-06	4265A-06	4270A-06	4275A-06
100 µV Resolution*	4210A-07	—	4250A-07	—	4270A-07	—
16-Bit Multi-strobe Logic	4210A-09	4216A-09	4250A-09	4265A-09	4270A-09	4275A-09

* Not compatible in same unit.

POWER SUPPLIES



MODEL 415B

Model	Voltage	Current (mA)	Regulation % Line	Regulation % Load	Stability % Per Hr.	Stability % Per Day	Calibration Accuracy % of Output	Max. Ripple RMS	Resolution
408B	0-6000V	0-20	0.001	0.001	0.005	0.02	0.25	1mV	5mV
410B	0-10,000V	0-10	0.001	0.001	0.005	0.02	0.25	1mV	5mV
412B	0-2100V	0-30	0.001	0.001	0.005	0.02	0.25	500µV	5mV
415B	0-3111V	0-30	0.0005	0.0005	0.002	0.01	0.25	100µV	5mV

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FREQUENCY SYNTHESIZERS

MODEL 6010A SYNTHESIZED SIGNAL GENERATOR

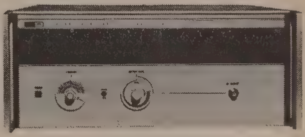
The Fluke 6010A Synthesized Signal Generator employs a microprocessor to assure you a new measure of performance. This versatile 7-digit, 10 Hz to 11 MHz instrument offers new dimensions in price/performance. Compare these features:

- **Memory — Store and Recall up to 10 Frequencies, Modulation and Attenuator Settings.**
- **Free-Form Entry of Frequency in Hz, kHz or MHz.**
- **Automatic Range Selection.**
- **7-Digit LED Readout.**
- **0.1 Hz Resolution, 10 Hz - 11 MHz Coverage.**
- **Compact — Measures 5¼″ x 8½″ x 19″.**
- **Interfaces Directly with Most Systems.**

MODEL 6010A

MODEL 6039A FREQUENCY SYNTHESIZER

The Fluke Model 6039A Frequency Synthesizer is an economical solution to many HF signal source requirements where programmability, high resolution and high speed are of concern. It features 1 MHz to 40 MHz frequency range, 1 Hz resolution (0.1 Hz from 1 MHz to 4 MHz), storage of remote frequency commands, −100 dB to −80 dB spurious, low noise and 0.8 msec switching speed. Options include two types of internal frequency standards, fixed output frequencies of 10 MHz, 5 MHz, 1 MHz, or 100 kHz and a high level output amplifier (+21 dBm).


MODEL 6039A

MODEL 6160B FREQUENCY SYNTHESIZER

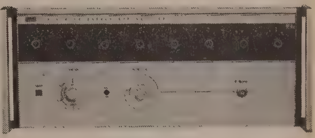
The Fluke 6160B Frequency Synthesizer offers better spectral performance than any other medium priced synthesizer. Covering the frequency range of 1 to 160 MHz in two ranges, (1 to 12 MHz and 10 to 160 MHz), the 6160B can be either manually or remotely controlled.

With non-harmonic spurious performance better than −83 dB, signal-to-phase noise ratio better than 74 dB and switching speed of less than 800 μsec in an operating environment of 0 to 50°C and 0 to 80% RH, the 6160B represents the highest performance for the lowest cost.

Option -02 — Frequency Std. 2 x 10^{-9}/24 hrs.

Option -04 — Rear Panel RF Output

Option -05 — TCXO 5 x 10^{-6}/year


MODEL 6160B

MODEL 645A FREQUENCY SYNTHESIZER

All solid state frequency synthesizer covers the frequency range of dc to 50 MHz. Offers modular construction and excellent spectral purity. Discrete non-harmonic spurious better than −100 dB. Includes .01 Hz resolution, search, sweep and rack mounting kit.

Optional — 2 x 10^{-9} Per Day Drift Rate Frequency Standard

Optional — A607 BDC-to-Decimal Interface

MODEL 645A

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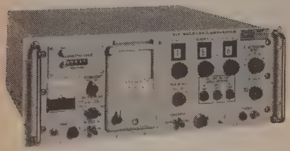
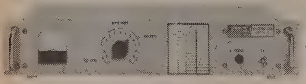
TIME AND FREQUENCY STANDARDS



MODEL 207-5

VLF RECEIVER — MODEL 207-5

The Model 207-5 is a coherent VLF tracking receiver for calibration of laboratory and communications center frequency standards. Frequency coverage is from 8.0 to 31.9 KHz in steps of 100 Hz with an additional channel at 60 KHz. The instrument is all solid state and employs integrated circuits. Multi-channel capability plus high sensitivity assures round-the-world reception of VLF signals for frequency standardization. The Model 207-5 includes an internal frequency standard and a frequency comparator.



MODEL 203A

FREQUENCY DISTRIBUTION AMPLIFIER — MODEL 203A

The Model 203A is a multi-channel distribution amplifier that features high stability, high interchannel isolation and freedom from harmonics and spurious outputs. These amplifiers are being widely used for distribution of standard frequencies in laboratories, communications installations and industrial facilities.

AUTOMATIC TEST EQUIPMENT

TERMINAL/10 COMPUTER CONTROLLED CALIBRATION SYSTEM

All Fluke ATE Systems Feature:

- Modular, flexible architecture. Easily expanded to meet your changing requirements.
- Time-shared multi-user test terminals. Several test terminals can simultaneously share a single computer configuration.
- User-oriented software.

The Fluke 7505A is a fully automatic calibration terminal designed to easily and precisely calibrate a wide variety of Test Instruments (TI). Typical of TI types that can be tested and calibrated using the 7505A include:

- Digital Voltmeters
- Differential Voltmeters
- Vacuum Tube Voltmeters
- Digital Multi-Meters
- Volt-Ohm Meters
- Oscillators
- AC, DC and Ohms Sources
- AC and DC Calibrators

The 7505B model of Terminal/10 provides these features:

- DC Voltage 0 to 1100V at ±10 ppm accuracy
- AC Voltage 0 to 1100V, 10 Hz to 1.2 MHz at ±0.02% Midband accuracy
- DC and AC Current to 10 amps
- Ohms to 10 Megohms
- Fully traceable to NBS

The Fluke 7510A is a fully automatic calibration terminal designed to provide fast and complete calibration of high-frequency instruments, including:

- Oscilloscopes
- Oscilloscope Plug-Ins

The 7510A model of Terminal/10 provides these features:

- Time-shared, multi-station operation
- Automatic Test Program Generators
- Wideband Stimulus, DC to 1400 MHz
- Pulse, Sine, and Squarewave Outputs, computer controlled in Amplitude and Frequency
- Direct Measurement of Oscilloscope Calibrator and Power Supplies

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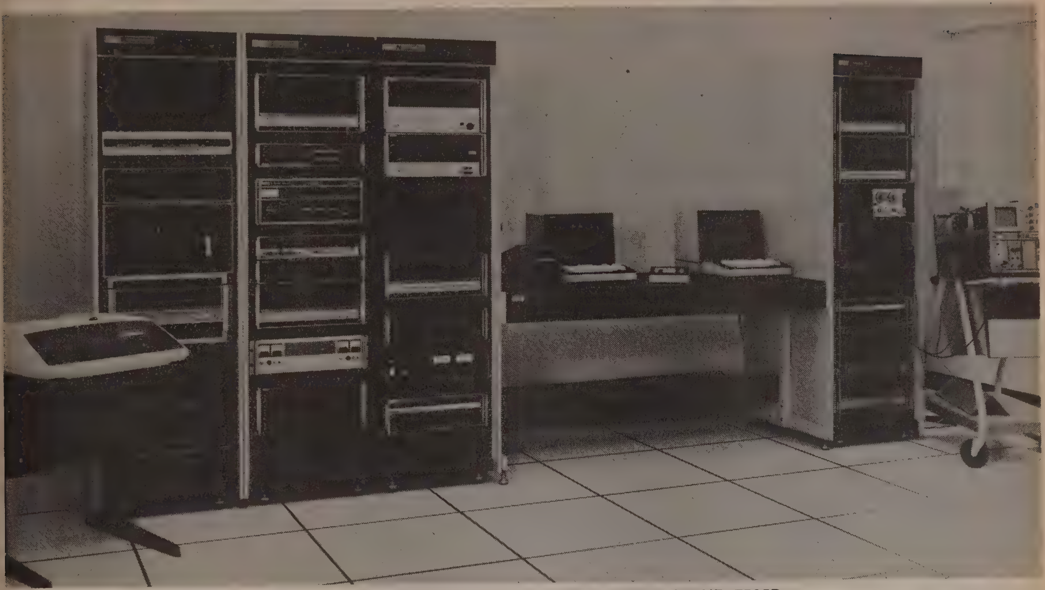
AUTOMATIC TEST EQUIPMENT

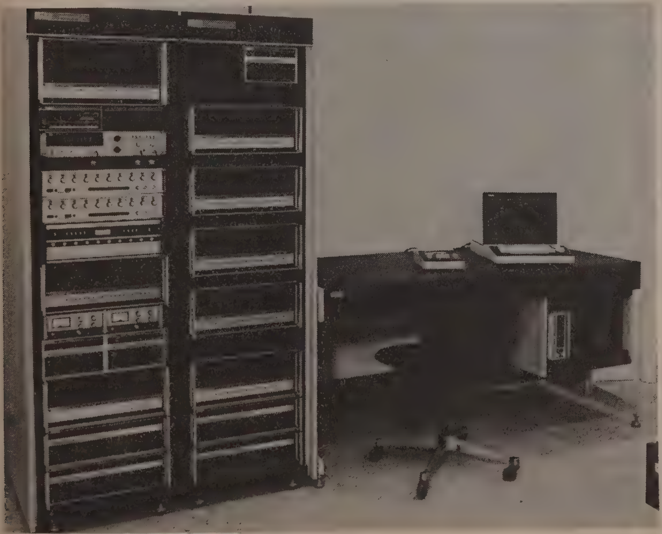


TERMINAL/10 COMPUTER CONTROLLED CALIBRATION SYSTEM — FLUKE 7505A AND 7505B

PRODUCTION TEST SYSTEMS

Production test systems have been designed and built by Fluke for major manufacturing firms. Fluke has extensive experience in:

- Analog PCB and Module Test Systems.
- Precision Component Test Systems.



TERMINAL/10 PRODUCTION TEST SYSTEM

Talk to the leader — John Fluke Manufacturing Company, Inc. — if you have Automatic Calibration or Production Test requirements.

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LOGIC TEST EQUIPMENT

TRENDAR 200

TRENDAR 200 TESTCLIP

FEATURES

Three instruments in one

- **In-circuit IC Comparator**
- **Logic States Clip**
- **Logic Probe**

Small, rugged, easy to use.
No controls to adjust, no scales to interpret.
Thresholds are automatically detected.
Automatically derives power from unit under test (UUT)
Minimum loading of UUT.
No calibration or routine maintenance.
DTL, TTL, C-MOS, and HTL compatible versions.

WHY USE TESTCLIP?

- Dramatically reduces IC troubleshooting time.
- Most effective method for diagnosing loop faults.
- Simple to use — frees personnel from troubleshooting drudgery.
- Reduces need for costly test equipment.
- Spare card inventories are significantly reduced due to increased productivity.
- Provides accurate results and highest test confidence.

SPECIFICATIONS

Supply Voltage*	Failure Blanking
200-01 4.5 to 10 V	Nominal 400 nsec @ 5 V
200-02 4.5 to 5.5 V	Nominal 100 nsec @ 5 V
200-03 10 to 15 V	Nominal 200 nsec @ 10 V

IC Pin Capacity: Handles 8, 14, and 16-pin dual in-line packages. Flatpacks require special probing adapters.

Logic Monitor: Single indicator displays ON for logic one, OFF for logic zero at IC pin selected by sixteen position rotary switch.

Logic Probe: 12″ lead, allows probing of nearby circuit nodes.

PULSE REPETITION RATE

Maximum pulse repetition rate 1 MHz for 200-01, 5 MHz for -02 & -03 (indicated by flashing at approximately 5 per second). Single pulse indication, single flash approximately 100 msec long.

TRENDAR 1000A LOGICTESTER

FEATURES

- **Single Pass, Go/No-Go Testing**
- **Precision Fault-Finding using FAULTRACK©**
- **129 Signal Sources**
- **Fully Compatible wtih TRENDAR 2000A Digital Logic Test Station**
- **Lowest True Cost**

GENERAL DESCRIPTION

The portable TRENDAR 1000A LOGICTESTER provides the same thorough test exercising — up to 4,000,000 128 bit words per second — as the program compatible TRENDAR 2000A. These test stations have established new levels of throughput in production board testing and field support.

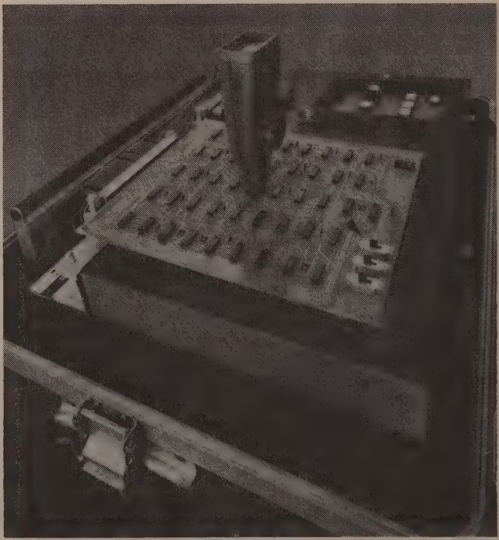
With the addition of Fluke Trendar's unique Output Count Integrator, the TRENDAR 1000A now offers the same fast one-pass, go/no-go testing as the larger TRENDAR 2000A.

Ideally suited to field service and low volume production testing, the TRENDAR 1000A is a complete test station.

TECHNICAL DESCRIPTION

OUTPUTS FROM PATTERN GENERATORS

Number: The LOGICTESTER supplies 129 (128 standard plus 1 programmable) separate signal outputs for test circuit modules.



TRENDAR 1000

Levels: Standard TTL ("O" $\leqslant 0.4$ V; "1" $\geqslant 2.4$ V).

MAXIMUM NUMBER OF PATTERNS

The maximum number of patterns is selectable from 40 thousand to 40 million.

OUTPUT COUNT INTEGRATOR

Inputs: 60.

Outputs: 9 test points, representing one overall count signature.

TEST REPEATABILITY

All circuit modules tested sequentially will undergo the identical test patterns for a given maximum number of patterns setting.

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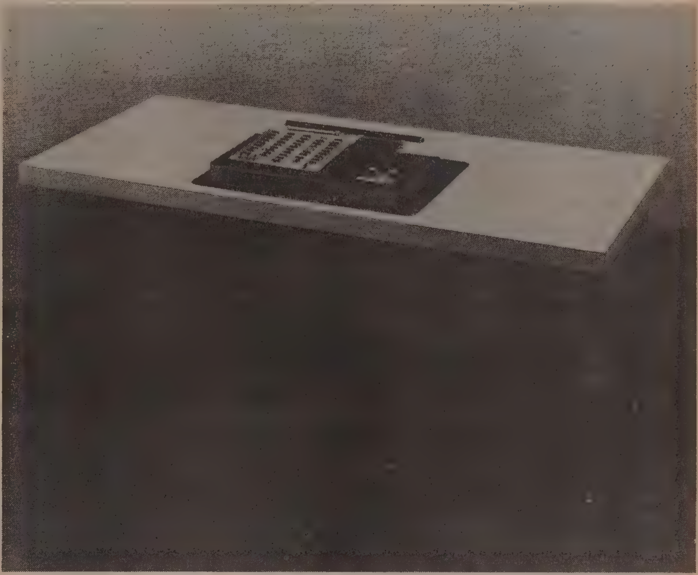
LOGIC TEST EQUIPMENT

TRENDAR 1010A LOGICTESTER

The TRENDAR LOGICTESTER console provides the same thorough test exercising — up to 4,000,000 128 bit words per second — as the program compatible TRENDAR 2000A. These test stations have established new levels of throughput in production board testing and field support.

The TRENDAR 1010A is a production digital test console for modest volume at a surprisingly low price. It is capable of one pass, go/no-go testing. And, if a fault is detected, the tester narrows the failure to a small group of outputs, and the operator then isolates the fault by measuring transition behavior with a built-in probe. See Model 1000A Technical Description.


TRENDAR 1010A

TRENDAR 2000A

FEATURES

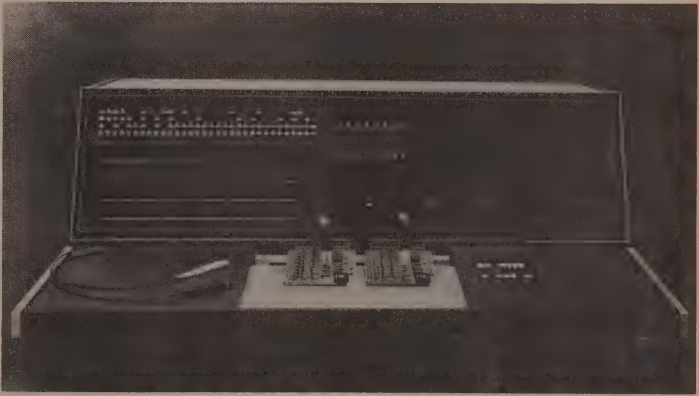
- **Highest Confidence Level in Tested Boards**
- **Fastest Startup**
- **Higher Productivity**
- **Fault-Finding Superiority**
- **Compatible Field Service Unit**
- **Lowest Annual Cost**

GENERAL DESCRIPTION

The TRENDAR 2000A production line tester station for high volume testing of digital circuit boards is the most recent version of the field proven TRENDAR 2000.

Up to 4 million 128-bit words per second are generated by the TRENDAR 2000A to test the most complex boards.

High speed testing and fault isolation produce a three to ten times increase in board throughput per man hour. Trendar techniques are quickly learned by technicians. Two days of training are sufficient and the TRENDAR 2000A typically will be testing boards the week it is delivered.


TRENDAR 2000A

TECHNICAL DESCRIPTION

OUTPUTS FROM PATTERN GENERATORS

Number: Test Station supplies 128 separate signal output pairs for reference and test circuit modules. Outputs are derived from 4 pattern generators producing 32 drive signals each.

TEST RATE

Test rates from 1 test/sec to 4 million tests/sec selectable by 12 position switch plus overlapping vernier. A test is a simultaneous comparison of 128 pairs of comparator inputs.

NUMBER OF TESTS

Number of tests selectable from 1 test to 10 million tests.

All patterns follow identical sequences from the start of a test, to allow repeatable troubleshooting. The statistical probability of a change is the same for each bit position of a given pseudorandom generator.

TEST REPEATABILITY

All circuit modules tested sequentially will undergo the identical test patterns for given test settings.

TEST MODES

Auto Test automatically applies up to ten million tests in each of four sequences.

INITIALIZATION

In the Auto Test mode all circuits are run through an initialization sequence.

TROUBLESHOOTING MODES

Stop on Fail will halt the test station with the logic patterns held in the pattern existing at the instant a failure was detected.

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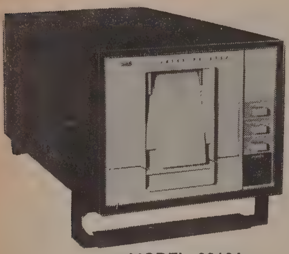
DIGITAL PRINTER



MODEL 2010A

MODEL 2010A

The Fluke 2010A is a versatile, low cost printer specifically designed for instrumentation requirements. The basic printer records 10 columns of data which can be expanded to 18 columns with the 01 option. Data storage is a standard feature and cables are available to interface to all Fluke digital measuring instruments.

Accuracy	Identical to input device
Printing Rate	2.65 lines/second — Black (375 ms) 2.5 lines/second — Red (400 ms)
Paper	2¼″ wide fan-fold or Standard 2¼″ wide roll paper
Data Input	1, 2, 4, 8 binary code for each data column 1 through 16 and for function columns 17 and 18 and decimal Parallel data entry standard Logic Level DTL/TTL compatible, positive logic Logic "1" = +3.5 V minimum to +5 V maximum or open

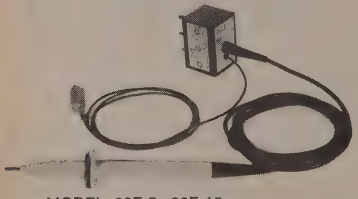
VOLTMETER ACCESSORIES

80K-40 HV PROBE

MODEL 80K-40

(80 K-40) Voltage Range	1 kV to 40 kV.
Input Resistance	100 MΩ.
Ratio	1000:1.
Overall Accuracy	20 kV to 30 kV ±2% (Calibrated 1% at 25 kV).
Upper Limit	Changes Linearly from 2% at 30 kV to 4% at 40 kV.

80F-5, 80F-15 HV PROBES



MODEL 80F-5, 80F-15

	80F-5	80F-15
Input Voltage Range	500 - 5000 V	1000 - 15,000 V
Input Resistance	50 MΩ	100 MΩ
Division Ratio	1000:1	1000:1
Ratio Accuracy (23°C ±1°C) (into 10 MΩ ±0.1% voltmeter input)	±0.05% of input	±0.05% of input

80E-10 HV DIVIDER

Accuracy	±0.01% for both division ratios over a temperature range from 18°C to 28°C and for any input voltage up to rated maximum. Derate at 2 ppm/°C outside this temperature range to 0°C and 50°C.
Maximum Input Voltage	10,000 VDC.

80I-600 CLAMP-ON AC CURRENT PROBE

MODEL 80I-600

Range	2A-6000A.
Frequency Response	30 Hz - 1 kHz.
Accuracy	±3%.
Division Ratio	1000:1.

A-90 CURRENT SHUNT

The Model A-90 current shunts may be used for both DC and AC current measurements over a wide range of currents and frequencies. Voltage may be sensed across the shunts with virtually any voltmeter.

Ranges 0.1, 1.0, 10, 100 mA and 1, 10 A.

80RF, 81RF RF PROBES

MODEL 80RF, 81RF

	81RF	80RF
Frequency Response	100 kHz to 100 MHz; ±1 dB	100 kHz to 500 MHz; ±1 dB 10 kHz to 500 MHz; ±3 dB
Extended Response (Useful for relative readings)	20 kHz to 250 MHz	1kHz to 1 GHz
Voltage Range	0.25 V to 30 V RMS 350 VDC Max.	0.25 V to 30 V RMS 200 VDC Max.

PHYSICAL ACCESSORIES

Carrying Cases, Dust Covers, Rack Mounting Hardware, Chassis Slides, Test Leads are included in the complete line of physical accessories available to protect or enhance the convenience of your Fluke instrument. Ask for the "Voltmeter Accessories" data sheet.

JOHN FLUKE MANUFACTURING COMPANY, INC.
P.O. BOX 7428, SEATTLE, WASHINGTON 98113
TEL. (206) 774-2211 • TWX 910-449-2850 • TLX 3-2213, CABLE: FLUKE

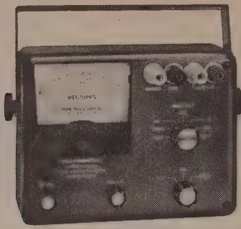
PRICE LIST

Model No.	Price
A40	$125
A55-110	100
A-90	255
C41	100
C55	100
P20J	20
P20K	20
P20T	20
1000A	6475
1010A	7500
1010A-02	975
1900A	349
1900A-01	125
1900A-02	150
1920A	859
1920A-01	150
1920A-02	195
1920A-04	185
1920A-06	100
1920A-13	150
1920A-14	250
1952B	659
1952B-03	120
1952B-17	45
1952B-18	90
1952B-19	25
1953A	849
1953A-02	195
1953A-04	185
1953A-05	100
1953A-07	345
1953A-10	365
1953A-11	120
1953A-12	350
1953A-13	485
1953A-14	545
1953A-16	50
200	395
2000A	28,900
2000A-01	1600
2010A	895
2010A-7017	100
2010A-7018	150
203A	1495
207-5	4495
2100A-03	749
2100A-03, -01	150
2100A-03, -02	150
2100A-06	995
2100A-06, -01	150
2100A-06, -02	150
2100A-10	895
2100A-10, -01	150
2100A-10, -02	150
2150A-10	250
2150A-20	350
2150A-30	450

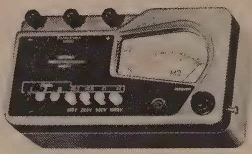
Model No.	Price
332B	$2595
332D	2995
3330B	3695
341A	1445
343A	1995
382A	1950
408B	1045
410B	1145
412B	595
415B	695
4210A	1445
4210A-03	200
4210A-07	300
4210A-09	125
4216A	1445
4216A-03	200
4216A-09	125
4250A	1795
4250A-03	200
4250A-06	200
4250A-07	300
4250A-09	125
4265A	1795
4265A-03	200
4265A-06	200
4265A-09	125
4270A	1895
4270A-03	200
4270A-06	200
4270A-07	300
4270A-09	125
4275A	1895
4275A-03	200
4275A-06	200
4275A-09	125
510A	565
515A	1995
5200A	4495
540B	1345
6010A	2495
6039A	3795
6160B	5495
6160B-02	550
6160B-04	N/C
6160B-05	250
645A	13,950
7105A	7825
720A	1795
721A	395
731B	495
750A	1395
7505B	51,250
7510A	44,800
760A	3195
80E-10	445
80F-5	295
80F-15	350

Model No.	Price
80I-600	$65
80K-40	40
80RF	75
81RF	40
8000A	299
8000A-01	50
8000A-02	75
8000A-05	25
8000A-06	51
8000A/MAS	475
8000A/MTR	385
8100B	695
8120A	795
8125A	2195
8200A	1095
8200A-01	350
8200A-02	295
8200A-03	250
8200A-04	150
8200A-06	200
8200A-07	400
8200A-08	200
8200A-09	595
8300A	1395
8300A-01	495
8300A-02	345
8300A-03	500
8300A-04	250
8300A-05	200
8350A	1695
8375A	2195
8375A-03	500
8375A-04	200
8375A-05	200
8400A	2495
8400A-01	695
8400A-02	300
8400A-03	500
8400A-04	200
8400A-05	200
8400A-06	700
8400A-09	750
845AB	595
845AR	595
8600A	649
8600A-01	100
8600A-02	150
8800A	985
8800A-02	150
883AB	1595
885AB	1395
887AB	1695
891A	945
893A	1195
895A	1495
931B	1295

Note: Add option prices to basic instrument prices.



2030-A-B-C-D-E



667

1620-A-B-C-D

1020-C-D

MEGOHMMETERS

Freed can supply a complete range of insulation resistance measuring equipment with fixed and variable d.c. test voltages from 5 to 2500 volts. Insulation and leakage measurements can be made on transformers, motors, cables, electronic assemblies and components, dielectric materials, electrical appliances and tools, capacitors and resistors.

Type	Resistance Range	Test Voltage	Accuracy	Power Requirements	Size and Weight	Price
1620	0.1 to 4,000,000 megohms 1 to 2,000,000 megohms @ 500 volts	Variable 50 to 1000 volts d.c.	±5% at full scale	105-125 volts 50-60 cycles	15″ x 9″ x 7½″ 24 lbs. •	400.00
1620-A	0.01 to 4,000,000 megohms 0.1 to 200,000 megohms @ 50 volts 1 to 2,000,000 megohms @ 500 volts	Variable 5-100 volts d.c. 100-1000 volts d.c.	±5% at full scale	105-125 volts 50-60 cycles	15″ x 9″ x 7½″ 24 lbs. •	415.00
1620-B	1 to 2,000,000 megohms 10 to 2,000,000 megohms @ 2500 volts	Variable 250-2500 volts d.c.	±5% at full scale	105-125 volts 50-60 cycles	15″ x 9″ x 7½″ 24 lbs. •	455.00
1620-C	All features same as Type 1620 with additional circuitry for capacitor measurements	Variable 50 to 1000 volts d.c.	±5% at full scale	105-125 volts 50-60 cycles	15″ x 9″ x 7½″ 24 lbs. •	435.00
1620-D	0.01 to 40,000,000 megohms 0.1 to 2,000,000 megohms @ 50 volts 1 to 20,000,000 megohms @ 500 volts	Variable 5-100 volts d.c. 100-1000 volts d.c.	±5% at full scale except highest range ±10%	105-125 volts 50-60 cycles	15″ x 9″ x 7½″ 25 lbs. •	455.00
1020-C	0.1 to 2,000,000 megohms 0.1 to 200,000 megohms @ 50 or 100 volts d.c. 1 to 2,000,000 megohms @ 500 volts d.c.	Fixed 50, 100, 500 volts Regulated	±3% all ranges except highest range ±5%	105-125 volts 50-60 cycles	9½″ x 10½″ x 8″ 18 lbs. •	330.00
1020-D	0.1 to 2,000,000 megohms 0.1 to 200,000 megohms @ 100 or 200 volts d.c. 1 to 2,000,000 megohms @ 500 volts d.c.	Fixed 100, 200, 500 volts Regulated	±3% all ranges except highest range ±5%	105-125 volts 50-60 cycles	9½″ x 10½″ x 8″ 18 lbs. •	330.00
2030-A	10 to 2,000,000 megohms	Fixed 500 volts d.c.	±5% full scale	battery operated transistor supply	6″ x 8″ x 4″ 8 lbs.	225.00
2030-B	1 to 20,000,000 megohms	Fixed 500 volts d.c.	±5% full scale	battery operated transistor supply	6″ x 8″ x 4″ 8 lbs.	260.00
2030-C	1 to 2,000,000 megohms	Fixed 50 volts d.c.	±5% full scale	battery operated transistor supply	6″ x 8″ x 4″ 8 lbs.	235.00
2030-D	1 to 2,000,000 megohms	Fixed 100 volts d.c.	±5% full scale	battery operated transistor supply	6″ x 8″ x 4″ 8 lbs.	235.00
2030-E	1 to 2,000,000 megohms	Fixed 200 volts d.c.	±5% full scale	battery operated transistor supply	6″ x 8″ x 4″ 8 lbs.	235.00
667	0 to 10,000 megohm	Fixed 100-250-500 1000 v.d.c.	± 2.5% of scale length	battery operated transistor supply	8½″ x 4½″ x 5″ 4½ lbs.	210.00

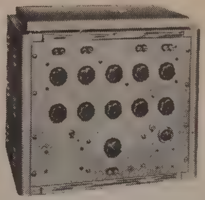
• Rack type available — 1620 series 19″ x 10½″ x 9½″
1020 series 19″ x 7″ x 9½″

Prices quoted are subject to change without notice

FREED TRANSFORMER CO., INC.

INCREMENTAL INDUCTANCE BRIDGES

Direct in-line readings of inductance and conductance of iron core component at audio frequencies with or without super-imposed direct current. The bridge uses the Owens circuit with provisions for measuring the series or parallel inductance and conductance of the unknown inductor; five precision resistance and capacitance decades are provided to indicate these values. "Q" or storage factor can be measured as the product of the inductive reactance and the conductance.


1110-C

Type	Inductance Range	Conductance Range	Frequency Range	D.C. Current	Accuracy	Dimensions and Weight	Price
1110-C	1111.1 h to 1 mh 5 decades 1.1 h to 1 µh 2 decades	0.015 µmho—100 mho "Q" = 600 max @ 100 cycles	20 cycles to 10KC	up to 2 amperes	±0.5% to 5 KC ±2% to 10 KC	21¾" x 17½" x 15¼" 50 lbs.	695.00
1115	111.1 h to 100 µh 5 decades 0.11 h to 0.1 µh 2 decades	0.15 µmho—1000 mho "Q" = 600 max @ 100 cycles	20 cycles to 10 KC	up to 15 amperes	±1% to 5 KC ±3% to 10 KC	21¾" x 28" x 15¼" 80 lbs.	995.00
1185	111.1 h to 100 µh 5 decades 0.11 h to 0.1 µh 2 decades	0.15 µmho—1000 mho "Q" = 600 max @ 100 cycles	20 cycles to 10 KC	up to 30 amperes	±1% to 5 KC ±3% to 10 KC	21¾" x 33¼" x 15¼" 100 lbs.	1395.00

NULL DETECTOR

Sensitive null detector for bridge measurements, with self contained selective filters to limit the amplifier characteristics at various bridge measuring frequencies.

1140-B

Type	Sensitivity	Frequency Range	Filter	Power Requirements	Dimensions and Weight	Price
1140-B	10µ volts @ 1 KC for 15% meter deflection filter in	20 to 20,000 cycles	Fixed 60, 400, 1000 cycles Adjustable ±5% of center Other frequencies available	105-125 volts 50-60 cycles	Cabinet 12" x 8½" x 10"—18 lbs. Rack—19" x 6" x 10"	275.00

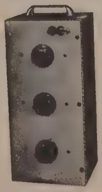
D.C. SUPPLY

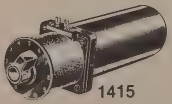
A constant voltage transformer regulated current source designed for use with the Freed Incremental Inductance Bridges. Solid state bridge rectification, L-C filters and low internal impedance provides good current regulation with a minimum of circuit complexity.

Type	Current Ranges	Voltage Ranges	Regulation	Power Requirement	Dimensions and Weight	Price
1170-A	4 ranges, 0-5, 25, 100 and 1000 milliamperes	Maximum no load voltage 1000 Ma, 270V, 100 Ma, 270V 25 Ma, 85 V, 5 Ma, 48 V	± 1% for line variation 105-125 V	105-125 volts 60 cycles	19" x 10½" x 13½" 66 lbs.	375.00

DECADE CAPACITORS

The Freed series of Decade Capacitors cover a wide range of values and can be supplied as individual decades from 0.0001 PF. per step to 1 mf. per step or in various combinations of assembled decade boxes. All capacitors are non-inductively wound and heat treated for stability.


1250


1415

Type	Total Capacity	Dielectric	Dissipation Factor	Accuracy	Dimensions and Weight		Price
1415	10 µf in steps of 1 µf	Mylar	<0.005	±1%	3" x 3" x 7"	2 lbs.	60.00
1416	1 µf in steps of 0.1 µf	Polystyrene	<0.0002	±1%	3" x 3" x 7"	2 lbs.	75.00
1417	0.1 µf in steps of 0.01 µf	Polystyrene	<0.0002	±1%	3" x 3" x 7"	2 lbs.	60.00
1418	0.01 µf in steps of 0.001 µf	Polystyrene	<0.0002	±1%	3" x 3" x 7"	2 lbs.	60.00
1419	0.001 µf in steps of 0.0001 µf	Polystyrene	<0.0002	±1%	3" x 3" x 7"	2 lbs.	70.00
1250	1.110 µf in steps of 0.001 µf	Polystyrene	<0.0002	±1%	13¾" x 6" x 4½"	8 lbs.	285.00
1352	1.111 µf in steps of 0.0001 µf	Polystyrene	<0.0002	±1%	19" x 5¼" x 10"	13 lbs.	335 00
1353	11.111 µf in steps of 0.0001 µf	Mylar Polystyrene	<0.005	±1%	19" x 5¼" x 10"	14 lbs.	395.00

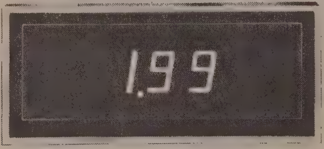
Maximum operating voltage, 500 VDC or peak. Capacitors can be supplied to better than ±1%, write for complete information.
In addtion to listed equipment, Freed manufactures a complete series of decade inductors, AC and DC regulated power supplies, comparison and limit bridges.
Write for complete catalog.

FREED TRANSFORMER COMPANY, INC. 1795 WEIRFIELD ST. (Ridgewood) Brooklyn, N.Y. 11227

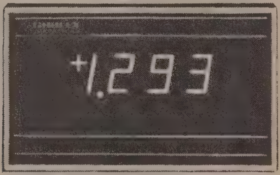
WE'VE GOT THEM ALL!

DPMs

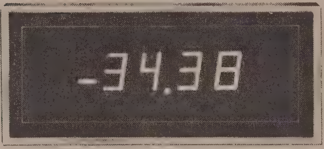
2½, 2¾, 3½, 3¾, 4½ digit models



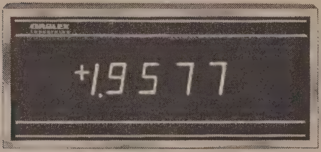
Model 37 2½-digit



Model 36 3½-digit



Model 37 3¾-digit



Model 45 4½-digit

GRALEX PROVIDES THE BROADEST LINE OF DPM'S IN THE INDUSTRY WITH A CHOICE OF MODELS FOR ALMOST ALL APPLICATIONS.

FEATURES INCLUDE:

- Big bright displays
- Reliable performance
- Applications versatility
- Standard size in most models
- Quality components and construction
- Low power consumption
- Choice of input configurations
- Easy installation
- Great value

2½ and 2¾ Digit Series 37
Economy grade models are available in AC line or DC powered versions with LED readouts. The planar gas discharge display can also be obtained in the 2¾ digit models.

3½ and 3¾ Digit Series 37
The Designers Choice includes interchangeable AC line or DC powered models. Displays are planar gas discharge or LED. The extended range 3¾ digit versions are priced only slightly above 3½ digit models.

Model 36
is a systems oriented 3½ digit design. BCD output is standard and all controls useful for interfacing with digital systems are included.

Model 45
is a high accuracy 4½ digit meter that is fully systems compatible. A very wide choice of input voltage and current ranges is available as well as ratiometric versions.

Model	37 2½ & 2¾ digits	37 3½ & 3¾ digits	36 3½ digits	45 4½ digits
Ranges, Full Scale	±19.9V, ±1.99V, ±199mV ±39.9V, ±3.99V, ±399mV	±19.99V, ±1.999V, ±199.9mV ±39.99V, ±3.999V, ±399.9mV	±19.99V, ±1.999V, ±199.9mV	±1.9999V, µA, mA, A ±19.999V, µA, mA ±199.99 mV, V, µA, mA
Display	Planar Gas Discharge or LED	Planar Gas Discharge or LED	Planar Gas Discharge or NIXIE	Planar Gas Discharge
Accuracy	±0.5% rdg ±1 count	±0.1% rdg ±1 count	±0.05% rdg ±1 count	±0.01% rdg ±1 count
Stability	100 PPM rdg/°C	80 PPM rdg/°C	80 PPM rdg/°C	20 PPM rdg/°C
Zero Drift	50 PPM fsr/°C	25 PPM fsr/°C	25 PPM fsr/°C	5 PPM fsr/°C
CMR	> 60 dB	> 60 dB	> 70 db	> 120 dB
Digital Outputs	Isolated BCD Optional	Isolated BCD Optional	BCD standard	BCD Optional
Power	Universal AC Line or 5VDC	Universal AC Line or 5VDC	115 or 230V, 50-400 Hz	115 or 230V, 50-400 Hz
Dimensions, behind bezel	1.66 H x 3.90 W x 4.04 D	1.66 H x 3.90 W x 4.04 D	2.00 H x 3.50 W x 2.82 D	1.66 H x 3.90 W x 4.04 D
Dimensions, bezel only	1.76 H x 4.00 W x .37 D	1.76 H x 4.00 W x .37 D	2.25 H x 3.75 W x .37 D	1.76 H x 4.00 W x .37 D

OTHER MODELS AVAILABLE, INCLUDING SPECIAL-PURPOSE APPLICATIONS

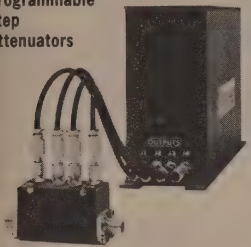
Specifications subject to change without notice

GRALEX
INDUSTRIES
DIVISION OF GENERAL MICROWAVE CORP.
155 MARINE ST., FARMINGDALE, N.Y. • 516-694-3607

LOW COST SOLID-STATE COMPONENTS AND TEST EQUIPMENT

ULTRA-BROADBAND 0.1 to 18.0 GHz PIN DIODE CONTROL COMPONENTS

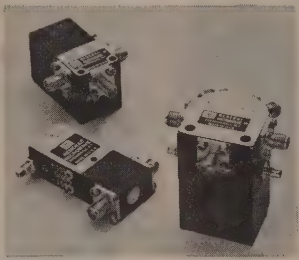
Programmable Step Attenuators



High Speed,
As fast as 3 μsec.
Solid State reliability.
Up to 120dB range.

- Programmable steps of 1, 2, 6 or 10dB
- Accuracy as low as ±0.2 dB, repeatability ±0.1dB
- Flat response, low insertion loss

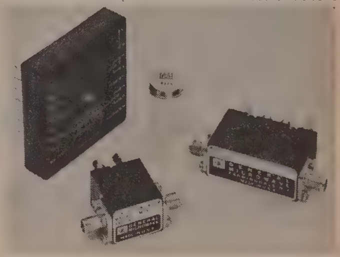
Switches/Modulators



From SPST to SP5T.
With built-in drivers.

- Subminiature size
- Low insertion loss
- Fast switching speed
- High isolation

Absorptive Attenuators



Available with voltage-controlled logarithmic and high-speed switch drivers.

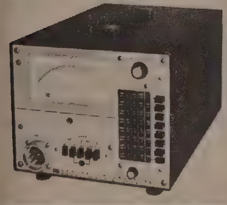
- Can also be used as nanosecond switches or pulse modulators.

BROADBAND RADIATION HAZARD METERS

Frequency Range: 0.01—18GHz
Power Range: 0.2—200 mW/cm^2

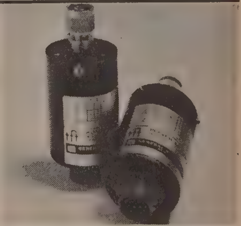
- Detects and measures potentially hazardous nonionizing energy radiating or leaking from microwave energy sources
- Assures conformance with OSHA radiation protection guide
- Designed to comply with U.S. Dept. HEW standards

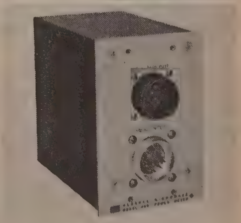
MICROWAVE POWER METERS



Frequency Range: 0.01-40 GHz
For Laboratory and System Applications

- Direct reading from 10 nanowatts to 3 watts
- Accuracy: as low as 0.5%
- Analog and digital
- Available with automatic zero setting, automatic range and scale selection





Another State-Of-The-Art Product Line From

GENERAL MICROWAVE CORPORATION

155 Marine Street, Farmingdale, New York • Tel. 516-694-3600

Get more performance per dollar

COMPUTING
FREQUENCY COUNTER

New 20 MHz Computing Frequency Counter

$595.00*
assembled

The SM-109A is the answer to your low frequency measurement problems. With its exclusive Heath-designed circuitry you can make rapid, high resolution, low frequency measurements that cannot be obtained with a standard frequency counter. It measures the elapsed time for a number of periods of the input waveform, then automatically computes the input frequency — all in much less time than would be required with a conventional counter. The display provides 6-digit resolution with automatic decimal placement and range indication. Range is 0.1 Hz to 20 MHz with sensitivity as low as 20 mV. Features include display of either Hertz or counts per minute . . . input for use of an external frequency standard . . . 1 megohm input impedance. (Shipping weight 12 lbs.)

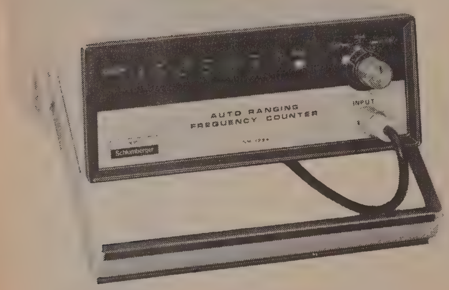
Precision 65 MHz Frequency Counters

SM-110A:
$495.00*
assembled

SM-110C:
$895.00*
assembled

Heath's SM-110 series counters have the features and capability to handle the most exacting measurements . . . at prices far lower than others. The SM-110A has a 1 Hz to 65 MHz range on the 1 megohm/15 pF input and a 10 MHz to 180 MHz range on the *separate* 50 ohm input. Input sensitivity is 10 mV rms at 35 Hz, 15 mV rms at 180 MHz. The 1 MHz crystal time base provides accuracy and stability sufficient for general design and testing applications. In addition to the features found in the SM-110A, the SM-110C has an extremely stable TCXO time base and complete remote programming capability. Frequency range extends to 600 MHz. (Shipping weight 11 lbs.)

PROGRAMMABLE
FREQUENCY COUNTER



Autoranging 110 MHz Frequency Counters

SM-128A:
$340.00*
assembled

SM-128B:
$425.00*
assembled

The Heath SM-128s are a pair of high performance counters with very reasonable prices. They deliver guaranteed performance to 110 MHz with 15 mV sensitivity. Typical performance is even better: 140 MHz at 2-10 mV sensitivity. The front panel trigger level control adjusts input trigger level above and below the zero-crossing point to reduce effects of signal noise. Two preset gate intervals of 1 sec and 10 ms are switch-selectable . . . or use the autoranging function for maximum resolution at all times. The SM-128A uses a standard clock stable to ±10 ppm/mo. over 0-40° C. The SM-128B has temperature stability of ±1 ppm/mo for precision applications. (Shipping weight 10 lbs.)

Best-Buy 30 MHz Frequency Counter

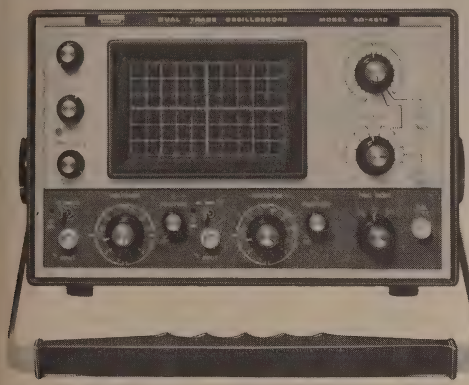
$250.00*
assembled

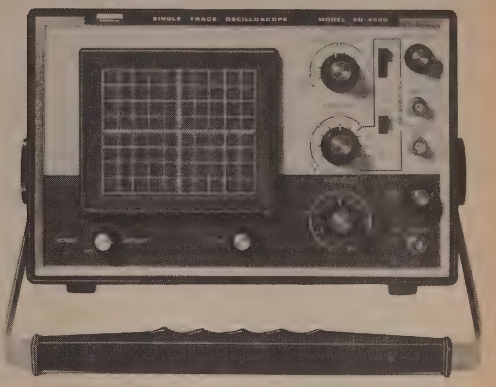
This compact frequency counter is Heath's best counter buy. It offers a guaranteed 5 Hz to 30 MHz range, with typical performance ranging from 2 Hz to 40 MHz. Input sensitivity is guaranteed to be 10 mV across the range, but typically it runs from 5.5 to 7.5 mV. Two preset switch-selectable gate intervals allow resolution to 1 Hz. Autorange automatically determines correct range for maximum resolution without overranging. The trigger level control allows adjustment of the input amplifier . . . to eliminate the effects of noise on the signal. Other features include 6-digit display, high impedance input, and external clock input. (Shipping weight 7 lbs.)

AUTO RANGING
FREQUENCY COUNTER
INPUT
Schlumberger

For complete specs, send for your free copies of the latest Heath catalogs.

with counters and scopes from Heath





Dual-Trace 15 MHz, 1 mV Scope features delay lines for complete waveform display

$549.95* kit

$750.00* assembled

Heath's 4510 is a compact scope with the professional performance necessary for today's high speed, sensitive circuits. It offers a DC-15 MHz bandwidth, vertical sensitivity of 1 mV/cm over the full bandwidth, time base sweep to 100 nsec/cm and complete dual trace capability — all at a practical price.

Internal delay lines for the vertical amplifiers allow display of at least 20 nanoseconds of the pretriggered waveform, insuring that the complete waveform will be displayed. X-Y operation uses the standard vertical inputs, making phase measurements easy.

The post-deflection accelerated CRT of the 4510 provides a brighter trace and allows faster writing speeds. It will typically trigger on signals up to 45 MHz and is guaranteed to 30 MHz. No stability control is needed with the digitally-controlled trigger circuits. In the automatic mode, a reference baseline is generated even when the trigger signal is absent. Complete triggering controls are provided with choice of AC or DC coupling, triggering at any point on the vertical signal. Choice of automatic or normal sweep uses any one of 22 time bases from 0.2 sec/cm to 0.1 μsec/cm.

All major circuitry is located on five easily-removed circuit boards for easy trouble-shooting and service. For maximum performance at low cost, order the factory assembled and calibrated SO-4510. To save even more, the IO-4510 offers the same performance and features in an easy-to-assemble kit. (Shipping weight 34 lbs.)

Single Trace 10 MHz, 10 mV Triggered Scope with TV coupling

$299.95* kit

$420.00* assembled

The 4530 features a DC-10 MHz bandwidth, wide-band triggering capability, sensitive 10 mV/cm vertical input, TV coupling and a calibrated X-channel input — making it one of the best scope values on the market today.

Trigger bandwidths are guaranteed to 15 MHz, AC and DC coupled. Trigger circuits are digitally controlled, requiring only a level control and a slope switch. Various trigger signals can be selected: a sample of the vertical input signal, a sample of the line voltage or an externally applied trigger signal. In the TV trigger coupling mode, the 4530 can be easily triggered on the vertical component in a composite video signal.

Time bases can be switched from 200 ms/cm to 200 ns/cm. and any sweep speed can be expanded five times.

The 4530 is easy to operate, easy to service and offers high performance-per-dollar ratios. The factory assembled SO-4530 comes completely calibrated. For even greater value, build your own with the IO-4530 kit. (Shipping weight 30 lbs.)

Heath has a complete line of scopes for every application

Whatever your application, Heath has a scope with the performance and features you need. In addition to the scopes described above, we also have single trace DC-15 MHz scopes for design or just plain trouble-shooting—at prices that won't destroy your budget. If you need a low cost scope for classroom demonstrations or general design work in audio, TV and receiver circuitry, then our 5 MHz scope is the scope for you. The complete line—kit and assembled — is described in the latest Heath catalogs. Send for your free copies today.

Send for your FREE Heath catalogs

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Your free '75 Heathkit Catalog describes the world's largest selection of electronic kits — including a full line of money-saving lab and design instruments. The latest **Heath/Schlumberger Assembled Instruments Catalog** features a complete line of ready-to-use instruments — many not found anywhere else. Your free catalogs are waiting. Call or write today.

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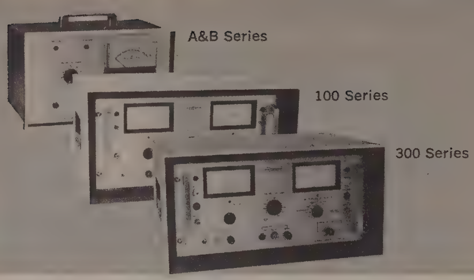

HIPOTRONICS

AC/DC hipot & insulation testers

NON-DESTRUCTIVE UNITS FOR PRODUCTION OR LABORATORY USE . . . IN RANGES UP TO 10 KV AC AND TO 25 KV DC

AC/DC HIPOT TESTERS & MEGOHMMETERS (300 Series)

- Three test functions . . . with one flexible unit: (1) AC dielectric/insulation tests, (2) DC dielectric/insulation tests, and (3) insulation/resistance tests with direct megohmmeter readings.
- Two versions available . . . to fit all requirements:
  A Series — current readings as low as 1 ua on four range meter, resistance to 1,000 megohms on two range megohmmeter.
  B Series — current readings as low as 0.01 ua on six range meter, resistance to 100,000 megohms on four range megohmmeter.
- Bench-top or rack mount . . . fits any standard 19-inch equipment rack.

FEATURES:

- Overload circuit has continuously adjustable sensitivity from 50 ua to 5 ma, allowing non-destructive testing of insulation and dielectrics.
- Dual range output connected KV meter, with calibrated set point for megohmmeter readings clearly marked.
- Reset button and failure indicator.
- Recalibration facilities.
- Guard circuit for grounded or ungrounded operation.
- Front panel re-entrant test lead connections.
- AC/DC function indicator lights.
- Zero start interlock — compels operator to start tests at zero volts.

SPECIFICATIONS:

Input . . . . 115 VAC, 60 Hz, 1 amp max.
Size & Weight . . . . 21″W x 19″D x 10″H; approx. 50 lbs.
Meters . . . . 2% full scale accuracy, 4½″ meter.
Current meter ranges:
A Series . . . . Ranges of 0-50/500/5000 ua, DC, 0 to 5 ma AC, 1 to 1000 megohms in 2 ranges
B Series . . . . Ranges of 0-0.5/5/50/500/5000 ua, 0 to 5 ma AC, 1 to 100,000 megohms in 4 ranges

Model	Output Voltage (KV) AC	DC	Current Meter Range AC	DC	Megohm Ranges
H 301A	1.0	1.5	0-5 ma	0-50/500/5000 ua	2
H 301B	1.0	1.5	0-5 ma	0-0.5/5/50/500/5000 ua	4
H 303A	2.5	3.0	0-5 ma	0-50/500/5000 ua	2
H 303B	2.5	3.0	0-5 ma	0-0.5/5/50/500/5000 ua	4
H 306A	5.0	6.0	0-5 ma	0-50/500/5000 ua	2
H 306B	5.0	6.0	0-5 ma	0-0.5/5/50/500/5000 ua	4

OPTIONAL EXTRAS (ALL UNITS):

Item	Price
HV test probe	$10
Gravity operated output shorting solenoid with discharge resistor	$35
Audible failure signal	$15

AC/DC HIPOT TESTERS (100 Series)

- Similar to our 300 series . . . without the direct reading megohmmeter. Megohms can be calculated from the accurate readings on the KV and DC current meters.
- Two versions available . . . a standard unit with simplified control features, and a more deluxe unit with all the necessary controls for laboratory precision testing programs.
- Bench top or rack mount . . . this attractive bench-top unit fits any standard 10-inch equipment rack.

FEATURES:

- Overload circuit has continuously adjustable sensitivity from 50 ua to 5 ma permitting non-destructive testing of insulation and dielectrics.
- KV meter recalibration facility.
- Output control continuously adjustable from zero to maximum.
- Front panel re-entrant test lead connections.
- AC/DC function indicator lights.

ADDITIONAL FEATURES IN DELUXE HD MODELS:

- Zero start interlock with HV on and off switches — compels operator to start tests at zero volts.
- Triple range KV meter and DC current meter.

SPECIFICATIONS:

Input . . . . 115 VAC, 60 Hz, 5 amps max.
Size & Weight . . . . 21″W x 19″D x 10″H; approx. 60 lbs.
Meter . . . . 2% full scale accuracy. 4½″ meter.

Model	Output Voltage (KV) AC	DC	Output Current Meter DC	AC	KV Meter Ranges
H 103	2.5	3.0	0-5 ma	0-5 ma	0-3 KV
HD 103	2.5	3.0	0-50/500/5000 ua	0-5 ma	0-0.6/1.2/3 KV
H 106	5.0	6.0	0-5 ma	0-5 ma	0-6 KV
HD 106	5.0	6.0	0-50/500/5000 ua	0-5 ma	0-1.2/3/6 KV
H 115	12.0	15.0	0-5 ma	0-5 ma	0-15 KV
HD 115	12.0	15.0	0-50/500/5000 ua	0-5 ma	0-3.75/7.5/15 KV
H 125	10.0	25.0	0-5 ma	0-5 ma	0-25 KV
HD 125	10.0	25.0	0-50/500/5000 ua	0-5 ma	0-5/10/25 KV

OPTIONAL EXTRAS (ALL UNITS):

Item	Price
HV test probe	$10
Gravity operated output shorting solenoid with discharge resistor	$35
Audible failure signal	$15

AC & DC PRODUCTION HIPOT TESTERS (A and B Series)

- Simple to operate . . . reliable for go-no/go testing. Designed for use by unskilled or semi-skilled personnel in mass testing of electrical components, transformers, etc.
- Visual indicators . . . illuminate on front panel when component leakage or internal arcing is detected . . . audible alarm optionally available.
- Compact, lightweight, and rugged . . . this unit goes where the problem is.

Hipot testers are available in all models which comply with revised UL specification 499, paragraph 280B. Consult factory for details.

FEATURES:

- Arcing detector employs corona pickup network for optimum sensitivity.
- Leakage detector sensitivity continuously adjustable from 500 ua to 5 ma permitting non-destructive testing of insulation and dielectrics.
- Output connected KV meter for maximum accuracy.
- Shielded output lead through re-entrant jack.

ADDITIONAL FEATURES IN HD MODELS:

- Audible failure alarm circuit incorporated into design of all deluxe models.

SPECIFICATIONS:

Input . . . . 115 VAC, 60 Hz, 3 amps max.
Size & Weight . . . . 7″H x 12″W x 8″D; approx. 20 lbs.
Meter . . . . 3% full scale accuracy, 4″ meter.

AC Models	Output Voltage	Short Circuit Current
H A1	1 KV AC	18 ma
H A2	2 KV AC	18 ma
H A3	3 KV AC	18 ma
HD A3	3 KV AC	18 ma
H A5	5 KV AC	18 ma
HD A5	5 KV AC	18 ma
H A10	10 KV AC	18 ma
HD A10	10 KV AC	18 ma
DC Models	**Output Voltage**	**Short Circuit Current**
H B1	1 KV DC	5 ma
H B2	2 KV DC	5 ma
H B3	3 KV DC	5 ma
H B4	4 KV DC	5 ma
HD B4	4 KV DC	5 ma
H B6	6 KV DC	5 ma
HD B6	6 KV DC	5 ma
H B12	12 KV DC	5 ma
HD B12	12 KV DC	5 ma

Hipotronics manufactures AC/DC dielectric and insulation testers from 10 volts to 2 million volts with KVA ratings to 10,000 KVA.
Contact factory for customized designs.

Prices and specifications subject to change without notice.

HIPOTRONICS®

HIPOTRONICS, INC.
Brewster, N. Y. 10509 / (914) 279-8091
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For more data call our Marketing Department and ask for descriptive literature. See other Hipotronics' listings under Power Supplies, Transformers, and Capacitors.

megohmmeters/insulation testers

HIPOTRONICS

PORTABLE HIGH RESISTANCE SERIES COVERING RANGES FROM 100,000 OHMS TO 20,000,000 MEGOHMS

Model H M3AS

. . . FOR TESTING INSULATION RESISTANCE TO ASTM SPECIFICATION D-257 AND TO APPLICABLE UL, CSA, AND MIL STANDARDS

FEATURES

- No meter bounce; therefore, meter averaging not required, even with large capacitive loads or any input voltage change in 20,000,000-megohm range . . . Output voltage is double regulated with both a ferro-resonant line and solid state electronic regulators.
- Dead shorts on megohmmeter output will not damage components . . . short circuit protection will handle continuous shorting without injury to any component.
- Grounded or ungrounded testing . . . with three-terminal output (positive, negative, and guard).
- Verify the calibration at any time . . . self-contained calibration resistors permit operator to periodically verify the calibration.
- Discharge internal and load capacitance . . . switch position and resistor provided for complete capacitive discharge.
- No zero shift . . . on any range. VTVM circuit drives the meter on this high quality megohmmeter.
- Better than 2% accuracy on all readings below 1 million megohms, with 3% on 20 million megohms.

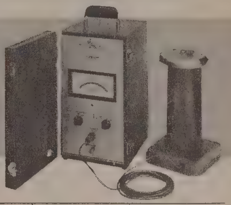
SPECIFICATIONS:

Input:	(all models)	115 volts, 60 Hz.
Weight:	(all models)	20 lbs. (approx.)
Size:	(all models)	7″H x 12″W x 8″D

Model No.	Output Voltage	Megohm Range	Megohm Ranges
H M1	500	1 to 1,000 megohms	2
H M3A	50 100 500 1000	0.1 to 1,000,000 megohms 0.2 to 2,000,000 megohms 1 to 10,000,000 megohms 2 to 20,000,000 megohms	6 6 6 6
H M3AS		Same as H M3A, but with mandatory 2 hand operation	
H M6B	50 250 500	0.1 to 1,000,000 megohms 0.5 to 5,000,000 megohms 1 to 10,000,000 megohms	6 6 6
H M6S		Same as H M6B, but with mandatory 2 hand operation	
M6C	250	0.1 to 1,000,000 megohms	6

AC/DC kilovoltmeters

. . . SELF-STORING ANALOG SERIES WITH ACCURACY GUARANTEED TO 0.5% DC AND 1.0% AC (TRACEABLE TO NBS)



Model KV50A

FEATURES

- Precision instruments for laboratory use — yet ruggedly designed and packaged for field and portable service.
- Models to 200 KV available from stock.
- Unique packaging concept permits one-hand portability for field use . . . plus safe storage for dividers behind front panel . . . yet operator safety is assured with two-piece construction.
- Average-reading meter calibrated in rms.
- Ripple measurements . . . merely turn the switch to AC.
- Burn-out proof . . . cannot be injured by over voltages or sharp rise time transients.

SPECIFICATIONS:

	Model KV50A	Model KV100A	Model KV200A
DC accuracy	0.5%	0.5%	0.5%
AC accuracy	1.0%	1.0%	1.0%
Tracking	0.5%	0.5%	0.5%
DC temp. coefficient	0.025%/C°	0.025%/C°	0.025%/C°
AC temp. coefficient	0.1%/C°	0.1%/C°	0.1%/C°
Frequency response	DC and 40 to 1000 Hz	DC and 40 to 1000 Hz	DC and 40 to 1000 Hz
Meter ranges (KV)	0-10/25/50	0-20/50/100	0-40/100/200
Volts division	100/250/500	200/500/1000	400/1000/2000
Impedance	190 megohms @ 200 pfd.	380 megohms @ 100 pfd.	760 megohms @ 50 pfd.
Size	8½″W x 10½″D x 15½″H	8½″W x 10½″D x 15½″H	9½″W x 10½″D x 40″H
Weight	20 lbs.	21 lbs.	40 lbs.
Delivery	From stock	From stock	From stock
Warranty	One year free parts and service		

Prices and specifications subject to change without notice.

liquid dielectric tester

TEST YOUR OIL, NOT YOUR OPERATOR. MODELS OC-50A, OC-60A, OC-90A AND OC-51M: PORTABLE, AUTOMATIC UNITS (50, 60 AND 90 KV) AND MANUAL UNIT (50 KV) DESIGNED TO TEST THE BREAKDOWN VOLTAGE OF INSULATING OILS IN ACCORDANCE WITH ASTM SPECIFICATIONS

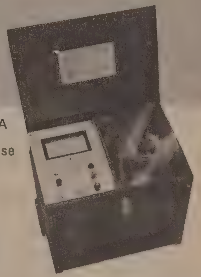
FEATURES

- Performs tests to ASTM D149, ASTM D877, and ASTM D1816.
- Fully automatic — just select motorized rate of rise.
- Accuracy assured — memory meter records breakdown point.
- Wide range — 50 KV rating is standard to accommodate the dielectrics now being used in transformers, bushings, capacitors, etc.
- Cup options — accepts all standard cups.

Prices and specifications subject to change without notice.

SPECIFICATIONS

Input:	115 volts, 50/60 Hz, 2 amps, single phase	
Output:	OC-50A	0-50 KV rms @ 2 KVA
	OC-60A	0-60 KV rms @ 2 KVA
	OC-90A	0-90 KV rms @ 2 KVA
	OC-51M	0-50 KV rms @ 2 KVA
Accuracy:	2% at full scale	
Dimensions:	OC-90A	16½″ W x 18½″ H x 20¾″ D
	All others	15½″ W x 14½″ H x 11½″ D
Weight:	OC-50A, OC-51M	60 lbs.
	OC-60A	65 lbs.
	OC-90A	90 lbs.



Model OC-60A

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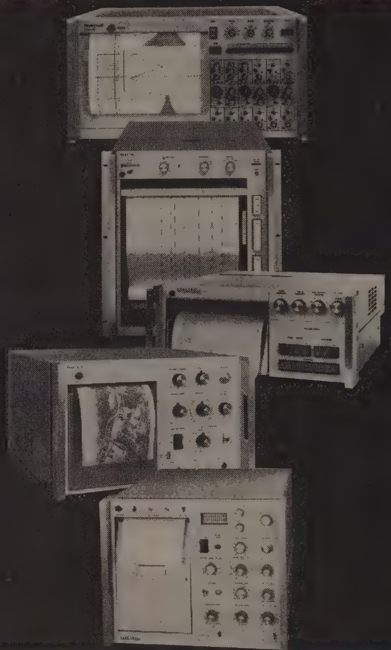
Honeywell

Transduce, Condition, Record, Analyze, Readout.



Spectrum Analyzers.

Real-time, time compression spectrum analyzers/digital integrators with MOS FET shift-register memory for digital time compression. Modular design allows simple conversion from 200 to 400 line models. All analyzers provide 11 frequency scales from 0 to 20 Hz to 0 to 50 kHz as well as 0 to 1 MHz.

Correlation and Probability Analyzers.

Two all-digital, high-speed correlation and probability analyzers that provide real-time measurements in 3 modes. Correlation (auto and cross); enhancement (or signal recovery); and probability (density and distribution). Both models have linear and exponential averaging, digital bin marker and a large dynamic range. Both correlators directly interface with the all digital Fourier Transform Analyzer Model SAI 470.

Oscillographs.

New Model 1858 is a complete data acquisition system with built-in signal conditioning in a 65-lb package only 8¾ inches high with 8-inch wide record and internal paper take-up. 18 channels, each with dc to 5,000 Hz response. 42 discrete paper speeds up to 120 inch/sec. Easier to set up and operate than any other graphic data acquisition system. 0.1% internal timing.

8-inch Visicorders, galvanometer-type oscillographs with dc to 25 kHz response, available with 24 or 12 data plus two or four event channels, internal take-up, 4 interval timing system.

12-inch Visicorder model has 36 data channels, dc to 25 kHz, plus six event channels, paper speeds from .005 to 200 inch/sec. Reversible drive system for record analysis.

Model 1856 Linescan Recorder gives permanent, hard-copy records of the output of infrared, video and sonic scanners, radar systems and real-time spectrum analyzers.

Model 1806A Recording Oscilloscope — single-channel, four-axis captures continuous or one-shot signals on 6-inch paper at frequencies from dc to 1 MHz.

Data Transmission Recording System uses Visicorder light-beam oscillograph to produce immediately-readable, permanent, simultaneous recordings to 9600 bps of up to 28 separate inputs or outputs of the data set. in any combination.

Honeywell

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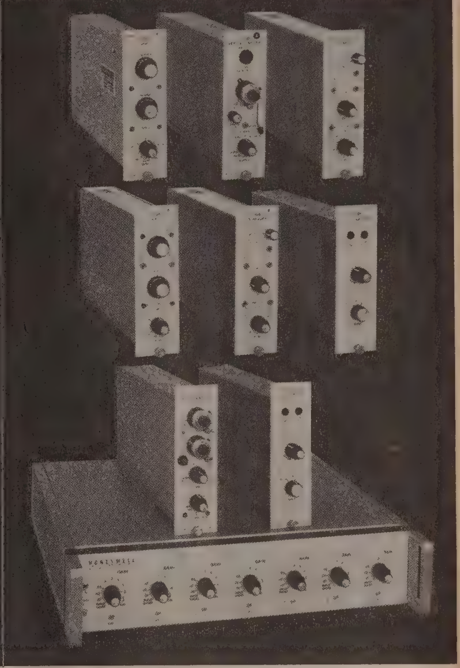

Tape Recorders/Reproducers.

Laboratory and portable systems, including the new model Ninety-Six, first all-new high-performance laboratory system since 1970. Simultaneously records/reproduces any combination of direct or FM data at nine pushbutton controlled speeds from 15/16 to 240 inch/sec. Choice of IRIG compatible tape heads allow ½ or 1-inch wide tape handling and 7, 14 or 28 data channels. Omniband electronics for more functions on fewer cards. Flutter, skew and time-displacement errors minimized by vacuum-buffered, balanced-tension transport. Wideband phase lock servo with absolute minimum time base error. Dozens of other outstanding features include selective track recording, full TTL-compatible remote control and modern cabinet design with modular subassemblies for ease of access and service.

Honeywell Model 5600 portable system is a full 14-channel instrumentation grade recorder that handles virtually any tape recording application. Extensive use of aerospace technology and electronics give laboratory performance in a 70-lb package. Features include easy conversion of tape width, power source and recording technique for a variety of special requirements at remote locations.

Signal Conditioning.

Complete line of signal conditioning devices for measurements from microvolts to hundreds of volts. Includes strain-gage, thermocouple and dc amplifier units.

New Accudata 218 Gage Control/Amplifier gives strain-gage transducer excitation, automatic bridge balancing and complete signal control in a single plug-in module. Three output amplifiers to drive oscillographs, magnetic tape systems, A/D converters, oscilloscopes and other recording and display devices.

Honeywell

Test Instruments Division, P.O. Box 5227
Denver, Colorado 80217 (303) 771-4700

HOYT ELECTRICAL INSTRUMENTS

BURTON-ROGERS COMPANY Sales Division
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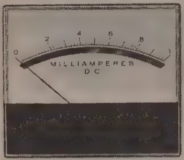
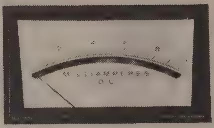
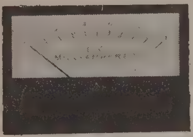
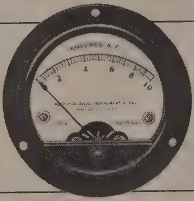




CUSTOM PANEL METERS

Available in sizes of 1½", 2½", 3½", 4½", 6" and 8". These smartly styled meters are available with die cast metal bezels for mounting the 1½" to 4½" meters behind equipment panels. They can also be supplied with an illumination provision. Other options include painted fronts and mirror dials. Four stud mounting permits interchangeability with most other meter types. Refer to dimensions on bottom of page. 2% A.C. Repulsion, 2% and 1% Moving Coil D.C. and VU meters available.





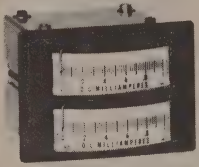
BAKELITE PANEL METERS FOR INDUSTRIAL APPLICATIONS

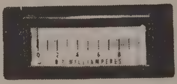
For more industrial panels Hoyt has a complete line of both round and square Bakelite Panel Meters. Square and Round Bakelite styles are available in 2½", 3½", and 4½" cases. Both A.C. Repulsion and D.C. D'Arsonval Movements available in most ranges. Some metal case styles also available in 2½" to 8" round sizes.

D.C. MILLIAMPERES

NEW ACRYLIC CASE PANEL METERS

These new 6" No. 2260 and 3" No. 2340 meters are supplied in scratch resistant acrylic cases. The 2260 has a projected front to permit behind the panel mounting without the customary bezel. Both models have a plain lined case front, and are available with either A.C. Repulsion or D.C. D'Arsonval movements.



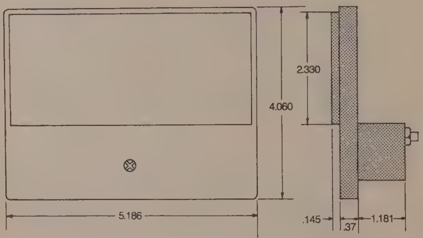


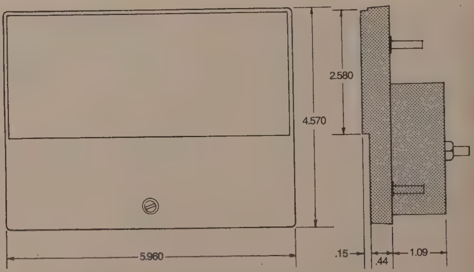
EDGEWISE PANEL METERS

The newest Hoyt Edgewise Meter No. 685 is designed without any barrel projection so that the meter may be used as a single unit or mounted together horizontally or vertically in quantities of two or more. Mounting bezels are available for one, two, or three stack units. This is completely shielded from interaction and stray magnetic fields. Our other Edgewise No. 673/S with a narrower .64" front is best for limited front panel space. Both types available in 2% Moving Coil ranges or VU Meters.

Many other styles available — write for catalog.

PROJECTED FRONT PANEL METERS





No. 3145 DC/No. 3146 AC ***Available SOON***
5" projected front meter. Mounts without bezel. Unobstructed, translucent case back and dial for best illumination distribution.

No. 2260 DC / No. 2261 AC
- Acrylic case — choice of colors
- Mounts on panel or through rectangular hole from behind panel

Both panel meters available with DC moving coil, AC moving vane, AC rectified and VU meter movements

HOYT ELECTRICAL INSTRUMENT WORKS, INC.

BURTON-ROGERS COMPANY Sales Division

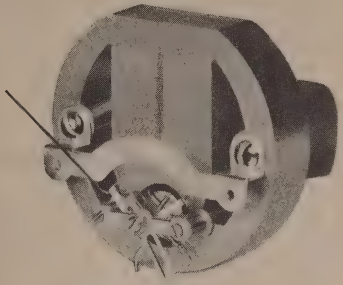
HOYT ELECTRICAL INSTRUMENTS

HOYT

BURTON-ROGERS COMPANY Sales Division
556 TRAPELO ROAD • BELMONT, MASSACHUSETTS 02179 • (617) 489-1520

New HOYT bakelite and glass panel meters featuring longer, lower cases for maximum scale length with minimum height.

Now in two sizes: 3½″ and 4½″

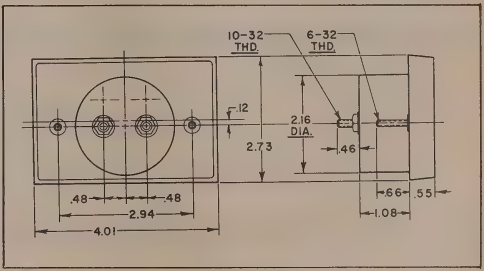


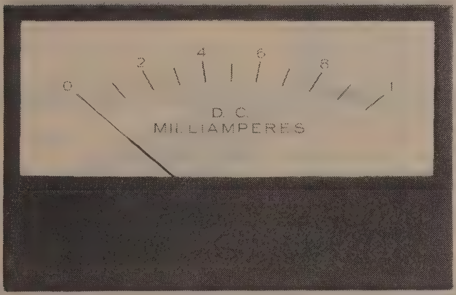
Available with our
high torque shielded
ACCU-RING movement

- Illumination is available or provisions for your own illumination
- Static-free bakelite and glass case
- DC moving coil, AC moving vane, AC rectified and VU meter movements

0
2
4
6
8
1
D.C.
MILLIAMPERES

No. 2135 DC / No. 2136 AC


10-32 THD.
6-32 THD.
.12
2.16 DIA.
2.73
.46
.48
.48
2.94
4.01
.66
.55
1.08


0
2
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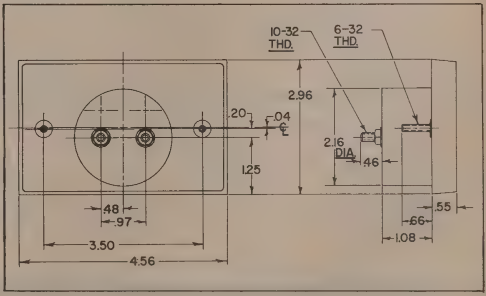
8
1
D.C.
MILLIAMPERES

No. 2145 DC / No. 2146 AC


10-32 THD.
6-32 THD.
2.96
.20
.04
℄
2.16 DIA.
.46
1.25
.48
.97
3.50
4.56
.55
.66
1.08

For additional information about these and other Hoyt panel meters refer to the Rep Section or call toll free (800) 225-1375

HOYT ELECTRICAL INSTRUMENT WORKS, INC.

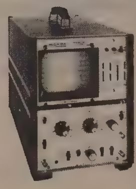
BURTON-ROGERS COMPANY Sales Division

HICKOK test instruments

WIDEBAND OSCILLOSCOPE

LAB QUALITY AND PERFORMANCE ALONG WITH ECONOMY

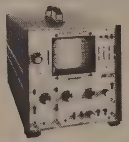
A lab quality 10 MHz triggered Oscilloscope, the Model **511** combines economy with reliability, ruggedness and advanced solid state circuitry. Provides 10 MHz response with 5 mV/cm sensitivity. Excellent pulse response minimizes overshoot and ringing. Foolproof triggering to 15 MHz. Bright 8 x 10 cm display for easy viewing. X-Y operation for vectorscope measurements. Auto mode triggering provides baseline for recurrent sweep operation and beam finder quickly locates off-scale traces. 12 calibrated verticle ranges and 18 calibrated sweep speeds as well as TV-V, TV-H and TV-VITS sync. Simplified front panel controls are colored coded and convenient for versatile, easy operation in industrial, lab, or service work. Regulated power supply maintains calibration within 0.1% over full line voltage variation. Power Required: 105-125 VAC, 50-400 Hz, 35 watts. Size: 8½" w x 19"d x 10½"h. Wt.: 15 lbs. Combination 10:1/direct probe included. **$465.00**



DUAL-TRACE OSCILLOSCOPE

THE ULTIMATE SIGNAL TRACING INSTRUMENT

Model **512** has all the features of the Model 511 plus the versatility of 4 dual trace modes. Display channel A only, channel B only, alternate A & B, chopped (100 kHz) A&B, or A + B, or A – B. Dual trace allows easy signal comparisons: input vs. output, left vs. right channel, differential amplifiers, phase shift, etc. Simplified color coded controls permits all this flexibility with fiddle-free operation. Power required: 105-125 VAC, 50-400 Hz, 35 Watts. Size: 10½" w x 19" d x 10½" h. Wt.: 17 lbs. Supplied with 2 combination 10:1 probes. **$675.00**



FUNCTION GENERATOR

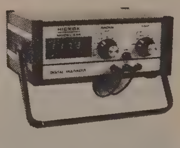
SINES, SQUARES, TRIANGLES AND MUCH MORE!

Model **270** provides sine, square, and triangle waves from 1Hz to 500 KHz in 6 ranges, with both step and variable attenuation, vairable DC offset (±6v) and 24v P/P output @600 ohm impedance. But this is only part of what this versatile instrument can do. The model 270 also has capability (rear panel input) for AM & FM modulation, sweep, ramps, pulses, mixed output, plus FSK and Tone Burst. The 270 has many uses in Audio and TV Service, the test lab, industry, the 2-way radio shops plus experimentors and Hams. Power required: 105-125 VAC 50-400Hz, 10W. Size: 8½" w x 4" h x 6" d. Wt. 4 lbs. **$166.00**

DIGITAL MULTIMETER

DIGITAL PRECISION YOU CAN RELY ON

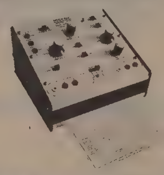
Model **334** is a complete digital measuring instrument backed by Hickok's ten years of digital multimeter experience. It measures AC & DC voltage from 1 mV to 1200V with up to 0.5% accuracy, current from 1µA to 2 Amps and ohms up to 20 megohms — 26 ranges and functions in all. Uses advanced P-MOS IC's and C-MOS logic for lowest parts count and greatest reliability. Fully guarded input takes overloads with no damage. Ohm ranges take full line voltage continuously! Green fluorescent display is easy to read and easy on your eyes. Lab quality at an affordable price. Power requirements: 105-125VAC or 210-250VAC, 50-400Hz, 5 watts. Size: 8½" w x 4" h x 6" d (exc. handle) Wt. 4 lbs. Probe included. **$229.00**



CURVE TRACER

WITH UNIQUE INSTA-BETA DISPLAY

The Model **440** is a complete professional curve tracter with several unique user-oriented features such as a pull-out instruction card and INSTA-BETA display that takes the guesswork out of beta and FET parameter measurement. The INSTA-BETA display shows a single Ic/Ib curve for transistors and a single Id/Vgs curve for FET's. The Model 440 also displays normal transistor, diode, and FET curves with up to 100mA collector current in 5 ranges; up to 100V collector voltage with 3 steps of horizontal sensitivity; and 11 ranges of base current or gate voltage. Two sets of panel sockets and connectors are included for easy device matching. Power required: 105-125VAC or 210-250VAC, 50-60Hz, Size: 8½" w x 4⅝" h x 7½" d. Wt. 4½ lbs. **$165.00**

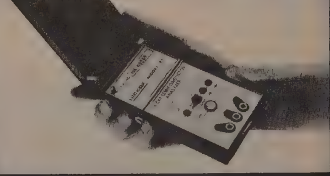


PORTABLE SEMICONDUCTOR TESTER

AS EASY TO USE AS IT IS TO CARRY

Model **215** gives instant GOOD/BAD analysis of NPN's, PNP's, FET's and diodes in or out of circuit. Automatically determines lead configuration and indicates in bright LED displays whether semiconductor is GOOD or BAD. No buttons to push for fast, "no hands" operation. Low power CMOS circuitry extends battery life. Small, compact instrument in a rugged polypropylene case. Powered by 2 standard 9 volt batteries (not included). Size: 3⅜" w x 5¾" d x 1⅞" h. Wt.: 12 oz. . **$138.00**

Recharger for use with n. cad batteries — Hickok P/N 20800-421 .... **$ 4.95**



These and other fine instruments from Hickok are available through local distributors.

HICKOK

the value innovator

INSTRUMENTATION & CONTROLS DIVISION
THE HICKOK ELECTRICAL INSTRUMENT CO.
10514 Dupont Avenue • Cleveland, Ohio 44108
(216) 541-8060 • TWX. 810-421-8286

PHAZOR

The operation of the Phazors is unique in that the input and reference signals are applied to an electronic multiplier which derives the instantaneous product of their amplitudes. The multiplier output is then applied to a DC meter which produces a deflection proportional to the time average of this product.

Expressing this function mathematically we have: Meter Deflection = $\frac{k}{T}\int_0^T V_S \cdot V_R\,dt$

PHASE METERS

High Accuracy and Resolution • Measures 0°-360° Without Ambiguity • Rejects All Noise and Harmonics (without filters) • Wide Input Voltage and Frequency Range • Self Calibration Assures Accuracy

MODEL 200A

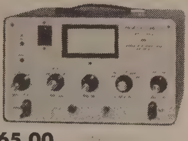
$595.00

APPLICATIONS: Measures phase shift in transformers, amplifiers, etc. • Readings not affected by noise and harmonics • Measures in-phase or quadrature voltage components • .01 degree can be measured employing special techniques.

SPECIFICATIONS

ACCURACY: .... ±2 degrees
FREQUENCY: .... 20 Hz to 20 KHz

MODEL 210AB



$965.00

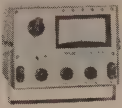
This instrument retains the essential feature of other Phazor models in that accurate measurements can be made even though signals may be complicated by noise and harmonics. The quadrant is read directly on a projection readout. The angle within the quadrant is displayed on the meter.

SPECIFICATIONS

ACCURACY: ..... ±2 degrees
FREQUENCY RANGE: 15 Hz—30 KHz
SENSITIVITY: .... 5 millivolts

VECTOR VOLTMETERS

Precise Measurement of:
IN-PHASE VOLTAGE • QUADRATURE VOLTAGE
TRUE RMS VOLTAGE • PHASE ANGLE
NULL VOLTAGE



MODEL 300PB

$1,100.00

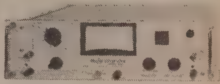
- Portable — All Solid State
- Direct Reading Phase and Quadrant Indicator
- Battery Operated — Eliminates Power Line Ground Loops

SPECIFICATIONS

INPUT VOLTAGE: .... 1 MV—300 V
INPUT IMPEDANCE: .. 1 megohm
VOLTAGE ACCURACY: 2% full scale
PHASE ACCURACY: ... ±1 degree
FREQUENCY RANGE: 60 Hz—10 KHz
NULL SENSITIVITY: .. 10 microvolts
HARM. REJECTION: .. 40 db down without filters
WEIGHT: .... 9 lbs., approx., with batteries

AC Power Pack Available — $150.00

MODEL 300C



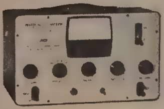
$1,700.00

- All Solid State
- Direct Reading Phase Angle
- Wide Frequency Range
- Rejection of Noise & Harmonics
- Input & Reference Isolation

SPECIFICATIONS

INPUT VOLTAGE:..........300 μV to 300 V
INPUT IMPEDANCE:....10 Megohm
VOLTAGE ACCURACY:....2% Full Scale
PHASE ACCURACY:........±1 degree
FREQUENCY RANGE:....15 Hz to 100 KHz
REF. VOLTAGE:..............100 MV to 130 V
NULL SENSITIVITY:......Less than 2 μV
HARM. REJECTION:......40 DB without filters
RACK PANEL SIZE:........19″ W x 5¼″ H

NULL METERS



A PHASE SENSITIVE NULL METER

MODEL 100 A

$465.00

SPECIFICATIONS

Input Impedance
High Gain . . . 2 megohm shunted by 30 MMF.
Low Gain . . . 2.5 megohm shunted by 15 MMF.
Sensitivity—6 millivolts off-scale deflection
Frequency Range—30-10,000 Hz
Selectivity—40 DB down on all noise and harmonics
Reference Voltage—8 volts to 120 volts
Maximum Input Voltage—120 Volts RMS
Peak Input Voltage—400 Volts
Power Supply—105-125 Volts, 50-400 Hz, 25 Watts
Dimensions—Height 9 inches, Width 15 inches, Depth 8 inches (19″ rack avail.)
Weight—25 pounds
Also available:
Model 100AH (similar to 100A with freq. range of 30 Hz to 50 KHz)

Powertron

ELECTRONIC GENERATORS

A complete line of 1ϕ, 2ϕ & 3ϕ models with power output ratings from 3 VA to 9 KVA and frequency accuracies to .0001%.

These AC Power Supplies provide stable, low distortion AC power at frequencies within the audio frequency spectrum. The highly reliable and versatile power sources find wide application in calibration and test stations, motor drives, gyro wheel supplies, laboratory use, military component testing, and operating foreign equipment.

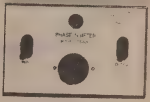
FOR ADDITIONAL INFORMATION SEE SECTION 4000—OR REQUEST COMPLETE CATALOG #969.

PHASE SHIFTERS

MODELS PS 60 and PS 400

FOR MEASUREMENT AND COMPARISON OF PHASE ANGLES OR AS A SECONDARY PHASE STANDARD.

$415.00



SPECIFICATIONS

Range ....0° —360° (continuously variable)
Accuracy .... ± 1.0 degrees
Supply Frequency
60 C. P. S. for Model 60, 400 C. P. S. for Model 400 (other frequencies on request)
Input Voltage .... 26 to 115 volts
Input Impedance
Approx. 1500 ohms for Model 60
Approx. 500 ohms for Model 400
Output Voltage .... ⅓ input voltage Approx.
Output Load .... 1 megohm or greater
Dimensions .... Height 5$^{11}/_{16}$ inches, Width 9 inches, Depth 6⅛ inches.

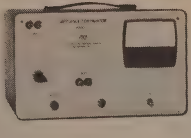
IMPEDANCE COMPARATORS

PRECISE,, RELIABLE AND RAPID COMPARISON OF COMPONENTS

The circuit consists of a bridge, two arms of which are precisely matched. The two remaining arms are the standard and the component under test. Any voltage resulting from bridge unbalance is amplified and fed to a phase discriminator. The percentage deviation is read directly in both sign and magnitude on a meter.

FEATURES: High Accuracy & Stability • Fast Response • Linear Meter Scales • Self Calibrated

MODEL 60



$355.00

SPECIFICATIONS

FREQUENCY: ....60 CPS
FULL SCALE RANGES:..±1%, 5%, 10%, 20%
IMPEDANCE LIMITS:
Resistance ....5 ohms to 5 megohms
Capacitance ....500 mmfd. to 500 mfd.
Inductance ....15 milihy to 10,000 hy

MODEL 1100

$595.00

SPECIFICATIONS

FREQUENCY: ....1KC, 10KC and 100KC
FULL SCALE RANGES:..±.5%, 2%, 5%, 20%
IMPEDANCE LIMITS:
Resistance ....3 ohms to 10 megohms
Capacitance ....30 mmfd. to 50 mfd.
Inductance ....10 microhy to 100 hy

OTHER MODELS AVAILABLE

MODEL 1010 — 1KC, 10KC — ±5%, 10%, 20% — $455.00
MODEL 1000 — 1000 CPS — ±1%, 5%, 10% — $455.00
MODEL 1100A — Similar to Model 1100, includes automatic category selection. $945.00

WRITE FOR CATALOGUES

Manufacturers of: PHASE SHIFTERS, FREQUENCY STANDARDS, NULL DETECTORS, AUTOMATIC HI-POT TESTERS AND OTHER ELECTRONIC TEST EQUIPMENT

ITECO **INDUSTRIAL TEST EQUIPMENT CO.**

21 Yonnicock Ave., Port Washington, N. Y. 11050
Phone (516) 883-1700

INFODEX
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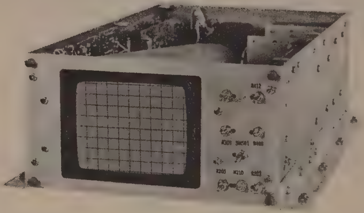
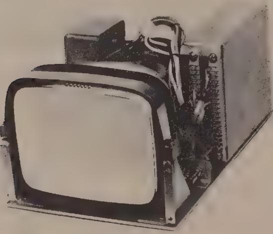
INFO/DATA

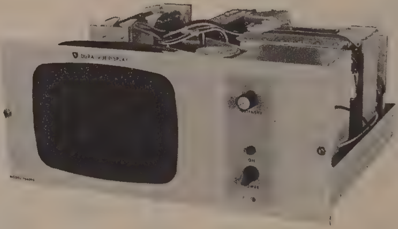
CRT
DISPLAY
SYSTEMS

OEM CRT displays

9620, 5″ 1 mhz phase matched X-Y


86B11, 5″ Mil-spec with sweeps


2712, 6″ EKG Monitor, 3 sweeps


8″ EKG Non-Fade Monitor

Hematology Pulse Monitor

Battery/AC Cardioscope

Infodex offers a standard line of 3″ rectangular and 5″ rectangular scopes. Each series embraces 22 standard models, ranging from X-Y indicators with AC-coupled Z axis for grey scale modulation, through a choice of 18 triggered sweep ranges, to three models with 12-step multi-range sweep. All sweep models have TTL-compatible Z axis control.

For the medical market Infodex offers a compact 6″ screen display operating from 12VDC regulated, 15-30VDC unregulated, or 115VAC. Larger screen units include 8″, 12″, and 17″ rectangular screen for conventional or "non-fade" trace presentation.

Infodex circuit design and packaging gives outstanding manufacturing flexibility so that we can provide specials with reasonable lead times and at reasonable prices. Be sure to consult us about your requirements.

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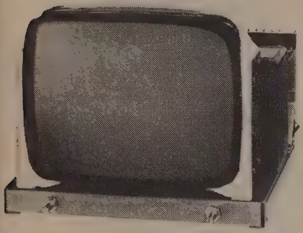
INFODEX
INCORPORATED

INFO/DATA

CRT DISPLAY SYSTEMS

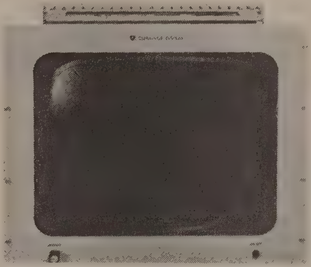
New Fast-Scan OEM Displays

with D-C coupled X & Y amplifiers offer choice of logic-compatible blanking/brightening or video modulation



9″ Screen
DC-8 mhz Video
25µs Slew Rate*

27M59

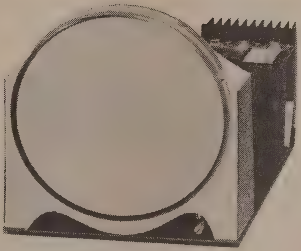


17″ Screen
Black Face Panel
Bright Contrast
30µs Slew Rate*

27M55

27M56

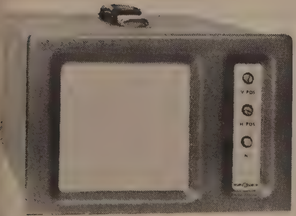
6″ Screen
DC-4 mhz Video
25µs Slew Rate*



27M43

Compact 7″ Screen
Long Persistence
Slow Scan
Oceanographic

*SLEW RATES FOR HALF SCREEN



4710

10 cm Square Screen
Vector Graphics Display
Bright 4 kv Trace

MANY OTHER COMBINATIONS AND SPECIAL FEATURES ARE AVAILABLE. GIVE DETAILS ON YOUR APPLICATION AND WE WILL RECOMMEND.

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INFODEX
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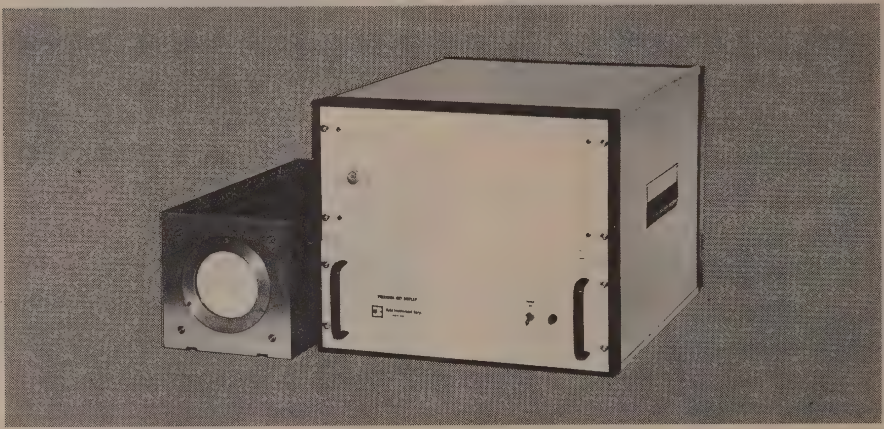
INFO/DATA

CRT
DISPLAY
SYSTEMS

Precision CRT displays



Precision X-Y CRT displays for film recording and film reading

The Infodex line of Precision CRT Displays consists of a series of high resolution cathode ray tube displays utilizing all Silicon solid state circuitry for application in:

a. film and hard copy printing recorders
b. flying spot scanners
c. film readers
d. radar displays
e. computer output displays
f. TV monitors
g. Heads-Up displays

or any application requiring a precision programmable light source. They are capable of random access X-Y deflection or scanning at any rates from DC to the maximum bandwidth capability of the deflection system.

Users of precision display systems who are familiar with the PD900, 950, 1200 and 1400 originated by Beta will be interested to know of the new (1975) model, the PD1250.

The PD1250 is a magnetically focused display using a gun/orifice combination which provides more energy density in the trace than the PD900 or PD950 thus providing more exposure on the recording film. In addition it is faster than the PD1200.

The PD1250 has excellent settling time, 10μs to 0.1%, 1 mhz small signal bandwidth, and improved drift, temperature stability and repeatability compared with the electrostatic focus models.

	PD900	PD950	PD1200	PD1250	PD1400
CRT Diameter	5 inches	5 inches	5 inches	5 inches	7 inches
Resolvable Elements/ Diameter	1700	2125	4250	2830	4200
Maximum Spot Size	0.0025	0.002	0.0010	0.0015	0.0015
Settling Time	10 usec	10 usec	20 usec	10 usec	20 usec
Small Signal Bandwidth	1 mhz	1 mhz	750 khz	1 mhz	750 khz

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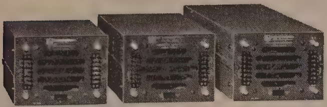
INFODEX
INCORPORATED
INFO/DATA

CRT
DISPLAY
SYSTEMS

Precision CRT modules



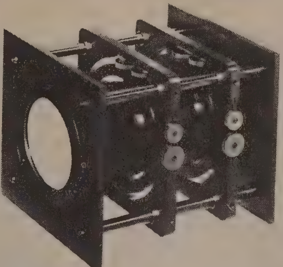
±35 Volt deflection amplifiers

The models DA223, DA224 and DA225 are dc-coupled, all-silicon, solid-state modular packages capable of supplying up to ±2.0, ±4.0 and ±6.0 amperes of deflection current respectively to each axis of a directly-coupled deflection yoke. A unique method of damping optimizes the amplifier for the particular yoke being used by means of an adjustable potentiometer. The amplifiers also feature extremely fast settling time and high bandwidth. The user has the choice of operating the amplifiers Class A for achieving nonlinearities of ±0.02% maximum or Class AB for minimum power consumption.

New this year is the "H" version of this series of amplifiers. With all of the features mentioned above, the new H version uses an improved integral sensing/feedback system which provides high stability and repeatability during operation. Any of the models can be ordered with this feature as a DA223H, etc.

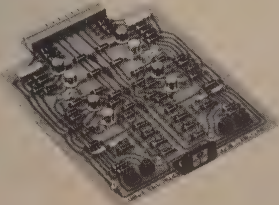
All of the above amplifiers are in regular production and normally in stock. For higher current requirements, the DA226 is available. The DA226 or DA226H is built to order and supplies ±8 amperes.

All of the above amplifiers are also available as powered assemblies. These consist of a PAK 16 low voltage supply and the deflection amplifier mounted in a rack mounting assembly with a single front panel 16" high. Call for descriptive literature.



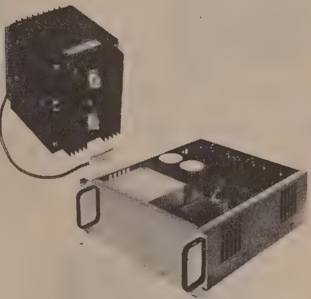
Precision tube and coil mounts

Flexible combinations of standard assemblies for the precision mounting and alignment of CRT's, yokes and coils: CRTM Basic CRT Mount includes removable bezel, rods and neck end clamps; DSTM Dual Gun Recording Storage Tube Mount, includes rods and neck clamps both ends; MCM Micropositioner Coil Mount allows 6 independent motions and positive lock; FYM Fixed Yoke Mount for application where micropositioning is not required; FYMS Fixed Yoke Mount for servo-type mounted yokes; CCM Centering and/or Alignment Coil Mount; MS983 Magnetic Shield Enclosure.



Modular CRT building block components

Individual, compatible plug-in circuits such as: DF2050 Dynamic Focus Generator; DF347 Dynamic Focus Amplifier; LC2656/2676 Precision Linearity Correction Circuit; VA2548 Video Amplifier (10 mhz); VA2549 Gamma-Corrected Video Amplifier (10 mhz); VA2077 Video Amplifier (30 mhz); SG1190 Sawtooth Generator; PP2425 Phosphor Protection Circuit; DA1340 Deflection Amplifier (±0.75 amperes); EDA800 Electrostatic Deflection Amplifier (350 volts plate-to-plate positive or negative); FR1882 Static Focus Regulator; BA1714 Blanking Amplifier. All circuitry features silicon semiconductors and temperature stable metal-film resistors throughout.



High & low voltage CRT power supplies

SERIES HV provides regulated high voltage outputs for CRT electrodes — anode, focus grid, G2 and filament.

Model No.	Anode Output Range
HV7	2-7 kv
HV25	10-25 kv

SERIES PAK provides regulated low voltage outputs for modules — ±35 volts, ±20 volts, G1 and filament.

Model No.	±35 volt (deflection) Output
PAK16	16 amperes

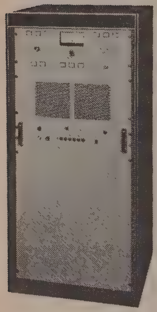
Also available; complete film recorders and scanners

7 CHERRY AVENUE • WATERBURY, CONNECTICUT 06702 • 203-757-9291

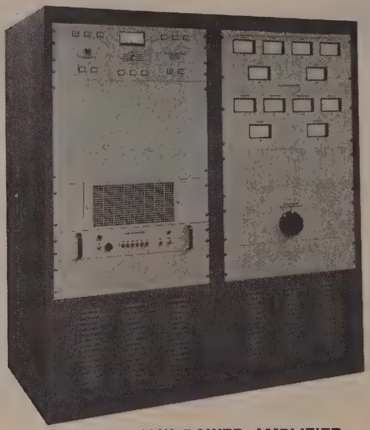
BROADBAND POWER AMPLIFIERS

- Linear, Amplifies All Forms of Modulation
- High Power Gain, Drive with Signal Generator
- No Tuning, No Bandswitching
- Fully Protected, Metered
- System Compatible, Modular
- Drive Mismatched Loads

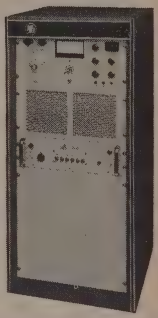
Power Output	Gain	Frequency Range	Model
10 Watts	40dB	5kHz to 250MHz	M5100
100 Watts	47dB	10kHz to 250MHz	M403
400 Watts	50dB	10kHz to 220MHz	M404
1kW	58dB	10kHz to 220MHz	M406
5kW	65dB	1MHz to 100MHz	M469



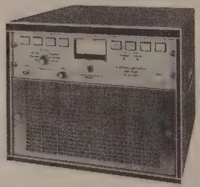
M406 POWER AMPLIFIER
Most versatile off-the-shelf amplifier available today.



M469 — 5kW POWER AMPLIFIER
Highest Power x Bandwidth



M404 POWER AMPLIFIER
Rugged and reliable medium powered amp.



M403 POWER AMPLIFIER
Features Solid State Controls. Automatic Leveling Capability

M5100 POWER AMPLIFIER
Remote Leveling Capability. Work into any load. Auto limit.

Instruments For Industry offers a complete line of high gain, high power, very wideband amplifiers from milliwatts to kilowatts and from Hertz to Megahertz. Many standard systems are available from stock. Frequency range and outputs can be made to meet your specific requirements. A phone call to our Applications Engineering department will help to solve your broadband power problem.

INSTRUMENTS FOR INDUSTRY, INC.
151 TOLEDO STREET/FARMINGDALE/N.Y. 11735/516-694-1414 ■ Cable: Electronic Hallandale, Fla.
TELEX 51-43-32

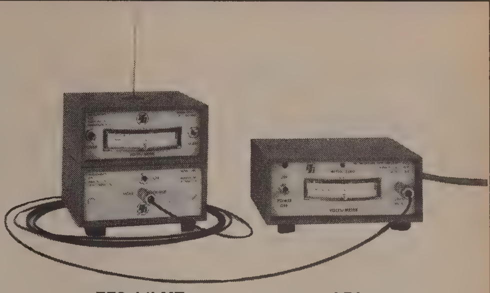
FIELD GENERATING AND MEASURING EQUIPMENT

- Instruments for Industry's new EFS-1 E-Field Sensor reads directly in volts/meter and operates from two standard 9-Volt Batteries. When the application requires a low cost test instrument for measuring strong electric fields from 10kHz to 220MHz with no tuning or bandswitching or frequency related adjustments . . . use the EFS-1.

EFS-1 with LMT attached

The IFI Light Modulator-Transmitter attaches directly to the EFS-1 to convert the voltage output to an optical signal which is coupled through non-conducting fiber links for remote reading and control . . . without disturbing the field being measured. Call or write today for full details.

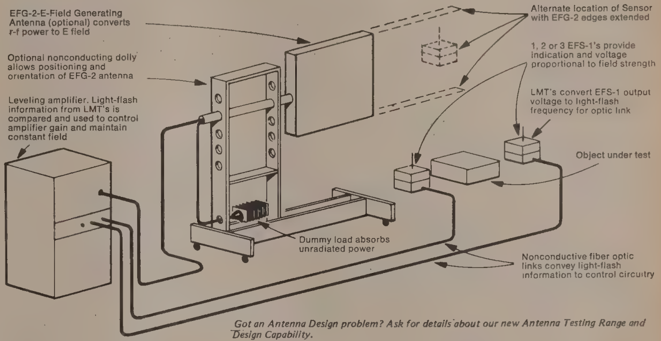
- The LDI Light Demodulator-Indicator is another accessory which is identical in size and similar in appearance to the EFS-1. It accepts the light-flash input from the LMT fiber optic link and converts it to a meter indication reading directly in volts/meter.


EFS-1/LMT
LDI

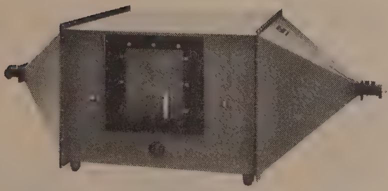
IFI's Automatic Constant Field Generating System can improve the quality as well as the quantity of your data and save you as much as two manhours per sweep. When it comes to generating high level fields there is really no other way.

Automatic Constant-Field Radiated Susceptibility Testing System.

Typical test set-up using IFI's broadband amplifier, leveling preamplifier, EFS-1 and LMT and Model EFG-2 E-Field Generaing Antenna. The EFG-2 generates a strong field over the range from 10kHz to 220MHz with a continuous power handling capability of 1000 watts. For help with your EMC measurement problems, call or write IFI Application Engineering Department.


EFG-2-E-Field Generating Antenna (optional) converts r-f power to E field
Optional nonconducting dolly allows positioning and orientation of EFG-2 antenna
Leveling amplifier. Light-flash information from LMT's is compared and used to control amplifier gain and maintain constant field
Alternate location of Sensor with EFG-2 edges extended
1, 2 or 3 EFS-1's provide indication and voltage proportional to field strength
LMT's convert EFS-1 output voltage to light-flash frequency for optic link
Object under test
Dummy load absorbs unradiated power
Nonconductive fiber optic links convey light-flash information to control circuitry

Got an Antenna Design problem? Ask for details about our new Antenna Testing Range and Design Capability.



The IFI Crawford Cell. It not only costs far less than a screened room — it's more versatile; instrumentation requirements are simpler; it eliminates both antennas and resonance problems. The IFI Crawford Cell provides broadband measurement of radiation from, or susceptibility to radiation of equipment placed in the cell. Compact (53″ x 24″ x 16″ with larger or smaller units available), the Model CC-103 Crawford Cell can be located anywhere in the lab. VSWR is $<$ 1.1:1 up to 300MHz. Calibration traceable to NBS.

INSTRUMENTS FOR INDUSTRY, INC.

151 TOLEDO STREET/FARMINGDALE/N.Y. 11735/516-694-1414 Cable: Electronic Hallandale, Fla.
TELEX: 51 43 32

SERIES 70

INTERSTATE

FUNCTION/PULSE GENERATORS/0.00002 Hz to 20 MHz

SERIES 70, a universal signal-source line, offers the ultimate blend of function generator, pulse generator, and sweep generator capabilities, combining broad frequency with an exceptional range of operating features.

CALIBRATED COARSE/ FINE TUNE Fine tune vernier is centered on the frequency dial. Two calibration scales (X1 & X2 on frequency dial) improve resolution and permit continuous tuning across the 20 KHz audio band.

SYMMETRICAL OR VARIABLE SYMMETRY WAVEFORMS Symmetrical waveforms to 20 MHz, or variable symmetry waveforms to 1 MHz with 5% to 95% time symmetry adjustment of sine, square, and triangle.

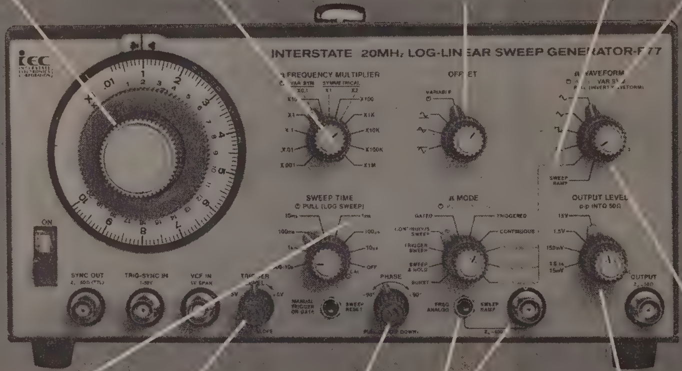
UNIPOLAR, BIPOLAR, OR VARIABLE OFFSET Unipolar offset clamps selected positive or negative waveform baseline to zero volts independent of variations in signal level. Variable offset baseline is smoothly adjustable from −15 to +15 V open circuit.

TRUE "PULSE GENERATOR" PULSE SERIES 70 is the first function generator series to offer pulse generator users a high-quality pulse with constant width setability independent of frequency.

POWER AMPLIFIER INPUT Using rear-panel BNC, generator can be operated as an analog power amplifier to amplify externally applied waveforms or pulse signals as much as 600%.

SWEEP SYNC Rear-panel TTL-compatible squarewave output can be used as a sync reference for plotters and recorders, or as an autonomous output when ramp generator is used independently.

LINEAR OR LOG SWEEP Log sweep pull-switch converts linear ramp to an exponential (logarithmic) sweep, so lower frequency portion of swept frequency has greater visibility.



F77

CONSTANT DUTY CYCLE PULSE Can also be generated when the squarewave output is operated in the variable symmetry setting. Circuits that are sensitive to duty cycle "on/off" times can be tested using varying pulse rates, without adjusting the width control.

WAVEFORM INVERSION CONTROL Pulls on to invert the output polarity in any mode of operation.

ADJUSTABLE TRIGGER LEVEL AND SLOPE CONTROLS Give oscilloscope-style triggering and facilitate noise discrimination and external signal synchronization.

VARIABLE START-STOP (Same as SERIES 50A).

FREQUENCY ANALOG/ SWEEP RAMP Two auxiliary signals are switch-selectable to the single output port to be used to drive recorders or graphic displays while using sweep techniques.

CALIBRATED ATTENUATOR Four-step attenuator with 20-dB vernier provides excellent resolution and signal-to-noise ratio for signals down to 1.5 millivolts, p-p.

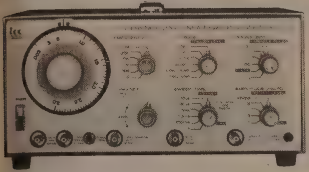
		sine, square, triangle with variable symmetry control to 1MHz; dc waveform	standard "pulse generator" pulses	pulse amplifier waveform	"constant duty cycle" (variable symmetry) pulse	standard pulse: 15 nanosec fixed rise/fall	standard pulse: separately adjustable rise/fall 15 nanosec to 1 sec	fixed and variable offset; 7.5 V range into 50 ohms, 15 V open circuit	15 V p-p into 50 ohms (30 V open circuit)	simultaneous high/low outputs with 30-dB separation	single output, controlled by 60-dB step attenuator with vernier	1000:1 VCF	trigger and gate; variable start-stop phase, slope and level adjustments	continuous sweep, triggered sweep, sweep-and-hold, burst	1000:1 sweep width	sweep up/sweep down selection	direct-reading sweep limit control	selectable logarithmic/linear sweep	external sync	selectable sweep ramp or frequency analog out	sweep sync	analog power amplifier
F71	**$695**	●			●			●	●	●		●										
F72	**$895**	●	●	●	●		●	●	●	●		●	●						●			
F74	**$945**	●	●		●	●		●	●		●	●	●	●	●	●	●		●	●		
F77	**$1095**	●	●		●	●		●	●		●	●	●	●	●	●	●	●	●	●	●	●

SERIES 70 SPECIFICATIONS: *Sine Distortion:* <0.5% to 100 kHz; *Sine Flatness:* >0.1 dB to 100 kHz; *Squarewave and Pulse Rise Time:* <15 nsec, *Triangle Linearity:* >99% to 100 kHz, *Dial Accuracy:* ±2%, full scale; *VCG Bandwidth:* 100 kHz (0.3 v/μ sec max.); *Sweep Time:* 1000 sec to 10μ sec; *Frequency, Offset, Amplitude Stability:* >0.05% for 10 min., 0.25% for 24 hours; *Pulse Abberations (total):* <5%.

Note: switch-selectable power; 100, 115, 200, or 230 vac, ± 10%.

INTERSTATE FUNCTION & PULSE GENERATORS

SERIES 30 Function Generators
3MHz/10V p-p into 50 ohms



All Series 30 models produce sine, square, and triangle waveforms with sync output and continuously variable offset. Other features include front panel offset switch and calibrated coarse/fine frequency vernier.

F31 $395
- 2-step, 40-dB attenuator
- 1000:1 VCF
- dc (zero) waveforms
- ±5V offset into 50 ohms
- plus all of the above

F33 $495
- 5-step, 60-dB attenuator
- trigger & gate modes
- variable width pulse
- external sync
- plus all other F31 features

F34 $595
- continuous & triggered sweep and burst modes
- direct-reading sweep limit
- analog of frequency out
- plus all other F33 features

F35 $595
- AM, 40-dB dynamic range
- FM, 1000:1
- internal 400Hz modulation
- sinewave to 6MHz
- plus all other F31 features

F36 $695
- AM, 40-dB dynamic range
- FM, 1000:1
- internal 400Hz modulation
- sinewave to 6 MHz
- plus all other F33 features

F37 $745 *NEW!*
- selectable logarithmic/linear sweep characteristics
- two separate plotter drive signals for log and linear applications
- plus all other F34 features

F38 $495 *NEW!*
- 200 mV p-p to 20 V p-p into 50 ohms
- external capacitor BNC to extend low frequency range below 0.03Hz
- plus all other F31 features

IEC INTERSTATE ELECTRONICS CORPORATION
A Subsidiary of **A-T-O** Inc.

SERIES 20 Pulse Generators
50MHz/10V into 50 ohms

All Series 20 models include constant duty cycle mode, normal (single pulse) and double pulse modes, trigger and gate with slope and level controls, single input BNC, single mode control, full-range offset, and pulse width and delay from 10 ns to 1 second. Three amplitude ranges: 10 V, 5 V, 1 V into 50 ohms with 10:1 vernier.

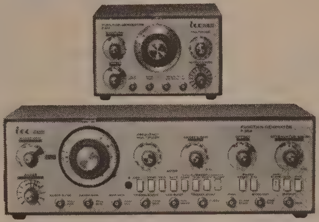
P22 $695
- single output, selectable positive or negative pulses
- fixed rise/fall times less than 3.5 ns
- plus all of the above

P23 $750
- dual outputs, simultaneous positive and negative pulses
- fixed rise/fall times less than 3.5 ns for each output
- plus all other P22 specifications and features

P24 $950
- single output, selectable positive or negative pulses
- adjustable rise/fall times from 5 ns to 0.5 sec
- independent rise and fall controls
- plus all other P22 specifications and features

P25 $1095
- dual outputs, simultaneous positive and negative pulses
- adjustable rise/fall times from 5 ns to 0.5 sec for each output
- independent rise and fall controls
- plus all other P22 specifications and features

SERIES 50A Function Generators
11MHz/15V p-p into 50 ohms

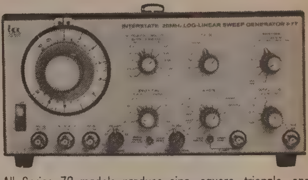


Both Series 50A models: waveforms include sine, square, triangle, 15/85% duty cycle positive and negative pulses and ramps. Also included is calibrated coarse/fine frequency vernier.

F51A $595
- variable width pulse
- fixed and variable offset
- 1000:1 VCF
- plus all of the above

F55A $1495
- trigger & gate modes
- 10-step 70-dB attenuator
- variable start-stop phase angle
- waveform inversion switch
- phase lock for frequency conversion and phase-shift applications
- continuous, triggered, & sweep and hold modes
- burst — single or multiple cycles
- direct-reading sweep limit control
- plus all other F51A features

SERIES 70 Function/Pulse Generators
20MHz/15V p-p into 50 ohms



All Series 70 models produce sine, square, triangle, and dc-level waveforms with 5/95% waveform variable symmetry control to 1 MHz, and fixed and variable offset (±7.5 V into 50 ohms). Also included on all models is a calibrated coarse/fine frequency vernier.

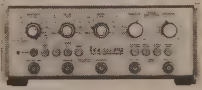
F71 $695 *NEW!*
- instant duty cycle pulses
- 1000:1 VCF
- waveform inversion
- hi/low output; 30-dB separation
- plus all of the above

F72 $895 *NEW!*
- standard "pulse generator" pulses; adjustable rise/fall to 15 ns
- 3 ns to 1000 ms adjustable pulse width
- pulse amplifier waveform
- trigger & gate with variable start-stop phase
- external sync
- plus all other F71 features

F74 $945 *NEW!*
- standard "pulse generator" pulses; fixed 15 ns rise/fall
- 3 ns to 10 ms adjustable pulse width
- 60-dB step attenuator with vernier
- continuous and triggered sweep, sweep-and-hold & burst modes
- sweep up/sweep down
- direct-reading sweep limit control
- sweep ramp/frequency analog outputs
- trigger & gate with variable start-stop phase
- external sync
- plus all other F71 features

F77 $1095 *NEW!*
- selectable logarithmic/linear sweep characteristics
- sweep sync
- analog power amplifier
- plus all other F74 features

SERIES 10 Pulse Generators
10MHz/10V into 50 ohms



P12* $540 *NEW!*
- dual outputs, simultaneous positive and negative pulses
- fixed rise/fall times less than 5 ns for each output
- normal (single pulse) and double pulse modes
- external or manual trigger and gate
- synchronous and asynchronous gating
- pulse width and delay variable from 50 ns to 1 sec
- normal/complement output selector
- adjustable amplitude from 1 V to 10V into 50 ohms

*Available USA & Canada only

All Interstate instruments are warranted against defects in material and workmanship for one full year; detailed operation and maintenance manuals are supplied for each instrument. Hardware for 19" rack mounting is optionally available at $35.00; rear panel function generator BNC's in parallel with front panel BNC's are also optional for $35.00. Many Interstate instruments have GSA listings; contact your local representative for further information and assistance.

Dept. 7000, Box 3117, Anaheim, Calif. 92803 Phone: (714) 549-8282 TWX U.S.A. 910-591-1197 TELEX 655443 & 655419

INTERNATIONAL

Frequency Meter

FM-2400CH (25 to 1000 MHz)

The FM-2400CH provides an accurate standard frequency signal for testing and adjustment of mobile transmitters and receivers at predetermined frequencies between 25 and 1000 MHz. Up to 24 crystals may be inserted. The frequencies can be those of the radio frequency channels of operation, and/or of the intermediate frequencies of the receivers between 5 MHz and 40 MHz. Frequency stability (standard) ±.001% from +32° to +122°F. Frequency stability with built-in thermometer, calibrated crystals and temperature corrected charts, ±.00025% form +25° to +125°F. (±.000125% special 450 MHz crystals available). Unit has solid state circuitry and rechargeable batteries.

SPECIFICATIONS

Crystal Oscillator
Frequency Range — 5 to 20 MHz
Frequency Stability — Standard —
±0.0005% from +50° to +104°F
±0.001% from +32° to +122°F
with built-in thermometer —
±0.00025% from +25°F to +125°F
with crystals calibrated and supplied with temperature corrected charts.
±.000125% +55° to +95°F
Frequency Tuning — 0.005%

Transmitter Pickup
Frequency Range — 25 to 500 MHz/1000 MHz
Sensitivity — 100,000 μV at 25 MHz to 250,000 μV at 470 MHz across 50 ohms

Counter Circuit
Frequency Ranges — 0 to 1.5 KHz
0 to 15 KHz
Residual Error — 100 cps at zero beat

RF Signal Generator
Frequency Range — 25 to 500 MHz/1000 MHz
Low Output* — 80 dbm to –100 dbm
High Output — Approximately 500 μV across 50 ohms
Crystal and tuning specifications are the same as for the Crystal Oscillator above.

*CH Model supplied with external attenuator to reduce signal to 0.5 to 2 μV range.

External Accessories

#246 IF Oscillator, 190 KHz to 8 MHz	**$35.00**
#241 Audio Oscillator, 1,000 Hz	**$35.00**

I.F. Signal Generator
Frequency Range — 5 MHz to 20 MHz on Fundamentals, and to 40 MHz on 2nd harmonics
Frequency Stability — ±0.002% from +32° to +122°F
Frequency Tuning — None
Output — 1,000 μV minimum into an open circuit
4 Nickel-Cadmium rechargeable batteries, charger supplied

Panel Controls
Frequency Channel Selector, 24 positions
Frequency Adjust, Calibrated 0 to 100
Function Selector,
7 positions — Battery Test "A"
Battery Test "B"
Calibration "C"
RF
Deviation X.3
Deviation X1
Deviation X3

FM-2400CH (meter only)	**$595.00**
RF Crystals (less temperature correction)	**24.00 ea.**
RF Crystals (less temperature correction)	**18.00 ea.**
IF Crystals	Catalog Price

HOW TO ORDER:
MAIL: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Okla. 73102
PHONE: Area Code 405 236-3741
CABLE: INCRYSTAL
WESTERN UNION TELEX: 747-147
BELL SYSTEM TWX: 910-831-3177

INTERNATIONAL
CRYSTAL MFG. CO., INC.
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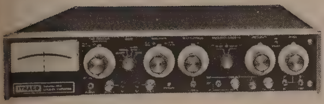
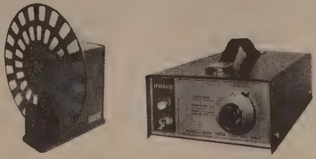
ITHACO

Lock-in amplifiers and accessories



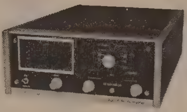
391A DYNATRAC® LOCK-IN AMPLIFIER

- Heterodyne lock-in – the world's only tracking lock-in that does not respond to interfering signals at multiples of the signal frequency. This means superior performance in all applications.
- 100nV to 1V full scale sensitivity
- .1Hz to 200kHz frequency response
- Noise and Ratio measurement options available



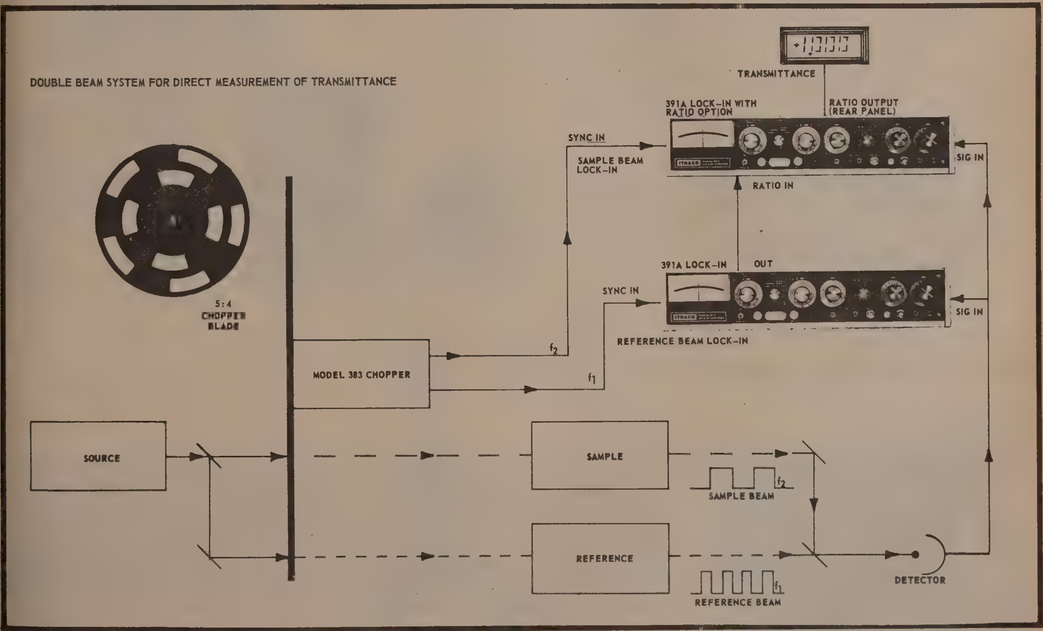
383 LIGHT CHOPPER

- 0.5Hz to 3kHz range; continuously variable
- Single and dual frequency blades available
- Dual reference outputs
- Separate solid state controller



3512 RATIOMETER

- 0.001 resolution
- Linear and log ratios
- 0.2% accuracy for inputs greater than 1VDC
- Optional $\sqrt{X^2 + Y^2}$ and BCD output modes


DOUBLE BEAM SYSTEM FOR DIRECT MEASUREMENT OF TRANSMITTANCE

+1.000
TRANSMITTANCE
391A LOCK-IN WITH RATIO OPTION
RATIO OUTPUT (REAR PANEL)
SYNC IN
SAMPLE BEAM LOCK-IN
SIG IN
RATIO IN
391A LOCK-IN
OUT
SYNC IN
SIG IN
REFERENCE BEAM LOCK-IN
5:4 CHOPPER BLADE
MODEL 383 CHOPPER
f_2
f_1
SOURCE
SAMPLE
SAMPLE BEAM
f_2
REFERENCE
REFERENCE BEAM
f_1
DETECTOR

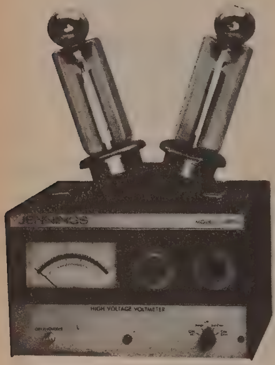
ITHACO also manufactures AC amplifiers, preamplifiers and custom engineered instruments and systems. See Section 1100. For precision variable electronic filters, see Section 2700.

ITHACO INC 735 West Clinton Street, Ithaca, New York 14850
Phone 607-272-7640 TWX 510-255-9307

ITHACO

high voltage test and measuring equipment

SOLID STATE AC VOLTMETER



MODEL J-1005

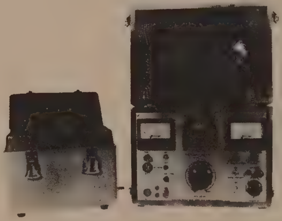
A compact, portable instrument for the accurate, direct reading of very high voltages at rf, audio and power frequencies . . . determination of the amplitude of pulses with oscilloscope connections for viewing wave shapes . . . removable high voltage input circuit for remote panel mounting of the meter . . . internal battery and ac line operation.

Specifications	Model J-1005
Voltage Ranges	Peak Kilovolts (single-ended) 0-2.5, 0-5, 0-10, 0-25, 0-50 Peak Kilovolts (double-ended) 0-2.5, 0-5, 0-10, 0-25, 0-50, 0-100
Frequency Response	Flat from 10 Hz to 20 MHz at full rated voltage. Internal resonances are above 100 MHz.
Accuracy	±3% of full scale on all voltage ranges.
Oscilloscope Connection	600 to 1 division ratio (approx.).
Meter Calibration	The meter is calibrated in peak kilovolts with linear voltage scales of 0-2.5, 0-5, 0-10, 0-25, 0-50.
Input Impedance	Greater than 2 x 10^{12} ohms and approx. 4 pf single-ended to ground, 2 pf double-ended.
Power Supply	117/230 volts ±10%, 50/60 Hz, 5 watts, or rechargeable battery.
Dimensions	Height, 16″; width, 10¾″; depth, 8″.
Net Weight	12 pounds (approx.). Ranges can be increased by using JCD5 series capacitors.

PORTABLE AC HIGH VOLTAGE TESTER

MODEL JHP-70A

The smallest and lightest instrument available at its power level the JHP70A will generate and measure 70,000 volts peak for on-site testing of high voltage components such as capacitors, switches, transformers, bushings, vacuum tubes, etc.



Maximum Output Voltage	70 KV Peak
Maximum Continuous Current	30 MA RMS
Short Circuit Current (Est.)	100 MA RMS
Power Requirements	105-125 Volts RMS
Frequency	50-60 Hz
Current	15 Amps
Surge Current	10 Amps
Weight:	
Control Cabinet	28 lbs.
Transformer	43 lbs.

MINIMEGOHMMETER — PORTABLE DIGITAL MEGOHMMETER

MODEL 15100

A hand-held portable instrument for general purpose electrical insulation testing. Applications include both production and maintenance testing of a wide variety of electrical equipment including motors, generators, cables, signal equipment, circuit breakers, transformers, switchgear, and insulators. Power is supplied by a self-contained rechargeable battery. Test voltage is fixed at 500 VDC, and there is a factory pre-set current limiter. This feature along with a digital readout makes for a simple and foolproof tester. There are three megohm ranges: 2.00-20.00 M, 20.0-200.0 M, and 200-2000 M and 0-200.0 ohms range for continuity testing. Test values are read on a 3½ digit LED display. Accuracy is ±2% of reading ±2% full scale ±one digit. The unit is compact, 7″ x 6″ x 3″, and weighs less than 3½ lbs. An external battery charger and vinyl carrying case are available as accessories.

ITT JENNINGS 970 McLaughlin Ave. • San Jose, Calif. 95116 • (408) 292-4025

DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

high voltage test and measuring equipment

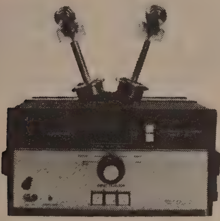
DIGITAL DC HIGH POTENTIAL TESTERS

Model 16420

Compact portable instruments for measuring high voltage leakage currents in the insulation of electrical equipment including: rotating machinery, transformers, switchgear, relays, interrupters, contactors, capacitors, cables and insulators. The high voltage power supply is electronically regulated against line and load changes. Circuitry is all solid state and features an adjustable current limiter (30 to 300 microamperes) for protection of the tester and non-destructive testing of components. Model 16400's functions are separately accessible, permitting its use as a portable laboratory high voltage power supply or as a digital kilovoltmeter. AC line operation.

Specifications	MODEL 16420
Max. Output Voltage	40 KV DC
Max. Output Current	300 μamps
Ripple	3% of rated output
Load Regulation	3%
Input Regulation	1%
Displays	Two 3-digit high intensity plasma "kilovolts" and "microamps"
Voltmeter and Microammeter Accuracy	0.5% of full scale, 1 bit LSD
Power Requirements	117/230 volts ±10% 50/60 Hz, 30 watts

AC & DC DIGITAL KILOVOLTMETERS



• DIGITAL AC KILOVOLTMETER, MODEL 11100

Direct Reading: For on-line applications.

Accuracy: Calibration better than 1.0% of full scale.

Wide Range: 0-10, 0-100 kilovolts; 10 Hz - 30 MHz.

Portability: Operates from internal battery or line. Weighs less than twelve pounds.

Oscilloscope Jack • Remote Display • Stability

Specifications	Model 11100	Model 12100
Voltage Ranges	Peak kilovolts (single-ended) 0-10, 0-50 Peak kilovolts (double-ended) 0-10, 0-100	DC: 0-10KV, 0-50KV AC (RMS): 0-10KV, 0-35KV ACpk (+): 0-10KV, 0-50KV ACpk (−): 0-10KV, 0-50KV
Frequency Range	Flat from 10 Hz to 30 MHz at full rated voltage. Internal resonances are above 100 MHz	8 Hz to 100 KHz on AC peak measurements, 8 Hz to 20 KHz on AC RMS measurements
Accuracy	±1% of full scale on both ranges	DC & AC pk: 1% of reading ±0.1% of full scale ±digit (LSD), AC (RMS) ±2% of full scale
Digital Display	3½ digit high intensity plasma	
Input Impedance	2X10¹² ohms and 4 pf single ended to ground, 2 pf double ended	10¹⁰ ohms and < 10 picofarads
Oscilloscope Connection	BNC connector, 600:1 division ratio approximate	BNC connector, output 1 volt for full scale reading
Power Supply	117 or 230 volts ±10%, 50/60 Hz, 5 watts or rechargeable battery, 8 hours recharge	
Dimensions	9″ x 16″ x 15″	6″ x 14″ x 11″
Net Weight	12 lbs. (approx.)	12 lbs. (approx.)

• DIGITAL AC/DC KILOVOLTMETER, MODEL 12100

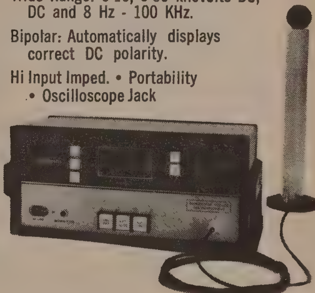
Versatility: Reads average DC, peak AC or true RMS AC.

Accuracy: DC calibration better than 1% of reading ±0.1% of full scale ±1 digit (LSD).

Wide Range: 0-10, 0-50 kilovolts DC; DC and 8 Hz - 100 KHz.

Bipolar: Automatically displays correct DC polarity.

Hi Input Imped. • Portability • Oscilloscope Jack



HIGH VOLTAGE AC DIVIDER

MODEL 13200

These dividers can be used with an oscilloscope to measure and observe voltages up to 60 kv at frequencies up to 20 MHz. Their low circuit loading design and shielded construction make them particularly suitable for rf measurement applications including tank circuit and transmission line voltages, pulse parameters, modulation voltages, and transient wave characteristics.

Specifications	Model 13200
Voltage	60 kv peak
Current	12.5 amperes RMS maximum through the voltage divider.
Input Impedance	Above 10¹² ohms, 4 pfd.
High Frequency Response	Flat to 20 MHz at 50 kv peak; maximum frequency 50 MHz at 20 kv peak.
Division Ratio	325:1 to termination of 3 ft. of RG-58A/U cable.
Low Frequency Response When operated into shunt resistance of 1 megohm 10 megohms	1000 Hz 100 Hz
Weight	2 lbs. 4 oz.

ITT JENNINGS 970 McLaughlin Ave. • San Jose, Calif. 95116 • (408) 292-4025

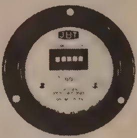
DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

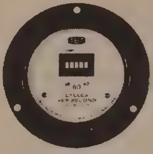
vibrating reed frequency meters

ROUND MOLDED CASE REED METERS

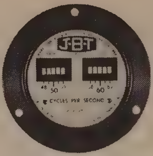
MODEL 34-FX-ser. A, a popular 9 reed meter.



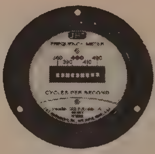
MODEL 21-FX, 5 reeds, matches other 2½″ panel instruments.



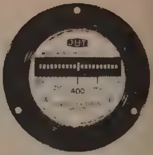
MODEL 31-FX, 5 reeds, standard. For appearance when operating, see "RESPONSE PATTERNS," below.



MODEL 30-FX, ser. A, 5 reeds in each of two frequency ranges.



MODEL 33-FX ser. A, 9 reeds for measuring frequency of high-cycle power sources.



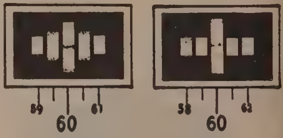
MODEL 36-FX-21, ser. A, 21 reeds for close reading over 380-420 cycle band. Shown operating at 400 cy.

- **USES, Commercial and Military** — J-B-T Vibrating Reed Frequency Meters are used extensively in radio, telephone, television, and radar service, on engine-generator sets and standby equipment, in laboratories, in many types of aviation and electronic equipment, on panel and control boards, in inspection setups, and in high-cycle power sources—wherever constant or known frequency is important to accurate and efficient operation of equipment. Superior performance for commercial and military applications is assured by more than 30 years of continuous experience and know-how covering the design and complete manufacturing of hundreds of thousands of these instruments in our Connecticut plant. Current production incorporates several innovations covered by recent J-B-T patents.

- **ADVANTAGES** — At reference temperature of 77°F most models have guaranteed accuracy of 0.3% or better of the frequency being measured, but the tables that follow indicate that certain models may be ordered with accuracy of ±0.1%. Accuracy on interrupted DC may be somewhat less. High fatigue strength provides a safety factor for continuous operation. Temperature compensations are not required as frequency change per °F is only .0075%, negative. For example, a 50°F temperature rise causes a 60 cps reed to read only 0.2 cps lower than at reference temperature.

- **OPERATING PRINCIPLE** — The patented, simplified design used in the J-B-T meter operates on AC or interrupted DC. Each reed is adjusted to respond by resonance to the frequency shown on the dial. As the current excites the driving coil, the reed "in tune" with the frequency in the coil will respond by vibrating rapidly because of permanent magnet polarization and induced magnetism from the coil. The instrument is adapted to specified operating voltage by a series resistor. To determine frequency, simply read the reed.

- **RESPONSE PATTERNS** — Breadth of actuation differs with the increments of frequency between reeds. For example, at 60 cycles, half-cycle steps give the broad response shown below at left, whereas full cycle steps bring the sharp response at right. In general, the lower the frequency the greater the amplitude, the higher the frequency the less the amplitude. Thus a 25 cycle reed normally will have substantially greater amplitude than a 400 cycle or a 1000 cycle reed.



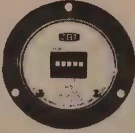
- **STABILITY** — All meters are permanently calibrated at the factory and do not require subsequent adjustment. J-B-T reeds have relatively high Q characteristics, an especially desirable factor in electronic circuits. Wave form or external fields do not ordinarily have an adverse effect. Built with no pivoted parts and with lock washers at every critical point, these rugged meters can take rougher treatment than many instruments.

- **TRUST THE METER** — If a meter plugged in on a 60-cycle AC power line does not indicate exactly 60 cycles, trust the meter. Power supply may momentarily be off-frequency due to changing load conditions. All J-B-T Frequency Meters are meticulously calibrated at the factory, entirely independent of frequency of power supply. Production and inspection equipment are checked regularly against National Bureau of Standards frequency signals.

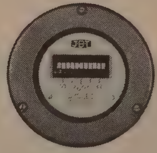
SEALED FREQUENCY METERS

MODEL 15-FHAC, 1½″; widely used as frequency standard for cathode follower circuit.

MODEL 21-FHXX, 2½″ 5 reeds, cased to match other 2½″ panel meters.



MODEL 34-FHXX-Z-11, ser. A, Accuracy, ±0.2%, 3½″, 11 reeds.



FHXX TYPE Sealed meters, glass-to-metal construction, with solder terminals and detachable flange, supersede the former FXH sealed meters. While JAN-I-6, MIL-M-6B, and MIL-M-10304B (Type MR36) do not refer specifically to frequency indicators, the FHXX series uses the front mounting dimensions of these specifications, and meets or exceeds the sealing requirements, and for 3½″ meters, electrical requirements, including 3000 volt breakdown. (1½″ and 2½″ meters meet 1000 volt breakdown.§) Electrical characteristics and accuracy are the same as for corresponding F models without the HXX designation. Sampling procedure includes a test in water where the absolute pressure of the air above the water is reduced to 2.5 inches of mercury (approx. 57,000 ft. altitude) and is maintained for one minute. Available in 3½″, 2½″ and 1½″ cases. For dimensions, see Table, Lines 1, 3 and 8. Standard voltage is 100-130.

§Model 15-FHAC meets 800 volt breakdown.

Some meters may have dials not exactly as shown

J-B-T

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

vibrating reed frequency meters

3½" AND 2½" ROUND MOLDED CASE REED METERS (NOT SEALED)

Model	Range, cps (Hz)	No. of Reeds	CPS Between Reeds	Standard Voltage	Ohms Per Volt‡	Power Consumed Watts‡	Accuracy¶ ± %	Case	Drawing No.	Table of Dimens.	Price Net, Each
*30-FX	48-52 & 58-62	10	1	100-130	140	0.9	0.3	3½"	SK-154	Line 5	$38.75
30-FX-18	46-54 & 56-64	18	1	100-130	180	0.7	0.3	3½"	SK-154	Line 5	62.50
*31-FX	58-62**	5	1	100-130	120	1.0	0.3	3½"	SK-50	Line 5	32.75
*31-FX-7	57-63	7	1	100-130	140	0.9	0.3	3½"	SK-154	Line 5	35.75
*33-FX	380-420	9	5	100-130	130	0.7	0.3	3½"	SK-156	Line 5	47.25
33-FX-11	360-440♦	11	♦	100-130	130	0.7	0.3	3½"	SK-156	Line 5	50.00
*34-FX	56-64	9	1	100-130	140	0.9	0.3	3½"	SK-154	Line 5	37.75
*34-FX-Z	58-62	9	½	100-130	140	0.9	0.2	3½"	SK-154	Line 5	40.00
34-FX-11	55-65	11	1	100-130	140	0.9	0.3	3½"	SK-154	Line 5	41.00
34-FX-Z-11	57.5-62.5	11	½	100-130	140	0.9	0.2	3½"	SK-154	Line 5	44.50
34-FX-21	45-65	21	1	100-130	180	0.7	0.3	3½"	SK-154	Line 5	53.25
36-FX-21	380-420	21	2	28	40	0.4	0.3†	3½"	SK-156	Line 5	58.75
*36-FX-21-115	380-420	21	2	100-130	130	0.7	0.3†	3½"	SK-156	Line 5	59.25
21-FX	58-62**	5	1	100-130	525	0.25	0.3	2½"	MD-20	Line 2	31.25
21-FX	116-124	5	2	100-130	525	0.7	0.3	2½"	MD-20	Line 2	35.00
23-FX	380-420	5	10	100-130	175	0.52	0.3	2½"	MD-20	Line 2	38.00
23-FX-54	390-410	5	5	100-130	175	0.52	0.3	2½"	MD-20	Line 2	38.00

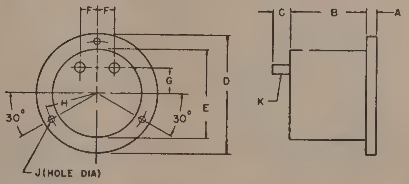
3½", 2½" and 1½" SEALED ROUND METAL CASE REED METERS

Model	Range, cps (Hz)	No. of Reeds	CPS Between Reeds	Standard Voltage	Ohms Per Volt‡	Power Consumed Watts‡	Accuracy¶ ± %	Case	Drawing No.	Table of Dimens.	Price Net, Each
30-FHXX	48-52 & 58-62	10	1	100-130	140	0.9	0.3	3½"	SK-153	Line 8	$45.25
30-FHXX-14	47-53 & 57-63	14	1	100-130	140	0.9	0.3	3½"	SK-153	Line 8	50.75
*31-FHXX	58-62	5	1	100-130	120	1.0	0.3	3½"	SK-51	Line 8	40.00
*31-FHXX-7	57-63	7	1	100-130	140	0.9	0.3	3½"	SK-153	Line 8	43.00
*33-FHXX	380-420	9	5	100-130	130	0.7	0.3	3½"	SK-155	Line 8	54.75
33-FHXX-11-LL	360-440	11♦	♦	100-130	130	0.7	0.3	3½"	SK-165	Line 8	67.00
*34-FHXX	56-64	9	1	100-130	140	0.9	0.3	3½"	SK-153	Line 8	44.75
34-FHXX-11	55-65	11	1	100-130	140	0.9	0.3	3½"	SK-153	Line 8	47.75
34-FHXX-Z-11	57.5-62.5	11	½	100-130	140	0.9	0.2	3½"	SK-153	Line 8	50.00
36-FHXX-21	380-420	21	2	28	40	0.4	0.3†	3½"	SK-155	Line 8	66.50
*36-FHXX-21-115	380-420	21	2	100-130	130	0.7	0.3†	3½"	SK-155	Line 8	68.25
21-FHXX	58-62	5	1	100-130	525	0.25	0.3	2½"	SK-67	Line 3	52.50
*23-FHXX	380-420	5	10	100-130	125	0.55	0.3	2½"	SK-67	Line 3	52.50
*15-FHAC§	60 & 400	2	—	8-10	270	0.04	0.5	1½"	SK-39	Line 1	27.00
15-FH-54	390-410	5	5	100-130	115	1.25	0.3	1½"	SK-55	Line 1	34.00
15-FH-56	58-62	5	1	100-130	540	0.25	0.3	1½"	SK-55	Line 1	28.25
*15-FH-400	380-420	5	10	100-130	115	1.25	0.3	1½"	SK-55	Line 1	33.25

3¼" ROUND METAL CASE REED METERS (NOT SEALED)

Model	Range, cps (Hz)	No. of Reeds	CPS Between Reeds	Standard Voltage	Ohms Per Volt‡	Power Consumed Watts‡	Accuracy¶ ± %	Case	Drawing No.	Table of Dimens.	Price Net, Each
*30-F	48-52 & 58-62	10	1	100-130	140	0.9	0.3	3¼"	MD-40	Line 4	$42.00
31-F	58-62	5	1	100-130	115	1.0	0.3	3¼"	MD-40	Line 4	35.00
33-F	380-420	9	5	100-130	130	1.0	0.3	3¼"	MD-40	Line 4	48.50
*34-F	56-64	9	1	100-130	140	0.9	0.3	3¼"	MD-40	Line 4	39.75
34-F-Z	58-62	9	½	100-130	140	0.9	0.2	3¼"	MD-40	Line 4	42.00

*Most popular models — normally stocked.
**Also available 48-52 or 59-63, but furnished 58-62 unless otherwise specified.
♦360-370-380-390-395-400-405-410-420-430-440
†Accuracy of 0.1% at reference temperature available at necessarily higher cost. Quotation on request.
‡Approximate values; reflect minor changes based on most recent design.
¶At reference temperature, see paragraph "ADVANTAGES."
§Model 15-FHAC meets 800 volt breakdown.



FREQUENCY METERS AND FREQUENCY-TIME METERS, TABLE OF DIMENSIONS, INCHES

	Model	Mil-M-6B* Mounting	A	B	C	D	E	F	G	H	J	K Terminal Description
Line 1	15-FH Series	—	3/32†	1 3/16	⅜	2 3/32‡	1½	⅜	⅜	0.875	0.125	Solder, 1/16" dia. hole
Line 2	21-FX and 23-FX Series	MR24, MR25	13/64	1⅜	23/32	2 11/16	2 5/32	7/16	5/16	1.220	0.116	10-32 NF-2A studs
Line 3	21-FHXX, 23-FHXX Series	MR26**	3/32†	1 27/32	11/16	2 11/16‡	2⅛	½	½	1.220	0.125	Solder, 3/32" dia. hole
Line 4	30-F to 34-F Series	—	7/64	2 3/32	23/32	3¼	2 3/16	7/16	⅞	1.453	0.150	10-32 NF-2A studs
Line 5	30-FX to 36-FX Series	MR34, MR35	19/64	2	23/32	3½	2 11/16	7/16	⅞	1.580	0.150	10-32 NF-2A studs
Line 6	31-FE Series	—	7/64	3⅞	23/32	3¼	2 3/16	7/16	⅞	1.453	0.150	10-32 NF-2A studs
Line 7	31-FEX-1 Series	MR34, MR35	5/32	3⅞	23/32	3½	2 3/16	7/64	⅞	1.580	1.150	10-32 NF-2A studs
Line 8	30-FHXX to 36-FHXX Series	MR36**	3/32†	2¼	⅝	3½‡	2 11/16	½	¾	1.580	0.150	Solder, 3/32" dia. hole

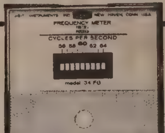
*Also JAN-I-6 and ASA C39.1-1951 Mounting
**Also MIL-M-10304B Mounting

†Not including neoprene cushioning gasket supplied with meter, but with detchable flange.
‡Including detachable flange.

Prices Net, F.O.B. Factory, domestic packing, were in effect October 1, 1974, and should be regarded as relative only. Quantity prices on request.

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

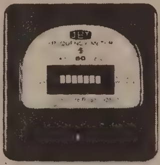
vibrating reed frequency meters



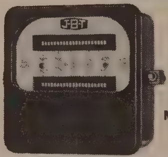
MODEL 34-FG for standard flush-type mounting. (match makers)

Same model with 13A-234 molded half-bezel.

MODEL 34-FB



MODEL 34-FS



MODEL 41-FX-42

RUGGEDIZED AND ILLUMINATED

Model with "RUG" — Sealed vibrating reed frequency meters and sealed elapsed time meters are available, when so ordered, to the intent of MIL-M-10304B, covering ruggedization of other kinds of meters, and usually are specified only for extra-severe shock and vibration.

LL Construction — Requirements for lighted meter dials have led to illuminating the 3½″ FHXX Series of sealed meters. Light from a source behind the panel is admitted through a sealed window built into the meter case. Inquiries are invited.

400 CYCLES, IN 1 CYCLE STEPS; 800 CYCLES

Among the variations which J-B-T produces on special order, are 21-reed, 390-410 cycles in 3½″ case; and 11-reed; 780-820 cycles with 4-cycle increments. Quotations on request.

FG SERIES FOR PICTURE WINDOW FRAME OPTIONAL

FG FREQUENCY METERS. The sparkling clear-plastic front and bright textured metal insert below the dial add zest to any panel. FG meters not only match the 3½″ wide x 3″ high front of the New EG elapsed time meters on the next page, but are interchangeable as to mounting with Triplett and other brands of panel meters. Standard voltage is 100-130 volts; accuracy and electrical characteristics equal corresponding FX frequency meters in the table on preceding page. For example, Model 30-FG differs from Model 30-FX only in the case. FG mounting details appear in line 9 of the Table of Dimensions below and in Prints SK-160 and SK-164. For picture window mounting diagram, use the half-bezel adapter. Listed below are typical 3½″ FG models and others are available. Groupings of 5 to 21 reeds and voltages of 28 to 230 are available on order.
Inquiries are invited on a 2½″ FG series.

30-FG, 48-52 and 58-62 cps, 10 reeds	**$40.75**
33-FG, 380-420 cps, 9 reeds	**49.25**
34-FG, (illus.) 56-64 cps, 9 reeds	**40.50**
13A-234 Half-bezel adapter, separate black **molded** frame and hardware for picture window appearance on any 3½″ FG or EG meter	**3.75**
13A-239 Half-bezel adapter, separate black **metal** frame particularly recommended for all 3½″ FG frequency meters and EG elapsed time meters; with hardware	**3.75**

NOTE ON METER VOLTAGE

J-B-T Vibrating Reed Frequency Meters of all sizes normally are made with two studs and are designed to be connected across one phase of a multi-phase line. The single phase voltage where the meter will be used thus becomes the voltage to be specified for the meter. Special meters with extra studs are made for the purpose of using at two or more voltages, not additional phases.

FB SERIES FREQUENCY METERS TO MATCH "BIG LOOK" PANEL METERS

SERIES FB METERS. Newest Match Makers, combine the GE "Big Look" case design with the time-tested accuracy of J-B-T vibrating reed frequency meters, at realistic prices. Typical 3½″ models for 100-130 volts follow and others are available. Line 11 in Table of Dimensions below gives mounting details. Groupings of 5 to 21 reeds and voltages of 28 to 230 are available on order. For further details: 60 cycle models, Drawing SK-182 (A); 400 cycle, Drawing SK-183 (A).

30-FB, 10 reeds, dual range, 48-52 and 58-62 cps	**$41.50**
33-FB, 9 reeds, 380-420 cps	**50.00**
34-FB, 9 reeds, 56-64 cps	**41.00**

3″ SQUARE-CASED FREQUENCY METERS

FS SERIES. Matching other 3″ x 3″ meters on a panel with square black molded cases, these meters are otherwise the same as the FX Series. For instance, 33-FS is the same as 33-FX except for the case. See Table of Dimensions, Line 10.

33-FS, 380-420 cps, 9 reeds, 3″ square molded case	**$48.50**
34-FS, 56-64 cps, 9 reeds, 3″ square molded case	**39.00**

PORTABLE FREQUENCY TESTERS

FP SERIES, METAL OR MOLDED CASE. Accuracy of ±0.3% meets the exacting test requirements of aviation, signal, and communication equipment. **M-Types** use anodized gray aluminum case, 6⅛″ long x 4″ wide x 3 3/32″ deep. Leads permanently attached. See Print SK-63-10. With pertinent name plate, **33-FP-9M** is known as **TS-328 A/U. L-Types,** sturdy molded case within top grain leather carrying case 6 3/32″ x 4¼″ x 2¾″; 4′ leads with 5″ test picks and banana plugs.

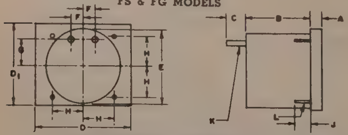
33-FP-9M, 380-420 cy., 9 reeds, 100-130 volts, 130 ohms per volt 1.0 watts power consumption; commercialy quality and packing	**$65.25**
34-FP-9M, 56-64 cy., 9 reeds, 100-130 volts, 140 ohms per volt, 0.9 watt power consumption; commercial quality and packing	**55.75**
33-FP-9L, 380-420 cy., 9 reeds, 100-130 volts	**62.50**
34-FP-9L, 56-64 cy., 9 reeds, 100-130 volts	**53.50**

42- AND 50-REED 400 CYCLE INDICATORS

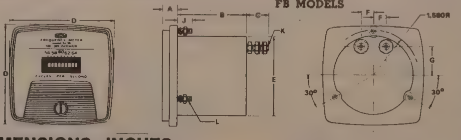
MODEL 41-FX-42 and **41-FX-50.** Both are widely used in commercial and military testing especially in aviation-electronic trouble-shooting. Model 41-FX-42 (supersedes Model 41-FX) has two banks of 21 reeds: one for 300-500 cps in 10 cycle steps, and for vernier effect, one for 380-420 cps in 2 cycle steps. Model 41-FX-50 has two banks of 25 reeds giving a continuous covering from 355-600 cps in 5 cycle steps. Black molded case, flush front is 4 3/64″ x 4 3/64″ x 2 17/32″ deep behind panel over studs. Power consumption is .45 watts at 30 volts, 2.7 watts at 115 volts, and 5.0 watts at 200 volts. For 41-FX-42, see Print MD-38-11; for 41-FX-50, Print SK-79.

41-FX-42, 100-130 volts only	**$163.50**
41-FX-42, 3 voltages: 200-240; 115; and 30; 4 studs (without switch)	**183.75**
41-FX-50, 3 voltages: 200-240; 115; and 30: 4 studs (without switch)	**236.00**

FS & FG MODELS



FB MODELS



FREQUENCY METERS, TABLE OF DIMENSIONS, INCHES

	Model	A	B	C	D	D₁	E	F	G	H	J	K	L
Line 9	30-FG to 36-FG	13/32	2 11/32	23/32	3½	3*	2¾	7/16	1	1⅛	9/16	10-32NF-2A	4-40NC-2A
Line 10	30-FS to 36-FS	¼	2 3/64	23/32	3	3	2¾	7/16	⅞	1⅛	9/16	10-32NF-2A	4-40NC-2A
Line 11	30-FB to 36-FB	15/32	2 11/32	23/32	3½	—	2¾	7/16	1	—	½	10-32NF-2A	6-32NC-2A

*Centerline of FG meter barrel is 1.588″ below top of case and 1.442″ above bottom of case.

Prices Net, F.O.B. Factory, domestic packing, were in effect October 1, 1974, and should be regarded as relative only. Quantity prices on request.

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

elapsed time meters

USES AND ADVANTAGES OF ELAPSED (OR RUNNING) TIME METERS

To record operating time of AC electrical and electronic equipment, these self-starting synchronous instruments normally register in 1/10th hour steps to 9,999.9 or 99,999.9 hours, then automatically reset. They are widely used for tube life, TV equipment, punch presses, conveyors, oil burners, ground support equipment, maintenance schedules, etc. J-B-T engineers recommend the AC type of elapsed time meter for superior accuracy, especially where voltage or ambient temperature vary widely.

EG SERIES FOR HIGH VISIBILITY; MODERN PICTURE WINDOW OPTIONAL

EG ELAPSED TIME METERS. These are designed to give a bright, jewel-like look to panels when used alone, in multiples, or in conjunction with other instruments such as the matching FG series of frequency meters. A gleaming textured metal shroud below the dial and a clear-plastic case front 3½″ wide x 3″ high give high visibility to the numeral read out. Dimensions are same as line 9 for FG meters on opposite page. For optional picture window frame effect, on panel area 3.83″ wide x 2.27″ high, add preferred 13A-239 metal, or 13A-234 molded half-bezel adapter. The quiet, sturdy motors and extensively field-tested mechanisms of other J-B-T elapsed time meters are used in the EG series. Two models are catalogued. Other voltages, frequencies, numerals and 2½″ EG Series will be quoted.

31-EGW-5, (illustrated) 5 wide digits, 0-9,999.9 hours, 60 cps, 110-125 volts **$27.00**

31-EGW, 6 wide digits, 0-99,999.9 hours, 60 cps, 110-125 volts **27.50**

13A-239 and 13A-234, half-bezel adapters, see opposite page.

BASIC 3½″ ELAPSED TIME METERS — 5-DIGIT WIDE NUMERAL ELAPSED TIME METERS

MODEL 31-EXW-5. Newest in the J-B-T line of elapsed time meters is Model 31-EXW-5 with 5 wide, easy to read numerals. This model is particularly recommended for **new** equipment because, with superior visibility, rugged construction and attractive price, it is expected to supplant the 31-EX. The meter registers to 9,999.9 hours and automatically resets. Tenths are shown in red on white, units in white on black. Model 31-EXW-5 is interchangeable electrically and mechanically with both 31-EX (below) and 31-EXW shown below. Mounting, which is the same as type MR-34 or MR-35 to MIL-M-6B, also JAN-I-6, and terminal location are per print SK-125 Rev. E.

31-EXW-5, 5 digits, 0-9,999.9 hours, 60 cy., 110-125 volts **$21.75**

MODEL 31-EX. This instrument has been the most widely used of any J-B-T elapsed time meters and continues to be available where parts lists of production runs call for style of numeral and dial appearance, as illustrated. The black molded case, which mounts according to Print SK-80 Rev. F, is interchangeable with the wide-numeral meters, 5-digit 31-EXW-5 and 6-digit 31-EXW.

31-EX, 5 digits, 0-9,999.9 hours, 60 cy., 110-125 volts **$22.75**

31-EX-200, same except 200-240 volts (not regularly stocked) **31.50**

ELAPSED TIME METERS — TENTHS OF MINUTES

MODEL 31-EXM, 60-cycles, 110-125 volts, reading 0-9,999.9 minutes; for short-run applications or reading at closer intervals than 31-EX. Tenths of minutes in red on white, minutes in white on black numerals otherwise identical with 31-EX.

31-EXM **$28.75**

6-DIGIT WIDE-NUMERAL ELAPSED TIME METERS

MODEL 31-EXW. One of the most easily-read and most versatile of J-B-T elapsed time meters is Model 31-EXW, illustrated. Easy-to-read, wide numerals register to 99,999.9 hours then automatically reset. Distinctive contemporary dial shows tenths in red on white and units in white on black. This model is interchangeable, electrically and mechanically with Models 31-EXW-5 and 31-EX. The black molded case is also interchangeable with all 3½″ FX types of frequency meter. Print SK-125 Rev. E gives mounting information.

31-EXW, 6-digits, 0-99,999.9 hours, 60 cy., 110-125 volts **$23.25**

3″ SQUARE-CASED ELAPSED TIME METERS

MODEL 31-ES. The square black molded case matches the appearance of other 3″ x 3″ panel meters including FS series of frequency meters described on the preceding page. Unlike line 10 of the table shown there, depth behind panel (b) is 2²¹⁄₃₂″, and terminals are located on horizontal center line, each spaced ½″ from center (G). Variations can be made for 99,999 hours (suffix U), 230 volts, matte finish or 50 cycles. Now supplied with tenths in red on white, and units in white on black.

31-ES, 60 cy., 110-125 volts, 0-9,999.9 hours **$23.75**

ELAPSED TIME METER
model 31-EGW-5
ELAPSED TIME
99999
HOURS TENTHS

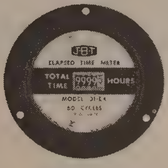
MODEL 31-EGW-5
for standard flush type mounting.

ELAPSED TIME METER
model 31-EGW-5
ELAPSED TIME
99999
HOURS TENTHS

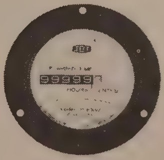
Same model with 13A-234 molded half-bezel.

JBT
ELAPSED TIME
99999
HOURS TENTHS
model 31-EXW-5

MODEL 31-EXW-5



MODEL 31-EX



MODEL 31-EXW

JBT
TOTAL TIME
9999
HOURS

MODEL 31-ES

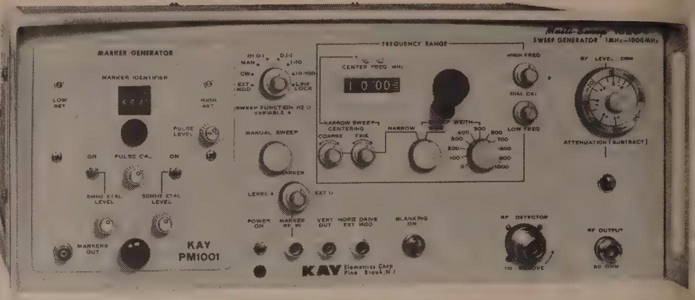
Prices Net, F.O.B. Factory, domestic packing, were in effect October 1, 1974, and should be regarded as relative only. Quantity prices on request.

SWEEP GENERATORS

Featuring

The Model 162C Wideband 1-1000 MHz Sweeper

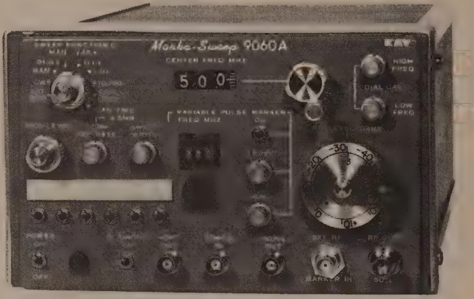
- Full Range in One Sweep
- Flat Wide Sweeps
- Stable Narrow Sweeps
- Excellent Linearity
- Digital Frequency Readout


MARKER GENERATOR
FREQUENCY RANGE
SWEEP GENERATOR 1MHz–1000MHz
KAY PM1001
KAY Elemetrics Corp Pine Brook, N.J.

$1495.

A New Line of Compact Sweepers

- Digital Readout of Frequency
- Extremely Flat and Linear
- Compact Size Lightweight
- High Output Low Distortion



$1150. Plus Markers

Plus . . . A Complete Line of Sweepers From 1 KHz—1.5 GHz

All with Digital Readout of Frequency

Model	Frequency Range	Sweep Width	RF Output	Features	Price
154C	50KHz-110MHz	0-100MHz	1.0V	IF, Video & FM coverage	$1095.00
159E	300KHz-300MHz	0-300MHz	1.0V	Full VHF coverage. High, flat output.	995.00
160KE	500KHz-500MHz	0-500MHz	1.0V	Low Cost. Internal provisions for fixed, harmonic & variable markers.	1195.00
160B	500KHz-600MHz	0-600MHz	1.0V	Expanded frequency coverage, in one band. Excellent flatness, linearity & distortion levels.	1395.00
162C	1MHz-1000MHz	0-1000MHz	0.5V	Full output range in one continuous sweep. Superb wide & narrow band operation.	1495.00
P9052	1KHz-20MHz	0-20MHz	1.0V	Stable narrowing sweeping. Compact format.	950.00
P9054	50KHz-110MHz	0-110MHz	1.0V	Linear IF and Video Sweeping. Low harmonic & spurious distortion.	995.00
P9059	1MHz-300MHz	0-300MHz	1.0V	High, flat start-stop VHF coverage. Compact size. Markers & precision attenuator optional.	845.00
P9060	500KHz-500MHz	0-500MHz	1.0V	Wide, ultra flat output. Compact size. Precision attenuation, with wide range vernier. Markers optional.	1150.00
P9062	1MHz-1000MHz	0-1000MHz	0.5V	Full sweep range in one band. Low distortion and spurious.	1350.00
P9063	1MHz-1500MHz	0-700MHz/0-900MHz	0.7V	Wide frequency coverage. 2 overlapping bands.	1590.00

For complete information write or call

KAY Elemetrics Corp Maple Ave., Pine Brook, N. J. 07058 • 201-227-2000

Spectrum Analyzer P9040A
3 0 0
KAY
HORIZONTAL

KAY's new spectrum analyzer

- 1-300 MHz
- Phase Locked
- 72 db Dynamic Range
- 1 KHz Resolution
- Compact Plug-In
- Low Cost: Only $2390

Originally designed to fill the need for a VHF spectrum analyzer for CATV measurements, this new analyzer is receiving wide acceptance to fill the need for a high performance low cost analyzer for spectrum analysis in the HF VHF frequency range.

The 9040 spectrum analyzer is available self contained in the 9014 power supply with X and Y outputs for independent use with any storage oscilloscope. At $2585.

The unit is also a compatible plug-in for the Tektronix 5103N and 5403 series of oscilloscopes and the Kay 9000AS split screen storage main frame. In addition to the spectrum analyzer plug-in, the Kay 9001AS Test Set main frame is compatible with a series of plug-ins including wideband sweep oscillators, gain loss/return loss measurement devices and the summation sweep receiver widely used in CATV system testing.

The 9040 features phase locked operation with 1 KHz resolution in the 1-300 MHz frequency range. The 72 db dynamic range with sensitivity to −50 dbmv's 75 ohm, −100 dbm 50 ohm is displayed in either 10 db/div or 2 db/div. Scan width is variable from 3 KHz per division to 30 MHz per division with excellent linearity. Scan speed is variable from 40 sec. per scan to 60 Hz in addition to a one shot sweep for use with XY plotters.

I.F. filters at 1 KHz, 30 KHz and 1 MHz are manually selected or automatically selected in the Auto Mode to reduce scan loss error. The unit also features built in frequency markers for calibration of both amplitude and frequency with cal adjustments readily accessible on front panel. A precision 0-70 db rotary attenuator provides attenuation in 10 db steps with 1% accuracy to 300 MHz. Spurious responses are greater than 72 db down.

Marker Generators

FEATURING

THE MODEL 8323A

- Three Variable Markers
- Five Digit Counter
- Counts Marker Frequencies While Sweeping **$1295.**

8323A FREQUENCY COUNTER & MARKER GENERATOR
KAY

THE PM7670

$495.00

- Variable Birdie Marker Plug-In
- 300KHz-300MHz Utility Oscillator
- One Volt RMS Output
- Available with Self Powered Case

Plus...A Full Range of Plug-Ins For Kay's Sweep Systems

- Pulse Marker Plug-Ins

PM7650
Freq. Range: 1-100MHz
Max. No. Mkrs.: 8
Price: $115.00 (plus Mkrs.)

- Variable Marker Plug-Ins

PM100-300-600 & 1001
1-1000MHz
Single Variable
$395.00 Ea.

- Birdie Marker Plug-Ins

PM7660 & PM7661
1-1000MHz
8-.3
$90 (plus Mkrs.) — $275

For complete information write or call

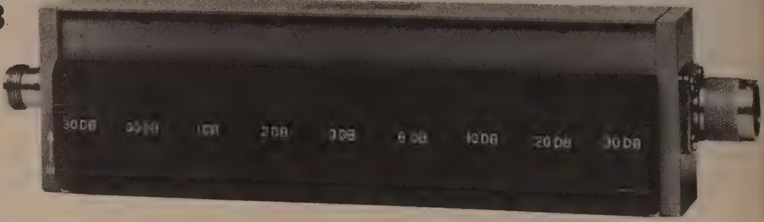
KAY Elemetrics Corp Maple Ave., Pine Brook, N. J. 07058 • 201-227-2000

ATTENUATORS

Featuring

The Model 461B

- DC-4 GHz
- 132DB in 1DB Steps
- Positive Slide — Switch Operation
- High Accuracy
- Low Phase Shift



$395.

Also...A complete line of toggle, rotary and programmable models from DC-12.4GHz.

Model	431-C	432-D	1/432-D	439-A	460-A	437-A	1/439A	434-A	464-A
Attenuation Range	0-41DB in 1DB steps	0-101DB in 1 DB steps	0-22.1DB in 0.1DB steps	0-101DB in 1 DB steps	0-132DB in 1DB steps	0-102.5DB in 0.5DB steps	0-22.1DB in 0.1DB steps	0-129DB in 1 DB steps	0-120DB in 10DB steps
Freq.	DC-1GHz	DC-1GHz	DC-.5GHz	DC-1GHz	DC-1GHz	DC-1GHz	DC-1GHz	DC-1GHz	DC-1.3GHz
Controls	In-line toggle switches	In-line toggle switches	In-line toggle switches	Miniature In-line toggle switches	Miniature In-line toggle switches	Miniature In-line toggle switches	Miniature In-line toggle switches	Rotary-Digital	Rotary Step
Typical Overall Accuracy DC-250MHz	0.5	0.6	0- .5DB steps: ±.5DB/step 1 -10DB steps: ±.2DB/steps	0.5	0.5	0.5	0- .5DB steps: ± .05DB/step 1- 10DB steps: ± .3DB/step	0.6	1% ±.1
Typical VSWR DC-250MHz	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1
Typical Insertion Loss DC-250MHz	.1	.1	.2	.1	.1	.25	.1	.1	.1
Power (watts)	1	1	1	1	1	1	1	1	1
Dimensions (inches)	2 x 7 x 2	2 x 9 3/4 x 2		1¼ x 6¼ x 7/8				5 x 2¼ x 2¾	1¾ x 3
Price	**$90**	**$110**	**$110**	**$120**	**$145**	**$145**	**$120**	**$240**	**$150**

Model	467-A	435-A	436-B	1/435-A	400-B	461-B	424-B	414-A	495-A	411-A
Attentuation Range	0-12DB in 1 DB steps	0-10DB in 1 DB steps	0-70DB in 10DB steps	0-1DB in 0.1DB steps	0-70DB in 10DB steps	0-132DB in 1DB steps	0-90DB in 10DB steps	0-130DB in 10DB steps	Single step switched coax pads	Single step switched coax pads
Freq.	DC-1.5 GHz	DC-2 GHz	DC-2GHz	DC-1GHz	DC-2GHz	DC-4GHz	DC-6GHz	DC-12.4GHz	DC-4GHz	DC-12.4GHz
Controls	Rotary-Step	Rotary-Step	Rotary-Step	Rotary-Step	Miniature Rotary-Step	Slide Switches	Slide Switches	Slide Switches	Slide Switches	Slide Switches
Typical Overall Accuracy DC-250MHz	.2	0.1	1% ±.1	.025	±1%,	1% ±.1	1% ±.2	1DB or 5% whichever is greater	1% ±.1	1DB or 5% whichever is greater
Typical VSWR DC-250MHz	1.2:1	1.1:1	1.1:1	1.1:1	1.1:1	1.05:1	1.05:1	1.1:1	1.05:1	1.1:1
Typical Insertion Loss DC-250MHz	.15	.1	.1	.1	.1	.1	.1	.1	.1	.1
Power (watts)	1	1	1	½	¼	1	1	2	1	2
Dimensions (inches)	7/16x2 11/16	2 dia. x 2 1/8	2 dia. x 2 7/8	2 dia. x 2 1/8	1¼ dia. x 2 3/16	8 3/8 x 2 3/8 x 1 5/8	2 3/8 x 4¼ x 1 5/8	2 3/8 x 5 1/8 x 1 5/8	2 3/8 x 1½ x 1 5/8	
Price	**$150**	**$99**	**$99**	**$99**	**$125**	**$395**	**$225**	**$395**	**$95**	**$125**

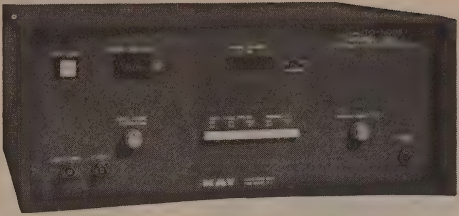
For complete information write or call

KAY Elemetrics Corp Maple Ave., Pine Brook, N. J. 07058 • 201-227-2000

Automatic Noise Figure Meters

FEATURING: THE MODEL 794A

- **Four Place LED Readout**
- **Extremely Accurate**
- **Pushbutton Operation**
- **Pushbutton Calibration**
- **Reads Noise Figure or Y-Factor**



Also the Model 792B for general purpose noise measurements and the Model 793A for CATV active and passive devices.

$1495.00

Model	NF Range	Readout	Dynamic Range	Bandwidth	Price
792C	0-20 db	Meter	0- −70dbm	6 MHz	$ 950.00
793C		Meter			$1090.00
794A		LED	+7- −72dbm	5 MHz	$1495.00

Model 255E Solid-State Electronic Switcher

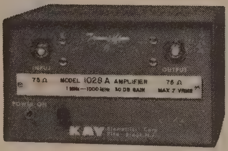
- **Pin Diode Switching**
- **Coverage to 1GHz**
- **Low SWR**

$325.00

Wide Band Amplifiers

Model 1028A

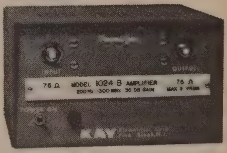
- **1-1000MHz**
- **30 db Gain**
- **±0.6 db Flatness**
- **0.7 VRMS Output**
- **50 or 75 Ohms**


75 Ω MODEL 1028 A AMPLIFIER 75 Ω
KAY

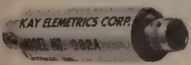
$390.00

Model 1024C

- **1-300MHz**
- **30 db Gain**
- **±0.25 db Flatness**
- **1.0 VRMS Output**
- **50 or 75 Ohms**

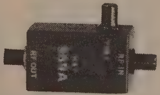

75 Ω MODEL 1024 B AMPLIFIER 75 Ω
KAY

$315.00


KAY ELEMETRICS CORP.

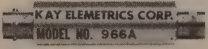
RF DETECTORS

- **DC-1.5GHz**
- **VSWR 1.03:1**
- **±0.25 Flat**
- **80% Efficiency**
- **Price — $45.00**



RETURN LOSS BRIDGES

- **DC-1000MHz**
- **VSWR 1.1:1**
- **30 db Directivity**
- **Price — $150.00**


KAY ELEMETRICS CORP.
MODEL NO. 966A

MATCHING PADS

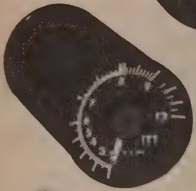
- **MP966A — .3-750MHz, VSWR 1.12:1**
- **MP967A — 40-1000MHz, VSWR 1.12:1**
- **0.25 db Insertion Loss to 400 MHz**
- **Price — $35.00**

For complete information write or call

KAY Elemetrics Corp Maple Ave., Pine Brook, N. J. 07058 • 201-227-2000

INSTRUMENTS

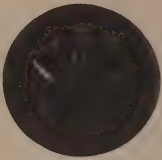
0
50
OIL
100
150
°C



AIRCRAFT INDICATORS

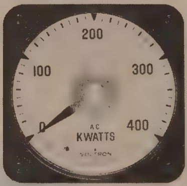
KRATOS' aircraft instruments incorporate a superior, frictionless, tautband movement characterized by extreme ruggedness, high accuracy, excellent damping, and an insensitivity to wide temperature excursions. Many dial presentations, unlit, spraylit, and transilluminated are available as off-the-shelf designs in all standard aircraft packages. Will display any parameter that can be converted to voltage, current, or resistance. Key areas of application in cockpit instrumentation are secondary (electrical parameters) and engine instrumentation.

150
100
LEFT
50
OIL TEMP
0
-50
°C
150
100
RIGHT
50
OIL TEMP
0
-50
°C
-30
0
30
FUEL TEMP
°C
-60
60



AC AMPS
3
2
1
0

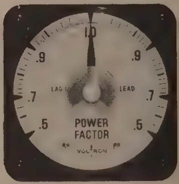
UTILITY (SWITCHBOARD)


0
100
200
300
400
AC
KWATTS
VOLTRON

SLOW
FAST
SYNCHROSCOPE
VOLTRON

0
100
200
300
400
500
600
AC
AMPERES
VOLTRON

Features include: Standardized, 1% taut-band movements; Linear scales; no parallax; interchangeable platforms and scales; integral or separate transducers. DC voltage and current are measured directly, while AC voltage and current, watts, vars, power factor, and frequency inputs are converted to DC by transducers. Transducers also permit the display of physical parameters such as pressure, temperature, rpm, etc. Expanded scales are available for increased accuracy. All meters and synchroscopes are manufactured in accordance with USA St. C39.1-1964, and are approved by most major utilities.


1.0
.9
.9
.7
.7
.5
.5
LAG
LEAD
POWER FACTOR
VOLTRON

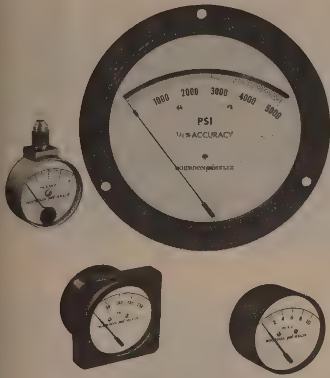
200
220
240
260
280
AC
VOLTS
VOLTRON

0
10
10
20
20
30
30
LAG
LEAD
MVARS
VOLTRON

KRATOS

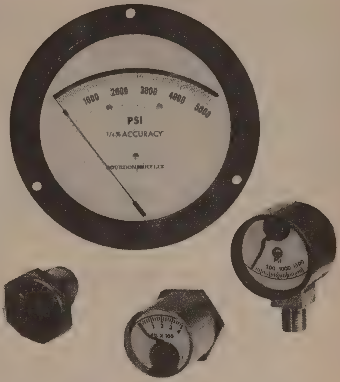
403 S. RAYMOND AVE.
BIN 45
PASADENA, CA 91109
(213) 449-3090
TWX 910-588-3288

PRESSURE DEVICES


1000
2000
3000
4000
5000
PSI
1/4% ACCURACY
BOURDON HELIX

GAUGES

Bourdon-Helix design — only one moving part. Small, light weight, accurate, and reliable with long operating life. No periodic service or recalibration required. High resistance to shock and vibration, line ripple, over-pressure, temperature extremes, and corrosive media. Available in ranges from 30 to 10,000 psi. Mil. Spec. Qualified.


1000
2000
3000
4000
5000
PSI
1/4% ACCURACY
BOURDON HELIX
PSI X 100

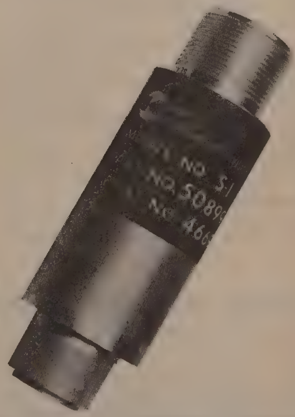
TRANSMITTERS & INDICATORS

Bourdon-Helix drives variable capacitor, transformer, or synchro. Electrical output is transmitted to remote indicator to display pressure. Used on all major aircraft to monitor oil, hydraulic, and water pressures. Excellent reliability, long service life, light weight, resistant to shock and vibration. Available in ranges from 50 to 10,000 psi. 1½% accuracy.

HYD PRESS
COMB
FLT
W/S
SPOIL
OFF
OFF

SWITCHES

MS-type snap action switch driven by Bourdon-Helix. Extremely rugged and reliable. 50,000-cycle endurance life. Resistant to shock and vibration, temperature extremes, and corrosive media. Available in ranges from 50 to 6000 psi.



KRATOS

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BIN 45
PASADENA, CA 91109
(213) 449-3090
TWX 910-588-3288

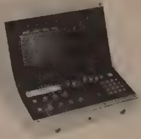
moxon INSTRUMENTATION

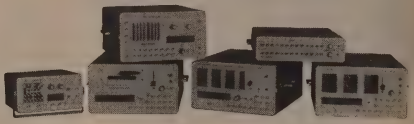
DATA GENERATORS WORLD'S LARGEST DIGITAL DATA GENERATOR SELECTION

These precision, compact instruments utilize exclusive patented linear programming to provide the equivalent of up to 960 toggle switches . . . in a portable bench-top housing. All units have both serial and parallel outputs with data rates in excess of 10 MHz.

The newest member of this unique family of generators incorporates a keyboard to program a self-contained CRT. The data pattern is visually presented as a waveform representing a "1" as a high level and a "0" as a low level. Sixteen lines of 64 bits each are displayed to aid the operator in formulating the data program. Once a satisfactory pattern has been established, the data is transferred to the transmit memory and sent to the device under test at rates up to 15 MHz in Serial or 10 MHz in Parallel.

A separate memory is then used to store the response of the device under test and this data can then be displayed by the CRT. This unique capability of displaying both the generate and receive data patterns sets the Model 777 apart from all other units available.





VIDEO CHARACTER GENERATORS

These Video Character Generators produce 16 lines of 32 characters each in black or white for commercial broadcast or closed circuit TV applications.

Character messages may first be generated and displayed in a preview position prior to insertion into a program. Messages may be viewed as a full page, or a line-at-a-time using a roll-down feature that displays individual lines at selected locations on the screen. Characters are easy-to-read 7 x 8 dot matrix, in place of conventional 5 x 7.

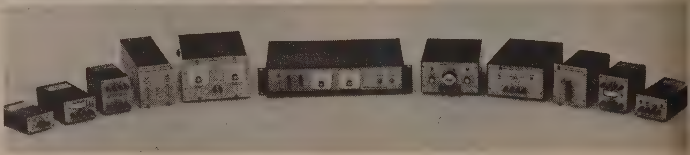
The Model 72 consists of a generator and integrated keyboard, while the Model 71 provides a separate standard 64 character ASCII keyboard which may be operated at remote locations up to 20 feet distant. Up to 4 generators may be operated from one keyboard.

Generators also include a character insert/delete capability, as well as offering a memory and computer interface option.

The rack or desk mounted units are supplied with all connectors required for connection to composite sync and video inputs and providing program, preview and sync outputs.

POWER SUPPLIES FINEST ISOLATED POWER SUPPLIES AVAILABLE IN WIDE RANGE OF OUTPUTS

To insure testing results that are precise, try one of the Mitey Mite Series Power Supplies that essentially eliminate noise, ripple and spikes . . . power supplies that provide battery quality DC . . . 0 to 50 volts with current to 5 amps. DC isolation: 10,000 megohms, AC isolation: less than 0.1 pF and ripple typically below 20 microvolts peak-to-peak.



TIMING PRODUCTS NEW TIMING PRODUCTS ADVANCE STATE-OF-ART TECHNOLOGY

MODEL 514 TIME CODE GENERATOR — Supplies all popular codes. Serial or parallel output, BCD or binary.

MODEL 520 TIME CODE TRANSLATOR — Accepts all standard and many unique time codes. Standard decoded outputs. Serial, parallel and pulse rates.

MODEL 524 TAPE SEARCH AND CONTROL UNIT — Operates with Models 520 or 540 to interface with any standard instrumentation tape recorder and provide output for search and playback.

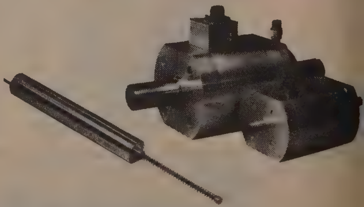
MODEL 540 TIME CODE TRANSLATOR/GENERATOR — Provides simultaneous translation and generation within the same chassis. NEW REMOTE DISPLAY AND TIMING TERMINAL UNIT ALSO AVAILABLE. COMPUTER INTERFACES FOR ALL ABOVE UNITS AVAILABLE.

VARIABLE RELUCTANCE TRANSDUCERS

Since pioneering variable reluctance transducers in 1938, Moxon has paced the industry with new transducer types and systems. Today's precision sensor types include Rotary Position, Linear Position, Velocity and Torque.

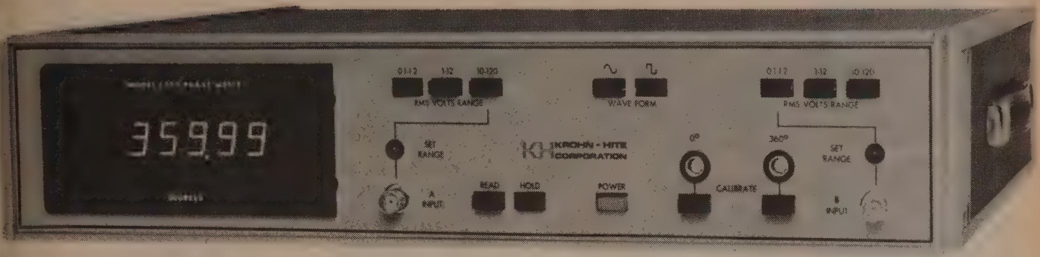
One of the newest DC-DC Linear Transducers is an LVDT type which provides high accuracy using self-contained electronics.

Also available is a new series of Torque Transducers offering 5 to 200,000 inch pound readout in both directions at speeds of 25,000 RPM. (Refer to Transducers section in EEM or contact the factory.)

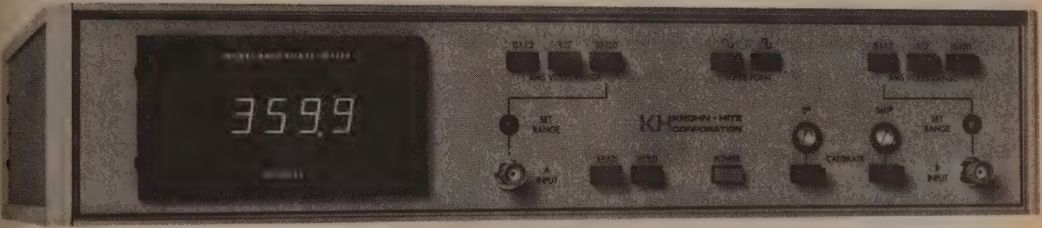


MOXON INC. • 2222 Michelson Drive • Irvine. California 92664 • Phone (714) 833-2000 • TWX (910) 596-1362

Phasemeters



MODEL 6500
Accuracy: 0.05°
Resolution: 0.01°
Frequency Range: 10Hz to 5MHz
Display: 5 digit Planar gas discharge
Input Voltage Range: 0.1-120 volts RMS
Accepts sine, triangle, square and positive pulse waveforms



MODEL 6400
Accuracy: 0.1°
Resolution: 0.1°
Frequency Range: 10Hz to 5MHz
Display: 4 digit Planar gas discharge
Input Voltage Range: 0.1-120 volts RMS
Accepts sine, triangle, square and positive pulse waveforms

Model	Phase Accuracy	Frequency Range	Resolution	Input Waveforms	Input Voltage Range	Display	Price
6500	0.05°	10Hz to 5MHz	0.01°	∿ ⊓ ∿ ⎍	0.1V-120V RMS	5 digit	$1995
6400	0.1°	10Hz to 5MHz	0.1°	∿ ⊓ ∿ ⎍	0.1V-120V RMS	4 digit	$1400

For Rack Mounting, Order Part No. PMR-6; Price $25.00.

Refer to Section 2700 for information on Krohn-Hite Filters.

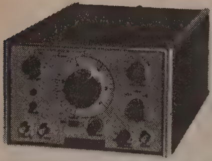
KROHN-HITE CORPORATION

Avon Industrial Park, Avon, Massachusetts 02322 • (617) 580-1660

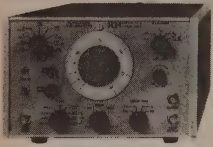
SALES OFFICES: ALA, Huntsville (205) 534-9771; ARIZ., Scottsdale (602) 947-7841; CAL., San Jose (408) 292-3220, Inglewood (213) 674-6850; COLO., Denver (303) 750-1222; CONN., Glastonbury (203) 633-0777; FLA., Orlando (305) 894-4401; HAWAII, Honolulu (808) 941-1574; ILL., Des Plaines (312) 298-3600; IND., Indianapolis (317) 244-2456; MASS., Lexington (617) 861-8620; MICH., Detroit (313) 526-8800; MINN., Minneapolis (612) 884-4336; MO., St. Louis (314) 423-1234; N.C., Burlington (919) 227-3639; N.J., Haddonfield (609) 795-1700; N.M., Albuquerque (505) 299-7658; N.Y., E. Syracuse (315) 437-6666, Rochester (716) 328-2230, Vestal (607) 785-9947, Elmont (516) 488-2100; OHIO, Cleveland (216) 261-5440, Dayton (513) 426-5551; PA., Pittsburgh (412) 371-9449; TEX., Houston (713) 688-9971, Richardson (214) 231-2573; VA., Alexandria (703) 354-1222; WASH., Bellevue (206) 624-4035; CANADA, Montreal, Quebec (514) 636-0525, Toronto, Ontario (416) 499-5544, Stittsville, Ontario (613) 836-3990, Vancouver, British Columbia (604) 278-2009, Halifax, Nova Scotia (902) 434-3402.

Function Generators & Oscillators

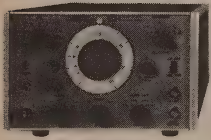
Function Generators



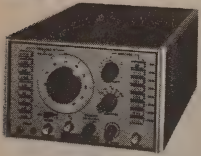
MODEL 5100A $495
0.002Hz to 3MHz
∿⊓∿⩘⩗⎍⊔⌃⌃
V.C.O.: 1000:1
D.C. Offset: ±5V
dB Attenuator



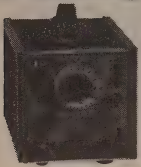
MODEL 5200 $595
0.002Hz to 3MHz
∿⊓∿⩘⩗⩘⎍
1000:1 Int. Sweep
Triggered/Gated/Burst
V.C.O.: 1000:1



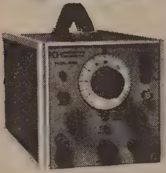
MODEL 5300 $695
0.002Hz to 3MHz
∿⊓∿⩘⩗⩘⩘⎍
1000:1 Lin-Log Sweep
Triggered/Gated/Burst
V.C.O.: 1000:1



MODEL 5400A $595
0.002Hz to 5MHz
∿⊓∿⩘⩗⎍⊔⌃⌃
V.C.O.: 1000:1
D.C. Offset: ±10V
dB Attenuator



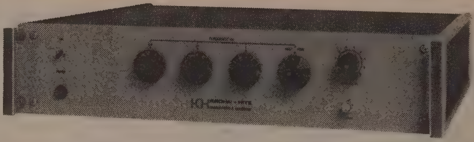
MODEL 5600 $395*
Portable
0.002Hz to 2MHz
∿⊓∿
D.C. Offset: ±5V
Line or Battery Operation
*Battery Option Add $100



MODEL 5700 $295
0.002Hz to 2MHz
∿⊓∿
D.C. Offset: ±5V
1000:1 Tuning

MODEL 5800 $245
0.2Hz to 2MHz
∿⊓∿
Pushbutton Operation
15V-p-p Output
Aux. Squarewave: 1V-p-p
1000:1 Tuning Dial

Oscillators

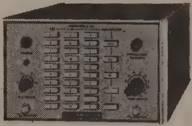


MODEL 4000A $995
0.1Hz to 100kHz
0.01% distortion
Main and quad outputs
0.5% Freq. acc.

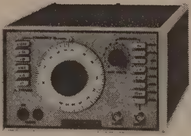
MODEL 4001A $1495
0.1% Freq. acc.

MODEL 4024A $1400
0.001Hz to 100kHz
0.01% distortion
∿⊓⎍
0.5% Freq. acc.

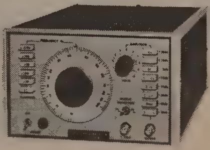
MODEL 4025A $1950
0.1% Freq. acc.



MODEL 4100A $695
0.01Hz to 1MHz
0.02% distortion
∿⊓
0.5% Freq. acc.



MODEL 4200 $495
10Hz to 10MHz
0.1% distortion
0.025 dB Response
dB Step Attenuator



MODEL 4300 $550
10Hz to 10MHz
∿⊓
0.1% distortion
0.025 dB Response
dB Step Attenuator

Refer to section 2700 for information on Krohn-Hite filters.

KH KROHN-HITE
CORPORATION
Avon Industrial Park, Avon, Massachusetts 02322 • (617) 580-1660

SALES OFFICES: ALA, Huntsville (205) 534-9771; ARIZ., Scottsdale (602) 947-7841; CAL., San Jose (408) 292-3220, Inglewood (213) 674-6850; COLO., Denver (303) 750-1222; CONN., Glastonbury (203) 633-0777; FLA., Orlando (305) 894-4401; HAWAII, Honolulu (808) 941-1574; ILL., Des Plaines (312) 298-3600; IND., Indianapolis (317) 244-2456; MASS., Lexington (617) 861-8620; MICH., Detroit (313) 526-8800; MINN., Minneapolis (612) 884-4336; MO., St. Louis (314) 423-1234; N.C., Burlington (919) 227-3639; N.J., Haddonfield (609) 795-1700; N.M., Albuquerque (505) 299-7658; N.Y., E. Syracuse (315) 437-6666, Rochester (716) 328-2230, Vestal (607) 785-9947, Elmont (516) 488-2100; OHIO, Cleveland (216) 261-5440, Dayton (513) 426-5551; PA., Pittsburgh (412) 371-9449; TEX., Houston (713) 688-9971, Richardson (214) 231-2573; VA., Alexandria (703) 354-1222; WASH., Bellevue (206) 624-4035; CANADA, Montreal, Quebec (514) 636-0525, Toronto, Ontario (416) 499-5544, Stittsville, Ontario (613) 836-3990, Vancouver, British Columbia (604) 278-2009, Halifax, Nova Scotia (902) 434-3402.

Programmable Signal Sources

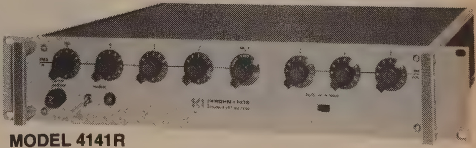
PROGRAMMABLE FUNCTION GENERATOR

MODEL 5500AR

- Frequency Range: 0.0001Hz—5MHz
- Waveforms: Sine, Square, Triangle, Pulse, Sawtooth
- Trigger and Gate Functions
- Output: 30V p-p
- Independent Control of Positive and Negative Waveform Duration
- High Speed FET Switching
- Aux. Square Wave: 5V p-p
- Auto/Manual Selection of All Functions
- Analog Frequency Control (VC): 1000:1
- Analog/Digital Control of DC Offset

Programmable Oscillators

MODEL 4031R

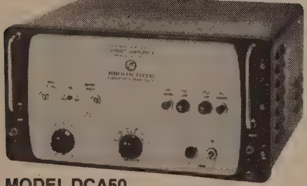


MODEL 4141R

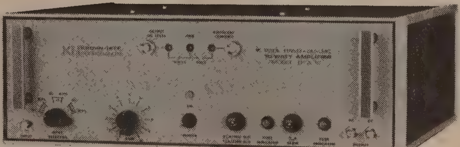
Frequency Range	Osc. Model	Freq. Acc. %	Max. Volts.	Output Impedance	Dist.	Square Wave	Prog. Amp.	Price
0.1Hz to 100kHz	4030R	0.5	10 RMS	200/600	0.01%	optional	optional	$1495*
0.1Hz to 100kHz	4031R	0.1	10 RMS	200/600	0.01%	optional	optional	$2145*
1Hz to 1MHz	4140R	0.5	10 RMS	50	0.02%	yes	yes	$1395
1Hz to 1MHz	4141R	0.1	10 RMS	50	0.02%	yes	yes	$1695

*Base Price

Laboratory Power Amplifiers



MODEL DCA50



MODEL DCA10

Frequency Range	Model	Output Power (watts)	Dist. %	Freq. Resp. (dB)	Input Volts (RMS)	Max. Voltage Gain	Matched Load (Ohms)	Max. Output Volts (RMS)	Max. Output Current	Price
DC-1MHz	DCA-10*	10	0.1	±1.0	10	10	600-1000	100	130ma	$750
DC-500kHz	DCA-50*	50	0.3	±1.0	13	10	200-330	130	500ma	$995
30Hz-1MHz	MT-56‡	50	—	—	106	—	1-1000	115	7A	$250

‡Accessory matching transformer

*Rack Model (19" Panel) add $25.00 Add Suffix 'R' to Model No.

Refer to Section 2700 for information on Krohn-Hite Filters.

KH KROHN-HITE CORPORATION

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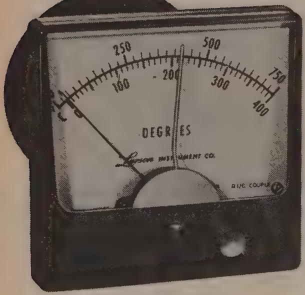
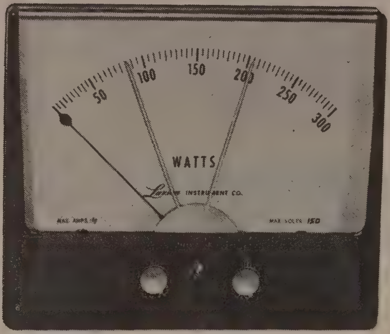
Larson CONTACTLESS METER CONTROLLERS

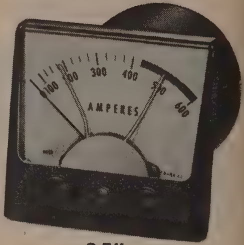
Where there is INDICATION, there is a need for CONTROL



3.5″



4.5″



2.5″

Wide View

The wide-view series of controllers offers crisp, modern styling together with reliable control for a wide range of measurements. Only Larson offers self-contained, true r.m.s. sensing in a.c. voltage, current and power controllers. Contactless optical control point sensing permits monitoring of the actual input value, regardless of the control point setting. "Fail-Safe" circuit design insures maximum reliability for your control, alarm or limit applications. The table at right shows the availability of units in all sizes.

	2.5″	3.5″	4.5″
d.c. and a.c. microamperes rectifier type	10 to 1000	5 to 1000	5 to 1000
d.c. and a.c. rectifier type milliamperes	——— 1 to 1000 ———		
a.c. iron vane milliamperes	——— 5 to 1000 ———		
d.c. amperes (self-contained)	1 to 5	1 to 30	1 to 30
a.c. iron vane amperes (self-contained)	1 to 5	1 to 30	1 to 30
d.c. millivolts	——— 5 to 1000 ———		
a.c. rectifier type millivolts	n.a.	500 to 1000	500 to 1000
d.c. and a.c. volts	——— 1 to 300 ———		

SPECIFICATIONS

CONTROL POINT ARRANGEMENT	SINGLE (HIGH)	DUAL(HIGH & LOW)
CONTROL POINT ADJUSTMENT	0-100% of Arc.	Low Limit: 0-97% of Arc. High Limit 3-100% of Arc. Adjustable to within 4% of each other.
CONTROL POINT SWITCHING	Within 1% of scale indication	
CONTROL POINT DIFFERENTIAL	Difference between "On" and "Off" is 0.5% Max.	
INPUT POWER REQUIREMENTS	105-130 VAC, 50-400 Hz., 6 VA Max.	
OUTPUT CONTACTS	DPDT relay contacts for each control point. Contacts rated at 7.5 A per pole, 115 VAC, resistive load.	
CALIBRATION ACCURACY	±2% of Full Scale	

Larson INSTRUMENT COMPANY, INC.

GREENBUSH RD. • ORANGEBURG, N.Y. 10962 • 914 EL 9-3800

Larson CONTACTLESS METER CONTROLLERS

and Inkless Event Recorder

Space Saver

800
600
°C
400
200
0

°F
0
50
100
150
200
250
300

The Larson Space Saver Model is designed to provide the maximum scale length (2.5") in the minimum panel space (4.9 sq. in.).

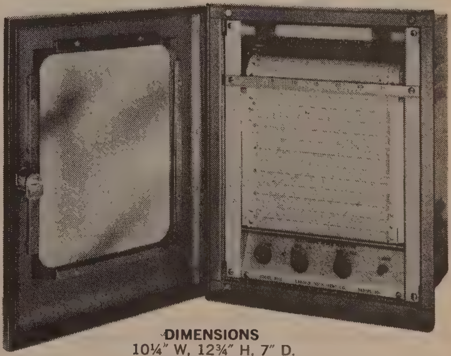
Available in either a horizontal or vertical mount version, it can monitor and control a wide range of d.c. or a.c. values. See typical specifications on facing page.

Inkless Event Recorder

The Larson Model ROS instrument will continuously record the time, sequence and duration of as many as 30 different events on one chart. The record is made on electro-sensitive paper, by a stylus which marks only when current flows through the paper. The recording is instantaneous, accurate and permanent.

RESPONSE and RESOLUTION. The recorder can remain on stand-by for an unlimited length of time, yet be ready to respond within 1 millisecond when a signal is applied. The instrument will record up to 60 pulses per second for each stylus. Response time of the styli is 1 millisecond.

CHART SPEEDS. ½" per hour to 10" per second. Standard speeds are ½", 1", 2", 3", 4", 6", 8" and 10" per hour, minute or second.



DIMENSIONS
10¼" W, 12¾" H, 7" D.
WEIGHT 20 Lbs.

SEND FOR OUR NEW, UP-TO-DATE CATALOG.

Larson **INSTRUMENT COMPANY, INC.**
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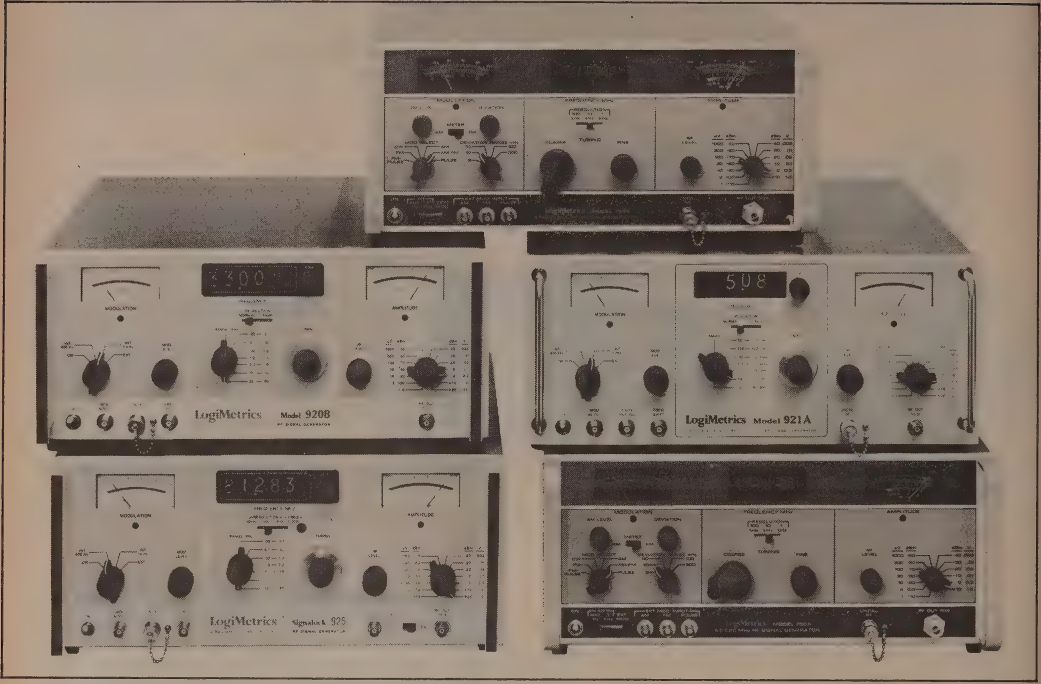
LogiMetrics RF SIGNAL GENERATORS



LogiMetrics provides the industry's most complete line of solid state signal generators, all of which are equipped with digital frequency readout. The signal generators cover the range of 50 kHz to 520 MHz with integral counters and leveled outputs. A precision attenuator allows the power to be varied from +23 dBm (3 V RMS) to –127 dBm (0.1 μV RMS) into 50 ohms.

The generators inherent stability and ease of calibration allow users to perform RF measurements with superior convenience and accuracy and at the best cost effectiveness.

Model 315 combines two models 925 for single sideband test.

Among the many features offered in the line is Signalock® *, the capability to count external signals and full modulation. Solid state design, self calibration and plug-in circuit cards insure ease of maintenance and long equipment life.

LogiMetrics signal generators are available with Federal Stock Nomenclature and under G.S.A. contract.

* LogiMetrics holds the original patents on the digital readout signal generator and Signalock®, the circuit that is the key to stabilized signal generators. These patents are licensed to other major companies.

Model	Frequency Range MHz	Accuracy	Digits Display	Features
925	.05 to 80	±10 Hz	6	AM, Signalock®
920B	.05 to 80	±500 Hz	5	AM, High Accuracy
921A	.05 to 80	0.01%	3 (+ x 100)	AM, Low Cost
750A	4.5 to 520	±0.0001%	5	FM/AM Pulse
950A	1.5 to 80	±500 Hz	5	FM/AM Com. Test
315	.25 to 80	±10 Hz	6	Two Tone S.S.B. Test

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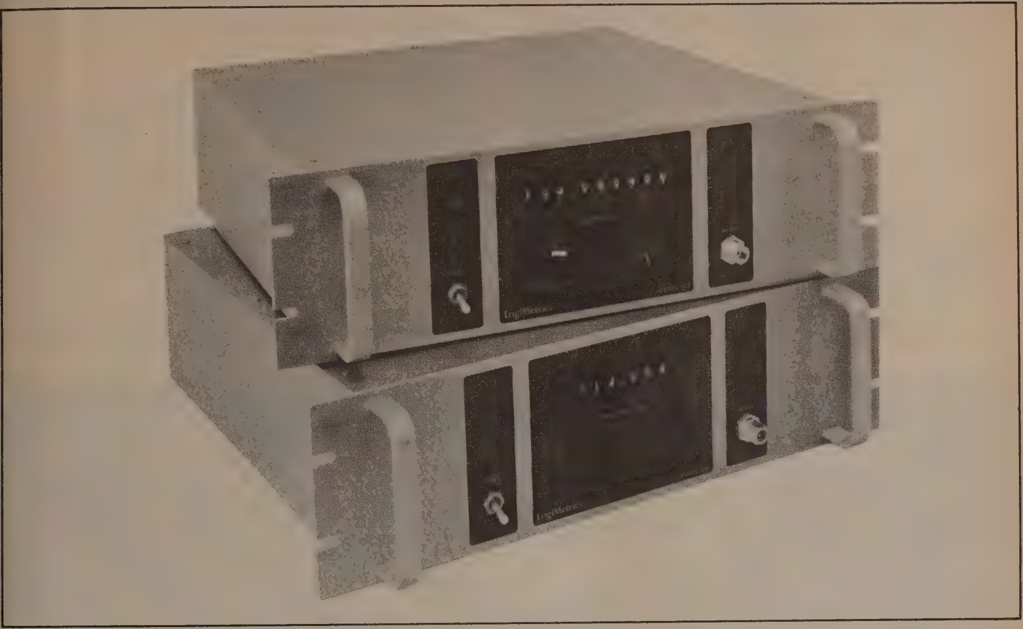
LogiMetrics FREQUENCY SYNTHESIZERS



LogiMetrics offers the first series of frequency synthesizers specifically designed for systems applications in satellite communications, frequency-agile radar, ECM, programmable local oscillators for surveillance receivers and microwave common-carrier systems. In these and similar applications, a relatively small slice of frequency is needed and that is what these remarkable synthesizers provide.

Their custom design obviates the need for expensive wide band, laboratory-style synthesizers. In addition, the synthesizer can offer much better performance characteristics in such critical areas as phase noise, spurious outputs, and cost.

LogiMetrics' standard synthesizers feature a choice of front panel digital thumbwheel switches or remote programming for frequency selection. They operate with an external frequency standard. Three optional internal standards are also available. The fixed outputs are leveled at +13 dBm ±1 dBm. Switching time is a maximum of 800 microseconds, using an external 5 MHz standard. Residual amplitude modulation is 94 dB.

4000 SERIES

Model	Frequency (MHz)
4005	40-65
4008	65-100
4014	100-160

RESOLUTION:
10 kHz (standard)
10 Hz (option)

NONHARMONIC
SPURS: 70 dBc

5000 SERIES

Model	Frequency (MHz)
5005	40-65
5008	65-100
5010	95-115
5014	100-160
5012	125-160

RESOLUTION:
1 kHz (standard)
1 Hz (option)

NONHARMONIC
SPURS: 83 dBc

OTHER OPTIONS

Full alarm monitor
Internal frequency standards from 1×10^{-6}/24 hours to 2×10^{-9}/24 hours

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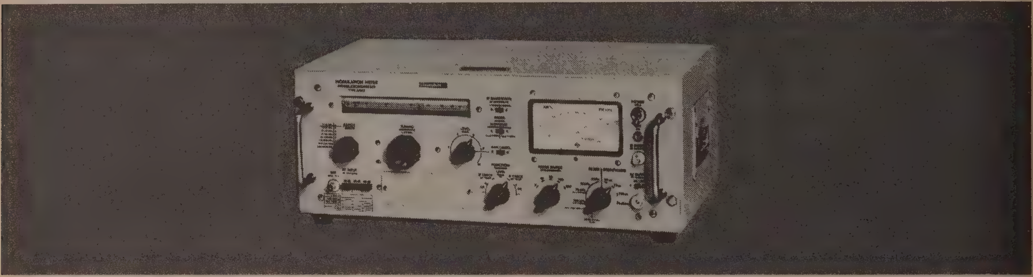
test equipment FROM RADIOMETER COPENHAGEN

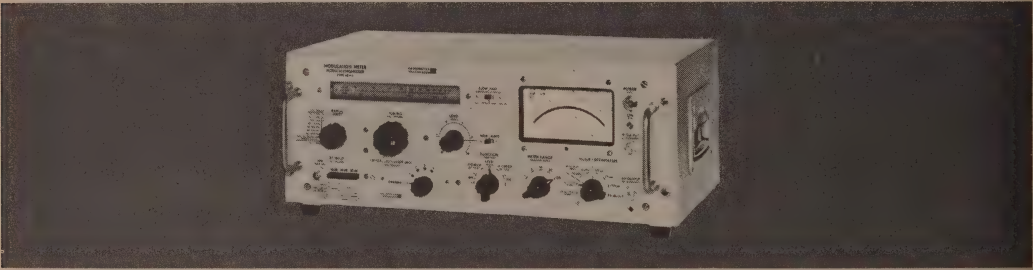
AFM2 MODULATION METER

The AFM2 Modulation Meter meets an increasing demand for sophisticated and critical modulation measurements on AM, FM or FM stereo generators and transmitters. It has all the important features (including low noise and distortion, and a linear wide-band detector) required to cover the broadest possible range of applications, both in the laboratory and on the transmitter site. The AFM2 has been accepted as a standard instrument by all leading European Broadcasting Authorities.

ABRIDGED SPECIFICATION

Frequency range:	5-1000 MHz
Sensitivity:	3 mV
Meter (f.s.d.):	AM: 3% to 100% FM: ±3 kHz to ±300 kHz
Accuracy:	2% of reading +1% of f.s.d.
IF:	2 MHz
Two IF bandwidths:	±25 kHz and ±400 kHz
Four deemphasis networks:	50, 75, 750 μsec and 6 dB/oct (ref. 1 kHz)
Four low-pass filters:	3, 15, 75 and 200 kHz
Band-pass filter:	50 Hz to 15 kHz
Distortion:	FM: < 0.1% at ±75 kHz; AM: 0.2% at 30% mod.
AM residual:	< 0.03% up to 200 MHz < 0.3% up to 1000 MHz
FM residual:	< 25 Hz up to 250 MHz < 100 Hz up to 1000 MHz
Dimensions/Weight:	W=485mm (7¾") D=245mm (9⅝") H=197mm (7¾")/13 Kg (28.6 lbs.)
Optional accessory:	Crystal-controlled plug-in oscillator with a choice of four frequencies within the range 67-1000 MHz.





AFM3 MODULATION METER

The AFM3 Modulation Meter is intended for accurate measurements of AM or narrow-band FM on VHF/UHF mobile equipment transmitters, both in the laboratory and in production and service departments. It may also be used as an AM/FM station monitor.

ABRIDGED SPECIFICATION

Frequency range:	6-1000 MHz
High sensitivity:	3 mV
Meter (f.s.d.):	AM: 1% to 100% FM: ±1 kHz to ±100 kHz
Accuracy:	2% of reading +1% of f.s.d.
IF:	1 MHz
IF bandwidth:	±300 kHz
Four deemphasis networks:	50, 75, 750 μsec and 6 dB/oct (ref. 1 kHz)
Two low-pass filters:	3 kHz and 15 kHz
Two band-pass filters:	50 Hz to 15 kHz and 300 Hz to 3 kHz (3 dB points)
Distortion:	FM: < 0.2% at ±15 kHz; AM: 0.2% at 30% mod.
AM residual: (with filter 0.3-3 kHz)	< 0.015% up to 200 MHz < 0.05% up to 500 MHz < 0.15% up to 1000 MHz
FM residual: (with filter 0.3-3 kHz)	< 8 Hz up to 200 MHz < 15 Hz up to 500 MHz < 30 Hz up to 1000 MHz
Dimensions/Weight:	W=485mm (7¾") D=245mm (9⅝") H=197mm (7¾")/13 Kg (28.6 lbs.)
Optional accessory:	Crystal-controlled plug-in oscillator with a choice of four frequencies within the range 67-1000 MHz.

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THE LONDON COMPANY

test equipment FROM RADIOMETER COPENHAGEN

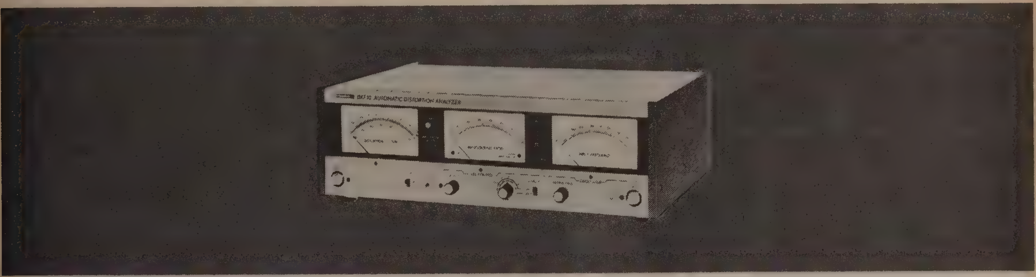
BKF10 AUTOMATIC DISTORTION ANALYZER

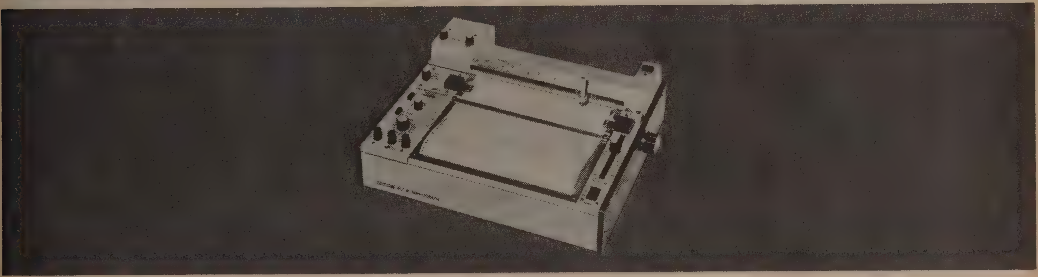
The BKF10 Automatic Distortion Analyzer is an outstanding and advanced instrument for sweep-frequency measurements of all the important parameters of Hi-Fi amplifiers, tape recorders, etc. It is a complete system in itself and incorporates the following features:

- Fully automatic distortion measurements—no balancing, etc.
- Built-in AF sweep oscillator with very low distortion.
- Automatic recordings of distortion and amplitude response—separately or simultaneously.
- Automatic recordings of distortion as a function of output power.
- Three precision meters indicate: Distortion and S/N ratio, Input/Output ratio and Input Frequency.
- Constant input level or constant output level capabilities.
- Facilities for incorporation in automatic test systems.

ABRIDGED SPECIFICATION

Fundamental Freq. range:	20 Hz to 20 kHz
Harmonic Freq. range:	10 Hz to 150 kHz
Distortion range:	0.02% to 10%
Input voltage limits:	10 mV to 30 V RMS
Min. sweep time (20 Hz-20 kHz):	Approx. 1 min.
S/N ratio range:	−80 dB to −20 dB
HP-LP filter cut-off freq.:	250 Hz
Input/output ratio range:	−50 dB to +90 dB
Input Freq. meter range:	20 Hz to 20 kHz
Sweep oscillator range:	20 Hz to 20 kHz, Int. and ext. sweep facilities
Osc. output voltage limits:	1 mV to 1 V rms
Recorder outputs: (dc analogue voltage)	For Distortion, Input/Output ratio Input Frequency and Output Frequency
Control inputs: (dc analogue voltage)	For external control of Frequency and Osc. amplitude output
Dimensions/Weight:	W=440mm ($17\frac{5}{16}$") D=344mm ($13\frac{9}{16}$") H=144mm ($5\frac{11}{16}$")/9.5 Kg (21 lbs.)





REC61 SERVOGRAPH

The REC61 Servograph is a general-purpose, high-sensitivity, dc analogue recorder built up on a modular system which can be used in conjunction with almost any form of instrumentation found in physical and electronic laboratories.

A special version, REC61S2, is available for convenient recording of distortion and amplitude response curves in connection with the BKF10 Automatic Distortion Analyzer.

ABRIDGED SPECIFICATION

Chart feed (time axis):	1 sec/cm to 2 h/cm, reversible
Charts:	250mm rolls (22m) and sheets to DIN 16230
Sensitivity:	4 μV/cm to 500 mV/cm dc, dependent on type of input module used
Input modules:	Plug-in, high input resistance (1-10 MΩ), floating inputs providing sensitivities of: 500 mV f.s.d. (REA110), 10 mV and 100 mV f.s.d. (REA111) and 100 μV to 12.5 V f.s.d. (REA112)
Recording system:	Potentiometric slide-wire, servo-driven pen
Response time:	0.6 s for 99% of f.s.d.
Resettability:	0.05% of pen deflection
Accuracy:	0.1% of pen deflection
Pens:	Expendable fibre pens
Mounting:	Horizontal or vertical, fits 19" rack
Dimensions/Weight:	W=440mm (17.3") D=355mm (13.9") H=130mm (5.1")/10 Kg (22 lbs.)
Optional accessories:	Event Marker and Tracking Potentiometer with remote control facilities

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test equipment FROM RADIOMETER COPENHAGEN

SMG1 STEREO GENERATOR

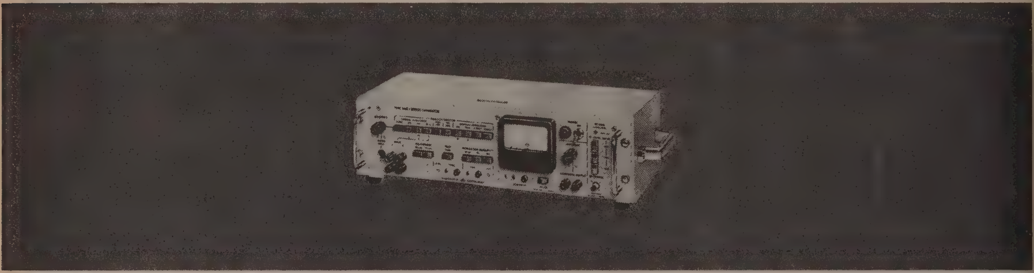
The SMG1 Stereo Generator complies with the standards for stereophonic broadcasting approved by the FCC and EBU. It provides an RF signal of 100 MHz, FM-stereo-modulated, for the testing of FM stereo receivers. In addition, an AF composite signal is available for the testing of multiplex decoders. The SMG1 includes a built-in oscillator for FM stereo modulation and a pilot signal, and is thus a self-contained instrument for use in the laboratory and in production and service departments.

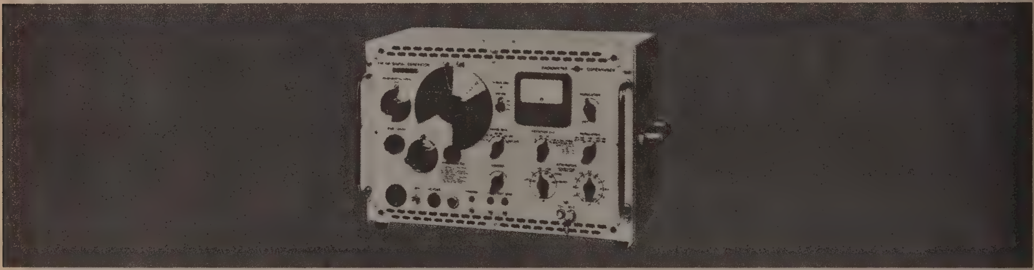
ABRIDGED SPECIFICATION

Operating modes:

1) Stereo modulation of either the R or L channel individually or both simultaneously.
2) Mono or stereo sub-channel output.
3) Stereo modulation with stereo material from records or tapes for listening tests.
4) SCA modulation with FM sub-carrier.

External modulation source:	L and R input: 40 Hz to 15 kHz, 250 mV AUDIO input (records and tapes): 40 Hz to 15kHz, 0.25 V to 10 V. SCA input: 10 to 75 kHz, 250 mV.
Internal modulation source:	80 Hz, 1 kHz and 5 kHz Alternative model available with 10 kHz instead of 5 kHz
Pre-emphasis:	50 μs and 75 μs
AF composite output:	0-7 V peak. Distortion < 0.2% L/R separation < 40 dB M/S separation < 45 dB Pilot signal: 19 kHz, variable 0-15% mod.
RF output:	100 MHz, variable ±0.5 MHz 10 μV to 100 mV in 20 dB steps FM ±75 kHz peak deviation for 100% modulation on meter Output impedance: 75 Ω Distortion, < 0.2% at ±75 kHz, deviation, typically 0.1%
Meter:	Scaled: 0-100% peak value and 0-15% for pilot signal
Dimensions/Weight:	W=565mm (22½″) D=235mm (9¼″) H=160mm (6¼″)/9.1 Kg (20 lbs.)





MS27 FM-AM SIGNAL GENERATOR

The MS27 FM-AM Signal Generator is a general-purpose, line-operated instrument for use in the laboratory and in production and service departments. It covers 0.3 to 240 MHz with an output of 0.1 μV to 0.1 V into 50 Ω and 75 Ω. Variable FM deviation and AM. Internal/External FM-AM facilities. Accepts external modulation up to 60 kHz for stereophonic modulation. Rugged mechanical construction.

ABRIDGED SPECIFICATION

Frequency coverage:	0.3 MHz to 240 MHz in 5 ranges
Calibration:	500 kHz crystal calibrator
Frequency stability:	Typical 10 ppm/10 min. after 1 hour warm-up
Incremental tuning:	±50 kHz (2 kHz divisions)
Carrier output:	0.1 μV to 0.1 V into matched load in 2 db steps
Output impedance:	50 Ω and 75 Ω, BNC connector
Stray radiation:	Negligible
FM:	0 to ±75 kHz full-scale deviation, up to ±600 kHz dev. in the higher frequency ranges. Distortion: < 1% at ±75 kHz dev.
Residual FM:	Typical: 0.5 ppm
AM:	0 to 80%. Distortion: < 5% at 50% AM
Internal mod.:	1 kHz. Distortion: < 0.5%. Output: approx. 15 V (3 kΩ source)
External mod.:	Approx. 3 V into 200 kΩ. 10 Hz to 60 kHz
Dimensions/Weight:	W=565mm (22¼″) D=275mm (10¾″) H=350mm (13¾″)/23 Kg (51 lbs.)

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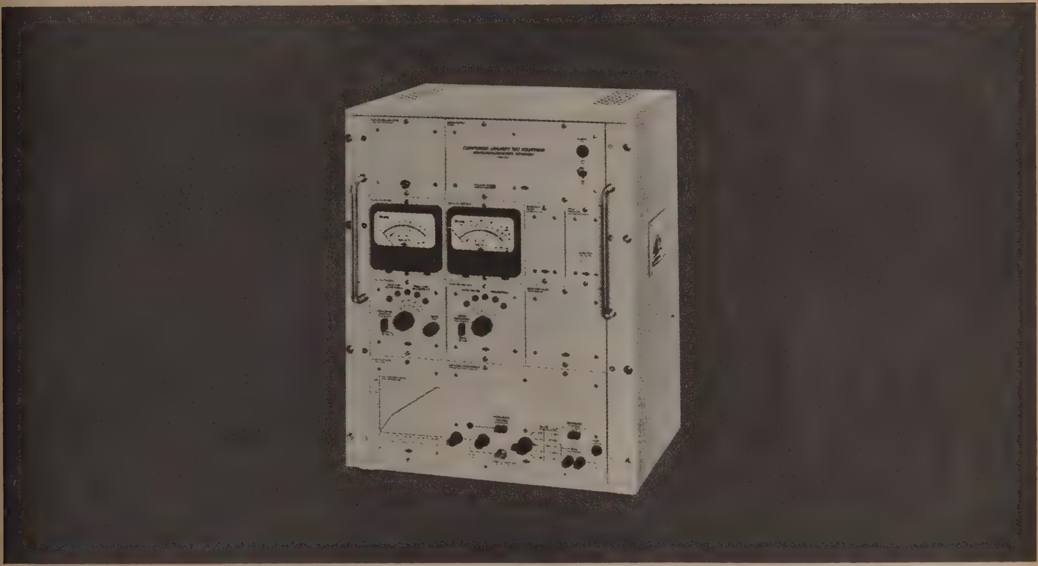
test equipment FROM **RADIOMETER COPENHAGEN**

CLTI COMPONENT LINEARITY TEST EQUIPMENT

METHOD

The CLT1 Component Linearity Test Equipment is based on a principle first developed by L. M. Ericsson in Sweden for the measurement of the non-linearity of nominally linear electronic components, such as resistors, capacitors, etc., this non-linearity being taken as a measure of the components' reliability. The method is non-destructive and therefore lends itself to both quality and production control. The criterion for classifying a component as less reliable is that its non-linearity is higher than the average non-linearity of the batch on test. The rejectable components enable the manufacturer to study the cause of the rejection and will thus lead to more reliable components.

In the CLT1, the non-linearity is determined by the measurement of the 3rd harmonic (30 kHz) of a pure 10 kHz current which is fed to the component, the non-linearity being defined as the ratio of the value of the 3rd harmonic voltage to that of the fundamental frequency voltage expressed in dB.



REFERENCES

1) Kirby, P. L. "Non-linearity Measurements Improve Resistor Reliability," Electronic Components, May 1967, Radiometer reprint BU1055.
2) Petersen, V., and Harris, P. O. "Harmonic Testing Pinpoints Passive Component Flaws," Electronics, July 11, 1966, Radiometer Reprint BU1052.
3) Stanley, K. W. "Improvements in Reliability of Metal Film Resistors," Radiometer reprint from Mullard Technical Communications of January 1971, Vol. II, No. 109.
4) Bristow, C. W. H., Clough, W. L., and Kirby, P. L. "The Current Noise and Non-linearity of Thick Film Resistors." Reprint from Welwyn Electric Ltd., England, sponsored by the Ministry of Defence (Aviation Supply).

ABRIDGED SPECIFICATION

Component range:	< 1 Ω to > 100 MΩ in 5 ranges
Max. power delivered:	1 VA at 10 kHz
Max. voltage delivered:	550 V
Voltmeters:	For 10 kHz: 0.01 to 1000 V in 5 ranges For 30 kHz: linear indication: 0.1 μV to 1 V in 5 ranges logarithmic indication: 20-160 dB in 5 ranges
Total accuracy of measurement:	1-1.2 dB
Residual non-linearity:	−140 dB to −160 dB depending on range
Component measuring speed:	Up to 10 components/sec.
Recorder output:	1 V dc for f.s.d. on both linear and log. scales.
Dimensions/Weight:	W=500mm (19¾") D=310mm (12¼") H=630mm (25")/40 Kg (88 lbs.)
Optional accessories:	Low impedance matching transformer. 900-231

Provision for remote switching and remote control of the 10 kHz voltage, and a recorder output for the registration of the 3rd harmonic voltage, whether set to the linear or to the logarithmic meter indication.

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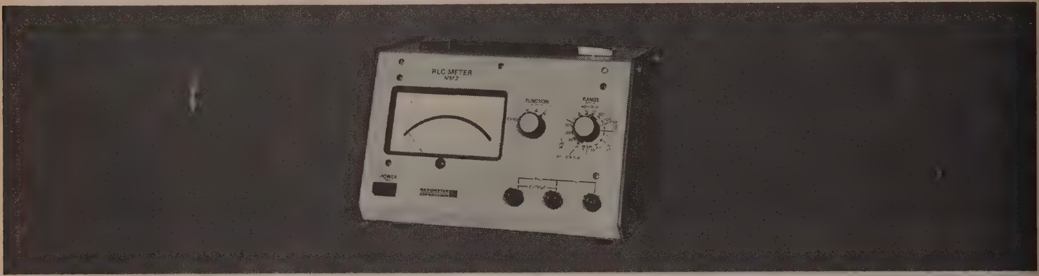
test equipment FROM RADIOMETER COPENHAGEN

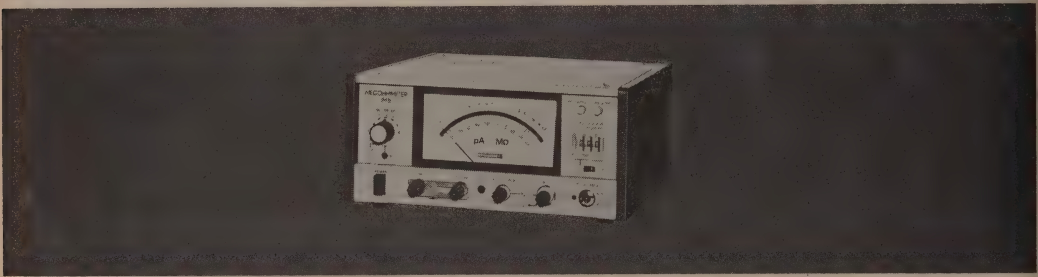
MM2 RLC METER

The MM2 RLC Meter is a direct reading, wide-range component tester for use in the laboratory and in production and service departments. It measures from 3 Ω to 1 MΩ in 12 ranges and from 3 μH to 100 H and 3 pF to 1000 μF in 16 ranges each. It is extremely easy and quick to use, and requires no balancing.

ABRIDGED SPECIFICATION

Resistance range:	3 Ω to 1 MΩ f.s.d. in 12 ranges
Inductance range:	3 μH to 100 H f.s.d. in 16 ranges
Capacitance range:	3 pF to 100 μF f.s.d. in 16 ranges. 100 μF to 5000 μF in one reciprocal range
Accuracy:	2% of reading +1% of f.s.d. (3 pF to 100 μF)
Test frequencies:	R: 160 Hz L and C: 160 Hz to 1.6 MHz dependent on range
Test voltage:	R and L: 10 mV at f.s.d. C: 10 mV to 316 mV at f.s.d. dependent on range
DC bias:	Up to ±60 V dc
Recorder output:	−1 V dc at f.s.d.
Dimensions/Weight:	W=250mm (10″) D=190mm (7¾″) H=165mm (6½″)/3.2 Kg (7 lbs.)
Optional accessories:	807-200 Component Clips IM501 Component Adapter





IM6 MEGOHMMETER

The IM6 Megohmmeter is a line-operated instrument for use in the laboratory and in quality control, production and service departments. It is an extremely advanced instrument with a low response time covering the range from 1 MΩ to 10^9 MΩ in 1 range of 9 decades or in 8 ranges of 2 decades. Resistance measurements are made with a highly stable test voltage which is variable in 1 V steps from 1 V to 999 V. It also measures dc current from 1 pA to 1 mA. Finally, the IM6 is provided with remote control facilities and a recorder output.

ABRIDGED SPECIFICATION

Resistance range:	1-10^9 MΩ
Test voltage:	1-999 V, variable in 1 V steps, internal or external control
Stability of test voltage:	Better than 10^{-7} for 10% line voltage variation
Current range:	1 pA to 1 mA
Accuracy:	5% of the indicated value (resistance or current)
Recorder output:	Resistance: −0.5 V/decade Current: 0.5 V/decade Source resistance 10 kΩ
Response time:	< 1 s to max. 3 s for resistance < 3 s for capacitance up to 1 μF
Dimensions/Weight:	W=300mm (12″) D=330mm (13¼″) H=140mm (5½″)/4.5 Kg (9 lbs.)
Optional accessories:	807-200 Component Clips LMS 1 Limit Sensor

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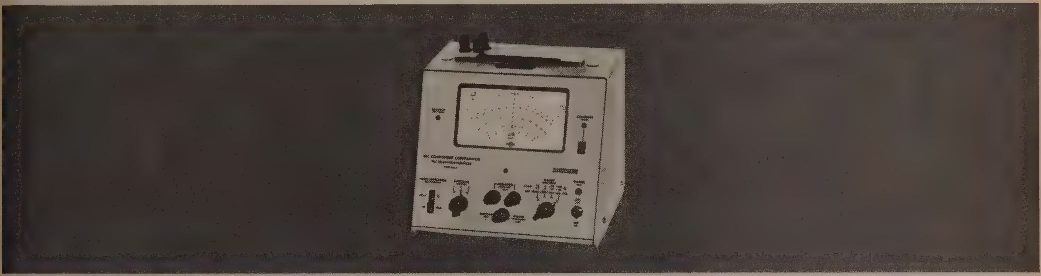
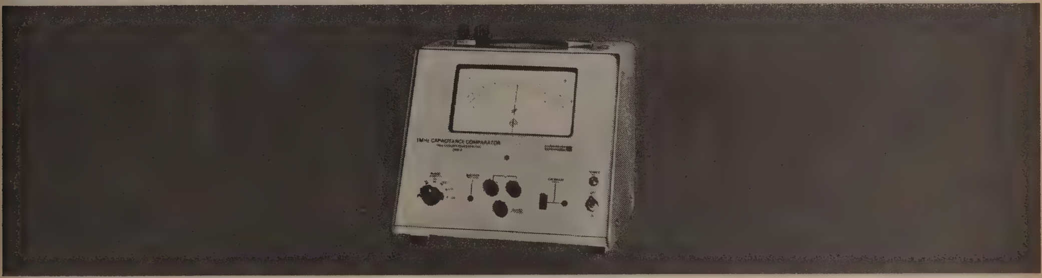
TRB11 COMPONENT COMPARATOR

The TRB11 RLC Component Comparator is a line-operated instrument intended for rapid comparison measurements of R, L and C in production control and incoming inspection. Direct percentage or radian deviation from a comparison standard. When used in conjunction with a limit sensor, it can be made to operate sorting machines in the selection of components.

ABRIDGED SPECIFICATION

Resistance range:	10 Ω to 10 MΩ
Capacitance range:	20 pF to 20 μF
Inductance range:	1 mH to 10 H
Test frequency:	1 kHz, 250 mV
Accuracy:	R, L, C and θ: 3% of f.s.d.
Meter:	Center zero, calibrated in ±% deviation from 1.5% to 100% f.s.d. for R, L and C, and 0.015 to 0.6 radians f.s.d. for phase angle
DC polarization of components on test:	−50 V dc to +20 V dc
Limit sensor/ recorder output:	±125 mV for f.s.d.
Dimensions/Weight:	W=280mm (11⅛") D=237mm (9⅜") H=235mm (9⅜")/6.2 Kg (13.7 lbs.)
Optional accessories:	807-200 Component Clips LMS1 Limit Sensor IM501 Component Adapter





CMB12 CAPACITANCE COMPARATOR

The CMB12 Capacitance Comparator is a line-operated instrument intended for rapid comparison measurements in production control and incoming inspection. It operates at 1 MHz in accordance with I.E.C. and MIL recommendations, and can be used for both direct and comparison measurements. When used in conjunction with a limit sensor, the CMB12 can be made to operate sorting machines in the selection of components.

ABRIDGED SPECIFICATION

Capacitance range:	1-1000 pF f.s.d.
Accuracy:	1% of reading +1% of f.s.d.
Meter:	Center zero with ±3 and ±10 pF scales
Test signal:	1 MHz, 100 mV
DC polarization:	±60 V dc
Guard terminals:	Up to 500 pF without affecting accuracy
Dimensions/Weight:	W=280mm (11⅛") D=237mm (9⅜") H=235mm (9⅜")/7 Kg (15 lbs.)
Optional accessories:	807-200 Component Clips LMS1 Limit Sensor IM501 Component Adapter

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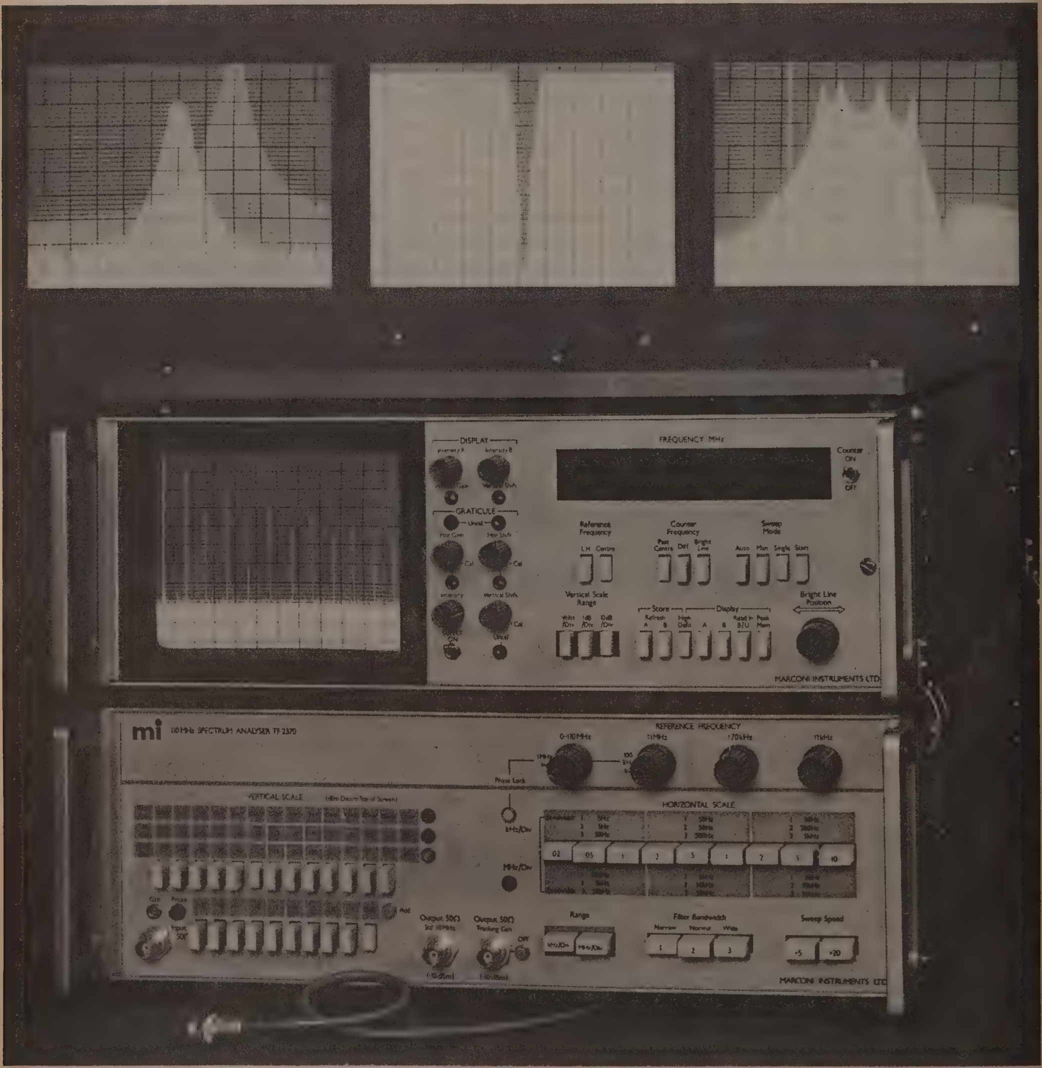
1975 SHORT FORM CATALOG

mi MARCONI INSTRUMENTS

DIVISION OF MARCONI ELECTRONICS INC.

- Signal Generators, FM/AM
- FM Deviation Meters
- H.F. Spectrum Analyzers
- Mobile Radio Test Gear
- Receivers, AM/FM/SSB
- Television Test Equipment
- Intermodulation and Baseband Test Gear
- Programmable Test Equipment
- Microwave Instrumentation
- Bridges and Q-Meters
- P.C.M./Digital Test Equipment


FREQUENCY MHz
DISPLAY
GRATICULE
MARCONI INSTRUMENTS LTD
mi 110 MHz SPECTRUM ANALYSER TF 2370
REFERENCE FREQUENCY
VERTICAL SCALE
HORIZONTAL SCALE
Range
Filter Bandwidth
Sweep Speed
MARCONI INSTRUMENTS LTD

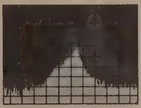
> ***"Marconi's Spectrum Analyzer, the TF2370, not only brings a fresh approach to this class of instrument but also zooms ahead of all others in performance in at least seven key areas."***
>
> *Quoted From Cover Story Electronic Design April 12, 1974*

Here's Why The.....
H. F. SPECTRUM ANALYZER MODEL 2370
Is Unique.....

Digital Storage of Spectral Information

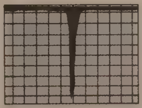
A most interesting innovation in this equipment is the digital storage and display in which the analogue information relating to amplitude and frequency of the signal being analyzed is converted to digital form giving a 256 level by 512 ordinate representation which is entered into a MOSFET recirculatory store. The stored information is continuously scanned at a field rate of 76 Hz and displayed on a bright 130 by 100 mm television camera monitor tube as a brightness modulated picture on a vertically scanned raster. This is the first use of such a display in an h.f. spectrum analyzer and overcomes the disadvantages of long-persistence tubes and storage tubes. It also enables the display to be retained indefinitely at any brightness.

Split Memory



Another very important advantage of the display method used is that the store can be split into two parts so that two displays can be screened together with independent brilliance controls and with the facility of updating either display while retaining the other. See left hand photo, front page.

Resolution



The 5 Hz filter bandwidth and 0.1 dB level resolution enables rapid analysis of extremely narrow filters as depicted on the center photograph, front page.

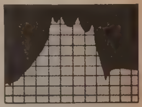
Electronic Graticule

An electronically produced graticule is superimposed on the display and can be shifted along either axis and scaled horizontally to give exact frequency setting and easy setting of amplitudes to a reference level.

Operational Simplicity

An important design principle has been simplicity of operation. The user has only to select the required centre frequency, sweep width and resolution; a built-in logic program then automatically selects the best r.f./i.f. gain ratio, sweep rate and filter bandwidth. This eliminates the possibility of measurement error resulting from incorrect setting of the controls.

Frequency Measurement



A nine-digit electronic counter is incorporated giving readout in MHz with automatic positioning of the decimal point. Three modes of operation are available; measuring the center frequency of any sweep, measuring the absolute frequency at any point on a display by use of a movable bright-line electronic cursor, or measuring the frequency difference between these two values. This last mode is particularly useful for such applications as rapidly measuring sideband frequencies relative to a carrier, or complex network characteristics as shown in right photograph on front cover.

Network Response Measurement

A built-in tracking generator produces a swept output signal with a frequency within 2 Hz of the analyzer tune frequency. This permits the spectrum analyzer to be used as a swept or manually-tuned selective level measuring set for frequency response characterization of networks over wide dynamic ranges. The split store system is very useful in this context for displaying the response of a standard network for as long as is required, while comparing with it the displayed response of a network under test.

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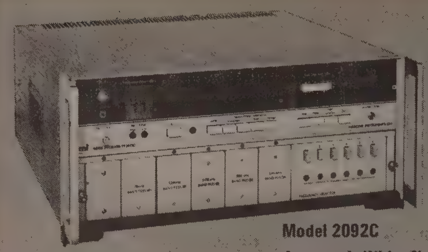


Model 2092C
Automatic White Noise
Loading Receiver

Model 2013
Low Noise 800-960MHz
Signal Generator

FM/AM SIGNAL GENERATORS

DESCRIPTION	FREQUENCY	FEATURES
FM/AM SIGNAL GENERATOR Model 2002B	10KHz to 88MHz	0.1µV to 1V ±1dB, fully solid state, AM variable to 100%, FM deviation ±1KHz to ±50KHz max. dependent upon range. Incremental frequency controls with discrimination of 0.025% and direct readout in KHz. Xtal calibrator. External frequency shift permits phase mod. or phase locking. Digital Synchronizer available.
FM/AM SIGNAL GENERATOR (6625-913-7223) Model 995B/Series	200KHz to 220MHz	0.1µV to 100mV. Calibrated ΔF. Step attenuator, Crystal standardized; extremely stable. Deviation ±600KHz on top bands. Has simultaneous FM & AM. Also available for narrow band working FM spurious less than 25Hz Model 995B/5.
FM SIGNAL GENERATOR (6625-937-2801) Model 1066B/6	10MHz to 470MHz	0.1µV to 100mv. 50 fm at 1 KHz and 5 KHz internal, deviation to ±400 KHz, ΔF to ±100 KHz, both meter monitored. Stability .0025% 10 min. Xtal calibrator.
FM/AM SIGNAL GENERATOR Model 2015	10MHz to 520MHz	Covers 10MHz to 520MHz in 11 bands with discrimination permitting tuning to narrow band (±3KHz) receivers. FM deviation 10KHz and 100KHz. AM to 80%. Precision ALC eliminates need for external set carrier control. Fundamental signal with low spurious content. Will also operate from external 24VDC. Portable, 5½" high 11" wide. Lowest cost for performance generator on USA market today.
DIGITAL SYNCHRONIZER Model 2171	10MHz to 520MHz	Used with Model 2015 to set frequency to stability of ±2 in 10^7 to resolution of 100Hz. Once locked frequency may be digitally tuned to at least 1% from center frequency, with full modulation capabilities retained.
LOW NOISE VHF/UHF FM SIGNAL GENERATORS Models 2011-2012-2013	130MHz to 180MHz 400MHz to 520MHz 800 MHz to 960MHz	Highly stable low noise unit for testing narrow band mobile receivers. Velvet vernier tuning. Infinitesimal leakage. Noise less than —140dB/Hz, VHF/UHF; —125dB/Hz, 800 — 960MHz, 20KHz from carrier. Output level 0.01µV to 100mV into 50Ω FM deviation to ±30KHz f_m 300Hz to 3KHz.
AM/FM SIGNAL GENERATOR AND SWEEP GENERATOR Model 2008	10KHz to 510MHz	This unique combination Generator/Sweeper provides both facilities without sacrifice to the precision quality of either function. Eleven bands with 1 : 1.5 cover span from VLF thru UHF. Output 0.1µV to 100mV into 50Ω. Stability 5 p.p.m. FM deviation ±3KHz ±10KHz ±30KHz ±100KHz and above 45MHz ±300KHz. Mod. frequency to 125KHz. AM to 80%. Comprehensive sweep facilities on all bands. Full Modulation facilities may be retained in sweep mode. Xtal calibrator and markers.
SOLID STATE PRECISION FM SIGNAL GENERATOR (6625-491-7755) Model 2006	4MHz to 1000MHz	Solid state precision FM unit accepts any 4 of 5 oscillators with bands 4 to 10MHz; 10 to 90MHz; 88 to 220MHz, 215 to 500MHz and 440 to 1000MHz. Output 0.1µV to 100mV into 50Ω. FM ±100KHz to ±300KHz max. dependent on frequency. Mod frequencies 20Hz to 125KHz internal or external. Synchronized version 2006/1 available.

FM DEVIATION METERS

DESCRIPTION	FREQUENCY	FEATURES
FM DEVIATION METER (6625-060-3320) Model 791D	4MHz to 1024MHz	Deviation ranges, ±5, ±25, ±75 and ±125KHz full scale. Accuracy 3%. Crystal standardized. Local oscillator can be xtal controlled for measuring deviations down to 10Hz.
FM DEVIATION/ AM MODULATION METER Model 2300A (USA) (6625-480-8706)	4MHz to 1000MHz to 2500MHz using ext. oscillator	Wide range, mod. freq. up to 200KHz; deviation ranges ±1.5, ±5, ±15, ±50, ±150, ±500KHz. Local oscillator can be xtal locked, external oscillator can be used. De-emphasis 50µsec. 75µsec. switch selected. FM accuracy ±3% for deviation up to ±500KHz f_m 30Hz to 150KHz. AM modulation two ranges 30% and 100% mod. freqs. 30Hz to 50KHz (carrier 4 to 350MHz).
FM DEVIATION/ AM MODULATION METER Model 2300B	4MHz to 1200MHz	Measures FM deviation to 500KHz, AM depth to 95% at carriers up to 400MHz. Very low internal noise allows narrow deviation measurements. Filter for noise measurement. De-emphasis 50µS, 75µS and 750µS. Distortion and channel separation on FM stereo meets FCC testing requirements.
PORTABLE MODULATION METER Model 2303	25 to 520MHz	Measures FM on all mobile bands thru 520MHz deviations 15, 5 and 1.5KHz. Accuracy 3%. Low noise. AM measurements to 225MHz. 95% depth. 3% accuracy. AC or battery operated. 13 lbs.
PROGRAMMABLE FM/AM MODULATION METER Model 2301A	4MHz to 1000MHz	FM deviation in six ranges from ±1.5KHz to ±500KHz FS. f_m 30Hz to 200KHz demodulated output distortion 0.25%. AM 30% and 100% FS. Automatic internal carrier level setting.

FM/AM Modulation Meter
Model 2300B

Model 2015
Low cost, high performance AM/FM generator

MOBILE RADIO TEST GEAR

DESCRIPTION	FREQUENCY	FEATURES
PORTABLE MODULATION METER Model 2303	25 to 520MHz	Measures FM on all mobile bands thru 520mHz deviations 15, 5 and 1.5KHz. Accuracy 3%. Low noise. AM measurements to 225MHz. 95% depth. 3% Accuracy. AC or battery operated. 13 lbs.
MOBILE RADIO SIGNAL GENERATORS	All Mobile Bands	Special low noise signal generator series for all bands. 130MHz thru 960MHz. See Signal Generator Section, Models 2011, 2012, 2013, and general purpose 2015.
AUTOMATIC DISTORTION METER Model 2337	20Hz to 20KHz	Simultaneous indication of level down to 3mV, distortion down to 0.1% without tuning adjustments. With external filter, the unit becomes ideal for SINAD testing.

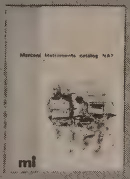
DIGITAL COMMUNICATIONS – P.C.M. TEST GEAR

MULTIPLEX TEST SET Model 2807	Voice Channel	Both sinewave and pseudo random noise stimulus available to measure channel gain, frequency response, idle channel noise, gain linearity, quantization distortion and interchannel crosstalk. National and International models available.
PATTERN GENERATOR AND ERROR DETECTOR Model 2808	1.536 to 8.448 Mbit/s	Generates pseudo random test signal in AMI, RZ or NRZ formats. Errors and blanking can be introduced to test regenerator clock recovery. Automatic locking of pseudo random signal in receiver. Performs bit by bit analysis of received signal.
DATA LINE ANALYZER Model 2809	300Hz to 3400Hz	Used for testing data transmission lines and links; measures peak-to-average rating (PAR), frequency response and system noise level. Has correction for phase-intercept distortion.

INTERMODULATION AND BASEBAND TEST GEAR

NOISE LOADING TEST SET TRANSISTORIZED (6625-965-8625) (AN/GSM 161A) Model 2090A	12KHz to 12.388MHz (i.e. up to 2700 channels)	Solid state unit has built-in standardizing noise source in receiver for gain setting, out-of-band testing, etc. Includes noise generator, receiver and a choice of many different filters. NPR measurements can be made up to 75 dB.
NOISE LOADING TEST SET Model 2090B	12KHz to 12.388MHz	Designed to meet latest CCIR and CCITT requirements (Recommendation 399-1 Oslo 1966). Operation similar to model 2090A.
Model 2099AB		This filter extension box can be added to any 2090A or 2090B system to provide accommodation for up to nine extra high, low or band stop filters and six extra band pass filters with oscillators. Minor modification required to existing generators and receivers to provide access. Simple field modification kits available.
AUTOMATIC NOISE RECEIVER Model 2092C	12KHz to 12.388MHz	The Automatic noise receiver automatically adjusts its sensitivity to the incoming noise level, intermodulation noise level, or residual noise level. The noise power ratio (NPR) of a microwave system or component under test, is automatically determined and the result displayed digitally. A three digit display will give direct readout of NPR, dBm, dBmO, dBrn or dBrnO with or without 'C' message or psophometric weighting. Can be used with any current noise generator.
HF SPECTRUM ANALYZER Model 2370	30Hz to 110MHz	Comprehensive spectrum analyzer system with dispersion from 20Hz/div to 100MHz full width, resolution 0.1 dB, filter bandwidths from 5Hz to 50KHz, displayed dynamic range 100dB, 10 x 12 cm filter-free digitally stored display, frequency measurement to counter accuracy. See front page illustration and text opposite.
TWELVE CHANNEL NOISE GENERATOR (6625-948-4724) Model TM7816A	300Hz to 3400Hz	Generates twelve non-related channels of Gaussian noise from twelve separate solid state sources. Output: each channel 1mW in 600Ω balanced, 300Hz to 3400Hz. Attenuation to —32 dBm in 2 dB steps. Spurious noise in OFF channel (all other channels ON) is less than 10 dBa (—75 dBm FIA weighted). Programmable option available.
TV AUTOMATIC MONITORING SYSTEM Model 2914/15		See television section overleaf.

mi publications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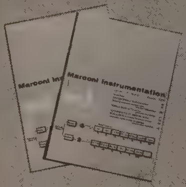
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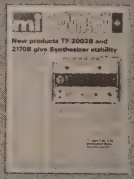
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New products TF 2002B and 2170B give Synthesizer stability

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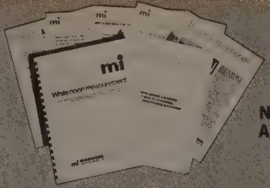
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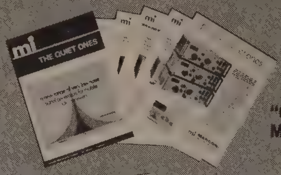
White noise measurement

Noise Loading Test Set Applications Kit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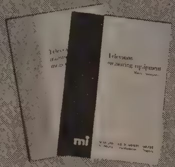
THE QUIET ONES

"Quiet Ones" kit for Mobile Radio Testing Notes


Television monitoring equipment
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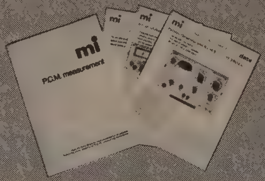
Automatic Monitoring of Television Signals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P.C.M. measurement

PCM Measurements Explained

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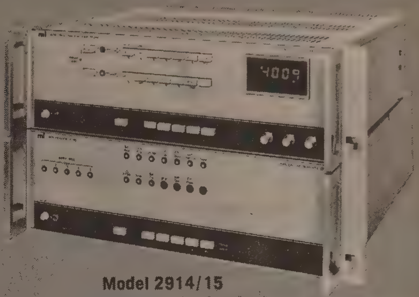
✱ Now with remote control printer interface

Model 2910 series
Non Linear Distortion Analyzer with Sampler



Model 2914/15
TV Automatic Monitoring System

TV TRANSMISSION TEST EQUIPMENT

DESCRIPTION	FREQUENCY	FEATURES
TV SIDEBAND ANALYZER Model 2360R		Provides a symmetrical or asymmetrical swept video signal for testing video amplifiers or transmitters using 625, 525 or 405 line systems, positive or negative modulation. Uses Converter TM6936 for UHF channels.
TV SWEEPER Model 2361		Main sweep unit has internal rep. rate 0.01Hz to 100Hz with linear, semi log, CW, single shot and manual modes. TV field lock, blanking and phase shift controls and alternate trace separation. Produces ultra flat, low distortion sweep. Plug-ins available: Video 25KHz to 30MHz. VHF 1 to 300MHz, UHF 220MHz to 1000MHz.
TV SWEEP ANALYZER Model 2900		Comprehensive frequency sweep analyzer combines Model 2361 Sweeper and video unit, Blanking and Sync Mixer Model 2908 and Differential Probes unit, Model 2907. Measures response of active or passive transmission networks. Differential measurements on composite signal to an accuracy of 0.01dB. Also measures termination impedance and return loss.
LUMINANCE/CHROMINANCE GAIN & DELAY TEST SET Model 2904/1		Measures gain and delay inequality with gain discrimination 0.5dB, delay discrimination 2 nanoseconds, visible display of misalignment with scope.
NON-LINEAR DISTORTION ANALYZER with SAMPLER Model 2910		Makes accurate, simultaneous measurements of differential gain, differential phase and luminance non-linearity, even in the presence of noise. Gain and phase can be directly measured against a calibrated pulse which can be varied over the ranges of 0 to 11% in .1% steps and 0 to 11° in .1° steps respectively, with the luminance non-linearity being resolvable down to 0.1% using an external scope display.
TV AUTOMATIC MONITORING SYSTEM Models 2914 and 2915		Automatically analyzes and displays all essential parameters including: amplitudes of bar, sync, various T pulses, and noise; luminance linearity, chrominance gain, chrominance/luminance crosstalk, differential gain and phase, etc., all measured in the most suitable units of measure and presented digitally when under manual control (see illustration above). ✱ Data Selector Model 2916 enables both local and remote print out of results.

COMMUNICATIONS RECEIVERS

DESCRIPTION	FREQUENCY	FEATURES
Model 1830	120 KHz to 30MHz	A unique series of communications receivers covering 10KHz thru 870MHz. All feature superb construction and top performance. Low frequency models provide AM/CW/SSB. 990 series offer AM/FM. Xtal locking facility optional on all models to enhance stability.
Model 990R	27MHz to 240MHz	
Model 990S	230MHz to 870MHz	

BRIDGES AND Q METERS

DESCRIPTION	FREQUENCY	FEATURES
UNIVERSAL BRIDGE Model 1313A	1KHz and 10KHz 20Hz to 20KHz External	0.1μh to 110h, 0.1pf to 100μf, 0.003Ω to 110MΩ. Accuracy 0.1%. Built-in osc. and det. Direct reading; simplest possible operation. Uses adapter TM6113 for biasing inductors to 200mA.
PORTABLE UNIVERSAL BRIDGE Model 2700	1KHz internal 20Hz to 20KHz External	0.2μh to 110h, 0.5pf to 1100μf, 0.01Ω to 11MΩ. Accuracy 1%. Transistorized, simple. Measures incremental L, electrolytics & non-linear resistance using external bias supplies.
Q METER Model 1245A	1KHz to 300MHz	Q ranges 5 to 1000, △Q 25-0-25. Accuracy 5% to 100MHz, 20% to 300MHz. Calibrated capacitor 7.5 to 500pf, △C ranges ±1 and ±5pf. Extremely stable and easy to operate. Uses separate oscillators. Dielectric and Series Loss Test Jigs available. Also HF & LF inductors.

MICROWAVE SIGNAL SOURCES

DESCRIPTION	FREQUENCY	FEATURES
Model 6055	0.85 to 2.15GHz	A unique series of transistor and gunn diode microwave signal sources covering 400MHz to 18.0GHz. Digital display of frequency, accuracy typically ±1%. Variable output levels typically 10mW on gunn diode sources. Up to 150mW on transistor models, Gunn Diode Models are 6057, 6058 and 6059. Model 6551 has FM. Special frequency coverages on request.
Model 6056	2.0 to 4.0GHz	
Model 6057	4.5 to 8.5GHz	
Model 6058	8.0 to 12.5GHz	
Model 6059	12.0 to 18.0GHz	
Model 6070	0.4 to 1.2GHz	
Model 6551	1.4 to 1.7GHz	

S/D & D/S MODULES & INSTRUMENTS, PHASE-SENSITIVE INSTRUMENTATION, RESOLVER/SYNCHRO INSTRUMENTS, AC RATIO BOXES

PHASE ANGLE VOLTMETERS

These instruments combine phase-sensitive modes with the functions of a multi-range conventional AC voltmeter. They provide voltage measurements of the total, fundamental, in-phase and quadrature components of an AC signal, as well as phase angle. They feature high harmonic-rejection, quadrature overload capability, and signal and reference isolation.

Model 220, 225-Digital Phase Angle Voltmeter

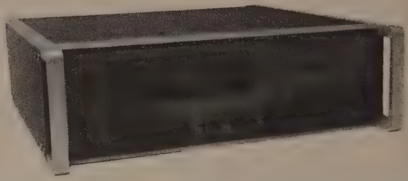
These new instruments directly measure and display phase angle and all components of signal voltage (total, fundamental, in-phase, and quadrature) at 1, 2, 3, or 4 push-button selected frequencies from 30Hz to 32KHz. Features include push-button and autorange selection of voltage, 4½ digit display of voltage and phase, push-button function selection, and panel display of selected function and voltage range. Other features are fully programmable operation, 0.1% full-scale voltage accuracy, 0.25° phase accuracy (0° to 360.0° display), digital output, and analog recorder output. Optionally available with ratiometric measurement modes.

Model 213—Single-Frequency Phase Angle Voltmeter

This instrument provides phase-sensitive measurement at a single prespecified frequency with ±5% bandwidth from 30Hz to 10KHz with full-scale measurement from 300μV to 300V.

Model 214—Four-Frequency Phase Angle Voltmeter

This instrument provides phase-sensitive operation at 2, 3, or 4 frequencies, 30Hz to 20KHz. Features include ±5% bandwidth, 300μV to 300V full-scale ranges, and rapid field change of frequency modules.



Model 220, 225

Model 213

RESOLVER/SYNCHRO SIMULATORS & BRIDGES

Most instruments offer a dual mode capability, permitting a single model to work with both resolvers and synchros. All units feature direct in-line readout of angle, i.e. 359.999° and input/output isolation.

Series 530—R/S Simulators

These 3½" full-rack simulators provide resolver and synchro output at 11.8, 26, 90 and 115V line-line voltages, with either 26V or 115V 400Hz excitation. Accuracy is 2 arc-seconds. Standard resolutions are .0001°, .001° and 1°.

Model 530/20—Broadband R/S Simulator

This 5¼" full-rack instrument features nominally 10 arc-second accuracy from 50Hz to 10KHz.

Model 532—Synchro Simulator, Model 531—Resolver Simulator

A miniature synchro simulator at 11.8V (or 90V) 400Hz line-line with 5° thumbwheel switches and 30 arc-seconds accuracy. Resolver model with 26V 400Hz line-line output.

Model 540/10 & 540/11 Resolver/Synchro Bridges

These 3½" rack-mounted bridges measure resolver and synchro transmitters with 2 arc-second accuracy at 400Hz (540/10) and 400Hz to 100Hz (540/11). Standard resolutions are .0001° and 1°.

Model 541/10, 542/10 Bridges

These miniature bridges measure angular position of 400Hz resolvers or synchros with accuracy of 5-arc-seconds. Manual balance is by 5° thumbwheel switches.

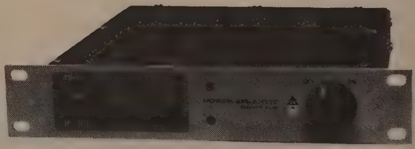
Model 540/20—Broadband Resolver/Synchro Bridge

This 5¼" rack-panel bridge features 10 arc-second accuracy over most of the frequency band from 55Hz to 10KHz.

Series 530

ANGLE POSITION INDICATOR—Model API-8025

This electromechanical servo measures synchro and resolver transmitters with 6 arc-minutes accuracy. Optional features include 4 arc-minute accuracy, retransmit components, dual-mode, and two-speed operation.



Model API-8025

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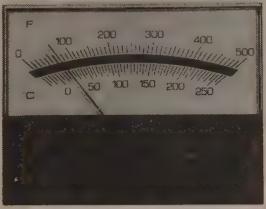
For D/S & S/D modules, Resolver/Synchro-To-Digital Converters, Digital-To-Resolver/Synchro Converters, and AC Ratio Boxes, see our page in the Computing, Data Handling Equipment & Accessories Section, Page 1•188.

MODUTEC

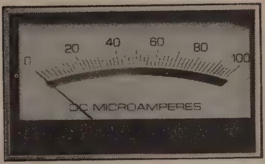
PANEL METERS FOR THE DISCRIMINATING

featuring fast delivery from factory modification centers

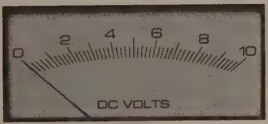
Surface Mount
black or
clear cover



Bezel Mount
black or clear
cover meter



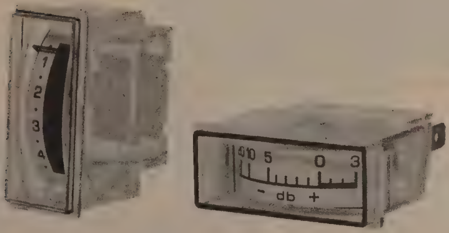
Windo-Mount
flush with
front of panel



TAUT BAND PANEL METERS

Standard accuracy ±2% full scale, ±1.5% tracking
Contemporary styling
Technically advanced movement and suspension
Six sizes: 1½″ through 8″
Flat 100° arc, linear scales
Many options and modifications available
See following pages for information and prices

Available in styles shown above,
also in edge reading style



MOVING MAGNET PANEL METERS

Standard accuracy ±5% full scale
High style — low cost
Rugged, dependable movements
Many options and modifications available
See following pages for information and prices

PYROMETERS · THERMOCOUPLES

Many types and styles for a wide range of applications.
Meters match styles described above.
See MODUTEC display in Section 5300

CONTROL METERS

for actuating & monitoring IC control circuits
Fast, precise response
Reliable — economical
Request Catalog CM-1011 for detailed information

MODUTEC, INC. 18 Marshall St., Norwalk, CT 06854 (203) 853-3636 TWX: 710-468-2039

MODUTEC TAUT BAND PANEL METERS

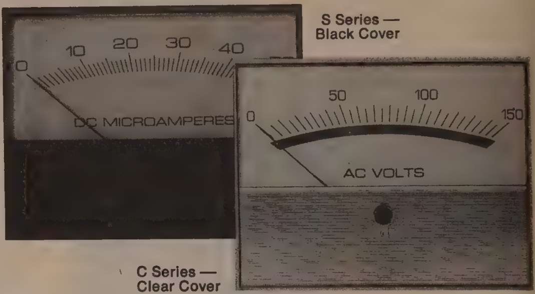
1½", 2½", 3½", 4½", 5½", 8" sizes

See overleaf for ranges & prices

SURFACE MOUNT

S Series — Black Cover
Handsome aspect ratio and clean-cut detailing add distinction to any panel. Optional colors available.

C Series — Clear Cover
Clear acrylic case front reduces contrast between the meter and adjacent panel for a pleasing overall effect.

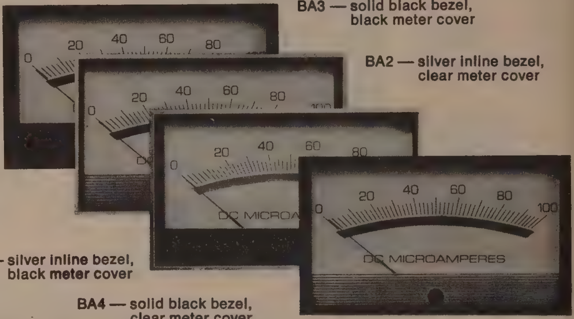


S Series —
Black Cover

C Series —
Clear Cover

BEZEL MOUNT

BA Series
Actually a package comprising a surface mount meter and a slender, graceful bezel in the combination shown. Mounting hardware and instructions are included. Bezels are available in optional colors; all meter options apply.



BA3 — solid black bezel, black meter cover

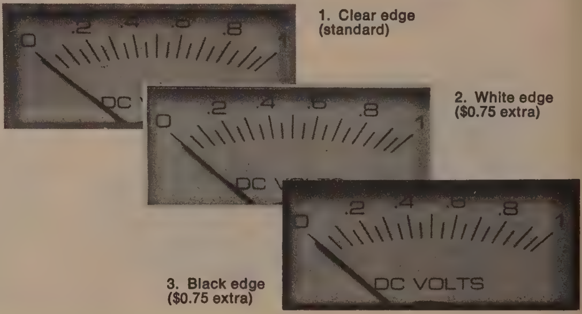
BA2 — silver inline bezel, clear meter cover

BA1 — silver inline bezel, black meter cover

BA4 — solid black bezel, clear meter cover

WINDO-MOUNT™

W Series
A sophisticated and original design that has been widely imitated, the W Series meters are easily installed without special adapters, and do not sink the meter dial deep behind the panel. Uniquely attractive edge options are available, as shown at right.



1. Clear edge (standard)
2. White edge ($0.75 extra)
3. Black edge ($0.75 extra)

BLUE-DOT™ RUGGEDIZED (MIL SPEC) METERS

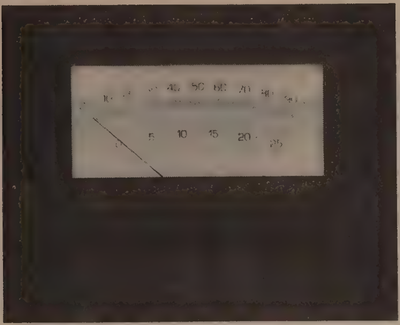
K Series
Blue-Dot meters are available in the styles described above, in all but the 8" size. Their covers are Lexan, so that they easily withstand physical punishment that would break or damage ordinary meters. Their movements are specially shockproofed, sealed, and compensated. This means that you can specify meters for tough situations without having to make concessions to size and appearance.
Blue-Dot meters meet various MIL, USA STND, and UL specifications for environment, shock, vibration, and flame resistance. For full information request Catalog 622.

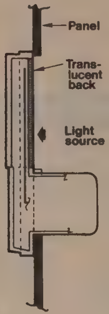
**24 OR LESS CATALOG METERS SHIPPED IN 1 WEEK OR YOU PAY ½ PRICE
FAST DELIVERY OF OPTIONS AND SPECIALS FROM FACTORY MODIFICATION CENTERS**

MODUTEC TAUT BAND PANEL METERS

New Additions — 3½″, 4½″, 5½″, 8″ sizes

See next page for ranges & prices

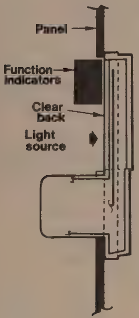


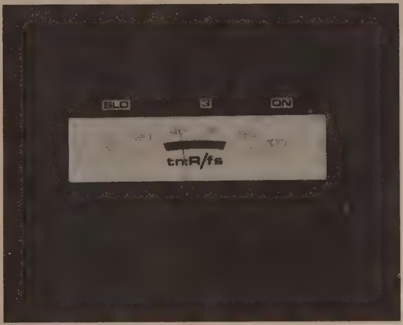


L SERIES

Trans-Lit™ Panel Meters

- Illuminated *through* the meter dial — highest quality lighting of any meter.
- Optional smoke-grey covers bring "blackout technology" to panel meters for the first time.
- Save money in installation and illumination accommodations.
- Available in Surface Mount, Bezel Mount, and Windo-Mount styles.

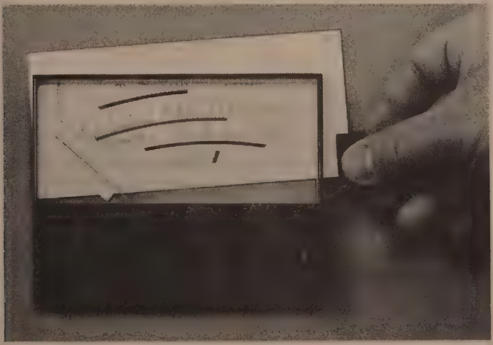




V SERIES

Thru-Vue™ Panel Meters

- Provide a "window into the product".
- Multiple metering functions visible through one cutout.
- Smoke-grey covers available for "meter blackout" effect.
- Bring high volume design advantages to custom and small run units.
- Save space and installation costs.



R SERIES

Multi-Dial™ Panel Meters

- Dials can be quickly switched — lift one out and drop another in!
- Accurate dial positioning is "built in".
- 1½% tracking standard.
- Entire meter remains sealed during dial replacement.
- Wide selection of dials available.
- Meter can be installed for trans-lighting, using translucent or transparent dials

MODUTEC, INC. 18 Marshall St., Norwalk, CT 06854 (203) 853-3636 TWX: 710-468-2039

MODUTEC

TAUT BAND PANEL METERS

See preceding pages for styles and descriptions

Ranges, Sizes, Prices (Request Modutec Catalog 622 for detailed information)

Note: Prices are approximately median for range groups; catalog price for any specific range may differ slightly. SIZE:	1½"	2½"	3½"	4½"	5½"	8"
DC MICROAMMETERS (Available in all series)						
Zero left — 5 ranges: 0-20µA to 0-500µA	$24.90	$23.80	$24.90	$26.50	$32.35	—
Zero center — 5 ranges: 10-0-10µA to 500-0-500µA	24.65	23.50	24.65	26.30	31.30	—
Logarithmic, zero left — 4 ranges: 0-100µA to 0-1000µA	—	—	36.60	38.35	46.45	$63.05
Logarithmic, suppressed zero — 4 ranges: 10-100µA to 100-1000µA	—	—	40.15	42.05	50.95	69.85
DC MILLIAMMETERS (Available in all series)						
Zero left — 15 ranges: 0-1mA to 0-750mA	22.10	21.00	22.10	23.40	27.90	35.20
Zero center — 8 ranges: 1-0-1mA to 500-0-500mA	22.60	21.60	22.60	23.90	28.55	36.25
DC AMMETERS (Available in all series)						
Zero left — 22 ranges: 0-1A to 0-2000A	21.10	20.20	21.10	22.50	26.90	33.70
Zero center — 13 ranges: 1-0-1A to 500-0-500A	22.15	21.25	22.15	23.60	28.20	35.70
DC MILLIVOLTMETERS (Available in all series)						
Zero left — 2 ranges: 0-50mV and 0-100mV	21.10	20.20	21.10	22.50	26.90	33.70
Zero center — 2 ranges: 50-0-50mV and 100-0-100mV	21.65	20.80	21.65	23.10	27.60	34.80
DC VOLTMETERS (Available in all series)						
Zero left — 23 ranges: 0-1V to 0-1000V	21.10	20.20	21.10	22.50	26.90	33.70
Zero center — 10 ranges: 5-0-5V to 600-0-600V	21.65	20.80	21.65	23.05	27.55	34.75
Expanded scale, volts — 8 ranges: 5V to 300V±10%, ±.05% acc.	—	72.95	76.55	80.20	83.75	—
Exp. scale, % deviation — 3 ranges: 12,28,120V±10%, ±.05% acc.	—	72.95	76.55	80.20	83.75	—
AC MILLIAMMETERS (Available in all series)						
8 ranges: 0-15mA to 0-500mA	29.40	27.55	29.40	32.35	37.00	—
AC AMMETERS (Available in all series)						
24 ranges: 0-1A to 0-2000A	29.40	27.55	29.40	32.35	37.00	48.90
AC VOLTMETERS (Available in all series)						
11 ranges: 0-3V to 0-600V	27.35	26.10	27.35	28.90	35.00	45.85
Expanded scale, volts: 105-125V or 210-250V at ±0.5% acc.	—	76.50	80.20	83.75	83.75	—
Expanded scale, volts: 95-135V or 190-270V at ±1.0% acc.	—	76.50	80.20	83.75	83.75	—
NULL METERS (Available in all series)						
35Ω, 640Ω, or 2550Ω resistance	29.75	28.90	29.75	—	—	—
ELAPSED TIME METERS (Series S, C, BA, W)						
AC, non-resettable; 0-99,999.9 mins. or hrs.	—	35.40	32.20	—	—	—
AC, front-resettable; 0-99,999.9 mins. or hrs.	—	—	46.20	—	—	—
DC, non-resettable; 0-9,999.9 hrs.; 4-10, 10-20, 104-120VDC	—	—	47.40	—	—	—
RF AMMETERS (Series S, C, BA, W)						
6 ranges: 0-1A to 0-10A	—	—	28.75	32.70	38.95	—
FREQUENCY METERS (Series S, C, BA, W)						
7 ranges: 47-53Hz to 380-420Hz	—	—	45.60	—	—	—
VU METERS (Available in all series)						
Per USA Std. C-16.5-1954	29.75	28.55	29.75	30.80	—	—
VU type DC Microammeters	22.25	21.70	22.25	23.65	—	—
S, C, and W Series — Prices are listed above.						
BA Series — Add to the prices listed above:	2.65	2.65	2.65	2.80	3.00	4.20
K Series — Add to the prices listed above: (plus bezel mount adder if desired)	7.90	7.26	7.90	9.25	10.55	—
R Series — Add to the prices listed above:	—	—	3.60	4.20	4.80	8.40
L & V Series — Add to the prices listed above: (plus bezel mount adder if desired)	—	—	2.40	3.00	3.00	3.60

DISCOUNT SCHEDULE: 1-9 NET; 10-24 15%; 25-49 35%; 50-99 45% on total order for one shipment.

PANEL METERS

OPTIONS - MODIFICATIONS - UNCASED MOVEMENTS

MOVING MAGNET METERS See following pages

OPTIONS — TAUT BAND METERS

A number of desirable options are available for immediate incorporation at modest additional cost. These are simply listed here but are described fully in Catalog 622.

*Improved Accuracy — Tracking & Full Scale ($4-$11)
*Colored Covers & Bezels ($1)
Blank Dials ($0.75; 8″ — $1.25)
Customer Specified Resistance ($2 plus set-up)
Fast Response ($1 plus set-up)
*Custom Pointers ($1-$1.50)
High Temperature Case & Cover ($2.25)
Dead Set Pointer ($5; 8″ — $7.50)
Illumination ($3.75 w/o lamps)
Hand Lettered Custom Dials ($7.50-$15)
Mirror Scale ($1)
Heavy Damping ($1)
*Single Point Calibration ($2.25)
Smoke-Grey Covers ($2; 8″ — $3)
Improved Terminal Resistance Tolerance ($1)
Sealed Case ($2.75)
Temperature Compensation ($4)
*Unit Meter Packaging ($1)
High Resistance Voltmeters ($3)
Rear Zero Adjustment ($2.25)

OPTIONS — MOVING MAGNET METERS

(Moving magnet meters are described, with ranges and prices, on following pages). The taut band meter options listed at left and designated with (*) are also available in moving magnet meters, at similar or reduced additional cost. The following options are available only in moving magnet meters:

Cases & Covers to UL Specs ($1)
Skin Pak (for retail, etc. — $0.50)
Self Leads ($1)
No Zero Adjustment (Reduces list price $0.25)
Magnetic Shielding ($1)
Thru-Vue Transparent Back & Scale ($1)
Tinted Covers ($1.50)
Heavy Duty Terminals ($1)

MODIFICATIONS

Certain modifications of catalog meters, the specifications of which are usually detailed by the customer, can be accomplished quickly at a nominal added charge. These, typically, might be:

Custom colors;
Special hot-stamp marking;
Custom dials;
Special cases and covers;
Zero right movements, etc. Consult factory for your requirements.

METER MECHANISMS

Modutec supplies many high-volume users with meter movements, either dial mounted or without dials. Both the Modutec Taut Band Movement and the Modutec Moving Magnet Movement are ideal for many user-installed applications. Custom units can be built — within technical limitations — to the user's specifications for performance, size, and shape, assuming sufficient volume to support tooling and set-up efforts. Inquire.

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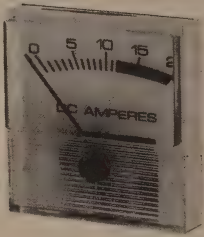
MODUTEC

MOVING MAGNET PANEL METERS & INDICATORS

1″, 1½″, 2½″, 3½″ and Edge-Reading (1.8″) sizes

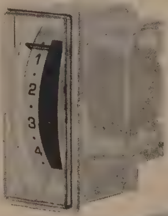
M SERIES

Modutec M Series meters and indicators have been specifically designed to meet the needs of large-volume users for accurate, well-made meters that are low in cost yet highly styled, assets to the equipment in which they are installed. They are available in five sizes, several styles, and in a wide selection of types and ranges.



Surface Mount Designated MS Style (black cover) or MC Style (clear cover) these are similar in appearance to the Taut Band Surface Mount meters shown four pages back. A new 1″ size, shown at right, is available in the MS and MC styles.

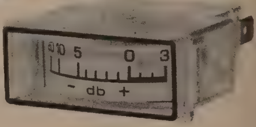
Bezel Mount The graceful bezel is easily installed and protects the meter in addition to looking well. The appearance is as shown four pages back, and the same variations, designated MB1, MB2, MB3, and MB4, are available. Cost of the bezel mount is $2.65 added to the prices listed on the next page.



Windo-Mount This easily installed flush-mounting meter is designated MW Style, and looks the same as the W Series, four pages back; the same edge options are available at a unit added charge of $0.50.

Edge Reading The ME Style meters may be used horizontally or vertically (specify when ordering), flush mounted or surface mounted. They make the most of panel and chassis room, and are available in one size only.

Options for M Series meters are listed on the preceding page.



FEATURES

- Available in microampere sensitivities previously restricted to moving-coil-construction meters.
- Molded front covers, available in clear or painted styles, molded plastic case.
- Plastic materials to meet UL requirements available as option.
- All styles except edge reading have scales printed on translucent rear wall of case, which facilitates back-lighting.
- Solder lug terminals are standard. Push-on tab terminals are available as an option.
- Quick-mount hardware available on all styles.
- Accuracy 5% full scale (3% available as an option).

SEE PRECEDING PAGES FOR MODUTEC TAUT BAND PANEL METERS — THE UTMOST IN QUALITY, PERFORMANCE, AND APPEARANCE

MODUTEC
MOVING MAGNET PANEL METERS & INDICATORS

M SERIES — Ranges, Sizes, Prices (Request Catalog MM115 for detailed information)

Note: Prices are approximately median; catalog prices for specific ranges may differ slightly. SIZE:	1″	1½″	2½″	3½″	Edge Reading (1.8″)
DC MICROAMMETERS & LEVEL (BALANCE) INDICATORS					
Standard Sensitivity					
Zero Left — 3 ranges: 0-200μA to 0-500μA	$5.05	$5.35	$5.75	$6.05	$4.90
Zero Center — 3 ranges: 100-0-100μA to 500-0-500μA	4.90	5.20	5.60	5.95	4.75
High Sensitivity					
Zero Left — 4 ranges: 0-200μA to 0-1000μA	6.65	6.85	7.20	7.50	6.00
Zero Center — 3 ranges: 100-0-100μA to 500-0-500μA	6.75	6.95	7.30	7.65	6.10
DC MILLIAMMETERS					
Zero Left — 14 ranges: 0-1mA to 0-500mA	4.05	4.35	4.70	5.10	3.60
Zero Center — 8 ranges: 1-0-1mA to 500-0-500mA	4.15	4.45	4.85	5.30	3.80
DC AMMETERS (Battery & Circuit Condition Indicators)					
Zero Left — 9 ranges: 0-1A to 0-30A Ammeters with ext. shunts can be supplied to 125A	3.85	4.15	4.60	5.00	3.60
Zero Center — 6 ranges: 1-0-1A to 25-0-25A	4.00	4.35	4.55	5.15	3.75
DC MILLIVOLTMETERS					
Zero Left — 0-50mV, 0-100mV	4.30	4.60	5.00	5.40	3.80
Zero Center — 50-0-50mV, 100-0-100mV	4.40	4.65	5.10	5.50	3.85
DC VOLTMETERS (Battery & Circuit Condition Indicators)					
Standard Sensitivity					
Zero Left — 20 ranges: 0-1V to 0-500V (Multiplier resistor furnished externally above 15V)	4.25	4.55	4.95	5.50	3.85
Zero Center — 9 ranges: 5-0-5V to 500-0-500V	4.40	4.70	5.15	5.70	4.00
High Sensitivity					
Zero Left — 19 ranges: 0-1V to 0-500V	4.55	4.85	5.30	5.85	4.15
Zero Center — 9 ranges: 5-0-5V to 500-0-500V	4.70	5.00	5.45	6.00	4.30
AC MILLIAMMETERS					
Zero Left — 6 ranges: 0-10mA to 0-500mA	4.25	4.60	4.95	5.50	3.85
AC AMMETERS — AVAILABLE ON SPECIAL ORDER					
AC VOLTMETERS					
(Multiplier resistor furnished externally above 15V) Zero Left — 8 ranges: 0-5V to 0-300V	4.45	4.75	5.25	5.60	4.05
VU METERS Supplied with either recording or broadcasting type scales, printed in black and red on white background. Designed to read zero VU (100%) with 1.23V applied to meter with the circuit supplied. DC Type are the same indicators, but the resistor/rectifier package is not supplied.					
AC TYPE — supplied with resistor/rectifier package					
Standard Sensitivity (1 mA basic)	6.30	6.65	7.05	7.50	5.95
High Sensitivity (200μA basic)	8.25	8.60	9.00	9.45	7.95
DC TYPE — resistor/rectifier package not supplied					
Standard Sensitivity (1 mA basic — 300 ohms)	5.80	5.15	5.55	6.00	4.50
High Sensitivity (200μA basic — 1140 ohms)	6.70	7.05	7.45	7.90	6.35

Bezel Mount — Available only on 1½″, 2½″, 3½″ meters; added unit cost $2.65, before discount.
Surface Mount and Windo Mount styles with clear cover — deduct $0.30 from unit prices, before discount.

DISCOUNT SCHEDULE (per type): 1-9 list; 10-24 10%; 25-99 20%; 100-249 30%; 250-499 40%; 500+ inquire.

MODUTEC, INC. 18 Marshall St., Norwalk, CT 06854 (203) 853-3636 TWX: 710-468-2039

Why you should consider a Digital Oscilloscope like the Nicolet EXPLORER T.M.

How the Digital Oscilloscope Works:

A DIGITAL OSCILLOSCOPE uses an analog-to-digital converter (ADC) to digitize the input signal and store it in a solid-state memory. The stored signal is then reconstructed through digital-to-analog conversion on the cathode ray tube (CRT). Since the signal is stored in a memory rather than on a special CRT, it can be displayed, expanded for closer inspection, and compared with other live or stored signals without concern for fading or repeating the signal. Points of interest may be selected by moveable electronic cursor for alphanumeric display of actual time and voltage values right on the same CRT.
Stored data may be outputted in digital form to a magnetic tape recorder or programmable calculator or in analog form to an X-Y recorder.

How the Digital Oscilloscope is Similar to the Analog 'Scope:

It has the characteristics of an analog oscilloscope with choice of plug-ins, input amplifier/attenuators, filters, choice of ± internal or external trigger, choice of sweep speeds, and built-in CRT display.

Why the Digital Oscilloscope is Better:

The DIGITAL OSCILLOSCOPE is superior to the analog oscilloscope in all these ways:

POWER TO MEASURE ACCURATELY: Horizontal resolution is 1 part in 4096 (4096-word by 12-bit memory). Vertical resolution, depending on plug-in used, is 1 part in 256 (8-bit resolution) or 1 part in 4096 (12-bit resolution).

ABILITY TO STORE AND COMPARE WAVEFORMS: Signals may be measured and stored in the DIGITAL OSCILLOSCOPE'S solid-state memory; signal fading is not a problem. Stored signals may then be displayed singly or superimposed on stored or live signals for comparison.

KEEP A LIBRARY OF RECORDS WITH NO LOSS OF RESOLUTION: The digital magnetic tape accessory allows you to keep a large number of records any of which can be found by tag word and read back into the EXPLORER later.

ANALYZE DATA VIA INTERFACE WITH H-P 9800 SERIES PROGRAMMABLE CALCULATORS: The NIC-191 Calculator Interface accessory plugs in for bidirectional versatility. Some DIGITAL OSCILLOSCOPE users have interfaced their instruments to minicomputers.

USE IT AS A VERY SPECIAL X-Y OR Y-T "RECORDER": The EXPLORER is extremely useful as a high speed, high resolution X-Y or Y-T "Recorder." Analog output is provided for hard copy records when desired.

PUSHBUTTON STORAGE CONTROL: Press a pushbutton to "freeze" a signal. Press another pushbutton to return to "live" measurement.

TAKE A CLOSER LOOK: Both the X and Y axes may be expanded, in steps of 2, up to a factor of 64 times so that waveform details may be closely examined. The expanded waveform can be automatically centered vertically on the CRT to save operator time and make expansion easier.

EASY CHOICE OF Y-T or X-Y DISPLAY: Two signals from one event may be displayed as functions of time, or of each other, at the flip of a switch.

READ ACTUAL VOLTAGE RECORDED, AND TIME FROM TRIGGER, AT ANY POINT ON A WAVEFORM: A moveable electronic cursor permits the selection of any point of interest on a waveform for display of that point's actual voltage and time values. No mental calculations are required.

FAST OR VERY SLOW MEASUREMENTS: With sweep speeds ranging from 100 nanoseconds to 200 seconds per point, sweeps of as little as 102.4 microseconds to as long as 9.48 days may be selected.

And, with all these extras, the DIGITAL OSCILLOSCOPE is *easier to use* than any analog 'scope. The DIGITAL OSCILLOSCOPE is now in use in hundreds of laboratories where it is revolutionizing measurements in the frequency range of DC to 5 Megahertz. (New plug-ins are being developed to add to the versatility of the EXPLORER DIGITAL OSCILLOSCOPE. Contact Nicolet for specifications and availability.)

Specifications:

MAINFRAME SPECIFICATIONS

Memory
4096 12-bit words.
All 4096 words can be used, or two 2048-word parts, or four 1024-word parts for record, display or readout modes.

Display Expansion
Separate controls for horizontal and vertical axes for expansion by factors of X2, X4, X8, X16, X32, X64.

Point Selection
Horizontal and vertical crosshairs are controlled separately to target the point around which expansion will take place.

Data Add/Subtract
Constants may be added or subtracted from Y values.

Autocenter
Vertically centers the expanded display.

Display
Switch-selectable choice of X-Y or Y-T.

Digital I/O
Binary out on rear panel, TTL-compatible. Accessories for interfacing and magnetic tape read-in and read-out.

Pen Recorder Output
X and Y axes 0-4.5 volts nominal. Variable read-out speeds.

Size
20.5'' length, 10.25'' width, 12.25'' height (standard model) or 20.7'' length, 19'' width, 7'' height (rack-mount model) 8 cm x 10 cm CRT

Weight
42 pounds including typical plug-in unit

Power
115 Volts ±10%, or 230 volts ±10%, 85 watts.
48 to 66 Hz. Specify voltage when ordering.

MODEL 93A PLUG-IN SPECIFICATIONS

Two Input Channels: Amplifier modules may be mixed or matched.

Single Ended Amplifier/Attenuator (Model C)
Input Ranges: ± 1, ± 2, ± 4, ± 10, ± 20, ± 40, ± 100, ± 200, ± 400 Volts full scale. Impedance 1 megohm, approximately 47 pf.
D.C. Offset: nominally 90% of range setting, ten-turn pot control.
Maximum Input Signal: 100X range setting, or ± 400 volts, whichever is least.

Differential Amplifier/Attenuator (Model D)
Differential Input Signal Ranges:
±100 mV to ±40 volts full scale in 9 steps in a 1, 2,4 sequence.
Maximum Common Mode Input Signal Ranges:
±8 volts on ±100, ±200, ±400 mV ranges.
±80 volts on ±1, ±2, ±4 volt ranges.
±400 volts on ±10, ±20, ±40 volt ranges.
Maximum Safe Input Signal: 300X range setting, or ± 400 volts, whichever is least.
D.C. Offset: At least 100% of range setting, ten-turn pot control.
Frequency Response (to -3 db point): DC to at least 5 MHz. Selectable upper -3 db points @ nominally 0.5 MHz and 1 kHz.
Input impedance: 1 megohm, approximately 47 pf.
Common Mode Rejection Ratio:

Ratio	Frequency	Amplifier Setting
>10,000:1	DC to 1 kHz	±100 mV, ±1 V, ±10V
> 4,000:1	to 10 kHz	
> 5,000:1	DC to 1 kHz	±200 mV, ±2 V, ±20V
> 1,000:1	to 10 kHz	
> 2,500:1	DC to 1 kHz	±400 mV, ±4V, ±40V
> 500:1	to 10 kHz	

Ratio decreases by less than 20 db per decade above 10 kHz
Overload Recovery Time:
(Time required to recover to within approximately 1% of correct voltage after removal of a test signal applied for one second. Signal source resistance 10K ohms)
Signal amplitude 200% of range setting; approximately 2 μS
Signal amplitude 100 times range setting; approximately 20 MS

Analog-to-Digital Converter: 12 bits, monotonic
Measurement Accuracy: (At normal room temperature range).
Voltage:
1. Scale calibration: 0.25% of range. Front panel adjustable.
2. Other errors: nonlinearity, misadjustment and noise, less than 0.05%.
3. Drift ± 0.25% per 5°F after warm up.
4. Sample-and-Hold Aperture time variation: Nominally 5 nanoseconds for single signal.
5. Signal Channel Crosstalk 0.05% or less.

Time:
1. Calibration: ±0.02%
2. Drift: ±0.01% per year.

Trigger Signal:
Range: ± 0.25 to ± 5V, a.c. or d.c. coupled.
Maximum allowable: 25V
Trigger occurs on transition through an adjustable threshold level.
External trigger input impedance is nominally 1 megohm.
Sweep Trigger Insensitive Times: At slow sweep speeds (10 μsec per point or slower) there is essentially no ''dead'' time between sweeps. At faster sweep speeds, a dead time of from 5 to 50 milliseconds exists depending upon the number of points used per sweep and the number of points displayed on the CRT. During this time, following acceptance of a signal into memory, the instrument is insensitive to incoming sweep trigger pulses.
Sweep Time Per Point: Ranges of 0.5, 1, 2 times 1, 10, or 100 microseconds, milliseconds, or seconds, one or two channels, simultaneously.
Push Button Controls:
Manual Trigger: Simulates electrical trigger signal.
Hold Last: Stores the information which followed the last trigger.
Hold Next: Stores the information which will follow the next trigger.
Live: Accepts the next valid trigger and records new information presented to the input.
Retain Reference: Displays stored information while also viewing ''live'' signals.
Remote Control: Hold and live commands +5 volts normal level, 0 to 0.5 volts, or switch closure to initiate action.
Filter: Low pass; nominally -3db at specified cut-off, 0.5 MHz or 1 kHz.

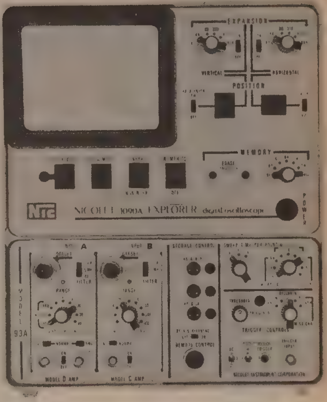
MODEL 94A PLUG-IN SPECIFICATIONS

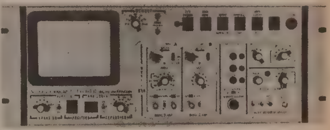
One Input Channel: Accepts either Model C or D amplifier module. (Module C and D Amplifier specifications same as Model 93A Plug-In)
Analog-to-Digital Converter: 8 bits, monotonic
Sweep Time Per Point: Ranges to 1, 2, 5 times 100 nanoseconds; 1, 10, or 100 microseconds; 1, 10, or 100 milliseconds; 1 or 10 seconds.
Sample-and-hold circuit aperture time: 3 ns.
Accuracy: ±0.4% of full-scale voltage.
Bandwidth: 5 MHz (3db)
(Other specifications same as for Model 93A Plug-In)
Specifications subject to change without notice.

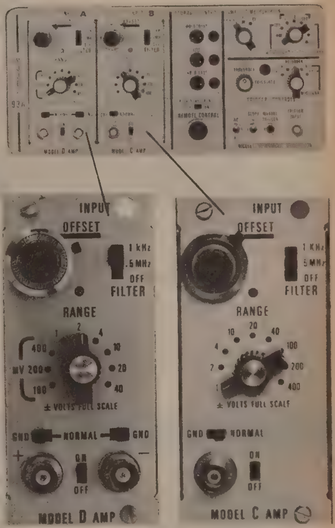
For full details, including technical brochures and applications notes, or to discuss your possible application of the EXPLORER DIGITAL OSCILLOSCOPE, please call Product Manager Bruce Hervey at Nicolet.

NIC NICOLET INSTRUMENT CORPORATION

5225 Verona Road
Madison, Wisconsin 53711
Telephone: 608/271-3333







In Europe: NICOLET INSTRUMENT GmbH, Goerdeler Strasse 48, D-605 Offenbach am Main, West Germany, 0611/852028,
Telex: 841/4185411.

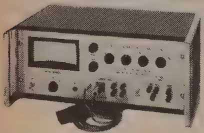
OSI EQUIPMENT FOR CURRENT AND POWER MEASUREMENT

MULTIRANGE A.C. WATTMETER

Model WM1000 wattmeter measures real power consumed by small motors, electronic test equipment and other electrical loads.

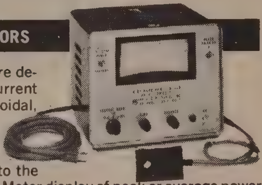
Selectable full scale ranges are 50, 100, 500 and 1000 watts with an accuracy of ±3%.

WIDEBAND WATTMETER



PM-4004 Wideband Pulse Power Monitors provide the unique ability to measure power in solid state switching circuits. The d.c. response and 30 nanosecond risetime insures accurate determination of instantaneous power waveform. Power input, power output, or power dissipated in solid-state devices may be readily determined. Built-in meters provide average or peak power reading. Instantaneous power, current, or voltage may be observed by connecting an oscilloscope to "monitor output" jack.

WIDEBAND POWER MONITORS

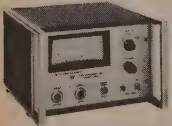


PM-6010 Series Power Monitors are designed to provide power or current measurements where d.c., sinusoidal, non-sinusoidal or pulse power is delivered to a load. Currents up to 1000 Amperes can be handled with negligible circuit interaction due to the use of circuit isolated transducers. Meter display of peak or average power is provided. 0 to 1 volt output proportional to instantaneous power or current is available for oscilloscope monitoring of detailed waveforms with risetimes less than 1 microsecond in the d.c. to Megahertz frequency range.

WIDEBAND d.c. to Megahertz CURRENT MEASURING EQUIPMENT

CM Series current measuring units provide an output signal proportional to instantaneous current flowing through the transducer window. The d.c to Megahertz response and ability to faithfully reproduce 1 micro-second transients provide an ideal way to monitor critical circuits without electrical connection and with minimum interaction caused by measurement. The panel meter provides a display of direct current while the +1 to −1 volt output can be used for monitoring or control purposes with current flow in either direction.

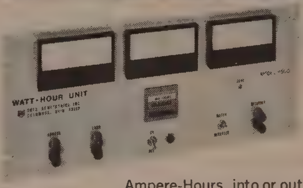
AUDIO WATTMETER



MODEL PM1215

The Model PM1215 Audio Wattmeter measures DC to 30 kHz power delivered to resistive or reactive loads. Full scale ranges of 400, 800, and 1600 watts are provided corresponding to voltage inputs of 25, 50, and 100V RMS. A front panel meter displays average power. A 0 to 1V output is provided for oscilloscope observation of the instantaneous power wave shape.

WATT-HOUR AND AMP-HOUR METERS

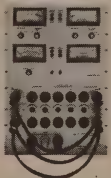


Registration of total energy consumption of motors, processes and equipment in a.c. or d.c. circuits is available on resettable counters. Other units provide a registration of charge flow, or Ampere-Hours, into or out of battery systems. Multiple measurement panels are available which provide display and electrical outputs related to instantaneous current, voltage and power in addition to energy registration.

CLAMP-ON CURRENT TRANSDUCER

Model CM-56F Current Transducer provides measurement of current without interrupting circuit. Accuracy of better than 0.50%, measurements to 50 Amperes and d.c. to Kilohertz response are featured. An electrical output providing an analog 0.1 Volt/Ampere signal is available for use in control systems, computer interfacing or recording.

POWER TEST PANELS



MODEL PTP-100

Current
Voltage
Power
VARS

Power Factor
Frequency
Watt-hour
Amp-hour

MODEL WM-2C5C

Power test panels are available for DC and AC (2, 3, or 4 wire) system loads. Voltage ranges from 50 to 500 volts and current ranges from 10 to 10,000 Amperes may be specified. Isolated electrical outputs are provided to drive recorders or remote indicators. Packaging methods include 19" rack panel, standard instrument housings and NEMA type enclosures. Available options: Digital meters, BCD outputs, true RMS outputs, set-point switched outputs and data storage for computer interfacing.

MILITARY EQUIPMENT

MODEL AH-10

NUCLEAR POWER PLANTS
SHIPBOARD • AVIONICS • SPACECRAFT

OSI has an established reputation for building rugged, highly reliable measurement systems to meet government and military specifications. Systems include current, power, amp-hour, watt-hour, etc.

OSI

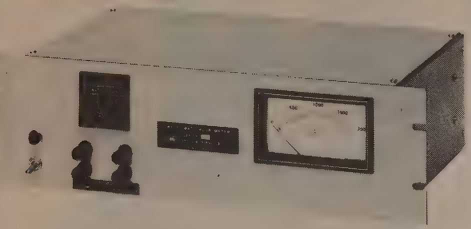
OHIO SEMITRONICS, INC.

1205 CHESAPEAKE AVENUE • COLUMBUS, OHIO 43212 • PHONE: 614/486-9561

PIONEER IN SOLID STATE TECHNOLOGY FOR ENERGY CONVERSION AND POWER MONITORING

OSI EQUIPMENT FOR CURRENT AND POWER MEASUREMENT

A.C. WATT-HOUR METERS



SINGLE PHASE 60 Hz MODELS

MODEL NUMBER WH3-	INPUT VOLTS	INPUT CURRENT AMPERES	METER FULL SCALE WATTS	W-H PER COUNT
1	120	5	600	.1
2	240	5	1.2K	1
3	480	5	2.5K	1
10	120	10	1.2K	1
11	240	10	2.5K	1
12	480	10	5. K	1
19	120	15	2. K	1
20	240	15	4K	1
21	480	15	8K	1
28	120	50	6K	1
29	240	50	12K	10
30	480	50	25K	10
31	120	100	12K	10
32	240	100	25K	10
33	480	100	50K	10
34	120	200	25K	10
35	240	200	50K	10
36	480	200	100K	10
37	120	400	50K	10
38	240	400	100K	10
39	480	400	200K	100
40	120	600	80K	10
41	240	600	150K	100
42	480	600	300K	100
43	120	1000	120K	100
44	240	1000	250K	100
45	480	1000	500K	100
46	120	2000	250K	100
47	240	2000	500K	100
48	480	2000	1M	100
49	120	50	6K	1
50	240	50	12K	10
51	480	50	25K	10
58	120	100	12K	10
59	240	100	25K	10
60	480	100	50K	10
67	120	200	25K	10
68	240	200	50K	10
69	480	200	100K	10
76	120	400	50K	10
77	240	400	100K	10
78	480	400	200K	100
85	120	600	80K	10
86	240	600	150K	100
87	480	600	300K	100
94	120	1000	120K	100
95	240	1000	250K	100
96	480	1000	500K	100

DESCRIPTION

The O.S.I. WH Series AC Watt-Hour Meters provide a convenient and highly accurate way to characterize, monitor and control critical manufacturing processes where product quality and cost are related to electrical energy input.

These solid-state units utilize Hall-effect watt-transducers and are especially suitable for watt-hour totalization, power monitoring and observation of power waveforms in applications where SCR chopped, or other non-sinusoidal waveforms are involved. The power wave shape applied to the load may be sinusoidal with wide power-factor variations, zero-crossing controlled sinusoidal, phase controlled SCR, or other waveforms derived from a 60 Hertz input.

In addition to the display of totalized watt-hours since last reset, the units provide a panel meter indication of average power in watts.

These units should be invaluable in processes where monitoring can lead to increased yields of quality products. They should lead to elimination of much costly down-time through the early detection of process variations which, if not corrected, could lead to breakdown.

SPECIFICATIONS

INPUT

Overload (Continuous):
Voltage, 1.25 X Rating
Current, 2 X Rating (5, 10 and 15 A Models)
10 X Rating (50 A thru 2000 A Models)

Burden (At Max Rated Input)
Voltage: 1.25 VA
Current: 1.25 VA

Power Factor Range: 0.5 Lead to 0.5 Lag

Frequency Range: 50 to 70 Hz

Instrument Power: 115 VAC 60 Hz 5 VA

OUTPUT

Response: 400 MS

Temperature Effect: (−15°C to +35°C) ±0.5% F.S.
(−10°C to +60°C) ±1% F.S.

Wattmeter: 4½″

Watthour Counter: 5 Digit (Push Button Reset)

Electrical Output: 8 V at Calibration Point

Pulse Output: 4 V for External Electronic Counter

Accuracy: (Linearity, setpoint, P.F.)
Meter: ±1.5% F.S. (WH3-1 to WH3-42)
±2.0% F.S. (WH3-43 to WH3-102)
W-H Counter: ±0.5% F.S. (WH3-1 to WH3-42)
±1.0% F.S. (WH3-43 to WH3-102)

Electrical Output: (Watts and W-H)
±0.5% F.S. (WH3-1 to WH3-42)
±1.0% F.S. (WH3-43 to WH3-102)

Zero Drift: ±0.1% F.S. of rated W-H per hour

Instrument Size: 19″ x 5¼″ x 11″ WHD

External Transducer Size: See Tables

WRITE FOR ADDITIONAL LITERATURE DESCRIBING 3ϕ 3 WIRE, 3ϕ 4 WIRE AND D.C. WATT-HOUR MODELS

OSI

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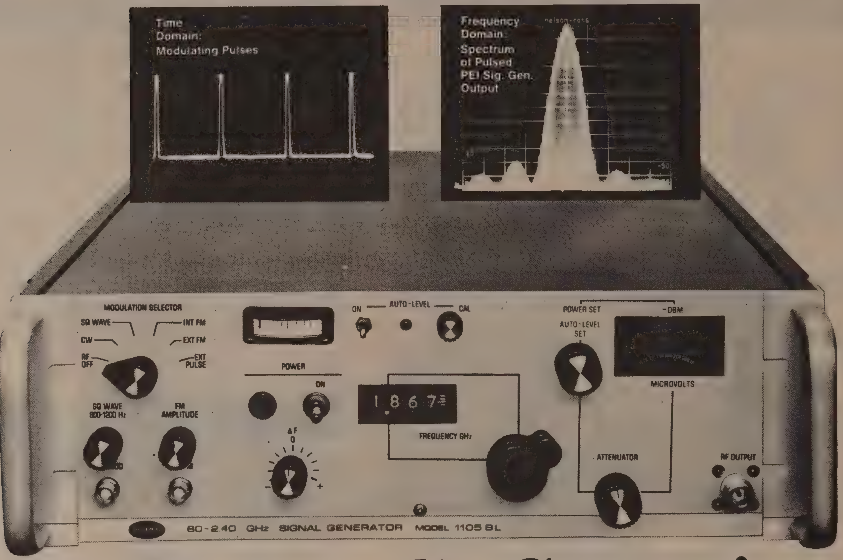
Get the Picture!

Clean, Fast Pulse Modulation. No CW Leakage.


Time Domain: Modulating Pulses
Frequency Domain: Spectrum of Pulsed PEI Sig. Gen. Output
MODULATION SELECTOR
SQ WAVE
CW
RF OFF
INT FM
EXT FM
EXT PULSE
SQ WAVE 800-1200 Hz
FM AMPLITUDE
ON
AUTO-LEVEL
CAL
POWER
ON
ΔF
1.867
FREQUENCY GHz
POWER SET
-DBM
AUTO-LEVEL SET
MICROVOLTS
ATTENUATOR
RF OUTPUT
80-2.40 GHz SIGNAL GENERATOR MODEL 1105 BL

It's Polarad's Superior Signal Generator 800 MHz to 21 GHz

But that's only part of the picture...

- **Digital Frequency Readout**
- **Stable, accurately calibrated, spectrally pure signals**
- **>130 dB calibrated attenuation dynamic range**
- **Auto-leveled outputs available to 4.6 GHz**
- **CW, FM, square wave and pulse modulation**
- **30 mw - 100 mw Signal Sources (to 11 GHz)**
- **Compact Rack/Stack modules**
- **Exceptional reliability backed by PEI's pace setting "NO EXCEPTION" warranty**
- **Lowest purchase and life cycle cost**

For the whole picture, call or write for more information, or circle the RSN for the current PEI Microwave Catalog.

Microwave Instrumentation
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polarad electronic instruments

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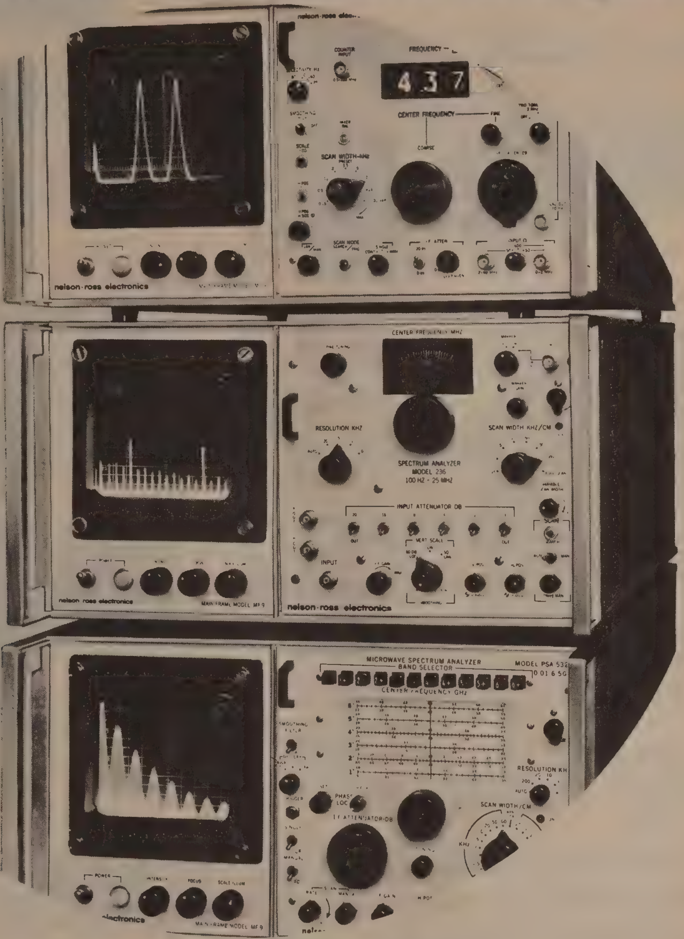
Value Packed Spectrum Analyzers


nelson·ross electronics
FREQUENCY
437
CENTER FREQUENCY
SCAN WIDTH-KHz
nelson·ross electronics
CENTER FREQUENCY MHZ
RESOLUTION KHZ
SCAN WIDTH KHZ/CM
SPECTRUM ANALYZER
MODEL 236
100 HZ - 25 MHZ
INPUT ATTENUATOR DB
INPUT
nelson·ross electronics
nelson ross electronics
MAIN FRAME MODEL MF9
MICROWAVE SPECTRUM ANALYZER
BAND SELECTOR
MODEL PSA 53
CENTER FREQUENCY GHZ
RESOLUTION KH
SCAN WIDTH/CM
IF ATTENUATOR-DB
POWER
INTENSITY
FOCUS
MAIN FRAME MODEL MF9

Communications
10Hz - 43MHz
(or 400MHz)

Broadband
100Hz - 25MHz

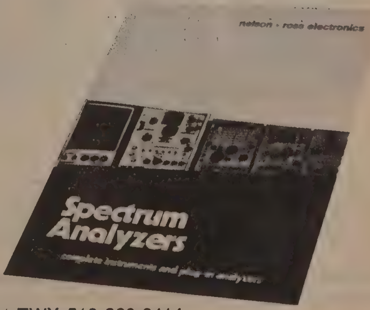
Microwave
10MHz - 6.5GHz

Sub-Audio thru Microwave; 0.5Hz to 6.5GHz
Self-Contained Analyzers or Plug-Ins for hp & Tek Scopes

Nelson Ross, the "SPECIALIST" in Spectrum Analyzers,offers you the most comprehensive selection of reliable, easy-to-use instruments — and backed by 15 years of spectrum analysis leadership.

Select from more than 30 models: Sub-Audio, Audio, Ultrasonic, Broadband, Telemetry, RF/SSB, RF/UHF, TV, Microwave . . . all at lowest cost.

Ask for your new NR SPECTRUM ANALYZER CATALOG with specifications and prices. Chances are that we have the right Spectrum Analyzer for you.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complete instruments and plug-in analyzers

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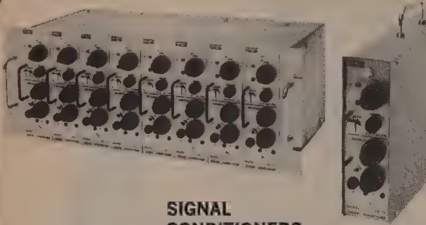
PPM, INC.

A subsidiary of TORO



SIGNAL CONDITIONERS

THE SG-11 IS A PLUG-IN MODULE with power supply, balance calibration and monitoring circuits. The power supply circuit offers high temperature and time stability, providing line and load regulation of 0.01%; excitation voltage is adjustable from 0 to 16 volts at 0 to 150 mA. Featured is a self-restoring current limit circuit. All units may be wired for constant-current operation.

THE SG-11 has very high isolation to line—under 0.03 pF coupling capacitance from power line to DC output—SG-11 performance approximates battery operation.

All controls are 10 turn potentiometers of very high resolution. Calibration is bipolar single shunt.

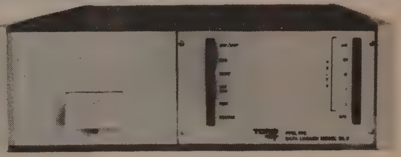
Two types of enclosures are available: A 19" relay rack that permits the mounting of eight units side-by-side and a portable enclosure accepting a single plug-in unit. A plug-in power supply is also available.

MODEL SG-11 PLUG-IN UNIT (eight shown in rack)	**$187.50**
PORTABLE ENCLOSURE (MODEL SG-11-P as shown)	**$ 39.50**
RELAY-RACK MOUNTING ENCLOSURE (MODEL SG-11-R as shown) with solder terminals only	**$129.00**
RELAY-RACK MOUNTING ENCLOSURE (MODEL SG-11-RC as shown) with MS connectors (mating connectors included)	**$395.00**

THE MODEL SG-16 series (not illustrated) provides lowest-cost strain-gage conditioning. A 20 channel system with common power supply occupies only 5¼ inches of vertical panel space at a total cost of $75 per channel. Amplifier options range from $10 per channel for 10ma galvo drive amplifiers to $100 per channel for low-drift differential amplifiers. Write for Bulletin SG-16.

THERMOCOUPLE MONITOR

THE TM 100A SCANS UP TO 100 THERMOCOUPLES, displaying temperature in digital form. A high-low limit circuit compares temperature with preset thumbwheel switches; a lamp matrix displays all out-of-limit channels. Interface provides for auxiliary printout or computer entry of data.

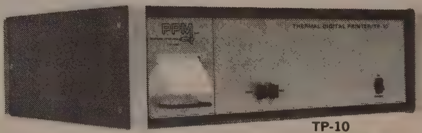


DATA LOGGER

THE MODEL DL-2 IS A COMPLETE DATA ACQUISITION SYSTEM in a compact, portable package. It scans up to 100 differential signals, digitizes them and a thermal printer records their values. Options include floating decimals, internal digital clock, conditioning for thermocouple or strain-gage transducers and punched paper or magnetic tape recording.

Input signals include DC voltage, resistance and frequency. Write for Bulletin DL-2.

Data Logger with 10 Channels	**$2320.00**
Data Logger with 100 Channels	**$3220.00**



TP-10

SILENT THERMAL DIGITAL PRINTER

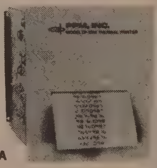
Model TP-10 is a quiet, moderately priced, reliable instrumentation printer with only one moving part. It prints up to 14 columns at 5 lines/second from BCD input signals.

Prints on standard thermal actuated paper . . . excellent legibility.

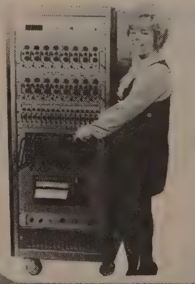
Model TP-10A is a plug-in printer module for OEM applications. All electronics except the power supply are included.

Options for TP-10 include a digital clock card, for recording the time of an event's occurrence, and a digital voltmeter card.

Write or call for prices and Bulletin TP-10.



TP-10A



PPM SYSTEMS

PPM OFFERS CUSTOM SYSTEMS AND SYSTEMS COMPONENTS for data acquisition, process and speed control. PPM Data Acquisition Systems will accept as many as 1000 individual signals; these signals are scanned, digitized and recorded in printed form or on punched or magnetic tape. Alarm outputs are available for signals falling outside of the preset limits. For systems applications we offer several Systems Components, such as: Printers, Scanners, and Digital Clocks.

For comprehensive information, write us or call us collect today.

Bulletin PE-2-4

Prices subject to change without notice.

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Quan-Tech
Division of SCIENTIFIC-ATLANTA, Inc.

RANDOLPH PARK WEST, ROUTE #10, RANDOLPH, N.J. 07801
TELEPHONE: (201) 361-3100 TWX: 710-987-7946

MODEL
304A
WAVE
&
SPECTRUM
ANALYZER
1 Hz to 5 KHz

A low cost, extremely stable instrument covering the frequency range from 1 Hz to 5 KHz. Three switch selectable filters provide maximally flat passbands wtih 24dB/octave skirts. Electronic tuning and automatic electronic sweep with direct readout of tuned frequency add to the versatility of this unit. Inputs of 3μv to 100V F.S. can be accommodated with a dynamic range capability of better than 70 dB. Constantly scaled outputs, proportional to amplitude and frequency, allow a simple connection to an oscilliscope or X-Y plotter for spectrum analysis. This compact, lightweight, portable instrument may be operated under battery power with an optional inverter.

MODEL
304TDL
WAVE
&
SPECTRUM
ANALYZER
1 Hz to 5 KHz

Our "Top of the Line" instrument in the 1Hz to 5KHz range features signal tracking without an external pilot or reference frequency. Five switch selectable constant bandwidth filters allow for signal analysis windows as narrow as 1Hz. The electronic tuning feature provides single and repetitive sweeps over increments as narrow as 50Hz. The unit may also be tuned by an external DC voltage. Fourteen (14) input ranges of from 30μV to 100V F.S. and a dynamic amplitude range of greater than 70dB linear (up to 90dB in the log mode) provide a wide range of rapid data display. An input overload indicator and sweep range/time/bandwidth compatibility indicator provide instantaneous indication of conditions which would lead to erroneous results.

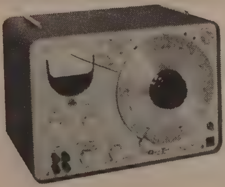
MODEL
2449
WAVE
&
SPECTRUM
ANALYZER
10 Hz to 50 KHz

A low cost precision instrument covering the audio and supersonic ranges. The analyzer features electronic tuning which may be manually or automatically scanned over all or discrete portions of the frequency range. The three constant bandwidth, flat-topped, filters of 7 ,100 and 1000 Hz are ideal for spectral density analysis of random signals. An AFC mode allows the analyzer to lock on to a drifting signal and follow it over a frequency range determined by the bandwidth. The 2449,when used with an oscilloscope or X-Y plotter, is a spectrum analyzer whose center frequency, sweep width and resolution can all be varied. Averaging time, bandwidth and sweep speed can be selected for optimum results in random signal analysis.

MODEL
306TDL
WAVE
&
SPECTRUM
ANALYZER
10 Hz to 50 KHz

A higher frequency version of our Model 304TDL covers the range of 10Hz to 50KHz making it suitable for audio and supersonic signal analysis. The Model 306TDL has all the features of its low frequency counterpart with the sweep ranges, sweep times and bandwidth filters adjusted to match the higher frequency range. A high degree of frequency stability is featured with a five digit direct display of tuned frequency to a resolution of 1Hz. A BFO output which is a sinewave at the tuned frequency and variable to 1V RMS is available as a driving signal for amplitude response testing, used in transfer function analysis and frequency response testing.

MODELS
303 & 2156
WAVE
&
SPECTRUM
ANALYZERS



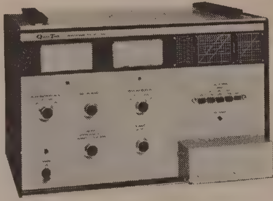
The Model 303 and Model 2156 are similar instruments covering the frequency range of 30Hz to 100KHz and 10Hz to 30KHz respectively. Basically, dual-conversion hetrodyne receivers, in which the selectivity of the second IF can be varied in four fixed steps, their broad frequency coverage makes these instruments extremely useful for harmonic measurements and complex signal analysis. These analyzers can also be used as frequency tuned or selective voltmeters. Tuning of the instruments is accomplished manually with a precisely calibrated large tuning dial with both mechanical and electrical vernier controls. Full scale input ranges are from 100μv to 300 V.

WRITE FOR FREE LITERATURE AND "WAVE & SPECTRUM ANALYZER FILE."

Quan-Tech
Division of SCIENTIFIC-ATLANTA, Inc.

RANDOLPH PARK WEST, ROUTE #10, RANDOLPH, N.J. 07801
TELEPHONE: (201) 361-3100 TWX: 710-987-7946

MODEL 315B RESISTOR NOISE TEST SET

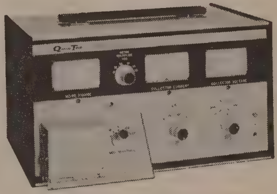


The Model 315B is the recognized and accepted standard of the electronics industry and government agencies for measuring current noise in resistors. It conforms to the recommendations of NBS and IEC and meets the requirements of Method 308, of MIL-STD-202B. It measures resistor current noise in absolute values over a resistance range from 1Ω to 25MΩ. The index of measurement is the accepted unit of microvolts of noise per volt of applied DC in a decade of frequency expressed in dB with a 1 microvolt reference.

MODEL 2500 AUTOMATIC RESISTOR NOISE TEST SET

The Model 2500 Automatic Resistor Noise Test Set is introduced to bridge the gap between the manually operated Model 315B Resistor Noise Test Set and the completely automated version called the Model 5012. The Model 2500 is designed to be operated with mechanical handling equipment, with interfacing to control both the mechanical and electrical cycles. Three bin sort information is provided to the handler. The readout of the Model 2500 is in resistor NOISE INDEX in accordance with the recommendations of the National Bureau of Standards.

MODELS 512B & 340B/1340 TRANSISTOR NOISE FIGURE TEST SETS



The Model 512B is a low cost instrument designed to measure Noise Figure directly in dB of both NPN and PNP bipolar transistors and FETs of both P and N channel. Two measurement bandwidths from 10Hz to 10KHz and 10Hz to 50Hz which cover broadband audio and noise and 1/f, burst, popcorn and other low frequency noise phenomena. The Model 340B/1340 measures Noise Figure of RF type transistors and FETs at spot frequencies in an effective bandwidth of 14KHz. Each frequency requires a plug-in head for either 1, 2, 10.7, 45 or 60MHz. Each of the units has independent controls to set the collector current and voltage and the Model 340 has adjustable gate bias voltage for FETs.

MODELS 2173C-2181 TRANSISTOR NOISE ANALYZER & 2283-2181 I.C. NOISE ANALYZER

These labortaoy type instruments measure the noise spectral density of transistors, FETs and linear integrated circuits. Noise is measured in an equivalent 1Hz bandwidth at 5 spot frequencies of 10Hz, 100Hz, 1KHz, 10KHz and 100KHz. Each instrument is a complete test system containing all the required adjustable power and bias supplies. These instruments have proven extremely useful in providing the user with information for low noise circuit development, quality control and production test for evaluating product quality. A cover interlock switch removes power while inserting and removing the device under test and also prevents stray pickup by requiring the shield cover to be closed during test.

MODELS 2307 & 2310 AUTOMATIC TRANSISTOR NOISE FIGURE TEST SYSTEM

These automatic systems are designed to measure the Noise Figure of transistors at high speeds using automatic handling equipment. For a complete measurement, it is only necessary for the transistor under test to remain stationary for 200 milli-seconds. The systems may also be operated manually using a hand-loaded test jig. Collector current, voltage and base resistance can be varied over wide limits without affecting calibration. Since most of these units are built to order, simplified versions can be supplied or additional features incorporated. Ten foot shielded cables are supplied to connect the instrument to the automatic handler or the manual test jig.

MODEL 2494 BURST NOISE TEST SET

The Model 2494, Burst (Popcorn) Noise Test Set is designed to detect the presence of "Popcorn" noise and to provide the threshold circuitry to segregate units on the basis of average noise voltage levels as well as peak voltage to average voltage ratio. Since the detection of burst noise inherently requires a relatively long observation period, the equipment is designed to measure four devices simultaneously in order to provide reasonable operator productivity. In addition to the GO-NO-GO information, a two digit LED readout, which can be made to read average noise voltage or the number of times the ratio threshold is exceeded, is provided for each of the four test channels.

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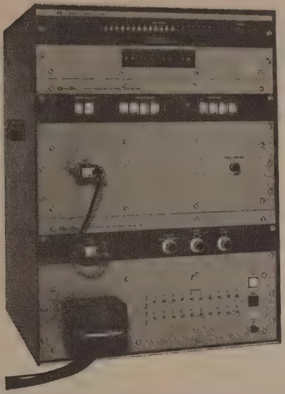
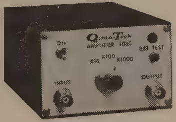
MODEL 5012 AUTOMATIC RESISTOR NOISE TEST SYSTEM



The Model 5012 automatically and rapidly measures the precise value of resistance and current noise of individual resistors or multi-element resistor networks. GO-NO-GO limit selectors are available to program noise and resistance reject levels for data storage or sorting. In addition, data is presented on front panel digital readouts, as well as digital outputs for computer processing. These systems are semi-custom, built to order and are extremely flexible. Their capabilities can be added to or changed without affecting the accuracy or speed of measurement. Resistor current noise measurement meets the requirements established in Method 308 of MIL-STD 202.

MODEL 206C LOW NOISE AMPLIFIER



The Model 206C is the latest version of a versatile battery operated amplifier, with a flat frequency response from 1 Hz to 100 KHz and selectable gains of 20, 40 and 60dB. A noise spectral density of less than 5 x 10^{-9} volts/$\sqrt{Hz}$ makes the 206C ideal for both laboratory and field applications in the amplification of very low level signals. Battery life is approximately 2000 hours.

MODEL 207 ISOLATION AMPLIFIER

The Model 207 is a reliable, low noise amplifier providing a high degree of isolation. The high CMR can be used to reduce the effects of ground loops or EMI so important in medical applications or other complex instrumentation systems. 1000 hour battery operation makes the 207 ideal for field measurements or in locations with poor power line conditions.

MODEL 2220 SERIES INSTRUMENTATION AMPLIFIERS

The 2220 series are high gain, low noise amplifiers with an outstanding performance record in oceanography and related applications. These amplifiers have a nominal gain of 80dB and are flat from 10Hz to 100KHz. A wide selection of plug-in filter boards are available to control the gain vs. frequency characteristics.

MODELS 420 & 421 RANDOM NOISE GENERATORS

Accurately calibrated and stable random noise sources have true Gaussian amplitude distribution and spectral density independent of frequency (white). The Model 420 is flat from approximately DC to 100KHz while the Model 421 is flat from 10KHz to 12.5MHz and is usable to 20MHz (–3dB). The outputs of both units are continuously metered and calibrated in $\mu V/\sqrt{Hz}$ which is the accepted basic standard of the industry.

MODEL 317C PROBABILITY DENSITY ANALYZER

The capability of measuring probability density or cumulative probability distribution, over a frequency range from dc to 1.75MHz, enhances the utility of the 317C. Measurements are no longer limited to the lower frequency spectrum found in vibration analysis. Self-contained true RMS calibration, internal sweep and analog outputs for an X-Y plotter, provide a convenient method of obtaining probability data. Gated clock outputs for low frequency or low probability are available at the front panel.

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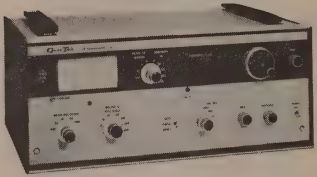
MODEL 2429 TORSIONAL VIBRATION ANALYZER

The Model 2429 is a unique instrument that is calibrated for measurement of angular vibration magnitudes of 1 millidegree to 30 degrees peak full scale over the 1 Hz to 5000 Hz frequency range, using electromagnetic or optical non contacting sensors with 100 point per revolution sensing. Internal calibration is crystal controlled for both frequency and magnitude and an auxiliary power inverter allows for use under extreme environments encountered in the field. This instrument is ideal for character signature measurements of critical machinery for maintenance and repair decision making. In addition, fault location within a mechanism can be easly ascertained. The uses for this instrument range from the evaluation of design and maintenance analysis of tape recorder mechanisms, to oil, gas or water well drilling systems, to steam, air or gas turbine systems for power generation.

MODEL 2415/2450 V F TRANSPONDER & CLOCK/TIMING GENERATOR



These instruments are building blocks for use within echo-sounding systems for atmospheric measurements of range and velocity of various turbulent conditions. The Model 2415 is operated as a tracking receiver while the 2450 provides synchronous transmission information as well as control of receiver parameters and clock/calender data for recording purposes. A complete minimal system consists of these instruments in in combination with a T/R switch (Model 2473), power amplifier and acoustic coupler. All data derived from both instruments may be processed immediately or recorded conveniently for future analysis and correlation with data from other similar systems.

SERIES 2400 TELEMETRY STATION TEST SETS

The 2400 series Telemetry Station Test Set verifies the performance characteristics of both central and remote units of a digital serial format, half-duplex, data telemetry system. The test set has the capability of generating and receiving up to 16 words of BCH parity checked data and displaying in binary form any one or all of the received words. The test set may operate in originate/answer mode for simulating either a central station or remote station. The data rate is selectably 150, 600 or 1200 bits/sec with stabilities of 0.01%. The interface is short circuit protected and meets the requirements of EIA RS-232C. Various plug-in units are available for formulating the transmit data in binary bit or hexadecimal form. Various test cables, transit case and FSK options are also available.

Quan-Tech is a professionally oriented organization devoted to the solution of unusual technical test and measurement problems in low frequency electrical, electronic and mechanical engineering.
A few of the areas of capability are:

A. Low, medium and high frequency noise characteristics of components and systems.
B. Signal analysis techniques at low and medium frequency on the spectral and probablistic level.
C. Mechanical device measurements in mechanical impedance and vibration studies (linear & torsional)
D. Digital systems testing-telemetry data communications error rate.
E. Acoustics emission and detection-atmospheric echo sounding, speech and hearing.

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INSTRUMENTATION DIVISION

Since 1922

AC/DC Voltage, Current and Power Standard

Model 829G

Model 829G	Measure & Deliver
Full-scale ranges	AC/DC Volts 0.01 — 1400 V AC/DC Current 10 $_{\mu}$A-14A Ohms 0.1-10 meg.
Accuracies of reading	±0.05% DC ±0.08% AC ±0.06%Ohms
AC Frequencies	50, 60, 400, 1000 Hz

Model 5058A

Model 5058A Wattmeter Calibration Module for use with two Model 829G's. For calibration of wattmeters ranging from 0.05 watt to 14,000 watts.

Digital Watt/Var/Vector Power Meter

Series 6200 measures single or polyphase power. Ten current ranges, 0.01-10.0A; nine potential ranges, 5-300VAC; 90 range-combinations, 50 mW-3kW. Direct reading; automatic captions and decimal points. Five-digit, 7-segment display; 0.01% resolution. Accuracy ± (0.02 ± 1 digit).

Magnet Chargers and Treaters

Model 747

High energy magnet charger covers full range of charging applications, from the lowest to the highest coercive forces, in all configurations.
Available in five separate energy-storage capacity levels from 2,000 to 10,000 watt-seconds.

Model 107A

Saturates most medium size and instrument magnets, including core types, using variety of fixtures. Two output ranges: Maximum 18-watt-seconds. Booster unit also available.

Model 1500

Produces 225 watt-seconds for large Alnico meter magnets plus cobalt platinum and barium ferrite materials. Wire-wound fixtures plug into front panel through safety interlocks.

Model 2470-350

Variable output voltage with energies up to 440 watt-seconds for saturating up to 4 lbs. of Alnico V using wire-wound fixture. Bench or rack mounting available. Accessory Booster available for doubling output.

Model 2470-700R

With variable voltage outputs and energies up to 880 watt-seconds. Will saturate Alnico V up to 5½ pounds, as well as many core-type indicating meters completely assembled and encased. Rack mounting only.

Model 942

Saturate Alnico magnets to 34 lbs. and high coercive force barium ferrite compounds of any shape or number of poles. Outputs to 3,600 watt-seconds. Safety interlocked.

MAGNETREATER 990

Magnetreater® Model 990

Completely solid-state demagnetizer for stabilization of permanent magnets. Power continuously variable from less than 1 VA to in excess of 80,000 VA. Resolution 0.1%. Can be programmed for automatic or semiautomatic operation.

Magnetreater®/Charger Model 580

Combination Magnet Charger and Magnetreater capable of charging and stabilizing permanent magnet materials and assemblies. Completely solid-state, providing high reliability. Energy storage for the charging mode is 105 watt-seconds; Magnetreater mode is 54 watt-seconds. Can be combined with RFL Gaussmeter for automatic or semi-automatic operation.

Gaussmeters

Model 505

Model 505, a low cost unit ranging from 5 gauss to 50 kilogauss in 7 full-scale ranges. Measures permanent magnet, DC and AC fields to 20 kHz. Built in probe calibration and zero center mode for determining polarity. Accuracy: ±3%.

Model 750A, sensitive wide-range device for analog measurement of 0.10 gauss to 50 kilogauss in 18 full-scale ranges. Measures permanent magnetic fields, DC and AC, to 400Hz. Polarity sensitive, self-calibrating. Nominal accuracy ±1%.

Model 750D, sensitive high-range device for digital measurement of 10 gauss to 100 kilogauss in five full-scale ranges. Measures permanent magnetic fields, DC and AC, to 400 Hz. 3½-digit panel meter. Polarity sensitive. Self-calibrating. Nominal accuracy ±0.2%.

Probes — Are InAs elements for temperature stability. Choice of flat, axial or tangential in various sizes to fit most gaps. Flat ranges from .015" thick x .080" wide x .309" long.

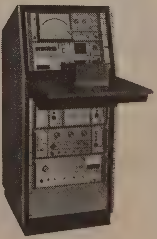
Reference Magnets — Traceable to NBS with 50 gauss to 20K gauss fields and gaps from .040" to .343" are standards for probe calibration.

Magnetometer

Model 101

Solid state low level magnetic flux density measurements from 1 gamma to 100,000 gamma (1 oersted). Temperature compensation is provided to enable virtual drift-free operation.

Automagnetic® Systems

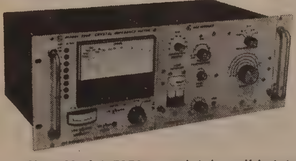


A combination of RFL standard magnetizing, measuring and demagnetizing equipment permits interconnection for semi-automatic and completely automatic systems designed for individual requirements. Processing includes TWT, BAR and C shaped magnets, DC meters, Torque motors, accelerometers and other designs embodying permanent magnets.

Crystal Impedance Meters

Model	Frequency Range	Impedance Range
459B	800kHz-15MHz	0-9,900 ohms
531	10-140MHz	10-150 ohms
541C	2.5-1100kHz	200 ohms-0.5 megohms
1207	75-200 MHz	10-125 ohms

Reference standards for measuring resonance and anti-resonance of quartz crystals in determination of capacitance, inductance and performance index. Meet U.S. MIL-C-3098E/Amd. 1 and U.K. Defense DEF-5271 A.



New Model 5950 completely solid-state CIM measures semi-automatically. Consists of a main-frame and two interchangeable RF modules covering a frequency range of 2.5kHz to 60MHz.

RFL Industries, Inc.

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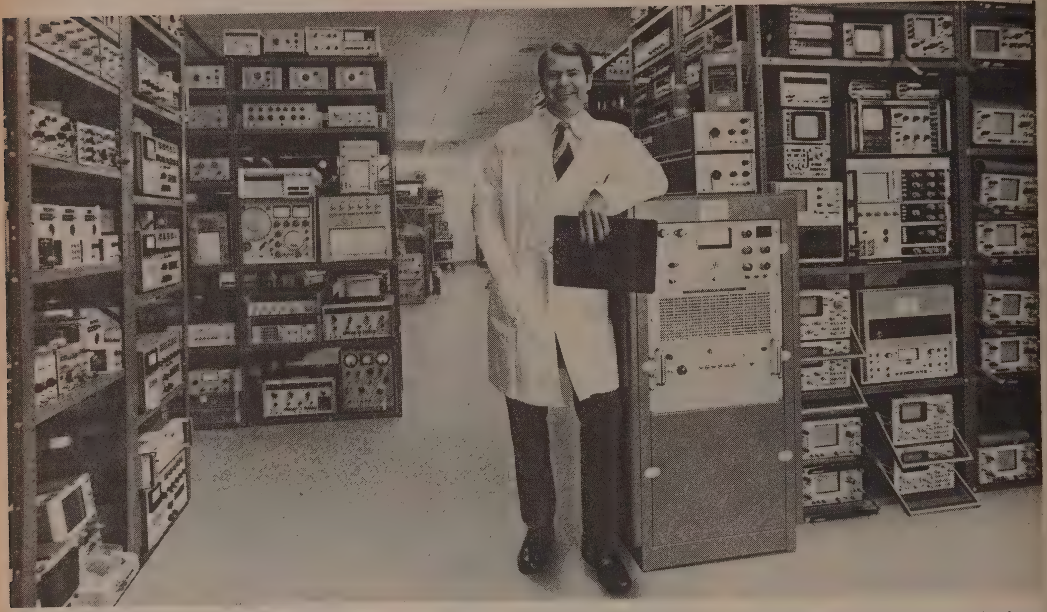

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REI is backed by the tremendous resources of the PepsiCo organization, which gives us the financial strength to keep on hand whatever test equipment you may need. And renting from us helps *your* financial strength, too. Since you pay only for the time you have your instruments, you'll never have to spend your money on idle equipment.

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Cushman
Dana
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Data General
Data Measurements
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Logimetrics
Marconi
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Microdot
Mincom
Monsanto
Narda
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Northeast Electronics
Philco-Sierra
Power Designs
Programmed Power
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Simpson
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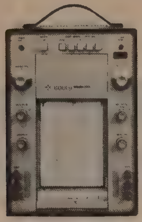
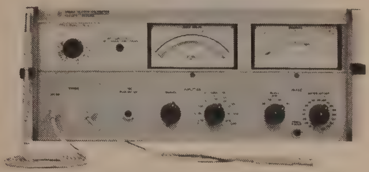
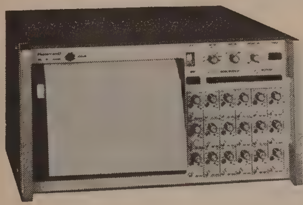


BRUSH 220 TWO CHANNEL RECORDER
1 mV to 500 V, chart speeds 125 mm/sec to 1 mm/min, incl two event markers, pressurized ink, response DC to 100 Hz. **$239.00/Mo.**

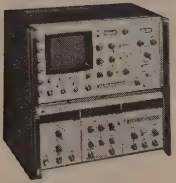


HP 8405A VECTOR VOLTMETER
1 MHz to 1 GHz, 1.5 mV to 1 V (chan A) and < 20 μV to 1 V (chan B), phase 360°. **$313.00/Mo.**

EIP 351D AUTOHET FREQUENCY COUNTER
20 Hz to 18 GHz, sens 12 mV to 40 mV dep on freq range, 11-digit display, 50 Ω input. **$528.00/Mo.**

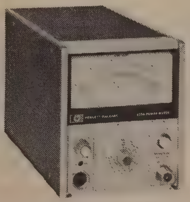


HONEYWELL 1858-T79 RECORDER
DC to 5 kHz, 18 channels, sens ± 100 μV to ± 300 V depending on input module. **$537.00/Mo.**

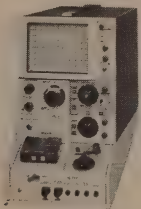


HP 3702A/3710A MICROWAVE LINK ANALYZER SYSTEM
Allows BB and IF link distortions to be identified, measured and localized. Requires plug-ins and converters.

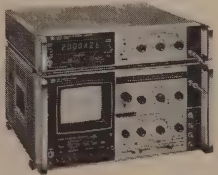
Price Upon Request



HP 435A POWER METER
5 MHz to 18 GHz, 0.3 μW to 100 mW, req 8481A thermistor. **$79.00/Mo.**



TEKTRONIX 577 CURVE TRACER
provides storage display of semiconductor characteristics, includes 177 standard test fixture and 10 cm x 10 cm screen. **$247.00/Mo.**



HP 141T/8552B/8553B SPECTRUM ANALYZER SYSTEM
1 KHz to 110 MHz, max sens −140 dbm, variable scan and IF BW, log or linear storage display. Optional 8443A tracking gen not included in price. **$823.00/Mo.**

Discounted rates for longer periods of time are available upon request.

These prices supersede all previously published prices and are subject to adjustment without notice.

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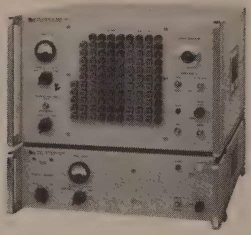
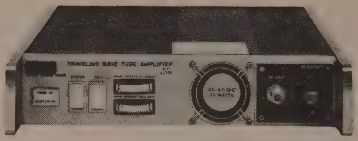
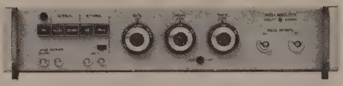


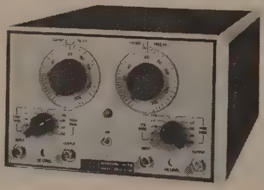
HP 5105A/5110B FREQUENCY SYNTHESIZER
100 kHz to 500 MHz, S/N >74 db, output −6 dbm to +6 dbm into 50Ω. **$2145.00/Mo.**



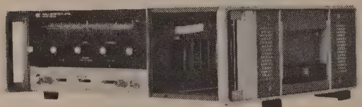
HUGHES 1177H05F000 TWT AMPLIFIER
2.5 GHz to 4 GHz, gain 30 dB, output 20W.
Price Upon Request



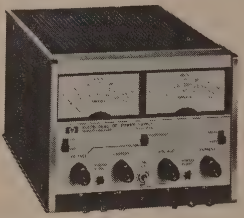
HP 8403A MODULATOR
for HP pin modulator, rep rate 50 Hz to 50 kHz, amplitude 5V to 20 V peak, drives pin modulators, not included in price. **$127.00/Mo.**



KROHN-HITE 3202 VARIABLE ELECTRONIC FILTER
20 Hz to 2 MHz, atten slope 24 db/oct (each channel), max atten 80 db, selectable band-pass, band-reject, low-pass, high-pass modes. **$87.00/Mo.**

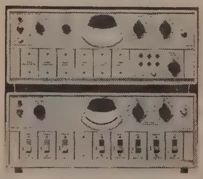


HP 8620A SWEEP OSCILLATOR MAINFRAME
.01 GHz to 10 GHz, sweep functions start-stop, delta F, CW, unit provides freq markers, req 86000 series RF module. **$172.00/Mo.**



HP 6227B DUAL POWER SUPPLY
separate supplies, each 25V/2A, stability 0.2% + 2 mV. **$67.00/Mo.**

HP 8640B AM-FM SIGNAL GENERATOR
500 kHz to 512 MHz, output 2 VRMS to 0.013 V into 50, 6 digit cw indicator or counter, AM-FM-pulse modulation. **$577.00/Mo.**



MARCONI 0A2090B NOISE LOAD TEST SET
consists of TF2091 Noise Generator and TF2092A Noise Receiver, req hi-pass, lo-pass, band-stop, band-pass filters, and local oscillator not included in price. **$387.00/Mo.**

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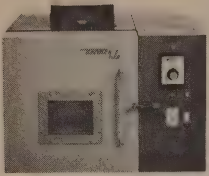
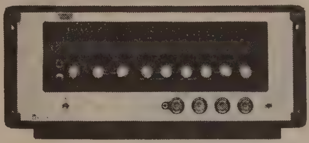
TEK 7A26 DUAL-TRACE AMPLIFIER PLUG-IN
DC to 200 MHz, 5 mV/div to 5 V/div, for 7000 mainframes. **$107.00/Mo.**



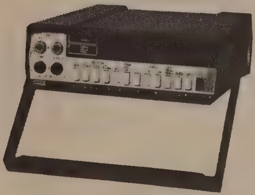
TENNEY "TENNEY JR" ENVIRONMENTAL TEST CHAMBER
−120° F to +350° F ± ½° F, work vol 16" x 12" x 11", self contained input 115V, 60 Hz, 1 phase. **Price Upon Request**

TEK 466 PORTABLE STORAGE OSCILLOSCOPE
DC to 100 MHz, storage > 15 nsec, variable persistence, line operation, sens 5 mV/div to 5 V/div. **$397.00/Mo.**

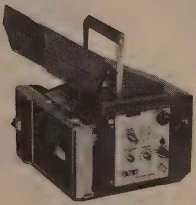


GR 1683 AUTOMATIC RLC BRIDGE
120 Hz, 0.1 pF to 100 mF, 0.001 μH to 1,000 H, 0.001 mΩ to 1,000 kΩ. **$677.00/Mo.**

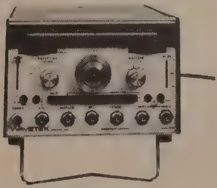
TEK 465 PORTABLE DUAL-TRACE OSCILLOSCOPE
DC to 100 MHz, sens 5 mV/div to 5 V/div. **$179.00/Mo.**



FLUKE 8600A DIGITAL MULTIMETER
200 mVDC/AC F.S. to 1200 VDC/AC, 200 μ ADC/AC F.S. to 2 ADC/AC, 200 ΩF.S. to 20 MΩ, 4½-digit LED readout. **$69.00/Mo.**



TEK C-51P OSCILLOSCOPE CAMERA
f/1.2 lens, fixed 0.5 mag, 4 to 1/60 sec shutter speed, used with 7000 series 8 X 10 CRT's, uses pack film. **$117.00/Mo.**



WAVETEK 2001A SWEEP/SIGNAL GENERATOR
1 MHz to 1400 MHz, 50 sweeps/sec to 0.01 sweep/sec, output 0.7 VRMS (+10 dBm) into 50Ω. **$179.00/Mo.**

Discounted rates for longer periods of time are available upon request.

These prices supersede all previously published prices and are subject to adjustment without notice.

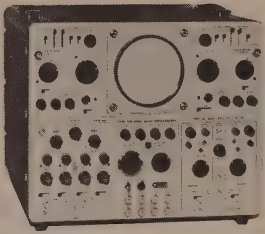
Rental Electronics, Inc. REI

A PEPSICO LEASING COMPANY

PREMIUM TEST EQUIPMENT

HONEYWELL: "5600" MAGNETIC TAPE RECORDER

Channels: 7; Speeds: 7 electronic switchable from 15/16 to 60 ips, ½ in. Tape; Direct Electronics: To 300 kHz; FM Electronics: To 40 kHz; Input level: 0.3 VRMS; Output level: 1.0 VRMS; Input Impedance For Record: 10 kΩ; Output Impedance For Reproduce: 51Ω ±10%. Freq. Response: DC to 2 MHz ±0.75 db; Total Harmonic Distortion: < 0.3% at 1 kHz, < 1.0% from 50 Hz to 2 MHz............**Price on Request**

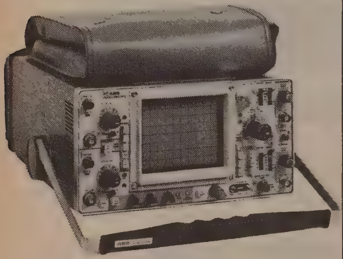


TEKTRONIX 556 DUAL BEAM OSCILLOSCOPE

DC to 50 MHz—2 identical vertical amplifiers. Accepts 2 letter or "1" series plug-ins. 2 independent horizontal deflection systems. Plug-Ins available at extra cost..................................**Sale Price $1750.00**

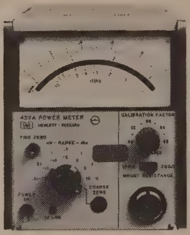
DATA GENERAL "NOVA-1200" MINI COMPUTER

Basic mini with 4k to 32k memory, TTL, auto program load. Software available. **Price based on configuration desired.**



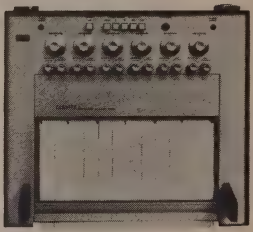
TEKTRONIX 465 PORTABLE DUAL TRACE OSCILLOSCOPE

DC to 100 MHz, 5mV/div to 5V/div vertical systems, sweep speeds 0.05 μsec/div to 0.5 sec/div, magnified-delayed-mixed sweep modes. **Sale Price $1640.00**



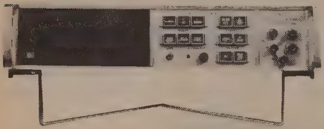
HP: "432A" POWER METER

Power Range: 10, 30, 100, and 300 μW, 1, 3, and 10 mW; −20 dbm to +10 dbm in 5 db steps; Accuracy: ±1% of full scale, all ranges; Thermistor Mounts: 486A, 478A, and 8478B series. Price does not include mount................................**Sale Price $575.00**



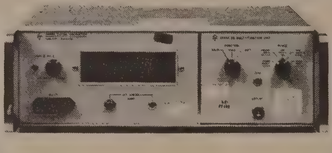
BRUSH MARK "260" PRESSURIZED INK RECORDER

Numbers of Channels: 4 standard event, 6 analog; Range: 1 mV to 500 VDC; Response: DC to 40 Hz at 50 div., DC to 100 Hz at 10 div.; Speeds: 1, 5, 15, 125 mm/sec., 1, 5, 15, 125 mm/min.; Sensitivity: 1 mV/div...**Sale Price $3750.00**



HP: "3450A" DIGITAL MULTI-FUNCTION METER

Voltage Range Display: ±100 mV to ±1000 V in 5 range settings. Range Selection: Manual or automatic. Accuracy 1 V thru 1000 V ±.003% of reading +.001% of range. DC Voltage Ratio: 100 mV to 1000 V. Input Resistance: 10 MegΩ; Display: 6 digit in line. Added measurement capability is achieved by the addition of plug-in options. Price does not include options............................**Sale Price $1895.00**



HP: "3440A" DIGITAL PLUG-IN VOLTMETER

DC voltages up to ±999.9 volts of either polarity are displayed in 4 digits with accuracy of 0.05 percent of reading ±1 digit. Sample rate, HOLD and variable 1/s to 5/s. Price does not include plug-ins **Sale Price $475.00**

BELL & HOWELL: "VR3360" MAGNETIC TAPE RECORDER/REPRODUCER

Tape Speeds: Six, 1-7/8 through 60 ips; Reels Accommodated: 10½ inch diameter with EIA hub, ½ in. or 1 in. tape; Direct Record/Reproduce System: Input Level—1 VRMS nominal: Output Level—1 VRMS; FM Record/Reproduce System: Input level—1 VRMS nominal; Output level—1 VRMS. **Price based on configuration desired.**

USED—BUT BY WHOM AND HOW?

All equipment offered for sale was originally bought brand new from the manufacturer by REI. It is a well-maintained instrument that you can rely on with a money-back guarantee. As the largest renter of test equipment in the nation, Rental Electronics, Inc. is continually adding the latest and most popular instruments to its inventory. As a result, REI Sales Company has been established to market some of the instruments on the REI shelves to keep making room for the latest equipment. The top quality, late model, brand name instruments that you'll find listed here are immediately available, tested to manufacturers specifications and at sale prices you can fit in your budget.

If you don't see an item that you've been needing, call us anyway at (617) 273-2777. We may have just added it to our stock.

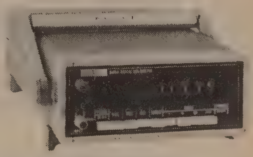
EVERYTHING'S LIKE NEW EXCEPT THE PRICE!

HP: "1707B/20" DUAL TRACE PORTABLE OSCILLOSCOPE

Bandwidth: DC to 75 MHz; Risetime: 4.7 ns; Deflection Factor: 10 mV/div to 5 V/div; Time Base: 0.0 μsec/div to 2 sec/div; Delayed Time Base: 0.1 μsec/div to 0.2 sec/div. Option "20" (1) External Horizontal Input. (2) Channel "A" Output.
Sale Price $1000.00

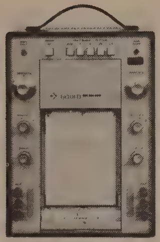
GENERAL RADIO: "1565A" PORTABLE SOUND LEVEL METER

Sound Level Range: 40 dbm to 140 dbm; Freq. Range: 20 Hz to 20 kHz; Output: 1.5 V/20 kΩ Input impedance: 13 meg Ω/25 pF; Power Internal battery. **Sale Price $210.00**



FLUKE: "8100A" DIGITAL MULTIMETER

Voltage Ranges DC: 1 V, 10 V, 100 V, 1000 V; Accuracy ±0.05% of reading plus 0.01% of range; Voltage Ranges AC: 1 V, 10 V, 100 V, 1000 V; Ω Ranges: 1 k, 10 k, 100 k, 1 M, 10 M; Display: 4 digits plus 20% overrange. .... **Sale Price $425.00**

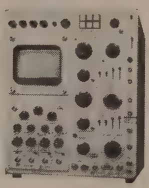


BRUSH MARK "220" PRESSURIZED INK RECORDER

Number of Channels: 2 standard event, 2 analog; Range: 1 mV to 500 VDC; Response: DC to 40 Hz at 50 div., DC to 100 Hz at 10 div.; Sensitivity: 1 mV/div.; Speeds: 1, 5, 15, 125 mm/sec. and 1, 5, 15, 125 mm/min. .... **Sale Price $1100.00**

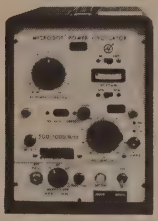
GR: "1551C" SOUND LEVEL METER

Sound Level Range: From 24 db to 150 db; Freq. Range: 20 Hz to 20 kHz amplifier response; Cal. Accuracy: ±1 db at 500 Hz; Input Impedance: 25 mΩ/parallel to 50 pF .... **Sale Price $425.00**



TEKTRONIX: "549" SPLIT SCREEN STORAGE OSCILLOSCOPE

Horizontal Time Base: 0.1 μsec/cm to 5 sec/cm; X5 Magnifier; Sweep Delay: 2 μsec to 10 sec; Storage CRT; Display Screen: 6 x 10 cm; Split Screen Storage; Viewing Time: Up to one hour; Erase Time: 150 ms; Writing Specs: 0.5 cm/μsec, 5 cm/μsec with enchantment. Price does not include plug-in units. .... **Sale Price $1450.00**

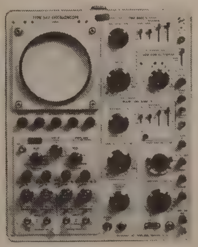


MICRODOT: "445" POWER OSCILLATOR

Freq. Range: Determined by RF Plug-in Unit; Modulation; Internal 1 kHz ±10% adjustable; Tuning; Single Control; Power: Stability: ±0.002" for 10 min. after 2 hours. Stabilization at constant power and frequency. Price does not include RF Plug-In unit.
Sale Price $1050.00

FLUKE: "8120A" DIGITAL MULTIMETER

Voltage Ranges DC: 100 mV, 1 V, 10 V, 100 V, 1000 V; Input Impedance: 10 MΩ; Voltage Ranges AC: 100 mV, 1 V, 10 V, 100 V, 1000 V; Ranges: 1 k, 10 k, 100 k, 1 M, 10 M: Current Ranges DC: 100 μA, 1 mA, 10 mA, 1000 mA; Current Ranges AC: 100 μA, 1 mA, 10 mA, 100 mA; Display: 4 digital plus 20% overrange. .... **Sale Price $525.00**



TEKTRONIX: "547" AUTOMATIC DISPLAY OSCILLOSCOPE

Vertical Bandwidth: DC to 50 MHz; Deflection: All 1-Series and Letter Series Plug-Ins; Horizontal Cal. Time Base: 0.1 μsec/cm to 5 sec/cm; Sweep Magnifier: X2, X5, X10; Cal Sweep Delay: 0.1 μsec to 50 sec. .... **Sale Price $1000.00**

ALL EQUIPMENT OFFERED IS SUBJECT TO PRIOR SALE.

REI Sales Company

A PEPSICO LEASING COMPANY

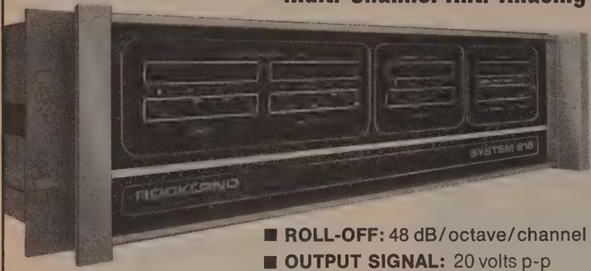
120 Cambridge St., Burlington, MA 01803
(617) 273-2777

for the BE$T in...

ANALOG FILTERS

- **HI** PERFORMANCE/ **LO** COST
- **WIDE RANGE**—CUT-OFF FREQUENCIES FROM 0.001 Hz to 1.1 MHz
- **DIGITAL TUNING**—INSTANT RESETTABILITY
- **FLEXIBILITY:** **Modes:** Low pass, high pass, band pass, band reject, notch.
  Roll-Offs: 24, 48, & 96 dB/octave
  Responses: Butterworth, Bessel, Linear Phase, RC
  Passband Gains: 0, 20 dB
- **REMOTE PROGRAMMABILITY**—*A ROCKLAND EXCLUSIVE!*

Multi-Channel Anti-Aliasing Filter: System 816



- ■ **FOR AUTOMATED DATA ACQUISITION AND SIGNAL ANALYSIS SYSTEMS**
- ■ **DIRECT INTERFACE WITH COMPUTER, PROGRAMMER OR SWITCH CLOSURES**
- ■ **PLUG-IN CARDS PROVIDE UP TO 16 INDEPENDENT FILTER CHANNELS IN 5¼″ HIGH PANEL**
- ■ **LOCAL, REMOTE, AND ON-CARD PROGRAMMING OF CUTOFF FREQUENCY**
- ■ **CUTOFF FREQUENCY RANGE:** 01 Hz to 150 KHz
- ■ **FUNCTIONS:** Low pass, high pass, bandpass, band reject
- ■ **RESPONSES:** Butterworth and Bessel
- ■ **ROLL-OFF:** 48 dB/octave/channel
- ■ **OUTPUT SIGNAL:** 20 volts p-p
- ■ **PASSBAND GAIN:** 0 dB
- ■ **IMPEDANCES:** 1 Meg input, 50 ohm output
- ■ **DYNAMIC RANGE:** 80 dB

New! Higher Performance, Lower Cost!

DUAL HI/LO: Models 452 and 852

Frequency Range: 0.01 Hz to 111 KHz
Roll-Off: 24 dB/octave/channel (452) 48 dB/octave/channel (852)
(Cascading channels doubles roll-off)
Responses: Butterworth, Linear Phase
Passband Gains: Selectable 0, 20 dB.

VARIABLE ANALOG: Models 1100 and 1200

Frequency Range: 10 Hz to 1.1 MHz **Roll-Off:** 24 dB /octave
Responses: Butterworth and Bessel **Passband Gain:** 0 dB.

PROGRAMMABLE DUAL HI/LO: Series 1500

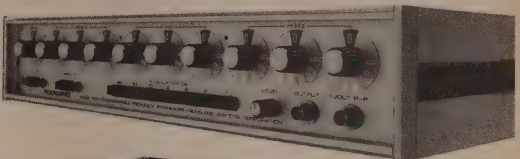
Frequency Range: 0.001 Hz to 111 KHz
Roll-Off: 24 dB/octave/channel (Cascading channels doubles roll-off)
Passband Gain: 0, 20 dB. **Responses:** Butterworth, RC.
Programming: Local and/or Remote of all Functions
Programming options: 02; 1-2-4-8 BCD positive logic,
03; 1-2-2-4 BCD positive logic.

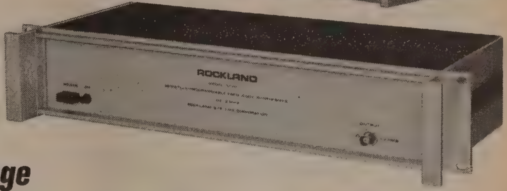
ROCKLAND

Rockland Systems Corporation 230 W. Nyack Road, West Nyack, N.Y. 10994 • (914) 623-6666 • TWX 710-575-2631

for the BE$T in...
FREQUENCY SYNTHESIZERS

DC to 2 MHz Range


ROCKLAND
MHZ
LEVEL
OUTPUT
1 VOLT P-P

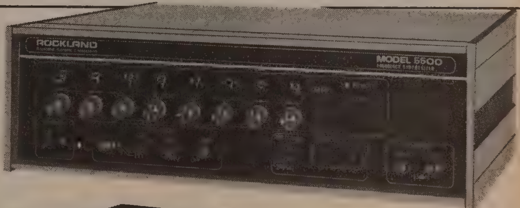

ROCKLAND
OUTPUT

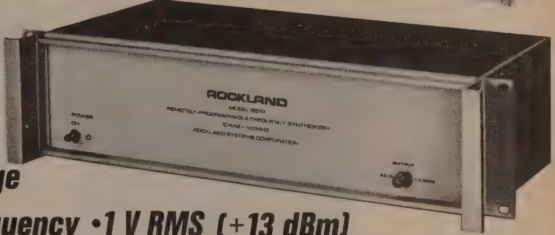
Model 5100
Local and remote programming
for laboratory and systems applications

Model 5110
Remote programming only. (for O.E.M.
and other "hands-off" applications)

- *DC to 2 MHz Range*
- *0.001 Hz Resolution throughout range*
- *1.5 Microsecond Programming Speed*
- *Full Programmability* BINARY OR BCD
- *No Switching Transients*
- *Direct Digital Techniques* NO MIXING OR PHASE LOCKING
- *High Spectral Purity* −70dB SPURIOUS −55dB HARMONIC
- *High Stability* ±2x10^{-8}/°C STANDARD ±2x10^{-10}/°C OPTIONAL

10 KHz to 39.999999 MHz


ROCKLAND
MODEL 5500


ROCKLAND
REMOTELY-PROGRAMMABLE FREQUENCY SYNTHESIZER
10KHZ - 40MHZ
ROCKLAND SYSTEMS CORPORATION
POWER
ON
OUTPUT

New! **Model 5500**
Precise, stable frequency source
for fine resolution HF applications.
Local and remote programming

New! **Model 5510**
Remote programming only. (for O.E.M.
and other "hands-off" applications)

- *10 KHz to 39.999999 MHz Range*
- *1 Hz Resolution throughout range*
- *LED Display of Programmed Frequency*
- *Full Programmability & Fast Switching* —1 MS TYPICAL
- *High Spectral Purity:* SPURIOUS: >60 dB down PHASE NOISE: −55 dB HARMONIC: −30 dB
- *High Stability:* ±2x10^{-8}/°C STANDARD ±2x10^{-10}/°C OPTIONAL
- *1 V RMS (+13 dBm)*
- *Amplitude Modulation:* 0-95%, 400 Hz, 1 KHz, EXTERNAL
- *Auxiliary TTL Square-wave Output*
- *ASCII, Calculator and Minicomputer Interface Options*

ROCKLAND

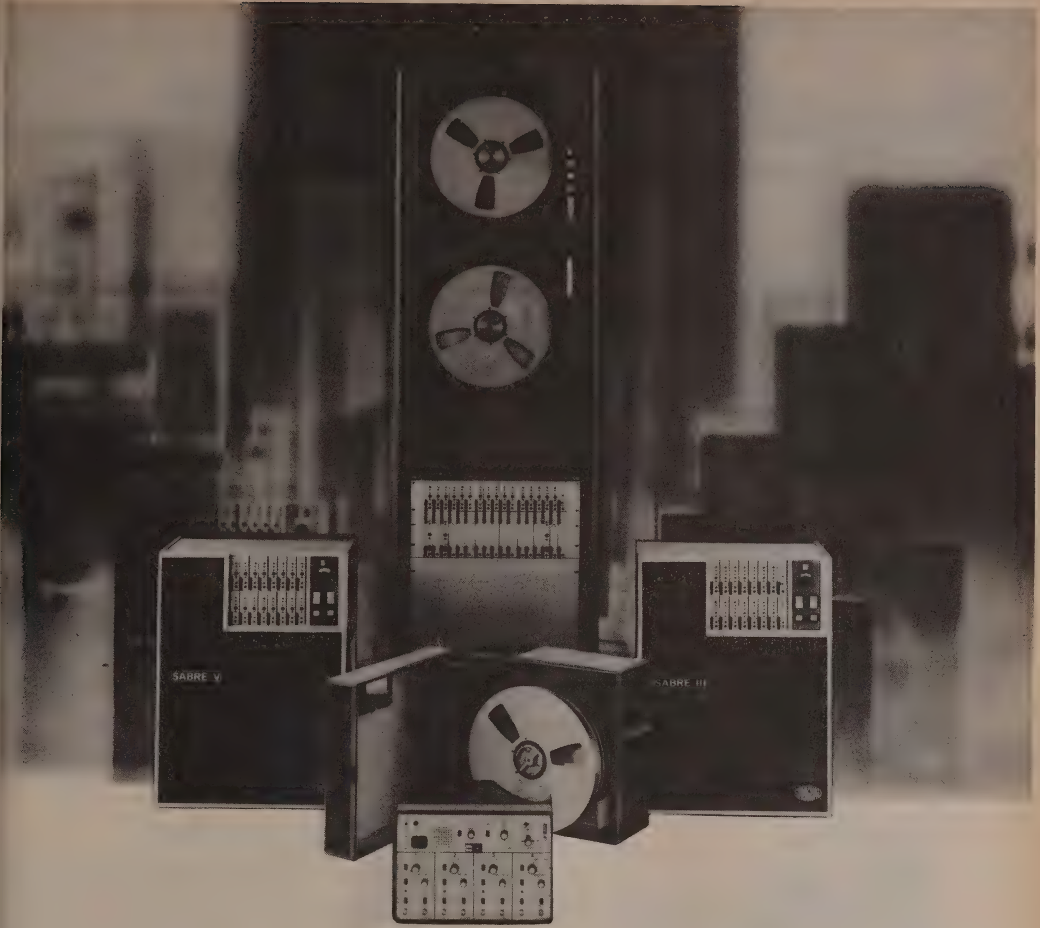
Rockland Systems Corporation 230 W. Nyack Road, West Nyack, New York • (914) 623-6666 • TWX 710-575-2631

The 70-lb. Sabre VI: It's a giant leap beyond any other small, high performance IRIG analog tape recorder/reproducer. Records at 8 electrically selectable speeds: 120 ips through 15/16 ips; reproduces at any 3 electrically selectable speeds; records from 15.3 minutes at the highest speed to 32.8 hours at the slowest on 14" reels. Remote speed selection and LED footage counter. LED bar data monitor. Let us give you full details.

SANGAMO RECORDERS

THE INNOVATORS IN TAPE INSTRUMENTATION
Sangamo Electric Company
Data Systems
P.O. Box 3347 • Springfield, Illinois 62714
(217) 544-6411

Introducing the carry-in recorder reproducer that will carry-on for 32.8 hours!



We haven't discovered how many recorder/reproducers are in our line of 5!

The ultimate number seems unlimited because each of our recorder/reproducers is designed and built to adapt to an amazing variety of functions. The basic five range from the 25 lb. Tandberg TIR series to the only IRIG all-band portable tape recorder on the market to the 48 channel Sabre IV. Each is designed and built to exceed industry standards for accuracy—and to meet challenges. Don't ask what a Sangamo recorder does—just say what you want it to do.

For information write: Sangamo Electric Company, Data Systems, P.O. Box 3347, Springfield, Illinois 62714,(217) 544-6411. Telex 406-421. Sales and service representatives world wide.

SANGAMO RECORDERS
THE INNOVATORS IN TAPE INSTRUMENTATION

Simpson®

INSTRUMENTS THAT STAY ACCURATE

TEST EQUIPMENT

260® SERIES 6 VOM

Fast, accurate measurements of 27 popular ranges. Direct dial reading of Amp-Clamp ranges. External access battery and fuse compartment. Multi-purpose test leads with combination probe and alligator clips. Two batteries supplied — one 9V, NEDA 1604 and one 1.5V "D" cell, NEDA 13F. Rugged taut band movement, varistor protected. Complete with batteries, test leads and manual **$75.50**

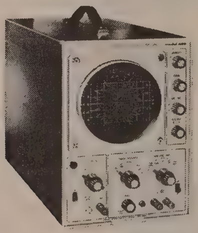
260 SERIES 6P VOM Circuit overload protected. Reset pushbutton releases when overload exists. Will not reset until overload is eliminated. With batteries, test leads and manual **$115.00**

260 SERIES 6M With mirror scale **$78.50**

260 SERIES 6XL VOM

For the special needs of the solid-state electronics industry. 33 ranges with extra voltage, current, resistance and low-power ohms functions. Extra shock and drop resistant construction. High impact, custom-molded panel and case. Extra large viewing area with color-keyed scales. **Plus,** all the features of the 260 Series 6. Complete with batteries, test leads and manual **$90.00**

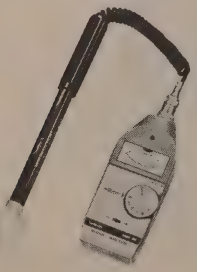
260 SERIES 6XLP Circuit overload protected — same as 260-6XL. With batteries, test leads and manual **$125.00**



MODEL 455 OSCILLOSCOPE

General purpose 5″ scope. DC coupled to 10 MHz. For color TV servicing and industrial applications. Amp/VECTOR display . .. R-Y, B-Y inputs. 10 mV/cm to 5 V/cm vertical sensitivity — 300 mV/cm horizontal sensitivity. Accepts scope camera and light hood. Low parallax, high contrast graticule. 1 kHz square wave calibration signal. High linearity sweep with automatic sync and retrace blanking — 15.75 kHz for TV work. Supplied complete with all front and rear controls, shielded input cable, 5-foot line cord and manual **$325.00**

Low capacitance 10 to 1 probe, Catalog No. 07548 .... **$17.50**



MODEL 380 MICROWAVE LEAKAGE TESTER

Direct reading, battery-operated, portable instrument for accurate measurement of potentially dangerous radiated microwave energy leakage. Complies with HEW standards in Federal Register, Vol. 35, Oct. 1970. Compact, completely self-contained. Probe attaches to top of instrument. High torque indicating movement with shock resistant, taut band suspension moving coil system. Easily accessible battery compartment. Built-in tripod mount. Rugged, high-impact carrying case supplied — holds Model 380 and all accessories. Complete with case, probe, foam spacer, two 9V batteries and manual **$195.00**

WRITE FOR CATALOG 4400

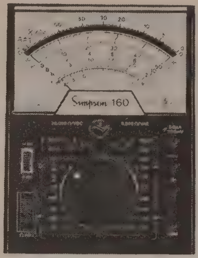
SIMPSON ELECTRIC COMPANY • 853 DUNDEE AVENUE • ELGIN, ILLINOIS 60120 • (312) 697-2260

TEST EQUIPMENT

Simpson®

INSTRUMENTS THAT STAY ACCURATE

MODEL 160 HANDI-VOM



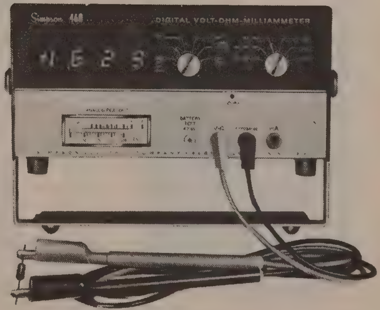
Drop and shock resistant case and meter. ±2% DC and ±3% AC accuracies. 3$\frac{5}{16}$" wide and only 12 ounces in weight, yet has the accuracy and sensitivity of a full size VOM. Taut band movement features outstanding repeatability and freedom from stray magnetic fields. Movement varistor protected against 2,000 times overloads. Built for today's VOM needs, including solid-state circuit testing, the 160 has 0.25 DCV range. Complete with test leads, batteries and manual.. **$65.00**

MODEL 360 DIGITAL VOM

Portable — AC line or self-contained battery operation. 3½ digit, non-blinking, auto-polarity, 0.33" LED display. 29 popular ranges including low-power ohms. Measures AC/DC voltage, current and resistance. Analog indicator scans nulls and peaks. Analog output permits monitoring input signal with chart recorder. Solid state IC design provides compactness with high reliability and low power dissipation. Complete with test leads, AC line cord and manual (less batteries).. **$325.00**

30 KV DC Probe, Catalog No. 00167 .... **$29.00**

MODEL 460-2 PORTABLE DMM



Unbeatable portability and range coverage. Highly accurate, compact, lightweight, multi-use VOM for lab, in field or general testing. 0.1% accuracies for DCV measurements. 3½ digit, non-blinking, auto-polarity 0.43" LED display. Automatic blanking on non-significant zeros. 26 popular ranges. Analog display with both linear and dB markings. AC line or self-contained battery operation. A single digital LSI module achieves high reliability, low power dissipation and compactness. Complete with test leads and manual (less batteries) **$395.00**
30 KV DC Probe, Catalog No. 00159 .... **$29.00**

WRITE FOR CATALOG 4400

SIMPSON ELECTRIC COMPANY • 853 DUNDEE AVENUE • ELGIN, ILLINOIS 60120 • (312) 697-2260

Simpson®

INSTRUMENTS THAT STAY ACCURATE

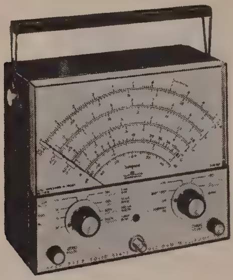
TEST EQUIPMENT

MODEL 314 SOLID-STATE FET VOM

Battery operated. Completely portable. Measures low power and conventional ohms. Voltage ranges have 10 MΩ and 100 MΩ input impedances. AC and DC ranges from 10 μA F.S. 58 ranges available. 7-inch anti-parallax mirror scale provides exceptional readability. Complete with X1, X10 (AC/DC/Ohms) probe #00194, a $33.00 value, batteries and manual **$220.00**

30 KV DC Probe, Catalog No. 00196 .... **$22.00**

RF Probe (10 kHz - 250 MHz, ±1 dB) Catalog No. 00193 .... **$13.75**



MODEL 313 SOLID-STATE FET VOM

11 MΩ DC input. Battery operated. Extra high impedance: 10 MΩ AC and DC. Operates 300 hours on a single set of batteries. All voltage ranges fully overload protected. Large, easy-to-read 7" scale. Built-in "battery check" switch. Self-shielding movement. Complete with AC/DC probe, batteries and manual **$155.00**

30 KV DC Probe, Catalog No. 00192 .... **$22.00**

RF Probe, Catalog No. 00193 .... **$13.75**

MODEL 303-3XL SOLID-STATE FET VOM

For field and factory electronic servicing as well as for design and components testing. FET, IC and LED are coordinated in an all solid-state circuitry to achieve high input impedance, high sensitivity and drift-free performance. High impact, shock resistant case. Conventional and low-power ohms selection. Automatic LED polarity and power-on indication. AC line or battery operation. 120-220V AC charger supplied. Complete with probe, test leads, battery, charger and manual **$165.00**

30 KV DC Probe, Catalog No. 00074 .... **$23.25**

WRITE FOR CATALOG 4400

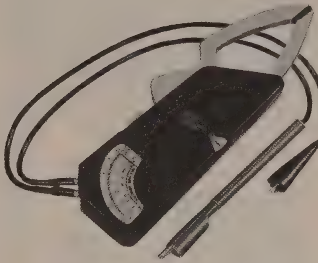
SIMPSON ELECTRIC COMPANY • 853 DUNDEE AVENUE • ELGIN, ILLINOIS 60120 • (312) 697-2260

TEST EQUIPMENT

Simpson®

INSTRUMENTS THAT STAY ACCURATE

AMP-CLAMP® MODELS 294, 295, 296



For faster, easier locating of grounds and shorts in motors, relays, transformers and control circuits. Load balance tests and AC current measurements are made with Amp-Clamps without equipment shut-down or power line interruption.

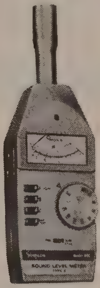
Model 294 Ammeter measures AC current, complete with manual **$43.00**

Model 295 Volt-Ammeter measures AC current and voltage. Complete with test leads and manual **$50.00**

Model 296 Volt-Ohm-Ammeter measures AC current, voltage and resistance. Complete with test leads, one 1.5V AAA alkaline battery, ¼-Amp Type 8AG fuse and spare and manual **$71.50**

Model 151 Line-Splitter with 2-ft. line cord, 3-prong plug and manual, Catalog No. 00534 .... **$7.15**

MODEL 886 SOUND LEVEL METER TYPE 2



Quickly, accurately measures noise and sound levels in factories, offices, stores, theaters, auditoriums, construction sites, studios. Simple, easy to operate. Helps you meet stringent OSHA and Walsh-Healy specifications for noise control. Meets the requirements for IEC 123 and ANSI specifications S1.4-1971 for Type 2 General Purpose Sound Level Meters. Rugged, all solid-state reliability, battery operated. Full coverage 40 to 140 dB, with special 85 to 115 dB, fast or slow OSHA range with standard A, B, C weightings selection. High impact case. Omnidirectional microphone. Complete with batteries and manual **$250.00**

MODEL 884 SOUND LEVEL METER TYPE S2A

50 to 130 dB range. Conforms to ANSI S1.4-1971 Type S2A. Rugged, high impact case. Solid-state construction. Complete with batteries and manual.... **$195.00**

MODEL 890 CALIBRATOR

For calibrating Simpson Models 884 and 886 Sound Level Meters and other microphone-instrument systems. Hand-size, self-contained, single switch control, built-in LED battery test indicator **$100.00**

WRITE FOR CATALOG 4400

SIMPSON ELECTRIC COMPANY • 853 DUNDEE AVENUE • ELGIN, ILLINOIS 60120 • (312) 697-2260

Insulation Testers

WRITE FOR DATA SHEETS ON THE INSTRUMENTS SHOWN . . . ALL ARE STANDARD PRODUCTION MODELS, AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK . . . LET US QUOTE ON YOUR REQUIREMENTS FOR MODIFIED UNITS OR SPECIAL TEST EQUIPMENT.

SLAUGHTER CO.
MOORE & HAILEY STREETS
ARDMORE, OKLAHOMA
TELEPHONE: 405-223-4773 TWX: 910-830-6972

High-voltage Insulation Tester

with buzzer signal on breakdowns
. . . grounds
. . . . shorts

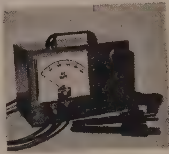
MODEL **101**

Watch what you are doing . . . not the tester

SIX TEST VOLTAGES . . 500 to 2500 V.A.C. PRICED SO YOU CAN AFFORD TO SPOT A FEW ALONG YOUR ASSEMBLY LINES.

Adjustable High-voltage Tester

with buzzer signal on breakdowns
. . . grounds
. . . . shorts



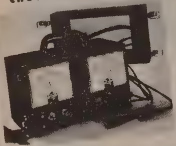
MODEL **106**

Voltmeter shows actual Test Voltage

CONTINUOUSLY VARIABLE TEST VOLTAGE RATINGS TO 10,000 VOLTS AC & DC . . RECOMMENDED FOR BREAKDOWN TESTING AT FINAL ASSEMBLY AND INSPECTION

High-voltage Leakage Tester

checks insulation for . . . leakage
. . . grounds
. . . . . arcing



MODEL **122**

16 lb. Portable for lab and field work

VARIABLE VOLTAGE RATINGS TO 2.5 KV AC & DC. DUAL RANGE LEAKAGE METER 0/100/1000μa. . . .CAPACITY COMPENSATION. . . MEASURES INSULATION RESISTANCE, CAPACITY, POWER FACTOR.

High-voltage Leakage Tester

audibly signals excess leakage
. . . grounds
. . . . . arcing

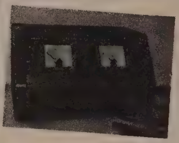
MODEL **103**

Measures Leakage . . . not capacity current

TEST VOLTAGE CONTINUOUSLY VARIABLE ADJUSTABLE LEAKAGE LIMIT. . CAPACITY COMPENSATION ON AC TESTS. . .RATINGS TO 10,000 VOLTS AC & DC. . . . LIMITED ENERGY. . NON-DESTRUCTIVE. . . FOR LAB AND PRODUCTION LINE SERVICE. . . . . .

Automatic H-V Insulation Tester

for precision checking . . . breakdowns
. . . leakage
. . . grounds



MODEL **103-MP**

Automatic Test Cycle

FULLY AUTOMATIC TEST CYCLE. . . CONTROLLED RATE-OF-RISE. . . ADJUSTABLE TEST VOLTAGE, DWELL TIME, & LEAKAGE LIMIT. . . CAPACITY COMPENSATION ON AC TEST. . . FOR PRECISION TEST OF CRITICAL PARTS & ASSEMBLIES. . .

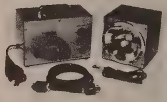
Stroboscopes

WRITE FOR DATA SHEETS ON THE INSTRUMENTS SHOWN . . . ALL ARE STANDARD PRODUCTION MODELS, AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK . . . LET US QUOTE ON YOUR REQUIREMENTS FOR MODIFIED UNITS OR SPECIAL TEST EQUIPMENT.

SLAUGHTER CO.
MOORE & HAILEY STREETS
ARDMORE, OKLAHOMA
TELEPHONE: 405-223-4773 TWX: 910-830-6972

Inspection Stroboscope

. . . with extra high intensity daylight lamp



MODEL **167**

0/600 Flashes per Minute

SUPER INTENSITY TRIGGERED FLASH UNIT ... PUSH—TO—SEE SWITCH.... FOR INSPECTION ON-THE-GO UNDER HIGH AMBIENT LIGHT CONDITIONS.

Inspection Stroboscope

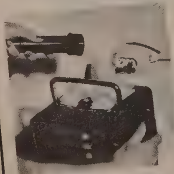
. . . . . with high intensity daylight lamp

MODEL **161**

0/2,000 Flashes per Minute

LIGHT WEIGHT INEXPENSIVE TRIGGERED FLASH UNIT. . . . .PUSH-TO-SEE SWITCH. . . . INTENSE WHITE LIGHT FOR INSPECTION ON —THE —GO

MIDGET STROBOSCOPE FLASH HEAD



MODEL **166**

0/10,000 Flashes per Minute

FOR WORK ON MINIATURIZED EQUIPMENT .... FOR PRINTING TRADES. . . . FOR BIO—MEDICAL WORK. . ADAPTS TO ANY SLAUGHTER STROBOSCOPE. . .

Universal Stroboscope

. . . with high intensity daylight lamp

MODEL **163**

110/25,000 Flashes per Minute

UNIVERSAL UNIT FOR MOTION STUDY & INSPECTION ON-THE-GO . . . INSTANT STARTING ... HIGH INTENSITY WHITE LIGHT .... TRIGGER EXTERNALLY OR OPERATE FROM INTERNAL OSCILLATOR

Metered Precision Stroboscope

. . . . . with high intensity daylight lamp

MODEL **165**

110/25,000 Flashes per Minute

PRECISION STROBOSCOPE TACHOMETER INSTANT STARTING. . .HIGH INTENSITY WHITE LIGHT. . . OPERATES FROM EXTERNAL CONTACTS OR INTERNAL OSCILLATOR. . EASILY SYNCHRONIZED. .OUTPUT JACKS TO COUPLE SCOPE, ETC....

Coil & Winding Testers

WRITE FOR DATA SHEETS ON THE UNITS SHOWN ALL ARE STANDARD PRODUCTION ITEMS, AVAILABLE FOR EARLY DELIVERY . . . LET US QUOTE ON YOUR REQUIREMENTS FOR MODIFIED UNITS OR SPECIAL TEST EQUIPMENT.

SLAUGHTER CO.
MOORE & HAILEY STREETS
ARDMORE, OKLAHOMA
TELEPHONE: 405-223-4773 TWX: 910-830-6972

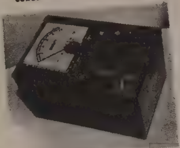
Precision Linear Ohmmeter
. . . . for accurate resistance testing

SERIES **203**

0.1 to 5000 Ohms Range

LINEAR RESISTANCE SCALES . . . CONTINUOUSLY SELF-CHECKING . . . GO/NO-GO LIMIT STYLE WITH BUZZER REJECTION SIGNAL.

High Energy Coil Tester
SURGE TESTS COILS FOR . . SHORTS . . GROUNDS . . OPENS

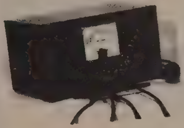


SERIES **640**

High Level Tester

DETECTS WEAKNESSES AS WELL AS DEFECTS . . . USE WITH CORE OR SOLENOID TYPE COILS . . . REQUIRES NO OPERATOR SKILL.

Adjustable Limit Megohmmeter
. . . . . with buzzer signal on rejections



SERIES **205**

1 to 20,000 Megohms

DRIFT FREE . . . NO WARM-UP . . . RUGGED TAUT BAND MOVEMENT . . . ADJUSTABLE REJECTION LIMIT WITH BUZZER SIGNAL.

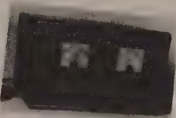
Universal Comparator
tests coils and windings for impedance
. . . . . shorts
. . . . . opens
. . . . turns

SERIES **635**

0.1 Percent Sensitivity

COMPARES COILS AND WINDINGS WITH STANDARD ON HIGH PRODUCTION GO/NO-GO BASIS . . . EXCELLENT AS A TURNS COUNT CHECKER . . .

Adjustable HI Voltage Surge Tester
tests coils and windings for shorts
. . . grounds
. . . . . opens



SERIES **648**

Ratings to 5000 Volts

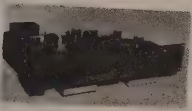
DIRECT READING PULSE-SURGE TESTER . . . REQUIRES NO ACTIVE MASTER . . . PRECISE ENERGY CONTROL . . . GO/NO-GO OPERATION FOR UNSKILLED PERSONNEL . . .

Automatic Test Equipment

WRITE FOR DETAILS ON THE EQUIPMENT SHOWN THESE ARE FULLY ENGINEERED, PROVEN, STANDARD DESIGNS AVAILABLE ON A REASONABLE DELIVERY SCHEDULE . . . LET US QUOTE ON YOUR REQUIREMENTS . . .

SLAUGHTER CO.
MOORE & HAILEY STREETS
ARDMORE, OKLAHOMA
TELEPHONE: 405-223-4773 TWX: 910-830-6972

Automatic Test Sequence Controller

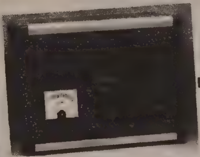


SERIES **910**

Brain Package

FULLY AUTOMATIC CONTROLLER WITH START — ACCEPT — REJECT — DELAY — SKIP — STOP — RESET FUNCTIONS . . . SELF-TIMING . . . PROGRAMMABLE.

Automatic Cable & Harness Tester
for continuity . . . breakdowns



SERIES **706**

Expandable to 50 Circuits

FULLY AUTOMATIC PROGRAMMABLE UNIT FOR HIGH PRODUCTION ON SIMPLE ASSEMBLIES . . . GO/NO-GO OPERATION . . . ADJUSTABLE LIMITS.

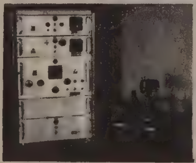
Automatic Cable & Harness Tester
for continuity . . . breakdowns
. . . megohms

SERIES **707**

Expandable to 10,000 Circuits

INTERCHANGEABLE PROGRAM BOARDS FOR RAPID SET-UP CHANGES . . . MODULAR CONSTRUCTION . . . TESTING RATES TO 200 CIRCUITS/MINUTE . . . ALL LIMITS ADJUSTABLE.

Automatic Wound Armature Tester
for insulation weakness...opens
...grounds...shorted turns



SERIES **930**

600 Parts Per Hour

CHECKS WOUND ARMATURES ON GO/NO-GO BASIS AT HIGH PRODUCTION RATES . . . HIGHLY EFFECTIVE PULSE-SURGE TEST SPOTS WEAKNESSES AS WELL AS DEFECTS.

Automatic Cable & Harness Tester
tape programmed...random access

SERIES **709**

Expandable to 10,000 Circuits

FULLY-AUTOMATIC TAPE-PROGRAMMED UNIT FOR HIGH PRODUCTION TESTING SIMPLE OR COMPLEX CABLES, HARNESSES, PRINTED CIRCUIT BOARDS . . . ALL TYPES OF ASSEMBLIES. GO/NO-GO OPERATION.

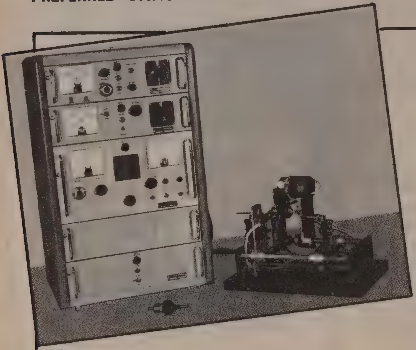
PRICE LIST

EFFECTIVE DATE 6-1-74

AUTOMATIC ARMATURE TESTERS
AUTOMATIC STATOR TESTERS

PREFERRED UNITS

SLAUGHTER Company
MOORE & HAILEY STREETS
ZIP 73401
ARDMORE, OKLAHOMA
TELEPHONE 405-223-4773
P. O. BOX 1805
TWX 910-830-6972



AUTOMATIC ARMATURE TESTERS — Series 930 equipment is high-speed fixed program self-sequencing equipment, particularly useful for in-line test stations. Test program includes low-level resistance tests, particularly effective for detection of poor connections and opens; high-level surge tests for detection of internal insulation weaknesses and shorts; and Hi-Pot tests. Systems intended for testing double-insulated armatures can also be used on single-insulated parts. Hi-Pot test levels on double-insulated systems are independently adjustable for iron/shaft and iron/com tests. Consequential tests from com to shaft is sum of voltages applied from iron-to-com and iron-to-shaft. Alternately operative dual-fixture systems provide maximum production rates as idle fixture can be unloaded and loaded while opposite fixture is testing.

Series 920 Analytical Type Equipment also available. Incorporates growler tests as well as the above tests. Contact factory for information.

By substituting the proper fixtures, Automatic Armature Testers can be used for testing motor fields. When used in this manner, poor connections and opens will be detected, as will be internal insulation weaknesses, reversed coils (but not reverse polarity on entire field) and grounds.

STK. #AAT-21 SERIES 930 EQUIPMENT
0/2000 VAC HI-POT TEST
0/1500 VP SURGE TEST
FOR SINGLE-INSULATED PARTS
SINGLE-FIXTURE
SYSTEM $4,844.00

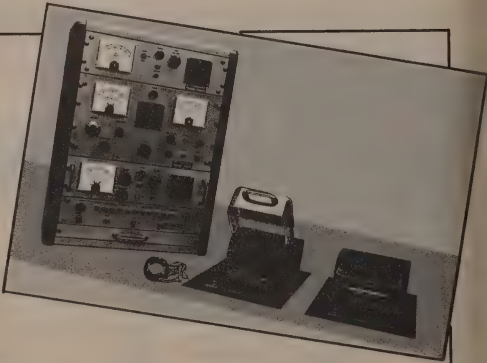
STK. #AAT-22 SERIES 930 EQUIPMENT
0/2000 VAC HI-POT TEST
0/1500 VP SURGE TEST
FOR SINGLE-INSULATED PARTS
DUAL-FIXTURE STYLE ... $6,625.00

STK. #AAT-31 SERIES 930 EQUIPMENT
0/2000 VAC HI-POT TEST
0/1500 VP SURGE TEST
FOR DOUBLE-INSULATED ARMS.
SINGLE-FIXTURE
EQUIPMENT $5,117.00

STK. #AAT-32 SERIES 930 EQUIPMENT
0/2000 VAC HI-POT TEST
0/1500 VP SURGE TEST
FOR DOUBLE-INSULATED ARMS.
DOUBLE-FIXTURE
STYLE $6,898.00

AUTOMATIC STATOR TESTERS — Series 910 Systems are applicable to all types of wound stators from salient-pole portable tool types through split-phase and 3-phase fractional horsepower types. Program includes dual voltage Hi-Pot; winding resistance, programmable for two different values; winding polarity; and surge test.

Series 930 is fixed-program, self-sequencing equipment intended primarily for the testing of salient-pole stators of the type used in portable tools, mixers and similar appliances. These systems apply Hi-Pot tests to ground; resistance test; and surge test. The surge test will detect internal insulation weaknesses and reversed coils. However, it will not detect reverse polarity on the entire stator.



STK. #AST-01 SERIES 910
0/2000 VAC HI-POT TEST
0.1/1,111-OHM RESISTANCE TEST
POLARITY (ROTATION) TEST
0/1500 VP SURGE TEST
SINGLE-FIXTURE SYSTEM ...$9,021.00

STK. #AST-02 SERIES 910
0/2000 VAC HI-POT TEST
0.1/1,111-OHM RESISTANCE TEST
POLARITY (ROTATION) TEST
0/1500 VP SURGE TEST
DUAL-FIXTURE SYSTEM $11,056.00

STK. #AST-31 SERIES 930
0/2000 VAC HI-POT TEST
0.1/1,111-OHM RESISTANCE TEST
0/1500 VP SURGE TEST
SINGLE-FIXTURE SYSTEMS .$5,310.00

STK. #AST-32 SERIES 930
0/2000 VAC HI-POT TEST
0.1/1,111-OHM RESISTANCE TEST
0/1500 VP SURGE TEST
DUAL-FIXTURE SYSTEMS $7,354.00

Prices listed here include guarded fixtures, but do not include tooling. Interchangeable tooling for stators up to 7″ diameter will be quoted on request. Optional features available in the above equipment include turns count test and high or low-level continuity test. Contact factory for information.

TEST WITH CONFIDENCE

10

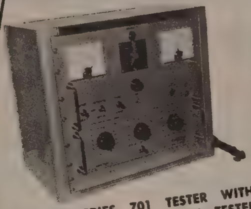
PL-7408

Better Production Testing

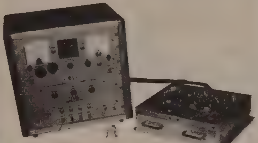
TYPICAL AUTOMATIC & SEMI-AUTOMATIC TEST EQUIPMENT CUSTOM ENGINEERED AND BUILT FOR SPECIFIC PRODUCTION TESTING JOBS. CONTACT US FOR PROMPT RECOMMENDATIONS AND QUOTATIONS ON YOUR REQUIREMENTS.

SLAUGHTER CO.
MOORE & HAILEY STREETS
ARDMORE, OKLAHOMA
TELEPHONE: 405-223-4773 TWX 910-830-6972

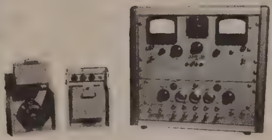
AUTOMATIC TESTERS FOR DYNAMIC TESTING OF FHP MOTOR CENTRIFUGAL STARTING SWITCHES . . . DUPLEX MACHINES ACHIEVE PRODUCTION RATE OF 900 PARTS PER HOUR.



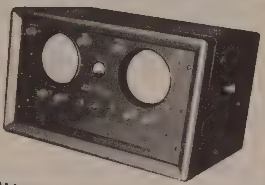
SPECIAL SERIES 701 TESTER WITH SERIES 105-MP INSULATION TESTER FOR CHECKING MULTI-CIRCUIT GYRO ASSEMBLIES.



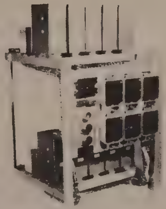
SERIES 920/648 TEST SYSTEM FOR CHECKING AUTOMOTIVE WINDSHIELD WASHER PUMP ASSEMBLIES . . . TOTAL TEST CYCLE TIME UNDER 2 SECONDS.



SERIES 920/646 TEST SYSTEM FOR TESTING AUTOMOTIVE STARTER FRAME ASSEMBLIES . . . DUAL FIXTURE DUPLEX MACHINES . . . PRODUCTION OVER 1000 PARTS HOURLY.

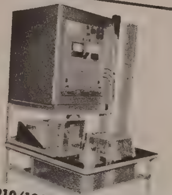


BALANCING MACHINE CONTROL UNIT DISPLAYS UNBALANCE ON BOTH ENDS OF MINIATURE MOTOR ARMATURE SIMULTANEOUSLY.

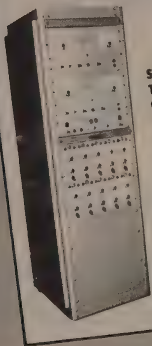


SPECIAL SERIES 910 SEQUENCE CONTROLLER FOR BURN-IN RACK, 50 CIRCUITS, 10 POSITIONS WITH AUTOMATIC FAILURE INDICATION AND CUT-OUT.

SERIES 707 SYSTEM FOR CHECKING PRINTED CIRCUIT BOARDS FOR CONTINUITY . . . INSULATION . . . PLATING INTEGRITY . . . 100 CIRCUITS AT LESS THAN ½ SECOND EACH . . . FULLY AUTOMATIC TEST CYCLE . .



SERIES 910/106 TEST SYSTEM CHECKS TWO SPEED VACUUM CLEANER MOTOR ASSEMBLIES FOR WATTAGE . . . INSULATION BREAKDOWN . . . VACUUM . . . ETC. . . . OVER 300 PARTS PER HOUR . . .



SERIES 910/103/105 TEST SYSTEM FOR GROUP CHECKING OF MULTIPLE WINDING SERVOS. TESTS WINDING TO WINDING AND WINDINGS TO GROUND FOR BREAKDOWN AND MEGOHMS.

SLAUGHTER Company ARDMORE, OKLAHOMA

TEST SYSTEMS SUCH AS THESE ARE CREATED BY COMBINING OUR STANDARD FIELD TESTED AND REFINED UNITS AS NECESSARY TO DO THE JOB AT HAND. WHEN YOU COME TO US FOR A TEST SYSTEM, YOU DO NOT HAVE TO PAY FOR ENGINEERING THE JOB FROM THE BOTTOM UP, NOR DO YOU HAVE TO LIVE THROUGH AN EXTENSIVE DE-BUGGING PERIOD.

TEST WITH CONFIDENCE

SERIES 910/648/633 /103 TEST SYSTEM FOR COMPLETE AUTOMATIC CHECK OF MINIATURE POLYPHASE MOTOR FIELD ASSEMBLIES, FOR IMPEDANCE, INSULATION WEAKNESSES, ROTATION, ETC.

BPT 11-67

SPRAGUE TEST EQUIPMENT

TO-6A TEL-OHMIKE® CAPACITOR ANALYZER

The TO-6A TEL-OHMIKE capacitor analyzer is a must for checking all capacitors. It is a moderately priced instrument with laboratory quality and accuracy — the highest accuracy of any instrument of its type available!

- **CAPACITANCE BRIDGE** measures up to 2000 μF. Five overlapping ranges include exclusive 1 pF to 100 pF range. Special shielded transformer for bridge voltage. Extremely low AC voltage; 1.35 volts for electrolytic capacitors, 2.85 for all others, permits safe testing of all low voltage capacitors.
- **INSULATION RESISTANCE** of paper, ceramic, and mica capacitors rated 25V and higher directly read on large meter. No guessing with neon lamps. Dual range—to 10KMΩ@ 25V for low voltage units . . . to 50KMΩ@ 150V for higher voltage components. Fast charge feature speeds testing of high capacitance units.

- **LEAKAGE CURRENT** of electrolytics measured directly on meter. Four ranges; .06, .6, 6, and 60mA. Three ranges of DC voltage (continuously variable within each range) permit testing capacitors at exact rated voltage up to 600 volts.
- **POWER FACTOR** of electrolytics, up to 50% measured by Wien Bridge.
- **METER PROTECTOR** of solid-state design allows severe accidental over-loads without burn-outs.
- **MAGIC-EYE TUBE** simplifies bridge balancing for capacitance and power factor measurements. High gain amplifier provides greatly improved sensitivity.
- **PUSH-BUTTONS** color-keyed for instant range selection.
- **MODERN CASE:** Silver-grey hammertone finish, panel is charcoal grey with highly contrasting white designations. Measures 8⅞" high, 14⅝" wide, 6⅛" deep. Weight only 13 pounds.

MODEL TO-6A .... **115 VAC/50-60 cy**
MODEL TO-6AS.......... **115-230V/50 cy**

Call Your Sprague Distributor for Current Prices

TEL-OHMIKES FOR RACK MOUNTING

Electrically identical to TO-6A and TO-6AS. These models have a standard 19"w. x 10½"h. panel so that it can be mounted in standard relay racks.

MODEL TO-6ARM..........**115 VAC/50-60 cy**
MODEL TO-6ASRM..........**115-230 V/50 cy**

Call Your Sprague Distributor for Current Prices

M-3 MIKE-O-METER® MOTOR CAPACITOR ANALYZER

- **ACCURATELY MEASURES** capacitance and power factor of any motor-starting, motor-running capacitor or any other capacitor within the range of .1 μF to 1000 μF. Uses the highly reliable Wien Bridge method.
- **SIMPLIFIES** capacitor testing for the air conditioning, refrigeration, and electric motor technician.
- **DIRECT READINGS** on highly visible, calibrated scales.
- **MAGIC EYE** tube makes bridge-balancing easy.
- **SAFE OPERATION** is assured by the automatic discharge of the capacitor when test switch is released. The M-3 is transformer operated. Instrument case is isolated from AC line.
- **BUILT FOR SERVICE** and a long dependable life, whether in your shop, or on the job in the field.
- **COMPONENTS IN THE M-3** were selected to provide reliability. Highest quality capacitors and resistors are used. The power transformer is specially treated to resist moisture.
- **ELECTRON TUBES** resistant to shock and vibration were chosen for the M-3. They can be obtained from any electronic parts distributor.
- **ALSO CHECKS** capacitors for open, shorted, or intermittent conditions.
- **SLOPING PANEL** and recessed eye designed to improve visibility, especially when working in lighted areas.
- **STEEL CASE** measures 9 inches high, 6 inches wide and 5¾ inches deep. Has folding metal carrying handle. Weighs only 6 pounds.
- **ATTRACTIVELY FINISHED** in blue hammerloid. Panel is light grey with black markings.

SPRAGUE MIKE-O-METER®

MODEL M-3, 110-125 VAC, 50/60 CYCLES. . . . .
MODEL M-3S, 110-125/220-230 VAC, 50-60 CYCLES. . . .
PROTECTIVE VINYL COVER, Cat. No. CV-3 . . . .

Call Your Sprague Distributor for Current Prices

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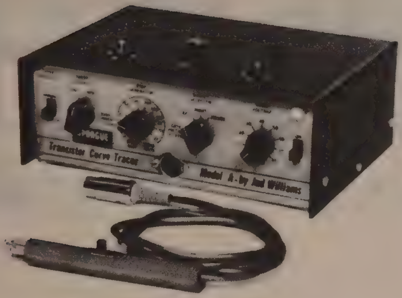
IND-EEM-65-EBAE

All sizes subject to change without notice.

SPRAGUE TEST EQUIPMENT

MODEL A TRANSISTOR CURVE TRACER



SPECIFICATIONS

V_{CE} (voltage, collector-to-emitter): Variable from 0-80V peak. Full wave rectified pulsating DC @ 120Hz.

I_B (base current): Six steps displayed simultaneously. Variable from 10μA/step to 1mA/step (5mA max.) in a 1-2-5 sequence.

V_{GS} (gate-source voltage): Six voltages displayed simultaneously with ranges of 0.2V/step, 0.5V/step, and 1/Vstep.

Dissipation limiting: Collector current limited by 2200Ω load resistor.

Collector current sensing resistor: 100Ω.

Staircase generator: Six steps, 1V/step.

Bias adjustment: Staircase generator offset control establishes zero base line location for bipolar transistors and identifies pinch-off voltage of FETs. Variable over a range of 5V.

Power: 105-125V, 50/60Hz.

Size: 8+″ W. x 3½″ H. x 6½″ D.

Weight: 3 lbs. 5 oz. (shipping wt. 4 lbs.)

. . . tests semiconductors on-board!

One of the best solutions to the problem of transistor and/or printed wiring board damage while removing and re-soldering transistors for test purposes is on-board testing by using **Signatory Pattern™** techniques.

WHAT IS A SIGNATURE PATTERN™? It is a scope readout of the dynamic impedance of a transistor. This unique method eliminates the uncertainties inherent in conventional test methods. With the Model A, the transistor under test is actually turned on, not merely made to oscillate as with most test techniques. The "Signature Pattern" method provides the user with these definite advantages: (1) Quick, decisive, "good-or-bad" tests of suspect transistors; (2) Indication of defective components within transistor circuits even when transistors are good; (3) Elimination of damage to transistors and other components during test; (4) Safe testing with system power removed.

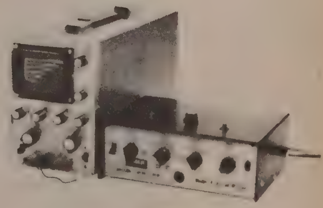
QUICK, SAFE, ACCURATE TESTS. Connect the Model A to any general-purpose oscilloscope and you have the most complete semiconductor testing facility possible at a budget price. You can determine at a glance such parameters as gain, linearity, saturation, avalanche point, and leakage. No zeroing or balancing is necessary. The Model A also performs the all-important breakdown voltage test. It will identify a transistor type as either silicon or germanium. In addition, it will analyze a field-effect transistor as either junction-type or insulated gate, as well as determine the pinch-off voltage.

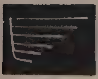
SIMPLE, EASY-TO-USE. All tests made with the Model A are non-destructive, even if performed incorrectly. You cannot damage a transistor – even if it is plugged in backward! The Model A is short-circuit-proof, is generally immune to external effects, and supplies its own test signals. Controls are designed for easy interpretation, and extensive knowledge of semiconductors is not required in order to use the instrument effectively. Working with the Model A is an education in itself.

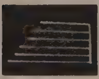
CALL YOUR SPRAGUE DISTRIBUTOR
FOR CURRENT PRICES

Special three-prod probe contacts a transistor in place on a printed wiring board, producing telltale "signature pattern" on oscilloscope.

The Sprague Model A Transistor Curve Tracer teams up with a general-purpose oscilloscope to become a complete semiconductor testing facility.




NPN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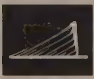
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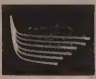
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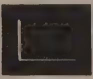
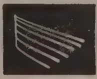
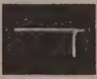
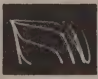
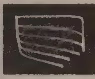
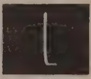

ZENER


LEAKAGE


BREAKDOWN


IN-CIRCUIT


REACH THROUGH


DIODE

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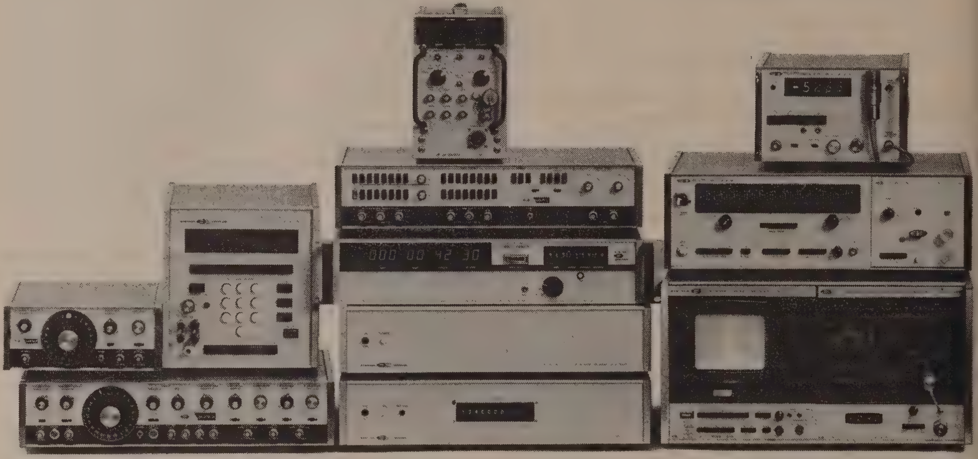
SYSTRON -DONNER



Systron-Donner manufactures one of the industry's broadest ranges of electronic instrumentation, systems and components. This year an exceptional number of new products will be introduced by S-D's various divisions. All of these high performance products are described in meticulous detail in our 1975/76 general instrument catalog . . . free for the asking. In addition, supplemental catalogs on certain product lines and descriptive brochures on all product lines may be requested.

S-D's 256-page Instrument Catalog covers:

MEASUREMENT. Counters, low frequency to microwave; DVM/Multimeters, 3½ digit to 5½ digit for bench, field and systems; digital power meter; digital L-C meter; NMR and Hall effect gaussmeters.

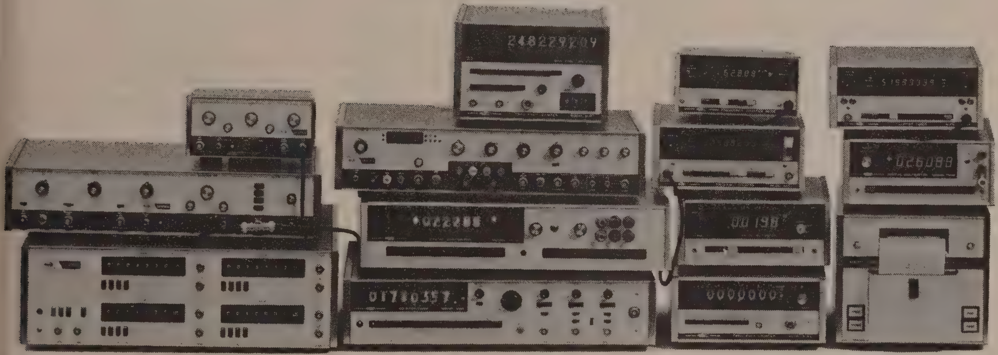
SIGNAL SOURCES. Pulse generators; data generators, function generators, sweep generators, microwave frequency synthesizers, time interval generators.

TESTERS. VERSATESTER™, a multi-function "test lab" in one self-contained low cost unit; CATSystems, computer-automated test systems for PC boards and instruments. Digital transitional redundancy tester (TRT).

TIMING. Time code generators, readers, tape search and control units, digital clocks. For a more detailed description of time code products, request catalog.

1975:

Year of the new product



ANALYZERS. Spectrum analyzers, audio to microwave, waveform analyzers.

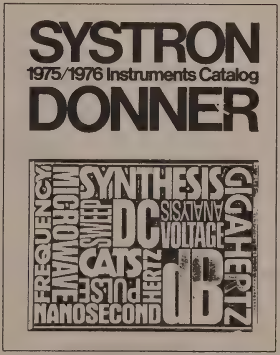
VOLTAGE STANDARDS. Precision digital voltage sources.

POWER SUPPLIES. DC laboratory, bench and OEM designs (request separate "Power Supply" catalog).

PRINTERS. General purpose digital printers.

COMPUTERS. Analog; hybrid simulators, DFG's and computing modules.

MICROWAVE COMPONENTS. A wide selection of waveguide and coax items covering DC to 140 GHz. Request separate 112-page catalog.



SYSTRON
1975/1976 Instruments Catalog
DONNER

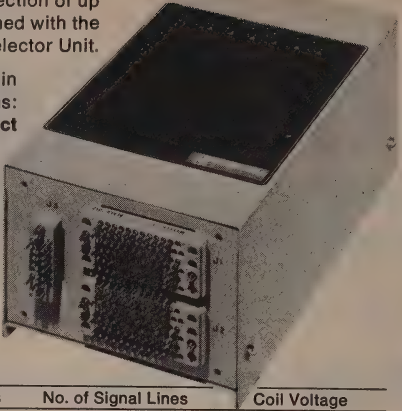
To request catalog: Contact your Scientific Devices office (listed in EEM), or Systron-Donner at 1 Systron Drive, Concord, CA 94518. Phone (415) 676-5000. Abroad, contact Systron-Donner GmbH, Munich; Systron-Donner Ltd., Leamington Spa, U.K.; Systron-Donner S.A., Paris (Le Port Marly); Systron-Donner Pty., Melbourne.

SYSTRON DONNER

2900 Series Tbar® Automatic Selector Units

Both random and sequential selection of up to 128 positions is accomplished with the Series 2900 Automatic Selector Unit.

The Series 2900 is available in two basic configurations:
1. TREEselect **2. NORselect**



Configurations

No. of Trunk Lines	No. of Signal Lines	Coil Voltage
1 or 2*	16, 32, 64 or 128**	6, 12, 24, 28, 48, 110 VDC*** and 115 VAC

*Selector units with two trunk lines can be specified with twisted pair wiring.
**128 signal line units are available with single trunk lines only.
***Magnetic latching units are available with DC voltages only.

1.0 Mechanical Specifications
- 1.1 **Construction:** The unit consists of a group of T-Bar Relays that are mounted on a common frame, wired together and to input-output connector(s). Each relay has its own T-Bar connectors for ease of maintenance.
- 1.2 **Contact Material:**
  - 1.2.1 **800 Series** Fine silver goldplated 50 millionths min. (bright finish)
  - 1.2.2 **900 Series** Movable contact (common). Fine silver button goldplated, bright silver diffusion bond. Then 5 millionths rhodium plate, then gold, 80 millionths min. Bright finish. Fixed contact (N. C. and N. O.) bifurcated: goldplated 200 millionths min.
- 1.3 **Mechanical Life:** 30,000,000 operations @ 20 cycles per min.
- 1.4 **Finish:** Painted gray per MIL-E-15090B
- 1.5 **Identification:** Pin identification and part number located on enclosure.

2.0 Electrical Specifications:
- 2.1 **Relay Coil Voltage:** 6, 12, 24, 28, 48, 110VDC or 115VAC. All continuous duty.
- 2.2 **Relay Coil Power:** Consult factory.
- 2.3 **Contact Rating:** Microvolts to 600VDC; Resistive load 3 amps @ 115VDC or 28VDC make or break. Consult factory for higher ratings and low level ratings. 1000VDC units available.
- 2.4 **Operate time:** 30 milliseconds max. to set up any relay. (for shorter operate time consult factory)
- 2.5 **Release time:** 10 milliseconds max. to release all relays. With diode suppression release time is 40 milliseconds max.
- 2.6 **Insulation Resistance:** 1000 megohms min. @ 30°C tested between circuits at 500VDC (up to 10,000 megohms min. available, on request).
- 2.7 **Contact Life:** @ 20CPM (derate 50% for relay or solenoid coil loads)
  - 2.7.1 @ 100 ma: 20,000,000 cycles
  - 2.7.2 @ 150 watts, 3 amps resistive: 200,000 cycles
  - 2.7.3 @ 3 amps, 115VAC Resistive: 100,000 cycles
- 2.8 **Dielectric Withstanding Voltage:** 1000 VAC between circuits and any circuit to enclosure.
- 2.9 **Relay Coil Overvoltage:** 120% of rated voltage continuous duty.

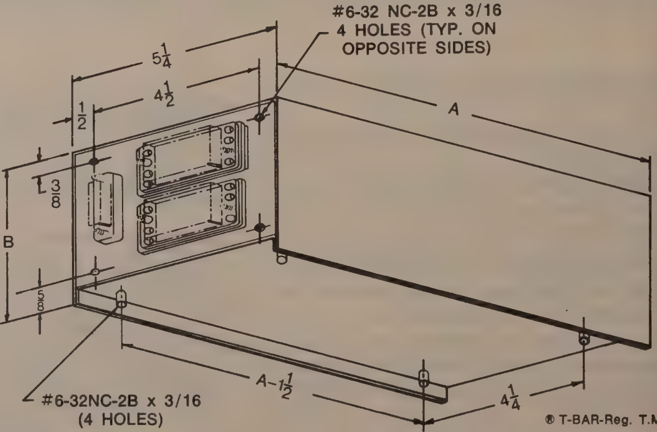
3.0 Available on Special Order:
- 3.1 For extra low level switching applications refer to factory.
- 3.2 **Magnetic Latching**
- 3.3 **Extra High Insulation Resistance:** 10,000 megohms min. Consult factory.
- 3.4 **Other coil voltages available:** Consult factory.
- 3.5 **Lock up circuit:** Consult factory.
- 3.6 **Drivers:** Transistorized or TTL compatible.
- 3.7 **Transient Suppression:** Diode suppression available.
- 3.8 **1000 VDC contact rating**
- 3.9 **Self scan capability**

SCANNER MODEL	HOUSING SIZE	
2801	A	B†
SPT 16	6¾	3¾
SPN 16	6¾	3¾
DPT 16	6¾	3¾
DPN 16	6¾	3¾
SPT 32	8	3¾
SPN 32	8	3¾
DPT 32	8	3¾
DPN 32	8	3¾
SPT 64	9½	3¾
SPN 64	9½	3¾
DPT 64	9½	3¾
DPN 64	11	4⁹⁄₁₆
SPT 128	11	4⁹⁄₁₆
SPN 128	11	4⁹⁄₁₆

†Add 1 inch for Scan Controller model numbers 2809 and 2909.

MATING CONNECTORS

Ask for Information Sheet No. CDS 2900/1/473 for mating connector information



® T-BAR-Reg. T.M.

All items are manufactured under one or more of the following patents: 3206990, 3226508, 3689856

Tbar INCORPORATED
SWITCHING COMPONENTS DIV.
144 Danbury Road, Wilton, Connecticut 06897
Telephone: 203/762-8351

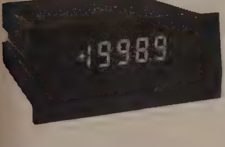
TEKELEC, INC.

2623 Saddle Avenue, Oxnard, California 93030
Tel: (805) 485-5445 TWX: 910-336-1280

LIQUID CRYSTAL DISPLAY DIGITAL PANEL METERS

All of these high performance DPMs have been designed around the most advanced and reliable display ever developed! "Field Effect" Liquid Crystal displays have bigger, more readable numbers and indicators, and only one "active" element — the liquid crystal material itself — to completely eliminate any catastrophic failure modes that can cause the loss of any single element in the display! **There are no filaments or "gas discharge" tubes to burn out!** Complementary custom designed MOS circuitry provides balanced AC drive voltages to extend the life expectancy to over **five years!**

Model TA 310 4½ DIGITS 6 Voltage Ranges 8 Current Ranges



The TA 310 offers full 4½ digit performance and reliability at a price you would expect to pay for a lesser quality 3½ digit unit. Now you can upgrade your instrument performance and actually lower the cost. The Model TA 310 is ideally suited to systems and display-only applications where exceptional accuracy and resolution are required.

Model TA 305 3½ DIGITS 6 Voltage Ranges 8 Current Ranges

Compare the exceptional performance, quality and price of this 3½ digit DPM. With an impressive repertoire of standard and optional features, there's surely a configuration that will precisely match the requirements of your application. The TA 305 will enhance the quality appearance of your product, substantially reduce your initial investment and lower the service cost to you and your customer. Try it. There isn't a better value in 3½ digit DPMs available anywhere.

DC VOLTAGE METERS

MODEL	TA 310-02	TA 310-03	TA 310-04	TA 310-05	TA 310-06	TA 305-02	TA 305-03	TA 305-04	TA 305-05	TA 305-06
Full-Scale Input	±199.99 mV	±1.9999 V	±19.999 V	±199.99 V	±1000.0 V	±199.9 mV	±1.999 V	±19.99 V	±199.9 V	±1000 V
Resolution	10 µV	100 µV	1 mV	10 mV	100 mV	100 µV	1 mV	10 mV	100 mV	1 V
Input Impedance	100 megΩ		10 megΩ			100 megΩ		10 megΩ		
Maximum Input Bias Current @ 23°C	±2 nA	±300 pA	±30 pA	±3 pA	±.3 pA	±300 pA		±30 pA	±3 pA	±.3 pA
Max. Input Bias Current Temperature Coefficient	±2 nA/°C	±150 pA/°C	±15 pA/°C	±1.5 pA/°C	±.15 pA/°C	±150 pA/°C		±15 pA/°C	±1.5 pA/°C	±.15 pA/°C
Maximum Safe Input	24 VDC 17 V RMS	250 VDC or RMS	1000 VDC or peak AC			250 VDC or RMS		1000 VDC or peak AC		
Accuracy @ 23°C ±1°C For 7 Hours	±.02% R. ±.02% F.S.	±.01% R. ±.01% F.S.			±.02% R. ±.01% F.S.	±.05% R. ±.05% F.S.				±.1% R. ±.05% F.S.
Accuracy @ 15°C to 35°C For 1 Year Without Adj.	±.03% R. ±.04% F.S.	±.03% R. ±.02% F.S.	±.04% R. ±.02% F.S.			±.15% R. ±.1% F.S.		±.2% R. ±.1% F.S.		±.3% R. ±.2% F.S.

Now Available: TA 310-01 and TA 305-01 ±20 mV F.S.

DC CURRENT METERS

MODEL	TA 310-12	TA 310-13	TA 310-14	TA 310-15	TA 310-16	TA 310-17	TA 310-18	TA 310-19	TA 305-12	TA 305-13	TA 305-14	TA 305-15	TA 305-16	TA 305-17	TA 305-18	TA 305-19
Full-Scale Input	±199.99 nA	±1.9999 µA	±19.999 µA	±199.99 µA	±1.9999 mA	±19.999 mA	±199.99 mA	±1.9999 A	±199.9 nA	±1.999 µA	±19.99 µA	±199.9 µA	±1.999 mA	±19.99 mA	±199.9 mA	1.999 A
Resolution	.01 nA	.1 nA	1 nA	10 nA	100 nA	1 µA	10 µA	100 µA	.1 nA	1 nA	10 nA	100 nA	1 µA	10 µA	100 µA	1 mA
Shunt Resistance	1 megΩ	100 kΩ	10 kΩ	1 kΩ	100 Ω	10 Ω	1 Ω	.1 Ω	1 megΩ	100 kΩ	10 kΩ	1 kΩ	100 Ω	10 Ω	1 Ω	.1 Ω
Maximum Safe Input	.2 mA	2.2 mA	7 mA	22 mA	70 mA	.22 A	.7 A	2.2 A	.2 mA	2.2 mA	7 mA	22 mA	70 mA	.22 A	.7 A	2.2 A
Voltage Drop	199.99 mV F.S. (nominal)															
Accuracy @ 23°C ±1°C For 7 Hours	±.025% R. ±.04% F.S.	±.025% R. ±.02% F.S.						±.03% R ±.02% F.S.	±.1% R. ±.1% F.S.							
Accuracy @ 15°C to 35°C For 1 Year Without Adj.	±.04% F.S. ±.08% R.	±.05% R. ±.04% F.S.			±.06% R. ±.04% F.S.		±.08% R. ±.04% F.S.	±.13% R. ±.04% F.S.	±.2% R. ±.2% F.S.							±25% R. ±.1% F.S.

To all quoted accuracy specifications add the digitizing uncertainty of ±.5 count. R = Reading F.S. = Full Scale

Specifications may be changed without notice

OPTIONS

Other AC Power Supplies: 220 VAC (Option A1), 240 VAC (Option A2), 100 VAC (Option A3), 125 VAC (Option A4), +5 VDC (Option A5).

A low voltage AC Power Supply that operates from 10.5 VAC, 50-60 Hz is also available for use where UL requirements apply. Contact factory for availability and specifications.

40 Millisecond Measurement Time — Used with 50 Hz power (Option A6)

Input Filter — adds 20 db Noise Rejection. (Option A7)

Fully Isolated Parallel BCD — (Option A8)

Behind-the-Panel Mounting — (Option A9)

Screw Terminal Input/Output — (Option A10)

Reflective Display — Reduces power requirements (Option A11)

Colored Display Characters — (Option A12)

Special Reading Rates — (specify) (Option A13)

GENERAL SPECIFICATIONS

Analog Input
Configuration — Two wire floating input
Polarity — Bipolar, automatic

Display
Type — Field Effect transmissive liquid crystal, single plane, non-blinking, 7-segment. (For reflective display, see Option A11)
Digits — 4½ (±19999) digits, .5″ high (Model TA 310)
3½ (±1999) digits, .5″ high (Model TA 305)
Decimal Point — 4 selectable locations
Color — White on black background (For colored numerals, see Option A12)
Overflow Indication — All display segments flash

A-D Conversion
Type — **Poly-Tek™** Conversion System
Measurement Period — 33.3 milliseconds (see Option A6)
Reading Rate — 2 readings/second or by external read command (For faster rates, see Option A13)

Noise Rejection
Common Mode Rejection — Greater than 80 db, DC to 60 Hz
Common Mode Voltage: 220 V RMS relative to Earth Ground (or digital low with Option A8)
Normal Mode Rejection — 40 db at line frequency (60 db with input filter Option A7)

Response Time — 10 ms to 0.1% for full scale step input

Calibration — Zero and Full Scale Screwdriver adjustments accessible from front by removing snap-on bezel

Outputs
BCD Data — Serial, non-isolated. Includes Data, Polarity and Overflow (For isolated parallel outputs, see Option A8)
Clock — 600 KHz, non-isolated (500 KHz with Option A6)

Controls
Decimal Point — Selectable at input connector
External Hold-Read — Holds previous reading until new reading is initiated. Single reading may be triggered

Environmental
Operating — 0°C to +55°C, 80% relative humidity
Storage — 40°C to +85°C

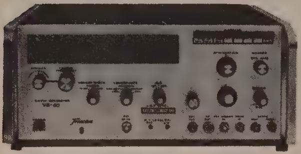
Power — 117 VAC ±10%, 60 Hz, 1.5 watts nominal. With reflective display (Option A11) power reduced to .95 watts nominal (See Options A1, A2, A3, A4 and A5)

Mechanical
Size — 3.880″W (98.55mm) x 1.670″H (42.41mm) x 4.280″D (108.71mm) behind panel, including connector protrusion
Panel Cutout — 3.890″W x 1.682″H ±.010″ (98.80mm W x 42.72mm H ±.25mm)
Case Material — All metal case with high-impact plastic decorative bezel

Mating Connectors (optional accessories)
Standard — Cinch Type 251-15-30-160 or TEKELEC P/N 211002802
For Parallel BCD (Option A8) — Cinch Type 251-18-30-160 or TEKELEC P/N 211002801

Sweep Generators. Spectrum Analyzers. Oscil

Texscan was incorporated on May 10, 1965 to engage in the design and manufacture of instruments and components for the electronic industry. The original line was limited to only a few of the products presently produced and consisted principally of sweep signal generators, display oscilloscopes and various coaxial and microwave components. Today, Texscan offers a complete line from a single source.



VS SERIES - SWEEP/SIGNAL GENERATORS

The VS series sweep/signal generators are completely solid state, low distortion, wide sweep instruments containing sufficient features for wide application in the industry. These include variable sweep rate capability, excellent linearity, with attenuated outputs and have extensive marker capability. The unit shown is the VS-60, and its controls are typical. Controls may be deleted or rearranged on other units. This line includes instruments with extensive tuning range.

Model	Frequency Range
VS-20	500 Hz to 25 MHz
VS-30A	300 kHz to 100 MHz
VS-40A	1 MHz to 300 MHz
VS-50A	5 MHz to 500 MHz
VS-60B	5 MHz to 1000 MHz
VS-80	1 MHz to 1200 MHz
VS-80DH	0.5 MHz to 1200 MHz
VS-90B	5 MHz to 2350 MHz
VS-340	3.6 GHz to 4.3 GHz 5.8 GHz to 6.5 GHz

WB SERIES - SWEEP/SIGNAL GENERATORS

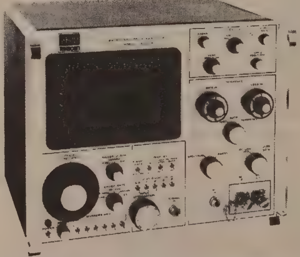
The WB series sweep signal generators are designed to make swept measurements at relatively low cost. They cover the frequency range of DC to 960 MHz in four units: DC to 32 MHz, 4 to 400 MHz, 1 to 500 MHz and 1 to 960 MHz. The unit covering 1 to 960 MHz is a two band unit. The bands are 1 to 500 MHz and 450 to 960 MHz. The instruments are less than one-half rack unit width, approximately 4-3/16 inches high and 12-5/8 inches deep.

SS SERIES - HIGH POWER SWEEP/SIGNAL GENERATORS - 5 WATTS

The SS series utilizes solid state power amplifier output devices. This combination eliminates the costly replacements previously associated with high power tube-type sweep/signal generators. These units produce 5 watts into 50 Ω and are VSWR protected. Frequency range is 1 to 1000 MHz.

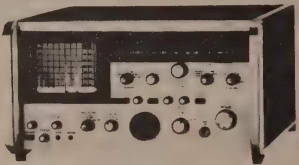
HS SERIES - HIGH POWER SWEEP/SIGNAL GENERATORS 4-10 WATTS

The two units in the HS series are high power, line rate, "hybrid" sweep/signal generators. Both have records of long, reliable service under extreme conditions. These instruments may be operated in either sweep or CW mode. Where special power or frequencies are required, modified HS units are available.



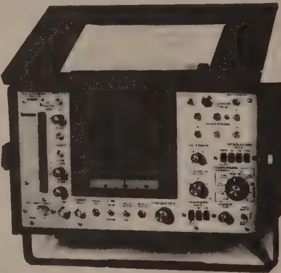
The Model 9650 tracking sweep spectrum analyzer makes possible dynamic measurements of over 100 dB. This technique provides rapid observation of many band pass — band reject responses previously available only on a point-to-point basis. This unique instrument combines the features of a sweep generator, spectrum analyzer, display section, reflection bridge and associated 1 dB step attenuators.

The Ultima 9000 Series and related products mark Texscan's entry into the realm of TV tuner and chassis testing. TV industry sweep instruments are by nature custom designed and the Texscan 9000 Series is fully flexible to meet user requirements.



SPECTRUM ANALYZER AL-60

1 MHz to 3 GHz, solid state,–110 to +30 dBm. Texscan's line of lab spectrum analyzers consists of two models, the AL-40, 1 to 300 MHz, the AL-60, 1 MHz to 3 GHz. Both are designed for maximum reliability and maintainability, accurate frequency and amplitude identification.



PORTABLE SPECTRUM ANALYZERS

The AL-50 family of portable spectrum analyzers provides the user with a rugged instrument for making RF measurements both in the lab and in the field. There are three units in the series — the AL-50, single resolution 4-300 MHz, AL-51 selectable resolution and phase lock, 4-1000 MHz, and the AL-55, 4-350 MHz, with crystal markers and special hum modulation measurement circuitry. These units will operate from an internal 12V rechargeable battery, an AC power converter or 12V vehicular systems. Weighing less than 25 lbs., they are provided with a protective cover and rugged field carrying case with handle.

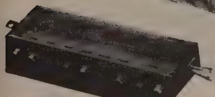
Texscan

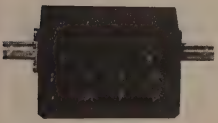
2446 North Shadeland Avenue, Indianapolis, Indiana 46219, PH: 317-357-8781, TWX: 810-341-3184, Telex: 272110
1, Northbridge Road, Berkhamsted, Hertfordshire, England UK, PH: 04427-71138, Telex: 82258
8 Munchen 90, Schlierseestrasse 31A, West Germany, PH: 0811/69 5421 Telex: 522915

lators. Attenuators. Filters and R.F. Components

DU SERIES OSCILLOSCOPES

Texscan oscilloscopes are sensitive, large screen, solid state, X-Y display units designed to satisfy the particular needs of a production or laboratory testing system using sweep generator techniques. These display units are complete with cathode ray tube, vertical and horizontal deflection amplifiers, video (Z axis) amplifier, and high and low voltage supplies.

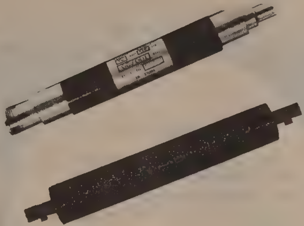




Attenuators — RA Series — Rotary — DC — 4000 MHz, direct reading in dB, 8 attenuation ranges up to 120 dB, 50 to 75 ohm. Texscan offers a complete range of attenuators with steps of 0.1, 1.0 and 10.0 dB, covering attenuation ranges of 1.0, 10.0 and 120.0 dB. Wide selection of connector choices available.

FP Series — Fixed Coaxial — DC — 18 GHz, 2 watt average power, values up to 50 dB.

PA Series — Digitally Programmable — DC — 1250 MHz, 6 millisecond switching speed. Three different units cover 0 — 127 dB in 1.0 dB steps. Each pad represents a single binary digit for easy mating to a digital system.



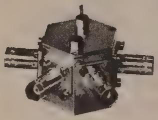
Filters — Tunable Bandpass — 48 MHz to 4 GHz, 3 dB BW, 1% to 10%, 3 and 5 sections. Any single model covers more than an octave.

Bandpass/Lowpass — 10 MHz to 13 GHz. Five different types available, each with its own unique characteristics. Choice of connector style as well as special mechanical designs to fit your packaging requirements, 48 hour delivery.

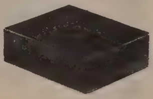
Lumped Component — 5 MHz to 100 MHz, 3 to 8 sections. Miniature size provides freedom in circuit layout, reducing overall package volume. Available in bandpass and lowpass designs.

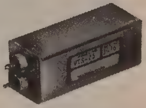
Cavity Bandpass — 30 MHz to 3000 MHz, 2 to 6 sections, 0.2 to 3%, 3 dB BW. Designed to provide low insertion loss at narrow bandwidths.

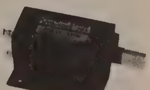
Waveguide — 4 GHz to 18 GHz Bandpass. Custom designs from 0.25 to 10% bandwidths.



RF COMPONENTS	FREQUENCY RANGE
Detectors	100 KHz – 4000 MHz
Minimum Loss Pads	DC – 1000 MHz
Reflection Coefficient Bridges	500 KHz – 2.5 GHz
Terminations	DC – 1000 MHz
RF Coax Switches	DC – 2000 MHz
Voltage Monitors	500 KHz – 4 GHz
Mismatches	DC – 2.5 GHz







Solid State Oscillators — Texscan's seven lines of solid state RF sources span between them 2.5 MHz to 20 GHz and supply RF power up to one watt. Both electronically and mechanically tuned devices are offered. Custom engineered models in all series can be supplied with integral pulse modulators or ovens for crystal stability.

SOLID STATE OSCILLATORS

Frequency Range	Series	Tuning	Tuning Range	Power Range
2.5 MHz - 2 GHz	VTS	Elect.	Up to an octave	200 - 1000 mW
1 GHz - 8 GHz	VTO	Elect.	Up to an octave	20 - 150 mW
10 MHz - 4 GHz	MTO	Mech.	Up to an octave	10 - 1000 mW
4 GHz - 20 GHz	GTO	Mech.	Up to 65%	5 - 1000 mW
4 GHz - 18 GHz	ETO	Elect.	Up to 2500 MHz	10 - 100 mW
32 MHz - 1 GHz	LTO	Elect.	Up to 3 octaves	
VHF - 18 GHz	PMO	Mech.	Up to an octave	0.1 - 500 mW Peak

Texscan

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8 Munchen 90, Schlierseestrasse 31A, West Germany, PH: 0811/69 5421 Telex: 522915

MAGNETIC INSTRUMENTS

DESIGNED BY THOMAS & SKINNER, INC.

. . . a rugged, sensitive and growing line of magnetic equipment perfect for magnetizing, demagnetizing, measuring and stabilizing permanent magnets in both production and laboratory situations . . .

GAUSSMETERS

The wide line of Thomas & Skinner Gaussmeters shares the following features:

- Magnetic field measurements from 1 Gauss to 100,000 Gauss.
- Output voltage accurate to 10X over range.
- Simple setup and operation with front panel controls.
- Accurate internal calibration.
- Wide range of high linearity Hall probes.

MODEL 7303 - HALL EFFECT

MODEL 7310 - PEAK READING MEMORY

MODEL 7315 - DIGITAL READ-OUT

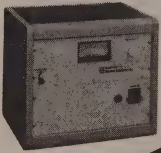
MODEL 7330 - 3-LEVEL COMPARATOR
(MODEL 7320
2-LEVEL COMPARATOR also available)

MAGNETIZERS

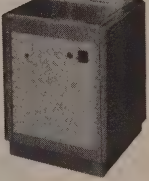
The Thomas & Skinner IMPULSE Magnetizer line features the following:

- High speed production operation.
- Energy levels from 300 to 5400 Joules.
- Low voltage — 425 volts maximum.
- Saturation of all ALNICO-BARIUM FERRITE-RARE EARTH COBALT magnetic materials.
- Continuous meter readout of capacitor voltage.
- Wide variety of fixtures — multi-pole fixtures.
- Control prevents firing below preset level.

Also ½ CYCLE Magnetizers for 110/220/440 v.



MODEL 7515



MODEL 7500

INTEGRATING FLUXMETERS

Fluxmeters by Thomas & Skinner provide:

- Very low drift rate.
- Push button or remote electronic zeroing.
- Up scale and down scale push button drive.
- Simple setup and operation with front panel controls.
- Solid state circuit design.

MODEL 7381

MODEL 7385

(not pictured) provides a digital readout in place of the 5½" taut-band mirror scale meter.
2- and 3-LEVEL COMPARATORS also available.

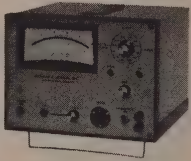
INDUSTRIAL MAGNETIC PROCESSING EQUIPMENT

This innovative Thomas & Skinner line provides magnetizing, measuring, stabilizing and demagnetizing systems built to NEMA 12/JIC specifications. These systems, including automatic parts feeding, are designed to customer specs.

7100 SERIES

MAGLAB

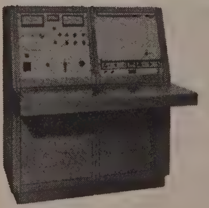
Thomas & Skinner's perfect answer for a dual-purpose test instrument for use where an Integrating Fluxmeter and a Hall Effect Gaussmeter are needed . . . but not simultaneously.



MODEL ML-40

MAGNETIC BRIDGE RECORDING PERMEAMETER

Designed by Thomas & Skinner to serve as one of the most versatile and accurate magnetic measuring instruments in the field, using a balanced magnetic bridge yoke system.



MODEL PR1000

When it comes to MAGNETIC INSTRUMENTATION, Thomas & Skinner can meet your every need from a flexible range of existing designs, modified designs, custom designs . . . just for you.

Since 1901
specialists in the manufacture of ALNICO PERMANENT MAGNETS and EI TRANSFORMER LAMINATIONS

Thomas & Skinner, Inc.
1120 EAST 23RD ST. INDIANAPOLIS, IN 46205 • PHONE: 317-923-2501

MAGNETIC INSTRUMENTS

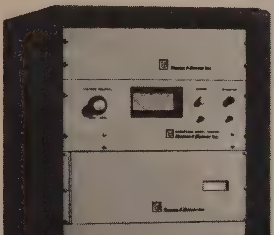
DESIGNED BY THOMAS & SKINNER, INC.

. . . a rugged, sensitive and growing line of magnetic equipment perfect for magnetizing, demagnetizing, measuring and stabilizing permanent magnets in both production and laboratory situations . . .

HIGH ENERGY MAGNETIZER

Designed for saturation of RARE EARTH COBALT MAGNETS.

- Energy level — 12000 Joules.
- 10-second recycle time.
- Continuous voltage control from 50 to 900 volts.
- Wide variety of fixtures.
- Safety interlocks.



MODEL 7500/900

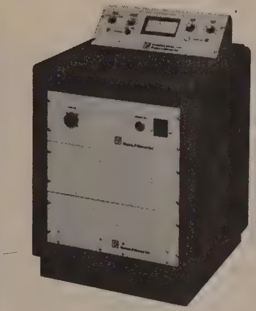
Since 1901

specialists in the manufacture of ALNICO PERMANENT MAGNETS and EI TRANSFORMER LAMINATIONS

HIGH ENERGY STABILIZER

Designed for stabilization/calibration of RARE EARTH COBALT MAGNETS.

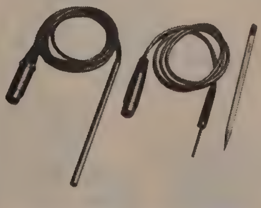
- Energy levels from 300 to 5400 Joules.
- Recycle rates from 2 pulses per second.
- Automatic ramping.
- Used with the Model 7330 Gaussmeter for automatic calibration.



MODEL 7161

HALL EFFECT PROBES

- Linearities from 0.1%.
- Transverse probes from 0.012 inch thick.
- Axial probes from 0.065 inch diameter.
- Hall elements from 0.040 x 0.060 inch.
- Special measurement fixtures and probes available.



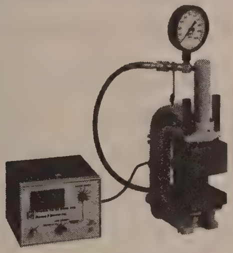
TRANSVERSE / AXIAL PROBES

EI TRANSFORMER LAMINATIONS

- Orthosil® 4-mil, 6-mil and 29 GA.
- Radio 3, 4, 6 non-oriented Laminations, 26 and 29 guage.
- 3 Phase Laminations EI ¼ through EI 3.600.
- Wide Window™ Laminations.
- Cruciform Laminations.
- Shunt and I Laminations.
- Single Phase Laminations EI ⅜ through EI 5.
- Centra-Gap™ Laminations.
- Vari-Gap™ System.

FRANKLIN TESTER

The Model 7105 Franklin Tester provides a means of testing single strips or punchings of flat rolled electrical steel for surface insulation resistance under predetermined conditions of voltage and pressure.



MODEL 7105

ALNICO PERMANENT MAGNETS

Thomas & Skinner is one of the largest manufacturers of high energy Alnico Permanent Magnets in the country. It is also the first manufacturer to develop and offer Alnico 9. Permanent Magnets are currently available in Sintered Alnico 2, 5 and 8, and Cast Alnico 2, 5, 6, 8C, 8HC, 8HE, 9A, 9C and 9Nb for applications that include simple holding and lifting devices, sophisticated current generating and electron beam focusing devices, motors and other rotating devices. Industries which are utilizing T & S Permanent Magnets include microwave, geophysical and aerospace, ample proof of the quality and performance of Thomas & Skinner's superior Permanent Magnet products.

Thomas & Skinner, Inc.

1120 EAST 23RD ST., INDIANAPOLIS, IN. 46205 • PHONE: 317-923-2501

TRIPLETT, for more than 70 years, has been a manufacturer of high quality, reliable instrumentation. The product line includes both panel instruments for OEM use and test equipment (V-O-M's) for OEM and general purpose electrical/electronic testing.

Both the panel instruments and test equipment is available in "off-the-shelf" standard designs or they can be "custom" designed for any size, style or type of measurement capabilities required to meet your specifications.

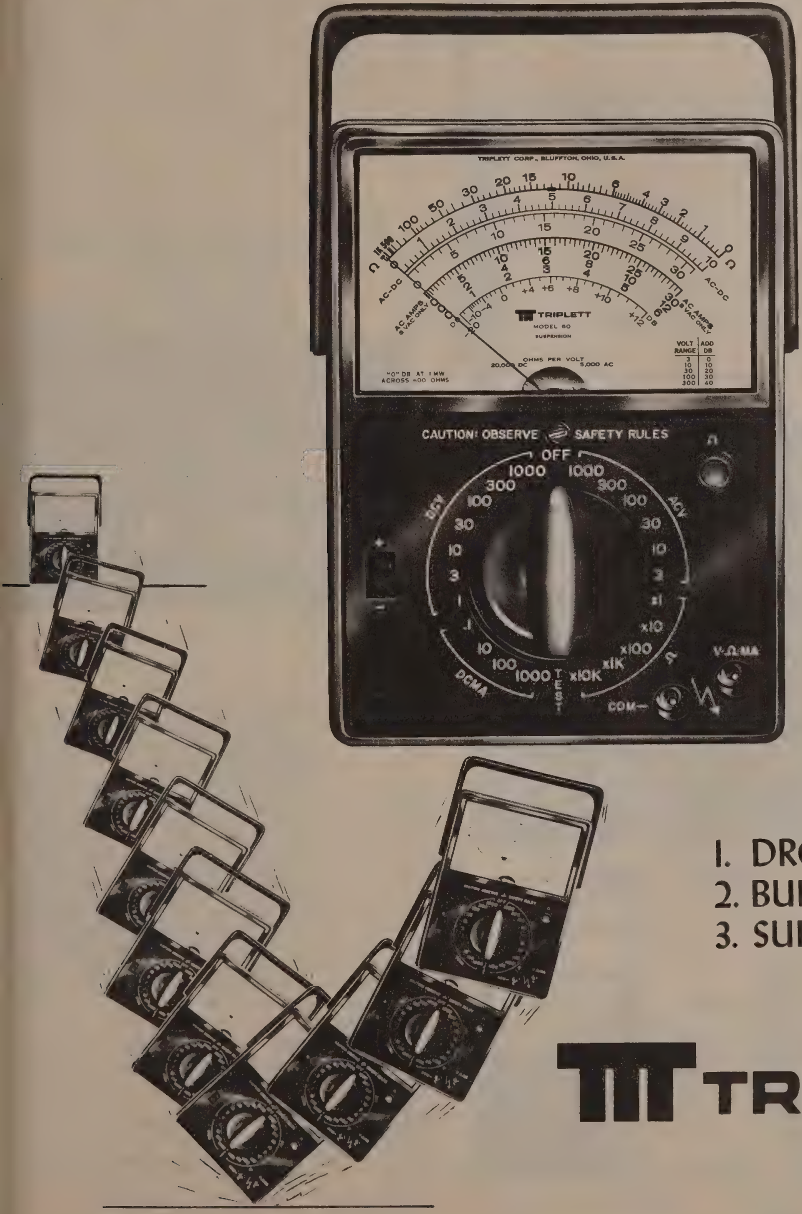
If the standard instruments on the following pages do not satisfy your requirements please contact the Triplett Representative nearest you (see the EEM yellow pages) or contact Triplett Corporation (419) 358-5015, for assistance from our Instrument or Tester Designers/Engineers who'll help you analyze the problem and suggest the optimum cost/result solution.

SEE PRODUCT INDEX PAGE 1•825

TRIPLETT

THE TRIPLETT CORPORATION
286 HARMON ROAD, BLUFFTON, OHIO 45817

NEW TRIPLETT Model 60 V-O-M


TRIPLETT CORP., BLUFFTON, OHIO, U.S.A.
TRIPLETT
MODEL 60
SUSPENSION
OHMS PER VOLT
20,000 DC
5,000 AC
"0" DB AT 1MW ACROSS 600 OHMS
AC-DC
AC AMPS 6 VAC ONLY
DB
VOLT RANGE
ADD DB
CAUTION: OBSERVE SAFETY RULES
OFF
DCV
ACV
DCMA
TEST
COM−
V-Ω-MA

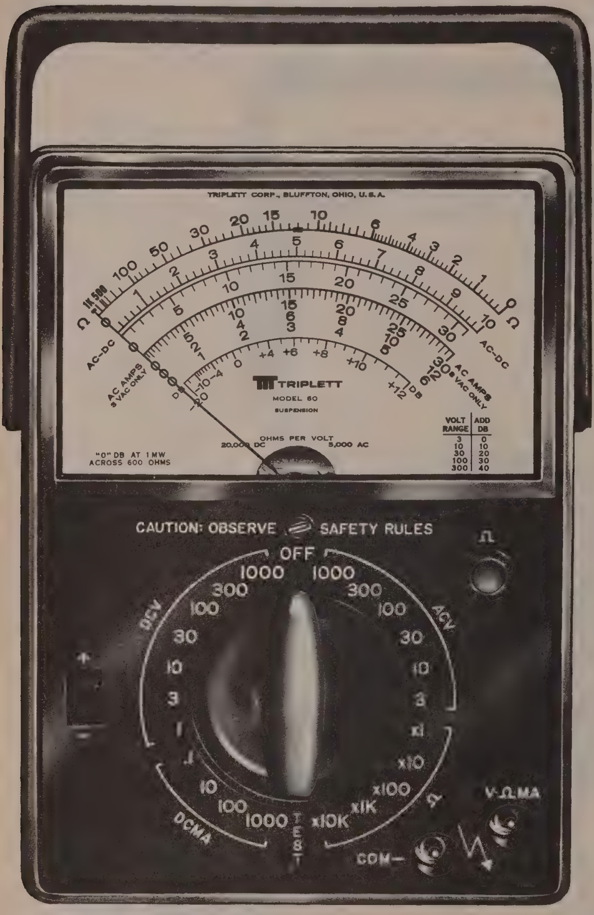
$90

1. DROP-PROOF
2. BURNOUT-PROOF
3. SUPER-SAFE

TRIPLETT

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

NEW MODEL 60 V-O-M



NEW MODEL 60 **$90**

1. **DROP-PROOF**—Virtually indestructible for an accidental drop up to a five foot height with deviation from stated accuracy not exceeding ±4%.
2. **BURNOUT-PROOF**—Protected by diodes and unusual three fuse arrangement, including ⅛ Amp, 1 Amp and 2 Amp/1000V fuses, up to maximum protection level provided by the 2 Amp/1000V (20kW) fuse.
3. **SUPER-SAFE**—Designed to most rigid safety standards to prevent explosive arcs in high energy circuits, up to the 2 Amp/1000V (20kW) fuse capacity; completely insulated unit with newly designed safety leads.

DROP-PROOF
BURNOUT-PROOF
SUPER-SAFE

Some inside information about V-O-M's:

V-O-M's are the most useful and popular devices for multi-function testing and measuring of electrical circuits. What happens when a user inadvertently attemps to measure voltage with the tester switched to measure resisance? Years ago, the meter movement, resistors, and perhaps the range switch would be burned. In high energy circuits a dangerous arc or explosion could also occur.

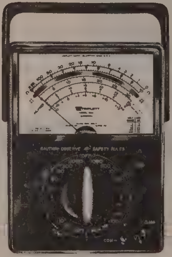
More recently some V-O-M's began utilizing a diode device to protect the meter movement and a fuse to protect the remaining components. These additions improved the protection for selected misuse conditions only. Damages both to the tester and the user are still a potential hazard. The Triplett Model 60 has closed these gaps to provide the last word in protection. While accidents can never be totally prevented, the Model 60 V-O-M has been extensively tested and where the conventionally fused V-O-M was damaged and where a hazardous condition was created for the operator, the Model 60 presented no hazard with total damage being confined to blown fuses.

Ropp Triplett, *President*

LABORATORY ACCURACY

A 60 Series V-O-M with greater accuracy is also available. The Model 60-A adds a mirror scale and ±1½% DC accuracy to all the other benefits of the Model 60. If your work requires the mirror scale and greater accuracy, the Model 60-A is the tester for you to buy.

Model 60-A Cat. No. 3148 .... **$100.00**



TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

NEW MODEL 60 V-O-M

APPLICATION DATA

Triplett is introducing the all new Model 60—a multi-range V-O-M for general electrical and electronic trouble shooting and measurement. It has been specifically developed to satisfy the need for a quality instrument which will stand up under the hard usage of the industrial and maintenance environment. A combination of unique design and selection of materials permits the instrument to withstand over 90% of the costly in-field and at-workbench misuses of V-O-M's. This Drop-Proof, Burnout-Proof, and Super-Safe V-O-M will provide accurate, reliable long life and virtually maintenance free service for use in the laboratory, vocational and trade schools, inspection department and manufacturing quality control and for the service technician.

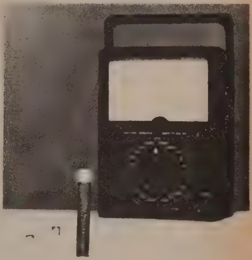
The single range selector switch helps reduce incorrect settings and enables you to easily select any of the 28 ranges without any inconvenient lead changes or other set-ups. The simplified scale includes markings for direct reading when using the optional Clamp-on AC Ammeter. The Model 60 has a special "Confidence-Test" feature built into the new test instrument for periodic reassurance checks of its meter. While not intended as a comprehensive test of the instrument it does permit a high level of confidence in the instrument meter if the pointer indicates within the area of the test symbol. Modular construction permits it to be easily and quickly serviced in the field or service station. The removal of eight screws completely disassembles the new Model 60. The independent meter module permits quick service or replacement, when needed.

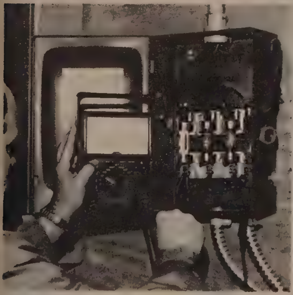
DROP-PROOF

The Model 60 has a rugged case molded of black, high impact thermoplastic material which combined with a rugged suspension meter provides a V-O-M that is virtually indestructible for an accidental drop up to a five foot height with deviation from stated accuracy not exceeding ±4%. This combination of unique design and material selection protects against those normal accidents of dropping and rough handling occurring in hard day to day use, providing long term, reliable and expense free service.

BURNOUT-PROOF

The Model 60 V-O-M has been engineered to virtually eliminate costly repairs and down time due to accidental burnout of meter movements and components. The V-O-M saves you from parts burn out due to inadvertent range or test function settings. The meter movement is protected by a diode module. The ⅛ Amp and 1 Amp fuses are used for normal overload conditions. Protection is provided for high energy fault currents beyond the capability of the instrument fuses up to the capacity of the 2 Amp/1000V (20kW) fuse. Spare ⅛ Amp and 1 Amp fuses are included in the tester.





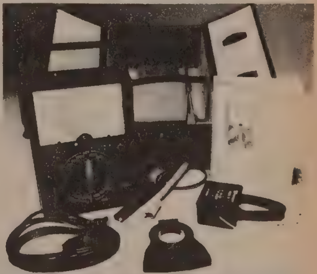
SUPER-SAFE

One of the prime design goals for the Model 60, was to produce a rugged, new, quality V-O-M that would provide the greatest possible safety to the user. Experienced engineers respect the danger of explosive arcs created when attempting to measure voltages in high energy circuits with a tester inadvertently set on the Ohms function. Now the Model 60, for the first time, provides a specially engineered internal electrical system to prevent explosive arcs in high energy circuits up to the 2 Amp/1000V (20kW) fuse capacity. In addition, the Model 60 has no exposed metal parts, providing complete insulation of the instrument for maximum protection from electrical shock. Newly engineered test leads connecting to the front panel by especially designed recessed safety connectors and a large imprinted label spelling out safety precautions to observe when using the V-O-M are additional safety features.

MODEL 60-K MAINTENANCE KIT

To extend the usefulness of the Model 60, it is also available in kit form—Model 60-K. The kit will be particularly valuable for individuals who also need to measure AC Amperes and who sometimes need to isolate one conductor of a two conductor cable. The Model 60-K comes complete with Model 60, Model 10, Model 101, Model 10 attachment lead, leather case, 48" safety test leads, insulated alligator clips, batteries, spare 1/8A and 1A fuses, Instruction Manual and one year warranty. If you need to use these accessories, buy the complete kit.

Model 60-K Cat. No. 3150 .... **$150.00**



TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

NEW MODEL 60 V-O-M

SPECIFICATIONS

DC VOLTS

Ranges: 0-0.3-1-3-10-30-100-300-1000 (Approx. 20,000 Ohms Per Volt).
Accuracy: ±2% of full scale all ranges.

AC VOLTS

Ranges: 0-3-10-30-100-300-1000 (Approx. 5,000 Ohms Per Volt).
Accuracy: ±3% of full scale all ranges.

OHMS

Ranges: 0-1k-10k-100k-1MΩ-10MΩ. (12 Ohms center scale on low range).
Accuracy: ±2% of arc length.
Open Circuit Voltage: 1.7V (10MΩ 10.2V).
Maximum power applied to device under test (low range): 60.4 mW. All other ranges, power is correspondingly less.

DC MILLIAMMETERS

Ranges: 0-0.1-10-100-1000 (Approx. 320 mV).
Accuracy: ±2% of full scale all ranges.

DECIBELS

Ranges: —20dB to +52dB.
Accuracy: ±2% of full scale all ranges.
Scale, lower arc, lettered —20 to +12.
"0" dB is equal to .775 ACV across 600 Ohms.

OUTPUT VOLTS (AC) (Requires external capacitor)

Ranges: 0-3-10-30-100-300 (Approx. 5,000 Ohms Per Volt).
Accuracy: ±3% of full scale all ranges.

AC AMPERES (Requires accessory Model 10 Adapter)

Ranges: 0-6-12-30-60-120-300.

TESTER CONSTRUCTION

Meter: 45μA ruggedized suspension movement, easily replaced integral module.
Polarity Switch: V-Ω-mA jack polarity changed from + to —.
Scale length: Approx. 4½".
Overload Protection: Meter movement protected by a diode module, 1/8A/250V, 1A/250V and 2A/1000V (20kW on DC/30kVA on AC) fuses.
Confidence Test: Reassurance check of instrument meter.
Case: Molded, black, high impact thermoplastic with new non-slip "finger-tread" surface finish; easy external access to sealed battery and fuse compartment; molded plastic handle can be used to place instrument on approx. 30° angle; dimensions approx. 5¼"W x 7¼"H x 3¼"D.
Weight: approx. 2½ lbs. with batteries.

BATTERIES

1-9V NEDA 1604; 1-1½V D Cell

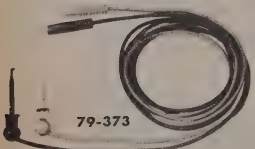
Model 60, complete with one year warranty, with 48" safety test leads, insulated alligator clips, batteries, spare 1/8A and 1A fuses and Instruction Manual. Cat. No. 3145 .... **$ 90.00**

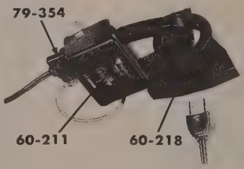
Model 60-A, similar to Model 60 with mirror scale and ±1½% DC accuracy. Cat. No. 3148 ....**$100.00**

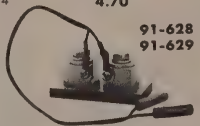
Model 60-K, includes complete Model 60, Model 10, Model 101, Model 10 attachment lead and leather case. Cat. No. 3150 ....**$150.00**

OPTIONAL ACCESSORIES

Leather Carrying Case	Cat. No. 10-2739	**$22.90**
High Voltage Probe—30 kVDC	Cat. No. 79-357	**24.50**
30 kVAC	Cat. No. 79-362	**24.50**
DC Current Shunt 30 Amp	Cat. No. 91-628	**17.30**
100 Amp	Cat. No. 91-629	**21.50**
Model 10 Clamp-On AC Ammeter (Requires 79-354 lead)	Cat. No. 60-211	**24.00**
Model 10 Attachment Lead	Cat. No. 79-354	**4.50**
Model 101 Line Separator	Cat. No. 60-218	**10.00**
Miniature Clip Leads for High Density Circuits	Cat. No. 79-373	**5.50**
Replacement Safety Test Leads	Cat. No. 79-374	**4.70**







79-357
79-362

TRIPLETT. THE EASY READERS.

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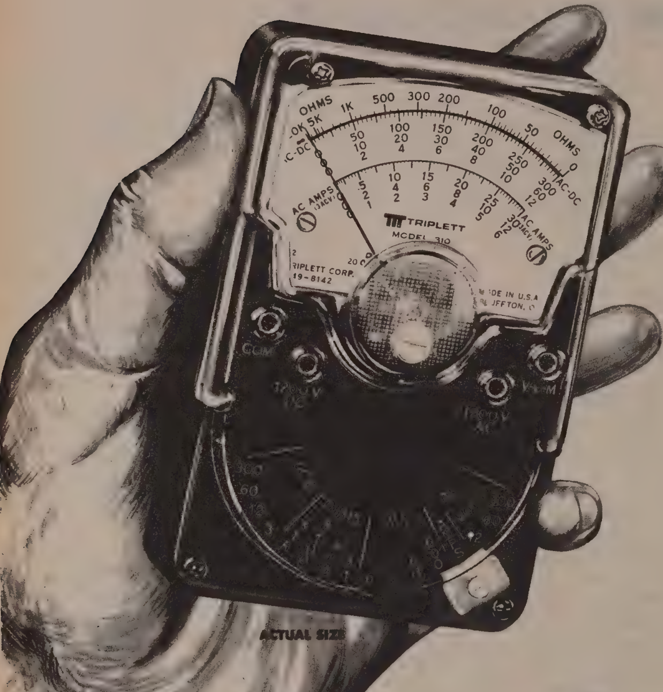
ALL YOU'LL EVER NEED IN V-O-M's.

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 310 TYPE 3



New DROP RESISTANT

1. **Drop-resistant, hand-size V-O-M with high-impact thermoplastic case.**
2. **20,000 Ohms per volt DC and 5,000 Ohms per volt AC; diode overload protection with fused Rx1 Ohms range.**
3. **Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.**

SPECIFICATIONS

DC VOLTS
Ranges: 0-3-12-60-300-1,200 (20,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

AC VOLTS
Ranges: 0-3-12-60-300-1,200 (5,000 Ohms per Volt).
Accuracy: ±4% of full scale all ranges.

OHMS
Ranges: 0-20k-200k-2MΩ-20MΩ (200 Ohm center scale on low range).
Accuracy: ±3% of full scale all ranges.
RX1 Ohms circuit fuse protected.

DC MICROAMPERES
Ranges: 0-600 at 250 mV.
Accuracy: ±3% of full scale.

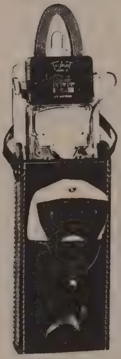
DC MILLIAMPERES
Ranges: 0-6-60-600 at 250 mV.
Accuracy: ±3% of full scale all ranges.

TESTER CONSTRUCTION
Meter: Self-shielding, extra rugged, high torque, 50 μA movement with diode overload protection and spring-back instrument jewels; meter movement brackets and pointer feature new rugged design.
Scale Length: approx. 2⅛".
Case: Molded, black, high impact polycarbonate thermoplastic; with new non-slip "finger tread" surface finish; simple slide-latch cover for access to batteries and fuse; newly designed lead jacks and Model 10 jack; 2¾" w X 1$\frac{5}{16}$" d X 4¼" h.
Weight: approx. 8 oz. with batteries.

BATTERIES
1-15V NEDA 220; 1-1½V NEDA 910-F.

MODEL 310, complete with 42" leads, alligator clips, batteries and instruction manual. Cat. No. 3018 .... $49.00

Model 369



Model 379

Model 369-S

Model 369-T

ACCESSORIES FOR 310's

Model 10 Clamp-on AC Ammeter—For 310 and 310-FET. Ranges, 0-6-12-30-120-300. Cat. No. 60-211 **$24.00**

Model 10-C Clamp-on AC Ammeter—For 310-C. Ranges, 0-6-12-30-120-300. Cat. No. 60-210 ...... **$24.00**

Model 101 Line Separator—Divides two conductor cords direct or increases Model 10 sensitivity 10x and 20x. Cat. No. 60-218 .... **$10.00**

Model 311 Lead—42" long lead to separate Model 10 from 310 unit for easy reading in awkward spots. Cat. No. 79-161 .... **$4.50**

Model 369 Carrying Case—For Model 310's. Cat. No. 10-1258 .... **$5.80**

Model 369-S Carrying Case—For Model 310's; front opens permitting use of tester in case. Cat. No. 10-1791 .... **$13.70**

Model 369-T Carrying Case—For Model 310's; neck strap carrying case. Cat. No. 10-1608 .... **$13.10**

Model 379 Carrying Case—For Model 310 and Model 10 in combination, plus Model 101. Cat. No. 10-1456 .... **$11.00**

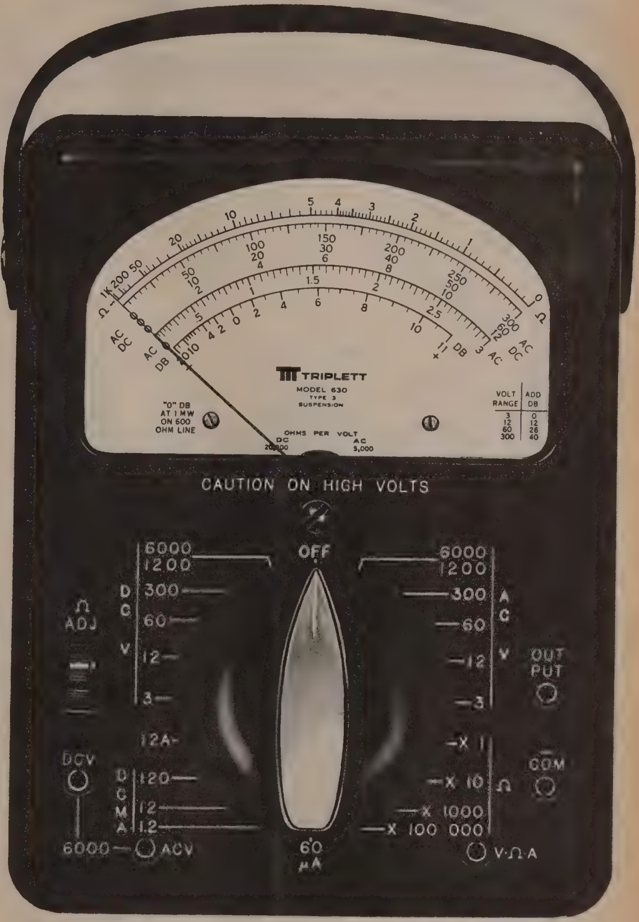
Model 79-153 Needle Tip Replacement Lead—For Model 310 series. Cat. No. 79-153 .... **$4.50**

Model 79-296 Blunt Tip Replacement Lead—For Model 310 series. Cat. No. 79-296 .... **$6.90**

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 630

1. **Diode overload-protected suspension movement V-O-M; single range switch minimizes error.**
2. **4 ohmmeter ranges with 4.4 Ohms center scale.**
3. **Simplified scale—only 4 arcs for all 27 ranges.**



GENERAL DESCRIPTION

The Model 630, popular for its reliability, is a compact, rugged portable volt-ohm-milliammeter. The single range selection switch and 4⅜" scale length, with only four arcs for all 27 ranges, enables you to make fast, accurate measurements. Protection for the suspension meter movement is provided by a silicon diode network with fuse protection for the ohms circuit.

The voltage and resistance ranges of the Model 630 have made this unit particularly desired for the classroom and for electrical and electronic maintenance use.

SPECIFICATIONS

DC VOLTS
Ranges: 0-3-12-60-300-1,200-6,000 (20,000 Ohms per Volt).
Accuracy: ±2% of full scale all ranges except 6,000, 4%.

AC VOLTS
Ranges: 0-3-12-60-300-1,200-6,000 (5,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges except 6,000, 5%.

OHMS
Ranges: 0-1k-10k-1MΩ-100MΩ (4.4 Ohm center scale on low range).
Accuracy: ±2% of full scale all ranges.
Ohms circuit protected with one ampere fuse (spare fuse included).

DC MICROAMPERES
Ranges: 0-60 at 250 mV.
Accuracy: ±2% of full scale.

DC MILLIAMPERES
Ranges: 0-1.2-12-120 at 250 mV.
Accuracy: ±2% of full scale all ranges.

DC AMPERES
Ranges: 01.2-112-120 at 250 mV.
Accuracy: ±2% of full scale.

DECIBELS
Ranges: −20 to +51 ("0" dB at 1 mW on 600 Ohm line).
Accuracy: ±2% of full scale all ranges.
Scale: Lower arc lettered −20 to +11 dB.

OUTPUT VOLTS (AC)
Ranges: 0-3-12-60-300 (5,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

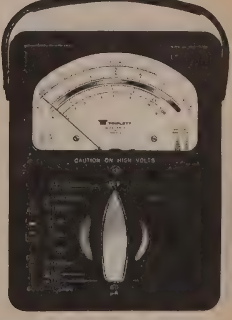
TESTER CONSTRUCTION
Meter: 50 µA suspension movement with diode overload protection.
Scale Length: approx. 4⅜".
Case: Molded, black plastic with removable black leather strap; dimensions 5½" w X 3-11/32" d X 7½" h.
Weight: approx. 3 lbs. with batteries.

BATTERIES
1-30V NEDA 210; 1-1½V NEDA 13F.

MODEL 630, complete with 48" leads, alligator clips, batteries and instruction manual.
Cat. No. 3030 .... **$76.00**

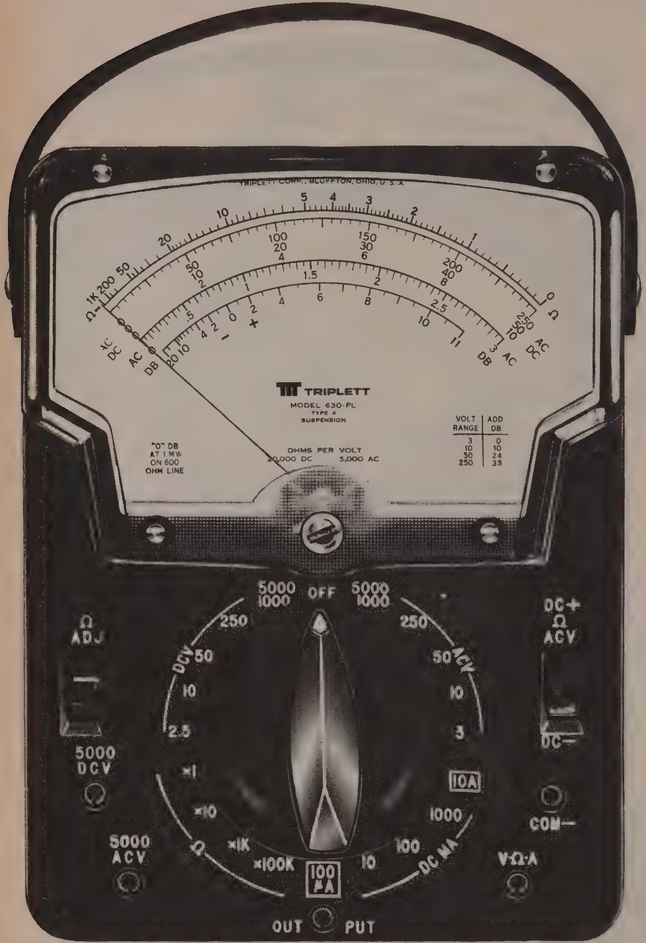
Model 630-A

A laboratory type volt-ohm-milliammeter with mirrored scale and greater accuracy made possible through the use of ½% resistors. Ranges and other features same as Model 630 except for accuracy of ±1½% DC and ±3% AC.
Model 630-A, complete with 48" leads, alligator clips, batteries and instruction manual. Cat. No. 3034 .... **$89.00**



TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 630-PL



1. 27-range V-O-M with single range switch minimizes error; DC polarity reversing switch.

2. 5" suspension meter with diode overload protection.

3. 4 ohmmeter ranges with 4.4 Ohms center scale.

GENERAL DESCRIPTION

The Model 630-PL is popular for its reliability and wide vision unbreakable plastic window. Convenience items such as DC polarity-reversing switch and 4½" scale, with only four arcs for all 27 ranges, simplifies and speeds up your measurement capabilities. The single range switch minimizes chances of incorrect function selection and resulting burnout. Additional durability is provided by diode overload protection for the suspension meter movement and fuse protection for the ohms circuit.

The voltage and resistance ranges of the Model 630-PL have been particularly useful for those of you in the construction industry and for the electrical and electronic maintenance service.

SPECIFICATIONS

DC VOLTS
Ranges: 0-2.5-10-50-250-1,000-5,000 (20,000 Ohms per Volt); 0-0.25 at 100 μA.
Accuracy: ±2% of full scale all ranges except 5,000, 4%.

AC VOLTS
Ranges: 0-3-10-50-250-1,000-5,000 (5,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges except 5,000, 5%.

OHMS
Ranges: 0-1k-10k-1MΩ-100MΩ (4.4 Ohm center scale on low range).
Accuracy: ±2% of full scale on all ranges.
Ohms circuit protected with one ampere fuse (spare fuse included).

DC MICROAMPERES
Ranges: 0-100 at 250 mV.
Accuracy: ±2% of full scale.

DC MILLIAMPERES
Ranges: 0-10-100 at 250 mV; 0-1,000 at 400 mV.
Accuracy ±2% of full scale all ranges.

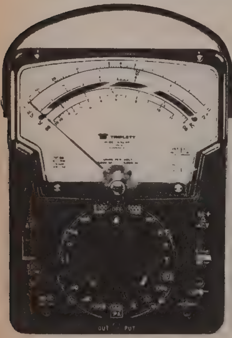
DC AMPERES
Ranges: 0-10 at 600 mV.
Accuracy: ±2% of full scale.

DECIBELS
Ranges: −20 to +49 ("0" dB at 1 mW on 600 Ohm line).
Accuracy: ±2% of full scale all ranges.
Scale: Lower arc lettered −20 to +11 dB.

OUTPUT VOLTS (AC)
Ranges: 0-3-10-50-250 (5,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

TESTER CONSTRUCTION
Meter: 50 μA suspension movement with diode overload protection.
Scale Length: approx. 4½".
Switch: DC polarity reversing switch.
Case: Molded, black plastic with removable black leather strap; dimensions 5½" w X 3-11/32" d X 7½" h.
Weight: approx. 3 lbs. with batteries.

BATTERIES
1-30V NEDA 210; 1-1½V NEDA 13F.
MODEL 630-PL, complete with 48" leads, alligator clips, batteries and instruction manual.
Cat. No. 3050 .... **$81.00**



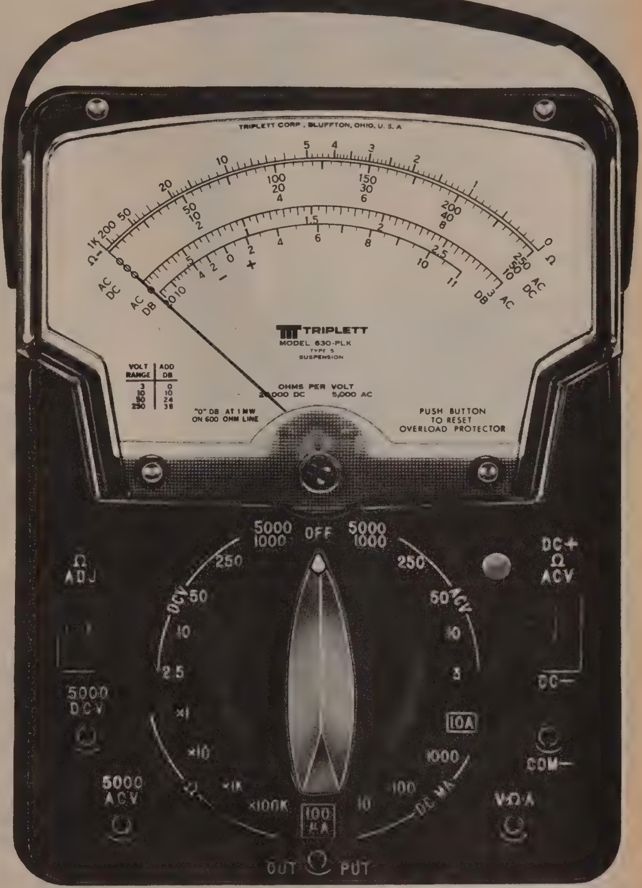
Model 630-APL

A laboratory type volt-ohm-milliammeter with mirror scale and greater accuracy made possible through the use of ½% resistors. Ranges and other features same as Model 630-PL except for accuracy of ±1½% DC and ±3% AC.
Model 630-APL, complete with 48" leads, alligator clips, batteries and instruction manual. Cat. No. 3038 ....**$91.00**

TRIPLETT
TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 630-PLK

1. **Burnout-proof solid-state overload protection; suspension movement.**
2. **Single range switch minimizes error; DC polarity-reversing switch.**
3. **4 ohmmeter ranges with 4.4 Ohms center scale.**


TRIPLETT CORP., BLUFFTON, OHIO, U. S. A.
TRIPLETT
MODEL 630-PLK
TYPE 5
SUSPENSION
OHMS PER VOLT 20,000 DC 5,000 AC
"0" DB AT 1 MW ON 600 OHM LINE
PUSH BUTTON TO RESET OVERLOAD PROTECTOR
OFF
DCV
ACV
Ω ADJ
DC+ Ω ACV
DC−
COM−
V-Ω-A
5000 DCV
5000 ACV
10A
100 μA
DC MA
OUT PUT

GENERAL DESCRIPTION

The Model 630-PLK volt-ohm-milliammeter, with its patented solid-state switching circuit, provides complete protection from accidental overload and burnouts. Added protection for the suspension meter movement is provided by a silicon diode network and for the 1 and 10 ampere ranges by 3 and 10 ampere fuses respectively. For measurement ease, this V-O-M also includes the single range switch, DC polarity-reversing and a 4½" scale with only four arcs for all 27 ranges.

The overload feature has made the Model 630-PLK extremely popular for the educational classroom as well as for electrical and electronic maintenance.

SPECIFICATIONS

DC VOLTS
Ranges: 0-2.5-10-50-250-1,000-5,000 (20,000 Ohms per Volt); 0-0.25 at 100 μA.
Accuracy: ±2% of full scale all ranges except 5,000, 4%.

AC VOLTS
Ranges: 0-3-10-50-250-1,000-5,000 (5,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges except 5,000, 5%.

OHMS
Ranges: 0-1k-10k-1MΩ-100MΩ (4.4 Ohm center scale on low range).
Accuracy: ±2% of full scale all ranges.

DC MICROAMPERES
Ranges: 0-100 at 250 mV.
Accuracy: ±2% of full scale.

DC MILLIAMPERES
Ranges: 0-10-100-1,000 at 250 mV.
Accuracy: ±2% of full scale all ranges.
Three ampere fuse protects 1,000 milliampere range (spare fuse included).

DC AMPERES
Ranges: 0-10 at 250 mV.
Accuracy: ±2% of full scale.
Ten ampere fuse protects 10 ampere range (spare fuse included).

DECIBELS
Ranges: −20 to +49 ("0" dB at 1 mW on 600 Ohm line).
Accuracy: ±2% of full scale all ranges.
Scale: Lower arc lettered −20 to +11 dB.

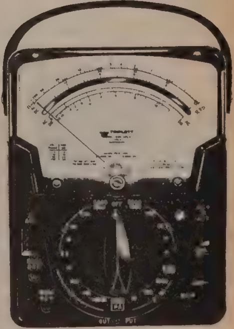
OUTPUT VOLTS
Ranges: 0-3-10-50-250 (5,000 ohms per Volt).
Accuracy: ±3% of full scale all ranges.

TESTER CONSTRUCTION
Meter: 50 μA suspension movement with diode overload protection.
Scale Length: approx. 4½".
Switch: DC polarity reversing switch.
Overload Protection: Complete tester protected with solid-state switching circuit. For additional protection, the one and ten ampere ranges are also protected by three and ten ampere fuses respectively.
Case: Molded, black plastic with removable black leather strap; dimensions 5½" w X 3-11/32" d X 7½" h.
Weight: approx. 4 lbs. with batteries.

BATTERIES
1-30V NEDA 210; 1-1½V NEDA 13F.
MODEL 630-PLK, complete with 48" leads, alligator clips, batteries and instruction manual.
Cat. No. 3055 ....$125.00

Model 630-APLK

A laboratory type volt-ohm-milliammeter with mirror scale and greater accuracy made possible through the use of ½% resistors. Ranges and other features same as Model 630-PLK except for accuracy of ±1½% DC and ±3% AC.
Model 630-APLK, complete with 48" leads, alligator clips, batteries and instruction manual. Cat. No. 3120 **$135.00**



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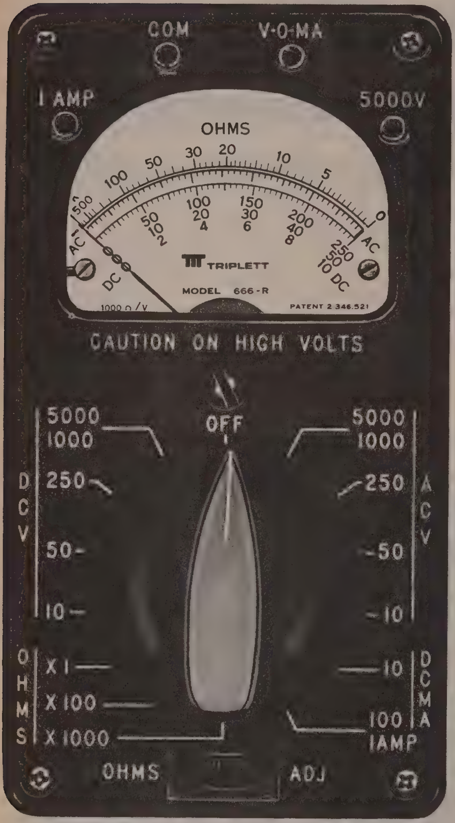
CORPORATION, BLUFFTON, OHIO 45817

MODEL 666-R



1. Rugged 16-range V-O-M; single range switch minimizes error.
2. 3 ohmmeter ranges reading to 3 megohms.
3. AC and DC voltage ranges from 10 to 5000 volts.

GENERAL DESCRIPTION

The Model 666-R is a simply designed, hand-size volt-ohm-milliammeter ideal for electrical work. Its convenience and size fit the hand, its design and ruggedness fit the tool box and its ranges and accuracy fit the job.

The on-the-job toughness and through-the-years reliability has made the Model 666-R famous among construction and electrical, electronic communications and installation and maintenance men.

SPECIFICATIONS

DC VOLTS

Ranges: 0-10-50-250-1,000-5,000 (1,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

AC VOLTS

Ranges: 0-10-50-250-1,000-5,000 (1,000 Ohms per Volt).
Accuracy: ±4% of full scale all ranges.

OHMS

Ranges: 0-3k-300k-3MΩ (20 Ohm center scale on low range).
Accuracy: ±3% of full scale all ranges.

DC MILLIAMPERES

Ranges: 0-10-100 at 250 mV.
Accuracy: ±3% of full scale all ranges.

DC AMPERES

Ranges: 0-1 at 250 mV.
Accuracy: ±3% of full scale.

TESTER CONSTRUCTION

Meter: Rugged 200 μA movement with spring-back instrument jewels.
Scale Length: approx. 3".
Case: Molded, black plastic; dimensions $3\frac{1}{16}$" w X $2\frac{9}{16}$" d X 5⅞" h.
Weight: Approx. 1¼ lbs. with batteries.

BATTERIES

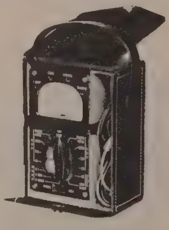
2-1½V NEDA 15A; 1-1½V NEDA 14F.

MODEL 666-R, complete with 48" leads, alligator clips, batteries and instruction manual. Cat. No. 3066 .... **$55.00**

Optional Accessories

Leather carrying case, top opening, Model 669	Cat. No. 5616	**$11.50**
Leather carrying case, front opening, Model 669-OS	Cat. No. 10-1792	**12.50**
Replacement test lead, 48"	Cat. No. 79-127	**4.50**
External Shunts: Plug in 0-25 DC Amp	Cat. No. 91-243	**17.30**
Portable 0-50 DC Amp	Cat. No. 91-244	**21.50**
Portable 0-100 DC Amp	Cat. No. 91-191	**21.50**

Model 669


Model 669-OS

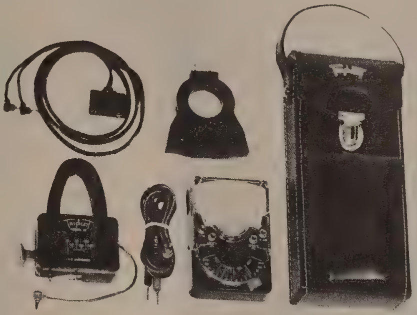
TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 100 SERIES

CLAMP-ON AMMETER SET

1. Complete maintenance kit with V-O-M and clamp-on AC Ammeter.
2. Diode overload protected; 20,000 Ohms per volt on DC.
3. AC clamp-on will read up to 300 Amps AC.

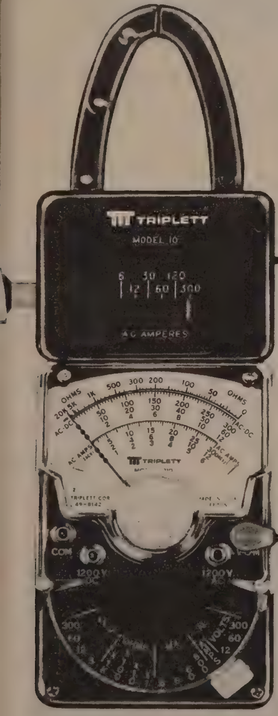
A combination clamp-on AC ammeter kit. The convenient kit includes: Model 310 V-O-M (310-C or 310-FET), Model 10 Clamp-On Ammeter (10-C), Model 101 Line Separator, No. 311 leads and Model 379 carrying case.



Model 100
Includes Model 310 V-O-M
Cat. No. 3014 ....**$92.00**

Model 100-C
Includes Model 310-C V-O-M
Cat. No. 3010 ....**$104.00**

Model 100-FET
Includes Model 310-FET V-O-M
Cat. No. 3013 ....**$130.00**

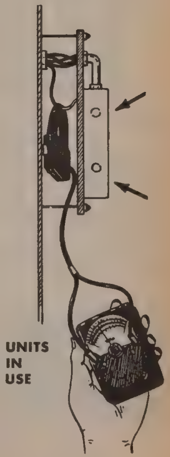


INDIVIDUAL COMPONENTS

MODEL 10 CLAMP-ON AC AMMETER

Checks all line loads instantly, accurately, safely—without breaking the circuit or interrupting work. Easy range switching. Model 10 Clamp-On Adapter AC Ammeter ranges: 0-6-12-30-60-120-300. Clips around single wire to read A.C. Amperes direct. Used with Adapter 101 to divide instantly two-conductor cords. A lever securely locks the Model 10 to Model 310 when used in combination. Model 10 can be left attached to Model 310 when the latter tester is used as an AC-DC V-O-M only. The only change is to remove the lead plug from the Model 310 V-O-M jack and insert it in the jack provided in the Model 10 housing. Case black molded plastic.

Model 10 (310, 310-FET) Cat. No. 60-211 ....**$24.00**
Model 10-C (310-C) Cat. No. 60-210 ....**$24.00**

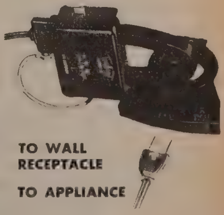


MODEL 101 LINE SEPARATOR

Plugs into AC outlet to divide instantly two-conductor cords. Increases ammeter sensitivity 10X and 20X. Use up to 30 AC amperes from 0.3 to 30 in eight steps.

Ranges: Divide by 20X—0-0.3-0.6-1.5-3-6 AC Amperes.
Direct—0-6-12-30 AC Amperes.
Divide by 10X—0-0.6-1.2-3-6-12 AC Amperes.
Case, black molded plastic with engraved markings.

Model 101 Cat. No. 60-218 ....**$10.00**



NO. 311 LEADS

42" long lead to separate Model 10 from 310 unit for easy reading in awkward spots.

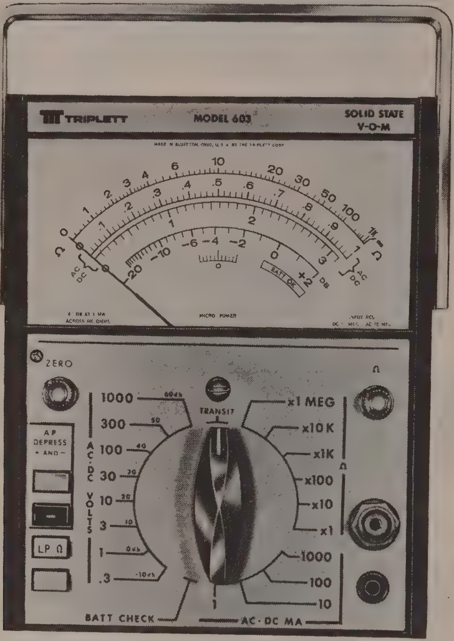
No. 311 Leads. Cat. No. 79-161 ....**$4.50**

379 LEATHER CASE

Model 379. Carrying case. Cat. No. 10-1456 ....**$11.00**

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 603 FET V-O-M



1. Exclusive TRIPLETT MICRO POWER — TMP™ provides battery life in excess of a year for carbon batteries.
2. LOW-POWER OHMS — LPΩ™ — 6 ranges with 70 mV power source for in-circuit measurements without component damage.
3. FET V-O-M WITH AUTO POLARITY — convenient and time saving, always reads up scale.

SPECIFICATIONS

DC VOLTS

Ranges: 0-0.3-1-3-10-30-100-300-1000.
Accuracy: ±3% of full scale all ranges.
Input Resistance All Ranges: 11.12 megohm (1.12 megohm resistor in probe tip).
Auto Polarity: Pointer indicates up scale for either polarity.
Polarity Determination: Push button + or −.

AC VOLTS

Ranges: 0-0.3-1-3-10-30-100-300-1000.
Accuracy: ±3% of full scale all ranges.
Input Impedance All Ranges: 10 megohm.
Frequency Range: 20 Hz to 10 kHz, all ranges except 300 and 1000V.
Detection: Average calibrated in RMS.

OHMS — LOW POWER

Ranges: 0-1k-10k-100k-1MΩ-10MΩ-1000MΩ.
Accuracy: ±3% of DCV arc on all ranges.
Open Circuit Voltage: 70mV.
Maximum power applied to device under test (low range): 123 μW.
All other ranges, power is correspondingly less.
10 Ohm center scale on low range.

OHMS — CONVENTIONAL

Ranges: 0-1k-10k-100k-1MΩ-10MΩ-1000MΩ.
Accuracy: ±3% of DCV arc on all ranges.
Open Circuit Voltage: 1.5 V.
Maximum power applied to device under test (low range): 56 mW.
All other ranges, power is correspondingly less.
10 Ohm center scale on low range.

AC AND DC MILLIAMPERES

Ranges: 0-1-10-100-1000 at 316 mV.
Accuracy: ±4% full scale all ranges.
Auto Polarity: Pointer indicates up scale for either positive or negative current flow.
Polarity Determination: Push button + or −.

DECIBELS

Ranges: −30 to +62.
Accuracy: ±3% of full scale all ranges.
Scale, lower arc, lettered −20 to +2.
"0" dB is equal to .776 V.

TESTER CONSTRUCTION

Meter: 20 μA suspension movement with approx. 4½" scale length.
Case: Shielded, black, molded high impact plastic with metal handle that can be used to place instrument on approx. 25° angle; anodized aluminum panel; dimensions 5⅛" w x 6½" h x 3³⁄₁₆" d.
Weight: Approx. 2½ lbs. with batteries.

BATTERIES

2 — 9V NEDA 1604; 1 — 1½V D Cell. TMP™ circuit provides battery life of one year or more with continuous use.
Model 603 with LPΩ™ and TMP™, complete with 48" leads, alligator clips, batteries and instruction manual.
Cat. No. 3037 .... **$173.00**

OPTIONAL ACCESSORIES

Leather Carrying Case: Model 639-OS — Cat. No. 10-1793	**$20.10**
High Voltage Probe: 30 kVDC — Cat. No. 79-270	**$34.50**
RF Detector Probe: 250 mHz/20V — Cat. No. 79-330	**$12.50**
Replacement Test Lead: 48" long — Cat. No. 79-288	**$17.90**
Replacement Ground Lead: 48" long (Black) — Cat. No. 79-261	**$ 3.20**

Model 639-OS

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

MODEL 310-C

1. Hand-size V-O-M with diode overload-protected suspension movement.
2. 20,000 Ohms per volt DC and 15,000 Ohms per volt AC.
3. Single, enclosed range switch minimizes error; DC polarity reversing switch.

HAND-SIZE SUSPENSION MOVEMENT

SPECIFICATIONS

DC VOLTS
Ranges: 0-3-12-60-300-600 (20,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

AC VOLTS
Ranges: 0-3-12-60-300-600 (15,000 Ohms per Volt).
Accuracy: ±4% of full scale all ranges.

OHMS
Ranges: 0-20k-200k-2MΩ-20MΩ (200 Ohms center scale on low range).
Accuracy: ±3% of full scale all ranges.

DC MICROAMPERES
Ranges: 0-600 at 250 mV.
Accuracy: ±3% of full scale.

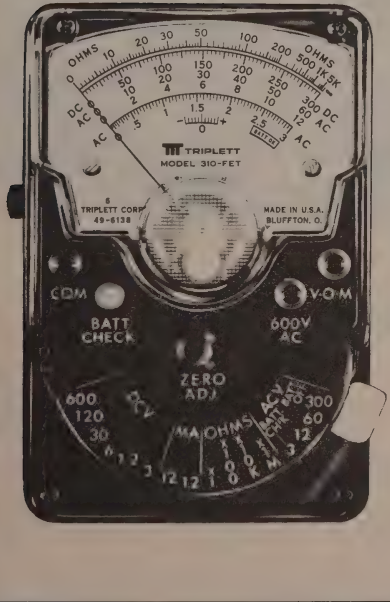
DC MILLIAMPERES
Ranges: 0-6-60-600 at 250 mV.
Accuracy: ±3% of full scale all ranges.

TESTER CONSTRUCTION
Meter: 50 μA suspension movement with diode overload protection.
Scale Length: Approx. 2⅛".
Switch: single enclosed range switch; DC polarity reversing switch.
Case: Molded, black plastic; dimensions 2¾" w X 1$\frac{5}{16}$" d X 4¼" h.
Weight: Approx. 8 oz. with batteries.

BATTERIES
1-15V NEDA 220; 1-1½V NEDA 910-F.

MODEL 310-C, complete with 42" leads, alligator clips, batteries and instruction manual. Cat. No. 3022 .... **$65.00**

MODEL 310-FET



1. Hand-size FET V-O-M with 10 megohn DC input resistance and diode overload-protected suspension movement.
2. Low voltage range of 300 mV DC; X1 megohm range.
3. Single range switch; DC polarity-reversing switch.

HAND-SIZE SOLID STATE

SPECIFICATIONS

DC VOLTS
Ranges: 0-0.3-1.2-6-30-120-600.
Accuracy: ±3% of full scale all ranges.
Input resistance all ranges—10 megohms.
Polarity reversing switch.

AC VOLTS
Ranges: 0-3-12-60-300-600.
Accuracy: ±4% of full scale on all ranges.
5,000 Ohms per Volt.

OHMS
Employs a 1½ Volt power source.
Ranges: 0-5k-500k-50MΩ-5,000MΩ.
50 Ohm center scale on low range.
Maximum power applied to device under test on low range—11 Milliwatts.
Accuracy: ±3% of DC V arc on all ranges.
Polarity reversing switch.

DC MILLIAMPERES
Ranges: 0-0.12-1.2 at 300 mV.
Accuracy: ±3% of full scale on all ranges.

TESTER CONSTRUCTION
Meter: 50 μA self-shielded suspension movement.
Scale Length: approx. 2⅛".
Case: Molded black high-impact plastic; dimensions 2¾" w X 1$\frac{5}{16}$" d X 4¼" h.
Weight: Approx. 14 oz.

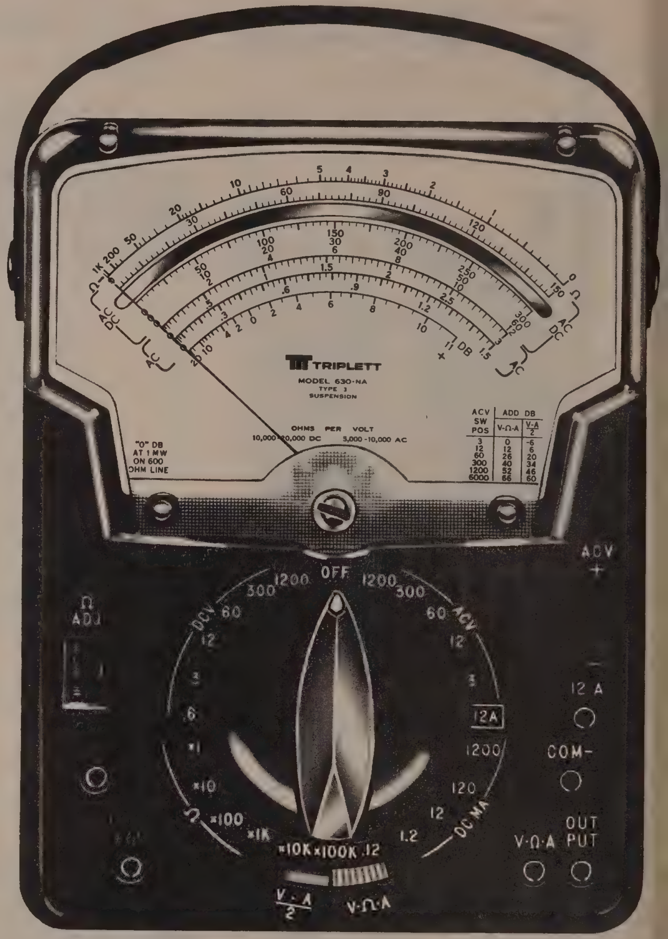
BATTERIES
1-7 V NEDA 1501M; 1-1½ V NEDA 910A.
Battery Check Position: Reads by touching lead to BATT. CHECK button on tester and reading BATT. OK area on dial.

MODEL 310-FET, complete with 42" leads, alligator clips, batteries and instruction manual. Cat. No. 3027 .... **$88.00**

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

MODEL 630-NA

1. 70-range V-O-M with single range switch and DC polarity-reversing switch.
2. Accuracy 1½% DC and 3% AC; mirrored scale.
3. Diode overload-protected suspension movement; temperature compensation.



MODEL 630-NA

$112

SPECIFICATIONS

DC VOLTS
Ranges: 0-0.6-3-12-60-300-1,200-6,000 (10,000 Ohms per Volt).
0-0.3-1.5-6-30-150-600-3,000 (20,000 Ohms per Volt).
0-0.120 at 60 microamperes; 0-0.240 at 120 microamperes.
Accuracy: ±1½% of full scale all ranges except 3,000 and 6,000, ±3½%.

AC VOLTS
Ranges: 0-3-12-60-300-1,200-6,000 (5,000 Ohms per Volt).
0-1.5-6-30-150-600-3,000 (10,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges except 3,000 and 6,000, ±5%.

OHMS
Ranges: 0-1k-10k-100k-1MΩ-10MΩ-100MΩ (4.4 Ohm center scale on low range).
Accuracy: ±1½% of full scale all ranges.
Ohms circuit protected with one ampere fuse (spare fuse included).

DC MICROAMPERES
Ranges: 0-60-600 at 120 mV; 0-120 at 240 mV.
Accuracy: ±1½% of full scale all ranges.

DC MILLIAMPERES
Ranges: 0-6-60-600 at 120 mV; 0-1.2-12-120-1,200 at 240 mV.
Accuracy: ±1½% of full scale all ranges.

DC AMPERES
Ranges: 0-6 at 120 mV; 0-12 at 240 mV.
Accuracy: ±1½% of full scale all ranges.

DECIBELS
Ranges: −26 to +51 ("0" dB at 1mW on 600 ohm line).
Scale: Lower arc lettered −20 to +11 dB.

OUTPUT VOLTS (AC)
Ranges: 0-3-12-60-300 (5,000 Ohms per Volt. 0-1.5-6-30-150) (10,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

TESTER CONSTRUCTION
Meter: 40μA suspension movement with diode overload protection, mirror scale, ½% resistors.
Scale Length: Approx. 4½".
Switch: DC polarity reversing switch; slide switch for doubling range selection.
Case: Molded, black plastic with removable black leather strap; dimension 5½" w x 3-11/32" d x 7½" h.
Weight: Approx. 4 lbs. with batteries.

BATTERIES
1—30V NEDA 210; 1—1½V NEDA 13F.

MODEL 630-NA, complete with 48" leads, alligator clips, batteries and instruction manual.
Cat. No. 3042 .... **$112.00**

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

MODEL 630-NS

1. V-O-M with 200,000 Ohms per volt DC and 20,000 Ohms per volt AC; accuracy 1½% DC and 3% AC.
2. 5μA suspension movement with diode overload protection; mirrored scale.
3. 62 ranges with single range switch and DC polarity reversing switch.

SPECIFICATIONS

DC VOLTS
Ranges: 0-0.6-3-12-60-300-1,200 (100,000 Ohms per Volt).
0-0.3-1.5-6-30-150-600 (200,000 Ohms per Volt).
0-0.15 at 60 microamperes.
Accuracy: ±1½% of full scale all ranges.

AC VOLTS
Ranges: 0-3-12-60-300-1,200 (10,000 Ohms per Volt).
0-1.5-6-30-150-600 (20,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges.

OHMS
Ranges: 0-1k-10k-100k-1MΩ-10MΩ-100MΩ (4.4 Ohm center scale on low range).
Accuracy: ±2% of full scale all ranges.
Ohms circuit protected with one ampere fuse (spare fuse included).

DC MICROAMPERES
Ranges: 0-60-600 at 150 mV; 0-5-120 at 300 mV.
Accuracy: ±1½% of full scale all ranges.

DC MILLIAMPERES
Ranges: 0-6-60-600 at 150 mV; 0-1.2-12-120-1,200 at 300 mV.
Accuracy: ±1½% of full scale all ranges.

DC AMPERES
Ranges: 0-6 at 150 mV; 0-12 at 300 mV.
Accuracy: ±1½% of full scale all ranges.

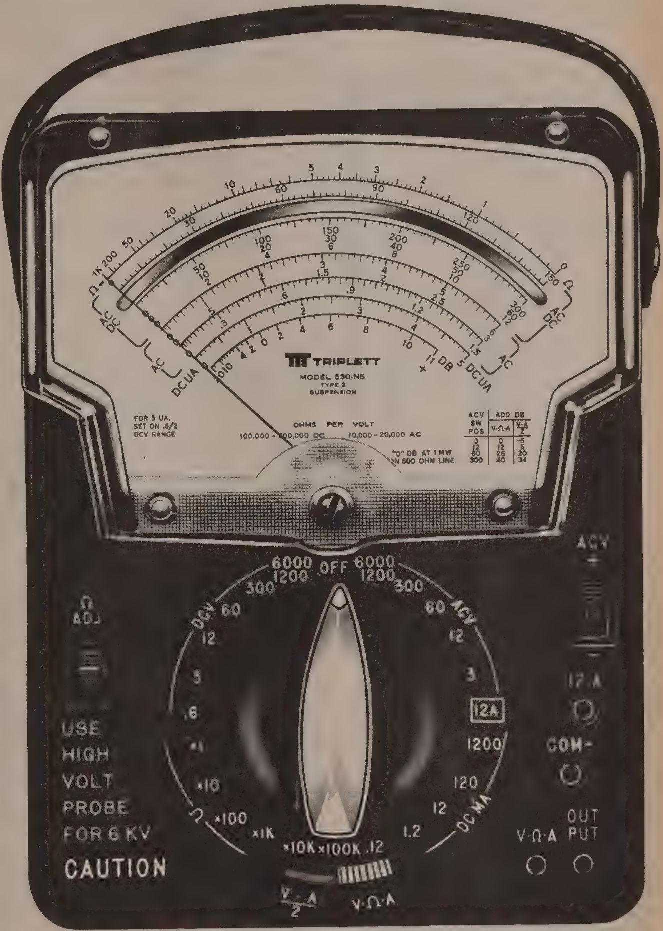
DECIBELS
Ranges: —26 to +51 ("0" dB at 1 mW on 600 Ohm line).
Scale: Lower arc lettered —20 to +11 dB.

OUTPUT VOLTS (AC)
Ranges: 0-3-12-60-300 (10,000 Ohms per Volt). 0-1.5-6-30-150 (20,000 Ohms per Volt).
Accuracy: ±3% of full scale all ranges:

TESTER CONSTRUCTION
Meter: 5μA suspension movement with diode overload protection; minor scale, ½% resistors.
Scale Length: Approx. 4½".
Switch: DC polarity reversing switch; slide switch for doubling range selection.
Case: Molded, black plastic with removable black leather strap; dimensions 5½" w x 3-11/32" d x 7½" h.
Weight: Approx. 4 lbs. with batteries.

BATTERIES
1—1½V NEDA 15A; 1—1½V NEDA 13F.

MODEL 630-NS, complete with 48" leads, alligator clips, batteries and instruction manual.
Cat. No. 3102 .... **$134.00**


TRIPLETT
MODEL 630-NS
TYPE 2
SUSPENSION
FOR 5 UA. SET ON .6/2 DCV RANGE
OHMS PER VOLT
100,000 - 200,000 DC
10,000 - 20,000 AC
"0" DB AT 1 MW ON 600 OHM LINE
DCV
ACV
OFF
DC MA
Ω ADJ
USE HIGH VOLT PROBE FOR 6 KV
CAUTION
12 A
COM-
V·Ω·A
OUT PUT

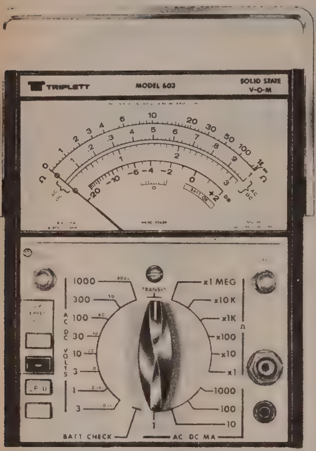
MODEL 630-NS

$134

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

FET V-O-M WITH MICRO POWER, LOW POWER OHMS, AND AUTO-POLARITY

MODEL 603—TYPE 1



1. **Exclusive TRIPLETT MICRO POWER—TMP™ provides battery life in excess of a year fo carbon batteries.**
2. **LOW-POWER OHMS—LPΩ™—6 ranges with 70 mV power source for in-circuit measurements without component damage.**
3. **FET V-O-M WITH AUTO-POLARITY—convenient and time saving, always reads up scale.**

RANGES

DC Volts: 0-0.3-1-3-10-100-300-1,000. Input resistance 11.12 megohms with 1.12 Meg in Probe.

AC Volts: 0-0.3-1-3-10-100-300-1,000. Input impedance 10 megohms. Frequency range 20 Hz to 10 kHz.

Ohms—Low Power: 0-1k-10k-100k-1MΩ-10MΩ-1000MΩ. (70 mV open circuit voltage, 123 µW maximum power applied to device under test, 10 Ohm center scale on low range).

Ohms—Conventional: 0-1k-10k-100k-1MΩ-10MΩ-1000MΩ. (1.5V open circuit voltage, 56 mW maximum power applied to device under test, 10 Ohm center scale on low range).

AC and DC Milliamperes: 0-1-10-100-1000 at 316 mV.

Decibels: −30 to +62 ("0" dB is equal to .776V).

Accuracy: ±3% all Voltage and Ohms ranges, ±4% all Current ranges.

Scale Length: 4⅛".

Meter: Diode overload protected suspension movement.

Case: Shielded, molded, black, 5⅛" w X $3\frac{3}{16}$" d X 6½" h.

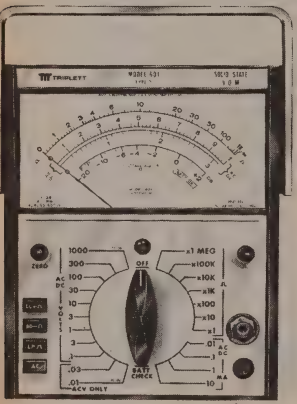
Batteries: NEDA 9V 1604 (2), 1½V 13F (1).

Complete with 48" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 5 lbs.

Model 603 Cat. No. 3037 .... **$173.00**

FET V-O-M WITH LOW POWER OHMS

MODEL 601—TYPE 2



1. **LOW-POWER OHMS—LPΩ™—7 ranges with 75 mV power source.**
2. **High sensitivity—10 mV AC full scale at 10 megohm input impedance; 100 mV DC at 11 megohm input resistance.**
3. **Simplified scale—only 4 arcs for all 53 ranges.**

RANGES

DC Volts: 0-0.1-0.3-1-3-10-30-100-300-1,000. Input resistance 11 megohms with 690k series resistor in probe tip. Includes 40 dB 60 Hz rejection.

AC Volts: 0-0.01-0.03-0.1-0.3-1-3-10-30-100-300-1,000. Input impedance 10 megohms. Frequency range 50 Hz to 50 kHz. Capacitance at input jack 60 mm fd max.

Ohms—Low-power: 0-1k-10k-100k-1MΩ-10MΩ-100MΩ-1,000MΩ (75 Mv open circuit voltage, 100 µW maximum power applied to device under test, 10 Ohm center scale on low range).

Ohms—Conventional: 0-1k-10k-100k-1MΩ-10MΩ-100MΩ-1,000MΩ (1.5V open circuit voltage, 56 mW maximum power applied to device under test, 10 Ohm center scale on low range).

AC and DC Milliamperes: 0-0.01-0.1-1-10 at 100 mV.

Decibels: −60 to +62 ("0" dB is equal to .775V).

Accuracy: DC ±2% Voltage, ±3% Current; AC ±3% Voltage, ±4% Current.

Scale Length: 4⅛".

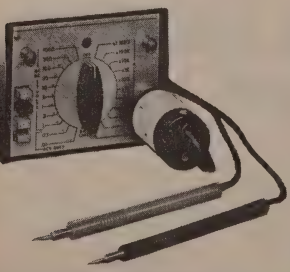
Meter: Diode overload protected suspension movement.

Case: Shielded, molded, black, 5⅛" w X $3\frac{3}{16}$" d X 6½" h.

Batteries: NEDA 1½V 15A (10).

Complete with 48" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 5 lbs.

Model 601 Cat. No. 3033 .... **$205.00**



AC CURRENT LEAKAGE ADAPTER

Adapter used with new or existing Model 601 V-O-M's for testing appliances, motors, hand tools, industrial equipment and machines, etc. for AC current leakage. Meets proposed ANSI Standard C101.1 for commercial appliance AC Current Leakage tests.

Leakage Readings: 7 ranges, 10µA f.s. to 30 mA f.s.

Resolution: .2µA on lowest V-O-M range.

Accuracy: ±4% of full scale.

Frequency Response: Approximates the C.F. Dalziel's "50 Percentile threshold of Perception Curve, within ±1.0dB"

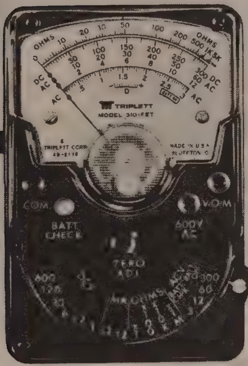
Input Impedance: 1500Ω test load.

Leakage Adapter for Model 601
Cat. No. 60-407 .... **$31.10**

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

HANDSIZE FET V-O-M

MODEL 310-FET—TYPE 1



1. **Hand-size FET V-O-M with 10 megohm DC input resistance and diode overload-protected suspension movement.**
2. **Low voltage range of 300 mV DC; X1 megohm range.**
3. **Single range switch; DC polarity-reversing switch.**

RANGES

DC Volts: 0-0.3-1.2-6-30-120-600. Input resistance 10 megohms.

AC Volts: 0-3-12-60-300-600 (5,000 Ohms per Volt).

Ohms: 0-5k-500k-50MΩ-5,000MΩ (50 Ohm center scale on low range).

DC Milliamperes: 0-0.12-1.2 at 300 mV.

Accuracy: ±3% DC; ±4% AC.

Scale Length: 2⅛".

Meter: Self-shielded, diode overload protected suspension movement; DC polarity-reversing switch.

Case: Molded, black, 2¾" w X 1 5⁄16" d X 4¼" h.

Batteries: NEDA 7V 1501M (1), 1½V 910A (1).

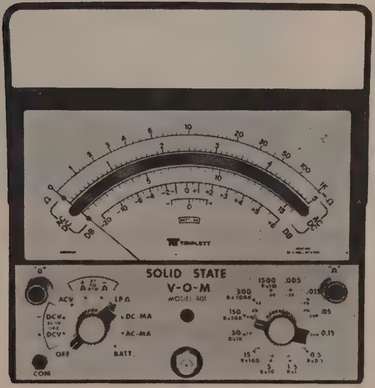
Complete with 42" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 2 lbs.

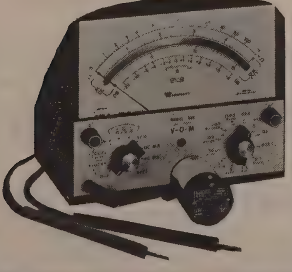
Model 310-FET Cat. No. 3027	**$88.00**
Model 100-FET Cat. No. 3013	**$130.00**

FET V-O-M WITH LOW POWER OHMS

MODEL 801—TYPE 2

1. **LOW-POWER OHMS—LPΩ™—8 ranges with 35 mV power source and 1 Ohm center scale.**
2. **High sensitivity—5 mV AC full scale at 10 megohm input impedance; 50 mV DC at 11 megohm input resistance.**
3. **Simplified scale—8" meter with only 4 arcs for all 73 ranges.**





RANGES

DC Volts: 0-0.05-0.15-0.5-1.5-5-15-50-150-500-1,500. Input resistance 11 megohms with 1 megohm series resistor in probe tip. Includes 40 dB 60 Hz rejection.

AC Volts: 0-0.005-0.015-0.05-0.15-0.5-1.5-5-15-50-150-500-1,500. Input impedance 10 megohms. Frequency range 50 Hz to 50 kHz. Capacitance at input jack 60 mm fd max.

Ohms—Low-power: 0-100-1k-10k-100k-1MΩ-10MΩ-100MΩ-1,000MΩ (35 mV open circuit voltage, 35 μW maximum power applied to device under test, and 1 Ohm center scale on low range).

Ohms—Conventional: 0-1k-10k-100k-1MΩ-10MΩ-100MΩ-1,000MΩ (1.5 open circuit voltage, 56mW maximum power applied to device under test, and 10 Ohm center scale on low range).

AC and DC Microamperes: 0-5-15-50-150-500 at 45 mV.

AC and DC Milliamperes: 0-1.5-5-15-50-150-500 at 45 mV.

AC and DC Amperes: 0-1.5 at 45 mV (Optional external shunt for 0-15A measurements).

Decibels: −70 to +66 ("0" dB is equal to .775 V).

Accuracy: DC ±2% Voltage, ±3% Current; AC ±3% Voltage, ±4% Current.

Scale Length: 6¾".

Meter: Diode overload protected suspension movement.

Case: Shielded, molded, black, 8" w X 5" d X 7" h.

Batteries: NEDA 9V 1604 (3), 1½V 13F (1).

Complete with 48" shielded probe, 36" grd. lead, alligator clips, batteries and instruction manual. Shpg. Wt. 10½ lbs.

Model 801 Cat. No. 3071	**$255.00**

AC CURRENT LEAKAGE ADAPTER

Adapter used with new or existing Model 801 FET V-O-M's permits AC current leakage measurement checks for either medical or commercial appliance applications. Meets NFPA and AAMI Standards for Type A Medical AC Current Leakage tests and proposed ANSI Standard C101.1 for commercial Appliance AC Current Leakage tests.

Leakage Readings: 8 ranges, 10 μA f.s. to 30 mA f.s.

Resolution: .2μA on lowest V-O-M range.

Accuracy: ±4% of full scale.

Frequency Response: Approximates the C. F. Dalziel's "50 Percentile threshold of Perception Curve, within ± 1.0 dB".

Input Impedance: Switch selection for Medical or Commercial Appliance leakage measurements.
Medical—500 Ω test load,
Commercial Appliance—1500 Ω test load.

Leakage Adapter for Model 801 Cat. No. 60-413	**$37.30**

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817

TEL: (419) 358-5015 TWX 810-490-2400

LABORATORY ACCURACY V-O-Ms

MODEL 630-A V-O-M TYPE 3

1. **Diode overload protected V-O-M with suspension movement; accuracy 1½% DC and 3% AC.**
2. **4 ohmmeter ranges with 4.4 Ohms center scale.**
3. **Simplified mirrored scale; only 4 arcs for all 27 ranges.**

RANGES

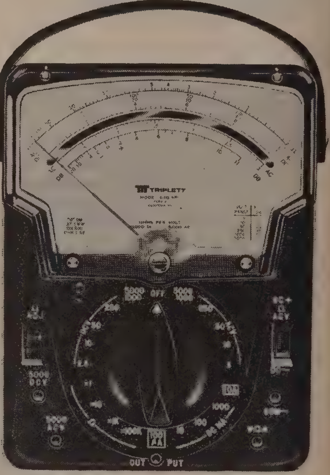
DC Volts: 0-3-12-60-300-1,200-6,000 (20,000 Ohms per Volt).
AC Volts: 0-3-12-60-300-1,200-6,000 (5,000 Ohms per Volt).
Ohms: 0-1k-10k-1MΩ-100MΩ (4.4 Ohm center scale on low range).
DC Microamperes: 0-60 at 250 mV.
DC Milliamperes: 0-1.2-12-120 at 250 mV.
DC Amperes: 0-12 at 250 mV.
Decibels: —20 to +51 ("0" dB at 1 mW on 600 Ohm line).
Output Volts (AC): 0-3-12-60-300 (5,000 Ohms per Volt).
Accuracy: ±1½% DC, ±3% AC.
Scale Length: 4⅜".
Meter: Diode overload protected suspension movement, mirror scale, ½% resistors.
Case: Molded, black, 5½" w X 3-11/32" d X 7½" h.
Batteries: NEDA 30V 210 (1), 1½V 13F (1). Complete with 48" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 5 lbs.
Model 630-A Cat. No. 3034 .... **$89.00**

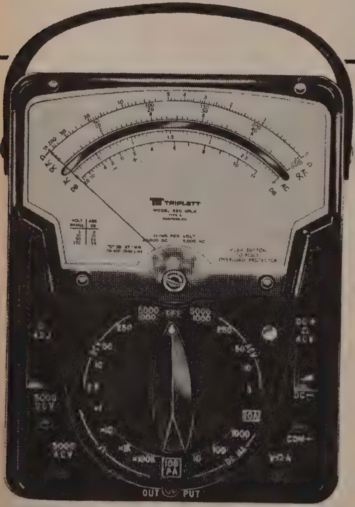
MODEL 630-APL V-O-M TYPE 4

1. **Accuracy 1½% DC and 3% AC; mirrored scale; diode overload-protected suspension movement.**
2. **27 range V-O-M with single range switch minimizes error; DC polarity reversing switch.**
3. **4 ohmmeter ranges with 4.4 Ohms center scale.**

RANGES

DC Volts: 0-2.5-10-50-250-1,000-5,000 (20,000 Ohms per Volt); 0-0.25 at 100 µA.
AC Volts: 0-3-10-50-250-1,000-5,000 (5,000 Ohms per Volt). Frequency range 10 Hz to 500 kHz.
Ohms: 0-1k-10k-1MΩ-100MΩ (4.4 Ohm center scale on low range).
DC Microamperes: 0-100 at 250 mV.
DC Milliamperes: 0-10-100-1,000 at 250 mV.
DC Amperes: 0-10 at 250 mV.
Decibels: —20 to +49 ("0" dB at 1 mW on 600 Ohm line).
Output Volts (AC): 0-3-10-50-250 (5,000 Ohms per Volt).
Accuracy: ±1½% DC, ±3% AC.
Scale Length: 4½".
Meter: Diode overload protected suspension movement, DC polarity reversing switch, mirror scale, ½% resistors.
Case: Molded, black, 5½" w X 3-11/32" d X 7½" h.
Batteries: NEDA 30V 210 (1), 1½V 13F (1). Complete with 48" leads, alligator clips, batteries and instruction manual. Shpg. wt. 5 lbs.
Model 630-APL Cat. No. 3038 ...... **$91.00**





MODEL 630-APLK V-O-M TYPE 3

1. **Burnout-proof solid-state overload protection; accuracy 1½% DC and 3% AC; mirrored scale.**
2. **Single range switch minimizes error; DC polarity-reversing switch.**
3. **4 ohmmeter ranges with 4.4 Ohms center scale.**

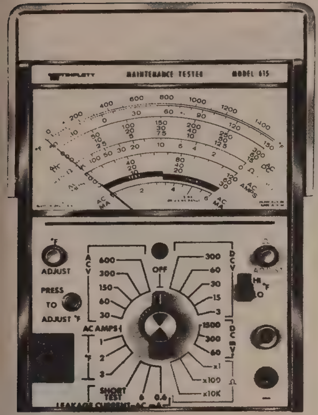
RANGES

DC Volts: 0-2.5-10-50-250-1,000-5,000 (20,000 Ohms per Volt); 0-0.25 at 100 µA.
AC Volts: 0-3-10-50-250-1,000-5,000 (5,000 Ohms per Volt).
Ohms: 0-1k-10k-1MΩ-100MΩ (4.4 Ohm center scale on low range).
DC Microamperes: 0-100 at 250 mV.
DC Milliamperes: 0-10-100-1,000 at 250 mV.
DC Amperes: 0-10 at 250 mV.
Decibels: —20 to +49 ("0" dB at 1 mW on 600 Ohm line).
Output Volts (AC): 0-3-10-50-250 (5,000 Ohms per Volt).
Accuracy: ±1½% DC, ±3% AC.
Scale Length: 4½".
Meter: Diode overload protected suspension movement, DC polarity reversing switch, mirror scale, ½% resistors.
Overload Protection: Complete tester protected with solid-state switching circuit.
Case: Molded, black, 5½" w X 3-11/32" d X 7½" h.
Batteries: NEDA 30V 210 (1), 1½V 13F (1). Complete with 48" leads, alligator clips, batteries and instruction manual. Shpg. Wt. 5 lbs.
Model 630-APLK Cat. No. 3120 ... **$135.00**

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

SPECIAL FEATURE V-O-Ms

MODEL 615 MAINTENANCE TESTER



1. **Maintenance tester . . . measures AC/DC Volts, Ohms, temperature and AC current leakage.**
2. **Two electrically compensated temperature ranges with switch selection for up to three temperature probes; ideal for air-conditioning, refrigeration maintenance.**
3. **Low millivolt ranges for thermocouple circuit touble-shooting; special scale for direct reading of AC Amps with clamp-on adapter accessory.**

RANGES

DC Volts: 0-.06-.3-1.5-3-15-30-60-300 (20,000 ohms/volt).

AC Volts: 0-3-30-60-150-300-600 (5,000 ohms/volt).

Ohms: 0-1K-100K-1MΩ. 10 ohm center scale on low range.

AC Amperes: (requires accessory Model 20-A Adapter) 0-6-12-30-60-120.

Temperature: −50°F to +150°F; −50°F to +1500°F.

AC Current Leakage: (through a network that simulates the human body. Short test and 0-0.6-6mA AC for ANSI C101.1—1971 commercial appliance AC Current Leakage Tests.

Accuracy: ±2% DC Voltage and Ohms ranges: ±3% AC Voltage and temperature ranges, ±4% AC Current Leakage ranges, ±8% AC Ampere ranges (basic VOM ±3%, Adapter ±5%).

Scale Length: 4½".

Meter: Diode overload protected suspension movement.

Case: Black, molded high impact plastic, 5⅛" W x 3$\frac{1}{16}$" D x 6½" H.

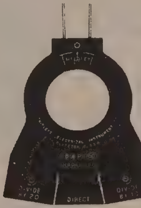
Batteries: NEDA 9V 1604 (2), 1½V 13F (1). Complete with 48" leads, 6' thermocouple probe, alligator clips, batteries and instruction manual.

Model 615 Cat. No. 3127 .... **$150.00**

OPTIONAL ACCESSORIES

Model 20-A Clamp-on AC Ammeter Adapter	Cat. No. 60-350	**$27.00**
Model 101 AC Line Separator	Cat. No. 60-218	**$10.00**
Replacement Leads	Cat. No. 79-127	**$ 4.50**
High Voltage Probes—0-30KVDC	Cat. No. 79-70	**$24.50**
0-30KVAC	Cat. No. 79-71	**$24.50**
0-60KVAC	Cat. No. 79-152	**$24.50**
Thermocouple Probes—General Purpose, Replacement, 6'.	Cat. No. 79-340	**$ 9.60**
Heavy Duty, Stainless Steel Sheath, 6'.	Cat. No. 79-339	**$14.10**
Carrying Case—Black leather, Model 639-OS.	Cat. No. 10-1793	**$20.10**
Carrying Case—Black molded plastic, with foam insert, holds tester and accessories.	Cat. No. 10-2691	**$22.60**

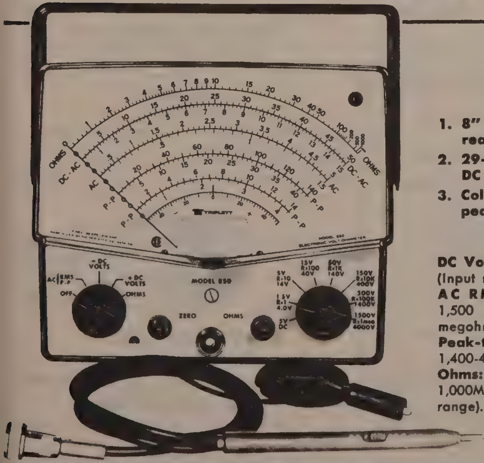
Model 20-A



Model 101

MAINTENANCE TESTER KIT

Model 615-K, complete with Model 615, Model 20-A, Model 101, black molded case, 48" leads, 6' thermocouple probe, alligator clips, batteries and instruction manual.
Cat. No. 3128 .... **$207.00**



MODEL 850

1. **8" meter with six scales for easy readability.**
2. **29-range VTVM with 11 megohm DC input resistance.**
3. **Color-coded scales for peak-to-peak measurements.**

RANGES

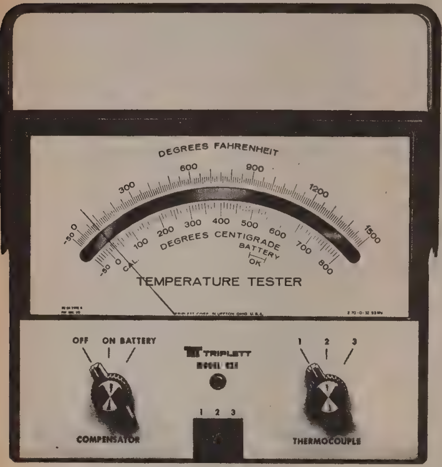
DC Volts: 0-0.5-1.5-5-15-50-150-500-1,500 (Input resistance 11 megohms).
AC RMS Volts: 0-1.5-5-15-50-150-500-1,500 (Input impedance minimum 0.83 megohms).
Peak-to-Peak Volts: 0-4-14-40-140-400-1,400-4,000.
Ohms: 0-1k-10k-100k-1MΩ-10MΩ-100MΩ-1,000MΩ (10 Ohm center scale on low range).

Accuracy: ±3% DC, ±3% AC.
Scale Length: 7".
Meter: Rugged spring-backed instrument jewels, DC polarity reversing switch.
Frequency Range: 15 Hz to 3 MHz (Optional accessory diode probe for 0-250 MHz measurements).
Tube Complement: 1—12AU7, 1—6AL5.
Case: Molded, black, 7⅝" w X 3¾" d X 6$\frac{7}{16}$" h.
Power: 115 Volts AC 50-60 Hz.
Battery: NEDA 1½V 14F.
Complete with 48" leads, alligator clips, battery and instruction manual. Shpg. Wt. 7 lbs.
Model 850 Cat. No. 3074 .... **$131.00**
Model 850 (Export—220V, 50 to 60 Hz)
Cat. No. 3075 .... **$137.00**

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817

TEL: (419) 358-5015 TWX 810-490-2400

TEMPERATURE TESTER



MODEL 825 TYPE 1

1. **Measures −50°F to +1500°F and −50°C to +800°C.**
2. **Large easy to read 8" dial with mirror scale.**
3. **Electrical Compensation for Ambient temperature.**

Range: −50°F to +1500°F; −50°C to +800°C.
Sensor Type: Thermocouple, type K (Chromel-Alumel*), 5Ω (±1%) resistance.
Compensation Type: Electrical.
Accuracy: Accuracy of Model 825 (including probe) operated in horizontal position at ambient temperature of 77°F is ±1¼% of full scale reading. Operated at ambient temperatures other than 77°F results in greater error; i.e., at extremes of 50°F to 120°F, an additional error of ±½% would result. Specific accuracy for other situations provided upon request.

TESTER CONSTRUCTION
Meter: Suspension movement.
Scale Length: 6¾".
Inputs: 3—switch selected inputs.
Case: Molded, black, 7⅝" w X 4¼" d X 6¾" h.
Battery: NEDA 1½V 13F (1).
Complete with 10′ thermocouple probe, alligator clips, battery and instruction manual. Shpg. Wt. 4½ lbs.
Model 825 Cat. No. 3119 .... **$126.00**

*Trademark of Hoskins Mfg. Co.

ACCESSORIES

Thermocouple probe, 10′.	Cat. No. 79-311	**$15.60**
Leather case lined with ⅜" sponge rubber.	10-2649	**$40.50**

ACCESSORIES

HIGH VOLTAGE PROBES

Completely insulated polystyrene test probe with guard-type handle. Probe is 11¾" long, with 48" hi-voltage wire lead with banana plug at tester end.

Models 601, 603

0-3-10-30	kVDC	79-270	**$34.50**

Model 615

0-30	kVDC	79-70	**$24.50**
0-30	kVAC	79-71	**24.50**
0-60	kVAC	79-152	**24.50**

Models 630, 630-A

0-30	kVDC	79-70	**$24.50**
0-30	kVAC	79-71	**24.50**
0-60	kVAC	79-152	**24.50**

Models 630-APL, 630-APLK, 630-PL, 630-PLK

0-10	kVDC	79-83	**$24.50**
0-25	kVDC	79-130	**24.50**
0-25	kVAC	79-166	**24.50**

Model 630-NA

0-30	kVDC	79-152	**$24.50**
0-30	kVAC	79-71	**24.50**
0-60	kVAC	79-152	**24.50**

Model 630-NS

0-6	kVDC	79-229	**$24.50**
0-6	kVAC	79-230	**24.50**
0-30	kVAC	79-152	**24.50**

Model 801

0-5-15-50	kVDC	79-292	**$33.00**

Model 850

0-5-15-50	kVDC	79-196	**$34.50**

EXTERNAL SHUNTS

Models 630, 630-A

0-30	DC AMP (plug in)	91-247	**$17.30**
0-60	DC AMP (portable)	91-248	**21.50**
0-120	DC AMP (portable)	91-255	**21.50**

Models 630-APL, 630-APLK, 630-PL, 630-PLK

0-25	DC AMP (plug in)	91-243	**$17.30**
0-50	DC AMP (portable)	91-244	**21.50**
0-100	DC AMP (portable)	91-191	**21.50**

Model 630-NA

0-15-30	DC AMP (plug in)	91-429	**$23.00**
0-30-60	DC AMP (portable)	91-430	**30.20**
0-60-120	DC AMP (portable)	91-431	**30.20**

Model 630-NS

0-30	DC AMP (plug in)	91-570	**$25.90**
0-60	DC AMP (portable)	91-564	**18.80**
0-120	DC AMP (portable)	91-565	**18.80**

Model 666-R

0-25	DC AMP (plug in)	91-243	**$17.30**
0-50	DC AMP (portable)	91-244	**21.50**
0-100	DC AMP (portable)	91-191	**21.50**

Model 801

0-15	AMP shunt adapter	91-620	**$13.10**

THERMOCOUPLE PROBES

Model 320 G/P Temperature

Thermocouple probe, 5′	79-310	**$ 10.60**

Model 615

Thermocouple probe, standard replacement, 6′	79-340	**$ 9.60**
Thermocouple probe, stainless steel, 6′	79-339	**$14.10**

Model 825

Thermocouple probe, 10′	79-311	**$15.60**

RF PROBES

Model 601	79-264	**$12.50**
Model 602, 603	79-330	**12.50**
Model 801	79-289	**12.50**
Model 850	79-215	**12.50**

REPLACEMENT LEADS

Model 310 Series

Needle nose test leads, 42"	79-153	**$ 4.50**
Blunt nose test leads, 42"	79-296	**6.90**

Model 320 G/P Series

Test leads, 48"	79-127	**$ 4.50**

Model 601

Test lead, gray including probe, 48"	79-267	**$17.90**
Test lead, gray less probe, 48"	79-267-1	**6.60**
AC/DC probe less lead	79-267-2	**11.30**
Ground lead, black, 48"	79-261	**3.20**

Model 603

Test lead, red including probe, 48"	79-288	**$17.90**
Ground lead, black, 48"	79-261	**3.20**

Model 615, 630 Series, 666-R, 900, 6028

Test leads, 48"	79-127	**$ 4.50**

Model 801

Test lead, gray shielded including probe, 48"	79-343	**$19.80**
Test lead, gray shielded less probe, 48"	79-291	**7.30**
AC/DC probe less lead	79-290	**12.50**
Ground lead, black, 36"	79-298	**2.30**

Model 850

Test lead, gray shielded, 48"	79-192	**$10.20**
Ground lead, black, 48"	79-214	**2.00**

Model 8035

Test leads, 48"	79-320	**$11.90**

SPECIALTY LEADS

Model 310 Series

No. 311 Leads	79-161	**$ 4.50**

Model 630 Series

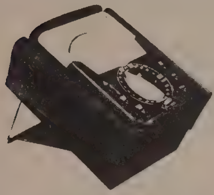
No. 611 Leads	79-160	**$ 4.50**

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

ACCESSORIES

QUALITY LEATHER CASES

For Model 630 Series (630, 630-A, 630-APL, 630-APLK, 630-L, 630-M, 630-NA, 630-NS, 630-PL, 630-PLK, 631)

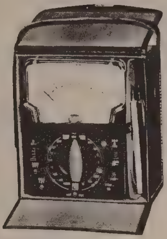


Model 639-N
Cat. No. 10-1189 **$17.30**
Center-cover flaps snap back allowing full view of scales and permitting complete access to instrument without removal from case. Tester stand included at no extra cost.

Model 639
Cat. No. 10-823 **$17.30**

Model 639-P
Cat. No. 10-921 **$24.50**
Lined with ⅜'' sponge rubber.

For Models 601, 602, 603, Model 630 Series, 615 & 6028



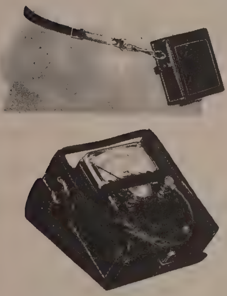
Model 639-OS
Cat. No. 10-1793 **$20.10**
Flaps open to permit use of tester in case. Accessory compartment, built-in stand on back.

For Model 666-R

Model 669-OS
Cat. No. 10-1792 **$12.50**
Flaps open to permit use of tester in case. Accessory compartment, built-in stand on back.

Model 669
Cat. No. 5616 ..... **$11.50**
Similar to 639 on left.

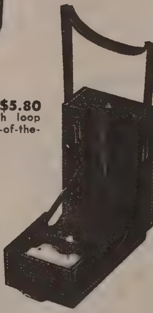
For Models 310, 310-C, 310-FET



Model 369-S
Cat. No. 10-1791 **$13.70**
Flaps fold back to form handy stand. Contains a retractable hook for hanging from nails, pipes, etc., freeing both hands, removable shoulder strap. Test leads store in case and remain plugged in.

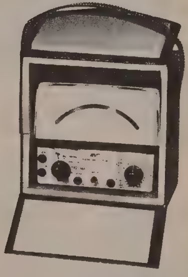
Model 379
Cat. No. 10-1456 **$11.00**
Has pocket for 101 and accommodates 310—10 in combination.

Model 369
Cat. No. 10-1258 ..**$5.80**
Trouser belt slips through loop on back of case for out-of-the-way carrying.



Model 369-T
Cat. No. 10-1608 **$13.10**
Neck strap carrying case.

For Models 800, 801, 825 & 850



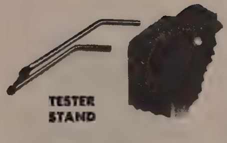
Flaps open to permit use of tester without removal from case. Built-in stand on back. Lined with ⅜'' sponge rubber.

For Models 800, 850
Cat. No. 10-1669 ....**$31.80**
859-OP Case

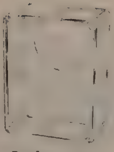
For Model 801
Cat. No. 10-2467 .... **$40.50**

For Model 825
Cat. No. 10-2649 ....**$40.50**

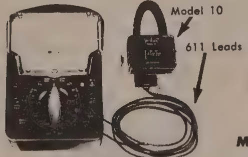
MODEL 630 SERIES ACCESSORIES



Cat. No. 255-35 ....**$2.80**
Metal stand holds tester in approximately 45° angle; enabling you to make easier readings.



Lucite Back
Cat. No. 10-1398 ..**$7.50**
Transparent back for classroom or industrial use.



No. 611 Leads
Cat. No. 79-160 ....**$4.50**
For use of Model 10 Clamp-On AC Ammeter with Model 630 Series. Leads 6' long.

Model 10
Cat. No. 60-211 ..**$24.00**
AC AMPERES. Range: 0-6-12-30-60-120-300. Accuracy: ±5% (including V-O-M ±8%.)
The Model 10 is used with the Model 630 Series by means of 611 leads to measure AC current flowing in a circuit without breaking the conductors or insulation of that circuit. It has a split yoke that can be opened and clamped around one wire of the circuit.

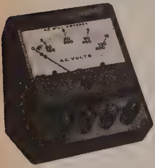
Model 101
Cat. No. 60-218 **$10.00**
AC RANGES. Direct Range: Ampere 0-6-12-30. Divide by 10: Milliampere 0-600-1200. Amperes 0-1.2-3-6-12. Divide by 20: Milliamperes 0-300-600-1500. Amperes 0-1.5-3-6.
The Model 101 is used to separate one conductor of a two-conductor cable from the other conductor so that the Model 10 can be used on a circuit having a two-conductor cable. The Model 101 also extends the range of the Model 10 to low AC currents.

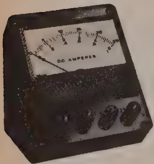
TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

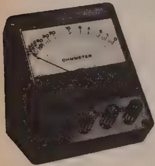
G/P PORTABLES

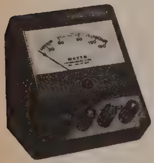
MODEL 320 G/P SERIES

DC Volts


AC Volts


DC Amperes


Ohmmeter


Watts

Temperature

1. **Wide clear view plastic meter, with Bar-Ring DC movements.**
2. **Overload protection on all models. (Diodes on DC, Fused AC)**
3. **Unbreakable molded black plastic cases with aluminum panels.**

- 59 Standard ranges available on 29 units.
- ±2% accuracy on DC and AC Iron Vane Type.
- ±3% accuracy on AC Rectifier Type and Ohms.
- ±3% or better accuracy on temperature.
- Wide clear view plastic 3½" Model 320-G panel instrument.
- Bar-Ring construction in DC movements assures self-shielding.
- Five-way binding posts; three switch selected inputs on temperature unit.
- Knife-edge pointers; approx. 3" scale length.
- Diodes protect against instantaneous overloads on DC movements.
- AC movements are fuse protected.
- Temperature unit electrically compensated; thermocouple, type J, sensor.
- Unbreakable molded black plastic case 3⅞" w X 4¼" d X 4¼" h.

RANGES AND PRICES

Range	Ohms Res.	Cat. No.	Price
DC TYPE 320-G/P			
0-1-5-25 Volts (1000 Ω/V)		3500	$39.20
0-25-100-500 Volts (1000 Ω/V)		3501	40.10
0-6-60-600 Volts (1000 Ω/V)		3502	40.10
0-50 μA	2300	3503	37.00
500-25-0-25-500 μA	6250	3504	41.30
0-0.25-1-5 mA		3505	38.20
0-25-100-500 mA		3506	38.70
0-1-10-100 mA		3507	38.70
0-1-5-25 Amp.		3508	39.20
0-50-100-250 mV		3509	38.70
0-3-15 Amp.		3510	35.40
0-10-50-250 μA (Suspension)		3511	74.90
40-0-40 μA (Suspension) Null Meter	1700	3512	51.50
AC RECTIFIER TYPE 350-G/P			
0-6-60-600 Volts (1000 Ω/V)		3530	$63.60
AC IRON VANE TYPE 330-G/P			
0-120-600 Volts (83 Ω/V) & 0-12 mA		3540	$53.10
0-5-25 Volts (4 Ω/V) & 0-250 mA		3541	39.60
0-30-120 Volts (17 Ω/V) & 0-60 mA		3542	41.10
0-150 Volts (125 Ω/V)		3543	31.50
0-1 Amp.	.3	3544	29.80
0-5 Amp.	.015	3545	29.80
0-25 Amp.	.002	3546	29.80
OHMS TYPE 320-G/P			
0-1K-100K (10-1000 at center scale) Includes 1.5 V battery & test leads		3560	$43.40
0-1 Meg-100 Meg (5K-500K at center scale) Includes 30 V battery & test leads		3561	50.10

Range	Ohms Res.	Cat. No.	Price
RF VOLTS TYPE 340-G/P			
0-2.5 Volts (240 Ω/V)		3570	$60.30
WATTS TYPE 360-G/P			
0-150 Watts (150 V, 2A. Max.)		3580	64.00

Note: The 0-50-100-250 DC mV model may be used with any of several standard switchboard shunts to extend range into higher current areas.

TEMPERATURE TYPE 320-G/P

Range		Cat. No.	Price
−150°F to +250°F −100°C to +120°C	(suspension)	3590	$70.00
−100°F to +300°F −75°C to +150°C	(suspension)	3594	70.00
0°F to +500°F −20°C to +260°C	(suspension)	3591	70.00
0°F to +750°F −20°C to +400°C	(suspension)	3592	70.00
0°F to +1000°F −20°C to +540°C	(suspension)	3593	70.00

Includes 5′ thermocouple probe, 1.5V C battery and instruction manual.

SPECIAL RANGES

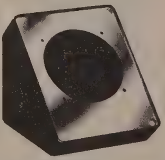
Special ranges to customer requirements on request. Special charges will apply.

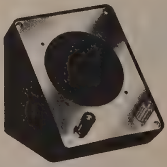
OPTIONAL ACCESSORIES

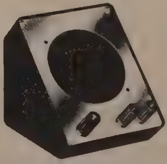
Item	Cat. No.	Price
Test leads for G/P Series (except temperature G/P)	79-127	$ 4.50
5′ thermocouple probe (temperature G/P)	79-310	10.60

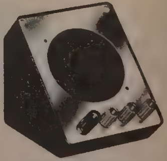
PORTABLE INSTRUMENT KIT

- Design your own portable instrument. Case styles with five-way binding posts available for single, double or triple range meters.
- Case assembly for mounting a 3½" square meter to meet specific needs.
- Permits greater flexibility in meter range selection. See Triplett Panel Instrument Catalog for nearly 250 3½" meters from which to choose.
- Accepts the 320-G and 327-T series meters.
- Easily assembled, ready to connect to panel instrument.


Case with panel.
Cat. No. 10-2192 $5.50


Case with panel,
1 black and 1 red post.
Cat. No. 10-2191 $7.30

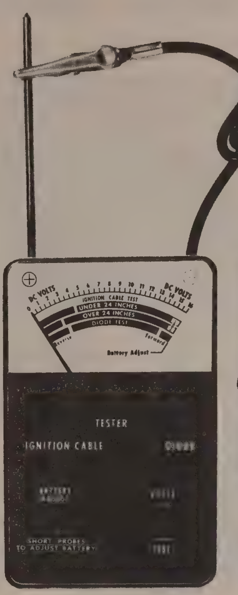

Case with panel,
1 black and 2 red posts.
Cat. No. 10-2190 $8.30


Case with panel,
1 black and 3 red posts.
Cat. No. 10-2189 $9.10

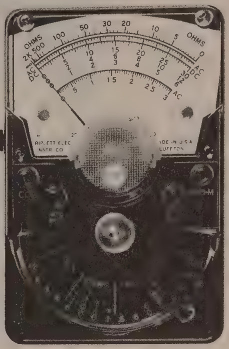
Test leads for use with G/P Kit Cat. No. 79-127 $4.50

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

If you need a tester with special scales, ranges, accessories or any combination...

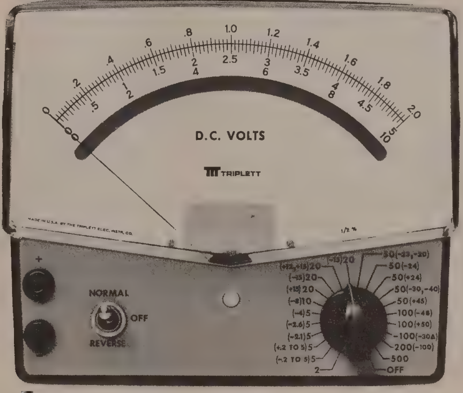

DC VOLTS
IGNITION CABLE TEST
UNDER 24 INCHES
OVER 24 INCHES
DIODE TEST
Reverse
Forward
Battery Adjust
TESTER
IGNITION CABLE
DIODE
SHORT PROBES TO ADJUST BATTERY

A


OHMS
OHMS
AC
DC

B

Buy a Triplett tester custom-designed for you


D.C. VOLTS
TRIPLETT
NORMAL
OFF
REVERSE

C

Triplett, manufacturer of the World's most complete line of V-O-M's, is ready, willing and able to design and manufacture special testers of virtually any size, style or type to meet your specifications.

Tester A (above) was designed to give auto mechanics a simple, rugged tester for "go/no go" tests that would otherwise be measured in electrical units unfamiliar to them.

Tester B is a modification of a standard Triplett tester incorporating only the specific ranges needed by the field service engineers for whom it was designed.

Tester C has special ranges and special input connectors and cables to permit a single-point connection for trouble-shooting and servicing all the circuits of a complex business machine.

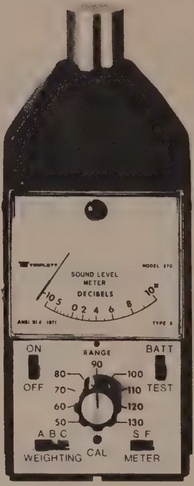
Several other buyers of standard Triplett test equipment request their company name on the dial to personalize their testers.

If you think a custom tester may solve some problems for you, contact your Triplett representative. He'll put you in touch with the Tester Designers and Engineers at Triplett who'll help you analyze the problem and suggest the optimum cost/result solution. Triplett Corporation, Bluffton, Ohio 45817

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

A better way to see sound.

MODEL 370 SOUND LEVEL METER—TYPE 3



MEASURING RANGE: 40 dB to 140 dB (ref. .0002 Microbar) in 10 dB increments.
WEIGHTING NETWORKS: A, B, and C weighting in accordance with ANSI Standard S1.4-1971 for Type 3 meters.
MICROPHONE: Lead-Zirconate-Titanate Ceramic Unit, 15/16" O.D.
ACCURACY: Exceeds ANSI Standard S1.4-1971 for Type 3 Sound Level Meters.
OUTPUT (full scale): Approximately 100mV RMS into a 10K ohm load for a full scale meter reading. Output impedance is less than 10 ohm.
METER: Quasi RMS response, with fast and slow meter speeds in accordance with ANSI S1.4-1971 Type 3.
OVERLOAD: With the indicating instrument replaced by an equivalent impedance the output of the Model 370 will not overload for input levels up to 8 dB above maximum scale reading for frequencies from 63Hz to 8000 Hz on any range or weighting.
CALIBRATION: The Model 370 can be acoustically calibrated at frequencies from 125 Hz to 2000 Hz with either Triplett Model 371 or 372 Calibrator or any other calibrator fixtured to accept a .936 diameter microphone.
A. C. OUTPUT PROVISION: Output Jack supplies an analog output signal of approximately 100mV RMS capable of being fed into external magnetic tape recorders, octave band analyzers or other similar analytical equipment.
OPERATING TEMPERATURE RANGE: 20°F to 125°F (−7°C to 50°C); temperature coefficient is +.02dB/°F (+.036dB/°C).
STORAGE TEMPERATURE RANGE: 0°F to 150°F (−18°C to 65°C) with battery removed.
OPERATING HUMIDITY RANGE: 5% to 85% relative humidity.
MAGNETIC FIELD: 1-Orsted field of 50 or 60 Hz has no measurable effect on the Model 370.
TESTER CONSTRUCTION: Meter—Suspension movement with 1.5" dial length.
Case—Flat black aluminum with high impact plastic cone; 7¼" long x 2" deep x 3" wide.
Weight—1 lb. with batteries.
BATTERIES: 2-9V NEDA 1604: life is approximately 40 hours with typical intermittent operation.
MODEL 370 (Type 3) complete with batteries and instruction manual.
Cat. No. 3130 .... $250.00

MODEL 375 (Type 2) similar to Model 370 above except meets all ANSI S1.4-1971 requirements for Type 2 Sound Level Meters. Complete with batteries and instruction manual.
Cat. No. 3131 .... $325.00

MODEL 371 SOUND CALIBRATOR

MODEL 371
MODEL 372

ACOUSTIC OUTPUT: Frequencies—1000 Hz ±3%.
Sound Pressure Level—114 dB (ref. .0002 Microbar).
Accuracy—±0.5 dB at 73.5°F (23°C) and 760 mm Hg.
Temperature Coefficient—Between 0 and −.006 dB/°F (−.01 dB/°C).
Pressure Correction—Chart supplied.
OPERATING ENVIRONMENT: Temperature—32°F to 125°F (0°C to 50°C).
Humidity—5-85% relative humidity.
CALIBRATOR CONSTRUCTION: Controls—Single pushbutton simultaneously operates output signal and battery check light.
Microphone sizes—for 1" and ½" outside diameters.
Case—Aluminum.
Dimensions—4⅝" long x 2" diameter.
Weight—1 pound with battery.
BATTERIES: 1—9V NEDA 1600.
MODEL 371, complete with battery, adapter for ½" microphone, and instruction manual.
Cat. No. 60-454 .... $125.00

MODEL 372 SOUND LEVEL CALIBRATOR

ACOUSTIC OUTPUT: Frequencies—125, 250, 500, 1000 and 2000 Hz ±3%.
Sound Pressure Level—100 dB or 114 dB (ref. .0002 Microbar) selected by two-position toggle switch.
Accuracy—±0.3 dB—500 Hz, ±0.5 dB—other frequencies at 73.5°F (23°C) and 760 mm Hg.
Output Jack—Electrical signal output of 1 volt RMS provided for tests on instruments without microphones.
Temperature Coefficient—Between 0 and −.006 dB/°F (−.01 dB/°C).
Pressure Correction—Chart supplied.
OPERATING ENVIRONMENT: Temperature—32°F to 125°F (0°C to 50°C).
Humidity—5-85% relative humidity.
CALIBRATOR CONSTRUCTION: Controls—Frequency level switch permits selection from five frequency levels or off position. Three-position toggle switch selects between two sound pressure levels and battery check function.
Microphone Sizes—for 1" and ½" outside diameters.
Case—Aluminum.
Dimensions—5¾" long x 2¼" diameter.
Weight—1 pound with battery.
BATTERIES: 1—9V NEDA 1600.
MODEL 372, complete with battery, adapter for ½" microphone and instruction manual.
Cat. No. 60-455 .... $240.00
OPTIONAL ACCESSORIES: Carrying Case.
Cat. No. 10-2695 .... $6.30

ACCESSORIES:

Leather Carrying Case for 370/375 (Includes Neck Strap), Cat. No. 10-2693	$10.50
Leather Carrying Case for 371, Cat. No. 10-2694	5.70
Leather Carrying Case for 372, Cat. No. 10-2695	6.30
Molded Plastic Case for Sound Level Kits, Cat. No. 10-2712	21.50
Neck Strap for 370/375, Cat. No. 3206-56	$ .60
Wind Screen for 370/375 (Package of 4), Cat. No. 12308	10.80
Microphone Cap for 370/375, Cat. No. 10-2700	.30
Recorder Chart paper for Model 380, 75' roll, Cat. No. 156-1	4.80

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

A better way to see sound.

SOUND LEVEL KITS

MODEL 370-K1 Sound Level Kit: Includes Model 370 Sound Level Meter—Type 3, Model 371 Acoustic Calibrator—1 Frequency with adapter for ½" microphone, Neck Strap for Model 370, Foam Wind Screen, Molded Plastic Case, batteries and instruction manuals.
Cat. No. 3134 .... $397.00

MODEL 370-K2 Sound Level Kit: Includes Model 370 Sound Level Meter—Type 3, Model 372 Acoustic Calibrator—5 frequencies with adapter for ½" microphone, Neck Strap for Model 370, Foam Wind Screen, Molded Plastic Case, batteries and instruction manuals.
Cat. No. 3135 .... $512.00

MODEL 375-K1 Sound Level Kit: Includes Model 375 Sound Level Meter Type 2, Model 371 Acoustic Calibrator—1 frequency with adapter for ½" microphone, Neck Strap for Model 375, Foam Wind Screen, Molded Plastic Case, batteries and instruction manuals.
Cat. No. 3136 .... $472.00

MODEL 375-K2 Sound Level Kit: Includes Model 375 Sound Level Meter—Type 2, Model 372 Acoustic Calibrator—5 frequencies with adapter for ½" microphone, Neck Strap for Model 375, Foam Wind Screen, Molded Plastic Case, batteries and instruction manuals.
Cat. No. 3137 .... $587.00

To control noise, you must first determine its source and intensity. That's what the Triplett instruments are designed to do. Once this is determined, you can take remedial steps. You also can use these instruments in preventive maintenance. Deteriorating equipment shifts to higher frequencies, so sound measuring instruments can catch this and permit correction at minimal expense and downtime.

The equipment is simple to use. Unskilled personnel can quickly learn to obtain accurate results, and Triplett offers both single and multi-frequency calibrators for fast, foolproof "on-site" calibration. Accuracy is assured, easily, quickly.

For nearly three quarters of a century, Triplett has manufactured high quality test instruments and panel meters for industry. Now it offers a better way to see sound.

WALSH-HEALEY NOISE PROVISIONS

The Walsh-Healey Public Contracts Act was modified in May 1970 to include safety standards aimed at protecting employees from hearing losses caused by long-term exposure to excessive noise levels.

Permissible Noise Exposures

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

DECIBEL CHART

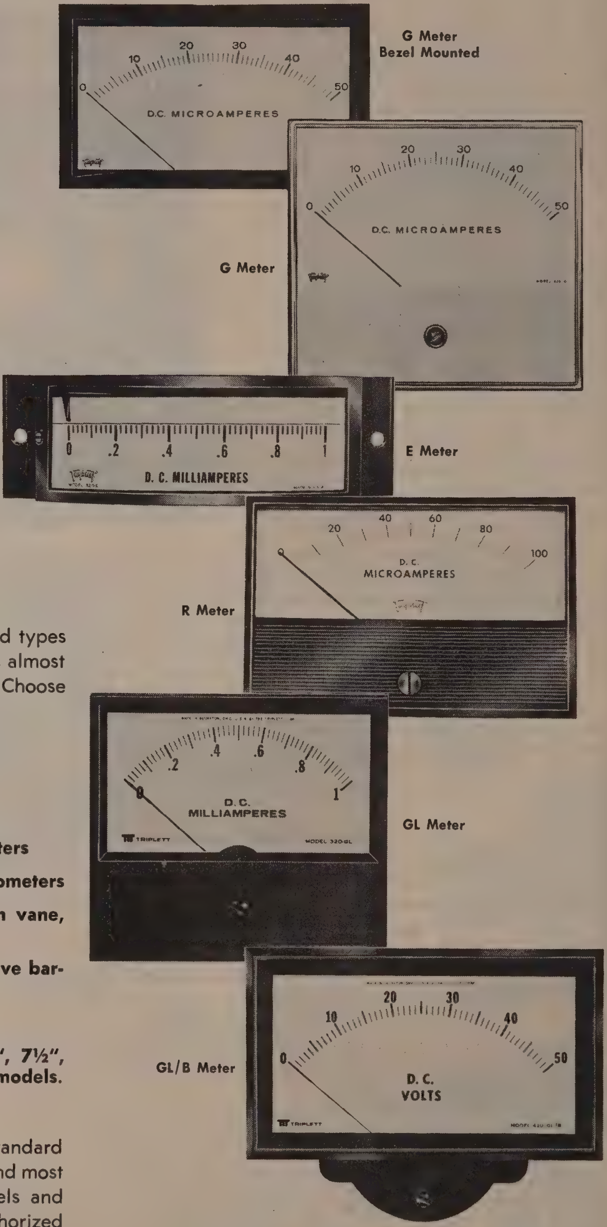
	dB	Source
EXTREME DANGER	155	Rifle blast; close-up jet engine; nearby siren
	140	Shotgun blast (to shooter); drag strip (near starting line); nearby jet engine
	120	Jet airport; some electronic music; rock-drill
PROBABLE PERMANENT HEARING LOSS AT THESE LEVELS	115-125	Drop hammers; chipping hammers
	110-115	Planers; routers; sheet metal speed hammers
	90-100	Subway; weaving mill; paper-making machine
	90- 95	Screw machines; punch press; riveter; cut-off saw
POSSIBLE DAMAGE	80- 95	Spinners; looms; lathes
	80	Heavy traffic; plate mill
	65- 75	Stenographic room; noisy typewriter
	70	Busy street
	60	Normal speech
	50	Average office
	45- 50	Low conversation
	20- 30	Quiet city apartment; whisper; comfortable sleeping limit
	15	Average threshold of acuity; leaf rustling
	0	Threshold of acute hearing (0 dB is 0.0002 dynes per sq. cm.)

Sustained exposure to dB above the upper levels may cause vibration of cranial bones, blurred vision, even weakening of body muscular structure. Frequencies of 500-2,000 Hz are most critical to noise-induced hearing loss.

National Safety News

TRIPLETT TEL: (419) 358-5015 TWX 810-490-2400
CORPORATION, BLUFFTON, OHIO 45817

For your standard panel instrument needs... Buy Triplett's off the shelf Panel Instruments


G Meter
Bezel Mounted
D.C. MICROAMPERES
G Meter
D.C. MICROAMPERES
E Meter
D. C. MILLIAMPERES
R Meter
D. C.
MICROAMPERES
GL Meter
D. C.
MILLIAMPERES
TRIPLETT
MODEL 320-GL
GL/B Meter
D. C.
VOLTS
TRIPLETT

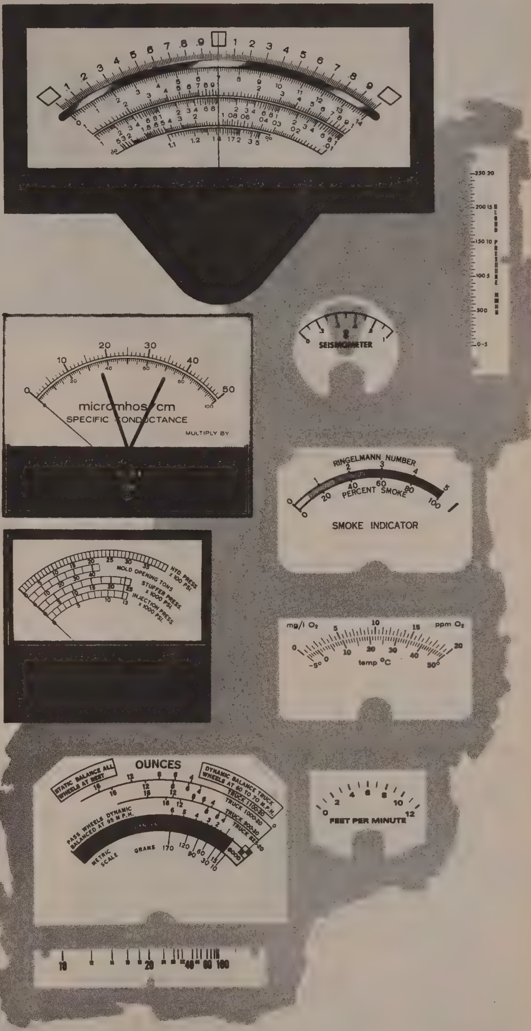
With 1369 different sizes, styles and types of analog panel instruments, there's almost certainly one to suit your needs. Choose from:

- **AC, DC, and RF types**
- **Volt, millivolt and VU meters**
- **Amp, milliamp and microamp meters**
- **Null meters, ohmmeters and pyrometers**
- **Pivot and jewel, suspension, iron vane, d'Arsonval**
- **All DC movements contain exclusive barring self shielded magnet**
- **1½", 3½", 4½" edgewise types**
- **1½", 2½", 3½", 4½", 5½", 6½", 7½", 8½" round, square & rectangular models.**

In addition to a large stock of standard models at the Bluffton, Ohio, plant and most Triplett distributors, standard models and specials are available from 40 authorized Sales / Service / Modification Centers throughout the United States and in Canada.

TRIPLETT CORPORATION, BLUFFTON, OHIO 45817
TEL: (419) 358-5015 TWX 810-490-2400

If you need panel instruments with custom dials, cases, accuracy, tracking, resistance, response time, or practically any combination of unusual specs...


micromhos/cm
SPECIFIC CONDUCTANCE
MULTIPLY BY
SEISMOMETER
RINGELMANN NUMBER
PERCENT SMOKE
SMOKE INDICATOR
HYD. PRESS x 100 PSI
MOLD OPENING TONS
STUFFER PRESS x 1000 PSI
INJECTION PRESS x 1000 PSI
mg/l O₂
ppm O₂
temp °C
OUNCES
STATIC BALANCE ALL WHEELS AT REST
DYNAMIC BALANCE TRUCK WHEELS AT 60 TO 70 M.P.H.
PASS WHEELS DYNAMIC BALANCED AT 95 M.P.H.
METRIC SCALE
GRAMS
FEET PER MINUTE

Buy Triplett's designed-for-you Panel Instruments

Although we stock some 1369 different styles, sizes and types of standard panel instruments, a very large proportion of our customers buy custom instruments.

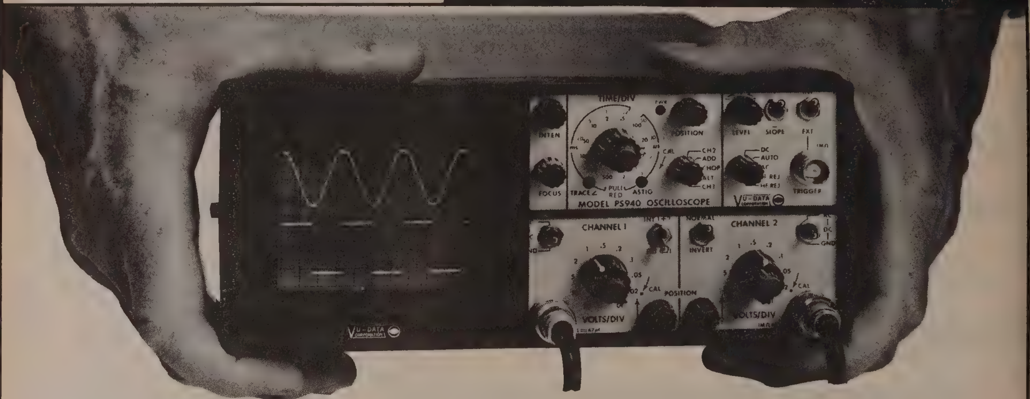
Because they need:

Custom Dials. Reading in such units as pH, roentgens, mm Hg, rpm, %, inches. **Custom Cases.** Square, round, rectangular, edgewise (horizontal and vertical), wide, narrow, shallow. **Custom Ranges.** 0-28.4, 25-0-75, 80-220, 75-0 or virtually any electrical range not listed in catalog. **Custom Accuracy.** To within ½% with mirror scales and knife-edge pointers. **Custom Tracking.** To match the specific needs of existing or new instrument designs. **Custom Resistance.** For low circuit loading with tolerances as low as ±1%. **Custom Damping.** To meet stringent electrical and vibration requirements. What custom panel instrument specifications do you need to make your product more reliable, more accurate, more rugged and — in the long run — less expensive? For quick, dependable delivery of small quantities of Triplett's "designed-for-you" panel instruments, contact your Triplett Sales/Service/Modification Center. For prototypes or production quantities, contact your Triplett representative. He'll put you in touch with our Instrument Designers/Engineers who'll help you analyze the problem and suggest the optimum cost/result solution.

PRODUCT SUMMARY

MINI-PORTABLE OSCILLOSCOPES

VU-DATA CORPORATION


TIME/DIV
INTEN
FOCUS
POSITION
LEVEL
SLOPE
EXT
TRIGGER
MODEL PS940 OSCILLOSCOPE
CHANNEL 1
CHANNEL 2
INVERT
NORMAL
POSITION
VOLTS/DIV
VU-DATA CORPORATION

MODEL PS940A

This dual-trace mini-portable oscilloscope serves as a high performance, battery operated visual trouble-shooting tool for use in servicing today's technology—in the plant or in the field. It includes all of the basic features and quality of a laboratory oscilloscope, yet it adds a new dimension to portable scope applications because of its small size, light weight and battery operation capability. Full dual-trace switching is included, and computerized triggering guarantees a stable CRT presentation at all times.

PS940A	Mini-Portable Oscilloscope	$1,145
PS9008	10:1 Probe Kit	$ 35
PS9010	Battery Pack	$ 50
PS9011	Viewing Hood	$ 10
PS9012	Rack Mount Kit	$ 25
PS9013	Extender Card	$ 25
PS9015	Accessory Pouch	$ 20
PS9016	Rear Panel Stand	$ 15

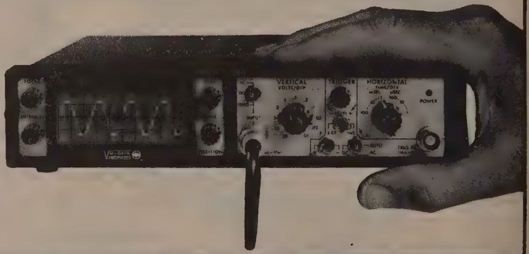
- DC — 20 MHz BANDWIDTH
- COMPUTERIZED TRIGGERING
- 10 mV/div SENSITIVITY
- 21 SWEEP RANGES TO 100 nsec/div
- DELAY LINE
- 18 nsec RISETIME
- WEIGHS ONLY 9.5 lbs
- FITS IN A TOOL KIT OR BRIEF CASE
- BATTERY, AC OR DC POWERED

MODEL PS910B

- DC — 20 MHz BANDWIDTH
- 10 mV/div SENSITIVITY
- 18 nsec RISETIME
- SWEEP RATES TO 100 nsec/div
- AUTOMATIC OR MANUAL TRIGGERED SWEEP
- FITS IN A TOOL KIT OR BRIEF CASE
- WEIGHS ONLY 5.5 lbs
- BATTERY OR AC POWERED

PS910B	Mini-Portable Oscilloscope	$645
PS910B(R)	Rack Mount Mini-Portable Oscilloscope	$645
PS9001	Nickel-Cadmium Batteries	$ 50
PS9003	207V-253V AC Line Operation	No Charge
PS9005	Rack Mount Kit for PS910B	$ 25
PS9007	P-7 Phosphor	$ 25
PS9008	10:1 Probe Kit	$ 35
PS9009	Viewing Hood	$ 10

This "mini-scope" brings laboratory quality and performance to "on-site" DC - 20 MHz oscilloscope test and measurement applications. It serves as a low to high frequency visual trouble-shooting tool for use in meeting both analog and digital service requirements —at the plant or in the field. Recharging circuitry is included, and standard "C" size battery cells can be used.


VERTICAL
VOLTS/DIV
TRIGGER
HORIZONTAL
TIME/DIV
POWER
POSITION
VU-DATA CORPORATION

ELECTRONICS FOR MONITOR — TEST — MEASUREMENT

VU-DATA CORPORATION

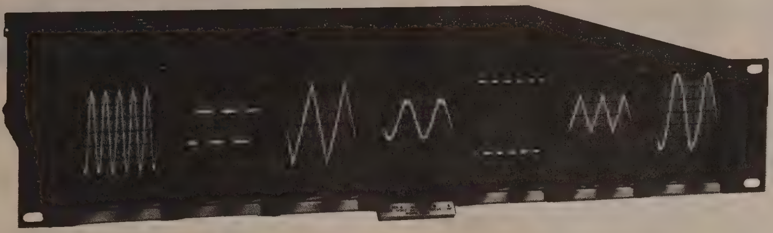
7170 Convoy Court, San Diego, California 92111

Phone: (714) 279-6572
TWX: 910-335-1586
Cable: VUDATA SANDIEGO

VU-DATA CORPORATION

PRODUCT SUMMARY

MONITOR OSCILLOSCOPES

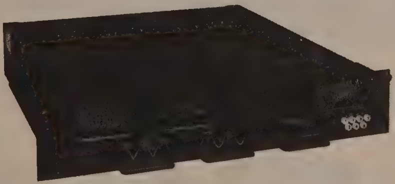


SERIES 1200

The multi-channel, "in-line" display capability offered by each Model 1200B Monitor Oscilloscope makes it ideally suited for real-time monitor applications where simultaneous display of several signals is desirable to guarantee optimum performance or to facilitate analysis. The self-contained vertical and horizontal control circuitry associated with each plug-in scope module allows a given signal to be analyzed without disturbing the display of the remaining signals. Model 1200B(R) is configured for instrumentation magnetic tape recorder applications. It facilitates setup of record/reproduce electronics and guards against data loss by providing record/reproduce monitor during recorder operation. A special attenuator allows each signal in a REC/REP input pair to be independently normalized for full scale display.

- **UP TO 7 PLUG-IN DC-5 MHz OSCILLOSCOPES**
- **2" DISPLAY HEIGHT**
- **"IN-LINE" CRT PRESENTATION**
- **ALL CONTROLS ON FRONT PANEL**
- **SELECTABLE DUAL INPUTS PER CHANNEL**
- **INDIVIDUAL ATTENUATOR AND SWEEP RATE CONTROLS**

1200B	Standard Monitor Oscilloscope	$2,895
1200B(R)	Recorder Monitor Oscilloscope	$2,895
12002	Extender Cable Assembly	$ 50
12004	Chassis Slides	$ 50



SERIES MS200

Similar to the Series 1200 Monitor Scopes, these units offer 10 MHz bandwidth and a broader horizontal display width. Standard scope and tape recorder monitor units are available, as well as X-Y display, biomedical and master/slave versions. Both these and the Series 1200 units are ideally suited for tape recorder or real-time monitor applications where simultaneous display of several signals is desirable to guarantee optimum performance or to facilitate comparison.

MS200A	Standard Monitor Oscilloscope	$3,145
MS200A(R)	Recorder Monitor Oscilloscope	$3,145
MS200A(B)	Biomedical Monitor Oscilloscope	$3,425
MS200A(S)	Master/Slave Monitor Oscilloscope	$3,245
MS200A(X)	X-Y Monitor Oscilloscope	$3,645
MS2002	Extender Cable Assembly	$ 50

SERIES MS700

The multi-channel input and selective dual display capability offered by these oscilloscopes makes them ideal for use in applications where the analysis of more than one signal is paramount to achieving successful results. Model MS700A includes standard scope controls, while providing a DC-10MHz bandwidth and a 0.1 μsec/div - 10 msec/div sweep rate. Another unit offers a slower sweep rate and greater vertical sensitivity, while a third unit is specially configured for tape recorder monitor. Up to 14 input signals can be selected for display. Panel height is only 1¾".

MS700A	Standard Monitor Oscilloscope	$1,795
MS700A(R)	Recorder Monitor Oscilloscope	$1,795
MS700A(B)	Biomedical Monitor Oscilloscope	$1,875
MS2002	Extender Cable Assembly	$ 50

ELECTRONICS FOR MONITOR — TEST — MEASUREMENT

VU-DATA CORPORATION

7170 Convoy Court, San Diego, California 92111

Phone: (714) 279-6572
TWX: 910-335-1586
Cable: VUDATA SANDIEGO

PRODUCT SUMMARY

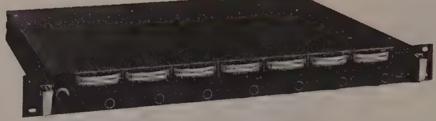
ADDITIONAL ITEMS

VU-DATA CORPORATION

MODEL VU600A TAPE RECORDER MONITOR METER

This precision Monitor Meter provides an off-the-shelf answer to the V.U. meter requirements of instrumentation magnetic tape recorder users. The combination of selectable RMS or PEAK modes, 3 inputs per channel and 3 full scale voltage ranges driven by self-contained, decoupled feedback amplifiers is unmatched by any other instrument of this type. Three basic functions are served in instrumentation magnetic tape recorder applications:

1. Facilitates setup of record/reproduce electronics to assure proper recording.
2. Provides monitor of all input data channels during the record phase to alert the operator to signal loss.
3. During the reproduce phase, provides simultaneous monitor of all data channels for analysis and verification.



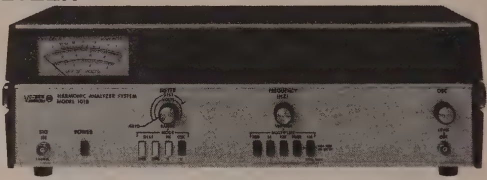
- RMS AND PEAK READING MODES — SELECTABLE
- DC TO 10 MHz BANDWIDTH
- 3 SELECTABLE INPUTS FOR EACH OF 7 CHANNELS
- ONLY 1¾" PANEL HEIGHT
- 100 mV, 1 V AND 10 V FULL SCALE RANGES

VU600A Monitor Meter	$850	VU6001 Chassis Slides	$50

MODEL 101B TAPE RECORDER ANALYZER

Model 101B is comprised of three instruments which are fundamental to total analog circuit analysis: (1) Sine Wave Oscillator, (2) RMS Voltmeter and (3) Wave Analyzer. The unique combination of these instruments in a single 5¼" high, rack mountable chassis provides a test and measurement system that not even an entire rack full of equipment can equal. These three separate instruments can be interfaced with each other, as well as with the recorder under test, by simple pushbutton control and the use of only two BNC cables. This simplicity eliminates complicated cabling and signal patching, thus reducing the chance for operator error and affording more time for the measurement task at hand. Complete end-to-end calibration of direct recorder system electronics can be achieved by this single, light weight device. It is ideal for use both in the field or during production test. Specifications include: Wave Analyzer - 100 Hz—1 MHz fundamental frequency range; Oscillator - 100 Hz—5 MHz output frequency at 100 mV—2V rms; RMS Voltmeter - 8 full scale ranges from 3 mV to 10 V rms.

101B Tape Recorder Analyzer	$3,495	1015 DC Source	$ 125
1012 Square Wave Output	$ 135	1016 Automatic S/N Ratio	$ 500
1013 DC Monitor Output	$ 125	1017 Front/Rear Panel Connectors	$ 75
1014 Rack Mount Brackets	$ 10		



- INCLUDES WAVE ANALYZER, SINE WAVE OSCILLATOR AND RMS VOLTMETER
- SIMPLIFIES MAGNETIC TAPE RECORDER CALIBRATION AND TEST
- PUSHBUTTON SELECTION AND DISPLAY OF 2ND AND 3RD HARMONIC DISTORTION
- MEASURES FREQUENCY RESPONSE AND S/N RATIO
- AUTOMATIC HARMONIC TRACKING, INPUT LEVELING AND RANGING

OSCILLOSCOPE CAMERAS

SCOPE MATE® (uses POLAROID Color Pack Land Camera)

SC02	(includes Shoot N' View Hood with Electronic Shutter Speed Control)	$185
SC03	(includes POLAROID CR-9 Land Camera with Shoot N' View Hood)	$200
LS01	Ultra Violet Light Source (SC02 only)	$ 75

POLAROID CR-9

33-1	CR-9 Land Camera with Hood	$175
33-1	CR-9 Land Camera without Hood	$153
33-6, 33-9, 33-10, 33-11, 33-12, 33-15, 33-16, or 33-18 Hood		$ 22

These SCOPE MATE® and POLAROID CR-9 oscilloscope cameras have given oscilloscope photography a new dimension—"portability." They are not only useful in the laboratory as a design aid, but also in the field as a quality control and inspection tool. Hard copy prints of various CRT trace displays can be obtained after only a few minutes familiarization by even the most inexperienced camera operator. Applications include the recording of transmission signal levels for verification and record purposes, and the gathering of vibration data for use in maintenance routines. A wide selection of hoods is available to fit almost any oscilloscope.

ELECTRONICS FOR MONITOR — TEST — MEASUREMENT

VU-DATA CORPORATION

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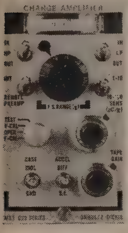
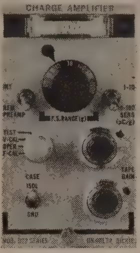
Phone: (714) 279-6572
TWX: 910-335-1586
Cable: VUDATA SANDIEGO

SIGNAL CONDITIONING AMPLIFIERS
D22 SERIES

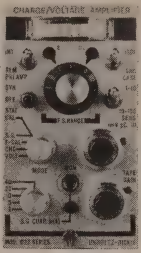
The D22 Series provides charge amp signal conditioning for all piezoelectric transducers. Some models also provide for strain gage operation. This series features all integrated circuit design with superior low noise characteristics, in a rugged modular construction. The basic Model D22PM includes the capability of operating with a remote preamp, and includes a meter. This and other standard models are shown below. The wide range of optional features available for addition to most models, is listed below.

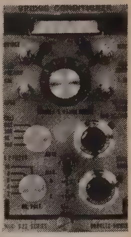

D22PMH

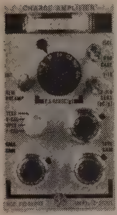

D22PM

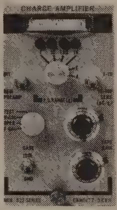
D22 OPTIONS

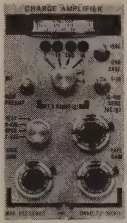
Description	Suffix
STRAIN GAGE OPERATION	R
HIGH TEMP ACCEL. INPUT	H
BRIDGE CONDITIONER	B
10 mV/g SERVO OUTPUT	S
100 mV-SEC/IN. VEL. OUTPUT	I
1 V/IN. DA DISP. OUTPUT	II
LINEAR DC OUTPUT	F
LOG DC OUTPUT	L
REMOTE RANGE CONTROL	E
AUTORANGING	A
±100 mA LINE DRIVER	C
±100 mA GALVO OUTPUT	G
CALIBRATION OSCILLATOR	0
TRACKING FILTER CONNECTION	T
0.5 HZ FREQ. RESPONSE	–2
EXTRA X10 GAIN	–3
FS RELAY CALIBRATION	–4
LARGE 2½" SCALE METER	–8

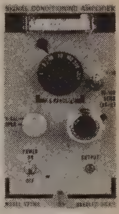

D22PMR

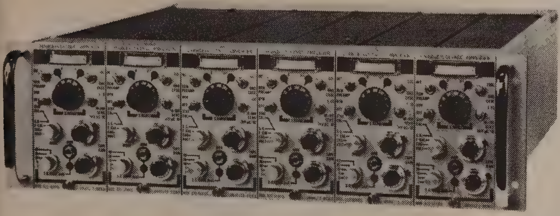

D22PMB


D22PMG

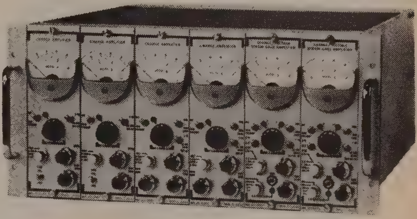

D22PMA


D22PMGA


P22MS


Model 22RA

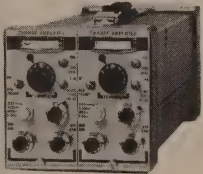
The Model 22RA Rack Adapter accepts six 22 Series modules in the standard 5¼ inch panel height. Also accepts the Model TF11 Tracking Filter.


Model 22RA-8

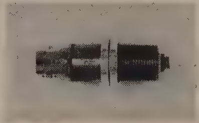
Rack mounted D22's with the "–8" large meter option require the 22RA-8 Rack Adapter with 8¾ inch panel height. Each 19 inch adaptor accepts six "–8" modules.

Model D22PM-8

Models D22PM and D22-PMR are available with the "–8" option which provides a 2½ inch meter scale for easier readout.


Model 22P2

The Model 22P2 Dual Channel Portable Adapter accepts two channels of 22 Series instruments.


Model 11PA-2

The Model 11PA-2 is a two-wire Remote Voltage Preamp designed for use with any of the 22 Series instruments.

Model 22CA-2

The Model 22CA-2 Remote Charge Preamp may be used with any of the 22 Series instruments shown above, and is a companion unit to the Model P22MS. Optional Model 22CA-2T is available for operation to 160°F.

manufacturers of shaker systems, advanced instruments and accelerometers

UNHOLTZ-DICKIE CORPORATION

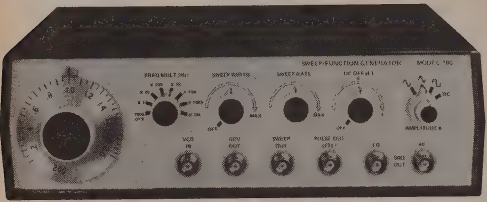
3000 WHITNEY AVE. / HAMDEN, CONN. 06518 / (203) 288-3358

FUNCTION GENERATORS

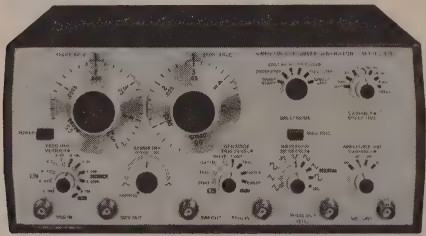
Wavetek function generators are high purity sources of various waveforms, including sine, square and triangle, with frequencies ranging from a low of 2μ Hz—a period of 135 hours—to 30 MHz. They are of rugged construction and have simultaneous output capability and can be operated on battery power supplies for line-free operation and portability.

Most models offer voltage control of generator frequency (VCG) and some also have voltage controlled amplitude (VCA) making possible FM and AM operation, as well as sweeping via external commands. Several models have internal sweep capability as well, with some offering logarithmic as well as linear sweep. Triggered and gated operation is available on many models.

Testing with repeatable noise can be carried out using the Model 132, which offers both digital and analog pseudo-random noise. The pseudo-random sequence length, clock rates and band-width are selectable.

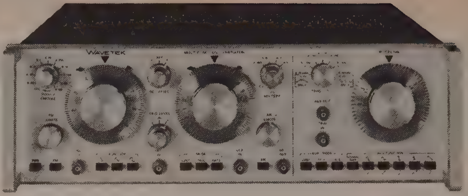


The new 180 Series consists of five high-performance low-cost generators. Despite their low prices, they offer such features as full sweep, continuous, triggered and gated operation, plus discrete step sweeping. Sweep widths go up to 100,000:1.



The 180 Series also introduces a brand new Wavetek capability—XCG. XCG stands for crystal-controlled-generator, and it stands for accuracy never before obtainable from a function generator. By phase-locking the generator output to a crystal at twenty-five discrete points on the dial, Models 181 and 183 can produce waveform frequencies accurate to within .01% of dial setting.

The 140 Series function generators have variable symmetry control. With this useful feature, the triangle wave can be modified to a ramp output with variable rise/fall ratios. The square duty cycle wave can be adjusted from a normal 50% to duty cycle ratios of 1:19 to 19:1 for variable pulse outputs.



The Models 162 and 164 provide signal generation of sine, square, triangle, positive and negative pulses over a frequency range of 30 μHz to 30MHz. In addition to the wide frequency coverage, the Model 164 has an integral ramp/step generator that can be used to sweep, sweep burst, or step the frequency of the main generator. In this mode of operation the sweep range is divided into ten steps and can be selected for auto or manual stepping. Other features include rise and fall time adjustments by means of an independent slope, width and symmetry controls. Different rise and fall times may be selected to suit testing or triggering requirements.

Frequency Range	Model	Functions	VCG	VCA (AM)	XCG	Trigger & Gate	Sweep	Log Sweep	Var. Symmetry	Var. Rise/Fall	Price
.000002Hz–200kHz	133	∿⊓⊔∧	■			■					$ 595
0.2Hz–2MHz	130	∿⊓⊔∧									395
	131A	∿⊓⊔∧	■								495
	132	∿⊓⊔∧(+ noise)	■								895
	136	∿⊓⊔∧ ∞	■	■							595
	134	∿⊓⊔∧ ⫼ ╫╫	■			■	■				595
	135	∿⊓⊔∧ ⫼ ╫╫ ⩘	■			■	■	■			795
.01Hz–2MHz	180	∿⊓⊔∧⊓	■				■				275
	181	∿⊓⊔∧⊓	■		■		■		■		495
.0001Hz–5MHz	183	∿⊓⊔∧⊓⊔	■		■	■	■		■		695
	184	∿⊓⊔∧⊓⊔	■			■	■		■		495
	185	∿⊓⊔∧⊓⊔	■			■	■	■	■		595
.005Hz–10MHz	142	∿⊓⊔∧⊓⊔	■						■		595
	144	∿⊓⊔∧⊓⊔⩘	■			■	■		■		895
	146	∿⊓⊔∧ ⫼ ∞ -∿	■	■		■	■		■		1495
	147	∿⊓⊔∧⊓⊔	■			■	■		■		1295
.00003Hz–30MHz	162	∿⊓⊔∧⊓⊔∿	■			■			■	■	895
	164	∿⊓⊔∧⊓⊔∿	■			■	■		■	■	1095

WAVETEK®

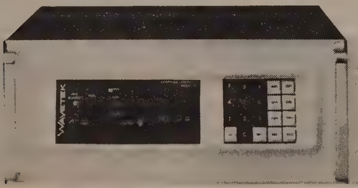
P.O. Box 651, San Diego, CA 92112, Tel. (714) 279-2200.
P.O. Box 190, Beech Grove, IN 46107, Tel. (317) 783-3221.

PROGRAMMABLE FUNCTION GENERATORS

Wavetek offers the most complete selection of programmable signal sources available. Models 158 and 159, greatly extend the utility of programmables. The 159 gives local and remote control, while the 158 is remote only. Model 159 features keyboard data entry with digital display. Both have sine, triangle, square, and ramp waveforms, simple ASCII programming, programmable dc offset, triggered and gated operation, and a 3 MHz top frequency.

For increased versatility, the Model 154 offers 10 MHz top frequency, amplitude and frequency modulation, programmable dc offset, as well as dc volts and triggered and gated operation.

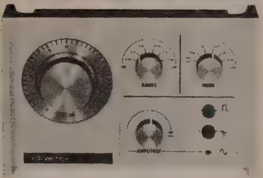
If the requirement is greater precision, the Model 157 Waveform Synthesizer is the solution. Covering frequencies from 100μHz to 1 MHz with accuracies of 0.01%, the 157 meets the critical demands of most automatic test systems. Other features include frequency lock to an external source, precision amplitude attenuation, and triggered and gated operation.



A recent addition to the line, the Model 152 Variphase Generator, can output 1 to 4 channels of waveforms and control the phase between all four from 0° to 360°. Other features include 0.1° phase control, 0.05% harmonic distortion for the sine wave, external phase lock, sine/cosine output, sine, triangle, and square wave output and a top frequency of 100 kHz. The Model 152 also features keyboard data entry with digital display and remote control.

Frequency Range	Model	Functions	BCD (Digital)	ASCII	Remote Control	Local Control	Programmable Frequency	Programmable Function	Programmable Amplitude	Programmable Mode	Programmable DC Offset	Programmable Phase Angle	Digital Display	Trigger & Gate	Price
1Hz–100KHz	152	∿∧⊓ (4outputs)	□	■	■	■	■	■	■	■	■	■	■	□	$4995
100yHz–1MHz	157	∿∧⊓	■	□	■	■	■	■	■	■	□	□	□	■	3295
1Hz–3MHz	158	∿∧⊓⊿	□	■	■	□	■	■	■	■	■	□	□	■	1245
	159	∿∧⊓⊿	□	■	■	■	■	■	■	■	■	□	■	■	1495
.001Hz–10MHz	154	∿∧⊓∞	■	□	■	■	■	■	■	■	■	□	□	■	1995

PORTABLE FUNCTION GENERATOR



The battery-operated Wavetek Model 30 Function Generator is a self-sweeping audio function generator . . . a complete audio signal source in an extremely compact, portable package. Three frequency ranges give an overall capability of 2 Hz to 200 kHz.

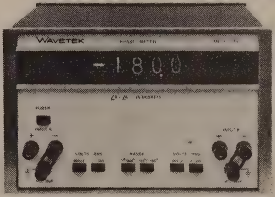
Operating modes are dial control of frequency, external voltage control of generator frequency (VCG) and fast, medium and slow frequency sweep modes, either linear or logarithmic.

Outputs include sine, square, and triangle waves, sweep sync, generator sync, and horizontal drive (linear and log ramp).

The supplied battery powers the Model 30 for approximately one 8-hour day. A battery charger and rechargeable battery are available.

Model	30
Price	$149.95

PHASE METERS



Wavetek Phase Meters accurately measure the phase angle between any two ac signals with amplitudes between 1 mV and 300 V within the 10 Hz to 2 MHz range. They have excellent sensitivity, broad dynamic range, wide bandwidth and 0.1 degree resolution.

Model 740 has a taut band meter readout and 360-degree phase offset capability. The digital Model 750 has a four digit readout. Its automatic operation eliminates the need for amplitude matching, frequency tuning, and output filtering.

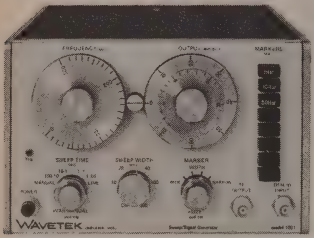
Model 755 is completely programmable for automatic phase measurement in systems applications.

Model	740	750	755
Price	$995	$1595	$1995

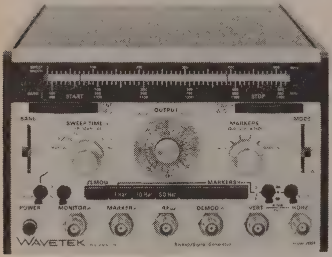
WAVETEK®

P.O. Box 651, San Diego, CA 92112, Tel. (714) 279-2200.
P.O. Box 190, Beech Grove, IN 46107, Tel. (317) 783-3221.

SWEEP/SIGNAL GENERATORS



Wavetek Sweep/Signal Generators are solid-state instruments that cover the frequency range from 0.5 MHz to 1.4 GHz. The 1000 Series (Models 1001A, 1002, 1004, 1005) are general purpose sweepers. All are useable as signal generators, with such features as AM and FM modulation, excellent dial accuracy and resolution, and calibrated output. Each is a completely programmable signal source.



Models 2000 and 2001 Sweep/Signal Generators offer versatility and an exceptionally wide frequency range (1 MHz to 1400 MHz). These instruments can be used in engineering laboratories and for production testing. Complete remote programming and external AM or FM modulation is possible through the use of electronic tuning and PIN diode leveling and attenuation.

The three frequency bands (1 MHz to 500 MHz, 450 MHz to 950 MHz and 900 MHz to 1400 MHz) are PIN diode switched and may be swept from CW to full 500 MHz sweep width. The units may be line locked or swept at rates of 50 sweeps per second to one sweep every 100 seconds. Manual and triggered modes are also provided.

The Model 2001 provides three operational modes. In the start/stop mode, the START dial sets the start-sweep frequency and the STOP dial sets the stop-sweep frequency. In the ΔF mode, the START dial sets the center frequency and the STOP dial sets the sweep width (from 200 kHz to 500 MHz). In the CW mode, the START dial sets the center frequency and the STOP dial is disabled. A 100% duty cycle is provided in the CW mode by removing the oscillator blanking. The Model 2000 provides for ΔF and CW operation only.

Both Models include a complete crystal-controlled birdy marker system with provisions for a combination of up to six plug-in marker modules.

Frequency Range	Model	Maximum Sweep Width	Output Amplitude	Price
Single Band				
0.5MHz–300MHz	1001A	300MHz	+13dBm	$1100
1.0MHz–500MHz	1002	500MHz	+13dBm	1150
500MHz–1000MHz	1004	500MHz	+10dBm	1100
700MHz–1400MHz	1005	700MHz	+10dBm	1100
Multi-Band				
1MHz–1400MHz	2000	500MHz	+10dBm	1450
1MHz–1400MHz	2001	500MHz	+10dBm	1850

SIGNAL GENERATOR

The Model 3000 Signal Generator is a rugged, solid-state signal source in the VHF frequency range (11 MHz to 520 MHz) with frequency accuracy of 0.001% and 1 kHz resolution. Internal and external AM and FM modes of operation and a calibrated output from +13 dBm to –137 dBm further increase the instrument's versatility.

The accuracy of 0.001% results from internally phase locking the voltage-controlled oscillators to various reference frequencies that are in turn referenced to a precision crystal-controlled oscillator.

Frequency is set with 1 kHz resolution via six front panel indicator switches, or it can be remotely programmed by digital input.

The Model 3000's accuracy, stability, dynamic range, and AM/FM capability can only be duplicated by instruments costing two to three times as much.

Model	3000
Price	$1975

WAVETEK®

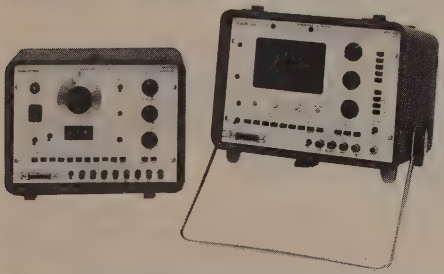
P.O. Box 651, San Diego, CA 92112, Tel. (714) 279-2200.
P.O. Box 190, Beech Grove, IN 46107, Tel. (317) 783-3221.

ECONOMICAL SWEEP GENERATOR

The Model 1050 Sweep Generator is a general-purpose broadband instrument covering the VHF range of 1 to 400 MHz. It has a maximum sweep width of 400 MHz, output amplitude of + 10 dBm, output flatness of ±0.25 dB, with spurious signals 30 dB below output. Its performance and price qualify it for use as production and maintenance test equipment as well as in engineering laboratories. The specifications and features also make it an ideal instrument for use in educational institutions.

Model	1050
Price	$495

TRANSMISSION TEST EQUIPMENT



These portable, battery-powered transmission test sets combine many functions for faster check-outs.

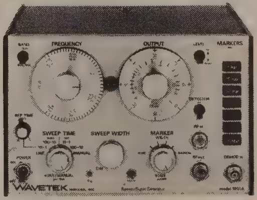
The Model 420 is a swept-frequency transmission test set allowing level and impedance measurements across the voice and program frequency ranges from 50 Hz to 15 kHz. Level versus frequency is displayed on a CRT. This allows a single visual inspection of the transmission characteristics of the facility under test across the entire frequency range.

The Model 430 transmission Multimeter is a 15-pound, easy-to-use instrument that does the job of five separate units: a frequency counter, dB meter, noise meter, capacitance bridge and decade box, and a DVM. All measurements are expressed on a digital readout. Push button controls for simple operation.

Model	420	430
Price	$1995	$1395

CATV TEST EQUIPMENT

The Model 1850/1860 Cable Sweep System is an economical maintenance tool that permits continuous monitoring of CATV system performance. It has built-in test point and drop cable compensation and a tuned RF trigger circuit. Frequency range is 5 to 350 MHz with transmitter flatness of ±0.25 dB, receiver flatness of ±0.5 dB, and sweep linearity of 1%. Simo sweep time is adjustable between 1 and 10 ms, with repetition time of 2 to 20 seconds.



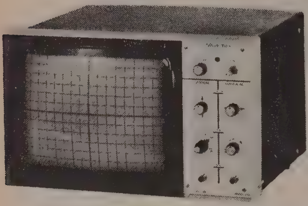
Model 1801A is a sweep generator with features and options ideally suited for the manufacturer, installer or operator of CATV systems. The standard frequency range of 1 MHz to 500 MHz, and optional 450 MHz to 950 MHz, covers the bands now being used as well as those of the future. The ultra-flat 75-ohm output system is calibrated from + 57 dBmv to –33 dBmv, with 20 dB being controlled by a continuously variable PIN diode attenuator. Other features include built-in RF detector, internal and external leveling and a crystal-controlled birdy marker system. A special sweep rate facilitates testing operating CATV systems with minimum subscriber interference.

Model	1850	1860	1801A
Price	$675	$1049	$1350

WAVETEK®

P.O. Box 651, San Diego, CA 92112, Tel. (714) 279-2200.
P.O. Box 190, Beech Grove, IN 46107, Tel. (317) 783-3221.

X-Y DISPLAY OSCILLOSCOPES



The Wavetek Model 1901A solid-state X-Y Display Oscilloscope incorporates an extremely stable, low noise, vertical amplifier with sensitivities from 1 mV per division, making it ideal for measuring frequency response in conjunction with available sweep/signal generators.

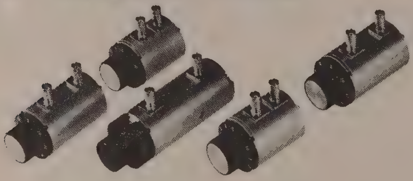
The 9 kV accelerating potential provides a bright, well focused, narrow trace on the large, easy to read, 12-inch cathode ray tube. Two intensity controls are provided, one for the beam itself and one for an intensity marker.

Standard units have P1 phosphor tubes and molded graticuled faceplates to minimize parallax. P4 or P7 phosphor tubes with clear faceplates are available.

The Model 1910 is a dual-trace version having features and specifications similar to the 1901A.

Model	1901A	1910
Price	$475	$595

ATTENUATORS



Series 5000 and 7500 Attenuators are miniature turret type units that operate over wide frequency ranges, making them equally suitable for bench setups, field use, or incorporation into test instruments. All units are direct reading, ruggedly constructed and have provisions for panel mounting.

Model	Frequency Range	Total Attenuation	Steps	Price
5001	to 2000 MHz	1 dB	0.1 dB	$ 90
5010	to 2000 MHz	10 dB	1.0 dB	90
5070	to 2000 MHz	70 dB	10.0 dB	90
5080	to 2000 MHz	80 dB	1.0 dB	190
7501	to 1000 MHz	1 dB	0.1 dB	90
7510	to 1000 MHz	10 dB	1.0 dB	90
7570	to 1000 MHz	70 dB	10.0 dB	90
7580	to 1000 MHz	80 dB	1.0 dB	190

RF DETECTORS

Series 150 and 170 detectors are designed for applications requiring low VSWR and flat frequency response across broad operating ranges. Models D151 and D152 are 50 ohm units with typical VSWR's of 1.2 at 1000 MHz. The D151 has a 1000 MHz upper limit and the D152 can be operated up to 2 GHz. Model D171 is a 75 ohm detector that operates over the frequency range of 200 kHz to 1000 MHz with a response of ±0.3 dB and a return loss greater than 23 dB. Model M151 is a three port, high impedance detector designed to obtain amplitude versus frequency response of an RF circuit with minimum circuit disturbance. It may also be used as an external monitor to level the sweep signal at the input junction of any device under test.

Model	D151	D152	D171	M151
Price	$60	$80	$60	$80

GENERATOR MODULES

Wavetek 120 Generator Modules offer a wide range of signal generation capabilities in convenient modular form for systems applications. The modules can be used as voltage-to-frequency converters, fixed frequency oscillators, voltage controlled oscillators, sawtooth and swept sine wave generators, and triggered and tone burst signal sources to 100 kHz. They can be directly integrated into various systems or supplied on a single assembled printed circuit card.

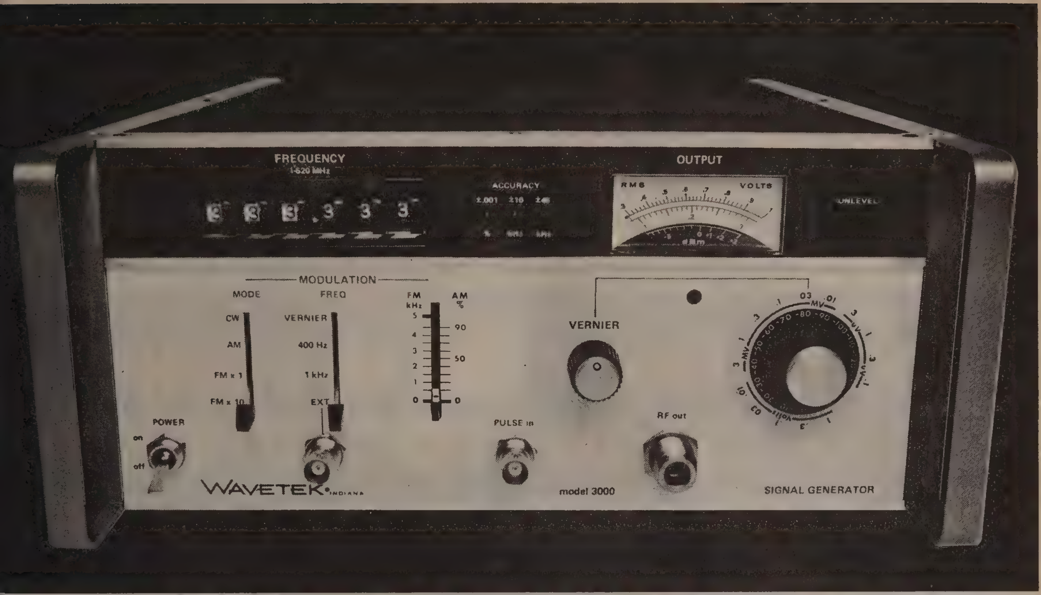
Prices available on request.

ACCESSORIES

Most Wavetek instruments can be ordered with factory-installed panels for single or dual (side by side) rack mounting. Rack adapter kits are also available.

WAVETEK®

P.O. Box 651, San Diego, CA 92112, Tel. (714) 279-2200.
P.O. Box 190, Beech Grove, IN 46107, Tel. (317) 783-3221.


FREQUENCY
1-520 MHz
ACCURACY
OUTPUT
RMS
VOLTS
dBm
UNLEVEL
MODULATION
MODE
CW
AM
FM x 1
FM x 10
FREQ
VERNIER
400 Hz
1 kHz
EXT
FM kHz
AM %
VERNIER
POWER
on
off
PULSE in
RF out
WAVETEK INDIANA
model 3000
SIGNAL GENERATOR

For $1,975 you have no right to expect a signal generator like this.

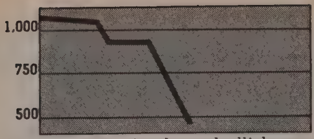
For $1,975 you should have to settle for tubes, or for a non-phase-locked generator.

But here's the Wavetek 3000, so you can toss your expectations out the window. This solid state signal generator is not only phase-locked and accurate (±0.001%), it's programmable as well. And it covers the entire range from 1 to 520 MHz in a single band. Yet once we've received your order, you can expect a signal generator like this one right away . . . for just $1,975.

That may not be right, but it sure is reasonable.

SPECIFICATIONS
Frequency Range: 1–520 MHz
Frequency Accuracy: ±0.001%
Resolution: 1 kHz
Stability: Less than 0.2 ppm per hour
Output Range: +13 dBm to −137 dBm
Flatness: ±0.75 dB
AM Modulation Range: 0–90%
FM Deviation: 0–5 kHz and 0–500 kHz
Internal Modulation Rates:
400 Hz and 1 kHz
Dimensions:
12″ wide x 5½″ high x 13¾″ deep
Price: $1,975

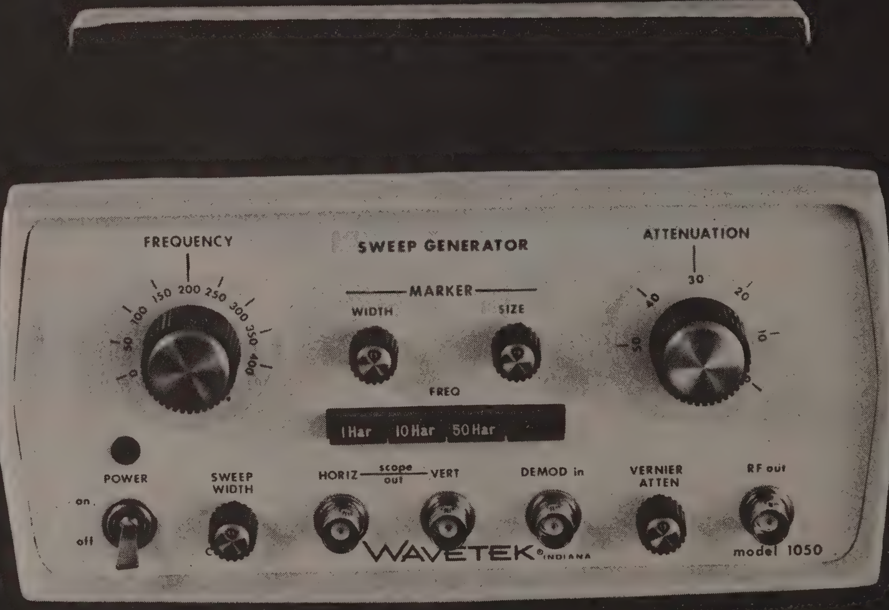
WAVETEK®
INDIANA INCORPORATED
P.O. Box 190, 66 North First Avenue
Beech Grove, Indiana 46107
Tel. (317) 783-3221 TWX 810-341-3226



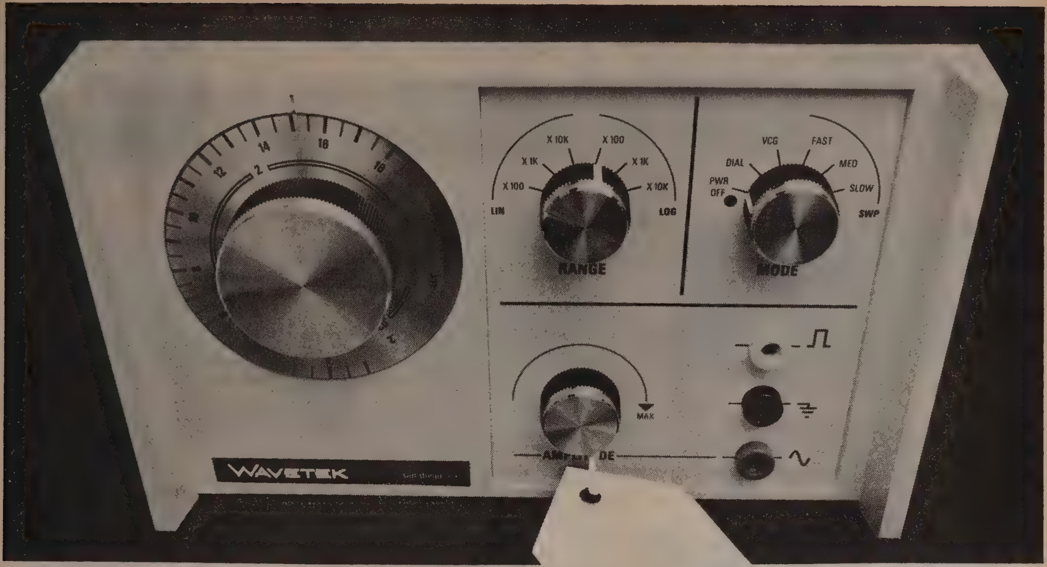
For years, we've been bullish on high-priced sweepers. Sure, there were plenty of low-priced offerings, if you wanted to speculate with hobbyist quality. But if you really wanted to make a clean sweep, you looked to the blue chips—and to spending about a grand. But now Wavetek has issued the Model 1050, an instrument that everyone can afford (even those in a tight capital equipment spending predicament). It sweeps from 1 MHz to 400 MHz with the signal quality needed for both lab and production use. The instrument features ±0.25 dB output flatness, 2% display linearity, spurious signals 30 dB below output, and a maximum amplitude of +10 dBm. It's available in 50-ohm and 75-ohm versions, and the price for either is just $495. In our opinion, this is the time to buy. Write or call us for a complete statement of the Model 1050's performance. Wavetek Indiana, Inc., P.O. Box 190, Beech Grove, Indiana 46107. Tel. (317) 783-3221. TWX 810-341-3226.

WAVETEK®

The bottom just dropped out of the sweeper market.


FREQUENCY
0
50
100
150
200
250
300
350
400
SWEEP GENERATOR
MARKER
WIDTH
SIZE
FREQ
1 Har
10 Har
50 Har
ATTENUATION
30
40
20
50
10
0
POWER
on
off
SWEEP WIDTH
HORIZ
scope out
VERT
DEMOD in
VERNIER ATTEN
RF out
WAVETEK® INDIANA
model 1050

$495


X 100
X 1K
X 10K
X 100
X 1K
X 10K
LIN
LOG
RANGE
DIAL
VCG
FAST
MED
PWR OFF
SLOW
SWP
MODE
MAX
AMPLITUDE
WAVETEK

This Model 30 portable function generator goes from 2 Hz to 200 kHz with sines, squares, triangles, and linear or log sweeps.

And it goes for $149.^{95}$

$149.95
WAVETEK

WAVETEK®

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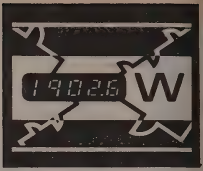
TWX 910-335-2007, Tel. (714) 279-2200

YEW Power & RMS Measurement

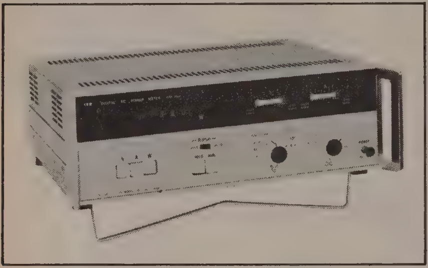


2504 DIGITAL AC METER

The Model 2504 is designed for use in single phase circuits for measuring TRUE RMS voltage, current and watts in the following ranges: 0-300 VAC, 0-10A and 0-3 kW (optional higher ranges are also available). 0.25% accuracy and a maximum resolution of 0.01% are maintained throughout these ranges. Interchangable plug-in modules and printed circuit boards allow the selection of a variety of functions to meet specific requirements. Thus, the initial cost of the instrument can be kept to a minimum while later expansion is possible through the purchase of additional plug-ins or p-c boards.

Simultaneous analog outputs for Voltage, Current and Watts are provided in the standard unit. A BCD output, compatible with TTL logic is also available as an option as is remote control of the measuring function. Frequency range of the 2504 is up to 2 kHz for Volts and Amps, and up to 1.2 kHz for Watts.

The basic principle of operation of the 2504 is through YEW's patented "Time Division Multiplier" technique which has been long proven in the power measuring field by such instruments as the YEW 0.02% Model 2885 Standard Wattmeter and the Model 2503 Digital AC Meter. Price: From $1,590.00



2503 AC POWER METER

The Model 2503 is a more comprehensive version of the 2504 described above with improved accuracy, more ranges and additional features. The accuracy of the Model 2503 is 0.1% on all voltage, current and watt ranges. Ranges are up to 600 VAC and up to 30A.

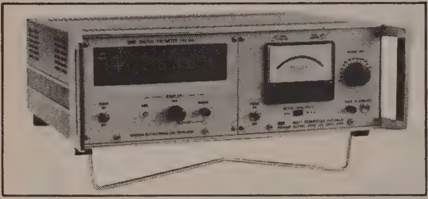
Unlike conventional thermocouple and dynamometer type wattmeters for RMS measurements, the Model 2503 offers exceptional spike and overload protection, negligably small instrument losses, long term stability and a direct capability for interface with data acquisition systems.

The primary applications for this instrument are found in power and True RMS measurement of distorted and low power factor waveforms. With an accuracy of 0.1%, the instrument can also meet the requirements of calibration laboratories and may be used to set quality control standards in both the lab and production facility.

BCD and analog outputs, isolated by photocouplers, are available as an option. Units for 3 Phase application are also available.

YEW's patented "Time Division Multiplier Technique" and "Steepest Descent Method" provide the basic operating principles of the instrument.

Price: From $3,995.00 (Single Phase)



2885 STANDARD WATTMETER

The Model 2885 Standard Wattmeter Series provides the very best precision wattmeter capability available and is utilized internationally by major calibration laboratories, institutes and industries as a calibration and inspection standard. The superior accuracy (0.02%) of the 2885 is a result a YEW-developed "Time Division Multiplier" technique combined with recent pulse technology developments and an extensive developmental engineering effort by YEW.

The accuracy of the 2885 watt transducer is 0.02% at 60 Hz and 0.03% with digital readout and direct reading switch. These combined units provide a complete digital wattmeter. Measuring ranges are up to 300 VAC and up to 20 A with 1 and 5 VDC outputs and/or 5 digit display. Frequency range is from 20 Hz to 10 kHz. The unit may also be used as an AC-DC transfer standard when used with an associated AC/DC shunt.

Price:		
	2885-11 Watt Transducer	$2,590.00
	2885-15,16 Digital Wattmeter	From $4,320.00

2041 PORTABLE WATTMETER

The Model 2041 Portable Wattmeter is of the electro-dynamometer type with a caut band suspension system to provide accurate and reliable performance. It is designed for use in laboratories or production facilities where accurate measurement of power at DC and AC to 1,000 Hz is required. The instrument also features an internal permalloy shield for protection against external magnetic fields.

YEW POWER & RMS MEASURING INSTRUMENTS

Item Instrument	Accuracy (at 60 Hz)	Watt (Voltage range x Current range)		TRUE RMS Volt.	TRUE RMS Current	Frequency	Three Phase
		Volt. range	Current range				
2885-11 Watt Converter	±0.02%	75/100/150/ 300V	0.5/1/2/5/10/ 20A	—	—	up to 10kHz	Available
2885-16 Digital Wattmeter	±0.03%	75/100/150/ 300V	0.5/1/2/5/10/ 20A	—	—	up to 10kHz	Available
2885-15 Digital Wattmeter	±0.05%	75/100/150/ 300V	0.5/1/2/5/10/ 20A	—	—	up to 10kHz	Available
2503 Power Meter	±0.1%	3/10/30/100/ 300/600V	0.1/0.3/1/3/ 6/10/30A	Same as Watt		up to 2kHz (Watt: 1.2 kHz)	Available
2504 Digital AC Meter	±0.25%	60/100/150/ 300V	0.5A/1/2/5/ 10A	Same as Watt		up to 2kHz (Watt: 1.2 kHz)	
2041 Analog Portable Wattmeter	±0.5%	120/240V	0.2/1, 1/5, 5/25A	—	—	DC and 25Hz to 1 kHz	Available

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Yokogawa Electric

YEWTEC CORPORATION
1995 Palmer Ave., Larchmont, N.Y. 10538
Telephone: 914-834-3550

60 Years of Measuring and Recording Instrumentation

YEW Taut-Band Precision Portables

YEW is the world's largest and most respected manufacturer of precision, tautband, 0.5% portable instruments.

Features

- Full One Year Warranty
- Fast and Complete Service Facilities Manned by Factory Personnel
- Lowest Prices in the Field
- Guaranteed 0.5% Accuracy Traceable to N.B.S.
- Tautband Friction-Free Meter Movements

STANDARD

AMMETERS AND VOLTMETERS

Specifications—DC: Moving Coil, AC: Iron Vane

Accuracy: ±0.5%

Scale Length: 130 mm

2011-01	DC 3/10/30/100µA
2011-02	DC 10/30/100/300µA
2011-03	DC 0.1/0.3/1/3mA
2011-04	DC 1/3/10/30mA
2011-05	DC 10/30/100/300mA
2011-06	DC 0.1/0.3/1/3A
2011-07	DC 1/3/10/30A
2011-08	DC 0.3/1/3/10V
2011-09	DC 3/10/30/100V
2011-10	DC 30/100/300/1000V
2013-01	AC 20/100mA
2013-02	AC 50/250mA
2013-03	AC 100/500mA
2013-04	AC 0.2/1A
2013-05	AC 0.5/2.5A
2013-06	AC 1/5A
2013-07	AC 2/10A
2013-08	AC 5/25A
2013-09	AC 10/50A
2013-10	AC 20/50/100/200mA
2013-11	AC 0.1/0.2/0.5/1A
2013-12	AC 0.5/1/2/5A
2013-13	AC 2/5/10/20A
2013-14	AC 10/20/50/100A
2013-15	AC 15/30V
2013-16	AC 30/75V
2013-17	AC 75/750V
2013-18	AC 150/300V
2013-19	AC 300/750V
2013-99	AC 150/300/600V

Price: $120.00 to $137.00

MULTI-RANGE AC AND DC METERS

Specifications—Same as 2011 and 2013

Model	Range
2012-00	DC 17, Voltage: up to 1000V Current: up to 30V
2014-00	AC 13, Voltage: up to 750V Current: up to 30A

Price: $240.00

WATTMETERS

Specifications—Electrodynamometer

Accuracy: ±0.5%

Scale Length: 130 mm

Frequency: DC, 25Hz to 1 kHz

Model	Range
2041-01	0.2/1A 120/240V
2041-02	1/5A 120/240V
2041-03	5/25A 120/240V
2041-11	0.2/1A 120/240V PF 0.2
2041-12	1/5A 120/240V PF 0.2
2041-13	5/25A 120/240V PF 0.2
2041-21	0.2/1A 30/60V PF 0.2
2041-22	1/5A 30/60V PF 0.2
2042-01	0.2/1A 120/240V (3 phases)
2042-02	1/5A 120/240V (3 phases)
2043-03	5/25A 120/240V (3 phases)

Price: $295.00 to $395.00

HIGH FREQUENCY METERS

Specifications—Thermocouple

Accuracy: ±0.5% (60 Hz) for Voltmeter, ±1.0% (60 Hz) for Ammeter

Frequency: up to 100 kHz for Voltmeter, Maximum up to 5 MHz for Ammeter

Scale Length: 130mm

Model	Range
2016-01	5/10/20/50mA
2016-02	20/50/100/200mA
2016-03	100/200/500/1000mA
2016-04	15/30/75/150V

Price: $315.00

POWER FACTOR METERS

Specifications—

Accuracy: ±3°

Scale: Dial provided for both power factor and phase angle.

Model	Range
2039-01	0.2/1A 120V
2039-02	1/5A 120V
2039-03	5/25A 120V

Price: $230.00

FREQUENCY METERS

Specifications—

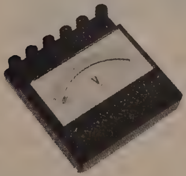
Accuracy: ±0.2% for 45 to 65 Hz, ±1.0% for 20 to 100 Hz

Scale Length: 130mm

Model	Range
2038-01	45-65Hz 120/240V
2038-02	20-100Hz 120/240V
2038-03	100-300Hz 120/240V
2038-04	300-500Hz 120/240V

Price: $195.00 to $230.00

MINIATURE



Specifications—

Accuracy: 2051, ±1.0%.
2052, 2053, ±1.5%

Size: 4½ x 4¼ x 1-7/8"

Type	Code	Name	Range	Price ($)
2051	205101	DC Ammeter	30/100/300/1,000/3,000µA	49.20
	205102		0.3/1/3/10/30 mA	49.20
	205103		10/30/100/300/1,000 mA	49.20
	205104		0.3/1/3/10/30 A	52.30
2051	205105	DC Voltmeter	0.3/1/3/10/30 V	49.20
	205106		3/10/30/100/300V	49.20
2052	205201	AC Ammeter	0.5/1/2.5 mA	45.60
	205202		2.5/5/10 mA	45.60
	205203		10/25/50 mA	45.60
	205204		50/100/250 mA	45.60
2053	205301	AC Ammeter	0.25/0.5/1 A	43.00
	205302		1/2.5/5 A	43.00
	205303		5/10/25 A	43.00
2052	205205	AC Voltmeter	3/7.5/15 V	45.60
	205206		15/30/75 V	48.20
	205207		75/150/300 V	48.20

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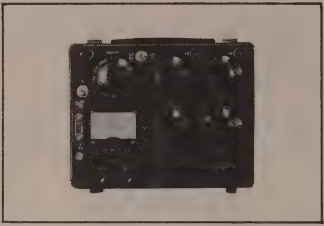
Telephone: 914-834-3550

60 Years of Measuring and Recording Instrumentation

YEW Maintenance & Field Testers

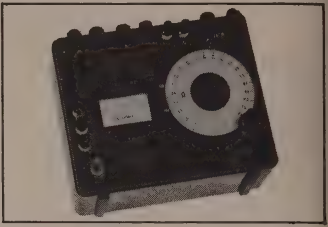
2607 PHOTO TACHOMETER

The 2607 is a photo tachometer which has a single lens and is capable of measuring from 200 rpm to 20,000rpm F.S. It is unaffected by the angle of the light beam. **Price:** $187.00



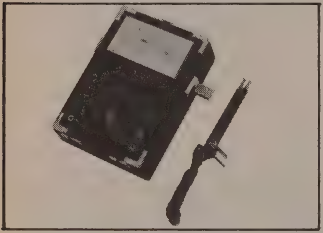
2755 PORTABLE WHEATSTONE BRIDGE

Suitable for general resistance measurement from 10 to 10MΩ. Has 0.1% accuracy on 100Ω to 100KΩ. Shock-proof with the high impact case and tautband meter. **Price:** $249.00



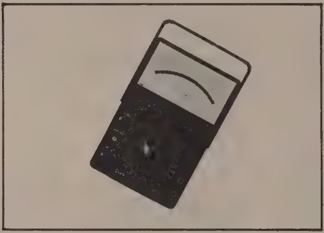
2769 PORTABLE DOUBLE BRIDGE

The 2769 is a Kelvin double bridge for measuring low resistance from 0.1mΩ to 110Ω. Features high-sensitivity electronic galvanometer, high-impact case and built-in battery. **Price:** $349.00



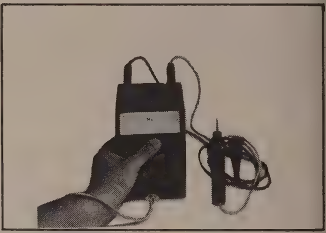
3201 TAUT-BAND V-O-M

The 3201 is rated as JIS "class A" which means that it meets the most severe government test requirements. Features 100KΩ/V for DC voltage and 12 microampere FS for DC current. **Price:** $73.00



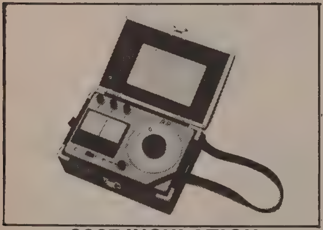
3223 ELECTRONIC V-O-M

With highly reliable discreet DC amplifier, 3223 offers high input impedance of 11 M for DC voltage. Uses a shock-proof tautband mechanism and is housed in a high impact case. **Price:** $128.00



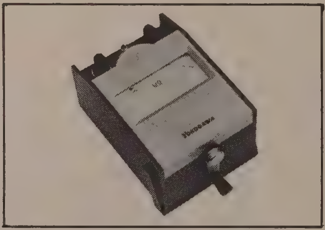
3213 INSULATION TESTER

The 3213 offers the exact same performance as 3221 Crank-type Insulation Tester. Ranges available are 100V/20M to 1000V/2,000M. **Price:** From $105.00



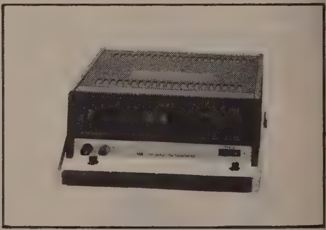
3207 INSULATION POLYTESTER

3207 is a universal field tester, capable of measuring insulation resistance, earth resistance, earth voltage, AC voltage and current. Ideal for all-round plant maintenance. **Price:** $320.00



3221 INSULATION TESTER

3221 is a solid state crank-type insulation tester which does not use critical mechanical parts such as a governor. **Price:** $124.00



2809 DIGITAL THERMOMETER

The 2809 is designed to accept five different thermocouples. Display is long-life LED. Analog output provided as standard. **Price:** From $890.00

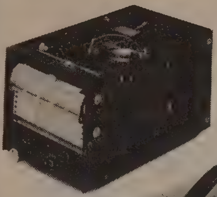
YEW®
Yokogawa Electric

YEWTEC CORPORATION
1995 Palmer Ave., Larchmont, N.Y. 10538
Telephone: 914-834-3550

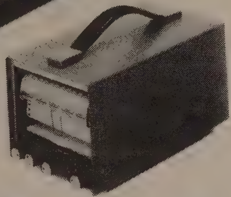
60 Years of Measuring and Recording Instrumentation

data technology

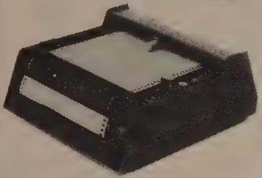
STRIP CHART RECORDERS



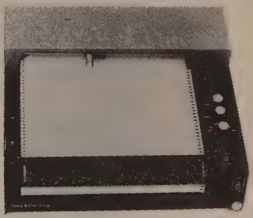
Model 704 OEM Recorder
Small size, lowest cost systems recorder; fixed single speed, single span, 4 inch chart width.



Model 714 Field/Factory Recorder
Small size, rugged case design for tough environments; 4 inch chart width, 5 selectable spans, 12 selectable speeds.



Model 705, 725 Laboratory Recorders
5 inch chart width; flat bed design. Available in either the fixed single span, single speed version (705) or the variable span, variable speed (725).
High accuracy, low cost, make these instruments the most popular recorders available.



Model 7210, 7212
High Resolution Recorders
10 inch chart width flat bed recorders; variable chart speed, variable full scale input span.
Model 7210 is a single pen design; Model 7212 is a dual pen design. Both models feature remote on/off control, 0.5% accuracy and event markers.

	Model 704	Model 705	Model 714	Model 725	Model 7210	Model 7212
CHART WIDTH	4 inches	5 inches	4 inches	5 inches	10 inches	10 inches (Dual Pen)
ACCURACY	±0.5% FS	±0.5% FS	±0.5% FS	±0.5% FS	±0.5% FS	±0.5% FS
FULL SCALE SPAN (Ranges)	Single span units. Please specify: 1 MV, 10 MV, 100 MV or 1 V full scale.		Five switch selectable spans: 1mV, 10mV, 100mV, 1V, 10V plus a variable attenuator to permit recording of signals up to 100V.			
CHART SPEEDS	Single speed units. Please specify: .25, 1, or 15 in/min; 1 or 4 in/hr; 2 or 8 cm/hr; .5 or 2 cm/min; or .5 cm/sec.		Twelve (12) switch-selectable chart speeds: .25, .5, 1, 2, 4, and 8 in/hr or .5, 1, 2, 4, 8 and 16 cm/hr plus .5, 1, 2, 4, and 16 cm/min.			
INPUT IMPEDANCE	100 Megohm	100 Megohm	10 Megohm	10 Megohm	10 Megohm	10 Megohm
PEN SPEED	30 inches / second					
ZERO	Pen may be zeroed anywhere on chart.					
NORMAL MODE REJECTION	60 db					
COMMON MODE REJECTION	140 db 200V maximum common mode voltage.					
DAMPING	Critically damped design for faithful reproduction of signal.					
PENS	Long life, no mess, disposable pens.					
CHART PAPER	Calibrated grid 24 ft fanfold	Calibrated grid 100 ft roll	Calibrated grid 24 ft fanfold	Calibrated grid 100 ft roll	Calibrated grid 120 ft roll	Calibrated grid 120 ft roll
PHYSICAL	6″ x 5″ x 10″ 5 lbs	9″ x 4″ x 11″ 7 lbs	6″ x 5″ x 10″ 5 lbs	9.2″ x 4.4″ x 12″ 7 lbs	15″ x 4.4″ x 14″ 11 lbs	15″ x 4.4″ x 14″ 14 lbs
PRICE	$295.00	$295.00	$555.00	$575.00	$675.00	$975.00

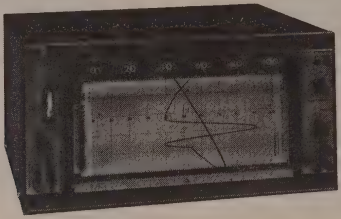
DATA TECHNOLOGY CORP 2700 S FAIRVIEW RD SANTA ANA CALIFORNIA U S A 92704 TEL (714) 546 7160 TWX 910 595 1570
designers and manufacturers of [illegible]

ESTERLINE ANGUS
A UNIT OF ESTERLINE CORPORATION

Data Recording Instruments

Eight different kinds of high performance recorders to track processes, power, experiments, tests and pollution. Save time, money, and data reduction with graphic and digital recorders up to 248 channels. The line includes servo, direct writing, and event recorders; miniature recorders, data acquisition systems and top performance X-Y recorders.

Servo recorders



Speed Servo® II recorders

Bulletin F700

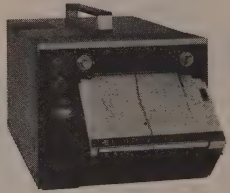
Description: 10" (254 mm) recorders with single, two pen crossover, or two pens side-by-side are available for a wide variety of lab uses or stripped down for dedicated or OEM use. Speed Servo II offers 0.3 sec. linear servo motor response, one moving part, wireless feedback pot, no-mess ink cartridge system or inkless writing. **Features:** Writing system and wiper contact integral parts of linear servo armature system: position of motor armature, feedback potentiometer and pen permanently locked. Armature assembly is the only moving part. Wireless potentiometer eliminates hunting, hysteresis, pot noise, contact and strip wear. Unlimited pot life. Stylus and ink are a single disposable unit. Available single or double channels, single, 2, 4, 5, 10 or PIP chart speed drives. Accessible front controls, sloped writing surface, 0.5 mV to 100 VDC input spans, and thermocouple compatible. Chart tear-off and mechanical pen lifter standard. Controls adjustable while unit operating. Price for single-channel model (L1101S) approx. $1,000. **Thermocouple:** Compensation available for ISA types E, J, K, R, S, T. **Event pen:** Available for left and right chart margins. Single ratings of 6, 12, or 24 VDC or 120 V, 50 or 60 Hz. **Alarms:** Two front set alarms/channel. SPDT contact rating, 5 amps, 125-250 VAC. Rear connections provided.

Quick specs: Single channel (L1101S), two-channel (L1102S), and two pens side-by-side (L11S2S). **Input.** Floating, guarded, front and rear terminals (thermocouple terminals rear only).

Electronics. Solid state with MOSFET chopper. **Dead band.** 0.1% of span. **Chart.** 11" (279 mm) overall, 10" (254 mm) calibrated, 120' (38.9 m) long. **Step response.** 0.3 seconds or better overall, 10" span. **Accuracy.** ±0.25% of span or 3.5 μV.

Chart drives: Chart drive power is provided by an interchangeable gear train and three motor choices: 1, 10 and 60 rpm. Available English or metric in ranges of ¼ in./hr. to 1 in./sec. or 6.25 mm/hr. to 25 mm/sec. **Single-speed:** Dedicated single speed motor. Choice of 18 speeds. **Two-speed:** Two gears in train, removable and reversible, ½, 2, 4, 8 x basic speeds available. Total speeds—88. **Four-speed:** Same as two-speed but with switch to select 10:1 and 60:1 jumps. Total speeds—120. **Five-speed:** Five position thumbwheel sets 1, 2, 4, 8 and 16 x basic speeds. Total speeds—140. **Ten-speed:** Ten position thumb-wheel sets 1, 2, 4, 8, 10, 16 and 60 x basic speed. Total speeds—300. **PIP drive option:** Provides variable chart speed proportional to a pulse input or a variable DC voltage and other inputs. **Span/Zero offset controls:** Six span arrangements (plug-in span cards, calibrated multi-span selector switch, or factory set) and two zero offset arrangements (uncalibrated and calibrated) offer eight basic control choices.

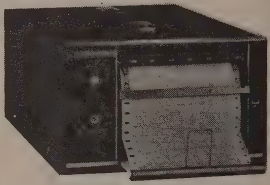
Mountings: Benchmount (shown) rack or panel mount available with or without trim, trim and door or trim and door lock. Can be illuminated.



Speed Servo® 4½" recorder

Bulletin F710

Single moving part linear servo motor. 1/8 sec. response. Takes 4 Hz signals without significant attenuation. High source impedance (100,000 ohms max.). Adjustable zero and span or multirange (0–1, 5, 10, 50, 100, 500 mV; 0–1, 5, 10, 50, 100V). 14 immediate-adjust mm speeds. Disposable ink writing system. **Quick specs:** Single 4½" (114 mm) channel (S 601S). Wireless feedback pot. **Amplifier.** Solid state (except one input tube), modular. **Accuracy.** ±0.5% of span. **Dead band.** 0.25% of span. **Zero adjust.** Full scale standard. Approx. $1,100.



Battery or AC operated Miniservo® recorder

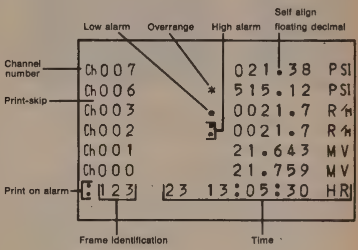
Bulletin F613

Stock model S-22243 is a portable internal battery (8 hr. operation) Miniservo for field applications. Accurate to ±1% span with input impedance potentiometric to 1 V. Adapts to AC (120 V, 60 Hz). 11 input spans (1 mV to 100 VDC) are switch selectable. Eight chart speeds from 15 to 3000 mm/hr. **For 72 hour delivery,** order Stock S-22243 at $725.

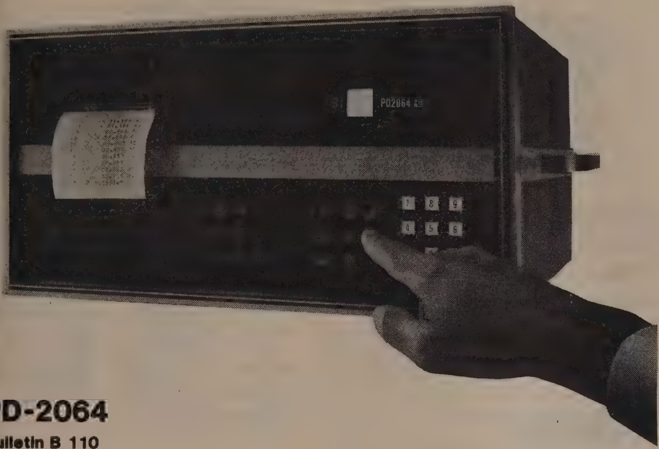
Esterline Angus Instrument Corporation / A Unit of Esterline Corporation

Key Programmable Data Systems

Simplify data acquisition from 8 to 248 channels by 11-function key programming and microprocessor control



```
Ch007        021.38  PSI
Ch006      * 515.12  PSI
Ch003      • 0021.7  R%H
Ch002      : 0021.7  R%H
Ch001        21.643  MV
Ch000        21.759  MV
: 123   23  13:05:30 HR
```



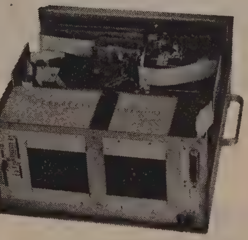
PD-2064

Bulletin B 110

Description: New self-contained system gathers data from 8 to 248 channels with control through an 11-function keyboard and microprocessor setup. Simplifies analog and digital data gathering in the field, laboratory, and plant, saves from 20% to 80% of the cost of any alternative hard wired system. At the heart of this standardized data acquisition system is a microprocessor—a solid state integrated circuit computer—combined with RAMs, ROMs and PROMs. Optional special ROM programs such as ratios, rate of change, accumulation, math functions, dedicated initialization ROM with keyboard override allows optimum versatility. Functions include signal conditioning, I/O, crystal controlled clocking, measurement intervals as fast as 25 channels/second, engineering units, optional high/low alarms. **Easy setup:** Programming by keyboard makes this a true GENERAL PURPOSE data system that easily adapts to specific experiments, tests, and dedicated applications. Seven red keys control the overall system, and seven black keys set up the system constants. Channel functions are selected through ten gray keys after the channel or channel pair is selected. Numeric keyboard for integer or fixed decimal entry of channel numbers, codes, or data sends keyed numeric values to memory after each program operation. **Measurement accuracy:** The PD-2064 will function with low level signals amid adverse power line and noise environments that would bomb out many other data systems. This is done through floating 3-wire guard shielding throughout, high common mode rejection and automatic circuit zero and open circuit check that assures integrity in the total input signal loop, multiplex relay, and wiring connections. Also, optical isolation between logic signals and multiplex relay drive coils is designed to end common mode problems. **Logical, simple programming:** Learn to program in a matter of an hour or two with the Programming Guide (shown below). Pick up is quick after months away from the PD-2064 because of the logical progression of programming: establish overall system variables, set channel or channel pair variables. Refresh your memory, and then program in virtually **any** order. Flexible heirarchy of operations allows quick debugging, permits changes in individual channel variables or the system as a whole at any time. Won't accept invalid commands or data (no autodestruct). Optional program printout allows quick dump of system settings.

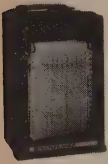
Outputs: A standard PD-2064 feeds data to any two output devices (three devices optional). Any two of the following may be ordered key-selected: On-board Seiko digital printer allows direct printing in engineering units; ASR33 Teletype and compatible devices allows computer compatibility; Mag tape recorder for recording large quantities of data; Paper tape perforator for rugged environmental conditions; Data telemetry interface, RS-232-C compatible, permits the PD-2064 to be used with a variety of receivers and transmitters.

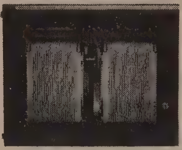
Guarded inputs: Sub-millivolt signals are noise-protected on each analog channel by a three-wire relay switch energized prior to each scan. Guarding is further provided by a metal shielding enclosure that may float above ground, tied to the guard wire. Solder terminals are standard. **Options:** Custom initialization, program printout (dump), memory save during power outage, self-calibration, integrator, special functions, thermocouple linearizing (4 types mixed), and individual channel alarms are all features available in internal or external housings. Base price approx. $3,700.



Box 24000, Indianapolis, Indiana 46224 / (317) 244-7611

Direct Writing and Event Recorders





Series "A" recorders

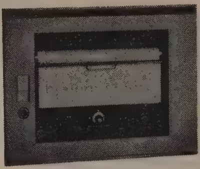
Bulletin C200

Electrodynamometer or permanent magnet-moving coil Series "A" case recorder with 6" (152 mm) wide curved coordinate chart, 4½" (114 mm) active width. Record µA, mA, A, mV, V, W, vars, kVA, frequency, pF, pressure, vacuum, speed, position. Four chart drives, chart speeds from ¾"/hr. to 3"/sec. or 12½ mm/hr. to 100 mm/sec. From $560.

Series "A" RectiGraph® recorder: four drive types, same chart speeds as curvilinear. Price approximately $750.

Two channel Series "A" recorder with two 2" (51 mm) channels also available with same chart speeds as above. Price approximately $850.

Series "A" event recorders with 5, 10, 15 or 20 channels for ink writing or 10 or 20 channels inkless available in portable, flush or front switchboard, wall mounted or twin mounted. Base price approximately $515. **See Bulletin D300.**



Series "E" RectiGraph® and event recorders

Bulletins DWC 271 and D300

RectiGraph models include two channel or four channel recording with independent side-by-side straight coordinate permanent magnet-moving coil elements. Measure µA, mA, A, mV, V (W, vars, pF, frequency, phase angle—with transducers). 15, 10 or 5 speed automatic drives; 10 or 5 speed manual drives. Chart speeds: ½"/hr. to 8"/sec. or 12.5 mm/hr. to 200 mm/sec. Two 4½" (114 mm) channels approx. $1,350. Four 2-3/16" (56 mm) channels approx. $2,100.

Series "E" event recorders have 40 channels, use ink or inkless writing. Flush or bench mount cases. Automatic or manual chart drives same as single and two channel models. Approx. $1,450.

Series "S" direct writing and event recorders

Bulletins DWC 271 and D300

Single 4½" (114 mm) or two 2-3/16" (56 mm) channel RectiGraph. 8" x 8" (203 x 203 mm) case. Records same parameters as Series "E". Single to 14 automatic speeds. Price from $710.

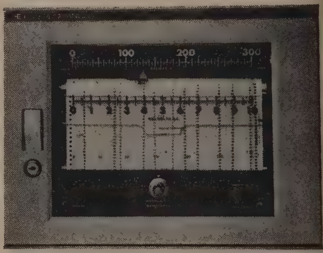
Event ink recorders available 5 to 20 channels, 10 or 20 inkless. Approx. $600.

Multipoint Recorders

Thermal printing

Bulletin F720

Gather analog data from four, six, eight, 12 or 24 points with a thermal printing Multipoint. A simple solid-state semiconductor printing device provides three basic readout combinations by thermally branding on the chart: dots for all channels, a dot plus number for all channels, or an Identaline pattern. Identaline, a number and dot combination, allows accurate curve analysis and channel identification of complex overlapped signals—at slow economical chart speeds. **Uses:** Two basic thermal multipoint models (L1112S, L1124S) with varying standard features can meet the exacting needs required by research labs, processing plants and a variety of OEM applications. **Features** include standard linear servo motor for smoother, quicker response, and a time/identification feature to enable a four-digit time or identification number to be printed on the hour, minute, or on command. **Options:** Selective or non-selective alarms; automatic dual range to record one of two preselected ranges; and programmed printing (print/skip) to allow deletion of any point or points. **Quick specs: Print rate.** as fast as 1 sec/point full scale with accuracy within 0.25% of any mV span or 5 microvolts, whichever is greater. **Type of inputs.** 0.5 to 100 mVDC, 0.1 to 100 VDC or thermocouple types E, J, K, R, S, and T. **Input impedance.** Spans of 100 mV or lower are potentiometric with input impedance of 100 megohms minimum. **Manual point advance.** Standard. **Scale.** 10" (254 mm) calibrated. **Chart drives.** Single-, two- or four-speed synchronous or 12-speed stepper for English or metric increments. Price approx. $1,600.



Ink printing

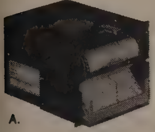
Bulletin F600

Model E1124E is a 2 to 24 point rotary servo recorder with print rates as fast as 1½ sec./point. **Features:** Manual point advance; slide-switch programming of preselected points; change gears to increase printing rate 4 times. Universal input common for all types of thermocouple or millivolt inputs. Five or ten speed manual or dial set chart speed selection available. 95 automatic drive speeds or 70 manual speeds. Base price approximately $1,650.

Esterline Angus Instrument Corporation / A Unit of Esterline Corporation

ESTERLINE ANGUS
A UNIT OF ESTERLINE CORPORATION

Miniservo® Recorders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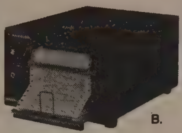
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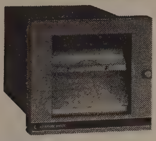

C.

A. OEM

Bulletin F612

For dedicated OEM applications at a low price, this stripped down basic unit is ready to fit your product. Sensitive to 100 mV span, response is 0.5 sec. full scale, accuracy of ±0.5% span. Single speed chart drive on 100 mm active width. Basic unit MS401E starts at $300.

B. Benchmount

Bulletin F610

Stock model S-22087 is the single best value servo recorder available. Packed with special lab options and features, such as 8 chart speeds (15, 30, 60, 150, 300, 1500 and 3000 mm/hr), roll or Z-fold chart, and input signal ranges from zero to 10, 50, 100, 500 mV, and 1 VDC with full scale zero adjust. If you need a specific range, thermocouple or thermistor type, Esterline Angus has it too. **For 72 hour shipment,** order Stock S-22087 at $525.

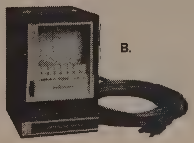
C. Panel or rack mount

Bulletin F611

The lowest cost precision servo is available to fit your permanent installation or product. Basic model MS401C provides a single speed, single span input of 100 mVDC with right-hand zero and 100-0 scale. Accepts Z-fold or roll chart. A ±10% electrical adjustment is provided on zero and span. All Miniservos use disposable ink cartridge with stylus. Options include adaptor rack, trim, door assembly, and a choice of ranges and speeds. Starts under $400.

Minigraph Recorders

A.


B.

C.

Lic. under US Patent No. 3,048,848
Mfg. under US Patent No. 3,717,881

A. Single channel

Bulletin C230

Records millivolt, volt, microampere or ampere input by series of inkless dots. A time share option accepts two inputs. Single 2-1/8" (54 mm) channel. 70 speeds 1/32—480 ipm, 0.7 mm to 12.2 mpm. Five event marker options. Price approx. $115. Two-channel available to record independently side-by-side. Price approximately $150.

B. Event

Bulletin D330

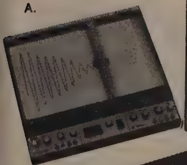
Four or eight channels. Designed for any on/off or yes/no application in 6-48 VDC range. 120 or 240 V/50 or 60 Hz ranges available with optional power converters. 70 chart speeds (1/32—480 ipm, or .08 mm/min.—12.2 m/min.). Price approximately $120.

C. Temperature

Bulletin C231

Thermocouple or thermistor probes sense temperature. Inkless stylus creates dot record on 2-1/8" (54 mm) active width chart. 70 chart speeds. ±2% accuracy. 5 event marker options. Snap-out label makes unit ideal for OEM/private label use. 3-5/8" W x 5-5/8" H x 4" D (92 x 143 x 111 mm), 6" deep (152 mm) with thermistor. Records 0-500° F to 0-2000°F. Room ambient 50° to 100° F or 20° to 130° F outdoors. Price approx. $160 with J or K thermocouple.

X-Y Recorders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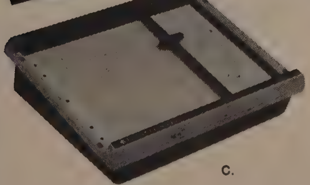

C.

A. Model XY 530

Bulletin E500

For medical, lab and industrial applications. This XY records low level signals from any source, whether grounded or floating. Plots Cartesian coordinate graphs, showing the relationship between two functions represented by DC or slowly changing AC voltages, or one function as it varies with respect to time. Quiet vacuum holddown; high speed; differential input of 1 mV sensitivity; ±0.2% of full scale accuracy; 11" x 17" or 8½" x 11" paper. Price approx. $1,450. Model XY 560 records signals as low as 1 μV. **See Bulletin E500.** Price approx. $2,400.

B. Model XYY' 540

Bulletin E500

Two pens simultaneously plot two separate vertical (Y and Y' axis) input signals in relation to a simple horizontal (X axis) signal. Priced approximately $2,650.

C. Model XY 575

Bulletin E510

Stripped down for OEM use with sensitivities from 1mV to 10V/in. (0.5mV to 5V/cm), delivers value and performance. Approx $900.

For lab use, multi-range, time-base and other options available, including expanded capability module. Approx. $1,100.

Box 24000, Indianapolis, Indiana 46224 / (317) 244-7611

gulton

Miniature Rustrak Chart Recorders

Rustrak miniature chart recorders generally measure 5-5/8″ high x 3-5/8″ wide x 4-1/8″ deep, and offer a wide range of sensitivities, writing and chart speeds. Accuracy is typically ±2% of full scale and response time is 0.8 to 1.0 seconds. The recorders operate in both chart rewind and tear-off modes. Chart width of single channel recorders is 2-5/16″, dual channels 1″ each.

PSI
Rustrak

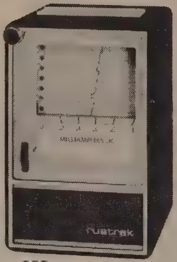
2162

Pressure Recorder.

Single channel pressure recording of most liquids and gases using a C-type Bourdon tube. Standard ranges 0-15, 0-30, 0-50, 0-100, 0-200, 0-300 and 0-500 psi. Many special offset ranges available.

Single Channel DC Recorder.

Basic recorder in the Rustrak line. Ranges from 0-10 microamperes to 0-5 amperes DC; 0-10 millivolts to 0-500 VDC. Multipliers and shunts available. Chart speeds 1/32″ to 480″ per hour. Many available options, features and accessories. AC models also available.



288

MICROAMPERES DC
Rustrak

291

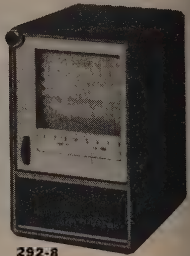
Dual Channel DC Recorder

Same as basic Model 288 except dual channel with two galvanometers. Available in combinations of current and voltage or different ranges each channel. Usable chart width, 1″ per channel. AC models also available.

One Microampere DC Recorder.

Solid state with full-scale sensitivity of 1 microampere, range of 0 to 10 millivolts DC and input impedance of 10,000 ohms. For use as temperature bridge and strain gage readout or as a recorder accessory for laboratory and process instruments.

2194



292-8

Event Recorders, Models 292-4, 292-8, & 392-16.

Four or eight channels. Records worktime, productivity of machines and personnel; provides data for time study, cost analysis, security control. Chart speeds to 50 inches per minute with definition of up to 16 events per second.

DEGREES FAHRENHEIT
Rustrak

2122

Temperature Recorders.

Wide variety of temperature recorders using thermocouples, thermistors or nickel wire sensors. Ranges from −100° F. to +2400° F. and custom spans as narrow as 25° F. Also available in °C. and in single or dual channels.

400

Potentiometric Recorder.

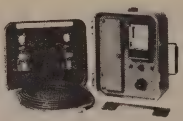
100 mV direct writing recorder offers 1 megohm input impedance and solid-state amplifier. Series of plug-in modules available for increased sensitivity to 1 mV full-scale. Other plug-ins with cold junction compensation and for special applications.

Recording-Controller Feature.

ON-OFF solid state controller feature available as option on most Rustrak recorders. Controls up to 5 amps resistive load at 30 VDC or 115 VAC. Set points continuously adjustable over entire chart range. Option price added to cost of companion recorder. Not available separately.

DEGREES FAHRENHEIT

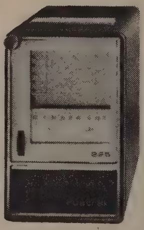
2133/F204AB



192

Dissolved Oxygen/Temperature Recorder.

Simultaneously records dissolved oxygen and temperature. Temp. range, 0 to 40° C. Operates unattended for about four weeks from two inexpensive batteries. Chart speed regulation, ±0.5%. For surveys in water pollution control programs.



225

RH/TEMP Recorder

Electronically monitors relative humidity from 10% to 90% and temperature from 60° to 90°F on a single chart. Chart lasts 2 months, continuous operation. No ink to add or messy cartridges to change. Sensors included. Ideal for computer room, clean rooms, or offices.

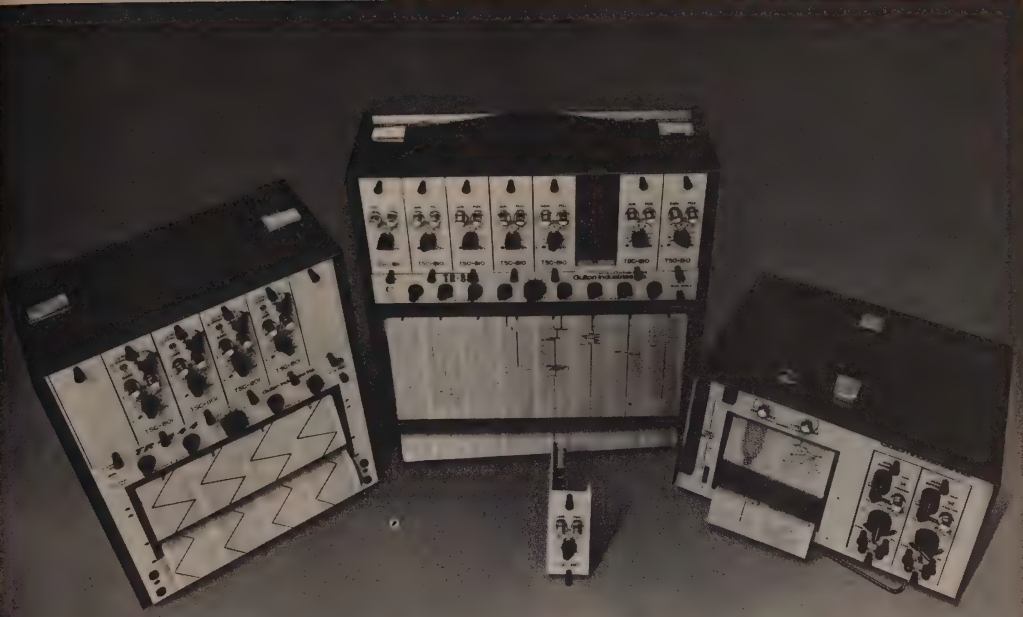
Series 300: Recorders

300

Available in many configurations combining functions of most other recorders. Event markers, controller feature, time-sharing also available. Case size is 6-5/8″ W, 6-1/2″ D, 5-5/8″ H. Accuracy ±2% of full scale. Useable chart width, 2-5/16″ per channel on basic recorder, 1″ per channel on four channel model.

gulton

Measurement & Control Systems Division
Gulton Industries Inc., East Greenwich, Rhode Island 02818
401-884-6800 • TWX 710-387-1500



2 WEEKS DELIVERY!

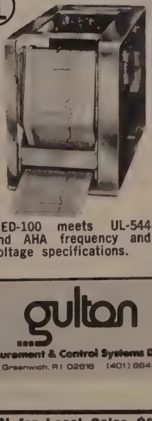
ON GULTON'S 2, 4, 6 AND 8 CHANNEL RECORDERS WITH OUR OFF-THE-SHELF PLUG-IN SIGNAL CONDITIONERS . . . THESE ARE THE SMALLEST, LIGHTEST, MOST VERSATILE PORTABLE RECORDERS AVAILABLE

COMPARE THESE FEATURES WITH ANY OTHER RECORDER'S:

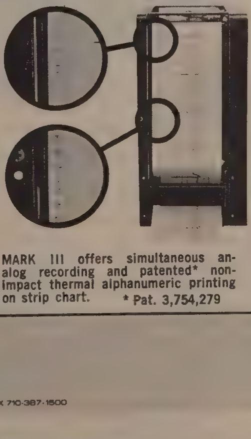
- True portability: for example, our 8 channel recorder weighs only 65 lbs. and measures 17½" x 19" x 6". Our 2-channel is only 30 lbs.
- Frequency response: 100 Hz (-3dB) for 2, 4, and 6-channel recorders, 125 Hz (-3dB) for 8-channel recorder.
- Interchangeable signal conditioners provide recording of temperature (thermocouple and thermistor), ac and dc strain, volts, millivolts, microvolts (down to 20 microvolts/div.), ac to dc, frequency to dc, EKG, and log to dc.
- Electrically selectable chart speeds from 0.5 to 100 mm/sec.
- Inkless writing by reliable heated stylus on rectilinear chart paper.

OEM RECORDER BUILDING BLOCKS

Standard building blocks available in 1 through 8 channels.



MED-100 meets UL-544 and AHA frequency and voltage specifications.



MARK III offers simultaneous analog recording and patented* non-impact thermal alphanumeric printing on strip chart. * Pat. 3,754,279

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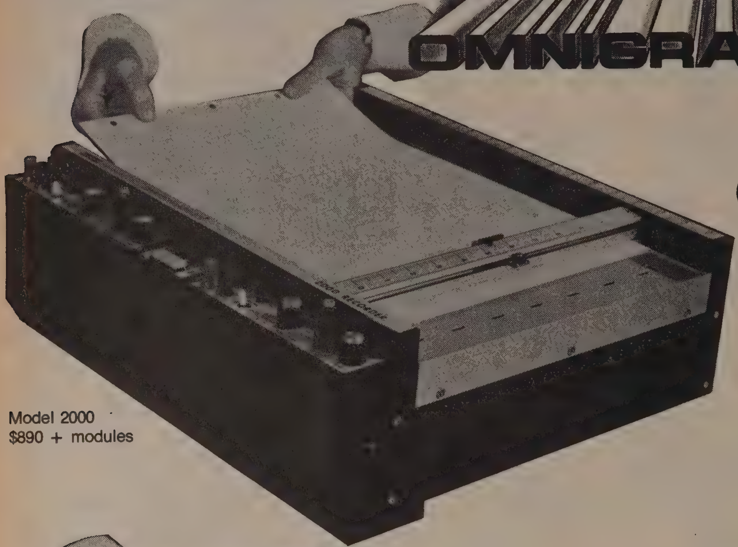
Capable Recording

OMNIGRAPHIC® 75



Model 2000
$890 + modules

X-Y CAPABILITY

Some 21 interchangeable modules plug into the basic chassis to give you the most capable X-Y recorder in the world or any place else.

- 30 in/sec speed (40 in/sec available)
- ± 0.2% accuracy
- local/remote pen control
- electric pen lift
- high input resistance
- interchangeable amplifiers

Model 3000
$890 + modules

STRIP CHART CAPABILITY

A truly capable strip chart recorder for such diverse functions as GC or spectrometry.

- 9 pushbotton speeds from 20 to 0.05 in/min
- ± 0.2% accuracy
- 30 in/sec slewing speed (with 40 in/sec available)
- English/Metric scaling at the flick of a switch
- Snap-in disposable pen
- Electric pen lift

Plug-in modules include:

Type 0 Customizing
Type 1 DC Coupler
Type 2 Ranging
Type 3 Switching
Type 4 Switching /Time Base
Type 5 Precision Attenuator
Type 6 Precision Attenuator /Time Base
Type 7 Pre-Amp Attenuator
Type 8 Pre-Amp Attenuator /Time Base
Type 9 Precision Ranging
Type 12 Precision Attenuator /Offset
Type 14 Log Convertor
Type 15 Two Channel
Type 16/17 Point Plotter
Type 26/17 Point Plotter

Control modules:

Type 50 Chart Drive
Type 51 Chart Drive
Type 52 Chart Drive
Type 53 Chart Drive
Type 100 Control
Type 200 Control

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OEM DISCOUNT

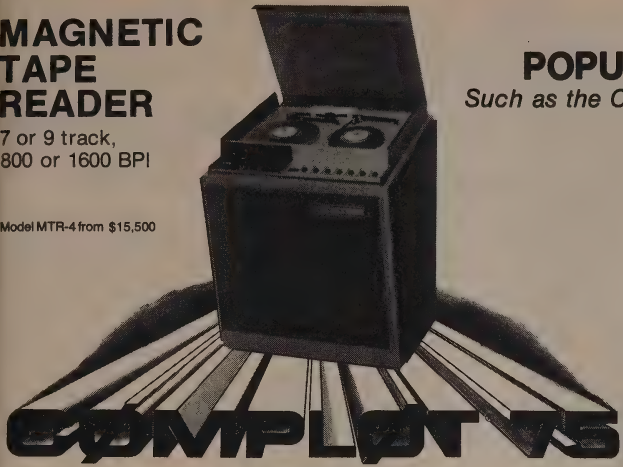
Be sure to ask about our unique module trade-in plan.

State of the art; yet least expensive

MAGNETIC TAPE READER

7 or 9 track,
800 or 1600 BPI

Model MTR-4 from $15,500

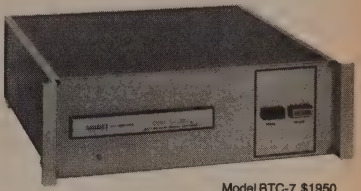


- Automatic block search—forward and reverse.
- Hardware vector generator—cuts computer time significantly.
- Buffered plot data records.

New from The Recorder Company, the model MTR-4, a fourth generation offline CØMPLØT magnetic tape reader with features found only in much higher priced competitive models.

BATCH TERMINAL CONTROLLER FOR POPULAR USER TERMINALS

Such as the CDC 200, Mohawk 2400 and Data 100



Model BTC-7 $1950

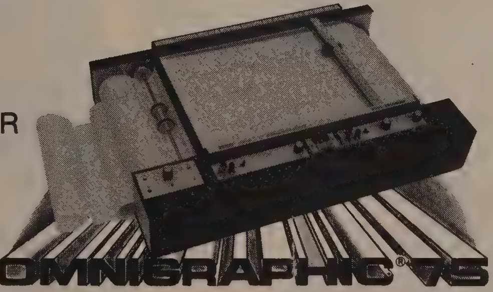
- Adds graphic output to the CDC, Mohawk, and Data 100 user terminals
- Field installable in less than 1 hour
- Completely automatic plotting at speeds from 300 steps per second
- Free housekeeping software may be loaded from the terminal

The BTC-7 controller plus plotter enables a 200 terminal user to produce fast reproducible records of graphs, charts and drawings, annotated with alphanumerics. Flexibility is limited only by programming imagination. CØMPLØT plotters use a bi-directional Z-fold (fan fold) paper mechanism, offering many advantages over conventional roll chart techniques.

NEW NEW NEW
STRIP CHART ADAPTER FOR X-Y RECORDER

NEW VERSATILITY
FOR YOUR
2000 X-Y RECORDER

Model 2000
Recorder
$890
plus modules



Model SCA-1
Strip Chart
Adapter
$765

- Converts any Omnigraphic 2000 X-Y into a Strip Chart Recorder.
- Provides single sheet advance (local or remote control) thus eliminating manual single sheet changing.
- Bi-directional chart drive
- Easily installed in the field
- Adapter only $765 complete

Send for brochure today.

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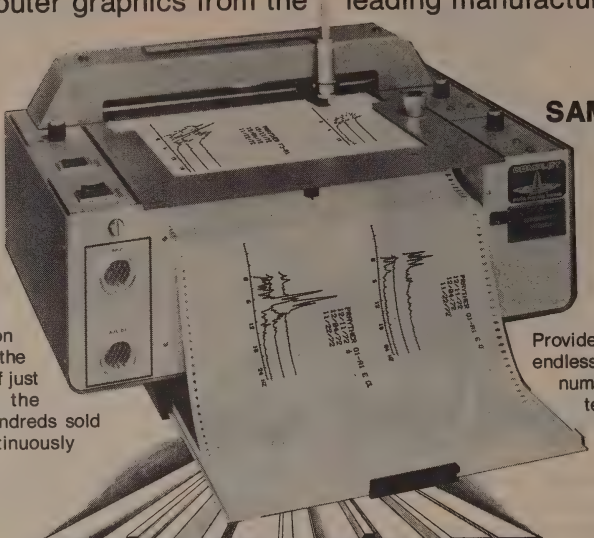
Up-to-date computer graphics from the leading manufacturer of



NEW SPECS 50% FASTER

Here's a reliable, popular Digital Plotter now updated to provide 50% more plotting speed at the same old price! Now you get up to 450 steps per second on an 11″ x 144′ chart for the inflation fighting price of just $3550. Eight years in the field. Hundreds and hundreds sold and still in use. Continuously updated.

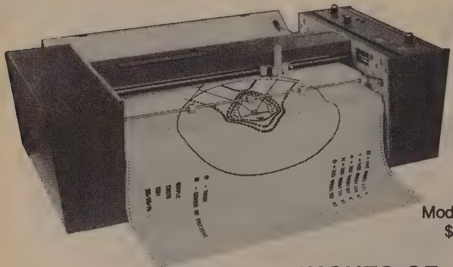
SAME OLD PRICE $3550

Model DP-1

Operates online, offline, remote batch or in time share mode. Interfaces to just about any intelligent data source. Provides a drawing in place of endless columns and rows of numbers. It's the most plotter for the money on the market today!

CØMPLØT® 75

DIGITAL PLOTTERS



Model DP-3
$5150

A FULL 22 INCHES OF PLOTTING POWER

Modern computer graphics methods turn pages of numbers into meaningful graphs, charts, maps and diagrams — by means of a wonderful new machine, the DP-3 Digital Plotter. Accepts input direct from a computer, magnetic tape reader, remote batch terminal or in a time sharing mode. Works efficiently in any application: mechanical or civil engineering, medical technology, geophysical studies, N/C tape verification, and hundreds of others. For details on how you can put this 400 step per second, 22 inch wide drafting machine to work for you.

Model DP-7
$13,500

FOR ONLINE, OFFLINE OR REMOTE BATCH PLOTTING

In any plotting application from drawing contour maps to plotting radiation therapy isodose distributions, CØMPLØT model DP- 7 Digital Plotter gives you more performance for less cost. Provides 1800 steps per second plus a full 36.5″ wide chart surface (150′ long) and three automatically selectable pens. Write today for details, brochure.

Write or call for literature

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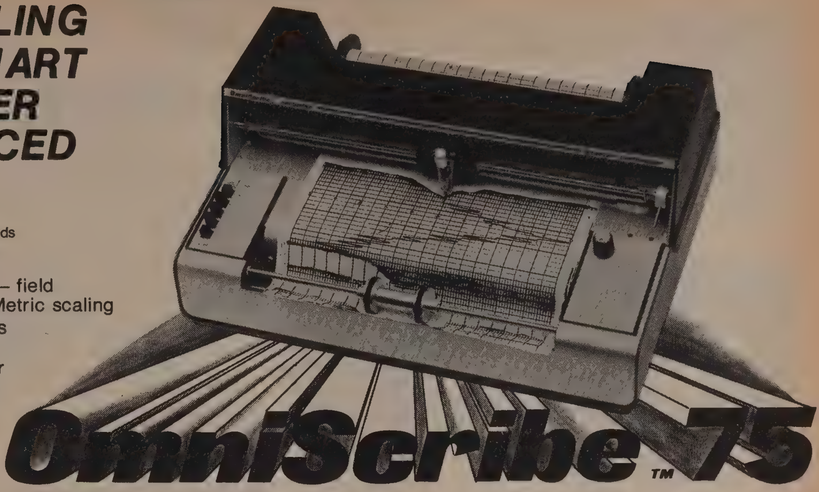
TOP SELLING STRIP CHART RECORDER LOW PRICED

Model 9112-1
Single Pen Recorder with
1, 2, 5, 10 in/min. chart speeds
and 10 mv fixed input span.

- Multi-speed chart drive — field adjustable for English / Metric scaling
- Self-aligning sprocketless paper drive
- New patented transducer eliminates troublesome slide wire
- Two-pen models available
- Off scale signal suppression

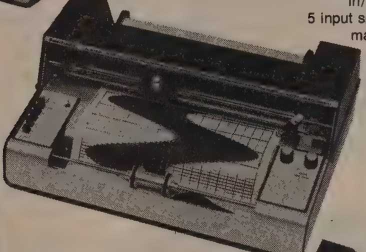


Model 9110-2 single pen recorder with 2.2, 5, 10, 20 cm/min. chart speeds and 5 input spans of 10 mv up.

Here's America's number one strip chart recorder for 1975! And for a rock bottom price in an age of inflation.

Pick a winner for 1975!

Model 9132-2 single pen recorder with 1, 2, 5, 10 in/min. chart speeds, 5 input spans of 10 mv up, event marker and electric pen lift.



NEW FEATURES!

- Overrange signal suppression
  - Quiet operation
  - Extended recorder life
- Second generation pen drive
  - One piece re-balance element
  - Wear compensated

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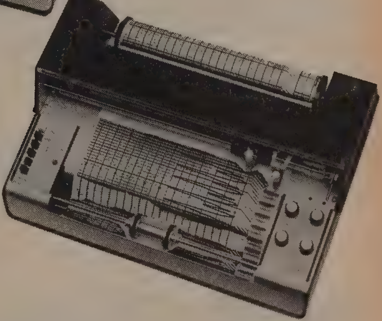
ZERO
CHECK
SPAN
MODE
VAR. SPAN
OFFSET
LINEAR

NEW OPTION

- Reciprocal log display
  - Converts transmittance to absorbance
  - Five spans 0,1A to 2.0A

Model 9213-15 two pen recorder with 12 chart speeds and 5 input spans of 1.0 mv up.
Two channel operation
and two integration modes.



Write for details today.

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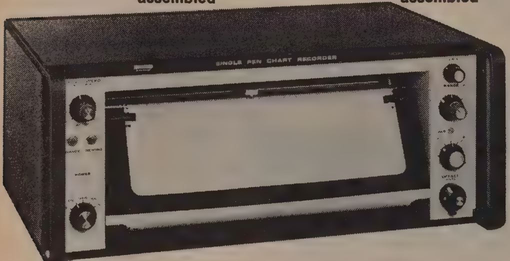
With Heath recorders, you don't pay extra for the extras.

The SR-204 has research-quality performance at low cost...only $395.00*

Precision lab recorders with all the performance you'll ever need

Single pen... $995.00* assembled **Dual pen... $1395.00*** assembled



DUAL PEN CHART RECORDER

Like all of our strip chart recorders, the SR-204 has many standard features that are available only as extra-cost options with other manufacturers. Features like pushbutton selection of 10 mV, 100 mV, 1 V and 10 V full scale spans. Variable span control allows expansion to 100 V full scale. Ten chart speeds of 10, 5, 2, 1, 0.5, 0.2, 0.1, 0.05, 0.02, and 0.01 in/min are instantly selectable. Overall error is less than ±0.5% of full scale. Balance time is only ½ second. The floating input provides better than 10^7 megohms input impedance with less than 10 nA bias current to minimize source loading. Standard equipment includes complete remote control capability (including electric pen lift), rack mount and easy metric conversion. Its versatility and ease of operation will make this 10" recorder the most-used instrument in your lab. (Shipping weight 20 lbs.)

Heath has engineered precision and performance into two new recorders that are probably all the lab recorder you will *ever* need. Each recorder is a complete system — there are no extras to buy. The price includes remote programming capability, events markers, electric pen lift, pushbutton paper advance and reroll, necessary hardware for rack mount and easy conversion to metric operation.

The single-pen SR-205 and dual-pen SR-206 use easily replaced, disposable nylon-tip pens for a distinct, continuous trace. Balance time is only 250 msec for accurate response to fast-changing signals. Maximum error is ±0.2% of full scale.

Front panel zero controls permit each pen to be set anywhere on the full 10" chart width with zero input. Full scale input ranges are 1, 2, 5, 10, 20, 50, 100, 200 and 500 mV *or* volts. A calibrated variable control allows full scale to be set anywhere between 1 mV and 500 V. The SR-205 has a built-in calibrated offset to provide positive or negative 0-10 mV, 0-100 mV, 0-1 V or 0-10 V input signal suppression. Twelve chart speeds range from 50 in/min to 0.01 in/min in a 1-2-5 sequence.

Chart drive is quartz crystal controlled for stable chart operation regardless of line frequency. Chart paper may be automatically rolled up or fed out of the recorder and conveniently torn off for examination or filing.

Remote control by TTL-level signals for pen lift, chart drive, events marker and servo mute is possible through a connector on the rear panel (mating connector supplied).

Dependability and low maintenance have been designed into both recorders. An enclosed conductive plastic slidewire is used for long life without periodic cleaning. The low inertia, ball-bearing motor provides rapid pen acceleration. Pen motor current limiting circuitry allows the pen to be driven continuously off scale with no audible noise and no possibility of damage to the recorder. (Shipping weights: SR-205, 28 lbs.: SR-206, 32 lbs.)

Heath/Schlumberger Assembled Instruments

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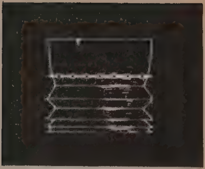
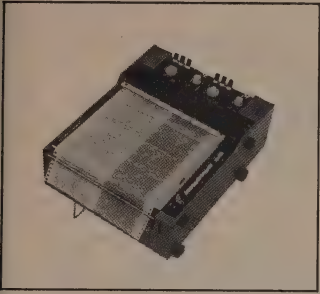
YEW Oscillographs & Recorders





3050 SERIES FLAT BED RECORDERS

The Model 3050 is a plug-in type single and dual pen strip chart recorder with a self-balancing potentiometric mechanism. A wide selection of plug-in modules make this recorder particularly suited for a variety of applications. Exceptionally well shielded and guarded input circuits provide a high degree of noise immunity such that extremely stable recordings are assured even under the most severe noise conditions.

Recorder functions can be further expanded through such options as remote control of chart speed, bi-directional paper feeding, remote control of pen lift, re-transmitting slide wire, alarm circuits, time markers, etc.

SPECIFICATIONS

Number of channels: Single pen (Type 3051) and Dual pen (Type 3052)

Accuracy: ±0.3%

Chart: 250 mm(10") wide, 15 m (45 feet) long, z-fold or Roll chart

Position of use: any angle from horizontal to vertical.

Rack mount type available.

Chart speed: single speed or 8-speed available

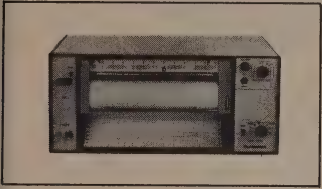
Plug-in modules

3053-11:	DC 0.5mV to 5V/cm (13 ranges)
3053-12:	DC 25μV to 5V/cm (17 ranges)
3053-13:	DC 5μV to 5V/cm (9 ranges)
3053-31:	AC 2.5/5/10V/cm (3 ranges)
3053-41:	DC OFF-SET UNIT

Price:

3051: Start @ $795.00, 3052: Start @ $1,295.00

Plug-in modules: Start @ $59.00



3040 SERIES LABORATORY RECORDER

The 3040 Series Laboratory Recorders are selfbalancing potentiometric recorders with either a single pen or dual pens. It uses a high-frequency modulated DC amplifier for high noise rejection and stable recording. These recorders have a maximum sensitivity of 200μV/200mm and an accuracy of ±0.3%.

SPECIFICATIONS

Accuracy: ±0.3%

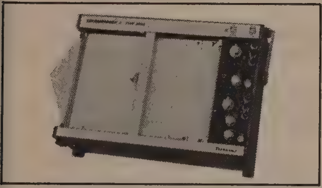
Chart: 250mm (10") wide, 15m (45 feet) long z-fold chart used.

Input range: 0.5mV to 100V/200mm (17 ranges)

Price:

3046 (single pen): Starts @ $850.00 (single input)

3047 (dual pen): Starts @ $1,295.00 (single input)



3083 SERIES X-Y RECORDER

The Model 3083 is a plug-in type single pen X-Y recorder with an 8½ x 11" chart (DIN and JIS Size A-4). Both rool chart and sheet are available. With the optional Paper Take-Up Unit, this X-Y Recorder may be used as a continuous recording strip chart recorder. The pen holder supplied permits the use of a standard commercial felt-tip pen, ball-point pen or pencil in addition to the unit's ink writing system.

SPECIFICATIONS

Accuracy: ±0.3%

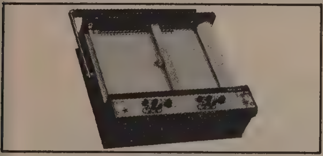
Pen speed: Approx. 0.7 seconds for 200mm

Plug-in-modules

Interchangeable with plug-ins for 3050 series Flat Bed Recorder except 3053-42 Time Base Unit with DC ranges of 0.5mV to 5V/cm (10 ranges) 3085 Paper Take-Up Unit

Price

3083: $1,190.00, Plug-ins: Starts @ $59.00



3070 SERIES X-Y RECORDER

The Models 3077 and 3078 are single pen and dual pen X-Y Recorders respectively with a DC servo system. DC measuring ranges are from 100 μV to 10V/cm (16 ranges) for applications requiring wide ranges. A time base is built-in as standard. Common mode rejection is high 160 dB at DC and 140dB at 60Hz. Desk-top, portable and rack mounting are available.

SPECIFICATIONS

Accuracy: ±0.3%

Recording area: 250 x 250 mm (10" x 10")

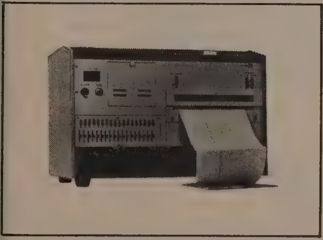
Pen speed: Approx. 1 second for full scale.

Input impedance: 1 MΩ constant

Price:

3077: $1,750.00 (1 pen)

3078: $2,490.00 (2 pen)



2900 SERIES LIGHT BEAM OSCILLOGRAPH

This series consists of photographic recorders which use light sensitive paper. Since these units respond to very high frequencies they are most suitable for recording waveforms which change at very high speeds. Three models, 6-channel, 9-channel and 18-channel, are available. The long optical arm (450mm) which is common to all models, provides high-accuracy recordings with minimum arc distortion.

SPECIFICATIONS

Model: Type 2901 6 channels, portable
Type 2924 9 channels, desk-top or rack mount available
Type 2925 18 channels, desk-top or rack mount available

Frequency: DC to 3,500Hz, depending on galvanometers used

Sensitivity: Approx. 3.3 μA/mm to 2.8mmA/mm, depending on galvanometers used.

Recording width: 127mm for 2901, 178mm for 2924 and 2925

Light source: High tension mercury arc lamp

Paper speed: Up to 200mm per second

Price:

2901: $1,990.00, 2924: $2,490.00

2925: $3,100.00, 2916 Galvanometers: Start @ $69.00

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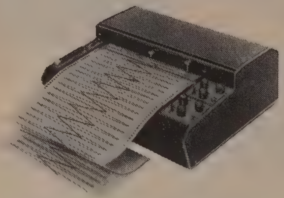
2100 SERIES

POTENTIOMETRIC STRIP CHART RECORDER



FEATURES

- Laboratory or Dedicated OEM Application
- Electronic Off-Scale Protection
- Single or Two Crossover Pens
- Versatile Chart Drive
- Z-Fold and Roll Chart
- Die-Cast Construction
- Convenient Paper Loading
- English or Metric Calibration
- Disposable Fibre Tip Pens — Four Colors
- Sealed Maintenance Free Follow-up Potentiometer

Z-FOLD PAPER

Z-fold paper stacks conveniently in front of the recorder. The folded perforated pack of 200 six-inch numbered sheets allows for instant data retrieval and provides a convenient indication of loaded paper remaining. Any number of consecutive or out-of-sequence sheets can be bound as is in a notebook.

SEALED CONDUCTIVE PLASTIC FOLLOW-UP ELEMENT

This exclusive conductive plastic follow-up element contributes infinite resolution, extended life, and noise-free performance to the servo system.

Unlike any other contact or non-contact transducer in the industry today, the 2100 element is completely sealed requiring no cleaning or lubrication.

DISPOSABLE FIBRE-TIP PENS

Writing is accomplished by disposable fiber-tip pens. The rugged nylon composition tips and fast-drying ink (available in black, red, blue, and green) provide a sharp consistent line for over 3200 feet of trace. The same pens used in analog and event marker channels can be snapped in in less than ten seconds without switching power off or externally disconnecting signal inputs.

IMMEDIATE DATA ACCESS

The positive sprocket chart drive and tear bar are located in close proximity to the pens. Traces, once written, can be accessed immediately and torn off cleanly.

GENERAL PURPOSE LABORATORY AND DEDICATED OEM CONFIGURATIONS

The 2100 Series of potentiometric flatbed stripchart recorders provides single and two-pen recorders in two configurations. The 2115B single pen and 2125B two-pen recorders (2115M ad 2125M — metric calibration) are general purpose laboratory instruments offering five calibrated spans and ten pushbutton selected chartspeeds.

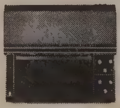
The 2100B single pen and 2120B two-pen recorders (2110M and 2120M — metric calibration) are dedicated single span instruments for OEM applications. An extremely wide range of options exists for span and chartspeed selection so that a dedicated model can be exactly tailored to fit a specific application.

OPTION FLEXIBILITY

A wide variety of options for every 2100 Series model is available to meet the requirements of special applications:

- Up to two optional event markers actuated by external contact closure can be installed.
- An electric penlift option operated by an external contact closure supplements the standard front panel manual penlift. Each pen is actuated independently in two-pen models.
- A proportional chart drive option provides for stepper-motor-driven chart advance actuated by an external TTL pulse train.
- The alarm circuit option has two setpoints adjustable over the entire chart width with a choice of either relay or solid state switching, each for normally open or normally closed circuits.

GENERAL PURPOSE LABORATORY MODELS



2120B

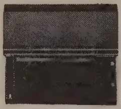
The 2115B/M and 2125B/M general purpose laboratory recorders provide the following standard features:

- Five calibrated spans of 1, 10, 100 mv; 1, 10 V fullscale with a continuous inter-span variable control.
- 10 pushbutton-select chartspeeds of 1, 2, 5, 10, 20 in./hr; 1, 2, 5, 10, 20 in./min. (English) or 2, 4, 10, 20, 40 cm/hr.; or 2, 4, 10, 20, 40 cm/min. (Metric)
- 110-120/220-240 VAC switchable 50-400 Hz power.

Model		Description	Price
English	Metric		
2115B	2115M	Single pen Multi-Span	$ 875*
2125B	2125M	Two pen Multi-Span	$1295*

*OEM Discounts Available—Consult factory

DEDICATED MODELS



2125B

The 2110B/M and 2120B/M dedicated recorders provide the following standard features:

- A single calibrated and fixed span of 1 V fullscale.
- A single chart speed of 6 in./min. (English), or 12 cm/min. (Metric)
- 110-120/220-240 VAC switchable 50-400 Hz power.

Model		Description	Price
English	Metric		
2110B	2110M	Single pen Single-Span	$ 595*
2120B	2120M	Two pen Single-Span	$ 875*

*OEM Discounts Available—Consult factory

Request 2100 Series Technical Data & Price List for full list of options available.

GENERAL SPECIFICATIONS

Response Time: 0.5 sec. for fullscale excursion.

Accuracy: ±0.2% fullscale.

Input Configuration: Floating and guarded.

Input Impedance: 1 Meg Ohm at DC, all spans.

Input Protection: Protected to 200VDC or peak AC normal mode at any span.

Common Mode Tolerance: 500VDC or peak AC from any input terminal to ground.

Temperature Stability: Less than ±0.25% fullscale, 10-40°C after 15 minute warmup, including zero shift.

Common Mode Rejection: Greater than 140 db DC-400 Hz.

Linearity: ±0.1% of fullscale

Deadband: 0.1% of fullscale.

Chart: 11.5 in. width; 10 in grid (English); 25 cm grid (Metric); 120 ft. roll; 100 ft. Z-fold, 6 in. repeats (English); 15 cm repeats (Metric).

Writing Technique: Disposable fibre tip pen.

Power Consumption: 40 watts, peak (single pen) 60 watts, peak (two-pen).

Weight: 25 lbs.; 28 lbs. shipping weight.

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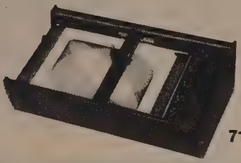
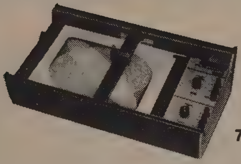
X-Y PLOTAMATIC RECORDERS

HIGH PERFORMANCE AT LOW COST

700 SERIES • 8½ in. by 11 in. (DIN A-4)



715 GENERAL PURPOSE



705 DEDICATED OEM

700 Series Recorders with Pad/Load®

The 700 Series recorders, while low in cost, still meet or exceed the performance specifications of many higher priced recorders. The new "PAD/LOAD®" paper handling system, operates three times faster than those available on conventional single sheet machines. A 50-sheet pad of paper is loaded into the recorder, and as each page is consumed, the operator simply tears off the used sheet, exposing a new sheet.

All 700 Series PLOTAMATICS have:

- I/C Circuitry
- No Mechanical or Photo Choppers
- Clean Fibre-tip Pens
- Electronic Overdrive Protection
- Operation from Switchable 115/230 V, 50-400 Hz Power
- Buffered Feedback Potentiometers for Noise Immunity
- ±0.2% F.S. Accuracy
- Differential Guarded Inputs with 140 dB CMR
- Constant 1 Megohm Input Impedance
- No Servo Gain Adjustments

Model No.		Application	Range	Slewing Speed	Price
English	Metric				
705		dedicated - OEM	1 range: 100 mV/in	17 in/sec	$800
	705M	dedicated - OEM	1 range: 40 mV/cm	43 cm/sec	$800
715		general purpose	5 ranges: 1 mV/in to 10 V/in	17 in/sec	$925
	715M	general purpose	5 ranges: 0.5 mV/cm to 5.0 V/cm	43 cm/sec	$925
7T	7T	plug-in time base generator (use with 700, 800 Series)	0.5, 1, 2, 5, 10, 20, 50, sec/in. (0.25, 0.5, 1, 2.5, 5, 10, 25 sec/cm metric)		$200

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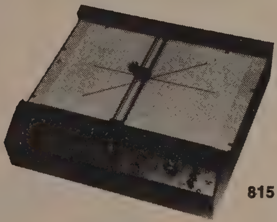
800 SERIES • 11 in. by 17 in. (DIN A-3)



815 GENERAL PURPOSE

800 Series X-Y Recorders

800 Series recorders meet or exceed the performance specifications of many higher-priced units. All 800 Series PLOTAMATICS have:

- I/C Circuitry
- No Mechanical or Photo Choppers
- Fibre-tip or Optional Capillary Pens
- Electronic Over-drive Protection
- Differential-pressure paper hold down
- Buffered Feedback Potentiometers for Noise Immunity
- ±0.2% F.S. Accuracy
- Differential, Guarded Inputs with 140 dB CMR
- Constant 1 Megohm Input Impedance
- No Servo Gain Adjustments
- Holds either 8½ in. x 11 in. or 11 in. x 17 in. paper

Model No.		Application	Range	Slewing Speed	Price
English	Metric				
805		dedicated - OEM	1 range: 100 mV/in	30 in/sec	$ 895
	805M	dedicated - OEM	1 range: 40 mV/cm	76 cm/sec	$ 895
815		general purpose	5 ranges: 1 mV/in to 10 V/in	30 in/sec	$1025
	815M	general purpose	5 ranges: 0.5 mV/cm. to 5.0 V/cm.	76 cm/sec	$1025

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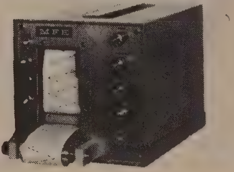
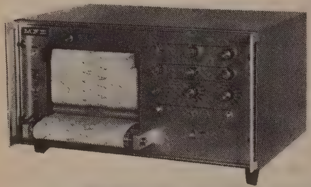
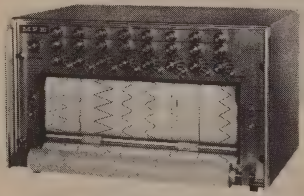
STRIP CHART RECORDERS

1-8 CHANNEL ANALOG RECORDERS







FEATURES

- Inkless Thermal Recording
- Rectilinear Coordinates
- All Solid State
- Modular Construction
- Compact — Lightweight
- Portable or Rack Mount
- Low Power Consumption
- Simple Paper Loading
- Multiple Chart Speeds
- Two Event Markers/Timer Marker
- Internal One Second Timer
- Seven Step Attenuator
- Internal Calibration
- Paper Takeup
- 50 MM Analog Channels (1-6 Channel)
- 40 MM Analog Channels (8 Channel)

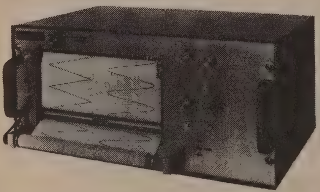
PORTABLE

Model	No. Channels	Weight	Width	Height	Depth	Power (Max.)
M-21CAHA	1	15 lbs.	8.3″	8.4″	11.1″	50 watts
M-22CAHA	2	22 lbs.	11.1″	8.4″	12.5″	75 watts
M-23CAHA	3	39 lbs.	19.5″	9.6″	12.5″	120 watts
M-24CAHA	4	45 lbs.	19.5″	9.6″	12.5″	150 watts
M-26DAHA	6	57 lbs.	19.5″	11.4″	12.5″	220 watts
M-28D	8	64 lbs.	19.5″	11.4″	12.5″	280 watts

RACK MOUNT — For Standard 19″ Retma Racks or Cabinets • All Recorders Mount Directly by Front Panel • No Slides Are Required • Rear Input Provided

Model	No Channels	Weight	Panel Height	Depth	Power (Max.)
M-21CRAHA	1	12 lbs.	8.75″	12″	50 watts
M-22CRAHA	2	20 lbs.	8.75″	12″	75 watts
M-23CRAHA	3	25 lbs.	8.75″	12″	120 watts
M-24CRAHA	4	30 lbs.	8.75″	12″	150 watts
M-26DRAHA	6	42 lbs.	10.5″	12″	220 watts
M-28DR	8	50 lbs.	10.5″	12″	280 watts

WIDE CHART RECORDERS



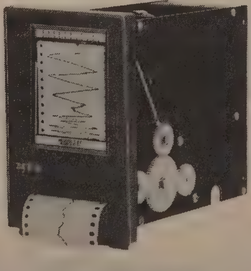
FEATURES

- 100 MM Wide Channels
- High Resolution
- Inkless Thermal Recording
- Rectangular Coordinates
- Lightweight
- Modular Construction
- Solid State
- Compact for Bench-top
- Portable or Rack Mounting
- Low Power Consumption
- Simple Paper Loading
- Wide Range of Speeds
- Event Marker Optional
- Plug-in Amplifiers

Model	Weight	Width	Height	Depth	Paper Type
M-51	20 lbs.	11.1″	8.4″	11.1″	CP217
M-52	40 lbs.	19.5″	9.6″	12.5″	CP227
M-53	48 lbs.	19.5″	11.4″	12.5″	CP237
M-51R*	16 lbs.	19″	8.75″	12″	CP217
M-52R*	22 lbs.	19″	8.75″	12″	CP227
M-53R*	30 lbs.	19″	10.5″	12″	CP237

* Rack-Mount Version

MINI STRIP CHART RECORDER



FEATURES

- 5 Hz Frequency Response
- Inkless Thermal Recording
- Continuous Rectilinear Trace
- Chart Reroll or Feed Out
- Quiet Operation
- Chart Paper Capacity of 70 Feet
- Rugged Construction
- Compact: 5½″ H x 3⅝″ W x 6½″ D
- Portable or Rack Mounting
- Lightweight 3.5 Pounds
- Wide Range of Chart Speeds From ½ in./hr. to 6 in./min.
- Cartridge Paper Loading

CHART SPEEDS

½ in./hr. 1 in./hr. 2 in./hr. 3 in./hr. 4 in./hr.	5 in./hr. 6 in./hr. 8 in./hr. 10 in./hr.	15 in./hr. 20 in./hr. 30 in./hr. 1 in./min.	2 in./min. 3 in./min. 4 in./min. 5 in./min. 6 in./min.

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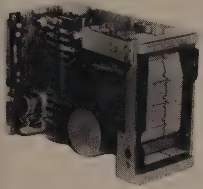
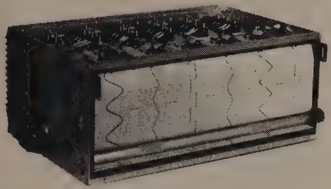
STRIP CHART RECORDERS

1-8 CHANNEL OEM RECORDER MODULES



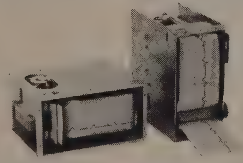
FEATURES

- Inkless Thermal Recording
- Rectilinear Coordinates
- All Solid State
- Modular Construction
- Compact-Lightweight
- Portable or Rack Mount
- Low Power Consumption
- Simple Paper Loading
- Multiple Chart Speeds
- Paper Take-up
- Plug In Amplifiers
- Event Markers
- Controls Supplied
  Gain Heat Position



Model	No. Channels	OVERALL DIMENSIONS Height	Width	Depth	Detail Outline Drawing Request as Required	Weight Recorder 2 speed & Electronics	Paper Type
M-2CAHA	1	6.000	4.125	8.500	0017000	7 lbs.	90003005
M-2CAHALP	1	4.750	3.875	12.000	0013900	7 lbs.	90003005
2M-3CAHA	2	6.500	6.625	10.375	0007300	14 lbs.	90003013
3M-3CAHA	3	6.500	9.062	10.375	0007500	18 lbs.	90003021
4M-3CAHA	4	6.500	11.562	10.375	0007600	25 lbs.	90003039
6M-3DAHA	6	6.500	16.500	10.375	0007800	35 lbs.	90003047
8M-3D	8	9.700	16.500	10.375	00111013	45 lbs.	90007006 (40 div.) 90007014 (50 div.)

12 VDC OEM RECORDER MODULES



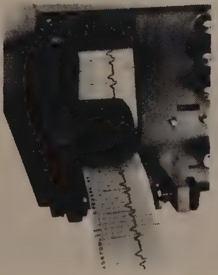
FEATURES

- Inkless Thermal Recording
- Simple Paper Loading
- Many Amplifiers Available
- Meet AHA Requirements
- Meet UL544 Requirements
- Rectilinear Coordinates
- Compact — Lightweight
- Low Power Consumption
- Multiple Chart Speeds
- Event Markers
- Controls Supplied
  Gain Heat Position

RECORDER INSTALLATION DATA

Model	POWER Chart Motor	Stylus Heat	Pen Motor	OVERALL DIMENSIONS Height	Width	Depth	Detail Outline Drawing Request as Required	Weight	Paper Type
M1-40-DC	12 V 150 ma	2.5 V 3 Amps. Nom.	±400 ma Max.	6.000	3.000	4.500	00080010	3 lbs.	90068008
M1-50AHA-DC	12 V 150 ma	2.5 V 3 Amps. Nom.	±450 ma Max.	5.900	3.360	5.225	00080028	3 lbs.	90003005
M-2DAHALP-DC	12 V 150 ma	2.5 V 3 Amps. Nom.	±450 ma Max.	3.380	3.710	10.000	00248005	3 lbs.	90003005
M-2CAHA-DC	Typical Power Consumption Complete Unit with Electronics 12 V 1.5 Amps.			6.000	4.125	8,500	00170001	7 lbs.	90003005
M-2CAHALP-DC				4.750	3.875	12.000	00139006	7 lbs.	90003005
M-20CAHA-DC				8.400	8.300	11.100	Packaged Recorder	13 lbs.	90003005

DIGITAL PRINTER ACCESSORY



DESCRIPTION

Model ADP Digital Printer Accessory is designed to be compatible with any MFE Single or Multi-channel high speed recorder. The system provides the capability to print quietly a continuous line of alpha-numeric or special characters from a set of 12 characters. Printing is accomplished without interruption of the analog recorder. Digital information is printed in the left margin of the chart at a maximum rate of 4½ characters per second while the paper is moving at speeds of up to 50 mm/sec.

The ADP consists of a print mechanism mounted externally on the recorder carriage and an electronic module mounted conveniently to the rear of an MFE analog recorder module or in any other available space within the system.

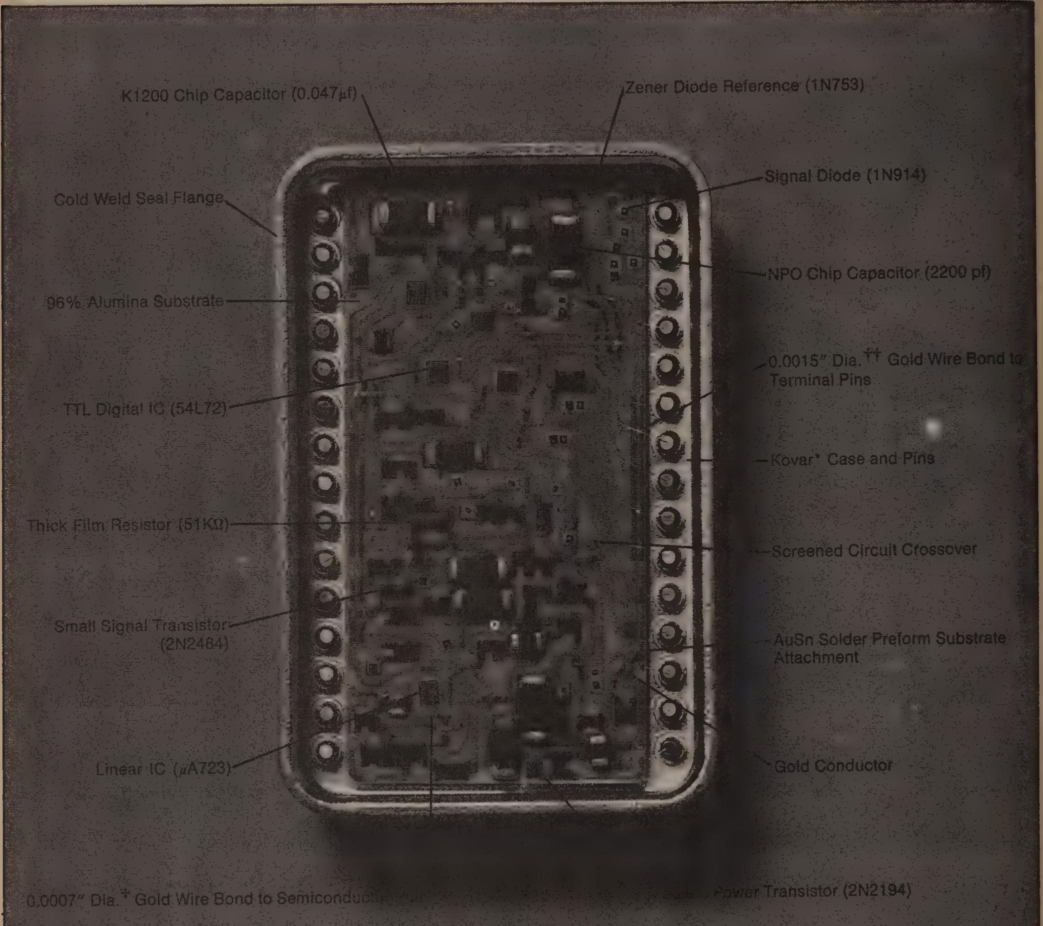
Data input is by standard 8-4-2-1 BCD at TTL IC logic levels. Control is accomplished by a simple print enable input and timing output.

APPLICATIONS

The ADP Series has been designed for application in medical intensive care monitoring to display ECG or other physiological data in conjunction with time, date, and patient identification. Applications also include industrial batch process identification, analytical instrumentation, geophysical survey work, quality control, seismographic monitoring, noise and sound detectors, and many others.

Beckman®

HYBRID MICROCIRCUITS


K1200 Chip Capacitor (0.047μf)
Zener Diode Reference (1N753)
Signal Diode (1N914)
Cold Weld Seal Flange
NPO Chip Capacitor (2200 pf)
96% Alumina Substrate
0.0015" Dia.†† Gold Wire Bond to Terminal Pins
TTL Digital IC (54L72)
Kovar* Case and Pins
Thick Film Resistor (51KΩ)
Screened Circuit Crossover
Small Signal Transistor (2N2484)
AuSn Solder Preform Substrate Attachment
Linear IC (μA723)
Gold Conductor
0.0007" Dia.† Gold Wire Bond to Semiconduct
Power Transistor (2N2194)

**Kovar is a trademark of Westinghouse Corporation*

† 0.0007 in. ≅ 0,018 mm.

†† 0.0015 in. ≅ 0,038 mm.

So extensive is our line of standard and custom hybrid microcircuits that we're the second largest user of semiconductor chips in the nation. Standard hybrids are available off-the-shelf from voltage regulators to DACs and ADCs, and ladder networks, or perhaps your need is for hybrid power amplifiers, or telephone tone receiver products . . . you'll find them all in Beckman's standard hybrid product line. And if a standard doesn't suit your need, try our custom capability. In custom hybrids, for example, we build to customer design and specifications, or we supply the design help when needed.

Beckman INSTRUMENTS, INC. **HELIPOT DIVISION** 2500 Harbor Boulevard, Fullerton, California 92634
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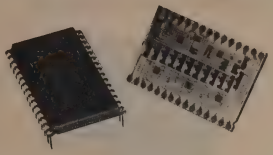
DAC/ADC PRODUCTS

Series 872 CMOS Compatible DAC

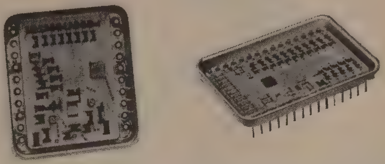


Series 872 Digital-To-Analog Converter is a medium speed, parallel input converter featuring:

- CMOS logic inputs (4,000 or 74C)
- 12-Bit resolution
- Very low power dissipation
- Preset/adjustable zero offset
- Preset full scale (0 to 10V or −10V to +10V)
- Internal + 10V precision reference

Price (1-9) . . . . $66.00 to $88.00
depending on accuracy code

Models 849 and 877-69 Multiplying DACs



Models 849 and 877-69 are 13-bit resolution binary four-quadrant multiplying D-to-A converters that accept an external ac or dc reference.

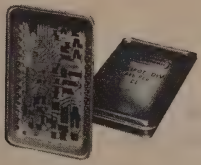
Model 849 utilizes serial data input (high threshold MOS) and provides 2 analog output phases (0 and 180° for ac references to 2.5 KHz).

Price (1-9) . . . . $155.00 to $185.00
depending on accuracy code

Model 877-69 accepts parallel DTL/TTL input data and reference frequencies to 10 KHz.

Price (1-9) . . . . $190.00 to $250.00
depending on accuracy code

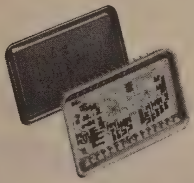
Series 848 11-Bit DACs



Series 848 is a complete 11-bit binary digital-to-analog converter with guaranteed monotonicity and accuracy levels. It offers 4 preset output ranges (0 to +5V, 0 to +10V, −5 to +5V and −10 to +10V), and features a slew rate of 4.0V/μsec min, and settling time of 0.25 μsec/volt +2 μsec. It is packaged in a hermetically sealed Kovar case and meets MIL-STD-883 requirements.

Price (1-9) . . . . $105.00 to $170.00
depending on accuracy code.

Series 876 11-Bit ADCs



Series 876 is an 11-bit DTL/TTL compatible, successive approximation A-to-D converter including the reference, ladder, comparator, and sequencing register. Series 876 provides serial and parallel output data corresponding to 4 preset input ranges (0 to +5V, 0 to +10V, −5 to +5V, and −10 to +10V), and operates with clock frequencies to 1 MHz.

Price (1-9) . . . . $176.00 to $300.00
depending on accuracy code.

Ladder Networks

Beckman Ladder Networks are miniature binary and BCD devices for use in digital to analog conversion applications requiring high accuracy and fast switching over a wide temperature range.

Model No.	Resolution	Standard "R" Values	Rsw Compensation	Best Standard Accuracy	Pricing 1-9
811 (Binary)	12-bit	5K, 10K, 20K	5Ω Bits 1-4	±122 ppm −55°C to +125°C	811-B12 $40.00
812 (Binary)	12-bit	50K, 100K	500Ω All Bits	±122 ppm −55°C to +125°C	812-B12 40.00
814 (Binary)	14-bit	10K	5Ω Bits 1-5	±30 ppm @ +25°C and ±61 ppm −20°C to +85°C	814-D14 90.00
815 (Binary)	8-bit	10K	None	±1952 ppm −55°C to +125°C	815 6.95
862 (BCD)	12-bit	50K, 100K	500Ω All Bits	±300 ppm −55°C to +125°C	862-B 49.50
813	10-bit	Binary network for Fairchild μA722			17.50
863	10-bit	BCD network for Fairchild μA722			19.25

For custom versions of these products or unique applications, call Microcircuit Application Engineering: (714) 871-4848, Ext. 3236.

Prices and specifications subject to change without notice.

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Beckman®

POWER AMPLIFIERS | ACTIVE FILTERS

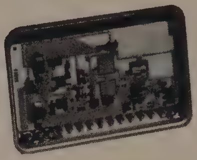
Models 821, 822, 823 and 866 Unity Gain Power Amplifiers

Model	±Supply Range	Output Max. Range	Minimum Load Resistance	Price (1-9)
821	10 - 20V	±16V	100Ω	$33.00
822	10 - 20V	±16V	50Ω	$38.50
823	10 - 30V	±26V	$\frac{30\ (E_O \text{ max.})}{E_{CC}-E_O \text{ max.}-1}$	$9.85
866	10 - 20V	±16V	50Ω	$44.00

Model 824 Gain-of-Three Power Amplifier

Model	±Supply Range	Output Max. Range	Minimum Load Resistance	Price (1-9)
824	18 - 30V	±27V	140Ω	$40.00

Model 825 High Speed, FET Input Op-Amp



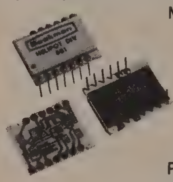
Model 825 is a high performance FET input, wideband operational amplifier featuring:

- 1,000 V/μs minimum slew rate
- 100 ns settling time (to 0.1%)
- 35 MHz SSBW (−6 dB/octave rolloff)
- 10 MHz full power BW
- $10^{11}\ \Omega \| 5$ pF input impedance
- ±100 mA output drive capability
- Complete thermal stability
- Hermetically sealed Kovar® package
- MIL-STD-883 environmental specifications

Price (1-9) $140.00

Model 881 Universal Active Filters

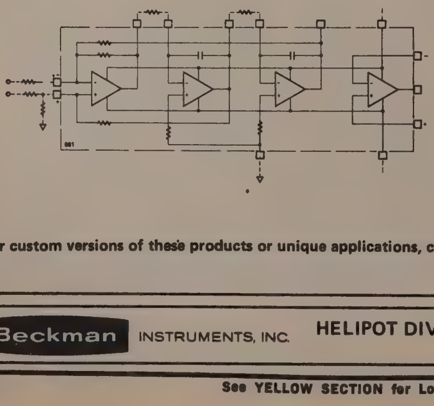
Model 881 is a two-pole, audio-frequency filter that can be used as a basic building block to generate virtually any complex filter function.



Model 881 features:

- Simultaneous high-pass, low-pass, and band-pass outputs
- Inverting, non-inverting or differential operation
- 10 KHz maximum operating frequency
- 0.5 to 50 adjustable Q range

Price (1-9) $20.00



Model 882 Touch-Tone* Frequency Band-Pass Active Filters

Beckman Series 882 Active Filters are pretuned, band-pass filters designed specifically for tone receiver applications where compatibility with standard Touch-Tone* frequencies is required. Series 882 Active Filters feature:

- Standard model Touch-Tone frequency settings of 697, 770, 852, 941, 1209, 1336, 1477, and 1633.
- ±0.5% f_o tolerance.
- ±0.01%/°C f_o temperature coefficient.
- Preset Q = 18 ±10% (6% BW).
- Filter design tunable over f_o range of 500 to 2,000 Hz, and Q range of 10 to 30.
- High input impedance and low output impedance.

Price (1-9) $12.00

*Touch-Tone is a registered trademark of American Telephone and Telegraph Company.

For custom versions of these products or unique applications, call Microcircuit Application Engineering: (714) 871-4848, Ext. 3236.

Prices and specifications subject to change without notice.

Beckman INSTRUMENTS, INC. **HELIPOT DIVISION** 2500 Harbor Boulevard, Fullerton, California 92634
(714) 871-4848 • TWX No. 910-592-1260

Beckman

DC VOLTAGE REGULATORS

Fixed Output Models	809	859	801	851	805	855
Output Voltage Range	+5 to +28V	−5 to −28V	+9 to +21V	−9 to −21V	+3 to +9	−3 to −9V
Max. Load Current	0.75		0.5 Amps			
DC Load Regulation	±0.003%/mA		±0.05%		±0.1%	
Oper. Temp. Range	−55°C to +125°C		−55°C to +125°C			
Reg. Power Dissipation T_A = +25°C T_A = +125°C T_C = +25°C T_C = +125°C	 1.6W 0.7W 4.0W 1.7W	 1.6W 0.7W 4.0W 1.7W	 1.8W 0.8W 5.0W 2.25W	 1.6W 0.7W 4.0W 1.7W	 1.8W 0.8W 5.0W 2.25W	 1.6W 0.7W 4.0W 1.7W
Min. Input Voltage	e_o + 2 Volts		e_o +4.0 Volts			
Max. Input Voltage	+40V DC	−40V DC	+40V DC	−40V DC	+40V DC	−40V DC
Max. Input Regulation for ±10% Input Voltage Change	±0.3%	±0.3%	±0.05%		±0.1%	
Standard Voltages Available (Example: Order Model 809-V5)	+5, +6, +9, +12, +15, +18, +21, +24, +28	−5, −6, −9, −12, −15, −18, −21, −24, −28	+9, +12, +15, +18, +21	−9, −12, −15, −18, −21	+5, +6,	−5, −6
Price (1-9 Qty.)	$9.85	$9.85	$33.00	$33.00	$33.00	$30.00

Fixed & Adjustable	High Performance — Fixed		Dual		Adjustable Models					
Models	828A	838A	843	844	802	852	804	854	806	856
Output Voltage Range	+5 to +30V	−5 to −30V	±12 to ±20V	±12 to ±20V	+9 to +12V	−9 to −12V	+20 to +32V	−20 to −32V	+3 to +9V	−3 to −9V
Max. Load Current	500mA		300mA		0.5 Amps					
DC Regulation — Line	±0.01%/V		±0.005%/V		±0.05% for ±10% Δe_i				±0.1% for ±10% Δe_i	
DC Regulation — Load	±0.01%		±0.005% NL/FL		±0.05% NL/FL				±0.1% NL/FL	
Oper. Temp. Range	−55°C to +125°C				−55°C to +125°C					
Reg. Power Dissipation T_A = +25°C T_A = +125°C T_C = +25°C T_C = +125°C	 1.8W 0.8W 5.0W 2.25W	 1.6W 0.7W 4.0W 1.7W	 — — 3.0W —	 — — 3.0W —	 1.8W 0.8W 5.0W 2.25W	 1.6W 0.7W 4.0W 1.7W	 1.8W 0.8W 5.0W 2.25W	 1.6W 0.7W 4.0W 1.7W	 1.8W 0.8W 5.0W 2.25W	 1.6W 0.7W 4.0W 1.7W
Min. Input Voltage	$\lvert e_o \rvert + 3.5 + I_L R_S$				$\lvert e_o \rvert$ + 4.0 Volts					
Max. Input Voltage	+45V	−45V	±45V	±45V	+40V	−40V	+40V	−40V	+40V	−40V
Max. Output Voltage Tolerance	±0.5%		±0.5% (±10 ppm/°C tracking)	±0.5%	—					
Standard Voltages Available (Example: Order 838A-V15)	+5, +6, +9, +12, +15	−5, −6, −9, −12, −15	±12, ±15	±12, ±15	Adjustable	Adjustable	Adjustable	Adjustable	Adjustable	Adjustable
Price (1-9 Qty.)	$55.00	$55.00	$32.00	$32.00	$38.50	$38.50	$38.50	$38.50	$38.50	$38.50

For custom versions of these products or unique applications, call Microcircuit Application Engineering: (714) 871-4848, Ext. 3236.

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CADDOCK
HIGH PERFORMANCE FILM RESISTORS

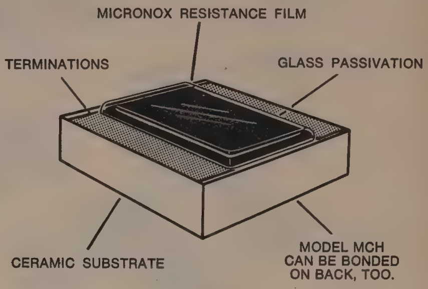
Type MC Precision Chip Resistors and High Resistance Precision Chip Resistors

Caddock introduces the Type MC Precision Chip Resistors — a new and complete line of precision chip resistors that meet the most stringent requirements of all types of hybrid circuits.

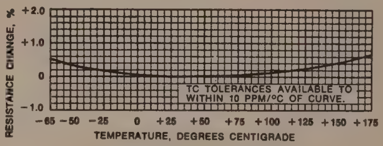
The latest advance in Caddock's 12 years of experience in the development and production of high performance film resistors, the Type MC Precision Chip Resistors utilize Micronox* complex oxide resistance films to provide all of these advantages:

- **Extended Resistance Range.**
  1 Megohm resistance values are now available in even the smallest of these chips, and the Model MCV Multi-Megohm Chip Resistors include resistance values up to 500 Megohms!
- **Precision Resistance Tolerances.**
  The standard resistance tolerance for all models and values is ±1%!
- **Higher Operating Temperatures.**
  +175°C maximum operating temperature is the standard specification for every model and all Type MC resistors can be operated without derating at +125°C!
- **Lower Temperature Coefficients.**
  TCs of 50 PPM/°C and 80 PPM/°C are standard over a 120°C operating temperature range.
- **Matched Temperature Coefficients.**
  TC tracking between any two chip resistors of any type, model and resistance value will stay within 40 PPM/°C over the temperature range from −15°C to +105°C.
- **Exceptional Stability.**
  The high stability of Caddock Micronox* resistance films keeps resistance shifts to a minimum under all thermal and environmental conditions.

There are four basic models to choose from, including chips for wire-bonding, solder reflow and a solderable design with wrap-around tinned terminals.



The typical TC curve shown in this graph illustrates the dish-shaped temperature characteristic of Micronox* resistance films. While the shape of this curve will vary slightly with the resistivity of the film, these resistance films provide a nearly 'zero' TC over a limited temperature range — a feature that can be the source of additional improvements in the stability of many electronic circuits.



For information on price and delivery of both production and evaluation quantities of any of the Type MC Precision Chip Resistors, contact the high performance film resistor specialists at Caddock.

Type MC Precision Chip Resistors are produced under carefully controlled manufacturing and test procedures.

Manufacturing Control.
Type MC Precision Chip Resistors, like all other Caddock High Performance Film Resistors, are produced under strict manufacturing controls with processes which include power conditioning, overvoltage conditioning and maximum temperature conditioning.

Quality Control.
Type MC Resistors receive quality surveillance which reaches from incoming raw materials to your packaged resistors in the shipping area. And our QC system has been approved for conformance to the requirements of NASA NPC200-3 and MIL-I-45208.

*Micronox is a registered trademark of Caddock Electronics, Inc.

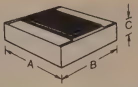
CADDOCK
ELECTRONICS, INCORPORATED
3127 CHICAGO AVENUE, RIVERSIDE, CALIFORNIA 92507 PHONE: (714) 683-5361 • TWX: 910-332-6108

Type MC Precision Chip Resistors and High Resistance Precision Chip Resistors

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

Type MCG and MCH for Wire-Bonding.

- Standard and High Resistance Ranges
- 175°C Maximum Operating Temperatures
- Power Ratings to .25 Watt

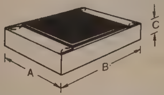


To order this type of chip with an electrically isolated gold backing for die-bonding, specify any of these Model Numbers as Type MCH.

	Model No.	Power Rating	Max. Voltage	Oper. Temp. (Max.)	TC ppm/°C†	Dimensions A ±.005	B ±.005	C ±.003	Resistance Range Min.	Max.
Standard Resistance Range	MCG 110	.1 W	50	175°C	50	.050	.050	.012	50Ω	40 K
	MCG 120	.2 W	100	175°C	50	.050	.100	.012	100Ω	50 K
	MCG 125	.25 W	150	175°C	50	.075	.150	.012	100Ω	100 K
High Resistance Range	MCG 210	.1 W	50	175°C	80	.050	.050	.012	40 K	1 Meg.
	MCG 220	.2 W	100	175°C	80	.050	.075	.012	50 K	2 Meg.
	MCG 225	.25 W	150	175°C	80	.075	.150	.012	100 K	5 Meg.

Type MCS for Solder Reflow.

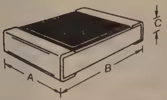
- Standard and High Resistance Ranges
- 175°C Maximum Operating Temperatures
- Power Ratings to .6 Watt
- Working Voltages to 400 Volts



	Model No.	Power Rating	Max. Voltage	Oper. Temp. (Max.)	TC ppm/°C†	Dimensions A ±.005	B ±.005	C♦ ±.003	Resistance Range Min.	Max.
Standard Resistance Range	MCS 325	.25 W	200	175°C	50	.075	.150	.012	100Ω	100 K
	MCS 330	.3 W	250	175°C	50	.100	.200	.012	100Ω	200 K
	MCS 340	.4 W	250	175°C	50	.150	.200	.027	75Ω	300 K
	MCS 350	.6 W	400	175°C	50	.200	.250	.027	75Ω	500 K
High Resistance Range	MCS 425	.25 W	200	175°C	80	.075	.150	.012	100 K	5 Meg.
	MCS 430	.3 W	250	175°C	80	.100	.200	.012	200 K	20 Meg.
	MCS 440	.4 W	250	175°C	80	.150	.200	.027	30 K	50 Meg.
	MCS 460	.6 W	400	175°C	80	.200	.250	.027	500 K	100 Meg.

Type MCW — Solderable with Wrap-Around Tinned Terminals

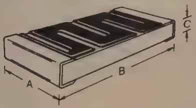
- Standard and High Resistance Ranges
- 175°C Maximum Operating Temperatures
- Power Ratings to .25 Watt



	Model No.	Power Rating	Max. Voltage	Oper. Temp. (Max.)	TC ppm/°C†	Dimensions A ±.005	B ±.005	C♦ ±.003	Resistance Range Min.	Max.
Standard Resistance Range	MCW 530	.3 W	250	175°C	50	.100	.200	.012	100Ω	200 K
	MCW 540	.4 W	250	175°C	50	.150	.200	.027	75Ω	300 K
	MCW 560	.6 W	400	175°C	50	.200	.250	.027	75Ω	500 K
High Resistance Range	MCW 630	.3 W	250	175°C	80	.100	.200	.012	200 K	20 Meg.
	MCW 640	.4 W	250	175°C	80	.150	.200	.027	30 K	50 Meg.
	MCW 660	.6 W	400	175°C	80	.200	.250	.027	500 K	100 Meg.

Type MCV — Multi-Megohm Chip Resistors

- Resistance Values from 1 Megohm to 500 Megohms!
- Maximum Working Voltages to 2000 Volts!
- Maximum Power Ratings to 1 Watt.
- 175° Maximum Operating Temperature
- Solderable with wrap-around tinned terminations.



	Model No.	Power Rating	Max. Voltage	Oper. Temp. (Max.)	TC ppm/°C†	Dimensions A ±.010	B ±.010	C♦ ±.005	Resistance Range Min.	Max.
Extended Resistance Range	MCV 770	.75 W	600	175°C	80	.25	.50	.027	1 Meg.	200 Meg.
	MCV 780	.8 W	1000	175°C	80	.25	.75	.027	1 Meg.	250 Meg.
	MCV 790	1.0 W	2000	175°C	80	.25	1.00	.027	1 Meg.	500 Meg.

SPECIFICATIONS

All Type MC Precision Chip Resistors

Resistance Tolerance: ±1% standard. Tolerances to ±0.1% on special order. (Tolerances less than ±1% will have organic passivation.)

Operating Temperature: −55°C to maximum specified temperature.

TC Tracking: 40 PPM/°C maximum between any resistor model and any resistance value. (Ref. 25°C, ΔR taken over range from −15°C and +105°C)

Short Time Overload: 5 times rated power or 1.5 times maximum allowable working voltage, whichever gives the lower power, for 5 seconds. Maximum ΔR .5%.

High Temperature Exposure: R Shift .5% max.*

Resistance to Bonding or Solder Exposure: R Shift .25% max.*

Moisture Resistance: R Shift .5% max.*

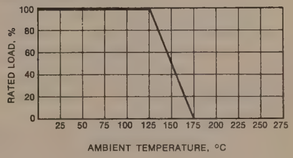
1000 Hour Load Life: R Shift .5% max. when mounted on a heat sink which maintains surface temperature within maximum range.

†Temperature Coefficient: Referenced to 25°C, ΔR taken at −15°C and +105°C.

♦ Dimension does not include thickness of solder deposit.

* Test parameters per applicable portions of Mil-R-55342

DERATING CURVE



Complete information on all types of Caddock High Performance Film Resistors is included on pages 2•1428 through 2•1443 of Volume 2 of EEM.

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CADDOCK
HIGH PERFORMANCE FILM RESISTORS

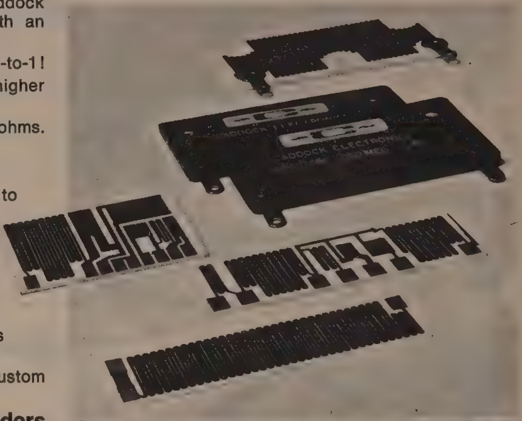
Custom Resistive Devices

For the ultimate in resistor network performance, Caddock produces many types of custom resistive networks with an unsurpassed combination of advantages:

- **High Resistance Ratios**—from 1-to-1 up to 1,000,000-to-1!
- **High Transient Handling Capability**—up to 100 times higher than the rated power level!
- **Extended Resistance Range**—from 1 ohm to 5000 Megohms.
- **Tight Resistance Tolerances**—to 0.05%.
- **Tight Ratio Tolerances**—to 0.025%.
- **Close Ratio Tracking** — to 5 PPM/°C from −15°C to +105°C.
- **Exceptional Resistor Stability** — as close as 0.01% per 1000 hours in extended life.

This combination of advantages in one resistor network often provides a practical — **and immediate** — means for improving the performance and specifications of electronic circuitry and equipment without any changes in the design!

Here are examples of the many high performance custom resistive networks available from Caddock Electronics:



Multimeter and Oscilloscope Input Signal Dividers

Precision voltage dividers with ratios as high as 1,000,000-to-1 are often required for range switching at the input of laboratory instruments. For these applications, Caddock produces single-chip networks with resistance ratios accurate to 0.025% and with the temperature coefficients matched to within 5 PPM/°C over the normal operating temperature range.

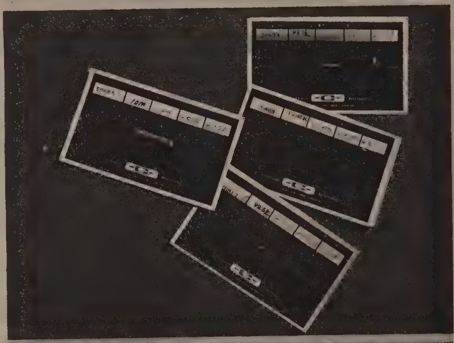
R-C Networks

A wide range of capacitance values can be combined with our precision resistors on a single chip. These high stability capacitors may be isolated from the other components on the chip or combined in R-C functions to meet your requirements.

Matched Resistor Sets

Sets of matched resistors with ratios held as close as 0.05% over the range of ratios from 1:1 to 1:100,000 provide solutions to the toughest accuracy problems in voltage dividers, reference networks, feedback networks, current summing networks, and high voltage divider networks. Virtually **all** of the various types of Caddock Film Resistors can be matched in discrete resistor sets for both tight ratio tolerances and TC tracking — some as tight as 2 PPM/°C over specific temperature ranges — making it practical to select **and intermix** the particular type of resistors needed to meet other important performance requirements.

These matched sets and networks can also be assembled in molded packages or DIP configurations, and in special shapes to meet your design requirements.



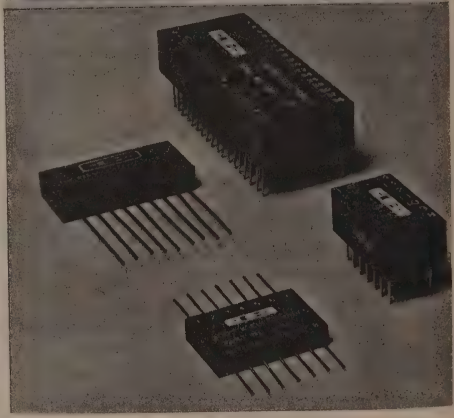
DAC Ladder Networks

Networks with resolution up to 12 binary bits can be produced, and the superior long-term stability of Micronox™ resistance films keeps accuracy higher for longer, more error-free operation of advanced digital systems.

Precision High Voltage Divider Networks

Special packages are available for discrete resistor sets, and flat ceramic substrates provide low profile configurations with integral mounting holes.

TC 'tracking' as close as 2 PPM/°C can be provided, and special encapsulation techniques meet rugged environmental limits.



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3127 CHICAGO AVENUE, RIVERSIDE, CALIFORNIA 92507 PHONE: (714) 683-5361 • TWX: 910-332-6108

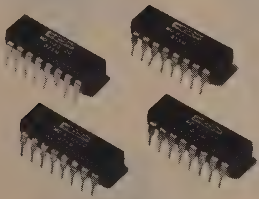
Precision Resistor Networks in DIP and SIP Packages

CADDOCK
HIGH PERFORMANCE FILM RESISTORS

The exceptionally high performance of Caddock Micronox* resistance films is now available in many standard DIP and SIP resistor packages that provide a unique combination of advantages:

- Tight Tolerances.
- Tight Resistance Ratios.
- Lower Temperature Coefficients.
- Matched TC Ratios.
- Extended Resistance Range.
- Excellent Transient Handling Capability.
- Outstanding Load-Life Stability.

These advantages make Caddock DIP and SIP Precision Resistor Networks the ideal choice for many high accuracy analog and digital circuits, including —

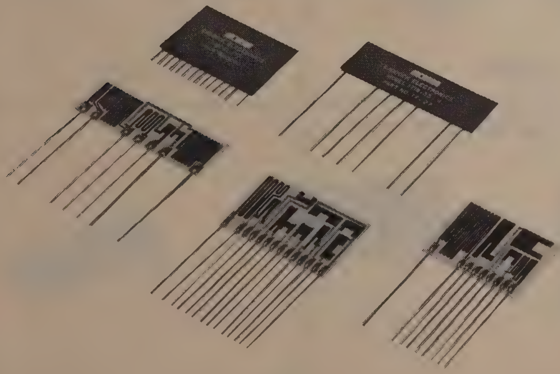


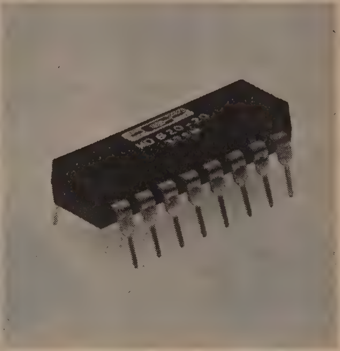
- Precision voltage dividers for multi-range instruments.
- Precision resistor ratios for accurate amplifier gain control.
- Feedback networks for precision power supplies.
- Custom ladder networks for precision D/A and A/D conversion circuits.

The DIP packages are available in all of the standard 14, 16 and 18 pin configurations. SIP packages are available in a wide variety of shapes and sizes to fit the requirements of each application, with standard or custom lead spacings and lengths.

For complete information on the high performance precision resistor network for your application, please call or write directly to the applications engineers at Caddock Electronics.

*Micronox is a registered trademark of Caddock Electronics, Inc.





14, 16 and 18 Pin DIP Packages and Standard and Custom SIP Packages

Resistance Range: 10 ohms to 10 Megohms in standard DIP packages. 1 ohm to 50 Megohms in SIP packages.

Number of Resistors per Package: Up to 36 resistors, depending upon interconnections.

Tolerance: ±0.5% and ±1.0% (Tolerances to ±0.1% on special order.)

Absolute Temperature Coefficient: ±50 PPM/°C for values up to 1 Megohm.§ ±80 PPM/°C for values above 1 Megohm.§

Ratio Tolerance: ±0.1%, ±0.25% or ±0.5%, as specified.

Ratio Temperature Coefficient: 40 PPM/°C.§ Special TCs to 5 PPM/°C.§

Power Rating: Up to 1 watt per resistor. Up to 2 watts per package.

Overload: 2.5 times rated voltage for 5 seconds. R shift .25% max.

Voltage Coefficient: To 0.1 PPM/volt when required.

Voltage Rating: 150 volts per resistor or 150 volts between adjacent pins.

Mechanical Configurations: DIP packages are molded of flame-proof high temperature materials and conform to mechanical outline requirements of Mil-R-83401B.

SIP packages include molded or conformal encapsulation and provide lead spacings of .100″, .125″, .150″ and .172″ as specified.

SIP package height is typically .300″ or .500″.

§ Temperature Coefficient: Referenced to 25°C, ΔR taken at −15°C and +105°C.

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CTS MICROELECTRONICS, INC.

SUBSIDIARY OF CTS CORPORATION, ELKHART, INDIANA

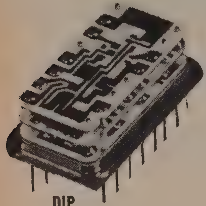
TOTAL CAPABILITY IN HYBRID CIRCUITRY

ACTIVE HYBRID CIRCUITS

- Over 11 years volume experience in active hybrids
- Skilled technical team available to convert your circuit to hybrid form
- Package flexibility — Hi Rel hermetic sealed or commercial grade packaging
- Multilayer capability . . . multilayer conductors can be used to provide the highest circuit density available
- Prototype and production facilities offer fast turn around per your requirements

CHIP AND WIRE CIRCUITRY

HERMETIC SEALED PACKAGES FOR HI REL APPLICATIONS

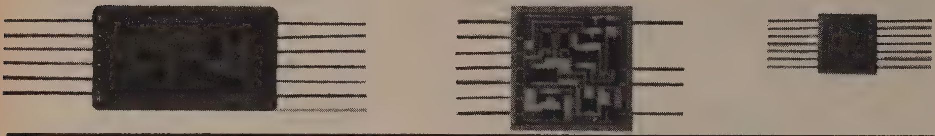

DIP

PLATFORM

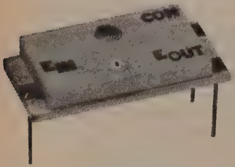
TO-5

TO-8

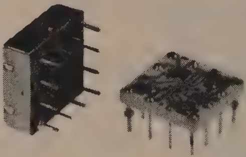
FLAT PACKS



PACKAGING FOR INDUSTRIAL AND COMMERCIAL APPLICATIONS

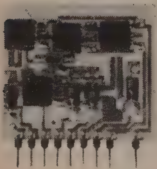


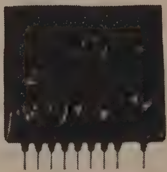
CERAMIC SHELL

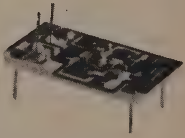

880 SERIES

DIP COATING

DISCRETE COMPONENTS CIRCUITRY







For solid cermet resistors, resistor networks, resistor capacitor networks, or resistor trimmer networks, see pg. **2•1421** in EEM. EEM.

CTS MICROELECTRONICS, INC.,
P.O. Box 1278 Dept. E
Lafayette, Indiana 47902
Phone: (317) 463-2565
TWX: 810-342-1882

For custom hybrid applications, contact your CTS Representative (listed under CTS in the yellow pages) or contact: **CTS MICROELECTRONICS, INC.**, P.O. Box 1278, Dept. E, Lafayette, Indiana 47902, or call and ask for Charles Sparks at (317) 463-2565 • TWX 810-342-1882

CUSTOM, HIGH PERFORMANCE MOS

Low-voltage CMOS and high-speed PMOS. Built by the people who introduced ion implantation to MOS processing technology.

CMOS

- Low operating voltage—down to one volt.
- Complex, high density circuits—no channel stoppers.
- Low, matched and selectible threshold voltages—as low as 0.5 volts on both N and P channels.
- Tight threshold voltage control—within ±0.2 volts.

PMOS

- High-speed at low power—low capacitance through zero gate overlap—example, 10 MHz shift register at 200 μW per bit.
- Single power supply—operating voltage as low as 3 volts with ion implanted resistors.
- High circuit density—advanced photolithographic technology.

PLUS...

- Full silicon nitride passivation plus overglass protection.
- TTL/DTL compatibility.
- Full MIL STD temperature range.
- 100% screening to MIL STD 883.

If our custom capability can serve your high performance requirements, contact us at the following address:
Hughes Aircraft Company, Microelectronic Products Division, 500 Superior Avenue,
Newport Beach, CA 92663
Telephone: (714) 548-0671.

HUGHES
HUGHES AIRCRAFT COMPANY
MICROELECTRONIC
PRODUCTS DIVISION

Hughes Industrial Electronic Products

Custom Hybrids

Special Processes

- MIL-STD-883, Class A & B.
- Thin & Thick Film
- Thermal Compression, Ultrasonic, Epoxy and Eutectic Bonding

Special Equipment

- Evaporation & Sputtering (Nickel-Chromium, Tantalum Nitride, Aluminum and Gold)
- Computerized Laser Trimmers
- Environmental Test Equipment (Centifuge; Fine & Gross Leak; Thermal Shock; Thermal Cycle, etc.

Custom Circuit Applications

- Navigation Guidance and Control Systems
- Radar and Electronic Warfare Systems
- Communications Systems & Equipment
- Biomedical Electronics & Equipment
- Industrial Controls & Systems

Thinking custom hybrids? Hybrid Systems offers the packaging expertise and engineering know-how that put it all together.

We specialize in the design and manufacture of custom hybrids that combine reliability and temperature stability with real savings in cost, size and weight. This means fewer interconnections and reductions in parasitic reactances. And it means products manufactured to the requirements of MIL-STD-883, Class A & B, and other exacting standards of quality.

Hybrid Systems' custom hybrid assemblies come in encapsulated modules, dual-in-line plastic and ceramic packages, hermetic TO cans, flat-packs, platform cases, and other packages suitable for chip and wire technology. Our work in functional modules has produced a library of proven designs for all types of custom circuits.

State-of-the-art thin and thick-film processes, thermal compression, ultrasonic, epoxy and eutectic bonding techniques and many package sealing methods are utilized. Depending upon the required performance and packaging, these circuits use thin-film nickel-chromium resistor networks deposited on silicon which have excellent TCR (better than 50PPM/°C), tracking (1PPM/°C typical), stability (0.1% @ 125°C), and appropriate power ratings. Tantalum nitride resistor films of similarly high quality and reliability are available.

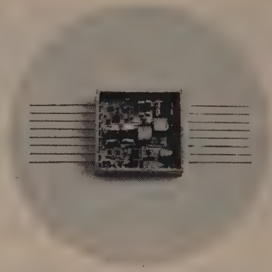
Thick-film capabilities include fine line conductor patterns with very low resistance; multilayers; and resistor patterns compatible with such assembly processes as eutectic or epoxy semiconductor bonding, capacitor brazing or soldering, gold or aluminum wire bonding, and lead frame attachments. Resistors feature absolute TCR (better than 100PPM/°C), tracking (15PPM/°C), stability (0.3% @ 125°C) and tolerance (up to 0.2%).

Rigid quality control programs are maintained to assure components are made to high-reliability standards and specifications at all phases of production. Hybrid Systems' is qualified to meet the requirements of MIL-STD-883, Class A and B, MIL-M-38510A, MIL-Q-9858A, NPC-200-3, and MIL-E-5400N.

It all adds up to the best, most efficient, most economical custom hybrid packaging available anywhere. You just supply the input and the output: we'll do the rest.

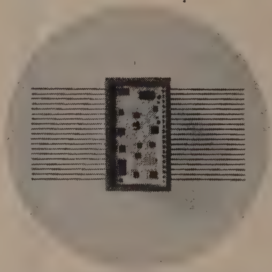
SEE OTHER HYBRID SYSTEMS LISTINGS IN SECTIONS 2000 AND 4700.

Multipower Regulator



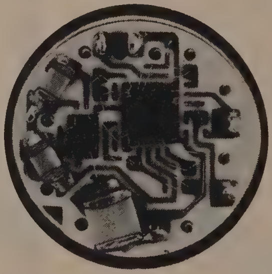
Actively trimmed power source performs voltage regulation, current limiting and filtering.

Multichannel Preamplifier



Low-noise precision amplifier in a high density package for high reliability airborne applications.

Oscillator



A combination of thin-film/thick-film components with discrete semiconductor and capacitor chips.

Hybrid Systems CORPORATION **Burlington, Massachusetts 01803**

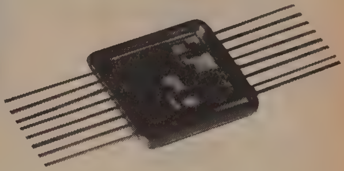
(617) 272-1522
TWX 710-332-7584

INTEGRATED CIRCUITS INCORPORATED

iCi

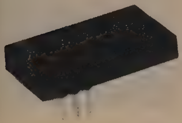
13256 NORTHRUP WAY
BELLEVUE, WASHINGTON 98005
TELEPHONE: (206) 747-8556

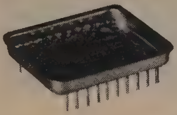
CUSTOM THICK FILM HYBRIDS

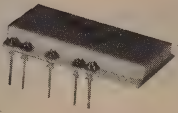


Broad capability in commercial, industrial, and military applications offering:

- Total design services
- Processing per MIL-STD-883 and MIL-M-38510
- Multi-layer capability
- Full range of packaging methods





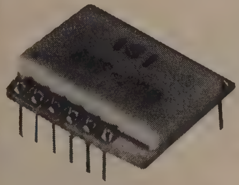


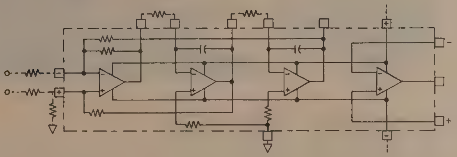
Specific experience in:

- Power conversion and regulator devices
- Active filters
- Amplifiers and preamplifiers
- Signal conditioning electronics
- Sample and hold circuits
- D/A converters
- Timing devices
- Digital devices

MODEL SVF 200
STATE VARIABLE ACTIVE FILTER

Model SVF 200 is a two-pole audio-frequency filter that can be used as a basic building block to generate virtually any complex filter function. The SVF 200 may be adjusted using external resistors, to provide Butterworth, Chebyshev, Cauer parameter and other functions.





MODEL SVF 200 FEATURES:

- Short circuit output current limiting
- Simultaneous bandpass, lowpass, and highpass outputs.
- Independent bandwidth, frequency, and gain adjustments.
- Constant bandwidth and constant Q tuning modes.
- Additional 'free' compensated amplifier for odd pole isolation, gain or feed forward element.

Price (1-9) $24.00

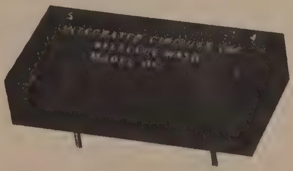
DC-DC CONVERTERS

GENERAL DESCRIPTION:

ICI's Model DC-200 series are dual output 6.0 watt high efficiency DC to DC converters designed to provide isolated positive and negative DC voltage outputs at current ratings of 200 milliamperes from each output. The devices are also capable of single ended outputs equal to twice the nominal dual output.

- 6.0 watts output over full operating temperature range.
- 200 ma. from each output.
- Input/output isolation — 100 meg. Ω min. at 500 VDC.
- Operates in non-saturating switching mode.
- No additional heat sinking required.
- High efficiency — typically 83% at rated load.

Price (1-9) $42.00



STANDARD 6.0 WATT CONVERTER MODEL AVAILABLE

Model	Nom. Input	Nom. Output
DC-200	28 VDC	±15 VDC
DC-201	5 VDC	±15 VDC
DC-202	28 VDC	±18 VDC
DC-203	28 VDC	± 5 VDC
DC-204	48 VDC	±15 VDC
DC-205	48 VDC	+ 5 VDC
DC-209	12 VDC	+ 5 VDC
DC-211	12 VDC	±12 VDC
DC-213	5 VDC	±12 VDC

SEE PAGE 1•1236 FOR ADDITIONAL MODELS AND INFORMATION

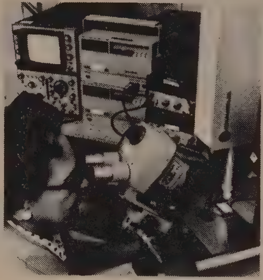
NEC
microsystems
CUSTOM HYBRIDS

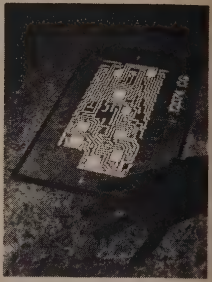
CAPABILITIES

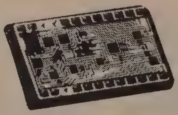
NEC Microsystems designs, develops and produces custom thick film hybrid microcircuits for many different customers and for a great variety of applications. This Division of North Electric is totally dedicated to serving the hybrid marketplace and has more than five years experience in this technology.

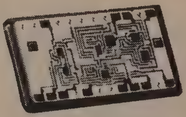
Although greatest emphasis is in telecommunications applications (telephony, "pocket pager" radios, etc.) current products range from simple relay drivers to pulse generators for demand cardiac pacemakers. The division is experienced in commercial and military applications.

Producing a custom hybrid from a conventional (discrete component) design should be a smooth, orderly transition. Cooperation between customer and vendor will assure a successful program. NEC Microsystems provides full cooperation and open communication in striving to make each new development a success.









FACILITIES

Modern and fully equipped design and development facilities are located in Fort Lauderdale, Florida. All phases of circuit design, photoreduction, screen fabrication, thick film substrate production, circuit assembly and packaging are performed at this plant. Assembly areas are air-conditioned and humidity controlled. The following types of equipment are utilized:

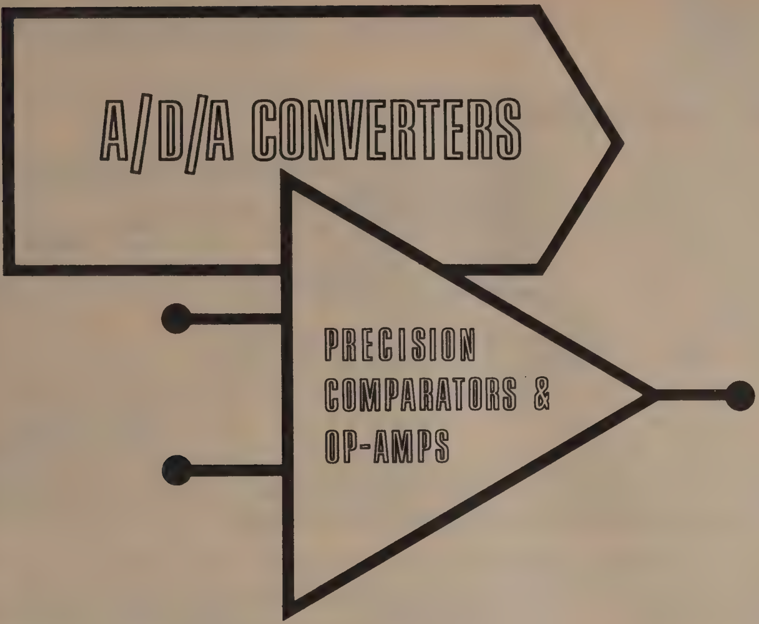
Photoreduction	Borrowdale Future Foto Camera 20 to 1 capability
Screen Fabrication	NuArc Platemaker, Precision Screen Frames
Thick Film Production	One AMI, One Presco, Three Weltek Precision Screen Printers One Thermco, Two BTU Belt Furnaces
Resistor Trim	One Teradyne, One Micronetics Computer Controlled High Speed Laser Trimmer One Apollo Laser Active Trim Station One S. S. White Air Abrasive Trimmer
Die Attach	K & S Eutectic Bonders Ewald Eutectic Bonders Laurier Silver Epoxy Bonders
Wire Bond	K & S Ultrasonic Machines, Aluminum and Gold Wire
Pin Swaging	Presco Swaging Machines
Lead Frame Attach	Unitek Solder Reflow Machines and Solder Dip Equipment
Capacitor Attach	Laurier Silver Epoxy Attach; Solder Reflow (Unitek, Ewald)
Substrate Solder Repair	Custom Made Hot Air Reflow Machines
Sealing	One Taylor-Winfield 75 KVA, One Taylor-Winfield 100 KVA Welder. Dry Line, Moisture Monitor, Bakeout, Backfill Capability
Encapsulation	Various Custom Plastic Shells, Dispensers, Curing Ovens, Plastic Coating Baths, Etc.
Leak Test	VEECO MS9AB Helium Tracer
Circuit Test	Substrate Probers, Special Test Interface Boxes. Bircher Tester, Many Standard Laboratory Oscilloscopes, DVM's, Power Supplies, Counters, Waveform Generators, Distortion Analyzers, Etc.
Wafer Scribe	Tempress Scriber
Die Probe	Siliconix Prober
Inspection	Metallurgical and Standard Binocular Microscopes
Environmental	Four Statham Hot/Cold Chambers. Other Environmental Testing Subcontracted
Pull Test (Wirebonds)	Microtech Calibrated Pull Tester

OFFSHORE FACILITY

Competitive pricing is always an important criterion in any production contract. In order to assure low costs, NEC Microsystems has carefully developed an offshore production facility which is capable of high volume, high quality assembly. After circuit development is complete and initial production has been stabilized in Fort Lauderdale's pilot line, detailed processing instructions and component parts are furnished to the offshore facility. Finished circuits are returned to the U. S. for final inspection, testing and branding. A system of checks and balances, as well as supervision and training by U. S. personnel, assures continued high quality. The facility is staffed with professional, technical, and supervisory personnel and is equipped with modern assembly equipment of U. S. manufacture.

NEC MICROSYSTEMS
DIVISION OF NORTH ELECTRIC
A UNITED TELECOM COMPANY

1150 N.W. 70th Street/Fort Lauderdale, Florida 33309
Phone 305-974-5400/TWX 510-956-9897



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PMI PRECISION MONOLITHICS INCORPORATED

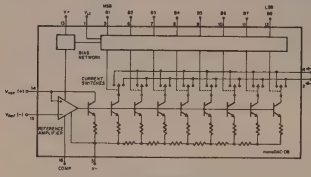
1500 SPACE PARK DRIVE, SANTA CLARA, CAL. 95050 408-246-9222 TWX: 910-338-0528 CABLE: MONO

PMI PRECISION MONOLITHICS INCORPORATED

1500 SPACE PARK DRIVE, SANTA CLARA, CALIFORNIA 95050
TEL. (408) 246-9222 • TWX 910-338-0528 • CABLE MONO

INDUSTRY'S BROADEST LINE OF MONOLITHIC D/A CONVERTERS

monoDAC-08 — 8 BIT HIGH SPEED MULTIPLYING DAC



monoDAC-08
HIGH SPEED MULTIPLYING D/A CONVERTER

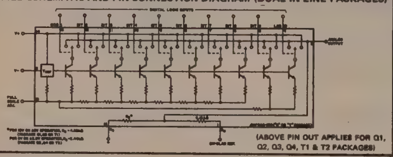
FASTEST, MOST FLEXIBLE MONOLITHIC DAC MADE!

- 85 nsec SETTLING TIME ....LOW COST
- FULL SCALE CURRENT PREMATCHED TO ±1 LSB
- DIRECT INTERFACE TO TTL, CMOS, ECL, HTL, PMOS
- ±4.5 to ±18V SUPPLIES ....33mW @ ±5V
- HIGH OUTPUT COMPLIANCE ....−10 TO +18V
- TRUE AND COMPLEMENTED OUTPUTS
- WIDE RANGE MULTIPLYING CAPABILITY

	Temp Range (°C)	Monotonicity Over Temp (BITS)	Max Linearity Over Temp (%)	Settling Time (nsec)	
monoDAC-08AZ	−55/+125	8	0.1	85	All monoDAC-08 devices are packaged in a hermetic 16 pin Dip.
monoDAC-08Z	−55/+125	8	0.19	100	
monoDAC-08EZ	0/+70	8	0.19	100	
monoDAC-08CZ	0/+70	8	0.39	100	

aimDAC-100 — 8 & 10 BIT COMPLETE CURRENT-OUTPUT DAC

SIMPLIFIED SCHEMATIC AND PIN CONNECTION DIAGRAM (DUAL-IN-LINE PACKAGES)



(ABOVE PIN OUT APPLIES FOR Q1, Q2, Q3, Q4, T1 & T2 PACKAGES)

INDUSTRY'S BEST SELLER — WIDE CHOICE OF SPECIFICATIONS

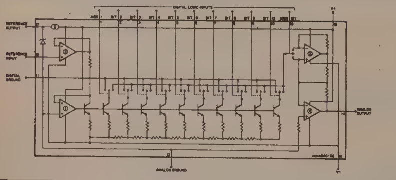
- INTERNAL REFERENCE ....CHOICE OF TEMPCOS TO 15PPM/°C
- LINEARITIES TO 0.05% MAX OVER TEMP RANGE
- FAST SETTLING ....225 nsec (8 BITS) 375 nsec (10 BITS)
- COMPACT ....16 PIN DIP OR 24 PIN FLAT PACK
- −55/+125°C UNITS FULLY PROCESSED TO 38510/LEVEL B
- LOW COST "T" SERIES MODELS FOR TOP VALUE
- ±6 TO ±18V SUPPLIES ....80mW @ ±6V

	Temp Range/Package Option Suffix				Max Linearity over Temp (%)	Max Tempco (ppm/°C)	Max Settling Time to Linearity Spec (nsec)
	−55/+125°C	−25/+85°C	0/+70°C Hermetic	0/+70°C Standard			
aimDAC-100AA	—	Q1,N1	—	—	.05	15	375
aimDAC-100AC	Q5*	Q1,N1	Q3	T1,T2	.05	60	375
aimDAC-100AD	—	Q1,N1	—	—	.05	120	375
aimDAC-100BA	—	Q1,N1	—	—	0.1	15	300
aimDAC-100BB	Q5*	Q1,N1	—	—	0.1	30	300
aimDAC-100BC	Q5*	Q1,N1	Q3	T1,T2	0.1	60	300
aimDAC-100CC	Q5*	Q1,N1	Q3	T1,T2	0.2	60	225
aimDAC-100DD	—	Q1,N1	Q3	T1,T2	0.3	120	200

Note: *Q5 Option includes complete MIL-38510/Level B processings Q5, Q1, Q3 and T1 devices include internal feedback resistors for 10 Volt output swing operation; T2 devices are configured for 5 Volt output swing; N1 devices incorporate both 10V and 5V output swing capability.
Q1, Q3, Q5: 16 pin Hermetic Dip; T1, T2: 16 pin Standard Dip; N1: 24 pin Hermetic Flatpack.

monoDAC-02 — 10 BIT PLUS SIGN D/A CONVERTER

SIMPLIFIED SCHEMATIC AND PIN CONNECTION DIAGRAM



UNIQUE SIGN/MAGNITUDE CODING

- 11-BIT RESOLUTION ....±10V, ±5V OUTPUTS
- COMPLETE WITH REFERENCE AND OP AMP
- MONOTONICITY GUARANTEED OVER 0/70°C
- ±12 TO ±18V SUPPLIES ....1.5μsec SETTLING
- FLEXIBLE ....EXTERNAL REFERENCE CAPABILITY
- COMPACT ....18 PIN DIP PACKAGE
- EXCELLENT IN COMMUNICATION & AUDIO APPLICATIONS

	Output Voltage Option Suffix		Resolution (BITS)	Montonicity (BITS) (0 to 70°C)	Max Linearity (0 to 70°C)	Max Full Scale Tempco (ppm/°C)
	±10V	±5V				
monoDAC-02AC	U1	U2	10 + Sign	10	0.1%	60
monoDAC-02BC	U1	U2	10 + Sign	9	0.1%	60
monoDAC-02CC	U1	U2	10 + Sign	8	0.2%	60
monoDAC-02DD	U1	U2	10 + Sign	7	0.4%	150

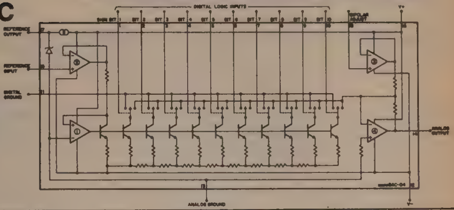
PMI PRECISION MONOLITHICS
INCORPORATED
1500 SPACE PARK DRIVE, SANTA CLARA, CALIFORNIA 95050
TEL. (408) 246-9222 • TWX 910-338-0528 • CABLE MONO

monoDAC-04—10 BIT TWO'S COMPLEMENT DAC

POPULAR TWO'S COMPLEMENT DIGITAL CODING

- COMPLETE WITH REFERENCE AND OP AMP
- COMPACT ....18 PIN DIP PACKAGE
- STABLE ....60 PPM/°C MAX TEMPCO
- STANDARD SUPPLIES ....±12 TO ±18V
- LOW POWER CONSUMPTION ....300mW MAX
- MONOTONICITY GUARANTEED ....0 TO 70°C
- DATA-LOGGING AND CONTROL APPLICATIONS

SIMPLIFIED SCHEMATIC AND PIN CONNECTION DIAGRAM


DIGITAL LOGIC INPUTS
SIGN BIT
BIPOLAR ADJUST
V+
REFERENCE OUTPUT
REFERENCE INPUT
DIGITAL GROUND
ANALOG OUTPUT
ANALOG GROUND
V-
monoDAC-04

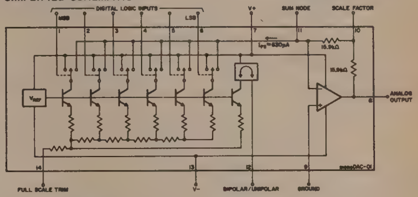
	Resolution (BITS)	Monotonicity (BITS) 0 to 70°C	Max Linearity 0 to 70°C	Max Full Scale Tempco (ppm/°C)	Output Voltage (V)
monoDAC-04-ACU2	10	10	0.1%	60	±5
monoDAC-04-BCU2	10	9	0.1%	60	±5
monoDAC-04-CCU2	10	8	0.2%	60	±5
monoDAC-04-DDU2	10	7	0.4%	150	±5

monoDAC-01 — 6 BIT COMPLETE DAC

COMPACT, EASY-TO-USE D/A CONVERTER

- INCLUDES REFERENCE AND OP AMP
- 14 PIN DIP OR FLATPACK
- PIN-SELECTED OUTPUTS ....+10, ±10, ±5V
- STANDARD SUPPLIES ....±12 TO ±18V
- −55/+125°C AND 0/70° MODELS
- 3 MICROSECOND SETTLING TIME

SIMPLIFIED SCHEMATIC


DIGITAL LOGIC INPUTS
MSB
LSB
V+
SUM NODE
SCALE FACTOR
IFS≈630μA
15.9kΩ
15.9kΩ
VREF
ANALOG OUTPUT
FULL SCALE TRIM
V-
BIPOLAR/UNIPOLAR
GROUND
monoDAC-01

	Package Options			Temp Range (°C)	Max. Linearity Over Temp (%)	Max. FS Tempco (ppm/°C)	Bipolar Output Option
	14 Pin Hermetic Dip	14 pin Flatpack	14 pin Standard Dip				
monoDAC-01A	P	M	—	−55/+125	.30	40	Yes
monoDAC-01	P	M	—	−55/+125	.45	80	Yes
monoDAC-01 B	P	M	—	−55/+125	.45	120	Yes
monoDAC-01 F	P	M	—	−55/+125	.45	80	No
monoDAC-01 C	P	—	S	0/70	.45	160	Yes
monoDAC-01 H	P	—	S	0/70	.45	160	No

SSS 1508A/1408A
8 BIT MULTIPLYING DAC

PMI'S IMPROVED VERSION OF THE MC1508/1408 SERIES

- FASTER SETTLING — 250 nsec
- LOWER POWER CONSUMPTION — 157 mW

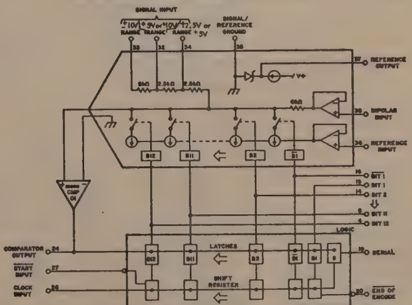
	Temp Range	Linearity
SSS 1508A-8Z	−55/+125°C	0.19%
SSS 1408A-8Z	0/70°C	0.19%
SSS 1408A-7Z	0/70°C	0.39%
SSS 1408A-6Z	0/70°C	0.78%

monoAD-124
8-12 BIT ANALOG-TO-DIGITAL CONVERTER

COMPLETE A/D IN A SINGLE DIP PACKAGE

- FAST SUCCESSIVE-APPROXIMATION ENCODING
- PIN-SELECTABLE RANGES ....±10, ±5, ±2.5V
- ENCODES 10 BITS IN 14 MICROSECONDS
- PARALLEL AND SERIAL OUTPUTS
- .625″ × 2.000″ 40 PIN DIP PACKAGE
- ±15, +5V SUPPLIES ....500 mW Pd
- LINEARITY OPTIONS: 0.1 AND 0.2%
- TEMPCO OPTIONS: 60 AND 120 PPM/°C

monoAD-124 SUCCESSIVE APPROXIMATION A/D CONVERTER


SIGNAL INPUT
±10V RANGE
±5V or 10V RANGE
±2.5V or +5V RANGE
SIGNAL/REFERENCE GROUND
REFERENCE OUTPUT
BIPOLAR INPUT
REFERENCE INPUT
BIT 1
BIT 2
BIT N
BIT 12
LOGIC
LATCHES
SERIAL
SHIFT REGISTER
END OF ENCODE
COMPARATOR OUTPUT
START INPUT
CLOCK INPUT

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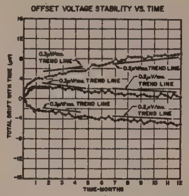
PRECISION OPERATIONAL AMPLIFIERS & VOLTAGE COMPARATORS

monoOP-07 ULTRA-LOW OFFSET VOLTAGE OP AMPS



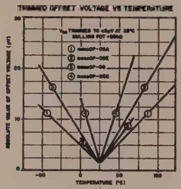
CHOPPER PERFORMANCE AT BIPOLAR PRICES!

- NO CHOPPERS OR CHOPPER NOISE
- ULTRA-LOW Vos 10μV
- ULTRA STABLE vs TIME 0.2μV/MONTH
- ELIMINATES NEED FOR ADJUSTMENT POTS
- TRUE DIFFERENTIAL INPUT ....CMRR 126dB
- NO EXTERNAL COMPONENTS REQUIRED
- FITS 725, 108A/308A, 741 SOCKETS

	Temp Range (°C)	Max Vos (μV)	Max TC V_{os} (μV/°C)	I_B Max (na)	Min CMRR (dB)	Min Gain (×10³)	Max TCI_B (PA/°C)
monoOP-07A	−55/+125	25	0.6	2.0	110	300	25
monoOP-07	−55/+125	75	1.3	3.0	110	200	50
monoOP-07E	0/70	75	1.3	4.0	106	200	35
monoOP-07C	0/70	150	1.8	7.0	100	120	50

8 Pin TO -99 Package: add suffix J; 14 Pin Hermetic Dip: add suffix Y.

monoOP-05 — LOW NOISE, LOW DRIFT OP AMPS



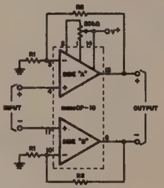
- OFFSET VOLTAGE DRIFT TO 0.5μV/°C MAX
- NOISE VOLTAGE TO 0.6μV P-P MAX
- LOW BIAS CURRENT ....TO 2nA MAX
- INPUT RESISTANCE ....30MEGΩ MIN
- HIGH COMMON MODE REJECTION ....TO 114 dB MIN
- HIGH POWER SUPPLY REJECTION ....TO 110 dB MIN
- MAXIMUM PERFORMANCE AT LOW COST

	Temp Range (°C)	Max Vos @ 25°C (mV)	Max TCVos (Nulled) (μV/°C)	Max I_B (nA)	Min CMRR (dB)	Min PSRR (dB)	Max Noise Voltage @ 10Hz (nV/√Hz)
monoOP-05A	−55/+125	0.15	0.5	2.0	114	100	18.0
monoOP-05	−55/+125	0.5	1.0	3.0	114	100	18.0
monoOP-05E	0/70	0.5	0.6	4.0	110	94	18.0
monoOP-05C	0/70	1.3	1.5	7.0	100	90	20.0

8 Pin TO -99 Package: add suffix J; 14 Pin Hermetic Dip: add suffix Y; 10 Pin Flatpack: add suffix L.

monoOP-10 — DUAL MATCHED INSTRUMENT OP AMPS

HIGH INPUT IMPEDANCE
DIFFERENTIAL-IN
DIFFERENTIAL-OUT
AMPLIFIER



DUAL OP AMPS WITH FANTASTIC MATCHING!

- EXCEPTIONAL ΔVos MATCHING
- EXCELLENT TCΔVos TRACKING OVER TEMP
- MATCHED CMRR FOR BEST COMMON MODE REJECTION
- MATCHED Ios+, Ios−, PSRR
- PERFECT FOR INSTRUMENT AMPLIFIERS
- INDIVIDUAL DEVICES SIMILAR TO monoOP-05 TYPES
- SAVES COST AND SPACE OVER INDIVIDUAL AMPS — 14 PIN DIP

	Temp Range (°C)	Max ΔVos (mV)	Max TCΔVos (Nulled) (μV/°C)	Max ΔIos+ (nA)	Min ΔCMRR (dB)	Max Vos (mV)	Max I_B (nA)
monoOP-10AY	−55/125	0.18	0.8	2.8	114	0.5	3.0
monoOP-10Y	−55/125	0.5	1.2	4.5	106	0.5	3.0
monoOP-10EY	0/70	0.5	0.9	4.5	106	0.5	4.0
monoOP-10CY	0/70	—	—	—	—	1.3	7.0

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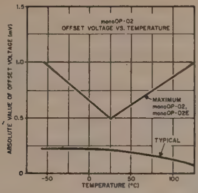
monoOP-02 — HIGH PERFORMANCE GENERAL PURPOSE OP AMP



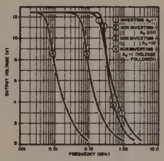
DRAMATIC IMPROVEMENT OVER STANDARD 741 TYPES!

- LOW COST ELIMINATES COSTLY SELECTED TYPES
- LOW OFFSET VOLTAGE ....0.5mV MAX
- LOW OFFSET AND BIAS CURRENTS
- GUARANTEED DRIFT ....5.0μV/°C MAX
- LOW NOISE VOLTAGE ....LOW NOISE CURRENT
- COMPLETE FREEDOM FROM "POPCORN" NOISE
- GUARANTEED SLEW RATE — 0.5 V/μsec MIN

	Temp Range (°C)	Max Vos (mV)	Max TCVos (μV/°C)	Max Ios (nA)	Max Ib (nA)	Min CMRR (dB)	Min PSRR (dB)	Min Gain (×1000)
monoOP-02A	−55/+125	0.5	5.0	2.0	30	90	90	100
monoOP-02	−55/+125	2.0	10.0	5.0	50	80	80	50
monoOP-02E	0/+70	0.5	5.0	2.0	30	90	90	100
monoOP-02C	0/+70	2.0	10.0	5.0	50	80	80	50

8 PIN TO-99; Add Suffix J; 14 PIN DIP: Add suffix "Y"; CONSULT FACTORY FOR AVAILABILITY OF 8 PIN MINIDIP AND FLATPACK TYPES.

monoOP-01 — LOW COST HIGH SPEED OP AMP



HIGH SPEED PERFORMANCE AT LOW COST!

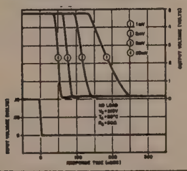
- FAST SETTLING TIME ....700 nsec to 0.1%
- HIGH SLEW RATE 18V/μsec
- WIDE POWER BANDWIDTH 250kHz
- WIDE SMALL SIGNAL BANDWIDTH 2.5MHz
- INTERNALLY COMPENSATED
- LOW POWER CONSUMPTION 40mW
- EXCELLENT D.C. SPECIFICATIONS

	Temp Range (°C)	Max Settling Time 0.1%, 5V (μs)	Max Vos (mV)	Max Ios (nA)	Max IB (nA)	Min Gain (x10³)	Max Pd (mW)
monoOP-01	−55/+125	1.0	0.7	2.0	30	50	60
monoOP-01F	−55/+125	1.0	2.0	5.0	50	50	90
monoOP-01G	−55/+125	1.0	5.0	20	100	25	90
monoOP-01H	0/70	1.0	0.7	2.0	30	50	60
monoOP-01E	0/70	1.0	2.0	5.0	50	50	90
monoOP-01C	0/70	1.0	5.0	20	100	25	90

8 PIN TO-99: Add Suffix "J"; 14 PIN DIP: Add suffix "Y"; 10 PIN FLATPACK: Add Suffix "L".

monoCMP-01/monoCMP-02 — FAST PRECISION COMPARATORS

RESPONSE TIME FOR 100mV STEP AND VARIOUS INPUT OVERDRIVES



MOST ACCURATE VOLTAGE COMPARATORS AVAILABLE!

- monoCMP-01 ....90nsec RESPONSE TIME
- monoCMP-02 ....50nA MAX BIAS CURRENT
- LOW OFFSET VOLTAGE AND DRIFT
- ±5 TO ±18V OR SINGLE +5V OPERATION
- DRIVES TTL WITHOUT PULL-UP
- HIGH GAIN WITHOUT OSCILLATIONS
- IDEAL FOR A/D CONVERTERS, PRECISION APPLICATIONS

	Temp Range (°/C)	tr 5mV Overdrive (ns)	Max IB (nA)	Max Vos (mV)	TCVos (μV/°C)	Max Ios (nA)	Min Gain (× 1000)
monoCMP-01	−55/+125	90	600	0.8	1.0	25	200
monoCMP/01E	0/70	90	600	0.8	1.0	25	200
monoCMP-01C	0/70	90	900	2.8	1.2	80	100
monoCMP-02	−55/+125	160	50	0.8	1.0	3.0	200
monoCMP/02E	0/70	160	50	0.8	1.0	3.0	200
monoCMP-02C	0/70	160	100	2.8	1.2	15	100

8 PIN TO-99: Add suffix "J"; 14 PIN DIP: Add suffix "Y"

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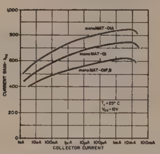
MATCHED TRANSISTORS
IMPROVED SECOND SOURCE OP AMPS
MONOLITHIC CHIPS

monoMAT-01 — ULTRA MATCHED DUAL TRANSISTORS

CURRENT GAIN
VS. COLLECTOR CURRENT



INDUSTRY'S TIGHTEST MATCHING SPECIFICATIONS!

- TIGHT Vos (Vbe MATCH) ....100μV MAX
- LOW TCVos ....0.5μV/°C MAX
- TIGHT hFE MATCH ....3.0% MAX
- HIGH hFE ....500 MIN
- HIGH hFE AT LOW Ic ....590 @ Ic = 10nA
- VERY LOW NOISE ....0.4 μVp-p MAX, 0.1 TO 10 Hz
- REPLACES MOST DUAL TRANSISTORS

	Temp Range (°C)	Min BVceo (V)	Max Vos (μV)	Max TCVos (μV/°C)	Max hFE Match (%)	Min hFE @ 10μA	Typ hFE @ 10nA
monoMAT-01AH	−55/+125	45	100	0.5	3.0	500	590
monoMAT-01GH	−55/+125	45	500	1.8	8.0	250	430
monoMAT-01H	−55/+125	60	100	0.5	2.7	330	520
monoMAT-01FH	−55/+125	60	500	1.8	8.0	250	430

6 Pin TO -99 Type Package.

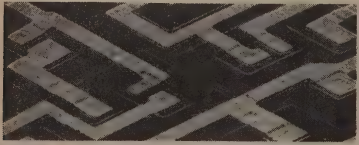
SUPERIOR SECOND SOURCE OPERATIONAL AMPLIFIERS

IMPROVED PERFORMANCE DIRECT REPLACEMENT VERSIONS OF POPULAR INDUSTRY STANDARDS. EACH DEVICE IS MANUFACTURED WITH PMI'S EXCLUSIVE SILICON-NITRIDE "TRIPLE PASSIVATION" PROCESS!

	Temp Range (°C)	Max Vos (mV)	Max TCVos (μV/°C)	Max Ios (nA)	Max IB (nA)	Min CMRR (dB)	Min PSRR (dB)	Min Gain (×1000)	Package Options
SSS 725 — INSTRUMENTATION OPERATIONAL AMPLIFIER									
SSS 725A	−55/+125	0.1	0.6	1.0	70	120	114	1000	J,L,Y
SSS 725	−55/+125	0.5	1.0	5.0	80	120	106	1000	J,L,Y
SSS 725B	−28/+85	0.75	1.0	5.0	80	110	106	1000	J,L,Y
SSS 725E	0/+70	0.5	0.6	5.0	80	120	106	1000	J,Y
SSS 725C	0/+70	1.3	1.5	13.0	110	100	100	500	J,Y
SSS 741 — IMPROVED PERFORMANCE OPERATIONAL AMPLIFIER									
SSS 741	−55/+125	2.0	2.2	5.0	50	80	80	100	J,Y
SSS 741G	−55/+125	5.0	5.0	25	100	70	77	50	J,Y
SSS 741B	−25/+85	3.0	2.2	5.0	50	80	80	50	J,Y
SSS 741C	0/+70	6.0	6.0	25	100	70	77	20	J,Y
SSS 747 — DUAL SSS 741 OPERATIONAL AMPLIFIER									
SSS 747	−55/+125	2.0	2.2	5.0	50	80	80	100	K,M,Y
SSS 747G	−55/+125	5.0	5.0	20	100	70	77	50	K,M,Y
SSS 747B	−25/+85	3.0	2.2	5.0	50	80	80	50	K,M,Y
SSS 747C	0/+70	5.0	5.0	20	100	70	77	50	K,Y
SSS 1558/1458 — DUAL SSS 741 OPERATIONAL AMPLIFIER									
SSS 1558	−55/+125	5.0	5.0	20	100	70	77	50	J
SSS 1458	0/+70	5.0	5.0	20	100	70	77	50	J

Package Suffixes — "J": 8 Pin TO -99; "K": 10 Pin TO -100; "L": 10 Pin Flatpack; "M": 14 Pin Flatpack; "Y": 14 Pin Heremetic Dip.

HIGH YIELD MONOLITHIC CHIPS



SAVE MONEY THROUGH INCREASED YIELDS!

The superior performance of Precision Monolithics products is available to the hybrid designer — all chips are 100% electrically tested for all guaranteed DC parameters at 25°C and are 100% visually inspected to 2010.1B. Each chip is protected with our exclusive "Triple-Passivation" process for maximum assembly yield and long-term reliability, then carefully packaged for protection during shipment.

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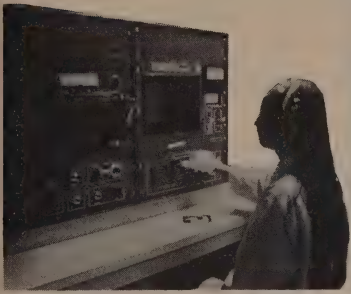
...delivering tomorrow's linear technology today!

PRECISION MONOLITHICS brings to the marketplace a superior monolithic process and the talents of an outstanding circuit design team capable of exploiting the monolithic and hybrid circuit art to its maximum potential. These advanced capabilities have been applied to produce state-of-the-art linear and A/D/A conversion circuits of exceptional performance, manufactured in volume at low cost to satisfy the exacting requirements of the Process Control, Instrumentation, Communication and Military/Aerospace Industries. Our ultra-modern Santa Clara facility has recently been expanded to over four times PMI's original capacity, further enhancing PMI's dedication to **delivering tomorrow's linear technology today!**



QUALITY CONTROL/RELIABILITY

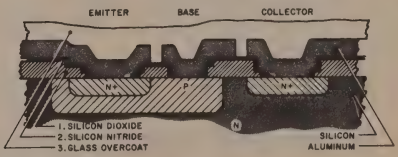
Precision Monolithics believes that Quality and Reliability must be **built into** the product; no amount of testing can replace these inherent properties.

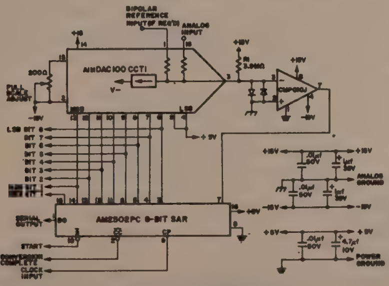
Precision Monolithics products are built in accordance with the requirements of MIL-STD 883 and 38510 with many exclusive processes and controls added to improve the outgoing quality and reliability. Proof of conformance is provided by continuous Q. A. sampling of outgoing lots; the customer return rate is among the lowest in the industry. Processes are thoroughly documented and a well-equipped failure analysis laboratory including the latest **Scanning Electron Microscope** equipment is maintained as a research and yield-improvement tool and as an aid to our customers. **Complete facilities are available for processing and qualification to all levels of MIL-STD/38510/883.** We are proud to be the supplier of devices to the highest reliability space programs, including the Viking and Mariner/Mars deep space probes.

TRIPLE PASSIVATION

Triple Passivation is an exclusive three-step process which provides superior reliability and protection for all Precision Monolithics active integrated circuits. First, a specially treated thermal silicon dioxide layer is grown. This protects the junctions and also attracts any residual ionic impurities to the top surface of the oxide, where they are held fixed. Next, a layer of silicon nitride is applied to prevent the entry of any potential contamination or impurities. The third step is the thick glass overcoat layer which leaves only the bonding pads exposed. This "glassivation" protects the chip from damage during assembly and is especially important in minimizing yield loss during shipment and assembly of chips for hybrid circuits.

PRECISION MONOLITHICS
TRIPLE PASSIVATED T.M.
INTEGRATED CIRCUIT PROCESS





COMPLETE 8 BIT A/D SCHEMATIC
(FROM AN-11)

APPLICATIONS LITERATURE is available upon request:

AN-6	Tracking A/D Converters
AN-11	3 I-C Successive Approximation A/D
AN-12	Matched Pair Temperature Sensor
AN-13	A Bipolar Op Amp That Challenges Choppers
AN-14	Interfacing CMOS With PMI DACS
AN-15	Minimizing Noise In Op Amp Circuits
AN-16	Low Cost 8 Bit, 1 µSecond A/D

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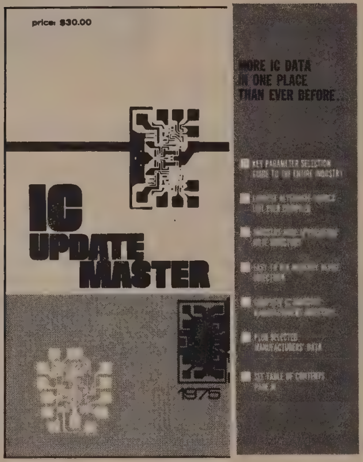
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PLUS SELECTED MANUFACTURERS' DATA
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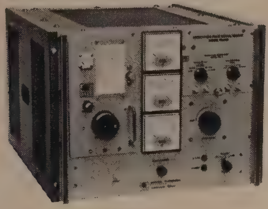
PULSE SIGNAL SOURCES



MODEL PH40K

the highest pulse power available in a single generator

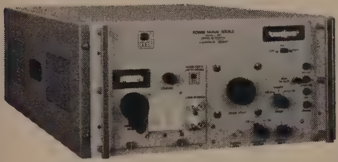
Covering the range from 150 to 6100 MHz, tuneable plug-in oscillator heads provide guaranteed minimum powers as high as 40 kW. Magnetron plug-ins further extend the upper limit to 16,500 MHz. Pulses are continuously variable in width from 0.4 to 25 μs and in repetition rate from 10 to 10,000 pps. Available also in pulse modulator configuration (MH250). Frequency ranges and power levels of oscillator heads are detailed on next two pages.

MODEL PG5KB

wide range, medium power unit

With guaranteed minimum powers as high as 5 kW, the Model PG5KB covers 150 to 6100 MHz with plug-in heads. Magnetron plug-ins further extend the upper limit to 16,500 MHz. Pulses are continuously variable in width from 0.3 to 50 μs and in repetition rate from 20 to 25,000 pps. Frequency ranges and power levels of oscillator heads are detailed on next two pages.

CW SIGNAL SOURCE

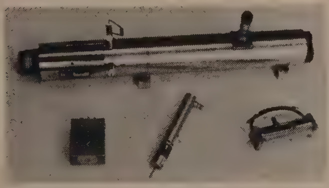


MODEL C203

the highest CW power available in a single instrument

Covering the range from 10 to 6100 MHz with plug-in heads, the Model C203 provides full power modulation at 0.5 duty cycle with internal 1000 Hz square wave generator or from an external pulse source. Frequency ranges and power levels of oscillator heads are detailed on next two pages.

CAVITY OSCILLATORS AND AMPLIFIERS



Standard oscillator models for CW or pulse applications in a variety of configurations cover selected frequency bands from 150 to 6100 MHz. Cavity amplifiers from 150 to 3000 MHz, CW and pulse, for applications in TACAN, DME, and similar requirements. Some special oscillator designs that have become standard:

Model 519	40 kW peak power, UHF.
Model 505	Conduction-cooled, high power, C-band.
Model 428	Wide tuning, CW for local oscillator applications.
Model 498	High power, duty cycle, and stability; wide pulse.

PEAK POWER CALIBRATION SYSTEM

A secondary standard for calibrating TACAN, DME, DABS, ATC, IFF and other accuracy-demanding systems in the 925 to 1225 MHz frequency range. Power accuracy of ±0.3 dB is directly traceable to the National Bureau of Standards. Peak power of 5 kW. Direct readout of pulse power, pulse width, PRF, and operating frequency. Pulse duration from 0.35 to 5 microseconds. Automatic sequencing. Sync output. Accepts internal/external trigger.

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(617) 329-1500 TWX (710) 348-0484

STANDARD RF OSCILLATOR PLUG-IN HEADS

PH40K/MH250 HEADS

MODEL	DUTY CYCLE* (Max)	OUTPUT CONNECTOR	FREQUENCY (MHz)	POWER OUT** (kW)	MAX WIDTH* (µs)
Triode Cavity					
1701H4	0.001 @	HN	150 to 300	10	12
1702H4	-6.0 kV max		225 to 450	15	12
1703AH4			450 to 700	15	12
1703BH4			700 to 950	15	12
1704H4			950 to 1220	15	12
1705H4			1220 to 1535	15	12
1706H4			1535 to 1900	15	12
1707H4			1900 to 2350	10	12
1708H4			2350 to 2700	10	12
1709H4			2700 to 3100	10	12
1710H4			3100 to 3400	5	12
6302H4	0.0033 @	TNC	3300 to 3700	1.8	6
6303H4	-3.5 kV max		3700 to 4000	1.2	6
6304H4	0.0025 @		4000 to 4400	1	3
6305H4	-3.0 kV max		4400 to 5000	1	3
6306H4			5000 to 5400	0.8	3
6307H4			5400 to 5900	0.5	3
6308H4			5900 to 6100	0.5	3
519H	0.003 @	HN	700 to 850	40	10
526H	-7 kV max		800 to 1000	40	10
520H			1000 to 1200	40	10
527H			1050 to 1110	40	10
528H			1140 to 1290	40	10
Magnetron					
M1	0.002	TNC	5400 to 5900	1.4	1
M2	0.002	TNC	5400 to 5900	3.5	1
M3	0.002	MS90064-5	8800 to 9500	2.0	1.2
M4	0.001	MS90064-5	8800 to 9500	3.0	1.2
M5	0.001	MS90064-5	8800 to 9500	4.0	1.2
M6	0.003	As Required	9310 to 9350	1.0	3.0
M8	0.002	UG541/U	15,500 Fixed	10.0	2.0
M9	0.002	WG	16,000 to 16,500	1.0	1.0
M10	0.003	MS90064-4	16,260 to 16,300	2.2	2.0
M11	0.002	WG	16,500 ± 0.05	10.0	0.3
M12†	0.001	UG52A/U	8500 to 9600	65	5
M13†	0.001	UG137B/U	9375 Fixed	75	7
M14†	0.001	UG137B/U	9345 Fixed	75	7
M15†	0.001	UG541/U	15,550 Fixed	60	1
M16†	0.001	UG541/U	16,000 to 17,000	75	2
M17†	0.0007	WG	23,800 to 24,270	40	0.5

*Higher duty cycle and wider pulses permitted at reduced power (for triode cavities only.)

**Power listed is guaranteed minimum throughout frequency band covered.

†Magnetron models M12 through M17 are for use with MH250 Modulator only.

PGK5B HEADS

MODEL	FREQUENCY (MHz)	POWER OUT* (W)
5231H/B1	150 to 300	5000
5232H/B2	225 to 450	5000
5233H/B3	450 to 950	5000
5234H/B4	950 to 1220	5000
5235H/B5	1220 to 1535	5000
5236H/B6	1535 to 1900	5000
5237H/B7	1900 to 2350	5000
5238H/B8	2350 to 2700	4500
5239H/B9	2700 to 3100	4000
6341H/B10	3100 to 3400	3000
6342H/B11	3300 to 3700	2000
6343H/B12	3700 to 4000	1000
6344H/B13	4000 to 4400	500
6345H/B14	4400 to 5000	500
6346H/B15	5000 to 5400	500
6347H/B16	5400 to 5900	500
6348H/B17	5900 to 6100	500
B18	5400 to 5900	1400
B19	8800 to 9500	2000
B20	16,000 to 16,500	1000

*Power listed is guaranteed minimum throughout frequency band covered. Pulse width is 0.3 to 50 μs with duty cycle of 0.005 except for B18 (1 μs, 0.002), B19 (1.2 μs, 0.002) and B20 (2 μs, 0.0015).

C203 HEADS

MODEL	FREQUENCY (MHz)	POWER OUT** (W)
7048H*	10 to 50 MHz	100
7049H*	50 to 200 MHz	100
7050H	200 to 500 MHz	100
7051AH	450 to 750 MHz	75
7051BH	750 to 1000 MHz	75
7052H	1000 to 2000 MHz	60
7053H	2000 to 3000 MHz	15
7054H	3000 to 6100 MHz	0.5

*Under development.

**Power listed is guaranteed minimum throughout frequency band covered.

Other models under development. Contact factory for availability.

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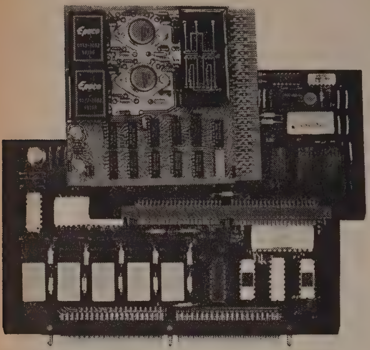
CONVERTER SYSTEMS



The Model 1010 Digital-to-Synchro Converter combines high accuracy (±6 minutes of arc) and high resolution (0.17°) in a low impedance unit designed to drive 50 ohms. Applications include navigation displays and remote operation of industrial controls.

The Model 1020 is a complete data acquisition system in one module. Includes a 16 channel multiplexer with buffer amplifier, a 12 bit successive approximation A/D converter, both serial and parallel output data transfer and five active low-pass filter signal conditioners capable of receiving high level differential signals up to ±10 volts.

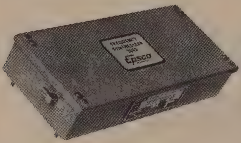
The Model 1030 Triple 12-Bit D/A Converter Module is designed specifically for interface with on-board avionic computer-controlled equipment. It contains three separate converters with individual storage registers. Completely qualified to MIL-E-5400/Class 3 requirements.

Other configurations available.

TACAN SIMULATORS

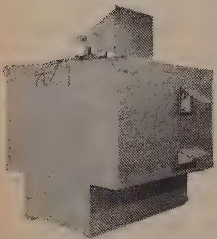
The Model 2010 TACAN Beacon Simulator Test Set is a digital, programmable depot/intermediate level instrument designed for continuous use under military service conditions in the checkout and alignment of all airborne TACAN receivers. The instrument is compatible with all standard A/B TACAN and CNI airborne systems including X-mode, Y-mode, and air-to-air operations. Standard values may be preset. Error detection circuits prevent incorrect parameter combination. Plug-in cards are functionally isolated for ease of maintenance.

FREQUENCY SYNTHESIZERS

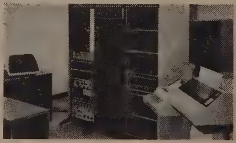


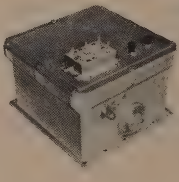
Typical of the line of synthesizers is the Model 2013, a digitally programmable unit with frequency increments as small as 10 kHz in the 100 to 200 MHz range. This reliable MIL-SPEC frequency synthesizer has a spurious output better than -70 dB. The small lightweight unit is suitable for airborne applications as well as for use with computer-controlled test equipment and computer peripherals. Custom configurations available.

CUSTOM PRODUCTS



The same high performance and reliability characteristics that distinguish our standard models are also evident in the custom product designed to your specifications. In single units or production quantities. Our extensive experience covers the spectrum from the smallest high-performance cavity to large transmitter systems in environmentally controlled transportable shelters. Automatic test systems can now be supplied for a variety of test applications. Of particular interest are the specialized applications for test of synchro conversion devices and RF components and subsystems. Our experience with testing these devices will often save a customer valuable time and effort in satisfying production test requirements.





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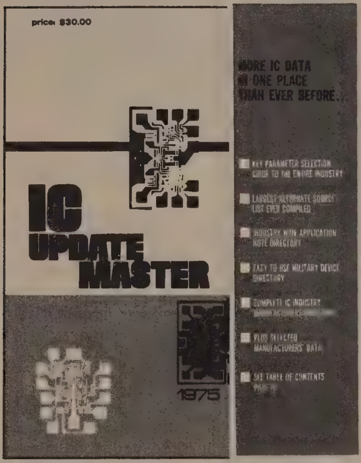
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IC Update Master also contains the most useful Alternate Source Directory in the industry. It is the only place you can go to find a listing of **all** manufacturers that make a pin-for-pin functional equivalent device.

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COBER MEANS HIGH POWER MICROWAVE!

COBER CAPABILITY

Cober Electronics, the company that has earned the reputation as "the high power people," specializes in high power systems for research, testing, communications and industrial processing. Cober's unique capability, coupled with one of the finest engineering teams, produces some of today's most advanced electronics equipment.

This technology is implemented in a product line of instruments, sub-systems and systems that encompass a capability in the areas of high power pulse, high power microwave and high power industrial microwave ovens.

HIGH POWER PULSE

Cober's capability in the generation of high power pulses is reflected in a line of production high power pulse generators and unique pulse modulators, plus pulsed microwave generators and amplifiers. Cober's pulse generators are characterized by their high pulse fidelity and flexibility. They are all at high power with rise times measured in nanoseconds, rep rates from a single shot up to a megahertz and pulse widths going to DC. Various models contain built-in bias supplies and high voltage isolation to allow convenient use as a microwave tube grid pulser. Cober's pulse modulators include units to drive virtually every high power pulsed microwave tube. Power levels range to over 100 megawatts. Plus, Cober is a specialist in generating state of the art rise times and high rep rates with sophisticated pulse shapes. Both soft tube and hard tube units are furnished for laboratories, particle accelerator facilities and for industrial applications, while full MIL spec requirements are supplied for systems uses.

HIGH POWER MICROWAVE

Cober has a unique capability in high power microwaves. In communications, Cober power amplifiers are the heart of troposcatter and satellite communications transmitters. Tropo amplifiers cover the "L", "S" and "C" bands at powers from 1 Kw to 75 Kw. For satellite communications, Cober has P.A.'s at the new 14 GHz Satcom frequency and a complete line of TWT and klystron amplifiers at 5.9 - 6.4 GHz and 7.9 - 8.4 GHz at power levels of 300 watts to more than 8 Kw.

Cober's Kilowatt Microwave Signal Generators and Laboratory Microwave Amplifiers are available in CW or Pulse versions. Some models have a dual mode capability. They are used for component testing, antenna pattern measurements and to power plasma tubes. Cober's experience with every type of microwave tube and inventory of basic power supply and modulator designs insures the perfect marriage of tube and supply. The result is delivery of a unit exactly right for your application.

HIGH POWER INDUSTRIAL MICROWAVE OVENS

The unique properties of microwave energy are applied by Cober as important new tools for industrial processing and research. There, the microwave energy is used for heating, drying and cooking. With Cober industrial microwave ovens, particular materials can be heated and processed at speeds, efficiencies and economies that cannot be realized by conventional means. The use of microwaves saves energy, avoids pollution problems, and does not require the use of scarce natural gas. Machines operating at 915 MHz and 2450 MHz are offered.

HIGH POWER PULSE

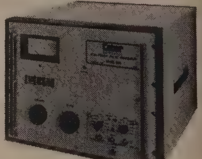
HIGH POWER PULSE GENERATORS

Cober's pulse generators are unique for high power applications. They drive plasma tubes, pulse lasers and flash lamps, and operate gridded power tubes and magnetrons. They are ideal for pulse testing of magnetic components, driving transducers and optic modulators, for pulse simulation in nuclear research and non-destructive testing — wherever big power is needed quickly and economically. Cober's pulse generators have peak powers of 9 Kw to over 31 Kw. The output pulse shape is exceptional with fast rise time, low ripple and virtually no droop. All of these generators use the Cober exclusive "floating deck" circuitry that permits operation at both positive or negative polarity and 5 Kv D.C. pulse isolation. Also, this reversible polarity and isolated pulse capability, permits the pulse generators to be connected in series and in parallel to give twice the current or twice the voltage or alternating positive and negative pulses.

This broad line is available from stock with pulse widths from 50 nanoseconds to D.C. at rep rates up to a megahertz. Standard plug-in accessories can extend the voltage to 30 Kv and current to more than 750 amperes.

Below are specification highlights for two of Cober's pulse generators. Please call us for information about our other pulse generators or for applications assistance.

	Model 606	**Model 605-P**
Peak Voltage:	0-2,500 Volts	0-2,200 Volts
Peak Current:	0-12.5 Amperes	0-11 Amperes
Duty Factor at Full Power:	1.5%	1.5%
Pulse Polarity (Selectable by Operator):	+ or −	+ or −
Rise Time:	20 ns	20 ns
Pulse Width: (microseconds)		
at full power	0.05-3000	0.05-1,000
at reduced power	0.05-10,000	0.05-10,000
Pulse Repetition Rate:	one shot — 1 MHz	one shot — 1 MHz
Floating Output Insulation:	5 KV D.C.	5 KV D.C.
Input Power:	115/230 Volts, 50/60 Hz, 1 ϕ, 10 A.	115/230Volts, 50/60 Hz, 1 ϕ, 8 A.
Size:	19″ W x 22¼″ D x 14″ H	19″ W x 22¼″ D x 14″ H



Model 606 generates 31 Kw pulses, 2500 Volts at 12.5 Amps.

HIGH POWER PULSE MODULATORS

When it comes to special high power pulse applications, our custom pulse modulators go from a few kilowatts to more than 100 megawatts. We specialize in the generation of state of the art nanosecond rise times and high rep rates. Hard tube designs for versatility and soft tube modulators for low cost and small size are in our store house of models and designs for economical and quick delivery of exactly the modulator for your application

Model 2004 Pulse Modulator drives modulating anodes of high power TWTs. Output is 30 KV with wide pulse range of 2-5,000 microseconds.

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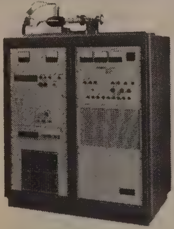
HIGH POWER MICROWAVE

KILOWATT MICROWAVE SIGNAL GENERATORS

Cober's High-Power R.F. Sources provide microwave frequency energy for use in antenna-pattern studies, EMI susceptibility measurements, and in testing microwave components, such as filters, circulators, and pin diodes. In ground support equipment stations, Cober units are the basic source of high-power, microwave test frequencies. These units use Klystrons, Magnetrons, TWT's and other suitable microwave tubes, selected for power output, frequency, or bandwidth required. Units are available from L-Band to millimeter frequencies, for C.W. or pulse operation, and at power levels of from several hundred watts to the megawatt region.



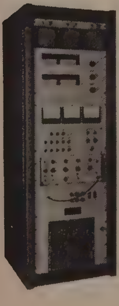
Series 1326 is typical of Cober Generators. With available R.F. heads, generates test frequencies from 350 MHz to 10,475 MHz at power levels up to 500 watts C.W. and 1.8 kw peak. The 1326 provides pulses variable from 1 to 10,000 microseconds at repetition rates from 10 to 100,000 p.p.s. with a maximum duty of 6.25.

MICROWAVE COMMUNICATIONS POWER AMPLIFIERS

Cober's Microwave Transmitters and Power Amplifiers are used in satellite and troposcatter communication systems. Frequencies between 1 and 14 GHz at power levels above 1 Kw are featured.

Model 2000, 1.25 kw Klystron Power Amplifier operates at new 14 to 14.3 GHz satellite communications frequency band. It transmits data, voice and TV and can be supplied for local or remote operation.

LABORATORY MICROWAVE AMPLIFIERS, CW AND PULSE



Cober produces TWT, klystron and CFA amplifier systems from 10 watts to over 100 Kw. Some units are available from stock with a full year warranty on equipment and tube. Series GP, provide 1 Kw, pulse output from 2 - 18 GHz for broad band ECM simulation.

Model 1977 is 3-band, TWTA, providing 1 kw from 2-12 GHz. Pulse width is variable from 0.5-10 microseconds and is used as ECM simulator.

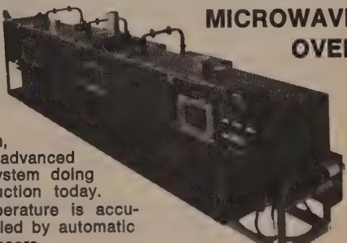
HIGH POWER OVENS

The efficiency and energy savings of Cober Industrial Microwave Ovens makes them the ideal tool for today's processes. Machines operating at 915 MHz and 2450 MHz with power levels from 2.5 Kw to over 100 Kw are supplied to the food, rubber, foundry, chemical, and research industries. The product line includes both batch and continuous systems.

MODEL BPH 2.5 INDUSTRIAL MICROWAVE OVEN

This unit has large heating chamber, extremely uniform fields, and plenty of power. Built in instrumentation helps you analyze microwave heating of your products.

15 KW CONTINUOUS MICROWAVE OVEN



Featuring an auxiliary hot air system, it is the most advanced microwave system doing on-line production today. Product temperature is accurately controlled by automatic electronic sensors.

STANDARD COBER INDUSTRIAL MICROWAVE HEATING POWER PACKS

Model Number	Frequency	Power Output (watts)
S1	2450 MHz	1,000
S2	2450 MHz	2,500
S5	2450 MHz	5,000
S30	2450 MHz	30,000
L2	915 MHz	2,000
L30	915 MHz	30,000

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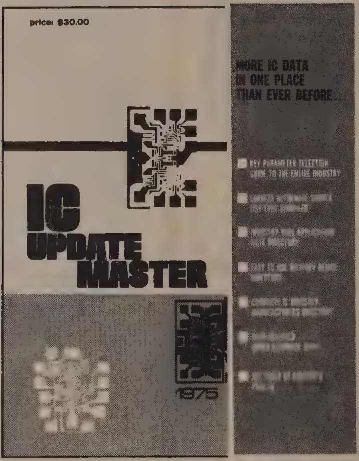

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The heart of this invaluable reference book is a Master Function Index. It allows you to survey the **entire** IC industry . . . it gives you an overview of what's available by device number and manufacturer . . . you no longer have to thumb through dozens of manufacturers' catalogs to find the device you need.

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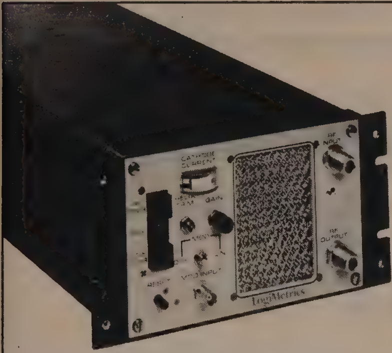
LogiMetrics TWT AMPLIFIERS


CATHODE CURRENT
GAIN
RF INPUT
RF OUTPUT
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Semi/Dyne Series A100, A200, A300

COLLECTOR CURRENT
HELIX CURRENT
LOCAL
REMOTE
STANDBY
RF ON
POWER ON
RESET
OVER LOAD
VSWR
HELIX
AIR
TWT THERMAL
PS THERMAL
RF OUTPUT
RF INPUT
LogiMetrics

Semi/Dyne Series A500, A600

The Semi/Dyne Traveling Wave Tube Amplifiers comprise the most complete product line available from one manufacturer. These compact, solid state units cover the frequency range from 0.45 to 18.0 GHz offering CW power outputs from 0.5 to 600 watts and peak pulse power up to 2 kw.

The amplifiers utilize integrated circuit power supplies and PPM Traveling Wave Tubes in their most efficient configurations. They are packaged for ease of maintenance and long equipment life.

Each TWT is protected by helix current and voltage sensors, filament surge limiting and thermal overload sensors. The high power amplifiers (A500 and A600 series) offer remote monitoring and control as standard features.

Options are available for military and commercial system applications including airborne and communication systems. The amplifiers are available under G.S.A. Contract.

Semi/Dyne Series	Frequency Range (GHz)	Power Output Min (Watts)	Gain Min (dB)	N.F. Max (dB)
A100	1.0 to 18.0	1	30	30
A102	1.0 to 18.0	2	30	30
A103	2.0 to 18.0	1	30	20
A200	1.0 to 18.0	10	35	35
A300	1.0 to 18.0	20	35	35
A400	All Communications Bands as specified			
A500	0.45 to 18.0	100	30	35
A600	0.45 to 18.0	200	30	35
A700	0.7 to 18.0	1kw	30	35

LogiMetrics 121-03 Dupont Street, Plainview, New York 11803/(516) 681-4700/TWX: 510-221-1833

MCL INC LA GRANGE ILL

MICROWAVE...

CAVITIES COMPONENTS SYSTEMS AND SUB SYSTEMS

The following pages reflect the results of over a decade of effort devoted to the design and development of microwave components and systems.

Dealing successfully, during that time frame, with almost every conceivable problem associated with cavity and system design has given us the confidence to boastfully exclaim "If we can't satisfy your microwave equipment requirements it can't be done"!

MCL/INC has designed and developed over 300 systems and subsystems, approximately 200 microwave accessories and over 400 different cavities, many of which are depicted in this catalog.

Browse through our microwave market place, assured that if you can't find the equipment to meet your needs, MCL can readily alter an existing unit or custom design to your exact specifications.

40 TO 18000 MEGAHERTZ
MILLIWATTS TO MEGAWATTS

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2002-10	15	1•922
2002-11	15	1•922
2002-12	15	1•922
2002-13	15	1•922
2002-14	15	1•922
2002-17	15	1•922
2014A	15	1•922
2016	15	1•922
2023A	18	1•923
2043	15	1•922
2044	18	1•923
2045	18	1•923
2047	15	1•922
2051	15	1•922
2052	15	1•922
2063	15	1•922
2065	15	1•922
3005	15	1•922
3006B	15	1•922
3014	18	1•923
3018	15	1•922
3020	15	1•922
3021	18	1•923
3022	18	1•923
3023	18	1.923
3028	15	1•922
3029	18	1•923
3031	18	1•923
3040	15	1•922
3042	18	1•923
3044B	18	1•923
3045	18	1•923
3046	18	1•923
3047	18	1•923
3051	15	1•922
3057	18	1•923
3058	18	1•923
3059	18	1•923
6002-7	16	1•922
6003-13	16	1•922
6024	16	1•922
6047	9	1•917
6048	9	1•917
6049	9	1•917
6050	9	1•917
6051	9	1•917
6052	9	1•917
7014	16	1•922
7200	16	1•922
8000-17	17	1•923
8002-8	17	1•923
8002-11M	17	1•923
8003-18	17	1•923
8018	16	1•919
8019	16	1•919
8021	16	1•919
8022	16	1•919
8024	16	1•919
8026	16	1•919
8027	16	1•919
8028	16	1•919
8029	16	1•919
8030	16	1•919
8035	17	1•923
8038	16	1•919
8041	17	1•923
8042	17	1•923
8043B	17	1•923
8044	17	1•923
8063	17	1•923
8064	17	1•923
8065	17	1•923
8066	17	1•923
8075	17	1•923
9009	17	1•923
9010B	17	1•923
9012	17	1•923
9013	17	1•923
9014	17	1•923
9015	16	1•922
9017	17	1•923
9018	17	1•923
9019	17	1•923
9021	17	1•923
9022B	17	1•923
9048	17	1•923
9057	17	1•923
9202	17	1•923
10109	12	1•918
10116	12	1•918
10224	12	1•918
10258	12	1•918
10264	12	1•918
10270	5	1•912
10275	12	1•918
10276	6	1•913
10278	6	1•913
10282	6	1•913
10283	6	1•913
10284	6	1•913
10285	6	1•913
10286	6	1•913
10287	6	1•913
10288	7	1•915
10292	12	1•918
10297	7	1•915
10299C	13	1•919
10315	12	1•918
10333	7	1•915
10343	12	1•918
10358	8	1•916
10359	8	1•916
10363	8	1•916
10364	8	1•916
10365	8	1•916
10376	8	1•916
10450	4	1•911
10451	4	1•911
10452	4	1•911
10453	4	1•911
10454	4	1•911
10455	4	1•911
10456	4	1•911
10457	4	1•911
10458	4	1•911
10459	4	1•911
10460	4	1•911
10461	14	1•920
10480	4	1•911
10481	4	1•911
10482	4	1•911
10483	4	1•911
10484	4	1•911
10485	4	1•911
10487	4	1•911
10488	4	1•911
10500	4	1•911
10501	4	1•911
10502	4	1•911
10503	4	1•911
10504	4	1•911
10520	4	1•911
10521	4	1•911
10522	4	1•911
10524	4	1•911
10525	4	1•911
11009	18	1•923
11010	15	1•922
11011	18	1•923
11024	15	1•922
11029	15	1•922
11030	15	1•922
11031	18	1•923
11033	18	1•923
11043	5	1•912
11044	5	1•912
11045	5	1•912
11104	5	1•912
11050	17	1•923
11051	18	1•923
11056	15	1•922
11057	15	1•922
11067	18	1•923
11074	15	1•922
11087	18	1•923
11088	18	1•923
11089	18	1•923
11090	18	1•923
11097	15	1•922
11099	15	1•922
15009	9	1•917
15022	9	1•917
16072	13	1•919
16073	13	1•919
16074	13	1•919

PRODUCT WARRANTY

Under recommended use and service, all MCL products are warranteed against defects in material and workmanship for nine (9) months from the date of original shipment. Material returned after 90 days of the original shipping date will be repaired on a pro-rata basis. MCL's obligation is limited to repairing or replacing, at our plant, products which prove to be defective during the warranty period. Tubes, transistors, and other solid state devices are covered by the respective manufacturer's warranty which applies from the date of shipment of the unit from MCL.

MCL is not liable for consequential damage resulting from the use of MCL equipment.

There will be no charge for repair of units under warranty except non-authorized shipping charges. In the event that responsibility for repair lies with the customer, customer will be charged for the cost of re-testing, repair and shipment. Estimates of charges will be supplied before work begins.

CLAIM FOR DAMAGE IN SHIPMENT
Your unit should be inspected and tested as soon as it is received. Claims for damage should be filed with carrier.

SHIPPING
Upon receipt of shipping instructions, forward the unit to the destination indicated. For non-warranty service, the unit must be shipped prepaid.

—MCL/INC DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH LA GRANGE ILLINOIS 60525 312-354-4350

MCL INC
LA GRANGE ILL

MICROWAVE SYSTEMS

TWT CW AMPLIFIERS

10, 20, 100 AND 200 WATTS

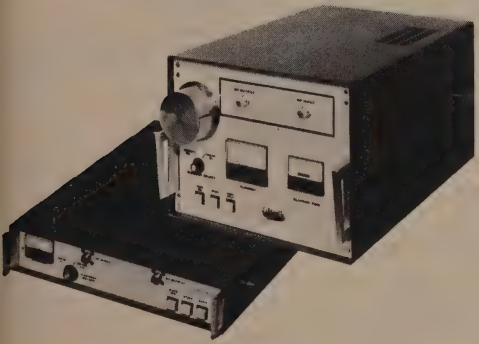
STOCKED (LESS TUBES) FOR IMMEDIATE SHIPMENT

The Industry's most advanced Traveling Wave Tube Amplifiers have broadband microwave amplifying capabilities and supply stable and powerful signals for calibration testing and other high power applications.

The power supplies are designed to maintain excellent regulation with a line input voltage variation of ±10%. The filament voltage is a regulated DC voltage supply. The helix voltage is maintained with ±0.1% with a ripple of less than .05%. The collector voltage for 10/20 watt units is regulated to ±.5% with .2% ripple. The 100/200 watt units use an unregulated collector for increased power supply efficiency. These characteristics result in superior spectral purity of the output signal.

Interlocks, overheat and overcurrent protective circuitry deactivate high power circuits should there be a fault. Metering is also included to provide performance verification and ease of maintenance.

In addition to the standard 10 to 200 watt amplifiers described in this catalog, custom modifications and designs are available on special order. MCL offers the following accessories on most models.



OPTIONS:

- VSWR PROTECTION (CIRCULATOR)
- OUTPUT POWER MONITORING
- SLIDES FOR 19" RACK MOUNTING
- GAIN CONTROL (SOME MODELS)

Rated power output does not include losses in option package. Consult factory for loss allowance.

GENERAL SPECIFICATIONS

Circuitry:	Solid State, except for series regulator and TWT tubes
Protection:	Time delay (filament warmup) Beam/Helix overcurrent protect Service interlocks Thermal cutout Power lines fused or circuit breakers
Controls:	Power on Standby Operate Beam/Helix current switch
Indicators:	Illuminated power controls Beam current/Helix current meter Elapsed time meter (100/200 Models)
RF Connectors:	On 10/20 watt: Wave Guide or TNC front panel mounted. On 100/200 watt: Wave Guide rear panel mounted. Type N front panel mounted.
Cooling:	Air
Input/Output Impedance:	50 ohms (nominal)
Input/Output VSWR:	< 1.3:1 (< 1.5:1 on 10 w units)
Load VSWR:	< 2.5:1
Operating Temperature:	0°C to +50°C
Storage Temperature:	−20°C to +70°C

SPECIFICATIONS

10 WATT

Frequency Range	Gain db	Model
1-2 GHz	30	10520
2-4 GHz	30	10521
4-8 GHz	30	10522
8-12.4 GHz	30	10524
12.4-18 GHz	30	10525

Power:
Single phase — 105-125V, 3A, or 210-240V, 1.5A, 48-63 Hz

Size:
25" D. x 19" W. x 3½" H.

20 WATT

Frequency Range	Gain db	Model
1-2 GHz	35	10450
2-4 GHz	35	10451
2-4 GHz	54	10452
4-8 GHz	35	10453
4-8 GHz	54	10454
6-11 GHz	35	10455
6-11 GHz	54	10456
8-12.4 GHz	35	10457
8-12.4 GHz	54	10458
12.4-18 GHz	30	10459
12.4-18 GHz	45	10460

Power:
Single phase — 105-125V, 6A, or 210-240V, 3A, 48-63 Hz

Size:
25" D. x 19" W. x 5¼" H.

100 WATT

Frequency Range	Gain db	Model
1-2 GHz	30	10480
2-4 GHz	30	10481
2-4 GHz	50	10482
4-8 GHz	30	10483
4-8 GHz	50	10484
7-11 GHz	30	10488
8-12.4 GHz	30	10485
12.4-18 GHz	30	10487

Power:
Single phase — 120 or 240, 30/15A, 57-63 Hz

Size:
26" D. x 19" W. x 15¾" H.

200 WATT

Frequency Range	Gain db	Model
1-2 GHz	30	10500
2-4 GHz	30	10501
4-8 GHz	30	10502
8-12.4 GHz	30	10503
12.4-18 GHz	30	10504

Power:
Single phase — 120 or 240, 40/20 Amps, 57-63 Hz

Size:
26" D. x 19" W. x 15¾" H.

—MCL/INC DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH LA GRANGE ILLINOIS 60525 312-354-4350

M-C-L INC
LA GRANGE ILL

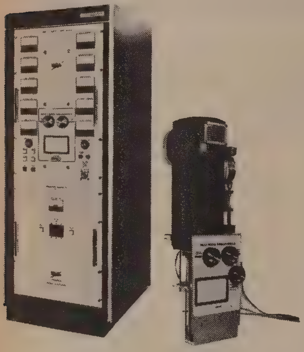
MICROWAVE SYSTEMS

1000-WATT RF, CW POWER AMPLIFIER SYSTEM 50 TO 1100 MHZ* COVERAGE IN ONE PACKAGE WITH BANDCHANGE CAVITIES

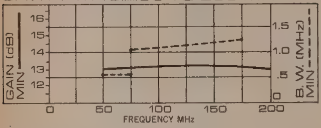
ALL UNITS STOCKED FOR IMMEDIATE SHIPMENT

- FRONT PANEL DIAL TUNING OF EACH RF CAVITY.
- FRONT PANEL DIAL VS. FREQUENCY CALIBRATION CHARTS ON EACH CAVITY.
- FRONT PANEL METERING OF PLATE, SCREEN, GRID AND FILAMENT CIRCUITS AND FORWARD AND REFLECTED POWER OF INPUT AND OUTPUT CIRCUITS.
- ELAPSED TIME INDICATOR.

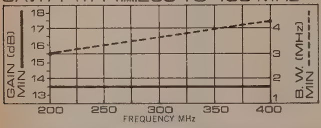
Model 10270 is the ultimate in RF power amplifier design... affording maximum utility in commercial, military and similar installations where space must be budgeted. Its modular cavity bandchange feature provides users with a high degree of flexibility, high power efficiency and extreme economy in one quality constructed package.



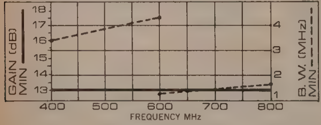
CAVITY 11143.....50 TO 200 MHz



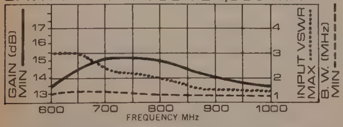
CAVITY 11144.....200 TO 400 MHz



CAVITY 11145.....400 TO 800 MHz



CAVITY *11104.....600 TO 1,000 MHz



*11104 cavity is available with a frequency range of 800 to 1100 MHz with a power output of 500 watts

FEATURES AND SPECIFICATIONS

Power output: 1.0 kilowatt*

Operation: Class B. (Other operating modes supplied upon special order.)

Maximum Input VSWR: 2:1 (3:1 from 600-800 MHz on M/N 11104 only).

Nominal Impedances: 50 ohms, input and output. Terminated in standard military connectors — Type "N" input, Type "LC" output.
Amplifier drawer assembly equipped with tilt-out sliderails to facilitate cavity changing, and servicing. Sliderails will fit any standard relay rack cabinet.
All solid state power supplies.
Filament, grid and screen supplies regulated for maximum stability.

Primary Power Requirements: 208/120 Y three-phase, four-wire 60 Hz or 240 VAC three phase, optional 208/120 VAC three-phase, four-wire 400 Hz. 50 Hz also available upon special request.

Cooling: Air is drawn in through top louver and exits through rear louver.

Dimensions (In Cabinet): 61½ High x 24 Wide x 26 Deep.

Weight (In Cabinet): 475 lbs.
Individual Cavity Weighs 40 to 75 lbs.

PROTECTIVE DEVICES

Operator:
High voltage chassis interlocks.
High voltage points shielded for safety.

Amplifier:
Excessive plate current trip-out relay.
Excessive screen current trip-out relay.
Screen voltage interlocked with plate voltage.
Screen and plate voltages interlocked with grid voltage.
Cooling failure trip-out.
Primary circuit breaker for short-circuit protection.
Time delay relay for filament warm-up.
Delayed blower turn-off cycle. (Blower continues running for 3 minutes after circuit breaker turns power off.)
VSWR protection (optional).

HOW TO ORDER

To order a complete amplifier system (in cabinet) specify model number according to frequency range desired.

Example: MODEL 10270 — 11143 (50-200 MHz)
MODEL 10270 — 11144 (200-400 MHz)
MODEL 10270 — 11145 (400-800 MHz)
MODEL 10270 — 11104 (600-1000 MHz)

To order separate, modular RF bandchange cavities specify cavity model number according to desired frequency range.

Example: CAVITY MODEL NUMBER 11045 (400 TO 800 MHz)
Cavities are equipped with tube and all accessories for band changing.

Note: System is shipped complete with cabinet as shown unless otherwise specified.

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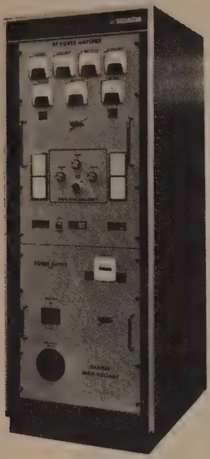
MCL INC LA GRANGE ILL

MICROWAVE SYSTEMS

500-2000-WATT KLYSTRON CW AMPLIFIER SYSTEMS

STOCKED (LESS TUBES) FOR IMMEDIATE SHIPMENT



An exclusive MCL achievement in design and development of self-contained, rack-mounted Klystron cavity amplifier-power supply systems that eliminates clutter and contributes to work area efficiency.

Suggested applications include biological research, factory test-source.
This series includes 8 individual systems, each embodying highly desirable features such as high power capability, broad frequency range. (Any of these systems can be custom modified.) Each system is engineered conservatively and quality built, affording users maximum reliability and economy.

- **RACK-MOUNTED, COMPLETELY SELF-CONTAINED**
- **1700 to 18,000 MHz COVERAGE**
- Individual front panel cavity tuning dials and dial vs frequency calibration charts.
- Front panel metering of beam voltage and current, body current, filament voltage and current, forward and reflected power of input and output circuits.
- Elapsed time indicator.
- Fault and Control Panel — indicates equipments operational status and fault status.
- Front panel high voltage control.

GENERAL FEATURES AND SPECIFICATIONS
PROTECTIVE DEVICES

Operator:
- High voltage chassis interlocks.
- High voltage points shielded for safety.

Amplifier:
- Adjustable time delay — beam voltage.
- Excessive beam current — Fault Trip.
- Excessive body current — Fault Trip.
- Low filament voltage — Fault Trip.
- Power supply — open interlock fault.
- Excessive VSWR — Fault Trip.
- Primary circuit breaker for short-circuit protection.

WEIGHT: 700 lbs.

DIMENSIONS: (IN CABINET)
61½ HIGH x 24 WIDE x 26 DEEP

- **Cooling:** Air is drawn in through rear and exits through top.
- Cooling failure trip-out.
- **Operation:** High gain, high efficiency or broad band tuning modes.
- Delayed blower turn-off cycle. (Blower continues running for at least three minutes after circuit breaker turns power off.)
- **VSWR:** 2:1, maximum — output load; 1.1:1, maximum — input circuit.
- **Nominal impedance:** 50 ohms, input and output through individual, directional couplers. Input connector — Type "N."
- Arc detection circuitry available on special order.
- Solid state high voltage supply unregulated.
- Front panel high voltage control.
- Regulated filament supply.
- **Main power requirements:** 208 Y/120, 4 wire, 60 Hz. 50 Hz operation available upon special order.

Freq. MHz	Power Output	Tube Type	Max. Gain Tuned		Max. B.W. Tuned		Output Connector	Model
			Gain db.	BW MHz	Gain db.	BW MHz		
1700-2400	1.0 KW	4K3SJ	47-45	4-6	—	—	1⅝ AL	10282
1700-2400	1.0 KW	4K3SL	41-38	9-12	38.3	13-14	1-⅝ AL	10283
2400-2700	1.0 KW	4K3SK	43-42	10-15	—	—	1⅝ AL	10284
2850-3050	1.0 KW	4K3SN	45	7	—	—	1⅝ AL	10285
4400-5000	1.0 KW	VA888	51	6-8	41	13-19	UG-149 A/U	10276
5900-6400	1.0 KW	VA936[1]	58	7-8	48	11	UG-343 A/U	10278[1]
7100-10,000	1.0 KW	VA866[2]	59	12	50	20	UG-51/U	10286[2]
10000	2.0 KW	VA903	43	19	—	—	UG-39/U	10473
15000-18000	0.5 KW	VA930[3]	50	12	40	20	UG-419/U	10287[3]

NOTE: A series of tubes with [1](40 MHz) [2](100 MHz) [3](250 MHz) tuning range.

HOW TO ORDER

TO ORDER COMPLETE AMPLIFIER SYSTEM, SPECIFY ACCORDING TO MODEL NUMBERS:

EXAMPLE: MODEL 10276 (4400-5000 MHz)

NOTE: SYSTEM IS SHIPPED COMPLETE WITH CABINET AS SHOWN UNLESS OTHERWISE SPECIFIED.

† Eliminates need for external monitoring scope.

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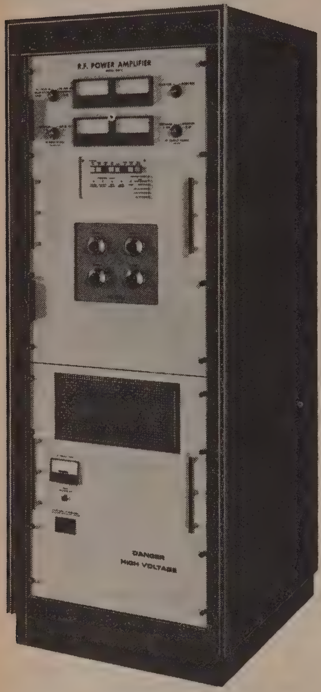
MICROWAVE SYSTEMS

HIGH POWER KLYSTRON AMPLIFIERS



This line of high Power Klystron amplifiers is designed for up-link satellite service in the tropo bands. The equipment consists of a klystron and the necessary power supplies, control-monitoring and protective circuitry to insure safe operation for equipment and personnel.

The amplifier uses Klystrons specifically designed to provide the performance in communication service. The supplies are conservatively designed to insure maximum reliability and are well regulated and filtered to minimize residual modulation.

Controls, fault indicators and meters are provided on the panel to permit ease of operation. Should a transitory fault occur the unit will automatically recycle and return to full service.

The circuitry is contained in slide out drawers or slide out shelves to permit complete maintenance from the front panel. In addition, test points are placed throughout at crucial circuit locations.

FEATURES

- Two bay configuration (some models).
- Front panel maintenance access.
- Electronic regulation of beam.
- Highly filtered supplies.

GENERAL SPECIFICATIONS

ENVIRONMENTAL

Temperature: −10°C to +50°C.

Relative Humidity: 95%.

Primary Power: 208/120 ±10%, 4 wire.

RF Connections: See Chart.

Dimensions: (45½″ w, 26¼″ d, 70″ h).

Weight: 1500 lb. (typical).

OPTIONS

- Alternate primary power.
- Harmonic output filter.
- Dummy load and switch.
- Driver amplifier to increase gain.
- Input/output switching for redundant operation.
- Channel selection remote/local (some models).
- Arc detector.

OPERATIONAL

- Automatic turn-on sequencing.
- Automatic recycling.
- Fault detection & status indicators.
    - Excessive reflected power.
    - Excessive beam current.
    - Excessive body current.
    - Insufficient filament warm-up.
    - Loss of cooling.
- High voltage chassis interlock & status indicator.
- High voltage shunting switches.

Freq. GHz	Power Output	Tube Type	Gain db	RF Connector	Model
.775-.985	2 KW	VA920	43	1⅝ AL	10495
1.7-2.4	2 KW	4K5SL-1	33	1⅝ AL	10496
1.6	2 KW	VK7711	VK60*	1⅝ AL	10475
5.925-6.425	.7 to 3 KW	VA936 (series)	46	CPR-137F	10497*

*with driver
For detailed specifications contact factory.

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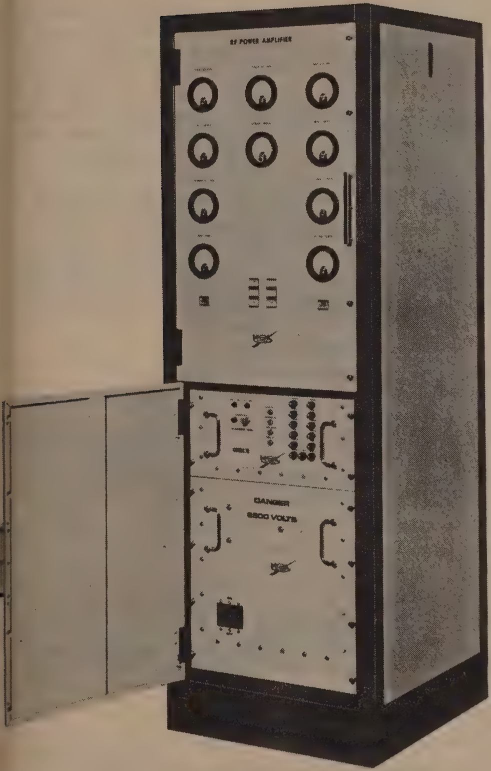
MICROWAVE SYSTEMS

COMMUNICATION AMPLIFIERS



MODEL 10581
225-400 MHZ

This line of high power amplifiers was designed specifically to fill the need for high power linear amplification to extend the communication range of existing AM transmitters. The amplifiers are also useful in Class B television or Class C FM service. The amplifiers are a complete package providing metering, safety features, and support circuitry. These versatile quality constructed units provide a simple and convenient means of obtaining increased power.

- Front panel dial tuning. Some models available with servo/local remote tuning.
- Individual front panel metering of plate, screen, grid and filament circuits, plus input, and output, RF power, forward and reflected.
- Elapsed time indicator.

PROTECTIVE DEVICES

Operator:

High voltage chassis interlocks.
High voltage points shielded for safety

Amplifier:

Excessive plate current trip-out relay.
Excessive screen current trip-out relay.
Screen voltage interlocked with plate voltage.
Screen and plate voltages interlocked with grid voltage.
Cooling failure trip-out.
Primary circuit breaker for short-circuit protection.
Time delay relay for filament warm-up.
Delayed blower turn-off cycle. (Blower continues running for 3 minutes after circuit breaker turns power off.)

OPTIONS:

The following items are available as options on most models:

Automatic tuning
Harmonic Filters
Antenna Transfer Relay and Control
Antenna tuner
Dummy load
VSWR fault trip circuit

SPECIFICATIONS

Frequency MHz	Power Out (FM)	Power Out (PEP)	Power Out CW 90% AM	Bandwidth @ 3 db	Gain	Size	Primary Power	Output VSWR	Model Number
120-160	2000 W	4000 W	1500 W	4 MHz	12 db	79″ H. x 24″ W. x 24″ D.	380 V, 3 phase, 50 Hz	1.25	10297
148-154	2000 W	4000 W	1500 W	6 MHz	10 db	61″ H. x 25″ W. x 28″ D.	208 V, 3 phase, 50 Hz	1.25	10288
148-156	2000 W	7.2 KW	2.0 KW	4 MHz	12 db	80″ H. x 24″ W. x 24″ D.	208 V, 3 phase, 60 Hz	1.25	10333
225-400	2000 W	4000 W	1400 W	4 MHz	13 db	72″ H. x 19″ W. x 24″ D.	208 V, 3 phase, 60 Hz	1.25	10581

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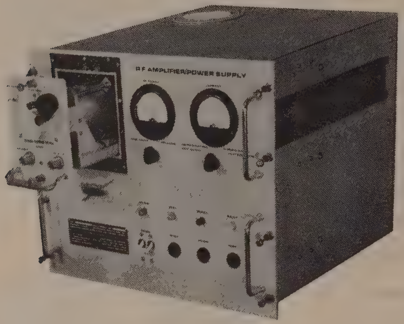
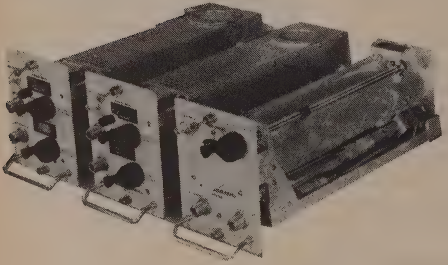
MICROWAVE SYSTEMS

200 WATT CW AMPLIFIER
MODEL 10358
PLUG-IN—10 TO 1000 MEGAHERTZ





Frequency MHz	Gain db (Min.)	Bandwidth at 3.0 db	Plug-In Cavity Drawer Nos.
10-50	11	.2- .9 MHz	10359
50-200	11	.5-1.9 MHz	10363
200-500	13	1.0-1.8 MHz	10364
500-1000	9	4.0-8.0 MHz	10365
3 Head Storage Drawer			10362

The 10358 is a versatile amplifier system which offers the user a high degree of flexibility. The choice of five plug-in amplifier cavities provides continuous frequency coverage from 10 MHz to 1000 MHz. The amplifier can be used to drive higher power amplifiers or as a final amplifier driven by a lower power source. The equipment is available in a commercial version or a military version under FSN 4931 - 130 - 5378.

GENERAL FEATURES AND SPECIFICATIONS

Power Output: 200 Watts (cavity 10365 100W)

Operation: Class C

Maximum Input VSWR: 2:1

Nominal Impedances: 50 ohm input and output terminated in standard type "N" connectors.

RFI: Shielded to meet MIL STD 461.

Solid State: Solid state except for amplifier tube.

Regulation: Filament, grid screen supply regulated for maximum stability.

Mounting: Designed for 19″ relay rack mounting or bench top use.

Input Power Requirements: 105/125 VAC, 50/60 Hz or 220 VAC, 50/60 Hz optional.

Dimensions: $15\frac{23}{32}$″ H x 19″ W x 18″ D.

Weight: 225 lbs. with cavity amplifier.

Cooling: Forced air.

Protective Devices:

Operator: High voltage chassis interlocks.

Amplifier: Sequential turn-on control; cooling failure trip-out; primary power circuit breakers.

ADDITIONAL FEATURES

- Front panel dial tuning of each plug in head.
- Front panel metering of plate and screen currents.
- Front panel metering of forward and reflected power of input and output circuits.
- Direct dial frequency read out.

19″ rack mounting storage drawer available for storage of any three of the above plug-in cavities.

Size: 7″ High x 19″ Wide x 20″ Deep.

ORDERING INFORMATION

Complete amplifier system — specify model number 10358 which designates the main frame. Each head desired to be specified by model number indicated in chart ie, 10 - 50 MHz Model 10359, etc. Specify desired input voltage.

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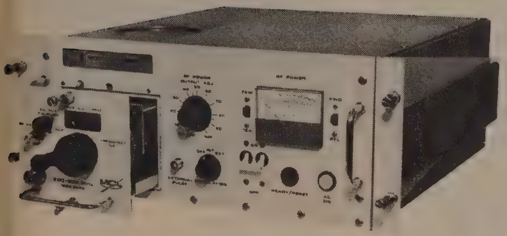
MICROWAVE SYSTEMS

MODEL 15022
65 WATT 10 TO 2,500 MHZ CW SIGNAL GENERATOR

ALL UNITS STOCKED FOR IMMEDIATE SHIPMENT

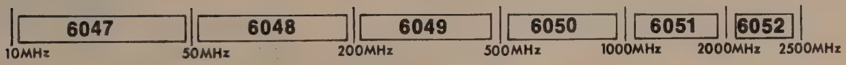


The Model 15022 is a compact high power signal generator which is completely solid state except for the long life vacuum tube used in the cavity oscillator. This highly reliable generator covers the 10 to 2500 MHz band with six plug-in cavity oscillator heads. A version which meets or exceeds MIL-STD-462 (RFI) and MIL-STD-810 (environmental) is widely used by the military in calibration laboratories and has been assigned a Federal Stock Number which is FSN 4931-152-1774 (MCL Model Number 15009).

This modern generator design provides the convenience of one knob frequency tuning which will permit frequency settings within ±1%, and front panel metering is provided to read forward or reflected power. Additional features include internal or external amplitude and pulse modulation. AM modulation is variable from 0 to 90%, 150 Hz to 10 KHz with an external source of 18 V across 16 Ohms. Amplitude level adjustment and a decoupled RF output sample port are also provided.

Regulated power supplies, conservative design, all solid-state (except oscillator) provides reliability and stability. Frequency stability of ±.003% after 10 minutes and power stability of ±.2db after one hour are minimum performance characteristics.

Plug-in cavity oscillator is protected against mismatch or loss of load. Other protection includes time delay sequenced turn-on and turn-off to insure adequate filament heating and adequate cooling at shut-down. These features make the 15022 an ideal laboratory tool.



DESCRIPTION

	Power Output	Model Number
10-50 MHz plug-in Oscillator	65 watts *	6047
50-200 MHz plug-in Oscillator	65 watts *	6048
200-500 MHz plug-in Oscillator	65 watts *	6049
500-1000 MHz plug-in Oscillator	65 watts *	6050
1000-2000 MHz plug-in Oscillator	45 watts *	6051
2000-2500 MHz plug-in Oscillator	35 watts *	6052

*Power Output is adjustable down to 50 MW.

ACCESSORIES

Rack mount storage drawer which accommodates three plug-in heads. Specify storage drawer model #15026.

Need rack and slide mounting?? Please **specify!** All units are shipped **without** 19″ panel adaptors and slides unless specified.

GENERAL SPECIFICATIONS

• Weight	Less than 50 pounds, without plug-in head.
• Dimensions	16½″ W. x 7″ H. x 18″ D. (19″ W. with panel adaptors)
• Output Impedance	50 ohms
• Primary Power	115 volts ±10V, 5 amps, 50/60 Hz 220V 50 Hz, specify M/N 15055
• Spurious Output	>30 db down (20-2500 MHz) >25 db down (10-20 MHz)
• RF Sample Output	30 db down

ORDERING INFORMATION

Models #15022 indicates mainframe (generator less plug-in head). Please specify model number according to frequency range. Example: 15022-6047 (10-50 MHz).

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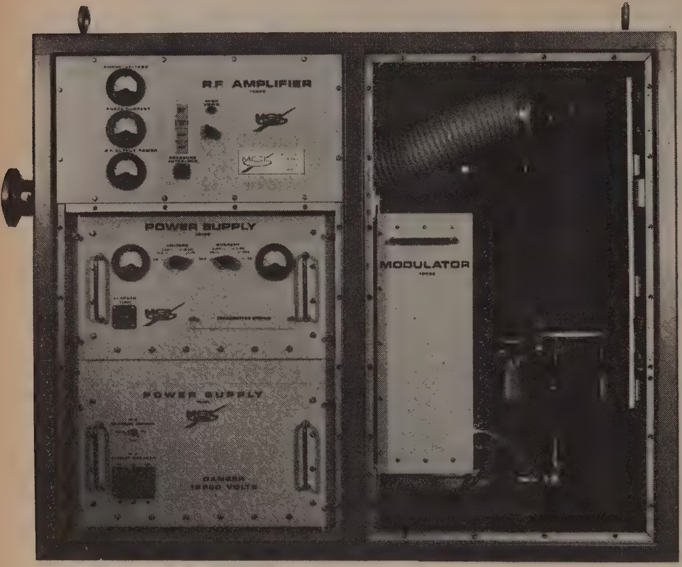
MICROWAVE SYSTEMS

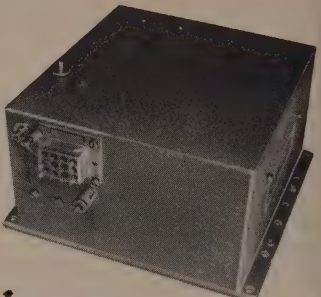
PULSE SYSTEMS

MCL has designed a number of high power pulse systems for special applications. The systems listed are but a few of the many designed and have been selected since they typify the broad capability of MCL. These equipments are complete assemblies and include the necessary power supplies, protective circuits and control circuitry to provide turn-key operation. The applications vary from ground and airborne radar to laboratory test instrumentation.

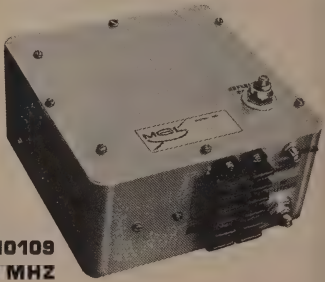
The capability and expertise represented by this array of systems are available to solve your system problems.



MODEL 10343 (WITH PANELS REMOVED)
146M HZ



MODEL 10116
2300-2450 MHZ



MODEL 10109
1010-1050 MHZ

PULSE SYSTEMS SPECIFICATIONS

Frequency	Power Out	Gain	Bandwidth @ 3 db	Duty Cycle	Pulse Width in μSec.	Input Requirements	Dimensions	Model
120-400	2 KW	23 db	4.5 MHz	.025	1	115 VAC, 60 Hz	32″ H. x 19″ W. x 25″ L.	10224
145-154	50 KW	——	———	.0015	2-5	115 VAC, 60 Hz	42″ H. x 52″ W. x 30″ L.	10258
146	100 KW	——	6.5 MHz	.005	.25	115 VAC, 3 phase, 400 Hz	40″ H. x 46″ W. x 32″ L.	10343
150-160	125 KW	——	———	.0028	4-7	208 VAC, 3 phase, 60 Hz	68″ H. x 29″ W. x 28″ L.	10275
216	30 KW	——	3 MHz	.001	10	115 VAC, 60 Hz	32″ H. x 19″ W. x 25″ L.	10264
205-225	50 KW	——	——	.067	6-200	208/440 VAC, 3 phase, 60 Hz	78″ H. x 43″ W. x 22″ L. HT. EXC. 72″ H. x 30″ W. x 24″ L.	10472
476	10 KW	——	———	.00087	14	115 VAC, 60 Hz	21″ H. x 19″ W. x 26″ L.	10315
500	15 KW	46 db	150 MHz	.003	1.5	208 VAC, 3 phase, 400 Hz	AMP. 23″ H. x 22″ W. x 27″ L. P/S 11″ H. x 22″ W. x 27″ L.	10292
1010-1050	1 KW	——	———	.005	.5	24 VDC @ 5.5 A. Trig: +3.5 V into 72 ohms	4″ H. x 6″ W. x 7″ L.	10109
2300-2450	350 W	——	———	.0146	28	24 VDC Trig: 4.0 V into 680 ohms	5¼″ H. x 6″ W. x 6½″ L.	10116

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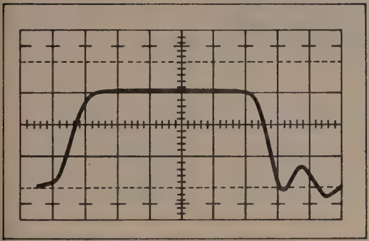
MCL INC LA GRANGE ILL.

MICROWAVE SYSTEMS

SERIES 10299C HIGH POWER PULSE MODULATORS

This versatile instrument offers virtually unlimited usage in laboratory or field. It is designed as a companion unit to MCL's popular Series "E" pulsed oscillators. Also interfaces readily with other plate pulsed oscillator cavities, beacon type magnetrons, experimental laser circuitry and low power microwave tubes.

PULSE WIDTH
PULSE RATE
PULSE AMPLITUDE
PULSE OUT
POS.
NEG.
PULSE MODULATOR
MODEL
DUTY CYCLE
EXT TRIG IN
SYNC OUT



Output Load: 1,000 ohms, paralleled by 100 Pf capacitor.

Note: Series 10299C pulse modulators are available as integral units with MCL Series "E" RF Power Oscillator test instruments.

Designed to fulfill the diversified and sophisticated demands of contemporary test equipment users, this unit embodies many "look ahead" features:

- Selection of three standard voltage ranges and accompanying sets of parameters:
- Duty cycle readout: .001 to .008, with 3.0% accuracy.
- Overload cut-off: adjustable from .001 to .01, via front panel. Protects external equipment from damage.

FEATURES AND SPECIFICATIONS

- Max. duty cycle at max. output .0075.
- Output pulse polarity: positive or negative.
- Internal or external triggering. (External: +2.0 V into 75 ohms.)
- Input power: 115 VAC, 50/60 Hz @ 300 watts.
- Conservative dimensions: 14" L x 8½" H x 11" W, permit ready usage on lab bench or in crowded areas.
- Built-in, floating, 6.3 VAC, 3.0 ampere filament supply for external tubes and tube cavity combinations.
- Weight: 35 pounds, approx.

Model No.	Adjustable Output Voltages	Peak Output Current	Rise Time	Fall Time	Droop @ 10 μsec Pulse Width	Overshoot at Full Rated Output
16072	0-1.5 KV	6.0 amp.	170 NS	200 NS	8.0%	12%
16073	0-3.0 KV	3.0 amp.	170 NS	200 NS	8.0%	10%
16074	0-6.0 KV	1.5 amp.	400 NS	400 NS	8.0%	8.0%

- Pulse repetition rate: adjustable, 100 Hz to 10 kHz, via front panel step switch and vernier control.
- Pulse width: adjustable, 0.5 to 10 microseconds, via front panel step switch and vernier control. Switch accuracy, 2.0%.

EXTENDED RANGE PULSE CAVITIES

Coverage: 150 to 4000 MHz (VHF, P. L. S. and C Bands) Extended tuning ranges combined with overall frequency coverage and power output make these cavities readily applicable to a broad variety of industrial, military and scientific requirements.

Frequency Range MHz	Minimum Power Output KW	Dimensions	Model Number
200-400 (P Band)	1.5	3" dia. x 22" L.	8021
250-500 (P Band)	1.5	3" dia. x 22" L.	8026
300-600 (L Band)	1.5	3" dia. x 22" L.	8018
400-800 (L Band)	1.5	3" dia. x 17" L.	8022
500-1000 (L Band)	1.5	3" dia. x 17" L.	8024
600-1200 (L Band)	1.0	2¼" dia. x 15" L.	8019
1000-1500 (L Band)	1.0	3" dia. x 22" L.	8028
1450-2000 (S Band)	1.0	3" dia. x 19½" L.	8029
2000-3000 (S Band)	1.0	2¼" dia. x 17¾" L.	8027
3000-4000 (C Band)	1.0	2¼" dia. x 15" L.	8030

MODEL 8026
250-500 MHZ

FEATURES

- Direct Dial Readout
- Single Knob Tuning (typ.)
- Output impedance: 50 ohms, nom.
- Forced air cooling not required
- Ease of Tube Replacement

DUTY CYCLE: .001

PULSE WIDTH: 1.0 μsec

MODULATOR REQUIREMENTS: 3.0 KV @ 3.0 amperes max. Internal impedance: 600 ohms.

POWER VARIATION: 2.0 db, max.

ANODE TO GROUND CAPACITANCE: 150 Pf, max.

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MCL INC LA GRANGE ILL

MICROWAVE SYSTEMS

MODEL 10461 PULSE GENERATOR

FIVE KILOWATT PULSE GENERATOR

The Model 10461 Pulse Generator is continuously tunable from 900 to 1220 MHz which is the Tacan Band. The generator is extremely useful as a Tacan test set. Peak power output is five kilowatts at .01 duty cycle. Pulse width and pulse repetition rates are adjustable.

The instrument is complete with power supplies, grid pulse modulator, cavity oscillator, cooling, output circulator, and protective circuitry.

The power output is adjustable from 50 watts to 5.0 kilowatts. A three digit numerical read-out with calibration chart provides accurate frequency setting.

The 10461 is a solid state instrument except for the planar triode oscillator. An output circulator is provided to minimize frequency pulling and power variations due to load mismatch; operation into open or short circuit conditions will not damage the equipment.

SPECIFICATIONS

Frequency:	900-1220 MHz tunable	Weight:	85 pounds
Power Output:	50 W - 5.0 KW adjustable	Primary Power:	110 or 220 volts* 50-60 Hz
Duty Cycle:	.01 maximum	Frequency Stability:	0.1%/hour after 15 minutes operation
Pulse Width:	0.5 - 10.0 microseconds adjustable	Power Stability:	0.02%/10 minutes after 1 hour operation
Pulse Repetition Rate:	10 - 4000 Hz adjustable	Sync Output:	±4 volts at 50 ohms
Pulse Rise Time:	100 nanoseconds maximum	Trigger Input:	+4 volts. High impedance
Pulse Fall Time:	100 nanoseconds maximum	Pulse Droop:	<5.0%
Maximum Load VSWR:	Open or short circuit (circulator protected)		
Dimensions:	19" rack panel, 10½" high x 20¼" deep	*Specify Desired Voltage	

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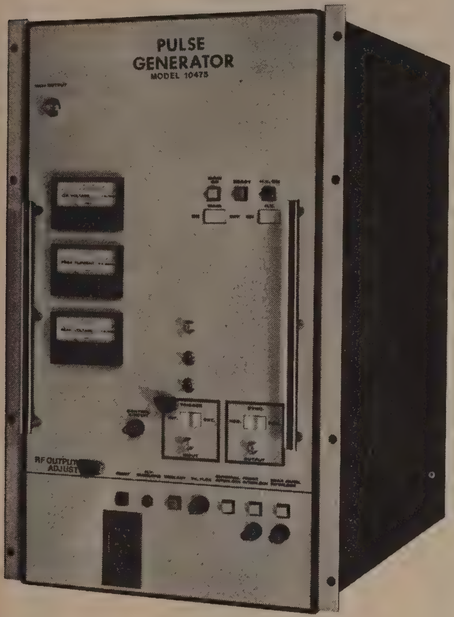
MICROWAVE SYSTEMS

HIGH POWER LONG PULSE MODULATOR



Designed to fulfill the need for a high power long pulse modulator in laboratory or field. The unit interfaces readily with plate pulsed oscillator cavities or other microwave tubes.

GENERAL FEATURES

- Integral floating filament supply, adjustable voltage @ 4A.
- Turn-on sequencing circuitry.
- T^2L compatible sync input and output.
- Fully protected.

SPECIFICATIONS

	10477	10478
Output Voltage KV	Adj.: 0-10 KV (10 KV @ 6 A)	Adj.: 0-10 KV (0-8 KV @ 3 A)
Pulse Rise Time Microsecond	1	1
Pulse Fall Time Microsecond	2	5
Pulse Width Microsecond	Adj.: 10-100	Adj.: 100-2000
Pulse Repetition Rate: PPS	Adj.: 10-500	Adj.: 10-500
Duty Factor %	5	6
Ripple %	Less than 5	Less than 5
Primary Input Voltage	220 V 1 φ	200 V 1 φ
Size in Inches	19″ x 36″ x 23½″	19″ x 36″ x 23½″

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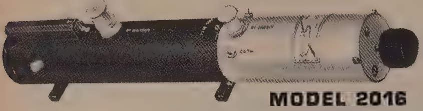
COMPONENTS CAVITIES

CW AMPLIFIERS



MODEL 2016
960-1215 MHZ

MODEL 11010
225-400 MHZ

Freq. in MHz	Power Output	Gain	Bandwidth	Dimensions	Model
30/150	40 W	13 db	3.0 MHz	7¼″ H. x 11¼″ W. x 13¼″ L.	2052
40/200	100 W	13 db Min.	1.5 MHz	11¼″ H. x 7½″ W. x 15″ L.	11024
150/300	40 W	13 db	3.0 MHz	4″ dia. x 32½″ L.	2051
225/250	25 W	12 db Min.	3 MHz	4⅝″ H. x 6¼″ L. x 3¾″ W.	2002-2
225/400	2 KW	13 db	4 MHz	11¾″ H. x 18½″ L. x 10″ W.	11097
225/400	1 KW	10 db	3 MHz	8¼″ H. x 19¾″ L. x 8¼″ W.	11099
225/400	120 W	13 db	4 MHz	8⅞″ H. x 20⅜″ L. x 9⁷⁄₃₂″ W.	11010
280/315	25 W	11 db	3 MHz	3¾″ H. x 4⅝″ L. x 3½″ W.	2002-4
360/480	1.5 KW	10 db	6.0 MHz	6″ dia. x 21″ L.	11030
360/480	120 W, Min.	13 db	6.0 MHz	3¾″ dia. x 15¾″ L.	11029
374/376	1.4 KW	13 db	10 MHz	6″ dia. x 15⅝″ L.	11057
374/376	60 W	13 db	8.0 MHz	6″ dia. x 10⁵⁄₁₆″ L.	11056
420/470	2.5 KW	13 db	3.0 MHz	6″ dia. x 27½″ L.	11074
500/560	25 W	10 db	6 MHz	2″ H. x 9″ L. x 5⅝″ W.	2002-9
560/630	25 W	11 db	6 MHz	2″ H. x 8¾″ L. x 2⅝″ W.	2002-10
630/710	25 W	11 db	6 MHz	2″ H. x 7¾″ L. x 2⅝″ W.	2002-11
710/800	25 W	10 db	3 MHz	2¼″ H. x 7½″ L. x 3″ W.	2002-12
800/900	25 W/CW	12 db	4 MHz	2¼″ H. x 7½″ L. x 3″ W.	2002-13
900/1000	22 W, CW	10 db	3 MHz	2⅛″ H. x 11⅛″ L. x 3½″ W.	2002-14
960/1215	20 W	12 db	4.0 MHz	2¼″ dia. x 17⅜″ L.	2016A
960/1000	100 W	10 db	2.5 MHz	2¼″ dia. x 16¼″ L.	2043
1260/1420	25 W	9 db	3 MHz	2⁵⁄₁₆″ H. x 8⅛″ L. x 2¾″ W.	2002-17
1260/1540	25 W, CW Min.	9.2 db Min.	10 MHz Min.	2³⁄₁₆″ H. x 4½″ L. x 2¼″ W.	3051
1650	30 W	10 db	10 MHz Min.	2¼″ H. x 4¼″ L. x 2⅜″ W.	2063
1650	125 W, CW	10 db	8 MHz Min.	3″ H. x 5″ L. x 2¼″ W.	2065
2000	20 W	10 db	30 MHz	5″ H. x 4½″ W. x 8½″ L.	3028
2000	50 W	7.0 db	3.0 MHz	4½″ H. x 3″ W. x 8″ L.	2047
2101.8	15 W	11 db Min.	15 MHz	5½″ H. x 3½″ W. x 8¾″ L.	3020
2106	10 W	7.0 db	10 MHz	3¼″ H. x 4⅞″ W. x 7″ L.	3006B
2125/2350	1.0 W	10 db	3.5 MHz	1½″ dia. x 5½″ L.	2014A
2200/2300	85 W	9.0 db Min.	10 MHz	2⅜″ dia. x 3¾″ L.	3018
2282.5	50 MW	10 db	15 MHz	1½″ H. x 3⅞″ W. x 4⅛″ L.	1010
2250	22 W	9.0 db Min.	4.0 MHz	2⅜″ H. x 6″ W. x 4″ L.	3040

CW OSCILLATORS

The CW Oscillator cavities designed by MCL cover a very wide range of frequencies, power levels and applications, and have been used by OEM in industrial and military applications ranging from oil exploration to aircraft altimeters. The listings below though not complete, typify the broad expanse of MCL's experience in CW Oscillator design and manufacture. If your exact requirements cannot be met using a listed cavity, call us for assistance.

MODEL 9015
4300 MHZ

SPECIFICATIONS

Frequency in MHz	Power Output	Dimensions	Model
400/500	1.5 W	1⅞″ W. x 2⁷⁄₁₆″ H. x 8⁹⁄₁₆″ L.	6002-7
800/900	40 W	3″ W. x 2″ H. x 6″ L.	6003-13
10000	20 W	3¼″ H. x 2³⁄₁₆″ W. x 5⅞″ L.	6024
4300	2.0 MW, Min.	⅝″ dia. x 2⅝″ L.	9015
4300	5.0 MW	¹¹⁄₁₆″ dia. x 2⅞″ L.	7200
5250/6050	5.0 MW, Min.	⅝″ dia. x 3″ L.	7014

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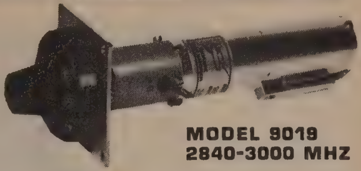
COMPONENTS CAVITIES

PULSE OSCILLATORS

The listed models are MCL standards, produced to satisfy the demanding needs of the original equipment manufacturer engaged in producing industrial or military equipment. These reliable, rugged cavities have been used in missiles, helicopters, ships and mobile applications. If your cavity needs are not listed here, minor modifications to existing units or custom design by MCL could make your requirements a reality.



MODEL 9019
2840-3000 MHZ

Freq. in MHz	Power Output	Duty Cycle	Pulse-Width	Dimensions	Model
150/160	25 KW	.005	5 μSec	6″ dia. x 24¼″ L.	11050
230	2.5 KW	.001	1 μSec	3¼″ dia. x 8″ L.	8035
415/475	20 KW	.001	1 μSec	6¼″ W. x 7″ H. x 12″ L.	9048
450/500	1.5 KW	.001	1 μSec	2⁷⁄₁₆″ H. x 1⅝″ W. x 8⁹⁄₁₆″ L.	8002-8
500/1000	50 KW	.003	6 μSec	6½″ H. x 5¼″ W. x 18″ L.	6057
630/710	2 KW	.001	1 μSec	3″ W. x 3″ H. x 9″ L.	8002-11M
900	20 W	.001	1.5 μSec	2⅛″ H. x 1″ W. x 2″ L.	8063
900/1050	1.0 KW	.01	.5 μSec	1¾″ H. x 1¾″ W. x 4¾″ L.	8041
960/1060	2.5 KW	.0006	1 μSec	1½″ dia. x 5½″ L.	9017
990/1010	3250 W	.0006	1 μSec	4⅝″ L. x 2⁵⁄₁₆″ H. x 1⁹⁄₁₆″ W.	9010B
1090	150 W	.01	45 μSec	⅞″ dia. x 4⅜″ L.	8042
1260/1420	15 W	.001	1 μSec	2¼″ H. x 3⁷⁄₁₆″ L. x 2″ W.	8000-17
1420/1600	1.5 KW	.003	1 μSec	8¹⁵⁄₁₆″ L. x 2⅜″ W. x 4¼″ H.	8003-18
1500	1.0 KW	.001	1 μSec	20⅜″ H. x 3″ W. x 8⅛″ L.	8044
2300/2450	1.0 KW	.015	28 μSec	1½″ dia. x 4¼″ L.	8043B
2400	500 W	.001	1.5 μSec	2″ H. x 2⁷⁄₁₆″ W. x 4⁹⁄₁₆″ L.	8075
2700	20 W	.001	1.5 μSec	2⅛″ H. x ⁹⁄₁₆″ W. x 2″ L.	8064
2840/3000	10 W	.00125	1 μSec	1″ dia. x 6½″ L.	9019
2840/3180	10 W	.00125 Max.	1 μSec	2″ H. x 6³⁄₁₆″ L. x 2″ W.	9012
3380/4000	2 KW	.005	.3 μSec	3¼″ L. x 1¼″ dia.	9057
3500/3520	2 KW	.005	.3 μSec	3¼″ L. x 1¼″ dia.	9058
3575/3635	500 W	.005	250 μSec	1⅜″ dia. x 3⅛″ L.	9021
4275/4325	100 W	.001	100 nSec	1″ dia. x 3″ L.	9202
4300	1.0 KW	.00029 Max.	75-100 nSec	1⅜″ dia. x 3½″ L.	9009
4300	250 W Max.	.0015	100 nSec	1″ dia. x 2⅜″ L.	9018
4820/5220	10 W	.00125 Max.	1 μSec	1″ dia. x 6³⁄₁₆″ L.	9013
5000	20 W	.001	1.5 μSec	2⅛″ H. x 1″ W. x 4″ L.	8065
5000	20 W, Peak	.001	1 μSec	¾″ dia. x 2½″ L.	9014
5300/5500	15 W, Min.	.0016	100 nSec	⅝″ dia. x 3″ L.	9022B
8500	20 W, Peak, Min.	.001	1.5 μSec	2⅛″ H. x 1⁵⁄₁₆″ W. x 2⁷⁄₁₆″ L.	8066

PULSE AMPLIFIERS

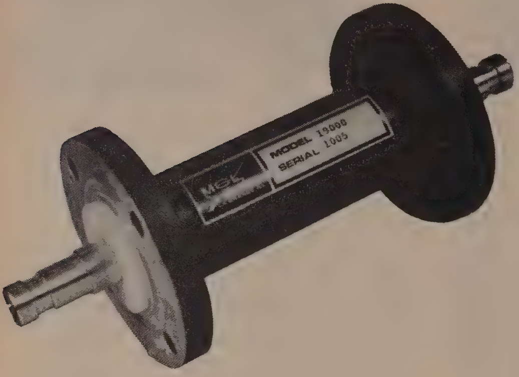
Freq. in MHz	Power Output	Pulse Width μSec	Duty Cycle	Gain	Bandwidth	Dimensions	Model
100/200	10 KW	1000.0	.025	8 db	4 MHz	12½″ L. x 29¹⁄₁₆″ H. x 14″ L.	11087
150/160	125 KW	15.0	.01	5.0 db	10 MHz	9⅝″ dia. x 24¼″ L.	11051
180/220	2.5 KW	15.0	.008	8 db	5 MHz	3½″ H. x 5²³⁄₃₂″ L. x 4⅜″ W.	3058
200/400	10 KW	1000.0	.025	8 db	4 MHz	11⅛″ L. x 28¾″ H. x 9″ W.	11088
216	3.0 KW	1.0	.004	10 db	4.0 MHz	5¼″ H. x 4¾″ W. x 3¾″ L.	3031
216	300 W	1.0	.004	10 db	4.0 MHz	5¼″ H. x 4¾″ W. x 3¾″ L.	3029
225/400	1.2 KW	1.0	.66	12 db	3.5 MHz	4¾″ dia. x 15″ L.	11009
400/800	10 KW	1000.0	.025	8 db	6 MHz	28¾″ H. x 8¼″ L. x 9¾″ W.	11089
420	5.0 KW	5.0	.02	10 db	20 MHz	2⅞″ H. x 10″ W. x 5″ L.	3021
420	200 W	5.0	.02	23 db	20 MHz	3¾″ H. x 8 ″ W. x 7¼″ L.	3022
425	400 W	4.5	.005	27 db	50 MHz	3½″ H. x 12¼″ W. x 7¾″ L.	3014
430.5	8.0 W	4.0	.005	7.0 db	33 MHz	6″ dia. x 7½″ L.	11033
470	2.0 KW	3.0	.003	19 db	100 MHz	4¾″ H. x 9½″ W. x 15⅞″ L.	3045
476	250 W	14.0	.001	12 db	8.0 MHz	2⅛″ dia. x 10″ L.	3023
512	2.5 KW	3.0	.003	20 db	75 MHz	19¼″ L. x 8¾″ W. x 3¼″ H.	3044B
512	10 KW	3.0	.003	6.0 db	75 MHz	17½″ L. x 7⅛″ H. x 6″ dia.	11067
550/1212	100 W	20.0	.02	10 db	3.0 MHz	1½″ dia. x 8½″ L.	2045
600/700	.55 KW	1.0	.01	11 db Min.	3.0 MHz	2″ H. x 3″ W. x 8½″ L.	2044
700/800	15 KW	1.0	.003	10 db	5.0 MHz	6″ dia. x 20″ L.	11031
800/1000	10 KW	1000.0	.025	8 db	8 MHz	28¾″ H. x 13″ L. x 10″ W.	11090
1000	2.0 KW Min.	10.0	.006	9.0 db	12 MHz	3⅜″ H. x 7⅝″ W. x 5½″ L.	2023A
1025/1150	1.5 KW	3.0	.003	7.0 db	120 MHz	2¼″ dia. x 6″ L.	3042
1025/1350	10 KW Peak	5.0	.003	6.0 db	6.0 MHz	3½″ dia. x 13″ L.	11011
1434/1487	63 W, CW	15.0	.008	10 db	15 MHz at 1 db	2″ H. x 2¼″ W. x 5⅜″ L.	3057
1545	2.0 KW	10.0	.01	13 db	20 MHz	3½″ H. x 3½″ W. x 6″ L	3047
1545	100 W	5.0	.01	23 db	20 MHz	3″ H. x 3½″ W. x 6″ L.	3046
2300/2450	2.5 KW	15.0	.008	8 db	5 MHz	3³⁄₁₆″ H. x 5⅙″ L. x 1½″ W.	3059

—MCL / INC DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH LA GRANGE ILLINOIS 60525 312-354-4350

MCL INC LA GRANGE ILL

COMPONENTS-FILTERS

FILTERS COAXIAL LOW PASS



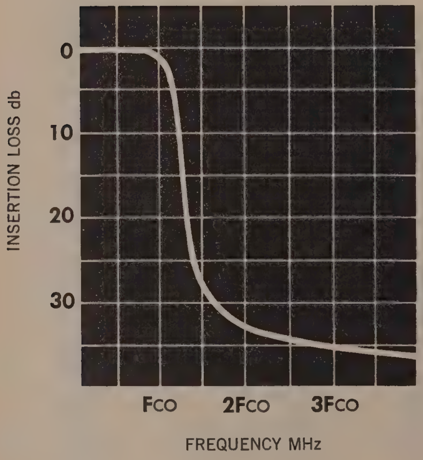
FREQUENCY RANGE FROM 200-2000 HZ

MCL Low Pass Filters are designed for cut off at a specific frequency (see table). The cut off curve is relatively steep and is sufficient for most applications; however, additional filter sections can be employed to increase the offband attenuation. For special applications, MCL's capability includes custom filter designs on a quick reaction basis.

All MCL Low Pass Filters employ conservative design techniques and are suitable for military applications. The body is constructed of 1⅝" rigid coaxial air line with silverplate finish.

TYPICAL SPECIFICATIONS

Max. VSWR (Passband): 1.4:1.
Max. Insertion Loss (Passband): .3 db.
Impedance: 50 ohms.
Power Rating, CW: 3 KW.
Power Rating, Peak: 50 KW.
Finish: Silverplate.
Flanges: LC and EIA RS-225.



Model Number		Cut Off Frequency MHz	Insertion Loss @ 1.25 Fco	Insertion Loss @ 1.5 Fco —6.0 Fco	Length Inches	
1⅝	LC				1⅝	LC
19051	19061	200	10	30	18	21½
19052	19062	400	10	30	14¹⁄₆₄	17³³⁄₆₄
19053	19063	700	10	30	8⁴³⁄₆₄	12¹¹⁄₆₄
19054	19064	1000	10	30	4	7½
19055	19065	2000	20	30	4	7½

MCL INC LA GRANGE ILL.

CAPABILITIES/APPLICATION

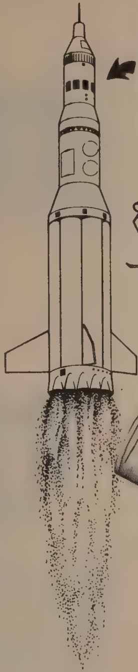
CAPABILITIES

MCL has been in the business of providing microwave cavities and high power amplifier systems to the electronics industry for over a decade. In an effort to prevent dilution of technical strength, the company has limited its product lines to cavities, cavity related systems and R.F. accessories. This intense concentration in a limited area has created a pool of technical excellence without peer.

The competence and imagination of MCL engineering has been tested repeatedly by the electronic industry, and MCL has successfully answered the call, delivering in excess of 400 different cavity designs and over 300 unique systems and subsystems.

MCL products are in use throughout the world performing a myriad of tasks that stagger the imagination. MCL cavities are used to provide pin-point accuracy for offshore drilling operations, to test the electromagnetic susceptibility of heart pacemakers, to maintain control of weather satellites, to determine the altitude of commercial and military aircraft, and many other operations. Our equipment has been used to communicate with the Apollo capsule and will be used on the Sky Lab program. Some of our equipment has gone into space on unmanned space probes. Be it satellite, ground, ship or shore, plane, helicopter, or missile MCL has built equipment to operate in the environment. We cover the field from cavities three inches long delivering 10 milliwatts to cavities four feet long delivering 100 plus kilowatts.

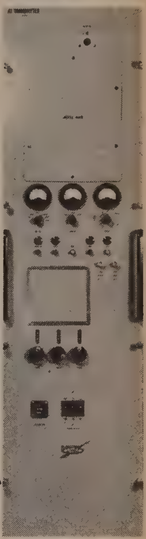
This experience can be applied to your microwave requirements by considering MCL a part of your design/development team.

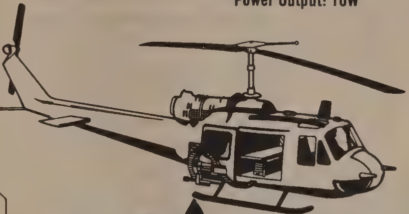


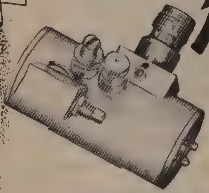
S-BAND RF AMPLIFIER

Freq.: 2101.80 MHz
Power Output: 10W

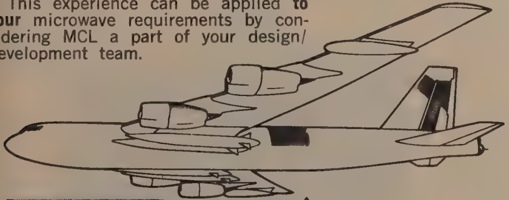
Freq.: 960 - 1200 MHz
Power Output: 10 KW

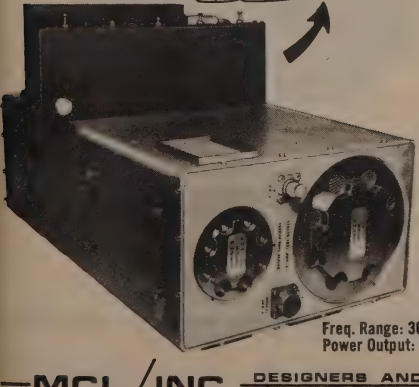




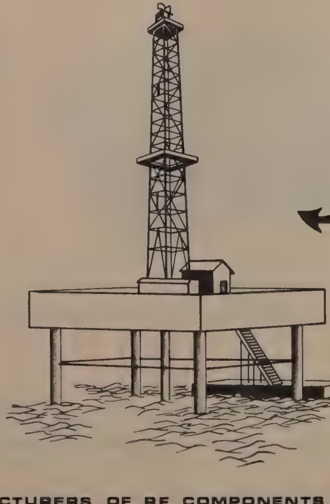


Freq.: 4300 MHz
Power Output: 250 W

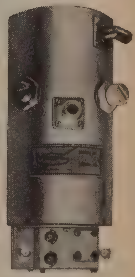




Freq. Range: 360-480 MHz
Power Output: 1.5 KW



Freq.: 230 MHz
Power Output: 15 KW

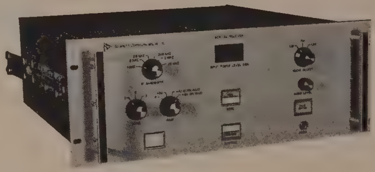


—MCL/INC DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH LA GRANGE ILLINOIS 60525 312-354-4350

SURVEILLANCE RECEIVERS

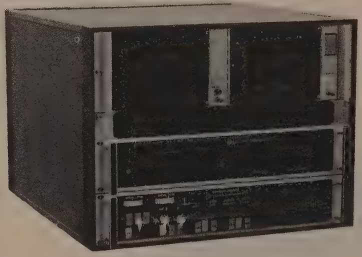
Scientific Communications has developed a full line of solid state microwave surveillance receivers. Current production models cover the frequency range from 5 KHz thru 40 GHz. Equipment available varies from fixed frequency down converters to complete digital controlled receiver systems offering simultaneous multi-band panoramic reception. All receiver models combine state-of-the-art performance with high reliability. Reliability and performance are enhanced through careful component selection and the wide use of standard modules and circuits. Modular construction is used wherever possible to optimize maintainability. Special features include computer compatibility, remote tuner capability and linear IFM processing, a technique pioneered by SCI to facilitate signal identification and analysis. SCI offers a demonstrated ability to respond quickly in designing and manufacturing custom equipment. Previously delivered models have ranged from standard commercial units to receivers tested and qualified to MIL-E-16400. The cost effectiveness and customer acceptance of SCI produced equipment has earned the company an excellent reputation in the field of microwave receivers.

RT SERIES REMOTE TUNERS
0.1 GHz to 40 GHz



SCR-25C COMPUTER CONTROLLED SURVEILLANCE FROM 5 KHz TO 1000 MHz

SCR-800 HIGH PERFORMANCE PANORAMIC RECEIVER COVERING SINGLE OCTIVE BAND



SCR-1200A SIMULTANEOUS PANORAMIC RECEPTION USING REMOTE TUNERS FROM .5 - 40 GHz

PARAMETRIC AMPLIFIERS

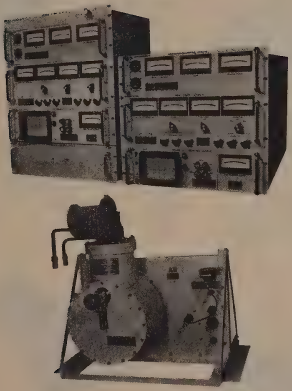
SR 395 PARAMETRIC AMPLIFIER
Scientific Communications, Inc.
GARLAND, TEXAS

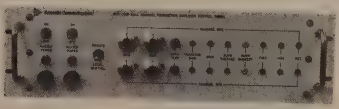
SCI has delivered parametric amplifiers all over the world for use in radar, telemetry, radio astronomy and satellite communications. Cryogenic or uncooled models are available from below 400 MHz to above 30 GHz. In addition to the many standard models available, SCI can design and manufacture amplifiers for any application. Contact Marvin Wallace, Vice President, Technical Marketing.

SR-395
3.7 - 4.2 GHz DOMSAT BAND PARAMP

UHFR-606 PARAMETRIC AMPLIFIER

UHFR-606
UHF PARAMP





CHANNEL ONE
CAUTION
CHANNEL TWO

LC-160A
CRYOGENIC
L-BAND
PARAMP

SCP-101B DUAL CHANNEL 2.2 - 2.3 GHz
PARAMP WITH OPTIONAL REMOTE CONTROL

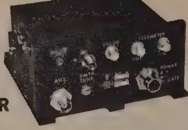
Scientific Communications, Inc.

PARAMETRIC AMPLIFIERS•TRANSISTOR AMPLIFIERS•SURVEILLANCE RECEIVERS•MANAGEMENT CONTROL COMPUTERS

3425 KINGSLEY ROAD, GARLAND, TEXAS, 75041
(214) 271-3685 TWX 910-860-5172

VEGA PRECISION LABORATORIES, INC.

VEGA MAJOR PRODUCTS: Portable Radar Tracking Systems • Command and Data Systems • Target Control Systems • Radar Transponders • Radar Beacons • Transmitters • Receivers • Location and Navigation Systems • Radar Augmentation Devices • Special Test Equipment • R-NAV Devices • Antennas and Microwave Devices • Ranging Systems



S-BAND RADAR TRANSPONDER

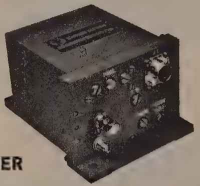
MODEL 312-S

Freq: 2775-3000 MHz; **Receiver Type:** Superhet with sensitivity of −70 dbm; **Transmitter Type:** Triode cavity with 300 w min. peak power output; **Input Power:** 22 to 32 VDC; **Size:** 50 cu. in.; **Weight:** 47 oz.; **Temp:** −55°C to +75°C; **Altitude:** 230,000 ft.; **Humidity:** 100%; **Shock:** 125 g in any direction, 3 shocks in opposite directions along each axis for 6 μsec each; **Acceleration:** 125 g applied along any axis for 3 minutes; **RF1:** Per MIL-1-26600. **Vibration:** Sinusoidal, 5 to 25 Hz, 0.4 in. DA and 15 g 15 to 2500 Hz.

C-BAND RADAR TRANSPONDER

MODEL 302C-2

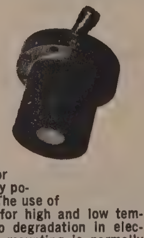
Freq: 5.4-5.9 GHz; **Receiver Type:** Superhet with sensitivity of −70 dbm; **Transmitter Type:** Magnetron with 400 w min. peak power output; **Input Power:** 22 to 32 VDC; **Size:** 43 cu. in.; **Weight:** 43 oz.; **Temp:** −35°C to +75°C; **Altitude:** 230,000 ft.; **Humidity:** 100%; **Shock:** 125 g in any direction, 3 shocks in opposite directions along each axis for 6 μsec. each; **Acceleration:** 125 g applied along any axis for 3 minutes; **RF1:** Per MIL-1-26600. **Vibration:** Sinusoidal, 5 to 25 Hz 0.4 in. DA and 15 g 15 to 2500 Hz.



C-BAND RADAR TRANSPONDER

MODEL 321C

Freq: 5400-5900 MHz; **Receiver Type:** Superhet with sensitivity of −70 dbm, 100% firing; **Transmitter Type:** Triode Cavity with 300 w min. peak power output; **Input Power:** 24 to 32 VDC, 45 w; **Size:** 38 cu. in.; **Weight:** 44 oz.; **Temp:** −37°C to +75°C; **Altitude:** 230,000 ft.; **Acceleration:** 125 g; **Shock:** 125 g; **Vibration:** Sinusoidal, 5 to 25 Hz, 0.4 DA. 25 to 2500 Hz, 15 g; **RF1:** Per MIL-1-26600.



CAVITY BACKED HELIX ANTENNAS

MODELS 815S, 820C and 830X — C, S, and X BAND

An optical quartz-loaded, cavity backed helix radiator which produces a circularly polarized radiation pattern. The use of quartz material provides for high and low temperature stability with no degradation in electrical performance. Flush mounting is normally used on reentry vehicles with no performance deterioration as a result of reentry heat.

X-BAND RADAR TRANSPONDER

VEGA'S MODEL 229X

Miniature all solid-state radar transponder is smaller than a king size pack of cigarettes; weighs only 10 oz. This X-Band (9.1-9.6 GHz) unit employs the latest state-of-the-art solid-state devices and construction techniques, and features high sensitivity (−40 dBm full-firing) with average power output of 4 watts peak. It operates with an input voltage from 24 to 32 VDC and draws only 60 milliamperes quiescent or 80 milliamperes at a PRF of 2500 PPS. Uses single or double pulse codes and operates with practically all X-Band airborne, ship and ground radars in use today without any change to the radar. A circularly polarized antenna is attached to the top of the unit. Optional battery pack available. Also available in C-Band (5.4-5.9 GHz).

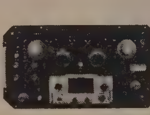
C, S AND X-BAND STUB ANTENNAS

MODELS 832S, 845CX

A vertically polarized omnidirectional antenna enclosed within a radome, it is compact and extremely lightweight while maintaining the electrical and environmental characteristics of this type antenna. Height of the radome is approximately ¾″; diameter is approximately 1″. The skin of the vehicle serves as the ground plane for the antenna due to the simplified mounting technique. Mounting is accomplished via a "D" hole (.505 dia. x .480 flat) through the vehicle skin. It is then secured to the vehicle with a locking nut.

RADAR SIMULATORS

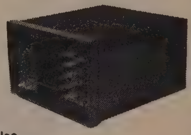
C-BAND
X-BAND
S-BAND



The 616C, 617X, and 627S Series are designed to interrogate and measure parameters of radar transponders or beacons during final checkout on a launch pad or flight line. They are particularly useful when tracking radars are located at great distances from launch sites. Transmitters and receivers are calibrated and controllable from the front panel in tuned frequency, output power, code spacing and sensitivity. Built-in oscilloscopes are hooded for daylight viewing. A resonant stubhorn antenna is standard. The internal battery supply includes a self-contained charging circuit. Telescoping legs are optional.

HORN ANTENNA TYPES

The Model 844X-2 Flared Horn Antenna was developed for use in target drone applications. Radiation coverage is controlled to the desired beamwidths by the flared aperture. A colinear type feed is employed to couple energy from the TNC input connector into the waveguide. Construction utilizes standard aluminum waveguide parts dip-brazed together. The radome is epoxied in position over the aperture. Flared horn antennae of this type are available in other frequency bands utilizing the same design.



DIGITAL CODE GENERATOR

MODEL 766

Generates extremely accurate pulse stream for pulse position code simulation. Pulse stream starts with a sync pulse followed by five data pulses. Each data pulse is independently adjustable for both delay from the sync pulse and for pulse width. Delay adjustable from 0.0 to 999.9 microseconds in 0.1 microsecond steps. Width is continuously adjustable from 0.1 to 1.0 microseconds. Operates from 115 VAC, 50 to 400 Hz. Outputs are TTL positive logic terminated in 50 ohms.

POWER DIVIDERS

Vega produces an assortment of power dividers with two, three or four-way division in addition to a variable power divider. Choice of input connectors (TNC or SMA) is offered in most models. All designs are well engineered and provide low VSWR, low insertion loss, and balanced power division with high power capabilities. Some designs are qualified for missile and satellite use. Frequency ranges extend through X-Band with stripline and coaxial devices.

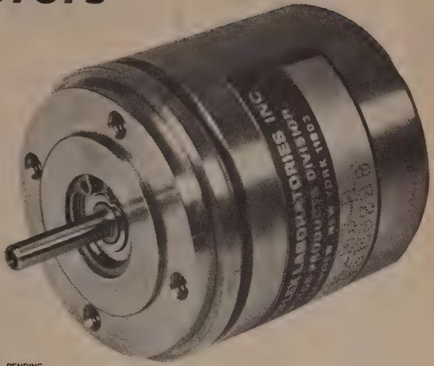
Vega's antenna and microwave engineering staff specialize in the design and development of aircraft, space and missile components. Among our designs are units intended for RPV control. A single basic system can be used to control virtually any vehicle. Our laboratory utilizes the latest in equipment and suitable antenna test ranges are maintained. Some of the more popular available components are shown above.

VEGA PRECISION LABORATORIES, INC.

800 Follin Lane S.E. • Vienna, Virginia 22180 • 703-938-6300

New brushless D.C. Motors from AEROFLEX

- LONG LIFE
- HIGH RELIABILITY
- HIGH STARTING TORQUE
- HIGH EFFICIENCY
- LOW EMI
- LOW ACOUSTIC NOISE



PATENT PENDING

Aeroflex Laboratories new line of brushless DC motors combine modern solid-state sensing and switching techniques with proven motor technology. The non-contacting rotor position sensors are speed independant and do not employ LED or RF techniques. The size, performance, and efficiency of these motors are comparable to brush type motors, **without** the problems inherent in brushes.

Aeroflex brushless DC motors have the high starting torque and linear speed/torque characteristics of conventional, permanent magnet, DC motors. The solid-state commutation circuitry is available with integral speed regulation, to meet custom requirements.

The motor can be supplied for operation from a fixed polarity voltage and rotation in either direction, or with the direction of rotation reversing with reverse polarity voltage.

Fan and blower motor applications can benefit by the higher reliability of the Aeroflex brushless DC motors. In addition, these motors may be used in AC blower applications without the rotational speed/line frequency limitations of AC motors.

In instrumentation and control applications, their reliability and long life can significantly enhance total system performance. They are compatible with pulse modulation and pulsed variable rep-rate types of servo control techniques.

Contact Aeroflex Motor Applications Engineering for assistance.

TYPICAL PERFORMANCE DATA

FRAME SIZE	8	11	15	25	33
Stall Torque (oz/in)	.2-8	1-1.5	1.5-8	3-13	5-40
Stall Power (watts)	6	8	14-22	23-35	50-110
Rotor Moment of Inertia (gm cm^2)	.5	1.0	5.0	140	750
Rated Torque (oz/in)	.1-.4	.5-.75	1-5	1.75-8	3.5-25
Speed at Rated Load (rpm)	2,500/5,000	2,500/5,000	150/5,000	150/5,000	150/5,000
No Load Speed (rpm)	5,000/10,000	5,000/10,000	3,000/10,000	3,000/10,000	3,000/10,000
Weight (oz.)	2.5	5.0	10	25	65
Dim. "A"	1.25	1.75	2.00	4.00	5.00
Dim. "B"	.750	1.062	1.437	2.75	3.31
Dim. "C"	.500	.825	.875	N/A	N/A
Dim. "D"	.040	.062	.040	N/A	N/A

NOTES:

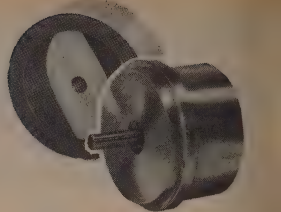
1. Designed to meet military and industrial specifications.
2. Available with speed regulation to ±1% for variations in load torque and supply voltage.
3. Shaft details as requested.
4. Synchro type mounting optional.
5. Excitation voltage-standard ratings available.
6. Peak torque ratings approx. 40% above continuous value.
7. Efficiency up to 75%.
8. Consult our engineering staff for other ratings.

AEROFLEX

MOTOR PRODUCTS DIVISION
AEROFLEX LABORATORIES INC.
SOUTH SERVICE ROAD • PLAINVIEW, LONG ISLAND, N. Y. 11803
TEL. (516) 694-6700 • TWX: 510-224-6417

AEROFLEX *brushless* D.C. Torquers

AEROFLEX



FEATURES:

- No commutator brush or contact friction
- Unlimited life
- Infinite resolution
- Direct Drive
- No radio noise or explosion hazard
- No motor ripple or "slot lock"

Wide Angle *brushless* D.C. Torquers (Partial Listing)

Basic Part Number	Peak Torque (oz. in.)	Peak Power (watts)	Continuous Torque (oz. in.)	Continuous Power at 25°C (watts)	Driving Voltage for Continuous Torque (volts D.C.)	Angular Excursion (degrees)	Torque Sensitivity (oz. in./amp.)	Back EMF (v/rad/sec)	Resistance at 25°C (ohms)	Electrical Time Constant L/R (sec)	Rotor Inertia (oz. in. sec²)	VISCOUS DAMPING		Weight (oz.)	PANCAKE DIMENSIONS		
												Infinite	Zero		O.D. (inch)	Thick. (inch)	I.D. (inch)
												Source Impedance (oz. in./rad/sec)					
TQ10Y-10	1.3	21	.5	2.4	12	120	2.5	.018	60	3×10^{-4}	1.6×10^{-5}	1.5×10^{-5}	1.1×10^{-3}	1	1.000	.350	.125
TQ10Y-1	6	110	1.5	7	34.5	120	7.6	.055	175	2×10^{-4}	4×10^{-5}	4×10^{-5}	2.4×10^{-3}	2	1.000	.700	.125
TQ10Y-2	6	103	1.5	7	26	120	5.8	.041	100	2×10^{-4}	4×10^{-5}	4×10^{-5}	3×10^{-3}	2	1.000	.700	.125
TQ10Y-4	6	85	1.5	5	5.6	120	1.6	.011	6	2×10^{-4}	4×10^{-5}	4×10^{-5}	3×10^{-3}	2	1.000	.700	.125
TQ18W-30	3	25	1.8	8	17	120	3.9	.027	36	5×10^{-4}	2.4×10^{-4}	3×10^{-4}	2×10^{-3}	3	1.718	.350	.187
TQ18W-37	3	20	1.9	8	15	120	3.5	.025	27	5×10^{-4}	2.4×10^{-4}	3×10^{-4}	2×10^{-3}	3	1.718	.350	.187
TQ18W-23	8	45	4	11	22.5	120	8.5	.060	48	8×10^{-4}	4.8×10^{-4}	3×10^{-4}	1×10^{-2}	4	1.718	.700	.187
TQ18W-35	8	35	4	9	4.6	120	2.2	.015	2.5	8×10^{-4}	4.8×10^{-4}	3×10^{-4}	1×10^{-2}	4	1.718	.700	.187
TQ18-25	5.6	25	3	7	20	50	9	.063	60	2×10^{-4}	3.2×10^{-4}	2×10^{-4}	1×10^{-3}	3	1.718	.350	.250
TQ18-26	5.6	25	3	7	13.4	50	5.6	.040	25	2×10^{-4}	3.2×10^{-4}	2×10^{-4}	1.1×10^{-3}	3	1.718	.350	.250
TQ18-28	10	47	5	12	7.6	50	3.3	.024	5	2×10^{-4}	5.8×10^{-4}	4×10^{-4}	1.6×10^{-2}	4	1.718	.600	.250
TQ18-1	18	75	8	14	51	50	30	.210	190	2×10^{-4}	6.7×10^{-4}	5×10^{-4}	3.3×10^{-2}	4	1.718	.700	.250
TQ18-11	18	75	8	14	12.8	50	7.5	.053	12	2×10^{-4}	6.7×10^{-4}	5×10^{-4}	3.3×10^{-2}	4	1.718	.700	.250
TQ18-47	18	80	8	16	20	50	10	.071	25	2×10^{-4}	6.7×10^{-4}	5×10^{-4}	2.9×10^{-2}	4	1.718	.700	.250
TQ25W-2	15	60	8	17	32.0	120	15	.106	60	2×10^{-3}	9×10^{-4}	1×10^{-4}	2.6×10^{-2}	4	2.500	.500	.250
TQ25W-4	15	60	8	17	52.8	120	25	.175	165	2×10^{-3}	9×10^{-4}	1×10^{-4}	2.6×10^{-2}	4	2.500	.500	.250
TQ25W-1	33	130	16	30	33.8	120	18	.130	38	3×10^{-3}	2.1×10^{-3}	2×10^{-4}	6×10^{-2}	7	2.500	1.000	.250
TQ25-6	30	63	10	7	8.3	50	12	.085	10	3×10^{-3}	1.5×10^{-3}	2×10^{-3}	1.6×10^{-1}	6	2.500	.500	.250
TQ25-9	30	70	15	17	9.5	50	8.5	.060	5.4	2×10^{-3}	1.5×10^{-3}	2×10^{-3}	9.4×10^{-2}	6	2.500	.500	.250
TQ25-2	80	150	25	14	14.8	50	27	.190	16	5×10^{-3}	4.4×10^{-3}	5×10^{-3}	3.2×10^{-1}	12	2.500	1.000	.250
TQ34W-1	40	90	30	37	25.7	120	21	.150	18	3×10^{-3}	4.2×10^{-3}	5×10^{-3}	1.8×10^{-1}	13	3.313	.625	.375
TQ34W-10	40	90	30	36	40	120	33	.240	44	3×10^{-3}	4.2×10^{-3}	5×10^{-3}	1.8×10^{-1}	13	3.313	.625	.375
TQ34W-12	80	180	60	83	38.6	120	28	.200	18	4×10^{-3}	8.4×10^{-4}	1×10^{-2}	3×10^{-1}	21	3.313	1.125	.375
TQ34-14	80	150	28	17	47.3	50	80	.570	135	1×10^{-3}	9.1×10^{-3}	1.5×10^{-2}	3.4×10^{-1}	16	3.375	.600	.250
TQ34-4	130	220	40	20	22.2	50	45	.310	25	1×10^{-3}	9.1×10^{-3}	1×10^{-2}	5.6×10^{-1}	16	3.375	.725	.250
TQ40W-4	150	270	60	45	8.5	120	12	.090	1.7	2×10^{-3}	2×10^{-2}	1×10^{-2}	6.3×10^{-1}	30	4.000	.850	.375
TQ40W-11	150	250	60	40	14.5	120	22	.160	5.2	2×10^{-3}	2×10^{-2}	1×10^{-2}	6.8×10^{-1}	30	4.000	.850	.375
TQ40W-1	260	250	120	50	14.1	120	34	.250	4.0	3×10^{-3}	4×10^{-2}	2×10^{-2}	1.9	51	4.000	1.500	.375
	Lb. Ft.		Lb. Ft.				Lb.Ft./Amp.				Lb. In. Sec²	Lb. In./Rad./Sec.		Lb.			
TQ52W-1	1.5	152	1.1	75	21.3	90	.31	.42	6.2	6.5×10^{-3}	6.9×10^{-3}	6.3×10^{-4}	2.6×10^{-1}	5	5.125	1.500	.750
TQ52-2	2.6	250	1.0	40	21.9	20	.57	.79	12	3×10^{-3}	8.8×10^{-3}	1.2×10^{-3}	4.5×10^{-1}	5	5.187	1.250	.984
TQ56-1	4.2	270	1.5	36	16.2	20	.70	.95	7.3	6×10^{-3}	1.8×10^{-2}	4.4×10^{-2}	1.06	10	5.625	2.000	1.000
TQ64W-5	4.2	230	2.4	91	14.5	90	.39	.53	2.3	6×10^{-3}	3×10^{-2}	2.5×10^{2}	1.06	16	6.235	2.300	1.187
TQ64-1	4.5	230	3.3	127	14.7	30	.39	.53	1.7	7×10^{-3}	5×10^{-2}	5.6×10^{-2}	1.25	16	6.375	2.300	1.187
TQ74W-5	4.2	300	1.5	39	24.2	110	.96	1.2	15	8×10^{-3}	5×10^{-2}	1.2×10^{-2}	5.8×10^{-1}	10	7.310	1.440	1.000
TQ74W-6	7.8	350	5.1	150	18.2	110	.62	.86	2.2	7×10^{-3}	1.5×10^{-1}	6×10^{-3}	2.4×10^{-1}	27	7.310	3.440	1.000
TQ74-4	3.3	170	1.6	43	15.1	30	.33	.46	1.7	4×10^{-3}	2.6×10^{-2}	4.4×10^{-2}	1.25	8	7.375	1.160	.812
TQ74-2	7.0	350	4.5	150	20.1	30	.66	.89	2.95	6×10^{-3}	5×10^{-2}	6×10^{-2}	2.4	19	7.380	2.290	.812
TQ82W-1	4.0	450	2.5	174	31.3	120	.48	.7	6.4	2.8×10^{-2}	3×10^{-2}	2×10^{-2}	1.2	12	8.190	1.380	.820
TQ120-2	22	375	18	178	20.2	40	2.05	2.1	2.3	1.5×10^{-2}	3.2×10^{-1}	2×10^{-1}	2.2×10^{1}	49	12.500	2.250	1.380
TQ140W-1	18	580	17	500	51	120	1.70	2.3	5.2	4×10^{-2}	6×10^{-1}	1.5	1.2×10^{1}	60	14.000	3.000	1.500

Full Rotation *brushless* D.C. Torque Motors

A torque delivery system designed to achieve maximum power efficiency within a minimum of space, weight and power. It consists of a permanent magnet brushless DC torquer mechanically coupled with a brushless resolver.

(Partial Listing)

Characteristics	TFR47-5P	TFR47-3P	TFR47-4P	TFR90-1P	TFR120-2P
Peak Torque	1.2 lb. ft.	4.1 lb. ft.	7.8 lb. ft.	16 lb. ft.	45 lb. ft.
Power	180 watts	240 watts	350 watts	180 watts	450 watts
Resistance	16 ohms	13 ohms	13 ohms	0.3 ohms	5.6 ohms
Size	4.625 in. O.D. x .62 in. Thick	4.625 in. O.D. x 1.75 in. Thick	4.625 in. O.D. x 2.25 in. Thick	9.00 in. O.D. x 2.50 in. Thick	12.00 in. O.D. x 3.25 in. Thick

Wide Angle *brushless* Tachometers

Basic Part Number	Output Sensitivity (v/rad/sec)	Resistance at 25°C (Ohms)	Rotor Inertia (oz. in. sec²)	Pancake Dimensions		
				O.D. (inch)	Thick. (inch)	I.D. (inch)
TG10Y-58	.03	210	1.6×10^{-5}	1.000	.350	.125
TG10Y-59	.06	390	4×10^{-5}	1.000	.700	.125
TG18W-56	.09	550	2.4×10^{-4}	1.718	.350	.187
TG18W-57	.24	1025	4.8×10^{-4}	1.718	.700	.187
TG18-54	.17	520	3.2×10^{-4}	1.718	.350	.250
TG18-55	.39	980	6.7×10^{-4}	1.718	.700	.250
TG25W-9	.7	920	2×10^{-3}	2.500	1.000	.250
TG25W-10	.5	500	1.5×10^{-3}	2.500	.500	.250
TG34W-5	1.0	1000	4.2×10^{-3}	3.313	.625	.375
TG34-41	1.5	825	9.1×10^{-3}	3.375	.725	.375
TG40W-5	1.2	335	2×10^{-2}	4.000	.850	.375
TG40W-3	2.5	535	4×10^{-2}	4.000	1.500	.375
TG52W-5	5.0	1100	1.1×10^{-1}	5.125	1.500	.750
TG52-7	3.7	360	1.4×10^{-1}	5.187	1.250	.984

For Commercial/Industrial Applications

Ask Aeroflex about the **Valueline**-Brushless, Wide Angle, Direct Drive Low Cost, DC Torque Motors.

Available in a great variety of sizes and outputs, Valueline offers thes designer benefits: • No gear trains required • System simplificatio • Precise positioning • Smooth, quiet output • Unlimited life

MOTOR PRODUCTS DIVISION

AEROFLEX LABORATORIES INC.

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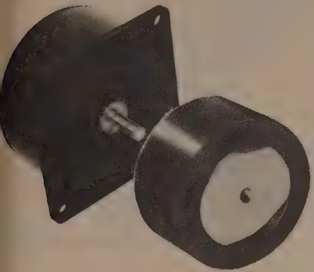
AEROFLEX

AEROFLEX VALUELINE brushless D.C. Torquers



for the commercial/industrial user

A quality counterpart of the mil-spec Aeroflex Brushless DC Torque Motor, Valueline offers the value-engineered alternative to motor-gearhead combinations. A low cost line that comes in a variety of sizes and outputs, its direct-drive design provides for compact, space-saving packaging and simplified installation. Performance benefits include:

FEATURES:

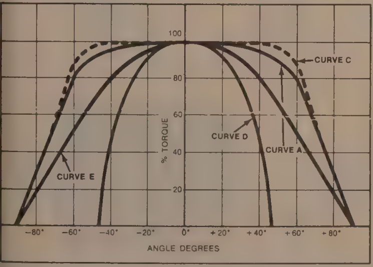
- High torque/power ratio
- Rapid acceleration at low speed
- Smooth, quiet output
- Precise positioning
- Excellent linearity
- Wide dynamic range
- Unlimited service life.

Wide Angle *brushless* D.C. Torquers

Part Number*	Peak Torque (oz. in.)	Peak Power (watts)	Continuous Torque (oz. in.)	Continuous Power (watts)	Volts for Continuous Torque (Vdc)	Angular Excursion (°)	Torque Sensitivity (oz. in/amp.)	Back EMF (v/rad/sec.)	Elec. Time Con. L/R (sec.)	Resistance (ohms)	Rotor Inertia (oz. in. sec.^{2})	Viscous Damping Inf. Source Imp. (oz. in/rad/sec.)	Viscous Damping Zero Source Imp. (oz. in/rad/sec.)	Wt. (oz.)	Performance Curve (letter)
V10Y-22	1.5	20	.5	2.2	10	80	2.4	.017	2×10^{-4}	50	3.2×10^{-5}	1.5×10^{-5}	5×10^{-4}	1	E
V10Y-30	3.8	50	1.2	5	17	80	4.5	.032	2×10^{-4}	64	8.0×10^{-5}	4×10^{-5}	2×10^{-3}	2	E
V18-43	4	25	2.4	7.5	20	50	6.5	.046	2×10^{-4}	55	3.2×10^{-4}	2×10^{-4}	5.6×10^{-2}	3	D
V18-44	10	65	4.6	12	25	50	9.0	.064	2×10^{-4}	48	6.7×10^{-4}	5×10^{-4}	1.3×10^{-2}	4	D
V18Y-40	2.7	30	1.4	7.5	20	120	3.7	.026	4×10^{-4}	54	2.4×10^{-4}	3×10^{-4}	2.0×10^{-3}	3	C
V18Y-41	6.7	70	2.8	12	25	120	5.7	.040	6×10^{-4}	50	4.8×10^{-4}	3×10^{-4}	4.5×10^{-3}	4	C
V25-8	20	40	11	12	20	50	20	.14	3×10^{-3}	36	1.5×10^{-3}	2×10^{-3}	8×10^{-2}	6	D
V25-9	52	100	23	20	22	50	27	.19	5×10^{-3}	26	4.4×10^{-3}	5×10^{-3}	1.9×10^{-1}	12	D
V25Y-5	10	40	6	12	23	120	10	.07	3×10^{-3}	38	9×10^{-4}	1×10^{-4}	2×10^{-2}	4	C
V25Y-6	28	110	12	20	23	120	14	.10	4×10^{-3}	27	2.1×10^{-3}	2×10^{-4}	5.2×10^{-2}	7	C
V34-21	78	130	33	22	25	50	37	.26	1×10^{-3}	28	9.1×10^{-3}	1×10^{-2}	3.8×10^{-1}	16	D
V34-26	180	230	86	50	24	50	40	.28	3×10^{-3}	11	1.8×10^{-2}	2×10^{-2}	1.1	30	D
V34Y-22	23	40	18	22	25	120	20	.14	3×10^{-3}	28	4.2×10^{-3}	5×10^{-3}	1.3×10^{-1}	13	C
V34Y-27	54	80	38	40	21	120	20	.14	4×10^{-3}	11	8.4×10^{-3}	1×10^{-2}	2.5×10^{-1}	24	C
V40-9	185	200	90	45	28	50	57	.40	3×10^{-3}	18	4×10^{-2}	2×10^{-2}	1.2	28	D
V40-8	315	275	190	80	29	50	71	.50	5×10^{-3}	11	8×10^{-2}	3×10^{-2}	3.2	55	D
V40Y-10	100	130	50	28	22	110	36	.25	2×10^{-3}	16	2×10^{-2}	1×10^{-2}	6.0×10^{-1}	26	A
V40Y-4	210	200	100	44	22	110	50	.35	3×10^{-3}	11	4×10^{-2}	2×10^{-2}	1.6	51	A
V52Y-17	315	250	150	55	23	110	60	.42	6×10^{-3}	9	1.1×10^{-1}	1×10^{-2}	3.2	80	A
V52-12	510	300	240	65	23	50	85	.60	3×10^{-3}	8	1.4×10^{-1}	2×10^{-2}	6.3	90	D
V62Y-1	850	300	475	90	14	80	75	.53	6×10^{-3}	2.2	3.6×10^{-1}	4×10^{-1}	25	224	E

Letter "Y" in part number indicates two-pole type; others are four-pole type. Rated winding temperature is 85°C.
*When specifying a housing, add the letter "H" to the part number.

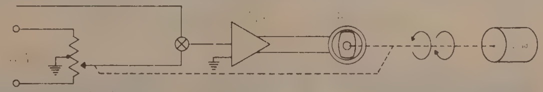
PERFORMANCE CURVES



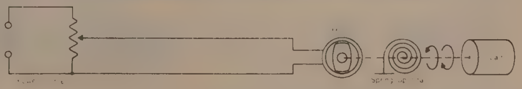
Torque output characteristic with a fixed current input as a function of angular position

TYPICAL APPLICATIONS

CLOSED LOOP APPLICATIONS (for high precision in rate and/or position)



OPEN LOOP APPLICATIONS (for simplicity and low cost)



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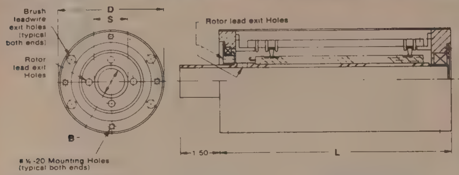
SLIP RING ASSEMBLIES

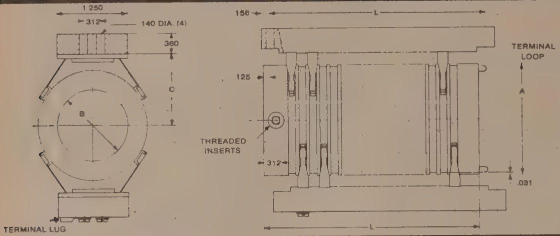

Brush leadwire exit holes (typical both ends)
D
S
Rotor lead exit Holes
Rotor lead exit Holes
B
¼-20 Mounting Holes (typical both ends)
1 50
L

DAY-490 / DAY-499

MODEL	"B" DIA.	"D" DIA.	"S" DIA.	MAX RPM	MIN LIFE 10^6	TQUE IN-LBS.
DAY-490	1.00	4.00	1.250	5000	50	.21
DAY-491	1.75	5.00	2.125	4000	40	.30
DAY-492	2.75	6.50	3.125	3000	30	.40
DAY-493	3.75	7.50	4.125	2500	25	.50
DAY-494	4.75	8.50	5.125	2000	20	.61
DAY-495	5.75	9.50	6.125	1500	15	.71
DAY-496	6.75	10.50	7.125	1500	10	.82
DAY-497	7.75	11.50	8.125	1000	10	.92
DAY-498	8.75	13.00	9.125	1000	10	1.02
DAY-499	9.75	14.00	10.125	750	7.5	1.12

NO. OF CIRCUITS	"L"
4-10	4.88
11-20	6.75
21-30	8.63
31-40	10.50
41-50	12.38

FRAME: Anodized Aluminum
RINGS: Coin Silver
BRUSHES: Silver Graphite
LEAFS: Beryllium Copper
CIRCUIT TERMINATION: Silver Lugs or Leadwire
CURRENT: 10 amp per circuit (20 amp available at extra cost)
VOLTAGE: 250V max. AC or DC
DIELECTRIC STRENGTH: 750 Vrms.
INSULATION RESISTANCE: 50 meg min
CONTACT RESISTANCE VARIATION: 10 milliohms max at max speed
OPERATING TEMP.: 0 to 250 F
HUMIDITY: 95% ° max.

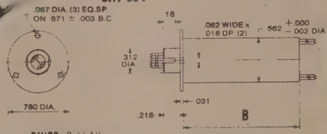

1 250
312
140 DIA. (4)
360
C
B
TERMINAL LUG
156
L
125
THREADED INSERTS
312
TERMINAL LOOP
A
.031
L

RINGS: Coin Silver
BRUSHES: Silver Graphite, two per ring
LEAFS: Beryllium Copper
INSULATION: Epoxy or Laminated Plastic
CURRENT: 10 amps per circuit standard (20 amps with 4 brushes per ring)
VOLTAGE: 250V max. AC or DC
DIELECTRIC STRENGTH: 750 Vrms.
CONTACT RESISTANCE VARIATION: 10 milliohms max
NO. OF CIRCUITS: 50 max

PART NO.	A	B	C
CAY-731	1.875	1.250	1.447
CAY-732	2.750	2.125	1.829
CAY-733	3.750	3.125	2.281
CAY-734	4.875	4.125	2.822
CAY-735	5.875	5.250	3.307
CAY-736	7.000	6.250	3.857
CAY-737	8.000	7.250	4.342
CAY-738	9.000	8.250	4.837
CAY-739	10.000	9.250	5.332
CAY-740	11.000	10.250	5.827

TO DETERMINE "L" DIMENSION USE THE FOLLOWING FORMULA:
"L" = .750 + .1875 x (No. of Rings)

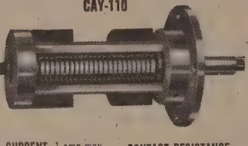
CAY-604

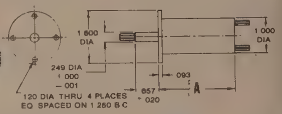

.067 DIA (3) EQ.SP. ON .671 ± .003 B.C
.18
.062 WIDE x .018 DP (2)
.562 +.000 −.002 DIA
.312 DIA
.780 DIA.
.031
.218
B

NUMBER OF RINGS	"B"
1 thru 12	.741
13 thru 24	1.137
25 thru 40	1.665

RINGS: Gold Alloy
BRUSHES: Gold Alloy Wire, Spring Temper
BALL BEARINGS: Stainless Steel, Shielded
SHAFT: Stainless Steel
HOUSING: Anodized Aluminum
TORQUE: 1 in. — oz. max
SPEED: 200 RPM max

CAY-110

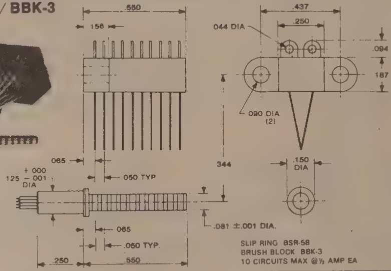



1 600 DIA
1 000 DIA
.249 DIA +.000 −.001
.093
.120 DIA THRU 4 PLACES EQ SPACED ON 1 250 B C
.657 +.020
A

CURRENT: 1 amp max per ring
VOLTAGE: 100V max
DIELECTRIC STRENGTH: 500Vrms.
CONTACT RESISTANCE VARIATION: 20 milliohms max
LIFE: 5 x 10^6 revs, min
ROTATION: Bi-directional
LEADWIRE: Teflon Insulated

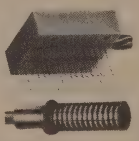
NUMBER OF RINGS	"A"
1 thru 12	1.48"
13 thru 24	2.20"
25 thru 30	2.56"

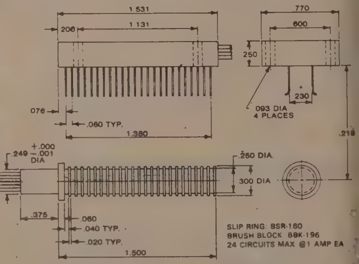
BSR-58 / BBK-3


.550
.156
.437
.250
.044 DIA
.094
.187
.090 DIA (2)
.344
.150 DIA
.065
.125 +.000 −.001 DIA
.050 TYP
.081 ±.001 DIA.
.065
.050 TYP.
.250
.550

SLIP RING BSR-58
BRUSH BLOCK BBK-3
10 CIRCUITS MAX @½ AMP EA

BSR-160 / BBK-196

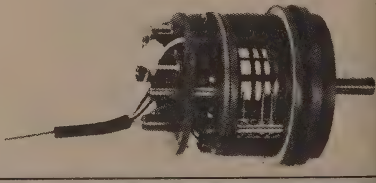



1 531
1 131
.206
.770
.600
.250
.230
.093 DIA 4 PLACES
.076
.060 TYP.
1.380
.249 +.000 −.001 DIA
.250 DIA.
.300 DIA
.375
.060
.040 TYP.
.020 TYP.
1.500

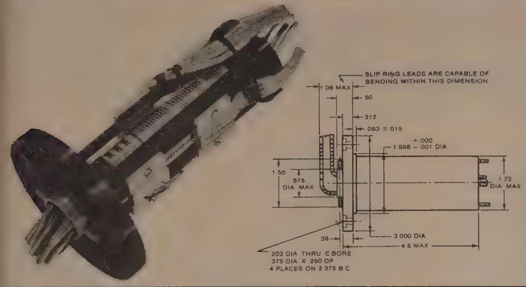
SLIP RING: BSR-160
BRUSH BLOCK BBK-196
24 CIRCUITS MAX @1 AMP EA

ENCODERS & SWITCHES

Airflyte encoders and rotary switches feature drum construction with solid gold alloy conducting segments embedded in epoxy and machined flush. Brushes are multi-strand, spring-temper gold-alloy. As small as Size 5.



airflyte ELECTRONICS CO.

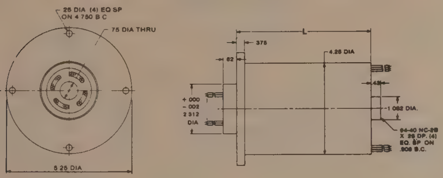

SLIP RING LEADS ARE CAPABLE OF BENDING WITHIN THIS DIMENSION
1 06 MAX
50
312
093 ± 015
+ 000
1 888 − 001 DIA
1 50
875 DIA MAX
1 72 DIA MAX
39
3 000 DIA
4 5 MAX
203 DIA THRU C BORE
375 DIA X 250 DP
4 PLACES ON 2 375 B C

CAY-150

NOTES:
MECHANICAL
1. **Rings:** Gold alloy
2. **Brushes:** Gold alloy wire, spring temper
3. **Ball Bearings:** Stainless steel
4. **Shaft:** Stainless steel, type 303
5. **Housing:** Anodized aluminum
6. **Torque:** 48 ring assembly 6.0 in-oz. maximum
7. **Speed:** 600 r.p.m. maximum-intermittent
8. **Life:** 2000 hours'@100 r.p.m.

ORDERING INFORMATION:
CAY-150-
No. of Rings (48 maximum)

ELECTRICAL
1. **Current:** Signal level to 2 amps.
2. **Voltage:** 400 vdc maximum
3. **Dielectric Strength:** 1000 Volts rms (all combinations).
4. **Contact Resistance:**
   A. Less than 8 milliohms @200 rpm
5. **No. of Rings:** 48 maximum
6. **Leadwire:** #28 awg 18" long


25 DIA (4) EQ SP ON 4 750 B C
75 DIA THRU
5 25 DIA
L
375
62
4.25 DIA
+ 000
− 002
2 312 DIA
43
1 062 DIA.
64-40 NC-2B X 25 DP. (4) EQ. SP ON .906 B.C.

DAY-705

NOTES:
MECHANICAL

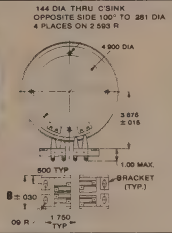
1. **Rings:** Coin silver
2. **Brushes:** Silver graphite
3. **Ball Bearings:** Shielded
4. **Shaft:** Anodized aluminum
5. **Housing:** Anodized aluminum
6. **Torque:** ½ in.oz. per circuit
7. **Speed:** 500 rpm maximum
8. **Life:** 3000 hours at 100 rpm

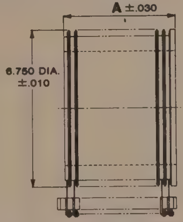
ORDERING INFORMATION:
DAY-705-☐
No.of Rings (160 maximum)

ELECTRICAL

1. **Current:** 5 amps maximum per circuit
2. **Voltage:** 0 to 150 volts, AC or DC
3. **Dielectric Strength:** 500 Volts rms (all combinations).
4. **Contact Resistance Variation:** 8 milliohms peak at maximum speed
5. **No. of Rings:** 160 maximum
6. **Leadwire:** #24 awg, teflon insulated.

No. of Rings	"L" ±.025"
1-20	5.375
21-40	8.187
41-60	11.000
61-80	13 812
81-100	16.625
101-120	19 437
121-140	22.250
141-160	25.062


144 DIA THRU C'SINK OPPOSITE SIDE 100° TO 281 DIA 4 PLACES ON 2 593 R
4 900 DIA
3 875 ± 015
1.00 MAX.
500 TYP
BRACKET (TYP.)
B ± 030
09 R
1 750 TYP

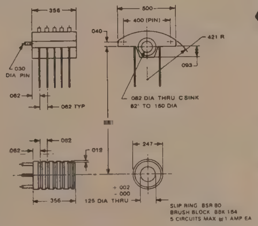

A ±.030
6.750 DIA. ±.010

CAY-94

1. **Rings:** Coin silver
2. **Brushes:** Silver graphite (two per ring)
3. **Brush Leafs:** Beryllium copper
4. **Insulation:** Phenolic
5. **Leadwire:** Available upon request
6. **Speed:** 750 r.p.m.
7. **Life:** 1000 hours
8. **Current:** 5 amps per ring: 10 amps per ring when 4 brushes are used
9. **Voltage:** 300 VR.M.S.
10. **Dielectric Strength:** 500 Volts rms (all combinations).
11. **Insulation Resistance:** 10 megohms minimum at 500 VDC
12. **Noise:** The Contact Resistance Change in Each Circuit Shall be Less Than .005 Ohms At Maximum Speed

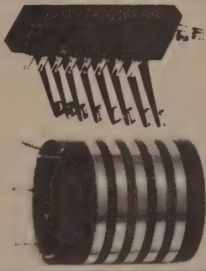
Part No.	A	B	No. of Rings
-41	6.065	6.497	41
-37	5.499	5.931	37
-33	4.933	5.365	33
-29	4.367	4.799	29
-25	3.801	4.233	25
-21	3.235	3 667	21
-19	2.952	3.384	19
-17	2.669	3.101	17
-15	2.386	2.818	15
-13	2.103	2.535	13
CAY-94 -11	1.820	2.252	11

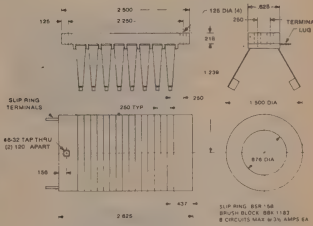
BSR-80 / BBK-164


356
500
400 (PIN)
040
421 R
093
030 DIA PIN
062
062 TYP
062 DIA THRU C'SINK 82° TO 150 DIA
062
012
247
+ 002
− 000
125 DIA THRU
356

SLIP RING BSR 80
BRUSH BLOCK BBK 164
5 CIRCUITS MAX @ 1 AMP EA

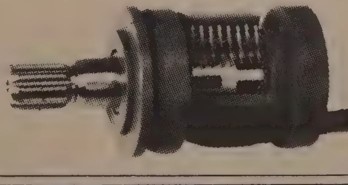
BSR-158 / BBK-1183




2 500
2 250
125
125 DIA (4)
250
.625
TERMINAL LUG
218
1 239
SLIP RING TERMINALS
250 TYP
250
1 500 DIA
86-32 TAP THRU (2) 120 APART
156
.876 DIA
437
2 625

SLIP RING BSR 158
BRUSH BLOCK BBK 1183
8 CIRCUITS MAX @ 3½ AMPS EA

ENCODERS A wide variety of encoders is available: T / B, BCD, Gray, etc. Special encoders may equire nominal tooling charges. Encoders can be supplied with uilt-in logic circuitry. Sizes: 3-33.



SWITCHES When close accuracy, repeatability and size are important, specify Airflyte rotary switches for timing and positioning applications. Successfully replaces snap action switches and cams. Pre-set to eliminate installation time. Zero hysteresis.

CATALOGS • MANY STOCK ITEMS • FINE DESIGN STAFF

CONTACT airflyte ELECTRONICS CO.
56 HOOK ROAD, BAYONNE, NEW JERSEY 07002
201 436 2230 • TWX 710 729 4469

hysteresis synchronous motors

AVAILABLE IN SINGLE SPEED, DUAL AND MULTIPLE SPEEDS, Ashland Hysteresis Synchronous motors are of the highest quality and are designed and manufactured for many years of trouble free operation.

Our type of construction provides rigidity for accurate bearing alignment and close air gap maintenance, so necessary in obtaining quiet and efficient motor operation.

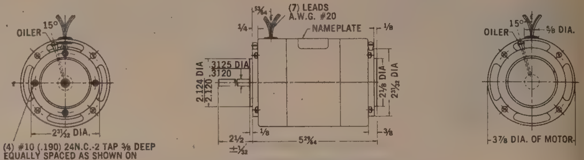
Noise and vibration have been eliminated. Peripheral equipment manufacturers using our motors have been able to greatly reduce their wow and flutter levels.

Ashland Hysteresis Synchronous motors can be supplied in numerous speeds, frequencies and voltages. The following pages supply specifications on only a few of our many designs.

SPECIFICATIONS

Model Number	RPM	Amps	Torque - Oz. In. P.I.*	S.T.*	Length (In.)	Dia. (In.)
A42ABM-1	1800	0.05	0.15	0.10	2 11/16	1¾
A52AZU-1	600	0.12	0.92	0.64	3	2
A60KBU-1	1800	0.40	6.0	8.0	3⅝	3¼
A74LAP-1	3600	0.30	4.1	3.4	4⅛	3 5/16
A80HCU-1	1200	0.40	5.0	8.0	3 61/64	3⅞
A88LDU-1	900	1.0	17.5	43,0	5 61/64	3⅞
D84QBU-3	1800	1.0	22.2	27	4 61/64	3⅞
A118TAU-1	3600	1.9	33.1	76	5 13/16	4⅜
C1112UBU-1	1800	2.3	66.2	90	6 13/16	4⅜
A120LCP-1	1200	0.51	13	14	3	3⅞
A98YAU-1	3600	5.5	85	120	5 61/64	5⅜
A912ZBU-1	1800	6.7	170	238	6 61/64	5⅜

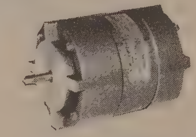
All motors listed above 115 VAC, 60 Hz Single Phase
* P.I. — Pull in torque, S.T. — Starting Torque



HYSTERESIS SYNCHRONOUS SLEEVE BEARING MOTOR
MODEL NO. D86MBKDU-1

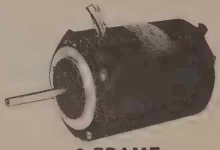
3-4-5 FRAME

Model Number	RPM	Amps	Volts	Frequency	Phase	Torque - Oz. In. P.I.	S.T.	Length (in.)	Dia. (in.)
A32ACM-1	1200	0.1	115	60	1	0.75	0.75	2.78	1.75
A32ABM-1	1800	0.06	115	60	1	0.20	0.15	2.78	1.75
A405BWM-2	12000	0.1	115	400	3	0.1	0.4	1.75	1.75
A42SAM-1	14400	0.8	115	240	3	3.5	9.0	2.68	1.75
A42PWM-1	3600	1.0	57	120	3	4.5	8.5	2.68	1.75
A42LCM-1	8000	0.4	115	400	1	2.0	2.0	2.68	1.75
A42EBM-1	1500/1800	0.16	115	50/60	1	1.9/1.8	1.6/1.7	2.68	1.75
A52BBADU-1	900/1800	0.21	115	60	1	0.88/0.96	0.72/0,72	3.0	2.0
A54PBLDU-1	6000/12000	1.3	115	400	1	2.7/2.9	2.8/3.2	3.5	2.0
A52HDU-1	1800/6000	0.2	60/200	120/400	2	0.95/1.2	1/3	3.0	2.0
A52MCU-1	8000	1.2	115	400	3	2.3	8.5	3.0	2.0
A50GAU-1	3600	0.15	115	60	1	1.5	1.3	2.56	2.0



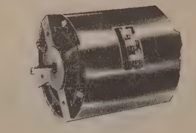
6-7 FRAME

Model Number	RPM	Amps	Volts	Frequency	Phase	Torque - Oz. In. P.I.	S.T.	Length (in.)	Dia. (in.)
A62NBU-1	1500/1800	0.5	115	60	1	12/13.5	16/22	4.12	3.31
A60KBU-1	1800	0.4	115	60	1	5.6	5.6	3.62	3.31
A607EDU-1	900	0.21	115	60	1	5.6	4.0	3.38	3.31
A66LCU-1	1200	0.4	115	60	1	11.2	12	5.12	3.31
A78UBU-1	12000	3.3	115	400	1	7.6	14	5.625	3.31
A72LAEDP-1	900/3600	0.40	115	60	1	5.2/4.9	4.7/3.8	3.75	3.31
A72DCBZU-1	600/1200	0.25	115	60	1	3.2/4.6	1.5/2.2	4.125	3.31
A76LAHBEDU-1	900/1800/3600	0.70	108	60	1	7/8/6	5/5/4	4.75	3.31
A73KBMAU-1	1800/3600	1.0	115	50/60	1	12/11	14/11	4.375	3.31
A73FDKBU-2	750/1500	0.21	220	50	1	7.5/8	10.5/11	4.375	3.31
A70KBGZM-2	6000/1200	0.32	115	400	1	0.9/0.9	1.2/1.3	3.0	3.31
A76NALBU-5	1500/3000	0.80	115	50/60	1	12/12	10/10	5.125	3.31



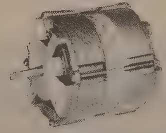
8 FRAME

Model Number	RPM	Amps	Volts	Frequency	Phase	Torque - Oz. In. P.I.	S.T.	Length (In.)	Dia. (In.)
A84GZU-3	600	0.60	115	60	1	9.0	6.2	4.95	3.875
A86KDU-2	900	0.50	115	60	1	11.5	11.5	5.45	3.875
A88UAU-3	3600	1.70	115	60	1	28.0	30.0	5.95	3.875
A84HCEZU-11	600/1200	0.40	115	60	1	6/8	4/6	4.95	3.875
A86RBU-4	1800	0.60	230	60	1	28.5	44	5.45	3.875
A86KBFZU-1	600/1800	0.40	115	60	2	9/12	13/11	5.45	3.875
A86MBKDU-1	900/1800	0.70	115	60	1	12/12	14/12	5.45	3.875
A86NBLCU-1	1200/1800	0.70	115	60	1	14/14	14/14	5.45	3.875
A84KAGBDDU-1	900/1800/3600	0.60	115	60	1	5/8/6	6/5/4	4.95	3.875



9 FRAME

Model Number	RPM	Amps	Volts	Frequency	Phase	Torque - Oz. In. P.I.	S.T.	Length (In.)	Dia. (In.)
A98GZKZU-1	300/600	0.60	115	60	2	20/21	12/28	5.95	5.375
A98SCRBU-1	1200/1800	1.6	115	60	1	57/48	40/20	5.95	5.375
A90CZEDHBU-2	450/900/1800	1.0	115	60	1	10/11/9	9/9/8	3.95	5.375
A98YBU-1	1800	6.3	115	60	1	170	210	5.95	5.375
A98TBVAU-1	1800/3600	3.0	115	60	1	79/45	60/34	5.95	5.375
A98SDVBU-1	900/1800	1.8	115	60	1	58/54	41/41	5.95	5.375
A98YAWBU-1Z	1500/3000	4.1	117	50	1	130/70	148/43	5.95	5.375
A98MCQZU-1Z	500/1000	0.7	220	50	1	36/41	23/24	5.95	5.375
A98RAMBCZU-1	300/1800/3600	2.7	115	60	1	13/32/21	7/20/19	5.95	5.375



11-12 FRAME

Model Number	RPM	Amps	Volts	Frequency	Phase	Torque - Oz. In. P.I.	S.T.	Length (In.)	Dia. (In.)
A118UAU-1	3600/3000	2.3	115	50/60	1	27/8	32	5.812	4.375
A116UWU-1	12000	5.0	208	400	3	8.3	120	5.312	4.375
A116PBU-1	3600/1800	5.6	115	60/120	2	13.9	17.5	5.312	4.375
A118TBU-4Z	1500	1.2	220	50	1	55.6	79	5.812	4.375
A1112VASBU-1	3600/1800	2.8	115	60	1	38/38	30/38	6.812	4.375
A1112TALDU-1Z	3000/750	2.9	115	50	1	40/20	27	6.812	4.375
A114KBFCGZU-1	600/1200/1800	0.5	115	60	1	10/8/5	5/4/4	4.812	4.375
A120LCP-1	1200	0.5	115	60	1	12	13	3.50	3.91
A123RAPCU-1	3600/1200	1.2	115	60	1	18/22	18/25	4.25	3.91
A124QCP-2	1200	1.1	115	60	1	35	20	4.50	3.91

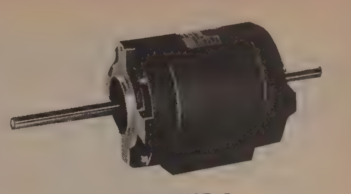
AEP MOTORS

IN PHASE WITH INDUSTRY

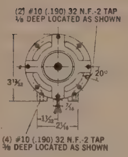
torque motors

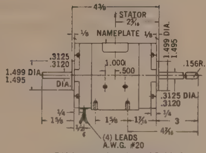
CAPACITOR START AND RUN. Ashland Torque Motors have met with a great deal of success in military as well as commercial applications. They are presently being used in Tape Recorders, Servo, and Positioning applications and when required, are capable of being locked on the line indefinitely without overheating.

Our high quality of design enables us to produce a motor with an extremely low external flux field, a minimum of hum and less than 1% variation in torque when the rotor is allowed to rotate from zero to 10 RPM at rated voltage.

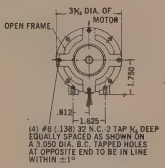


C74NKP-2


(2) #10 (.190) 32 N.F.-2 TAP
1/8 DEEP LOCATED AS SHOWN
3 13/32
20°
7/16
1 1/32
2 1/16
(4) #10 (.190) 32 N.F.-2 TAP
3/8 DEEP LOCATED AS SHOWN

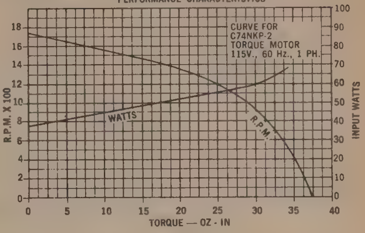

4 3/8
STATOR
2 3/16
1/8
NAMEPLATE
1/8
1.499 DIA.
1.495
.3125
.3120
1.000
.500
.156R.
1.499 DIA
1.495
DIA.
.3125 DIA.
.3120
1/4
1 5/8
1/2
1 5/8
1 7/16
1/4
3
4 7/16
(4) LEADS
A.W.G. #20

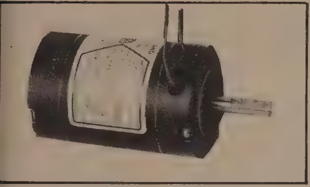
TORQUE MOTOR BALL BEARING
MODEL NO. C74NKP-2


3 5/16 DIA. OF
MOTOR
OPEN FRAME
1.750
.812
1.625
(4) #6 (.138) 32 N.C.-2 TAP 5/16 DEEP
EQUALLY SPACED AS SHOWN ON
A 3.050 DIA. B.C. TAPPED HOLES
AT OPPOSITE END TO BE IN LINE
WITHIN ±1°

SPECIFICATIONS

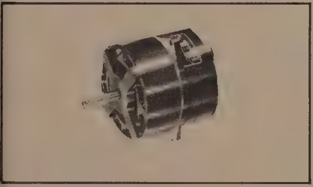
PERFORMANCE CHARACTERISTICS





3-4-5-6-7-8 FRAME TORQUE MOTORS

Model Number	No Load RPM	Volts	Frequency	Phase	Amps	Locked Rotor Torque Int.	Locked Rotor Torque Cont.	Length (In.)	Dia. (In.)
A32ALM-1	1100	115	60	1	0.20	3.2	2	2.78	1.75
A44GKM-1	1700	115	60	1	0.11	4	4	3.25	1.75
A42FZM-1	5700	208	400	3	0.07	4	4	2.68	1.75
A41DKM-1	1700	115	60	1	0.09	3	3	2.50	1.75
A64MMP-1	850	115	60	1	0.6	34	34	4.25	3.31
A60KLP-5	1100	115	60	1	0.41	25	12	3.25	3.31
A70KKP-1	1720	115	60	1	0.21	16	16	3.25	3.31
A74NKP-10	1720	115	60	1	1.0	40	20	4.25	3.31
A78PKP-1	1720	115	60	1	1.3	70	50	5.25	3.31
A72QKP-2	1720	115	60	1	1.1	60	20	3.75	3.31
A84NWM-1	1700	208	60	3	0.2	30	15	4.95	3.875
A86GZU-1	550	115	60	1	0.3	14	14	5.45	3.875
A88MMP-1	850	115	60	1	1.0	70	30	5.95	3.875
A82PKU-1	1700	115	60	1	1.1	29	15	4.45	3.875



9-11-12 FRAME TORQUE MOTORS

Model Number	No Load RPM	Volts	Frequency	Phase	Amps	Locked Rotor Torque Int.	Locked Rotor Torque Cont.	Length (In.)	Dia. (In.)
A96SLP-1	1125	115	60	1	4.6	300	300	5.45	5.375
A96RMP-1	835	115	60	1	2.5	225	225	5.45	5.375
A98WLL-1	1100	115	60	1	8.0	520	520	5.95	5.375
A98TLL-1	1100	115	60	1	3.4	450	450	5.95	5.375
A92QMU-1Z	700	115	50	1	1.5	143	75	4.45	5.375
A118TKP-1	1440	115	60	1	4.5	153	45	5.81	4.375
A1110KMP-1	720/600	115	50/60	1	2.3	140	53	6.31	4.375
A112TKP-3	1440/1200	115	50/60	1	2.5	120	60	4.31	4.375
A1112SMP-3	720	115	60	1	4.2	350	125	6.81	4.375
A114GZU-1	480	208	60	3	4.0	42	42	4.81	4.375
A122NKP-1	1720	115	50/60	1	0.7	44	16	4.00	3.91
A124PLP-1	1100	115	50/60	1	0.9	85	35	4.50	3.91
A124HLP-1	1100	115	50/60	1	0.4	38	38	4.50	3.91
A120KLP-1	1100	115	50/60	1	0.6	38	16	3.50	3.91

ASHLAND ELECTRIC PRODUCTS INC.

32-02 QUEENS BLVD., LONG ISLAND CITY, N. Y. 11101 • PHONE (212) 392-4010

AEP MOTORS

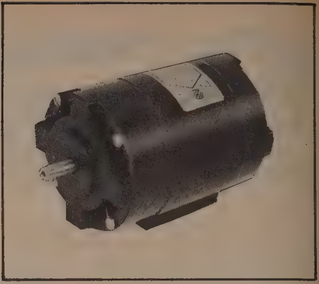
IN PHASE WITH INDUSTRY

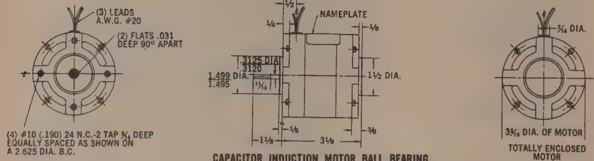
induction motors

60 Hz-400 Hz-VARIABLE FREQUENCY. 1-2 or 3 Phase Designed for Your Specific Application. Ashland Electric manufacturers a wide range of induction motors, either self-cooled or totally enclosed, motors for a wide variety of fan, blowers and instrumentation drives are our specialty. All temperature grades of insulation are available as required up to Class H to meet your specific ambient conditions.

AEP military type models are designed to meet all existing specifications for shock, vibration, humidity and environmental conditions.

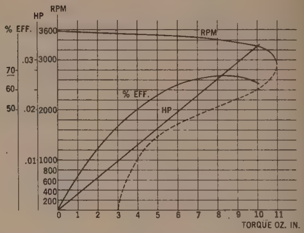
AEP Induction Motors are designed for efficiency, and manufactured to close tolerances, assuring a low temperature rise, and longer bearing life with minimumum noise and vibration.

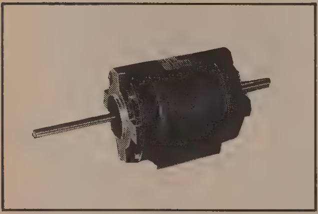




CAPACITOR INDUCTION MOTOR BALL BEARING
MODEL NO. A70MJM-1

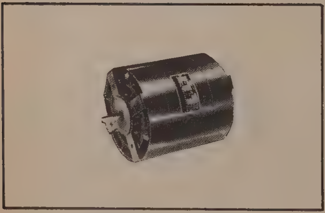
SPECIFICATIONS





3-4-5-6-7 FRAME INDUCTION MOTORS

Model Number	RPM	Volts	Frequency	Phase	Amps	Torque - Oz. In. Rated	Torque - Oz. In. S.T.	H.P.	Length (in.)	Dia. (in.)
A34EKM-1	1250	115	60	1	0.1	2.4	4.5	1/300	3.28	1.75
A407EXM-1	2050	115	60	2	0.025	1.46	2.5	1/300	2.00	1.75
A42MLM-1	6900	115	400	1	0.5	2.9	1.5	1/50	2.68	1.75
A405EJM-3	3300	115	60	1	0.12	0.1	0.1	1/3000	1.75	1.75
A50EJU-1	3200	115	60	1	0.3	1.0	2.5	1/300	2.56	2.00
A52KVU-1	7200	115	400	3	0.4	1.5	3.0	1/70	3.00	2.00
A52RKU-1	9650	115	400	1	0.4	5.2	3.0	1/20	2.75	2.00
A52RWU-1	10,000	115	400	3	0.45	5	7	1/20	3.00	2.00
A52KJU-1	3150	115	60	1	0.29	3.6	2	1/100	3.00	2.00
A61UZU-1	3550	208	400	3	2.0	28	17	1/10	3.75	3.31
A66VJU-1	3300	115	60	1	1.4	39	18	1/8	5.00	3.31
A74RJP-1	3400	115	60	1	1.0	24.5	6	1/12	4.50	3.31
A72KMP-1	740	115	60	1	0.2	11	7	1/125	4.00	3.31
A70KKM-2	1600	115	60	1	0.4	5.5	7.7	1/100	3.50	3.31
A70MJM-1	3450	115	60	1	0.3	5.8	4.0	1/50	3.50	3.31



8-9-11-12 FRAME INDUCTION MOTORS

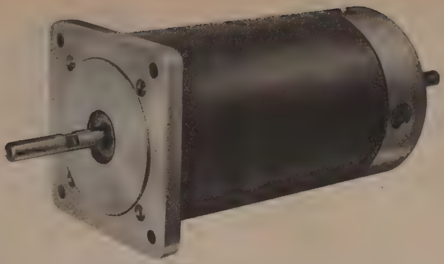
Model Number	RPM	Volts	Frequency	Phase	Amps	Torque - Oz. In. Rated	Torque - Oz. In. S.T.	H.P.	Length (in.)	Dia. (in.)
A88TKU-1	1725	115	60	1	1.7	58	35	1/10	5.95	3.875
A84QKU-1	1725	115	60	1	1.4	38	17	1/15	4.95	3.875
A88YZM-1	5000	115	400	1	9.0	60	29	1/3	5.75	3.875
A88WXU-1	3450	208	60	3	1.0	72	72	1/6	5.95	3.875
A96XKU-2	1625	115	60	1	5.0	154	250	1/4	5.45	5.375
A94ZXR-1	3400	115	60	3	4.8	150	480	1/2	5.50	5.375
A92ULU-1Z	900	115	50	1	1.1	81	63	1/10	4.45	5.375
A114NMU-1	860	115	60	1	0.8	29	30	1/40	4.813	4.375
A118VKU-1	1725	115	60	1	2.1	98	23	1/6	4.813	4.375
A116ZXU-1	3400	208	60	3	2.0	150	150	1/2	5.312	4.375
A118XWM-1	1700	208	60	3	1.1	147	350	1/4	5.813	4.375
A110PKP-1	1700	115	60	1	1.0	39	43	1/15	3.50	4.375
A122KKP-1	1600	26	60	1	2.2	16	9	1/40	4.25	3.91
A122XXL-1Z	2750	208	50	3	1.1	91	155	1/4	5.50	3.91

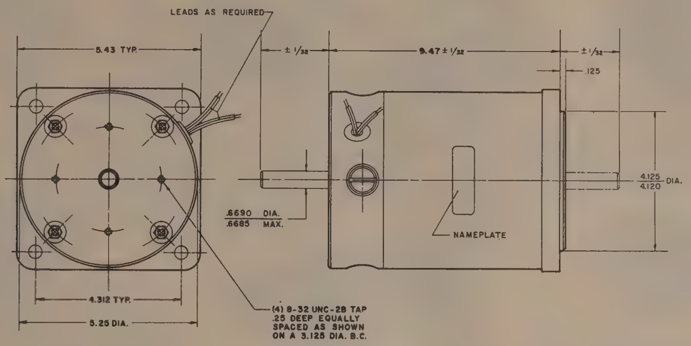
ASHLAND ELECTRIC PRODUCTS INC.

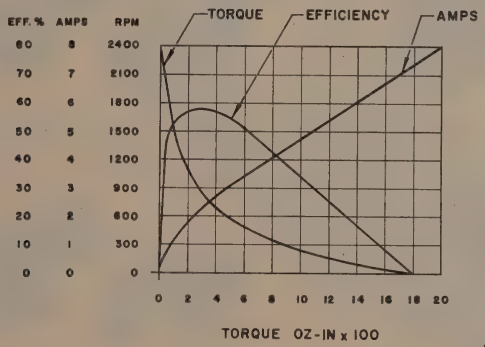
32-02 QUEENS BLVD., LONG ISLAND CITY, N. Y. 11101 • PHONE (212) 392-4010

AEP MOTORS

wound field d.c. motors




LEADS AS REQUIRED
5.43 TYP.
± 1/32
9.47 ± 1/32
± 1/32
.125
4.125
4.120 DIA.
.6690 DIA.
.6685 MAX.
NAMEPLATE
4.312 TYP.
5.25 DIA.
(4) 8-32 UNC-2B TAP
.25 DEEP EQUALLY
SPACED AS SHOWN
ON A 3.125 DIA. B.C.



A complete line of DC motors to continue Ashland's twenty-three year reputation for quality and performance. Available in series, split series, shunt and compound wound designs. The split series operates on half wave rectified AC as supplied by thyratron or silicon controlled rectifiers for economical control and fast reversal.

Applications

1. Where control of RPM and torque are required as in Bi-Directional speed controlled systems in data handling transports.
2. Tension maintaining devices such as in winding of plastic films, fibers or yarns.
3. Conventional motor uses and where high starting or running torque is required.

Design Features

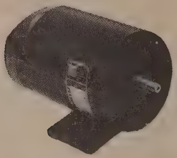
- Maximum brush life through minimum current density
- Dynamically balanced armatures
- Electric motor quality bearings selected and lubricated for maximum life.
- Insulation grades available class A-through class H.
- Stainless steel shafting
- Brake mounting provisions
- High torque to inertia ratio for plugging applications.
- Provision for external cooling if required
- Voltage range 12 to 120 VDC
- HP range 1/100 to 1 HP
- Size commensurate with requirements

ASHLAND ELECTRIC PRODUCTS INC.

32-02 QUEENS BLVD., LONG ISLAND CITY, N. Y. 11101 • PHONE (212) 392-4010

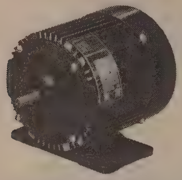
BODINE

fhp motors— gearmotors & speed controls

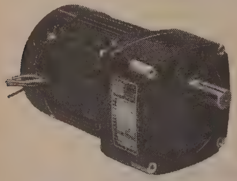


42A Permanent Magnet Motor Line: Standard TENV ratings are ⅛, ⅙, and ¼ Hp at 2500 Rpm. Only 4.3″ in diameter. Available with NEMA Type C face mounting shields.

42A-E Permanent Magnet Parallel Shaft Gearmotor Line: Torques thru 350 Lb-in. Ratios thru 300:1. Helical steel gearing. High overhung and thrust load capabilities.

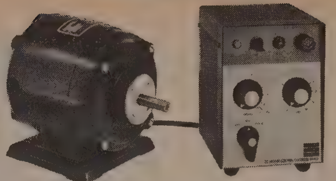


42R Induction Motor Line: TEFC ratings from 1/20 thru ¼ Hp. All A-C winding types. Options include capacitor mountings, overload protectors, and special wiring provisions.

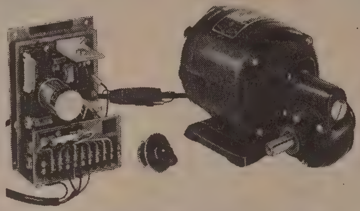


42R-E Induction Parallel Shaft Gearmotor Line: Torques thru 350 Lb-in. Ratios thru 300:1. Helical steel gearing. High overhung and thrust load capabilities.

Torque Motors: Selected K-2 and N-line motors for holding, positioning, and winding applications. Intermittent and continuous duty. Standard ratings from 7 thru 92 Oz-In.

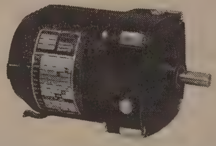


Encased Speed Controls: Nine models are stocked. Several with extended speed range or adjustable torque control.



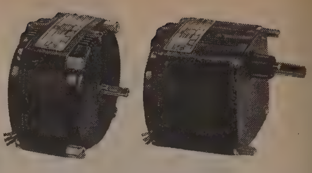
Chassis Speed Control Kits: Four models stocked. Unlimited adaptability. Adjustable torque control available. Permits maximum performance with matched Bodine drives.

N-Line Motors: Three basic sizes; 3.36″, 4.50″ and 5.68″ in diameter. Stock ratings from 1/125 thru ¼ Hp. All popular windings are available.

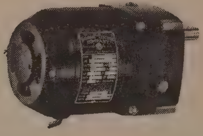


N-1S Gearmotors: Special purpose gearmotors for applications not requiring the ruggedness of the N-1D. Parallel in-line shaft. Only 3.41″ square. 100 lot minimum order.

K-4 Motors: Special purpose motors for high volume applications. Standard ratings from 1/60 thru 1/20 Hp. Only 2.88″ square. 500 lot minimum order upon application approval.

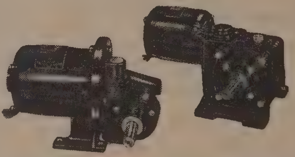


K-2 Line Motors and Gearmotors: Permanent-split capacitor instrument designs. Normal slip, high slip, and synchronous windings. Gearmotor torques thru 120 Oz-in. Only 2.405″ square.

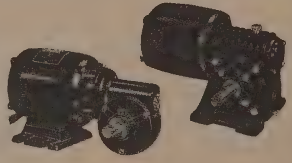


N-1D Gearmotors: Parallel shaft helical and spur gearing. Ratings thru 40 Lb-in. Ratios thru 900:1. Only 3.41″ square.

N-1R Gearmotors: Single and double reduction right angle worm gearmotors. Stock ratings thru 5 Lb-in. Many ratios available for a wide range of speed selection.



Double Reduction Right Angle Worm Gearmotors: Provide high torques at low speeds. Stock ratings over 200 Lb-in. Ample reserves for overloads.



Single Reduction Right Angle Worm Gearmotors: 6 frame sizes with stock ratings over 200 Lb-in. Ratios thru 60:1. Ample reserves for overloads.

There are more than 3,500 standards in the Bodine line. From 1/2000 thru ¼ Hp. Torques from 0.3 Oz-in. thru 350 Lb-in. Custom or specials? Yes . . . designed and built for your needs and available in small quantities, too. Over 340 STOCK motors, gearmotors, and speed/torque controls are available off-the-shelf from Bodine distributors. Call 312-478-3515 . . . or write for Catalog S: Bodine Electric Co., 2542 W. Bradley Place, Chicago, Illinois 60618.

BODINE
ELECTRIC
COMPANY

BODINE MOTORS
GEARMOTORS
SPEED CONTROLS

New PM drive systems

From the people at Bodine ...and Bodine Distributors

PM Controls *– Encased type.*

42D Control Gearmotors
Torques through 350 Lb-in.

42D Control Motors
Standard continuous duty ratings – 1/8 through 1/4 Hp at 2500 Rpm.

PM Controls *– Chassis type.*

New Type DPM permanent magnet SCR adjustable speed/torque drive systems designed and built for a wide variety of demanding applications. Available from stock.

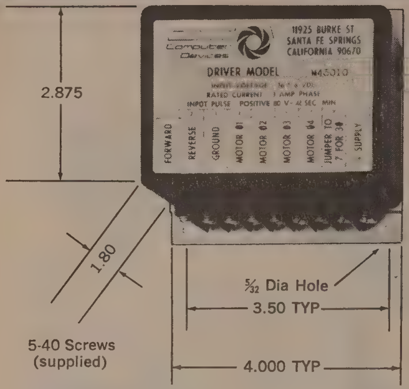
Built for rugged, long term use—controls feature new circuitry with an unusually wide degree of engineering flexibility for end-use convenience. Chassis type controls can be adapted into virtually any type of sub-system.

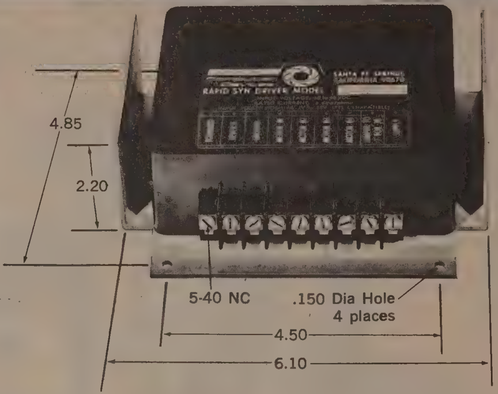
Our proven single source systems approach—Bodine designs and manufactures both the control and drive units. The result is perfect matching. DPM controls are perfectly matched with 42D control motors and gearmotors providing performance and reliability often found only in more complex and costlier systems. Get the facts on Bodine DPM control systems.

Bodine Electric Company, 2500 W. Bradley Place, Chicago, IL 60618.
Phone: (312) 478-3515. Telex 25-3646.

BODINE
ELECTRIC
COMPANY
BODINE MOTORS
GEARMOTORS
SPEED CONTROLS

RAPiD SYN DRIVERS


11925 BURKE ST
SANTA FE SPRINGS
CALIFORNIA 90670
Computer Devices
DRIVER MODEL M43010
FORWARD
REVERSE
GROUND
MOTOR Ø1
MOTOR Ø2
MOTOR Ø3
MOTOR Ø4
JUMPER TO 7 FOR 38
SUPPLY
2.875
1.80
5⁄32 Dia Hole
3.50 TYP
4.000 TYP
5-40 Screws (supplied)


RAPID SYN DRIVER MODEL
SANTA FE SPRINGS CALIFORNIA 90670
4.85
2.20
5-40 NC
.150 Dia Hole 4 places
4.50
6.10

DESCRIPTION

Rapid-Syn Drivers are solid state pulse-to-step converters capable of providing bi-directional operation of the stepping motor.

All Rapid-Syn Drivers listed, except Model M2301F, are designed to drive 3 Phase and 4 Phase motors regardless of type or step angle of the motor. Model M2301F is a bi-polar driver designed for 4 Phase PM motors.

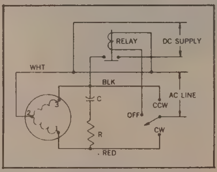
All models require 2.4 to 30 volts positive going pulse with a minimum pulse width of 20 micro-seconds (TTL compatable). For rated input voltage and maximum current rating of various models, refer to table.

GENERAL SPECIFICATIONS

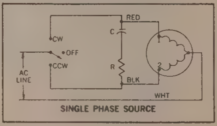
Operating Temperature Range: 0°C to 60°C
Input Impedance: 3KΩ Minimum
Switching Capability: 10K PPS Minimum

Model No.	Rated Current Amp/Phase Max.	Rated Voltage VDC	Excitation Mode	Connection Diagram	Type
M61	6	10 to 40	Single Phase	Fig. 1, 2, 3	Unipolar
M62	6	10 to 40	Dual Phase	Fig. 1, 2, 3	Unipolar
M68	6	10 to 40	Single, Dual	Fig. 1, 2, 3	Unipolar
M43010	3	22 to 34	Single Phase	Fig. 1, 2, 3	Unipolar
M43020	3	22 to 34	Dual Phase	Fig. 1, 2, 3	Unipolar
M83010	3	22 to 34	Single, Dual	Fig. 1, 2, 3	Unipolar
M2301F	3	22 to 34	Two Phase	Fig. 4	Bipolar

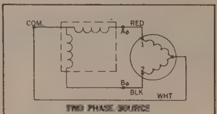
SYNCHRONOUS MOTORS INCREASING HOLDING TORQUE WITH A D.C. SOURCE


RELAY
DC SUPPLY
WHT
BLK
C
AC LINE
CCW
OFF
CW
R
RED
1
2
3

DRIVE SCHEMATIC

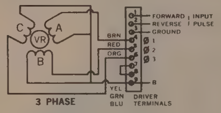

RED
C
CW
OFF
CCW
AC LINE
R
BLK
WHT
1
2

SINGLE PHASE SOURCE


COM.
RED
Aϕ
Bϕ
BLK
WHT
1
2

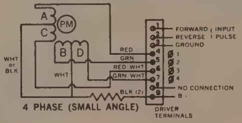
TWO PHASE SOURCE

FIG. 1


C
A
VR
B
BRN
RED
ORG
YEL
GRN
BLU
FORWARD
REVERSE
GROUND
INPUT PULSE
Ø 1
Ø 2
Ø 3
B
DRIVER TERMINALS

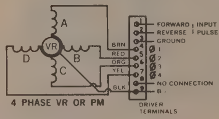
3 PHASE

FIG. 3


A
PM
C
B
D
WHT or BLK
WHT
RED
GRN
RED WHT
GRN WHT
BLK (2)
FORWARD
REVERSE
GROUND
INPUT PULSE
Ø 1
Ø 2
Ø 3
Ø 4
NO CONNECTION
B
DRIVER TERMINALS

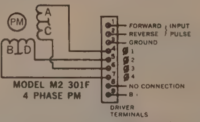
4 PHASE (SMALL ANGLE)

FIG. 2


A
VR
D
B
C
BRN
RED
ORG
YEL
BLK
FORWARD
REVERSE
GROUND
INPUT PULSE
Ø 1
Ø 2
Ø 3
Ø 4
NO CONNECTION
B
DRIVER TERMINALS

4 PHASE VR OR PM

FIG. 4


PM
A
C
B
D
FORWARD
REVERSE
GROUND
INPUT PULSE
Ø 1
Ø 2
Ø 3
Ø 4
NO CONNECTION
B
DRIVER TERMINALS

MODEL M2 301F
4 PHASE PM

RATING FOR 120 VAC, 60 Hz. AC SYNCHRONOUS MOTORS

Model No.	Size	Speed (RPM)	Resist. Per Phase (Ohms)	Torque (Oz. In.)	Rotor Inertia (GM CM²)	Phase Shifting Component		Weight (Oz.)	Length (In.)	Fig. No.
						Res. ±5%	Cap. ±5%			
20PE-450	20	450	770	4.0	26	—	1.0 MFD-300VAC	8	1.00	8
20PS-300	20	300	770	4.0	26	—	1.0 MFD-300VAC	8	1.00	8
23H-400	23	200	420	25	120	200Ω-5W	1.75MFD-330VAC	32	3.25	6
23H-600	23	72	1100	25	50	500Ω-5W	.75MFD-330VAC	20	2.25	6
28PF-600	28	600	1000	10	93	—	1.0 MFD-300VAC	24	2.25	10
28PS-300	28	300	1000	12	93	—	1.0 MFD-300VAC	24	2.25	10
34H-400	34	200	225	50	1100	300Ω-25W	3.75MFD-330VAC	75	3 11⁄16	7
34H-600	34	72	300	100	550	400Ω-25W	2.25MFD-330VAC	50	2 7⁄16	7

Computer Devices

COMPUTER DEVICES CORPORATION OF CALIFORNIA
TEL. (213) 698-2595   TELEX 65-7478
11901 BURKE STREET / SANTA FE SPRINGS, CALIFORNIA 90670

RAPID SYN
STEPPING MOTORS AND CONTROLS

INCREASE PRODUCT RELIABILITY—REDUCE COSTS!

Choose Steppers and Controls from the broad, flexible line of Computer Devices Corporation, and be assured of top quality at prices you can live with. Check our widest range of step angles in 2, 3, 4 and 5 phase units—all designed to operate from a wide variety of solid state logics which are stock items. Also available, RAPID SYN Synchronous 72, 200, 300, 450 and 600 RPM motors (not shown). You'll like our service on your special requirements.

RAPID-SYN STEPPERS . . . RATINGS AND CHARACTERISTICS*

Step Angle	Size	*Model Number	Type	Res/ϕ (Ohms)	Rated Voltage (VDC)	Static Stall Torque (Oz. In.)	Detent Torque (Oz. In.)	Dynamic Torque (Oz. In.)	Response (PPS)	Induct. mh	Rotor Inertia (gm. cm.^{2})	Weight (Oz.)	Length Max. (In.)	Fig. No.
1.8°	23	23F-180	VR/5ϕ	0.4	2.0	50	0	25	2000	1.00	350	66	4.938	9
	23	23D-6102	PM/4ϕ	5.1	5.1	53	5	35	700	6.80	87	20	2.0	6
	23	23D-6108	PM/4ϕ	0.63	1.3	53	5	35	1100	.68	87	20	2.0	6
	23	23D-6204	PM/4ϕ	2.6	4.3	100	8	65	900	6.30	200	32	3.25	6
	23	23D-6209	PM/4ϕ	0.37	1.7	100	8	65	1350	.80	200	32	3.25	6
	23	23D-6306	PM/4ϕ	1.16	3.4	150	10	100	1050	3.90	320	44	4.0	6
	23	23D-6309	PM/4ϕ	0.48	2.2	150	10	100	1150	1.43	320	44	4.0	6
	23	23H-02	PM/4ϕ	80	28	30.0	1.0	20.0	700	73.00	30.0	17.0	2.000	6
	23	23H-05	PM/4ϕ	5	6	30.0	1.0	20.0	1000	5.10	30.0	17.0	2.000	6
	23	23H-501	PM/4ϕ	5	6	60.0	2.0	40.0	450	67.00	120.0	20.0	2.250	6
	23	23H-502	PM/4ϕ	20	12	60.0	2.0	40.0	425	16.30	120.0	20.0	2.250	6
	23	23H-503	PM/4ϕ	80	24	60.0	2.0	40.0	425	66.50	120.0	20.0	2.250	6
	23	23H-700	PM/4ϕ	3	6	90.0	4.0	65.0	480	11.50	200.0	30.0	3.250	6
	34	34D-9106	PM/4ϕ	0.95	2.9	150	5	110	750	3.8	643	52	2.45	7
	34	34D-9109	PM/4ϕ	0.39	1.8	150	5	115	875	1.63	643	52	2.45	7
	34	34D-9209	PM/4ϕ	0.55	2.9	300	10	200	750	2.71	1200	88	3.7	7
	34	34D-9311	PM/4ϕ	0.52	2.8	450	15	300	650	1.90	1850	124	5.31	7
	34	34D-9314	PM/4ϕ	0.31	2.2	450	15	300	750	1.0	1850	124	5.31	7
	34	34H-02	PM/4ϕ	0.50	2	125.0	4.0	90.0	1100	1.76	375.0	45.0	2.500	7
	34	34H-501	PM/4ϕ	20	14	140.0	6.0	100.0	500	65.00	550.0	50.0	2.437	7
	34	34H-507	PM/4ϕ	150	35	140.0	6.0	100.0	500	1.25	550.0	50.0	2.437	7
	34	34H-508	PM/4ϕ	10	8	140.0	6.0	100.0	500	27.00	550.0	50.0	2.437	7
	34	34H-509	PM/4ϕ	4.50	5.5	140.0	6.0	100.0	500	20.00	550.0	50.0	2.437	7
	34	34H-510	PM/4ϕ	0.50	2.0	140.0	6.0	100.0	550	1.50	550.0	50.0	2.437	7
	34	34H-700	PM/4ϕ	0.70	3.0	280.0	10.0	200.0	800	4.00	1100.0	76.0	3.687	7
	34	34H-901	PM/4ϕ	1.1	4.5	500.0	15.0	250.0	600	6.13	1800.0	150.0	5.312	7
2.25°	23	23F-215	VR/5ϕ	0.4	2.0	50	0	25	2000	1.76	350	66	4.938	9
5°	23	23H-300	PM/4ϕ	3.0	6	45.0	6.0	30.0	350	5.80	120.0	30.0	3.25	6
	23	23V-300	VR/4ϕ	3.0	6	40.0	0	22.0	420	7.50	120.0	30.0	3.25	6
	34	34H-300	PM/4ϕ	0.75	3	90.0	7	60.0	400	3.4	1200.0	75.0	3.687	7
7.5°	11	11RS-01	VR/4ϕ	100	28	2.3	0	1.20	750	45.00	2.5	5.0	1.400	2
	15	15RS-03	VR/4ϕ	55	28	8.0	0	5.0	1100	47.0	3.0	6.5	1.500	3
	20	20PS-24S	PM/4ϕ	90.0	24.0	7.0	2.0	4	275	40.0	26	8	1.00	8
	20	20RS-01	VR/4ϕ	20.0	28	30.0	0	10.0	700	47.0	10.0	20.0	2.500	5
	23	23RS-01B	PM/4ϕ	70.0	28	11	1.2	6	260	66.5	26	8	1.00	8
	28	28PS-05-24	PM/4ϕ	175	24	18.5	3.0	12.5	140	260.0	93	24	2.25	10
11.25°	20	20PE-24S	PM/4ϕ	90.0	24.0	7.0	2.0	4	275	40.0	26	8	1.00	8
15°	8	08R-01	VR/4ϕ	100	28	1.0	0	0.6	1400	65.0	0.18	1.8	1.000	1
	8	08V-01	VR/3ϕ	60	28	1.3	0	0.50	1100	30.0	0.18	1.8	1.000	1
	11	11R-01	VR/4ϕ	55	28	5.8	0	3.25	1040	45.0	1.0	4.7	1.625	2
	11	11V-01	VR/3ϕ	80	28	2.75	0	1.75	630	56.0	1.0	4.7	1.625	2
	15	15R-01	VR/4ϕ	35	28	8.0	0	4.50	1170	60.00	0.7	6.5	1.500	3
	15	15V-01	VR/3ϕ	16	28	5.8	0	2.25	1000	14.0	0.6	6.5	1.500	3
	18	18R-01	VR/4ϕ	55	28	11.5	0	8.0	620	140.0	5.0	13.0	1.875	4
	20	20R-03	VR/4ϕ	35	28	18.0	0	6.6	625	75.0	3.5	20.0	2.500	5
	20	20R-07	VR/4ϕ	20	28	38.0	0	25.0	400	51.0	10.0	20.0	2.500	5
	20	20R-17	VR/4ϕ	10	28	40.0	0	30.0	700	24.0	10.0	20.0	2.500	5
	20	20V-01	VR/3ϕ	10	28	50.0	0	13.6	475	30.0	10.0	20.0	2.500	5
	20	20V-03	VR/3ϕ	20	28	40.0	0	10.0	400	54.0	10.0	20.0	2.500	5
	28	28PF-08-24	PM/4ϕ	175	24	17.5	1.5	12.0	130	260.0	93	24	2.25	10
45°	8	08M-01	PM/4ϕ	65	28	1.0	0.10	0.35	700	35.0	0.3	1.75	1.000	1
	11	11M-01	PM/4ϕ	45	28	2.5	0.20	1.50	425	14.0	1.2	4.5	1.625	2
	15	15M-01	PM/4ϕ	30	28	8.1	0.30	4.80	300	17.9	5.0	10.0	2.100	3
	18	18M-01	PM/4ϕ	40	28	6.0	0.25	3.5	350	14.0	4.0	13.0	1.875	4
	20	20M-01	PM/4ϕ	12	28	15.0	0.40	8.7	300	13.0	15.0	26.0	2.500	5
90°	8	08P-02	PM/4ϕ	100	28	0.8	0.10	0.25	350	18.0	0.3	1.75	1.000	1
	11	11P-01	PM/4ϕ	60	28	2.5	0.20	1.10	240	22.0	1.2	4.3	1.625	2
	15	15P-03	PM/4ϕ	20	28	11.0	0.30	7.0	175	14.1	5.0	10.0	2.100	3
	18	18P-01	PM/4ϕ	20	28	8.0	0.25	6.0	260	20.0	4.0	13.0	1.875	4
	20	20P-03	PM/4ϕ	12	28	20.0	0.40	9.0	180	13.0	10.0	20.0	2.500	5

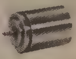


Fig. 1 Size 8 — ¾″ Dia.

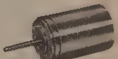


Fig. 2 Size 11 — 1⅙″ Dia.

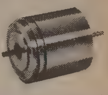


Fig. 3 Size 15 — 1⁷⁄₁₆″ Dia.

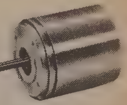


Fig. 4 Size 18 — 1¾″ Dia.

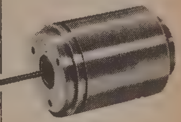


Fig. 5 Size 20 — 2″ Dia.

Fig. 6 Size 23 — 2²⁵⁄₃₂″ Dia.

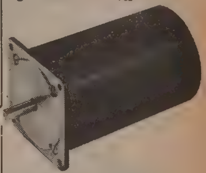
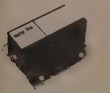

'ig. 7 Size 34 — 3⅜″ Dia.

Fig. 8 Commercial Grade Stepper

ELECTRONIC ANCILLARIES


Pulse Source

Driver

Preset Indexer

Adjustable Speed Drive

Accelerating Decelerating Drive

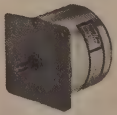


Fig. 10 Pacesetter

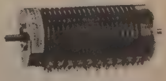


Fig. 9 Five Phase Stepper

*For complete Model No. and detailed specifications, call or write to factory

COMPUTER DEVICES CORPORATION OF CALIFORNIA

Computer Devices

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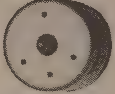
Canon®

SMALL D.C. MOTORS



The Canon lines of d.c. motors are both extensive and comprehensive. They offer the equipment designer a broad variety of options from which he can select the size and performance characteristic combinations best suited for his application. All models are proven designs whose reliability has been demonstrated in numerous applications.

There are two basic lines: Type C, unshielded, and type M, which are shielded electrically to minimize R.F. noise and mechanically to reduce acoustic noise. All are permanent magnet, iron core motors.

Both types include models which are: Ungoverned, electronically governed and mechanically governed at a single speed, two speeds or three speeds. Also included motor-tachometer units. For electronically governed motor applications where the customer wishes to provide the electronics himself, the motors can be supplied without the p.c. boards.

Where torque multiplication and speed reduction are required, a variety of gearheads, to fit many of the models, are available. (A few representative units are listed.)

Mounting: Most models are designed for front mounting and are supplied with holes tapped for metric and U.S. screw sizes.

Shafts: Shaft lengths are supplied to customer order. Flats, grooves, holes splines etc. can be specified.

Wiring: Shielded units have floating ground. For R.F. filtering motors can be supplied, pre-wired with capacitors and choke coils, internal on shielded, external on unshielded. Electronically governed units are pre-wired to p.c. board.

GEAR HEADS

Model	Reduction Range	Torque max. con. oz-in
OFFSET OUTPUT SHAFT		
GH30	1/50 to 1/150	27.78
GH35	1/30 to 1/500	27.78 to 83.33
RB-54	1/10 to 1/1800	13.88 to 25
CONCENTRIC OUTPUT SHAFT		
RA-20	1/5 to 1/3000	1.38 to 13.88
RA-27	1/8 to 1/3000	5.55 to 34.72

Canon U.S.A., Inc.
Electronics Components Div.
10 Nevada Drive,
Lake Success, L. I., N. Y. 11040

516/488-6700
Telex No. 96-1333
Cable - Canon USA LAKS

SELECTION TABLE–TYPE M, SHIELDED ELECTRICALLY AND ACOUSTICALLY

Model No.	Voltage Rated	Voltage Range	Rated Current, milliamp.	Nominal Resistance, ohms	Rated Speed rpm	Torque Rated oz-in	Torque Starting oz-in	Inertia oz-in sec² ×10⁻⁶
UNGOVERNED								
MK 29-R1	6	3-12	340	10.5	2000	0.42	0.70	62.0
MK 39-R5	6	3.3-16	280	7.8	3000	0.31	1.11	146.6
MK 39-R8	6	3.3-16	150	6.7	2000	0.17	0.50	172.0
MK 39-S8	7.5	3.3-16	125	11.5	2000	0.11	0.50	165.0
MK 41-K1	4.5	3.3-16	390	5.5	2000	0.42	0.90	143.8
MK 41-Q5	9	3.3-16	175	11.5	4000	0.22	1.25	165.0
MK 41-Q7	9	3.3-16	140	10.4	4000	0.22	1.40	197.4
MK 41-R1	6	4-16	300	5.5	3000	0.28	1.11	143.8
MK 41-R2	6	3.3-16	300	9.0	2000	0.42	0.76	146.6
MK 41-R3	6	4-16	300	5.0	3000	0.28	1.10	155.1
MK 41-R4	6	4-16	250	6.8	3000	0.28	1.00	155.1
MK 41-R5	6	3.3-16	280	7.8	3000	0.31	1.10	146.6
MK 41-R8	6	3.3-16	240	6.7	3000	0.28	1.10	172.0
MK 41-R13	6	3.3-16	380	6.6	3000	0.42	1.00	155.1
MK 41-R31	6	3.3-16	280	5.4	3000	0.39	1.00	181.9
MK 41-R32	6	3.3-16	320	7.0	3000	0.42	1.10	155.1
MK 41-S7	7.5	3.3-16	190	11.5	3000	0.28	1.00	165.0
MK 41-T7	12	3.3-16	145	16.5	3000	0.28	1.00	167.8
MK 41-T13	12	3.3-16	160	32.0	3000	0.35	0.90	162.2
MECHANICALLY GOVERNED								
MA 39-R5	6	3.3-16	160	7.8	2000 ±30	0.17	0.50	146.6
MA 39-R8	6	3.3-16	150	6.7	2000 ±30	0.17	0.50	172.0
MA 39-S8	7.5	3.3-16	125	11.5	2000 ±30	0.11	0.50	165.0
MA 41-Q5	9	3.3-16	120	11.5	2200 ±40	0.13	0.50	165.0
MA 41-Q7	9	3.3-16	160	10.4	2000 ±30	0.25	0.50	197.4
MA 41-R5	6	3.3-16	160	7.8	2000 ±30	0.17	0.50	146.6
MA 41-R8	6	3.3-16	150	6.6	2000 ±30	0.17	0.50	172.0
MA 41-R31	6	3.3-16	135	5.4	2400 ±30	0.13	0.50	181.9
MA 41-R40	6	3.3-16	155	7.5	2000 ±30	0.14	0.50	183.3
MA 41-S7	7.5	3.3-16	125	11.5	2000 ±30	0.17	0.50	165.0
MA 41-T7	12	3.3-16	110	16.5	2000 ±30	0.17	0.50	167.8
MA 41-T13	12	3.3-16	105	32.0	2000 ±30	0.17	0.50	162.2
MB 41-K1	4.5	3.3-16	155	5.5	2200 ±40	0.11	0.50	143.8
MB 41-R2	6	3.3-16	130	9.0	2000 ±40	0.14	0.50	146.6
MB 41-R12	6	3.3-16	165	7.8	2000 ±40	0.17	0.50	146.6
MB 41-R13	6	3.3-16	155	6.6	2200 ±40	0.11	0.50	155.1
MB 41-R32	6	3.3-16	140	7.0	2400 ±40	0.13	0.50	155.1
ELECTRONICALLY GOVERNED								
MKB 29-R1	6	4-12	135	10.5	2000 ±50	0.11	0.28	62.0
MKB 41-R3	6	4-16	160	5.0	2000 ±50	0.17	0.50	155.1
MKB 41-R4	6	4-16	135	6.8	2000 ±50	0.11	0.50	155.1
MLB 41-R1	6	4-16	125	5.5	2000 ±50	0.11	0.50	143.8

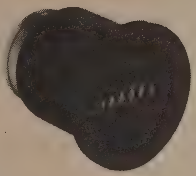
SELECTION TABLE–TYPE C, UNSHIELDED

Model No.	Voltage Rated	Voltage Range	Rated Current, milliamp.	Nominal Resistance, ohms	Rated Speed rpm	Torque Rated oz-in	Torque Starting oz-in	Inertia oz-in sec² × 10⁻⁶
UNGOVERNED								
CK 20-R1	5	3-12	110	14.2	3400	0.09	0.40	38.6
CK 20-T1	12	3-12	70	80.0	3000	0.14	0.39	38.6
CK 22-S1	7	4-12	70	21.0	3400	0.10	0.50	52.6
CK 22-S2	6.5	4-12	170	12.9	2400	0.28	0.80	71.3
CK 26-R1	6	3-12	340	10.5	2000	0.42	0.70	62.0
CK 26-U1	15	9-20	250	6.2	6300	0.42	3.50	229.8
CK 35-H1	24	6-24	180	14.2	7200	0.35	2.08	245.3
CK 35-K1	4.5	4-16	130	8.2	3000	0.11	0.56	125.5
CK 35-R21	6	4.5-18	160	12.5	1200	0.25	0.56	167.8
CK 35-R24	6	4.5-18	260	11.0	2000	0.42	0.83	169.2
CK 35-T3	12	3.3-18	145	24.0	3000	0.28	1.00	169.2
CK 35-T6	12	6-24	330	5.0	7200	0.35	2.08	249.6
CK 38-H1	24	3-24	1800	2.1	6000	6.94	35.00	1988.1
MECHANICALLY GOVERNED								
CA 22-K1	3.6	3-24	320	1.5	2970 ±80	0.18	1.02	58.2
CA 35-R21	6	3-24	70	12.5	1200 ±50	0.07	0.50	167.8
CA 35-R24	6	3-24	80	11.0	2000 ±50	0.04	0.50	169.2
CA 35-T3	12	3-24	100	24.0	1440 ±40	0.21	0.50	169.2
MULTIPLE SPEED MECHANICALLY GOVERNED								
CKM 22-Q1	6	3-12	280	3.05	3240 ±80	0.22	0.83	62.0
	6.75	3-12	290	3.05	4320 ±80	0.22	0.83	62.0
	8.50	3-12	300	3.05	9720 ±500	0.22	0.83	62.0
CKM 22-R1	3.8	3-12	280	2.88	3300 ±80	0.18	0.83	48.2
	5.5	3-12	290	2.88	6324 ±100	0.18	0.83	48.2
CKM 22-R3	3.8	3-12	280	2.88	3350 ±80	0.18	1.20	48.2
	4.7	3-12	290	2.88	4460 ±100	0.18	1.20	48.2
	5.2	3-12	300	2.88	6550 ±400	0.18	1.20	48.2
MOTOR TACHOMETER COMBINATION								
CKT 26-T3	9.5	9-20	600	1.75	7000 ±600	0.56	4.9	248.2
CKT 26-T4	12	12-20	1300	4.1	2160 ±250	4.20	6.3	415.6
CKT 38-U1	14	24-70	1300	4.3	1500 ±300	6.94	13.2	2223.6

Specify CRAMER MOTORS & TIMING DEVICES . . . for a better chance of solving your timing problem.

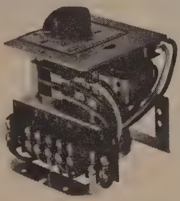
635 SERIES ETIs

- large selection of models, built around same basic mechanism
- inductor motor for faster starts and stops
- excellent readability from large numerals on 1″ diameter wheels
- low cost
- durable
- compact
- UL recognized



472/473 SERIES RESET TIMERS

- 5 basic models with varying combinations of switches, terminal blocks and wiring arrangements
- low cost through design simplicity
- better than 1% accuracy
- cam-actuated switches for programmed timing
- reduced switch actuator overtravel provides longer switch life
- mounts on front or rear of control panel
- optional high capacity load switch (up to 25 amps)
- UL recognized



402/403 SERIES PLUG-IN RESET TIMERS

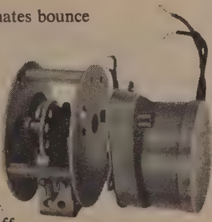
- plug-in for instant time range interchangeability and simplified maintenance
- can be used for interval or delay timing
- includes pilot light and progress indicator
- modern square bezel provides up-to-date panel design
- unique damping method eliminates bounce
- thirteen time ranges
- UL recognized

6 0
SECONDS
1
2
3
4
5

140* SERIES CLUTCH MECHANISMS

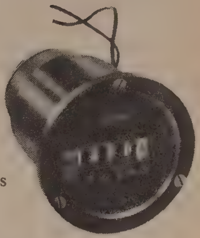
- hardened gear clutch construction
- AC or DC power-operated
- driven by input from timing or other motor, belt or chain take-off
- end plates, shafts, gear mechanisms available to meet special clutching or speed changing requirements
- integrally mounted reset springs available

*When a Cramer timing motor is the input source, the mechanism is known as the 142 clutch motor.



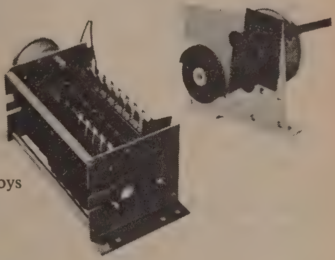
636 SERIES ETIs PUSHBUTTON RESET

- faster and more reliable than thumbwheel reset
- excellent readability
- inductor motor for faster starts and stops, higher accuracy
- unique "anti-topping" mechanisms
- UL recognized



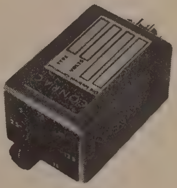
525/526 SERIES CYCLE TIMERS

- compact
- low cost
- two types of switch actuators available
- Model 525 uses adjustable cams
- Model 526 employs fixed cams
- UL recognized



3800/3801 SERIES ELECTRONIC TIMERS

- time delay (3800) or interval (3801) versions
- standard time ranges 1, 10, 30, 60 sec. and 5 min.
- time calibrated dials
- for 115 or 24 volts AC
- DPDT output contacts rated 10 ampere
- compact plug-in units for base or panel mounting



117 SERIES AC MOTORS

- fast starting and stopping
- superior output bearing design
- low power input
- stainless steel output shaft
- round or pear-shaped gear trains
- output torque up to 60 in. oz. at 1 rpm.

800 SERIES DC MOTORS

- low current drain
- high torque output
- long life brushes
- wide choice of gear ratios
- round or pear-shaped gear trains

CRAMER

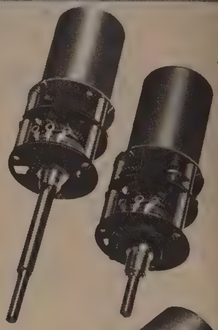
Mill Rock Road, Old Saybrook, Conn. 06475
(203) 388-3574

CONRAC CORPORATION

DEPENDABLE DALE® ELECTROMECHANICAL PRODUCTS

REVERSIBLE AC MOTOR DRIVEN POTENTIOMETERS

FOR USE IN ■ Home Entertainment Appliances ■ Instrumentation ■ Controls



FEATURES

■ Available with all standard potentiometers: Single, ganged or with power switch—dimensions change accordingly.

■ Magnetic clutch eliminates coasting and allows manual control independent of gear motor inertial load.

■ Long life expectancy ■ No lubrication in normal use ■ Operates in any position ■ Special terminal configurations available

SPECIFICATIONS

Operating Voltage: 6, 12, 24, 117 V.A.C., or any specified

Power Input: 5.5 Volt Amperes

Output: Approximately 5.6 R.P.M.

Torque at Potentiometer Shaft: 10 in./oz. minimum (with decoupler); 21 in./oz. minimum (without decoupler).

Reversing: Accomplished by switching capacitor as shown in hysteresis motor circuit diagram below.

Dimensions: Length: 3.275″ (not including shaft) Diameter: 1.531

REVERSIBLE AC GEARHEAD MOTORS

FOR USE WITH ■ Switches ■ Potentiometers ■ Projectors ■ Turret Drives ■ Ribbon Drives ■ Chart Drives ■ Turntable Drives ■ Business Machines ■ Displays ■ Light industrial and consumer product controls

SPECIFICATIONS

MECHANICAL

Overall Dimensions: Length: 3.275″ (not including shaft) Diameter: 1.531″

Shipping Weight: .32 lbs.

Will meet normal industrial environmental requirements.

Mounting: Horizontal standard, vertical optional; bracket provided for chassis mounting and mounting control.

Output Torque: 14 in./oz. at 5.3 R.P.M.

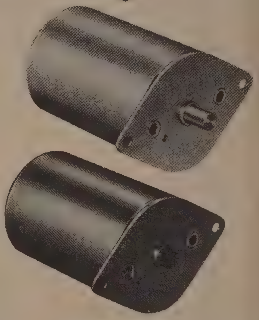
ELECTRICAL

Operating Voltage: 117 volts AC, 60 cycles standard. Available from 6 to 117 volts AC, 60 cycles.

Capacitor size: Dependent on input voltage. (Capacitor not supplied.)

REVERSIBLE AC HYSTERESIS SYNCHRONOUS MOTORS

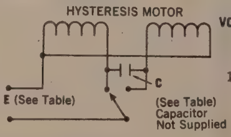
FOR USE IN ■ Low Power Driving Mechanisms ■ Control Circuits ■ Timers ■ Fans ■ Entertainment Appliances ■ Scanning Devices ■ Stirring Devices ■ Cassette Drives



FEATURES

- ■ Output shaft configuration can be specified. Standard units provided with gear.
- ■ Mounting arrangement can be varied to meet customer requirements.
- ■ Self-lubricating bearings.
- ■ Aluminum housing.
- ■ Long life expectancy.
- ■ Reversing accomplished by switching external capacitor as shown in circuit diagram.

CIRCUIT DIAGRAM



E VOLTAGE	C CAPACITANCE	C VOLTAGE
6	170 MFD	20
12	50 MFD	25
24	16 MFD	50
117	.47 MFD	300

SPECIFICATIONS

Operating Voltage: 6, 12, 117 V.A.C., or any specified.

Power Input: 5.5 Volt Amperes

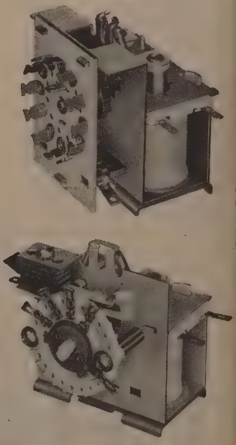
Output: Approximately 1800 & 3600 R.P.M.

Torque: 0.1 in./oz. min.

AC & DC STEPPING RELAYS

FOR USE IN ■ Control Circuits ■ Television Controls ■ Hi-Fi, Stereo & Radio ■ Appliances ■ Telephone Devices ■ Coin Machines ■ Car Washes ■ Crystal Switching ■ Copy Machines ■ Medical Electronics ■ Computers ■ Coin-operated Laundry Equipment ■ Programmers

FOUR TYPES AVAILABLE ■ Uni-Directional A.C. & D.C. ■ Bi-Directional A.C. and D.C.



SPECIFICATIONS

ELECTRICAL

Operating Voltage: 6 V, 12 V, 24 V, 117 V (AC or DC)

Power Required: 2.5 watts with Plate Sequence Switch (Fig. A); 4.5 watts with Wafer Sequence Switch (Fig. B).

Contact Arrangement: Single Pole 4, 6, 10, 12 or 13 throw sequence. Auxiliary power switch operates at predetermined position of sequence.

Contact Rating: From Dry Circuit to 1 amp at 24 V.A.C. on Sequence Switch. Optional power switch 5 amps at 117 V.A.C.

MECHANICAL

Overall Dimensions: Height: 2.200″
Width: 2.190″
Depth: 2.005″

Shipping Weight: 0.27 lbs. Uni-Directional; 0.40 lbs. Bi-Directional

Will meet normal commercial environmental requirements.

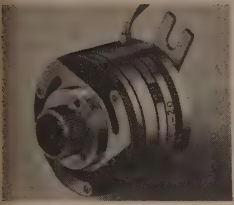
Standard auxiliary power switch may be omitted.

Mounting: Vertical or horizontal using one screw and two locating tabs.

DALE ELECTRONICS, INC., Box 180, Yankton, South Dakota 57078 • Phone: 605—665-9301

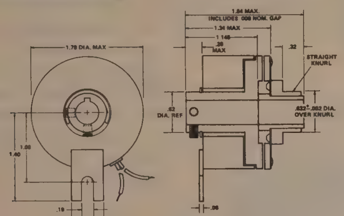
CLUTCHES & BRAKES ELECTRO MAGNETIC

MODEL 20 . . . Where performance and price are critical



FEATURES

- High torque in compact package (only 1.78" diameter)
- Fast response
- Ease of maintenance
- Available as stock items
- Standardized design at competitive price
- Flange or shaft mounting
- Long life
- Zero backlash armature with spring release
- **NO BURNISHING REQUIRED**



MECHANICAL CHARACTERISTICS

Static torque without burnishing	12 Lb. in. minimum*
Dynamic or slip torque	12 Lb. in. @ 1800 RPM 8 Lb. in @ 3600 RPM
Standard bores	1/4" 5/16" 3/8"
Standard key slots	1/16 x 1/32 3/32 x 3/64 3/32 x 3/64
Armature and hub inertia	8 x 10—5 Lb. in sec.2
Rotor inertia	10 x 10—5 Lb. in sec.2
Mechanical response time	
65% Rated torque	27 MS*
100% Rated torque	45 MS*
Electrical response time	12 MS*
Max. energy absorption continuous	420 FT. Lb./Min.

*With forcing voltage the response time can be reduced and torque increased. See Performance Characteristic Curves.

ELECTRICAL CHARACTERISTICS

(continuous duty)

Volts DC	12	24	90	
Resistance DC	24	96	1350	Ohms minimum

Power requirements	6 Watts
Standard leads	12", 22 AWG, 105°C-UL, 600 Volt

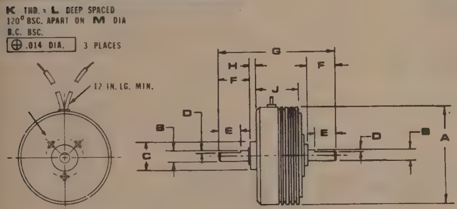
OPTIONS AVAILABLE BY SPECIAL ORDER:

1. Coil voltages not listed above.
2. Armature mounted drive elements such as pulleys, sprockets and gears.
3. Rotor and armature hub bores, including metric, not listed above.

Other standard designs for higher or lower torque ranges . . . write for further information.

HYSTERESIS CLUTCHES/BRAKES . . . HYB-HYSTERESIS BRAKES

A continuous slip device capable of providing precise, infinitely adjustable torque control. Units are basically direct current sensitive . . . having excellent reliability, repeatability and linearity. Described below are some of the infinite variations of Hysteresis Brakes manufactured. Also available are a similar wide variety of clutches.



ENGINEERING SPECIFICATIONS

	A	B	C	D	E	F	G	H	J	K	L	M
Size	±.015	+.0000 −.0005	+.0000 −.0005	±.005	± .015	MIN.	± .015	±.005	± .015	THD.2B	MIN.	BSC.
10	1.250	.1875	.3750	.020	.375	.500	2.125	.050	.900	4-40	.125	.687
20	1.750	.1875	.5000	.020	.375	.500	2.030	.090	.765	4-40	.125	.687
30	1.953	.1875	.5000	.020	.375	.500	2.280	.090	1.000	4-40	.125	.687
35	2.093	.2500	.6250	.030	.500	.750	3.020	.090	1.200	6-32	.250	.937
40	2.875	.2500	.6250	.030	.500	.750	3.415	.090	1.540	8-32	.312	1.000
45	3.625	.3750	.8750	.062	.750	1.000	4.155	.125	1.530	8-32	.312	1.500
50	4.437	.5000	1.1250	.062	1.000	1.250	5.140	.150	2.000	10-32	.500	1.750
55	5.484	.5000	1.1250	.062	1.000	1.250	5.175	.150	2.060	10-32	.562	1.750

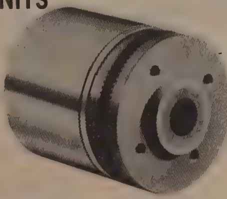
Information on sizes 70/85/120 rated at 750/1600/3000 oz. in respectively, available on request

TECHNICAL DATA	10	20	30	35	40	45	50	55
Torque—Oz. In. Min. At Rated Voltage	4	8	20	35	60	125	210	425
Watts—Max. At Rated Voltage At 25°C.	4.0	4.0	4.5	7.0	7.0	7.0	7.0	8.0
Dissipation Capacity, Max. Avg.—Watts	5	10	15	20	50	80	120	150
Maximum Recommended Speed (Input)—RPM	3600	3600	3600	3600	3600	3600	3600	3600
Moment Of Inertia—Oz. In. Sec.2 x 10—3 (Input)	.144	.57	.58	1.4	4 57	12.7	30.6	91.3
Drag Torque—Oz. In. Max. (De-energ. & Degaussed)	.20	.20	.20	.30	40	.70	1.0	1.0
Weight—Lb. Max.	.3	.60	.80	1.2	2.6	4.1	7.8	12.5

SPECIAL ENGINEERED UNITS

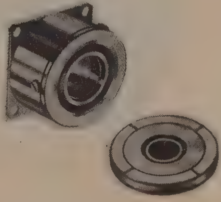
SUBMINIATURE CLUTCHES/ BRAKES

Fast response, low drag torque, high torque-to-inertia ratio, zero backlash. Torque from 3.5 to 240 oz. in. and response time from 4 to 50 mili. sec. Variety of designs for use as clutches, brakes, or clutch/brake combinations.



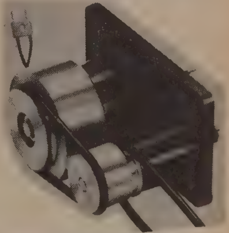
TOOTH TYPE CLUTCHES

Positive engagement and high torque to weight ratio make them ideal for airborne and space applications. Clutches and brakes available to 700 lb. in. Unit shown rated at 250 lb. in. in a 2-1/8" diameter x 2" long package.



APILON® FACED CLUTCHES and BRAKES

For severe service over extended periods of time. Special APILON ceramic friction facing has exceptionally high wear resistance and heat dissipation properties. Life expectancy of APILON faced units is in the area of 100 million operating cycles. The mechanical life of the unit matches the extraordinary life of the facings.



CUSTOM-DESIGNED UNITS

Delevan can provide units to meet the highly specialized requirements of virtually any commercial, industrial or military application. Here is a clutch/brake used to incrementally move recording type. The molded frame not only supports the clutch and brake, but also includes an idler pulley for a secondary speed output.

Delevan
Division

AMERICAN
PRECISION
INDUSTRIES INC.

270 QUAKER RD. / EAST AURORA, N. Y. 14052
TELEPHONE (716) 652-3600 TELEX 91-293

ELECTRO-CRAFT CORPORATION

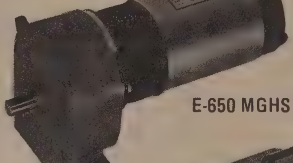
D.C. Permanent Magnet Motors
Solid State Motor Control Systems

MOTOMATIC®

Transistorized Motor Speed Control Systems

FEATURES

- **VERY WIDE SPEED RANGE**
  Typically 1000:1. For example 5 to 5000 rpm. Motomatic's speed range is wider than any SCR-type controller's.
- **FULL TORQUE**
  Even at lowest speeds. Hence, a 1/5 HP Motomatic has more torque at the low end of its speed range than a 1/2 HP SCR system.
- **COGGING FREE**
  Smooth output torque in the entire 1000:1 speed range.
- **EXELLENT SPEED REGULATION**
  From no load to full load the variation in speed is typically better than 1% of set speed (not nominal speed).
- **UNIQUE* CLOSED-LOOP SYSTEM**
  Consisting of an integrally-wound permanent magnet motor-generator and transistorized DC servo amplifier.


E-650 MGHS

E-650
Master Control

E-650 MGHR

- **RELIABLE DESIGN AND CONSTRUCTION**
  Typically rated for 5000 hrs. use. In the past 8 years, over 1/2 million units were sold to over 1000 different customers, establishing and excellent history of reliability in the field.
- **PRECISE CONTROL — LOW DRIFT**
  Speed can be set very accurately and monitored continuously. Ultra-stable amplifiers and temperature compensated motor-generators assure stable performance.
- **OVERLOAD PROTECTED**
  All systems can be stalled without damage to motor or controller.

*Patents issued and pending.

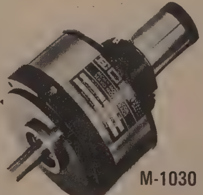
P6000 Series High P.W.M. Servo Systems

FEATURES

- Unique Open Modular Construction
- Completely self contained
- Plug in Standard or Custom Options
- Regenerative Energy Protected
- Silent Operation
- 115/230 AC or DC Power Options
- Independent Average and Peak Current Limits
- Cro-Bar Protected AC Power Supply

P-6200

S-670/596


M-1030

NOMINAL RATINGS

P6100
- Voltage at Rated Current ± 60V
- Rated Current 7A
- Peak Current 12A
- Rated Power 420W
- Peak Power 670W
- Bandwidth 3000 Hz

P6200
- Voltage at Rated Current ± 55V
- Rated Current 15A
- Peak Current 25A
- Rated Power 825W
- Peak Power 1250W
- Bandwidth 3000 Hz

MOTOMATIC®

THE MOTOMATIC CONCEPT

MOTOMATIC is a unique* transistorized motor speed control system designed, engineered and manufactured by Electro-Craft Corporation. MOTOMATIC is not a SCR-type motor speed control, MOTOMATIC is a complete closed-loop system consisting of a fast response, permanent magnet, integrally-wound motor-generator and high-gain transistorized servo feedback amplifier. MOTOMATIC systems offer precise speed control, even in the presence of changing load and line voltage conditions. Using MOTOMATIC speed can be accurately controlled from a potentiometer or from any transducer sensing heat, light, tension, etc.

SPEED REGULATION

Speed regulation is defined as the ability of a motor to maintain a set speed when a load torque is applied. A DC motor with "open loop" control has a relatively constant power input so if the load increases, the speed decreases. In order to maintain a constant speed with increasing load, the power input to the motor must, therefore, be increased.

The MOTOMATIC closed-loop control system is a self-balancing system which automatically adjusts the input to the motor so that an essentially constant speed is maintained even while the load on the motor is changing. The integral tachometer-generator senses that the load wants to change the motor speed and calls for more or less power to maintain constant speed. From no-load to full-load conditions, the variation in speed is typically better than 1% of set speed. It may be noted that similar claims made for certain SCR variable speed drives are frequently based upon "percent regulation of maximum speed". MOTOMATIC's speed regulation can be considerably better than 1% if less than the full load or the 1000:1 speed range is utilized.

DESIGN AND CONSTRUCTION

Electro-Craft motor-generators are quality engineered and manufactured to exacting specifications. Typical life cycle, on the basis of over 500,000 MOTOMATIC systems in operation, is in the range of 5000 hours at rated speed before brush changes are necessary. All rotors are epoxy resin insulated by a spray-coating process before winding and all finished armatures are impregnated to NEMA standards. Commutators are turned with a diamond cutter for a 20 micro-inch surface finish, assuring perfect brush seating and minimum brush bounce. Finally, all rotors are dynamically balanced for smooth operation and long bearing life. Motors are rated at a maximum armature temperature rise of 75 degrees C, which is better than the limits of Class "B" insulation. All units are "run in" before 100% final testing and shipment.

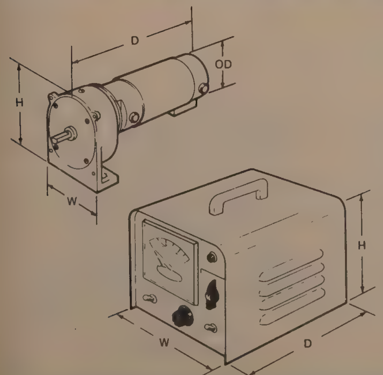
*Patents issued and pending.

SPECIFICATIONS

	System			
	E350	E550	E586	E650
Max. Output Power (watts), (hp)	11 w (.015 hp)	29 w (.04 hp)	67 w (.09 hp)	118 w (.16 hp)
Max. Output Torque (oz-in)	2	10	20	80
Max. Output Speed (rpm)	7500 (set)	5000 (set)	6000 (set)	3000 (set)
Speed Range	5-7500	5-5000	5-6000	3-3000
Speed Regulation (%) Mid Range	1% typ	1½% typ	1% typ	1% typ
Speed Drift (% per ^{0}C) Mid Range	±.05% typ	+.05% typ	±.03% typ	+.1%/C^{0} typ

See next page for gear motors and performance curves.

OUTLINE DIMENSIONS



	Height H	Depth D	Width W	Shaft Diameter S	Shaft Central Height C	Weight W	Outside Diameter O
E350-MG	1.4	2.65	1.40	0.156	0.70	0.5	1.4
E350-MGH	1.44	3.75	1.44	0.1875	0.72	0.63	1.44
E350-0	1.5	4.5	6.5	—	—	—	—
E550-MG	2.5	4.5	3.25	.25	1.38	2.0	2.0
E550-MGHD	4.75	6.75	3.75	.50	2.55	4.8	2.0
E550-MGHP	3.5	6.0	3.5	.25	2.2	2.3	—
E550-M	7.5	10.25	7.5	—	—	7.6	—
E550-0	4.0	6.0	8	—	—	4.5	—
E586-MG	2.25	5.6	2.25	0.25	1.125	3.0	2.25
E586-0	6.0	7.0	8.5	—	—	7.5	—
E650-MG	3.5	6.0	3.66	.375	1.94	5.3	3.0
E650-MGHS	4.75	8.0	3.75	.50	2.55	8.8	3.0
E650-MGHR	4.91	12.0	3.66	.50	1.75	12.751	3.66
E650-M	7.5	10.0	7.5	—	—	10.0	—
E650-0/M	7.75	7.5	8.5	—	—	6.2	—
E650-O/S	7.75	7.5	8.5	—	—	6.1	—

All dimensions are in inches, weights in pounds.

P6000 SERIES P.W.M. MOTOR CONTROL SYSTEMS

The P6000 series are the fastest pulse width modulated servo controls competitively available, providing bandwidths at full load exceeding 2000 H_Z. The unique fixed frequency design gives completely silent operation free from annoying audible "chirps". The standard unit, which is available for operation from AC line (model P6000AP) or for operation from a DC power supply (model P6000A), has the following features: three input fully adjustable summing amplifier with independent gain and lead-lag adjustment to enable operation with a wide range of motor and load types; a dual stage current limiter providing independent adjustment of peak and average current limit as well as pulse duration; unique cro-bar protection (model P6000AP) which protects the amplifier from damage due to short circuits, motor failure or misuse; space for two 4-5/16" x 2-3/4" option cards which can be selected from a wide range of standard options or custom designed options; logic compatible end of travel limit and clamping inputs; all major subassemblies are mounted on plug-in connectors to enable replacement without the need to change the entire unit; and all major test points are brought out to a 14 pin D.I.P. socket for fast, easy troubleshooting and set up. This, combined with the unique open construction, makes the P6000 series the most accessible and serviceable units of their type available. The P6000 series amplifiers can be readily adapted, by means of plug-in options, for interfacing with an unlimited range of remote inputs, programmers, and computer controls. Larger volume users can purchase the basic modules and harnesses for use in applications where space and cost are critical.

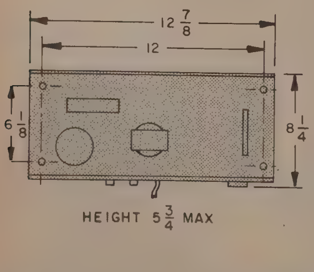
The P6000 amplifiers are also available in Electro-Craft's D.P.S. range of Digital Positioning Systems which typically can provide fully programmable step motion drives capable of completing single steps of 1.8° in 8 ms including settling, and slew speeds of 15,000 steps per second with inertial loads of 0.05 oz-in-sec^2 and friction loads of 50 oz-in. The D.P.S. series are available in a wide range of step sizes; consult our factory for further details.

*Patents applied for.

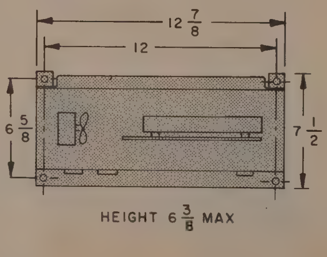
SPECIFICATIONS

Specification	Conditions	P6100	P6200
Rated current	Continuous	7 A	15 A
Peak current	100 mS max	12 A	20 A
	5 mS max	—	25 A
Voltage output	At rated current	60v	55v
	At peak current	56v	50v
	No load	75v	75v
Power output	Continuous	420 w (0.56 hp)	825 w (1.11 hp)
	Peak	670 w (0.90 hp)	1250 w (1.68 hp)
AC input or	Single phase (AP models)	110/230 ± 10% at 50/60 Hz	
DC input	At rated current (A models)	+ 80v nom	+ 80v nom
	Low current	+ and − 24v ± 20%	
	Fan supply	115v 50/60 H_Z — 230v by special option.	
Audible noise generation	All conditions (excludes fan)	None	
Frequency response	Open loop 3 db point	3 kH_Z	
Current limit	Dual stage independently adjustable.		
Protection	Fusing and Cro-bar (AP models only).		

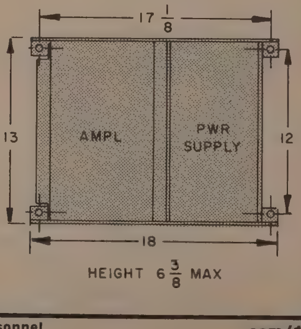
OUTLINE DIMENSIONS



HEIGHT 5 3/4 MAX

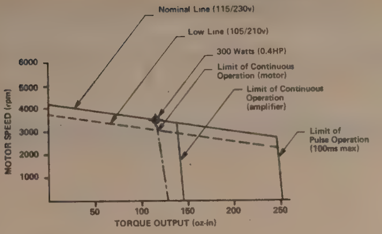


HEIGHT 6 3/8 MAX

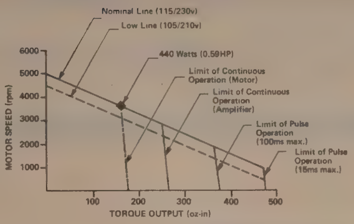


HEIGHT 6 3/8 MAX

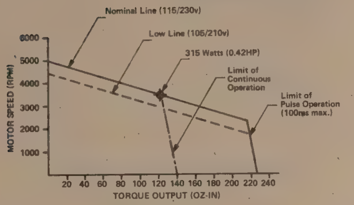
LIMITS OF OPERATION
E660/596 (K_t = 21 oz-in/A, R_t = 1.2Ω)
with P6100AP Servo Control.



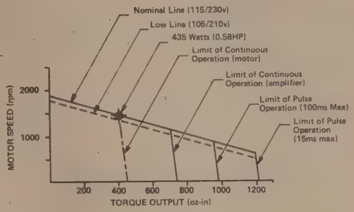
LIMITS OF OPERATION
S670/596 Motor-Tach (Pt. # 0670-01-XXX)
with P6200AP Servo Control.



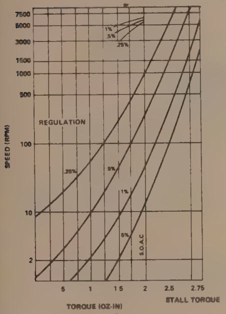
LIMITS OF OPERATION
S670-/596 Motor-Tach (Pt. # 0670-01-XXX)
with P6100AP Servo Control.



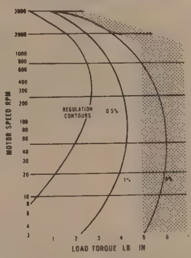
LIMITS OF OPERATION
S703/596 Motor-Tach (Pt. # 0703-02-XXX)
with P6200AP Servo Control.



E350 SYSTEM PERFORMANCE

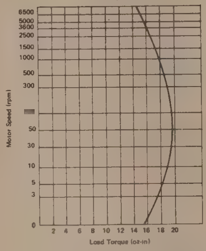


E-650 SYSTEM PERFORMANCE

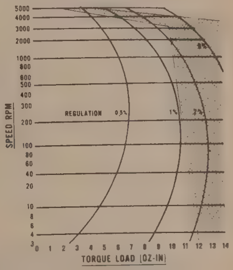


E586 Motomatic II

Load Regulation



E-550 SYSTEM PERFORMANCE



MOTOMATIC GEARHEAD RATINGS

	E350-MGH		E550-MGHD		E550-MGHP		E650-MGHS		E650-MGHR	
	Max* Speed at rpm	Max Torque in. lbs.	Max* Speed at rpm	Max Torque in. lbs.	Max* Speed at rpm	Max Torque in. lbs.	Max* Speed at rpm	Max Torque in. lbs.	Max* Speed at rpm	Max Torque in. lbs.
5:1	1400	.59	600	3.2	600	3.2	360	20.25	360	12
10:1	700	1.17	300	6.5	300	6.5	180	40.0	180	24
20:1	350	2.35	150	13.0	150	13.0	90	80.0	90	48
30:1	450	2.5	100	19.5	100	19.5	83	80.0	60	73
40:1	187	2.5	75	26.0	75	26.0	72	80.0	45	97.2
50:1	160	2.5	60	32.5	60	32.5	58	80.0	36	115
100:1	80	2.5	30	65.0	30	50.0	29	80.0	–	–
200:1	40	2.5	20	80.0	20	50.0	14.5	80.0	–	–
500:1	16	2.5	9.6	80.0	9.6	50.0	5.8	80.0	–	–
1000:1	8	2.5	4.8	80.0	4.8	50.0	2.9	80.0	–	–
5000:1	1.6	2.5	1	80.0	1	50.0	.58	80.0	–	–
Typical Backlash	40′		3°		1°		3°		3°	
Type	In Line Spur		In Line Spur		In Line Spur		In Line Spur		Right Angle Worm	

Shading indicates availability from stock.

*Max. speed indicates the maximum speed at which the full rated torque of the gearhead is available; the no load maximum speed is given by the maximum no load speed of the motor divided by the gear ratio.

ELECTRO-CRAFT CORPORATION

For Further Information Contact:

ELECTRO-CRAFT CORPORATION
1600 Second Street South, Hopkins, Minnesota 55343
Telephone: (612) 935-8226
or any authorized distributor

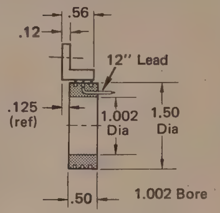
SHEET 1 SLIP RING ASSEMBLIES Best Cost & Best Delivery

DELIVERY

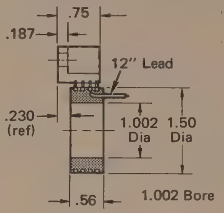
For BEST COST and BEST DELIVERY of multi-track units, Fabricast maintains all the components necessary to manufacture the slip ring assemblies shown on this page.

SEPARATE ROTOR AND BRUSH BLOCK ASSEMBLY

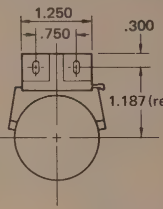
TYPE 1301 – 3 Ring


.56
.12
12" Lead
.125 (ref)
1.002 Dia
1.50 Dia
.50
1.002 Bore

TYPE 1401 – 4 Ring

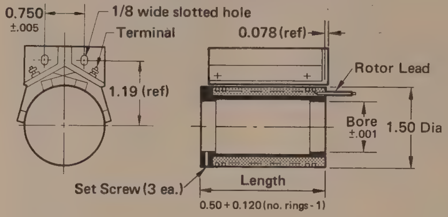

.75
.187
12" Lead
.230 (ref)
1.002 Dia
1.50 Dia
.56
1.002 Bore

TYPICAL END VIEW


1.250
.750
.300
1.187 (ref)

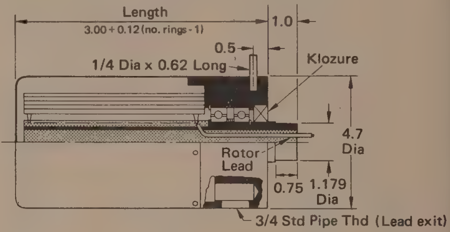
Slip Ring Assembly Type 1057
Separate Rotor and Brush Block

5 amp — 50 rings max — Bore 1.002 dia max


0.750 ±.005
1/8 wide slotted hole
Terminal
0.078 (ref)
Rotor Lead
1.19 (ref)
Bore ±.001
1.50 Dia
Set Screw (3 ea.)
Length
0.50 + 0.120 (no. rings - 1)

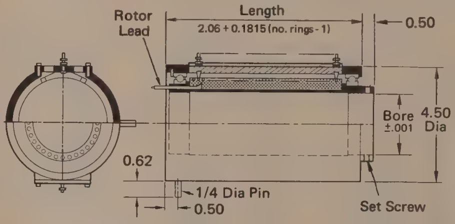
Slip Ring Assembly Type 1302
Sealed Housing

5 amp — 50 rings max — Solid Bore


Length
3.00 + 0.12 (no. rings - 1)
1.0
0.5
1/4 Dia x 0.62 Long
Klozure
4.7 Dia
Rotor Lead
0.75
1.179 Dia
3/4 Std Pipe Thd (Lead exit)

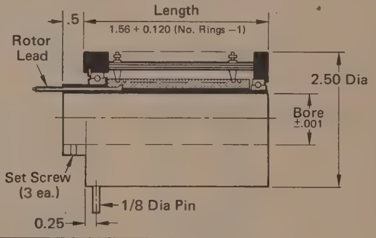
Slip Ring Assembly Type 1067
Rigid Tube Housing — Exposed Stator Terminals

5 amp — 100 rings max — Bore 2.502 dia max


Rotor Lead
Length
2.06 + 0.1815 (no. rings - 1)
0.50
Bore ±.001
4.50 Dia
0.62
1/4 Dia Pin
0.50
Set Screw

Slip Ring Assembly Type 1186
Rigid Tube Housing — Exposed Stator Terminals

5 amp — 50 rings max — Bore 1.002 dia max


.5
Length
1.56 + 0.120 (No. Rings —1)
Rotor Lead
2.50 Dia
Bore ±.001
Set Screw (3 ea.)
1/8 Dia Pin
0.25

CHARACTERISTICS

RPM: Rigid one piece housing eliminates bearing alignment problems

RINGS: Coin Silver 5 AMP Rings

BRUSHES: Silver Graphite
Fabricast Grade FAG 180 (80% AG — 20% C)
Two brushes per ring
Brushes individually removable and replaceable

NOISE: 10 Milliohms dynamic resistance MAX
5 Milliohms MAX with 4 brushes per CKT

HI-POT: 1200 VAC 60 CYCLE for 15 seconds

ROTOR: One piece steel sleeve
Ring complement vacuum cast on sleeve as unit with epoxy dielectric

COVER: Easily removable for brush and ring inspection

BEARINGS: Shielded or sealed ball bearings

PART NUMBER CODING — Specify fully when ordering

Type	Bore (Inches)	No. Rings	Lead Length (Inches)	Lead Type (Shielded - S Unshielded - U)
X—	—X—	—X—	—X—	—X

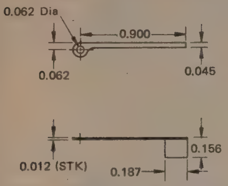
Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLY

2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733
Phone 213/443-3247 (S. El Monte/Los Angeles)

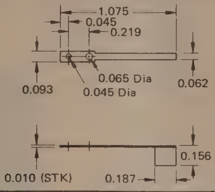
BRUSH ASSEMBLIES SHEET 2

LEAF TYPE (BRUSH MATERIAL - FAG 180 LEAF MATERIAL - BeCu)

2.0 AMP SINGLE BRUSH
P/N 1113007 BRUSH - .040 WIDE

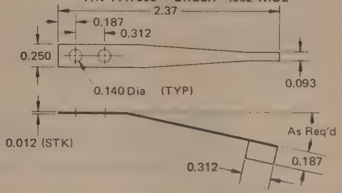

0.062 Dia
0.900
0.062
0.045
0.156
0.012 (STK)
0.187

2.0 AMP SINGLE BRUSH
P/N 1120051 BRUSH - .040 WIDE

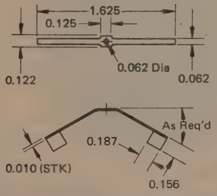

1.075
0.045
0.219
0.065 Dia
0.045 Dia
0.093
0.062
0.156
0.010 (STK)
0.187

STOCK DELIVERY

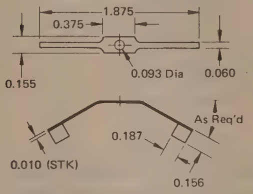
5.0 AMP SINGLE BRUSH
P/N 1117003 BRUSH - .062 WIDE


2.37
0.187
0.312
0.250
0.140 Dia (TYP)
0.093
As Req'd
0.012 (STK)
0.312
0.187

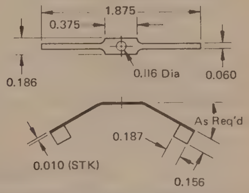
5.0 AMP DOUBLE BRUSH
P/N 1103004 BRUSH .040 WIDE


1.625
0.125
0.062 Dia
0.122
0.062
As Req'd
0.187
0.010 (STK)
0.156

5.0 AMP DOUBLE BRUSH
P/N 1050006-5 BRUSH .040 WIDE

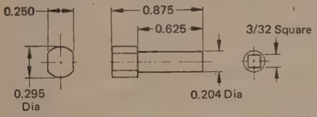

1.875
0.375
0.093 Dia
0.060
0.155
As Req'd
0.187
0.010 (STK)
0.156

5.0 AMP DOUBLE BRUSH
P/N 1050006-2 BRUSH .040 WIDE

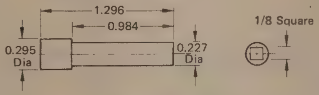

1.875
0.375
0.116 Dia
0.060
0.186
As Req'd
0.187
0.010 (STK)
0.156

PLUNGER TYPE (BRUSH MATERIAL - FAG 180 HOLDER - BRASS)

2.5 AMP CAPACITY - 3/32" SQUARE BRUSH
HOLDER ASSY P/N 1070004
BRUSH ASSY P/N 1072-1

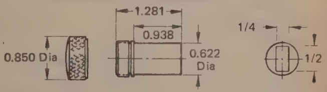

0.250
0.875
0.625
3/32 Square
0.295 Dia
0.204 Dia

4.0 AMP CAPACITY - 1/3" SQUARE BRUSH
HOLDER ASSY P/N 1051032
BRUSH ASSY P/N 1072-2


1.296
0.984
0.295 Dia
0.227 Dia
1/8 Square

STOCK DELIVERY

25 AMP CAPACITY
1/4" x 1/2" RECTANGULAR BRUSH
HOLDER ASSY P/N 1092006
BRUSH ASSY P/N 1092003


1.281
0.938
0.850 Dia
0.622 Dia
1/4
1/2

BRUSH MATERIAL

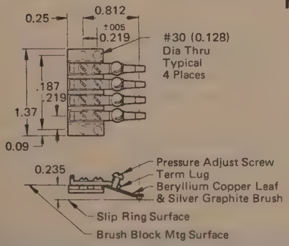
- Fabricast grade Fag 180, the universal low noise level grade used for all standard brush assembles.
- Fabricast grade FAG 193, the lowest noise level grade, however, the ring surface speed is limited to 250 SFM.
- Fabricast grade FAG 150, the highest surface speed grade, however, noise levels are compromised.

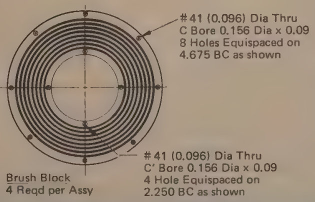
Grade No.	Composition	Recommended Surface Speed	Carrying Capacity
FAG150	50% silver, 50% graphite	Over 3500 ft. per min.	100 Amps per sq. in.
FAG180	80% silver, 20% graphite	Up to 3500 ft. per min.	250 Amps per sq. in.
FAG193	93% silver, 7% graphite	Up to 250 ft. per min.	300 Amps per sq. in.

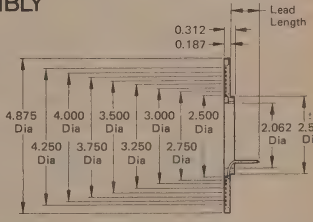
COIN SILVER RINGS – ½" TO 24" DIA – QUOTATION UPON REQUEST

PANCAKE TYPE SLIP RING ASSEMBLY

TYPE 1062 8 RINGS - 5 AMP CAPACITY


0.25
0.812
±.005
0.219
#30 (0.128) Dia Thru Typical 4 Places
.187
.219
1.37
0.09
0.235
Pressure Adjust Screw
Term Lug
Beryllium Copper Leaf & Silver Graphite Brush
Slip Ring Surface
Brush Block Mtg Surface


#41 (0.096) Dia Thru C Bore 0.156 Dia x 0.09 8 Holes Equispaced on 4.675 BC as shown
Brush Block 4 Reqd per Assy
#41 (0.096) Dia Thru C' Bore 0.156 Dia x 0.09 4 Hole Equispaced on 2.250 BC as shown


Lead Length
0.312
0.187
4.875 Dia
4.000 Dia
3.500 Dia
3.000 Dia
2.500 Dia
4.250 Dia
3.750 Dia
3.250 Dia
2.750 Dia
2.062 Dia
±.005
2.500 Dia

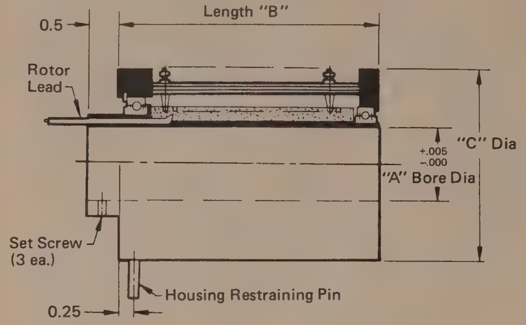
Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLY

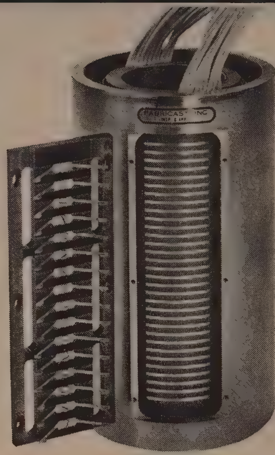
2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733
Phone 213/443-3247 (S. El Monte/Los Angeles)

SHEET 3 SLIP RING ASSEMBLY Minimum Size

DISTINGUISHING CHARACTERISTICS

Rigid one piece housing eliminates bearing alignment problems. Bearings are thin section aircraft torque tube type or Kaydon KA series bearing.





NON-REPLACEABLE BRUSH ASSEMBLIES – 500 VAC HYPOT

TYPE	BORE DIA "A" INCHES		NO. RINGS MAX	CURRENT	LENGTH "B" INCHES	HOUSING DIA "C"
	NOMINAL	RANGE				
4087	.250	.250 - .502	50	3 amp std 2 brushes per ring	.875 + .080 (no. rings -1)	1.56
4125	.500	.250 - .752	50		.875 + .100 (no. rings -1)	2.00
4230	2.000	1.500 - 2.002	50		.875 + .080 (no. rings -1)	3.50

REPLACEABLE BRUSH ASSEMBLIES – 1200 VAC HYPOT

TYPE	BORE DIA "A" INCHES		NO. RINGS MAX	CURRENT	LENGTH "B" INCHES	HOUSING DIA "C"
	NOMINAL	RANGE				
4100	.500	.250 - .502	48	5 amp std 2 brushes per ring	1.19 + .125 (no. rings -1)	2.00
4150	1.000	.500 - 1.002	64		1.19 + .120 (no. rings -1)	2.50
4200	1.312	1.000 - 1.312	100		1.19 + .125 (no. rings -1)	3.00
4237	1.750	1.312 - 1.752	78		1.19 + .130 (no. rings -1)	3.37
4268	2.000	1.750 - 2.002	100		1.28 + .150 (no. rings -1)	3.62
4350	2.750	2.250 - 2.752	100	10 amp std or lo noise 4 brushes per ring	1.75 + .150 (no. rings -1)	4.50
4400	3.250	2.750 - 3.252	100		1.75 + .160 (no. rings -1)	5.00
4462	3.750	3.250 - 3.752	100		1.75 + .160 (no. rings -1)	5.50
4500	4.250	3.750 - 4.252	100		1.75 + .187 (no. rings -1)	6.00
4600	5.250	4.250 - 5.252	79		1.75 + .165 (no. rings -1)	7.00
4700	6.250	5.250 - 6.252	63		1.75 + .186 (no. rings -1)	8.00
4800	7.250	6.250 - 7.252	58		1.75 + .187 (no. rings -1)	9.00
4900	8.750	7.250 - 8.750	58		1.75 + .187 (no. rings -1)	11.00
1271	1.000	.000– 2.000	15	50 amp std	3.50 + 1.05 (no. rings -1)	4.50
1291	3.000	2.000 - 3.252	9	50 amp std	4.50 + 1.12 (no. rings -1)	6.50

SEE CHARACTERISTICS ON SHEET 4.

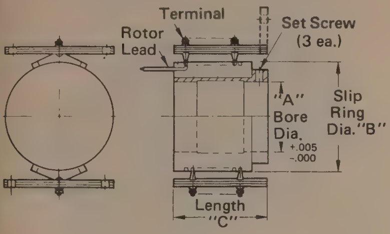
Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLY

2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733
Phone 213/443-3247 (S. El Monte/Los Angeles)

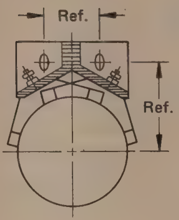
SLIP RING ASSEMBLY Separate Rotor & Brush Block

SHEET 4

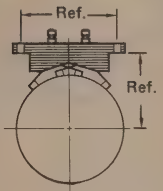
Brush Block Assy
5 AMP STD



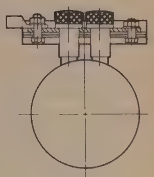
Brush Block Assy
TYPE "A"



Brush Block Assy
TYPE "E"



Brush Block Assy
50 AMP STD



TYPE	BORE DIA "A" INCHES		NO. RINGS MAX.	CURRENT AMPS	SLIP RING DIA "B"	LENGTH "C" INCHES
	NOMINAL	RANGE				
2050	SOLID	000 - .127	18	5 AMP STD	.500	.625 + .125 (no. rings -1)
2087	SOLID	000 - .377	48	5 AMP STD	.875	.625 + .110 (no. rings -1)
2112	.375	000 - .627	52	5 AMP STD	1.125	.625 + .125 (no. rings -1)
2150	.750	.62 - 1.002	52	5 AMP STD	1.500	.625 + .120 (no. rings -1)
2237	1.250	1.00 - 1.502	78	5 AMP STD	2.375	.750 + .130 (no. rings -1)
2268	1.500	1.25 - 1.752	107	5 AMP STD	2.687	1.000 + .150 (no. rings -1)
2350	2.000	1.75 - 2.502	78	5 AMP STD	3.500	1.000 + .181 (no. rings -1)
2375	2.500	2.37 - 2.875	48	5 AMP STD	3.750	1.000 + .200 (no. rings -1)
2462	3.000	2.75 - 3.752	58	5 AMP STD	4.652	1.250 + .160 (no. rings -1)
2500	4.000	3.25 - 4.002	40	5 AMP STD	5.000	1.250 + .250 (no. rings -1)
2600	5.000	4.00 - 5.002	48	5 AMP STD	6.000	1.250 + .186 (no. rings -1)
2700	6.000	5.00 - 6.002	63	5 AMP STD	7.000	1.250 + .186 (no. rings -1)
2800	7.000	6.00 - 7.002	58	5 AMP STD	8.000	1.250 + .187 (no. rings -1)
2900	8.000	7.00 - 9.002	58	5 AMP STD	10.000	1.250 + .187 (no. rings -1)
3268	1.000	.750 - 1.187	16	50 AMP STD	2.687	2.000 + 1.050 (no. rings -1)
3300	1.500	1.187 - 1.500	6	50 AMP STD	3.000	2.000 + 1.000 (no. rings -1)
3350	2.000	1.500 - 2.000	16	50 AMP STD	3.500	2.000 + 1.050 (no. rings -1)
3462	3.000	2.000 - 3.125	9	50 AMP STD	4.625	2.000 + 1.120 (no. rings -1)
3600	4.000	3.125 - 4.500	8	50 AMP STD	6.000	2.000 + 1.116 (no. rings -1)
3700	5.000	4.500 - 5.500	10	50 AMP STD	7.000	2.000 + 1.116 (no. rings -1)
3800	6.000	5.500 - 6.500	10	50 AMP STD	8.000	2.000 + 1.125 (no. rings -1)
3900	7.000	6.500 - 8.500	10	50 AMP STD	10.000	2.000 + 1.125 (no. rings -1)

CHARACTERISTICS

RINGS: Coin Silver 5 AMP Rings
Copper 50 AMP Rings

BRUSHES: Silver Graphite
Fabricast Grade FAG 180 (80% AG – 20% C)
Two brushes per ring
Brushes individually removable and replaceable

NOISE: 10 Milliohms dynamic resistance MAX
5 Milliohms MAX with 4 brushes per CKT

CURRENT: Noted in tabulated block
Rating may be doubled with 4 brushes per CKT

HI-POT: 1200 VAC 60 CYCLE for 15 seconds

ROTOR: One piece steel sleeve
Ring complement vacuum cast on sleeve as unit with epoxy dielectric

ROTOR LEADS: 5 AMP Leads – 20 GA per MIL-W-16878 TYPE "E"
50 AMP Leads – 8 GA per MIL-W-16878 TYPE "B"
Lead exit as shown on most units. Maximum ring complement may require smaller wire or leads to exit both ends.

BRUSH BLOCK: Laminated phenolic
Optional mounting methods shown.

PART NUMBER CODING – Specify fully when ordering

Type	Bore (Inches)	No. Rings	Lead Length (Inches)	Lead Type	(Shielded - S / Unshielded - U)	Type Brush Block
X	X	X	X	X		X

Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLY

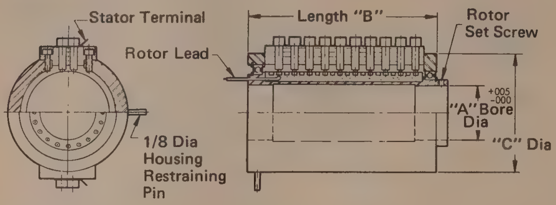
2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733
Phone 213/443-3247 (S. El Monte/Los Angeles)

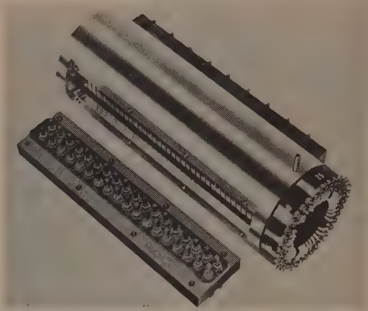
SHEET 5 SLIP RING ASSEMBLY

Ease of Field Maintainance & Brush Replacement

DISTINGUISHING CHARACTERISTICS

Ease of field maintenance/brush replacement.





TYPE	BORE DIA "A" INCHES		NO. RINGS MAX.	CURRENT	LENGTH "B"	HOUSING DIA "C"
	NOMINAL	RANGE				
6150	1.000	.50 - 1.002	50	5 AMP 220 VAC	1.75 + .240 (no. rings -1)	2.50
6200	1.250	1.00 - 1.312	50		1.75 + .250 (no. rings -1)	3.00
6237	1.500	1.312 - 1.752	50		1.75 + .260 (no. rings -1)	3.37
6268	2.000	1.75 - 2.002	50		1.75 + .300 (no. rings -1)	3.62
6350	2.500	2.25 - 2.752	50		2.25 + .300 (no. rings -1)	4.50
6462	3.500	3.25 - 3.75	50		2.25 + .320 (no. rings -1)	5.50
6500	4.000	3.75 - 4.25	50		2.25 + .375 (no. rings -1)	6.00
6600	5.000	4.25 - 5.25	50		2.25 + .330 (no. rings -1)	7.00
6700	6.000	5.25 - 6.25	50		2.25 + .372 (no. rings -1)	8.00
6800	7.000	6.25 - 7.25	50		2.25 + .375 (no. rings -1)	9.00
6900	8.000	7.25 - 8.75	50		2.25 + .375 (no. rings -1)	11.00
1271	1.000	000 - 2.000	15	50 AMPS	3.50 + 1.05 (no. rings -1)	4.50
1291	2.000	2.00 - 3.25	9	50 AMPS	4.50 + 1.12 (no. rings -1)	6.50

CHARACTERISTICS

LIFE: Max. brush life slip ring assy, wear length of plunger type brush is approximately 3 times ordinary brush

RPM: Rigid one piece housing eliminates bearing alignment problems

RINGS: Coin Silver 5 AMP Rings
Copper 50 AMP Rings

BRUSHES: Silver Graphite
Fabricast Grade FAG 180 (80% AG – 20% C)
Two brushes per ring
Brushes individually removable and replaceable

NOISE: 10 Milliohms dynamic resistance MAX
5 Milliohms MAX with 4 brushes per CKT

CURRENT: Noted in tabulated block
Rating may be doubled with 4 brushes per CKT

HI-POT: 1200 VAC 60 CYCLE for 15 seconds

ROTOR: One piece steel sleeve
Ring complement vacuum cast on sleeve as unit with epoxy dielectric

ROTOR LEADS: 5 AMP Leads – 20 GA per MIL-W-16878 TYPE "E"
50 AMP Leads – 8 GA per MIL-W-16878 TYPE "B"
Lead exit as shown on most units. Maximum ring complement may require smaller wire or leads to exit both ends.

HOUSING: One piece steel tubing construction

COVER: Easily removable for brush and ring inspection

BEARINGS: Shielded or sealed ball bearings

PART NUMBER CODING – Specify fully when ordering

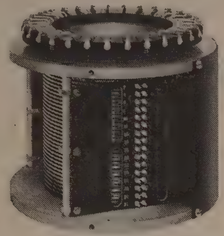
Type	Bore (Inches)	No. Rings	Lead Length (Inches)	Lead Type (Shielded - S / Unshielded - U)
X	X	X	X	X

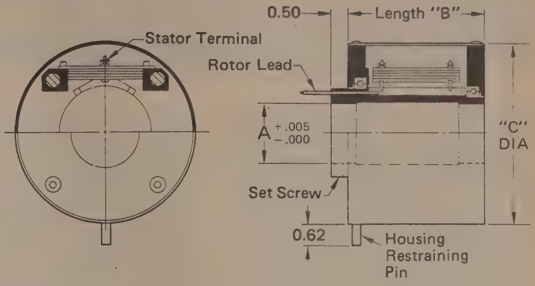
Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLY

2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733
Phone 213/443-3247 (S. El Monte/Los Angeles)

SLIP RING ASSEMBLY Covered Stator Terminals SHEET 6

DISTINGUISHING CHARACTERISTICS
Bearing Bell and space bar type units best suited for larger bore assemblies.





TYPE	BORE DIA "A" INCHES		NO. RINGS MAX.	CURRENT AMPS	LENGTH "B" INCHES	HOUSING DIAMETER "C" INCHES
	NOMINAL	RANGE				
1292	SOLID	–––	41	5 AMP STD 10 AMP OR LO NOISE TWO PARALLEL RINGS	.85 + .088 (no. rings -1)	2.50
1293	SOLID	–––	19		1.12 + .110 (no. rings -1)	1.62
1294	SOLID	–––	48		1.12 + .100 (no. rings -1)	2.25
1295	SOLID	–––	200		7.50 + .150 (no. rings -1)	5.00
1296	.250	.250 - .377	48		1.25 + .110 (no. rings -1)	2.25
1297	.500	.378 - .565	50		1.25 + .120 (no. rings -1)	2.75
1298	1.000	.566 - 1.002	50		1.25 + .120 (no. rings -1)	3.00
1272	1.000	1.000 - 1.750	100	5 AMP STD 10 AMP OR LO NOISE 4 BRUSHES PER RING	2.00 + .150 (no. rings -1)	5.25
1273	2.000	1.750 - 2.625	100		2.00 + .150 (no. rings -1)	6.25
1274	3.000	2.625 - 3.750	58		2.00 + .160 (no. rings -1)	7.50
1275	4.000	3.750 - 4.750	48		2.00 + .186 (no. rings -1)	9.00
1276	5.000	4.750 - 5.750	63		2.00 + .186 (no. rings -1)	10.50
1277	6.000	5.750 - 6.750	58		2.00 + .187 (no. rings -1)	12.00
1278	8.000	6.750 - 8.750	58		2.00 + .187 (no. rings -1)	15.00
1282	1.000	1.000 - 1.250	16	50 AMP STD 100 AMP 4 BRUSHES PER RING	3.00 + 1.05 (no. rings -1)	8.00
1283	2.000	1.250 - 2.000	16		3.00 + 1.05 (no. rings -1)	9.00
1284	3.000	2.000 - 3.125	9		3.00 + 1.12 (no. rings -1)	10.00
1285	4.000	3.125 - 4.375	8		3.00 + 1.11 (no. rings -1)	11.50
1286	5.000	4.375 - 5.375	10		3.00 + 1.11 (no. rings -1)	12.50
1287	6.000	5.375 - 6.375	10		3.00 + 1.12 (no. rings -1)	13.50
1288	8.000	6.375 - 8.375	10		3.00 + 1.12 (no. rings -1)	16.00

CHARACTERISTICS

RINGS: Coin Silver 5 AMP Rings
Copper 50 AMP Rings

BRUSHES: Silver Graphite
Fabricast Grade FAG 180 (80% AG – 20% C)
Two brushes per ring
Brushes individually removable and replaceable

NOISE: 10 Milliohms dynamic resistance MAX
5 Milliohms MAX with 4 brushes per CKT

CURRENT: Noted in tabulated block
Rating may be doubled with 4 brushes per CKT

HI-POT: 1200 VAC 60 CYCLE for 15 seconds

ROTOR: One piece steel sleeve
Ring complement vacuum cast on sleeve as unit with epoxy dielectric

LEADS: 5 AMP Leads – 20 GA per MIL-W-16878 TYPE "E"
50 AMP Leads – 8 GA per MIL-W-16878 TYPE "B"

HOUSING: Bell, Bell Spacer and Cover type construction
Cadmium plated steel

COVER: Easily removable for brush and ring inspection
Anodized aluminum

BEARINGS: Shielded or sealed ball bearings

PART NUMBER CODING – Specify fully when ordering

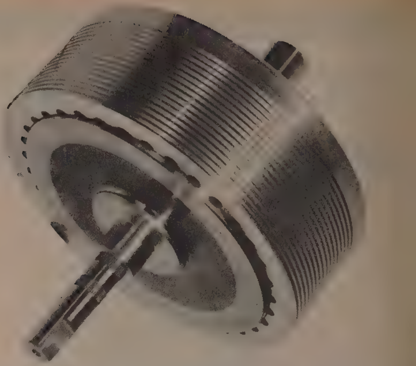
Type	Bore (Inches)	No. Rings	Lead Length (Inches)	Lead Type (Shielded - S Unshielded - U)
X	X	X	X	X

Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLY

2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733 Phone 213/443-3247 (S. El Monte/Los Angeles)

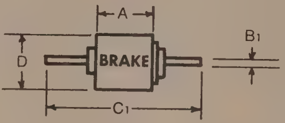
HYSTERESIS CLUTCHES & BRAKES

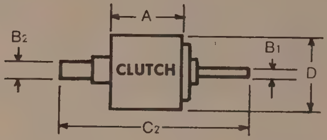
offer maximum reliability — smooth clutching minimum maintenance. They are ideal for tension control and power absorption devices where smooth variable slip torque is required. Torque is proportional to control current. Clutch-brake combinations and fixed field clutches also available.



	PMC-6 PMB-6	PMC-16 PMB-16	PMC-35 PMB-35	PMC-120 PMB-120	PMC-175 PMB-175	PMC-325 PMB-325	PMC-.75K PMB-.75K	PMC-1.5K PMB-1.5K	PMC-3K PMB-3K	PMC-5K PMB-5K
A	.76	.81	1.72	1.53	1.98	2.06	3.62	5.83	4.37	5.12
B_1	.187	.187	.250	.375	.500	.500	.75	.875	.786	1.181
B_2	.375	.375	.500	.625	.750	.750	1.312	1.500	1.000	1.181
C_1	2.12	2.15	3.82	3.96	4.37	5.15	6.37	10.00	10.04	12.12
C_2	2.93	2.84	4.41	4.64	5.40	5.75	8.12	11.06	9.63	9.87
D	1.75	1.93	2.46	3.62	4.43	5.48	7.25	8.50	12.00	14.00

SPECIFICATIONS	MODELS									
	PMC-6 PMB-6	PMC-16 PMB-16	PMC-35 PMB-35	PMC-120 PMB-120	PMC-175 PMB-175	PMC-325 PMB-325	PMC-.75K PMB-.75K	PMC-1.5K PMB-1.5K	PMC-3K PMB-3K	PMC-5K PMB-5K
TORQUE - RATED OZ. IN.	6	16	35	120	175	325	750	1500	3000	5000
OUTPUT INERTIA SLUG FT^2	1.55×10^{-6}	3.03×10^{-6}	6.3×10^{-6}	5.4×10^{-5}	1.5×10^{-4}	2.0×10^{-4}	6.3×10^{-3}	1.26×10^{-2}	2.68×10^{-2}	4.05×10^{-2}
CONTROL WATTAGE	2.5	4.5	12	5	3	7	8.1	17	25	6





FRICTION CLUTCHES & BRAKES — FLANGE MOUNTED

LOW COST • HIGH TORQUE • LOW CONTROL POWER • FAST RESPONSE • MIN. EFFECT BY AMBIENTS

SPECIFICATIONS	MODELS						
	FC-25 FB-25	FFC-35 FFB-35	FFC-60 FFB-60	FFC-160 FFB-160	FFC-480 FFB-480	FFC-960 FFB-960	FFC-3.5K FFB-3.5K
TORQUE - RATED OZ. IN.	25	35	60	160	480	960	3500
OUTPUT INERTIA - SLUG $FT.^2$	1.06×10^{-6}	2×10^{-6}	2.8×10^{-5}	5.11×10^{-6}	1.7×10^{-5}	6.56×10^{-5}	5.86×10^{-4}
CONTROL WATTAGE	3	6	3.6	9	10	10	30

CROWN TOOTH CLUTCHES & BRAKES

MAX. TORQUE – MIN. SIZE
POSITIVE ENGAGEMENT
LOW CONTROL POWER
FAST RESPONSE

ADJUSTA-TORQ CLUTCHES & BRAKES

- CONSTANT REPEATABLE SLIP TORQUE
- LIFE LIMITED ONLY BY BEARINGS
- CAN BE RUN IN OIL

USE AS A TORQUE LIMITING SLIP DEVICE, CLUTCH COUPLING, CONSTANT DRAG BRAKE OR IN TENSIONING APPLICATIONS.

NEW!

PERMANENT MAGNET

TENSION BRAKES

- CONSTANT PRESET TENSION
- MANUAL ADJUSTABLE TORQUE

0-3 OZ. IN. OR 0-10 OZ. IN.
PROVIDE SMOOTH, REPEATABLE TENSION FOR YARN, FIBER AND FINE WIRE

FAIL-SAFE BRAKES

FOR POSITIVE SHAFT BRAKING WHEN POWER FAILS

PREVENTS
CREEPING • COASTING
HUNTING

Torque Ranges
8 to 7000 oz. in.

SPECIALS GEMCOR WILL DESIGN NEW UNITS OR MODIFY EXISTING UNITS TO SUIT CUSTOMER'S SPECIAL REQUIREMENTS. THIS SERVICE IS AVAILABLE ON HYSTERESIS, FRICTION AND PERMANENT MAGNET TYPES.

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GEMCOR

Gemcor Digital Instruments *for* *Industrial Monitoring Applications*

GEMCOR
TACHOMETER
22575
RPM

Digital Tachometer

A digital instrument designed and used for the direct measurement of angular velocity expressed in revolutions per minute of a rotating spindle or shaft. A typical application is the measurement of drill and shave spindle revolutions per minute.

The unit contains an amplifier, logic board with power supply and readouts.

SPECIFICATIONS:

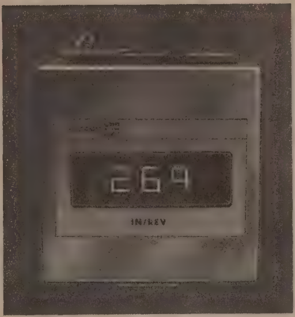
Number of digits: 5 or 6

Range: 100 to 999,999 RPM

Accuracy:
Better than ± 2% at any RPM

Input:
Magnetic pick-up also adaptable to any type of electro-mechanical transducer.

Sampling Rate:
.24, 1, or 2.4 Sec. Adaptable to different pitch transducers.



Digital Feed Rate Indicator and Monitor

A digital instrument designed to directly measure and display the chip load or cut per revolution of a rotating cutter. The digital readout displays the cutter chip load directly in units of thousandths of an inch. Typical application is measurement of drill spindle chip load.

The unit contains amplifiers, power supply and logic needed to compute and display cutter chip load.

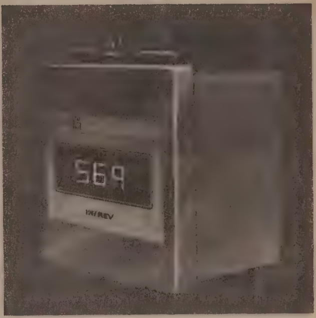
SPECIFICATIONS:

Number of digits: 3

Range: .001 to .999 in/Rev.

Accuracy:
Better than 2% of reading

Input:
Magnetic pick-up for RPM, photo-electric for feed. Adaptable to other transducers.



Digital Feed Rate Control and Feedback System

A digital instrument designed to monitor and maintain a constant cutter chip load by correcting feed or speed or both of a cutter spindle. The system can also be programmed to stop a spindle at a pre-set cutter depth. Digital or analog outputs are available to control auxiliary equipment. A typical application is constant feed per revolution control of a cutter spindle.

SPECIFICATIONS:

Range:
.001 to .999 in/Rev.

Accuracy of Control Unit:
More than 2%

Input:
Magnetic pick-up for RPM, photo-electric for feed. Adaptable to other transducers.

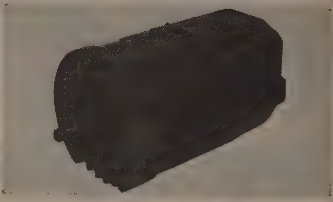
Gemcor Manufactures & Custom Designs Digital Electromechanical Measuring Devices for Various Applications in Industry

785 Hertel Ave., Buffalo, N.Y. 14207 (716) 876-9685 Telex-91-222

GEMCOR

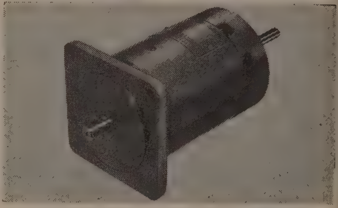
AC and DC MOTORS AND GEAR-MOTORS

DC Motors



For general duty on variable- or constant-speed applications where the power supply is d-c or where a-c/d-c conversion is used for controlled speeds. Also ideal for reversing applications. Type BC direct-current motors will start, accelerate, and run fractional-horsepower devices smoothly and easily. They are available in open, totally enclosed, explosion-proof, and severe-duty enclosures with solid base, round frame, or end mounting in most ratings. Special-purpose type motors are also available for full- and half-wave rectified power drives. For complete information, write for Bulletins GEA-9956 and GEA-9965.

Reel-Drive Motors



GE's full line of fhp direct-current motors includes three frame sizes widely used for reel drives: 3.4″, 4⅝″, and 6 5/16″ diameters. Special end mountings and shaft extensions meet exacting application requirements. Series, split-series, compound, shunt, and compensated-shunt winding designs offer a broad design choice. Stall torque ratings from 3 to 120 ounce-feet and higher span various application needs, and motor voltage requirements are normally matched to your system design.

New Permanent Magnet Motors

GE's new BPA-34 permanent-magnet motors are smaller and lighter than comparable wound-field motors of the same rating. Permanent magnets replace field windings, eliminating the need for field power supply and the chance of field-winding failure or burnout; and with battery power efficiency is increased, battery drain decreased. Two leads from power supply reduce connect and disconnect time. The motor features double shielded ball bearings and Class B-R insulation system that meets NEMA and USA Standards for Class B, and is recognized by UL for up to 130 C hot spot temperature.

In 3.4-inch-diameter totally enclosed frame, the BPA-34 is available in face, flange, or welded-base design for 115 volts d-c with modifications from 6 volts d-c. Speed-torque is linear, producing a d-c rating of about ⅓ hp at 3450 rpm, ⅕ hp at 1725 rpm, and 1/7 hp at 1140 rpm on a continuous basis.

The BPA-34 is ideally suited for such applications as copy machines, tape reel drives, printers, and filing equipment, and for any other equipment utilizing variable-speed drives or battery power where size and weight are critical.

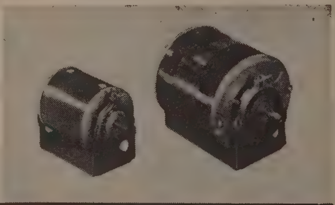
NEMA 48- and 56-Frame A-c Induction Motors

Dependable Form G Motors in Thousands of Variations

Form G a-c induction motors are available in most any electrical type, enclosure, and mounting in a variety of ratings from 1/20 to 5 hp for a complete range of commercial/industrial applications. **For complete information write for Bulletins GEC-5000 and GEA-9964.**

Small, Compact, A-c Induction Motors

Provide High Power in a Lightweight Package

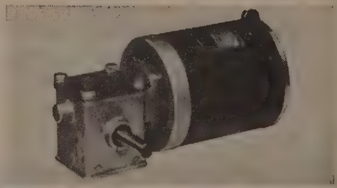


Small in size, but high in reliability, General Electric compact, powerful, a-c induction motors are available in ranges from 35 mhp to ½ horsepower. These reversible motors provide consistent, quiet, long-life operation in any mounting position. Synchronous motors for constant-speed applications are available in 3- and 3⅞-inch diameter models. Special designs can be provided for various torque motor applications such as tape reel drives. For dimensions, features, ratings, and application information, write for Bulletin GEA-8254.

Typical Electronic Applications: Computer memory drums, tape reels, capstans, disc filers, card stackers, card printers, card punchers, and data cells.

Mina-Gear™ Motors

Right-Angle and Parallel-Shaft



A compact, dependable, lightweight line of gear-motors with a flexible range of speeds, ratios, motor types, and frame sizes. Right-angle gear-motors are rated 1/40- to ½-hp with gear ratios of 102:1 to 11:1 with output speeds from 323 to 8 rpm. Parallel-shaft designs are of lightweight construction with aluminum gear housing and motor endshields. Ratings from 15 mhp to ⅙ hp with gear ratios of 195:1 to 4:1 and with output speeds from 417 to 8 rpm in two gear sizes. Mina-Gear motors offer you years of efficient operation, and are ideal for such devices as printing and office machines, medical equipment, door operators, and vending machines, and for many other applications requiring a compact design with relatively high-torque capability. For complete information on right-angle write for Bulletin GEA-7839; for parallel-shaft, Bulletin GEP-466.

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Section 998-2. Schenectady, N. Y. 12345.

GENERAL ELECTRIC

AC and DC MOTORS

Small Induction and Synchronous Motors

Versatility is synonymous with General Electric Small Induction and Synchronous motors. With this complete line, GE offers the design engineer the widest possible application freedom, plus the traditional fine quality of General Electric motors.

These small diameter motors are designed to provide dependable power for a wide variety of applications, including data communication printers, cash registers, telecopiers, typewriters, audio recording equipment, air compressors, projectors, computer card readers, disc file drives, as well as various machine tool applications. And many other jobs as well.

Such versatility is made possible by the choice of mounting styles, electrical types, bearing and insulation systems available.

M-49 FRAME MOTOR

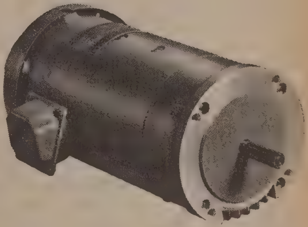
The 3 inch diameter M-49 motor is specifically built for applications requiring AC power in a limited space. This reversible motor can be mounted at any angle because it is available with either steel-backed babbit sleeve or ball bearings. The M-49 is offered in reluctance synchronous, permanent split-capacitor, split-phase and capacitor-start models. Shaft diameter is 5/16 or 3/8 inches.

19-FRAME MOTOR

The 3⅞ inch diameter 19-frame motor is designed to meet most small induction motor needs. Available with bolted cast-aluminum endshields, the 19-frame comes in synchronous, polyphase, permanent split-capacitor, split-phase and capacitor-start electrical types. This motor also features all-angle mounting, with the choice of either steel-backed babbit sleeve or ball bearings. On open models, a standard NEMA 42-frame mount is offered. Standard shaft diameters are 5/16 or 3/8 inches.

Write for Bulletin GEA-9964

56-Frame DC Motors



General Electric's 56-frame DC motors are designed to start, accelerate, and run FHP devices on variable- or constant-speed applications, with a DC or AC/DC conversion power source. They offer unequalled design flexibility, long-life quiet operation, and easy installation.

With a wide range of design choices in accessories, modifications, winding types, and enclosures, the 56-frame offers the designer/manufacturer valuable options in motor selection. These motors are available in open, totally-enclosed, and severe duty enclosures for most ratings, while totally-enclosed non-ventilated construction is also available for dirty indoor environments. Low voltage drip-proof fully-guarded types are available for battery-powered equipment drives, as are full- and half-wave rectified power drives.

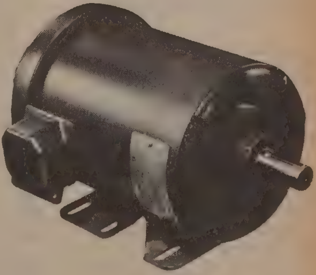
The 56-frame motor features a new, improved insulation system which is superior to the previous one. This insulation has proved its excellent resistance to heat, aging, and dielectric failure in tests at the Underwriters' Laboratory, and has been designated Class B-R by the UL. Its unique capabilities enable the use of smaller, lighter weight motors in applications such as office and business machines.

All design elements of the 56-frame DC motor contribute to its high reliability, and long-life, efficient performance. These motors are designed to operate over a wide speed range, and provide fast starting, acceleration, deceleration, and reversing — while maintaining stable motor temperatures.

Write for Bulletin GEA-9965

Form G Motors

For commercial and industrial equipment, when you choose from the Form G Line, you choose from literally hundreds of standard models . . . and thousands of variations. Designs are available in almost every enclosure, electrical type, and speed rating in the wide scope of the NEMA 48- through 145T frame sizes up to five horsepower.



6½-INCH-DIAMETER FORM G MOTOR NOW INCLUDES NEMA 56-, 56H-, 143T- and 145T-FRAME DESIGNS

General Electric's reliable Form G motor line now includes commercial and industrial motors with more power per pound, yet compact and lightweight for today's new equipment. The new heavy-duty designs have welded-on steel bases that are large and rigid for sturdy mounting and accurate shaft alignment. Comparable solid and resilient cradle bases are also available. Meeting high horsepower torque requirements are heavy-duty bearings and large diameter shaft extensions.

5½-INCH-DIAMETER FORM G MOTOR INCLUDES NEMA 48- AND 56- FRAMES

Now it is common to have ratings up to one horsepower in General Electric's 5½-inch-diameter motors. This is so because the Form G motor family contains many advanced design features. These features include improved ventilation, insulation, and bearing load-carrying ability and motor life.

If you have specialized requirements, contact us for the General Electric solution.

Write for Bulletin GEA-8130

For complete information contact your nearby GE Sales Office, or
write to General Electric Co., Section 998-2. Schenectady, N. Y. 12345.

GENERAL ELECTRIC

GRAPHALLOY

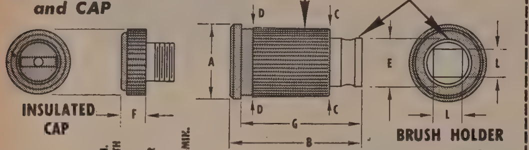
SILVER GRAPHALLOY BRUSHES and BRUSH & SLIP-RING ASSEMBLIES . . .

GRAPHALLOY BRUSHES

are used on such equipment as . . . SERVO SYSTEMS • SYNCHROS • CHOPPERS • RADAR • GYROS • INVERTERS • THERMOCOUPLE and STRAIN GAGE CIRCUITS • GUIDED MISSILES • PULSE SYSTEMS • DIGITAL COMPUTERS • WAVE GUIDES • SONAR • TRANSDUCERS • TORQUE INDICATORS

Silver GRAPHALLOY Brushes have been widely used because *of* LOW *and* CONSTANT CONTACT DROP, EXTREMELY LOW ELECTRICAL NOISE *and* LONG LIFE. Over 200 grades are now serving in a wide variety of applications. Silver GRAPHALLOY Brushes on ½″-diameter coin silver slip rings have operated successfully in highly critical electrical circuits at speeds up to 100,000 R.P.M. *Our Engineering Department will assist in determining the exact grade of* GRAPHALLOY *for your needs.* Ask for our Brush Inquiry Form 109.

BRUSH HOLDER and CAP



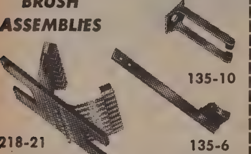
Other Sizes Available

BRUSH HOLDER & CAP NO.	BRUSH SIZE	SUGGESTED MIN. SLIP-RING WIDTH	**MOUNTING HOLE DIAMETER	BRUSH HOLDER TO SLIP RING—MIN.	A	OVERALL LENGTH B	F	C	D	E	G	BROACHED HOLE L
14326	1/8″ sq.	3/16″	13/32″	1/16″	.437″	7/8″	3/16″	.404″	.418″	.281″	25/32″	.129″
11509†	5/32″ sq.	1/4″	13/32″	1/16″	.437″	7/8″	3/16″	.404″	.418″	.281″	25/32″	.160″
11570†	3/16″ sq.	1/4″	7/16″	1/16″	.484″	7/8″	3/16″	.441″	.451″	.313″	25/32″	.193″
19011†	1/4″ x 3/16″	5/16″	9/16″	1/8″	.616″	1 5/16″	3/16″	.561″	.573″	.438″	1 3/16″	.256 x .193″
11527†	1/4″ sq.	5/16″	9/16″	1/8″	.616″	1 5/16″	3/16″	.561″	.573″	.438″	1 3/16″	.256″
14292†	3/8″ x 1/4″	7/16″	43/64″	1/8″	.718″	1 7/16″	1/4″	.672″	.682″	.533″	1 5/16″	.382 x .256″
12166†	3/8″ sq.	7/16″	13/16″	1/8″	.921″	1 13/16″	1/4″	.813″	.828″	.628″	1 5/8″	.382″
31392†	1/2″ sq.	9/16″	1 1/8″	1/8″	1.237″	1 13/16″	1/4″	1.126″	1.141″	.878″	1 9/16″	.503″
35439†	3/4″ x 1/2″	7/8″	1 33/64″	1/8″	1.661″	2 1/32″	5/16″	1.508″	1.528″	1.253″	1 25/32″	.753″
35440†	3/4″ sq.	7/8″	1 33/64″	1/8″	1.661″	2 1/32″	5/16″	1.508″	1.528″	1.253″	1 25/32″	.753″

†Shunts are provided. **Mounting hole diameter for brush holder dimension D.

Request and fill in Brush Inquiry Sheet, Form 109, so that we can supply the proper grade of brush material.

BRUSH ASSEMBLIES



CONTACTS

GRAPHALLOY, because of its inherent non-welding and arc-quenching characteristics, is used widely for contacts. Ask for Data Sheet 950.

BUSHINGS, Oil-free

Replace oil-lubricated bushings in synchros, instruments, timers and missiles.

Advantages: 1) Lower friction at room temperatures. 2) No oil to solidify at low temperatures. 3) No oil to carbonize at prolonged elevated temperatures.

*Ask for Data Sheets 270 and 277 on Miniature Bronze-*GRAPHALLOY *Bushings.*

CONNECTORS (garter springs)

These silver-plated coil spring Connectors make for positive electrical connection to the brass body of the brush holder by snapping into the groove on the holder. The connecting lead can be pre-soldered to the Connector.

GARTER SPRING CONNECTORS	BRUSH SIZE	BRUSH HOLDER NO.
127-9	1/8″ sq.	14326
127-9	5/32″ sq.	11509
127-10	3/16″ sq.	11570
127-14	1/4″ x 3/16″	19011
127-14	1/4″ sq.	11527
127-18	3/8″ x 1/4″	14292
127-20	3/8″ sq.	12166
127-24	1/2″ sq.	31392
127-32	3/4″ x 1/2″	35439
127-32	3/4″ sq.	35440

CLUTCH FACINGS and CLUTCH GEAR ASSEMBLIES

Torque remains same within close operating limits despite changes in temperature and humidity. For instrumentation, guided missiles, constant friction devices.

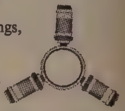
SLIP RINGS Solid Coin Silver

Standard Coin Silver Slip Rings, both *cylindrical* and *flat* types, are illustrated at right. We recommend the cylindrical type rings with three brushes per ring . . . spaced at 120°. The cylindrical type are designed for press fitting over standard steel shafting. The flat type rings are designed for nesting either on an insulated plate or for molding into insulation. Insulated slip rings of either type or slip-ring assemblies can be furnished with leads attached.

No. 168 Series flat type to 20″ O.D.

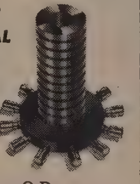
Standard "Flat" rings have ¼″ radial contact surface and ⅛″ radial spacing between adjacent rings.

No. 116 Series cylindrical type to 36″ O.D.



Copper Slip Rings, flat or cylindrical, are available.

Model 319 CYLINDRICAL SLIP-RING assembly

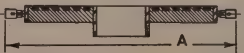


Solid Coin Silver Rings

MODEL	RINGS	LENGTH
319-4	4	2 9/16″
319-6	6	3 5/16″
319-10	10	4 13/16″
319-14	14	6 5/16″

O.D.
Slip-ring 1⅝″
Terminal 4″
Assembly I.D.: .814″/.813″
Range: Same as for Model 399

Model 409 FLAT SLIP-RING assembly



Solid Coin Silver Rings

MODEL	RINGS	OVERALL O.D.—"A"
409-2	2	5 1/2″
409-4	4	7″
409-6	6	8 1/2″
409-10	10	11 1/2″

Hub: O.D. 2″
I.D. 1.753″/1.751″
Length 1⅛″
To 5 amps., 125 v.
More rings on application.

SPRING BINDING POSTS

(with or without Insulated Cap)

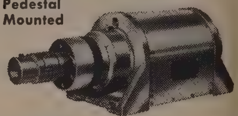
O.D.: ⅜″, ½″, 17/32″
Lgth.: ⅝″, ¾″, 25/32″

Also Miniature Spring Typel

19185
22978

Model 399 BRUSH and SLIP-RING assembly

Pedestal Mounted



MODEL	RINGS	bolt slot distances CL to CL WIDTH	bolt slot distances CL to CL LENGTH	**OVERALL LENGTH
399-4	4	4 1/2″	7 3/4″	13 1/4″
399-6	6	4 1/2″	8 1/2″	14″
399-10	10	4 1/2″	10″	16″
399-14	14	4 1/2″	11 1/2″	18″

Specifications: Width 6½″—Height 6½″. Shaft CL above base 3¼″.
Applications: from strain gage or thermocouple up to 5 amperes, 125 volts, 250°F.
Speeds to 5,000 RPM.
Three Silver-GRAPHALLOY Brushes per solid coin silver slip ring.
Extraneous noise level low.
Rugged in design and construction.
Readily connected mechanically and electrically.
Complete coupling provided for 15/16″ shaft.
More rings and higher speeds available upon application.

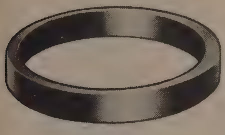
Write for data sheets

CALL ON OUR OVER 50 YEARS OF DESIGN EXPERIENCE FOR HELP IN SOLVING YOUR BRUSH PROBLEMS!

GRAPHITE METALLIZING CORPORATION
1036 Nepperhan Avenue
YONKERS, New York 10702

SLIP RINGS *of Solid Coin Silver*

Standard Coin-Silver Slip Rings, both cylindrical and flat types, are illustrated below. We recommend the cylindrical-type ring with three brushes per ring . . . spaced at 120°. The cylindrical rings are designed for press fitting over insulation on standard steel shafting. The flat-type rings are designed for nesting either on an insulated plate or for molding into insulation. Insulated slip rings of either type or slip-ring assemblies can be furnished with leads attached.


Cylindrical
116

Flat
168

Standard Coin Silver Slip Rings

Part No.	OD	ID	Width
116S-4	1/4	.127/ .123	3/16
116S-6	3/8	.252/ .248	3/16
116S-8	1/2	.377/ .373	3/16
116S-10	5/8	.502/ .498	3/16
116S-12	3/4	.627/ .623	3/16
116S-14	7/8	.752/ .748	1/4
116S-16	1	.877/ .873	1/4
116S-18	1 1/8	1.000/ .996	1/4
116S-19	1 3/16	1.000/ .996	1/4
116S-23	1 7/16	1.250/1.246	1/4
116S-27	1 11/16	1.500/1.496	1/4
116S-31	1 15/16	1.750/1.746	1/4
116S-35	2 3/16	2.000/1.996	1/4
116S-39	2 7/16	2.250/2.246	1/4
116S-43	2 11/16	2.500/2.496	1/4
116S-52	3 1/4	3.000/2.996	5/16
116S-60	3 3/4	3.500/3.496	5/16
116S-68	4 1/4	4.000/3.996	5/16
116S-76	4 3/4	4.500/4.496	5/16
116S-84	5 1/4	5.000/4.996	5/16
116S-92	5 3/4	5.500/5.496	5/16
116S-102	6 3/8	6.000/5.996	5/16
116S-118	7 3/8	7.000/6.996	5/16
116S-134	8 3/8	8.000/7.996	5/16
116S-150	9 3/8	9.000/8.996	5/16
116S-166	10 3/8	10.000/9.996	5/16

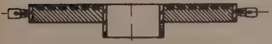
Larger Cylindrical and Flat Rings are available!

Part No.	OD	ID	Thickness
168S-20	1 1/4	3/4	3/16
168S-32	2	1 1/2	3/16
168S-44	2 3/4	2 1/4	3/16
168S-56	3 1/2	3	3/16
168S-68	4 1/4	3 3/4	3/16
168S-80	5	4 1/2	3/16
168S-92	5 3/4	5 1/4	3/16
168S-104	6 1/2	6	3/16
168S-116	7 1/4	6 3/4	3/16
168S-128	8	7 1/2	3/16
168S-140	8 3/4	8 1/4	3/16
168S-152	9 1/2	9	3/16
168S-164	10 1/4	9 3/4	3/16
168S-176	11	10 1/2	1/4
168S-188	11 3/4	11 1/4	1/4
168S-200	12 1/2	12	1/4
168S-212	13 1/4	12 3/4	1/4
168S-224	14	13 1/2	1/4
168S-236	14 3/4	14 1/4	1/4
168S-248	15 1/2	15	1/4
168S-260	16 1/4	15 3/4	5/16
168S-272	17	16 1/2	5/16
168S-284	17 3/4	17 1/4	5/16
168S-296	18 1/2	18	5/16
168S-308	19 1/4	18 3/4	5/16
168S-320	20	19 1/2	5/16

BRONZE and COPPER Slip Rings, cylindrical or flat, are available in the above sizes.

Cylindrical coin-silver rings, stacked with insulating rings between them, are press-fitted over insulation on the shaft. The insulation should be kept concentric on the shaft to avoid losing the high degree of concentricity already built into the slip rings and to maintain the effectiveness of the highly finished ring surface.

Model 409 Flat Slip-Ring Assembly



Where cylindrical-type slip rings cannot be used because of axial space limitations, standard flat (or disc type) coin-silver slip rings will solve the problem. A series of these rings has been designed so that the rings will nest with a standard 1/8"-spacing between successive rings. Each ring provides a radial contact surface of 1/4" width. Our 5/16"-square brush in Brush Holder 11570 should be used with these rings. We strongly recommend three brushes per ring to reduce noise level to a minimum.

BINDING POSTS

Binding Posts (normally spring-type 19185 or 22978) insure simple, low resistance, positive electrical connections between brush shunts (which have been threaded through brush-holder caps) and the external circuits. Binding posts are used also with brush and slip-ring assemblies and with brush-holder assemblies to make connection between the assembly and the external circuit.

Miniature (Spring-type) Miniature binding posts are valuable where space is at a premium, particularly for some rotary strain-gage and rotary thermocouple applications. These miniature binding posts are not insulated.

30624

30625

Metal Binding Post (Spring-type) 30624
Not Insulated
1/8" O.D. x 11/32" long. Stud. 2-56 x 7/32" long.

Metal Binding Post (Spring-type) 30625
Not Insulated
5/32" O.D. x 15/32" long. Stud 2-56 x 7/32" long.

Standard (Spring Type) — Standard spring-type binding posts are used for most rotary strain-gage and thermocouple applications. These binding posts may be furnished with either *red or black* insulating caps.

19185

22978-1
22978-2
40541-1
40541-2

22978-A

Metal Binding Post (Spring-type) 19185
No insulated cap.
3/8" O.D. x 5/8" long. Wire hole dia. 3/32"
I.D. Thd. 6-32

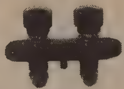
Metal Binding Post (Spring-type) 22978
Insulated Cap: Black—1; Red—2
7/16" OD. x 3/4" long.
Wire hole dia. 3/32". I.D. Thd. 6-32

Metal Binding Post (Spring-type) 40541
Insulated Cap: Black—1; Red—2
1/2" O.D. x 3/4" long. Wire hole dia. 1/8" Thd. 6-32

Insulated Binding Post Base 22978-A
For 22978-1 & 22978-2

Screw-Type Binding Posts — Screw-type binding posts, such as are used for aircraft applications, provide constant blocking pressure on the wire. They are well insulated, and have non-removable phenolic knobs and molded bases. These posts are furnished in single, double or triple configuration.

20123


20124

20125

Single Binding Post (Screw-type) 20123
1/2" O.D. x 7/8" long. Stud 6-32 x 9/16" long.

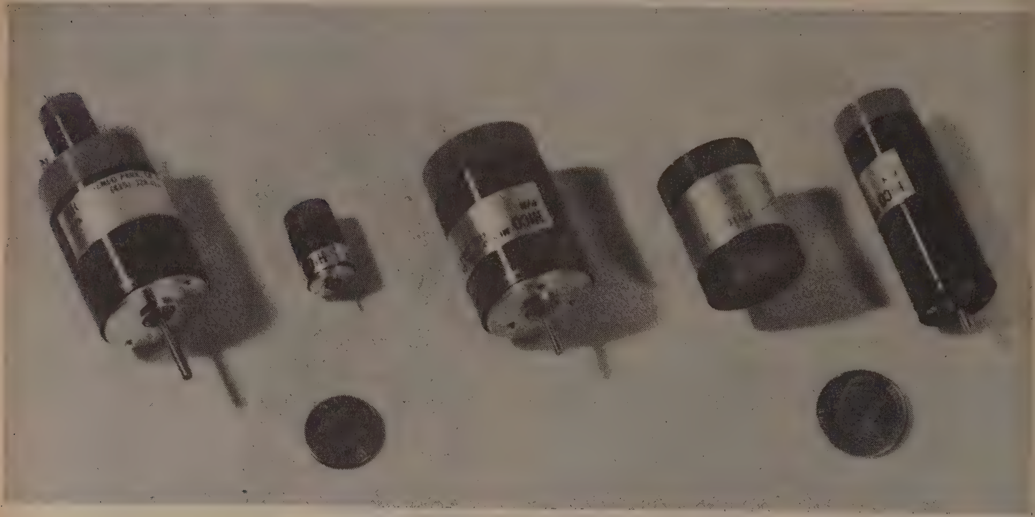
Double Binding Post (Screw-type) 20124
Each Post 1/2" O.D. x 3/4" long.
Studs 6-32 x 1/2" long.
Plate: 11/16" x 2"

Triple Binding Post (Screw-type) 20125
Each Post 1/2" O.D. x 3/4" long.
Studs 6-32 x 1/2" long.
Plate: 11/16" x 2.4"

SPECIAL BINDING POSTS

Special binding posts are designed where particular characteristics are required.

HICO MAXON : MINIATURE PRECISION DC MOTORS

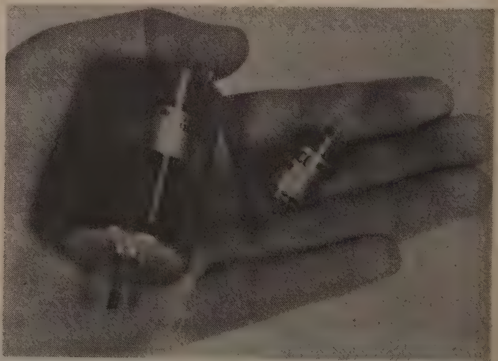


FEATURES

Subminiature Motors, Tachometers and Gearmotors: (9 Frame Sizes)

1. Low inertia, servo design, PM.
2. Ironless rotors, wave wound.
3. Life, to several thousand hours.
4. Highest torque to sizes ratio available.
5. Efficiency to 90%; low friction.
6. Flatter speed-torque curves.
7. Up to 13 bar commutators, 3 and 4 element brushes.
8. Reliable low voltage starts; .5-48 VDC.
9. Gearmotors — low to high ratios. Stock.
10. Tachometers: Ripple under 2% RMS; Voltage .5 to 6.00/1000 RPM. Stock.
11. USA tapped mounting holes.
12. Precision Swiss made.
13. Sizes from 12mm (.472″) to 32mm (1.26″) for every application.
14. Operating Temp. Range: −20°C to +65°C (−4°F to +150°F).
15. Bearings, sintered oilite bronze, standard; ball bearing additional.
16. Windings, standard and specials, with torques to over 3 oz.-in. running and 8-10 oz.-in. stall, without gearing and low speeds to over 20,000 RPM.
17. Stocks of popular sizes and windings, others reasonable delivery.
18. Competitively priced. Application engineering assistance.

HICO Horizons International Company
716 Willow Rd., Menlo Park, California 94025
(415) 328-1111



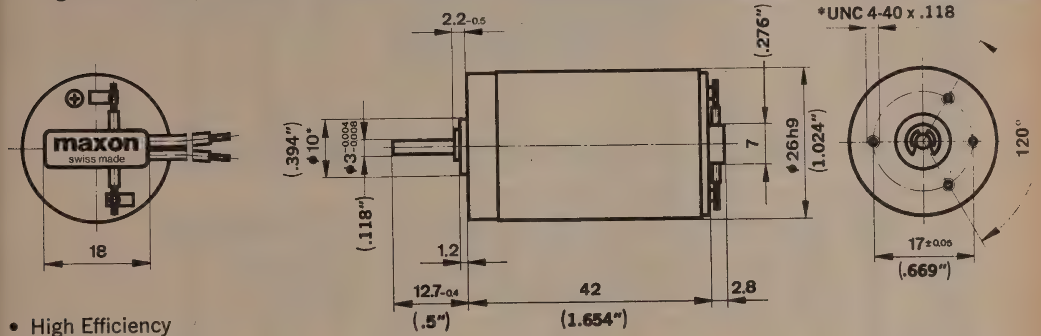
The 2326... HICO maxon MINIATURE PRECISION DC MOTORS

Motor Type	Nominal Voltage VDC	Rotor Resistance Ohms	No Load Speed NL RPM	Average No Load Current IL mA	Max. Power at 65°C mW	Speed at P Max. RPM	Torque at P Max. Oz/In	Current at P Max. mA	Starting Torque Warm Ta2 Oz/In	Starting Torque Cold Ta1 Oz/In	Starting Current Warm mA	Specific Torque Generated per Amp 1/P Current Oz/In	Specific Speed RPM	Generated EMF per 1000 RPM VDC	Armature Moment of Inertia gcm²	Starting Time Constant mS
2326N935*	6,0	2,31	5050	27	3530	2340	2.0	1300	3.8	4.1	2420	1.6	847	1,18	8,66	17,0
2326N938*	12,0	8,13	5450	15	4050	2700	2.0	695	4.0	4.3	1380	3.0	457	2,22	8,17	16,4
2326N941*	24,0	30,7	5850	8	4290	2990	1.9	357	4.0	4.3	727	5.5	245	4,08	7,47	16,2
2326N942*	24,0	47,3	4750	7	2660	1870	1.9	288	3.2	3.4	472	6.8	199	5,00	7,33	16,2
2326N943*	24,0	70,1	3950	6	1430	1020	1.9	236	2.6	2.8	318	8.2	166	6,00	7,13	16,2
2326N944*	6,0	4,56	3850	20	1330	941	1.9	927	2.5	2.7	1230	2.1	649	1,55	7,27	16,5
2326N945*	12,0	9,48	5300	14	3430	2420	1.9	644	3.5	3.8	1180	3.0	445	2,24	7,38	16,4
2326N946*	15,0	16,9	4950	11	2710	1660	2.2	551	3.3	3.6	826	4.1	331	3,02	7,44	16,3
2326N947*	24,0	37,3	6000	8	3440	2780	1.7	324	3.2	3.4	598	5.4	252	3,95	5,78	16,2

*Preferred range, available from stock. Other ranges available on special order.

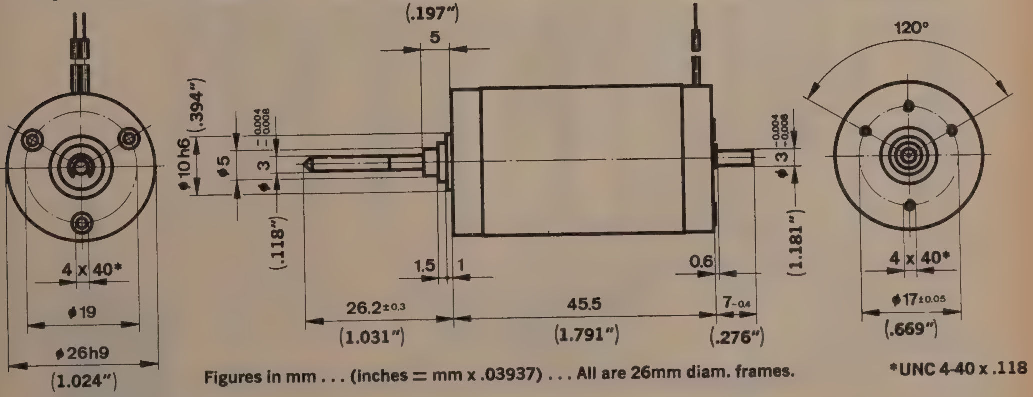
- 11 Coils (not 9) for Smoother Operation at Low Speeds
- Larger 3mm Shaft, Standard (Optional 2mm Shaft to Interchange with Older Styles)

- Ironless Rotor
- Smaller Size
- Wider Voltage Range


2.2-0.5
(.276")
*UNC 4-40 x .118
maxon
swiss made
18
(.394")
φ10*
φ3-0.004 -0.008
7
φ26h9
(1.024")
120°
(.118")
1.2
17±0.05
(.669")
12.7-0.4
42
2.8
(.5")
(1.654")

- High Efficiency
- Wide Temperature Range
- Quiet Running
- Fully Tested for Reliability

- Lower Starting Voltages
- Higher Performance
- Low Inertia


(.197")
5
120°
(.394")
φ10 h6
φ5
3 -0.004 -0.008
φ3 -0.004 -0.008
(.118")
(1.181")
4 x 40*
1.5
1
0.6
φ19
26.2±0.3
45.5
7-0.4
φ17±0.05
φ26h9
(1.024")
(1.031")
(1.791")
(.276")
(.669")
*UNC 4-40 x .118

Figures in mm . . . (inches = mm x .03937) . . . All are 26mm diam. frames.

- 12 Different Frame Sizes, all Ironless Low Inertia Rotors, 12mm to 36mm

Horizons International Co.
716 Willow Road
Menlo Park, California 94025 U.S.A.
Telex: 9103731170
Phone: (415) 328-1111

IMC MOTOR FACTS

FHP motors... precision, power, performance

Whatever your motor requirements, chances are IMC Eastern Division has a pre-engineered design to meet them. If not, we will custom engineer to your exact specifications.

IMC offers a complete range of motor types, sizes and performance characteristics.

Hysteresis synchronous, polarized and reluctance synchronous, induction, torque, and servo motors. 50, 60 400, 800 and 1000 Hz, multi-Hz and variable frequency types. Standard voltages from 13 to 230 V, single, 2 and 3-phase. Models include totally enclosed and open frame designs with or without internal cooling. Base, face, flange and servo mountings. Shafts offset, double-ended, with slots, keyways, tapers, etc. at customer option.

The tables below provide a few typical examples of IMC Eastern Division motor capability. For additional data on these designs, information on your individual requirements, or application engineering assistance, contact us at

imc

IMC MAGNETICS CORP.
EASTERN DIVISION
570 MAIN STREET, WESTBURY, NEW YORK 11590

Tel. | (516) 334-7070, TWX 510-222-4469.

INDUCTION MOTORS

Motor No. Size	Type	Voltage (VAC)	Frequency (Hz)	Current (A)	Rated Torque (oz-in)	Speed (rpm)	Poles (No.)	H.P. Rated	Power Input (Watts)	Dimensions (Typ.) (inches) Housing O.D.	Housing length
BC905	804	115	400	.075	.18	18000	2	1/350	8	.937	1.178
BC1307	1330	115	400	.16	1.0	10500	4	1/90	17	1.500	1.468
BT1310	1972	200	400	.07	.25	20000	2	1/200	10	1.500	1.768
BC1507	520	115	60	.06	.10	3000	2	1/3000	6.5	1.700	1.703
BC1511	338	115	60	.095	.90	1400	4	1/800	12	1.700	2.103
FBC1615	101	115	400	.70	3.8	8500	4	1/30	75	2.000	3.000
BC2210	1246	115	60	.31	5.0	3300	2	1/60	35	2.750	2.437
BC2210	1382	115	60	.45	7.5	3300	2	1/40	44	2.750	2.437
BC2305	2151	115	60	.065	0.75	1200	4	1/1100	7	2.500	1.500
BC2910	2030	115	60	.28	9.0	1600	4	1/70	30	3.312	3.187
FBC2922	507	115	400	2.6	28.5	7000	6	1/5	300	3.312	5.312
FBC3815	1392	220	60	1.4	64.0	2600	2	1/6	300	4.375	5.718
FBT4525	1635	208	60	4.5	375.0	3400	2	1-1/4	1400	5.375	7.062
FBT4530	1095	208	400	12.0	510.0	5800	8	3	2700	5.375	7.281
FBT4625	1820	208	60	5.0	500.0	3400	2	1.7	1600	5.375	7.062

HYSTERESIS & RELUCTANCE SYNCHRONOUS MOTORS

Motor No. Size	Type	Volts (V)	Frequency (Hz)	Current (Amps)	Rated Torque (oz-in)	Start Torque (oz-in)	Speed (rpm)	Poles (No.)	H. P. Rated	Input Power (Watts)	Dimensions (Typ.) (inches) Housing O.D.	Housing length
BC703H	1787	26	400	.27	.025	.022	24000	2	1/1700	6.9	0.750	0.865
BC905H	1032	26	400	.210	.070	.10	8000	6	1/1800	4.7	0.937	1.178
BC100TH	1316	26	400	.23	.055	.027	8000	6	1/2270	4.7	1.062	1.375
BT1210H	1272	26	60	.28	.38	.59	3600	2	1/730	10.0	1.300	1.707
BC130TH	4.9	115	400	.11	.36	.360	12000	4	1/230	11.0	1.500	1.468
BC1404H	1549	115	400	.05	.16	.11	8000	6	1/780	5.7	1.437	1.363
BC1510H	1954	115	400	.21	.40	.45	8000	6	1/300	15.0	1.700	2.003
FBC1610H	1832	115	400	.24	.90	.6	6000	8	1/350	26.0	2.000	2.500
FBC1615H	633	115	400	1.20	1.9	2.3	12000	4	1/44	98.0	2.000	3.000
BC230TH	1900	115	60	.25	1.5	3.0	3600	2	1/180	28.0	2.500	1.750
FBC2922H	2049	115	60	1.8	35.0	44.0	1800	4	1/16	150.0	3.312	5.312
FBC3825H	2095	115	50	1.9	60.0	86.0	1500	4	1/11	160.0	4.375	6.718
FBC3830H	749	115	60	2.41	74.0	72.0	1800	4	1/8	214.0	4.375	7.218
FBC4530H	2147	115	60	2.8	100.0	150.0	1200	6	1/8	210.0	5.375	7.562
FBT4545H	1691	208	60	3.6	180.0	432.0	1800	4	1/3	430.0	5.375	9.062

TORQUE MOTORS

Motor No. Size	Type	Volts (V)	Frequency (Hz)	Stall Current (Amps)	Stall Torque (oz-in)	No Load Speed (rpm)	Poles (No.)	Stall Watts	No Load Watts	Duty Cycle Class H%	Dimensions (Typ.) (inches) Housing O.D.	Housing length
BT703T	903	18/18	400	.12/.12	.15	6300	6	1.6/1.7	1.3/1.4	cont.	0.750	0.765
BT707T	948	115/33	400	.05/.14	.26	5900	6	3.4/3.0	3.0/2.5	cont.	0.750	1.165
BC907T	1835	115	400	.05	.27	7000	6	5.0	3.6	cont.	1.000	1.496
BT1005T	1687	115/36	400	.05/.16	.66	6200	6	3.4/3.5	1.6/1.5	cont.	1.062	1.175
BT1210T	1273	26	60	.35	1.9	3300	2	15.0	7.9	50	1.300	1.707
BC1307T	162	115	400	.17	1.25	5000	8	19.0	18.0	40	1.500	1.468
BC1311T	330	115	400	.45	3.8	5500	8	60.0	60.0	15	1.500	1.868
BT1406T	599	24/24	60	.24/.24	1.7	1600	4	4.6/4.4	4.7/4.5	cont.	1.437	1.563
BC1507T	96	115	60	.105	2.7	1650	4	12.5	13.0	cont.	1.700	1.703
BC1511T	338	115	60	.088	2.6	1600	4	10.7	10.5	cont.	1.700	2.103
BC1615T	347	115	400	1.4	9.0	10000	4	140.0	92.0	12	1.750	2.703
BT1615T	629	200	400	1.26	19.0	7300	6	290.0	64.0	7	1.750	2.703
BC2210T	1197	24	60	0.67	3.4	725	8	16.0	15.0	cont.	2.750	2.437
BC2929T	440	115	60	1.36	72.0	1100	6	145.0	120.0	30	3.312	5.125
FBC3825T	1208	115	60	1.3	110.0	830	8	142.0	100.0	55	4.375	6.718
FBC3830T	881	115	50	1.8	156.0	900	6	204.0	140.0	40	4.375	7.218
BC4520T	1718	115	60	2.7	250.0	810	8	305.0	220.0	35	5.375	6.562
BC4530T	1777	115	50	4.0	320.0	900	6	370.0	255.0	30	5.375	7.562

ALPHA MAX-LOW INERTIA DC SERVO MOTORS

Available with integrally mounted incremental encoder or DC tachometer. Also with forced air internal cooling.

Motor No. Size	Torque Constant (oz-in/Amp.)	Armature Inertia (oz-in-sec^2)	Armature Inductance (microhenries)	Rated Power Output (Watts)	Terminal Resistance (Ohms)	Dimensions (inches) Housing O.D.	Housing length
IM4000	6.0	.00039	< 100	92	0.9	3.980	3.46

SERVO MOTORS

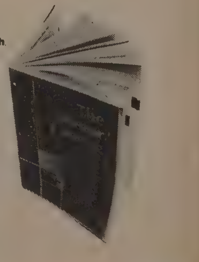
Motor-generators, motor-tachometers in BuOrd sizes 5-18. All available with precision gearheads.

BRUSHLESS DC MOTORS

Newly developed IMCom Brushless DC Motor meets maximum power output requirements — up to two horsepower.

FREE

Our Driver Manual. It's your license to control all driving situations, free for the asking. 100 pages of detailed motor specifications, comprehensive theory and applications information (ref. cat. #EMistr.). From IMC Eastern Division.



IMC MOTOR FACTS

A FIRST!

Available in frame sizes
from ¾″ to 5⅜″ diameter.

IMC Brushless DC Motor meets requirements up to TWO HORSEPOWER

A first — this newly developed product meets maximum power output requirements, unfolding a new era for the Brushless DC motor. Features electromagnetic commutation, wide temperature range, two wire input, exceptional life/reliability, electronic motor control and modular construction. Literature on request! For further information please call Gene Egan, V.P. Sales — (516) 334-7070 or write:

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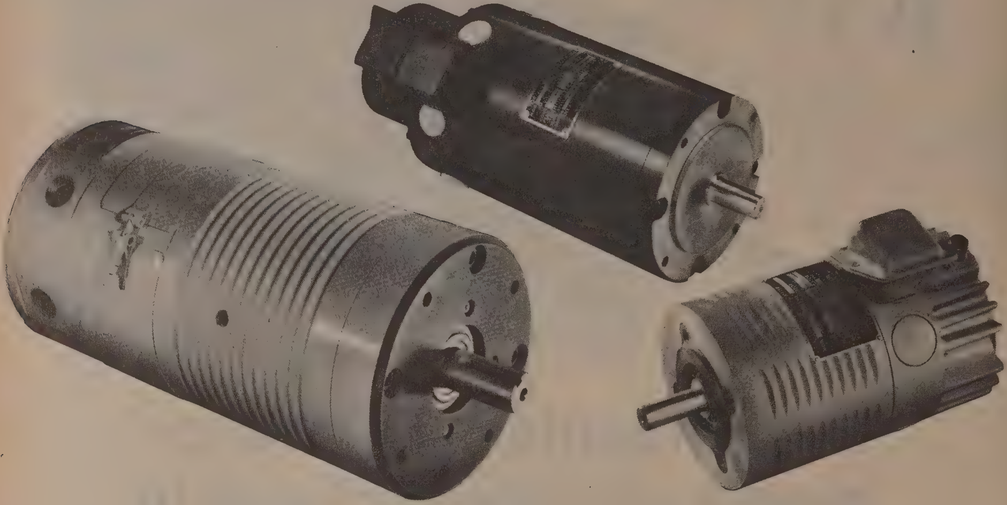
EASTERN DIVISION
570 MAIN STREET, WESTBURY, NEW YORK 11590

Inland Motor
DC Servo Motors for machine tools and high-performance industrial drives.

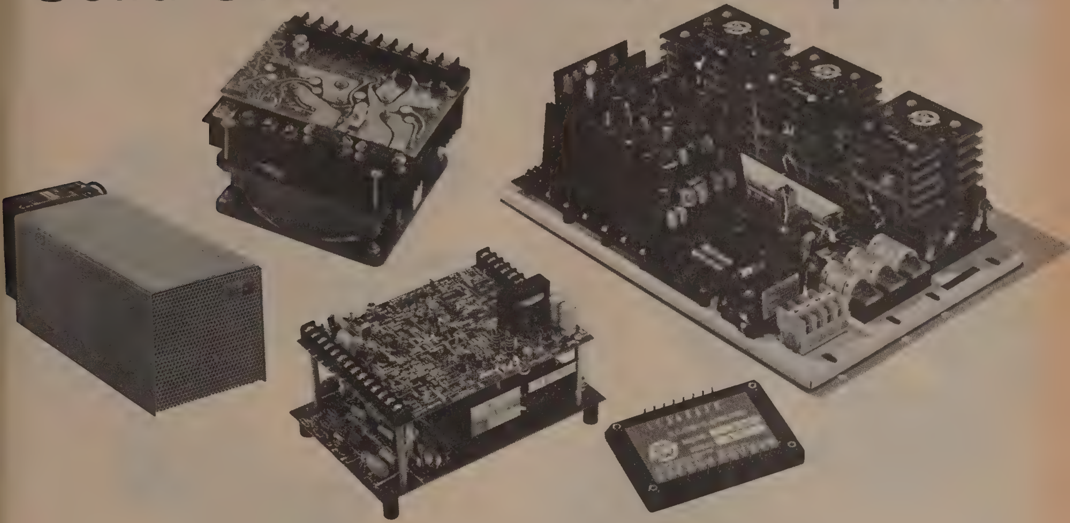


Our full line of DC motor-tachometers ranging from 1.5 to 12 HP will fit an exceptionally wide range of high-performance industrial drive applications. Integral tachometers yield precision speed regulation and eliminate the need for adaptors, gears, couplings or special mountings. Integral brake and resolver options available. Choice of various connections available on all models. A fully compatible solid state SCR power amplifier can be matched to any unit. We will custom design to meet your special machine requirements.

MODEL	PERFORMANCE				MECHANICAL		
	Torque lb. ft.						
	Cont.	Peak	HP	Max Speed RPM	Rotor Inertia lb. ft. Sec^2	Max dia. Inches	Length Inches
TT-2923	6	23	1.5	2000	0.0024	5.5	12
TT-4033	13	60	2.75	3000	0.012	6.5	17.4
TT-5300	15	66	2	3000	0.022	9	13
TT-5301	20	100	3	2000	0.030	9	15
TT-5302	30	160	4.5	1200	0.047	9	19.4
TT-5306	35	82	5.5	2400	0.047	9	20.7
TTV-5302	50	160	5.5	1200	0.047	9	32.5
TT-5801	60	250	10	1000	0.085	10.5	26.0
TT-9503	100	500	10	1000	0.65	12	27.75

INLAND MOTOR DIVISION, Kollmorgen Corporation, 501 First St., Radford, Va. 24141. (703) 639-3973 TWX 710-875-3740

Inland Motor
Solid State DC Power Amplifiers.



These SCR and transistor amplifiers are specifically designed to provide optimum system performance, operation and protection. Inherent stiffness and wide bandwith assure fast accurate control for position, tension or variable speed applications at moderate cost. SCR and PWM transistor models are highly modular in construction with interchangeable PC boards and other components for easy serviceability. Compact configurations save valuable space.

SCR AMPLIFIERS

MODEL	SPAR 1330 SPA 1330	TPAR 3330 TPA 3330	TPAR 3340 TPA 3340	TPAR 3380 TPA 3380
Output Voltage	160 VDC	160 VDC	160 VDC	160 VDC
Continuous Output Current	30 Amps	30 Amps	40 Amps	80 Amps
Peak Current	200 Amps	230 Amps	275 Amps	300 Amps
Peak Power Output	32 KW	37 KW	44 KW	48 KW
Bandwidth*	25-30 Hz	30-35 Hz	30-35 Hz	30-35 Hz
Form Factor	1.3 to 1.5	1.2 to 1.3	1.1 to 1.2	1.05 to 1.2
Signal Input Voltage	± 4-10 VDC	± 4-10 VDC	± 4-10 VDC	± 4-10 VDC
Signal Input Impedance	10 K minimum	10 K minimum	10 K minimum	10 K minimum
Operating Temperature Range	0-55° C	0-55° C	0-55° C	0.55° C
Input Voltage	460 VAC Center Tapped	275 VAC Y	275 VAC Y	275 VAC Y
Input Phases	1 Phase	3 Phase	3 Phase	3 Phase

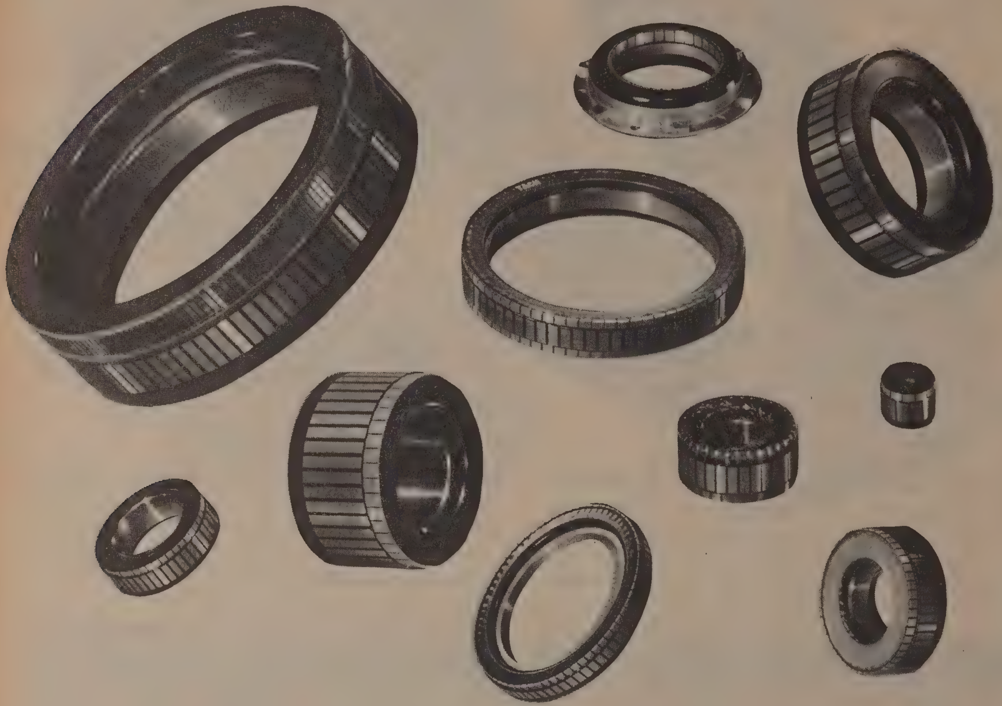
* Bandwidths for 50 Hz Input are 5 Hz less.

TRANSISTOR AMPLIFIERS

MODEL	Output Voltage (Volts)	Output Current (Amps) Continuous	Output Current (Amps) Peak	Voltage Gain Open Loop (db)	Thermal Drift (u V/°C)	Power Bandwidth (KHz)
EM1801	20	1	0.75	26*	10	1
EM1803	20	10	10	26*	10	1
LM4015	40	15	15	110	5	5
LR6520	65	20	20	120	5	5
SM5015	50	15	50	100	5	2
SM6007	60	7	20	100	5	2
SP9040	90	40	100	100	10	2
SP15040	150	40	150	100	10	2

Note: Typical figures only at 25°C / *Power stage only / Operating temperature range for all units is 0-50°C.

Inland Motor
DC Direct Drive Pancake Torquers for aerospace applications.



As the world's largest producer of DC torque motors and servos, we can supply the widest range of sizes and configurations to meet standard as well as the most unique and highest precision applications.

Product reliability of 99.999% made Inland the exclusive supplier for Apollo, Gemini, Mercury, Saturn, the Orbiting Solar Observatory, MOL, Skylab, Titan and Sprint. We're sole or primary supplier on Polaris, Minuteman, Poseidon, TIROS, SINS, Trident and Phoenix programs.

Our direct drive pancake torque motors are specified first where there can be no compromise with reliability. Every major aerospace and weaponry project during the past 20 years has depended on the proven reliability of Inland torque motors, servos and tachometer generators.

In addition to our competitively priced standard models, we custom design to meet your special performance requirements. Our design bank includes thousands of standard and advanced-concept model variations ready for production on short notice. We probably have one ideally suited to your special application. Selecting a model from our design bank can save you considerable engineering time and money right now.

INLAND MOTOR DIVISION, Kollmorgen Corporation, 501 First St., Radford, Va. 24141, (703) 639-3973 TWX 710-875-3740

Inland Motor

Instrumentation DC Servo Motors for computer peripheral and data handling equipment.

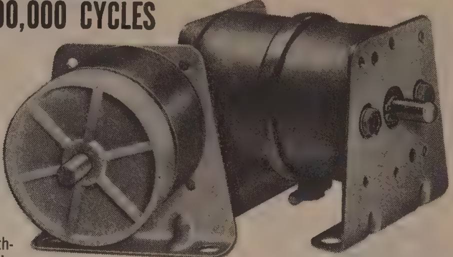
Model	Performance Peak Torque Oz. In.	No-Load Speed* RPM	Watts @ Tp
NT-0716	7	7650	40.2
NT-0724	20	4400	65
T-1243	50	2400	90
OT-1311	60	4300	195
T-1801	80	920	55
T-1802	100	1350	100
T-1804	200	812	120
T-1806	100	1240	95
T-1808	140	620	64
T-1809	300	830	183
T-1813	140	685	70
T-1814	200	812	120
T-1816	100	1240	95
T-1817	200	812	120
TT-1806	100	1240	95
TT-1808	200	812	120
NT-2173	54	1430	57
NT-2178	54	1430	58
TT-2135	54	1430	57
TT-2137	54	1430	57

* No-load speeds given are based upon applied voltage at Tp (stalled). Higher maximum speeds are available based upon specific motor winding selected. However, units with integral tachometer may be limited in speed by tachometer winding. Consult factory for data.

Compact size and high thermal capacity under severe duty cycles characterize these high performance DC motors and motor tachometers. All units are available as housed or unhoused units. We custom design for special applications.

LEDEX

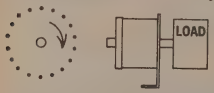
SERIES 50-L EXTENDED LIFE STEPPING MOTORS NOW 10,000,000 CYCLES



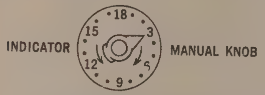
TORQUES TO 246 OUNCE INCHES

New internal design extends life 3 times without changing external dimensions. Accurate to ±1°, non-accumulative. Series 50-L stepping motors are engineered expressly for simplicity of construction and economy. All parts are permanently lubricated and enclosed for maintenance free operation. Their high torque to size ratio is a major benefit.

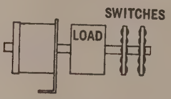
With a **unidirectional** Series 50 you can . . .



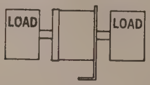
drive your load remotely through a series of short steps and stop at any one of 12, 18, 24, or 36 positions.



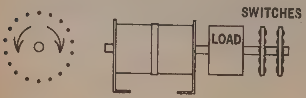
or add a knob for manual reset in either direction . . .



or add rotary switches for a combination power positioning drive and a step or program switch



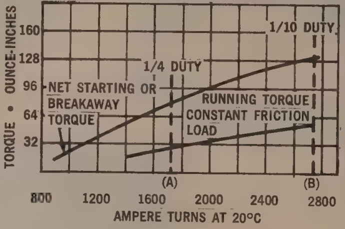
or use shaft extensions on each end to direct-couple two loads and drive them in the same direction at the same time.



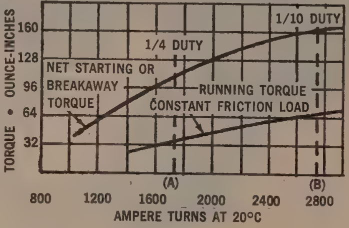
With a **bidirectional** Series 50 you can do all this . . . plus **remotely position** loads CW or CCW.

stock models for quick prototype starts

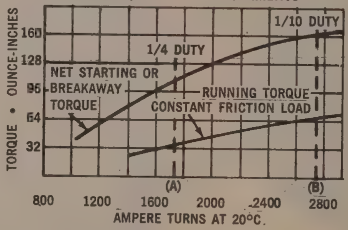
12 POSITION, 30° STEP INCREMENTS



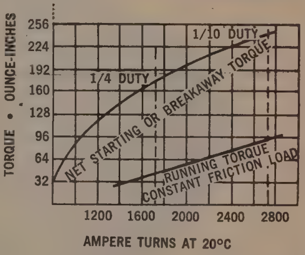
18 POSITION, 20° STEP INCREMENTS



24 POSITION, 15° STEP INCREMENTS



36 POSITION, 10° STEP INCREMENTS



Top curve in each graph shows net starting or breakaway torque, typical when friction component of load is high in beginning — as in driving a valve. **Lower** curve applies when friction load is consistent throughout stroke. Dotted lines "A" show output at 1/4 duty, 84 watts; dotted lines "B" 1/10 duty at 210 watts.

Highlights	Unidirectional	Bidirectional
Voltage	6 to 220 VDC	6 to 220 VDC
Length	1.9″	2.5″
Width	2 1/16″ (Dia.)	2.5″
Height	2⅛″ (Sq. plate)	2 13/32
Weight	14 oz.	24 oz.
Price, 1-9	$30	$48
Price, 1000 up	$15	$25

All working parts are completely enclosed. Minimum life is 10 million steps. For bidirectional, 10 million in each direction. And, the Series 50-L works on simple square wave input pulses . . . so you don't need expensive logic circuitry. Ledex Series 50-L stepping motors are engineered for high torque-to-size, uniform stepping accuracy, construction simplicity and economy.

Newly developed tooth clutch drive gives positive grip stepping action (no slip) and doubles as a built-in electromechanical clutch brake to eliminate the natural tendency of overdriving at the end of a step.

Catalog D-7500 lists complete details on stock models, performance data and engineering considerations.

LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

Magnetic Technology®

Direct-Drive Servo Motors and Tachometers

DC Servo Motors
DC Tachs
Brushless DC Motors
and
DC Torque Motors

Magnetic Technology®

High Performance DC Torque Motors

Brush type and Brushless, More than 500 standard models

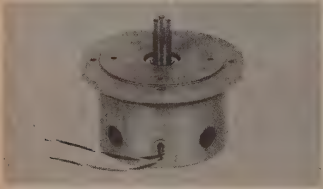
Magnetic Technology® offers designers the broadest standard line of high performance DC torque motors, as well as exotic one-of-a-kind units. These motors are produced to the most exacting reliability and performance standards, and have been proven in aerospace, ground-based and undersea applications.

Magnetic Technology® has paced the industry with developments such as 40 million oz-in/sec² power rate motors, ultra light-weight units for deep space use, 500°F temperature rated motors and compact units for implanted cardiac assist systems.

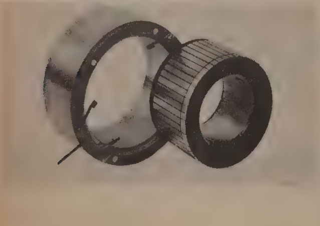
MAGTECH® DC torque motors combine high ratios of torque to power, speed and size with other desirable characteristics such as low electrical time constant and low ripple torque.

Example Specifications

	1500G-050	1937G-050	2340-077	2813-100	3680-185	6980-195	14000E-300
Peak Torque	15 OZ. IN.	20 OZ. IN.	60 OZ. IN.	90 OZ. IN.	500 OZ. IN.	10 LB. FT.	120 LB. FT.
Power @ Tp (watts)	40	56	60	42	110	112	695
No Load Speed (rad/sec)	340	375	134	60	29	7.5	4.0
Inertia (oz.in.sec.²)	.0006	.001	.0056	.013	.09	1.7	41
O.D. (inches)	1.500	1.937	2.343	2.813	3.680	6.980	14.000
Length (inches)	0.50	0.50	0.77	1.00	1.85	1.95	3.00
Weight (oz.)	2.5	4.2	7.6	18	49	145	850



Typical high performance units



These permanent magnet, armature excited motors are furnished frameless for direct mounting to the driven load without gears. Large bore, minimum width and thin-ring configurations make possible compact system packaging.

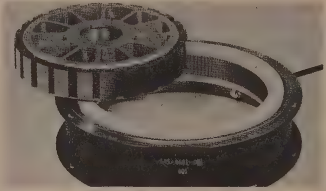
Peak torque ratings of standard models range from 7 oz-in. to more than 120 lb-ft., OD's from 1.5 inches to more than 19 inches, and armature bores to more than 10 inches. Special designs may be furnished to meet specific customer requirements.

Brushless motors are continuous rotation type that have advantages over conventional brush-type DC torque motors in some applications.

Example Brushless Specifications

Mag Tech Part No.	1600B-035	2375D-050	3625B-050	3350B-125	645-0661	645-0697
Peak Torque (oz-in)	6	32	45	300	3250	14000
Pwr/Phase (watts)	26	60	25	200	250	680
O.D.	1.6	2.375	3.625	3.35	10.496	19.30
I.D.	.810	1.250	2.50	1.83	7.0	14.623

Brushless motor and electronics



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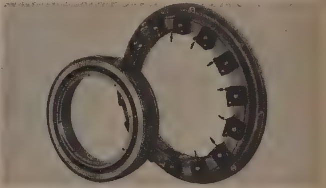
Magnetic Technology®

Tachometers

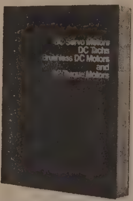
Any of the more than 500 standard MAGTECH® torque motors may be operated as a tachometer generator. In addition, separate product lines of precision tachometers and industrial tachometers are available. These range from .05% ripple voltage units usable at rates less than one revolution per day and units with a 50,000:1 dynamic range, to popular industrial units.

These tachometers feature open, frameless configuration for direct drive mounting. The direct mounting without gears eliminates dead zones and inaccuracies that can result from gearing backlash and gear imperfections. Typical characteristics include high voltage gradient, low time constant, high coupling stiffness and resolution, and accuracy at low speeds.



Precision rate reference unit

Typical industrial units



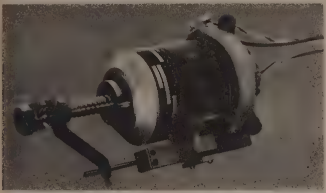
162 Pages of Vital Technical Assistance

Send for your free copy of our most comprehensive product and application guide — 374 photographs, drawings, performance, curves plus some 14,000 data points.

Magnetic Technology®

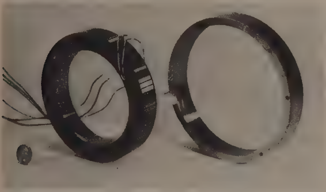
Special Products

Magnetic Technology® also produces linear actuators, and a wide variety of custom devices including the examples below.



Linear actuator: Example shown incorporates ball screw directly driven by DC torque motor, thus eliminating gearing. Motor is rare earth design providing exceptional peak torque for its size and having the added feature of withstanding excessive peak currents without altering performance characteristics.

Gimbal Cartridge. This model 4000B-100 cartridge, with integral labyrinth shield for class 7 special low torque duplex bearings, contains the model 3375-057 torque motor.



Limited Angle Brushless DC Torquers are now available either as adapted from a conventional brush type torquer as shown above or in custom designs providing characteristics and performance to customers exact requirements.

Precision Motor Tachometer is an example of MAGTECH® design combining both aerospace quality motor and precision tachometer into an integral package to precisely fit, electrically and physically, into customers specific application.

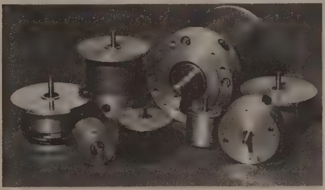
Industrial DC Servo Motors

Brushless and Brush-type, Frameless or Housed, Motor-Tach Combinations

Only subtle design, performance and materials variations distinguish these quality, direct drive motors from Magnetic Technology's® established military grade motors. Yet, through volume production they are priced for industrial applications.

Features include fast response, high torque, precise positioning, high tracking accuracy, quiet operation, and relatively low ripple. These DC servo motors utilize a permanent magnetic field for higher efficiency plus a moving iron armature for maximum thermal inertia.

The motors are available in frameless configuration to allow compact packaging and mounting of the armature directly on the driven load. Housed units, with shaft and bearings also are available. Direct coupling to the driven load eliminates the disadvantages of gears and couplings in servo systems. System simplification is possible and excellent system stability results.



Remember . . . call or write us today for your free copy of our new 162 page product and application guide. Magnetic Technology®, a division of Vernitron Corporation, 21001 Kittridge Street, Canoga Park, California 91303. TWX 910-494-1217. Telephone (213) 887-7700.

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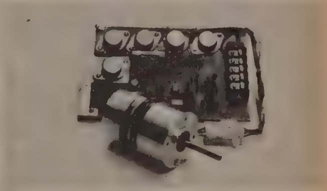
Applications for these units include disc memory systems, card sorters, tape transports and printers, N.C. machine table drives and feedback tachometers.

Continuous rotation brushless units, for constant or variable speed operation, also are available. Electronic drive and control systems can be supplied with these units.

In addition to MAGTECH® industrial servo motors and tachometers, motor-tach combinations can be supplied. A number of standard combinations are available, but virtually any motor and tachometer can be combined to meet drive and tachometer sensitivity requirements. The combination unit is smaller, lighter, easier to mount and generally lower in cost than separate units. These units aid reduction of system resonances.

Example Specifications

Mag Tech Part No.	1937D-100	1937D-150	3069-175	3069-237	H5500-550	H5500-750
Peak Torque (oz-in)	[illegible]	50	75	140	1650	2750
Pwr @ Tp @ 25°C (watts)	33	50	52	79	1480	1125
Ripple Torque (%)	5	5	6	6	3	3
Elec Time Const (sec)	.0004	.0006	.001	.015	.003	.006
No Load Speed (rad/sec)	215	140	94	75	120	56
O.D.	1.937	1.937	3.50	3.069	5.0	5.0
Length	1.00	1.50	2.50	2.37	5.50	7.50



Brushless motor and electronics

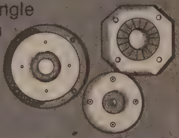
Rare Earth Brushless DC motor. Special motor developed for use as cardiac assist incorporating rare earth magnets to prevent alteration of motor characteristics in case of over current. Motor designed for maximum efficiency, i.e. lowest temperature rise under continuous load conditions.

Magnetic Technology®

Direct-Drive Servo Motors and Tachometers

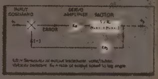
Motor Operation Theory

- Basic Equations — Brush Type
- Basic Equations — Full Rotation Brushless Operation
- Power Relationships
- Damping
- Limited Angle Operation



Direct Drive Servo System Technical Information

- Direct Drive Advantages
- DC vs. AC
- Motor Transfer Functions
- Gain Determination
- Network Compensation
- Tachometer Stabilization
- EMI Considerations

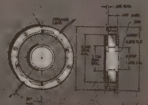


Application Calculations

- Point to Point Motion Calculations: Torque Requirements — Minimum Time Solution / Torque Requirements — Minimum Power Solution
- Rotary to Linear Conversion
- Thermal Considerations
- Low Speed Operation
- Temperature Effects

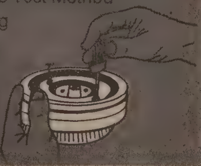
Selection Techniques

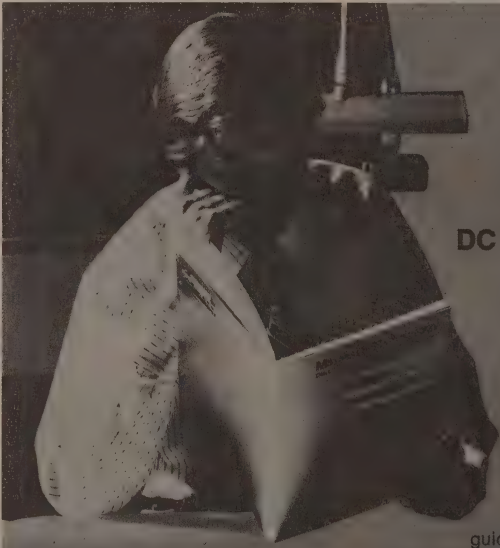
- Selection Guide
- Example Selection Procedure
- Matching Motor to Requirements
- Significance of K_m
- Overspeed Operation



Installation Information

- Photo Sequence Installation Procedures
- Component Part Definitions
- Performance Parameters Definitions
- A Simple Test Method
- Handling
- Storage





DC Servo Motors

DC Tachs

Brushless DC Motors and DC Torque Motors

Now systems designers may choose from 840 standard motors tooled for production, featured in our comprehensive product and application guide. This new, one-of-a-kind publication focuses on complete data presentation including: installation drawings, dynamic performance characteristics and electrical parameters. Included in its 162 pages are 374 photographs, drawings, performance curves and 14,000 data points. Reason enough to request your copy today. Free.

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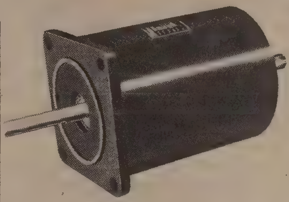
McLEAN COMPUTER DESIGNED PRECISION INSTRUMENT MOTORS

All motors feature: air-cooled bearings to reduce temperature and extend life; dimensionally stable aluminum alloy motor frames; rotors that exceed requirements of MIL-M-17059 to assure extra-smooth running; and other quality features.

HYSTERESIS SYNCHRONOUS MOTORS

OUTPUT PERFORMANCE ON 115 VOLTS, 60 Hz.			
FRAME	RPM	PULL-OUT TORQUE	CAPACITOR
47	1200	15 oz-in.	3 Mfd.
47	1800	14 oz-in.	3 Mfd.
47	3600	12 oz-in.	5 Mfd.
59	1200	55 oz-in.	8 Mfd.
59	1800	60 oz-in.	6 Mfd.
59	1200 3600	45 25 oz-in.	9 Mfd.



REQUEST DATA SHEET

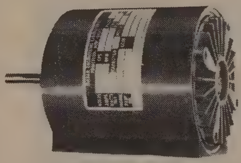
FEATURES

- The starting torque approximates the running torque. Self-starting.
- The motor runs at synchronous speed, but is not phase polarized as are the polarized synchronous motors shown elsewhere.
- The direction of rotation of the shaft is reversible externally.
- Dual voltage and/or dual speed motors available.

POLARIZED SYNCHRONOUS MOTORS

PERFORMANCE ON 115 VOLTS, 60 Hz., WITH INTERNAL FAN		
FRAME USED	47 FRAME	59 FRAME
Speed	3600 RPM	3600 RPM
Line current	1.2 amp.	1.5 amp.
Capacitor required	5 Mfd.	8 Mfd.
Stall torque	10-14 oz-in.	27 oz-in. max.
Pull-in torque	15-18 oz-in.	25 oz-in.
Pull-out torque	15 oz-in.*	14 oz-in.*
Reversible	yes	no

*Must not be exceeded for continuous duty.



REQUEST DATA SHEET

FEATURES

- Ideal where repeated phase synchronization is required between line voltage and shaft position for one or more motors.
- Single or dual voltage, but only single speed, motors available.
- Currently available for 3600 rpm only at 60 Hz. Other speeds and frequencies available when the need materializes.

INDUCTION MOTORS

PSC and 3-PHASE

McLEAN 47 FRAME MOTOR

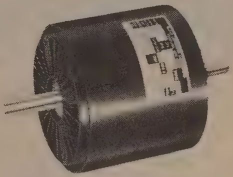
OUTPUT PERFORMANCE ON 115 VOLTS				
RPM	WATTS	HERTZ	VENTILATION	PHASE
1600	30	60	totally enclosed	single
1600	40	60	open, with circulation	single
3200	60	60	totally enclosed	single
3200	80	60	open, with circulation	single
5400	80	400	open, with circulation	single
5400	100	400	open, with circulation	three

McLEAN 59 FRAME MOTOR

OUTPUT PERFORMANCE ON 115 VOLTS					
RPM	WATTS	"B"	HERTZ	VENTILATION	PHASE
1600	20	2⅝	60	open, with circulation	single
3300	20	2⅝	60	open, with circulation	single
1600	100	4⅛	60	totally enclosed	single
1600	165	4⅛	60	open, with circulation	single
3200	250	5⅛	60	open, with circulation	single
3200	525	6⅞	60	open, with circulation	single
3200	100	4⅛	400	open, with circulation	single
3200	130	4⅛	400	open, with circulation	three

FEATURES

Optimum design achieved using McLean high speed electronic digital computer with our internally programmed analysis.



Starting and running torques matched to fan and blower loads, where the motors are so used.

Direction of rotation of the shaft is reversible externally.

Dual voltage and/or dual speed motors available.

Face mount is standard, but base mount is available in 47 Frame Size Motor and flange mount is available in 59 Frame Size Motor.

Available for single-phase use in 2, 4, 6, 8, and 12-pole speeds, and for three-phase use in the same speeds.

REQUEST DATA SHEET

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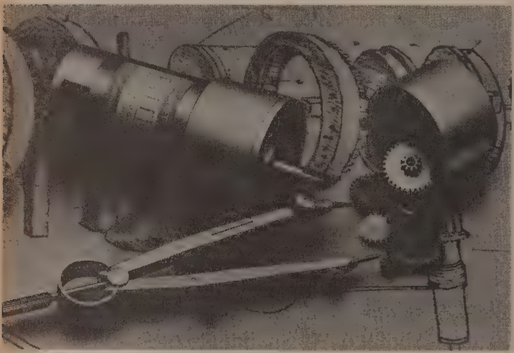
For cost effective solutions to your miniature D-C motor application problems...

Put Pittman's forty years of experience to work for you.

MOTORS: Three series of d-c motors having diameters of 1.27″, 1.63″ and 2.05″. Each in three lengths ranging upward from 2.2″ exclusive of shaft extension. Most models can be supplied for inputs from 6 to 48 VDC. Load speeds from under 1,000 rpm to approximately 10,000 rpm. Stall torques from under one oz.-in. to more than 70 oz.-in. Quality materials and construction ensure high performance and durability at moderate cost. All motors available with your choice of self-aligning oil-impregnated bronze bearings or double-shielded ball bearings. Custom modifications possible in production quantities.

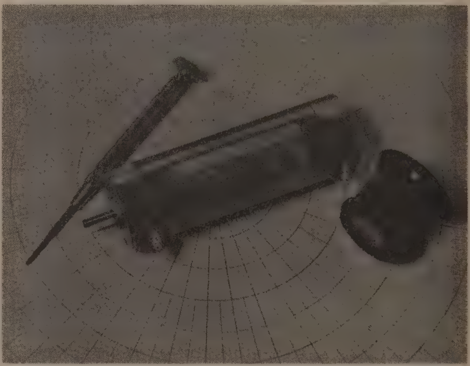
LO-COG® servo motors are built in three series identical externally to the motors described above plus a fourth series 1.18″ in diameter exclusive of terminal block. These LO-COG motors offer exceptionally low magnetic cogging yet provide the desirable thermal characteristics and high torques of iron armature designs.



GEARMOTORS: PITMO® gearmotors have a gearbox diameter of 1.375″ with lengths from 2.99″ to 3.39″ excluding output shaft extension and pilot boss. Gears are sintered iron to precision tolerances. Selected armature windings and gear ratios provide shaft speeds under load from approximately 5 rpm to 650 rpm. Torque limit on the gearbox is 250 oz.-in. Motor sections feature LO-COG construction as described above under "MOTORS".

MOTOR TACHOMETERS: Units in the current series of PITMO motor-tachs have a diameter of 1.18″ exclusive of terminal blocks. Their length is 3.66″ exclusive of shaft extension and pilot boss. Separate motor and tachometer-generator armatures are mounted on a single shaft and operate within two different field magnet systems. Standard 12-volt unit provides stall torque of 3.6 oz.-in. and No-load speed of 4,100 rpm. Tachometer gradient is two volts per 1,000 rpm with typical ripple of 6% peak-to-peak with no filtering. Other windings are available for both motor and tach.

Typical applications include digital tape cassette drives, chart and pen drives, and other velocity or position servo systems where accuracy of speed control or high damping is a requirement.



For specifications, performance curves and prices for models of PITMO miniature d-c motors to meet your needs, call or write us today. 112

PITMO ®

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MODEL GM 9213

PERMANENT MAGNET D-C
SERVO GEARMOTOR

THE PITTMAN CORPORATION
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SELLERSVILLE, PENNSYLVANIA 18960
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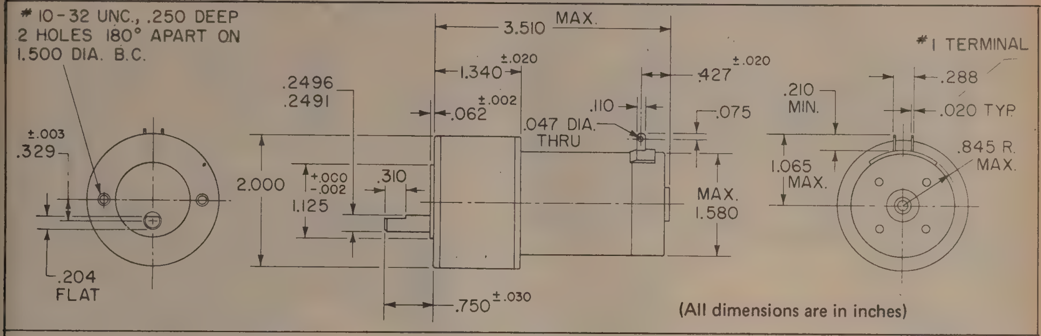
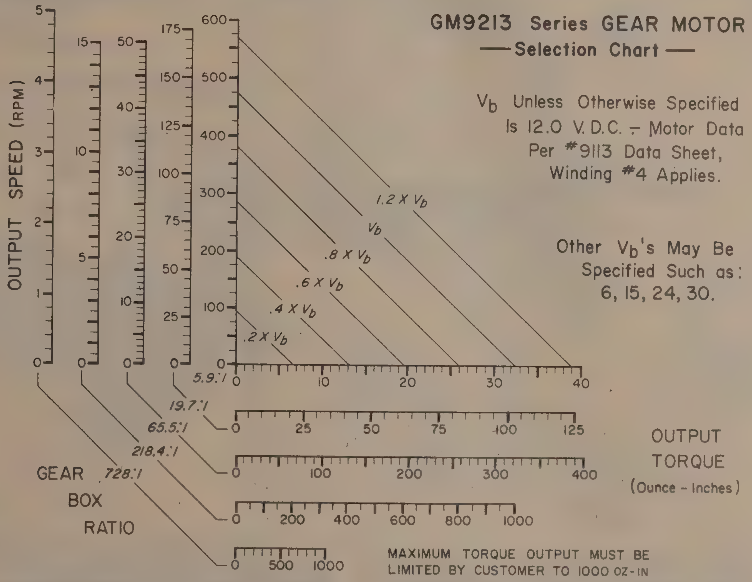


# 10-32 UNC., .250 DEEP
2 HOLES 180° APART ON
1.500 DIA. B.C.
±.003
.329
.204
FLAT
.2496
.2491
2.000
+.000
-.002
1.125
.310
3.510 MAX.
±.020
1.340
±.002
.062
.110
.047 DIA.
THRU
±.020
.427
.075
MAX.
1.580
.750 ±.030
# 1 TERMINAL
.210
MIN.
.288
.020 TYP.
1.065
MAX.
.845 R.
MAX.

(All dimensions are in inches)



GM9213 Series GEAR MOTOR
— Selection Chart —

V_b Unless Otherwise Specified Is 12.0 V. D.C. – Motor Data Per #9113 Data Sheet, Winding #4 Applies.

Other V_b's May Be Specified Such as: 6, 15, 24, 30.

MAXIMUM TORQUE OUTPUT MUST BE LIMITED BY CUSTOMER TO 1000 OZ-IN

MODEL NUMBER	GEAR RATIO	ROTATION SEE NOTE 1
GM9213 - 1	5.9 : 1	CW
GM9213 - 2	19.7 : 1	CCW
GM9213 - 3	65.5 : 1	CW
GM9213 - 4	218.4 : 1	CCW
GM9213 - 5	728 : 1	CW

NOTES:

1. **A positive voltage applied to the #1 terminal gives rotation per the table when viewed from the shaft output end.**
2. **Motor electrical and mechanical data per 9113 or 9213 series data sheet winding #4. Other windings are available for varying speed and torque requirements.**

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SPECIAL DESIGN FEATURES AVAILABLE . . .
- CHOICE OF OPERATING VOLTAGES
- POLY-PHASE DESIGN
- VARIABLE FREQUENCIES

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ROTATING COMPONENTS

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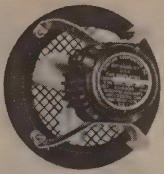
THE SOURCE FOR THE BROADEST VARIETY OF ROTATING COMPONENTS FOR THE MILITARY AND INDUSTRIAL ELECTRONICS INDUSTRY

- SYNCHRONOUS MOTORS
- INDUCTION MOTORS
- PM GENERATORS
- BRUSHLESS DC MOTORS
- SERVO MOTORS
- GEAR MOTORS
- TACHOMETER GENERATORS
- DRAG CUP MOTORS
- INDUCTION GENERATORS
- FANS
- BLOWERS

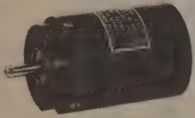
FANS



- 50/60 Hz
- 400 Hz
- 1 or 3 Phase

- 115-208 Volts
- 3300-11,000 RPM
- 40-1000 CFM

INDUCTION DRIVE MOTORS



Powerful • Rugged • Extremely Reliable • Versatile in Application

Frequencies:	50-60-400 cps • Variable Frequency • Dual Frequency
Speeds:	450 thru 22,000 rpm • 1-2-3 Speeds
Horsepower:	1/2000 to ¼ H.P.
Voltages:	To 440V AC • Single or Dual Voltages
Phases:	1-2-3 • Reversible or Unidirectional
Bearings:	Precision Life Lubricated Ball Bearings
Mounting:	Face, Base, Flange, Servo
MIL SPECS:	Exceed MIL-M-7969, MIL-M-17059, MIL-M-13787, MIL-E-16400, MIL-E-5400, MIL-E-5272, MIL-STD-202 Also for quality commercial applications
Life:	In excess of 10,000 hours in many designs
Gearheads:	Available with all models Hundreds of models available

BRUSHLESS DC MOTORS

- IMPROVE YOUR PRODUCT
- REPLACE BRUSH TYPE MOTORS, FANS, BLOWERS.

OPERATE FROM DC POWER SOURCES • SOLAR CELLS.

LIFE — extremely long — no brushes to replace — no brush dust.

SAFER — no sparking in explosive atmosphere.

RFI — minimal.

MIL SPEC APPROVED for severe environments.

SPEEDS — wide selection as required.

QUIET — no brush noise.

EFFICIENT — low input power.

SUPERIOR at high altitudes.

USES — Aircraft — Submarines — Spacecraft — Ground Equipment — Any Electronic Equipment.

RCI PRODUCTION MODELS QUICKLY AVAILABLE — SEND FOR DATA

GEAR MOTORS

R.C. offers a wide range of integral motor-gearhead combinations with synchronous and induction motors as well as Servo motors in all R.C.I. frame sizes including 8, 10, 11, 15, 18, on up to 3⅞ O.D.

- Precision engineered for long life.
- Torque up to 4000 in oz.
- All Ratios.
- Backlash: 30 minutes maximum.
- Temperature Range: —55°C to + 150°C.
- Lubrication: MIL-L-6085, MIL-G-3278.
- Environmental Testing: MIL-E-5272.
- Mechanical slip clutch available on request.
- Ball bearings are stainless steel ABEC 5 or better as reqd.
- All gears precision class 2 or better per AGMA 236.04

BLOWERS

- Single
- Double
- 115-208 Volts

- 50-60 Hz
- 400 Hz
- 1 or 3 Phase

Be selective turn to *SERVO-TEK*

for superior quality products produced by efficient, modern manufacturing techniques. These products — Bi-Mode Servos, Control Meter Relay Systems, Adjustable-Speed Drives, Permanent-Magnet Servomotors, Speed Indicating Systems and Tachometer Generators — are products of proven design versatility and reliability. Turn to us for advice on your design problems and information on standard unit modifications too! Be selective.

FREE CATALOG of rotating components available.

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SERVO-TEK
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Servo-Tek is located in suburban Hawthorne, New Jersey where the firm was founded in 1945. Modern facilities house all company operations: Administrative, Sales, Research and Development, Design, Engineering, Production and Shipping. Just 30 minutes from New York City the plant, which ships its products to major industrial concerns in all 50 states and to companies in most of the Free World, is conveniently close to world-wide land, sea and air transportation routes.

Servo-Tek, by combining innovative engineering programs with highly efficient methods of production, manufactures items of matchless quality at truly economical prices. In 1958, Servo-Tek introduced a line of tachometer generators with a guaranteed brush life of 100,000 hours, and in 1963 temperature compensation was introduced. Today, under the guiding hand of its president, Helen N. Wilkins, Servo-Tek also offers a complete line of miniature motors, adjustable-speed drives, bimode servos, speed indicating systems and a series of low ripple generators. Indicative of the versatility of these products is the fact that some are used in computers, satellites and other space projects, while others are used on heavy machine tools and in the wheels of commercial and military aircraft. Still others are used in delicate pumps that replace the human heart during surgery and in complicated equipment associated with medical research.

Servo-Tek's enviable reputation is founded upon superior quality and in years of specialization in the advancement of state-of-the-art techniques combined with rigid quality control.
With the nation's top industrial and commercial manufacturers among its extensive list of repeat customers, Servo-Tek takes pride in its position as a leader in the field of instrument-type dc generators and servomotors.

Servo-Tek maintains a sales office in Van Nuys, California, and has several sales agents representing the company throughout the United States and Western Europe.

SERVO-TEK Just what you've been looking for...

In Speed Measurement and Control

Proven Performance, Reliability and Ease of Maintenance for the Most Demanding Industrial Applications

Solid-State "500" Series Precision Adjustable-Speed Drives*

All Motors Totally Enclosed, Fan-Cooled

MAINTENANCE — Design eliminates vacuum tubes, selenium rectifiers and time delays. Utilizes silicon diodes, transistors and a magnetic amplifier for exceptionally long service life. Modular plug-in construction requires only a screwdriver for servicing.
REMOTE CONTROL — A 10-turn potentiometer provides precise adjustment and can be placed in any convenient location. Meter monitors operation and continuously indicates speed.
GEARED MOTORS — Motors are available with integral gear reducers.
BRAKE-REVERSING — Relay-controlled braking and reversing models available.
SPEED RANGE — Infinitely adjustable from less than 24 rpm to 3600 rpm (150:1) while delivering full-rated torque. Continuous duty rating at all speeds.
REGULATION — Temperature-compensated tachometer feed-back provides both line and load regulation of better than 1/3 of 1% of rated speed.

Models available from 1/8 to 1½ hp

D-C Permanent-Magnet Tachometer Generators

Temperature-Compensated

Applications
SERVOS — The highly linear output and wide speed range are ideal for velocity or integrating servos. Low-driving torque permits its use as a damping or rate signal in all types of servos.
TEMPERATURE-COMPENSATED — The voltage output @ +25°C will not deviate from this amount by more than 1/100 of 1% per degree of change when operated at any temperature within the temperature range of −20°C to +75°C.
SIZE — Miniature. Approx. Dia. 1⅛".
OUTPUT — Various models with outputs as high as 45v/1000 rpm.
LINEARITY — On most models from 0 to 12,000 rpm is better than 1/10 of 1% of voltage output at 3600 rpm.
BRUSH LIFE — Better than 100,000 hours (10 years) of continuous operation at 3600 rpm.
BIDIRECTIONAL OPERATION — Output in either direction is held to ¼ of 1% tolerance.
RIPPLE — The rms value will not exceed 3% of the d-c value at any speed in excess of 40 rpm.
CONSTRUCTION — Aluminum housings with protective treatment; stainless steel shafts; fully shielded stainless steel ball bearings; Mylar insulation.
Consult our Engineering Department for information on our low ripple generators.

Bi-Mode Servo

A device which is so versatile it can be programmed to operate as either a bi-directional speed regulator or positioning servo. A d-c permanent magnet servo motor and temperature compensated d-c generator (torque unit) designed for maximum reliability provide control to the driven load. An integrated operational amplifier with external gain adjustment coupled with a high efficiency booster provide high follow-up accuracy and excellent dynamic response under various load conditions. A highly regulated temperature compensated reference supply insures stable operation with variations in ambient temperature, line voltage and time.

Features

Adjustable, stepless bi-directional speed control — Dynamic speed range in excess of 2000:1 — High accuracy maintained with load, line voltage and temperature variation — Adjustable output torque control — Controlled deceleration capability — Remote programming capability — Easy conversion from one mode to the other.

D-C Permanent-Magnet Servo Motors

Model SU-680D-29 Delivers 13.3 Watts of Continuous Power Output at 9000 rpm

Applications
Chart Recorder Pen Drives, Null-seeking Devices, Capstan Drives for Tape Transports, Proportioning Applications, Prime Mover in Servo-Mechanisms.

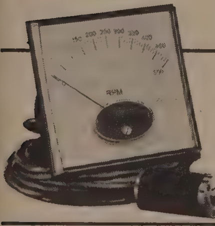
Specifications

DYNAMIC: Maximum No-Load Speed @ 23v D-C — 10,000 rpm; ±500 rpm; Full Load Torque @ 9,000 rpm — 2.0 oz-in (max.); Stall Torque @ 23v D-C (Theo.) — 20.0 oz-in (min.); Frictional Torque — 0.25 oz-in (max.); Acceleration at Stall (Torque/Inertia) — 46,800 RAD/SEC² (min.); Case Temperature Rise @ Full Load (Free Air Dissipation) −55°C (max.); Case Temperature Rise Per Watt of I²R loss (Free Air Dissipation) −6°C.

STATIC: D-C Resistance — 3.24 Ohms (typ.); Inductance — 2.5 Millihenry (typ.); Rotor Inertia — 30.0 GM-CM² (typ.); Total Weight — 8.25 oz. (max.); Length — 3.25 in., excluding shaft; Maximum Ambient Temp. −40°C.

FUNCTIONAL CONSTANTS: Inertial Time Constant — 25.0 Milliseconds (max.); Electrical Time Constant — 0.77 Milliseconds (typ.); Torque Constant — 2.8 oz-in/Amp. (min.); Voltage Constant (back emf) — 2.07 x 10^{-3} volts/rpm (min.); Viscous Damping Factor — 1.79 x 10^{-3} oz-in/rpm (min.).

Other Models Available



Accurate Speed Indicating Systems

A truly versatile "package" provides accurate speed indication for almost anything that moves. Nearly every industrial process or machine can benefit by the economy and safety of continuous speed indication.
SELF POWERED — No batteries or external power required.
LOW VOLTAGE — Connecting cable can be as long as 500 ft.
PERMANENTLY LUBRICATED BALL BEARINGS.
EASILY READ 4½" INDICATOR.
TAUT BAND MOVEMENT — Withstands vibration and shock.
STANDARD RANGES — 0 to 100, 250, 500, 1000, 2000, 3000, 4000, 6000, 8000, 10,000 and 12,000 rpm. These speeds can also be provided to read "Percent of Full Speed" or "Percent of Capacity."
0 to 10 rpm available at small additional cost.
Complete System includes Generator, Indicator (specify range), Mounting Base, Coupling and 15 ft. of Connecting Cable.

Control Meter Relay Systems

A speed monitoring system using an optically controlled meter relay and a d-c tachometer generator. Ideal for use in process and control applications requiring under and over speed limit control while continuously monitoring speed settings and changes. Also can be used to directly control power to motors, alarms, solenoids, etc. without the use of power controls. Both single and double set-point systems are available from 10 to 12,000 rpm full scale. System accuracy is 2% of full scale including indication and set-point accuracy. The set-point repeatability is 0.5% Input power requirement is 3 watts at 105 to 130 volts AC 60 Hz.

***An additional discount is available to resale organizations and original equipment manufacturers using these drives as an integral part of their product.**
Prices subject to change without notice.

Write for our RC200 Catalog and Tachometer Test Report

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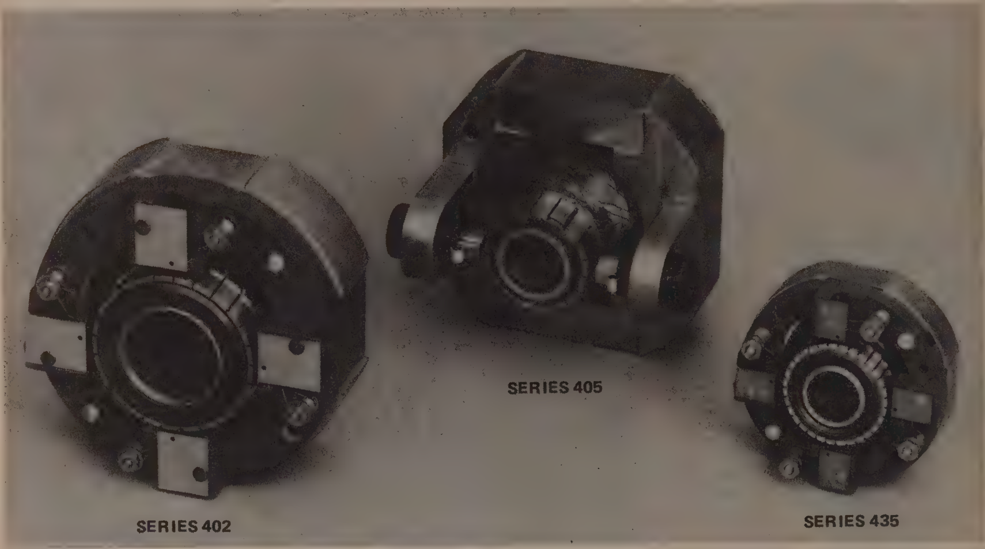
Sierracin/Magnedyne

5580 El Camino Real, Carlsbad, Calif. 92008 • (714) 729-7191

DC TACHOMETER GENERATORS



The D C tachometer generator is a servo control device which converts mechanical rotation into an electrical signal. Attached directly to the driving shaft, eliminating the need for gearing, the tachometer functions as a rate reference in rate servo systems and for velocity damping in position servo systems. The high voltage gradient available from these tachometers significantly reduces signal to noise and drift problems and allows higher gain systems providing more precise servo control. The extremely low ripple and high linearity of Sierracin/Magnedyne tachometers have made them the standard of the industry for machine tool control. Frameless units, requiring very little space, offer great flexibility and adaptability in application. Housed models, as well as housed D C torque motor/tachometer combinations coupled on a common shaft are also available.

The illustrated models, which are shown approximately full size, are representative commercial/industrial, unhoused tachometers. From left to right, the 402 Series is available with average to peak ripple of less than 2% linearity of less than .5% and a wide range of voltage gradients.

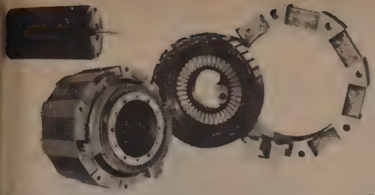
The center illustration, Series 405, is a recently developed 2-pole tachometer intended for low-cost, high volume commercial applications. Performance data is available in response to your specification requirements.

The 2" O.D. 435 Series is a high performance unit with average to peak ripple of less than 2% and output of .1 volts/rad/sec. All the above models are supplied with cartridge type brushes for long life and with air stabilized permanent magnet field which minimizes assembly and disassembly problems.

Larger sizes, up to 9.37" O.D., with reduced ripple are available for precision applications. Special encapsulated designs to full MIL-SPEC requirements are available in equivalent O.D.'s but with reduced axial length resulting in lighter weight units for aerospace applications.

The basic simplicity of our designs and our production experience have put Sierracin/Magnedyne tachometers in major defense programs, in addition to the many industrial and process control applications.

Please write or call with your specific requirements.



Sierracin/Magnedyne

DC TORQUE MOTORS

for accurate, high torque positioning and speed control

2 types to choose from

Standard – Low cost units. Reliable varnished construction. Axially displaced commutator for easy installation. Cartridge-type brushes.

High-Performance – High torque in smaller, lighter motors. Special encapsulated, wrap-around commutator construction.

Advantages

High Efficiency – High energy, permanent magnets in a unique field structure and an efficient, multi-pole armature produce high torque-to-power and torque-to-weight ratios.

Torque Applied Directly To Load – Wrap-around rotor mounts directly to, or around shafts; eliminates gear trains and backlash problems.

Housed or frameless models available for integration into customer's equipment.

Top source for big thin-ring motors

DC torquer up to 58" OD, 45" ID. Rated to 3000 ft-lbs.

Wide Application

- Position and velocity servo systems
- Antenna drives
- Missile and aircraft flight control actuators
- Memory drives
- Rate-of-turn tables
- Inertial navigation platforms
- Control moment gyros
- Rocket motor thrust vectoring systems
- Precision tape recorders
- Film drives
- Machine tool controls
- Throttle control actuators
- Linear and rotary servo actuators

Low Inertia Motors

For computer tape drives, high-speed printers, wherever high acceleration, low torsional resonance required. Intermediate and high performance models.

DC tachometers for every job

Extra low ripple, high-output tachs from 2" OD to 9.375" OD for big precision jobs. Low-cost units for machine tool control.

DC TORQUE MOTORS – VARNISHED

MODEL	Peak Torque (oz.-in.)	Power @ Peak Torque (watts)	No-Load Speed (rad./sec.)	OD (in.)	ID (in.)	Width (in.)	Weight (oz.)	Inertia (oz-in-sec^2)
443-11	30	80	360	1.937	.500	1.500	5.5	.0015
443-12	60	110	245	1.937	.500	1.875	9.2	.0025
443-13	90	145	215	1.937	.500	2.250	13.0	.0035
443-14	120	170	190	1.937	.500	2.625	16.5	.0045
402-06	100	92	125	3.070	.427	1.750	25	.011
402-05	200	125	84	3.070	.427	2.450	45	.02
402-14	300	155	69	3.070	.427	3.150	65	.029
402-15	400	190	64	3.070	.427	3.850	85	.038
	(lb.-ft.)	(watts)	(rad./sec.)	(in.)	(in.)	(in.)	(lb.)	(lb.-ft.-sec.^{2} x 10^3)
235-01	1	90	63	3.907	.875	1.680	1.65	.218
235-02	2	120	42	3.907	.875	2.245	3.1	.364
235-03	3	150	35	3.907	.875	2.810	4.4	.51
235-04	4	180	31	3.907	.875	3.375	5.9	.665
235-05	5	210	29	3.907	.875	3.940	6.9	.8
235-06	6	240	28	3.907	.875	4.505	8.6	.95
409-01	8	165	15	7.90	3.50	3.06	14.5	.009
409-02	16	220	10	7.90	3.50	4.06	24.0	.013
409-03	24	275	8.3	7.90	3.50	5.06	34.0	.018
409-04	32	320	7.3	7.90	3.50	6.06	44.0	.023
223-01	13	250	14	9.37	5.13	2.937	18.5	.022
223-02	26	315	8.9	9.37	5.13	3.937	30	.032
223-03	39	380	7.1	9.37	5.13	4.937	43	.042
223-04	52	450	6.4	9.37	5.13	6.375	55	.054
229-01	25	255	7.5	12.4	8.0	2.937	26	.066
229-02	50	340	5.1	12.4	8.0	3.937	42.5	.11
229-03	75	420	4.1	12.4	8.0	4.937	60	.15
229-04	100	500	3.7	12.4	8.0	6.375	78	.20
230-01	40	310	5.7	18.75	8.0	3.00	45	.095
230-02	80	405	3.7	18.75	8.0	4.00	71	.165
230-03	120	500	3.1	18.75	8.0	5.00	98	.24
230-04	160	590	2.7	18.75	8.0	6.00	123	.31
232-01	75	390	3.8	23.75	13.0	3.00	60	.31
232-02	150	500	2.5	23.75	13.0	4.00	95	.52
232-03	225	610	2.0	23.75	13.0	5.00	130	.72
232-04	300	720	1.8	23.75	13.0	6.00	165	.93
236-02	215	600	2.1	28.5	17.0	4.50	130	1.25
236-04	430	870	1.5	28.5	17.0	6.50	225	2.2
236-06	645	1125	1.3	28.5	17.0	8.50	315	2.85
240-02	310	645	1.5	33.6	21.5	4.50	170	2.6
240-04	620	940	1.1	33.6	21.5	6.50	290	4.4
240-06	930	1220	.97	33.6	21.5	8.50	400	5.8
244-02	450	800	1.3	40.6	27.6	4.50	220	5.8
244-04	900	1170	.96	40.6	27.6	6.50	380	9.5
244-06	1350	1500	.82	40.6	27.6	8.50	530	13
248-02	680	940	1.0	49.4	35.2	4.50	300	13
248-04	1360	1370	.74	49.4	35.2	6.50	500	21
248-06	2040	1770	.64	49.4	35.2	8.50	700	29
252-02	1000	1100	.81	60	44.5	4.50	380	29
252-04	2000	1590	.58	60	44.5	6.50	650	46
252-06	3000	2070	.51	60	44.5	8.50	920	65

DC TORQUE MOTORS – ENCAPSULATED

MODEL	Peak Torque (oz.-in.)	Power @ Peak Torque (watts)	No-Load Speed (rad./sec.)	OD (in.)	ID (in.)	Width (in.)	Weight (oz.)	Inertia (oz.-in.-sec.^{2})
433-01	30	90	400	1.937	.940	.600	4.7	.0017
433-06	150	310	292	1.937	.940	1.960	16.0	.0051
443-21	30	80	360	1.937	.625	.63	6	.0012
443-22	60	110	245	1.937	.625	1.00	10	.002
443-23	90	145	215	1.937	.625	1.38	14	.003
443-24	120	170	190	1.937	.625	1.75	16	.004
431-01	75	80	145	2.875	1.000	.600	11.0	.011
450-01	96	20	29.3	4.300	2.675	.687	1.1	.059
451-01	173	36	29.3	4.500	2.675	.687	1.54	.077
	(lb.-ft.)	(watts)	(rad./sec.)	(in.)	(in.)	(in.)	(lb.)	(lb.-ft.-sec.^{2} x 10^3)
403-04	1.0	90	63	3.907	1.640	.920	1.6	.218
403-05	2.0	120	42	3.907	1.640	1.460	2.65	.364
403-06	3.0	150	35	3.907	1.640	1.990	3.7	.51
403-07	4.0	180	31	3.907	1.640	2.520	4.7	.665
412-01	1.45	110	48	4.500	2.240	.920	2.0	.55
412-02	2.9	145	36	4.500	2.240	1.460	3.4	.91
412-03	4.35	185	30	4.500	2.240	1.990	4.8	1.27
412-04	5.8	220	27	4.500	2.240	2.520	6.1	1.66
414-01	2.0	130	45	5.125	2.900	.920	2.5	.98
414-02	4.0	175	30	5.125	2.900	1.460	4.2	1.64
414-03	6.0	220	26	5.125	2.900	1.990	5.8	2.3
414-04	8.0	265	23	5.125	2.900	2.520	7.5	3.0
416-01	2.6	150	40	5.750	3.500	.920	3.0	1.76
416-02	5.25	200	26	5.750	3.500	1.460	5.0	2.95
416-03	7.9	250	22	5.750	3.500	1.990	6.9	4.14
416-04	10.5	305	20	5.750	3.500	2.520	8.9	5.5
418-01	3.35	165	34	6.380	4.110	.920	3.4	3.0
418-02	6.75	225	23	6.380	4.110	1.460	5.7	5.0
418-03	10.0	285	20	6.380	4.110	1.990	8.0	7.0
418-04	13.5	340	18	6.380	4.110	2.520	10.0	9.0
420-01	4.12	185	31	7.000	4.730	.920	3.8	4.8
420-02	8.25	250	21	7.000	4.730	1.460	6.4	8.0
420-03	12.4	315	18	7.000	4.730	1.990	9.1	11.2
420-04	16.5	380	16	7.000	4.730	2.520	11.7	14.6
422-01	5.1	205	28	7.630	5.360	.920	4.3	7.4
422-02	10.2	275	19	7.630	5.360	1.460	7.2	12.4
422-03	15.3	345	16	7.630	5.360	1.990	10.0	17.3
422-04	20.4	420	15	7.630	5.360	2.520	12.9	22.6
424-01	6.0	220	26	8.245	5.970	.920	4.7	10.9
424-02	12.0	300	18	8.245	5.970	1.460	7.8	18.2
424-03	18.0	380	15	8.245	5.970	1.990	10.9	25.5
424-04	24.0	455	13	8.245	5.970	2.520	14.0	33.2
426-01	7.2	240	23	8.860	6.590	.920	5.1	15.7
426-02	14.3	325	16	8.860	6.590	1.460	8.4	26.2
426-03	21.2	410	14	8.860	6.590	1.990	11.8	36.8
426-04	28.6	495	12	8.860	6.590	2.520	15.2	48.0
428-01	8.4	260	22	9.500	7.200	.920	5.5	21.8
428-02	16.7	350	15	9.500	7.200	1.460	9.0	36.4
428-03	25.0	440	12	9.500	7.200	1.990	12.7	51.0
428-04	33.4	530	11	9.500	7.200	2.520	16.3	66.5
444-01	42	435	7	12.040	10.050	2.000	13.75	50.0

TACHOMETERS

MODEL	Kg(volts/ rad./sec.)	Ripple % Avg. to Pk.	Max. Output Volts	OD (in.)	ID (in.)	Width (in.)	Weight (lb.)	Inertia (oz.-in.-sec.^{2})
402-49	.3	2.0	63	3.070	.625	1.75	1.44	.011
435-01	.1	1.0	78	2.000	.500	1.000	.44	.0012
256-01	4.0	1.0	100	4.950	1.375	2.000	4.9	.18
224-100	23.4	.1	200	9.375	5.000	2.937	15	4.2
443-05	.5	5.0	52	1.937	.625	.625	.34	.0012

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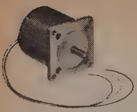
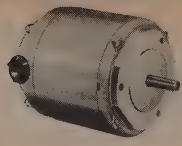

TYPE SS25

TYPES SS400 & SS402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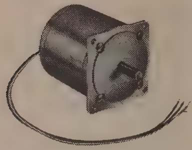
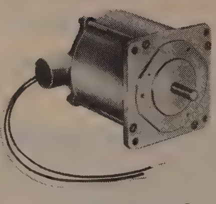
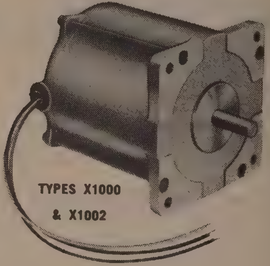

TYPES TS50 & TS52


TYPES X250 & X252


TYPES X1000 & X1002

AC OPERATION

Standard SLO-SYN Synchronous/Stepping Motors are permanent magnet a-c motors having extremely rapid starting, stopping and reversing characteristics and a slow basic shaft speed of 72 rpm synchronous with a line frequency of 60 hertz. Three-lead types need only a single-pole, three-position switch for complete forward, reverse and "off" control. No excessive inrush current when energized because starting and operating current are nearly identical. Can be completely stalled without overheating and with no harmful effects on components. Starts or stops in less than 5° of shaft rotation; no need for mechanical or electrical braking. When used with an auxiliary high speed motor, the SLO-SYN motor can remain coupled to the load and safely overdriven. Phase shifting resistor and capacitor must be used when operating from a single-phase source but not from two-phase. All standard motors are rated for continuous duty at maximum ambient temperature of 65 °C. All models have Class B insulation.

DC STEPPING

When used for phase switched d-c stepping, 28.8 rpm models take 500 steps per revolution, 72 rpm models take 200 steps per revolution and 200 rpm models take 72 steps per revolution. Accuracy of the steps is ±.09° noncumulative. Three-lead types require a center-tapped d-c supply and single-pole, double-throw switching. Four-lead types require a single-ended power supply and single-pole, double-throw switching. Bifilar models can be used with transistorized switching circuits. Models specifically designed for stepping offer the best characteristics for most applications.

PRECISION STEPPING

For phase switched d-c stepping. These motors make 200 steps per shaft revolution. Each 1.8° step is accurate within ±3% (.06°) noncumulative. With properly designed circuitry incorporating programmed acceleration and deceleration, precision stepping motors can be operated at rates to 5000 steps per second.

RATINGS AND SPECIFICATIONS FOR A-C APPLICATIONS

TYPE	MAXIMUM AMPERES	TORQUE (Oz-In)	MAXIMUM MOMENT OF INERTIA OF A RIGIDLY ATTACHED LOAD (Lb-In²)	PHASE-SHIFTING COMPONENTS*				APPROXIMATE MOTOR WEIGHT (POUNDS)	
				RESISTOR	RESISTOR PART NUMBER	CAPACITOR	CAPACITOR PART NUMBER	NET	SHIPPING
120 Volts, 50/60 hertz, 1 Phase, 28.8 RPM at 60 hertz									
LS50§	0.2	40	0.5	1000 ohm ±5%, 10 watt	R-SS52/LS50	1.5 mfd ±6%, 330 VAC	C-LS50	4¾	5¾
120 Volts, 50/60 hertz, 1 Phase, 200 RPM at 60 hertz									
TS25 §	0.2	25	0.12	200 ohm ±5%, 25 watt	R-TS25	1.75 mfd ±6%, 330 VAC	C-TS25	2	2½
TS50	0.3	50	0.25	300 ohm ±5%, 25 watt	R-TS50	3.75 mfd ±6%, 330 VAC	C-SS150/TS50	4¾	5¾
120 Volts, 50/60 hertz, 1 Phase, 72 RPM at 60 hertz									
SS25§	0.1	25	0.15	500 ohm ±5%, 5 watt	R-SS25	0.75 mfd ±6%, 330 VAC	C-SS25	1¼	1½
SS50§	0.3	50	0.5	400 ohm ±5%, 25 watt	R-SS50	2.25 mfd ±6%, 330 VAC	C-SS50	3	3½
SS50M†§	0.3	50	0.5	400 ohm ±5%, 25 watt	R-SS50M	2.25 mfd ±6%, 330 VAC	C-SS50M	3	3½
SS150	0.4	150	1.5	250 ohm ±5%, 25 watt	R-SS50X/150	3.75 mfd ±6%, 330 VAC	C-SS150/TS50	6½	8
SS150M†	0.4	150	1.5	250 ohm ±5%, 25 watt	R-SS150M	3.75 mfd ±6%, 330 VAC	C-SS150M	6½	8
SS250	0.6	250	3	150 ohm ±5%, 50 watt	R-SS250/400	6.5 mfd ±6%, 330 VAC	C-SS250/400	6½	8
SS250M†	0.6	250	3	150 ohm ±5%, 50 watt	R-SS250M	6.5 mfd ±6%, 330 VAC	C-SS250M	6½	8
X250‡	0.6	250	3	150 ohm ±5%, 50 watt	R-SS250/400	6.5 mfd ±6%, 330 VAC	C-SS250/400	7¾	9
SS400	0.6	400	4.5	150 ohm ±5%, 50 watt	R-SS250/400	6.5 mfd ±6%, 330 VAC	C-SS250/400	12¼	13¾
X1000‡	3.0	1000	9	65 ohm ±5%, 160 watt	R-X1000	30 mfd ±6%, 330 VAC	C-X1000/1500	31	33
X1500	3.0	1500	12	55 ohm ±5%, 375 watt	R-X1500	30 mfd ±6%, 330 VAC	C-X1000/1500	38	41
240 Volts, 50/60 hertz, 1 Phase, 200 RPM at 60 hertz									
TS52	0.2	50	0.25	1200 ohm ±5%, 25 watt	R-SS152/TS52	1.0 mfd ±6%, 660 VAC	C-SS152/TS52	4¾	5¾
240 Volts, 50/60 hertz, 1 Phase, 72 RPM at 60 hertz									
SS52	0.2	50	0.5	1000 ohm ±5%, 10 watt	R-SS52/LS50	0.67 mfd ±6%, 660 VAC	C-SS52	3	3½
SS152	0.2	150	1.5	1200 ohm ±5%, 25 watt	R-SS152/TS52	1.0 mfd ±6%, 660 VAC	C-SS152/TS52	6½	8
SS252	0.4	250	3	500 ohm ±5%, 50 watt	R-SS252/402	1.75 mfd ±6%, 660 VAC	C-SS252/402	6½	8
X252‡	0.4	250	3	500 ohm ±5%, 50 watt	R-SS252/402	1.75 mfd ±6%, 660 VAC	C-SS252/402	7¾	9
SS402	0.4	400	4.5	500 ohm ±5%, 50 watt	R-SS252/402	1.75 mfd ±6%, 660 VAC	C-SS252/402	12¼	13¾
X1002‡§	1.5	1000	9	250 ohm ±5%, 200 watt	R-X1002	8 mfd ±6%, 660 VAC	C-X1002	31	33

*External resistor and capacitor must be ordered separately. †Militarized. ‡Explosion-proof. §For 60 hertz. Other phase-shifting components required for 50 hertz.

THE SUPERIOR ELECTRIC COMPANY
1000 MIDDLE STREET • BRISTOL, CONN. 06010 • PHONE: (203) 582-9561

Synchronous / Stepping Motors FOR A-C CONSTANT SPEED • FOR D-C STEPPING

THREE-LEAD SLO-SYN SYNCHRONOUS/STEPPING MOTORS — RATINGS FOR STEPPING APPLICATIONS

MOTOR TYPE	TS25	TS50	TS52	SS25	SS50 SS50M	SS52	SS150 SS150M	SS152	SS250 SS250M X250	SS252 X252	SS400	SS402	X1000	X1002	X1500
D-C VOLTS	60	50	100	80	50	100	35	70	32	64	30	60	11.5	23	10
AMPERES PER WINDING	0.15	0.25	0.13	0.07	0.15	0.08	0.35	0.18	0.50	0.25	0.60	0.30	3.2	1.6	4

FOUR-LEAD SLO-SYN SYNCHRONOUS/STEPPING MOTORS RATINGS FOR STEPPING APPLICATIONS

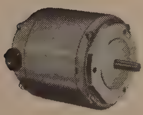
TYPES	D-C INPUT VOLTS PER WINDING	AMPERES PER WINDING
SS25-1014	16	0.35
SS25-1012	40	0.14
SS25-1013	80	0.07
SS50-1012	2.5	3.1
SS50-1011	10	0.75
SS50-1002	25	0.30
SS50-1014	50	0.15
SS150-1007	2	6.3
SS150-1018	7	1.75
SS150-1015	17.5	0.70
SS150-1025	35	0.35
SS250-1010	3	5.3
SS250-1009	8	2.0
SS250-1008	16	1.0
SS250-1007	32	0.50
SS400-1005	15	1.2
SS400-1007	30	0.6
X1000-1005	11.5	3.2
X1000-1008	23	1.6
SS1800-1004	9.5	4.7
SS1800-1005	19	2.4

SLO-SYN PRECISION STEPPING MOTORS RATINGS FOR DC STEPPING APPLICATIONS

TYPES	DC VOLTS	AMPERES PER WINDING
HS25	5.4	1.5
HS25B	4.5	1.75
HS25-1045	2	4.8
HS50	3	4
HS50L	4.5	3.5
HS55	2	5.4
HS55L	2	6.3

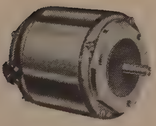
BIFILAR SLO-SYN SYNCHRONOUS/STEPPING MOTORS RATINGS FOR STEPPING APPLICATIONS

TYPE	D-C VOLTS	AMPERES PER WINDING
TS50-1001	3	4.0
SS25-1002	5.9	0.88
SS25-1001	11.8	0.44
SS25-1011	23.6	0.22
SS50-1010	2	3.3
SS50-1009	5.5	1.3
SS50-1008	8	0.85
SS50-1001	14	0.53
SS50-1007	35	0.21
SS150-1023	1.4	8.5
SS150-1009	2.5	4.0
SS150-1010	10	1.25
SS150-1017	25	0.5
SS250-1006	2.5	5.0
SS250-1027	4.6	3.1
SS250-1002	9	1.55
SS250-1004	22.5	0.61
X250-1003	4.6	3.1
X250-1002	9	1.55
SS400-1021	5.3	3.4
SS400-1002	8.3	2.2
SS400-1006	21.2	0.85
X1000-1002	10	3.6
X1000-1007	25.4	1.42
SS1800-1007	11.5	3.9
SS1800-1002	14.4	3.1
SS1800-1006	23	2.0



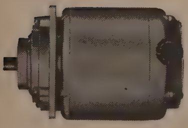
BIFILAR

Used for d-c stepping where use of push-pull circuitry and center-tapped power supply is not possible or where increased torque at high stepping speeds is required.



SPECIAL ENVIRONMENT

High Vacuum types for vacuums to 10^{-8} Torr; High Temperature types for temperatures to 130°C; High Radiation types withstand dosage of 3,000 megarads. All available from 50 to 1800 oz-in; High Vacuum 25 oz-in also.



PLANETARY GEAR

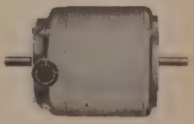
Basic 50 and 150 oz-in types and type X250 available with planetary gear assemblies in speeds of 16.6, 3.32, 0.665, 0.133 or 0.027 rpm; 16.6 rpm available in other 250 and on 400 oz-in types.

ENCODER

Consist of a precision stepping motor with an integrally mounted incremental photo encoder. The encoder outputs allow continuous monitoring of motor speed, position and direction of rotation.

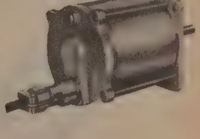
FOUR-LEAD

Designed for d-c stepping to provide the flexibility needed for use with equipment requiring isolated windings with no common connection.



DOUBLE END

Three-lead, bifilar and four-lead types with output shaft at each end of motor available in all listed torque ratings. 50, 150 and 250 oz-in types available also with planetary gear assemblies in 16.6, 3.32, 0.665, 0.133 or 0.027 rpm speeds.

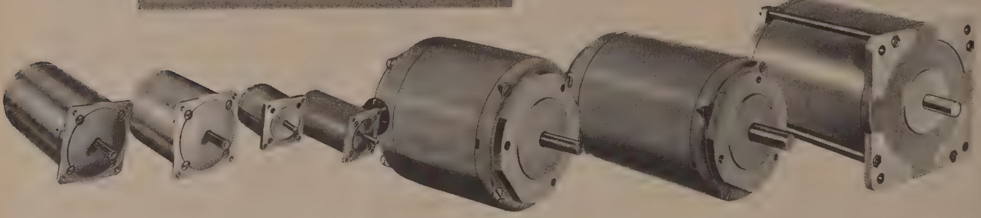


VISCOUS DAMPED

Type HS50D precision stepping motor has a unique fluid system resulting in a step function approaching critical damping. Speed of response and running characteristics are essentially unaffected by the silicone viscous damping fluid. Possesses characteristics of types described under PRECISION STEPPING on facing page.

M Series SLO-SYN® *Stepping Motors*

HIGHLIGHTS OF M SERIES SLO-SYN MOTORS
- Widest range of sizes and torque
- Highest torque to inertia ratios
- Faster single-step response
- High stepping rates
- Compact, space-saving design
- Proved reliability



The M Series SLO-SYN motors represent the most advanced permanent magnet stepping motor design available. They offer the most complete range, both in torque ratings and in size configuration. The motors provide the highest torque per pound and torque to inertia ratios and can be driven at rates above 10,000 steps per second with a minimum of power input. Standard drives are available for rates to 5000 steps per second. Drives for higher rates can be supplied on special order.

CONSTRUCTION

All M Series motors have permanent magnet rotors and eight-pole stators. They have no brushes, ratchets or detents and use shielded ball bearings to insure maximum reliability and long life.

TEMPERATURE

M Series motors have Class B insulation and may be operated at ambient temperatures from —40°C to +65°C. The continuous duty temperature rise is 65°C.

STEP ANGLE

Using a four-step input sequence, the stepping increment is 1.8° with a choice of +5% or precision +3% accuracies available as standard. An eight-step input sequence gives a stepping increment of 0.9°.

TORQUE

Standard types are offered in torque ratings from 35 to 840 ounce-inches.

RATINGS AND SPECIFICATIONS M SERIES SLO-SYN MOTORS‡

MOTOR TYPE	3% ACCURACY	M061-FC08	M061-FC02	M062-FC09	M062-FC04	M063-FC09	M063-FC06	M091-FC09	M091-FC06	M092-FC09	M093-FC11	M093-FC14				
	5% ACCURACY	M061-FD08	M061-FD02	M062-FD09	M062-FD04	M063-FD09	M063-FD06	M091-FD09	M091-FD06	M092-FD09	M093-FD11	M093-FD14	M111-FD12	M111-FD16	M112-FJ12	M112-FJ25
STEP ANGLE		1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1 8°
DC VOLTS		1.3	5.1	1.7	4.3	2.2	3.4	1.8	2.9	2.5	2.8	2.2	2.3	1.7	3.6	1.8
AMPERES PER WINDING		3.9	1.0	4.7	1.8	4.6	2.9	4.8	3.05	4.6	5.5	7.0	6.1	8.0	6 1	12.7
HOLDING TORQUE* (OZ-IN)		53	53	100	100	150	150	150	150	300	450	450	625	625	1125	1125
RESIDUAL TORQUE§ (OZ-IN)		5	5	8	8	10	10	5	5	10	15	15	1[illegible]	15	30	30
NUMBER OF LEADS OR TERMINALS		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
SHAFT DIAMETER (INCHES)		.250	.250	.250	.250	.250	.250	.375	.375	.375	.375	.375	.375	.375	.625	.625
APPROX. WEIGHT (LB)	NET	1¼	1¼	2	2	2¾	2¾	3¼	3¼	5½	7¾	7¾	8	8	14½	14½
	SHIPPING	1½	1½	2½	2½	3¼	3¼	4	4	6¾	9	9	9¼	9¼	16¼	16¼

* Both windings energized at rated current.
‡Ratings shown are typical values, not for specification.
§Approximate value with neither coil energized.

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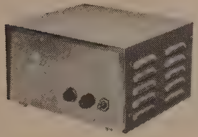
SLO-SYN® *Preset Indexers*

SINGLE-AXIS
TYPE SP1800B-5

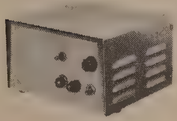
Used to control indexing of SLO-SYN bifilar motors. The index angle, or position, can be preset by dial setting on the control panel the number of steps to be driven. Have provision for actuating any external equipment needed to perform related operations. Index, jog and free run can be initiated manually from the control panel or from an external switch. Can be made to cycle automatically with proper external switching. Speed adjustable from 4 steps/second up to maximum possible with motor used. Optional backlash take-up circuit.

SLO-SYN® *Translator*


TYPE ST1800B

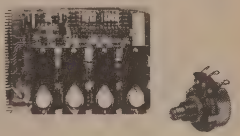
Pulse-to-step converter designed for use with appropriate bifilar SLO-SYN motors converted for incremental stepping. Convert low level signal pulses or square waves into the correct switching sequence needed to step a SLO-SYN motor. Input is 105-125 volts a-c, 1 ampere. Signal input impedance is 500 ohms. Used for programmed positioning, indexing and indicating operations.

SLO-SYN® *Adjustable Speed Drive*


TYPE ST1800BV

Essentially, SLO-SYN Adjustable Speed Drive type ST1800BV is a translator which includes a built-in oscillator to supply the triggering signals. Oscillator frequency can be adjusted to vary the speed from 4 steps/second up to the maximum permissible with the motor used. Direction of rotation can be controlled either from the front panel or from a remotely located switch.

SLO-SYN® *Translator Module*


TYPE STM1800CV

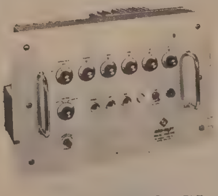
Plug-in printed circuit boards with logic capabilities for stepping SLO-SYN motors. Models offered for external triggering only or with built-in oscillator for either internal or external triggering. Models STM1800 and STM1800V drive bifilar SLO-SYN motors. Models STM1800C and STM1800CV drive bifilar and precision stepping motors and provide stepping rates to 2000 steps per second.

SLO-SYN® *High Speed Drives*

TRANSLATORS

Drive SLO-SYN Precision Stepping motors at rates to 5000 steps per second. An internal oscillator can be adjusted to any desired stepping rate and provides programmed acceleration and deceleration. Translators can also be triggered externally by pulses from tape readers, computers, oscillators, pulse generators and other signal producing equipment.

TYPE HTR105RT

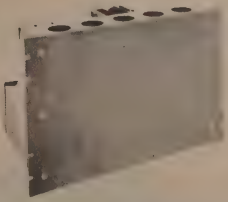

TYPE HPI 155T

PRESET INDEXERS

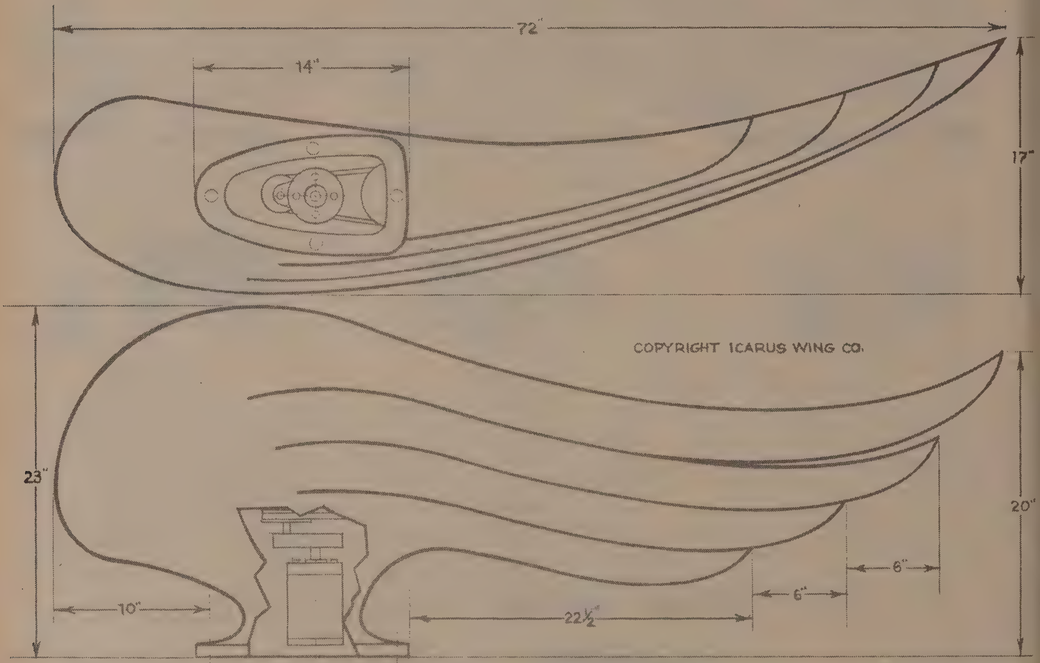
Drive SLO-SYN Precision Stepping Motors in indexing and other positioning operations. Acceleration and deceleration circuit rates to 5000 steps per second without missing steps. Can be controlled from the front panel or from a TTL compatible computer link. Backlash take-up circuit is optional.

BUFFERED TRANSLATORS

Drive SLO-SYN motors in response to commands from computers, digital controls and other devices which operate at fixed pulse rates. The translator stores the pulses and feeds them to the motor, automatically providing acceleration and deceleration at a rate compatible with the response characteristics of the motor. The motor is driven one step for each pulse received from the control unit at rates to 5000 steps per second. A built-in oscillator can also supply the triggering pulses.


TYPE BTR105RT

Your application really deserves a super-reliable mini motor, but the cost enrages the boss. Now what do you do?



Good time to call TRW/Globe. When your product can't afford to fail (like this design for the Icarus Wing Co.), we can supply precision miniature motors that will protect you and calm the boss.

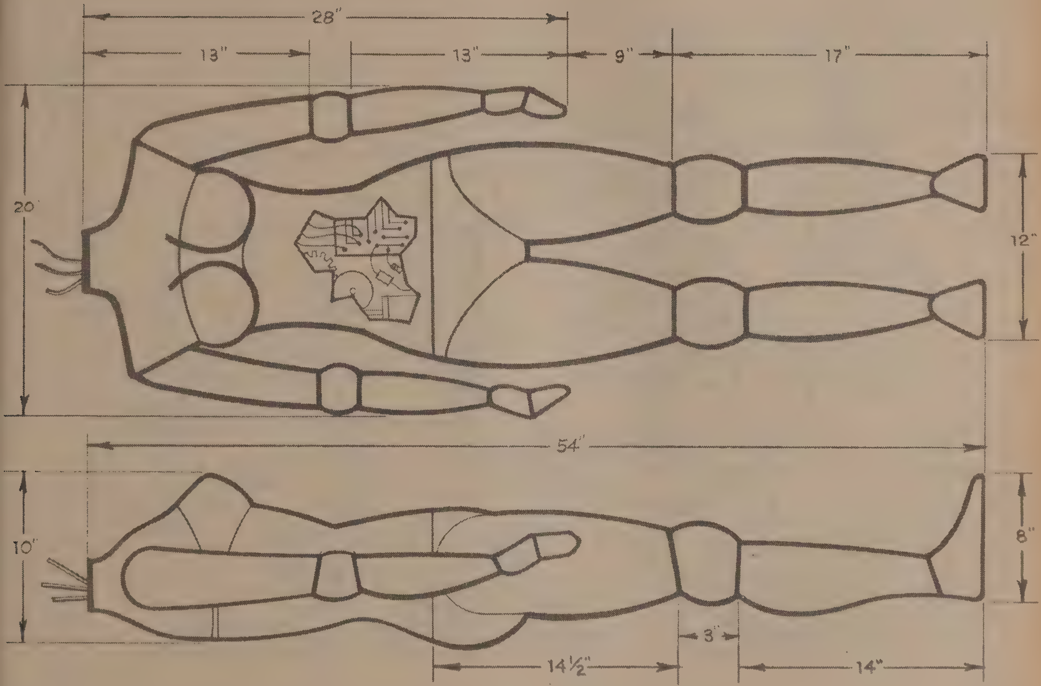
We learned about reliability the hard way, designing motors for military, aerospace, and nuclear applications.

Many commercial and industrial applications benefit from that "military" experience. They gain dependable performance, superior output per cubic inch, multiple functions in small "motion packages," and minimum interfacing, assembly, and inventory costs.

To learn more about protecting your product from failure, **write for our free booklet: "Protect Yourself."** TRW/Globe Motors, an Electronic Components Division of TRW Inc., Dayton, Ohio 45404 (513-228-3171).

TRW® GLOBE MOTORS

Your design was beautiful, but you got a hot mini motor and no space for cooling. Now what do you do?



Good time to call TRW/Globe. Chances are good we can rescue your dream design from the potential wastebasket.

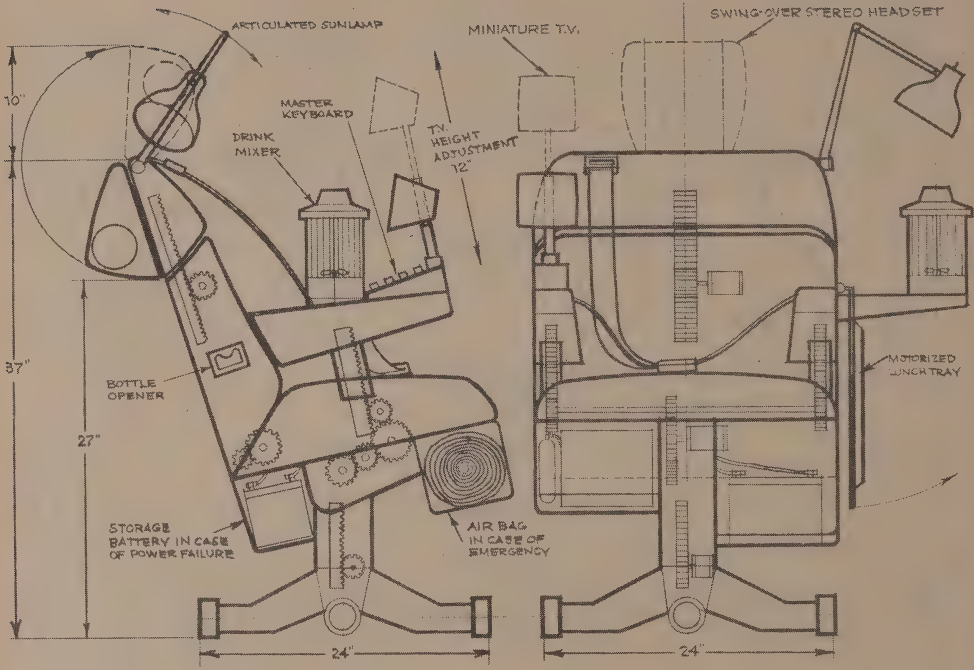
One of our precision miniature motors and blowers can probably fit the same shape with equal or better performance.

Designers constantly come to us with their occupational hazard: changing parameters. "Got to get more torque in the same space." "Now we need a limit switch and a brake." "Our service people want a motor they can forget." "Some dingaling forgot about this motor, so now it has to fit way back in there."

The ways we can help you cope with changing parameters are described in our **free booklet: "Quick-change Artists."** TRW/Globe Motors, an Electronic Components Division of TRW Inc., Dayton, Ohio 45404 (513-228-3171).

TRW GLOBE MOTORS

You tried a stock mini motor and added a bunch of detail parts, but it's a mess of assemblies. Now what do you do?


ARTICULATED SUNLAMP
MINIATURE T.V.
SWING-OVER STEREO HEADSET
MASTER KEYBOARD
DRINK MIXER
T.V. HEIGHT ADJUSTMENT 12"
10"
37"
27"
BOTTLE OPENER
MOTORIZED LUNCH TRAY
STORAGE BATTERY IN CASE OF POWER FAILURE
AIR BAG IN CASE OF EMERGENCY
24"
24"

Good time to call TRW/Globe. We can build a "motion package" that will cost less than your cheap motor with a lot of kluge hung onto it.

TRW/Globe motion packages combine multiple functions to save space, simplify purchasing, eliminate assembly and interfacing costs, and reduce inventory problems.

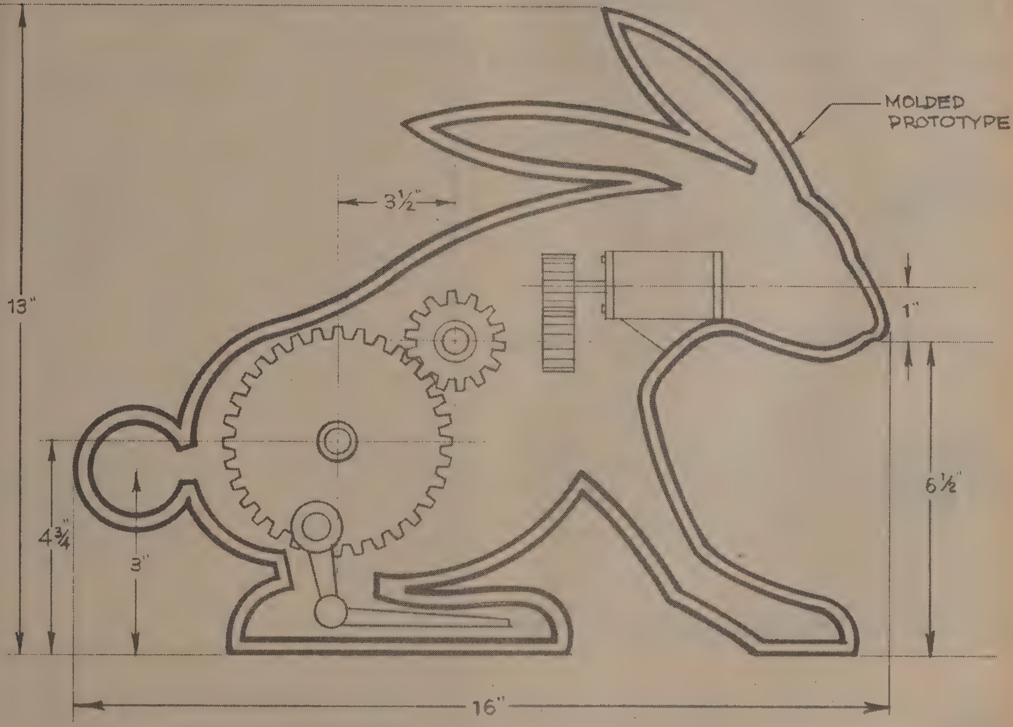
For example, a recent package combined motor, gearing, limit switch, mechanical stop, slip clutch, electro-mechanical brake, and filter in one complete unit measuring just a few cubic inches.

We're the largest builder of precision miniature motors that will do that for you.

For more information about our "motion packages" **write for our free booklet: "The Simplifiers".** TRW/Globe Motors, an Electronic Components Division of TRW Inc., Dayton, Ohio 45404 (513-228-3171).

TRW® GLOBE MOTORS

You need a prototype mini motor from a very fast guy who can make 200,000 when your design's final. Now what do you do?



Good time to call TRW/Globe. Our Small Order department is hopped up to build and deliver prototype precision miniature motors quick like a rabbit.

Then, when you're ready to multiply that prototype into thousands, we have 191,000 square feet of plant and equipment to handle volume production.

Our new plant in Dothan, Alabama, is designed and equipped specially for production runs of commercial and industrial precision miniature motors.

So whether you need one motor or a million, you'll find us the fastest thumpers in the briar patch.

For more information on this uncommon capability, **write for our free booklet: "The Multipliers."** TRW/Globe Motors, an Electronic Components Division of TRW Inc., Dayton, Ohio 45404 (513-228-3171)

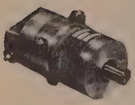
TRW® GLOBE MOTORS

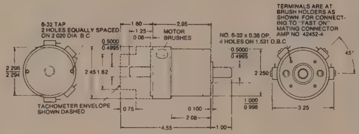
TORQUE SYSTEMS
INCORPORATED

Snapper Series Wide Bandwidth
DC SERVO MOTORS

The SNAPPER is a high performance permanent magnet field DC servo motor for use in both direct drive or geared servo systems. It is capable of high speed, low speed, control through zero speed, as well as plugging and operation at stall. The SNAPPER line is so named because of its very high torque capability in a totally enclosed, non ventilated frame. The excellent thermal capacity of the SNAPPER makes it possible to operate severe servo duty cycles without overheating. Its rotor construction is not subject to warpage, or to the extreme temperature cycles that plague designs of lesser thermal capacities and ruggedness.

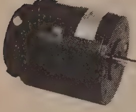
SPECIFICATIONS FOR FRAME SIZE 2212 (A) THRU (H)

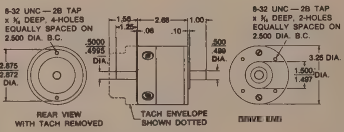



6-32 TAP
2 HOLES EQUALLY SPACED ON 2 020 DIA B C
2 296
2 294
1 60
1 25
0 06
2.95
MOTOR BRUSHES
0 5000
0 4995
2 45 1 62
TACHOMETER ENVELOPE SHOWN DASHED
0 75
0 100
2 08
4.55
1 00
NO. 6-32 x 0.38 DP. 4 HOLES ON 1.531 D.B.C
0.5000
0 4995
2 250
1 000
0 998
TERMINALS ARE AT BRUSH HOLDERS AS SHOWN FOR CONNECTING TO "FAST ON" MATING CONNECTOR AMP NO 42452-4
45°
3 25

SPECIFICATIONS	Peak Torque	Rated Torque	Rated Power	Inertia	Mech. Time Const.	Elec. Time Const.	Resistance @ 25°C	Torque Sensitivity	Back EMF
SYM	T_P	T_R		J_M	τ_M	τ_E	R_M	K_T	K_B
Units	oz-in	oz-in	HP	oz-in-sec^2 X 10^{-3}	milli-sec	milli-sec	ohms	oz-in-amp	volts-KRPM
A	70	20	1/20	4.4	26	0.58	5.0	11.2	8.3
B	70	20	1/20	4.4	26	0.58	12.1	18.2	13.8
C	70	20	1/20	4.4	26	0.58	7.7	14	10.3
D	70	20	1/20	4.4	26	0.58	3.1	8.9	6.6
E	70	20	1/20	4.4	26	0.58	19.3	22.4	16.6
F	70	20	1/20	4.4	26	0.58	1.92	7.0	5.2
G	70	20	1/20	4.4	26	0.58	1.20	5.6	4.1
H	70	20	1/20	4.4	26	0.58	0.77	4.4	3.2

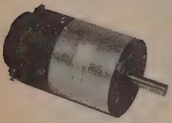
SPECIFICATIONS FOR FRAME SIZE 3210 (A) THRU (H)

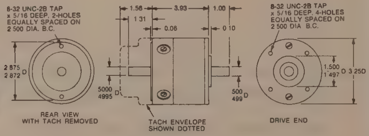



8-32 UNC — 2B TAP x ¼ DEEP, 4-HOLES EQUALLY SPACED ON 2.500 DIA. B.C.
2.875
2.872
DIA.
REAR VIEW WITH TACH REMOVED
.5000
.4995
DIA.
1.56
1.25
.06
2.68
.10
1.00
TACH ENVELOPE SHOWN DOTTED
.500
.499
DIA.
8-32 UNC — 2B TAP x ¼ DEEP, 2-HOLES EQUALLY SPACED ON 2.500 DIA. B.C.
3.25 DIA.
1.500
1.497
DIA.
DRIVE END

SPECIFICATIONS	Peak Torque	Rated Torque	Rated Power	Inertia	Mech. Time Const.	Elec. Time Const.	Resistance @ 25°C	Torque Sensitivity	Back EMF
A	100	30	1/20	3.8	9.6	0.34	4.5	16.0	11.9
B	100	30	1/20	3.8	9.6	0.34	11.0	26.0	19.3
C	100	30	1/20	3.8	9.6	0.34	7.0	20.0	15.0
D	100	30	1/20	3.8	9.6	0.34	2.8	12.7	9.4
E	100	30	1/20	3.8	9.6	0.34	17.5	32.0	23.7
F	100	30	1/20	3.8	9.6	0.34	1.75	10.0	7.4
G	100	30	1/20	3.8	9.6	0.34	1.1	8.0	5.9
H	100	30	1/20	3.8	9.6	0.34	.70	6.3	4.7

SPECIFICATIONS FOR FRAME SIZE 3220 (A) THRU (H)




8-32 UNC-2B TAP x 5/16 DEEP, 2-HOLES EQUALLY SPACED ON 2 500 DIA. B.C.
2 875
2 872
D
REAR VIEW WITH TACH REMOVED
1.56
1 31
3.93
0.06
0 10
1.00
5000
4995
D
TACH ENVELOPE SHOWN DOTTED
500
499
D
8-32 UNC-2B TAP x 5/16 DEEP, 4-HOLES EQUALLY SPACED ON 2 500 DIA B.C.
1.500
1 497
D 3 250
DRIVE END

SPECIFICATIONS	Peak Torque	Rated Torque	Rated Power	Inertia	Mech. Time Const.	Elec. Time Const.	Resistance @ 25°C	Torque Sensitivity	Back EMF
A	300	75	1/8	7.0	6.0	0.34	7.2	34	25.3
D	300	75	1/8	7.0	6.0	0.34	4.5	27	20
F	300	75	1/8	7.0	6.0	0.34	2.8	21	15.7
G	300	75	1/8	7.0	6.0	0.34	1.75	17	12.5
H	300	75	1/8	7.0	6.0	0.34	1.1	13.5	10

Motor/Tachometer/Encoders

Torque Systems Incorporated can provide an integral shaft encoder for each of its Snapper Series DC Servo Motors with or without integral DC tach generators. The available options for the encoder include:

- Any number of lines/revolution up to 1000
- Up to 3 tracks—2 signal (phase quadrature) plus marker pulse
- Sine wave or square wave TTL outputs

For assistance in ordering encoders with your motor or motor/tach, call or write the factory sales office.

LOW RIPPLE MATING DC TACHOMETERS are available for all SNAPPER Series Motors (see next page).

225 Crescent Street • Waltham, Massachusetts 02154 • (617) 891-0230

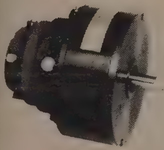
A Complete Line of Wide Bandwidth, DC Servo Components and Control Systems

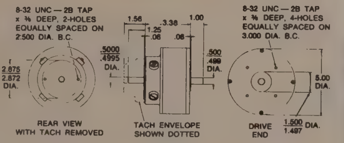
(described on these and following pages)

- **DC PM SERVO MOTORS (1/20-1/2 HP, TENV)**
- **50 OZ-IN TO 1600 OZ-IN, PEAK TORQUE**
- **LOW RIPPLE, MATING DC TACHOMETERS**
- **INTEGRALLY MOUNTED OPTICAL ENCODERS***
- **DOUBLE SHAFT EXTENSION ON MOTOR/ TACHOMETERS***

*OPTIONS on all motors

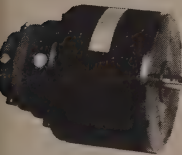
SPECIFICATIONS FOR FRAME SIZE 5010 (A) THRU (H)

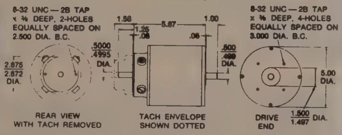



8-32 UNC — 2B TAP x ⅜ DEEP, 2-HOLES EQUALLY SPACED ON 2.500 DIA. B.C.
1.56
3.38
1.00
1.25
.06
.06
.5000 / .4995 DIA.
.500 / .499 DIA.
2.875 / 2.872 DIA.
8-32 UNC — 2B TAP x ⅜ DEEP, 4-HOLES EQUALLY SPACED ON 3.000 DIA. B.C.
5.00 DIA.
REAR VIEW WITH TACH REMOVED
TACH ENVELOPE SHOWN DOTTED
DRIVE END
1.500 / 1.497 DIA.

SPECIFICATIONS	Peak Torque	Rated Torque	Rated Power	Inertia	Mech. Time Const.	Elec. Time Const.	Resistance @ 25°C	Torque Sensitivity	Back EMF
SYM	T_P	T_R		J_M	τ_M	τ_E	R_M	K_T	K_B
Units	oz-in	oz-in	HP	oz-in-sec^2 X 10^{-3}	milli-sec	milli-sec	ohms	oz-in-amp	volts-KRPM
A	600	150	1/6	45	10.0	1.2	0.63	20.0	14.8
B	600	150	1/6	45	10.0	1.2	6.4	62.0	46.0
C	600	150	1/6	45	10.0	1.2	2.5	40.0	29.5
D	600	150	1/6	45	10.0	1.2	0.25	12.8	9.5
E	600	150	1/6	45	10.0	1.2	4.0	50.0	37.0
F	600	150	1/6	45	10.0	1.2	1.57	32.0	23.7
G	600	150	1/6	45	10.0	1.2	1.0	25.0	18.5
H	600	150	1/6	45	10.0	1.2	.40	16.0	11.8

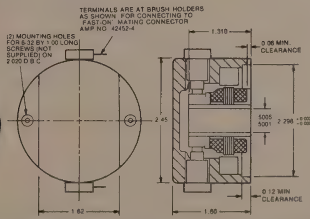
SPECIFICATIONS FOR FRAME SIZE 5030 (A) THRU (H)




8-32 UNC — 2B TAP x ⅜ DEEP, 2-HOLES EQUALLY SPACED ON 2.500 DIA. B.C.
1.56
5.87
1.00
1.25
.06
.06
.5000 / .4995 DIA.
.500 / .499 DIA.
2.875 / 2.872 DIA.
8-32 UNC — 2B TAP x ⅜ DEEP, 4-HOLES EQUALLY SPACED ON 3.000 DIA. B.C.
5.00 DIA.
REAR VIEW WITH TACH REMOVED
TACH ENVELOPE SHOWN DOTTED
DRIVE END
1.500 / 1.497 DIA.

SPECIFICATIONS	Peak Torque	Rated Torque	Rated Power	Inertia	Mech. Time Const.	Elec. Time Const.	Resistance @ 25°C	Torque Sensitivity	Back EMF
A	1600	400	1/2	120	10.0	1.6	0.70	36.0	26.0
C	1600	400	1/2	120	10.0	1.6	1.1	44.0	33.0
D	1600	400	1/2	120	10.0	1.6	1.75	56.0	41.0
E	1600	400	1/2	120	10.0	1.6	0.45	28.0	21.0
F	1600	400	1/2	120	10.0	1.6	0.30	22.0	16.4
G	1600	400	1/2	120	10.0	1.6	0.08	17.5	13.0
H	1600	400	1/2	120	10.0	1.6	0.12	13.7	10.0

DC Tachometer Kits


TERMINALS ARE AT BRUSH HOLDERS AS SHOWN FOR CONNECTING TO 'FAST-ON' MATING CONNECTOR AMP NO 42452-4
(2) MOUNTING HOLES FOR 6-32 BY 1.00 LONG SCREWS (NOT SUPPLIED) ON 2.020 D B C
1.310
0.06 MIN. CLEARANCE
2.45
5005 / 5001
2.296 +0.002 / −0.000
0.12 MIN CLEARANCE
1.62
1.60

Specifications TX-2402-001 (E) thru (G)	E	F	G
Output Voltage (volts/1000 rpm)	3	7	15
Armature DC Resistance (ohms)	45	100	450
Voltage Ripple (max. dev. from avg. with 10 KHz filter)	±1%	±1%	±1%
Ripple Frequency (cycles/ revolution)	21	21	21
Output Voltage Linearity (referenced to 3600 rpm)	±0.05%	±0.05%	±0.05%
Reversibility Error (% of nominal output)	0.25%	0.25%	0.25%
Temperature Coefficient (nominal)	−0.016%/°C	−0.016%/°C	−0.016%/°C
Inertia, oz. in. sec.^{2}	.001	.001	.001

FRAMELESS (unhoused) DC SERVO MOTORS (Model 9800 Series) are also available in three standard sizes with peak torque ratings from 25 to 100 ft/lbs. Designed for direct mounting on the load shaft, they have excellent acceleration and smooth running speed to make them suitable for antenna drives, gyro rate tables, machine tools, etc.

TORQUE SYSTEMS
INCORPORATED

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TORQUE SYSTEMS
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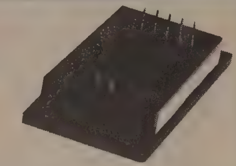
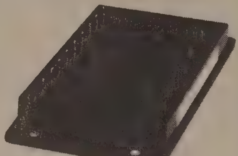
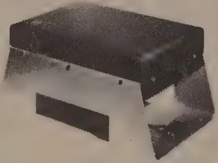
Snapper Series Wide Bandwidth
DC SERVO AMPLIFIERS

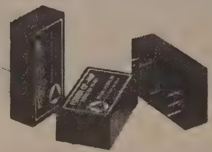
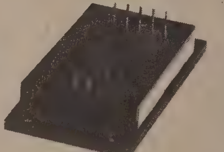
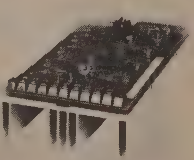
NOTE: Torque Systems offers a complete line of dual polarity power supplies.

These high performance amplifiers are all silicon transistor, linear, bi-directional class B, short-circuit protected and ruggedly built for tough environments. They are priced for high volume use. Detailed Application Notes on each model plus immediate quotations on special amplifiers are available on request.

BI-POLAR OUTPUT (REQUIRES SINGLE POLARITY POWER SUPPLY)

PACKAGE	SPECIFICATIONS	PRINCIPAL FEATURES
PA-122 Length 3.5 Width 1.8 Height 0.47 	Output Watts = 60 Output Volts = ±22 Output Amps = ±3 Internal Dissipation: Peak Watts = 60 Average Watts with 1.2°C per watt heat sink = 35 Response, Full Power = 20 KHz Voltage Gain = 25 v/v Power Supply Volts = +28	Bridge type amplifier designed for use with single polarity, +28 volts supply. Fast response power booster for IC Op-Amps. Mating Socket PC-120 for convenient location of input, balancing, and current limit adjust components. Use with heat sink HS-200 or equivalent.
PA-223 Length 4.7 Width 2.8 Height 0.62 	Output Watts = 110 Output Volts = ±22 Output Amps = ±5 Internal Dissipation: Peak Watts = 150 Average Watts with 0.12°C per watt heat sink = 130 Response, Full Power = 1.0 KHz Open Loop Gain = 100,000 v/v Power Supply Volts = + 28	Bridge type amplifier designed for use with single polarity power supply. Nominal supply volts = +28 only, and minus reference voltage is internally generated. Unit includes "inhibit" input for clamping output to zero volts. Use with heat sink HS-200 or equivalent. Mating socket is PC-220.
PA-301 Length 12.4 Width 7.7 Height 6.7 	Output Watts = 1000 Output Volts = ±25 Output Amps = ±40 Internal Dissipation: Peak Watts = 1400 Average Watts = 700 Response, Full Power = 1.5 KHz Open Loop Gain = 20 v/v Power Supply Volts = +35 Reference Supply Volts = −15 ±5	Designed as a power stage for severe average as well as good peak power, from a single power supply. Contains provisions for front end "plug ins" internally, and has its own heat sink and fan. Available at 40 volts output, and also with a pulse power capability to 2000 watts.

BI-POLAR OUTPUT (REQUIRES DUAL POLARITY POWER SUPPLY)

PA-011 Length 2.0 Width 1.1 Height 0.62 	Output Watts = 20 Output Volts = ±20 Output Amps = ±1 Internal Dissipation: Peak Watts = 20 Average Watts = 5 Response, Full Power = 5 KHz Open Loop Gain = 20,000 v/v Power Supply Volts = ±24	Designed for PC card mounting, for driving small servo motors, valves, solenoids, etc. Gain is sufficient for high performance applications. Feedback components for gain shaping to be mounted on same PC card. Unit is epoxy molded for maximum reliability. Mating socket is PC-1001.
PA-112 Length 3.5 Width 1.8 Height 0.47 	Output Watts = 60 Output Volts = ±20 Output Amps = ±3 Internal Dissipation @ 25°C: Peak Watts = 80 Average Watts with 1.2°C per watt heat sink = 40 Response, Full Power = 10 KHz Open Loop Gain = 60,000 v/v Power Supply Volts = ±24	Designed for "plug in" applications utilizing mating socket and servo feedback component board PC-110. Rated for driving size 32 and larger DC motors. Must be mounted onto model HS-200 heat sink or equivalent for full performance.
PA-601 Length 8.0 Width 4.4 Height 2.0 	Output Watts = 525 Output Volts = ±35 Output Amps = ±15 Internal Dissipation: Peak Watts = 600 Average Watts Using 50 CFM Forced Air = 350 Response, Full Power = 5 KHz Open Loop Gain = 60,000 v/v Power Supply Volts = ±40	Designed for high acceleration low cycle servos, where large peak power is involved. Amplifier contains provisions for feedback components, and its own heat sink extrusion. Optional fan and bracket is FB-200.

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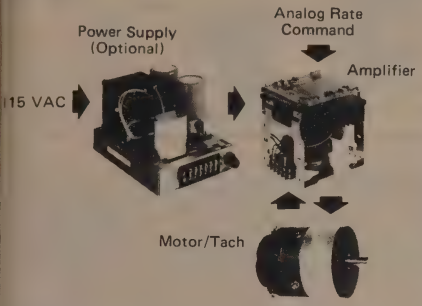
Snapper Series Wide Bandwidth

ANALOG CONTROL SERVO SYSTEMS

For Speed Control or use as Stable Inner Loops

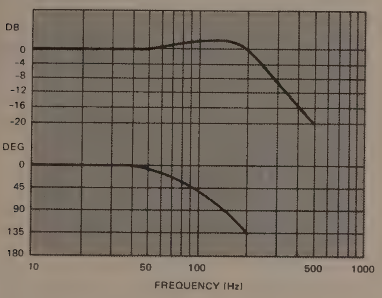


The SNAPPER Series of wideband, direct drive, servo systems consists of a low inertia, permanent magnet, DC motor/tachometer and a transistorized servo controller. In contrast to an SCR control system, the high gain and wide bandwidth of the SNAPPER system assures response to rapidly varying command signals, rejection of torque disturbances and freedom from parameter variations. In addition to precise average speed regulation, it minimizes instantaneous speed fluctuations.

Features include:

Choice of Output Power	**—.01 to .5 HP**
Wide Speed Range	**—2000 to 1 bidirectional**
Precise speed regulation	**—1 RPM from no load to full load**
Low Flutter	**—1% instantaneous speed variation**
Excellent Linearity	**—1% of set speed or 1 RPM**
Fast Dynamic Response	**—Over 200 Hz servo bandwidth**

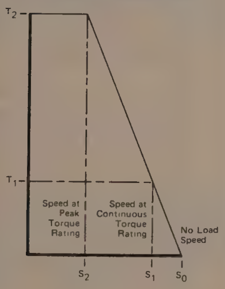
Typical Gain and Phase vs Freq (Closed Loop)



Partial Listing

The several standard speed control systems below represent only a few configurations. Many other speed/torque combinations can be supplied.

Max Speed/ Torque Curve at Servo Saturation


T2
T1
Speed at Peak Torque Rating
Speed at Continuous Torque Rating
No Load Speed
S2
S1
S0

STANDARD SPEED CONTROL SYSTEMS

System Model No.	Peak Torque oz. in. T_2	Rated Torque oz. in T_1	RPM at Peak Torque S_2	Rated Speed RPM S_1	No Load RPM S_0	Motor/Tach* Inertia oz-in-sec2 X10−3	Motor Frame Included	Controller Type Included	Power Supply (Optional)
RL-3201B	30	30	Stall	Stall	800	5.0	3210	01	DPS-24-3
RL-3211B	44	~~30~~	Stall	350	1200	5.0	3210	11	DPS-24-3
RL-3260A	90	30	500	2500	3500	5.0	3210	60	DPS-24-15
RL-3211L	75	75	Stall	Stall	750	8.0	3220	11	DPS-24-3
RL-3260D	150	75	Stall	750	1500	8.0	3220	60	DPS-24-15
RL-3260E	300	75	Stall	1000	3000	8.0	3220	60	DPS-40-25
RL-5011A	150	150	Stall	Stall	400	50.0	5010	11	DPS-24-3
RL-5060B	600	150	Stall	1350	1750	50.0	5010	60	DPS-40-25
RL-5060C	960	400	Stall	650	1100	120.0	5030	60	DPS-40-25

*The servo compensation is based upon load inertias of zero to twice the motor/tach inertia. Higher load inertias may require the adjustment of a single feedback resistor.

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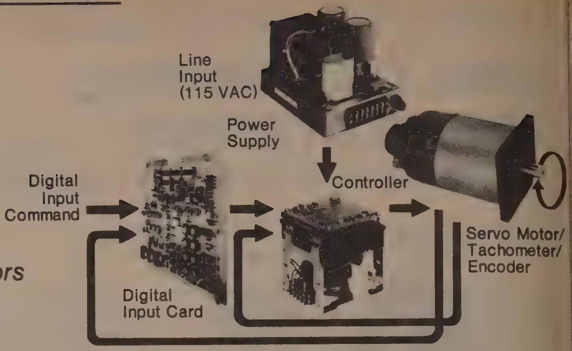
TORQUE SYSTEMS
INCORPORATED

DIGITAL CONTROL SERVO SYSTEMS

The logical replacement for stepper motors providing high-speed control of shaft position and accuracy possible only with a closed-loop digital servo system.


Line Input (115 VAC)
Power Supply
Controller
Digital Input Command
Servo Motor/ Tachometer/ Encoder
Digital Input Card

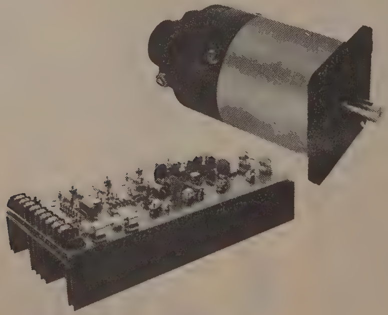
- **COMPLETE SYSTEMS include all necessary components direct from the actual manufacturer—Motor/Tachometer/Encoder Assembly, Power Amplifier, Power Supply and from 1 to 3 Digital Input PC Cards**
- **HORSEPOWER RATINGS from 1/20 to over 1/2 HP continuous duty**
- **ACCELERATIONS to over 300 rpm per millisecond**
- **SLEW RATES to 50,000 steps per second**
- **OVERSHOOT CONTROL by simple feedback adjustment**
- **SELECTABLE ENCODER RESOLUTIONS to 2,000 steps per revolution**

System Operation

Digital control features of DS Systems are achieved by means of a feedback Encoder integrally mounted on the Motor/Tachometer (shown above) plus one or more Digital Input Cards (right). This digital circuitry is available for control of ANY of the rate loops described on the previous page, thereby providing a very wide choice of torques and speeds.

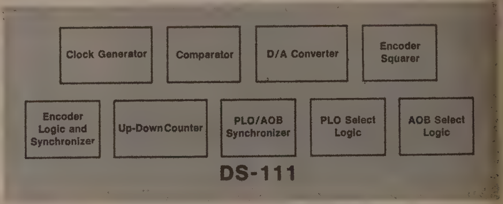
The inner velocity loop (Motor/Tachometer, Rate Loop Controller and Power Supply) provides fast response time and a tolerance for widely varying load conditions.

Bi-directional shaft positioning is provided by each TSI system in response to TTL compatible digital input commands which are accepted at very high rates without loss of steps and with minimum positioning time.

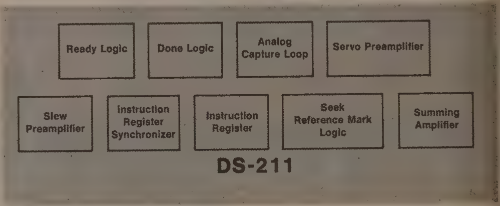


Three Digital Input Cards Provide a Full Range of Options

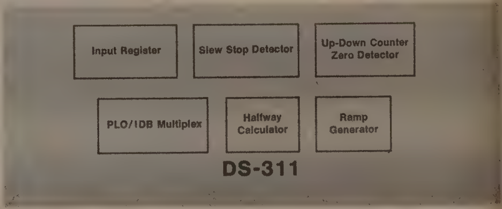
(Detailed descriptions of these PC cards and their functions are contained in the 12-page Torque Systems' DIGITAL POSITION SERVO CONTROL Catalog.)


Clock Generator
Comparator
D/A Converter
Encoder Squarer
Encoder Logic and Synchronizer
Up-Down Counter
PLO/AOB Synchronizer
PLO Select Logic
AOB Select Logic
DS-111

INCREMENTAL CONTROLLER CARD DS-111
is the basic card required for all systems. It accepts a serial pulse train and permits control of either position or velocity. The DS system incorporating DS-111 effectively replaces a stepper motor.


Ready Logic
Done Logic
Analog Capture Loop
Servo Preamplifier
Slew Preamplifier
Instruction Register Synchronizer
Instruction Register
Seek Reference Mark Logic
Summing Amplifier
DS-211

MODE PROGRAMMER CARD DS-211,
used in conjunction with DS-111, permits a programmed series of commands to be fed into the system. It includes provisions for homing in on a positional reference pulse. An analog capture loop on this card provides continuous position feedback information when the digital error is less than 1 bit, thus eliminating jitter.

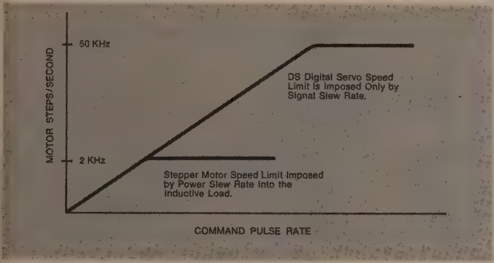

Input Register
Slew Stop Detector
Up-Down Counter Zero Detector
PLO/IDB Multiplex
Halfway Calculator
Ramp Generator
DS-311

OPTIMUM MOTION PROFILE COMPUTER CARD DS-311
used with DS-111 and DS-211 cards, accepts BCD or binary coded incremental position commands. Using information from a half-way calculator, it computes the optimum response profile and defines the acceleration/deceleration curves to achieve it.

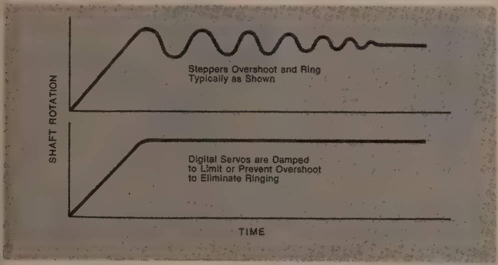
225 Crescent Street ● Waltham, Massachusetts 02154 ● (617) 891-0230

DS Digital Servo Systems are
- *Faster than the Fastest Stepper Motor*
- *Programmable—Internally or Externally*
- *Available as Modules or Prepackaged*

Speed Comparison of Digital Servo vs. Stepper Motor Performance



SPEED COMPARISON



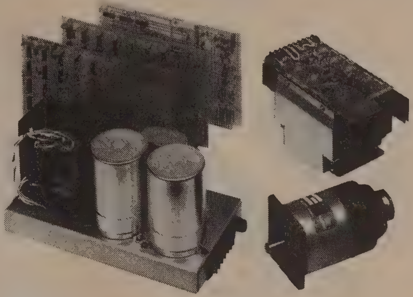
STABILITY COMPARISON

Programmability of DS Digital Servo Systems

The DS digital servo contains features to permit programming either externally or by automatic internal sequencing (any sequence) or a combination of both. The several operating modes available in the standard DS System are:

NOP	Standby Mode	up/down counter is cleared and all other instructions ignored
SRM	Go to Reference Mark	reference mark is usually an externally generated pulse
AOB	Stepper Mode	Motor will take one step per input pulse
IDB	Advance by 12 Bit Data Word in Minimum Time	uses internal halfway computer
PLO	Feed Rate Mode	operates as servo phase locked to an external frequency
GTD	Absolute Position Mode	advances to any absolute position up to 1,000,000 steps from reference mark under external feed-rate control

Do It Yourself—Or Have Us Do The Packaging



As Modules

A modular DS Digital Servo System includes the following items of Torque Systems' hardware:

1. Motor/Tachometer/Encoder Assembly
2. Rate Loop Controller Module
3. Line to DC Power Supply Module
4. One or more Digital Input Cards (as required)

The Motor and Controller which constitute the DS Systems Analog Rate Loop are power-matched.

or Prepackaged

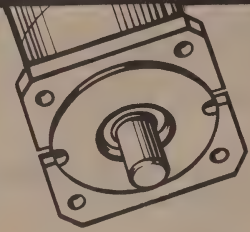
Torque Systems is prepared to provide all help necessary to specify a system tailored to your exact requirements. The DS Systems Catalog includes performance data and instructions on how to order Digital Servo Systems.

TORQUE SYSTEMS
INCORPORATED

225 Crescent Street
Waltham, Massachusetts 02154
(617) 891-0230
Telex 92-3424

pm motors

gear motors
servo motors
fans & blowers
torque motors
ac & dc tachometers



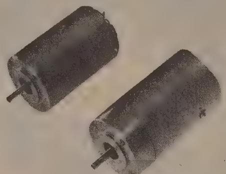
1/100 hp to 1/4 hp

military & commercial

The quality, performance and life of the prototype you get from Wertonix is the same as you get in production. And we can deliver just as fast as a cross-town distributor.

Special low torque speed reducer, enclosed and special blower.

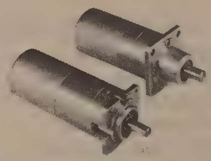
Ratings @ continuous duty.



1/100 & 1/65 hp, 3-50 vdc,
4500 to 24,000 rpm,
1-1/4 D. x 2-1/32".

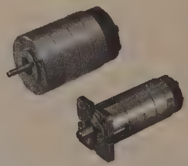
1/45 & 1/30 hp, 3-115 vdc,
3500 to 12,650 rpm,
1-1/2" D. x 2-15/16".

G'Box torques to 1600 oz. in.,
3-115 vdc, 0.53 to 3446 rpm,
1-1/2" D. x 4-37/64".

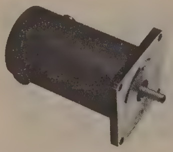


G'Box torques to 1250 oz. in.,
3-50 vdc, 0.2 to 6300 rpm,
1-1/4" D. x 4."

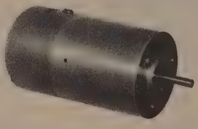
50 & 100 vdc/1000 rpm
tach/generator,
3-1/14" D. x 6-1/2";
Low ripple & high linearity.



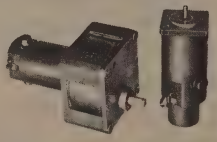
1/100 & 1/65 hp, 3-50 vdc,
4900 to 16,400 rpm,
1-1/4" D. x 1-3/4".
Available with G'Box.



1/12 & 1/10 hp, 6-115 vdc,
2600 to 8550 rpm,
2-1/8" D. x 4".



7, 20, 35, & 45 vdc/1,000 rpm
tach/generator,
1-1/4" D. x 3-1/4". Ripple —
3% RMS, Alnico V magnet
for good linearity.



Special high torque speed reducer with tach/generator.

SQD DEPARTMENT Super Quick Delivery

Work directly with the people who design and build to your standard or special requirements — from sketch or phone call. We can build to specs from scratch, often within 24 hours.

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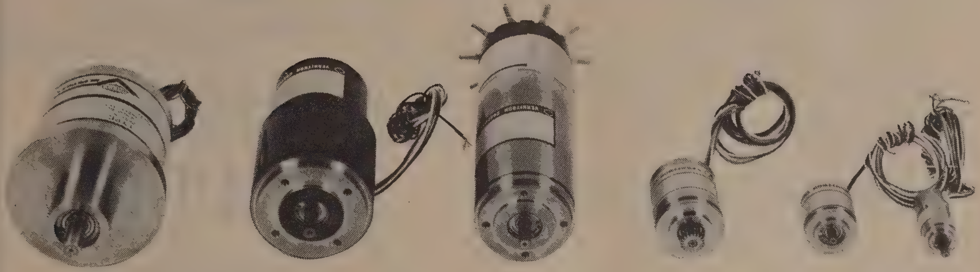
VERNITECH
DIVISION OF VERNITRON CORPORATION

the best known name in

MOTORS, TACHOMETERS, INTEGRATORS & STEPPER MOTORS

Over 1500 standard designs
or, custom designed to YOUR requirements



ALL UNITS WITH AND WITHOUT GEARHEADS

the full range of motors

TYPES		Servomotors Viscous Damped Motors Inertially Damped Motors	Hysteresis Synchronous Motors Stepper Motors Motor Generators Rate Motor Tachometers	Computing Motor Tachometers Integrating Motor Tachometers Spin (Gyro) Motors
SIZES	BuOrd Size 5 (0.5″ Dia.) to BuOrd Size 23 (2.250″ Dia.)			
SPEEDS	900 RPM to 36,000 RPM (Stepper Motors in Steps of 7.5°, 15°, 45°, and 90°)			
FREQUENCY	50, 60, 80, 400, 420, 480, 1000, and 1200 (Sine or Square Wave) Variable Frequency Motors are also standard at Vernitron			
VOLTAGES	6.3V (Filament) to 280V			
PHASES	1, 2, and 3 (In Stepper Motors — 2, 3, and 4)			

PLUS THE NEW 14M4B SERIES INDUSTRIAL GRADE INDUCTION MOTORS

typical data

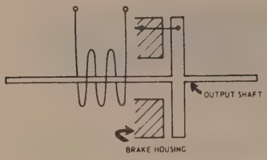
SIZE	1.375″ Dia. x 2.5″	**VOLTAGE**	115 VAC, Single ϕ
BREAKDOWN TORQUE	1.0 Oz.-In.	**POWER**	27 Watts
NO LOAD SPEED	11,000 RPM	**FREQUENCY**	400 Hz

Also available in 60 Hz, 26 VAC versions. Ask about our industrial synchronous motors.

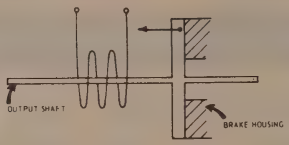
VERNITRON
DIVISION OF VERNITRON CORPORATION
300 Marcus Boulevard, Deer Park, New York 11729 / (516) 586-5100, TWX: 510-227-6079

SCHEMATICS

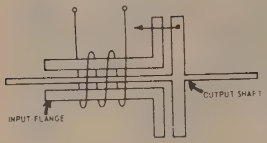
TYPE — MB
TYPE — WMB


OUTPUT SHAFT
BRAKE HOUSING

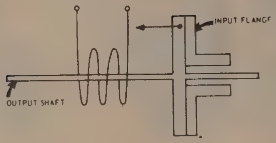
TYPE — SB
TYPE — WSB


OUTPUT SHAFT
BRAKE HOUSING

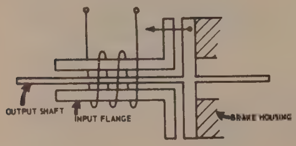
TYPE — MC
TYPE — WMC


OUTPUT SHAFT
INPUT FLANGE

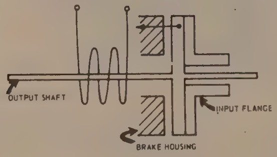
TYPE — SC
TYPE — WSC


INPUT FLANGE
OUTPUT SHAFT

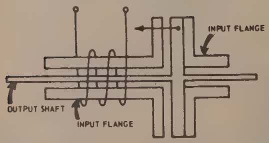
TYPE — MCSB
TYPE — WMCSB


OUTPUT SHAFT
INPUT FLANGE
BRAKE HOUSING

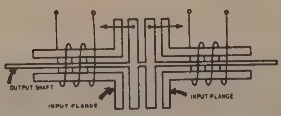
TYPE — SCMB
TYPE — WSCMB


OUTPUT SHAFT
INPUT FLANGE
BRAKE HOUSING

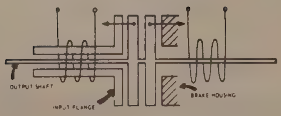
TYPE — MCSC
TYPE — WMCSC


INPUT FLANGE
OUTPUT SHAFT
INPUT FLANGE

TYPE — MCMC
TYPE — WMCMC


OUTPUT SHAFT
INPUT FLANGE
INPUT FLANGE

TYPE — MCMB
TYPE — WMCMB


OUTPUT SHAFT
INPUT FLANGE
BRAKE HOUSING

VERNITECH DIVISION OF
VERNITRON CORPORATION

DYNAMIC* CLUTCH AND BRAKE

* FORMERLY DIVISION OF
DYNAMIC INSTRUMENT CORP.

A COMPLETE LINE OF FRICTION CLUTCH AND BRAKE

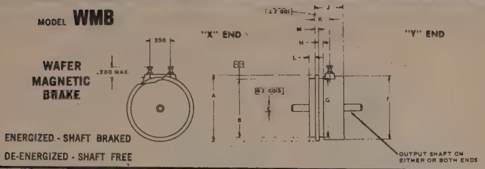
- **Precision** Instrument Type Standard Length
- **Precision** Instrument Type Wafer Length
- **Industrial Type** (Enclosed Frame)
- **Industrial Type** (Open Frame)
- **Unitized Modules** (In-line Servo Assemblies)
- **Special** Application Units

For complete information ask for our Brake & Clutch Catalog

VERNITECH
DIVISION OF VERNITRON CORPORATION

MODEL **WMB**

WAFER MAGNETIC BRAKE



.350
.200 MAX.
"X" END
"Y" END
J
K
M
H
L
A
B
G
F
OUTPUT SHAFT ON EITHER OR BOTH ENDS

ENERGIZED - SHAFT BRAKED
DE-ENERGIZED - SHAFT FREE

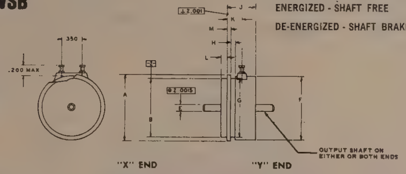
MODEL WMB WAFER MAGNETIC BRAKE

WMB FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE (OZ. IN. MIN.) MAGNETIC BRAKE	8	48	50	80	200
BREAKAWAY DRAG TORQUE					
ENERGIZED — BRAKED DE-ENERGIZED (OZ. IN. MAX.)	.10	.10	.15	.20	.20

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005			+.0000 −.0003	±.005	±.005	±.005		±.015	REF.	±.005	+.003 −.000		
8	.877	.7500			.1248	.800	.800	—		.500	.190	.100	.047		
11	1.115	1.0000			.1248	1.025	1.025	—		.500	.180	.100	.060		
13	1.370	1.2500			.1873	1.350	1.255	.080		.625	.245	.125	.060		
15	1.620	1.5000			.2498	1.600	1.505	.080		.750	.248	.125	.060		
18	1.740	1.5620			.2498	1.650	1.650	—		1.000	.320	.125	.090		

MODEL **WSB**

WAFER SPRING BRAKE



J
K
M
H
L
.350
.200 MAX
A
B
G
F
OUTPUT SHAFT ON EITHER OR BOTH ENDS
"X" END
"Y" END

ENERGIZED - SHAFT FREE
DE-ENERGIZED - SHAFT BRAKED

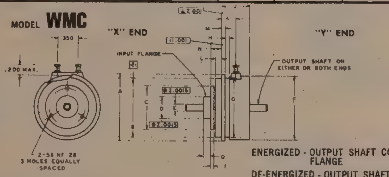
MODEL WSB WAFER SPRING BRAKE

WSB FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE SPRING BRAKE (OZ. IN. MIN.)	5	12	16	32	100
BREAKAWAY DRAG TORQUE					
ENERGIZED — (OZ. IN. MAX.) DE-ENERGIZED BRAKED	.10	.15	.20	.25	.30

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005			+.0000 −.0003	±.005	±.005	±.005		±.015	REF.	±.005	+.003 −.000		
8	.877	.7500			.1248	.800	.800	—		.500	.190	.100	.047		
11	1.115	1.0000			.1248	1.025	1.025	—		.500	.180	.100	.060		
13	1.370	1.2500			.1873	1.350	1.255	.080		.625	.245	.125	.060		
15	1.620	1.5000			.2498	1.600	1.505	.080		.750	.248	.125	.060		
18	1.740	1.5620			.2498	1.650	1.650	—		1.000	.320	.125	.090		

MODEL **WMC**

WAFER MAGNETIC CLUTCH



.350
.200 MAX.
"X" END
"Y" END
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS
2-56 NF 2B 3 HOLES EQUALLY SPACED
A
B
C
D
G
F
J
K
M
H
N
L
O
I

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE
DE-ENERGIZED - OUTPUT SHAFT FREE INPUT FLANGE FREE

MODEL WMC WAFER MAGNETIC CLUTCH

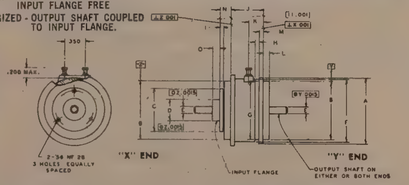
WMC FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.)	6	32	40	72	180
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — BOTH SHAFTS	.15	.20	.25	.30	.35
DE-ENERGIZED — OUTPUT SHAFT	.15	.15	.20	.25	.25
INPUT FLANGE	.15	.15	.20	.25	.25

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.500	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.500	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.625	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.750	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.000	.320	.125	.090	.230	.177

ENERGIZED - OUTPUT SHAFT FREE
INPUT FLANGE FREE
DE-ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE.

MODEL **WSC**

WAFER SPRING CLUTCH



N
J
K
M
H
L
O
I
.350
.200 MAX.
A
B
C
D
G
F
"X" END
"Y" END
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS
2-56 NF 2B 3 HOLES EQUALLY SPACED

MODEL WSC WAFER SPRING CLUTCH

WSC FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE SPRING CLUTCH (OZ. IN. MIN.)	5	12	16	32	100
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — OUTPUT SHAFT	.10	.15	.20	.25	.30
INPUT FLANGE	.20	.20	.25	.30	.35
DE-ENERGIZED — BOTH SHAFTS	.30	.35	.50	.75	1.0

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.532	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.532	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.659	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.801	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.042	.320	.125	.090	.230	.177

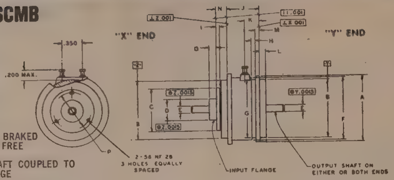
300 MARCUS BOULEVARD / DEER PARK, LONG ISLAND, NEW YORK 11729 / (516) 586-5100 / TWX 510-227-6079

VERNITECH

DIVISION OF VERNITRON CORPORATION

MODEL WSCMB

WAFER SPRING CLUTCH
MAGNETIC BRAKE


"X" END
"Y" END
.350
.200 MAX.
2-56 NF 2B
3 HOLES EQUALLY SPACED
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS

ENERGIZED - OUTPUT SHAFT BRAKED INPUT FLANGE FREE

DE-ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE

MODEL WSCMB WAFER SPRING CLUTCH MAGNETIC BRAKE

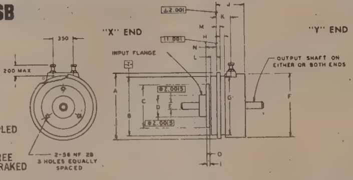
WSCMB FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE MAGNETIC BRAKED (OZ. IN. MIN.) SPRING CLUTCH (OZ. IN. MIN.)	6 5	16 12	16 16	32 32	100 80
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — INPUT FLANGE DE-ENERGIZED — BOTH SHAFTS	.20 .30	.20 .35	.25 .50	.30 .75	.30 1.0

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.532	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.532	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.659	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.801	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.042	.320	.125	.090	.230	.177

MODEL WMCSB

WAFER MAGNETIC CLUTCH

SPRING BRAKE


"X" END
"Y" END
.350
.200 MAX
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS
2-56 NF 2B
3 HOLES EQUALLY SPACED

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE

DE-ENERGIZED - INPUT FLANGE FREE OUTPUT SHAFT BRAKED TO HOUSING

MODEL WMCSB WAFER MAGNETIC CLUTCH SPRING BRAKE

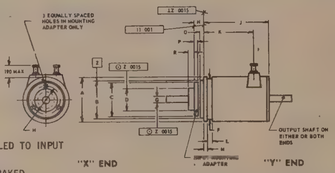
WMCSB FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.) SPRING BRAKE (OZ. IN. MIN.)	6 5	16 12	16 16	32 32	100 80
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — BOTH SHAFTS DE-ENERGIZED — INPUT FLANGE OUTPUT SHAFT (BRAKED)	.15 .25	.20 .30	.25 .45	.30 .70	.30 .95

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.500	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.500	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.625	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.750	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.000	.320	.125	.090	.230	.177

MODEL MCSB

MAGNETIC CLUTCH

SPRING BRAKE


3 EQUALLY SPACED HOLES IN MOUNTING ADAPTER ONLY
.190 MAX
OUTPUT SHAFT ON EITHER OR BOTH ENDS
INPUT MOUNTING ADAPTER
"X" END
"Y" END

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE

DE-ENERGIZED - OUTPUT SHAFT BRAKED INPUT FLANGE FREE

MODEL MCSB MAGNETIC CLUTCH SPRING BRAKE

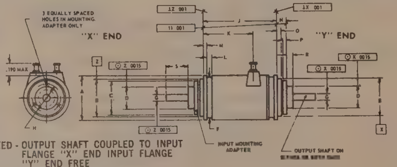
MCSB FRAME SIZE	5	8	11	13	18
COIL RESISTANCE ±10% OHMS	300	205	180	150	120
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.) SPRING BRAKE (OZ. IN. MIN.)	2.5 2.25	10 9	20 18	38 35	75 70
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — BOTH SHAFTS DE-ENERGIZED — OUTPUT SHAFT INPUT FLANGE	.10 BRK .10	.15 BRK .15	.20 BRK .35	.25 BRK .55	.30 BRK .75

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	M	N	O	P	R
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005		±.005	+.0000 −.0003	±.005		±.015	+.003 −.000	±.005	±.005	±.002	±.005
5	.594	.5000	.450	.2190		.531	.0935	.344		.882	.047	.126	.060	.056	.079
8	.827	.7500	.740	.3750		.750	.1248	.625		1.240	.060	.171	.100	.061	.120
11	1.090	1.0000	.934	.5000		1.000	.1248	.750		1.485	.060	.178	.100	.064	.177
13	1.370	1.2500	.934	.5000		1.250	.1873	.750		1.620	.060	.204	.125	.064	.177
18	1.750	1.5620	.934	.5000		1.625	.1873	.750		1.930	.093	.252	.172	.064	.177

MODEL MCSC

MAGNETIC CLUTCH

SPRING CLUTCH


3 EQUALLY SPACED HOLES IN MOUNTING ADAPTER ONLY
"X" END
"Y" END
.190 MAX
INPUT MOUNTING ADAPTER
OUTPUT SHAFT ON

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE "X" END INPUT FLANGE "Y" END FREE

DE-ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE "Y" END, INPUT FLANGE "X" END FREE.

MODEL MCSC MAGNETIC CLUTCH SPRING CLUTCH

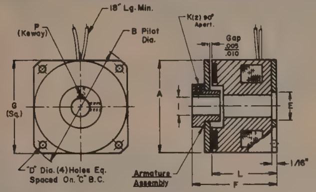
MCSC FRAME SIZE	5	8	11	13	18
COIL RESISTANCE ±10% OHMS	300	205	180	150	120
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.) SPRING CLUTCH (OZ. IN. MIN.)	2.5 2.25	10 9	20 18	38 35	75 70
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — ("X") BOTH SHAFTS ("Y") INPUT SHAFT D-ENERGIZED — ("Y") BOTH SHAFTS ("X") SHAFT	.10 .10 .10 .10	.20 .15 .20 .15	.30 .25 .40 .35	.35 .30 .55 .50	.50 .45 .75 .70

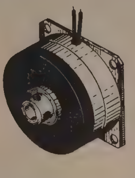
FRAME SIZE	A	B	C	D	E	F	G	H	I	J	M	N	O	P	R
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005		±.005	+.0000 −.0003	±.005		±.015	+.003 −.000	±.005	±.005	±.002	±.005
5	.594	.5000	.450	.2190		.531	.0935	.344		.965	.047	.126	.060	.056	.079
8	.827	.7500	.740	.3750		.750	.1248	.625		1.350	.060	.171	.100	.061	.120
11	1.090	1.0000	.934	.5000		1.000	.1248	.750		1.628	.060	.178	.100	.064	.177
13	1.370	1.2500	.934	.5000		1.250	.1873	.750		1.740	.060	.204	.125	.064	.177
18	1.750	1.5620	.934	.5000		1.625	.1873	.750		2.042	.093	.252	.172	.064	.177

300 MARCUS BOULEVARD / DEER PARK, LONG ISLAND, NEW YORK 11729 / (516) 586-5100 / TWX 510-227-6079

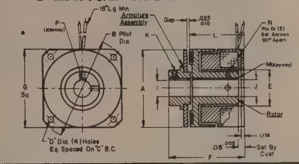
VERNITECH
DIVISION OF VERNITRON CORPORATION

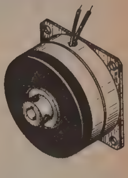
MBF MAGNETIC BRAKE FLANGE MOUNTED


18" Lg. Min.
P (Keway)
B Pilot Dia.
K(2) 90° Apart
Gap .005 .010
G (Sq.)
A
I
E
"D" Dia. (4) Holes Eq. Spaced On "C" B.C.
Armature Assembly
L
F
1/16"



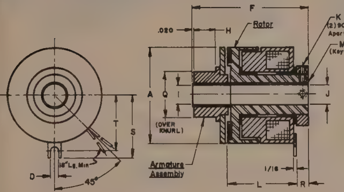
MCCF MAGNETIC CLUTCH COUPLING FLANGE MOUNTED

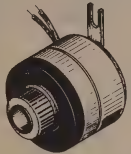

18" Lg Min.
P (Keyway)
B Pilot Dia.
Armature Assembly
Gap .005 .010
K
L
N Pin Or (2) Set Screws 90° Apart
M (Keyway)
G Sq
A
I
J
E
Rotor
"D" Dia. (4) Holes Eq. Spaced On "C" B.C.
.08
.005
1/16
Set By Cust
F



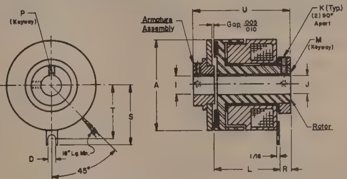
Size	A Nom.	B +.000 −.002	C ±.005	D +.005 −.001	E +.001 −.000	F Max.	G Nom.	I +.001 −.000 Symbol	I Inches	J +.001 −.000 Symbol	J Inches	K (2) 90° Apart	L Nom.	M	N	P
08	.97	1.200	1.031	.094	.374	.93	.89	A	.188	A	.188	#4-40	.63	None	.062/.065	None
								B	.250	B	.250					
12	1.24	1.499	1.312	.125	.437	.94	1.13	A	.188	A	.188	#4-40	.63	1/16 x 1/32	.078/.081	None
								B	.250	B	.250					
								C	.313	C	.313			None		
17	1.78	2.437	2.125	.188	.750	1.38	1.81	B	.250	B	.250	#6-32	.98	1/16 x 1/32	#6-32	None
								C	.313	C	.313			1/16 x 1/32		
								D	.375	D	.375			3/32 x 3/64		
22	2.25	2.874	2.500	.188	1.000	1.63	2.25	D	.375	D	.375	#8-32	1.05	3/32 x 3/64	#8-32	3/32 x 3/64
								F	.500	F	.500			1/8 x 1/16		1/8 x 1/16
26	2.64	3.500	3.125	.188	1.061	1.75	2.64	D	.375	D	.375	#8-32	1.25	3/32 x 3/64	#8-32	3/32 x 3/64
								F	.500	F	.500			1/8 x 1/16		1/8 x 1/16
								H	.625	H	.625			3/16 x 3/32		3/16 x 3/32

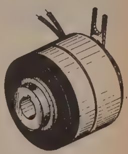
MCB MAGNETIC CLUTCH BEARING MOUNTED


F
.020
H
Rotor
K (2) 90° Apart
M (Keyway)
A
Q
I
J
(OVER KNURL)
T
S
D
18" Lg. Min
45°
Armature Assembly
1/16
L
R



MCCB MAGNETIC CLUTCH COUPLING BEARING MOUNTED


P (Keyway)
Armature Assembly
U
Gap .005 .010
K (Typ) (2) 90° Apart
M (Keyway)
A
I
J
T
S
Rotor
D
18" Lg Min.
45°
1/16
L
R



Size	A Nom.	D Min.	F Max.	H Min.	I +.001 −.000 Symbol	I Inches	J +.001 −.000 Symbol	J Inches	K	L Nom.	M	Q ±.002	R Nom.	S Max.	T ±.015	U Max.
08	.97	.094	1.27	.23	A	.188	A	.188	#4-40	.63	None	.506	.19	.63	.50	1.06
					B	.250	B	.250								
12	1.24	.13	1.38	.31	A	.188	A	.188	#4-40	.63	None	.506	.19	.75	.64	1.12
					B	.250	B	.250								
					C	.313	C	.313								
17	1.78	.19	1.84	.31	B	.250	B	.250	#6-32	.98	None	.631	.20	1.38	1.06	1.59
					C	.313	C	.313								
					D	.375	D	.375								
22	2.25	.19	2.13	.38	D	.375	D	.375	#8-32	1.05	3/32 x 3/64	.756	.23	1.50	1.25	1.86
					F	.500	F	.500			1/8 x 1/16					
26	2.64	.19	3.45	1.5	D	.375	D	.375	#8-32	1.25	3/32 x 3/64		.25	1.75	1.50	2.01
					F	.500	F	.500			1/8 x 1/16					
					H	.625	H	.625			3/16 x 3/32					

WHEN ORDERING A UNIT FOLLOW THIS METHOD OF IDENTIFICATION

EXAMPLE:

MC B — 17 — 28 — C 2 C

Magnetic Clutch
Bearing Mounted Unit
Frame Size (1.78 Diameter)
Voltage (28 V.D.C.)
Bore, Armature Assy. (.313 Diameter)
Zero Backlash — Spring Release
Bore, Rotor (.313 Diameter)

TYPES OF ARMATURE ASSEMBLIES

Symbol	Description
1	STANDARD ARMATURE
2	ZERO BACKLASH ARMATURE WITH SPRING RELEASE

UNIT CHARACTERISTICS

Torque and Resistance are typical for all above models

Size	Torque (lb. in.)	Inertia (in. lb.²) Armature Assembly	Weight (lb.) Nom.
08	2		.07
12	5		.17
17	15		.50
22	40		1.10
26	75		1.60

RESISTANCE TABLE (Ohms Min.)

Voltage (d.c.)	Frame Size 08	12	17	22	26
6	6.0	5.0	4.0	4.0	4.0
12	37	25	19	15	16
28	138	150	115	97	90
90	1944	1548	1116	900	895

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VERNITRON

vernitorq® BRUSHLESS DC TORQUE MOTORS

■ Limited rotation, wide angle ■ Infinite resolution for precise positioning ■ Direct drive for increased sensitivity, and response ■ Simplified design for economy, compact packaging.

Elimination of brushes, use of toroidal field windings and permanent magnet rotors provides smooth operation without slot effect. Infinite resolution and high linearity result, allowing these motors to provide high accuracy in positioning, actuating, tensioning, measuring and indicating applications for both military and industrial use.

Vernitorq motors develop high torque with low input power and high acceleration rates which make it possible to couple them directly to the driven load without gears. The elimination of gearing aids response and eliminates backlash, gear tooth resilience, acceleration attenuation and other disadvantages of gearing.

Brushless and gearless operation eliminates electrical and mechanical noise, and explosion hazard. It also reduces the number of moving parts and associated friction wear.

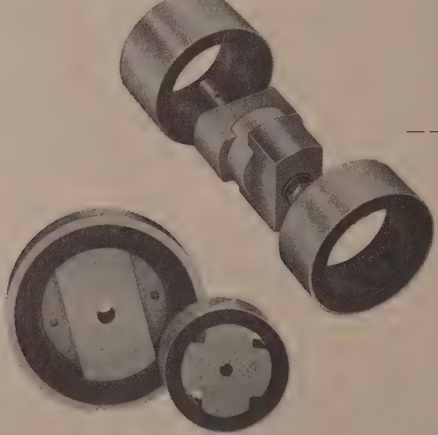
Vernitorq brushless DC torque motors are available in two and four-pole configurations, in a variety of sizes and outputs.

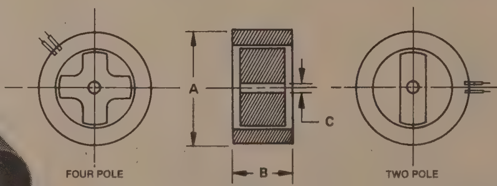
The motors are normally supplied "frameless" — without housing, shaft and bearings. Housed versions, with or without mounting flanges, are also available for all units.

vernitorq® CHARACTERISTICS

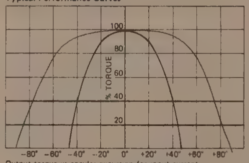
Type Number		VBTM-10A	VBTM-12B	VBTM-15A	VBTM-18A	VBTM-23B	VBTM-26A	VBTM-34B	VBTM-52A
Peak Torque	(oz-in)	1.3	4.5	5	12	25	18	130	600
Power @ Peak Torque	(watts)	16	36	28	67	63	57	278	360
Continuous Torque	(oz-in)	.5	.9	2.8	4	7	6	40	150
Power @ Continuous Torque	(watts)	2.4	1.5	9	8	5	6.5	27	23
Input Volt @ Cont. Torque	(volts)	12	4	24	15	7	22	16	10
Torque Sensitivity	(oz-in/amp)	2.5	2.25	7.5	8	10	6.5	24	67
D. C. Resistance	(ohms)	60	9	62	30	10	7.5	9.5	4.5
Angular Excursion	(degrees)	120	120	50	120	60	60	120	40
Back EMF	(volts/rad/sec)	.018	.017	.055	.060	.100	.125	.195	.480
Elec. Time Constant L/R	(seconds)	3x10^{-4}	3x10^{-4}	2.2x10^{-4}	6x10^{-4}	1.2x10^{-3}	3.2x10^{-3}	3.2x10^{-3}	7.0x10^{-3}
Rotor Inertia	(oz-in sec^{2})	1.8x10^{-5}	1.7x10^{-4}	3.7x10^{-4}	6.9x10^{-4}	1.76x10^{-3}	1.95x10^{-3}	2.2x10^{-2}	12x10^{-2}
Viscous Damping	(oz-in/rad/sec)								
Infinite Source Impedance		1.5x10^{-5}	7x10^{-5}	8.3x10^{-5}	5x10^{-4}	3x10^{-2}	3.2x10^{-2}	1x10^{-2}	2x10^{-2}
Zero Source Impedance		7.5x10^{-4}	4.4x10^{-3}	6.6x10^{-3}	3.3x10^{-2}	0.10	.10	.50	7.1
Weight	(oz) Max.	1.5	2.5	3	3.9	8	7	26	88
Dimensions	(inches)								
	A	1.000	1.178	1.500	1.719	2.270	2.500	3.400	5.250
	B	.350	.610	.500	.940	.720	.500	1.500	1.700
	C	.125	.125	.125	.187	.250	.250	.250	.500

NOTES: 1. Vernitorq motors have no friction or ripple torque.
2. Vernitorq brushless tachometer generators are also available in the various frame sizes.





Typical Performance Curves



Output torque vs angular excursion for input current

● 2 POLE MOTOR ● 4 POLE MOTOR

VERNITRON CONTROL COMPONENTS

A Division of Vernitron Corp.
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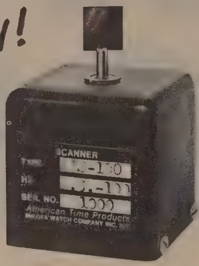
BULOVA® Optical Scanners,*

Frequencies from 10 Hz to 16 KHz   Scan Angles to 30°
Available with Drivers

NEW!



Tracks input signal with precise linearity whether waveform is ramp, triangular, sawtooth, step or any combination from d c to design frequency band. X–Y mounts available for raster scan.

LINEAR (ANALOG) SCANNER

This new electromagnetic scanner, Model ALS-100, from Bulova has a veritable host of new features which the optical systems engineer can apply to solve design problems. Here are just some of the things it can do:

Scan a field up to 30° pp – up to 100° pp at lower frequency available.
Scan any portion of that field around a selected "center" left or right of true center.
Hold at any static angle in its field, move and hold again.
Center automatically with current off.
Track any analog input with good linearity—mirror position is proportional to input current.
Mirrors to 30mm X 30mm standard, larger for lower frequencies.

It does all this and much more in a compact package that uses very little power < 30mA/degree. The model ALS-100 has an operating frequency range from dc to 100Hz.

If you have requirements other than shown for the specified model above please contact us.

Low Cost Lock-In Amplifier

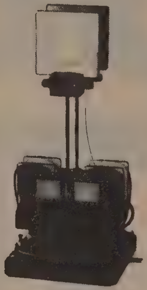
Bulova has designed a low-cost Lock-In Amplifier for use with scanners, choppers and other instruments in applications where it is desired to distinguish and pull out weak signals from high back-ground noise. It is available in three forms: cased as a lab bench instrument, for standard rack mounting or for incorporation without casing as a module in OEM's instrumentation.

For details see Bulova Lock-In Amplifier ad in Volume 1.

Typical Torsion Bar Type

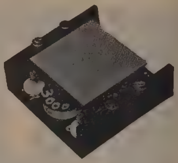
Type L45
1-1/2" x 1-1/2" x
approx. 3" high

Dual Mirror Torsion Bar



Type L44
3/4" x 1" x
approx. 3" high

Taut Band



Type L50
1-7/16" x
1-7/16" x 5/8"

GENERAL SPECIFICATIONS

(The principle of operation and general features are given on facing page.)

Scanners are produced in two basic types, torsion bar, with single or dual mirrors, and taut band, capable of handling large mirrors.

TORSION BAR

Type L45: Single Mirror
Type L44: Dual Mirror
Frequency: L45, 600 Hz to 16 KHz; L44, 100 Hz to 600 Hz (any fixed discrete)
Accuracy: ±2% standard
Scan Angle, P to P: 10° max reduces to 2° at higher frequencies. L44, 20° max
Mirror Size: 30mm x 30mm max, reduces as frequency increases
Power: 500 milliwatts, max. with driver

TAUT BAND TYPE L50

Frequency: 10 Hz to 400 Hz (any fixed discrete)
Accuracy: ±2% standard
Scan Angle, P to P: 30° max, reduces with frequency increase to 5° at upper end.
Mirror size: 30 x 30mm, standard max. (This type scanner also can mount larger mirrors.) Reduces as frequency increases.
Power: 500 milliwatts max, with driver

MIRRORS

Flatness: 1/2 wavelength standard, 1/4 or better available
Stock Sizes, mm: 30 x 30, 20 x 20, 15 x 15, 10 x 10, 7 x 7, 5 x 5, 2 x 3.

*Patents pending and issued

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Choppers, Modulators*

Frequencies from 5 Hz to 3 KHz   Many Modulation Patterns
Available with Drivers

OPERATING PRINCIPLE AND BASIC FEATURES

The same basic principle, mechanical resonance, is involved in the three basic types of units which are the foundation of Bulova's line of Optical Scanners and Light Choppers.

Application of this principle enables design of optical scanning and chopping devices which have many advantageous properties. Chief of these are:

- Reliability: No rotating parts, no bearings, no lubrication; hence no wear and no service problems
- Excellent Accuracy: ±1% usual, ±0.1 attainable. Can be any discrete fixed frequency, even fractions of a hertz
- Small Size: Down to 0.5 in ^{3} and less than 0.5 oz.
- Low Power: In milliwatt range.
- Virtually Drift Free: Exceptional stability with time, excellent temperature characteristics
- Reference Signals: Inherently available through driver Also, an optional, isolated pick-up can be incorporated directly in the scanner or chopper as a signal source.
- Environment: Withstand vibration to 20g, shock to 100g; temperature from cryogenic to 250°C; altitude to space vacuum; radiation $>2 \times 10^{13}$ NVT.
- Raster Scan: X-Y mounts and slaved units provide synchronized raster scan.

Existence of a broad range of stock designs enables Bulova to supply prototype and production quantities to customer specification on short lead time.

GENERAL SPECIFICATIONS

Choppers and Modulators are available in three basic types: tuning fork, torsion bar and taut band. The torsion bar and taut band mount single vanes, the tuning fork, pairs of vanes. Configuration and mounting positions of the vanes control beam modulation patterns.

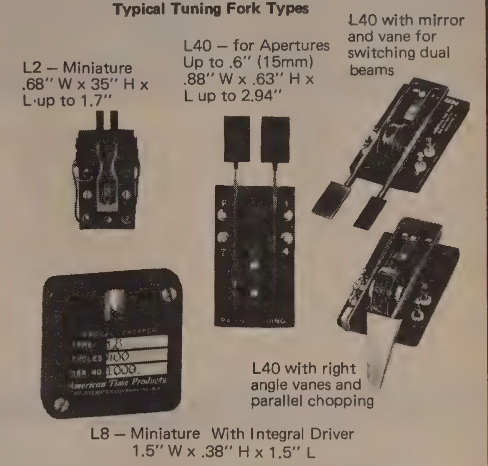
TUNING FORK

Type L2: Miniature (.68 W x .35 H x L to 1.7")
Type L8: L2 with integral driver (1.5" W x .38" H x 1.5L)
Type L40: (.88 W x .63 H x L up to 2.94)
Frequency: 10 Hz to 3000 Hz (any fixed discrete)
Frequency: (any fixed discrete)
  L2 Range 200 to 3000 Hz
  L8 Range 200 to 2000 Hz
  L40 Range 10 to 1000 Hz
Aperture; Max (L40): Width 0.6", length .63". All reduce with increase in frequency
Accuracy: ±1% Standard, special to 0.1%
Power: 500 milliwatts max., with driver

TAUT BAND TYPE L51C

Frequency: 5 Hz to 100 Hz (any fixed discrete)
Accuracy: ±2% standard
P to P: 30° max. reduces with frequency increases to 5° at upper end. Excursion a function of vane length
Vane: Length 1 1/2" x 1" max. Can chop 1 or two beams to 0.60" diameter. Reduces with frequency increase to 0.30" dia. max. at 100 Hz.
Power: 500 milliwatts, max., with driver

Typical Tuning Fork Types



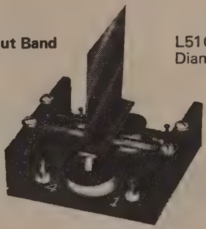
L2 – Miniature .68" W x 35" H x L up to 1.7"

L40 – for Apertures Up to .6" (15mm) .88" W x .63" H x L up to 2.94"

L40 with mirror and vane for switching dual beams

L40 with right angle vanes and parallel chopping

L8 – Miniature With Integral Driver 1.5" W x .38" H x 1.5" L



Taut Band

L51C – for Large Diameter Beams

DRIVERS

The scanners and choppers can be driven in any one of three modes:

1 Closed loop at the natural frequency of the fork, torsion bar or taut band with negative feedback from the pick-up coil;
2 Open loop at the natural frequency; or
3 In a phase lock or frequency lock loop.

Electrical or mechanical dampening can be included to reduce Q. In addition, automatic gain control can be added where extreme precision in amplitude is desired. Drivers can be supplied to operate from a DC source having an AC input. All drivers provide a reference signal for synchronizing other devices and instruments. Furthermore, an isolated pick-up can be incorporated directly in the chopper or scanner as a reference signal source.

Bulova designs and manufactures drivers. However, engineering assistance is offered to customers desiring to build their own drivers.

From Bulova Electronics Division: Frequency Control Components • Crystals • Crystal Oscillators • Monolithic Crystal Filters • Fork Oscillators • DC Servo Amplifiers • 400 Hz Servo Amplifiers • Optical Devices • Choppers and Scanners • Frequency Changers • Inverters • Lock-in Amplifiers

BULOVA® BULOVA atp

Phototransistors

This listing represents only a portion of the Clairex line of phototransistors

PHOTO TRANSISTORS and DARLINGTON PHOTOTRANSISTORS

TO 18 FLAT WINDOW

	I_L (ma) $V_{CE}=5V$ Min	Max	H (Note 1) mw/cm^2	BV_{CEO} Volts	I_{CEO} (na) $V_{CE}=10V$	P_T (mw) 25°C
CLT 2065	7.0	—	5.0	40	50	250
CLT 2064	3.0	7.0	5.0	50	50	250
CLT 2030	1.0	3.0	5.0	30	25	250
CLT 2020	0.4	1.2	5.0	30	25	250
CLR 2060	0.2 14.0	1.4 —	0.20 2.0	40	100	250
CLR 2050	0.6 6.0	1.8 —	0.20 2.0	40	100	250
CLR 2049	.2	.6	0.20	40	100	250

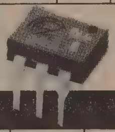
TO 18 LENS

	I_L (ma) $V_{CE}=5V$ Min	Max	H (Note 1) mw/cm^2	BV_{CEO} Volts	I_{CEO} (na) $V_{CE}=10V$	P_T (mw) 25°C
CLT 2165	15.0	—	5.0	40	50	250
CLT 2164	7.0	—	5.0	40	50	250
CLT 2160	4.0	12.0	5.0	30	25	250
CLT 2150	2.4	7.2	5.0	40	25	250
CLT 2140	1.2	3.6	5.0	40	25	250
CLR 2180	0.6 4.0	— —	0.02 0.20	40	100	250
CLR 2170	0.2 2.0	0.8 —	0.02 0.20	40	100	250

WINDOW LENS .115 LENGTH X .077 DIAM.

	Lens	I_L (ma) $V_{CE}=5V$ Min	Max	H (Note 1) mw/cm^2	BV_{CEO} Volts	I_{CEO}(na) $V_{CE}=10V$	P_T (mw) 25°C
CLT 5170	L	1.4 6.0	— —	5 20	40	25	50
CLT 5160	L	0.5 2.0	— 7.0	5 20	40	25	50

-2 Designation is with second lead welded to the header



WINDOW LENS .110 LENGTH X .060 DIAM

	Window or Lens	I_L (ma) $V_{CE}=5V$ Min	Max	H (Note 1) mw/cm^2	BV_{CEO} Volts	I_{CEO} (na) $V_{CE}=10V$	P_T (mw) 25°C
CLT 3170	L	2.0 7.0	— —	5 20	40	10	50
CLT 3160	L	0.5 2.0	— 7.0	5 20	50	10	50
CLT 3030	W	0.25 1.0	— 3.0	5 20	40	10	50
CLT 3020	W	01.0 0.40	— 1.2	5 20	50	10	50

OPTO-ISOLATORS

	Transfer Ratio $V_{CE}=10V$ % Min	% Max	I_F ma	V_{CE} (sat) $I_C=2ma$ $I_F=50ma$ volts	BV_{CEO} $I_C=1$ ma volts	I_{CEO} (na) V_{CE} 10V	Peak-AC Isolation volts	V_F $I_F=16ma$ volts	I_R $V_R=3V$ μa	T_R, T_F $I_C=2ma$, $R_L=100$ $V_{CE}=10V$ μsec
CLI-2	30	100	10	0.40 max	50	25	1500	1.5	10	5
CLI-3	30 100	— 200	1 10	0.40 max	50	25	1500	1.5	10	5
CLI-5	20	—	10	0.40 max	50	25	1500	1.5	10	2.5
CLI-10	600 600	— —	1 10	1.0 max	50	100	1500	1.5	10	150 typ
CLI-20	20	100	10	0.40 max	30	50	1500	1.5 @ 60ma	10	5
CLI-510	100	—	10	1.0 max	30	100	1500	1.5	10	150 typ
CLI-511	100	—	10	1.0 max	55	100	1500	1.5	10	150 typ
*CLA-7	20	—	10	0.50 @ 10 ma/1 ma	40	50	6000	1.5	10	5
*CLA-7D	400	—	10	1.00 @ 10 ma/10 ma	40	100	6000	1.5	10	150 typ

Note 1: The light source is a frosted tungsten incandescent lamp at 2854°K.

*Axial Lead Construction

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Photoconductive Cells

[illegible] of the Clairex standard and special photocells available. A [illegible] manual is available [illegible]

Photocell ordering abbreviation	Diam. X Length (inches)	Resistance @ 2 ftc ± 33⅓%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25° C (mw)
CL5M9M	.55 X .18	11K	1:1000	170	2000-500[1]
CL709L	.36 X .18	28K		100	125
CL909L	.21 X .15	100K		100	50

Type 9 Cds, peak spectral response 5500 angstroms combines high speed with extreme temperature stability and high linearity.

CL503	.5 X .5	7.2K	1:10,000	250	500-250[1]
CL5M3	.55 X .18	7.2K		250	2000-500[1]
CL603	.25 X .5	133K		300	75
CL603A	.25 X .5	75K		300	75
CL603AL	.25 X .5	3.5K		170	75
CL703	.36 X .18	133K		300	125
CL703A	.36 X .18	67K		300	125
CL703L	.36 X .18	2.7K		100	125
CL903	.21 X .15	133K		250	50
CL903A	.21 X .15	67K		250	50
CL903L	.21 X .15	6.0K		100	50

Type 3 CdSe, peak spectral response 7350 angstroms, fast response, and very high light-to-dark resistance ratio. Can be used for high speed switching or counting. Sensitive to near infra red. For use with incandescent or neon lamps.

CL504	.5 X .5	1.5K	1:400	250	500-250[1]
CL5M4	.55 X .18	1.5K		250	2000-500[1]
CL504L	.5 X .5	0.25K		170	500-250[1]
CL5M4L	.55 X .18	0.25K		170	2000-500[1]
CL604	.25 X .5	30K		300	75
CL604L	.25 X .5	1.5K		170	75
CL704	.36 X .18	30K		300	125
CL704L	.36 X .18	0.6K		100	125
CL904	.21 X .15	30K		250	50
CL904L	.21 X .15	2K		100	50

Type 4 CdSe, peak spectral response 6900 angstroms, lowest resistance photocells available. Can be used for "on-off" applications when low resistance is desired. For use with incandescent or neon lamps.

CL505	.5 X .5	9K	1:100	250	500-250[1]
CL5M5	.55 X .18	9K		250	2000-500[1]
CL505L	.5 X .5	1.5K		170	500-250[1]
CL5M5L	.55 X .18	1.5K		170	2000-500[1]
CL605	.25 X .5	166K		300	75
CL605L	.25 X .5	7.5K		170	75
CL705	.36 X .18	166K		300	125
CL705L	.36 X .18	3.3K		100	125
CL905	.21 X .15	166K		250	50
CL905L	.21 X .15	10K		100	50

Type 5 CdS, peak spectral response 5500 angstroms (closely matches the human eye), most stable, lowest memory photocell available. Can be used in light measuring applications and precision low speed switching. For use with incandescent, fluorescent or neon lamps.

CL705HL	.36 X .18	28K	1:1000	100	125
CL905HLL	.21 X .15	15K	1:1000	60	50
CL905HL	.21 X .15	100K		100	50
CL905HN	.21 X .15	700K		100	50

Type 5H CdS, peak spectral response 5500 angstroms (closely matches the human eye). Combines high speed, stability, linearity, and uniform color temperature response.

Photocell ordering abbreviation	Diam. X Length (inches)	Resistance @ 2 fc ± 33⅓%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)
CL507	.5 X .5	7.2K	1:300	250	500-250[1]
CL5M7	.55 X .18	7.2K		250	2000-500[1]
CL607	.25 X .5	133K		300	75
CL707	.36 X .18	133K		300	125
CL707L	.36 X .18	2.7K		100	125
CL907	.21 X .15	133K		250	50
CL907N	.21 X .15	66K		100	50

Type 7 CdS, peak spectral response 6150 angstroms, moderate speed and ratio. Can be used in general beam breaking applications. For use with incandescent, neon or fluorescent lamps.

CL707H	.36 X .18	500K	1:1000	300	125
CL707HM	.36 X .18	100K		250	125
CL907H	.21 X .15	600K		250	50
CL907HN	.21 X .15	300K		100	50
CL907HL	.21 X .15	24K		100	50

Type 7H CdS Peak Spectral response 6200 angstroms. Very fast decay time coupled with low resistance and high linearity. Ideal for beam breaking applications.

Photocell ordering abbreviation	Diam. X Length (inches)	Resistance @ 2 fc ± 33⅓%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)	Type
CL703/2	.36 X .18	50K	1:10,000	300	125	3 CdSe
CL703L/2	.36 X .18	6.5K	1:10,000	100	125	3 CdSe
CL704/2	.36 X .18	17K	1:400	300	125	4 CdSe
CL704L/2	.36 X .18	1.5K	1:400	100	125	4 CdSe
CL705/2	.36 X .18	166K	1:100	300	125	5 CdSe
CL705L/2	.36 X .18	7.5K	1:100	100	125	5 CdSe

DUAL ELEMENT

Photocells contain two separate elements with two separate leads and one common lead.

LED PHOTOCELL ISOLATORS

	R "ON" Ohms	R "OFF" Ohms	CELL volt.	CELL Pd mw	VF volts	T (decay) msec	Isolation volts
CLM6000	250 Max	500K Min	60pac	50	2.0 @ 20ma	500	1500
CLM6200	6000 Max	10MegMin	60pac	50	2.0 @ 20ma	12	1500
CLM8200	2750 Max	10MegMin	220pac	125	2.0 @ 20ma	20	2500
CLM8000	400 Max	500K Min	220pac	125	3.2 @ 20ma	500	2500
CLM8500	2000 Max	10MegMin	220pac	125	2.8 @ 15ma	40	2000
CLM8500/2	1000 Max.	1MegMin	100pac	60	2.8 @ 15ma	150	2000

PHOTOMOD® PHOTOCELL-LAMP ASSEMBLIES

Part No.	Rated Lamp Voltage	Resistance (Max. Ohms) @ Rated Lamp Voltage	Max. Allowable Cell Voltage @ Peak AC
CLM3006A	6	160	120V
CLM4006A	6	55	120V
CLM4012A	12	30	120V
CLM3012A	12	160	120V
CLM5H10A	10	3000	120V
CLM7H16A	16	550	170V
CLM3120A	120	1150	120V
CLM4120A	120	160	120V

FOOTNOTE: [1] With and without heat sink.

Isolation Voltages are Peak AC.

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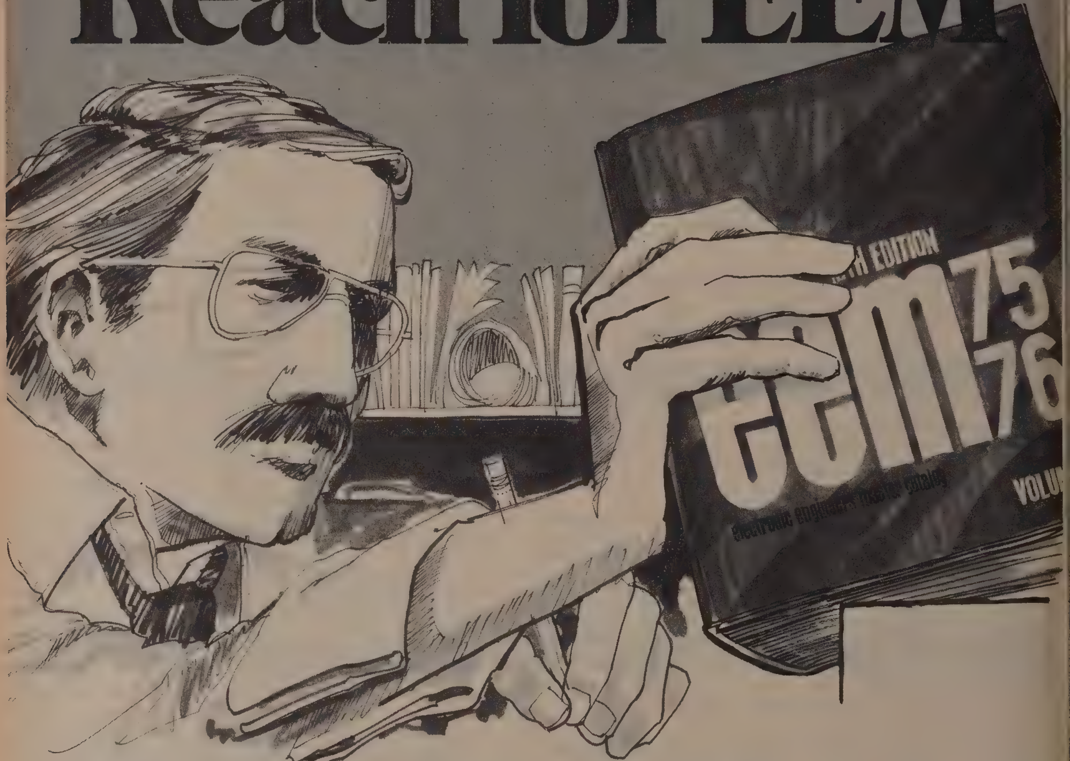
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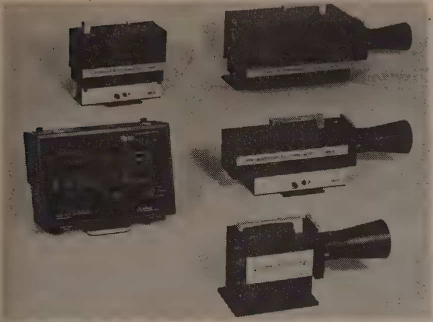
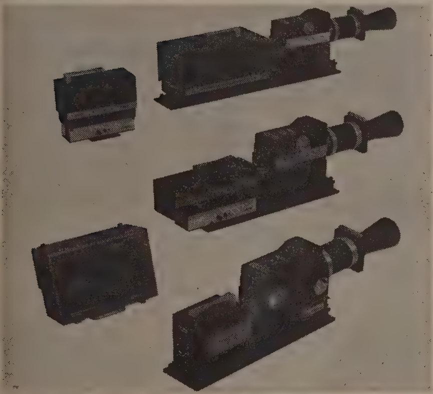
LIGHT MEASUREMENT INSTRUMENTS



MODEL 580 RADIOMETER/PHOTOMETER SYSTEMS

The Model 580 Systems provide fast, accurate measurements of optical radiation in radiometric and photometric terms. The systems are inherently capable of measuring both continuous (cw) sources as well as pulsed events as fast as one nanosecond in duration. An autoranging digital panel display provides readings of average power and integrated energy. The Detector Heads also have provision for oscilloscope display of pulsed light signals so that wave shape measurements can be made, i.e., peak power, pulse duration, and rise and fall times. The spectral range is from 0.2 μm (200 nm) in the ultraviolet to 3.2 μm (3200nm) in the near infrared. The overall dynamic range is over fifteen decades (full scale) of light intensities. The basic system concept can be used in a great variety of applications due to the designed modular approach of interchangeable Detector Heads and accessories. The Model 580 has become an industry standard for most laser output measurements.



MODEL 580/585 SPECTRORADIOMETER SYSTEMS

The Model 580/585 Systems add a digital grating monochromator and additional optics onto the Model 580 Radiometer Detector Head, thereby allowing absolute measurements of the power and energy of chromatic cw and pulsed light sources as a function of wavelength. A truly functional system with provision for recorder ouput and BCD computer interface, the 580/585 can measure over a 12-decade range of light levels. The system can also be used as a radiometer and photometer.

MODEL 550 RADIOMETER/PHOTOMETER SYSTEM

The Model 550 Radiometer/Photometer provides fast, precise measurements with direct readings in 12 photometric and radiometric units. The direct readings, which are easily taken from a 3½ digit panel meter and digital decade indicator, eliminate the need for post measurement calculations. The system is both manual and autoranging over seven full scale decades. Measurements can be obtained of both pulsed and continuous sources with excellent accuracy, repeatability, and stability. Provision for ambient compensation permits its use outside of a dark room environment. High sensitivity is achieved through the use of a single, low noise silicon multiprobe detector.

MODEL 450 PHOTOMETER/RADIOMETER SYSTEM

The Model 450 Photometer/Radiometer System is a lower cost version of the Model 550 System. It is similar in capability to the Model 550 except for one less decade of sensitivity, fewer units of direct readout, and the lack of the autoranging feature.

Other standard light measurement instruments together with accessories and optical calibration standards are available.
E G & G also offers complete optical calibration services.

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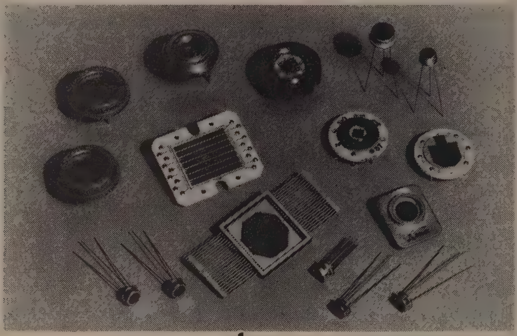
SILICON PHOTODIODES



SILICON PIN PHOTODIODES High Speed Photoconductive

- Spectral Range: 0.35 to 1.15 μm
- Responsivity: 0.5 A/W @ 0.9 μm; 0.42 A/W @ 1.06 μm (YAG Series)
- Linearity of Response: Within 5% over 7 Decades
- Operating Voltage: 0 to 180 Volts

	Active Area	Package	Dark Current	NEP (λ, 600, 1)	Rise Time	Capacitance	Test Voltage
Type No.	(mm²)	(JEDEC)	(nA)	(watts)	(ns)	(pf)	(V)
SGD-040A	0.82	TO-5	3	9.6 x 10^{-14} @ 0.9 μm	3	2	100
SGD-040B	0.82	TO-46	3	9.6 x 10^{-14} @ 0.9 μm	3	2	100
SGD-040L	0.82	TO-5/Lens	3	9.6 x 10^{-14} @ 0.9 μm	3	2	100
SGD-100A	5.1	TO-5	10	1.0 x 10^{-13} @ 0.9 μm	4	4	100
SGD-160	13	TO-8	50	3.0 x 10^{-13} @ 0.9 μm	7	8	100
SGD-444	100	TO-36	200	5.9 x 10^{-13} @ 0.9 μm	10	80	100
SGD-444-2		Same as SGD-444 but in bi-cell configuration					
SGD-444-4		Same as SGD-444 but in quad-cell configuration					
YAG-100A	5.1	TO-5	20	2.2 x 10^{-13} @ 1.06 μm	8	3.5	180
YAG-444	100	TO-36	200	5.6 x 10^{-13} @ 1.06 μm	8	35	180
YAG-444-4		Same as YAG-444 but in quad-cell configuration					
SND-130	0.82	TO-46	—	1.5 x 10^{-14} @ 0.9 μm			
SND-140	5.1	TO-5	—	2.7 x 10^{-14} @ 0.9 μm			
SND-680	23.6	TO-8	—	5.5 x 10^{-14} @ 0.9 μm			
DT-25	5.1	TO-5	30	3.5 x 10^{-13} @ 0.9 μm	5	7	90
DT-40	13	TO-8	70	6.0 x 10^{-13} @ 0.9 μm	7	10	90
DT-110	100	TO-36	400	9.5 x 10^{-13} @ 0.9 μm	10	100	90
SHS-100		Similar to SGD-100A with 30% higher peak responsivity					

SILICON PHOTOVOLTAIC DETECTORS — Low Noise

- Spectral Range: 0.35 to 1.15 μm (PV Series); 0.20 to 1.15 μm (UV Series)
- Responsivity: 0.47 A/W @ .95 μm; 0.09 A/W @ 0.2 μm (UV Series)
- Linearity of Response: Within 1% over 7 Decades
- Operating Mode: Photovoltaic — no bias

	Active Area	Package	Shunt Resistance	NEP (λ, 600, 1)	Rise Time	Capacitance
Type No.	(mm²)	(JEDEC)	(MΩ)	(watts)	(ns)	(pf)
PV-040	0.82	TO-46	500	1.0 x 10^{-14} @ 0.95 μm	12	25
PV-100A	5.1	TO-5	100	3.2 x 10^{-14} @ 0.95 μm	25	150
PV-215	23.6	TO-8	50	4.3 x 10^{-14} @ 0.95 μm	30	700
PV-444A	100	TO-36	10	9.0 x 10^{-14} @ 0.95 μm	45	2800
PV-800A	314	Special	5	1.3 x 10^{-13} @ 0.95 μm	75	9000
UV-100A	5.1	TO-5	100	2.3 x 10^{-13} @ 0.23 μm	25	150
UV-215	23.6	TO-8	50	2.5 x 10^{-13} @ 0.23 μm	30	700
UV-444A	100	TO-36	10	5.0 x 10^{-13} @ 0.23 μm	45	2800
UV-800A	314	Special	5	7.5 x 10^{-13} @ 0.23 μm	75	9000

SILICON DETECTOR/ AMPLIFIER COMBINATIONS

- Spectral Range: 0.35 to 1.15 μm (except HUV Series); 0.20 to 1.15 μm (HUV Series)
- Supply Voltage: ±15 Volts

	Active Area	Package	Responsivity R_f = 200 MΩ	NEP (λ, f, 1)	Gain Band-width Product	Slew Rate
Type No.	(mm²)	(JEDEC)	(V/W)	(watts)	(MHz)	(v/μsec)
HAD-1000A	5.1	TO-5	10^8 @ 0.9 μm	1.5 x 10^{-13} @ 0.95 μm @ 400Hz	2.0	6
HAV-1000	5.1	TO-5	10^8 @ 0.9 μm	1.1 x 10^{-13} @ 0.95 μm @ 400Hz	1.0	6
HAV-4000A	100	Modified DIP	10^8 @ 0.9 μm	9.0 x 10^{-14} @ 0.95 μm @ 400Hz	0.1	5
HUV-1000	5.1	TO-5	10^7 @ 0.23 μm	7.0 x 10^{-13} @ 0.23 μm @ 400Hz	1.0	6
HUV-4000A	100	Modified DIP	10^7 @ 0.23 μm	6.0 x 10^{-13} @ 0.23 μm @ 400Hz	0.1	5
MHZ-018	5.1	Modified DIP	10^8 @ 0.9 μm	4.7 x 10^{-11} @ 0.95 μm @ 18MHz	100	
MHZ-018Y	5.1	Modified DIP	5x10^9 @ 1.06 μm	5.9 x 10^{-11} @ 1.06 μm @ 18MHz	100	
MHZ-016	13	Modified DIP	10^8 @ 0.9 μm	6.8 x 10^{-11} @ 0.95 μm @ 16MHz	100	

CUSTOM PHOTODIODES

In addition to these standard photodiode products, E G & G engineering and production capabilities permit the design and fabrication of custom photodiode devices. Special configurations such as larger and smaller areas, circular and rectangular active areas, arrays, matrices can be manufactured per specific customer requirements. Inquiries for both small and OEM quantities are welcome.

EG&G
ELECTRO-OPTICS DIVISION
35 CONGRESS STREET, SALEM, MASS. 01970 • TEL.: 617-745-3200

XENON FLASHTUBES

Xenon flashtubes. dc krypton arc lamps, and long arc Xenon lamps are available from E G & G in a wide variety of configurations and envelope materials. Tubes are available in linear, bulb-type, helical, "U" shape, coaxial, and air or liquid cooled designs. Envelope materials include quartz, UV inhibiting quartz, and hard glass with a wide range of bore and arc length sizes. Custom configurations are available upon request.

Common applications involve the use of these lamps as the primary light source for:

Laser stimulation
Photocopy systems
Phototypesetting machines
Microfiche systems
Strobes
UV curing of polymers
Marine, aircraft and satellite beacons
Warning beacons
Photoresist exposure
Large area indoor lighting

LINEAR XENON FLASHTUBES — QUARTZ

Type No.	Bore Size I.D. x O.D (mm)	Arc Length (inches)	Max. Energy 1.0 msec pulse (joules)	Min. Operating Voltage (kv)	Min. Trigger Voltage (kv)	Ave.* Power @ 25°C Ambient (watts)
FX-1C-6	4 x 6	6	1680	0.7	20	40
FX-5C-9	4 x 6	9	2520	1.2	20	50
FX-33C-1.5	4 x 6	1.5	420	0.5	15	10
FX-33C-2	4 x 6	2	560	0.6	15	15
FX-38C-2	4 x 6	2	560	0.6	15	15
FX-38C-3	4 x 6	3	840	0.7	15	20
FX-42C-3	7 x 9	3	1490	1.0	20	60
FX-45C-6	7 x 9	6	2980	1.1	20	80
FX-47C-3	13 x 15	3	2040	1.0	20	75
FX-47C-6.5	13 x 15	6.5	5500	1.0	25	100
FX-47C-12	13 x 15	12	8160	1.3	25	125
FX-47C-18	13 x 15	18	12,240	1.6	25	135
FX-52C-3S	7 x 9	3	1490	1.0	20	60
FX-55C-6S	7 x 9	6	2980	1.1	20	80
FX-77C-4	19 x 22	4	5040	1.0	25	125
FX-77C-8	19 x 22	8	10,000	1.2	25	150
FX-77C-13	19 x 22	13	16,400	1.5	25	200
FX-81C-4	10 x 12	4	3080	1.0	25	80
FX-81C-6.5	10 x 12	6.5	5000	1.0	25	90
FX-81C-8	10 x 12	8	6160	1.0	25	100
FX-84C-1.5	4 x 6	1.5	420	0.5	15	10
FX-85C-3	4 x 6	3	840	0.7	15	20
FX-98C-3	5 x 7	3	1050	0.8	15	30
FX-103C-2	4 x 6	2	560	0.6	15	15
FX-103C-3	4 x 6	3	840	0.7	15	20
FX-147C-2	3 x 5	2	420	0.5	15	15

*Forced air cooling (10-15 cu. ft./min.) increases ave. power by approx. factor of 8. Water cooling (1.0 gpm) increases ave. power by approx. factor of 50.

LINEAR WATERCOOLED XENON FLASHTUBES

Type No.	Bore Dia. I.D. (mm)	Arc Length (inches)	Max. Energy (joules)	Average Power (kw)	Operating Voltage Range (kv)	Trigger Voltage Range (kv)
FX-62B-3	7	3	600	4	1.5-2.5	25-30
FX-65B-3	7	3	2000	8	1.5-2.5	25-30
FX-67B-6.5	13	6.5	4000	10	1.7-3.0	25-30
FX-74B-1.5	4	1.5	100	0.5	1.2-1.8	25-30
FX-75B-3	4	3	400	1.0	1.2-2.5	25-30

BULB TYPE XENON FLASHTUBES

Type No.	Max. Energy (joules)	Average Power (watts)	Operating Voltage Range (volts)	Min. Trigger Voltage (kv)	Max. Rep. Rate (pps)	Arc Discharge Length (inches)
FX-6A, FX-6AU, FX-48, FX-101, FX-108, FX-108AU	5	7	400-1000	2.5	500	5/16
FX-6B, FX-6BU, FX-35B, FX-101B, FX-102, FX108B, FX-108BU	5	7	500-1000	4.0	2500	5/16
FX-127	5	7	500-1000	4.0	2500	⅛
FX-76, FX-133, FX-138	20	20	500-1500	5.0	2500	5/16
FX-124, FX-137	15	20	500-1500	5.0	2500	⅛
FX-132	200	100	100-1500	7.0	500	⅜

DC KRYPTON ARC DISCHARGE TUBES

Type No.	Bore Dia. I.D. (mm)	Arc Length (ins.)	Ave. Power Water Cooled (kw)	Steady State Voltage (Vdc)	Steady State Current (Adc)	Static Impedance (Ohms)	Min. Anode Voltage (kvdc)	Min. Trigger Voltage (kv)
FK-99C-2	4	2	2750	81	34	2.3	1-1.5	15-20
FK-99C-3	4	3	4000	125	32	3.9	1-1.5	15-20
FK-111C-2	7	2	4000	80	50	1.6	1-1.5	15-20
FK-111C-3	7	3	6000	115	52	2.2	1-1.5	15-20
FK-125C-2	5	2	3500	81	43	1.9	1-1.5	15-20
FK-125C-3	5	3	5000	115	44	2.6	1-1.5	15-20
FK-128C-3	10	3	8000	97	84	1.2	1-1.5	15-20
FK-128C-10	10	10	15000	276	56	4.9	1-1.5	15-20

XENON FLASHTUBES FOR PULSED DYE LASERS

Type No.	Bore Dia. I.D. (mm)	Arc Length (inches)	Max. Energy (joules)	Operating Voltage (kv)	Pulse Width (μs)
FX-139C-3.5	3.5	3.5	10	10	1
FX-140C-3.5	5.0	3.5	25	10	2
FX-141C-3.5	7.0	3.5	100	10	3
FX-142C-3.5	7.0	3.5	200	20	6
FX-143C-6.0	15.0	6.0	1000	20	12

HEWLETT PACKARD
COMPONENTS

Isolators and Photodetectors

PIN PHOTODIODES

- High Speed — <1 ns
- Low Light Level Detection
- Wide Dynamic Range — dc to 1 GHz
- Low Noise
- Wide Spectral Response — UV to IR
- Low Capacitance

ISOLATORS

- High Speed — to 10M bit/s
- Low Input Currents — from 0.5 mA
- High CTR — to 800%
- Performance Guaranteed over Temperature Range
- TTL Compatible Output
- High Common Mode Rejection
- U.L. Recognized Component
- High Density Packaging

PIN Photodiodes

OPTICAL CHARACTERISTICS AT 25°C

Characteristics		Irradiance Response at 770 nm [1] (RA)	Sensitive Area (A)	Detectivity (D*)	Speed of Response	Dark Current		Noise Equivalent Power (NEP)
Units		μA/mW/cm²	cm²	cm $Hz^{1/2}$/watt	nsec	pA	pA	W $Hz^{-1/2}$
Test Conditions		V = -20 R_L = 1 MΩ		(0.8, 100, 6) (λ, f, Δf)	V = -20 R_L = 50Ω	V_R = -10 V	V_R = -25 V	(0.8, 100, 6) (λ, f, Δf)
5082-4203	Min.			0.9×10^{12}				
	Typ.	1.0	2×10^{-3}		<1			
	Max.						2000	5.1×10^{-14}
5082-4204	Min.			4.1×10^{12}				
	Typ.	1.0	2×10^{-3}		<1			
	Max.					600		1.2×10^{-14}
5082-4205	Min.			3.95×10^{12} [2]				
	Typ.	1.5 [2]	3×10^{-3} [2]		<1			
	Max.					150		1.4×10^{-14}
5082-4207	Min.			2.5×10^{12}				
	Typ.	4.0	8×10^{-3}		<1			
	Max.					2500		3.6×10^{-14}
5082-4220	Min.			0.57×10^{12}				
	Typ.	1.0	2×10^{-3}		<1			
	Max.						5000	8×10^{-14}

NOTES:

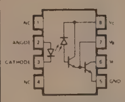
1. Response at 770 nm may be described as a RESPONSIVITY, R ≈ 0.5 μA/μW corresponding to a quantum efficiency, η ≈ 0.75 electron/photon.
2. Specification includes lens effect.
3. For further information ask for AN 915 on Threshold Detection with PIN Photodiodes.

HEWLETT PACKARD

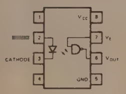
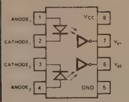
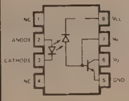
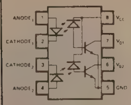
HPA DIVISION · 640 Page Mill Road, Palo Alto, California 94304, Telephone 415 493-1212, TWX 910 373-1751/1247

HEWLETT PACKARD
COMPONENTS

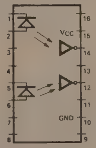
Low Input Current/High Gain Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation
	5082-4371[2]	Low Input Current, High Gain. V_{CC}=18V Max.	Line Receiver, Ultra Low Current Ground Isolation, CMOS/LTTL CMOS/TTL, CMOS/CMOS	300k bit/s	400% Min.	0.5mA	2500V[4]
	5082-4370[2]	Low Input Current, High Gain. V_{CC}=7V Max.	Line Receiver, Low Current, TTL/TTL, LTTL/TTL, CMOS/TTL		300% Min.	1.6mA	

High Speed Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation
	5082-4360[2]	Ultra High Speed Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	600% Typ.	5.0mA	2500V[4]
	5082-4364[2]	Dual 5082-4360	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	600% Typ.	5.0mA	2500V[4]
	5082-4350	High Speed Transistor Output Isolator	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LTTL, Ground Isolation	1M bit/s	7% Min.	16mA	2500V[4]
	5082-4351				15% Min.		
	5082-4352				15-22%[3]		
	5082-4354	Dual 5082-4350	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LTTL, Ground Isolation	1M bit/s	7% Min.	16mA	2500V
	5082-4355	Dual 5082-4351			15% Min.		

High Reliability Isolator

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation
	5082-4365[2]	Dual Channel Hermetically Sealed Optically Coupled Logic Gate. TX – Screened TXB – Screened with Grp. B Data	Line Receiver, Ground Isolation for High Reliability Systems	10M bit/s	400% Typ.	10mA	1500V
	TX-4365[2]						
	TXB-4365[2]						

NOTES:
1. For further information ask for Application Notes 939, 948 and 951-1.
2. Performance guaranteed over complete operational temperature range.
3. The 5082-4352 Current Transfer Ratio Specification is guaranteed to be 15% minimum and 22% maximum.
4. U.L. recognized.

HEWLETT PACKARD

HPA DIVISION · 640 Page Mill Road, Palo Alto, California 94304, Telephone 415 493-1212, TWX 910 373-1751/1247

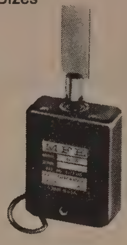
MFE

KEEWAYDIN DRIVE • SALEM, NEW HAMPSHIRE 03079
TEL. (603) 893-1921 • TWX 710-366-1887 • TELEX 94-7477

OPTICAL SCANNING MOTORS

FOR ALL OPTICAL AND MECHANICAL SCANNING APPLICATIONS:

- Moving Iron Motors
- High Reliability
- Up To ±15° Deflection
- High Frequency Response
- Long Life
- Tangent Corrected Response
- Low Power
- Four Frame Sizes



DESCRIPTION

MFE Optical Scanning Motors are a development of the highly proven MFE moving iron motor technology. All MFE scanning motors feature high reliability, long life, low-power consumption, and up to ±15° deflection.

Typically, MFE Scanning Motors are internally compensated for tangent corrected response. Tangent correction is provided such that the deflection of the image on a flat projection plane is directly proportional to driving current.

Accessory equipment such as mirrors, mirror mounts, drive amplifiers and power supplies can be provided with the Scanning Motors. The aluminized mirrors with silicon oxide protective coating have one wave per inch flatness and are available in a variety of sizes. Special mirrors to satisfy individual requirements are available.

PERFORMANCE SPECIFICATIONS

Model	S4-025	S4-050			S4-075			S4-150	
Spring Selection	A	A	B	C	A	B	C	B	C
Maximum Rotation (Degrees)	±15	±15	±15	±7.5	±15	±15	±7.5	±15	±7.5
Rotor Inertia (gm-cm²)	1.3	2.6	2.6	2.6	4	4	4	6.7	6.7
Null Torque (gm-cm)	125	250	250	250	350	350	350	750	750
Natural Frequency (Hz)	160	110	160	230	90	130	185	100	130
Linearity (% of p.t.p.)	2	1	1	1	.75	.75	.75	.5	.5
Hysteresis (% of p.t.p.)	2	1	1	1	.75	.75	.75	.5	.5
Repeatability	.05	.05	.05	.05	.05	.05	.05	.05	.05
Resistance (OHMS/coil)	15	19	19	19	14	14	14	22	22
Weight (oz.)	6	8	8.5	8.5	9.5	8.5	8.5	14.5	14.5
Cross Section (inches)	2x1⅛	2x1⅛	2x1⅛	2x1⅛	2 x 1⅛	2x1⅛	2x1⅛	2x1⅛	2x1⅛
Height (inches) (L)	1 11/32	1 9/16	1⅝	1⅝	1 27/32	1⅝	1⅝	2 9/16	2 9/16

PEN MOTORS

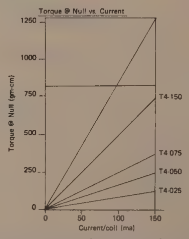
Output rotation is tangent corrected to facilitate use in edge writing oscillographs. The R-4 Series Motors have been successfully used in many thousands of strip chart recorders which are now employed in the medical monitoring field as well as other industrial applications. When used with a stylus of less than 25 gram-cm² inertia, 100 Hz or better 3 db frequency response is easily attainable.

PERFORMANCE DATA

	Units	R4-077	R4-155
Rotation	degrees	±14.5	±14.5
Rotor Inertia	gm-cm²	4	8
Null Torque (Minimum)	gm-cm	350	750
D.C. Power for full scale	watts	1.5	2.0
Natural Frequency (no load)	cps	90	100
Linearity	% of p.t.p.	±.75	±.5
Hysteresis	% of p.t.p.	±.75	±.5
Weight	ounces	9	16
Cross Section	inches	1⅛ x 2	1⅛ x 2
Height, overall	inches	1⅝	2½
Height of stack	inches	.77	1.54
Resistance*	ohms/coil	14	22

* Each motor is wound with two coils which may be used in series or parallel.

TORQUE MOTORS



The proprietary MFE Series T-4 limited rotation torque motors are moving iron devices. The high performance of these units makes them widely applicable in the actuator field. The features are small size, ruggedness, low power and high stability. The output torque and response time are as high as those of competing devices which exhibit hysteresis and nonlinearity greater by an order of magnitude. The T-4 Series is designed for maximum torque in applications requiring ±15° rotation such as:

- Servo systems
- Process control
- Optical systems
- Stable platforms

Technical Information:

Standard spring stiffness values are:

A — 1350 B — 2850
C — 5700 gm-cm/rad 0 — No spring

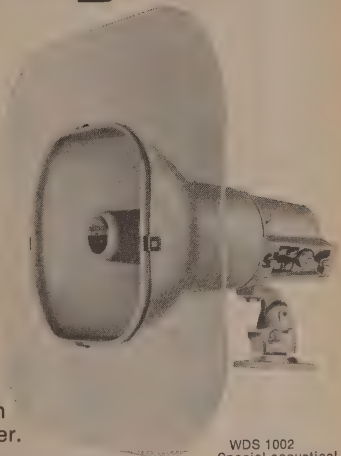
Standard units are supplied with rotor mounted on a spring and bearings. Other configurations with single or dual flexures are available with small angle of rotation for extremes of environment or performance.

TYPICAL SPECIFICATIONS

Model No.	T4-025	T4-050	T4-075	T4-150
Maximum Torque at Null (gm-cm)	125	250	350	750
Power at Rated Torque (watts)	0.7	0.9	1.0	1.5
Coil Resistance/ coil (ohms)	15	19	22	32
Rotation	±15°	±15°	±15°	±15°
Inertia (gm-cm²)	1.3	2.6	4	8
Linearity	0.2% — 2.0% peak-to-peak			
Force Hysteresis	0.2% peak-to-peak			
Motion Hysteresis	0.2% — 1 % depending on mounting			

the SOUND of security.

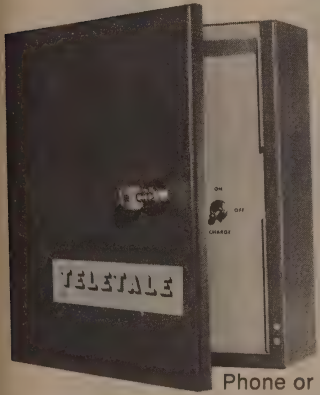
It warns intruders to stay out, and triggers the alarm if they don't.



WDS 1002
Special acoustical
sensor/transducer

There's nothing quiet about the Teletale surveillance system. But that's the idea behind it—to discourage break-ins and prevent costly damage and trouble. Teletale sends out a continuous, audible tone (840 Hz) that makes intruders think twice. If they ignore it, intrusion is sensed immediately and a relay activates to sound an alarm, switch on auxiliary equipment or signal a security center.

You can rely on Teletale. Because the sensing frequency responds only to movement of man-sized objects. It rejects other mechanical and electrical disturbances which are apt to trigger false alarms, such as those that occur in high frequency, ultrasonic or microwave systems. Attempts to disarm it will trip the alarm circuit.



WDS 2001
Teletale master
motion detector

The basic Teletale system consists of a solid state master motion detector, and a special sensor that fills each area with an audible tone. Up to eight sensors can be used to cover larger areas, separate locations or remote buildings. The Teletale sensors can be used for paging, local warble alarm or audio monitoring applications. The master unit has both normally closed and normally open contact outputs. Even during power failure, rechargeable batteries in the master detector will provide uninterrupted service for over 24 hours. The batteries are recharged automatically when AC power is restored.

Installation is simple as well as day-to-day operation.

Phone or write for Technical Information and Specifications.
MRC Alarm Systems and Devices Company, 700 West Virginia Street,
Milwaukee, Wisconsin 53204, 414/271-4343

TELETALE

SEIA

NATIONAL
BURGLAR &
FIRE ALARM

SURVEILLANCE SECURITY SYSTEMS

1393

NSL OPTOELECTRONIC

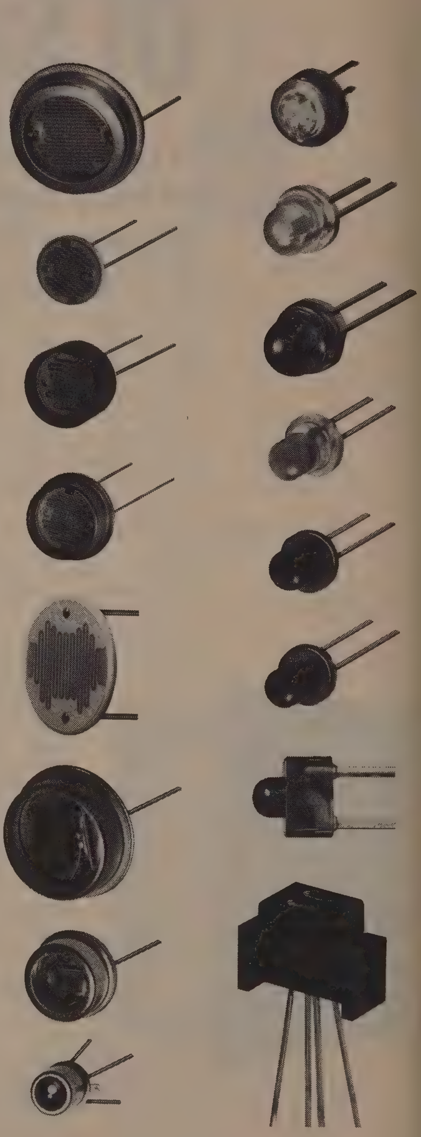
GALLIUM PHOSPHIDE LEDs

NSL Part No.	Applications	Lens Type	Angle of Half Intensity	Normal Luminous Intensity in mcd @ 10 mA Red @ 20 mA Green Yellow Minimum	Typical	Package Style
RED						
MA 2301R	Extended Source Indicator	Water Clear	25°	1.0	4.0	.215″ dia. .160″ H faceted epoxy
MA 2302R	Extended Source Indicator	Red Clear	25°	1.0	4.0	
MA 2401R	Indicator/Illuminator	Water Clear	30°	.85	3.6	Hi-profile T 1 ¾; .2″ dia. .36″ H epoxy, lead frame
MA 2402R	Indicator/Illuminator	Red Clear	30°	.85	3.6	
MA 2403R	Indicator	Translucent	30°	.85	2.4	
MA 2404R	Indicator	Red Diffused	30°	.85	2.4	
MA 2601R	Indicator/Illuminator	Water Clear	30°	.85	3.6	Low-profile T 1 ¾; .2″ dia. .25″ H epoxy; lead frame
MA 2602R	Indicator/Illuminator	Red Clear	30°	.85	3.6	
MA 2603R	Indicator	Translucent	30°	.85	2.4	
MA 2604R	Indicator	Red Diffused	30°	.85	2.4	
MA 2701R	Indicator	Water Clear	30°	.85	3.6	Low profile T 1 ¾ in side viewing PCB mount, epoxy package
MA 2702R	Indicator	Red Clear	30°	.85	3.6	
MA 2703R	Indicator	Translucent	30°	.85	2.4	
MA 2704R	Indicator	Red Diffused	30°	.85	2.4	
MA 2801R	Wide-angle Indicator	Water Clear	75°	.4	1.5	TO-18 style, .168″ dia., .225″ H epoxy, lead frame
MA 2802R	Wide-angle Indicator	Red Clear	75°	.4	1.5	
MA 2803R	Wide-angle Indicator	Translucent	75°	.4	1.0	
MA 2804R	Wide-angle Indicator	Red Diffused	75°	.4	1.0	
MA 3101R	Min. Indicator/Illuminator	Water Clear	40°	.8	2.3	T ¾; .08″ dia., .14″ H epoxy, lead frame
MA 3102R	Min. Indicator/Illuminator	Red Clear	40°	.8	2.3	
MA 3103R	Miniature Indicator	Translucent	40°	.8	1.5	
MA 3104R	Miniature Indicator	Red Diffused	40°	.8	1.5	
MA 3201R	Indicator/Illuminator Array Element	Water Clear	25°	.6	2.2	Narrow .084″ w, .160″ l, .151″ H stackable epoxy, lead frame
MA 3202R	Indicator/Illuminator Array Element	Red Clear	25°	.6	2.2	
MA 3203R	Indicator Array Element	Translucent	25°	.6	1.6	
MA 3204R	Indicator Array Element	Red Diffused	25°	.6	1.6	
GREEN						
MA 2301G	Extended Source Indicator	Water Clear	25°	1.0	2.8	.215″ dia. .160″ H faceted epoxy
MA 2302G	Extended Source Indicator	Green Clear	25°	1.0	2.8	
MA 2401G	Indicator/Illuminator	Water Clear	30°	.8	2.4	Hi-profile T 1 ¾; .2″ dia. .36″ H epoxy, lead frame
MA 2402G	Indicator/Illuminator	Green Clear	30°	.8	2.4	
MA 2403G	Indicator	Translucent	30°	.8	1.6	
MA 2404G	Indicator	Green Diffused	30°	.8	1.6	
MA 2601G	Indicator/Illuminator	Water Clear	30°	.8	2.0	Low-profile T 1 ¾; .2″ dia. .25″ H epoxy; lead frame
MA 2602G	Indicator/Illuminator	Green Clear	30°	.8	2.0	
MA 2603G	Indicator	Translucent	30°	.8	1.6	
MA 2604G	Indicator	Green Diffused	30°	.8	1.6	
MA 2701G	Indicator	Water Clear	30°	.8	2.0	Low-profile T 1 ¾ in side viewing PCB mount, epoxy package
MA 2702G	Indicator	Green Clear	30°	.8	2.0	
MA 2703G	Indicator	Translucent	30°	.8	1.6	
MA 2704G	Indicator	Green Diffused	30°	.8	1.6	
MA 2801G	Wide-angle Indicator	Water Clear	75°	.3	.9	TO-18 style, .168″ dia., .225″ H epoxy, lead frame
MA 2802G	Wide-angle Indicator	Green Clear	75°	.3	.9	
MA 2803G	Wide-angle Indicator	Translucent	75°	.3	.6	
MA 2804G	Wide-angle Indicator	Green Diffused	75°	.3	.6	
MA 3101G	Min. Indicator/Illuminator	Water Clear	40°	.8	3.0	T ¾; .08″ dia., .14″ H epoxy, lead frame
MA 3102G	Min. Indicator/Illuminator	Green Clear	40°	.8	3.0	
MA 3103G	Miniature Indicator	Translucent	40°	.8	1.5	
MA 3104G	Miniature Indicator	Green Diffused	40°	.8	1.5	
MA 3201G	Indicator/Illuminator Array Element	Water Clear	25°	.6	1.8	Narrow .084″ w, .160″ l, .151″ H stackable epoxy, lead frame
MA 3202G	Indicator/Illuminator Array Element	Green Clear	25°	.6	1.8	
MA 3203G	Indicator Array Element	Translucent	25°	.6	1.5	
MA 3204G	Indicator Array Element	Green Diffused	25°	.6	1.5	
YELLOW						
MA 2301Y	Extended Source Indicator	Water Clear	25°	1.0	3.5	.215″ dia. .160″ H faceted epoxy
MA 2302Y	Extended Source Indicator	Yellow Clear	25°	1.0	3.5	
MA 2401Y	Indicator/Illuminator	Water Clear	30°	.8	3.4	Hi-profile T 1 ¾; .2″ dia. .36″ H epoxy, lead frame
MA 2402Y	Indicator/Illuminator	Yellow Clear	30°	.8	3.4	
MA 2403Y	Indicator	Translucent	30°	.8	2.3	
MA 2404Y	Indicator	Yellow Diffused	30°	.8	2.3	
MA 2601Y	Indicator/Illuminator	Water Clear	30°	.8	2.9	Low-profile T 1 ¾; .2″ dia. .25″ H epoxy lead frame
MA 2602Y	Indicator/Illuminator	Yellow Clear	30°	.8	2.9	
MA 2603Y	Indicator	Translucent	30°	.8	1.9	
MA 2604Y	Indicator	Yellow Diffused	30°	.8	1.9	
MA 2701Y	Indicator	Water Clear	30°	.8	2.9	Low-profile T 1 ¾ in side viewing PCB mount, epoxy package
MA 2702Y	Indicator	Yellow Clear	30°	.8	2.9	
MA 2703Y	Indicator	Translucent	30°	.8	1.9	
MA 2704Y	Indicator	Yellow Diffused	30°	.8	1.9	
MA 2801Y	Wide-angle Indicator	Water Clear	75°	.3	1.3	TO-18 style, .168″ dia., .225″ H epoxy, lead frame
MA 2802Y	Wide-angle Indicator	Yellow Clear	75°	.3	1.3	
MA 2803Y	Wide-angle Indicator	Translucent	75°	.3	.8	
MA 2804Y	Wide-angle Indicator	Yellow Diffused	75°	.3	.8	
MA 3101Y	Min. Indicator/Illuminator	Water Clear	40°	.8	4.3	T ¾; .08″ dia., .14″ H epoxy, lead frame
MA 3102Y	Min. Indicator/Illuminator	Yellow Clear	40°	.8	4.3	
MA 3103Y	Miniature Indicator	Translucent	40°	.8	3.0	
MA 3104Y	Miniature Indicator	Yellow Diffused	40°	.8	3.0	
MA 3201Y	Indicator/Illuminator Array Element	Water Clear	25°	.6	2.6	Narrow .084″ w, .160″ l, .151″ H stackable epoxy, lead frame
MA 3202Y	Indicator/Illuminator Array Element	Yellow Clear	25°	.6	2.6	
MA 3203Y	Indicator Array Element	Translucent	25°	.6	1.8	
MA 3204Y	Indicator Array Element	Yellow Diffused	25°	.6	1.8	

GALLIUM ARSENIDE INFRARED LEDs

NSL Part No.	Typical Characteristics P_O mW	@ I_F V_F V	@ I_F I_F mA	Maximum Ratings Power Dissip.	Fwd. Current Cont.	Pulse	Half Angle	Package Style
NSL-110	2.5	1.3	40	400 mW	300 mA	5 A	25°	Lensed TO-18
MA 2601 IR	2.0	1.3	40	75 mW	50 mA	1 A	15°	Low-profile T 1 ¾

NATIONAL SEMICONDUCTORS LTD.



Manufacturers of optoelectronic devices

NSL OPTOELECTRONIC

CdS & CdSe PHOTOCELLS

Cell Type No.	Typ. 1 Ftc Res. KΩ	Min. Dark Res. MΩ	Max. Peak Volt.	Max. Power MW.	Description
NSL-312	75	100	70	50	CdSe Photoconductive Cell in Hermetic Glass and Metal TO-18. Hermetic CdS and epoxy coated "open pill" versions also available.
NSL-313	30	100	70	50	
NSL-314	14	100	70	50	
NSL-315	550	1000	250	50	
NSL-316	260	1000	250	50	
NSL-317	110	1000	250	50	
NSL-318	50	500	120	50	
NSL-443	200	300	2000	1000	CdS Photoconductive Cell in Hermetic Glass and Metal 1.25″ Dia. Case. Epoxy coated "open pill" versions also available.
NSL-444	120	100	2000	1000	
NSL-445	26.0	15	420	1000	
NSL-446	11.4	5	420	1000	
NSL-447	.5.5	1	420	1000	
NSL-361	65	200	70	100	CdSe Photoconductive Cell in Hermetic Glass and Metal ¼″ Dia. Case. Hermetic CdS versions also available.
NSL-362	28	200	70	100	
NSL-363	12	200	70	100	
NSL-364	5.2	200	70	100	
NSL-365	550	3000	250	100	
NSL-366	230	3000	250	100	
NSL-367	100	3000	250	100	
NSL-481	43.0	65	120	200	CdS Photoconductive Cell in Hermetic Glass and Metal TO-5. Hermetic CdSe and epoxy coated "Open Pill" versions also available.
NSL-482	18.6	15	120	200	
NSL-483	8	1.8	120	200	
NSL-484	3.5	0.25	120	200	
NSL-485	330	200	250	200	
NSL-486	155	130	250	200	
NSL-487	66	20	250	200	
NSL-294	.75	10	70	500	CdS/Se photoconductive cell in Hermetic Glass and Metal TO-8. Glass Lens and Epoxy coated "Open Pill" versions also available
NSL-297	7.5	100	250	500	
NSL-3921	4.0	2	80	200	CdSe Photoconductive Cell in Plastic Case. Glass Lens and Epoxy Coated "Open Pill" and CdS versions also available
NSL-3931	1.7	2	80	200	
NSL-3941	0.75	1	80	200	
NSL-3951	40.0	20	320	200	
NSL-3961	17.0	20	320	200	
NSL-3971	7.5	10	320	200	
NSL-491	9.3	14	80	500	CdS Photoconductive Cell in Hermetic Glass and Metal TO-8. Hermetic CdSe version also available.
NSL-492	4.0	3.2	80	500	
NSL-493	1.7	0.4	80	500	
NSL-494	0.75	0.05	80	500	
NSL-495	40	32	320	500	
NSL-496	17	4.0	320	500	
NSL-497	7.5	0.54	320	500	

PHOTODETECTOR LAMP ASSEMBLIES

CdSe Photodetector

	Emitter		Detector				
Module Type No.	Volts	Current MA	Max. ON Res. Ω	Min. OFF Res. MΩ	Max. Volts	Max. Power	Description
PL-1033-1	10	15	100	10	80	250	Phenolic .75″ x .75″ x .625″ Pin Leads for P.C. Board Mounting. (Matched, Multi-Detector Configurations also available)
PL-1036-1	10	15	400	100	320	250	
PL-2H33-1	120	2	100	10	80	250	
PL-2H36-1	120	2	400	100	320	250	
PL-3A33-1	100	2	150	10	80	250	
PL-3A36-1	100	2	500	100	320	250	
PL-5S33-1	2	25	200	10	80	250	
PL-5S36-1	2	25	2000	100	320	250	
PLT-10384	10	15	400	10	80	100	Standard Tube; Axial Leads
PLT-10387	10	15	5000	100	320	100	
PLT-2H384	200	2	500	10	80	100	
PLF-5S380	2	25	250	10	80	100	4 Leaded, Hermetic TO-5
PLF-5S387	2	25	4000	100	320	100	
PLS-5S380	2	25	250	10	80	100	Small Tube, Axial Leads
PLS-5S387	2	25	4000	100	320	100	
PLM-5S310	2	25	500	10	80	50	Miniature Tube, Axial Leads
PLM-5S387	2	25	5000	100	320	50	

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331 Cornelia St., Plattsburgh, N.Y. 12901 - Tel. (518) 561-3160
2150 Ward Street, Montreal, Que. H4M 1T7 - Tel. (514) 744-5507
TWX 610-421-3362

Silicon Photodetector

	Emitter		Detector		Coupled Characteristics		
Module Type No.	Volts	Current MA	Min. BV_{CEO}	Typ. Dark Curr. nA	Current Trans. Ratio	Rise Fall Time µsec	Description
PLF-6S610	1.5	50	30	1	30	3	4 Leaded, Hermetic TO-5 Isolation: 700V
PLF-6S510	1.5	50	50	2	0.1	0.05	
PLF-6S910	1.5	50	15	20	1000	70	
PLM-6S610	1.5	50	30	1	30	3	Miniature Tube, Axial Leads. Isolation: 2.5 kV
PLM-6S510	1.5	50	50	2	0.1	0.05	
PLM-6S910	1.5	50	15	20	1000	70	
PLS-6S610	1.5	50	30	1	30	3	Small Tube, axial leads. Isolation: 5kV.
PLS-6S510	1.5	50	50	2	0.1	0.05	
PLS-6S910	1.5	50	15	20	1000	70	
ORL-6S600	1.5	25	30	1	0.1	5	Reflective .5″ x .225″ x .375″ PCB Mount.
ORL-6S900	1.5	25	15	20	20	70	
ORM-6S600	1.5	25	30	1	0.1	5	Mini-Reflective .316″ x .225″ x .19″.
ORM-6S900	1.5	25	15	20	20	70	
OIL-6S600	1.5	25	30	1	30	5	Interruptor 1.0″ x .25″ x .425″
OIL-6S900	1.5	25	15	20	1000	70	

SILICON PHOTODIODES

NSL Type No.	Minimum Short Ckt.* Curr. MA	Min. Open Ckt.* Volt.	Dark Curr. µA @ 1 V @ 55°C	Reverse Voltage Recom. Maximum	Description
NSL-701-1	0.30	0.35	10	5	.1″ x .2″ Chip. Wire Leads
NSL-801-1	0.325	0.275	5	10	
NSL-701-9	0.30	0.35	10	5	9 element Cell, 0.1″ Spacing
NSL-702	0.6	0.35	10	5	.2″ x .2″ Chip. Wire Leads
NSL-802	0.65	0.275	5	10	
NSL-703	1.4	0.35	40	5	.2″ x .4″ Chip. Wire Leads
NSL-803	1.5	0.275	20	10	
NSL-705	4.5	0.35	50	5	.76″ x .354″ Chip. Wire Leads
NSL-805	4.77	0.275	25	10	
NSL-706	2.9	0.35	40	5	.4″ x .4″ Chip. Wire Leads
NSL-806	3.0	0.275	20	10	
NSL-707	3.3	0.35	50	5	.2″ x 1″ Chip. Wire Leads
NSL-807	3.5	0.275	25	10	
NSL-708	1.3	0.35	30	5	.1″ x 1″ Chip. Wire Leads
NSL-808	1.4	0.275	15	10	
NSL-710	0.125	0.4	2	5	TO-18 Package
NSL-810	0.150	0.275	1	10	
NSL-751	1.4	0.35	40	5	0.5″ dia. Epoxy Package
NSL-851	1.5	0.275	20	10	
NSL-781	0.28	0.35	10	5	Hermetic TO-5 Case
NSL-881	0.3	0.275	5	10	
NSL-782	0.42	0.35	10	5	
NSL-791	0.60	0.35	10	5	Hermetic TO-8 Case
NSL-792	1.1	0.35	30	5	

*At 500 Ftc (25 MW/cm²) 2870°K Source.

SILICON PHOTOTRANSISTORS & PHOTODARLINGTONS

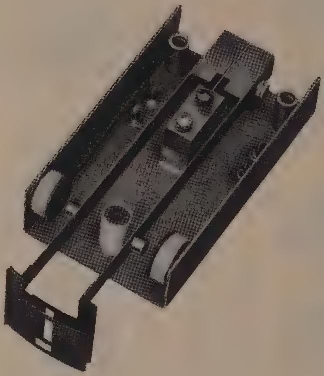
	I_{CEO} MA @ 5 V			Dark I_{CEO} @ 15V 25°C — nA		
NSL Type No.	Min.	Typ.	MW/cm²	Typ.	Max.	Description
NSL-610-1	.2	1	10	1	50	TO-18 Encased NPN Silicon Phototransistor; Power Dissipation @ 25°C 200 mW, Minimum Breakdown Voltage BV_{CEO} 30 volts
NSL-610-3	1	3	10	1	50	
NSL-610-6	4	6	10	1	50	
NSL-610-9	7	9	10	1	50	
NSL-611	8	15	10	10	100	
NSL-612	.4	1.5	1	10	100	Epoxy/no lens.
NSL-613	.4	2.5	1	10	100	Epoxy/lens.
NSL-614	.2	.9	5	2	100	Epoxy/no lens.
NSL-615	.2	1.4	5	2	100	Epoxy/lens.
NSL-2565	.4	2	10	2	100	9 Element Array. 0.1″ Spacing
NSL-2638	.4	2	10	2	100	
NSL-910	1	6	.1	20	250	TO-18, BV_{CEO} 15 V
NSL-912	.7	4	.1	20	250	Epoxy/no lens
NSL-913	1	6	.1	20	250	Epoxy/lens

FORK OSCILLATORS

Output frequencies from 1.0 to 20,000 Hz. Absolute frequency accuracies from ±.10% to ±.001%. Operating temperature ranges up to from −55°C to +100°C depending upon accuracy. Wide choice of DC inputs from 5 to 28 volts and output waveshapes such as logic-clock, square or sine. Full MIL shock and vibration environmental capability, hermetically-sealed designs. Also ultra low current versions, miniature sizes, specials to suit either your performance or packaging requirements.

FORK OPTICAL MODULATORS

Frequencies from 40 to 1,000 Hz . . . for modulating or chopping either light or energy beams. May often be used to replace motor driven choppers, offering weight and power savings plus no need to lubricate. Particular design and construction provides exceptional fork balance and high resistance to shock and vibration for most MIL specs. Tine ends may be fitted with shutters, lenses, or mirrors to suit your special requirements, various drive circuits available.



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Still smaller oscillators, a greater selection of fork optical modulators, and new optical scanning devices.

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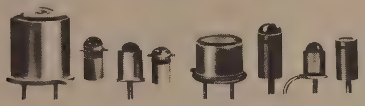
OPTOELECTRONIC PRODUCTS FROM SPECTRONICS

Whether your requirements are for opto chips, components, assemblies or systems—call Spectronics *first*. We make optoelectronics work . . . for you!

DISCRETE PHOTOTRANSISTORS & LEDs

Spectronics offers the industry's largest selection of standard optoelectronic components. Included are detectors in phototransistor, photodarlington and photodiode configurations that directly replace popular industrial types. High performance GaAs LED's are available also in standard industrial types. For special applications, non-standard devices are available upon request.



OPTICALLY COUPLED ISOLATORS

Spectronics offers the first 5KV isolator in the popular 6-pin dual in-line package. These components are directly inter-changeable with standard industrial 6-pin isolators. The complete Spectronics line ranges from miniature hybrid couplers to hermetically sealed TO-5 packages for both photodarlington and phototransistor versions.

OPTICAL SWITCHES

Spectronics low-cost optical switches are available in the industry's largest selection of standard device types. Direct replacements for such popular devices as the H13A1, A2; H13B1, B2; MCA 8, 81 and MCT 8, 81 are available at competitive prices. Six popular Spectronics switches are offered with off-the-shelf delivery, in both phototransistor and photodarlington versions.

REFLECTIVE ASSEMBLIES

Standard reflective assemblies are offered in four basic configurations in both phototransistor and photodarlington versions. These low-cost assemblies are available with off-the-shelf delivery.

Spectronics
INCORPORATED
830 East Arapaho Rd., Richardson, Texas 75080
(214) 234-4271 TELEX 73-0890

CUSTOM ASSEMBLIES

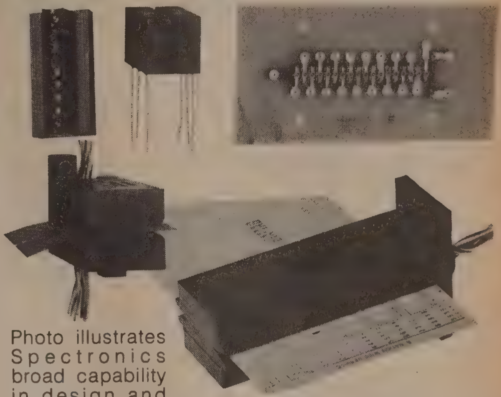
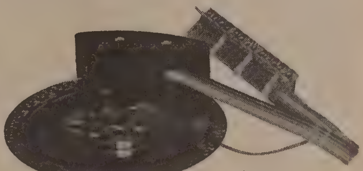


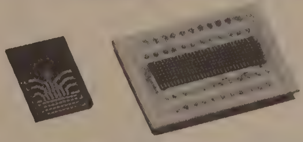
Photo illustrates Spectronics broad capability in design and manufacturing of custom optical assemblies. Units shown range from PC board arrays to specially configured optical switches with such features as aperturing, to functional card and tape readers containing complete logic circuits.

PRECISION ENCODERS



Spectronics precision rotary optical encoders used in encoding altimeters, numerical control machine tools, and other measuring instruments. The units are available with from 1 to 10 data channels and with analog signal or digital signal outputs. The code disc is typically manufactured using chrome on glass. Construction is all solid state utilizing light emitting diodes and phototransistors.

CUSTOM VISIBLE LEDs (IN RED AND GREEN) & IR DETECTORS



Spectronics offers state-of-the-art performance in linearity, element size and spacing with linear, staggered and x-y select configurations available. Capability ranges from VLEDs to detectors available in silicon, indium antimonide, indium arsenide and mercury cadmium telluride. Up to several hundred individual elements offered in a variety of packages and dewars.

VACTEC PHOTOTRANSISTORS PHOTODARLINGTONS

NPN SILICON
PASSIVATED

Hermetic VTT, VTA 101 and 111 SERIES TO-18

		P.N.	$I_{CEO\ TYP}$**	WINDOW
PHOTOTRANSISTORS	LARGE CHIP *	VTT1012	.5	Flat
		VTT1011	1.0	''
		VTT1010	2.0	..
		VTT1013	4.0	..
		VTT1110	2.0	Lens
		VTT1111	3.5	''
		VTT1112	6.0	..
		VTT1113	12.0	..
	SMALL CHIP *	VTT1020	.125	Flat
		VTT1021	.250	..
		VTT1022	.500	..
		VTT1023	1.0	''
		VTT1120	.5	Lens
		VTT1121	1.0	''
		VTT1122	2.0	..
		VTT1123	4.0	''
PHOTODARLINGTONS	LARGE CHIP *	VTA1011	2.0	Flat
		VTA1012	6.0	''
		VTA1013	15.0	''
		VTA1111	9.0	Lens
		VTA1112	35.0	''
	SMALL CHIP *	VTA1021	.5	Flat
		VTA1022	1.5	''
		VTA1023	4.0	''
		VTA1121	3.0	Lens
		VTA1122	8.0	''

* Small chips are 25 x 25 mil., Large are 50 x 50 mil.

VTT, VTA 202 and 212 SERIES Hermetic Pill Package

		P.N.	$I_{CEO\ TYP}$**	WINDOW
PHOTOTRANSISTORS	SMALL CHIP *	VTT2021	.25	Flat
		VTT2022	.5	''
		VTT2023	1.0	''
		VTT2121	1.0	Lens
		VTT2122	3.0	''
		VTT2123	8.0	''
PHOTODARLINGTONS	SMALL CHIP *	VTA2021	.5	Flat
		VTA2022	1.5	''
		VTA2023	4.0	''
		VTA2121	3.0	Lens
		VTA2122	8.0	''

VTT, VTA 312 SERIES Coaxial Package

		P.N.	$I_{CEO\ TYP}$**	WINDOW
PHOTO TRANSISTORS	SMALL CHIP *	VTT3121	1.0	Lens
		VTT3122	3.0	''
		VTT3123	8.0	''
PHOTO DARLINGTONS	SMALL CHIP *	VTA3121	3.0	Lens
		VTA3122	8.0	''

VTT, VTA 931 and 932 SERIES Epoxy Lens–Ceramic Base (See VT 900 dimensions)

		P.N.	$I_{CEO\ TYP}$**	WINDOW
PHOTOTRANSISTORS	LARGE CHIP *	VTT9310	.5	EPOXY LENS WITH SLIGHT MAGNIFICATION
		VTT9311	1.0	
		VTT9312	2.0	
		VTT9313	4.0	
	SMALL CHIP *	VTT9320	.125	
		VTT9321	.250	
		VTT9322	.5	
		VTT9323	1.0	
PHOTODARLINGTONS	LARGE CHIP *	VTA9311	2.0	EPOXY LENS WITH SLIGHT MAGNIFICATION
		VTA9312	6.0	
		VTA9313	15.0	
	SMALL CHIP *	VTA9321	0.5	
		VTA9322	1.5	
		VTA9323	4.0	

**I_{ceo} - in mA @ 5 mW/cm^2 for phototransistors and .2 mW/cm^2 for darlingtons (V_{ce} = 5V.)

PHOTOCONDUCTOR–LIGHT SOURCE
OPTO-COUPLERS–ISOLATORS

VACTROLS

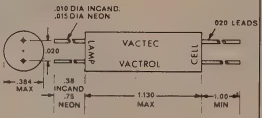
INPUT-OUTPUT ISOLATION FOR ON-OFF OR
PROPORTIONAL CONTROL OF OUTPUT RESISTANCE

VTL 3 SERIES Photoconductor Plastic Axial INCANDESCENT TYPES

Part Number	LAMP mA	LAMP Volts	Cell Resis.-ohms ON Light Adapted (max.)	Cell Resis.-ohms OFF (5 sec) (min)
VTL3A11	55	1.5	350	5 x 10^7
VTL3A12	15	3.0	350	↓
VTL3A13	60	4.0	160	
VTL3A14	40	6.0	160	
VTL3A15	14	10	350	
VTL3A16	25	12	400	
VTL3A17	40	12	160	
VTL3A21	55	1.5	800	10^6
VTL3A22	15	3.0	600	↓
VTL3A23	60	4.0	300	
VTL3A24	40	6.0	350	
VTL3A25	14	10	600	
VTL3A26	25	12	500	
VTL3A27	40	12	150	
VTL3A31	55	1.5	5000	10^7
VTL3A32	15	3.0	4000	↓
VTL3A33	60	4.0	500	
VTL3A34	40	6.0	800	
VTL3A35	14	10	3000	
VTL3A36	25	12	2000	
VTL3A37	40	12	300	
VTL3A41	55	1.5	200	10^6
VTL3A42	15	3.0	200	↓
VTL3A43	60	4.0	55	
VTL3A44	40	6.0	55	
VTL3A45	14	10	150	
VTL3A46	25	12	100	
VTL3A47	40	12	40	

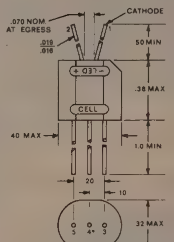
VTL 3 SERIES NEON TYPES

Part Number	LAMP mA (max.)	LAMP Volts	Cell Resis.-ohms ON Light Adapted (max.)	Cell Resis.-ohms OFF (5 sec) (min)
VTL3B18	—	120	7000	5 x 10^7
	0.3	—	5000	
VTL3B19	—	120	1150	5 x 10^7
	2.0	—	900	
VTL3B28	—	120	5000	10^6
	0.3	—	4000	
VTL3B29	—	120	650	10^6
	2.0	—	600	
VTL3B38	—	120	15000	10^7
	0.3	—	12000	
VTL3B39	—	120	6000	10^7
	2.0	—	3000	
VTL3B48	—	120	1000	10^6
	0.3	—	900	
VTL3B49	—	120	160	10^6
	2.0	—	135	



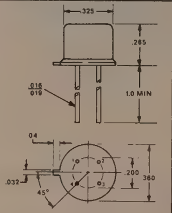
VTL 5 SERIES Led/Photoconductor Plastic

Part Number	Cell Resis.-ohms * ON Light Adapt (max)	Cell Resis.-ohms OFF (5 sec) (min)
VTL5C1	500	5 x 10^7
VTL5C2	500	10^6
VTL5C3	2000	10^7
VTL5C4	100	.4 x 10^6
VTL5C6	3500	10^8
VTL5C7	1500	10^6
DUAL ELEMENT		
VTL 5C3/2	3000	10^7
VTL 5C4/2	150	.4 x 10^6



VTL 2 SERIES Hermetic TO-5

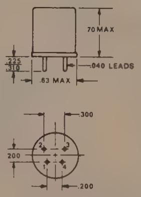
Part Number	Cell Resis.-ohms * ON Light Adapted (max.)	Cell Resis.-ohms OFF (5 sec) (min)
VTL2C1	10K	10[illegible]
VTL2C2	500	10[illegible]
VTL2C3	2K	10[illegible]
VTL2C4	100	4x10[illegible]



*At 40 mA LED input

VTL 9 SERIES

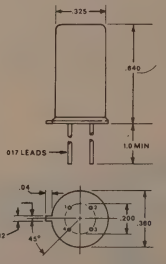
	Part Number	** LAMP Volts	Cell Resis.-ohms ON Light Adapted (max)	Cell Resis.-ohms OFF (5 sec) (min)
INCANDESCENT	VTL9A1	1.5	400	10^7
	VTL9A2	6.0	60	10^7
	VTL9A3	10	250	10^7
	VTL9A4	10	300	10^7
	VTL9A5	10	1500	10^7
	VTL9A9	6.0	200	10^7
	VTL9A10	10	800	10^7
	VTL9A11	12	600	10^7
NEON	VTL9B6	105	300	10^6
	VTL9B7	105	800	10^7
	VTL9B8	65	2000	10^7



**See VTL3 Series for lamp current at indicated lamp volts.

VTL 1 SERIES

	Part Number	** LAMP Volts	Cell Resis.-ohms ON Light Adapted (max)	Cell Resis.-ohms OFF (5 sec) (min)
INCANDESCENT	VTL1A1	1.5	500	10^7
	VTL1A2	6.0	250	10^7
	VTL1A3	10	800	10^7
	VTL1A4	12	250	10^7
NEON	VTL1B5	150	1000	10^7
	VTL1B6	90	5000	10^7



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VACTEC

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LIGHT DEPENDENT
RESISTORS

Photoconductors are thin films of CdS or CdSe on a ceramic substrate.
The material is designated by the second digit (0, 1, 2, 3, 4 or 7) of the part number.

Material	0 - CdS	1 - CdSe	2 - CdS	3 - CdS	4 - CdSe	7 - CdS
Peak Spectral nm	565	735	515	550	675	615

FIGURE A

DIM.	VT 200	VT 300	VT 500
A	.155	.240	.430
B	.210	.360	.550
C	.183	.325	.486
D	.140/.154	.172/.183	.190/.230
E	1.5/1.53	1.5/1.53	1.5/1.53
F	.016/.019	.016/.019	.019
G	.100	.200	.295

FIGURE B

DIM.	VT 700	VT 800	VT 900
H	.300/.320	.216/.236	.144/.164
I	.070/.090	.070/.090	.070/.090
J	.353/.373	.256/.276	.172/.192
K	.75 min.	.75 min.	.75 min.
L	.255/.275	.190/.210	.090/.110

FIG. A

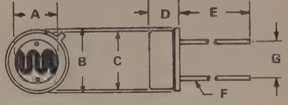
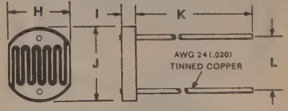


FIG. B



VT 300 SERIES (Fig. A) Hermetic TO-5 (125 mW)

Part No.	R_1*	R_2*
VT-30L	1.8	100 K
VT-301	3	200 K
VT-301H	6	1 meg
VT-302L	10	1 meg
VT-302	16	5 meg
VT-303L	32	10 meg
VT-303	70	10 meg
VT-304	144	50 meg
VT-305	1000	200 meg
VT-311L	2.1	500 K
VT-311	4.2	1 meg
VT-312L	8.4	5 meg
VT-312	22	50 meg
VT-312H	30	50 meg
VT-313L	60	100 meg
VT-314	140	200 meg
VT-32L	1.95	100 K
VT-321	3.9	200 K
VT-321H	7.8	1 meg
VT-322L	15.6	5 meg
VT-322	31.2	10 meg
VT-325	1000	200 meg
VT-333L	14	5 meg
VT-333	28	10 meg
VT-34L	.6	100 K
VT-341	1.2	500 K
VT-341H	2.4	1 meg
VT-342L	4.8	1 meg
VT-342	7	5 meg
VT-343L	14	10 meg
VT-343	28	10 meg
VT-301/2	7.5	1 meg
VT-302/2	16	5 meg
VT-303L/2	32	5 meg
VT-312/2	5	1 meg
VT-313L/2	10	1 meg
VT-333/2	60	25 meg
VT-34L/2	1.5	100 K
VT-341/2	3	200 K

VT 200 SERIES (Fig. A) Hermetic TO-18 (50 mW)

Part No.	R_1*	R_2*
VT-201	4.3	500 K
VT-202	8	750 K
VT-202H	15	1 meg
VT-203	22	5 meg
VT-203H	44	5 meg
VT-204L	88	10 meg
VT-204	110	20 meg
VT-205	1000	200 meg
VT-211	2.3	500 K
VT-211H	3.5	1 meg
VT-212L	6	5 meg
VT-212	7.8	5 meg
VT-213L	16	10 meg
VT-213	22	50 meg
VT-213H	32	50 meg
VT-214L	64	100 meg
VT-214	140	200 meg
VT-221	6.8	750 K
VT-222	10	1 meg
VT-222H	20	1 meg
VT-223	40	5 meg
VT-223H	65	5 meg
VT-224L	80	10 meg
VT-224	500	50 meg
VT-225	1000	200 meg
VT-23L	11	1 meg
VT-231	22	1 meg
VT-232	100	50 meg
VT-233L	150	50 meg
VT-233	350	100 meg
VT-234	700	200 meg
VT-235	1400	200 meg
VT-241	2	500 K
VT-241H	4	1 meg
VT-242L	8	1 meg
VT-242	15	10 meg
VT-242H	30	10 meg
VT-271	4	2.5 meg
VT-272	6	5 meg

VT 500 SERIES (Fig. A) Hermetic TO-8 (500 mW)

Part No.	R_1*	R_2*
VT-50L	1.3	100 K
VT-501	2.6	200 K
VT-501H	4	500 K
VT-502L	8	1 meg
VT-502	16	5 meg
VT-503L	32	10 meg
VT-503	66	50 meg
VT-51L	.7	100 K
VT-511L	1.4	200 K
VT-511	2.3	500 K
VT-511H	4.6	1 meg
VT-512L	9.2	10 meg
VT-521	2.6	100 K
VT-521H	5	500 K
VT-522L	9	1 meg
VT-522	18	5 meg
VT-523L	36	10 meg
VT-533L	12.5	5 meg
VT-533	25	10 meg
VT-54L	.25	100 K
VT-541	.5	500 K
VT-541H	1	1 meg
VT-542L	1.5	1 meg
VT-542	2	1 meg

VT 700 SERIES (Fig. B) (250 mW)

Part No.	R_1*	R_2*
VT-70L	1.6	1 meg
VT-701	3.0	5 meg
VT-721	2.6	1 meg
VT-721H	4.8	2 meg
VT-732	10.0	10 meg
VT-74L	.45	500 K
VT-741	.90	500 K
VT-771	2.0	2 meg
VT-773	8.4	10 meg

VT 800 SERIES (Fig. B) (175 mW)

Part No.	R_1*	R_2*
VT-801	3.0	250 K
VT-804	140.0	50 meg
VT-82L	1.90	100 K
VT-833	33.0	15 meg
VT-835	330.0	100 meg
VT-841L	.90	500 K
VT-871	3.0	10 meg
VT-811/2	2.4*	1 meg
VT-833/2	52 *	10 meg
VT-841/2	2.4*	500 K
VT-871/2	8.8*	1 meg
*dual element cells ½ this each element		

VT 900 SERIES (Fig. B) (80 mW)

Part No.	R_1*	R_2*
VT-901	4.3	500 K
VT-902	8.0	750 K
VT-903H	44.0	5 meg
VT-904L	88.0	10 meg
VT-904	110.0	20 meg
VT-912L	6.0	5 meg
VT-912	15.0	20 meg
VT-913H	32.0	50 meg
VT-914L	64.0	100 meg
VT-914	140.0	200 meg
VT-93L	11.0	1 meg
VT-931	22.0	1 meg
VT-932	100.0	50 meg
VT-941	2.0	500 K

*R_1 2fc resistance in K ohms (tolerance ±33-1/3% (2850°K source)
*R_2 min dark resistance in 5 sec

PHOTOVOLTAIC
CURRENT GENERATORS

SILICON CELLS

POWER CONVERSION OR
INSTRUMENT APPLICATIONS

LOW CAPACITANCE DETECTORS

	PART NO.	DIMENSIONS	I_{sc} @ 100fc
High speed	VTS 3080	.8 x .8 in 2.03 x 2.03 cm	2.5 mA
	VTS 3081	.8 x .4 in 2.03 x 1.02 cm	1.2 mA
	VTS 3082	.4 x .4 in 1.02 x 1.02 cm	0.6 mA
	VTS 3083	.8 x .2 in 2.03 x .51 cm	0.55 mA
	VTS 3084	.4 x .2 in 1.02 x .51cm	0.27 mA
	VTS 3085	.2 x .2 in .51 x .51 cm	0.14 mA
	VTS 3086	.1 x .2 in .25 x .51 cm	0.065 mA
	VTS 3087	.087 x .2 in .22 x .51 cm	0.055 mA
Low leakage	VTS 1086	See VT800 Series Dwg.	.065 mA
	VTS 4085	See VT700 Series Dwg.	.14 mA
	VTS 5086	See VT300 Series Dwg.	.065 mA
	VTS 5088	See VT300 Series Dwg.	.12 mA
	VTS 6089	See VT500 Series Dwg.	.28 mA
	VTS 708A	1¼″ diameter hermetic	1.5 mA

BES BLUE ENHANCED DETECTORS

PART NO.	DIMENSIONS	I_{scs}^{**} @ 100fc
VTS 3070	.8 x .8 in 2.03 x 2.03 cm	1.9 mA
VTS 3071	.8 x .4 in 2.03 x 1.02 cm	.93 mA
VTS 3072	.4 x .4 in 1.02 x 1.02 cm	.46 mA
VTS 3073	.8 x .2 in 2.03 x .51 cm	.42 mA
VTS 3074	.4 x .2 in 1.02 x .51 cm	.21 mA
VTS 3075	.2 x .2 in .51 x .51 cm	.10 mA
VTS 3076	.1 x .2 in .25 x .51 cm	.05 mA
VTS 3077	.087 x .2 in .22 x .51 cm	.042 mA
VTS 1076	See VT800 Series Dwg.	.05 mA
VTS 4075	See VT700 Series Dwg.	.10 mA
VTS 5076	See VT300 Series Dwg.	.05 mA
VTS 5078	See VT300 Series Dwg.	.09 mA
VTS 6079	See VT500 Series Dwg.	.23 mA
VTS 7070A	1¼″ diameter hermetic	1.12 mA

SOLAR CELLS

PART NO.	DIMENSIONS	I_L*
VTS 3011	.087 x .20 (.22 x .51)	1.7
VTS 3012	.10 x .20 (.25 x .51)	2.0
VTS 3013	.20 x .20 (.51 x .51)	4.2
VTS 3014	.40 x .20 (1.02 x .51)	8.4
VTS 3018	.80 x .20 (2.03 x .51)	17.0
VTS 3020	.40 x .40 (1.02 x 1.02)	18.0
VTS 3022	.40 x .40 (1.02 x 1.02)	21.0
VTS 3024	.80 x .40 (2.03 x 1.02)	38.0
VTS 3026	.80 x .40 (2.03 x 1.02)	44.0
VTS 3028	.80 x .80 (2.03 x 2.03)	79.0
VTS 3050	1.125 ⌀ (2.86 ⌀)	110.0

*I_L minimum current @ 0.4 voltage (mA) for 100 mW/cm^2 @ 2850°K ** I_{sc} at 400nm for 1mW/cm^2.

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MINIATURE HIGH VOLTAGE POWER SUPPLIES

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Unit Price	MODEL No.	Output Proportional To Input	Switching Penetron	Low Power Battery Operated	PMT	Focus	Dynamic Focus	CRT	Hi-Bright CRT	X-Ray Microscope	Volume in Cubic Inches
$680.00	H-30N							✓	✓	✓	48
680.00	H-30							✓	✓	✓	48
590.00	H-20							✓	✓	✓	31
590.00	H-20N							✓	✓	✓	31
590.00	H-16F					✓		✓			31
550.00	G-12							✓			15
490.00	G-10							✓			15
365.00	G-5					✓		✓			15
690.00	MG-12							✓			7
490.00	D-16					✓		✓			89
175.00	LR-20					✓		✓			40
159.00	LR-15					✓		✓			33
135.00	LR-6					✓					33
175.00	LR-2N				✓	✓					33
120.00	LU-15	✓				✓		✓			27
350.00	E-10				✓						45
285.00	F-50					✓	✓				7
260.00	F-25				✓	✓	✓				7
235.00	F-12				✓	✓	✓				7
209.00	F-6					✓	✓				7
158.00	K-30	✓			✓	✓	✓				2
149.00	K-15	✓			✓	✓	✓				2
99.00	C-15	✓			✓	✓	✓				3
105.00	C-30	✓			✓	✓	✓				3
168.00	Q-30	✓		✓	✓						2
168.00	Q-15	✓		✓	✓						2
249.00	ST-10N	✓		✓							7
1850.00	CS-14		✓					✓			62
125.00	O-6.75			✓							2
120.00	M-15N										3

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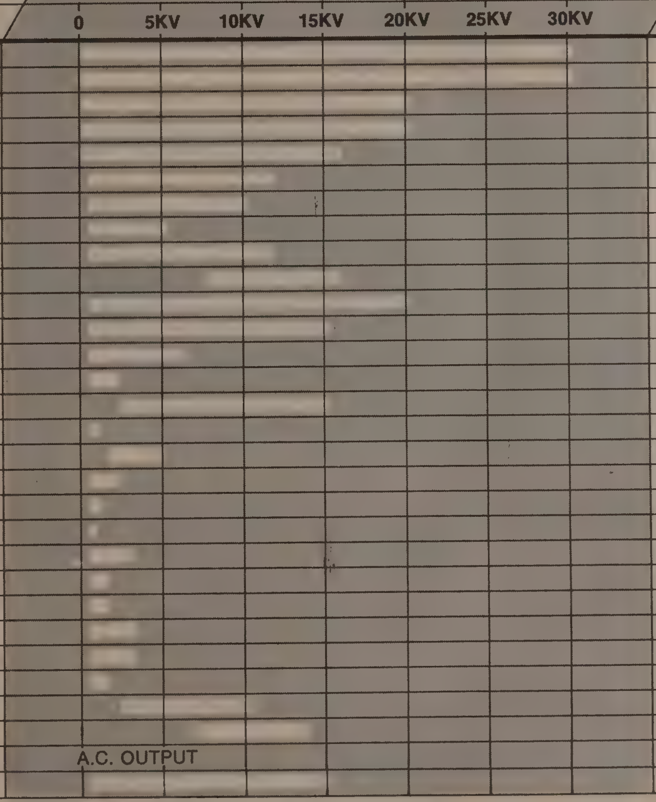
STD PRODUCT (QUICK) SELECTION CHART

OUTPUT VOLTAGE RANGE



MODEL No.	−55° to +71°C Full Rating	(−55° to +85°C Reduced Rating)* / 0° to 55°C
H-30N	300 μa	*
H-30	300 μa	*
H-20	500 μa	*
H-20N	500 μa	*
H-16F	500 μa	*
G-12	500 μa	*
G-10	500 μa	*
G-5	500 μa	*
MG-12	500 μa	*
D-16	1 ma	*
LR-20	—	150 μa
LR-15	—	300 μa
LR-6	—	500 μa
LR-2N	—	5 ma
LU-15	—	300 μa
E-10	10 ma	*
F-50	2 ma	*
F-25	4 ma	*
F-12	8 ma	*
F-6	16 ma	*
K-30	500 μa	*
K-15	1 ma	*
C-15	—	1 ma
C-30	—	500 μa
Q-30	200 μa	*
Q-15	400 μa	*
ST-10N	10 μa	*
CS-14	4.5 watts	*
O-6.75	—	*
M-15N	10 μa	*

***NOTE:** *— contact Factory*

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MODEL	152-	113-	223-	187-	118-	238-
Output						
Power (Volt-Amps)	500	1000	2000	800	1600	3000
Phase	Single	Single	Single	Three	Three	Three
Voltage	100-130	100-130	100-130	100-130 LL	100-130 LL	100-130 LL
Frequency	*See Table	*See Table	*See Table	*See Table	*See Table	*See Table
Distortion	4%	4%	4%	4%	4%	4%
Regulation	5%	5%	5%	5%	5%	5%
Load Power Factor	±.7	±.7	±.7	±.7	±.7	±.7
Input						
Voltage	105-125	105-125	115/208	105-125	105-125	115/208
Phase	Single	Single	Three	Single	Single	Three
Frequency	47-63**	47-63**	47-63**	47-63**	47-63**	47-63**
Mechanical Configuration						
Height	8¾″	8¾″	8¾″	8¾″	8¾″	12¼″
Width	19″	19″	19″	19″	19″	19″
Depth	20″	20″	20″	20″	20″	20″
Weight	50 Lbs.	70 Lbs.	80 Lbs.	50 Lbs.	70 Lbs.	95 Lbs.

*Frequency Options (Add Dash No. to Part No.)

-1	400 Hz ± .05%
-2	350-450 Hz ± .25%
-3	50 Hz ± .05%
-4	60 Hz ± .05%
-5	45-65 Hz ± .25%

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GENERAL SPECIFICATIONS

(See back page for weights and dimensions)

	OEM & TR	CD CARD TYPE	HCM HIGH CURRENT	JP & JT ① HIGH EFFICIENCY TRANSISTOR SWITCHING	PCM MINIATURE PLUG-IN
OUTPUT					
Single	5 to 32V, up to 36A	5 to 30V, up to 1.5A	5 to 28V, up to 100A	5 to 24V, up to 150A	5 to 24V, to 200mA
Dual	±12 & ±15V, up to 2.7A	±12 & ±15V up to .42A	—	Available—consult factory	±12 & ±15V, to 400mA
Triple	5/±12 & 5/±15V, up to 10A	—	—	5/±12 & 5/±15V, up to 50A	—
Input	105-125 VAC or 210-250 VAC, 47-63 Hz (some models useable at 400 Hz, consult factory for proper derating). 100 VAC, 50 Hz available			115/230VAC 47-63 Hz 48 VDC, 100 VAC, 50 Hz available	115 VAC 50-400Hz (230 VAC available)
Load Regulation	0.1% +5mV NL-FL. ±0.1% ±5mV for ±10% input variation.				Singles: ±.02% Duals: ±.02% Logic: ±.04%
Ripple	2mV RMS and 20mV P-P max.			5mV RMS max., 50mV P-P max.	Singles: ±0.5mV RMS Duals: ±0.5mV RMS Logic: ±1.0mV RMS (4mV P-P max)
Temperature Stability	Typical 10mV for eight hour period after initial warmup.			0.1% +5mV for 8-hour period after initial warm-up	
Transient Response	Output voltage returns to within regulation limits within 50µsec in response to a 50% step change in load current.			Output voltage returns to within 1% in less than 500 µsecs following a 50% load step	
Remote Sensing	Terminals are provided to maintain regulation at the load, compensating for the DC voltage drop in the load cable.				
Remote Voltage Adjustment	Remote voltage adjustment is provided. Consult factory.				
Ambient Temperature	Operating: See tables for output rating vs. temperature. Storage: −55°C to +85°C.				Storage: −25°C to +85°C
Overload Protection	All models are inherently protected against overload and short circuits of any duration. No fuses or reset buttons are used — automatic recovery is electronically accomplished.				Limited duration, current limiting
Over-voltage Protection (Optional)	Optional: Any model can be furnished with overvoltage protection which "crowbars" the output in the event of a rise in the output voltage of 10% or 2 volts (whichever is greater). On dual outputs, overvoltage protection "crowbars" both voltages to near zero in the event of a rise of one or both of the voltages of 20% or 4 volts (whichever is greater). (Fixed on CD series.)			Standard: Output is crowbarred and output power is removed when output voltage exceeds adjustable trip points. This protection is reset by recycling the input power.	Standard on logic modules only
Connector	Barrier strip termination	Power supply mates with standard PC edge card connector (22x 156x1/16" thick). Barrier strip available as option.	Barrier strip and Stud terminals	Barrier strip and stud terminals	Plug-in (mating sockets available)
Output Impedance	DC — 1KHz 0.001 R_L or 0.005 ohm max. 1 KHz-100KHz 0.005 R_L or 0.5 ohm max. R_L = rated load.		DC-1 KHz 003 ohm max. 1K-100 KHz 15 ohm max.	See additional specs for this series in note ① below.	200 Milliohms @ 10KHz
Temperature Coefficient	0.02%/°C max.				

①Additional JP Specifications:
A. Typical Efficiency: 70-80% B. Holdover storage 25m/secs C. External inhibit control (remote programming) D. Soft start circuit on turn on.

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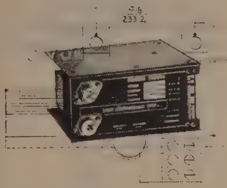
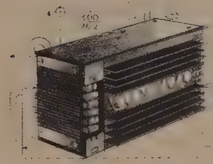
OEM SERIES VALUE ENGINEERED POWER SUPPLIES FOR THE OEM

• Single and Dual Output • 0.1% Regulation • U/L Recognized • Optional overvoltage protection④ • Open Frame Construction, Covers Available⑥





OEM SINGLE OUTPUT

Nominal Output Voltage ①	Adj. Range ±V	Maximum Current Rating (Amps) 40°C	55°C	71°C	Case Size	Model Number (Add -1 for OVP)	Base Price 10-24 Pcs. ③
5②	.25	3	2.5	1.9	R8	OEM5N3.0	$ 35.00
		5.7	4.8	3.7	R1	OEM5N5.7	66.00
		10	8.5	6.5	R2	OEM5N10	79.00
		17	14.5	11.0	R3	OEM5N17	115.00
		25	21.2	16.3	R4	OEM5N25	160.00
		35	29.8	22.8	R5	OEM5N35	195.00
6	.25	2.7	2.3	1.7	R8	OEM6N2.7	35.00
		5.2	4.4	3.4	R1	OEM6N5.2	66.00
		9.5	8.1	6.2	R2	OEM6N9.5	79.00
		15	12.7	9.7	R3	OEM6N15	115.00
		22	18.7	14.3	R4	OEM6N22	160.00
		30.7	26.1	20.0	R5	OEM6N30.7	195.00
10	.5	3.5	3.0	2.3	R1	OEM10N3.5	66.00
		6.5	5.5	4.2	R2	OEM10N6.5	79.00
		10.2	8.6	6.6	R3	OEM10N10.2	115.00
		14.9	12.7	9.7	R4	OEM10N14.9	160.00
		21.0	17.9	13.6	R5	OEM10N21	195.00
12②	.5	1.7	1.4	1.1	R8	OEM12N1.7	35.00
		3.2	2.7	2.1	R1	OEM12N3.2	66.00
		5.8	4.9	3.8	R2	OEM12N5.8	79.00
		9.5	8.1	6.2	R3	OEM12N9.5	115.00
		13.0	11.1	8.5	R4	OEM12N13	160.00
		18.5	15.7	12.0	R5	OEM12N18.5	195.00
15②	.5	1.5	1.3	1.0	R8	OEM15N1.5	35.00
		2.7	2.3	1.7	R1	OEM15N2.7	66.00
		5.0	4.2	3.2	R2	OEM15N5	79.00
		8.2	7.0	5.3	R3	OEM15N8.2	115.00
		11.2	9.5	7.3	R4	OEM15N11.2	160.00
		15.8	13.4	10.3	R5	OEM15N15.8	195.00
16	.5	2.6	2.2	1.7	R1	OEM16N2.6	66.00
		4.7	4.0	3.0	R2	OEM16N4.7	79.00
		7.7	6.5	5.0	R3	OEM16N7.7	115.00
		10.8	9.2	7.0	R4	OEM16N10.8	160.00
		15.0	12.8	9.8	R5	OEM16N15	195.00
20	1	2.1	1.8	1.4	R1	OEM20N2.1	66.00
		3.8	3.2	2.5	R2	OEM20N3.8	79.00
		6.2	5.3	4.0	R3	OEM20N6.2	115.00
		8.7	7.4	5.7	R4	OEM20N8.7	160.00
		12.2	10.4	7.9	R5	OEM20N12.2	195.00
24②	1	1.0	.85	.65	R8	OEM24N1.0	35.00
		1.8	1.5	1.2	R1	OEM24N1.8	66.00
		3.3	2.8	2.1	R2	OEM24N3.3	79.00
		5.4	4.6	3.5	R3	OEM24N5.4	115.00
		7.5	6.4	4.9	R4	OEM24N7.5	160.00
		10.6	9.0	6.9	R5	OEM24N10.6	195.00
26	1	1.7	1.4	1.1	R1	OEM26N1.7	66.00
		3.1	2.6	2.0	R2	OEM26N3.1	79.00
		5.0	4.2	3.2	R3	OEM26N5.0	115.00
		7.1	6.1	4.6	R4	OEM26N7.1	160.00
		10.0	8.5	6.5	R5	OEM26N10.0	195.00
28②	1	1.6	1.4	1.0	R1	OEM28N1.6	66.00
		2.9	2.5	1.9	R2	OEM28N2.9	79.00
		4.7	4.0	3.1	R3	OEM28N4.7	115.00
		6.7	5.7	4.4	R4	OEM28N6.7	160.00
		9.3	7.9	6.1	R5	OEM28N9.3	195.00
30	1	1.5	1.3	1.0	R1	OEM30N1.5	66.00
		2.7	2.3	1.8	R2	OEM30N2.7	79.00
		4.5	3.8	2.9	R3	OEM30N4.5	115.00
		6.3	5.4	4.1	R4	OEM30N6.3	160.00
		8.8	7.5	5.7	R5	OEM30N8.8	195.00
32	1	1.4	1.2	0.9	R1	OEM32N1.4	66.00
		2.5	2.1	1.6	R2	OEM32N2.5	79.00
		4.3	3.6	2.8	R3	OEM32N4.3	115.00
		5.7	4.9	3.7	R4	OEM32N5.7	160.00
		8.1	6.9	5.3	R5	OEM32N8.1	195.00

OEM DUAL OUTPUT

Nominal Output Voltage ①	Adj. Range ±V	Maximum Current Rating (Amps) 40°C	55°C	71°C	Case Size	Model Number (Add -1 for OVP)	Base Price 10-24 Pcs. ③
±12	.5	1.5	1.3	1.0	R1	OEM12D1.5	$89.00
		2.7	2.3	1.8	R2	OEM12D2.7	99.00
±15	.5	1.3	1.1	0.8	R1	OEM15D1.3	89.00
		2.4	2.0	1.6	R2	OEM15D2.4	99.00

TR TRIPLE OUTPUT

0.01% Regulation • Built-in Overvoltage Protection on Single Output, Optional on Dual Output⑤• Open Frame Construction, Covers Available⑥• Optional 71° C Operation⑦

Nominal Output Voltage ①	Adj. Range ±V	Maximum Current Rating (Amps) 40°C	55°C	71°C	Case Size	Model Number (Add -1 for OVP)	Base Price 10-24 Pcs. ③
5 ±12	0.25 .5	3.0 .75	2.6 .64	2.0 .49	R1	TR101	$ 99.00
5 ±15	0.25 .5	3.0 .64	2.6 .54	2.0 .42	R1	TR102	99.00
5 ±12	0.25 0.5	5.0 1.0	4.2 0.85	3.2 .65	R2	TR201	130.00
5 ±15	0.25 0.5	5.0 0.85	4.2 0.72	3.2 .55	R2	TR202	130.00
5 ±12	0.25 0.5	10.0 1.0	8.4 0.85	6.4 .65	R3	TR301	155.00
5 ±15	0.25 0.5	10.0 0.85	8.4 0.72	6.4 .55	R3	TR302	155.00

① Contact ACDC for voltages not listed.

② Usually in stock.

③ For smaller quantities, add the following to the base price listed above:

	Case R8	Cases R1-R5
1-4 pieces	$15	$25
5-9 pieces	10	15
10-24 pieces	See base prices above	
Over 24 pieces	Refer to factory	

④ For overvoltage protection, add to the base price:

Case R8	Case R1, R2 & R3	Case R4 & R5
$8	$10	$14

⑤ Overvoltage protection is built into the single output of the TR Series. For OVP on the dual output, add $10.

⑥ Covers: Add to the base price: (Add -2 to Model #)

Case R8	Case R1 & R2	Case R3, R4 & R5
$2	$4	$6

⑦ TR Series only. Optional 71°C operation: Add $15. (Standard Models are rated at 55°C. If the unit is to be operated at 71°C it must be specified when ordering so selected high temperature components can be included.

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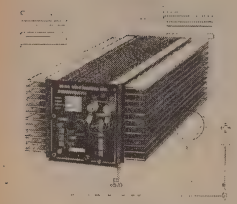
JP SERIES HIGH EFFICIENCY SWITCHING POWER SUPPLIES



Smaller, cooler and more efficient than series-pass types, these 20KHz inaudible switching power supplies operate from a selectable input of 115/230 VAC, 47-63Hz (48 VDC & 100 VAC inputs also available), 70% efficiency, 0.1% regulation. Overvoltage and overload protection is standard① and EMI is minimized by shielding and filtering. (An optional built-in filter for compliance with MIL-STD-461, CE03 is also available④.) You get low inrush on turn on for soft start and can parallel switchers in master-slave configuration.

Conservative packaging density: A packaging density of approximately 1 watt per cubic inch was chosen as the optimum design. This includes a generous heat sink that minimizes temperature rise and permits the power supply to operate in free air (at 40°C or lower) at 100% of rated output.

JP SINGLE OUTPUT

Output Voltage ±5% Adj.	Output Current ③	Case Size	Model No.	Base Price Qty 1-9 ④
5	30	150	JP5N30	$295.00
	60	300	JP5N60③	485.00
	100	500	JP5N100③	595.00
	150	750	JP5N150⑤	850.00
12	13	150	JP12N13	295.00
	26	300	JP12N26③	485.00
	43	500	JP12N43③	595.00
15	11	150	JP15N11	295.00
	21	300	JP15N21③	485.00
	35	500	JP15N35③	595.00
20	8	150	JP20N8	295.00
	16	300	JP20N16③	485.00
	27	500	JP20N27③	595.00
24	7	150	JP24N7	295.00
	14	300	JP24N14③	485.00
	23	500	JP24N23③	595.00

JT TRIPLE OUTPUT

Output Voltage ±5% Adj.	Output Current ③	Case Size	Model No.	Base Price Qty 1-9 ④
5 ±12	50 5	330	JT301③	595.00
5 ±15	50 4	330	JT301② ⑤	595.00

① Overvoltage protection is standard in JP Series and on 5 volt output of JT Series. For overvoltage protection on other outputs of JT add $8 each output.

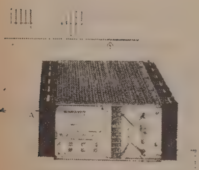
② Rated output @ 40°C with free air convection. **Note:** The total output of the JT Series is 300 watts max. The sum of outputs 2 and 3 is rated at 100 watts max.

③ Model No. shown for Vertical Heatsink Fins and with standard input filters. For horizontal Heatsink Fins add "H" (no extra charge). For MIL-STD-461, CE03 Input Filter add "F" (filter for 50/60Hz input only).

④ MIL-STD-461 filter
Case 300: Add $35 Case 330: Add $35 Case 500: Add $45
Case 150: Add $30 Case 750: Add $50

⑤ Heat radiator fin direction may be field changed to suit air flow.

HCM SERIES HIGH CURRENT POWER SUPPLIES



• 0.1% Regulation • U/L Recognized • Optional overvoltage protection①

Nominal Output Voltage	Adj. Range ±V	Maximum Current Rating (Amps) 40°C	55°C	71°C	Case Size	Model Number (Add -1 for OVP)	Base Price Qty 1-9
5②	.25	65	50	40	1	HCM5N65	$310
		100	80	65	2	HCM5N100	395
12	.50	35	28	22	1	HCM12N35	310
		53	42.5	34.5	2	HCM12N53	395
15	.50	29	23	19	1	HCM15N29	310
		44	35	28.5	2	HCM15N44	395
24	1.0	19	15	12	1	HCM24N19	310
		29	23	19	2	HCM24N29	395
28	1.0	16	13	10	1	HCM28N16	310
		25	20	16	2	HCM28N25	395

①Overvoltage protection. Case 1: Add $35. Case 2: Add $45.
②Usually in stock at ACDC

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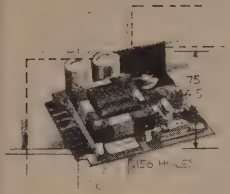
CD SERIES A COMPLETE REGULATED POWER SUPPLY ON A CARD

- Single and Dual Output • 0.1% Regulation • Optional Overvoltage Protection③
- Optional voltage adjustment pot③ • Optional Barrier Strip Terminal③



CD SINGLE OUTPUT

Volts①	Max. Current Rating 40°C	55°C	71°C	Model No. (add -1 for OVP)	Base Price③ 10-24 pcs
5②	1.5	1.3	1.0	CD5N1.5	Any Model $28.50
6	1.4	1.2	.9	CD6N1.4	
8	1.1	.94	.72	CD8N1.1	
12②	.85	.72	.55	CD12N.85	
15②	.74	.63	.48	CD15N.74	
18	.64	.55	.42	CD18N.64	
20	.58	.50	.38	CD20N.58	
24②	.51	.44	.33	CD24N.51	
28②	.45	.38	.29	CD28N.45	
30	.42	.36	.27	CD30N.42	

CD DUAL OUTPUT

Volts①	Max. Current Rating 40°C	55°C	71°C	Model No. (add -1 for OVP)	Base Price③ 10-24 pcs
±12②	.42	.36	.27	CD12D.42	$37.50
±15②	.37	.32	.24	CD15D.37	$37.50

①Factory fixed to within 1%
②Usually in stock at ACDC
③Small quantity "adders" (add to base price listed above)

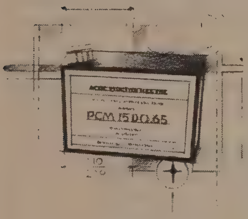
1-4 pieces:	Add $15
5-9 pieces:	Add $10
10-24 pieces:	See base price
Over 24 pieces:	Refer to factory

Options and accessories

Barrier strip:	Add $2
Overvoltage protection:	Add $4
Voltage adjustment pot:	Add $2

PCM SERIES MINIATURE, ENCAPSULATED PLUG-IN POWER SUPPLIES

- Single and Dual Output • 0.02 and 0.04% Regulation • Built-in short Circuit Protection • Mating sockets available



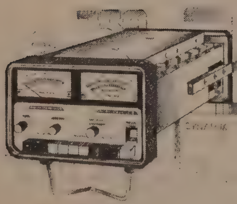
SINGLE OUTPUT

Nominal Output Voltage	Max. Current Rating @ 40°C	Case Size	Model No.	Base Price Qty 1-9
5	500	3	PCM5L0.5	$49.00
5	1000	4	PCM5L1.0	69.00
5	2000	8	PCM5N2.0	89.00
12	100	1	PCM12N0.1	25.00
15	100	1	PCM15N0.1	25.00
24	50	1	PCM24N0.05	25.00

DUAL OUTPUT

Nominal Output Voltage	Max. Current Rating @ 40°C	Case Size	Model No.	Base Price Qty 1-9
±12	120	3	PCM12D0.12	$49.00
±12	240	4	PCM12D0.24	69.00
±12	400	8	PCM12D0.4	99.00
±15	65	3	PCM15D0.065	39.00
±15	100	3	PCM15D0.1	49.00
±15	200	4	PCM15D0.2	69.00
±15	350	8	PCM15D0.35	99.00

EL-750 SERIES PROGRAMMABLE ELECTRONIC LOAD TEST INSTRUMENT



EL-750 electronic load instrument tests performance of DC power sources. The EL-750 is a precision, programmable electronic load test instrument capable of dissipating up to 750 watts of DC power. It is a small, compact, portable unit designed for static and dynamic testing in laboratories, quality control and receiving inspection departments.

The EL-750 operates in either a constant current or constant resistance mode, selected with front panel push buttons.

Load current programming can be accomplished by a steady DC voltage level externally applied through a connector mounted on the rear panel. Dynamic loading is available in two modes: a square wave generator, built into the unit for testing at 1KHz or twice line frequency; or a variety of voltage waveforms (pulsed, ramp, square, sine, etc.) may be externally applied through the remote program input on the rear of the unit.

The EL-750 is 9.00″ wide x 6.00″ high x 17.3″ long and, without the case, is suitable for 5″ high half rack mounting. Price: $850.

For complete details on the EL-750, contact ACDC or your local ACDC representative.

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MISCELLANEOUS

DIMENSIONS AND WEIGHTS FOR STANDARD POWER SUPPLIES

Series	Case Size	Height in. mm	Width in. mm	Depth in. mm	Weight lbs. kg
JP & JT	150	3.18 80.7	4.87 123.7	12.0 304.8	8.0 3.6
	300	4.87 123.7	7.50 180.8	12.0 260.4	15.0 6.8
	330	4.87 123.7	7.5 190.5	10.25 260.4	15.0 6.8
	500	4.87 123.7	7.12 180.8	15.0 381.0	19.0 8.6
	750	4.87 123.7	10.5 266.7	15.0 381.0	28.0 12.7
OEM & TR	R1	3.19 81.0	6.25 158.8	4.94 125.5	4.5 2.0
	R2	3.19 81.0	10.0 254.0	4.94 125.5	7.5 3.4
	R3	4.94 125.4	10.0 254.0	4.94 125.5	12.0 5.4
	R4	4.94 125.4	12.0 304.8	6.62 168.1	20.0 9.1
	R5	4.94 125.4	16.0 406.4	7.25 184.2	29.0 13.2
	R8	2.75 69.9	4.0 101.6	4.87 123.7	2.25 1.0
HCM	1	4.94 125.5	11.0 279.4	15.25 387.4	56 25.4
	2	4.97 126.2	15.25 387.4	18.0 457.2	82 37.2
CD		1.94 49.3	4.50 114.3	4.50 114.3	1.33 .5
PCM	1	1.0 25.4	1.75 44.5	2.25 57.2	.19 .09
	3	.87 22.1	2.50 63.5	3.50 88.9	.22 .10
	4	1.25 31.8	2.50 63.5	3.50 88.9	.25 .11
	8	1.62 41.1	2.50 63.5	3.50 88.9	.28 .12

5 YEAR WARRANTY

When used within specified operating conditions, every catalog listed linear power supply is unconditionally guaranteed to meet all of its published specifications for a period of five years. JP and JT series power supplies are warranted under the same terms for eighteen months.

UL RECOGNITION

All 115 volt models in the OEM and HCM series are recognized under the Component Program of Underwriters' Laboratories, Inc. (File Number E48765)

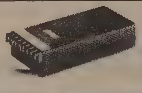
GSA

All ACDC power supplies are available under GSA contract number 95-00S-28294.

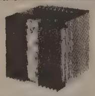
ORDERING INFORMATION

Model callouts: Order ACDC power supplies by model number and be sure to include the proper suffix for any options desired. (Example: OEM5N10-1 calls out the 5 volt, 10 amp model of the OEM series and also calls for built-in over voltage protection).
Prices: All prices quoted are in U.S. dollars, F.O.B. Oceanside, California. Terms are net 30 days.
Discounts: ACDC offers liberal quantity discounts to OEM buyers. Contact the factory or your local representative for a prompt quotation.

OTHER ACDC POWER SUPPLIES, ACCESSORIES AND CAPABILITIES

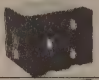


JR **MINIATURIZED HIGH EFFICIENCY SWITCHING POWER SUPPLY.** This compact, precision-regulated DC supply provides AC conversion, isolation, regulation and low output noise (only 25 mV p-p) in a slim, lightweight package. At only one-fifth the usual size, it's the answer to those "impossible" packaging problems. 0.1% regulation, 3 to 30 volts, up to 10 amps.



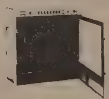
IC **OPTIMUM PERFORMANCE FOR IC APPLICATIONS.** A complete line of power supply modules designed to deliver optimum performance with IC circuits. Overvoltage and overload protection plus stability and regulation matched to the application make the IC series first choice in digital logic designs. 0.05% regulation, 5 volts, up to 25 amps.

OA **DUAL OUTPUT POWER SUPPLIES FOR DRIVING OP AMPS.** Built-in tracking and long-term stability are the special features of our OA series. Both regulation and temperature stability are optimized to assure the best performance for your op amp application. Size and weight are ideal for rack mounting. 0.01% regulation, ±12 and ±15 volts, up to 3.7 amps.



BX **PRECISION POWER SUPPLY MODULES.** All of the high performance features you need for ultra-critical applications are available in these precision power modules. For minimum output impedance and ripple coupled with outstanding regulation specify the BX series. 0.01% regulation, 2 to 28 volts, up to 20 amps.

III **RACK SYSTEMS.** ACDC's standardized rack system provides you with a method for packaging total power system in a single compact unit . . . quickly, easily, economically. Five basic models, all designed to fit standard 19" racks. Available in kit form, factory assembled and/or factory wired.



CPS **CUSTOM POWER SUPPLIES.** ACDC has the ability to design a custom power supply for virtually any application. Past designs range from 400 Hz airborne power supplies to 3,000 amp power supplies incorporate such features as auto-progression, margining, sequencing, transistor switching, phase control and series regulation as well as special packing configurations. Call ACDC for your custom power supply requirements.

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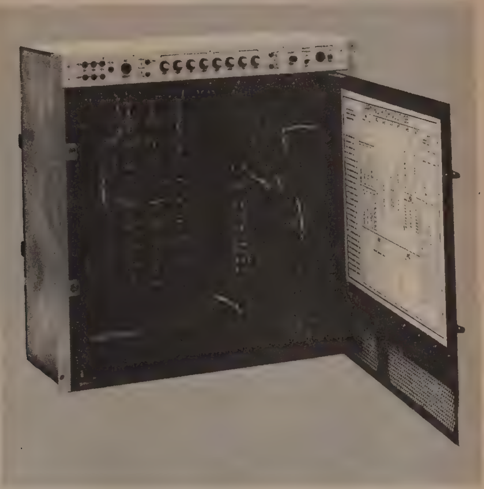
CUSTOM POWER SUPPLIES



ACDC's ability to tailor a power supply to specific applications is virtually unlimited. As pictured on the following pages, it ranges from miniature 400Hz airborne power supplies to 3,000 amp power systems for state-of-the-art computer complexes. Many of these power supplies incorporate such features as auto-progression, margining, sequencing, transistor switching, phase control and series regulation as well as special packaging configurations.

Since these custom power supplies represent a substantial portion of the company's business, standard procedures have been established to facilitate the handling of these demanding requirements. This normally begins with the assignment of a cognizant engineer with complete responsibility for your project. His initial contact is made at the planning stage to assist you in determining the necessary special characteristics. (Incidentally, the technical section of this catalog contains an excellent article entitled "Ten Suggestions to Reduce the Cost of Custom Power Supplies"). The same project engineer stays with the job through production to assure that it stays right.

For large production orders, assembly lines are established, procedures are formalized and parts and other control systems are initiated. The Project Engineer maintains total responsibility for all phases of the program from initial design through assembly and test.

To assure conformance to customer specifications, complete documentation accompanies every custom power supply order. This documentation includes schematics, parts lists, instruction manuals and other collateral information deemed necessary for the satisfactory operation and maintenance of the system.

On the following pages we have presented some typical custom power supplies that have been produced by ACDC Electronics. They are not presented as a line, but merely as an indication of our capabilities. If your requirements are similar to those which we have met in the past or if they fall within the scope of our versatile capability, we would welcome the opportunity to discuss them with you.

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1. POWER SUPPLY FOR MINI-COMPUTER WITH CORE MEMORY.
Features: High power density. Protection circuitry for overload, overvoltage and overtemperature. Parallel capability. Power on/off control and sequence. Data save for undervoltage or AC line failure. **Input:** 105-129 or 210-258 VAC, 47-440 Hz, 1ϕ. **Outputs:** +15V @ 13.0A, +5V @ 12.5A, —5V @ 1.5A.

2. FOUR (4) POWER SUPPLIES FOR STATE OF THE ART COMPUTER SYSTEM. CONSISTS OF ECL, MOS, MEMORY SYSTEM CIRCUITRY.
Features: State of the art, high frequency SCR type regulators in the 5.2 and 22V units. Designed to meet UL 478. Logic interface signals for undervoltage, overvoltage, temperature, and overload. On/off sequence programming. The 5.2V units may be paralleled to provide 1800 amps. Overload protection is constant current. Thermal and overvoltage protection is automatic power shut down. High efficiency on 5.2 and 22V units. Forced air cooling provided. Remote voltage programming. **Input:** 208 VAC ±10%, 380-420 Hz, 3ϕ. **Outputs:** 5.2 VDC @ 300A, 22 VDC @ 270A, 6.5 VDC @ 10A Source, 50A Sink, 11.5 VDC @ 25A.

3. POWER SUPPLY FOR SHIPBOARD MILITARY DISC DRIVE SYSTEM.
Features: Primary fuse protection. Overload and overvoltage protection. Designed for forced air cooling. Ruggedized construction for shock and vibration. **Input:** 208 to 235 VAC, 380-420 Hz, 3ϕ. **Outputs:** +5V @ 25A, —5V @ 3A, —12V @ .7A, +25V @ 3.2A.

4. POWER SUPPLY FOR HAWK MISSILE INSTRUMENTATION.
Features: Military quality. Extended temperature range. Shock, vibration, humidity and altitude. **Input:** 117.5 VAC ±14.5 VAC, 380-420 Hz, 1ϕ. **Outputs:** +12V @ 1A, —12V @ 1A.

5. POWER SUPPLY FOR BLOOD ANALYZER.
Features: Separate AC inputs for sequence control. Plug in regulator assemblies. Convection and radiation cooled only. Low output impedance and fast recovery time. **Input:** 105-125 VAC, 47-420 Hz, 1ϕ. **Outputs:** 12 VDC @ 12A, 48 VDC @ 4A, 58 VDC @ 1A.

6. POWER SUPPLY FOR AUTO-REFRACTOR. PROVIDES FAST, ACCURATE AUTOMATIC MEASUREMENT OF THE OBJECTIVE REFRACTION OF THE HUMAN EYE FOR PRESCRIPTION OF CORRECTIVE LENSES. PRESCRIPTION IS PREPARED AS AN AUTOMATIC PRINT OUT.
Features: Designed to meet UL. Protection circuitry for overvoltage, undervoltage and overtemperature. Down sequencing and special interference rejection. **Input:** 105-130 VAC, 47-63 Hz, 1ϕ. **Outputs:** +15 VDC @ 3.5A, —15 VDC @ 3.5A, +5 VDC @ 6.0A, +7 VDC @ 8.0A.

7. DC POWER SUPPLY FOR CONTROL CONSOLE OF POWER DISTRIBUTION SYSTEM.
Features: Automatic failure indicators with redundant circuits for uninterrupted operation. Plug-in regulator assembly. AC and DC indicators. Spare components, diodes and transistors.
Input: 120 VAC ±10%, 47-63 Hz, 1ϕ.
Output: 24-26V @ 10A.

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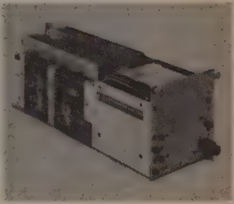

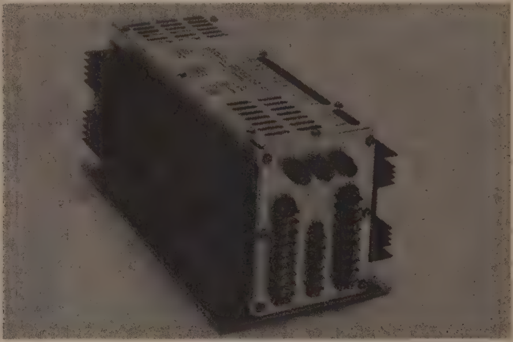

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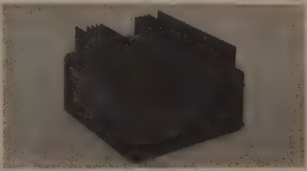

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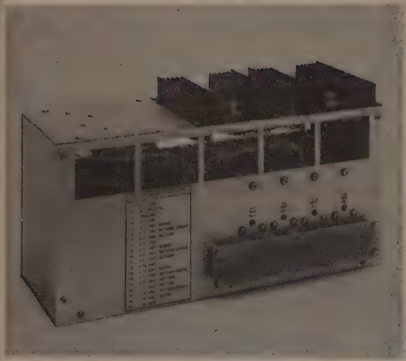

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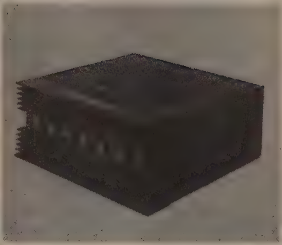
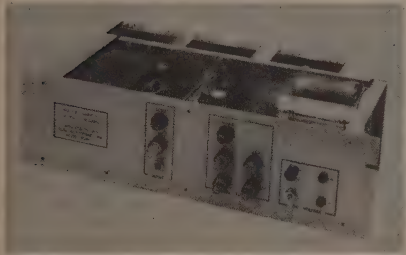
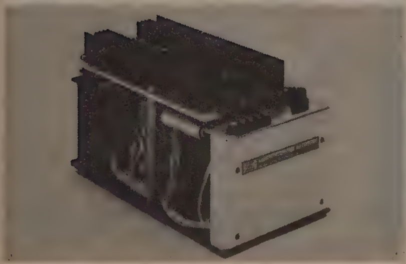


8. POWER SUPPLY FOR TERMINAL AND PRINTER ASSEMBLY.
Features: Fused primary protection. Overload and short circuit protection. Overvoltage protection on the +5V output. +27V output has pulse load requirement of 4 amps for impact printer. Droop less than .5 volts. **Input:** 105-125 VAC, 47-63 Hz, 1ϕ. **Outputs:** +5 VDC @ 5A, —12 VDC @ .2A, —5 VDC @ .3A. +27 VDC @ 10A plus 4A pulses.

9. SINGLE, DUAL AND MULTIPLE OUTPUT MIL-TYPE POWER SUPPLIES FOR SHIPBOARD VERSATILE AVIONICS SHOP TEST (VAST) EQUIPMENT AND CLASSIFIED AIRBORNE COMMUNICATIONS SYSTEMS.
Features: Fifteen (15) different models. Output voltages, 5V to 56 VDC. Output currents to 25 amps. Established reliability components. Severe environmental requirements including shock, vibration, humidity and temperature. High quality processing and workmanship.

7





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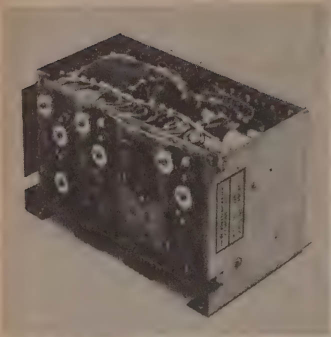

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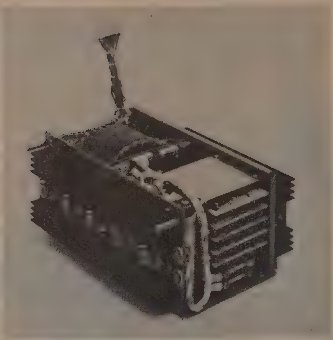

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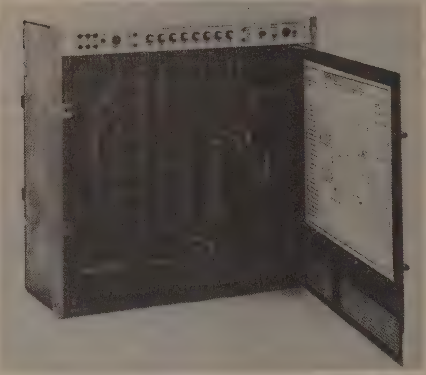

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10. POWER SUPPLY FOR MODEM MULTIPLEX COMMUNICATIONS SYSTEM.
Features: Unique mechanical envelope with provision for forced air cooling. Overload and overvoltage protection. Low output impedance and special filtering of 12 VDC @ 1.25A lamp supply. **Input:** 105-135 VAC, 47-440 Hz, 1φ. **Outputs:** +5 VDC @ 12A, +12 VDC @ .5A, —12 VDC @ .75A, 12 VDC @ 1.25A.

11. POWER SUPPLY FOR MEMORY EXERCISER.
Features: High power density. Protection circuitry for overload and overvoltage. Plug-in regulator PCB assemblies. Convection and radiation cooled. Remotely programmable outputs. **Input:** 103.5 to 127.5 VAC, 60 Hz, 1φ. **Outputs:** 5 VDC @ 20A, 5 VDC @ 1A, 125 VDC @ 50MA, 3-25 VDC Programmable @ .5A, 3-25 VDC Programmable @ .5A.

12. POWER SUPPLY FOR TRANSMITTER AND RECEIVER IN MICROWAVE RADIO EQUIPMENT. REMOTE, UNATTENDED LOCATIONS.
Features: Fault indication for ±25% tolerance band. Automatic recovery type overload and overvoltage protection circuitry. Voltage and current limit adjustments. Special shielding and primary to secondary interference rejection. **Input:** 115 or 230 VAC ±10%, 47-440 Hz, 1φ. **Outputs:** +15V @ .6A, +5V @ .5A, —15V @ .9A, —28V @ 1.2A, —28V @ .1A, +100V @ .2A.

13. POWER SUPPLY FOR CORE MEMORY COMPUTER SYSTEM.
Features: UL approved. Protection circuitry for overcurrent, overvoltage, undervoltage AC line detection and overtemperature. Sequencing, margin testing, status and fault indicators. The ultimate of pluggable modular construction for minimum mean time to repair (MTTR). **Input:** 208 VAC ±10%, 50-60 Hz, 3φ. **Outputs:** +15V @ 13A, —15V @ 7A, +5V @ 32A, —5V @ 22A.

14. POWER SUPPLY FOR DATA ACQUISITION SYSTEM.
Features: Primary control and protection. Output voltage and current meters. Self-contained forced air cooling. Overvoltage, undervoltage, overcurrent and short circuit protection, adjustable from front panel. Low ripple and output impedance. Overtemperature protection with automatic reset. **Input:** 105-132 VAC or 210-264 VAC, 47-65 Hz, 1φ. **Outputs:** 5.5 VDC @ 150A, +10.5 VDC @ 20A, —10.5 VDC @ 20A.

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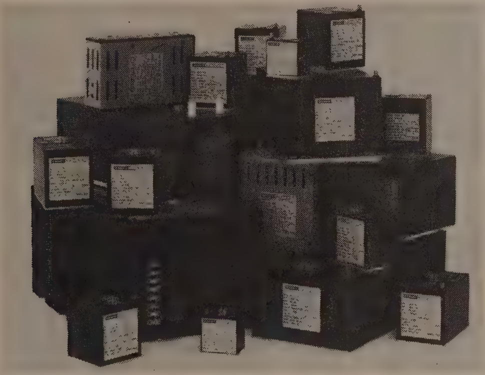
abbott Power Supply Modules

The Next 19 Pages List 913 Regulated Modules with Specifications and Prices



The most complete line of small size MIL-Spec and OEM type power modules available in the industry is fully described in the following 19 pages. The Abbott line of power modules includes output voltages from 3 volts to 100 volts DC, output current from 2 milliamperes to 20 amperes and output power from 1 watt to 300 watts. Sizes, weights, regulations and environments are shown for the various input and output powers. Abbott is proud to continue its policy of introducing new products to meet the growing demands of our customers by listing a completely new line of 28 VDC to DC power modules. The Model BN series is highly efficient (50-70%), is hermetically sealed, and it meets all military specifications. Look through the next 19 pages and you may find the power module you want is a standard Abbott model.

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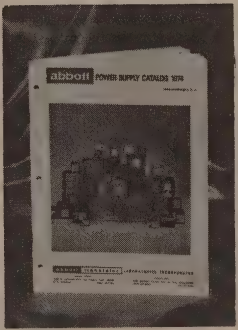

See Abbott's 1975 catalog for complete information on all our products plus additional items such as:

- Quality Control System
- Thermal Data
- Input Currents
- Overvoltage Protectors
- Input Line Filters
- Operating Hints

To receive your free copy of this comprehensive 60 page Power Supply Catalog, simply call or write Abbott.

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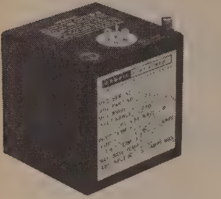
abbott 400 ∿ to DC (Reg.) Hi-Temp.



POWER MODULES

features

- Hi-temp. +212°F.
- 5 to 740 volts
- Hermetically sealed
- Compact, low cost
- Low ripple
- For aerospace application

specifications

INPUT VOLTAGE RANGE: 105 to 125 volts AC
INPUT FREQUENCY RANGE: 380 to 420 Hertz, 1 phase
INPUT TRANSIENT PROTECTION: In accordance with MIL-STD-704A, Figure 3, Limit 1 (180 VAC for 0.1 sec.)
LINE REGULATION: ±0.2% for 105-125 VAC input, with load constant
COMBINED LINE AND LOAD REGULATION: ±0.5% for 105-125 VAC input and load variation of ½ to full load
RIPPLE: 0.2% RMS
SHORT CIRCUIT PROTECTION: Protected against short circuit conditions of any duration
VOLTAGE ADJUSTMENT RANGE: 12% by screwdriver adjustment
TEMPERATURE: +212°F (+100°C) Maximum at mounting base using adequate heat sink −65°F (−54°C) minimum at mounting base
RELIABILIIY: 70,000 hourse MTBF typical per MIL-HDBK-217 under worst case operating conditions. See Page **1•1053**.
ENVIRONMENT: Encapsulated to meet the environmental requirements of MIL-STD-810B and MIL-E-5400K, Class 2, including: altitude (to a vacuum), vibration, shock, acceleration, sand, dust, humidity, saltspray, fungus, explosion, etc. See Page **1•1051**.
ISOLATION: Inputs, outputs, and case are isolated so that either a plus or minus output voltage polarity can be obtained
OUTPUT VOLTAGE AND CURRENT: See specific models listed

Output Voltage Range	Output Current (Amps)	Size*	Wt. lbs.	Model Number	Price 1 pc.	Price 2-4 pcs.
4.7-5.3	0.400	2C	0.8	U02DS-5A	$212	$193
	1.0	3A	1.7	U05DS-5A	217	198
	2.0	3	1.8	U1DS-5A	234	213
	4.0	5	2.0	U2DS-5A	247	225
	6.0	6	2.3	U3DS-5A	261	237
	10.0	11	5.5	U5DS-5A	326	296
5.3-5.9	0.357	2C	0.8	U02DS-5.6A	212	193
	0.9	3A	1.7	U05DS-5.6A	217	198
	1.8	3	1.8	U1DS-5.6A	234	213
	3.6	5	2.0	U2DS-5.6A	247	225
	5.4	6	2.3	U3DS-5.6A	261	237
	8.91	11	5.5	U5DS-5.6A	326	296
5.9-6.6	0.318	2C	0.8	U02DS-6.3A	212	193
	0.8	3A	1.7	U05DS-6.3A	217	198
	1.6	3	1.8	U1DS-6.3A	234	213
	3.2	5	2.0	U2DS-6.3A	247	225
	4.8	6	2.3	U3DS-6.3A	261	237
	7.92	11	5.5	U5DS-6.3A	319	290
6.6-7.4	0.286	2C	0.8	U02DS-7A	212	193
	0.7	3A	1.7	U05DS-7A	217	198
	1.4	3	1.8	U1DS-7A	234	213
	2.8	5	2.0	U2DS-7A	247	225
	4.2	6	2.3	U3DS-7A	261	237
	7.15	11	5.5	U5DS-7A	319	290
7.4-8.3	0.253	2C	0.8	U02DS-7.9A	204	186
	0.63	3A	1.7	U05DS-7.9A	211	192
	1.26	3	1.8	U1DS-7.9A	229	208
	2.52	5	2.0	U2DS-7.9A	241	219
	3.78	6	2.3	U3DS-7.9A	261	237
	6.32	7	3.0	U5DS-7.9A	319	290
8.3-9.3	0.227	2C	0.8	U02DS-8.8A	204	186
	0.57	3A	1.7	U05DS-8.8A	211	192
	1.14	3	1.8	U1DS-8.8A	229	208
	2.28	5	2.0	U2DS-8.8A	241	219
	3.42	6	2.3	U3DS-8.8A	261	237
	5.68	7	3.0	U5DS-8.8A	319	290
9.3-10.4	0.202	2C	0.8	U02DS-9.9A	204	186
	0.50	3A	1.7	U05DS-9.9A	211	192
	1.00	3	1.8	U1DS-9.9A	229	208
	2.00	5	2.0	U2DS-9.9A	241	219
	3.00	6	2.3	U3DS-9.9A	255	232
	5.05	7	3.0	U5DS-9.9A	319	290
	10.10	11	5.5	U10DS-9.9A	383	349
10.4-11.6	0.182	2C	0.8	U02DS-11A	204	186
	0.45	3A	1.7	U05DS-11A	211	192
	0.91	3	1.8	U1DS-11A	229	208
	1.82	5	2.0	U2DS-11A	241	219
	2.73	6	2.3	U3DS-11A	255	232
	4.55	7	3.0	U5DS-11A	319	290
	9.10	11	5.5	U10DS-11A	383	349
11.6-13.0	0.163	2C	0.8	U02DS-12.3A	204	186
	0.40	3A	1.7	U05DS-12.3A	211	192
	0.81	3	1.8	U1DS-12.3A	229	208
	1.62	5	2.0	U2DS-12.3A	241	219
	2.43	6	2.3	U3DS-12.3A	255	232
	4.06	7	3.0	U5DS-12.3A	313	285
	8.12	11	5.5	U10DS-12.3A	371	338
	13.83	14	14.5	U17DS-12.3A	436	397
13.0-14.8	0.145	2C	0.8	U02DS-13.8A	$199	$181
	0.36	3A	1.7	U05DS-13.8A	204	186
	0.72	3	1.8	U1DS-13.8A	222	202
	1.44	5	2.0	U2DS-13.8A	234	213
	2.16	6	2.3	U3DS-13.8A	247	225
	3.62	7	3.0	U5DS-13.8A	313	285
	7.24	11	5.5	U10DS-13.8A	371	338
	12.31	14	14.5	U17DS-13.8A	436	397
14.8-16.6	0.127	2C	0.8	U02DS-15.7A	199	181
	0.32	3A	1.7	U05DS-15.7A	204	186
	0.64	3	1.8	U1DS-15.7A	222	202
	1.28	5	2.0	U2DS-15.7A	234	213
	1.92	6	2.3	U3DS-15.7A	247	225
	3.18	7	3.0	U5DS-15.7A	313	285
	6.36	11	5.5	U10DS-15.7A	359	327
	10.81	14	14.5	U17DS-15.7A	424	386
16.6-18.6	0.114	2C	0.8	U02DS-17.6A	199	181
	0.28	3A	1.7	U05DS-17.6A	204	186
	0.57	3	1.8	U1DS-17.6A	222	202
	1.14	5	2.0	U2DS-17.6A	234	213
	1.71	6	2.3	U3DS-17.6A	247	225
	2.84	7	3.0	U5DS-17.6A	313	285
	5.68	11	5.5	U10DS-17.6A	359	327
	9.65	14	14.5	U17DS-17.6A	424	386
18.6-20.8	0.101	2C	0.8	U02DS-19.7A	199	181
	0.255	3A	1.7	U05DS-19.7A	204	186
	0.510	3	1.8	U1DS-19.7A	222	202
	1.02	5	2.0	U2DS-19.7A	234	213
	1.53	6	2.3	U3DS-19.7A	247	225
	2.54	7	3.0	U5DS-19.7A	307	279
	5.08	11	5.5	U10DS-19.7A	359	327
	8.62	14	14.5	U17DS-19.7A	424	386
20.8-23.3	0.098	2C	0.8	U02DS-22A	193	176
	0.230	3A	1.7	U05DS-22A	199	181
	0.460	3	1.8	U1DS-22A	214	195
	0.920	5	2.0	U2DS-22A	229	208
	1.38	6	2.3	U3DS-22A	241	219
	2.27	7	3.0	U5DS-22A	307	279
	4.54	11	5.5	U10DS-22A	353	321
	7.72	14	14.5	U17DS-22A	413	376
23.3-26.1	0.081	2C	0.8	U02DS-24.7A	193	176
	0.205	3A	1.7	U05DS-24.7A	199	181
	0.410	3	1.8	U1DS-24.7A	214	195
	0.820	5	2.0	U2DS-24.7A	229	208
	1.23	6	2.3	U3DS-24.7A	241	219
	2.02	7	3.0	U5DS-24.7A	307	279
	4.04	11	5.5	U10DS-24.7A	353	321
	6.88	14	14.5	U17DS-24.7A	413	376
26.1-29.2	0.073	2C	0.8	U02DS-27.6A	193	176
	0.180	3A	1.7	U05DS-27.6A	199	181
	0.360	3	1.8	U1DS-27.6A	214	195
	0.720	5	2.0	U2DS-27.6A	229	208
	1.08	6	2.3	U3DS-27.6A	241	219
	1.81	7	3.0	U5DS-27.6A	307	279
	3.62	11	5.5	U10DS-27.6A	342	311
	6.16	14	14.5	U17DS-27.6A	401	365
29.2-32.6	0.065	2C	0.8	U02DS-31A	$193	$176
	0.160	3A	1.7	U05DS-31A	199	181
	0.320	3	1.8	U1DS-31A	214	195
	0.640	5	2.0	U2DS-31A	229	208
	0.960	6	2.3	U3DS-31A	241	219
	1.61	7	3.0	U5DS-31A	307	279
	3.22	11	5.5	U10DS-31A	359	327
	5.48	14	14.5	U17DS-31A	424	386
32.6-36.5	0.058	2C	0.8	U02DS-34.6A	193	176
	0.145	3A	1.7	U05DS-34.6A	199	181
	0.290	3	1.8	U1DS-34.6A	214	195
	0.580	5	2.0	U2DS-34.6A	229	208
	0.870	6	2.3	U3DS-34.6A	241	219
	1.44	7	3.0	U5DS-34.6A	307	279
	2.88	11	5.5	U10DS-34.6A	383	349
	4.91	14	14.5	U17DS-34.6A	444	404
36.5-40.9	0.052	2C	0.8	U02DS-38.7A	193	176
	0.130	3A	1.7	U05DS-38.7A	199	181
	0.260	3	1.8	U1DS-38.7A	214	195
	0.520	5	2.0	U2DS-38.7A	229	208
	0.780	6	2.3	U3DS-38.7A	247	225
	1.29	7	3.0	U5DS-38.7A	313	285
	2.58	11	5.5	U10DS-38.7A	409	372
	4.39	14	14.5	U17DS-38.7A	469	427
40.9-45.8	0.046	2C	0.8	U02DS-43.3A	193	176
	0.115	3A	1.7	U05DS-43.3A	199	181
	0.230	3	1.8	U1DS-43.3A	214	195
	0.460	5	2.0	U2DS-43.3A	229	208
	0.690	6	2.3	U3DS-43.3A	247	225
	1.15	7	3.0	U5DS-43.3A	313	285
	2.30	11	5.5	U10DS-43.3A	427	389
	3.92	14	14.5	U17DS-43.3A	491	447
45.8-51.4	0.041	2C	0.8	U02DS-48.6A	199	181
	0.103	3A	1.7	U05DS-48.6A	204	186
	0.206	3	1.8	U1DS-48.6A	222	202
	0.412	5	2.0	U2DS-48.6A	234	213
	0.618	6	2.3	U3DS-48.6A	255	232
	1.03	7	3.0	U5DS-48.6A	319	290
	2.06	11	5.5	U10DS-48.6A	452	411
	3.49	14	14.5	U17DS-48.6A	512	466
51.4-59.0	0.036	2C	0.8	U02DS-55.2A	217	198
	0.091	3A	1.7	U05DS-55.2A	223	203
	0.182	3	1.8	U1DS-55.2A	241	219
	0.364	5	2.0	U2DS-55.2A	255	232
	0.546	6	2.3	U3DS-55.2A	267	243
	0.905	7	3.0	U5DS-55.2A	326	296
	1.81	11	5.5	U10DS-55.2A	452	411
	3.07	14	14.5	U17DS-55.2A	512	466
59.0-740.0	174 other standard models are available available with output voltages between 59.0 and 740.0 Vdc at output power ratings of 2, 5, 10, 20, 30, 50, 100 or 170 watts. For complete information, please consult one of the offices listed below.					

* See Page 1•1048 for size charts

abbott transistor LABORATORIES, INCORPORATED

general offices
5200 W. Jefferson Blvd., Los Angeles, Calif. 90016
(213) 936-8185 Telex: 69-1398

eastern office
1224 Anderson Avenue, Fort Lee, New Jersey 07024
(201) 224-6900 Telex: 13-5332

abbott 400 ∿ to DC Hi-Performance Single & Dual Output

abbott transistor
MFG SER NO
MFG PART NO
MFG MODEL
INPUT RANGE
CPS. SINE WAVE 1 φ
INPUT TERM
OUTPUT
OUTPUT TERM
AMPS
MAX. BASE TEMP
FUSE INPUT
AMPS MAX

features

- Low Peak-to-Peak Ripple
- RFI/EMI to MIL-STD-461
- Small
- Hermetically Sealed
- +100°C Operation
- 0.1% Regulation

specifications

INPUT VOLTAGE RANGE: 105 to 125 VRMS

INPUT FREQUENCY RANGE: 380 to 420 Hertz, 1 phase

INPUT POWER: Per MIL-STD-704A for category B equipment

LINE REGULATION: 0.1% (0.2% for duals) or 10 mv (whichever is greater) for input change of 105 to 125 VRMS with load constant

LOAD REGULATION: 0.1% (0.2% for duals) or 20 mv (whichever is greater) for change from no load to full load with line constant

RIPPLE: 0.02% or 5 mv (whichever is greater) 25 mv peak-to-peak maximum, each output, measured with scope having 25 MHz bandwidth

OUTPUT VOLTAGE ADJUSTMENT: Voltage is continuously adjustable between the limits shown in the table by means of an externally accesible screwdriver adjustment potentiometer

TRACKING ACCURACY: The negative output will track the positive output to within 1.0% or 100 mv (whichever is greater) for all rated conditions of input voltage, output current, operating temperature, and output voltage adjustment

ISOLATION VOLTAGE: 750 vdc input to output and input to case • 200 vdc output to case

INSULATION RESISTANCE: 50 megohms minimum between input and output, input and case, and output and case when measured at 50 vdc

POLARITY: Inputs and outputs are isolated, either positive or negative side may be grounded

TEMPERATURE RANGE: Operating: −55° to +100°C maximum at center of mounting base
Storage: −55°C to +125°C

TEMPERATURE COEFFICIENT: 0.03% per degree Celsius maximum

ENVIRONMENT: Encapsulated to meet the environmental requirements of MIL-STD-810B and MIL-E-5400K, Class 2, including: altitude (to a vacuum), vibration, shock, acceleration, sand, dust, humidity, salt spray, fungus, explosion, etc. See Page 1•1051.

SHORT CIRCUIT PROTECTION: Each unit is completely protected against an overload or short circuit of any duration. The output voltage automatically restores to normal when the overload is removed

INPUT TRANSIENT PROTECTION: MIL-STD-704A Figure 3, Limit 1 (180 VAC for 0.1 seconds)

OVERVOLTAGE PROTECTION: Overvoltage protection modules are available for these units. Please see Page 1•1047 for further information

LOAD TRANSIENT RECOVERY TIME: Output voltage returns to regulation limits within 100 microseconds (200 microseconds for duals) after 50% step change in load current

ELECTROMAGNETIC INTERFERENCE: Built to meet the requirements of MIL-STD-461 for generation of and susceptability to radiated and conducted interference

RELIABILITY: The Mean Time Between Failure (MTBF) per MIL-HDBK-217 under worst case operating conditions of full rated output current, 125 vac input voltage, and +100°C base plate temperature, has been calculated for typical units. Values are: W5D10 — 56,148 hrs; W95D0.3 — 47,393 hrs; WW3D0.3 — 67,385 hrs; WW30D4.0 — 48,618 hrs. See Page 1•1053.

DELIVERY FROM STOCK

MODELS IN BOLD TYPE NORMALLY IN STOCK

Output Voltage Range	Output Curr. (Amps)	Size*	Wt. (Lbs.)	Model Number	Price 1 pc.	Price 2-4 pcs.
4.5-5.5	2.5	2E	1.9	W5D2.5	$285	$260
	5.0	4D	2.7	W5D5.0	320	295
	10.0	10B	5.1	W5D10	403	367
	15.0	14C	8.9	W5D15	455	414
	20.0	14C	8.9	W5D20	490	446
5.5-6.5	2.5	2E	1.9	W6D2.5	285	260
	5.0	4D	2.7	W6D5.0	320	295
	10.0	10B	5.1	W6D10	403	367
	15.0	14C	8.9	W6D15	455	414
	20.0	14C	8.9	W6D20	490	446
6.5-7.5	2.5	2E	1.9	W7D2.5	285	260
	5.0	4D	2.7	**W7D5.0**	320	295
	10.0	10B	5.1	W7D10	403	367
	15.0	14C	8.9	W7D15	455	414
	20.0	14C	8.9	W7D20	490	446
7.5-8.5	2.5	2E	1.9	**W8D2.5**	285	260
	5.0	4D	2.7	**W8D5.0**	320	295
	10.0	10B	5.1	**W8D10**	403	367
	15.0	14C	8.9	W8D15	455	414
	20.0	14C	8.9	W8D20	490	446
8.5-9.5	2.5	2E	1.9	W9D2.5	295	270
	5.0	4D	2.7	W9D5.0	340	310
	10.0	10B	5.1	**W9D10**	426	388
	15.0	14C	8.9	W9D15	485	441
	20.0	14C	8.9	W9D20	519	472
9.5-10.5	2.5	2E	1.9	W10D2.5	295	270
	5.0	4D	2.7	W10D5.0	340	310
	10.0	10B	5.1	W10D10	426	388
	15.0	14C	8.9	W10D15	485	441
	20.0	14C	8.9	W10D20	519	472
10.5-11.5	2.5	2E	1.9	**W11D2.5**	295	270
	5.0	4D	2.7	**W11D5.0**	340	310
	10.0	10B	5.1	**W11D10**	426	388
	15.0	14C	8.9	W11D15	485	441
	20.0	14C	8.9	W11D20	519	472
11-13	2.5	2E	1.9	W12D2.5	295	270
	5.0	4D	2.7	W12D5.0	340	310
	10.0	10B	5.1	W12D10	426	388
	15.0	14C	8.9	W12D15	485	441
	20.0	14C	8.9	W12D20	519	472
13-15	1.2	2E	1.9	**W14D1.2**	$285	$260
	2.5	4D	2.7	W14D2.5	320	295
	5.0	10B	5.1	W14D5.0	403	367
	10.0	14C	8.9	W14D10	455	414
	15.0	14C	8.9	W14D15	490	446
14-16	1.2	2E	1.9	W15D1.2	285	260
	2.5	4D	2.7	W15D2.5	320	295
	5.0	10B	5.1	W15D5.0	403	367
	10.0	14C	8.9	W15D10	455	414
	15.0	14C	8.9	W15D15	490	446
15-17	1.2	2E	1.9	**W16D1.2**	285	260
	2.5	4D	2.7	W16D2.5	320	295
	5.0	10B	5.1	W16D5.0	403	367
	10.0	14C	8.9	W16D10	455	414
	15.0	14C	8.9	W16D15	490	446
17-19	1.2	2E	1.9	W18D1.2	285	260
	2.5	4D	2.7	**W18D2.5**	320	295
	5.0	10B	5.1	**W18D5.0**	403	367
	10.0	14C	8.9	W18D10	455	414
19-21	1.2	2E	1.9	W20D1.2	290	265
	2.5	4D	2.7	W20D2.5	340	310
	5.0	10B	5.1	**W20D5.0**	426	388
	10.0	14C	8.9	W20D10	485	441
21-23	1.2	2E	1.9	W22D1.2	290	265
	2.5	4D	2.7	**W22D2.5**	340	310
	5.0	10B	5.1	**W22D5.0**	426	388
	10.0	14C	8.9	W22D10	485	441
23-25	1.2	2E	1.9	W24D1.2	290	265
	2.5	4D	2.7	W24D2.5	340	310
	5.0	10B	5.1	**W24D5.0**	426	388
	10.0	14C	8.9	W24D10	485	441
25-27	1.2	2E	1.9	**W26D1.2**	290	265
	2.5	4D	2.7	W26D2.5	340	310
	5.0	10B	5.1	**W26D5.0**	426	388
	10.0	14C	8.9	W26D10	485	441
27-29	1.2	2E	1.9	W28D1.2	$290	$265
	2.5	4D	2.7	W28D2.5	340	310
	5.0	10B	5.1	W28D5.0	426	388
	10.0	14C	8.9	W28D10	485	441

Other standard Models with any output up to 100 vdc are available. For complete information, please consult our nearest office.

DUAL OUTPUT

Output Voltage Range	Output Curr. (Amps)	Size*	Wt. (Lbs.)	Model Number	Price 1 pc.	Price 2-4 pcs.
±3.75- ±4.25	0.3	8B	1.9	WW4D0.3	$300	$270
	0.5	9C	2.2	WW4D0.5	335	300
	1.0	9C	2.2	WW4D1.0	365	325
	2.0	9D	3.1	WW4D2.0	409	372
	4.0	11D	5.5	WW4D4.0	444	404
±4.5- ±5.5	0.3	8B	1.9	WW5D0.3	300	270
	0.5	9C	2.2	WW5D0.5	335	300
	1.0	9C	2.2	WW5D1.0	365	325
	2.0	9D	3.1	WW5D2.0	409	372
	4.0	11D	5.5	WW5D4.0	444	404
±11- ±13	0.3	8B	1.9	WW12D0.3	315	280
	0.5	9C	2.2	WW12D0.5	345	310
	1.0	9C	2.2	WW12D1.0	385	345
	2.0	9D	3.1	WW12D2.0	444	404
	4.0	11D	5.5	WW12D4.0	496	451
±14- ±16	0.3	8B	1.9	WW15D0.3	315	280
	0.5	9C	2.2	WW15D0.5	345	310
	1.0	9C	2.2	WW15D1.0	385	345
	2.0	9D	3.1	WW15D2.0	444	404
	4.0	11D	5.5	WW15D4.0	554	504
±29- ±31	0.3	9C	2.2	WW30D0.3	340	305
	0.5	9C	2.2	WW30D0.5	375	335
	1.0	9D	3.1	WW30D1.0	430	385
	2.0	11D	5.5	WW30D2.0	565	514
	4.0	14C	8.0	WW30D4.0	652	593

Other standard Models with any output between ±2.75 and ±31.0 vdc are available. For complete information, please consult our nearest office.

*See Page 1•1048 for size charts

abbott transistor LABORATORIES, INCORPORATED

abbott 60 ~ to DC Hi-Performing Compacts

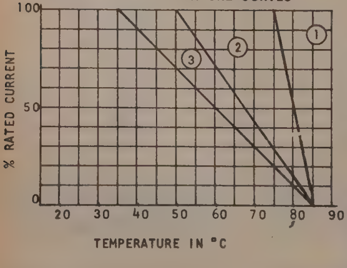
features

- Compact
- Input Frequency Range 47-440 Hz
- Input Voltage Range 100-132 vac
- Hi-Reliability
- +80°C Operation
- Parallel Operation
- Delivery is stock to 10 days.

Output Voltage Range (vdc)	Output Current* (amps)	Model No.	Price 1-4 pcs.
SINGLE OUTPUT			
2.7 - 3.3	10	**Z3T10**	$269
3.7 - 4.3	10	**Z4T10**	269
4.7 - 5.3	10	**Z5T10**	269
5.7 - 6.3	9	**Z6T9**	269
6.0 - 6.6	9	**Z6.3T9**	269
9.5 - 10.5	6	**Z10T6**	269
11.5 - 12.5	5	**Z12T5**	269
14.5 - 15.5	4	**Z15T4**	269
17.5 - 18.5	3.5	**Z18T3.5**	269
19 - 21	3	**Z20T3**	269
21 - 23	3	**Z22T3**	269
23 - 25	2.5	**Z24T2.5**	269
27 - 29	2.5	**Z28T2.5**	269
29 - 31	2.5	**Z30T2.5**	269
DUAL OUTPUT			
±11.5 - ±12.5	2.5†	**ZZ12T2.5**	$349
±14.5 - ±15.5	2†	**ZZ15T2**	349

*See Current vs Temperature Curves below.
† Each Output

CURRENT VS TEMPERATURE CURVES



specifications

INPUT VOLTAGE RANGE: 100 to 132 VRMS

INPUT FREQUENCY RANGE: 47 to 440 Hz, 1 phase

EFFICIENCY: As high as 75%

OUTPUT VOLTAGE AND CURRENT: See specific models listed in table

LINE REGULATION: 0.04% or 5 mv (whichever is greater) for input change of 100 to 132 VRMS with load constant

LOAD REGULATION: 0.1% or 20 mv (whichever is greater) for change from no load to full load with line constant

RIPPLE: 0.02% or 5 mv RMS (whichever is greater); 50 mv (100 mv for duals) peak-to-peak maximum, measured with scope having 25 MHz bandwidth.

OUTPUT VOLTAGE ADJUSTMENT: Voltage is continuously adjustable between the limits shown in table by means of an externally accessible screwdriver adjustment potentiometer

ADJUSTMENT RESOLUTION:

Nom. Output Voltage	Resolution
3-16 vdc	35 mv
18-30 vdc	60 mv

ISOLATION VOLTAGE: 500 vdc input to output and input to case — 200 vdc output to case

INSULATION RESISTANCE: 50 megohms minimum between input and output, input and case, and output and case when measured at 50 vdc

TEMPERATURE RANGE: Operating: −20°C to +80°C (see curves below)
Storage: −55°C to +85°C

TEMPERATURE COEFFICIENT: 0.03% per degree Celsius maximum — 0.01% per degree Celsius typical

SHORT CIRCUIT PROTECTION: Each unit is completely protected against a short circuit of any duration. The output voltage automatically restores to normal when the short is removed

INPUT TRANSIENT PROTECTION: 180 vac for 0.1 second

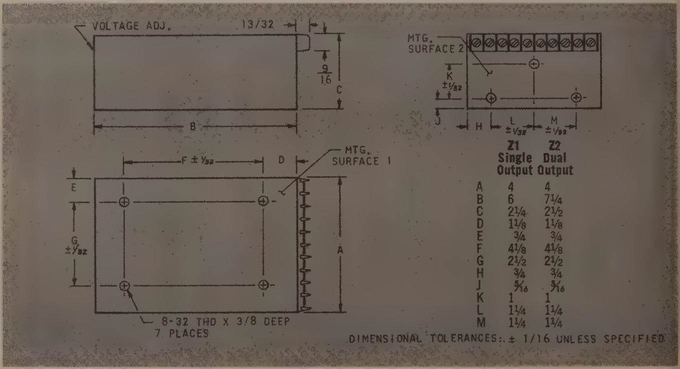
OVERVOLTAGE PROTECTION: Internal circuitry will reduce the output voltage to approximately 1 vdc within 15 microseconds if the output voltage rises 10% or 2 vdc (whichever is greater) above nominal. Available as an optional feature by adding "—1" to the model number and $10.00 to the 1-4 piece price ($20.00 for dual units)

LOAD TRANSIENT RECOVERY TIME: Output voltage returns to regulation limits within 200 microseconds in response to a step change of 50% in load current. Typical over/undershoot is less than 10% of output voltage

PARALLEL OPERATION: Any two identical single output units may be connected in parallel. Output should be derated to 90% of rated current

WEIGHT: 3.0 pounds maximum

ELECTROMAGNETIC INTERFERENCE: EMI filters are used in each unit for suppression of conducted interference



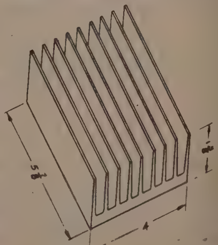
	Z1 Single Output	Z2 Dual Output
A	4	4
B	6	7¼
C	2¼	2½
D	1⅛	1⅛
E	¾	¾
F	4⅛	4⅛
G	2½	2½
H	¾	¾
J	5⁄16	5⁄16
K	1	1
L	1¼	1¼
M	1¼	1¼

DIMENSIONAL TOLERANCES: ± 1/16 UNLESS SPECIFIED

OUTPUT CURRENT VS TEMPERATURE

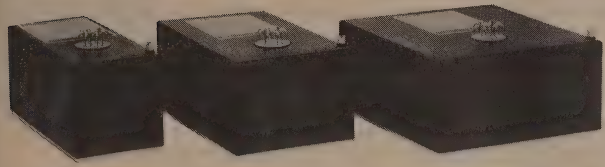
1) CONDUCTION COOLING — Mounting Surface 1 should be attached to a heat sink plate or chassis. The percentage of rated output current that may be drawn from any "Z" model at various mounting surface temperatures is indicated by Curve ①. Thus, 100% of the rated output current may be drawn at a **mounting surface temperature** of 75°C.

2) CONVECTION COOLING — A thermal finned radiator, Model TRZ1, may be attached to Mounting Surface 1. Using Mounting Surface 2, install the unit with fins in a vertical position. Curve ② indicates the percentage of rated output current that may be drawn from any "Z" model in this configuration at various **ambient temperatures.** Thus, 100% of the rated current may be drawn at 50°C **ambient temperature.** Model TRZ1, shown at right, adds 1⅜" to Dimension "C." Price is $5.00 each for 1 to 99 pieces.



3) RADIATION COOLING — Units may be installed on Mounting Surface 2 with **no** additional **heat sinking.** The percentage of rated current that may be drawn from any "Z" model at various ambient temperatures is indicated by Curve ③. The ambient temperature should be measured within ¼ inch of Mounting Surface 1 in still air. Thus 100% of the rated current may be drawn at 35°C **ambient temperature.**

abbott 60 ∿ to DC Hi-Efficiency



features

- Hi-Efficiency (64 to 77%)
- Low EMI
- Compact
- +160°F Operation
- Hi-Reliability
- Hermetically Sealed

specifications

INPUT VOLTAGE RANGE: 115 VRMS, ±10%

INPUT FREQUENCY RANGE: 47 to 440 Hz, 1 Phase

EFFICIENCY: Typical efficiency ranges from 64 to 77%

OUTPUT VOLTAGE AND CURRENT: See specific models listed in tables

LINE REGULATION: 0.4% or 50 mv (whichever is greater) for input change of 103.5 to 126.5 VRMS with load constant

LOAD REGULATION: 0.4% or 50 mv (whichever is greater) from no load to full load with line constant

RIPPLE AND NOISE (PARD): 0.2% plus 125 mv peak-to-peak from +25°C to +71°C. At 0°C peak-to-peak ripple increases to 0.4% plus 200 mv maximum. Measurements made with a scope having a 25MHz bandwidth

OUTPUT VOLTAGE ADJUSTMENT: Voltage is continuously adjustable between the limits shown in the table by means of an externally accessible screwdriver adjustment potentiometer

ADJUSTMENT RESOLUTION:

Nominal Output Voltage	Resolution
3-16 VDC	35 millivolts
18-50 VDC	60 millivolts

ISOLATION VOLTAGE: 500 VDC input to output and input to case, 100 output to case

INSULATION RESISTANCE: 50 megohms minimum between input and output, input and case, and output and case when measured at 50 VDC

POLARITY: Inputs and outputs are isolated, either positive or negative side may be grounded

TEMPERATURE RANGE: Operating: 0°C (32°F) to +71°C (+160°F) baseplate temperature. Storage: −55°C (−65°F) to +85°C (+185°F)

TEMPERATURE COEFFICIENT: 0.03% per degree Celsius maximum

ENVIRONMENT: Hermetically sealed and encapsulated to meet severe environmental requirements, including:
Vibration: MIL-STD-810B, Method 514, Procedure I, Curve H (±10g's) and Procedure XII. Also MIL-STD-167B, Type I
Shock: MIL-STD-810B, Method 516, Procedure II (75g's crash safety)
Humidity: MIL-STD-810B, Method 507, Procedure I
Saltspray: MIL-STD-983E, Paragraph 4.4.12
Saltfog: MIL-STD-810B, Method 509, Procedure I. See Page 1•1051.

SHORT CIRCUIT PROTECTION: Each unit is completely protected against an overload or short circuit of any duration

INPUT TRANSIENT PROTECTION: Unit will withstand 180 VAC for 0.1 second in accordance with MIL-STD-704A, Figure 3, Limit 1

OVERVOLTAGE PROTECTION: Available as separate modules. See Page 1•1047 for complete information

REMOTE ERROR SENSING: Each unit contains a means by which the regulator circuit monitors the voltage directly at the load using extra "Sensing" leads. The resulting circuit action compensates for a DC voltage drop up to 0.3 volts in the load leads

LOAD TRANSIENT RECOVERY TIME: Output voltage returns to regulation limits within 7 msec. after a 50% step change in load current. Maximum over/undershoot is less than 0.8 VDC or 3% of the output voltage, whichever is greater

OUTPUT IMPEDANCE: DC to 1 KHz: .04 R_L or 0.1 ohm, whichever is greater. 1 KHz to 10 KHz: .06 R_L or 0.15 ohms, whichever is greater. 10 KHz to 100 KHz: .08 R_L or 0.4 ohms, whichever is greater.
R_L = Rated Load

ELECTROMAGNETIC INTERFERENCE: EMI filters are used in each unit for suppression of conducted interference

RELIABILITY: The Mean Time Betwen Failure (MTBF) per MIL-HDBK-217A under worst conditions of full rated output current, 126.5 VAC input voltage, and 40°C baseplate temperature was calculated to be 60,000 hours. See Page 1•1053.

Output Voltage Range	Output Current (Amps)	Size*	Weight (Lbs)	Model Number	Price 1-4 pcs
4.7-5.3	5.0	11F	2.8	VN25D-5A	$282
	10.0	12C	4.0	VN50D-5A	301
	20.0	14E	5.4	VN100D-5A	325
5.3-5.9	4.5	11F	2.8	VN25D-5.6A	282
	9.0	12C	4.0	VN50D-5.6A	301
	18.0	14E	5.4	VN100D-5.6A	325
5.9-6.6	4.0	11F	2.8	VN25D-6.3A	282
	8.0	12C	4.0	VN50D-6.3A	301
	16.0	14E	5.4	VN100D-6.3A	325
6.6-7.4	3.6	11F	2.8	VN25D-7.0A	282
	7.2	12C	4.0	VN50D-7.0A	301
	14.4	14E	5.4	VN100D-7.0A	325
7.4-8.3	3.2	11F	2.8	VN25D-7.9A	282
	6.4	12C	4.0	VN50D-7.9A	301
	12.8	14E	5.4	VN100D-7.9A	325
8.3-9.3	2.8	11F	2.8	VN25D-8.8A	282
	5.7	12C	4.0	VN50D-8.8A	301
	11.4	14E	5.4	VN100D-8.8A	325
9.3-10.4	2.5	11F	2.8	VN25D-9.9A	282
	5.1	12C	4.0	VN50D-9.9A	301
	10.2	14E	5.4	VN100D-9.9A	325
10.4-11.6	2.3	11F	2.8	VN25D-11A	$282
	4.6	12C	4.0	VN50D-11A	301
	9.2	14E	5.4	VN100D-11A	325
11.6-13.0	2.0	11F	2.8	VN25D-12.3A	282
	4.1	12C	4.0	VN50D-12.3A	301
	8.2	14E	5.4	VN100D-12.3A	325
13.0-14.8	1.8	11F	2.8	VN25D-13.8A	282
	3.6	12C	4.0	VN50D-13.8A	301
	7.2	14E	5.4	VN100D-13.8A	325
14.8-16.6	1.6	11F	2.8	VN25D-15.7A	282
	3.2	12C	4.0	VN50D-15.7A	301
	6.4	14E	5.4	VN100D-15.7A	325
16.6-18.6	1.4	11F	2.8	VN25D-17.6A	282
	2.8	12C	4.0	VN50D-17.6A	301
	5.6	14E	5.4	VN100D-17.6A	325
18.6-20.8	1.2	11F	2.8	VN25D-19.7A	282
	2.5	12C	4.0	VN50D-19.7A	301
	5.0	14E	5.4	VN100D-19.7A	325
20.8-23.3	1.1	11F	2.8	VN25D-22A	282
	2.3	12C	4.0	VN50D-22A	301
	4.6	14E	5.4	VN100D-22A	325
23.3-26.1	1.0	11F	2.8	VN25D-24.7A	$282
	2.0	12C	4.0	VN50D-24.7A	301
	4.0	14E	5.4	VN100D-24.7A	325
26.1-29.2	0.9	11F	2.8	VN25D-27.6A	282
	1.8	12C	4.0	VN50D-27.6A	301
	3.6	14E	5.4	VN100D-27.6A	325
29.2-32.6	0.8	11F	2.8	VN25D-31A	282
	1.6	12C	4.0	VN50D-31A	301
	3.2	14E	5.4	VN100D-31A	325
32.6-36.5	0.7	11F	2.8	VN25D-34.6A	282
	1.4	12C	4.0	VN50D-34.6A	301
	2.8	14E	5.4	VN100D-34.6A	325
36.5-40.9	0.6	11F	2.8	VN25D-38.7A	282
	1.3	12C	4.0	VN50D-38.7A	301
	2.6	14E	5.4	VN100D-38.7A	325
40.9-45.8	0.5	11F	2.8	VN25D-43.3A	282
	1.1	12C	4.0	VN50D-43.3A	301
	2.2	14E	5.4	VN100D-43.3A	325
45.8-50.0	0.5	11F	2.8	VN25D-47.9A	282
	1.0	12C	4.0	VN50D-47.9A	301
	2.0	14E	5.4	VN100D-47.9A	325

* See Page 1•1048 for size charts.

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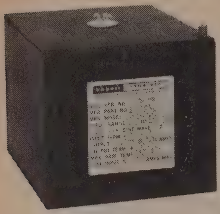
abbott 60 ∿ to DC Hermetically Sealed



features

- Compact
- Hermetically Sealed
- Close Regulation
- High Reliability
- 5 to 740 Volts

specifications

INPUT VOLTAGE RANGE: 105 to 125 volts AC

INPUT FREQUENCY RANGE: 55 to 65 Hertz, 1 phase

INPUT TRANSIENT PROTECTION: In accordance with MIL-STD-704A, Figure 3, Limit 1 (180 VAC for 0.1 sec.)

LINE REGULATION: ±0.2% for 105-125 VAC input, with constant load

COMBINED LINE AND LOAD REGULATION: ±0.5% for 105-125 VAC input and load variation of ½ to full load

RIPPLE: 0.2% RMS

SHORT CIRCUIT PROTECTION: Protected against short circuit conditions of any duration. Output automatically recovers upon removal of short.

VOLTAGE ADJUSTMENT RANGE: 12% by screwdriver adjustment

TEMPERATURE: +160°F (+71°C) maximum at mounting base using adequate heat sink
−4°F (−20°C) minimum at mounting base
Storage: −30°C to +85°C

RELIABILITY: 80,000 hours (See Page 1•1053.

ENVIRONMENT: Encapsulated to meet the environmental requirements of MIL-STD-810B including: altitude, vibration, shock, acceleration, sand, dust, humidity, saltspray, fungus, explosion, etc. (See Page 1•1051.

ISOLATION: Inputs, outputs, and case are isolated so that either a plus or minus output voltage polarity can be obtained.

OUTPUT VOLTAGE AND CURRENT: See specific models listed

Output Voltage Range	Output Current (Amps)	Size*	Wt. (Lbs.)	Model Number	Price 1 pc.	Price 2-4 pcs.
4.7-5.3	1.0	9B	4.0	V05DS-5A	$200	$185
	2.0	9A	4.2	V1DS-5A	205	190
	4.0	10A	6.1	V2DS-5A	220	200
	6.0	11C	8.3	V3DS-5A	230	210
	12.0	13A	16.1	V6DS-5A	290	265
5.3-5.9	0.9	9B	4.0	V05DS-5.6A	200	185
	1.8	9A	4.2	V1DS-5.6A	205	190
	3.6	10A	6.1	V2DS-5.6A	220	200
	5.4	11C	8.3	V3DS-5.6A	230	210
	10.8	13A	16.1	V6DS-5.6A	290	265
5.9-6.6	0.8	9B	4.0	V05DS-6.3A	200	185
	1.6	9A	4.2	V1DS-6.3A	205	190
	3.2	10A	6.1	V2DS-6.3A	220	200
	4.8	11C	8.3	V3DS-6.3A	230	210
	9.6	13A	16.1	V6DS-6.3A	285	260
6.6-7.4	0.7	9B	4.0	V05DS-7A	200	185
	1.4	9A	4.2	V1DS-7A	205	190
	2.8	10A	6.1	V2DS-7A	220	200
	4.2	11C	8.3	V3DS-7A	230	210
	8.4	13A	16.1	V6DS-7A	285	260
7.4-8.3	0.63	9B	4.0	V05DS-7.9A	195	180
	1.26	9A	4.2	V1DS-7.9A	200	185
	2.52	10A	6.1	V2DS-7.9A	210	195
	3.78	11C	8.3	V3DS-7.9A	225	205
	7.56	12A	11.6	V6DS-7.9A	285	260
8.3-9.3	0.57	9B	4.0	V05DS-8.8A	195	180
	1.14	9A	4.2	V1DS-8.8A	200	185
	2.28	10A	6.1	V2DS-8.8A	210	195
	3.42	11C	8.3	V3DS-8.8A	225	205
	6.84	12A	11.6	V6DS-8.8A	285	260
9.3-10.4	0.50	9B	4.0	V05DS-9.9A	195	180
	1.00	9A	4.2	V1DS-9.9A	200	185
	2.00	10A	6.1	V2DS-9.9A	210	195
	3.00	11C	8.3	V3DS-9.9A	225	205
	6.00	12A	11.6	V6DS-9.9A	285	260
	12.00	13A	16.1	V12DS-9.9A	355	325
10.4-11.6	0.45	9B	4.0	V05DS-11A	195	180
	0.91	9A	4.2	V1DS-11A	200	185
	1.82	10A	6.1	V2DS-11A	210	195
	2.73	11C	8.3	V3DS-11A	225	205
	5.46	12A	11.6	V6DS-11A	285	260
	10.92	13A	16.1	V12DS-11A	355	325
11.6-13.0	0.40	9B	4.0	V05DS-12.3A	195	180
	0.81	9A	4.2	V1DS-12.3A	200	185
	1.62	10A	6.1	V2DS-12.3A	210	195
	2.43	11C	8.3	V3DS-12.3A	225	205
	4.86	12A	11.6	V6DS-12.3A	280	255
	9.72	13A	16.1	V12DS-12.3A	345	315
	19.44	16A	16.3	V24DS-12.3A	430	395
13.0-14.8	0.36	9B	4.0	V05DS-13.8A	$190	$175
	0.72	9A	4.2	V1DS-13.8A	195	180
	1.44	10A	6.1	V2DS-13.8A	205	190
	2.16	11C	8.3	V3DS-13.8A	220	200
	4.32	12A	11.6	V6DS-13.8A	280	255
	8.64	13A	16.1	V12DS-13.8A	345	315
	17.28	16A	16.3	V24DS-13.8A	430	395
14.8-16.6	0.32	9B	4.0	V05DS-15.7A	190	175
	0.64	9A	4.2	V1DS-15.7A	195	180
	1.28	10A	6.1	V2DS-15.7A	205	190
	1.92	11C	8.3	V3DS-15.7A	220	200
	3.84	12A	11.6	V6DS-15.7A	280	255
	7.68	13A	16.1	V12DS-15.7A	335	305
	15.36	16A	16.3	V24DS-15.7A	420	385
16.6-18.6	0.28	9B	4.0	V05DS-17.6A	190	175
	0.57	9A	4.2	V1DS-17.6A	195	180
	1.14	10A	6.1	V2DS-17.6A	205	190
	1.71	11C	8.3	V3DS-17.6A	220	200
	3.42	12A	11.6	V6DS-17.6A	280	255
	6.84	13A	16.1	V12DS-17.6A	335	305
	13.68	16A	16.3	V24DS-17.6A	420	385
18.6-20.8	0.255	9B	4.0	V05DS-19.7A	190	175
	0.510	9A	4.2	V1DS-19.7A	195	180
	1.02	10A	6.1	V2DS-19.7A	205	190
	1.53	11C	8.3	V3DS-19.7A	220	200
	3.06	12A	11.6	V6DS-19.7A	275	250
	6.12	13A	16.1	V12DS-19.7A	335	305
	12.24	16A	16.3	V24DS-19.7A	420	385
20.8-23.3	0.230	9B	4.0	V05DS-22A	185	170
	0.460	9A	4.2	V1DS-22A	190	175
	0.920	10A	6.1	V2DS-22A	200	185
	1.38	11C	8.3	V3DS-22A	210	195
	2.76	12A	11.6	V6DS-22A	275	250
	5.52	13A	16.1	V12DS-22A	330	300
	11.02	16A	16.3	V24DS-22A	410	375
23.3-26.1	0.205	9B	4.0	V05DS-24.7A	185	170
	0.410	9A	4.2	V1DS-24.7A	190	175
	0.820	10A	6.1	V2DS-24.7A	200	185
	1.23	11C	8.3	V3DS-24.7A	210	195
	2.46	12A	11.6	V6DS-24.7A	275	250
	4.92	13A	16.1	V12DS-24.7A	330	300
	9.84	16A	16.3	V24DS-24.7A	410	375
26.1-29.2	0.180	9B	4.0	V05DS-27.6A	185	170
	0.360	9A	4.2	V1DS-27.6A	190	175
	0.720	10A	6.1	V2DS-27.6A	200	185
	1.08	11C	8.3	V3DS-27.6A	210	195
	2.16	12A	11.6	V6DS-27.6A	275	250
	4.32	13A	16.1	V12DS-27.6A	315	290
	8.64	16A	16.3	V24DS-27.6A	400	365
29.2-32.6	0.160	9B	4.0	V05DS-31A	$185	$170
	0.320	9A	4.2	V1DS-31A	190	175
	0.640	10A	6.1	V2DS-31A	200	185
	0.960	11C	8.3	V3DS-31A	210	195
	1.92	12A	11.6	V6DS-31A	275	250
	3.84	13A	16.1	V12DS-31A	335	305
	7.68	16A	16.3	V24DS-31A	420	385
32.6-36.5	0.145	9B	4.0	V05DS-34.6A	185	170
	0.290	9A	4.2	V1DS-34.6A	190	175
	0.580	10A	6.1	V2DS-34.6A	200	185
	0.870	11C	8.3	V3DS-34.6A	210	195
	1.74	12A	11.6	V6DS-34.6A	275	250
	3.48	13A	16.1	V12DS-34.6A	355	325
	6.96	16A	16.3	V24DS-34.6A	440	400
36.5-40.9	0.130	9B	4.0	V05DS-38.7A	185	170
	0.260	9A	4.2	V1DS-38.7A	190	175
	0.520	10A	6.1	V2DS-38.7A	200	185
	0.780	11C	8.3	V3DS-38.7A	220	200
	1.56	12A	11.6	V6DS-38.7A	280	255
	3.12	13A	16.1	V12DS-38.7A	385	350
	6.24	16A	16.3	V24DS-38.7A	460	420
40.9-45.8	0.115	9B	4.0	V05DS-43.3A	185	170
	0.230	9A	4.2	V1DS-43.3A	190	175
	0.460	10A	6.1	V2DS-43.3A	200	185
	0.690	11C	8.3	V3DS-43.3A	220	200
	1.38	12A	11.6	V6DS-43.3A	280	255
	2.76	13A	16.1	V12DS-43.3A	400	365
	5.52	16A	16.3	V24DS-43.3A	485	445
45.8-51.4	0.103	9B	4.0	V05DS-48.6A	190	175
	0.206	9A	4.2	V1DS-48.6A	195	180
	0.412	10A	6.1	V2DS-48.6A	215	190
	0.618	11C	8.3	V3DS-48.6A	225	205
	1.24	12A	11.6	V6DS-48.6A	285	260
	2.48	13A	16.1	V12DS-48.6A	420	385
	4.94	16A	16.3	V24DS-48.6A	505	460
51.4-59.0	0.091	9B	4.0	V05DS-55.2A	205	190
	0.182	9A	4.2	V1DS-55.2A	210	195
	0.365	10A	6.1	V2DS-55.2A	225	205
	0.546	11C	8.3	V3DS-55.2A	235	215
	1.10	12A	11.6	V6DS-55.2A	290	265
	2.20	13A	16.1	V12DS-55.2A	420	385
	4.40	16A	16.3	V24DS-55.2A	505	460
59.0-740.0	174 other standard models are available with output voltages between 59.0 and 740.0 VDC at output power ratings of 5, 10, 20, 30, 60, 120 or 240 watts. For complete information, please consult one of the offices listed below.					

*See Page 1•1048 for size charts

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abbott 28 VDC to DC (Reg.) Hi-Temp.

POWER MODULES

features

- Hi-temp. +212°F.
- 5 to 740 volts
- Hermetically sealed
- Short circuit protection
- Input spike protection

specifications

Input Voltage Range
24 to 30 volts DC

Line Regulation
±0.2% for input 24 to 30 VDC

Voltage Regulation
±1.5% for input 24 to 30 VDC and from ½ load to full load on Model B's
±2.5% for input 24 to 30 VDC and from ½ load to full load on Model BL's

Ripple
0.5 RMS — Model B's
1.0% RMS — Model BL's

Voltage Adjustment Range
12% by screwdriver adjustment

Input Transient Protection
In accordance with MIL-STD-704A, Limit 1, Category B (80 volts for 0.1 sec.)

Reliability
120,000 hours MTBF typical per MIL-HDBK-217 under worst case operating conditions See Page 1•1053.

Environment
+212°F max. at mounting base using adequate heat sink
−65°F min. at mounting surface
Altitude: To vacuum (true hermetic seal).
Vibration, shock, sand, dust, humidity, salt-spray, fungus, sunshine, rain, and explosion to MIL-STD-810B and MIL-E-5400K, Class 2 See Page 1•1051.

Output Voltage and Current
See specific models listed
(Outputs and inputs are isolated)

Output Voltage Range	Output Current (Amps)	Size*	Wt. lbs.	Model Number	Price 1 pc.	Price 2-4 pcs.
4.7-5.3	0.400	1B	0.5	BL02D-5A	$218	$197
	1.0	1A	0.9	BL05D-5A	231	208
	2.0	1	1.0	BL1D-5A	253	230
	4.0	2	1.1	BL2D-5A	279	254
	6.0	4	1.3	BL3D-5A	299	272
	10.0	6A	2.5	BL5D-5A	344	313
5.3-5.9	0.357	1B	0.5	BL02D-5.6A	212	191
	0.9	1A	0.9	BL05D-5.6A	225	203
	1.8	1	1.0	BL1D-5.6A	247	225
	3.6	2	1.1	BL2D-5.6A	267	243
	5.4	4	1.3	BL3D-5.6A	293	266
	8.91	6A	2.5	BL5D-5.6A	339	308
5.9-6.6	0.318	1B	0.5	BL02D-6.3A	212	191
	0.8	1A	0.9	BL05D-6.3A	225	203
	1.6	1	1.0	BL1D-6.3A	247	225
	3.2	2	1.1	BL2D-6.3A	267	243
	4.8	4	1.3	BL3D-6.3A	293	266
	7.92	6	1.9	BL5D-6.3A	339	308
6.6-7.4	0.286	1B	0.5	BL02D-7A	212	191
	0.7	1A	0.9	BL05D-7A	225	203
	1.4	1	1.0	BL1D-7A	247	225
	2.8	2	1.1	BL2D-7A	267	243
	4.2	4	1.3	BL3D-7A	286	260
	7.15	6	1.9	BL5D-7A	331	301
7.4-8.3	0.253	1B	0.5	BL02D-7.9A	212	191
	0.63	1A	0.9	B05D-7.9A	225	203
	1.26	1	1.0	BL1D-7.9A	247	225
	2.52	2	1.1	BL2D-7.9A	267	243
	3.78	4	1.3	BL3D-7.9A	286	260
	6.32	6	1.9	BL5D-7.9A	331	301
8.3-9.3	0.227	1B	0.5	BL02D-8.8A	212	191
	0.57	1A	0.9	B05D-8.8A	225	203
	1.14	1	1.0	BL1D-8.8A	240	218
	2.28	2	1.1	BL2D-8.8A	260	236
	3.42	4	1.3	BL3D-8.8A	279	254
	5.68	6	1.9	BL5D-8.8A	324	295
9.3-10.4	0.202	1B	0.5	B02D-9.9A	206	186
	0.50	1A	0.9	B05D-9.9A	218	197
	1.00	1	1.0	BL1D-9.9A	240	218
	2.00	2	1.1	BL2D-9.9A	253	230
	3.00	4	1.3	BL3D-9.9A	273	248
	5.05	6	1.9	BL5D-9.9A	324	295
	10.10	11	3.7	BL10D-9.9A	365	329
10.4-11.6	0.182	1B	0.5	B02D-11A	206	186
	0.45	1A	0.9	B05D-11A	218	197
	0.91	1	1.0	BL1D-11A	234	213
	1.82	2	1.1	BL2D-11A	247	225
	2.73	4	1.3	BL3D-11A	273	248
	4.55	6	1.9	BL5D-11A	319	290
	9.10	11	3.7	BL10D-11A	362	326
11.6-13.0	0.163	1B	0.5	B02D-12.3A	206	186
	0.40	1A	0.9	B05D-12.3A	218	197
	0.81	1	1.0	BL1D-12.3A	234	213
	1.62	2	1.1	BL2D-12.3A	253	230
	2.43	4	1.3	BL3D-12.3A	273	248
	4.06	6	1.9	BL5D-12.3A	311	283
	8.12	11	3.7	BL10D-12.3A	350	315
	13.83	14	10.3	BL17D-12.3A	465	419
13.0-14.8	0.145	1B	0.5	B02D-13.8A	206	186
	0.36	1A	0.9	B05D-13.8A	218	197
	0.72	1	1.0	BL1D-13.8A	234	213
	1.44	2	1.1	BL2D-13.8A	267	243
	2.16	4	1.3	BL3D-13.8A	279	254
	3.62	6	1.9	BL5D-13.8A	305	277
	7.24	11	3.7	BL10D-13.8A	343	309
	12.31	14	10.3	BL17D-13.8A	409	369
14.8-16.6	0.127	1B	0.5	B02D-15.7A	$206	$186
	0.32	1A	0.9	B05D-15.7A	218	197
	0.64	1	1.0	BL1D-15.7A	234	213
	1.28	2	1.1	BL2D-15.7A	267	243
	1.92	4	1.3	BL3D-15.7A	279	254
	3.18	6	1.9	BL5D-15.7A	305	277
	6.36	11	3.7	BL10D-15.7A	337	304
	10.81	14	10.3	BL17D-15.7A	398	359
16.6-18.6	0.114	1B	0.5	B02D-17.6A	200	180
	0.28	1A	0.9	B05D-17.6A	212	191
	0.57	1	1.0	BL1D-17.6A	228	207
	1.14	2	1.1	BL2D-17.6A	260	236
	1.71	4	1.3	BL3D-17.6A	267	243
	2.84	6	1.9	BL5D-17.6A	299	272
	5.68	11	3.7	BL10D-17.6A	331	298
	9.65	14	10.3	BL17D-17.6A	392	353
18.6-20.8	0.101	1B	0.5	B02D-19.7A	200	180
	0.255	1A	0.9	B05D-19.7A	212	191
	0.510	1	1.0	BL1D-19.7A	228	207
	1.02	2	1.1	BL2D-19.7A	260	236
	1.63	4	1.3	BL3D-19.7A	267	243
	2.54	6	1.9	BL5D-19.7A	286	260
	5.08	11	3.7	BL10D-19.7A	331	298
	8.62	14	10.3	BL17D-19.7A	392	353
20.3-23.3	0.091	1B	0.5	B02D-22A	193	174
	0.230	1A	0.9	B05D-22A	206	186
	0.460	1	1.0	BL1D-22A	221	201
	0.920	2	1.1	BL2D-22A	253	230
	1.38	4	1.3	BL3D-22A	260	236
	2.27	6	1.9	BL5D-22A	286	260
	4.54	11	3.7	BL10D-22A	331	298
	7.72	14	10.3	BL17D-22A	392	353
23.3-26.1	0.081	1B	0.5	B02D-24.7A	193	174
	0.205	1A	0.9	B05D-24.7A	206	186
	0.410	1	1.0	BL1D-24.7A	221	201
	0.820	2	1.1	BL2D-24.7A	253	230
	1.23	4	1.3	BL3D-24.7A	260	236
	2.02	6	1.9	BL5D-24.7A	286	260
	4.04	11	3.7	BL10D-24.7A	331	298
	6.88	14	10.3	BL17D-24.7A	392	353
26.1-29.2	0.073	1B	0.5	B02D-27.6A	193	174
	0.180	1A	0.9	B05D-27.6A	206	186
	0.360	1	1.0	BL1D-27.6A	221	201
	0.720	2	1.1	BL2D-27.6A	247	225
	1.08	4	1.3	BL3D-27.6A	260	236
	1.81	6	1.9	BL5D-27.6A	286	260
	3.62	11	3.7	BL10D-27.6A	331	298
	6.16	14	10.3	BL17D-27.6A	392	353
29.2-32.6	0.065	1B	0.5	B02D-31A	193	174
	0.160	1A	0.9	B05D-31A	206	186
	0.320	1	1.0	B1D-31A	221	201
	0.640	2	1.1	B2D-31A	240	218
	0.960	4	1.3	BL3D-31A	260	236
	1.61	6	1.9	BL5D-31A	286	260
	3.22	11	3.7	BL10D-31A	331	298
	5.48	14	10.3	BL17D-31A	392	353
32.6-36.5	0.058	1B	0.5	B02D-34.6A	193	174
	0.145	1A	0.9	B05-34.6A	206	186
	0.290	1	1.0	B1D-34.6A	221	201
	0.580	2	1.1	B2D-34.6A	228	207
	0.870	4	1.3	BL3D-34.6A	260	236
	1.44	6	1.9	BL5D-34.6A	286	260
	2.88	11	3.7	BL10D-34.6A	331	298
	4.91	14	10.3	BL17D-34.6A	392	353
36.5-40.9	0.052	1B	0.5	B02D-38.7A	$193	$174
	0.130	1A	0.9	B05D-38.7A	206	186
	0.260	1	1.0	B1D-38.7A	221	201
	0.520	2	1.1	B2D-38.7A	228	207
	0.780	4	1.3	BL3D-38.7A	260	236
	1.29	6	1.9	BL5D-38.7A	286	260
	2.58	11	3.7	BL10D-38.7A	331	298
	4.39	14	10.3	BL17D-38.7A	392	353
40.9-45.8	0.046	1B	0.5	B02D-43.3A	193	174
	0.155	1A	0.9	B05D-43.3A	206	186
	0.230	1	1.0	B1D-43.3A	221	201
	0.460	2	1.1	B2D-43.3A	228	207
	0.690	4	1.3	BL3D-43.3A	260	236
	1.15	6	1.9	BL5D-43.3A	286	260
	2.30	11	3.7	BL10D-43.3A	331	298
	3.92	14	10.3	BL17D-43.3A	392	353
45.8-51.4	0.041	1B	0.5	B02D-48.6A	193	174
	0.103	1A	0.9	B05D-48.6A	206	186
	0.206	1	1.0	B1D-48.6A	221	201
	0.412	2	1.1	B2D-48.6A	228	207
	0.618	4	1.3	B3D-48.6A	260	236
	1.03	6	1.9	BL5D-48.6A	286	260
	2.06	11	3.7	BL10D-48.6A	331	298
	3.49	14	10.3	BL17D-48.6A	392	353
51.4-59.0	0.036	1B	0.5	B02D-55.2A	193	174
	0.091	1A	0.9	B05D-55.2A	206	186
	0.182	1	1.0	B1D-55.2A	221	201
	0.364	2	1.1	B2D-55.2A	228	207
	0.546	4	1.3	B3D-55.2A	260	236
	0.905	6	1.9	BL5D-55.2A	286	260
	1.81	11	3.7	BL10D-55.2A	331	298
	3.07	14	10.3	BL17D-55.2A	392	353
59.0-66.0	0.032	1B	0.5	B02D-63A	193	174
	0.080	1A	0.9	B05D-63A	206	186
	0.160	1	1.0	B1D-63A	221	201
	0.320	2	1.1	B2D-63A	228	207
	0.480	4	1.3	B3D-63A	260	236
	0.795	6	1.9	BL5D-63A	286	260
	1.59	11	3.7	BL10D-63A	331	298
	2.69	14	10.3	BL17D-63A	392	353
66.0-74.0	0.029	1B	0.5	B02D-70A	193	174
	0.071	1A	0.9	B05D-70A	206	186
	0.143	1	1.0	B1D-70A	221	201
	0.286	2	1.1	B2D-70A	228	207
	0.429	4	1.3	B3D-70A	253	230
	0.715	6	1.9	BL5D-70A	279	254
	1.43	11	3.7	BL10D-70A	331	298
	2.42	14	10.3	BL17D-70A	392	353
74.0-83.0	0.025	1B	0.5	B02D-79A	193	174
	0.063	1A	0.9	B05D-79A	206	186
	0.127	1	1.0	B1D-79A	221	201
	0.254	2	1.1	B2D-79A	228	207
	0.381	4	1.3	B3D-79A	253	230
	0.634	6	1.9	BL5D-79A	267	243
	1.27	11	3.7	BL10D-79A	331	298
	2.15	14	10.3	BL17D-79A	392	353
83.0-740.0	150 other standard models are available with output voltages between 83.0 and 740.0 Vdc at output power ratings of 2, 5, 10, 20, 30, 50, 100 or 170 watts. For complete information, please consult one of the offices listed below.					

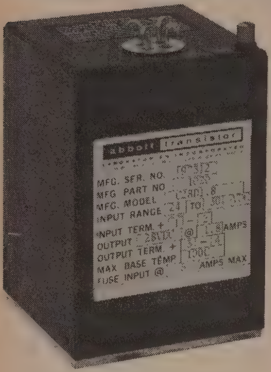
* See Page 1•1048 for size charts

abbott transistor LABORATORIES, INCORPORATED

general offices
5200 W. Jefferson Blvd., Los Angeles, Calif. 90016
(213) 936-8185 Telex: 69-1398

eastern office
1224 Anderson Avenue, Fort Lee, New Jersey 07024
(201) 224-6900 Telex: 13-5332

abbott 28 VDC to DC Hi-Performance Single & Dual Output



features

- Low Peak-to-Peak Ripple
- RFI/EMI to MIL-STD-461
- Small
- Hermetically Sealed
- +100°C Operation
- 0.1% Regulation

specifications

INPUT VOLTAGE RANGE: 24 to 30 vdc. Other input ranges are available

LINE REGULATION: 0.1% (0.2% for duals) or 10 mv (whichever is greater) for input change of 24 to 30 vdc with load constant

LOAD REGULATION: 0.1% (0.2% for duals) or 20 mv (whichever is greater) for load change of no load to full load with line constant

RIPPLE: 0.02% or 5 mv RMS (whichever is greater) 50 mv peak-to-peak maximum, each output, measured with scope having a bandwidth of 25 MHz

OUTPUT VOLTAGE ADJUSTMENT: Voltage is continuously adjustable between the limits shown in the table by means of an externally accessible screwdriver adjustment potentiometer.

TRACKING ACCURACY: The negative output will track the positive output to within 1.0% or 100 mv (whichever is greater) for all rated conditions of input voltage, output current, operating temperature, and output voltage adjustment

ISOLATION VOLTAGE: 200 volts DC between input and output, input and case, and output and case.

INSULATION RESISTANCE: 50 megohms minimum at 50 volts DC between input and output, input and case, and output and case.

POLARITY: Inputs and outputs are isolated; either positive or negative side may be grounded.

TEMPERATURE RANGE: Operating: −55°C to +100°C maximum at center of mounting base.
Storage: −55°C to +125°C.

TEMPERATURE COEFFICIENT: 0.03% per degree Celsius maximum

ENVIRONMENT: Encapsulated to meet the environmental requirements of MIL-STD-810B and MIL-E-5400K, Class 2, including altitude (to a vacuum), vibration, shock, acceleration, sand, dust, humidity, salt spray, fungus, explosion, etc. See Page 1•1051.

SHORT CIRCUIT PROTECTION
Each unit is completely protected against an overload or short circuit of any duration. The output voltage automatically restores to normal when the overload is removed.

INPUT TRANSIENT PROTECTION: MIL-STD-704A, Limit 1, Category B (80 volts for 0.1 sec.).

OVERVOLTAGE PROTECTION: Overvoltage protection modules are available for use with these units. Please see Page 1•1047 for further information.

LOAD TRANSIENT RECOVERY TIME: Output voltage returns to regulation limits within 100 microseconds (200 microseconds for duals) after 50% step change in load current

ELECTROMAGNETIC INTERFERENCE: Built to meet the requirements of MIL-STD-461 for generation of and susceptability to radiated and conducted interference.

RELIABILITY: The mean time between failure (MTFB) per MIL-HDBK-217 under worst case operating conditions of full rated output current, 30 vdc input voltage, and +100°C base plate temperature has been calculated for typical units. Values are: C5D10 — 41,305 hrs; C95D0.25 — 55,463 hrs; CC3D3.5 — 34,710 hrs; CC30D3.5 — 20,105 hrs. See Page 1•1053.

*DELIVERY FROM STOCK**

Output Voltage Range	Output Curr. (Amps)	Size†	Wt. (Lbs.)	Model Number	Price 1 pc.	Price 2-4 pcs.
4.5-5.5	2.5	2D	1.2	**C5D2.5**	$291	$265
	5.0	6B	1.7	C5D5.0	319	290
	10.0	7A	2.6	**C5D10**	395	359
5.5-6.5	2.5	2D	1.2	C6D2.5	291	265
	5.0	6B	1.7	C6D5.0	319	290
	10.0	7A	2.6	C6D10	395	359
6.5-7.5	2.5	2D	1.2	C7D2.5	291	265
	5.0	6B	1.7	C7D5.0	319	290
	10.0	7A	2.6	C7D10	395	359
7.5-8.5	1.8	2D	1.2	C8D1.8	291	265
	3.5	6B	1.7	**C8D3.5**	319	290
	7.5	7A	2.6	**C8D7.5**	395	359
8.5-9.5	1.8	2D	1.2	C9D1.8	291	265
	3.5	6B	1.7	**C9D3.5**	319	290
	7.5	7A	2.6	**C9D7.5**	395	359
9.5-10.5	1.8	2D	1.2	C10D1.8	291	265
	3.5	6B	1.7	**C10D3.5**	319	290
	7.5	7A	2.6	**C10D7.5**	395	359
10.5-11.5	1.8	2D	1.2	**C11D1.8**	291	265
	3.5	6B	1.7	**C11D3.5**	319	290
	7.5	7A	2.6	**C11D7.5**	395	359
11-13	1.2	2D	1.2	**C12D1.2**	291	265
	2.5	6B	1.7	**C12D2.5**	319	290
	5.0	7A	2.6	**C12D5.0**	395	359
13-15	1.2	2D	1.2	C14D1.2	291	265
	2.5	6B	1.7	C14D2.5	319	290
	5.0	7A	2.6	**C14D5.0**	395	359
14-16	1.2	2D	1.2	C15D1.2	291	265
	2.5	6B	1.7	**C15D2.5**	319	290
	5.0	7A	2.6	C15D5.0	395	359
15-17	1.2	2D	1.2	C16D1.2	291	265
	2.5	6B	1.7	**C16D2.5**	319	290
	5.0	7A	2.6	**C16D5.0**	395	359
17-19	1.2	2D	1.2	C18D1.2	$291	$265
	2.5	6B	1.7	C18D2.5	319	290
	5.0	7A	2.6	C18D5.0	395	359
19-21	0.8	2D	1.2	**C20D0.8**	291	265
	1.8	6B	1.7	**C20D1.8**	319	290
	3.5	7A	2.6	C20D3.5	395	359
21-23	0.8	2D	1.2	C22D0.8	291	265
	1.8	6B	1.7	**C22D1.8**	319	290
	3.5	7A	2.6	**C22D3.5**	395	359
23-25	0.8	2D	1.2	C24D0.8	291	265
	1.8	6B	1.7	C24D1.8	319	290
	3.5	7A	2.6	**C24D3.5**	395	359
25-27	0.8	2D	1.2	C26D0.8	291	265
	1.8	6B	1.7	C26D1.8	319	290
	3.5	7A	2.6	C26D3.5	395	359
27-29	0.8	2D	1.2	C28D0.8	291	265
	1.8	6B	1.7	**C28D1.8**	319	290
	3.5	7A	2.6	C28D3.5	395	359
29-31	0.6	2D	1.2	C30D0.6	291	265
	1.2	6B	1.7	C30D1.2	319	290
	2.5	7A	2.6	C30D2.5	395	359
31-33	0.6	2D	1.2	C32D0.6	291	265
	1.2	6B	1.7	C32D1.2	319	290
	2.5	7A	2.6	C32D2.5	395	359
33-35	0.6	2D	1.2	C34D0.6	291	265
	1.2	6B	1.7	C34D1.2	319	290
	2.5	7A	2.6	C34D2.5	395	359
35-37	0.6	2D	1.2	C36D0.6	291	265
	1.2	6B	1.7	C36D1.2	319	290
	2.5	7A	2.6	C36D2.5	395	359

Other standard Models with any output up to 100 vdc are available. For complete information, please consult our nearest office.

DUAL OUTPUT

Output Voltage Range	Output Curr. (Amps)	Size†	Wt. (Lbs.)	Model Number	Price 1 pc.	Price 2-4 pcs.
±2.75-±3.25	0.5	10C	2.3	CC3D0.5	$352	$320
	1.0	10C	2.3	CC3D1.0	380	346
	2.0	10D	2.5	CC3D2.0	409	372
	3.5	11E	3.9	CC3D3.5	455	414
±4.5-±5.5	0.5	10C	2.3	CC5D0.5	352	320
	1.0	10C	2.3	CC5D1.0	380	346
	2.0	10D	2.5	**CC5D2.0**	409	372
	3.5	11E	3.9	CC5D3.5	455	414
±11-±13	0.5	10C	2.3	CC12D0.5	363	330
	1.0	10C	2.3	CC12D1.0	392	357
	2.0	10D	2.5	CC12D2.0	444	404
	3.5	11E	3.9	CC12D3.5	519	472
±14-±16	0.5	10C	2.3	CC15D0.5	363	330
	1.0	10C	2.3	CC15D1.0	392	357
	2.0	10D	2.5	CC15D2.0	444	404
	3.5	11E	3.9	CC15D3.5	519	472
±19-±21	0.5	10C	2.3	CC20D0.5	369	336
	1.0	10D	2.5	CC20D1.0	403	367
	2.0	11E	3.9	CC20D2.0	462	420
	3.5	14D	7.9	CC20D3.5	547	498
±23-±25	0.5	10C	2.3	CC24D0.5	375	341
	1.0	10D	2.5	CC24D1.0	415	378
	2.0	11E	3.9	CC24D2.0	485	441
	3.5	14D	7.9	CC24D3.5	565	514

Other standard Models with any output between ±2.75 and ±31.0 vdc are available. For complete information, please consult our nearest office.

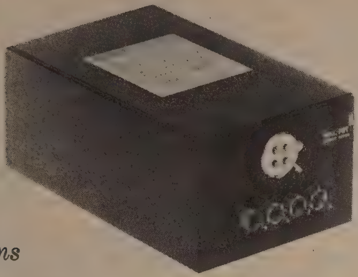
* All models with output voltages from 5 to 30 VDC are normally available from stock.
† See Page 1•1048 for size charts.

abbott transistor LABORATORIES, INCORPORATED

general offices
5200 W. Jefferson Blvd., Los Angeles, Calif. 90016
(213) 936-8185 Telex: 69-1398

eastern office
1224 Anderson Avenue, Fort Lee, New Jersey 07024
(201) 224-6900 Telex: 13-5332

abbott DC to DC Hi-Efficiency



features

- Wide Range DC Input
- Up to 70% Efficiency
- EMI Filters
- Reverse Polarity Protection
- +100°C Operation
- Single & Dual Outputs

specifications

INPUT VOLTAGE RANGE: 20 to 32 VDC

EFFICIENCY: Typical efficiency ranges from 50 to 70%.

INRUSH CURRENT: Less than 8 times normal steady-state full load input current

LINE EFFECT (REGULATION): 0.5% for input change of 20 to 32 VDC

LOAD EFFECT (REGULATION): 0.5% for load change of no load to full load

PARD (RIPPLE & NOISE): 100 mv peak-to-peak, 25 mv rms from 25°C to +100°C; 130 mv peak-to-peak, 40 mv rms from −55°C to +25°C. Measured at power module terminals with measurement system noise bandwidth of 25 MHz

OUTPUT VOLTAGE ADJUSTMENT: Voltage is continuously adjustable between the limits shown by means of an externally accessible screwdriver adjustment potentiometer. Wider output ranges are available by restricting the input voltage range. Consult the factory for further information

ADJUSTMENT RESOLUTION:

Nominal Output Voltage	Resolution
5-10 VDC	37 mv
12-18 VDC	49 mv
24-31 VDC	75 mv

ISOLATION VOLTAGE: 100 VDC between input & output and input & case; 50 VDC between output & case

INSULATION RESISTANCE: 50 megohms minimum between input & output, input & case and output & case when measured at 50 VDC

POLARITY: Inputs and outputs are isolated; either positive or negative side may be grounded.

TEMPERATURE RANGE: Operating; −55°C to +100°C baseplate temperature. Derate maximum output current linearly above 85°C baseplate temperature to 80% of full load rating at 100°C baseplate temperature. Storage; −65°C to +125°C

TEMPERATURE EFFECT (COEFFICIENT): 0.03% per degree Celsius

ENVIRONMENT: Hermetically sealed and encapsulated to meet the environmental requirements of MIL-STD-810 and MIL-E-5400, Class 2, including altitude (to a vacuum), vibration, shock, acceleration, sand, dust, humidity, salt spray, fungus, explosion, etc.

Output Voltage Range	Output Current (Amps)	Size*	Weight (Lbs.)	Model Number	Price 1-4 pcs.
4.75-5.25	5.0	10E	1.8	BN25D-5A	$275
	10.0	11J	2.9	BN50D-5A	325
	20.0	12F	4.4	BN100D-5A	425
5.7-6.3	4.17	10E	1.8	BN25D-6A	275
	8.33	11J	2.9	BN50D-6A	325
	16.67	12F	4.4	BN100D-6A	425
9.5-10.5	2.5	10E	1.8	BN25D-10A	275
	5.0	11J	2.9	BN50D-10A	325
	10.0	12F	4.4	BN100D-10A	425
11.4-12.6	2.08	10E	1.8	BN25D-12A	275
	4.17	11J	2.9	BN50D-12A	325
	8.33	12F	4.4	BN100D-12A	425
14.25-15.75	1.67	10E	1.8	BN25D-15A	275
	3.33	11J	2.9	BN50D-15A	325
	6.67	12F	4.4	BN100D-15A	425
17.1-18.9	1.39	10E	1.8	BN25D-18A	275
	2.78	11J	2.9	BN50D-18A	325
	5.56	12F	4.4	BN100D-18A	425
22.8-25.2	1.04	10E	1.8	BN25D-24A	275
	2.08	11J	2.9	BN50D-24A	325
	4.17	12F	4.4	BN100D-24A	425

*See Page 1•1048 for size charts

SHORT CIRCUIT PROTECTION: Each unit is completely protected against overloads (greater than 150% rated load) and short circuits of any duration. The output automatically restores to normal when the fault is removed

INPUT TRANSIENT PROTECTION: Each unit is completely protected against the transients of MIL-STD-704, Category B, (80 VDC for 0.1 sec) having rise times greater than 100 microseconds. Unit will turn off and resume operation when the input returns to normal

OVERVOLTAGE PROTECTION: Internal OVP is available as an optional feature and is indicated by adding "—1" to the model number (i.e.: BN25D-5A-1 indicates that OVP has been included.) The price is $15.00 additional on 1-4 pieces. The overvoltage threshold is factory set to approximately 2 V or 10% (whichever is greater) above the nominal output voltage. The OVP circuitry has a built-in delay of approximately 500 microseconds to minimize 'nuisance' tripping

REMOTE ERROR SENSING: Each unit contains a means by which the regulator circuit can monitor the voltage directly at the load by using extra "sense" leads. The resulting circuit action will compensate for a DC voltage drop of up to 0.3 volts in the load leads

LOAD TRANSIENT RESPONSE: Output voltage returns to regulation limits within 2 ms after a 50% step change in load current. Maximum overshoot is less than 0.8 V

TURN-ON/TURN-OFF OVERSHOOT: No overshoot during turn-on into loads greater than half load. For loads less than half load, turn-on overshoot is less than 0.8 V for 25 ms. No turn-off overshoot under any conditions

OUTPUT IMPEDANCE:

DC-500 Hz	0.02 R_L or 0.04 ohms
500-5K Hz	0.10 R_L or 0.35 ohms
5K-100K Hz	0.30 R_L or 0.04 ohms

ELECTROMAGNETIC INTERFERENCE: Designed to meet the requirements of MIL-STD-461 for generation of conducted and radiated interference. Test report on a typical model is available

RELIABILITY: The Mean Time Between Failures (MTBF) per MIL-HDBK-217A under worst case operating conditions of 32 VDC input, full load output, and 100°C baseplate temperature was calculated to be 13,950 hours for Model BN100D-5A. At 71°C baseplate temperature, the MTBF increases to 23,000 hours

Output Voltage Range	Output Current (Amps)	Size*	Weight (Lbs.)	Model Number	Price 1-4 pcs.
26.6-29.4	0.89	10E	1.8	BN25D-28A	$275
	1.79	11J	2.9	BN50D-28A	325
	3.57	12F	4.4	BN100D-28A	425
29.45-32.55	0.81	10E	1.8	BN25D-31A	275
	1.61	11J	2.9	BN50D-31A	325
	3.23	12F	4.4	BN100D-31A	425
45.6-50.4	0.52	10E	1.8	BN25D-48A	275
	1.04	11J	2.9	BN50D-48A	325
	2.08	12F	4.4	BN100D-48A	425
±11.4 to ±12.6	1.04	10F	2.2	BBN25D-12A	325
	2.08	11J	2.9	BBN50D-12A	375
	4.17	12F	4.4	BBN100D-12A	450
±14.25 to ±15.75	0.83	10F	2.2	BBN25D-15A	325
	1.67	11J	2.9	BBN50D-15A	375
	3.33	12F	4.4	BBN100D-15A	450

Dual Output Units: 1) The output current listed is for each output.
2) The negative output is "semiregulated" and will meet regulation specifications only when operated into a balanced load.
3) The negative output will typically be within 4% of the positive output voltage for load imbalances up to 4:1 in magnitude.

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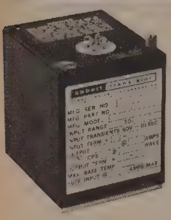
abbott DC to Sine Wave ∿1 ∅

DC to 400 Hz



POWER MODULES

features

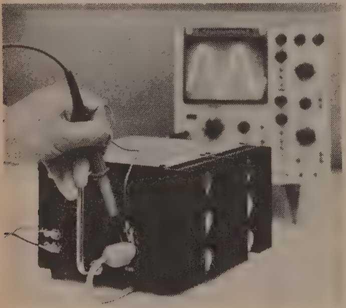
- Close regulation
- 400 or 800 Hertz
- Hermetically sealed
- No moving parts
- Compact

specifications

Input Voltage Range: 24 to 30 volts DC. Other input ranges are available.
Line Regulation: ±0.5% from ½ to full load.
Frequency Stability: ±1%.
Voltage Adjustment Range: 12% by screwdriver adjustment.
Reliability: 55,000 hours MTBF typical per MIL-HDBK-217 under worst case operation conditions. See Page 1•1053.
Input Transient Protection: In accordance with MIL-STD-704A, Limit 1, Category B (80 volts for 0.1 seconds).
Environment: +212°F max. at mtg. base using adequate heat sink. −65°F min. at mtg. surface. Altitude: To vacuum (true hermetic seal). Vibration, shock, sand, dust, humidity, salt spray, fungus, sunshine, rain, and explosion to MIL-E-5272C and MIL-E-5400K. See Page 1•1051.
Output Voltage, Current, and Frequency: See specific models listed (Outputs and inputs are isolated).
Output freqencies up to 1600 Hz are listed in our catalog as standard models. Contact our nearest office for your free copy.

Input Voltage Range	Output Frequency (Hertz)	Output Voltage Range	Output Power (Volt-Amps)	Harmonic Distortion (%)	Size (See Page 1•1048)	Weight (Lbs.)	Model Number	Price 1 Piece	Price 2-4 Pieces
24-30	400	25.4-28.6	5	2.0	4	1.6	S05D-27A-400	$297	$270
			10	2.5	4C	1.7	S1D-27A-400	308	280
			20	2.5	4B	2.3	S2D-27A-400	319	290
			30	2.5	6A	2.4	S3D-27A-400	330	300
			60	3.0	12	4.8	S6D-27A-400	436	397
			120	4.0	14	9.1	S12D-27A-400	687	625
24-30	400	108-122	5	2.0	4	1.6	S05D-115A-400	270	245
			10	2.5	4C	1.7	S1D-115A-400	280	255
			20	2.5	4B	2.3	S2D-115A-400	291	265
			30	2.5	6A	2.4	S3D-115A-400	302	275
			60	3.0	12	4.8	S6D-115A-400	410	373
			120	4.0	14	9.1	S12D-115A-400	654	595
24-30	800	25.4-28.6	5	2.0	4	1.6	S05D-27A-800	325	295
			10	2.5	4C	1.7	S1D-27A-800	335	305
			20	2.5	4B	2.3	S2D-27A-800	346	315
			30	2.5	6A	2.4	S3D-27A-800	357	325
			60	3.0	12	4.8	S6D-27A-800	436	397
			120	4.0	14	9.1	S12D-27A-800	715	650
24-30	800	108-122	5	2.0	4	1.6	S05D-115A-800	297	270
			10	2.5	4C	1.7	S1D-115A-800	308	280
			20	2.5	4B	2.3	S2D-115A-800	319	290
			30	2.5	6A	2.4	S3D-115A-800	330	300
			60	3.0	12	4.8	S6D-115A-800	436	397
			120	4.0	14	9.1	S12D-115A-800	687	625

DC to 60 Hz



DC TO 60 Hz INVERTERS

features

- 115 VRMS 60 Hz Sine Wave Output
- 12, 24, 28, 36 VDC Inputs
- Low Cost
- High Reliability
- −20°C to +55°C ambient operation
- Reverse Polarity Protection

specifications

INPUT VOLTAGE RANGE: 11 to 15 VDC for KN's; 22 to 30 VDC for PN's; 29 to 38 VDC for LN's
OUTPUT VOLTAGE: 115 VAC ±2% at full load and nominal input voltage
OUTPUT FREQUENCY: 60 Hz ±2 Hz
LINE REGULATION: 3% for specified input voltage range with load constant
LOAD REGULATION: 3% for load change of half load to full load with line constant: 6% for change of no load to full load
WAVE FORM: Sine wave with maximum 5% distortion
LOAD POWER FACTOR: Full rated output VA from unity to 0.7 PF lagging or leading
EFFICIENCY: At full load and nominal input voltage: 40% minimum on KN's; 50% minimum on PN's; 58% minimum on LN's
OPERATING TEMPERATURE RANGE: −4°F to +131°F (−20°C to +55°C) ambient air temperature
INPUT TRANSIENT PROTECTION: 45 VDC for 0.1 second
ALTITUDE: 10,000 feet above sea level
OVERLOAD PROTECTION: Magnetic type circuit breaker

DELIVERY FROM STOCK

Abbott has designed a new line of quality, low cost DC to 60 Hz Sine Wave inverters. These units will convert DC battery voltage to regulated 60 Hz power to drive any AC equipment, such as, lamps, compressors, motors, televisions, radios, power tools, appliances, test equipment, etc. Surge current capabilities of these units is up to 3 times rated output power.

Input Voltage Range (VDC)	Output Frequency	Output Power (VA)	Size (See Page 1•1048)	Weight (Lbs.)	Model Number	Unit Prices 1-4 pcs.
11-15	60	30	K2	16	KN3T-115-60	$262
		60	F2	18	KN6T-115-60	295
		120	J2	30	KN12T-115-60	361
22-30	60	60	K2	16	PN6T-115-60	262
		120	F2	18	PN12T-115-60	295
		240	J2	30	PN24T-115-60	361
29-38	60	80	K2	16	LN8T-115-60	262
		160	F2	18	LN16T-115-60	295
		320	J2	30	LN32T-115-60	361

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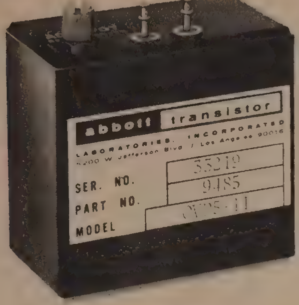
abbott Overvoltage Protectors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5200 W. Jefferson Blvd / Los Angeles 90016
SER. NO. 33219
PART NO. 9485
MODEL OVP5-11

features

- Fast Response
- Adjustable Trip Voltage Setting
- Compact
- Hermetically Sealed

These modular overvoltage protectors will protect expensive circuitry, such as integrated or logic circuits, from damage which could be caused by an overvoltage condition. They are specifically designed for use with Abbott lines of hi-performance inverters and converters: Model C's, CC's, VN's, W's and WW's. If the power supply output voltage ever exceeds your pre-set trip-point voltage, the overvoltage protector will reduce the output to approximately one volt within 15 microseconds.

Model Number	For Use With Units Having A Nom. Output Voltage of:	Trip Point Adjust. Range	Price 1-99 pcs.
OVP5-11	5 to 11 VDC	6 to 14 V	$35
OVP12-24	12 to 24 VDC	14 to 27 V	35
OVP26-50	26 to 50 VDC	27 to 56 V	35
OVP55-75	55 to 75 VDC	55 to 90 V	35
OVP85-95	85 to 95 VDC	85 to 110 V	35

specifications

RESPONSE TIME: 15 microseconds maximum

RECOMMENDED TRIP-POINT SETTING: 10% or 2 volts (whichever is greater) above the output voltage of the power supply

OVERSHOOT VOLTAGE: 15% maximum above trip-point setting

TEMPERATURE COEFFICIENT: 0.05% per degree Celsius

OPERATING TEMPERATURE: −55°C to +100°C maximum at mounting base

STORAGE TEMPERATURE: −65°C to +125°C ambient

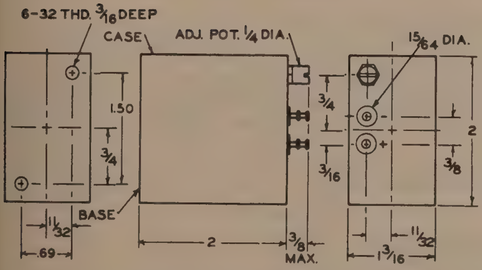
ENVIRONMENT: Encapsulated to meet the environmental requirements of MIL-STD-810B and MIL-E-5400K, Class 2, including altitude (to a vacuum), vibration, shock, acceleration, sand, dust, humidity, saltspray, fungus, explosion, etc.

SIZE: See drawing

WEIGHT: 0.5 pounds

CONNECTIONS: The overvoltage protector should be connected to the Abbott power module as shown in Figure I. Use a Bussmann Mfg. Co., Type GBB Tron Rectifier fuse or equivalent with a current rating as indicated on the power supply identification label.

SETTING THE TRIP-POINT VOLTAGE: With an adjustable laboratory power supply adjusted to 0 volts output, connect the O.V.P. module in the circuit as shown in Figure II. Select the resistance R_1 required to limit the current in this circuit to 0.2 amps at the **desired** trip-point voltage. Increase the voltage of the power supply slowly and observe the voltage reading on the DC volt-meter until the voltage suddenly drops. This is the trip-point voltage of the O.V.P. module. The trip-point voltage setting can be increased by adjusting the potentiometer on the O.V.P. module clockwise, and decreased by adjusting it counterclockwise.



TOLERANCE: FRACTION = ± 1/32, DECIMAL = 0.015
MATERIAL: BASE – ALUMINUM 1100F
CASE – STEEL
FINISH: BLACK SEMIGLOSS LACQUER
FED. STD. 595 COLOR 37038

Figure I

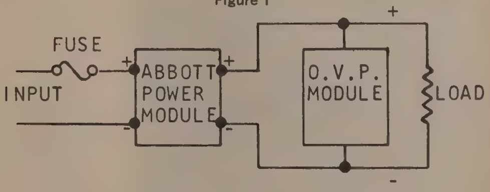
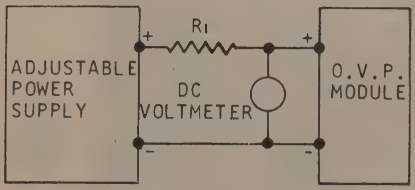


Figure II



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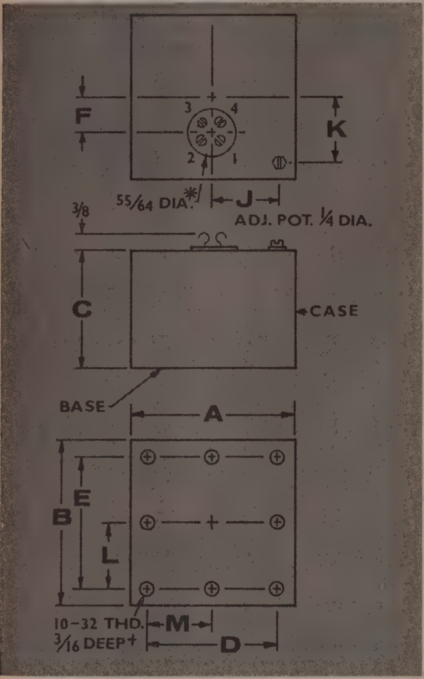
abbott Size Charts



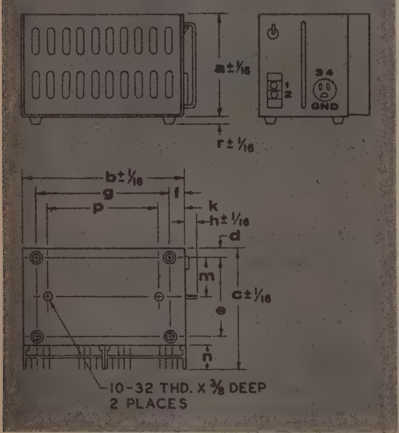
Size	A	B	C	D	E	F	J	K	L	M
1	1½	2¾	3	1.00	2.25	9/16	½	1⅛	—	—
1A	1½	2¾	2¾	1.00	2.25	9/16	½	1⅛	—	—
1B	1½	2	2	1.00	1.50	0	½	¾	—	—
2	1⅞	2¾	3¼	1.37	2.25	¾	11/16	1⅛	—	—
2C	2	2¾	2⅛	1.50	2.25	0	¾	1⅛	—	—
2D	2	3	3½	1.50	2.50	¾	¾	1¼	—	—
2E	2⅛	3¼	3¼	1.62	2.75	⅞	13/16	1⅜	—	—
3	2¾	2¾	3	2.25	2.25	¾	1⅛	1⅛	—	—
3A	2¾	2¾	2¾	2.25	2.25	¾	1⅛	1⅛	—	—
4	2¼	2¾	3¼	1.75	2.25	¾	⅞	1⅛	—	—
4B	2½	3	3¾	2.00	2.50	¾	1	1¼	—	—
4C	2¼	2¾	3½	1.75	2.25	¾	⅞	1⅛	—	—
4D	2½	3½	3½	2.00	3.00	0	1	1½	—	—
5	2¾	2¾	3¼	2.25	2.25	¾	1⅛	1⅛	—	—
6	2¾	3	3¼	2.25	2.50	¾	1⅛	1¼	—	—
6A	2¾	3	4	2.25	2.50	¾	1⅛	1¼	—	—
6B	2¾	3⅛	3⅝	2.25	2.62	¾	1⅛	15/16	—	—
7	2¾	2¾	4	2.25	2.25	¾	1⅛	1⅛	—	—
7A	2⅞	3⅜	4½	2.37	2.87	¾	1 3/16	1 7/16	—	—
8B	2⅝	3½	2⅞	2.12	3.00	¾	1 1/16	1½	—	—
9A	2¾	4¾	3¾	2.25	4.25	0	1⅛	2⅛	—	—
9B	2¾	4¾	3½	2.25	4.25	0	1⅛	2⅛	—	—
9C	2½	4⅜	3⅛	2.00	3.87	1	1	1 15/16	—	—
9D	2⅝	4¾	3⅝	2.12	4.25	1	1 1/16	2⅛	—	—
10A	3	5	4	2.50	4.50	0	1¼	2¼	—	—
10B	2⅞	4¼	4⅜	2.37	3.75	1⅜	1 3/16	1⅞	—	—
10C	3⅜	3⅜	3¾	2.87	2.87	¾	1 7/16	1 7/16	—	—
10D	3½	3½	4	3.00	3.00	¾	1½	1½	—	—
10E	2⅜	6¼	2½	CONSULT FACTORY						
10F	2¾	6¼	2½	CONSULT FACTORY						
11	3	5½	3¼	2.50	5.00	2⅛	1¼	2½	2.50	—
11C	4¼	5¼	4	3.75	4.75	0	1⅞	2⅜	2.37	—
11D	4	4⅞	3⅞	3.50	4.37	1⅜	1¾	2 3/16	—	—
11E	3¾	4½	4¼	3.25	4.00	¾	1⅝	2	—	—
11F	2¾	6¼	2¾	2.25	5.75	1	1⅛	2⅞	2.87	—
11J	3⅜	6¼	2½	CONSULT FACTORY						
12	3	5½	4	2.50	5.00	2⅛	1¼	2½	2.50	—
12A	4½	6	4	4.00	5.50	0	2	2¾	2.75	—
12C	3⅞	6¼	2¾	3.37	5.75	1½	1 11/16	2⅞	2.87	—
12F	5½	5⅞	2⅝	CONSULT FACTORY						
13A	5½	6½	4½	5.00	6.00	0	2½	3	3.00	2.50
14	6	6	4	5.50	5.50	2⅜	2¾	2¾	2.75	2.75
14C	5½	5½	3⅝	5.00	5.00	1⅞	2½	2½	2.50	2.50
14D	6	6¼	3⅞	5.50	5.75	1¼	2¾	2⅞	2.87	2.75
14E	5¾	6¼	2¾	5.25	5.75	1¼	2⅝	2⅞	2.87	2.62
16A	6¾	7½	4¼	6.25	7.00	2¾	3⅛	3½	3.50	3.12

DIMENSIONAL TOLERANCES: FRACTIONS ±1/32; DEMICALS .XX ±0.015.

* Models CC and WW use special 8 pin header.
Model VN uses special 9 pin header.
Model BN uses special terminals on A x C face.
Size of special headers is 1 1/16 dia. by 9/16 high.

† 6-32 Thd, 3/16 deep on case size 1B

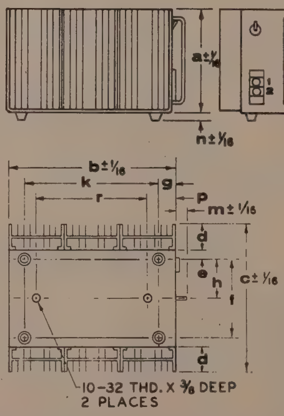
CASE K2



a — 5
b — 8
c — 7½
d — ½
e — 5¼
f — ¾
g — 6½
h — 1 15/16
k — 1⅛
m — 2⅝
n — 1¼
p — 5¾
r — ½

Terminal Functions
1 + Input
2 — Input
3 AC Output
4 AC Output

CASE F2, J2



	F2	J2
a —	5	6½
b —	8	12
c —	8¾	9¾
d —	1¼	2⅛
e —	½	⅜
f —	5¼	4¾
g —	¾	1¼
h —	2⅝	2⅜
k —	6½	9½
m —	1 15/16	1 15/16
n —	½	½
p —	1⅛	1¼
r —	5¾	9½

Terminal Functions
1 + Input
2 — Input
3 AC Output
4 AC Output

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abbott General Information

ordering information

Abbott power modules can be ordered easily by indicating the exact model number that describes your requirement. When ordering to your own specification control number, please reference the corresponding Abbott model number to expedite your order. Should you need additional information or assistance of any kind, please contact us. We are always pleased to confirm price and delivery, and discuss the application of our product to your requirement.

prices

All of the prices listed are FOB, Factory, Los Angeles, California and are the same as those we charge for equal items and quantities to any customer including the United States Government. The prices shown do not include the costs of any special services, source inspections, environmental testings, special packaging or certified audits. All prices and specifications are subject to change without notice.

QUANTITY DISCOUNTS

1 piece — price listed. (This is the net price.)
2-4 pieces — price listed. (This is the net price.)
5-9 pieces — less 3% of the 2-4 piece price.
10-24 pieces — less 5% of the 2-4 piece price.
25-49 pieces — less 7% of the 2-4 piece price.
50-99 pieces — less 9% of the 2-4 piece price.
Above 100 pieces — Contact nearest office for an exact quotation.

TAXES — All applicable federal, state and local taxes are extra.

TERMS OF PAYMENT — Net payment within thirty (30) days from date of shipment to all accounts which have been rated (approved).

SPECIAL FORMS — Preparation cost of U.S. Defense Department's form DD250 is $10.00 per destination.

SOURCE INSPECTION — 2% or $25 per shipment for witnessing our standard final electrical inspection.

UNITS ORDERED IN ERROR — Stock units may be returned within 30 days from shipment if they are unused and in original cartons. Restocking charge is 20% or $25 each for 1 to 9 pieces.

delivering and shipping

Many units listed are normally carried **in stock ready for immediate delivery** — subject to prior sale.
All Abbott power supplies are shipped complete with mounting hardware, thermal compound, printed instructions and final test data. Abbott power modules are packaged for shipment per Interstate Commerce Commission, Uniform Freight Classification Rules No. 40 and 41. Special military preservation and packaging is available upon request at a modest additional cost. Shipment made by air freight or United Parcel Service has proved to be the safest and fastest delivery method for Abbott power modules.

warranty and service

All Abbott products are under warranty for one (1) year from date of shipment (see warranty conditions below). When you need repair service, please consult our factory by letter, wire or telephone. We will assign a "Return Material Authorization" number to your shipment to provide for its expedient handling when it reaches our factory. It is very helpful to receive your assessment of the problem along with the returned equipment. Please include the name of a company representative with whom we can discuss our recommendations. Only prepaid shipments of returned equipment can be accepted without prior written authorization from us. To minimize accounting paperwork, documents such as credit memorandums should not be issued until you have been advised by us as to the disposition of your equipment.

WARRANTY

"Supplier warrants products of its own manufacture against faulty workmanship or the use of defective materials for a period of one year from the date of shipment. This warranty is the only warranty made by the supplier, and is in lieu of all other warranties, expressed or implied, and can be amended only by a written instrument signed by an officer of the Supplier. The liability of the Supplier under this warranty is limited solely to replacing, repairing, or issuing credit (at Supplier's discretion) for any products which are returned by Buyer during the warranty period provided that (a) supplier is promptly notified in writing upon discovery of such defects by Buyer, (b) the defective unit is returned to Supplier, transportation charges prepaid by Buyers, and (c) Supplier's examination of such unit shall disclose, to its satisfaction, that such defects have not been caused by misuse, neglect, improper installation, repair, alteration, or accident. In no event shall Supplier be liable to Buyer for loss of profit, loss of use, or damages of any kind based upon a breach of warranty.

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abbott Optional Features

terminals on mounting base (B option)

The electrical terminals extending through a glass sealed header may be located on the mounting base on most Abbott units at no increase in price. To include this feature, simply change the letter "D" preceding the first dash to "B". (Example V05**B**S-5A indicates a header out the base.) This feature is not available on Case Size 1B or the Model BN, C, CC, W, WW, and VN lines.

special connectors (A & C option)

A Military type hermetically sealed connector is available on most Abbott power modules. Simply change the letter "D" in the Model Number to "A" to have the connector extend out the top surface (opposite the mounting base), or to a "C" to have it extend out the mounting base. Example: V05**A**S-5A indicates a connector out the top surface and V05**C**S-5A indicates a connector out the mounting base. Not available on Model BN, W, and WW lines. Please consult factory if Military connectors are required on these units. Remote error sensing ('Y' Option) automatically included when ordering A Option on Model C, CC, W, and WW.

PRICE 1 pc	PRICE 2-4 pcs
$25.00	$20.00

remote output adjustment (R option)

Provision for locating an adjustment potentiometer in a remote location from the power supply can be made for an additional cost. To have this feature included, simply add an "R" after the character preceding the first dash of the model number. Example: V05DS**R**-5A indicates the remote output adjustment feature has been included. Special terminal arrangement includes additional terminals for connection to a remote potentiometer. A detailed outline and dimensional drawing is available on request from the factory.

$12.00	$10.00

special encapsulation (E option)

All of our hermetically sealed power modules are encapsulated to meet or exceed the shock, acceleration, and vibration requirements of MIL-STD-810B (see Page **1•1051**). Special encapsulation to enable these modules to withstand higher shock levels of 60 g's, acceleration levels of 50 g's, and vibration levels of 30 g's, is available. To have this feature included, simply add an "E" before the last series of digits in the model number. Example: V05DS**E**-5A indicates special encapsulation has been included.

$12.00	$10.00

recentering of dc input (H option) **(Model B's, C's, CC's, and S's only)**

The standard Model B's, C's, CC's, and S's operate from an input voltage range of 24 to 30 VDC. The units can be modified to operate from any one of the other input voltage ranges as shown below. To have this feature included simply add an "H" after the "D" in the model number then specify the desired input voltage range in parenthesis after the entire model number. Example: BL02D**H**-5A (20-26) indicates the input voltage range for Model BL02D-5A has been changed to 20 to 26 VDC. Consult the factory if input voltage changes are desired on Model B17's. Information on the input current of units with this option is available from the factory.

Input Voltage Range (Model B's, C's, and CC's)		
20 to 26; 22 to 28; 26 to 32	$12.00	$10.00
22 to 32 (Derate output current by 10%)	$18.00	$15.00

Input Voltage Range for Model S's Only	Derate Output Current By		
22 to 28; 26 to 32	0%	$12.00	$10.00
20 to 26	10%	$12.00	$10.00
20 to 28	20%	$12.00	$10.00
22 to 30	20%	$12.00	$10.00
22 to 32	25%	$18.00	$15.00
24 to 32	20%	$12.00	$10.00

remote error sensing (Y option) **(Model C's, CC's, W's, and WW's only)**

Additional sensing terminals can be provided on Model C's and W's to enable the regulator circuit to monitor the output voltage directly at the load and compensate for DC voltage drops of up to 0.3 volts in the load leads. To have this feature included simply add a "Y" after the "D" in the model number. Example: W5D**Y**2.5 indicates remote error sensing has been included.

$ 7.00	$ 5.00

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abbott Environmental Testing

ALL OF THE HERMETICALLY SEALED POWER MODULES LISTED IN THIS CATALOG WILL MEET OR EXCEED MOST OF THE ENVIRONMENTAL SPECIFICATIONS OF MIL-STD-810B

Specification MIL-STD-810B establishes the climatic and environmental conditions applicable to aeronautical and associated equipment. The procedures described in this specification are utilized in simulating environmental test conditions. There are several different Military Specifications currently in use besides MIL-STD-810B which also specify climatic and environmental conditions. Among these are MIL-E-5400M, MIL-E-16400F, MIL-E-4058D, MIL-T-21200J, MIL-STD-202D, and MIL-E-5272C. Abbott's hermetically sealed power modules meet nearly all the requirements of these specifications. We have chosen MIL-STD-810B as our prime environmental standard because of its stringent specifications and wide use in today's systems.

In order to assist you in determining whether or not our power supplies will meet your environmental requirements, the adjacent table lists parameters which are met or exceeded by all of our hermetically sealed power modules. If your specific requirement is not listed in the table, or is more stringent than the levels shown, please consult our factory. Our experienced Sales Engineers will be happy to provide any additional information that you may require.

Over the years we have had occasion to environmentally test several of our hermetically sealed power modules to the stringent requirements of MIL-E-5272C. The cost incidentally, of environmentally testing one power module is approximately $3,300 and requires three months. Certified Test Reports from Wyle Laboratories of Los Angeles are available on two of our units. Because the units chosen for environmental testing are representative of our entire line of over 3,500 power modules, we will in most cases, certify any unit in our entire line of hermetically sealed power supplies to meet these standards.

The tests included in these reports are High Temperature, Low Temperature, Humidity, Altitude, Vibration, Immersion, Temperature-Altitude, Shock and Acceleration. Furthermore, specifications such as Salt Spray, Fungus, Sunshine, Rain, Sand and Dust are automatically satisfied by the hermetic sealing of the units.

Copies of these certified Test Reports from Wyle Laboratories are available at no charge, on request.

MIL-STD-810B

Condition	Method	Procedure	Level	NOTES*
Altitude	500	II	Vacuum	4
High Temp.	501	II		1
Low Temp.	502	I	−54°C	2
Temp. Shock	503	I	−54°C to +100°C	1, 2
Temperature Altitude	504	I	−54°C to 71°C 0-70,000 ft.	1, 2, 4
Sunshine	505	I	48 hrs.	
Rain	506	I	12 in 1 hr.	
Humidity	507	I	95% @ 71°C	
Fungus	508	I		
Salt Fog	509	I	48 hrs.	
Dust	510	I		
Explosion	511	I		
Immersion	512	I		
Acceleration	513	I, II	±14 g's	3
Vibration	514	I	±15 g's	3
Shock	516	I, II, III, V, VI	40 g's	3

*NOTES:

1. Maximum allowable base plate temperature is +100°C on all models except V and VN where the maximum is +71°C.
2. Minimum temperature is −20°C on Model V, 0°C on Model VN, and −54° on all others.
3. Special encapsulation is available so that any hermetically sealed unit can withstand vibration of ±30 g's, shock of 60 g's, and acceleration of 50 g's. Please see Page 1•1050 for complete details of the special encapsulation feature.
4. Model V power modules with case size 10 or larger have a maximum operating altitude of 10,000 ft.

U.S. AIR FORCE

Air Force personnel tested three Abbott model power supplies (two model CL24D-55A and one model A1D-70A) used to power electronic equipment on the Air Force Rocket Sled at Holloman Air Force Base. Test conditions consisted of 1½ minute sweeps of 30-G's peak sine vibration from 40 Hz to 1500 Hz, on each of three axis. Throughout these tests the Abbott power supplies operated within specifications.

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abbott Electromagnetic Interference

In today's complex and sensitive systems, Electromagnetic Interference (EMI) requirements for power supplies are of increasing importance. EMI, however, is often a broad and confusing field to everyone concerned. The power supply user wants to know what areas of EMI he is going to have to be concerned with when using a power supply. The specifier of a power supply wants to know what he can expect from Abbott's power supply in the area of EMI.

The first question can best be answered by defining the types and methods of Electromagnetic Interference. **Interference** is defined as any electromagnetic disturbance, phenomenon, signal, or emission which causes or can cause undesired response, malfunctioning, or degradation of performance of electrical and electronic equipment. There are two basic types of EMI concerned with power supplies: **Broadband** and **narrowband.**

> **Broadband interference** exhibits energy over a wide frequency spectrum (30 Hz to 100 MHz) and is generally a result of sudden changes in voltage or current. It is usually measured in "decibels-above-one-microvolt-per-Megahertz-bandwidth" or dBuV/MHz.
>
> **Narrowband interference** is produced by an oscillatory circuit containing energy only at the frequency of oscillation and, usually, at harmonics or multiples of the frequency of oscillation. It is usually measured in "decibels-above-one-microvolt" or dBuV.

The EMI may be propagated by either of two methods: **conduction** or **radiation.**

> **Conducted interference** is any undesired electromagnetic energy appearing on the external conductors (input and output lines of the power supply) which may be conducted into other sensitive equipment and cause malfunction or otherwise affect its operation.
>
> **Radiated interference** is the propagation of electromagnetic energy without a direct conducting path and is generally the result of radiation from external wiring or inadequate shielding afforded by the power supply case.

Besides the Electromagnetic Interference generated by a power supply, there may also be concern about the affect on the power supply by interference generated from other sources. This is known as susceptibility.

> **Susceptibility** is defined as that characteristic which causes an equipment to malfunction or exhibit an undesirable response when its case or any external lead is subjected to electromagnetic voltages or fields.

These then, are the areas of EMI that concern the user of a power supply. Now, what can be expected from an Abbott power module in these areas?

First, Abbott's hermetically sealed power modules are encased in a 0.025 inch thick steel case, which is electro-copper plated to 0.002 inch and electro-tin plated to 0.001 inch, and then fused to a 0.25 inch thick aluminum base. This eliminates almost all radiated interference emanating from the unit. If the user provides shielded cables for the input and output leads of the unit, and the case is grounded, radiation levels will be negligible. Similarly, the power module is not susceptible to radiated interference from external sources.

Abbott Model LC's, RN's, U's, V's,, W's, and WW's contain no switching or oscillatory circuits. Therefore, the broadband and narrowband conducted interference of the units is minimal. Model B's, C's, CC's, GB's, HA's, VN's, and Z's employ switching circuits, which is a source of broadband interference; and Model KN's, PN's, LN's, and S's employ Class B amplifiers, a source of narrowband interference: if necessary, the following techniques can be used to minimize the effect of this interference.

> The magnitude of the conducted interference on the **input lines** of these units is directly proportional to the total impedance of the source (including the power lines) and the current demand of the unit itself. If the source impedance is low and care is taken to isolate the wiring to the converter from other associated circuitry, the interference on the DC input line can be kept to a minimum. If further attenuation is required, the use of one of Abbott's input filters is recommended. They have been designed specifically for this purpose.
>
> Isolation and decoupling networks within the power supply loads usually provide enough filtering to maintain the conducted interference on the DC **output leads** at a minimal level. However, the amplitude of this interference can be substantially reduced by installing a capacitor directly across the load. If further reduction is desired, a small inductor can be inserted in series with one or both output leads to obtain the desired attenuation level.

Abbott's standard power modules meet the EMI requirements of most systems. In addition, the hi-performance series of Model C's, CC's, VN's, W's, and WW's have been built to meet the stringent requirements of MIL-STD-461 for generation of and susceptability to radiated and conducted interference. A test report prepared by the Genistron Company per MIL-STD-461 on Model W5D2.5, 400 Hz to DC converter, is available. The test was conducted per methods CE03, CE04, and RE02 and shows that levels of narrowband and broadband conducted and radiated interference over the applicable frequency range were within the specification limits.

A formal Electromagnetic Interference Test per MIL-STD-826 has also been conducted by a specialist firm, the Filtron Company, Inc., of Los Angeles, on an Abbott Model S6AE-115A-400, DC to 400 Hz inverter, used with its appropriate input filter, Abbott Model YS6AE. This inverter was found to fully comply with all applicable EMI specification requirements.

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abbott Reliability

The urgent need for the highest possible degree of reliability in today's military, industrial and commercial electronic equipment requires no explanation. Over-all power supply reliability can only be obtained through the use of stable, long-life components operated well within their capabilities. Although improvement in reliability can sometimes be realized by using excessive safety factors in the selection of certain components, this unbalanced approach is costly, it fails to take advantage of advanced designs, and it is seriously limited in the amount of improvement actually realized. In the final analysis, reliability must be **built** into a power supply from its inception. A true reliability assurance program must not only include the injection of the reliability concept into the basic design but also close quality control of all manufacturing steps. (See below.)

The responsibility for the reliability of a product lies squarely with the manufacturer—and Abbott accepts this principle. Abbott's Quality Assurance Program has the objective of achieving the highest probability of continuous trouble free performance of their power supplies in their customer's systems. A careful reliability analysis has been conducted on all of the units listed in this catalog, prior to their production, to insure meeting this company objective. As a result, Abbott has been approved for many military and aerospace high reliability programs, in accordance with the general requirements of MIL-Q-9858A, including: Saturn/Apollo Space Program, F-111 Tactical Fighter Plane, Hornet Missile, Trident Missile, Lunar Landing Training Vehicle, SUU-11A/A Minigun, TAT-102 Helicopter Turret, and many other priority programs.

In addition to a reliability analysis on all catalog power supplies, Abbott has also conducted a failure analysis on several representative units from each model family of power supply in accordance with MIL-HDBK-217. The following list indicates the **typical** Mean Time Between Failure (MTBF) of several of our models of power supplies:

Models Beginning With	Function	See Pages	Typical MTBF	Operating Temperatures
B	DC to DC	1•1043	120,000 hrs	100°C
BN	DC to DC	1•1045	23,000 hrs	71°C
C	DC to DC	1•1044	48,000 hrs	100°C
CC	DC to DC	1•1044	27,000 hrs	100°C
LC	60 Hz to DC	1•1054	100,000 hrs	50°C
LLC	60 Hz to DC	1•1054	70,000 hrs	50°C
RN	60 Hz to DC	1•1055	75,000 hrs	71°C
S	DC to 400 Hz	1•1046	55,000 hrs	100°C
U/GB	400 Hz to DC	1•1038	70,000 hrs	100°C
V/HA	60 Hz to DC	1•1042	80,000 hrs	71°C
VN	60 Hz to DC	1•1041	50,000 hrs	40°C
W	400 Hz to DC	1•1039	50,000 hrs	100°C
WW	400 Hz to DC	1•1039	45,000 hrs	100°C
Z	60 Hz to DC	1•1040	66,000 hrs	40°C

It should be noted that all of the failure rates are calculated in accordance with MIL-HDBK-217 at worst case operating conditions of specified operating temperature, maximum operating input voltage, and maximum rated output power. Models BN and VN were calculated in accordance with MIL-HDBK-217A.

abbott Quality Assurance

All of Abbott's Power Supplies Are Inspected No Less Than 41 Times During The Process of Their Manufacture

INCOMING INSPECTION

Incoming material is inspected on an "Attribute Basis" per MIL-STD-105D. Critical materials are given a 100% inspection. Raw and finished materials are inspected mechanically to insure mechanical specifications and quality. Inspected parts are sorted according to acceptance or rejection, and a record is made containing the date, vendor's name, number of parts accepted or rejected, the percentage of attribute basis used, together with the reasons for any rejections, and the inspectors stamp. All rejected parts carry a red rejection tag to insure they are returned to the vendor for correction or replacement. Vendor corrective action will be initiated when the vendor fails to meet company specifications or standards.

MECHANICAL INSPECTION

All in-process material is physically inspected. "First article" inspection is also performed on parts for new designs. All machined parts and hardware are fully inspected prior to stocking. Accepted or rejected material is noted in the record and all rejected material is either reworked or remade to insure its compliance to company specifications.

ELECTRICAL INSPECTION

In-process electrical components are mechanically inspected and electrically tested. All sub-assembly and harness wiring are carefully inspected and electrically tested. The wiring of the final sub-assembled units is mechanically inspected and electrically tested again. Assembled units are sent to the laboratory for their preliminary electrical test to Abbott specifications. After being mounted in their steel containers, the units are again mechanically and electrically tested for exact performance **better** than their published specifications. The results of all the above inspection points are recorded in the company's inspection records.

HERMETIC SEAL INSPECTION

When a power supply is encapsulated and hermetically sealed, it is again inspected. Each unit is given a special hermetic seal test to insure its leak-proof operation. Results of these tests are recorded including date, status, and inspectors stamp in the Quality Assurance Records.

FINAL INSPECTION

All completed power modules are now submitted to a final mechanical inspection for correct dimensions, test data, identification labels and appearance. Electrical performance must **exceed** catalog specifications. All of these final inspection results are recorded in the quality control assurance records which contain all pertinent information for each unit leaving the factory.

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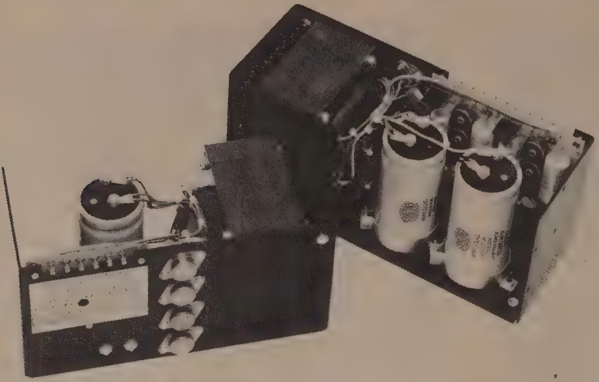
abbott 60 to DC Low Cost

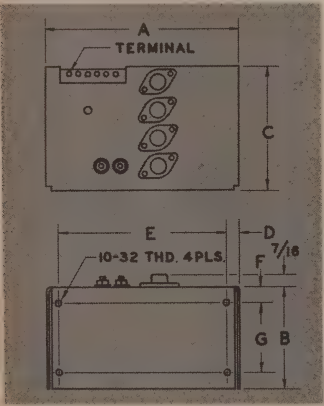


features

- 1 Day Stock Delivery
- Single and Dual Outputs
- 0.1% Regulation
- +50°C Ambient Operation
- 47-420 Hz Input Frequency

DELIVERY FROM STOCK

These reliable Abbott power modules are designed to meet the needs of OEM engineers. For their intended application, these units are not only rated high in overall quality, but also priced relatively low. Thus, they provide more quality per dollar compared to similar items on the market. Your best buy in OEM power modules is ABBOTT.



Size	A	B	C	D	E	F	G
L1	7½	3 1/16	3⅝	½	6½	⅝	1 13/16
L2	8½	4	4¾	½	7½	⅝	2¾
L3	9¼	4	4¾	½	8¼	⅝	2¾
L4	9½	3 1/16	3⅝	½	8½	⅝	1 13/16
L5	10	4	4¾	½	9	⅝	2¾
L6	10¾	4	4¾	½	9¾	⅝	2¾

specifications

INPUT VOLTAGE RANGE: 103 to 127 VRMS.

INPUT FREQUENCY: 47 to 420 Hertz, 1 Phase.

LINE REGULATION: 0.1% or 10 mV (whichever is greater), for input change of 103 to 127 VAC.

LOAD REGULATION: 0.1% or 10 mV, (whichever is greater), from no load to full load.

RIPPLE: 10 mV rms; 30 mV peak-to-peak.

OUTPUT VOLTAGE ADJUSTMENT RANGE: Voltage is continuously adjustable between the limits shown on the table by means of a screwdriver adjustment potentiometer.

ISOLATION VOLTAGE: 300 VDC between output terminals and chassis ground.

INSULATION RESISTANCE: 50 megohms between output terminals and chassis ground when measured at 50 VDC.

POLARITY: Inputs and outputs are isolated, either positive or negative side may be grounded.

TEMPERATURE: Operating: 0°C to +50°C ambient without derating, forced air or heat-sinking. Storage: −55°C to 85°C.

TEMPERATURE COEFFICIENT: 0.08% per degree Celsius.

ALTITUDE: 10,000 feet above sea level.

SHORT CIRCUIT PROTECTION: Each unit is completely protected against an overload or short circuit of any duration. The output voltage automatically restores to normal when the overload is removed within approx. 25 msec.

LOAD TRANSIENT RECOVERY TIME: Output voltage returns to regulation limits within 75 microseconds after a 50% step change in load current. Maximum overshoot/undershoot is 5% of nominal output voltage.

TURN ON/TURN OFF OVERSHOOT: The output voltage overshoot during "turn on" or "turn off" will not exceed 1% of the output voltage.

REMOTE ERROR SENSING: Each unit contains a means by which the regulator circuit monitors the voltage directly at the load using extra "sensing" leads. The resulting circuit action compensates for a DC voltage drop up to 0.5 volts in the load leads.

OVERVOLTAGE PROTECTION: Additional circuitry will reduce the output voltage to approximately 1 VDC within 25 μsec typ., if the output voltage rises 10% or 2 VDC (whichever is greater) above nominal. Available as an optional feature by adding "-1" to the model number and $8 ($16 for dual output units) to the 1-24 piece price.

OUTPUT IMPEDANCE: DC to 1K Hz — .003 R_L ohms or .03 ohms, whichever is greater.
1K Hz to 10K Hz — .008 R_L or .08 ohms, whichever is greater.
10K Hz to 100K Hz — .015 R_L or .30 ohms, whichever is greater.
R_L = rated load resistance.

RELIABILITY: The Mean Time between failure (MTBF) per MIL-HDBK-217A under worst case operating conditions is in excess of 100,000 hours per single output units and in excess of 70,000 hours per dual output units. For example: LC12T10 - 114,268 hours (MTBF); LC28T1 - 158,290 hours (MTBF); LLC12T5 - 75,593.

SINGLE OUTPUT

Output Voltage Range	Output Size Curr. (Amps)	(See Dwg)	Wt. (Lbs.)	Model Number	Price 1-24 Pieces
4.5 - 5.5	6.0	L1	5.5	LC5T6	$62.00
	10.0	L3	12.5	LC5T10	73.00
11.5 - 12.5	2.5	L1	5.5	LC12T2.5	62.00
	5.0	L2	8.7	LC12T5	73.00
	10.0	L3	12.5	LC12T10	99.00
14.5 - 15.5	2.0	L1	5.5	LC15T2	62.00
	4.0	L2	8.7	LC15T4	73.00
	8.0	L3	12.5	LC15T8	99.00
23 - 25	1.2	L1	5.5	LC24T1.2	62.00
	2.5	L2	8.7	LC24T2.5	73.00
	5.0	L3	12.5	LC24T5	99.00
27 - 29	1.0	L1	5.5	LC28T1	62.00
	2.1	L2	8.7	LC28T2.1	73.00
	4.3	L3	12.5	LC28T4.3	99.00

DUAL OUTPUT

Output Voltage Range	Output Size Curr. (Amps)	(See Dwg)	Wt. (Lbs.)	Model Number	Price 1-24 Pieces
±11.5 - ±12.5	1.2	L4	6.0	LLC12T1.2	$87.00
	2.5	L5	9.2	LLC12T2.5	93.00
	5.0	L6	13.5	LLC12T5	119.00
±14.5 - ±15.5	1.0	L4	6.0	LLC15T1	87.00
	2.0	L5	9.2	LLC15T2	93.00
	4.0	L6	13.5	LLC15T4	119.00

Dual Output Units:

1. Both outputs are isolated and non-tracking so each output can be used as a completely separate power supply.
2. The output current listed is for each output voltage.

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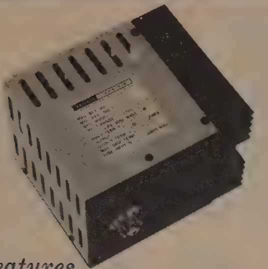
abbott 60 ∿ to DC Industrial



features

- −4 to +160°F ambient
- 5 to 37 VDC
- 0.15 to 20 amps
- 0.1% regulation
- Stock delivery

specifications

INPUT VOLTAGE RANGE: 105-125 VRMS

INPUT FREQUENCY RANGE: 50-420 Hertz, 1 phase

LINE REGULATION: 0.1% or 10 mv (whichever is greater) for input change of 105-125 VRMS

LOAD REGULATION: 0.1% or 10 mv (whichever is greater) for change from no load to full load

RIPPLE: 0.02% or 5 mv RMS (whichever is greater)

OUTPUT VOLTAGE ADJUSTMENT: Voltage is continuously adjustable between the limits shown in table by means of an externally accessible screwdriver adjustment potentiometer

ADJUSTMENT RESOLUTION: 30 mv max.

POLARITY: Inputs and outputs are isolated; either positive or negative side may be grounded

TEMPERATURE: Operating: −4°F (−20°C) to +160°F (+71°C) without derating, forced air, or heatsinking. Storage: −40°F (−40°C) to +185°F (+85°C)

TEMPERATURE COEFFICIENT: 0.03% per degree Celsius

SHORT CIRCUIT PROTECTION: Each unit is completely protected against an overload or short circuit of any duration. The output voltage automatically restores to normal when the overload is removed.

LOAD TRANSIENT RECOVERY TIME: Output voltage returns to regulation limits within 75 microseconds after a 50% step change in load current

TURN ON/TURN OFF OVERSHOOT: The output voltage overshoot during "turn on" or "turn off" will not exceed 0.1% of the output voltage, or 20 mv, whichever is greater

REMOTE ERROR SENSING: Each unit contains a means by which the regulator circuit monitors the voltage directly at the load using extra "sensing" leads. The resulting circuit action compensates for a DC voltage drop up to 0.5 volts in the load leads.

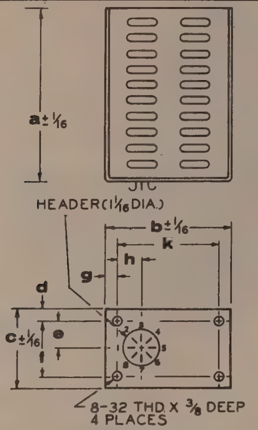
OVERVOLTAGE PROTECTION, 230 VAC OPERATION, AND REMOTE VOLTAGE ADJUSTMENT: Available as optional features.

Output Voltage Range	Output Curr. (Amps)	Size*	Wt. (Lbs.)	Model Number	Price 1-24 pcs.
4.5-5.5	0.15	AA	3.0	RN5S0.15	$ 66
	0.3	AA	3.0	**RN5S0.3**	69
	0.6	BB	6.0	RN5S0.6	86
	1.2	BB	6.0	**RN5S1.2**	89
	2.5	CC	8.0	**RN5S2.5**	93
	5.0	DD	13.0	**RN5S5**	110
	10	FF	22.0	**RN5S10**	160
	15	GG	28.0	RN5T15	205
	20	JJ	33.0	**RN5T20**	239
5.5-6.5	0.15	AA	3.0	RN6S0.15	66
	0.3	AA	3.0	RN6S0.3	69
	0.6	BB	6.0	RN6S0.6	86
	1.2	BB	6.0	**RN6S1.2**	89
	2.5	CC	8.0	RN6S2.5	93
	5.0	DD	13.0	RN6S5	110
	10	FF	22.0	RN6S10	160
	15	GG	28.0	RN6T15	205
	20	JJ	33.0	RN6T20	239
6.5-7.5	0.15	AA	3.0	RN7S0.15	66
	0.3	AA	3.0	RN7S0.3	69
	0.6	BB	6.0	RN7S0.6	86
	1.2	BB	6.0	RN7S1.2	89
	2.5	CC	8.0	RN7S2.5	93
	5.0	DD	13.0	RN7S5	110
	10	FF	22.0	RN7S10	160
	15	GG	28.0	RN7T15	205
	20	JJ	33.0	RN7T20	239
7.5-8.5	0.15	AA	3.0	RN8S0.15	66
	0.3	AA	3.0	RN8S0.3	69
	0.6	BB	6.0	RN8S0.6	86
	1.2	BB	6.0	RN8S1.2	89
	2.5	CC	8.0	RN8S2.5	93
	5.0	DD	13.0	RN8S5	110
	10	FF	22.0	RN8S10	160
	15	GG	28.0	RN8T15	205
	20	JJ	33.0	RN8T20	239
8.5-9.5	0.15	AA	3.0	RN9S0.15	66
	0.3	AA	3.0	RN9S0.3	69
	0.6	BB	6.0	RN9S0.6	86
	1.2	BB	6.0	RN9S1.2	89
	2.5	CC	8.0	RN9S2.5	93
	5.0	DD	13.0	RN9S5	110
	10	FF	22.0	RN9S10	160
	15	HH	31.0	RN9T15	205
	20	JJ	33.0	RN9T20	239
9.5-10.5	0.15	AA	3.0	RN10S0.15	66
	0.3	AA	3.0	RN10S0.3	69
	0.6	BB	6.0	RN10S0.6	86
	1.2	BB	6.0	RN10S1.2	89
	2.5	CC	8.0	RN10S2.5	93
	5.0	DD	13.0	RN10S5	110
	10	FF	22.0	RN10S10	160
	15	HH	31.0	RN10T15	205
	20	JJ	33.0	RN10T20	239
10.5-11.5	0.15	AA	3.0	RN11S0.15	$ 66
	0.3	AA	3.0	RN11S0.3	69
	0.6	BB	6.0	RN11S0.6	86
	1.2	BB	6.0	RN11S1.2	89
	2.5	CC	8.0	RN11E2.5	93
	5.0	DD	13.0	RN11S5	110
	10	FF	22.0	RN11S10	160
	15	HH	31.0	RN11T15	205
	20	JJ	33.0	RN11T20	239
11-13	0.15	AA	3.0	RN12S0.15	66
	0.3	AA	3.0	**RN12S0.3**	69
	0.6	BB	6.0	RN12S0.6	86
	1.2	BB	6.0	**RN12S1.2**	89
	2.5	CC	8.0	RN12S2.5	93
	5.0	DD	13.0	RN12S5	110
	10	GG	22.0	RN12S10	160
	15	HH	31.0	RN12T15	205
	20	JJ	33.0	RN12T20	239
13-15	0.15	AA	3.0	RN14S0.15	66
	0.3	AA	3.0	RN14S0.3	69
	0.6	BB	6.0	RN14S0.6	86
	1.2	BB	6.0	**RN14S1.2**	89
	2.5	CC	8.0	RN14S2.5	104
	5.0	DD	13.0	**RN14S5**	110
	10	GG	28.0	RN14T10	205
	15	HH	31.0	RN14T15	239
15-17	0.15	AA	3.0	RN16S0.15	66
	0.3	AA	3.0	RN16S0.3	69
	0.6	BB	6.0	RN16S0.6	86
	1.2	BB	6.0	RN16S1.2	89
	2.5	CC	8.0	RN16S2.5	104
	5.0	DD	13.0	RN16S5	110
	10	GG	28.0	RN16T10	205
	15	HH	31.0	RN16T15	239
17-19	0.15	AA	3.0	RN18S0.15	66
	0.3	AA	3.0	RN18S0.3	69
	0.6	BB	6.0	RN18S0.6	86
	1.2	BB	6.0	RN18S1.2	89
	2.5	CC	8.0	RN18S2.5	104
	5.0	DD	13.0	RN18S5	110
	10	GG	28.0	RN18T10	205
19-21	0.15	AA	3.0	RN20S0.15	66
	0.3	AA	3.0	RN20S0.3	69
	0.6	BB	6.0	RN20S0.6	86
	1.2	BB	6.0	RN20S1.2	89
	2.5	CC	8.0	RN20S2.5	104
	5.0	DD	13.0	RN20S5	110
	10	GG	28.0	RN20T10	205
21-23	0.15	AA	3.0	RN22S0.15	66
	0.3	AA	3.0	RN22S0.3	69
	0.6	BB	6.0	RN22S0.6	86
21-23	1.2	BB	6.0	RN22S1.2	$ 89
	2.5	CC	8.0	RN22S2.5	104
	5.0	EE	13.0	RN22S5	139
	10	GG	28.0	RN22T10	205
23-25	0.15	AA	3.0	RN24S0.15	66
	0.3	AA	3.0	RN24S0.3	69
	0.6	BB	6.0	RN24S0.6	86
	1.2	BB	6.0	**RN24S1.2**	89
	2.5	CC	8.0	RN24S2.5	104
	5.0	EE	13.0	**RN24S5**	139
	10	GG	28.0	RN24T10	205
25-27	0.15	AA	3.0	RN26S0.15	69
	0.3	BB	6.0	RN26S0.3	86
	0.6	BB	6.0	RN26S0.6	89
	1.2	CC	8.0	RN26S1.2	104
	2.5	DD	13.0	RN26S2.5	121
	5.0	EE	20.0	RN26S5	139
27-29	0.15	AA	3.0	RN28S0.15	69
	0.3	BB	6.0	RN28S0.3	86
	0.6	BB	6.0	**RN28S0.6**	89
	1.2	CC	8.0	**RN28S1.2**	104
	2.5	DD	13.0	RN28S2.5	121
	5.0	EE	20.0	**RN28S5**	139
29-31	0.15	AA	3.0	RN30S0.15	69
	0.3	BB	6.0	RN30S0.3	86
	0.6	BB	6.0	RN30S0.6	89
	1.2	CC	8.0	RN30S1.2	104
	2.5	DD	13.0	RN30S2.5	121
	5.0	EE	20.0	RN30S5	139
31-33	0.15	AA	3.0	RN32S0.15	69
	0.3	BB	6.0	RN32S0.3	86
	0.6	BB	6.0	RN32S0.6	89
	1.2	CC	8.0	RN32S1.2	104
	2.5	DD	13.0	RN32S2.5	121
	5.0	EE	20.0	RN32S5	139
33-35	0.15	AA	3.0	RN34S0.15	69
	0.3	BB	6.0	RN34S0.3	86
	0.6	BB	6.0	RN34S0.6	89
	1.2	CC	8.0	RN34S1.2	104
	2.5	DD	13.0	RN34S2.5	121
	5.0	EE	20.0	RN34S5	139
35-37	0.15	AA	3.0	RN36S0.15	69
	0.3	BB	6.0	RN36S0.3	86
	0.6	BB	6.0	RN36S0.6	89
	1.2	CC	8.0	RN36S1.2	104
	2.5	DD	13.0	RN36S2.5	121
	5.0	EE	20.0	RN36S5	139

* See Page 1•317 for size charts

abbott RN Case Sizes

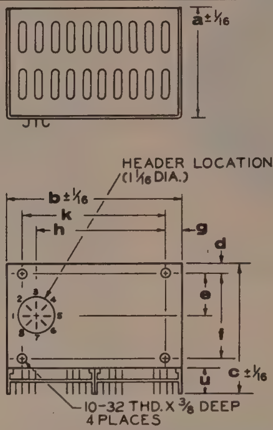
CASE AA


a ± 1/16
JTC
HEADER (1 1/16 DIA.)
b ± 1/16
k
h
g
d
c ± 1/16
e
f
8-32 THD. X 3/8 DEEP
4 PLACES

a	6½
b	4
c	1⅞
d	¼
e	11/16
f	1⅜
g	½
h	⅝
k	3

Terminal Functions (Standard)
1 AC Input
2 + Output
3 + Sense
4 − Sense
5 − Output
6
7 Ground
8 AC Input

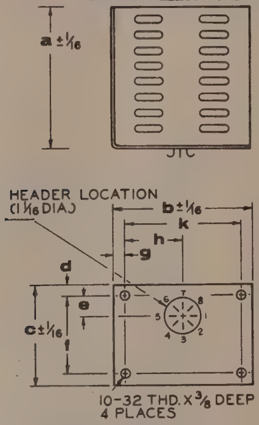
CASE EE


a ± 1/16
JTC
HEADER LOCATION
(1 1/16 DIA.)
b ± 1/16
k
h
g
d
e
f
c ± 1/16
u
10-32 THD. X 3/8 DEEP
4 PLACES

a	5
b	8
c	8⅜
d	½
e	2⅝
f	5¼
g	¾
h	5⅞
k	6½
u	2⅛

Terminal Functions (Standard)
1 AC Input
2 + Output
3 + Sense
4 − Sense
5 − Output
6
7 Ground
8 AC Input

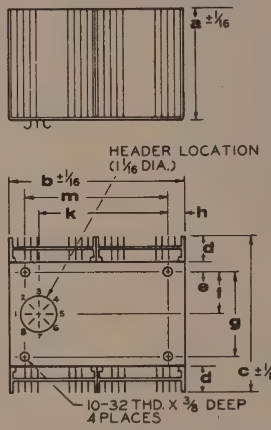
CASE BB


a ± 1/16
JTC
HEADER LOCATION
(1 1/16 DIA.)
b ± 1/16
k
h
g
d
e
c ± 1/16
f
10-32 THD. X 3/8 DEEP
4 PLACES

a	5
b	4
c	4½
d	⅜
e	⅞
f	3¾
g	9/16
h	1 7/16
k	3 1/16

Terminal Functions (Standard)
1 AC Input
2 + Output
3 + Sense
4 − Sense
5 − Output
6
7 Ground
8 AC Input

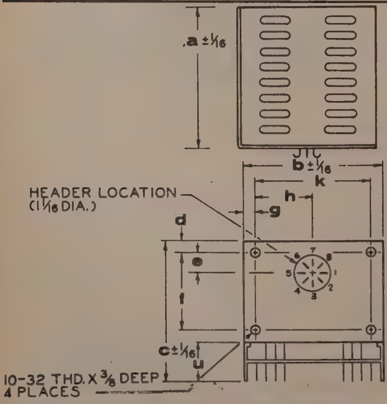
CASE FF


a ± 1/16
JTC
HEADER LOCATION
(1 1/16 DIA.)
b ± 1/16
m
k
h
d
e
f
g
c ± 1/16
10-32 THD. X 3/8 DEEP
4 PLACES

a	5
b	8
c	8¾
d	1¼
e	½
f	2⅝
g	5¼
h	¾
k	5⅞
m	6½

Terminal Functions (Standard)
1 AC Input
2 + Output
3 + Sense
4 − Sense
5 − Output
6
7 Ground
8 AC Input

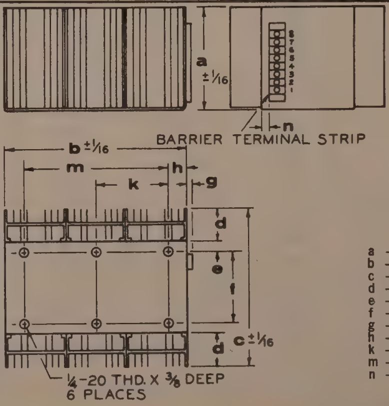
CASE CC & DD


a ± 1/16
JTC
b ± 1/16
k
h
g
HEADER LOCATION
(1 1/16 DIA.)
d
e
f
c ± 1/16
u
10-32 THD. X 3/8 DEEP
4 PLACES

	C	D
a	5	6½
b	4	4
c	5¾	7½
d	⅜	⅜
e	⅞	½
f	3 7/16	4⅜
g	9/16	½
h	1 7/16	1½
k	2 7/16	2½
u	1¼	2⅛

Terminal Functions (Standard)
1 AC Input
2 + Output
3 + Sense
4 − Sense
5 − Output
6
7 Ground
8 AC Input

CASE GG, HH, JJ


a
± 1/16
n
BARRIER TERMINAL STRIP
b ± 1/16
m
h
k
g
d
e
f
c ± 1/16
1/4-20 THD. X 3/8 DEEP
6 PLACES

Terminal Functions (Standard)
1 AC Input
2 AC Input
3 + Output
4 + Sense
5 − Sense
6 − Output
7
8 Ground

	G	H	J
a	5	6½	6½
b	12	12	12
c	8	8	9¾
d	1¼	1¼	2⅛
e	⅜	⅜	⅜
f	4¾	4¾	4¾
g	½	½	½
h	1¼	1¼	1¼
k	4¾	4¾	4¾
m	9½	9½	9½
n	⅜	⅜	⅜

Dimensional Tolerances: ±1/32 unless otherwise specified.

when you order any Acopian power module listed on the following 25 pages...

3-DAY SHIPMENT IS GUARANTEED

Any time you order Acopian power modules, selected from the thousands of models described on the following pages, shipment will be made within 3 days after your purchase order is received. To save more time, telephone your order. Call us, or your local Acopian representative. We'll ship within 3 days after you've put down the phone.

Miniaturized Single Output 2
Miniaturized Dual Output 4
Miniaturized Chassis Mounting 6
Series A Premium Performance, Series B General Purpose 8
Narrow Profile 12
Rack Mounting 14
Series U Unregulated 16
Dual Output for Op Amps 18
Single Output Plug-In 19
Dual Output Plug-In 20
Unregulated Plug-In 21
Multiple Output Power Systems 22
Benchtop Power Supplies 24
What Does Acopian's 3-Day Shipping Promise Mean? 26

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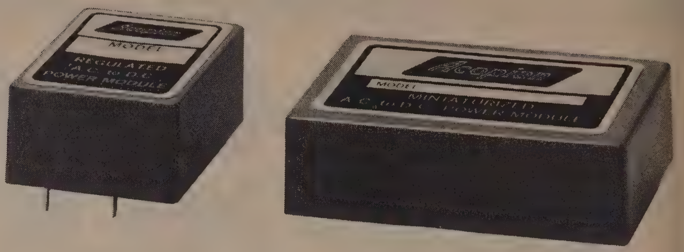
Acopian

MINIATURIZED REGULATED SINGLE OUTPUT


Acopian
MODEL
REGULATED A.C. to D.C. POWER MODULE
Acopian
MODEL
MINIATURIZED A.C. to D.C. POWER MODULE

Conserve space with mini-modules as small as 2.3″ x 1.8″ x 1.0″. Models with outputs ranging from 1 to 75 volts, and from 30 ma to 2.5 amps are available. All feature excellent regulation and ripple parameters, and are short circuit protected. Rugged encapsulated construction and generously derated components insure years of reliable operation. Mini-modules are also available with multiple outputs—see pages 4 and 5.

STANDARD FEATURES

- May be used in series
- No derating or heat sinking required
- Short circuit protected
- Small, lightweight

SPECIFICATIONS

Input Voltage: 105–125 VAC, 47 to 420 Hz, single phase.

Output Specifications: See table.

Output Voltage Trim Adjustment: Output is factory preset to ±2% (1 to 9 volt models) or ±1% (10 to 75 volt models) of nominal output voltage. Output may be trimmed to the nominal voltage rating with an external trim resistor.

Polarity: Output is floating. Either positive or negative terminal may be grounded.

Ambient Operating Temperature: −20 to +71°C. (Model 5E150, 0 to +71°C.) No derating required.

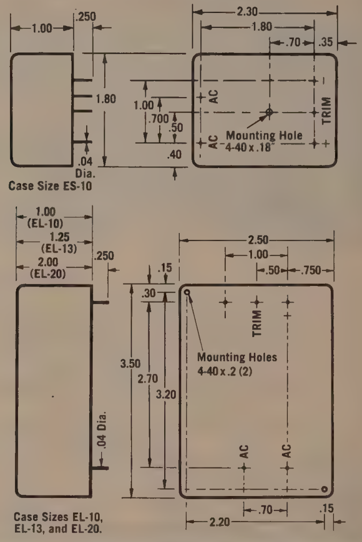
Storage Temperature: −55 to +85°C.

Temperature Coefficient: From 9 to 75 volts, approximate TC is .015%/°C; 1 to 8 volts, .03%/°C.

Impedance: 0.07 ohms at 1 kHz and 0.2 ohms at 10 kHz (approx.).

Weight: 7 oz. (Case size ES-10.)
1 lb. (Case size EL-10.)
1 lb. 3 oz. (Case size EL-13.)
2 lb. (Case size EL-20.)

Optional 230 Volt Input: All models can be alternately furnished for operation on an input of 210 to 250 VAC, 47-420 Hz. To order, add suffix "−230" to model number and $10.00 to price.

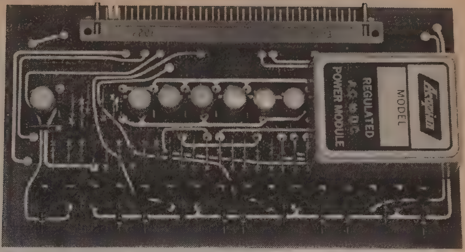

1.00
.250
2.30
1.80
.70
.35
1.80
1.00
.700
.50
.40
.04 Dia.
AC
AC
TRIM
Mounting Hole 4-40 x .18
1.00 (EL-10)
1.25 (EL-13)
2.00 (EL-20)
.250
.15
2.50
1.00
.50
.750
.30
TRIM
Mounting Holes 4-40 x .2 (2)
3.50
2.70
3.20
.04 Dia.
AC
AC
.70
.15
2.20

Case Size ES-10

Case Sizes EL-10, EL-13, and EL-20.

High voltage displays such as NIXIE* indicators may be powered with the Model NX-25A or NX-50. With an input of 115 VAC 47-420 Hz, they provide nominal (unregulated) outputs of 185 VDC.

*Registered trademark of Burroughs Corp.



Placement of a mini-module on a printed circuit assembly eliminates the need for an outboard power supply, as well as all the associated wiring, connectors and hardware. Layout and construction are simplified, equipment size can be reduced, and system reliability is improved.

Output Voltage	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Case Size
		Load ±%	Line ±%				
1	.250	.1	.05	0.5	$ 49	1E25	ES-10
1	.500	.2	.05	1	59	1E50A	EL-10
1.5	.250	.1	.05	0.5	49	1.5E25	ES-10
1.5	.500	.2	.05	1	59	1.5E50A	EL-10
1.5	1.0	.3	.05	1	98	1.5E100	EL-13
1.5	2.5	.3	.05	1	125	1.5E250	EL-20
2	.200	.1	.05	0.5	49	2E20	ES-10
2	.400	.2	.05	1	59	2E40A	EL-10
3	.250	.1	.05	0.5	49	3E25	ES-10
3	.500	.2	.05	1	59	3E50A	EL-10
3.6	.250	.05	.05	0.5	39	3.6E25	ES-10
3.6	.500	.1	.05	1	59	3.6E50A	EL-10
3.6	1.0	.3	.05	1	98	3.6E100	EL-13
3.6	2.5	.3	.05	1	125	3.6E250	EL-20
4	.200	.05	.05	0.5	49	4E20	ES-10
4	.400	.1	.05	1	59	4E40A	EL-10
5	.250	.05	.05	0.5	39	5E25	ES-10
5	.500	.1	.05	1	49	5E50A	EL-10
5	1.0	.2	.05	1	69	5E100	EL-13
5	1.5	.3	.1	1	98	5E150	EL-13
5	2.0	.15	.05	1	110	5E200	EL-20
5	2.5	.15	.05	1	125	5E250	EL-20
6	.200	.05	.05	0.5	39	6E20	ES-10
6	.400	.1	.05	1	59	6E40A	EL-10
6	.550	.2	.05	1	79	6E55	EL-10
6	1.0	.2	.05	1	98	6E100	EL-13
6	1.75	.15	.05	1	125	6E175	EL-20
7	.170	.05	.05	0.5	49	7E17	ES-10
7	.340	.1	.05	1	59	7E34A	EL-10
7	.450	.2	.05	1	79	7E45	EL-10
7	.900	.2	.05	1	98	7E90	EL-13
7	1.15	.15	.05	1	125	7E115	EL-20
8	.150	.05	.05	0.5	49	8E15	ES-10
8	.300	.1	.05	1	59	8E30A	EL-10
8	.700	.2	.05	1	98	8E70	EL-13
8	1.1	.15	.05	1	125	8E110	EL-20
9	.130	.05	.05	0.5	39	9E13	ES-10
9	.260	.1	.05	1	59	9E26A	EL-10
9	.450	.15	.05	1	79	9E45	EL-10
9	.850	.15	.05	1	98	9E85	EL-13
9	1.5	.15	.05	1	125	9E150	EL-20
10	.120	.02	.02	0.5	30	10E12	ES-10
10	.240	.05	.05	1	59	10E24A	EL-10
10	.400	.15	.05	1	79	10E40	EL-10
10	.750	.15	.05	1	98	10E75	EL-13
10	1.2	.1	.05	1	125	10E120	EL-20
11	.110	.02	.02	0.5	39	11E11	ES-10
11	.220	.05	.05	1	59	11E22A	EL-10
11	.350	.15	.05	1	79	11E35	EL-10
11	.600	.15	.05	1	98	11E60	EL-13
11	1.0	.1	.05	1	125	11E100	EL-20
12	.100	.02	.02	0.5	30	12E10	ES-10
12	.200	.05	.05	1	59	12E20A	EL-10
12	.400	.1	.05	1	79	12E40	EL-10
12	.700	.1	.05	1	98	12E70	EL-13
12	1.2	.15	.05	1	125	12E120	EL-20
13	.100	.02	.02	0.5	39	13E10	ES-10
13	.200	.05	.05	1	59	13E20A	EL-10
13	.350	.1	.05	1	79	13E35	EL-10
13	.600	.1	.05	1	98	13E60	EL-13
13	1.0	.1	.05	1	125	13E100	EL-20
14	.100	.02	.02	0.5	39	14E10	ES-10
14	.200	.05	.05	1	59	14E20A	EL-10
14	.300	.1	.05	1	79	14E30	EL-10
14	.500	.1	.05	1	98	14E50	EL-13
14	1.0	.1	.05	1	125	14E100	EL-20
15	.100	.02	.02	0.5	30	15E10	ES-10
15	.200	.05	.05	1	59	15E20A	EL-10
15	.400	.1	.05	1	79	15E40	EL-10
15	.600	.1	.05	1	98	15E60	EL-13
15	1.0	.1	.05	1	125	15E100	EL-20
16	.080	.02	.02	0.5	39	16E08	ES-10
16	.160	.05	.05	1	59	16E16A	EL-10
16	.350	.1	.05	1	79	16E35	EL-10
16	.500	.1	.05	1	98	16E50	EL-13
16	.900	.1	.05	1	125	16E90	EL-20
17	.070	.02	.02	0.5	39	17E07	ES-10
17	.140	.05	.05	1	59	17E14A	EL-10
17	.325	.1	.05	1	79	17E33	EL-10
17	.450	.1	.05	1	$ 98	17E45	EL-13
17	.750	.1	.05	1	125	17E75	EL-20
18	.060	.02	.02	0.5	30	18E06	ES-10
18	.120	.05	.05	1	59	18E12A	EL-10
18	.270	.1	.05	1	79	18E27	EL-10
18	.400	.1	.05	1	98	18E40	EL-13
18	.550	.1	.05	1	125	18E55	EL-20
19	.060	.02	.02	0.5	39	19E06	ES-10
19	.120	.05	.05	1	59	19E12A	EL-10
19	.250	.1	.05	1	79	19E25	EL-10
19	.400	.1	.05	1	98	19E40	EL-13
19	.700	.1	.05	1	125	19E70	EL-20
20	.060	.02	.02	0.5	39	20E06	ES-10
20	.120	.05	.05	1	59	20E12A	EL-10
20	.200	.1	.05	1	79	20E20	EL-10
20	.400	.1	.05	1	98	20E40	EL-13
20	.700	.1	.05	1	125	20E70	EL-20
21	.060	.02	.02	0.5	39	21E06	ES-10
21	.120	.05	.05	1	59	21E12A	EL-10
21	.175	.1	.05	1	79	21E18	EL-10
21	.375	.1	.05	1	98	21E38	EL-13
21	.600	.1	.05	1	125	21E60	EL-20
22	.050	.02	.02	0.5	39	22E05	ES-10
22	.100	.05	.05	1	59	22E10A	EL-10
22	.150	.1	.05	1	79	22E15	EL-10
22	.300	.1	.05	1	98	22E30	EL-13
22	.500	.1	.05	1	125	22E50	EL-20
23	.050	.02	.02	0.5	39	23E05	ES-10
23	.100	.05	.05	1	59	23E10A	EL-10
23	.200	.1	.05	1	79	23E20	EL-10
23	.300	.1	.05	1	98	23E30	EL-13
23	.600	.1	.05	1	125	23E60	EL-20
24	.050	.02	.02	0.5	30	24E05	ES-10
24	.100	.05	.05	1	59	24E10A	EL-10
24	.200	.1	.05	1	79	24E20	EL-10
24	.350	.1	.05	1	98	24E35	EL-13
24	.600	.1	.05	1	125	24E60	EL-20
25	.050	.02	.02	0.5	39	25E05	ES-10
25	.100	.05	.05	1	59	25E10A	EL-10
25	.190	.1	.05	1	79	25E19	EL-10
25	.325	.1	.05	1	98	25E33	EL-13
25	.550	.1	.05	1	125	25E55	EL-20
26	.040	.02	.02	0.5	39	26E04	ES-10
26	.080	.05	.05	1	59	26E08A	EL-10
26	.170	.1	.05	1	79	26E17	EL-10
26	.300	.1	.05	1	98	26E30	EL-13
26	.450	.1	.05	1	125	26E45	EL-20
27	.040	.02	.02	0.5	39	27E04	ES-10
27	.080	.05	.05	1	59	27E08A	EL-10
27	.160	.1	.05	1	79	27E16	EL-10
27	.300	.1	.05	1	98	27E30	EL-13
27	.500	.1	.05	1	125	27E50	EL-20
28	.040	.05	.05	0.5	39	28E04	ES-10
28	.080	.02	.02	1	59	28E08A	EL-10
28	.150	.1	.05	1	79	28E15	EL-10
28	.300	.1	.05	1	98	28E30	EL-13
28	.500	.1	.05	1	125	28E50	EL-20
30	.080	.02	.02	1	59	30E08A	EL-13
32	.070	.02	.02	1	59	32E07A	EL-13
34	.060	.02	.02	1	59	34E06A	EL-13
35	.050	.02	.02	1	59	35E05A	EL-13
36	.050	.02	.02	1	59	36E05A	EL-13
38	.040	.02	.02	1	59	38E04A	EL-13
40	.030	.02	.02	1	62	40E03A	EL-13
40	.060	.02	.02	1	89	40E06A	EL-13
42	.030	.02	.02	1	62	42E03A	EL-13
44	.030	.02	.02	1	62	44E03A	EL-13
45	.030	.02	.02	1	62	45E03A	EL-13
48	.030	.02	.02	1	62	48E03A	EL-13
48	.050	.02	.02	1	89	48E05A	EL-13
50	.030	.02	.02	1	62	50E03A	EL-13
50	.050	.02	.02	1	89	50E05A	EL-13
55	.040	.02	.02	1	89	55E04A	EL-13
60	.050	.02	.02	1	89	60E05A	EL-13
65	.050	.02	.02	1	89	65E05A	EL-13
70	.040	.02	.02	1	89	70E04A	EL-13
75	.030	.02	.02	1	89	75E03A	EL-13
185	.025	Unregulated		2V	35	NX-25A	EL-10
185	.050	Unregulated		3.5V	49	NX-50	EL-13

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Acopian

Acopian
MODEL
DUAL OUTPUT REGULATED
POWER SUPPLY

MINIATURIZED REGULATED MULTIPLE OUTPUT

These dual and triple output mini-modules are compact and convenient sources of the voltages required to power operational amplifiers and related circuits. They may be mounted directly on printed circuit board assemblies, simplifying system layout and minimizing the connectors and wiring required.

STANDARD FEATURES

- May be used in series
- No derating or heat sinking required
- Short circuit protected
- Compact, lightweight

SPECIFICATIONS

Input Voltage: 105–125 VAC, 47 to 420 Hz, single phase.

Output Specifications: See table.

Output Voltage Setting: Each output is factory preset to ±2% (1 to 9 volt outputs) or ±1% (10 to 28 volt outputs) of the nominal output voltage. Outputs of Case Size END modules, except those marked (*), may be trimmed to the nominal voltage rating with an external trim resistor.

Polarity: Single output sections may be used in either polarity. Dual output sections, marked (*), are provided with a plus/common/minus output connection configuration.

Ambient Operating Temperature: −20 to +71°C. No derating required.

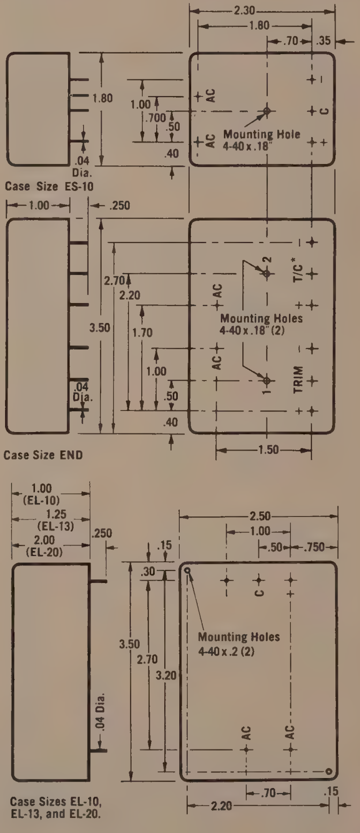
Storage Temperature: −55 to +85°C.

Temperature Coefficient: From 9 to 28 volts, approximate TC is .015%/°C; 1 to 8 volts, .03%/°C.

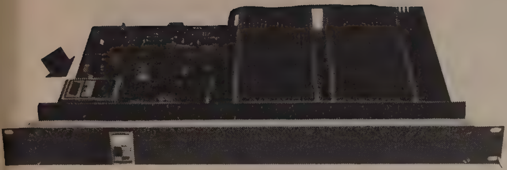
Impedance: 0.07 ohms at 1 kHz and 0.2 ohms at 10 kHz (approx.).

Weight: 7 oz. (Case size ES-10.)
13 oz. (Case size END.)
1 lb. (Case size EL-10.)
1 lb. 3 oz. (Case size EL-13.)
2 lb. (Case size EL-20.)

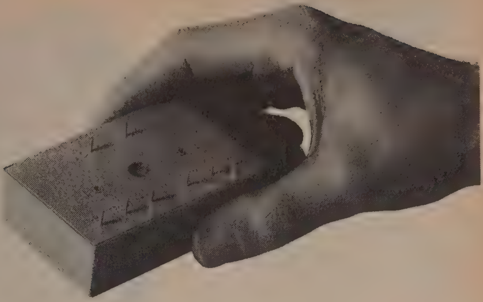
Optional 230 Volt Input: All models can be alternately furnished for operation on an input of 210 to 250 VAC, 47-420 Hz. To order, add suffix "—230" to model number and $10.00 to price.


2.30
1.80
.70
.35
1.80
1.00
.700
.50
.40
.04 Dia.
AC
AC
C
Mounting Hole 4-40 x .18"
Case Size ES-10
1.00
.250
2.70
2.20
3.50
1.70
1.00
.50
.40
.04 Dia.
AC
AC
2
1
T/C*
TRIM
Mounting Holes 4-40 x .18" (2)
1.50
Case Size END
1.00 (EL-10)
1.25 (EL-13)
2.00 (EL-20)
.250
.15
2.50
1.00
.50
.750
.30
3.50
2.70
3.20
.04 Dia.
C
Mounting Holes 4-40 x .2 (2)
AC
AC
.70
.15
2.20
Case Sizes EL-10, EL-13, and EL-20.

*TRIM or COMMON, depending upon model



Complete system assemblies only 1¾-inches high. Mini-modules permit exceptional flexibility in the design of rack-mounting assemblies built on standard 19-inch panels as small as 1¾-inches high.



Dual output modules have isolated outputs; triples provide two balanced and tracking voltages in a three-terminal configuration, plus an isolated third output for logic, control circuits, etc.

HOW TO ORDER:

Any two of the sections listed below, or two of the same section, can be combined into a multiple-output module. The complete model number is the combination of the two section numbers selected. Note that some sections provide two outputs; combination with a single output section results in a triple-output module.

Example: The combination of sections 6E20D and 15E10D is the Model 6E20D-15E10D. Always assign the lower voltage section first. For pricing purposes, add the costs of the sections selected. Example: The price of the Model 6E20D-15E10D is $39.00 plus $29.00, or $68.00 total.

Output Voltage	Output Current Amps.	Regulation		Ripple mv RMS	Price per Section	Section (See "How to order")	Case Size
		Load ±%	Line ±%				
1	.250	.1	.05	0.5	$39	1E25D	END
1.5	.250	.1	.05	0.5	39	1.5E25D	END
2	.200	.1	.05	0.5	39	2E20D	END
3	.250	.1	.05	0.5	39	3E25D	END
3.6	.250	.05	.05	0.5	39	3.6E25D	END
4	.200	.05	.05	0.5	39	4E20D	END
5	.250	.05	.05	0.5	39	5E25D	END
6	.200	.05	.05	0.5	39	6E20D	END
7	.170	.05	.05	0.5	39	7E17D	END
8	.150	.05	.05	0.5	39	8E15D	END
9	.130	.05	.05	0.5	29	9E13D	END
10	.120	.02	.02	0.5	29	10E12D	END
±12*	.050	.10	.05	1.0	49	D12E05	END
12	.100	.02	.02	0.5	29	12E10D	END
12	.150	.05	.05	0.5	33	12E15D	END
13	.100	.02	.02	0.5	29	13E10D	END
14	.100	.02	.02	0.5	$29	14E10D	END
±15*	.050	.10	.05	1.0	49	D15E05	END
15	.100	.02	.02	0.5	29	15E10D	END
15	.150	.05	.05	0.5	33	15E15D	END
16	.080	.02	.02	0.5	29	16E08D	END
17	.070	.02	.02	0.5	29	17E07D	END
18	.060	.02	.02	0.5	29	18E06D	END
20	.060	.02	.02	0.5	29	20E06D	END
21	.060	.02	.02	0.5	29	21E06D	END
22	.050	.02	.02	0.5	29	22E05D	END
23	.050	.02	.02	0.5	29	23E05D	END
24	.050	.02	.02	0.5	29	24E05D	END
25	.050	.02	.02	0.5	29	25E05D	END
26	.040	.02	.02	0.5	29	26E04D	END
27	.040	.02	.02	0.5	29	27E04D	END
28	.040	.02	.02	0.5	29	28E04D	END

*Dual output section. Combination with a single output section results in a triple output module.

DUAL OUTPUT SUPPLIES FOR OP AMPS

(These model numbers are complete as shown.)

Nominal Output Voltages	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Case Size
		Load ±%	Line ±%				
±12	.025	.1	.05	1	$ 24	D12-03	ES-10
±12	.050	.1	.05	1	39	D12-05	ES-10
±12	.100	.05	.05	1	49	D12-10A	EL-10
±12	.150	.05	.05	1	59	D12-15A	EL-10
±12	.200	.05	.05	1	69	D12-20	EL-10
±12	.300	.05	.05	1	98	D12-30	EL-13
±12	.350	.05	.05	1	105	D12-35	EL-13
±12	.500	.1	.05	1	130	D12-50	EL-20
±15	.025	.1	.05	1	$ 24	D15-03	ES-10
±15	.050	.1	.05	1	39	D15-05	ES-10
±15	.100	.05	.05	1	49	D15-10A	EL-10
±15	.150	.05	.05	1	59	D15-15A	EL-10
±15	.200	.05	.05	1	69	D15-20	EL-10
±15	.300	.05	.05	1	98	D15-30	EL-13
±15	.350	.05	.05	1	105	D15-35	EL-13
±15	.500	.1	.05	1	130	D15-50	EL-20

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Acopian

MINIATURIZED REGULATED Terminal Strip Connections

AC
AC
+ OUT
T/C
− OUT
Acopian
MODEL
AC to DC
POWER MODULE

Although small in size, these mini-modules offer high performance at modest prices. All models, with series regulated outputs ranging from 1 to 75 volts and as high as 2.5 amps, may be mounted in an area only 3.5″ x 2.5″. Dual output models are available with the ratings commonly required for driving op amps and other balanced loads. Terminal strip input/output connections eliminate all need for sockets or soldering. Short circuit protection, encapsulated construction, and conservative design assure long term reliability.

STANDARD FEATURES

- May be used in series
- No derating or heat sinking required
- Short circuit protected
- Small, lightweight

SPECIFICATIONS

Input Voltage: 105–125 VAC, 47 to 420 Hz, single phase.

Output Specifications: See tables.

Output Voltage Trim Adjustment: Outputs factory preset to ±2% (1 to 9 volt models) or ±1% (10 to 75 volt models) of nominal output voltage. Single output models may be trimmed to the nominal voltage rating with an external trim resistor.

Polarity: Either positive or negative terminal of a single output module may be grounded. Dual output modules have a positive/common/negative output terminal configuration.

Ambient Operating Temperature: −20 to +71°C. (Model 5EB150, 0 to +71°C.) No derating required.

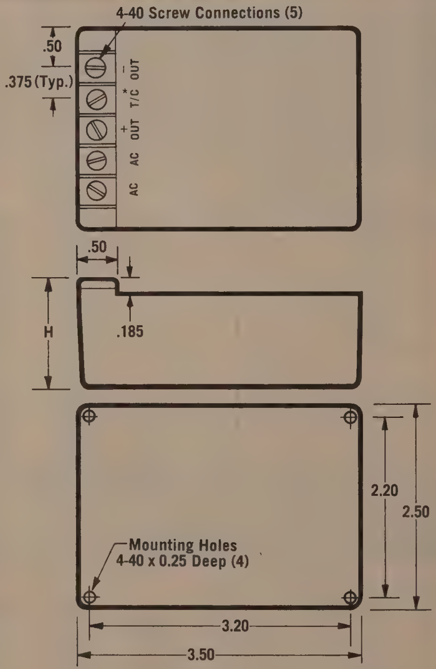
Storage Temperature: −55 to +85°C.

Temperature Coefficient: From 9 to 75 volts, approximate TC is .015%/°C; 1 to 8 volts, .03%/°C.

Impedance: 0.07 ohms at 1 kHz and 0.2 ohms at 10 kHz (approx.).

Optional 230 Volt Input: All models can be alternately furnished for operation on an input of 210 to 250 VAC, 47-420 Hz. To order, add suffix "–230" to model number and $10.00 to price.

> **High voltage displays** such as NIXIE* indicators may be powered with the Model NX-25B or NX-50B. With an input of 115 VAC 47-420 Hz, they provide nominal (unregulated) outputs of 185 VDC.
>
> *Registered trademark of Burroughs Corp.



*TRIM on single output modules; COMMON on duals

Case	H	Approx. Weight
EB-10	1.375	15oz
EB-13	1.625	1lb 5oz
EB-20	2.375	2lb 1oz

An Acopian miniaturized power module is used in the Valitron credit validation system manufactured by Video Systems Corporation. A Valitron terminal is capable of retrieving and displaying credit information for any of 100,000 accounts on a six inch video screen, in response to an account number being entered via its keyboard.

SINGLE OUTPUT MODELS

Output Voltage	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Case Size
		Load ±%	Line ±%				
1	.500	.4	.05	1	$ 65	1EB50	EB-10
1.5	.500	.3	.05	1	65	1.5EB50	EB-10
1.5	1.0	.5	.05	1	105	1.5EB100	EB-13
1.5	2.5	.6	.05	1	130	1.5EB250	EB-20
2	.400	.25	.05	1	65	2EB40	EB-10
3	.500	.25	.05	1	65	3EB50	EB-10
3.6	.500	.15	.05	1	65	3.6EB50	EB-10
3.6	1.0	.4	.05	1	105	3.6EB100	EB-13
3.6	2.5	.4	.05	1	130	3.6EB250	EB-20
4	.400	.15	.05	1	65	4EB40	EB-10
5	.500	.15	.05	1	55	5EB50	EB-10
5	1.0	.25	.05	1	75	5EB100	EB-13
5	1.5	.35	.1	1	105	5EB150	EB-13
5	2.0	.25	.05	1	115	5EB200	EB-20
5	2.5	.25	.05	1	130	5EB250	EB-20
6	.400	.1	.05	1	65	6EB40	EB-10
6	.550	.25	.05	1	85	6EB55	EB-10
6	1.0	.25	.05	1	105	6EB100	EB-13
6	1.75	.2	.05	1	130	6EB175	EB-20
7	.340	.1	.05	1	65	7EB34	EB-10
7	.450	.2	.05	1	85	7EB45	EB-10
7	.900	.25	.05	1	105	7EB90	EB-13
7	1.15	.2	.05	1	130	7EB115	EB-20
8	.300	.1	.05	1	65	8EB30	EB-10
8	.700	.2	.05	1	105	8EB70	EB-13
8	1.1	.2	.05	1	130	8EB110	EB-20
9	.260	.1	.05	1	65	9EB26	EB-10
9	.450	.15	.05	1	85	9EB45	EB-10
9	.850	.2	.05	1	105	9EB85	EB-13
9	1.5	.2	.05	1	130	9EB150	EB-20
10	.240	.05	.05	1	65	10EB24	EB-10
10	.400	.15	.05	1	85	10EB40	EB-10
10	.750	.2	.05	1	105	10EB75	EB-13
10	1.2	.15	.05	1	130	10EB120	EB-20
11	.220	.05	.05	1	65	11EB22	EB-10
11	.350	.15	.05	1	85	11EB35	EB-10
11	.600	.15	.05	1	105	11EB60	EB-13
11	1.0	.15	.05	1	130	11EB100	EB-20
12	.200	.05	.05	1	65	12EB20	EB-10
12	.400	.1	.05	1	85	12EB40	EB-10
12	.700	.15	.05	1	105	12EB70	EB-13
12	1.2	.2	.05	1	130	12EB120	EB-20
13	.200	.05	.05	1	65	13EB20	EB-10
13	.350	.1	.05	1	85	13EB35	EB-10
13	.600	.1	.05	1	105	13EB60	EB-13
13	1.0	.15	.05	1	130	13EB100	EB-20
14	.200	.05	.05	1	65	14EB20	EB-10
14	.300	.1	.05	1	85	14EB30	EB-10
14	.500	.1	.05	1	105	14EB50	EB-13
14	1.0	.15	.05	1	130	14EB100	EB-20
15	.200	.05	.05	1	65	15EB20	EB-10
15	.400	.1	.05	1	85	15EB40	EB-10
15	.600	.1	.05	1	105	15EB60	EB-13
15	1.0	.15	.05	1	130	15EB100	EB-20
16	.160	.05	.05	1	65	16EB16	EB-10
16	.350	.1	.05	1	85	16EB35	EB-10
16	.500	.1	.05	1	105	16EB50	EB-13
16	.900	.15	.05	1	130	16EB90	EB-20
17	.140	.05	.05	1	65	17EB14	EB-10
17	.325	.1	.05	1	85	17EB33	EB-10
17	.450	.1	.05	1	105	17EB45	EB-13
17	.750	.15	.05	1	130	17EB75	EB-20
18	.120	.05	.05	1	65	18EB12	EB-10
18	.270	.1	.05	1	85	18EB27	EB-10

Output Voltage	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Case Size
		Load ±%	Line ±%				
18	.400	.1	.05	1	$105	18EB40	EB-13
18	.550	.1	.05	1	130	18EB55	EB-20
19	.120	.05	.05	1	65	19EB12	EB-10
19	.250	.1	.05	1	85	19EB25	EB-10
19	.400	.1	.05	1	105	19EB40	EB-13
19	.700	.1	.05	1	130	19EB70	EB-20
20	.120	.05	.05	1	65	20EB12	EB-10
20	.200	.1	.05	1	85	20EB20	EB-10
20	.400	.1	.05	1	105	20EB40	EB-13
20	.700	.1	.05	1	130	20EB70	EB-20
21	.120	.05	.05	1	65	21EB12	EB-10
21	.175	.1	.05	1	85	21EB18	EB-10
21	.375	.1	.05	1	105	21EB38	EB-13
21	.600	.1	.05	1	130	21EB60	EB-20
22	.100	.05	.05	1	65	22EB10	EB-10
22	.150	.1	.05	1	85	22EB15	EB-10
22	.300	.1	.05	1	105	22EB30	EB-13
22	.500	.1	.05	1	130	22EB50	EB-20
23	.100	.05	.05	1	65	23EB10	EB-10
23	.200	.1	.05	1	85	23EB20	EB-10
23	.300	.1	.05	1	105	23EB30	EB-13
23	.600	.1	.05	1	130	23EB60	EB-20
24	.100	.05	.05	1	65	24EB10	EB-10
24	.200	.1	.05	1	85	24EB20	EB-10
24	.350	.1	.05	1	105	24EB35	EB-13
24	.600	.1	.05	1	130	24EB60	EB-20
25	.100	.05	.05	1	65	25EB10	EB-10
25	.190	.1	.05	1	85	25EB19	EB-10
25	.325	.1	.05	1	105	25EB33	EB-13
25	.550	.1	.05	1	130	25EB55	EB-20
26	.080	.05	.05	1	65	26EB08	EB-10
26	.170	.1	.05	1	85	26EB17	EB-10
26	.300	.1	.05	1	105	26EB30	EB-13
26	.450	.1	.05	1	130	26EB45	EB-20
27	.080	.05	.05	1	65	27EB08	EB-10
27	.160	.1	.05	1	85	27EB16	EB-10
27	.300	.1	.05	1	105	27EB30	EB-13
27	.500	.1	.05	1	130	27EB50	EB-20
28	.080	.05	.05	1	65	28EB08	EB-10
28	.150	.1	.05	1	85	28EB15	EB-10
28	.300	.1	.05	1	105	28EB30	EB-13
28	.500	.1	.05	1	130	28EB50	EB-20
30	.080	.02	.02	1	65	30EB08	EB-13
32	.070	.02	.02	1	65	32EB07	EB-13
34	.060	.02	.02	1	65	34EB06	EB-13
35	.050	.02	.02	1	65	35EB05	EB-13
36	.050	.02	.02	1	65	36EB05	EB-13
38	.040	.02	.02	1	65	38EB04	EB-13
40	.030	.02	.02	1	69	40EB03	EB-13
40	.060	.02	.02	1	95	40EB06	EB-13
42	.030	.02	.02	1	69	42EB03	EB-13
44	.030	.02	.02	1	69	44EB03	EB-13
45	.030	.02	.02	1	69	45EB03	EB-13
48	.030	.02	.02	1	69	48EB03	EB-13
48	.050	.02	.02	1	95	48EB05	EB-13
50	.030	.02	.02	1	69	50EB03	EB-13
50	.050	.02	.02	1	95	50EB05	EB-13
55	.040	.02	.02	1	95	55EB04	EB-13
60	.050	.02	.02	1	95	60EB05	EB-13
65	.050	.02	.02	1	95	65EB05	EB-13
70	.040	.02	.02	1	95	70EB04	EB-13
75	.030	.02	.02	1	95	75EB03	EB-13
185	.025	Unregulated		2V	40	NX-25B	EB-10
185	.050	Unregulated		3.5V	55	NX-50B	EB-13

DUAL OUTPUT MODELS

Output Voltage Voltages	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Case Size
		Load ±%	Line ±%				
±12	.100	.05	.05	1	$ 55	DB12-10	EB-10
±12	.150	.05	.05	1	65	DB12-15	EB-10
±12	.200	.05	.05	1	75	DB12-20	EB-10
±12	.300	.05	.05	1	105	DB12-30	EB-13
±12	.350	.05	.05	1	110	DB12-35	EB-13
±12	.500	.1	.05	1	135	DB12-50	EB-20

Output Voltage Voltages	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Case Size
		Load ±%	Line ±%				
±15	.100	.05	.05	1	$ 55	DB15-10	EB-10
±15	.150	.05	.05	1	65	DB15-15	EB-10
±15	.200	.05	.05	1	75	DB15-20	EB-10
±15	.300	.05	.05	1	105	DB15-30	EB-13
±15	.350	.05	.05	1	110	DB15-35	EB-13
±15	.500	.1	.05	1	135	DB15-50	EB-20

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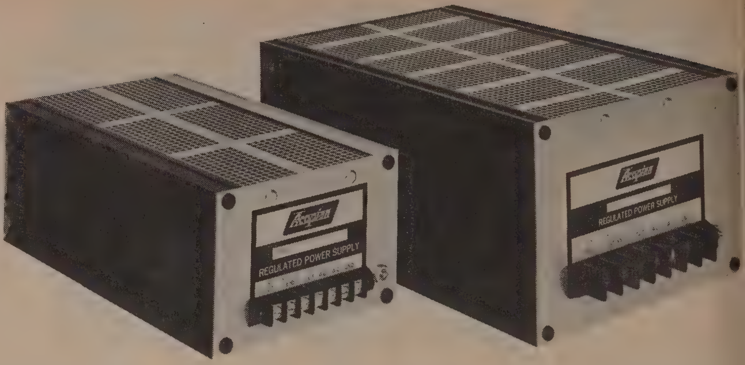
SERIES A REGULATED PREMIUM PERFORMANCE

SERIES B REGULATED LOWEST COST


Acopian
REGULATED POWER SUPPLY
Acopian
REGULATED POWER SUPPLY

A broad selection of power supplies offering unusually high performance – many models have regulation of ±0.005%. Electronic current limiting and provision for remote voltage sensing are standard features; overvoltage protection is available as a built-in option. Rugged extruded aluminum cases include threaded mounting holes on bottom, back, and side, permitting mounting in any position.

SERIES A PREMIUM PERFORMANCE POWER SUPPLIES

STANDARD FEATURES

- Provision for remote sensing and/or external output adjustment
- Short circuit proof with automatic recovery (electronic current limiting)
- Can be mounted on any of three surfaces (case sizes H11 and H16, two surfaces)
- Convection cooled – no heat sinking or forced-air ventilation is necessary
- Silicon semiconductors
- Completely serviceable

SPECIFICATIONS

Input Voltage: 105–125 VAC, 50–400 Hz, single phase.

Output Specifications: See pages 10 and 11. Series A supplies have model numbers beginning with the letter A.

Remote Voltage Sensing: Provision for sensing the output voltage across the load, so that drops in the load line are compensated, is a standard feature.

Polarity: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Ambient Operating Temperature: −20 to +71°C.

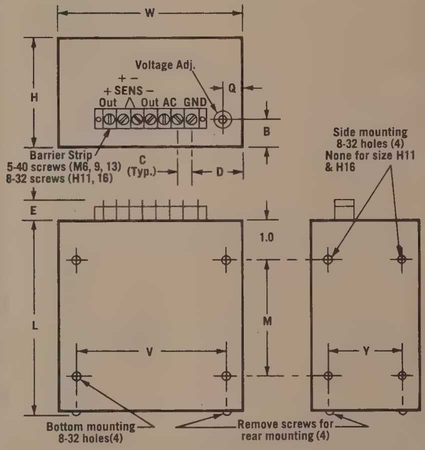
Storage Temperature: −55 to +85°C.

Response Time: Less than 20 microseconds.

OPTIONS

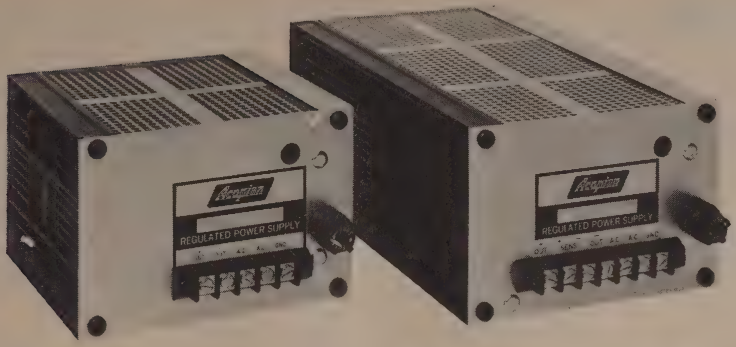
Overvoltage Protection: An internal preset overvoltage protector is available on all models. To order, add prefix "V" to the model number, and increase standard price as follows:

For all case sizes except H16:
Nominal output voltages from 3 to 28 V. $25.00
30 to 70 V. 35.00
Case size H16 (all voltages) 75.00


W
H
Voltage Adj.
+ −
+ SENS −
Out
Out
AC
GND
Q
B
Barrier Strip
5-40 screws (M6, 9, 13)
8-32 screws (H11, 16)
C
(Typ.)
D
Side mounting
8-32 holes (4)
None for size H11
& H16
E
1.0
L
M
V
Y
Bottom mounting
8-32 holes(4)
Remove screws for
rear mounting (4)

Size	L	W	H	M	V	Y	E	Q	B	C	D	Approx. Weight
M6	6.59	5.12	3.44	4.0	4.5	3.0	.38	.5	.75	.375	1.44	4lb 4oz
M9	9.25	5.12	3.44	6.0	4.5	3.0	.38	.5	.75	.375	1.44	7lb 4oz
M13	13.25	5.12	3.44	10.0	4.5	3.0	.38	.5	.75	.375	1.44	11lb
H11	11.25	7.37	5.12	8.0	6.75	4.56	.75	1.12	1.25	.562	2.25	18lb 4oz
H16	16.00	7.37	5.12	11.0	6.75	4.56	.75	1.12	1.25	.562	2.25	23lb

230 Volt Input: Available on some models. Contact factory for information.


Acopian
REGULATED POWER SUPPLY
Acopian
REGULATED POWER SUPPLY
OUT SENS OUT AC AC GND

These low-cost supplies provide the same high reliability as the Series A, and without sacrificing the basic features necessary for most applications. Many models have regulation of ±0.1% or better. All components are generously derated to insure a long and trouble-free life. And they use the same rugged construction as the Series A line. Overvoltage protection and other options are available.

SERIES B LOW-COST POWER SUPPLIES

STANDARD FEATURES

- Delivers current surges without damage — built-in fuse protects supply against prolonged overloads and shorts
- May be mounted on any of three surfaces
- Convection cooled — no heat sinking or forced-air ventilation is necessary
- Silicon semiconductors
- Completely serviceable

SPECIFICATIONS

Input Voltage: 105–125 VAC, 50–400 Hz, single phase.

Output Specifications: See pages 10 and 11. Series B supplies have model numbers beginning with the letter B.

Remote Voltage Adjustment/Sensing: Available as an option. See below.

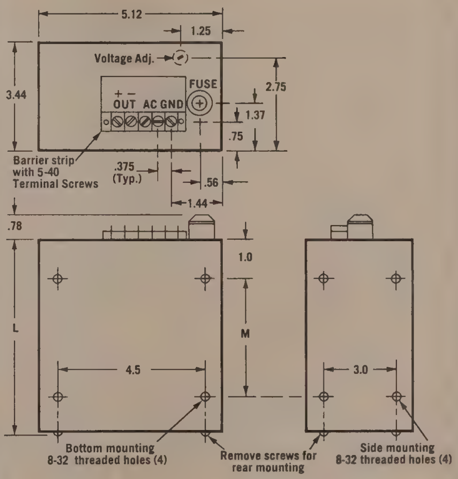
Polarity: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Ambient Operating Temperature: 0 to +71°C.
Storage Temperature: −55 to +85°C.

OPTIONS

Overvoltage Protection: An internal preset overvoltage protector is available on all models up to 70 V. To order, add prefix "V" to the model number and add $25.00 to the standard price of models with output voltages of 3 to 28 V, $35.00 to the price of models with output voltages from 30 to 70 V.

Remote Voltage Sensing: Provision for sensing the output voltage across the load, so that drops in the load lines are compensated, is available on all models. (This option also permits the use of an externally located potentiometer to adjust output voltage.) To order, add prefix "R" to the model number. No increase in price.


5.12
1.25
Voltage Adj.
FUSE
2.75
3.44
+ −
OUT AC GND
1.37
.75
Barrier strip with 5-40 Terminal Screws
.375 (Typ.)
.56
1.44
.78
1.0
L
M
4.5
3.0
Bottom mounting 8-32 threaded holes (4)
Remove screws for rear mounting
Side mounting 8-32 threaded holes (4)

Size	L	M	Approx. Weight
G3	3.71	1.62	3lb 2oz
G5	5.09	3.00	4lb 14oz
G6	6.59	4.00	5lb 8oz
G9	9.25	6.00	7lb 4oz
G13	13.25	10.00	11lb

230 Volt Input: All models can be alternately furnished for operation on inputs of 210–250 VAC, 50–400 Hz. To order, add suffix "-230" to model number and $10.00 to price.

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SERIES A
SERIES B

Nominal Output Voltage	Adjust ±V.	Output Current Amps. at 40°C	55°C	71°C	Regulation Load ±%	Line ±%*	Ripple mv RMS	Price	Model	Size
1.5	.5	6.0	4.3	3.5	.005	.005	.250	$155	A1.5MT600	M6
1.5	.5	9.0	7.2	5.5	.005	.005	.250	180	A1.5MT900	M9
1.5	.5	12.0	10.0	8.0	.005	.005	.250	200	A1.5MT1200	M13
1.5	.5	22.0	18.5	15.5	.005	.005	.250	270	A1.5HT2200	H11
1.5	.5	32.0	27.0	22.5	.005	.005	.250	320	A1.5HT3200	H16
3	.5	.250	.250	.250	.2	.1	1	60	B3GT25	G3
3	.5	.500	.500	.500	.2	.1	1	75	B3GT50	G3
3	.5	.750	.750	.750	.2	.1	1	80	B3GT75	G3
3	.5	1.2	1.1	1.0	.2	.1	1	90	B3GT120	G3
3	.5	2.1	2.1	2.0	.5	.1	1	110	B3GT210	G5
3	.5	4.0	3.5	3.0	.5	.1	1.5	135	B3GT400	G6
3	.5	6.0	4.3	3.5	.005	.005	.250	160	A3MT600	M6
3	.5	7.0	5.9	4.9	.5	.1	1.5	170	B3GT700	G9
3	.5	9.0	7.2	5.5	.005	.005	.250	180	A3MT900	M9
3	.5	10.0	9.0	7.0	.5	.1	1.5	190	B3GT1000	G13
3	.5	12.0	10.0	8.0	.005	.005	.250	200	A3MT1200	M13
3	.5	20.0	16.5	13.5	.005	.005	.250	270	A3HT2000	H11
3	.5	30.0	25.0	20.0	.005	.005	.250	320	A3HT3000	H16
3.6	.5	.250	.250	.250	.2	.1	1	60	B3.6GT25	G3
3.6	.5	.500	.500	.500	.2	.1	1	75	B3.6GT50	G3
3.6	.5	.750	.750	.750	.2	.1	1	80	B3.6GT75	G3
3.6	.5	1.2	1.1	1.0	.2	.1	1	90	B3.6GT120	G3
3.6	.5	2.1	2.1	2.0	.5	.1	1	110	B3.6GT210	G5
3.6	.5	4.0	3.5	3.0	.5	.1	1.5	135	B3.6GT400	G6
3.6	.5	6.0	4.3	3.5	.005	.005	.250	160	A3.6MT600	M6
3.6	.5	7.0	5.9	4.9	.5	.1	1.5	170	B3.6GT700	G9
3.6	.5	9.0	7.2	5.5	.005	.005	.250	180	A3.6MT900	M9
3.6	.5	12.0	10.0	8.0	.005	.005	.250	200	A3.6MT1200	M13
3.6	.5	22.0	18.5	15.5	.005	.005	.250	270	A3.6HT2200	H11
3.6	.5	32.0	27.0	22.5	.005	.005	.250	320	A3.6HT3200	H16
5	.5	.250	.250	.250	.1	.1	1	60	B5GT25	G3
5	.5	.500	.500	.500	.1	.1	1	75	B5GT50	G3
5	.5	.750	.750	.750	.1	.1	1	80	B5GT75	G3
5	.5	1.2	1.1	1.0	.1	.1	1	90	B5GT120	G3
5	.5	1.7	1.5	1.3	.2	.1	1.5	95	B5GT170	G3
5	.5	2.1	2.1	2.0	.2	.1	1.5	110	B5GT210	G5
5	.5	4.0	3.5	3.0	.3	.1	1.5	130	B5GT400	G6
5	.5	5.0	4.4	3.0	.4	.1	1.5	140	B5GT500	G6
5	.5	5.1	3.6	2.6	.005	.005	.250	150	A5MT510	M6
5	.5	6.0	4.3	3.5	.005	.005	.250	160	A5MT600	M6
5	.5	8.0	7.0	5.0	.4	.1	1.5	165	B5GT800	G9
5	.5	9.0	7.2	5.5	.005	.005	.250	180	A5MT900	M9
5	.5	10.0	9.0	7.0	.4	.1	1.5	185	B5GT1000	G13
5	.5	12.0	10.0	8.0	.005	.005	.250	200	A5MT1200	M13
5	.5	16.5	14.0	11.5	.005	.005	.250	240	A5HT1650	H11
5	.5	22.0	18.5	15.0	.005	.005	.250	270	A5HT2200	H11
5	.5	32.0	27.0	22.0	.005	.005	.250	320	A5HT3200	H16
6	1	.250	.250	.250	.1	.1	1	60	B6GT25	G3
6	1	.500	.500	.500	.1	.1	1	75	B6GT50	G3
6	1	.750	.750	.750	.1	.1	1	80	B6GT75	G3
6	.5	1.2	1.1	1.0	.1	.1	1	90	B6GT120	G3
6	.5	1.7	1.5	1.3	.2	.1	1.5	95	B6GT170	G3
6	.5	3.2	3.1	3.0	.3	.1	1.5	125	B6GT320	G6
6	.5	4.9	3.5	2.5	.005	.005	.250	140	A6MT490	M6
6	.5	5.5	4.5	3.5	.4	.1	1.5	145	B6GT550	G6
6	.5	6.0	4.5	3.5	.005	.005	.250	160	A6MT600	M6
6	.5	8.5	7.5	5.2	.005	.005	.250	180	A6MT850	M9
6	.5	8.8	6.9	5.0	.4	.1	1.5	180	B6GT880	G9
6	.5	10.0	8.0	7.0	.4	.1	1.5	185	B6GT1000	G13
6	.5	11.0	9.3	7.5	.005	.005	.250	200	A6MT1100	M13
6	.5	21.0	17.0	14.0	.005	.005	.250	270	A6HT2100	H11
6	.5	28.0	23.0	19.0	.005	.005	.250	320	A6HT2800	H16
7	1	.200	.200	.200	.05	.05	1	60	B7GT20	G3
7	1	.500	.500	.500	.1	.05	1	75	B7GT50	G3
7	1	.750	.750	.750	.1	.1	1	85	B7GT75	G3
7	1	1.0	1.0	1.0	.1	.1	1	90	B7GT100	G3
7	.5	2.0	2.0	2.0	.2	.1	1.5	115	B7GT200	G5
7	.5	3.0	2.7	2.5	.3	.1	1.5	125	B7GT300	G6
7	.5	5.0	4.0	3.0	.005	.005	.250	140	A7MT500	M6
7	.5	6.5	5.2	4.0	.4	.1	1.5	160	B7GT650	G9
7	.5	8.0	6.5	5.0	.005	.005	.250	180	A7MT800	M9
7	.5	10.0	8.0	7.0	.4	.1	1.5	190	B7GT1000	G13
7	.5	10.0	8.8	7.0	.005	.005	.250	200	A7MT1000	M13
8	1	.200	.200	.200	.05	.05	1	60	B8GT20	G3
8	1	.500	.500	.500	.1	.05	1	75	B8GT50	G3
8	1	.750	.750	.750	.1	.1	1	80	B8GT75	G3
8	1	1.0	1.0	1.0	.1	.1	1	90	B8GT100	G3
8	.5	2.0	2.0	2.0	.2	.1	1.5	115	B8GT200	G5
8	.5	3.0	2.7	2.5	.2	.1	1.5	125	B8GT300	G6
8	.5	5.0	4.0	3.0	.005	.005	.250	140	A8MT500	M6
8	.5	6.5	5.2	4.0	.3	.1	1.5	160	B8GT650	G9
8	.5	8.0	6.5	5.0	.005	.005	.250	180	A8MT800	M9
8	.5	10.0	8.0	7.0	.4	.1	1.5	180	B8GT1000	G13
8	.5	10.5	8.8	7.0	.005	.005	.250	200	A8MT1050	M13
8	.5	20.0	16.8	13.5	.005	.005	.250	270	A8HT2000	H11
8	.5	28.0	23.0	19.0	.005	.005	.250	320	A8HT2800	H16
9	1	.200	.200	.200	.05	.05	1	60	B9GT20	G3
9	1	.500	.500	.500	.1	.05	1	75	B9GT50	G3
9	1	.750	.750	.750	.1	.1	1	85	B9GT75	G3
9	1	1.0	1.0	1.0	.1	.1	1	90	B9GT100	G3
9	.5	2.0	2.0	2.0	.2	.1	1.5	115	B9GT200	G5
9	.5	3.0	2.7	2.5	.2	.1	1.5	125	B9GT300	G6
9	.5	6.5	5.2	4.0	.3	.1	1.5	155	B9GT650	G9
9	.5	10.0	8.3	7.0	.4	.1	1.5	190	B9GT1000	G13
9	.5	10.0	8.3	7.0	.005	.005	.250	200	A9MT1000	M13
10	1	.200	.200	.200	.05	.05	1	60	B10GT20	G3
10	1	.500	.500	.500	.1	.05	1	75	B10GT50	G3
10	1	.750	.750	.75	.1	.1	1	85	B10GT75	G3
10	1	1.0	1.0	1.0	.1	.1	1	90	B10GT100	G3

Nominal Output Voltage	Adjust ±V.	Output Current Amps. at 40°C	55°C	71°C	Regulation Load ±%*	Line ±%*	Ripple mv RMS	Price	Model	Size
10	.5	2.0	2.0	2.0	.2	.1	1.5	$115	B10GT200	G5
10	.5	3.0	2.7	2.5	.2	.1	1.5	125	B10GT300	G6
10	.5	4.5	3.6	2.7	.005	.005	.250	140	A10MT450	M6
10	.5	6.0	5.0	4.0	.3	.1	1.5	165	B10GT600	G9
10	.5	7.5	6.0	4.5	.005	.005	.250	180	A10MT750	M9
10	.5	10.0	8.3	7.0	.4	.1	1.5	180	B10GT1000	G13
10	.5	10.0	8.3	7.0	.005	.005	.250	200	A10MT1000	M13
10	.5	18.0	15.0	12.0	.005	.005	.250	270	A10HT1800	H11
10	.5	25.0	20.0	16.5	.005	.005	.250	320	A10HT2500	H16
12	1	.200	.200	.200	.05	.05	1	60	B12GT20	G3
12	1	.500	.500	.500	.1	.05	1	75	B12GT50	G3
12	1	.750	.750	.750	.1	.1	1	85	B12GT75	G3
12	1	1.0	1.0	1.0	.1	.1	1	90	B12GT100	G3
12	1	1.3	1.1	1.0	.1	.1	1	95	B12GT130	G3
12	1	1.5	1.4	1.3	.1	.1	1.5	105	B12GT150	G3
12	.5	2.0	1.7	1.5	.2	.1	1.5	110	B12GT200	G5
12	.5	3.0	2.7	2.5	.2	.1	1.5	125	B12GT300	G6
12	.5	3.8	3.3	2.6	.2	.1	1.5	130	B12GT380	G6
12	.5	4.0	3.3	2.6	.005	.005	.250	140	A12MT400	M6
12	.5	6.5	5.3	4.0	.3	.1	1.5	165	B12GT650	G9
12	.5	6.5	5.3	4.0	.005	.005	.250	180	A12MT650	M9
12	.5	9.0	7.5	6.0	.4	.1	1.5	190	B12GT900	G13
12	.5	9.0	7.5	6.0	.005	.005	.250	200	A12MT900	M13
12	.5	17.0	14.3	11.5	.005	.005	.250	270	A12HT1700	H11
12	.5	21.0	17.5	14.5	.005	.005	.250	320	A12HT2100	H16
13	1	.200	.200	.200	.05	.05	1	60	B13GT20	G3
13	1	.500	.500	.500	.1	.05	1	75	B13GT50	G3
13	1	.750	.750	.750	.1	.1	1	85	B13GT75	G3
13	1	1.0	1.0	1.0	.1	.1	1	90	B13GT100	G3
13	1	1.5	1.4	1.3	.1	.1	1.5	105	B13GT150	G3
13	.5	2.0	2.0	2.0	.2	.1	1.5	115	B13GT200	G5
13	.5	3.0	2.7	2.5	.2	.1	1.5	130	B13GT300	G6
13	.5	3.5	3.0	2.5	.005	.005	.250	140	A13MT350	M6
13	.5	5.0	4.5	4.0	.2	.1	1.5	155	B13GT500	G9
13	.5	8.0	7.5	7.0	.3	.1	1.5	185	B13GT800	G13
13	.5	8.0	7.5	7.0	.005	.005	.250	200	A13MT800	M13
14	1	.200	.200	.200	.05	.05	1	60	B14GT20	G3
14	1	.500	.500	.500	.1	.05	1	75	B14GT50	G3
14	1	.750	.750	.750	.1	.1	1	80	B14GT75	G3
14	1	1.0	1.0	1.0	.1	.1	1	90	B14GT100	G3
14	1	1.5	1.4	1.3	.1	.1	1.5	105	B14GT150	G3
14	.5	2.0	2.0	2.0	.2	.1	1.5	115	B14GT200	G5
14	.5	3.0	2.7	2.5	.2	.1	1.5	130	B14GT300	G6
14	.5	3.0	2.7	2.5	.005	.005	.250	140	A14MT300	M6
14	.5	5.0	4.5	4.0	.2	.1	1.5	155	B14GT500	G9
14	.5	7.0	6.5	6.0	.3	.1	1.5	185	B14GT700	G13
14	.5	8.0	6.7	7.0	.005	.005	.250	200	A14MT800	M13
15	1	.200	.200	.200	.05	.05	1	60	B15GT20	G3
15	1	.500	.500	.500	.1	.05	1	75	B15GT50	G3
15	1	.750	.750	.750	.1	.1	1	85	B15GT75	G3
15	1	1.0	1.0	1.0	.1	.1	1	90	B15GT100	G3
15	1	1.3	1.1	1.0	.1	.1	1	95	B15GT130	G3
15	1	1.5	1.4	1.3	.1	.1	1.5	105	B15GT150	G3
15	.5	2.0	1.7	1.5	.1	.1	1.5	115	B15GT200	G5
15	.5	3.0	2.8	2.5	.1	.1	1.5	130	B15GT300	G6
15	.5	3.0	2.8	2.5	.005	.005	.250	140	A15MT300	M6
15	.5	4.2	3.8	3.0	.15	.1	1.5	155	B15GT420	G9
15	.5	5.5	4.7	4.0	.005	.005	.250	180	A15MT550	M9
15	.5	6.0	5.0	4.0	.2	.1	1.5	180	B15GT600	G9
15	.5	7.0	6.0	5.0	.2	.1	1.5	185	B15GT700	G13
15	.5	8.0	6.5	5.5	.005	.005	.250	200	A15MT800	M13
15	.5	15.0	12.8	10.5	.005	.005	.250	270	A15HT1500	H11
15	.5	19.0	16.3	13.5	.005	.005	.250	320	A15HT1900	H16
16	1	.200	.200	.200	.05	.05	1	60	B16GT20	G3
16	1	.500	.500	.500	.1	.05	1	75	B16GT50	G3
16	1	.750	.750	.750	.1	.1	1	85	B16GT75	G3
16	.5	1.0	1.0	1.0	.1	.1	1	95	B16GT100	G3
16	.5	3.0	2.5	2.0	.15	.1	1	140	B16GT300	G9
16	.5	5.0	5.0	5.0	.2	.1	1.5	180	B16GT500	G9
16	.5	6.5	5.0	5.5	.005	.005	.250	200	A16MT650	M13
18	1	.200	.200	.200	.05	.05	1	60	B18GT20	G3
18	1	.500	.500	.500	.05	.05	1	75	B18GT50	G3
18	1	.750	.750	.750	.1	.1	1	80	B18GT75	G3
18	.5	1.1	1.1	1.0	.1	.1	1	90	B18GT110	G5
18	.5	2.1	2.0	1.8	.1	.1	1	115	B18GT210	G5
18	.5	2.1	2.1	2.0	.005	.005	.250	130	A18MT210	M6
18	.5	3.0	2.8	2.5	.15	.1	1	150	B18GT300	G9
18	.5	4.5	4.0	3.5	.005	.005	.250	170	A18MT450	M9
18	.5	5.5	5.0	5.0	.2	.1	1.5	180	B18GT550	G13
18	.5	6.5	6.0	5.5	.005	.005	.250	200	A18MT650	M13
18	.5	14.0	12.0	10.0	.005	.005	.250	270	A18HT1400	H11
18	.5	18.0	15.5	13.0	.005	.005	.250	320	A18HT1800	H16
20	1	.200	.200	.200	.05	.05	1	60	B20GT20	G3
20	1	.500	.500	.500	.05	.05	1	75	B20GT50	G3
20	1	.750	.750	.750	.1	.05	1	80	B20GT75	G3
20	1	1.1	1.1	1.0	.1	.1	1	90	B20GT110	G5
20	.5	1.7	1.7	1.5	.1	.1	1.5	105	B20GT170	G5
20	.5	2.0	2.0	2.0	.005	.005	.250	130	A20MT200	M6
20	.5	2.7	2.0	1.2	.15	.1	1.5	150	B20GT270	G6
20	.5	4.0	3.5	3.0	.005	.005	.250	170	A20MT400	M9
20	.5	5.0	5.0	5.0	.15	.1	1.5	180	B20GT500	G13
20	.5	6.0	5.5	5.0	.005	.005	.250	200	A20MT600	M13
20	.5	13.0	11.3	9.5	.005	.005	.250	270	A20HT1300	H11
20	.5	16.0	14.0	12.0	.005	.005	.250	320	A20HT1600	H16
24	1	.200	.200	.200	.05	.05	1	60	B24GT20	G3
24	1	.500	.500	.500	.05	.05	1	75	B24GT50	G3
24	1	.750	.750	.750	.1	.05	1	80	B24GT75	G3
24	1	1.1	1.1	1.0	.1	.1	1.5	95	B24GT110	G5
24	.5	1.7	1.7	1.5	.1	.1	1.5	105	B24GT170	G5

*or 2 mv, whichever is greater

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Nominal Output Voltage	Adjust ±V.	Output Current Amps. at 40°C	55°C	71°C	Regulation Load ±%*	Regulation Line ±%*	Ripple mv RMS	Price	Model	Size
24	.5	2.1	2.0	2.0	.1	.1	1.5	$115	B24GT210	G5
24	.5	2.1	2.0	2.0	.005	.005	.250	130	A24MT210	M6
24	.5	3.5	3.0	2.5	.15	.1	1.5	160	B24GT350	G9
24	.5	3.5	3.0	2.5	.005	.005	.250	175	A24MT350	M9
24	.5	5.0	5.0	5.0	.15	.1	1.5	185	B24GT500	G13
24	.5	5.5	5.0	4.5	.005	.005	.250	200	A24MT550	M13
24	.5	12.0	10.5	9.0	.005	.005	.250	270	A24HT1200	H11
24	.5	15.0	13.0	11.0	.005	.005	.250	320	A24HT1500	H16
25	1	.200	.200	.200	.05	.05	1	65	B25GT20	G3
25	1	.500	.500	.500	.05	.05	1	75	B25GT50	G3
25	1	.750	.750	.750	.1	.05	1	80	B25GT75	G3
25	1	1.2	1.1	1.0	.1	.1	1.5	95	B25GT120	G5
25	.5	1.7	1.7	1.5	.1	.1	1.5	115	B25GT170	G5
25	.5	2.1	2.1	2.0	.1	.1	1.5	125	B25GT210	G5
25	.5	3.5	3.0	2.5	.15	.1	1.5	160	B25GT350	G9
25	.5	5.0	5.0	5.0	.15	.1	1.5	185	B25GT500	G13
28	1	.100	.100	.100	.05	.05	1	65	B28GT10	G3
28	1	.200	.200	.200	.05	.05	1	70	B28GT20	G3
28	1	.500	.500	.500	.05	.05	1	75	B28GT50	G3
28	1	.800	.800	.800	.1	.05	1	95	B28GT80	G5
28	1	1.1	1.1	1.0	.1	.05	1	110	B28GT110	G5
28	.5	1.8	1.6	1.0	.1	.1	1.5	120	B28GT180	G5
28	.5	2.1	2.1	2.0	.1	.1	1.5	125	B28GT210	G5
28	.5	2.1	2.1	2.0	.005	.005	.250	135	A28MT210	M6
28	.5	3.0	2.7	2.5	.15	.1	1.5	145	B28GT300	G9
28	.5	3.0	2.7	2.5	.005	.005	.250	160	A28MT300	M9
28	.5	5.0	5.0	5.0	.15	.1	1.5	185	B28GT500	G13
28	.5	5.0	5.0	5.0	.005	.005	.250	200	A28MT500	M13
28	.5	11.0	9.5	8.0	.005	.005	.250	270	A28HT1100	H11
28	.5	14.0	12.0	10.0	.005	.005	.250	320	A28HT1400	H16
30	1	.100	.100	.100	.05	.05	1	65	B30GT10	G3
30	1	.200	.200	.200	.05	.05	1	70	B30GT20	G3
30	1	.500	.500	.500	.05	.05	1	75	B30GT50	G3
30	1	.750	.750	.700	.1	.05	1	95	B30GT75	G5
30	1	1.1	1.1	1.0	.1	.1	1	110	B30GT110	G5
30	.5	1.7	1.6	1.5	.1	.1	1.5	120	B30GT170	G5
30	.5	2.1	2.1	2.0	.1	.1	1.5	125	B30GT210	G5
30	.5	2.1	2.1	2.0	.005	.005	.250	140	A30MT210	M6
30	.5	3.0	2.7	2.5	.005	.005	.250	165	A30MT300	M9
30	.5	5.0	5.0	5.0	.15	.1	1.5	185	B30GT500	G13
30	.5	5.0	5.0	5.0	.005	.005	.250	200	A30MT500	M13
30	.5	10.0	9.0	8.0	.005	.005	.250	270	A30HT1000	H11
30	.5	14.0	12.0	10.0	.005	.005	.250	320	A30HT1400	H16
32	1	.100	.100	.100	.05	.05	1	65	B32GT10	G3
32	1	.300	.300	.300	.05	.05	1	75	B32GT30	G3
32	1	.500	.500	.500	.05	.05	1	80	B32GT50	G3
32	1	.600	.600	.600	.1	.05	1	95	B32GT60	G3
32	1	1.0	1.0	1.0	.1	.1	1	110	B32GT100	G5
32	1	1.5	1.5	1.5	.1	.1	1.5	125	B32GT150	G5
34	1	.200	.200	.200	.05	.05	1	70	B34GT20	G3
34	1	.800	.800	.800	.1	.1	1	105	B34GT80	G5
34	1	1.5	1.5	1.5	.1	.1	1.5	125	B34GT150	G5
35	1	.100	.100	.100	.05	.05	1	65	B35GT10	G3
35	1	.200	.200	.200	.05	.05	1	70	B35GT20	G3
35	1	.500	.500	.500	.05	.05	1	80	B35GT50	G3
35	1	.600	.600	.600	.1	.05	1	95	B35GT60	G3
35	1	.800	.800	.800	.1	.1	1.5	105	B35GT80	G5
36	1	.100	.100	.100	.05	.05	1	65	B36GT10	G3
36	1	.200	.100	.100	.05	.05	1	75	B36GT20	G3
36	1	.500	.500	.500	.05	.05	1	85	B36GT50	G3
36	1	.600	.600	.500	.1	.05	1	95	B36GT60	G5
36	1	.800	.750	.700	.1	.05	1	105	B36GT80	G5
36	.5	1.3	1.3	1.3	.1	.1	1.5	115	B36GT130	G6
36	.5	1.3	1.3	1.3	.005	.005	.250	130	A36MT130	M6
36	.5	2.3	2.0	1.8	.1	.1	1.5	160	B36GT230	G9
36	.5	2.3	2.0	1.8	.005	.005	.250	175	A36MT230	M9
36	.5	4.0	3.2	2.5	.005	.005	.250	210	A36MT400	M13
40	1	.100	.100	.100	.05	.05	1	65	B40GT10	G3
40	1	.200	.200	.200	.05	.05	1	75	B40GT20	G3
40	1	.300	.300	.300	.05	.05	1	85	B40GT30	G3
40	1	.400	.400	.400	.05	.05	1	90	B40GT40	G3
40	1	.500	.500	.500	.1	.05	1	100	B40GT50	G5
45	1	.100	.100	.100	.05	.05	1	65	B45GT10	G3
45	1	.200	.200	.200	.05	.05	1	75	B45GT20	G3
45	1	.300	.300	.300	.05	.05	1	85	B45GT30	G3
45	1	.400	.400	.400	.05	.05	1	100	B45GT40	G3
48	1	.100	.100	.100	.05	.05	1	70	B48GT10	G3
48	1	.200	.200	.200	.05	.05	1	80	B48GT20	G3
48	1	.300	.300	.300	.05	.05	1	95	B48GT30	G3
48	1	.400	.400	.400	.05	.05	1	105	B48GT40	G3
48	1	.600	.600	.600	.1	.1	1	120	B48GT60	G5
48	1	1.1	1.0	.600	.1	.1	1.5	135	B48GT110	G6
48	1	1.8	1.6	1.2	.1	.1	1.5	165	B48GT180	G9
48	1	1.8	1.6	1.2	.005	.005	.250	180	A48MT180	M9
48	.5	3.0	2.6	2.1	.005	.005	.250	210	A48MT300	M13
50	1	.100	.100	.100	.05	.05	1	65	B50GT10	G3
50	1	.200	.200	.200	.05	.05	1	75	B50GT20	G3
50	1	.300	.300	.300	.05	.05	1	95	B50GT30	G3
50	1	.400	.400	.400	.05	.05	1	105	B50GT40	G3
50	1	.500	.500	.500	.05	.05	1	130	B50GT50	G5
50	.5	2.7	2.3	1.8	.005	.005	.250	220	A50MT270	M13
55	1	.100	.100	.100	.05	.05	1	75	B55GT10	G3
55	1	.200	.200	.200	.05	.05	1	95	B55GT20	G3
55	1	.300	.300	.300	.05	.05	1	105	B55GT30	G3
55	1	.400	.400	.400	.05	.05	1	125	B55GT40	G5
55	1	.500	.500	.500	.05	.05	1	130	B55GT50	G5
60	1	.050	.050	.050	.05	.05	1	75	B60GT05	G3
60	1	.100	.100	.100	.05	.05	1	85	B60GT10	G3
60	1	.200	.200	.200	.05	.05	1	95	B60GT20	G3
60	1	.300	.300	.300	.05	.05	1	$125	B60GT30	G3
60	1	.400	.400	.400	.05	.05	1	130	B60GT40	G5
65	1	.050	.050	.050	.05	.05	1	75	B65GT05	G3
65	1	.100	.100	.100	.05	.05	1	85	B65GT10	G3
65	1	.300	.300	.300	.05	.05	1	125	B65GT30	G3
67	1	.050	.050	.050	.05	.05	1	75	B67GT05	G3
67	1	.100	.100	.100	.05	.05	1	85	B67GT10	G3
67	1	.300	.300	.300	.05	.05	1	125	B67GT30	G3
70	1	.050	.050	.050	.05	.05	1	75	B70GT05	G3
70	1	.100	.100	.100	.05	.05	1	85	B70GT10	G3
70	1	.200	.200	.200	.05	.05	1	95	B70GT20	G3
70	1	.300	.300	.300	.05	.05	1	125	B70GT30	G3
75	1	.050	.050	.050	.05	.05	1	85	B75GT05	G3
75	1	.100	.100	.100	.05	.05	1	95	B75GT10	G3
75	1	.200	.200	.200	.05	.05	1	125	B75GT20	G3
75	.5	2.0	1.3	1.5	.005	.005	.250	220	A75MT200	M13
80	1	.050	.050	.050	.05	.05	1	85	B80GT05	G3
80	1	.100	.100	.100	.05	.05	1	95	B80GT10	G3
80	1	.200	.200	.200	.05	.05	1	125	B80GT20	G3
85	1	.050	.050	.050	.05	.05	1	90	B85GT05	G3
85	1	.100	.100	.100	.05	.05	1	115	B85GT10	G3
85	1	.200	.200	.200	.05	.05	1	125	B85GT20	G3
90	1	.050	.050	.050	.05	.05	1	95	B90GT05	G3
90	1	.100	.100	.100	.05	.05	1	120	B90GT10	G3
90	1	.200	.200	.200	.05	.05	1	130	B90GT20	G3
90	1	1.5	1.3	1.0	.005	.005	.250	220	A90MT150	M13
95	1	.050	.050	.050	.05	.05	1	110	B95GT05	G3
95	1	.100	.100	.100	.05	.05	1	120	B95GT10	G3
95	1	.200	.200	.200	.05	.05	1	130	B95GT20	G3
100	1	.050	.050	.050	.05	.05	1	110	B100GT05	G3
100	1	.100	.100	.100	.05	.05	1	120	B100GT10	G3
100	1	.200	.200	.200	.05	.05	1	130	B100GT20	G3
100	1	.460	.460	.340	.1	.1	1.5	130	B100GT46	G6
100	1	.650	.650	.650	.1	.1	1.5	160	B100GT65	G9
100	1	1.3	1.2	1.0	.005	.005	.250	220	A100MT130	M13
105	1	.050	.050	.050	.05	.05	1	115	B105GT05	G3
105	1	.100	.100	.100	.05	.05	1	125	B105GT10	G3
105	1	.200	.200	.200	.05	.05	1	135	B105GT20	G3
110	1	.050	.050	.050	.05	.05	1	115	B110GT05	G3
110	1	.100	.100	.100	.05	.05	1	125	B110GT10	G3
110	1	.200	.200	.200	.05	.05	1	135	B110GT20	G3
115	1	.050	.050	.050	.05	.05	1	115	B115GT05	G3
115	1	.100	.100	.100	.05	.05	1	125	B115GT10	G3
115	1	.200	.200	.200	.05	.05	1	135	B115GT20	G3
120	1	.050	.050	.050	.05	.05	1	115	B120GT05	G3
120	1	.100	.100	.100	.05	.05	1	125	B120GT10	G3
120	1	.200	.200	.200	.05	.05	1	135	B120GT20	G3
120	1	.400	.400	.300	.1	.1	1.5	150	B120GT40	G6
120	1	.550	.550	.550	.1	.1	1.5	160	B120GT55	G9
120	1	1.2	1.1	1.0	.005	.005	.250	220	A120MT120	M13
125	1	.050	.050	.050	.05	.05	1	120	B125GT05	G3
125	1	.100	.100	.100	.05	.05	1	130	B125GT10	G3
125	1	.200	.200	.200	.05	.05	1	140	B125GT20	G3
130	1	.200	.200	.200	.05	.05	1	140	B130GT20	G3
135	1	.200	.200	.200	.05	.05	1	140	B135GT20	G3
140	1	.200	.200	.200	.05	.05	1	140	B140GT20	G3
150	1	.050	.050	.050	.05	.05	1	120	B150GT05	G3
150	1	.100	.100	.100	.05	.05	1	130	B150GT10	G3
150	1	.200	.200	.200	.05	.05	1	140	B150GT20	G3
150	1	.320	.320	.250	.1	.1	1.5	140	B150GT32	G6
150	1	.420	.420	.420	.1	.1	1.5	160	B150GT42	G9
150	1	1.0	.900	.800	.005	.005	.250	240	A150MT100	M13
200	1	.050	.050	.050	.5	.5	5	125	B200GT05	G3
200	1	.100	.100	.100	.5	.5	5	135	B200GT10	G3

*or 2 mv, whichever is greater

MODELS WITH WIDE ADJUSTMENT RANGES

Load Regulation: ±0.005%*

Line Regulation: ±0.005%*

Ripple: 0.250 mv RMS

Other Specifications:
Same as Series A

Contact factory for information on other models with wide adjustment ranges.

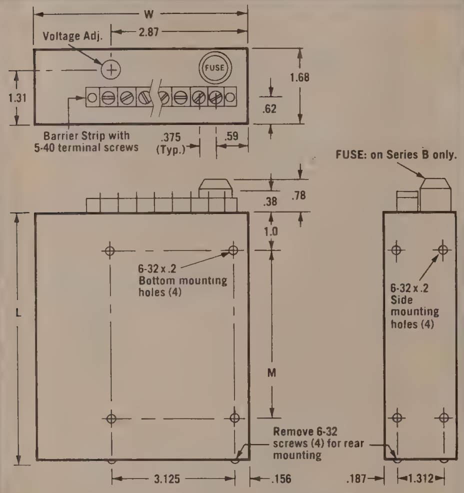
Output Voltage Range	Output Current Amps. at 40°C	55°C	71°C	Price	Model	Size
0-6	1.2	1.2	1.2	$110	A06MT120	M6
0-6	2.0	2.0	2.0	125	A06MT200	M6
0-6	3.0	2.5	2.0	150	A06MT300	M6
0-6	5.0	4.0	3.0	170	A06MT500	M9
0-6	8.0	7.0	6.0	205	A06MT800	M13
0-6	12.0	10.0	7.0	275	A06HT1200	H11
0-6	16.0	13.0	10.0	325	A06HT1600	H16
0-15	1.0	1.0	1.0	110	A015MT100	M6
0-15	2.0	2.0	2.0	150	A015MT200	M6
0-15	2.5	2.0	1.5	170	A015MT250	M9
0-15	5.0	4.0	2.5	205	A015MT500	M13
0-15	8.0	6.0	4.0	275	A015HT800	H11
0-15	10.0	8.0	6.0	325	A015HT1000	H16
0-30	.500	.500	.500	125	A030MT50	M6
0-30	1.0	1.0	1.0	150	A030MT100	M6
0-30	1.6	1.4	1.2	170	A030MT160	M9
0-30	2.5	2.0	1.5	205	A030MT250	M13
0-30	4.0	3.0	2.0	275	A030HT400	H11
0-30	5.0	4.0	3.0	325	A030HT500	H16
0-50	.350	.340	.330	125	A050MT35	M6
0-50	.600	.500	.400	150	A050MT60	M6
0-50	.850	.750	.650	170	A050MT85	M9
0-100	.100	.090	.080	160	A0100MT10	M6
0-100	.250	.200	.150	180	A0100MT25	M6

Acopian

Acopian
MODEL
FUSE
+OUT−
AC
AC
GND
Acopian
V. ADJ.
MODEL
OUT
SENS
OUT
AC
AC
GND

NARROW PROFILE REGULATED

Where only a narrow mounting space is available, Acopian narrow profile power supplies fit when many others cannot. Choose from Series A (high performance) and Series B (lower priced) models with output ratings up to 150 volts, up to 4 amps.


W
Voltage Adj.
2.87
FUSE
1.68
1.31
.62
Barrier Strip with 5-40 terminal screws
.375 (Typ.)
.59
FUSE: on Series B only.
.38
.78
1.0
6-32 x .2 Bottom mounting holes (4)
6-32 x .2 Side mounting holes (4)
L
M
Remove 6-32 screws (4) for rear mounting
3.125
.156
.187
1.312

Size	L	W	M	Approx. Weight
F6	6.59	3.44	4.0	2lb 4oz
F6T	6.59	3.81	4.0	2lb 4oz
N8	8.47	3.44	5.0	3lb
F8T	8.47	3.81	5.0	3lb 2oz
N8T	8.47	3.81	5.0	3lb 2oz
N8H	8.47	4.68	5.0	3lb 14oz

SPECIFICATIONS

Input Voltage: 105–125 VAC, 50–400 Hz, single phase.

Output Specifications: See table. Series A supplies have model numbers beginning with the letter A; Series B, with the letter B.

Remote Voltage Adjustment/Sensing: Standard in Series A, not available in Series B.

Polarity: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Ambient Operating Temperature: Series A, −20 to +71°C; Series B, 0 to 71°C.

Storage Temperature: −55 to +85°C.

Short Circuit and Overload Protection: Series A, electronic current limiting with automatic recovery; Series B, fused — delivers current surges without damage.

OPTIONS

Overvoltage Protection: An internal preset overvoltage protector is available on all models up to 70 V. To order, add prefix "V" to the model number and add $25.00 to the standard price of models with output voltages of 3 to 28 V, $35.00 to the price of models with output voltages from 30 to 70 V.

230 Volt Input: Available on some models. Contact factory for information.

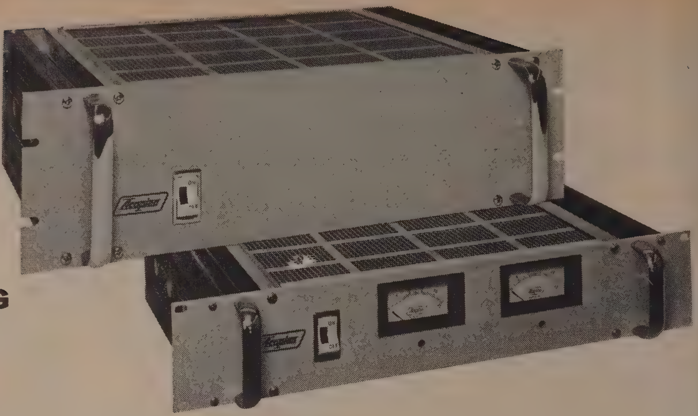
MODELS WITH WIDE ADJUSTMENT RANGES

Output Voltage Range	Output Current (To +71°C)	Regulation		Ripple mv RMS	Price	Model	Size
		Load ±%*	Line ±%*				
0-7	1.0	0.005	0.005	0.250	$100	A07NT100	N8
0-7	2.1	0.005	0.005	0.250	135	A07NT210	N8H
0-18	.400	0.005	0.005	0.250	90	A018NT40	N8
0-18	1.0	0.005	0.005	0.250	120	A018NT100	N8H
0-32	.250	0.005	0.005	0.250	90	A032NT25	N8
0-32	.600	0.005	0.005	0.250	130	A032NT60	N8H
0-60	.125	0.005	0.005	0.250	130	A060NT12	N8T
0-60	.250	0.005	0.005	0.250	150	A060NT25	N8H
0-150	.050	0.005	0.005	0.250	145	A0150NT05	N8T
0-150	.100	0.005	0.005	0.250	165	A0150NT10	N8H

Nominal Output Voltage	Ad-just ±V.	Output Current Amps. at			Regulation		Ripple mv RMS	Price	Model	Size
		40°C	55°C	71°C	Load ±%*	Line ±%*				
1	.5	1.1	1.0	1.0	.005	.005	.250	$ 95	A1NT110	N8
1	.5	2.2	2.1	2.0	.005	.005	.250	125	A1NT220	N8T
1	.5	4.0	3.5	3.0	.005	.005	.250	150	A1NT400	N8H
1.5	.5	1.1	1.0	1.0	.005	.005	.250	95	A1.5NT110	N8
1.5	.5	2.2	2.1	2.0	.005	.005	.250	125	A1.5NT220	N8T
1.5	.5	4.0	3.5	3.0	.005	.005	.250	150	A1.5NT400	N8H
2	.5	1.1	1.0	1.0	.005	.005	.250	95	A2NT110	N8
2	.5	2.2	2.1	2.0	.005	.005	.250	125	A2NT220	N8T
2	.5	3.5	3.3	3.0	.005	.005	.250	150	A2NT350	N8H
3	.5	.500	.500	.500	.5	.05	1	80	B3FT50	F6
3	.5	1.0	1.0	1.0	.5	.1	1	85	B3FT100	F6
3	.5	1.1	1.0	1.0	.005	.005	.250	95	A3NT110	N8
3	.5	2.2	2.1	2.0	.005	.005	.250	125	A3NT220	N8T
3	.5	4.0	3.5	3.0	.005	.005	.250	150	A3NT400	N8H
3.6	.5	.500	.500	.500	.5	.05	1	80	B3.6FT50	F6
3.6	.5	1.0	1.0	1.0	.5	.1	1	85	B3.6FT100	F6
3.6	.5	1.1	1.0	1.0	.005	.005	.250	95	A3.6NT110	N8
3.6	.5	2.2	2.1	2.0	.005	.005	.250	125	A3.6NT220	N8T
3.6	.5	4.0	3.5	3.0	.005	.005	.250	150	A3.6NT400	N8H
5	.5	.500	.500	.500	.1	.1	1	80	B5FT50	F6
5	.5	1.0		1.0	.1	.1	1	85	B5FT100	F6
5	.5	1.1	1.0	1.0	.005	.005	.250	95	A5NT110	N8
5	.5	2.2	2.1	2.0	.005	.005	.250	125	A5NT220	N8T
5	.5	4.0	3.5	3.0	.005	.005	.250	150	A5NT400	N8H
6	1	.500	.500	.500	.1	.1	1	80	B6FT50	F6
6	.5	1.0	1.0	1.0	.1	.1	1	85	B6FT100	F6
6	.5	1.1	1.0	1.0	.005	.005	.250	95	A6NT110	N8
6	.5	2.2	2.1	2.0	.005	.005	.250	125	A6NT220	N8T
6	.5	3.0	3.0	3.0	.005	.005	.250	150	A6NT300	N8H
7	1	.500	.500	.500	.1	.1	1	80	B7FT50	F6
7	1	1.0	1.0	1.0	.1	.1	1	90	B7FT100	F6
7	.5	1.1	1.0	1.0	.005	.005	.250	100	A7NT110	N8
7	.5	2.0	2.0	2.0	.005	.005	.250	130	A7NT200	N8H
8	1	.500	.500	.500	.1	.1	1	80	B8FT50	F6
8	1	1.0	1.0	1.0	.1	.1	1	90	B8FT100	F6
8	.5	1.1	1.0	1.0	.005	.005	.250	100	A8NT110	N8
8	.5	2.0	2.0	2.0	.005	.005	.250	135	A8NT200	N8H
9	1	.500	.500	.500	.1	.1	1	85	B9FT50	F6
9	1	1.0	1.0	1.0	.1	.1	1	95	B9FT100	F6
9	.5	1.1	1.0	1.0	.005	.005	.250	105	A9NT110	N8
9	.5	2.0	2.0	2.0	.005	.005	.250	135	A9NT200	N8H
10	1	.500	.500	.500	.1	.1	1	85	B10FT50	F6
10	1	1.0	1.0	1.0	.1	.1	1	95	B10FT100	F6
10	.5	1.1	1.0	1.0	.005	.005	.250	105	A10NT110	N8
10	.5	2.0	2.0	2.0	.005	.005	.250	135	A10NT200	N8H
11	1	.500	.500	.500	.1	.1	1	85	B11FT50	F6
11	1	1.0	1.0	.750	.1	.1	1	95	B11FT100	F6
11	.5	1.1	1.0	1.0	.005	.005	.250	105	A11NT110	N8
11	.5	2.0	2.0	2.0	.005	.005	.250	135	A11NT200	N8H
12	1	.500	.500	.500	.1	.1	1	85	B12FT50	F6
12	1	1.0	1.0	.750	.1	.1	1	95	B12FT100	F6
12	.5	1.1	1.0	1.0	.005	.005	.250	105	A12NT110	N8
12	.5	2.0	2.0	2.0	.005	.005	.250	135	A12NT200	N8H
13	1	.500	.500	.500	.1	.1	1	85	B13FT50	F6
13	1	1.0	1.0	.750	.1	.1	1	95	B13FT100	F6
13	.5	1.1	1.0	1.0	.005	.005	.250	105	A13NT110	N8
13	.5	2.0	2.0	2.0	.005	.005	.250	135	A13NT200	N8H
14	1	.500	.500	.500	.1	.1	1	85	B14FT50	F6
14	1	1.0	1.0	.750	.1	.1	1	95	B14FT100	F6
14	.5	1.1	1.0	1.0	.005	.005	.250	105	A14NT110	N8
14	.5	2.0	2.0	2.1	.005	.005	.250	135	A14NT200	N8H
15	1	.500	.500	.500	.1	.1	1	85	B15FT50	F6
15	1	1.0	1.0	.750	.1	.1	1	95	B15FT100	F6
15	.5	1.1	1.0	1.0	.005	.005	.250	105	A15NT110	N8
15	.5	2.0	2.0	2.0	.005	.005	.250	135	A15NT200	N8H
16	1	.500	.500	.500	.1	.1	1	85	B16FT50	F6
16	1	1.0	1.0	.750	.1	.1	1	95	B16FT100	F6
16	.5	1.0	1.0	1.0	.005	.005	.250	110	A16NT100	N8
16	.5	1.75	1.75	1.75	.005	.005	.250	135	A16NT175	N8H
18	1	.500	.500	.500	.1	.1	1	85	B18FT50	F6
18	1	.750	.750	.750	.1	.1	1	95	B18FT75	F6
18	.5	1.0	1.0	1.0	.005	.005	.250	115	A18NT100	N8
18	.5	1.5	1.5	1.5	.005	.005	.250	130	A18NT150	N8H
20	1	.400	.400	.400	.05	.05	1	85	B20FT40	F6
20	1	.750	.750	.750	.1	.1	1	95	B20FT75	F6
20	.5	.900	.900	.900	.005	.005	.250	110	A20NT90	N8
20	.5	1.25	1.25	1.25	.005	.005	.250	130	A20NT125	N8H
24	1	.200	.200	.200	.05	.05	1	75	B24FT20	F6
24	1	.400	.400	.400	.05	.05	1	85	B24FT40	F6
24	1	.750	.750	.750	.1	.1	1	95	B24FT75	F6
24	.5	.900	.800	.750	.005	.005	.250	110	A24NT90	N8
24	.5	1.0	1.0	1.0	.005	.005	.250	120	A24NT100	N8
24	.5	1.25	1.25	1.25	.005	.005	.250	130	A24NT125	N8H
25	1	.200	.200	.200	.05	.05	1	75	B25FT20	F6
25	1	.400	.400	.400	.05	.05	1	85	B25FT40	F6
25	1	.750	.750	.750	.1	.05	1	95	B25FT75	F6
25	.5	.750	.750	.750	.005	.005	.250	120	A25NT75	N8
25	.5	1.25	1.25	1.25	.005	.005	.250	130	A25NT125	N8H
26	1	.200	.200	.200	.05	.05	1	75	B26FT20	F6
26	1	.400	.400	.400	.05	.05	1	85	B26FT40	F6
26	1	.750	.750	.750	.1	.05	1	95	B26FT75	F6
26	.5	1.25	1.25	1.25	.005	.005	.250	130	A26NT125	N8H
28	1	.200	.200	.200	.05	.05	1	75	B28FT20	F6
28	1	.400	.400	.400	.05	.05	1	85	B28FT40	F6
28	1	.700	.700	.700	.1	.05	1	95	B28FT70	F6
28	.5	.800	.800	.800	.005	.005	.250	120	A28NT80	N8T
28	.5	1.25	1.25	1.25	.005	.005	.250	130	A28NT125	N8H
30	1	.200	.200	.200	.05	.05	1	75	B30FT20	F6
30	1	.400	.400	.400	.05	.05	1	85	B30FT40	F6
30	1	.500	.500	.500	.05	.05	1	95	B30FT50	F6
30	.5	.750	.750	.750	.005	.005	.250	125	A30NT75	N8T
30	.5	1.1	1.1	1.1	.005	.005	.250	135	A30NT110	N8H
32	1	.100	.100	.100	.05	.05	1	75	B32FT10	F6
32	1	.200	.200	.200	.05	.05	1	85	B32FT20	F6
32	1	.400	.400	.400	.05	.05	1	95	B32FT40	F6
32	.5	.600	.600	.600	.005	.005	.250	125	A32NT60	N8
32	.5	1.1	1.1	1.1	.005	.005	.250	$135	A32NT110	N8H
34	1	.100	.100	.100	.05	.05	1	75	B34FT10	F6
34	1	.200	.200	.200	.05	.05	1	85	B34FT20	F6
34	1	.400	.400	.400	.05	.05	1	95	B34FT40	F6
34	.5	.600	.600	.600	.005	.005	.250	125	A34NT60	N8
34	.5	1.1	1.1	1.1	.005	.005	.250	135	A34NT110	N8H
35	1	.100	.100	.100	.05	.05	1	75	B35FT10	F6
35	1	.200	.200	.200	.05	.05	1	85	B35FT20	F6
35	1	.400	.400	.400	.05	.05	1	95	B35FT40	F6
35	.5	.600	.600	.600	.005	.005	.250	125	A35NT60	N8
35	.5	1.1	1.1	1.1	.005	.005	.250	135	A35NT110	N8H
36	1	.100	.100	.100	.05	.05	1	75	B36FT10	F6
36	1	.200	.200	.200	.05	.05	1	85	B36FT20	F6
36	1	.400	.400	.400	.05	.05	1	95	B36FT40	F6
36	.5	.600	.600	.600	.005	.005	.250	125	A36NT60	N8
36	.5	1.0	1.0	1.0	.005	.005	.250	135	A36NT100	N8H
38	1	.100	.100	.100	.05	.05	1	75	B38FT10	F6
38	1	.200	.200	.200	.05	.05	1	85	B38FT20	F6
40	1	.100	.100	.100	.05	.05	1	75	B40FT10	F6
40	1	.200	.200	.200	.05	.05	1	90	B40FT20	F6
40	1	.400	.400	.400	.05	.05	1	100	B40FT40	F6
40	.5	.600	.600	.600	.005	.005	.250	125	A40NT60	N8
40	.5	.750	.750	.750	.005	.005	.250	135	A40NT75	N8T
45	1	.100	.100	.100	.05	.05	1	75	B45FT10	F6
45	1	.200	.200	.200	.05	.05	1	90	B45FT20	F6
45	1	.400	.400	.400	.05	.05	1	100	B45FT40	F6
45	.5	.600	.600	.600	.005	.005	.250	135	A45NT60	N8T
48	1	.050	.050	.050	.05	.05	1	80	B48FT05	F6
48	1	.100	.100	.100	.05	.05	1	90	B48FT10	F6
48	1	.200	.200	.200	.05	.05	1	100	B48FT20	F6
48	1	.400	.400	.400	.05	.05	1	110	B48FT40	F6
48	.5	.500	.500	.500	.005	.005	.250	135	A48NT50	N8T
50	1	.050	.050	.050	.05	.05	1	80	B50FT05	F6T
50	1	.100	.050	.100	.05	.05	1	90	B50FT10	F6T
50	1	.200	.050	.200	.05	.05	1	100	B50FT20	F6T
50	1	.400	.400	.400	.05	.05	1	110	B50FT40	F6T
50	1	.450	.450	.450	.005	.005	.250	135	A50NT45	N8T
55	1	.050	.050	.050	.05	.05	1	80	B55FT05	F6T
55	1	.100	.100	.100	.05	.05	1	90	B55FT10	F6T
55	1	.200	.200	.200	.05	.05	1	100	B55FT20	F6T
55	1	.400	.400	.400	.005	.005	.250	140	A55NT40	N8T
60	1	.050	.050	.050	.05	.05	1	80	B60FT05	F6T
60	1	.100	.100	.100	.05	.05	1	90	B60FT10	F6T
60	1	.150	.150	.150	.05	.05	1	100	B60FT15	F6T
60	1	.300	.300	.300	.05	.05	1	125	B60FT30	F8T
60	1	.350	.350	.350	.005	.005	.250	145	A60NT35	N8T
65	1	.050	.050	.050	.05	.05	1	80	B65FT05	F6T
65	1	.100	.100	.100	.05	.05	1	90	B65FT10	F6T
65	1	.250	.250	.250	.05	.05	1	125	B65FT25	F8T
65	1	.270	.270	.270	.005	.005	.250	145	A65NT27	N8T
67	1	.050	.050	.050	.05	.05	1	80	B67FT05	F6T
67	1	.100	.100	.100	.05	.05	1	90	B67FT10	F6T
70	1	.050	.050	.050	.05	.05	1	80	B70FT05	F6T
70	1	.100	.100	.100	.05	.05	1	95	B70FT10	F6T
70	1	.200	.200	.200	.05	.05	1	105	B70FT20	F8T
70	1	.250	.250	.250	.005	.005	.250	145	A70NT25	N8T
75	1	.050	.050	.050	.05	.05	1	90	B75FT05	F6T
75	1	.100	.100	.100	.05	.05	1	100	B75FT10	F6T
75	1	.200	.200	.200	.05	.05	1	125	B75FT20	F8T
75	1	.250	.250	.250	.005	.005	.250	145	A75NT25	N8T
80	1	.050	.050	.050	.05	.05	1	90	B80FT05	F6T
80	1	.100	.100	.100	.05	.05	1	100	B80FT10	F6T
80	1	.200	.200	.200	.05	.05	1	125	B80FT20	F8T
80	1	.250	.250	.250	.005	.005	.250	155	A80NT25	N8T
85	1	.050	.050	.050	.05	.05	1	100	B85FT05	F6T
85	1	.100	.100	.100	.05	.05	1	125	B85FT10	F6T
85	1	.200	.200	.200	.05	.05	1	125	B85FT20	F8T
85	1	.250	.250	.250	.005	.005	.250	155	A85NT25	N8T
90	1	.050	.050	.050	.05	.05	1	100	B90FT05	F6T
90	1	.100	.100	.100	.05	.05	1	125	B90FT10	F6T
90	1	.200	.200	.200	.05	.05	1	135	B90FT20	F8T
90	1	.250	.250	.250	.005	.005	.250	155	A90NT25	N8T
95	1	.050	.050	.050	.05	.05	1	115	B95FT05	F6T
95	1	.100	.100	.100	.05	.05	1	125	B95FT10	F6T
95	1	.200	.200	.200	.05	.05	1	135	B95FT20	F8T
95	1	.200	.200	.200	.005	.005	.250	155	A95NT20	N8T
100	1	.020	.020	.020	.05	.05	1	105	B100FT02	F6T
100	1	.050	.050	.050	.05	.05	1	115	B100FT05	F6T
100	1	.100	.100	.100	.05	.05	1	130	B100FT10	F6T
100	1	.200	.200	.200	.05	.05	1	145	B100FT20	F8T
100	1	.200	.200	.200	.005	.005	.250	155	A100NT20	N8T
105	1	.050	.050	.050	.05	.05	1	115	B105FT05	F6T
105	1	.100	.100	.100	.05	.05	1	130	B105FT10	F6T
105	1	.200	.200	.200	.05	.05	1	145	B105FT20	F8T
105	1	.200	.200	.200	.005	.005	.250	155	A105NT20	N8T
110	1	.050	.050	.050	.05	.05	1	120	B110FT05	F6T
110	1	.100	.100	.100	.05	.05	1	135	B110FT10	F6T
110	1	.200	.200	.200	.05	.05	1	145	B110FT20	F8T
110	1	.200	.200	.200	.005	.005	.250	155	A110NT20	N8T
115	1	.050	.050	.050	.05	.05	1	125	B115FT05	F6T
115	1	.100	.100	.100	.05	.05	1	135	B115FT10	F6T
115	1	.200	.200	.200	.05	.05	1	145	B115FT20	F8T
115	1	.200	.200	.200	.005	.005	.250	155	A115NT20	N8T
120	1	.050	.050	.050	.05	.05	1	130	B120FT05	F6T
120	1	.200	.200	.200	.05	.05	1	145	B120FT20	F8T
120	1	.200	.200	.200	.005	.005	.250	160	A120NT20	N8T
125	1	.050	.050	.050	.05	.05	1	130	B125FT05	F6T
125	1	.200	.200	.200	.05	.05	1	150	B125FT20	F8T
125	1	.200	.200	.200	.005	.005	.250	160	A125NT20	N8T
130	1	.150	.150	.150	.05	.05	1	140	B130FT15	F8T
130	1	.170	.170	.170	.005	.005	.250	160	A130NT17	N8T
135	1	.150	.150	.150	.005	.005	.250	160	A135NT15	N8T
140	1	.130	.130	.130	.005	.005	.250	160	A140NT13	N8T
150	1	.100	.100	.100	.05	.05	1	140	B150FT10	F8T
150	1	.100	.100	.100	.005	.005	.250	160	A150NT10	N8T

*or 2 mv, whichever is greater

Acopian



RACK MOUNTING

Up to 50 Volts

Up to 60 Amps

Acopian rack-mounting power supplies feature excellent regulation and ripple specifications in 76 models with outputs up to 50 volts and 60 amps. Metering and overvoltage protection are available as options. These power supplies are constructed in sturdy extruded aluminum assemblies designed expressly for mounting in standard 19″ wide RETMA cabinet racks. The front panels are finished in light gray enamel; sides are black; the remaining casework is finished in gold alodyne.

STANDARD FEATURES

- Excellent line and load regulation, low noise
- Convection cooled
- Silicon semiconductors for maximum reliability
- Short circuit proof
- Attractively finished in light gray enamel and gold alodyne

SPECIFICATIONS

Input Voltage: 105–125 VAC, 50–400 Hz, single phase.

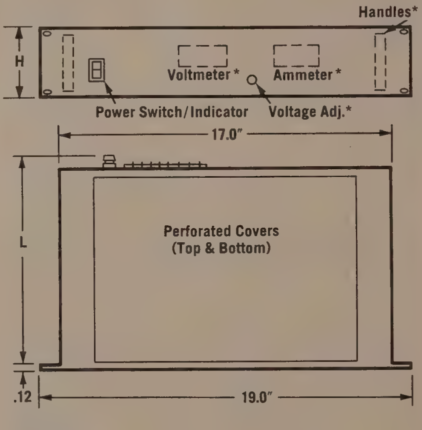
Output Voltage/Current:
Line Regulation:
Load Regulation:
Ripple:
Output Voltage Adjustment Range:
} See table.

Polarity: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Storage Temperature: −55 to +85°C.

Ambient Operating Temperature: −20 to +55°C.

Protection: Short circuit. Overvoltage protection optional; see "Options."



*Optional

Size	H	L	Approx. Weight
3P11	3½	11.0	22lb
5P12	5¼	12.0	28lb
5P17	5¼	17.0	43lb

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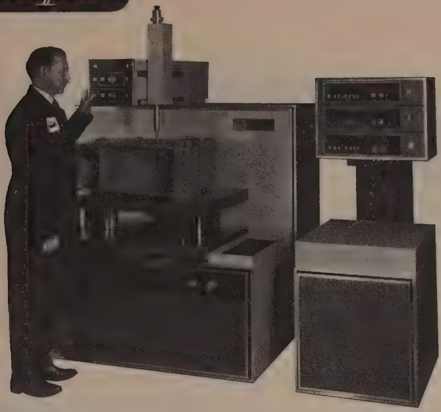
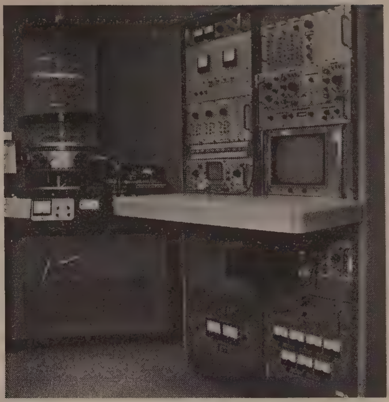


The Bendix Corp. eliminated the coupling of AC into the low level circuitry of this Cordax three-axis measurement system by using Acopian DC-output supplies for powering electromechanical components.



Sandia Laboratories uses Acopian power supplies in test equipment. Shown above is a Sandia electron beam nondestructive dielectric strength tester which is used to evaluate ceramic materials.

OPTIONS

Overvoltage Protection: An internally installed and preset overvoltage protector is available for all models. To order, add the prefix "V" to the model number and $25.00 to the price of models with an output current rating of 20 amps or less (at 40°C); add $75.00 to the price of higher current models.

Front Panel Voltage Adjustment: Standard models have a voltage adjustment located at the rear. A voltage control mounted on the front panel is available as an option. To order, add suffix "P" to the model number and $5.00 to price.

Voltmeter: Add suffix "F" to model number and $15.00 to price.

Ammeter: Add suffix "A" to model number and $15.00 to price.

230 Volt Input: Add suffix "-230" to model number and $10.00 to price.

Handles: Add suffix "H" to model number and $10.00 to price.

EXAMPLE: The Model 5PT20 equipped with all options is designated as the Model V5PT20AFHP-230. (List suffix letters in alphabetical sequence.)

Nominal Output Voltage	Adjust Range ±V	Output Current Amps.		Regulation		Ripple mv RMS	Price	Model	Size
		40°C	55°C	Load* ±%	Line* ±%				
1.5	.5	20	20	.005	.005	.25	$280	1.5PT20	3P11
1.5	.5	32	27	.005	.005	.25	330	1.5PT32	5P12
1.5	.25	60	47	.05	.05	1	525	1.5PT60	5P17
3	.5	20	20	.005	.005	.25	280	3PT20	3P11
3	.5	30	25	.005	.005	.25	330	3PT30	5P12
3	.25	60	47	.05	.05	1	525	3PT60	5P17
3.6	.5	20	20	.005	.005	.25	280	3.6PT20	3P11
3.6	.5	32	27	.005	.005	.25	330	3.6PT32	5P12
3.6	.25	60	47	.05	.05	1	525	3.6PT60	5P17
4	.25	60	47	.05	.05	1	525	4PT60	5P17
5	.5	20	20	.005	.005	.25	280	5PT20	3P11
5	.5	32	27	.005	.005	.25	330	5PT32	5P12
5	.25	60	47	.05	.05	1	525	5PT60	5P17
6	.5	20	20	.005	.005	.25	280	6PT20	3P11
6	.5	28	23	.005	.005	.25	330	6PT28	5P12
6	.25	58	45	.05	.05	1	525	6PT58	5P17
7	.5	20	20	.005	.005	.25	280	7PT20	3P11
8	.5	20	20	.005	.005	.25	280	8PT20	3P11
8	.5	28	23	.005	.005	.25	330	8PT28	5P12
8	.25	54	42	.05	.05	1	525	8PT54	5P17
9	.5	20	20	.005	.005	.25	330	9PT20	3P11
9	.5	52	41	.05	.05	1	550	9PT52	5P17
10	.5	20	20	.005	.005	.25	330	10PT20	3P11
10	.5	25	20	.005	.005	.25	350	10PT25	5P12
10	.5	50	39	.05	.05	1	550	10PT50	5P17
11	.5	20	20	.005	.005	.25	330	11PT20	3P11
12	.5	20	20	.005	.005	.25	330	12PT20	5P12
12	.5	45	35	.05	.05	1	550	12PT45	5P17
13	.5	16	16	.005	.005	.25	330	13PT16	3P11
13	.5	43	34	.05	.05	1	550	13PT43	5P17
14	.5	12	12	.005	.005	.25	280	14PT12	3P11
15	.5	10	10	.005	.005	.25	280	15PT10	3P11
15	.5	19	16	.005	.005	.25	330	15PT19	5P12
15	.5	40	31	.05	.05	1	590	15PT40	5P17
16	.5	10	10	.005	.005	.25	280	16PT10	3P11
18	.5	10	10	.005	.005	.25	280	18PT10	3P11
18	.5	18	15	.005	.005	.25	330	18PT18	5P12
18	.5	36	28	.05	.05	1	590	18PT36	5P17

Nominal Output Voltage	Adjust Range ±V	Output Current Amps.		Regulation		Ripple mv RMS	Price	Model	Size
		40°C	55°C	Load* ±%	Line* ±%				
20	.5	10	10	.005	.005	.25	$280	20PT10	3P11
20	.5	16	14	.005	.005	.25	330	20PT16	5P12
20	.5	32	25	.05	.05	1	590	20PT32	5P17
22	.5	10	10	.005	.005	.25	280	20PT10	3P11
24	.5	10	10	.005	.005	.25	280	24PT10	3P11
24	.5	15	13	.005	.005	.25	330	24PT15	5P12
24	.5	30	23	.05	.05	1	590	24PT30	5P17
25	.5	10	10	.005	.005	.25	280	25PT10	3P11
26	.5	10	10	.005	.005	.25	280	26PT10	3P11
28	.5	10	10	.005	.005	.25	280	28PT10	3P11
28	.5	14	12	.005	.005	.25	330	28PT14	5P12
28	.5	28	22	.05	.05	1	590	28PT28	5P17
30	.5	10	10	.005	.005	.25	330	30PT10	3P11
30	.5	14	12	.005	.005	.25	350	30PT14	5P12
32	.5	5	5	.005	.005	.25	230	32PT5	3P11
32	.5	10	10	.005	.005	.25	280	32PT10	5P12
34	.5	5	5	.005	.005	.25	230	34PT5	3P11
34	.5	10	10	.005	.005	.25	280	34PT10	5P12
35	.5	5	5	.005	.005	.25	230	35PT5	3P11
35	.5	10	10	.005	.005	.25	280	35PT10	5P12
36	.5	5	5	.005	.005	.25	230	36PT5	3P11
36	.5	10	10	.005	.005	.25	280	36PT10	5P12
38	.5	5	5	.005	.005	.25	280	38PT5	3P11
38	.5	10	10	.005	.005	.25	330	38PT10	5P12
40	.5	5	5	.005	.005	.25	280	40PT5	3P11
40	.5	10	10	.005	.005	.25	330	40PT10	5P12
42	.5	5	5	.005	.005	.25	280	42PT5	3P11
42	.5	10	10	.005	.005	.25	330	42PT10	5P12
44	.5	5	5	.005	.005	.25	280	44PT5	3P11
44	.5	10	10	.005	.005	.25	330	44PT10	5P12
45	.5	5	5	.005	.005	.25	280	45PT5	3P11
45	.5	10	10	.005	.005	.25	330	45PT10	5P12
46	.5	5	5	.005	.005	.25	280	46PT5	3P11
46	.5	10	10	.005	.005	.25	330	46PT10	5P12
48	.5	5	5	.005	.005	.25	280	48PT5	3P11
48	.5	10	10	.005	.005	.25	330	48PT10	5P12
50	.5	5	5	.005	.005	.25	280	50PT5	3P11
50	.5	10	10	.005	.005	.25	330	50PT10	5P12

*or 2 mv, whichever is greater

ACOPIAN CORP., EASTON, PA. 18042 • TEL: (215) 258-5441 • TWX: (510) 651-4919 • 3-DAY SHIPMENT GUARANTEED

Acopian

SERIES U UNREGULATED

Low-cost DC power suitable for driving loads such as lamps, relays, and small motors is provided by Series U unregulated power supplies. All components are generously derated, insuring a long and trouble-free life; built-in fusing prevents damage due to prolonged overloading or short circuits. Mechanically similar to the regulated supplies shown on pages 8 and 9, they are housed in extruded aluminum cases which can be mounted in any position.

STANDARD FEATURES

- Silicon rectifiers
- Capacitive filtering
- Fused input
- May be used in series or parallel
- No derating or heat sinking required
- Completely serviceable

SPECIFICATIONS

Input Voltage: 0–125 VAC, 50–400 Hz, single phase.

Output Voltage:
Output Current: } See table
Ripple:

Load Regulation: Nominal output voltage is based on 115 VAC input, with approximately 50% of rated output current being drawn.

Line Regulation: With fixed load, output voltage change is proportional to input voltage change.

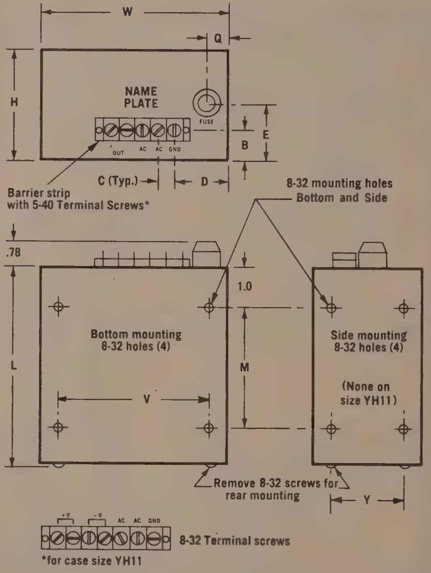
Output Voltage Adjustment: An adjustable autotransformer (not included) may be used to adjust output voltage by varying the AC input voltage to the supply.

Polarity: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

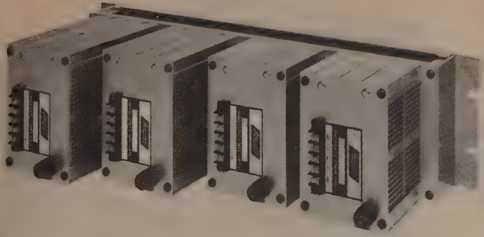
Ambient Operating Temperature: −10 to +65°C. No derating required.

Storage Temperature: −55 to +85°C.

Optional 230 Volt Input
Provision for inputs of 210–250 VAC, 50–400 Hz, replacing the standard 105–125 VAC input voltage range, is available on all models except those having an output current rating of 20 ma. To order, add the suffix "-230" to the model number, and $10.00 to the standard price.

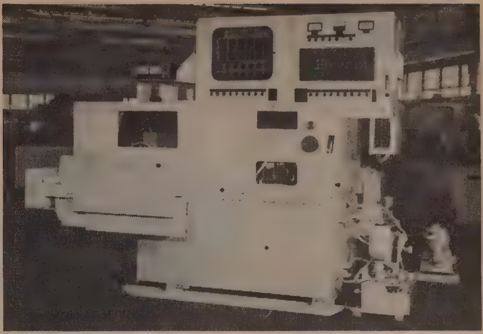

W
Q
H
NAME PLATE
FUSE
OUT
AC
AC
GND
E
B
C (Typ.)
D
Barrier strip with 5-40 Terminal Screws*
8-32 mounting holes Bottom and Side
.78
1.0
L
M
Bottom mounting 8-32 holes (4)
V
Side mounting 8-32 holes (4)
(None on size YH11)
Remove 8-32 screws for rear mounting
Y
+V
-V
AC
AC
GND
8-32 Terminal screws
*for case size YH11

Size	L	W	H	M	V	Y	Q	E	B	D	C	Approx. Weight
Y3	3.71	5.12	3.44	1.62	4.5	3.0	.56	1.37	.75	1.44	.375	2 lb. 8 oz.
Y5	5.09	5.12	3.44	3.00	4.5	3.0	.56	1.37	.75	1.44	.375	4 lb. 8 oz.
Y6	6.59	5.12	3.44	4.00	4.5	3.0	.56	1.37	.75	1.44	.375	7 lb. 8 oz.
YH11	11.25	7.37	5.12	8.0	6.75	4.56	1.10	2.64	1.25	2.25	.562	18 to 23 lb.



The cross-sectional dimensions of Series U power supplies permit efficient rear mounting on either 3½″ or 5¼″ rack assemblies. Threaded holes on three surfaces permit mounting in any position. See page 24.

Nominal Output Voltage	Output Amps.	Output Voltage N/L—F/L	Ripple Volts RMS	Price	Model	Size
4	.200	4.4 to 3.6	.2	$35	U4Y20	Y3
5	10.0	7.6 to 3.0	1.8	85	U5Y1000	Y6
	(@ 5.0)	(4.2)	(1.5)			
6	.800	6.6 to 5.4	.7	40	U6Y80	Y3
6	10.0	8.8 to 3.9	2.2	85	U6Y1000	Y6
	(@ 5.0)	(5.1)	(1.7)			
7	1.0	7.7 to 6.3	.8	40	U7Y100	Y3
8	.400	8.8 to 7.2	.4	35	U8Y40	Y3
9	1.0	9.9 to 8.1	.7	40	U9Y100	Y3
9	10.0	11.5 to 5.7	2.5	85	U9Y1000	Y6
	(@ 5.0)	(7.3)	(2.0)			
10	10.0	12.4 to 6.4	2.7	85	U10Y1000	Y6
	(@ 5.0)	(8.0)	(2.1)			
11	10.0	14.0 to 7.6	3.0	85	U11Y1000	Y6
	(@ 5.0)	(9.6)	(2.2)			
12	1.5	14.9 to 10.9	2.5	35	U12Y150	Y3
12	10.0	16.0 to 9.2	3.4	85	U12Y1000	Y6
	(@ 5.0)	(11.3)	(2.3)			
14	1.0	15.4 to 12.6	.7	40	U14Y100	Y3
14	10.0	17.2 to 10.5	3.5	85	U14Y1000	Y6
	(@ 5.0)	(12.2)	(2.4)			
15	10.0	18.3 to 11.2	3.6	85	U15Y1000	Y6
	(@ 5.0)	(13.4)	(2.4)			
16	1.0	17.6 to 14.4	.7	40	U16Y100	Y3
16	10.0	19.5 to 12.0	3.7	85	U16Y1000	Y6
	(@ 5.0)	(14.4)	(2.5)			
17	.250	18.7 to 15.3	.2	35	U17Y25	Y3
17	1.0	18.7 to 15.3	.7	40	U17Y100	Y3
18	1.0	19.8 to 16.2	.7	40	U18Y100	Y3
18	10.0	22.0 to 14.0	4.0	85	U18Y1000	Y6
	(@ 5.0)	(16.5)	(2.6)			
19	.600	20.9 to 17.1	.5	35	U19Y60	Y3
20	10.0	24.8 to 16.5	4.2	85	U20Y1000	Y6
	(@ 5.0)	(19.1)	(2.6)			
24	1.0	26.4 to 21.6	1.7	35	U24Y100	Y3
24	5.0	26.5 to 21.0	2.5	85	U24Y500	Y6
24	10.0	26.8 to 20.0	3.2	125	U24Y1000	Y6
24	17.0	26.4 to 21.6	1.5	160	U24Y1700	YH11
24	23.0	27.0 to 21.0	1.5	190	U24Y2300	YH11
25	5.0	28.1 to 22.3	2.5	85	U25Y500	Y6
27	5.0	30.0 to 24.0	2.6	85	U27Y500	Y6
28	1.0	30.8 to 25.2	1.7	35	U28Y100	Y3
28	5.0	31.2 to 24.8	2.6	85	U28Y500	Y6
28	8.0	31.4 to 25.0	3.2	125	U28Y800	Y6
28	15.0	30.8 to 25.2	1.5	160	U28Y1500	YH11
28	20.0	30.4 to 24.5	1.5	190	U28Y2000	YH11
30	1.0	33.0 to 27.0	1.6	45	U30Y100	Y5
30	2.0	33.0 to 27.0	1.5	65	U30Y200	Y5
30	5.0	33.0 to 26.5	2.6	85	U30Y500	Y6
32	.400	35.2 to 28.8	.6	35	U32Y40	Y3
32	5.0	35.5 to 28.0	3.3	85	U32Y500	Y6
35	1.0	38.5 to 34.5	1.6	45	U35Y100	Y5
35	2.0	38.5 to 31.5	1.5	65	U35Y200	Y5
35	5.0	38.0 to 30.0	3.3	85	U35Y500	Y6
37	.400	40.3 to 33.7	.6	35	U37Y40	Y3
37	5.0	40.5 to 32.2	3.3	85	U37Y500	Y6
38	5.0	43.0 to 34.0	3.3	85	U38Y500	Y6
40	1.0	44.0 to 36.0	1.6	45	U40Y100	Y5
40	2.0	44.0 to 36.0	1.5	65	U40Y200	Y5
40	5.0	45.0 to 37.0	3.3	85	U40Y500	Y6
41	.400	45.1 to 36.9	.6	35	U41Y40	Y3
42	5.0	48.0 to 36.0	6.5	85	U42Y500	Y6
44	.100	48.4 to 39.6	.7	50	U44Y10	Y3
44	2.0	48.4 to 39.6	1.5	65	U44Y200	Y5
45	1.0	49.5 to 40.5	1.6	50	U45Y100	Y5
45	5.0	51.0 to 38.5	6.5	85	U45Y500	Y6
48	.400	52.8 to 43.2	.6	45	U48Y40	Y3
50	1.0	55.0 to 45.0	1.6	50	U50Y100	Y5
52	.400	57.2 to 46.8	.6	45	U52Y40	Y3



Bryant Grinder Corporation uses Acopian unregulated power supplies in the programmable controller of the Centra-Form Grinder. The controller features a display which provides immediate diagnosis of machine malfunctions.

Nominal Output Voltage	Output Amps.	Output Voltage N/L—F/L	Ripple Volts RMS	Price	Model	Size
55	.250	60.5 to 49.5	.4	$45	U55Y25	Y3
55	1.0	59.4 to 48.4	2.8	55	U55Y100	Y5
56	.400	61.6 to 51.4	.6	50	U56Y40	Y3
60	1.0	65.3 to 53.0	2.8	60	U60Y100	Y5
62	.400	69.0 to 58.0	1.5	50	U62Y40	Y3
65	.250	71.5 to 58.5	.4	50	U65Y25	Y3
72	.250	79.2 to 64.8	.9	50	U72Y25	Y3
80	.150	88.0 to 72.0	.6	45	U80Y15	Y3
80	.300	88.0 to 72.0	1.0	50	U80Y30	Y3
85	.150	93.5 to 76.5	.6	50	U85Y15	Y3
90	.150	99.0 to 81.0	1.1	45	U90Y15	Y3
90	.400	99.0 to 81.0	2.2	55	U90Y40	Y3
95	.150	105 to 85	1.1	55	U95Y15	Y3
100	.200	110 to 93	1.0	55	U100Y20	Y3
110	.200	121 to 100	1.0	55	U110Y20	Y3
120	.200	132 to 110	1.0	55	U120Y20	Y3
130	.200	143 to 120	1.5	55	U130Y20	Y3
140	.200	154 to 126	1.7	60	U140Y20	Y3
150	.200	165 to 135	1.7	60	U150Y20	Y3
165	.200	176 to 144	1.7	60	U165Y20	Y3
170	.200	187 to 153	2.0	60	U170Y20	Y3
180	.200	190 to 162	2.0	60	U180Y20	Y3
200	.200	220 to 180	2.0	65	U200Y20	Y3
210	.100	231 to 189	2.0	55	U210Y10	Y3
215	.100	236 to 193	2.0	60	U215Y10	Y3
230	.100	252 to 207	3.0	60	U230Y10	Y3
250	.100	275 to 225	3.0	60	U250Y10	Y3
250	.200	275 to 225	5.0	80	U250Y20	Y5
275	.100	303 to 247	3.0	60	U275Y10	Y3
275	.200	303 to 247	3.6	80	U275Y20	Y5
300	.200	330 to 270	5.0	80	U300Y20	Y5
325	.200	360 to 295	6.0	80	U325Y20	Y5
340	.100	374 to 306	3.0	60	U340Y10	Y3
350	.200	385 to 330	6.0	80	U350Y20	Y5
360	.100	396 to 324	3.0	60	U360Y10	Y3
370	.100	407 to 333	3.0	60	U370Y10	Y3
375	.200	412 to 352	6.0	80	U375Y20	Y5
400	.200	440 to 360	6.0	80	U400Y20	Y5
420	.100	462 to 378	7.0	60	U420Y10	Y3
425	.200	467 to 383	9.1	80	U425Y20	Y5
450	.200	495 to 405	9.1	80	U450Y20	Y5
475	.020	523 to 426	3.1	50	U475Y02	Y3
475	.200	524 to 426	9.1	80	U475Y20	Y5
500	.200	550 to 450	9.1	80	U500Y20	Y5
525	.100	574 to 473	4.8	80	U525Y10	Y5
550	.100	605 to 495	4.8	80	U550Y10	Y5
575	.100	630 to 518	4.8	80	U575Y10	Y5
580	.020	638 to 522	3.1	55	U580Y02	Y3
600	.100	660 to 540	10.0	80	U600Y10	Y5
625	.100	680 to 565	10.0	80	U625Y10	Y5
650	.100	715 to 595	10.0	80	U650Y10	Y5
675	.100	732 to 608	10.0	80	U675Y10	Y5
700	.100	770 to 630	10.0	80	U700Y10	Y5
725	.100	790 to 665	10.0	80	U725Y10	Y5
750	.020	825 to 675	3.1	60	U750Y02	Y3
750	.100	838 to 710	13.0	80	U750Y10	Y5
800	.100	880 to 720	13.0	80	U800Y10	Y5
850	.100	935 to 765	13.0	80	U850Y10	Y5
900	.020	990 to 810	5.0	65	U900Y02	Y3
900	.100	990 to 810	13.0	80	U900Y10	Y5
950	.100	1045 to 855	13.0	80	U950Y10	Y5
1000	.100	1100 to 900	13.0	80	U1000Y10	Y5

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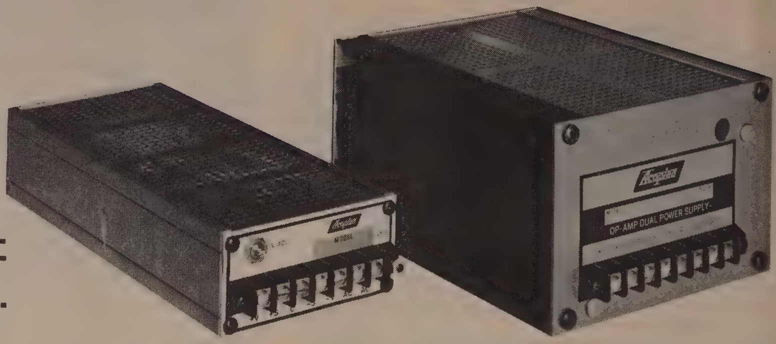

DUAL OUTPUT For Op Amps.

Series D dual output power supplies are a convenient source of the tracking voltages required for powering operational amplifiers and related circuits. Their positive/common/negative output terminal configuration minimizes system wiring. Provision for remote sensing permits compensation of load line effects. Although moderately priced, they are sturdily constructed and conservatively rated.

SPECIFICATIONS

Input Voltage: 105–125 VAC, 50–400 Hz, single phase.
Output Voltages: Tracking within 1%.
Output Currents:
Output Voltage Adjustment Ranges:
See tables. Outputs are short circuit protected.
Load Regulation: ±0.1%.
Line Regulation: ±0.1%.
Ripple: 1.5 mv RMS.
Polarity: Positive output, common, and negative output.
Remote Voltage Sensing: Standard.
Ambient Operating Temperature: −10 to +71°C.
Storage Temperature: −55 to +85°C.

OPTIONS

Overvoltage Protection: A built-in preset overvoltage protection circuit is available on all models. If either output fails, both outputs are "crowbarred." To order, add prefix "V" to the model number, and increase standard price by $30.00.

230 Volt Input: All models can be alternately furnished for operation on inputs of 210–250 VAC, 50–400 Hz. To order, add suffix "-230" to model number and $10.00 to price.

*Minor differences in panel layout. Same overall and mounting dimensions apply. (Pp. 8, 9, 12.)

Nominal Output Voltages	Adjust ±V.	Output Current Amps. at 40°C	55°C	71°C	Price	Model	Case Similar to*
±5	.5	.750	.650	.550	$125	TD5-75	G5
±5	.5	1.5	1.25	1.0	150	TD5-150	G6
±5	.5	2.5	2.0	1.5	160	TD5-250	G9
±12	1	1.0	.900	.800	125	TD12-100	G5
±12	1	1.6	1.4	1.0	150	TD12-160	G6
±12	1	2.5	2.0	1.5	160	TD12-250	G9
±12	.5	4.5	3.7	3.0	215	TD12-450	G13
±12	.5	8.5	7.0	5.5	299	TD12-850	H11
±15	1	.400	.400	.400	85	TD15-40	G5
±15	1	1.0	.900	.800	125	TD15-100	G5
±15	1	1.6	1.4	1.0	150	TD15-160	G6
±15	1	2.5	2.0	1.5	160	TD15-250	G9
±15	.5	4.5	3.7	3.0	225	TD15-450	G13
±15	.5	8.5	7.0	5.5	299	TD15-850	H11

NARROW PROFILE MODELS — for limited space applications

Nominal Output Voltage	Adjust ±V.	Output Current Amps. at 40°C	55°C	71°C	Price	Model	Case Similar to*
±12	1	.500	.500	.400	$115	FD12-50	N6
±12	.5	1.0	.900	.800	145	LD12-100	N8H
±15	1	.500	.500	.400	115	FD15-50	N6
±15	.5	1.0	.900	.800	145	LD15-100	N8H

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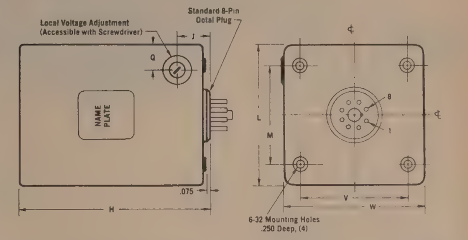
Acopian

SINGLE OUTPUT REGULATED PLUG-IN

An Acopian plug-in power module can be installed in a matter of seconds. Simply plug it into an octal socket. You don't even have to screw it down (although threaded holes are provided) unless it is to be mounted in other than a vertical position, or will be subjected to shock or vibration.


Local Voltage Adjustment (Accessible with Screwdriver)
Standard 8-Pin Octal Plug
J
Q
NAME PLATE
.075
H
℄
L
M
8
1
℄
V
W
6-32 Mounting Holes .250 Deep, (4)

Size	L	W	H	M	V	J	Q	Approx. Weight
AS	3.40	3.28	4.67	2.625	2.625	1.00	0.66	2lb 8oz
BS	3.40	3.28	5.25	2.625	2.625	1.00	0.66	2lb 14oz
TS	3.33	4.15	4.85	2.562	2.750	1.12	0.62	3lb 6oz
US	3.33	4.15	5.43	2.562	2.750	1.12	0.62	3lb 8oz
WS	3.40	5.02	5.43	2.562	3.562	1.12	0.62	4lb 14oz
HS	3.40	5.02	6.57	2.562	3.562	1.12	0.62	5lb

Standard models are available for any voltage from 1 to 200. For information on those not listed, contact factory.

SPECIFICATIONS

Input Voltage: 105 - 125 VAC, 50-400 Hz, single phase.

Polarity: Output floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Ambient operating temperature: −10 to +65°C. No derating required.

MIL Tested/Increased Temperature Range: See p. 21.

Storage Temperature: −55 to +85°C.

Installation: Plugs into standard octal socket. Mounting holes (6-32) provided at each corner for installation in any position.

OPTIONS

Solder Terminals: All models can be furnished with solder terminals instead of the octal-type plug. To order, add suffix "L" to model number and $5.00 to price.

Remote Output Adjustment: All models have a local voltage adjustment. When provision for remote (external) adjustment is also desired, add prefix "E" to model number. No increase in price.

Remote Sensing: Provision for remote sensing of the output voltage to compensate for drops in the load lines can be furnished at an additional charge of $10.00 per unit. Add prefix "R" to model number when ordering. "R" power supplies have a local voltage adjustment and provision for remote (external) output adjustment.

230 Volt Input: All models can be alternately furnished for operation on inputs of 210 to 250 VAC, 50-400 Hz. Add suffix "–230" to model number and $10.00 to price.

Nominal Output Voltage	Adjustment ±Volts	Output Current Amps.	Regulation		Ripple mv RMS	Price	Model	Size
			Load ±%	Line ±%				
5	1	.050	.5	.5	5	$ 45	5L05	AS
5	1	.100	.5	.5	5	50	5L10	AS
5	1	.200	.5	.5	5	55	5L20	AS
5	1	.200	.2	.05	1	65	5J20	AS
5	1	.400	.3	.05	1	75	5J40	AS
5	1	.750	.4	.05	1	80	5J75	AS
5	.5	1.0	.5	.05	1	95	5J100	AS
5	.5	1.5	.4	.05	1	115	5J150	US
5	.5	2.0	.5	.05	1	145	5J200	WS
5	.5	3.0	.5	.05	1	155	5J300	WS
5	.5	4.0	.5	.05	1	165	5J400	HS
5	.5	5.0	.7	.05	1	180	5J500	HS
12	1	.100	.5	.5	5	45	12L10	AS
12	1	.200	.5	.5	5	50	12L20	AS
12	1	.200	.05	.05	0.5	60	12J20	AS
12	1	.400	.5	.5	5	70	12L40	AS
12	1	.400	.1	.05	1	75	12J40	AS
12	1	.750	.15	.05	1	80	12J75	AS
12	1	1.0	.1	.05	1	95	12J100	AS
12	.5	2.0	.1	.05	1	160	12J200	WS
12	.5	3.0	.25	.05	1	170	12J300	HS
15	1	.100	.05	.05	0.5	60	15J10	AS
15	1	.200	.05	.05	0.5	65	15J20	AS
15	1	.400	.5	.5	5	70	15L40	AS
15	1	.400	.1	.05	1	75	15J40	AS
15	1	.750	.5	.5	5	75	15L75	AS
15	1	.750	.15	.05	1	80	15J75	AS
15	1	1.0	.15	.05	1	95	15J100	AS
15	1	1.5	.2	.05	1	135	15J150	US
15	.5	2.0	.1	.05	1	160	15J200	WS
15	.5	3.0	.25	.05	1	170	15J300	HS
24	1	.100	.05	.05	0.5	60	24J10	AS
24	1	.200	.5	.5	5	65	24L20	AS
24	1	.200	.05	.05	0.5	70	24J20	AS
24	1	.400	.5	.5	5	70	24L40	AS
24	1	.400	.05	.05	1	75	24J40	AS
24	1	.750	.5	.5	5	75	24L75	AS
24	1	.750	.1	.05	1	85	24J75	AS
24	1	1.0	.1	.05	1	100	24J100	US
24	1	1.5	.15	.05	1	135	24J150	WS
24	.5	2.0	.1	.05	1	160	24J200	WS
28	1	.100	.05	.05	0.5	65	28J10	AS
28	1	.200	.5	.5	5	65	28L20	AS
28	1	.200	.05	.05	0.5	70	28J20	AS
28	1	.400	.5	.5	5	70	28L40	AS
28	1	.400	.05	.05	1	75	28J40	AS
28	1	.750	.1	.05	1	95	28J75	TS
28	1	1.0	.1	.05	1	105	28J100	US
28	1	1.5	.15	.05	1	150	28J150	WS
28	.5	2.0	.1	.05	1	175	28J200	WS

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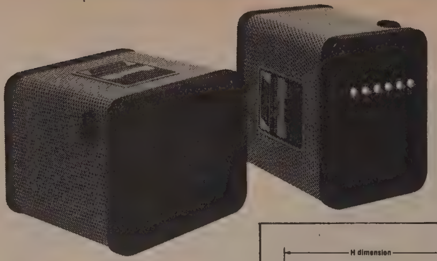
Acopian

DUAL OUTPUT REGULATED PLUG-IN



Space-saving Acopian duals combine two electrically independent DC outputs in a single case. Either identical or different outputs may be selected. And with a choice of more than 300 output ratings, over 10,000 combinations can be supplied . . . each with Acopian's usual 3-day shipment guarantee.

SPECIFICATIONS

Input Voltage: 105-125 VAC, 50-400 Hz, single phase.

Output Adjustment Range: ±1 volt.

Polarity: Outputs are floating. Each section may be independently connected to provide any combination of positive and negative outputs.

Short Circuit Protection: Delivers current surges without damage—to protect against prolonged overloads and shorts, use of an input fuse is recommended.

Ambient Operating Temperature: −10 to +65°C. No derating required.

MIL Tested/Increased Temperature Range: See p. 21.

Storage Temperature: −55 to +85°C.

HOW TO ORDER

Select the two sections desired. The complete model number is the combination of the two sections selected. Example: The combination of section 6J20D and section 12L40D is Model 6J20D-12L40D. Always assign the lower voltage section first. Where the indicated case sizes for the two sections differ, the larger case size applies.

For pricing purposes, add the cost of the individual sections selected.

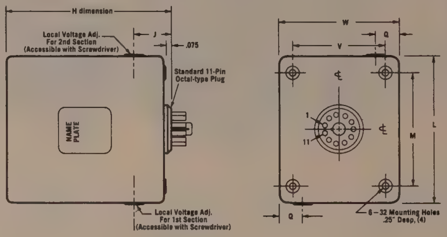
OPTIONS

Solder Terminals: All models can be furnished with solder terminals instead of the 11-pin plug. To order, add suffix "L" to model number and $5.00 to price.

Remote Output Adjustment: All models have local voltage adjustments. When provision for remote (external) adjustments is also desired, add prefix "E" to model number.

Remote Sensing: Provision for remote sensing of the output votlages, to compensate for drops in the load lines, can be furnished at an additional charge of $20.00 per unit. Add prefix "R" to model number when ordering.

230 Volt Input: All models can be alternately furnished for operation on inputs of 210 to 250 VAC, 50-400 Hz. Add suffix "–230" to model number and $10.00 to price.


H dimension
Local Voltage Adj. For 2nd Section (Accessible with Screwdriver)
J
.075
Standard 11-Pin Octal-type Plug
NAME PLATE
Local Voltage Adj. For 1st Section (Accessible with Screwdriver)
W
Q
V
1
11
M
L
Q
6–32 Mounting Holes .25" Deep, (4)

Size	L	W	H	M	V	J	Q	Approx. Weight
ADJ	3.28	3.40	4.60	2.625	2.625	1.0	.66	1lb 8oz
TDJ	4.15	3.33	4.85	2.750	2.562	1.12	.62	3lbs
UDJ	4.15	3.33	5.43	2.750	2.562	1.12	.62	3lbs
WDJ	5.02	3.40	5.43	3.562	2.562	1.12	.62	4lb 12oz

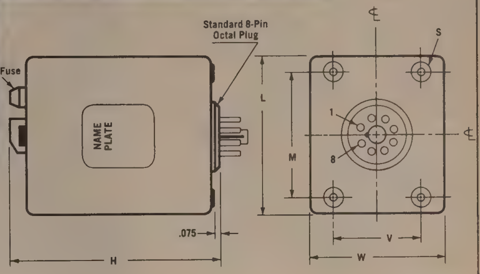
Standard models are available for any voltages from 1 to 150, and with current ratings to 1 amp. For information on those not listed, contact factory.

Nominal Output Voltage	Output Current Amps.	Regulation		Ripple mv RMS	Price per Section	Section (See "How to Order")	Size
		Load ±%	Line ±%				
5	.200	.2	.05	1	$64	5J20D	TDJ
5	.400	.3	.05	1	67	5J40D	TDJ
6	.100	.05	.05	1	60	6J10D	ADJ
6	.200	.5	.5	5	55	6L20D	TDJ
6	.200	.05	.05	1	64	6J20D	TDJ
6	.400	.5	.5	5	64	6L40D	TDJ
6	.400	.15	.05	1	67	6J40D	TDJ
10	.100	.05	.05	1	55	10J10D	ADJ
10	.200	.5	.5	5	55	10L20D	TDJ
10	.200	.05	.05	1	60	10J20D	TDJ
10	.400	.5	.5	5	64	10L40D	TDJ
10	.400	.1	.05	1	67	10J40D	TDJ
12	.100	.05	.05	1	55	12J10D	ADJ
12	.200	.5	.5	5	55	12L20D	TDJ
12	.200	.05	.05	1	60	12J20D	TDJ
12	.400	.5	.5	5	64	12L40D	TDJ
12	.400	.1	.05	1	67	12J40D	TDJ
15	.060	.02	.02	.25	44	15J06D	ADJ
15	.100	.05	.05	1	55	15J10D	ADJ
15	.200	.5	.5	5	55	15L20D	TDJ
15	.200	.05	.05	1	60	15J20D	TDJ
15	.400	.5	.5	5	64	15L40D	TDJ
15	.400	.1	.05	1	67	15J40D	TDJ
18	.100	.5	.5	5	55	18L10D	ADJ
18	.100	.05	.05	1	60	18J10D	ADJ
18	.200	.5	.5	5	60	18L20D	TDJ
18	.200	.05	.05	1	64	18J20D	TDJ
18	.400	.5	.5	5	64	18L40D	TDJ
18	.400	.1	.05	1	67	18J40D	TDJ
24	.100	.05	.05	1	60	24J10D	TDJ
24	.200	.5	.5	5	60	24L20D	TDJ
24	.200	.05	.05	1	64	24J20D	TDJ
24	.400	.5	.5	5	64	24L40D	TDJ
24	.400	.1	.05	1	67	24J40D	TDJ
28	.100	.05	.05	1	60	28J10D	TDJ
28	.200	.5	.5	5	60	28L20D	TDJ
28	.200	.05	.05	1	64	28J20D	TDJ
28	.400	.5	.5	5	64	28L40D	TDJ
28	.400	.05	.05	1	67	28J40D	TDJ
30	.100	.05	.05	1	60	30J10D	TDJ
30	.200	.5	.5	5	60	30L20D	TDJ
30	.200	.05	.05	1	64	30J20D	TDJ
30	.400	.5	.5	5	64	30L40D	TDJ
30	.400	.05	.05	1	67	30J40D	TDJ

Acopian

UNREGULATED PLUG-IN FOR RELAYS, LAMPS AND NIXIE TUBES

These low-cost, yet highly reliable unregulated power supplies have been specially designed to power DC relays, lamps and NIXIE tubes. Each has husky silicon rectifiers and a fused input to insure long and trouble-free operation. Installation consists of simply plugging the unit into a standard octal socket.



Size	L	W	H	M	V	S	Approx. Weight
G	3.40	3.28	5.0	2.625	2.625	Four 6–32 x ¼″ deep mounting holes	2lb 8oz
K	4.15	3.33	5.2	2.750	2.562	Four 6–32 x ¼″ deep mounting holes	2lb 14oz
Q	4.15	3.33	7.0	2.750	2.562	Four 10–32 x ½″ long mounting studs	7lb

SPECIFICATIONS

Input Voltage: 0-125 VAC, 50-400 Hz, single phase.

Output Voltage:
Output Current: } See table.
Ripple:

Load Regulation: Nominal voltage is based on 115 VAC input with approximately one-half load. At no load, the output voltage will increase by approximately 10%. At full load, the output voltage will be reduced by approximately 10%.

Line Regulation: Output voltage change due to input voltage change is directly proportional to the change in input.

Polarity: Output is floating; either positive or negative terminal may be grounded or floated up to 300 V above ground.

Ambient Operating Temperature: −10 to +65°C. No derating required.

Storage Temperature: −55 to +85°C.

Installation: Plugs into standard octal socket.

OPTIONS

Solder Terminals: All models can be furnished with solder terminals instead of the octal plug. To order, add suffix "L" to model number and add $10.00 to price. Example: Model 24U100 becomes 24U100L.

230 Volt Input: All models can be alternately furnished for operation on inputs of 210 to 250 VAC, 50-400 Hz. Add suffix "–230" to model number and $10.00 to price.

Nominal Output Voltage	Output Current Amps.	Ripple Volts RMS	Model	Price	Size
4	.200	.2	4U20	$35	G
6	.800	.7	6U80	40	G
7	1.0	.8	7U100	40	G
7	2.0	1.5	7U200	60	Q
8	.400	.4	8U40	35	G
9	.600	.6	9U60	35	G
9	1.0	.7	9U100	40	G
13	.600	.5	13U60	35	G
13	2.5	1.8	13U250	65	Q
14	1.0	.7	14U100	40	G
16	1.0	.7	16U100	40	G
18	1.0	.7	18U100	40	G
20	3.0	2.3	20U300	65	Q
22	.400	.7	22U40	40	G
24	.600	1.1	24U60	35	G
24	1.0	1.7	24U100	35	G
24	3.0	2.2	24U300	65	Q
28	1.0	1.7	28U100	35	G
28	3.0	2.7	28U300	65	Q
30	1.0	1.6	30U100	45	K
30	2.0	1.5	30U200	65	Q
32	.400	.6	32U40	35	G
35	1.0	1.6	35U100	45	K
35	2.0	1.5	35U200	65	Q
40	1.0	1.6	40U100	45	K
40	2.0	1.5	40U200	65	Q
45	1.0	1.6	45U100	50	K
48	.400	.6	48U40	45	G
56	.400	.6	56U40	50	G
62	.300	2.7	62U30	50	K
72	.250	.9	72U25	50	G
80	.150	.6	80U15	45	G
80	.300	1	80U30	50	K
100	.200	1	100U20	55	K
120	.200	1	120U20	55	K
140	.200	2	140U20	60	K
150	.200	2	150U20	60	K
160	.100	1.7	160U10	55	G
*180	.100	1.7	180U10	55	G
*200	.150	2	200U15	60	K
250	.100	3	250U10	60	K
340	.100	3	340U10	60	K
420	.100	6.7	420U10	60	K
475	.020	3.1	475U02	50	G
580	.020	3.1	580U02	55	G
750	.020	3.1	750U02	60	G
900	.020	5	900U02	65	G

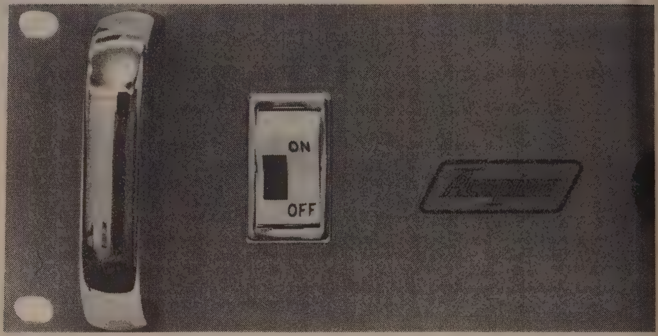
*Suitable for supplying input voltages to NIXIE tubes. NIXIE is a registered trademark of Burroughs Corporation.

Acopian

MULTIPLE-OUTPUT POWER SUPPLY SYSTEMS

shipped in only

9 days



Now you can fill your requirements for completely wired multiple-output rack-mounting power supply systems, without any need to search through a catalog and prepare time-consuming mechanical layouts, item-by-item pricing and detailed purchase requisitions. Instead, simply call the Acopian "hotline" and specify the output voltages and currents that you require.

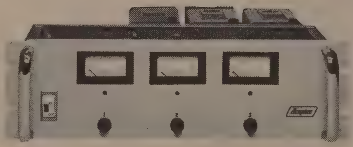
Acopian power systems offer the features that are most often required, and at reasonable cost. Each system is designed and constructed to provide an optimum mechanical and wiring configuration for the complement of power modules necessary to deliver the outputs specified. Acopian production expertise assures shipment of each system, completely wired and 100% tested, within 9 days after your order is received.

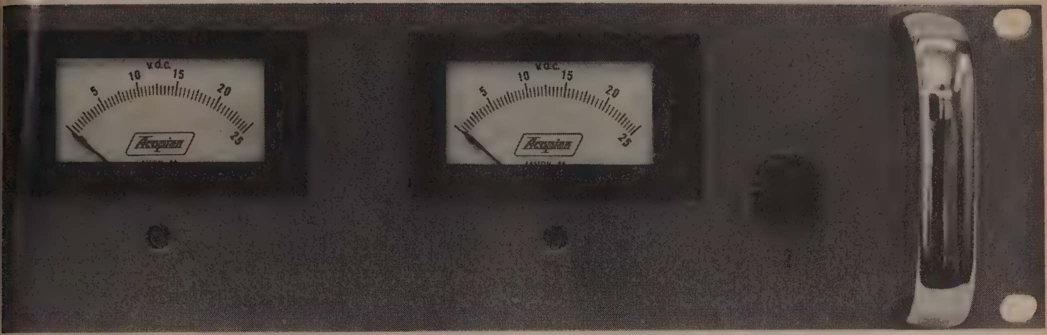
Ordering an Acopian power system is this easy:
List the DC outputs that you require. (Or, select the power modules that you wish to be included.) Note the system features which you consider necessary. Then, call the "Power Systems Hotline" collect at (215) 258-5441 and ask for the POWER SYSTEM DEPARTMENT.

An Acopian Applications Engineer will answer—on the phone—any questions which you may have. A distinctive system model number will be assigned, and a firm price will be quoted. Your completely-wired power supply system will be shipped within 9 days.

System Description
Any of the power modules listed in this catalog can be included in a power system. The rack assembly will be designed and wired in a manner optimum for the complement of modules included.

TYPICAL BUILT-TO-ORDER POWER SUPPLY SYSTEMS





Now you can design your power system on the phone . . . just call Acopian.

Pricing of assemblies equipped with plug-in type power modules is calculated as indicated below, and includes wiring, all necessary fuses, power switch/indicator on front panel, and all input and output connections via terminal strip(s) at the rear. When rear panel space is insufficient for terminal strips, a connector may alternately be furnished. Minimum price, $150.00.

To obtain pricing information for assemblies containing other than plug-in type modules, contact factory.

Panel height (19″ wide)	Price (not including plug-in power modules)
3½″	$20.00 plus $5.00 per output
5¼″	$25.00 plus $5.00 per output
7″	$30.00 plus $5.00 per output
8¾″	$35.00 plus $5.00 per output
10½″	$40.00 plus $5.00 per output

Description

The standard front panel is ⅛-inch aluminum finished in light gray baked enamel. Also available, at no additional cost, are Emcor or Amco gray formed steel panels. (The panel can also be supplied in any other color conventional type enamel supplied by customer, at an additional charge of $10 per purchase order.)

The rear portion of the assembly is normally constructed from extruded aluminum panels, alodyne finished.

Accessories and Options

Voltmeters and/or ammeters–
$15.00 each.

Front panel voltage adjustments–
$5.00 each.

Front panel handles–
$10.00/pair.

Chassis slides–
$50.00/pair.

Other features and accessories
Should you require any non-standard features, call the Acopian "hotline" at Area Code 215, 258-5441 and discuss your needs with an Acopian Application Engineer. A procurement charge of $25.00 minimum (exclusive of material) will apply if components not stocked by Acopian are specified. Engineering charges to cover special layout and wiring may also apply. Extra charges are minimized and delivery accelerated when the customer provides any special components which he wishes to be incorporated into a power system.

Redundant outputs—For applications where extreme reliability is a critical consideration, as in data communications and process controls, the use of redundant output power systems is recommended. Two power modules are included for each output and interwired in a manner permitting one to continue furnishing the required output should the other fail. Call the "Power Systems Hotline" at (215) 258-5441 for further information.

Delivery—Shipment of your completely-wired power supply system will be made nine days after receipt of order. Of course, the famous Acopian three-day shipping guarantee on any of 82,000 different individual power modules remains unchanged.

Guarantee—Acopian Corp. warrants each power supply system to be free from defects in material and workmanship for a period of five years from date of delivery.

ACOPIAN CORP., EASTON, PA. 18042 • TEL: (215) 258-5441 • TWX: (510) 651-4919

Acopian

BENCHTOP POWER SUPPLIES

These benchtop power supplies provide all the performance and operating features necessary in a laboratory instrument. A wide choice of single and multiple output models offer optimum combinations of the operating features and output ratings that are most often needed.

They are also "human engineered" for convenience and ease of use. Two meters provide for the simultaneous monitoring of voltage and current on single output supplies, or a combination of two output voltages or currents on dual and triple output models. When more than one is required, they may be stacked to conserve bench space. Interlocking design prevents the upper units from slipping off.

Coarse and fine voltage controls permit setting outputs to a high degree of resolution, and adjustable current limiting prevents the load from drawing a higher current than intended. Many models provide constant voltage/constant current crossover, and may be used to deliver a regulated current to a varying impedance load. Some also include adjustable overvoltage protection.

The rugged casework is attractively finished in black and gold. "Five way" output binding posts and a retracting handle contribute to user convenience.

SPECIFICATIONS

Input Voltage: 105-125 Vac, 50-400 Hz, single phase.

Output Ratings: See table.

Regulation, Ripple (constant voltage operation):
Line Regulation: ±0.01% or 2 mv, whichever is greater.
Load Regulation: ±0.01% or 2 mv, which is greater.
Ripple: 0.25 mv rms.
(Model KT7-20, ±10-20 V outputs only: Line regulation, ±0.05%; load regulation, ±0.05%, ripple, 1.0 mv rms.)

Regulation, Ripple (constant current operation):
Line Regulation: 2.0 ma (Model K7S500
6.0 ma).
Load Regulation: 10.0 ma.
Ripple: 1.0 ma rms (Model K7S500, 2.0 ma rms).

Output Current Control: Outputs marke ACL are short circuit and overload pro tected by means of a continuously adjust able rolloff type current limiting circuit.

Output marked CV/CC deliver a constan voltage with increasing load until the cur rent limiting point (continuously adjust able) is reached, beyond which voltage decreases as required to maintain a con stant current. In addition to providing shor circuit and overload protection, this fea ture permits the supply to be used as current regulated power source.

Temperature Coefficient: 0.015%/° C.

SINGLE OUTPUT MODELS

OUTPUT VOLTAGE RANGE	OUTPUT CURRENT, AMPS.	CURRENT CONTROL	PRICE	MODEL	CASE SIZE
0-7	1.0	ACL	$99	K7S100	K9
0-7	2.0	CV/CC	135	K7S200	K10
0-7	5.0	CV/CC	190	K7S500	K11
0-18	0.6	ACL	99	K18S60	K9
0-18	1.0	CV/CC	120	K18S100	K10
0-32	0.35	ACL	99	K32S35	K9
0-32	0.6	CV/CC	120	K32S60	K10
0-50	0.35	CV/CC	120	K50S35	K10

DUAL OUTPUT MODELS

OUTPUT VOLTAGE RANGES	CURRENT PER OUTPUT, AMPS.	CURRENT CONTROL	PRICE	MODEL	CASE SIZE
0-20/0-20	0.25	ACL	$139	K20D25	DK9
0-20/0-20	0.5	ACL	175	K20D50	DK10

TRIPLE OUTPUT MODEL

OUTPUT VOLTAGE RANGE	CURRENT PER OUTPUT, AMPS.	CURRENT CONTROL	PRICE	MODEL	CASE SIZE
0-7 ±10-20 (tracking)	2.0 0.5	CV/CC Fixed	$235	KT7-20	TK10

Stability: Over an eight-hour period, following a 30 minute warmup.
Constant voltage operation: 0.1%.
Constant current operation: 15 ma.

Temperature Range:
Operating: 0 to +50° C.
Storage: —40 to +85° C.

Protection:
Input: Line fuse.
Overload: Adjustable electronic current limiting.
Overvoltage: "Crowbar" circuit, continuously adjustable down to 3 volts, protects load by effectively short circuiting output when "crowbar" trip point setting is exceeded. (Models K7S200, K7S500 and KT7-20 only.)

Transient Response Time: Less than 50 μsec, for a step change in input from 105 to 125 Vac, or in output current from no load to full rated output current.

Output Impedance (constant voltage operation):
Less than 0.03 ohms from dc to 1 kHz.
Less than 0.5 ohms from 1 kHz to 100 kHz.

Meters: Two, each accurate to 2% of full scale. On multiple output models, selector switches permit monitoring every output voltage and current.

Controls:
Power switch
Output voltage, coarse and fine adjustments
Output current limit
Overvoltage protection trip point (Models K7S200, K7S500 and KT7-20 only)
Meter switches (multiple output models only)

Construction: Gold-finished extruded aluminum top and sides. Bottom, perforated aluminum panel. Front and rear panels, molded black phenolic. Retracting handle. Input power cord, 3-wire UL approved. Output connections, "five way" binding posts.

Case Size	Dimensions (overall) H x W x D (inches)	Approx. Weight
K9 DK9	3.3 x 8.5 x 10.9	4 lb 1 oz 4 lb 6 oz
K10 DK10 TK10	3.3 x 8.5 x 11.3	5 lb 5 lb 6 oz 7 lb 6 oz
K11	3.3 x 8.5 x 12.2	7 lb 8 oz

Warranty:
All Acopian products listed in this brochure are covered by a firm five year warranty which includes the cost of both parts and labor.

WHAT DOES ACOPIAN'S 3-DAY SHIPPING PROMISE MEAN?

For more than a decade, Acopian has been shipping standard AC to DC power modules three days after receipt of an order. During this period, the Acopian line has expanded from the original plug-in modules to a number of complete power supply families.

Our unique 3-day shipping guarantee has prompted many questions. Here are some of those most often asked.

Q. What does Acopian's 3-day shipping promise mean?

A. It means that any time you order power modules selected from our catalog, shipment will be made 3 days after we receive your purchase order.

Q. Has Acopian ever failed to meet this promise?

A. Never.

Q. Do I have to ask for 3-day shipment on my order?

A. No. It's automatic. In fact, you must tell us if you want the shipment delayed.

Q. What if I need four or five different models? Does Acopian still keep the 3-day promise?

A. Yes. Guaranteed 3-day shipment applies to one model or to a combination of models.

Q. Is the 3-day promise affected by quantity? Suppose we need 50 or 100 pieces?

A. The 3-day promise applies to small quantities. Acopian will ship a portion of a larger order in 3 days and, after discussing your requirements with you, schedule the balance.

Q. What do you mean by a "portion"? Isn't Acopian hedging?

A. Not at all. Our experience substantiates that shipping five or ten units in 3 days will get almost any project underway. Rarely are larger quantities required at one time.

Q. It takes me so long to get a requisition processed and approved that your 3-day shipment doesn't mean much to me. What's your answer to this problem?

A. Processing your internal paperwork is out of our control. However, verbal orders are acceptable. We suggest you ask your purchasing people to use the phone. Telephone orders to our area representatives are also shipped in 3 days. All we require is the purchase order number.

Q. How long after you ship will I have the power supplies?

A. Transportation time is out of our control. Some carriers are quite efficient. Even overnight service coast-to-coast is not unusual. Your purchasing department probably knows the fastest shipping method to your location. If not, Acopian can recommend the fastest carrier.

Q. I'm curious. You say Acopian has never failed to meet the 3-day promise. How do you do it?

A. We can't tell you all of the details, but it's in our attitude and commitment supported by efficient personnel, streamlined procedures and modern facilities. Facilities that have been designed and equipped specifically to meet our 3-day shipping promise.

It may surprise you to know we manufacture each power supply to order and do not ship from inventory.

Q. I've seen other power supply manufacturers advertise "stock delivery." Why should I consider 3-day shipment a significant benefit?

A. Because a "delivery-from-stock" promise is not precise. It may even be misleading. Consider what happens if the power module you require is out-of-stock when your order reaches a typical vendor. Four to six weeks is not unusual before inventory is replenished and your order is shipped. Consider further how this problem is compounded when you need four or five regulated outputs for your project. The significant difference, then, is that fulfillment of a "ship-from-stock" promise is dependent on a variable —the quantity in stock when your order is received. Acopian's 3-day shipment promise contains no unknowns.

Q. In a legitimate emergency, do you ever do better than 3 days?

A. Yes. Please call in an emergency. If we can't do it, we'll tell you immediately.

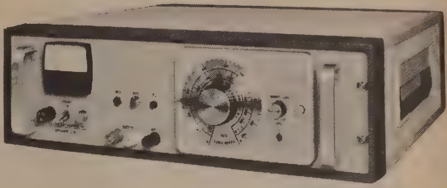
If you don't find the answers to your questions here, please call or write to our Vice-President, Marketing. You will receive a prompt and straightforward reply.

AC Power Sources—Single and Three Phase

The Standard "S" Features:

- All silicon solid state semiconductors.
- Multiple output voltages 0-135, 0-270.
- Instantaneous overload protection.
- Accepts over 50 different plug-in oscillators
- Frequency stabilities to 0.1%
- 13 models from 130VA to 5,000VA.
- 45 Hz to 10,000 Hz frequency range.

Solid State "S" Series Frequency Converters



MODEL 200SA WITH V141B OSCILLATOR

All aluminum parts are finished in gold iridite or black anodize. Steel parts are cadmium plated and finished with gold iridite. Front panels are blue enamel. Other paint available on special order. Furnish color chip and federal specification number.

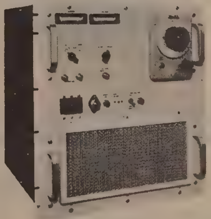
SINGLE PHASE OUTPUT

MODEL	POWER OUTPUT VA	DIMENSIONS (INCHES)			APPROX. WEIGHT	PRICE*
		H	W	D		
130SA	130	5¼	19	16⅝	53	$ 565
200SA	200	5¼	19	16⅝	60	650
300SA	300	7	19	16⅝	90	1200
500SA	500	7	19	16⅝	105	1375
600SA	600	7	19	16⅝	125	1575
1000SA	1000	14	19	16⅝	215	2250
1500SA	1500	14	19	16⅝	300	3100

THREE PHASE OUTPUT

MODEL	POWER OUTPUT VA	DIMENSIONS (INCHES)			APPROX. WEIGHT	PRICE*
		H	W	D		
Y390SA	390	7	19	16⅝	115	$1700
Y500SA	500	7	19	16⅝	150	1750
Y600SA	600	7	19	16⅝	165	1900
Y900SA	900	14	19	16⅝	240	2750
Y1500SA	1500	14	19	16⅝	320	4175
Y1800SA	1800	14	19	16⅝	390	4500

"T" Series High Power Frequency Converters



MODEL Y2500TA WITH F34C OSCILLATOR

The "T" series of regulated A.C. power sources is an extension of the "S" series in the higher power range with outputs up to 5,000 VA. The standard "T" series feature all silicon solid state components except for the output stage where rugged, forced air vacuum tubes are used. These units can also be used as high power audio amplifiers. The supplies are compact, ruggedly constructed, and contain all of the electrical and mechanical features of the "S" series.

SINGLE PHASE OUTPUT

MODEL	POWER OUTPUT VA	DIMENSIONS (INCHES)			APPROX. WEIGHT	PRICE*
		H	W	D		
1500T	1500	21	19	17	275	$4200
2000T	2000	21	19	17	325	4625
2500T	2500	21	19	17	350	5050
5000T	5000	45	25	25	845	11,050

THREE PHASE OUTPUT

MODEL	POWER OUTPUT VA	DIMENSIONS (INCHES)			APPROX. WEIGHT	PRICE*
		H	W	D		
Y1800TA	1800	21	19	17	355	$4700
Y2000TA	2000	21	19	17	360	5100
Y2500TA	2500	21	19	17	365	5375
Y5000TA	5000	45	25	25	940	11,500

*Price is for basic unit w/o oscillators. PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

CONSULT FACTORY FOR PLUG-IN OSCILLATOR SPECS AND PRICES

T.D.C. products from

AMERICAN VECTOR

201 Culver Road, Dayton, N. J. 08810
(201) 329-4683

ACDCo *Power* WHERE *you need it!*

Inverters-Uninterruptible Power Systems -Battery Chargers-Frequency Changers-Power Supplies

ACDCo Power Equipment is designed to meet high reliability and performance standards providing maximum life with minimum maintenance to protect all system circuits that require dependable, high quality power.

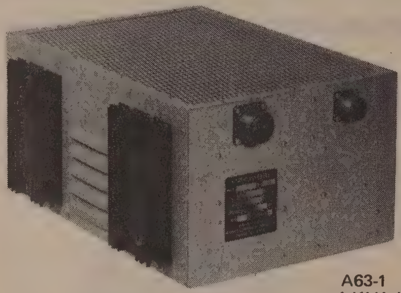
ENGINEERING SERVICES

SYSTEMS CONSULTATION
ACDCo's engineering is available to discuss protection of your valuable equipment from power crises effects, and also show you how ACDCo can save you money on your equipment.

FIELD SERVICE & ENGINEERING
ACDC's consulting engineers will conduct surveys and studies to determine systems definition and make appropriate recommendations.

CUSTOM CONTROLS
ACDCo designs custom built controls for all power systems. Contact our engineering department for specialized and custom power analyzing, monitoring and recording systems.

PROCUREMENT SATISFACTION
If ACDCo can not satisfy your power requirements, we will direct you to a choice of firms whose equipment should.


A63-1
1 KVA INVERTER

HARDWARE

Uninterruptible AC Power Systems – 36 VA to 5 KVA
Frequency Converters – AC to AC: 50/60 Hz, 60/50 Hz, 50/400 Hz and 60/400 Hz.
Battery Chargers – AC to DC Power Supply: 0-30 VDC/30-300 VDC Auctioneer Units and Automatic Transfers
Power Supplies – Constant current and constant voltage current regulated and modular.
Power Monitors (AC and DC) and Fault Detectors – Specialized and custom power analizing, monitoring and recording systems, and controls.
Inverters, power – DC to AC output: Fixed-base, portable, mobile and marine.
ACDCo INVERTERS are used in one of the **ROUGHEST** of Marine Environments on the **U.S. COAST GUARD'S - RESCUE LIFE BOATS** to power their Navigation and Communication equipment.

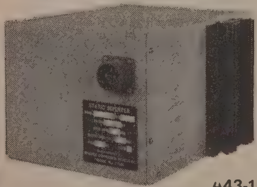
TYPICAL SPECIFICATION

INPUT** ± 15% from nominal
OUTPUT** Sine wave, 120 Volts RMS, 60 Hz
VOLTAGE REGULATION** 2% over full input and load range
FREQUENCY REGULATION** 1% over full input and load range
POWER FACTOR** .9 Lead to .8 Lag
EFFICIENCY** Over 80% at nominal input
DISTORTION** Less than 5%
OVERLOAD** Within specifications for ONE MINUTE at 140% load
OVERLOAD PROTECTION** No damage from short to open circuit, reversal of input, or input voltage to 140% nominal.

DESIGN FEATURES

Ruggedized construction, no moving parts, completely solid state, easy servicing - sides fold down, plug-in transistors and I/C's, transistors and I/C's on Printed Circuit Boards, all P/C boards plug-in removable.

250VA
INVERTER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STATIC INVERTER MODELS

Rating	12VDC	24VDC	48VDC	120VDC
36VA	A12-1	A13-1	A14-1	A16-1
72VA	A22-1	A23-1	A24-1	A26-1
125VA	A32-1	A33-1	A34-1	A36-1
250VA	A42-1	A43-1	A44-1	A46-1
500VA	A52-1	A53-1	A54-1	A56-1
1000VA		A63-1	A64-1	A66-1
2500VA		A73-1	A74-1	A76-1
5000VA			A84-1	A86-1

THREE PHASE MODELS AVAILABLE UP TO 15KVA

36VA
INVERTER

A12-1

ADVANCE CONVERSION DEVICES COMPANY

109 EIGHTH STREET, PASSAIC, NEW JERSEY 07055 Phone (201) 778-0707 ACDCo

Power WHEN you need it!

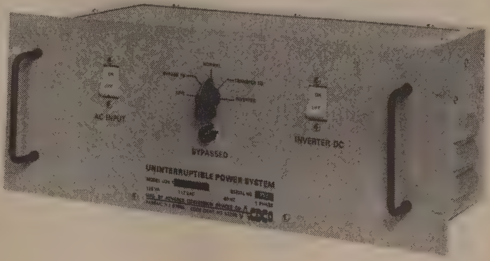
Protect Against Costly Power Interruptions

ACDCo UNINTERRUPTIBLE POWER SYSTEMS protect critical circuits for computer peripherals, process controls, telephone switch boards, high risk medical or experimental procedures and all systems requiring dependable emergency power when normal AC is lost.

UNINTERRUPTIBLE POWER SYSTEMS

Your margin of safety to insure continuous high quality power even in the event of any utility line or generator power fluctuation or failure.

Typical UPS model U34-1 is used to power a critical liquid hydrogen temperature control system at a major government research center.


AC INPUT
BYPASSED
INVERTER DC
UNINTERRUPTIBLE POWER SYSTEM
ACDCo

U 34-1

DESIGN FEATURES

Ruggedized Construction • Easy Servicing
Plug in Transistors and I/C's • Removable P/C Boards
Optimized design to provide maximum value for the procurement dollar

VA rating	36VA	72VA	125VA	250VA	500VA	1KVA	2.5KVA	5KVA
Model No.	U14-1	U24-1	U34-1	U44-1	U54-1	U64-1	U74-1 U76-1	U84-1 U86-1*

Three phase models also available from 100 VA to 15000 VA / Typical specifications relate to those of static inverters.

FREQUENCY CHANGERS

AC to AC converters available in eight model sizes 36 VA to 5000 VA plus three phase up to 15 KVA. Power frequencies changed from: 50 to 60 Hz - 60 to 50 Hz - 50 to 400 Hz - 60 to 400 Hz

STANDBY EMERGENCY POWER

DC source (battery or generator) up to 5 KVA - 1 Ø and up to 15 KVA - 3Ø - AC load.

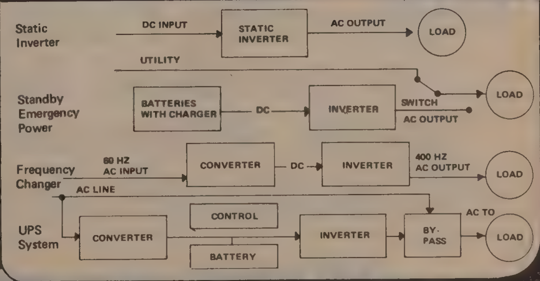
WIND DRIVEN SYSTEMS

ACDCo designs and manufactures the control, regulation, and power conversion subsystems for "modern" power systems from this "ancient" energy source.

SPECIAL POWER SYSTEMS BULLETIN

Ask for our power systems outline discussion in which ACDCo answers many outstanding questions of systems configuration.

ACDCo Power Systems Functional Diagrams

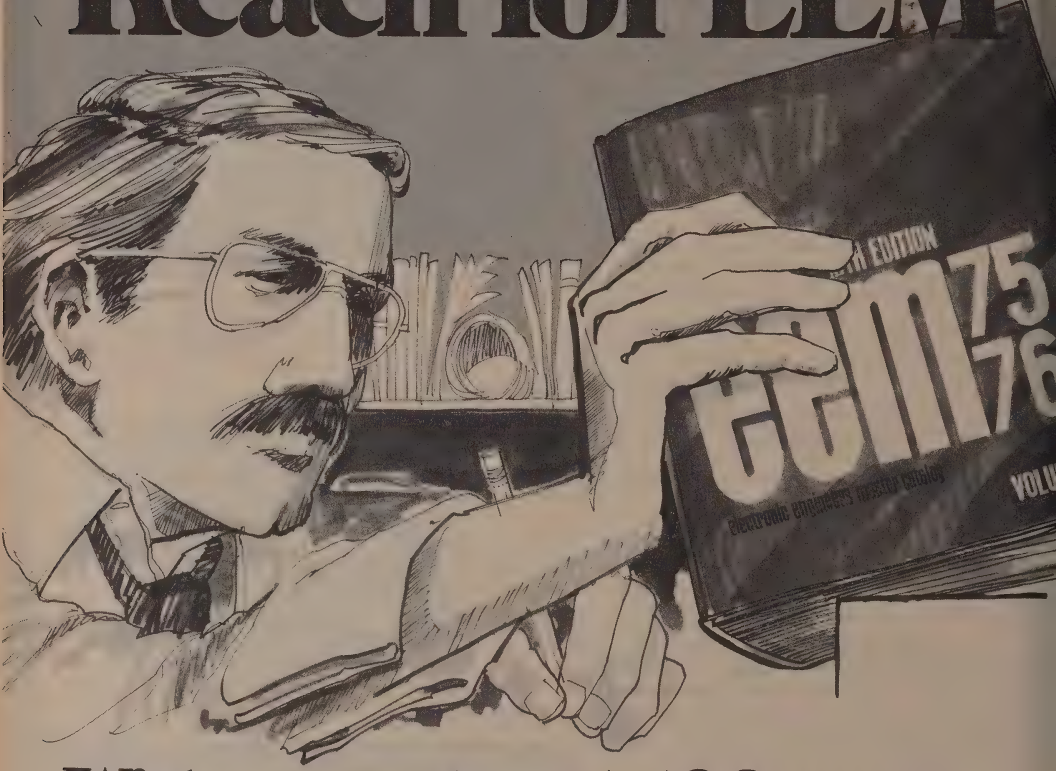

Static Inverter
DC INPUT
STATIC INVERTER
AC OUTPUT
LOAD
UTILITY
Standby Emergency Power
BATTERIES WITH CHARGER
DC
INVERTER
SWITCH
AC OUTPUT
LOAD
Frequency Changer
60 HZ AC INPUT
CONVERTER
DC
INVERTER
400 HZ AC OUTPUT
LOAD
AC LINE
UPS System
CONVERTER
CONTROL
BATTERY
INVERTER
BY-PASS
AC TO
LOAD

ADVANCE CONVERSION DEVICES COMPANY

109 EIGHTH STREET, PASSAIC, NEW JERSEY 07055 Phone (201) 778-0707

There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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With more than 4,400 pages of product data from 700 manufacturers of electronic products in EEM.

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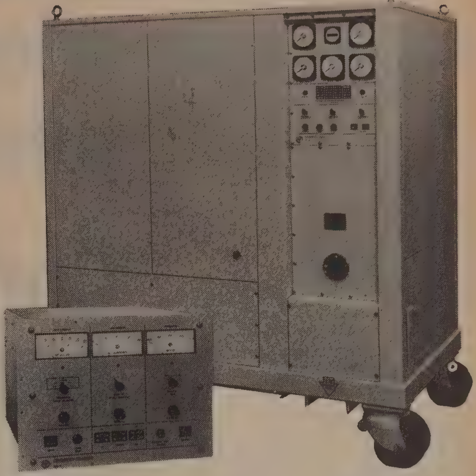
645 STEWART AVE., GARDEN CITY, N.Y. 11530 (516) 248-9700

Solid State Frequency Changers Inverters-Uninterruptible Power Systems

A•L•S has achieved major innovations in power conversion techniques and power systems control. These accomplishments enable A•L•S to offer, at competitive prices, frequency changers, inverters and uninterruptible power systems embodying the best characteristics of both solid state and rotating machine equipments without the performance and reliability limitations of either.

The SMG Series General Purpose Frequency Changers are available in 50, 60, or 400 Hz output and will accept 45 to 450 Hz input. There are ten standard models available from 5 to 375 KVA. Single phase output systems to 50 KVA are also available.

In addition to their superior performance, the SMG Series offer many truly unique features, the most important of which are listed below.



Model SMG-5.
5 KVA, 400 Hz
Output.

Model SMG-150.
150 KVA, 400 Hz
Output.

EXCLUSIVE FEATURES

- Unity power factor rated. Will handle continuous full rated load from .5 leading to .5 lagging power factor.
- Reserve capacity to handle surge loads. Will start and run one horsepower of motor load per KVA of rating.
- Convenient, reliable parallel operation. Any number of units may be paralleled to increase capacity.
- Status lamps indicate specific cause and power circuits deactivate in the event of abnormal line voltage, sustained overload, excessive temperature or output voltage.
- Very low open loop output impedance. Less than 5% transient voltage excursion for 50% step load change.
- Operates with any input phase rotation. No need to worry about expensive blow-ups each time the input source location is changed.
- Integral KVA meter and switch monitor each phase or total load KVA. Accuracy, ±2% regardless of load unbalances.
- Cannot be damaged by progressively applied or stepped overloads, or by input line transients.
- High input power factor and low line distortion. Does not control output by phase firing SCR's in the rectifier section.
- Plug-in modules can be easily replaced and are designed so that a component failure in one module will not produce a consequent failure of any other module.
- Switchboard instrumentation. 4½" square, 250° instruments are used exclusively on all units 50 KVA and above.

SPECIFICATIONS

INPUT

Voltage: Available in all standard, domestic and foreign nominal voltages ±10% or per customer specifications. Frequency 45 to 450 Hz.

OUTPUT

Voltage: Available in all standard, domestic and foreign voltages or per customer specifications. Output adustment is ±10% from nominal or optionally 0 to 110%. Regulation is ±0.5% for the combined effects of line, load and temperature.

Waveform: 2% THD at full load. 1% available optionally.

Current: Adjustable current limit from 75 to 125% of ratings or optionally from 0 to 125%. Manual current limit override allows over 200% of ratings for motor starting. Regulation is ±0.5% for the combined effect of line, load and temperature.

Power Factor: Full rated power from 0.5 capacitive to 0.5 inductive.

Phase Displacement: 120° ± < 1° for balanced loads. Load may be 100% unbalanced. Line-to-line voltage will remain within ±1% from the average for load unbalances of 50%.

Incidental Modulation: 0.025% peak FM and 0.025% to 1.0% peak AM depending on input power frequency and phase unbalance.

Response Time: 1 cycle of output.

Recovery Time: 4 cycles of output.

Frequency: 50, 60 and 400 Hz adustable ±5% are standard. Stability is ±0.1% constant environment, ±0.5% from cold start. Quartz time base with ±0.001% stability is available optionally.

Instrumentation: All indications are accurate to ±2% of full scale. Provided are input/output voltmeter(s), ammeter(s), KVA meter, dial and pointer hertzmeter and running time meter.

Status Lamps: Depending on model, 6 to 20 lamps indicate system operating status.

Protection: Combination of circuit breakers, fuses, sensing circuitry, air switches, thermostats and contactors positively protect the unit from fault loads, improper input voltages and consequential power train damage.

Environment: 0-50°C continuous, full ratings.

EMI

Shielded and filtered. Meets most EMI requirements. Optional filters for the most stringent requirements can be provided.

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Looking for a special power supply?

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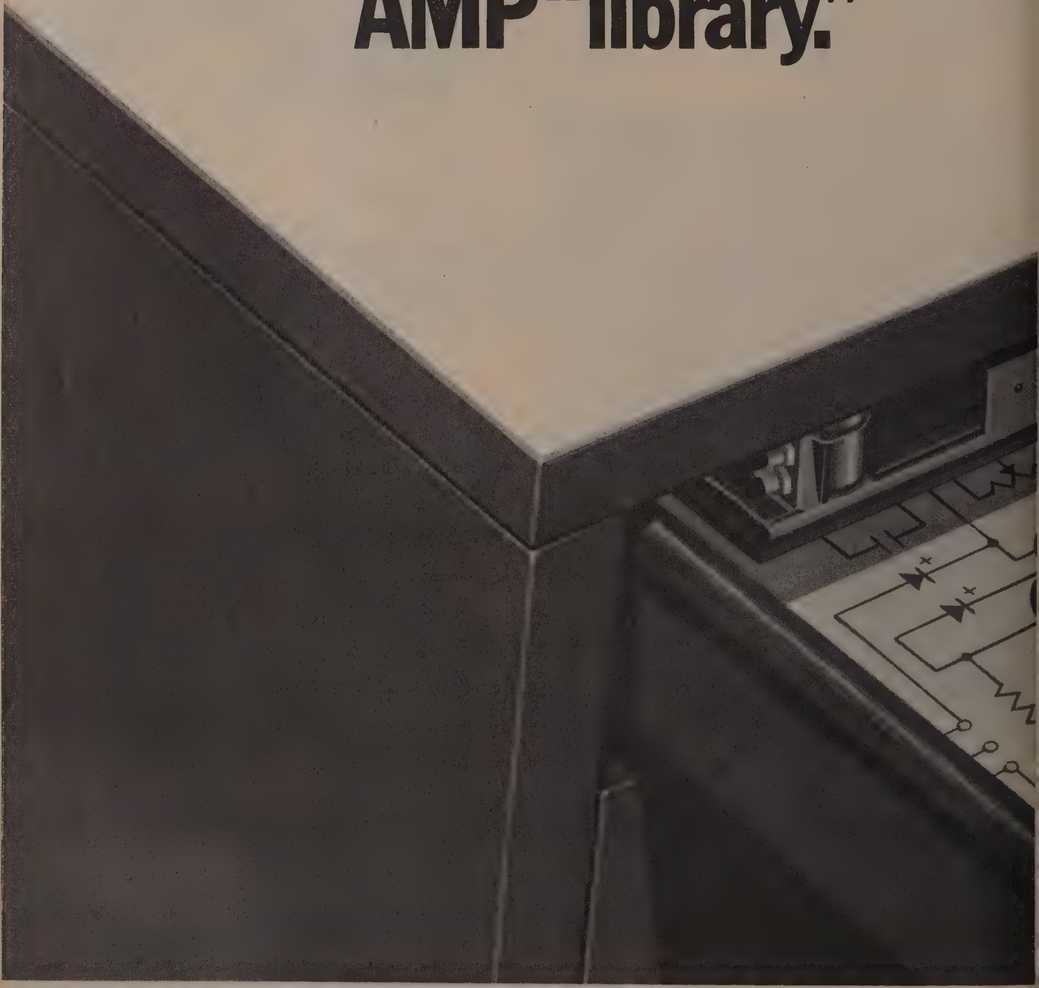

You'll find over 1000 performance proven designs—up to 60 KV, and 2 KW. The result of 20 years' experience in power supply design. In high-, low- or combination-voltage configurations.

For CRT's, lasers, scan converters, klystrons, photomultipliers, X-ray, vac-ion pumps, image intensifiers, orthicons, silicon image tubes, TWT's and low voltage systems.

Limited room? We'll design a power supply to fit. With more output per cubic inch than probably any other supply you can lay your hands on. And we'll work with you from start to finish—using specs you write or helping you write them.

Whatever you decide, you can be sure of one thing. You'll wind up with a good power supply that fits the space available...at a reasonable cost and in a reasonably short period of time.

For more information, call 717 367-1105
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Elizabethtown, Pa. 17022.

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POWER SUPPLY
CAPITRON
HIGH VOLTAGE

High Voltage Power Supplies and Modules

Telephone: (213) 997-7222

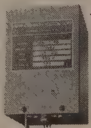
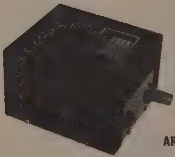
The HV models listed here fill the broadest range of applications and choice of options. In addition, Advanced High Voltage Co. has fully engineered High Voltage Power Supplies and Modules for a long list of specialized applications. See page 1•1092.

Advanced High Voltage Co. offers technical assistance for selecting and specifying High Voltage Supplies and Modules. Call us. If we cannot supply a unit to your specifications, we will assist you in obtaining a source.

HOW TO ORDER: Specify unit by model number and if applicable, add option number(s).

Advanced High Voltage Co. also manufactures the following type of High Voltage Supplies: High efficiency DC to DC converters, 1 to 500 watts, regulated and unregulated. OEM High Voltage Supplies for laser applications, x-ray, ion implantation, CRT displays, photo and microwave tubes, precipitation and electrostatic charge applications, multiple output and programmable supplies. Please contact factory for details.

Units are listed by series in order of increasing power output, then by increasing output voltage. Model number code: First letter refers to INPUT. A = 117 VAC, 50 to 400 Hz; D = 28 VDC. Second letter refers to LOAD REGULATION. R = regulated; U = unregulated. See specifications for line regulation. Other letters and numbers designate particular models.

EOUT Nom. kV	IOUT Max. mA	Model No.	Features, Specifications and Options	
1	15	HVA 1085	Encapsulated, compact High Voltage Sources for applications where user can supply 14 to 25 kHz at low cost. Units contain HV transformer, rectifier and filter components, and the upper, high resistance portion of the sensing divider. **Nominal Sensing Current:** 50 μa. **Ripple:** 0.1% P-P for 20 kHz, square wave drive. **Dimensions:** 2.13 x 1.06 x 3.13, 10 KV and above: 2.50 x 1.25 x 4.38. **Temperature** −10 to +65°C. **Weight:** 8 to 14 oz.	HVA
5	3	HVA 100		
10	1.5	HVA 200		
15	1	HVA 300		
20	0.8	HVA 400		
200V	15.0	DRF 325	Miniature, fully regulated DC to DC converter with 0.1% load regulation. Has remote programming capability. 3 watts output. Fully encapsulated, shielded, RFI decoupled, hermetically sealed. **Input:** 28 VDC. **Output Adjustment Range:** −30% to +10%. **Regulation (L/L):** 0.1%. **Ripple:** 0.1% P-P. **TC:** 100 ppm. **Operating Temperature:** −10°C to +65°C. **Dimensions:** 3.0″ x 1.5″ x 0.6″. (Flange length is 3.625″.) **Weight:** 4 oz. **Options:** Negative output (−01), remote program (−05), ±15 volt input (−33). Other options.	DRF/DUG
400V	7.5	DRF 335		
600V	5.0	DRF 345		
800V	3.7	DRF 355		
1.1	3.0	DRF 365		
1.5	2.0	DRF 375		
2.0	1.5	DRF 385		
2.5	1.2	DRF 395		
3.0	1.0	DRF 405		
4.0	0.8	DRF 415		
5.0	0.6	DRF 425		
200V	15.0	DUG 103	Miniature DC to DC converter similar to DRF series above, but with floating output. Units are line regulated adjustable and/or programmable. Minimum adjustment range is −20% to +10%. Other electrical and mechanical specifications same as DRF series.	
400V	7.5	DUG 113		
600V	5.0	DUG 123		
800V	3.7	DUG 133		
1.1	3.0	DUG 143		
1.5	2.0	DUG 153		
2.0	1.5	DUG 163		
2.5	1.2	DUG 173		
3.0	1.0	DUG 183		
4.0	0.8	DUG 193		
5.0	0.6	DUG 203		
200V	30.0	ARM 016	Fully regulated, 6 watt, DC to DC converter with self-contained AC-line to 28 VDC power supply. Units are shielded, serviceable short circuit proof and light weight. Input and output are RFI decoupled. Standard adjustment range is −30% to +10%. Series has wide range of options. **Input:** 117 VAC, 50 to 400 Hz. **Regulation (L/L):** 0.01%, (better with less than 0 to full load changes). **Ripple and Noise:** 0.1% P-P. **Operating Temperature:** −10°C to +65°C. **Size:** 3.04″ x 2.60″ x 4.23″. **Weight:** 32 oz. **Options:** Negative output (−01), wide adjustment range (−04), remote program (−05), improved ripple (−09). Other options.	 ARM
400V	15.0	ARM 026		
600V	10.0	ARM 036		
800V	7.5	ARM 046		
1.0	6.0	ARM 056		
1.2	5.0	ARM 066		
1.5	4.0	ARM 076		
1.8	3.3	ARM 086		
2.2	2.7	ARM 096		
2.5	2.4	ARM 106		
4.0	0.6	DRC 127	Dual output, MIL-SPEC, DC to DC converter, 6 watts. Unit has voltage monitor point, logic level turn-on, is short circuit proof and magnetically shielded. HV section is hermetically sealed. MTBF is 50,000 hrs. Meets MIL-P-81279, MIL-STD-5400, MIL-STD-704 and MIL-I-6181. **Input:** 28 VDC. **Regulation (L/L):** 0.1%. **Ripple:** 0.1% P-P. **Control Input:** +5 volts. **TC:** 100 ppm. **Operating Temperature:** −55°C to +80°C. **Focus Output:** 350 volts @ 50 μa. **Line Regulation:** 0.1%. **Load Regulation:** 2%. **Ripple:** 0.1%. **TC:** 0.1%/°C. **Dimensions:** 5.05″ x 2.9″ x 2.6″. **Weight:** 32 oz. Many other features and options. Contact factory for detail.	DRC
5.0	0.6	DRC 137		
7.5	0.4	DRC 147		
10	0.3	DRC 157		
12	0.2	DRC 167		
15	0.2	DRC 177		
3.0	5.0	ARA 106	Line operated, 15 watt High Voltage Module. Adjustable and/or programmable to zero. Fully serviceable, short circuit proof and shielded. Standard adjustment range is −30% to +10%. **Input:** 117 VAC, 50 to 400 Hz. **Regulation (L/L):** 0.1%. **Ripple:** 0.1% P-P. **TC:** 100 ppm. **Operating Temperature:** −10°C to +65°C. **Dimensions:** 4.66″ x 3.98″ x 3.0″. **Weight:** 3.5 lbs. **Options:** 0 to 110% voltage adjustment (−03), remote program, any voltage, either polarity (−05), negative output (−01), lower ripple figure (−09), higher power output (−19). Many other options.	 ARA
4.0	4.0	ARA 116		
5.0	3.0	ARA 126		
8.0	2.0	ARA 146		
10	1.5	ARA 156		
12	1.3	ARA 166		
15	1.0	ARA 176		
18	0.8	ARA 186		
22	0.7	ARA 196		

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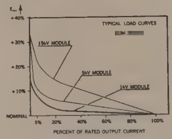
High Voltage Power Supplies and Modules

Advanced High Voltage Co. manufactures many other High Voltage Supplies not listed here. Telephone the factory sales office, (213) 997-7222, for assistance in selecting or specifying.

Eout Nom. kV	Iout Max. mA	Model No.	Features, Specifications and Options
800V	18.0	DRM 105	Fully regulated High Voltage Module. 15 watts output. All solid state silicon. Output adjustment +10%, −30%. Short-circuit proof. HV return may be floated to 500 volts from chassis. Magnetically shielded. Serviceable. **Input:** 28 VDC. **Regulation (L/L):** 0.1%. **Ripple:** 0.1% P-P. **TC:** 150 ppm. **Operating Temperature:** −20°C to +65°C. **Options:** Negative output (−01), wider adjustment range (−04), remote program (−05), ripple of 0.005% (−09), wider operating temperature range (−16), 30 watts output power (−19), ±15 volts input (−33). Other options.
1.0	15.0	DRM 115	
1.5	10.0	DRM 125	
2.5	6.0	DRM 135	
3.5	4.0	DRM 145	
5.0	3.0	DRM 155	
7.5	2.0	DRM 165	
10	1.5	DRM 175	
12.5	1.2	DRM 185	
15	1.0	DRM 195	
18	0.8	DRM 205	
22	0.6	DRM 215	
800V	18.0	DUM 044	28 VDC operated High Voltage Modules similar to DRM series above, except HV output is not in the regulation loop. This allows floating HV option with only 30 to 40 pf capacitance to input. More economical than DRM series where the higher internal impedance can be tolerated. (See regulation graph.) Input regulation, ripple and other data per DRM series. Units are normally furnished with attached leads.
1.0	15.0	DUM 054	
1.5	10.0	DUM 064	
2.5	6.0	DUM 074	
3.5	4.0	DUM 084	
5.0	3.0	DUM 094	
7.5	2.0	DUM 104	
10	1.5	DUM 114	
12.5	1.2	DUM 124	
15	1.0	DUM 134	
18	0.8	DUM 144	
22	0.6	DUM 154	

DRM/DUM

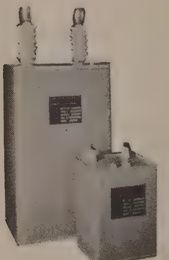


DUM LOAD CURVES

AUC SERIES

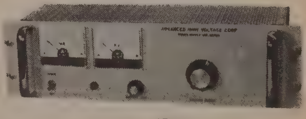
Economy High Voltage Module. Output adjustable by varying input voltage. Hermetically sealed. Shielded. **Input:** 117 VAC nom., 50 to 400 Hz. **Ripple at F/L:** 1% rms. **Operating Temperature:** 0 to +85°C.

Eout Nom. kV	Iout Max. mA	Model No.	DC Output Impedance Megohms	Case Width	Case Depth	Case Height	Terminal Height	Approx. Weight Pounds
				Inches				
1.0	1.5	AUC 017	0.90	3.75	1.75	3.38	0.38	1
1.0	5.0	AUC 015	0.65	3.75	2.25	3.38	0.38	1
1.0	10.0	AUC 011	0.04	3.75	2.25	3.38	0.38	2
2.0	1.5	AUC 027	0.13	3.75	1.75	3.38	0.38	1
2.0	5.0	AUC 025	0.10	3.75	2.25	3.38	0.38	2
2.5	10.0	AUC 031	0.08	3.75	2.25	3.75	0.63	3
5.0	1.5	AUC 037	0.40	3.75	2.25	3.38	0.56	2
5.0	5.0	AUC 035	0.25	3.75	2.25	3.75	0.63	3
5.0	10.0	AUC 041	0.13	3.75	4.56	5.88	1.06	11
10	1.5	AUC 047	1.50	3.75	3.19	4.50	1.06	4
10	5.0	AUC 045	0.50	3.75	4.56	5.88	1.06	8
10	10.0	AUC 051	0.26	3.75	4.56	8.00	1.06	12
15	1.5	AUC 057	1.60	3.75	3.19	5.50	1.69	5
15	5.0	AUC 055	0.50	3.75	4.56	6.13	1.69	11
15	10.0	AUC 061	0.28	4.69	6.00	8.50	1.69	20
20	1.5	AUC 067	1.70	3.75	4.56	5.88	2.25	9
20	5.0	AUC 065	0.86	3.75	4.56	8.00	2.25	12
25	10.0	AUC 071	0.30	5.63	7.38	12.13	3.25	45
30	1.5	AUC 077	2.00	3.75	4.56	7.50	3.25	11
30	5.0	AUC 075	1.00	4.69	6.00	8.50	3.25	22
37.5	10.0	AUC 081	1.30	11.13	14.63	16.25	4.31	124
50	1.5	AUC 087	5.00	4.69	6.00	8.50	4.31	18
50	5.0	AUC 085	1.20	5.63	7.38	12.13	4.31	40
75	1.5	AUC 097	4.70	5.63	7.38	12.13	7.50	45
75	5.0	AUC 095	2.20	11.13	14.63	16.13	7.50	124



AUC

Eout Nom. kV	Iout Max. mA	Output Power Watts	Model No.	Features, Specifications and Options
3	10	30	ARR 269	Rackmounted Supplies for Lab and Systems use. 19″ x 5¼″ rack. Separate voltage and current meter. Solid state silicon. Output adjustable from 0 to 100% with ten-turn pot. Adjustable 30 watt units have dissipative regulator, 150 watt units have high efficiency switching regulator. **Input:** 117 VAC, 50 to 400 Hz. **Ripple:** 0.1% P-P. **Regulation (L/L):** 0.1%. Other electrical data same as ARA series. **Options:** Negative output (−01), reversible output (−35), remote program (−05), ripple to 0.005% (−09), regulation to 0.005% (−15), delete meters (−39). Other options.
3	50	150	ARR 260	
5	6	30	ARR 279	
5	30	150	ARR 270	
10	3	30	ARR 289	
10	15	150	ARR 280	
15	2	30	ARR 299	
15	10	150	ARR 290	
20	1.5	30	ARR 309	
20	7.5	150	ARR 310	
30	1.0	30	ARR 319	
30	5.0	150	ARR 320	



ARR

DYNAMIC ELECTRONIC LOAD for testing of High Voltage Sources • Switches between 2 independently adjustable current levels at rates from DC (manual) to 100 kHz • Yields scope display of Regulation, Ripple, Load-Change-Response • Emax: +24 KV, Imax: 1 mA. Model No.: ARL 007. Size: 11″L x 7″H x 8″D.

ARL 007

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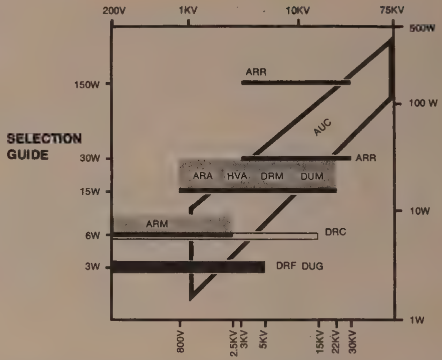
High Voltage Power Supplies and Modules

Advanced High Voltage Co., Inc. manufactures High Voltage DC sources anywhere in the graph, to 75 kilovolts, to 500 watts. The bars in the graph indicate the range covered by the company's STANDARD lines of modules and supplies. They are identified by the letters of their series. All units are adjustable, and most are programmable over a wide range of output voltages. The shaded areas indicate extended power output (option) for the particular series.



The following list shows examples of High Voltage Power Supplies and Modules, which were originally custom-designed for special applications as listed. They are now available as standard items. With the exception of the AUC referenced supplies, all units are DC to DC converters and can be furnished with different input and output voltages. The low-voltage units all have High Voltage input to output insulation. Output is adjustable on all regulated units (fully regulated and line only). Unregulated supplies have their output adjusted by means of the input. Units are listed in order of increasing output voltage. The 4th column lists the maximum output voltage available for the specific configuration. Maximum power output depends on the mechanical configuration and is one of the following: 6, 15, 30, 80, 150 or 280 watts. We invite you to telephone the factory engineering department for any other data you might need.

EOUT Nom. KV	IOUT mA	POUT Watt	Design EOUT Max. KV	EIN Nom.	Regulation Line % P-P	Regulation Load	Ripple % P-P	Dimensions W D H	Config. Reference	Model Number	Misc. Data and Application
2.2V	5A	11	10	28 VDC	0.1	—	0.5	2.70x2.34x3.77	DRM	1232	15 KV insulation Magnetron filament
6.3V	2A	12.6	10	28 VDC	0.1	N/A	0.5	2.70x2.34x3.77	DRM	1138	CRT 15 KV Insulation display
+10V, +20V	20	1	10	28 VDC	N/A	N/A	0.5	2.70x2.34x3.77	DRM	1220	+5, ±15V 3-terminal regulators, 15 KV insulation
200V	.2A	40	200V	115 VAC	0.2	0.2	.01	4.85x6x2.75	Finned box	1260	Gas discharge display
250V	.2A	50	15	28 VDC	0.1	0.1	0.1	5.0x4.75x4.75	ARA	1142	General purpose
300V	20	6	2.5	115 VAC	0.01	0.01	0.1	3.04x2.6x4.23	ARM	1168	Display
400V	35	14	10	28 VDC	0.1	8-10	0.1	2.72x2.34x3.77	DRM	1183	Laser application
800V	1.5	1.2	30	115 VAC	N/A	N/A	1%	3.75x1.75x3.38	AUC	1204	CRT focus, floating output
1000V	100	100	5	28 VAC	0.1	0.1	0.1	5.0x4.75x4.75	ARA	1172	External program, 500 to 1000V
1.5 P-P	—	15	15	15 VDC	—	—	—	2.70x2.34x3.77	DRM	1190	7.5 or 15 kHz, test diode/capacitor multipliers
2.5	20	50	30	115 VAC	0.1	0.1	0.1	19x5.25x8	ARR	1175	No meters, constant voltage/constant current
2.5	100	250	5	150 VDC	0.1	0.1	0.1	5.0x4.75x4.75	ARA	1177	Laser Applications
3	10	30	30	115 VAC	—	1-5%	1	3.75x4.56x5.88	AUC	1210	Ion pump supply
3.7	60	225	5	28 VDC	0.1	0.1	0.1	5.0x4.75x4.75	ARA	1169	VT Magnetron, remote program
3.7	75	278	5	115 VAC	0.1	0.1	0.1	19x5.25x8	ARR	1191	VT Magnetron, remote program
+6 −3	.5	4.5	22	28 VDC	0.1	—	0.1	3.54x3.03x4.84	DRM	1147	CRT display
10	50μa	.5	10	12 VDC	0.1	—	0.1	2.70x2.34x3.77	DRM	1211	Image intensifier
10	8	80	15	28 VDC	0.1	0.1	0.1	5.0x4.75x4.75	ARA	1189	Laser flash lamp. Constant current
15	1	15	22	30 VDC	—	8-10	0.1	3.54x3.03x4.84	DRM	1102	Electron Microscope
30	.1	3	30	24 VDC	0.005	0.05	0.05	4.66x3.98x3.25	DRC	1156	Low noise, low Tc, remote program
30	1	30	30	115 VAC	0.001	0.01	0.01	19x5.25x8	ARR	1247	5 digit thumbwheel voltage set, constant voltage/constant current.

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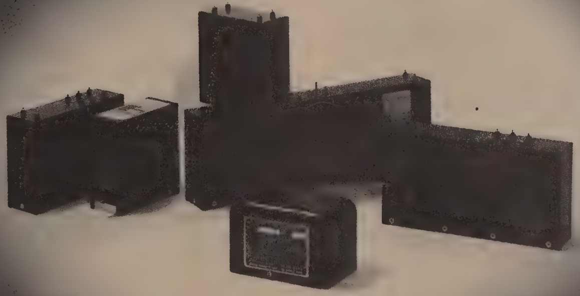
miniaturized • high efficiency • sub-modular

POWER CONVERSION EQUIPMENT



ARNOLD MAGNETICS

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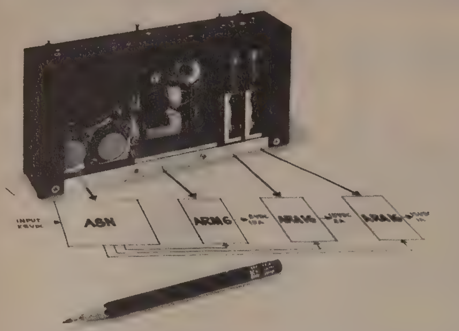
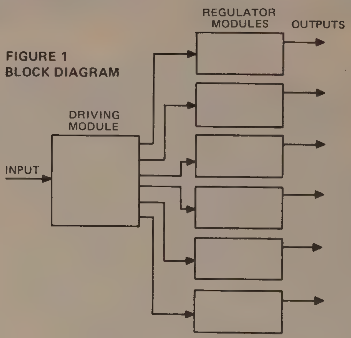
MODULAR POWER SUPPLIES

Design As You Order



Arnold Magnetics Thin-Mods let you design your own custom power conversion system as you order. No engineering charges . . . no lost design time. And, the complete power supply is provided in a pretested, encapsulated miniature package.

FIGURE 1
BLOCK DIAGRAM



HOW TO SPECIFY AND ORDER

1. **BLOCK DIAGRAM:** Construct your Power Conversion System block diagram in Figure 1.
   A. Use one block for the Driving Module.
   B. Use one block for each output required.
2. **REGULATOR SELECTION:** Select Regulator Modules from Table M1. Enter the following in Table M3 for each output:
   A. Module Part Number
   B. Output voltage (nominal) from Table M1 in Volts column
   C. Maximum output current for application in Amps column
   D. Output power in Watts column
   E. Input power (Watts/Efficiency) in Input Power column
3. **DRIVING MODULE SELECTION:** Select Driving Module from Table M2 using prime power source and Total Input Power from Table M3. The Driving Module must be capable of providing more power than the Total Input Power required for the Regulator Modules.
4. **CASE SIZE SELECTION:** Using the sum of all module lengths selected from Table M3, select the shortest case size that will accommodate from Table M4.
5. **PRICING:** Price and Weight for complete power system is the sum of the applicable column from Table M3.
6. **PART NUMBER:** Construct Power Converter Part Number as follows: Driving Module Part Number from Table M2 — Last Letter of Regulator Module Part Number from Table M1 — Operating Voltage (VDC)/Operating Current (AMPS) — Case Size Letters from Table M4.
   List Regulators in descending order of operating current.
   Enter Power Converter Part Number at "AMC/PN".
   Example: APT-M5/15V-T30/1-A15/.2-DA
   INPUT: (APT)-105 to 125 VRMS, 50-500 Hz
   OUTPUTS:
   1. (ARM 6) — Delivers 5 VDC @ 15 AMPS, overvoltage protection option (V) at 6 ±.5V
   2. (ART 30) — Delivers 30 VDC @ 1 AMP
   3. (ARA 16) — Delivers 15 VDC @ .2 AMP

   CASE SIZE: (DA Table M4) 1⅝ × 3⅝ × 10½
7. **DELIVERY:** Normal delivery is 10 days ARO.
8. **HOW TO ORDER:** Order using AMC P/N (defined as above) and base price (1 pc) from Table M3. Price discounts 2-4 pcs. .90 × base price, 5-9 pcs .85 × base price, 10-24 pcs .80 × base price. Consult sales representative or factory for higher quantity price discounts and special modules.

AMC P/N______________________________

TABLE M3
SPECIFICATION WORK FORM

No.	Required Outputs: Volts (1) (Nominal)	Amps (Max. Req.)	Watts	Regulator Input Power (Watts/Eff.)	Module: Part Number	Length (inches)	Price (3) (1 pc)	Weight (oz.)
1								
2								
3								
4								
5								
6								
Total Regulator Input Power								
Driving Module Output Power (2)								
				Total				

NOTES:
(1) From Table M1.
(2) From Table M2, must exceed Total Input Power.
(3) For quantity discounts see "How To Order", instruction #8.

TABLE M4
MECHANICAL CHARACTERISTICS

Fig. (See Page A8)	Case Size	Number of Terminals	Total of Module Lengths (inches)	Outside L (Max.) (inches)	N (inches)	Number of Mtg. Holes
4	AA		3.2	3½	2.750	4
4	BA		4.7	5	4.250	4
4	CA		6.7	7	2.750	6
4	DA		10.2	10½	4.500	6
5	AB		3.2	3½	2.750	4
5	BB		4.7	5	4.250	4
5	CB		6.7	7	2.750	6
5	DB		10.2	10½	4.500	6
5	EB		14.7	15	4.500	8

Case: Black anodized aluminum.
Terminals: Turret style with Teflon insulation.
Mounting Holes: Threaded for 6/32 screw, ¼" deep.

MODULAR POWER SUPPLIES
Design As You Order

ARNOLD MAGNETICS

TABLE M1
GENERAL SPECIFICATIONS FOR REGULATOR MODULES

- Magnetic Amplifier Regulator — High Power — High Efficiency ARM, BRP and BRQ.
- Switching Regulator — Medium Power — High Efficiency — ART
- Series Regulator — Medium Power — Low Voltage — ARA and ARC
- Series Regulator — Medium Power — High Voltage — ARB

Nominal Output Voltage (Adjustable) ±5%		Max. Output (71°C Case Temp.) Current (Amps)	Regulator Power Efficiency (1)	Regulation(2)		Module(4) Part Number	Module Length (inches)	Price (1 pc)
Min.	Max.			Line (±10%)	Load (½FL-FL)			
4.2	6	4.0	70%	1.0%	1.0%	ART 6	1.4	$158
2.9	6	4.0	55%	0.1%	0.1%	ARA 6	0.6	74
4.2	6	6.0	55%	0.1%	0.1%	ARC 6	1.2	102
2.9	6	20.0	73%	0.2%	0.2%	ARM 6(3)	1.4	297
4.2	6	50.0	73%	0.2%	0.3%	BRP 6*	4.2	515
4.2	6	100.0	73%	0.2%	0.3%	BRQ 6*	4.2	760
6.1	16	2.5	80%	1.0%	1.0%	ART 16	1.4	158
6.1	16	2.5	65%	0.1%	0.1%	ARA 16	0.6	74
6.1	16	5.0	65%	0.1%	0.1%	ARC 16	1.2	102
6.1	16	9.0	84%	0.2%	0.2%	ARM 16(3)	1.4	297
6.1	16	18.0	84%	0.2%	0.3%	BRP 16*	4.2	515
6.1	16	52.0	84%	0.2%	0.3%	BRQ 16*	4.2	760
16.1	22	7.0	84%	0.2%	0.2%	ARM 22(3)	1.4	297
16.1	22	22.0	87%	0.2%	0.3%	BRP 22*	4.2	515
16.1	22	38.0	87%	0.2%	0.3%	BRQ 22*	4.2	760
16.1	30	1.0	80%	1.0%	1.0%	ART 30	1.4	158
16.1	30	1.5	70%	0.1%	0.1%	ARA 30	0.6	74
16.1	30	3.0	70%	0.1%	0.1%	ARC 30	1.2	102
22.1	30	5.0	90%	0.2%	0.2%	ARM 30(3)	1.4	297
22.1	30	15.0	90%	0.2%	0.3%	BRP 30*	4.2	515
22.1	30	28.0	90%	0.2%	0.3%	BRQ 30*	4.2	760
30.1	50	0.5	80%	0.1%	0.1%	ARB 50	0.6	89
70	100	0.25	80%	0.1%	0.1%	ARB 100	0.6	89
70	100	2.0	91%	0.2%	0.3%	ARM 100(3)	1.4	297
70	100	5.0	91%	0.2%	0.3%	BRP 100*	4.2	515
70	100	10.0	91%	0.2%	0.3%	BRQ 100*	4.2	760
110	160	0.16	70%	0.1%	0.1%	ARB 160	0.6	94
161	200	0.13	70%	0.1%	0.1%	ARB 200	0.6	100
100	200	5.0	91%	0.2%	0.3%	BRQ 200*	4.2	760
201	250	0.10	70%	0.1%	0.1%	ARB 250	0.6	110
251	300	0.01	70%	0.1%	0.1%	ARB 300	0.6	143

*Consult factory for delivery.

Outputs are all isolated Output Voltage Adjustment ±5% min.

Short Circuit Protection on all Regulator Modules

Overvoltage Protection Option Available for All Regulator Modules up to 30 VDC, set to 20% above maximum output voltage. Specify "V" after module part number. (add 0.6" to module length for each output with this option). (See Table 1.)

Ripple and Noise (Max.):	0.1% VRMS + 10 MV for ARA & ARB 0.5% VRMS + 10 MV for ART, ARM, BRP & BRQ
Temperature Coefficient:	0.01%/°C for ARA, ARB, & ARC 0.02%/°C for ART, ARM, BRP, BRQ
Weight (Including Case):	4.5 oz. for ARA & ARB & option "V" 10.0 oz. for ART 20.0 oz. for ARM 88.0 oz. for ARQ, BRP & BRQ
Operating Case Temperature:	−10°C to 71°C

TABLE M2
GENERAL SPECIFICATIONS FOR DRIVING MODULES

- 115 VAC, 47–500 Hz Input (25 KHz Converter)
  - 110 Watts output—APS
  - 200 Watts output—APT
  - 500 Watts output—BRN
  - 1000 Watts output—BPQ*
- 115 VAC, 400 Hz Input (Transformer)
  - 50 Watts output—ATA
  - 100 Watts output—ATB
- 220 VAC, 47–500 Hz Input (25 KHz Inverter)
  - 110 Watts output—APF
  - 200 Watts output—APG
  - 500 Watts output—BPF
  - 1000 Watts output—BPE
- 28 VDC Input (25 KHz Inverter)
  - 100 Watts output—ASM
  - 200 Watts output—ASN
  - 600 Watts output—BST*
  - 1200 Watts output—BSP
- 12 VDC Input (25 KHz Inverter)
  - 45 Watts output—ASL
  - 90 Watts output—ASA
  - 230 Watts output—BSB*
- 48 VDC Input (25 KHz Inverter)
  - 100 Watts output—ASG
  - 200 Watts output—ASJ
  - 600 Watts output—BSD*
  - 1200 Watts output—BSF*
- 115 VDC Input (25 KHz Inverter)
  - 110 Watts output—ASH
  - 220 Watts output—ASK
  - 500 Watts output—BSR*
  - 1000 Watts output—BSQ*

Input	Output Power (watts)	Module Part Number	Module(4) Length (inches)	Price (1 pc)
115V, 47 – 500 Hz	110	APS	4.1	$212
115V, 47 – 500 Hz	200	APT	4.8	319
115V, 47 – 500 Hz	500	BRN	7.8	635
115, 240 or 480V 3 Phase†	1000	BPQ*	6.2	980
115V, 340 – 500 Hz	50	ATA	3.6(5)	154
115V, 340 – 500 Hz	100	ATB	4.3(5)	192
187 – 242 AC, 47 – 500 Hz	110	APF	6.2	249
187 – 242 AC, 47 – 500 Hz	200	APG	6.2	337
187 – 242 AC, 47 – 500 Hz	500	BPF	9.0	745
187 – 242 AC, 47 – 500 Hz	1000	BPE	9.0	990
11 – 13 VDC	45	ASL	2.4	142
11 – 13 VDC	90	ASA	2.4	205
11 – 13 VDC	230	BSB*	4.2	556
24 – 30 VDC	100	ASM	2.4	142
24 – 30 VDC	200	ASN	2.4	205
24 – 30 VDC	600	BST	4.2	525
24 – 30 VDC	1200	BSP*	4.2	862
44 – 52 VDC	100	ASG	2.4	170
44 – 52 VDC	200	ASJ	2.4	264
44 – 52 VDC	600	BSD*	4.2	551
44 – 52 VDC	1200	BSF*	4.2	862
135 – 165 VDC	110	ASH	2.4	156
135 – 165 VDC	220	ASK	2.4	233
105 – 120 VDC	500	BSR*	4.2	537
105 – 120 VDC	1000	BSQ*	4.2	862

*Consult factory for delivery

Inputs are isolated from output and Case EMI/RFI Filtering

Transient Protection Option Available

Special Driving Modules available with Modified Output Power and Input Voltages

Weight (Including Case): APS—23 oz. ASL, ASM, ASG, ASH—18 oz., APT—26 oz., ASA, ASN, ASJ, ASK—20 oz., ATA—30 oz., ADN—14 oz., ATB—35 oz., BRN, BPF, BSB, BSD, BSR, BPQ, BPE, BST, BSF, BSQ—75 oz.

Operating Case Temperature -10°C to +71°C

†Specify input in Model Number, thus: BPQ (240 Δ) –XXX (47-500 Hz) 480V must be 4 wire Y

NOTES:

(1) Max. Output Voltage and Current, nominal Input

(2) Add 10 MV to Load Regulation and Line Regulation for all models.

(3) ARM Regulator Modules may not be used with ATA or ATB Driving Modules

(4) Module part numbers beginning with the letter "B" defines case 3¼"W × 3⅝" H (Mate with "B" Driver only)

(5) Add 0.6 inches to length for each additional amp of output current over 3 amps for each regulator. Not to be used with ARM regulators.

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ARNOLD MAGNETICS

AC-DC REGULATED CONVERTERS

115 VAC 50-500 Hz to single or multiple DC outputs

Case CA

FEATURES:

- Wide output voltage choice
- Multiple outputs standard
- Short circuit protected
- Miniature size
- Light weight
- Fully encapsulated
- Meets MIL-E-5272C

SPECIFICATIONS

INPUT: 105-125 VRMS, 10 47-500 Hz (See Note 4)
OUTPUT: 2 VDC through 2000 VDC, 12 Amps and below up to four outputs
OUTPUT REGULATION AND RIPPLE: See Notes 1 thru 4
OPERATING TEMPERATURE: −10° to 71°C at case
COOLING: Primarily cooling by conduction through base plate
ENVIRONMENTAL: Per MIL-E-5272C
EMI/RFI: Filtering in all models

SINGLE OUTPUT MODELS

Output			Case Size (See table II)	Model Number	Price (1 pc)
Voltage (Volts)	Current (Amps)	Notes			
2	5.00	(1)	A	PHU-2	$287
3	5.00	(1)	A	PHU-3	287
5 5 5	5.00 4.00 12.00	(1) (2) (3)	A CA CA	PHU-5 APS-A5 APS-M5	287 286 509
6	5.00	(1)	A	PHU-6	287
10	4.00	(1)	A	PHU-10	306
12 12	3.30 5.00	(1) (3)	A CA	PHU-12 APS-M12	306 509
15 15 15	2.00 2.60 5.00	(2) (1) (3)	CA A CA	APS-A15 PHU-15 APS-M15	286 306 509
18	2.20	(1)	A	PHU-18	306
22	1.80	(1)	A	PHU-22	306
24 24 24	1.00 1.60 2.60	(2) (1) (3)	CA A CA	APS-A24 PHU-24 APS-M24	286 306 509
28 28	1.40 2.60	(1) (3)	A CA	PHU-28 APS-M28	306 509
30 30 30	1.00 1.30 2.60	(2) (1) (3)	CA A CA	APS-A30 PHU-30 APS-M30	286 306 509
50	0.80	(1)	A	PHU-50	306
100 100	0.25 0.40	(2) (1)	CA A	APS-B100 PHU-100	301 306
180	0.10	(2)	CA	APS-B180	312
200	0.20	(1)	A	PHU-200	306
300	0.13	(1)	A	PHU-300	306
500	0.80	(1)	A	PHU-500	306
750	0.05	(1)	A	PHU-750	306
1000	0.03	(1)	A	PHU-1000	320
1500	0.01	(1)	A	PHU-1500	457
2000	0.01	(1)	A	PHU-2000	457

MULTIPLE OUTPUT MODELS

Output			Case Size (See table II)	Model Number	Price (1 pc)
Voltage (Volts)	Current (Amps)	Notes			
15 5	1.00 3.00	(2)	CA	APS-A5-A15	$360
15 5	1.00 2.50	(1)	A	PHU-15-5	345
15 −15	1.00 1.00	(2)	CA	APS-A15-A15	360
15 −15	1.30 1.30	(1)	A	PHU-30CT	345
−24 15	0.80 1.50	(1)	A	PHU-24-15	345
180 5	0.10 3.00	(1)	A	PHU-180-5	345
15 −15 5	0.50 0.50 2.00	(1)	A	PHU-30CT-5	411
15 −15 5	0.50 0.50 4.00	(2)	CA	APS-A5-A15-A15	434
−24 15 5	0.50 0.50 3.00	(2)	CA	APS-A5-A24-A15	434
180 15 −15	0.03 0.30 0.30	(1)	A	PHU-180-30CT	411
180 15 −15	0.10 0.60 0.60	(2)	CA	APS-A15-A15-B180	460
750 150 5	0.01 0.10 1.00	(1)	A	PHU-750-150-5	425
15 −15 5 −5	0.30 0.30 1.00 1.00	(1)	A	PHU-30CT-10CT	446
−24 15 −15 5	0.10 0.30 0.30 2.00	(1)	A	PHU-30CT-24-5	466
180 15 −15 5	0.03 0.30 0.30 2.00	(1)	A	PHU-180-30CT-5	466

OPTIONS (See Table 1):

A — Remote external voltage adjustment
CT — Center tap output
E — Input voltage
G — Flexible Leads
I — RFI qualified (MIL-1-6181D certification)
S — Short terminals
V — Overvoltage protection

NOTES:

(1) Load Reg. (½ FL-FL) 2% Max., Line Reg. .3%, adjust ±5% of nominal output, ripple .3% VRMS +10 MV. Options available: A, CT, E, G, I, S, V

(2) Load Reg. (½ FL-FL) 0.1% + 10 MV, Line Reg. 0.1% + 10 MV, Adjust ±5% of nominal output, Ripple 0.1% VRMS + 10 MV.

(3) Load Reg. (½ FL-FL) 0.2% + 10 MV, Line Reg. 0.2% + 10 MV. Adjust ±5% of nominal output, Ripple 0.5% VRMS + 10 MV.

(4) Input voltage range for PHU 105-125 VRMS.

Case BB

HOW TO ORDER:

- Standard models: Use model numbers listed. Add option letters as required per Table 1.
- Special models: Use three letter model number followed by voltage (volts)/current (amps). Use standard model of highest voltage for output power rating and price. For PHU model only.

EXAMPLE: PHU-5.5V/5 has output of 5.5 VDC at 5 amps with overvoltage protection option. Price in 1 pc. quantity $335 00 Case Size B.

For other Models see "Design As You Order" pages. **A·4**

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AC-DC REGULATED POWER SUPPLIES

115 VAC 400 Hz to single or multiple DC outputs

ARNOLD MAGNETICS

FEATURES:

- ■ Short circuit protected
- ■ Multiple outputs standard
- ■ MIL STD 704 power input
- ■ Isolated outputs
- ■ Small size
- ■ Tight regulation
- ■ EMI/RFI free
- ■ Fully encapsulated
- ■ Conduction cooled

SPECIFICATIONS:

INPUT: 105-125 VAC, 1Ø, 380 to 420 Hz
OUTPUT: Up to three outputs. 5 VDC to 200 VDC
REGULATION:
LINE: ±.1% (105-125 VRMS) + 10 MV
LOAD: ±.1% (1/2 FL-FL) + 10 MV
TEMP. COEFFICIENT: −.015%/°C
RIPPLE: .1% VRMS: +10 MV Max.
OPERATING TEMPERATURE: −10°C to +71°C at case.

OPTIONS: (See Table 1)

A — Remote external voltage adjustment
E — Input voltage alteration
G — Flexible leads
S — Short terminals
V — Overvoltage protection

SINGLE OUTPUT MODELS

Output					
Voltage (Volts)	Current (Amps)	Notes	Case Size (See table II)	Model Number	Price (1 pc)
5	3.0	Logic Power	BA	ATA-A5	$228
12	2.0	Linear Amp Power	BA	ATA-A12	228
15	2.0	Op Amp Power	BA	ATA-A15	228
22	1.0	Linear Amp Power	BA	ATA-A22	228
24	1.0	24 VDC	BA	ATA-A24	228
28	1.0	Linear Power Amp	BA	ATA-A28	228
100	0.25	Vacuum Tube Power	BA	ATA B100	243
150	0.16	Vacuum Tube Power	BA	ATA-B150	248
200	0.13	Display Power	BA	ATA-B200	254

MULTIPLE OUTPUT MODELS

Output					
Voltage (Volts)	Current (Amps)	Notes	Case Size (See table II)	Model Number	Price (1 pc)
12 5	1.00 4.00	Linear Amp and Logic Power	CA	ATB-A5-A12	$340
15 5	1.00 4.00	Linear Amp and Logic Power	CA	ATB-A5-A15	340
15 15	1.00 1.00	Op Amp Power	CA	ATB-A15-A15	340
28 5	1.00 4.00	Combination Logic Power	CA	ATB-A5-A28	340
200 5	0.13 4.00	Display and Logic Power	CA	ATB-A5-B200	366
15 15 5	0.50 0.50 2.00	Op Amp and Logic Power	CA	ATA-A5-A15-A15	376
15 15 5	1.00 1.00 4.00	Op Amp and Logic Power	CA	ATB-A5 A15-A15	414
24 14 5	0.50 0.50 4.00	MOS and Logic Power	CA	ATB-A5-A24-A14	414
200 28 5	0.13 0.50 4.00	Display, Linear Amp and Logic Power	CA	ATB-A5-A28-B200	440

HOW TO ORDER:

Standard models: Use model numbers listed. Add option letters as required per Table 1.

For other Models see "Design As You Order" pages.

DC-SINE WAVE INVERTERS

28 VDC to 400 Hz Sine Wave Output

FEATURES:

- ■ Miniature Size
- ■ Closely Regulated Output Voltage
- ■ Low Harmonic Distortion
- ■ Meets MIL-E-5272 & MIL-STD-709A
- ■ Closely Regulated Output Frequency
- ■ Generates NO RFI-EMI

SPECIFICATIONS:

INPUT: 24-30 VDC
OUTPUT: Voltage: 28 or 115 VRMS, Isolated from case and input. (Other voltages 6-440 VRMS available).
FREQUENCY: 400 Hz (Other frequencies 360 to 10 KHz available).
WAVE SHAPE: Sine Wave with maximum distortion of 6%.
REGULATION: Output Voltage: ±.5% line, ±2% load.
OUTPUT FREQUENCY: ±.3% line, ±.2% load.
OPERATING TEMPERATURE: −10° to +71°C at case.
COOLING: Primarily cooling by conduction thru base plate.
TEMP. COEFFICIENT: ±.05%/°C.

Output (VRMS)	Output Power (VA)	Case	Model Number	Price 1 pc.
115	50	K	SKB-28-115-400-50	$353
115	100	L	SKD-28-115-400-100	625
28	50	K	SKB-28-28-400-50	353
28	100	L	SKD-28-28-400-100	625

HOW TO ORDER:

(1) Standard Units: Use Model Numbers listed.

(2) Special Units: Specify SKB (50VA), SKD (100VA)—Nominal Input Voltage—Output Voltage—Frequency—Output Power (VA).

EXAMPLE: SKB 26-100-800-40 operates on a nominal 26 VDC input and deliver 100 VRMS at 800 Hz with output power of 40 VA.

DC-DC REGULATED CONVERTERS

11 to 13 VDC Input to DC Power Converters

FEATURES

- ■ Wide choice of input voltage
- ■ Polarity reversal protection
- ■ 5000 Volt output isolation
- ■ Small size
- ■ EMI/RFI filtering
- ■ High reliability

SPECIFICATIONS:

See notes for individual models.

OPTIONS (See Table 1):

A — Remote external voltage adjustment
CT — Center tap output
E — Input voltage modification
G — Flexible leads
V — Overvoltage protection

Case A

Output								
Voltage (VDC)	Current (Amps)	Line(5) Reg. %	Load(5) Reg. %	Ripple(6) (%V RMS)	Notes	Case Size (See Table II)	Model Number	Price (1 pc)
5 5	2.50 4.00	0.3 0.1	2.0 0.1	0.5 0.1	(2) (4)	A AA	SHU-5EE ASL-A5	$316 316
12 12	1.00 5.00	0.3 0.2	2.0 0.2	0.5 0.5	(2) (4)	A BA	SHU-12EE ASA-M12	302 502
15 15	1.00 1.30	0.3 0.1	2.0 0.1	0.5 0.1	(2) (4)	A AA	SHU-15EE ASL-A15	302 216
30 30	0.50 2.00	0.3 0.2	2.0 0.2	0.5 0.5	(2) (4)	A BA	SHU-30EE ASA-M30	302 502
50	0.40	0.3	2.0	0.5	(2)	A	SHU-50EE	302
100	0.20	0.3	2.0	0.5	(2)	A	SHU-100EE	302
250	0.08	0.3	2.0	0.5	(2)	A	SHU-250EE	302
500	0.04	0.3	2.0	0.5	(2)	A	SHU-500EE	340
750	0.02	0.3	2.0	0.5	(2)	A	SHU-750EE	322
1000	0.02	0.3	2.0	0.5	(2)	A	SHU-1000EE	355
1500	0.01	0.3	2.0	0.5	(2)	A	SHU-1500EE	394
2000	0.01	0.3	2.0	0.5	(2)	A	SHU-2000EE	453
2500	0.008	0.3	2.0	0.5	(2)	A	SHU-2500EE	453
15 −15	0.40 0.40	0.3	2.0	0.5	(2)	A	SHU-30CT EE	344
15 −15	1.50 1.50	0.1	0.1	0.1	(4)	BA	ASA-A15-A15	353
24 12	0.20 0.40	0.3	2.0	0.5	(2)	A	SHU-24-12EE	352
24 12	1.00 2.00	0.1	0.1	0.1	(4)	BA	ASA-A12-A24	353
180 5	0.05 2.00	0.3	3.0	0.5 0.5	(2)	A	SHU-180-5 EE	381
15 −15 5	0.20 0.20 1.00	0.3	3.0	0.5 0.5 0.5	(2)	A	SHU-30CT-5EE	416
−24 −12 5	0.10 0.20 1.00	0.3	3.0	0.5 0.5 0.5	(2)	A	SHU-24-12-5EE	416
180 15 −15 5	0.02 0.20 0.20 1.00	0.3	3.0	0.5 0.5 0.5 0.5	(2)	A	SHU-180-30CT-5EE	486

NOTES: See next page.

ARNOLD MAGNETICS CORPORATION 11520 W. Jefferson Blvd., Culver City, Ca. 90230 • (213) 870-7014 • TWX 910-343-6468

ARNOLD MAGNETICS

DC-DC REGULATED CONVERTERS

12, 28, 48 or 115 VDC to single or multiple DC outputs

FEATURES

- Wide choice of input voltage
- Polarity reversal protection
- 5000 Volt output isolation
- Small size
- EMI/RFI filtering
- High reliability

SPECIFICATIONS: See notes for individual models.

OPTIONS (See Table 1):

A — Remote external voltage adjustment
CT — Center tap output
E — Input voltage modification
G — Flexible leads
V — Overvoltage protection

11-13 VDC INPUT MODELS (See preceding page)

Case AA
Case BA

24 TO 30 VDC INPUT SINGLE OUTPUT MODELS

Output								
Voltage (VDC)	Current (Amps)	Line(5) Reg. %	Load(5) Reg. %	Ripple(6) (% VRMS)	Notes	Case Size (See Table II)	Model Number	Price (1 pc)
2	0.75	0.3	2.0	0.3	(1)	M	SMU-002	$261
3	0.75	0.3	2.0	0.3	(1)	M	SMU-003	261
3	5.00	0.3	2.0	0.5	(2)	A	SHU-3	254
5	0.50	0.3	2.0	0.3	(1)	M	SMU-005	248
5	5.00	0.3	2.0	0.5	(2)	A	SHU-5	261
5	4.00	0.1	0.1	0.1	(3)	BA	ASM-A5	216
5	8.00	0.3	2.0	0.5	(2)	A	SHU-5-WW	302
5	15.00	0.2	0.2	0.5	(3)	BA	ASN-M5	502
6	0.50	0.3	2.0	0.3	(1)	M	SMU-006	248
6	5.00	0.3	2.0	0.5	(2)	A	SHU-6	261
10	0.30	0.3	2.0	0.3	(1)	M	SMU-010	240
10	4.00	0.3	2.0	0.5	(2)	A	SHU-10	261
12	0.25	0.3	2.0	0.3	(1)	M	SMU-012	240
12	3.33	0.3	1.5	0.5	(2)	A	SHU-12	261
12	8.00	0.2	0.2	0.5	(3)	BA	ASN-M12	502
15	0.20	0.3	2.0	0.3	(1)	M	SMU-015	235
15	2.00	0.1	0.1	0.1	(3)	BA	ASM-A15	216
15	2.66	0.3	1.5	0.5	(2)	A	SHU-15	261
15	6.00	0.2	0.2	0.5	(3)	BA	ASN-M15	502
24	1.66	0.3	1.5	0.5	(2)	A	SHU-24	261
24	4.00	0.2	0.2	0.5	(3)	BA	ASN-M24	502
28	0.11	0.3	1.5	0.3	(1)	M	SMU-028	235
28	1.42	0.3	1.5	0.5	(2)	A	SHU-28	261
28	3.00	0.2	0.2	0.5	(3)	CA	ASN-M28	502
30	1.00	0.1	0.1	0.1	(3)	BA	ASM-A30	216
30	1.34	0.3	1.5	0.5	(2)	A	SHU-30	261
30	3.00	0.2	0.2	0.5	(3)	BA	ASN-M30	502
50	0.06	0.3	1.5	0.3	(1)	M	SMU-05	235
50	0.08	0.3	1.5	0.5	(2)	A	SHU-50	261
100	0.03	0.3	1.5	0.3	(1)	M	SMU-1	235
100	0.25	0.1	0.1	0.1	(3)	AA	ASM-B100	231
100	0.40	0.3	1.5	0.5	(2)	A	SHU-100	261
150	0.02	0.3	1.5	0.3	(1)	M	SMU-15	235
150	0.26	0.3	1.5	0.5	(2)	A	SHU-150	261
180	0.13	0.1	0.1	0.1	(3)	AA	ASM-B180	235
250	0.16	0.3	1.5	0.5	(2)	A	SHU-250	261
300	0.01	0.3	1.5	0.3	(1)	M	SMU-3	248
300	0.13	0.3	1.5	0.5	(2)	A	SHU-300	261
500	0.006	0.3	1.5	0.3	(1)	M	SMU-5	254
500	0.08	0.3	1.5	0.5	(2)	A	SHU-500	280
750	0.004	0.3	1.5	0.3	(1)	M	SMU-75	261
750	0.053	0.3	1.5	0.5	(2)	A	SHU-750	280
1000	0.003	0.3	1.5	0.3	(1)	M	SMU-1	320
1000	0.040	0.3	1.5	0.5	(2)	A	SHU-1000	300
1500	0.002	0.3	1.5	0.3	(1)	M	SMU-1.5	326
1500	0.026	0.3	1.5	0.5	(2)	A	SHU-1500	339
2000	0.0015	0.3	1.5	0.3	(1)	M	SMU-2	339
2000	0.020	0.3	1.5	0.5	(2)	A	SHU-2000	398
2500	0.0012	0.3	2.0	0.3	(1)	M	SMU-2.5	353
2500	0.016	0.3	2.0	0.5	(2)	A	SHU-2500	398
3000	0.001	0.3	2.0	0.3	(1)	M	SMU-3	380
3000	0.013	0.3	2.0	0.5	(2)	A	SHU-3000	449
3500	0.0008	0.3	2.0	0.3	(1)	M	SMU-3.5	484
3500	0.011	0.3	2.0	0.5	(2)	A	SHU-3500	470
4000	0.0007	0.3	2.0	0.3	(1)	M	SMU-4	484
4000	0.010	0.3	2.0	0.5	(2)	A	SHU-4000	489
5000	0.0006	0.3	2.0	0.3	(1)	M	SMU-5	548
5000	0.008	0.3	2.0	0.5	(2)	A	SHU-5000	509

24 TO 30 VDC INPUT MULTIPLE OUTPUT MODELS

Output								
Voltage (VDC)	Current (Amps)	Line(5) Reg. %	Load(5) Reg. %	Ripple(6) (% VRMS)	Notes	Case Size (See Table II)	Model Number	Price (1 pc)
15 5	1.00 3.00	0.1	0.1	0.1	(3)	BA	ASM-A5-A15	$290
15 5	1.00 2.50	0.20	2.00	0.5	(2)	A	SHU-15-5	320
15 −15	1.00 1.00	0.1	0.1	0.1	(3)	BA	ASM-A15-A15	290
15 −15	1.00 1.00	0.20	2.00	0.5	(2)	A	SHU-30CT	297
−28 −12	0.80 1.50	0.20	2.00	0.5	(2)	A	SHU-28-12	320
28 5	0.50 2.50	0.1	0.1	0.1	(3)	BA	ASM-A28-A5	290
28 5	0.50 2.50	0.20	2.00	0.5	(2)	A	SHU-28-5	320
180 5	0.13 3.00	0.1	0.1	0.1	(3)	BA	ASM-A5-B180	316
180 5	0.10 3.00	0.20	2.00	0.5	(2)	A	SHU-180-5	326
15 −15 5	0.50 0.50 2.00	0.20	3.00	0.5	(2)	A	SHU-30CT-5	361
15 −15 5	0.50 0.50 4.00	0.1	0.1	0.1	(3)	BA	ASM-A5-A15-A15	364
−24 −14 5	0.50 0.50 3.00	0.1	0.1	0.1	(3)	BA	ASM-A5-A14-A24	364
180 15 −15	0.03 0.30 0.30	0.20	3.00	0.5	(2)	A	SHU-180-30CT	358
180 15 −15	0.13 0.60 0.60	0.1	0.1	0.1	(3)	BA	ASM-A15-A15-B180	390
180 15 −15 5	0.03 0.30 0.30 2.00	0.20	3.00	0.5	(2)	A	SHU-180-30CT-5	431

44 TO 52 VDC INPUT TO DC POWER CONVERTERS

Output								
Voltage (VDC)	Current (Amps)	Line(5) Reg. %	Load(5) Reg. %	Ripple(6) (%V RMS)	Notes	Case Size (See Table II)	Model Number	Price (1 pc)
5	4.00	0.1	0.1	0.1	(4)	AA	ASG-A5	$244
30	1.00	0.1	0.1	0.1	(4)	AA	ASG-A30	244
250	0.08	0.2	1.5	0.5	(2)	A	SHU-250E (44-52)	303
500	0.04	0.2	1.5	0.5		A	SHU-500E (44-52)	322
1000	0.02	0.2	1.5	0.5	(2)	A	SHU-1000E (44-52)	342
15 −15	1.00 1.00	0.1	0.1	0.1	(4)	BA	ASG-A-15-A15	318
5 180	4.00 0.13	0.1	0.1	0.1	(4)	BA	ASG-A5-B180	270

105 TO 120 VDC INPUT TO DC POWER CONVERTERS

Output								
Voltage (VDC)	Current (Amps)	Line(5) Reg. %	Load(5) Reg. %	Ripple(6) (%V RMS)	Notes	Case Size (See Table II)	Model Number	Price (1 pc)
5	4.00	0.1	0.1	0.1	(4)	AA	ASH-A5	$230
5	10.00	0.2	0.2	0.5	(4)	BA	ASH-M5	453
5	20.00	0.2	0.2	0.5	(4)	CA	ASK-M5	530
12	2.00	0.1	0.1	0.1	(4)	AA	ASH-A12	230
12	12.00	0.2	0.2	0.5	(4)	CA	ASK-M12	530
24	1.00	0.1	0.1	0.1	(4)	AA	ASH-A24	230
24	3.20	0.2	0.2	0.5	(4)	BA	ASH-M24	453
24	6.00	0.2	0.2	0.5	(4)	CA	ASK-M24	530
30	1.30	0.3	2.0	0.5	(2)	A	SHU-30E (105-120)	303
48	3.00	0.2	0.2	0.5	(4)	CA	ASK-M48	530
500	0.08	0.3	2.0	0.5	(2)	A	SHU-500E (105-120)	322
1000	0.04	0.3	2.0	0.5	(2)	A	SHU-1000E (105-120)	342
15 −15	1.00 1.00	0.1	0.1	0.1	(4)	BA	ASH-A15-A15	304
15 −15 5	1.00 1.00 4.00	0.1	0.1	0.1	(4)	BA	ASH-A5-A15-A15	378

NOTES:

(1) Input 26-30 VDC, Load Reg. (½ FL-FL). Adjust 90% to 105% of nominal output, operating case temp. −55 to 100°C 2500-5000 VDC output isolation. Options available: A, CT, E, I, S.

(2) Input 26-30 VDC or other input range specified load regulation (½ FL-FL). Adjust 40% to 105% of nominal output, operating case temp. −55 to +100°C. 2500-5000 VDC output isolation. Options available: A, CT, EE, G, I.

(3) Input 24-30 VDC, Load Reg. (½ FL-FL). Adjust ±5% min. of nominal output, Overload/short circuit protected, operating case temp. −10 to +71°C. Options available: see Table 1

(4) Load Reg. (½ FL-FL). Adjust ±5% min. of nominal output, Overload/short circuit protected, operating case temp. −10 to +71°C. Options available: see Table 1.

(5) Add 10 MV to Load Regulation and Line Regulation for all models.

(6) Add 10 MV RMS to ripple for all models.

HOW TO ORDER:

(1) Standard models: Use model numbers listed. Add option letters as required per Table 1.

(2) Special models: For SHU converters use three letter model number followed by voltage (volts/current/amps). Use standard model of highest voltage for output power rating and price.

EXAMPLE: SHU 28 CT has output of ±14 VDC at 1.4 Amps with a 1 pc. price of $297.00

For other Models see "Design As You Order" pages.

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OPTIONS FOR POWER CONVERTERS
Table I

ARNOLD MAGNETICS

Option Letter	Option	Specifications (Examples)	Use on Models	Price $
A	External (Remote) Adjustment of Output Voltage	Two (2) flexible leads for external pot. All performance specifications unchanged, 5K pot PHU, SMU; 10K pot SHU (PHU-5-A)	SHU, SMU, PHU	$ 39
(CT)	Center Tapped Outputs	Put "CT" in parenthesis for center tapped output. Example: SHU-30(CT) provides ±15 VDC @ 1.3A. Output voltage available to 500 volts except 50 volts for SMU.	SHU, SMU, PHU	44
E	Input Voltage Alteration	Permits operation over specified range of input voltage: E_L to E_H. Output power and adjustment range are affected. Consult factory for maximum values. When E-E exceeds 4V, observe case temperature closely. Specify lowest and highest input voltage (E & E). Example: SHU 30E (20-30) will deliver 30 volts @ 0.87 A at any input from 20 to 30 VDC.	ALL MODELS	44
EE	12 Volt Nominal Input	Derate output current 50%. Input: 11–13 VDC Max. Output: 2500 VDC (SHU-12EE)	SHU	60
G	Flexible Leads	Leads per MIL-W-16878 where applicable. Lead length: 10 inches minimum. Price per pair of leads (ASN-M5/15-A15/1-BA-6)	MOST MODELS	20
I	EMI/RFI Qualified	Conducted and radiated noise below spec. Level of MIL-I-26600, Class I and MIL-I-6181D. Qualification is by similarity. PHU and SHU to MIL-I-6181D only case size b SMU case size Q (PHU-5-I)	SHU, SMU, PHU Single Outputs Only	150
KI	Constant current in overload†	Constant voltage – constant current (sharp "knee"). (APT-M100/1KI-DA)	Available on all regulators of table M1 (except "series" types).	100
L	Logic Control (Inhibit)†	The output voltage of any regulator will drop below 3% of rated when a control signal of 3.5 to 20V is applied to the control terminals. (APS-M5/8L-CA)	Consult Factory	85
PE	Programmable Output Voltage (By Voltage)†	Output varies directly with 0–10 VDC applied between control terminals. Input resistance to control terminals 5K ohm approx. Output voltage range: 3% to 105% (min. of rated output). Programming linearity will not exceed 5% full scale.* (APT-M5-A15PE-DA)	Available on all regulators of table M1.	75
PI	Programmable current limit†	Output current limit is a linear function of programming resistor, R. $R = 50\left[\frac{\text{Desired limit current}}{\text{Maximum output current (table M1)}}\right]$ The power supply output changes from constant voltage mode to constant current mode when the load demand exceeds the programmed value. (BPQ-Q5/100PI-EB)	Available on all regulators of table M1.	125
PR	Programmable Voltage (By Resistance)†	Output Voltage $\leqslant (K = 500\Omega/V)$. R = Total resistance connected to programming terminals. Programming temperature coefficient: .01%/°(Max.) *Programming response time will not exceed 1 ms. (BPQ-Q30/30PR-EB)	Available on all regulators of table M1.	75
R	Remote Sensing	Senses Voltages at point of Load (cable drop reduces max. output voltage). (Output reduces with open sense leads.) (BPQ-Q5/75R-EB)	Available on all models except models .6" long	85
S	Short Terminals	3/8 inch maximum terminal length. Sleeving will be required for high voltage outputs. Price per pair of terminals. (PHU-30-S)	SHU, SMU. PHU	14
T	Wide Temperature Range	Operates from –55°C To +85°C baseplate temperature. (Maximum output currents from table M1 and output powers from table M2 must be derated 20%. (ASM-A5/2-A15/1-BA-T)	Available on most models in tables M1 and M2.	*
U	Uninterruptable Output†	Will deliver I_0 amps to load for T (seconds) after line drops below 105VRMS. (Add C_x Mfd to terminals provided) $C_{x(mfd)} \equiv KI_{0(A)}\,T_{sec}$ (for 115V to 5VDC supply: K = 1792). I.e.: 17,920 MF (200V) cap will provide 10A (at 5V) for 1 second. (APS-M5/10-CA-U)	APT, BPE (also all AS– series drivers).	35
V	Overvoltage Protection	Prevents output voltage from increasing above overvoltage set point. PHU-increase to case size B. Other models add 0.6 inch to total module length for each output. Set to 120 ± 10% of nominal output. Example: (APT-M5/17V-CA)	PHU, ARA, ARC ARM, ART BRP, BRQ	48 96 144

*Consult Factory

†PERFORMANCE GUARANTEE

In addition to our normal warranty, and to encourage new application effort, Arnold Magnetics will accept selected orders for standard, single output, converters on a 40-day trial basis (ie: undamaged items received FOB our plant within 40 days of date of previous shipment will receive full credit, on demand, without cause).

As a condition of this cost free trial, the buyer agrees to provide Arnold Magnetics with a description of the application, and how it performs, together with the right to publish the information submitted with (or without) identifying the writer, at the writer's option.

CASE SIZES FOR POWER CONVERTERS
Table II

Case Size	W (Width)	H (Height)	L (Length)	Mounting Holes M	N	No. Holes	Size – Depth	Dwg. Fig.
A	1 5/8	3 5/8	3 1/2	1.125	2.750	4	6-32NC ¼" Min.	1
B	1 5/8	3 5/8	5	1.125	4.250	4	6-32NC ¼" Min.	1
C	1 5/8	3 5/8	7	1.125	2.750	6	6-32NC ¼" Min.	1
D	1 5/8	3 5/8	10 1/2	1.125	4.500	6	6-32NC ¼" Min.	1
K	2 1/2	2 1/2	4	2.000	1.750	6	6-32NC ¼" Min.	2
L	4	2 1/2	5	3.420	2.210	6	8-32NC ¼" Min.	2
AA	1 5/8	3 5/8	3 1/2	1.125	2.750	4	6-32NC ¼" Min.	4
BA	1 5/8	3 5/8	5	1.125	4.250	4	6-32NC ¼" Min.	4
CA	1 5/8	3 5/8	7	1.125	2.750	6	6-32NC ¼" Min.	4
DA	1 5/8	3 5/8	10 1/2	1.125	4.500	6	6-32NC ¼" Min.	4
AB	3 1/4	3 5/8	3 1/2	2.625	2.750	4	6-32NC ¼" Min.	5
BB	3 1/4	3 5/8	5	2.625	4.250	4	6-32NC ¼" Min.	5
CB	3 1/4	3 5/8	7	2.625	2.750	6	6-32NC ¼" Min.	5
DB	3 1/4	3 5/8	10 1/2	2.625	4.500	6	6-32NC ¼" Min.	5
EB	3 1/4	3 5/8	15	2.625	4.500	8	6-32NC ¼" Min.	5
M	2 1/32	2 3/4	1 7/8		1.590	2	6-32NC ¼" Min.	3

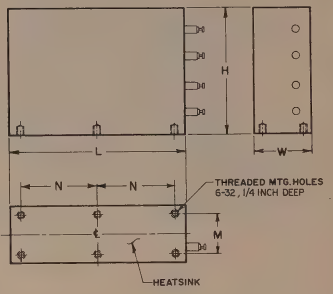
H
L
W
N
N
THREADED MTG. HOLES 6-32, 1/4 INCH DEEP
M
℄
HEATSINK

Figure 1

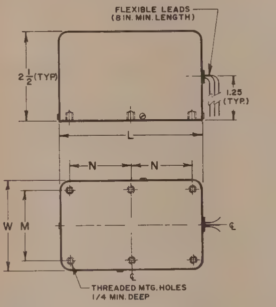
FLEXIBLE LEADS (8 IN. MIN. LENGTH)
2 1/2 (TYP)
1.25 (TYP.)
L
N
N
W
M
℄
℄
THREADED MTG. HOLES 1/4 MIN. DEEP

Figure 2

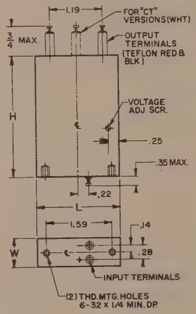
1.19
FOR "CT" VERSIONS (WHT)
3/4 MAX.
OUTPUT TERMINALS (TEFLON RED & BLK)
H
VOLTAGE ADJ SCR.
℄
.25
.35 MAX.
.22
L
1.59
.14
W
℄
.28
INPUT TERMINALS
(2) THD. MTG. HOLES 6-32 x 1/4 MIN. DP.

Figure 3

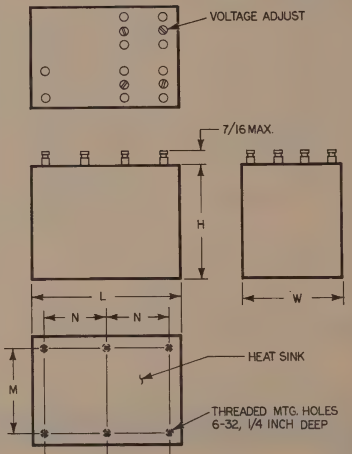
VOLTAGE ADJUST
7/16 MAX.
H
L
W
N
N
HEAT SINK
M
THREADED MTG. HOLES 6-32, 1/4 INCH DEEP

Figure 5

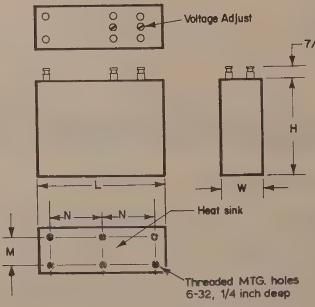
Voltage Adjust
7/16 Max.
H
L
W
N
N
Heat sink
M
Threaded MTG. holes 6-32, 1/4 inch deep

Figure 4

NOTE: All dimensions in inches
(to convert to MM, multiply inches by 25.4).

Prices and specifications subject to change without notice.

ARNOLD MAGNETICS CORPORATION

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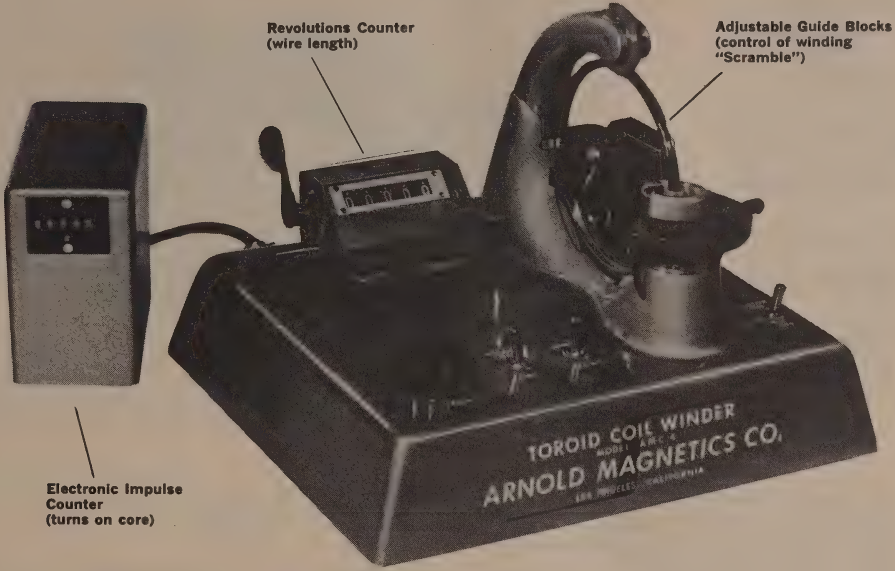
TOROIDAL WINDING MACHINE

ARNOLD MAGNETICS

● Sets up quickly ● Winds at high speeds ● Easy to operate ● Wide range of wire sizes ● Portable


Revolutions Counter
(wire length)
Adjustable Guide Blocks
(control of winding
"Scramble")
Electronic Impulse
Counter
(turns on core)
TOROID COIL WINDER
MODEL AMC-4
ARNOLD MAGNETICS CO.
LOS ANGELES, CALIFORNIA

SETS UP QUICKLY—Install core, lock the ring, and begin winding in less than 45 seconds. Change of wire and core size equally fast.

EASY TO OPERATE—Just drop the core in place and start winding. No accurate centering of core required. One tension adjustment point. A continuous range of tension settings easily selected. Quiet operation. Both fingertip and foot controls provided. Easy to train, easy to set up and operate.

REDUCES WIRE WASTE—Precise control of length of wire loaded into machine.

Price (FOB our plant) Model AMC-4 complete with all accessories both counters, set of three winding rings and slides, set of nylon inserts and foot control . . . $1300.00. Model WTB (same as AMC-4) except, no mechanical counter, without 1/4" and 1/8" rings, slides, and inserts $1,050.00

DELIVERY: STOCK TO 3 WEEKS ARO

SPECIFICATIONS

Wire range		AWG #26HF to #44HF
Minimum toroid ID		0.18 inch
Maximum toroid OD		4.0 inches
Maximum toroid height		1.5 inches
Max. recommended winding rate		1500 turns/min.
Winding rings	OD (all rings)	4.5 inches

Capacities of rings:

Nom. size of crossection (inches)	Wire range (AWG-AWG)	(ozs.)	Approx. Wire Capacity (ft. of #40 HF)
1/8 × 1/8	33.44	.15	300
3/16 × 3/16	26-44	.35	700
1/4 × 1/4	26-44	.62	1240

Bench Space	11 × 11 inches
Power required	115 VAC, 50-60 Hz

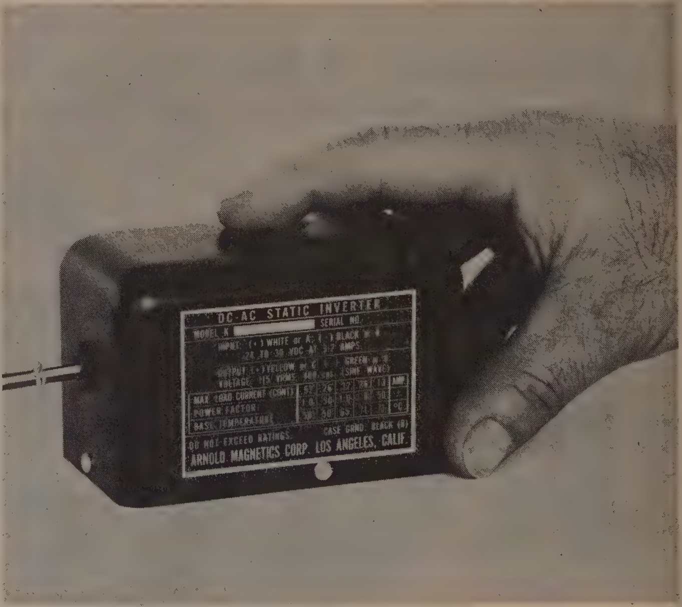
ARNOLD MAGNETICS CORPORATION 11520 W. Jefferson Blvd., Culver City, Ca. 90230 • (213) 870-7014 • TWX 910-343-6468

ARNOLD MAGNETICS

SOLID STATE INVERTER

DC-115 VRMS • 400 Hz SINE WAVE @ 50VA

- **Low harmonic distortion**
- **Closely regulated outlet**
- **Small size and weight**
- **Short circuit protected**
- **Operates from battery source**



This power supply is ideally suited for driving A.C. motors (both synchronous and phase sensitive), A.C. gyros, magnetic amplifiers and other A.C. devices from a 28 volt battery line. It is self protected for short circuits, overload or reactive loads, transients on the input line and reversal of input polarity. A unique circuit design renders this unit insensitive to widely varying load impedance and power factor. It is tested 100% for compliance to MIL-STD-704 (line spikes of a 60 volt peak). The output contains low harmonic distortion and is regulated to close limits (see specifications). This makes the unit well adapted to military systems.

To meet aerospace and shipborne environment, the unit is fully encapsulated. This allows it to meet the requirements of MIL-STD-704 (ASG) including vibration, heat and moisture. Its compact design makes it readily adaptable to airborne systems. The standard Model (SKB) is generally in stock and is comparatively inexpensive.

SPECIFICATIONS

INPUT Voltage: 24 to 30 VDC(1)
OUTPUT Voltage (isolated): 115 VRMS
  Frequency: 400 ±0.5% Hz (Also available in other frequencies from 360 to 10,000 Hz)
  Power: 50 VA at 50°C† (1)
    30VA at 71°C†
  Wave Shape: Sinusoidal with 6% harmonic distortion (at specified load)
  Power Factor: Any (derate per fig. 1)
OPERATING Temperature: −55°C to +71°C
  Environment: per MIL-STD-704

SIZE: 2½" × 4" × 2½" high
  Weight: 28 oz.
REGULATION (*typical*): As the below variable changes, it has these effects:*

VARIABLE	FROM	TO	FREQUENCY	VOLTAGE
Input Voltage	24 VDC	30	±0.3%	±0.5%
Load Current	0.25 AMP	0.5	±0.3%	±2.0%
Temperature†	−10°C	+71°	±2.0%	±3.5%
Power Factor‡	0.8	1.0	±0.5%	±1.0%

---

(1) Arnold also manufactures higher power units. Specify Model SKD for double the load current, weight and width (EI: 5.00"W).

NOTES
*Values listed are for one variable changing when all other variables are held at their maximum rated or nominal values.
†Temperature at surface of base plate.
‡Power factor with a load of 27 volt-amperes (leading or lagging).
Specifications subject to change without notice.

ARNOLD MAGNETICS CORPORATION 11520 W. Jefferson Blvd., Culver City, Ca. 90230 • (213) 870-7014 • TWX 910-343-6468

SOLID STATE INVERTER

DC-115 VRMS • 400 Hz SINE WAVE @ 50VA

ARNOLD MAGNETICS

PRICES

Output (VRMS)	Output Power (VA)	Case	Model Number	Price 1 pc.
115	50	K	SKB-28-115-400-50	$353
115	100	L	SKD-28-115-400-100	625
28	50	K	SKB-28-28-400-50	353
28	100	L	SKD-28-28-400-100	625

F.O.B. Culver City, California
Terms: Net 30 Days

HOW TO ORDER

FOR STANDARD UNITS

Specify simply: Model "SKB" static inverter (This standard unit will have an input of 28 VDC and an output of 115V 400 Hz).

FOR SPECIAL UNITS

Specify Model "SK" followed by termination desired, nominal input voltage, output voltage and output frequency. (All other specifications will be as described on the reverse side).

EXAMPLE

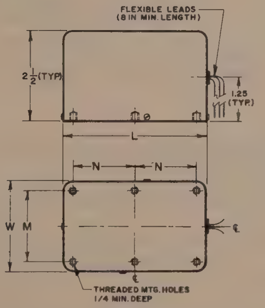
SKB-28-115-400-40

SK	B —	28 —	115 —	400 —	40
Model	Termination	Nominal Input Voltage	Output Voltage	Output Frequency	Output Power

TERMINATION DESIGNATION:
Wire leads out end "B" (standard configuration)

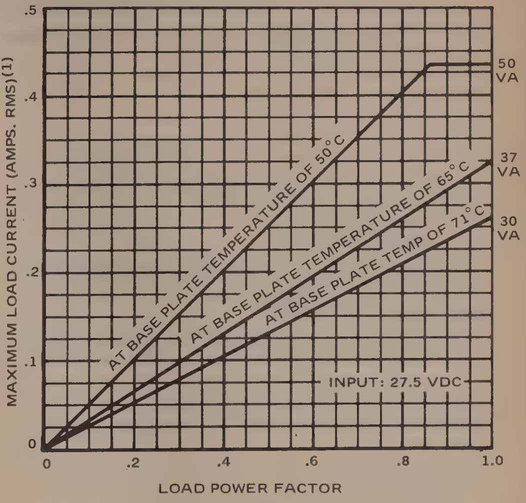
Each Inverter is identified with Serial Number and AMC Part Number. In the example above, the correct AMC Part No. is: SKB-28-115-400-40. Order by AMC Part No. only.

MECHANICAL SPECIFICATIONS

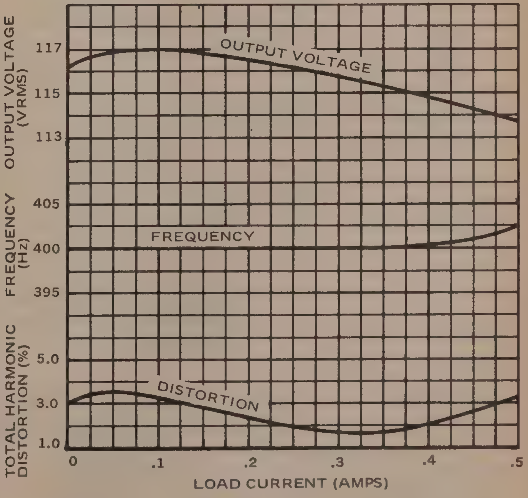


Case Size	W (Width)	H (Height)	L (length)	Mounting Holes			
				M	N	No. Holes	Size – Depth
K	2 1/2	2 1/2	4	2.000	1.750	6	6-32NC ¼" Min.
L	4	2 1/2	5	3.420	2.210	6	8-32NC ¼" Min.

Figure 1 MAXIMUM OUTPUT CURRENT VS POWER FACTOR (AT SEVERAL BASEPLATE TEMPERATURES)



(TYPICAL VALUES)



ARNOLD MAGNETICS CORPORATION 11520 W. Jefferson Blvd., Culver City, Ca. 90230 • (213) 870-7014 • TWX 910-343-6468

ARNOLD MAGNETICS

POWER CONVERSION EQUIPMENT

Miniaturized • High Efficiency

SPECIAL PRODUCTS THRU MODULARIZATION

(If your application is experimental, see the free trial provision in the performance guarantee, Page A8)

The following new product concepts are based on the application of Arnold Magnetics' modularized power conditioning elements (such as those depicted in the first pages of this presentation).

This method of contributing to your product development is suggested because of its lower cost (due to using stock modules) and proven reliability (the MTBF of a typical module exceeds 100,000 hrs.).

Several modifications to the modules' performance, involving voltage and current control, as a function of analog quantities, make these units as flexible as high power operational amplifiers. Special characteristics such as the following are obtained by adding modification letters to the model number. (Keep in mind these controllers have constant internal dissipation over their entire load line to, and including, short circuit).

Figure 2 — MODIFICATION PI

PROGRAMABLE CURRENT LIMIT

To Order:
1. Add "PI" to Model No.
2. Add $125 to 1 pc. price

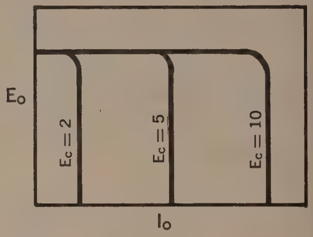


Figure 1 — MODIFICATION PE

PROGRAMABLE OUTPUT VOLTAGE

To Order:
1. Add "PE" to Model No.
2. Add $75 to 1 pc. price

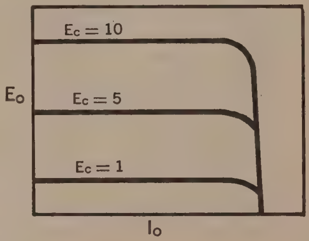
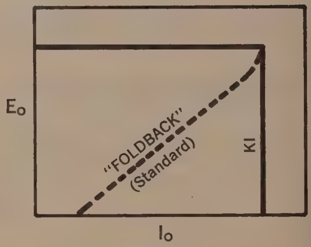


Figure 3 — MODIFICATION KI

CONSTANT CURRENT IN OVERLOAD

To Order:
1. Add 'KI' to Model No.
2. Add $100 to 1 pc. price



EXAMPLE: Mod APT-ARM100PE will deliver 0-100 VDC @ 2 amps as a function of 0-10V control signal fed of 3K Ohm (min.) input. Response time will be approximately 1 ms, depending on load.

SINE WAVE POWER SOURCES

Bidirectional outputs at frequencies of 360 to 10KHz (400 Hz is typical) with harmonic distortion under 6% can be produced at 5VA/in³ (if the system can tolerate zero crossing distortion during load transients affecting power factor).

A typical model is SKB-28-115-400-100 with specs of:

Input: 24-30VDC
Output: 115V, 400 Hz, 100VA
Efficiency: 82%
T.H.D. (at PF = 1.0) 6% max.
Size: 4" × 2½" × 5
Weight: 56 oz.

This unit exhibits constant power per unit weight at lower output frequencies because no low frequency transformer is used. (i.e.: Regulator feeds load directly). To allow for "reverse" currents required by uncorrected load power factor, the output is "shorted" during load discharge. This results in approximately a 20° "flat spot" in the voltage waveshape at 0.85 power factors. (A "clean" sine wave is obtained by adding a capacitor to correct the power factor).

POWER CONVERSION EQUIPMENT

Miniaturized • High Efficiency

ARNOLD MAGNETICS

SPECIAL PRODUCTS THRU MODULARIZATION

SERVO AMPLIFIERS

High power, miniaturized, servo amplifiers are made possible by utilizing these modularized converters with the programmable features such as shown in Figure 1. Response to frequencies near 600 Hz (3db point) is possible with DC motors or torquers with reasonable inductance and load inertia.

HIGH PERFORMANCE DC MOTORS - TORQUERS

Because of the relative ease of controlling high currents with high frequency magnetic amplifiers, the programmable, low voltage modules (such as ARM5PE) match well with low impedance motor windings (including printed circuit types).

CONSTANT CURRENT SOURCES

Electro magnets frequently must be controlled so as to regulate their field. Instantaneous output current sensing with gauss meter feedback can be effective in controlling currents in the hundreds of amperes.

As an example, Model BPQ-BRQ6PI would supply constant, adjustable current to a copper wire load whose temperature rose 100°C. Currents to 100 amps at 5 volts (.05 ohm) are available from this 3¼" × 3⅝" × 15 unit.

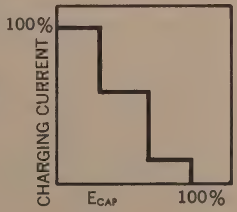
REDUNDANT OPERATION

For the ultimate in reliability, two or more separate systems can be operated in the current tracking (sharing) mode. In this way, each operates a half load. In the event of failure, the survivor operates at full load. Random and early failures are thereby nearly eliminated. The large dynamic overload range provided by this connection is often useful in enhancing reliability and performance.

LASER POWER (and other pulsed devices)

Pulsed laser systems frequently require rapid charging of large capacitors. By paralleling the outputs of an ARM30, and 100, a capacitor can be charged at 5, 1.7 and 1.0 amps as its voltage reaches 16, and 100V, respectively. The end voltage will be determined by the voltage at which the ARM-100 is set.

SPECIAL DESIGNS OF THESE UNITS ARE BEING SOUGHT BY ARNOLDS' DEVELOPMENT STAFF.



BATTERY CHARGING

When charging battery systems such as Nickel-Cadmium types, the charging current should be varied as a function of voltage, temperature, cell pressure, or history (of the cells).

Cyclical charging-discharging to "condition" such cells is accomplished by relay shorting of the battery-charging circuit. The charger will operate in the "foldback" current limit mode with little increase in internal dissipation.

A small system such as model APT-ARM30 would provide 5A charging current to a 28V battery. Shorting, "tapering" or other conditioning would be possible.

LOW FREQUENCY POWER

Low frequency energy (0.1-100Hz) is frequently difficult to generate with reasonable power — size — cost relationships. It is also sometimes difficult to control amplitude near resonance and to provide for the widely varying "power factor". The Arnold programmable units are so insensitive to loading conditions, that experimental use is encouraged. Models BRQ are suggested for the higher power systems.

OTHER APPLICATIONS INCLUDE:

SQUIB firing
SOLENOID control
DIGITAL analog power
AIRCRAFT power source
GEOPHYSICAL (earth-charging,
  truck mounted)
SERVO power (torpedo-bombs,
  x-y plotters i.e.: Fast & Small)
AMPLIFIERS, power, DC coupled,
  to 2 KW, to 1KHz response

HOW TO SPECIFY

1. Pick modules from tables M1 and M2. (Page A3)
2. Enter in table M3 with modifications from Figure 1, 2 or 3
3. If desired, add the following paragraph to the face of the purchase order:

"The subject item will be experimentally applied by the buyer as a(n)________

____

Seller agrees to issue full credit if returned prepaid, within 40 days of the date of shipment."

POWER SUPPLIES

BUNKER RAMO AMPHENOL

Series 279 Mini Power Supply

AMPHENOL
REGULATED D.C.
POWER SUPPLY
MODEL
AMPHENOL
REGULATED D.C.
POWER SUPPLY
MODEL

For the first time Amphenol now offers distributor availability of high reliability mini power supplies.

Amphenol offers you the benefit of saving manufacturing and engineering time and cost—and insures prompt delivery through **"off-the-shelf"** availability at your Component Marketing Service distributors and at the Broadview, Ill. CMS Distribution Center.

These compact, fully epoxy encapsulated power supplies are ideal companion power sources for op amps, CMOS logic and other types of low power logic systems.

They are high quality components incorporating a superior thermal design which gives longer life. The units are designed so that internal components run cooler resulting in no derating of output current at higher temperatures.

COST-SAVING BENEFIT TO YOU

- Compact size allows placing power supply adjacent to the load which reduces power losses, uses less interconnecting hardware and requires minimum cabinet space.
- The availability of a compete power module means you do not have to buy, inventory and assemble individual components to make your power supply and also saves you design and engineering time.

CUSTOMER USAGE BENEFITS

- Performance is guaranteed — no need to reinvent the wheel.
- **Longer life and higher reliability** than competitive units due to superior thermal design.
- **Fast mounting capability** because terminals may be soldered directly to boards by flow solder method.
- Rugged construction is **resistant to** printed circuit flux cleaning solvents.
- The design of the units assures **short circuit protection** . . . and **isolates** the output **from AC line** . . . and on dual voltage models, tracking outputs.

**FOR LOCAL SOURCE OF SUPPLY
SEE EEM VOL. 2 PAGE 462**

So . . . **ACT NOW** . . . Ask your local Amphenol distributor or CMS Sales Representative to supply you with Amphenol's Mini Power Supplies and enjoy their "powerpacked" advantages.

MINIATURIZED SINGLE OUTPUT DC POWER MODULES

Output Voltage	Output Current Amps	Regulation Load ±%	Regulation Line ±%	Ripple mv RMS	Price 1-24*	Model	Case Size
3.6	.250	.05	.05	0.5	$39	279-3.6E25	ES-10
3.6	.500	.1	.05	0.5	59	279-3.6E50A	EL-10
5	.250	.05	.05	0.5	39	279-5E25	ES-10
5	.500	.1	.05	0.5	49	279-5E50A	EL-10
5	1.0	.2	.05	1	69	279-5E100	EL-13
5	1.5	.3	.1	1	98	279-5E150	EL-13
6	.200	.05	.05	0.5	39	279-6E20	ES-10
6	.400	.1	.05	0.5	59	279-6E40A	EL-10
10	.120	.02	.02	0.5	30	279-10E12	ES-10
12	.100	.02	.02	0.5	30	279-12E10	ES-10
12	.200	.05	.05	0.5	59	279-12E20A	EL-10
12	.700	.1	.05	1	98	279-12E70	EL-13
15	.100	.02	.02	0.5	30	279-15E10	ES-10
15	.200	.05	.05	0.5	59	279-15E20A	EL-10
15	.600	.1	.05	1	98	279-15E60	EL-13
18	.060	.02	.02	0.5	30	279-18E06	ES-10
18	.120	.05	.05	0.5	59	279-18E12A	EL-10
20	.060	.02	.02	0.5	39	279-20E06	ES-10
20	.120	.05	.05	0.5	59	279-20E12A	EL-10
24	.050	.02	.02	0.5	30	279-24E05	ES-10
24	.100	.05	.05	0.5	59	279-24E10A	EL-10
28	.040	.02	.02	0.5	39	279-28E04	ES-10
28	.080	.05	.05	0.5	59	279-28E08A	EL-10

DUAL OUTPUT SUPPLIES FOR OP AMPS

Nominal Output Voltages	Output Current Amps	Regulation Load ±%	Regulation Line ±%	Ripple mv RMS	Price 1-24*	Model	Case Size
±12	.025	.1	.05	1	$24	279-D12-03	ES-10
±12	.050	.1	.05	1	49	279-D15-10A	EL-10
±12	.100	.1	.05	1	49	279-D12-10A	EL-10
±12	.150	.1	.05	1	59	279-D12-15A	EL-10
±12	.300	.05	.05	1	98	279-D12-30	EL-13
±12	.350	.05	.05	1	105	279-D12-35	EL-13
±15	.025	.1	.05	1	24	279-D15-03	ES-10
±15	.050	.1	.05	1	39	279-D15-05	ES-10
±15	.100	.1	.05	1	47	279-D15-10A	EL-10
±15	.150	.1	.05	1	59	279-D15-15A	EL-10
±15	.300	.05	.05	1	98	279-D15-30	EL-13
±15	.350	.05	.05	1	105	279-D15-35	EL-13

* OEM discounts available on higher quantities

POWER SUPPLIES

BUNKER RAMO AMPHENOL

SPECIFICATIONS — Single output

Input Voltage: 105-125 VAC, 47 to 420 Hz, single phase.

Output Specifications: See table.

Output Voltage Trim Adjustment: Output is factory preset to ±2% (1 to 9 volt models) or ±1% (10 and up) of nominal output voltage. Output may be trimmed to the nominal voltage rating with an external trim resistor.

Polarity: Output is floating. Either positive or negative terminal may be grounded.

Ambient Operating Temperature: −20 to +71°C. (Model 279-5E150, 0 to +71°C.) No derating required.

Storage Temperature: −55 to +85°C.

Temperature Coefficient: From 9 volts up. Approximate TC is .015%/°C; 1 to 8 volts, .03%/°C.

Impedance: 0.07 ohms at 1 kHz and 0.2 ohms at 10 kHz (approx.).

Weight: 7 oz. (Case size ES-10.); 1 lb. (Case size EL-10.); 1 lb. 3 oz. (Case size EL-13.)

Optional 230 Volt Input: All models can be alternately furnished for operation on an input of 210 to 250 VAC, 47-420 Hz. To order, add suffix "-230" to model number and $10.00 to price.

SPECIFICATIONS — Dual output

Input Voltage: 105-125 VAC, 47 to 420 Hz, single phase.

Output Specifications: See table.

Output Voltage Setting: Each output is factory preset to ±1% of the nominal output voltage.

Ambient Operating Temperature: −20 to +71°C. No derating required.

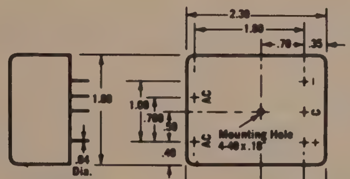
Storage Temperature: −55 to +85°C.

Temperature Coefficient: Approximate TC is .015%/°C.

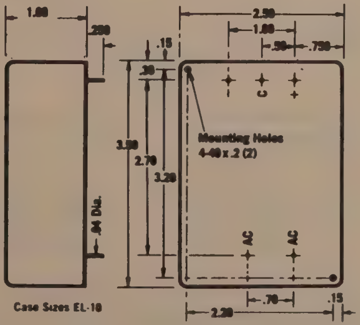
Impedance: 0.07 ohms at 1 kHz and 0.2 ohms at 10 kHz (approx.).

Weight: 7 oz. (Case size ES-10.); 1 lb. (Case size EL-10.); 1 lb. 3 oz. (Case size EL-13.)

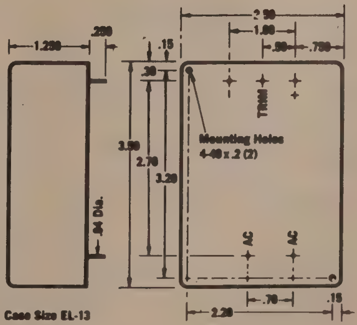
Optional 230 Volt Input: All models can be alternately furnished for operation on an input of 210 to 250 VAC, 47-420 Hz. To order, add suffix "-230" to model number and $10.00 to price.


2.30
1.80
.70
.35
1.80
1.00
.700
.30
.40
.04 Dia.
AC
AC
C
Mounting Hole 4-40 x .18

Case Size ES-10


1.80
.250
.15
2.50
1.80
.50
.750
.30
3.50
2.70
3.20
C
Mounting Holes 4-40 x .2 (2)
.04 Dia.
AC
AC
.70
.15
2.20

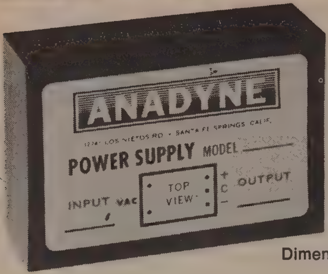
Case Sizes EL-10


1.250
.250
.15
2.50
1.80
.50
.750
.30
3.50
2.70
3.20
TRIM
Mounting Holes 4-40 x .2 (2)
.04 Dia.
AC
AC
.70
.15
2.20

Case Size EL-13

FOR LOCAL SOURCE OF SUPPLY
SEE EEM VOL. 2 PAGE 462

MINIATURE AC/DC POWER SUPPLIES



SERIES 400
Dimensions: 1 x 2 x 3 in.

POWER AT THE RIGHT PRICE. Regulation, ripple, and temperature stability of these supplies are comparable to much larger and more expensive units. In all cases, the specs are consistent with the requirements of most monolithic and discrete-circuit type operational amplifiers.

POWER WITH PROTECTION. All models are protected against sustained overloads and short circuits either to ground or between the two outputs. The 5V (600 Series) is protected against overvoltage. In addition, current limiting prevents excessive heating in case of shorted outputs.

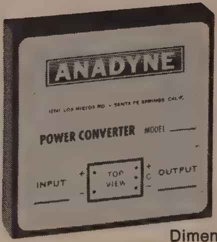
POWER WITHOUT RIPPLE PROBLEMS. The low ripple of these power supplies is far better than most required circuit applications. ANADYNE'S power supplies will operate over a temperature range of 0° to 71°C; however, the output is derated outside the 10° to 55°C range.

SERIES 400

Output Current	0.100 A
Input Voltage	105 to 125 VRMS, 50 to 400 Hz
Dual Output Voltage	+15 VDC and −15 VDC (Also available: ±6, ±10, ±12, ±18, ±24, +28)
Accuracy (Each Output)	±0.1 VDC
0 to Full Load Regulation	0.02% max.
Line Regulation	±0.005% max.
Ripple	0.5 mv RMS max.
Short Circuit Protection	Either or both outputs to common or together indefinitely
Dimensions	1 x 2 x 3 inches
Weight	Less than 9 ounces

OTHER MODELS AVAILABLE
WRITE FOR BROCHURE 127208

MINIATURE DC/DC POWER CONVERTERS



SERIES 700
Dimensions: 2.0 x 2.0 x 0.4 in.

These ANADYNE 700 Series Power Converters contain an efficient, miniature DC to DC converter and a state-of-the-art precision integrated circuit regulator.

Filtering is included on the inputs as is magnetic shielding, to reduce radiated noise. Audible noise is non-existent since these units operate above 20 KHz.

SERIES 700

Input Voltage ±10%, VDC 5, 6, 10, 12, 15, 26	Dual Output Voltage, VDC ±10, ±12, ±15, ±18, ±20 Single Output Voltage, VDC 20, 24, 30, 36, 40
Accuracy (Each Output	±1%
Temperature Coefficient	.02%/°C max., .01%/°C typical
Warm-up Drift (After 5 Seconds)	±0.1%
0 to Full Load Regulation	.02%
Line Regulation	.02% max. for 10% change
Ripple & Noise	2 mv p-p max. 1 Hz-1 MHz
Output Impedance	1 ohm @ 10 KHz
Operating Temperature (Derate above 55°C)	0°C to +71°C
Input Transients (Conducted Noise)	<25% of nominal input current, peak to peak
Surface Temperature Rise	20°C at full load
Input Isolation	50 megohms
Short Circuit Protection	Either or both outputs to common or together indefinitely

Series 700 Power Supply Designation Chart

Part Number
7XX

Series Number Output ±1%
70X — ±10 V 70 ma
71X — ±12 V 60 ma
72X — ±15 V 50 ma
73X — ±18 V 40 ma
74X — ±20 V 35 ma

Input ±10%
7X1 — 5 V .6 A
7X2 — 6 V .5 A
7X3 — 10 V .3 A
7X4 — 12 V .25 A
7X5 — 15 V .2 A
7X6 — 26 V .13 A

WRITE FOR BROCHURE 047301

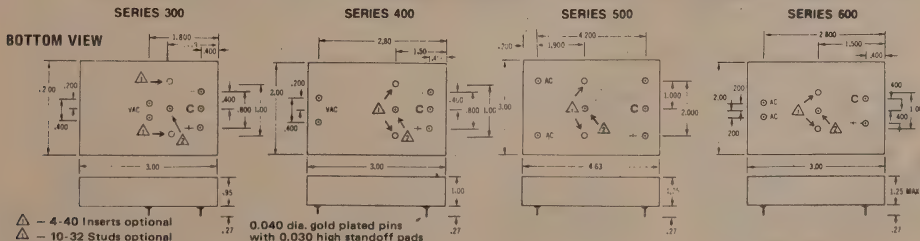
ANADYNE

12741 LOS NIETOS ROAD
SANTA FE SPRINGS, CALIFORNIA 90670
(213) 698-7991
TWX 910-586-1881

MINIATURE AC/DC POWER SUPPLIES

MINIATURE DC/DC POWER CONVERTERS

	SERIES			
Electrical Specifications	**300** 0.050A	**400** 0.100A	**500** 0.200A	**600** 0.500A
INPUT VOLTAGE	105 to 125 VRMS, 50 to 400 Hz	105 to 125 VRMS, 50 to 400 Hz	105 to 125 VRMS, 50 to 400 Hz	105 to 125 VRMS, 50 to 400 Hz
DUAL OUTPUT VOLTAGE (Also available ±6, ±10, ±12, ±18, ±24, ±28)	+15VDC and −15VDC	+15VDC and −15VDC	+15VDC and −15VDC	
GREATEST SINGLE OUTPUT VOLTAGE	30VDC	30VDC	30VDC	30VDC
ACCURACY (EACH OUTPUT)	±0.1VDC	±0.1VDC	±0.15VDC	±0.05VDC
TEMPERATURE COEFFICIENT	0.02% per °C max (0.01%/°C typical)	0.02% per °C max (0.01%/°C typical)	0.02% per °C max (0.01%/°C typical)	0.05% per °C max (0.02%/°C typical)
WARM-UP DRIFT (AFTER 5 SECONDS)	±0.1%	±0.1%	±0.15%	±0.3% (no overshoot on turn on)
0 TO FULL LOAD REGULATION	0.1% maximum	0.02% maximum	0.02% maximum	0.02% maximum
LINE REGULATION	±0.05% maximum	±0.005% maximum	±0.05% maximum	±0.005% maximum
RIPPLE	1 millivolt RMS maximum	0.5 millivolt RMS maximum	0.5 millivolt RMS maximum	0.5 millivolt RMS maximum
OUTPUT IMPEDANCE	1 ohm at 10KHz	1 ohm at 10KHz	1 ohm at 10KHz	0.1 ohm at 10KHz
SHORT CIRCUIT PROTECTION	Either or both outputs to common or together indefinitely	Either or both outputs to common or together indefinitely	Either or both outputs to common or together indefinitely	
OPERATING TEMPERATURE	0 to 71°C (derated according to Fig. 1 beyond 10° and 55° range)	0 to 71°C (derated according to Fig. 1 beyond 10° and 55° range)	0 to 71°C (derated according to Fig. 1 beyond 10° and 55° range)	0 to 71°C (derated according to Fig. 1 beyond 10° and 55° range)
STORAGE TEMPERATURE	−25°C to +85°C	−25°C to +85°C	−25°C to +85°C	−25°C to +85°C
SURFACE TEMPERATURE RISE	25°C above ambient at full load of 50 milliamperes	25°C above ambient at full load of 100 milliamperes	25°C above ambient at full load of 200 milliamperes	25°C above ambient at full load of 500 milliamperes
INPUT ISOLATION	50 megohms	50 megohms	50 megohms	50 megohms
Mechanical Specifications				
MOUNTING	Designed for direct soldering to printed circuit boards	Designed for direct soldering to printed circuit boards	Designed for direct soldering to printed circuit boards	Designed for direct soldering to printed circuit boards
DIMENSIONS	0.95 x 2 x 3 inches	1 x 2 x 3 inches	1.25 x 3 x 4.63 inches	1.25 x 2 x 3 inches
VOLUME	5.7 cubic inches	6.0 cubic inches	14 cubic inches	7.5 cubic inches
WEIGHT	Less than 8 ounces	Less than 9 ounces	Less than 19 ounces	Less than 12 ounces



△ – 4-40 Inserts optional
△ – 10-32 Studs optional
△ – Shield Lead Pin

0.040 dia. gold plated pins with 0.030 high standoff pads
C – is common pin

ANADYNE

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SANTA FE SPRINGS, CALIFORNIA 90670
(213) 698-7991
TWX 910-586-1881

ATR UNIVERSAL INVERTERS

Specially Designed for Operating Standard A.C. Tape Recorder, Television Set, Dictating Machine, Radio Set, Ham Gear, Public Address System, Amplifier, Record Player, Electric Razor, Food Mixer, Vacuum Cleaner, Sewing Machine, Business Machine, Electric Drill, Fluorescent and Incandescent Lamp, and Electronic Test Equipment from D.C. Voltages in Automobiles, Buses, Trucks, Boats, Trains, Planes, and D.C. Districts. Ideal for Emergency Lighting Applications for Civil Defense, Red Cross, Rescue Work, etc., Simply Using Extension Cords.

ATR
CONTROL
GND
HOT

Featured cut above illustrates Model 12U-RHG.

ATR Universal Inverters are actually a combination of 4 Inverter designs in one unit! These Inverters are especially recommended for applications as mentioned above and feature complete RF frequency interference suppression, instant starting, frequency stability, and built-in power factor corrector utilizing a simple toggle switch. With ATR Inverters, the need for special equipment is eliminated. They are designed for quiet, long-life operation at high efficiency and maximum reliability. All models indicated are equipped with ATR heavy duty plug-in Inverter Vibrators. These Inverters also come equipped with four-point voltage regulator which make possible the correct output voltage for minimum to maximum loads and also help compensate for input voltages which are lower or higher than normal. The operating efficiency is in excess of 75%. To figure approximate current consumption from storage battery, divide the rated input wattage of the recorder (or load) being operated by the storage battery voltage and further divide this answer by .75 which will give the actual current consumption based on the actual load and efficiency. The battery current consumption required for a tape recorder is normally less than that drawn by ordinary automobile headlight(s). These Universal Inverters are recommended only for use with loads having power factors in excess of 70%.

All Units are Frequency Stable and have Automatic Frequency Control.

"—P" models equipped with cigarette lighter cord set to plug into dash receptacle.

All ATR Universal Inverters are housed in attractively finished brown-hammerloid metal cabinets.

Dimensions of Standard (RSF) Model Universal Inverters, 8½" x 9⅞" x 5¼"; shipping weight 22 lbs.

Dimensions of Heavy Duty (RHG) Model Universal Inverters, 6⅞" x 11¼" x 8½"; shipping weight 27 lbs.

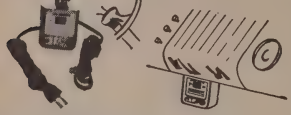
Dimensions of Super Heavy Duty (HSJ) Model Universal Inverters 6½" x 12⅞" x 8½"; shipping weight 37 lbs.

For correct replacement Vibrator, consult Inverter Vibrator Guide.

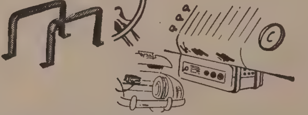
Type	Input D.C. Volts	A.C. Output 60 Cycles	Output Watt. Int.	Output Watt. Cont.	Shipping Weight	Net Price
12U-RSF	12	110	175	150	22	84.10
12U-RSF-P	12	110	175	150	22	84.10
12U-RHG	12	110	225	200	27	105.87
12U-HSJ	12	110	275	250	37	142.72
*28U-RSF	28	110	125	100	22	109.72
*28U-RHG	28	110	175	150	27	137.73
*28U-HSJ	28	110	250	200	37	170.99
32U-RSF	32	110	150	100	22	109.72
32U-RHG	32	110	200	180	30	137.73
32U-HSJ	32	110	325	225	37	170.99
50U-RSF	50	110	150	100	22	109.72
50U-RHG	50	110	225	200	27	148.51
110U-RSF	110	110	250	150	22	87.39
110AU-RHG	110	110	325	250	27	125.23
110BU-RHG	110	110	450	350	30	148.51
110U-HSJ	110	110	600	400	37	163.12
220U-RSF	220	110	250	150	22	105.87
220U-RHG	220	110	325	250	27	148.51
220U-HSJ	220	110	500	300	37	170.99

* Recommended for 24 volt battery systems.

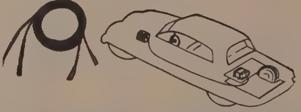
ACCESSORIES for 6, 12, and 28 Volt D.C. Input Inverters.



REMOTE CONTROL UNIT — for under-dash mounting permitting installation of Inverter in auto-trunk compartment.
Net Price $15.67



MOUNTING BRACKETS — to securely mount Inverter in trunk compartment of car or under-dash, as illustrated
Net Price $9.08 pr.



EXTENSION CABLES — to provide additional cable lengths for installation of Inverter in trunk compartment; #8 gauge, 15′ length.
Net Price $15.13 pr.

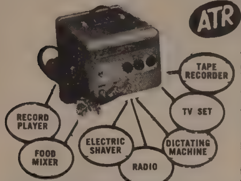
NOTE CAREFULLY: ATR Inverters are not recommended for operating refrigerators, washing machines, or similar motor-driven appliances; also, ATR Inverters are not recommended for operating toasters, electric irons, sun lamps, or similar appliances of high wattage or low power factor. Any attempt to use the Inverter for applications not recommended will ruin the Inverter immediately and void the guarantee.

INVERTERS, VIBRATORS, "A" ELIMINATORS, ETC.

ATR ELECTRONICS, INC.

MANUFACTURERS OF QUALITY PRODUCTS SINCE 1931
(612) 222-3791 • 300 East Fourth St., St. Paul, Minnesota 55101

ALL ATR INVERTERS LISTED ARE FREQUENCY STABLE AND HAVE AUTOMATIC FREQUENCY CONTROL



DC TO AC UNIVERSAL INVERTERS

Frequency Stable with Automatic Frequency Control.

New, universal inverters for operating 110V, 60 cycle AC equipment from DC voltages in autos, buses, trucks, boats, trains, planes and DC districts. Designed especially for standard 110 VAC tape recorders, TV sets, radios, PA systems, electric razors, test equipment, etc. Units are carefully engineered and ruggedly constructed to provide long life operation. All feature complete RF interference suppression and exceptional frequency stability. Have operating efficiency in excess of 75%. Four-point voltage regulator corrects output voltage for minimum and maximum loads, and also helps compensate for input voltages lower or higher than normal. Inverters are recommended for use with loads having power factors in excess of 70%. Built-in toggle switch selects most efficient operation for use with TV sets or tape recorders. Inverters are not recommended for use with large motor driven appliances such as refrigerators, washing machines, etc. All have On-Off switches. Housed in attractive brown hammerloid metal cabinet with convenient leather carrying strap. Sizes: Standard Model RSF, 8½x9⅞x5¼″; Heavy-Duty Model RHG, 6⅞x11¼x8½″; Extra-Heavy-Duty Model HSJ, 6½x12⅞x8½″. With battery clips for instant connection to power source. Models with "P" suffix equipped with adapter cord for use in auto cigarette lighter receptacles.

Mfr's Type	DC Input (Volts)	AC Output 60 Cycles (Volts)	Output Wattage Int.	Cont.	Shipping Wt. (Lbs.)	Net Price
12U-RSF	12	110	175	150	22	$84.10
12U-RSF-P	12	110	175	150	22	84.10
12U-RHG	12	110	225	200	27	105.87
12U-HSJ	12	110	275	250	37	142.72
*28U-RSF	28	110	125	100	22	109.72
*28U-RHG	28	110	175	150	27	137.73
*28U-HSJ	28	110	250	200	37	170.99
32U-RSF	32	110	150	100	22	109.72
32U-RHG	32	110	200	180	30	137.73
32U-HSJ	32	110	325	225	37	170.99
50U-RSF	50	110	150	100	22	109.72
50U-RHG	50	110	225	200	27	148.51
110U-RSF	110	110	250	150	22	87.39
110AU-RHG	110	110	325	250	27	125.23
110BU-RHG	110	110	450	350	30	148.51
110U-HSJ	110	110	600	400	37	163.12
220U-RSF	220	110	250	150	22	105.87
220U-RHG	220	110	325	250	27	148.51
220U-HSJ	220	110	500	300	37	170.99

*Recommended for 24V battery operation. **Before ordering, check wattage of equipment with which inverter will be used.**

PORTABLE PLUG-IN TYPE INVERTERS — DC TO AC

Frequency Stable with Automatic Frequency Control.

Specially Designed for Operating Standard AC Dictating Machines, Record Players, Incandescent Lamps, Electric Razors, Electronic Test Equipment, and other Small Electrical and Electronic Devices from DC Voltages in Automobiles, Buses, Trucks, Boats, Planes, Trains, and DC Districts.

Lightweight inverters for operating 110 VAC equipment from DC voltage sources. Feature excellent frequency stability and high efficiency. 6 and 12V units plug into cigarette lighter receptable of any vehicle; others are equipped with standard 2-prong plugs. All are designed especially for use with dictating machines; record players, electric razors, test equipment, etc. Not recommended for large tape recorders and motor driven appliances such as refrigerators, washing machines, etc. Brown Hammerloid case with leather carrying strap. Sizes: DME, 5¼x4¾x2¾″; RME & RMF, 8⅜x8x3¾″.

Mfr's Type	DC Input (Volts)	AC Output 60 Cycles (Volts)	Output Wattage Int.	Cont.	Shipping Wt. (Lbs.)	Net Price
12-DME	12	110	60	40	5	$27.70
†12T-RME-1	12	110	125	110	14	57.46
*28-RME	28	110	100	80	12	72.53
32-RME	32	110	100	80	12	72.53
110-RME	110	110	150	100	12	69.57
220-RME	220	110	150	100	12	72,53

*Recommended for 24V operation. **Check wattage rating of equipment before ordering. RME Model Inverters equipped with voltage regulator.**

†This Inverter specially designed and recommended also for use with portable TV set.

SOLID STATE INVERTERS — DC TO AC

Frequency Stable with Automatic Frequency Control.

Specially Designed to Provide 117V 60 Cycle AC Power for the Operation of Tape Recorders, VTR Equipment, Public Address Systems, TV Sets, Ham Gear, Small Portable Tools and Appliances, Test Instruments, Closed Circuit TV, Scientific Laboratory and Hospital Equipment, Small AC-DC Universal Motors, Fluorescent and Incandescent Lamps from 12 VDC Storage Battery Power in Automobiles, Buses, Trucks, Campers, Motor Homes, Boats, and Aircraft.

ATR SOLID STATE Inverters are Universal Type Inverters recommended for the applications as listed above plus hundreds more! These Inverters are very well filtered and feature quick starting, frequency stability with varying load and input voltage, rugged heavy-duty construction, reverse polarity protection, and built-in power factor corrector utilizing a simple toggle switch. With ATR Inverters, the need for special equipment is eliminated. They are designed for quiet, long-life operation at high efficiency and maximum reliability. All models indicated here are equipped with heavy duty power transistors and plug-in frequency reed for automatic frequency control. These Inverters also come equipped with four-point voltage regulators which make possible the correct output voltage for minimum to maximum loads and also help compensate for input voltages which are lower or higher than normal. The operating efficiency is approximately 80%. To figure approximate current consumption from storage battery, divide the rated input wattage of the load being operated by the storage battery voltage, and further divide this answer by .80 which will give the approximate current consumption from the battery based on the actual load being operated. These Inverters are recommended primarily for use with loads having power factors in excess of 70%. Inverters come complete with battery cables ready for operation.

Mfr's Type	DC Input (Volts)	AC Output 60 Cycles (Volts)	Output Wattage Int.	Cont.	Shipping Wt. (Lbs.)	Net Price
12U-S2A	12	117	300	275	17	$153.44
*12U-S2A-P	12	117	300	275	17	153.44
12U-S4G	12	117	500	450	27	251.08
12U-S6M	12	117	650	600	34	291.22
12U-S44G	12	117	1000	900	59	547.25
12U-S66M	12	117	1200	1100	75	648.73

*"-P" model is equipped with cigarette lighter cord set to plug into dash receptacle. Caution — Do not load beyond 150 watts due to possible damage to cigarette receptacle wiring.

Dimensions of Model 12U-S2A, 11x9x4″. Dimensions of Model 12U-S4G, 11x9¾x5¼″. Dimensions of Model 12U-S6M, 11x11¼x6¾″. Dimensions of Model 12U-S44G, 11x9¾x10½″. Dimensions of Model 12U-S66M, 11x11¼x13½″.

All ATR Inverters are housed in attractively finished brown-hammerloid metal cabinets and are complete with battery cables ready for operation.

For Inverters having larger or smaller output capacities, or for operation on other DC input voltages from 6V to 220V, please consult available ATR Inverter catalog sheets.

STANDBY POWER SYSTEMS

FOR EMERGENCY LIGHTING AND POWER

Illustrates ATR Standby Power System complete with lamps, automatic crossover, and battery charger.

Completely Automatic Standby Power Units specially designed to permit the instantaneous continued operation of critical lighting equipment, PA systems, amplifiers, intercom systems, burglar alarms, fire alarms, synchronous electric clocks, electric time and recording clocks, incubators, gas valves, telephone and test equipment, and similar critical devices in the event of 115 volt AC commercial power line failure. For use: In hospitals, banks, hotels, theatres, factories, office buildings, schools, homes and other areas of operation.

Type	Storage Battery Input (Volts)	AC Output 60 Cyc. (Volts)	Output Wattage Int.	Cont.	Shipping Wt. (lbs.)	Net Price Without Lamps
‡1232-ETS	12	110	175	150	38	$293.09
‡1233-ETH	12	110	225	200	43	314.87
‡1234-ETJ	12	110	275	250	53	351.68
†1235-S2A	12	110	300	275	33	362.44
†1236-S4G	12	110	500	450	43	460.07
†1237-S6M	12	110	650	600	50	505.72
†1238-S44G	12	110	1000	900	75	783.75
†1239-S66M	12	110	1200	1100	92	885.22

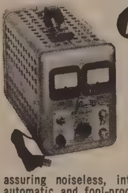
†Solid State type. ‡Vibrator type.
For Units with Lamps add $45.10 additional Net.

All Models designated above are housed in attractively finished brown-hammerloid metal cabinets. Dimensions of all Models **without lamps** are as follows: ETS, 11″Wx11¾″Dx9″H; ETH, 11″Wx11¾″Dx11″H; ETJ, 11″Wx13″Dx12½″H; S2A, 11″Wx11¾″Dx7¾″H; S4G, 11″Wx11¾″Dx9″H; S6M, 11″Wx11¾″Dx11″H; S44G, 11″Wx11¾″Dx14½″H; S66M, 11″Wx11¾″Dx18½″H. For units with Lamps, change W to 16″ and add 7½″ to H; also increase shipping weight by 5 lbs.

SHAV-PAKS

Every man should have this lightweight ATR Inverter in his car for that "Keep Clean-Shaved Look." Will operate standard AC electric shavers and other small electrical devices from your car or boat. Complete with 3 ft. cord set. Plugs into cigarette lighter receptacle. Fuse protected, rugged construction, and attractively housed in grey hammerloid-finish steel case. Input: 12 VDC. Output: 110 VAC. 60 cycles, 15-25 watts. Size: 4x2⅝x2¾″. Ship. wt., 2½ lbs.

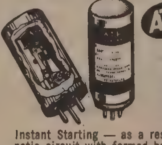
Model 12-SPB .... Net **$18.10**



BATTERY ELIMINATOR & CHARGER

For Demonstrating and Testing Transistor or Vibrator-Type Auto Radios. Ideal as a Power Supply for Model Railroad Trains, Radio Sets, Electro Plating Outfits, and other 6 or 12 VDC Equipment. May also be used as a Battery Charger. Designed for testing DC electrical apparatus on regular 110 VAC lines — equipped with full-wave solid state rectifier, assuring noiseless, interference-free operation. Fully automatic and fool-proof; has voltmeter, ammeter, and 8-position voltage control. Fuse protected and housed in heavy gauge brown hammerloid-finish metal case. 6 ft. cord set included. Size: Model 610C-ELIF, 6½x8⅛x8½″, ship. wt., 22 lbs.; Model 620C-ELIT, 6½x12⅞x8½″, ship. wt., 33 lbs.

Model 610C-ELIF (6 volt at 10 amps or 12 volt at 6 amps) .... Net **$82.50**
Model 620C-ELIT (6 volt at 20 amps or 12 volt at 10 amps) .... Net **109.73**



VIBRATORS

For All Auto Radio Sets Since 1954 Use One of the ATR Vibrators Listed Below.

ATR Vibrators Feature:
Ceramic Stack Spacers with two-bolt stack construction.
Instant Starting — as a result of highly efficient magnetic circuit with formed base for more uniform operation on both high and low voltages.
Large Oversize Tungsten Contacts having Full Wiping Action — for greater reliability and longer life.
Perforated Reed of Highest Quality Swedish Spring Steel.
Highest Precision Construction and Workmanship.

Ship. Wt., ½ lb.

ATR No. 1400 (Bulk), 4 Prong, 6 Volt.	Net $3.57
ATR No. 1843 (Bulk), 3 Prong, 12 Volt.	Net $3.57
ATR No. 1848 (Bulk), 4 Prong, 12 Volt.	Net $3.57

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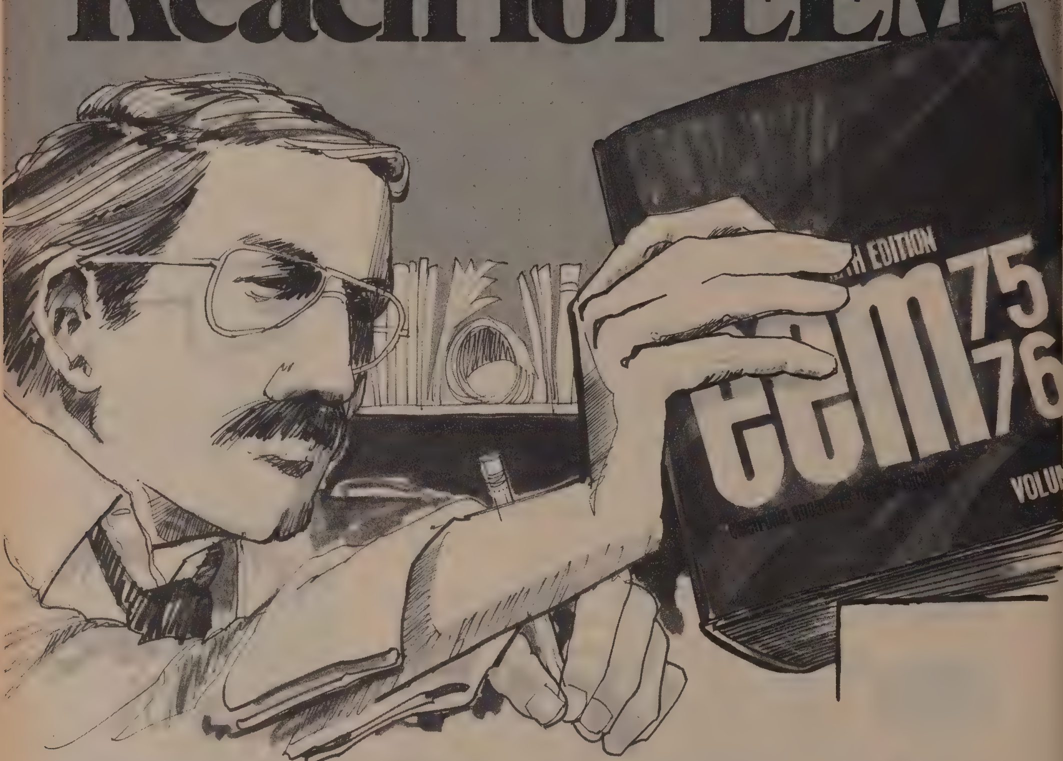

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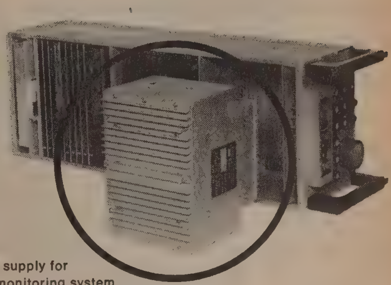
If you're looking for a custom designed power supply we would like to talk to you.

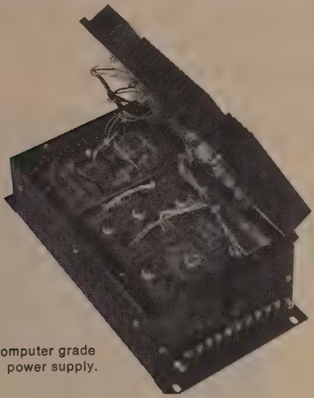
Over the past 19 years we've saved countless customers time and effort by applying our design and manufacturing expertise to their custom power supply applications.

The know-how we have developed during this time has enabled us to produce single and multiple output units combining switching and linear techniques for optimum performance. Designs range from plug-in card types to highly sophisticated packages — for both military and commercial/industrial applications.

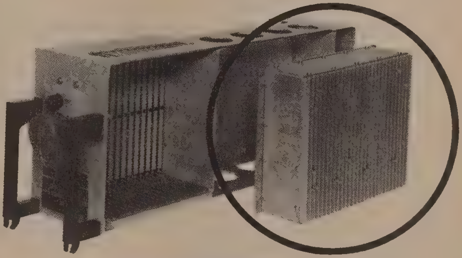
A condensed listing of our general product capabilities is shown below. Call us first the next time you need a custom power supply. If we can't help you we'll try to tell you who can.



Computer power supply for in-flight engine monitoring system.



Computer grade power supply.



Airborne data processing computer power supply.

Typical Applications

- Power supplies for military computers designed to monitor aircraft engine parameters in flight.
- Power supplies for data processing computers used in commercial aircraft.
- Power supplies for computers in automated oil field installations.
- Power supplies for control logic and sonar transmitters for manned anti-submarine warfare targets.
- Inverter power for gyro stabilized systems.

See EEM Controls Section 2200 for Autronics' Custom Controls capabilities.

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A.C.POWER

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STANDARDS ■ SPECIALS ■ CUSTOM

20 years of innovation by the A.C. power supply pioneers — power outputs from milliwatts to tens of kilowatts — all silicon solid state.

The smallest, lightest, least expensive units available. ■ All units rated at worst case condition. ■ All units capable of continuous duty at 150% of their power rating at nominal line and high power factor load. ■ Single, two and three phase outputs. ■ Units available with switch selection of single or multi-phase output.

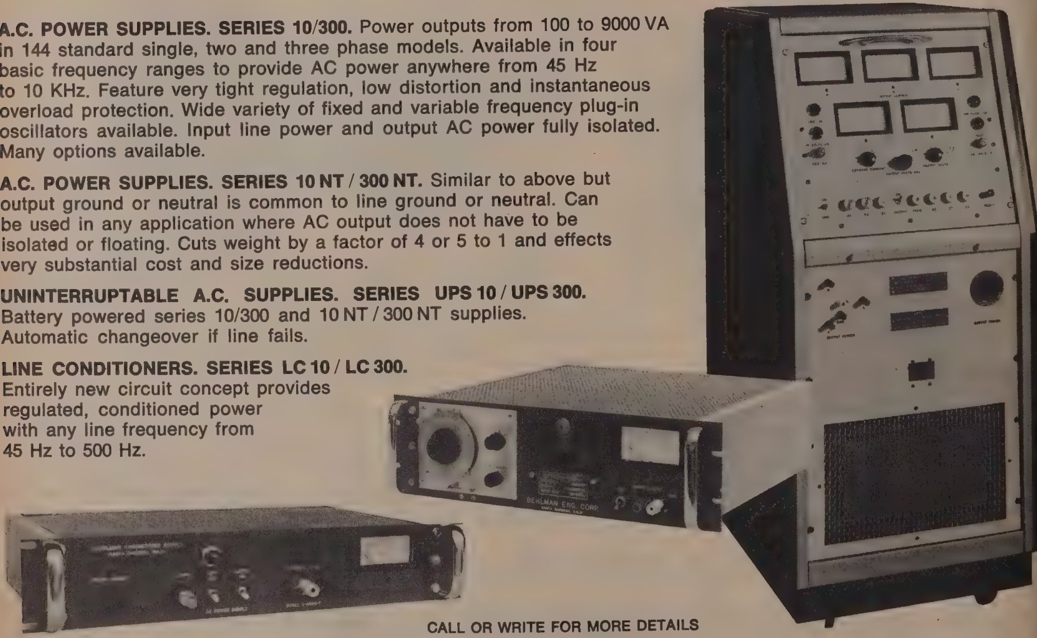
Ultra-sophisticated magnetics in combination with highly simplified circuitry effect dramatic size, weight and cost reduction plus greatly improved reliability. Basic power amplifiers are available in frequency ranges to suit your application, thereby eliminating the need to pay size, weight and price penalties for unnecessary frequency capability.

A.C. POWER SUPPLIES. SERIES 10/300. Power outputs from 100 to 9000 VA in 144 standard single, two and three phase models. Available in four basic frequency ranges to provide AC power anywhere from 45 Hz to 10 KHz. Feature very tight regulation, low distortion and instantaneous overload protection. Wide variety of fixed and variable frequency plug-in oscillators available. Input line power and output AC power fully isolated. Many options available.

A.C. POWER SUPPLIES. SERIES 10 NT / 300 NT. Similar to above but output ground or neutral is common to line ground or neutral. Can be used in any application where AC output does not have to be isolated or floating. Cuts weight by a factor of 4 or 5 to 1 and effects very substantial cost and size reductions.

UNINTERRUPTABLE A.C. SUPPLIES. SERIES UPS 10 / UPS 300. Battery powered series 10/300 and 10 NT / 300 NT supplies. Automatic changeover if line fails.

LINE CONDITIONERS. SERIES LC 10 / LC 300. Entirely new circuit concept provides regulated, conditioned power with any line frequency from 45 Hz to 500 Hz.



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Behlman Engineering Corporation

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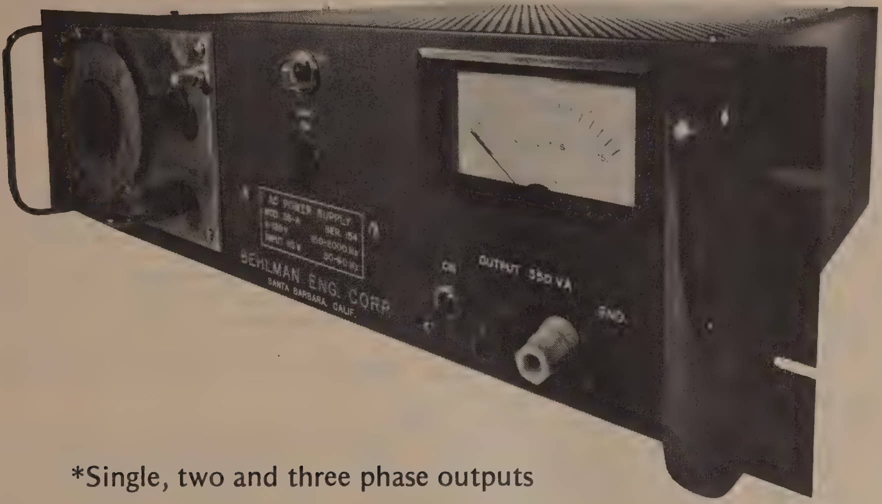
SERIES 10/300 AC POWER SOURCES



*Single, two and three phase outputs

*Up to 3000 VA per phase in 144 standard models

*Fixed or variable output frequencies, 45 Hz - 10 kHz

*Tight regulation vs. line and load changes

*Instant response time

*Low output distortion

* Full rated output into loads of any power factor

*Up to 150% of rated output with high power factor loads

*Instantaneous overload protection, automatic recovery

*Complete transformer-coupled isolation, input and output

*All silicon solid state, entirely new circuit concepts

*Smaller, lighter, simpler, less expensive, more reliable

*Can be used as linear power amplifier

*Complete line of plug-in oscillators

*Wide variety of options available

Specialists in electronic energy conversion devices

Behlman Engineering Corporation

P.O. BOX 4518 · 427 N. NOPAL STREET · SANTA BARBARA, CALIFORNIA 93103 (805) 963-9019

The 10/300 series of AC Power Supplies are linear power amplifiers driven by plug-in oscillators. Fixed and variable frequency oscillators, with frequency accuracies to 0.001% and 0.1% respectively, are available in a wide variety of standard models. An almost unlimited variety of oscillators with various degrees of accuracy and many special features can be provided.

An entirely new concept has been employed in the power amplifiers. This concept greatly increases the power conversion efficiency while at the same time reducing circuit complexity. This, in combination with very advanced magnetics, makes possible units that are smaller, lighter, less expensive and much more reliable. Behlman Engineering AC Power Supplies weigh only one half to two thirds as much as competitive units.

An extremely high degree of feedback is employed in the power amplifier resulting in very low output distortion, tight line and load regulation and exceptional stability. Distortion is 0.5% max.at frequency extremes and less at mid band. Load regulation is ±0.5% and is adjustable through zero for specific loads. Line regulation is ±0.1% for ±10% line.

Two separate power amplifiers driven by a two phase oscillator and three separate power amplifiers driven by a three phase oscillator are used to provide two and three phase power outputs. Units are available capable of providing a choice of single or multi-phase output by means of a front panel mode selector switch.

The output power is transformer coupled and completely isolated. It can be left floating or one side grounded.

Line input to these units is via very advanced islolating magnetics.

These power supplies are capable of providing continuous full-rated volt-ampere output under worst case conditions, i.e., zero power factor loads either leading or lagging, 10% low line and output voltage at 75% of maximum. With unity power factor loads, nominal line and maximum output voltage, continuous duty at 150% of rating is permissable. The graph on the next page shows maximum power output for various conditions of load power factor output voltage, line voltage and ambient temperature. Even though these power supplies are rated under worst case conditions and in addition have a 50% overload capability they are nevertheless smaller, lighter and less expensive than other supplies whose ratings have been derived under considerably more favorable operating conditions.

Complete overload, short circuit and fault protection is provided by a combination of an instantaneous, automatic-recovery electronic protector plus a fast acting main circuit breaker and fuses in various low level internal D.C. supplies.

SPECIFICATIONS

INPUT VOLTAGE: 117 VAC ±10%, single phase. Units up to 750 VA output.

230 VAC ±10%, single phase. 1000 VA to 2250 VA output.

120/208 or 230 VAC ±10%, three phase. Units over 2250 VA output.

INPUT FREQUENCY: 60 Hz ±20%

EFFICIENCY: 50-70%, depending on operating conditions.
Various input voltage, frequency and power options are available, many at no extra charge.

OUTPUT VOLTAGE: 0-130 standard. Other ranges or combinations of ranges available.

LOAD REGULATION: ±0.5% No load to full load. Adjustable through zero for specific loads.

LINE REGULATION: ±0.1% for ±10% line change

POWER FACTOR: Full rated VA into any power factor load down to zero, lead or lag.

DISTORTION: 0.5% max. harmonic distortion at frequency extremes. Less at mid-band.

OVERLOAD AND FAULT PROTECTION: Instantaneous, automatic recovery short circuit and overload protection. Fast acting main circuit breaker and fuses for fault protection.

METERING: Output voltmeter

EXTERNAL INPUT: Via optional plug-in. 12 volts RMS. 80K ohms input impedance.

OPERATING TEMPERATURE: 0° to 55°C.

FRONT PANEL COLOR: Dark grey, white lettering.

Some of the special options available include input power types, output voltage ranges or combinations of ranges, metering, higher and lower frequency outputs, higher and lower power outputs, physical configurations, paint colors, tighter regulation specifications, single to multi-phase output switching, etc. Completely special or custom units providing solutions to virtually any A.C. power supply problem can be furnished.

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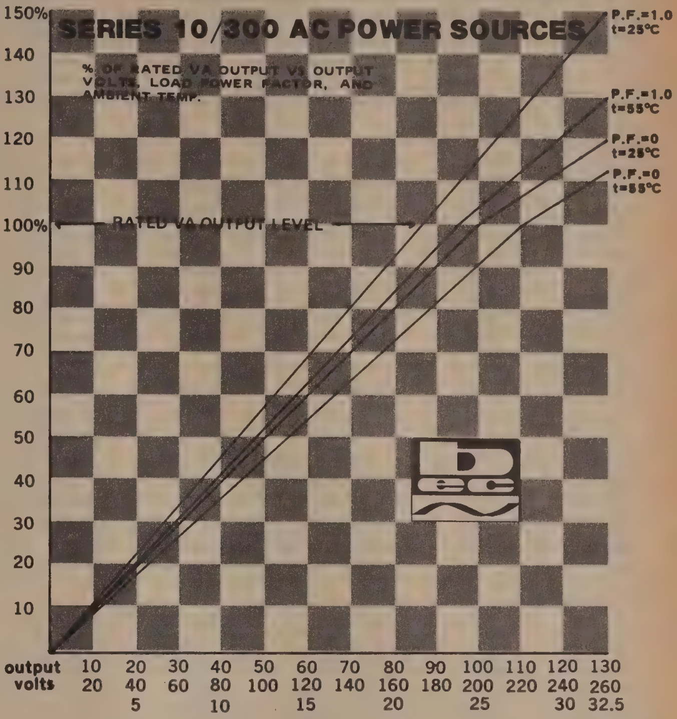
The graph to the right relates output power limits, expressed as a percentage of rated output, to various conditions of output voltage, load power factor, and ambient temperature.

The output voltages shown are the three most popular ranges. Other voltage ranges are comparable on a pro-rata basis.

An important advantage, inherent in Behlman Engineering Corp. AC Power Sources, lies in the availability of power amplifiers in four separate output frequency ranges. The narrow band power supplies effect cost and weight savings that add to the already existing size, weight and cost advantages of our full frequency models.

Many AC power supplies require derating to half power in the 5kHz to 10kHz range. This derating is not required with the Behlman Engineering 10/300 series.

This graph carries an important message: Don't buy an AC power supply without knowing how its ratings were determined.



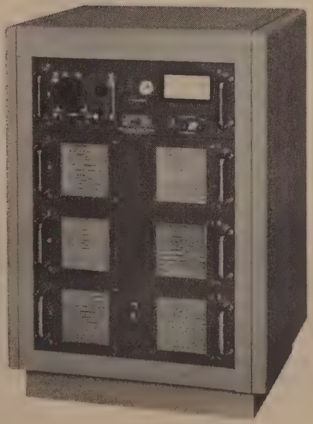
THE AC POWER SUPPLY PROBLEM SOLVERS

DO YOU HAVE A SPECIAL AC PROBLEM?

Behlman Engineering versatility can solve it. Standard units can be stacked for more power or multi-phase output or combined in special configurations. Omitting input and/or output isolation can effect dramatic cost and size savings. A great variety of options provide solutions to many special requirements. Completely special or custom units or systems can be provided.

Behlman experience in the field of AC power sources covers a period of 20 years. The expertise accumulated in pioneering this field, and introducing most of its innovations, has earned for Behlman Engineering Corporation the reputation of being "The AC Power Supply Problem Solvers."

An example of Behlman Engineering's versatility is the special Model 600-8-1K shown at right. Designed for an unusual field service application, it generates 6000 VA of A.C. power over the frequency range of 8 to 1000 Hz. Its weight of only 250 lbs. and overall panel height of 28 inches was accomplished through a combination of very high efficiency linear power amplifiers and unique magnetics design.



MODEL 600-8-1K

SERIES 10/300 AND 10 NT/300 NT A.C. POWER SUPPLIES
SERIES UPS 10/UPS 300 AND UPS 10 NT/UPS 300 NT UNINTERRUPTIBLE A.C. POWER SUPPLIES

OUTPUT POWER	MODEL NUMBERS				BASIC POWER AMPLIFIER Output Frequency Range (Hz)			
	A.C. Power Supplies		Uninterruptible A.C. Supplies					
	Isolated Output	Common Ground	Isolated Output	Common Ground	150-2000	150-10,000	45-2000	45-10,000
SINGLE PHASE					A	B	C	D
100 VA	10-	10 NT-	UPS-10-	UPS-10 NT-				
250 VA	25-	25 NT-	UPS-25-	UPS-25 NT-				
350 VA	35-	35 NT-	UPS-35-	UPS-35 NT-				
500 VA	50-	50 NT-	UPS-50-	UPS-50 NT-				
750 VA	75-	75 NT-	UPS-75-	UPS-75 NT-				
1000 VA	100-	100 NT-	UPS-100-	UPS-100 NT-				
1500 VA	150-	150 NT-	UPS-150-	UPS-150 NT-				
2000 VA	200-	200 NT-	UPS-200-	UPS-200 NT-				
3000 VA	300-	300 NT-	UPS-300-	UPS-300 NT-				
TWO PHASE								
200 VA	2-10-	2-10 NT-	UPS2-10-	UPS2-10 NT-				
500 VA	2-25-	2-25 NT-	UPS2-25-	UPS2-25 NT-				
700 VA	2-35-	2-35 NT-	UPS2-35-	UPS2-35 NT-				
1000 VA	2-50-	2-50 NT-	UPS2-50-	UPS2-50 NT-				
1500 VA	2-75-	2-75 NT-	UPS2-75-	UPS2-75 NT-				
2000 VA	2-100-	2-100 NT-	UPS2-100-	UPS2-100 NT-				
3000 VA	2-150-	2-150 NT-	UPS2-150-	UPS2-150 NT-				
4000 VA	2-200-	2-200 NT-	UPS2-200-	UPS2-200 NT-				
6000 VA	2-300-	2-300 NT-	UPS2-300-	UPS2-200 NT-				
THREE PHASE T								
200 VA	2T-10-	2T-10 NT-	UPS2T-10-	UPS2T-10 NT-				
500 VA	2T-25-	2T-25 NT-	UPS2T-25-	UPS2T-25 NT-				
700 VA	2T-35-	2T-35 NT-	UPS2T-35-	UPS2T-35 NT-				
1000 VA	2T-50-	2T-50 NT-	UPS2T-50-	UPS2T-50 NT-				
1500 VA	2T-75-	2T-75 NT-	UPS2T-75-	UPS2T-75 NT-				
2000 VA	2T-100-	2T-100 NT-	UPS2T-100-	UPS2T-100 NT-				
3000 VA	2T-150-	2T-150 NT-	UPS2T-150-	UPS2T-150 NT-				
4000 VA	2T-200-	2T-200 NT-	UPS2T-200-	UPS2T-200 NT-				
6000 VA	2T-300-	2T-300 NT-	UPS2T-300-	UPS2T-300 NT-				
THREE PHASE Y								
300 VA	3-10-	3-10 NT-	UPS3-10-	UPS3-10 NT-				
750 VA	3-25-	3-25 NT-	UPS3-25-	UPS3-25 NT-				
1050 VA	3-35-	3-35 NT-	UPS3-35-	UPS3-35 NT-				
1500 VA	3-50-	3-50 NT-	UPS3-50-	UPS3-50 NT-				
2250 VA	3-75-	3-75 NT-	UPS3-75-	UPS3-75 NT-				
3000 VA	3-100-	3-100 NT-	UPS3-100-	UPS3-100 NT-				
4500 VA	3-150-	3-150 NT-	UPS3-150-	UPS3-150 NT-				
6000 VA	3-200-	3-200 NT-	UPS3-200-	UPS3-200 NT-				
9000 VA	3-300-	3-300 NT-	UPS3-300-	UPS3-300 NT-	A	B	C	D

To Order: Use model no. corresponding to output power level and number of phases required. Add letter corresponding to desired frequency range. Plug-in oscillators are available in a very wide variety of frequencies, both fixed and variable. Most units are in rack mounting enclosure. Cabinet enclosed versions of any of these units are available. Specify desired lengths of time for battery operation and battery recharge of UPS units.

SERIES LC 10/LC 300 A.C. LINE CONDITIONERS

These line conditioners are not frequency sensitive and will accept and condition line power of any frequency over the range of 45-500 Hz. They are not frequency converters but true line conditioners and provide very high correction ratios of Line voltage variations, distortion, noise, spikes and transients. They are exceptionally efficient, compact, light and inexpensive.

This series of line conditioners is available in all of the power output ratings and phase configurations applicable to the A.C. power supplies listed above. For example a line conditioner to provide 1050 VA of 3 phase conditioned power in a wye configuration would be ordered as model 3-LC35. Specify nominal line voltage.

CALL OR WRITE FOR MORE DETAILS

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POWER SOURCES (INCLUDING BATTERIES)
PRICE, SIZE & WEIGHT LIST
Main Frame Amplifiers

MODEL NUMBER	OUTPUT FREQUENCY RANGE (Hz) 150-2000	150-10,000	45-2000	45-10,000	WEIGHT D MODELS	DIMENSIONS
	A	B	C	D	LBS	
10–	$ 450	$ 495	$ 520	$ 540	26	5¼"Hx12"Dx19"W
25–	550	605	630	660	42	5¼"Hx15"Dx19"W
35–	795	875	915	955	55	5¼"Hx17"Dx19"W
50–	945	1040	1090	1135	60	5¼"Hx19"Dx19"W
75–	1435	1580	1650	1725	80	7"Hx19"Dx19" W
100–	1795	1975	2065	2155	105	8¾"Hx19"Dx19"W
150–	2550	2805	2930	3060	140	15¾"Hx19"Dx19"W
200–	3295	3625	3790	3955	175	17½"Hx21"Dx19"W
300–	4825	5310	5550	5790	250	21"Hx21"Dx19"W
2-10–	975	1070	1120	1170	46	5¼"Hx15"Dx19"W
2-25–	1175	1290	1350	1410	75	5¼"Hx19"Dx19"W
2-35–	1785	1965	2050	2140	95	7"Hx19"Dx19"W
2-50–	1965	2160	2260	2360	110	8¾"Hx19"Dx19"W
2-75	2945	3240	3390	3535	150	15¾"Hx19"Dx19"W
2-100–	3665	4030	4215	4400	210	17½"Hx19"Dx19"W
2-150–	5225	5750	6010	6270	280	26¼"Hx21"Dx19"W
2-200–	6750	7425	7750	8100	350	26¼"Hx21"Dx19"W
2-300–	9875	10850	11350	11850	425	33¼"Hx21"Dx19"W
3-10–	1425	1570	1640	1710	65	5¼"Hx19"Dx19"W
3-25–	1750	1925	2010	2100	85	7"Hx19"Dx19"W
3-35–	2665	2930	3065	3200	120	8¾"Hx21"Dx19"W
3-50–	2935	3230	3375	3520	180	15¾"Hx21"Dx19"W
3-75–	4405	4850	5065	5285	220	17½"Hx21"Dx19"W
3-100–	5385	5925	6190	6460	295	26¼"Hx21"Dx19"W
3-150–	7450	8195	8565	8940	370	28"Hx21"Dx19"W
3-200–	9625	10600	11075	11550	450	40¼"Hx21"Dx19"W
3-300–	14100	15500	16225	16925	550	47¼"Hx21"Dx19"W

Oscillators

FIXED FREQUENCY	MODEL	FREQUENCY ACCURACY 1%	0.5%	0.25%	0.1%	0.01%	0.001%
		E	F	G	H	J	K
SINGLE PHASE	OSC-1-XXX*–	$ 95	$ 110	$ 130	$ 155	$ 330	$ 485
TWO PHASE	OSC-2-XXX*–	170	190	210	235	395	555
THREE PHASE T	OSC-2T-XXX*–	180	200	220	245	410	575
THREE PHASE Y	OSC-3-XXX*–	195	220	240	265	445	585

*Insert desired frequency in place of XXX. Add code letter for desired frequency accuracy to model number.

VARIABLE FREQUENCY	MODEL				
SINGLE PHASE	OSC-1-380/420–	$ 225	$ 245	$ 270	$ 345
	OSC-1-350/450–	225	245	270	
	OSC-1-300/500	225	275	295	
	OSC-1-44/66–	235	295	320	
	OSC-1-44/66/320/480	330	415		
	OSC-1-45/2000–	360			
	OSC-1-150/2000–	350			
	OSC-1-45/10000–	410			
	OSC-1-150/10000–	390			
TWO PHASE	-2-	ADD 25% TO SINGLE PHASE PRICE			
THREE PHASE T	-2T-	ADD 30% TO SINGLE PHASE PRICE			
THREE PHASE Y	-3-	ADD 35% TO SINGLE PHASE PRICE			
EXTERNAL INPUT PLUG-IN	EIP-1	$ 25			
	EIP-2, 2T	35			
	EIP-3	45			
EXTERNAL SYNC	-SN	15			

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BA
BERTAN ASSOCIATES, INC.

HIGH VOLTAGE

REGULATED POWER SUPPLIES

FOR:

Cathode Ray Tubes • Photomultipliers • Lasers
Image Intensifiers • X-Rays
Electron Beams • Nuclear Instrumentation
Flying Spot Scanners • Scanning Electron Microscopes
Electron Microprobes • High Resolution Displays
CRT Photocomposition • Computer Output Microfilm
Optical Character Recognition • Pollution Control
Microwave Tubes • Medical Instrumentation
General Laboratory and Systems Instrumentation

BERTAN ASSOCIATES, INC. is engaged in the design, development and manufacture of high voltage power supplies and instrumentation. Our staff of specialists has developed the unique techniques, components and designs required to manufacture quality instruments at reasonable prices. The products described in this catalog are typical of our sophisticated capabilities. They underscore our ability to convert your custom requirements into quality products quickly and economically.

Typical of BERTAN excellence is the use of proprietary linear circuits for the development of high voltages. Linear circuit techniques provide three advantages which advance the state—of—the—art. First, they eliminate the spikes and noise associated with competitive saturated core and inverter devices. Second, they can be readily programmed by remote control, computer or internal tracking circuitry. Third, linear operation of the high voltage assembly is inherently more reliable than inverter operation with its high surges of peak power. The resultant purity and versatility of our power supplies makes them ideal for applications where noise cannot be tolerated, or where program control is required. All units are arc protected, short circuit proof and self restoring.

BERTAN ASSOCIATES, INC. is equipped to provide you with the most advanced high voltage power supplies available from today's technology. We would be pleased to discuss our capabilities with you and to quote on either your custom or catalog requirements.

Inquires for OEM applications are particularly invited. Specifications for all units shown can be tailored for optimum performance in your application.

BERTAN ASSOCIATES, INC. 180 MILLER PLACE, HICKSVILLE, N.Y. 11801 (516) 433-3110

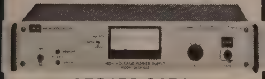
BERTAN ASSOCIATES, INC.

HIGH VOLTAGE

REGULATED POWER SUPPLIES

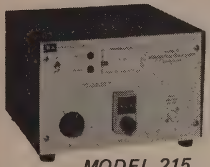
- **TO 50 kV**
- **REMOTE PROGRAMMABLE**
- **PROPRIETARY LINEAR CIRCUITRY RESULTS IN EXCEPTIONALLY LOW NOISE AND HIGH STABILITY**
- **FULLY SOLID STATE AND INTEGRATED CIRCUIT DESIGN**
- **SHORT CIRCUIT PROOF**
- **ARC PROTECTED**
- **SELF RESTORING**
- **LABORATORY INSTRUMENTS**
- **OEM MODULES**
- **CUSTOM DESIGNS**

PRECISION PROGRAMMABLE LABORATORY POWER SUPPLIES



SERIES 205A

GENERAL PURPOSE LABORATORY POWER SUPPLY

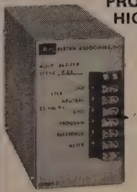


MODEL 215

NUCLEAR INSTRUMENTATION MODULES

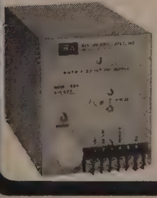
SERIES NIM

FULLY PROGRAMMABLE HIGH VOLTAGE MODULES



SERIES 602

MULTIPLE OUTPUT CRT SUPPLIES



MODELS 620 AND 625

Model	Output Volts	Output mA	Regulation Line/Load %	Ripple mV p-p	Remote Program	H x W x D Inches	*Input Power
205A-01R	0 to ±1000	0 to 30	0.001/0.01	10	✓	3.5 x 19 x 10	A
205A-03R	0 to ±3000	0 to 10	0.001/0.01	15	✓	3.5 x 19 x 10	A
205A-05R	0 to ±5000	0 to 5	0.001/0.01	50	✓	3.5 x 19 x 10	A
205A-10P	0 to +10,000	0 to 2	0.001/0.01	100	✓	3.5 x 19 x 10	A
205A-10N	0 to -10,000	0 to 2	0.001/0.01	100	✓	3.5 x 19 x 10	A
205A-20P	0 to +20,000	0 to 1	0.001/0.01	400	✓	3.5 x 19 x 10	A
205A-20N	0 to -20,000	0 to 1	0.001/0.01	400	✓	3.5 x 19 x 10	A
205A-30P	0 to +30,000	0 to 0.5	0.001/0.01	600	✓	5.3 x 19 x 15	A
205A-30N	0 to -30,000	0 to 0.5	0.001/0.01	600	✓	5.3 x 19 x 15	A
205A-50P	0 to +50,000	0 to 0.3	0.001/0.01	2000	✓	5.3 x 19 x 15	A
205A-50N	0 to -50,000	0 to 0.3	0.001/0.01	2000	✓	5.3 x 19 x 15	A
215	0 to ±3000	0 to 5	0.001/0.01	15		5 x 7.6 x 7.3	A
NIM 301	0 to ±1000	0 to 3	0.001/0.01	1	✓	Dual NIM	B
NIM 303	0 to ±3000	0 to 1	0.001/0.01	3	✓	Dual NIM	B
NIM 305	0 to ±5000	0 to 0.5	0.001/0.01	5	✓	Dual NIM	B
NIM 310P	0 to +10,000	0 to 0.2	0.001/0.01	20	✓	Dual NIM	B
NIM 310N	0 to -10,000	0 to 0.2	0.001/0.01	20	✓	Dual NIM	B
NIM 313	0 to ±3000	0 to 10	0.001/0.01	10	✓	Dual NIM	A
NIM 315	0 to ±5000	0 to 5	0.001/0.01	25	✓	Dual NIM	A
NIM 320P	0 to +10,000	0 to 2	0.001/0.01	100	✓	Dual NIM	A
NIM 320N	0 to -10,000	0 to 2	0.001/0.01	100	✓	Dual NIM	A
602-15P	0 to +1500	0 to 10	0.001/0.01	15	✓	5 x 3 x 7.5	A
602-15N	0 to -1500	0 to 10	0.001/0.01	15	✓	5 x 3 x 7.5	A
602-30P	0 to +3000	0 to 5	0.001/0.01	30	✓	5 x 3 x 7.5	A
602-30N	0 to -3000	0 to 5	0.001/0.01	30	✓	5 x 3 x 7.5	A
602-50P	0 to +5000	0 to 2	0.001/0.01	50	✓	5 x 3 x 7.5	A
602-50N	0 to -5000	0 to 2	0.001/0.01	50	✓	5 x 3 x 7.5	A
602-150P	0 to +15,000	0 to 0.6	0.001/0.01	300	✓	5 x 3 x 7.5	A
602-150N	0 to -15,000	0 to 0.6	0.001/0.01	300	✓	5 x 3 x 7.5	A
602-250P	0 to +25,000	0 to 0.3	0.001/0.01	500	✓	5 x 4.8 x 9	A
602-250N	0 to -25,000	0 to 0.3	0.001/0.01	500	✓	5 x 4.8 x 9	A
605-30P	+1000 to +3000	0 to 3	0.01/0.02	0.01%		5.1 x 2.8 x 4.8	C, D
605-30N	-1000 to -3000	0 to 3	0.01/0.02	0.01%		5.1 x 2.8 x 4.8	C, D
605-75P	+2500 to +7500	0 to 1	0.01/0.02	0.01%		5.1 x 2.8 x 4.8	C, D
605-75N	-2500 to -7500	0 to 1	0.01/0.02	0.01%		5.1 x 2.8 x 4.8	C, D
605-150P	+5000 to +15,000	0 to 0.3	0.01/0.02	0.01%		5.1 x 2.8 x 4.8	C, D
605-150N	-5000 to -15,000	0 to 0.3	0.01/0.02	0.01%		5.1 x 2.8 x 4.8	C, D
620 620AC	6 - 20 kV 0 - 5 kV 150 - 500V	0.2 0.2 1	0.002/0.03 0.002/0.03 0.002/1	0.02% 0.02% 0.05%	✓	6 x 5 x 10	C, D A
625	5 - 15kV 300 - 1000V	0.2 1	0.002/0.03 0.002/1	0.03% 0.05%		5.1 x 2.8 x 4.8	C, D
630	High Speed Dynamic Electrostatic Focus Supply. Static Focus Variable 0 to +5000 V @ 2 mA. Dynamic Focus 0 to 250 V/25 µsec. G-2 Supply +300 V included.				✓	5.8 x 5.3 x 6.5	A

Specifications subject to change.

*Input Power: A- 115/230V ± 10%, 50-400Hz. B - ±12V, ±24V dc input from NIM bin. C - +28 Vdc. D - Other dc input available on special order.

BERTAN ASSOCIATES, INC.
180 MILLER PLACE
HICKSVILLE, NEW YORK 11801
(516) 433-3110

DC-DC UNREGULATED POWER CONVERTERS

- Built-in short circuit protection
- Isolated input/output
- 0.5% maximum ripple

11 TO 14 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC) @ 12 VDC Input	Current (Amps)			
12	4.0	DDU 1201	A	122.40
	7.0	DDU 1202	B	153.90
24	2.0	DDU 1204	A	122.40
	3.5	DDU 1205	B	153.90
48	1.0	DDU 1207	A	122.40
	1.8	DDU 1208	B	153.90
110	0.5	DDU 1210	A	122.40
	0.8	DDU 1211	B	153.90

22 TO 30 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC) @ 24 VDC Input	Current (Amps)			
12	4.0	DDU 2401	A	122.40
	7.0	DDU 2402	B	153.90
24	2.0	DDU 2404	A	122.40
	3.5	DDU 2405	B	153.90
48	1.0	DDU 2407	A	122.40
	1.8	DDU 2408	B	153.90
110	0.5	DDU 2410	A	122.40
	0.8	DDU 2411	B	153.90

44 TO 56 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC) @ 48 VDC Input	Current (Amps)			
12	4.0	DDU 4801	A	127.40
	7.0	DDU 4802	B	158.40
24	2.0	DDU 4804	A	127.40
	3.5	DDU 4805	B	158.40
48	1.0	DDU 4807	A	127.40
	1.8	DDU 4808	B	158.40
110	0.5	DDU 4810	A	127.40
	0.8	DDU 4811	B	158.40

105 TO 140 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC) @ 110 VDC Input	Current (Amps)			
12	4.0	DDU 11001	A	127.40
	7.0	DDU 11002	B	158.40
24	2.0	DDU 11004	A	127.40
	3.5	DDU 11005	B	158.40
48	1.0	DDU 11007	A	127.40
	1.8	DDU 11008	B	158.40
110	0.5	DDU 11010	A	127.40
	0.8	DDU 11011	B	158.40

DC-DC REGULATED POWER CONVERTERS

- 0.2% line regulation (LL-HL)
- 0.2% load regulation (NL-FL)
- 0.3% maximum ripple
- Overload/short circuit protected
- Overvoltage protection option
- 5% output voltage adjust range

SINGLE OUTPUT MODELS

11 TO 14 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
5	2.0	DDR 1200	A	145.90
	5.0	DDR 1201	B	155.90
	10.0	DDR 1202	C	177.00
15	1.0	DDR 1203	A	145.90
	2.0	DDR 1204	B	155.90
	4.0	DDR 1205	C	177.00
28	0.5	DDR 1206	A	145.90
	1.0	DDR 1207	B	155.90
	2.0	DDR 1208	C	177.00

22 TO 30 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
5	2.0	DDR 2400	A	145.90
	5.0	DDR 2401	B	155.90
	10.0	DDR 2402	C	177.00
15	1.0	DDR 2403	A	145.90
	2.0	DDR 2404	B	155.90
	4.0	DDR 2405	C	177.00
28	0.5	DDR 2406	A	145.90
	1.0	DDR 2407	B	155.90
	2.0	DDR 2408	C	177.00

44 TO 56 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
5	2.0	DDR 4800	A	150.90
	5.0	DDR 4801	B	160.90
	10.0	DDR 4802	C	182.00
15	1.0	DDR 4803	A	150.90
	2.0	DDR 4804	B	160.90
	4.0	DDR 4805	C	182.00
28	0.5	DDR 4806	A	150.90
	1.0	DDR 4807	B	160.90
	2.0	DDR 4808	C	182.00

105 TO 140 VDC INPUT				
Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
5	2.0	DDR 11000	A	150.90
	5.0	DDR 11001	B	160.90
	10.0	DDR 11002	C	182.00
15	1.0	DDR 11003	A	150.90
	2.0	DDR 11004	B	160.90
	4.0	DDR 11005	C	182.00
28	0.5	DDR 11006	A	150.90
	1.0	DDR 11007	B	160.90
	2.0	DDR 11008	C	182.00

MULTIPLE OUTPUT MODELS

+5 −5	2.0 2.0	DDR 1220	B	194.40	+5 −5	2.0 2.0	DDR 2420	B	194.40	+5 −5	2.0 2.0	DDR 4820	B	199.40	+5 −5	2.0 2.0	DDR 11020	B	199.40
+15 −15	0.5 0.5	DDR 1221	B	146.50	+15 −15	0.5 0.5	DDR 2421	A	146.50	+15 −15	0.5 0.5	DDR 4821	B	151.50	+15 −15	0.5 0.5	DDR 11021	B	151.50
+15 −15	2.0 2.0	DDR 1222	B	211.90	+15 −15	2.0 2.0	DDR 2422	B	211.90	+15 −15	2.0 2.0	DDR 4822	B	216.90	+15 −15	2.0 2.0	DDR 11022	B	216.90
+5 +15 −15	2.0 0.5 0.5	DDR 1230	B	197.50	+5 +15 −15	2.0 0.5 0.5	DDR 2430	B	197.50	+5 +15 −15	2.0 0.5 0.5	DDR 4830	B	202.50	+5 +15 −15	2.0 0.5 0.5	DDR 11030	B	202.50
+5 +15 −15	4.0 1.0 1.0	DDR 1231	C	255.40	+5 +15 −15	4.0 1.0 1.0	DDR 2431	C	255.40	+5 +15 −15	4.0 1.0 1.0	DDR 4831	C	260.40	+5 +15 −15	4.0 1.0 1.0	DDR 11031	C	260.40

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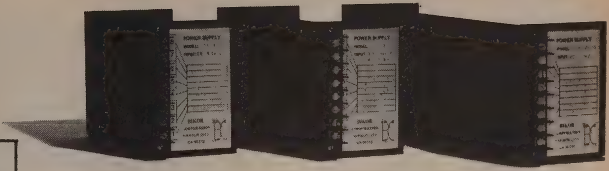
HIGH EFFICIENCY SWITCHING REGULATOR LOGIC POWER SUPPLIES

- 115/230 VAC, 50/60 Hz input
- 70% efficiency
- 50 mV max. output ripple
- 0.5% line regulation (LL-HL)
- 0.5% load regulation (½ FL-FL)
- Overvoltage protection



Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
5	10	ATS 1100	D	200
	20	ATS 1101	D	250
	30	ATS 1102	E	300

AC TO DC REGULATED POWER CONVERTERS

- Small size
- Lightweight
- 105-125 VAC, 50-500 Hz input
- 0.2% line regulation (LL-HL)
- 0.2% load regulation (NL-FL)
- 0.3% maximum ripple
- Short circuit protected
- 5% output voltage adjust range
- Overvoltage protection option

AC TO DC
XEON POWER SUPPLY
CONSTANT CURRENT OUTPUT

- 6 amps with 11-14 VDC output compliance range
- 1000 VDC @ 10 mA output for HV starting
- Other models available with complete starting units to meet specific Xeon or Mercury Lamp specifications

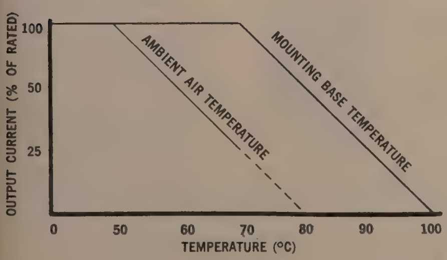
SINGLE OUTPUT MODELS

Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
5	5.0	ADR 1100	B	185.90
	10.0	ADR 1101	C	216.00
12	2.0	ADR 1102	B	185.90
	5.0	ADR 1103	C	216.00
15	2.0	ADR 1104	B	185.90
	4.0	ADR 1105	C	216.00
28	1.0	ADR 1106	B	185.90
	2.0	ADR 1107	C	216.00
48	0.5	ADR 1108	B	185.90
	1.0	ADR 1109	C	216.00
100	0.2	ADR 1110	B	185.90
250	0.1	ADR 1111	B	185.90

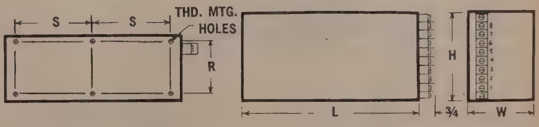
MULTIPLE OUTPUT MODELS

Output		Model Number	Case Size	Price (1-24)
Voltage (VDC)	Current (Amps)			
+5 −5	4.0 4.0	ADR 1120	B	250.90
+15 −15	0.5 0.5	ADR 1121	B	179.00
+15 −15	2.0 2.0	ADR 1122	B	250.90
+5 +15 −15	2.0 0.5 0.5	ADR 1123	B	227.50
+5 +15 −15	5.0 1.0 1.0	ADR 1124	C	294.40
+5 +15 −15	8.0 0.5 0.5	ADR 1125	C	267.60
+5 +15 −15 +250	5.0 0.5 0.5 0.1	ADR 1126	C	302.50

TEMPERATURE RATINGS FOR ALL MODELS



MECHANICAL SPECIFICATIONS FOR ALL MODELS



Case	L	W	H	R	S	Number of Mounting Holes / Thread Size
A	5¾ (14.61)	3 (7.62)	4 (10.16)	2.4 (6.10)	5 (12.70)	4 / #6-32 THD.
B	8 (20.32)	3 (7.62)	4 (10.16)	2.4 (6.10)	3.5 (8.89)	6 / #6-32 THD.
C	12 (30.48)	3 (7.62)	4 (10.16)	2.4 (6.10)	5.5 (13.97)	6 / #6-32 THD.
D	10 (25.40)	4 (10.16)	4⅝ (11.75)	3 (7.62)	4.5 (11.43)	6 / #10-32 THD.
E	15 (38.10)	4 (10.16)	4⅝ (11.75)	3 (7.62)	4.5 (11.43)	8 / #10-32 THD.

NOTE: Sizes Inches (CM)

BIKOR CORPORATION 1228 253rd STREET, HARBOR CITY, CALIFORNIA 90710 • (213) 325-2820

BULOVA Inverters and Frequency Changers

Features:

- Up to 500–VA Output
- Fully Regulated Sine Wave
- All Solid-State
- Protected Input/Output

Performance Specifications:

OUTPUT:

Frequency Output: 50 or 60 Hz, standard; other specific frequency, custom

Frequency Regulation: ±1%, ±.1%, ±.015%, ±.005% or better.

Temperature Range: 0° C to + 50° C

Wave Shape: Sine Wave, 3% Distortion max.

Output Voltage: 115 or 230V AC nominal

Voltage Regulation: ± 1% any combination of full line and load change

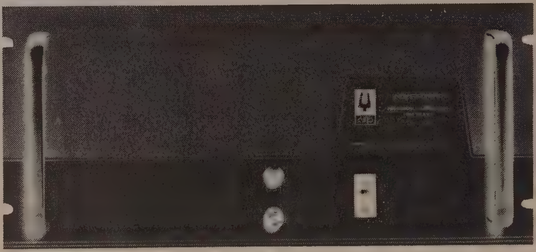
INPUT:

115V AC or 230V AC, ±10%, 45 to 65 Hz; or 22 to 30V DC

Applications:

Ideally suited for synchronous motor drives, chronographs, stroboscopes, generator frequency control; running timers, clock and time-of-day systems, tape recorders, general laboratory use.

INVERTERS

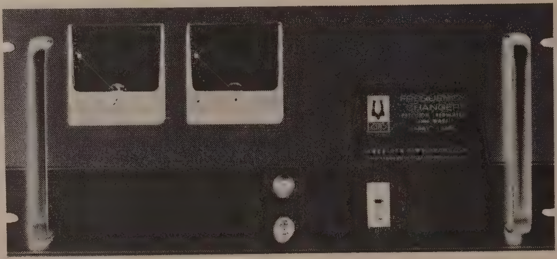


(Meters optional)

Model	Input VDC	Output			Wt. Lbs. (2)	Dimensions (For 19" Rack)	
		VA	Freq. Hz	Volt		H	D
DA-250S	22-30	250	50 or 60	115 (1)	70	8¾"	13"

(1) 230 Volt Available (2) For 50 Hz, add about 5 lbs.

FREQUENCY CHANGERS



Meters optional)

Model	Input		Output			Wt. Lbs. (2)	Dimensions (For 19" Rack)	
	VAC. ±10%	Freq. Hz	VA	Freq. Hz	Volt		H	D
ADA-100S	115/230	45-65	100	50 or 60	115	75	5¼"	13"
ADA-250S	115/230	45-65	250	50 or 60	115 (1)	80	8¾"	13"
ADA-500S	115/230	45-65	500	50 or 60	115	130	10½"	15"

(1) 230 Volt Available (2) For 50 Hz, add about 5 lbs.

5VA INVERTER — PRECISION FREQUENCY

Model DA5S

Standard 115 V 60 Hz, available at any fixed frequency from 50 to 400 Hz

- Accuracy to ±.0002%
- Sine Wave, max. THD 5%
- Input 28V DC ± 4V

Size: 4½" x 5" x 3¼"
Weight: 3 lbs. approx.

From Bulova Electronics Division: Frequency Control Components • Crystals • Crystal Oscillators • Monolithic Crystal Filters • Fork Oscillators • DC Servo Amplifiers • 400 Hz Servo Amplifiers • Optical Devices • Choppers and Scanners • Frequency Changers • Inverters • Lock-in Amplifiers

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1 Aerovista Park, San Luis Obispo, Calif. 93401
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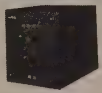
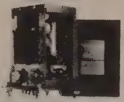
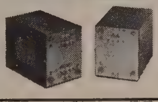
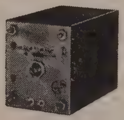
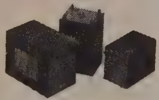
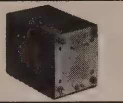
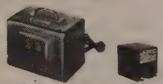
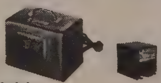
PRODUCT SELECTION GUIDE

PRODUCT DESCRIPTION	TECHNICAL SPECIFICATIONS										SPECIAL PACKAGING AVAILABLE	PAGE
		OUTPUT RANGE										
		E	I	P				LINE + LOAD REG.	RIPPLE (RMS)	TEMP. COEFF.		
	INPUT	VOLTS	AMPS	WATTS	BEST EFF.	BEST RESPONSE	CLASS	(%)	(%)	(%/°C)		
CEAT SERIES AC-DC / DC-AC TRIPLE OUTPUT MODULES +5V & ±15V	A.C. or D.C.	4.5 to 6.0 ±10 to ±18	.1 to 20 .25 to 5.0	to 250	60%	10 µ sec	—	.02% .01%	1 mv rms	.01		2
CEA6 SERIES A.C.-D.C. SINGLE OUTPUT MODULES HIGHEST REGULATION	A.C. or D.C.	3.5 to 500	.05 to 25	to 800	75%	10 µ sec	A	.05	.01	.01		3 & 4
							B	.01	.001	.005		
							C	.0025	.0005	.001		
							D	.0005	.0003	.0005		
CEAC6 SERIES A.C.-D.C. CONSTANT CURRENT SUPPLIES	A.C. or D.C.	0 to 200	.002 to 5.0	to 160	75%	10 µ sec	A	.5	.1	.1		5 & 6
							B	.1	.01	.05		
							C	.025	.005	.01		
							D	.005	.003	.005		
CEAD6 SERIES A.C.-D.C. DUAL ± OUTPUT MODULES HIGHEST REGULATION	A.C. or D.C.	3.5 to 500	.05 to 10	to 300	75%	10 µ sec	A	.05	.01	.01		7 & 8
							B	.01	.001	.005		
							C	.0025	.0005	.001		
							D	.0005	.0003	.0005		
CEA3 SERIES AC / DC-DC SINGLE OUTPUT MODULES MINIATURE SIZE HIGH EFFICIENCY	A.C. or D.C.	4.0 to 256	.1 to 60	to 640	80%	1 m sec	A	1.0	0.3	0.1		9 & 10
							B	0.1	0.07	.01		
CEA2 SERIES D.C.-D.C. D.C. CONVERTERS	D.C. ONLY	3.5 to 500	.05 to 40	to 640	90%	10 µ sec	A	LINE = NONE LOAD = 10%	1.0	0.1		11 & 12
						1 m sec	C	LINE = 0.5% LINE = 0.5%	0.3	.05		
CEA1 SERIES A.C.-D.C. SINGLE OUTPUT MODULES UNREGULATED	A.C. or D.C.	4.5 to 620	.05 to 25	to 1000	90%	—	—	LINE = NONE LOAD = 10%	5.0 rms	—		13 & 14
CEA11 THRU CEA35 SERIES A.C.-A.C. SHIELDED LINE ISOLATORS UNREGULATED	A.C. ONLY	110 or 220	2.2 to 17.3	250 to 2000	96%	60 Hz		4%	—	—	 Modular	15 & 16
							Available in Three Classes of Shielding. Maximum Coupling Capacitance of .01 pfd, .001 pfd, and 0.0005 pfd					
OL21 THRU OL25 SERIES A.C.-A.C. SHIELDED LINE ISOLATORS MEDICAL	A.C. ONLY	110 or 220	2.2 to 17.3	250 to 2000	90%	60 Hz		4%	—	—	 Modular	17
							Available in Two Classes of Shielding. Output-Input Leakage, 1 µA. Output-Case Leakage 5 µA					
COMPACT NI-CAD BATTERY A.C.-D.C. **CHARGERS**	110 VAC ONLY	1.2 to 36	22 MA to 1.1	to 40		60 Hz	Available in Two Configurations, One for Commercial Applications, One for Military (Sealed Case and Connector)					18
THERMAL DATA **THERMAL RADIATORS**	(a) Internal Dissipation (b) Temperature Rise — Chassis Mounting (c) Temperature Rise — Chassis & Radiator Mounting Effect of forced air cooling.											19
MOUNTING & TERMINATIONS	Sizes — Weights — Wiring											20
NEW PRODUCTS	AC Output; Rack, UPS, Custom Supplies and Low Profile Modules										*	1, 22-28

NEW PRODUCTS
AC OUTPUT; RACK, UPS AND CUSTOM SUPPLIES

CEA, a division of Berkleonics, Inc.
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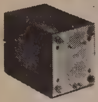
AC/DC — AC
AC FREQUENCY POWER SUPPLY



SPECIFICATIONS

OUTPUT: 24 VAC RMS, 50 Hz - 10KHz (Set ±1%).
OUTPUT POWER: 2.5, 5, 10, 25, or 50 VA.
INPUT: 105 - 125 VAC, 50 - 420 Hz. (Other AC & DC inputs optional.)
REGULATION: Line (10% change) ±1%. Load (N/L to F/L) ±1%.
MAXIMUM DISTORTION: 1%.
TEMPERATURE COEFFICIENT: ±.01%/°C.
FREQUENCY STABILITY: ±.01%/°C.
VOLTAGE SETTING ACCURACY: ±1%.
SHIELDING: 20 db standard.
OVERLOAD AND SHORT CIRCUIT PROOF.

PART NUMBERS & PRICE

PART* NUMBER	OUTPUT VOLTAGE	OUTPUT POWER	OUTPUT CURRENT	CASE SIZE	THERMAL NO.	PRICE
CEA4F25X	24 V	2.5 VA	104 MA	FA	1	$145
CEA4F50X	24 V	5 VA	208 MA	HA	2	$160
CEA4F10Y	24 V	10 VA	420 MA	JA	3	$170
CEA4F25Y	24 V	25 VA	1.04 A	KA	5	$200
CEA4F50Y	24 V	50 VA	2.08 A	NA	5	$270

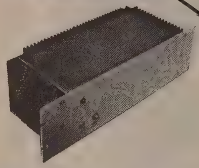
*Note: Add frequency (digits only) desired to Part Number. (Preceding Options).

See 73-74 EEM 1•638, 1•639 for complete case size and thermal number information.

OPTIONS

SYMBOL OPTION	DESCRIPTION	PRICE
G1	Voltage adjust ±5% (remote)	$10
G2	Frequency adjust ±5% (remote)	$10
L	Input 90-135 VAC, 50-420 Hz (derate cur. to 60%)	$10 or 10%
L1	Input 208 VAC ±10%, 50-420 Hz	$15 or 10%
L2	Input 230 VAC ±10%, 50-420 Hz	$15 or 10%
L3	Input 460 VAC ±10%, 50-420 Hz	$25 or 15%
L4	Input 105-125 VAC, 400 ±20 Hz	$15 or 10%
L5	Input 115/230 VAC, 50-420 Hz	$30 or 20%
L6	Input 11.6 to 13.8 VDC (derate current to 60%)	$70 or 40%
L7	Input 23.2 to 27.6 VDC (derate current to 80%)	$70 or 40%
L8	Input 46.4 to 55.2 VDC (derate current to 80%)	$70 or 40%
P2	Overtemperature cutout (+80°C)	$20
T	40 db transformer shielding	$25 or 15%
T1	100 db transformer shielding	$50 or 25%
W	Potted for ruggedization FA, HA, JA	$10
	KA	$15
	NA	$20

RACK SUPPLIES

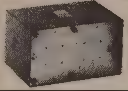


Recently developed multiple output rack supplies integrate either standard or custom modules into 19″ rack cases for system applications.

FEATURES INCLUDE: All options in this catalogue, metering, cooling, interface and protection circuitry, high density and efficency.

CALL THE FACTORY TOLL-FREE TO DISCUSS YOUR PARTICULAR APPLICATION AND REQUIREMENTS.

UPS
AC — BATTERY — DC/AC UNINTERRUPTABLE POWER SUPPLY



SYSTEM SUPPLIES CONTINUOUS AC OR DC POWER, EVEN IN EVENT OF POWER LINE OR GENERATOR FAILURE.

SPECIFICATIONS

OUTPUT: AC or DC, Regulated typically 1% OR battery characteristic.
OUTPUT POWER: 6 watt hours and up — to 1000 VA.
INPUT: 105 - 125 VAC, 50 - 420 Hz. (Other AC inputs optional.)
PACKAGING: Modular or rack. Internal batteries provided. (optional).

CALL THE FACTORY TOLL-FREE TO DISCUSS YOUR PARTICULAR APPLICATION AND REQUIREMENTS.

CUSTOM SUPPLIES

CEA's vast experience and technical expertise in all phases of power supply design and development is available to answer your custom power supply requirements.

Our highly reliable custom designs are presently hard at work in many commercial, industrial, and military applications around the world meeting requirements different than the standard units listed.

CALL THE FACTORY — TOLL FREE (800) 235-4150 OR IN CA. (800) 592-5910 TO DISCUSS YOUR REQUIREMENTS.

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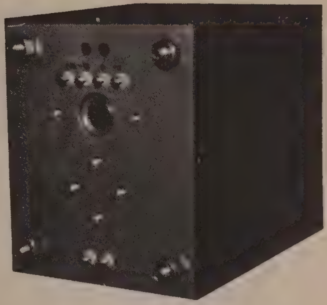
AC-DC Regulated TRIPLE OUTPUT +5V & ±15V MODULAR POWER SUPPLIES

CEAT SERIES — DISSIPATIVE REGULATORS

STANDARD FEATURES INCLUDE



- OUTPUTS +5, ±15VDC. .25 to 20 AMPS, to 250 WATTS.
- INPUTS 50 to 420 Hz, 95 to 460VAC and DC inputs are optional.
- REGULATION ±.02% and ±.04% for line plus load.
- 80°C BASE TEMPERATURE without derating.
- SHIELDING line isolation eliminating glitches and other noise problems. 20 db standard up to 100 db optional.
  Floating outputs, + or − may be ±500VDC from case.
  No voltage overshoot on turn-on or turn-off.
  Short ciruit protected.
  MIL-T-27 modular case sizes with removable covers for servicing.
  Critical components pretested aged and graded.
- BURN-IN (stabilization) 16 hrs. min. at rated load and high base temperature.
  100% TESTING after burn-in, test data with shipment.
  Specifications guaranteed, not just typical
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.

SPECIFICATIONS — PART NUMBERS — PRICE

Part Number	+5V Output Current	±15V Output Current	Line Regulation (10% Change)		Load Regulation (N/L to F/L)		RMS Ripple	Temperature Coefficient	Case Size	Ther-Mal No.	Base Price
			+5V	±15V	+5V	±15V					
CEAT50J15	1.0A	.25A	±.02% for all Models	±.01% for all Models	±.02% +.0005 Ω for all Models	±.01% for all Models	1 mV for all Models	±.01%/°C for all Models	JA	3	$116
CEAT50M15	2.5A	.5A							MA	4	$176
CEAT50N15	5.0A	1.0A							NA	5	$204
CEAT50Q15	10.0A	2.5A							QA	6	$314
CEAT50S15	20.0A	5.0A							SA	7	$418

Input Voltage and Frequency: 105 to 125VAC, 50 to 420 Hz are standard. DC and other voltage ranges are optional.

Output Voltage and Current: +5, ±15VDC. .25 to 20A. See correlation in table above. +4.5-6.0VDC. ±10-18VDC also aavilable. Call factory.

Voltage Setting Accuracy: +5V ±1%. −15V ±1%. +15V tracks ±1%.

Temperature Base: −20°C to +80°C operating. −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (3 thru 7) in table above are shown on page 19.

Size - Weight - Terminations: Details associated with MIL-T-27 case (JA thru SA) in table above are shown on page 20.

OPTIONAL FEATURES

The extra charge for each option is either a flat rate or a percentage of the base price; add the larger number to the base price.

Sym-bol	Option Description	Prices	Extend Delivery (Weeks)	REMARKS
G	−15 remote balance adjust ±3%	$5	None	
G5	+5 remote adjust ±5%	$5	None	Increase thermal number by one.
G15	±15 remote adjust ±5%	$5	None	Increase thermal number by one.
L	Input 95-135 VAC, 50-420 Hz	10%	1	Input terminals parallel or series for 115/230 volts.
L1	Input 208 VAC ±10%, 50-420 Hz	$15 or 10%	1	
L2	Input 230 VAC ±10%, 50-420 Hz	$15 or 10%	1	
L3	Input 460 VAC ±10%, 50-420 Hz	$25 or 15%	1	
L4	Input 105-125 VAC, 400 Hz ±20 Hz	$15 or 10%	1	Derate current to 60% of rated.
L5	Input 115/230 VAC, 50-420 Hz	$30 or 20%	1	Reduce case size to next smaller. Derate ripple by 5X.
L6	Input 12 VDC (11.6-13.8 VDC)	$70 or 40%	1	Derate current to 60% of rated.
L7	Input 24 VDC (23.2-27.6 VDC)	$70 or 40%	1	Derate current to 80% of rated.
L8	Input 48 VDC (46.4-55.2 VDC)	$70 or 40%	1	Derate current to 80% of rated.
P2	Overtemperature cutout	$20	1	Limits base temperature to maximum rated. Self restarting.
P3	Crowbar voltage limit on +5 V	$30 or 15%	1	Operates at 10% or 1 volt over maximum settable voltage.
P4	Crowbar on all outputs			
T	40 db transformer shielding	$25 or 15%	1	Reduces capacitance between line and circuit by 100X.
T1	100 db transformer shielding	$50 or 25%	1	Reduces capacitance between line and circuit by 100,000X.
U	Output float up to ±1000 V	10%	1	Any output terminal will withstand ±1000 volts to case or input.
W	Potted for ruggedization in polyurethane resin JA	$10	1	Weight increased about 30%.
	MA, NA	$20	1	
	QA	$30	1	
	SA	$40	1	

PRICE

The **total price** is the **base price** from the table, **plus** the **price** of the **optional features** selected.

Quantity Discount Schedule

1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California

DELIVERY

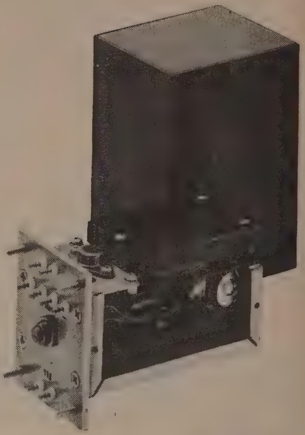
All supplies 3 weeks. Some options extend delivery as shown above. Shipments will be as directed. United Parcel where serviced or Parcel Post for the remaining.

AC-DC Regulated
SINGLE OUTPUT
MODULAR POWER SUPPLIES

CEA, *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

CEA6 SERIES DISSIPATIVE REGULATORS

STANDARD FEATURES INCLUDE



- OUTPUTS from 3.5 to 500VDC, .05 to 25 AMPS, to 800 WATTS.
- INPUTS 50 to 420 Hz, 95 to 460VAC and DC inputs are optional.
- REGULATION from .05% to .0005% for line plus load.
- 80°C BASE TEMPERATURE without derating.
- SHIELDING, line isolation, eliminating glitches and other noise problems. 20 db standard, up to 100 db optional.
  Floating outputs, + or − output may be ±500VDC from case.
  Remote sensing standard, all models, eliminates load lead errors.
  Adjustment of output ±5% standard. Other ranges are optional.
  Remote adjustment optional at no charge.
  Series starting with rated load, for multiple supplies to a common load.
  Short circuit output current will not damage supplies.
  No voltage overshoot on turn-on or turn-off.
  MIL-T-27 modular case sizes with removable covers for servicing.
  Critical components pretested, aged, and graded.
- BURN-IN (stabilization), 16 hrs. min. at rated load and high base temperature.
- 100% TESTING after burn-in, test data with shipment. **Specifications guaranteed, not just typical.**
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.

SPECIFICATIONS

REGULATION — STABILITY — RIPPLE — BASE MODEL PRICE

Class of Regulation	Line Plus Load Regulation	Line Regulation for 10% Line Change	Load Regulation for No Load to Full Load	Temperature Coefficient Per Degree C	Stability for 40 Hours	RMS Ripple	Option Required	Output Current Limit	BASE MODEL PRICE
A	±0.05%	±0.01%	±0.04%	±0.01%	±0.05%	0.01%	None	25A	Tabulated below
B	±0.01%	±0.002%	±0.008%	±0.005%	±0.01%	0.001%	None	25A	A plus $15.00
C	±0.0025%	±0.0005%	±0.002%	±0.001%	±0.0025%	0.0005%	F's or R's	5A	A plus $75.00
D	±0.0005%	±0.0001%	±0.0004%	±0.0005%	±0.0005%	0.0003%	F's or R's	1A	A plus $155.00

Input Voltage and Frequency: 105 to 125 volts — 50 to 420 Hz are standard. DC and other voltage ranges are optional.

Output Voltage and Current: 3.5 to 500VDC — .05 to 25A. See correlation in table below.

Recovery Time: As fast as 10 microseconds, depending on model selected.

Insulation Resistance: 100 Megohms — standard for input, output and case; 1K Megohms for option "T"; 10K Megohms for option "TI".

Temperature, Base: −20°C to +80°C operating, −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (1 thru 9) in table below are shown on page 19.

Size-Weight-Terminations: Details associated with MIL-T-27 case (FA thru TA), tabulated below, are shown on pages 4 and 20.

PART NUMBERS

Example: .01% Reg, 5V, 1A with options "F" and "P3"; "CEA6B50X102FP3"

YOUR SELECTION: **CEA6**_ __ _ __ ___

Specify regulation — Insert A, B, C or D

Specify output voltage — Insert any digits, 35 to 500

Specify voltage decimal — Insert X, Y or Z

Specify output currents — Insert bracketed digits

Specify desired options — Insert option symbols

OUTPUT VOLTAGE		OUTPUT RATED CURRENT																										
2 digits under 10V 3 digits 10V & over	Decimal Code	.05A (500)			.1A (101)			.25A (251)			.5A (501)			1A (102)			2.5A (252)			5A (502)			10A (103)			25A (253)		
Select any voltage between limits		Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price
3.5 to 9.9	X				FA	1	99	GA	2	99	HA	3	116	JA	4	116	MA	5	176	NA	7	204	QA	7	314	SA	8	418
10.0 to 12.4	Y				FA	1	99	GA	2	99	HA	3	116	JA	5	116	MA	5	176	NA	7	204	QA	7	314	SA	9	418
12.5 to 27.4	Y				GA	1	99	HA	3	110	JA	4	116	KA	5	138	NA	6	204	PA	7	253	RA	7	385	TA	9	435
27.5 to 29.9	Y				GA	1	99	HA	3	110	KA	3	138	LA	5	143	NA	6	204	PA	7	253	RA	8	385	TA	9	435
30.0 to 39.9	Y				GA	2	99	JA	3	116	LA	3	143	NA	4	204	PA	6	253	QA	7	314	SA	8	418			
40.0 to 49.9	Y				HA	2	116	JA	3	116	LA	4	143	NA	5	204	PA	7	253	QA	7	314	SA	8	418			
50.0 to 59.9	Y	HA	1	116	JA	2	116	KA	3	138	MA	4	176	PA	5	253	QA	6	314	RA	7	385	TA	8	435			
60.0 to 79.9	Y	JA	1	143	KA	2	165	LA	3	176	MA	5	209	PA	5	308	QA	7	369	SA	7	506	TA	9	550			
80.0 to 89.9	Y	JA	1	143	KA	2	165	LA	4	176	MA	5	209	PA	5	308	RA	6	484	SA	8	506						
90.0 to 99.9	Y	JA	2	143	KA	2	165	LA	4	176	MA	5	209	QA	5	369	RA	7	484	SA	7	506						
100 to 119	Z	KA	2	165	LA	2	176	MA	4	209	NA	5	237	QA	5	369	RA	7	462	TA	8	550						
120 to 139	Z	KA	2	165	LA	3	176	MA	4	220	NA	6	259	QA	6	407	SA	7	578	TA	8	644						
140 to 159	Z	KA	3	165	LA	3	176	MA	5	220	NA	6	259	RA	5	523	SA	7	578									
160 to 199	Z	LA	3	176	MA	3	209	NA	5	259	PA	6	330	RA	6	523	SA	8	578									
200 to 219	Z	LA	3	176	MA	3	220	NA	5	259	PA	6	330	RA	6	523	TA	7	644									
220 to 259	Z	MA	3	231	NA	3	281	PA	5	352	QA	6	440	SA	6	649	TA	8	732									
260 to 279	Z	MA	3	231	NA	4	281	PA	5	352	QA	6	440	SA	6	649												
280 to 339	Z	NA	3	297	PA	3	363	QA	5	462	RA	5	611	SA	7	688												
340 to 379	Z	NA	3	297	PA	4	363	QA	5	462	RA	6	611	TA	7	776												
380 to 500	Z	PA	3	363	QA	4	462	RA	5	611	SA	6	688	TA	7	776												

"C" and "D" regulation not available in FA case for voltage range 3.5VDC to 8.4VDC, order GA or larger case.

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AC-DC Regulated SINGLE OUTPUT MODULAR POWER SUPPLIES

CEA6 SERIES

OPTIONAL FEATURES

The extra charge for each option is either a flat rate or percentage of the base model price; add the larger number to the base price.

Symbol Option	Option Description	Prices	Delivery (Weeks Added)	REMARKS
	FIXED OUTPUTS			Not available with "G" or "R" options.
F	Fixed output ±1.0%	No charge	None	Available in all classes of regulation.
F1	Fixed output ±0.1%	$15	1	Available in classes C & D.
F2	Fixed output ±0.01%	$50	1	Available in class D only.
	ADJUSTABLE OUTPUTS			
G	Output adjust range ±1%	$5	None	Increases resolution of adjustment output.
Std.	Output adjust range ±5%	No charge	None	Provided unless a "G" or "F" option is specified.
G1	Output adjust range ±10%	$5 or 5%	1	Reduce maximum current to 80% of rated output.
G2	Output adjust range ±20%	$10 or 10%	1	Reduce maximum current to 60% of rated output.
G3	Output adjust range ±30%	$15 or 15%	1	Reduce maximum current to 50% of rated output.
G4	Output adjust range ±40%	$20 or 20%	1	Reduce maximum current to 45% of rated output.
G5	Output adjust range ±50%	$25 or 25%	1	Reduce maximum current to 40% of rated output.
Note: Next larger case size may be required for options G2,G3, G4 & G5. The temperature coefficient is degraded in classes B, C & D for options G2 thru G5.				
	EXTENDED TEMPERATURE RANGE			
H1	Temperature range −55°C to +80°C	$100 or 50%	4	Requires next larger case size. Storage to −62°C.
H2	Temperature range −40°C to +80°C	$20 or 20%	4	Storage to −55°C
H3	Temperature range −55°C to +115°C	$200 or 100%	6	Requires next larger case size. Storage to −62°C.
	AC INPUT VOLTAGE AND FREQUENCY			
L	Input 95-135V, 50-420 Hz	$10 or 10%	1	Derate maximum current to 60% of rated output.
L1	Input 208V ±10%, 50-420 Hz	$15 or 10%	1	
L2	Input 230V ±10%, 50-420 Hz	$15 or 10%	1	
L3	Input 460V ±10%, 50-420 Hz	$25 or 15%	1	
L4	Input 105-125V, 400 ±20 Hz	$15 or 10%	1	Reduce case size to next smaller. Derate ripple by 5X.
L5	Input 115/230V, 50-420 Hz	$30 or 20%	1	Input terminals parallel or series for 115/230 volts.
	DC INPUT VOLTAGES			
L7	Input 12 VDC (11.6 to 13.8 VDC)	$70 or 40%	1	Derate output to 60% of normal.
L8	Input 24 VDC (23.2 to 27.6 VDC)	$70 or 40%	1	Derate output to 80% of normal.
L9	Input 14 VDC (12.0 to 16.0 VDC)	$90 or 50%	1	Derate output to 60% of normal.
L10	Input 28 VDC (24.0 to 32.0 VDC)	$90 or 50%	1	Derate output to 80% of normal.
L11	Input 48 VDC (42-60 VDC)	$90 or 50%		
L12	Input 40-115/210-230 ±10%	$30 or 20%		
	SPECIAL CONNECTIONS			
N1	Screw terminals #6-32	$15	3	Used for connections of 20A or less HA size or larger.
	PROTECTION CIRCUITS			Available in all sizes except FA.
P1	Current limiting	$25 or 15%	1	Protects system circuit. Limits current to 130% of rated.
P2	Overtemperature cutout	$20	1	Limits base temperature to maximum rated. Self restarting.
P3	Crowbar voltage limit	$30 or 15%	1	Protects power supply and system circuit under all circumstances. Operates at 10% or 1 volt, whichever is greater over maximum settable voltage. Remove input power to restart.
	REMOTE PROGRAMMING			
R	Remote adjust (no pot provided)	No charge	None	Remote programming options allow power supply to be externally adjusted. Resistance to output ratio is approximately 5 mv per ohm except for class C and D units below 8.5 volts which are approximately 1 mv per ohm.
R1	Remote adjust with 1% linearity	$20 or 10%	1	
R2	Remote adjust plus internal pot (A & B only)	$5	1	
R3	Remote adjust with pot provided (A & B only)	$5	1	
	START INTO HIGH CAPACITANCE LOADS			
S1	Start with 30,000 mfd/amp-100,000 mfd max.	$20 or 10%	1	Recommended for all high capacitance loads.
	HIGH ISOLATION			6″ minimum shielded leads vs. terminals.
T	40 db transformer shielding	$25 or 15%	1	Reduces capacitance between line and circuit by 100X.
T1	100 db transformer shielding	$50 or 25%	1	Reduces capacitance between line and circuit by 100,000X.
	HIGH FLOAT VOLTAGE			
U	Output float up to ±1000V	$10 or 10%	1	Either output terminal will withstand ±1000 volts to case or input.
	RUGGEDIZED			
W	Potted for ruggedization in polyurethane resin. FA, GA, HA, JA	$10	1	Weight increased about 30%.
	KA, LA	$15	1	
	MA, NA	$20	1	
	PA	$25	1	
	QA	$30	1	
	RA	$35	1	
	SA	$40	1	
	TA	$45	1	
			1	

CASE SIZES AND WEIGHTS (UNPOTTED)

CASE SIZE	FA	GA	HA	JA	KA	LA	MA	NA	PA	QA	RA	SA	TA
WIDE	2 5/16	2 3/4	3 1/16	3 9/16	3 15/16	4 15/16	4 11/16	5 1/16	6 1/16	7 1/16	8 1/16	11 11/16	11 11/16
DEEP	2 1/16	2 3/8	2 5/8	3 1/16	3 3/8	3 11/16	4	4 5/16	4 13/16	5 9/16	6 11/16	5 9/16	6 11/16
HIGH	3 1/8	3 13/16	4 1/4	4 7/8	5 1/4	5 9/16	6	6 13/16	6 13/16	7 1/16	7 1/16	7 1/16	8 1/16
WT (lbs)	1	1 3/4	2 1/2	3 1/2	4 1/4	5 1/2	7	9	12	17	30	35	50

PRICE

The **total price** is the **base model price** from the regulation table, **plus** the **price of optional features** selected.

```
PRICE EXAMPLE: "CEA6B150Y101GRW"
      "B"       $15 } "B"  REGULATION  BASE
  "150Y101"      99 } MODEL PRICE  $114.00
      "G"                OPTION        5.00
      "R"                OPTION   NO CHARGE
      "W"                OPTION       10.00
-----------------------------------------
               TOTAL PRICE  $129.00
```

Discount Schedule
Quantity Discount

1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

Regulation class "A" and "B" supplies 2 weeks; "C" supplies 3 weeks; "D" supplies 4 weeks. Some options extend delivery as shown above. Shipments will be as directed, United Parcel where serviced, or Parcel Post for the remaining.

AC-DC Regulated CONSTANT CURRENT MODULAR POWER SUPPLIES

CEA, a division of Berkleonics, Inc.
1 Aerovista Park, San Luis Obispo, Calif. 93401
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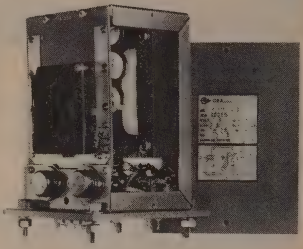
CEAC6 SERIES DISSIPATIVE REGULATORS

STANDARD FEATURES INCLUDE



- OUTPUTS from .002 to 5.0 AMPS, zero to 200 volts, to 160 WATTS.
- INPUTS 50 to 420 Hz, 95 to 460VAC and DC inputs are optional.
- REGULATION from .5% to .005% for line plus load.
- 80°C BASE TEMPERATURE without derating.
- SHIELDING, line isolation, eliminating glitches and other noise problems. 20 db standard, up to 100 db optional.
  Floating outputs, + or − output may be ±500VDC from case.
  Adjustment of output, current from 20% to 100% standard.
  Remote adjustment optional at no charge.
  No current overshoot on turn-on or turn-off.
  Short circuit output current will not damage supplies.
  MIL-T-27 modular case sizes with removable covers for servicing.
  Critical components pretested, aged, and graded.
- BURN-IN (stabilization), 16 hrs. min. at rated load and high base temperature.
- 100% TESTING after burn-in, test data with shipment.
  Specifications guaranteed, not just typical.
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.

SPECIFICATIONS

REGULATION — STABILITY — RIPPLE — BASE MODEL PRICE

Class of Regulation	Line Plus Load Regulation	Line Regulation for 10% Line Change	0 to 100% Rated Votage Change	Temperature Coefficient Per Degree C	Guaranteed Stability for 40 Hours	Guaranteed RMS Ripple	Option Required	Output Current Limit	BASE MODEL PRICE
A	±0.5%	±0.1%	±0.4%	±0.1%	±0.5%	0.1%	None	5A	Tabulated below
B	±0.1%	±0.02%	±0.08%	±0.05%	±0.1%	0.01%	None	5A	A plus $15.00
C	±0.025%	±0.005%	±0.02%	±0.01%	±0.025%	0.005%	R's	5A	A plus $75.00
D	±0.005%	±0.001%	±0.004%	±0.005%	±0.005%	0.003%	R's	1A	A plus $155.00

Input Voltage and Frequency: 105 to 125 volts, 50 to 420 Hz are standard. DC and other ranges are optional.

Output Current and Compliance Voltage: .002 to 5.0A, 12 to 200VDC. See correlation tabulated below.

Recovery Time: As fast as 10 microseconds, depending on model selected.

Insulation Resistance: 100 Megohms DC standard for input, output and case; 1K Megohms for option "T"; 10K Megohms for option "TI".

Temperature, Base: −20°C to +80°C operating, −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (1 thru 7) in table below are shown on page 19.

Size-Weight-Terminations: Details associated with MIL-T-27 case (FA thru TA), tabulated below, are shown on pages 6 and 20.

PART NUMBERS

Example: .1% Reg, 2A, 0-12V, with options "P2" and "TI"; "CEAC6B120Y202P2TI"

YOUR SELECTION: **CEAC6** _ _ _ _ _

Specify regulation — Insert A, B, C or D
Specify output voltage — Insert any digits listed
Specify voltage decimal — Insert Y or Z
Specify desired options — Insert option symbols
Specify output currents — Insert bracketed digits

OUTPUT COMPLIANCE VOLTAGE		OUTPUT CURRENT (Adjustable 20% to 100%)																										
Operation, 100% Voltage Listed	Decimal Code	.01A (100)			.02A (200)			.05A (500)			.1A (101)			.2A (201)			.5A (501)			1A (102)			2A (202)			5A (502)		
		Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price
12.0	Y	FA	1	110	FA	1	110	GA	1	110	HA	1	116	JA	1	121	MA	3	187	NA	3	220	QA	4	292	SA	5	460
30.0	Y							HA	1	116	JA	2	121	KA	3	138	NA	4	226	PA	5	259	RA	5	380	TA	7	505
40.0	Y	GA	1	116	GA	1	116																					
50.0	Y										LA	2	154	NA	3	231	PA	5	259				SA	6	556			
60.0	Y	HA	1	121	JA	1	121	KA	2	138										RA	5	380						
80.0	Y																QA	5	418				TA	7	649			
90.0	Y													PA	4	347												
100	Z	JA	1	165	KA	2	198	LA	3	209	MA	4	253							SA	6	622						
120	Z																RA	5	462									
140	Z													QA	5	424				TA	7	660						
160	Z	KA	2	198	LA	3	209	MA	4	253	NA	5	325															
200	Z	LA	2	209	MA	3	253	NA	4	325	PA	5	369	RA	5	462	SA	7	622									

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AC-DC Regulated CONSTANT CURRENT MODULAR POWER SUPPLIES

CEAC6 SERIES

OPTIONAL FEATURES

The extra charge for each option is either a flat rate or percentage of the base model price; add the larger number to the base price.

Symbol Option	Option Description	Prices	Delivery (Weeks Added)	REMARKS
	EXTENDED TEMPERATURE RANGE			
H1	Temperature range −55°C to +80°C	$100 or 50%	4	Requires next larger case size. Storage to −62°C.
H2	Temperature range −40°C to +80°C	$20 or 20%	4	Storage to −55°C
H3	Temperature range −55°C to +115°C	$200 or 100%	6	Requires next larger case size. Storage to −62°C.
	AC INPUT VOLTAGE AND FREQUENCY			
L	Input 95-135V, 50-420 Hz	$10 or 10%	1	Derate maximum current to 60% of rated output.
L1	Input 208V ±10%, 50-420 Hz	$15 or 10%	1	
L2	Input 230V ±10%, 50-420 Hz	$15 or 10%	1	
L3	Input 460V ±10%, 50-420 Hz	$25 or 15%	1	
L4	Input 105-125V, 400 ±20 Hz	$15 or 10%	1	Reduce case size to next smaller. Derate ripple by 5X.
L5	Input 115/230V, 50-420 Hz	$30 or 20%	1	Input terminals parallel or series for 115/230 volts.
	DC INPUT VOLTAGES			
L7	Input 12 VDC (11.6 to 13.8 VDC)	$70 or 40%	1	Derate output to 60% of normal.
L8	Input 24 VDC (23.2 to 27.6 VDC)	$70 or 40%	1	Derate output to 80% of normal.
L9	Input 14 VDC (12.0 to 16.0 VDC)	$90 or 50%	1	Derate output to 60% of normal.
L10	Input 28 VDC (24.0 to 32.0 VDC)	$90 or 50%	1	Derate output to 80% of normal.
	PROTECTION CIRCUITS			
P2	Overtemperature cutout	$20	1	Available in all sizes except FA. Limits base temperature to maximum rated. Self restarting.
	REMOTE PROGRAMMING			
R	Remote adjust (no pot provided)	No charge	None	Remote programming options allow power supply to be externally adjusted. Resistance to ouput ratio is approximately 1% linearity from 20% to 100% rated output. For potentiometer requirements see below.
R1	Remote adjust with 1% linearity	$20 or 10%	1	
R2	Remote adjust plus internal pot (A & B only)	$5	1	
R3	Remote adjust with pot provided (A & B only)	$5	1	
	HIGH ISOLATION			6″ minimum shielded leads vs. terminals.
T	40 db transformer shielding	$25 or 15%	1	Reduces capacitance between line and circuit by 100X.
T1	100 db transformer shielding	$50 or 25%	1	Reduces capacitance between line and circuit by 100,000X.
	HIGH FLOAT VOLTAGE			
U	Output float up to ±1000V	$10 or 10%	1	Either output terminal will withstand ±1000 volts to case or input.
	RUGGEDIZED			
W	Potted for ruggedization in polyurethane resin. FA, GA, HA, JA KA, LA MA, NA PA QA RA SA TA	$10 $15 $20 $25 $30 $35 $40 $45	1 1 1 1 1 1 1 1 1 1	Weight increases about 30%

EXTERNAL ADJUSTMENT

For **CONSTANT CURRENT** supplies (CEAC6 series), remote programming is accomplished by adding resistance to the remote adjust terminals. With the terminals shorted, the output current will be at maximum. To decrease the output current on supplies rated at 1 amp and below, add approximately 1 ohm of resistance for each .1% of change wanted. For supplies rated above 1 amp, add 1 ohm per each .2% of change wanted. Constant current supplies may also be voltage programmed. Use zero to 1 volt for units 1 amp and below and zero to ½ volt for units over 1 amp.

CASE SIZES AND WEIGHTS (UNPOTTED)

CASE SIZE	FA	GA	HA	JA	KA	LA	MA	NA	PA	QA	RA	SA	TA
WIDE	2 5/16	2 3/4	3 1/16	3 9/16	3 15/16	4 15/16	4 11/16	5 1/16	6 1/16	7 1/16	8 1/16	11 11/16	11 11/16
DEEP	2 1/16	2 3/8	2 5/8	3 1/16	3 3/8	3 11/16	4	4 5/16	4 13/16	5 9/16	6 11/16	5 9/16	6 11/16
HIGH	3 1/8	3 13/16	4 1/4	4 7/8	5 1/4	5 9/16	6	6 13/16	6 13/16	7 1/16	7 1/16	7 1/16	8 1/16
WT (lbs)	1	1 3/4	2 1/2	3 1/2	4 1/4	5 1/2	7	9	12	17	30	35	50

PRICE

The **total price** is the **base model price** from the regulation table, **plus** the **price of optional features** selected.

PRICE EXAMPLE: CEAC6B120Y500LRW

"B"	$10	"B" REGULATION BASE	
"120Y500"	110	MODEL PRICE	$125.00
"G"		OPTION	11.00
"R"		OPTION	NO CHARGE
"W"		OPTION	10.00
		TOTAL PRICE	$146.00

Discount Schedule

Quantity	Discount
1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

Regulation class "A" and "B" supplies 2 weeks; "C" supplies 3 weeks; "D" supplies 4 weeks. Some options extend delivery as shown above. Shipments will be as directed, United Parcel where serviced, or Parcel Post for the remaining.

AC-DC Regulated DUAL ±OUTPUT MODULAR POWER SUPPLIES

CEA, a division of Berkleonics, Inc.
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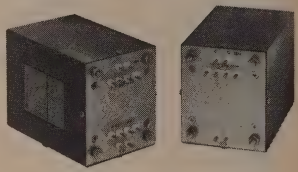
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

CEAD6 SERIES DISSIPATIVE REGULATORS

STANDARD FEATURES INCLUDE

- OUTPUTS from 3.5 to 500VDC, .05 to 10 AMPS, to 300 Watts each output.
- INPUTS 50 to 420 Hz, 95 to 460VAC and DC inputs are optional.
- REGULATION from .05% to .0005% for line plus load.
- 80°C BASE TEMPERATURE without derating.
- SHIELDING, line isolation, eliminating glitches and other noise problems. 20 db standard, up to 100 db optional.
  Floating outputs, + or − output may be ±500VDC from case.
  Remote sensing standard, all models, eliminates load lead errors.
  Fixed output voltages to within 1% unless specified otherwise.
  Remote adjustment optional at no charge.
  Series starting with rated load, for multiple supplies to a common load.
  Short circuit output current will not damage supplies.
  No voltage overshoot on turn-on or turn-off.
  MIL-T-27 modular case sizes with removable covers for servicing.
  Critical components pretested, aged, and graded.
- BURN-IN (stabilization), 16 hrs. min. at rated load and high base temperature.
- 100% TESTING after burn-in, test data with shipment.
  Specifications guaranteed, not just typical.
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.



SPECIFICATIONS

REGULATION — STABILITY — RIPPLE — BASE MODEL PRICE

Class of Regulation	Line Plus Load Regulation	Line Regulation for 10% Line Change	Load Regulation for No Load to Full Load	Temperature Coefficient Per Degree C	Stability for 40 Hours	RMS Ripple	Tracking	Option Required	Output Current Limit	BASE MODEL PRICE
A	±0.05%	±0.01%	±0.04%	±0.01%	±0.05%	0.01%	±0.05%	F's or R's	10A	Tabulated below
B	±0.01%	±0.002%	±0.008%	±0.005%	±0.01%	0.001%	±0.01%	F's or R's	10A	A plus $30.00
C	±0.0025%	±0.0005%	±0.002%	±0.001%	±0.0025%	0.0005%	±0.0025%	F's or R's	5A	A plus 130.00
D	±0.0005%	±0.0001%	±0.0004%	±0.0005%	±0.0005%	0.0003%	±0.0005%	F's or R's	1A	A plus 270.00

Input Voltage and Frequency: 105 to 125 volts — 50 to 420 Hz are standard. DC and other voltage ranges are optional.

Output Voltage and Current: 3.5 to 500VDC. 0.05 to 10A. See correlation in table below.

Recovery Time: As fast as 10 microseconds, depending on model selected.

Insulation Resistance: 100 Megohms DC standard for input, output and case; 1K Megohms for option "T"; 10K Megohms for option "TI".

Temperature, Base: −20°C to +80°C operating, −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (1 thru 9) in table below are shown on page 19.

Size-Weight-Terminations: Details associated with MIL-T-27 case (HA thru TA), tabulated below, are shown on pages 8 and 20.

PART NUMBERS

Example: .01% Reg, 15V, 1A with option "F" and "P3"; "CEAD6B150Y102FP3"

YOUR SELECTION: **CEAD6**_ _ _ _ _ _ _

Specify regulation — Insert A, B, C or D

Specify output voltage — Insert any digits, 35 to 500

Specify voltage decimal — Insert X, Y or Z

Specify output currents — Insert bracketed digits

Specify desired options — Insert option symbols

OUTPUT VOLTAGE		OUTPUT RATED CURRENT																							
2 digits under 10V 3 digits 10V & over	Decimal Code	.05A (500)			.1A (101)			.25A (251)			.5A (501)			1A (102)			2.5A (252)			5A (502)			10A (103)		
Select any voltage between limits		Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price
3.5 to 9.9	X				HA	1	182	JA	3	182	KA	4	209	LA	5	209	PA	6	314	QA	7	363	SA	8	561
10.0 to 12.4	Y				HA	1	182	JA	3	182	KA	4	209	LA	5	209	PA	6	314	QA	7	363	SA	8	561
12.5 to 27.4	Y				JA	2	182	KA	3	198	LA	5	209	MA	6	248	QA	7	363	RA	7	457	TA	8	699.
27.5 to 29.9	Y				JA	2	182	KA	3	198	MA	4	248	NA	6	259	QA	6	363	RA	8	457	TA	9	699
30.0 to 39.9	Y				JA	3	182	LA	4	209	NA	5	259	QA	5	363	RA	6	457	SA	8	561			
40.0 to 49.9	Y				KA	3	209	LA	4	209	NA	5	259	QA	5	363	RA	7	457	SA	8	561			
50.0 to 59.9	Y	KA	2	209	LA	3	209	MA	4	248	PA	5	314	RA	5	457	SA	7	561	TA	8	699			
60.0 to 79.9	Y	LA	2	259	MA	3	303	NA	4	314	PA	5	374	RA	5	556	SA	7	666						
80.0 to 89.9	Y	LA	2	259	MA	3	303	NA	5	314	PA	6	374	RA	6	556	TA	7	875						
90.0 to 99.9	Y	LA	3	259	MA	3	303	NA	5	314	PA	6	374	SA	5	666	TA	7	875						
100 to 119	Z	MA	3	303	NA	3	314	PA	5	374	QA	5	429	SA	6	666	TA	6	875						
120 to 139	Z	MA	3	303	NA	4	314	PA	5	391	QA	6	468	SA	6	704									
140 to 159	Z	MA	3	303	NA	4	314	PA	5	391	QA	6	468	TA	6	935									
160 to 199	Z	NA	4	314	PA	4	374	QA	5	468	RA	6	594	TA	7	935									
200 to 219	Z	NA	4	314	PA	4	391	QA	5	468	RA	6	594	TA	7	935									
220 to 259	Z	PA	4	418	QA	4	506	RA	5	638	SA	6	792												
260 to 279	Z	PA	4	418	QA	4	506	RA	5	638	SA	6	792												
280 to 339	Z	QA	3	534	PA	4	660	SA	5	880	TA	6	1106												
340 to 379	Z	QA	4	534	RA	4	660	SA	5	880	TA	7	1106												
380 to 500	Z	RA	4	660	SA	4	880	TA	6	1106															

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AC-DC Regulated
DUAL ±OUTPUT
MODULAR POWER SUPPLIES

CEAD6 SERIES

OPTIONAL FEATURES

The extra charge for each option is either a flat rate or percentage of the base model price; add the larger number to the base price.

Symbol Option	Option Description	Prices	Delivery (Weeks Added)	REMARKS
	FIXED OUTPUTS			Not available with "G" or "R" options.
F	Fixed output ±1.0%	No charge, std.	None	Available in all classes of regulation.
F1	Fixed output ±0.1%	$30	1	Available in classes C & D.
F2	Fixed output ±0.01%	$100	1	Available in class D only.
	ADJUSTABLE OUTPUTS			
G	Output adjust range ±1%	$10	None	Increases resolution of output adjustment.
Std.	Output adjust range ±5%	No charge	None	Provided with "R" option if no other "G" option is specified.
G1	Output adjust range ±10%	$10 or 5%	1	Reduce maximum current to 80% of rated output.
G2	Output adjust range ±20%	$20 or 10%	1	Reduce maximum current to 60% of rated output.
G3	Output adjust range ±30%	$30 or 15%	1	Reduce maximum current to 50% of rated output.
G4	Output adjust range ±40%	$40 or 20%	1	Reduce maximum current to 45% of rated output.
G5	Output adjust range ±50%	$50 or 25%	1	Reduce maximum current to 40% of rated output.
Note: Next larger case size may be required for options G2,G3, G4 & G5. The temperature coefficient is degraded in classes B, C & D for options G2 thru G5.				
	EXTENDED TEMPERATURE RANGE			
H1	Temperature range −55°C to +80°C	$200 or 50%	4	Requires next larger case size. Storage to −62°C.
H2	Temperature range −40°C to +80°C	$40 or 20%	4	Storage to −55°C
H3	Temperature range −55°C to +115°C	$400 or 100%	6	Requires next larger case size. Storage to −62°C.
	DUAL OUTPUT ISOLATION			
K	Isolated outputs	$20 or 10%	1	Outputs isolated from each other and case ±500 volts.
	AC INPUT VOLTAGE AND FREQUENCY			
L	Input 95-135V, 50-420 Hz	$10 or 10%	1	Derate maximum current to 60% of rated output.
L1	Input 208V ±10%, 50-420 Hz	$15 or 10%	1	
L2	Input 230V ±10%, 50-420 Hz	$15 or 10%	1	
L3	Input 460V ±10%, 50-420 Hz	$25 or 15%	1	
L4	Input 105-125V, 400 ±20 Hz	$15 or 10%	1	Reduce case size to next smaller. Derate ripple by 5X.
L5	Input 115/230V, 50-420 Hz	$30 or 20%	1	Input terminals parallel or series for 115/230 volts.
	DC INPUT VOLTAGES			
L7	Input 12 VDC (11.6 to 13.8 VDC)	$70 or 40%	1	Derate output to 60% of normal.
L8	Input 24 VDC (23.2 to 27.6 VDC)	$70 or 40%	1	Derate output to 80% of normal.
L9	Input 14 VDC (12.0 to 16.0 VDC)	$90 or 50%	1	Derate output to 60% of normal.
L10	Input 28 VDC (24.0 to 32.0 VDC)	$90 or 50%	1	Derate output to 80% of normal.
	PROTECTION CIRCUITS			Available in all sizes except HA.
P1	Current limiting	$50 or 15%	1	Protects system circuit. Limits current to 130% of rated.
P2	Overtemperature cutout	$20	1	Limits base temperature to maximum rated. Self restarting.
P3	Crowbar voltage limit	$60 or 15%	1	Protects power supply and system circuit under all circumstances. Operates at 10% or 1 volt, whichever is greater over maximum settable voltage. Remove input power to restart.
	REMOTE PROGRAMMING			
R	Remote adjust (no pot provided)	No charge	None	Remote programming options allow power supply to be externally adjusted. Resistance to output ratio is approximately 5 mv per ohm except for class C and D units below 8.5 volts which are approximately 1 mv per ohm.
R1	Remote adjust with 1% linearity	$40 or 10%	1	
R3	Remote adjust with pot provided (A & B only)	$10	1	
	OPTIONAL STARTING CIRCUITS			
S1	Start with 30,000 mfd/amp-100,000 mfd max.	$40 or 10%	1	Recommended for high capacitance loads.
S2	Start positive output first	$20	1	
S3	Start negative output first	$20	1	
	HIGH ISOLATION			6" minimum shielded leads vs. terminal.
T	40 db transformer shielding	$40 or 15%	1	Reduces capacitance between line and circuit by 100X.
T1	100 db transformer shielding	$80 or 25%	1	Reduces capacitance between line and circuit by 100,000X.
	HIGH FLOAT VOLTAGE			
U	Output float up to ±1000V	$20 or 10%	1	Either output terminal will withstand ±1000 volts to case or input.
	RUGGEDIZED			
W	Potted for ruggedization in polyurethane resin. HA, JA	$10	1	Weight increased about 30%.
	KA, LA	$15	1	
	MA, NA	$20	1	
	PA	$25	1	
	QA	$30	1	
	RA	$35	1	
	SA	$40	1	
	TA	$45	1	

CASE SIZES AND WEIGHTS (UNPOTTED)

CASE SIZE	HA	JA	KA	LA	MA	NA	PA	QA	RA	SA	TA
WIDE	3 1/16	3 9/16	3 15/16	4 5/16	4 11/16	5 1/16	6 1/16	7 1/16	8 1/16	11 11/16	11 11/16
DEEP	2 5/8	3 1/16	3 3/8	3 11/16	4	4 5/16	4 13/16	5 9/16	6 11/16	5 9/16	6 11/16
HIGH	4 1/4	4 7/8	5 1/4	5 9/16	6	6 13/16	6 13/16	7 1/16	7 1/16	7 1/16	8 1/16
WT (lbs)	2 1/2	3 1/2	4 1/4	5 1/2	7	9	12	17	30	35	50

PRICE

The **total price** is the **base model price** from the regulation table, **plus** the **price of optional features** selected.

PRICE EXAMPLE: CEAD6B150Y101GRW"

"B"	$20	"B" REGULATION BASE	
"150Y101"	182	MODEL PRICE	$212.00
"G"		OPTION	10.00
"R"		OPTION	NO CHARGE
"W"		OPTION	10.00
		TOTAL PRICE	$242.00

Discount Schedule
Quantity Discount

1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

Regulation class "A" and "B" supplies 2 weeks; "C" supplies 3 weeks; "D" supplies 4 weeks. Some options extend delivery as shown above. Shipments will be as directed, United Parcel where serviced, or Parcel Post for the remaining.

AC/DC-DC HF Regulated COMPACT MODULAR POWER SUPPLIES

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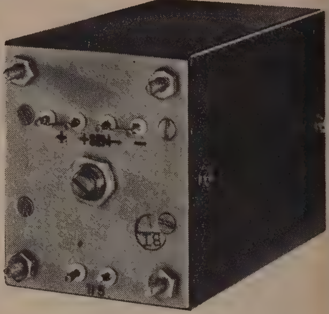
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

CEA3 SERIES — IMPROVED SWITCHING REGULATOR

STANDARD FEATURES INCLUDE



- OUTPUTS from 4.0 to 256VDC, .1 to 60 AMPS, to 640 WATTS.
- INPUTS 50 to 420 Hz, 95 to 135VAC or 105-190VDC.
- REGULATION, 1% or .1% for line plus load.
- 80°C BASE TEMPERATURE without derating.
  Floating outputs, + or − output may be ±500VDC from case.
  Remote sensing standard, all models, eliminates load lead effects.
  Adjustment of output voltage, 50% to 100% is standard. Ranges tabulated below.
  Remote adjustment optional at no charge.
  Series starting with rated load, for multiple supply to a common load application.
  Short circuit and overload output currents will not damage supplies.
  No voltage overshoot on turn-on or turn-off.
  MIL-T-27 modular case sizes with removable covers for servicing.
  Critical components pretested, aged, and graded.
- BURN-IN (stabilization), 16 hrs. min. at rated load and high base temperature.
- 100% TESTING after burn-in, test data with shipment.
  Specifications guaranteed, not just typical.
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.

SPECIFICATIONS — IMPROVED

REGULATION — STABILITY — RIPPLE — BASE MODEL PRICE

Class of Regulation	Line Plus Load Regulated	Line Regulation for 10% Line Change	Load Regulation 10% Load to Full Load	Temperature Coefficient Per Degree C	Stability for 40 Hours	Ripple (RMS)	BASE MODEL PRICE
A	0.5%	0.25%	0.25%	0.5%	0.5%	0.3%	Tabulated below
B	±0.1%	±0.05%	±0.05%	±0.02%	±0.1%	0.07%	A plus $30.00

Input Voltage and Frequency: 105 to 125 volts, 50 to 420 Hz or 120 to 180VDC.

Output Voltage and Current: 4.0 to 256VDC, 0.1 to 60A. See correlation in table below.

Efficiency: Up to 80%. The output rectifier voltage drop of 1.2 volts is a major loss, hence a 5V output is 64% on some models.

Recovery Time: Typically less than 1ms for a 50% to 100% load change.

Insulation Resistance: 100 Megohm DC standard for input, output and case.

Temperature, Base: −20°C to +80°C operating, −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (4 thru 9) in table below are shown on page 19.

Size-Weight-Terminations: Details associated with MIL-T-27 case (GA thru RA), tabulated below, are shown on pages 10 and 20.

PART NUMBERS

Example: .1% Reg, 5V, 60A, with options "F" and "W"; "CEA3B50X603FW"

YOUR SELECTION: **CEA3**_ _ _ _ _ _

Specify regulation — Insert A or B
Specify output voltage — Insert any digit, 40 to 256
Specify voltage decimal — Insert X, Y or Z
Specify desired options — Insert option symbols
Specify output currents — Insert bracketed digits

OUTPUT VOLTAGE		OUTPUT RATED CURRENT																													
2 Digits Under 10V 3 Digits 10V and Over	Decimal Code	.1A (101)			.25A (251)			.5A (501)			1A (102)			2.5A (252)			5A (502)			10A (103)			20A (203)			40A (403)			60A (603)		
Select any voltages between the limits		Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price
4.0 to 7.9	X													GA	5	237	HA	6	286	JA	7	314	MA	7	385	NA	9	446	PA	9	501
8.0 to 15.9	X Y										GA	5	237	HA	6	286	JA	7	330	KA	8	352	NA	9	446	RA	8	622			
16.0 to 31.9	Y							GA	5	237	NA	5	275	JA	7	330	KA	8	352	NA	8	446	RA	7	622						
32.0 to 63.9	Y				GA	5	237	HA	5	275	HA	6	330	KA	8	352	NA	8	440	RA	7	622									
64.0 to 127	Y Z	GA	4	237	HA	5	275	JA	6	314	KA	7	330	NA	8	446	RA	7	622												
128 to 256	Z	HA	5	275	JA	6	314	KA	7	352	NA	7	446	RA	7	622															

SEE OPPOSITE PAGE FOR ADJUSTABLE OR FIXED OUTPUT OPTIONS.

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AC/DC-DC HF Regulated COMPACT MODULAR POWER SUPPLIES

CEA3 SERIES

OPTIONS

The extra charge for each option is either a flat rate or percentage of the base model price; add the larger number to the base price.

Symbol Option	Option Description	Prices	Delivery (Weeks Added)	REMARKS
	FIXED OUTPUTS			
F	Fixed output ±1.0%	No charge	None	Not available with "R" options. Available in both classes of regulation.
F1	Fixed output ±0.2%	$15	1	Available in class B only
	ADJUSTABLE OUTPUTS			
G1	Output adjust range ±10%	No charge	None	Increases resolution of adjustment output.
G2	Output adjust range ±5%	No charge	None	
G3	Output adjust 50% to 100% of nominal	No charge	None	
	EXTENDED TEMPERATURE RANGE			
H1	Temperature range −55°C to +80°C	$100 or 50%	4	Requires next larger case size. Storage to −62°C.
H2	Temperature range −40°C to +80°C	$20 or 20%	4	Storage to −55°C
H3	Temperature range −55°C to +115°C	$200 or 100%	6	Requires next larger case size. Storage to −62°C.
	INPUT VOLTAGE AND FREQUENCY			
L	Input 95-135VAC, 50-420 Hz or 105-190VDC	$20 or 10%	1	Derate maximum current to 60% of rated output.
	SPECIAL CONNECTIONS			
N	Octal plug in lieu of standard terminations	$15	3	Specify option "R" or "F" with "N". Sizes GA or larger, 5 amps or less.
N1	Screw terminals #6-32	$15	3	Used for connections of 20A or less. HA size or larger.
	PROTECTION CIRCUITS			
Std.	Current limiting	No Charge	1	Limits current to protect system circuit.
P2	Overtemperature cutout	$20	1	Limits base temperature to maximum rated. Self restarting.
P3	Crowbar voltage limit	$30 or 15%	1	Protects power supply and system circuit under all circumstances. Operates at 10% or 1 volt, whichever is greater over maximum settable voltage. Remove input power to restart.
	REMOTE PROGRAMMING			
R	Remote adiust (no pot provided)	No charge	None	Remote programming options allow power supply to be externally adjusted.
R2	Remote adjust plus internal pot	$5	1	
R3	Remote adjust with pot provided	$5	1	
	HIGH FLOAT VOLTAGE			
U	Output float up to ±1000V	$10 or 10%	1	Either output terminal will withstand ±1000 volts to case or input.
	RUGGEDIZED			Weight increased about 50% (except W2).
W	Potted for ruggedization in polyurethane resin. GA, HA, JA	$10	1	**Fixed output** or **remote programming** option is required with option "W".
	KA, LA	$15	1	
	MA, NA	$20	1	
	PA	$25	1	
	QA	$30	1	
	RA	$35	1	
W2	Light weight rigid foam	"W" + $20.00	1	

CASE SIZES AND WEIGHTS (UNPOTTED)

CASE SIZE	GA	HA	JA	KA	LA	MA	NA	PA	QA	RA
WIDE	2¾	3 1/16	3 9/16	3 15/16	4 15/16	4 11/16	5 1/16	6 1/16	7 1/16	8 1/16
DEEP	2⅜	2⅝	3 1/16	3⅜	3 11/16	4	4 5/16	4 13/16	5 9/16	6 11/16
HIGH	3 13/16	4¼	4⅞	5¼	5 9/16	6	6 13/16	6 13/16	7 1/16	7 1/16
WT (lbs)	1	1½	1⅞	2½	3⅓	4¼	5⅜	7¼	10	18

PRICE

The **total price** is the **base model price** from the regulation table, **plus** the **price of optional features** selected.

PRICE EXAMPLE: "CEA3B160Y102LRW"

"B"	$30	"B" REGULATION BASE	
"160Y102"	275	MODEL PRICE	$305.00
"L"		OPTION	30.50
"R"		OPTION	NO CHARGE
"W"		OPTION	10.00
		TOTAL PRICE	$345.50

Discount Schedule
Quantity Discount

1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

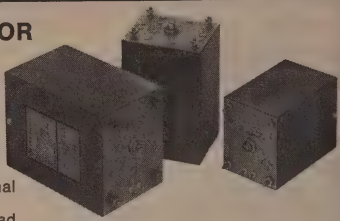
DELIVERY

Regulation class "A" and "B" supplies 4 weeks. Some options extend delivery as shown above. Shipments will be as directed, United Parcel where serviced, or Parcel Post for the remaining.

DC-DC Regulated/Unregulated
CONVERTERS
MODULAR POWER SUPPLIES

CEA, a division of Berkleonics, Inc.
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

CEA2 SERIES — IMPROVED SWITCHING REGULATOR



STANDARD FEATURES INCLUDE

- OUTPUTS from 3.5 to 500VDC, .05 to 40AMPS, to 640 WATTS.
- INPUTS from 10.5 to 60VDC (CEA3 Series, 105-190 VDC).
- REGULATION 1% for line or load and unregulated.
- 80°C BASE TEMPERATURE without derating.
  - Floating outputs, + or − output may be ±500VDC from case.
  - Remote sensing on regulated models, eliminating load lead errors.
  - Adjustment of output ±5% regulated models. Other ranges are optional
  - Remote adjustment optional at no charge.
  - Series starting with rated load, for multiple supply to common load application.
  - Short circuit output currents will not damage supplies.
  - No voltage overshoot on turn-on or turn-off.
  - MIL-T-27 modular case sizes with removable covers for servicing.
  - Critical components pretested, aged, and graded.
- BURN-IN (stabilization), 16 hrs. min. at rated load and high base temperature.
- 100% TESTING after burn-in, test data with shipment. **Specifications guaranteed, not just typical.**
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.

SPECIFICATIONS — IMPROVED

REGULATION — STABILITY — RIPPLE

Class of Regulation	Line Regulation for Full DC Input Change	Load Regulation from 10% to Full Load	Ripple (RMS)	Temperature Coefficient Per Degree C	Efficiency Up to	Option Required
A	None	10% + .5 V	1.0%	0.1%	90%	F
C	0.5%	0.5%	0.3%	0.02%	80%	None

FOR CLOSER REGULATION SUPPLIES SEE DC INPUT OPTIONS FOR CEA6 SERIES.

Input Voltage: 21 to 30VDC standard, other input ranges are optional.

Output Voltage and Current: 3.5 to 500VDC .05 to 40A. See correlation in table below.

Recovery Time: As fast as 10 μs for "A" regulation supplies. For "C" supplies typically less than 1ms for a 50% to 100% load change.

Insulation Resistance: 100 Megohms DC for input, output and case.

Temperature, Base: −20°C to +80°C operating, −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (4 thru 9) in table below are shown on page 19.

Size-Weight-Terminations: Details associated with MIL-T-27 case (FA thru RA), tabulated below, are shown on pages 12 and 20.

PART NUMBERS

Example: 1% Reg, 5V, 40A with options "F1" and "P3"; "CEA2C50X403F1P3"

CEA2_ __ _ __ __

YOUR SELECTION:
Specify regulation — Insert A or C
Specify output voltage — Insert any digits, 35 to 500
Specify voltage decimal — Insert X, Y or Z
Specify desired options — Insert option symbols
Specify output currents — Insert bracketed digits

OUTPUT VOLTAGE		OUTPUT RATED CURRENT																													
2 Digits Under 10V 3 Digits 10V and Over	Decimal Code	.05A (500)			.1A (101)			.25A (251)			.5A (501)			1A (102)			2.5A (252)			5A (502)			10A (103)			20A (203)			40A (403)		
select any voltage between limits		Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price	Size	Thermal	Price
		"A" Regulation Below																													
3.5 to 9.9	X													FA	3	94	GA	4	99	HA	5	110	KA	6	127	NA	7	204	QA	7	297
10.0 to 15.9	Y													FA	3	94	GA	5	99	JA	6	110	MA	6	171	PA	7	253	RA	7	374
16.0 to 29.9	Y										FA	3	94	GA	4	99	JA	5	110	MA	5	176	PA	6	253	RA	7	374			
30.0 to 59.9	Y										GA	4	99	JA	4	116	MA	5	176	PA	6	253	RA	6	374						
60.0 to 99.9	Y				FA	1	94	GA	3	99	HA	5	110	KA	5	127	NA	6	215	RA	6	374									
100 to 159	Z				FA	3	94	GA	5	99	JA	5	116	MA	5	176	QA	6	297												
160 to 299	Z	FA	2	94	GA	3	99	JA	5	116	MA	5	176	PA	6	253															
300 to 500	Z	GA	3	99	HA	4	110	LA	5	165	NA	6	204	RA	5	374															
		"C" Regulation Below																													
3.5 to 9.9	X													FA	5	172	GA	7	182	HA	8	204	KA	9	226	NA	9	358	QA	9	523
10.0 to 15.9	Y													FA	5	172	GA	7	182	JA	8	204	MA	8	297	PA	9	451	RA	9	649
16.0 to 29.9	Y										FA	5	172	GA	6	182	JA	7	204	MA	8	297	PA	9	451	RA	9	649			
30.0 to 59.9	Y										GA	6	182	JA	7	204	MA	7	297	PA	8	451	RA	9	649						
60.0 to 99.9	Y				FA	4	172	GA	5	182	HA	7	204	KA	7	226	NA	9	358	RA	8	649									
100 to 159	Z				FA	5	172	GA	7	182	JA	7	204	MA	8	297	QA	8	523												
160 to 299	Z	FA	5	176	GA	6	182	JA	7	204	MA	7	297	PA	8	451															
300 to 500	Z	GA	5	182	HA	7	204	LA	7	297	NA	9	358	RA	8	649															

CEA *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

DC-DC Regulated/Unregulated CONVERTERS MODULAR POWER SUPPLIES

CEA2 SERIES

OPTIONAL FEATURES

The extra charge for each option is either a flat rate or percentage of the base model price; add the larger number to the base price.

Symbol Option	Option Description	Prices	Delivery (Weeks Added)	REMARKS
	FIXED OUTPUTS			
F	Fixed output ±5%	No charge	None	Setting at 50% load and mid voltage. Standard for class A. Available for CEA2C.
F1	Fixed output ±1%	$15	1	CEA2C series only.
	ADJUSTABLE OUTPUTS			
G	Output adjust range ±1%	$10	1	CEA2C only.
Std.	Output adjust range ±5%	No charge	None	CEA2C only.
G1	Output adjust range ±10%	$5 or 5%	1	CEA2C only.
G2	Output adjust range ±20%	$10 or 10%	1	CEA2C only.
Note: Adjustable units will have an internal potentiometer unless "R" option specified.				
	EXTENDED TEMPERATURE RANGE			
H1	Temperature range −55°C to +80°C	$50 or 50%	4	Requires next larger case size. Storage to −62°C.
H2	Temperature range −40°C to +80°C	$15 or 15%	2	Storage to −55°C
H3	Temperature range −55°C to +115°C	$100 or 100%	6	Requires next larger case size. Storage to −62°C.
	INPUT VOLTAGE OPTIONS			(For 105 to 190 VDC — See CEA3 Series)
L	Input 10.5 to 15.0 VDC	$10 or 10%	1	Load regulation, 15% ±.5 V over 100 W output.
L1	Input 24 to 32 VDC	$10 or 10%	1	
L2	Input 42 to 60 VDC	$10 or 10%	1	
	SPECIAL CONNECTIONS			
N1	Screw terminals #6-32	$15	3	Used for connections of 20A or less. HA size or larger.
	PROTECTION CIRCUITS			
P2	Overtemperature cutout	$20	1	Set at base temperature rating. Self restarting.
P3	Crowbar voltage limit	$30 or 15%	1	Set at 1 volt or 10% over maximum settable voltage, whichever is larger.
	REMOTE PROGRAMMING			
R	Remote adjust (no pot provided)	No charge	None	Remote program options allow power supply to be externally adjusted with resistance (1 mv/ohm). Not available in CEA2A series. Available in CEA2C series only.
R1	Remote adjust with 1% linearity	$20 or 10%	1	
R2	Remote adjust plus internal pot	$5	1	
R3	Remote adjust with pot provided	$5	1	
	HIGH FLOAT VOLTAGE			
U	Output float up to ±1000V	$10 or 10%	1	Either output terminal will withstand ±1000 volts to case or input.
	RUGGEDIZED			
W	Potted for ruggedization in polyurethane resin. FA, GA, HA, JA	$10	1	Weight increased about 50% (except W2).
	KA, LA	$15	1	
	MA, NA	$20	1	Fixed output or remote programming option is required with option "W".
	PA	$25	1	
	QA	$30	1	
	RA	$35	1	
W2	Light weight rigid foam.	"W" + $20.00	1	

CASE SIZES AND WEIGHTS (UNPOTTED)

CASE SIZE	FA	GA	HA	JA	KA	LA	MA	NA	PA	QA	RA
WIDE	2 5/16	2¾	3 1/16	3 9/16	3 15/16	4 15/16	4 11/16	5 1/16	6 1/16	7 1/16	8 1/16
DEEP	2 1/16	2⅜	2⅝	3 1/16	3⅜	3 11/16	4	4 5/16	4 13/16	5 9/16	6 11/16
HIGH	3⅛	3 13/16	4¼	4⅞	5¼	5 9/16	6	6 13/16	6 13/16	7 1/16	7 1/16
WT (lbs)	¾	1	1½	1⅞	2¾	3⅓	4¼	5⅜	7¼	10	18

PRICE

The **total price** is the **base model price** from the table, **plus** the **price of optional features** selected.

PRICE EXAMPLE: "CEA2C150Y102LRW"

"C150Y102"	BASE MODEL PRICE	$172.00
"L"	OPTION	17.00
"R"	OPTION	NO CHARGE
"W"	OPTION	$10.00
	TOTAL PRICE	$199.00

Discount Schedule
Quantity Discount

1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

Regulation class "A" and "C" supplies 4 weeks. Some options extend delivery as shown above. Shipments will be as directed, United Parcel where serviced, or Parcel Post for the remaining.

12

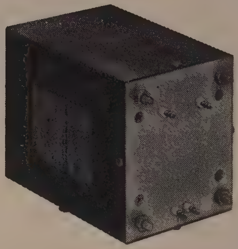
AC-DC Unregulated SINGLE OUTPUT MODULAR POWER SUPPLIES

CEA, a division of Berkleonics, Inc.
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

CEA1A SERIES

STANDARD FEATURES INCLUDE

- OUTPUTS from 4.5 to 620VDC, up to 25 Amps, to 1000 WATTS
- INPUTS 95 to 460VAC, 50 to 420 Hz.
- 80°C BASE TEMPERATURE without derating.
- SHIELDING, line isolation, eliminating glitches and other noise problems. 20 db standard, up to 100 db optional.
  Floating outputs, + or − output may be ±500VDC from case.
  Series starting with rated load, for multiple supplies to a common load.
  MIL-T-27 modular case sizes with removable covers for servicing.
- BURN-IN (stabilization), 16 hrs. min. at rated load and high base temperature.
- 100% TESTING after burn-in, test data with shipment.
  Specifications guaranteed, not just typical.
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.



SPECIFICATIONS

Input Voltage and Frequency: 105 to 125 volts, 50 to 420 Hz are standard. Other voltage ranges are optional.

Output Voltage and Current: 4.5 to 620VDC, .05 to 25A See tabulation below. For DUAL OUTPUT SUPPLIES (CEAD1 series), contact the factory.

Regulation: Line; proportional to input. Load; 10% plus 1VDC from no load to full load.

Ripple, RMS: Less than 5%, standard. Less than 2% optional.

Voltage Setting: ±5% of any specified voltage from 4.5 to 620VDC while at 115 volts 60 Hz input and fully loaded.

Insulation Resistance: 100 Megohms DC standard for input, output and case; 1K Megohms for option "T"; 10K Megohms for option "TI".

Temperature, Base: −20°C to +80°C operating, −40°C to +85°C storage.

Thermal Data: Details associated with thermal curve numbers (1 thru 7) in table below are shown on page 19.

Size-Weight-Terminations: Details associated with MIL-T-27 case (FA thru TA), tabulated below, are shown on pages 14 and 20.

PART NUMBERS

Example: 5V, 1A with options "P3" and "T1"; "CEA1A50X102P3T1"

YOUR SELECTION: **CEA1A** ___ ___ ___ ___

Specify output voltage — Insert any digits, 45 to 620

Specify voltage decimal — Insert X, Y or Z

Specify desired options — Insert option symbols

Specify output currents — Insert bracketed digits

OUTPUT VOLTAGE 2 digits under 10V 3 digits 10V & over	Decimal Code	.05A (500)			.1A (101)			.25A (251)			.5A (501)			1A (102)			2.5A (252)			5A (502)			10A (103)			25A (253)		
Select any voltage between limits		Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price	Size	Thermal	A-Reg. Price
4.5 to 9.9	X				FA	1	39	GA	1	44	HA	1	50	JA	1	55	MA	3	77	NA	3	99	QA	4	132	SA	5	171
10.0 to 16.9	Y				FA	1	39	GA	1	44	HA	1	50	JA	2	61	MA	3	83	NA	4	110	QA	5	149	SA	6	209
17.0 to 35.4	Y				GA	1	44	HA	1	50	JA	1	55	KA	2	66	NA	3	94	PA	5	121	RA	5	176	TA	6	237
35.5 to 38.4	Y				GA	1	44	HA	1	50	KA	1	66	LA	2	83	NA	3	105	PA	5	149	RA	5	209	TA	7	270
38.5 to 49.9	Y				GA	1	50	JA	1	61	LA	1	77	NA	1	99	PA	3	127	QA	4	165	SA	5	231			
50.0 to 64.9	Y				HA	1	50	JA	1	66	LA	2	88	NA	2	110	PA	4	149	QA	5	209	SA	5	264			
65.0 to 75.9	Y	HA	1	55	JA	1	61	KA	1	72	MA	2	99	PA	2	121	QA	3	165	RA	4	231	TA	5	286			
76.0 to 99.9	Y	JA	1	55	KA	1	66	LA	1	77	MA	2	116	PA	2	132	QA	4	187	SA	5	270	TA	6	319			
100 to 111	Z	JA	1	61	KA	1	66	LA	1	88	MA	2	127	PA	2	165	RA	3	226	SA	5	297						
112 to 123	Z	JA	1	61	KA	1	72	LA	1	99	MA	2	132	QA	2	182	RA	3	248	SA	5	319						
124 to 147	Z	KA	1	66	LA	1	72	MA	1	105	NA	2	138	QA	2	193	RA	4	264	TA	5	336						
148 to 172	Z	KA	1	66	LA	1	77	MA	1	110	NA	2	143	QA	3	204	SA	4	275	TA	5	352						
173 to 196	Z	KA	1	66	LA	1	77	MA	1	121	NA	3	149	RA	2	215	SA	4	303									
197 to 246	Z	LA	1	72	MA	1	99	NA	1	138	PA	2	182	RA	3	253	SA	5	341									
247 to 270	Z	LA	1	77	MA	1	105	NA	1	149	PA	3	209	RA	3	281	TA	4	374									
271 to 320	Z	MA	1	83	NA	1	116	PA	1	160	QA	2	220	SA	3	308	TA	5	407									
321 to 344	Z	MA	1	94	NA	1	121	PA	1	165	QA	2	231	SA	3	325												
345 to 419	Z	NA	1	105	PA	1	138	QA	1	182	RA	2	275	SA	3	363												
420 to 468	Z	NA	1	149	PA	1	160	QA	1	198	RA	2	292	TA	3	396												
469 to 620	Z	PA	1	165	QA	1	182	RA	1	242	SA	3	347	TA	4	446												

CEA, *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

AC-DC Unregulated SINGLE OUTPUT MODULAR POWER SUPPLIES

CEA1A SERIES

OPTIONAL FEATURES

The extra charge for each option is either a flat rate or percentage of the base model price; add the larger number to the base price.

Symbol Option	Option Description	Prices	Delivery (Weeks Added)	REMARKS
	EXTENDED TEMPERATURE RANGE			
H1	Temperature range −55°C to +80°C	$100 or 50%	4	Requires next larger case size. Storage to −62°C.
H2	Temperature range −40°C to +80°C	$20 or 20%	4	Storage to −55°C.
H3	Temperature range −55°C to +115°C	$200 or 100%	6	Requires next larger case size. Storage to −62°C.
	AC INPUT VOLTAGE AND FREQUENCY			
L1	Input 208V ±10%, 50-420 Hz	$15 or 10%	1	
L2	Input 230V ±10%, 50-420 Hz	$15 or 10%	1	
L3	Input 460V ±10%, 50-420 Hz	$25 or 15%	1	
L4	Input 105-125V, 400 ±20 Hz	$15 or 10%	1	Reduce case size to next smaller.
L5	Input 115/230V, 50-420 Hz	$30 or 20%	1	Input terminals parallel or series for 115/230 volts.
	DC INPUT VOLTAGES			See CEA2A series
	SPECIAL CONNECTIONS			
N1	Screw terminals #6-32	$15	3	Used for connections of 20A or less. HA size or larger.
	PROTECTION CIRCUITS			
P1	Current limiting and shorted output	$25 or 15%	1	Protects system circuit-limits current to about 150% of rated. Add 1 VDC to regulation.
P2	Overtemperature cutout	$20	1	Limits base temperature to maximum rated. Self restarting.
P3	Crowbar voltage limit (P1 features included)	$30 or 25%	1	Protects power supply and system circuit under all circumstances. Operates at 10% or 1 volt, whichever is greater over maximum operating voltage. Remove input power to restart.
	RIPPLE REDUCTION			Increase the size to the next larger case.
Q	Ripple at rated load, 2% or less	$10 or 20%	1	
	HIGH ISOLATION			6″ minimum shielded leads vs. terminals.
T	40 db transformer shielding	$25 or 15%	1	Reduces capacitance between line and circuit by 100X.
T1	100 db transformer shielding	$50 or 25%	1	Reduces capacitance between line and circuit by 100,000X.
	HIGH FLOAT VOLTAGE			
U	Output float up to ±1000V	$10 or 10%	1	Either output terminal will withstand ±1000 volts to case or input.
	RUGGEDIZED			
W	Potted for ruggedization in polyurethane resin. FA, GA, HA, JA KA, LA MA, NA PA QA RA SA TA	$10 $15 $20 $25 $30 $35 $40 $45	1 1 1 1 1 1 1 1	Increases weight about 30%.

CASE SIZES AND WEIGHTS (UNPOTTED)

CASE SIZE	FA	GA	HA	JA	KA	LA	MA	NA	PA	QA	RA	SA	TA
WIDE	2 5/16	2¾	3 1/16	3 9/16	3 15/16	4 15/16	4 11/16	5 1/16	6 1/16	7 1/16	8 1/16	11 11/16	11 11/16
DEEP	2 1/16	2⅜	2⅝	3 1/16	3⅜	3 11/16	4	4 5/16	4 13/16	5 9/16	6 11/16	5 9/16	6 11/16
HIGH	3⅛	3 13/16	4¼	4⅞	5¼	5 9/16	6	6 13/16	6 13/16	7 1/16	7 1/16	7 1/16	8 1/16
WT (lbs)	1	1¾	2½	3½	4¼	5½	7	9	12	17	30	35	50

PRICE

The **total price** is the **base model price** from the output table, **plus** the **price of optional features** selected.

PRICE EXAMPLE: "CEA1A150Y102UW"

"150Y102"	BASE MODEL PRICE	$61.00
"U"	OPTION	10.00
"W"	OPTION	10.00
	TOTAL PRICE	$81.00

Discount Schedule

Quantity	Discount
1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

All supplies 2 weeks. Some options extend delivery as shown above. Shipments will be as directed. United Parcel where serviced, or Parcel Post for the remaining.

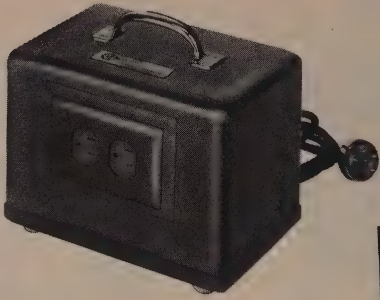
SHIELDED LINE ISOLATORS AC-AC Unregulated

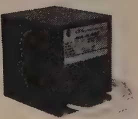
CEA. *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • **In Calif. 800-592-5910**

CEA11 TO CEA35 SERIES

FEATURES

- Stops high frequency line transients.
- Stops 60 Hz leakage current.
- Breaks AC power ground loops.
- 250 VA to 2 KVA units available from stock to two weeks.
- Input - output voltages, 95 to 270VAC.
- Portable — Ready to plug-in and use anywhere.
- Rack-mounted easily by removing feet and using bolts.
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.





Modular CEA11M to CEA35M

APPLICATIONS

This series of highly-shielded power Line Isolators offers the systems and laboratory engineers an opportunity to fully isolate electronic test equipment such as oscilloscopes. DVM's, power supplies, oscillators, amplifiers, counters, VTVM's and signal conditioning equipment. For example, with a Line Isolator connected between the power source and an oscilloscope, electrical measurements may be made without fear of tripping circuit breakers or blowing fuses because of power ground loops. Most high-frequency line transients are capacitance-coupled through standard power transformers (500 to 5000 pfd), and cause considerable unexplained interference. Reduction of such coupling capacity is the CEA secret to interference-free performance and high common mode rejection. CEA offers three choices of Line Isolators with reduced coupling capacity; 0.01 pfd, 0.001 pfd, and 0.0005 pfd. The effect of input-to-output coupling capacity is illustrated by the impedance of that capacity at various frequencies (5000 pfd for an unshielded transformer).

CEA shielded line isolators are also finding wide acceptance among OEM manufacturers of computers and computer peripheral equipment such as computer terminals. Line transients are coupled directly thru the unshielded power supplies of such equipment and act as bona fide signals to the sensitive I.C. circuits. For integral installation into OEM equipment, special physical packaging can be designed to accommodate the particular system space.

SPECIFICATIONS

Isolation: Input-to-output coupling capacity; less than 0.01, 0.001, or 0.0005 pfd.
Input-to-output DC resistance; greater than 100,000 megohms.
60 Hz leakage current less than .001μamps.

Input: 95-135 VAC, 50-65 Hz standard, other ranges optional.

Output Voltage: Within 2% of the input voltage, from no load to full load.

Output Current: See model table.

Efficiency: Better than 95%.

Mechanical: Unit has chrome handle, grey baked enamel finish, 6 ft. shielded line cord, non-scuff feet and #¼-20 inserts for bolt mounting. Modular unit has modified MIL-T-27 cases with 12″ lead, and threaded holes vs. studs; see page 20.

SIZE — PART NUMBER — PRICE

VA Rating	Max. Output (Amps)	Size (Inches)			Wt. Lbs.	Coupling Capacity 0.01 pfd		Coupling Capacity 0.001 pfd		Coupling Capacity 0.0005 pfd	
		W	D	H		Model	Price	Model	Price	Model	Price
250	2.2	5⅜	5⅛	7	12	CEA11	$116.00	CEA21	$149.00	CEA31	$193.00
500	4.3	6½	6⅛	8	27	CEA12	132.00	CEA22	176.00	CEA32	226.00
1000	8.6	9⅜	6⅛	8	33	CEA13	160.00	CEA23	215.00	CEA33	275.00
1500	13.0	9⅜	6⅛	9	38	CEA14	198.00	CEA24	248.00	CEA34	330.00
2000	17.3	9	9	9	55	CEA15	253.00	CEA25	336.00	CEA35	435.00
250	2.2	5 1/16	4 5/16	4½	12	CEA11M	101.00	CEA21	134.00	CEA31M	178.00
500	4.3	6 1/16	4 13/16	5¼	27	CEA12M	117.00	CEA22	161.00	CEA32M	211.00
1000	8.6	7 1/16	5 9/16	6¼	33	CEA13M	145.00	CEA23	200.00	CEA33M	260.00
1500	13.0	7 1/16	5 9/16	6¼	33	CEA14M	183.00	CEA24	233.00	CEA34M	315.00
2000	17.3	8 1/16	6 11/16	7 1/16	55	CEA15M	238.00	CEA25	321.00	CEA35M	420.00

DISCOUNT SCHEDULE: 1-4 net, 5-9 less 5%, 10-24 less 10%, 25-99 less 15%, 100 — factory.

OPTIONAL INPUT AND OUTPUT VOLTAGES

(add the option symbol to model selected, add whichever price is greater to the base price).

"L1" Input 190-270 VAC Output within 2% of Input	$20 or 10%
"L2" Input 190-270 VAC Output 95-135 VAC (50% of Input)	$20 or 10%
"L3" Input 95-135 VAC Output 190-270 VAC (200% of Input)	$20 or 10%

TERMS

NET 30 days, F.O.B San Luis Obispo, California.

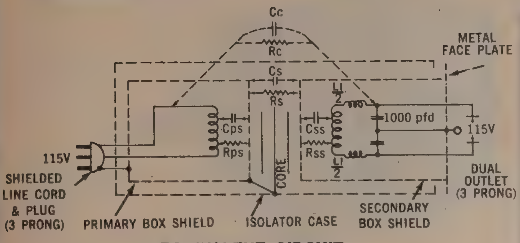
DELIVERY

Isolators and cables (next page) available from stock, 2 weeks ARO. Shipment will be as directed, United Parcel, under 50 lbs., where serviced, or truck for the remaining.

CEA, *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

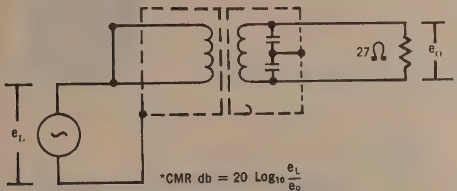
SHIELDED LINE ISOLATORS
AC-AC Unregulated

CEA11 TO CEA35 SERIES
TECHNICAL DATA



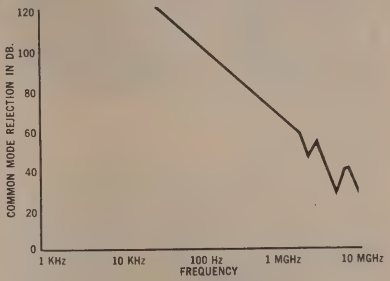
EQUIVALENT CIRCUIT

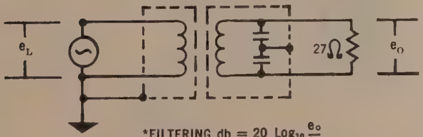
Symbol	Description	Worst Values For CEA11	Worst Values For CEA35
Cc	Capacity between primary & secondary windings	.01 pfd	.0005 pfd
Rc	Resistance between primary & secondary windings	100K MegΩ	100K MegΩ
Cs	Capacity between primary shield plus case & secondary shield	300 pfd	1000 pfd
Rs	Resistance between primary shield plus case & secondary shield	100K MegΩ	100K MegΩ
Cps	Capacity between primary winding & primary shield	1000 pfd	3000 pfd
Rps	Resistance between primary winding & primary shield	100 MegΩ	100 MegΩ
Cps	Capacity between secondary winding & secondary shield	1000 pfd	3000 pfd
Rss	Resistance between secondary winding & secondary shield	100 MegΩ	100 MegΩ
Li	Leakage inductance (referred to secondary)	10 mh	.5 mh



$$\text{*CMR db} = 20 \text{ Log}_{10} \frac{e_L}{e_o}$$

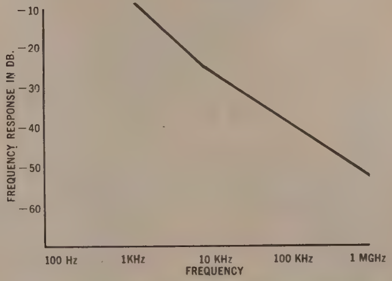
COMMON MODE REJECTION* VS. FREQUENCY
*DATA TAKEN FROM A STANDARD CEA12 ISOLATOR





$$\text{*FILTERING db} = 20 \text{ Log}_{10} \frac{e_o}{e_L}$$

FILTER ACTION* VS. FREQUENCY
*DATA TAKEN FROM A STANDARD CEA12 ISOLATOR



SHIELDED LINE CORDS FOR ISOLATOR OUTPUTS

STYLE A

STYLE B

To make optimum use of CEA Line Isolators, CEA offers specially designed shielded line cords in two styles and several lengths. Style A can be used as an extension cord for equipment that has a line receptacle mounted at the chassis (such as Tektronix scopes). Style B has stripped and tinned leads on one end and can be installed into equipment as a direct replacement for unshielded line cords (such as Hewlett-Packard equipment). The plugs on these cords, as well as the cable, are shielded and are constructed of the finest materials available. Other lengths, current ratings, and connectors are available on request.

STANDARD SHIELDED LINE CORDS

Model	Max. Current (Amps)	Length (Feet)	Style	Price (Each)
CEA8A6	5	6	A	$25.00
CEA8B6	5	6	B	19.00
CEA8A10	5	10	A	33.00
CEA8B10	5	10	B	28.00
CEA9A6	15	6	A	31.00
CEA9B6	15	6	B	26.00
CEA9A10	15	10	A	44.00
CEA9B10	15	10	B	39.00

(Minimum $25.00 order)

MEDICAL-SHIELDED LINE ISOLATORS

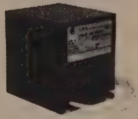
AC-AC Unregulated

CEA, *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

OL21 - OL25 / OWEN LABORATORIES PART DISTRIBUTED BY CEA

FEATURES

- Stops 60 Hz leakage currents
- Stops high frequency line transients.
- Less than 25 db audio noise
- Portable — Ready to plug-in and use anywhere.
- 250 VA to 2 KVA units available.
- Rack-mounted easily by removing feet and using bolts.
- 3 YEAR WARRANTY for parts and labor against defects in workmanship and materials.



Module OL21M to OL25M

APPLICATIONS

Recent investigations by safety conscious people in the medical field have shown that stray currents in the order of 10 microamps can be dangerous to patients exposed to surgical and intensive care instrumentation in hospitals. CEA's line isolators are capable of reducing line leakage currents to less than 5.0 microamps thus providing the necessary safety factor between hospital instrumentation and patient.

SPECIFICATIONS

Isolation: Leakage currents, 60 Hz, either output to case less than 5μA. DC resistance, output to case or to input, greater than 100,000 megohms.

Input: 95-135 VAC, 50 - 65 Hz is standard, other ranges are optional.

Output Voltage: Within 2% of input voltage at full load.

Output Current: See tabulation below.

Efficiency: Better than 90% at full load.

Mechanical: Unit has chrome handle, grey baked enamel finish, 6 ft. shielded line cord on the input, non-scuff feet, and #¼-20 inserts for bolt mounting. Modular unit has modified MIL-T-27 cases with 12" lead, and threaded holes vs. studs; see page 20.

SIZE — PART NUMBER — PRICE

VA Rating	Max. Output (Amps)	Overall Size W	Overall Size D	Overall Size H	Wt.Lbs.	Model	Price
250	2.2	5⅜	5⅛	7	12	OL21	$154.00
500	4.3	6½	6⅛	8	27	OL22	176.00
1000	8.6	9⅜	6⅛	8	33	OL23	215.00
1500	13.0	9⅜	6⅛	9	38	OL24	248.00
2000	17.3	9	9	9	55	OL25	330.00
250	2.2	5⅜	5⅛	7	12	OL21M	139.00
500	4.3	6½	6⅛	8	27	OL22M	161.00
1000	8.6	9⅜	6⅛	8	33	OL23M	200.00
1500	13.0	9⅜	6⅛	9	38	OL24M	233.00
2000	17.3	9	9	9	55	OL25M	315.00

OPTIONAL INPUT VOLTAGES

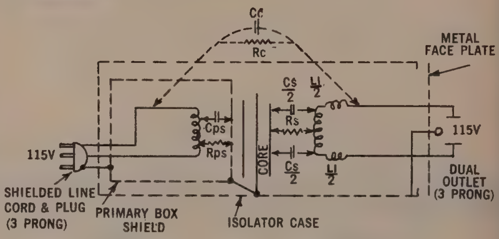
Add the option symbol "L2" to the model selected for an input voltage of 190-270 VAC, output voltage 95-135 VAC (50% of input) and add $20.00, to the base price.

DISCOUNT SCHEDULE QUANTITY DISCOUNT

1-4	net	25-99	less 15%
5-9	less 5%	100-	factory
10-24	less 10%		

CIRCUIT AND VALUES:

	Worst Values For	OL21	OL25
Cc	Capacity between primary & secondary windings	.01 pfd	.01 pfd
Rc	Resistance between primary & secondary windings	100k meg	100K meg
Cs	Capacity between primary shield, case & secondary	150 pfd	150 pfd
Rs	Resistance between primary shield, case & secondary	100K meg	100K meg
Cps	Capacity between primary winding & primary shield	1000 pfd	3000 pfd
Rps	Resistance between primary winding & primary shield	100 meg	100 meg
Li	Leakage inductance (referred to secondary)	15 mh	.7 mh



TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

Available from stock, to 4 weeks. Shipments will be as directed, United Parcel under 50 lbs. where serviced, or truck for the remaining.

CEA. *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

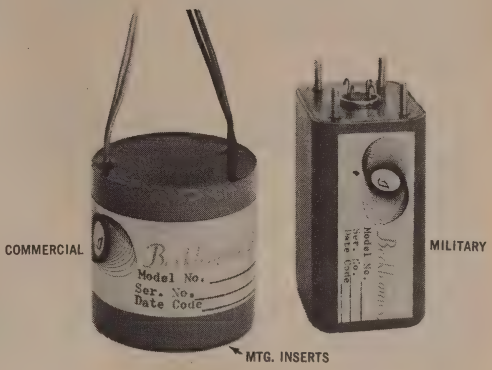
BATTERY CHARGERS FOR NI-CAD CELLS

C1.2 TO C36 / BERKLEONICS PART DISTRIBUTED BY CEA

FEATURES

These 115V, 60 Hz battery chargers are designed specifically for nickel cadmium and similar rechargeable cells. Average charge time for these chargers is 14 to 16 hours with **no damage to cells or charger** if the charger is left on indefinitely.

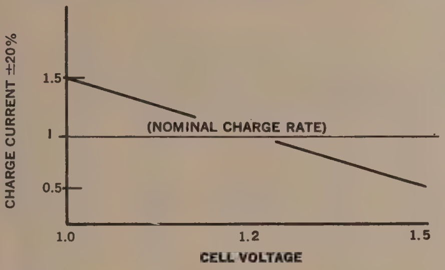
Variations of mechanical sizes and electrical specifications for every need are available on special request.



SPECIFICATIONS

INPUT: 115VAC, 60 Hz.

OUTPUT: DC current (rectified unfiltered AC) as indicated by table and curve below.



PART NUMBERS

Example: Commercial 12V, 400Ma charger; "C12.0-400"
YOUR SELECTION: Insert in the blanks as indicated.

cell charge current in Ma @ 10 Hr rate from table
nominal battery voltage @ 1.2 volts/cell, from table
package type — LETTER CODE: below

"C" — Commercial grade (metal encased & potted with epoxy) unit has 2 threaded holes in end opposite lead exit.

"M" — Military (designed to satisfy MIL-T-27/TF 4 R X 02)
Transformer
Metal Encased & Hermetically Sealed
105°C
10,000 Hour Life
Power Transformer Supplying Rectified Load

NOMINAL CHARGE CURRENT IN MA @ 10 HOUR RATE

NOMINAL BATTERY VOLTAGE (NUMBER OF CELLS @ 1.2 VOLTS CELL)

	22	50	90	120	160	230	300	400	600	800	1100
1.2	$14.	$14.	$14.	$14.	$17.	$17.	$20.	$20.	$20.	$20.	$29.
2.4	$14.	$14.	$14.	$17.	$17.	$20.	$20.	$20.	$20.	$20.	$29.
3.6	$14.	$14.	$17.	$17.	$20.	$20.	$20.	$24.	$29.	$29.	$29.
4.8	$14.	$14.	$17.	$20.	$20.	$20.	$24.	$24.	$29.	$29.	$29.
6.0	$14.	$17.	$20.	$20.	$24.	$24.	$24.	$29.	$29.	$29.	$36.
7.2	$14.	$17.	$20.	$20.	$24.	$24.	$29.	$29.	$29.	$36.	$36.
8.4	$17.	$17.	$20.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$36.
9.6	$17.	$17.	$20.	$24.	$24.	$29.	$29.	$29.	$36.	$36.	[illegible]
10.8	$17.	$20.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$36.	$41.
12.0	$17.	$20.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$36.	$41.
13.2	$17.	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$36.	$41.	$41.
14.4	$17.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$36.	$41.	$41.
15.6	$17.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$36.	$41.	$41.
16.8	$17.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$41.
18.0	$17.	$20.	$24.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$41.
19.2	$17.	$20.	$24.	$24.	$29.	$36.	$36.	$36.	$41.	$41.	$41.
20.4	$17.	$20.	$24.	$24.	$29.	$36.	$36.	$36.	$41.	$41.	$47.
21.6	$17.	$20.	$24.	$24	$29.	$36.	$36.	$36.	$41.	$41.	$47.
22.8	$17.	$20.	$24.	$29.	$29.	$36.	$36.	$36.	$41.	$41.	$47.
24.0	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$36.	$41.	$47.	$47.
25.2	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
26.4	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
27.6	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
28.8	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
30.0	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
31.2	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
32.4	$20.	$20.	$24.	$29.	$29.	$36.	$36.	$41.	$41.	$47.	$47.
33.6	$20.	$20.	$24.	$29.	$29.	$36.	$41.	$41.	$41.	$47.	$47.
34.8	$20.	$20.	$24.	$29.	$29.	$36.	$41.	$41.	$41.	$47.	$47.
36.0	$20.	$20.	$24.	$29.	$29.	$36.	$41.	$41.	$41.	$47.	$47.
	0.22	0.5	0.9	1.2	1.6	2.3	3	4	6	8	11

NOMINAL STORAGE CAPACITY IN AMPERE HOURS

MECHANICAL: Reference the photos. The shading in the table denotes one of four sizes as follows.

$	MIL T 27 Size AJ — 1⅝ x 1⅝ x 2⅜ Commercial Size — 1.52H x 1.32 Dia., 4 oz
$	MIL T 27 Size EB — 1 15/16 x 1 13/16 x 2 7/16 Commercial Size — 1.77H x 1.82 Dia., 8 oz
$	MIL T 27 Size FB — 2 5/16 x 2 1/16 x 2½ Commercial Size — 2.58H x 2.05 Dia.. 20 oz
■	MIL T 27 Size HB — 3 1/16 x 2⅝ x 3 3/16 Commercial Size — 3 1/16 x 2⅝ x 3 3/16 ,50 oz

PRICE (minimum $25.00 order)

Prices shown in the table are for type "C" chargers (commercial). When ordering type "M" chargers (military), increase the prices in the table by 100%.

Discount Schedule
Quantity Discount

1-4	net
5-9	less 5%
10-24	less 10%
25-99	less 15%
100-	factory

TERMS

NET 30 days, F.O.B. San Luis Obispo, California.

DELIVERY

From stock to two weeks. Shipment will be as directed, United Parcel, where serviced, and Parcel Post for the remaining.

THERMAL DATA THERMAL RADIATORS

CEA, *a division of Berkleonics, Inc.*
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

Heat flows from regions of high temperature to regions of low temperature by:
1. CONDUCTION — heat flow within a material without material motion required.
2. CONVECTION — heat flow by physical motion of a material; e.g., liquids and gases.
3. RADIATION — heat flow by radiant energy, materials for the flow path not required.

The heat conductivity of various substances are: Silver 1.0, Copper .9, Gold .7, Aluminum .5, Iron .15, Steel .1, Silica .0024, Mica .0018 (.5 conductivity corresponds to about 1°C per inch or a heat flow of 5.3 watts per square inch).

The conductivity of some aluminum alloys are three times better than others, 1100F and 6063T5 are two of the better alloys.

Convection by natural means can vary about 2 to 1 for flat surface up versus a flat surface down.

Forced convection (fan-driven air) is a common cooling procedure and has the effects shown in the curve below.

Radiation depends to a large extent on the roughness of the surface. The rougher the better (e.g., the emissivity of aluminum unoxidized is .02 vs .3 oxidized).

From the above it is clear that heat flow is complex and quite variable. THE DATA GIVEN BELOW IS PRESENTED NOT AS ABSOLUTE BUT RATHER AS A GUIDE.

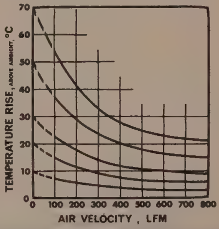
THERMAL DATA — Worst Case Condition: high input voltage, full load, no forced air.
(a) Power Dissipated Internally (watts) (b) Temp. Rise, chassis mounted (°C) (c) Temp. Rise, chassis & thermal radiator mounted (°C)

THERMAL NUMBERS	DATA	CASE SIZE FA	GA	HA	JA	KA	LA	MA	NA	PA	QA	RA	SA	TA
1	(a)	2.9	3.9	4.8	6.5	8.0	9.5	11	13	17	24	32	39	47
	(b)	2.9	3.9	4.8	6.5	8.0	9.5	8	9	12	11	14	17	20
	(c)	—	—	—	—	—	—	6	7	8	6	9	7	9
2	(a)	3.8	5.2	6.4	8.6	11	13	15	17	23	31	43	52	63
	(b)	3.8	5.2	6.4	8.6	11	13	10	12	15	13	18	22	26
	(c)	—	—	—	—	—	—	8	10	10	8	11	10	12
3	(a)	5.7	7.8	9.6	13	16	19	22	26	34	47	65	78	94
	(b)	5.7	7.8	9.6	13	15	18	14	17	22	20	27	31	37
	(c)	—	—	—	—	—	—	12	14	15	12	17	14	17
4	(a)	7.6	10	13	17	21	25	30	35	45	63	86	100	130
	(b)	7.6	10	13	16	20	23	20	22	28	26	34	38	46
	(c)	—	—	—	—	—	—	16	18	19	16	22	18	24
5	(a)	11	16	19	26	32	38	45	52	68	94	130	160	190
	(b)	11	15	18	24	29	34	29	32	40	37	46	53	58
	(c)	—	—	—	—	—	—	23	26	28	24	31	28	32
6	(a)	15	21	26	35	43	51	60	70	91	130	170	210	250
	(b)	14	20	24	32	38	42	36	41	49	46	55	62	67
	(c)	—	—	—	—	—	—	30	34	36	31	39	35	40
7	(a)	23	31	39	52	64	76	90	100	140	190	260	310	380
	(b)	22	28	35	43	49	55	49	52	63	58	69	75	—
	(c)	—	—	—	—	—	—	42	45	49	42	52	47	53
8	(a)	30	42	51	69	85	100	120	140	180	250	340	420	500
	(b)	27	37	42	52	59	64	58	63	71	67	78	—	—
	(c)	—	—	—	—	—	—	50	56	58	50	61	57	62
9	(a)	43	63	77	100	130	150	180	210	270	380	520	620	750
	(b)	38	49	55	64	73	78	71	77	—	—	—	—	—
	(c)	—	—	—	—	—	—	64	69	71	64	75	69	76
CHASSIS ³⁄₃₂″ x (In. x In.)		10x10	10x10	10x10	10x10	10x10	10x10	12x12	12x12	12x12	15x15	15x15	15x15	15x15
RADIATORS (Qty.) P/N		—	—	—	—	—	—	(1) CEATR1	(1) CEATR1	(2) CEATR1	(2) CEATR2	(2) CEATR2	(4) CEATR2	(4) CEATR2

Example: Thermal No. 5, Case SA may dissipate 160 watts, have a base temperature of 53°C above ambient for a 15″ x 15″ x ³⁄₃₂″ aluminum chassis mounting, reduce the 53°C to 28°C by adding four CEATR2 THERMAL RADIATORS (mounted thru chassis to base), and then have the 28°C decreased to 11°C by 400LFM air velocity to all surfaces.

The base limitation to the life of your CEA Power Supply is the upper temperature of the internal components. As with most temperature-affected items, the cooler the unit the greater the life expectancy. Keeping the base temperature of your power supply under +80°C during normal operation will cause the internal components to be safe and give a good life.

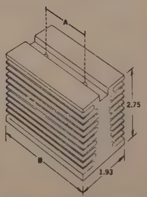
Temperature stability may require from 10 to 40 minutes after a change, e.g., turn-on. This can be an aid during intermittent duty, and should be remembered when performing a steady-state systems analysis.



THERMAL RADIATORS

Models CEATR1 and CEATR2 Thermal Radiators, designed for use with CEA Power Supplies, may be mounted directly into the module base or on the opposite side of the mounting body. The mounting hole configuration in the Thermal Radiators and the base of each Module are symmetrical so that the radiators may be mounted for airflow in either direction across the base of the Module. A coating of silicon grease should be applied on each mating surface of the Module, mounting body and Thermal Radiator. The mounting body must be a smooth, highly thermal conductive metallic surface. (Minimum $25.00 order.)

Thermal Radiator Model No.	Radiation Area (sq. in.)	Dimensions A	B	Weight (Pounds)	Price Each
CEATR1	75	1.000	1.93	0.75	$14.00
CEATR2	150	2.000	3.93	1.50	$20.00



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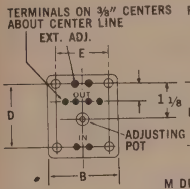
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

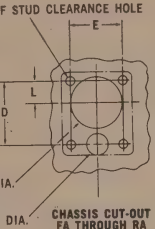
MOUNTING and TERMINATIONS

MECHANICAL DATA

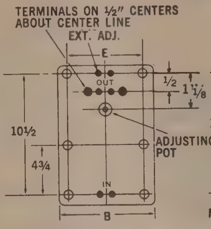
For convenience in mounting handling, the entire CEA line of over 100,000 power supplies are packaged in only 13 different case sizes. The physical dimensions and simplest chassis cutout dimensions are given below. Use adequate cooling to maintain base temeprature below 80°C.


TERMINALS ON 3/8" CENTERS ABOUT CENTER LINE
EXT. ADJ.
E
OUT
IN
D
1 1/8
ADJUSTING POT
B

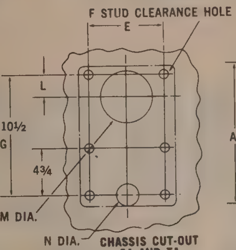
BASE CONFIGURATION FA THROUGH RA


F STUD CLEARANCE HOLE
E
L
D
M DIA.
N DIA.

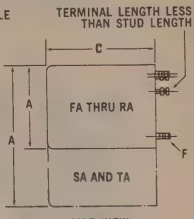
CHASSIS CUT-OUT FA THROUGH RA


TERMINALS ON 1/2" CENTERS ABOUT CENTER LINE
EXT. ADJ.
E
OUT
1/2
1 1/8
10 1/2
4 3/4
ADJUSTING POT
IN
B

BASE CONFIGURATION SA AND TA


F STUD CLEARANCE HOLE
E
L
10 1/2
4 3/4
M DIA.
N DIA.

CHASSIS CUT-OUT SA AND TA


TERMINAL LENGTH LESS THAN STUD LENGTH
C
A
A
FA THRU RA
SA AND TA
F

SIDE VIEW

MODULE DIMENSIONS / CASE SIZES AND WEIGHTS

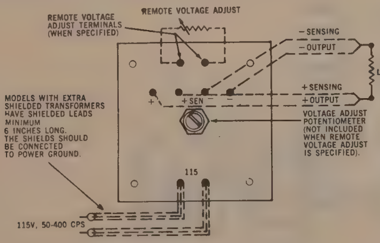
MIL-T-27A‡ Size	A	B	C	D	E	F	L	Chassis Clearance Holes†		Standard* Wt. Lbs.	Potted Units Option W Lbs.	Base Area Sq. In.	Volume Cu. In.
								M	N				
FA	2 5/16	2 1/16	3 1/8	1 11/16	1 7/16	6-32 x 3/8	11/16	1 11/16	3/4	1	1 1/4	4.8	13
GA	2 3/4	2 3/8	3 13/16	2 1/8	1 3/4	6-32 x 3/8	11/16	1 11/16	3/4	1 3/4	2 1/4	6.5	25
HA	3 1/16	2 5/8	4 1/4	2 19/64	1 55/64	6-32 x 3/8	11/16	1 11/16	3/4	2 1/2	2 3/4	8.0	34
JA	3 9/16	3 1/16	4 7/8	2 5/8	2 1/8	8-32 x 3/8	11/16	1 11/16	3/4	3 1/2	4	10.8	53
KA	3 15/16	3 3/8	5 1/4	3	2 7/16	10-32 x 1/2	11/16	1 11/16	3/4	4 1/4	6 1/4	13.3	70
LA	4 5/16	3 11/16	5 9/16	3 5/16	2 11/16	10-32 x 1/2	11/16	1 11/16	3/4	5 1/2	7 3/4	15.9	88
MA	4 11/16	4	6	3 11/16	3	1/4-20 x 5/8	11/16	1 11/16	3/4	7	9 1/2	18.7	112
NA	5 1/16	4 5/16	6 13/16	4 1/16	3 5/16	1/4-20 x 5/8	11/16	1 11/16	3/4	9	12 1/2	21.8	149
PA	6 1/16	4 13/16	6 13/16	5 1/16	3 13/16	1/4-20 x 5/8	11/16	1 11/16	3/4	12	16 1/2	28.4	198
QA	7 1/16	5 9/16	7 1/16	6 1/16	4 9/16	5/16-18 x 21/32	11/16	1 11/16	3/4	17	23	39.2	277
RA	8 1/16	6 11/16	7 1/16	7 1/16	5 11/16	5/16-18 x 21/32	11/16	1 11/16	3/4	30	38	53.9	381
SA	11 11/16	5 9/16	7 1/16	—	4 7/16	5/16-18 x 7/8	11/16	2 1/4	3/4	35	45	63.0	463
TA	11 11/16	6 11/16	8 1/16	—	5 9/16	5/16-18 x 7/8	11/16	2 1/4	3/4	50	65	78.2	632

‡ MIL-T-27 tolerances apply.

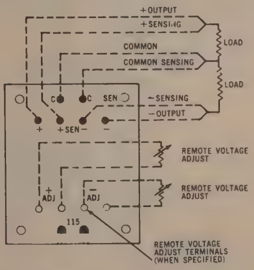
† Chassis cutout dimensions are typical for all single output supplies and fixed output dual units. For dual output units with terminals, omit "N" hole and substitute "M" diameter hole using "L" dimensions both ends.

* Weights shown are for 60 Hz supplies. CEA2 and CEA3 supplies are about 60 percent of these tabulated standard weight.

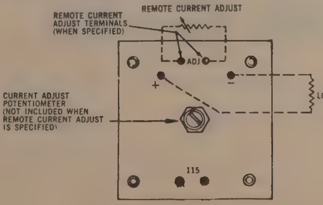
ELECTRICAL TERMINATION DATA


REMOTE VOLTAGE ADJUST TERMINALS (WHEN SPECIFIED)
REMOTE VOLTAGE ADJUST
− SENSING
− OUTPUT
LOAD
+ SENSING
+ OUTPUT
+
SEN
VOLTAGE ADJUST POTENTIOMETER (NOT INCLUDED WHEN REMOTE VOLTAGE ADJUST IS SPECIFIED).
MODELS WITH EXTRA SHIELDED TRANSFORMERS HAVE SHIELDED LEADS MINIMUM 6 INCHES LONG. THE SHIELDS SHOULD BE CONNECTED TO POWER GROUND.
115
115V, 50-400 CPS

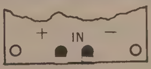
termination data single output units


+ OUTPUT
+ SENSING
LOAD
COMMON
COMMON SENSING
LOAD
C
C
SEN
− SENSING
− OUTPUT
+
+ SEN −
−
REMOTE VOLTAGE ADJUST
REMOTE VOLTAGE ADJUST
+ ADJ
− ADJ
115
REMOTE VOLTAGE ADJUST TERMINALS (WHEN SPECIFIED)

termination data dual output units


REMOTE CURRENT ADJUST TERMINALS (WHEN SPECIFIED)
REMOTE CURRENT ADJUST
ADJ
+
−
LOAD
CURRENT ADJUST POTENTIOMETER (NOT INCLUDED WHEN REMOTE CURRENT ADJUST IS SPECIFIED)
115

termination data constant current units



DC INPUTS

20 Amps and Under — Solder Turret Type
Over 20 Amps — 1/4-20 Studs (Input Terminal Spacing Modified)

terminals

CEA

MAKES POWER SUPPLIES

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TOLL FREE

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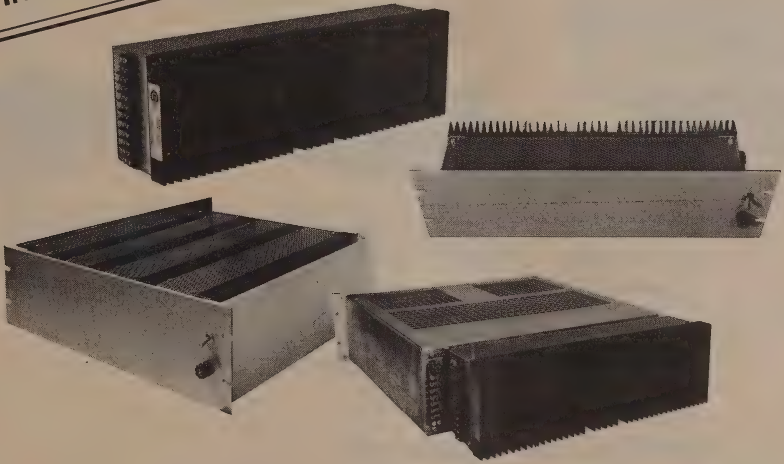

CONVECTION COOLED DISSIPATIVE AND SWITCHING REGULATED MODULAR POWER SUPPLIES

• AC OR DC INPUTS • SINGLE, DUAL AND TRIPLE OUTPUTS • THERMALLY EFFICIENT PACKAGING FOR PANEL, CHASSIS AND RACK INSTALLATIONS

22

CEA's Newest Thermally Efficient POWER SUPPLIES CONVECTION COOLED

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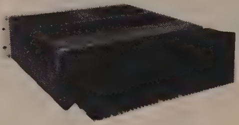
C1, C2 and C3 SERIES

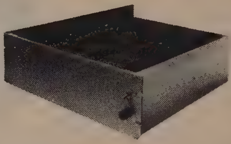
MODULAR

PANEL

CHASSIS



RACK



CONVECTION COOLED DESIGN
FOR NATURAL CONVECTION OR FORCED AIR COOLING
IN PANEL, CHASSIS AND RACK INSTALLATIONS

VARIOUS STANDARD FEATURES

- CURRENT LIMITING
- OVERVOLTAGE PROTECTION
- OVER TEMPERATURE TURN-OFF
- REMOTE SENSING
- REMOTE ADJUST
- 16 HOUR BURN-IN AT FULL LOAD
- 100% FINAL TESTING TO MIL-I-45208A
- 3 YEAR WARRANTY
- RACK SYSTEM OPTION
- TWO REGULATIONS AVAILABLE FOR EACH MODEL

C1 FEATURES

- DISSIPATIVE REGULATORS
- AC TO DC
- HIGHER REGULATION
- LOW NOISE and FAST RESPONSE

C2 FEATURES

- SWITCHING REGULATORS
- DC TO DC
- HIGHER EFFICIENCY
- WIDE INPUT RANGE

C3 FEATURES

- SWITCHING REGULATORS
- AC TO DC
- HIGHER EFFICIENCY
- WIDE INPUT RANGE

23

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AC-DC Modular Power Supplies CONVECTION COOLED DISSIPATIVE REGULATOR

C1 SERIES / SINGLE, DUAL and TRIPLE OUTPUTS

Convection Cooled Design for natural convection or forced air cooling in rack or cabinet installations. Dissipative Regulators offer low ripple, higher regulation, fast response, simplified circuitry and lower cost with efficiencies up to 65%.

SPECIFICATIONS

INPUT VOLTAGES — AC
115/230 VAC ±10% 50-420 Hz, either voltage selectable.

OUTPUT VOLTAGES and CURRENTS
Tabulated below for Single, Dual and Triple Outputs.

REGULATION
Two types available —
"A" ±0.1% line and load (NL-FL) with ±0.1% ripple p-p.
"B" ±0.005% line and load (NL-FL) with ±0.01% ripple p-p.

TEMPERATURE
−20°C to +50°C ambient or +80°C case. Higher ambients require forced air cooling or reduced output current.

PROTECTIONS
1. **Overload** and shorted output will not damage unit. Self restarting.
2. **Overvoltage** of crowbar type on all outputs. Remove power to reset.
3. **Overtemperature** turn-off, self restarting.

Output Voltage	Current		Regulation On All Outputs	CEA Part Number	Price $
	80°C Case	50°C Ambient			
5	40	15	±0.1% ±0.005%	C1SA5 C1SB5	523 539
12	16	8	±0.1% ±0.005%	C1SA12 C1SB12	523 539
15	13	7.5	±0.1% ±0.005%	C1SA15 C1SB15	523 539
18	12	7	±0.1% ±0.005%	C1SA18 C1SB18	523 539
24	10	6	±0.1% ±0.005%	C1SA24 C1SB24	523 539
48	5	3	±0.1% ±0.005%	C1SA48 C1SB48	523 539

DUAL OUTPUT MODELS

±12	±8	±4	±0.1% ±0.005%	C1DA12 C1DB12	549 574
±15	±7	±3.5	±0.1% ±0.005%	C1DA15 C1DB15	549 574
±18	±6	±3	±0.1% ±0.005%	C1DA18 C1DB18	549 574

TRIPLE OUTPUT MODELS

±12, 5	±4, 20	±2, 7.5	±0.1% ±0.005%	C1TA125 C1TB125	574 599
±15, 5	±3.5, 20	±1.7, 7.5	±0.1% ±0.005%	C1TA155 C1TB155	574 599
±18, 5	±3, 20	±1.5, 7.5	±0.1% ±0.005%	C1TA185 C1TB185	574 599

ISOLATION
500 VDC input, output and case.

REMOTE SENSING
On all outputs.

ADJUSTABLE
Outputs are adjustable ±5% to include external line drop.

SIZE
4"W x 5"H x 16"D.
See complete mechanical data chart for details.

QUANTITY PRICE DISCOUNTS
1-4 — Net
5-9 — Less 5%
10-24 — Less 10%
25-99 — Less 15%
100 and up — Call the factory

AC-DC Modular Power Supplies
CONVECTION COOLED
SWITCHING REGULATOR

CEA, a division of Berkleonics, Inc.
1 Aerovista Park, San Luis Obispo, Calif. 93401
Toll-Free: Phone 800-235-4150 • In Calif. 800-592-5910

C2 SERIES / SINGLE, DUAL and TRIPLE OUTPUTS

Convection Cooled Design for natural convection or forced air cooling in rack or cabinet installations. Switching Regulators offer higher efficiency, 80% on some models, and wide input variations, AC, with more power in a smaller size.

SPECIFICATIONS

INPUT VOLTAGES — DC
Choose one of the following:
1. 10.5-15.0 VDC add "L" to P/N
2. 21.0-32.0 VDC standard
3. 42.0-60.0 VDC add "L1" to P/N
4. 105-150 VDC add "L2" to P/N

OUTPUT VOLTAGES and CURRENTS
Tabulated below for Single, Dual and Triple Outputs.

REGULATION
Two types available —
"A" ±1.0% line and load (NL-FL) with ±1.0% ripple RMS.
"B" ±0.2% line and load (NL-FL) with ±0.2% ripple RMS.

TEMPERATURE
−20°C to +50°C ambient or +80°C case. Higher ambients require forced air cooling or reduced output current.

PROTECTIONS
1. **Overload** and shorted output will not damage unit.
2. **Overvoltage** of crowbar type on all outputs. Remove power to reset.
3. **Overtemperature** — Turn-off, self restarting.

Output Voltage	Current 80°C Case	Current 50°C Ambient	Regulation On All Outputs	CEA Part Number	Price $
5	70	20	±1.0%	C2SA5	560
			±0.2%	C2SB5	590
12	30	15	±1.0%	C2SA12	560
			±0.2%	C2SB12	590
15	24	12	±1.0%	C2SA15	560
			±0.2%	C2SB15	590
18	20	10	±1.0%	C2SA18	560
			±0.2%	C2SB18	590
24	14	8	±1.0%	C2SA24	560
			±0.2%	C2SB24	590
48	10	6	±1.0%	C2SA48	560
			±0.2%	C2SB48	590

DUAL OUTPUT MODELS

±12	±15	±7.5	±1.0%	C2DA12	585
			±0.2%	C2DB12	610
±15	±12	±6	±1.0%	C2DA15	585
			±0.2%	C2DB15	610
±18	±10	±5	±1.0%	C2DA18	585
			±0.2%	C2DB15	610

TRIPLE OUTPUT MODELS

±12, 5	±5, 30	±2.5, 10	±1.0%	C2TA125	610
			±0.2%	C2TB125	635
±15, 5	±4, 30	±2, 10	±1.0%	C2TA155	610
			±0.2%	C2TB155	635
±18, 5	±3, 30	±1.5, 10	±1.0%	C2TA185	610
			±0.2%	C2TB185	635

ISOLATION
500 VDC input, output and case from each other.

REMOTE SENSING
On all outputs.

ADJUSTABLE
Outputs are adjustable ±5% to include external line drop.

SIZE
4"W x 5"H x 16"D.
See complete mechanical data chart for details.

QUANTITY PRICE DISCOUNTS
1-4 — Net
5-9 — Less 5%
10-24 — Less 10%
25-99 — Less 15%
100 and up — Call the factory

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DC-DC Modular Power Supplies
CONVECTION COOLED SWITCHING REGULATOR

C3 SERIES / SINGLE, DUAL and TRIPLE OUTPUTS

Convection Cooled Design for natural convection or forced air cooling in rack or cabinet installations. Switching Regulators offer higher efficiency, 80% on some models, and wide input variations, DC, with more power in a smaller size.

SPECIFICATIONS

INPUT VOLTAGES — AC/DC
95-135 VAC 50-420 Hz located at rear of power supply.

OUTPUT VOLTAGES and CURRENTS
Tabulated below for Single, Dual and Triple Outputs.

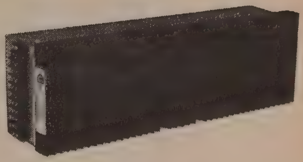
REGULATION
Two types available —

"A" ±1.0% line and load (NL-FL) with ±1.0% ripple RMS.

"B" ±0.2% line and load with ±0.2% ripple RMS.

TEMPERATURE
−20°C to +50°C ambient or +80°C case. Higher ambients require forced air cooling or reduced output current.

PROTECTIONS
1. **Overload** and shorted output will not damage unit. Self restarting.
2. **Overvoltage** of crowbar type on all outputs. Remove power to reset.
3. **Overtemperature** — Turn-off, self restarting.



Output Voltage	Current		Regulation On All Outputs	CEA Part Number	Price $
	80°C Case	50°C Ambient			
5	70	20	±1.0%	C3SA5	560
			±0.2%	C3SB5	590
12	30	15	±1.0%	C3SA12	560
			±0.2″	C3SB12	590
15	24	12	±1.0%	C3SA15	560
			±0.2%	C3B15	560
18	20	10	±1.0%	C3SA18	560
			±0.2%	C3SB18	590
24	14	8	±1.0%	C3SA24	560
			±0.2%	C3SB24	590
48	10	6	±1.0%	C3SA48	560
			±0.2%	C3SB48	590
DUAL OUTPUT MODELS					
±12	±15	±7.5	±1.0%	C3DA12	585
			±0.2%	C3DB12	610
±15	±12	±6	±1.0%	C3DA15	585
			±0.2%	C3DB15	610
±18	±10	±5	±1.0%	C3DA18	589
			±0.2%	C3DB18	610
TRIPLE OUTPUT MODELS					
±12, 5	±5, 30	±2.5, 10	±1.0%	C3TA125	610
			±0.2%	C3TB125	635
±15, 5	±4, 30	±2, 10	±1.0%	C3TA155	610
			±0.2%	C3TB155	635
±18, 5	±3, 30	±1.5, 10	±1.0%	C3TA185	610
			±0.2%	C3TB185	635

ISOLATION
500 VDC input, output and case from each other.

REMOTE SENSING
On all outputs.

ADJUSTABLE
Outputs are adjustable ±5% to include external line drop.

SIZE
4″W x 5″H x 16″D.
See complete mechanical data chart for details.

QUANTITY PRICE DISCOUNTS
1-4 — Net
5-9 — Less 5%
10-24 — Less 10%
25-99 — Less 15%
100 and up — Call the factory

VERSATILE PACKAGING

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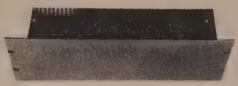
C1, C2 and C3 SERIES

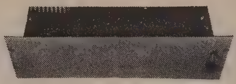
CHOOSE THE MOUNTING APPLICATION MOST SUITABLE FOR YOUR NEEDS

RACK PANEL MOUNTS



PANEL MOUNT #1
$25.00

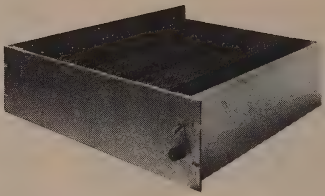
- PAINTED ⅛″ ALUMINUM PANEL 5¼″ HIGH
- ON THE C1, C2 OR C3 OF YOUR CHOICE



PANEL MOUNT #2
$40.00

- SIMILAR TO PANEL #1 WITH INPUT FUSE and ON-OFF SWITCH
- ON THE C1, C2 OR C3 OF YOUR CHOICE

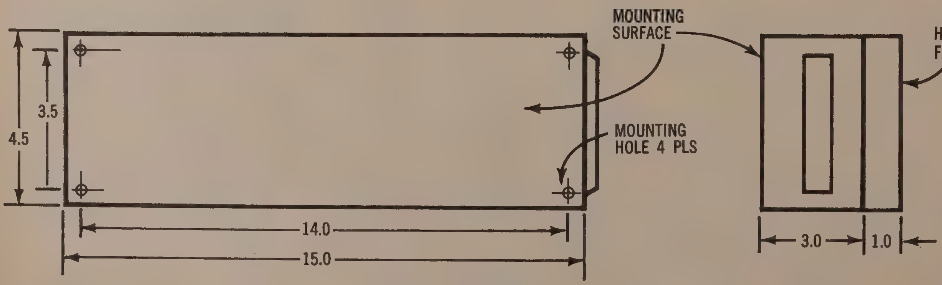
BUILD A RACK SYSTEM



RACK ASSEMBLY
$75.00

- OPTIONAL RACK SYSTEMS FOR ANY FOUR POWER SUPPLIES FROM THE C1, C2 OR C3 SERIES
- METERS, SWITCHES, INDICATORS AVAILABLE UPON REQUEST

MECHANICAL DATA



- 8-32 x ⅜″ Mounting Inserts
- Typical Connections: Terminal Strip Standard, Other Connectors Available Upon Request

- CALL THE FACTORY TOLL-FREE
  Discuss Your Particular Applications
  800-235-4150 — U.S.
  800-592-5910 — Calif.

CALEX

CALEX MFG. CO., INC.
3305 Vincent Road
Pleasant Hill, CA 94523
Telephone (415) 932-3911

dc power supplies

Calex manufactures modular DC power supplies and mounting kits specifically designed for use in instrumentation and control circuits. You'll find voltages of 5V to ±15V and currents of up to 1 Amp. One unit, the Model 23-100, can be externally programmed to any voltage between +4V to +16V. For data conversion circuits, the triple supply is recommended . . . it has outputs of ±15V at ±100mA *and* +5V at 500mA.

All units feature output short-circuit protection and conservative ratings. The transformers are all vacuum impregnated to ensure reliable operation over many years. Voltage accuracy, regulation, and stability are excellent. And at Calex, quantities of 1-9 are *always* in shelf stock . . . you'll never have to wait!

CALEX
CALEX
MODEL 3.15.5
TRIPLE
POWER SUPPLY
P.O. BOX 555 ALAMO CALIF 94507
(415) 932-3911

mounting kits

Calex provides two types of mounting kits . . .

- Connector and PC card combination for vertical plug-in installation or use in racks. Just plug in the supply.
- Barrier strip and PC card combination for mounting on a chassis or other surface. Connections to the supply are made by screwdriver to a barrier strip.

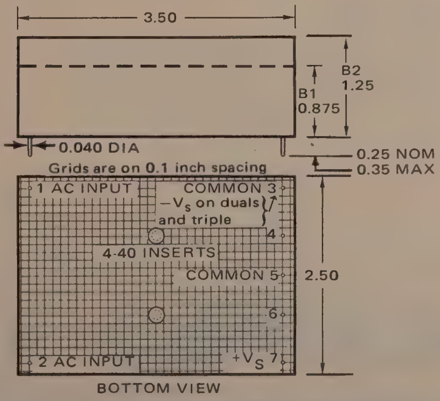
modular power supplies selection guide...

Model	Output	Case	Size	Price, 1-9
SINGLES				
1.5.500	+5V @ 500mA	B1	2.5" x 3.5" x 0.875"	$49
21-500	+5V @ 500mA and +8V Unreg.	A	2" x 3" x 1"	$52
1.5.1000	+5V @ 1000mA	B2	2.5" x 3.5" x 1.25"	$59
23-100	Adj., +4V to +16V @ 100mA	A	2" x 3" x 1"	$68
21-200	+15V @ 200mA and +24V Unreg.	A	2" x 3" x 1"	$58
1.15.400	+15V @ 400mA	B2	2.5" x 3.5" x 1.25"	$68
DUALS				
2.12.100	±12V @ ±100mA	B1	2.5" x 3.5" x 0.875"	$49
2.15.50	±15V @ ±50mA	B1	2.5" x 3.5" x 0.875"	$42
2.15.100	±15V @ ±100mA	B1	2.5" x 3.5" x 0.875"	$49
22-100	±15V @ ±100mA	A	2" x 3" x 1"	$54
2.15.200	±15V @ ±200mA	B2	2.5" x 3.5" x 1.25"	$68
TRIPLE				
3.15.5	±15V @ ±100mA and +5V @ 500mA	B2	2.5" x 3.5" x 1.25"	$79

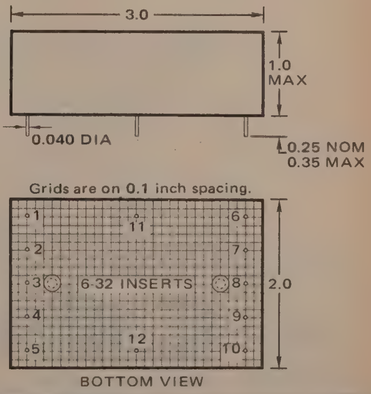
selection guide...

Power Supply	Mounting Kits Connector Type	Barrier Strip Type
SINGLE		
1.5.500	MK215-022	MK215-08B
21-500	MK015	MK08B
1.5.1000	MK215-022	MK215-08B
23-100	MK23-015	MK23-08B
21-200	MK015	MK08B
1.15.400	MK215-022	MK215-08B
DUAL		
2.12.100	MK215-022	MK215-08B
2.15.50	MK215-022	MK215-08B
2.15.100	MK215-022	MK215-08B
22-100	MK015	MK08B
2.15.200	MK215-022	MK215-08B
TRIPLE		
3.15.5	MK215-022	MK215-08B

CASES B1 AND B2
All dimensions shown in inches


3.50
B2
1.25
B1
0.875
0.040 DIA
0.25 NOM
0.35 MAX
Grids are on 0.1 inch spacing
1 AC INPUT
COMMON 3
−Vs on duals and triple
4
4-40 INSERTS
COMMON 5
2.50
6
2 AC INPUT
+Vs 7
BOTTOM VIEW

CASE A — Models 21-500, 23-100, 21-200 and 22-100
All dimensions shown in inches


3.0
1.0 MAX
0.040 DIA
0.25 NOM
0.35 MAX
Grids are on 0.1 inch spacing.
1
11
6
2
7
3
6-32 INSERTS
8
2.0
4
9
12
5
10
BOTTOM VIEW

CML MACARR, INC.

NEW!

SYNAMP® solid state AC power sources synthesized sine wave

single phase 50-60-400 Hz

ST series 250VA to 6000VA

OUTPUT VOLTAGE: Adjustable 105-130V

- High Efficiency 75% Typical
- Rack Mount Construction
- Versatility — may be used as a Frequency Converter or Precision AC Power Source
- Output Voltage Range: 105-130VAC
- Output Frequency Range: 45-460 Hz at Full Rated Output
- Modular Power Transistor Assemblies

MODEL ST2000

MODEL	OUTPUT POWER VA	INPUT	DIMENSIONS H x W x D	SHIPPING WEIGHT
ST250	250	115/230 1ϕ 47-63 Hz	5 x 19 x 20	35 lbs.
ST500	500	115/230 1ϕ 47-63 Hz	7 x 19 x 20.5	40 lbs.
ST1000	1000	115/230 1ϕ 47-63 Hz	7 x 19 x 21.5	50 lbs.
ST2000	2000	208/230 3ϕ 47-63 Hz	7 x 19 x 21.5	70 lbs.
ST4000	4000	208/230 3ϕ 47-63 Hz	21 x 19 x 21.5	150 lbs.

Specifications

OUTPUT CONFIGURATION: Single phase, two wire, isolated

INPUT CONFIGURATION: Single phase, 2 wire for Models ST250, ST500 and ST1000; Three phase, 3 wire for Models ST2000 and ST4000

OUTPUT VOLTAGE: 105-130V, internally adjustable optional panel mounted potentiometer control available

LOAD POWER FACTOR: .7 lead or lag at rated output

VOLTAGE REGULATION: Line ±1%; Load ±1%

FREQUENCY STABILITY: .25% standard, optional to .001%

EFFICIENCY: 75% typical

HARMONIC DISTORTION: Max 3% at full load. Lower available on special order

AMBIENT TEMPERATURE: −20° to +55°C

TEMPERATURE STABILITY: Voltage 0.01%/degree C typical — Frequency 0.05%/degree C typical

CONTROLS AND METERS: All models include front panel voltmeter and ammeter. Variable frequency models have front panel frequency control

PROTECTION: Input line circuit breaker. Output breaker optional at extra cost

Ordering Information

To specify give model number and option code number as shown below. For example: 500VA single phase 45-66 Hz, Model ST500-01.

Frequency	Code	Mode
45-66 Hz	-01	variable
320-460 Hz	-02	variable
45-66 Hz and 320-460 Hz	-03	2 range variable
50 Hz	-50	fixed
60 Hz	-60	fixed
400 Hz	-41	fixed

Write or Call for Complete Specifications

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CML MACARR, INC.

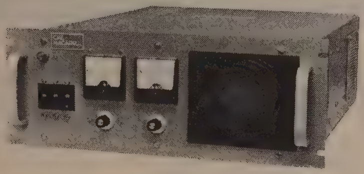
NEW! SYNAMP® solid state AC power sources synthesized sine wave

three phase 50-60-400 Hz

TT series 750VA to 12000VA

OUTPUT VOLTAGE: Adjustable 105-130V

- High Efficiency 75% Typical
- Rack Mount Construction
- Versatility — may be used as a Frequency Converter or Precision AC Power Source
- Output Voltage Range: 105-130V, 185-225V
- Output Frequency Range: 45-460 Hz at Full Rated Output
- Plug-in Power Transistor Assemblies



MODEL TT1500

MODEL	OUTPUT POWER VA	INPUT	DIMENSIONS H x W x D	SHIPPING WEIGHT
TT750	750	115/230 1ϕ 47-63 Hz	8¾ x 19 x 20	60 lbs.
TT1500	1500	208/230 3ϕ 47-63 Hz	8¾ x 10 x 20	70 lbs.
TT3000	3000	208/230 3ϕ 47-63 Hz	14 x 19 x 20	150 lbs.
TT6000	6000	208/230 3ϕ 47-63 Hz	17 x 19 x 20	225 lbs.
TT12000	12000	208/230 3ϕ 47-63 Hz	32 x 19 x 20	340 lbs.

Single Phase and Two Phase Output

Standard 3 phase power supplies may be used to provide a 2 phase output at ⅔ of rated power. An internal selector switch internally provided either 90 degrees or 120 degrees phase separation for 2 or 3 phases respectively.

Standard 3 phase power supplies may be used to provide a 1 phase output of 57% of rated power over an adjustable range of 105-130 volts.

Specifications

OUTPUT CONFIGURATION: Three phase, four wire, WYE-neutral floating, or Delta

INPUT CONFIGURATION: Single phase, 2 wire for Model TT750. Three phase, 3 wire for Models TT1500 and up

OUTPUT VOLTAGE: 105-130 Volts line to line and 185-225 Volts line to line; both sets of terminals are presented at output. Full power available at output of 105-130 Volts and 185-225 Volts. Internally adjustable. Panel mounted control available.

PHASE DISPLACEMENT: 3°

LOAD POWER FACTOR: .7 lead or lag at rated output

EFFICIENCY: 75% typical

VOLTAGE REGULATION: Line ±1%; Load ±1%

FREQUENCY STABILITY: .25% standard, optional to .001%

HARMONIC DISTORTION: Max 3% at full load. Lower available on special order

AMBIENT TEMPERATURE: −20° to +55°C

TEMPERATURE STABILITY: Voltage 0.01%/degree C typical — Frequency 0.05%/degree C typical

CONTROLS AND METERS: All models include front panel voltmeter and ammeter. Variable frequency models have front panel frequency control

PROTECTION: Input line circuit breaker. Output breaker optional at extra cost

Ordering Information

To specify, give model number and option code number as shown below. For example, 1500VA three phase 45-66 Hz, Model TT1500-01.

Frequency	Code	Mode
45-66 Hz	-01	variable
320-460 Hz	-02	variable
45-66 Hz and 320-460 Hz	-03	2 range variable
50 Hz	-50	fixed
60 Hz	-60	fixed
400 Hz	-41	fixed

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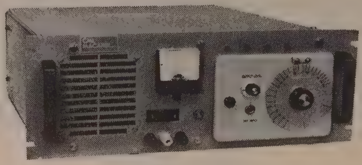
CML MACARR, INC.

N E W!

SOLID STATE
WIDE BAND AC POWER SUPPLIES—45-10KHz
Single Phase and Three Phase

NAS series 200VA to 1KVA
Single Phase



MODEL NAS-750

- Plug-In Oscillators
- Low Harmonic Distortion
- Outputs 0-130V Line to Line and 0-260V Line to Line
- Minimum Package Sizes 200VA in 5¼" high standard rack space
- Response time 50 microseconds
- Frequency stability .25% to .001%

MODEL	OUTPUT POWER VA	INPUT POWER	DIMENSIONS H x W x D	SHIPPING WEIGHT
NAS-200	200	115/230 1ϕ 47-63 Hz	5¼ x 19 x 16	60 lbs.
NAS-300	300	115/230 1ϕ 47-63 Hz	5¼ x 19 x 16	100 lbs.
NAS-500	500	115/230 1ϕ 47-63 Hz	7 x 19 x 17	110 lbs.
NAS-750	750	115/230 1ϕ 47-63 Hz	7 x 19 x 19	200 lbs.
NAS-1000	1000	208/230 3ϕ 47-63 Hz	12¼ x 19 x 19	220 lbs.

TAS series 500VA to 1KVA
Three Phase

MODEL	OUTPUT POWER VA	INPUT POWER	DIMENSIONS H x W x D	SHIPPING WEIGHT
TAS-500	500	115/230 3ϕ 47-63 Hz	7 x 19 x 19	150 lbs.
TAS-2000	2000	115/230 3ϕ 47-63 Hz	14 x 19 x 19	375 lbs.
TAS-3000	3000	115/230 3ϕ 47-63 Hz	20 x 19 x 15	450 lbs.

Specifications

OUTPUT CONFIGURATION: Single phase, two wire isolated; three phase, four wire.

OUTPUT VOLTAGE: 0-130V/0-260V line to line in single phase units
0-130V line to line and 0-225V line to line, WYE or DELTA loads in three phase units.

LOAD POWER FACTOR: .7 lead or lag

HARMONIC DISTORTION: Less than 1.0%, 45-6KHz @ full load. Less than 2.0%, 6KHz to 10KHz @ full load

REGULATION: ±.25% with ±10% input line variation ±1.0% NF-FL

NOISE LEVEL: 70 db below rated output

OPERATING TEMPERATURE: −20 degrees C to 70 degrees C

COOLING: Forced Air

PLUG IN OSCILLATORS

Frequency	1ϕ	3ϕ	Frequency Stability .25	.1	.01	.001
400	SSG14	SSG34	A	B	—	—
400	STG14	STG34	—	—	E	G
50	SSG11	SSG31	A	B	—	—
50	STG11	STG31	—	—	E	G
60	SSG12	SSG32	A	B	—	—
60	STG12	STG32	—	—	E	G
45-70	SSG13	SSG33	A	B	—	—
350-450	SSG15	SSG35	A	B	—	—
300-2KHZ	SSG16	SSG36	A	B	—	—
45-10KHZ	SSG17	SSG37	A	B	—	—

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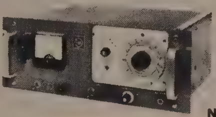
CML MACARR, INC.

single phase AC power supplies

NS series 70VA to 350VA

OUTPUT VOLTAGE: Adjustable 0-125 Volts; full power available at output of 110-125 Volts.



MODEL NS175-7A-V

MODEL	OUTPUT POWER VOLT-AMPERES	DIMENSIONS* H x W x D	WEIGHT (APPROX.) LBS.
NS70	70	7″ x 19″ x 14″	53
NS120	120	7″ x 19″ x 14″	57
NS175	175	7″ x 19″ x 14″	60
NS350	350	8¾″ x 19″ x 20¾″	115

* Dimensions apply to standard rack mount models. Add ¾″ to height if bench adapters are included.

NS Series Oscillators**

	OUTPUT FREQUENCY	FREQUENCY STABILITY ±0.25%	±0.1%	±0.01%	±0.001%
		SUFFIX #			
Fixed	400 Hz	—4A	—4B	—4E	—4G
	800 Hz	—8A	—8B	—8E	—8G
	50 Hz	—1A	—1B	—1E	Special Order
	60 Hz	—2A	—2B	—2E	
	Selectable 50/60/400/800 Hz	—9A	—9B	X	X
Adjustable	350-450 Hz	—5A	—5B	X	X
	45-70 Hz	—3A	—3B	X	X
	300-2,000 Hz	—6A	—6B	X	X
	45-6,000 Hz	—7A	X	X	X

****AUDIO AMPLIFIER ONLY:** Each model is also available as an audio power amplifier only (without a built-in oscillator) with a full power range of 45-6,000 Hz. All standard models include an input signal jack for use with external signal source. Specify the Basic Power Supply Models and suffix # (—JA) if oscillator is not required.

NA series 500VA to 15KVA

OUTPUT VOLTAGE: Adjustable 0-125 Volts; full power available at output of 110-125 Volts.

MODEL	OUTPUT POWER—VA	INPUT	DIMENSIONS* H x W x D	WT. (APPROX.) LBS.
N500A	500	115V, 1ϕ 47-65 Hz	8¾″ x 19″ x 21″	175
N750B	750	115V, 1ϕ 47-65 Hz	8¾″ x 19″ x 21″	180
N750A	750	208/230V, 3ϕ 47-65 Hz	14″ x 19″ x 20½″	260
N1000A	1,000	208/230V, 3ϕ 57-65 Hz	14″ x 19″ x 20½″	270
N1500A	1,500	208/230V, 3ϕ 57-65 Hz	22¾″ x 19″ x 17″	315
N2000A	2,000	208/230V, 3ϕ 57-65 Hz	22¾″ x 19″ x 17″	325
N5000A	5,000	208/230V, 3ϕ 57-65 Hz	51″ x 24″ x 24″	850
N15000A	15,000	208/230V, 3ϕ 57-65 Hz	47″ x 68″ x 24″	1600

* 500VA to 2000VA units are standard rack mount models. Add ¾″ to height if bench adapters are included. 5000VA and 15000VA units are cabinet models. Model N5000A includes casters.

MODEL N2000A

With SG-17A Plug-in Oscillator

NA Series Oscillators***

	OUTPUT FREQUENCY	FREQUENCY STABILITY ±0.25%	±0.1%	±0.01%	±0.001%
		MODEL #			
Fixed	400 Hz	SG-14A	SG-14B	SG-14E	SG-14G
	800 Hz	SG-18A	SG-18B	SG-18E	SG-18G
	60 Hz	SG-12A	SG-12B	SG-12E	Special Order
	50 Hz	SG-11A	SG-11B	SG-11E	
	Selectable 50/60/400/800 Hz	SG-19A	SG-19B	X	X
Adjustable	350-450 Hz	SG-15A	SG-15B	X	X
	45-70 Hz	SG-13A	SG-13B	X	X
	300-2,000 Hz	SG-16A	SG-16B	X	X
	45-6,000 Hz	SG-17A	X	X	X
	45-6,000 Hz	EXTERNAL SIGNAL ADAPTER Model SA-2			

***All Plug-in Oscillators are provided with a jack for external signal drive.

- Fixed or Adjustable Output Frequencies between 45 & 6000 Hz
- Each model can be operated either as a precision AC Power Supply or as Regulated Audio Power Amplifier
- Minimum package sizes . . . 2000 VA in 22¾″ rack height, 750 VA in 8¾″ rack height
- Instantaneous Overload Protection
- Interchangeable Plug-in Oscillators Frequency Stabilities to 0.001%
- Constant Voltage Output, 0.5% regulation—response time less than 50 microseconds
- Low Distortion Sinewave Output, less than 1% 300 to 1000 Hz, less than 3% 45 to 6000 Hz
- Full Rated Output into Load Power Factors of 0.7 Lead or Lag to Unity

programmable plug-in oscillators 14 & 34

FOR USE WITH NA AND TA SERIES

- Programmable voltage and/or frequency
- Output frequency range 350 to 440 Hz in 1 Hz steps
- Analog programmable by external voltage or resistance range
  Voltage: 0 to 10 Volts DC
  Resistance: 0 to 2.0 Megohms
- Digitally programmable by externally supplied BCD signals compatible with TTL, DTL and Relay Logic
- Can be used with all standard Mini-computers
- Total Harmonic Distortion less than 0.25%
- Frequency stability: 0.1%
- Single phase for use with NA and NS series. Voltage output 100 to 130V in one volt steps — other voltages available on request
- Three phase for use with TA series. Voltage output 100 to 130 line to line or line to neutral in one volt steps

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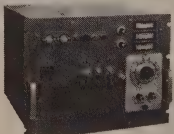
CML MACARR, INC.

three phase AC power supplies

- **Minimum Package Sizes** . . . 2500 VA in 14" rack height.
- **Interchangeable Plug-in Oscillators** . . . 23 standard oscillators are available—to provide fixed or adjustable output frequencies between 45 and 6,000 Hz and stabilities to ±0.001%.
- **Instantaneous Overload Protection** . . . An overload of any one phase causes complete output shutdown, protecting 3 phase load.
- **Dual Output Voltage for △ or Y Loads** . . . Adjustable voltages 0-125 volts line-to-line as well as 0-217 volts line-to-line are presented at output terminals; output is isolated for maximum versatility.
- **Constant Voltage Output** . . . 0.5% regulation for no load to full load change.
- **Response time less than 50 microseconds.**
- **Output Voltage** unaffected by unbalanced loads.

TA series 300VA to 20KVA



Model T2500A with SG-36B oscillator

Three Phase Amplifiers

MODEL	3φ OUTPUT POWER—VA	INPUT	DIMENSIONS H	x W	x D	WT. APPROX. LBS.
T300B	300	115V, 1φ, 47-65 Hz	12¼	19	20	180
T500	500	115V, 1φ, 47-65 Hz	12¼	19	20	190
T750	750	208/230V, 3φ, 47-65 Hz	14	19	20½	275
T1200	1,200	208/230V, 3φ, 57-65 Hz	14	19	20½	285
T1750	1,750	208/230V, 3φ, 47-65 Hz	14	19	20½	365
T2500A	2,500	208/230V, 3φ, 47-65 Hz	14	19	20½	365
T5000	5,000	208/230V, 3φ, 47-65 Hz	45	24	24	950
T10000	10,000	208/230V, 3φ, 57-65 Hz	78	35	36	1650
T15000	15,000	208/230V, 3φ, 57-65 Hz	78	35	36	1700
T20000	20,000	208/230V, 3φ, 57-65 Hz	78	35	36	1900

Single Phase & Two Phase Output

Standard 3 phase amplifiers may be used to provide a 2 phase output at ⅔ of rated output power. Special plug-in oscillators are available with selectable 90° or 120° phase separation for 2 phases or 3 phase operation respectively.

Standard 3 phase amplifiers may be used to provide a single phase output at 57% of rated output power over an adjustable voltage range of 110-125 volts.

Write or Call for Complete Specifications

Specifications

OUTPUT CONFIGURATION: Three Phase, 4 wire wye, neutral floating.

OUTPUT VOLTAGE: 0-125 Volts line-to-line and 0-217 Volts line-to-line; both sets of terminals are presented at output. Full power available at output of 110-125 volts and 190-217 volts. Master gain control and phase 2 and 3 trim controls provided on front panel.

OUTPUT POWER: Rated output power for each model is shown in chart. Maximum power per phase is ⅓ of 3φ output.

LOAD POWER FACTOR: 0.7 lead or lag to unity at rated output; wider power factor range with slight derating.

FREQUENCY RANGE: Each amplifier model is rated at full power 45-6,000 Hz except for the models T15000A and T20000A which have a 300-500 Hz full power range. The operating output frequency range is determined by the particular plug-in oscillator which is used.

HARMONIC DISTORTION: Less than 3% over the entire 45-6,000 Hz amplifier range; less than 1%, 300-1000 Hz.

HUM AND NOISE: 60 db below maximum output voltage.

OUTPUT PHASE SEPARATION: 120 ±1° for fixed frequency models as well as 350-450 Hz models. 120 ±2° for 45-70 and 300-2,000 Hz models. 120 ±3° for 45-6,000 Hz models.

CONSTRUCTION: Models rated 300VA to 2500VA are standard 19" rack mount units with full dust covers. Bench adapters available as accessories for these models; specify suffix (—C). Side support is recommended for rack mount models. Slides are available as optional accessories; specify suffix (—S). 5KVA-20KVA models are furnished complete in cabinet enclosure. 5KVA model includes casters.

Plug-in Oscillators

	3φ OUTPUT FREQUENCY	FREQUENCY STABILITY ±0.25%	±0.1%	±0.01%	±0.001%
		MODEL #			
Fixed	400 Hz	SG-34A	SG-34B	SG-34E	SG-34G
	800 Hz	SG-38A	SG-38B	SG-38E	SG-38G
	60 Hz	SG-32A	SG-32B	SG-32E	Special Order
	50 Hz	SG-31A	SG-31B	SG-31E	Special Order
Adjustable	Selectable 50/60/400/800 Hz	SG-39A	SG-39B	X	X
	350-450 Hz	SG-35A	SG-35B	X	X
	45-70 Hz	SG-33A	SG-33B	X	X
	300-2,000 Hz	SG-36A	SG-36B	X	X
	45-6,000 Hz	SG-37A	X	X	X

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CORPORATION
A Symbol of Quality

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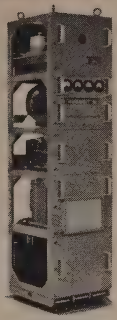
CML MACARR, INC.

wide band power amplifiers for audio and ultrasonic testing

SPG series 1KVA to 100KVA



MODEL S5K
PASSES THROUGH
A STANDARD
SUBMARINE HATCH

MODEL	OUTPUT POWER KVA	LOAD POWER FACTOR RANGE AT RATED KVA	STANDARD OUTPUT IMPEDANCE TAPS OHMS	DIMENSIONS* H x W x D (APPROX.)	WEIGHT (APPROX.) LBS.	TYPE OF COOLING
A1K	1	±0.4 to Unity	4/16/36/64/144/576	22¾″ x 19″ x 20½″	345	FORCED AIR
A2K	2	±0.4 to Unity	4/16/36/64/144/576	22¾″ x 19″ x 17″	400	
S2K	2	±0.4 to Unity	4/16/36/64/144/576	22¾″ x 17″ x 17″	400	
A3K	3	±0.1 to Unity	4/16/36/64/144/576	53″ x 27″ x 26″	750	
S5K	5	±0.4 to Unity	16/64/256	62″ x 17″ x 17″	800	
B5K	5	±0.1 to Unity	8/32/72/128/288/1152	45″ x 24″ x 24″	850	
A10K	10	±0.1 to Unity	16/64/144/256/576/2304	47″ x 68″ x 24″	1,700	
A20K	20	±0.3 to Unity	16/64/144/256/576	47″ x 68″ x 24″	2,100	
VA30K	30	±0.1 to Unity	16/64/144/256/576	72″ x 72″ x 36″	3,000	WATER COOLED
VA50K	50	±0.4 to Unity	16/64/144/256/576	72″ x 72″ x 36″	4,200	
VA100K	100	±0.1 to Unity	16/64/144/256	2 sections, ea. 90″ x 72″ x 57″	9,400	

* Model A1K and A2K are standard 19″ rack mount units; bench adapters available on special order. All other models are furnished complete in cabinet enclosures. Models A3K, S5K and B5K include casters. Models S2K and S5K are designed to go through a 25″ standard submarine hatch.

Specifications

FREQUENCY RESPONSE: ±0.5 db, 100-10,000 Hz; Model A3K ±0.5 db, 200-15,000 Hz. Other frequency ranges between 5 Hz and 100 KHz available on a custom basis.

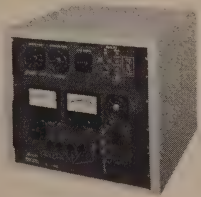
HARMONIC DISTORTION: Less than 3% over rated frequency range; less than 1.5% midband.

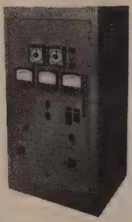
HUM & NOISE: At least 60 db below rated tap voltage.

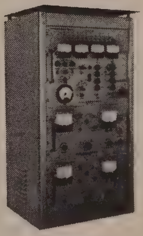
- Full power into reactive loads
- Low distortion
- ±0.5 db frequency response
- Ideal for CW and PULSED duty.
- Selectable output taps for matching wide range of load impedances
- Rugged construction for marine or airborne installations
- Applications: Sonar Testing; Vibration Testing; Industrial Process Control; High Intensity Acoustic Systems

battery service and analysis equipment

BATTERY
- **CHARGER**
- **DISCHARGER**
- **ANALYZER**







Specifications

	MODEL 12-30.1-101	MODEL 505-50	MODEL 403KA3A
Input Power	115/230V, 1ϕ, 60 Hz	230V, 1ϕ, 60 Hz	115V, 1ϕ, 60 Hz
Output Charge	35A @ 35V	50A @ 6V/12V/24V	5A @ 50V per channel
Output Discharge	35A @ 35V	40A @ 28.5V	45A @ 24V
Charge Channels	1	4	2
Discharge Channels	1	1	1
Type of Charge:			
Constant Current	Yes	Yes	Yes
Constant Potential	Yes	Yes	Yes
Modified Constant Potential	Yes	Yes	Yes
Pulse Charge	No	Yes	No
Analyzer	Yes	Yes	No
Size H x W x D (Approx.)	21″ x 27″ x 15¼″	42″ x 22″ x 18″	43″ x 22″ x 18″
Weight (Approx.)	225 lbs.	250 lbs.	235 lbs.

Write or Call for Complete Specifications

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CORPORATION

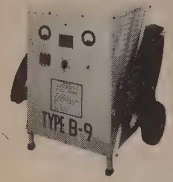
CML MACARR, INC.

167 National Road, Edison, New Jersey 08817 (201) 287-2810 • TWX 710-998-0560 • FMC 00062

CML MACARR, INC.

helicopter starting
high current-low voltage DC supplies

MODELS 28-UP MOBILE POWER SUPPLIES FOR AIRCRAFT STARTING



- Mobile — extremely rugged and reliable.
- Good load regulation, low ripple. Meets RF interference requirements of Mil-I-26600.
- All units feature heavy intermittent load capability.
- Easily maneuvered . . . large units have pneumatic tires.
- Weatherproof construction for outdoor duty.

MODEL:		28-50 UP	28-100 UP	28-200 UP	28-300 UP	28-400 UPA	28-400 UPB	28-600 UP	28-800 UP	28-1000 UP
INPUT:	V	115/230	220/440	220/440	220/440	220/440	220/440	440	440	400
	ϕ	1	3	3	3	3	3	3	3	3
	A	20/10	10/5	20/10	30/15	40/20	40/20	30	40	50
NOMINAL OUTPUT CONTINUOUS	V	28	28	28	28	28	28	28	28	28
	A	50	100	200	300	400	400	600	800	1000
OUTPUT INTERMITTENT:		3 min. 65A 3 sec. 200A	3 min. 125A 3 sec. 400A	3 min. 250A 3 sec. 800A	3 min. 375A 3 sec. 1200A	3 min. 500A 3 sec. 1600A	3 min. 500A 3 sec. 1600A	3 min. 750A 3 sec. 2400A	3 min. 1200A 3 sec. 2900A	3 min. 1500A 3 sec. 3500A

MODELS — 28-US GROUND SUPPORT POWER SUPPLIES FOR AIRCRAFT STARTING

Specifications listed in chart above. To order, change model suffix from UP to US.

solid state DC to AC power inverters

DRS Series 400 Hz

OUTPUT: 115 Volts rms. Single Phase.
INPUT: 22-30 Volts D.C.
VOLTAGE & FREQUENCY REGULATION: 0.5%.

MODEL	OUTPUT VA	DIMENSIONS H x W x D	NET WT. LBS. (APPROX.)
DRS-50	50	5″ x 11″ x 8″	25
DRS-100	100	5″ x 11″ x 8″	26
DRS-500	500	8″ x 14″ x 16″	70
DRS-1000	1000	14″ x 17″ x 18″	160

MNS Series 60 Hz

OUTPUT: 105/115/125 Volt rms. Single Phase.
INPUT: 22-30 Volts D.C.
FREQUENCY REGULATION: 0.5%.

MODEL	OUTPUT VA	DIMENSIONS H x W x D	NET WT. LBS. (APPROX.)
MNS-50	50	5″ x 11″ x 11″	28
MNS-100	100	5″ x 11″ x 11″	28
MNS-500	500	8″ x 14″ x 14″	80
MNS-1000	1000	14″ x 17″ x 19″	162

- 50 to 2000 VA — Single Phase Output
- 0.5% Frequency Regulation
- 1% Voltage Regulation
- Harmonic Distortion less than 1% at 400 Hz, less than 3% at 60 Hz
- High Efficiency Switched Mode Operation

MRS Series 60 Hz

OUTPUT: 115 Volts rms. Single Phase.
INPUT: 22-30 Volts D.C.
VOLTAGE & FREQUENCY REGULATION: 0.5%.

MODEL	OUTPUT VA	DIMENSIONS H x W x D	NET WT. LBS. (APPROX.)
MRS-1000	1000	14″ x 17″ x 19″	175
MRS-2000	2000	14″ x 17″ x 22″	300

solid state frequency converters

105-125 V RMS, 400 Hz Single Phase Output

MODEL	OUTPUT VA	45-65 Hz INPUT SINGLE ϕ VOLTS	DIMENSIONS H x W x D	WEIGHT (APPROX). LBS.
CRS-50A	50	105-125	3½″ x 19″ x 14″	24
CRS-100A	100	105-125	3½″ x 19″ x 14″	26
CRS-150A	150	105-125	5¼″ x 19″ x 10″	30
CRS-500A	500	105-125	10½″ x 19″ x 16″	88
CRS-1000A	1000	105-125	15¾″ x 19″ x 16″	135
CRS-2000A	2000	200-240V 3ϕ	26¼″ x 19″ x 20″	260

- 50 to 2000 VA — Single Phase Output
- 0.5% Frequency Regulation
- 0.5% Voltage Regulation (DRS & MRS Series)
- Harmonic Distortion less than 1% at 400 Hz, less than 3% at 60 Hz
- High Efficiency Switched Mode Operation

Write or Call for Complete Specifications

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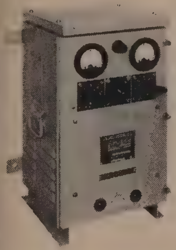
CML MACARR, INC.

battery charging equipment
standard - custom - commercial - military

MODEL 40-30 BCN MULTIPLE PURPOSE BATTERY CHARGER

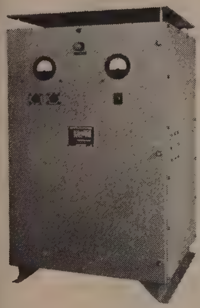
- Charges 6, 8, 12, 24 or 36 volt, 15 to 300 AH batteries, @ 2, 8, 15 or 30 Amp.
- Fully voltage-regulated, current limited. Suitable for lead-acid and nickel-cadmium batteries.
- Meets applicable U.S. Navy and U.S Army Mil Specs.



MODEL 40-30 BCN is an extremely flexible and reliable constant potential battery charger which meets the requirements of Mil-B-24095 (Naval Shipboard). It can charge a wide variety of batteries up to 36 volts nominal (18 cells) and 300 ampere hours. The charger is a fully regulated, current limited stable source for float charging, utilizing SCR's with magnetic gating. A fully discharged battery can be safely recharged with this model. As an example of efficiency, a 130 AH battery can be recharged in 7 hours.

MODEL 30 NICKEL CADMIUM AIRCRAFT BATTERY CHARGER

- Designed specifically for 24 volt Nickel Cadmium Aircraft Batteries.
- Ideally suited for charging helicopter batteries . . . reduces battery maintenance.
- Most efficient charge method — constant current charge with topping mode. Charges battery to absolutely full capacity.
- Compact and lightweight . . . can be carried on the aircraft.
- Three selectable charge modes.
- Ideally suited for charging helicopter batteries.



The Model 30 Battery Chargers cover charge current ratings from 6 to 30 amps for use on nickel cadmium aircraft batteries presently in common use. The chargers are uniquely suited to efficiently charge 24 volt aircraft batteries rated at up to 60 ampere hours. The charger also features a constant current charge mode without topping as well as a float charge mode, to maintain battery at full charge during long periods of storage. The three charge-modes are selectable by means of front panel selector switch.

MODEL 45-140BC FORK LIFT TRUCK BATTERY CHARGER

- Fast recharging. Will recharge 720 AH battery in less than 8 hours — smaller batteries in less time.
- Charges both lead-acid and nickel-iron batteries.
- Fully voltage regulated — current limited.

MODEL 45-140 BC is suitable for recharge of electric fork lift truck batteries of the sizes listed in specification W-C-260b. The unit is extremely rugged and reliable by virtue of its fully magnetic power circuitry (saturable reactors) and the solid state (controlled rectifier) regulating control. Recharge of fork lift truck batteries is extremely tough duty and the application of saturable reactors for control of the charge is ideal to its inherent current limiting characteristic and ability to withstand heavy loads.

The magnetically gated controlled rectifiers provide the regulation performance necessary to insure full recharge within the alloted time.

Write or Call for Complete Specifications

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CPS INC.

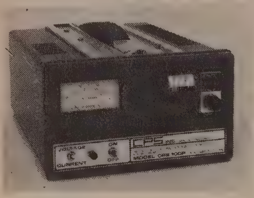
722 East Evelyn Avenue
Sunnyvale, California 94086
(408) 738-0530, Ext. 26: Sales Dept.—Telex 357450

HIGH VOLTAGE SYSTEM AND BENCH SUPPLIES TO 50 KV DC

GENERAL SPECIFICATIONS

OUTPUT—Fixed with ±5% vernier or programmable over any range between 0 and full output by series RPA or alternatively a 0 to 10 V voltage (applicable to series 100 system supplies and series 1000 and 5000).
INPUT—105-125 volts; or 210-230 47-63 Hz (440 Hz most models).

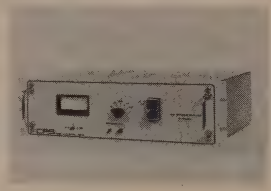
OUTPUT PROTECTION—Completely short-circuit proof. Self restoring after short removal.
TEMPERATURE RANGE—Operating 0°-50°C.



MODEL 100PA 30KV LAB SUPPLY

SPECIFICATIONS

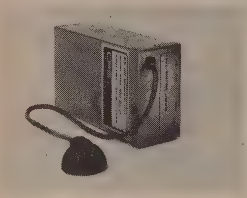
Output: 0 to 30KV @ 1.0 ma (2.0 ma versions available); Line/Load regulation: 0.001%; Ripple: 0.2V peak to peak.



MODEL 101PA UP TO 50 KV LAB SUPPLY

SPECIFICATIONS

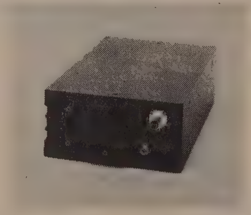
Output: 0-50kV @ 1mA (optional 2mA output available); Line/Load regulation: 0.001%; Ripple: 0.5V peak to peak.



MODEL 4008 POWER SUPPLY FOR GENERAL-PURPOSE CRT APPLICATIONS

SPECIFICATION

Anode: 15 KV @ 0.2ma; load regulation: 0.05%; line regulation: 0.1%. G-1 and G-2 outputs also available.



MODEL 5001 VERSATILE, PRECISION HIGH VOLTAGE POWER SUPPLY

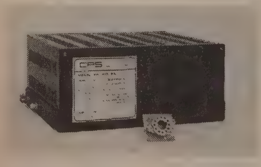
SPECIFICATION

Output: 5 models available: 2, 3, 5, 10, 20KV; with load/line regulation of 0.01%. Excellent dynamic transient response.

MODEL 5003N PHOTOMULTIPLIER TUBE POWER SUPPLY

SPECIFICATION

Output: 0 to −2KV @ 5.0ma; load regulation: 0.01%; ripple: 5mv peak to peak.



MODEL 1410 PRECISION FIBER-OPTIC CRT POWER SUPPLY

SPECIFICATIONS

Cathode: −15KV @ 250μa; load regulation: 0.01%; ripple: 0.01% peak to peak.
Filament: 6.3 vdc @ 0.6a
G-2: 1kv @ 5mA
G-1: −50 to −180 vdc @ 10μa

POWER SUPPLY SELECTION CHART

Feature	Specifications Apply Between (kV)	Current (mA)	Load or Line Regulation (%)	Ripple (Volts p-p)	Model	Price*
PMT SPECIAL	−(0.5-2)	5.0	0.01	.005	5003N	$ 360
CRT SPECIAL 3 OUTPUTS (DC INPUT)	10-15	0.2	.05/0.1	15	4008	198
	0.1-1.0	1.0	1.0/0.1	1		
	−(.05-0.2)	1.0	1.0/0.1	0.2		
0.001% • REGULATION LINE OR LOAD	10-20	0.25	0.001	.2	1200	1095
	20-30	0.125	0.001	.3	1300	1495
	1-30	0.5	0.001	.2	130	1345
	1-30	0.5	0.001	.2	100P	1725
	1-30	1.0	0.001	.2	100A	1825
	±(1-30)	1.0	0.001	.2	100R	2495
	10-50	0.5	0.001	.5	131	1995
	10-50	0.5	0.001	.5	101	2495
0.01% REGULATION LINE OR LOAD	0.5-2	5.0	0.01	0.2	5001	495
	1-3	3.0	0.01	0.3	5001	495
	2-5	2.0	0.01	0.5	5001	495
	5-10	1.0	0.01	1.0	5001	595
	10-20	0.25	0.01	2.0	5001	645
	1-30	0.5	0.01	3.0	132	1045
	10-50	0.5	0.01	5.0	133	1650
SEM & PROBE GUN SUPPLY	1-30	0.5		.2	6001	4150
	10-50	0.5		.5	6002	5400
PRECISION STABILITY	20-30	0.25	0.0002	.200	134	2195
	20-30	0.5	0.0002	.060	136	3900

*Prices subject to change.

CPS INC.

722 East Evelyn Avenue
Sunnyvale, California 94086
(408) 738-0530, Ext. 26: Sales Dept.—Telex 357450

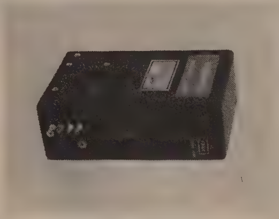
HIGH VOLTAGE SYSTEM AND BENCH SUPPLIES TO 50 KV DC

MODEL 1458 GROUNDED ANODE FIBER OPTIC CRT SUPPLY

SPECIFICATIONS

Cathode:	−18 KV @ 30μa; load regulation: 0.2%; ripple: 0.02% peak to peak.
Filament:	6.3vdc @ 0.15a
G-2:	1.5KV @ 15μa
G-1:	−110 vdc adj. @ 15μa

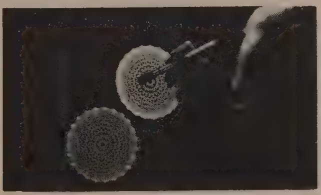
MODEL 1591 ANALYTICAL X-RAY DEVICE POWER SUPPLY



SPECIFICATIONS

Output: 10KV to 30KV adj. @ 300μa; line regulation: 0.005%; load regulation: 0.05% for 50% load variation; ripple: 0.05% peak to peak.

FOUR-COLOR CRT MONITOR CPS-8001



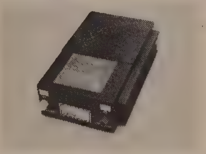
FEATURES

Four colors:	Red, orange, yellow & green
High resolution:	.015" to .025" depending on intensity
High light output:	28 foot lamberts (worst case)
High speed:	1.5μsec per inch, 18μsec color change
High contrast faceplate:	HEA coated
Low power dissipation:	High voltage switches are 90% efficient
High reliability:	All solid state
CRT size:	21" diagonal

HIGH VOLTAGE DIVIDER PROBE HVP-250

Input:	Up to 50 KV DC
Ratio:	1000:1 50 KV IN = 50 V OUT
Input:	250 MΩ
Output:	250 K
Ratio accuracy:	0.01% up to 30 KV, 20-30°C
Temperature coefficient:	10 PPM/°C
Length:	12 inches
Price:	$435

MODEL SP-1592 A COMPLETE ELECTROSTATIC FOCUS CRT SUPPLY SYSTEM



SPECIFICATIONS

Anode:	15kV @ 200 μA; load plus load regulation: 0.05%; ripple: 0.02% peak to peak.
Static Focus:	2.2 to 2.6kV adjustable at 500 μA
Dynamic Focus:	30V to 330V with respect to static focus. Slew rate is 30 volts/μsec.
G-2:	+300V @ 100μA

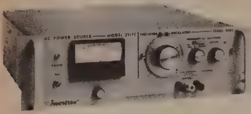
In addition to models shown, CPS offers a wide selection of other commercial and military designs. However demanding your requirements, CPS welcomes the opportunity to offer technical and pricing information for custom or off-the-shelf designs. Sales offices are located in major cities throughout the world.

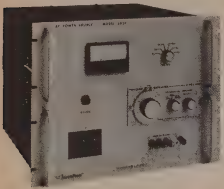
Recognized as the leader, CPS offers only designs which reflect the latest advancements made in circuit and packaging techniques.

Uncompromising insistence on the highest standards of workmanship and service assure you a long, trouble-free, life time of reliable operation.

CPS multicolored beam-penetration CRT Monitors add a new dimension to high resolution CRT graphics, data, and radar Display Monitors. Specification sheets provide detailed data on the Model 8001 four-color, the Model 8006 dual-persistance, and the Model 8007 black/white film-recording monitor units.

CALIFORNIA INSTRUMENTS AC POWER SOURCES



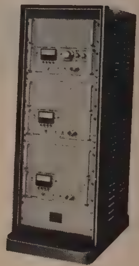


SOLID STATE *Invertron*®

THE MOST RESPECTED NAME IN AC POWER
ALL-SILICON SOLID-STATE POWER SOURCES

FEATURING 14 MODELS WITH 48 POWER LEVELS

- 100 VA TO 6000 VA SINGLE-PHASE OUTPUT
- 100 VA 2ϕ TO 18,000 VA 3ϕ OUTPUT
- FREQUENCY RESPONSES FROM 45Hz TO 20KHz
- SINE-WAVE WITH LOW HARMONIC DISTORTION
- EXCELLENT LINE AND LOAD REGULATION TO .01%
- SWITCHABLE OUTPUT VOLTAGE RANGES FOR FULL POWER AT LOWER VOLTAGES
- BROAD CHOICE OF INTERCHANGEABLE PLUG-IN OSCILLATORS
- OVERLOAD AND SHORT-CIRCUIT PROTECTION
- OPTIONAL INPUT VOLTAGES: 117 V 1ϕ TO 460 V 3ϕ



Invertrons® have earned world-wide respect through their versatility, reliability, and outstanding performance. In addition to low distortion, high input stability and high power density, these silicon solid-state AC power sources use plug-in oscillators as frequency-determining elements and can be stacked electrically to provide one-, two-, or three-phase power. All Invertrons® fit a standard 19" rack, or may be ordered with the appropriate cabinet for floor or bench use.

Output Power	ϕ*	Standard Output Voltage Ranges**	Frequency Range	Model Number
100VA	1	0-135 L to N	45Hz-10KHz	101T
150VA	3	0-17.5, 30, 75, 130 L-N	45Hz-20KHz	153T
160VA	1	0-120 L to N	45Hz- 5KHz	161T
200VA	3Δ	0-35 L to N	45Hz-10KHz	200T/2-3D
250VA	1	0-30, 75, 135 L to N	45Hz-20KHz	251T
250VA	1	0-67.5, 135 L to N	45Hz- 5KHz	251TC
300VA	3	0-135 L to N	45Hz-10KHz	300T/3-3
320VA	3Δ	0-120 L to N	45Hz- 5KHz	320T/2-3D
350VA	1	0-120, 240 L to N	45Hz- 5KHz	351TC
480VA	3	0-120 L toN	45Hz- 5KHz	480TC/3-3
500VA	1	0-135, 270 L to N	45Hz- 5KHz	501TC
500VA	3Δ	0-30, 75, 135 L to N	45Hz-20KHz	500T/2-3D
500VA	3Δ	0-135, 270 L to N	45Hz- 5KHz	500TC/2-3D
500VA	3	0-30, 45, 75, 135 L-N	45Hz-10KHz	503T
700VA	3Δ	0-120, 240 L to N	45Hz- 5KHz	700TC/2-3D
750VA	1	0-30, 75, 135, 270 L-N	45Hz-10KHz	751T
750VA	3	0-30, 75, 135 L to N	45Hz-20KHz	750T/3-3
750VA	3	0-67.5, 135 L to N	45Hz- 5KHz	750TC/3-3
900VA	1	0-30, 60, 120, 240 L-N	45Hz- 5KHz	901T
1000VA	1	0-30, 75, 135, 270 L-N	45Hz-10KHz	1001T
1000VA	3Δ	0-135, 270 L to N	45Hz- 5KHz	1000TC/2-3D
1050VA	3	0-120, 240 L to N	45Hz- 5KHz	1050TC/3-3
1200VA	1	0-30, 60, 120, 240 L-N	45Hz- 5KHz	1201T
1500VA	1	0-30, 60, 120, 240 L-N	45Hz- 5KHz	1501T

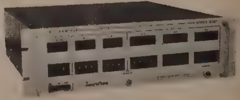
*Models designated "D" are open delta configuration; all others 4-wire wye.
**Other output ranges available on special order.

Output Power	ϕ*	Standard Output Voltage Ranges**	Frequency Range	Model Number
1500VA	3Δ	0-30, 75, 135, 270 L-N	45Hz-10KHz	1500T/2-3D
1500VA	3	0-135, 270 L to N	45Hz- 5KHz	1500TC/3-3
1500VA	3	0-75, 135 L to N	45Hz- 5KHz	1503T
1800VA	1	0-60, 120, 240 L to N	45Hz- 5KHz	1800T/2-1
1800VA	3Δ	0-30, 60, 120, 240 L-N	45Hz- 5KHz	1800T/2-3D
2000VA	3Δ	0-30, 75, 135, 270 L-N	45Hz-10KHz	2000T/2-3D
2250VA	3	0-30, 75, 135, 270 L-N	45Hz-10KHz	2250T/3-3
2400VA	1	0-60, 120, 240 L to N	45Hz- 5KHz	2400T/2-1
2400VA	3Δ	0-30, 60, 120, 240 L-N	45Hz- 5KHz	2400T/2-3D
2700VA	3	0-30, 60, 120, 240 L-N	45Hz- 5KHz	2700T/3-3
3000VA	1	0-60, 120, 240 L to N	45Hz- 5KHz	3000T/2-1
3000VA	3Δ	0-30, 60, 120, 240 L-N	45Hz- 5KHz	3000T/2-3D
3000VA	3	0-30, 75, 135, 270 L-N	45Hz-10KHz	3000T/3-3
3600VA	3	0-30, 60, 120, 240 L-N	45Hz- 5KHz	3600T/3-3
4000VA	1	0-120 L to N	45Hz- 2KHz	4000T/4-1
4500VA	3	0-30, 60, 120, 240 L-N	45Hz- 5KHz	4500T/3-3
4800VA	1	0-120, 240 L to N	45Hz- 2KHz	4800T/4-1
5400VA	3	0-60, 120, 240 L to N	45Hz- 5KHz	5400T/6-3
6000VA	1	0-120, 240 L to N	45Hz- 2KHz	6000T/4-1
7200VA	3	0-60, 120, 240 L to N	45Hz- 5KHz	7200T/6-3
9000VA	3	0-60, 120, 240 L to N	45Hz- 5KHz	9000T/6-3
12000VA	3	0-120, 240 L to N	45Hz- 2KHz	12000T/12-3
14400VA	3	0-120, 240 L to N	45Hz- 2KHz	14400T/12-3
18000VA	3	0-120, 240 L to N	45Hz- 2KHz	18000T/12-3

2 phase versions available at comparable power levels.

REMOTE-PROGRAMMABLE INVERTRONS®

Solid state Invertrons® combined with 830T-Series Programmable Oscillators provide the most advanced programmable AC power sources available on the market today. 830T-Series Programmable Oscillators feature simultaneous and independent programming of frequency, phase, and amplitude compatible with remote controllers such as a computer, punched tape, cards, etc. Models are available in single, two or three phase.



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Representatives in principal cities throughout the world.

CALIFORNIA INSTRUMENTS

OSCILLATORS AC LINE CORRECTORS

800T-SERIES PLUG-IN OSCILLATORS

Companion Plug-in Oscillators are available in three types: (A) General-purpose, fixed-frequency; (B) Crystal-controlled, high-stability fixed-frequency; and (C) Continuously variable frequencies. All may be used with the Solid-State Invertrons® to create 1φ, 2φ, or 3φ custom AC power sources tailored to exact requirements. The fixed-frequency oscillators may be ordered with a servo-feedback option for systems requiring extremely high amplitude stabilities and accuracies. This feature provides overall regulation of up to 0.01% against line and load changes.

800T VARIABLE-FREQUENCY MODELS

Freq. Range	Freq. Accy. @ 25°C	Model Number
20Hz to 20KHz in three bands Sine or Square Wave	±1.0%	(1φ) 800T-20/20K-1-1 (2φ) 800T-20/20K-1-2 (3φ) 800T-20/20K-1-3 (3φ) 800T-20/20K-1-3D
45Hz to 75Hz in one band Sine or Square Wave	±0.25%	(1φ) 800T-45/75-.25-1 (2φ) 800T-45/75-.25-2 (3φ) 800T-45/75-.25-3 (3φ) 800T-45/75-.25-3D
300Hz to 500Hz in one band Sine or Square Wave	±0.25%	(1φ) 800T-300/500-.25-1 (2φ) 800T-300/500-.25-2 (3φ) 800T-300/500-.25-3 (3φ) 800T-300/500-.25-3D

810T FIXED-FREQUENCY GENERAL-PURPOSE MODELS

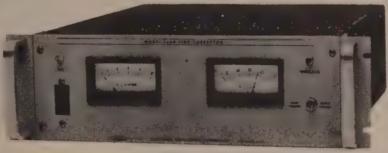
Any Single Freq. 45Hz to 10KHz Sine or Square Wave	±0.1%	(1φ) 810T-Freq.-1.1 (2φ) 810T-Freq.-.1-2 (3φ) 810T-Freq.-.1-3 (3φ) 810T-Freq.-.1-3D
Any Single Freq. 45Hz to 10KHz Sine or Square Wave	±0.1%	(1φ only) System-Servo oscillator with servo feedback set to maintain power source output at 115 VAC. Provides 0.01% line and load regulation from power source.
Any Single Freq. 45Hz to 10KHz Sine or Square Wave	±0.1%	(1φ only) System-Servo oscillator with servo feedback adjustable to produce power source output of 105 to 135 VAC. Provides 0.01% line and load regulation from power source.

820T FIXED-FREQUENCY CRYSTAL-CONTROLLED MODELS

400Hz Sine or Square Wave	±0.01%	(1φ) 820T-400-.01-1 (2φ) 820T-400-.01-2 (3φ) 820T-400-.0001-3
400Hz Sine or Square Wave	±0.0001%	(1φ) 820T-400-.01-1 (2φ) 820T-400-.0001-2 (3φ) 820T-400-.0001-3
Any Single Freq. 45Hz to 10KHz Sine or Square Wave	±0.01%	(1φ) 820T-Freq.-.01-1 (2φ) 820T-Freq.-.01-2 (3φ) 820T-Freq.-.01-3 (3φ) 820T-Freq.-.01-3D
Any Single Freq. 45Hz to 10KHz Sine or Square Wave	±0.0001%	(1φ) 820T-Freq.-.0001-1 (2φ) 820T-Freq.-.0001-2 (3φ) 820T-Freq.-.0001-3 (3φ) 820T-Freq.-.0001-3D

SERIES 1000 DYNAMIC AC LINE CORRECTORS

For Precision AC Power Independent of Powerline Disturbances



- PEAK INSTANTANEOUS POWER TO FIVE TIMES RATING
- 3.5-TO-1 CREST FACTOR
- REDUCES 500 VOLT 10 μSEC TRANSIENTS BY 1000-TO-1
- PURE SINE WAVE POWER
- HARMONIC DISTORTION REDUCTION OF 50:1
- SUPER REGULATION
  LINE — 0.025%
  LOAD — 0.025%
- PEAK AMPLITUDE STABILITY: ±0.01% CYCLE-TO-CYCLE
- IMPULSE SETTLING TIME LESS THAN 20 MICROSECONDS
- PEAK AMPLITUDE INSTABILITY LESS THAN 0.01%
- LOW OUTPUT TEMPERATURE COEFFICIENT — 0.005%/°C
- 100 DB COMMON MODE ISOLATION
- HIGH STABILITY — 0.05%/24 HOURS
- AUTOMATICALLY RECOVERS FROM OVERLOAD IN LESS THAN ONE CYCLE
- MONITORING OF VOLTAGE AND CURRENT OUTPUT
- SELF-CONTAINED AIR COOLING
- ALL-SILICON SOLID STATE

115 VOLT OUTPUT MODELS

Model	Input Voltage Range	Freq. Hz	Output Power (VA)		Exact Output Volts
			Contin-uous	Max. Inst. Peak	
1040 1050 LC1201B	95-115, 105-125, 115-135 (selectable by tap switch)	380-420 47-53 57-63	1200	5000	115V RMS ±0.15% Setable to 0.01% (±0.25% 400Hz Models)
1340 1350 1360		380-420 47-53 57-63	3000	15,000	
1361	180-264 in three ranges	57-63			

230 VOLT OUTPUT MODELS

1052A 1062	180-220, 198-244, 216-264 (selectable by tap switch)	47-53 57-63	1000	5000	220,230 or 240V RMS ±0.15% Setable to 0.01% (Single Output voltage only; specify on order)
1352 1362		47-53 57-63	3000	15,000	

*At power factors of 1.0 to ±0.7.

MECHANICAL

	1000 VA Models	3000 VA Models
Dimensions:	19" x 5¼"H x 17½"D	19"W x 14"H x 20¼"D
Net Wt.:	55 lbs.	175 lbs.
Shipping Wt.:	70 lbs.	235 lbs.

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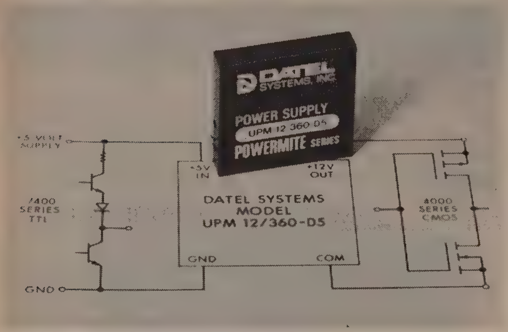
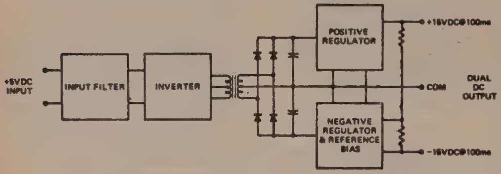
DC-DC CONVERTER MODULES


DATEL SYSTEMS, INC.
POWER SUPPLY
UPM 12 360 D5
POWERMITE SERIES
+5 VOLT SUPPLY
7400 SERIES TTL
+5V IN
+12V OUT
DATEL SYSTEMS MODEL UPM 12/360-D5
GND
COM
4000 SERIES CMOS
GND

This line of compact low cost DC to DC converters offers a wide choice of input and output voltages for powering data conversion modules, linear and digital IC's, and other circuits from local DC bus lines. They feature efficient power conversion with excellent regulation, isolation, and temperature coefficient. Internal shielding is used around the converters and the output voltage has low noise and ripple. These converters are packaged in compact, low profile cases and weigh only 3 ounces. The table below lists in compact form the 18 dual output models and 17 single output models.

BLOCK DIAGRAM MODEL BPM-15/100-D5


+5VDC INPUT
INPUT FILTER
INVERTER
POSITIVE REGULATOR
NEGATIVE REGULATOR & REFERENCE BIAS
+15VDC@100ma
COM
−15VDC@100ma
DUAL DC OUTPUT

GENERAL SPECIFICATION FOR ALL CONVERTERS

Output Voltage Accuracy	±1%
Line and Load Regulation	.02%
Output Noise and Ripple	1mV RMS
Isolation	100 Megohms
Output Impedance (DC to 10 kHz)	0.2 Ohm
Temperature Coefficient	.02%/°C
Conversion Efficiency	50% - 60%
Operating Temperature Range	−25°C to +71°C
Output Current Limiting	Short Circuit Protected

		1-WATT SERIES			3-WATT SERIES		
		MODEL	INPUT VOLTAGE	OUTPUT CURRENT	MODEL	INPUT VOLTAGE	OUTPUT CURRENT
SINGLE OUTPUT	+5V	UPM-5/200-D12 UPM-5/200-D28	12V 28V	200 mA	UPM-5/500-D5 UPM-5/500-D12 UPM-5/500-D28	5V 12V 28V	500 mA
	+12V	UPM-12/80-D5 UPM-12/80-D28	5V 28V	80 mA	UPM-12/250-D5 UPM-12/250-D28	5V 28V	250 mA
	+24V	UPM-24/40-D5 UPM-24/40-D12	5V 12V	40 mA	UPM-24/125-D5 UPM-24/125-D12	5V 12V	125 mA
	+28V	UPM-28/25-D5 UPM-28/25-D12	5V 12V	25 mA	UPM-28/100-D5 UPM-28/100-D12	5V 12V	100 mA
DUAL OUTPUT	±12V	BPM-12/25-D5 BPM-12/25-D12 BPM-12/25-D28	5V 12V 28V	25 mA	BPM-12/100-D5 BPM-12/100-D12 BPM-12/100-D28	5V 12V 28V	100 mA
	±15V	BPM-15/25-D5 BPM-15/25-D12 BPM-15/25-D28	5V 12V 28V	25 mA	BPM-15/100-D5 BPM-15/100-D12 BPM-15/100-D28	5V 12V 28V	100 mA
	±18V	BPM-18/25-D5 BPM-18/25-D12 BPM-18/25-D28	5V 12V 28V	25 mA	BPM-18/100-D5 BPM-18/100-D12 BPM-18/100-D28	5V 12V 28V	100 mA
CASE SIZE		2.0″ x 1.5″ x .375″			2.0″ x 2.0″ x .432″		
PRICE (1-9)		$49.00			$79.00		

ENGINEERING PRODUCT HANDBOOK
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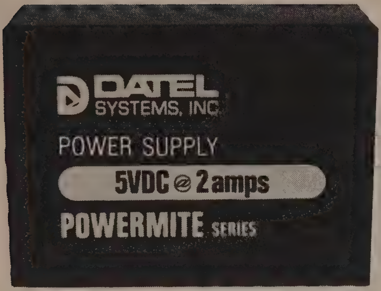
DATEL
SYSTEMS, INC.
1020 TURNPIKE STREET / CANTON, MASS. 02021
TEL. (617) 828-8000 / TWX: 710-348-0135 / TELEX: 924461

LINE OPERATED SINGLE/DUAL DC MODULAR SUPPLIES



This broad line of compact single and dual output power modules is the ideal solution for powering A/D and D/A converter modules, op amps, digital and linear IC's and other related components. These supplies are rugged, epoxy encapsulated with output current limiting, and feature excellent line and load regulation, low temperature coefficient, and high isolation. They are extremely useful for localized power distribution in systems.

GENERAL SPECIFICATIONS FOR ALL SUPPLIES:

Input Voltage .... 115VAC ±10V
Line Frequency .... 50 Hz-440 Hz
Isolation .... 25-50 Megohms
Output Voltage Accuracy .... ±1%
Output Ripple Voltage .... 1mV RMS
Operating Temperature Range .... 0°C to 70°C
Optional Inputs .... 220VAC ±20V @ 47-440 Hz (Add Suffix "E")
100VAC ±10V @ 47-440 Hz (Add Suffix "J")

	MODEL	OUTPUT VOLTAGE	OUTPUT CURRENT	REGULATION LINE/LOAD	TEMPERATURE COEFFICIENT	OUTPUT (2) IMPEDANCE	CASE SIZE	SOCKET	PRICE (1-9)
DUAL OUTPUT	BPM-5/250	±5VDC	±250mA	0.2% (1)	.02%/°C	.05Ω	2.5" x 3.5" x .875"	MS-7	$79.00
	BPM-5/500	±5VDC	±500mA				2.5" x 3.5" x 1.250"	MS-7	$89.00
	BPM-12/60	±12VDC	±60mA	.01% .05%	.015%/°C	0.2Ω	2.5" x 3.5" x .875"	MS-7	$39.00
	BPM-12/100	±12VDC	±100mA				2.5" x 3.5" x .875"	MS-7	$49.00
	BPM-12/200	±12VDC	±200mA		.02%/°C		2.5" x 3.5" x 1.250"	MS-7	$59.00
	BPM-12/300	±12VDC	±300mA				2.5" x 3.5" x 1.560"	MS-7	$99.00
	BPM-15/60	±15VDC	±60mA	.01% .05%	.015%/°C		2.5" x 3.5" x .875"	MS-7	$39.00
	BPM-15/100	±15VDC	±100mA	.05% 0.1%		0.1Ω	2.5" x 3.5" x .875"	MS-7	$49.00
	BPM-15/200	±15VDC	±200mA	.01% .05%	.02%/°C	0.2Ω	2.5" x 3.5" x 1.250"	MS-7	$69.00
	BPM-15/300	±15VDC	±300mA	.01% .05%			2.5" x 3.5" x 1.560"	MS-7	$89.00
SINGLE OUTPUT	UPM-5/250	+5VDC	+250mA	.05% 0.1%	.02%/°C	.05Ω	2.5" x 3.5" x .875"	MS-7	$49.00
	UPM-5/500	+5VDC	+500mA				2.5" x 3.5" x .875"	MS-7	$59.00
	UPM-5/1000	+5VDC	+1000mA				2.5" x 3.5" x 1.250"	MS-7	$69.00
	UPM-5/1000B	+5VDC	+1000mA	0.5% 0.5%			2.5" x 3.5" x 1.250"	MS-7	$49.00
	UPM-5/2000	+5VDC	+2000mA	.01% .05%			2.5" x 3.5" x 1.560"	MS-7	$89.00
	UPM-6/150	+6VDC	+150mA	0.25% (1)			2.5" x 3.5" x .875"	MS-7	$39.00
	UPM-9/100	+9VDC	+100mA					MS-7	$39.00
	UPM-12/100	+12VDC	+100mA					MS-7	$49.00
	UPM-15/100	+15VDC	+100mA					MS-7	$49.00

NOTES: (1) Combined line and load regulation.
(2) From DC to 10 kHz

ENGINEERING PRODUCT HANDBOOK
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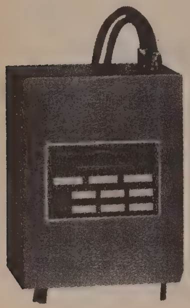
HIGH VOLTAGE EQUIPMENT

UNREGULATED SERIES "S"

These power supplies are designed for operation from either a 0-115 volt or 0-125 volt line at 60/400 cycles. Three input terminals are provided to permit proper line connection. The output is available from shielded polyethylene cables and may be varied over the full range by varying the input AC line. The two output cables are insulated for the full output voltage, so that either the positive or negative terminal may be grounded. All units have selenium rectifiers and are hermetically sealed in an epoxy, vacuum filled, metal case.

Units for 50 cycle operation at various line voltages are available on request.



FEATURES

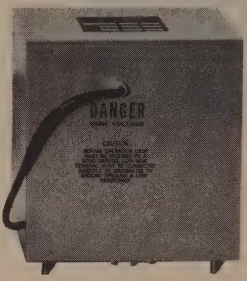
- Solid State Rectifiers
- Low Ripple
- Reversible Polarity†
- Shielded Output Cables
- Hermetically Sealed Can
- Epoxy Vacuum Filled

†Model 40-2-4 is designed with one output cable for single polarity operation. When ordering, please specify polarity.

Model No.	Max. Output Voltage	Max. Rated Current	Ripple at Full Load %Rms/MA at 60 cps	Dimensions (Inches)	Net Weight (Lbs.)
2.5-2-6	0-2.5 KV	2 MA	0.25	3x2⅝x4¼	3¼
5-2-4	0-5.0 KV	2 MA	0.25	3x3½x3⅞	4¼
10-1-12	0.10 KV	1.25 MA	0.30	3x3½x4⅞	5½
15-1-8	0-15 KV	1.25 MA	0.25	4¼x5x5¾	11½
20-1-4	0-20 KV	1.25 MA	0.25	4¼x5⅛x6¾	14
25-1-3	0-25 KV	1.25 MA	0.30	4¾x6x7¼	18½
30-1-5	0-30 KV	1.25 MA	0.20	5x6½x8	24½
40-1-1	0-40 KV	1 MA	.15	8¼x5½x7	27
40-2-4	0-40 KV	2 MA	0.30	6¼x8¼x7	29
50-1-5	0-50 KV	1 MA	0.25	9⅞x7¾x9⅜	52
60-1.5-1	0-60 KV	1.5 MA	.15	12⅛x9 3/16x11 5/16	87
1-5-2	1 KV	5 MA	.20	3x2¾x4¼	3½
2.5-5-3	2.5 KV	5 MA	.20	3½x3x5	5
5-5-4	5 KV	5 MA	.25	4x3⅜x5¼	7½
7.5-5-1	7.5 KV	5 MA	.20	4⅜x3¾x5½	8½
10-5-1	10 KV	5 MA	.25	4⅜x3¾x5½	10
15-5-1	15 KV	5 MA	.30	5¾x5x6¾	19½
20-5-3	20 KV	5 MA	.25	6⅛x6⅛x6½	21
25-5-1	25 KV	5 MA	.25	6¾x6¼x7¼	27¼
30-5-8	30 KV	5 MA	.30	7¼x6½x7¾	38
1-10-1	1 KV	10 MA	.10	3½x3x5	5
2.5-10-1	2.5 KV	10 MA	.10	4x3¾x5½	6½
5-10-2	5 KV	10 MA	.12	4⅜x3¾x5½	9
7.5-10-1	7.5 KV	10 MA	.10	4¾x4x7¼	13½
10-10-3	10 KV	10 MA	.10	5x4⅜x6¾	14½
15-10-2	15 KV	10 MA	.15	6⅛x6⅛x6½	22½
20-10-3	20 KV	10 MA	.15	6¾x6¼x7¼	27½
25-10-2	25 KV	10 MA	.10	7½x6½x8½	38
30-10-3	30 KV	10 MA	.15	8x7¾x8¾	50

HIGHLY REGULATED ADJUSTABLE SERIES "HRM"

The HRM series of regulated power supplies are compact transistorized modules. An exceptionally high degree of regulation, low ripple and fast response without the use of vacuum tubes. All transistors are high quality silicon. These supplies are rugged and feature excellent line, load and thermal stability. Output voltage adjustment from remote control. Electronic overload protection up to and including a short circuit with immediate voltage recovery upon removal of the short. No output voltage overshoot on turn on, turn off, or power removal.



FEATURES

- Short-circuit proof (no fuses)
- All silicon transistors
- Fast response
- No warmup time required
- No voltage overshoot on turn-on or turn-off
- Adjustable output
- Remote programming
- Excellent thermal stability
- Low RFI — no choppers or high frequency oscillators
- Sealed construction
- Epoxy filled under vacuum
- Single shielded output cable
- Available for either output polarity
- Small size, light weight, compact
- Low stored energy
- Automatic resetting thermal cutout
- Meet environmental conditions and performance requirements of military specifications such as MIL-E-16400

SPECIFICATIONS

Input: 115V ± 10% 57-420 Hz single phase to 10 KV.115V ± 10% 60 or 400 Hz single phase 15KV and above

Output: See table

Regulation:

Line: Less than 0.03% for 10% line voltage change

Load: Less than 0.03% for a no-load to full-load change

Ripple: .03% RMS max to 60 Hz input
.01% RMS max at 400 Hz input

Temperature Range: −54°C to +65°C operating

Temperature Coefficient: .02%/°C

Model No. Positive Output	Model No. Negative Output	Output Voltage	Max. Current	Dimensions (Inches)	Net Weight (Lbs.)
.6HRM5PI	.6HRM5NI	300-600V	5 MA	4⅜x3⅜x4¾	7
1.2HRM5PI	1.2HRM5NI	600-1.2KV	5 MA	4⅜x3¾x4¾	7½
1.7HRM5PI	1.7HRM5NI	900V-1.7KV	5 MA	4⅜x3¾x4¾	9
2.5HRM4PI	2.5HRM4NI	1.3KV-2.5KV	4 MA	4⅜x3¾x4¾	9
3.5HRM3PI	3.5HRM3NI	2.0KV-3.5KV	3 MA	4 11/16x4x4 15/16	10
5HRM2PI	5HRM2NI	3.0KV-5KV	2 MA	4 11/16x4x4 15/16	10
7HRM1.5PI	7HRM1.5NI	3.5KV-7KV	1.5 MA	5½x4½x6	15
10HRM1PI	10HRM1NI	5KV-10KV	1 MA	5½x4½x6	15
15HRM1.5PI	15HRM1.5NI	7.5KV-15V	1.5 MA	7¼x4 5/16x7½	20
20HRM1PI	20HRM1NI	10KV-20KV	1 MA	7¼x4 5/16x8	20
25HRM2PI	25HRM2NI	13KV-25KV	2 MA	9¼x5½x9⅝	35
30HRM.75PI	30HRM.75NI	15KV-30KV	0.75 MA	8¼x5 5/16x7⅞	37
40HRM.5PI	40HRM.5NI	25KV-40KV	0.5 MA	6¼x8¼x8	42
50HRM.5PI	50HRM.5NI	30KV-50KV	0.5 MA	10x8x10	60

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HIGH VOLTAGE EQUIPMENT

PMS SERIES
PHOTOMULTIPLIER POWER SUPPLY

The PMS Series is a family of extremely compact, rugged design DC to DC proportional converters for use as power sources for photomultiplier and other tube applications.

FEATURES

- Input reverse polarity protected
- Output isolated from input
- Output proportional to input
- Output momentary short circuit protected
- Extremely compact

Operating Temperature: 0°-60°C

Temperature Coefficient: ±.02% per degrees C, typical

Performance Curves available on request

SPECIFICATIONS

Model	Input DC	Output		Ripple P to P	Size Dia. x Length	Mounting
		Voltage	Load			
PMS 1-1	3-15 V	300-1500 V	1.5 Meg	1.5 V	1x2¼	*Loop Clamp
PMS 1-2	3-10 V	300-1000 V	800 K	1.0 V	1x2⅝	8-32 Insert
PMS 1-3A	3-15 V	300-1500 V Negative	1.0 Meg	1.0 V	1¼x2½	10-32 Stud
PMS 1-4	3-19 V	300-2000 V	2.0 Meg	7.0 V	1x2¼	*Loop Clamp
PMS 1-5	3-10 V	300-1000 V	3.0 Meg	.5 V	1x2½	*Loop Clamp
PMS 1-6A	3-15 V	400-2500 V	5 Meg	30 V	1¼x2½	*Loop Clamp
PMS 1-7	4-12 V 11-14 V	500-1500 V 1500-2000 V	1.0 Meg 2.0 Meg	6.0 V	2.4x1.5x.812	2 ea. Thru Holes
PMS B2-.025A	3-10 V 12MA @ 1.8KV & 180 Meg	300-2000 V	80 Meg Min.	3.0 V	1¼x2½	*Loop Clamp
PMS 3-.5	3-15 V	300-3000 V	6 Meg	7.5 V	1¼x2⅜	8-32 Stud
PMS 5-.5A	3-15 V	500-5000 V	10 Meg	5.0 V	1 7/16x3⅛	8-32 Stud
PMS 10-.025	3-10 V	3KV 10KV	25 ua	50 V	2.07x2.32x3.13	4 Studs

*Optional Equipment. Not supplied with unit.

HARD/HDRD SERIES
CATHODE RAY TUBE POWER SUPPLIES

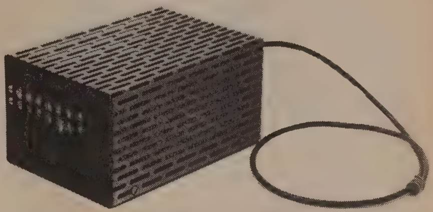
The HARD/HDRD series power supplies provide a well regulated source of high voltage at power levels from 2 to 20 watts. The units feature automatic shutdown after short and low stored energy which makes them highly suitable for use in CRT, PMT applications, as well as any application requiring a precise stable source of high voltage in a compact modular form.

FEATURES

Short Ckt Proof

Flash-Over Protected

Compact Size



SPECIFICATIONS

Input: HARD 115V 50/60 Hz 1ϕ HDRD 28 V DC ±10%

Output: Variable via resistive program from 50% to 100% of rated output (see chart)

Regulation:
Line: ±.005% for ±10% Line
Load: ±.005% for 0 to Full Load

Ripple: .03% RMS at Full Load

Temperature Range: −20°C to +55°C

Temperature Coefficient: ±.02%/°C

STANDARD MODELS

Model	Output		Model
	Voltage	Current	
1.2HARD2-1	1200	2	1.2HDRD2-1
1.2HARD10-1	1200	10	1.2HDRD10-1
1.2HARD20-1	1200	20	1.2HDRD20-1
2.5HARD1-1	2500	1	2.5HDRD1-1
2.5HARD4-1	2500	4	2.5HDRD4-1
2.5HARD8-1	2500	8	2.5HDRD8-1
5HARD.5-1	5000	.5	5HDRD.5-1
5HARD2-1	5000	2	5HDRD2-1
5HARD4-1	5000	4	5HDRD4-1
10HARD.25-1	10KV	.25	10HDRD.25-1
10HARD1-1	10KV	1	10HDRD1-1
10HARD2-1	10KV	2	10HDRD2-1
15HARD.25-1	15KV	.25	15HDRD.25-1
15HARD.5-1	15KV	.5	15HDRD.5-1
15HARD1-1	15KV	1	15HDRD1-1
20HARD.2-1	20KV	.2	20HDRD.2-1
20HARD.5-1	20KV	.5	20HDRD.5-1
20HARD1-1	20KV	1	20HDRD1-1
30HARD.75-1	30KV	.75	30HDRD.75-1
40HARD.5-1	40KV	.5	40HDRD.5-1

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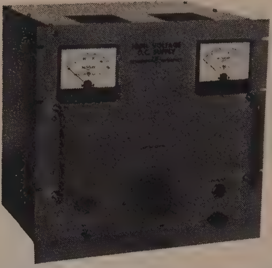
HIGH VOLTAGE EQUIPMENT

RHPT SERIES

RACK-MOUNTING DC POWER SUPPLIES and HI-POT TESTERS ALSO AVAILABLE IN CABINET ENCLOSURES

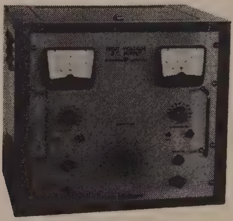
The Del RHPT series of rack mounted Hi Pot Testers are general-purpose power supplies which are fully instrumented, completely enclosed, and fully protected. They provide DC outputs up to 60,000 volts. These units are designed for standard 19-inch racks and have light gray panels. They are recommended for all commercial, industrial, and laboratory uses where reliable DC high-voltage sources are required.

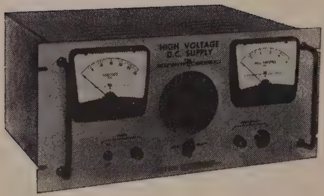
A wide selection of models is offered for all applications. Cabinets to contain these units for bench-top use are available as an option.



FEATURES

- Operate to 50°C
- Semi-conductor rectifiers
- Continuously adjustable output voltage controlled from front panel
- Reversible polarity
- Easily read 4½″ voltage and current meters 2% F.S. accuracy
- SAFETY: Meters are protected against overloads and high-voltage flashovers.
  Zero-start interlock withholds AC input from high-voltage transformer until the HV output control has first been returned to zero.
  Provision for external interlocks
- PROTECTION: Fixed overcurrent and overvoltage trips
  Surge limiting resistor
  Easily accessible HV fuses
  HV indicating light
- Line regulators available





Input: 105-125 volts, 60 Hz, single phase

Output: (See table.) Output is provided on shielded polyethylene cable.

Ripple: See table

Metering: ±2% kilovoltmeter and milliammeter, 4½″

Model No.	Output Voltage Range (KV)	Max. Current (MA)	Ripple (%rms/MA)	Panel Height (In.)	Dimensions of Optional Rack Cabinet (In., w x d x h)
1RHPT-5-1	0-1	5	0.2	8¾	21¾x15¼x10½
1RHPT-10-1	0-1	10	0.1		
1RHPT-25-1	0-1	25	0.1		
1RHPT-50-1	0-1	50	0.05		
1RHPT-100-1	0-1	100	0.03		
1RHPT-500-1	0-1	500	0.005	17½	21¾x18x19¼
1RHPT-1000-1	0-1	1000	0.003		
1RHPT-1500-1	0-1	1500	0.003	26¼	21¾x18x28
2.5RHPT-2-1	0-2.5	2	0.25	8¾	21¾x15¼x10½
2.5RHPT-5-1	0-2.5	5	0.2		
2.5RHPT-10-1	0-2.5	10	0.1		
2.5RHPT-25-1	0-2.5	25	0.1		
2.5RHPT-50-1	0-2.5	50	0.04		
2.5RHPT-100-1	0-2.5	100	0.02		
2.5RHPT-200-2	0-2.5	200	0.02	17½	21¾x18x19¼
2.5RHPT-400-1	0-2.5	400	0.01		
2.5RHPT-600-1	0-2.5	600	0.01	26¼	21¾x18x28
5RHPT-2-1	0-5	2	0.25	8¾	21¾x15¼x10½
5RHPT-5-1	0-5	5	0.25		
5RHPT-10-1	0-5	10	0.12		
5RHPT-25-1	0-5	25	0.1		
5RHPT-50-1	0-5	50	0.04		
5RHPT-100-2	0-5	100	0.02	17½	21¾x18x19¼
5RHPT-200-2	0-5	200	0.02		
5RHPT-300-1	0-5	300	0.015		
7.5RHPT-5-1	0-7.5	5	0.2	8¾	21¾x15¼x10½
7.5RHPT-10-1	0-7.5	10	0.1		
7.5RHPT-25-1	0-7.5	25	0.1		
7.5RHPT-50-1	0-7.5	50	0.04	17½	21¾x18x19¼
7.5RHPT-100-1	0-7.5	100	0.02		
10RHPT-1-1	0-10	1.25	0.3	8¾	21¾x15¼x10½
10RHPT-5-1	0-10	5	0.25		
10RHPT-10-1	0-10	10	0.1		
10RHPT-25-1	0-10	25	0.1		
10RHPT-50-1	0-10	50	0.04	17½	21¾x18x19¼
10RHPT-100-1	0-10	100	0.03		
10RHPT-150-1	0-10	150	0.02	26¼	21¾x18x28
15RHPT-1.25-1	0-15	1.25	0.3	8¾	21¾x15¼x10½
15RHPT-5-1	0-15	5	0.3		
15RHPT-10-1	0-15	10	0.15		
15RHPT-25-1	0-15	25	0.1	17½	21¾x18x19¼
15RHPT-50-1	0-15	50	0.04		
15RHPT-75-1	0-15	75	0.04	26¼	21¾x18x28
20RHPT-1.25-1	0-20	1.25	0.25	8¾	21¾x15¼x10½
20RHPT-5-1	0-20	5	0.25		
20RHPT-10-1	0-20	10	0.15		
20RHPT-25-1	0-20	25	0.1	17½	21¾x18x19¼
20RHPT-50-1	0-20	50	0.04		
20RHPT-75-1	0-20	75	0.04	26¼	21¾x18x28
25RHPT-1.25-1	0-25	1.25	0.3	8¾	21¾x15¼x10½
25RHPT-5-1	0-25	5	0.25		
25RHPT-10-1	0-25	10	0.1		
25RHPT-25-1	0-25	25	0.1	17½	21¾x18x19¼
30RHPT-1.25-1	0-30	1.25	0.3	8¾	21¾x15¼x10½
30RHPT-5-1	0-30	5	0.3		
30RHPT-10-1	0-30	10	0.15		
30RHPT-25-1	0-30	25	0.1	17½	21¾x18x19¼
40RHPT-1-1	0-40	1	0.2		
40RHPT-2-1	0-40	2	0.3		
50RHPT-1-1	0-50	1	0.3		
60RHPT-1-1	0-60	1	0.35		

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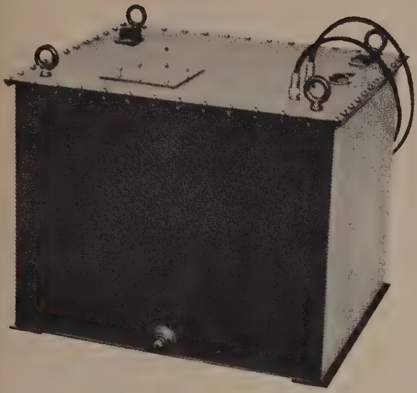
HIGH VOLTAGE EQUIPMENT

SERIES "O" OIL INSULATED



Model No. PSO 120-5-3

The Del Series PSO Oil-Insulated Power Supplies offers one of the most comprehensive lines of basic high-voltage units available to industry and laboratories. These DC supplies are designed to provide long, reliable service in such applications as dielectric testing, capacitor charging, electrostatic precipitation, electron microscopy, image intensification, plasma research, and electron acceleration. PSO series supplies feature reversible polarity on most units; shielded polyethylene output cables; high quality insulating oil in dust-free tanks, and quiet, long-life operation with low corona. Stock units are available for 115V, 208V, 220V, 440V single-phase and three-phase line inputs. Units for other line voltages and frequencies are available on request.

HAC SERIES

AC DIELECTRIC TESTERS

SOME CONVENIENT TESTER FEATURES:

A unique transformer winding arrangement in these testers permits an external capacitance decade box (not furnished) to measure:

- Capacitance
- R in phase × C quadrature components of load current
- Actual load current apart from stray-capacitance currents

HIGH VOLTAGE A.C. SUPPLY

All require 115 V ±10%, 60 Hz, single phase

Max current, all models: 5 ma

All cabinets 9½"W x 11"D x 12"H

Model No.	Output Voltage (rms)
2.5HAC-5-1	0- 2,500
5HAC-5-1	0- 5,000
10HAC-5-1	0-10,000
20HAC-5-1	0-20,000
35HAC-5-1	0-35,000

FEATURES

- Continuously variable output from zero to maximum voltage
- Easy-to-read 2% kilovoltmeter and milliammeter.
- Separate switches for line input and high-voltage output
- Fixed overload relay set for 120% of rated current — Readily accessible fuses
- Gunmetal finish cabinet — Light gray control panel
- Self-grounding line cord

These are fully protected and instrumented portable testers providing rms outputs up to 35 KV. Conservatively designed, they are recommended for all industrial and laboratory uses where reliable high-voltage AC sources are required.

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HIGH VOLTAGE EQUIPMENT

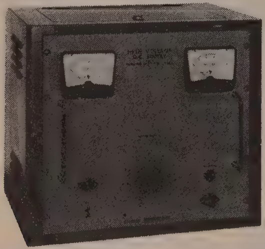
CONTROL PANELS

RM2 and 3RM2 SERIES

CONTROL FEATURES

- Standard 19″ rack-panel mounting design
- Variable autotransformer
- On-off switch
- 4½″ two-percent kilovoltmeter and milliammeter, completely protected
- Line and high-voltage primary fuses
- High-voltage indicating light

RM3 and 3RM3 SERIES



Typical RM3 or 3RM3 in Optional Cabinet

FEATURES

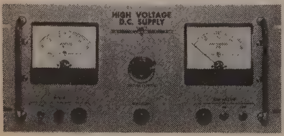
- Electronically controlled voltage and current overload protection accurately settable and resettable over full range from 0 to 120% of rated voltage and current
- Zero-start protection interlock
- Provision for external interlocks
- Reversible Polarity

POWER SUPPLIES*

Model No.	Output Voltage (KV)	Output Current (MA)	Input V	Input Hz	Input ϕ	RMS Ripple (% rms/MA)*	Dimensions (In., l x w x h)	Current Limiting Resistor Included	Shorting Solenoid Included	Meter Multiplier Resistor Included
PS020-200-3	20	200	208	60	3	4.2	20¾x17½x18			X
PS020-300-2	20	300	208	60	3	4.2	20¾x17½x18	X		X
PS025-200-11	25	200	208	60	3	4.2	20¾x17½x18			X
PS025-400-1	25	400	208	60	3	4.2	29¼x19x27			X
PS030-20-12	30	20	115	60	1	0.40	16½x16½x21½		X	X
PS030-75-1	30	75	208	60	3	4.2	20¾x17½x24½			X
PS030-150-4	30	150	208	60	3	4.2	20¾x17½x24½			X
PS030-200-2	30	200	208	60	3	4.2	20¾x17½x24½			X
PS040-5-6	40	5	115	60	1	0.40	14x13x16½	X	X	X
PS040-10-4	40	10	115	60	1	0.30	16½x16½x21½	X	X	X
PS040-20-1	40	20	115	60	1	0.4	16½x16½x21½	X	X	X
PS050-5-6	50	5	115	60	1	0.4	14x13x16½	X	X	X
PS050-10-5	50	10	115	60	1	0.4	16½x16½x21½	X	X	X
PS050-30-4	50	30	115	60	1	0.45	16½x16½x21½	X	X	X
PS050-50-7	50	50	208	60	3	4.2	20¾x17½x18			X
PS050-75-3	50	75	208	60	3	4.2	20¾x17½x24			X
PS050-100-4	50	100	208	60	3	4.2	29¼x19x27			X
PS060-5-2	60	5	115	60	1	0.3	14x13x16½	X	X	X
PS060-10-1	60	10	115	60	1	0.4	16½x16½x21½	X	X	X
PS070-5-1	70	5	115	60	1	0.35	16½x16½x21½	X	X	X
PS075-30-1	75	30	208	60	3	4.2	20¾x17½x24½	X		X
PS075-60-1	75	60	208	60	3	4.2	29¼x19x27			X
PS080-5-1	80	5	115	60	1	0.3	16½x16½x21½	X	X	X
PS080-10-1B	80	10	115	60	1	0.35	29¼x19x27	X	X	X
PS080-60-1	80	60	208	60	3	0.05	24⅜x27½x43½	X	X	X
PS0100-2-4	100	2	115	60	1	0.5	20¾x17½x24½	X	X	X
PS0100-50-1	100	50	208	60	3	4.2	29¼x19x31½			X
PS0120-5-3	120	5	115	60	1	0.35	29¼x19x27	X	X	X
PS0120-10-1	120	10	115	60	1	0.35	29¼x19x27	X	X	X
PS0120-30-1	120	30	208	60	3	4.2	29¼x19x31½			X
PS0130-2-3	130	2	115	60	1	0.5	29¼x19x27	X	X	X
PS0150-5-5	150	5	115	60	1	0.6	29¼x19x31½	X	X	X
PS0150-10-1	150	10	115	60	1	0.3	29¼x19x31½	X	X	X
PS0150-20-1	150	20	208	60	3	4.2	29¼x19x31½			X
PS0160-2-1	160	2	115	60	1	0.45	29¼x19x31½	X	X	X

*"PSC" Option Available PSO, RM3 Supplied in a Cabinet with Casters. Prices Available on Request.

RM4 and 3RM4 SERIES



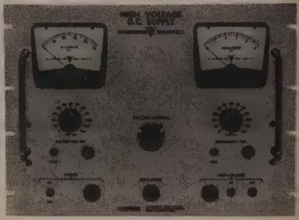
Typical RM4 or 3RM4 Control Section

CONTROL FEATURES

Each unit has a variable autotransformer driven by servo controlled motor for line and load regulation. ALSO —

- Regulation —
  - ±0.5% for ±10% line change
  - ±0.5% from no load to full load
- Precision 10-turn potentiometer voltage control
- 15 seconds from 0 to rated output (30 or 60 seconds on special request)
- 4½″ two-percent kilovoltmeter and milliammeter, completely protected
- On-off switch
- Line and high-voltage primary fuses
- High-voltage indicating pilot light
- Fixed overcurrent and overvoltage trip, preset for 110% of rated output
- Automatic return to zero on turnoff
- Zero-start interlock
- Zero position indicator
- Provision for external interlock
- Reversable polarity

RM6 and 3RM6 SERIES



Typical RM6 or 3RM6 Control Section

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HIGH VOLTAGE EQUIPMENT

TC SERIES

COMPACT, FULLY PROTECTED and INSTRUMENTED HV DC UNITS

Del TC Series Power Supplies are multi-purpose, compact, fully instrumented and fully protected units providing continuously variable ratings up to 80,000 VDC. They are recommended for industrial and commercial applications such as laboratory use, dielectric testing, electrostatic painting, electrostatic flocking, and similar service where a rugged, dependable DC high-voltage source is required.

Selenium rectifiers are used throughout to provide long life and instantaneous operation. No filament warmup time is required.

All high-voltage components are immersed in high grade insulating oil, assuring **long** trouble-free **life.**

As shown in the photograph, the high-voltage section is integral with the controls, which are mounted on a sloping-front instrument panel.

Model No. 60 TC-5-1 with castered cradle

FEATURES

- Reversible output polarity
- Selenium-rectifier circuits provide long life and instantaneous operation — No filament warmup time
- All high-voltage components are immersed in high-grade insulating oil — Assures trouble-free life
- Easy-to-read 2% kilovoltmeter and milliammeter
- SAFETY:

1. Meters are protected against overloads and high-voltage flashovers.
2. Zero-start interlock withholds AC input from high-voltage transformer unless high-voltage output control has been returned to zero.
3. Automatic shorting solenoid discharges the energy stored in the output capacitor immediately on shutdown.

- Self-grounding line cord — Shielded polyethylene coaxial output cable
- Sloping-front instrument panel

SPECIFICATIONS

Input: 105-125 volts, 50/60 Hz, single phase

Output voltage: Continuously variable from zero to rated maximum DC output voltage (see table.)

Output current: See table

Ripple: See table

Meters: ±2% full scale kilovoltmeter and milliammeter provided

Circuit protection: Fixed overload relay set for 120% of rated current
Load current suger-limiting resistor
Readily accessible fuses

Model No.	Full Load Voltage Range (KV)	Current Range (MA)	Ripple (% rms/ MA at 60 Hz)	Dimensions	
				Complete Unit (In., w x d x h)	Tank Only (In., w x d x h)
30TC-5-1	0-30	0-5	0.4	14½x13½x25¾	14x13x16½
40TC-5-1	0-40	0-5	0.5		
50TC-5-1	0-50	0-5	0.4		
60TC-5-1	0-60	0-5	0.4		
30TC-20-1	0-30	0-20	0.4	17x17x32	16½x16½x21½
40TC-20-1	0-40	0-20	0.4		
50TC-10-1	0-50	0-10	0.4		
60TC-10-1	0-60	0-10	0.4		
70TC-5-1	0-70	0-5	0.4		
80TC-5-1	0-80	0-5	0.4		

HRPS SERIES

HIGHLY-REGULATED — POWER SUPPLIES

Del HRPS Series High Voltage Power Supplies are highly regulated adjustable units providing a reliable 1 KW source of power with units available having maximum output ranges covering voltages from 1 to 50 KVDC. The units hybrid regulated design allows for fast dynamic response. The units are suited for use in vacuum electronic applications. They are designed with full function color coded controls for simplified operation. The units are supplied in smartly appointed cabinets.

FEATURES

- Highly regulated for line and load
- Adjustable output 5%-100%
- High resolution of 10 turn voltage control
- 3 range meters
- Positive polarity (negative available on special request)
- Fast dynamic response
- Hybrid series regulator
- Designed to withstand vacuum sparkovers
- Automatic overload tripout
- Short circuit protection

SPECIFICATIONS

Input: 115 or 230 volts 50/60 Hz

Output: Adjustable 5 to 100% (See chart below)

Ripple: .01% RMS — at full load

Regulation:
Line : ±.0025% (For ±10% line change)
Load: ±.005% (0 to full load)

Response Time: 100usec

Resolution: .1%

Size: 1-15 KV units — 24 x 29 x 53″
30-50 K units — 24 x 29 x 70″

Model No.	Output Voltage	Output Current	Insulation
HRPS1-1000	50 V- 1000 V	1000 MA	AIR
HRPS2.5-400	125 V- 2500 V	400 MA	AIR
HRPS5-200	250 V- 5000 V	200 MA	AIR
HRPS10-100	500 V-10,000 V	100 MA	AIR
HRPS15-66	750 V-15,000 V	66 MA	AIR
HRPS30-33	1500 V-30,000 V	33 MA	OIL
HRPS50-20	2500 V-50,000 V	20 MA	OIL
HRPS60-30	Also Available 30,000-60,000 V Check factory for specifications	30 MA	OIL

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TRANSFORMERS

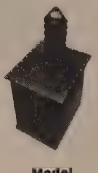
LINE ISOLATION

Standard types available for 120 V and 240 V input lines in 1:1, 1:2, and 2:1 voltage ratios. Other input and output voltages available on request.

Recommended for industrial, research, and developmental uses.

FEATURES

- Complete varnish impregnation under vacuum
- Epoxy anchoring
- Immersed in high grade insulating oil
- Electrostatic shield between primary and secondary windings
- "AN" type connector provided for input connections
- Good regulation



Model
2-TR-250-21

Model
3-CTR-250-11

HIGH VOLTAGE ISOLATION TRANSFORMER
OPEN TYPE CONSTRUCTION — EPOXY COATED

Primaries: 115 V, 230 V — 60 cps ***Secondaries: 115 V***

Type	KVA	Size	Mtg. Dim.	Insulation KV DC Working
AD1640	.200	6⅛x4x5⅛	4½x3	10
AD1641	.500	7⅝x5⅞x7¾	5⅜x4¼	10
AD1642	.750	9½x6 5/16x8¼	7¼x4 13/16	10
AD1643	1.000	8½x8x9¾	6x5	10
AD1644	.200	8½x4x5⅝	6⅞x3⅛	20
AD1645	.500	10¼x5⅝x7½	8x4¼	20
AD1646	.750	9¾x6¾x8	7½x4 13/16	20
AD1647	1.000	11¼x6⅝x8¾	8¾x4⅝	20
AD3060	.250	8½x7¼x6½	7 5/16x3⅜	30
AD3061	.500	9¾x7x8¾	7 13/16x3½	30
AD3062	.750	10½x7½x9½	8½x3⅝	30
AD3063	1.000	11x9x9½	8¾x3¾	30
AD3064	.250	10x7x6½	8 13/16x3⅜	40
AD3065	.500	11¼x7¼x8¾	9⅛x3½	40
AD3066	.750	12½x7½x9½	10¼x3⅝	40
AD3067	1.000	12¾x9x9½	10 17/16x3¾	40
AD3068	.250	13¼x7¼x6½	12x3⅜	50
AD3069	.500	13¼x7¼x8¾	11⅛x3½	50
AD3070	.750	14½x7½x9½	12¼x3⅝	50
AD3071	1.000	14¾x9x9½	12 7/16x3¾	50

STANDARD 60 HZ TYPES

Model No.	Max. K VA	KV DC Insulation	Tank Size** (In., w x d x h)	Insulator Height (In.)††
1-TR-30-XX†	1	30	10x12x11	6
1.5-TR-30-XX	1.5	30	13x13⅞x16½	6
1-TR-50-XX†	1	50	13x13⅞x16⅜	8½
3-TR-50-XX†	3	50	13x13⅞x16⅜	8½
1-TR-60-XX†	1	60	9¾x12⅜x13⅜	11
2-TR-60-XX†	2	60	16½x16½x21⅜	11
3-TR-60-XX†	3	60	16½x16½x21⅜	11
5-TR-60-XX†	5	60	16½x16½x21⅜	11
3-TR-75-XX†	3	75	16½x16½x22	11
1-TR-100-XX†	1	100	20¾x17½x17 13/16	14
3-TR-100-XX†	3	100		
3-TR-150-XX†	3	150	29¼x19x27	19½
5-TR-150-XX†	5	150	29¼x19x27	19½
.5-TR-250-XX	.5	250	25x33x37 5/16	28¾
2-TR-250-XX†	2	250	25x33x37 5/16	28¾
3-TR-250-XX†	3	250	29¾x29¾x36⅜	28¾
5-TR-250-XX†	5	250	25x33x37¼	28¾
4-TR-300-XX†	4	300	39½x47½x50½	35

**Dimensions are nominal. Outline drawings available on request.

†NOTE — Add the following suffix in place of XX

For	Suffix	For	Suffix
120/120	11	240/120	21
120/240	12	240/240	22

††If shielded polyethylene output cables are desired in place of porcelain insulator, designate by a C prefix; e.g., 1-CTR-30-XX.

Models also available with two shielded polyethylene output cables in place of porcelain insulator. (See footnote.)

LOW VOLTAGE ISOLATION TRANSFORMERS
OPEN TYPE CONSTRUCTION — FLEXIBLE LEADS

Primaries: 208 V, 230 V — 60 cps ***Secondaries: 115 V***
Hi-Pot 1500 V RMS — 60 cps

Type	KVA	Size	Mtg. Dim.
AD1650	.05	2⅝x2⅝x3⅛	2x2⅜
AD1651	.100	2⅞x3x3½	2¼x2⅝
AD1652	.200	3⅞x3¾x4⅝	3x3
AD1653	.300	4½x3¾x5⅜	3½x2⅞
AD1654	.500	5⅜x4½x6⅝	4¼x3⅜
AD1655	1.000	5¾x5½x7	5x4¼
AD1656	1.500	6⅝x6⅜x7⅞	5½x5⅛
AD1657	2.500	7⅞x6¼x9⅜	6¾x4½

VDU-UNCASED TRANSFORMER FOR VOLTAGE DOUBLER OR ONE END GROUND OPERATION

Primary: 115 V — 50/60Hz

The VDU 2.5 and VDU 5 Transformers, (as well as the EGU 2.5 and EGU 5 units), are designed for air insulation. All other transformers of this series are designed for oil operation and, therefore, must be immersed in oil by the customer prior to placing in operation.

However, the VDU 7.5 (EGU 7.5) up to VDU 30 (EGU 30) transformers can be furnished with epoxy coating for use in air at slight additional charge.

All VDU (Voltage Doubler Uncased) and EGU (End Ground Uncased) units oil immersed are available in sturdy tanks including poreclain insulators.

Type	Sec. Peak Volts	Max. Sec. Current (MA rms)	Size	Insulation Required
VDU2.5-1 EGU2.5-1	2500	10	4¼x2½x3½	Solid Compound
VDU5-1 EGU5-1	5000	10	4½x3½x4	"
VDU7.5-1 EGU7.5-1	7500	10	4½x4x5½	Oil
VDU10-1 EGU10-1	10,000	10	4¾x4½x7	Oil
VDU15-1 EGU15-1	15,000	10	7x6x6	Oil
VDU20-1 EGU20-1	20,000	10	7½x5x7	Oil
VDU30-1 EGU30-1	30,000	10	9¼x5½x9¼	Oil
VDU50-1 EGU50-1	50,000	10	10½x7x11	Oil
EGU100-1	100,000	10	14¼x9½x15	Oil
EGU150-1	150,000	10	14⅛x10x16½	Oil
VDU2.5-3 EGU2.5-3	2500	30	3 9/16x3x4¼	Solid Compound
VDU5-3 EGU5-3	5000	30	4½x4 5/16x5⅜	"
VDU7.5-3 EGU7.5-3	7500	30	6½x4⅛x6⅜	Oil
VDU10-3 EGU10-3	10,000	30	7x4½x6¾	Oil
VDU20-3 EGU20-3	20,000	30	8⅞x6x9⅞	Oil
VDU30-3 EGU30-3	30,000	30	11⅞x7½x12½	Oil
VDU50-3 EGU50-3	50,000	30	11⅜x10x14¾	Oil
EGU100-3	100,000	30	12⅞x12x17	Oil
EGU150-3	150,000	30	16⅛x13¾x20½	Oil

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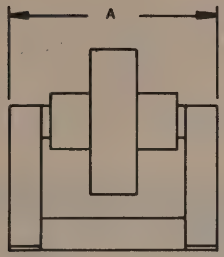
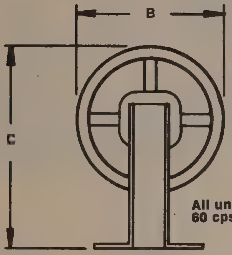
TRANSFORMERS

LOW CAPACITY FILAMENT TRANSFORMERS





All units 60 cps

Type	Primary Volts	Sec. Volts	Sec. Amps	Insul. KV DC	Air Cap. uuf	Size a x b x c
AD2980	115	5	1.5	20	15	4¾x3¼x4¾
AD2911	120	6.3	1.3	15	12	3⅞x3½x4⅞
AD1431	115	5	2	6	10	4¾x3½x5½
AD1898	115	2.5	5	25	15	5¼x5½x7¾
AD1570	115	6.3CT	2	12	12	4¾x3¾x5½
AD1877	115	4	4	10	7	8¼x4x9
AD3159	115	6	3	20	10	6⅝x5½x9
AD1421	115	12.6	1.5	15	8	6½x5¼x9
AD876	117	6.3	6	20	15	6½x5¾x8¼
AD874-1	115	5	5	25*	10	9¾x9½x14¼
AD2372	115	25	1	15	30	6¾x6¼x9½
AD2905	208	9	3.5	20	16	6½x5¾x8¼
AD1409	115	8	4	20	10	6¾x6¼x9½
AD2044	120	15	3	12	20	6½x6¾x8½
AD1316	115	8	6	12	15	6½x6¾x8½
AD2520	115	10	5	18	20	8x7x10
AD3003	115	14	3.5	20	15	5¾x6½x8¼
AD2129	115	6.3	11	15	15	9½x7x10¾
AD1505	115	6.3	12		15	9¼x6x9¼
AD2126	115	14	6	6	25	6½x7x9½
AD2289	115	115	.750	6	25	7⅛x5¾x8
AD420	210	6.3	15	40	25	9¾x9x14¾
AD2704	115	10	10	25	8.5	7x6¾x9¾
AD2408	115	20	5	20	15	9¼x7½x11
AD1610	115	6	20	25	12	9¼x7½x11
AD1097	115	10	12.5	25	20	9¼x7x10½
AD2484	115	5	30	60	25	11½x11x16½
AD2782	115	15	10	25	10	7⅛x7⅞x10⅜
AD2738	115	30	5	30	10	7⅛x7⅞x10⅜
AD839	200	14.5	150	35*	30	10¼x11x16
AD1365	115	10	25	30	15	10½x8¼x13
AD419	210	6.3	40	40	25	10x10½x16½
AD2705	115	15	20	25	10	8x8½x10⅝
AD1581	115	5/11.5	30/15	15	15	12¼x6¾x10½
AD2623	110	110	2.8	30	14	10½x8½x13
AD2478	117	70	10	50	30	13¼x12x18½
AD3030	115	115	8.5	25	30	10¾x10¾x14
AD2356	117	117	10.2	15	40	9x8½x11¾
AD3194	230	230	5.2	30	40	9¾x10x14
AD3195	230	12	200	30	40	12¼x11⅝x16¾
AD2350	120	120	16.6	30	35	15½x11x16½

*To be used in oil.

ALL UNITS DESIGNED FOR 60 CPS LINE

HIGH VOLTAGE FILAMENT TRANSFORMERS

Type	Sec. Volts	Sec. Amps	Isolation KV DC (Working)	Size a x b x c
AD3229	2.5	1	10 KVDC	2¾x2⅛x2⅜
AD3228	2.5	3	10 KVDC	2⅝x2⅜x3⅛
AD3232	2.5	5	10 KVDC	3x2⅝x3½
AD3227	5	1	10 KVDC	2⅝x2⅜x3⅛
AD3231	5	3	10 KVDC	3x2⅝x3½
AD3234	5	5	10 KVDC	3¼x2⅝x3⅞
AD3226	6.3	1	10 KVDC	2⅝x2⅜x3⅛
AD3230	6.3	3	10 KVDC	3x2⅞x3½
AD3233	6.3	5	10 KVDC	3¼x2⅞x3⅞
AD3235	2.5	1	20 KVDC	3⅝x2½x3¼
AD3236	2.5	3	20 KVDC	4½x3x4
AD3237	2.5	5	20 KVDC	4⅜x3½x4⅜
AD3238	5	1	20 KVDC	4½x3x4
AD3239	5	3	20 KVDC	4⅜x3½x4⅜
AD3240	5	5	20 KVDC	4⅞x3½x5⅛
AD3241	6.3	1	20 KVDC	4½x3x4
AD3242	6.3	3	20 KVDC	4⅜x3½x4⅜
AD3243	6.3	5	20 KVDC	4⅞x3½x5⅛
AD3244	2.5	1	30 KVDC	4⅞x3¼x4⅞
AD3245	2.5	3	30 KVDC	4⅞x4x5¼
AD3246	2.5	5	30 KVDC	5¾x3¾x5¼
AD3247	5	1	30 KVDC	4⅞x3½x5
AD3248	5	3	30 KVDC	5¾x3¾x5¼
AD3249	5	5	30 KVDC	6¼x3¾x6½
AD3250	6.3	1	30 KVDC	4⅞x3½x5
AD3251	6.3	3	30 KVDC	5¾x3¾x5¼
AD3252	6.3	5	30 KVDC	6¼x3¾x6½

All Primaries: 115 Volts 60 Cycles

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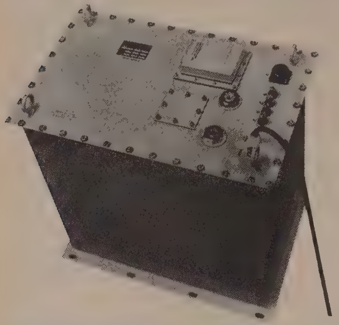
HIGH VOLTAGE METER MULTIPLIERS

In each model listed:

- All resistors are immersed in high-grade insulating oil
- Case is hermetically sealed and grounded
- Multiplier is designed for use with a 100 μa full-scale meter
- Neon lamp is provided across the meter terminals to assure safe operation

Model No.	Max. Voltage (KV)	Dimensions (In., w x d x h)	Height (Inches) Insulator
M-5	5	2 5/16x2 1/16x2½	1 7/16
M-10	10	2 5/16x2 1/16x2½	2
M-15	15	2 5/16x2 1/16x3⅛	2⅜
M-20	20	2¾x2⅜x3 13/16	2⅜
M-30	30	4 5/16x3 11/16x5 9/16	2⅞
M-50	50	5x4¼x6¾	8⅛
M-75	75	6x7½x8½	9⅞
M-100	100	10¾x10¾x10	14
M-150	150	12½x12½x12⅝	19½
M-250	250	16½x16½x22	28¾

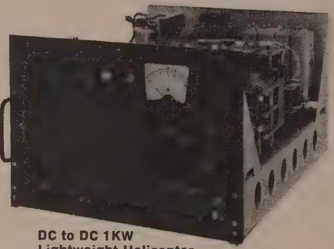
TYPICAL CUSTOM-BUILT POWER SUPPLIES and RELATED EQUIPMENT



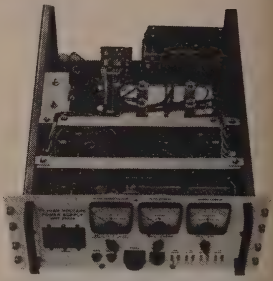
Model A8604 3KW 30KV .03% Regulated Power Supply for TWT Application

300,000 Volt DC Regulated High Voltage Power Supply

60KV Compact Paint Spray Power Supply

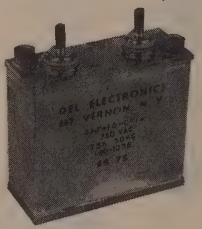


DC to DC 1KW Lightweight Helicopter Power Supply



Model A10825 Balloon Borne TV Power Supply

Custom designed Capacitors



Extremely compact Water Cooled Capacitor rated at more than 55 KVA continuous duty, currently in production. This unit represents one of the most unique designs in the industry today. Size: 5″ x 2″ x 4½″ high.

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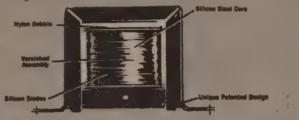
WALL PLUG-IN LOW VOLTAGE

CONVERTERS/INVERTERS/CHARGERS

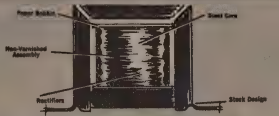
To insure high quality and top performance in our plug-in power supplies and chargers, we make our own low voltage

TRANSFORMERS

using superior materials in a smaller sized unit. The years of successfully satisfying the unique needs of the industry with specialty transformers is "at your service".



WHY IS THIS LOW COST DYNAMIC TRANSFORMER BETTER THAN THIS



STOCK TRANSFORMER COSTING MORE.

In addition to those advantages already pointed out, DYNAMIC TRANSFORMERS can be made to your SPECIFICATIONS in days and in most cases with NO COST for prototypes.

TRANSFORMERS FOR ALL REASONS

- ☐ Patented, U/L listed
- ☐ Internal or External
- ☐ Wall-mounted
- ☐ Fast-charging
- ☐ Power conversion
- ☐ Conversion/charging
- ☐ Printed circuit
- ☐ Sub-miniature
- ☐ Ferro-resonant
- ☐ Multi-input
- ☐ Multi-output

THE TRANSFORMATION OF POWER

A unique brochure explaining the many advantages and application possibilities of Dynamic's patented U/L listed transformers, converters, chargers and power supplies, technical data sheets and bulletins, are available on specific products. A request on your letterhead or phone our Sales Engineering Department WPX-1.

Designed to be listed under the U/L • CSA SPECIFICATIONS

Illustrated at right is the Model 3-1743 presently in production for use with a keyboard logic circuit. Suitable for minicomputers, calculators, remote CRT terminals, etc.

Dynamic Instrument Corp. has designed, developed and patented a complete range of low-voltage, filtered, transistor-regulated power supplies and chargers designed to supply the necessary power to a vast variety of Electronic equipment.

Utilizing a wall plug-in type unit eliminates or greatly reduces the problems involved with UL listing your product. They also remove the major heat source, reduce size and weight, and also greatly increase your design flexibility. The latest design applications of the Dynamic wall plug-in supplies are in conjunction with such sophisticated equipment as mini-computers, calculators, keyboard logic circuits, and remote CRT Terminals.

Just call or write: Dept. WPX-1.

Dynamic's product range and capabilities also cover:

POWER CONVERSION
AC-AC for products requiring low-level AC voltage. AC-DC for small electric motor driven products that do not use batteries.

SECONDARY BATTERY CHARGING
Dynamic Chargers for charging Nickel-Cadmium; Lead-Acid and Manganese-Alkaline Batteries.

AC-DC CONVERSION/CHARGING
Dynamic Converter-Chargers providing rechargeability or instant use of battery operated products.

FAST CHARGING SYSTEMS
Dynamic design and production capability relative to Fast Charging Systems.

TRANSFORMERS
Internal, External and Wall-Mounted Dynamic Transformers.

SPECIALTY TRANSFORMERS
Dynamic Plug-In, Printed Circuit Transformers; Sub-Miniature Transformers; Ferro-resonant Transformers; Multi-Input Voltage and Multi-Output Voltage Transformers.

CONVERTER/CHARGER FOR PORTABLE MEDICAL-ELECTRONIC EQUIPMENT

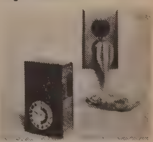
CHARGER FOR BATTERY ELECTRIC-STARTER SYSTEMS

CHARGER FOR BATTERY OPERATED TOYS

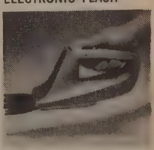
CONVERTER/"FAST" CHARGER FOR MINI-CALCULATORS

CONVERTER/CHARGER FOR MOTER DRIVEN CAMERAS

AC CONVERTER FOR PORTABLE ELECTRONIC EQUIPMENT



"FAST" CHARGER FOR ELECTRONIC FLASH



DYNAMIC INSTRUMENT CORP.

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Hauppauge, N.Y. 11787
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TWX 510-227-9884 CABLE ADDRESS "DYNINST" HAUPPAUGE, N.Y.

DYNAGE OPEN FRAME POWER SUPPLIES

WHERE QUALITY IS NOT EXPENSIVE

Dynage single, dual, triple output M Series Power Supplies featuring:

- Integrated circuit control
- High power per dollar ratio
- High MTBF. Few components
- Construction:
  Anodized aluminum chassis
  Glass-Epoxy FR-4 PC boards
  Computer — grade electrolytics
  Teflon wiring

Specifications:

Input:
105-125 VAC-47 to 420 Hz.
Optional: 210-250 VAC.

Output:
See models and ratings.

Adjust Range:
± 5% at ratings listed.

Regulation:
Line only ± .05% (10 VAC change from nominal).
Load only ± .2% (0 to full load).
+ .1% (50% load change).

Remote Sense: Optional.

Ripple and Noise (PARD):
5 + 15 volt outputs — 1 mv rms max.

24 volt sections — 3 mv rms max.

Temperature:

- Operating 0°C to 71°C with ratings at:
  0° to + 40°C — full rating.
  + 50°C — 80% rating.
  + 60°C — 60% rating.
  + 71°C — 38% rating.
- Storage −20°C to + 85°C.

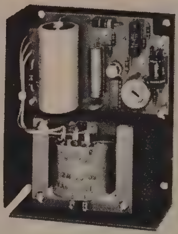
Temperature Coefficient:
± 0.02% per degree C maximum.

Stability:
0.1% for 8 hours after warm-up.

Short Circuit and Overload Protection:
Standard.

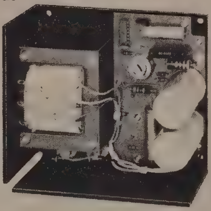
Transient Response:
10 microseconds for 25% load change, typical.

Type MA
Single Output



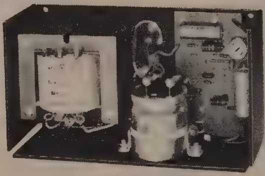
Model No.	DC Volts	Output AMPS
MA5-3	5 6	3 2.5
MA15-1.3	12 15	1.5 1.3
MA24-1	18 20 24	1.0 1.0 1.0

Type MB
Single Output



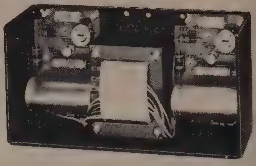
Model No.	DC Volts	Output AMPS
MB5-6	5 6	6 5
MB15-2.8	12 15	3.0 2.8
MB24-2.3	18 20 24	2.0 2.3 2.3

Type MC
Single Output



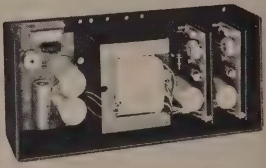
Model No.	DC Volts	Output AMPS
MC5-12	5 6	12 10
MC15-6	12 15	6.5 6.0
MC24-5	18 20 24	4.0 4.5 4.0

Type 2M
Dual Output



Model No.	DC Volts	Output AMPS
2MA12	± 12	1.5
2MA15	± 15	1.3
2MB12	± 12	3.0
2MB15	± 15	2.8

Type 3M
Triple Output



Model No.	DC Volts	Output AMPS
3MA5-12	5 ± 12	6 1.5
3MA5-15	5 ± 15	6 1.3
3MB5-12	5 ± 12	12 1.5
3MB5-15	5 ± 15	12 1.3
3MC5-12	5 ± 12	12 3
3MC5-15	5 ± 15	12 2.8

Overvoltage Protectors fit all M Series models. Model MVP-1

Other quality Dynage Products:

System power supplies and voltage references. Write for Catalog 73-1.

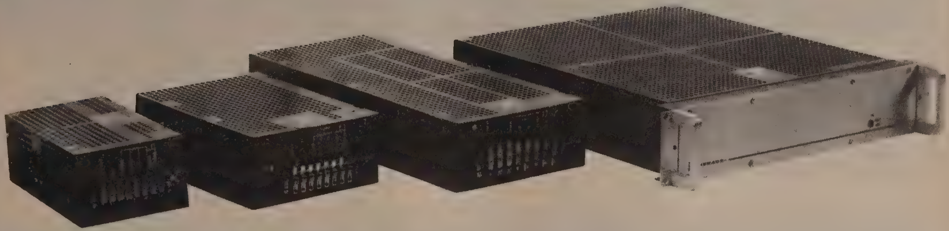
Solid State logic systems for industrial controls. Write for Bulletin PB2-72.

DYNAGE

Dynage Inc., 1331 Blue Hills Ave.
Bloomfield, Connecticut 06002
Telephone (203) 243-0315
TWX 710-425-6063

DYNAGE inc.

L SERIES FOR LOGIC APPLICATIONS, BUILT-IN O/V, STANDARD



SPECIFICATIONS

Input: 105-125 VAC, 47-420 Hz

Output (Floating): See table of Models

Output Voltage Adjustment: ±5% from nominal. See range in table of models

Resolution of Adjustment: 0.5%

Regulation: Line only: ±0.2% for ±10 VAC at constant load
Load only: ±0.3% for 0 to full load at 115 VAC
±0.2% for 25% load change at 115 VAC
Combined: ±0.5% for combined ±10 VAC change and 0 to full load variation

Ripple and Noise: 0.1% RMS max. — 1.0% P-P max.

Temperature: Operating: −20°C to +71°C (see current ratings at three temperatures)
Storage: −62°C to +85°C
Coefficient: ±0.05%/°C from −20°C to +71°C

Electronic Short Circuit Protection: Foldback type. Standard, all Units. Max Current approximately 125% of full load current. At short circuit current is approximately 25% of rated full load current at 50°C.

Overvoltage Protection: Adjustable, set for approximately 130% of output voltage at no load when shipped. Range: 110-150%

Overtemperature Protection: Standard, all Units

Remote Programming (Resistance): Standard, all Units (100 ohms per volt)

Remote Sensing: Standard, all Units

Parallel Operation: Current Sharing within ±10%

OPTIONS AVAILABLE

MODEL NUMBER Suffix required	OPTION
F (Specify level)	Fixed output (to ±1%)
FF (Specify level)	Fixed output (to ±0.25%)
M	Meters (E Case only); Voltage and current — 1 pair
N	230 VAC input

CASE SIZES:

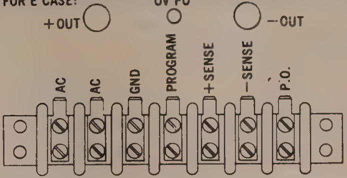
B	$3\frac{3}{16}'' \times 4\frac{15}{16}'' \times 9\frac{3}{8}''$
C	$3\frac{3}{16}'' \times 7\frac{1}{8}'' \times 9\frac{5}{8}''$
D	$3\frac{3}{16}'' \times 8'' \times 16\frac{1}{2}''$
E	$3\frac{15}{32}'' \times 16\frac{5}{8}'' \times 17''$

OTHER DYNAGE POWER SUPPLY PRODUCTS

H Series: high performance systems supplies
K Series: dual enclosed models
WR Series: wide range models
Voltage References: for systems applications

TERMINATIONS

FOR E CASE:



FOR B, C, D CASES:

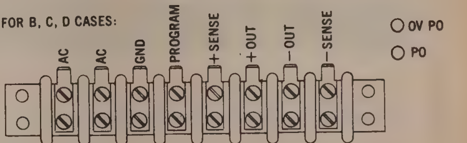


CHART DATA

OUTPUT VOLTAGE RANGE	OUTPUT CURRENT (AMPS)			CASE SIZE	MODEL NUMBER
	50°C	60°C	71°C		
5.0-5.5	12.0	11.0	9.7	B	L-5.25-12
5.0-5.5	18.0	16.4	14.5	C	L-5.25-18
5.0-5.5	31.0	28.0	25.0	D	L-5.25-31
5.0-5.5	75.0	68.0	61.0	E	L-5.25-75
12.0-13.2	6.5	5.9	5.3	B	L-12.6-6.5
12.0-13.2	10.0	9.1	8.1	C	L-12.6-10
12.0-13.2	18.0	16.4	14.5	D	L-12.6-18
12.0-13.2	40.0	36	33	E	L-12.6-40
15.0-16.5	5.6	5.1	4.6	B	L-15.7-5.6
15.0-16.5	8.4	7.6	6.8	C	L-15.7-8.4
15.0-16.5	15.0	13.6	12.2	D	L-15.7-15
15.0-16.5	36	33	29	E	L-15.7-36
24.0-26.4	3.6	3.3	2.9	B	L-25.2-3.6
24.0-26.4	5.8	5.3	4.7	C	L-25.2-5.8
24.0-26.4	10	9.1	8.1	D	L-25.2-10
24.0-26.4	24	21.8	19.5	E	L-25.2-24

UL RECOGNIZED
SEND FOR COMPLETE CATALOG

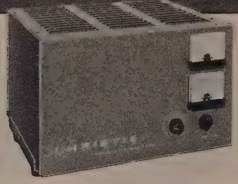
DYNAGE inc.
1331 BLUE HILLS AVENUE, BLOOMFIELD, CONN. 06002
TEL: (203) 243-0315 TWX: 710-425-6063

CHRISTIE SINCE 1929 ELECTRIC CORP.

BATTERY CHARGERS & BATTERY PACKS

REV CHARGER FOR LEAD-ACID & SILVER-ZINC

Nominal Battery Voltages	Std. Current Ratings (amps)	Service	Typical Regulation	Typical Ripple	A-C Input
6, 12, 24 12, 24, 36 36, 48 72, 120	25, 50 150* 25, 50, 60*, 130* 12, 25, 30*, 50, 60*, 100*	Float or Charge	±0.25%	1%	Ratings with * are 3-ph; all others 1-ph.

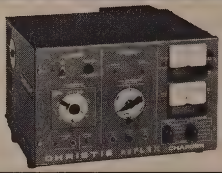


REFLEX® CHARGER & ANALYZER FOR LARGE NI-CADS

Patented charging principle employs DEPOLARIZATION PULSES to reduce battery impedance, gassing & heating, resulting in —

- 1 HOUR FULL CHARGE
- Higher battery capacity (over 130% not unusual)
- Frequent battery rejuvenation
- Better cell balance, less "memory"
- 95% vs. conventional 70% charging efficiency

	Model	For Sintered, Vented Ni-cad Batteries Rated	
CHARGER-ANALYZER	RF80GT	19, 20, 22 cell 6-55 A-H	11 cell 40-55 A-H
CHARGER only	RF80G	19, 20, 22 cell 6-55 A-H	11 cell 40-55 A-H

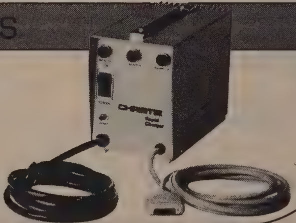


RAPID CHARGER® FOR SMALL NI-CADS

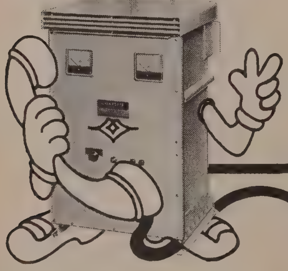
Patented REFLEX battery charging principle, employing depolarization pulses, provides 20-minute rapid charge for sealed cylindrical ni-cads.

Services battery packs from ½ AA to D and larger sizes.

Standard & Custom Chargers available.



TALK TO THE CHRISTIE



OUTSIDE CALIFORNIA
CALL TOLL-FREE 24 HRS
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SINCE 1929
CHRISTIE
ELECTRIC CORP.
3404A WEST 67TH STREET
LOS ANGELES, CALIFORNIA • 90043
(213) 750-1151 • TWX 910-321-3867

NI-CAD BATTERY PACKS

Produced specifically for Christie Rapid Charger. Also delivers superior performance with conventional chargers.

Stringent 3-way cell matching provides superior characteristics, more dependable performance.

4-way control and safety features.

Standard & Custom Battery Packs available.

ELECTRO-OPTICAL SYSTEMS

CHRISTIE XENOLITE®

XENON AND MERCURY
ARC LAMP SYSTEMS
Lamphouses ▪ Power Supplies
Igniters ▪ Optics ▪ Bulbs
Slide Projectors

SEE OUR OTHER PAGE IN THIS SECTION ON MILITARY AND D-C POWER SUPPLIES, PAGE 1•1186

DELTEC equipment has a reputation for providing quality power with the highest reliability available at an economical life-cycle cost.

The systems can solve power problems — blackouts, brownouts, transients — that cause poor performance or expensive downtime on critical electronic or computer systems. They are easily installed and maintained by the customer and can be counted on to work when needed.

Contact Deltec if your application requires special design considerations such as:

- Unusual input/output combinations — voltage, frequency, phasing
- Monitoring or control circuits
- Packaging

WRITE FOR FREE APPLICATIONS ASSISTANCE BROCHURES

Deltec has several pamphlets to assist you in understanding, evaluating and solving your power problems. They are:

Super-Isolation Transformer/Line Conditioner Installation Handbook
Super-Isolation Transformer/Line Conditioner Selection Guide
UPS System Selection Guide
UPS System Specification Check List

ISOLATED AC LINE CONDITIONERS
IVACON®
1200 VA TO 5 KVA

DELTEC
AC LINE CONDITIONER

DLC 3060

- **PURE SINE WAVE OUTPUT**
- **HIGH EFFICIENCY**
- **WIDE INPUT VOLTAGE RANGE**
- **ELIMINATE COMMON-MODE NOISE & GROUND LOOPS, BROWNOUT PROBLEMS**
- **OVERLOAD & SHORT-CIRCUIT PROTECTION**

AC Output
Regulation: ± 3% of Nominal Output
Isolation: Input to Ouptut Capacitance .005 pf

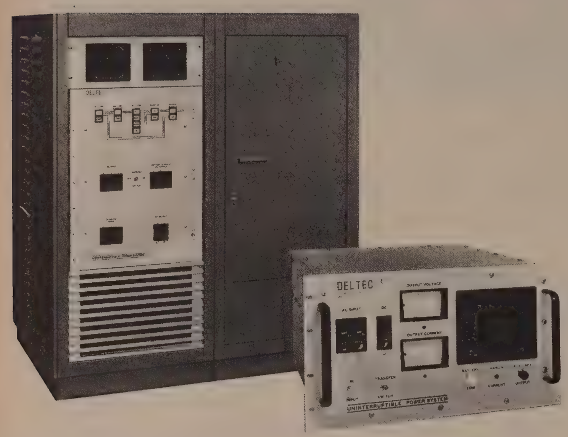
Normal-Mode Noise
Suppression: >120 db, 1 KHz to 1 MHz
Harmonic Distortion: <5%, 50% — 100% Load

Model Number	Input*		Output		Circuit Breaker	Meters	H	W	D	Price Each
	Volts AC	Freq Hz	Volts AC	Power VA						
DLC 1260	90-125	58-62	115	1,200	Yes	Yes	7	17	14¼	720.00
DLC 1260A	90-125	58-62	115	1,200	No	No	7	17	14¼	490.00
DLC 1262	190-270	58-62	230	1,200	Yes	Yes	7	17	14¼	745.00
DLC 1262A	190-270	58-62	230	1,200	No	No	7	17	14¼	535.00
DLC 1860	90-125	58-62	115	1,800	Yes	Yes	10½	17	20	995.00
DLC 1860A	90-125	58-62	115	1,800	No	No	10½	17	20	685.00
DLC 1862	190-270	58-62	230	1,800	Yes	Yes	10½	17	20	1,025.00
DLC 1862A	190-270	58-62	230	1,800	No	No	10½	17	20	720.00
DLC 3060	90-125	58-62	115	3,000	Yes	Yes	14	17	20	1,355.00
DLC 3060A	90-125	58-62	115	3,000	No	No	14	17	20	955.00
DLC 3062	190-270	58-62	230	3,000	Yes	Yes	14	17	20	1,410.00
DLC 3062A	190-270	58-62	230	3,000	No	No	14	17	20	1,010.00
DLC 5060	90-125	58-62	115	5,000	Yes	Yes	14	17	20	1,865.00
DLC 5060A	90-125	58-62	115	5,000	No	No	14	17	20	1,450.00
DLC 5062	190-270	58-62	230	5,000	Yes	Yes	14	17	20	2,210.00
DLC 5062A	190-270	58-62	230	5,000	No	No	14	17	20	1,625.00

* Regulation available to 70 VAC input at 80% load factor.

DELTEC
CORPORATION 980 BUENOS AVENUE • SAN DIEGO. CALIFORNIA 92110 • TELEPHONE (714) 275-1331

UNINTERRUPTIBLE POWER SYSTEMS FROM 700 VA TO 30 KVA SINGLE AND THREE PHASE



5255
15KVA

DSU 710
700 VA

- **ON-LINE SYSTEMS (NO-BREAK POWER)**
- **REDUNDANT SYSTEMS AVAILABLE**
- **OVERLOAD/SHORT-CIRCUIT PROTECTION**
- **ALL SOLID STATE — MODULAR (EASILY MAINTAINED)**
- **PURE SINE WAVE OUTPUT — REGULATED AND TRANSIENT-FREE**
- **HIGH EFFICIENCY**

Output Power VA	Input			Output		Battery (External)	H x W x D
	Model #	Phase	Hz	Phase	Hz		
1,800	5244	1	47-63	1	60	48 VDC	53 x 24 x 32
	5245	1	47-63	1	60	125 VDC	
3,000	5246	1	47-63	1	60	48 VDC	53 x 24 x 32
	5247	1	47-63	1	60	125 VDC	
5,000	5248	1	47-63	1	60	125 VDC	53 x 24 x 32
	5249	3	47-63	1	60		
7,500	5250	3	47-63	1	60	125 VDC	53 x 24 x 32
10,000	5254	3	47-63	1	60	125 VDC	53 x 46 x 32
15,000	5255	3	47-63	1	60	125 VDC	53 x 46 x 32
20,000	5256	3	47-63	1	60	125 VDC	53 x 68 x 68
25,000	5257	3	47-63	1	60	125 VDC	(2) 53 x 46 x 32
30,000	5258	3	47-63	1	60	125 VDC	(2) 53 x 46 x 32
5,400	5262	3	47-63	3	60	125 VDC	53 x 46 x 32
9,000	5263	3	47-63	3	60	125 VDC	53 x 46 x 32
15,000	5264	3	47-63	3	60	125 VDC	53 x 68 x 32
22,500	5265	3	47-63	3	60	125 VDC	(2) 53 x 46 x 32
30,000	5266	3	47-63	3	60	125 VDC	(2) 53 x 46 x 32

NOTE:
1) Battery chargers for external battery systems are sized for reservoir up to 1 hour backup time, others available on request. Backup time to be specified by customer.
2) Single phase input/output voltages available – 115 to 440 VAC (customer specified).
3) Three phase input/output voltages available – 208 to 480 VAC (customer specified).

STANDARD OPTIONS
Sensors, Alarms, Controls
Static Reverse Transfer Swtich (4 ms)
Frequency Synchronization and Phase Lock

"5000" Series Models are capable of providing long-term battery power for medium- to large-capacity loads. The basic system consists of: circuit breakers, rectifier/battery-charger, inverter and minimal sensing and control circuitry. Modular design permits building the system to customer requirements.

"DSU" Systems are low- to medium-power systems, rack-mountable and self-contained for simplicity of installation. Built-in gelled-electrolyte batteries provide reliable, maintenance-free power. The systems are complete with circuit breakers, rectifier/battery-charger, inverter, batteries, meters, sensors, alarms and control circuitry.

CONTACT DELTEC FOR NON-STANDARD SYSTEMS INCLUDING:

- Special Input/Output Combinations (Voltage, Phasing, Frequencies)
- Special Circuitry, Controls

Output Power VA	Model #	Input			Output			Battery	Backup Time	H x W x D
		VAC	Phase	Hz	VAC	Phase	Hz			
700	DSU 710	115	1	47-63	115	1	60	Internal	5-60 minutes	10½ x 17 x 20
1,200	DSU 1210	115	1	47-63	115	1	60	Internal	15-40 minutes	15¾ x 17 x 20
1,800	DSU 1810	115	1	47-63	115	1	60	Internal	10-30 minutes	24½ x 17 x 20

NOTE: The DSU Series is provided with sealed internal batteries.

DELTEC
CORPORATION 980 BUENOS AVENUE • SAN DIEGO, CALIFORNIA 92110 • TELEPHONE (714) 275-1331

DC TO AC INVERTERS
300 VA TO 10 KVA
SINGLE AND THREE PHASE

- SINE WAVE OUTPUT
- AC MOTOR START CAPABILITY
- RELIABLE 1/4-START SYSTEM
- OVERLOAD AND SHORT CIRCUIT PROTECTION

Input
VOLTAGES: 12/24 VDC, 48 VDC, 125 VDC, 250 VDC

Output
VOLTAGE: 115 VAC ±2 VAC (230 VAC available)
REGULATION: ± 3% of nominal for line and load changes
HARMONIC DISTORTION: < 5% near full load, nominal output

DELTEC
STATIC INVERTER
DELTEC
STATIC INVERTER

DI 5003

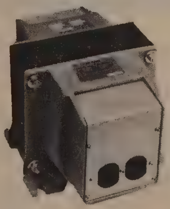
DI 701

Model #	Input VDC	Input Current		Power VA	Output VAC/Hz	Front Panel	Case*
		No Load	Full Load			H x W	H x W x D
DI 301	12/24	12/6	34/17	300	115/60	5.25 x 19	4.75 x 16.7 x 13.5
DI 302	48	3.5	10	300	115/60	5.25 x 19	4.75 x 16.7 x 13.5
DI 303	125	1.3	3.9	300	115/60	5.25 x 19	4.75 x 16.7 x 13.5
DI 701	12/24	22/11	84/42	700	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 702	48	6.3	21	700	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 703	125	2.4	8.0	700	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 704	250	1.2	4.0	700	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 1201	12/24	24/12	132/66	1,200	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 1202	48	6	33	1,200	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 1203	125	3.5	13	1,200	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 1204	250	1.8	6.5	1,200	115/60	8.75 x 19	8.25 x 16.7 x 18
DI 1802	48	12.5	50	1,800	115/60	14 x 19	13.5 x 16.7 x 20
DI 1803	125	4.8	19.2	1,800	115/60	14 x 19	13.5 x 16.7 x 20
DI 3002	48	21	84	3,000	115/60	—	30 x 17 x 21
DI 3003	125	8	32	3,000	115/60	—	30 x 17 x 21
DI 5003	125	13.8	53.5	5,000	115/60	—	30 x 17 x 21
DI 10003	125	26.6	107	10,000	115/60	—	53 x 45 x 32

*W — Case width only, screw heads protrude .17 inches each side
D — Case depth only, connectors protrude .5 inches on units through DI 1803
Connections on DI 3002 through DI 10003 are inside the case
WT — Weights are approximate

STANDARD OPTIONS
Input/Output Power Meters
Frequency Meters
Frequency Synch & Phase Lock
Static Transfer Switch (4 ms)

SUPER-ISOLATION TRANSFORMERS
60 Hz SINGLE PHASE MODELS



- STOP LINE NOISE
- ELIMINATE POWER AND SYSTEM GROUND LOOPS
- REMOVE ELECTROMAGNETIC NOISE

COMMON-MODE REJECTION:	>140 db
LOAD REGULATION:	±3%, Output to Input, no load to full load
INTERCOUPLING NOISE SUPPRESSION:	>150 db, 10 KHz to 1 MHz
ISOLATION:	Capacitance, .0005 pf or .001 pf Resistance, greater than 10,000 Megohms

Model Number*	Interwinding Capacitance	Power (VA)	Input/Output	Price Each
DT25R1 & DT25T1	.001 pf	250	120/120	105.00
DT25R5 & DT25T5	.0005 pf	250	120/120	140.00
DT50R1 & DT50T1	.001 pf	500	120/120	110.00
DT50R5 & DT50T5	.0005 pf	500	120/120	160.00
DT100R1 & DT100T1	.001 pf	1,000	120/120	180.00
DT100R5 & DT100T5	.0005 pf	1,000	120/120	255.00
DT250R1 & DT250T1	.001 pf	2,500	120/120	275.00
DT250R5 & DT250T5	.0005 pf	2,500	120/120	370.00
DT251R1 & DT251T1	.001 pf	2,500	240/120	305.00
DT251R5 & DT251T5	.0005 pf	2,500	240/120	405.00
DT500T1	.001 pf	5,000	120/120	410.00
DT500T5	.0005 pf	5,000	120/120	555.00
DT501T1	.001 pf	5,000	240/120	495.00
DT501T5	.0005 pf	5,000	240/120	645.00

*R Denotes Receptacle,
T Denotes Terminal on Input and Output

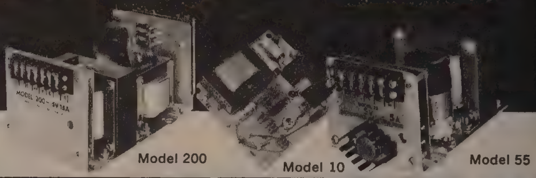
DELTEC
CORPORATION 980 BUENOS AVENUE • SAN DIEGO, CALIFORNIA 92110 • TELEPHONE (714) 275-1331

low cost
24-hour delivery
direct from stock

DC POWER SUPPLIES

QUALITY SUPPLIES SINCE 1965

SINGLES—DUALS—TRIPLES



60 WATTS $59

MODEL	VOLTAGE	AMPS
55 - 3	2.5 - 3.5	5.0
55 - 4	3.5 - 4.5	5.0
55 - 5	4.5 - 5.5	5.0
55 - 6	5.5 - 6.5	4.5
55 - 7	6.5 - 7.5	4.5
55 - 8	7.5 - 8.5	4.5
55 - 9	8.5 - 9.5	4.0
55 - 10	9.5 - 10.5	4.0
55 - 11	10.5 - 11.5	4.0
55 - 12	11.0 - 13.0	3.0
55 - 14	13.0 - 15.0	3.0
55 - 16	15.0 - 17.0	3.0
55 - 18	17.0 - 19.0	2.5
55 - 20	19.0 - 21.0	2.0
55 - 22	21.0 - 23.0	2.0
55 - 24	23.0 - 25.0	2.0
55 - 26	25.0 - 27.0	2.0
55 - 28	27.0 - 29.0	2.0
55 - 30	29.0 - 30.0	2.0
55 - 1212	±11.0 - 13.0	1.0
55 - 1515	±14.0 - 16.0	1.0
55 - 1818	±17.0 - 19.0	1.0

Size: 6.00 L x 3.50 W x 3.13 H Wt.: 4.25 lbs.

QUANTITY	PRICE	WITH OVERVOLTAGE
SINGLE (Models 55 - 3 thru 55 - 30)		
1 - 9	$59 ea.	$65 ea.
10 - 24	$56 ea.	$60 ea.
DUAL (Models 55 - 1212 thru 55 - 1818)		
1 - 9	$69 ea.	$79 ea.
10 - 24	$65 ea.	$74 ea.

10 WATTS $35

MODEL	VOLTAGE	AMPS
10 - 5	4.5 - 5.5	1.2
10 - 10	9 - 11	0.9
10 - 12	11 - 13	0.8
10 - 15	14 - 16	0.6
10 - 24	23 - 25	0.4
10 - 28	26 - 30	0.35
10 - 1212	±11 - 13	0.35
10 - 1515	±14 - 16	0.35
10 - 1818	±17 - 19	0.35

ANY OUTPUT TO 30 VOLTS AVAILABLE
Size: 4.5 L x 4.5 W x 1.63 H Wt.: 1.2 Lbs.

SINGLE	PRICE	WITH OVERVOLTAGE
1 - 9	$35 ea.	$40 ea.
10 - 24	$32 ea.	$36 ea.
DUAL		
1 - 9	$45 ea.	$55 ea.
10 - 24	$42 ea.	$51 ea.

30 WATTS $31

MODEL	VOLTAGE	AMPS
30 - 5	5	3.0
30 - 10	10	1.8
30 - 12	12	1.5
30 - 15	15	1.2
30 - 24	24	1.0
30 - 28	28	1.0

ANY OUTPUT TO 30 VOLTS AVAILABLE
Size: 4.0 L x 2.75 W x 4.5 H Wt.: 2.1 Lbs.

QUANTITY	PRICE	WITH OVERVOLTAGE
1 - 9	$31.00 ea.	$36.00 ea.
10 - 24	$29.20 ea.	$33.70 ea.

TRIPLE $70

MODEL	VOLTAGE	AMPS
300	5 V ±12 or 15 V	1 0.25
301	5 V ±12 or 15 V	5A 1A
302	5 V ±12 or 15 V	15A 2A

Size: 300 - 4.5 L x 4.5 W x 2.25 H
Wt.: 2 Lbs.
301 - 7.0 L x 6.0 W x 3.38 H
Wt.: 6 Lbs.
302 - 13.25 L x 6.0 W x 4.00 H
Wt.: 16.5 Lbs.

	MODEL	PRICE	WITH OVERVOLTAGE
1 - 9	300 - 12 300 - 15	$ 70 ea.	$ 80 ea.
	301 - 12 301 - 15	$ 99 ea.	$111 ea.
	302 - 12 302 - 15	$159 ea.	$174 ea.
10 - 24	300 - 12 300 - 15	$ 65 ea.	$ 75 ea.
	301 - 12 301 - 15	$ 93 ea.	$104 ea.
	302 - 12 302 - 15	$149 ea.	$163 ea.

200 WATTS $99

MODEL	VOLTAGE	AMPS
200 - 5	4.5 - 5.5	15.0
200 - 10	9.5 - 10.5	12.0
200 - 12	11.5 - 12.5	10.0
200 - 15	14.5 - 15.5	9.0
200 - 24	23.5 - 24.5	7.5
200 - 28	27.5 - 28.5	7.0
200 - 48	47.5 - 48.5	4.0
200 - 0505	± 4.5 - 5.5	7.0
200 - 1212	±11.5 - 12.5	5.0
200 - 1515	±14.5 - 15.5	4.5
200 - 2424	±23.5 - 24.5	3.5
200 - 2828	±27.5 - 28.5	3.5

ANY SINGLE OUTPUT TO 50 VOLTS AVAILABLE
ANY DUAL OUTPUT TO 30 VOLTS AVAILABLE
Size: 10.75 L x 5.50 W x 5.00 H Wt.: 15 Lbs.

SINGLE	PRICE	WITH OVERVOLTAGE
1 - 9	$99 ea.	$114 ea.
10 - 24	$94 ea.	$107 ea.
DUAL		
1 - 9	$119 ea.	$129 ea.
10 - 24	$113 ea.	$122 ea.

100 WATTS $72

MODEL	VOLTAGE	AMPS
100 - 5	5	10
100 - 10	10	7
100 - 12	12	6
100 - 15	15	6
100 - 24	24	4
100 - 28	28	3.5
100 - 0505	± 5	5
100 - 1212	±12	3.5
100 - 1515	±15	3
100 - 2424	±24	2
100 - 2828	±28	2

ANY OUTPUT TO 30 VOLTS AVAILABLE
Size: 7 L x 5.5 W x 5.5 H Wt.: 6 Lbs.

SINGLE	PRICE	WITH OVERVOLTAGE
1 - 9	$72 ea.	$78 ea.
10 - 24	$68 ea.	$73 ea.
DUAL		
1 - 9	$85 ea.	$97 ea.
10 - 24	$81 ea.	$91 ea.

ELECTRICAL SPECIFICATIONS: ALL MODELS

INPUT: 105-125 VAC. 50-420 Hz (230V OPTIONAL)
REGULATION: LINE: 0.005% or 2 MV MIN (10 VOLT CHANGE)
LOAD: 0.05% or 10 MV MIN (FULL LOAD CHANGE)
RIPPLE: LESS THAN 250 MICROVOLTS
IMPEDANCE: 100 Hz - 0.001 OHMS
1 KHz - 0.005 OHMS
10 KHz - 0.01 OHMS
100 KHz - 0.1 OHMS
RECOVERY TIME: 25 MICROSECONDS
OVERSHOOT: NONE ON TURN ON OR OFF
TEMPERATURE:
OPERATING −20 TO +71°C
STORAGE −65 TO +85°C
COEFFICIENT 0.01%/°C MAX
CURRENT LIMITING: FIXED - FOLD-BACK TYPE - AUTOMATIC RECOVERY
OUTPUT: FLOATING
SEMICONDUCTORS: SILICON
CAPACITORS: COMPUTER GRADE 10 YEAR LIFE
OVERVOLTAGE PROTECTION: OPTIONAL

ORDERING INFORMATION

All prices FOB San Diego
One Year Warranty
For Overvoltage Models Add -0 To Model Number
Free Catalog on Request

Prices and specifications subject to change without notice.

"Quality Power Supplies Since 1965"

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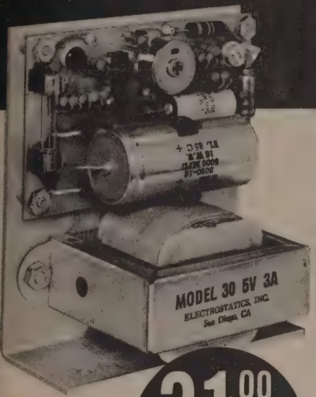
DIRECT FROM STOCK

5V3A



31^{00} (1-9)

$23.70 · 100 pcs.

Excellent regulation and ripple.

SPECIFICATIONS

Size: 4 x 4.5 x 2.75 overall
Input: 105-125V, 47-420 Hz
Output: Any DC voltage 3 to 30
Regulation: Line — 0.005%
Load — 0.05%
Ripple: Less than 250 Microvolts
Temp: Operative —40 to +71°C
Storage —65 to +85°C
Coefficient —0.01%/°C Max.
Current Limiting: Fixed Foldback Type
Overvoltage: Optional

MODEL	VOLTAGE	AMPS
30-5	5.0	3.0
30-10	10.0	1.8
30-12	12.0	1.5
30-15	15.0	1.2
30-24	24.0	1.0
30-28	28.0	1.0

ORDERING INFORMATION

QUANTITY	PRICE	WITH O.V.
1-9	$31.00	$36.00
10-24	29.20	33.70
25-49	26.60	29.90
50-99	25.10	28.20
100-	23.70	26.90

FULL RATING AT 71°C

CALL (714) 279-1414

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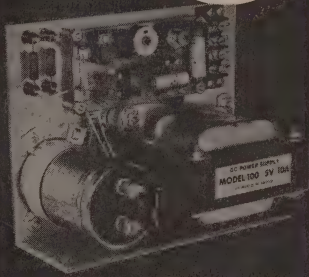
7718 CLAIREMONT MESA BLVD. • SAN DIEGO, CA 92111

DIRECT FROM STOCK

SINGLES 72^{00}



5V10A

SINGLES AND DUALS FULL RATING AT 71°C

SPECIFICATIONS

Size: 7 x 5.5 x 5.5 overall
Input: 105-125V, 47-420 Hz
Output: Any DC voltage 3 to 30
Regulation: Line — 0.005%
Load — 0.05%
Ripple: Less than 500 Microvolts
Temp. Operative —20 to +71°C
Storage —65 to +85°C
Coefficient —0.01%/°C Max.
Current Limiting: Fixed Foldback Type
Overvoltage: Optional

SINGLE OUTPUTS			DUAL OUTPUTS		
Model	Voltage	Amps	Model	Voltage	Amps
100-5	5.0	10.0	100-0505	5.0 5.0	5.0 5.0
100-10	10.0	8.0	100-1212	12.0 12.0	3.5 3.5
100-12	12.0	7.0	100-1515	15.0 15.0	3.0 3.0
100-15	15.0	6.0	100-2424	24.0 24.0	2.0 2.0
100-24	24.0	4.0	100-2828	28.0 28.0	2.0 2.0
100-28	28.0	4.0			

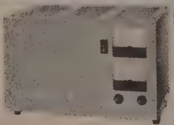
ORDERING INFORMATION

Quantity	Singles	With O.V.*	Duals	With O.V.*
1-9	$72 ea	$78 ea	$85 ea	$97 ea
10-14	68	73	81	91
25-49	62	67	73	83
50-99	57	61	67	76
100-	53	57	63	72

*O.V. = Overvoltage protection

CHRISTIE SINCE 1929 ELECTRIC CORP.

GENERAL PURPOSE HIGH CURRENT D-C POWER SUPPLIES



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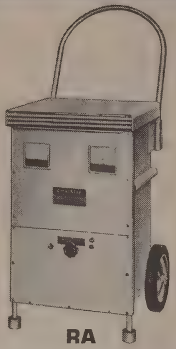

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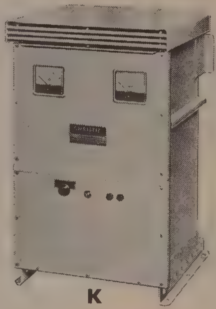

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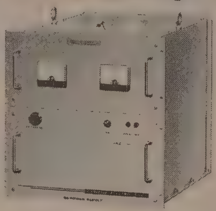
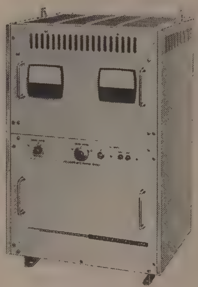


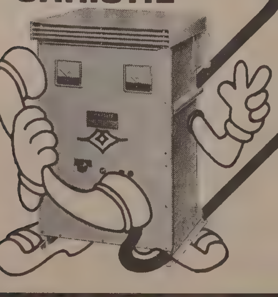
EE & M



KKGG

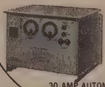
	Power Supply Series	D-C Output Volt Range	Std. Current Ratings (amps)	Inter-mittent Current Rating	Type of Regulator	Typical Regulation (±)	Typical Ripple	Typical Response Time	A-C Input
Most Economical	SCO	2-15 2-37 2-48	100 50 40	–	SCR	0.25%	1%	75 msec.	1-ph.
	RA	28	100, 200, 300, 400, 600, 1000	500%	Shunt	2% load	1%	–	3-ph.
	K	22-32 26-36(32) 110-135 220-280	50, 100, 200, 300 400, 500, 600, 800 1000, 1200, 1500 40, 60, 100, 200, 300 100	500%	Magamp	0.25%	1%	50 msec.	3-ph.
	M & EE	0-15 0-30 0-40 0-31/0-62 0-80 0-135	1000 1500 150, 300, 500, 600 700/350 125 75, 150, 300	–	SCR	0.1%	0.1%-0.4%	50 msec.	3-ph.
Most Sophisticated	KKGG	15(26)-36	50, 100, 200, 400, 600	–	Transistor	0.01%	0.0025%	0.05 msec.	3-ph.

TALK TO THE CHRISTIE

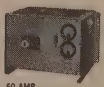


MILITARY POWER SUPPLIES & CHARGERS

Typical Special Army, Navy, Air Force, A.E.C. and NASA Units

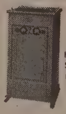


30 AMP AUTOMATIC BATTERY CHARGER



50 AMP RADIO POWER

75 AMP MISSILE TESTING SUPPLY



HELICOPTER STARTING POWER SUPPLY

175 AMP FORKLIFT TRUCK CHARGER

OUTSIDE CALIFORNIA
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SEE OUR OTHER PAGE IN THIS SECTION ON BATTERY CHARGERS & PACKS, PAGE 1•1180

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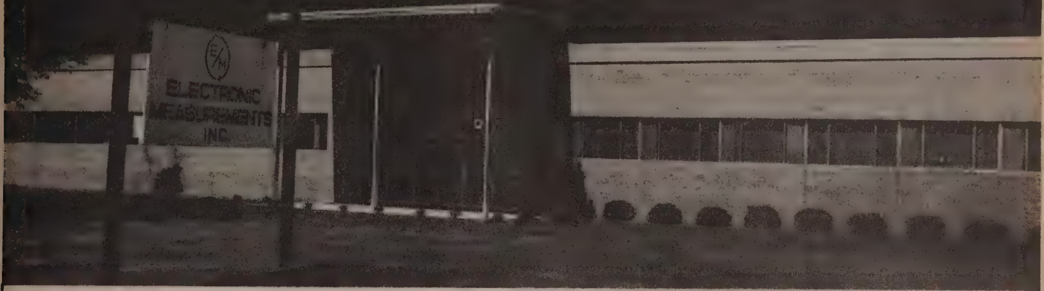
POWER SUPPLIES BY ELECTRONIC MEASUREMENTS INC.



Custom designed power supplies are nothing new at Electronic Measurements. Our design engineers can fulfill your most stringent application requirements.

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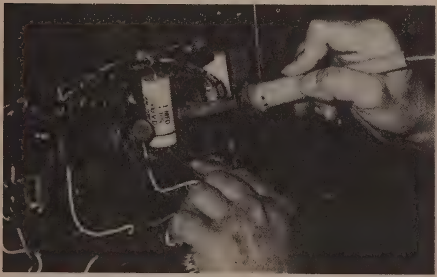

Handcrafted workmanship at each stage of assembly assures a high level of reliability. Every unit comes with a 5 year warranty and is backed by our over thirty years of experience in building power supplies.

Electronic Measurements designs and manufactures quality power supplies for a broad range of applications under clean, modern and environmentally controlled conditions.

E/M

ELECTRONIC MEASUREMENTS INC.

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Phone: (New Jersey) 201-922-9300 (Toll- Free) 800-631-4298
Specialists in Power Conversion Equipment

MORE

Precise Regulation Single Phase Input Power Supplies–500, 800, 1,600 & 2,400 Watt Units

Designed for a variety of applications, these high-efficiency 0.1% precision-regulated SCR power supplies provide from 500 to 2400 watts of true "constant voltage/constant current" power with automatic crossover depending upon load requirements. Overvoltage protection and a choice of input voltage are available as options. All SCR models are warranted for 5 years.

* **Maximum Watts per Cubic Inch**
* **Remote Sensing**
* **Remote Programming**
* **Series or Parallel Operation**
* **Designed for varied uses**
* **Rack or bench mounting**

AC INPUT:

500W, 800W & 1600W Models: 105-130V, 47-63Hz standard, 190-253V, 47-63Hz optional. 2400W Models: 190-253V,47-63Hz standard. Power Factor: 75% minimum. For input currents, see rating table. 500W/800W units shipped with 6ft. (1.83m) line cord and plug. 1600W & 2400 units have barrier strip for AC input.

REGULATION:

Voltage Mode:

For line voltage variations and load current variations within the rating of the supply, the output voltage will not vary more than 0.1% of the maximum voltage rating. This measurement may be affected by the fact that the RMS content of the ripple exceeds the amount of the output change allowed (0.1%). On an average-responding meter the regulation typically approaches 0.02%.

Current Mode:

For line voltage variations and load voltage variations within the rating of the supply, the output current will not vary more than 0.25% of the maximum current rating. This measurement is affected by the fact that the RMS content of the ripple exceeds the amount of output change allow- (0.25%). On an average-responding meter the regulation typically approaches 0.1%

RIPPLE:

Measured with either positive or negative grounded or output floating at nominal 117 VAC or 220 VAC and 100% output voltage and current into a resistive load. (See Rating Table). Ripple increases by 3% for each 1% increase in line voltage above nominal. Ripple decreases by 2% for each 1% decrease in line voltage below nominal. Ripple at 50Hz AC input is 30% above 60Hz ratings.

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Models & Rating Table For Single Phase Input SCR Units

VOLTAGE	CURRENT	CV-rms RIPPLE	CC-rms RIPPLE	% EFF.	AC input I NOM. E.	PRICE $
0-7.5	100	75mv	1000ma	63	13	650
	180	80mv	1920ma	65	26	850
	250	80mv	2990ma	66	20	1100
0-10	40	80mv	320ma	65	7.5	450
	80	75mv	600ma	65	13	600
	150	80mv	1200ma	68	26	850
	210	80mv	1680ma	69	19	1100
0-20	25	80mv	100ma	68	7.5	450
	40	60mv	120ma	67	13	600
	80	80mv	320ma	70	25	800
	120	80mv	480ma	73	18	1000
0-40	13	100mv	33ma	70	7.5	425
	20	60mv	30ma	68	13	500
	40	100mv	100ma	75	24	750
	60*	100mv	150ma	80	18	900
0-60	9	120mv	18ma	75	7.5	450
	13	70mv	15ma	70	13	500
	26	90mv	39ma	81	23	850
	40	90mv	60ma	81	18	1000
0-80	6	150mv	11ma	80	7.5	450
	10	80mv	10ma	77	12	500
	20	120mv	30ma	83	21	850
	30**	100mv	35ma	82	18	1000
0-150	3	300mv	6ma	85	7.5	425
	5	150mv	5ma	80	10	500
	10	200mv	13ma	87	20	850
	15	200mv	20ma	84	18	1000
0-300	1.5	500mv	3ma	86	7.5	475
	3	250mv	3ma	85	10	500
	5	300mv	5ma	87	20	850
	8	300mv	8ma	85	17	1000
0-600	0.75	1000mv	2ma	87	7.5	500
	1.5	700mv	2ma	87	10	650
	3.0	700mv	4ma	88	20	850
	4.0	750mv	5ma	85	17	1100

*Specify Model No. SCR40-58
**Specify Model No. SCR80-28

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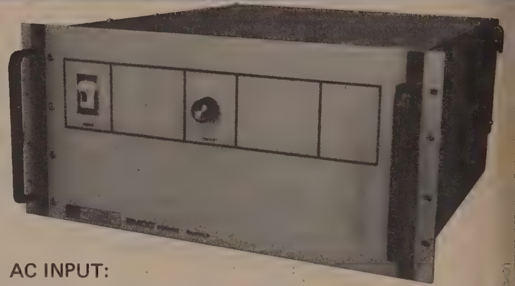
MORE

Medium Power Three Phase Input Power Supplies. Models EMCV & EMCC

Models EMCV & EMCC are designed to provide an economical 1% regulated DC source for laboratory and OEM applications where power to 10kW is required. The EMCV series are constant voltage sources which are current limited. The EMCC units are constant current supplies with voltage limiting. Both types feature automatic crossover and come with a 5 year warranty.



- **Maximum Watts per Cubic Inch**
- **High Efficiency**
- **Remote Programming & Sensing**
- **Thermal Overload Protection**
- **Current or Voltage Limiting**
- **2.5, 5 and 10kW Models**

AC INPUT:

2.5kW Models: 208/220V±10%, 3ph, 47-63Hz, * input current 10A, P.F. = 75%

5kW Models: 208/220V±10%, 3ph, 47-63Hz, * input current 20A, P.F. = 75%

10kW Models: 480V±10%, 3ph, 57-63Hz, * input current 18A, P.F. = 75%

* Typical line currents and power factors measured at nominal line and maximum output voltage and current.

EMCV & EMCC Models & Specifications

BASIC EM MODEL	EMCV OUTPUT		EMCC OUTPUT		RIPPLE (RMS)		SIZE			NET WGT. LBS.	PRICE $
					EMCV	EMCC					
	VOLTS	AMPS	AMPS	VOLTS	MV*	MA*	H	W	D		
6-600	1.5-6	600	50-600	6	150	15A	8.75	19	20	200	2000
7.5-300	1.5-7.5	300	30-300	7.5	150	6A	7.0	19	20	145	1400
10-250	1.5-10	250	50-250	10	150	5A	7.0	19	20	145	1300
10-500	1.5-10	500	100-500	10	150	8A	8.75	19	20	200	2000
20-125	2-20	125	25-125	20	150	2A	7.0	19	20	130	1200
20-250	2-20	250	50-250	20	150	3A	8.75	19	20	175	1600
20-500	2-20	500	100-500	20	150	4A	12.25	19	20	330	2500
30-100	3-30	100	25-100	30	150	500	7.0	19	20	130	1200
30-200	3-30	200	50-200	30	150	1000	8.75	19	20	170	1600
40-60	4-40	60	10-60	40	150	250	7.0	19	20	130	1200
40-125	4-40	125	25-125	40	150	500	8.75	19	20	165	1500
40-250	4-40	250	50-250	40	150	1000	12.25	19	20	320	2300
50-200	5-50	200	40-200	50	150	600	12.25	19	20	320	2500
80-30	10-80	30	5-30	80	300	120	7.0	19	20	130	1200
80-60	10-80	60	10-60	80	300	240	8.75	19	20	165	1500
100-100	15-100	100	20-100	100	300	500	12.25	19	20	310	2500
120-20	15-120	20	5-20	120	300	50	7.0	19	20	125	1200
120-40	15-120	40	5-40	120	300	100	8.75	19	20	165	1500
160-15	20-160	15	5-15	160	300	30	7.0	19	20	130	1200
160-30	20-160	30	5-30	160	300	60	8.75	19	20	165	1500
160-60	20-160	60	10-60	160	300	120	12.25	19	20	320	2300
250-10	25-250	10	2-10	250	300	12	7.0	19	20	130	1200
250-20	25-250	20	5-20	250	300	24	8.75	19	20	165	1600
250-40	25-250	40	5-40	250	300	48	12.25	19	20	310	2500
500-5	50-500	5	1-5	500	300	6	7.0	19	20	130	1400
500-10	50-500	10	2-10	500	300	12	8.75	19	20	165	2000
500-20	50-500	20	2-20	500	300	24	12.25	19	20	300	2500

* AT MAXIMUM OUTPUT — Ripple is measured into a resistive load and is less at reduced power output.

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Specialists in Power Conversion Equipment

Precise Regulation Three Phase Input Power Supplies – 2,500, 5,000 & 10,000 Watt Units

These three phase SCR model DC power supplies provide precision 0.1% regulation for laboratory and OEM applications. They are true "constant voltage/constant current" supplies with automatic crossover to either mode. All models are covered by a 5 year warranty and are offered with a variety of options to meet your specific application.

AC INPUT:

2.5kW Models: 208/220V±10%, 3ph, 47-63Hz, * input current 10A, P.F. = 75%

5kW Models: 208/220V±10%, 3ph, 47-63Hz,* input current 20A, P.F. = 75%

10kW Models: 480V±10%, 3ph, 57-63Hz, * input current 18A, P.F. = 75%

* Typical line currents and power factors measured at nominal line and maximum output voltage and current.

- **Maximum Watts per Cubic Inch**
- **High Efficiency**
- **Series or Parallel Operation**
- **Thermal Overload Protection**
- **Remote Programming & Sensing**

SCR MODELS AND SPECIFICATIONS

SCR MODEL	DC OUTPUT		REGULATION				RIPPLE rms		% EFF	SIZE			NET WGT. lbs.	PRICE $
			CV LINE/LOAD		CC LINE/LOAD		VOLT.	CUR.						
	VOLTS	AMPS	%	MV*	%	MA**	MV	MA†		H	W	D		
6-600	0-6	600	0.1%	3	0.1%	180	5	300	65	8.75	19	20	210	2300
7.5-300	0-7.5	300	0.1%	3	0.1%	90	5	150	65	7.0	19	20	155	1600
10-250	0-10	250	0.1%	3	0.1%	75	5	125	70	7.0	19	20	155	1500
10-500	0-10	500	0.1%	3	0.1%	150	5	250	65	8.75	19	20	210	2300
20-125	0-20	125	0.1%	6	0.1%	40	5	30	75	7.0	19	20	140	1400
20-250	0-20	250	0.1%	6	0.1%	75	5	60	75	8.75	19	20	185	1900
20-500	0-20	500	0.1%	6	0.1%	150	5	120	75	12.25	19	20	340	2900
30-100	0-30	100	0.1%	8	0.1%	30	5	30	75	7.0	19	20	140	1400
30-200	0-30	200	0.1%	8	0.1%	60	5	60	75	8.75	19	20	180	1900
40-60	0-40	60	0.1%	12	0.1%	20	5	10	78	7.0	19	20	140	1400
40-125	0-40	125	0.1%	12	0.1%	40	5	30	75	8.75	19	20	185	1800
40-250	0-40	250	0.1%	12	0.1%	75	5	125	75	12.25	19	20	330	2700
50-200	0-50	200	0.1%	16	0.1%	60	5	60	80	12.25	19	20	330	2900
80-30	0-80	30	0.1%	30	0.1%	10	10	10	85	7.0	19	20	140	1400
80-60	0-80	60	0.1%	30	0.1%	20	10	10	85	8.75	19	20	175	1800
100-100	0-100	100	0.1%	35	0.1%	30	10	30	85	12.25	19	20	320	2900
120-20	0-120	20	0.1%	40	0.1%	8	10	3	85	7.0	19	20	135	1400
120-40	0-120	40	0.1%	40	0.1%	12	10	10	85	8.75	19	20	175	1800
160-15	0-160	15	0.1%	50	0.1%	5	10	3	80	7.0	19	20	140	1400
160-30	0-160	30	0.1%	50	0.1%	10	10	3	80	8.75	19	20	175	1800
160-60	0-160	60	0.1%	50	0.1%	15	10	10	80	12.25	19	20	330	2700
250-10	0-250	10	0.1%	75	0.1%	4	10	3	85	7.0	19	20	140	1400
250-20	0-250	20	0.1%	75	0.1%	8	10	3	85	8.75	19	20	175	1900
250-40	0-250	40	0.1%	75	0.1%	12	10	10	85	12.25	19	20	320	2900
500-5	25-500	5	0.1%	150	0.1%	2	10	3	85	7.0	19	20	140	1600
500-10	25-500	10	0.1%	150	0.1%	4	10	3	85	8.75	19	20	175	2300
500-20	25-500	20	0.1%	150	0.1%	8	10	6	85	12.25	19	20	310	2900

*% or MV whichever is greater **% and MA Total † At maximum output voltage

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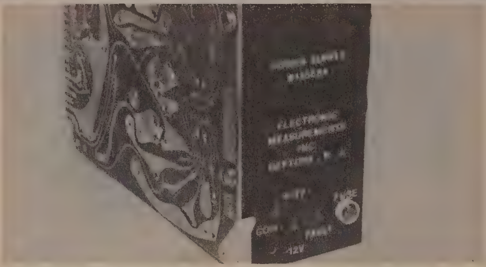


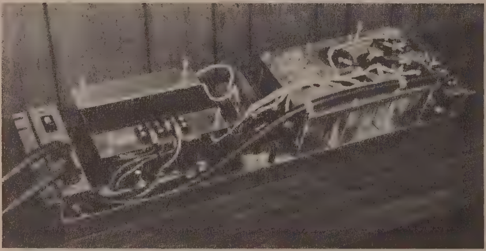
CARD FILE

The CF-1 card file power supply provides two complementary outputs as required by operational amplifiers. This unit provides 0.5% regulation, ± 12/15 VDC ± 2% at 1.5 amps output, a 50% operating efficiency and ripple of 0.1% P/P. Designed to provide excellent reliability and performance in hostile OEM applications.

EMXL RECTIFIER POWER SUPPLY

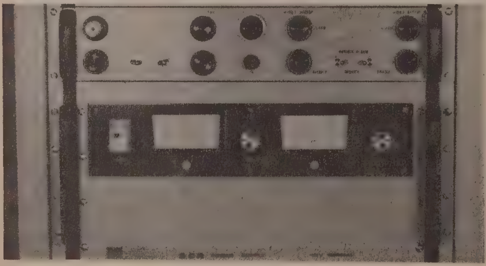
PRECISION ARC LAMP

The EMX Series power supply provides well-regulated constant current with low lamp current ripple for xenon, krypton and other high power arc lamps, as well as laser excitation and environmental testing applications. Key features include: High Efficiency, low ripple, excellent stability and small size.



BATTERY ELIMINATOR

Available as a 15 amp unit (Model 452-6) or as a 30 amp unit (Model 452-7), these DC power supplies provide economical and highly reliable voltage sources where current limiting (as required in battery chargers) is not a requirement.



EMHP POWER SYSTEM

Electronic Measurements can custom design power systems where requirements exceed 10kW. The EMHP System provides maximum versatility at minimum cost. Precise 0.1% regulation and 5-10mV rms ripple is provided through series or parallel connections of our standard SCR Series power supplies.

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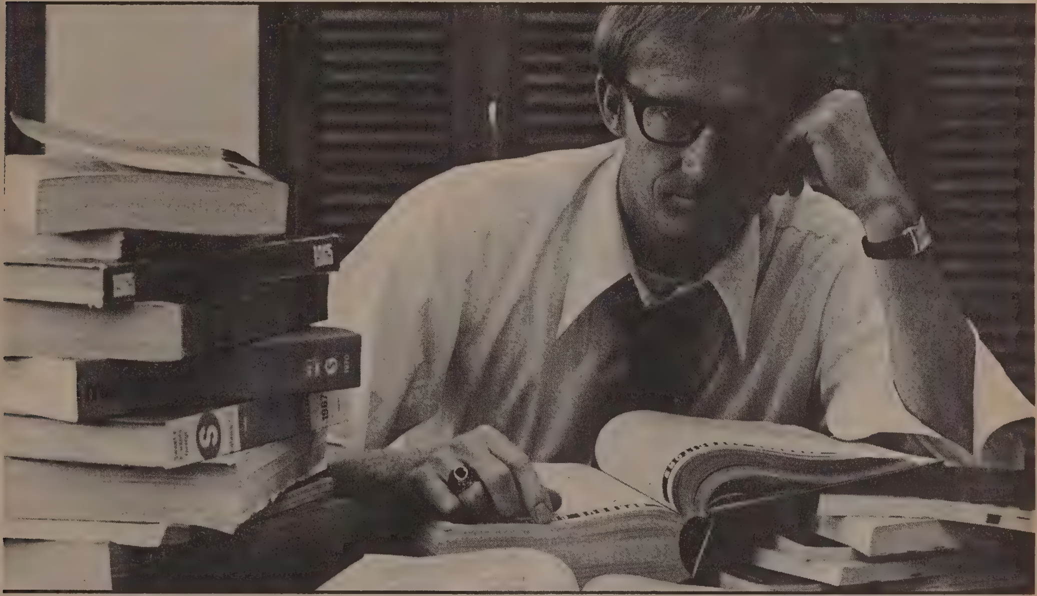
Specialists in Power Conversion Equipment

ELDEC has custom low voltage power supplies for the designer who knows what he needs but can't find it.



When you need a multi-output power supply that has to meet stringent size and weight criteria, and has to perform reliably day in and day out, turn to ELDEC, not your catalog sources.

Chances are you won't find an off-the-shelf model to do the job. ELDEC specializes in custom designed low voltage power supplies. Has for over 10 years. And they're reliable. ELDEC low voltage power supplies have been delivering top performance in tactical military aircraft under tough conditions for years.

Our state-of-the-art, high technology is available to tackle your most demanding power supply problems. ELDEC takes pride in supplying the smallest size, lowest weight power supplies available. You spec it, we'll design, build, and deliver it. When you need it.

ELDEC power supplies use advanced switching regulator and modular packaging techniques to achieve superior power output to volume density ratios. A supply doesn't go out the door unless it meets EMI specifications.

ELDEC delivers. No gap between promises and prototype. Plenty of back-up and documentation. A prestigious customer list. Get all the facts.

ELDEC

ELDEC Corporation, 16700 - 13th Ave. W.,
Lynnwood, Washington 98036,
phone (206) 743-1313.

ELDEC

ADVANCED TECHNOLOGY

ELDEC is engaged in the custom design and manufacture of miniature, high efficiency power supplies for systems requirements. ELDEC's total resources have provided a 10-year history of field-proven performance and reliability, even in the most stringent environments.

ELDEC's advanced research, design and production facilities include in-house transformer manufacture, machine and metal shops and automated electronic assembly areas. All electronic products and systems are manufactured under the highest standards of excellence, MIL-Q-9858-A.

Some Facts About ELDEC:

- 18-years operation
- New 80,000 sq. ft. facility
- Annual sales volume exceeds $14 million
- 500 employees
- Extensive investment in modern test equipment for testing EMI, temperature, humidity, shock, vibration, etc.

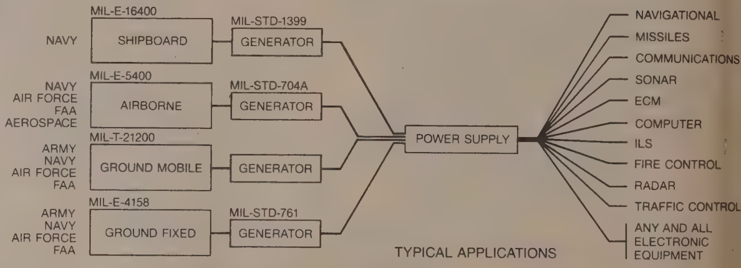
Low Voltage Power Supplies

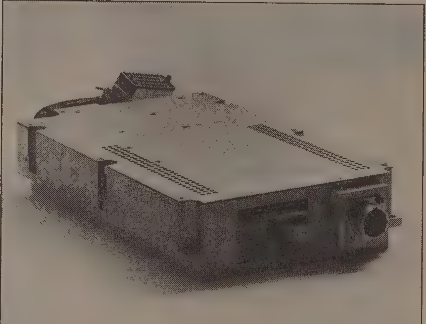
ELDEC continues to advance the state of the art in switching regulator power supply technology, thus enabling us to supply the smallest size and lowest weight power supplies available, with no sacrifice in reliability.

Features:

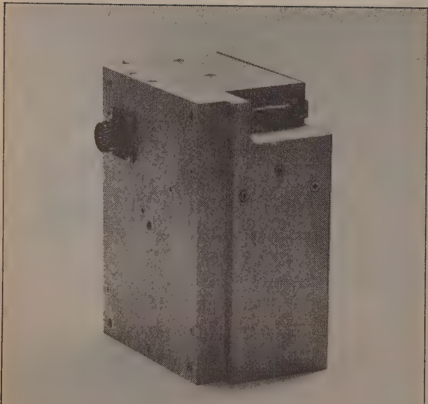
- **Multi-output switching regulator supplies**
- **Densities to four watts/cubic inch**
- **Efficiencies to 90%**
- **Proven reliability**
- **MIL-STD-461 EMI proofed**
- **Compliant with all airborne, shipboard and ground-use military specifications**

Typical applications:

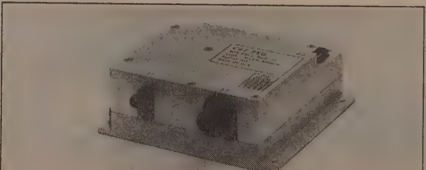

MIL-E-16400
NAVY
SHIPBOARD
MIL-STD-1399
GENERATOR
MIL-E-5400
NAVY
AIR FORCE
FAA
AEROSPACE
AIRBORNE
MIL-STD-704A
GENERATOR
MIL-T-21200
ARMY
NAVY
AIR FORCE
FAA
GROUND MOBILE
GENERATOR
MIL-E-4158
ARMY
NAVY
AIR FORCE
FAA
GROUND FIXED
MIL-STD-761
GENERATOR
POWER SUPPLY
NAVIGATIONAL
MISSILES
COMMUNICATIONS
SONAR
ECM
COMPUTER
ILS
FIRE CONTROL
RADAR
TRAFFIC CONTROL
ANY AND ALL ELECTRONIC EQUIPMENT
TYPICAL APPLICATIONS



Model 4-050 LV PS



Model 4-084 LV PS



Model 4-057 HV PS

POWER SUPPLIES

High Voltage Power Supplies

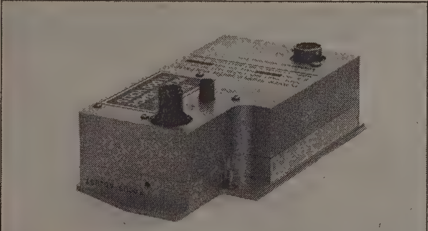
Features:

- **Multiple outputs**
- **Small size; light weight**
- **Reverse polarity and short circuit protected**
- **Low ripple and noise**
- **Monitor outputs**
- **Adjustable and programmable outputs**

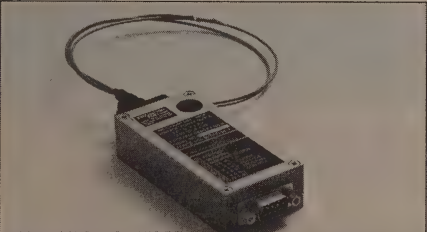
ELDEC custom designs and manufactures high reliability high voltage power supplies for display and TWT systems. Continued research has enabled ELDEC to overcome the reliability problems normally associated with other HV power supplies.

Typical applications include:

- Military and commercial display systems
- Traveling wave tube applications
- Color displays



Model 4-031 CRT HV PS



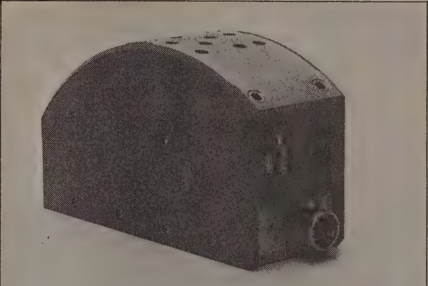
Model 7-015-02 HV PS

Battery Chargers and Power Converters

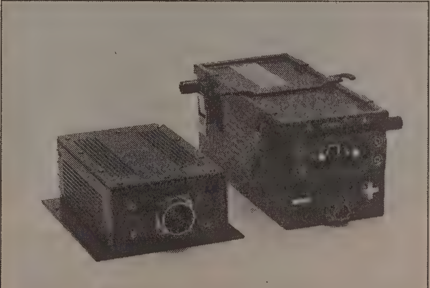
ELDEC designs and manufactures battery chargers and transformer rectifier units for many U.S.-produced commercial and military jet aircraft, including the 707, 727, 737, 747; L-1011; DC-10; A-7D CH-53; F-15; and B-1.

Features:

- **Field proven high reliability**
- **Meet all FAA and MIL-SPEC requirements**
- **Automatic, fail-safe performance**
- **Small size; low weight**



Transformer Rectifier unit



Aircraft Battery Charger

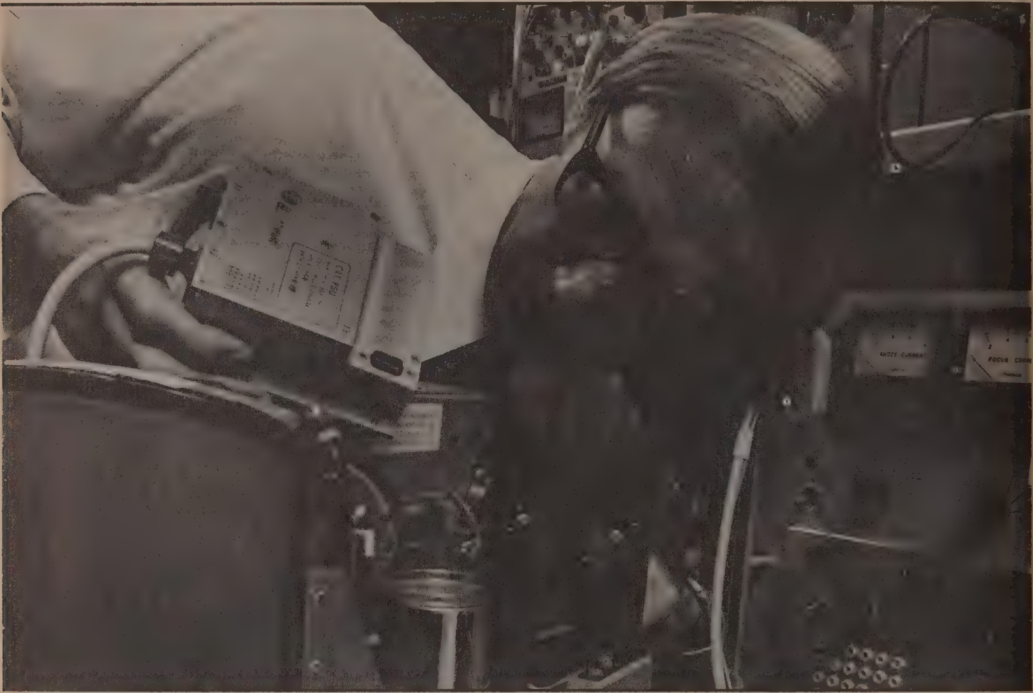
For detailed specifications, delivery or price information contact:

ELDEC Corporation
P.O. Box 100, Lynnwood, Washington 98036
Telephone: (206) 743-1313
TWX: 910-449-2855
TELEX: 032-526

ELDEC CORPORATION

Engineering and sales offices located throughout the United States and Europe.

When you need a custom high voltage power supply, ELDEC designs, packages, and builds them so you can rely on them.



Power supplies for CRT displays. Small size. Light weight. Look to ELDEC. We have years of experience combined with field proven reliability. ELDEC specializes in high voltage, custom mil-spec requirements. Air, ground, or shipboard.

Now by-pass that make or buy decision. When reliability is on the line, rely on proven experience. And ELDEC delivers. No gap between promises and prototype. High quality levels of manufacturing? You can bet on it!

We understand the custom business. Plenty of back-up documentation and service support. A successful track record you can check on. Ask for our brochure.

ELDEC

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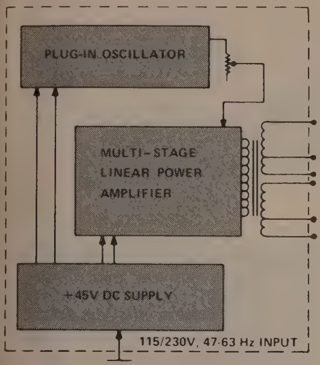
FREQUENCY CONVERTERS



AC POWER SOURCE
MODEL 121
ELGAR
SERIES 400V

Elgar has long been the industry leader in producing solid-state Frequency Converters (AC power sources) for a variety of applications. These include laboratories, receiving inspection, production testing, computer-controlled automatic test systems, and facilities which require variable voltage, fixed or variable frequencies independent of power line and load variations.

Think of an Elgar AC power source as a high-power linear amplifier driven by a precision oscillator. Actually, the basic power amplifier consists of a ±DC supply and a multi-state amplifier with a multiple-tap power output transformer. Output frequency is established by a plug-in oscillator.

Although frequently classed as instruments, Elgar power sources are actually power systems. They can deliver a variety of voltages and frequencies at the output, and the phase angles of the oscillators can be controlled, enabling the user to interconnect the output of two or more power sources into 2-phase and either Delta or Wye, 3-phase configurations.

Because of the relative ease of control of the output frequency, amplitude and phase angle, Elgar power sources can be externally programmed by a computer or other digital commands via an Elgar Decoder Programmer Oscillator. This enables avionics and other system designers to automatically "exercise" their end products under simulated power conditions.

Since the many possible output variations are achieved either by a plug-in device or by external interconnection, Elgar power sources can serve many needs without fear of obsolescence.

STANDARD MODELS

SINGLE PHASE		TWO PHASE		THREE PHASE			
MODEL	RATING VA	MODEL	RATING VA	MODEL	RATING VA	MODEL	RATING VA
121	120	240-2	240	153A	150	1500-3	1500
251	250	500-2	500	240-3D	240	1753A	1750
501A	500	1000-2	1000	360-3	360	2000-3D	2000
751A	750	1500-2	1500	503	500	2250-3	2250
1001A	1000	2000-2	2000	500-3D	500	3000-3	3000
1751	1750	3500-2	3500	750-3	750	3500-3D	3500
2000-1	2000			1000-3D	1000	5250-3	5250
3500-1	3500			1000-3Y	1000	10500-3	10500

Note: D is an open delta configuration.

GENERAL SPECIFICATIONS

Output Voltage Ranges: 0–32, 0–130, 0–260
Output Frequency Range: 45–10,000 Hz
Load Power Factor: ±0.7 at full VA
Output Harmonic Distortion: 0.6% THD worst case

Line Regulation:
±0.25% at full load vs. ±10% change of input line voltage.
Load Regulation:
±1% from no load to full load over full frequency range and ±10% input range. Adjustable to better than 0.1% for specific load conditions. Fixed frequency systems always less than ±0.25%.

Response Time: Less than 50 μsec.
Noise Level: 70db below full output. Includes plug-in oscillator.
Gain Stability:
±0.25% for 24 hours at constant line, load and temperature.
Temperature Range:
Operating, –20° to +50°C;
Storage, –40° to +80°C.

PLUG-IN OSCILLATOR MODULES

VARIABLE FREQUENCY

Type	Model	Frequency Range (Hz)	Phase*	Calibration Accuracy	Frequency Temp. Coeff.
Decade Dial	401-V	45–10000	1	±1%	±0.02%/°C
Continuous Dial	431-V	300–500	1	±0.25%	±0.02%/°C
	461-V	45–70	1	±0.25%	±0.02%/°C
	4641-V	45–70 & 350–450	1	±0.25%	±0.02%/°C

*Oscillators are also available in two- and three-phase versions. To indicate a multi phase oscillator, change the last digit of the model number; for example, 403-V = 3-phase, and so on.

These oscillators provide 0.01% line and 0.01% load regulation and 0.01° phase angle regulation around the power amplifier(s) at the point(s) of sense. They also provide 0.1% amplitude and 0.1° phase angle stability for 1000 hours at constant line, load and temperature. Normally for fixed voltage applications. Please specify voltage. Amplitude temperature coeff. 0.005%/°C.

FIXED FREQUENCY

Type	Model	Frequency Range (Hz)	Phase*	Calibration Accuracy	Frequency Temp. Coeff.
R-C Phase Shift	451-.1	50	1	±0.1%	±0.015%/°C
	461-.1	60	1	±0.1%	±0.015%/°C
	441-.1	400	1	±0.1%	±0.015%/°C
Crystal Control	461-.01	60	1	±0.01%	±0.0002%/°C
	441-.01	400	1	±0.01%	±0.0002%/°C
	461-.0001	60	1	±0.0001%	±0.00005%/°C
	441-.0001	400	1	±0.0001%	±0.00005%/°C
Crystal Control with Amplitude Servo Control	461-.01SS	60	1	±0.01%	±0.0002%/°C
	441-.01SS	400	1	±0.01%	±0.0002%/°C

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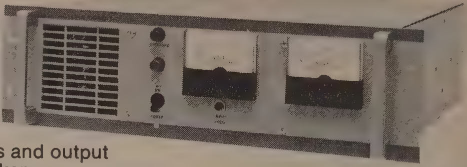
AC LINE CONDITIONERS



Elgar AC Line Conditioners provide precise, clean AC power to critical loads by eliminating high-speed AC line and load transients and distortion as well as providing precise regulation. These versatile instruments have response times 5,000 times faster than the fastest conventional AC line regulators and line isolation of 70 to 100 db, far superior to mere isolation transformers. All Elgar AC line conditioners are designed for continuous operation and are contained in rack-mount enclosures. Front panel controls include meters to monitor input and output voltages and output load current, an overload indicator and an input circuit breaker.

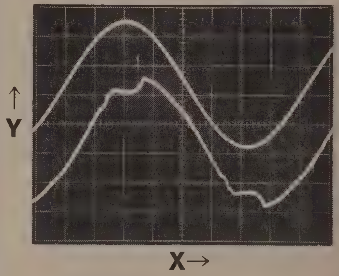
Users of voltage-sensitive equipment need isolation from high-speed AC line transients. These transients can cause erratic operation, component failures, and a reduction in equipment life. In sensitive instrumentation and data processing equipment, high-speed line transients often are the cause of erroneous information.

Elgar AC Line Conditioners are the best, most reliable solution to these problems.

GENERAL SPECIFICATIONS

INPUT/OUTPUT ISOLATION: 100 db (60 Hz)
OUTPUT DISTORTION: 0.2% max for up to 10% input harmonic distortion*
LINE REGULATION: ±0.025% for ±10% input AC line variation
LOAD REGULATION: ±0.025% for no load/full change full current into unity to zero lagging or leading load**
REDUCES 500V 10μ SEC TRANSIENTS BY 1000:1
SUPPLIES PEAK CURRENTS 3.5 TIMES RMS RATING
TEMPERATURE COEFFICIENT: 0.005% per °C
PEAK AMPLITUDE STABILITY: ±0.01% (cycle to cycle)
AMPLITUDE DRIFT: ±0.05% 24 hrs constant line, load and temperature
IMPULSE SETTLING TIME: less than 20 μsec
AMBIENT TEMPERATURE: 0–55°C
OVERLOAD INDICATION: Front panel lamp lights when rated output current is exceeded
OVERLOAD PROTECTION: Continuous overload actuates front panel circuit breaker
METERING: Reads: input voltage, output voltage, & output current
COOLING: Forced Air

*400 Hz models 0.5% max. **400 Hz models ±0.1%



Y=75 volts/cm
X=2 millisec/cm
The lower trace shows a very distorted input AC line waveform with a 75 volt peak spike riding on it. The upper trace shows the output of the Elgar AC Line Conditioner which is perfectly clean and shows no trace of the AC input anomalies.

STANDARD MODELS

	OUTPUT				INPUT
	POWER, VA		Voltage	FREQ	Voltage
MODEL	Cont.	Peak	VRMS	HZ	Range^{2}
6006B	1000	5000	115	57–63	95–135
6106B	870	4300	100^{1}	57–63	80–120
6226B	1000	5000	220	57–63	180–260
6426B	1000	5000	240	57–63	200–280
6005B	1000	5000	115	47–53	95–135
6105B	870	4300	100^{1}	47–53	80–120
6225B	1000	5000	220	47–53	180–260
6245B	1000	5000	240	47–53	200–280
6004B	1000	5000	115	380–420	95–135
3006B	3000	15000	115	57–63	95–135^{3}
3106B	2600	13000	100^{1}	57–63	80–120^{4}
3226B	3000	15000	220	57–63	180–260
3246B	3000	15000	240	57–63	200–280

	OUTPUT				INPUT
	POWER, VA		Voltage	FREQ	Voltage
MODEL	Cont.	Peak	VRMS	HZ	Range^{2}
3005B	3000	15000	115	47–53	95–135^{3}
3105B	2600	13000	100	47–53	80–120^{4}
3225B	3000	15000	220	47–53	180–260
3245B	3000	15000	240	47–53	200–280
3004B	3000	15000	115	380–420	95–135
5006B	5000	25000	115	57–63	95–135^{3}
5106B	4350	21500	100^{1}	57–63	80–120^{4}
5226B	5000	25000	220	57–63	180–260
5246B	5000	25000	240	57–63	200–280
5005B	5000	25000	115	47–53	95–135^{3}
5105B	4350	21500	100^{1}	47–53	80–120^{4}
5225B	5000	25000	220	47–53	180–260
5245B	5000	25000	240	47–53	200–280

NOTES:
1. Rear panel switch for 115V output.
2. Input voltage ranges selected by 3 position tap switch
   95–115, 105–125, 115–135V for 95–135V range
   80–100, 90–110, 100–120V for 80–120V range
   180–220, 200–240, 220–260V for 180–260V range
   200–240, 220–260, 240–280V for 200–280V range
3. 115V output with 230V input available. Add -230 to model number, e.g., 3006B-230
4. 100V output with 200V input available. Add -200 to model number, e.g., 5106B-200

DIMENSIONS (INCHES)

MODEL	Height	Width	Depth
SERIES 6000B	5.25	19.0	16.0
SERIES 3000B	12.25	19.0	20.0
SERIES 5000B	24.5	19.0	20.2

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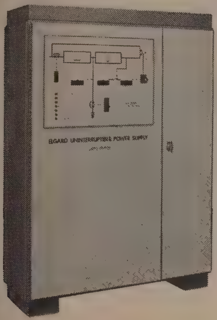
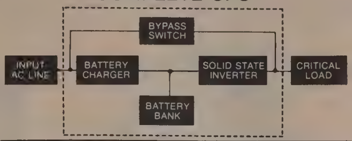
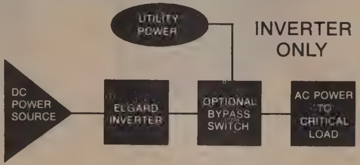
UPS/INVERTERS



COMPLETE UPS





ELGARD UPS all solid-state Uninterruptible Power Systems combine a battery charger, battery bank, solid-state inverter and bypass switch to provide clean, continuous power to critical loads. The battery charger converts AC line power to DC. Normally, this DC power simultaneously float-charges the battery bank and powers the inverter. Upon loss of input AC, the inverter continues to furnish the critical load with uninterruptible AC power by drawing its energy from the battery bank. Since the battery bank is always connected to the inverter as well as to the battery charger, there is no switchover time. AC output frequency from the Uninterruptible Power Source is phase-locked to the input AC under normal conditions. When there is no input AC, the output frequency is automatically determined by the stable internal oscillator.

In the unlikely event of a component failure within the Uninterruptible Power Source, the bypass switch will be activated and the critical load will automatically transfer to the input AC line. The standard switch is an electromechanical contactor which performs the reverse transfer with a 50- to 150-millisecond interruption. An optional solid-state bypass switch (SBS) that can make the transfer with no interruption in power to the load is available for all UPS and Inverter models.

ELGARD INVERTERS are designed to accept DC input power (derived from a nominally 125 or 130VDC rectifier system or from a battery bank with a final discharge voltage of 105VDC) and convert it to tightly regulated, single-phase AC power.

ELGARD UPS are designed for a useful life of 15 to 20 years. Mathematical analysis and operating history indicate the anticipated mean-time between failures (MTBF) will be about 20,000 hours, depending upon the model and features selected. With appropriate interface of the bypass switch (electromechanical or static) with the load, so that bypass action does not cause a transient greater than the load can tolerate, an MTBF in excess of 100,000 hours for the output load bus can be demonstrated.

GENERAL SPECIFICATIONS

Input and Output Voltages:
- 0.5 to 2.5KVA: 115VAC std., 230V available
- 5KVA and above, single-phase: 230VAC std., 115V available
- Three-phase models: 120/208, 380, 480 available

Voltage Regulation: ±1%
Instantaneous Transient (50% load change): ±8%
Frequency: 60Hz Std., 50Hz avail.
Frequency Stability: ±0.25%
Continuous Power: Rated KVA at 0.8 P.F.
Load Power Factor: 0.7 lag to unity
Harmonic Distortion: 5% THD maximum

Overload Rating:
- 0.5 to 2.5KVA:
  - 110% for 15 minutes
  - 150% for 5 seconds
  - 200% for 5 cycles
- 5KVA and above:
  - 125% for 15 minutes
  - 150% for 10 seconds
  - 200% for 10 cycles

Inverter Efficiency at Full Load:
- 0.5 to 2.5KVA: 75% minimum
- 5KVA to 15KVA: 80% minimum
- 20KVA and above: 85% minimum

STANDARD INSTRUMENTS:
- DC Voltmeter, AC Voltmeter, Output AC Ammeter

STANDARD INDICATORS:
- Input Power On
- Low DC
- Bypass Switch Position
- Fuse(s) Open
- Battery Operation
- Overheat
- Overload

CONSTRUCTION:
- In accordance with applicable NEMA standards and the National Electric Code (NEC).

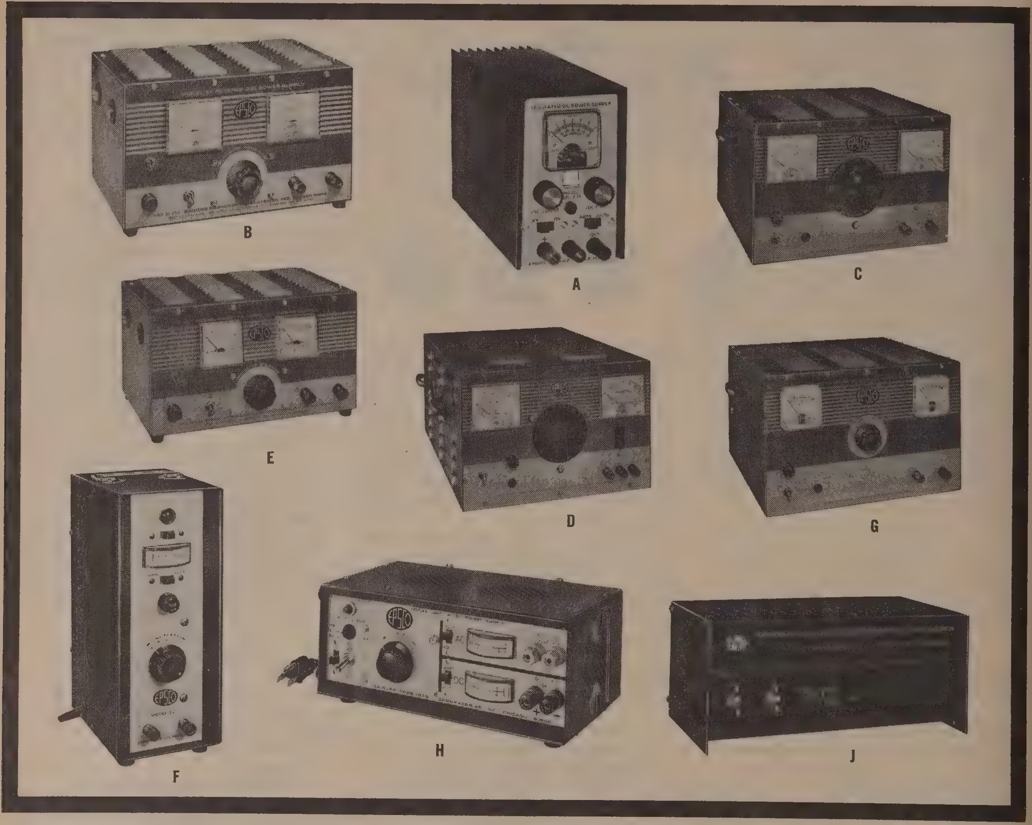
ENVIRONMENT:
- Operating Temperature: 0 to 40°C
- Humidity: to 95%

AVAILABLE MODELS

SINGLE PHASE UPS			THREE PHASE UPS			125VDC INPUT INVERTERS		
MODEL	RATING VA	SIZE—INCHES H x W x D	MODEL	RATING VA	SIZE—INCHES H x W x D	MODEL	RATING VA	SIZE—INCHES H x W x D
UPS-501-1*	500	7 x 19 x 19	UPS-502-3	5000	60.5 x 54 x 17.5	INV-102	1000	12.25 x 19 x 19
UPS-102-1*	1000	12.25 x 19 x 19	UPS-103-3	10000	72.5 x 54 x 19	INV-252	2500	14 x 19 x 19
UPS-172-1	1750	12.25 x 19 x 19	UPS-153-3	15000	76.5 x 54 x 19	INV-502	5000	72 x 37 x 19
UPS-252-1	2500	14 x 19 x 19	UPS-253-3	25000	80 x 72 x 24	INV-103	10000	78 x 44 x 19
UPS-502-1	5000	60.5 x 54 x 17.5	UPS-373-3	37500	80 x 72 x 24	INV-203	20000	80 x 54 x 24
UPS-103-1	10000	72.5 x 54 x 19						
UPS-203-1	20000	80 x 60 x 24						

*Includes 10-Minute Internal Battery Bank.

EPSCO REGULATED & SEMI-REGULATED POWER SUPPLIES



Ruggedly-constructed, low voltage dc power supplies for use in design, development, testing of transistor circuitry . . . for servicing and operating auto, aircraft, marinecraft radio, electronic equipment . . . for production line testing, industrial and educational laboratory work and many other applications.

Precision made and engineered to give unequalled performance life per dollar. Features include: Voltage regulation, ac ripple filtering, adjustable output voltage, large easy-to-read meters, isolated output terminals.

INPUT — *Regulated Models:* 105-125 vac. 60 Hz *Industrial and General Purpose Models:* 117 vac 50/60 Hz. Models available to fit W.E. and EIA racks. Custom-design or modification of standard units to your specs.

INVERTER — Transistorized. Converts 12 vdc to 117 vac, 60 Hz to operate equipment from car, truck or boat battery or other 12 vdc source for camping, traveling, boating. Reverse polarity and short circuit protection.

EPSCO, INC. 920 WESTWOOD AVENUE, ADDISON, ILLINOIS 60101 • (312) 543-0410

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REGULATED & SEMI-REGULATED POWER SUPPLIES

EPSCO

REGULATED

Model	Figure	Output Volts	Output Current	Line Reg.**	Load Reg.*	Max. Ripple, RMS	Meters††	DC Imp. Ohms*	Size (H x W x D)	Net Wt. Lbs.	Net Price
PSR-12-25	A	0-25	0-500mA	0.01% + 2mV	0.01%	100µV	0-30V/600mA	.006	5¼ x 3⅛ x 10	7	125.64
PSR-12-50	A	0-50	0-250mA	0.01% + 2mV	0.01%	100µV	0-60V/300mA	.02	5¼ x 3⅛ x 10	7	125.64

INDUSTRIAL

Model	Figure	Output Voltage	Output Amps.	Load Regulation* (V/A)†	Max. Ripple %	Meters††	DC Impedance Ohms*	Size (H x W x D)	Net Wt. Lbs.	Net Price
EF	B	4-28 2-14	0-5 0-5	0.9 (1-5A) 0.6 (1-5A)	1.0 1.0	0-50V, 0-6A	0.9 (1-5A) 0.6 (1-5A)	7 x 12 x 8½	22	154.00
EFB	B	0-32 0-16	0-4 0-8	1.25 1.0	0.1 0.1	0-40/20V, 0-10A	1.25 1.0	7 x 12 x 8½	28	215.60
EFBR‡		0-32 0-16	0-4 0-8	1.25 1.0	0.1 0.1	0-40/20V, 0-10A	1.25 1.0	8¾ x 19 x 8½	34	248.09
GFL	C	0-125	0-5	1.5	0.5	0-150V, 0-5A	1.5	9¾ x 14¼ x 14¼	88	406.81
GFLR‡		0-125	0-5	1.5	0.5	0-150V, 0-5A	1.5	10½ x 19 x 14¼	100	455.37
NFB	C	0-32	0-15	0.4	0.75	0-50V, 0-25VA	0.4	9¾ x 14¼ x 14¼	84	429.90
NFBR‡		0-32	0-15	0.4	0.75	0-50V, 0-25A	0.4	10½ x 19 x 14¼	97	464.90
PS-5	C	0-55	0-10	0.8	0.5	0-75V, 0-15A	0.7	9¾ x 14¼ x 14¼	70	390.51
PS-5R‡		0-55	0-10	0.8	0.5	0-75V, 0-15A	0.7	10½ x 19 x 14¼	89	420.50
PS-1000-32	D	0-32	0-30	0.2	0.75	0-50V, 0-30A	0.2	9¾ x 14¼ x 19¼	113	599.50
PS-1000-55	D	0-55	0-20	0.5	0.5	0-75V, 0-30A	0.5	9¾ x 14¼ x 19¼	113	599.50
PS-1000-125	D	0-125	0-8A	1.0	Less than 1%	0-150V, 0-10A	1.0	9¾ x 14¼ x 19¼	113	599.50

GENERAL PURPOSE

D-612T	E	0-16 0-8	0-10 0-10	0.44 (3-10A) 0.3 (3-10A)	0.5 @ 5A 2 @ 10A	0-20V, 0-10A	0.44 (3-10A) 0.3 (3-10A)	7 x 12 x 8½	20	111.45
H	E	12 (adj.) 6 (adj.)	0-10 0-20	0.23 (3-10A) 0.15 (3-20A)	5 5	0-20V, 0-30A	0.23 (3-10A) 0.15 (3-20A)	7 x 12 x 8½	30	145.60
EC-1	F	12 (adj.)	0-5	1.4	0.5	None	1.4	10¾ x 4⅜ x 6½	12	61.05
EC-2	F	0-16	0-5	1.8	0.5	0-20V, 10A	1.8	10¾ x 4⅜ x 6½	11	86.23
PS-30	G	12 (adj.)	0-30	0.12 (6-30A)	1	0-20V, 0-50A	0.27	9¾ x 14¼ x 14¼	68	257.60
PS-50	G	12 (adj.)	0-50	0.17	0.5	0-20V, 0-50A	0.17	9¾ x 14¼ x 19¼	106	580.00
3301	H	0-16 DC 0-20 AC	0-3 0-3	1.8 (1-3A)	.5	0-20V, 0-5A DC 0-20V, 0-5A AC	2.4 DC 0.5 AC	4¾ x 10¾ x 6½	12	115.00

INVERTER

TI250B	J	**Input:** 12 vdc. **Output:** 117 vac, 60 Hz, 250 VA max. **Voltage Regulation:** 15% max. no load to full load constant battery voltage. **Frequency Regulation:** 4 Hz max. no load to full load.	4½ x 10 x 7½	11½	87.44

‡Rack mounted version.
*No-load to full-load unless otherwise specified.

†Output voltage change for each ampere of output current change, except on regulated units, % applies for either line or load.
††All 2% accuracy except 5% for general purpose units. Rectifiers: Selenium and Silicon ("avalanche" characteristics on Industrial units).
**From 105-125 VAC.

PRECISION-BUILT. Every model is engineered to give top, long-life performance per dollar invested.

ONE YEAR WARRANTY on every EPSCO Power Supply.

EPSCO also provides custom designing or modification of standard power supplies for the Original Equipment Market.

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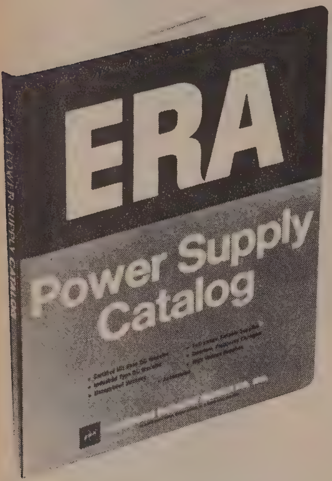
Buying Power?



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- Inverters, Frequency Changers
- High-Voltage Supplies

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Military Specifications DC Modular Power Supplies

75°C
FREE AIR
RATING

MEETS COMPONENT, WORKMANSHIP AND ENVIRONMENTAL REQUIREMENTS OF
MIL-E-4158, MIL-E-5400, MIL-E-16400, MIL-E-5272, MIL-T-21200

CERTIFIED Certificate of Conformity by Independent Laboratory supplied on request

Transpac MS Series DC Power Modules are all-silicon designs capable of meeting the highest military requirements. These units incorporate full MIL components where applicable and are designed to meet full military environmental and component specifications. Transformers are per MIL-T-27A, semiconductors are MIL-STD-701 or MIL-S-19500 preferred types. Tantalum foil capacitors per MIL-C-3965 are used throughout except in the filter sections of higher current types where MIL-C-62 military grade electrolytic capacitors are used. These units have been fully tested to meet the component, workmanship, and environmental requirements of MIL-E-4158, MIL-E-5400, MIL-E-16400, MIL-E-5272, MIL-T-21200 and are supplied with an independent testing laboratory certification as to compliance for representative models.

OUTPUT VOLTAGE (DC)	CURRENT	RIPPLE (RMS)	SIZE W x D x H (INCHES)	WEIGHT (LBS.)	CONNECTOR	MODEL
0-7VDC	**0-500MA**	**800μV**	**3-5/16 x 4-3/16 x 5-1/2**	**4.8**	**Solder Loop**	**MS07P5***
0-7VDC	0-1AMP	800μV	4 x 4-3/4 x 5-15/16	6.1	Solder Loop	MS071*
0-7VDC	**0-2AMP**	**800μV**	**5-3/4 x 7-3/16 x 5-1/4**	**11.3**	**Terminal Block**	**MS072**
0-7VDC	0-4AMP	800μV	6 x 8-15/16 x 6-5/16	23.7	Terminal Block	MS074
0-7VDC	**0-8AMP**	**800μV**	**6 x 10-5/16 x 6-5/16**	**24.1**	**Terminal Block**	**MS078**
10-20VDC	**0-250MA**	**800μV**	**3-1/4 x 3-1/4 x 4-31/32**	**3.9**	**Solder Loop**	**MS10P3***
11.5-12.5VDC	**0-4AMP**	**800μV**	**6 x 8-15/16 x 6-5/16**	**23.7**	**Terminal Block**	**MS124**
11.5-12.5VDC	0-8AMP	800μV	6 x 10-5/16 x 6-5/16	24.1	Terminal Block	MS128
11-13VDC	**0-500MA**	**800μV**	**3-5/16 x 4-3/16 x 5-1/2**	**4.8**	**Solder Loop**	**MS12P5***
11-13VDC	**0-1AMP**	**800μV**	**4 x 4-3/4 x 5-15/16**	**6.1**	**Solder Loop**	**MS121***
11-13VDC	0-2AMP	800μV	5-3/4 x 7-3/16 x 5-1/4	11.2	Terminal Block	MS122
14.5-15.5VDC	0-4AMP	800μV	6 x 8-15/16 x 6-5/16	23.7	Terminal Block	MS154
14.5-15.5VDC	0-8AMP	800μV	6-15/16 x 10-5/8 x 6-5/16	24.8	Terminal Block	MS158
14.5-15.5VDC	0-500MA	800μV	3-5/16 x 4-3/16 x 5-1/2	4.8	Solder Loop	MS15P5*
14.5-15.5VDC	0-1AMP	800μV	4 x 4-3/4 x 5-15/16	6.1	Solder Loop	MS151*
14.5-15.5VDC	0-2AMP	800μV	5-3/4 x 7-3/16 x 5-1/4	11.3	Terminal Block	MS152
20-30VDC	**0-250MA**	**800μV**	**3-1/4 x 3-1/4 x 4-31/32**	**3.9**	**Solder Loop**	**MS20P3***
23.5-24.5VDC	0-4AMP	800μV	6 x 8-15/16 x 6-5/16	23.7	Terminal Block	MS244
23.5-24.5VDC	0-8AMP	800μV	6-15/16 x 10-5/8 x 6-5/16	24.1	Terminal Block	MS248
23-25VDC	0-500MA	800μV	3-5/16 x 4-3/16 x 5-1/2	4.8	Solder Loop	MS24P5*
23-25VDC	0-1AMP	800μV	4 x 4-3/4 x 5-15/16	6.1	Solder Loop	MS241*
23-25VDC	0-2AMP	800μV	5-3/4 x 7-3/16 x 5-1/4	11.3	Terminal Block	MS242
27.5-28.5VDC	**0-4AMP**	**800μV**	**6 x 8-15/16 x 6-5/16**	**23.7**	**Terminal Block**	**MS284**
27.5-28.5VDC	**0-8AMP**	**800μV**	**6-15/16 x 10-5/8 x 6-5/16**	**24.1**	**Terminal Block**	**MS288**
27-29VDC	**0-500MA**	**800μV**	**3-5/16 x 4-3/16 x 5-1/2**	**4.8**	**Solder Loop**	**MS28P5***
27-29VDC	**0-1AMP**	**800μV**	**4 x 4-3/4 x 5-15/16**	**6.1**	**Solder Loop**	**MS281***
27-29VDC	**0-2AMP**	**800μV**	**5-3/4 x 7-3/16 x 5-1/4**	**11.3**	**Terminal Block**	**MS282**
150-160VDC	0-100MA	0.005%	5 x 5-3/4 x 6	9.5	Solder Loop	MS150P1
200-210VDC	**0-100MA**	**0.005%**	**5 x 5-3/4 x 6**	**9.5**	**Solder Loop**	**MS200P1**
250-260VDC	**0-100MA**	**0.005%**	**5 x 5-3/4 x 6**	**9.5**	**Solder Loop**	**MS250P1**
300-310VDC	0-100MA	0.005%	5 x 5-3/4 x 6	9.5	Solder Loop	MS300P1

*Full Tantalum Types

Solid State Inverters

CONVERT LOW VOLTAGE DC TO LINE VOLTAGE AC. ALSO HIGH-SURGE MODELS

ERA Transpac Inverters convert low voltage DC into higher voltage AC. Solid-state designs provide minimum operating maintenance, high shock and vibration resistance, high conversion efficiency and stable, trouble-free, long-life operation.

Units incorporate all advanced features including overload and transient protection, self-starting networks, reverse polarity protection, and MOPA designs where applicable.

High surge types use MOPA designs which provide for high peak power for motor starting, lamp powering, and other high surge applications.

	FREQ. OUTPUT	POWER OUTPUT	INPUT VDC	SIZE W x D x H (INCHES)	OUTPUT VAC	WT. LBS.	MODEL
① UNREGULATED SQUARE WAVE OUTPUT	60CPS	15VA	5-7VDC	2-5/8 x 3-1/16 x 4-1/2	115VAC	2.5	IT616B
	60CPS	25VA	10-14VDC	3-1/16 x 3-9/16 x 4-7/8	115VAC	4.0	IT126B
	60CPS	50VA	19-29VDC	3-7/8 x 3-7/8 x 4-3/4	115VAC	5.5	IT256B
	60CPS	**100VA**	**19-29VDC**	**3-1/4 x 4 x 5-15/16**	**115VAC**	**6.5**	**IT2106B**
	400CPS	15VA	5-7VDC	2-3/8 x 2-3/4 x 3-13/16	115VAC	1.6	IT614B
	400CPS	25VA	10-14VDC	2-5/8 x 3-1/16 x 4-1/2	115VAC	2.6	IT124B
	400CPS	50VA	19-29VDC	3-1/16 x 3-9/16 x 4-7/8	115VAC	4.0	IT254B
	400CPS	100VA	19-29VDC	3-1/4 x 4 x 5-15/16	115VAC	6.5	IT2104B
② REGULATED SQUARE WAVE OUTPUT	60CPS	50VA	20-29VDC	5-1/2 x 6-1/16 x 6-5/32	115VAC	11.0	IT256SB
	60CPS	100VA	20-29VDC	5-1/2 x 6-1/16 x 6-5/32	115VAC	11.0	IT2106SB
	60CPS	250VA	10-14VDC	6-1/8 x 5-15/16 x 6-1/2	115VAC	15.0	IT2256SB(12)
	60CPS	**250VA**	**19-29VDC**	**6-1/8 x 5-15/16 x 6-1/2**	**115VAC**	**15.0**	**IT2256SB(24)**
	60CPS	500VA	10-14VDC	7-13/32 x 9 x 6-3/16	115VAC	28.0	IT2506SB(12)
	60CPS	**500VA**	**19-29VDC**	**7-13/32 x 9 x 6-3/16**	**115VAC**	**28.0**	**IT2506SB(24)**
	400CPS	50VA	20-29VDC	6-1/8 x 5-15/16 x 6-1/2	115VAC	13.0	IT254SB
	400CPS	100VA	20-29VDC	6-1/8 x 5-15/16 x 6-1/2	115VAC	7.0	IT2104SB
	400CPS	250VA	20-29VDC	6-1/8 x 5-15/16 x 6-1/2	115VAC	10.0	IT2254SB
	400CPS	500VA	20-29VDC	7-13/32 x 9 x 6-3/16	115VAC	28.0	IT2504SB
③ REGULATED SINE WAVE OUTPUT	60CPS	50VA	26-29VDC	6-1/8 x 5-15/16 x 6-1/2	115VAC	10.5	IT256RS
	60CPS	100VA	26-29VDC	7-13/32 x 9 x 6-3/16	115VAC	16.0	IT2106RS
	60CPS	**250VA**	**26-29VDC**	**12 x 9 x 8**	**115VAC**	**35.0**	**IT2256RS**
	400CPS	50VA	26-29VDC	6-1/8 x 5-15/16 x 6-1/2	115VAC	8.0	IT254RS
	400CPS	100VA	26-29VDC	7-13/32 x 9 x 6-3/16	115VAC	16.0	IT2104RS
	400CPS	250VA	26-29VDC	12 x 9 x 8	115VAC	35.0	IT2254RS
HIGH SURGE INVERTERS	60CPS	250VA	11-13VDC	11-1/8 x 11-3/4 x 5-19/32	115VAC	23.0	IR250(12)
	60CPS	**500 VA**	**11-13VDC**	**11-1/8 x 11-3/4 x 5-19/32**	**115VAC**	**23.0**	**IR500**

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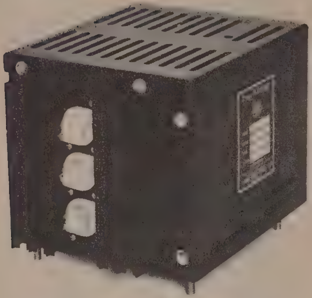
Solid-State Sinusoidal AC Regulators

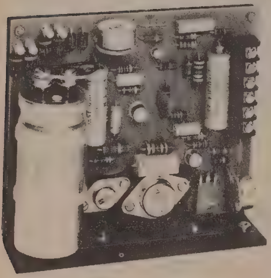


Transpac RT modular AC regulators are all solid-state designs for incorporation into equipment or for external and bench use. Utilizes a unique design approach incorporating a modulated AC bridge which is referenced to variations in the output level. This special circuitry permits fast-acting RMS regulation independent of input frequency, and provides sinusoidal output. RT units are highly efficient, require minimum no-load current and operate over a wide range of load power factors.

- Provide highly RMS-regulated sinusoidal output
- Operate over a wide range of AC inputs and frequencies
- Run cool and quiet with no distorted magnetic field interference
- Operate over a wide range of leading or lagging power factors
- Provide a modular AC Regulator for end-equipment or bench use

Power Rating	Size (Inches)	Weight	Model
250 VA	6-5/16 x 7-1/4 x 4-7/8	13 lbs.	RT250
500 VA	6-7/8 x 8-7/8 x 7-1/2	17 lbs.	RT500
1000 VA	7-13/16 x 9-15/16 x 7-5/8	22 lbs.	RT1000

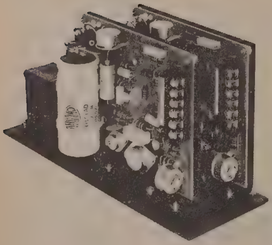
DC Regulator Assemblies



"CR" series assemblies are complete power supplies and require only the addition of a center-tapped input transformer for full functioning. These units incorporate a heat sink preform and provide highly regulated dc outputs combined with protective and control features, including OVP.

Model Number	Suffix Designations									
	–0		–8		–12		–18		–24	
	Voltage Range									
	4.7V–7V		7V–10V		10V–16A		16V–22V		22V–30V	
	Current Ranges									
CR53	3A	2.5A	2.5A	2A	2A	1.5A	1.5A	1.3A	1.3A	1.2A
CR56	6A	5A	5A	4A	4A	3A	3A	2.6A	2.6A	2.4A
CR512	12A	12A	10A	8A	8A	7A	7A	6A	6A	5A
CR520	20A	20A	20A	16A	16A	14A	14A	12A	12A	10A

OEM DC Power Supplies



"OE" series power supplies are highly regulated open frame DC power supplies which come complete with isolating input transformers, power control, OVP protective circuitry and full heat sinking. These low cost units are available in either single or multiple outputs and are ideally suited for all OEM, IC, Op-Amp, Computor, and general applications. Also available are optional dust covers for modular power supply conversion.

Model Number	Suffix Designations			
	–0	–12	–18	–24
	Output Voltage DC			
	5V or 6V	12V or 15V	18V	24V or 28V
	Current Amperes			
OE53	3A or 2.5A	1.5A or 1.0A	1.3A	0.9A or 0.8A
OE56	6A or 5A	3.3A or 2.5A	2.5A	1.8A or 1.5A
OE512	12A	6.5A or 5.3A	5.0A	3.8A or 3.3A
OE520	20A	12.8A or 10.5A	10.0A	7.5A or 6.5A

ERA TRANSPAC CORPORATION

A Subsidiary of Electronic Research Associates, Inc.

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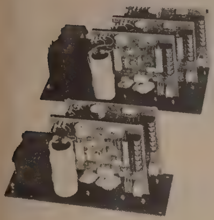
OEM DC Power Supplies (Continued)



Multi-Output

Model Number	Output No. 1	Output No. 2	Output No. 3
0E53-12/2	12VDC @ 1.5 amps or 15 VDC @ 1.0 amps	12 VDC @ 1.5 amps or 15 VDC @ 1.0 amps	NA
0E56/12/2	12 VDC @ 3.2 amps or 15 VDC @ 2.9 amps	12 VDC @ 3.2 amps or 15 VDC @ 2.9 amps	NA
0E53-12/3	12 VDC @ 1.5 amps or 15 VDC @ 1.0 amps	12 VDC @ 1.5 amps or 15 VDC @ 1.0 amps	5 VDC @ 6 amps or 6 VDC @ 5 amps
0E56-12/3	12 VDC @ 3.5 amps or 15 VDC @ 3.0 amps	12 VDC @ 3.5 amps or 15 VDC @ 3.0 amps	5 VDC @ 12 amps or 6 VDC @ 10.5 amps

Solid State Non-Regulated DC Supplies

FEATURES

- Compact Low Cost Designs
- Line Isolated
- Full Wave Silicon Rectification
- Computer Grade Capacitance Filtering
- Ungrounded Outputs
- Low Internal Impedance
- Module or Rack Mounting
- Rugged Long-Life Design

OUTPUT VDC	OUTPUT CURRENT	PANEL SIZE W x D x H (INCHES)	MODEL
28VDC	5AMP	3-1/2 x 9-1/2 x 7-3/16	F28/5
28VDC	7AMP	3-1/2 x 9-1/2 x 9-3/4	F28/7
28VDC	10AMP	3-1/2 x 9-1/2 x 9-3/4	F28/10
28VDC	20AMP	5-1/4 x 9-1/2 x 14-3/4	F28/20
28VDC	40AMP	7 x 9-1/2 x 14-3/4	F28/40

Dual Output Silicon DC Power Modules

FEATURES

- Dual outputs, ± 12 through ± 15 VDC or 4-18 VDC
- Precision tracking
- Individual offset voltage adjustment
- All silicon
- 71°C free air rating
- No heat sinking or air blow required
- Fully repairable
- Automatic overcurrent protection
- Fast warm-up stabilization time
- Highly regulated
- Wide input range

OUTPUT VOLTAGE (DC)	CURRENT 71°C	SIZE W x D x H (INCHES)	WEIGHT (LBS.)	MODEL
± (4-18)	0-60MA	2-15/32 x 3-27/32 x 3-3/4	1.6	DV418
± (12-15)	0-60MA	2-1/4 x 3-15/32 x 3-3/4	1.2	DV60
± (12-15)	0-500MA	3-3/16 x 4 x 5-1/8	2.8	DV500
± (12-15)	0-1AMP	4 x 4-3/4 x 6-1/4	3.9	DV1000

Universal Solid State Over-Voltage Protector

FEATURES

- Protects against power supply switching transients
- DC bus powered — no AC
- Connects at any location along supply DC bus
- Two-terminal operation
- Self-powered-universal application
- Fast response time
- Completely independent of connected supply or source
- Provides protection for all types of supplies regulated or unregulated
- Independent of type of power supply failure
- Protects against line inductive over-voltage transients
- Low standby current
- Temperature compensated for stability
- Low shunt trip impedance
- Wide range — continuously adjustable trip point
- Available in industrial or military models

MODEL NUMBER	0V448	0V448M*
CURRENT RANGE	0-8AMPS	0-8AMPS
VOLTAGE RANGE	4.5-40VDC	4.5-40VDC
WEIGHT	10 oz.	10 oz.
SIZE (INCHES)	1-21/32 x 3-1/32 x 1-5/16	

Solid State Emergency Power Source

stores power during
normal conditions and
automatically provides
emergency power
during line failure.

Other models provide higher power ratings of 250 VA, 500 VA, 1000 VA and higher, on order.

Specifications : MODEL EP 100

Input: 115VAC, 60 cps
Output: 115VAC, 60 cps
Output Wave Form: Approx. square wave
Power output: (AV.) 100 VA
Power output: (surge) 150 VA
Capacity: Approx. 4 hrs. at 100 VA
9 hrs. at 50 VA
Recovery time: (fully discharged to fully charged) 8 hrs.
Power input: (quiescent) 10 VA
Power input: (average charge) 280 VA
Power input: (max. charge) 450 VA
Temp. range: -20°C to + 55°C
Switching: Automatic/Manual, Failure Simulator
Metering: Battery and AC output voltage
Size: 14 x 11 x 14½ inches (W x D x H)
Weight: 30 lbs. (less battery)

ERA TRANSPAC CORPORATION

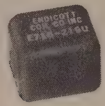
A Subsidiary of Electronic Research Associates, Inc.
Dept. 1202 311 E. Park Street, Moonachie, N.J. 07074 ● (201) 641-3650 ● TWX: 710-990-5064

DC-to-DC POWER SUPPLIES
from Endicott Coil

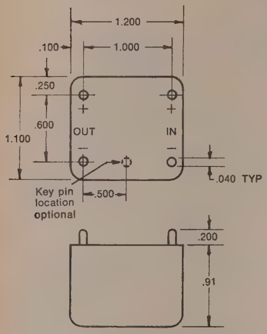
Activate your information displays

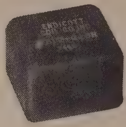
When you must convert low DC line voltages to nominal 200 or 250 V DC levels to activate your information displays, ask us to recommend the DC-to-DC power supply that's right for your application.

E 700

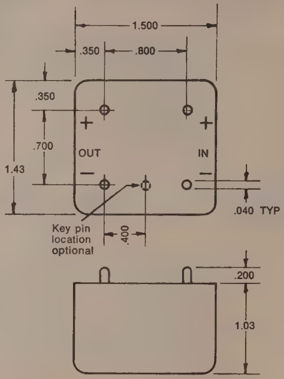

ENDICOTT COIL CO INC E71A-216U

unregulated


1.200
.100
1.000
.250
.600
1.100
OUT
IN
+
+
−
−
.040 TYP
Key pin location optional
.500
.200
.91

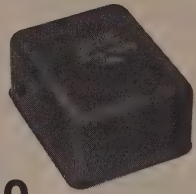

ENDICOTT COIL CO INC

regulated

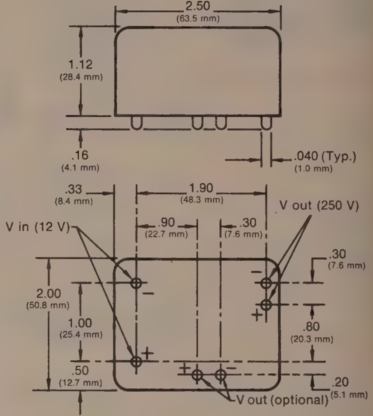

1.500
.350
.800
.350
.700
1.43
OUT
IN
+
+
−
−
.040 TYP
Key pin location optional
.400
.200
1.03

Specifications for E 700

Input: Standard inputs 5, 9, 12, 15 V DC (others up to 48 V DC)
Output: 200 V DC @ 15 MA.
Input/Output Isolation: 600 V RMS; 60 Hz. breakdown for 1 minute
Weight: 30 gms. (unregulated)
40 gms. (regulated)
Size: 1.1″ (27.94 mm) x 1.2″ (30.48 mm) x .910″ (23.11 mm) max. high (unregulated)
1.43″ (36.32 mm) x 1.5″ (38.10 mm) x 1.03″ (26.16 mm) max. high (regulated)
Mounting: Designed for PC mounting
Packaging: Plastic case, fully encapsulated



E 900


2.50
(63.5 mm)
1.12
(28.4 mm)
.16
(4.1 mm)
.040 (Typ.)
(1.0 mm)
.33
(8.4 mm)
1.90
(48.3 mm)
V out (250 V)
V in (12 V)
.90
(22.7 mm)
.30
(7.6 mm)
.30
(7.6 mm)
2.00
(50.8 mm)
1.00
(25.4 mm)
.80
(20.3 mm)
.50
(12.7 mm)
.20
(5.1 mm)
V out (optional)
+
−

Specifications for E 900

Input: 12 V DC standard (5 V, 9 V, 15 V DC, and other inputs available to your specification)
Standard Outputs: Available with either single or dual outputs, capable of up to 12 watts total. Single: 250 V DC @ up to 45 MA. Dual: 250 V DC @ 30 MA., and -16 V DC @ up to 100 MA. to provide the -12 V DC needed for the drive electronics in many applications using the Burroughs SELF-SCAN® displays.
Input/Output Isolation: 600 V RMS (60 Hz. breakdown for 1 minute)
Weight: 122 gms.
Size: 2″ (50.8 mm) x 2.5″ (63.5 mm) x 1.12″ (28.4 mm)
Mounting: Designed for PC board mounting
Packaging: Aluminum case, acting as heat sink, may rise 10–15° C. above ambient temperature at full load; may be connected to ground to provide electrostatic shielding

Although we develop our lightweight, compact DC-to-DC power supplies to activate "glow-type" information displays, our customers have demonstrated that this "big performer in a little package" has a host of other applications besides. Here are just some of them:

- Outputs to 1,500 V @ 1 MA. for portable oscilloscopes and photo-multiplier applications.
- Low wattage fluorescent tube power supply for battery operation (4 watt to 8 watt).
- High frequency AC excitation for remote sensors and transducers.
- Multiple DC and/or AC outputs from battery sources.
- Highly isolated power supplies for electromedical applications.

- **Pin layout permits mounting on most standard motherboards.**
- **Lightweight and compact size of these power supplies keeps the equipment in which they are used easily portable.**
- **Models shown here are fully encapsulated.**

uni-weld®

ENDICOTT COIL CO., INC.
30 Charlotte Street
Binghamton, New York 13905
Phone (607) 797-1263

CAUTION: 50,000 VOLTS

LET ERIE DESIGN and BUILD YOUR HIGH VOLTAGE POWER SUPPLIES and VOLTAGE MULTIPLIERS

When you talk about designing and packaging miniature, low current High Voltage Power Supplies and Voltage Multipliers, the name ERIE should come to mind first. Why? *No other manufacturer of these sophisticated devices has its own capacitor and rectifier technology in-house.* Only ERIE does it all. Our many years experience in producing State of the Art high voltage capacitors and high voltage silicon rectifiers --- plus an unsurpassed technology in circuit designing, packaging and encapsulation, makes ERIE an ideal source for your high voltage component needs. From very low input voltages, ERIE can produce output voltages up to 50,000 volts. Application for these compact, high reliability devices includes night-vision image intensification systems. Apollo TV cameras. CRT displays. Avionics systems exposed to rugged environments. Industrial, commercial and military equipments . . . an almost infinite variety of applications. So bring ERIE in early. Let us design and build *your* High Voltage Power Supplies and Voltage Multipliers. We're equipped to handle large or small volume orders . . . in-house.

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ERIE TECHNOLOGICAL PRODUCTS, INC.
Erie, Pennsylvania 16512

ERIE

RECHARGEABLE POWER . . .

STOCK BATTERY CONFIGURATIONS AVAILABLE

BATTERY NO.	Norm. Voltage	Nominal Capacity @ 20 Hr. Rate (A.H.)	Dimensions Inches				Weight (lbs.)
			Length	Width	Height	Height (Over Term.)	
CF6V1	6	0.9	2.00	1.65	1.97	2.18	0.6
CF12V1	12	0.9	2.00	3.30	1.97	2.18	1.2
CF12V1-L	12	0.9	4.00	1.65	1.97	2.18	1.2
CF18V1	18	0.9	4.95	2.00	1.97	2.18	1.8
CF12V1.5	12	1.5	7.02	1.33	2.40	2.58	1.5
CF2V2.5	2	2.5	2.29	1.04	2.62	2.84	0.5
CF6V2.5	6	2.5	3.12	2.29	2.62	2.84	1.5
CF8V2.5	8	2.5	4.16	2.29	2.62	2.84	2.0
CF10V2.5	10	2.5	5.20	2.29	2.62	2.84	2.5
CF12V2.5	12	2.5	3.12	4.59	2.62	2.84	3.0
CF6V2.6	6	2.6	5.28	1.34	2.36	2.56	1.3
CF12V2.6	12	2.6	5.28	2.68	2.36	2.56	2.6
CF2V5	2	5	2.31	1.06	3.90	4.21	0.78
CF6V5	6	5	3.18	2.31	3.90	4.12	2.34
CF8V5	8	5	4.25	2.31	3.90	4.12	3.12
CF10V5	10	5	5.30	2.31	3.90	4.12	3.90
CF12V5	12	5	4.62	3.18	3.90	4.12	4.68
CF12V5-L	12	5	6.12	2.41	3.94	4.12	4.75
CF12V5PP	12	5	6.12	2.43	6.56	6.56	5
CF8V6	8	6.5	3.34	2.15	6.50	6.65	3.8
CF6V8	6	8	6.00	2.00	3.75	3.96	3.75
CF12V8	12	8	6.00	4.00	3.75	3.96	7.50
CF12V12	12	12	6.46	3.34	6.50	6.65	11.4
CF12V12-L	12	12	10.03	2.15	6.50	6.65	11.4
CF12V20	12	20	6.51	4.93	6.53	6.75	17.2
CF2V30	2	30	3.34	2.15	6.50	6.65	3.75
CF6V30	6	30	6.46	3.34	6.50	6.65	11.5
CF6V30-L	6	30	10.03	2.15	6.50	6.65	11.5
CF12V30	12	30	6.68	6.46	6.50	6.65	23.0
CF12V30-L	12	30	10.03	4.31	6.50	6.65	23.0

Specifications are subject to change without notice

Eagle-Picher offers Carefree® Rechargeable Batteries in 30 Spill-Proof, No Maintenance Sizes . . .

At Eagle-Picher you can choose from the world's largest selection of rechargeable lead-acid batteries. The Carefree® rechargeables combine the advantages of dry cell batteries with the economies of a power source that can be used over and over again.

- Spill-Proof • Long Life
- Safe • Economical
- No Maintenance
- No Memory Conditioning
- Excellent Shelf Life
- Wide Operating Temperature Range

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Carefree
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Carefree
RECHARGEABLE BATT
Carefree Porta-Pac
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Carefree
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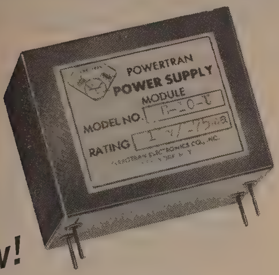
EAGLE-PICHER INDUSTRIES, INC.
Commercial Products Dept. EE
P.O. Box 130 Seneca, Missouri 64865
Phone 417-776-2258

FERROTRAN ELECTRONICS CO., INC.
683 BROADWAY, New York, N.Y. 10012

1975-76 CATALOG


POWERTRAN
POWER SUPPLY
MODULE
MODEL NO.
RATING
FERROTRAN ELECTRONICS CO., INC.

FERROTRAN
ELECTRONICS CO., INC.

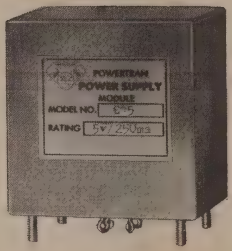
New!

E-10-U; 10 v @ 175ma;
in a universal case; 2½"x2"x1⅞";
for metal chassis or PC boards

INPUT VOLTAGE — 115 volts A.C.

Model	D.C. Volts	D.C. Current	% Reg.	% Rip.	Price
E-5	5	250 ma	.3	.01	$49
E-6	6	200	.3	.01	49
E-10	10	175	.2	.10	49
E-12	12	150	.2	.20	49
E-15	15	150	.2	.05	49
E-20	20	120	.1	.10	49
E-24	24	120	.2	.10	49
E-28	28	120	.2	.10	49

Case; GB metal case; 2¾"x2⅜"x2¹³⁄₁₆". 4 pin connector.
Also available in a metal case 2½"x2"x1⅞" as shown above and with a 4 pin connector on narrow side of unit (similar to SMF units).


POWERTRAN
POWER SUPPLY
MODULE
MODEL NO.
RATING

New!

Ultra-compact
medium current modules.
E-5; 5 v @ 250ma;

ECONOMY-POWER MODULES

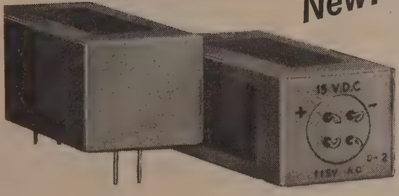
AC to DC

POWER SUPPLY MODULES

including: MINIATURE RECTIFIER TRANSFORMERS

SUBMINIATURE MODULES

New!


15 V.D.C
+
−
115V AC

SML-15U SML-15

INPUT VOLTAGE — 115 volts A.C.

Model	D.C. Volts	D.C. Current	% Reg.	% Rip.	Price
SML-5	5	80 ma	.5	.10	$44
SML-6	6	75	.5	.10	44
SML-10	10	70	.5	.20	45
SML-12	12	65	.5	.20	44
SML-15	15	60	.8	.20	44
SML-20	20	55	.8	.30	45
SML-24	24	50	.8	.30	46

Case; 3"x1³⁄₁₆"x1¼"; Mounts on a chassis with 2 ea. 4-40 blind inserts; no projecting studs; ideal for printed circuit boards; fixed voltage. 4 pin connector.

FERROTRAN
ELECTRONICS CO., INC.

SOLID STATE POWER SUPPLY MODULES

All silicon, long-life semi-conductor, regulated POWERTRAN power supply modules. Guaranteed 3 years. Gives single, fixed D.C. output voltages.

FIXED VOLTAGE MODULES

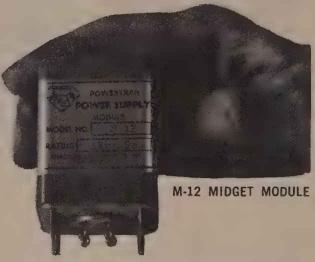
INPUT VOLTAGE — 115 Volts A.C

Single output voltage; all-steel MIL-T-27 cases; 4 pin connector; screw type studs for fastening to the chassis; grey paint.

Model	D.C. Volts	D.C. Cur.	% Reg.	% Rip.	Case	Price
M-1.5	1.5	30ma	4.	.9	EB	$37
M-2.0	2.0	30	4.	.45	EB	37
M-3.0	3.0	30	6.	.6	EB	38
M-4.0	4.0	30	5.	.5	EB	38
M-5	5	50	3.	.3	EB	38
HM-5	5	50	2.	.08	FB	40
E-5	5	250	.3	.01	GB	49
EH-5	5	500	.5	.1	GB	52
M-6	6	50	1.8	.18	EB	38
E-6	6	200	.3	.01	GB	49
EH-6	6	450	.3	.1	HB	52
MC-7	7	175	1.3	.1	HB	45
M-9	9	50	1.6	.2	EB	38
M-10	10	50	1.4	.12	EB	37
HM-10	10	50	1.	.03	FB	40
E-10	10	175	.2	.10	GB	49
EH-10	10	350	.2	.3	HB	52
M-12	12	45	1.3	.12	EB	40
HM-12	12	50	1.	.03	FB	40
MC-12	12	150	1.3	.08	HB	48
E-12	12	150	.2	.50	GB	49
EH-12	12	325	.2	.1	HB	52
M-15	15	45	1.5	.13	EB	37
MC-15	15	140	1.3	.1	HB	47
E-15	15	150	.2	.05	HB	49
EH-15	15	300	.2	.1	HB	52

All "M" type units are now available in a metal case 2½"x2"x⅞" similar to E-10-U (low silhouette). Order as M-5U, M6U, etc. Also in a case style similar to SMF units with a 4 pin connector.

Order as MF-5, MF-6, etc. No extra charge.



M-12 MIDGET MODULE

Model	D.C. Volts	D.C. Cur.	% Reg.	% Rip.	Case	Price
MC-18	18	140ma	1.5	.1	HB	$46
M-20	20	45	1.5	.15	EB	40
HM-20	20	50	1.	.05	FB	42
MC-20	20	140	1.3	.05	HB	45
E-20	20	120	.2	.10	GB	49
EH-20	20	250	.2	.1	HB	52
MC-22	22	130	1.3	.08	HB	45
MCH-22	22	225	1.5	.1	JB	52
MC-23	23	130	1.3	.05	HB	45
M-24	24	40	1.5	.15	EB	40
HM-24	24	45	1.2	.02	FB	42
E-24	24	120	.2	.10	GB	49
EH-24	24	225	.2	.1	HB	52
MC-26	26	125	1.3	.05	HB	44
M-27	27	40	1.5	.15	EB	40
MC-27	27	125	1.3	.05	HB	45
MCH-27	27	180	1.8	.1	JB	47
M-28	28	40	1.5	.15	EB	40
HM-28	28	45	1.5	.05	FB	40
E-28	28	120	.2	.1	GB	49
M-30	30	40	1.5	.15	EB	40
HM-30	30	40	1.5	.05	FB	42
MC-30	30	110	1.5	.1	HB	47
E-30	30	100	.3	.01	HB	52

All units shown are available with 220 volts A.C. input.

Model	D.C. Volts	D.C. Cur.	% Reg.	% Rip.	Case	Price
M-35	35	40ma	1.5	.15	EB	$40
M-40	40	40	1.5	.22	EB	40
M-45	45	35	1.5	.2	EB	40
MC-45	45	100	1.5	.1	HB	47
MCH-45	45	140	1.8	.1	JB	53
M-50	50	40	1.5	.2	EB	42
HV-50	50	40	1.5	.15	GA	50
HV-60	60	40	1.5	.15	GA	50
HV-75	75	60	1.3	.1	GA	54
M-100	100	2	1.5	.1	EB	42
HM-100	100	6	1	.05	HB	50
HV-100	100	60	1.5	.1	GA	60
HM-120	120	6	1	.05	HB	50
HV-120	120	55	1.3	.12	HA	64
HM-150	150	5	1	.05	HB	50
HV-150	150	40	1	.1	HA	66
HV-175	175	40	1.2	.12	HA	68
HM-200	200	5	.5	.05	HB	56
HV-200	200	40	1.3	.12	HA	68
HM-250	250	4	1	.05	HB	59
HV-250	250	40	1.5	.05	JA	72
HM-300	300	3	1	.05	HB	64
HV-300	300	35	1.5	.1	JA	74
HM-400	400	2	1	.05	HB	66
HV-400	400	20	1.5	.2	JA	77
HM-500	500	1.8	1	.05	JB	68
HV-500	500	15	1.5	.2	JA	77
HM-750	750	1.2	1	.1	JB	68
HV-750	750	8.5	1.2	.3	JB	100
HM-1000	1000	1	1	.1	JB	74
HV-1000	1000	5	1.3	.3	LB	120

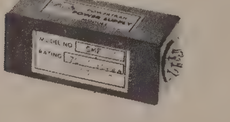
Power supplies output volts of 750 or higher have special ceramic high voltage terminals.

NEW!!
MIDGET MODULES

EB Case; 1¾"x1⅞"x2⅜"
Also available in a PC Case 2½"x2"x1⅞.

Model	D.C. Volts	D.C. Current	% Reg.	% Rip.	Price
ML-5	5	150ma	.5	.2	$44
ML-6	6	125	.5	.1	44
ML-10	10	100	.5	.1	45
ML-12	12	100	.5	.2	44
ML-15	15	90	.5	.2	44
ML-20	20	80	.5	.2	45
ML-24	24	80	.5	.2	45

INPUT VOLTAGE — 115 volts A.C.



SMF-70.

SMF SERIES

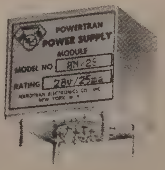
Case: 3"x1³⁄₁₆"x1¼"; Mounts on a chassis with 2 ea. 4-40 blind inserts; no projecting studs; ideal for printed circuit boards; fixed voltage. 4 pin connector.

Add $4 to SMF prices for 220 volts A.C. input unit. Height of case is 1½".

SUBMINIATURE MODELS

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
SMF-5	5	40ma	2.	.2	$40
SMF-6	6	40	1.3	.15	40
SMF-10	10	40	1.	.15	40
SMF-12	12	40	1.	.1	40
SMF-15	15	40	1.	.1	40
SMF-20	20	30	1.2	.25	40
SMF-24	24	30	1.2	.2	40
SMF-28	28	25	1.2	.3	41
SMF-30	30	20	1.5	.3	41
SMF-40	40	15	1.5	.2	42
SMF-50	50	15	1.5	.2	42
SMF-60	60	10	1.5	.1	42
SMF-70	70	10	1.2	.1	42

NO DERATING WITH TEMPERATURE



SM-28

SM SERIES

Case; 1⅝"x1⅞"x1⅝"; Mounts on a chassis with 4 ea. 6-32 studs. ⅝" diam. connector in cover. 4 pin connector.

Specifications and prices are the same as for SMF units. i.e.; SM-28 corresponds to SMF-28. Only difference is case style.

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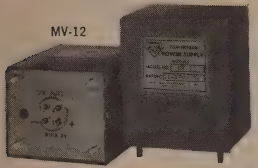
SOLID STATE POWER SUPPLY MODULES

All silicon, long-life, semi-conductor POWERTRAN power supply modules.
Guaranteed 3 years.

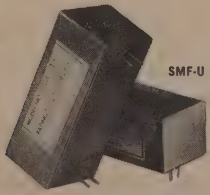
INPUT VOLTAGE — 115 volts A.C.
ADJUSTABLE OUTPUT MODULES

MV-12



Variable D.C. output; repairable; output voltage adjustable thru screwdriver control on stud side of case. Compact series regulated modules with short circuit protection; all silicon.

Model	D.C. Volts	D.C. Cur.	% Reg.	% Rip.	Case	Price
MV-3	2.5-3.8	200ma	.8	.1	HB	**$56**
MCS-3	2.5-3.8	450	.8	.1	JB	**62**
MV-5	4.5-5.5	200	.7	.1	HB	**56**
MCS-5	4.5-5.5	450	.8	.1	JB	**62**
HCV-5	4.5-5.5	1a	.4	.2	JA	**78**
MV-6	5.8-7	200	.6	.2	HB	**56**
MCS-6	5.8-7	450	.8	.3	HB	**62**
HCV-6	5.5-6.8	1a	.4	.2	JA	**78**
MV-10	9-12	200	.4	.03	HB	**56**
MCS-10	9-11	450	.5	.1	HB	**62**
HCV-10	8.5-11.8	1a	.4	.1	JA	**78**
MV-12	11-13	200	.2	.025	HB	**56**
MCS-12	11-13	400	.5	.05	HB	**62**
HCV-12	11-14.5	1a	.4	.05	JA	**78**
MV-15	14-16	200	.5	.03	HA	**56**
MCS-15	14-16	350	.5	.05	HB	**62**
HCV-15	14-18	800	.4	.1	JA	**78**
MV-20	19-22	180	.5	.03	HA	**56**
MCS-20	19-22	350	.5	.05	HB	**64**
HCV-20	18-22	700	.4	.3	JA	**79**
MV-24	23-26	180	.5	.04	HB	**56**
MCS-24	23-26	350	.5	.05	JB	**64**
HCV-24	23-26	700	.4	.3	JA	**79**
MV-28	27-29	150	.5	.04	HB	**56**
MCS-28	27-29	300	.4	.04	JB	**66**
HCV-28	26.5-29	600	.25	.3	JA	**79**
MV-30	28-32	150	.5	.04	HA	**58**



SMF-U SERIES

A new series of subminiature, fixed voltage power supplies in a shielded metal case for mounting either on PC boards or metal chassis. Prices and specs. identical to SMF units. Order as SMF-5U, SMF-6U, etc.

INPUT VOLTAGE — 115 volts A.C.
UNREGULATED MODULES

Ideal raw D.C. supplies containing transformer, rectifiers and capacitor filter. Simply attach series regulator, zener diode or 'IC" to convert to a regulated power supply; all solid state.

Model	D.C. Volts	D.C. Current	Case	Price
SU-5A	5	2amp	HA	**$38**
SU-6A	6	1	GB	**36**
SU-6B	6	2	HA	**36**
SU-10A	10	1.5	HA	**38**
SU-10B	10	.5	GB	**36**
SU-12A	12	1.5	HA	**40**
SU-12B	12	.5	HA	**38**
SU-12C	12	.25	HA	**36**
SU-15A	15	1	HA	**38**
SU-15B	15	.5	GB	**36**
SU-15C	15	.25	FB	**34**
SU-20A	20	.8	HA	**38**
SU-20B	20	.3	GA	**36**
SU-20C	20	1.2	HA	**37**
SU-24C	24	2	JA	**48**
SU-25A	25	.8	HA	**40**
SU-25B	25	.3	HA	**38**
SU-28A	28	.8	HA	**40**
SU-28B	28	.3	GB	**36**
SU-28C	28	1.8	JA	**48**
SU-30A	30	.7	HA	**40**
SU-30B	30	.3	GB	**36**
SU-40A	40	.5	HA	**40**
SU-40B	40	.2	GB	**36**
SU-50A	50	.4	HA	**40**
SU-50B	50	.2	GA	**37**
SU-60	60	.38	HA	**40**
SU-75	75	.3	HA	**40**
SU-90A	90	.25	HA	**40**
SU-90B	90	.1	HA	**37**
SU-100	100	.2	HA	**40**
SU-120A	120	.2	HA	**40**
SU-120C	120	.5	JA	**47**
SU-150	150	.1	HA	**34**
SU-200A	200	.09	HA	**40**
SU-250	250	.065	HA	**40**
SU-300	300	.06	HA	**40**
SU-400	400	.06	HA	**40**
SU-500	500	.05	LB	**52**
SU-750	750	.03	LB	**62**
SU-900	900	.025	LB	**62**
SU-1000	1000	.02	LB	**64**
SU-1250	1250	10ma	LB	**64**
SU-1400	1400	5	LB	**64**
SU-2000	2000	2	LB	**74**

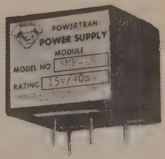
NEW ! ! !
UNREGULATED MODULES FOR I.C. SUPPLIES

Designed to feed proper voltages to Fairchild I.C.'s: Produces fixed regulated voltages shown below. Input voltage is 115 v. a.c.; 5 pin connector; EB case or P.C. case 2½" x 2" x 1⅞".

Model	D.C Volts	D.C. Current	Price
SIC-5	5	150ma	**$36**
SIC-6	6	125	**36**
SIC-8	8	100	**36**
SIC-12	12	100	**36**
SIC-15	15	90	**36**
SIC-18	18	80	**36**
SIC-24	24	80	**36**

INPUT VOLTAGE — 115 volts A.C.
PRINTED CIRCUIT MODULES

SMP-15



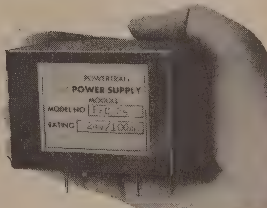
FOR PRINTED CIRCUIT BOARDS

Epoxy encapsulated power modules in an epoxy shell; incorporates 4 pins for direct soldering to printed circuit boards; lightweight.

SMP Units in Case: 1⅝"x1⅞"x1½".
MP Units in Case: 2⅛"x1⅞"x1⅝".

SINGLE OUTPUT VOLTAGE

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
SMP-5	5	40ma	2.0	.30	**$39**
MP-5	5	50	3.0	.30	**40**
SMP-6	6	40	1.3	.15	**39**
MP-6	6	50	1.8	.18	**40**
MP-10	10	50	1.4	.12	**40**
SMP-12	12	40	1.0	.10	**39**
MP-12	12	45	1.3	.12	**40**
MP-15	15	45	1.5	.13	**40**
MP-20	20	45	1.5	.15	**41**
MP-24	24	40	1.5	.15	**41**
SMP-28	28	25	1.2	.30	**41**
MP-28	28	40	1.5	.15	**41**
MP-30	30	40	1.5	.15	**42**
MP-40	40	40	1.5	.22	**43**
MP-50	50	30	1.5	.20	**43**
MP-100	100	2	1.5	.10	**44**



FIXED VOLTAGE — SINGLE OUTPUT MODULES FOR P.C. BOARDS

Case; Black epoxy; 2⅞"x2"x2".

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
EPC-5	5	150ma	.4	.20	**$47**
EPC-6	6	150	.4	.20	**47**
EPC-10	10	150	.2	.10	**47**
EPC-12	12	100	.2	.10	**47**
EPC-15	15	100	.2	.10	**47**
EPC-20	20	100	.2	.10	**47**
EPC-24	24	100	.2	.10	**47**

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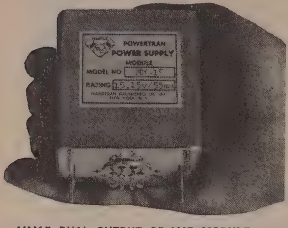
SOLID STATE POWER SUPPLY MODULES

All silicon, long-life semi-conductor, regulated POWERTRAN power supply modules. Guaranteed 3 years. Gives single, fixed D.C. output voltages.

INPUT VOLTAGE — 115 volts A.C.
DUAL OUTPUT MIDGET MODULES



MM15 DUAL OUTPUT OP-AMP MODULE

These precision engineered modules furnish two matched output voltages from independent power supply units. The current shown is available from each tap. Ideal for OP-AMPS; 6 pin connector.

Model	D.C. Volts	D.C. Cur.	% Reg.	% Rip.	Case	Price
MM-5	5, 5	50ma	1.7	.08	GB	$54
EE-5	5, 5	150	.5	.10	GB	60
MM-6	6, 6	50	1.6	.05	GB	54
EE-6	6, 6	150	.4	.10	GB	60
MM-10	10, 10	60	1.2	.005	GB	54
HMC-10	10, 10	150	1.2	.05	JB	62
MM-12	12, 12	60	1.2	.005	GB	54
EE-12	12, 12	120	.3	.05	GB	60
HMC-12	12, 12	150	1.5	.02	JB	68
MM-15	15, 15	55	1	.006	GB	55
EE-15	15, 15	100	.3	.04	GB	62
HMC-15	15, 15	150	1.5	.02	JB	65
MM-20	20. 20	50	1	.01	GB	55
HMC-20	20, 20	120	1.2	.04	JB	60
HMC-23	23, 23	110	1.3	.04	JB	58
MM-24	24, 24	45	1	.01	GB	55
EE-24	24, 24	100	.3	.05	GB	62
MM-25	25, 25	45	1	.01	GB	53
HMC-27	27, 27	110	1.4	.05	JB	60
MM-28	28, 28	45	1	.01	HB	55
MM-30	30,30	45	1	.01	HB	55
HMC-30	30, 30	100	1.5	.15	JB	62
HMC-45	45, 45	80	1.5	.15	JB	65
HHV-50	50, 50	40	1	.2	JA	60
HHM-60	60, 60	20	1.5	.1	HB	55
HHV-60	60, 60	40	1	.2	JA	65
HHM-70	70, 70	20	1.5	.1	HB	55
HHV-70	70, 70	40	1	.2	JA	65
HHM-100	100, 100	10	1.5	.1	JB	62
HHV-100	100, 100	30	1	.08	JA	72
HHM-120	120, 120	5	1.5	.1	JB	60
HHV-120	120, 120	25	1	.05	JA	72
HHV-150	150, 150	20	1	.05	JA	75

INPUT VOLTAGE — 115 volts A.C.
SUBMINIATURE DUAL OUTPUT

SMA-6

Case; 3″x1³⁄₁₆″x1¼″; Mounts on a chassis with 2 ea. 4-40 blind inserts; no projecting studs; ideal for printed circuit boards; fixed voltage; 6 pin connector.

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
SMA-6	6, 6	20ma	1.0	.3	$45
SMA-10	10, 10	20	1.0	.1	45
SMA-12	12, 12	20	1.0	.1	45
SMA-15	15, 15	20	1.5	.1	45
SMA-20	20, 20	15	1.5	.2	46
SMA-24	24, 24	15	1.5	.2	46
SMA-28	28, 28	12	1.5	.2	46

Case; 1⅝″1⅞″x1⅝″; Mounts on a chassis with 4 ea. 6-32 studs. ⅝″ diam. connector in cover. 6 pins; case style similar to SM units (see photo).

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
SMAC-6	6, 6	20ma	1.0	.3	$45
SMAC-10	10, 10	20	1.0	.1	45
SMAC-12	12, 12	20	1.0	.1	45
SMAC-15	15, 15	20	1.5	.1	45
SMAC-20	20, 20	15	1.5	.2	45
SMAC-24	24, 24	15	1.5	.2	45
SMAC-28	28, 28	12	1.5	.2	45

NEW!!!
DUAL OUTPUT 15 V.P.C. SUPPLY

Dual 15 v. supply specially designed for P.C. boards and operational amplifiers; metal case isolates it electrostatically from adjacent circuits; two independent 15 v. outputs isolated from case; can be grounded neg. or pos.

MODEL NO. — EE-15U.
INPUT VOLTAGE — 115 v. a.c.
OUTPUT VOLTAGE — 15 v. d.c.
OUTPUT CURRENT — 100 ma from each tap.
LOAD REGULATION — .1%.
RIPPLE — .03%.
ISOLATION: 1000 v. ins. (between outputs and case).
OUTPUT CONNECTION: 6 P.C. pins.
CASE DIMENSIONS: 2½″ x 2″ x 1⅞″. (See E-10-U front cover)
PRICE: $50.

SUBMINIATURE DUAL OUTPUT
FOR P.C. BOARDS

Lightweight; Epoxy; SMMP case: 1⅝″x1⅞″x 1½″; MMP case: 2″x2¾″x2″. 6 pins.

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
MMP-6	6, 6	45ma	2.	.100	$46
MMP-10	10, 10	45	1.2	.005	46
SMMP-12	12, 12	20	1.	.1	44
MMP-12	12, 12	45	1.2	.005	46
SMMP-15	15, 15	20	1.5	.1	46
MMP-15	15, 15	45	1.2	.005	48
MMP-20	20, 20	40	1.2	.01	48
MMP-24	24, 24	35	1.5	.01	48

INPUT VOLTAGE — 115 volts A.C.
INDICATOR TUBE SUPPLIES

All solid-state, silicon, power supply modules used to operate indicator display devices, numeral lights, etc. for digital read-out. Also for power decoder drivers and diode counters.

Model	D.C. Volts	D.C. Current	Case	Price
NI-1	175	20ma	AJ	$36
NI-3	180	15	AJ	36
NI-4	200	12	AJ	36
NI-6	175	35	EB	36
NI-7	180	30	EB	36
NI-8	200	25	FB	36
NI-10	175	48	FB	36
NI-11	180	45	FB	37
NI-12	200	40	FB	37

Models NI-1 through NI-4 also available in epoxy encapsulated plastic case for PC board mounting 1⅝″x1⅞″x1½″. NI-6 through NI-12 in case 2″x2¾″x2″ for PC board mounting.

The following regulated modules are recommended for use as indicator tube supplies:
HV-175 • HM-200 • HV200

Write for complete catalog of of power supplies & rectifier transformers. No charge.

**SEE SECTION 5600
FOR LIST OF FERROTRAN TRANSFORMERS**

ABOUT FERROTRAN POWER SUPPLIES

All Ferrotran power supplies are designed so that line voltage is applied to a conventional, laminated, **layer-wound**, 50-450 hz, silicon-steel transformer followed by silicon rectifiers and condenser filters.

- No pre-regulators or high frequency circuits are used so that noise effects are minimized.
- No random-wound transformers or toroids are used.
- No circuits are used which eliminate the transformer.
- All components used are of recent domestic manufacture.

F
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SOLID STATE POWER SUPPLY MODULES

All silicon, long-life, semi-conductor POWERTRAN power supply modules.
Guaranteed 3 years.

MIL-SPEC MODULES

Meets MIL-E-5272C as follows:
Acceleration—Non-op; Proc III; 10g along each axis for 10 minutes.
Shock—Non-op; Proc V; 30g for 6 ms each axis.
Vibration—Proc XII; 5-20cps double amp. of .25 in.; 20-400cps—5g; 400—3KC—7.5g.
Temp. (operating)— —65° C to +75°C
All power supplies described on these pages may be militarized. Below are representative units and prices.

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Case	Price
MSM-4.8	4.8	15ma.	3.0	0.1	AJ.	**$75**
MSM-12	12	50	.8	0.5	EB	**60**
MAS-15	15, 15	15ma.	.6	0.1	GB	**80**

MIDGET MODULES
220 V. A.C. INPUT

These all-silicon solid state modules operate from either 115 v. a.c. or 220 v. a.c. line voltage to furnish the d.c. outputs shown below. They will operate to 70°C. without derating.

EB Case: 1¾" x 1⅞" x 2⅜". Wt. Ea., ¾ lb.

Model	D.C. Volts	D.C. Current	% Reg.	% Ripple	Price
M-5-2	5	50	3.0	.30	**$42**
M-6-2	6	50	1.8	.18	**42**
M-10-2	10	50	1.4	.12	**42**
M-12-2	12	45	1.3	.12	**42**
M-15-2	15	45	1.5	.13	**42**
M-20-2	20	45	1.5	.15	**42**
M-24-2	24	40	1.5	.15	**43**
M-27-2	27	40	1.5	.15	**43**
M-28-2	28	40	1.5	.15	**43**

SPECIAL COMPONENTS

In addition to its off-the-shelf products, FERROTRAN designs all types of power supplies and transformers to meet special requirements. This is done at relatively little cost to the customer.

For example, we can package a power supply in a high or low silhouette, with blind inserts or studs, with solder pin connectors or porcelain terminals, with connectors on the same side of the studs or on opposite sides.

We can locate printed circuit pins as per your specifications.

We can attach special AC or UHF fittings supplied by the customer.

You can be sure that when you buy a FERROTRAN power supply, you buy the finest product available.

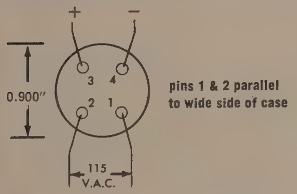
POWER SUPPLY DESIGN INFORMATION

MECHANICAL FEATURES

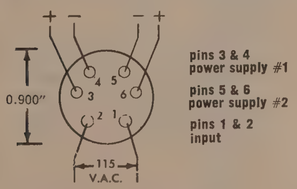
CONNECTOR — Compression type multi-lead glass headers, 0.900" dia. for all units. Hook type solder pins are standard. Hooks are ¼-inch high. (Transformer type terminals or octal plug-in types may be specified. Transformer terminals are 7/16" high x 3/16" in dia. Octal plug-in terminals fit standard 8-pin sockets.

CONNECTIONS

Single D.C. Output Voltage Connections for E, EH, M, HM, MC, MCH, HV, SMF, SM, SU, MCS, MV, NI Modules.



Dual D.C. Output Voltage Connectors for EE, MM, HMC, HHM, HHV, SMA, SMAC Modules.



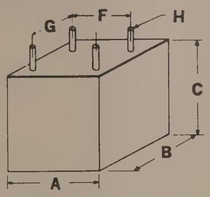
HCV module, as per above sketch. Pins 1 & 2 115 AC input. Pins 3 & 4 DC output. Connect a fuse between Pins 5 & 6 equal to d.c. rated current of module.

CONNECTOR MOUNTING — All connectors are mounted dead-center in stud side of case. Clearance hole for standard hook connector is 1 1/16".

HEATSINKS — Internal, for all units. No transistors or zeners mounted externally; no fins mounted externally.

CASE MOUNTING—Chassis mounted with four threaded studs.

DIMENSIONS PER MIL-T-27A



Case	A	B	C	F	G	H
AH	1 5/16	1 5/16	1¾	1¼	—	6-32x⅜
AJ	1⅝	1⅝	1⅜	1 3/16	1 3/16	6-32x⅜
EB	1 15/16	1 13/16	2 7/16	1⅜	1¼	6-32x⅜
FB	2 5/16	2 1/16	2½	1 11/16	1 7/16	6-32x⅜
GA	2¾	2⅜	3 13/16	2⅛	1¾	6-32x⅜
GB	2¾	2⅜	2 13/16	2⅛	1¾	6-32x⅜
HA	3 1/16	2⅝	4¼	2 19/64	1 55/64	8-32x⅜
HB	3 1/16	2⅝	3 3/16	2 19/64	1 55/64	8-32x⅜
JA	3 9/16	3 1/16	4⅞	2⅝	2⅛	8-32x⅜
JB	3 9/16	3 1/16	3⅞	2⅝	2⅛	8-32x⅜
LB	4 5/16	3 11/16	4½	3 5/16	2 11/16	10-32x½

ELECTRICAL FEATURES

INPUT VOLTAGE RANGE — Regulated from 105 to 130 volts a.c. input; max. is 140 v.

INPUT FREQUENCY RANGE—55 to 450 cycles; 55 to 2 kc at small additional charge.

REGULATION—Load regulation is specified in tables. Line voltage regulation is approximately 3% (105-130 v. a.c.)

RIPPLE — RMS value specified in tables at 60 cycles input and at currents indicated; will be reduced at lower currents. For approximate ripple at 400c divide 60c. ripple by 6.

OUTPUT VOLTAGE — Fixed voltage units have an output voltage within 5% of values shown. Customers may specify exact output voltage required at no extra charge.

COMPONENTS—All components rated for minimum of 85 degrees C. and are of domestic manufacture. All semi-conductors are silicon.

POLARITY—Outputs are floating off case with 1000 v. d.c. test voltage; may be used positively or negatively.

STABILITY — Fully operable on turn-on; voltage varies within a few percent during first five minutes; after half-hour of operation, voltage remains stable within a small fraction of 1%.

TEMP. (STORAGE) — −54°C to +85°C.

TEMP. (OPERATING) — −30°C to +70°C exc. where specified.

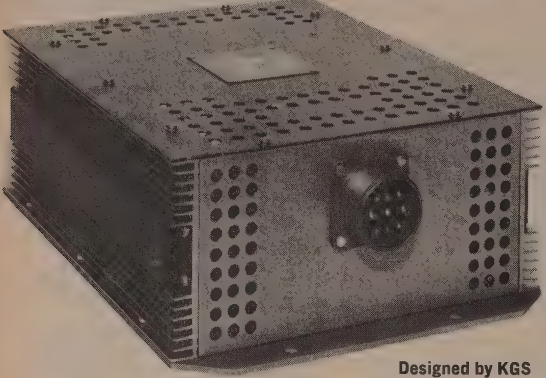
NOTE: All modules in these pages may be obtained with a 220 v. a.c. input. These units will work at 50 cycles.

WARRANTY

The manufacturer warrants its product for a period of three years. If failure of product occurs during this time, manufacturer will repair unit at no charge, or if it is non-repairable, to replace the unit on a pro-rated basis. Ferrotran's only obligation shall be to replace such quantity of product proved to be defective. Manufacturer shall not be liable for any injury, loss or damage direct or consequential arising out of use or inability to use the product.

FERROTRAN ELECTRONICS COMPANY, INC.
683 BROADWAY ▪ NEW YORK, N. Y. 10012 ▪ PHONE 212-254-5810

FLITE-TRONICS 60 Hz & 400 Hz STATIC INVERTERS



Designed by KGS

Other Inverters Available:

- Model PC-14D ( ) 60 VA
- Model PC-14B 125 VA
- Model PC-15BC( ) 250 VA
- Model PC-15H ( ) 300 VA
- Model PC-17 600 VA

Environmental specifications of the above models, same as PC-17A

- 12 VDC to 24 VDC Converters
- 24 VDC to 12 VDC Converters
- Three Phase Converters
  Model PH-3ϕ-400

For applications requiring greater than 750 VA of continuous power, the Flite-Tronics' Model PC-17A Inverter can be paralleled as necessary to double, triple, or quadruple the output power of a single unit. This is simply done by phase locking the oscillator in the PC-17A. Malfunction of a single unit when connected in this manner will not damage the other units in parallel. Each unit has its own overload protection. Each device is capable of self-preservation.

SPECIFICATIONS MODEL PC-17A (750 VA) STATIC INVERTER

INPUT VOLTAGE:
28 VDC ±2.0 VDC

INPUT CURRENT:
39A — full load
1.5A — no load

OUTPUT VOLTAGES:
115 VAC +5% −7%
26 VAC +5% −7%

OUTPUT FREQUENCY:
400 Hz ±1%

OUTPUT POWER:
750 VA continuous for 115 VAC output
150 VA continuous for 26 VAC output
NOTE: Total continuous output power 750 VA.

OUTPUT WAVEFORM:
Sine Wave, Single Phase

HARMONIC DISTORTION:
7% maximum (Typically 3%)

POWER FACTOR:
.8 to −.95

ALTITUDE:
45,000 feet

EFFICIENCY:
70% typical

TEMPERATURE:
−65°F to 160°F

WEIGHT:
16.2 lbs.

SIZE:
Width 8½″
Length 12″
Height 4$\frac{1}{16}$″

INPUT OVERVOLTAGE:
Withstands 130% overvoltage (37 VDC) for five minutes minimum while delivering full rated 750 VA output power. Output voltage under this condition 115 VAC +5% −7%.

EMISSION RFI:
Radiated & Conducted . . . 90KC to 1000MC.

Far below levels specified in Appendix A of RTCA Paper 120-61/DO-108 Category "A".

HUMIDITY:
Greater than 95% for ten days, temperature cycled between 75°F to 160°F.

VIBRATION:
Tested to withstand in three directions:

.08 DA	5-15 Hz
.036 DA	15-70 Hz
10 G's	70-500 Hz

SHOCK:
To withstand at least 10 G's for 11 milliseconds in three directions.

OVERLOAD CAPABILITY:
Deliver 150% of rated output current at rated output voltage for a duration of not less than 5 minutes (i.e., 900 volt amp load).

INPUT VOLTAGE PROTECTION:
Unit withstands transients of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

EXCESSIVE OVERLOAD & OUTPUT SHORT CIRCUIT:
Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition.

SPECIFICATIONS MODEL PC-16 STATIC INVERTER

POWER OUTPUT:
250 VA Continuous
150% Overload 5 minutes
pf — .8 to 1.0

VOLTAGE INPUT:
1. 28 VDC ±2 Volts
2. Withstands 88 Volt Transient for 1 Millisecond

INPUT CURRENT:
14 Amp — full load
1 Amp — no load

FREQUENCY:
60 HZ ±1 Hz

VOLTAGE OUTPUT:
115 VAC RMS +5% −7%

AMPLITUDE DISTORTION:
Less than 7%

WAVE FORM:
Sine Wave

PHASE:
Single

SHORT CIRCUIT
Withstand for 1 minute or longer

TEMPERATURE:
−10°F to +160°F

ALTITUDE:
45,000 Ft.

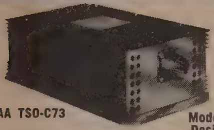
WEIGHT:
16 lbs.

SIZE:
7½″ x 12″ x 4″ overall dimensions

For application requiring greater than 250 VA of continuous power Model PC-16 can be paralleled to double or triple the output power of a single unit.

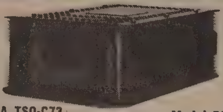
FLITE-TRONICS, co., inc.
3314 Burton Avenue., Burbank, Calif. 91504 U.S.A.
Phone: (213) 849-1483

FLITE-TRONICS 400 Hz INVERTERS & 3-PHASE CONVERTER



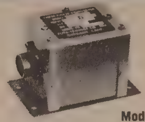
FAA TSO-C73

Model PC-15BC ( )
Designed by K.G.S.



FAA TSO-C73

Model PC-17
Designed by K.G.S.



Model PH-3φ-400
Designed by K.G.S.

PC-15BC ( ) TSO'D (250 VA) STATIC INVERTER

SPECIFICATIONS:

INPUT VOLTAGE:
28.0VDC ±2VDC, operates electrically down to 20VDC.

INPUT CURRENT:
13.2A Full Load
.75A No Load

OUTPUT VOLTAGE:
115VAC rms +5% −7%
26VAC +5% −7%

OUTPUT FREQUENCY:
400Hz ±1%

OUTPUT POWER:
250VA @ 115VAC and 75VA @ 26VAC. Total load not to exceed 250VA

OUTPUT CONFIGURATION:
1 Phase Sine Wave

HARMONIC DISTORTION:
Typically 3% (7% max)

POWER FACTOR:
.8 to 1.0

ALTITUDE:
45,000 feet

EFFICIENCY:
70% typical

TEMPERATURE:
−65°F. to 160°F.

WEIGHT:
7.5 lbs.

DIMENSIONS:
W6" L10⅝" H3⁷⁄₃₂"

INPUT OVERVOLTAGE:
Withstand 130% input overvoltage for 5 minutes while supplying full rated VA output power. Output voltage under this condition 115VAC +5% −7%.

OVERLOAD CAPACITY:
Capable of 150% output current overload for at least 5 minutes.

INPUT VOLTAGE PROTECTION:
Inverter withstands transients of 88 volts lasting 1 millisecond on the 28.0VDC input line.

EXCESSIVE OVERLOAD AND OUTPUT SHORT CIRCUITS
Withstand without damage or degradation loads exceeding 150% of rated output to an output short circuit. Inverter delivers rated output on removal of above condition.

HUMIDITY:
Tested to greater than 95% for ten days, temperature was cycled between 75°F. to 160°F.

VIBRATION:
Tested to withstand in three directions:

.08 DA	5-15 Hz
.036 DA	15-70 Hz
10 G's	70-500 Hz

SHOCK:
Tested to withstand at least 10 G's for 11 milliseconds in three directions.

EMISSION RFI:
Radiated and conducted . . .90 KC to 1000 MC, far below specification limits of RTCA Paper 120-61/DO-108, Appendix A.

PC-17 TSO'D (600 VA) STATIC INVERTER

SPECIFICATIONS:

INPUT VOLTAGE:
28.0VDC ±2VDC, operates electrically down to 20.0VDC.

INPUT CURRENT:
31 Amps full load
1¼A no load typical

OUTPUT VOLTAGE:
115VAC +5% −7%
26VAC +5% −7%

OUTPUT FREQUENCY:
400 Hz ±1%

OUTPUT POWER:
600VA @ 115VAC and 125VA @ 26VAC. Total load not to exceed 600VA.

OUTPUT CONFIGURATION:
Sine Wave, Single Phase

HARMONIC DISTORTION:
Typically 3% (7% max)

POWER FACTOR:
.8 to −.95

ALTITUDE:
45,000 feet

EFFICIENCY:
70% typical

TEMPERATURE:
−65°F. to 160°F.

WEIGHT:
14.6 lbs.

DIMENSIONS:
W8½" L12" H4¹⁄₁₆"

INPUT OVERVOLTAGE:
Withstand 130% input overvoltage for 5 minutes while supplying full rated VA output power. Output voltage under this condition 115VAC +5% −7%.

OVERLOAD CAPACITY:
Capable of 150% output current overload for at least 5 minutes.

INPUT VOLTAGE PROTECTION:
Inverter withstands transients of 88 volts lasting 1 millisecond on the 28.0VDC input line.

EXCESSIVE OVERLOAD AND OUTPUT SHORT CIRCUITS:
Withstand without damage or degradation loads exceeding 150% of rated output to an output short circuit. Inverter delivers rated output on removal of overload condition.

HUMIDITY:
Tested to greater than 95% for ten days, temperature was cycled between 75°F. to 160°F.

VIBRATION:
Tested to withstand in three directions:

.08 DA	5-15 Hz
.036 DA	15-70 Hz
10 G's	70-500 Hz

SHOCK:
Tested to withstand at least 10 G's for 11 milliseconds in three directions.

EMISSION RFI:
Radiated and conducted . . . 90 KC to 1000MC, far below specification limits of RTCA Paper 120-61/DO-108, Appendix A.

PH-3φ-400 THREE PHASE CONVERTER

Flite-Tronics Co., Inc. introduces a **three phase converter** Model PH-3φ-400, for use with Flite-Tronics' 400 Hz static inverters.

The PH-3φ-400 is designed to convert two Flite-Tronics' inverters into a 115VAC, 400 Hz DELTA three phase power source with 60 degrees between phases. A transformer can be used to realize 120 degrees between phases. The PH-3φ-400 will also convert three inverters into a WYE 115/200VAC, 400 Hz three phase operation.

SPECIFICATIONS:

INPUT:
28VDC at .15 Amp. max.

FREQUENCY:
400 Hz

FUNCTION:

DELTA CONFIGURATION

2 Each Inverters	Output VAC	Phase Angle	Total Power
PC-15BC ( )	115	60°	500VA
PC-17	115	60°	1200VA
PC-17A	115	60°	1500VA

WYE CONFIGURATION

3 Each Inverters	Output VAC	Phase Angle	Total Power
PC-15BC ( )	115/200	120°	750VA
PC-17	115/200	120°	1800VA
PC-17A	115/200	120°	2250VA

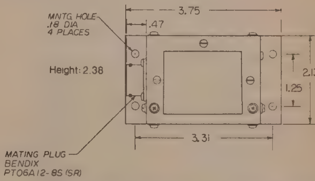
ENVIRONMENTAL:
Designed to meet RTCA paper DO-138 Category A

TEMPERATURE:
−55°C. to 71°C.

ALTITUDE:
50,000 feet

SIZE IN INCHES:
L3¾" W2⅛" H2⅜"

WEIGHT:
0.5 lbs.



FLITE-TRONICS, co., inc. 3314 Burton Avenue., Burbank, Calif. 91504 U.S.A.
Phone: (213) 849-1483

1975-76 CATALOG

GATES

POWER SUPPLIES

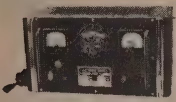
A single source for all possible types of "brute force" and regulated power supplies that can fill 90% of your design and application needs. Gates Power Supplies give you absolutely lowest cost and long life. The units are excellently constructed of high rated components for trouble free, years of service.

Silicon or Selenium. Single and three-phase units. 1 to unlimited Volts, 1 to unlimited Amps. Metered and unmetered Static or variable outputs. Rack, cabinet or chassis mounts. Unit or hundred quantities 48 hour delivery. Two year guarantees. Power Supplies for OEM Application, Testing Prototype, Lab Type Units, Plating, Motor Control, Cathode Protection, Transistor Power, Anodizing, Battery Charging, Battery Conversions, Marine Types, Aircraft Starting.

GATES ELECTRONIC COMPANY, INC. / 526 Van Nest Ave., Bronx, N. Y. 10460 / (212) 881-5900 — 823-8200

GATES POWER SUPPLIES

SILICON POWER RECTIFIER



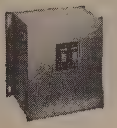
For transister circuits and electronic equipment

MODEL G92F

Input: 115 VAC, 60 Hz, 1 phase. **Output:** 0-32 VDC, 0-10* Amps DC Continuous Duty. **Regulation:** No load to full load 15%. **Ripple:** Less than 0.3% RMS. **Meters:** Volt. & Amp. 2% Accuracy. **Dimen.:** 17″ x 9″ x 9″.

***Also available in 5 Amperes**

INDUSTRIAL POWER UNIT WALLMOUNT

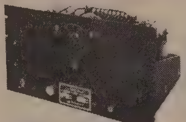


MODEL A10

Input: 115 or 230 VAC, 60 cycles, single phase. **Output:** 115 VDC, 125 Watts. **Application:** Power sources for operating DC Motors, Relays, Solenoids, Magnetic Chucks. **Dimen.:** 11″H x 9″W x 6½″D.

Also available 250 Watts

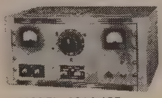
SILICON POWER SUPPLY



MODEL G48-6FM

Input: 115 VAC, 60 cycles, single phase. **Output:** 0-48 VDC, 0-6 Amps. **Control:** Continuously variable over entire range. **Ripple:** 1% RMS. **Dimen.:** 19″W x 13″D x 10½″H, Fits RETMA, Western Electric racks.

SILICON POWER SUPPLY

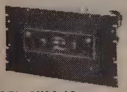


MODEL GS14-15F

Input: 115 VAC, 60 cycles, single phase. **Output:** 0-14 VDC, 0-15 Amps Continuous Duty. **Ripple:** Less than 1% RMS. **Meters:** 2% Accuracy. **Dimen.:** 9″H x 17½″W x 9″D.

Rack Model Also Available

SILICON RACK MOUNT SUPPLY

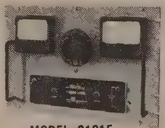


MODEL GX30-10

Input: 115 VAC, 60 cycles, single phase. **Output:** 26, 28, 30 VDC, 0-10 Amps Continuous Duty. **Regulation:** 10% no load to full load. **Ripple:** 0.3% RMS. **Dimen.:** 8¾″H x 19″W x 10″D.

Price: $175.00 Net

AIRCRAFT BATTERY ELIMINATOR



MODEL G101F

Input: 115 VAC, 60 cycles, single phase. **Output:** 0-32 VDC, 0-20 Amps Continuous Duty. **Ripple:** 0.5% RMS. Unique overload device prevents needle slam and shows overload condition. **Regulation:** VDC at full load, 30; VDC at 1/10 load, 35. **Meters:** 2% Accuracy. **Dimen.:** 19″ x 14¼″ x 12¼″.

For Rack or Bench Use

ECONOMY RANGE DC POWER SUPPLIES

Less Than 1% Ripple, Good Regulation, Rack Mount Type, Heavy Duty Construction, Powerstat, Fused 2% Meters, 115 VAC Input.

Model	Output Volts DC	@ Amps	Price
GT 12-5	0-12	5	$ 96
GT 12-10	0-12	10	130
GT 12-15	0-12	15	160
GT 12-25	0-12	25	200
GT 12-100	0-12	100	485
GT 14-5	0-14	5	125
GT 14-15	0-14	15	180
GT 14-20	0-14	20	200
GT 14-30	0-14	30	220
GT 14-40	0-14	40	320
GT 14-50	0-14	50	385
GT 14-75	0-14	75	413
GT 14-100	0-14	100	550
GT 16-5	0-16	5	130
GT 16-10	0-16	10	145
GT 16-25	0-16	25	225
GT 16-30	0-16	30	260
GT 16-40	0-16	40	300
GT 16-50	0-16	50	Inquire
GT 16-70	0-16	70	450
GT 16-80	0-16	80	475
GT 28-5	0-28	5	135
GT 28-12	0-28	12	186
GT 28-24	0-28	24	302
GT 28-50	0-28	50	440
GT 32-5	0-32	5	140
GT 32-8	0-32	8	150
GT 32-12	0-32	12	220
GT 32-15	0-32	15	250
GT 32-24	0-32	24	325
GT 32-30	0-32	30	385
GT 32-50	0-32	50	Inquire
GT 32-60	0-32	60	561
GT 48-5	0-48	5	175
GT 48-10	0-48	10	240
GT 48 15	0-48	15	270
GT 48-25	0-48	25	340
GT 48-35	0-48	35	Inquire
GT 48-50	0-48	50	Inquire
GT 48-60	0-48	60	Inquire
GT 48-80	0-48	80	Inquire
GT 48-100	0-48	100	Inquire
GT 80-5	0-80	5	Inquire
GT 80-10	0-80	10	Inquire
GT 80-20	0-80	20	Inquire
GT 80-50	0-80	50	Inquire
GT 80-100	0-80	100	Inquire

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GATES

ELECTRONIC COMPANY, INC.
526 VAN NEST AVE., BRONX, N.Y. 10460
TELEPHONES: (212) 881-5900 — 823-8200

ECONOMY RANGE DC POWER SUPPLIES (Cont'd)

Model	Output Volts DC	@ Amps	Price
GT 115-5	0-115	5	Inquire
GT 115-10	0-115	10	Inquire
GT 115-15	0.115	15	Inquire
GT 115-20	0-115	20	Inquire
GT 115-25	0-115	25	Inquire
GT 115-30	0-115	30	Inquire
GT 115-40	0-115	40	Inquire
GT 115-50	0-115	50	Inquire
GT 115-60	0-115	60	Inquire
GT 115-70	0-115	70	Inquire
GT 125-5	0-125	5	Inquire
GT 125-10	0-125	10	Inquire
GT 125-15	0-125	15	Inquire
GT 125-20	0-125	20	Inquire
GT 125-25	0-125	25	Inquire
GT 125-30	0-125	30	Inquire
GT 125-40	0-125	40	Inquire
GT 125-50	0-125	50	Inquire
GT 125-80	0-125	80	Inquire
GT 130-2	0-130	2	Inquire
GT 130-5	0-130	5	Inquire
GT 130-10	0-130	10	Inquire
GT 200-10	0-200	10	Inquire
GT 300-1	0-300	1	Inquire
GT 300-2	0-300	2	Inquire
GT 350-1	0-350	1	Inquire

HIGH VOLTAGE DC POWER SUPPLIES

1% Ripple, Good Regulation, Cabinets, Meters, Heavy Duty Construction, Powerstat, Fused, 2% Meters, Heavy Duty Line Cord.

Model	Input VAC	Input Phase	Output VDC	Output Amps
GP 30-200	220	3	0-30	200
GP 30-250	220	3	0-30	250
GP 30-300	220	3	0-30	300
GP 32-5	115	1	0-32	5
GP 32-10	115	1	0-32	10
GP 32-30	115	1	0-32	30
GP 32-40	115	1	0-32	40
GP 32-100	220	3	0-32	100
GP 32-150	220	3	0-32	150
GP 48-100	220	3	0-48	100
GP 50-50	220	3	0-50	50
GP 60-6	115	1	0-60	6
GP 60-10	115	1	0-60	10
GP 60-12	115	1	0-60	12
GP 60-20	115	1	0-60	20
GP 60-50	220	3	0-60	50
GP 60-80	220	3	0-60	80
GP 60-250	220	3	0-60	250
GP 125-2.5	115	1	0-125	2.5
GP 125-3	115	1	0-125	3
GP 125-5	115	1	0-125	5
GP 125-3	115	1	0-125	3
GP 125-5	115	1	0-125	5
GP 125-10	115	1	0-125	10
GP 125-20	115	1	0-125	20
GP 125-24	220	3	0-125	24
GP 125-40	220	3	0-125	40
GP 125-60	220	3	0-125	60
GP 125-80	220	3	0-125	80
GP 125-120	220	3	0-125	120
GP 125-125	220	3	0-125	125
GP 240-5	115	1	0-240	5
GP 240-10	115	1	0-240	10
GP 250-5	115	1	0-250	5
GP 250-15	220	3	0-250	15
GP 250-12	220	3	0-250	12
GP 250-20	220	3	0-250	20
GP 250-25	220	3	0-250	25
GP 250-40	220	3	0-250	40
GP 250-50	220	3	0-250	50
GP 250-75	220	3	0-250	75

HIGH VOLTAGE DC POWER SUPPLIES (Cont'd)

Model	Input VAC	Input Phase	Output VDC	Output Amps
GP 300-1	220	3	0-300	1
GP 300-2.5	220	3	0-300	2.5
GP 300-3	220	3	0-300	3
GP 300-5	220	3	0-300	5
GP 500-5	220	1	0-500	5
GP 500-5	220	3	0-500	5
GP 500-10	220	3	0-500	10
GP 500-20	220	3	0-500	20
GP 500-25	220	3	0-500	25
GP 500-30	220	3	0-500	30
GP 500-35	220	3	01500	35
GP 1000-1	220	3	0-1000	1
GP 1000-½	220	3	0-1000	½

NEW

TRANSISTORIZED REGULATED DC POWER SUPPLIES RACK MOUNT, LINE & LOAD REGULATED

Regulation: ±0.1%, Line & Load ±100 mv. Input: 115 VAC, 60 Hz, single phase. Volt and Amp Meters. Overload protected.

Model	Output Volts DC	@ Amps	Price
GQ 15-5	0-15	5	$225
GQ 15-10	0-15	10	310
GQ 15-24	0-15	25	495
GQ 15-50	0-15	50	729
GQ 36-5	0-36	5	310
GQ 36-10	0-36	10	407
GQ 36-15	0-36	15	530
GQ 36-25	0-36	25	649
GQ 36-50	0-36	50	989
GQ 60-5	0-60	5	407
GQ 60-10	0-60	10	530
GQ 60-15	0-60	15	655
GQ 60-20	0-60	20	975
GQ 125-2.5	0-125	2.5	407
GQ 125-5	0-125	5	510
GQ 125-10	0-125	10	980

LOW-COST BASIC/OEM SUPPLIES

Model	Output Volts DC	Output Amps	Ripple	Price
L 6.3-30	6.3	30	1%	$137
L 12-12	12	12	1MV/.01%	198
L 12-15	12	15	1%	187
L 12-24	12	24	5%	125
L 12-24	12	24	1%	158
L 12-50	12	50	5%	146
L 12-50	12	50	1%	300
L 24-30	24	30	1%	325
L 28-1	28	1	1/0.5%	61
L 28-2	28	5	5%	94
L 28-5	28	5	1%	150
L 28-8	28	8	5%	121
L 28-12	28	12	5%	132
L 28-24	28	24	N.F.	160
L 28-24	28	24	5%	200
L 28-30	28	30	5%	344
L-28-50	28	50	N.F.	350
L 28-50	28	50	5%	375
L 28-50	28	50	1%	443
L 28-100	28	100	1%	560
L 115-2.5	115	2.5	5%	136
L 115-5	115	5	5%	170
L 115-10	115	10	N.F.	207
L 115-10	115	10	5%	250
L 220-5	220	5	5%	245
L 220-10	220	10	5%	375
L 440-5	440	5	5%	400

ALL TYPES OF POWER SUPPLIES

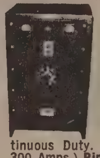
SILICON POWER RECTIFIER
MODEL G50-50R

Input: 220 VAC, 60 cycles, 3 phase. **Output:** 0-50 VDC, 0-50 Amps Continuous Duty. **Ripple:** .3% RMS. **Regulation:** No load to full load 8%. **Meters:** 2% Accuracy. **Dimen.:** 21″ x 15″ x 19″.

SILICON INDUSTRIAL POWER UNIT
MODEL G30-100

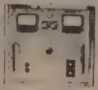
Input: 220 VAC, 60 cycles, 3 phase. **Output:** 0-32 VDC, 0-100 Amps Continuous Duty. Also 440 and 480 Volts. **Ripple:** .3% RMS. **Regulation:** 5-8% 1/10th load to full load with constant input and at maximum output voltage setting. **Meters:** 2% Accuracy. **Dimen.:** 21″ x 15″ x 19″.

SILICON AIRCRAFT BATTERY ELIMINATOR
MODEL G48-100



Input: 220 or 440 VAC, 60 cycles, 3 phase. **Output:** 0-32 VDC, 100 Amps Continuous Duty. (Also avail. 150 and 300 Amps.) **Ripple:** .5% RMS. **Regulation:** 5-8% 1/10th load to full load with constant input and maximum output voltage setting. **Meters:** 2% Accuracy. **Dimen.:** 25″ x 25″ x 43″.

SILICON REGULATED POWER SUPPLY
MODEL G30-200

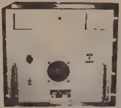


Input: 115 VAC, 60 cycles, 1 phase. **Output:** 5-30 VDC, 0-40 Amps. **Ripple:** 1% RMS. **Regulation:** ±1% from no load to full load. **Meters:** 2% Accuracy. **Dimen.:** 21″ x 15″ x 19″.

SILICON POWER SUPPLY
MODEL GX30-5

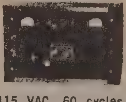
Input: 115 VAC, 60 cycles, single phase. **Output:** 28-30-32 VDC, 0-5 Amps, DC Continuous Duty. Also 6 Amps. **Regulation:** 12% no load to full load. **Ripple:** .5% RMS. **Dimen.:** 5″W x 13½″L x Overall Height 9″.

SILICON GENERAL PURPOSE RECTIFIER
MODEL G-115



Input: 115 VAC, 60 cycles, single phase. **Output:** 0-32 VDC, 0-50 Amps DC Continuous Duty variable over entire range. **Ripple:** 1% RMS. **Dimen.:** 19¼″H x 14″W x 17½″D.

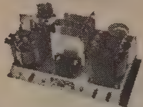
DC POWER SUPPLY
MODEL G94F



Input: 115 VAC, 60 cycles, single phase. **Output:** 0-300 VDC Continuous Duty variable 0-1 Amps. **Ripple:** 3 MV RMS. **Dimen.:** Rack 8¾″H x 19″L x 9½″D. Cabinet 10½″H x 22″L x 12″D. Rack or cabinet.

Also Available 0-350V 0-2 Amp

SILICON POWER SUPPLY
MODEL GX30-20



Input: 115 VAC, 60 cycles, single phase. **Output:** 0-34 VDC, 0-20 Amps Continuous Duty. **Regulation:** No load to full load 18%. **Ripple:** Below 1%. Silicon Rectifiers, High Efficiency. **Dimen.:** 10″ x 17″ x 3″.

1φ & 3φ SILICON PLATING SUPPLIES

Volt & Amp. Meters. Powerstat Control or Tap Switch. Controls Start at Zero. Overload Protection. AC Input — 110-115-220 VAC 1φ, or 220-440-480VAC 3φ. 3φ Units 5% Ripple. Cabinet Enclosure Fan Cooled. (Also Available 28 VDC.)

Model	Output Volts DC	Amps
GI 10-6	6V	10
GI 10-6F	6V	10
GI 10-9	9V	10
GI 10-9F	9V	10
GI 10-12	12V	10
GI 10-12F	12V	10
GI 25-6	6V	25
GI 25-6F	6V	25
GI 25-9	9V	25
GI 25-9F	9V	25
GI 25-12	12V	25
GI 25-12F	12V	25
GI 25-18	18V	25
GI 25-18F	18V	25
GI 25-24	24V	25
GI 25-24F	24V	25
GI 35-6	6V	35
GI 35-6F	6V	35
GI 35-9	9V	35
GI 35-9F	9V	35
GI 35-12	12V	35
GI 35-12F	12V	35
GI 35-18	18V	35
GI 35-18F	18V	35
GI 35-24	24V	35
GI 35-24F	24V	35
GI 50-6	6V	50
GL 6-50	6V	50
GL 8-60	8V	50
GL 9-50	9V	50
GL 10-50	10V	50
GL 12-50	12V	50
GL 15-50	15V	50
GL 18-50	18V	50
GL 6-75	6V	75
GL 9-75	9V	75
GL 12-75	12V	75
GL 18-75	18V	75
GL 6-100	6V	100
GL 9-100	9V	100
GL 12-100	12V	100
GL 18-100	18V	100
GL 20-100	20V	100
GL 30-100	30V	100
GL 6-150	6V	150
GL 9-150	9V	150
GL 12-150	12V	150
GL 18-150	18V	150
GL 6-200	6V	200
GL 9-200	9V	200
GL 12-200	12V	200
GL 18-200	18V	200
GL 20-200	20V	200
GL 30-200	30V	200
GL 6-250	6V	250
GL 9-250	9	250
GL 12-250	12V	250
GL 18-250	18V	250
GL 20-250	20V	250
GL 30-250	30V	250
GL 6-300	6V	300
GL 9-300	9V	300
GL 12-300	12V	300
GL 18-300	18V	300
GL 20-300	20V	300
GL 30-300	30V	300
GL 6-400	6V	400
GL 6-500	6V	500
GL 9-500	9V	500
GL 12-500	12V	500
GL 18-500	18V	500
GL 20-500	20V	500
GL 30-500	30V	500
GL 6-1000	6V	1000
GL 9-1000	9V	1000
GL 12-1000	12V	1000
GL 18-1000	18V	1000
GL 20-1000	20V	1000
GL 30-1000	30V	1000

24 VOLT POWER SUPPLIES — RACK TYPE — 1% RIPPLE

Model	Output Volts DC	@ Amps	Price
G 24-3	24	3	Inquire
G 24-6R	24	6	Inquire
G 24-15R	24	15	Inquire
G 24-20R	24	20	Inquire
G 24-25R	24	25	Inquire
G 24-30R	24	30	Inquire
G 24-50	24	50	Inquire
G 24-100	24	100	Inquire
G 24-150	24	150	Inquire

Also supplied unfiltered.

WRITE FOR CATALOG.
PRICES SUBJECT TO CHANGE.

12 VOLT POWER SUPPLIES — 1% RIPPLE

Fixed 12 VDC Power Supplies. 1% Ripple. Cabinet Meters extra.

Model	Output Volts DC	Amps
GS 12-1	12	1
GS 12-3	12	3
GS 12-3	12	3
GS 12-10	12	10
GS 12-15	12	15
GS 12-20	12	20
GS 12-25	12	25
GS 12-30	12	30
GS 12-40	12	40
GS 12-50	12	50
GS 12-100	12	100
GS 12-150	12	150
GS 12-200	12	200

INDUSTRIAL LINE 1φ - CABINET - NO METERS

Model	Output VDC	@ Watts	Input	Price
GK 115-125A	115	125	115	$105
GK 115-125B	115	125	230	105
GK 115-125C	115	125	440	105
GK 115-250A	115	250	115	118
GK 115-250B	115	250	230	118
GK 115-250C	115	250	440	118
GK 115-375A	115	375	115	123
GK 115-375B	115	375	230	123
GK 115-375C	115	375	440	123
GK 115-500A	115	500	115	136
GK 115-500B	115	500	230	136
GK 115-500C	115	500	440	136
GK 115-750A	115	750	115	173
GK 115-750B	115	750	230	173
GK 115-750C	115	750	440	173
GK 115-1000A	115	1000	115	200
GK 115-1000B	115	1000	230	200
GK 115-1000C	115	1000	440	200
GK 230-125A	230	125	115	114
GK 230-125B	230	125	230	114
GK 230-125C	230	125	440	114
GK 230-250A	230	250	115	125
GK 230-250B	230	250	230	125
GK 230-250C	230	250	440	125
GK 230-375A	230	375	115	150
GK 230-375B	230	375	230	150
GK 230-375C	230	375	440	150
GK 230-500A	230	500	115	180
GK 230-500B	230	500	230	180
GK 230-500C	230	500	440	180
GK 230-750A	230	750	115	220
GK 230-750B	230	750	230	220
GK 230-750C	230	750	440	220
GK 230-1000A	230	1000	115	290
GK 230-1000B	230	1000	230	290
GK 230-1000C	230	1000	440	290

GATES

ELECTRONIC COMPANY, INC.
526 VAN NEST AVE., BRONX, N.Y. 10460
TELEPHONES: (212) 881-5900 — 823-8200

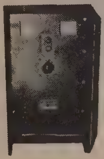
GATES POWER SUPPLIES

MODEL G230-25

Input: 208/440, 3ph 60 Hz. **Output:** 230 @ 25A. **Ripple:** 4.5%. **Regulation:** 1/10 Load 8%. **Dimensions:** 21″W x 15″D x 14″H.

Meters Extra

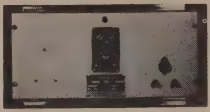
MODEL G12-250



Input: 208, 3ph 60 Hz. **Output:** 0-12V @ 250A. **Ripple:** 4.5%. **Regulation:** 1/10 Load 8%. **Meters:** Volt. & Amp. 2%. **Dimensions:** 20″W x 20″D x 35″H.

Also 12V, 300A and Up

MODEL G220-10

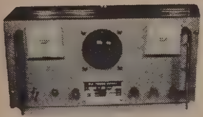


Input: 115VAC, 1φ, 60 Hz. **Output:** 220VDC @ 10A. **Ripple:** 48% (also 1% supplied). **Meters:** None. **Dimensions:** 21″W x 15″D x 10″H.

SILICON INDUSTRIAL POWER UNIT
MODEL G30-40F

Input: 115VAC, 60 Hz, 1 phase. **Output:** 0-32 VDC, 0-40A DC, continuous duty. **Ripple:** 1% RMS. **Dimensions:** 12¼″H x 19″W x 13″D. **Regulation:** D.C.V. at full load: 32 minimum D.C.V. at 1/10 load: 35 maximum.

MODEL GT125-5F



Input: 115VAC. **Output:** 0-125 @ 5A. **Ripple:** 0.5%. **Regulation:** Unregulated. **Meters:** Volt & Amp. 2%. **Dimensions:** 21″W x 15″ D x 10½″H.

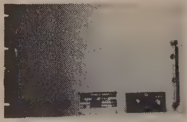
Available Rack

MODEL GT14-40

Input: 115VAC. **Output:** 0-14 @ 40A. **Ripple:** 0.1%. **Regulation:** Unregulated. **Meters:** Volt & Amp. 2%. **Dimensions:** 19″W x 13½″D x 8½″H.

Cabinet Available

MODEL GX28-50



Input: 115VAC. **Output:** 28 @ 50A. **Ripple:** 0.5%. **Regulation:** Unregulated. **Meters:** None. **Dimensions:** 19″W x 13½″D x 12¼″H. Rack.

Also Supplied with Cabinet

MODEL G45-30

Input: 115VAC. **Output:** 45, 42, 40, 36, 32, 30, 29, 28, 26 @ 30A. **Ripple:** 1%. **Regulation:** Fan Cooled. **Meters:** Volt & Amp. 2%. **Dimensions:** 19″Wx10″Dx8½″H.

Overload Protected

MODEL G20-200

Input: 220VAC, 60 Hz. 1 or 3φ. **Output:** 0-22VDC @ 200A. **Ripple:** 1%. **Cabinet:** 35″ x 20″ x 20″. **Meters:** Volt & Amp. 2%.

NEW SCR REGULATED POWER SUPPLIES

GCR32-30 — **Input:** 115VAC. **Output:** 24-32 @ 30A. **Ripple:** 1%. **Meters:** ±1%. **Dimensions:** 19″W x 17″D x 12¼″H.

GCR32-25 — **Input:** 115VAC. **Output:** 24-32 @ 25A. **Ripple:** 1%. **Meters:** ±1%. **Dimensions:** 19″W x 17″D x 12¼″H.

GCR32-20 — **Input:** 115VAC. **Output:** 24-32 @ 20A. **Ripple:** 1%. **Meters:** ±1%. **Dimensions:** 19″W x 17″D x 10¼″H.

Also GCR32-15.

GATES

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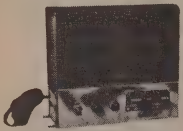
HIGHEST QUALITY—LOWEST PRICE

SILICON POWER SUPPLY—MODEL GX24-1



Input: 115VAC, 60 Hz, 1 phase. **Output:** 24VDC, 0-1 Amperes DC, continuous duty. **Ripple:** 0.3% RMS. **Regulation:** 8% no load to full load. **Dimensions:** 3″ x 5″ x 10″.

Available also 0-2 Amps and up.

PORTABLE SILICON BATTERY CHARGER MODEL G612-20

Input: 115VAC, 60 Hz, 1 phase. **Output:** 6/12VDC, 20 Amperes continuous duty. **Meter:** Amp. meter 2% Accuracy. **Dimensions:** 11″H x 9″W x 6½″D. (Also available constant voltage battery charger. Output 12VDC, 45 or 48 or 50 Amps continuous duty. Input 105-130VAC.)

SILICON RECTIFIER MODEL GT32-30

Input: 115VAC, 50-60 Hz, 1 phase. **Output:** 30 Amperes, 0-32VDC. **Rectifier:** Full wave silicon rectifier. **Ripple:** 1% RMS. **Voltage Control:** Powerstat. **Meters:** 2% Accuracy volt & amp. meter. **Dimensions:** 10½″ x 13½″ x 19″. **Weight:** 92 lbs. approx.

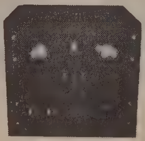
Overload Protected

SILICON RECTIFIER MODEL GT32-24

Input: 115VAC, 50-60 Hz, 1 phase. **Output:** 24 Amperes, 0-32VDC. **Rectifier:** Full wave silicon rectifier. **Ripple:** 1%. **Voltage Control:** Powerstat. **Dimensions:** 8¾″ x 13½″ x 19″. **Meters:** 2% Accuracy volt meter, amp. meter. **Weight:** 75 lbs.

Overload Protection

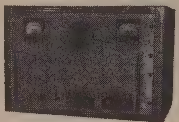
BENCH PLATING RECTIFIER MODEL GL50-8



Input: 115VAC, 50-60 Hz, 1 phase. **Output:** 50 Amperes, 0-8VDC. **Rectifier:** Full wave silicon rectifier. **Ripple:** 2% at extra cost. **Voltage Control:** Powerstat. **Meter:** 2% Accuracy, volt & amp. meter. **Dimensions:** 21″ x 15″ x 10″.

Overload Protected

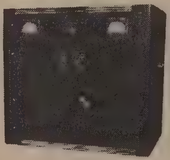
BENCH PLATING RECTIFIER MODEL GL100-8



Input: 115VAC, 50-60 Hz, 1 phase. **Output:** 100 Amperes, 0-8VDC. **Rectifier:** Full wave silicon rectifier. **Ripple:** 2% at extra cost. **Voltage Control:** Powerstat. **Meters:** 2% Accuracy, volt & amp. meter. **Dimensions:** 21″ x 15″ x 10″.

Overload Protected

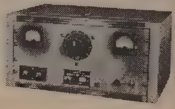
BENCH PLATING RECTIFIER MODEL GL200-6



Input: 115VAC, 50-60 Hz, 1 phase. **Output:** 200 Amperes, 0-6 VDC. **Rectifier:** Full wave silicon rectifier. **Ripple:** 2% at extra cost. **Cooling:** Fan. **Voltage Control:** Powerstat. **Meters:** 2% Accuracy, volt & amp. meter. **Dimensions:** 21″ x 15 ″ x 19″.

Overload Protected

BENCH PLATING RECTIFIER MODEL G50-15



Input: 115VAC, 50-60 Hz, 1 phase. **Output:** 50 Amperes, 0-15VDC. **Rectifier:** Full wave silicon rectifier. **Ripple:** 2% at extra cost. **Voltage Control:** Powerstat. **Meters:** 2% Accuracy, volt & amp. meter. **Dimensions:** 21″ x 15″ x 10″.

Overload Protected

FIXED VOLTAGE, 1% LINE AND LOAD REGULATED POWER SUPPLIES

SPECIFICATIONS

AC Input: 105-125V, 60 Hz, 1 phase. **Regulation:** ±1% for ±10% line change. ±1% for no load to full load. **Ripple:** 0.1% +10MV rms maximum. **Grounding:** Floating output; either positive or negative may be grounded. **Protection:** Automatic short-circuit protection.

FIXED VOLTAGE, 1% LINE AND LOAD REGULATED POWER SUPPLIES

Model	Output	Rating
G-30-1	3.6- 9V	30 Watts
G-30-2	9-17V	or 2.5
G-30-3	17-30V	Amperes
G-30-4	30-60V	Maximum
G-60-1	3.6- 9V	60 Watts
G-60-2	9-17V	or 5
G-60-3	17-30V	Amperes
G-60-4	30-60V	Maximum
G-120-1	3.6- 9V	120 Watts
G-120-2	9-17V	or 10
G-120-3	17-30V	Amperes
G-120-4	30-60V	Maximum

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TELEPHONES: (212) 881-5900 — 823-8200

ALL TYPES OF POWER SUPPLIES

MAGNETICALLY REGULATED D.C. POWER SUPPLIES

REGULATION: Line ±1% for ±15% line voltage change load ±2% for any load change between ½ load and full load. Ripple 1% RMS Maximum. Rack or cabinet types.

Volts	D.C. Output Amps	VA	Catalog Number	Load Regulation 20% F.L.	Load Regulation 50% F.L.	Price
6	10	60	6GDCV10	9	7	Inquire
6	15	90	6GDCV15	9	7	Inquire
12	5	60	12GDCV5	7	5	Inquire
12	10	120	12GDCV10	7	5	Inquire
12	15	180	12GDCV15	7	5	Inquire
18	5	90	18GDCV5	5	4	Inquire
18	10	180	18GDCV10	7	5	Inquire
24	5	144	24GDCV5	5	4	Inquire
24	10	240	24GDCV10	6	4	Inquire
24	15	360	24GDCV15	5	4	Inquire
24	25	600	24GDCV25	6	4	Inquire
24	40	960	24GDCV40	6	4	Inquire
28	8	224	28GDCV8	6	4	Inquire
28	15	420	28GDCV15	7	5	Inquire
48	4	192	48GDCV4	3.5	2.5	Inquire
48	4	480	48GDCV4	4	2	Inquire
48	20	960	48GDCV20	3	2	Inquire
125	2	250	125GDCV2	2.5	1.5	Inquire
150	2	300	150GDCV2	2	1.5	Inquire
150	1	200	200GDCV1	3	2	Inquire
250	1	250	250GDCV1	3	2	Inquire

A single source for all possible types of "brute force" and regulated power supplies that can fill 90% of your design and application needs. Gates Power Supplies give you absolutely lowest cost and long life. The units are excellently constructed of high rated components for trouble free, years of service.

Silicon or Selenium. Single and three-phase units. 1 to unlimited Volts, 1 to unlimited Amps, Metered and unmetered Static or variable outputs. Rack, cabinet or chassis mounts. Unit or hundred quantities 48 hour delivery. Two year guarantees. Power Supplies for OEM Application, Testing Prototype, Lab Type Units, Plating, Motor Control, Cathode Protection, Transistor Power, Anodizing, Battery Charging, Battery Conversions, Marine Types, Aircraft Starting.

GATES

ELECTRONIC COMPANY, INC.
526 VAN NEST AVE., BRONX, N.Y. 10460
TELEPHONES: (212) 881-5900 — 823-8200

SEND FOR COMPLETE CATALOG AND PRICES

NOBRUSH® FREQUENCY GEORATOR CORPORATION

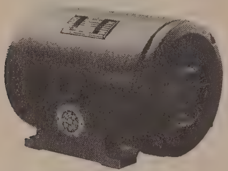
Celebrating our 25th anniversary

PERMANENT MAGNET GENERATOR DESIGN

"NoBrush" Motor Generators and Frequency Converters are efficient, compact, dependable, quiet running units for powering all types of electronic systems and electrical equipment. The heart of each "NoBrush" power system is a "NoBrush" permanent magnet generator which features a cast aluminum rotor designed to give superior voltage stability. • A typical "NoBrush" generator is mounted with a high quality induction or synduction motor within a single aluminum alloy shell. • Oversize pre-lubricated ball bearings sealed for life, coupled with the absence of brushes, commutators or slip rings, insure long-term maintenance-free operation. • Georator brushless permanent magnet generators are noted for their compact construction, ruggedness, ability to withstand short circuits, and excellent wave form. • All Georator power systems whether utilized for frequency conversion or basic power requirements, provide true "line isolation and stabilization" for protecting sensitive electronic systems from momentary power interruptions, switching transients, brown outs, or voltage spikes.

PERMANENT MAGNET FEATURES:

- ☐ *Line Isolation and Stabilization*
- ☐ *Stable Output Voltage*
- ☐ *High Overload Capacity*
- ☐ *Withstands Short Circuits*
- ☐ *Extremely Low R. F. Noise*
- ☐ *Minimum Maintenance*
- ☐ *Lightweight*
- ☐ *Low Audible Noise*
- ☐ *Cool Operation*
- ☐ *Operates in Adverse Environments*

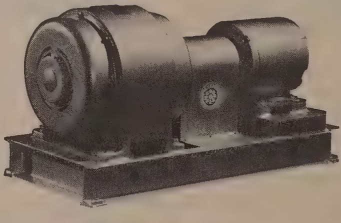


60 TO 60 Hz LINE ISOLATOR SERIES 30 UNIT SHELL

This small isolator stabilizer Motor-Generator offers full line isolation for small power requirements up to 1 KVA. Permanent magnet field generator coupled with the high inertia of the rotating system assures maximum electrical isolation between line and load. The rugged unit shell construction gives long, maintenance-free operation.

Model No.	KVA Rating	Phase In/Out	Output Voltage	Input Voltage	Dimensions H"/L"/Weight
35-118	0.35	1/1	115/230	115/230	14.5"/14.0"/110 lbs.
30-194	0.5	3/1	115/230	230/460	14.8"/16.1"/120 lbs.
30-198	0.5	1/1	115/230	115/230	14.8"/16.1"/120 lbs.
30-195	1.0	3/3	120/208	230/460	14.8"/16.1"/130 lbs.
30-199	1.0	1/3	120/208	115/230	14.8"/16.1"/130 lbs.

These 60 to 60 Hz brushless generators, including those in the next column are designed to accept long term input variation of up to ±15% from nominal with no change in output. Inertia stabilization allows these units to absorb input line transients of as much as 30% for as long as 500 milliseconds with less than 1% change in output.

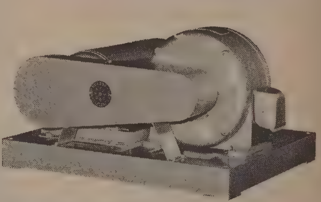


60 TO 60 Hz ISOLATOR STABILIZER SERIES 37 IN LINE

Larger Motor Generators in ratings up to 25 KVA are also available to provide full line isolation and distortion free power to protect electronic equipment from power line excursions and momentary power loss.

Model No.	KVA Rating	Phase In/Out	Output Voltage	Input Voltage	Dimensions H"/L"/Weight
37-015	1.5	3/1	115/230	220/440	18.3"/34"/300 lbs.
37-118	1.5	1/1	115/230	230	18.3"/34"/315 lbs.
37-130	2.5	3/3	120/208	220/440	18.3"/34"/215 lbs.
37-133	2.5	1/3	120/208	230	18.3"/34"/400 lbs.
37-070	2.5	3/1	115/230	220/440	18.3"/34"/335 lbs.
37-134	2.5	1/1	115/230	230	18.3"/34"/400 lbs.
37-123	5.0	3/3	120/208	220/440	18.3"/38"/410 lbs.
37-AAA	6.25	3/1	120/240	220/440	26.0"/48"/650 lbs.
37-129	12.5	3/1	120/240	230/460	29.0"/62"/910 lbs.
37-135	12.5	3/3	120/208	230/460	29.0"/62"/910 lbs.
37-136	18.75	3/3	120/240	230/460	37.5"/70"/1300 lbs.
37-137	18.75	3/1	120/208	230/460	29.0"/63"/1000 lbs.
37-138	25	3/3	120/240	230/460	37.5"/72"/1550 lbs.
37-139	25	3/1	120/208	230/460	29.0"/65"/1230 lbs.

Series 37 Data Sheets containing detailed specifications are available upon request.



50 TO 60 Hz and 60 TO 50 Hz FREQUENCY CONVERTERS

These ruggedly built, belt driven, motor-generator sets are mounted on a sturdy steel frame base. Units in the 0.5 to 5 KVA power range are designed around the highly efficient NoBrush Permanent Magnet Generator. Units in the 6.25 to 25 KVA power range have brushless rotating rectifier type generators with voltage regulators, to provide ±1% output voltage regulation. These motor-generators provide frequency conversion, basic power, and superior line isolation and stabilization for exported and imported electrical and electronic equipment.

50 to 60 Hz

Model No.	KVA Rating	Phase In/Out	Voltage Output	Approx. Wt. lbs.
37-110	2.0	1/1	115/230	420
37-151	2.5	3/1	115/230	420
37-109	5.0	3/3	120/208	465
37-177	6.25	3/1	115/230	750
37-184	12.5	3/1	115-120/230-240	1,050
37-xxx	25.0	3/3	208-240/416-480	1,550

60 to 50 Hz

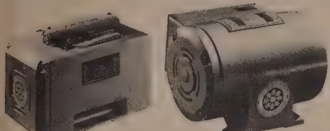
Model No.	KVA Rating	Phase In/Out	Voltage Output	Approx. Wt. lbs.
37-105	0.5	1/1	115/230	230
37-102	1.5	1/1	115/220	400
37-111	1.5	3/1	115/230	400
37-095	2.5	3/1	115/230	440
37-197	6.25	3/1	115/230	750
37-180	12.5	3/3	220/440	1,000
37-170	12.5	3/1	115-120/230-240	1,100
37-192	25.0	3/1	208-240/230-240	1,580

Universal 50/60 to 60/50 Hz

Model No.	KVA Rating	Phase In/Out	Voltage Output	Approx. Wt. lbs.
37-116	1.5	3/1	115/230	380
37-112	2.5/1.5	3/3-1	115/200 & 115	400

CONVERTERS & GENERATORS

The simplest, most rugged, most dependable power source.



60 TO 400 Hz FREQUENCY CONVERTERS SERIES 30 UNIT SHELL

A highly compact, brushless, Motor Generator Set for conversion of 50 or 60 Hz power to 400 Hz or higher frequencies. Generator and Motor Rotors are pressed on a common shaft, with shielded ball bearing at ends of shaft, all contained within an aluminum alloy shell.

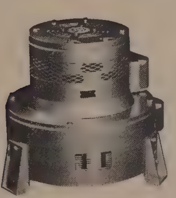
Model No.	KVA Rating	Phase In/Out	Output Voltages Full Load *	Input Voltage **	Dimensions H"/L"/Weight
30-021	0.15	1/1	115/200	115/230	8"/11"/40 lbs.
30-001	0.25	1/1	115	115/230	8"/11"/43 lbs.
30-004	0.25	1/3	115/200	115/230	8"/11"/43 lbs.
30-002	0.5	1/1	115	115/230	8"/11"/51 lbs.
30-005	0.5	1/3	115/200	115/230	8"/11"/51 lbs.
30-016	0.5	3/3	115/200	208-220/440	8"/11"/51 lbs.
30-006	0.75	3/3	115/200	208-220/440	8"/11"/51 lbs.
30-003	1.0	1/1	115	115/230	12¼"/15¼"/118 lbs.
30-025	1.0	1/3	115/200	115/230	12¼"/15¼"/107 lbs.
30-007	2.0	1/3	115/200	115/230	12¼"/15¼"/137 lbs.
30-020	2.0	3/3	115/200	208-220/440	12¼"/15¼"/121 lbs.
30-029	2.5	3/3	115/200	208-220/440	12¼"/15¼"/153 lbs.

☐ Other Generator Outputs Available: 120, 180, 280, 360, and 840 Hz

☐ Other Standard and Non-Standard Voltages.

☐ Exact 400 Hz Output.

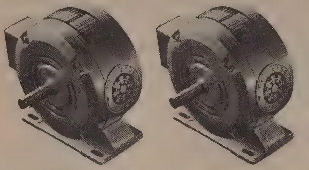
☐ DC Outputs at Low or High Voltage.



60 TO 400 Hz FREQUENCY CONVERTER SERIES 33 VERTICAL

High quality induction motor is close coupled to a famous "NoBrush" generator for a really outstanding unit. Very compact, with high power to weight and size ratio. Available variations include: 50 Hz Input; Standard and Non-Standard AC output voltages; DC outputs at low or high voltage; and other output frequencies.

Model No.	KVA Rating	Phase In/Out	Dimensions Diameter	Height	Weight
33-001	2.5	3/1	20.5"	18.3"	173 lbs.
33-002	3.5	3/1	20.5"	18.3"	178 lbs.
33-003	5.0	3/1	20.5"	18.3"	273 lbs.
33-004	5.0	3/3	20.5"	18.3"	250 lbs.
33-005	7.5	3/3	20.5"	19.5"	259 lbs.
33-006	10.0	3/3	20.5"	19.5"	340 lbs.
33-102	15.0	3/3	24.0"	24.2"	485 lbs.
30-120	25.0	3/3	23.0"	26.5"	1,213 lbs.



ALTERNATORS PERMANENT MAGNET

The original, revolutionary, "NoBrush" generator. Permanent magnets yield stability, reproducibility, ruggedness and virtually zero R.F. noise. Available in large variety of ratings, frequencies and voltages. Supplementary windings with rectifiers available for D.C. output.

400 Hz ALTERNATORS

Model No.	KVA Rating	Phase Out	Speed RPM	Dimensions H"/L"/Weight
36-001	0.25	1	3428	8¼"/4¹⁄₁₆"/17 lbs.
36-003	0.5	1	3428	8¼"/4¹⁄₁₆"/22 lbs.
36-030	0.5	3	3428	8¼"/4¹⁄₁₆"/21½ lbs.
36-006	1.0	1	1714	12³⁄₁₆"/4⁹⁄₁₆"/35½ lbs.
36-007	1.0	3	1714	13³⁄₁₆"/4⁹⁄₁₆"/35½ lbs.
36-008	2.0	3	1714	13³⁄₁₆"/4⁹⁄₁₆"/45 lbs.
36-009	2.5	1	1714	17¼"/6¾"/105 lbs.
36-010	5.0	1	1714	17¼"/6¾"/137 lbs.
36-011	5.0	3	1714	17¼"/6¾"/103½ lbs.
36-012	7.5	3	1714	17¼"/6¾"/120 lbs.
36-013	10.0	3	1714	17¼"/6¾"/135 lbs.
36-151	15.0	3	1714	25"/11.2"/310 lbs.
36-152	25.0	3	1714	25.3"/17"/730 lbs.

☐ Alternator Frequencies Available Include:
50, 60, 120, 180, 240, 300, 360, 420, 840 Hz.

☐ All Units are Available with:
- Standard and Non-Standard AC Voltages.
- Multiple DC Outputs/Low Voltage taps.
- Special Housings for Flange Mountings.

☐ Separate ROTORS and STATORS can be provided for OEM Applications.

☐ Permanent Magnet Alternators for: Pilot Excitors—Field Flashing—Tachometers—Control Applications—Aircraft.

LIGHTWEIGHT 400 Hz ENGINE-GENERATORS

Lightweight portable 400 Hz permanent magnet engine generators are available with 1 ϕ or 3 ϕ outputs from 0.5 KVA to 2.0 KVA. Choice of outputs include 400 Hz, or combination of AC and DC output, or entire output rectified to single or dual DC output.

VOLTAGE REGULATED 60 TO 400 Hz FREQUENCY CONVERTERS

This new, Series 39, Regulated, Vertical Frequency Converter combines the "NoBrush" permanent magnet generator together with control windings and simplified sensing electronics, to provide both the traditional "Brushless" rugged design and a closely regulated 400 Hz power system. Voltage regulation is ±1.5% no load to full load, 0.8 to 1.0 power factor, with a voltage adjustment feature of ±5%.

Model No.	KVA Rating	Voltage Output	Voltage Regulation	Phase In/Out
39-001	5	120/208	±1.5%	3/3
39-002	5	115/230	±1.5%	3/1

60 TO 180 Hz, 360 Hz, 840 Hz FREQUENCY CONVERTERS FOR HIGH FREQUENCY TOOLS, MOTORS, AND LIGHTING

These frequency converters are available for powering high frequency metal-working tools, wood-working tools, motors, and lighting systems. The highly dependable, minimum maintenance, PERMANENT MAGNET BRUSHLESS DESIGNS are available in many ratings up to: 5 KVA for 180 Hz applications; 10 KVA for 360 Hz applications; and 30 KVA for 840 Hz applications.

GEORATOR CORPORATION

Makers of NOBRUSH® power systems

9016 PRINCE WILLIAM STREET MANASSAS, VIRGINIA 22110
TELEPHONE: (703) 368-2101

Celebrating our 25th anniversary

NOBRUSH® FREQUENCY CONVERTER SERIES 30 • UNIT SHELL DESIGN • FOR CONVERSION OF 60 TO 400 CYCLES

APPLICATION: Wherever a dependable, trouble-free source of 400 cycle power within the range of 2½ KVA is required. As a source of high frequency power for electronic apparatus; for test and research work; for the servicing of aircraft electrical equipment; for portable radio and military electronic devices; for high frequency motors; in the operation of electronic computers.

CONSTRUCTION: Generator and motor stators contained within aluminum alloy unit shell. Generator and motor rotors pressed on unit shaft, with ball bearings at ends of shaft. All "NoBrush" units are ruggedly designed and manufactured to withstand extremes of mechanical and electrical operating conditions.

AVAILABLE VARIATIONS: Other output frequencies—180, 280, 360, 840 cycles

Other standard or non-standard output voltages

Reconnectable output windings for full power at either of two voltages

Low voltage taps

Auxiliary D.C. output at low or high voltage

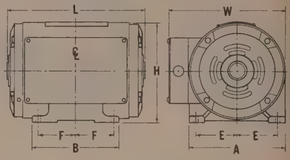
Two phase output

Militarized construction

Other standard single or three phase input voltages

50 cycle input

Synchronous motor drive



	OUTPUT					INPUT					DIMENSIONS								WEIGHT		
MODEL NO	KVA RATING	PHASE	NOMINAL VOLTAGES NO LOAD	NOMINAL VOLTAGES FULL LOAD	NOMINAL FREQ. FULL LOAD	H.P.	SPEED	PHASE	VOLTAGE	CURRENT FULL LOAD	A	B	C	E	F	H	L	W	NET WT. Lbs.	APPROX. SHIPPING WT. Lbs.	MODEL NO.
30-021	0.15	1	124	115/200	410	¼	3500	1	RECONNECTABLE 115/230 VOLTS	3/1.5	7¾	7	9/32	3 3/16	3	8	11	9¾	40	53	30-021
30-022	0.15	3	124/214	115/200	410	¼	3500	1		3/1.5	7¾	7	9/32	3 3/16	3	8	11	9¾	40	53	30-022
30-001	0.25	1	124	115	410	½	3500	1		6.6/3.3	7¾	7	9/32	3 3/16	3	8	11	9¾	43	56	30-001
30-004	0.25	3	124/214	115/200	410	½	3500	1		6.6/3.3	7¾	7	9/32	3 3/16	3	8	11	9¾	43	56	30-004
30-002	0.5	1	124	115	410	¾	3500	1		11.7/5.8	7¾	7	9/32	3 3/16	3	8	11	9¾	51	64	30-002
30-005	0.5	3	124/214	115/200	410	¾	3500	1		11.7/5.8	7¾	7	9/32	3 3/16	3	8	11	9¾	51	64	30-005
30-025	1.0	3	124/214	115/200	410	1½	1750	1		24/12	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	107	135	30-025
30-003	1.0	1	124	115	410	1½	1750	1		24/12	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	118	146	30-003
30-026	1.5	3	124/214	115/200	410	2¼	1750	1		30/15	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	128	156	30-026
30-028	1.5	1	124	115	410	2¼	1750	1		30/15	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	137	165	30-028
30-007	2.0	3	124/214	115/200	410	3	1750	1		34/17	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	137	165	30-007
30-009	0.15	1	124	115	410	¼	3500	3	RECONNECTABLE 208-220/440 VOLTS	1.2/0.6	7¾	7	9/32	3 3/16	3	8	11	9¾	40	53	30-009
30-014	0.15	3	124/214	115/200	410	¼	3500	3		1.2/0.6	7¾	7	9/32	3 3/16	3	8	11	9¾	40	53	30-014
30-010	0.25	1	124	115	410	½	3500	3		1.8/0.9	7¾	7	9/32	3 3/16	3	8	11	9¾	43	56	30-010
30-015	0.25	3	124/214	115/200	410	½	3500	3		1.8/0.9	7¾	7	9/32	3 3/16	3	8	11	9¾	43	56	30-015
30-011	0.50	1	124	115	410	¾	3500	3		3.2/1.6	7¾	7	9/32	3 3/16	3	8	11	9¾	51	64	30-011
30-016	0.50	3	124/214	115/200	410	¾	3500	3		3.2/1.6	7¾	7	9/32	3 3/16	3	8	11	9¾	51	64	30-016
30-006	0.75	3	124/214	115/200	410	1.1	3500	3		5.2/2.6	7¾	7	9/32	3 3/16	3	8	11	9¾	51	64	30-006
30-018	1.0	3	124/214	115/200	410	1½	1750	3		5/2.5	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	104	132	30-018
30-012	1.0	1	124	115	410	1½	1750	3		5/2.5	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	113	141	30-012
30-019	1.5	3	124/214	115/200	410	2¼	1750	3		7/3.5	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	115	143	30-019
30-013	1.5	1	124	115	410	2¼	1750	3		7/3.5	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	126	154	30-013
30-020	2.0	3	124/214	115/200	410	3	1750	3		9/4.5	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	121	149	30-020
30-029	2.5	3	124/214	115/200	410	4½	1750	3		12.6/6.3	12	9⅜	7/16	4 9/16	3 15/16	12¼	15¼	14½	153	181	30-029

Specifications subject to change without notice.

SPECIFICATIONS

INPUT: Low-slip induction motors utilized for drive, available in single and three-phase models.

DUTY: Continuous.

BEARING TYPE: Ball bearings, sealed, lubricated-for-life.

OUTPUT VOLTAGE: 115 volts, for single phase output. Three phase output models reconnectable for 115/200 (120/208) four-wire or 115 volts delta, line-to-line.

OUTPUT VOLTAGE STABILITY: Within 1% for constant load and constant input frequency.

EFFECT OF INPUT VOLTAGE CHANGE ON OUTPUT VOLTAGE: Output voltage will change less than 1% for input changes of plus or minus 10%, or for short period input disturbances as great as 30%.

OUTPUT FREQUENCY: From 420 cycles at no load to approximately 410 cycles, full load.

OUTPUT FREQUENCY STABILITY: Within plus or minus ½% at constant load and constant input frequency.

EXCITATION: Internal, permanent magnet.

REGULATION: Inherent usually within an 8% envelope for unity p.f. loads from no load to full load. Regulator not required for most applications. See typical curves.

WAVE FORM: No sharp peaks or spikes. Total harmonics, single or three phase, within 4% for ratings 1 KVA or over; -5% -8% for ratings under 1 KVA, depending on model. Improved wave form on special order.

TEMPERATURE RISE: 40°C (72°F)

COOLING: By internally mounted fan.

AUDIBLE NOISE: Approximately 70 db. (Measurement on 'B' scale, at 3 feet distance from unit, in accordance with ASA Standard No. Z24.7-1950.)

R.F. NOISE: Extremely low; may be considered zero for most applications.

GEORATOR CORPORATION

Makers of NOBRUSH power systems
9016 Prince William Street
Manassas, Virginia 22110
Phone: (703) 368-2101

Celebrating Our 25th Anniversary

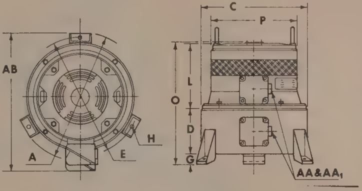
NOBRUSH® FREQUENCY CONVERTER

SERIES 33 • VERTICAL MODEL FOR CONVERSION OF 60 TO 400 CYCLES

APPLICATION: Wherever a dependable, trouble-free source of 400 cycle power within the range of 2½ to 10 KVA is required, where 60 cycles (and in some cases, 50 cycles) is available for primary energy.

SPECIFIC APPLICATIONS: As a source of high frequency power for: electronic equipment; test and research work; servicing of aircraft and missile electrical equipment; portable radio and military electronic devices; high frequency power tools; induction heating; shipboard high frequency power supplies; aircraft trainers; military ground equipment.

CONSTRUCTION: Motor & Generator Stators mounted within rugged cast aluminum housings. Motor & Generator Rotors mounted on a common shaft with ball bearings at ends of shaft. Unit is compact, 2 bearing, low contour. Permits mounting in limited space. All "NoBrush" units are designed and built to withstand extremes of mechanical and electrical operating conditions.



OUTPUT						INPUT					DIMENSIONS												WEIGHT		
MODEL NO.	KVA RATING	PHASE	VOLTAGE NO LOAD	VOLTAGE FULL LOAD (NOM)	FREQ. FULL LOAD	H.P.	SPEED R.P.M. (NOM)	PHASE	VOLTAGE	APPROX. FULL LOAD AMPS.	A	C	D	E	G	H	L	O	P	AA	AA₁	AB	NET WT. LBS.	APPROX. SHIPPING WT. LBS.	MODEL NO.
33-001	2.5	1	125 MAX	115	410	5	1760	3	RECONNECTABLE 208-220/440 VOLTS	15.2/7.6	20.5	16.8	7.2	18.75	1.8	.65	9.3	18.3	13.3	1.0	1.0	22	173	219	33-001
33-002	3.5	1	125 MAX	115	410	5	1760	3		15.2/7.6	20.5	16.8	7.2	18.75	1.8	.65	9.3	18.3	13.3	1.0	1.0	22	178	224	33-002
33-003	5	1	125 MAX	115	410	7½	1760	3		21.1/10.5	20.5	16.8	7.2	18.75	1.8	.65	9.3	18.3	13.3	1.0	1.0	22	273	335	33-003
33-004	5	3	125/217 MAX	115/200	410	7½	1760	3		21.1/10.5	20.5	16.8	7.2	18.75	1.8	.65	9.3	18.3	13.3	1.0	1.0	22	250	304	33-004
33-005	7.5	3	125/217 MAX	115/200	410	12	1760	3		36/18	20.5	16.8	7.2	18.75	1.8	.65	10.3	19.5	13.6	1.0	1.0	22	259	315	33-005
33-006	10	3	125/217 MAX	115/200	410	15	1760	3		40/20	20.5	16.8	7.2	18.75	1.8	.65	10.3	19.5	13.6	1.0	1.0	22	340	408	33-006
33-009	3	3	125/217 MAX	115/200	410	5	1760	3		15.2/7.6	20.5	16.8	7.2	18.75	1.8	.65	9.3	18.3	13.3	1.0	1.0	22	169	215	33-009
33-102	15	3	125/217	115/200	410	25	1750	3		68/34	24	20.6	9.2	22.50	1.8	.65	13.2	24.2	15	1.0	1.0	25.8	485	550	33-102
33-103	10	1	120/240	110/220	410	15	1750	3		40/20	24	20.6	9.5	22.50	1.8	.65	10.5	21.8	13.6	1.0	1.0	25.8	405	470	33-103

(These dimensions should not be used for construction or installation purposes. Certified drawings available on request.)

NOTE: Specifications subject to change without notice.

SPECIFICATIONS

INPUT: Low-slip induction motors, three phase.

DUTY: Continuous.

BEARING TYPE: Ball bearings, shielded, life-time lubricated.

OUTPUT VOLTAGE: 115 volts, for single phase output. Three phase output models reconnectable for 115/200 (120/208) four-wire or 115 volts delta, line-to-line.

OUTPUT VOLTAGE STABILITY: Within 1% for constant load and constant input frequency.

EFFECT OF INPUT VOLTAGE CHANGE ON OUTPUT VOLTAGE: Output voltage will change less than 1% for input changes of ±10% or for short period input disturbances as great as 30%.

OUTPUT FREQUENCY: From 420 cycles at no load to approximately 410 cycles, full load.

OUTPUT FREQUENCY STABILITY: Within ±½% at constant load and constant input frequency.

TEMPERATURE RISE: 40°C generator, 55°C motor.

R.F. NOISE: May be considered zero for most applications.

EXCITATION: Internal, permanent magnet field.

REGULATION: Inherent—within 10% envelope for unity p.f. loads. Regulator not required for most applications.

WAVE FORM: No sharp peaks or spikes. Total harmonics, single or three phase, within 4%.

AUDIBLE NOISE: Average 79 db for standard units. (Measurements on 'B' scale, at 3 feet distance from unit, in accordance with ASA Standard No. Z24.7-1950).

SHORT-CIRCUIT IMMUNITY: Due to internal shielding, unit will tolerate repeated short circuits on output without significant change in normal operating voltage.

SHORT-CIRCUIT CURRENT: On dead short circuit on generator, unit will deliver approximately four times rated full load current.

GEORATOR CORPORATION

Makers of NOBRUSH power systems

9016 Prince William Street
Manassas, Virginia 22110
Phone: (703) 368-2101

Celebrating Our 25th Anniversary

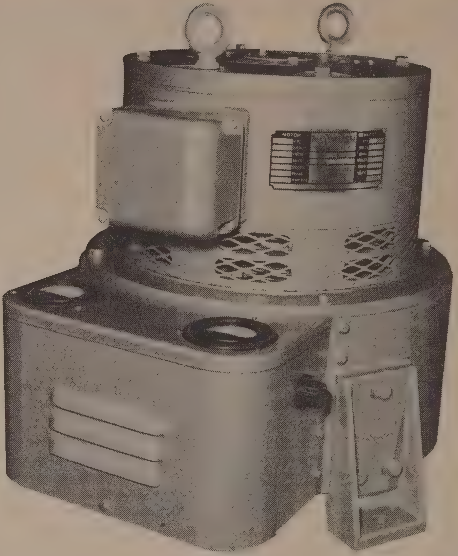
NOBRUSH® FREQUENCY CONVERTER

SERIES 39 • VOLTAGE REGULATED FOR CONVERSION OF 60 TO 400 CYCLES

FEATURES

- ☐ *Voltage Regulation of ±1.5%*
- ☐ *Brushless Permanent Magnet Design*
- ☐ *Line Isolation & Stabilization*
- ☐ *Maximum Dependability*
- ☐ *Low Audible Noise*
- ☐ *Cool Operation*
- ☐ *Excellent Wave Form*

This new, Series 39, Regulated, Vertical Frequency Converter combines the "No-Brush" permanent magnet generator together with control windings and simplified sensing electronics, to provide both the traditional "Brushless" rugged design and a closely regulated 400 Hz power system. The standard features of the "No-Brush" design of: Line isolation and stabilization; low audible noise; cool operation; and excellent wave form are covered in detail in the Specifications below. Units rated 5KVA, 0.8 to 1.0 power factor are available on a production basis.



	Output					Input			Dimensions		
Model No.	KVA	Volts	Regulation	Phase	Freq. Full Load	Motor	Volts	Full Load Current-Amps	H	Dia.	Wt.
39-001	5	120/208	±1.5%	3	410Hz	7.5 HP 3 phase 60 Hz 1760 RPM	220/440 ±10%	21.1/10.5	18.3"	16.8"	243 lbs.
39-002	5	115	±1.5%	1	410Hz		±10%	21.1/10.5	18.3"	16.8"	243 lbs.

NOTE: Specifications subject to change without notice.

SPECIFICATIONS

GENERATOR: Permanent Magnet Rotor, Brushless design, control windings added to stator, 3 phase, continuous duty.

MOTOR: Low slip induction motor, 3 phase, continuous duty.

VOLTAGE REGULATION: ±1.5% from no load to full load for 0.8 to 1.0 power factor loads.

EFFECT OF INPUT VOLTAGE CHANGE ON OUTPUT VOLTAGE: For long term voltage fluxuations of ±10%, output voltage will change less than 1%. For short term input voltage disturbances of as great as 30%, output voltage will change less than 1%.

OUTPUT VOLTAGE: Three phase, reconnectable 120/208 volts four-wire or 120 volts delta, line-to-line.

VOLTAGE ADJUSTMENT: Output voltage can be adjusted ±5% at no load & full load, greater at partial loads.

TRANSIENT PERFORMANCE:
a) Maximum time for voltage to return and remain within steady state regulation band after instantaneous application or removal of full load is 250 milliseconds.
b) Maximum voltage dip on application of full load from a no load condition is 10%.
c) Maximum voltage rise on removal of full load to a no load condition is 5%.

OUTPUT FREQUENCY STABILITY: Within ±½% at constant input frequency.

OUTPUT FREQUENCY TOLERANCE: 420 Hz no load to 410 Hz at full load.

TEMPERATURE RISE: 50°C, Maximum for both motor and generator.

WAVE FORM: No sharp peaks or spikes. Total harmonics, less than 4%.

EXCITATION: Internal permanent magnet field.

RF NOISE: Extremely low. May be considered zero for almost all applications.

BEARING TYPE: Ball bearings, shielded, life time lubricated.

AUDIBLE NOISE: 79 db. Measurement on 'B' scale at 3 feet distance, in accordance with ASA Standard No. Z24.7-1950.

SHORT CIRCUIT IMMUNITY: Due to internal shielding, unit will withstand repeated short circuit.

FINISH: Silver blue metallic enamel, oil and water resistant.

GEORATOR CORPORATION

Makers of NOBRUSH power systems

9016 Prince William Street
Manassas, Virginia 22110
Phone: (703) 368-2101

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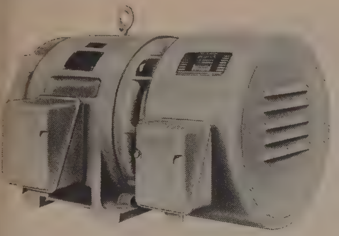
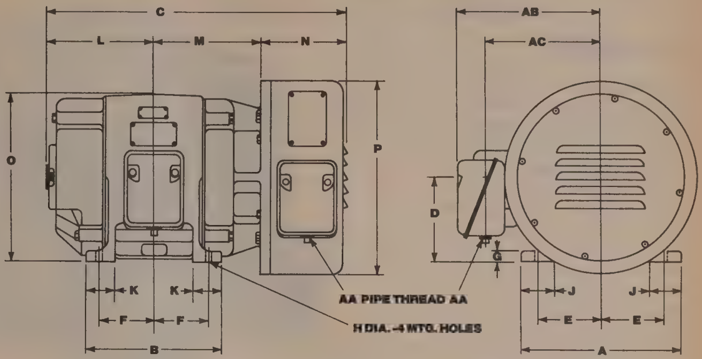
NOBRUSH® FREQUENCY CONVERTER

SERIES 35 • SYNCHRONOUS DRIVEN • FOR CONVERSION OF 60 TO 400 CYCLES





FEATURES

- ☐ *Exact 400 Cycle Output*
- ☐ *Negligible Harmonic Distortion*
- ☐ *Extremely Low Audible Noise*
- ☐ *Compact Design*
- ☐ *Short Circuit Resistant*
- ☐ *Stable Output Voltage*
- ☐ *Practically Maintenance Free*
- ☐ *Long Continuous Service Life*

Here is the ultimate in 60 to 400 cycle frequency conversion. The combination of a low speed brushless synchronous motor direct coupled to a famous "NoBrush" permanent magnet generator results in a converter far superior to any previously available. For applications requiring exactly 400 cycles coupled with minimum audible noise, long service life and absolutely minimum maintenance, these converters meet every need.

	OUTPUT					INPUT					DIMENSIONS																			WEIGHT		
			NOMINAL																													
MODEL NO	KVA RATING	PHASE	VOLTAGE NO LOAD	VOLTAGE FULL LOAD	FREQ. FULL LOAD	H.P.	SPEED	PHASE	VOLTAGE	APPROX CURRENT FULL LOAD AT 220V	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	AA	AA₁	AB	AC	NET WT. LBS.	APPROX SHIPPING WT LBS	MODEL NO.
35-001	2.5	1	124	115	400	5	1200	3	208-220/440	20	14	12	26	7	5.50	4.75	.75	.53	2.75	2.50	9.31	9	7.68	14	16.5	1.25	1.25	1275	10	470	545	35-001
35-003	3	3	124/214	115/200																										472	547	35-003
35-002	5	1	124	115	400	7.5	1200	3		29	16	1275	29.8	8	6.25	5.25	.87	.65	3	2.75	1031	9.75	9.81	1593	16.5	1.50	1.50	1331	10	620	700	35-002
35-005	10	3	124/214	115/200		15				56																				665	745	35-005
35-004	5	3	124/214	115/200	400	7.5	1200	3		29	16	12.75	27.75	8	6.25	5.25	.87	.65	3	2.75	10.31	9.75	7.68	1593	16.5	1.50	1.25	13.31	10	586	670	35-004

(These dimensions should not be used for construction or installation purposes. Certified drawings available on request)

SPECIFICATIONS

INPUT: Brushless synduction motors, three phase.

DUTY: Continuous.

BEARING TYPE: Shielded lubricated-for-life oversized ball bearings.

OUTPUT VOLTAGE: 115 volts for single phase output. Three phase output models, reconnectable for 115/200 (120/208) volts four-wire or 115 volts delta, line-to-line.

OUTPUT VOLTAGE STABILITY: Within 1% for constant load and constant input frequency.

EFFECT OF INPUT VOLTAGE CHANGE ON OUTPUT VOLTAGE: No change for input changes of ±10%.

OUTPUT FREQUENCY: With constant 60 cycle input, 400 ±0 cycles, no load to full load.

OUTPUT FREQUENCY STABILITY: Within ±0 cycles at constant input frequency.

TEMPERATURE RISE: 40°C (104°F) maximum.

RF NOISE: Practically zero. Test data available on request.

EXCITATION: Internal, permanent magnet.

REGULATION: Inherent usually within 8% envelope for Unity Power Factor loads. Regulator not required for most applications.

WAVE FORM: Nearly pure sine wave. No sharp peaks or spikes. Total harmonics usually less than 2%.

MOUNTING: Four cast feet on motor housing. Holes in mounting feet for hold down bolts.

AUDIBLE NOISE: At full load 65 db, measured in an ambient of 57 db.

SHORT CIRCUIT IMMUNITY: Due to internal shielding, unit will tolerate repeated short circuits on output without significant change in normal operating voltage.

SHORT CIRCUIT CURRENT: On dead short circuit on generator, unit will deliver maximum of five times rated full load current.

GEORATOR CORPORATION

Makers of NOBRUSH power systems

9016 Prince William Street
Manassas, Virginia 22110
Phone: (703) 368-2101

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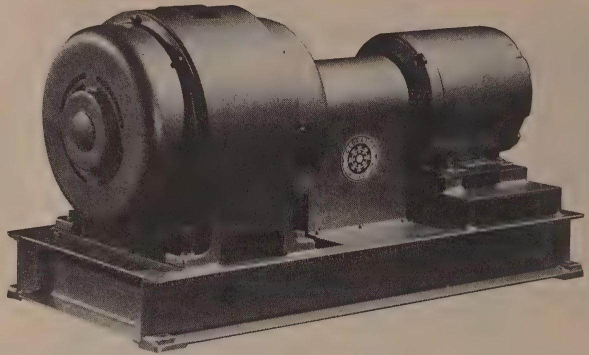
GEORATOR™ CORPORATION

SERIES 37 • COUPLED IN LINE RATINGS FROM 1.5 KVA TO 25 KVA 60 HERTZ ISOLATOR STABILIZER MOTOR GENERATORS

FEATURES

- ☐ *Complete Line Isolation*
- ☐ *Maximum Dependability*
- ☐ *Inertia Stabilized Output*
- ☐ *Exceptional Voltage Stability*
- ☐ *Isolated 60 Cycle Output*
- ☐ *Minimum Maintenance*



Input	3 Phase, 60 Hertz, 220/440V, 1800 RPM Brushless Synduction Motor				3 Phase, 60 Hertz, 230/460V, 1800 RPM Induction L.S. Motor				1 Phase, 60 Hertz, 230 V, 1800 RPM, CAP. Start, Induction Run L.S. Motor		
Output KVA	1.5	2.5	2.5	5.0	1.5	2.5	2.5	5.0	1.5	2.5	2.5
Phase	1	3	1	3	1	3	1	3	1	3	1
Freq.	60	60	60	60	60^{+0}_{-2}	60^{+0}_{-2}	60^{+0}_{-2}	60^{+0}_{-2}	60^{+0}_{-2}	60^{+0}_{-2}	60^{+0}_{-2}
Voltage	115/230	120/208	115/230	120/208	115/230	120/208	115/230	120/208	115/230	120/208	115/230
P.F.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Motor H.P.	3.0	5.0	5.0	10.0	3.0	5.0	5.0	10.0	3.0	5.0	5.0
Model No.	37-015	37-130	37-070	37-123	37-034	37-131	37-104	37-132	37-118	37-133	37-134
L (In.)	34.0	34.0	34.0	38.0	34.0	34.0	34.0	36.0	34.0	34.0	34.0
H (In.)	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3
W (In.)	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2
Approx. Net Wt.	300#	315#	335#	410#	300#	315#	335#	400#	315#	400#	400#

Input	3 Phase, 60 Hertz, 230/460V, 1800 RPM, Brushless Synduction Motor					
Output KVA	12.5 KVA 10 KW	12.5 KVA 10 KW	18.75 KVA 15 KW	18.75 KVA 15 KW	25 KVA 20 KW	25 KVA 20 KW
Phase	3	1	3	1	3	1
Freq.	60	60	60	60	60	60
Voltage	120/208	120/240	120/208	120/240	120/208	120/240
P.F.	80%	80%	80%	80%	80%	80%
Motor H.P.	20	20	25	25	40	40
Model No.	37-135	37-129	37-136	37-137	37-138	37-139
L (In.)	54	54	63.2	69.5	64.7	72.0
H (In.)	26	26	29.0	37.5	29.0	37.5
W (In.)	21.8	21.8	21.8	21.8	23.3	23.3
Approx. Net Wt.	910#	910#	1000#	1300#	1230#	1550#

(These dimensions should not be used for construction or installation purposes. Certified drawings available on request.)

This series of Isolator Stabilizer Motor-Generator has been designed specifically for use where line transients may interfere with the proper operation of instrumentation and control equipment.

This brushless generator completely isolates the output from the input line. Coupled with "Inertia Stabilization," this results in an output voltage which remains relatively undisturbed by most input line variations, either transient or long term.

Units are designed to accept long term input voltage variations of up to ±15% from nominal, when required. Standard units will accept ±10% change with no change in output. "Inertia Stabilization" allows unit to absorb input line transients of as much as 30% for as long as 500 milliseconds with less than 1% change in output.

Standard "Inertia Stabilized" units employ the inertia of the rotating systems of the motor and generator to secure their unusually stable output voltage characteristics during line fluctuations. Exact 60 cycle output regardless of load is attained by use of synchronous speed motor drive. With constant 60 cycle input, output frequency will remain constant regardless of input voltage transients and load variations, within the generator rating. Maintenance is greatly minimized because of the simplicity of the motor-generator combination. These units are designed to give years of continuous trouble-free service.

For Complete Information

We would be pleased to furnish you with complete information on the "NoBrush" line of motor-generator sets, frequency converters, and alternators, and how they can be efficiently implemented or custom-designed to meet your specific requirements. For all the facts, please write or call:

GEORATOR CORPORATION

Makers of NOBRUSH power systems

9016 Prince William Street
Manassas, Virginia 22110
Phone: (703) 368-2101

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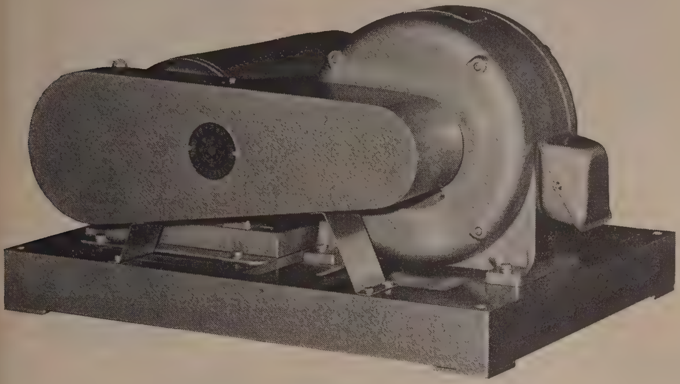
GEORATOR™ CORPORATION

SERIES 37 • FREQUENCY CONVERTERS FOR CONVERSION OF: 50 HZ TO 60 HZ AND 60 HZ TO 50 HZ



FEATURES

- ☐ *Line Isolation & Stabilization*
- ☐ *Exceptional Voltage Stability*
- ☐ *Withstands Short Circuit*
- ☐ *Maximum Dependability*
- ☐ *Extremely Low RF Noise (0 for most applications)*
- ☐ *Excellent Wave Form*

FUNCTION: These Series 37 Motor-Generator Sets provide frequency conversion from 50 Hz power to 60 Hz, and from 60 Hz to 50 Hz, in ratings from 0.5 KVA to 25 KVA. The units are also designed to isolate power line disturbances from your equipment. The built-in "Inertia Stabilization" of these units protects electrical and electronic equipment from momentary power outages, switching transients, over and under voltages, brown-outs and power line noise.

CONSTRUCTION: These ruggedly built, belt-driven, motor-generator sets are all mounted on a sturdy steel frame base. Units in the 0.5 KVA to 5 KVA power range are designed around the highly efficient "NoBrush" Permanent Magnet Generator. Units in 12.5, 18.75, and 25 KVA power range have brushless rotating rectifier type generators with voltage regulators, to provide ±1% output voltage regulation. Three phase synduction motor driven units with timing belt give exact 50 Hz or 60 Hz output with constant input frequency. Three phase induction motor and single phase capacitor start-induction run motor driven units with "V" belts provide an output frequency of ±2%.

APPLICATION: To provide frequency conversion, basic power, and superior line isolation and stabilization for exported and imported electrical and electronic equipment. Available in power ratings from 0.5 KVA to 25 KVA. Detail specifications are given on the following page.

50 TO 60 Hz FREQUENCY CONVERTERS

		INPUT				OUTPUT			DIMENSIONS			
Model No.	KVA Rating	Motor H.P.	Ph.	Voltage	Motor Type	Voltage	Ph.	Freq.	L	W	H	Approx. Wt (lbs)
37-097	0.5	1.0	1	115/230	CS	115/230	1	60±1.2	33	15	16	230
37-044	1.5	3.0	1	115/230	CS	117	1	60±1.2	37	20	19	400
37-110	2.0	3.0	1	115/230	CS	115/230	1	60±1.2	37	20	19	420
37-151	2.5	5.0	3	380	Syn.	115/230	1	60	37	20	19	420
37-109	5.0	10.0	3	220/380	Ind.	120/208	3	60±1.2	37	20	19	465
37-*	12.5/10Kw	20.0	3	** 380	Syn.	208-240/ 416-480	3	60	50	34	25	1020
37-*	12.5/10Kw	20.0	3	** 380	Syn.	115-120/ 230-240	1	60	50	34	25	1050
37-*	18.75/15Kw	30.0	3	** 380	Syn.	208-240/ 416-480	3	60	52	34	25	1100
37-*	18.75/15Kw	30.0	3	** 380	Syn.	115-120/ 230-240	1	60	52	34	25	1250
37-*	25/20Kw	40.0	3	** 380	Syn.	208-240/ 416-480	3	60	58	34	27	1550
37-*	25/20Kw	40.0	3	** 380	Syn.	115-120/ 230-240	1	60	58	38	27	1820

60 TO 50 Hz FREQUENCY CONVERTERS

		INPUT				OUTPUT			DIMENSIONS			
Model No.	KVA Rating	Motor H.P.	Ph.	Voltage	Motor Type	Voltage	Ph.	Freq.	L	W	H	Approx. Wt (lbs)
37-105	0.5	1.0	1	115/230	CS	115/230	1	50±1	33	15	16	230
37-148	0.5	1.0	3	230/460	Syn.	115/230	1	50	33	15	16	230
37-102	1.5	3.0	1	115/230	CS	115/230	1	50±1	34	20	19	400
37-111	1.5	3.0	3	220/440	Syn.	115/230	1	50	34	20	19	400
37-119	1.5	3.0	3	230/460	Ind.	115/230	1	50±1	34	20	19	380
37-121	2.5	5.0	1	230	CS	115/230	1	50±1	37	20	19	450
37-095	2.5	5.0	3	220/440	Syn.	115/230	1	50	34	20	19	440
37-117	2.5	5.0	3	230/460	Ind.	120/208	3	50±1	34	20	19	400
37-142	5.0	10.0	3	220/440	Syn.	120/208	3	50	36	20	19	500
37-*	12.5/10Kw	20.0	3	** 230/460	Syn.	190-220/ 380-440	3	50	50	34	25	1000
37-*	12.5/10Kw	20.0	3	** 230/460	Syn.	115-120/ 230-240	1	50	50	34	25	1100
37-*	18.75/15Kw	30.0	3	** 230/460	Syn.	190-220/ 380-440	3	50	52	34	25	1220
37-*	18.75/15Kw	30.0	3	** 230/460	Syn.	115-120/ 230-240	1	50	56	36	27	1560
37-*	25/20Kw	40.0	3	** 230/460	Syn.	190-220/ 380-440	3	50	56	37	27	1580
37-*	25/20Kw	40.0	3	** 230/460	Syn.	115-120/ 230-240	1	50	56	37	27	1760

UNIVERSAL 50/60 Hz TO 50/60 Hz MOTOR GENERATORS

†37-116	1.5	3	3	220/440 & 380	Syn.	115/230	1	50/60	37	20	19	380
†37-112	2.5/1.5	5	3	220/440 & 380	Syn.	115/200 & 115	3/1	50/60	37	20	19	400

GEORATOR CORPORATION

Makers of NOBRUSH power systems

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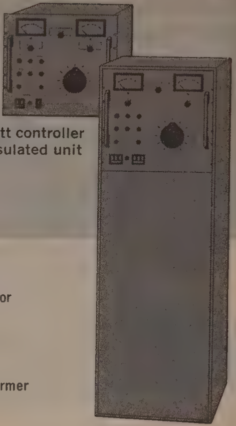
HV DC power supplies

HIPOTRONICS®

. . . A COMPLETE LINE OF HIGH VOLTAGE POWER SUPPLIES FOR ALL HV REQUIREMENTS, INCLUDING PULSED APPLICATIONS AND ACCELERATOR SUPPLIES. OUTPUT CURRENTS RANGE FROM 0.1 MA TO 100 AMPERES. ALL UNITS ARE CONSERVATIVELY DESIGNED FOR CONTINUOUS USE; THEY ARE AVAILABLE WITH FULLY INSTRUMENTED CONTROL CONSOLES, OR WITHOUT CONTROLS FOR USE IN OEM EQUIPMENT OR WITH EXISTING CONTROLLERS.



5 kilowatt controller for oil-insulated unit

5 and 10 kilowatt air insulated unit

DESIGN FEATURES

- Reversible polarity
- Output-connected, triple-range voltage meter
- Triple-range current meter in return leg of HV circuit
- Adjustable overload relay, 10% to 110% rated current, with reset button
- Rated current available from zero to rated voltage
- Meter recalibration potentiometers

CUSTOMIZED CAPABILITY

Hipotronics has designed and custom-manufactured a wide variety of power supplies for a wide variety of uses. Customized power supplies include application-oriented units for: electrostatics, accelerators, lasers, high power radar, high voltage component testing, and many more.

PERSONNEL SAFETY FEATURES

- Output shorting solenoid and/or bleeder resistor
- Series-limiting resistor in output circuit
- External interlock provision and pilot light
- Zero start interlock and pilot light

EQUIPMENT SAFETY FEATURES

- Surge protection for meters and relays
- Backup circuit breaker in primary of HV transformer
- Input circuit breakers and pilot light

SPECIFICATIONS

400-WATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.
1	400	801-400
2	200	802-200
3	130	803-130
4	100	804-100
5	80	805- 80
6	65	806- 65
7.5	50	807.5- 50
10	40	810- 40
15	25	815- 25
20	20	820- 20
25	15	825- 15
30	12	830- 12
40	10	840- 10
50	8	850- 8
60	6.5	860- 6.5
75	5	875- 5
90	4.5	890- 4.5
100	4	8100- 4

INPUT . . . . 115 volts, 50/60 Hz, 1 phase, 5 amperes
REGULATION . 15% no load to full load
RIPPLE . . . . . . 2% rms
HV OUTPUT . . . 20-foot shielded cable (Bushing available on request)

1 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.
1	1000	801-1000
2	500	802- 500
3	330	803- 330
4	250	804- 250
5	200	805- 200
6	165	806- 165
7.5	130	807.5- 130
10	100	810- 100
15	65	815- 65
20	50	820- 50
25	40	825- 40
30	33	830- 33
40	25	840- 25
50	20	850- 20
60	16	860- 16
75	13	875- 13
90	11	890- 11
100	10	8100- 10
120	8	8120- 8
150	6.5	8150- 6.5
200	5	8200- 5

INPUT . . . . 115 volts, 50/60 Hz, 1 phase, 12 amperes
REGULATION . . 15% no load to full load
RIPPLE . . . . . 2% rms
HV OUTPUT . . . 20-foot shielded cable (Bushing available on request)

1.5 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.
1	1500	801-1500
2	750	802- 750
3	500	803- 500
4	375	804- 375
5	300	805- 300
6	250	806- 250
7.5	200	807.5- 200
10	150	810- 150
15	100	815- 100
20	75	820- 75
25	60	825- 60
30	50	830- 50
40	37.5	840- 37.5
50	30	850- 30
60	25	860- 25
75	20	875- 20
90	17	890- 17
100	15	8100- 15
120	12.5	8120- 12.5
150	10	8150- 10
200	7.5	8200- 7.5
250	6.0	8250- 6.0
300	5.0	8300- 5.0

INPUT . . . . . . 115 volts, 50/60 Hz, 1 phase, 20 amperes
REGULATION . 15% no load to full load
RIPPLE . . . . . . 2% rms
HV OUTPUT . . . 20-foot shielded cable (Bushing available on request)

2.5 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.
1	2500	801-2500
2	1250	802-1250
3	830	803- 830
4	625	804- 625
5	500	805- 500
6	425	806- 425
7.5	300	807.5- 300
10	250	810- 250
15	160	815- 160
20	125	820- 125
25	100	825- 100
30	80	830- 80
40	60	840- 60
50	50	850- 50
60	40	860- 40
75	33	875- 33
90	27	890- 27
100	25	8100- 25
120	20	8120- 20
150	16	8150- 16
200	12.5	8200- 12.5
250	10	8250- 10
300	8	8300- 8
400	6	8400- 6
500	5	8500- 5

INPUT . . . . 115 volts, 50/60 Hz, 1 phase, 30 amperes
REGULATION . . 15% no load to full load
RIPPLE . . . . . . 2% rms
HV OUTPUT 20-foot shield cable (Bushing available on request)

5 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.	Input
1	5000	801-5000	208/230 V, 3 PHASE, 50/60 Hz, 20 AMPS
2	2500	802-2500	
3	1666	803-1666	
4	1250	804-1250	
5	1000	805-1000	
6	840	806- 840	
7.5	670	807.5- 670	
10	500	810- 500	
15	335	815- 335	
20	250	820- 250	
25	200	825- 200	
30	166	830- 166	
40	125	840- 125	208/220 V, SINGLE PHASE 50/60 Hz, 35 AMPS
50	100	850- 100	
60	84	860- 84	
75	67	875- 67	
90	56	890- 56	
100	50	8100- 50	
120	41.5	8120- 41.5	
150	33.3	8150- 33.3	
200	25.0	8200- 25	
250	20.0	8250- 20	
300	16.6	8300- 16.6	
400	12.5	8400- 12.5	
500	10.0	8500- 10.0	

REGULATION . . 10% 3 phase, 15% 1 phase, no load to full load
RIPPLE . . . . . . 1% or 5% rms, 3 phase units; 2% rms, 1 phase units (see chart)
HV OUTPUT 20-foot shielded cable (Bushing available on request)

10 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.	Input
1	10 AMP	801- 10A	208/230 V, 3 PHASE, 50/60 Hz, 40 AMPS
2	5 AMP	802- 5A	
3	3300	803-3300	
4	2500	804-2500	
5	2000	805-2000	
6	1650	806-1650	
7.5	1300	807.5-1300	
10	1000	810-1000	
15	650	815- 650	
20	500	820- 500	
25	400	825- 400	
30	330	830- 330	
40	250	840- 250	
50	200	850- 200	440/480 V, SINGLE PHASE, 50/60 Hz, 35 AMPS
60	160	860- 160	
75	130	875- 130	
90	110	890- 110	
100	100	8100- 100	
120	80	8120- 80	
150	65	8150- 65	
200	50	8200- 50	
250	40	8250- 40	
300	33	8300- 33	
400	25	8400- 25	
500	20	8500- 20	
600	16	8600- 16	
750	13	8750- 13	
1000	10	81000- 10	

REGULATION . . 10% 3 phase, 18% 1 phase, no load to full load
RIPPLE . . . . . . 1% or 5% rms, 3 phase units; 2% rms, 1 phase units (see chart)
HV OUTPUT . . Cable to 600 KV; Toroid over 600 KV

HIPOTRONICS®

HIPOTRONICS INC. Brewster, N. Y. 10509 914-279-8091 TELEX: 710-574-2420

HV DC power supplies (contd.)

HIPOTRONICS®

15 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.	Input
1	15 AMP	801- 15A	440/480 V, 3 PHASE, 50/60 Hz, 25 AMPS
2	7.5 AMP	802- 7.5A	
3	5 AMP	803- 5A	
4	3.75 AMP	804- 3.75A	
5	3 AMP	805- 3A	
6	2.5 AMP	806- 2.5A	
7.5	2 AMP	807.5- 2A	
10	1.5 AMP	810- 1.5A	
15	1000	815-1000	
20	750	820- 750	
25	600	825- 600	
30	500	830- 500	
40	375	840- 375	
50	300	850- 300	
60	250	860- 250	
75	200	875- 200	440/480 V, 1 PHASE, 50/60 Hz, 45 AMPS
90	170	890- 170	
100	150	8100- 150	
120	125	8120- 125	
150	100	8150- 100	
200	75	8200- 75	
250	60	8250- 60	
300	50	8300- 50	
400	37.5	8400- 37.5	
500	30.0	8500- 30	
600	25.5	8600- 25	
750	20.0	8750- 20	
1000	15.0	81000- 15	

REGULATION 10% 3 phase, 18% 1 phase, no load to full load
RIPPLE ...... 1% or 5% rms, 3 phase units; 2% rms, 1 phase units (see chart)
HV OUTPUT Cable to 600 KV; Toroid over 600 KV

25 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.	Input
1	25 AMP	801- 25A	440/480 V, 3 PHASE, 50/60 Hz, 45 AMPS
2	12.5 AMP	802- 12.5A	
3	8.8 AMP	803- 8.8A	
4	6.2 AMP	804- 6.2A	
5	5 AMP	805- 5A	
6	4.2 AMP	806- 4.2A	
7.5	3.3 AMP	807.5- 3.3A	
10	2.5 AMP	810- 2.5A	
15	1.7 AMP	815- 1.7A	
20	1.25 AMP	820- 1.25A	
25	1 AMP	825- 1A	
30	830	830-830	
40	620	840-620	
50	500	850-500	
60	420	860-420	
75	335	875-335	
90	280	890-280	
100	250	8100-250	1 PHASE 80 AMPS
120	200	8120-200	
150	170	8150-170	
200	125	8200-125	
250	100	8250-100	
300	85	8300- 85	
400	62	8400- 62	
500	50	8500- 50	
600	42	8600- 42	
750	33	8750- 33	
1000	25	81000- 25	

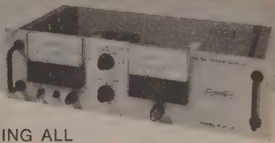
REGULATION 10% 3 phase, 18% 1 phase, no load to full load
RIPPLE . 1% or 5% rms, 3 phase units; 2% rms, 1 phase units (see chart)
HV OUTPUT Cable to 600 KV: Toroid over 600 KV

50 KILOWATT OUTPUT UNITS

Voltage (KV)	Current (ma)	Model No.	Input
1	50 AMP	801- 50A	440/480 V, 3 PHASE, 50/60 Hz, 90 AMPS
2	25 AMP	802- 25A	
3	16.6 AMP	803- 16.6A	
4	12.5 AMP	804- 12.5A	
5	10 AMP	805- 10A	
6	8.4 AMP	806- 8.4A	
7.5	6.7 AMP	807.5- 6.7A	
10	5 AMP	810- 5A	
15	3.3 AMP	815- 3.3A	
20	2.5 AMP	820- 2.5A	
25	2 AMP	825- 2A	
30	1.7 AMP	830- 1.7A	
40	1.25 AMP	840- 1 25A	
50	1 AMP	850- 1A	
60	830	860-830	
75	670	875-670	
90	560	890-560	
100	500	8100-500	
120	420	8120-420	
150	335	8150-335	1 PHASE 160 AMPS
200	250	8200-250	
250	200	8250-200	
300	166	8300-166	
400	125	8400-125	
500	100	8500-100	
600	83	8600- 83	
750	67	8750- 67	
1000	50	81000- 50	

REGULATION 10% 3 phase, 18% 1 phase, no load to full load
RIPPLE 1% or 5% rms, 3 phase units; 2% rms, 1 phase units (see chart)
HV OUTPUT Cable to 600 KV; Toroid over 600 KV

metered HV power packs



. . . STANDARD 5-MA AND 2-MA HV POWER PACKS WITH SIMPLIFIED CONTROLS. THEY ARE LOW COST SUPPLIES, DESIGNED FOR RELAY RACK MOUNTING, FEATURING ALL INDUSTRIAL GRADE COMPONENTS.

FEATURES

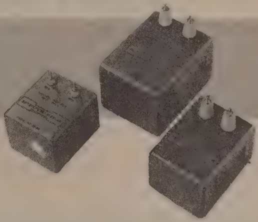
- Output-connected KV meter, 3½" square, 2% accuracy, single range
- Output-connected current meter, 3½" square, 2% accuracy, single range
- Continuously adjustable output control
- AC input switch, fuse, and pilot light
- HV fuse, with blown indicator
- 115-volt, 50/60-Hz input
- Surge and transient protection on all meters and powerstats
- Reversible polarity

SPECIFICATIONS

Output (KV)	Current (ma)	Ripple (% rms/ma)	Polarity	Model No.	KV Meter	Current Meter (ma)	Size WxHxD (in.)
0-2.5	5	.5	Reversible	R 2B	0-3	0-5	19x7x8
0-5	5	.5	Reversible	R 5B	0-6	0-5	19x7x8
0-10	5	.5	Reversible	R 10B	0-12	0-5	19x7x8
0-15	5	.5	Reversible	R 15B	0-15	0-5	19x7x8
0-20	5	.5	Reversible	R 20B	0-25	0-5	19x7x8
0-30	5	.5	Reversible	R 30B	0-30	0-5	19x12x10
0-50	5	.5	Reversible	R 50B	0-50	0-5	19x12x10
0-60	2	.5	Reversible	R 60B	0-60	0-2.5	19x12x10

OPTIONAL EXTRAS
1. Bench top cabinet $50.00
2. Short circuit limiter — Ideal for capacitor charging, flocking, electrostatic operations, etc. Supply will operate with short circuit on output and limit current to 5 ma .... $ 5.00

standard HV power packs



. . . WIDE RANGE OF COMPACT MINATURIZED HV POWER PACKS, WITH OUTPUT VOLTAGES FROM 2 TO 100 KV AND CURRENT RATINGS OF 2, 5 OR 10 MA.

FEATURES

- Hermerically sealed, oil-or epoxy-filled
- Solid state rectifiers
- 10-year life
- Low ripple
- Good regulation
- Compact, highly miniaturized
- Reversible polarity

Note:
Inquiries are invited for units with outputs different than our standards, built-in line regulation, short circuit, current-limited features, lower output ripple, 220V, 50/60-cycle inputs, DC to HV DC, or center-tapped output.

SPECIFICATIONS

Input: 0-125 volts, output voltages and currents stated for nominal 117 volt input
Regulation: 10 to 15% no load to full load
Ripple: 0.5% rms per milliampere output
Life: 10 years at 25°C ambient with rated output voltage and current
Terminations: Ceramic bushings on models 30 KV and below. Re-entrant receptacles with 3-foot mating coaxial cables on models 40 KV and up

Output Voltage (KV)	Current (ma)	Model No.	Size HxWxD (in.)	Output Voltage (KV)	Current (ma)	Model No.	Size HxWxD (in.)
2.5	5	2.5B	3½x3¾x2¾	15	10	15C	6⅛x4⅝x4
2.5	10	2.5C	4¼x3⅞x3⅞	20	5	20B	6⅛x4⅝x4
5	5	5B	4¼x3⅞x3⅜	25	10	25C	10x6x5
5	10	5C	5¼x3⅞x3⅜	30	5	30B	10x6x5
7.5	10	7.5C	5¼x3⅞x3⅜	50	5	50B	10x6x8
10	5	10B	5¼x3⅞x3⅜	60	2	60A	10x6x8
10	10	10C	6⅛x4⅝x4	100	2	100A	15½x8⅛x9¼
15	5	15B	6⅛x4⅝x4				

Prices and specifications subject to change without notice.

HIPOTRONICS®

HIPOTRONICS, INC.
Brewster, N. Y. 10509 / (914) 279-8091

For more information call or write our Marketing Department. See other Hipotronics' listings under Test Instruments.

digital or analog

7.5V, 10A POWER SUPPLY
7.50
15V, 5A POWER SUPPLY
15.00
30V, 3A POWER SUPPLY
30.0
60V, 1.5A POWER SUPPLY
60.0

Heath's new power supplies set new performance standards

- Choice of four DC outputs: 0-7.5 V, 0-15 V, 0-30 V or 0-60 V
- 3½-digit or 3½″ meter readout
- Constant voltage *or* constant current operation
- Remote voltage and current programming
- Precise load and line regulation—±0.05% voltage, ±0.1% current
- Complete output protection
- Remote sensing automatically compensates for lead voltage drops
- Available factory assembled or in easy-to-build kit form

Heath's versatile new 2700-Series DC power supplies do much more than just provide the right voltage and current—they set new standards for precision and ease of operation.

Digital or analog readout. These power supplies are the first in their price range to offer a choice of readouts. The digital models have two-decade autoranging to provide high resolution for low voltage and current settings.

Constant current or constant voltage operation. And it's true constant current, not simple current limiting. Adjust two controls to get the voltage and current you need. And if one supply doesn't deliver exactly the output you require, just connect them in series or parallel—with no loss of regulation!

Remote programming and sensing. For systems use and remote applications, both voltage and current can be programmed. And all supplies provide remote sensing at the load to automatically compensate for voltage drops due to long leads and connectors.

Output protection. You don't have to worry about these power supplies. Short circuit operation or accidentally applied high voltages can't harm them.

All 2700-Series power supplies are available in easy-to-build kit form or completely factory assembled and calibrated. Either way you get a power supply with the precision and performance that your application demands. Send the reply card or coupon for our latest catalogs and get complete details.

Model	Readout	Maximum Rated Output Volts	Maximum Rated Output Cur.	Price*
IP/SP-2700	Analog	60 V	1.5 A	$169.95 kit $255.00 assem.
IP/SP-2701	Digital	60 V	1.5 A	$219.95 kit $340.00 assem.
IP/SP-2710	Analog	30 V	3.0 A	$169.95 kit $255.00 assem.
IP/SP-2711	Digital	30 V	3.0 A	$219.95 kit $340.00 assem.
IP/SP-2720	Analog	15 V	5.0 A	$169.95 kit $255.00 assem.
IP/SP-2721	Digital	15 V	5.0 A	$219.95 kit $340.00 assem.
IP/SP-2730	Analog	7.5 V	10.0 A	$169.95 kit $255.00 assem.
IP/SP-2731	Digital	7.5 V	10.0 A	$219.95 kit $340.00 assem.

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Dept. 522-03
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EK-458

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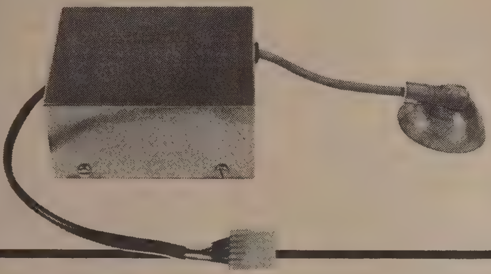
CUSTOM POWER SUPPLIES

DC To DC Or DC To AC
- Custom designed
- High reliability
- Operation temperatures up to 125°C
- High efficiency
- Low E.M.I.
- Wide variety of package configurations.
- Voltage regulators designed to meet customer requirements.

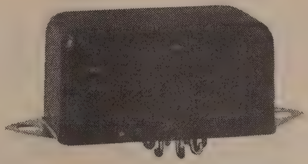


HIGH VOLTAGE DC TO DC POWER SUPPLY

DC Input: 23 V @ 240 ma
Outputs: 9 KV DC @ 60 ua
400 V DC @ 4 ma
12 V RMS (13 KHZ) @ 75 ma
Special characteristics: designed for operation @ 35,000 ft.
Physical size:
3.7" x 2.81" x 1.75" metal cased

LOW VOLTAGE DUAL OUTPUT DC TO DC POWER SUPPLY

DC Input: 24 V @ 350 ma
Outputs: +24 V @ 125 ma
−24 V @ 125 ma
Special characteristics: hermetically sealed.
Physical size: 2.125" x 1.25" x .875" metal cased



MULTI-OUTPUT DC TO AC POWER SUPPLY

DC Input: 28 V @ 2.5 a
Outputs: 30 V peak @ 270 ma
30 V peak @ 630 ma
30 V peak @ 1 ma w/ct
3.8 V peak @ 320 ma
Special characteristics: all outputs are 200 HZ square wave — hermetically sealed
Physical size: 3.125" x 2.312" x 2.06" metal cased
Output voltage(s) may be revised as long as the total power remains the same.

STANDARD EPOXY INCAPSULATED DC TO DC POWER SUPPLIES

DC Input 12 V @ 150 ma

Part No's	Output
27-0011-11	±6 V DC @ 100 ma
-12	±10 V DC @ 60 ma
-13	±12 V DC @ 50 ma
-14	±18 V DC @ 32 ma
-15	±24 V DC @ 25 ma

Physical size: 1.65" x 1.3" x 1"

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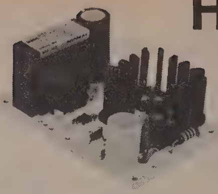
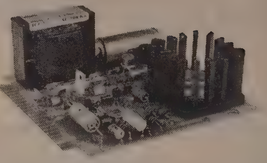
OTHER PRODUCTS: Precision Inductors • Transformers & Reactors • Tuned Circuits • Amp/Phase Equalizers • Lumped Constant Delay Lines

HOPE ELECTRONICS



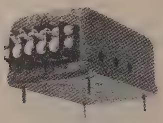
POWER SUPPLIES



LOW COST PLUG-IN

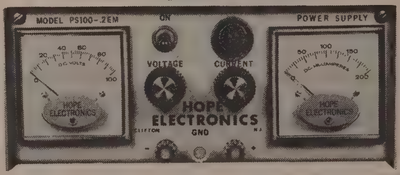
Model	Output Voltage	Output Current	Regulation	Ripple & Noise	Dimensions W L H	Price 1 - 24
EP5-.750	4.5V to 5.5V	0-750 ma	1%	<10 mv	4½x3x1⅞	$24.50
EP5-1/5	4.5V to 5.5V	0-1.5 amps	1%	<10 mv	4½x4½x1¾	$31.50
EP5-2.5	4.5V to 5.5V	0-2.5 amps	1%	<10 mv	4½x6½x2½	$37.50
EP5-4	4.5V to 5.5V	0-4 amps	1%	<10 mv	4½x6½x3	$45.50
EP15-.400	11.5V to 15.5V	0-400 ma	1%	<10 mv	4½x3x1⅞	$24.50
EP15-.700	11.5V to 15.5V	0-700 ma	1%	<10 mv	4½x4½x1¾	$31.50
EP15-1	11.5V to 15.5V	0-1 amp	1%	<10 mv	4½x6½x2½	$37.50
IP5-1/.1	4.5V to 5.5V	0-1 amp	0.1%	<1 mv	4½x4½x2¼	$33.00
IP5-2.5/.1	4.5V to 5.5V	0-2.5 amps	0.1%	<1 mv	4½x6½x2½	$45.00
IP15-.5/.1	11.5V to 15.5V	0-500 ma	0.1%	<1 mv	4½x4½x2¼	$33.00
IP15-1/.1	11.5V to 15.5V	0-1 amp	0.1%	<1 mv	4½x6½x2½	$45.00
IP30-.2/.1	15V to 30V	0-200 ma	0.1%	<2 mv	4½x4½x2¼	$35.00
IP50-.1/.1	25V to 55V	0-100 ma	0.1%	<50 mv	4½x4½x2¼	$45.00
IP100-.05/.1	50V to 105V	0-50 ma	0.1%	<100 mv	4½x4½x2¼	$45.00
IP200-.025/.1	100 to 210V	0-25 ma	0.1%	<200 mv	4½x4½x2¼	$45.00
DUAL OUTPUT						
EP12-.200/D	±11 to 13	0-200 ma	1%	<10 mv	4½x4½x1⅞	$45.00
EP15-.200/D	±14 to 16	0-200 ma	1%	<10 mv	4½x4½x1⅞	$45.00
DUAL OUTPUT TRACKING						
IP12-.200/DT	±11V to 13V	0-200 ma	0.1%	<2 mv	4½x6½x2¼	$59.00
IP15-.200/DT	±11V to 16V	0-200 ma	0.1%	<2 mv	4½x6½x2¼	$59.00
IP15-.025/DT	15V	0-25 ma	0.1%	<2 mv	4½x3x1⅞	$29.00
IP12-.400/DT	±11V to 13V	0-400 ma	0.1%	<2 mv	4½x7½x2½	$85.00
IP15-.400/DT	±14V to 16V	0-400 ma	0.1%	<2 mv	4½x7½x2½	$85.00

MODULAR SUPPLIES



Model	Output Voltage	Output Current	Regu-lation	Ripple & Noise	Price 1-24
MPS-SAE-5	5V	750 ma	.5%	<10 mv	$35.00
MPS-SAE-12	12V	400 ma	.5%	<10 mv	$35.00
MPS-SAE-15	15V	250 ma	.5%	<10 mv	$35.00
MPS-SAE-24	24V	250 ma	.5%	<10 mv	$35.00
MPS-SAE-28	28V	250 ma	.5%	<10 mv	$35.00

LAB SUPPLIES



Model	Output Voltage	Output Current	Regu-lation	Ripple & Noise	Price 1-24
PS30-1EM	0-30V	0-1 amp	.05%	<500 v	$128.00
PS30-.3EM	0-30V	0-300 ma	.01%	<500 v	$125.00
PS15-2EM	0-15V	0-2 amps	.05%	<500 v	$128.00
PS50-.5EM	0-50V	0-300 ma	.1%	<1 mv	$138.00
PS100-.2EM	0-100V	0-200 ma	.1%	<2 mv	$155.00

HOPE ELECTRONICS BOX 773 CLIFTON, N. J. 07013 (201) 777-3522

Powertron SOLID STATE AC POWER SUPPLIES

The Powertron AC Power Supplies provide stable, low distortion, AC power at frequencies within the audio frequency spectrum. These highly reliable and versatile power sources find wide application in calibration and test stations, motor drives, gyro wheel supplies, laboratory use, military component testing, and operating foreign equipment. These supplies may be used whenever it is necessary to provide AC power at a frequency not available from the power lines. The various supplies feature all solid state construction, wide operating frequency range, low distortion, and a wide variety of output voltages and impedances. The units are designed to be used in modular form so that a single unit can provide single phase output, and two or three units may be used to provide two phase or three phase outputs respectively.

AMPLIFIER SPECIFICATIONS
(Series 250S, Illustrated)

Output Circuit:
Single phase, isolated (Ground terminal is provided for optional grounding of output.)

Output Power:
250 VA

Load Power Factor:
.7 Lead through .7 Lag for full power output. Useable to .2 at reduced power.

Output Voltage Range:
0-130 V RMS (An output connector provided at the rear of the unit may readily be reconnected to provide optimum power output at other voltages. Ranges available are 0-260 V, 0-190 V, 0-130 V, 0-90 V, 0-75 V, 0-67 V, 0-60 V, 0-38 V, 0-30 V, and 0-17 V.

Output Frequency Range:
45 Hz to 10,000 Hz for full power out. 20 Hz to 20,000 Hz at reduced power.

Output Distortion:
0.1% mid band

Load Regulation:
Factory set to ±0.5% mid band (A control is provided for zero regulation adjustment over most of frequency range.)

Line Regulation:
±0.1% for ±5% line change.

Transient Response:
50 Microseconds.

Hum Level:
80 db approx. below rated output voltage.

Thermal Overload Protection:
Output transistors protected by thermal cut-out circuit.

Short Circuit Protection:
Output may be shorted indefinitely without damage to unit.

External Amplifier Input:
An input connector is provided at the rear of the unit when it is desired to drive the amplifier from an external source. Model XA-1 plug-in Module is required for this mode of operation.

External Sync. Input:
An input connector is provided at the rear when it is desired to synchronize the plug in oscillator with an external frequency source.

Convenience Outlets:
Two convenience outlets controlled by the power switch are provided at the rear of the unit. These permit single control operation of one or two additional amplifiers when 2ø or 3ø outputs are required. When not used for this purpose, the outlets may also be used to turn on auxiliary equipment which is mounted in the same test console.

Meter:
A voltmeter with range of 0-150 V RMS is provided to monitor the output voltage.

Input Power:
115 V or 230 V, 50-60 Hz (400 Hz input available).

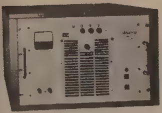
Ambient Temperature Range:
0° C to 55° C.

Dimensions:
5¼ x 19″ Rack Panel x 14″ Deep.

Weight:
75 Lbs. Approx.

The ordering designations listed below are for convenience of specifying the components required for various power supply configurations. To select an appropriate unit for your requirements first determine which category, 1-phase, 2-phase, or 3-phase, is most suitable to your intended load. Then use the ordering designation adjacent to the required output power within that category. For the complete ordering designation replace the asterisk with the ordering code letters of the plug-in-oscillator listed

1ø Power Supplies (For Use with Single Phase Loads)

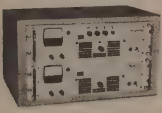


Model 1000S-1-N

Ordering Designation	Total Output Power	Output Voltage Range	Input
80S-1- *	80VA	17, 30, 38, 60, 67, 75, 90, **130**, 190, 260	1-Phase **115**, 230
250S-1- *	250VA		
500S-1- *	500VA	35, 60, 75, 120, **135**, 150, 180, 260, 380	
750S-1- *	750VA	50, 90, **115**, 180, 200, 225, 270, 390	
1000S-1- *	1KVA	65, 76, **130**, 140, 150, 260, 300	3-Phase, Line to Line 190, **208**, 225, 380, 450
1500S-1- *	1.5KVA		
2000S-1- *	2KVA	**130**, 150, 260, 280, 300	
3000S-1- *	3KVA		

2ø - 3ø (Open Delta) Power Supplies

(For use with 2ø loads and 3ø, 3 wire Delta loads.

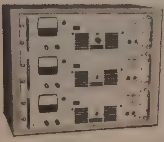


Model 500S-23-MM

Ordering Designation	Total Output Power	Output Voltage Range	Input
160S-23- *	160VA	17, 30, 38, 60, 67, 75, 90, **130**, 190, 260	1-Phase **115**, 230
500S-23- *	500VA		
1000S-23- *	1KVA	35, 60, 75, 120, **135**, 150, 180, 260, 380	
2000S-23- *	2KVA	65, 76, **130**, 140, 150, 260, 300	3-Phase, Line to Line 190, **208**, 225, 240, 380, 450
3000S-23- *	3KVA		
4000S-23- *	4KVA	**130**, 150, 260, 280, 300	
6000S-23- *	6KVA		

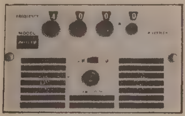
3ø Wye-Delta Power Supplies

(For use with 3ø, 4 wire wye loads or 3ø, 3 wire, Delta Loads.



Model 750S-3-AA

Ordering Designation	Total Output Power	Output Voltage Ranges (line to neutral)	Input
240S-3- *	240VA	17, 30, 38, 60, 67, 75, 90, **130**, 190, 260	1-Phase **115**, 230
750S-3- *	750VA		
1500S-3- *	1.5KVA	35, 60, 75, 120, **135**, 150, 180, 260, 380	
3000S-3- *	3KVA	65, 76, **130**, 140, 150, 260, 300	3-Phase, Line to Line 190, **208**, 225, 240, 380, 450
4500S-3- *	4.5KVA		
6000S-3- *	6KVA	**130**, 150, 260, 280, 300	
9000S-3- *	9KVA		



PLUG-IN OSCILLATORS

Single phase (1ø) and polyphase (Pø) oscillators are available for both fixed frequency and variable frequency output. A coarse and fine concentric control is included on each oscillator panel for precise amplitude adjustment. Polyphase oscillators include a switch on the front panel which provides either two-phase or three-phase output. All plug-in oscillators are provided with Sync. capability which permits locking-in their output frequency with an external source of the same nominal frequency.

CODE		FREQUENCY	ACCURACY
Single Phase	Poly Phase		
A	AA	400 Hz	0.1%
B	BB	60 Hz	0.1%
C	CC	Specify	0.1%
D	DD	Specify	0.01%
E	EE	Specify	0.001%
K	KK	10 Hz - 10 KHz	1.0%
L	LL	10 Hz - 100 Hz	1.0%
M	MM	100 Hz - 1 KHz	1.0%
N	NN	350 Hz - 450 Hz	0.25%
P	PP	300 Hz - 500 Hz	0.25%
Q	QQ	1 KHz - 10 KHz	1.0%

WRITE FOR CATALOG 969

ITECO INDUSTRIAL TEST EQUIPMENT CO.

21 Yennicock Ave., Port Washington, N. Y. 11050
Phone (516) 883-1700

INTEGRATED
CIRCUITS
INCORPORATED

ICI

13256 NORTHRUP WAY
BELLEVUE, WASHINGTON 98005
TELEPHONE: (206) 747-8556

DC-DC CONVERTERS

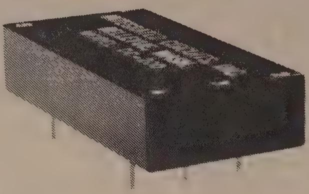
ENGINEERING AND DESIGN CAPABILITY

CIRCUIT DESIGN AND ANALYSIS

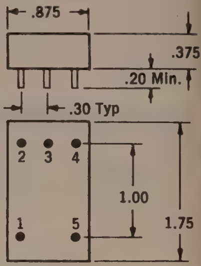
ICI Engineering offers the customer complete capability from designing and analysing circuits from his applications or specifications. ICI has specific experience in power conversion and regulator devices; complex active filters of the low pass, high pass, band pass or band reject types; linear circuits such as servo amplifiers, transducer signal conditioning electronics; high accuracy sample and hold circuits; as well as D/A converters; timing devices; digital devices such as specially packaged memory systems, A/D converters and other logic systems.

COMPLEX PACKAGE DESIGN AND CIRCUIT LAYOUT

ICI Engineering is expert at converting even the most complex circuits to practical and producible designs. Layouts combine thick and thin film elements to achieve the least expensive solutions to the circuit packaging needs of the customer.



OUTLINE DIMENSIONS



MODEL DC-200 DUAL OUTPUT DC/DC CONVERTER

ELECTRICAL CHARACTERISTICS: Operating Temp. Range = 0 to 85°C; see Note 1 V_{in} = 28 VDC and T = 25°C unless specified otherwise.

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage ±Vo	$+I_L = -I_L$ = 100 Ma.	14.0	15.0	16.0	VDC
Output Current $\pm I_L$	T = 0 −85°C	0	200	250	Ma.
Output Balance ($+I_L = I_L$)	T = 0 −85°C	—	0.15	0.5	VDC
Load Regulation (I_L = 0 to 200 Ma.)	T = 0 −85°C	—	1.5	—	VDC
Output Ripple	f >100 KHz	—	0.7	1.0	VPP
Input Voltage	T = 0 −85°C	10	28	32	VDC
Input No Load Current	T = 0 −85°C	—	40	50	Ma.
Efficiency	P_O = 6 Watts	75	80	—	%
Output Voltage T.C.	T = 0 −85°C I_L = 200 Ma.	—	.02	—	%/°C
Line Ripple Current		—	—	50	Ma. RMS
Converter Freq.		—	150	—	KHz
Isolation, Input/Output	500 VDC	100	—	—	Meg. Ω
Line Regulation	Output varies in proportion to Input				
Storage Temp. Range	−65°C to +150°C				
Size (excluding Pins)	1.2 in³				
Weight	1.0 ounce				
Finish	Black Anodize				

Note 1: −55°C to +100°C Op. Temp. Range available.

MODEL DC-202 DUAL OUTPUT DC/DC CONVERTER

ELECTRICAL CHARACTERISTICS: Operating Temp. Range = 0 to 85°C; V_{in} = 28 VDC and T = 25°C unless specified otherwise.

Output Voltage ±Vo	$+I_L = -I_L$ = 170 Ma.	16.8	18.0	19.2	VDC
Output Current $\pm I_L$	T = 0 −85°C	0	170	250	Ma.
Output Balance ($+I_L = I_L$)	T = 0 −85°C	—	0.15	0.5	VDC
Load Regulation (I_L = 0 to 200 Ma.)	T = 0 −85°C	—	1.5	—	VDC
Output Ripple	f >100 KHz	—	0.7	1.0	VPP
Input Voltage	T = 0 −85°C	10	28	32	VDC
Input No Load Current	T = 0 −85°C	—	40	50	Ma.
Efficiency	P_O = 6 Watts	75	83	—	%
Output Voltage T.C.	T = 0 −85°C I_L = 170 MA.	—	.02	—	%/°C
Line Ripple Current		—	—	50	Ma. RMS
Converter Freq.		—	150	—	KHz
Isolation, Input/Output	500 VDC	100	—	—	Meg. Ω
Line Regulation	Output varies in proportion to Input				

SEE DC-200 DATA SHEET FOR FURTHER INFORMATION

MODEL DC-203 SINGLE OUTPUT DC/DC CONVERTER

ELECTRICAL CHARACTERISTICS: Operating Temp. Range = 0 to 85°C; V_{in} = 28 VDC and T = 25°C unless specified otherwise.

Output Voltage Vo	I_L = 1.0 Amp	4.7	5.0	5.3	VDC
Output Current I_L	T = 0 −70°C (Derate Linearly to 0.9 Amps at 85°C)	—	—	1.25	Amps
Load Regulation (I_L = 0.1 to 1.25 Amps)		—	0.5	0.7	VDC
Output Ripple	I_L = 1.25 Amps	—	0.4	0.6	VPP
Input Voltage V_{in}	T = 0 −85°C	10	28	32	VDC
Input No Load Current	V_{in} = 48 VDC	—	35	50	Ma.
Efficiency	Po = 6 Watts	63	70	—	%
Output Voltage T.C.	T = 0 −85°C	—	.02	—	%/°C
Line Ripple Current		—	—	30	Ma. RMS
Converter Freq.		—	150	—	KHz
Isolation Input/Output	500 VDC	100	—	—	Meg. Ω
Line Regulation	Output varies in proportion to Input				

SEE DC-200 DATA SHEET FOR FURTHER INFORMATION

MODEL DC-204 DUAL OUTPUT DC/DC CONVERTER

ELECTRICAL CHARACTERISTICS: Operating Temp. Range = 0 to 85°C; V_{in} = 48 VDC and T = 25°C unless specified otherwise.

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage ±Vo	$+I_L = I_L$ = 200 Ma.	14.0	15.0	16.0	VDC
Output Current $\pm I_L$	T = 0 −85°C	0	200	250	Ma.
Output Balance ($+I_L = I_L$)	T = 0 −85°C	—	0.15	0.5	VDC
Load Regulation (I_L = 0 to 200 Ma.)	T = 0 −85°C	—	1.3	—	VDC
Output Ripple	f >100 KHz	—	0.7	1.0	VPP
Input Voltage	T = 0 −85°C	36	48	56	VDC
Input No Load Current	T = 0 −85°C	—	18	25	Ma.
Efficiency	P_O = 6 Watts	75	83	—	%
Output Voltage T.C.	T = 0 −85°C	—	.02	—	%/°C
Line Ripple Current		—	—	30	Ma. RMS
Converter Freq.		—	150	—	KHz
Isolation, Input/Output	500 VDC	100	—	—	Meg. Ω

SEE DC-200 DATA SHEET FOR FURTHER INFORMATION

MODEL DC-205 SINGLE OUTPUT DC/DC CONVERTER

ELECTRICAL CHARACTERISTICS: Operating Temp. Range = 0 to 85°C; V_{in} = 48 VDC and T = 25°C unless specified otherwise.

Output Voltage Vo	I_L = 1.0 Amp	4.7	5.0	5.3	VDC
Output Current I_L	T = 0 −70°C (Derate Linearly to 0.9 Amps at 85°C)	—	—	1.25	Amps
Load Regulation (I_L = 0.1 to 1.25 Amps)		—	0.5	0.7	VDC
Output Ripple	I_L = 1.25 Amps	—	0.4	0.6	VPP
Input Voltage V_{in}	T = 0 −85°C	36	48	56	VDC
Input No Load Current	V_{in} = 48 VDC	—	18	25	Ma.
Efficiency	Po = 6 Watts	63	70	—	%
Output Voltage T.C.	T = 0 −85°C	—	.02	—	%/°C
Line Ripple Current		—	—	30	Ma. RMS
Converter Freq.		—	150	—	KHz
Isolation Input/Output	500 VDC	100	—	—	Meg. Ω
Line Regulation	Output varies in proportion to Input				

SEE DC-200 DATA SHEET FOR FURTHER INFORMATION

STANDARD 6.0 WATT CONVERTER MODEL AVAILABLE

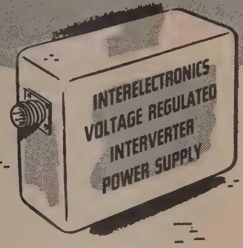
Model	Nom. Input	Nom. Output
DC-200	28 VDC	±15 VDC
DC-201	5 VDC	±15 VDC
DC-202	28 VDC	±18 VDC
DC-203	28 VDC	± 5 VDC
DC-204	48 VDC	±15 VDC
DC-205	48 VDC	+ 5 VDC
DC-209	12 VDC	+ 5 VDC
DC-211	12 VDC	±12 VDC
DC-213	5 VDC	±12 VDC

SEE DC-200 DATA SHEET FOR FURTHER INFORMATION
SEE PAGE 1•891 FOR FURTHER INFORMATION

PROVEN RELIABILITY—

DC-DC, DC-AC, SOLID-STATE POWER INVERTERS

over 260,000 logged hours— voltage-regulated, frequency-controlled, for missile, telemeter, ground-support, 135°C all-silicon units available now—



Interelectronics all-silicon thyratron-like gating elements and cubic-grain toroidal magnetic components convert DC to any desired number of AC or DC outputs from 1 to 10,000 watts.

Ultra-reliable in operation (over 260,000 logged hours), no moving parts, unharmed by shorting output or reversing input polarity. High conversion efficiency (to 92%, including voltage regulation by Interelectronics patented reflex high-efficiency magnetic amplifier circuitry).

Wide input voltage range (1 to 250 volts DC). Wide input voltage regulation (output voltage maintained with variations up to 50% in input voltage).

Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2%) with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards.

Complies with MIL specs. for shock (100G 11 misc.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).

AC single and polyphase units supply sine waveform output (to 2% harmonics), will deliver up to ten times rated line current into a short circuit to actuate MIL type magnetic circuit breakers or fuses, will start gyros and motors with starting current surges up to ten times normal operating line current.

Now in use in major missiles, powering telemeter transmitters, radar beacons, electronic equipment. Single and polyphase units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics—first and most experienced in the solid-state power supply field produces its own all-silicon solid-state gating elements, all high flux density magnetic components, high temperature ultra-reliable film capacitors and components, has complete facilities and know how—has designed and delivered more working KVA than any other firm!

For complete engineering data, write Interelectronics today, or call (914) EL 8-8000 in Congers.

INTERELECTRONICS CORPORATION
550 U.S. Route 303, Congers, New York 10920

K.G.S.
electronics, inc.

kgs electronics

2029 North Lincoln Avenue • Pasadena, California 91103 • Telephone (213) 798-0787

POWER SUPPLIES
INVERTERS
BATTERIES

MODEL PC-19 1 KW SQUARE WAVE STATIC INVERTER

The Model PC-19 is a 1000 watt, 28 VDC to 200 VAC rise-time controlled square wave static inverter. This inverter is primarily designed to power windshield heaters for de-icing. DC to DC power conversion to 200 VDC and up to 5.0 amps is also available as an option. Special units can be manufactured to give different output AC voltage and frequencies.*

SPECIFICATIONS:

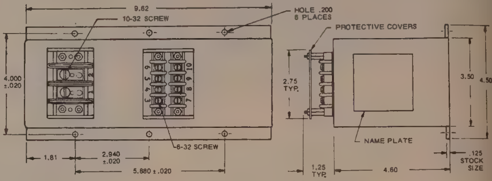
Input Voltage:	27.5 VDC ±.25 V at inverter terminals. Withstand 35 V for one minute. 0 to 27.5 V no condition will develop that will be detrimental to the unit.
Output Voltage:	#1 — 200 VRMS ±10% with 6 V tap. #2 — 5.5 VRMS ±10% and up to 1.0 Amps. #3 — 200 VDC ±10%, Ripple less than 3 VRMS (Optional).
Output Current:	Up to 5.0 Amps.
Output Power:	1000 Watts total continuous.
Overload:	1300 Watts for one minute and/or on an intermittent basis, provided the base plate temperature of 160°F is not exceeded.
Protection:	Overload and short circuit protection above approximately 7.0 Amps provided.
Frequency:	1000 Hz ±200 Hz.
Waveform:	Essentially square wave; Access to vary rise and decay time up to 50 microseconds (μsec).
Efficiency:	90% typical @ 50 μsec rise and decay time.
Temperature:	−65°F to +160°F (sufficient air circulation of 25 CFM must be provided @ +160°F for continuous operation, unless the base plate temperature is below 160°F).
Humidity:	Greater than 95% for 10 days.
Vibration:	Meets RTCA Paper DO-138 Para 7.2.1 Cat. H Curve 2.
Altitude:	45,000 Feet.
Size:	3.5″W x 9.6″L x 4.6″H (refer to outline drawing).
Weight:	10 Pounds.

***NOTE:**

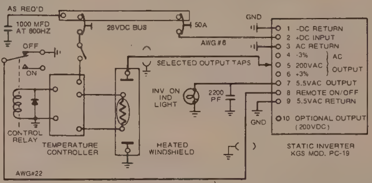
1. Frequency down to 350 Hz is available at reduced VA (500 VA @ 350 Hz) rating in the same package.
2. Different output voltage from 25 VAC to 250 VAC is available.

FEATURE

- Provision for remote on/off by opening or grounding a low current line.
- Thermal cut off above 225°F in the event of prolonged overload causing excessive temperature condition. (Automatic reset)
- Easy access to vary the rise and decay time of the AC output waveform up to 50 microseconds.


9.62
10-32 SCREW
HOLE .200
8 PLACES
PROTECTIVE COVERS
4.000
±.020
2.75
TYP.
3.50
4.50
6-32 SCREW
NAME PLATE
1.81
2.940
±.020
5.880 ±.020
1.25
TYP.
4.60
.125
STOCK
SIZE

OUTLINE & MOUNTING DIMENSIONS


AS REQ'D
1000 MFD
AT 800HZ
28VDC BUS
50A
GND
AWG #8
OFF
ON
SELECTED OUTPUT TAPS
1 -DC RETURN
2 +DC INPUT
3 AC RETURN
4 -3%
5 200VAC
6 +3%
AC
OUTPUT
7 5.5VAC OUTPUT
8 REMOTE ON/OFF
9 5.5VAC RETURN
10 OPTIONAL OUTPUT
(200VDC)
INV ON
IND
LIGHT
2200
PF
GND
CONTROL
RELAY
TEMPERATURE
CONTROLLER
HEATED
WINDSHIELD
STATIC INVERTER
KGS MOD. PC-19
AWG#22

SUGGESTED EXTERNAL HOOK-UP

LIGHT DIMMER FOR INCANDESCENT LAMPS

The KGS Electronics Model LT-50 is a pulse width modulated DC to DC regulated converter that delivers 5 VDC and up to 50 watts of power. This converter is primarily designed to power 5 V light bulbs and remotely control the light intensity by a potentiometer. Other model LT-series also available from KGS ELECTRONICS are:

LT-51: 28 VDC input to 5 V and 26 VDC outputs, adjustable down to .5 V and 4 VDC respectively, and delivers total of 50 watts of output power.

LT-24: 28 VDC input to 5 V and/or 26 V amplitude controlled AC output @ 400 Hz, the outputs adjustable down to .5 V and 2.6 VAC respectively, and delivers total of 25 watts of output power.

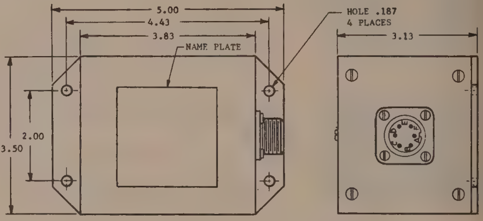
LT-26: 115 VAC, 400 Hz input to 5 V amplitude controlled AC output @ 400 Hz, the output adjustable down to .5 VAC and delivers 25 watts of output power.

LT-27: 115 VAC, 400 Hz input to 5 V pulse width controlled AC output @ 400 Hz, the output adjustable down to .5 VAC and delivers 25 watts of output power.

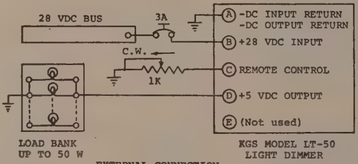
LT-23: 115 VAC, 400 Hz input to 5 VDC output unregulated output, adjustable down to .5 VDC and delivers total of 25 watts of output power.

SPECIFICATIONS MODEL LT-50

Input Voltage:	28 VDC ±3 V operate electrically down to 20 VDC.
Input Current:	2.5 Amps typical @ 28 VDC input and decreases as the input voltage is increased.
Output Voltage:	.25 VDC to 5 VDC adjustable.
Output Current:	10 Amps from 3 VDC to 5 VDC range.
Control:	1 inch diameter, 2 Watt, wire-wound, linear taper potentiometer controls DC output from .25 to 5 VDC.
Regulation:	Better than ±2.5% from no load to full load. Better than ±2.5% from 25 to 32 VDC input voltage for output voltage setting from 1 to 5 VDC.
Ripple:	Less than 25 MV RMS; Spike less than 100 MVp-p.
Efficiency:	72% typical.
Temperature:	−50°F to +160°F.
Humidity:	Greater than 95% for 10 days.
Altitude:	45,000 Feet.
Size:	3.2″H x 3.5″W x 5.0″L.
Weight:	2.7 Pounds.


5.00
4.43
3.83
NAME PLATE
HOLE .187
4 PLACES
3.13
2.00
3.50

OUTLINE & MOUNTING DIMENSIONS


28 VDC BUS
3A
A -DC INPUT RETURN
-DC OUTPUT RETURN
B +28 VDC INPUT
C.W.
1K
C REMOTE CONTROL
D +5 VDC OUTPUT
E (Not used)
LOAD BANK
UP TO 50 W
KGS MODEL LT-50
LIGHT DIMMER

EXTERNAL CONNECTION

BATTERY CHARGER

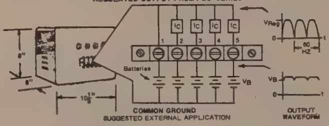
DESCRIPTION:

Ferro-Resonant Battery Charger (FBC) provides a stable pulsating DC voltage with short circuit protection. A series of these FBC models are available from KGS ELECTRONICS with high efficiency and reliability at reasonable cost.

FEATURE:

- Full wave rectified unfiltered DC output.
- 105-125 VAC input range*
- Output regulated by KGS standard Ferro-Resonant Transformer (FRT).
- Five output terminals: One terminal is for high charging rate and the remaining four are provided with current limiting via light bulb. Current limiting control module for trickle charging to replace light bulb is also available.
- Inverse intensity of light bulb indicates a degree of battery charge.
- The unfiltered rectified pulsating DC voltage is capable of trickle charging batteries with different degree of charge.
- Sufficient range of the regulated output may be obtained by:
  - (a) Specifying the percent tap
  - (b) Specifying the number of taps
  - (c) Utilizing combination of taps
  - (d) Selecting different bulbs
- Output filter capacitor can be added to provide filtered DC output.

REGULATED OUTPUT FROM FBC–SERIES


6"
6"
10½"
I_C
1
2
3
4
5
Batteries
V_B
COMMON GROUND
V_{Reg}
0
t
60 HZ
V_B
0
t
OUTPUT
WAVEFORM

SUGGESTED EXTERNAL APPLICATION

Where:

V_B = Battery Voltage
V_{Reg} = Regulated output from FBC-series
I_C = Current Control Module (light bulb is standard)

Model Number	Power Rating VA	Average DC Output Voltage Range
FBC200	200	10 to 200
FBC300	300	15 to 200
FBC400	400	20 to 200
FBC500	500	25 to 200

HOW TO ORDER

FBC200 — 28 — 3 — X
X: Number of taps**
3: % tab (−3% is standard)
28: Rated battery voltage (28 V Ni-Cad battery is standard)
FBC200: Model Number and VA Rating

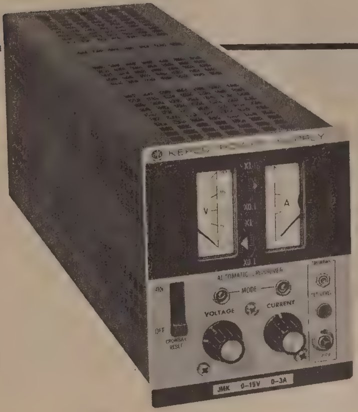
*230 VAC input available on special order.
**Additional taps can be provided at additional cost.

We also manufacture Transformers & Chokes. See Vol. 3. All technical data and prices subject to change without notice, F.O.B, Pasadena, California

KEPCO

POWER SUPPLIES

all KEPCO products are backed by a firm 5-Year Warranty



the company Kepco, Inc., is a New York, U.S.A.-based manufacturer of advanced d-c voltage and current stabilizers, with a 28-year history of innovations and excellence.

the product Kepco has concentrated in several important areas of power supply design:

- **Linear series regulators:** ideal for remote control, as in automatic test equipment, because of their faithful execution of programming instructions, their fast recovery and noise-free operation.
- **High Voltage Hybrids:** a combination of integrated circuit and transistor controls, with high vacuum valves for the direct linear control of voltage to 5000 volts.
- **Operational Power Supplies:** both conventionally filtered and models with a minimum output capacitance for wide bandwith. These power supplies act like giant operational amplifiers, and can be used to scale, sum, or integrate signals on a power basis up to 1000 watts.
- **Bipolar Power Supplies:** operational power amplifiers that respond to the *sense* of a control instruction, as well as the magnitude.
- **Ferroresonant Voltage Stabilizers:** the simplest, most reliable sources of d-c that can be fabricated.
- **Programmers:** interfaces between the digital world of control and the analog world of power supplies.

the philosophy of construction Kepco Power Supplies may be characterized by their cool operation, and easily repairable construction. It is Kepco's practice to employ sealed-bearing blowers with efficient heat radiators in models above 200 watts, (and even some smaller ones) to achieve the necessary thermal exhaust with an absolutely minimum temperature rise in such sensitive components as the transistors, zener references, filter capacitors, etc.

Kepco *sockets* all transistors and all integrated circuits for easy trouble shooting and repair. Even most *power transistors* are socketed. Construction is on double-sided printed circuit cards, interconnected by cabled harnesses through easily removed edge connectors.

the warranty Kepco warrants each of its power supplies to be free of defect and to meet published specifications for a period of 5-years. Our representatives around the world are prepared to honor this warranty, and provide such service as may be necessary.

manuals instruction Kepco Power Supplies are accompanied by a comprehensive manual containing Specifications, Operating Instructions, Theory of Operation, Schematic, Parts Locating Drawings, Complete Parts List and Outline Drawings.

source power wiring Models equipped for 115/230V, 50/60 Hz operation will be set up at the factory for 115V, 60 Hz. Your Kepco representative, in addition to providing import and warranty services, will usually also be able to assist you in the matter of local power cords, and setting the source power to conform with the local mains. (Note: the "PRM" Models with suffix "–50" are factory-wired for 230V a-c, 50 Hz).

Data and prices subject to change without notice.
All prices F.O.B. Flushing, N.Y.

KEPCO®

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX # 710-582-2631 • Cable: KEPCOPOWER NEWYORK

KEPCO™ POWER SUPPLIES

ABC
TRANSISTOR

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		SIZE	PRICE	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C			lbs.	kg.
ABC 2–1M	0–2	0–1	1 mΩ + 0.5 µH	400 Ω + 2.5 kµF	A	$182.00	9	4.1
ABC 7.5–2M	0–7.5	0–2	2 mΩ + 0.5 µH	750 Ω + 4.0 kµF	B	242.00	13	5.9
ABC 10–0.75M	0–10	0–0.75	7 mΩ + 1 µH	3.7 kΩ + 2.1 kµF	A	182.00	9	4.1
ABC 15–1M	0–15	0–1	8 mΩ + 0.5 µH	3 kΩ + 2.5 kµF	B	241.00	13	5.9
ABC 18–0.5M	0–18	0–0.5	20 mΩ + 1 µH	7.2 kΩ + 625.0 µF	A	182.00	9	4.1
ABC 30–0.3M	0–30	0–0.3	50 mΩ + 1 µH	20 kΩ + 500.0 µF	A	182.00	9	4.1
ABC 40–0.5M	0–40	0–0.5	40 mΩ + 0.5 µH	16 kΩ + 1.0 kµF	B	241.00	13	5.9
ABC 100–0.2M	0–100	0–0.2	250 mΩ + 1 µH	100 kΩ + 450.0 µF	B	274.00	13	5.9

(1) d-c value is for external sensing and feedback with a 1 volt sample.

ABC power supplies are bench-style units made in two groups. This page describes the low voltage models, 0–2 volts to 0–100 volts. The *High Voltage* section of the Kepco Catalog lists ABC models from 0–200 volts to 0–2500 volts. ABC power supplies have a single stabilization channel, controlled by a differential transistor amplifier driving a linear series-pass output stage.

INFLUENCE QUANTITY		OUTPUT EFFECTS	
		VOLTAGE MODE	CURRENT MODE (2) (External Sensing)
SOURCE: 105–125/210–250V a-c		<0.05% or 1 mV (3)	<0.1%
LOAD: No load – full load		<0.05% or 1 mV (3)	<0.5%
TIME: 8-hours [drift]		<0.05% or 3 mV (3)	<0.1% or 1 mA (3)
TEMPERATURE: Per °C		<0.05%	<0.1%
UNPROGRAMMED OUTPUT DEVIATION (4) (Ripple and noise)	rms	<0.25 mV	<0.1% of I_o max.
	p-p (5)	<2.5 mV	<1% of I_o max.

(2) Current control using current feedback around the voltage channel derived from a 1 volt sample across an external current sensing resistor.

(3) Whichever is greater.

(4) One terminal must be grounded or connected so that common mode current does not flow through the load or through a current-sensing resistor.

(5) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: ABC are full-range, programmable power supplies. They can be programmed or set to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output voltage is controlled continuously throughout 100% of the range by a panel-mounted, 10-turn rheostat. External voltage control can be exercised by a resistance (1000 ohms per volt) or by a control voltage.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The ABC is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by a single-turn panel adjustment over the range 25% to 150% I_o max. For the precision control of current, the voltage control channel may be reconnected so as to sample the drop across an external current-sensing resistor in the minus (−) output lead. Using an external current feedback rheostat, the current range is 1 milliampere to 100% I_o max. For similar units in which the main control channel is committed to current stabilization, please see the CC models in the *Special Purpose* section in the Kepco Catalog.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:
The time required for a stabilized voltage to recover within the load effect band (or 2mV, whichever is greater) is less than 50 µs.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:
As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the CC models in the *Special Purpose* section of the Kepco Catalog.

PROGRAMMING SPEED: The rate at which ABC responds to a step program is determined by the current limit setting, the load resistance and the tabulated output capacitance. For fast programming applications, please see the OPS Group II in the *High Speed* section of Kepco's Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The table gives these values for each ABC model.

GENERAL

SERIES/PARALLEL: Units can be connected in series or in parallel. Terminals are provided for master/slave interconnection.

ISOLATION FROM GROUND: The circuit and output terminals of ABC have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption approximately 30 watts for the "A" size units; 50 watts for the "B" size units. Power factor 0.9. All models are equipped with a nondetachable, 3-wire molded line cord.

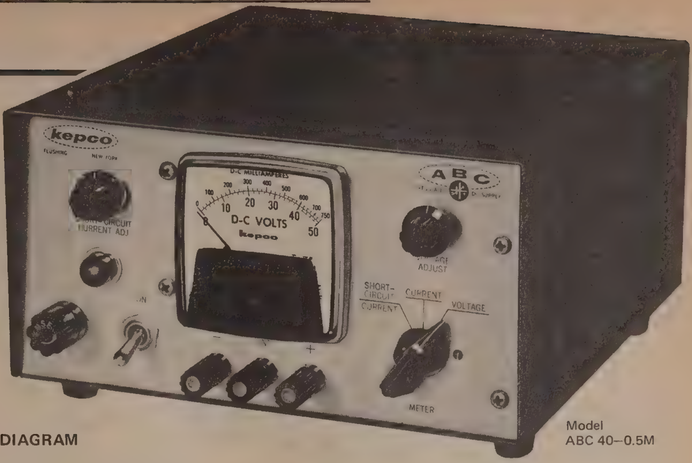
TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +50°C. Cooling is by natural convection. Full output current is delivered at +50°C; no derating or external heat sink is required.

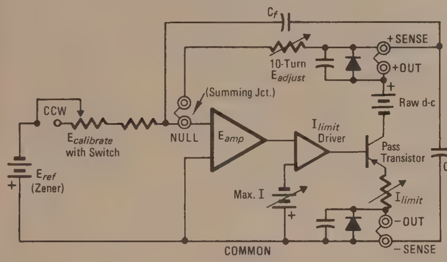
Data and prices subject to change without notice

all KEPCO products are backed by a firm 5-Year Warranty


kepco
FLUSHING NEW YORK
SHORT-CIRCUIT CURRENT ADJ
D-C MILLIAMPERES
D-C VOLTS
kepco
ABC
VOLTAGE ADJUST
SHORT-CIRCUIT CURRENT
CURRENT
VOLTAGE
METER
ON

Model
ABC 40–0.5M

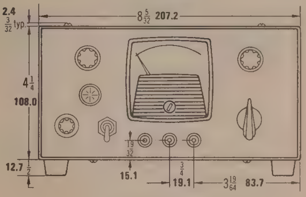
SIMPLIFIED SCHEMATIC DIAGRAM


C_f
+SENSE
+OUT
10-Turn
E_{adjust}
(Summing Jct.)
Raw d-c
CCW
NULL
E_{amp}
I_{limit} Driver
Pass Transistor
C_o
$E_{calibrate}$ with Switch
E_{ref} (Zener)
Max. I
I_{limit}
–OUT
COMMON
–SENSE

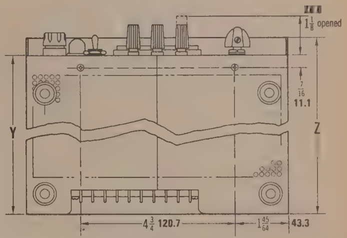
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

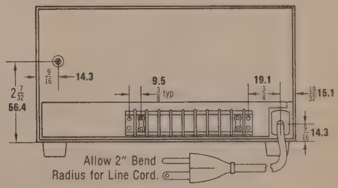
Tolerance:
±1/64″ **(0.4)** between mounting holes.
±1/32″ **(0.8)** other dimensions.
Panels: Per Mil. Std. 189


2.4
3/32 typ.
8 5/32 207.2
4 1/4
108.0
12.7 1/2
19/32
15.1
3/4
19.1
3 19/64 83.7

FRONT VIEW


1 1/8 opened
7/16
11.1
Y
Z
4 3/4 120.7
1 45/64 43.3

BOTTOM VIEW


9/16
14.3
9.5
3/8 typ
19.1
3/4
19/32 15.1
2 7/32
56.4
5/16 14.3
Allow 2″ Bend Radius for Line Cord.

REAR VIEW

STANDARDS: ABC bench supplies are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: D-C output, sensing and control functions are terminated at a rear-mounted barrier-strip. Front panel binding posts carry d-c output and ground.

METERS: A single 2½-inch, 2% combination voltmeter/ammeter is provided, together with a selector switch. A separate position on this switch shorts the output internally to facilitate the setting of the current limit adjustment.

MOUNTING: ABC power supplies may be mounted in standard 19-inch equipment racks by the use of rack adapter RA–5 (for a single unit) or RA–4 for two units side-by-side. ABC power supplies can be mounted in the RA–24 rack mount system by use of adapter RAP 24–45.

Model RA–4 Rack Adapter	Price: $20.00.
Model RA–5 Rack Adapter	Price: $20.00.
Model RA–24 Rack Adapter	Price: $25.00.
Model RAP 24–45 Panel Adapter	Price: $15.00.

DIMENSIONS

A Size Models:
English measure: 4¼″H x 8 5/32″W x 5⅝″D.
Metric measure: 108.0 H x 207.2 W x 142.9 D mm.

B Size Models:
English measure: 4¼″H x 8 5/32″W x 9⅝″D.
Metric measure: 108.0 H x 207.2 W x 244.5 D mm.

See outline drawings.

FINISH: *Panel:* Brushed aluminum.
Case: Charcoal gray texture.

SIZE	MODEL	Y	Z
A	ABC 2–1M ABC 10–0.75M ABC 18–0.5M ABC 30–0.3M	5⅛ 130.2	5⅝ 142.9
B	ABC 7.5–2M ABC 15–1M ABC 40–0.5M ABC 100–0.2M	9⅛ 231.8	9⅝ 244.5

KEPCO™ POWER SUPPLIES

ABC
HYBRID

MODEL	d-c OUTPUT RANGE VOLTS	mA	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C	UNPROGRAMMED OUTPUT DEVIATION rms (mV)	p-p (mV)	PRICE	SHIP WGT. lbs.	kg.
ABC 200M	0–200	0–100	1 Ω + 2 μH	2 MΩ + 150 μF	0.5	3.0	$297.00	13	5.9
ABC 425M	0–425	0–50	4 Ω + 2 μH	8.5 MΩ + 8 μF	0.5	3.0	297.00	14	6.4
ABC 1000M	0–1000	0–20	25 Ω + 10 μH	50 MΩ + 2.75 μF	1.0	5.0	413.00	14	6.4
ABC 1500M	0–1500	0–10	75 Ω + 10 μH	150 MΩ + 1 μF	1.0	5.0	413.00	14	6.4
ABC 2500M	0–2500	0–2	625 Ω + 10 μH	1250 MΩ + 1 μF	1.0	7.0	523.00	17	7.7

(1) d-c value is for external sensing and feedback with a 10-volt sample.

ABC Power Supplies are bench-style units made in two groups. This page describes the high voltage models, 0–200 volts to 0–2500 volts. The *General Purpose* section of Kepco's Catalog lists ABC models from 0–2 volts to 0–100 volts. The high voltage ABC models have a single stabilization channel controlled by a differential transistor amplifier driving a high voltage vacuum-tube output stage.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE (3) (External Sensing)
SOURCE: 105–125/210–250V a-c		<0.05% or 5 mV(2)	<0.1%
LOAD: No load – full load		<0.05% or 5 mV(2)	<0.1%
TIME: 8-hours [drift]		<0.05% or 50 mV(2)	<0.1% or 10 μA(2)
TEMPERATURE: Per °C		<0.05%	<0.1%
UNPROGRAMMED OUTPUT DEVIATION(4) (Ripple and noise)	rms	See table	<0.1% of I_o max
	p-p(5)	See table	<0.5% of I_o max

(2) Whichever is greater.

(3) Specifications are based on external current sensing and feedback using a 10-volt sample.

(4) One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor.

(5) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: ABC are full-range, programmable power supplies. They can be programmed or set to any level within their rated range and be fully loaded at any output setting. An exception is Model ABC 2500M, which, when programmed by external *voltage* signal, is restricted to the upper two-thirds of the range determined by its voltage control setting.

CONTROL/PROGRAMMING: Output voltage is controlled from the panel by a combination of a 10-position decade step switch and 10-turn vernier control. The models ABC 200M and ABC 425M use the 10-turn control alone. External voltage control can be exercised by a resistance (1000 ohms per volt) or by a control voltage delivering 0 to +1 milliampere into the summing junction with respect to the plus (+) output terminal (see restriction, Model ABC 2500M, above).

CURRENT STABILIZATION

The ABC–Hybrid group of power supplies are equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by a single turn panel adjustment over the range 25% to 150% I_o max. An internal factory-set adjustment to limit at approximately 150% current is provided on Models ABC 1000M, ABC 1500M and ABC 2500M. For the precision control of current, the voltage control channel may be reconnected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. Using an external current feedback rheostat, the current range is 1 milliampere to 100% I_o max.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:

The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:

As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the OPS Group IX models in the Kepco Catalog.

PROGRAMMING SPEED: The rate at which the ABC responds to a step-program is determined by the current limit setting, the load resistance and the tabulated output capacitance. For fast programming models, please see the OPS Group IX in the *High Speed* section of the Kepco Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each ABC–Hybrid model.

GENERAL

SERIES/PARALLEL: Units can be connected in series only up to the limit of their isolation voltage (1000V). They may be used in parallel for added current. Terminals are provided for master/slave interconnection.

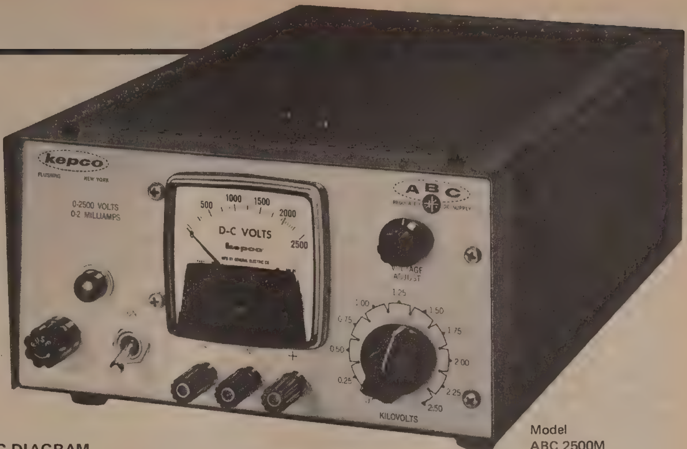
ISOLATION FROM GROUND: The circuit and output terminals of the ABC–Hybrid have no d-c connection to ground, and may be floated up to 1000 volts (d-c or peak) off ground. The common mode current from output to ground is less than 50 microamperes rms, 500 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. All models are equipped with a nondetachable, 3-wire molded line cord, plug Pattern No. 1. (See page 111 of the Kepco Catalog.)

AUXILIARY OUTPUT: Models ABC 200M and ABC 425M feature a 6.3V a-c, 2A filament output.

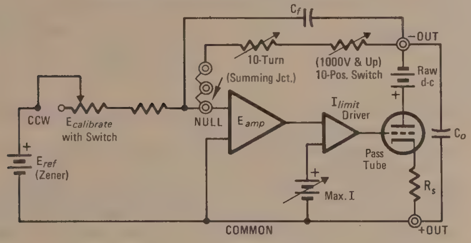
Data and prices subject to change without notice

all KEPCO products are backed by a firm *5-Year Warranty*


kepco
FLUSHING NEW YORK
0-2500 VOLTS
0-2 MILLIAMPS
D-C VOLTS
500
1000
1500
2000
2500
ABC
VOLTAGE ADJUST
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
KILOVOLTS

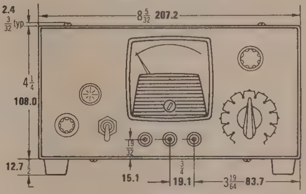
Model
ABC 2500M

SIMPLIFIED SCHEMATIC DIAGRAM

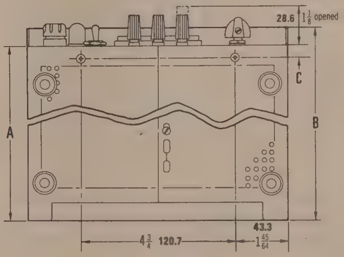

C_f
−OUT
10-Turn
(1000V & Up)
10-Pos. Switch
(Summing Jct.)
Raw d-c
CCW
$E_{calibrate}$ with Switch
NULL
E_{amp}
I_{limit} Driver
C_o
E_{ref} (Zener)
Pass Tube
R_s
Max. I
COMMON
+OUT

OUTLINE DIMENSIONAL DRAWINGS

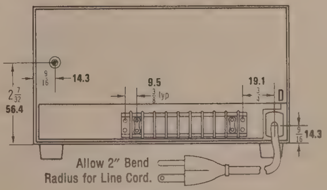
Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.
Tolerance: ±1/64″ **(0.4)** between mounting holes.
±1/32″ **(0.8)** other dimensions.
Panels: Per Mil. Std. 189


2.4
3/32 typ.
8 5/32 207.2
4 1/4
108.0
19/32
12.7 1/2
15.1
3/4
19.1
3 19/64 83.7

FRONT VIEW


28.6
1 1/8 opened
C
A
B
43.3
4 3/4 120.7
1 45/64

BOTTOM VIEW


9/16
14.3
2 7/32
56.4
9.5
3/8 typ
19.1
3/4
D
9/16 14.3

Allow 2″ Bend
Radius for Line Cord.

REAR VIEW

	A	B	C	D
MODEL 2500	13 ⅛ 333.4	13 ⅝ 346.1	⅜ 9.5	⅝ 15.9
ALL OTHER MODELS	9 ⅛ 231.8	9 ⅝ 244.5	7/16 11.1	19/32 15.1

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +55°C. Cooling is by natural convection. Full output current is delivered at +55°C; no derating or external heat sink is required.

STANDARDS: ABC bench supplies are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: d-c output, sensing and control functions are terminated at a rear-mounted barrier-strip. Front panel binding posts carry d-c output and ground.

METERS: The models ABC 200M and ABC 425M are provided with a single 2½-inch, 2% combination voltmeter/ammeter with a selector switch. The Models ABC 1000M, ABC 1500M and the ABC 2500M are equipped with voltmeters only.

MOUNTING: ABC power supplies may be mounted in standard 19-inch equipment racks by the use of rack adapter RA–5 (for a single unit) or RA–4 for two units side-by-side. ABC power supplies can be mounted in the RA–24 rack-mount system by use of panel adapter RAP 24–45.

Model RA–4 Rack Adapter	Price: $20.00.
Model RA–5 Rack Adapter	Price: $20.00.
Model RA–24 Rack Adapter	Price: $25.00.
Model RA 24–45 Panel Adapter	Price: $15.00.

DIMENSIONS

English measure: 4¼″H x 8 5/32″W x 9⅝″D.

Metric measure: 108.0 x 207.2 W x 244.5 D mm.
Except Model ABC 2500M is 13⅝″D(346.1mm).

FINISH: *Panel:* Brushed aluminum.
Case: Charcoal gray texture.

KEPCO POWER SUPPLIES

BHK
HIGH VOLTAGE

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE CONVENTIONAL SPEED STRAPPING		OUTPUT IMPEDANCE HIGH SPEED STRAPPING		PRICE	SHIP WGT.	
	VOLTS	mA	VOLTAGE MODE d-c OHMS + SERIES L	CURRENT MODE d-c OHMS + SHUNT C	VOLTAGE MODE d-c OHMS + SERIES L	CURRENT MODE d-c OHMS + SHUNT C		lbs.	kg.
BHK 500–0.4M	0–500	0–400	0.13 Ω + 0.5 μH	5 MΩ + 8 μF	0.13 Ω + 15 μH	5 MΩ + 0.8 μF	$1,067.00	46	20.9
BHK 1000–0.2M	0–1000	0–200	0.5 Ω + 0.5 μH	10 MΩ + 4 μF	0.5 Ω + 15 μH	10 MΩ + 0.4 μF	1,067.00	46	20.9
BHK 2000–0.1M	0–2000	0–100	2.0 Ω + 2.0 μH	20 MΩ + 2 μF	2.0 Ω + 30 μH	20 MΩ + 0.2 μF	1,067.00	46	20.9

BHK power supplies are bench/rack style instruments offering both voltage and current stabilization with automatic crossover between the voltage and current operating modes. Additionally, BHK power supplies can be converted (by internal strapping) for high-speed voltage programming or fast-recovery current stabilization. The voltage and current stabilization channels are each controlled by differential transistor amplifiers driving a high voltage vacuum tube output stage.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE (Internal Sensing)	VOLTAGE AMPLIFIER OFFSETS		VOLTAGE REFERENCE (Internal)
				ΔE_{io}	ΔI_{io}	
SOURCE: 105–125/210–250V a-c		<0.005% or 1 mV(1)	<100 μA	<1 mV	<10 nA	0.001%
LOAD: No load – full load		<0.01% or 1 mV(1)	<100 μA	<1 mV	<10 nA	–
TIME: 8-hours [drift]		<0.01% or 2.0 mV(1)	<0.01% or 20 μA(1)	<50 μV	<50 nA	0.005%
TEMPERATURE: Per °C		<0.01%	<0.05% of I_o max	<100 μV	<50 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:(2) (Conventional mode)	rms	<1 mV	<100 μA	–	–	–
	p-p(3)	<10 mV	<1 mA	–	–	–
UNPROGRAMMED OUTPUT DEVIATION:(2) (High speed mode)	rms	<50 mV	<500 μA	–	–	–
	p-p(3)	<500 mV	<5 mA	–	–	–

(1) Whichever is greater.

(2) One terminal grounded or connected so that the common mode current does not flow through load or (in current mode) through a sensing resistor. Unprogrammed output deviation is the same as "ripple and noise."

(3) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: BHK are full-range, programmable power supplies. They can be programmed or set to any level within their rated range and can be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 500,000 volts/volt.

CONTROL/PROGRAMMING: Output voltage is controlled from the panel by a combination of 10-position decade switch and 10-turn vernier control. This arrangement provides 0.005% resolution yet does not inhibit the ability to sweep program a BHK linearly through its entire range. External control can be exercised by a resistance (1000 ohms per volt) or by a control voltage, delivering 0 to +1 milliampere into the summing junction with respect to the plus (+) output/sense terminal. External signals can be substituted for, or summed with, the internal reference for additional control. Operationally, the BHK is a 3-terminal, unipolar, inverting, d-c power amplifier in which the plus (+) output/sensing terminal serves as common between the output and an external programming signal. For control with respect to the minus (–) output/sensing terminal, see Model NTC–2000. For isolated digital control, see the type SN digital programmers in the *Programming Accessories* section of the Kepco Catalog.

OFFSETS: The equivalent offset voltage and current variations for BHK are tabulated for the effect of source, load, temperature, and time changes. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the combination of feedback rheostat (panel voltage control) and decade step switch. R_i is the input resistor from the reference, E_r. Part of R_r is a trimmer to calibrate the control current at 1 milliampere for exact 1000-ohms-per-volt programming. Internal trimmers are also provided to zero or null the initial offset voltage, E_{io} and offset current, I_{io}.

REFERENCE: A +6.2V ±5%, 1 milliampere reference [referred to the (+) output/sense terminal] is provided for control purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The BHK is equipped with a built-in current sensing and control for precision current stabilization with automatic crossover from and to the voltage stabilization mode.

OUTPUT RANGE: Current is controlled by a 10-turn panel-mounted potentiometer over the range 0.2–100% I_o max.

CONTROL/PROGRAMMING: Current may be externally controlled (programmed) by a remote rheostat (approximately 1000 ohms programs full scale current) or by means of an external signal with respect to the (+) output terminal. The current control circuit is compatible with the Kepco SN digital programming system.

Note: Current can also be controlled with a BHK by using the *voltage channel*, connected so as to sample the drop across an external current sensing resistor in the plus (+) output lead. An external current feedback rheostat will control current from approximately 1 mA to I_o max.

MODE FLAG: A pair of panel lamps indicate whether the voltage channel or the internally-sensed current channel has control of the output. A switched 115V a-c (10 watt maximum) signal is provided at terminals on the rear barrier-strip when BHK is in current mode.

DYNAMICS

BHK can be converted (internally strapped) for either "conventional-speed" operation with energy storage output and feedback capacitors or as a "high speed" unit with only such feedback capacitance (selectable) as is required for stability.

The conventional mode is recommended for most voltage stabilization applications for minimum output noise and best load transient response. The high-speed mode is recommended for maximum voltage agility. This mode would be selected for best response to step or dynamic programming of the output voltage or for fastest recovery time as a current stabilizer into a dynamically changing load. See preface to the High Speed section of Kepco's Catalog for a further discussion of the High Speed models.

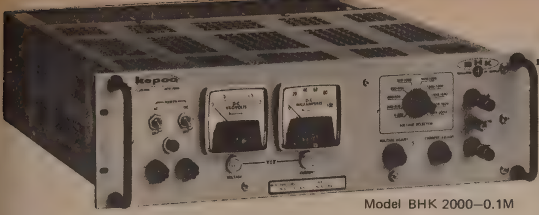
CONVENTIONAL SPEED DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: The time required for stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 μsec.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery is given by the ratio of the current setting to the tabulated output capacitance.

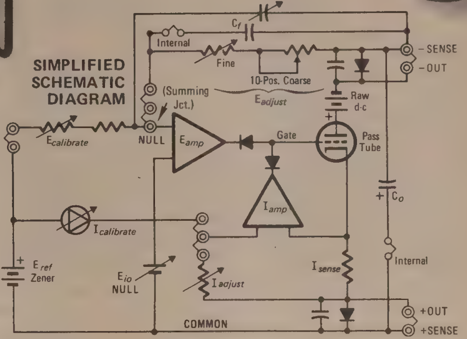
PROGRAMMING SPEED: Conventionally strapped BHK models respond to step programs at a rate determined by the current limit setting, the load resistance and the tabulated output capacitance.

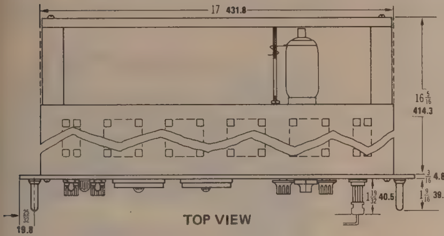
Data and prices subject to change without notice

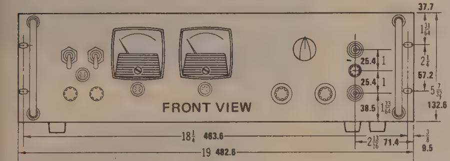


Model BHK 2000–0.1M

SIMPLIFIED SCHEMATIC DIAGRAM

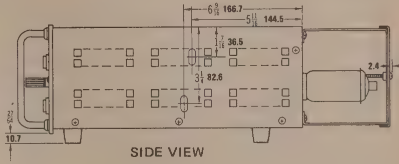

C_f
Internal
Fine
10-Pos. Coarse
E_{adjust}
(Summing Jct.)
– SENSE
– OUT
Raw d-c
Gate
Pass Tube
$E_{calibrate}$
NULL
E_{amp}
I_{amp}
C_o
$I_{calibrate}$
E_{ref} Zener
E_{io} NULL
I_{adjust}
I_{sense}
Internal
COMMON
+OUT
+SENSE


17 431.8
$16\frac{5}{16}$ 414.3
$\frac{3}{16}$ 4.8
$1\frac{19}{32}$ 40.5
$1\frac{9}{16}$ 39.7
$\frac{25}{32}$ 19.8
TOP VIEW


37.7
$1\frac{31}{64}$
25.4 1
$2\frac{1}{4}$ 57.2
25.4 1
$5\frac{7}{32}$ 132.6
38.5 $1\frac{33}{64}$
FRONT VIEW
$18\frac{1}{4}$ 463.6
19 482.6
$2\frac{13}{16}$ 71.4
$\frac{3}{8}$ 9.5

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.


$6\frac{9}{16}$ 166.7
$5\frac{11}{16}$ 144.5
$1\frac{7}{16}$ 36.5
$3\frac{1}{4}$ 82.6
2.4 $\frac{3}{32}$
$\frac{27}{64}$ 10.7
SIDE VIEW

HIGH SPEED DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate-of-change that can be obtained by overdriving or forcing): More than 0.5 volt per microsecond.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 800 pF to 6000 pF.

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: $f\ max = 0.5 \times 10^6/\pi E_{pp}$, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for the conventional and high speed strappings of each BHK model.

LOAD REACTANCE: Strapped for "high speed" operation, BHK power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the BHK to drive most cable or harness capacitance up to this limit without loss of speed. To drive larger capacitances, the BHK should be strapped for conventional-speed use.

GENERAL

SERIES/PARALLEL (strapped for conventional speed dynamics): Units can be connected in series (up to the rated isolation) or in parallel. Terminals are provided for master/slave interconnection.

ISOLATION FROM GROUND: The circuit and output terminals of BHK have no d-c connection to ground and may be floated up to 1000 volts (d-c or peak) off ground. The common-mode current from output to ground is less than 100 microamperes rms, 1 milliampere peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENTS: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption approximately 500 watts. Power factor 0.9. Internally fused. All models equipped with a detachable 3-wire line cord.

TEMPERATURE RATINGS

Storage: –40°C to +85°C.

Operating: –20°C to +55°C. Cooling is by natural convection. Full output is delivered at +55°C; no derating or external heat sink is required.

TERMINALS: D-C output, sensing and control terminals are brought out on a rear-mounted barrier-strip. The front panel carries the d-c output and ground on safety (recessed) connections, for which mating plugs are provided. The strapping connections for conversion from standard to high speed mode (and vice versa) are internal.

METERS: A pair of 2½-inch, 2% meters monitor output voltage and output current.

MOUNTING: BHK power supplies are dimensioned to fit directly in a 19-inch rack or cabinet, occupying 5¼ inches of panel space. Detachable feet are provided for bench-top use.

DIMENSIONS

English measure: $5\frac{7}{32}$"H x 19"W x $16\frac{5}{16}$"D behind panel.

Metric measure: 132.6 H x 482.6 W x 414.3 D mm.

FINISH: The panel is finished in light gray, Color 26440 per Fed. Std. 595.

KEPCO POWER SUPPLIES

BKF

BKF offer stabilized voltage, adjustable over a narrow "slot" and protected by a re-entrant (foldback) current limiter. Designed for powering sensitive logic elements, the BKF models feature a built-in overvoltage crowbar. BKF Group I output is in the 15 and 25 watt range in a package similar to PAT and CCP. BKF Group II have output in the 100 watt range and can be purchased with or without a protective dust cover (Option "C").

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OV TRIP POINT VOLTS (MAX.)	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	MAX. INPUT AMPS at 125 V a-c	PRICE	SHIP WGT. lbs.	SHIP WGT. kg.
BKF 1.25–7	1.25 ±10%	0–7	(1)	1 mΩ + 1 μH	0.7	$179.00	6	2.7
BKF 3.5–5	3.5 ±10%	0–5	(1)	1 mΩ + 1 μH	0.7	179.00	6	2.7
BKF 5–3	5.0 ±10%	0–3	6.5	3 mΩ + 1 μH	0.6	156.00	6	2.7
BKF 5–5	5.0 ±10%	0–5	6.5	1 mΩ + 1 μH	0.9	179.00	6	2.7
BKF 12–1.4	12.0 ±10%	0–1.4	15.3	9 mΩ + 1 μH	0.6	156.00	6	2.7
BKF 12–2.4	12.0 ±10%	0–2.4	15.3	5 mΩ + 1 μH	0.7	179.00	6	2.7
BKF 15–1.2	15.0 ±10%	0–1.2	19.5	13 mΩ + 1 μH	0.6	156.00	6	2.7
BKF 15–2	15.0 ±10%	0–2	19.5	8 mΩ + 1 μH	0.8	179.00	6	2.7
BKF 24–0.8	24.0 ±10%	0–0.8	30.0	30 mΩ + 1 μH	0.6	156.00	6	2.7
BKF 24–1.2	24.0 ±10%	0–1.2	30.0	20 mΩ + 1 μH	0.7	179.00	6	2.7
BKF 28–0.6	28.0 ±10%	0–0.6	35.3	50 mΩ + 1 μH	0.5	156.00	6	2.7
BKF 28–1	28.0 ±10%	0–1	35.3	30 mΩ + 1 μH	0.7	179.00	6	2.7

(1) Adjustable overvoltage trip point is standard. See option "–V" paragraph for specifications.

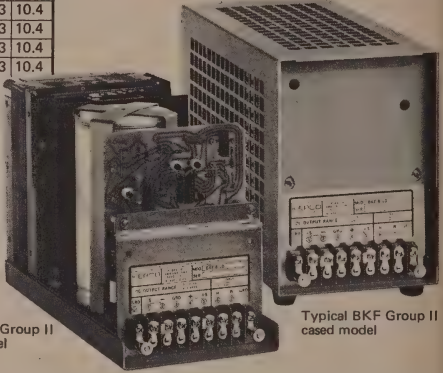
Model BKF 5–5

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OV TRIP POINT VOLTS (MAX.)	OUTPUT IMPEDANCE VOLTAGE MODE d-c OHMS + SERIES L	MAX. INPUT AMPS at 125 V a-c	PRICE (1)	SHIP WGT. lbs.	SHIP WGT. kg.
BKF 5–11	5.0 ±5%	0–11	6.5	0.3 mΩ + 0.5 μH	1.4	$259.00	23	10.4
BKF 8–10	8.0 ±5%	0–10	11.1	0.4 mΩ + 0.5 μH	1.3	259.00	23	10.4
BKF 12–7	12.0 ±5%	0–7	15.3	0.9 mΩ + 0.5 μH	2.0	259.00	23	10.4
BKF 15–6	15.0 ±5%	0–6	19.5	1.3 mΩ + 0.5 μH	2.0	259.00	23	10.4
BKF 24–4	24.0 ±5%	0–4	30.0	3.0 mΩ + 0.5 μH	2.0	259.00	23	10.4
BKF 28–4	28.0 ±5%	0–4	35.3	4.5 mΩ + 0.5 μH	2.2	259.00	23	10.4
BKF 36–3	36.0 ±5%	0–3	45.7	6.0 mΩ + 0.5 μH	2.0	259.00	23	10.4
BKF 48–2.5	48.0 ±5%	0–2.5	59.5	10.0 mΩ + 0.5 μH	2.2	259.00	23	10.4

(1) Uncased. To order a cased BKF II model, add suffix "C" and $15.00 to the price.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE
SOURCE: 105–125/210–250V a-c		<0.05%
LOAD: No load – full load		<0.05% or 2.5 mV(2)
TIME: 8-hours (drift)		<0.05%
TEMPERATURE: Per °C		<0.05%
UNPROGRAMMED OUTPUT DEVIATION:(3) (Ripple and noise)	rms	<0.5 mV
	p-p(4)	<3 mV

(2) Whichever is greater except 5 mV for Model BKF 1.25–7.
(3) One terminal grounded, or connected so that common-mode current does not flow through load.
(4) 20 Hz to 10 MHz.



Typical BKF Group II uncased model

Typical BKF Group II cased model

VOLTAGE STABILIZATION

OUTPUT RANGE: Adjustable ±10% around the rated nominal value.

CONTROL: Voltage control is by a built-in, screwdriver adjustment. There is no provision for external programming control.

REMOTE ERROR SENSING: Separate voltage-sensing terminals permit a 4-wire connection to the load. The BKF will compensate for static load effects up to 0.5 volt drop per power lead. An additional 1 volt is provided in the output for this purpose.

CURRENT LIMITING

A re-entrant (foldback) output limiter operates for loads outside of the operating range. The point at which limiting occurs is adjustable from 10% to 110% of the power supply's current ratings.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:

The time required for the stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 microseconds (Current step, 25–100% and 100–25%).

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by thy load effect. See the *Applications Notes* in the Kepco Catalog. At frequencies above the stabilizer's cutoff, the impedance increase with frequency becomes asymptotic to a characteristic series inductance. The model table gives these values for each BKF model.

OVERVOLTAGE CROWBAR

All models are equipped with an independent voltage-sensing circuit to trip an SCR crowbar in the event of excess voltage. The crowbar trip voltage is normally fixed and is tabulated for each model.

OVERVOLTAGE CROWBAR SPECIFICATIONS:

Trigger time: Less than 10 microseconds.

Reset: Interrupt source power and reduce excess voltage.

Adjustable trip point (optional, add suffix "–V" to the model number): This option provides an adjustment of the crowbar's trip voltage from −10% E_o nominal to +20% E_o nominal.

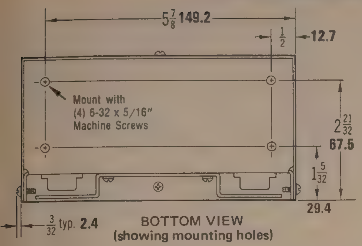
Price for "–V" option: Add $15.00 to the price.

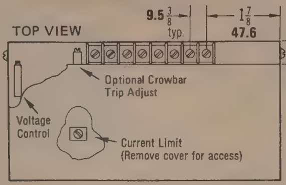
Threshold: Allow 5% of E_o max. or 0.5 volt, whichever is greater. Crowbar setting should account for a −4% warm-up settling effect.

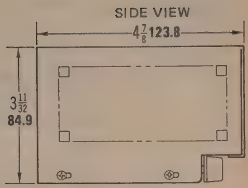
Temperature effect (on crowbar's trip voltage): −0.1% per °C.

Data and prices subject to change without notice

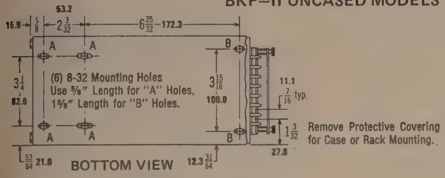
BKF–I CASED MODELS

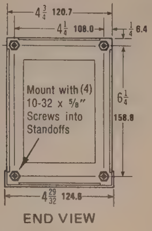

5 7/8 149.2
1/2 12.7
Mount with (4) 6-32 x 5/16" Machine Screws
2 21/32 67.5
1 5/32 29.4
3/32 typ. 2.4
BOTTOM VIEW (showing mounting holes)

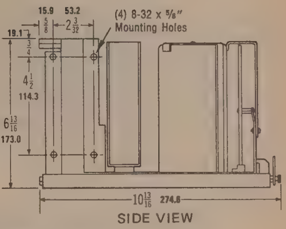

TOP VIEW
9.5 3/8 typ.
1 7/8 47.6
9/16 14.3
Optional Crowbar Trip Adjust
Voltage Control
Current Limit (Remove cover for access)


SIDE VIEW
4 7/8 123.8
3 11/32 84.9

BKF–II UNCASED MODELS


53.2
15.9 5/8 2 3/32
6 25/32 172.3
3 1/4 82.6
(6) 8-32 Mounting Holes Use 5/8" Length for "A" Holes, 1 3/8" Length for "B" Holes.
3 15/16 100.0
11.1 7/16 typ.
1 3/32 27.8
Remove Protective Covering for Case or Rack Mounting.
53/64 21.8
BOTTOM VIEW
12.3 31/64


4 3/4 120.7
4 1/4 108.0
1/4 6.4
Mount with (4) 10-32 x 5/8" Screws into Standoffs
6 1/4 158.8
4 29/32 124.6
END VIEW

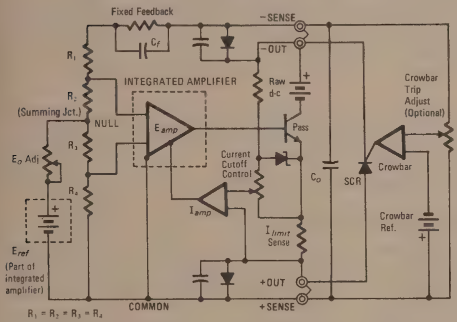

15.9 53.2
5/8 2 3/32
(4) 8-32 x 5/8" Mounting Holes
19.1 3/4
4 1/2 114.3
6 13/16 173.0
10 13/16 274.6
SIDE VIEW

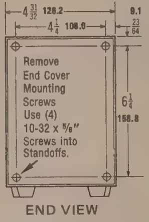
OUTLINE DIMENSIONAL DRAWINGS

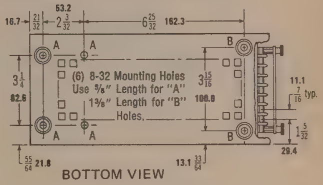
Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.

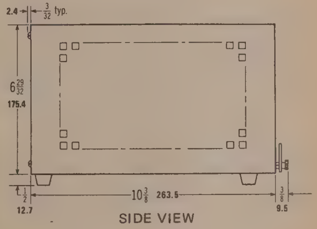
SIMPLIFIED SCHEMATIC DIAGRAM


Fixed Feedback
Cf
–SENSE
–OUT
R1
R2
(Summing Jct.)
INTEGRATED AMPLIFIER
NULL
Eamp
Raw d-c
Pass
Crowbar Trip Adjust (Optional)
R3
Eo Adj
Current Cutoff Control
Co
SCR
Crowbar
R4
Iamp
Crowbar Ref.
Eref (Part of integrated amplifier)
Ilimit Sense
+OUT
COMMON
+SENSE
R1 = R2 = R3 = R4


4 31/32 126.2
9.1
4 1/4 108.0
23/64
Remove End Cover Mounting Screws Use (4) 10-32 x 5/8" Screws into Standoffs.
6 1/4 158.8
END VIEW


53.2
16.7 21/32 2 3/32
6 25/32 162.3
3 1/4 82.6
(6) 8-32 Mounting Holes Use 5/8" Length for "A" 1 3/8" Length for "B" Holes.
3 15/16 100.0
11.1 7/16 typ.
1 5/32 29.4
55/64 21.8
13.1 33/64
BOTTOM VIEW

BKF–II CASED MODELS


2.4 3/32 typ.
6 29/32 175.4
1/2 12.7
10 3/8 263.5
3/8 9.5
SIDE VIEW

all KEPCO products are backed by a firm 5-Year Warranty

GENERAL

ISOLATION FROM GROUND: The circuit of BKF is isolated from its case and ground. It may be placed in series with up to 500 volts d-c (or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SERIES/PARALLEL: There is no provision for series or parallel operation.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power must be hard-wired to the provided terminals. Internally fused. Source current tabulated at 125V a-c. Power factor 0.9.

TEMPERATURE RATINGS

Storage: -40°C to +85°C.

Operating: 0°C to +55°C. Full output current rating to +55°C. No derating. Cooling is by natural convection. No external heat sink is required.

STANDARDS: BKF Group I models are designed and tested in accord with the NEMA standard for stabilization power supplies, d-c output, Publication No. PY-1-1972. Additionally, BKF Group I models are recognized under the component program of Underwriters' Laboratories, Inc., UL478 and UL114.

TERMINALS: All input, output and sensing connections are made via a single multiterminal barrier-strip.

MOUNTING: The BKF models will mount to your chassis using 6-32 hardware into recessed captive nuts.

19-inch rack mounting adapter panels include:

BKF–I MODELS	BKF–II MODELS
RA 26–1 for a single module.	RA 25–1 for a single module.
RA 27–2 for two modules.	RA 8–2 for two modules.
RA 28–4 for four modules.	RA 9–3 for three modules.

Rack adapters are $15.00 each. Please refer to the *Hardware* section for a description.

DIMENSIONS

BKF–I MODELS

English measure: $3\frac{11}{32}$"H x $6\frac{3}{8}$"W x $4\frac{7}{8}$"L.

Metric measure: 84.9 H x 161.9 W x 123.8 L mm.

BKF–II MODELS

English measure:

Uncased module: $6\frac{13}{16}$"H x $4\frac{29}{32}$"W x $10\frac{13}{16}$"L.

Cased module: $6\frac{29}{32}$" H x $4\frac{31}{32}$"W x $10\frac{3}{8}$"L.

Metric measure:

Uncased module: 173.0 H x 124.6 W x 274.6 L mm.

Cased module: 175.4 H x 126.2 W x 263.5 L mm.

KEPCO POWER SUPPLIES

BOP
BIPOLAR OPERATIONAL

The Bipolar Operational Power Supply combines the capabilities of fast-programmable power supplies like the OPS, with a bi-directional complementary-symmetry output stage that can respond in either direction from zero. The BOP is, in effect, a large, d-c coupled, inverting power amplifier. It is made in a bench/system rack form with a single control channel equipped with a patch-board panel for easy access to the control functions. For a modular version, suited to OEM applications, please see the BOP listings in the *Modular* section of the Kepco Catalog.

MODEL	d-c OUTPUT RANGE VOLTS	AMPS	CURRENT SINK	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C	SOURCE CURRENT at 125V a-c	SIZE	PRICE	SHIP WGT. lbs.	kg.
BOP 15–20M	+15 to −15	+20 to −20	±4A	0.2 mΩ + 25 μH	1750 Ω + 10.0 μF	8.0A	C	$1,331.00	94	42.7
BOP 36–1.5M	+36 to −36	+1.5 to −1.5	±0.3A	5 mΩ + 10 μH	23 kΩ + 0.22 μF	1.6A	A	649.00	27	12.3
BOP 36–5M	+36 to −36	+5 to −5	±1A	1.5 mΩ + 15 μH	7 kΩ + 0.75 μF	4.6A	B	924.00	50	22.7
BOP 72–1.5M	+72 to −72	+1.5 to −1.5	±0.3A	10 mΩ + 20 μH	23 kΩ + 0.17 μF	3.2A	C	1,392.00	64	29.1
BOP 72–5M	+72 to −72	+5 to −5	±1A	3 mΩ + 30 μH	7 kΩ + 0.56 μF	9.2A	C	1,826.00	94	42.7

(1) External current sensing using a 1-volt current sensing sample.

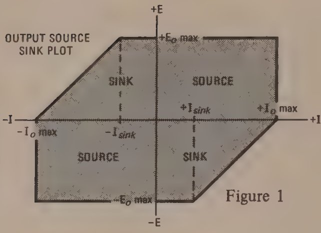


Figure 1

INFLUENCE QUANTITY		AMPLIFIER OFFSETS VOLTAGE ΔE_{io}	CURRENT ΔI_{io}	REFERENCES 6.2V ± 5%
SOURCE: 105–125/210–250V a-c		<0.1 mV	<10 nA	0.005%
LOAD: No load – full load		<1.0 mV	<10 nA	–
TIME: 8-hours [drift]		<0.1 mV	<50 nA	0.005%
TEMPERATURE: Per °C		<0.08 mV	<50 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:(3) (Ripple and noise)	rms	<0.01% of E_o — or 3 mV(2)		–
	p-p(4)	<0.05% of E_o — or 15 mV(2)		–

(2) Whichever is greater.

(3) One terminal grounded, or connected so that the common mode current does not flow through the load or (in current mode) through a sensing resistor.

(4) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: The unique character of the BOP, ability to operate with either positive or negative output, bidirectionally, as a source, is enhanced by its ability to function as a limited *sink*. BOP is a *"sink"* when the polarity of its voltage does not agree with the direction of its current–it absorbs energy.

If voltage and current are plotted orthogonally, as in Figure 1, quadrants I and III are the source quadrants, II and IV are sink quadrants. The operating region of a BOP is defined by the shaded portion of the output characteristic.

CONTROL/PROGRAMMING: BOP models have a front panel patch board with a built-in vernier voltage feedback rheostat and bipolar reference. Output voltage is controlled by controlling the reference potentiometer from the plus (+) to the minus (−) reference through zero. The output voltage is proportioned to the selected reference by the feedback rheostat. The patch board construction makes it easy to sum or substitute other potentials at the input and to substitute external feedback to stabilize current or such physical phenomena–heat, speed, force, or electrochemical action.

OFFSETS: The equivalent offset voltage and current variations for BOP are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the main control channel's voltage offset (E_{io}) and current offset (I_{io}) can be nulled (zeroed) by built-in trimmers.

REFERENCES: A pair of ±6.2V ±5%, 1 milliampere references referred to the common/sense terminal are provided for offsetting or biasing purposes.

GAIN: The open-loop d-c gain is in excess of 35,000 volts/volt.

CURRENT STABILIZATION

The BOP is equipped with a pair of built-in current-sensing and feedback arrangements for protective limiting. They are set for approximately 110% of the rated current in both directions and are not adjustable.

For the precision control of current, bidirectionally, the feedback to the main control channel can be reconfigured so as to sample the drop across an external current-sensing resistor in the common output lead.

DYNAMICS

Each BOP is equipped with an internal, fast/slow selector switch. The slow position restricts the bandwidth so that the BOP can drive reactive loads without restriction. The slow position is recommended for low frequency or d-c application to discrimminate against higher frequency pick-up noise. In the fast position, load capacitance should be restricted to less than 0.01 microfarad to avoid oscillation with near 100% feedback.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. As a voltage stabilizer, the d-c and low frequency value is given by the load effect. At frequencies above the stabilizer's cutoff, the impedance increase with frequency becomes asymptotic to the tabulated characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to the tabulated characteristic shunt capacitance. The table gives these values for each BOP model.

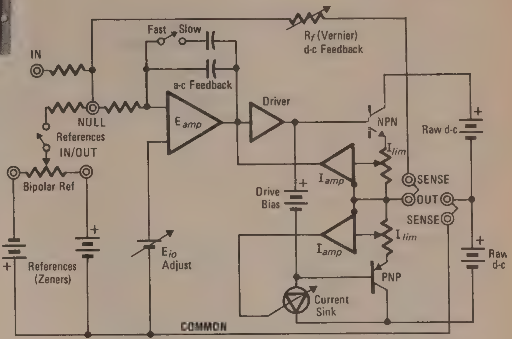
Data and prices subject to change without notice

Model BOP 15–20M
(Size C—"full-rack")

Model BOP 36–1.5M
(Size A—"half-rack")

all KEPCO
products are
backed by a firm
5-Year
Warranty

SIMPLIFIED SCHEMATIC DIAGRAM



DISTORTION: For a small signal (2 volts peak-to-peak, no load), harmonic distortion is less than 0.5%.

BANDWIDTH/PROGRAMMING SPEED: The dynamics of the BOP output may be expressed in both the time domain (as its response to a step-program) or in the frequency domain (bandwidth for large and small signals). These figures are tabulated below.

a-c SPECIFICATION	MODE SWITCH	BOP 15–20M	BOP 36–1.5M	BOP 36–5M	BOP 72–1.5M	BOP 72–5M
SMALL SIGNAL FREQUENCY RESPONSE frequency at which the open loop gain becomes unity	FAST SLOW	300 kHz 10 kHz	300 kHz 30 kHz	300 kHz 30 kHz	300 kHz 30 kHz	300 kHz 30 kHz
LARGE SIGNAL FREQUENCY RESPONSE frequency at which the fully modulated, fully loaded output reaches 3% harmonic distortion	FAST SLOW	25 kHz 1 kHz	30 kHz 3 kHz	30 kHz 3 kHz	20 kHz 2 kHz	20 kHz 2 kHz
AMPLIFIER SLEWING RATE	FAST SLOW	2V/μsec. 0.1V/μsec.	7V/μsec. 0.7V/μsec.	7V/μsec. 0.7V/μsec.	9V/μsec. 0.9V/μsec.	9V/μsec. 0.9V/μsec.
PROGRAMMING TIME CONSTANT input/feedback set for gain = 10	FAST SLOW	12 μsec. 250 μsec.	12 μsec. 150 μsec.	12 μsec. 150 μsec.	12 μsec. 150 μsec.	12 μsec. 150 μsec.
VOLTAGE RECOVERY TIME CONSTANT for step-load current	FAST SLOW	50 μsec. 500 μsec.	50 μsec. 500 μsec.	50 μsec. 500 μsec.	50 μsec. 500 μsec.	50 μsec. 500 μsec.
CURRENT RECOVERY TIME CONSTANT for step-load voltage	FAST SLOW	50 μsec. 1 msec.	50 μsec. 500 μsec.	50 μsec. 500 μsec.	50 μsec. 500 μsec.	50 μsec. 500 μsec.

GENERAL

SERIES/PARALLEL: Units may be connected in series for added voltage, using a master/slave interconnection for shared voltage. They cannot be used in parallel.

ISOLATION FROM GROUND: The circuit and output terminals of BOP have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes, peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENTS: Units are factory-wired for 105–125V a-c, 50–65 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–65 Hz. The two ±36V BOP models (in a half-rack package) are protected by a fuse. The two ±72V models and the ±15V unit (in the full-rack size) are protected by a circuit breaker. All models incorporate a low-source voltage monitor which trips an internal clamp at turn-off (precluding overshoot). A timing circuit delays reapplication of source power for approximately 2 seconds.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +65°C. Cooling is by built-in, sealed-bearing blowers exhausting to the rear. Full output current is delivered at +65°C. No derating, or external heat sink is required.

STANDARDS: BOP models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: BOP models are equipped with a 10-terminal patch board through which convenient access is had to the signal input, output, feedback, and reference points. The front panel connections are duplicated on a rear-mounted barrier-strip.

METERS: Half-rack models use a single 2-inch recessed meter for reading d-c volts and amperes and a-c (rms) volts. Accuracy is ±3%. The full-rack models have independent 3-inch recessed meters with ±2% accuracy. Meters are designated by the suffix "–M." To order an unmetered model (without the patch panel and the feedback and reference potentiometers), see the BOP listing in the *Modular* Section of the Kepco Catalog.

MOUNTING: The "full-rack" sized models have accessory flanges for direct installation in standard 19-inch racks. Half-rack sized models may be mounted in RA–24 or RA–32.

DIMENSIONS:

English measure:

Size A: 5 7/32"H x 8 11/32"W x 12 7/8"D*
Size B: 5 7/32"H x 8 11/32"W x 17 3/8"D*
Size C: 5 7/32"H x 16½"W** x 17 1/64"D*

Metric measure:

Size A: 132.6 H x 211.2 W x 327.0 D* mm.
Size B: 132.6 H x 211.2 W x 441.3 D* mm.
Size C: 132.6 H x 419.1 W** x 432.2 D* mm.

*behind panel
**with "ears" standard 19" panel width.

FINISH: *Panel:* Light gray color 26440, Fed. Std. 595.
Case: Charcoal gray texture.

Data and prices subject to change without notice

KEPCO POWER SUPPLIES

CC
CURRENT STABILIZER

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE CURRENT MODE	PRICE	SHIP WGT.	
	AMPS	VOLTS	d-c OHMS + SHUNT C		lbs.	kg.
CC 7–2M	0–2	0–7	70 kΩ + 8.0 μF	$266.00	8	3.6
CC 15–1.5M	0–1.5	0–15	200 kΩ + 3.0 μF	266.00	8	3.6
CC 21–1M	0–1	0–21	420 kΩ + 2.0 μF	266.00	8	3.6
CC 40–0.5M	0–0.5	0–40	1.6 MΩ + 1.0 μF	266.00	8	3.6
CC 72–0.3M	0–0.3	0–72	4.8 MΩ + 0.6 μF	266.00	8	3.6
CC 100–0.2M	0–0.2	0–100	10 MΩ + 0.4 μF	266.00	8	3.6

The CC plug-in power supply modules are current stabilizers with built-in, dual-range, current-sensing resistors and 10-turn panel-mounted current control. The CC module has a single control channel with an I-C front end for low offsets and exceptional stability. The CC offers a full complement of meters and controls on a compact 1/6th rack width panel. They can be installed in rack housings RA 22–6A or RA–32 for systems use, or in a variety of bench-style enclosures.

INFLUENCE QUANTITY		OUTPUT EFFECTS CURRENT MODE
SOURCE: 105–125/210–250V a-c		<0.0005% or 0.2 μA(1)
LOAD: 10% load – 100% load		<0.005% or 2 μA(1)
TIME: 8-hours [drift]		<0.02% or 2 μA(1)
TEMPERATURE: Per °C		<0.01%
UNPROGRAMMED OUTPUT DEVIATION:(2) (Ripple and noise)	rms	<0.02% of selected scale
	p-p(3)	<0.1% of selected scale

(1) Whichever is greater.

(2) One terminal grounded or connected so that the common-mode current does not flow through the load or through the sensing resistor.

(3) 20 Hz to 10 MHz.

CURRENT CONTROL CHANNEL

OUTPUT RANGE: CC current stabilizers have two output ranges selected by a panel-mounted switch 0–100% I_o or 0–10% I_o. They can be set or programmed to any level within the selected range and can be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output current is controlled by a panel-mounted, 10-turn rheostat. External control can be exercised by a resistance (0–10,000 ohms controls the current through the selected range) or by a control voltage delivering 0–100 microamperes. Control is fully operational with the CC power supplies functioning as inverting d-c power amplifiers with current-sensitive feedback to the summing junction. Their plus (+) output terminal is common.

For isolated digital control, see the type SN digital programmers in the *Programming Accessories* section of Kepco's Catalog.

VOLTAGE LIMITING

The maximum open circuit voltage limit of the CC current stabilizer is fixed at approximately 150–200% of the rated load compliance voltage.

DYNAMICS

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:
The current recovery is an exponential, given by the RC product of the load and tabulated output capacitance—or is a slope defined by the ratio of current setting to output capacitance.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. At frequencies above the stabilizer's cutoff, the impedance decrease with frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each CC model.

LOAD REACTANCE: Fast-slewing power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in roll-off control (lag) networks will allow the CC to drive most cable or harness capacitances up to this limit. When driving major inductive loads, a series diode is recommended for the protection of the CC.

GENERAL

SERIES/PARALLEL: Parallel operation of current sources may be made without restriction. CC power supplies are not equipped for series operation.

ISOLATION FROM GROUND: The circuit of the CC current stabilizer is isolated from its case and ground. It may be placed in series with up to 500 volts d-c (or peak) off ground. Common-mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption approximately 50 watts; power factor 0.9. Internally fused. A pilot light and on/off switch are provided on the panel.

TERMINALS: Source power, d-c output, sense, and control connections terminate on a male PC connector that mates with the built-in socket in the bench housings or with the rack housings (see *Hardware* section of Kepco's Catalog). A pair of output terminals are provided on the front panel.

STANDARDS: CC modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

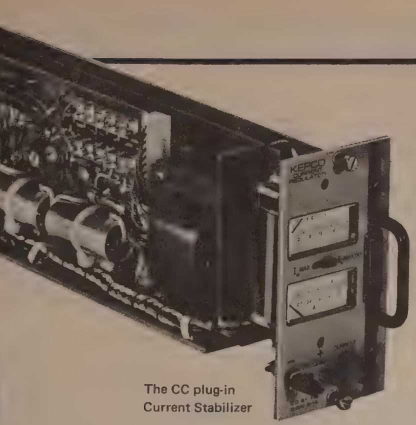
TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Cooling is by natural convection. Full output is delivered at +71°C. No derating or external heat sink is required.

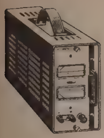
METERS: Voltage and current are displayed on a pair of recessed 2-inch ±3% meters. Current is measured in two ranges corresponding to the full scale selector. Both meters are driven from an isolation amplifier so that they do not load the output.

Data and prices subject to change without notice

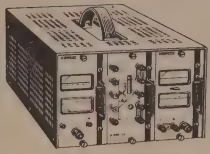


The CC plug-in Current Stabilizer

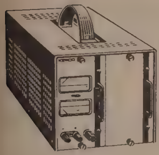
all KEPCO products are backed by a firm 5-Year Warranty



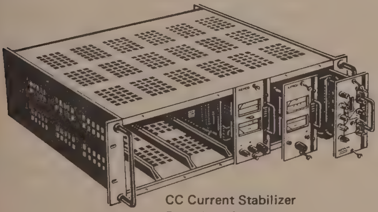
CC Current Stabilizer Mounted in CA-3 single unit case



CC Current Stabilizer Mounted (along with OPS II and PCX–MAT) in CA-5 triple case



CC Current Stabilizer Mounted in CA-4 dual case



CC Current Stabilizer Plugs into 6-unit RA 22–6A Rack Adapter

MOUNTING: The CC current stabilizer fits a single slot in the 6-unit housing, RA 22–6A, the intermix housing, RA–32, and the three bench housings, CA–3, CA–4 and CA–5. They slide in on the provided rails, obtain power and deliver their output to the mating connector.

Model RA 22–6A Rack Adapter(1)	Price: $99.00.
Model RA–32 Rack Adapter(1)	Price: $75.00.
Model CA–3 Case	Price: $25.00.
Model CA–4 Case	Price: $35.00.
Model CA–5 Case	Price: $45.00.

(1) Includes all PC–2 connectors.

DIMENSIONS

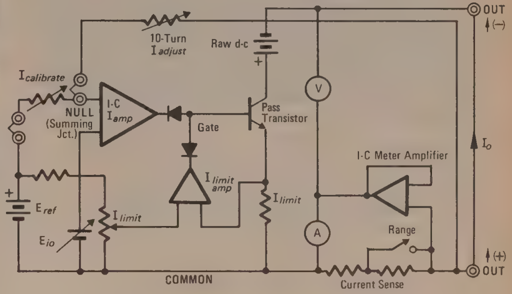
English measure: 5 7/32" H x 2 25/32" W x 14 15/16" D. (behind panel)

Metric measure: 132.6 H x 70.6 W x 379.4 D mm.

See outline drawings.

FINISH: *Panel:* Gray, Color 26440, Fed Std. 595.

SIMPLIFIED SCHEMATIC DIAGRAM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I-C Meter Amplifier
I limit amp
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Range
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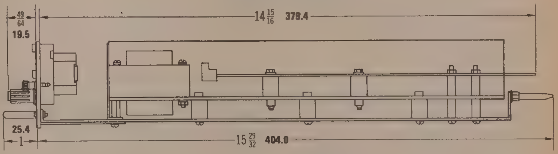
OUT
COMMON
Current Sense

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.
Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.
Panels: Per Mil. Std. 189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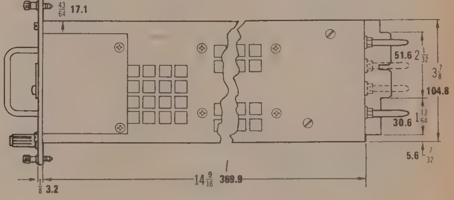
379.4
25.4
1
15 29/32
404.0

TOP VIEW


43/64
17.1
51.6
2 1/32
3 7/8
104.8
30.6
1 13/64
5.6
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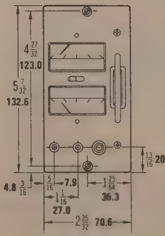
369.9
1/8
3.2

SIDE VIEW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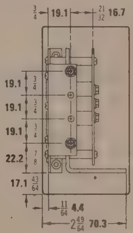
2 25/32
70.6

FRONT VIEW


3/4
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21/32
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19.1
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19.1
3/4
19.1
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22.2
7/8
17.1
43/64
11/64
4.4
2 49/64
70.3

REAR VIEW.

KEPCO™ POWER SUPPLIES

CCP
MODULAR

MODEL	d-c OUTPUT RANGE AMPS	VOLTS	OUTPUT IMPEDANCE CURRENT MODE d-c OHMS + SHUNT C	PRICE	SHIP WGT. lbs.	kg.
CCP 7–2	0–2	0–7	70 kΩ + 8 μF	$193.00	6	2.7
CCP 15–1.5	0–1.5	0–15	200 kΩ + 3 μF	193.00	6	2.7
CCP 21–1	0–1	0–21	420 kΩ + 2 μF	193.00	6	2.7
CCP 40–0.5	0–0.5	0–40	1.6 MΩ + 1 μF	193.00	6	2.7
CCP 72–0.3	0–0.3	0–72	4.8 MΩ + 0.6 μF	193.00	6	2.7
CCP 100–0.2	0–0.2	0–100	10 MΩ + 0.4 μF	193.00	6	2.7

The Kepco CCP is a current stabilized, d-c power module equipped with an internal current-sensing resistance. It is normally controlled or programmed by an external variable resistance, but may also use an optional internal control. A built-in, adjustable voltage limiter sets the maximum open circuit voltage. The current control channel employs an integrated circuit front end for excellent short-term stability. This channel features capacitorless output filtering so that the CCP may drive dynamically varying loads without the transients generated by large shunt capacitances.

INFLUENCE QUANTITY		OUTPUT EFFECTS CURRENT MODE
SOURCE: 105–125/210–250V a-c		<0.0005% or 0.2 μA(1)
LOAD: 10% load – 100% load		<0.005% or 2 μA(1)
TIME: 8-hours [drift]		<0.02% or 2 μA(1)
TEMPERATURE: Per °C		<0.01%
UNPROGRAMMED OUTPUT DEVIATION:(2) (Ripple and noise)	rms	<0.02% of I_o max.
	p-p(3)	<0.1% of I_o max.

(1) Whichever is greater.

(2) One terminal grounded or connected so that the common-mode current does not flow through the load or through the sensing resistor.

(3) 20 Hz to 10 MHz.

CURRENT CONTROL CHANNEL

OUTPUT RANGE: CCP current stabilizers can be programmed (or set with the optional current control trimmer, option "–P") anywhere in the range 0–100% I_o. They may be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output current is operationally controlled by resistance or external voltage signals. The sample voltage across the internal current-sensing resistor is approximately 1 volt at rated maximum current. The external resistance needed for full range control is 0–1000 ohms through which passes approximately 1 milliampere. The option "–R" provides a means of calibrating the control current at 1.0 milliampere. The option "–P" provides for a built-in current control rheostat. For control near zero current, the zeroing option "–E" is recommended.

For isolated digital control, see the type SN Digital Programmers in the *Programming Accessories* section of the Kepco Catalog.

REFERENCE: + 6.2V d-c ±5% with respect to the plus (+) error-sense terminal, capable of supplying up to 1 milliampere.

VOLTAGE LIMITING

OUTPUT RANGE: Adjustable from 0.1 volt to 110% of the rated maximum voltage.

CONTROL/PROGRAMMING: The voltge limit is controlled normally by an internal rheostat. An external rheostat (approximately 1000 ohms per volt) may be connected in series with the internal trimmer in order to control the voltage limit externally.

REMOTE ERROR SENSING: Separate error-sensing terminals are provided for the voltage limiting circuit so that you can establish the maximum voltage at a remotely located load irrespective of the voltage drop in the connecting wires (up to 0.5 volt maximum per wire).

DYNAMICS

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:
The current recovery is an exponential, given by the RC product of the load and tabulated output capacitance—or is a slope defined by the ratio of current setting to output capacitance.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. At frequencies above the stabilizer's cutoff, the impedance decrease with frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each CCP model.

LOAD REACTANCE: Fast-slewing power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the CCP to drive most cable or harness capacitances up to this limit. When driving major inductive loads, a series diode is recommended for the protection of the CCP.

GENERAL

SERIES/PARALLEL: Parallel operation of current sources may be made without restriction. CCP power supplies are not equipped for series operation.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power must be hard-wired to the provided terminals. Internally fused; power consumption approximately 60 watts; power factor 0.9.

ISOLATION FROM GROUND: The circuit of the CCP module is isolated from its case and ground. It may be placed in series with up to 500 volts d-c (or peak) off ground. Common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz

TEMPERATURE RATINGS

Storage: -40° to +85°C.

Operating: -20°C to +65°C. Full output is delivered at +65°C without derating. Cooling is by natural convection; no external heat sink is required.

STANDARDS: CCP modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: All input, output and control connections are made via a multiterminal barrier-strip.

Data and prices subject to change without notice

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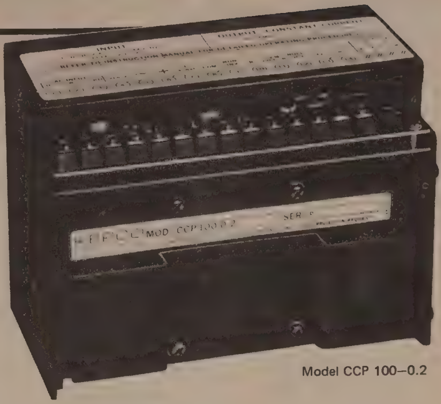
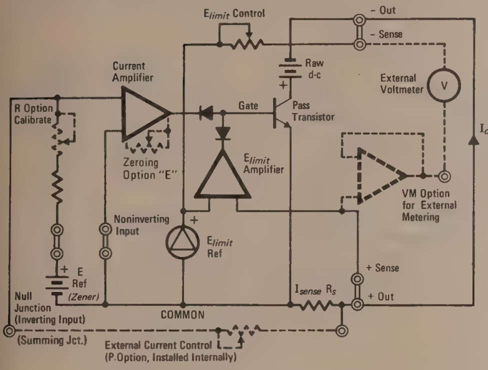

Model CCP 100–0.2



E*limit* Control
– Out
– Sense
Raw d-c
Current Amplifier
External Voltmeter
V
R Option Calibrate
Gate
Pass Transistor
I*o*
Zeroing Option "E"
E*limit* Amplifier
VM Option for External Metering
Noninverting Input
E*limit* Ref
+ Sense
E Ref (Zener)
Null Junction (Inverting Input)
I*sense* R*s*
+ Out
COMMON
(Summing Jct.)
External Current Control (P.Option, Installed Internally)

SIMPLIFIED SCHEMATIC DIAGRAM

MOUNTING: The CCP will mount to your chassis using 6-32 hardware into recessed captive nuts. 19-inch rack mounting adapter panels include:
- RA 26–1 for a single module.
- RA 27–2 for two modules.
- RA 28–4 for four modules.
- Rack adapters are $15.00 each.

DIMENSIONS

English measure: 3 11/32"H x 6 3/8"W x 4 7/8"L.

Metric measure: 84.9 H x 161.9 W x 123.8 L mm.

See outline drawings.

FINISH: Black anodized aluminum. The rack adapter panels are painted light gray Color 26440, Fed. Std. 595.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–E": Offset voltage nulling: This control zeros the fixed part of the current channel control amplifier voltage offset; extends the control setting range to zero. Price: $10.00.

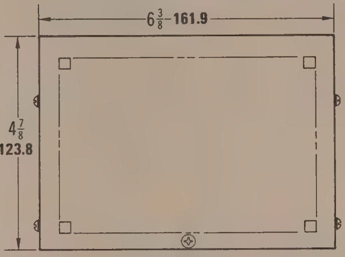
Suffix "–P": Built-in output current control: An internal 1000-ohm rheostat for local control of the output current. Price: $25.00.

Suffix "–R": Calibration adjustment: A ±10% trimmer permits calibration of the control current at 1 milliampere, so that current is controlled by exactly 1000 ohms, full scale. Price: $10.00.

Suffix "–VM": Remote voltage monitor: This option provides a voltage repeater amplifier to reproduce the load's voltage for metering purposes (so that an external meter does not act as a shunt load) delivers 0–1 milliampere. Price: $15.00.

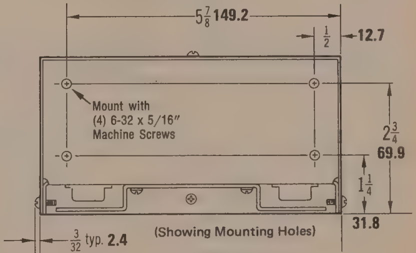
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in Inches, dimensions in bold face type are in millimeters.
Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.



6 3/8 – **161.9**
4 7/8
123.8

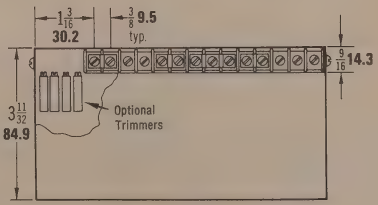
REAR VIEW



5 7/8 **149.2**
1/2 **12.7**
Mount with (4) 6-32 x 5/16" Machine Screws
2 3/4
69.9
1 1/4
31.8
3/32 typ. **2.4**

(Showing Mounting Holes)

BOTTOM VIEW



1 3/16
30.2
3/8 **9.5**
typ.
9/16 **14.3**
3 11/32
84.9
Optional Trimmers

TOP VIEW

KEPCO POWER SUPPLIES

CPS

COMPUTER I-C

CPS power supplies are especially designed for driving digital logic, RTL, DTL, TTL, ECL, MOS. . . . They feature exceptional stability and a low noise output, provided by the integrated front end on the *linear* voltage control channel. Load current is limited and adjustable. An integral overvoltage crowbar is standard on all CPS models. CPS units are also available unmetered, in modular form for OEM's.

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		MAX. INPUT AMPS at 125 V a-c	SIZE	PRICE	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C				lbs.	kg.
CPS 6–10M	0–6	0–10	30 μΩ + 1 μH	50 kΩ + 3 kμF	2.0	¼	$461.00	19	8.6
CPS 6–22M	0–6	0–22	14 μΩ + 1 μH	23 kΩ + 5.8 kμF	4.2	½	750.00	42	19.1
CPS 6–45M	0–6	0–45	7 μΩ + 1 μH	11 kΩ + 8 kμF	9.0	½	867.00	56	25.4
CPS 6–90M	0–6	0–90	3.5 μΩ + 1 μH	5.5 kΩ + 17.6 kμF	15.7	Full	1,329.00	103	46.8
CPS 15–6M	0–15	0–6	125 μΩ + 1 μH	83 kΩ + 1 kμF	2.1	¼	461.00	19	8.6
CPS 15–12M	0–15	0–12	63 μΩ + 1 μH	42 kΩ + 2.9 kμF	4.0	½	750.00	42	19.1
CPS 15–25M	0–15	0–25	30 μΩ + 1 μH	20 kΩ + 4.5 kμF	8.4	½	867.00	56	25.4
CPS 15–50M	0–15	0–50	15 μΩ + 1 μH	10 kΩ + 12 kμF	16.6	Full	1,329.00	103	46.8

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE (1)	OFFSET VOLTAGE ΔE_{io}	OFFSET CURRENT ΔI_{io}	VOLTAGE REFERENCE (INTERNAL)
SOURCE: 105–125/210–250V a-c		<0.0005%	<0.005%	<10 μV	<2 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.2 mV(2)	<0.01%	<200 μV	<5 nA	–
TIME: 8-hour [drift]		<0.01% or 1 mV(2)	<0.02%	<20 μV	<2 nA	0.005%
TEMPERATURE: Per °C(3)		<0.01%	<0.02%	<20 μV	<5 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:(4) (Ripple and noise)	rms	<0.2 mV	<0.02% of I_o max	–	–	–
	p-p(5)	<2.0 mV	<0.2% I_o max	–	–	–

(1) External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.

(2) Whichever is greater.

(3) Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.01% per °C externally sensed current mode. See option "–T."

(4) One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor.

(5) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: CPS power supplies may be adjusted or programmed to any level within their rated range and may be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output voltage is controlled continuously throughout the range by a panel-mounted, 10-turn control. External control can be exercised by resistance (1000 ohms per volt—calibrated by built-in control) or by an external control voltage.

For isolated digital control (with memory) see the type SN digital programmer in the *Programming Accessories* section of the Kepco Catalog. Control is fully operational with CPS functioning as an operational power amplifier with its plus output sensing terminal common. For control with respect to the negative output sense terminal, see Model NTC–200.

OFFSETS: The equivalent offset voltage and current variations for the CPS's voltage control channel are tabulated for the effect of source changes, load, temperature and time. Their effect on the output may be calculated from the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the external feedback rheostat and R_i is the input resistor from the reference, E_r. Option "–E" provides a control for zeroing the fixed or initial part of the offset voltage, E_{io}.

GAIN: The open-loop d-c gain is in excess of 0.5×10^6 volts/volt.

REFERENCE: +6.2V d-c ±5% with respect to the plus (+) error sense terminal, capable of supplying up to 1 milliampere.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The CPS power supplies are equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by a panel-mounted multiturn control over the range 10% to 105% of I_o maximum. For the precision control of current, the voltage control channel may be reconnected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. Using an external current feedback rheostat, the current range is 1 milliampere to 100% I_o max. Models equipped with option "–E" can be controlled from approximately 1 microampere to 100% I_o max.

Note: The range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:

The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 μs.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:

As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the OPS Groups V, VI, VII and VIII in the Kepco Catalog.

PROGRAMMING SPEED: The rate at which CPS responds to a step program is determined by the current limit setting, the load resistance and the tabulated output capacitance. For fast programming response units, please see the OPS Groups V, VI, VII and VIII in the *High Speed* section of the Kepco Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c

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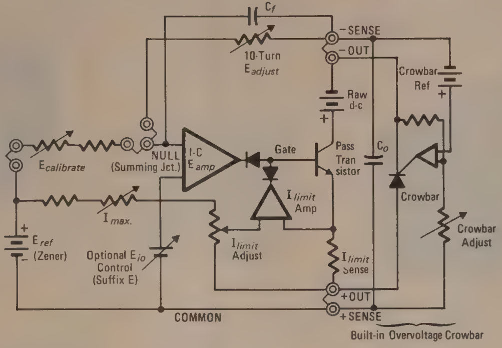

SIMPLIFIED SCHEMATIC DIAGRAM

and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The table gives these values for each CPS model.

OVERVOLTAGE CROWBAR

A voltage-triggered crowbar is included as standard equipment on all CPS models. This provides a voltage-triggered electronic "short" across the output terminals if the voltage exceeds the set level. The setting adjustment is accessible through the front panel. The crowbar is linked to the main on/off circuit breaker. Crowbar trigger time 5 to 10 microseconds with an adjustable delay capacitor (to minimize the false alarm rate).

Crowbar setting range: 3 volts (minimum) to 20 volts d-c.

Crowbar threshold: 5% of E_o or 0.25 volt, whichever is greater. Initial setting should account for −2% warm-up settling drift.

Crowbar temperature effect coefficient: 0.05% per °C.

GENERAL

SERIES/PARALLEL: CPS models can be operated together in series, up to the 500V isolation limit, and can be interconnected for master/slave tracking. CPS cannot be paralleled because of their crowbar.

ISOLATION FROM GROUND: The circuit and output terminals of CPS power supplies have no d-c connection to ground and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENTS: Units are factory-wired for 105–125V a-c, 50–65 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–65 Hz. Power consumption is tabulated for each model; power factor 0.9. All models are protected by a combination on/off switch and circuit breaker. Units are equipped with a 3-wire line cord. The "1/4" and "1/2" rack units use plug Pattern No. 1; "full-rack" models use plug Pattern No. 2. See page 111 in the Kepco Catalog.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C without derating. Cooling is by means of a built-in, sealed-bearing blower (two in the full rack sized models) exhausting to the rear.

STANDARDS: CPS models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: The d-c output terminations are binding posts or pressure clamps (for the heavy current units) located on the rear. All sensing and control connections are made via a multiterminal barrier-strip.

METERS: Voltage and current are displayed on a pair of 2-inch recessed meters with an accuracy of ±3%.

MOUNTING: Full-rack sized models rack-mount directly with accessory flanges (also predrilled for slides, Jonathan type 110 QD 20-2, 22-2 or 24-2). The quarter-rack and half-rack sized units are designed for rack-mount installation in type RA–24 or RA–32 drawers. Unmetered modular format models are also available, see the *Modular* section of the Kepco Catalog.

Model RA–24 Rack Adapter	Price: $25.00.
Model RA–32 Rack Adapter	Price: $75.00.

DIMENSIONS

Quarter-rack models:	*Metered*
English measure:	5 7/32"H x 4 5/32"W x 17 3/16"D*
Metric measure:	132.6 H x 105.6 W x 436.6 D mm
Half-rack models:	
English measure:	5 7/32" H x 8 11/32"W x 17 3/8" D*
Metric measure:	132.6 H x 211.9 W x 441.3 D mm
Full-rack models:	
English measure:	5 7/32"H x 16½"W** x 17 1/64"D*
Metric measure:	132.6 H x 419.1 W x 432.2 D mm

*behind panel.
**with "ears" standard 19" panel width.

FINISH: *Panel:* Two-tone black and light gray (Color 26440 per Fed. Std 595.)
Case: Textured dark charcoal.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–E": Zeroing trimmer for the offset voltage of the voltage channel. Price: $10.00.

Suffix "–T": Lowered temperature effect coefficient: 0.005% per °C voltage mode; 0.01% per °C current mode. Price: $30.00.

KEPCO POWER SUPPLIES

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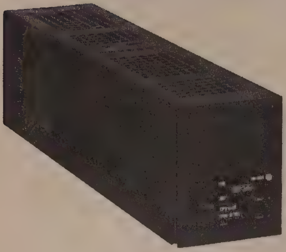
CPS
MODULAR



Model CPS 6–10 "Quarter-Rack" Size Modular Power Supply for OEM chassis mounting or for rack systems.

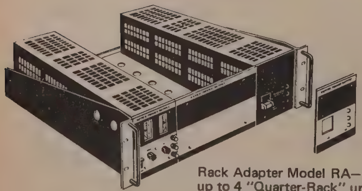
A 0–6V, 0–10A @ +71°C Linear Power Supply.

Model JQE 6–45, a "Half-Rack" sized Power Module for OEM chassis mounting or for rack-mount systems.

A 0–6V, 0–45A @ +71°C Linear Power Supply.

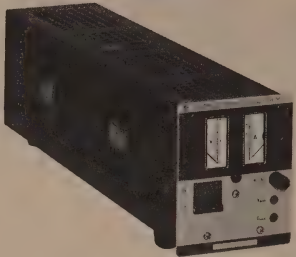
Model CPS 15–50, unmetered Power Module shown with "ears" for 19" rack mounting. The ears are detachable for chassis mounting.

A 0–15V, 0–50A @ +71°C Linear Power Supply.



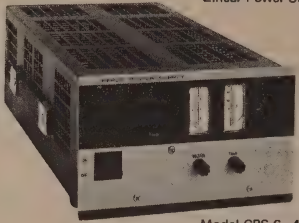
Rack Adapter Model RA–24 accommodates up to 4 "Quarter-Rack" units in 5¼" of panel space. RA–24 can be used to intermix units. Here a metered model is shown with an unmetered module and the Adapter Panel RAP 24–1.

CPS
COMPUTER I-C



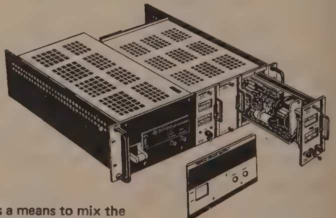
Model CPS 6–10M Metered "Quarter-Rack" Power Supply for bench use or for rack systems.

A 0–6V, 0–10A @ +71°C Linear Power Supply.



Model CPS 6–45M, a husky bench/rack style 0–6V, 0–45A – +71°C Linear Power Supply.

Model CPS 6–90M, a bench/rack style 0–6V, 0–90A @ +71°C Linear Power Supply.



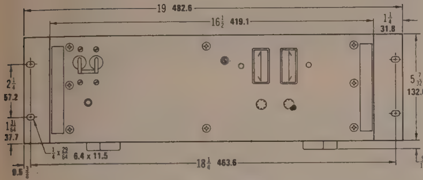
Model RA–32 provides a means to mix the quarter-rack and half-rack sized modules with any of the 1/6th width plug-in units, CC, OPS II, or PCX–MAT. The 1/6th width slots will also accommodate type SN Digital Programming Cards.

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX #710-582-2631 • Cable: KEPCOPOWER NEWYORK

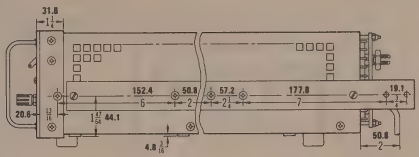
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches,
dimensions in bold face type are in millimeters.

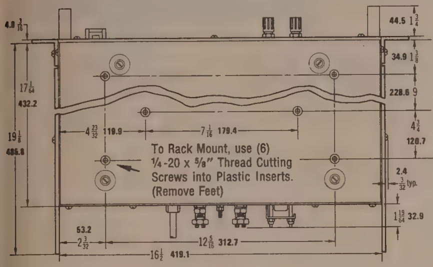
CPS "FULL-RACK" SIZE


19 **482.6**
$16\frac{1}{2}$ **419.1**
$1\frac{1}{4}$ **31.8**
$2\frac{1}{4}$ **57.2**
$1\frac{31}{64}$ **37.7**
$5\frac{7}{32}$ **132.6**
$\frac{1}{4} \times \frac{29}{64}$ **6.4 x 11.5**
$18\frac{1}{4}$ **463.6**
9.5 $\frac{3}{8}$
$\frac{9}{16}$ **14.3**

FRONT VIEW

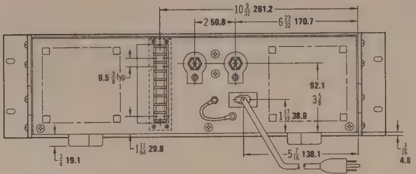

31.8
$1\frac{1}{4}$
152.4
6
50.8
2
57.2
$2\frac{1}{4}$
177.8
7
19.1
$\frac{3}{4}$
20.6
$\frac{13}{16}$
$1\frac{47}{64}$ **44.1**
4.8 $\frac{3}{16}$
50.8
2

SIDE VIEW


4.8 $\frac{3}{16}$
44.5 $1\frac{3}{4}$
34.9 $1\frac{3}{8}$
$17\frac{1}{64}$
432.2
228.6 9
$19\frac{1}{8}$
485.8
$4\frac{23}{32}$ **119.9**
$7\frac{1}{16}$ **179.4**
$4\frac{3}{4}$
120.7
2.4
$\frac{3}{32}$ typ.
$1\frac{19}{64}$ **32.9**
53.2
$2\frac{3}{32}$
$12\frac{5}{16}$ **312.7**
$16\frac{1}{2}$ **419.1**

To Rack Mount, use (6) ¼-20 x ⅝" Thread Cutting Screws into Plastic Inserts. (Remove Feet)

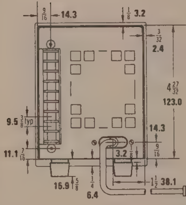
BOTTOM VIEW


$10\frac{9}{32}$ **261.2**
2 **50.8**
$6\frac{23}{32}$ **170.7**
9.5 $\frac{3}{8}$ typ
92.1
$3\frac{5}{8}$
$1\frac{17}{32}$ **38.9**
$1\frac{11}{64}$ **29.8**
$\frac{3}{4}$ **19.1**
$5\frac{7}{16}$ **138.1**
$\frac{3}{16}$
4.8

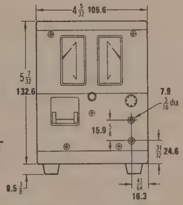
TYPICAL REAR VIEW

Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.
Panels: Per Mil. Std. 189

CPS "QUARTER-RACK" SIZE

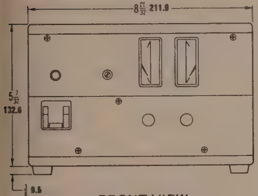

$\frac{9}{16}$ **14.3**
$\frac{1}{8}$ **3.2**
$\frac{3}{32}$
2.4
$4\frac{27}{32}$
123.0
9.5 $\frac{3}{8}$ typ
14.3
11.1 $\frac{7}{16}$
3.2
$\frac{9}{16}$
15.9 $\frac{5}{8}$
$\frac{1}{4}$
6.4
$1\frac{1}{2}$ **38.1**

REAR VIEW


$4\frac{5}{32}$ **105.6**
$5\frac{7}{32}$
132.6
7.9
$\frac{5}{16}$ dia
15.9 $\frac{5}{8}$
$\frac{31}{32}$ **24.6**
9.5 $\frac{3}{8}$
$\frac{41}{64}$
16.3

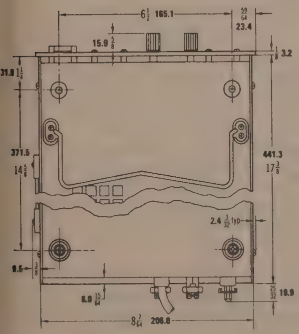
FRONT VIEW

CPS "HALF-RACK" SIZE


$8\frac{11}{32}$ **211.9**
$5\frac{7}{32}$
132.6
$\frac{3}{8}$ **9.5**

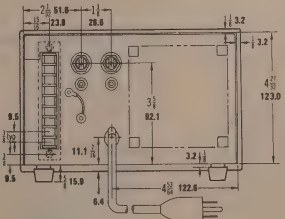
FRONT VIEW

all KEPCO
products are
backed by a firm
5-Year
Warranty


$6\frac{1}{2}$ **165.1**
$\frac{59}{64}$
23.4
15.9 $\frac{5}{8}$
$\frac{1}{8}$ **3.2**
31.8 $1\frac{1}{4}$
371.5
$14\frac{5}{8}$
441.3
$17\frac{3}{8}$
2.4 $\frac{3}{32}$ typ
9.5 $\frac{3}{8}$
6.0 $\frac{15}{64}$
$\frac{25}{32}$ **19.9**
$8\frac{7}{64}$ **206.0**

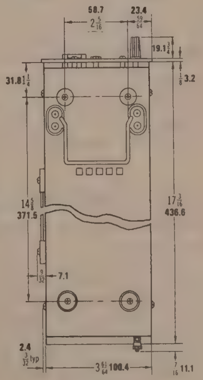
BOTTOM VIEW

To Rack Mount, remove Handle, Feet and Bail. Use (4) 8-18 x ⅝" Thread Cutting Screws into Plastic Inserts.


$2\frac{1}{32}$ **51.6**
$1\frac{1}{8}$
$\frac{15}{16}$ **23.8**
28.6
$\frac{1}{8}$ **3.2**
$\frac{1}{8}$ **3.2**
$4\frac{27}{32}$
123.0
$3\frac{5}{8}$
92.1
9.5
$\frac{3}{8}$ typ
11.1 $\frac{7}{16}$
3.2 $\frac{1}{8}$
$\frac{3}{8}$
9.5
$\frac{5}{8}$ **15.9**
$4\frac{53}{64}$ **122.6**
6.4

TYPICAL
REAR VIEW

To Rack Mount, remove Handle, Feet and Bail. Use (4) 8-18 x ⅝" Thread Cutting Screws into Plastic Inserts.


58.7
$2\frac{5}{16}$
23.4
$\frac{59}{64}$
19.1 $\frac{3}{4}$
31.8 $1\frac{1}{4}$
$\frac{1}{8}$ **3.2**
$14\frac{5}{8}$
371.5
$17\frac{3}{16}$
436.6
$\frac{9}{32}$ **7.1**
2.4
$\frac{3}{32}$ typ
$3\frac{61}{64}$ **100.4**
$\frac{7}{16}$ **11.1**

BOTTOM VIEW

KEPCO™ POWER SUPPLIES

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	PRICE	SHIP WGT. lbs.	SHIP WGT. kg.
DTM 2X16–0.6	0 to +16 0 to −16	0 to +0.6 0 to −0.6	13 mΩ + 1 μH	$156.00	5	2.3

DTM
MODULAR

The Kepco DTM design provides, in a single package, a pair of voltage stabilizers controlled by a single adjustment. The two outputs are positive and negative with respect to a common center, and track so as to maintain output symmetry. The DTM is ideal for powering Op-amps and other linear circuits where supply voltage balance is significant.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE No. 1 [1]	OUTPUT EFFECTS VOLTAGE No. 2
SOURCE: 105–125/210–250V a-c		<0.05% or 2 mV[2]	<0.05% or 2 mV[2]
LOAD: No load – full load		<0.05% or 2 mV[2]	<0.05% or 2 mV[2]
TIME: 8 hours (drift)		<0.05% or 4 mV[2]	<0.05% or 4 mV[2]
TEMPERATURE: Per °C		<0.05%	<0.05%
UNPROGRAMMED OUTPUT DEVIATION:[3] (Ripple and noise)	rms	<0.5 mV	<0.5 mV
	p-p[4]	<2.5 mV	<2.5 mV

[1] Voltage No. 1 is the positive output with respect to common, which serves as the master. Voltage No. 2 tracks Voltage No. 1.

[2] Whichever is greater.

[3] One terminal grounded or connected so that common-mode current does not flow through load.

[4] 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE

Voltage No. 1: Zero to plus 16 volts.
Voltage No. 2: Zero to minus 16 volts.

CONTROL/PROGRAMMING: The two outputs are controlled by a single multiturn trimmer adjusted by screwdriver. This control operates on the plus (+) output, while the minus (-) output tracks. The tracking ratio may be adjusted by a separate trimmer which sets the minus output relative to the positive. They may be set for any ratio; e.g., 0 to +15 volts and 0 to -15 volts—or unequal voltages; e.g., 0 to +12 volts and 0 to -6 volts. When set for equal voltage, the outputs will track to within ±100 millivolts from 1 volt to the rated maximum output.

An external rheostat may be substituted for the master control trimmer—by means of terminals on the barrier-strip—so that remote control of the voltage can be exercised at approximately 1000 ohms per volt (not calibrated).

REMOTE ERROR SENSING: Separate voltage-sensing terminals for each output and the common permit the DTM to compensate for static load effects up to 0.5 volt per power lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT LIMITING

Each output is individually protected by an independently adjusted current limiter.

RANGE: 10% to 110% of the maximum rated current. Should a load attempt to draw current in excess of the limiter's setting, the output voltage is diminished so that the preset current limit is maintained, whatever the load.

Note: Should Voltage No. 1, the master, be the one overloaded, its diminished voltage will be tracked by Voltage No. 2 even though No. 2, itself, may not be overloaded.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 microseconds.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. At frequencies above the stabilizer's cutoff, the impedance increase with frequency becomes asymptotic to the characteristic series inductance given in the model table.

GENERAL

SERIES/PARALLEL: The two outputs of DTM share a common (center) terminal. They may be loaded individually or in series. There is no provision for parallel operation.

ISOLATION: The circuit of DTM is isolated from its chassis and ground. It may be placed in series with up to 500 volts d-c (or peak) off ground. The common-mode current from output to ground is less than 5 microamperes rms, 50 microvolts peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power must be hard-wired to the provided terminals. Source current is 0.5 ampere at 125V a-c (internally fused); power factor 0.9.

TEMPERATURE RATINGS
Storage: −40°C to +85°C.
Operating: −20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

Data and prices subject to change without notice

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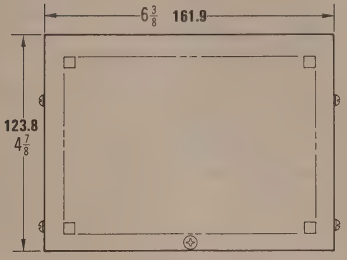
5-Year
Warranty

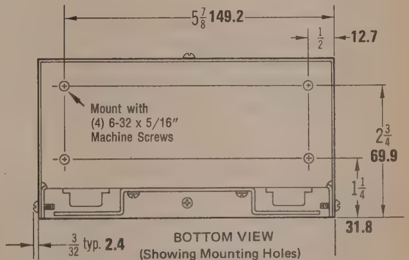
Model DTM 2X16—0.6

OUTLINE DIMENSIONAL DRAWINGS

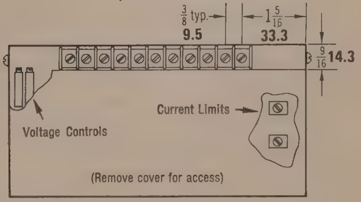
Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.
Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.


6 3/8 **161.9**
123.8
4 7/8

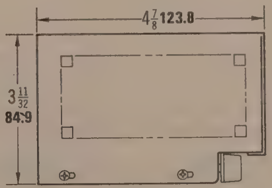
REAR VIEW


5 7/8 **149.2**
1/2
12.7
Mount with
(4) 6-32 x 5/16"
Machine Screws
2 3/4
69.9
1 1/4
31.8
3/32 typ. **2.4**

BOTTOM VIEW
(Showing Mounting Holes)

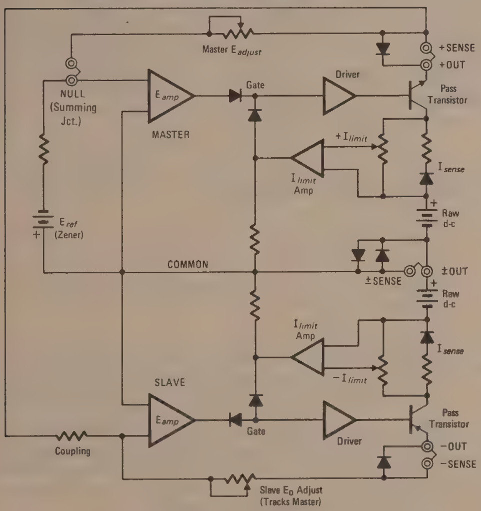

3/8 typ.
9.5
1 5/16
33.3
9/16 **14.3**
Current Limits
Voltage Controls
(Remove cover for access)

TOP VIEW


4 7/8 **123.8**
3 11/32
84.9

SIDE VIEW

SIMPLIFIED SCHEMATIC DIAGRAM


Master E adjust
+SENSE
+OUT
NULL
(Summing
Jct.)
E amp
MASTER
Gate
Driver
Pass
Transistor
+I limit
I limit
Amp
I sense
E ref
(Zener)
Raw
d-c
COMMON
±SENSE
±OUT
Raw
d-c
I limit
Amp
I sense
−I limit
SLAVE
E amp
Gate
Driver
Pass
Transistor
Coupling
−OUT
−SENSE
Slave E0 Adjust
(Tracks Master)

STANDARDS: DTM modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: All input, output and sensing connections are made via a single multiterminal barrier-strip.

MOUNTING: The DTM modules will mount to your chassis using 6-32 hardware to recessed captive nuts.

19-inch rack mounting adapter panels include:
RA 26—1 for a single module.
RA 27—2 for two modules.
RA 28—4 for four modules.
Rack adapters are $15.00 each.

DIMENSIONS

English measure: 3 11/32"H x 6 3/8"W x 4 7/8"L.
Metric measure: 84.9 H x 161.9W x 123.8 L mm.

FINISH: Black anodized aluminum.

KEPCO POWER SUPPLIES

HB
HYBRID

HB power supplies are built in a combination "bench/rack" style offering high voltage stabilization using a hybrid circuit, combining the stability of a differential transistor control amplifier with the reliability of a vacuum-tube, series-pass regulator. HB models feature a pair of auxiliary 6.5V a-c, 6A outputs for energizing tube filaments.

MODEL	d-c OUTPUT RANGE VOLTS	AMPS	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C	MAX. INPUT AMPS at 125	PRICE	SHIP WGT. lbs.	kg.
HB 4AM	0–325	0–0.4	0.1 Ω + 0.5 μH	8 MΩ + 280 μF	3.0	$495.00	35	15.9
HB 8AM	0–325	0–0.8	0.05 Ω + 1.0 μH	4 MΩ + 280 μF	5.5	592.00	41	18.6
HB 525M	0–525	0–0.5	0.1 Ω + 0.8 μH	10 MΩ + 50 μF	8.0	748.00	41	18.6

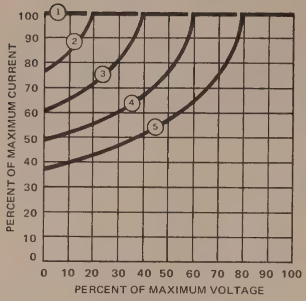


FIGURE 1: RATING CURVES

Curves represent the volt/ampere rating for range switch positions 1–5. To use, determine which position covers the desired voltage. Read the maximum current for each voltage on the left scale.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE (1) (External Sensing)
SOURCE: 105–125/210–250V a-c		<0.01%	<0.1% at rated sample
LOAD: No load – full load		<0.01% or 2 mV(2)	<0.01% at rated sample
TIME: 8-hours [drift]		<0.01% or 2 mV(2)	<0.05% or 0.2 mA(2)
TEMPERATURE: Per ° C		<0.01%	<0.05% at rated sample
UNPROGRAMMED OUTPUT DEVIATION:(3) (Ripple and noise)	rms	<1 mV	<0.01% of I_o max
	p-p(4)	<5 mV	<0.05% of I

(1) Rated sample is 10 volts d-c across an external current sampling resistor, with external current control.

(2) Whichever is greater.

(3) One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor.

(4) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: The HB is equipped with a 5-position range selector which divides the voltage into five bands each covering 20% of the rated voltage. The 10-turn voltage control sets the output within any 20% range. When programmed externally to a voltage *lower* than the minimum setting for the range selected, the output maximum current must be derated per Figure 1.

CONTROL/PROGRAMMING: Output voltage is controlled by the combination of 10-turn rheostat and 5-position range selector. External voltage control can be exercised by a resistance of approximately 100 ohms per volt, or by a control voltage delivering 0 to +10 milliamperes into the summing junction with respect to the plus (+) output terminal. Refer to the output current derating curve, Figure 1, for operation outside of the lower boundary of the range switch.

OVERLOAD: The HB is protected by fuses against overload or short circuit while functioning as a voltage stabilizer.

CURRENT STABILIZATION

The HB's voltage control channel may be reconnected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. So connected, and with an external current feedback rheostat, the HB output current is stabilized. The range of currents that can be controlled is 10 milliamperes to 100% of I_o max, although the current ratio for any single sensing resistor should be limited to 50:1 maximum.

The maximum load voltage compliance range for the HB as a current stabilizer is given by the derating curve (Figure 1). The maximum voltage is the upper limit of the range selector switch position. The minimum compliance voltage for any stabilized current is given by its intersection with the derating curve for that range selector switch position.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:
The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 μs.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:
As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the BHK models in this section of the catalog.

PROGRAMMING SPEED: The rate at which an HB responds to a step program (within the limits of the selector switch derating curve) is determined by the load resistance, the tabulated output capacitance and the current rating. For fast programming applications, please see the BHK models

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The table gives these values for each HB model.

GENERAL

SERIES/PARALLEL: HB models can be connected in series or (as current stabilizers) in parallel. Terminals are provided for master/slave interconnection. Series operation is limited to the maximum isolation voltage rating (600V).

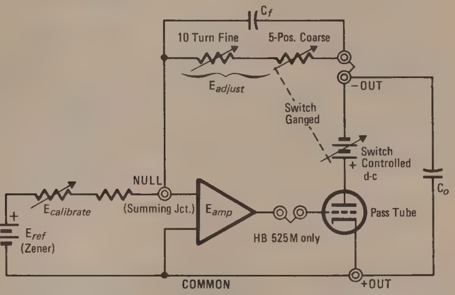
Data and prices subject to change without notice

kepco
FLUSHING NEW YORK
POWER
D-C VOLTS
VOLTAGE
FINE
D-C MILLIAMPERES
H B
D-C

Model HB 8AM

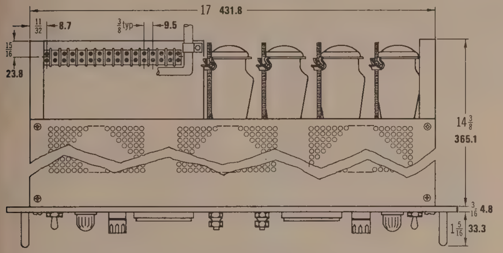
all KEPCO products are backed by a firm 5-Year Warranty

SIMPLIFIED SCHEMATIC DIAGRAM

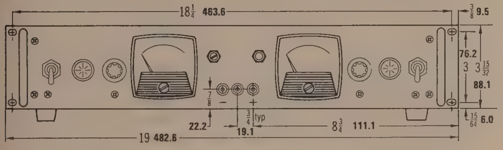

C_f
10 Turn Fine
5-Pos. Coarse
E_{adjust}
−OUT
Switch Ganged
Switch Controlled d-c
+
NULL
$E_{calibrate}$
(Summing Jct.)
E_{amp}
Pass Tube
C_o
+
E_{ref} (Zener)
HB 525M only
COMMON
+OUT

OUTLINE DIMENSIONAL DRAWINGS

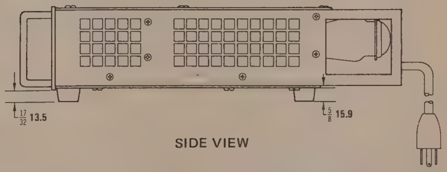
Fractional dimensions in light face type are in inches,
dimensions in bold face type are in millimeters.
Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.
Panels: Per Mil. Std. 189


17 431.8
11/32 8.7
3/8 typ
9.5
15/16
23.8
14 3/8
365.1
3/16 4.8
1 5/16 33.3

TOP VIEW


18 1/4 463.6
3/8 9.5
76.2
3 15/32
88.1
7/8
−
+
3/4 typ
22.2
19.1
8 3/4 111.1
15/64 6.0
19 482.6

FRONT VIEW


17/32 13.5
5/8 15.9

SIDE VIEW

Allow 2" Bend Radius for Line Cord.

ISOLATION FROM GROUND: The circuit and output terminals of HB have no d-c connection to ground, and may be floated up to 600 volts (d-c or peak) off ground. The common-mode current from output to ground is less than 50 microamperes rms, 500 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Source power requirements are tabulated in the model table. Units are protected by built-in fuse and are equipped with a 3-wire, line cord.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +55°C. Cooling is by natural convection.

STANDARDS: HB power supplies are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: D-C output, sensing and control functions, as well as the two independent 6.5-volt, 6-ampere a-c outputs, are terminated at a rear-mounted barrier-strip. Front panel binding posts carry the d-c output and ground.

AUXILIARY OUTPUTS: Each HB model offers a pair of independent 6.5-volt a-c (unstabilized) outputs, each rated for 6 amperes. These outputs may be used to power vacuum tube heater filaments or for similar tasks.

METERS: A pair of 2½-inch meters display the d-c output voltage and output current with ±2% accuracy.

MOUNTING: HB power supplies are sized for direct mounting in standard 19-inch equipment racks. Panel height is 3½-inch nominal.

DIMENSIONS

English measure: 3¹⁵⁄₃₂"H x 19"W x 14⅜"D (behind panel).

Metric measure: 88.1 H x 482.6 W x 365.1 D mm (behind panel).

FINISH: *Panel:* Light gray, Color 26440, per Fed. Std. 595.

KEPCO POWER SUPPLIES

JMK
AUTOMATIC CROSSOVER

The JMK is a systems-type automatic crossover (voltage/current) stabilizer. Its mechanical design, quarter-rack, is intended to minimize the panel space occupancy in conventional 19-inch racks. The unique plug-access arrangement allows for very rapid installation and demounting without fumbling with wires, screws and links. The JMK has three control channels, each with an I-C front end for maximum stability. One is committed to voltage control; the other two are reserved for current control. One via the panel control; the other for external current programming. A built-in overvoltage crowbar is standard.

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		SOURCE CURRENT at 125 V a-c	PRICE	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C			lbs.	kg.
JMK 6–5M	0–6	0–5	60 µΩ + 1 µH	0.2 MΩ + 1000 µF	1.4A	$479.00	16	7.3
JMK 6–10M	0–6	0–10	30 µΩ + 2 µH	0.1 MΩ + 2000 µF	2.4A	563.00	19	8.6
JMK 15–3M	0–15	0–3	250 µΩ + 1 µH	0.33 MΩ + 500 µF	1.4A	479.00	16	7.3
JMK 15–6M	0–15	0–6	125 µΩ + 2 µH	0.16 MΩ + 1000 µF	2.4A	563.00	19	8.6
JMK 25–2M	0–25	0–2	625 µΩ + 1 µH	0.5 MΩ + 350 µF	1.4A	479.00	16	7.3
JMK 25–4M	0–25	0–4	312 µΩ + 2 µH	0.25 MΩ + 700 µF	2.4A	563.00	19	8.6
JMK 36–1.5M	0–36	0–1.5	1.2 mΩ + 1 µH	0.67 MΩ + 200 µF	1.4A	479.00	16	7.3
JMK 36–3M	0–36	0–3	0.6 mΩ + 2 µH	0.33 MΩ + 400 µF	2.4A	563.00	19	8.6
JMK 55–1M	0–55	0–1	2.75 mΩ + 1 µH	1.0 MΩ + 110 µF	1.4A	479.00	16	7.3
JMK 55–2M	0–55	0–2	1.4 mΩ + 2 µH	0.5 MΩ + 220 µF	2.4A	563.00	19	8.6
JMK 75–0.7M	0–75	0–0.7	5.4 mΩ + 1 µH	1.3 MΩ + 80 µF	1.4A	479.00	16	7.3
JMK 75–1.5M	0–75	0–1.5	2.5 mΩ + 2 µH	0.65 MΩ + 160 µF	2.4A	563.00	19	8.6
JMK 100–0.5M	0–100	0–0.5	10 mΩ + 1 µH	2.0 MΩ + 55 µF	1.4A	479.00	16	7.3
JMK 100–1M	0–100	0–1	5 mΩ + 2 µH	1.0 MΩ + 110 µF	2.4A	563.00	19	8.6

(1) d-c value is for external sensing and feedback; d-c value for internal-sensing mode is E_o/5 mA.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE		AMPLIFIER OFFSETS		REFERENCE +6.2V ± 5% NOMINAL
			INTERNAL	EXTERNAL (2)	VOLTAGE ΔE_{io}	CURRENT ΔI_{io}	
SOURCE: 105-125/210-250V a-c		<0.0005%	<0.005% or 25 µA (3)	<0.005%	<5 µV	<1 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.1 mV (3)	<5.0 mA	<0.01%	<100 µV	<5 nA	–
TIME: 8-hour [drift]		<0.01% or 0.2 mV (3)	<0.02% or 0.1 mA (3)	<0.02%	<20 µV	<1 nA	0.005%
TEMPERATURE: Per °C (4)		<0.01%	<0.02% or 0.1 mA (3)	<0.02%	<20 µV	<2 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION: (5) (Ripple and noise)	rms	<0.2 mV	<0.02% or 0.5 mA (3)		–	–	–
	p-p (6)	<2.0 mV	<0.08% or 2.0 mA (3)		–	–	–

(2) External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.

(3) Whichever is greater.

(4) Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.02% per °C internally sensed current mode; 0.01% per °C externally sensed current mode. See option "–T."

(5) One terminal grounded or connected so that the common-mode current does not flow through load or (in current mode) through a sensing resistor.

(6) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: JMK are full range, operationally programmable power supplies. They may be set or programmed to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output voltage is controlled continuously through the range by a panel-mounted, 10-turn rheostat. External control can be exercised by resistance (1000 ohms per volt with built-in calibration control) or by a control voltage. Control is fully operational with the JMK functioning as a differential operational power amplifier with its plus (+) output-sensing terminal the common.

For control with respect to the minus (–) output-sensing terminal, see Model NTC–200. For isolated digital control, see the type SN programmers in Kepco's Catalog.

OFFSETS: The equivalent offset voltage and current variations for the JMK's voltage channel are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference, E_r. JMK has a built-in control for zeroing the fixed or initial part of the offset voltage, E_{io}.

GAIN: The open-loop d-c gain is in excess of 10^6 volts per volt.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The JMK is equipped with a built-in current sensing and control channel for precision current stabilization with automatic crossover from and to the voltage stabilization mode.

OUTPUT RANGE: Current is controlled by a 10-turn, panel-mounted potentiometer over the range 0 to 100% I_o max.

CONTROL/PROGRAMMING: Current may be externally controlled (programmed) by a remote potentiometer or small control voltage (0–1 volt for units rated under 5 amperes; 0–0.5 volt for units rated 5 amperes and more). This voltage, with respect to the plus (+) output terminal can be derived from a divider across the internal reference or from a separate programming source such as the Kepco type SN digital programmer. The external control of current is exercised through a separate control amplifier channel, gated to the regulator. This allows the panel current control to remain operative and to function as an override or programming limit control. For a wider current control range, the *voltage channel* may be connected to sample the drop across an external current-sensing resistor in the plus (+) output lead. An external rheostat will control current from 1 microampere to 100% I_o max. The maximum recommended range of currents for any single current-sensing resistor is 50:1.

MODE FLAG: JMK uses a pair of panel lamps to indicate whether it is functioning as a voltage stabilizer or as a current stabilizer. A d-c "flag" signal is also provided to the rear connector for remote signalling. This signal is ⩾5 volts in voltage mode, ⩽0 volt in current mode, referred to the plus (+) output terminal. The source impedance is 5 kilohms.

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:

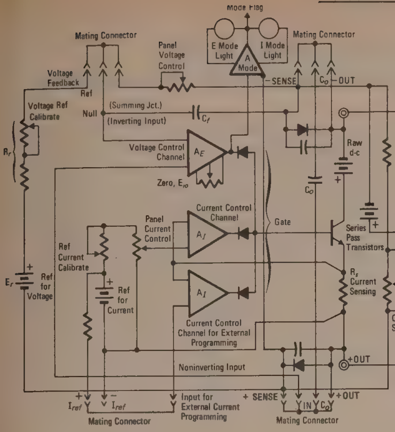
The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 µs.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:

A stabilized current recovers with an exponential having an RC time constant determined by the load's resistance and the value for "C," the output capacitance, given in the tables. For a fast recovery current stabilizer, see OPS Groups IV and V models in the *High Speed* section of Kepco's Catalog.

PROGRAMMING SPEED (voltage channel): The rate at which a JMK responds to a step-program is determined by the current setting, the load resistance and the tabulated output capacitance. For fast programming models, see OPS Groups IV and V in the *High Speed* section of Kepco's Catalog.

Data and prices subject to change without notice



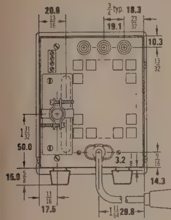
Mode Flag
Mating Connector
Panel Voltage Control
E Mode Light
I Mode Light
A Mode
Mating Connector
Voltage Feedback
Ref
-SENSE
C_o
-OUT
Voltage Ref Calibrate
Null
(Summing Jct.)
(Inverting Input)
C_r
R_r
Voltage Control Channel
A_E
Raw d-c
Zero, E_{io}
C_o
Current Control Channel
Panel Current Control
A_I
Gate
Built-In Overvolt Sense
Ref Current Calibrate
Series Pass Transistors
A_{VP}
SCR
Crowbar
E_r
Ref for Voltage
Ref for Current
A_I
R_s Current Sensing
Overvolt Set
Current Control Channel for External Programming
+OUT
Noninverting Input
I_{ref}
Input for External Current Programming
+ SENSE
+OUT
Mating Connector
IN
C_o
Mating Connector

SIMPLIFIED SCHEMATIC DIAGRAM

Typical JMK Model

OUTLINE DIMENSIONAL DRAWINGS

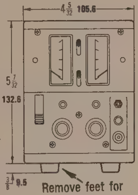
Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.



20.6
19.1
18.3
10.3
50.0
3.2
14.3
15.9
17.5
29.8

REAR VIEW

Allow 2" Bend Radius for Line Cord.

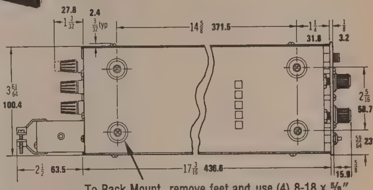


$4\frac{5}{32}$ 105.6
$5\frac{7}{32}$
132.6
9.5

FRONT VIEW

Remove feet for Rack Mounting

Tolerance:
±1/64" (**0.4**) between mounting holes.
±1/32" (**0.8**) other dimensions.
Panels: Per Mil. Std. 189



27.8
2.4
$14\frac{5}{8}$ 371.5
31.8
3.2
$3\frac{61}{64}$
100.4
$2\frac{5}{16}$
58.7
23.4
$2\frac{1}{2}$ 63.5
$17\frac{3}{16}$ 436.6
15.9

BOTTOM VIEW

To Rack Mount, remove feet and use (4) 8-18 x ⅝" Thread Cutting Screws into plastic inserts.

GENERAL

SERIES/PARALLEL: JMK models can be operated together in series (up to the limit of their isolation voltage, (500V) and can be interconnected for master/slave tracking. The built-in crowbar does not allow for parallel operation.

ISOLATION FROM GROUND: The circuit and output terminals of JMK have no d-c connection to ground and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENTS: An internal switch selects either 105–125V a-c or 210–250V a-c, 50–65 Hz. The JMK is shipped with the switch in the 105–125V a-c position. Units are equipped with a detachable 3-wire safety line cord, plug Pattern No. 1. (See page 111 of the Kepco Catalog.) Power factor 0.9. Each JMK is protected by a panel-mounted circuit breaker.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Full output current is delivered at +71°C without derating. Cooling is by means of a built-in, sealed-bearing blower, exhausting to the rear. Mounting should allow for air movement (generated by the blower) of approximately 10 CFM.

STANDARDS: JMK models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: All sensing and control connections to JMK are made via a rear-mounted plug connector. A mating connector is supplied, wired with jumpers for local control and sensing. Space is provided in the connector for the installation of resistors to set up the JMK for specific output levels. The mating connector is Kepco Model PC–4. Extra PC–4 connectors: $10.00 each.

Output d-c connections are made via rear-mounted binding posts.

METERS: JMK power supplies are fitted with separate 2-inch recessed ±3% voltage and current meters. Each is equipped with a 10:1 range switch for improved readability at low output levels.

MOUNTING: The JMK power supplies are "quarter-rack" sized to mount up to four abreast in the Model RA–24 rack mount drawer (5¼" panel height in a 19" wide rack). Two JMK's can be mounted in the RA–32 drawer with room for three plug-in, one-sixth rack modules.

Model RA–24 Rack Adapter	Price: $25.00.
Model RA–32 Rack Adapter	Price: $75.00.

DIMENSIONS

English measure: $5\frac{7}{32}$"H x $4\frac{5}{32}$"W x $17\frac{3}{16}$" D
(add 2 ½" for connector).

Metric measure: 132.6 H x 105.6 W x 436.6 D mm
(add 63.5 mm for connector).

FINISH: *Panel:* Two tone black and light gray.
(Color No. 26440, Fed. Std. 595.)
Case: Textured dark charcoal gray.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–T": Certified test and report for lowered temperature effect coefficient.
0.005% per °C voltage mode; 0.01% per °C (external) current mode.
Price: $30.00.

OVERVOLTAGE CROWBAR

A voltage-triggered crowbar is included as standard equipment on all JMK models. The setting adjustment and indicator are located on the front panel together with a push button that disables the crowbar so the voltage setting may be made without upsetting the output. The crowbar is linked to the main on/off circuit breaker.

Crowbar trigger time: Less than 50 microseconds.

Crowbar setting range: 4V (minimum) to 110% of E_o max.

Crowbar threshold: 5% E_o max or 0.5 volt (whichever is greater). An initial setting should account for a −2% warm-up settling effect.

Crowbar temperature effect coefficient: 0.05% per °C.

KEPCO POWER SUPPLIES

JQE
SYSTEM POWER

The JQE is a systems-type voltage stabilizer with current limiting, in a variety of ratings up to 100 watts in a "quarter-rack" package, 250–500 watts in the "half-rack" package, and up to 1000 watts in the "full-rack width" design. They occupy only 5¼ vertical inches of valuable rack space.

JQE's voltage control channel has an I-C front end for maximum stability and minimum offset. The rated power is delivered under the realistic thermal environs of a system's cabinet with no derating. The 10-turn voltage control is standard; an overvoltage crowbar is optional.

Unmetered (Modular) JQE Models are also available. See the *Modular* section of Kepco's Catalog.

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		MAX. INPUT AMPS at 125 V a-c	RACK SIZE (1)	PRICE (2)	VP OPTION	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (3) d-c OHMS + SHUNT C					lbs.	kg.
JQE 6–10M	0–6	0–10	30 μΩ + 1 μH	50 kΩ + 3 kμF	2.0	1/4	$375.00	$98.00	19	8.6
JQE 6–22M	0–6	0–22	14 μΩ + 0.5 μH	23 kΩ + 5.8 kμF	4.2	1/2	659.00	127.00	42	19.1
JQE 6–45M	0–6	0–45	7 μΩ + 0.5 μH	11 kΩ + 8 kμF	9.0	1/2	780.00	132.00	56	25.4
JQE 6–90M	0–6	0–90	3.5 μΩ + 0.5 μH	3.5 kΩ + 17.6 kμF	15.7	Full	1,242.00	151.00	103	46.8
JQE 15–6M	0–15	0–6	125 μΩ + 1 μH	84 kΩ + 1 kμF	2.1	1/4	375.00	98.00	19	8.6
JQE 15–12M	0–15	0–12	63 μΩ + 0.5 μH	42 kΩ + 300 μF	4.0	1/2	659.00	127.00	42	19.1
JQE 15–25M	0–15	0–25	30 μΩ + 0.5 μH	20 kΩ + 4.5 kμF	8.4	1/2	780.00	132.00	56	25.4
JQE 15–50M	0–15	0–50	15 μΩ + 0.5 μH	10 kΩ + 12 kμF	16.6	Full	1,242.00	151.00	103	46.8
JQE 25–4M	0–25	0–4	300 μΩ + 1 μH	125 kΩ + 700 μF	2.2	1/4	375.00	98.00	19	8.6
JQE 25–10M	0–25	0–10	125 μΩ + 0.5 μH	50 kΩ + 2.4 kμF	5.3	1/2	659.00	127.00	42	19.1
JQE 25–20M	0–25	0–20	63 μΩ + 0.5 μH	25 kΩ + 4.3 kμF	10.5	1/2	780.00	132.00	56	25.4
JQE 25–40M	0–25	0–40	31 μΩ + 0.5 μH	12.5 kΩ + 14 kμF	21.0	Full	1,242.00	151.00	103	46.8
JQE 36–3M	0–36	0–3	600 μΩ + 1 μH	165 kΩ + 400 μF	2.2	1/4	375.00	98.00	19	8.6
JQE 36–8M	0–36	0–8	225 μΩ + 0.5 μH	62.5 kΩ + 1.4 kμF	6.0	1/2	659.00	127.00	42	19.1
JQE 36–15M	0–36	0–15	120 μΩ + 0.5 μH	33 kΩ + 3.6 kμF	9.5	1/2	780.00	132.00	52	23.6
JQE 36–30M	0–36	0–30	60 μΩ + 0.5 μH	16 kΩ + 11 kμF	19.0	Full	1,242.00	151.00	98	44.5
JQE 55–2M	0–55	0–2	1.4 mΩ + 1 μH	250 kΩ + 220 μF	2.3	1/4	393.00	98.00	19	8.6
JQE 55–5M	0–55	0–5	550 μΩ + 1 μH	100 kΩ + 850 μF	5.0	1/2	659.00	127.00	42	19.1
JQE 55–10M	0–55	0–10	275 μΩ + 1 μH	50 kΩ + 2.1 kμF	9.0	1/2	807.00	132.00	52	23.6
JQE 55–20M	0–55	0–20	138 μΩ + 1 μH	25 kΩ + 7.3 kμF	18.0	Full	1,269.00	151.00	98	44.5
JQE 75–1.5M	0–75	0–1.5	2.5 mΩ + 1 μH	330 kΩ + 160 μF	2.3	1/4	393.00	98.00	19	8.6
JQE 75–3M	0–75	0–3	1.25 mΩ + 1 μH	165 kΩ + 850 μF	4.0	1/2	659.00	127.00	42	19.1
JQE 75–8M	0–75	0–8	469 μΩ + 1 μH	62.5 kΩ + 1.2 kμF	10.0	1/2	807.00	132.00	52	23.6
JQE 75–15M	0–75	0–15	250 μΩ + 1 μH	33 kΩ + 4.2 kμF	18.0	Full	1,269.00	151.00	98	44.5
JQE 100–1M	0–100	0–1	5 mΩ + 2 μH	500 kΩ + 110 μF	2.1	1/4	393.00	98.00	19	8.6
JQE 100–2.5M	0–100	0–2.5	2 mΩ + 1 μH	200 kΩ + 600 μF	4.5	1/2	659.00	127.00	42	19.1
JQE 100–5M	0–100	0–5	1.25 mΩ + 1 μH	100 kΩ + 600 μF	8.4	1/2	807.00	132.00	52	23.6
JQE 100–10M	0–100	0–10	0.62 mΩ + 1 μH	50 kΩ + 2.2 kμF	17.0	Full	1,269.00	151.00	98	44.5
JQE 150–1.5M	0–150	0–1.5	5 mΩ + 2 μH	330 kΩ + 440 μF	4.6	1/2	692.00	127.00	42	19.1
JQE 150–3.5M	0–150	0–3.5	2.2 mΩ + 2 μH	140 kΩ + 440 μF	8.7	1/2	867.00	132.00	52	23.6
JQE 150–7M	0–150	0–7	1.1 mΩ + 2 μH	72 kΩ + 1 kμF	18.0	Full	1,299.00	162.00	98	44.5

(1) "1/4" means quarter-rack width, "1/2" is half-rack width, etc. See dimensions.

(2) Add the cost of other options as listed. The crowbar option is tabulated separately.

INFLUENCE QUANTITY		OUTPUT EFFECTS		AMPLIFIER OFFSETS		REFERENCE 6.2V ± 5%
		VOLTAGE MODE	CURRENT MODE (3)	VOLTAGE ΔEio	CURRENT ΔIio	
SOURCE: 105–125/210–250V a-c		<0.0005%	<0.005%	<10 μV	<2 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.2 mV (4)	<0.01%	<200 μV	<5 nA	–
TIME: 8-hours [drift]		<0.01% or 1 mV (4)	<0.02%	<20 μV	<2 nA	0.005%
TEMPERATURE: Per °C		<0.01% (5)	<0.02% (5)	<20 μV	<5 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION: (6) (Ripple and noise)	rms	<0.2 mV	<0.02% of I_o max	–	–	–
	p-p (7)	<1.0 mV	<0.1% of I_o max	–	–	–

(3) External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.

(4) Whichever is greater.

(5) Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.01% per °C externally sensed current mode. See option "–T."

(6) One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor.

(7) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: JQE's are full-range, operationally programmable power supplies. They can be set or programmed to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output voltage is controlled continuously throughout the range by a panel-mounted, 10-turn rheostat. External control can be exercised by resistance at 1000 ohms per volt (with a built-in calibration control), or by a control voltage. Control is fully operational, with the JQE functioning as an operational power amplifier with its plus (+) output-sensing terminal the common.

For control with respect to the minus (–) output-sensing terminal, see Model NTC–200. For isolated digital control see the type SN digital programmers in the *Programming Accessories* section of the Kepco Catalog.

OFFSETS: The equivalent offset voltage and current variations for the JQE's voltage channel are tabulated for the effect of changes in source, load, temperature, and time. Their effect on the output may be calculated from the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is an external feedback rheostat and R_i is the input resistor from the reference, E_r. Option "–E" offers a means of zeroing the fixed or initial part of the offset voltage E_{io} which otherwise is set somewhat negative to insure the ability to program zero.

GAIN: The open-loop d-c gain is in excess of 0.5 x 10^6 volts/volt.

REFERENCE: +6.2V d-c ±5% with respect to the plus (+) output/sense terminal, capable of supplying up to 1 milliampere.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

Data and prices subject to change without notice

CURRENT STABILIZATION

The JQE is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by a multiturn front panel control over the range 10% to 105% of the rated current. Option "–Y" provides an additional current stabilization channel using the built-in current-sensing resistor, but terminated on a separate rear barrier-strip for external control by a potentiometer or small control voltage. This voltage, with respect to the plus (+) output terminal, can be derived from a divider across the internal reference or from a separate programming source such as the Kepco type SN Digital Programmer.

For the precision control of current, the voltage control channel may be reconnected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. Using an external current feedback rheostat, the current range is 1 milliampere to 100% I_o max. Models equipped with option "–E" can be controlled from approximately 1 microampere to 100% I_o max.

The recommended ratio of current for any single current-sensing resistor is 50:1.

DYNAMICS

VOLTAGE RECOVERY FOR STEP-LOAD CURRENT:

The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 µs.

CURRENT RECOVERY FOR STEP-LOAD VOLTAGE:

As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast-recovery current stabilizers, please see the OPS Groups V, VI, VII and VIII in Kepco's Catalog.

PROGRAMMING SPEED: The rate at which JQE responds to a step program is determined by the current limit setting, the load resistance and the tabulated output capacitance. For fast programming applications, please see the OPS Groups V, VI, VII and VIII in the *High Speed* section of Kepco's Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The table gives these values for each JQE model.

GENERAL

SERIES/PARALLEL: JQE models can be operated together in series or parallel and can be interconnected for master/slave tracking. Note: Units with optional crowbar may not be used in parallel. Series operation up to rated isolation limit (500V).

ISOLATION FROM GROUND: The circuit and output terminals of JQE have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–65 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–65 Hz. Power consumption is tabulated for each model; power factor 0.9. "Quarter-rack" models are protected by a built-in fuse; all others have a combination on/off switch and circuit breaker. Units are equipped with a 3-wire line cord; the "quarter" and "half" rack units use plug Pattern No. 1, "full-rack" models use plug Pattern No. 2. (See page 111 of the Kepco Catalog.)

STANDARDS: JQE models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TEMPERATURE RATINGS

Storage: –40°C to +85°C.

Operating: –20°C to +71°C. Full output current is delivered at +71°C without derating. Cooling is by means of a built-in, sealed-bearing blower exhausting to the rear.

TERMINALS: All sensing and control connections to JQE are made via a rear-mounted barrier-strip. All units have separate rear binding posts or pressure-type output connections for the d-c output. Models rated 15 amperes and less have auxiliary front panel d-c output binding posts.

METERS: JQE power supplies are fitted with separate 2-inch recessed ±3% voltmeters and ammeters; each is equipped with a 10:1 range switch for improved readability at low output levels.

MOUNTING: Full-rack-sized models rack-mount directly with accessory flanges (also predrilled for slides, Jonathan type 110 QD 20-2, 22-2 or 24-2). The quarter-rack and half-rack-sized units are designed for rack-mount installation in type RA–24 or RA–32 drawers. Unmetered units are available in modular form. Please see the *Modular* section in the Kepco Catalog.

Model RA–24 Rack Adapter	Price: $25.00.
Model RA–32 Rack Adapter	Price: $75.00.

DIMENSIONS

Quarter-rack models:	*Metered*
English measure:	5 7/32"H x 4 5/32"W x 17 3/16"D*
Metric measure:	132.6 H x 105.6 W x 436.6 D mm
Half-rack models:	
English measure:	5 7/32" H x 8 11/32"W x 17 3/8" D*
Metric measure:	132.6 H x 211.9 W x 441.3 D mm
Full-rack models:	
English measure:	5 7/32"H x 16½"W** x 17 1/64"D*
Metric measure:	132.6 H x 419.1 W x 466.7 D mm

*behind panel

**with "ears" standard 19" panel width.

FINISH: *Panel:* Two-tone black and light gray (Color 26440 per Fed. Std 595.)
Case: Textured dark charcoal.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–VP": The crowbar option provides a voltage triggered electronic "short" across the output terminals if the voltage exceeds the set level.

Crowbar trigger time: 5–10 microseconds with an adjustable delay capacitor to minimize the false alarm rate.

Crowbar threshold: 5% of E_o or 0.25 volt, whichever is greater. An initial setting should account for a –2% warm-up settling effect.

Crowbar temperature effect coefficient: 0.05% per °C.
Price: See table.

Suffix "–E": Zeroing trimmer for the offset voltage of the voltage channel. Price: $10.00.

Suffix "–T": Lowered temperature effect coefficient:
0.005% per °C voltage mode; 0.01% per °C current mode.
Price: $30.00.

Suffix "–Y": Remote current control. This option provides a separate control amplifier for remote control over the current limit function. Available for the ½ rack and full rack JQE models only. For remote current limit programming in a ¼ rack sized model, please see the comparable JMK models.

Price:	Quantities 1–4 units	each: $95.00.
	5 or more units	each: $50.00.

Note: Units ordered with the "–Y" option come with a built-in voltage channel zeroing control. Option "–E" is, in effect, included.

KEPCO POWER SUPPLIES

all KEPCO products are backed by a firm 5-Year Warranty

JQE
MODULAR

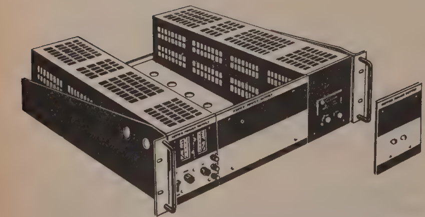
Model JQE 36–3 "Quarter-Rack" Size Modular Power Supply for OEM chassis mounting or for rack systems.

A 0–36V, 0–3A @ +71°C Linear Power Supply.

Model JQE 6–45, a "Half-Rack" sized Power Module for OEM chassis mounting or for rack-mount systems.

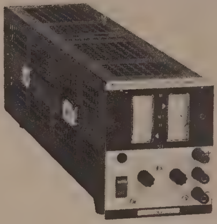
A 0–6V, 0–45A @ +71°C Linear Power Supply.

Model JQE 55–20M,
a bench/rack style
0–55V, 0–20A @ +71°C
Linear Power Supply.



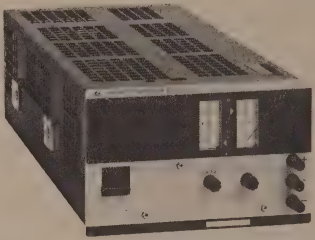
Rack Adapter Model RA–24 accommodates up to 4 "Quarter-Rack" units in 5¼" of panel space. RA–24 can be used to intermix units. Here a metered model is shown with an unmetered module and the Adapter Panel RAP 24–1J.

JQE
SYSTEM POWER



Model JQE 36–3M "Quarter-Rack" Size Modular Power Supply for OEM chassis mounting or for rack systems.

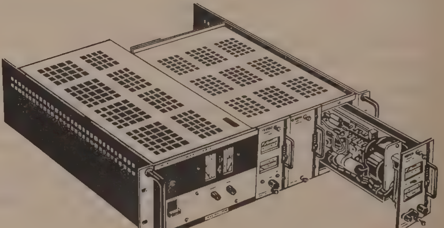
A 0–36V, 0–3A @ +71°C Linear Power Supply.



Model JQE 36–8M, a "Half-Rack" sized Power Module for OEM chassis mounting or for rack-mount systems.

A 0–36V, 0–8A @ +71°C Linear Power Supply.

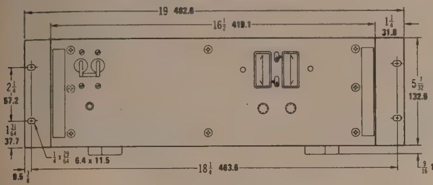
Model JQE 55–20M,
a bench/rack style
0–55V, 0–20A @ +71°C
Linear Power Supply.



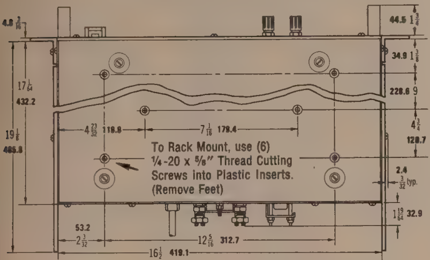
Model RA–32 provides a means to mix the quarter-rack and half-rack sized modules with any of the 1/6th width plug-in units, CC, OPS II, or PCX–MAT. The 1/6th width slots will also accommodate type SN Digital Programming Cards.

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX #710-582-2631 • Cable: KEPCOPOWER NEWYORK

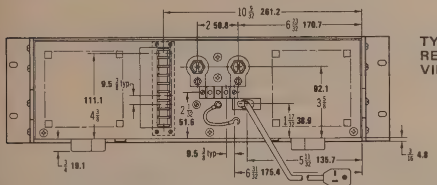
JQE "FULL-RACK" SIZE


19 482.6
16½ 419.1
1¼ 31.8
5 7/32 132.6
2¼ 57.2
1 31/64 37.7
¼ x 29/64 6.4 x 11.5
18¼ 463.6
9/16 14.3
⅜ 9.5

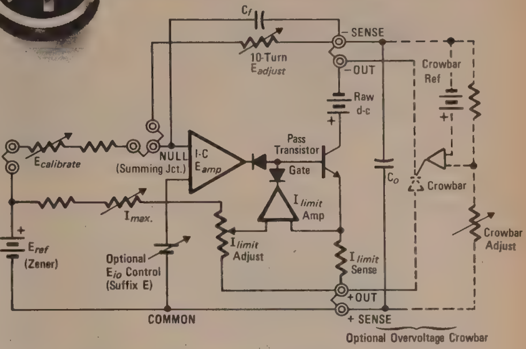
FRONT VIEW


4.8 3/16
44.5 1¾
34.9 1⅜
228.6 9
17 1/64
432.2
19⅛
485.8
4 23/32 119.8
7 1/16 179.4
4¾
120.7
To Rack Mount, use (6)
¼-20 x ⅝" Thread Cutting
Screws into Plastic Inserts.
(Remove Feet)
2.4
3/32 typ.
1 19/64 32.9
53.2
2 3/32
12 5/16 312.7
16½ 419.1

BOTTOM VIEW


10 9/32 261.2
2 50.8
6 23/32 170.7
9.5 ⅜ typ
111.1
4⅜
92.1
3⅝
2 1/32
51.6
1 17/32 38.9
9.5 ⅜ typ
5 11/32 135.7
6 29/32 175.4
¾ 19.1
3/16 4.8

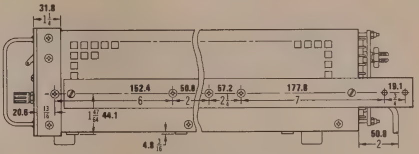
TYPICAL REAR VIEW


C_f
SENSE
10-Turn
E_{adjust}
−OUT
Raw
d-c
Crowbar
Ref
Pass
Transistor
NULL
I-C
E_{amp}
(Summing Jct.)
$E_{calibrate}$
Gate
C_o
Crowbar
I_{limit}
Amp
$I_{max.}$
E_{ref}
(Zener)
Optional
E_{io} Control
(Suffix E)
I_{limit}
Adjust
I_{limit}
Sense
Crowbar
Adjust
+OUT
+ SENSE
COMMON
Optional Overvoltage Crowbar

SIMPLIFIED SCHEMATIC DIAGRAM

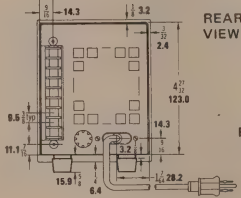
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

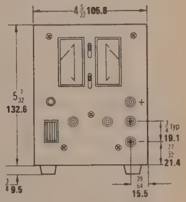

31.8
1¼
152.4
6
50.8
2
57.2
2¼
177.8
7
19.1
¾
20.6 13/16
1 47/64 44.1
4.8 3/16
50.8
2

SIDE VIEW

JQE "QUARTER-RACK" SIZE

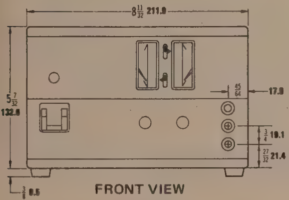

9/16 14.3
⅛ 3.2
3/32
2.4
4 27/32
123.0
9.5 ⅜ typ
14.3
9/16
11.1 7/16
3.2
15.9 ⅝
¼
6.4
1 7/64 28.2

REAR VIEW


4 5/32 105.6
5 7/32
132.6
¾ typ
19.1
27/32
21.4
⅜ 9.5
39/64
15.5

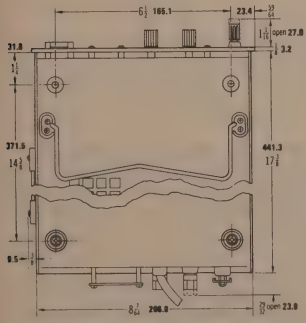
FRONT VIEW

JQE "HALF-RACK" SIZE


8 11/32 211.9
5 7/32
132.6
45/64
17.9
¾ 19.1
27/32 21.4
⅜ 9.5

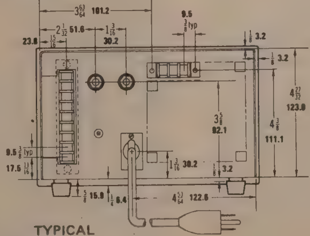
FRONT VIEW

all KEPCO products are backed by a firm 5-Year Warranty


6½ 165.1
23.4
59/64
1 1/16 open 27.0
⅛ 3.2
31.8
1¼
371.5
14⅝
441.3
17⅜
9.5 ⅜
8 7/64 206.0
29/32 open 23.0

BOTTOM VIEW

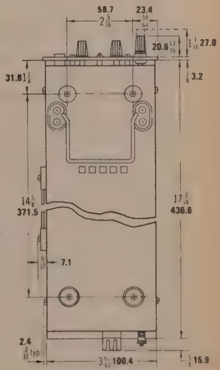
To Rack Mount, remove Handle, Feet and Bail. Use (4) 8-18 x ⅝" Thread Cutting Screws into plastic inserts.


3 63/64 101.2
2 1/32 51.6
1 3/16
30.2
9.5
⅜ typ
⅛ 3.2
23.8 15/16
⅛ 3.2
4 27/32
123.0
3⅝
92.1
4⅜
111.1
9.5 ⅜ typ
17.5 11/16
1 1/2 38.2
⅛ 3.2
⅝ 15.9
¼ 6.4
4 53/64 122.6

TYPICAL REAR VIEW

Tolerance:
±1/64" (0.4) between mounting holes.
±1/32" (0.8) other dimensions.
Panels: Per Mil. Std. 189

To Rack Mount, remove Handle, Feet and Bail. Use (4) 8-18 x ⅝" Thread Cutting Screws into Plastic Inserts.


58.7
2 5/16
23.4
59/64
20.6 13/16
1 1/16 27.0
31.8 1¼
⅛ 3.2
14⅝
371.5
17 3/16
436.6
9/32
7.1
2.4
3/32 typ
3 61/64 100.4
⅝ 15.9

BOTTOM VIEW

KEPCO POWER SUPPLIES

KW
AUTOMATIC CROSSOVER

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		PRICE	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE d-c OHMS + SHUNT C		lbs.	kg.
KW 6–600M	4–6	0–600	1 μΩ + 0.1 μH	100Ω + 10 kμF	$2,965.00	200	91
KW 6–500M*	4–6	0–500	1 μΩ + 0.1 μH	100Ω + 10 kμF	3,262.00	200	91

*KW 6–500M is for 380V a-c, 50 Hz source only.

OUTPUT LOCUS FOR MODEL KW 6–600M

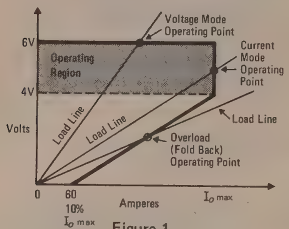


Figure 1

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE
SOURCE: 208V a-c, ±10%(3)		<0.01%	<0.01%
LOAD: Minimum to maximum		<0.01%	<0.01%
TIME: 8-hours [drift]		<0.05%	<0.05%
TEMPERATURE: Per °C		<0.05%	<0.05%
UNPROGRAMMED OUTPUT DEVIATION(1) (Ripple and noise)	rms	<2 mV	<0.3A
	p-p(2)	<60 mV	<10A

(1) One terminal grounded, or connected so that common mode current does not flow through the load.
(2) 20 Hz to 10 MHz.
(3) Except 380V a-c ±10% for Model KW 6–500M.

The KW is an automatic crossover, voltage/current stabilizer featuring a linear transistor *shunt* regulator functioning with a 3-phase SCR controller for exceptional efficiency. The KW has three control channels, as illustrated, a voltage control channel, a current stabilizer, and a re-entrant overload control channel. The operating mode of the power supply, a function of the load and the setting of the two controls, is signalled by means of panel-mounted LED indicators. The KW makes extensive use of plug-in linear I-C's for exceptional stability and control precision. A built-in overvoltage crowbar is standard.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: The KW may be set or programmed over the voltage range given in the model table. For any voltage setting, KW can be operated from zero to maximum load current.

CONTROL/PROGRAMMING: Output voltage is controlled continuously through the range by a panel-mounted, 10-turn rheostat. External control can be exercised by resistance (1000 ohms per volt with a built-in calibration control) or by a control voltage. The output may be digitally controlled with an accessory Kepco type SN Digital Programmer.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connnection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. The voltage dropped in the power leads is subtracted from the voltage available to the load.

CURRENT STABILIZATION

The KW is equipped with a built-in current sensing and control channel for precision current stabilization with automatic crossover from and to the voltage stabilization mode.

OUTPUT RANGE: Current is controlled by a 10-turn, panel-mounted control over the range 10% I_o to 100% I_o max.

CONTROL/PROGRAMMING: Current may be externally controlled (programmed) by an external rheostat or an external resistance (5 k ohms is full scale current) or an external control voltage (5 volts d-c corresponds to full scale current).

RE-ENTRANT (FOLDBACK) OVERLOAD LIMITER: Output of the KW is bounded by a third control channel functioning as the maximum current boundary for compliance voltage less than the minimum value for current stabilization. Internally set.

MODE FLAG: KW uses three panel-mounted, light-emitting diodes (LED) annunciators to signal which mode of operation controls the output: the voltage stabilization channel, the current stabilizer, or the re-entrant foldback protector.

DYNAMICS

VOLTAGE RECOVERY FOR STEP-LOAD CURRENT: Because the KW consists of a linear regulator combined with SCR controller, the voltage recovery time is dependent on both the size and direction of the load current step.

For a current-on step, up to 10% I_o, or a current-off step, up to 50% I_o, voltage recovery to within the load effect band (or 2 mV, whichever is greater) is less than 50 microseconds.

For a current-on step greater than 10% I_o, or a current-off step greater than 50% I_o, voltage recovery occurs in less than 50 milliseconds. Voltage overshoot amplitude for any load current-off step is limited to 0.5 volt maximum by built-in absorber circuit.

CURRENT RECOVERY FOR STEP-LOAD VOLTAGE: A stabilized current recovers at a rate of approximately 1 second per volt of compliance change.

PROGRAMMING SPEED (voltage channel): KW models can be programmed at approximately 1 volt per second.

GENERAL

SERIES/PARALLEL: KW models can be operated together in series up to the maximum isolation-voltage. Up to 5 units can be connected in parallel. Terminals are provided for master/slave tracking and for interconnected operation of their overvoltage crowbar (necessary for parallel use).

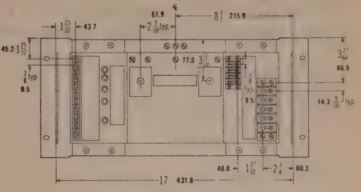
ISOLATION FROM GROUND: The circuit and output terminals of the KW have no d-c connections to ground and may be floated up to 25 volts (d-c or peak) off ground. The common mode current from output to ground is 3 milliamperes rms, 30 milliamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENTS-Model KW 6–600M: 208V a-c ±10%, 60 Hz ±3 Hz, 3-phase, 4-wire wye. Source power consumption is approximately 20 amperes rms per phase, 5500 watts. The KW is protected by a panel-mounted, 3-phase circuit breaker interlocked with the crowbar trip circuit.

Data and prices subject to change without notice

KEPCO
AC POWER

Model KW 6–600M



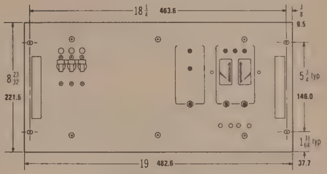
REAR VIEW

OUTLINE DIMENSIONAL DRAWINGS

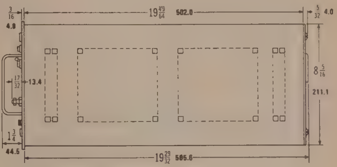
Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

Tolerance: ±1/64" **(0.4)** between mounting holes. ±1/32" **(0.8)** other dimensions.

Panels: Per Mil. Std. 189

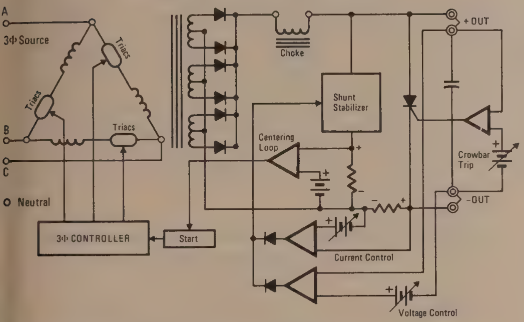


FRONT VIEW



SIDE VIEW

SIMPLIFIED SCHEMATIC DIAGRAM



SOURCE POWER REQUIREMENTS-Model KW 6–500M: Model KW 6–500M is designed for use in 50 Hz service areas. Power requirements: 380V a-c ±10%, 50 Hz ±3 Hz, 3-phase, 4-wire wye. Source power consumption is approximately 15% smaller than for Model KW 6–600M.

TEMPERATURE RATINGS

Storage: -40°C to +71°C.

Operating: -20°C to +71°C. Full output current is delivered at +71°C without derating. Cooling is by means of built-in, sealed-bearing blowers. The intake is on the right side (viewed from the front); the exhaust is to the left. Mounting should allow for air movement (generated by the blower) of approximately 500 CFM.

STANDARDS: KW power supplies are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: The main plus and minus output connections are 1½" x 2" (40 mm x 50 mm) plated copper plates fitted with 3/8" tapped inserts for the accommodation of lugs. Wire of 500,000 circular mills is recommended for the 600 ampere unit. Separate barrier-strips are provided for the a-c source power connection, for the crowbar connection, for the remote on/off connection and for the sensing and control connections.

METERS: The KW power supplies are fitted with separate 2-inch recessed ±3% voltage and current meters. Test points are provided on the panel for the connection of external measuring apparatus. The voltage monitor terminals are connected to the error-sensing point. The current monitor terminals are connected across the KW's current-sensing resistor.

MOUNTING: KW power supplies can be rack-mounted in standard 19" equipment cabinets occupying 8 3/4" of panel height. The power supply's 200 lb. (91 kg) weight requires a rear support bracket in contact with the frame. The Kepco Model FSB Filler Support Brackets are suitable.

DIMENSIONS

English measure: 8 23⁄32"H x 19"W x 19 29⁄32"D (behind panel).

Metric measure: 221.5 H x 482.6 W x 505.6 mm (behind panel).

FINISH: *Panel:* Light gray Color No. 26440 per Fed. Std. 595.

OVERVOLTAGE CROWBAR/ABSORBER

A voltage-triggered crowbar/absorber is included as standard equipment on KW models. The setting adjustment and indicator are located on the front panel together with a push button that disables the absorber so that the voltage setting may be made without upsetting the output. The crowbar/absorber circuit is in two parts.

- A self-resetting absorber circuit that clamps the output at a selected level above the output setting.
- A back-up shorting crowbar that shorts the output (and turns off the circuit breaker) should the absorber circuit be unable to contain the energy of an overvoltage.

For transients, such as load-off steps greater than 50% I_O max, the absorber will clamp the maximum output amplitude to the set value–to within 0.5 volt of the output voltage setting. More durable overvoltage stresses activate the SCR crowbar and circuit breaker and require manual reset.

A feature of the KW's crowbar is the provision for remote tripping. A "trigger" terminal is provided on the rear which can be wired to as many as five other KW units in a parallel "wired-or" configuration. Any one of these crowbars tripping, simultaneously activates all of the crowbars in the system.

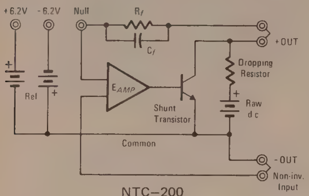
Crowbar/absorber setting range: 4 volts (min) to 100% E_O max. plus 0.5 volt.

Crowbar/absorber temperature effect coefficient: 0.05% per °C.

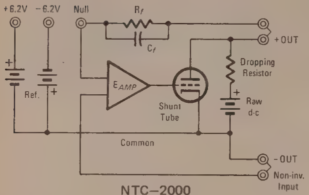
KEPCO POWER SUPPLIES

NTC
PROGRAMMING INTERFACE

SIMPLIFIED SCHEMATIC DIAGRAMS



NTC–200



NTC–2000

The Kepco NTC is an interface between active programming signal and operationally programmable power supply, to allow for control with the power supply's *negative* output terminal common, or grounded. The NTC is, itself, a *shunt* stabilized operational inverting amplifier which boosts a programming signal to the desired *voltage* level, where it may be connected to the feedback terminals of a power supply for noninverting repeater operation.

MODEL	d-c OUTPUT RANGE VOLTS	mA	OUTPUT IMPEDANCE dc OHMS + SERIES L	SLEWING RATE	PRICE	SHIP WGT. lbs.	kg.
NTC–200	0–200	0–10	3.4Ω + 10 μH	1V/μsec.	$230.00	11	5
NTC–2000	0–2000	0–1	334Ω + 100 μH	3V/μsec.	394.00	21	9.5

INFLUENCE QUANTITY		VOLTAGE AMPLIFIER OFFSETS ΔE_{io}	ΔI_{io}	REFERENCE ± 6.2V
SOURCE: 105–125/210–250V a-c		<100 μV	<10 nA	0.0005%
LOAD: No load – full load		<1 mV	<10 nA	———
TIME: 8-hours [drift]		<20 μV	<5 nA	0.005%
TEMPERATURE: Per °C		<20 μV	<5 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION(1) Ripple and noise	rms	<0.01% or 5 mV(3)		———
	p-p(2)	<0.05% or 50 mV(3)		———

(1)One terminal grounded, or connected so that common mode current does not flow through the load.
(2)20 Hz to 10 MHz. (3)Whichever is greater.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: NTC are full range, operationally programmable power supplies, principally intended for use as a programming interface. They can be programmed to any level within their rated range, and be fully loaded at any output setting.

GAIN: The open loop d-c gain is >0.5 x 10^6 volts per volt.

FEEDBACK: NTC are provided with a built-in fixed feedback resistor (200 KΩ Model NTC–200, 2 megohms Model NTC–2000) providing feedback from the positive output terminal so that NTC serves as a wide-band, inverting d-c amplifier. It is a unipolar device, producing a positive (+) output for a negative (-) input with respect to the (-) output terminal, which is common. The output of NTC may drive a load directly (if current is sufficient to the purpose). More frequently, it drives the feedback terminals of a companion operational power supply as illustrated in Figure A. The companion operational amplifier serves as a voltage repeater, producing identical voltage at rated current.

OFFSETS: The equivalent offset voltage and current variations for NTC are tabulated for the effect of changes in source, load, temperature and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm\Delta E_r (R_f/R_i) \pm\Delta E_{io} (1 + R_f/R_i) \pm\Delta I_{io} (R_f),$$

where R_f is the built-in feedback resistance, and R_i is the external coupling resistance from the signal source or reference, E_r.

OFFSET NULLING: The initial or bias part of the voltage and current offsets can be nulled (zeroed) by built-in trimmers, accessible through the panel.

REFERENCES: A pair of ±6.2V ±5%, 1 milliampere references are provided for offsetting or biasing purposes.

CURRENT LIMITING: Output current is limited at approximately 110% of rated current into a short circuit. Recovery is automatic when overload is removed.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): See table.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the built-in feedback resistance and capacitance, (200 KΩ and 350 pF in Model NTC–200; 2 megohms and 100 pF in Model NTC–2000).

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression:

$$f_{max.} = \frac{\text{Slewing Rate}}{\pi E_{pp}}$$

where E_{pp} is the peak-to-peak modulation voltage. The -3 dB respons is given by the programming time constant.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage amplifier, the impedance increase above the amplifier's cutoff frequency becomes asymptotic to a characteristic series inductance. The table gives these values for each NTC.

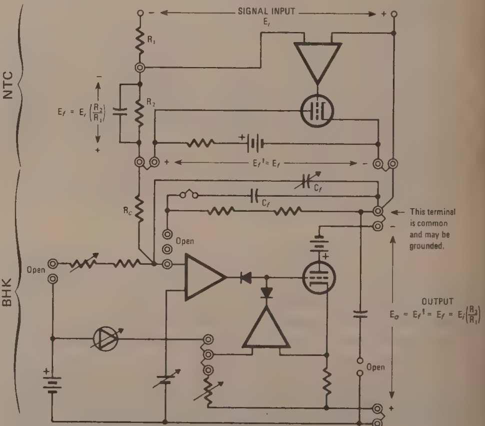

NTC
BHK
SIGNAL INPUT E_i
R_1
R_2
$E_f = E_i\left(\frac{R_2}{R_1}\right)$
$E_f{}' = E_f$
R_c
C_f
C_f
Open
Open
Open
This terminal is common and may be grounded.
OUTPUT
$E_o = E_f{}' = E_f = E_i\left(\frac{R_2}{R_1}\right)$

Figure A: NTC–2000, used to drive a Model BHK 2000–0.1M.

LOAD REACTANCE: NTC, like all high speed operational power supplies, are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff (lag) networks will allow the NTC to drive most cable or harness capacitances up to this limit. Note: When driving the feedback terminals of a conventionally filtered operational power supply, a significant capacitance will usually be

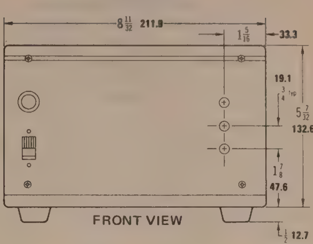
Data and prices subject to change without notice

KEPCO
KEPCO POWER SUPPLY PROGRAMMER
POWER
ON
OFF

Model NTC–200

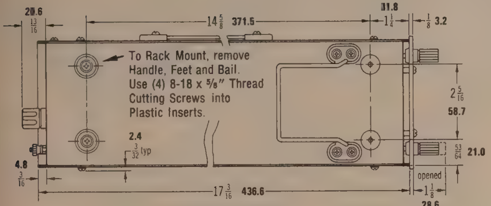
Model NTC–2000

NTC 2000


8 11/32 211.9
1 5/16
33.3
19.1
3/4 typ
5 7/32
132.6
1 7/8
47.6
1/2 12.7

FRONT VIEW

NTC 200

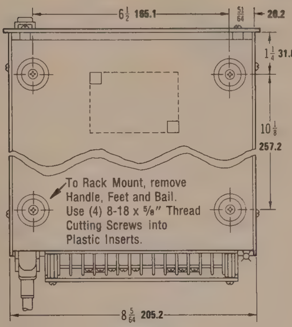

20.6
13/16
14 5/8 371.5
31.8
1 1/4
1/8 3.2
To Rack Mount, remove Handle, Feet and Bail. Use (4) 8-18 x 5/8" Thread Cutting Screws into Plastic Inserts.
2 5/16
58.7
2.4
3/32 typ
53/64 21.0
4.8
3/16
17 3/16 436.6
opened
1 1/8
28.6

BOTTOM VIEW

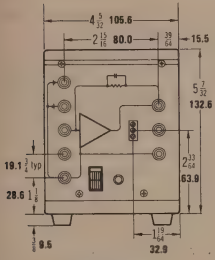
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

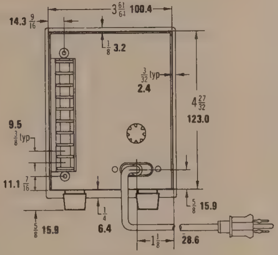
Tolerance:
±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.
Panels: Per Mil. Std. 189


6 1/2 165.1
51/64
20.2
1 1/4 31.8
10 1/8
257.2
To Rack Mount, remove Handle, Feet and Bail. Use (4) 8-18 x 5/8" Thread Cutting Screws into Plastic Inserts.
8 5/64 205.2

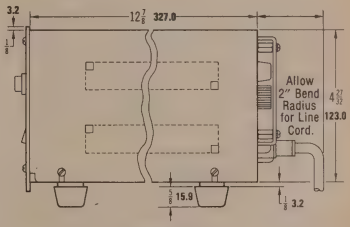
BOTTOM VIEW


4 5/32 105.6
2 15/16 80.0
39/64
15.5
5 7/32
132.6
2 33/64
63.9
19.1 3/4 typ
28.6 1 1/8
1 19/64
32.9
3/8 9.5

FRONT VIEW


14.3 9/16
3 61/64 100.4
1/8 3.2
3/32 typ
2.4
4 27/32
123.0
9.5
3/8 typ
11.1 7/16
1/4
6.4
5/8 15.9
5/8 15.9
1 1/8
28.6

REAR VIEW


3.2
1/8
12 7/8 327.0
Allow 2" Bend Radius for Line Cord.
4 27/32
123.0
5/8 15.9
1/8 3.2

SIDE VIEW

encountered. The NTC may either be slowed (by external feedback capacitance of its own) or may be isolated, by using a suitable resistance (R_c in Figure A), between the NTC output and its load.

GENERAL

SOURCE POWER REQUIREMENT: Units are factory wired for 105–125V a-c, 50–65 Hz, single phase. A simple jumper change will reconfigure the input for 210–250V a-c, 50–65 Hz. Power consumption: Approximately 35W; power factor 0.9; internally fused.

ISOLATION FROM GROUND: The circuit and output terminals of NTC have no d-c connection to ground, and may be floated: Up to 500 Volts for Model NTC–200, up to 1000 Volts for Model NTC–2000, (d-c or peak) off ground. The common mode current from output to ground is: For Model NTC–200, 5 μA rms, 50 μA p-p; for Model NTC–2000, 30 μA rms, 300 μA p-p at 60 Hz.

TEMPERATURE RATINGS:

Storage: -40°C to +85°C.
Operating: -20°C to +65°C.

Cooling is by natural convection. No derating or external heat sink is required.

STANDARDS: NTC Models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: Model NTC–200 features an 8-terminal front panel patch board, superimposed over a schematic representation of the NTC. These terminals access signal input and feedback connections. For Systems use, the connections are duplicated on a barrier-strip located at the rear. Model NTC–2000, for safety, has the rear barrier-strip connections only. Source power is connected via a 3-wire safety-grounded line cord, terminated in plug Pattern No. 1

DIMENSIONS:

English measure:

NTC–200:	5 7/32" H x 4 5/32" W x 17 3/16" D.
NTC–2000:	5 7/32" H x 8 11/32" W x 12 7/8" D.

Metric measure:

NTC–200:	132.6 H x 105.6 W x 436.6 D mm.
NTC–2000:	132.6 H x 211.9 W x 327.0 D mm.

FINISH:

Panel:	Light gray, Color 26440 per Fed. Std. 595.
Case:	Charcoal gray texture.

MOUNTING: Units may be rack-mounted with Adapter RA–24.

KEPCO OPERATIONAL POWER SUPPLIES

OPS group I

Kepco operational power supplies are a unique concept in power instrumentation. They are d-c power supplies, fully able to stabilize a voltage or current against the effects of load, source or temperature changes, yet able to respond with agility to programming signals requiring swift changes in the output.

The OPS–I are modular devices with a single uncommitted control channel using an integrated circuit front end for low drift and good temperature immunity.

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		SLEWING RATE	PRICE (2)	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C	VOLTS/µ Sec.		lbs.	kg.
OPS 7–2B	0–7	0–2	0.5 mΩ + 15 µH	0.25 MΩ + 4.0 µF	0.5	$187.00	5	2.3
OPS 15–1.5B	0–15	0–1.5	1 mΩ + 15 µH	0.33 MΩ + 1.5 µF	1.0	187.00	5	2.3
OPS 21–1B	0–21	0–1	2.5 mΩ + 15 µH	0.5 MΩ + 1.0 µF	1.0	187.00	5	2.3
OPS 40–0.5B	0–40	0–0.5	8 mΩ + 15 µH	1.0 MΩ + 0.3 µF	1.5	187.00	5	2.3
OPS 72–0.3B	0–72	0–0.3	25 mΩ + 15 µH	1.65 MΩ + 0.2 µF	1.5	187.00	5	2.3
OPS 100–0.2B	0–100	0–0.2	50 mΩ + 15 µH	2.5 MΩ + 0.1 µF	2.0	187.00	5	2.3

(1) This d-c value is for current feedback to the uncommitted control channel with external (1 volt) sensing.
(2) Models OPS–I are open units, uncased. For case, add Suffix "–C" to model number and $15.00 to price.

INFLUENCE QUANTITY		UNCOMMITTED CONTROL CHANNEL OFFSET VOLTAGE ΔE_{io}	UNCOMMITTED CONTROL CHANNEL OFFSET CURRENT ΔI_{io}	REFERENCE ±6.2V±5% NOMINAL
SOURCE: 105–125/210–250V a-c		<10 µV	<2 nA	<0.0001%
LOAD: No load – full load		<200 µV(3)	<5 nA	–
TIME: 8-hours [drift]		<20 µV	<2 nA	<0.005%
TEMPERATURE: Per °C		<20 µV	<5 nA	<0.005%
UNPROGRAMMED OUTPUT DEVIATION:(5) (Ripple and noise)	rms	<0.01% of E_o — or 3 mV(4)		–
	p-p(6)	<0.05% of E_o — or 10 mV(4)		–

(3) ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.
(4) Whichever is greater.
(5) One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.
(6) 20 Hz to 10 MHz.

NOTE: OPS Models are *not* general purpose power supplies.

UNCOMMITTED CONTROL CHANNEL

OUTPUT RANGE: OPS–I are full-range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 0.5×10^6 volts/volt.

FEEDBACK: Provision is made for feedback from the negative (–) output/sense terminal so that OPS–I will function as a wide-band, inverting d-c amplifier. It is a unipolar device, producing a negative (–) output for a positive (+) input with respect to the plus (+) output/sense terminal which is common. Output voltage may be programmed by a selection of input and feedback resistances (R_i and R_f) functioning with the built-in reference (E_r) according to the relationship $E_o = E_r\,(R_f/R_i)$. OPS–I operational power amplifiers can be used to stabilize various physical phenomena—heat, speed, force, electrochemical action . . . that is, to whatever the feedback is made proportional.

OFFSETS: The equivalent offset voltage and current variations for OPS–I are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm\ \Delta E_r\,(R_f/R_i)\ \pm\ \Delta E_{io}\,(1 + R_f/R_i)\ \pm\ \Delta I_{io}\,(R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the uncommitted channel's voltage offset (E_{io}) and current offset (I_{io}) can be nulled (zeroed) by built-in trimmers.

REFERENCES: A pair of ±6.2V ±5%, 1 milliampere references referred to the plus (+) output/sense terminal are provided for offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The OPS–I is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by an internal trimmer over the range 10% to 105% I_o max. For the precision control of current, the uncommitted control channel may be connected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. Using an external current feedback rheostat, current can be controlled from approximately 1 microampere to 100% I_o max. Note: The range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio. For a similar power supply module in which the main control channel is committed to current stabilization, please see the CCP modules in the Kepco Catalog.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): See table.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 400 pF to 1000 pF (except 800 pF to 1600 pF for Model OPS 7–2B).

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: $f\,\text{max.} = \text{slewing rate}/\pi E_{pp}$, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

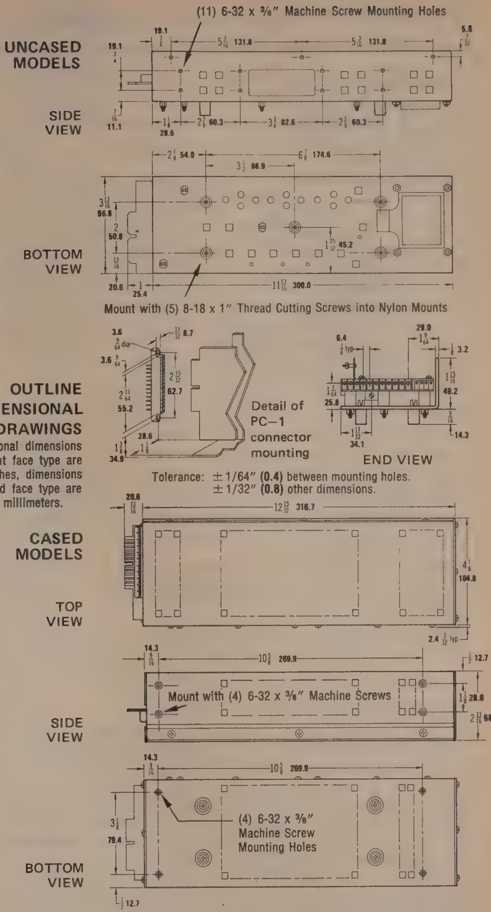
OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS–I model.

LOAD REACTANCE: Operational power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit. To drive larger capacitances, external voltage feedback and/or output capacitance will be required to stabilize the OPS as a conventionally filtered power supply. See Kepco's PCX Design Group. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

Data and prices subject to change without notice

Open, uncased OPS I module
Cased OPS I module

OPS I (open, uncased module) mounted in RA 22–6A using BPA–22 Slide Adapter.

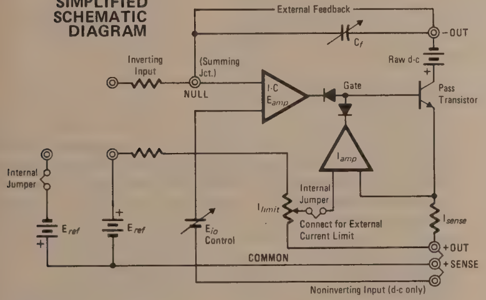

UNCASED MODELS
SIDE VIEW
(11) 6-32 x ⅜" Machine Screw Mounting Holes
BOTTOM VIEW
Mount with (5) 8-18 x 1" Thread Cutting Screws into Nylon Mounts
Detail of PC–1 connector mounting
END VIEW
CASED MODELS
TOP VIEW
SIDE VIEW
Mount with (4) 6-32 x ⅜" Machine Screws
BOTTOM VIEW
(4) 6-32 x ⅜" Machine Screw Mounting Holes

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.

SIMPLIFIED SCHEMATIC DIAGRAM


External Feedback
C_f
−OUT
Raw d-c
Inverting Input
(Summing Jct.)
NULL
I-C E_{amp}
Gate
Pass Transistor
I_{amp}
Internal Jumper
E_{ref}
E_{ref}
E_{io} Control
I_{limit}
Internal Jumper
Connect for External Current Limit
I_{sense}
COMMON
+OUT
+SENSE
Noninverting Input (d-c only)

GENERAL

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption: approximately 50W; 0.9 power factor; internally fused.

ISOLATION FROM GROUND: The circuit and output terminals of OPS–I have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: OPS–I models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: Source power, d-c output, sense and control connections are duplicated on a printed circuit edge connector and a barrier-strip. The connector mates with Kepco PC–1 and PC–8.

MOUNTING: Mount an uncased OPS–I module in a protected area using 6-32 hardware to tapped holes in the heat sink or 8-18 thread cutting screws to the nylon standoffs provided. The uncased module can be mounted on a BPA–22 slide adapter for plug-in mounting in the RA22–6A or RA–32 enclosure. Mount the cased model (see option "–C") by means of 6-32 hardware to any of three surfaces. The cased model can be rack-mounted into 19-inch equipment racks.

Model RA 12–1 mounts a single cased model.
Model RA 13–4 mounts up to four cased models.
Model RA 11–6 mounts up to six cased models.
Rack adapters are $15.00 each.

DIMENSIONS

English measure:	*Uncased:*	2½"H x 3¹³⁄₁₆"W x 12¹³⁄₁₆"L.
	Cased:	2¹¹⁄₁₆"H x 4⅛"W x 13³⁄₃₂"L.
Metric measure:	*Uncased:*	63.5 H x 96.8 W x 325.4 L mm.
	Cased:	68.3 H x 104.8 W x 337.3 L mm.

See outline drawings.

FINISH: The optional case has a blue anodized finish. Rack adapter panels are painted light gray, Color 26440, Fed. Std. 595.

OPTION (add the identifying letter as a suffix to model number):
Suffix "–C": Enclosure case. Price: $15.00
The case for an OPS–I module can also be ordered separately as Model CA–1, for installation in the field.

KEPCO OPERATIONAL POWER SUPPLIES

OPS group II

all KEPCO products are backed by a firm 5-Year Warranty

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OUTPUT IMPEDANCE VOLTAGE MODE d-c OHMS + SERIES L	OUTPUT IMPEDANCE CURRENT MODE (1) d-c OHMS + SHUNT C	SLEWING RATE VOLTS/μSec.	PRICE (2)	SHIP WGT. lbs.	SHIP WGT. kg.
OPS 7–2BTA	0–7	0–2	0.5 mΩ + 150 μH	0.25 MΩ + 8.0 μF	0.25	$241.00	8	3.6
OPS 15–1.5BTA	0–15	0–1.5	1 mΩ + 150 μH	0.33 MΩ + 6.0 μF	0.25	241.00	8	3.6
OPS 21–1BTA	0–21	0–1	2.5 mΩ + 150 μH	0.5 MΩ + 2.0 μF	0.5	241.00	8	3.6
OPS 40–0.5BTA	0–40	0–0.5	8 mΩ + 150 μH	1.0 MΩ + 0.5 μF	1.0	241.00	8	3.6
OPS 72–0.3BTA	0–72	0–0.3	25 mΩ + 150 μH	1.65 MΩ + 0.3 μF	1.0	241.00	8	3.6
OPS 100–0.2BTA	0–100	0–0.2	50 mΩ + 150 μH	2.5 MΩ + 0.13 μF	1.5	241.00	8	3.6

(1) This d-c value is for current feedback to the uncommitted control channel with external (1 volt) sensing.
(2) Price is for open slide-mounted unit. See Hardware/Mounting for choice of enclosures.

INFLUENCE QUANTITY		UNCOMMITTED CONTROL CHANNEL OFFSET VOLTAGE ΔE_{io}	UNCOMMITTED CONTROL CHANNEL OFFSET CURRENT ΔI_{io}	REFERENCE ±6.2V ±5% NOMINAL
SOURCE: 105–125/210–250V a-c		<10 μV	<2 nA	<0.0001%
LOAD: No load – full load		<200 μV (3)	<5 nA	–
TIME: 8-hours (drift)		<20 μV	<2 nA	<0.005%
TEMPERATURE: Per °C		<20 μV	<5 nA	<0.005%
UNPROGRAMMED OUTPUT DEVIATION: (5) (Ripple and noise)	rms	<0.01% of E_o — or 3 mV (4)		–
	p-p (6)	<0.05% of E_o — or 10 mV (4)		–

(3) ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.
(4) Whichever is greater.
(5) One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.
(6) 20 Hz to 10 MHz.

Kepco operational power supplies are a unique concept in power instrumentation. They are d-c power supplies, fully able to stabilize a voltage or current against the effects of load, source or temperature changes, yet able to respond with agility to programming signals requiring swift changes in the output.

The OPS–II are similar to the OPS–I modules, except that they are mounted on a slide adapter to fit various plug-in housings and are equipped with a patchboard panel.

NOTE: OPS Models are *not* general purpose power supplies.

UNCOMMITTED CONTROL CHANNEL

OUTPUT RANGE: OPS–II are full-range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 0.5 x 10^6 volts/volt.

FEEDBACK: Provision is made for feedback from the negative (–) output/sense terminal so that OPS–II will function as a wide-band, inverting d-c amplifier. It is a unipolar device, producing a negative (–) output for a positive (+) input with respect to the plus (+) output/sense terminal which is common. Output voltage may be programmed by a selection of input and feedback resistances (R_i and R_f) functioning with the built-in reference (E_r) according to the relationship $E_o = E_r\ (R_f/R_i)$. OPS–II operational power amplifiers can be used to stabilize various physical phenomena–heat, speed, force, electrochemical action . . . that is, to whatever the feedback is made proportional.

OFFSETS: The equivalent offset voltage and current variations for OPS–II are tabulated for the effect of changes in source, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm\ \Delta E_r\,(R_f/R_i)\ \pm\ \Delta E_{io}\,(1 + R_f/R_i)\ \pm\ \Delta I_{io}\,(R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the uncommitted channel's voltage offset (E_{io}) and current offset (I_{io}) can be nulled (zeroed) by built-in trimmers accessible through the panel.

REFERENCES: A pair of ±6.2V ±5%, 1 milliampere references referred to the plus (+) output/sense terminal are provided for offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The OPS–II is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by an internal trimmer over the range 10% to 105% I_o max. For the precision control of current, the uncommitted control channel may be connected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. Using an external current feedback rheostat, current can be controlled from approximately 1 microampere to 100% I_o max. Note: The range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio. For a similar power supply module in which the main control channel is committed to current stabilization, please see the CC units in the Kepco Catalog.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): See table.

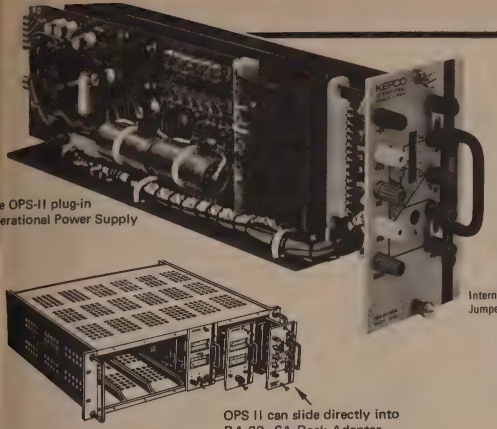
PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 800 pF to 1800 pF.

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: f max. = slewing rate/πE_{pp}, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

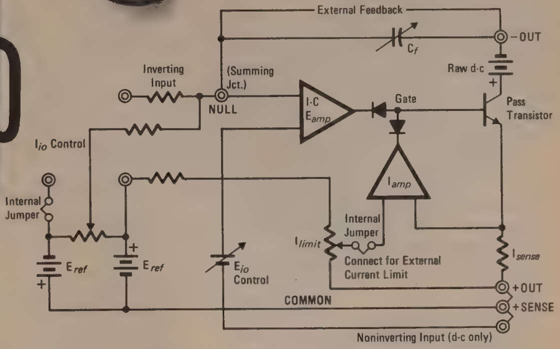
Data and prices subject to change without notice



e OPS-II plug-in
erational Power Supply

OPS II can slide directly into
RA 22–6A Rack Adapter

SIMPLIFIED SCHEMATIC DIAGRAM

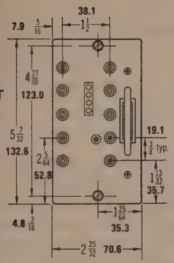

External Feedback
−OUT
C_f
Raw d-c
Inverting Input
(Summing Jct.)
NULL
I-C
E_{amp}
Gate
Pass Transistor
I_{io} Control
I_{amp}
Internal Jumper
Internal Jumper
I_{limit}
Connect for External Current Limit
I_{sense}
E_{ref}
E_{ref}
E_{io} Control
COMMON
+OUT
+SENSE
Noninverting Input (d-c only)

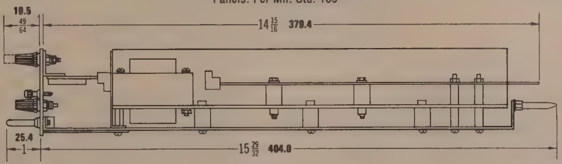
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches,
dimensions in bold face type are in millimeters.

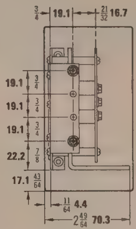
Tolerance: ±1/64" (**0.4**) between mounting holes.
±1/32" (**0.8**) other dimensions.
Panels: Per Mil. Std. 189

FRONT VIEW


38.1
7.9 5/16
1 1/2
4 27/32
123.0
5 7/32
132.6
2 5/64
52.8
19.1
3/4 typ.
1 13/32
35.7
4.8 3/16
1 25/64
35.3
2 25/32 70.6


19.5
49/64
14 15/16 379.4
25.4
1
15 29/32 404.0

TOP VIEW


3/4 19.1
21/32 16.7
19.1 3/4
19.1 3/4
19.1 3/4
22.2 7/8
17.1 43/64
11/64 4.4
2 49/64 70.3

REAR VIEW

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS–II model.

LOAD REACTANCE: Operational power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit. To drive larger capacitances, external voltage feedback and/or output capacitance will be required to stabilize the OPS as a conventionally filtered power supply. See Kepco's PCX–MAT Design Group. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

GENERAL

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250 a-c, 50–440 Hz. Power consumption: approximately 50W; 0.9 power factor; internally fused.

ISOLATION FROM GROUND: The circuit and output terminals of OPS–II have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: OPS–II models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: Source power, d-c output, sense and control connections are made through a rear PC plug that mates with the connector in a selected housing. The amplifier summing junction (null terminal), output and sense terminals, and both references are brought to a front panel patch board for easy access for input, output and feedback connections.

MOUNTING: The OPS–II plug-in operational power supplies can be manifolded up to six abreast in the RA 22–6A housing or intermixed in the RA–32 housing. The type CA–3, CA–4, and CA–5 bench-top cases accommodate 1, 2 or 3 units, respectively, with the mating plugs terminated in convenient barrier strips for cable access.

Model RA 22–6A Rack Adapter	Price: $99.00.
Model RA–32 Rack Adapter	Price: $75.00.
Model CA–3 Case	Price: $25.00.
Model CA–4 Case	Price: $35.00.
Model CA–5 Case	Price: $45.00.
Model CA–7 Case	Price: $35.00.
Model CA–8 Case	Price: $45.00.

DIMENSIONS

English measure: 5 7/32"H x 2 25/32"W x 14 15/16" max. D.

Metric measure: 132.6 H x 70.6 W x 379.4 max. D mm.

See outline drawings.

FINISH: *Panel:* Gray Color 26440, Fed. Std. 595.

KEPCO OPERATIONAL POWER SUPPLIES

OPS
group III

MODEL	d-c OUTPUT RANGE VOLTS	AMPS	OUTPUT IMPEDANCE VOLTAGE MODE d-c OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C	PRICE	SHIP WGT. lbs.	kg.
OPS 7–5.5	0–7	0–5.5	64 μΩ + 20 μH	0.18 MΩ + 5.5 μF	$297.00	11	5.0
OPS 15–3.3	0–15	0–3.3	225 μΩ + 10 μH	0.3 MΩ + 3.3 μF	297.00	11	5.0
OPS 21–2.5	0–21	0–2.5	420 μΩ + 10 μH	0.42 MΩ + 2.5 μF	297.00	11	5.0
OPS 40–1.4	0–40	0–1.4	1.4 mΩ + 10 μH	0.71 MΩ + 1.4 μF	297.00	11	5.0
OPS 72–0.8	0–72	0–0.8	4.5 mΩ + 30 μH	1.25 MΩ + 0.8 μF	297.00	11	5.0
OPS 100–0.6	0–100	0–0.6	10 mΩ + 20 μH	1.67 MΩ + 0.6 μF	297.00	11	5.0

(1) This d-c value is for current feedback to the uncommitted control channel, with external (1 volt) sensing. The d-c value for the internal current control channel is E_o/3 mA.

Kepco operational power supplies are a unique concept in power instrumentation. They are d-c power supplies, fully able to stabilize a voltage or current against the effects of load, source or temperature changes, yet able to respond with agility to programming signals requiring swift changes in the output.

The OPS–III are modular devices with two control channels; one uncommitted, the other devoted to current stabilization. Both are equipped for programming with an integrated circuit front end for low drift and good temperature immunity.

NOTE: OPS Models are *not* general purpose power supplies.

INFLUENCE QUANTITY		UNCOMMITTED CONTROL CHANNEL OFFSET VOLTAGE ΔE_{io}	OFFSET CURRENT ΔI_{io}	INTERNALLY SENSED CURRENT CONTROL CHANNEL	REFERENCE ±6.2V±5% NOMINAL
SOURCE: 105–125/210–250V a-c		<5 μV	<1 nA	<0.005%	0.0005%
LOAD: No load – full load		<100 μV(2)	<5 nA	<3 mA	–
TIME: 8-hours [drift]		<20 μV	<1 nA	<0.05% or 0.1 mA(3)	0.005%
TEMPERATURE: Per °C		<20 μV	<2 nA	<0.05% or 0.1 mA(3)	0.002%
UNPROGRAMMED OUTPUT DEVIATION:(4) (Ripple and noise)	rms	<0.01% of E_o — or 3 mV(3)		<0.5 mA	–
	p-p(5)	<0.05% of E_o — or 10 mV(3)		<2.0 mA	–

(2) ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.

(3) Whichever is greater.

(4) One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.

(5) 20 Hz to 10 MHz.

UNCOMMITTED CONTROL CHANNEL

OUTPUT RANGE: OPS–III are full range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 10^6 volts per volt.

FEEDBACK: Provision is made for feedback from the negative (–) output/sense terminal so that OPS–III will function as a wideband, inverting d-c amplifier. It is a unipolar device, producing a negative (–) output for a positive (+) input with respect to the plus (+) output/sense terminal, which is common. Output voltage may be programmed by a selection of input and feedback resistances (R_i and R_f) functioning with the built-in reference (E_r) according to the relationship $E_o = E_r (R_f/R_i)$. OPS–III operational power amplifiers can be used to stabilize various physical phenomena–heat, speed, force, electrochemical action . . . that is, to whatever the feedback is made proportional.

OFFSETS: The equivalent offset voltage and current variations for OPS–III are tabulated for the effect of changes in source, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the uncommitted channel's voltage offset (E_{io}) can be nulled (zeroed) by a built-in trimmer.

REFERENCES: A pair of ±6.2V ±5%, 1 milliampere references referred to the plus (+) output/sense terminal are provided for offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT CONTROL CHANNEL

OPS–III will stabilize current by means of an independent, committed control channel which functions with feedback from a built-in current-sensing resistor.

OUTPUT RANGE: Current is controlled by an internal (screwdriver-adjusted) trimmer with a range of 2% I_o max to 100% I_o max. For a wider current control range, the uncommitted control channel may be connected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. An external feedback rheostat will control current from approximately 1 microampere to 100% I_o max. Note: the range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio.

CONTROL/PROGRAMMING: The current control channel itself may be externally programmed by a 0–0.5 volt control voltage or by an external potentiometer.

MODE FLAG: OPS–III produces a "flag" signal which indicates which channel controls the output. The flag is +5 volts (1 mA max) with respect to the plus (+) sense terminal when the current channel has control. The flag is approximately zero volts when the uncommitted channel has control.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): More than 1V per μsec.

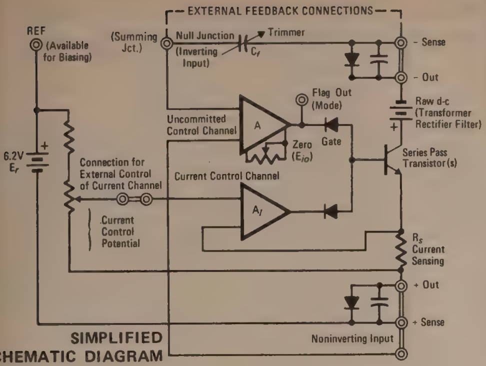
PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 800 pF to 1800 pF.

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: f max. = $10^6/\pi E_{pp}$,, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

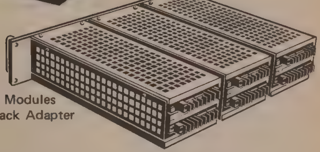
Data and prices subject to change without notice

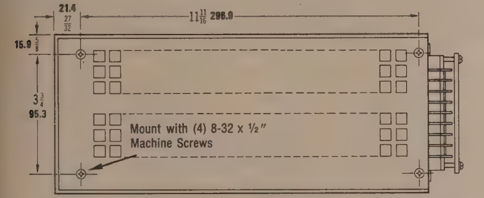

EXTERNAL FEEDBACK CONNECTIONS
REF
(Available for Biasing)
(Summing Jct.)
Null Junction
(Inverting Input)
Trimmer
C_f
− Sense
− Out
Flag Out (Mode)
Raw d-c (Transformer Rectifier Filter)
Uncommitted Control Channel
A
Zero (E_{io})
Gate
Series Pass Transistor(s)
6.2V E_r
Connection for External Control of Current Channel
Current Control Channel
A_I
Current Control Potential
R_s Current Sensing
+ Out
+ Sense
Noninverting Input

SIMPLIFIED SCHEMATIC DIAGRAM

all KEPCO products are backed by a firm 5-Year Warranty

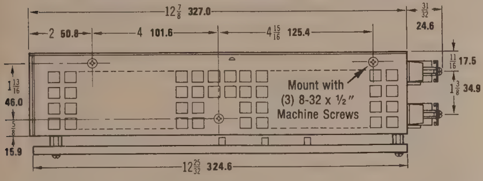
Single OPS III Module


Three OPS III Modules mounted in Rack Adapter RA 33–3

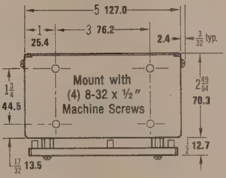

21.4
$\frac{27}{32}$
$11\frac{11}{16}$ 296.9
15.9 $\frac{5}{8}$
$3\frac{3}{4}$
95.3
Mount with (4) 8-32 x ½″ Machine Screws

BOTTOM VIEW

Tolerance: ± 1/64″ (0.4) between mounting holes. ± 1/32″ (0.8) other dimensions.


$12\frac{7}{8}$ 327.0
$\frac{31}{32}$
24.6
2 50.8
4 101.6
$4\frac{15}{16}$ 125.4
$\frac{11}{16}$ 17.5
$1\frac{3}{8}$ 34.9
$1\frac{13}{16}$
46.0
$\frac{5}{8}$
15.9
Mount with (3) 8-32 x ½″ Machine Screws
$12\frac{25}{32}$ 324.6

SIDE VIEW


5 127.0
1
25.4
3 76.2
2.4
$\frac{3}{32}$ typ.
Mount with (4) 8-32 x ½″ Machine Screws
$1\frac{3}{4}$
44.5
$2\frac{49}{64}$
70.3
$\frac{1}{2}$ 12.7
$\frac{17}{32}$ 13.5

END VIEW

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS–III model.

LOAD REACTANCE: Operational power supplies should be restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit without loss of speed. To drive larger capacitances, external voltage-feedback and/or output capacitance will be required to stabilize the OPS as a conventionally filtered power supply. See Kepco's PTR Design Group. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

GENERAL

SOURCE POWER INPUT: Units are factory wired for 105–125V a-c, 50–440 Hz. A switch reconfigures the input for 210–250V a-c. Power must be hard-wired to the provided terminals. Internally fused. Source current: 1.2 amperes at 125V a-c. Power factor 0.9.

ISOLATION FROM GROUND: The OPS–III circuit is isolated from its case and ground. It may be placed in series with 500 volts d-c (or peak) off ground. Common mode current, output to ground is less than 5 µA rms, 50 µA peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: OPS–III models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS AND ADJUSTMENTS: All input, output, control and sensing connections are made via a pair of barrier-strips located on one of the small surfaces. The built-in zeroing, lag adjustments and current control are located on the same surface and are accessible for screwdriver adjustment without removing the cover.

MOUNTING: OPS–III modules will mount on any of its three surfaces using 8-32 hardware to recessed threaded inserts.

19-inch rack mounting accessories include:
RA 35–1 mounts a single unit on a 3½" high panel.
Model RA 33–3 mounts up to 3 units on a 3½" high panel.
Model RA 34–4 mounts up to 4 units on a 5¼" high panel.
Rack adapters are $15.00 each.

DIMENSIONS

English measure:

3¹⁷⁄₆₄" H x 5" W x 13²⁷⁄₃₂" L (including barrier-strip).

Metric measure:

83.0 H x 127.0 W x 351.6 L mm (including barrier-strip).

See outline drawings.

FINISH: Black anodized aluminum.

KEPCO OPERATIONAL POWER SUPPLIES

OPS
group IV-V

Kepco operational power supplies are a unique concept in power instrumentation. They are d-c power supplies, fully able to stabilize a voltage or current against the effects of load, source or temperature changes, yet able to respond with agility to programming signals requiring swift changes in the output.

The OPS IV and V are bench/system, rack-type instruments with two control channels, one committed to voltage stabilization, the other to current. Both channels are equipped for programming with an integrated circuit front end for low drift and good temperature immunity.

NOTE: OPS Models are *not* general purpose power supplies.

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OUTPUT IMPEDANCE VOLTAGE MODE d-c OHMS + SERIES L	OUTPUT IMPEDANCE CURRENT MODE[1] d-c OHMS + SHUNT C	SOURCE CURRENT at 125 V a-c	PRICE	SHIP WGT. lbs.	SHIP WGT. kg.
OPS 6–5M	**0–6**	**0–5**	60 μΩ + 20 μH	0.2 MΩ + 5.0 μF	1.4	$453.00	16	7.2
OPS 15–3M	**0–15**	**0–3**	250 μΩ + 20 μH	0.33 MΩ + 3.0 μF	1.4	453.00	16	7.2
OPS 25–2M	**0–25**	**0–2**	625 μΩ + 50 μH	0.5 MΩ + 2.0 μF	1.4	453.00	16	7.2
OPS 36–1.5M	**0–36**	**0–1.5**	1.2 mΩ + 80 μH	0.67 MΩ + 1.5 μF	1.4	453.00	16	7.2
OPS 55–1M	**0–55**	**0–1**	2.75 mΩ + 80 μH	1.0 MΩ + 1.0 μF	1.4	453.00	16	7.2
OPS 75–0.7M	**0–75**	**0–0.7**	5.4 mΩ + 80 μH	1.3 MΩ + 0.7 μF	1.4	453.00	16	7.2
OPS 100–0.5M	**0–100**	**0–0.5**	10 mΩ + 80 μH	2.0 MΩ + 0.5 μF	1.4	453.00	16	7.2
OPS 6–10M	**0–6**	**0–10**	30 μΩ + 50 μH	0.1 MΩ + 10.0 μF	2.4	$538.00	19	8.6
OPS 15–6M	**0–15**	**0–6**	125 μΩ + 50 μH	0.16 MΩ + 6.0 μF	2.4	538.00	19	8.6
OPS 25–4M	**0–25**	**0–4**	312 μΩ + 50 μH	0.25 MΩ + 4.0 μF	2.4	538.00	19	8.6
OPS 36–3M	**0–36**	**0–3**	0.6 mΩ + 80 μH	0.33 MΩ + 3.0 μF	2.4	538.00	19	8.6
OPS 55–2M	**0–55**	**0–2**	1.4 mΩ + 80 μH	0.5 MΩ + 2.0 μF	2.4	538.00	19	8.6
OPS 75–1.5M	**0–75**	**0–1.5**	2.5 mΩ + 80 μH	0.65 MΩ + 1.5 μF	2.4	538.00	19	8.6
OPS 100–1M	**0–100**	**0–1**	5 mΩ + 80 μH	1.0 MΩ + 1.0 μF	2.4	538.00	19	8.6

[1] This d-c value is for current feedback to the voltage control channel with external (1 volt) sensing. The d-c value for the internal current control channel is E_o/3 mA.

INFLUENCE QUANTITY		UNCOMMITTED CONTROL CHANNEL OFFSET VOLTAGE ΔE_{io}	UNCOMMITTED CONTROL CHANNEL OFFSET CURRENT ΔI_{io}	INTERNALLY SENSED CURRENT CONTROL CHANNEL	REFERENCE + 6.2V ± 5% NOMINAL
SOURCE: 105–125V a-c		<5 μV	<1 nA	<0.005% or 25 μA[3]	0.0001%
LOAD: No load – full load		<100 μV[2]	<5 nA	<3 mA	–
TIME: 8-hour [drift]		<20 μV	<1 nA	<0.05% or 0.1 mA[3]	0.005%
TEMPERATURE: Per °C		<20 μV	<2 nA	<0.05% or 0.1 mA[3]	0.005%
UNPROGRAMMED OUTPUT DEVIATION:[4] (Ripple and noise)	rms	<0.01% of E_o or 3 mV[3]		<0.02% or 0.5 mA[3]	–
	p-p[5]	<0.05% of E_o or 10 mV[3]		<0.08% or 2.0 mA[3]	–

[2] ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.

[3] Whichever is greater.

[4] One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.

[5] 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: OPS IV and V are full range, operationally programmable power supplies. They can be set or programmed to any level within their rated range and can be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 10^6 volts per volt.

CONTROL/PROGRAMMING: A built-in feedback rheostat senses the voltage at the negative (–) output/sense terminal. OPS models Groups IV and V have a fixed 1.0 milliampere d-c control current connected to their input summing terminal. This current passes through the feedback rheostat so that output control is exercised at 1000 ohms per volt. Both the feedback rheostat and the input 1 milliampere d-c control current can be disconnected (by removing the jumpers on the mating plug) so that an external d-c control signal can be applied as if to an inverting amplifier and/or the feedback can be taken from another point to stabilize various physical phenomena (heat, speed, force, electrochemical action. . .).

OFFSETS: The equivalent offset voltage and current variations for OPS IV and V are tabulated for the effect of changes in source, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference E_r.

VOLTAGE/CURRENT STABILIZATION: Refer to the specifications for JMK in the *General Purpose* section in the Kepco Catalog.

OFFSET NULLING: The initial or bias part of the voltage control channel's voltage offset (E_{io}) can be nulled (zeroed) by a built-in trimmer accessible at the rear.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT CONTROL CHANNEL

OPS Groups IV and V will stabilize current by means of an independent control channel which functions with feedback from a built-in current sensing resistor.

OUTPUT RANGE: Current is controlled by a panel-mounted 10-turn precision potentiometer with a range of 2% I_o max to 100% I_o max.

For a wider current control range, the voltage control channel may be connected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. An external feedback rheostat will control current from approximately 1 microampere to 100% I_o max. Note: The range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio.

CONTROL/PROGRAMMING: A separate channel is provided for external current programming. This channel uses the built-in current-sensing resistor, but is externally controlled by either a voltage or a remote potentiometer. The front panel current control serves as an overriding backup current limit.

MODE FLAG (a d-c signal referred to plus (+) sense):

Voltage mode: ⩾5V d-c; source impedance: 5 k ohms.

Current mode: ⩽0V d-c.

A pair of panel lamps indicate whether the voltage channel or the internally-sensed current channels have control of the output.

DYNAMICS

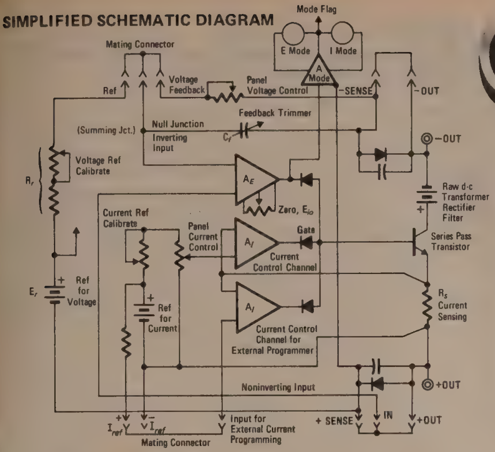
MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): More than 1 volt per microsecond.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 800 pF to 1600 pF.

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: f max. = $10^6/\pi E_{pp}$, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB point on the frequency response curve is given by the programming time constant.

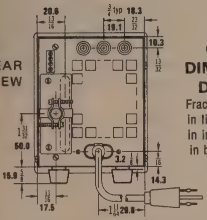
Data and prices subject to change without notice

SIMPLIFIED SCHEMATIC DIAGRAM


Mode Flag
Mating Connector
E Mode
I Mode
A Mode
Ref
Voltage Feedback
Panel Voltage Control
–SENSE
–OUT
Feedback Trimmer
Null Junction
(Summing Jct.)
Inverting Input
C_f
–OUT
Voltage Ref Calibrate
R_r
A_E
Zero, E_{io}
Raw d-c Transformer Rectifier Filter
Current Ref Calibrate
Panel Current Control
A_I
Gate
Series Pass Transistor
Current Control Channel
Ref for Voltage
E_r
Ref for Current
A_I
R_s Current Sensing
Current Control Channel for External Programmer
Noninverting Input
+OUT
I_{ref}
V_{ref}
Mating Connector
Input for External Current Programming
+ SENSE
IN
+OUT

TM
KEPCO POWER SUPPLY
VOLTAGE
CURRENT

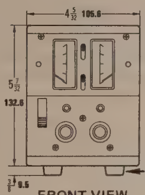
Typical OPS IV & V Model


EAR
IEW
20.6
13/16
3/4 typ
18.3
19.1
23/32
10.3
13/32
1 31/32
50.0
3.2
9/16
14.3
15.9
5/8
11/16
17.5
1 11/64 29.8

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

Allow 2" Bend Radius for Line Cord.

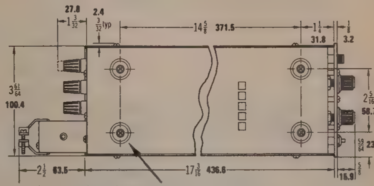

4 5/32 105.6
5 7/32
132.6
3/8 9.5

Remove feet for Rack Mounting

FRONT VIEW

Tolerance:
±1/64" (0.4) between mounting holes.
±1/32" (0.8) other dimensions.
Panels: Per Mil. Std. 189

BOTTOM VIEW


27.8
1 3/32
2.4
3/32 typ
14 5/8 371.5
1 1/4
31.8
1/8
3.2
3 61/64
100.4
2 5/16
58.7
59/64 23.4
15.9
5/8
2 1/2 63.5
17 3/16 436.6

To Rack Mount, remove feet and use (4) 8-18 x 5/8" Thread Cutting Screws into plastic inserts.

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:
Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:
The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS Group IV and V model.

LOAD REACTANCE: Operational power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit without loss of speed. To drive larger capacitances, external voltage-feedback and/or output capacitance will be required to stabilize the OPS as a conventionally filtered power supply. See Kepco's JMK Design Group. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

GENERAL

SOURCE POWER INPUT: Units are factory-wired for 105–125V a-c. A switch enables changeover to 210–250V a-c, 50–65 Hz, protected by a resettable circuit breaker. A 3-wire line cord is provided.

ISOLATION FROM GROUND: The circuit of OPS models in Groups IV and V is isolated from its case and ground. It may be placed in series with up to 500 volts d-c (or peak) off ground. Common mode current from output to ground less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Full output current is delivered at +71°C without derating. Cooling is aided by a built-in, sealed-bearing blower, exhausting to the rear.

STANDARDS: The OPS Groups IV and V models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS AND CONNECTIONS: All sensing and control connections to OPS models, Groups IV and V are made via a rear-mounted plug connector. A mating connector is supplied, wired with jumpers for local control and sensing. D-C output connections are made via rear-mounted "5-way" binding posts. The mating connector is Kepco Model PC–4. Extra PC–4 connectors are $10.00 each.

METERS: Two dual-range, 2-inch, ±3% recessed meters monitor the (average) output voltage and current. Panel switches provide a 10:1 range of sensitivity.

MOUNTING: OPS IV and V are "quarter-rack" sized and mount up to four abreast in the Kepco RA–24 rack mounting drawer. Up to two OPS IV or V models can be mounted side-by-side in Kepco rack mounting drawer RA–32, with space for up to three "one-sixth rack" plug-in power supplies.

Model RA–24 Rack Adapter	Price: $25.00.
Model RA–32 Rack Adapter	Price: $75.00.

RA–24 and RA–32 are predrilled for Jonathan slides, type 110 QD 20-2, 22-2, 24-2.

DIMENSIONS

English measure: 5 7/32"H x 4 5/32"W x 17 3/16" D.*

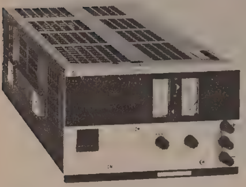
Metric measure: 132.6 H x 105.6 W x 436.6 D mm.

See outline drawings. * (add 2½" for connector)

FINISH: *Panel:* Two-tone black and light gray. (Color No. 26440, Fed. Std. 595).
Case: Textured dark charcoal gray.

OPS VI-VII-VIII KEPCO OPERATIONAL POWER SUPPLIES

OPS group VI



Typical OPS VI and VII half-rack model.

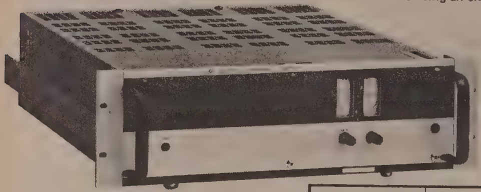
MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OUTPUT IMPEDANCE VOLTAGE MODE d-c OHMS + SERIES L	OUTPUT IMPEDANCE CURRENT MODE (1) d-c OHMS + SHUNT C	SOURCE CURRENT at 125 V a-c	PRICE	SHIP WGT. lbs.	SHIP WGT. kg.
OPS 6–45M	0–6	0–45	7 μΩ + 75 μH	11 kΩ + 900 μF	9.0	$908.00	56	25.4
OPS 15–25M	0–15	0–25	30 μΩ + 75 μH	20 kΩ + 500 μF	8.4	908.00	56	25.4
OPS 25–20M	0–25	0–20	63 μΩ + 75 μH	25 kΩ + 400 μF	10.5	908.00	56	25.4
OPS 36–15M	0–36	0–15	120 μΩ + 50 μH	33 kΩ + 150 μF	9.5	908.00	52	23.6
OPS 55–10M	0–55	0–10	275 μΩ + 50 μH	50 kΩ + 100 μF	9.0	908.00	52	23.6
OPS 75–8M	0–75	0–8	469 μΩ + 30 μH	62 kΩ + 80 μF	10.0	935.00	52	23.6
OPS 100–5M	0–100	0–5	1.25 mΩ + 25 μH	100 kΩ + 50 μF	8.4	935.00	52	23.6
OPS 150–3.5M	0–150	0–3.5	2.2 mΩ + 25 μH	142 kΩ + 35 μF	8.7	994.00	52	23.6

(1) Current mode using an external current sensing and feedback circuit. Impedance data based on a 1-volt sample.

OPS group VII

OPS 6–22M	0–6	0–22	14 μΩ + 50 μH	22.5 kΩ + 440 μF	4.2	$773.00	42	19.1
OPS 15–12M	0–15	0–12	63 μΩ + 50 μH	33 kΩ + 120 μF	4.0	773.00	42	19.1
OPS 25–10M	0–25	0–10	125 μΩ + 50 μH	50 kΩ + 100 μF	5.3	773.00	42	19.1
OPS 36–8M	0–36	0–8	225 μΩ + 30 μH	63 kΩ + 80 μF	6.0	773.00	42	19.1
OPS 55–5M	0–55	0–5	550 μΩ + 25 μH	100 kΩ + 50 μF	5.0	773.00	42	19.1
OPS 75–3M	0–75	0–3	1.25 mΩ + 20 μH	167 kΩ + 30 μF	4.0	773.00	42	19.1
OPS 100–2.5M	0–100	0–2.5	2 mΩ + 20 μH	200 kΩ + 25 μF	4.5	773.00	42	19.1
OPS 150–1.5M	0–150	0–1.5	5 mΩ + 15 μH	330 kΩ + 15 μF	4.6	806.00	42	19.1

(1) Current mode using an external current sensing and feedback circuit. Impedance data based on a 1-volt sample.



Typical OPS VIII full-rack model.

OPS group VIII

OPS 6–90M	0–6	0–90	3.5 μΩ + 100 μH	5.5 kΩ + 1800 μF	15.7	$1,392.00	103	46.8
OPS 15–50M	0–15	0–50	15 μΩ + 100 μH	10 kΩ + 1000 μF	16.6	1,392.00	103	46.8
OPS 25–40M	0–25	0–40	31 μΩ + 100 μH	12.5 kΩ + 800 μF	21.0	1,392.00	103	46.8
OPS 36–30M	0–36	0–30	60 μΩ + 75 μH	16.6 kΩ + 600 μF	19.0	1,392.00	98	44.5
OPS 55–20M	0–55	0–20	138 μΩ + 75 μH	25 kΩ + 400 μF	18.0	1,419.00	98	44.5
OPS 75–15M	0–75	0–15	250 μΩ + 50 μH	33 kΩ + 150 μF	18.0	1,419.00	98	44.5
OPS 100–10M	0–100	0–10	620 μΩ + 50 μH	50 kΩ + 100 μF	17.0	1,419.00	98	44.5
OPS 150–7M	0–150	0–7	1.1 mΩ + 50 μH	73 kΩ + 70 μF	18.0	1,449.00	98	44.5

(1) Current mode using an external current sensing and feedback circuit. Impedance data based on a 1-volt sample.

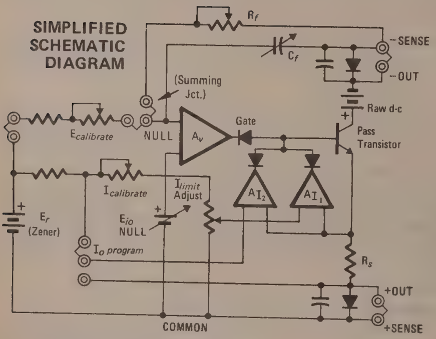
A high-gain, single-channel, wide-band power supply which can be configured for a variety of signal processing chores, OPS Groups VI and VII are "half-rack" sized, OPS Group VIII is a full (19") rack width for systems or bench use. They are equipped with meters and a 10-turn voltage control. The I-C front end in the control channel contributes very low offsets for accurate tracking of control signals. The low shunt capacitance output allows for rapid voltage programming or fast current-stabilized load recovery.

NOTE: OPS Models are *not* general purpose power supplies.

INFLUENCE QUANTITY		VOLTAGE CONTROL CHANNEL OFFSET VOLTAGE ΔE_{io}	VOLTAGE CONTROL CHANNEL OFFSET CURRENT ΔI_{io}	REFERENCE ±6.2V±5% NOMINAL
SOURCE: 105–125V a-c		<10 μV	<2 nA	<0.0001%
LOAD: No load – full load		<200 μV(1)	<5 nA	—
TIME: 8-hour [drift]		<20 μV	<2 nA	<0.005%
TEMPERATURE: Per °C		<20 μV	<5 nA	<0.005%
UNPROGRAMMED (3) OUTPUT DEVIATION: (Ripple and noise)	rms	<0.02 % of E_o — or 6 mV(2)		—
	p-p(4)	<0.25 % of E_o — or 50 mV(2)		—

(1) ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.
(2) Whichever is greater.
(3) One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.
(4) 20 Hz to 10 MHz.

SIMPLIFIED SCHEMATIC DIAGRAM



VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: OPS VI, VII, and VIII are full range, operationally programmable power supplies. They can be set or programmed to any level within their rated range and can be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 0.5 x 10^6 volt/volt.

CONTROL/PROGRAMMING: A built-in feedback rheostat senses the voltage at the negative (–) output/sense terminal. OPS Groups VI, VII and VIII models have a fixed 1.0 milliampere d-c control current connected to their input summing terminal. This current

Data and prices subject to change without notice

passes through the feedback rheostat so that output control is exercised at 1000 ohms per volt. Both the feedback rheostat and the input 1 milliampere d-c control current can be disconnected (by removing jumpers on the rear barrier-strip) so that an external d-c control signal can be applied as if to an inverting amplifier and/or the feedback can be taken from another point to stabilize various physical phenomena, heat, speed, force, electrochemical action. . . .

OFFSETS: The equivalent offset voltage and current variations for OPS Groups VI, VII, and VIII are tabulated for the effect of changes in source, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback rheostat and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the voltage control channel's voltage offset (E_{io}) can be nulled (zeroed) by a built-in trimmer.

VOLTAGE/CURRENT STABILIZATION: Refer to the specifications for JQE in the Kepco catalog.

REFERENCE: +6.2V d-c ±5% with respect to the plus (+) error-sense terminal, capable of supplying up to 1 milliampere.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT CONTROL CHANNEL

The output current of OPS Groups VI, VII and VIII is *limited* by a built-in current sensing and feedback arrangement. This channel offers approximately 2% current stabilization as a maximum current limiter.

CONTROL/PROGRAMMING: A separate channel is provided for external current programming. This channel uses the built-in current-sensing resistor, but is externally controlled by either a voltage or a remote potentiometer. The front panel current control serves as an overriding backup current limit. For the precision control of current, the voltage control channel may be connected so as to sample the drop across an external current-sensing resistor in the plus (+) output lead. An external rheostat will control current from approximately 1 microampere to 100% I_o max. Note: The range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): More than 100V per millisecond for models rated less than 20 amperes; more than 50V per millisecond for models rated 20 amperes and greater.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally are: 2500 pF to 3500 pF, except the 6V and 15V models are shunted by approximately 5000 pF.

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: f max. = slewing rate/πE_{pp}, where E_{pp} is the peak-to-peak modulation voltage. The −3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS VI, VII, and VIII model.

LOAD REACTANCE: Operational power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit without loss of speed. To drive larger capacitances, external voltage feedback and/or output capacitance will be required to stabilize the OPS as a conventionally filtered power supply. See Kepco's JQE Design Group. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

GENERAL

SOURCE POWER INPUT: Units are factory wired for 105–125V a-c, 50–65 Hz. A simple jumper change reconfigures the input for 210–250V a-c. The input is protected with a resettable circuit breaker. A 3-wire line cord is provided. OPS Groups VI and VII are terminated in plug Pattern No. 1 and OPS Group VIII is terminated in plug Pattern No. 2. (See page 111 of the Kepco Catalog.)

ISOLATION FROM GROUND: The circuit of OPS models in Groups VI, VII and VIII is isolated from its case and ground. It may be placed in series with up to 500 volts d-c (or peak) off ground. Common-mode current from output to ground is less than 5 microamperes rms, 50 microamperes p-p at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +71°C. Full output current is delivered at +71°C without derating. Cooling is aided by a built-in, sealed-bearing blower, exhausting to the rear.

STANDARDS: OPS VI, VII and VIII models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS AND CONNECTIONS: All sensing and control connections to OPS Groups VI, VII and VIII models are at the rear. The d-c output connections are binding posts, the reference, feedback and signal input terminations are on a barrier-strip. Models with output current of 15 amperes or less, have front panel output binding posts.

METERS: Two dual range, 2-inch, ±3% recessed meters monitor the (average) output voltage and current. Panel switches provide a 10:1 range of sensitivity.

MOUNTING: OPS VI and VII models are "half-rack" sized and mount up to two abreast in the Kepco RA–24 rack mounting drawer. A single "half-rack" model can be combined with up to three one-sixth width models in the RA–32 drawer.

Model RA–24 Rack Adapter	Price: $25.00.
Model RA–32 Rack Adapter	Price: $75.00.

RA–24 and RA–32 are predrilled for Jonathan slides, type 110 QD 20-2, 22-2 or 24-2.

OPS Group VIII models are "full-rack" sized and have accessory flanges for direct installation in standard 19-inch racks. They are predrilled for slides, Jonathan type 110 QD 21-1, 22-1, 24-1.

DIMENSIONS

(Refer to JQE Design Group for outline dimensional drawings).

English measure:

Group VI and VII:	5 7/32"H x 8 11/32"W x 17 3/8"D (behind panel)
Group VIII:	5 7/32"H x 19"W x 17 1/64"D (behind panel)

Metric measure:

Group VI and VII:	132.6 H x 211.9 W x 441.3 D mm.
Group VIII:	132.6 H x 482.6 W x 432.2 D mm.

FINISH: *Panel:* Two-tone black and light gray.
(Color No. 26440, Fed. Std. 595.)
Case: Textured dark charcoal gray.

KEPCO OPERATIONAL POWER SUPPLIES

OPS group IXB

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		PRICE	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE (1) d-c OHMS + SHUNT C		lbs.	kg.
OPS 500B	0–500	0–0.04	2.2 Ω + 100 mH	125 MΩ + 0.04 μF	$531.00	19	8.6
OPS 1000B	0–1000	0–0.02	9.0 Ω + 100 mH	250 MΩ + 0.02 μF	531.00	19	8.6
OPS 2000B	0–2000	0–0.01	34.0 Ω + 100 mH	500 MΩ + 0.01 μF	531.00	19	8.6

(1) This d-c value is for current feedback to the uncommitted control channel with external (10 volt) sensing.

The three high voltage operational power supplies designated collectively as OPS-IXB feature:

1) A low-drift, integrated front end.
2) An added "Free Amplifier" to simplify certain operational control manipulations.
3) A timed on-off circuit.
4) Front and rear safety shields for personnel protection.

NOTE: OPS models are *not* general purpose power supplies.

INFLUENCE QUANTITY		UNCOMMITTED CONTROL CHANNEL		CURRENT CONTROL CHANNEL OUTPUT EFFECTS	REFERENCE ±6.2V ± 5% NOMINAL
		OFFSET VOLTAGE ΔE_{io}	OFFSET CURRENT ΔI_{io}		
SOURCE: 105–125V a-c		<10 μV	<1 nA	<10 μA	<0.0005%
LOAD: No load – full load		<10 μV (2)	<1 nA	<10 μA	–
TIME: 8-hour [drift]		<20 μV	<1 nA	<0.01% of I_o max	<0.005%
TEMPERATURE: Per °C		<20 μV	<0.5 nA	<0.01% of I_o max	<0.005%
UNPROGRAMMED OUTPUT DEVIATION: (4) (Ripple and noise)	rms	<0.01% of E_o — or 15 mV (3)		<50 μA	–
	p-p (5)	<0.1% of E_o — or 150 mV (3)		<250 μA	–

(2) ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.
(3) Whichever is greater.
(4) One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.
(5) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: OPS–IXB are full-range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 10^6 volts per volt.

CONTROL/PROGRAMMING: A built-in fixed feedback resistor (0.5 MΩ: OPS 500B, 1 MΩ: OPS 1000B, 2 MΩ: OPS 2000B) senses the voltage at the negative (–) output/sense terminal. A 0–1 mA control current connected to the input summing terminal programs the d-c output throughout the rated range. This current, with respect to the plus (+) sense terminal, which is common, may be externally generated–as from a function generator–or may be derived from a built-in "free amplifier." The built-in free amplifier, together with the built-in 6.2V reference, allow for low-level, passive-element control over the OPS–IXB output. A simple rheostat supporting 0–5 volts will control the high voltage output linearly through its entire range. The internal feedback resistance can be easily disconnected so that feedback can be taken from another point to stabilize various physical phenomena (heat, speed, force, current, electrochemical action . . . etc.).

OFFSETS: The equivalent offset voltage and current variations for OPS–IXB are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm\ \Delta E_r\,(R_f/R_i)\ \pm\ \Delta E_{io}\,(1 + R_f/R_i)\ \pm\ \Delta I_{io}\,(R_f)$$

where R_f is the feedback resistor and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the voltage control channel's voltage offset (E_{io}) and offset current (I_{io}) can be nulled (zeroed) by a built-in trimmer.

REFERENCE: A pair of ±6.2V ±5% 1 milliampere references referred to the plus (+) output/sense terminal are provided for offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT CONTROL CHANNEL

Output current is controlled by a built-in current sensing and feedback circuit compensated to account for the shunting effect of the voltage feedback circuit. The stabilization of this channel against the four major influences is tabulated.

OUTPUT RANGE: Current is controlled by a recessed trimmer accessible through the front panel. The range of this control is 2% I_o max to 100% I_o max. For a wider current control range, the voltage control channel may be connected so as to sample the drop across an external current-sensing resistor to obtain current feedback. Based on a 10-volt sample, control can be exercised from approximately 1 microampere to the maximum output current.

CONTROL/PROGRAMMING: The current control channel may be controlled externally by an analog voltage (0–1 volt for full scale current) or by means of a potentiometer divider across the internal reference. Control of the current is referred to the positive (+) output terminal.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): More than 1V per μsec.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 400 pF to 3900 pF.

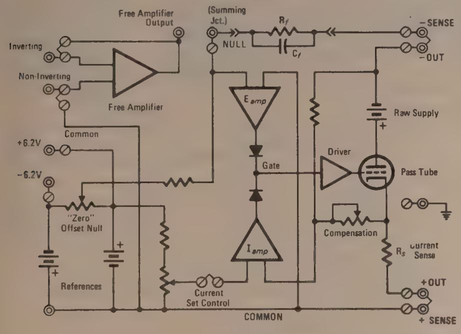
FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: f max. = $10^6/\pi E_{pp}$, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS–IXB model.

Data and prices subject to change without notice


Free Amplifier Output
(Summing Jct.)
R_f
− SENSE
Inverting
NULL
C_f
− OUT
Non-Inverting
Free Amplifier
E_{amp}
Raw Supply
Common
+6.2V
Driver
−6.2V
Gate
Pass Tube
"Zero" Offset Null
I_{amp}
Compensation
R_s
Current Sense
References
+ OUT
Current Set Control
COMMON
+ SENSE

SIMPLIFIED SCHEMATIC DIAGRAM

⊘ Rear Barrier Strip
◎ Panel Binding Posts

LOAD REACTANCE: Operational power supplies should be restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

GENERAL

SOURCE POWER INPUT: Units are factory-wired for 105–125V a-c, 60 Hz source power. Internal jumpers will reconfigure the input for 210–250V a-c. Power consumption is approximately 75 watts. Power factor 0.9. Protected by a built-in fuse. A 3-wire line cord is provided.

ISOLATION FROM GROUND: The circuit is isolated from its case and ground. It may be placed in series with up to 1000 volts d-c (or peak) off ground. Common-mode current from output to ground is less than 30 microamperes rms, 300 microamperes peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +65°C. Cooling is by natural convection. Full output current is delivered at +65°C; no derating or external heat sink is required.

STANDARDS: OPS–IXB models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

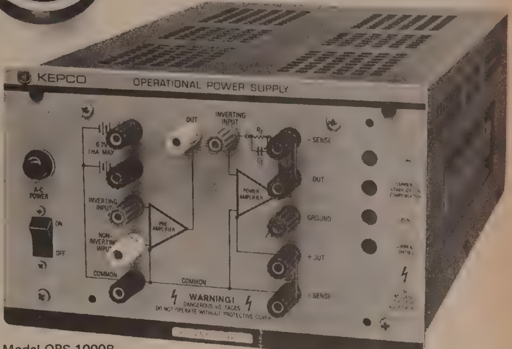
TERMINALS: D-C output, signal input, and feedback connections are made on a 12-terminal patch board on the front panel, which is superimposed over a schematic representation of the OPS–IXB circuit. For systems use, the connections are duplicated through two barrier-strips located at the rear

MOUNTING: OPS–Group IXB models are "half-rack" sized for bench top use or rack mounting in either the RA–24 or RA–32 Hardware Systems. Please refer to the *Hardware* section of the Kepco Catalog for descriptions. Note: Transparent plastic shields are provided for front panel binding posts and rear barrier-strips.

DIMENSIONS

English measure: 5$\frac{7}{32}$" H x 8$\frac{11}{32}$" W x 12$\frac{7}{8}$" D (behind panel).
Metric measure: 132.6 H x 211.9 W x 327.0 D mm.
See outline drawings.

FINISH: *Panel:* Gray, Color 26440, Fed. Std. 595.
Case: Textured dark charcoal gray.

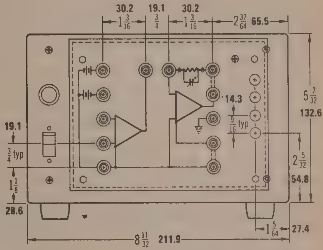

KEPCO
OPERATIONAL POWER SUPPLY
A-C POWER
ON
OFF
INVERTING INPUT
OUT
NON-INVERTING INPUT
COMMON
PRE AMPLIFIER
POWER AMPLIFIER
− SENSE
OUT
GROUND
+ OUT
+ SENSE
WARNING!
DANGEROUS VOLTAGES
DO NOT OPERATE WITHOUT PROTECTIVE COVER

Model OPS 1000B

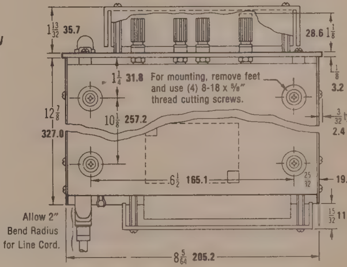
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.
Tolerance: ±1/64" (**0.4**) between mounting holes.
±1/32" (**0.8**) other dimensions.
Panels: Per Mil. Std. 189

FRONT VIEW


30.2
19.1
30.2
1 3/16
3/4
1 3/16
2 37/64
65.5
5 7/32
132.6
14.3
9/16 typ
19.1
3/4 typ
2 5/32
54.8
1 1/8
28.6
1 5/64
27.4
8 11/32
211.9

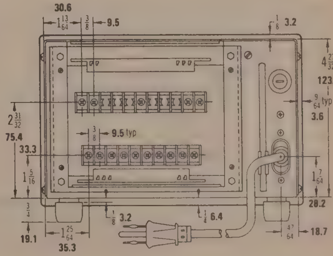
BOTTOM VIEW


1 13/32
35.7
28.6
1 1/8
1 1/4
31.8
1/8
3.2
12 7/8
327.0
10 1/8
257.2
3/32 typ
2.4
6 1/2
165.1
25/32
19.9
15/32
11.9
8 5/64
205.2

For mounting, remove feet and use (4) 8-18 x 3/8" thread cutting screws.

Allow 2" Bend Radius for Line Cord.

REAR VIEW


30.6
1 13/64
3/8
9.5
1/8
3.2
4 27/32
123.0
9/64 typ
3.6
2 31/32
75.4
3/8
9.5 typ
33.3
1 5/16
1 7/64
28.2
3/4
19.1
1/8
3.2
1/4
6.4
1 25/64
35.3
47/64
18.7

KEPCO OPERATIONAL POWER SUPPLIES

OPS
group X

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		PRICE	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE FEEDBACK d-c OHMS + SERIES L	CURRENT MODE d-c OHMS + SHUNT C		lbs.	kg.
OPS 3500	0–3500	0–10 mA	0.5 Ω + 0.1 H	350 MΩ + 3.3×10^{-9} F	$1,137.00	45	20.4
OPS 5000	0–5000	0– 5 mA	1.6 Ω + 0.1 H	500 MΩ + 1.6×10^{-9} F	1,283.00	45	20.4

Kepco operational power supplies are a unique concept in power instrumentation. They are d-c power supplies, fully able to stabilize a voltage or current against the effects of load, source or temperature changes, yet able to respond with agility to programming signals requiring swift changes in the output.

OPS–X is a bench/system rack-type high voltage instrument, featuring a low drift integrated front end, transistor drivers and vacuum tube high voltage stage. The OPS–X features a "free-amplifier," which allows its output to be controlled by a small signal passive control.

NOTE: OPS Models are *not* general purpose power supplies.

INFLUENCE QUANTITY		VOLTAGE CONTROL CHANNEL		CURRENT CONTROL CHANNEL OUTPUT EFFECTS	REFERENCE ±6.2V ± 5% NOMINAL
		OFFSET VOLTAGE ΔE_{io}	OFFSET CURRENT ΔI_{io}		
SOURCE: 105–125V a-c		<10 μV	<1 nA	<10 μA	<0.0005%
LOAD: No load – full load		<10 μV(1)	<1 nA	<10 μA	–
TIME: 8-hour [drift]		<20 μV	<1 nA	<0.01% of I_o max	<0.005%
TEMPERATURE: Per °C		<20 μV	<0.5 nA	<0.01% of I_o max	<0.005%
UNPROGRAMMED OUTPUT DEVIATION:(3) (Ripple and noise)	rms	<0.01% of E_o — or 35 mV(2)		<50 μA	–
	p-p(4)	<0.1% of E_o — or 150 mV(2)		<500 μA	–

(1) ΔE_{io} for load in current stabilization mode ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.
(2) Whichever is greater.
(3) One terminal must be grounded or connected so that common mode current does not flow through the load or through a current- sensing resistor.
(4) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: OPS–X are full-range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 10^6 volts per volt.

CONTROL/PROGRAMMING: A built-in fixed feedback resistor (3.5 megohms for OPS 3500; 5 megohms for OPS 5000) senses the voltage at the negative (–) output/sense terminal. A 0–1 milliampere control current connected to the input summing terminal programs the d-c output throughout the rated range. This current, with respect to the plus (+) sense terminal, which is common, may be externally generated—as from a function generator—or may be derived from a built-in uncommitted op-amp. The built-in uncommitted amplifier, together with the built-in 6.2V reference, allow for low-level, passive-element control over the OPS–X output. A simple rheostat supporting 0–5 volts will control the high voltage output linearly through its entire range. The internal feedback resistance can be easily disconnected so that feedback can be taken from another point to stabilize various physical phenomena (heat, speed, force, current, electrochemical action . . . etc.).

OFFSETS: The equivalent offset voltage and current variations for OPS–X are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback resistor and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the voltage control channel's voltage offset (E_{io}) and offset current (I_{io}) can be nulled (zeroed) by a built-in trimmer.

REFERENCE: A pair of ±6.2V ±5%, 1 milliampere references referred to the plus (+) output/sense terminal are provided for offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT CONTROL CHANNEL

Output current is controlled by a built-in current sensing and feedback circuit compensated to account for the shunting effect of the voltage feedback circuit. The stabilization of this channel against the four major influences is tabulated.

OUTPUT RANGE: Current is controlled by a recessed trimmer accessible from the rear through an interlocked door. The range of this control is 2% I_o max to 100% I_o max. For a wider current control range, the voltage control channel may be connected so as to sample the drop across an external current-sensing resistor to obtain current feedback. Based on a 10-volt sample, control can be exercised from approximately 1 microampere to the maximum output current.

CONTROL/PROGRAMMING: The current control channel may be controlled externally by an analog voltage (0–1 volt for full scale current) or by means of a potentiometer divider across the internal reference. Control of the current is referred to the positive (+) output terminal.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): More than 3V per μsec.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 200 pF to 1900 pF.

FREQUENCY RESPONSE: The maximum modulation frequency is given by the expression: $f \text{ max.} = 3 \times 10^6/\pi E_{pp}$, where E_{pp} is the peak-to-peak modulation voltage. The –3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS–X model.

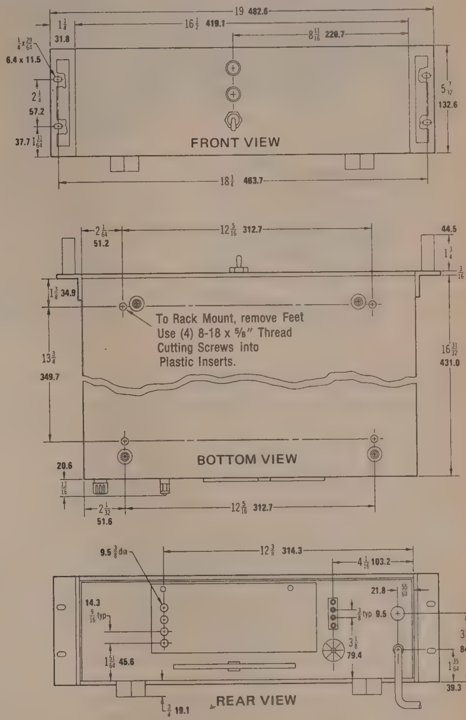
Data and prices subject to change without notice

KEPCO POWER SUPPLY

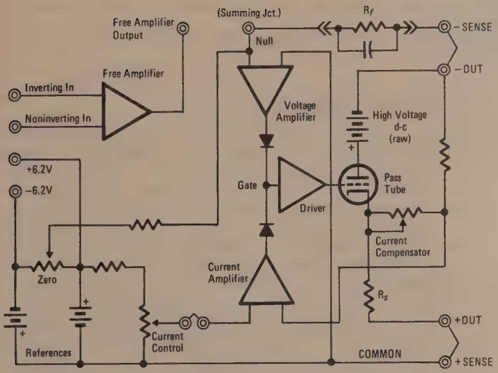
Model OPS 5000

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.
Tolerance: ±1/64" (**0.4**) between mounting holes.
±1/32" (**0.8**) other dimensions.
Panels: Per Mil. Std. 189


19 482.6
16½ 419.1
8 11/16 220.7
1¼ 31.8
¼ x 29/64 6.4 x 11.5
2¼ 57.2
37.7 1 31/64
5 7/32 132.6
FRONT VIEW
18¼ 463.7
2 1/64 51.2
12 5/16 312.7
44.5
1¾
3/16 4.8
1⅜ 34.9
To Rack Mount, remove Feet Use (4) 8-18 x ⅝" Thread Cutting Screws into Plastic Inserts.
13¾ 349.7
16 31/32 431.0
BOTTOM VIEW
20.6
13/16
2 1/32 51.6
12 5/16 312.7
9.5 ⅜ dia
12⅜ 314.3
4 1/16 103.2
21.8 55/64
14.3
9/16 typ
⅜ typ 9.5
3⅛ 79.4
1 51/64 45.6
3 5/16 84.1
1 35/64 39.3
¾ 19.1
REAR VIEW

all KEPCO
products are
backed by a firm
5-Year
Warranty


Free Amplifier Output
(Summing Jct.)
R_f
–SENSE
Null
–OUT
Free Amplifier
Inverting In
Noninverting In
Voltage Amplifier
High Voltage d-c (raw)
+6.2V
–6.2V
Gate
Pass Tube
Driver
Current Compensator
Zero
Current Amplifier
R_s
+OUT
References
Current Control
COMMON
+SENSE

SIMPLIFIED SCHEMATIC DIAGRAM

LOAD REACTANCE: Operational power supplies should be restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

GENERAL

SOURCE POWER INPUT: Units are factory-wired for 105–125V a-c, 60 Hz source power. An internal switch will reconfigure the input for 210–250V a-c. Model OPS 5000, which uses a resonant power transformer, will function on 60 Hz ±3 Hz only. A special model is required for use in a 50 hertz service area. To order, append the suffix "–50" to the model number for a 210–250V a-c, 50 Hz ±3 Hz source input, and add $25.00 to the unit price. Power consumption is approximately 125 watts. Power factor 0.9. Protected by a built-in fuse. A 3-wire line cord is provided. terminated in plug Pattern No. 1. (See page 111 of the Kepco Catalog.)

ISOLATION FROM GROUND: The circuit is isolated from its case and ground. It may be placed in series with up to 1000 volts d-c (or peak) off ground. Common-mode current from output to ground is less than 50 microamperes rms, 500 microamperes peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: –40°C to +85°C.

Operating: –20°C to +65°C. Cooling is by natural convection. Full output current is delivered at +65°C; no derating or external heat sink is required.

STANDARDS: OPS–X models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: D-C output, signal input, and feedback connections are made through two recessed, interlocked barrier-strips located at the rear.

MOUNTING: OPS Group X models are "full-rack" sized. Detachable rack mounting "ears" are provided for mounting in standard 19-inch equipment racks. The sides are drilled for equipment slides Jonathan type 110 QD 20-2, 22-2 or 24-2.

DIMENSIONS

English measure: 5 7/32"H x 19 "W x 16 31/32"D.

Metric measure: 132.6 H x 482.6 W x 431.0 D (behind panel). See outline drawings.

FINISH: *Panel;* two-tone black and light gray, Color 26440, Fed. Std. 595. *Case;* textured dark charcoal gray.

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX #710-582-2631 • Cable: KEPCOPOWER NEWYORK

KEPCO POWER SUPPLIES

PAT

MODULAR

These operationally programmable power modules offer a single high-gain control channel for voltage or current stabilization, backed up by an adjustable overcurrent limiter. An I-C front-end contributes to very low offsets for accurate tracking of programming instructions and exceptionally stable output in fixed applications.

all KEPCO products are backed by a firm 5-Year Warranty

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	OUTPUT IMPEDANCE CURRENT MODE [1] d-c OHMS + SHUNT C	PRICE	SHIP WGT. lbs.	SHIP WGT. kg.
PAT 7–2	0–7	0–2	0.2 mΩ + 1 μH	250 kΩ + 2.9 kμF	$164.00	6	2.7
PAT 15–1.5	0–15	0–1.5	0.5 mΩ + 1 μH	333 kΩ + 2.0 kμF	164.00	6	2.7
PAT 21–1	0–21	0–1	1 mΩ + 1 μH	500 kΩ + 1.4 kμF	164.00	6	2.7
PAT 40–0.5	0–40	0–0.5	4 mΩ + 1 μH	1 MΩ + 950 μF	164.00	6	2.7
PAT 72–0.3	0–72	0–0.3	12 mΩ + 1 μH	1.6 MΩ + 375 μF	164.00	6	2.7
PAT 100–0.2	0–100	0–0.2	25 mΩ + 1 μH	2.5 MΩ + 275 μF	164.00	6	2.7

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE [1]	OFFSET VOLTAGE ΔE_{io}	OFFSET CURRENT ΔI_{io}	VOLTAGE REFERENCE (INTERNAL)
SOURCE: 105–125/210–250V a-c		<0.0005%	<0.005%	<10 μV	<2 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.2 mV[2]	<0.01%	<200 μV	<5 nA	–
TIME: 8-hours (drift)		<0.01% or 1 mV[2]	<0.02%	<20 μV	<2 nA	0.005%
TEMPERATURE: Per °C		<0.01%[3]	<0.02%[3]	<20 μV	<5 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:[4] (Ripple and noise)	rms	<0.1 mV	<0.02% of I_o max	–	–	–
	p-p[5]	<0.5 mV	<0.1% of I_o max	–	–	–

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: PAT are full-range, operationally programmable power modules. They can be programmed to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Voltage may be operationally controlled using the built-in stable reference and summing resistance together with an external voltage feedback rheostat. The ratio of reference voltage to input resistance gives a control current of approximately 1 milliampere through the external voltage feedback rheostat, for a control ratio of approximately 1000 ohms per volt. An external trimmer can be used to calibrate this value. Option "–R" provides for a built-in calibrating trimmer. External signals can be substituted for or summed with the internal reference for additional control. The feedback can be derived from other sensors to stabilize current or such physical phenomenon as heat, speed, force or electrochemical action.

Operationally, PAT is a 3-terminal, unipolar, inverting, d-c amplifier in which the plus (+) output/sensing terminal serves as common between the output and an external programming signal.

For control with respect to the minus (–) output-sensing terminal, see Model NTC–200. For isolated digital control, see the type SN digital programmers in the *Programming Accessories* section of the Kepco Catalog.

OFFSETS: The equivalent offset voltage and current variations for PAT are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the external feedback rheostat and R_i is the input resistor from the reference, E_r. Option "–E" offers a means of zeroing the fixed or initial part of the offset voltage, E_{io}, which otherwise is set somewhat negative to insure the ability to program zero.

GAIN: The open-loop d-c gain is in excess of 500,000 volts/volt.

REFERENCE: +6.2V d-c ±5% with respect to the plus (+) error-sense terminal, capable of supplying up to 1 milliampere.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The PAT is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by an internal trimmer over the range 10% to 105% I_o max. Terminals are provided on the barrier-strip of PAT for external control of the current limit function using either a 3-terminal potentiometer or a 0–1 volt control voltage. For the precision control of current, the main control channel may be connected so as to sample the drop across an external current sensing resistor in the plus (+) output lead. An external current feedback rheostat, will control current from 1 milliampere to 100% I_o max. Models equipped with option "–E" can be controlled from approximately 1 microampere to 100% I_o max. Note: The range of currents controlled by any single current-sensing resistor should be limited to a 50:1 ratio. For a similar power supply module, in which the main control channel is committed to current stabilization, please see the CCP models in the Kepco Catalog

DYNAMICS

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 μs.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the CCP group in the Kepco Catalog.

PROGRAMMING SPEED: The rate at which PAT responds to a step-program is determined by the current limit setting, the load resistance and the tabulated output capacitance. For fast programming applications, please see OPS Group I in the *High Speed* section of the Kepco Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The table gives these values for each PAT model.

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[1] External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.

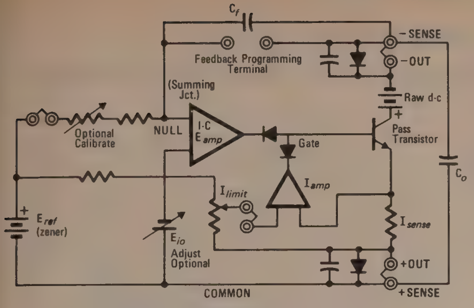
[2] Whichever is greater.

[3] Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.01% per °C externally sensed current mode. See option "–T."

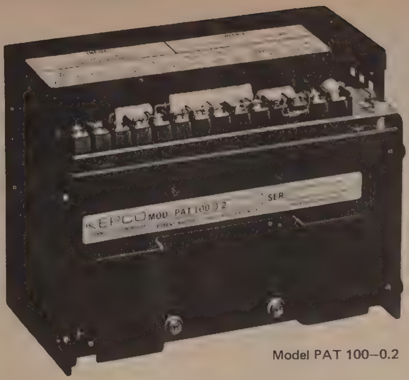
[4] One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor.

[5] 20 Hz to 10 MHz.

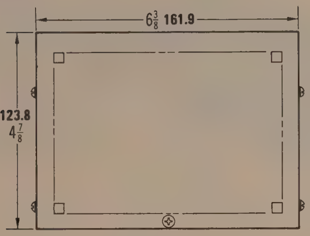
Data and prices subject to change without notice


Cf
Feedback Programming Terminal
(Summing Jct.)
–SENSE
–OUT
Raw d-c
NULL
I-C
E_{amp}
Optional Calibrate
Gate
Pass Transistor
C_o
I_{limit}
I_{amp}
E_{ref} (zener)
E_{io} Adjust Optional
I_{sense}
+OUT
COMMON
+SENSE

SIMPLIFIED SCHEMATIC DIAGRAM



Model PAT 100–0.2

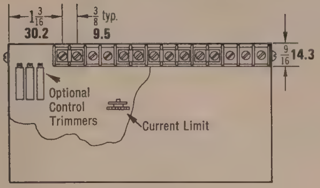

$6\frac{3}{8}$ 161.9
123.8
$4\frac{7}{8}$

REAR VIEW

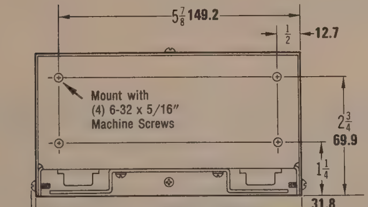
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

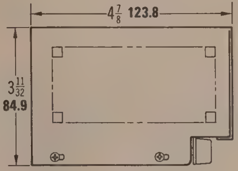
Tolerance:
±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.


$1\frac{3}{16}$
30.2
$\frac{3}{8}$ typ.
9.5
$\frac{9}{16}$ 14.3
Optional Control Trimmers
Current Limit

TOP VIEW


$5\frac{7}{8}$ 149.2
$\frac{1}{2}$ 12.7
Mount with (4) 6-32 x 5/16" Machine Screws
$2\frac{3}{4}$
69.9
$1\frac{1}{4}$
31.8
$\frac{3}{32}$ typ. 2.4

BOTTOM VIEW
(Showing Mounting Holes)


$4\frac{7}{8}$ 123.8
$3\frac{11}{32}$
84.9

SIDE VIEW

GENERAL

SERIES/PARALLEL: PAT modules may be connected together in series, up to the limit of the isolation voltage (500V) or in parallel. Terminals are provided for master/slave interconnection.

ISOLATION FROM GROUND: The circuit and output terminals of PAT have no d-c connection to ground, and may be floated up to 500V (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption, approximately 50W. Power factor: 0.9; internally fused.

TEMPERATURE RATINGS

Storage: –40°C to +85°C.

Operating: –20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: PAT modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: Source power, d-c output, sense and control connections are made on a multiterminal barrier-strip.

MOUNTING: The PAT modules will mount to your chassis using 6-32 hardware to recessed captive nuts.

19-inch rack mounting adapter panels include:
Model RA 26–1 mounts a single module.
Model RA 27–2 mounts two modules.
Model RA 28–4 mounts up to four modules.
Rack adapters are $15.00 each.

DIMENSIONS

English measure: 3¹¹⁄₃₂"H x 6⅜"W x 4⅞"L.
Metric measure: 84.9 H x 161.9 W x 123.8 L mm.
See outline drawings.

FINISH: Black Anodized aluminum.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–E": Zeroing trimmer for the offset voltage of the voltage control channel. Price: $10.00.

Suffix "–R": Calibration control for the voltage channel's control current. Price: $10.00.

Suffix "–T": Lowered temperature effect coefficient: 0.005% per °C voltage mode; 0.01% per °C current mode. Price: $30.00.

KEPCO POWER SUPPLIES

PCX
MODULAR

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE		PRICE[1]	SHIP WGT.	
	VOLTS	AMPS	VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE[2] d-c OHMS + SHUNT C		lbs.	kg.
PCX 7–2	0–7	0–2	0.2 mΩ + 1 μH	250 kΩ + 500 μF	$164.00	5	2.3
PCX 15–1.5	0–15	0–1.5	0.5 mΩ + 1 μH	333 kΩ + 225 μF	164.00	5	2.3
PCX 21–1	0–21	0–1	1 mΩ + 1 μH	500 kΩ + 150 μF	164.00	5	2.3
PCX 40–0.5	0–40	0–0.5	4 mΩ + 1 μH	1 MΩ + 100 μF	164.00	5	2.3
PCX 72–0.3	0–72	0–0.3	12 mΩ + 1 μH	1.6 MΩ + 50 μF	164.00	5	2.3
PCX 100–0.2	0–100	0–0.2	25 mΩ + 1 μH	2.5 MΩ + 40 μF	164.00	5	2.3

[1] For case, add Suffix "–C" to model number and $15.00 to price.

These operationally programmable power modules offer a single high-gain control channel for voltage or current stabilization, backed up by an adjustable overcurrent limiter. An I-C front-end contributes to very low offsets for accurate tracking of programming instructions.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE[2]	AMPLIFIER OFFSETS VOLTAGE ΔEio	AMPLIFIER OFFSETS CURRENT ΔIio	VOLTAGE REFERENCE (INTERNAL)
SOURCE: 105–125/210–250V a-c		<0.0005%	<0.005%	<10 μV	<2 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.2 mV[3]	<0.01%	<200 μV	<5 nA	–
TIME: 8-hours [drift]		<0.01% or 1 mV[3]	<0.02%	<20 μV	<2 nA	0.005%
TEMPERATURE: Per °C		<0.01%[4]	<0.02%[4]	<20 μV	<5 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:[5] (Ripple and noise)	rms	<0.1 mV	<0.02% of I_o max.	–	–	–
	p-p[6]	<3 mV	<0.2% of I_o max.	–	–	–

[2] External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.
[3] Whichever is greater.
[4] Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.01% per °C externally sensed current mode. See option "–T."
[5] One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor.
[6] 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: PCX are full-range, operationally programmable power modules. They can be programmed to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Voltage may be operationally controlled with the main control channel using the built-in stable reference and summing resistance together with an external voltage feedback rheostat. The ratio of reference voltage to input resistance gives a control current of approximately 1 milliampere through the external voltage feedback rheostat, for a control ratio of approximately 1000 ohms per volt. An external trimmer can be used to calibrate this value. Option "–R" provides for a built-in calibrating trimmer. External signals can be substituted for, or summed with, the internal reference for additional control. The feedback can be derived from other sensors to stabilize current, or such physical phenomenon as heat, speed, force or electrochemical action.

Operationally, PCX is a 3-terminal, unipolar, inverting, d-c amplifier in which the plus (+) output/sensing terminal serves as common between the output and an external programming signal.

For control with respect to the minus (–) output-sensing terminal, see Model NTC–200. For isolated digital control, see the type SN digital programmers in the *Programming Accessories* section of the Kepco Catalog.

OFFSETS: The equivalent offset voltage and current variations for PCX are tabulated for the effect of changes in source, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the external feedback rheostat and R_i is the input resistor from the reference, E_r. Option "–E" offers a means of zeroing the fixed or initial part of the offset voltage, E_{io}, which otherwise is set somewhat negative to insure the ability to program zero.

GAIN: The open-loop d-c gain is in excess of 0.5 x 10^6 volts/volt.

REFERENCE: +6.2V d-c ±5% with respect to the plus (+) error-sense terminal, capable of supplying up to 1 milliampere.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The PCX is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by an internal trimmer over the range 10% to 105% I_o max. For the precision control of current, the uncommitted control channel may be connected so as to sample the drop across an external current sensing resistor in the plus (+) output lead. An external current feedback rheostat will control current from 1 milliampere to 100% I_o max. Models equipped with option "–E" can be controlled from approximately 1 microampere to I_o max. For a similar power supply module in which the main control channel is committed to current stabilization, see the CCP models in the Kepco Catalog.

DYNAMICS

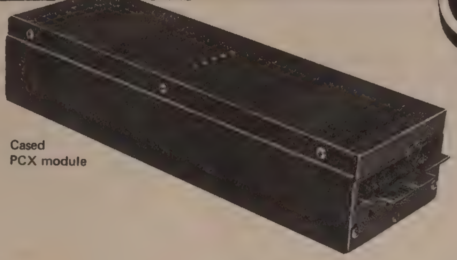
VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 μsec.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the CCP group in the Kepco Catalog.

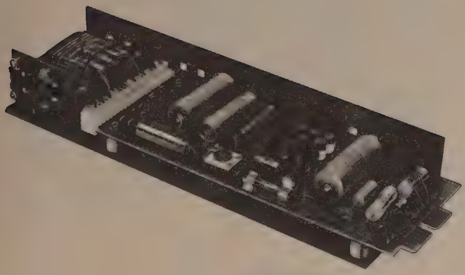
PROGRAMMING SPEED: The rate at which a PCX responds to a step-program is determined by the current setting, the load resistance and the tabulated output capacitance. For fast programming models, see OPS Group I in the Kepco Catalog.

Data and prices subject to change without notice

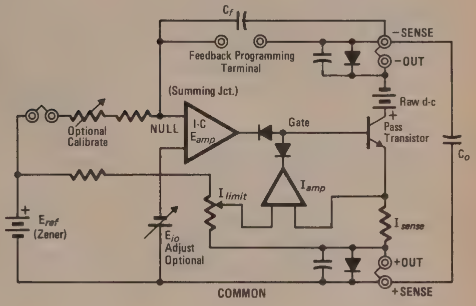
all KEPCO
products are
backed by a firm
5-Year
Warranty



Cased
PCX module



Open, uncased
PCX module



SIMPLIFIED SCHEMATIC DIAGRAM

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each PCX model.

GENERAL

SERIES/PARALLEL: Units can be connected in series, up to the limit of their isolation voltage (500V) or in parallel. Terminals are provided for master/slave interconnection.

ISOLATION FROM GROUND: The circuit and output terminals of PCX have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption, approximately 50W. Power factor: 0.9, internally fused.

TEMPERATURE RATINGS

Storage: –40°C to +85°C.

Operating: –20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: PCX modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: Source power, d-c output, sense and control connections are duplicated on a PC connector and a barrier-strip. The connector mates with PC–1 and PC–8.

MOUNTING: Mount an uncased PCX module in a protected area using 6-32 hardware to tapped holes in the heat sink, or 8-18 thread cutting screws to the nylon standoffs provided. The uncased module can be mounted on a BPA–22 slide adapter for plug-in mounting in the RA 22–6A or RA–32 enclosure. Mount the cased model (see option "–C") by means of 6-32 hardware to any of three surfaces. The cased modules can be rack mounted into 19-inch equipment racks.

Model RA 12–1 mounts a single cased model.
Model RA 13–4 mounts up to four cased models.
Model RA 11–6 mounts up to six cased models.
Rack adapters are $15.00 each.

DIMENSIONS

English measure:	*Uncased:*	2½"H x 3 13/16"W x 12 13/16"L.
	Cased:	2 11/16"H x 4⅛"W x 13 9/32"L.
Metric measure:	*Uncased:*	63.5 H x 96.8 W x 325.4 L mm.
	Cased:	68.3 H x 104.8 W x 337.3 L mm.

FINISH: The optional case has a blue anodized finish. Rack adapter panels are painted light gray Color 26440, Fed. Std. 595.

OPTIONS add identifying letters as a suffix to model number):

Suffix "–C": Enclosure case. Price: $15.00.
The case for a PCX module can also be ordered separately as Model CA–1 for installation in the field.

Suffix "–E": Zeroing trimmer for the offset voltage of the voltage control channel. Price: $10.00.

Suffix "–R": Calibration control for the voltage channel's control current. Price: $10.00.

Suffix "–T": Lowered temperature effect coefficient:
0.005% per °C voltage mode; 0.01% per °C current mode.
Price: $30.00.

KEPCO POWER SUPPLIES

PCX-MAT
VOLTAGE STABLIZER

MODEL	d-c OUTPUT RANGE		OUTPUT IMPEDANCE VOLTAGE MODE	OUTPUT IMPEDANCE CURRENT MODE (2)	PRICE	SHIP WGT.	
	VOLTS	AMPS	dc OHMS + SERIES L	d-c OHMS + SHUNT C		lbs.	kg.
PCX 7–2MAT	0–7	0–2	0.2 mΩ + 1 μH	250 kΩ + 500 μF	$229.00	8	3.6
PCX 15–1.5MAT	0–15	0–1.5	0.5 mΩ + 1 μH	333 kΩ + 225 μF	229.00	8	3.6
PCX 21–1MAT	0–21	0–1	1 mΩ + 1 μH	500 kΩ + 150 μF	229.00	8	3.6
PCX 40–0.5MAT	0–40	0–0.5	4 mΩ + 1 μH	1 MΩ + 100 μF	229.00	8	3.6
PCX 72–0.3MAT	0–72	0–0.3	12 mΩ + 1 μH	1.6 MΩ + 50 μF	229.00	8	3.6
PCX 100–0.2MAT	0–100	0–0.2	25 mΩ + 1 μH	2.5 MΩ + 40 μF	229.00	8	3.6

These power supplies, derivative of the PCX modules, offer a full complement of meters and controls on a compact one-sixth rack panel. They can be installed in rack housings RA 22–6A or RA–32 for systems use, or a variety of bench-style enclosures. The PCX–MAT are operationally programmable, too, with an I-C front end for low offsets and exceptional stability.

all KEPCO products are backed by a firm 5-Year Warranty

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE (1)	VOLTAGE AMPLIFIER OFFSETS OFFSET VOLTAGE ΔEio	VOLTAGE AMPLIFIER OFFSETS OFFSET CURRENT ΔIio	VOLTAGE REFERENCE (INTERNAL)
SOURCE: 105–125/210–250V a-c		<0.0005%	<0.005%	<10 μV	<2 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.2 mV(2)	<0.01%	<200 μV	<5 nA	–
TIME: 8-hours [drift]		<0.01% or 1 mV(2)	<0.02%	<20 μV	<2 nA	0.005%
TEMPERATURE: Per °C		<0.01%(3)	<0.02% (3)	<20 μV	<5 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:(4) (Ripple and noise)	rms	<0.1 mV	<0.02% of $I_o$max.	–	–	–
	p-p(5)	<3 mV	<0.2% of I_o max.	–	–	–

(1) External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.
(2) Whichever is greater.
(3) Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.01% per °C externally sensed current mode. See option "–T."
(4) One terminal grounded or connected so that the common-mode current does not flow through the load or (in current mode) through a sensing resistor
(5) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: PCX–MAT are full-range, operationally programmable power supplies. They can be set or programmed to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Output voltage is controlled by a panel-mounted, 10-turn rheostat. External control can be exercised by a resistance at 1000 ohms per volt (see option "–R") or by a control voltage delivering 0–1 mA. Control is fully operational with PCX–MAT power supplies functioning as inverting d-c power amplifiers. Their plus (+) output-sensing terminal is common.

For control with respect to the minus (-) output-sensing terminal, see Model NTC–200. For isolated digital control, see the type SN digital programmers in the *Programming Accessories* section of the Kepco Catalog.

OFFSETS: The equivalent offset voltage and current variation for PCX–MAT are tabulated for the effect of source changes, load temperature and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the panel feedback rheostat and R_i is the input resistor from the reference, E_r. Option "–E" offers a means of zeroing the fixed or initial part of the offset voltage, E_{io} which otherwise is set somewhat negative to insure the ability to program zero.

GAIN: The open-loop d-c gain is in excess of 0.5×10^6 volts/volt.

REFERENCE: +6.2V d-c ±5% with respect to the plus (+) output-sense terminal, capable of supplying up to 1 milliampere.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The PCX–MAT is equipped with a built-in current sensing and feedback arrangement for protective limiting. It is controlled by an internal trimmer over the range 10% to 105% I_o max. For the precision control of current, the voltage control channel may be reconnected so as to sample the drop across an external current sensing resistor in the plus (+) output lead. Using an external current feedback rheostat, the current range is 1 milliampere to 100% I_o max. The recommended ratio of current for any single current-sensing resistor is 50:1. Models equipped with option "–E" can be controlled from approximately 1 microampere to 100% I_o max. For equivalent units in which the main control channel is committed to current stabilization, please see the CC models in the *Special Purpose* section of the Kepco Catalog.

DYNAMICS

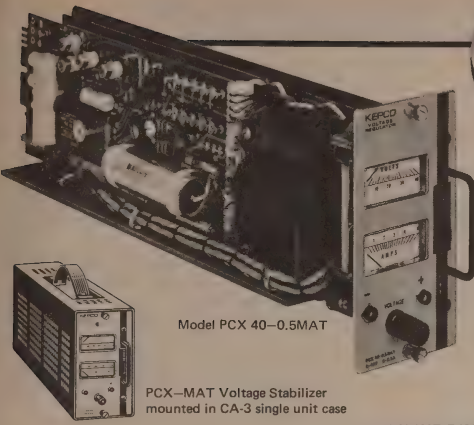
VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:
The time required for a stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 μs.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:
As a current stabilizer, the recovery exponential is governed by the RC time constant formed by the load and the tabulated shunt capacitance. For fast recovery current stabilizers, please see the CC models in the *Special Purpose* section of Kepco's Catalog.

PROGRAMMING SPEED: The rate at which PCX–MAT responds to a step program is determined by the current setting, the load resistance and the tabulated output capacitance. For fast programming applications, please see OPS Group II in the *High Speed* section of the Kepco Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance.

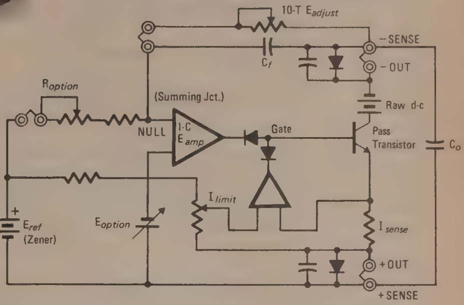
Data and prices subject to change without notice



Model PCX 40–0.5MAT

PCX–MAT Voltage Stabilizer mounted in CA-3 single unit case

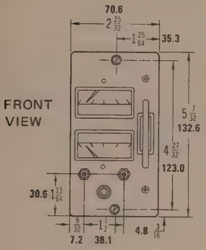
SIMPLIFIED SCHEMATIC DIAGRAM

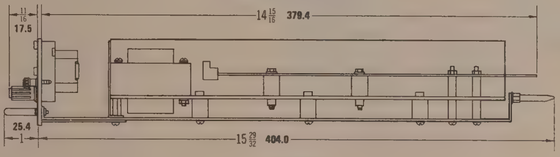


OUTLINE DIMENSIONAL DRAWINGS

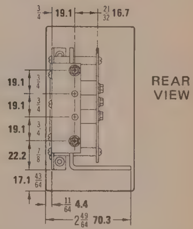
Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

Tolerance: ± 1/64″ **(0.4)** between mounting holes.
± 1/32″ **(0.8)** other dimensions.
Panels: Per Mil. Std. 189





TOP VIEW



As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each PCX–MAT model.

GENERAL

SERIES/PARALLEL: Units can be connected in series, up to the limit of the isolation voltage (500V) or in parallel. Terminals are provided for master/slave interconnection.

ISOLATION FROM GROUND: The circuit and output terminals of PCX–MAT have no d-c connection to ground, and may be floated up to 500 volts (d-c or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: Units are factory-wired for 105–125V a-c, 50–440 Hz power. A simple jumper change will reconfigure the input for 210–250V a-c, 50–440 Hz. Power consumption approximately 50W. Power factor: 0.9; internally fused. Power is delivered via the printed circuit connector which mates with a connector in the selected housing. A pilot light and on/off slide switch are provided on the panel.

TEMPERATURE RATINGS

Storage: –40°C to +85°C.

Operating: –20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: PCX–MAT modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: Source power, d-c output, sense and control connections, terminate on a male PC connector that mates with the built-in socket in the bench housings or with the PC–2 socket used with the rack housings. (See *Hardware* section.) A pair of pinjacks on the front panel are provided for output monitoring.

METERS: Voltage and current are displayed on a pair of 2-inch recessed meters with an accuracy of ±3%.

MOUNTING: The PCX–MAT power supplies fit a single slot in the 6-unit housing RA 22–6A, the intermix housing, RA–32, and the three bench housings, CA–3, CA–4 and CA–5. They slide in on the provided rails, obtain power, and deliver their output to the mating connector. Refer to the *Hardware* section for details on the various enclosures.

Model RA 22–6A Rack Adapter(1)	Price: $99.00.
Model RA–32 Rack Adapter(1)	Price: $75.00.
Model CA–3 Case	Price: $25.00.
Model CA–4 Case	Price: $35.00.
Model CA–5 Case	Price: $45.00.

(1) Includes all PC–2 connectors.

DIMENSIONS

English measure: 5 7/32"H x 2 25/32"W x 14 15/16 max. "D.

Metric measure: 132.6 H x 70.6 W x 379.4 max. D mm.

See outline drawings.

FINISH: *Panel:* Gray, Color 26440, Fed. Std. 595.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–E": Zeroing trimmer for the offset voltage of the voltage control channel. Price: $10.00.

Suffix "–R": Calibration control for the voltage channel's control current. Price: $10.00.

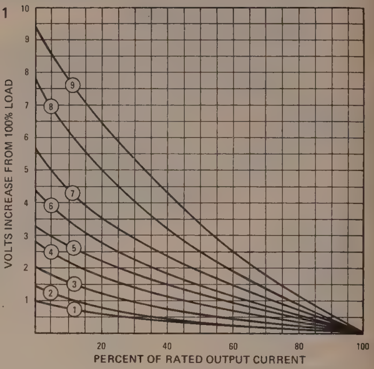
Suffix "–T": Lowered temperature effect coefficient: 0.005% per °C voltage mode; 0.01% per °C current mode. Price: $30.00.

KEPCO™ POWER SUPPLIES

PRM
MODULAR

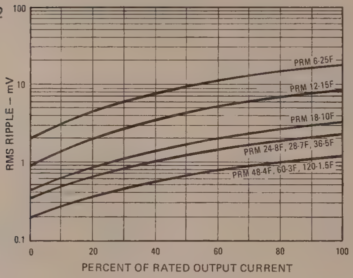
ALL KEPCO PRM MODELS HAVE WON UNDERWRITERS' LABORATORIES RECOGNITION UNDER THE COMPONENT RECOGNITION PROGRAM; UL SPECIFICATIONS 114 AND 478.
Kepco PRM voltage stabilizers obtain their source-isolated, overload-protected output from a special sort of magnetic circuit in which a portion of the power transformer is resonated to stabilize voltage at a predetermined level. This ferroresonant stabilizing technique provides extraordinary isolation from a wide variety of source noise, is inherently short-circuit proof, exposes delicate loads to no overvoltage hazard, and is the heart of the simplest, therefore the most reliable, power supply you can buy.

Figure 1



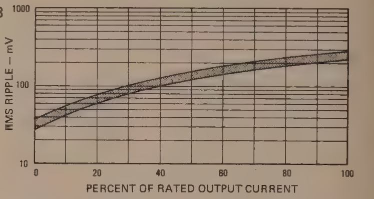
TYPICAL LOAD EFFECT CURVE FOR ALL MODELS (EXCEPT SIZE "D")

Figure 2



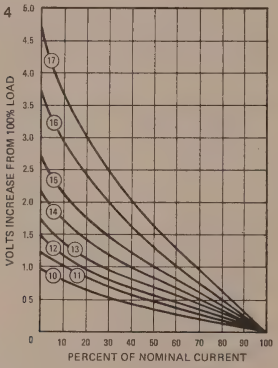
TYPICAL OUTPUT RIPPLE CURVES FOR EXTRA-FILTERED MODELS, PLOTTED AS A FUNCTION OF LOAD CURRENT.

Figure 3



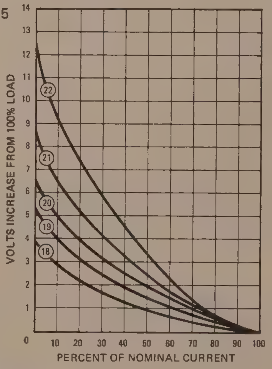
TYPICAL OUTPUT RIPPLE CURVES FOR SIZES "A," "B," and "C" (duals), PLOTTED AS A FUNCTION OF LOAD CURRENT.

Figure 4



TYPICAL LOAD EFFECT CURVES FOR THE SIZE "D" PRM MODELS

Figure 5



INFLUENCE QUANTITY	OUTPUT EFFECTS				
	SIZE A 180 SERIES	SIZE B 120 SERIES	SIZE C—180F Extra-Filter	SIZE C—300 Dual — Output	SIZE D 60 SERIES
SOURCE: 100–130V a-c	±1%(1)	±1%(1)	±1%(1)	±1%(1)	±1%(1)
LOAD: No load – full load	See charts for maximum value; the graphs show typical performance.				
TIME: 8-hour [drift]	1% or 0.1V(2)	1% or 0.1V(2)	1% or 0.1V(2)	1% or 0.1V(2)	1% or 0.1V(2)
TEMPERATURE: Per °C	0.05%	0.05%	0.05%	0.05%	0.05%
UNPROGRAMMED OUTPUT DEVIATION [rms] (Ripple and noise)	See charts for maximum value; the graphs show typical performance.				
INPUT POWER: [at 115V a-c]	3A [280 W]	2A [190 W]	3A [280 W]	5A [465 W]	1.1A [100 W]

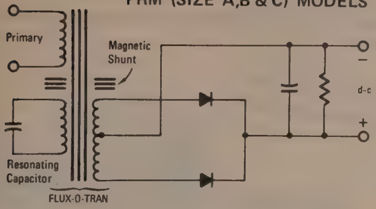
(1) For ±15V a-c source variation at full load. The source effect increases to ±1.5% at no load. (2) Whichever is greater.

Data and prices subject to change without notice

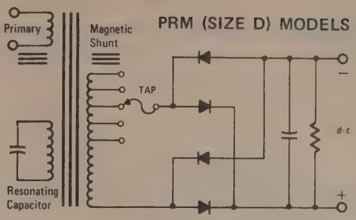
Special terms used in these specifications are defined in the glossary section.

SIMPLIFIED SCHEMATIC DIAGRAMS

PRM (SIZE A,B & C) MODELS



PRM (SIZE D) MODELS



VOLTAGE STABILIZATION

OUTPUT RANGE: The Kepco PRM models are essentially fixed-output devices made in a variety of the most popular d-c voltages in four power classes:

60 watts, Size D	180 watts, Size A
120 watts, Size B	300 watts, Size C

The Size D Design offers a selection of fixed output settings for each model by means of a moveable tap.

The Size C Design has both a 300 watt capability (in a dual output configuration), and a reduced-ripple 180 watt class which incorporates an extra LC filter section.

OUTPUT ACCURACY: The output of a PRM is set to the nominal value within ±2% (or 0.25 volt, whichever is greater). This is the output at full load, 115 volts a-c input and 30°C ambient temperature after approximately one-half hour warm-up. Allow for an initial (cold) voltage approximately 1% higher. The output at loads smaller than the rated maximum may be determined by consulting the load effect curves, Figures 1, 4 or 5, and checking the curve that is specified for the model being considered.

NOISE: The output deviation at twice source frequency (ripple) is given in the tables for the maximum rms voltage. Figure 3 is a plot of the typical rms amplitude versus load current. The extra-filtered models in the Size C, 180F group have an additional LC section which attenuates the ripple by approximately a factor of 10. Figure 2 plots the ripple of the extra-filtered models versus load. The construction of PRM power supplies results in substantial isolation (more than 120 dB) from conducted "source noise" up to 1 megahertz.

CURRENT LIMITING

Automatic current limiting occurs between 125% and 150% of the rated maximum current (depending on the source voltage). A PRM limits its output current safely—and automatically recovers to a normal operating point when overload is removed. For a graphical representation of the overload characteristic. see Kepco's Catalog.

DYNAMICS

VOLTAGE RECOVERY FOR A 50% STEP-LOAD CURRENT: The time required for the stabilized voltage to recover within the load effect band is less than 400 milliseconds.

OUTPUT IMPEDANCE: The d-c impedance is a function of the load effect and may be determined by the slope ΔV/ΔI from the respective load effect curve (Figures 1, 4 and 5). Above 10 kilohertz add the effect of a 0.5 microhenry series inductance.

GENERAL

ISOLATION FROM GROUND: The circuit of PRM is isolated from its chassis and ground. It may be placed in series with up to 600 volts d-c (or peak) off ground. Common mode current from output to ground is less than 50 microamperes rms, 500 microamperes peak-to-peak at 60 Hz.

SERIES/PARALLEL: PRM modules can be connected in series up to the 600-volt isolation limit. Identical models, or halves of a dual supply, can be paralleled for approximately double current; allow for 10% imbalance. Note: on dual models, the maximum d-c (or peak) difference between outputs is limited to 50 volts.

SOURCE POWER INPUT: 115V a-c ±15V a-c, 60 Hz ±5%. The ferroresonant power transformer is frequency-sensitive and should be operated from a stable frequency source. (A 1% change in frequency will produce from 1 to 1.5% change in output voltage.)

OVERSEAS MODELS: For 50 Hz ±5% source frequency specify an option "−50." The primary for 50 Hz overseas models is connected for 230V ±30V a-c. Other source voltages may be accommodated by means of internal jumpers: 104V ±13.5V a-c, 115V ±15V a-c, or 208V ±27V a-c. The 20% lower frequency causes a corresponding derating of the output current. A 10-ampere model with the "−50" suffix is, therefore, rated at 8 amperes.

Power must be hard-wired to the terminals provided. Power requirements:

Size A, 180 Series,	3 amperes	280 watts
Size B, 120 Series,	2 amperes	180 watts
Size C, 180F Series,	3 amperes	280 watts
Size C, 300 Series,	5 amperes	465 watts
Size D, 60 Series,	1.1 amperes	100 watts.

TEMPERATURE RATINGS

Storage: −40°C to +85°C.

Operating: −20°C to +55°C. Cooling is by natural convection. Full output current is delivered at +55°C. No derating or external heat sink is required.

STANDARDS: PRM modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972. All PRM models are recognized by Underwriters' Laboratories under the UL Component Recognition Program; UL specifications 114 and 478.

TERMINALS: All input and output connections are made via a multiterminal barrier-strip located on one surface.

DIMENSIONS: *

English measure:

Size A Models: * 6 13/16"H x 4 3/4"W x 10 13/16"L.
Size B Models: 3 13/32"H x 5"W x 13 7/8"L.
Size C Models: * 6 13/16"H x 4 3/4"W x 15 1/8"L.
Size D Models: 3 13/32"H x 5"W x 10 7/8"L.

Metric measure:

Size A Models: * 173.0 H x 120.7 W x 274.6 L mm.
Size B Models: 86.5 H x 127.0 W x 352.4 L mm.
Size C Models: * 173.0 H x 120.7 W x 384.2 L mm.
Size D Models: 86.5 H x 127.0 W x 276.2 L mm.

See the Kepco Catalog for details on mounting centers.

*Dimensions, Models A and C are for uncased module.

ENCLOSURES: Size A and C units may be equipped with an optional dust cover.

CA–200 for the Size A model
CA–300 for the Size C model
(See *Hardware* section.)

To order a unit with the dust cover factory-installed, add the suffix letter "−C" to the model number and add $15.00 to the price. Note: The Size B and D models are housed in a unitized cover/chassis.

MOUNTING 19-inch rack mounting adapter panels include a variety of single and multiple unit panels. Please refer to the *Hardware* section in the Kepco Catalog.

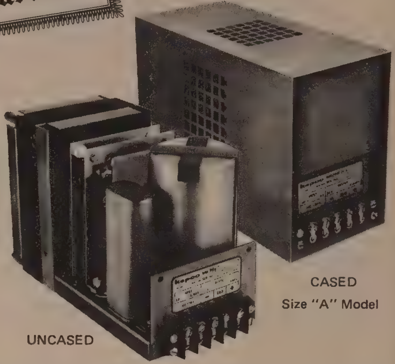
FINISH: The Size B and D models have a blue anodized finish on their housing. The Size A and C enclosures, CA–200 and CA–300, are painted a royal blue with epoxy paint. The 19-inch rack adapter panels are painted a light gray, Color No. 26440, Fed. Std. 595.

all KEPCO products are backed by a firm 5-Year Warranty

Size A-180 Series

MODEL	d-c OUTPUT (3) VOLTS	d-c OUTPUT (3) AMPS	LOAD EFFECT (1) VOLTS INCREASE 100%–50% LOAD	LOAD EFFECT (1) VOLTS INCREASE 100%–25% LOAD	LOAD EFFECT CURVE	RIPPLE (max) RMS VOLTS	PRICE (2)	SHIP WGT. lbs.	SHIP WGT. kg.
PRM 5–25	5.2	0–25	0.5	0.8	1	0.4	$162.00	24	10.9
PRM 6–25	6.3	0–25	0.5	0.8	1	0.4	162.00	24	10.9
PRM 12–15	12	0–15	0.6	1.0	1	0.4	162.00	24	10.9
PRM 18–10	18	0–10	0.6	1.0	2	0.3	162.00	24	10.9
PRM 24–8	24	0–8	0.7	1.2	2	0.3	162.00	24	10.9
PRM 28–7	28	0–7	0.7	1.2	2	0.4	162.00	24	10.9
PRM 36–5	36	0–5	0.8	1.3	3	0.4	162.00	24	10.9
PRM 48–4	48	0–4	1.0	1.8	4	0.3	162.00	24	10.9
PRM 60–3	60	0–3	1.1	1.9	5	0.3	162.00	24	10.9
PRM 120–1.5	120	0–1.5	2.2	3.6	7	0.3	162.00	24	10.9

(1) Measured at 115V a-c source.
(2) For case, add Suffix "C" to model number and $15.00 to price.
(3) Accuracy ±2% or 0.25V, voltage set at 115V a-c, full load and 30°C. The initial (cold) output is 1% higher



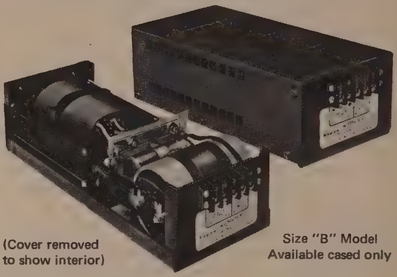
UNCASED

CASED
Size "A" Model

Size B-120 Series

MODEL	d-c OUTPUT (3) VOLTS	d-c OUTPUT (3) AMPS	LOAD EFFECT VOLTS INCREASE 100%–50% LOAD	LOAD EFFECT VOLTS INCREASE 100%–25% LOAD	LOAD EFFECT CURVE	RIPPLE (max) RMS VOLTS	PRICE (2)	SHIP WGT. lbs.	SHIP WGT. kg.
PRM 5–15	5.2	0–15	0.5	0.8	1	0.4	$135.00	17	7.6
PRM 6–15	6.3	0–15	0.5	0.8	1	0.4	135.00	17	7.6
PRM 12–10	12	0–10	0.6	1.0	2	0.4	135.00	17	7.6
PRM 18–6.7	18	0–6.7	0.8	1.3	3	0.3	135.00	17	7.6
PRM 24–5	24	0–5	1.0	1.7	3	0.3	135.00	17	7.6
PRM 28–4.3	28	0–4.3	1.2	2.0	4	0.3	135.00	17	7.6
PRM 36–3.3	36	0–3.3	1.5	2.4	5	0.3	135.00	17	7.6
PRM 48–2.5	48	0–2.5	2.0	3.4	6	0.3	135.00	17	7.6
PRM 60–2	60	0–2	2.3	3.8	7	0.3	135.00	17	7.6
PRM 120–1	120	0–1	4.6	7.6	9	0.3	135.00	17	7.6

(1) Measured at 115V a-c source.
(2) Available cased only. Price includes case.
(3) Accuracy ±2% or 0.25V, voltage set at 115V a-c, full load and 30°C. The initial (cold) output is 1% higher.



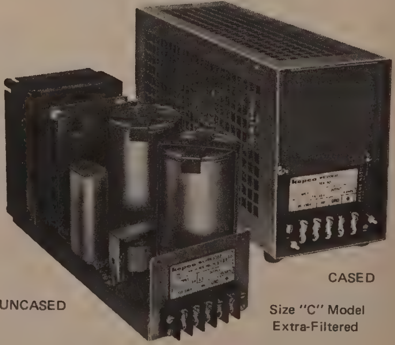
(Cover removed to show interior)

Size "B" Model
Available cased only

Size C-180F Series (extra-filtered)

MODEL	d-c OUTPUT (3) VOLTS	d-c OUTPUT (3) AMPS	LOAD EFFECT (1) VOLTS INCREASE 100%–50% LOAD	LOAD EFFECT (1) VOLTS INCREASE 100%–25% LOAD	LOAD EFFECT CURVE	RIPPLE (max) RMS VOLTS	PRICE (2)	SHIP WGT. lbs.	SHIP WGT. kg.
PRM 5–25F	5.2	0–25	0.7	1.2	1	0.04	$231.00	30	13.5
PRM 6–25F	6.3	0–25	0.7	1.2	1	0.04	231.00	30	13.5
PRM 12–15F	12	0–15	0.9	1.4	2	0.02	231.00	30	13.5
PRM 18–10F	18	0–10	0.9	1.5	3	0.01	231.00	30	13.5
PRM 24–8F	24	0–8	1.2	2.0	3	0.005	231.00	30	13.5
PRM 28–7F	28	0–7	1.3	2.1	3	0.005	231.00	30	13.5
PRM 36–5F	36	0–5	1.5	2.4	4	0.005	231.00	30	13.5
PRM 48–4F	48	0–4	1.7	2.9	5	0.003	231.00	30	13.5
PRM 60–3F	60	0–3	2.3	3.6	6	0.003	231.00	30	13.5
PRM 120–1.5F	120	0–1.5	3.8	6.8	8	0.003	231.00	30	13.5

(1) Measured at 115V a-c source.
(2) For case, add suffix "–C" to model number and $15.00 to price.
(3) Accuracy ±2% or 0.25V, voltage set at 115V a-c, full load and 30°C. The initial (cold) output is 1% higher. Allow for extra 2% filter drop at full load.



UNCASED

CASED

Size "C" Model
Extra-Filtered

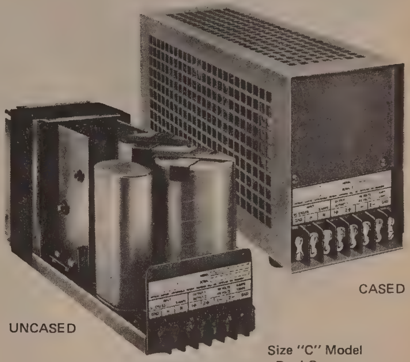
Data and prices subject to change without notice

PRM
MODULAR
™

Size C-300 Series (dual output)

MODEL	d-c OUTPUT (3) VOLTS	d-c OUTPUT (3) AMPS	LOAD EFFECT (1) VOLTS INCREASE 100%–50% LOAD	LOAD EFFECT (1) VOLTS INCREASE 100%–25% LOAD	LOAD EFFECT CURVE	RIPPLE (max) RMS VOLTS	PRICE (2)	SHIP WGT. lbs.	SHIP WGT. kg.
PRM 2X4.5–20	4.5 4.5	0–20 0–20	0.5	0.7	1	0.3	$255.00	38	17.3
PRM 2X5–20	5.2 5.2	0–20 0–20	0.5	0.7	1	0.3	255.00	38	17.3
PRM 2X6–20	6.3 6.3	0–20 0–20	0.5	0.7	1	0.3	255.00	38	17.3
PRM 2X12–12	12 12	0–12 0–12	0.5	0.7	1	0.3	255.00	38	17.3
PRM 2X15–10	15 15	0–10 0–10	0.5	1.0	1	0.3	255.00	38	17.3
PRM 2X18–8	18 18	0–8 0–8	0.6	1.6	1	0.3	255.00	38	17.3
PRM 2X24–6	24 24	0–6 0–6	0.6	1.0	2	0.3	255.00	38	17.3
PRM 2X28–5	28 28	0–5 0–5	0.7	1.2	2	0.3	255.00	38	17.3
PRM 2X36–4	36 36	0–4 0–4	0.7	1.2	3	0.3	255.00	38	17.3
PRM 2X48–3	48 48	0–3 0–3	0.8	1.4	3	0.3	255.00	38	17.3
PRM 2X60–2.5	60 60	0–2.5 0–2.5	1.0	1.7	3	0.3	255.00	38	17.3

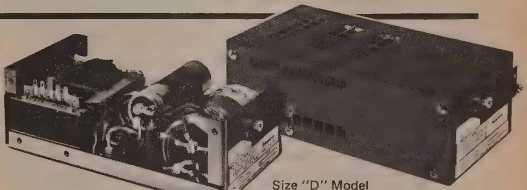
(1) Measured at 115V a-c source.
(2) For case, add Suffix "C" to model number and $15.00 to price.
(3) Accuracy ±2% or 0.25V, voltage set at 115V a-c, full load and 30°C. The initial (cold) output is 1% higher. Interaction between sections of the dual supply produce an extra +2% change when one section is unloaded from maximum to zero.



Size "C" Model
Dual Output

Size D- 60 Series

The size D, Series 60 PRM modules are equipped with an adjustable tap arrangement, selecting two increments of voltage above the nominal output and two increments of voltage below the nominal output. In the table of voltages, the nominal (center) tap is indicated by the bold face type. The table of currents has a corresponding bold face column showing the current rating at the nominal voltage. The two adjacent columns on either side correspond to the respective voltage tap increments. The specifications are computed for the nominal (center) tap.



(Cover removed to show adjustable taps)

Size "D" Model
Available cased only

MODEL	VOLTS –B	VOLTS –A	VOLTS NOM	VOLTS +A	VOLTS +B	AMPS –B	AMPS –A	AMPS NOM	AMPS +A	AMPS +B	LOAD EFFECT (1) VOLTS INCREASE 100%–50% LOAD	LOAD EFFECT (1) VOLTS INCREASE 100%–25% LOAD	LOAD EFFECT CURVE	RIPPLE (max) RMS %	PRICE (2)	SHIP WGT. lbs.	SHIP WGT. kg.
PRM 5–10	4.2	4.6	**5.0**	5.4	5.8	12.0	11.0	**10.0**	9.3	8.6	0.5	0.8	10	0.50	$117.00	11	5.0
PRM 6.3–8	5.5	5.9	**6.3**	6.7	7.1	9.1	8.5	**8.0**	7.5	7.1	0.5	0.8	10	0.50	117.00	11	5.0
PRM 8–7	7.2	7.6	**8.0**	8.4	8.8	7.8	7.5	**7.0**	6.7	6.4	0.6	0.9	10	0.33	117.00	11	5.0
PRM 10–6	8.4	9.2	**10.0**	10.8	11.6	7.1	6.5	**6.0**	5.6	5.2	0.7	1.0	11	0.33	117.00	11	5.0
PRM 12–5	10.4	11.2	**12.0**	12.8	13.6	5.7	5.4	**5.0**	4.7	4.5	0.8	1.2	12	0.33	117.00	11	5.0
PRM 15–4	13.4	14.2	**15.0**	15.8	16.6	4.5	4.2	**4.0**	3.8	3.6	0.9	1.3	13	0.33	110.00	11	5.0
PRM 18–3.3	16.4	17.2	**18.0**	18.8	19.6	3.6	3.5	**3.3**	3.2	3.1	1.0	1.5	14	0.33	110.00	11	5.0
PRM 21–2.9	17.9	19.4	**21.0**	22.6	24.2	3.4	3.1	**2.9**	2.7	2.6	1.1	1.7	14	0.33	110.00	11	5.0
PRM 26–2.3	22	24	**26**	28	30	2.7	2.5	**2.3**	2.1	2.0	1.3	2.1	15	0.33	110.00	11	5.0
PRM 36–1.7	32	34	**36**	38	40	1.9	1.8	**1.7**	1.6	1.5	1.7	2.7	16	0.33	110.00	11	5.0
PRM 48–1.25	42	45	**48**	51	54	1.43	1.33	**1.25**	1.18	1.11	2.1	3.4	17	0.33	110.00	11	5.0
PRM 60–1	52	56	**60**	64	68	1.15	1.07	**1.00**	0.94	0.88	1.5	2.7	18	0.33	110.00	11	5.0
PRM 70–0.86	60	65	**70**	75	80	1.00	0.92	**0.86**	0.80	0.75	1.8	3.2	18	0.33	110.00	11	5.0
PRM 90–0.67	80	85	**90**	95	100	0.75	0.71	**0.67**	0.63	0.60	2.2	4.1	19	0.33	110.00	11	5.0
PRM 120–0.50	110	115	**120**	125	130	0.54	0.52	**0.50**	0.48	0.46	3.0	5.4	20	0.33	110.00	11	5.0
PRM 160–0.37	140	150	**160**	170	180	0.43	0.40	**0.37**	0.35	0.33	4.0	7.2	21	0.33	110.00	11	5.0
PRM 240–0.25	220	230	**240**	250	260	0.27	0.26	**0.25**	0.24	0.23	6.0	10.8	22	0.33	110.00	11	5.0

(1) Measured at 115V 1-c source. (2) Available cased only. Price includes case.

KEPCO POWER SUPPLIES

PTR
AUTOMATIC CROSSOVER

PTR are modular power supplies offering automatic crossover for voltage and current stabilization. An I-C front end in each channel contributes to very low offsets for accurate tracking of programming instructions. An optional overvoltage crowbar mounts within the module. Temperature ratings allow for full output at +71°C with no derating and no need for external heat sinking.

MODEL	d-c OUTPUT RANGE VOLTS	d-c OUTPUT RANGE AMPS	OUTPUT IMPEDANCE VOLTAGE MODE d-c OHMS + SERIES L	OUTPUT IMPEDANCE CURRENT MODE(1) d-c OHMS + SHUNT C	PRICE	SHIP WGT. lbs.	SHIP WGT. kg.
PTR 7–5.5	0–7	0–5.5	64 µΩ + 0.5 µH	90 kΩ + 1250 µF	$273.00	11	5.0
PTR 15–3.3	0–15	0–3.3	225 µΩ + 0.5 µH	150 kΩ + 800 µF	273.00	11	5.0
PTR 21–2.5	0–21	0–2.5	420 µΩ + 0.5 µH	200 kΩ + 500 µF	273.00	11	5.0
PTR 40–1.4	0–40	0–1.4	1.4 mΩ + 0.5 µH	350 kΩ + 350 µF	273.00	11	5.0
PTR 72–0.8	0–72	0–0.8	4.5 mΩ + 0.5 µH	625 kΩ + 300 µF	273.00	11	5.0
PTR 100–0.6	0–100	0–0.6	10 mΩ + 0.5 µH	840 kΩ + 100 µF	273.00	11	5.0

(1) d-c value is for external sensing and feedback; d-c value for internal sensing mode is E_o/5 mA.

INFLUENCE QUANTITY		OUTPUT EFFECTS VOLTAGE MODE	OUTPUT EFFECTS CURRENT MODE INTERNAL	OUTPUT EFFECTS CURRENT MODE EXTERNAL(2)	AMPLIFIER OFFSETS ΔE_{io}	AMPLIFIER OFFSETS ΔI_{io}	REFERENCE +6.2V ± 5% NOMINAL
SOURCE: 105–125/210–250V a-c		<0.001%	<0.005% or 25 µA(3)	<0.005%	<5 µV	<1 nA	0.0001%
LOAD: No load – full load		<0.005% or 0.1 mV(3)	<3.0 mA(4)	<0.01%	<100 µV	<5 nA	–
TIME: 8-hour [drift]		<0.01% or 0.2 mV(3)	<0.05% or 0.1 mA(3)	<0.02%	<20 µV	<1 nA	0.005%
TEMPERATURE: Per °C(5)		<0.01%	<0.05% or 0.1 mA(3)	<0.02%	<20 µV	<2 nA	0.005%
UNPROGRAMMED OUTPUT DEVIATION:(6) (Ripple and noise)	rms	<0.1 mV	<0.5 mA	<0.5 mA	–	–	–
	p-p(7)	<2.0 mV	<2.0 mA	<2.0 mA	–	–	–

(2) External current sensing, using the *voltage* amplifier. Effects are measured for a 1-volt current sensing voltage drop.
(3) Whichever is greater.
(4) 5 mA with "–VP" option.
(5) Typical temperature effect coefficients are: 0.005% per °C voltage mode; 0.02% per °C internally sensed current mode; 0.01% per °C externally sensed current mode. See option "–T."
(6) One terminal grounded or connected so that the common-mode current does not flow through load or (in current mode) through a sensing resistor.
(7) 20 Hz to 10 MHz.

all KEPCO products are backed by a firm 5-Year Warranty

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: PTR are full-range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

CONTROL/PROGRAMMING: Voltage may be operationally controlled with this channel using the built-in stable reference and summing resistance together with an external voltage feedback rheostat. The ratio of reference voltage to summing resistance gives a control current of approximately 1 milliampere through the external voltage feedback rheostat for a control ratio of 1000 ohms per volt. An external trimmer can be used to calibrate this value. Option "–R" provides for a built-in calibrating trimmer. External signals can be substituted for, or summed with, the internal reference for additional control. The feedback can be derived from other sensors to stabilize current or such physical phenomena as heat, speed, force, or electrochemical action.

Operationally, the PTR is a 3-terminal, unipolar, inverting, d-c amplifier in which the plus (+) output/sensing terminal serves as common between the output and an external programming signal. For control with respect to the minus (–) output sensing terminal, see Model NTC–200. For isolated digital control, see the type SN digital programmers in the *Programming Accessories* section of the Kepco Catalog.

OFFSETS: The equivalent offset voltage and current variations for the PTR's voltage channel are tabulated for the effect of source changes, load, temperature and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm\ \Delta E_r\,(R_f/R_i) \pm \Delta E_{io}\,(1 + R_f/R_i) \pm \Delta I_{io}\,(R_f)$$

where R_f is the external feedback rheostat and R_i is the input resistor from the reference, E_r. Option "–E" offers a means of zeroing the fixed or initial part of the offset voltage, E_{io}, which otherwise is set somewhat negative to insure the ability to program zero.

GAIN: The open-loop d-c gain is in excess of 10^6 volts per volt.

REFERENCE: A +6.2V ±5%, 1 milliampere reference [referred to the plus (+) output/sense terminal] is provided for control offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead. An additional 1 volt is provided in the output, beyond the rating, for this purpose.

CURRENT STABILIZATION

The PTR is equipped with a built-in current-sensing and control channel for precision current stabilization with automatic crossover from and to the voltage stabilization mode.

OUTPUT RANGE: Current is controlled by an internal trimmer over the range 2% I_o max to 100% I_o max.

CONTROL/PROGRAMMING: Current may be externally controlled (programmed) by a remote potentiometer or by a small d-c voltage. The potentiometer functions as part of a divider across the internal reference delivering 0–0.5 volt to the current control terminal. This voltage (with respect to plus output) can be derived from a separate programming source such as, for example, the Kepco type SN Digital Programmer.

For a wider current control range, the voltage channel may be connected so as to sample the drop across an external current sensing resistor in the plus (+) plus output lead. An external rheostat will control current from 1 milliampere to 100% $I_o$max. Models equipped with option "–E" can be controlled from approximately 1 microampere to 100% I_o.

Select current-sensing resistors for less than 50:1 range of current through any single resistor.

MODE FLAG: PTR produces a "flag" signal, which indicates which channel controls the output. The flag is +5 volts (1 mA max) with respect to the plus (+) sense terminal when the current channel has control. The flag is approximately zero volts when the voltage channel has control.

DYNAMICS

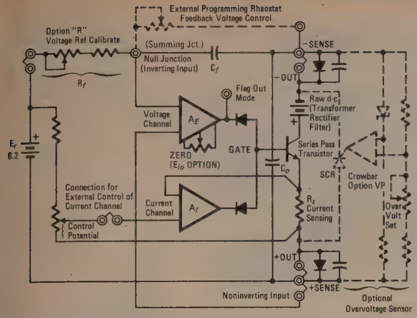
VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT:

The time required for stabilized voltage to recover within the load effect band (or 2 mV, whichever is greater) is less than 50 µsec.

CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE:

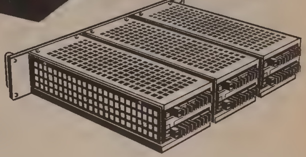
The current recovery is an exponential defined by the RC time

Data and prices subject to change without notice

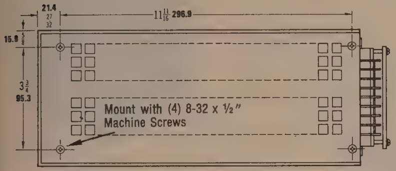

External Programming Rheostat
Feedback Voltage Control
Option "R"
Voltage Ref Calibrate
R_f
(Summing Jct.)
Null Junction
(Inverting Input)
C_f
–SENSE
–OUT
Flag Out
Mode
Voltage
Channel
A_E
E_r
6.2
ZERO
(E_{io} OPTION)
GATE
Raw d-c
(Transformer
Rectifier
Filter)
Series Pass
Transistor
C_o
SCR
Crowbar
Option VP
R_s
Current
Sensing
Over
Volt
Set
Connection for
External Control of
Current Channel
Current
Channel
A_I
Control
Potential
+OUT
+SENSE
Noninverting Input
Optional
Overvoltage Sensor

SIMPLIFIED SCHEMATIC DIAGRAM

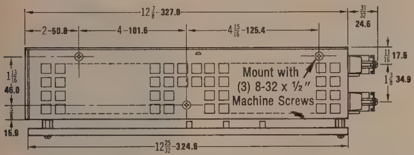
Single PTR Module



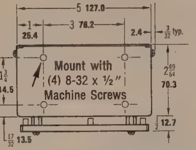
(3) PTR Models mounted in RA 33–3


21.4
27/32
11 11/16 296.9
15.9 5/8
3 3/4
95.3
Mount with (4) 8-32 x ½"
Machine Screws

BOTTOM VIEW


12 7/8 327.0
31/32
24.6
2 50.8
4 101.6
4 15/16 125.4
11/16 17.5
1 3/8 34.9
1 13/16
46.0
5/8
15.9
Mount with
(3) 8-32 x ½"
Machine Screws
12 25/32 324.6

SIDE VIEW


5 127.0
1
25.4
3 76.2
2.4
3/32 typ.
1 3/4
44.5
Mount with
(4) 8-32 x ½"
Machine Screws
2 49/64
70.3
½ 12.7
17/32 13.5

END VIEW

OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.

Tolerance: ±1/64" **(0.4)** between mounting holes.
±1/32" **(0.8)** other dimensions.

constant formed by the load and the tabulated shunt capacitance. For a fast-recovery current stabilizer, please see the OPS Group III in the *High Speed* section of the Kepco Catalog.

PROGRAMMING SPEED: The rate at which PTR responds to a step program is determined by the current setting, the load resistance and the tabulated output capacitance. For fast programming applications, please see OPS Group III in the *High Speed* section of the Kepco Catalog.

OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The table gives these values for each PTR model.

GENERAL

SERIES/PARALLEL: Units can be connected in series or in parallel. Terminals are provided for master/slave interconnection. Note: Units with optional overvoltage crowbar may not be used in parallel. Series operation up to rated isolation limit (500V).

ISOLATION FROM GROUND: The circuit and output terminals of PTR have no d-c connection to ground and may be floated up to 500 volts d-c (or peak) off ground. The common mode current from output to ground is less than 5 microamperes rms, 50 microamperes peak-to-peak at 115V a-c, 60 Hz.

SOURCE POWER REQUIREMENT: An internal switch selects either 105–125 or 210–250V a-c, 50–65 Hz (shipped with the switch in the 105–125V a-c position). Power must be hard-wired to the provided terminals. Internally fused. Source current approximately 1.2 amperes rms at 125V a-c. Power factor 0.9.

TEMPERATURE RATING

Storage: –40°C to +85°C.

Operating: –20°C to +71°C. Cooling is by natural convection. Full output current is delivered at +71°C; no derating or external heat sink is required.

STANDARDS: PTR modules are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: All input, output, control and sensing connections are made via a pair of barrier-strips located on one end. The built-in and optional trimmer adjustments are located behind the same surface, accessible for screwdriver-adjustment without removing the cover.

MOUNTING: PTR modules will mount on any of three surfaces using 8-32 hardware to recessed threaded inserts.

19-inch rack mounting accessories include:
Model RA 35–1 mounts a single unit on a 3½" high panel.
Model RA 33–3 mounts up to 3 units on a 3½" high panel.
Model RA 34–4 mounts up to 4 units on a 5¼" high panel.
Rack adapters are $15.00 each. Please refer to the *Hardware* section in the Kepco Catalog.

DIMENSIONS

English measure:
$3\frac{17}{64}$" H x 5" W x $13\frac{27}{32}$" L (inc. barrier-strip).

Metric measure:
83.0 H x 127.0 W x 351.6 L mm (inc. barrier-strip).

FINISH: Black anodized aluminum.

OPTIONS (add identifying letters as a suffix to model number):

Suffix "–E": Zeroing trimmer for the offset voltage of the voltage control channel. Price: $10.00.

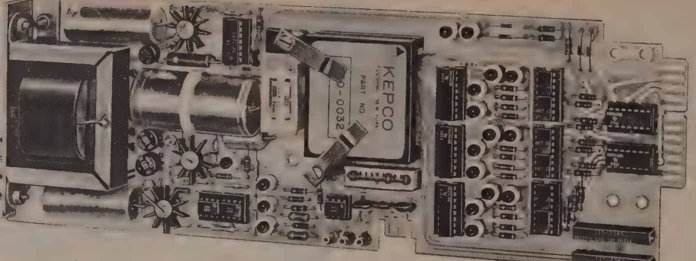
Suffix "–R": Calibration control for the voltage channel's control current. Price: $10.00.

Suffix "–T": Lowered temperature effect coefficient:
0.005% per °C voltage mode; 0.01% per °C current mode.
Price: $30.00.

Suffix "–VP": Built-in overvoltage sensing crowbar.
Trigger time: Less than 10 microseconds.
Setting range: 4.8 volts (min.) to 110% E_o max.
Threshold: 5% E_o max. or 0.5 volt, whichever is greater.
Temperature effect on setting: ±0.03% per °C.
Price, factory installed: $25.00.

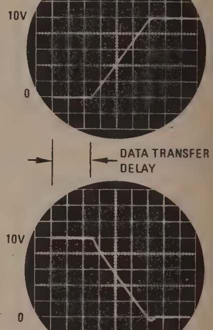
SN

programmer on a card

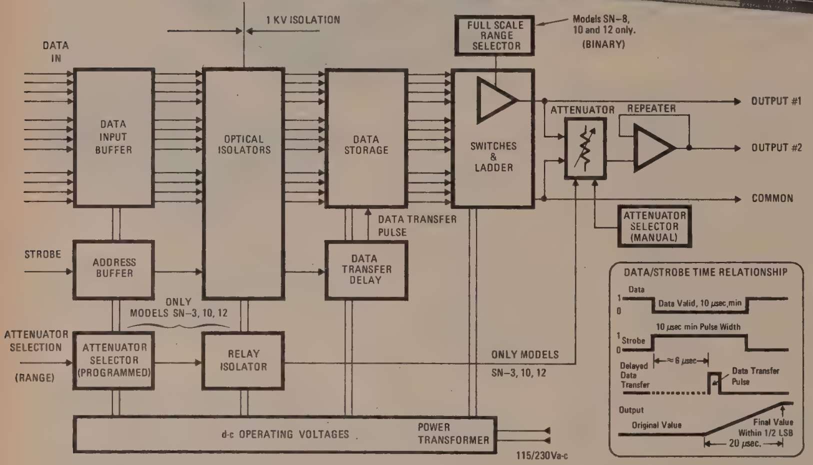

KEPCO
PART NO.
0-0032

Model SN–3: Digital Programmer Card
3^15/16" x 11^23/32" x 1½".
100.0 x 297.7 x 38.1 mm.

0–10V Program Model SN–3
2V/cm Vertical
2 μs/cm Horizontal



10V–0 Program Model SN–3
2V/cm Vertical
2 μs/cm Horizontal


1 KV ISOLATION
DATA
IN
DATA
INPUT
BUFFER
OPTICAL
ISOLATORS
DATA
STORAGE
FULL SCALE
RANGE
SELECTOR
Models SN–8,
10 and 12 only.
(BINARY)
SWITCHES
&
LADDER
ATTENUATOR
REPEATER
OUTPUT #1
OUTPUT #2
COMMON
DATA TRANSFER
PULSE
STROBE
ADDRESS
BUFFER
DATA
TRANSFER
DELAY
ATTENUATOR
SELECTOR
(MANUAL)
ONLY
MODELS SN–3, 10, 12
ATTENUATOR
SELECTION
(RANGE)
ATTENUATOR
SELECTOR
(PROGRAMMED)
RELAY
ISOLATOR
ONLY MODELS
SN–3, 10, 12
d-c OPERATING VOLTAGES
POWER
TRANSFORMER
115/230Va-c
DATA/STROBE TIME RELATIONSHIP
Data
1
0
Data Valid, 10 μsec,min
10 μsec min Pulse Width
1
Strobe
0
≈ 6 μsec
Delayed
Data
Transfer
Data Transfer
Pulse
Output
Original Value
Final Value
Within 1/2 LSB
20 μsec.

SPECIFICATIONS	MODEL SN–2	MODEL SN–3	MODEL SN–8	MODEL SN–10	MODEL SN–12
RESOLUTION	2-Digit	3-Digit	8-Bit	10-Bit	12-Bit
INPUT DATA CODING	Complementary Binary Coded Decimal 4 Lines per Digit 8–4–2–1		Bipolar Output: Complementary Offset Binary Unipolar Output: Complementary Binary		
OUTPUT NO. 1	0 to +10V	0 to +10V	0 to +10V	0 to +10V	0 to +10V
FULL SCALE RANGE SELECTOR	–	–	±10V; ±5V	±10V; ±5V	±10V; ±5V
OUTPUT NO. 2	Output No. 2 is equal to Output No. 1 (whichever scale selected) multiplied by selected or programmed attenuation ratio.				
ATTENUATOR SELECTOR (Manual)	1:1; 10:1; 20:1				
PROGRAMMABLE RANGING	–	1:1; 10:1	–	1:1; 10:1	1:1; 10:1

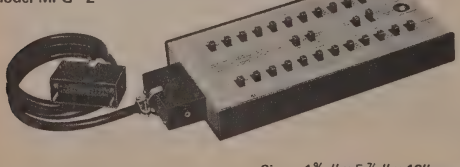
SPECIFICATIONS	MODEL SN–2	MODEL SN–3	MODEL SN–8	MODEL SN–10	MODEL SN–12
ACCURACY @ 25°C (% of full scale reading) SCALE FACTOR ERROR(1)	±0.2%	±0.1%	±0.1%	±0.1%	±0.05%
ZERO OFFSET	Zeroing Trimmer is Built-In.				
LINEARITY	±0.2%	±0.05%	±0.2%	±0.05%	±0.01%
TEMPERATURE EFFECT per °C (% of full scale reading) ON SCALE FACTOR	±0.005%	±0.005%	±0.005%	±0.005%	±0.002%
ON ZERO OFFSET	±0.005%	±0.005%	±0.005%	±0.005%	±0.002%
ON LINEARITY	±0.002%	±0.002%	±0.002%	±0.002%	±0.002%
DRIFT per 1000 HOURS (% of full scale reading)	±0.2%	±0.2%	±0.2%	±0.2%	±0.1%

(1) May be calibrated with optional trimmer. Option "–R"
Add the option letter as a suffix to the model number.

SN GENERAL SPECIFICATIONS

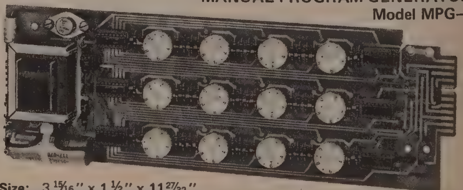
DATA INPUT: Parallel, 1 line/bit DTL/TTL, 10 μsec minimum.
STROBE: 10 μsec pulse transfer data to buffer registers.
SETTLING TIME (½ LSB): <20 μsec + 6 μsec delay.
RANGE SELECT: (SN–3,–10,–12): <2 milliseconds.
ISOLATION: Maximum 1000V input to output.
TEMPERATURE RANGE (operating): 0 to +70°C.
SOURCE POWER: 105–125 or 210–250V a-c, 50–440 Hz.
MAXIMUM CAPACITIVE LOAD: 1000 pF.
OUTPUT IMPEDANCE (d-c): <0.1 Ω.
NOISE ON OUTPUT (20 Hz–10 mHz): <1 mV p-p.
MANUAL INPUTS: MPG–2 or MPG–4.

MANUAL PROGRAM GENERATOR
Model MPG–2



Size: 1 9/16" x 5 7/8" x 12".
39.7 x 149.2 x 304.8 mm.
3-digit BCD or 12-bit binary Manual Program Generator.

MANUAL PROGRAM GENERATOR
Model MPG–4



Size: 3 15/16" x 1½" x 11 27/32".
100.0 x 38.1 x 300.8 mm.
Pre-set storage of (4) 3-digit (BCD) programs.

KEPCO

ACCESSORY EQUIPMENT

FG-100A

Model FG–100A is an integrating-type triangular waveform generator, producing symmetric or asymmetric up and down ramps in the range 0–20V d-c. Independent high and low limit settings control the points of reversal which establish both the amplitude and frequency of the waveform.

CALIBRATED RAMP RATE[1] V/SEC	MAXIMUM TIME BASE SEC	RETRACE SPEED V/SEC	STOPPED DRIFT mV/hour	RAMP LINEARITY %	RAMP LINEARITY TEMP. EFFECT %/°C	UNPROGRAMMED OUTPUT DEVIATION (ripple & noise) rms	p-p[2]
0.001	20,000	10	50	1.5	0.25	0.2 mV	5 mV
0.01	2,000	10	50	0.15	0.025	0.2 mV	5 mV
0.1	200	10	50	0.015	0.0025	0.2 mV	5 mV
1	20	10	50	0.01	0.001	0.2 mV	5 mV
10	2	100	500	0.01	0.001	2.0 mV	15 mV
100	0.2	200	500	0.01	0.001	2.0 mV	15 mV

[1]Tolerance ±15%. [2]20 Hz to 10 MHz.

Output:	0–20V up to 20 mA.
Dwell:	Stop at high limit or low limit.
Retrace:	Up or down to re-set long-duration sweeps.
Remotes:	Timing and limit set connections for external control. 3V sync signal provided.
Source power:	105–125V a-c or 210–250V a-c, 50–440 Hz.
Operating Temperature:	0 to +55°C.

Model FG–100A

DIMENSIONS:
English measure:
4¼"H x 8 5/32"W x 13 5/8"L.
Metric measure:
108.0 H x 207.2 W x 346.1 L mm.

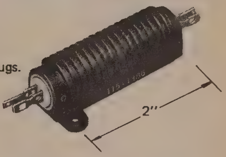
CURRENT SENSING RESISTORS

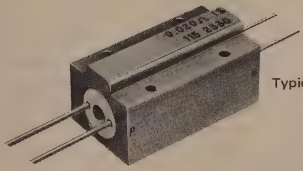
SENSING RESISTORS

PART NUMBER	RESISTANCE OHMS	TERMINAL	MAXIMUM DISSIPATION WATTS (1)	PRICE	SHIP WGT. lbs.	kg.
KT–1915	1.0 Ω	lugs	50 W	$20.00	2 oz.	0.06
KT–1385	0.67 Ω	lugs	50 W	20.00	2 oz.	0.06
KT–1399	0.5 Ω	lugs	50 W	20.00	2 oz.	0.06
KT–1386	0.333 Ω	lugs	50 W	20.00	2 oz.	0.06
KT–1598	0.2 Ω	lugs	50 W	20.00	2 oz.	0.06
KT–1387	0.1 Ω	lugs	50 W	20.00	2 oz.	0.06
KT–2537	0.0625 Ω	leads	100 W	30.00	3 oz.	0.09
KT–2536	0.05 Ω	leads	100 W	30.00	3 oz.	0.09
KT–2480	0.033 Ω	leads	100 W	30.00	3 oz.	0.09
KT–2330	0.02 Ω	leads	100 W	30.00	3 oz.	0.09
KT–2325	0.01 Ω	leads	100 W	30.00	3 oz.	0.09

(1)Recommended Heat Sink: 144 square inch, 1/4" aluminum or equivalent (950 square cm x 0.5 cm). Power rating based on 275°C max hot spot temperature in 25°C ambient, derate to 80% power in 71°C ambient.

Typical 50 watt resistor with lugs.





Typical 100 watt resistor with leads.

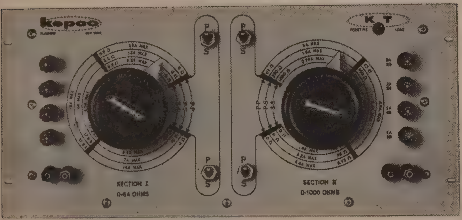
1000Ω current feedback control.

Tolerance: ±1%
Temperature Effect Coefficient: 0.002%/°C

CURRENT CONTROL RHEOSTAT

KT–1304	0–1000 Ω (Rheostat Connected)	lugs	1 W	18.75	3 oz.	0.03

VARIABLE RHEOSTAT LOAD BANK



Model KT 6212 – Price: $787.00 – Shp. Wgt. 47 lbs.(21.4 kg.)

The Model KT 6212 is a multiganged, eight-section group of dual-wound power rheostats used in the testing of regulated power supplies.

Model KT 6212 consists of two independent gangs of four rheostats apiece, 0-64 ohms and 0-1000 ohms. The rheostats can be switched for parallel, series parallel and series operation. Each rheostat has heavy and light windings so that the maximum load current changes at approximately each third rotation point around the dial.

CONTROLS:
Switches select series and parallel combinations of the four ganged rheostats with the corresponding resistance and current rating designated by concentric bands.

Each band defines the resistance range for its particular connection with zero ohms (maximum current) in the clockwise position. The bands are divided into three sections that correspond to the position of the heavy and light windings, respectively. The maximum current in each section is shown on the corresponding portion of the band.

FUSING:
Each rheostat in the 0-64 ohm gang is fused at 7 amperes. Each rheostat of the 0-1000 ohm gang is fused for 2 amperes.

TERMINALS:
A pair of 5-way binding posts is provided at each gang for connection to the power source under test. These connections are duplicated at the rear.

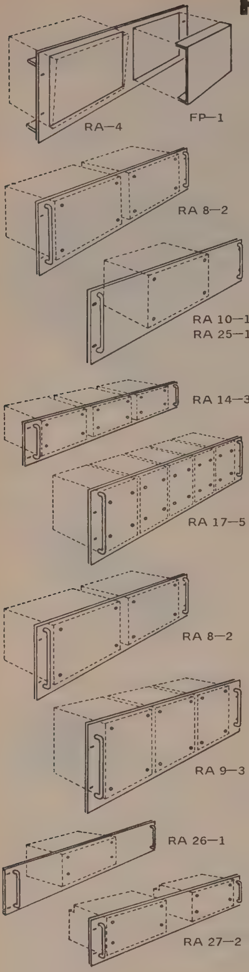
EXTERNAL POWER REQUIREMENTS:
None. The Model KT 6212 is a passive device.

DIMENSIONS:
8¾"H x 19"W 13 5/8 "D. The Model KT 6212 resistive load is designed for mounting in standard 19" equipment racks.

Data and prices subject to change without notice

RACK ADAPTERS

Adapt bench style, modular and half-rack power supplies to the standard 19" wide equipment rack or cabinet. Panels and rack adapters are finished light gray Color 26440 per Fed. Std. 595.


RA–4
FP–1
RA 8–2
RA 10–1
RA 25–1
RA 14–3
RA 17–5
RA 8–2
RA 9–3
RA 26–1
RA 27–2

ABC and FG–100A

MODEL	DESCRIPTION	DIMENSIONS (1) H	W	D	SHIP WGT. lbs.	kg.
RA–4	Dual adapter	5 7/32 132.6	19 482.6	—	3	1.4
RA–5	Single unit adapter	5 7/32 132.6	19 482.6	—	4	1.8
FP–1	Filler panel for RA–4	4¼ 108.0	8 5/32 207.2	—	½	0.2

BKF II and PRM Size "A" – 180 Series

CA–200	Case	6 15/16 176.2	5 127.0	10 7/16 265.1	5	2.3
RA 8–2	2 unit rack adapter	5 7/32 132.6	19 482.6	—	3	1.4
RA 9–3	3 unit rack adapter	6 31/32 177.0	19 482.6	—	4	1.8
RA 10–1	1 PRM unit adapter	5 7/32 132.6	19 482.6	—	3	1.4
RA 25–1	1 BKF II unit adapter	5 7/32 132.6	19 482.6	—	3	1.4

PRM Size "B" – 120 Series and Size "D" – 60 Series

RA 14–3	3 unit rack adapter	3 15/32 88.1	19 482.6	—	2	0.9
RA 15–1	1 Size "B" unit adapter	3 15/32 88.1	19 482.6	—	2	0.9
RA 16–4	4 unit rack adapter	5 7/32 132.6	19 482.6	—	3	1.4
RA 17–5	5 unit rack adapter	5 7/32 132.6	19 482.6	—	3	1.4
RA 30–1	1 Size "D" unit adapter	3 15/32 88.1	19 482.6	—	2	0.9

PRM Size "C" – Dual Output and Extra-Filtered

CA–300	Case	6 15/16 176.2	5 127.0	14 7/16 366.7	7	3.2
RA 8–2	2 unit rack adapter	5 7/32 132.6	19 482.6	—	3	1.4
RA 9–3	3 unit rack adapter	6 31/32 177.0	19 482.6	—	4	1.8
RA 18–1	1 unit rack adapter for Extra-Filtered	5 7/32 132.6	19 482.6	—	3	1.4
RA 31–1	1 unit rack adapter for Dual Output	5 7/32 132.6	19 482.6	—	3	1.4

PTR GROUP

RA 35–1	1 unit rack adapter	3½ 88.9	19 482.6	—	3	1.4
RA 33–3	3 unit rack adapter	3½ 88.9	19 482.6	—	3	1.4
RA 34–4	4 unit rack adapter	5¼ 133.4	19 482.6	—	3	1.4

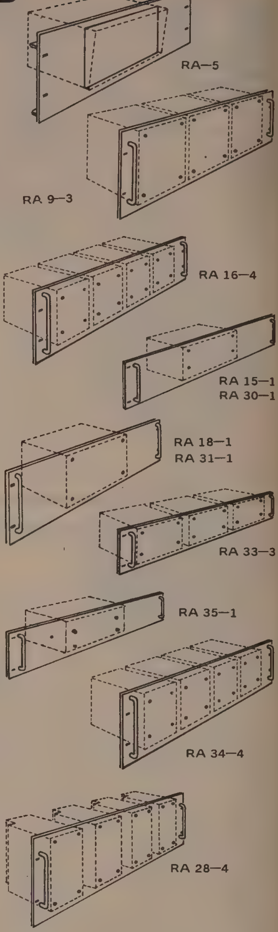
BKF I, CCP, DTM and PAT GROUPS

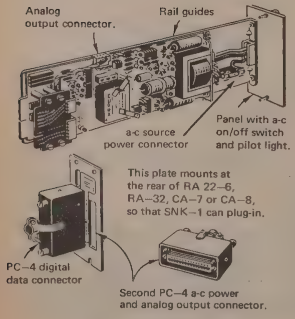
RA 26–1	1 unit rack adapter	3 15/32 88.1	19 482.6	—	2	0.9
RA 27–2	2 unit rack adapter	3 15/32 88.1	19 482.6	—	2	0.9
RA 28–4	4 unit rack adapter	6 31/32 177.0	19 482.6	—	3	1.5

SN SYSTEM

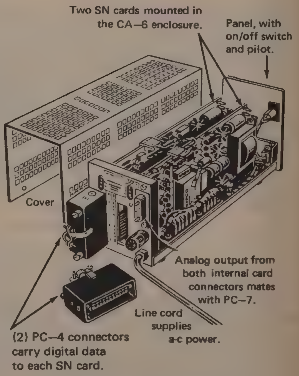
SNK–1	Slide adapter (complete with connectors) for use in RA 22–6A, RA–32, CA–7 & CA–8.	3½	1.6
CA–6	Enclosure case, accommodates 2 SN cards (includes connectors) in ¼-rack space.	7	3.2
PC–4	24-terminal digital data connector	½	0.2
PC–5	a-c source power connector	½	0.2
PC–6	Analog output connector	½	0.2
PC–7	14-terminal analog signal connector	½	0.2

(1) Upper dimensions are in inches; lower dimensions in millimeters


RA–5
RA 9–3
RA 16–4
RA 15–1
RA 30–1
RA 18–1
RA 31–1
RA 33–3
RA 35–1
RA 34–4
RA 28–4


Analog output connector.
Rail guides
a-c source power connector
Panel with a-c on/off switch and pilot light.
This plate mounts at the rear of RA 22–6, RA–32, CA–7 or CA–8, so that SNK–1 can plug-in.
PC–4 digital data connector
Second PC–4 a-c power and analog output connector.

SNK–1 Slide Adapter with SN–3 card mounted in place.


Two SN cards mounted in the CA–6 enclosure.
Panel, with on/off switch and pilot.
Cover
Analog output from both internal card connectors mates with PC–7.
Line cord supplies a-c power.
(2) PC–4 connectors carry digital data to each SN card.

Two SN cards mounted in the CA–6 enclosure.

PANEL MOUNTING HOLES ARE PRE-DRILLED IN STANDARD E.I.A. PATTERN

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX #710-582-2631 • Cable: KEPCOPOWER NEWYORK

RA22-6A Rack System

HARDWARE FOR PLUG-IN MODELS OPS–II, PCX–MAT AND CC

OPS–I and PCX models can also be mounted using BPA–22 Adapter.

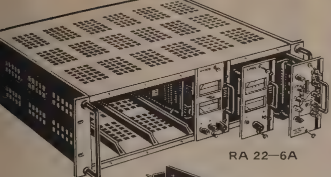
MODEL	DESCRIPTION		DIMENSIONS (2) H	W	D	SHIP WGT. lbs.	kg.
RA 22-6A[(1)]	Six-slot rack housing including (6) PC–2 connectors.		5 7/32 132.6	19 482.6	16¼ 412.8	23	10.4
BPA–22	Blank panel assembly with slide plate		5 7/32 132.6	2 25/32 70.5	14⅝ 371.5	3	1.4
RFP 22–1	Single filler panel		5 7/32 132.6	2 25/32 70.5	—	½	0.2
RFP 22–2	Double filler panel		5 7/32 132.6	5 9/16 141.2	—	½	0.2
RFP 22–3	Triple filler panel		5 7/32 132.6	8⅜ 212.5	—	½	0.2
RA–32 (1)	Rack adapter for (1) half-rack or (2) 1/4-rack plus (3) 1/6-rack slots		5 7/32 132.6	19 482.6	19 482.6	12	6.0
CA–3 (1)	Single Slot	For PCX–MAT, CC or OPS–II	5 7/32 132.6	2 25/32 70.5	16 406.4	6	2.7
CA–4 (1)	Double Slot		5 7/32 132.6	5 9/16 141.2	16 406.4	8	3.6
CA–5 (1)	Triple Slot		5 7/32 132.6	8⅜ 212.5	16 406.4	10	4.5
CA–7 (1)	Double Slot	For PCX–MAT, CC, OPS–II or SNK–1	5 7/32 132.6	5 9/16 141.2	16 406.4	7	3.2
CA–8 (1)	Triple Slot		5 7/32 132.6	8⅜ 212.6	16 406.4	8	3.6
PC–2 (1)	Edge-connector to barrier-strip interface		5 7/32 132.6	2 21/32 67.5	—	½	0.2
PC–8	Edge-connector to cable interface		—	—	—	½	0.2
8282	Plug-in kit for BPA–22		—	—	—	½	0.2

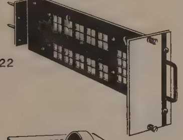
CHASSIS MOUNTING TYPES OPS–I AND PCX MODELS CAN BE ENCASED WITH CASE CA–1 AND FITTED WITH PLUG PC–1 OR PC–8 FOR QUICK-DISCONNECT

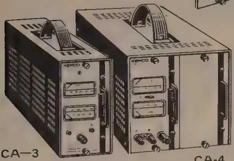
MODEL	DESCRIPTION	DIMENSIONS (2) H	W	D	SHIP WGT. lbs.	kg.
CA–1	Chassis mounting case (single)	2 11/16 68.4	4⅛ 104.8	13 3/16 378.0	2	0.9
PC–1	Connector	—	—	—	½	0.2
RA 12–1	1 cased unit rack adapter	3 15/32 88.1	19 482.6	—	2	0.9
RA 13–4	4 cased unit rack adapter	3 15/32 88.1	19 482.6	—	2	0.9
RA 11–6	6 cased unit rack adapter	5 7/32 132.6	19 482.6	—	3	1.5

(1) RA 22–6A, RA–32, CA–7 and CA–8 are provided complete with Type PC–2 connectors, which are detachable to accommodate SNK–1 or the PC–8.
CA–3, CA–4, and CA–5 are supplied with non-detachable connectors.

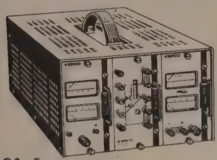
(2) Upper dimensions are in inches; lower dimensions are in millimeters.


RA 22–6A

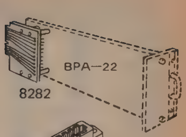

BPA–22

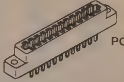


CA–3 CA–4

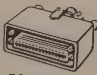


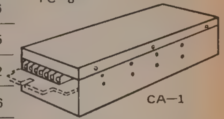
CA–5

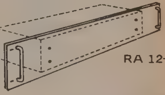

BPA–22
8282

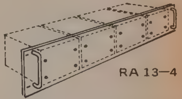

PC–1

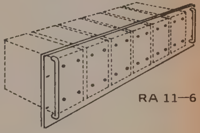
PC–2


PC–8


CA–1


RA 12–1


RA 13–4


RA 11–6

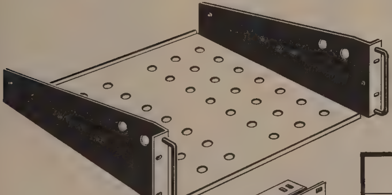
RA24 Rack System

The RA–24 will house ¼ and ½ rack models in the following groups:

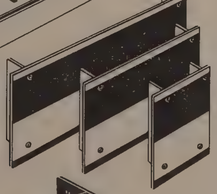
ABC, BOP, FG, JMK, JQE, OPS IV, V, OPS VI, VII, OPS IX & IXB

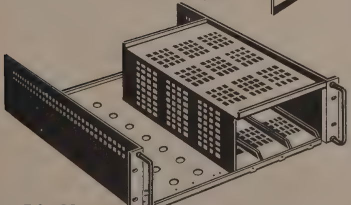
MODEL	DESCRIPTION	DIMENSIONS (1) H	W	SHIP WGT. lbs.	kg.
RA–24	Rack adapter for (2) ½ or (4) ¼ rack models, 17⅞″ deep	5 7/32 132.6	19″ 482.6	7	3.2
RA 24B	Blank bottom for custom drilling	5 7/32 132.6	19″ 482.6	7	3.2
RAP 24–1	Adapter for unmetered ¼ rack CPS models	5 7/32 132.6	4 5/32 105.6	½	0.2
RAP 24–2	Adapter for unmetered ½ rack CPS models	5 7/32 132.6	8 11/32 211.9	½	0.2
RAP 24–1J	Adapter for unmetered ¼ rack JQE models	5 7/32 132.6	4 5/32 105.6	½	0.2
RAP 24–2B	Adapter for unmetered ½ rack BOP models	5 7/32 132.6	8 11/32 211.9	½	0.2
RAP 24–2J	Adapter for unmetered ½ rack JQE models	5 7/32 132.6	8 11/32 211.9	½	0.2
RAP 24–45	RA–24 Adapter for ABC, FG	—	—	½	0.2
RFP 24–1	¼ filler panel for RA–24	5 7/32 132.6	4 5/32 105.6	½	0.2
RFP 24–2	½ filler panel for RA–24	5 7/32 132.6	8 11/32 211.9	2	0.9
RFP 24–3	¾ filler panel for RA–24	5 7/32 132.6	11 3/16 284.2	3	1.4
FSB–1	Filler support bracket	1 23/32 43.6	19″ 482.6	5	2.3
FSB–3	Filler support bracket	3 15/32 88.1	19″ 482.6	6	2.7
FSB–5	Filler support bracket	5 7/32 132.6	19″ 482.6	7	3.2

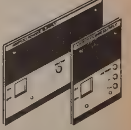
(1) Upper dimensions are in inches; lower dimensions in millimeters.

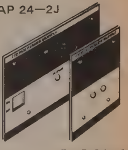

RA 24

FSB-1




RA–32
Combines (3) slots of the RA 22–6A system with a half-rack space from RA–24.

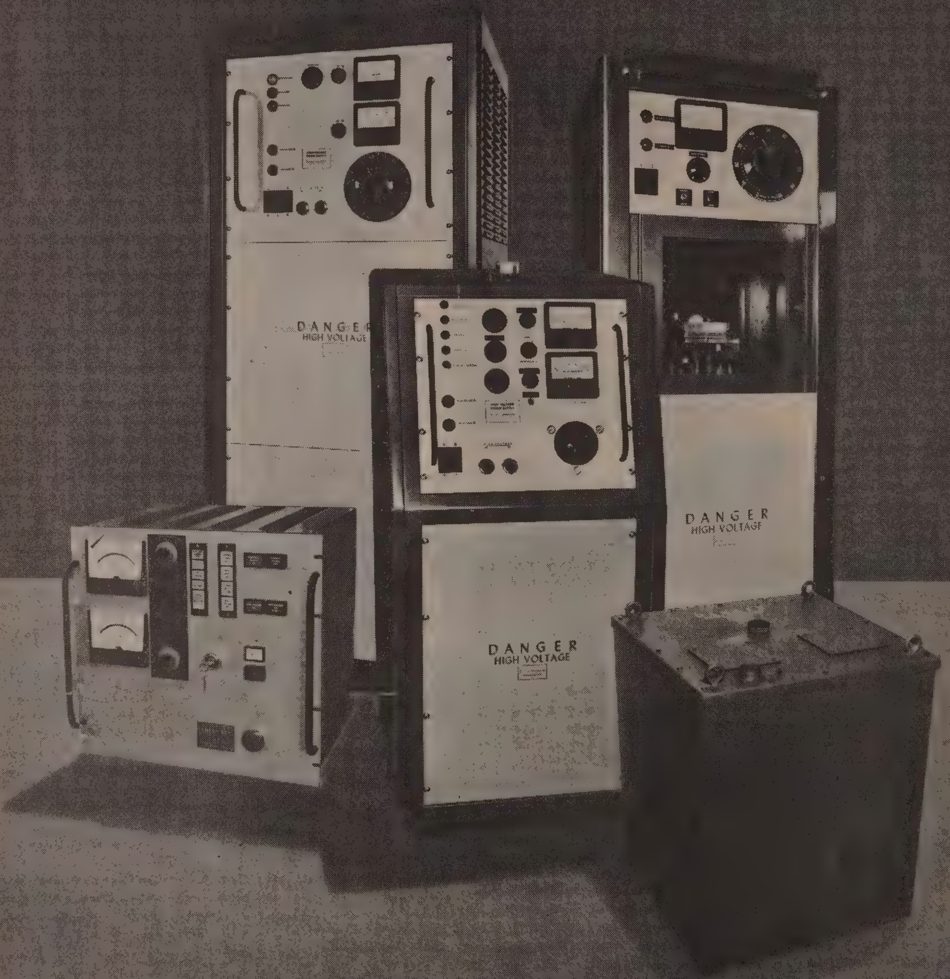

RAP 24–2
RAP 24–1


RAP 24–2J
RAP 24–1J

HIGH VOLTAGE

POWER SUPPLIES • INSULATION TESTERS • POWER PACKS

HIGH VOLTAGE ACCESSORIES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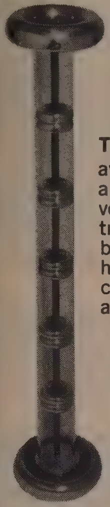
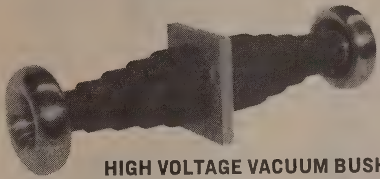
COME TO KILOVOLT CORPORATION WITH YOUR HIGH VOLTAGE PROBLEMS

In addition to our standard line of power supplies, insulation testers and power packs, we custom design units to meet exacting requirements.

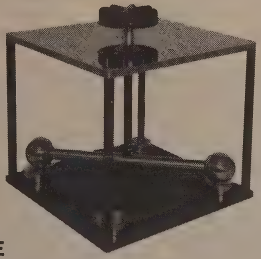
We also specialize in the design and manufacture of unusual auxiliary high voltage hardware and accessories.



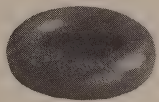
TERMINATING RESISTOR
available in ratings to 600 KV D.C. in air. Intended for isolation of the high voltage supply from the load where transients might be encountered. Can be had with provisions for plugging-in high voltage cable. These resistors are custom-built to meet your specific application.



HIGH VOLTAGE VACUUM BUSHING
for feeding high voltage from atmosphere into a vacuum. Models are available for voltages from 25 KV to 150 KV D.C.



HIGH VOLTAGE SELECTOR SWITCH SINGLE-POLE, DOUBLE-THROW
for operation under oil. Intended for "cold" switching of D.C. potentials to 250 KV D.C. Models are also available in ratings from 25 KV D.C.



PRECISION-SPUN TOROIDS
are available in sizes from four to forty-eight inches in diameter. They are used to minimize corona where high voltage is terminated in atmosphere and to reduce stresses where voltages are terminated in gas or oil.

KILOVOLT CORPORATION

PORTABLE DIELECTRIC TESTERS
Kilovolt manufactures a range of A.C. and D.C. Models similar to the one shown. Designed for convenience in moving from one location to another. The instrument panel is protected by a fold-back cover and a rack is attached to the back for storing cable. Models are available to 50 KV A.C. RMS - to 75 KV D.C.

KILOVOLT CORPORATION

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KILOVOLT
CORPORATION

HIGH VOLTAGE

POWER SUPPLIES • INSULATION TESTERS
ACCESSORIES • POWER PACKS

A pioneer in high voltage techniques, KILOVOLT CORPORATION designs and manufactures a wide variety of power supplies and insulation testers and power packs ranging from 1,000 to 1,000,000 volts. These units are soundly engineered, ruggedly constructed and conservatively rated. Units are custom designed for all types of industrial processing as well as experimental laboratory work.

In addition, KILOVOLT CORPORATION can furnish anti-corona hardware devices, isolating resistors, high voltage voltmeters and high voltage spark gaps. Why not check us for all your high voltage requirements.

HIGH VOLTAGE D.C. POWER SUPPLIES FOR INDUSTRY

FEATURES

- **Reversible Polarity Output (most models)**
- **Continuously Variable Output Control**
- **Adjustable Over-Current Shut-Off**
- **Adjustable Over-Voltage Shut-off**
- **Safety Interlock on H.V. Cabinet Door**
- **Zero-Start Interlock**
- **Dual Range Voltage and Current Meter**
- **Fail-Safe Output Shorting Mechanism**
- **Circuit-Breaker Operation**
- **Functional Pilot Lamps**
- **Surge Limiting Resistor**
- **External Interlock**

OUTPUT		MODEL	OUTPUT		MODEL	OUTPUT		MODEL	OUTPUT		MODEL
KV	MA	NUMBER	KV	MA	NUMBER	KV	MA	NUMBER	KV	MA	NUMBER
0-1	500	KV1-500	0-10	30	KV10-30	0-30	500	KV30-500	0-150	500	KV150-500
0-1	1,000	KV1-1,000	0-10	50	KV10-50	0-30	1,000	KV30-1,000	0-200	5	KV200-5
0-1	3,000	KV1-3,000	0-10	100	KV10-100	0-50	50	KV50-50	0-200	10	KV200-10
0-1	5,000	KV1-5,000	0-10	250	KV10-250	0-50	100	KV50-100	0-250	2	KV250-2
0-1	15,000	KV1-15,000	0-10	500	KV10-500	0-50	300	KV50-300	0-250	5	KV250-5
0-3	200	KV3-200	0-10	1,500	KV10-1,500	0-50	1,000	KV50-1,000	0-250	10	KV250-10
0-3	1,000	KV3-1,000	0-20	10	KV20-10	0-60	10	KV60-10	0-250	25	KV250-25
0-3	2,000	KV3-2,000	0-20	50	KV20-50	0-120	5	KV120-5	0-350	2	KV350-2
0-3	5,000	KV3-5,000	0-20	150	KV20-150	0-120	10	KV120-10	0-350	5	KV350-5
0-3	10,000	KV3-10,000	0-20	300	KV20-300	0-120	30	KV120-30	0-500	2	KV500-2
0-5	100	KV5-100	0-20	800	KV20-800	0-120	100	KV120-100	0-500	20	KV500-20
0-5	500	KV5-500	0-30	20	KV30-20	0-150	5	KV150-5	0-600	2	KV600-2
0-5	1,000	KV5-1,000	0-30	50	KV30-50	0-150	10	KV150-10	0-600	5	KV600-5
0-5	2,000	KV5-2,000	0-30	100	KV30-100	0-150	30	KV150-30	0-600	20	KV600-20
0-5	3,000	KV5-3,000	0-30	200	KV30-200	0-150	100	KV150-100	0-1,000	5	KV1,000-5

ELECTRO-MECHANICAL REGULATION. The above models may be ordered with either voltage regulation, current regulation, or both by means of a servo regulating system.

SATURABLE REACTOR CONSTANT CURRENT. By use of a saturable reactor in conjunction with any of the standard models above, the output current can be held constant to within approximately 10% of the preset level for load variations from short circuit to full load and to within 3% for a half-load to full load change.

REGULATED HIGH VOLTAGE D.C. POWER SUPPLIES

Highly regulated against input line variations or changes in load, these power supplies employ fast response electronic regulation.

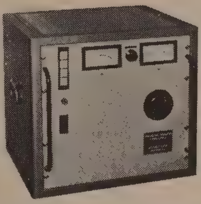
FEATURES

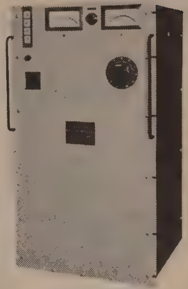
- **Continuously Variable Output**
- **Overload Protection**
- **Zero-Start Interlock**
- **Cabinet Interlock**
- **Provisions for External Interlock**
- **Reversible Polarity Output (most models)**
- **Circuit Breaker Operation**
- **Monitoring Pilot Lamps**
- **Electronically Protected 4½″ Meters**

OUTPUT (MAX.)		MODEL	OUTPUT (MAX.)		MODEL
KV	MA	NUMBER	KV	MA	NUMBER
1.5	100	KVR1.5-100	10	250	KVR10-250
1.5	200	KVR1.5-200	10	500	KVR10-500
1.5	500	KVR1.5-500	10	1000	KVR10-1000
1.5	1000	KVR1.5-1000	15	7	KVR15-7
3	100	KVR3-100	15	45	KVR15-45
3	200	KVR3-200	15	150	KVR15-150
3	500	KVR3-500	15	250	KVR15-250
3	1000	KVR3-1000	15	750	KVR15-750
7	100	KVR7-100	20	10	KVR20-10
7	250	KVR7-250	20	50	KVR20-50
7	500	KVR7-500	20	150	KVR20-150
7.5	1000	KVR7.5-1000	20	500	KVR20-500
10	50	KVR10-50	20	750	KVR20-750
10	100	KVR10-100	24	10	KVR24-10

OUTPUT (MAX.) KV	MA	MODEL NUMBER	OUTPUT (MAX.) KV	MA	MODEL NUMBER
24	45	KVR24-45	50	100	KVR50-100
24	200	KVR24-200	75	5	KVR75-5
24	500	KVR24-500	75	10	KVR75-10
24	1000	KVR24-1000	75	50	KVR75-50
30	1	KVR30-1	75	100	KVR75-100
30	10	KVR30-10	100	5	KVR100-5
30	45	KVR30-45	100	25	KVR100-25
30	100	KVR30-100	150	5	KVR150-5
30	200	KVR30-200	150	15	KVR150-15
30	400	KVR30-400	200	5	KVR200-5
30	800	KVR30-800	200	12	KVR200-12
50	5	KVR50-5	250	5	KVR250-5
50	15	KVR50-15	250	10	KVR250-10
50	50	KVR50-50			

REGULATED HIGH VOLTAGE D.C. POWER SUPPLIES (cont'd.)





CURRENT REGULATION. Voltage regulated power supplies can be provided with current regulation capability on special order.

HIGH-VOLTAGE D.C. INSULATION TESTERS

FEATURES

- Reversible Polarity Output (most models)
- Continuously Variable Output Control with Vernier Adjust
- Adjustable Overcurrent and Overvoltage Shutoffs
- Safety Interlock
- Provision for External Interlock
- Zero-Start Interlock
- Triple Range Current Meters
- Triple Range Voltage Meters
- Fail-Safe Output Shorting Mechanism
- Meters Electronically Protected
- Functional Pilot Lamps
- Selenium Rectifiers
- Surge Limiting Resistor
- Circuit Breaker Operation

OUTPUT KV	MA	MODEL NO.	OUTPUT KV	MA	MODEL NO.
0-30	5	DC 30-5	0-250	5	DC 250-5
0-60	5	DC 60-5	0-350	5	DC 350-5
0-120	5	DC 120-5	0-600	5	DC 600-5
0-150	5	DC 150-5	0-1,000	5	DC 1,000-5

HIGH VOLTAGE A.C. INSULATION TESTERS

for Dielectric Testing under ASTM, MIL and Federal Specs.

FEATURES

• Motor-Driven output control with djustable speeds permits selection f proper rate-of-rise for various pecification testing. • Plexiglas, afety-Interlocked Access Door • 1/2" Memory-type Voltage Meter • unctional Pilot Lamps • Dual ange Circuit Breaker Operation • Plug-in Test Jigs available, most odels.

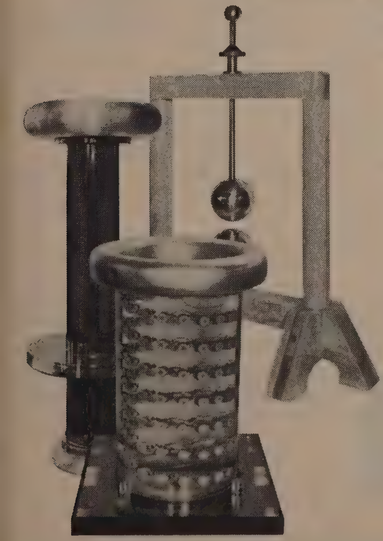
OUTPUT KV	KVA	MODEL NO.
0-15	5	AC 15-5
0-25	2.5	AC 25-2.5
0-25	5	AC 25-5
0-60	2.5	AC 60-2.5
0-100	5	AC 100-5

HIGH VOLTAGE A.C./D.C. INSULATION TESTERS

FEATURES

• Reversible Polarity D.C. Output (most models) • Continuously Variable Voltage Output Control • Adjustable D.C. Over-Current Shut-Off • Zero-Start Interlock • Safety Interlock on High Voltage Cabinet Door • Provision for External Interlock • Electronically-Protected Meters • Fail-Safe Output Shorting Mechanism • Functional Pilot Lamps • Circuit-Breaker Operation • Surge-Limiting Resistor.

OUTPUT KV Peak AC	DC	MA AC	DC	MODEL NO.
15	30	20	5	DAC 15/30-20-5
30	60	20	5	DAC 30/60-20/5
75	150	20	5	DAC 75/150-20/5
125	250	20	5	DAC125/250-20/5



HIGH VOLTAGE D.C. POWER PACKS

These units are high voltage sections of standard power supplies minus meters and controls and contain the basic components described for standard power supplies — filter system, fail-safe mechanism, surge resistor, meter multiplier, primary gaps, etc.

HIGH VOLTAGE HARDWARE AND ACCESSORIES

MULTIPLIERS AND DIVIDERS. High voltage resistance strings, accurate to 0.15% or better with division ratios which may be specified. Stability is 25 PPM/°C; current drain 1 ma. Accuracy traceable to NBS standards as an option.

ELECTRONIC CROWBAR designed to protect Klystron or other sensitive loads from damage by discharge of power supply energy can be manufactured into your custom-built power supply or provided as separate devices. A typical unit has a response time of 3-5 microseconds and is capable of discharging five microfarads in approximately one millisecond at 20 KV.

CALIBRATED SPARK GAPS provided with micrometer calibration and may be used for determining crest voltage.

HIGH VOLTAGE OUTPUT BUSHING. Oil filled and terminated with anti-corona toroids, these devices are designed for oil-to-air outlet of very high voltages; available in two ratings, 300 and 600 KV D.C.

Call or write for a copy of our latest catalog.

KILOVOLT CORPORATION

238 HIGH STREET • HACKENSACK, N. J. 07602
201 488-7373

LH RESEARCH

LH RESEARCH, INC., 2052 South Grand Avenue, Santa Ana, CA 92705 • (714) 546-5279

LH Switching Regulated Power Supplies

- ☐ 80% efficient
- ☐ 250 to 1500 watts
- ☐ Single, dual, triple and quad DC outputs
- ☐ 115/230 AC, or DC inputs
- ☐ 10 different case shapes
- ☐ Smallest and lightest designs available

Hundreds of standard models priced as low as 65 cents per watt!

250 to 1500 watts

LH offers 8 standard wattage ratings — 250, 300, 500, 600, 700, 1000, and 1500, plus a double dual with two isolated 250-watt outputs. This is the most comprehensive line of high-efficiency switchers available anywhere.

4 outputs, fully regulated

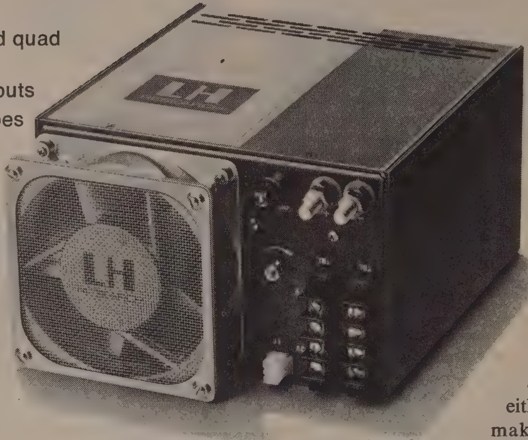
Standard LH switchers are available with single, dual, triple or quad DC outputs. All outputs are fully regulated as a standard feature.

Low DC voltage, high power outputs

Primary outputs are 5 VDC at 50, 100, 120, and 300 amps; 2nd and 3rd voltages are standard ±12, ±15, and ±18V at 8 amps each; 4th voltage is 24V at 2 amps. Other voltages available.

Input voltages externally selectable

115/230 VAC, 47 to 440 Hz, can be selected by simply changing a jumper on the front terminal strip. DC input 24, 48, 120 VDC and others available.



Pictured is the super-compact, forced-air cooled 700 series with 700-watt multiple output, weighing only 11.5 lbs.

10 case configurations

All LH switchers use one basic proven design, and package it in eight different case shapes — wide and short or narrow and long — for customer convenience. With a nominal power density of 1.37 (and as high as 2.5) watt/cu. in., LH switchers pack more power into a smaller package than any other switchers you can buy.

80% efficient

On single output models, over 80 percent of the primary input power is delivered to the output terminal. On models with multiple outputs, efficiency averages 75 percent.

Lighter weights

LH's 250-watt single output model weighs only 7 lbs.; the 1500-watt less than 20 lbs.

A number of options

Over-voltage protection (which is standard on some outputs), power fail detection, remote on-off, DC input, paralleling, master-slave paralleling (up to ten units) — all are available to adapt LH switchers to a wide range of applications.

Easy maintenance

True modular construction — all components are mounted on either two or three circuit boards — makes servicing easy. The entire switcher can be disassembled in less than five minutes.

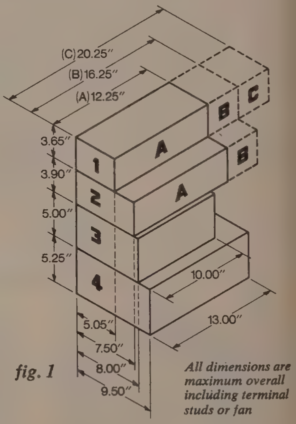


fig. 1

All dimensions are maximum overall including terminal studs or fan

Ask for full-line folder

The LH rep in your area has a new six-page folder that fully describes the several hundred standard LH switchers, and discusses possible options and modifications to meet specific requirements. Ask him for a copy today.

High power switchers exclusively
(that's why we're No. 1)

LH RESEARCH

LH RESEARCH

One of these LH models will probably meet your power supply needs

The following table lists all LH Switching Regulated Power Supply models. The table includes all output voltage and current information plus the price, weight, and physical configuration of the unit.

This last parameter is described on the case notation, which refers to the corresponding dimensional drawing found in figure 1. The numerical digit is, of course, the case format; the letter is the case length code.

The numerical digits of the model number designate the power supply series and model within that series. Total maximum wattage is a function of the series and is listed in the table below. This table also summarizes the other output characteristics of the LH power supplies.

If your needs are not met by one of these units with the options and optional features described herein, contact our offices directly for a quote on a special unit or modification.

SINGLE OUTPUT MODELS

MODEL NO.	D-C OUTPUT		TOTAL MAXIMUM OUTPUT, WATTS
	V	A	
Case 1A — Wt. 7 lbs. — Price $360.00*			
LH251S	5	50	250
LH252S	12	21	250
LH253S	15	17	250
LH254S	18	14	250
LH255S	24	10	250
Case 1C — Wt. 12 lbs. — Price $510.00*			
LH501S	5	100	500
LH502S	12	42	500
LH503S	15	34	500
LH504S	18	28	500
LH505S	24	20	500
Case 2B — Wt. 12 lbs. — Price $510.00*			
LH551S	5	100	500
LH552S	12	42	500
LH553S	15	34	500
LH554S	18	28	500
LH555S	24	20	500
Case 3 — Wt. 10.5 lbs. — Price $595.00* (Also available in 5⅛″ x 5⅛″ x 12″ case size)			
LH700S	2	175	600
LH701S	5	120†	600
LH702S	12	50	600
LH703S	15	40	600
LH704S	18	30	600
LH705S	24	25	600
Case 4 — Wt. 15 lbs. — Price $1295.00*			
LH800S	2	350	700
LH801S	5	300	1500
LH802S	12	125	1500
LH803S	15	100	1500
LH804S	18	80	1500

DUAL OUTPUT MODELS

MODEL NO.	D-C OUTPUT				TOTAL MAXIMUM OUTPUT, WATTS
	V	A	V	A	
Case 1B — Wt. 9 lbs. — Price $465.00*					
LH301D	+ 5	50	— 5	8	300
LH302D	+12	15	—12	8	300
LH303D	+15	15	—15	8	300
Case 2A — Wt. 9 lbs. — Price $465.00*					
LH401D	+ 5	50	— 5	8	300
LH402D	+12	15	—12	8	300
LH403D	+15	15	—15	8	300
Case 2B — Wt. 13 lbs. — Price $650.00*					
LH601D	+ 5	100	— 5	8	600
LH602D	+12	41	—12	8	600
LH603D	+15	33	—15	8	600
Case 3 — Wt. 11.5 lbs. — Price $730.00* (Also available in 5⅛″ x 5⅛″ x 16″ case size)					
LH701D	+ 5	120†	— 5	8	600
LH702D	+12	50	—12	8	600
LH703D	+15	40	—15	8	600

TRIPLE OUTPUT MODELS

MODEL NO.	D-C OUTPUT						TOTAL MAXIMUM OUTPUT, WATTS
	V	A	V	A**	V	A**	
Case 1B — Wt. 9.5 lbs. — Price $520.00*							
LH312T	+5	50	+12	8	—12	8	300
LH313T	+5	50	+15	8	—15	8	300
LH314T	+5	50	+18	8	—18	8	300
Case 2A — Wt. 9.7 lbs. — Price $520.00*							
LH412T	+5	50	+12	8	—12	8	300
LH413T	+5	50	+15	8	—15	8	300
LH414T	+5	50	+18	8	—18	8	300
Case 2B — Wt. 13.5 lbs. — Price $705.00*							
LH612T	+5	100	+12	8	—12	8	600
LH613T	+5	100	+15	8	—15	8	600
LH614T	+5	100	+18	8	—18	8	600
Case 3 — Wt. 11.5 lbs. — Price $790.00* (Also available in 5⅛″ x 5⅛″ x 16″ case size)							
LH712T	+5	120†	+12	8	—12	8	700
LH713T	+5	120†	+15	8	—15	8	700
LH714T	+5	120†	+18	8	—18	8	700

QUAD OUTPUT MODELS

MODEL NO.	D-C OUTPUT								TOTAL MAXIMUM OUTPUT, WATTS
	V	A	V	A**	V	A**	V	A**	
Case 2A — Wt. 10.5 lbs. — Price $580.00*									
LH4121Q	+5	50	+12	8	—12	8	5	2	300
LH4123Q	+5	50	+12	8	—12	8	15	2	300
LH4124Q	+5	50	+12	8	—12	8	18	2	300
LH4125Q	+5	50	+12	8	—12	8	24	2	300
LH4131Q	+5	50	+15	8	—15	8	5	2	300
LH4132Q	+5	50	+15	8	—15	8	12	2	300
LH4134Q	+5	50	+15	8	—15	8	18	2	300
LH4135Q	+5	50	+15	8	—15	8	24	2	300
LH4141Q	+5	50	+18	8	—18	8	5	2	300
LH4142Q	+5	50	+18	8	—18	8	12	2	300
LH4143Q	+5	50	+18	8	—18	8	15	2	300
LH4145Q	+5	50	+18	8	—18	8	24	2	300
Case 2B — Wt. 14 lbs. — Price $765.00*									
LH6121Q	+5	100	+12	8	—12	8	5	2	600
LH6123Q	+5	100	+12	8	—12	8	15	2	600
LH6124Q	+5	100	+12	8	—12	8	18	2	600
LH6125Q	+5	100	+12	8	—12	8	24	2	600
LH6131Q	+5	100	+15	8	—15	8	5	2	600
LH6132Q	+5	100	+15	8	—15	8	12	2	600
LH6134Q	+5	100	+15	8	—15	8	18	2	600
LH6135Q	+5	100	+15	8	—15	8	24	2	600
LH6141Q	+5	100	+18	8	—18	8	5	2	600
LH6142Q	+5	100	+18	8	—18	8	12	2	600
LH6143Q	+5	100	+18	8	—18	8	15	2	600
LH6145Q	+5	100	+18	8	—18	8	24	2	600

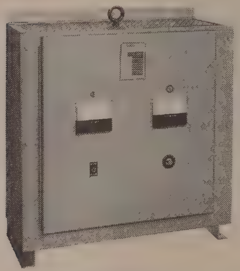
*1 to 24-piece price. Prices and specifications subject to change without notice.

**8 amps combined except 700 series.

†Optional 150 amps.

LAMARCHE... SUPPLYING RELIABLE POWER FOR CRITICAL APPLICATIONS FOR 30 YEARS.

FLOAT BATTERY CHARGERS



The model A-11 Float Battery Charger is a completely automatic, solid state, constant voltage device having:

AC VOLTAGE COMPENSATION — DC VOLTAGE REGULATION — CURRENT LIMITING

The A-11 charger is designed and built to carry continuous and intermittent loads up to its maximum rated output. The A-11 is current limited at 140% of rated output. Each unit is designed to charge a specific type of battery containing a specific number of cells.

The LaMarche transistor-controlled, magnetic-amplifier circuits provide continuous taper charging. Rated output voltage is maintained within ±1% from no load to full load with AC input variations of ±10%. Silicon diodes are used, for rectification.

The model A-11 charger floats lead-acid or nickel-cadmium batteries. Both float and equalize voltages are adjustable to meet battery manufacturers' recommendations. This type of charging imparts the longest battery life and is the accepted method for charging batteries used in standby service.

Design Features:

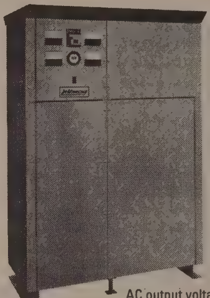
- Quality parts throughout. Silicon diode rectifiers and transistor magnetic amplifiers used exclusively.
- AC power loss relay, output voltmeter/ammeter and fused input-output are standard on all models.
- Eighty types and sizes are available in five input voltages.
- Adjustable equalize and float levels; float-equalize controls located on face panel for easy operation.
- Design and operation tested and approved by battery manufacturers, utilities, railroads and military.

Standard accessories supplied:

1. Potentiometer for desired float and equalize charge voltage adjustments.
2. Quality DC ammeter and voltmeter with 50-millivolt movement, 2% accuracy.
3. Power-failure relay with terminals for connections to a remote alarm system.
4. Fused AC input and DC output for complete protection.
5. Convenient switch to transfer from float charge to high rate equalize charge.
6. Internal terminal board for easy connection of AC input, DC output and power failure equipment.

INVERTERS

DC-to-AC power source with regulated sine wave output



The LaMarche Model A-51 is a completely solid-state SCR inverter which provides a regulated, sine wave output for such applications as:

- Boiler Controls
- Telephone and Microwave Communications
- Burglar Alarms
- Supervisory Control Equipment
- Data Processing and Telemetering Equipment
- Nuclear and Missile Installations
- P.A. Systems
- Fire Alarms

Model A-51 120-volt AC — 60 Hz sine wave output

SPECIFICATIONS

AC output voltage	120 volts nominal
Line regulation	±1% for ±15% DC change
Load regulation	±2% no load to full load
Frequency	60-cycle nominal
Frequency stability	±1% for load, input voltage and temperature variations
Wave shape	Sine wave
Distortion	Approximately 7%
Overall efficiency	Approximately 65%
Ambient temperature	—20° to 60°C (0° to 140°F)

FILTERED DC POWER SUPPLIES

Design features

- Silicon-diode rectifiers.
- Current-limiting circuit.
- Automatic AC voltage compensation.
- DC voltage regulation.
- Output ammeter and voltmeter.

These units are solid-state, fully automatic, constant-voltage DC power supplies designed for all regulated applications.

Standard features include automatic AC line compensation, DC voltage regulation and current limiting. The LaMarche transistor-controlled, magnetic amplifier circuit is designed to automatically provide a DC output regulation of ±1% on the Model A-29 and ±5% on the Model A-28 from no load to full rated output. Accurate output regulation is maintained with AC line variations of ±10%. Offered in a wide range of sizes and voltages.

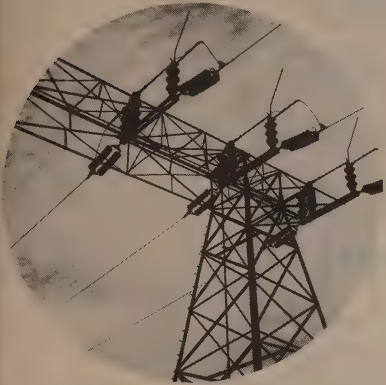
Also... voltage-sensing relays and DC-to-AC converters for a wide variety of applications.

1,000 CHARGERS IN STOCK AT ALL TIMES, READY FOR NEXT-DAY SHIPMENT.

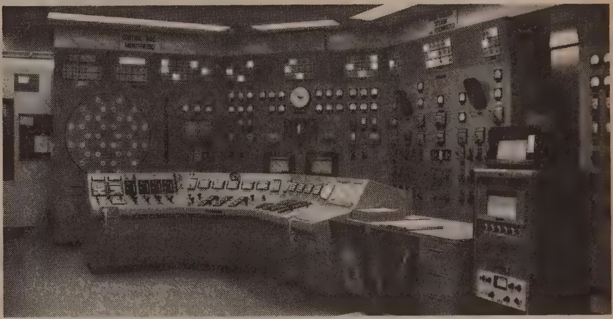
LAMARCHE
Manufacturing Company

102 Bradrock Drive,
Des Plaines, Illinois 60018
Phone: 312/299-1193
Telex: 282-526

LAMARCHE

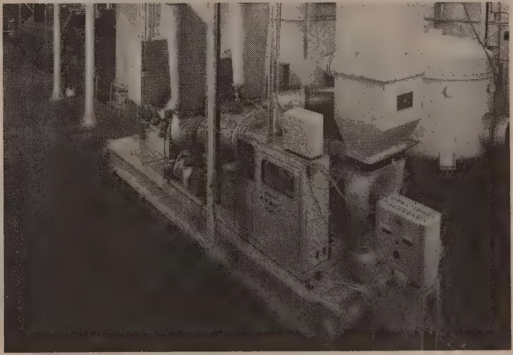


Electric utilities install LaMarche equipment for supervisory control, microwave communications and switchgear tripping.

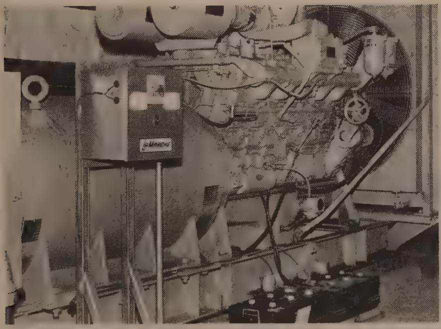


Where absolutely reliable battery charging or an alternate source of AC power is mandatory, such as at this nuclear power plant, LaMarche is a safe specification.

This huge apartment/hotel/shopping complex uses LaMarche equipment for dependable standby power.

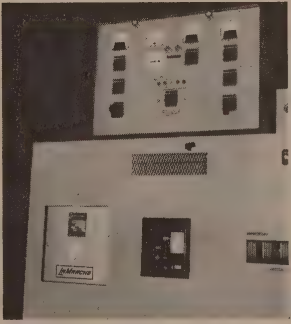


LaMarche charger at U.S. Government agency.

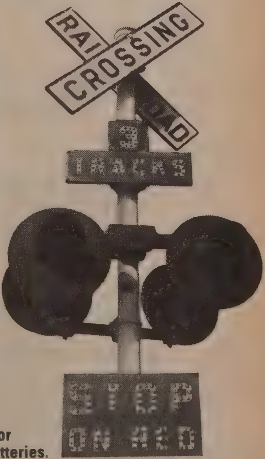


LaMarche battery charger installation at state institutional facility.

All LaMarche chargers are UL listed.



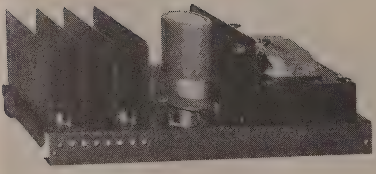
This LaMarche trickle charger is a popular choice at telephone power installations throughout the country.



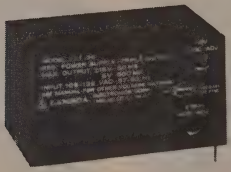
LaMarche chargers are used extensively by railroads for crossing signals, microwave facilities and car lighting batteries.

LAMBDA STANDARD OPEN-FRAME, P-C BOARD MOUNTABLE and MODULAR POWER SUPPLIES

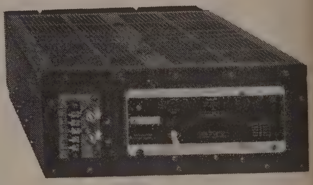
modular supplies for rack or chassis mounting,
industrial and commercial types
open-frame and p-c board power supplies
for industrial and commercial applications



LO SERIES



LZ SERIES



LX SERIES

Send for Lambda's New 1975 General Catalog — Volume 1

5-YEAR GUARANTEE **1-DAY DELIVERY**

LAMBDA
ELECTRONICS CORP.
A Veeco Company

Lambda's Distributor Division maintains a total inventory of over 10,000 power supply units with locations at:

MELVILLE,
NEW YORK 11746
515 Broad Hollow Rd.
Tel. (516) 694-4200

NORTH HOLLYWOOD,
CALIF. 91605
7316 Varna Ave.
Tel. (213) 875-2744

MONTREAL, QUEBEC
100C Hymus Blvd.,
Pointe-Claire, Quebec-730
Tel. (514) 697-6520

LAMBDA POWER INSTRUMENTS

bench and rack mounted power supplies for laboratory, test instrumentation and general purpose applications

LAMBDA CUSTOM POWER SUPPLIES

custom power supplies designed to customer's requirements

Send for Lambda's New 1975 General Catalog — Volume 1

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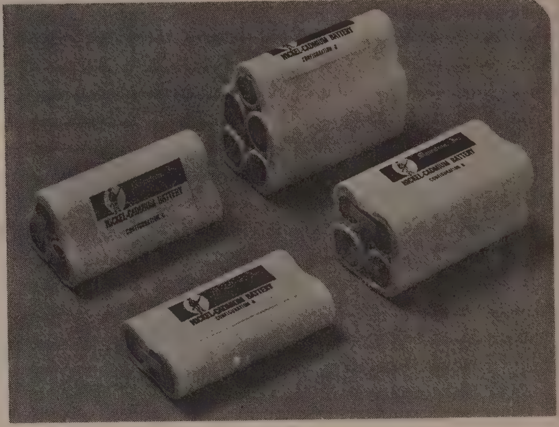
MONTREAL, QUEBEC
100C Hymus Blvd.,
Pointe-Claire, Quebec-730
Tel. (514) 697-6520

Mauratron, Incorporated

2741 Satsuma, Dallas, Texas 75231 214/243-3329

SERIES 100 NICKEL-CADMIUM BATTERY PACKS

- Available in 4 basic configurations for optimum packing density
- Hermetically sealed
- All standard voltages from 2.4 V to 28.8 V
- Amp-hour ratings 20 mAH to 7.0 AH

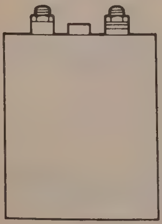


DISTRIBUTOR-STOCKED ITEMS

NICKEL-CADMIUM RECHARGEABLE BATTERIES

BUTTON CELLS
1.2 V
20 mAH to 500 mAH

CYLINDRICAL CELLS
1.2 V
0.475 AH to
1.0 AH

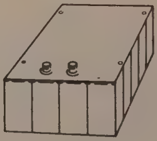


RECTANGULAR CELLS
6 V
11 AH to
23 AH

MULTIPLE CONFIGURATIONS

BUTTON STACKS
2.4 V to 12 V
250 mAH to 500 mAH

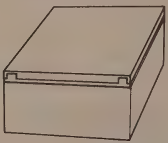
CYLINDER STACKS
2.4 V to 6 V
750 AH to 7.0 AH



CYLINDER BLOCKS
6 V to 28.8 V
.6 AH to 7.0 AH

RECTANGULAR BLOCKS: 6 V to 24 V, 11 AH to 23 AH

GELLED ELECTROLYTE BATTERIES



Globe, 6 V to 12 V, all standard AH capacities.
We stock both A and B versions

HEAT SHRINK TUBING

Ideal for repair shops for insulation replacement.
White PVC, any length, 4, 8, and 22 mils thick.

ZENER DIODES: SCHAUER, 1 W

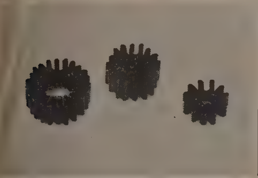
1, 2, 5 and 10% tolerances
Any voltage: V_{ZT} 2.4 to 16 V nominal
Complete inventory in stock
New package: 0.32″ x 0.16″ dia.

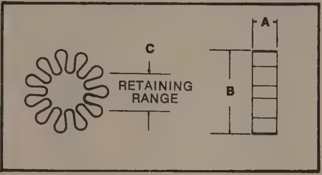
MAURATRON: THE BATTERY POWER PEOPLE Mauratron has solved a wide variety of battery power problems with its unique designs. Whatever your battery power problem, call us for immediate response. We'll be glad to help you find the best solution.

Mauratron, Incorporated

2741 Satsuma, Dallas, Texas 75231 214/243-3329

TR SERIES TRANSISTOR HEAT RADIATORS





TYPE	DIMENSIONS A	DIMENSIONS B	DIMENSIONS C
TR 101	.250	.600 .650	.290 .400
TR 120	.185	.600 .650	.290 .400
TR 108	.250	.650 .825	.360 .525
TR 118	.150	.450 .500	.150 .200

- Protect TO-packaged transistors from destructive heat rise
- Provide up to 4 sq. in. radiating surface in close thermal contact with package
- Self-adjusting. Sizes for TO packages listed with tolerances as specified by JEDEC.
- May be PC-board mounted
- Beryllium copper #25 with black ebanol finish

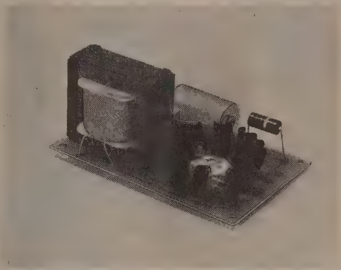
Self-adjusting to the following outlines:

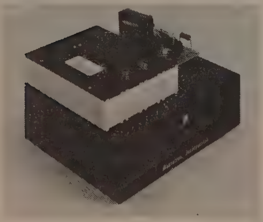
TR 118	TO-18
TR 108	TO-8
TR 101	TO-5, TO-9, TO-11, TO-12, TO-16, TO-29, TO-33, TO-39, TO-42, TO-43

TO ORDER: SPECIFY TYPE NUMBER.

CURRENT-REGULATED BATTERY CHARGERS

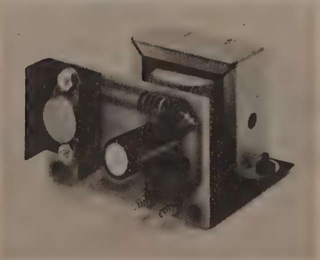
- Complete line, 20 mA to 50A output current
- Chargers available for all output voltage ranges
- Multiple-cell series-charging capability
- PC card, rack, or wall mounting
- Input frequencies available from 40 to 400 Hz.
- Current regulation ±2% (1%, 3%, or 5% available)
- Options include meters, timers, dual charge rates (full and trickle) and multiple current ranges (laboratory-type chargers).





POWER-PAKS

- Nickel-cadmium batteries integrally packaged with Mauratron's transistorized, current-regulated chargers
- "Dierdre" Power Paks: Pressed pocket-type plates for average discharge rates, long cycle life
- "Sean" Power Paks: Sintered plate type for high discharge current loads, extremely long cycle life
- 115 VAC, 60 Hz inputs (25 Hz to 400 Hz available)
- Ideal for standby power for controls, uninterruptible power systems, etc.



GELLED-ELECTROLYTE BATTERY CHARGERS

- Voltage regulated chargers specifically designed for gelled electrolyte batteries
- Models available for "float" installation or recharge in 16 hours
- Recharges unlimited number of cells
- Models available for all standard Gelled Electrolyte Batteries

For complete literature and specifications on all Mauratron products, request Catalog No. SDE 75

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MID-EASTERN INDUSTRIES

• About Mid-Eastern Industries

Mid-Eastern's engineering experience in the design and manufacture of standard and custom power supplies covers a span of 16 years. Over this period Mid-Eastern power supplies have proven their performance in computers, data processing, communications, nuclear research, machine tools; medical apparatus, ground support equipment, process controls and many other special applications.

• How to Select a Power Supply

The selection chart has been arranged so that you can choose the features you desire and then locate the Mid-Eastern power supply that contains those features. The power supplies listed are all standard production units and are usually delivered from stock. If a standard power supply does not meet all your requirements, Mid-Eastern will custom build for you. For more details, refer to Custom Power Supplies and Systems.

• Warranty

Mid-Eastern power supplies are backed by an unconditional repair or replacement warranty for one year after date of sale.

Power Supply Selection Chart

Select and Check Desired Features		√	HT HTA	HV	HW	LA	MIC	MS	PR	RA
Constant Voltage Only			■	■		■	■	■		■
Constant Voltage/Current					■				■	
High Power								■		■
Remote Programming				■	■	●	■		■	■
Remote Sensing			■	■	■	■	■	■	■	■
Tight Regulation			■	■	■	■	■	■	■	■
Low Ripple			■	■	■	■	■	■	■	■
Series/Parallel Operation				■	■				■	■
Input Frequency	50-60 Hz		■	■	■		■	■	■	■
	50-400 Hz		●			■	●			
Fast Response Time			■	■	■	■	■		■	■
Temperature Environment	0-50°C				■		■	■		
	0-60°C		■			■			■	■
	0-70°C						●	●		
Solid State Current Limiting			■	■	■	■	■	■	■	■
Modular			■			■	■			
Rack Mounting				■	■		●	■	■	■
Plug-In			■			■				
Bench Mounting				●	■				●	●
Meters				●	■		●		●	●
Adjustable Over Voltage Crowbar			●	●	●	●	●	●	●	●
10-Turn Potentiometers				●	●	●	●	●	●	●
Mode Lights									●	

● Options available

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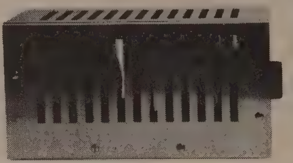
MIC Modular Power Supply System

RA5-1 $35.00

Features

- Low Cost
- .02% Load Regulation
- Parallel or Series Operation
- .02% Line Regulation
- Full Repairability
- 500 Microvolts Ripple
- Remote Sensing
- 0-50°/71°C Operation
- Integrated Circuit Control



B5 $5.00

P5 $20.00

B5M
$35.00

P5M
$40.00

Model Number	Output Volts	Output Amps	Price	Model Number	Output Volts	Output Amps	Price	Model Number	Output Volts	Output Amps	Price	Model Number	Output Volts	Output Amps	Price
MIC A3	3	6.0	$135.45	MIC B3	3	12.0	$187.95	MIC D3	3	18.0	$250.95	MIC E3	3	9.0	$141.75
MIC A5	5	5.8	135.45	MIC B5	5	11.6	187.95	MIC D5	5	17.4	250.95	MIC E5	5	8.7	141.75
MIC A6	6	5.5	135.45	MIC B6	6	11.0	187.95	MIC D6	6	16.5	250.95	MIC E6	6	8.2	141.75
MIC A8	8	5.0	135.45	MIC B8	8	10.0	187.95	MIC D8	8	15.0	250.95	MIC E8	8	7.5	141.75
MIC A10	10	4.7	135.45	MIC B10	10	9.4	187.95	MIC D10	10	14.1	250.95	MIC E10	10	7.0	141.75
MIC A12	12	4.4	135.45	MIC B12	12	8.8	187.95	MIC D12	12	13.2	250.95	MIC E12	12	6.6	141.75
MIC A15	15	3.9	135.45	MIC B15	15	7.8	187.95	MIC D15	15	11.7	250.95	MIC E15	15	5.8	141.75
MIC A18	18	3.5	135.45	MIC B18	18	7.0	187.95	MIC D18	18	10.5	250.95	MIC E18	18	5.2	141.75
MIC A24	24	2.9	135.45	MIC B24	24	5.8	187.95	MIC D24	24	8.7	250.95	MIC E24	24	4.3	141.75
MIC A28*	28	2.6	135.45	MIC B28*	28	5.2	187.95	MIC D28*	28	7.8	250.95	MIC E28*	28	3.9	141.75
MIC A200	200	0.5	158.55	MIC B200	200	1.0	225.75	—	—	—	—	MIC E200	200	0.7	189.00
												MIC F5	5	50	467.25
												MIC F15-2	±15	12†	467.25

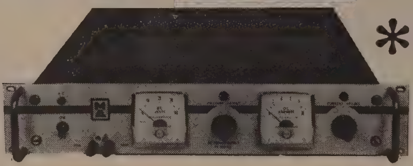
* Other standard models with outputs between 28 and 200 volts are available. Consult factory.

† 12 amps for each output voltage.

PR Constant Voltage/Current Silicon Power Supplies

Features

- High Power — Small Size
- .01% Regulation
- Remotely Programmable
- Low Ripple
- All Silicon Semiconductors
- Constant Voltage/Constant Current
- Mode Lites
- Parallel Operation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Model Number	Output Volts	Output Current Amps	Regulation Line CV	Regulation Line CC	Regulation Load CV	Regulation Load CC	Panel Height	Price
PR 20-15	0-20	0-15	0.01%	0.01%	0.01%	0.25%	3½″	$577.50
PR 40-10	0-40	0-10	0.01%	0.01%	0.01%	0.25%	3½″	566.50
PR 60-7	0-60	0-7	0.01%	0.01%	0.01%	0.25%	3½″	594.00
PR 125-3.2	0-125	0-3.2	0.01%	0.01%	0.01%	0.25%	3½″	688.50
PR 20-25	0-20	0-25	0.01%	0.01%	0.01%	0.25%	5¼″	786.50
PR 40-20	0-40	0-20	0.01%	0.01%	0.01%	0.25%	5¼″	803.00
PR 60-14	0-60	0-14	0.01%	0.01%	0.01%	0.25%	5¼″	786.50
PR 125-6.5	0-125	0-6.5	0.01%	0.01%	0.01%	0.25%	5¼″	1012.00

HV Constant High Voltage Power Supplies

Features

- Adjustable Current Limit
- 0.01% Regulation
- Remote Programming
- All Solid State
- 1 Millivolt Ripple
- 10-Turn Voltage Adjustments
- Remote Sensing

Model Number	Output Volts	Output Amps	RMS Ripple	Regulation Line	Regulation Load	Size	Price
HV 350-1	0-350	1	< 1mv	0.005%	0.01%	3½ x 19 x 16½	$761.25
HV 350-2	0-350	2	< 1mv	0.005%	0.01%	5¼ x 19 x 16½	892.50
HV 350-3	0-350	3	< 1mv	0.005%	0.01%	7 x 19 x 16½	1076.25

* Photograph illustrates both PR and HV Series.

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MS High Power System Component Power Supplies

Features

Most Complete Coverage
Up to 600 Volts
Up to 1200 Amperes
139 Standard Models

Low Cost
All Solid State
Extreme Reliability
10 Year Guarantee

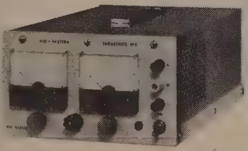
Model Number	Inches in Height
MS9-600	48⅝
MS9-1200	67⅞
MS12-12	3¼
MS12-40	5¼
MS12-60	8¾
MS12-100	12¼
MS12-150	17½
MS12-225	24
MS12-400	67⅞
MS13.5-12	3½
MS13.5-40	5¼
MS13.5-60	8¾
MS13.5-100	12¼
MS13.5-150	17½
MS13.5-225	24
MS13.5-400	67⅞
MS17-10	3½
MS17-30	5¼
MS17-45	8¾
MS17-80	12¼
MS17-120	17½
MS17-180	24
MS17-400	67⅞
MS20-10	3½
MS20-30	5¼
MS20-45	8¾
MS20-80	12¼
MS20-120	17½
MS20-180	24
MS20-400	67⅞
MS25-8	3½
MS25-25	5¼
MS25-37	8¾
MS25-60	12¼
MS25-90	17½
MS25-140	24
MS25-200	48⅝
MS25-400	67⅞
MS29-8	3½
MS29-25	5¼
MS29-37	8¾
MS29-60	12¼
MS29-90	17½
MS29-140	24
MS29-200	48⅝
MS29-400	67⅞
MS34-6	3½
MS34-20	5¼
MS34-30	8¾
MS34-50	12¼
MS34-75	17½
MS34-125	24
MS34-300	67⅞
MS38-6	3½
MS38-20	5¼
MS38-30	8¾
MS38-50	12¼
MS38-75	17½
MS38-125	24
MS38-300	67⅞
MS46-5	3½
MS46-15	5¼
MS46-22	8¾
MS46-40	12¼
MS46-60	17½
MS46-90	24
MS46-120	48⅝
MS46-240	67⅞
MS65-3	3½
MS65-10	5¼
MS65-15	8¾
MS65-25	12¼
MS65-35	17½
MS65-50	24
MS65-75	48⅝
MS65-150	67⅞
MS77-3	3½
MS77-10	5¼
MS77-15	8¾
MS77-25	12¼
MS77-35	17½
MS77-50	24
MS77-75	48⅝
MS77-150	67⅞
MS109-2	3½
MS109-6	5¼
MS109-10	8¾
MS109-15	12¼
MS109-24	17½
MS109-35	24
MS109-45	48⅝
MS109-90	67⅞
MS128-2	3½
MS128-6	5¼
MS128-10	8¾
MS128-15	12¼
MS128-24	17½
MS128-35	24
MS128-45	48⅝
MS128-90	67⅞
MS240-.75	3½
MS240-3	5¼
MS240-5	8¾
MS240-7	12¼
MS240-10	17½
MS240-15	24
MS240-40	67⅞
MS273-.75	3½
MS273-3	5¼
MS273-5	8¾
MS273-7	12¼
MS273-10	17½
MS273-15	24
MS273-40	67⅞
MS350-1.5	5¼
MS350-3	8¾
MS350-5	12¼
MS350-7	17½
MS350-10	24
MS350-30	67⅞
MS410-1.5	5¼
MS410-3	8¾
MS410-5	12¼
MS410-7	17½
MS410-10	24
MS410-30	67⅞
MS470-2	8¾
MS470-3	12¼
MS470-5	17½
MS470-7	24
MS470-10	48⅝
MS470-20	67⅞
MS545-2	8¾
MS545-3	12¼
MS545-5	17½
MS545-7	24
MS545-10	48⅝
MS545-20	67⅞

NOTE: The digits of the Model Number indicate the output voltage and current in amps. Example: MS9-600 has an output of 9 volts, current of 600 amps. MS9-1200 has an output of 9 volts at 1200 amps. **Consult factory for prices.**

HW Constant Voltage/ Constant Current Power Supplies

Features

Models up to 100 Volts
Remotely Programmable
Remote Sensing
Series and Parallel Operation
500μ Volts Ripple
.01% Load Regulation
Half Rack Size
Separate Voltmeter and Ammeter
Rack or Bench mounted
.005% Line Regulation



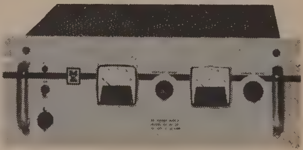
Model Number	Output		Regulation				Price
	Volt-age	Amps	Line		Load		
			CV	CC	CV	CC	
HW 10-8	0-10	0-8	0.01%	0.1%	0.01% or 1 mv	0.5%	$257.
HW 10-15	0-10	0-15	0.01%	0.1%	0.01% or 1 mv	0.5%	369.
HW 20-4	0-20	0-4	0.01%	0.1%	0.01% or 1 mv	0.5%	268.
HW 20-10	0-20	0-10	0.01%	0.1%	0.01% or 1 mv	0.5%	369.
HW 40-2	0-40	0-2	0.01%	0.1%	0.01% or 1 mv	0.5%	268.
HW 40-5	0-40	0-5	0.01%	0.1%	0.01% or 1 mv	0.5%	348.
HW 60-1.5	0-60	0-1.5	0.01%	0.1%	0.01% or 1 mv	0.5%	268.
HW 60-3	0-60	0-3	0.01%	0.1%	0.01% or 1 mv	0.5%	369.
HW 100-2	0-100	0-2	0.01%	0.1%	0.01% or 1 mv	0.5%	423.
HW 200-1	0-200	0-1	0.01%	0.1%	0.01% or 1 mv	0.5%	476.

rices include: meters, case, carry handle, and rubber feet.
ptions: overvoltage, 10-turn potentiometers, and special input voltage.

RA Constant Voltage Silicon Supplies

Features

High Power — Small Size
Remotely Programmable
Low Ripple
Parallel Operation
.01% Regulation
All Silicon Semiconductors



Model Number	Output		Voltage Regulation		Panel Height	Price
	Voltage	Amps	Line	Load		
RA 20-15	0-20	0-15	0.01%	0.01%	3½″	$478.50
RA 40-10	0-40	0-10	0.01%	0.01%	3½″	478.50
RA 60-7	0-60	0-7	0.01%	0.01%	3½″	495.00
RA 125-3.2	0-125	0-3.2	0.01%	0.01%	3½″	495.00
RA 20-25	0-20	0-25	0.01%	0.01%	5½″	544.50
RA 40-20	0-40	0-20	0.01%	0.01%	5½″	522.50
RA 60-14	0-60	0-14	0.01%	0.01%	5½″	605.00
RA 125-6.5	0-125	0-6.5	0.01%	0.01%	5½″	676.00
RA 40-30	0-40	0-30	0.01%	0.01%	7″	764.50
RA 60-20	0-60	0-20	0.01%	0.01%	7″	792.00
RA 125-10	0-125	0-10	0.01%	0.01%	7″	885.50

Options include: meters, overvoltage, 10-turn potentiometers, and special input voltages.

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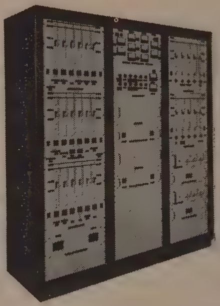
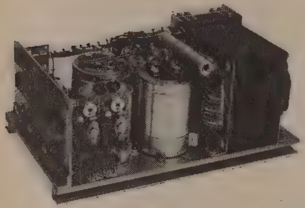
Custom Power Supplies and Systems

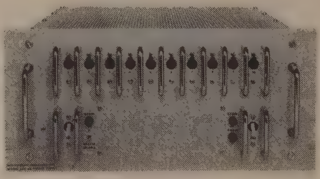
In addition to standard power supplies, Mid-Eastern designs and manufactures special power supplies and power distribution systems to customer specifications. A few custom devices are shown and their applications briefly described to demonstrate the broad scope of Mid-Eastern's experience in this field. If your needs are special, this experience can be of value to you. Whether you need a power supply with unusual outputs, features or dimensions, or a complete power distribution system, take advantage of Mid-Eastern's free consultation service. There is no obligation. Call your local Mid-Eastern representative or direct an inquiry to the factory.



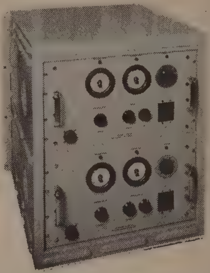
Regulated, no-break, redundant power distribution system with battery back-up for petroleum processing industry.



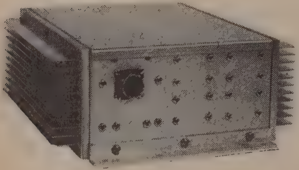
Regulated multi-output power supply for mini-computer.



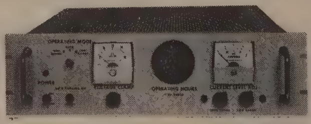
Regulated no-break, redundant 24-volt dc, 15-ampere, 10-channel power distribution system for television studios.



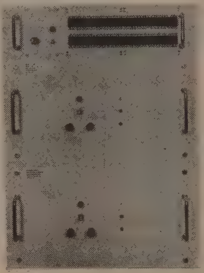
High power, 150-Volt, constant current//constant voltage, shipboard-qualified power supply.



Mil Spec 4 output regulated power supply.



Automatic constant current battery charger with automatic range selection based on battery temperature and voltage level.



Regulated no-break, redundant power distributior system for military application.

NOTE: Not pictured are these special devices: (a) Power supply for CW lasers; (b) Redundant power systems for military telephone communications systems; (c) Xenon lamp power supplies; (d) True RMS regulated ac power supplies; and (e) High current dc power supply for automotive production line testing.

• Applications Assistance

Mid-Eastern power supply experts will welcome the opportunity to assist you and to recommend the best standard or custom power supply for your intended application. Request assistance from any Mid-Eastern representative or consult the factory.

• Additional Literature

Send for a free copy of Mid-Eastern's full-line power supply catalog. It contains detailed technical descriptions and specifi-cations for all Mid-Eastern standard power supplies. Not al types and models are listed in EEM. Literature is also avail-able on custom power supplies. Please request it.

MIL ELECTRONICS
POWER SUPPLY
MODEL NO.
SERIES 15

POWER SUPPLIES

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Small Series G..p. 1.1321

DC to DC

1 Watt Output Power.................................p. 1.1322
3 Watt Output Power..............................p. 1.1322, 1.1323
15 Watt High Reliability..............................p. 1.1323
High Voltage Proportional ....p. 1.1324
Nixie Tube Supply.....................................p. 1.1324
New Products and Developments.........................p. 1.1324

MIL ELECTRONICS has an extremely large selection of cataloged DC to DC and AC to DC power supplies. There are over 1000 different models available in this catalog with output power ratings of one, through twenty-five watts and output voltages from four to four thousand volts.

MIL ELECTRONICS designs and manufactures their own magnetic components. A fully staffed engineering department is constantly developing new products and upgrading the old. The quality of the end product has made MIL ELECTRONICS a leader in the power conversion field.

MIL ELECTRONICS reserves the right to make any changes in design, or to make additions and improvements in its products without imposing any obligation on itself to make similar changes in its products previously manufactured. Specifications and prices are subject to change without notice.

POWER SUPPLIES

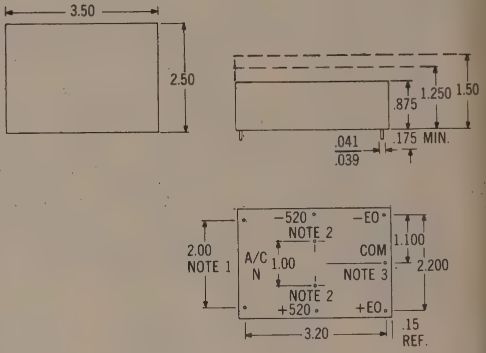
AC TO DC POWER SUPPLIES
SERIES F

- SHORT CIRCUIT PROTECTED
- LONG TERM RELIABILITY
- IC REGULATION

MIL ELECTRONICS
POWER SUPPLY
MODEL NO.

MIL FOR PERFORMANCE

Mil has taken every step to insure that you will receive a quality product at the lowest possible price.
Only quality components are used to insure safe and reliable operation. Specialized equipment such as the soldering line and custom transformer winding machinery have been installed to enable Mil's engineering department to optimize power supply design to your exact needs.



ELECTRICAL SPECIFICATIONS

Input: 105 to 125V A/C, 220V A/C Available Option K
Ripple and Noise: 1 mv rms
Regulation For Load: −0 to F/L .2%
Regulation for Line: .05%
Temp. Coefficient: .02%/°C
Temp. Operation: −25°C to +71°C
Temp. Storage: −55°C to +85°C
Isolation: 50 meg. Ohms.
Hi Pot: 1500 VDC

PHYSICAL SPECIFICATIONS

Mounting—PC Pins
(2) 4-40 Inserts
Case Finish—Diallylphthalate, Black
Semiconductors—All Silicon
Encapsulation—Epoxy

NOTE 1 2.200 spacing Available. Ask for Option "W".
NOTE 2 Used on Triple Output Models only.
NOTE 3 Not used on Single output models.

STANDARD MODELS

SINGLE OUTPUT SUPPLIES

OUTPUT VOLTAGE	OUTPUT CURRENT	WATTS P=E x I	MODEL NO.	CASE HEIGHT	PRICE 1-9
5	500 ma	2.5 W	F5SB50	.875	$33.00
5	1000 ma	5.0 W	F5SA1A	1.250	48.00
6	450 ma	2.7 W	F6SB45	.875	33.00
6	900 ma	5.4 W	F6SA90	1.250	48.00
8	350 ma	2.8 W	F8SB35	.875	33.00
8	700 ma	5.6 W	F8SA70	1.250	48.00
10	250 ma	2.5 W	F10SB25	.875	33.00
10	500 ma	5.0 W	F10SA50	1.250	48.00
12	250 ma	3.0 W	F12SB25	.875	33.00
12	500 ma	6.0 W	F12SA50	1.250	48.00
15	200 ma	3.0 W	F15SB20	.875	33.00
15	500 ma	7.5 W	F15SA50	1.250	48.00
18	100 ma	1.8 W	F18SB10	.875	33.00
18	200 ma	3.6 W	F18SA20	1.250	48.00
20	100 ma	2.0 W	F20SB10	.875	33.00
20	200 ma	4.0 W	F20SA20	1.250	48.00
24	100 ma	2.4 W	F24SB10	.875	33.00
24	200 ma	4.8 W	F24SA20	1.250	48.00
28	100 ma	2.8 W	F28SB10	.875	33.00
28	200 ma	5.6 W	F28SA20	1.250	48.00

MIL ELECTRONICS *176 WALKER ST., LOWELL, MASS. 01854 (617) 453-4142 (617) 452-8981 ... OR TELEX 94-7490*

POWER SUPPLIES
AC TO DC POWER SUPPLIES SERIES F

STANDARD MODELS cont'd.

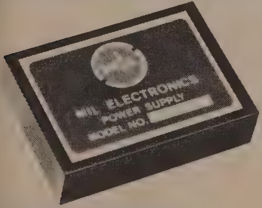
DUAL OUTPUT SUPPLIES

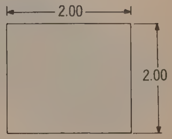
OUTPUT VOLTAGE	OUTPUT CURRENT	WATTS P=E x I	MODEL NO.	CASE HEIGHT	PRICE 1-9
± 5	± 50 ma	.50 W	F5DB05	.875	$33.00
± 5	±150 ma	1.50 W	F5DB15	.875	48.00
± 5	±400 ma	4.0 W	F5DA40	1.250	59.00
± 6	± 50 ma	.60 W	F6DB05	.875	33.00
± 6	±150 ma	1.80 W	F6DB15	.875	48.00
± 6	±400 ma	4.80 W	F6DA40	1.250	59.00
± 8	±300 ma	4.80 W	F8DA30	1.250	48.00
±10	± 50 ma	1.0 W	F10DB05	.875	33.00
±10	±100 ma	2.0 W	F10DA10	1.250	48.00
±10	±250 ma	5.0 W	F10DA25	1.250	48.00
±12	±100 ma	2.4 W	F12DB10	.875	36.00
±12	±200 ma	4.8 W	F12DA20	1.250	48.00
±12	±300 ma	7.2 W	F12DC30	1.500	69.00
±15	± 50 ma	1.5 W	F15DB05	.875	33.00
±15	±100 ma	3.0 W	F15DB10	.875	36.00
±15	±200 ma	6.0 W	F15DA20	1.250	48.00
±15	±300 ma	9.0 W	F15DC30	1.500	48.00
±18	± 50 ma	1.8 W	F18DB05	.875	33.00
±18	±100 ma	3.6 W	F18DB10	.875	36.00
±18	±200 ma	7.2 W	F18DA20	1.250	48.00
±20	± 80 ma	3.2 W	F20DB08	.875	33.00
±20	±200 ma	8.0 W	F20DA20	1.250	48.00
±24	± 50 ma	2.4 W	F24DA20	.875	48.00
± 24	±150 ma	7.2 W	F24DA15	1.250	48.00
±28	±100 ma	5.6 W	F28DA10	1.250	48.00

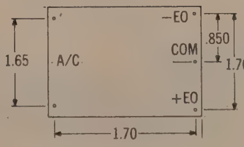
TRIPLE OUTPUT SUPPLIES

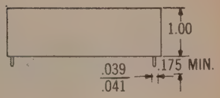
±15 5V	±100 ma 500 ma	5.5 W total	F15TA10	1.25	$73.00
±12 5V	±100 ma 500 ma	4.9 W total	F12TA10	1.25	73.00

SMALL AC TO DC POWER SUPPLIES—SERIES G









ELECTRICAL SPECIFICATIONS

Input: 105 to 125V A/C
Ripple and Noise: 1 mv rms
Regulation For Load: −0 to F/L .2%
Regulation For Line: .05%
Temp. Coefficient: .02%/°C
Temp. Operation: −25°C to +71°C
Temp. Storage: −55°C to +85°C
Isolation: 50 meg. Ohms.
Hi Pot: 1500 VDC

PHYSICAL SPECIFICATIONS

Mounting—PC Pins
Case Finish—Diallylphthalate, Black
Semiconductor—All Silicon
Encapsulation—Epoxy

Eo	Io	WATTS	MODEL NO.	PRICE (1-9)
+ 5V	200 ma	1.00	G5SE20	$29.95
±15V	±50 ma	1.50	G15DE15	29.95
±12V	±50 ma	1.20	G12DE12	29.95

Optional 5V at 200 ma .875 Height. Specify G5SB20

MIL ELECTRONICS *176 WALKER ST., LOWELL, MASS. 01854 (617) 453-4142 (617) 452-8981 ... OR TELEX 94-7490*

POWER SUPPLIES

DC TO DC POWER SUPPLIES
3 WATT TO 15 WATT ISOLATED POWER

SERIES I

1 WATT • ADJUSTABLE ±10% • WELL REGULATED • METAL CASE • SIZE 1.5 x 1 x .55 • TEMP. OPERATING −55°C TO +100°C

OUTPUT VOLTAGES:

±4V to ±50 VDC Dual
4V to 100 VDC Single

ELECTRICAL SPECIFICATIONS:

Regulation Load—½ to Full ±1.25%
Regulation Line—±.5%
Ripple—.3% p-p

INPUT VOLTAGES:

5V ±.5 VDC 12V ±2 VDC
24V ± 4 VDC 28V ±4 VDC

Temp. Stability .05%/°C
Input Overvoltage 50%
Isolation 150V

Price 1-9 Qty. $120.00

SERIES P

1 WATT • ECONOMICAL • WELL REGULATED • PLASTIC CASE • FIXED OUTPUT ±1% • SIZE 1.5 x 1 x .50 • TEMP. OPERATING −20°C TO +100°C

OUTPUT VOLTAGES:

±4V to ±50 VDC Dual
4V to 100 VDC Single

ELECTRICAL SPECIFICATIONS:

Regulation Load—½ to Full ±1.25%
Regulation Line—±.5%
Ripple—±.3% p-p

INPUT VOLTAGES:

5V ±.5 VDC 12V ±2 VDC
24V ± 4 VDC 28V ±4 VDC

Temp. Stability .05%/°C
Input Overvoltage 50%
Isolation 150V

Price 1-9 Qty. $49.00

SERIES D

3 WATT • HIGHLY REGULATED • SHORT CIRCUIT PROTECTED • ALUMINUM CASE • SIZE 3.00 x 1.51 x .60 • PC MOUNTING

OUTPUT VOLTAGE:

4V to 46V Single
±4V to ±46V Dual
Reg. for Load—0 to Full ±.2%
Reg. for Line—±.05%
Output Ripple—.1%
Temp. Stability—.01%/°C
Temp. Oper. Case—−55°C to +100°C
Efficiency Typ.—50%

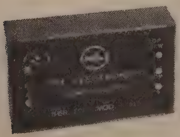
INPUT VOLTAGE:

5V ±.5 VDC 12V ±2 VDC
24V ± 4 VDC 28V ±4 VDC

Price 1-9 Qty. $135.00

SERIES M

3 WATT • WELL REGULATED • ADJUSTABLE ±10% • ALUMINUM CASE • SIZE 2.425 x 1.51 x .60 • P.C. MOUNTING



OUTPUT VOLTAGE:

5V to 250 V Single
±5V to ±110V Dual
Reg. for Load—0 to Full ±1.25
Reg. For Line—±.5%
Output Ripple—.3% P-P
Temp. Stability—.05%/°C
Temp. Oper. Case—−20°C to +100°C
Efficiency Typ.—65%

INPUT VOLTAGE:

5V ±.5VDC 12V ±2 VDC
24V ±.4VDC 28V ±4 VDC

Price 1-9 Qty. $135.00

MIL ELECTRONICS *176 WALKER ST., LOWELL, MASS. 01854 (617) 453-4142 (617) 452-8981 ... OR TELEX 94-7490*

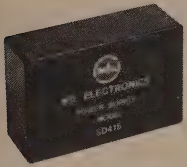
POWER SUPPLIES

DC TO DC POWER SUPPLIES

3 WATT TO 15 WATT ISOLATED POWER

SERIES S

3 WATT • WELL REGULATED • ECONOMICAL • DIALLYLPHTHALATE CASE • SIZE 2.40 x 1.50 x .812 • P.C. MOUNTING



OUTPUT VOLTAGE:

5V to 250V Single
±5V to ±110V Dual
Reg. for Load—½ to Full ±1.25%
Reg. for Line—±.5%
Output Ripple—.3% P-P
Temp. Stability—.05%/°C
Temp. Oper. Case—−20°C to +100°C
Efficiency Typ.—65%

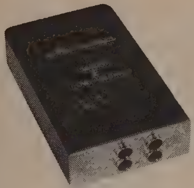
INPUT VOLTAGE:

5V ±.5 VDC 12V ±2 VDC
24V ± 4 VDC 28V ±4 VDC

Price 1-9 Qty. $85.00
Triple Output Price 1-9 Qty. $95.00

SERIES E

15 WATT • HIGHLY REGULATED • FOLD OVER CURRENT LIMITING • ALUMINUM CASE • SIZE 5.0 x 3.03 x 1.16



OUTPUT VOLTAGE:

4 to 45 VDC Single
±5 to ±45 VDC Dual
±12 +5 Triple
±15 +5 Triple
Reg. for Full Load—±.5%
Reg. Line—±.05%
Temp. Stability—.01%/°C
Efficiency—60%
Temp. Oper. Case—−55°C to +100°C
Ripple—.3% P-P

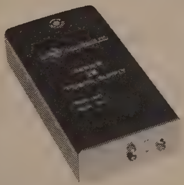
INPUT VOLTAGE RANGE:

11 to 34 VDC 15 to 35 VDC
20 to 60 VDC Rev-Polarity

Price 1-9 Qty. $575.00
Triple Output Price 1-9 Qty. $595.00

SERIES 15

15 WATT • WELL REGULATED • SHORT CIRCUIT PROTECTED • ALUMINUM CASE • ADJUSTABLE ±10% • SIZE 5.0 x 2.58 x 1.16



OUTPUT VOLTAGE:

5 to 500 VDC Single
±5 to ±500 VDC Dual
±12 +5 VDC Triple
±15 +5 VDC Triple
Reg. for Load—½ to Full ±1.25%
Reg. for Line—±.5%
Temp. Stability—.02%/°C
Efficiency—65%
Ripple—.3% P-P

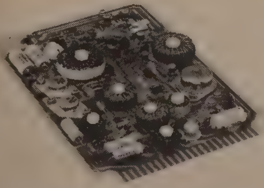
INPUT VOLTAGE RANGE:

11 to 34 VDC 15 to 36 VDC
20 to 60 VDC Rev-Polarity

Price 1-9 Qty. $479.00
Triple Output Price 1-9 Qty. $499.00

SERIES C

15 WATT • WELL REGULATED • SHORT CIRCUIT PROTECTED • CARD MOUNTED • 22 PIN CONNECTOR • SIZE 6.50 x 4.50 x .75



OUTPUT VOLTAGE:

5 to 500 VDC Single
±5 to ±500 VDC Dual
±12 +5 VDC Triple
±15 +5 VDC Triple
Reg. for Load—½ to Full ±1.25%
Reg. for Line—±.5%
Temp. Stability—.02%/°C
Efficiency—65%
Ripple—.3% P-P

INPUT VOLTAGE RANGE:

11 to 34 VDC 15 to 26 VDC
20 to 50 VDC Rev-Polarity

Price 1-9 Qty. $220.00
Triple Output Price 1-9 Qty. $240.00

MIL ELECTRONICS *176 WALKER ST., LOWELL, MASS. 01854 (617) 453-4142 (617) 452-8981 ... OR TELEX 94-7490*

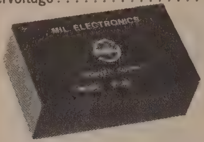
POWER SUPPLIES

DC TO DC POWER SUPPLIES

HIGH VOLTAGE PROPORTIONAL

ELECTRICAL SPECIFICATIONS:

Isolation (Input-Output) . . . . ±2500 Volts
Ripple . . . . Less than 1% pp
Temp. (Operating, Case) . . . . . . −20 to +85°C
Storage Temperature . . . . −55 to +100°C
Input Overvoltage 30%



Size: 2.4" x 1.5" x .812" Price: (1-9 Qty.) $49.00

OUTPUT VOLTS D.C. FROM — TO	INPUT VOLTS D.C. FROM — TO	LOAD RESISTOR	LOAD CURRENT MILLIAMPS FROM — TO	INPUT CURRENT FULL LOAD MAX. OUTPUT	INPUT CURRENT 1/10 LOAD MAX. OUTPUT	MODEL NUMBER
300 — 1000	4 — 12	10 MEG	.03 — .1	45 ma	35 ma	VL10
300 — 1000	4 — 12	1 MEG	.3 — 1.0	220 ma	140 ma	VH10
500 — 1500	4 — 12	10 MEG	.05 — .15	60 ma	35 ma	VL15
500 — 1500	4 — 12	1 MEG	.5 — 1.5	340 ma	140 ma	VH15
700 — 2000	4 — 12	10 MEG	.07 — .2	70 ma	30 ma	VL20
700 — 2000	4 — 12	2 MEG	.35 — 1.0	300 ma	150 ma	VH20

NIXIE TUBE POWER SUPPLY

MIL ELECTRONICS

Size: 1.5" x 1.0" x .50" Price: (1-9 Qty.) $39.95

INPUT VOLTS	MODEL NUMBER	TYPICAL INPUT CURRENT	OUTPUT* VOLTS	OUTPUT CURRENT	OUTPUT RIPPLE	OUTPUT RESISTANCE
5	N5	750 ma				
6	N6	650 ma				
12	N12	300 ma	200 VDC	12 milliamps	10 VPP	1200 OHMS
24	N24	150 ma				
28	N28	125 ma				

*Proportional output

NEW PRODUCTS AND DEVELOPMENTS

SERIES 6

6 WATT • HIGHLY REGULATED • SHORT CIRCUIT PROTECTED

PHYSICAL SPECIFICATIONS:

Aluminum Case or Plastic Case or Card Mounted

OUTPUT VOLTAGE:

5 to 100V Single
±5 to ±100V Dual
Reg. for Load—0 to Full ±.2%
Reg. for Input—±.05%

Output Ripple—.1% P-P
Temp. Oper.—−55°C to +100°C
Eff. Typ.—60%

INPUT VOLTAGE RANGE:

10 to 30 VDC
20 to 60 VDC

For Further Information On This New Product Call The Factory.

SERIES 10

10 WATT • HIGHLY REGULATED • SHORT CIRCUIT PROTECTED

PHYSICAL SPECIFICATIONS:

Aluminum Case or Plastic Case or Card Mounted

OUTPUT VOLTAGE:

5 to 100V Single
±5 to ±100V Dual
Reg. for Load—0 to Full ±.2%

Reg. for Input—±.05%
Output Ripple—.1% P-P
Temp. Oper.—−20°C to +100°C
Eff. Typ.—60%

INPUT VOLTAGE RANGE:

10 to 30 VDC
20 to 60 VDC

For Further Information On This New Product Call The Factory.

CRT AND HV POWER SUPPLIES

If your requirement is for a high voltage supply up through the 20KV range, MIL Electronics Inc. has in development proven HV Designs which may be used to meet your standard or custom needs.

For a power supply to meet your particular application, contact factory directly for prompt attention to your specific needs.

MIL ELECTRONICS *176 WALKER ST., LOWELL, MASS. 01854 (617) 453-4142 (617) 452-8981 ... OR TELEX 94-7490*

CUSTOM BUILT AC/DC POWER SUPPLIES, INDUSTRIAL AND LABORATORY TYPES,

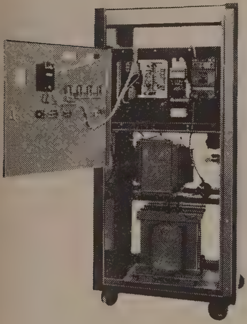
TO YOUR SPECIFICATIONS – HIGH OR LOW CURRENT, VOLTAGE OR FREQUENCY, CONSTANT OUTPUT, PRECISE REGULATION FOR SPECIALIZED APPLICATIONS

Manufacturing power supplies utilizing forced air, water, natural convection and oil cooling systems; both regulated and non-regulated using saturable reactor; variac or SCR controls.

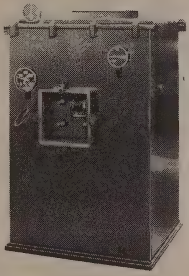
75 KVA water-cooled SCR controlled supply for electric melting furnace.

MANUFACTURING RANGE

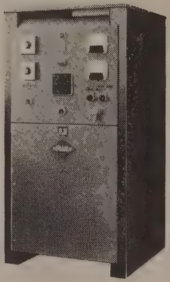
Up to 150 KV
1 ma to 50,000 AMP
4 Hz to 20 Khz
5 KVA to 2000 KVA
50 lb. to 15,000 lb.



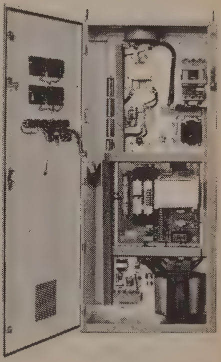
45.5 KVA Saturable Reactor controlled precisely regulated high voltage power supply for sputtering film application.



This unit is typical of our oil-filled power supplies and is rated 45 KV DC at 1 amp output.



Distortion free high current low voltage programmed power supply with precise regulation used for laboratory component testing.



Solid State SCR type Controller with current limiter and spark rate control used with an NWL manufactured Transformer Rectifier set.

NWL also manufactures various types of power transformers, reactors, chokes. See our full page ad in the transformer section of EEM.

Our engineers are available to assist you in selecting magnetic components to meet your application requirements.

NWL TRANSFORMERS

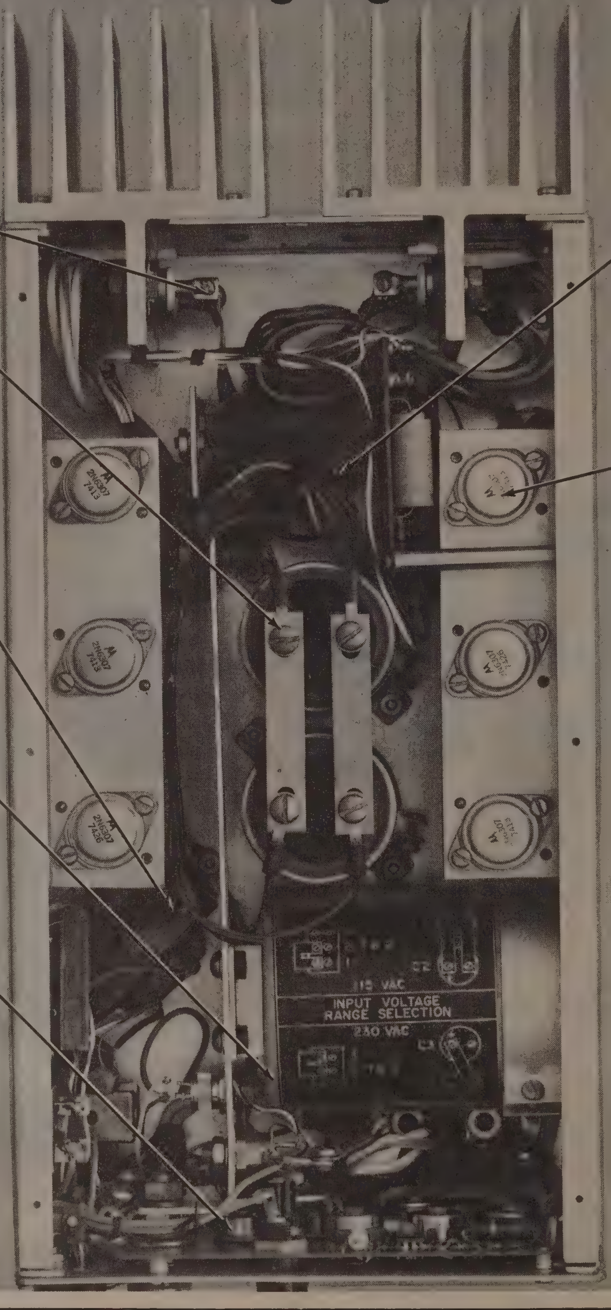
"Manufacturers of the World's Finest Electrical Equipment"

• POST OFFICE BOX 455 • TRENTON, NEW JERSEY, 08603 • 609-298-7300 •

SWITCH WITH NJE

NEW Energy Saver™ Power Supplies

Switching Regulated



80% EFFICIENCY
High speed low forward drop diodes provide efficiencies up to 80%.

20 MILLISECOND POWER HOLDUP
Simple strapping of input caps allows change of input voltage from 115 VAC nominal to 230 VAC nominal. Large input capacitance provides energy storage for at least 20 ms during power failures.

RFI and SOFT START
Input circuitry includes RFI filtering, and "Soft Start" to prevent high input current surges.

LOW RIPPLE
Use of extremely low ESR stacked foil output capacitor produces low output ripple and excellent transient response.

AUTOMATIC RECOVERY FOR OVP and OCP
New concepts in circuit design greatly simplify switching circuitry through use of integrated circuits. Unique features include automatic recovery from overvoltage and an overcurrent trip circuit which reduces average short circuit current to below 10% of maximum.

UNIQUE TRANSFORMER DESIGN
Pulse width modulated transformer operates at 20 KHZ carrier frequency. Provides full regulated output to 88 volts RMS input.

MULTIPLE SWITCHING TRANSISTORS
Super high reliability with over 1 Joule of secondary breakdown capability.

UNIT SHOWN

ESEE-5/OVP
5V @ 100A
Weight: 16 lbs.
Size: $4^{7}/_{8}$ x $7^{1}/_{2}$ x $16^{1}/_{2}$
List Price: $595.00

24 new models available.
Write for catalog.

Another T.D.C. product by

NJE

50 Culver Road,
Dayton, N.J. 08810
(201) 329-4616
TWX: 710-480-5674

ES switching power supply* specifications

OPERATING CHARACTERISTICS

AC INPUT REQUIREMENTS

Voltage, RMS	88 to 132 volts and 176 to 264 volts (See Note 1)
Frequency, (Hz)	47 to 440
Starting Current	Slow or "Soft" start characteristic avoids current surges
Noise Generation (RFI)	Input filter provides noise suppression and maintains line integrity

PERFORMANCE

Output Voltage	See Model Table
Output Voltage Adjustment	± 5% of nominal
Output Current	See Model Table
Line Regulation	0.1% + 5mv for a 10% line change
Load Regulation	0.1% + 5mv, NL to FL
Ripple and Noise	0.2% RMS; 1% p-p max.
Stability	0.1% after initial warm-up
Overshoot	None
ransient Response	
Recovery Time	Returns to within 1.0% of nominal within 500 microseconds (50% of load step)
Excursion for load steps from nominal load	2% max. for 25% step 3% max. for 50% step
emperature Coefficient	0.02%/°C
Efficiency, Typical	65% for 5 volt units; 80% for 28 volt units. See options for 75% 5 volt units.

Note 1: All units may have the input voltage changed from one to the other of the stated ranges by internally shifting two jumpers. Units will be shipped for 88-132 input volts operation unless specified.

FEATURES

Temperature:
Operating: 0° to +71°C (See Model Table)
Storage: -55° to +85°C

Remote Output Voltage Control: Logic "1" at control terminal brings output voltage to zero automatically.

Remote Voltage Sensing: Terminals are provided to maintain regulation at the load to compensate for up to 0.5 volt line drop.

Overload Protection: Input power drops to zero when overloaded, but restores automatically to normal operation when overload disappears. Adjustable from 75% to 125% of nominal.

Overvoltage Protection (OVP): Standard on all 5 volt units; optional for other voltages. Automatically restarts when overvoltage condition disappears without having to recycle input power.

Accessible Controls: Output voltage adjust; Overvoltage adjust (where provided)

Internal Controls: Overload; (Note: Input voltage range is shifted by shifting two jumpers.)

Output Connections: Studs; Terminal Board connections for remote sensing and remote output voltage control.

Input Connections: Terminal Board

Cooling: Natural convection (see Operating Temperature and Model Table).

Transformer Design: Rugged, vacuum impregnated to comply generally with the requirements of MIL-T-27B, Grade 6

Case Finish: Iridite

Mounting: Tapped holes on each of the two or three mounting faces (See Model Table).

Power Interrupt: Output Voltage will remain within basic performance characteristics when input is interrupted for 20 ms.

AVAILABLE OPTIONS

Overvoltage Protection (OVP): Units not provided with OVP as standard, are available with this feature as an option (Contact Factory)

High Efficiency (HE): 5 volt units are available for typical 75% efficiency in lieu of 65%. (Contact Factory)

Early Warning Signal (EW): Output logic "O" signal alerts user to impending loss of output (within 10 milliseconds). (Contact factory)

Low Ripple (LR): For units to be furnished with more stringent ripple requirements, 5 millivolts rms option is available. (Contact Factory)

RFI (RF): Units may be specified to meet the input requirement CEO3 of MIL-STD-461. (Contact Factory)

TBC: Units so specified will be provided with a Terminal Board cover. (See Table for prices)

E: Moisture and fungus resistance coating furnished on certain pc boards (Contact Factory)

B: Uninterruptible operation — battery standby available. (Contact Factory)

Another T.D.C. product by

NJE

50 Culver Road, Dayton, N.J. 08810
(201) 329-4616 / TWX: 710-480-5674

*Patent Pending

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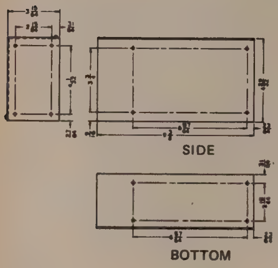
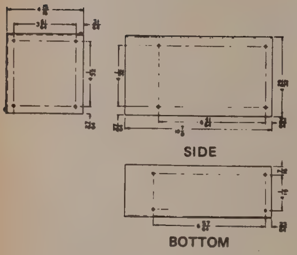
ENERGY SAVING POWER

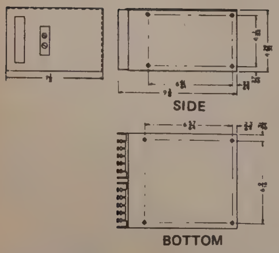
- **Switching Regulator Circuitry*(20KC)**
- **Power Supplies to Combat "Brown-Out" (88V-132V Input)**
- **Power Failure Absorbed within its Design (20 ms holdup)**
- **Two User Settable AC Input Voltages (88-132) or (180-260)**
- **High Efficiency Performance (65-80%)**
- **Small Size and Greatly Reduced Weight per Watt**



Model No.	Voltage Range	40°C	Current Rating 50°C	60°C	71°C	Option TBC	List Price†
ESC 5/OVP	4.75-5.25	24	19.4	15.5	10.0	$15.00	$260.00
ESC 12/OVP	11.4-12.6	12	9.5	7.7	6.0	15.00	260.00
ESC 15/OVP	14.2-15.7	10	8	6.4	5.1	15.00	260.00
ESC 24/OVP	22.8-25.2	8	6.4	5.1	4.1	15.00	260.00



Model No.	Voltage Range	40°C	Current Rating 50°C	60°C	71°C	Option TBC	List Price†
ESCC 5/OVP	4.75-5.25	42	33	27	21	$15.00	$340.00
ESCC 12/OVP	11.4-12.6	20	16	13	10	15.00	340.00
ESCC 15/OVP	14.2-15.7	17	12.5	10	8	15.00	340.00
ESCC 24/OVP	22.8-25.2	12	9.5	7.7	6	15.00	340.00



Model No.	Voltage Range	40°C	Current Rating 50°C	60°C	71°C	Option TBC	List Price†
ESD 5/OVP	4.75-5.25	50	40	32	25	$15.00	$475.00
ESD 12/OVP	11.4-12.6	25	20	16	13	15.00	475.00
ESD 15/OVP	14.2-15.7	20	16	12	9.5	15.00	475.00
ESD 24/OVP	22.8-25.2	17	14	11	9.0	15.00	475.00

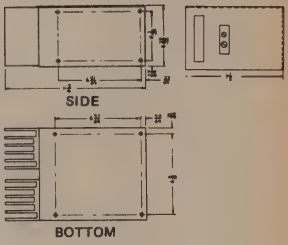
** Patent Pending*

NOTE: All models available in 8V & 18V

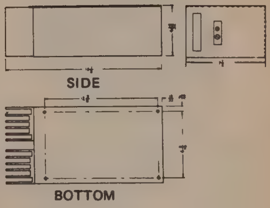
SUPPLIES* FROM NJE

- Fast Recovery Time within 2% Envelope
- Built In Soft Start Circuitry
- OVP Provides Automatic Restart after OVP Condition without recycling
- Early Warning Signal for Input Failure (Optional)
- Uninterruptible Operation (Optional)

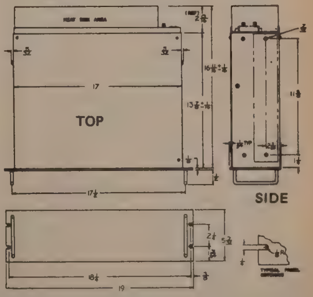
Model No.	Voltage Range	Current Rating				Option TBC	List Price†
		40°C	50°C	60°C	71°C		
ESE 5/OVP	4.75-5.25	65	57.5	50	42.5	$15.00	$495.00
ESE 12/OVP	11.4-12.6	30	27	22	18	15.00	495.00
ESE 15/OVP	14.2-15.7	27	22.5	17.5	12.5	15.00	495.00
ESE 24/OVP	22.8-25.2	18	16	14	12	15.00	495.00



Model No.	Voltage Range	Current Rating				Option TBC	List Price†
		40°C	50°C	60°C	71°C		
ESEE 5/OVP	4.75-5.25	100	80	64	50	$15.00	$595.00
ESEE 12/OVP	11.4-12.6	50	40	32	25	15.00	595.00
ESEE 15/OVP	14.2-15.7	40	32	25	20	15.00	595.00
ESEE 24/OVP	22.8-25.2	30	24	19	15	15.00	595.00



Model No.	Voltage Range	Current Rating				Option TBC	List Price†
		40°C	50°C	60°C	71°C		
ESG 5/OVP	4.75-5.25	225	180	144	115	$15.00	$1095.00
ESG 12/OVP	11.4-12.6	100	80	64	51	15.00	1095.00
ESG 15/OVP	14.2-15.7	85	68	54	43	15.00	1095.00
ESG 24/OVP	22.8-25.2	55	44	35	28	15.00	1095.00

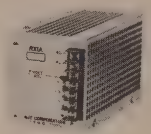


†Prices subject to quantity discounting and change without prior notice.

*Patent Pending

NOTE: All models available in 8V & 18V

MODULAR POWER



A CASE 3 23/32″ x 3 11/64″ x 6½″

MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS1-A-5/OVP	5V ±5%	3.4A	$104
RX1-A-5/OVP	5V ±5%	4.0A	104
RS1-A-12	12V ±5%	2.3A	104
RX1-A-12	12V ±5%	2.7A	104
RS1-A-15	15V ±5%	2.0A	104
RX1-A-15	15V ±5%	2.4A	104
RS1-A-24	24V ±5%	1.35A	104
RX1-A-24	24V ±5%	1.5A	104

WIDE RANGE MODELS A SIZE

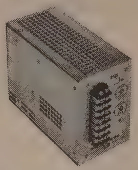
RSA-07-OVP	0-7V	2.0A	$114
RSA-015-OVP	0-15V	1.2A	114
RSA-024-OVP	0-24V	0.8A	114
RSA-032	0-32V	0.66A	114
RSA-060	0-60V	0.35A	114
RSA-120	0-120V	0.15A	114

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $15 except on 5V



B CASE 4 29/32″ x 3 15/64″ x 6½″

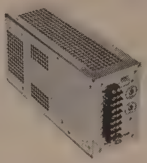
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS1-B-5/OVP	5V ±5%	6.0A	$139
RX1-B-5/OVP	5V ±5%	7.5A	139
RS1-B-10	10V ±5%	4.0A	139
RX1-B-10	10V ±5%	4.4A	139
RS1-B-12	12V ±5%	3.6A	139
RX1-B-12	12V ±5%	4.4A	139
RS1-B-15	15V ±5%	3.2A	139
RX1-B-15	15V ±5%	3.7A	139
RS1-B-18	18V ±5%	2.8A	139
RX1-B-18	18V ±5%	3.4A	139
RS1-B-20	20V ±5%	2.5A	139
RX1-B-20	20V ±5%	3.0A	139
RS1-B-24	24V ±5%	2.2A	139
RX1-B-24	24V ±5%	2.7A	139
RS1-B-28	28V ±5%	2.0A	139
RX1-B-28	28V ±5%	2.4A	139
RS1-B-36	36V ±5%	1.4A	139
RX1-B-36	36V ±5%	1.7A	139
RS1-B-48	48V ±5%	1.2A	145
RX1-B-48	48V ±5%	1.4A	145

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $15 except on 5V



C CASE 4 29/32″ x 3 15/64″ x 9⅜″

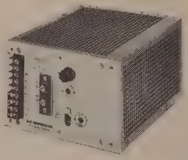
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS1-C-5/OVP	5V ±5%	9.0A	$169
RX1-C-5/OVP	5V ±5%	11.0A	169
RS1-C-10	10V ±5%	6.0A	169
RX1-C-10	10V ±5%	7.0A	169
RS1-C-12	12V ±5%	5.5A	169
RX1-C-12	12V ±5%	6.5A	169
RS1-C-15	15V ±5%	5.0A	169
RX1-C-15	15V ±5%	6.0A	169
RS1-C-18	18V ±5%	4.8A	169
RX1-C-18	18V ±5%	5.5A	169
RS1-C-20	20V ±5%	4.4A	160
RX1-C-20	20V ±5%	5.0A	160
RS1-C-24	24V ±5%	3.9A	160
RX1-C-24	24V ±5%	4.5A	160
RS1-C-28	28V ±5%	3.6A	160
RX1-C-28	28V ±5%	4.0A	160
RS1-C-36	36V ±5%	2.5A	160
RX1-C-36	36V ±5%	3.0A	160
RS1-C-48	48V ±5%	2.0A	175
RX1-C-48	48V ±5%	2.3A	175

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $15 except on 5V



EE CASE 4 29/32″ x 7½″ x 16½″

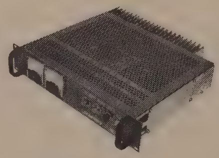
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS2-EE-5/OVP	5V ±5%	44.5A	$475
RX2-EE-5/OVP	5V ±5%	52.5A	450
RS1-EE-10	10V ±5%	32.0A	449
RX1-EE-10	10V ±5%	36.0A	449
RS2-EE-12	12V ±5%	29.0A	449
RX2-EE-12	12V ±5%	34.0A	435
RS2-EE-15	15V ±5%	24.5A	449
RX2-EE-15	15V ±5%	29.0A	449
RS1-EE-18	18V ±5%	21.0A	449
RX1-EE-18	18V ±5%	24.0A	449
RS1-EE-20	20V ±5%	20.0A	449
RX1-EE-20	20V ±5%	23.0A	449
RS2-EE-24	24V ±5%	17.0A	449
RX2-EE-24	24V ±5%	20.0A	435
RS2-EE-28	28V ±5%	15.0A	449
RX2-EE-28	28V ±5%	18.0A	449
RS1-EE-36	36V ±5%	12.0A	449
RX1-EE-36	36V ±5%	14.0A	449
RS1-EE-48	48V ±5%	9.0A	449
RX1-EE-48	48V ±5%	10.0A	449

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $50 except on 5V



OEM RACK
F CASE 3½″ x 19″ x 16⅝″

MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RSF-5	5V ±5%	60A	$495
RSF-12	12V ±5%	34A	495
RSF-15	15V ±5%	30A	495
RSF-24	24V ±5%	24A	495
RSF-28	28V ±5%	20A	535
RSF-36	36V ±5%	15A	535
RSF-48	48V ±5%	12A	535

Regulation: ±.01%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $75 for All Models

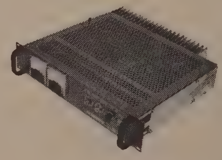
RXF-5	5V ±5%	85A	$535
RXF-12	12V ±5%	50A	535
RXF-15	15V ±5%	45A	535
RXF-24	24V ±5%	30A	535
RXF-28	28V ±5%	28A	535

Regulation: ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $75 for All Models



OEM RACK
G CASE 5¼″ x 19″ x 16⅝″

MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RSG-5	5V ±5%	100A	$695
RSG-12	12V ±5%	56A	695
RSG-15	15V ±5%	50A	695
RSG-24	24V ±5%	36A	695
RSG-28	28V ±5%	33A	695
RSG-36	36V ±5%	25A	725
RSG-48	48V ±5%	19A	725

Regulation: ±.01%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $75 for All Models

RXG-5	5V ±5%	135A	$695
RXG-12	12V ±5%	75A	695
RXG-15	15V ±5%	67A	695
RXG-24	24V ±5%	48A	695
RXG-28	28V ±5%	44A	695

Regulation: ±.1%

Ripple: 1 mv Rms

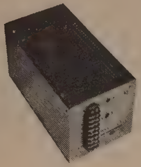
Input: 105-132V 47-440 Hz

OVP: Add $75 for All Models

NJE CORPORATION

P.O. BOX 50, DAYTON, N. J. 08810 / Phone (201) 329-4616
TWX: 710-480-5674

SUPPLIES FROM NJE



CC CASE 4 29/32″ x 4 15/16″ x 9 3/8″

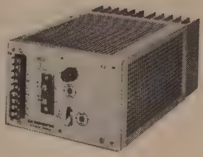
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS1-CC-5/OVP	5V ±5%	14.0A	$225
RX1-CC-5/OVP	5V ±5%	16.0A	225
RS1-CC-10	10V ±5%	10.0A	215
RX1-CC-10	10V ±5%	12.0A	215
RS1-CC-12	12V ±5%	9.0A	215
RX1-CC-12	12V ±5%	10.5A	215
RS1-CC-15	15V ±5%	8.5A	215
RX1-CC-15	15V ±5%	9.5A	215
RS1-CC-18	18V ±5%	7.0A	215
RX1-CC-18	18V ±5%	8.5A	215
RS1-CC-20	20V ±5%	6.7A	215
RX1-CC-20	20V ±5%	7.7A	215
RS1-CC-24	24V ±5%	6.0A	215
RX1-CC-24	24V ±5%	6.8A	215
RS1-CC-28	28V ±5%	5.5A	215
RX1-CC-28	28V ±5%	6.0A	215
RS1-CC-36	36V ±5%	3.8A	215
RX1-CC-36	36V ±5%	4.6A	215
RS1-CC-48	48V ±5%	3.4A	215
RX1-CC-48	48V ±5%	4.0A	215

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $20 except on 5V



D CASE 4 29/32″ x 7 1/2″ x 9 3/8″

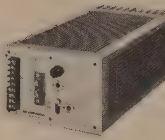
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS2-D-5/OVP	5V ±5%	27.5A	$275
RX2-D-5/OVP	5V ±5%	32.5A	265
RS1-D-10	10V ±5%	16.0A	275
RX1-D-10	10V ±5%	20.0A	275
RS2-D-12	12V ±5%	18.0A	300
RX2-D-12	12V ±5%	21.0A	265
RS2-D-15	15V ±5%	15.0A	300
RX2-D-15	15V ±5%	18.0A	265
RS1-D-18	18V ±5%	10.5A	295
RX1-D-18	18V ±5%	14.0A	275
RS1-D-20	20V ±5%	10.0A	295
RX1-D-20	20V ±5%	13.0A	265
RS2-D-24	24V ±5%	10.5A	300
RX2-D-24	24V ±5%	12.5A	265
RS2-D-28	28V ±5%	9.5A	300
RX2-D-28	28V ±5%	10.5A	265
RS1-D-36	36V ±5%	6.5A	295
RX1-D-36	36V ±5%	7.5A	265
RS1-D-48	48V ±5%	5.0A	295
RX1-D-48	48V ±5%	6.5A	265

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $25 except on 5V



E CASE 4 29/32″ x 7 1/4″ x 11 3/4″

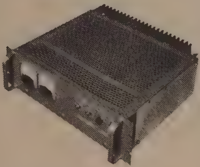
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RS2-E-5/OVP	5V ±5%	35.0A	$365
RX2-E-5/OVP	5V ±5%	41.0A	329
RS1-E-10	10V ±5%	22.0A	329
RX1-E-10	10V ±5%	25.0A	329
RS2-E-12	12V ±5%	22.5A	365
RX2-E-12	12V ±5%	27.0A	329
RS2-E-15	15V ±5%	19.0A	365
RX2-E-15	15V ±5%	23.0A	329
RS1-E-18	18V ±5%	16.0A	329
RX1-E-18	18V ±5%	18.0A	329
RS1-E-20	20V ±5%	15.0A	329
RX1-E-20	20V ±5%	17.0A	329
RS2-E-24	24V ±5%	13.5A	365
RX2-E-24	24V ±5%	15.5A	329
RS2-E-28	28V ±5%	11.0A	329
RX2-E-28	28V ±5%	14.0A	339
RS1-E-36	36V ±5%	8.5A	329
RX1-E-36	36V ±5%	10.0A	329
RS1-E-48	48V ±5%	7.5A	329
RX1-E-48	48V ±5%	8.5A	329

Regulation: RS = ±.01% RX = ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $25 except on 5V



OEM RACK
H CASE 7″ x 19″ x 16 5/8″

MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RSH-5	5V ±5%	140A	$750
RSH-12	12V ±5%	80A	750
RSH-15	15V ±5%	72A	750
RSH-24	24V ±5%	52A	750
RSH-28	28V ±5%	47A	750
RSH-36	36V ±5%	40A	850
RSH-48	48V ±5%	28A	850

Regulation: ±.01%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $75 for All Models

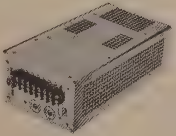
MODEL	VOLTAGE	CURRENT @ 40°C	PRICE
RXH-5	5V ±5%	175A	$850
RXH-12	12V ±5%	100A	850
RXH-15	15V ±5%	90A	850
RXH-24	24V ±5%	70A	850
RXH-28	28V ±5%	60A	850

Regulation: ±.1%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP: Add $75 for All Models



DUALS
B, C, CC, D, E, EE CASE SIZES

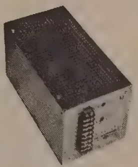
MODEL	VOLTAGE	CUR. @ 40°C	CASE SIZE	PRICE
RXBB-15-.5	±15	.50A	B	$ 99
RXBB-15-1	±15	1.0A	B	130
RXB2-12	±15 ±12	1.6A 1.4A	B	159
RXC2-12	±15 ±12	3.0A 2.5A	C	175
RJC2-12	±15 ±12	3.0A 2.5A	C	175
RJCC2-12	±15 ±12	4.0A 3.3A	CC	270
RJD2-12	±15 ±12	8.5A 7.0A	D	315
RJE2-12	±15 ±12	10.5A 8.5A	E	390
RJEE2-12	±15 ±12	12.5A 10.5A	EE	469

Regulation: RX = ±0.1% RJ = ±.05%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP Available — Consult Factory



TRIPLES
C, CC, D, E, EE CASE SIZES

MODEL	VOLTAGE	CUR. @ 40°C	CASE SIZE	PRICE
RJC3-5-12	5V ±5% ±15 ±12	5.0A 1.2A 1.0A	C	$190
RJCC3-5-12	5V ±5% ±15 ±12	10.0A 1.6A 1.3A	CC	299
RJD3-5-12	5V ±5% ±15 ±12	16.0A 3.1A 2.3A	D	349
RJE3-5-12	5V ±5% ±15 ±12	25.0A 4.5A 3.5A	E	449
RJEE3-5-12	5V ±5% ±15 ±12	35.0A 5.0A 4.0A	EE	499

Regulation: ±.05%

Ripple: 1 mv Rms

Input: 105-132V 47-440 Hz

OVP Available — Consult Factory

NJE CORPORATION

P.O. BOX 50, DAYTON, N. J. 08810 / Phone (201) 329-4616
TWX: 710-480-5674

MANUAL & DIGITAL

PRECISION CURRENT SOURCES

ACCURACIES TO 0.01%

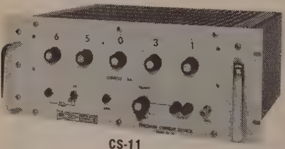
FEATURES:

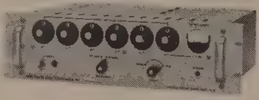
- Digital In-line Current Setting and Readout.
- 5 or 6 Decade Dividers for Setting to 1 Part in 100,000 or 1 Part in 1,000,000 of Full Scale.
- Uni- and Bi-Polar Models.
- External Modulation Capability.
- Externally Programmable Models.
- Automatic Protection Circuits.

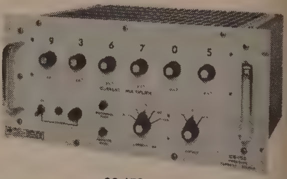
STABILITIES TO 2 PPM

APPLICATIONS:

- Laboratory and Production Testing of Semiconductors, Gyros, Lamps, Meters, Thermistors, etc.
- Systems requiring a Precision Constant Current Setting such as X-ray Equipments, Electron Beam Welders, and Electron Beam Microscopes.


CS-11


CS-31


CS-152

Model	Current Range (mA)	Compliance Range (V)	Accuracy (%)	Stability (ppm)	REGULATION Line (ppm)	Load (ppm)	Temperature (ppm/°C)	Decades
CS-11	0 - 100	100	0.015	10	10	10	10	5
CS-12	0 - 1000	12.5	0.015	10	10	10	10	6
CS-14	0 - 10,000	12.5	0.03	10	10	10	15	6
CS-21	0 - ±500	±100	0.05	10	10	10	10	6
CS-31	0 - 2000	60	0.01	5	2	2	10	6
CS-111	0 - 500	250	0.1	30	25	25	100	6
CS-120	0 - 10	2000	2.0	1000	1000	1000	200	5
CS-151	0 - ±10	± 10	0.01	2	5	5	1	6
CS-152	0 - ±150	± 25	0.01	2	5	5	1	6
CS-153	0 - ±150	±100	0.01	2	5	5	1	6

VOLTAGE REFERENCE SOURCES

Series RA-50 DC Voltage Reference Sources are precision loadable 10 Vdc references designed for printed circuit board mounting.

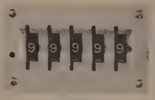
	Model RA-51	Model RA-52	Model RA-53
Input Voltage:	30 Vdc ±10%	±15 Vdc ±10%	
Input Current:	70 mA maximum.		
Output Voltage:	+10 Vdc.	+10 Vdc	−10 Vdc
(Nominal)	9 to 10 Vdc with trim terminals shorted. Trimmable by external resistor to exactly 10 Vdc.		
Load Current:	0 to 5 mA.		
Voltage Regulation:			
Vs. Line:	3.5 ppm/V for input change of 27 to 33 V.	7 ppm/V for input change of ±13.5 to ±16.5 V.	
Vs. Load:	2 ppm/mA for 0 to 5 mA load change.		
Temperature Coefficient:	1 ppm/°C for 0° to 50°C ambients.		
Stability:	±3 ppm in 8 hours.	±10 ppm in 30 days.	

NORTH HILLS ELECTRONICS, INC.
GLEN COVE, N.Y. 11542
RA-53

Length: 2.37 in.
Width: 1.31 in.
Height: 0.90 in.

PRECISION KELVIN-VARLEY VOLTAGE DIVIDERS

MANUAL AND COMPUTER CONTROLLED



MANUAL MODELS

10 kohm input resistance 10 ppm linearity.
RD-10 — 6 decades, rotary switches
RD-11 — 5 decades, thumbwheel switches

COMPUTER-CONTROLLED MODELS

10 kohm input resistance.
RD-12-8 — 8 bits
RD-12-12 — 12 bits
RD-12-16 — 16 bits
RD-12-20 — 20 bits

North Hills Electronics, INC.

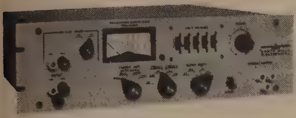
GLEN COVE, N.Y. 11542 • 516-671-5700

PRECISION CURRENT & VOLTAGE SOURCES

PRECISION VOLTAGE/CURRENT SOURCES

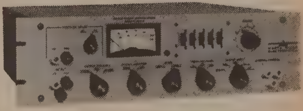
These highly stable and accurate precision sources can be operated in either constant voltage or constant current modes.
All models include such features as manual and remote programming, and output voltage regulation by either local or remote sensing.
Voltage and current outputs are selected on decade switches whose markings form an in-line digital readout.

Automatic protection limits output voltage and current to safe levels. No voltage or current overshoot occurs during turn-on or turn-off. A warning indicator alerts the operator if the actual output should differ from the dialed setting beyond the specified limits. Models TC-100.2BR and TC-602CR include a panel meter to monitor output current.



TC-602CR

CVS-264



TC-100.2BR

Model	Constant Voltage (V)	Constant Current (mA)	Accuracy (%)	Stability (ppm)	Decades	Regulation		
						Line (ppm)	Load (ppm)	Temperature (ppm/°C)
CVS-264	0 to ±100 @ 100 mA max	0 to ±100 @ 100 V max	0.1	25	5	20	20	25
TC-100.2 BR	0 to 100 @ 200 mA max	0 to 100 @ 100 V max	0.01	5	5 + vernier	2	2	8
TC-602 CR	0 to 60 @ 2 A max	0 to 2000 @ 60 V max	0.01	5	5 + vernier	2	2	8

DIGITAL PRECISION CURRENT, VOLTAGE, AND VOLTAGE/CURRENT SOURCES

FOR COMPUTER-CONTROLLED AUTOMATIC TEST SYSTEMS

Output Selection:	4 digit BCD or 16 bit binary
Accuracy:	0.02% + ½ LSB
Stability:	100 ppm
Regulation	
vs. line:	10 ppm
vs. load:	10 ppm
vs. temperature:	50 ppm/°C
Response Time:	100 μsec

CONSTANT VOLTAGE		
Model DVS-40	Full-Scale Volts	Max. Amps.
−010	10	2
−015	15	1.5
−020	20	1
−050	50	0.5
−075	75	0.3
−110	100	0.2

CONSTANT CURRENT		
Model DCS-30	Full-Scale Amps.	Max. Volts
−110	0.1	100
−150	0.5	40
−210	1	40
−220	2	40
−250	5	20
−310	10	10

Digital Constant Voltage/Current Source, Model DCVS-52

Constant Current Mode: 0-2 Amps. at 50 Volts Compliance
Constant Voltage Mode: 0-50 Volts at 2 Amps. max

North Hills Electronics, INC.
GLEN COVE, N.Y. 11542 • 516-671-5700

See Section 2000 for Reed Scanners and Switching Matrices.

AC-AC FREQUENCY CONVERTERS 50 Hz, 60 Hz, 400 Hz

SPECIFICATIONS:

AC INPUT

Voltage: 105 to 125VAC, 1φ (other voltages and 3φ available).

Frequency: 48 to 440 Hz.

AC OUTPUT

Voltage: 117VAC, single phase (other voltages and phases available).

Voltage Regulation: ±1% for line or load.

Voltage Adjustment Range: ±10% of nominal.

Frequency: 60 Hz (50 Hz and 400 Hz available with same spec's, see ordering information).

Frequency Regulation: ±0.15% for line and load.

Frequency/Temperature Coefficient: 0.01%/°C.

Frequency Adjustment Range: ±5% of nominal.

Transient Response: Less than 50 ms for 100% load change.

Maximum Distortion: Less than 4% worse case.

CIRCUIT PROTECTION

Input circuit breaker.

Short circuit protection.

Output automatic current limited.

Thermal protected.

OTHER FEATURES

Load Power Factor Range: 0.7 lagging to 0.7 leading.

Operating Temperature: −20 to +50°C.

Two Mounting Surfaces: Front and bottom.

All units adaptable for rack mounting with addition of front panel.

OPTIONAL FEATURES AND ACCESSORIES

Consult Factory

Output VA	SIZE H	SIZE W	SIZE D	Weight Lbs.	Model No.	Price
MINIATURE FREQUENCY CONVERTERS						
30	5	5	6½	8	FCC304*	$385
30	6	5	7½	10	FCC306**	350
60	5	5	6½	8	FCC604*	450
60	6	5	7½	10	FCC606**	410
90	6	5	7½	12	FCC904*	575
120	6	5	7½	12	FCC1204*	625
STANDARD FREQUENCY CONVERTERS						
125	5¼	11	9	30	FC1260U	$510
250	6⅞	15¼	14¼	63	FC2560U	800
500	6⅞	15¼	14¼	80	FC5060U	1060
1000	8 11/16	17	16⅞	140	FC1K60U	1500
1500	14	17¼	20⅞	160	FC1.5K60	2400
2000	14	17¼	20⅞	200	FC2K60	2990
3000	15¾	17¼	22	350	FC3K60	4790

*These units are available with 400 Hz output only, at prices indicated.

**These units are available with 60 Hz output only.

Terms — Net 30 F.O.B. Nutley, New Jersey

ORDERING INFORMATION

Model numbers for 50 Hz and 400 Hz output converters 125VA and larger are obtained from the equivalent 60 Hz model (FC25 60 U) and insert the number 50 or 400 in the space where the 60 appears. Therefore the new model for 50 Hz is FC25 50 U and for 400 Hz is FC25 400 U. Units 120VA and smaller constitute Nova's Miniature line and are available only in the frequencies indicated by the asterisk.

Weights on 50 Hz converters are approximately the same as the 60 Hz units; the 400 Hz inverters weigh about 25% less. Dimensions essentially remain the same.

Pricing for 50 Hz and 400Hz converters—add 10% to the 60 Hz price.

THREE-PHASE FREQUENCY CHANGERS

SPECIFICATIONS:

Input Range: 115V ±10%.

AC Input: 48-440 Hz.

Input Configuration: 1φ 115V.

Output specifications same as for corresponding fixed freqjuency inverter types.

60 Hz MODELS*

Output VA	Output Freq. Hz	Size W	Size L	Size H	Weight Lbs.	Model No.	Price
150	60	10	10	7	45	FC150-3/6	$1030
375	60	14	14	8¾	100	FC375-3/6	1390
750	60	17¼	20	10½	130	FC750-3/6	1900
1000	60	17¼	22	14	170	FC1K-3/6	2410
1500	60	17¼	22	14	200	FC1.5K-3/6	2950
3000	60	23	22	46	360	FC3K-3/6	5500
4500	60	23	22	50	460	FC4.5K-3/6	**
6000	60	23	22	56	590	FC6K-3/6	**
9000	60	23	22	72	800	FC9K-3/6	**

400 Hz MODELS*

Output VA	Output Freq. Hz	Size W	Size L	Size H	Weight Lbs.	Model No.	Price
150	400	10	10	7	35	FC150-3/4	$1135
375	400	14	14	8¾	80	FC375-3/4	1530
750	400	17¼	20	10½	105	FC750-3/4	2090
1000	400	17¼	22	14	120	FC1K-3/4	2640
1500	400	17¼	22	14	140	FC1.5K-3/4	3245
3000	400	23	22	46	290	FC3K-3/4	6050
4500	400	23	22	50	370	FC4.5K-3/4	**
6000	400	23	22	56	490	FC6K-3/4	**
9000	400	23	22	72	680	FC9K-3/4	**

*50 Hz models available. **Consult factory.

WARRANTY

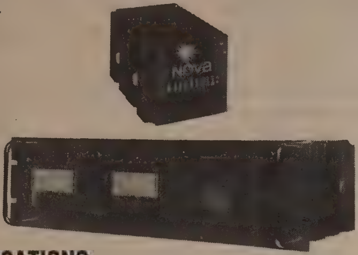
NOVA ELECTRIC Manufacturing Company warrants each instrument manufactured by it to be free from defects in material and workmanship. Our liability under this warranty is limited to repairing or replacing any unit or part thereof which shall within one year after delivery to the original purchaser, be returned to us with transportation charges prepaid and prove after our examination to be thus defective. Our warranty for this instrument is rendered void if the unit has been modified, or if it has been subject to operating conditions inconsistent with the specifications as outlined in this catalog, unless such changes or operation have been made in accordance with written instructions received from NOVA ELECTRIC. NOVA ELECTRIC reserves the right to discontinue particular models without notice, and to make modifications in design at any time without incurring any obligations to make such modifications to units previously delivered.

NOVA ELECTRIC shall not be liable for any operation delays or consequent damages under this warranty. There shall be no other obligation expressed or implied.

FOR SALES OR APPLICATION ENGINEERING CALL: (201) 661-3434

WRITE: NOVA ELECTRIC MFG. CO., 263 Hillside Avenue, Nutley, New Jersey 07110

STATIC INVERTERS SINE WAVE 50 Hz, 60 Hz, 400 Hz



SPECIFICATIONS:

OUTPUT

Voltage: 117VAC, single phase (3ϕ units available).
Voltage Regulation: ±1% for line or load.
Voltage Adjustment Range: ±10% of nominal.
Frequency: 60 Hz (50 Hz and 400 Hz available with same spec's, see ordering information).
Frequency Regulation: ±0.15% for line and load.
Frequency/Temperature Coefficient: 0.01%/°C.
Frequency Adjustment Range: ±5% of nominal.
Transient Response: Less than 50 ms for 100% load change.
Maximum Distortion: Less than 6% worse case.
Inverter Efficiency (except 12 and 24V units): 75%.
Load Power Factor Range: 0.7 lagging to 0.7 leading.

CIRCUIT PROTECTION

Reverse input polarity protection.
Short circuit protection.
Output automatic current limited.
Thermal protected.

OTHER FEATURES

Operating Temperature: −20°C to ±50°C.
Two Mounting Surfaces: Front or bottom.
Adaptable for rack mounting, with addition of front panel.
All barrier strips are recessed to prevent accidental shorts.

OPTIONAL FEATURES AND ACCESSORIES

CONSULT FACTORY

ORDERING INFORMATION

Model numbers for 50 Hz and 400 Hz output inverters are obtained in the following manner:

A. Units 125VA or larger — Take the equivalent 60 Hz model (25 60 -24) and insert the number 50 or 400 in the space where the 60 appears. Therefore a typical model designation for 50 Hz is 25 50 -24 and for 400 Hz is 25 400 -24.

B. Units 60VA and smaller — Take the equivalent 60 Hz model (60 6 -24) and insert the number 4 in the space where the 6 appears. Therefore a typical model designation for 400 Hz is 60 4 -24.

Weights on 50 Hz inverters are approximately the same as the 60 Hz units; the 400 Hz inverters weigh about 25% less. Dimensions essentially remain the same. Pricing for 50 Hz and 400 Hz inverters — add 10% to the 60 Hz price.

* These units are available with 400 Hz output only, at prices indicated.

MINICON™

Output VA	Input DC Volts	Input DC Amps @ Nom. Volts	Wgt. Lbs.	SIZE H x W x D	60 Hz Model	Price
30	11-16	4.2	7	4½x5½x6¾	MC306-12	$245
	22-32	1.9			MC306-24	235
	42-54	0.9			MC306-48	255
	105-150	0.3			MC306-150	275
60	11-16	8.3	9	4½x5½x6¾	MC606-12	285
	22-32	3.9			MC606-24	275
	42-54	1.8			MC606-48	290
	105-150	0.6			MC606-150	310
120	11-16	16.7	7	5¼x7x8	MC1204-12	435
	22-32	7.7			MC1204-24	415
	42-54	3.6			MC1204-48	435
	105-150	1.0			MC1204-150	485

STANDARD INVERTERS

Output VA	Input DC Volts	Input DC Amps @ Nom. Volts	Wgt. Lbs.	SIZE H x W x D	60 Hz Model	Price
125	11-16	17.4	19	5¼x6½x9¾	1260-12	$360
	22-32	8.0			1260-24	340
	42-54	3.7			1260-48	360
	105-150	1.1			1260-150	400
	150-250	0.7			1260-250	450
	250-350	0.5			1260-350	525
250	11-16	35.0	37	6⅞x9x13¼	2560-12	510
	22-32	16.0			2560-24	485
	42-54	7.5			2560-48	540
	105-150	2.2			2560-150	630
	150-250	1.3			2560-250	695
	250-350	1.0			2560-350	735
500	11-16	70	60	6⅞x11¼x14¼	5060-12	785
	22-32	32			5060-24	725
	42-54	15			5060-48	775
	105-150	4.4			5060-150	965
	150-250	2.7			5060-250	1065
	250-350	1.9			5060-350	1125
1000	11-16	140	125	8⅝x17x17	1K60-12	1540
	22-32	64	100	8¾x13¾x16	1K60-24	1120
	42-54	30			1K60-48	1210
	105-150	9			1K60-150	1360
	150-250	5.3			1K60-250	1450
	250-350	3.8			1K60-350	1540
1500	22-32	96	145	8¾x17⅛x17	1.5K60-24	1710
	42-54	45			1.5K60-48	1770
	105-150	13.3			1.5K60-150	1930
	150-250	8		10¼x17⅛x20¼	1.5K60-250	2020
	250-350	5.7		10¼x17⅛x20¼	1.5K60-350	2140
2000	22-32	128	200	10½x17⅛x20¼	2K60-24	1845
	42-54	60			2K60-48	1920
	105-150	17.8			2K60-150	2140
	150-250	10.7			2K60-250	2345
	250-350	7.6			2K60-350	2480
2500	22-32	160	250	14x17⅛x21	2.5K60-24	2460
	42-54	75			2.5K60-48	2605
	105-150	22			2.5K60-150	2940
	150-250	13.3			2.5K60-250	3100
	250-350	9.5			2.5K60-350	3240
3000	22-32	193	325	14x17⅛x23	3K60-24	3200
	42-54	90			3K60-48	3520
	105-150	26.6			3K60-150	3700
	150-250	16			3K60-250	3900
	250-350	11.4			3K60-350	4000

Terms Net 30 Days — F.O.B. Nutley, New Jersey

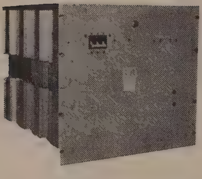
NOVA

FOR SALES OR APPLICATION ENGINEERING

CALL: (201) 661-3434

WRITE: NOVA ELECTRIC MFG. CO., 263 Hillside Avenue, Nutley, New Jersey 07110

THREE-PHASE INVERTERS



Case Size	Dimensions W	L	H
A	10	10	6¾
B	14	14	8½
C	17¼	20	10½
D	17¼	22	14
E	23	22	36
F	23	22	42
G	23	22	60

SPECIFICATIONS:

Efficiency: 75% Minimum (Except 12 and 24 Volt Types)
Distortion: Less than 6% RMS
Phase Accuracy: ±3° No Load to Full Load
Output Configuration: Delta or WYE 208/120 VAC
Transient Response: 3 cycles
Load Power Factor Range: 0.7 Lead or Lag
Output: 95-130 VAC Continuously Variable
Frequency Output: Adjustable ±5%
Regulation, Line and Load: ±1%
Frequency/Temperature Coefficient: 0.01%/°C
Frequency Regulation: ±0.15% for line and load
Operating Temperature: −20°C to +50°C

400 Hz TYPES

Output VA	Input VDC	Model No.	Input DC Volts @ Nom. Amps	Weight Lbs.	Size	Price
150	11-16	150-3/4-12	23	16	A	$875
	22-32	150-3/4-24	11			875
	42-54	150-3/4-48	5			875
	105-150	150-3/4-150	1.7			950
	150-250	150-3/4-250	1.0			1045
	250-350	150-3/4-350	0.7			1135
375	11-16	375-3/4-12	55	35	B	1155
	22-32	375-3/4-24	26			1155
	42-54	375-3/4-48	12			1155
	105-150	375-3/4-150	3.3			1265
	150-250	375-3/4-250	2.0			1375
	250-350	375-3/4-350	1.4			1510
750	11-16	750-3/4-12	110	70	C	1900
	22-32	750-3/4-24	52			1760
	42-54	750-3/4-48	24			1760
	105-150	750-3/4-150	6.6			1960
	150-250	750-3/4-250	4.0			2135
	250-350	750-3/4-350	2.8			2380
1000	11-16	1K-3/4-12	160	95	D	2365
	22-32	1K-3/4-24	60			2170
	42-54	1K-3/4-48	29			2170
	105-150	1K-3/4-150	83			2405
	150-250	1K-3/4-250	5.0			2630
	250-350	1K-3/4-350	3.5			2895

Output VA	Input VDC	Model No.	Input DC Volts @ Nom. Amps	Weight Lbs.	Size	Price
1500	22-32	1.5K-3/4-24	100	125	D	$2585
	42-54	1.5K-3/4-48	48			2585
	105-150	1.5K-3/4-150	12			2860
	150-250	1.5K-3/4-250	7.5			3150
	250-350	1.5K-3/4-350	5.3			3455
3000	22-32	3K-3/4-24	190	205	E	4240
	42-54	3K-3/4-48	92			4660
	105-150	3K-3/4-150	25			5120
	150-250	3K-3/4-250	15			5500
	250-350	3K-3/4-350	10.5			6230
4500	22-32	4.5K-3/4-24	290	305	F	*
	42-54	4.5K-3/4-48	140			*
	105-150	4.5K-3/4-150	38			*
	150-250	4.5K-3/4-250	22			*
	250-350	4.5K-3/4-350	16			*
6000	22-32	6K-3/4-24	380	410	F	*
	42-54	6K-3/4-48	184			*
	105-150	6K-3/4-150	50			*
	150-250	6K-3/4-250	30			*
	250-350	6K-3/4-350	22			*
9000	22-32	9K-3/4-24	550	725	G	*
	42-54	9K-3/4-48	270			*
	105-150	9K-3/4-150	70			*
	150-250	9K-3/4-250	43			*
	250-350	9K-3/4-350	31			*

*Consult factory.

MINITRON™ INVERTERS

The Minitron™ series of low cost DC/AC inverters are available in power ratings of 30, 60 and 120 VA for 400, 50 and 60 Hz operation. They feature light weight, an hermetically sealed enclosure and they are fully repairable. Minitrons comply with MIL requirements for shock, vibration, humidity and altitude.

SPECIFICATIONS

OUTPUT

Voltage .... 117 VAC
Regulation .... ±1% for line or load
Remote voltage adjust. range ±10% of nominal
Frequency regulation ±0.15% for line or load
Frequency temp. coefficient .... ±0.01%/°C
Remote frequency adjustment ±5% of nominal
Maximum distortion 6%
Operating temp. range .... −20°C to +50°C
Typical efficiency .... 50%-70% depending on input voltage and power

CIRCUIT PROTECTION

Output is automatic current limited.
Short circuit protected.
Overtemperature output (automatic reset).
Slow-start-overshoot less than 5%.
Input transient protection per MIL-STD-704 (80 VDC for 0.1 sec.) (for 24V units only) for other input voltages consult factory.
Environment — meets the environmental requirements of MIL-STD-810B and MIL-E-5400.

Can Size	Dimensions H	W	L
A	4½	5½	6¾
B	5¼	7	8
C			

Output VA	Input DC Volts	Input DC Amps Nom. Volt	Model No.	Weight	Case Size	Output Freq.*	Price
30	11-16	6.0	MT 306-12	11	A	60	$295
	22-32	2.5	MT 306-24				285
	42-54	1.2	MT 306-48				310
	105-150	0.4	MT 306-150				335
60	11-16	10.0	MT 606-12	11	B	60	345
	22-32	3.5	MT 606-24				330
	42-54	1.8	MT 606-48				350
	105-150	0.6	MT 606-150				380
120	11-16	18.0	MT 1206-12	22	C	60	440
	22-32	7.0	MT 1206-24				420
	42-54	3.0	MT-1206-48				440
	105-150	1.2	MT 1206-150				485

*Also available for 50 Hz and 400 Hz at a 10% higher price.

NOVA

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WRITE: NOVA ELECTRIC MFG. CO., 263 Hillside Avenue, Nutley, New Jersey 07110

UNINTERRUPTIBLE POWER SYSTEMS

Total System Responsibility!

***EMERGENCY *NO BREAK *STAND BY**

- *Nova offers complete uninterruptible power systems (UPS), designed, manufactured and warranteed by one company
- *Complete system with battery housed in one cabinet or rack
- *One cabinet — one easy installation

INPUT

Voltage: 117V ±15% 1ϕ (other voltages and phases available).
Frequency: 60 Hz ±5% (other frequencies available).

OUTPUT

Voltage: 117V, 60 Hz, 1ϕ (other voltages and phases available).
Adjustable Range: Voltage ±10%.
Frequency: ±5%.
Voltage Regulation: ±1% no load to full load.
Frequency Regulation: ±0.15% no load to full load.
Recovery Time: Less than 50 milliseconds for 100% load change.
Distortion: Less than 6%.
Power Factor Range: 0.7 lead to 0.7 lag.
Frequency Temperature Coefficient: 0.01% per °C.
Overload Capability: 130% of rating for 5 min. (at reduced tolerances).

FEATURES

AC Ammeter and Voltmeter.
Automatic Transfer Relay Switch: Transfers critical load to utility in the event of system failure.
Cooling: Natural convection, no fans or external heat sinks.
Temperature: −20°C to 50°C, except battery rated @ 25°C.
Recharge Time: 8 hours.
Battery Protection Time: 15 minutes.

CIRCUIT PROTECTION

Input Circuit Breaker.
Short Circuit Protection.
Output Automatic Current Limited.
Internal Over Temperature Protection.
Input, Battery and Output: Electrically isolated. Contacts for remote power switching.

OPTIONAL FEATURES AND ACCESSORIES

Static Transfer Switch.
Emergency Mode, Indicator Lamp and Alarm Contacts: Activated when emergency battery is in use.
System Monitor, Indicator Lamp and Alarm Contacts: Indicates failure of system.
Exerciser for Automatic Transfer Relay Switch: For testing of relay switch.
High Precision Frequency: ±0.005%.
Synchronizing Circuit: Syncs inverter output to that of an external signal.
Manual By-Pass (break-before-make): To remove system from service for maintenance.
Additional Meters: AC or DC volt ammeters.
Additional Back-up protection time.
Consult Factory for Special Requirements or Options Not Listed.

Output Power	Model No.		Cabinet Size		Approx. Weight	Price
		H	W	D		
125VA	NB-1260-1Q	8½″	14½″	17	90	$1215
250VA	NB-2560-1Q	8½″	14½″	17	120	1525
500VA	NB-5060-1Q	12″	17″	18″	200	2040
1000VA	NB-1K60-1Q	42″	22″	18″	370	2910
2000VA	NB-2K60-1Q	60″	22″	22″	560	4170
3000VA	NB-3K60-1Q	72″	22″	22″	915	6495

NOVA

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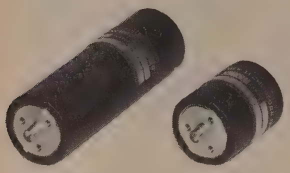
WRITE: NOVA ELECTRIC MFG. CO., 263 Hillside Avenue, Nutley, New Jersey 07110

LASER POWER SUPPLIES & DIODE PULSERS
DC MOTOR SPEED CONTROLS

ILC



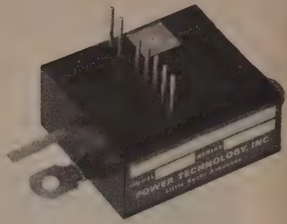
ILC LASER DIODE PULSERS

Suitable for driving laser diodes at pulse widths of 10 to 200NS. Models available for pulse currents of 2 through 100 amps. Very fast rise and fall time with low power consumption. Internal power supply and clock available. Pulse rates to 500,000 PPS.

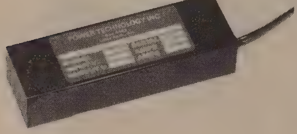
IL LASER DIODE PULSERS

Low-cost general purpose pulsers for pulse widths of 50 to 300NS. Models available for pulse currents of 10 to 100 amps. Internal power supply for operation from 6 to 28V source. Internal clock for pulse rates of 1 to 10,000 PPS. Long pulse version available for LED'S.

IL



L23



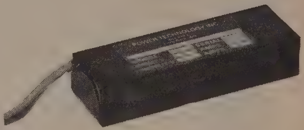
L23 HELIUM NEON LASER POWER SUPPLY

Very compact, highly efficient module for portable lasers from 10 to 17V DC input. For applications requiring long battery life, excellent current regulation and cool operation. 6 and 24V versions available.

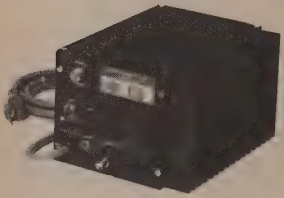
BR6B

Converter for operating L23 from 115/230V AC 50-400HZ power while retaining the 12V operating feature. Measures only 15/16 x 1 7/16 x 4 1/2''.

BR6B



L30



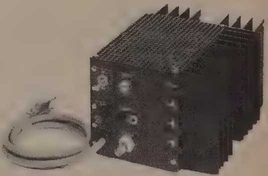
L30, CO, CO^2, AND METAL VAPOR LASER POWER SUPPLY

Low ripple, well regulated; 50 to 300 watt models available. Operates from 117V AC 50-400HZ.

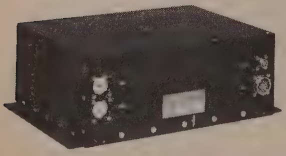
L12-13 METAL VAPOR LASER POWER SUPPLY

Light weight, high efficiency for Helium Cadmium Laser. 150 and 200 watt models for operation from 117V AC 50-400HZ. Rack mount and modular versions available.

L12-13



L22



L18-L22 CO^2 LASER POWER SUPPLY

Light weight, compact, high efficiency power supplies for CO^2 Lasers requiring 300 to 1500 watts input. Liquid cooled and air cooled versions.

M21-M33 MOTOR SPEED CONTROL

High efficiency DC motor speed controls for 12V and 24V battery operation with full load current of 15 to 90 amps. Joystick control available for two-axis control.

M26

Power
Technology
Inc.

POWER TECHNOLOGY, INC.
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LITTLE ROCK, ARKANSAS 72204
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Nickel - Cadmium
RECHARGEABLE

Sealed Cells and Batteries

CAPACITIES UP TO 2000 AMPERE HOURS ON REQUEST

Mr BATTERY
T.M.

MR. BATTERY SAYS:

"We have over 10,000 cell and battery sizes in stock. If you don't see exactly what you are looking for here, let us know, chances are we'll be able to take care of your application immediately. We'd be happy to answer any questions. If we can't help you, no one can."

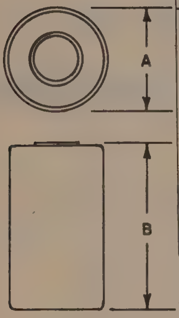

FIG. A

TYPICAL CYLINDRICAL CELLS (FIG. A) 1.2 VOLTS PER CELL

Type	Capacity mAH	Dimensions (in.) A	Dimensions (in.) B	Wt. (oz.)
90SC	090	0.450	1.015	0.3
110SC	110	0.574	0.702	0.3
170SC	170	0.643	0.656	0.4
200SC	200	0.673	0.655	0.5
250SC	250	0.542	1.209	0.6
500SC	500	0.554	1.920	1.0
600SC	600	0.625	1.920	1.0
750SC	750	1.020	0.910	1.1
900SC	900	0.562	3.532	1.4
1000SC	1000	1.000	1.280	1.1
1200SC	1200	0.875	1.600	1.5
1800SC	1800	1.000	1.840	2.5
2000SC	2000	1.272	1.400	2.8
4000SC	4000	1.289	2.300	4.6
7000SC	7000	1.290	3.490	7.6
10,000SC	10,000	1.683	4.218	12.5

Oval cell also available (Fig. C) in 4000 mAH, W-2.080, T-1.260 and H-1.656. Wt. 0.37 oz.

All battery configurations available with pressure contact buttons or solder lug terminals.

All cylindrical and oval battery types feature a pressure safety device for security and reliability making them especially suited for cordless consumer and electronic products.

CUSTOM BATTERY PACKS

Cylindrical cells are incased in a rigid, high impact case. Case materials are highly dielectric to provide maximum cell insulation at minimum cost. The case is vented to each cell to provide cooling and long life. Packs are available to your specifications in any voltage.

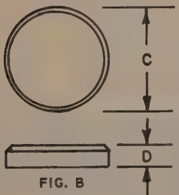

FIG. B

TYPICAL BUTTON CELLS (FIG. B) 1.2 VOLTS PER CELL

Type	Capacity mAH	Dimensions (in.) C	Dimensions (in.) D	Wt. (oz.)
20B	20	0.449	0.201	0.04
50B	50	0.606	0.230	0.09
100B	100	0.984	0.240	0.28
150B	150	0.984	0.260	0.30
180VBH*	180	0.984	0.290	0.39
225B	225	0.984	0.339	0.41
225BH*	225	0.984	0.347	0.44
250VBH*	250	1.340	0.210	0.58
400B	400	0.992	0.571	0.66
450B	450	1.689	0.299	1.10
500BH*	500	1.340	0.374	0.90
1000VBH*	1000	2.000	0.330	2.24
2000VBH*	2000	2.000	0.590	3.50

*H denotes high rate discharge capability.

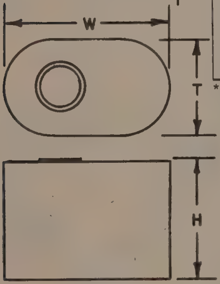

FIG. C

ALSO MARKETS:

- Emergency lighting units.
- Flashlight and lantern rechargeable batteries.
- Custom and prototype design battery packs built to your specifications.
- Battery chargers for all types of batteries.
- Batteries - **NICKLE CADMIUM - SILVER CADMIUM - SILVER ZINC - MERCURY - SEALED LEAD-ACID.**

Button cell batteries are constructed of sealed nickle cadmium button cells (see fig. B) to meet almost any application requirement. The compact size of button cells permits easy stacking to form multiple cell batteries of optimum power/volume ratio and space utilization. Completely sealed button cells are ideally suited for portable radios, flashlights, photoflash, alarms, and any low-drain, high capacity application.

TYPICAL BUTTON CELL BATTERIES

INVESTIGATE direct current emergency power sources available in any regulated voltage or current, featuring automatic SCR solid state switchover to a self-contained battery. We have the answer to reliable economical D.C. power with automatic emergency back-up.

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PHONE: (612) 890-1360

"If we can't help you — no one can!"

POWER INCORPORATED

BATTERY CHARGERS

For Sealed Cell Nickel Cadmium Batteries and Sealed Lead Acid Batteries. Automatic Transistorized Zener Referenced for Float and Cycle Service Version Available for Sealed Lead Acid Batteries.

NOMINAL CHARGE RATE WITH 115 V AC 60 CYCLE INPUT*

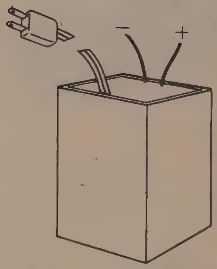
	NUMBER OF SERIES CONNECTED CELL											
	1	2	3	4	5	6	7	8	9	10	11	12
20 MA.	1-020	2-020	3-020	4-020	5-020	6-020	7-020	8-020	9-020	10-020	11-020	12-020
45 MA.	1-045	2-045	3-045	4-045	5-045	6-045	7-045	8-045	9-045	10-045	11-045	12-045
60 MA.	1-060	2-060	3-060	4-060	5-060	6-060	7-060	8-060	9-060	10-060	11-060	12-060
75 MA.	1-075	2-075	3-075	4-075	5-075	6-075	7-075	8-075	9-075	10-075	11-075	12-075
120 MA.	1-120	2-120	3-120	4-120	5-120	6-120	7-120	8-120	9-120	10-120	11-120	12-120
180 MA.	1-180	2-180	3-180	4-180	5-180	6-180	7-180	8-180	9-180	10-180	11-180	12-180
230 MA.	1-230	2-230	3-230	4-230	5-230	6-230	7-230	8-230	9-230	10-230	11-230	12-230
400 MA.	1-400	2-400	3-400	4-400	5-400	6-400	7-400	8-400	9-400	10-400	11-400	12-400
700 MA.	1-700	2-700	3-700	4-700	5-700	6-700	7-700	8-700	9-700	10-700	11-700	12-700

"A"=Upper grey area. "B"=Middle white area. "C"=Lower grey area.

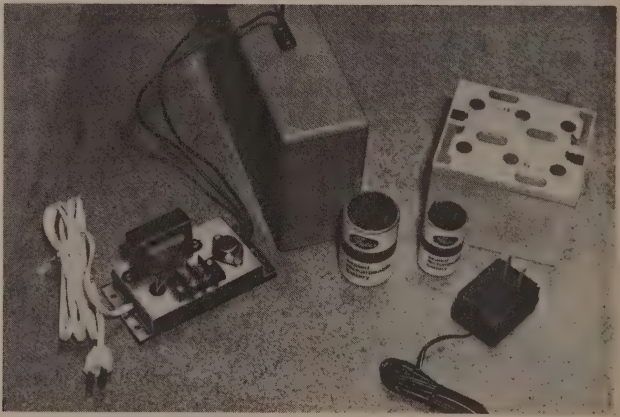
INPUT: UL approved line cord, 48″ minimum free length, color cream white.

OUTPUT: UL approved lead wire, 10″ long, ends stripped and tinned, red positive, black negative.

	L	W	H
"A". .	1-3/8″	x 1-3/16″	x 2-1/16″
"B". .	1-3/4″	x 1-3/4″	x 2-1/4″
"C". .	2-3/8″	x 2-3/8″	x 2-3/4″



NOTE: Technical and engineering assistance for the proper battery selection is available to help you solve your specific application requirements.



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QUALITY POWER SUPPLIES

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FROM 0.01 AMP TO 1000 AMPS
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FOR SAME-DAY-SHIPMENT.

WHATEVER YOUR REQUIREMENTS YOU'LL FIND A FIELD PROVEN, FULLY TESTED, FULLY GUARANTEED POWER/MATE PRODUCT TO FILL YOUR REQUIREMENTS.

CHOOSE FROM OVER 32,600 MODELS.

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MEANS QUALITY

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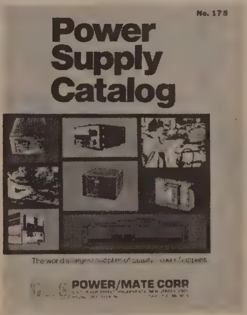
A small portion of one of the assembly areas at the Power/Mate plant. Production lines are laid out by our manufacturing engineers for the rapid and efficient assembly of our one and only product . . . POWER SUPPLIES. We know our business. It can save you time and money.

Our skilled assemblers, through training and experience . . . know what it takes and most important, know what it means to produce a quality product.

SEND FOR FULL-LINE COMPLETE CATALOG OVER 36,000 MODELS



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- ECONOMATE II
- ECONOTWIN II
- SMS SERIES
- SUPER-UNI
- PM SERIES
- PX SERIES
- FPS SERIES
- HV/HW SERIES
- UNI SERIES
- OEM SERIES
- FR SERIES
- RACKS AND ACCESSORIES
- BP SERIES
- PR SERIES
- MM SERIES
- CP SERIES
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PMC

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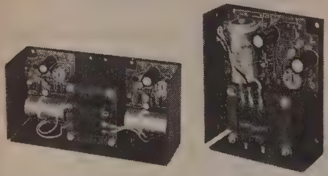
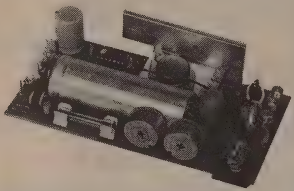
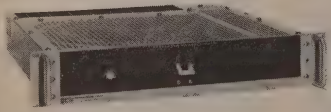
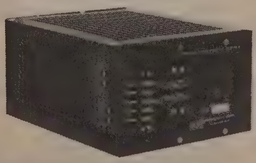
	**EM II/ET II SERIES** New ECONO/MATE and ECONO/TWIN Series features High Reliability at Modest Cost . . . 3 Case Sizes . . . Solid State Regulators . . . OVP Optional . . . Same-Day-Shipment . . . 15 Models.	1•1347-1•1350
	**SMS SUBMODULAR SERIES** New for '75/'76 . . . Everything You Need for Rectifying, Filtering, Regulating, and Circuit Protection on Just (1) One Printed Circuit Board . . . Optional Transformers and Heat Sinks Available for Virtually Any Power Supply Application.	1•1351-1•1354
	SUPER/UNI SERIES New . . . Modular . . . Wide Multiple Ranges Very High Power Density . . . Remotely Programmable . . . Built-In OVP . . . Same Day-Shipment . . . 9 Case Sizes . . . UL Approved.	1•1355-1•1358
	PM SERIES Modular . . . Singular Range, Utilizing State-of-the-Art Integrated Circuits . . . 6 Case Sizes, 90 Models . . . All with Built-In OVP . . . UL Approved . . . OEM Discounts.	1•1359-1•1361
	**PM FULL RACK SERIES** Full Rack . . . Voltage up to 60 VDC with Currents to 150 Amps . . . Metered or Non-Metered . . . Remotely Programmable . . . Also Wide Range Models Available.	1•1362-1•1364
	**PX SERIES** Over 90 Compact High Current Power Supplies Ideally Suited for IC Logic and Systems Applications . . . All Units Have Built-In OVP and "Fail-Safe" Thermal Protection Compact Size.	1•1365-1•1367

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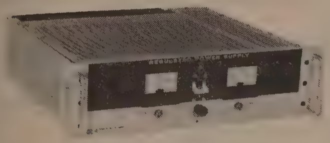	**PX FULL RACK SERIES** Full Rack Mountable . . . from 3 VDC to 60 VDC . . . Up to 180 Amps . . . Metered or Non-Metered . . . Built-In OVP . . . High Power Density.	1•1368- 1•1370
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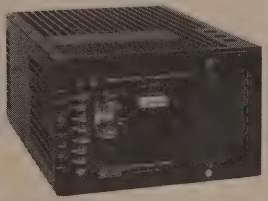
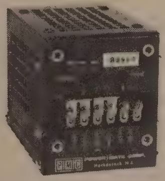
	**HV/HW SERIES** Modular or Full Rack . . . Efficiencies to 80% . . . Uses Patented "Simag" Circuitry . . . Built-In OVP . . . Self-Restoring Current Limiting . . . Use with All Logic and IC's . . . 5 Year Warranty.	1•1374- 1•1378
	**UNI/OEM SERIES** New . . . Modular . . . Wide Multiple Ranges Very High Power Density . . . Remotely Programmable . . . Built-In OVP . . . Same-Day-Shipment . . . 9 Case Sizes . . . UL Approved.	1•1379- 1•1386
	FR WIDE RANGE SERIES Full Wide Range Systems Supplies . . . No Internal Changes Required . . . Optional Built-In OVP . . . Same-Day-Shipment . . . Continuously Adjustable . . . 104 Off-the-Shelf Models.	1•1387- 1•1389
	RACKS & ACCESSORIES Racks, Panels, Metered Panels, Terminal Strips, Overvoltage Protection, Adapters, etc. . . . For Use with All PMC Power Supplies . . . Same-Day-Shipment.	1•1390- 1•1396

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

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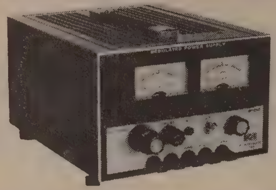
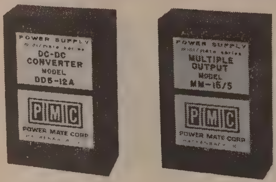
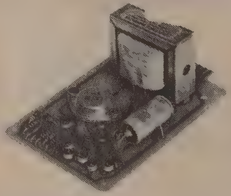
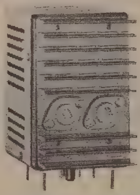
	**BP BENCH PAC SERIES** Laboratory Bench Supplies with Built-In Meters, Voltage and Current Controls . . . Rack Mountable . . . 6 Case Sizes . . . All Models Series Regulated . . . Built-In Short Circuit Protection.	1•1397- 1•1399
	PR HIGH CURRENT SERIES Rack Lab Supplies . . . High Current Pre-Regulated, High Efficiency . . . Metered or Non-Metered . . . Low Ripple . . . 15 Separate Models . . . Many Options.	1•1400- 1•1401
 POWER SUPPLY DC-DC CONVERTER MODEL DD5-12A PMC POWER MATE CORP POWER SUPPLY MULTIPLE OUTPUT MODEL MM-15/5 PMC POWER MATE CORP	**MM/DD SERIES** Miniature Encapsulated Power Supplies for OP Amp, Logic and Display Circuitry . . . Single or Dual Outputs . . . Same-Day-Shipment . . . AC to DC . . . DC to DC . . . Over 165 Models . . . Multiple Outputs.	1•1402- 1•1405
	**CP CARD PAC SERIES** "Plug-In" PC Board Power Supplies for OP Amp and Logic . . . Dual and Single Outputs . . . Off-The-Shelf.	1•1406- 1•1407
	**RA SERIES** Complete Series of Plug-In Modular DC Power Supplies . . . High Power Density . . . Designed to meet MIL-Specs . . . 5 Case Sizes . . . Over 100 Models . . . Full Temperature Range for Critical Applications.	1•1408- 1•1412

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ECONO/MATE II POWER SUPPLIES

NEW ECONO/MATE II — SUPERIOR PERFORMANCE OPEN FRAME MODULE POWER SUPPLIES

OUTSTANDING FEATURES

- Remote sensing
- Adjustable current limiting
- Vacuum impregnated Mil-T-27 Transformers
- 100,000 MTBF per Mil Handbook 217
- Computer-Aided-Design
- Computer Grade Components
- Dual AC inputs
- Integrated Circuit Regulation
- Guaranteed performance
- Off-the-shelf delivery

PRODUCT DIGEST

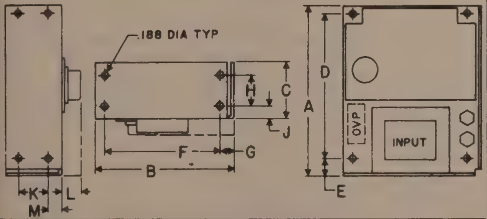
The Power/Mate Econo/Mate II power supplies are superior performance modules which provide ultra reliable performance at low cost. Power/Mate has been able to achieve these high performance qualities through the use of our "PWR-CHK" design program. This concept insures not only 100,000 hour MTBF but also continuous full life high performance to full rated specifications under worst case conditions.

Our Econo/Mate II designs are complete with remote sensing, adjustable self resting current limiting, dual AC inputs, built in short-circuit protection, vacuum impregnated transformers and the highest quality capacitors. Our modern computer control production facilities utilize the latest production techniques, thus allowing Power/Mate to pass along savings to you the customer without sacrificing quality or reliability. The Econo/Mate II open frame modules are particularly appropriate for use in today's modern application.

In addition, overvoltage protection is available for even further protection for each Econo/Mate unit.

Every "EM Series" power supply is thoroughly tested and backed by Power/Mate's enviable record of technical excellence.

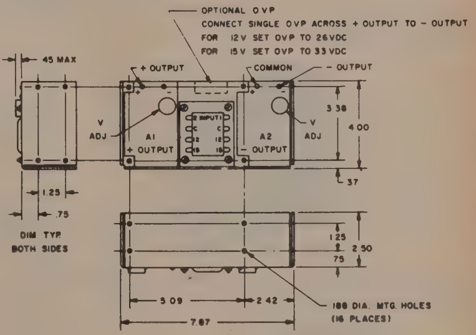
SERIES B


.188 DIA TYP
D
H
C
A
J
F
G
B
E
K
L
M
OVP
INPUT

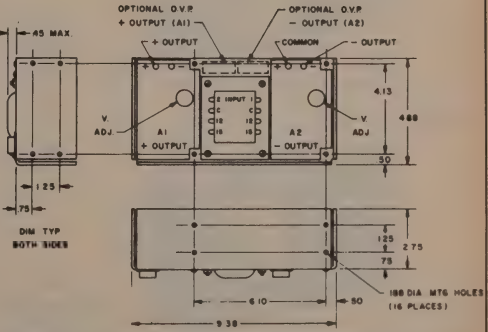
A	B	C	D	E	F
4.87	4.00	1.62	4.13	.50	3.38
G	**H**	**J**	**K**	**L**	**M**
.38	NA	.75	NA	.45 MAX.	.75

MECHANICAL DATA

SERIES C


OPTIONAL O V P
CONNECT SINGLE O V P ACROSS + OUTPUT TO − OUTPUT
FOR 12 V SET OVP TO 26 VDC
FOR 15 V SET OVP TO 33 VDC
45 MAX
+ OUTPUT
COMMON
− OUTPUT
V ADJ
A1 + OUTPUT
INPUT
A2 − OUTPUT
V ADJ
3 38
4 00
37
1.25
.75
DIM TYP BOTH SIDES
1 25
2 50
75
5 09
2 42
7.87
188 DIA. MTG. HOLES (16 PLACES)

SERIES D


OPTIONAL O.V.P. + OUTPUT (A1)
OPTIONAL O.V.P. − OUTPUT (A2)
45 MAX.
+ OUTPUT
COMMON
− OUTPUT
V. ADJ.
A1 + OUTPUT
INPUT
A2 − OUTPUT
V. ADJ
4.13
4 88
50
1 25
.75
DIM TYP BOTH SIDES
1 25
2 75
75
6 10
50
9 38
188 DIA MTG HOLES (16 PLACES)

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

ECONO/MATE II POWER SUPPLIES

SERIES A

only
$29⁰⁰

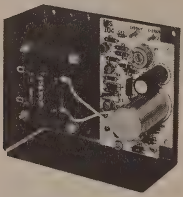
Model	Voltage	Current
EM2-5A	5	1.5
EM2-6A	6	1.3
EM2-9A	9	1.0
EM2-10A	10	1.0
EM2-12A	12	0.7
EM2-15A	15	0.7
EM2-18A	18	0.5
EM2-20A	20	0.5
EM2-24A	24	0.5

SERIES B

only
$49⁰⁰

Model	Voltage	Current
EM2-5B	5	4.0
EM2-6B	6	3.3
EM2-9B	9	2.5
EM2-10B	10	2.4
EM2-12B	12	2.0
EM2-15B	15	1.7
EM2-18B	18	1.5
EM2-20B	20	1.4
EM2-24B	24	1.3

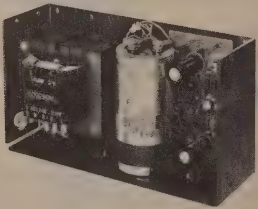
SERIES C



only
$69⁰⁰

Model	Voltage	Current
EM2-5C	5	7.5
EM2-6C	6	6.5
EM2-9C	9	5.0
EM2-10C	10	4.8
EM2-12C	12	4.0
EM2-15C	15	3.5
EM2-18C	18	3.3
EM2-20C	20	3.2
EM2-24C	24	3.0

SERIES CC



only
$89⁰⁰

Model	Voltage	Current
EM2-5CC	5	11.0
EM2-6CC	6	10.0
EM2-9CC	9	8.0
EM2-10CC	10	7.5
EM2-12CC	12	6.0
EM2-15CC	15	5.0
EM2-18CC	18	4.5
EM2-20CC	20	4.0
EM2-24CC	24	3.8

SERIES D

only
$109⁰⁰

Model	Voltage	Current
EM2-5D	5	15.0
EM2-6D	6	12.5
EM2-9D	9	10.5
EM2-10D	10	10.0
EM2-12D	12	8.8
EM2-15D	15	8.0
EM2-18D	18	7.1
EM2-20D	20	7.0
EM2-24D	24	6.5

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**
514 S RIVER STREET HACKENSACK, N J 07601
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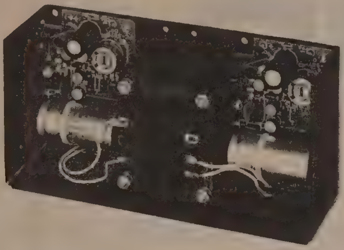
ET II ECONOTWIN POWER SUPPLIES

ET SERIES "C" DUAL OUTPUT MODELS

only $\$69^{00}$



Model	Power Outputs	
	Output "A"	Output "B"
ET-12C	+12V @ 1.5A	−12V @ 1.8A
ET-15C	+15V @ 1.3A	−15V @ 1.5A
ET-5C	5V @ 3.0A or 6V @ 2.5A	5V @ 4.0A or 6V @ 3.0A
ET-515C	5V @ 3.0A or 6V @ 2.5A	12V @ 1.8A or 15V @ 1.5A
ET-524C	5V @ 3.0A or 6V @ 2.5A	18V @ 1.3A or 24V @ 1.3A

ET SERIES "D" DUAL OUTPUT MODELS

only $\$109^{00}$

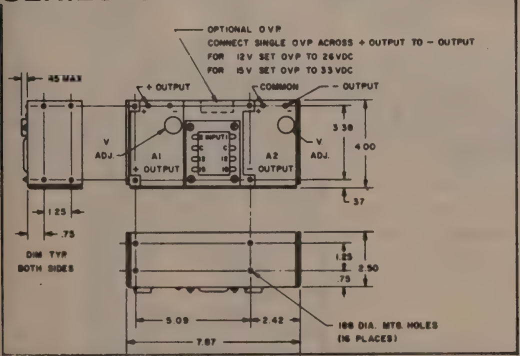
Model	Power Outputs	
	Output "A"	Output "B"
ET-12D	+12V @ 3.0A	−12V @ 4.0A
ET-15D	+15V @ 2.8A	−15V @ 3.0A
ET-5D	5V @ 6.0A or 6V @ 5.0A	5V @ 7.0A or 6V @ 6.0A
ET-515D	5V @ 6.0A or 6V @ 5.0A	12V @ 4.0A or 15V @ 3.0A
ET-524D	5V @ 6.0A or 6V @ 5.0A	18V @ 2.3A or 24V @ 2.5A

OVERVOLTAGE PROTECTION MODULES

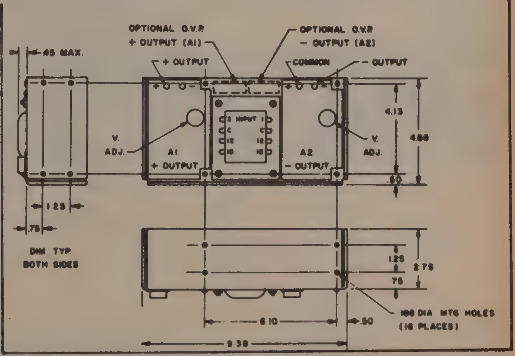
only $\$12^{95}$

Model	For Use With Series C	For Use With Series D	Price
OVP-4	1 req'd	2 req'd	12.95 ea.

SERIES C


OPTIONAL O.V.P.
CONNECT SINGLE OVP ACROSS + OUTPUT TO − OUTPUT
FOR 12V SET OVP TO 26VDC
FOR 15V SET OVP TO 33VDC
.45 MAX
+ OUTPUT
COMMON
− OUTPUT
V ADJ.
A1 + OUTPUT
INPUT
A2 − OUTPUT
V. ADJ.
3.30
4.00
.37
1.25
.75
DIM TYP BOTH SIDES
1.25
2.50
.75
5.09
2.42
7.87
.188 DIA. MTG. HOLES (16 PLACES)

SERIES D


OPTIONAL O.V.P. + OUTPUT (A1)
OPTIONAL O.V.P. − OUTPUT (A2)
.45 MAX.
+ OUTPUT
COMMON
− OUTPUT
V. ADJ.
A1 + OUTPUT
INPUT
A2 − OUTPUT
V. ADJ.
4.13
4.88
.50
1.25
.75
DIM TYP. BOTH SIDES
1.25
2.75
.75
6.10
.50
9.36
.188 DIA MTG HOLES (16 PLACES)

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

NOBODY KNOWS MORE

ABOUT POWER SUPPLIES THAN POWER/MATE BECAUSE . . . WE HAVE THE WORLD'S MOST COMPLETE MANUFACTURING PLANT DEVOTED EXCLUSIVELY TO POWER SUPPLIES.

A small portion of one of the assembly areas at the Power/Mate plant. Production lines are laid out by our manufacturing engineers for the rapid and efficient assembly of our one and only product . . . POWER SUPPLIES. We know our business. It can save you time and money.

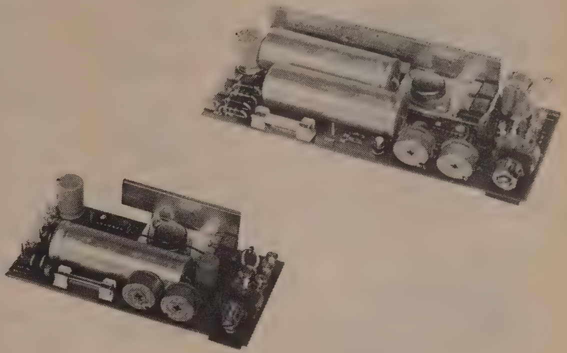
Our skilled assemblers, through training and experience . . . know what it takes and most important, know what it means to produce a quality product.

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

SMS SUBMODULAR POWER SUPPLIES

OUTSTANDING FEATURES

- Separate modular components
- Multiple or single outputs
- Built-in overvoltage protection
- Includes filter, regulators and rectifiers
- Fully adjustable current limiting
- Wide range voltage adjustment
- Special inhibit function for turn on/off
- Remote sensing and remote programming
- Computer grade capacitors
- Same-day-shipment



PRODUCT DIGEST

Power/Mate's innovative power supply technology has created new circuit designs which offer improved power supply performance via Power/Mate's new SUBMODULAR power supply System approach.

Whether you decide to build or to buy your own power supplies, Power/Mate's innovative features give you single, dual or multiple outputs and provide you with everything needed for the best power supply possible. Our SUBMODULAR System units contain all the electronics for rectifying, filtering, regulating and circuit protection. Everything you need for virtually any power supply application is built in to Power/Mate's SUBMODULAR System.

You need only select the necessary transformer and heat sinks. Then merely connect the SUBMODULAR System to the appropriate transformer taps and bind down and secure the unit to its heat sink. Couldn't be simpler and obviously, manufacturing labor is almost extinct.

Power/Mate's SUBMODULAR power supply System concept provides the greatest design and application versatility ever realized and certainly more significant than is obtainable through either monolithic or hybrid approaches.

With Power/Mate's SUBMODULAR power supply System, an almost unlimited variety of configurations which can accommodate the most sophisticated power supply requirements have now been reduced to simply a SUBMODULAR System unit, a transformer and a heat sink.

SPECIFICATIONS

DC OUTPUT VOLTAGES AND CURRENTS: See respective tables.

REGULATION (ALL DC OUTPUTS): Line . . . ±.075% for load variations from 0 to full load.

RIPPLE: Less than 1mV RMS, 3mV Pk to Pk typical.

INPUT CHARACTERISTICS: Requires low level AC input; Derate output current 15% for operations at 50 Hz.

LOGIC INHIBIT FUNCTION: A low-level signal between 1V and 50V will inhibit the DC output. May be used for control, sequencing or maintenance.

OVERLOAD PROTECTION: Fully adjustable foldback type current limiting is standard. "Constant current" overload protection available for use with constant current loads (consult factory).

OVERVOLTAGE PROTECTION: SCR crowbar type. Trigger level fully adjustable.

REMOTE SENSE: Standard on Models B through F.

TEMPERATURE RATING, STORAGE: −55°C to +85°C.

TEMPERATURE RATING, OPERATING: 0°C to +40°C full load, derated to +71°C. Percent of full-rated load at ambient temperature: +40°C/100%, +50°C/75%, +60°C/50%, +71°C/35%.

TEMPERATURE COEFFICIENT: ±.007%/°C typical.

TRANSIENT RESPONSE: 50 sec for a 50% load change.

STABILITY: ±0.1% for 8 hours after warm-up.

INPUT PROTECTION: Input fusing standard.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**

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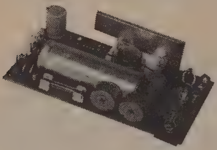
Phone (201) 343-6294 TWX: (710) 990-5023

SMS SUBMODULAR POWER SUPPLIES

SUBMODULAR SERIES A

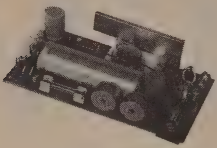


SAME DAY DELIVERY

only $35 00*

Model Number	Voltage Adjust Range	Typical Output Current
SMA-050	1.20V-4.75V	1.0A
SMA-100	4.75V-7.0V	5V @ 1.0A 6V @ .875A
SMA-200	7.0V-10.5V	8V @ .725A 10V @ .625A
SMA-300	10.5V-15.75V	12V @ .575A 15V @ .500A
SMA-400	15.75V-22.0V	18V @ .475A 20V @ .450A
SMA-500	22.0V-30.0V	24V @ .425A 28V @ .400A

SUBMODULAR SERIES B

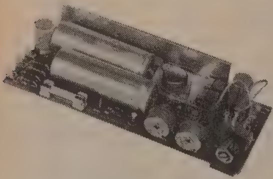


SAME DAY DELIVERY

only $45 00*

SMB-050	1.20V-4.75V	3.0A
SMB-100	4.75V-7.0V	5V @ 3.0A 6V @ 2.5A
SMB-200	7.0V-10.5V	8V @ 2.2A 10V @ 1.9A
SMB-300	10.5V-15.75V	12V @ 1.7A 15V @ 1.5A
SMB-400	15.75V-22.0V	18V @ 1.4A 20V @ 1.3A
SMB-500	22.0V-30.0V	24V @ 1.2A 28V @ 1.1A

SUBMODULAR SERIES C

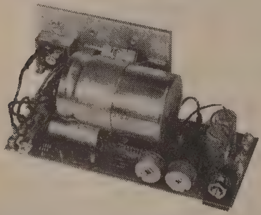


SAME DAY DELIVERY

only $60 00*

SMC-050	1.20V-4.75V	6.0A
SMC-100	4.75V-7.0V	5V @ 6.0A 6V @ 5.2A
SMC-200	7.0V-10.5V	8V @ 4.4A 10V @ 3.8A
SMC-300	10.5V-15.75V	12V @ 3.4A 15V @ 3.0A
SMC-400	15.75V-22.0V	18V @ 2.8A 20V @ 2.6A
SMC-500	22.0V-30.0V	24V @ 2.5A 28V @ 2.3A

SUBMODULAR SERIES D

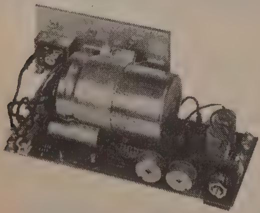


SAME DAY DELIVERY

only $85 00*

SMD-050	1.20V-4.75V	12.0A
SMD-100	4.75V-7.0V	5V @ 12.0A 6V @ 10.4A
SMD-200	7.0V-10.5V	8V @ 8.8A 10V @ 7.6A
SMD-300	10.5V-15.75V	12V @ 6.8A 15V @ 6.0A
SMD-400	15.75V-22.0V	18V @ 5.6A 20V @ 5.2A
SMD-500	22.0V-30.0V	24V @ 5.0A 28V @ 4.7A

SUBMODULAR SERIES E



SAME DAY DELIVERY

only $100 00*

SME-050	1.20V-4.75V	18.0A
SME-100	4.75V-7.0V	5V @ 18.0A 6V @ 15.6A
SME-200	7.0V-10.5V	8V @ 13.2A 10V @ 11.4A
SME-300	10.5V-15.75V	12V @ 10.2A 15V @ 9.0A
SME-400	15.75V-22.0V	18V @ 8.4A 20V @ 7.8A
SME-500	22.0V-30.0V	24V @ 7.5A 28V @ 7.1A

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PMC

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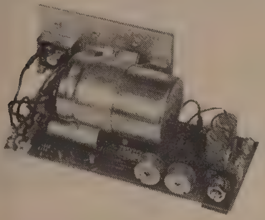
SMS SUBMODULAR POWER SUPPLIES

SUBMODULAR SERIES F



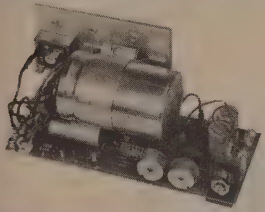
SAME DAY DELIVERY

only

$\$130^{00*}$

Model Number	Voltage Adjust Range	Typical Output Current
SMF-050	1.20V-4.75V	24.0A
SMF-100	4.75V-7.0V	5V @ 24.0A 6V @ 21.0A
SMF-200	7.0V-10.5V	8V @ 17.25A 10V @ 15.0A
SMF-300	10.5V-15.75V	12V @ 13.7A 15V @ 12.2A
SMF-400	15.75V-22.0V	18V @ 11.2A 20V @ 10.7A
SMF-500	22.0V-30.0V	24V @ 10.0A 28V @ 9.4A

SUBMODULAR SERIES G



SAME DAY DELIVERY

only

$\$160^{00*}$

SMG-050	1.20V-4.75V	36.0A
SMG-100	4.75V-7.0V	5V @ 36.0A 6V @ 31.5A
SMG-200	7.0V-10.5V	8V @ 26.0A 10V @ 22.5A
SMG-300	10.5V-15.75V	12V @ 20.6A 15V @ 18.2A
SMG-400	15.75V-22.0V	18V @ 16.8A 20V @ 16.0A
SMG-500	22.0V-30.0V	24V @ 15.0A 28V @ 14.1A

SH HEATSINKS

The SMS Series high efficiency SH Heatsinks are used to allow "stand alone" operation at full ratings of each SUBMODULE. All SH Heatsinks are compatible with and can be mounted in virtually any 5¼" rack mounting chassis.

Model	Used With SMS SUBMODULE	Cooling	Price
SH-A	Series A	Convection*	$ 6
SH-B	Series B	Convection*	8
SH-C	Series C	Convection*	10
SH-D	Series D	Convection*	15
SH-E	Series E	Convection* Forced Air 200 FPM	20
SH-F	Series F	Forced Air 1000 FPM	25

*Moving air is recommended when mounting in confined area.

TH Thermostats are used with SMS Series SUBMODULES to prevent the possibility of overtemperature damage. Also, in conjunction with the Logic Inhibit Function, these devices can inhibit operation when an overtemperature condition is reached.

Part Number	Contacts	Opening Temperature +5°C	Price
TH-70	Normally Closed	+70°C	$6
TH-80	Normally Closed	+80°C	6
TH-90	Normally Closed	+90°C	6
TH-100	Normally Closed	+100°C	6

ST TRANSFORMERS

The SM Series multiple tapped "ST" transformers are designed for use with the SMS Series SUBMODULES. A separate ST Transformer is required for each SUBMODULE used.

Model	Used With SMS SUBMODULE	Weight	Size H x W x D	Price
ST-A	Series A	1.0	2.0 x 3.3 x 2.2	$20
ST-B	Series B	3.0	3.4 x 3.0 x 2.8	25
ST-C	Series C	5.5	3.8 x 3.3 x 4.0	30
ST-D	Series D	8.6	4.5 x 3.8 x 4.0	40
ST-E	Series E	11.0	4.5 x 3.8 x 4.8	45
ST-F	Series F	22	4.5 x 5.5 x 6.0	50

***INDICATES UNIT QUANTITY ONLY. CONSULT FACTORY FOR LIBERAL OEM DISCOUNTS ON QUANTITY PURCHASES.**

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

THE POWER/MATE MANAGEMENT COMMITMENT TO QUALITY IS TOTAL.

POWER/MATE MEANS PEOPLE

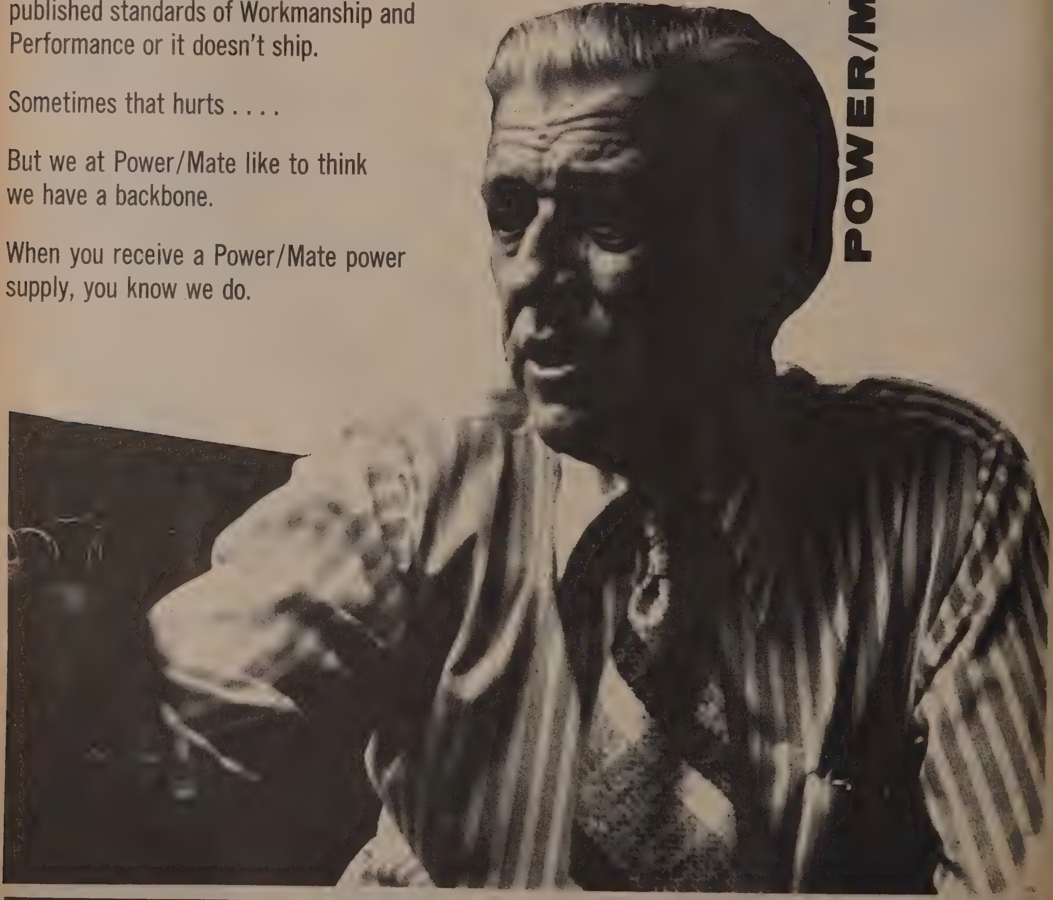
IT Also Takes Dedication, Guts, and Backbone . . . .

That's because there is no compromise or rationalization when it comes to to shipping out a quality product. Your power supply has to meet our published standards of Workmanship and Performance or it doesn't ship.

Sometimes that hurts . . . .

But we at Power/Mate like to think we have a backbone.

When you receive a Power/Mate power supply, you know we do.



PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

SUPER/UNI UNIVERSAL POWER SUPPLIES

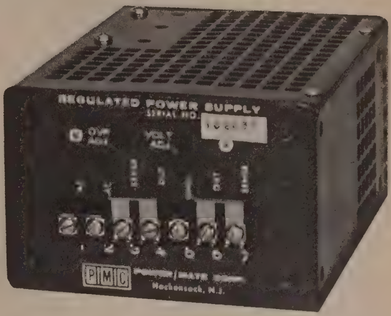
PRODUCT DIGEST

Power/Mate's new SUPER/UNI Series of variable rated modular power supplies represent a major advance in power supply technology. Through Power/Mate's unique design techniques, the SUPER/UNI Series offer all the inherent advantages of Power/Mate's field proven original UNI Series while simultaneously achieving significant power density and high efficiency advantages.

The new SUPER/UNI Series offers optimum rated DC outputs between 0-30 VDC with output currents up to 36 amps. In addition, the SUPER/UNI Series exhibit excellent performance characteristics, high efficiencies and 100,000 hr. MTBF.

All models are designed to meet MIL Spec environment requirements. Also, the SUPER/UNI Series are short-circuit proof, contain built-in over-voltage protection and are designed for efficient operation up to 71°C without the need for external cooling.

All models are UL recognized and carry a full 5-year Warrantee.



REGULATION: SUPER/UNI-76V and SUPER/UNI-88V better than ±0.005% + 1MV for line and load. All other units better than ±0.05% + 1MV for line and load.
RIPPLE: Less than 250 microvolts.

SPECIFICATIONS

INPUT: 105-125V, 47-420 CPS.

OUTPUT VOLTAGE: 0-30 volts for all units.

OUTPUT VOLTAGE RANGE: Set in overlapping ranges by means of internal quick disconnect taps.

OUTPUT CURRENT: See chart on following page.

REGULATION: SUPER/UNI-76V and SUPER/UNI-88V better than ±0.005% +1MV for line and load. All other units better than ±0.05% +1MV for line and load.

RIPPLE: Less than 250 microvolts.

RESPONSE TIME: Less than 50 microseconds.

TEMPERATURE COEFFICIENT: Better than 0.02%/°C.

LONG TERM STABILITY: Better than 0.025% for 8 hours.

OVERLOAD & SHORT CIRCUIT PROTECTION: Solid state short circuit and overload protected. Instantaneous recovery, and automatic reset. Unit cannot be damaged by prolonged short circuits or overloads.

POLARITY: May be either positive, negative or floating up to 300 volts.

AMBIENT OPERATING TEMPERATURE: Continuous duty from −20°C to +71°C ambient.

STORAGE TEMPERATURE: −55°C to +85°C.

OUTPUT CURRENT vs. TEMPERATURE: Unit is rated for full current output at temperatures between −20°C and +45°C and is linearly derated from +45°C to 70% of the full output at +71°C.

REMOTE-LOCAL SENSING: Provision is included to permit remote sensing of the output voltage directly at the load for improved over-all regulation. Unit may be connected for local sensing if desired.

REMOTE-LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted, or internally adjusted with course and fine controls. Both are accessible through holes in the terminal end of the supply.

MECHANICAL DATA

The SUPER/UNI power supplies may be mounted on any of three surfaces (except EE case which mounts only on bottom or side). Units will function when mounted in any position. 3½-inch and 5¼-inch rack mounting assemblies are available, along with other accessories. See pages 41-44

SAME-DAY-SHIPMENT

You can be sure that POWER/MATE CORP. will ship any of its UNI series power supplies to you the same day that your order arrives in our offices.

UL APPROVED

POWER/MATE's power supplies are listed as a recognized component in Underwriter Laboratory's recognized component index. (UL 478-1967).

5-YEAR WARRANTY

5 Year Warranty

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

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514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

SUPER/UNI UNIVERSAL POWER SUPPLIES

OUTPUT VOLTAGE vs. OUTPUT CURRENT FOR VARI-RATED SUPER/UNI SERIES

Model	VOLTAGE											
	3V	5V	6V	8V	10V	12V	15V	18V	20V	24V	28V	30V
SUNI-76V	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SUNI-88V	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
SUNI-AV	2.8	2.8	2.2	2.2	2.2	2.2	2.0	1.8	1.8	1.8	1.7	1.6
SUNI-BV	4.0	3.8	3.7	3.6	3.5	3.3	3.2	2.8	2.7	2.1	1.8	1.8
SUNI-CV	6.5	6.2	6.1	5.8	5.6	5.3	5.0	4.5	4.2	3.6	3.0	3.0
SUNI-CCV	13.0	12.5	12.0	11.7	11.0	10.5	9.5	8.0	7.7	6.8	6.0	5.5
SUNI-DV	18.0	17.4	17.0	16.4	15.7	15.0	14.0	12.5	11.5	10.0	9.0	8.0
SUNI-EV	25.0	24.0	23.0	22.0	21.0	20.0	19.0	16.0	15.0	13.0	11.0	10.0
SUNI-EEV	36.0	34.0	33.0	32.0	30.0	29.0	28.0	24.0	22.0	19.0	17.0	16.0

CURRENT

SERIAL NO 82907
COARSE
PMC POWER/MATE CORP.

SUPER/UNI-76V

0-34 VOLTS, 0.5 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection

3-5/16" x 3-7/8"H x 5-1/8"D
Weight: Net 3-3/4 lbs.
Shipping: 4-3/4 lbs.

$89⁰⁰

WARNING
DO NOT ADJUST COARSE
WITHOUT CHECKING INTERNAL
TRANSFORMER TAP RANGE
COARSE
FINE
PMC POWER/MATE CORP.
Hackensack, N.J.

SUPER/UNI-88V

0-34 VOLTS, 1.5 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection

3-5/16"W x 3-7/8"H x 6-7/8"D
Weight: Net 5-1/4 lbs.
Shipping: 6-3/4 lbs.

$109⁰⁰

SERIAL NO
PMC POWER/MATE CORP.
Hackensack, N.J.

SUPER/UNI-30AV

0-34 VOLTS, UP TO 2.8 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection

3-3/16"H x 3-3/4"W x 6-1/2"L
Weight: Net 5-3/4 lbs.
Shipping: 7 lbs.

$119⁰⁰

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Phone: (201) 343-6294 TWX: (710) 990-5023

SUPER/UNI UNIVERSAL POWER SUPPLIES

"More Power per Penny"

SUPER/UNI-30BV

0-30 VOLTS, UP TO 4.5 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection
3-3/16"H x 4-15/16"W x 6-1/2"L
Weight: Net 8 lbs.
Shipping: 10 lbs.
$139⁰⁰

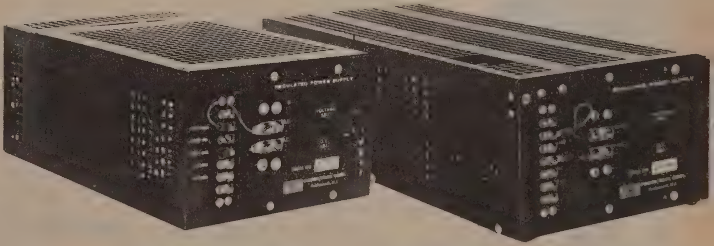
SUPER/UNI-30CV

0-30 VOLTS, UP TO 6.6 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection
3-3/16"H x 4-15/16"W x 9-3/8"L
Weight: Net 11 lbs.
Shipping: 14 lbs.
$159⁰⁰

SUPER/UNI-30CCV

0-30 VOLTS, UP TO 13.5 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection
4-15/16"H x 4-15/16"W x 9-3/8"L
Weight: 16 lbs.
Shipping: 19 lbs.
$199⁰⁰

"More Power per Penny"



SUPER/UNI-30DV

0-30 VOLTS, UP TO 18 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection
4-15/16"H x 7-1/2"W x 9-3/8"L
Weight: Net 20 lbs.
Shipping: 25 lbs.
$239⁰⁰

SUPER/UNI-30EV

0-30 VOLTS, UP TO 25 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection
4-15/16"H x 7-1/2"W x 11-3/4"L
Weight: Net 26 lbs.
Shipping: 31 lbs.
$289⁰⁰

SUPER/UNI-30EEV

0-30 VOLTS, UP TO 36 AMPS
Built-In Overvoltage Protection
Built-In Short Circuit Protection
4-15/16"H x 7-1/2"W x 16-1/2"L
Weight: Net 34-1/2 lbs.
Shipping: 39-1/2 lbs.
$349⁰⁰

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

qual•i•ty \ˈkwäl-ət-ē\ *n*, a degree of excellence, a distinguishing attribute, superiority in kind.

The word QUALITY

Is one of the more mis-applied and insincerely used words in industry today . . .

That's too bad, because it's a word, when properly used, that has a lot of importance to **you** and **your** product.

We at Power/Mate, take the word at face value. We don't rationalize about a product failure. Failures are inexcusable.

At Power/Mate . . . We take Action ! ! . . . .

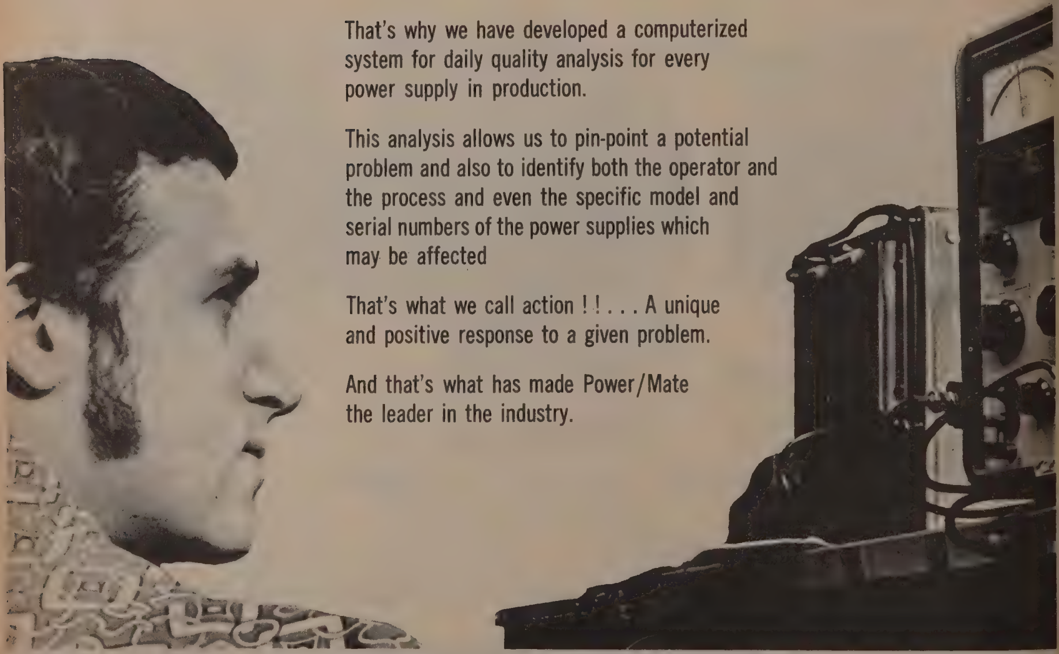
Thats why we thermally cycle and burn-in all power supplies a minimum of 24 hours before shipment to you.

That's why we have developed a computerized system for daily quality analysis for every power supply in production.

This analysis allows us to pin-point a potential problem and also to identify both the operator and the process and even the specific model and serial numbers of the power supplies which may be affected

That's what we call action ! ! . . . A unique and positive response to a given problem.

And that's what has made Power/Mate the leader in the industry.



PMC POWER/MATE CORP.

514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

PM MODULAR POWER SUPPLIES

PRODUCT DIGEST

PM Series of regulated power supplies are a 1 for 1 replacement for other manufacturers older model power supplies. Package for package power supplies are identical but the similiarity ceases there.

The Power/Mates' PM Series systems power supply design is modern and uses only the latest state-of-the-art integrated circuits and hybrids of the seventies.

The new PM Series are available to OEM users with liberal quantity discounts. Thus, the PM Series provides a high quality, power supply that saves space, weight and money. And offers a superior alternative to five year old, old fashioned power supply designs.

One of the PM Series space-saving features is a built-in over-voltage protection that doesn't add a fraction to the basic module dimensions. Over-voltage protection is inside the module case and is standard on most models.

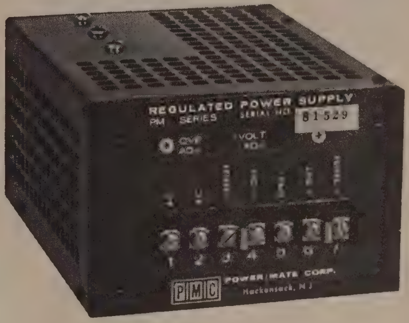
Self-restoring current limiting and built-in circuit protection limit the maximum output available on external loads. In addition a 'fail-safe' thermal device offers even further protection for each PM unit.

The PM Series are available with the same wide variety of options as the other Power/Mate systems power supplies. Typical available options are fungus proofing with MIL-173 varnish, wide input AC ranges and rack accessories.

As with all Power/Mate power supplies, the new PM Series is backed by Power/Mate's Five Year Warranty.

UL APPROVED

POWER/MATE's power supplies are listed as a recognized component in Underwriter Laboratory's recognized component index. (UL 478-1967).



REGULATION (ALL DC OUTPUTS): Line . . . ± 0.015% + 1mV for line variations from 105-132 VAC. Load . . . ± 0.015% + 1mV for load variations from 0 to full load.

RIPPLE: Less than 1mV RMS.

SPECIFICATIONS

AC INPUT: 105-132 Vac, 47-440 Hz.

DC OUTPUT VOLTAGES AND CURRENTS: See respective tables.

REGULATION (ALL DC OUTPUTS): Line . . . ± 0.015% + 1mV for line variations from 105-132 VAC. Load . . . ± 0.015% + 1mV for load variations from 0 to full load.

RIPPLE: Less than 1mV RMS.

RESPONSE TIME: Less than 20 micro-seconds.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

REMOTE OR LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted or internally adjusted.

POLARITY: May be either positive, negative or floating up to 300 volts.

TEMPERATURE COEFFICIENT: Better than 0.01%°C.

LONG TERM STABILITY: Better than 0.01%°C.

AMBIENT OPERATING TEMPERATURE: Continuous duty from — 20°C to + 71°C.

STORAGE TEMPERATURE: −55°C to +85°C.

OVERSHOOT: No voltage spikes for turn on-turn off or power failure.

OVERLOAD AND SHORT CIRCUIT PROTECTION: Solid state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short circuits or overloads.

MIL SPECS: Designed to meet the environmental requirements of MIL-E-5272 and RFI requirements of MIL-1-6181. Meantime between failures — in excess of 100,000 hours per MIL HDBK 217.

TRANSFORMERS: Meets MIL-T-27 specs.

INPUT AND OUTPUT CONNECTIONS: Heavy duty terminal blocks.

MECHANICAL DATA

The PM power supplies may be mounted on any of three surfaces (except EE case which mounts only on bottom or side). Units will function when mounted in any position, 3½-inch and 5¼-inch rack mounting assemblies are available, along with other accessories.

AVAILABLE OPTIONS

1. Fungus proofing, with MIL-V-173 varnish, for all fungus nutrient components, at $10 per unit. Use suffix "F".
2. AC input. For 205-265 VAC, 47-420 Hz operation, specify "LJ" option and add $10.00 to price.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

POWER/MATE CORP.
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

PM MODULAR POWER SUPPLIES

PM SERIES "B" PACKAGE

with Over-Voltage Protection built-in

3 3/16" x 4 13/16" x 6½"

$115

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PM-B-3.6V	3.6 ± 5%	3.8	3.3	2.6	1.6
PM-B-5V	5 ± 5%	3.7	3.2	2.5	1.5
PM-B-6V	6 ± 5%	3.2	2.9	2.4	1.4
PM-B-10V	10 ± 5%	2.7	2.5	2.2	1.4
PM-B-12V	12 ± 5%	2.5	2.3	2.1	1.3
PM-B-15V	15 ± 5%	2.2	2.0	1.8	1.3
PM-B-18V	18 ± 5%	2.0	1.8	1.7	1.3
PM-B-20V	20 ± 5%	1.8	1.6	1.5	1.2
PM-B-24V	24 ± 5%	1.4	1.3	1.2	1.1
PM-B-28V	28 ± 5%	1.3	1.2	1.1	1.0
PM-B-36V	36 ± 5%	1.1	1.0	0.90	0.85
PM-B-48V	48 ± 5%	0.9	0.85	0.80	0.75
PM-B-100	100 ± 5%	0.37	0.34	0.30	0.28
PM-B-120	120 ± 5%	0.30	0.28	0.25	0.23
PM-B-150	150 ± 5%	0.25	0.23	0.20	0.19

PM SERIES "C" PACKAGE

with Over-Voltage Protection built-in

3 3/16" x 4 13/16" x 9⅜"

$135

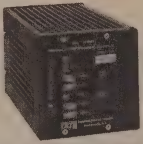
Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PM-C-3.6V	3.6 ± 5%	5.2	4.5	3.6	2.5
PM-C-5V	5 ± 5%	5.1	4.3	3.4	2.4
PM-C-6V	6 ± 5%	4.8	4.1	3.3	2.4
PM-C-10V	10 ± 5%	4.2	3.6	3.0	2.0
PM-C-12V	12 ± 5%	4.0	3.5	2.9	1.9
PM-C-15V	15 ± 5%	3.5	3.2	2.8	1.9
PM-C-18V	18 ± 5%	3.2	3.0	2.7	1.9
PM-C-20V	20 ± 5%	3.1	2.9	2.6	1.8
PM-C-24V	24 ± 5%	2.5	2.4	2.2	1.5
PM-C-28V	28 ± 5%	2.3	2.1	2.0	1.4
PM-C-36V	36 ± 5%	2.0	1.8	1.7	1.3
PM-C-48V	48 ± 5%	1.6	1.4	1.3	1.0
PM-C-100	100 ± 5%	0.55	0.51	0.47	0.42
PM-C-120	120 ± 5%	0.49	0.45	0.42	0.38
PM-C-150	150 ± 5%	0.39	0.36	0.33	0.30

PM SERIES "CC" PACKAGE

with Over-Voltage Protection built-in

4 13/16" x 4 13/16" x 9⅜"

$175



Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PM-CC-3.6V	3.6 ± 5%	11.0	9.4	8.2	5.5
PM-CC-5V	5 ± 5%	10.5	9.0	8.0	5.5
PM-CC-6V	6 ± 5%	9.0	8.4	7.7	5.5
PM-CC-10V	10 ± 5%	7.5	7.0	6.3	5.0
PM-CC-12V	12 ± 5%	7.3	6.8	5.9	4.7
PM-CC-15V	15 ± 5%	6.0	5.6	5.1	4.3
PM-CC-18V	18 ± 5%	5.5	5.1	4.7	4.1
PM-CC-20V	20 ± 5%	5.0	4.6	4.2	3.6
PM-CC-24V	24 ± 5%	4.0	3.7	3.4	3.0
PM-CC-28V	28 ± 5%	3.5	3.4	3.1	2.8
PM-CC-36V	36 ± 5%	3.0	2.9	2.7	2.4
PM-CC-48V	48 ± 5%	2.5	2.4	2.2	1.9
PM-CC-100	100 ± 5%	1.0	0.96	0.90	0.80
PM-CC-120	120 ± 5%	0.9	0.86	0.80	0.70
PM-CC-150	150 ± 5%	0.7	0.67	0.62	0.55

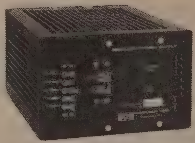
Quantity Discounts up to 50%

PM SERIES "D" PACKAGE

with Over-Voltage Protection built-in

4 13/16" x 7½" x 9⅜"

$205



Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PM-D-3.6V	3.6 ± 5%	13.1	11.3	9.2	6.2
PM-D-5V	5 ± 5%	12.6	10.8	9.2	6.1
PM-D-6V	6 ± 5%	12.4	10.6	8.9	6.0
PM-D-10V	10 ± 5%	10.8	9.7	8.5	5.7
PM-D-12V	12 ± 5%	10.0	9.2	8.3	5.7
PM-D-15V	15 ± 5%	9.0	8.4	7.9	5.3
PM-D-18V	18 ± 5%	7.9	7.4	6.9	5.0
PM-D-20V	20 ± 5%	7.4	6.9	6.5	4.9
PM-D-24V	24 ± 5%	6.7	6.3	5.8	4.8
PM-D-28V	28 ± 5%	6.0	5.6	5.2	4.7
PM-D-36V	36 ± 5%	5.4	5.0	4.7	4.3
PM-D-48V	48 ± 5%	4.1	3.9	3.6	3.1
PM-D-100	100 ± 5%	1.7	1.5	1.3	1.1
PM-D-120	120 ± 5%	1.5	1.3	1.1	1.0
PM-D-150	150 ± 5%	1.1	1.0	0.90	0.80

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

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514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

PM MODULAR POWER SUPPLIES

PM SERIES "E" PACKAGE

with Over-Voltage
Protection built-in

4 15/16" x 7½" x 11⅞"

$265

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of 40°C	50°C	60°C	71°C
PM-E-3.6V	3.6 ± 5%	21.0	19.0	16.5	10.0
PM-E-5V	5 ± 5%	20.0	18.0	16.4	10.0
PM-E-6V	6 ± 5%	19.0	17.3	15.6	10.0
PM-E-10V	10 ± 5%	16.0	14.5	13.0	9.5
PM-E-12V	12 ± 5%	15.0	13.6	12.3	9.5
PM-E-15V	15 ± 5%	14.0	12.7	11.5	8.6
PM-E-18V	18 ± 5%	13.0	11.8	10.6	8.6
PM-E-20V	20 ± 5%	12.0	10.9	9.8	8.5
PM-E-24V	24 ± 5%	11.0	10.0	9.0	7.6
PM-E-28V	28 ± 5%	10.0	9.0	8.0	7.1
PM-E-36V	36 ± 5%	8.0	7.3	6.5	5.7
PM-E-48V	48 ± 5%	6.0	5.4	4.9	4.3
PM-E-100	100 ± 5%	2.0	1.7	1.6	1.5
PM-E-120	120 ± 5%	1.7	1.5	1.4	1.2
PM-E-150	150 ± 5%	1.4	1.3	1.2	1.0

PM SERIES "EE" PACKAGE

with Over-Voltage
Protection built-in

4 15/16" x 7½" x 17"

$339

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of 40°C	50°C	60°C	71°C
PM-EE-3.6V	3.6 ± 5%	32.0	26.0	22.0	18.3
PM-EE-5V	5 ± 5%	31.0	24.6	20.8	17.3
PM-EE-6V	6 ± 5%	30.0	24.6	20.8	17.3
PM-EE-10V	10 ± 5%	24.0	20.4	16.8	13.8
PM-EE-12V	12 ± 5%	21.0	19.0	16.1	13.2
PM-EE-15V	15 ± 5%	19.0	18.0	15.5	12.7
PM-EE-18V	18 ± 5%	16.5	14.8	12.4	10.1
PM-EE-20V	20 ± 5%	15.2	13.7	11.8	9.7
PM-EE-24V	24 ± 5%	14.0	12.5	10.8	9.0
PM-EE-28V	28 ± 5%	13.0	11.5	9.8	8.2
PM-EE-36V	36 ± 5%	10.4	9.8	8.6	7.1
PM-EE-48V	48 ± 5%	7.7	7.1	6.5	5.4
PM-EE-100	100 ± 5%	3.3	3.0	2.5	2.1
PM-EE-120	120 ± 5%	3.0	2.7	2.2	1.9
PM-EE-150	150 ± 5%	2.2	2.0	1.75	1.50

PM, PC, PX MODULAR POWER SUPPLY DIMENSIONS

PM—PX—PC SERIES DIMENSIONS

LETTER	"A"	"B"	"C"	"CC"	"D"	"E"	"EE"
A	3.72	4.91	4.91	9.38	9.38	9.38	16.50
B	3.17	3.17	3.17	4.91	4.91	4.91	4.91
C	6.50	6.50	9.38	4.94	7.50	7.50	7.50
D	2.84	4.03	4.03		3.25	3.25	
E	2.38	2.23	2.23	3.98	6.52	6.52	
F	5.06	5.06	6.89	6.89	6.89	6.89	12.38
G	2.84	3.75	3.75	4.06	6.56	6.56	6.56
H	.42	.56	.56	.44	.48	.48	.48
J	.36	.48	.48	.73	.73	.73	.36
K	1.42	2.02	2.02	2.11	4.20	4.20	4.20
L	5.31	5.06	6.89				
M		3.08	3.08				
N		2.08	2.08				
P		2.48	2.48				
FIG. #	1	1	1	2	2	2	2

NOTE 1 Mounting Screws, #8-32 THD

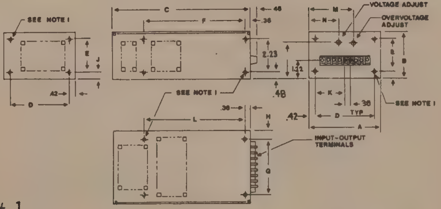
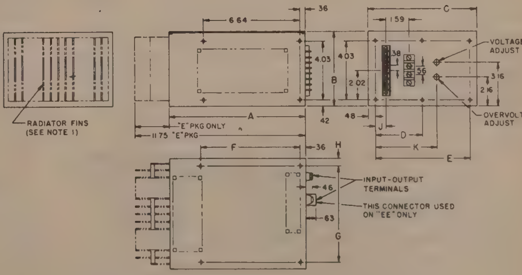

SEE NOTE 1
E
J
.42
D
C
F
.48
.36
2.23
1.22
.48
SEE NOTE 1
.36
L
H
G
INPUT-OUTPUT TERMINALS
M
N
VOLTAGE ADJUST
OVERVOLTAGE ADJUST
B
K
.36
TYP
.42
D
A
SEE NOTE 1

FIG. # 1


RADIATOR FINS
(SEE NOTE 1)
6 64
36
4.03
4 03
B
2 02
.38
.56
A
42
"E" PKG ONLY
11 75 "E" PKG
C
1 59
VOLTAGE ADJUST
3 16
2 16
OVERVOLTAGE ADJUST
48
J
D
K
E
F
36
H
46
63
G
INPUT-OUTPUT TERMINALS
THIS CONNECTOR USED ON "EE" ONLY

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

PM FULL RACK POWER SUPPLIES

PRODUCT DIGEST

POWER/MATE'S expanded PM Series, an extension of our field proven PM Series Systems Power Supply Modules, now make available "Full Rack" power supplies with voltages up to 150 VDC and currents up to 150 amperes. The expanded PM Series are offered in three additional package sizes (F, G and H case), all of which set into standard 19" racks. The expanded series are ideally suited for use with digital (TTL, ECL, TRL, DTL and HTL) integrated circuits and the new MOS/LSI logic.

The PM Full Rack power supplies are offered in 42 fixed voltage range models and 4 wide range models in metered or nonmetered versions. Built-in over-voltage protection on all PM Series "H" package models is standard. Self-restoring current limiting and over-voltage protection provide complete protection. Advanced electronic circuitry limits the output current on external loads, including short circuit providing protection for the load as well as the power supply. Remote sensing, remote programming and complete serviceability are additional features.

The Full Rack PM Series offer the same wide variety of options as the systems PM power supplies. Typical available options are fungus proofing with MIL-V-173 varnish, metering, dual AC inputs, high performance option, OVP and dual primaries.

As with all Power/Mate power supplies, the Full Rack PM Series are backed by Power/Mate's Five Year Warranty.

REGULATED POWER SUPPLY

REGULATED POWER SUPPLY

REGULATED VOLTAGE:
Line—0.05% +4mV for line variations from 105-132 VAC.
0.01% +1.0mV for line variations from 105-132 VAC. (optional)*
Load—0.03% +3mV for load variations from 0 to full load.
0.02% +2mV for load variations from 0 to full load. (optional)*
RIPPLE: .5mV RMS with either positive or negative terminal grounded.

SPECIFICATIONS

AC INPUT: 105-132 VAC, 47-420 Hz.

OUTPUT VOLTAGE AND CURRENT: See respective tables.

REGULATED VOLTAGE:
Line—0.05% +4mV for line variations from 105-132 VAC.
0.01% +1.0mV for line variations from 105-132 VAC. (optional)*
Load—0.03% +3mV for load variations from 0 to full load.
0.02% +2mV for load variations from 0 to full load. (optional)*

RIPPLE: .5mV RMS with either positive or negative terminal grounded.

METERS: Voltmeter and ammeter, rated accurate to 2% of full scale value, are provided on the front panel. See options.

POLARITY: The output may be "floated" up to 300V peak above ground. Either polarity may be grounded to chassis by means of terminals provided.

FINISH: Front panel is finished with dual tone gray and black baked enamel with brushed aluminum handles. Panel marking is gray. All other finishes are appropriate paint, plating, or chemical film, as required.

TEMPERATURE COEFFICIENT: Better than 0.01%°C.

LONG TERM STABLITY: Better than 0.025% for 8 hours.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

REMOTE OR LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted or internally adjusted with course and fine control.

OVERLOAD AND SHORT CIRCUIT PROTECTION: Solid state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short circuits or overloads.
Thermal—Thermostat; automatic rest when overtemperature condition is eliminated.

AMBIENT OPERATING TEMPERATURE: Continuous duty from −20°C to +71°C ambient.

STORAGE TEMPERATURE: −55°C to +85°C.

INPUT AND OUTPUT CONNECTIONS: Heavy duty terminal block on rear of chassis.

*See Options.

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

MIL/SPEC PERFORMANCE

Independently tested to meet the environment of MIL-E-5272 and related specs. See MIL SPEC Section of this catalog.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**
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Phone: (201) 343-6294 TWX: (710) 990-5023

PM FULL RACK POWER SUPPLIES

AVAILABLE OPTIONS

METERS: Prices of "F" and "G" packages are for non-metered models. For metered models add suffix "M" to model number and $30 to price.
Package "H" models are available only with overvoltage protection, high performance option, and meters, all of which are included in the price.

OVERVOLTAGE PROTECTION: Built-in overvoltage protection is standard on all package "H" models and available as an option on all package "F" and "G" models. To order OVP for "F" and "G" packages, add suffix "OV" to the model number and add $50 to price. Price of package "H" models includes overvoltage protection.

CHASSIS SLIDES: "F", "G" and "H" packages are available with mounted chassis slides. Add suffix "CS" to model number, and add $50 to the price of "F" and "G" models, $89 to the price of "H" models.

HIGH PERFORMANCE: Better regulation, ripple, and temperature coefficient for extra performance and safety margin in your system.

All package "F" and "G" units are available with the following high performance specifications at a $15 surcharge.

Load Regulation: .02% +2mV.
Line Regulation: .01% +1dV.
Ripple and Noise: with 60 Hz input: 0.5mV RMS; 1.5mV p-To-p.
Temperature Coeff; .01%°C.

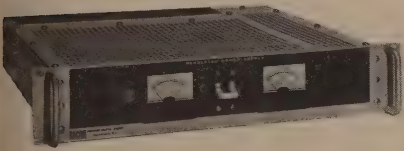
Add suffix "Y" to package "F" and "G" model numbers. High performance option standard on "H" case units.

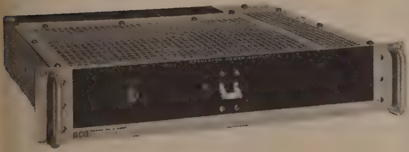
AC INPUT: All models are available with 205-265 VAC input voltage. Add suffix "LJ" to model number (40°C rating not applicable) and add $10 to cost.

FUNGUS PROOFING: All models available with fungus proofing with MIL-V-173 varnish for all fungi Nutrient components. To order add suffix "FP" to model number and add $15 to the price of "F", "G" and "H" package models.

"F" PACKAGE

3-1/2" x 19" x 16-1/2"





FIXED VOLTAGE MODELS

Model	Output Volt.	Volt. Adj.	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PM-F-3	3	±5%	48.0	42.0	34.0	25.0	$469
PM-F-3-P-6	3.6	±5%	48.0	42.0	34.0	25.0	469
PM-F-4	4	±5%	48.0	42.0	34.0	25.0	469
PM-F-4-P-5	4.5	±5%	48.0	42.0	34.0	25.0	469
PM-F-5	5	±5%	48.0	41.0	33.0	25.0	469
PM-F-6	6	±5%	47.0	40.0	32.0	24.0	469
PM-F-8	8	±5%	44.0	37.0	30.0	23.0	469
PM-F-10	10	±5%	38.0	33.0	27.0	21.0	469
PM-F-12	12	±5%	33.0	28.0	22.0	17.0	469
PM-F-15	15	±5%	25.0	22.0	18.0	14.0	469
PM-F-18	18	±5%	25.0	22.0	18.0	14.0	469
PM-F-20	20	±5%	23.0	20.0	17.0	13.0	469
PM-F-24	24	±5%	20.0	17.0	14.0	11.0	469
PM-F-28	28	±5%	19.0	16.0	13.0	10.0	469
PM-F-36	36	±5%	13.0	11.0	10.0	7.5	499
PM-F-48	48	±5%	10.0	9.0	7.5	6.0	499
PM-F-60	60	±5%	8.0	7.0	6.0	5.0	499

WIDE RANGE MODELS

Model	Adj. Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PM-F-0-7	0-7	25.0	21.0	17.0	14.0	$469
PM-F-0-20	0-20	10.0	9.0	8.0	7.0	469

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PMC

POWER/MATE CORP.

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Phone: (201) 343-6294 TWX: (710) 990-5023

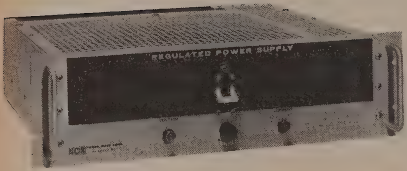
PM FULL BACK POWER SUPPLIES

"G" PACKAGE

5-1/4″ x 19″ x 16-1/2″

REGULATED POWER SUPPLY

SHOWN WITH METERS



FIXED VOLTAGE MODELS

Model	Output Volt.	Volt. Adj.	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PM-G-3	3	±5%	95.0	80.0	62.0	45.0	$599
PM-G-3-P-6	3.6	±5%	85.0	80.0	62.0	45.0	599
PM-G-4	4	±5%	85.0	80.0	62.0	45.0	599
PM-G-4-P-5	4.5	±5%	85.0	80.0	62.0	45.0	599
PM-G-5	5	±5%	80.0	75.0	62.0	45.0	599
PM-G-6	6	±5%	80.0	75.0	62.0	45.0	599
PM-G-8	8	±5%	68.0	62.0	53.0	41.0	599
PM-G-10	10	±5%	64.0	53.0	44.0	35.0	599
PM-G-12	12	±5%	56.0	46.0	37.0	29.0	599
PM-G-15	15	±5%	45.0	42.0	36.0	28.0	599
PM-G-18	18	±5%	38.0	34.0	28.0	21.0	599
PM-G-20	20	±5%	35.0	32.0	28.0	21.0	599
PM-G-24	24	±5%	32.0	26.0	21.0	16.0	599
PM-G-28	28	±5%	28.0	25.0	21.0	16.0	599
PM-G-36	36	±5%	22.0	20.0	16.0	13.0	619
PM-G-48	48	±5%	17.0	14.0	12.0	9.0	619
PM-G-60	60	±5%	13.0	11.0	9.0	7.0	619

WIDE RANGE MODELS

Model	Adj. Volt. Range VDC	Max. Amps at Ambient of: 40°C	50°C	60°C	71°C	Price
PM-G-7	0-7	35.0	29.0	24.0	20.0	$599
PM-G-20	0-20	18.0	15.0	12.0	10.0	599

"H" PACKAGE

7″ x 18″ x 18-1/2″

REGULATED POWER SUPPLY

FIXED VOLTAGE MODELS

Model	Output Volt.	Volt. Adj.	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PM-H-3-OV-Y-M	3	±5%	150	140	125	91	$950
PM-H-3-P-6-OV-Y-M	3.6	±5%	130	109	90	69	950
PM-H-4-OV-Y-M	4	±5%	135	118	100	74	950
PM-H-4-P-5-OV-Y-M	4.5	±5%	120	104	84	66	950
PM-H-5-OV-Y-M	5	±5%	130	110	90	70	950
PM-H-6-OV-Y-M	6	±5%	117	100	84	66	950
PM-H-10-OV-Y-M	10	±5%	95	83	69	56	950
PM-H-12-OV-Y-M	12	±5%	90	77	63	50	950

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

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Phone (201) 343-6294 TWX: (710) 990-5023

PX MODULAR POWER SUPPLIES

PRODUCT DIGEST

Power/Mates new PX Series power supplies consist of 90 different models in 6 convection cooled package sizes. The PX Series utilizes state-of-the-art Integrated Circuit regulators and high efficiency internal heat dissipating devices to achieve their compact size and high reliability.

The PX Series are ideally suited for IC Logic and Systems applications. The new models provide DC outputs to 3.6VDC to 150VDC with currents to 40 amps. Most models contain built-in overvoltage protection. All PX Series power supplies are short circuit and overload protected. In addition, all models contain built-in "fail-safe" thermal protection devices.

Power/Mates' unique PX Series power supplies offer the same wide variety of options as other Power/Mate systems power supplies. Typical available options are fungus proofing with MIL-173 varnish, wide input AC ranges, and standard Power/Mate racks and accessories.

The PX Series power supplies are also a direct form-fit-function replacement for LXS, RS and other manufacturers older model units.

As with all Power/Mate power supplies, the new PX Series is backed by Power Mate's Five Year Warranty.

UL APPROVED

POWER/MATE's power supplies are listed as a recognized component in Underwriter Laboratory's recognized component index. (UL 478-1967).

REGULATION (ALL DC OUTPUTS): Line 0.1% — Load 0.1%.

NOISE AND RIPPLE: 1.5mv RMS, 5mv PK-PK with pos. or neg. grounded.

SPECIFICATIONS

AC INPUT: 105-132 Vac, 47-440 Hz.

DC OUTPUT VOLTAGES AND CURRENTS: See respective tables.

REGULATION (ALL DC OUTPUTS): Line 0.1% — Load 0.1%.

NOISE AND RIPPLE: 1.5mv RMS, 5mv PK-PK with pos. or neg. grounded.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

REMOTE OR LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted or internally adjusted.

POLARITY: May be either positive, negative or floating up to 300 volts.

DC OUTPUT CONTROL: Simple screwdriver voltage adjustment.

AMBIENT OPERATING TEMPERATURE: Continuous duty from 0°C to +71°C.

STORAGE TEMPERATURE: −55°C to +85°C.

OVERLOAD AND SHORT CIRCUIT PROTECTION: Solid state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short circuits or overloads.

OVERSHOOT: No voltage spikes for turn on-turn off or power failure.

TRANSFORMERS: Meets MIL-T-27 specs.

MIL SPECS: Designed to meet the environmental requirements of MIL-E-5272 and RFI requirements of MIL-I-6181. Meantime between failures — in excess of 100,000 hours per MIL HDBK 217.

INPUT AND OUTPUT CONNECTIONS: Heavy duty terminal blocks or rear of module.

MECHANICAL DATA

The PX power supplies may be mounted on any of three surfaces (except EE case which mounts only on bottom or side). Units will function when mounted in any position, 3½-inch and 5¼-inch rack mounting assemblies are available, along with other accessories.

AVAILABLE OPTIONS

1. Fungus proofing, with MIL-V-173 varnish, for all fungus nutrient components, at $10 per unit. Use suffix "F".
2. AC input. For 205-265 VAC, 47-420 Hz operation, specify "LJ" option and add $10.00 to price.

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

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Phone: (201) 343-6294 TWX: (710) 990-5023

PX HIGH CURRENT POWER SUPPLIES

PX SERIES "B" PACKAGE

with built-in
Over-Voltage Protection

3$\frac{3}{16}$" x 4$\frac{15}{16}$" x 6½"

$119

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PXS-B-3.6V	3.6 ± 5%	6.1	5.3	4.0	3.4
PXS-B-5V	5 ± 5%	6.0	5.2	3.9	3.3
PXS-B-6V	6 ± 5%	5.5	4.7	3.8	3.0
PXS-B-10V	10 ± 5%	4.0	3.6	3.2	2.8
PXS-B-12V	12 ± 5%	3.8	3.6	3.0	2.5
PXS-B-15V	15 ± 5%	3.2	2.8	2.5	2.1
PXS-B-18V	18 ± 5%	2.6	2.3	2.0	1.8
PXS-B-20V	20 ± 5%	2.4	2.1	1.9	1.6
PXS-B-24V	24 ± 5%	2.0	1.8	1.6	1.4
PXS-B-28V	28 ± 5%	1.8	1.6	1.4	1.2
PXS-B-36V	36 ± 5%	1.3	1.1	1.0	.91
PXS-B-48V	48 ± 5%	1.1	1.0	.94	.87
PXS-B-100	100 ± 5%	.40	.35	.30	.28
PXS-B-120	120 ± 5%	35	.30	.25	.23
PXS-B-150	150 ± 5%	.30	.25	.20	.19

PX SERIES "C" PACKAGE

with built-in
Over-Voltage Protection

3$\frac{3}{16}$" x 4$\frac{15}{16}$" x 9⅜"

$143

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PXS-C-3.6	3.6 ± 5%	9.2	7.8	6.2	5.9
PXS-C-5V	5 ± 5%	9.0	7.6	6.0	5.8
PXS-C-6V	6 ± 5%	8.8	7.6	6.3	5.6
PXS-C-10V	10 ± 5%	6.5	6.1	5.4	4.8
PXS-C-12V	12 ± 5%	6.5	6.1	5.4	4.8
PXS-C-15V	15 ± 5%	5.0	4.5	4.0	3.5
PXS-C-18V	18 ± 5%	4.5	4.3	3.8	2.7
PXS-C-20V	20 ± 5%	4.2	3.9	3.5	2.5
PXS-C-24V	24 ± 5%	3.6	3.4	3.1	2.2
PXS-C-28V	28 ± 5%	3.0	2.7	2.6	1.8
PXS-C-36V	36 ± 5%	2.3	2.1	1.9	1.5
PXS-C-48V	48 ± 5%	1.8	1.6	1.5	1.1
PXS-C-100	100 ± 5%	.55	.51	.47	.42
PXS-C-120	120 ± 5%	.50	.45	.42	.38
PXS-C-150	150 ± 5%	.40	.36	.33	.30

PX SERIES "CC" PACKAGE

with built-in
Over-Voltage Protection

4$\frac{15}{16}$" x 4$\frac{15}{16}$" x 9⅜"

$189

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PXS-CC-3.6V	3.6 ± 5%	16.0	14.5	12.7	10.5
PXS-CC-5V	5 ± 5%	16.0	14.5	12.7	10.5
PXS-CC-6V	6 ± 5%	16.0	14.5	12.7	10.5
PXS-CC-10V	10 ± 5%	10.5	9.4	8.2	5.0
PXS-CC-12V	12 ± 5%	10.5	9.4	8.2	5.0
PXS-CC-15V	15 ± 5%	9.5	8.6	7.4	4.8
PXS-CC-18V	18 ± 5%	7.7	7.2	6.5	4.4
PXS-CC-20V	20 ± 5%	7.7	7.2	6.5	4.4
PXS-CC-24V	24 ± 5%	6.8	6.4	5.7	4.4
PXS-CC-28V	28 ± 5%	6.0	5.6	5.0	4.3
PXS-CC-36V	36 ± 5%	5.0	4.4	3.8	3.0
PXS-CC-48V	48 ± 5%	3.5	3.1	2.6	2.1
PXS-CC-100	100 ± 5%	1.8	1.6	1.4	1.1
PXS-CC-120	120 ± 5%	1.5	1.3	1.1	.9
PXS-CC-150	150 ± 5%	1.2	1.0	.9	.6

Quantity Discounts up to 50%

PX SERIES "D" PACKAGE

with built-in
Over-Voltage Protection

4$\frac{15}{16}$" x 7½" x 9⅜"

$229

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PXS-D-3.6V	3.6 ± 5%	27.5	24.2	20.5	16.5
PXS-D-5V	5 ± 5%	27.5	24.2	20.5	16.5
PXS-D-6V	6 ± 5%	27.5	24.2	20.5	16.5
PXS-D-10V	10 ± 5%	16.0	14.0	11.9	8.0
PXS-D-12V	12 ± 5%	16.0	14.0	11.9	8.0
PXS-D-15V	15 ± 5%	14.0	12.3	10.4	7.5
PXS-D-18V	18 ± 5%	14.0	12.3	10.4	7.5
PXS-D-20V	20 ± 5%	11.5	10.0	8.6	6.8
PXS-D-24V	24 ± 5%	10.0	8.8	7.5	6.0
PXS-D-28V	28 ± 5%	9.0	8.0	6.8	5.5
PXS-D-36V	36 ± 5%	7.0	6.0	5.2	4.0
PXS-D-48V	48 ± 5%	5.0	4.3	3.8	3.0
PXS-C-100	100 ± 5%	2.5	2.2	1.9	1.5
PXS-D-120	120 ± 5%	2.0	1.8	1.5	1.2
PXS-D-150	150 ± 5%	1.5	1.3	1.1	.9

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PX HIGH CURRENT POWER SUPPLIES

PX SERIES "E" PACKAGE

with built-in Over-Voltage Protection

4 1/8" x 7½" x 11⅞"

$289

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PXS-E-3.6V	3.6 ± 5%	32	28	24	19
PXS-E-5V	5 ± 5%	30	27.2	22.5	17.5
PXS-E-6V	6 ± 5%	30	27.2	22.5	17.5
PXS-E-10V	10 ± 5%	25	22	19	15
PXS-E-12V	12 ± 5%	20	17.5	15	12
PXS-E-15V	15 ± 5%	18	16	13.5	11
PXS-E-18V	18 ± 5%	17	15	12.8	10
PXS-E-20V	20 ± 5%	16	14	12.0	9
PXS-E-24V	24 ± 5%	15	13	11.3	8.2
PXS-E-28V	28 ± 5%	14	12.2	10.5	7.5
PXS-E-36V	36 ± 5%	10	8.8	7.5	6
PXS-E-48V	48 ± 5%	7.5	6.5	5.6	4.5
PXS-E-100	100 ± 5%	3.5	3.1	2.6	2.1
PXS-E-120	120 ± 5%	2.5	2.2	1.9	1.5
PXS-E-150	150 ± 5%	2.3	2.0	1.7	1.4

PX SERIES "EE" PACKAGE

with built-in Over-Voltage Protection

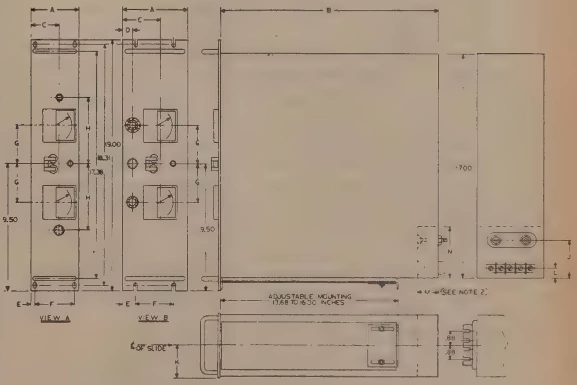
4 1/8" x 7½" x 17"

$389

Model	Adjustable Voltage Range	Max. Amps at Ambient Temp. of			
		40°C	50°C	60°C	71°C
PXS-EE-3.6V	3.6 ± 5%	45	39	32	25
PXS-EE-5V	5 ± 5%	43	39	32	25
PXS-EE-6V	6 ± 5%	42	36	30	22
PXS-EE-10V	10 ± 5%	35	30.5	27.2	21
PXS-EE-12V	12 ± 5%	30	26	22.5	18
PXS-EE-15V	15 ± 5%	25	22	19.0	15
PXS-EE-18V	18 ± 5%	23	20	17.3	13.5
PXS-EE-20V	20 ± 5%	22	19.0	16.5	13
PXS-EE-24V	24 ± 5%	20.0	17.5	15.0	12
PXS-EE-28V	28 ± 5%	18.0	16.0	13.5	10.5
PXS-EE-36V	36 ± 5%	15	13.0	11.3	9.0
PXS-EE-48V	48 ± 5%	10	8.8	7.5	5.5
PXS-EE-100	100 ± 5%	5.0	4.4	3.8	3.0
PXS-EE-120	120 ± 5%	4.0	3.5	3.0	2.4
PXS-EE-150	150 ± 5%	3.0	2.6	2.3	1.8

PM, PX FULL RACK DIMENSIONS

PM-PX FULL RACK POWER SUPPLIES			
	VIEW A		VIEW B
MODEL	PM-F	PM-G	PM-H
DIM	PX-F	PX-G	PX-H
A	3.47	5.22	6.97
*B	16.50	16.50	16.50
*C	2.00	3.12	4.68
*D	——	1.06	1.62
E	0.23	1.48	1.48
F	3.00	2.25	4.00
*G	2.94	2.94	2.94
*H	4.94	——	——
*J	2.50	4.06	4.06
K	1.75	3.50	3.50
*L	1.88	1.12	1.12
*M	0.88	——	——
*N	3.50	——	——



NOTE:

1. *Denotes approximate dimensions
2. Dotted area denotes recessed corner and terminals on model PM-F only.

Quantity Discounts up to 50%

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PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

PX FULL RACK POWER SUPPLIES

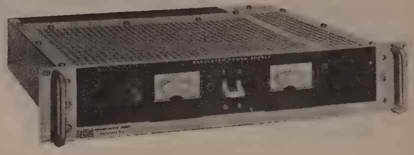
PRODUCT DIGEST

Power/Mate's "PX Series" full rack power supplies are offered in over 40 fixed voltage models and 4 wide range models are ideally suited for use with any digital IC system or with MOS/LSI logic. All models are designed to set into standard 19" racks.

Built-in over-voltage protection is standard on all full rack PX Series "H" package models. Self-restoring current limiting and over-voltage protection provide complete protection. Advanced electronic circuitry limits the output current on external loads, including short circuit protection for the load as well as the power supply. Remote sensing, remote programming and complete serviceability are additional features.

The Full Rack PX Series offer the same wide variety of options as the systems OEM power supplies. Typical available options are fungus proofing with MIL-V-173 varnish, metering, dual AC inputs, high performance option, OVP and dual primaries.

As with all Power/Mate power supplies, the Full Rack PX Series are backed by Power/Mate's Five Year Warranty.



REGULATED VOLTAGE:
Line— 0.015% + 1mV for line variations from 105-132 VAC.
Load— 0.015% + 1mV for load variations from 0 to full load.

RIPPLE: Less than .5mV RMS with either positive or negative terminal grounded.

SPECIFICATIONS

AC INPUT: 105-132 VAC, 47-420 HZ.

OUTPUT VOLTAGE AND CURRENT: See respective tables.

REGULATED VOLTAGE:
Line—0.1% +1MV for line variations from 105-132 VAC.
Load—0.1% +1MV for load variations from 0 to full load.

RIPPLE: .5mV RMS with either positive or negative terminal grounded.

METERS: Voltmeter and ammeter, rated accurate to 2% of full scale value, are provided on the front panel. See options.

POLARITY: The output may be "floated" up to 300V peak above ground. Either polarity may be grounded to chassis by means of terminals provided.

FINISH: Front panel is finished with dual tone gray and black baked enamel with brushed aluminum handles. Panel marking is gray. All other finishes are appropriate paint, plating, or chemical film, as required.

TEMPERATURE COEFFICIENT: Better than 0.01%°C.

LONG TERM STABILITY: Better than 0.025% for 8 hours.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

MECHANICAL DATA

REMOTE OR LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted or internally adjusted with coarse and fine control.

OVERLOAD AND SHORT CIRCUIT PROTECTION: Solid state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short circuits or overloads.
Thermal—Thermostat; automatic reset when overtemperature condition is eliminated.

AMBIENT OPERATING TEMPERATURE: Continuous duty from —20°C to +71°C ambient.

STORAGE TEMPERATURE: —55°C to +85°C.

INPUT AND OUTPUT CONNECTIONS: Heavy duty terminal block on rear of chassis.

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

MIL/SPEC PERFORMANCE

Independently tested to meet the environment of MIL-E-5272 and related specs. See MIL SPEC Section of this catalog.

PMC

POWER/MATE CORP.

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Phone: (201) 343-6294 TWX: (710) 990-5023

PX FULL RACK POWER SUPPLIES

AVAILABLE OPTIONS

METERS: Prices of "F" and "G" packages are for non-metered models. For metered models add suffix "M" to model number and $30 to price.

Package "H" models are available only with overvoltage protection, high performance option, and meters, all of which are included in the price.

OVERVOLTAGE PROTECTION: Built-in overvoltage protection is standard on all package "H" models and available as an option on all package "F" and "G" models. To order OVP for "F" and "G" packages, add suffix "OV" to the model number and add $50 to price. Price of package "N" models includes overvoltage protection.

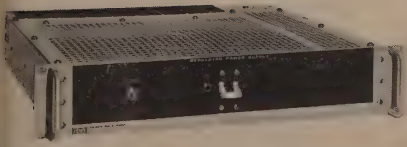
CHASSIS SLIDES: "F", "G" and "H" packages are available with mounted chassis slides. Add suffix "CS" to model number, and add $50 to the price of "F" and "G" models, $89 to the price of "H" models.

AC INPUT: All models are available with 205-265 VAC input voltage. Add suffix "LJ" to model number. (40°C rating not applicable) and add $10 to price.

FUNGUS PROOFING: All models available with fungus proofing with MIL-173 varnish for all fungi Nutrient components. To order add suffix "FP" to model number and add $15 to the price of "F", "G" and "H" package models.

"F" PACKAGE

3-1/2" x 19" x 16-1/2"



FIXED VOLTAGE MODELS

Model	Adj. Volt. Range	VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PX-F-3	3	±5%	52	44	35	26	$529
PX-F-3-P-6	3.6	±5%	52	44	35	26	529
PX-F-4	4	±5%	52	44	35	26	529
PX-F-4-P-5	4.5	±5%	52	44	35	26	529
PX-F-5	5	±5%	52	44	35	26	529
PX-F-6	6	±5%	51	42	34	25	529
PX-F-8	8	±5%	47	39	32	24	529
PX-F-10	10	±5%	41	35	28	22	529
PX-F-12	12	±5%	35	29	24	18	529
PX-F-15	15	±5%	27	23	19	15	529
PX-F-18	18	±5%	27	22	18	15	529
PX-F-20	20	±5%	25	21	18	14	529
PX-F-24	24	±5%	22	18	15	12	529
PX-F-28	28	±5%	21	17	14	11	529
PX-F-36	36	±5%	14	11.5	10.5	8	549
PX-F-48	48	±5%	11	9.5	8	6.5	549
PX-F-60	60	±5%	9	8	6.5	5.5	549

WIDE RANGE MODELS

Model	Adj. Volt. Range VDC	Max. Amps at Ambient of: 40°	50°C	60°C	71°C	Price
PX-F-0-7	0-7	27	23	19	15	$529
PX-F-0-20	0-20	11	9.5	9	7.5	529

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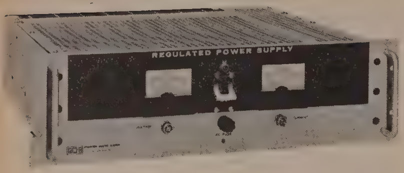
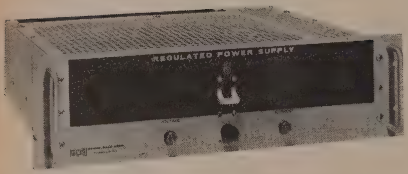
PX FULL RACK POWER SUPPLIES

"G" PACKAGE

5-1/4" x 19" x 16-1/2"



SHOWN WITH METERS



FIXED VOLTAGE MODELS

Model	Adj. Volt. Range	VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PX-G-3	3	±5%	100	83	66	46	$629
PX-G-3-P-6	3.6	±5%	91	83	66	46	629
PX-G-4	4	±5%	91	83	66	46	629
PX-G-4-P-5	4.5	±5%	91	83	66	46	629
PX-G-5	5	±5%	86	78	66	46	629
PX-G-6	6	±5%	86	78	66	46	629
PX-G-8	8	±5%	73	68	58	43	629
PX-G-10	10	±5%	69	58	48	37	629
PX-G-12	12	±5%	58	48	40	32	629
PX-G-15	15	±5%	48	44	36	28	629
PX-G-18	18	±5%	41	36	30	21	629
PX-G-20	20	±5%	37	33	28	21	629
PX-G-24	24	±5%	34	30	24	18	629
PX-G-28	28	±5%	30	26	21	17	629
PX-G-36	36	±5%	23	21	17	13	649
PX-G-48	48	±5%	18	15	12	9	649
PX-G-60	60	±5%	14	12	10	7	649

WIDE RANGE MODELS

Model	Adj. Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PX-G-0-7	0-7	38	32	26	21	$629
PX-G-0-20	0-20	20	16	13	11	629

"H" PACKAGE

7" x 18" x 18-1/2"

FIXED VOLTAGE MODELS

Model	Adj. Volt. Range	VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PX-H-3-OV-Y-M	3	±5%	180	165	145	100	$999
PX-H-3-P-6-OV-Y-M	3.6	±5%	150	130	100	80	999
PX-H-4-OV-Y-M	4	±5%	150	130	100	80	999
PX-H-4-P-5-OV-Y-M	4.5	±5%	140	115	95	70	999
PX-H-5-OV-Y-M	5	±5%	130	110	90	70	999
PX-H-6-OV-Y-M	6	±5%	127	100	90	67	999
PX-H-10-OV-Y-M	10	±5%	100	85	75	60	999
PX-H-12-OV-Y-M	12	±5%	97	80	70	55	999

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Phone: (201) 343-6294 TWX: (710) 990-5023

FPS FERRORESONANT POWER SUPPLIES

PRODUCT DIGEST

FPS Power Supplies use PMC's uniquely designed "MAG-POWER" ferroresonant power transformer to provide simple, efficient and economical operation. They deliver more power-per-penny than conventional units. FPS Series units supply DC outputs from 5 to 60 volts with currents to 75 amps. The inherent simplicity of design of these supplies greatly increases the reliability. All components are conservatively rated to further assure optimum performance.

Efficiency is high, in the area of 70-90%. Typical reliability is more than 150,000 hours MTBF. Quality features include built-in limiting for over-voltage and over-current, short circuit protection, and all-silicon semiconductors.

The FPS units, which operate in series or parallel, may be used with many of the standard POWER/MATE racks and metered accessories. This makes the FPS Series compatible with all other PMC supplies to produce a uniquely tailored power supply system to suit your demands.

REGULATION LINE: ±1%, for ±15 volt AC line variation, at 25-100% load. For loads below 25%, line regulation is ±1.5% output change.

REGULATION LOAD: See charts.

SPECIFICATIONS

INPUT: 115 VAC ±15 VAC, 60 Hz ±5% single phase. Input frequency variations produces an approximate equal percentage output voltage change.

OUTPUT VOLTAGE: See charts.

OUTPUT IMPEDANCE: 1 kHz-10 kHz: 0.05 ohms, 10 kHz-100 kHz: 0.05 ohms +0.5 microhenries.

ACCURACY: ±2%, measured at 115 VAC, full load, 30°C. Initial cold output is 1% higher.

REGULATION LINE: ±1%, for ±15 volt AC line variation, at 25-100% load. For loads below 25%, line regulation is ±1.5% output change.

REGULATION LOAD: See charts.

STABILITY (8 hr.): 1% or 0.1V, whichever is greater.

TEMPERATURE COEFFICIENT: 0.05%/C°.

AMBIENT OPERATING TEMPERATURE: −20°C to +55°C.

STORAGE TEMPERATURE: −40°C to +85°C.

COOLING: Convection.

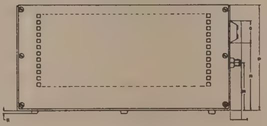
TRANSIENT RESPONSE: (50-100% current) 50 milliseconds.

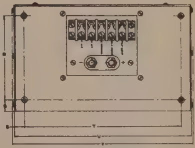
OVERLOAD PROTECTION: Current limiting transformer restricts short circuit current to safe value.

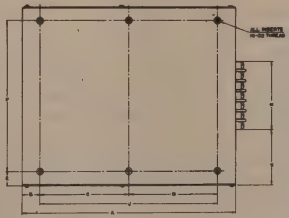
ISOLATION VOLTAGE: 600 volts to chassis.

SERIES/PARALLEL OPERATION: Identical models, can be paralleled for approximately double current (allow for 10% imbalance). Series operation to rated isolation.

MECHANICAL DATA







		FPS SERIES		
MODEL	FB	FC	FCF	FD
A	8	10-5/8	14-5/8	12
B	3/8	5-1/16	5-1/16	1
C			4-13/16	5
D			4	5
E	3/8	17/32	17/32	13/16
F	2-9/16	3-3/4	3-3/4	8-3/8
G				3-3/32
H				3-13/16
J	7-1/4	4-13/16		
K	1/8	1/8	1/8	1/8
L	13/32	5/8	5/8	5/8
M				2-11/16
N	2-1/8	2-3/8	2-3/8	3-7/8
O	7/8	1-1/4	1-1/4	1-1/4
P	4	5-13/32	5-13/32	6
Q	13/16	5/8	5/8	5/8
R	2-9/16	4-3/8	4-3/8	4-1/8
S	3/8	17/32	17/32	5/8
T	2-9/16	3-3/4	3-3/4	8-3/4
U	3-5/16	4-27/32	4-27/32	10
V	3-1/2			

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

MIL/SPEC PERFORMANCE

Independently tested to meet the environment of MIL-E-5272 and related specs. See MIL SPEC Section of this catalog.

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FPS FERRORESONANT POWER SUPPLIES

SERIES 60

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-7	5	7	.8	1.2	.4	11	FB	$ 83
FPS-5-7	6	7	.8	1.2	.4	11	FB	83
FPS-12-5	12	5	.7	1.2	.4	11	FB	83
FPS-15-4	15	4	.7	1.2	.3	11	FB	83
FPS-18-3.3	18	3.3	.7	1.2	.3	11	FB	83
FPS-24-2.5	24	2.5	.7	1.2	.3	11	FB	83
FPS-28-2	28	2.0	.7	1.2	.3	11	FB	83
FPS-36-1.6	36	1.6	.8	1.3	.3	11	FB	83
FPS-48-1.2	48	1.2	1.0	1.7	.3	11	FB	83
FPS-60-1	60	1.0	1.4	2.4	.3	11	FB	83

$83.00

SERIES 90

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-12	5	12	.5	.8	.4	13	FC	$105
FPS-5-12F	5*	12	.7	1.2	.04	16	FCF	145
FPS-6-12	6	12	.5	.8	.4	13	FC	105
FPS-6-12F	6*	12	.7	1.2	.04	16	FCF	145
FPS-12-7.5	12	7.5	.6	1.0	.4	13	FC	105
FPS-12-7.5F	12*	7.5	.9	1.4	.03	16	FCF	145
FPS-15-6	15	6	.6	1.0	.3	13	FC	105
FPS-15-6F	15*	6	.9	1.4	.02	16	FCF	145
FPS-18-5	18	5	.6	1.0	.3	13	FC	105
FPS-18-5F	18*	5	.9	1.5	.02	16	FCF	145
FPS-24-3.7	24	3.7	.7	1.2	.3	13	FC	105
FPS-24-3.7F	24*	3.7	1.2	2.0	.01	16	FCF	145
FPS-28-3.2	28	3.2	.7	1.2	.3	13	FC	105
FPS-28-3.2F	28*	3.2	1.3	2.1	.01	16	FCF	145
FPS-36-2.5	36	2.5	.8	1.3	.3	13	FC	105
FPS-36-2.5F	36*	2.5	1.5	2.4	.01	16	FCF	145
FPS-48-1.9	48	1.9	1.0	1.8	.3	13	FC	105
FPS-48-1.9F	48*	1.9	1.7	2.9	.005	16	FCF	145
FPS-60-1.5	60	1.5	1.2	2.4	.3	13	FC	105
FPS-60-1.5F	60*	1.5	2.0	3.4	.005	16	FCF	145

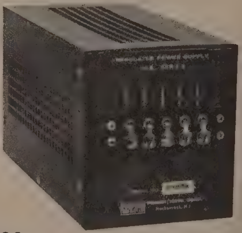
*Less 2% Filter Drop

$105.00

SERIES 120

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-15	5	15	.5	.8	.4	16	FC	$112
FPS-5-15F	5*	15	.7	1.2	.04	22	FCF	165
FPS-6-15	6	15	.5	.8	.4	16	FC	112
FPS-6-15F	6*	15	.7	1.2	.04	22	FCF	165
FPS-12-10	12	10	.6	1.0	.4	16	FC	112
FPS-12-10F	12*	10	.9	1.4	.02	22	FCF	165
FPS-15-8.0	15	8.0	.6	1.0	.3	16	FC	112
FPS-15-8.0F	15*	8.0	.9	1.4	.02	22	FCF	165
FPS-18-6.7	18	6.7	.6	1.0	.3	16	FC	112
FPS-18-6.7F	18*	6.7	.9	1.5	.01	22	FCF	165
FPS-24-5.0	24	5.0	.7	1.2	.3	16	FC	112
FPS-24-5.0F	24*	5.0	1.2	2.0	.005	22	FCF	165
FPS-28-4.3	28	4.3	.7	1.2	.3	16	FC	112
FPS-28-4.3F	28*	4.3	1.3	2.1	.005	22	FCF	165
FPS-36-3.3	36	3.3	.8	1.3	.3	16	FC	112
FPS-36-3.3F	36*	3.3	1.5	2.4	.005	22	FCF	165
FPS-48-2.5	48	2.5	1.0	1.8	.3	16	FC	112
FPS-48-2.5F	48*	2.5	1.7	2.9	.003	22	FCF	165
FPS-60-2.0	60	2.0	1.2	2.0	.3	16	FC	112
FPS-60-2.0F	60*	2.0	1.9	3.0	.002	22	FCF	165

*Less 2% Filter Drop



$112.00

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC POWER/MATE CORP.

514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone (201) 343-6294 TWX (710) 990-5023

FPS FERRORESONANT POWER SUPPLIES

SERIES 180

$135^{00}

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-25	5	25	.5	.8	.4	18	FC	$135
FPS-5-25F	5*	25	.7	1.2	.04	24	FCF	185
FPS-6-25	6	25	.5	.8	.4	18	FC	135
FPS-6-25F	6*	25	.7	1.2	.04	24	FCF	185
FPS-12-15	12	15	.6	1.0	.4	18	FC	135
FPS-12-15F	12*	15	.9	1.4	.02	24	FCF	185
FPS-15-12	15	12	.6	1.0	.3	18	FC	135
FPS-15-12F	15*	12	.9	1.4	.02	24	FCF	185
FPS-18-10	18	10	.6	1.0	.3	18	FC	135
FPS-18-10F	18*	10	.9	1.5	.01	24	FCF	185
FPS-24-8	24	8	.7	1.2	.3	18	FC	135
FPS-24-8F	24*	8	1.2	2.0	.005	24	FCF	185
FPS-28-7	28	7	.7	1.2	.4	18	FC	135
FPS-28-7F	28*	7	1.3	2.1	.005	24	FCF	185
FPS-36-5	36	5	.8	1.3	.4	18	FC	135
FPS-36-5F	36*	5	1.5	2.4	.005	24	FCF	185
FPS-48-4	48	4	1.0	1.8	.3	18	FC	135
FPS-48-4F	48*	4	1.7	2.9	.003	24	FCF	185
FPS-60-3	60	3	1.2	2.2	.2	18	FC	135
FPS-60-3F	60*	3	2.0	3.2	.002	24	FCF	185

*Less 2% Filter Drop

SERIES 300

$175^{00}

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-48	5	48	.7	1.0	.5	25	FCF	$175
FPS-6-45	6	45	.7	1.0	.5	25	FCF	175
FPS-12-25	12	25	.9	1.2	.5	25	FCF	175
FPS-15-20	15	20	.9	1.2	.4	25	FCF	175
FPS-18-17	18	17	.9	1.2	.4	25	FCF	175
FPS-24-12	24	12	1.0	1.2	.4	25	FCF	175
FPS-28-11	28	11	1.0	1.2	.4	25	FCF	175
FPS-36-8.5	36	8.5	1.2	1.5	.4	25	FCF	175
FPS-48-6.3	48	6.3	1.2	1.8	.4	25	FCF	175
FPS-60-5.0	60	5.0	1.5	2.4	.4	25	FCF	175

SERIES 500

$240^{00}

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-100	5	100	1.0	1.7	.5	45	FD	$240
FPS-6-100	6	100	1.0	1.7	.5	45	FD	240
FPS-12-45	12	45	1.0	1.7	.5	45	FD	240
FPS-15-35	15	35	1.0	1.7	.4	45	FD	240
FPS-18-28	18	28	1.0	1.7	.4	45	FD	240
FPS-24-22	24	22	1.2	1.9	.4	45	FD	240
FPS-28-18	28	18	1.2	1.9	.4	45	FD	240
FPS-36-15	36	15	1.2	1.9	.4	45	FD	240
FPS-48-11	48	11	1.5	2.4	.3	45	FD	240
FPS-60-8.5	60	8.5	1.5	2.4	.3	45	FD	240

SERIES 750

$325^{00}

MODEL	DC OUTPUT		LOAD REGULATION VOLTAGE INCREASE		RIPPLE V. RMS	NET WEIGHT POUNDS	CASE SIZE	PRICE
	VOLTS	AMPS	FULL ½ LOAD	FULL ¼ LOAD				
FPS-5-125	5	125	1.2	1.7	.7	65	FD	$325
FPS-6-120	6	120	1.2	1.7	.7	65	FD	325
FPS-12-62	12	62	1.2	1.7	.6	65	FD	325
FPS-15-50	15	50	1.2	1.7	.6	65	FD	325
FPS-18-45	18	45	1.4	2.0	.5	65	FD	325
FPS-24-30	24	30	1.4	2.0	.5	65	FD	325
FPS-28-26	28	26	1.4	2.0	.5	65	FD	325
FPS-36-24	36	24	1.4	2.0	.5	65	FD	325
FPS-48-15	48	15	1.7	2.5	.4	65	FD	325
FPS-60-12.5	60	12.5	2.0	3.0	.4	65	FD	325

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

HV/HW HIGH EFFICIENCY POWER SUPPLIES

PRODUCT DIGEST

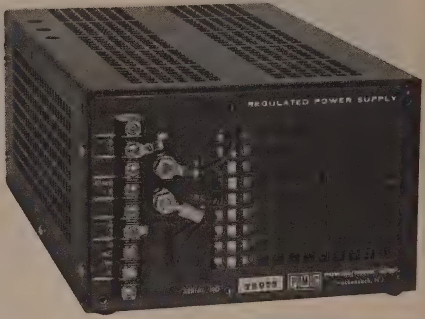
Power/Mate's new HV/HW High Efficiency Power Supply Series, utilizes Power/Mate's "SIMAG" circutry (patent pending), a breakthrough in power supply design and is the result of a development program to provide high efficiency power supplies for use with digital (TTL, ECL, TRL, DTL, and HTL) integrated circuits and MOS/LSI logic.

The new HV/HW series operates at efficiencies greater than 50% and are offered in a wide range of voltages up to 150 VDC with current ratings up to 200 amps.

Power/Mate's unique mechanical and electrical design allows the power supplies to be packaged in almost half the space required for equivalent conventional series power supplies.

Built-in overvoltage protection and self-restoring current limiting provide complete protection. Advanced electronic circuitry limits the output current on external loads, including short circuit providing protection for the load as well as the power supply. Remote sensing, remote programming and complete serviceability are additional features.

The HV/HW Series are backed by Power/Mate's Five Year Warranty.



LINE REGULATION: ±0.1% 10 mv for line variations from 105-132 VAC.
LOAD REGULATION: ±0.1% 10 mv from no load to full load.
RIPPLE: 10 mv RMS MAX.

HV SERIES SPECIFICATIONS

INPUT VOLTAGE: 105-132 VAC, 57-63 HZ.
OUTPUT VOLTAGE: Refer to applicable charts.
LINE REGULATION: ±0.1% + 10 mv for line variations from 105-132 VAC.
LOAD REGULATION: ±0.1% + 10 mv from no load to full load.
RIPPLE: 10 mv RMS MAX.
TEMPERATURE COEFFICIENT: .015% + 0:5 mv/°C.
EFFICIENCY: Greater than 50%.
OPERATING AMBIENT TEMPERATURE: 0-71°C.
STORAGE TEMPERATURE: —55°C to +85°C.
REMOTE OR LOCAL SENSING: Provision included for remote sensing of the DC output voltage directly at the load.
OVERLOAD PROTECTION: Both thermal and adjustable electronic current limiting overload protection and circuit breaker on all models.
OVERVOLTAGE PROTECTION: "Built-in" continuously adjustable overvoltage protection is standard on all models. Response time 5-10 microseconds.
NO OVERSHOOT ON TURN ON/OFF OR POWER FAILURE.
DC OUTPUT CONTROL: Voltage adjustment over entire voltage range.
OVERVOLTAGE PROTECTOR CONTROL: Overvoltage adjustment covers entire operating range.
OVERVOLTAGE PROTECTION: Built-in, continuously adjustable overvoltage protection crowbars output when trip level is exceeded. Included on all models.
OVERLOAD PROTECTION: (Thermal) Thermostat—Automatic reset of thermostat on all models when overtemperature condition is eliminated.
OVERLOAD PROTECTION: (Electrical) External overload protection; fixed, automatic electronic current limiting circuit limits the output current upon external overloads, including short circuit, thereby providing protection for load as well as power supply. On EE and G packages, ON-OFF circuit breaker must be manually reset.
MOUNTING: One surface with tapped mounting holes for E and EE packages; package G is rack mounted.
INPUT CONNECTIONS: Heavy duty terminal block on rear of chassis.
OUTPUT CONNECTIONS: Two heavy-duty studs on rear of chassis.

AVAILABLE OPTIONS

G case models are available with mounted chassis slides. Add suffix "—CS" to the model number and $60 to the price.

G case models are available with meters. For meters use suffix "M" and add $75 to the price.

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC POWER/MATE CORP.
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

HV/HW HIGH EFFICIENCY POWER SUPPLIES

HV "E" CASE

$319.00

Model	Fixed Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
HV-E-3-P-3-OV	2.8-3.8	47	39	28	13	$319
HV-E-4-OV	5±5%	44	39	28	13	319
HV-E-4-P-5-OV	4.5±5%	41	38	28	12	319
HV-E-5-OV	5±5%	37	34	28	13	319
HV-E-6-OV	6±5%	33	30	27	18	319

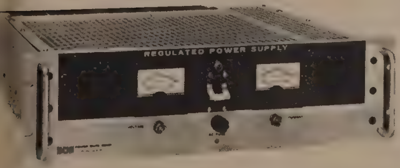
HV "EE" CASE

$400.00
Above 10 Volts

$479.00
Up to 10 Volts

Model	Fixed Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
HV-EE-3-OV	3±5%	98	90	74	61	$479
HV-EE-3-P-6-OV	3.6±5%	92	85	70	57	479
HV-EE-4-OV	4±5%	87	82	70	54	479
HV-EE-4-P-5-OV	4.5±5%	81	77	70	52	479
HV-EE-5-OV	5±5%	74	70	65	45	479
HV-EE-6-OV	6±5%	64	61	56	40	479
HV-EE-10-OV	10±5%	41	39	36	25	400
HV-EE-12-OV	12±5%	34	32	30	21	400
HV-EE-15-OV	15±5%	28	26	24	18	400

HV "G" CASE



$735.00

Model	Fixed Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
HV-G-3-OV	3±5%	170	160	150	135	$735
HV-G-3-P-6-OV	3.6±5%	160	155	140	125	735
HV-G-4-OV	4±5%	150	145	132	120	735
HV-G-4-P-5-OV	4.5±5%	135	131	119	108	735
HV-G-5-OV	5±5%	130	126	115	100	735
HV-G-6-OV	6±5%	110	107	98	90	735
HV-G-10-OV	10±5%	74	71	65	61	735
HV-G-12-OV	12±5%	65	63	57	54	735
HVG-15-OV	15±5%	50	48	44	40	735

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PMC **POWER/MATE CORP.**
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Phone: (201) 343-6294 TWX: (710) 990-5023

HV/HW HIGH EFFICIENCY POWER SUPPLIES

SPECIFICATIONS

The specifications for the HW Series are identical to those of the HV Series except that:

OUTPUT VOLTAGE: Refer to applicable charts.

LINE REGULATION: 1.0% for line variations from 105=132 VAC.

LOAD REGULATION: 1% for a 20% load to full load or full load to 20% load; or 1% full load to no load with a 20% preload throughout the voltage adjust range.

RIPPLE: 150 mv RMS or 1% of output voltage, whichever is greater.

OVERLOAD PROTECTION: (Electrical) External overload protection: fixed, automatic electronic current limiting circuit limits the output current upon external overloads, including short circuit, thereby providing protection for load as well as power supply. In addition, an automatic thermal reset switch is incorporated to sense overtemperature.

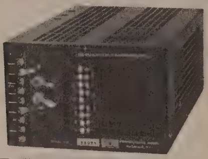
OVERVOLTAGE PROTECTION: (OPTIONAL) Built-in continuously adjustable overvoltage protection crowbars output when trip level is exceeded. Optional on all models. Add suffix OV to model number and $50 to price.

HW "D" CASE

$243⁰⁰

Model	Fixed Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
HW-D-10	10±5%	27	25	23	17	$243
HW-D-12	12±5%	26.5	20	13.7	8.8	243
HW-D-15	15±5%	22.5	20	13.7	8.8	243
HW-D-18	18±5%	19	18.3	13.7	8.8	243
HW-D-20	20±5%	17.5	16.7	13.7	8.8	243
HW-D-24	24±5%	14.7	14	13.2	8.8	243
HW-D-28	28±5%	12.5	12	11.1	7.7	243
HW-D-48	48±5%	7.6	7.3	6.8	6.2	243
HW-D-60	60±5%	6.0	5.8	5.5	5.0	243
HW-D-150	150±5%	2.4	2.3	2.1	2.0	243

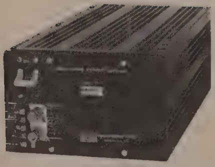
HW "E" CASE



$260⁰⁰

HW-E-3-P-3	2.8-3.8	55	52	49	45	$260
HW-E-4	4±5%	53	50	47	43	260
HW-E-4-P-5	4.5±5%	49	46	43	40	260
HW-E-5	5±5%	45	42	40	37	260
HW-E-6	6±5%	39	37	35	32	260

HW "EE" CASE



$339⁰⁰
Above 10 Volts

$389⁰⁰
Up to 10 Volts

HW-EE-3	3±5%	120	113	98	80	$389
HW-EE-3-P-6	3.6±5%	113	108	98	77	389
HW-EE-4	4±5%	107	102	96	74	389
HW-EE-4-P-5	4.5±5%	99	95	89	70	389
HW-EE-5	5±5%	91	87	82	62	389
HW-EE-6	6±5%	78	75	70	54	389
HW-EE-10	10±5%	51	48	45	35	339
HW-EE-12	12±5%	42	40	37	28	339
HW-EE-15	15±5%	35	33	31	24	339
HW-EE-18	18±5%	33	32	30	23	339
HW-EE-20	20±5%	31	30	28	22	339
HW-EE-24	24±5%	26	25	23	17	339
HW-EE-28	28±5%	22	21	20	15	339
HW-EE-48	48±5%	13	13	12	9	339
HW-EE-60	60±5%	10	10	9	8	339
HW-EE-150	150±5%	4	4	4	3	339

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HV/HW HIGH EFFICIENCY POWER SUPPLIES

HW "G" CASE

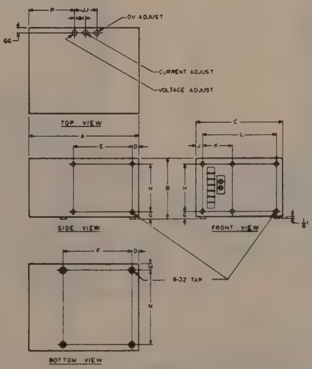
REGULATED POWER SUPPLY

$663⁰⁰

Model	Fixed Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
HW-G-3	3±5%	200	195	180	165	$663
HW-G-3-P-6	3.6±5%	190	185	170	155	663
HW-G-4	4±5%	180	175	162	148	663
HW-G-4-P-5	4.5±5%	160	155	142	132	663
HW-G-5	5±5%	150	146	135	123	663
HW-G-6	6±5%	128	123	115	105	663
HW-G-10	10±5%	88	85	79	72	663
HW-G-12	12±5%	75	72	67	61	663
HW-G-15	15±5%	60	57	53	49	663
HW-G-18	18±5%	58	56	52	47	663
HW-G-20	20±5%	53	51	47	43	663
HW-G-24	24±5%	48	46	42	39	663
HW-G-28	28±5%	39	37	34	32	663
HW-G-48	48±5%	24	23	21	19	663
HW-C-60	60±5%	19	18	17	15	663
HW-G-150	150±5%	7.5	7	6.5	6	663

MECHANICAL DIMENSIONS FOR HV/HW

LETTER	MODEL HE"D"	HE"E"	HE"EE"
A	9⅜	11¾	16½
B	4²⁹⁄₃₂	4²⁹⁄₃₂	4²⁹⁄₃₂
C	7½	7½	7½
D	²³⁄₆₄	²³⁄₆₄	²³⁄₆₄
E	6⁴¹⁄₆₄	6⁴¹⁄₆₄	—
F	6⁵⁷⁄₆₄	6⁵⁷⁄₆₄	12⅜
G	²⁷⁄₆₄	²⁷⁄₆₄	—
H	4¹⁄₃₂	4¹⁄₃₂	—
J	⅜	⅜	—
K	2¾	2¾	—
L	6¾	6¾	—
M	³¹⁄₆₄	³¹⁄₆₄	³¹⁄₆₄
N	6⁹⁄₁₆	6⁹⁄₁₆	.6⁹⁄₁₆
P	2⁹⁄₁₆	6³¹⁄₃₂	5¹⁵⁄₁₆
GG	½	½	½
HH	1⁹⁄₃₂	1⁹⁄₃₂	1⁹⁄₃₂
JJ	2¹¹⁄₁₆	2¹¹⁄₁₆	2¹¹⁄₁₆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8-32 TAP
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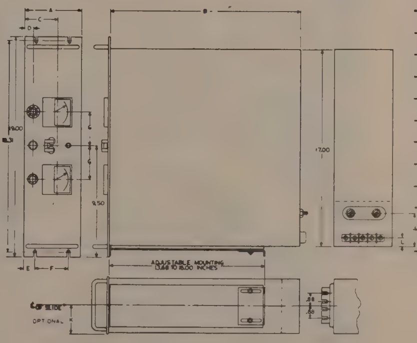
"G" CASE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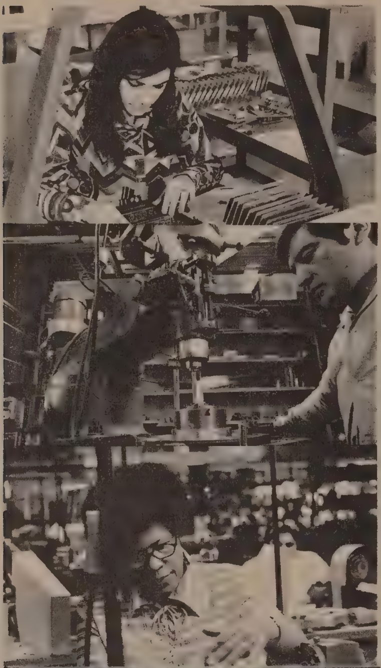
17.00
9.50
ADJUSTABLE MOUNTING 13.48 TO 18.00 INCHES
SLIDE
OPTIONAL
K
L

DIM.	HE K
A	5.22
*B	16.50
*C	3.12
*D	1.06
E	1.48
F	2.25
*G	2.94
*H	—
*J	2.38
K	1.75
*L	0.94

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

AT POWER/MATE...
QUALITY IS A SIMPLE MATTER



Simply Stated . . . "Every Power/Mate power supply must surpass its published performance specifications and conform to Power/Mate's rigid workmanship standards . . . OR . . . it doesn't leave our plant".

At Power/Mate, there is no compromise on Quality ! ! !

This high level of performance was **not simple** to achieve. It took much effort on everyone's part. Many of our employees and managers spent countless hours "burning the midnight oil". It took a total commitment to quality by everyone . . . from production to president. It means that our entire plant has to work together. It means a lot of training. It means skilled hands . . . specialized equipment . . . automated testing and much more. But it's worth it. "Because at Power/Mate we know how important it is to produce a quality power supply product".

Today we are proud of our achievements . . . We have combined a team of skilled men with machines, together with understanding, all producing power supplies you can depend on.

THERE IS NO
COMPROMISE
ON QUALITY!

POWER/MATE MEANS PEOPLE

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

UNI UNIVERSAL POWER SUPPLIES

PRODUCT DIGEST

The UNI Series VARI-rated power supply modules may be operated at any range of DC output voltages and currents, so the nine units replace literally thousands of more expensive, narrow-range power supplies. Collectively, the outputs of the UNI Series cover currents from 0 to 34 amperes and voltages from 0 to 34 volts. All units are UL approved.

These power supplies are compact, rugged, mount on any of three sides, and meet Mil Spec environment requirements. They are short-circuit proof, designed for efficient operation up to 71°C without external cooling, carry a 5-year Warranty, and are significantly less expensive than narrow-range units.

THE UNIQUE UNI CONCEPT

The key to the versatility of PMC's UNI Series is an exceptional design concept pioneered by POWER/MATE CORP. It allows any UNI power supply to be set for a range of DC outputs. This adjustable feature simplifies the customer's inventory situation, and it makes possible POWER/MATE's Same-Day-Shipment policy for UNI power supplies.

POWER SUPPLY MODEL UNI 30 B
POWER/MATE CORP
DO NOT OPERATE BEYOND INTERNAL VOLTAGE RANGE SETTING

SPECIFICATIONS

INPUT: 105-125V, 47-420 CPS.

OUTPUT VOLTAGE: 0-30 volts for all units except Uni-76 (0-34V); Uni-88 (0-34V); and UniTwin 164 (0-25V dual output).

OUTPUT VOLTAGE RANGE: Set in overlapping ranges by means of internal quick disconnect taps.

OUTPUT CURRENT: See chart on following page.

REGULATION: Uni-76 and Uni-88 better than ±0.005% +1MV for line and load. All other units better than ±0.01% +1MV for line and load.

RIPPLE: Less than 250 microvolts.

RESPONSE TIME: Less than 20 microseconds.

TEMPERATURE COEFFICIENT: Better than 0.01%/°C.

LONG TERM STABILITY: Better than 0.025% for 8 hours.

OVERLOAD & SHORT CIRCUIT PROTECTION: Solid state short circuit and overload protected. Instantaneous recovery, and automatic reset. Unit cannot be damaged by prolonged short circuits or overloads.

POLARITY: May be either positive, negative or floating up to 300 volts.

AMBIENT OPERATING TEMPERATURE: Continuous duty from −20°C to +71°C ambient.

STORAGE TEMPERATURE: −55°C to +85°C.

OUTPUT CURRENT vs. TEMPERATURE: Unit is rated for full current output at temperatures between −20°C and +45°C and is linearly derated from +45°C to 70% of the full output at +71°C.

REMOTE-LOCAL SENSING: Provision is included to permit remote sensing of the output voltage directly at the load for improved over-all regulation. Unit may be connected for local sensing if desired.

REMOTE-LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted, or internally adjusted with coarse and fine controls. Both are accessible through holes in the terminal end of the supply.

MECHANICAL DATA

UNI power supplies may be mounted on any of three surfaces. They will function when mounted in any position.

3½-inch and 5¼-inch rack mounting assemblies are available, along with other accessories.

SAME-DAY-SHIPMENT

You can be sure that POWER/MATE CORP. will ship any of its UNI series power supplies to you the same day that your order arrives in our offices.

UL APPROVED

POWER/MATE's power supplies are listed as a recognized component in Underwriter Laboratory's recognized component index. (UL 478-1967).

5-YEAR WARRANTY

5 Year Warranty

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

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UNI UNIVERSAL POWER SUPPLIES

OUTPUT VOLTAGE vs. OUTPUT CURRENT FOR VARI-RATED UNI SERIES

Model	VOLTAGE																
	3	5	6	8	10	12	14	15	16	18	20	22	24	26	28	30	AMPERES
UNI-76	0.5 amps throughout range																
UNI-88	1.5 amps throughout range																
UNI-30C	4	4	4	4	4	3.75	3.6	3.5	3.4	3.25	3.0	2.9	2.75	2.5	2.5	2.1	
UNI-30D	6	6	6	5.6	5.2	5.0	4.7	4.5	4.3	4.2	4.1	3.7	3.5	3.4	3.3	3.1	
UNI-30E	12	12	11	10.5	9.5	9.3	8.5	8.0	7.7	7.5	7.0	6.5	6.0	5.7	5.5	5.2	
UNI-30F	15	15	15	14.2	12.8	12.0	11.5	10.0	10.0	9.9	9.4	8.9	8.7	8.5	8.0	7.6	
UNI-30G	24	22	21	20	18	17	16.5	16.0	15.5	15	14	13.5	13	12.5	12	11.5	
UNI-30H	34	32	31	29	25	23	22	21	20	19	17	16.5	16	15.5	15	14.3	

SAME DAY SHIPMENT

SERIAL NO 82907
COARSE
FINE
PMC POWER/MATE CORP. Hackensack, N.J.

CASE A

UNI-76 0-34 volts, 0.5 amp over entire voltage range. Regulation: Better than ±0.005% +1 Mv for line and load.

3⁵⁄₁₆"W x 3⅞"H x 5⅛"D
Weight: Net 3¾ lbs.,
Shipping 4¾ lbs.

$79.00

WARNING
DO NOT ADJUST COARSE WITHOUT CHECKING INTERNAL TRANSFORMER TAP RANGE
COARSE
FINE
PMC POWER/MATE CORP.

CASE B

UNI-88 0-34 volts, 1.5 amps over entire range. Regulation: Better than ±0.005% +1 Mv for line and load.

3⁵⁄₁₆"W x 3⅞"H x 6⅞"D
WEIGHT: Net 5¼ lbs.,
Shipping 6¾ lbs.

$99.00

SERIAL NO. 82907
COARSE
PMC POWER/MATE CORP. Hackensack, N.J.

CASE BB

UniTwin-164 DUAL OUTPUT 0-25 volts, 0.75 amps over entire voltage range. Regulation: Better than ±0.005% +1 Mv for line and load.

3⁵⁄₁₆"W x 4⁵⁄₁₆"H x 6⅞"D
WEIGHT: Net 5¾ lbs.,
Shipping 7½ lbs.

$169.00

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

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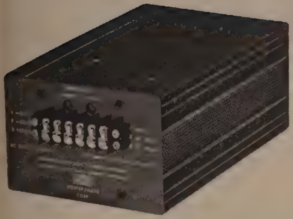
Phone: (201) 343-6294 TWX: (710) 990-5023

UNI UNIVERSAL POWER SUPPLIES

SAME DAY SHIPMENT


CASE C

CASE D

CASE E

UNI-30C 0-30 volts, up to 4 amps. Regulation: Better than ±0.01% +1 Mv for line and load.

5³⁄₃₂"W x 3⁵⁄₁₆"H x 7⅝"D
WEIGHT: Net 8¼ lbs.,
Shipping 10¼ lbs.

$134⁰⁰

UNI-30D 0-30 volts, up to 6 amps (see chart). Regulation: ±0.01% +1 Mv for line and load.

5³⁄₃₂"W x 3⁵⁄₁₆"H x 9⅜"D
WEIGHT: Net 11½ lbs.,
Shipping 14 lbs.

$151⁰⁰

UNI-30E 0-30 volts, up to 12 amps (see chart). Regulation: ±0.01% +1 Mv for line and load.

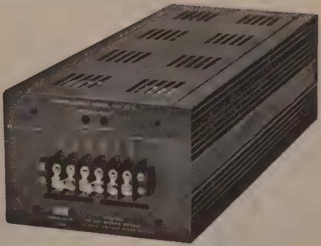
5³⁄₃₂"W x 5³⁄₃₂"H x 9⅜"D
WEIGHT: Net 15½ lbs.,
Shipping 19 lbs.

$174⁰⁰

SAME DAY SHIPMENT

CASE F

CASE G


CASE H

UNI-30F 0-30 volts, up to 15 amps (see chart). Regulation: ±0.01% +1 Mv for line and load.

7½"W x 5³⁄₃₂"H x 9⅜"D
WEIGHT: Net 20¼ lbs.,
Shipping 24¼ lbs.

$205⁰⁰

UNI-30G 0-30 volts, up to 24 amps (see chart). Regulation: ±0.01% +1 Mv for line and load.

7½"W x 5³⁄₃₂"H x 11⅞"D
WEIGHT: Net 25¾ lbs.,
Shipping 30¼ lbs.

$265⁰⁰

UNI-30H 0-30 volts, up to 34 amps (see chart). Regulation: ±0.01% +1 Mv for line and load.

7½"W x 5³⁄₃₂"H x 16½"D
WEIGHT: Net 34½ lbs.,
Shipping 39½ lbs.

$315⁰⁰

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

THE POWER/MATE MANAGEMENT COMMITMENT TO QUALITY IS TOTAL

POWER/MATE MEANS PEOPLE

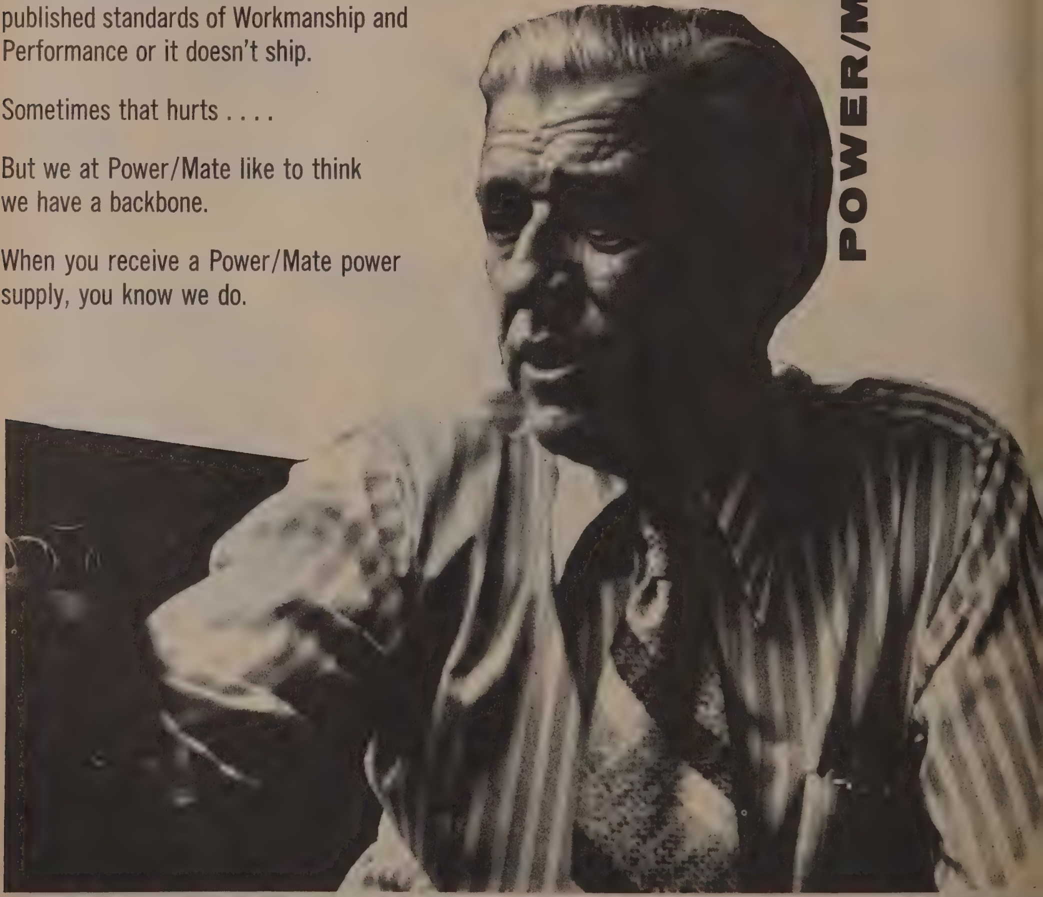
IT Also Takes Dedication, Guts, and Backbone . . . .

That's because there is no compromise or rationalization when it comes to to shipping out a quality product. Your power supply has to meet our published standards of Workmanship and Performance or it doesn't ship.

Sometimes that hurts . . . .

But we at Power/Mate like to think we have a backbone.

When you receive a Power/Mate power supply, you know we do.



PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

OEM POWER SUPPLIES

PRODUCT DIGEST

The POWER/MATE OEM Series of DC, regulated power supplies is available to manufacturers at liberal quantity discounts. This, combined with the fact that the OEM Series is based on the proven principles of the UNI Series, and is Underwriter Laboratory Approved, provides a quality, regulated voltage power supply that can save space, weight, and money.

One of the OEM Series space-saving features is a built-in over-voltage protection option that doesn't add a fraction to the basic module dimensions. Over-voltage protection is inside the module case, so there is no need for design changes in your product.

Complete freedom of mounting is another design advantage, by virtue of the fact that these power supplies are convection cooled. No heat sinking or forced air is required; however, substantial increases in ratings are possible with small amounts of forced air cooling.

The OEM power supplies can tolerate a wide input voltage and frequency range; therefore, they are suitable for field gear and worst-case conditions, reducing the need for special provisions.

Consider, too, that OEM units can be connected in series, parallel, or series/parallel for various outputs, and that the wide variety of POWER/MATE racks and metered or non-metered control panels and other accessories are compatible with the OEM Series. You can assemble virtually any supply system on the spot to meet your precise requirements.

SPECIFICATIONS

VOLTAGE INPUT: 105-125 VAC, 47-420 cps.

CURRENT OUTPUT: Up to 34 amps.

VOLTAGE OUTPUT: 3 to 48 volts.

REGULATION: ±0.01% line and load +1 mv.

RIPPLE: Less than 250 microvolts.

RESPONSE TIME: Less than 20 microseconds.

TEMPERATURE COEFFICIENT: Better than 0.01%/°C.

LONG TERM STABILITY: Better than 0.025% for 8 hours.

OVERLOAD & SHORT-CIRCUIT PROTECTION: Solid-state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short-circuits or overloads.

POLARITY: May be either positive, negative or floating up to 300 volts.

AMBIENT OPERATING TEMPERATURE: Continuous duty from −20°C to +71°C ambient.

STORAGE TEMPERATURE: −55°C to +85°C.

OUTPUT CURRENT vs TEMPERATURE: Rated for full current output at temperatures between −20°C and +45°C. Linearly derated from +45°C.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

REMOTE OR LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted, or internally adjusted with coarse and fine controls. Fine control is accessible through hole in terminal end of supply.

MECHANICAL DATA

OEM power supplies may be mounted on any of their three surfaces.

They will function when mounted in any position.

3½ and 5¼-inch rack mounting assemblies are available, along with other accessories.

5 Year Warranty

UL APPROVED

POWER/MATE's power supplies are listed as a recognized component in Underwriter Laboratory's recognized component index. (UL 478-1967).

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

MIL/SPEC PERFORMANCE

Independently tested to meet the environment of MIL-E-5272 and related specs. See MIL SPEC Section of this catalog.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC POWER/MATE CORP.

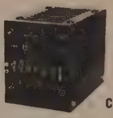
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

OEM POWER SUPPLIES

OEM SERIES A

3 5/16"W x 3⅞"H x 5⅛"D
Net Weight: 3¾ lbs.
Shipping Weight: 4¾ lbs.
Price:

$79.00*



Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-A	3.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-3.6-A	3.6 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-4-A	4.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-4.5-A	4.5 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-5-A	5.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-6-A	6.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-8-A	8.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-10-A	10.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-12-A	12.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-15-A	15.0 ± .5 volts	1.25 amps	1.17	1.03	.88
OEM-18-A	18.0 ± .5 volts	1.00 amps	.94	.82	.70
OEM-20-A	20.0 ± .5 volts	.90 amps	.84	.74	.63
OEM-24-A	24.0 ± .5 volts	.80 amps	.75	.66	.56
OEM-28-A	28.0 ± .5 volts	.70 amps	.66	.58	.49
OEM-36-A	36.0 ± .5 volts	.60 amps	.56	.49	.42
OEM-48-A	48.0 ± .5 volts	.30 amps	.28	.25	.21

OEM SERIES B

3 5/16"W x 3⅞"H x 6⅞"D
Net Weight: 5¼ lbs.
Shipping Weight: 6¾ lbs.
Price:

$102.00*

Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-B	3.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-3.6-B	3.6 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-4-B	4.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-4.5-B	4.5 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-5-B	5.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-6-B	6.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-8-B	8.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-10-B	10.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-12-B	12.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-15-B	15.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-18-B	18.0 ± .5 volts	2.25 amps	2.1	1.8	1.6
OEM-20-B	20.0 ± .5 volts	2.00 amps	1.9	1.6	1.4
OEM-24-B	24.0 ± .5 volts	1.90 amps	1.8	1.5	1.3
OEM-28-B	28.0 ± .5 volts	1.80 amps	1.7	1.4	1.2
OEM-36-B	36.0 ± .5 volts	1.20 amps	1.1	1.0	0.8
OEM-48-B	48.0 ± .5 volts	0.60 amps	.56	0.5	.42

OEM SERIES C

5 5/32"W x 3 5/16"H x 7⅝"D
Net Weight: 8¼ lbs.
Shipping Weight: 10¼ lbs.
Price:

$137.00*

Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-C	3.0 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-3.6-C	3.6 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-4-C	4.0 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-4.5-C	4.5 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-5-C	5.0 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-6-C	6.0 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-8-C	8.0 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-10-C	10.0 ± .5 volts	4.00 amps	3.7	3.3	2.8
OEM-12-C	12.0 ± .5 volts	3.75 amps	3.5	3.1	2.6
OEM-15-C	15.0 ± .5 volts	3.50 amps	3.3	2.9	2.4
OEM-18-C	18.0 ± .5 volts	3.25 amps	3.0	2.6	2.2
OEM-20-C	20.0 ± .5 volts	3.00 amps	2.8	2.4	2.1
OEM-24-C	24.0 ± .5 volts	2.75 amps	2.6	2.2	1.9
OEM-28-C	28.0 ± .5 volts	2.50 amps	2.3	2.0	1.7
OEM-36-C	36.0 ± .5 volts	2.00 amps	1.9	1.6	1.4
OEM-48-C	48.0 ± .5 volts	1.25 amps	1.17	1.03	.88

OEM SERIES D

5 5/32"W x 3 5/16"H x 9⅜"D
Net Weight: 11½ lbs.
Shipping Weight: 14 lbs.
Price:

$154.00*

Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-D	3.0 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-3.6-D	3.6 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-4-D	4.0 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-4.5-D	4.5 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-5-D	5.0 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-6-D	6.0 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-8-D	8.0 ± .5 volts	5.60 amps	5.3	4.6	3.9
OEM-10-D	10.0 ± .5 volts	5.20 amps	4.9	4.3	3.6
OEM-12-D	12.0 ± .5 volts	5.00 amps	4.7	4.1	3.5
OEM-15-D	15.0 ± .5 volts	4.50 amps	4.2	3.7	3.1
OEM-18-D	18.0 ± .5 volts	4.20 amps	3.9	3.4	2.9
OEM-20-D	20.0 ± .5 volts	4.10 amps	3.8	3.3	2.8
OEM-24-D	24.0 ± .5 volts	3.50 amps	3.3	2.9	2.4
OEM-28-D	28.0 ± .5 volts	3.30 amps	3.1	2.7	2.3
OEM-36-D	36.0 ± .5 volts	3.00 amps	2.8	2.4	2.1
OEM-48-D	48.0 ± .5 volts	2.00 amps	1.9	1.6	1.4

Quantity Discounts up to 50%

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

POWER/MATE CORP.

514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

OEM POWER SUPPLIES

OEM SERIES E

5$\frac{3}{32}$"W x 5$\frac{3}{32}$"H x 9⅜"D
Net Weight: 15½ lbs.
Shipping Weight: 19 lbs.
Price:
$177.00*

Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-E	3.0 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-3.6-E	3.6 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-4-E	4.0 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-4.5-E	4.5 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-5-E	5.0 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-6-E	6.0 ± .5 volts	11.00 amps	10.3	9.1	7.7
OEM-8-E	8.0 ± .5 volts	10.50 amps	9.9	8.6	7.3
OEM-10-E	10.0 ± .5 volts	9.50 amps	8.9	7.8	6.6
OEM-12-E	12.0 ± .5 volts	9.30 amps	8.7	7.7	6.5
OEM-15-E	15.0 ± .5 volts	8.00 amps	7.5	6.6	5.6
OEM-18-E	18.0 ± .5 volts	7.50 amps	7.0	6.2	5.2
OEM-20-E	20.0 ± .5 volts	7.00 amps	6.6	5.8	4.9
OEM-24-E	24.0 ± .5 volts	6.00 amps	5.6	4.9	4.2
OEM-28-E	28.0 ± .5 volts	5.50 amps	5.2	4.5	3.8
OEM-36-E	36.0 ± .5 volts	5.00 amps	4.7	4.1	3.5
OEM-48-E	48.0 ± .5 volts	3.00 amps	2.8	2.5	2.1

OEM SERIES F

7½"W x 5$\frac{3}{32}$"H x 9⅜"D
Net Weight: 20¼ lbs.
Shipping Weight: 24¼ lbs.
Price:
$208.00*

Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-F	3.0 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-3.6-F	3.6 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-4-F	4.0 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-4.5-F	4.5 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-5-F	5.0 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-6-F	6.0 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-8-F	8.0 ± .5 volts	14.20 amps	13.4	11.7	9.9
OEM-10-F	10.0 ± .5 volts	12.80 amps	12.0	10.6	8.9
OEM-12-F	12.0 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-15-F	15.0 ± .5 volts	11.00 amps	10.3	9.1	7.7
OEM-18-F	18.0 ± .5 volts	9.90 amps	9.3	8.2	6.9
OEM-20-F	20.0 ± .5 volts	9.40 amps	8.8	7.7	6.5
OEM-24-F	24.0 ± .5 volts	8.70 amps	8.2	7.2	6.1
OEM-28-F	28.0 ± .5 volts	8.00 amps	7.4	6.6	5.6
OEM-36-F	36.0 ± .5 volts	7.40 amps	6.9	6.1	5.2
OEM-48-F	48.0 ± .5 volts	4.50 amps	4.2	3.7	3.15

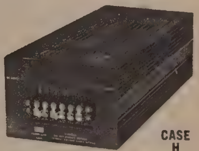
OEM SERIES G

7½"W x 5$\frac{3}{32}$"H x 11⅞"D
Net Weight: 25¾ lbs.
Shipping Weight: 30¼ lbs.
Price:
$268.00*

Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-G	3.0 ± .5 volts	24.00 amps	22.5	19.8	16.8
OEM-3.6-G	3.6 ± .5 volts	23.00 amps	21.6	19.0	16.1
OEM-4-G	4.0 ± .5 volts	23.00 amps	21.6	19.0	16.1
OEM-4.5-G	4.5 ± .5 volts	22.00 amps	20.7	18.2	15.4
OEM-5-G	5.0 ± .5 volts	22.00 amps	20.7	18.2	15.4
OEM-6-G	6.0 ± .5 volts	21.00 amps	19.8	17.4	14.7
OEM-8-G	8.0 ± .5 volts	20.00 amps	18.8	16.5	14.0
OEM-10-G	10.0 ± .5 volts	18.00 amps	16.9	14.8	12.6
OEM-12-G	12.0 ± .5 volts	17.00 amps	16.0	14.0	11.9
OEM-15-G	15.0 ± .5 volts	16.00 amps	15.1	13.2	11.2
OEM-18-G	18.0 ± .5 volts	15.00 amps	14.1	12.4	10.5
OEM-20-G	20.0 ± .5 volts	14.00 amps	13.2	11.5	9.8
OEM-24-G	24.0 ± .5 volts	13.00 amps	12.2	10.7	9.1
OEM-28-G	28.0 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-36-G	36.0 ± .5 volts	10.00 amps	9.4	8.7	7.0
OEM-48-G	48.0 ± .5 volts	7.00 amps	6.6	5.8	4.9

OEM SERIES H

7½"W x 5$\frac{3}{32}$"H x 16½"D
Net Weight: 34½ lbs.
Shipping Weight: 39½ lbs.
Price:
$318.00*



Model	Adjustable Voltage Range, ±0.5 volts	Ambient Temperature			
		45°C	50°C	60°C	71°C
OEM-3-H	3.0 ± .5 volts	34.00 amps	32.0	28.1	23.8
OEM-3.6-H	3.6 ± .5 volts	33.00 amps	31.0	27.3	23.1
OEM-4-H	4.0 ± .5 volts	33.00 amps	31.0	27.0	23.1
OEM-4.5-H	4.5 ± .5 volts	32.00 amps	30.1	26.5	22.4
OEM-5-H	5.0 ± .5 volts	32.00 amps	30.1	26.5	22.4
OEM-6-H	6.0 ± .5 volts	31.00 amps	29.2	25.6	21.7
OEM-8-H	8.0 ± .5 volts	29.00 amps	27.3	24.0	20.3
OEM-10-H	10.0 ± .5 volts	25.00 amps	23.5	20.7	17.5
OEM-12-H	12.0 ± .5 volts	23.00 amps	21.6	19.0	16.1
OEM-15-H	15.0 ± .5 volts	21.00 amps	19.8	17.4	14.7
OEM-18-H	18.0 ± .5 volts	19.00 amps	17.9	15.7	13.3
OEM-20-H	20.0 ± .5 volts	17.00 amps	16.0	14.0	11.9
OEM-24-H	24.0 ± .5 volts	16.00 amps	15.1	13.2	11.2
OEM-28-H	28.0 ± .5 volts	15.00 amps	14.1	12.4	10.8
OEM-36-H	36.0 ± .5 volts	12.00 amps	11.3	9.9	8.4
OEM-48-H	48.0 ± .5 volts	8.50 amps	8.0	7.0	5.9

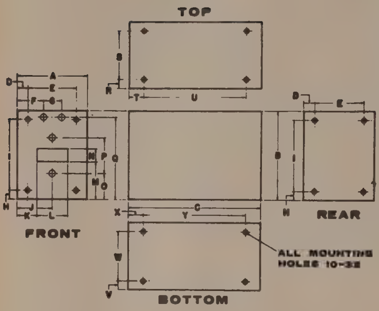
***Quantity Discounts up to 50%**

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

MECHANICAL DATA

CASE DIMENSIONS FOR UNI AND OEM SERIES



Model	CASE A	CASE B	CASE BB	CASE C	CASE D	CASE E	CASE F	CASE G	CASE H
A	3 5/16	3 5/16	3 5/16	5 3/32	5 3/32	5 3/32	7 1/2	7 1/2	7 1/2
B	3 7/8	3 7/8	4 3/16	3 5/16	3 5/16	5 3/32	5 3/32	5 3/32	5 3/32
C	5 1/8	6 7/8	6 7/8	7 5/8	9 3/8	9 3/8	9 3/8	11 7/8	16 1/2
D	3/8	3/8	3/8	1 17/64	1 17/64	1 17/64	1 17/64	1 17/64	1 17/64
E	2 9/16	2 9/16	2 9/16	2 9/16	2 9/16	2 9/16	4 31/32	4 31/32	4 31/32
F	1 1/8	1 1/8		2 11/64	2 11/64	2 11/64	3 3/8	3 3/8	3 3/8
G	1 1/16	1 1/16		3/4	3/4	3/4	3/4	3/4	3/4
H	13/16	13/16	13/16	3/8	3/8	43/64	43/64	43/64	43/64
I	2 9/16	2 9/16	2 9/16	2 9/16	2 9/16	3 3/4	3 3/4	3 3/4	3 3/4
J			1 21/32						
K	13/64	13/64	25/64	1 3/32	1 3/32	1 3/32	1 5/64	1 5/64	1 5/64
L	2 29/32	2 29/32	2 17/32	2 29/32	2 29/32	2 29/32	4 11/32	4 11/32	4 11/32
M	1 9/32	1 9/32	1 1/2	1 9/16	1 9/16	2 3/32	1 9/16	1 9/16	1 9/16
N	29/32	29/32	1 3/8	7/8	7/8	7/8	1 5/16	1 5/16	1 5/16
O			1 1/16						
P			2 1/16						
Q	2 5/8	2 5/8		2 11/16	2 11/16	4 5/16	4 5/16	4 5/16	4 5/16
R	3/8	3/8	3/8						
S	2 9/16	2 9/16	2 9/16						
T	15/16	1 1/16	1 1/16						
U	3 1/4	4 3/4	4 3/4						
V				1/4	1/4	1/4	1/4	1/4	1/4
W				4 19/32	4 19/32	4 19/32	7	7	7
X				1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
Y				5 1/4	7	7	7	9 1/2	14 1/8

HOW TO ORDER POWER/MATE OEM POWER SUPPLIES

To specify voltage and current, including those not listed, place the required voltage after OEM-, and the current after the case size A, B, etc.

For example: OEM-34C-2.25 or OEM-5-HOV for over-voltage protection.

AVAILABLE OPTIONS

1. Built-in over-voltage protection at $30 per unit. Use suffix "OV."
2. Fungus proofing, with MIL-V-173 varnish, for all fungus nutrient components, at $10 per unit. Use suffix "FP."
3. AC input. All units are available with 208 VAC ±10% (use suffix "L") or 230 VAC ±10% (use suffix "LL") at no extra cost.

OTHER VOLTAGE/CURRENT COMBINATIONS AVAILABLE

It is always worthwhile to contact POWER/MATE, even if the exact power supply you need is not shown in this catalog. The supply you want has probably been designed and is in the PMC "design bank" waiting to be specified. Send us your specifications on the sheet provided in the back of this catalog.

4. Dual AC input. All units are available with 208 VAC and 230 VAC (use suffix "Y," at $25 per unit).
5. Dual primary. All units are available with 230 VAC and 115 VAC (use suffix "X," at $25 per unit).

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

POWER/MATE CORP.

514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

FR FULL RANGE POWER SUPPLIES

PRODUCT DIGEST

The new Power/Mate "FR" Full Range Modular Power Supply Series combines the field proven reliability of our Uni-Power and OEM Series with the benefits of our same day off-the-shelf delivery to give the Systems Engineer a new dimension in design flexibility.

Now, with the new "FR" Series, the full wide voltage ranges of these modular power supplies may be accomplished without the necessity of internal power supply adjustments or changes. The power supplies may be set at any voltage within the specified range by merely a simple pot adjustment.

Built-in overvoltage protection is optional and does not add a fraction to the module dimensions. Thus, all components are internal — no need for design changes or extra space in your product.

All "FR" power supply modules feature remote sensing and programming, built-in current limiting with automatic recovery, thermal overload protection, excellent temperature stability and may be connected in series, parallel or series/parallel for virtually any voltage and/or current output. Plus, the new "FR" Series is backed by Power/Mate's Five Year Warranty.

Accessories available for use with the "FR" Series include Power/Mate's full line of rack adapters and metered panels.

REGULATED POWER SUPPLY
WIDE RANGE FR SERIES
FINE
COARSE
AC INPUT
AC INPUT

SPECIFICATIONS

VOLTAGE INPUT: 105-125 VAC, 47-420 cps.

CURRENT OUTPUT: Refer to applicable chart.

VOLTAGE OUTPUT: Refer to applicable chart.

REGULATION: ± 0.01% line and load +1 mv.

RIPPLE: Less than 250 microvolts.

RESPONSE TIME: Less than 20 microseconds.

TEMPERATURE COEFFICIENT: Better than 0.01%/°C.

LONG TERM STABILITY: Better than 0.25% for 8 hours.

OVERLOAD & SHORT-CIRCUIT PROTECTION: Solid state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short-circuits or overloads.

POLARITY: May be either positive, negative or floating up to 300 volts.

AMBIENT OPERATING TEMPERATURE: Continuous duty from −20C° to +71°C ambient.

STORAGE TEMPERATURE: −55°C to +85°C.

OUTPUT CURRENT vs. TEMPERATURE: Rated for full current output at temperatures between −20°C and +45°C. Linearly derated from +45°C as shown in charts.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

REMOTE OR LOCAL VOLTAGE ADJUST: Output voltage may be remotely adjusted, or internally adjusted with coarse and fine controls. Fine control is accessible through hole in terminal end of supply.

MECHANICAL DATA

The "FR" Series power supplies may be mounted on any of three surfaces. They will function when mounted in any position.

3½-inch and 5¼-inch rack mounting assemblies are available, along with other accessories.

SAME DAY SHIPMENT

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

POWER/MATE CORP.

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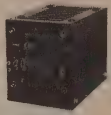
Phone (201) 343-6294 TWX: (710) 990-5023

FR FULL RANGE POWER SUPPLIES

FR SERIES A

3 5/16″W x 3 7/8″H x 5 1/8″D
Net Weight: 3 3/4 lbs.
Shipping Weight: 4 3/4 lbs.
Price:

$79⁰⁰



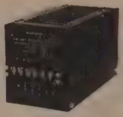
CASE A

Model	Volt. Adj. Range (VDC)	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRA-7	0-7	1.0	.87	.73	.60
FRA-12	0-12	.7	.61	.51	.42
FRA-15	0-15	.6	.52	.44	.36
FRA-18	0.18	.55	.48	.40	.33
FRA-24	0-24	.5	.43	.37	.30
FRA-30	0-30	.4	.25	.30	.24
FRA-3-6	3-6	1.25	1.08	.92	.75
FRA-5-8	5-8	1.20	1.05	.88	.72
FRA-6-10	6-10	1.0	.87	.73	.6
FRA-10-15	10-15	.9	.78	.66	.54
FRA-10-20	10-20	.7	.61	.51	.42
FRA-15-20	15-20	.9	.78	.66	.54
FRA-30	0-30	.4	.35	.30	.24

FR SERIES B

3 5/16″W x 3 7/8″H x 6 7/8″D
Net weight: 5 1/4 lbs.
Shipping Weight: 6 3/4 lbs.
Price:

$99⁰⁰



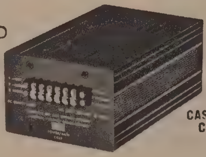
CASE B

Model	Volt. Adj. Range (VDC)	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRB-7	0-7	1.7	1.48	1.25	1.0
FRB-12	0-12	.9	.87	.73	.60
FRB-15	0-15	.9	.78	.66	.54
FRB-18	0-18	.8	.69	.59	.48
FRB-24	0.24	.7	.61	.51	.42
FRB-30	0-30	.6	.52	.44	.36
FRB-3-6	3-6	2.0	1.73	1.47	1.20
FRB-5-8	5-8	1.8	1.56	1.32	1.08
FRB-6-10	6-10	1.5	1.30	1.10	.90
FRB-10-15	10-15	1.3	1.12	.95	.78
FRB-10-20	10-20	1.0	.87	.73	.60
FRB-15-20	15-20	1.3	1.12	.95	.78
FRB-20-30	20-30	1.0	.87	.73	.60

FR SERIES C

5 3/32″W x 3 5/16″H x 7 5/8″D
Net Weight: 8 1/4 lbs.
Shipping Weight: 10 1/4 lbs.
Price:

$139⁰⁰



CASE C

Model	Volt. Adj. Range	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRC-7	0-7	2.7	2.4	2.0	1.6
FRC-12	0-12	2.0	1.7	1.5	1.20
FRC-15	0-15	1.6	1.4	1.2	1.0
FRC-18	0-18	1.4	1.0	1.2	.8
FRC-24	0-24	1.0	.9	.7	.6
FRC-30	0-30	.8	.7	.6	.5
FRC-3-6	3-6	3.5	3.00	2.55	2.10
FRC-5-8	5-8	3.2	2.8	2.3	1.90
FRC-6-10	6-10	2.5	2.2	1.8	1.50
FRC-10-15	10-15	2-2	1.90	1.60	1.30
FRC-10-20	10-20	1.6	1.4	1.2	1.0
FRC-15-20	15-20	2.0	1.7	1.5	1.20
FRC-15-24	15-24	1.8	1.6	1.3	1.1
FRC-20-30	20-30	1.8	7.6	1.3	1.1
FRC-24-30	24-30	2.4	2.1	1.8	1.4

FR SERIES D

5 3/32″W x 3 5/16″H x 9 3/8″D
Net Weight: 11 1/2 lbs.
Shipping Weight: 14 lbs.
Price:

$159⁰⁰

CASE D

Model	Volt. Adj. Range	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRD-7	0-7	4.0	3.5	3.0	2.40
FRD-12	0-12	3.0	2.60	2.20	1.80
FRD-15	0-15	2.4	2.1	1.8	1.40
FRD-18	0-18	2.0	1.7	1.5	1.20
FRD-24	0-24	1.5	1.30	1.10	.90
FRD-30	0-30	1.2	1.0	.9	.7
FRD-3-6	3-6	5.5	4.8	4.0	3.3
FRD-5-8	5-8	5.0	4.3	3.7	3.0
FRD-6-10	6-10	3.5	3.00	2.6	2.1
FRD-10-15	10-15	3.1	2.70	2.3	1.9
FRD-10-20	10-20	2.4	2.1	1.8	1.4
FRD-15-20	15-20	2.8	2.42	2.0	1.7
FRD-15-24	15-24	2.4	2.1	1.8	1.4
FRD-20-30	20-30	2.4	2.1	1.8	1.4
FRD-24-30	24-30	3.0	2.6	2.2	1.8

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PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX (710) 990-5023

FR FULL RANGE POWER SUPPLIES

FR SERIES E

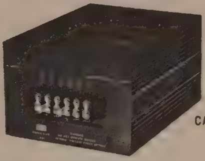
5 3/32″W x 5 3/32″H x 9 3/8″D
Net Weight: 15 1/2 lbs.
Shipping Weight: 19 lbs.
Price:
$179.00

CASE E

Model	Volt. Adj. Range	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRE-7	0-7	7.0	6.1	5.1	4.2
FRE-12	0-12	5.0	4.3	3.7	3.0
FRE-15	0-15	4.0	3.5	3.0	2.4
FRE-18	0-18	3.5	3.0	2.6	2.1
FRE-24	0-25	2.5	2.2	1.8	1.5
FRE-30	0-30	2.1	1.8	1.5	1.2
FRE-3-6	3-6	9.5	8.2	7.0	5.7
FRE-5-8	5-8	8.5	7.4	6.2	5.1
FRE-6-10	6-10	6.0	5.2	4.4	3.6
FRE-10-15	10-15	5.4	4.1	4.0	3.2
FRE-10-20	10-20	4.0	3.5	3.0	2.4
FRE-15-20	15-20	4.8	4.2	3.5	2.9
FRE-15-24	15-24	4.1	3.6	3.0	2.5
FRE-20-30	20-30	4.1	3.6	3.0	2.5
FRE-24-30	24-30	5.0	4.3	3.7	3.0

FR SERIES F

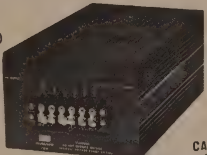
7 1/2″W x 5 3/32″H x 9 3/8″D
Net Weight: 20 1/4 lbs.
Shipping Weight: 24 1/4 lbs.
Price:
$209.00


CASE F

Model	Volt. Adj. Range	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRF-7	0-7	10.0	8.7	7.3	6.0
FRF-12	0-12	7.0	6.1	5.1	4.2
FRF-15	0-15	6.0	5.2	4.4	3.6
FRF-18	0-18	5.0	4.3	3.7	3.0
FRF-24	0-24	4.5	3.9	3.3	2.7
FRF-30	0-30	4.0	3.5	3.0	2.4
FRF-3-6	3-6	13.0	11.3	9.5	7.8
FRF-5-8	5-8	12.5	10.8	9.1	7.5
FRF-6-10	6-10	9.0	7.8	6.6	5.4
FRF-10-15	10-15	8.0	6.9	5.8	4.8
FRF-10-20	10-20	5.8	5.0	4.2	3.5
FRF-15-20	15-20	7.0	6.1	5.1	4.2
FRF-15-24	15-24	6.0	5.2	4.4	3.6
FRF-20-30	20-30	6.0	5.2	4.4	3.6
FRF-24-30	24-30	7.5	6.5	5.5	4.5

FR SERIES G

7 1/2″W x 5 3/32″H x 11 7/8″D
Net Weight: 25 3/4 lbs.
Shipping Weight: 30 1/4 lbs.
Price:
$269.00


CASE G

Model	Volt. Adj. Range	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRG-7	0-7	14.0	12.1	10.3	8.4
FRG-12	0-12	10.5	9.1	7.7	6.3
FRG-15	0-15	8.5	7.4	6.2	5.1
FRG-18	0-18	7.0	6.1	5.1	4.2
FRG-24	0-24	6.5	5.6	4.8	3.9
FRG-30	0-30	5.5	4.7	4.0	3.3
FRG-3-6	3-6	18.0	15.6	13.2	10.8
FRG-5-8	5-8	18.0	15.6	13.2	10.8
FRG-6-10	6-10	13.0	11.3	9.5	7.8
FRG-10-15	10-15	11.0	9.5	8.1	6.6
FRG-10-20	10-20	8.0	6.9	5.8	4.8
FRG-15-20	15-20	10.0	8.7	7.3	6.0
FRG-15-24	15-24	8.5	7.4	6.2	5.1
FRG-20-30	20-30	8.5	7.4	6.2	5.1
FRG-24-30	24-30	10.5	9.1	7.7	6.3

FR SERIES H

7 1/2″W x 5 3/32″H x 16 1/2″D
Net Weight: 34 1/2 lbs.
Shipping Weight. 39 1/2 lbs.
Price:
$319.00

CASE H

Model	Volt. Adj. Range	Max. Amps. at Ambient of:			
		40°C	50°C	60°C	71°C
FRH-7	0-7	17.0	14.7	12.5	10.2
FRH-12	0-12	14.0	12.1	10.3	8.4
FRH-15	0-15	11.0	9.5	8.1	6.6
FRH-18	0-18	9.0	7.8	6.6	5.4
FRH-24	0-24	8.2	7.1	6.0	4.9
FRH-30	0-30	7.5	6.5	5.5	4.5
FRH-3-6	3-6	25.0	21.7	18.3	15.0
FRH-5-8	5-8	22.5	19.5	16.5	13.5
FRH-6-10	6-10	16.0	13.8	11.7	9.6
FRH-10-15	10-15	14.0	12.1	10.3	8.4
FRH-10-20	10-20	10.0	8.7	7.3	6.0
FRH-15-20	15-20	12.5	10.8	9.1	7.5
FRH-15-24	15-24	11.0	9.5	8.1	6.6
FRH-20-30	20-30	11.0	9.5	8.1	6.6
FRH-24-30	24-30	13.5	11.7	9.9	8.1

Quantity Discounts up to 50%

Pioneers of the UNI concept in power supplies

PMC

POWER/MATE
INTERNATIONAL
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone (201) 343-6294 TWX: (710) 990-5023

RACKS AND ACCESSORIES

PRODUCT DIGEST

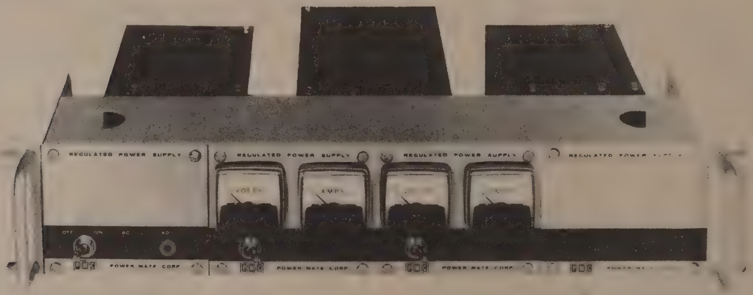
All PMC racks and accessories accommodate a variety of PMC modules in any configuration in a standard 19″ rack, 3½″ high or 5¼″ high, with 5 different styles. All of the racks and panels are finished in durable baked gray enamel, with predrilled and tapped holes, ready for easy assembly.

THE PMC "BUILDING BLOCK" APPROACH

Because most PMC power supply modules are compatible with PMC racks, panels and other accessories, an infinite variety of combinations is possible to produce the exact requirements of the application. Assembly of a CUSTOM power supply, instead of specifying a "special order," gains the substantial benefits of lower cost and the use of industry proven and accepted PMC power supplies.

This approach also gives the engineer a new dimension in design freedom. He chooses from readily available, off-the-shelf, standard modules (at standard prices), and from matching off-the-shelf mounting racks, metered and non-metered control panels, in addition to the complete assortment of other accessories.

PANELS



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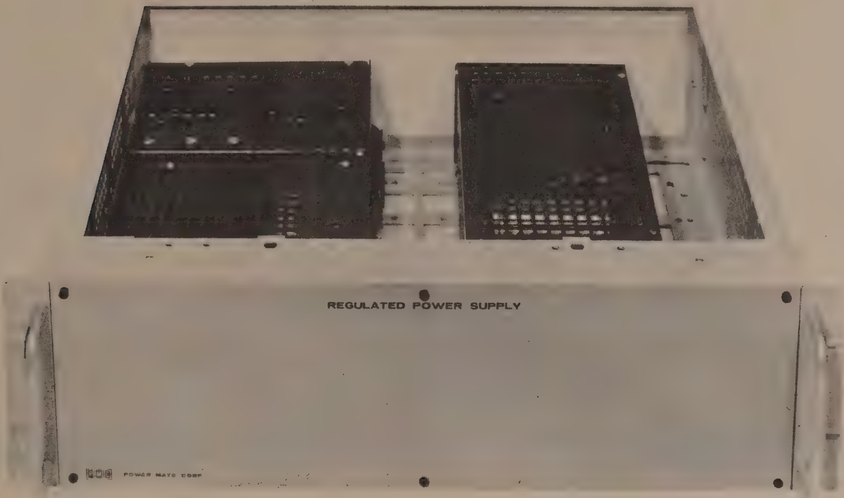
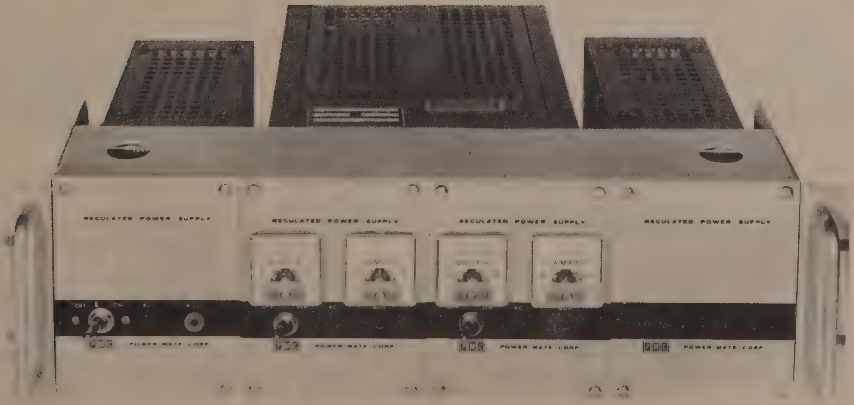
RACKS AND ACCESSORIES


REGULATED POWER SUPPLY
POWER MATE CORP


REGULATED POWER SUPPLY
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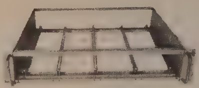
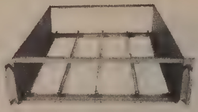
RACKS FOR USE WITH UNI, OEM, PT AND FR SERIES

MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
AR-35 W x H x D 19 x 3½ x 5¼	FOR USE WITH POWER SUPPLY CASE SIZE A, B, BB, & C	P-35-1 P-35-2 P-35-4 CP35 CPM35-(....)-(....)*

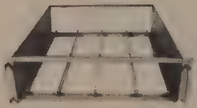


MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
AR-35-14 W x H x D 19 x 3½ x 14⅝	FOR USE WITH POWER SUPPLY CASE SIZE A, B, BB & C	P-35-1 P-35-2 P-35-4 CP35 CPM35-(....)-(....)*

MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
AR-525 W x H x D 19 x 5¼ x 5 5/16	FOR USE WITH POWER SUPPLY CASE SIZE A,** B,** BB,** C, D, E, F, G & H	P525-1 P525-2 P525-4 CP525 CPM525-(....)-(....)*



MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
AR-525-14 W x H x D 19 x 5¼ x 14⅝	FOR USE WITH POWER SUPPLY CASE SIZE A,** B,** BB,** C, D, E, F, G & H	P525-1 P525-2 P525-4 CP525 CPM525-(....)-(....)*



MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
AR-525-21 W x H x D 19 x 5¼ x 21⅝	FOR USE WITH POWER SUPPLY A,** B,** BB,** C, D, E, F, G & H	P525-1 P525-2 P525-4 CP525 CPM525-(....)-(....)*

*See description of CPM panels for complete ordering data.
**These models to be used with adapter A-525-1.

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Phone (201) 343-6294 TWX: (710) 990-5023

RACKS FOR USE WITH PM, PX, PC, HV, HW AND SUPER UNI SERIES

	MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
	AP-35 W x H x D 19 x 3½ x 5¼	FOR USE WITH POWER SUPPLY CASE SIZE A, B & C	P-35-1 P-35-2 P-35-4 CPM35-(....)-(....)*

	MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
	AP-35-14 W x H x D 19 x 3½ x 14⅝	FOR USE WITH POWER SUPPLY CASE SIZE A, B & C	P-35-1 P-35-2 P-35-4 CP35 CPM35-(....)-(....)*

	MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
	AP-525 W x H x D 19 x 5¼ x 5⁵⁄₁₆	FOR USE WITH POWER SUPPLY CASE SIZE A, B, C, CC, D, E & EE	P525-1 P525-2 P525-4 CP525 CPM525-(....)-(....)*

	MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
	AP-525-14 W x H x D 19 x 5¼ x 14⅝	FOR USE WITH POWER SUPPLY CASE SIZE A, B, C, CC, D & E	P525-1 P525-2 P525-4 CP525 CPM525-(....)-(....)*

	MODEL	RACKS FOR USE WITH	PANELS FOR USE WITH
	AP-525-21 W x H x D 19 x 5¼ x 21⅝	FOR USE WITH POWER SUPPLY CASE SIZE A, B, C, CC, D, E & EE	P525-1 P525-2 P525-4 CP525 CPM525-(....)-(....)*

*See description of CPM panels for complete ordering data.
**These models to be used with adapter A-525-1.

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See YELLOW SECTION for Local Sales Offices and Key Personnel

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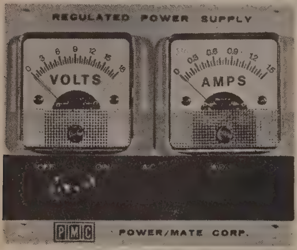
ACCESSORIES FOR USE WITH AR & AP RACKS

PANELS

FOR USE WITH AR-35 OR AP-35 RACK SERIES

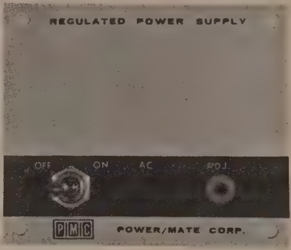
HOW TO ORDER PANELS: Select desired voltmeter range and ammeter range from listing below. Insert voltmeter range selected in first bracket, followed by ammeter range. For example, a CPM-525-36-1.5 indicates a metered quarter rack panel wiht a 0-36 voltmeter and a 0-1.5 ammeter.


REGULATED POWER SUPPLY
VOLTS
AMPS
OFF
ON
AC
ADJ.
PMC
POWER/MATE CORP.

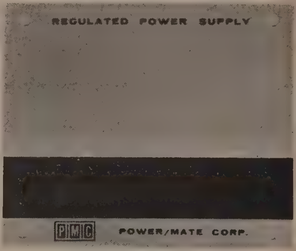
MODEL CPM-35-( )-( ) Quarter rack metered control panel with voltmeter and ammeter, on-off switch, and AC indicator. Screwdriver output voltage adjust from front panel. On panel rear is input cable, AC fuse and output solder terminals.

VOLTMETERS: 0-10, 0-18, 0-36, 0-50, 0-150 volts

AMMETERS: 0-0.5, 0-1.5, 0-6, 0-15, 0-36 amps


REGULATED POWER SUPPLY
OFF
ON
AC
ADJ.
PMC
POWER/MATE CORP.

MODEL CP-35 Quarter rack control panel with same features as above, but without meters.

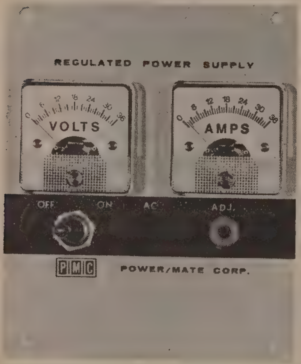

REGULATED POWER SUPPLY
PMC
POWER/MATE CORP.

BLANK PANELS for use in AR-525 series racks. For filling spaces in front panel after selection of above control panels, or for use in adding your own controls or instrumentation.

MODEL P-525-4 ¼ rack size blank panel
MODEL P-525-2 ½ rack size blank panel
MODEL P-525-1 Full size blank panel

PANELS

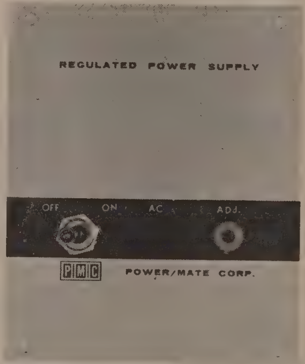
FOR USE WITH AR-525 OR AP-525 RACK SERIES


REGULATED POWER SUPPLY
VOLTS
AMPS
OFF
ON
AC
ADJ.
PMC
POWER/MATE CORP.

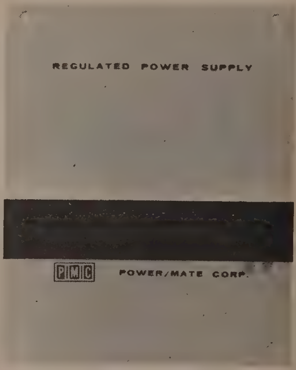
MODEL CPM-525-( )-( ) Quarter rack metered control panel with voltmeter and ammeter, on-off switch, and AC indicator. Screwdriver output voltage adjust from front panel. On panel rear is input cable, AC fuse, and output solder terminals.

VOLTMETERS: 0-10, 0-18, 0-36, 0-50, 0-150 volts full scale

AMMETERS: 0-0.5, 0-1.5, 0-6, 0-15, 0-36 amps full scale


REGULATED POWER SUPPLY
OFF
ON
AC
ADJ.
PMC
POWER/MATE CORP.

MODEL CP-525 Quarter rack control panel with same features as above but with no meters.


REGULATED POWER SUPPLY
PMC
POWER/MATE CORP.

BLANK PANELS for use in AR-35 series racks. For completing front panel after selection of desired control panels, or for use in adding your own controls or instrumentation.

MODEL P-35-4 ¼ rack size blank panel
MODEL P-35-2 ½ rack size blank panel
MODEL P-35-1 Full size blank panel

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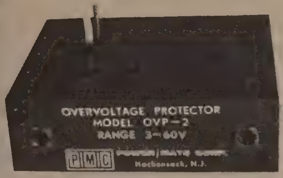
RACKS AND ACCESSORIES

ACCESSORIES

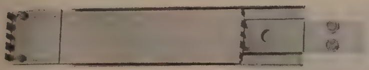
REAR PANELS for use with AP or AR-35 and AP or AR-425 series accessories racks. Six terminal barrier strips are mounted on each panel for ease of input/output conection. Complete with mounted hardware and all terminals marked for ease of wiring.

Models RP-35-1 and RP-525-1:



OVERVOLTAGE PROTECTOR for use on any POWER/MATE power supply up to 34 amps. Self contained crowbar type solid state unit. Independent of power supply or type of failure. Output adjustable to trip between 3 and 60 volts. Trips within 10 microseconds. Dimensions 2⅞ x 3⅜ x 1

Model OVP-2



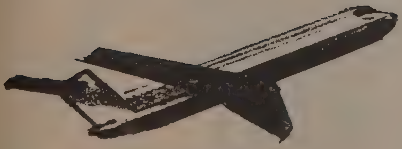
RACK SLIDE for use with all POWER/MATE CORP. racks. Feature quick disconnect and ball bearing action. Includes hardware for mounting.

Model CS-1

ADAPTER for mounting type A, B, C and D cases in AR525 rack. Permits mounting 3½ inch height modules in 5¼ inch mounting space on AR525 rack. Permits complete intermixing of both 3½ and 5¼ inch supplies in this rack. Complete with hardware.

Model A525-1

SAME DAY SHIPMENT



HOW TO ORDER ACCESSORIES:

Determine the quantity of each unit you will need and order them by the model numbers shown above. Notice that numbers ending in 35 represent the 3½ inch rack and those ending in 525 indicate the 5¼ inch rack.

PMC racks and accessories plus PMC's high quality power supplies give you the best possible combination of design freedom and proven reliability. If you have further questions, please contact either your local PMC Representative or POWER/MATE CORPORATION.

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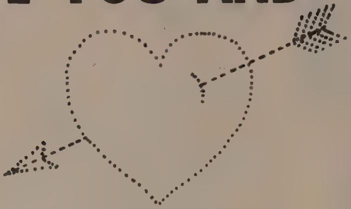
POWER/MATE DOESN'T LOVE YOU AND LEAVE YOU



Because SERVICE to our CUSTOMERS is one of our KEY policies.

That's why we have automated and computerized our entire paper work system . . . so our people can spend more time serving you and your needs.

And that's why our Customer Service group is under one responsible operating manager. His task encompasses order handling, processing applications, field service and technical publications; and most importantly over $1,000,000 worth of finished power supply inventory on the shelf! ! !

All these services are coordinated to serve you better and more efficiently than anyone else.

POWER/MATE MEANS PEOPLE

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POWER/MATE CORP.
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BP LABORATORY POWER SUPPLIES

PRODUCT DIGEST

The POWER/MATE Bench Pac (BP) line of laboratory power supplies consists of 23 different models. This versatile group of DC bench units, voltage and current regulated, can meet every laboratory and systems power supply requirement, offering a complete range of outputs from 0 to 60 volts with currents up to 15 amperes.

Special features of the UniPower Bench Pacs include: high accuracy, adjustable current limiting, concentric controls for course and fine voltage adjustment, constant voltage and/or constant current, front panel remote sensing of output voltage (Models "E" through "H"), AC indicator, on/off switch, five-way binding posts, easy-to-read dual meters, and the added feature of built-in short-circuit protection.

Low in cost and high in performance, these general-purpose bench supplies employ the same field-proven designs and state-of-the-art solid state silicon circuitry found in POWER/MATE's UNI Series and OEM Series power modules. The UNI concept provides a combination of mechanical and electrical maximum reliability features, and the Bench Pacs carry the full 5-Year POWER/MATE Warranty.

REGULATED POWER SUPPLY

REGULATION —
Load: The regulation for load changes is less than .01% +1 millivolt, whichever is greater from no load to full load.

Line: The regulation is less than 0.01% +1 millivolt, whichever is greater, for a line change from 125V to 105V at constant load.

RIPPLE: Less than 250 microvolts.

SPECIFICATIONS

INPUT: 105-125 Volts, 47-420 cps, single phase.

OUTPUT VOLTAGE AND CURRENT: See Respective Tables.

REGULATION —
Load: The regulation for load changes is less than .01% +1 millivolt, whichever is greater from no load to full load.

Line: The regulation is less than 0.01% +1 millivolt, whichever is greater, for a line change from 125V to 105V at constant load.

RIPPLE: Less than 250 microvolts.

TRANSIENT RESPONSE: For a ±10 Volt step change in line voltage, or for a no load to full load, or a full load to no load step change, the output voltage will return to within 10 millivolts of the regulated region in less than 20 microseconds.

METERS: Voltmeter and ammeter, rated accurate to 2% of full scale value, are provided on the front panel.

POLARITY: The output may be "floated" up to 300V peak above ground. Either polarity may be grounded to chassis by means of terminals provided.

CONSTANT CURRENT, CONSTANT VOLTAGE: Constant current and constant voltage levels may be preset within the maximum rated voltage and current levels specified in appropriate tables. The intersection of the constant voltage and constant current operation lines called the "Crossover Point" may be located anywhere within the output volt-ampere range of the unit. Regardless of the demands of the load, the output voltage and/or the output current will never exceed the limits (1% or better) preset by the output voltage and output current controls.

CONTROLS —
Voltage: Continuously variable coarse and vernier DC OUTPUT ADJUST potentiometers on concentric shafts provide variable DC Output.

Current: Continuously variable single turn potentiometer provides current limiting adjustment.

TEMPERATURE COEFFICIENT: Better than 0.01%/°C.

LONG TERM STABILITY: Better than 0.025% for 8 hours.

DUTY: Continuous at ambient temperatures from 0°C to 50°C. Operation above 50°C is allowed provided the output current is derated 20% for every 10°C rise above 50°C.

REMOTE SENSING: Sensing terminals, separate from the Output terminals, provide sensing and load regulation against the voltage at the load rather than the voltage at the power supply output terminals on Models "E" through "H". This eliminates the otherwise unavoidable load regulation due to the voltage drop in the wires connecting the supply to the adjacent load.

REMOTE PROGRAMMING: The output voltage may be controlled accurately from a remote point if desired by inserting a resistance across the REMOTE PROGRAM terminals. The sensitviity of this circuit is approximately 100 ohms per volt on Models "E" through "H".

PARALLELING: Two or more units may be operated in series to provide higher voltage output at rated current. Units of the same voltage and current ratings may be operated in parallel.

PROTECTION: Load and power supply protection for any overload condition is accomplished by an adjustable electronic current limiting circuit controlled by a front panel potentiometer.

AIRFLOW: All units are convection cooled and do not require internal blowers or depend on internal forced air cooling.

INSPECTION: MIL-Q-9858 Procedures.

MECHANICAL DATA

FINISH: Front panel is finished with dual tone grey and black baked enamel. Panel marking is grey. All other finishes are appropriate paint, plating, or chemical film as required.

MOUNTING: Units are designed for bench operation, however, rack adapters are available (see page 55).
Consult factory for special systems configurations.

ACCESSORIES: Bench Pacs can be rack mounted as required. Up to three Series "C," or two Series "D" power supplies will mount in a standard 19" rack, just 3½" high.

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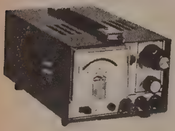
Phone: (201) 343-6294 TWX: (710) 990-5023

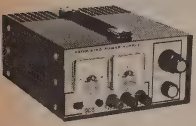
BP LABORATORY POWER SUPPLIES



"SERIES C" BENCH PACS

$89.00

Model	DC Output		Case Size	Price	Shipping Weight
	Volts	Amperes	Height Width Depth		
BP-10C	0-10	0-1.5	3⅜ x 5⅜ x 7¼	$89.00	6.5 lbs.
BP-20C	0-20	0-1.0	3⅜ x 5⅜ x 7¼	89.00	6.5 lbs.
BP-40C	0-40	0-0.5	3⅜ x 5⅜ x 7¼	89.00	6.5 lbs.



"SERIES D" BENCH PACS

$129.00

Model	DC Output		Case Size	Price	Shipping Weight
	Volts	Amperes	Height Width Depth		
BP-10D	0-10	0-4	3⅜ x 6⅞ x 7¼	129.00	8.0 lbs.
BP-20D	0-20	0-2.0	3⅜ x 6⅞ x 7¼	129.00	8.0 lbs.
BP-40D	0-40	0-1.0	3⅜ x 6⅞ x 7¼	129.00	8.0 lbs.
BP-60D	0-60	0-.750	3⅜ x 6⅞ x 7¼	129.00	8.0 lbs.

"SERIES E" BENCH PACS

$225.00

Model	DC Output		Case Size	Price	Shipping Weight
	Volts	Amperes	Height Width Depth		
BP-10E	0-10	0-6.5	5 3/32 x 7½ x 9⅜	225.00	20.0 lbs.
BP-20E	0-20	0-3.0	5 3/32 x 7½ x 9⅜	225.00	20.0 lbs.
BP-40E	0-40	0-2.2	5 3/32 x 7½ x 9⅜	225.00	20.0 lbs.
BP-60E	0-60	0-1.25	5 3/32 x 7½ x 9⅜	225.00	20.0 lbs.

BENCH PAC ACCESSORIES

POWER/MATE's Bench Pac may be rack mounted when desired. Up to 3 BP Series C Bench Pacs or 2 Series D, E, F, G or H Bench Pacs can be mounted in a standard 19" rack. Adaptors available are:

1. Model RK 89 for 1, 2, or 3 Series C Bench Pacs
   Price—$22.00 each.
2. Model RK 118 for 1, or 2 Series D Bench Pacs
   Price $22.00 each.
3. Model RK 135 for 1 Series E, F, G, or H Bench Pacs
   Price—$37.00 each.
4. Model RK 139 for 2 Series E, F, G, or H Bench Pacs
   Price—$39.00 each.

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Phone: (201) 343-6294 TWX: (710) 990-5023

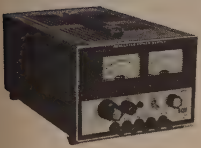
BP LABORATORY POWER SUPPLIES

"SERIES F" BENCH PACS

$249⁰⁰

Model	DC Output Volts	DC Output Amperes	Case Size Height x Width x Depth	Price	Shipping Weight
BP-10F	0-10	0-9	5³⁄₃₂ x 7½ x 9⅜	249.00	25.0 lbs.
BP-20F	0-20	0-4.5	5³⁄₃₂ x 7½ x 9⅜	249.00	25.0 lbs.
BP-40F	0-40	0-3.0	5³⁄₃₂ x 7½ x 9⅜	249.00	25.0 lbs.
BP-60F	0-60	0-1.75	5³⁄₃₂ x 7½ x 9⅜	249.00	25.0 lbs.

"SERIES G" BENCH PACS



$319⁰⁰

Model	DC Output Volts	DC Output Amperes	Case Size Height x Width x Depth	Price	Shipping Weight
BP-10G	0-10	0-12	5³⁄₃₂ x 7½ x 11⅞	319.00	31.0 lbs.
PB-20G	0-20	0-6.0	5³⁄₃₂ x 7½ x 11⅞	319.00	31.0 lbs.
BP-40G	0-40	0-4.5	5³⁄₃₂ x 7½ x 11⅞	319.00	31.0 lbs.
BP-60G	0-60	0-2.5	5³⁄₃₂ x 7½ x 11⅞	319.00	31.0 lbs.

"SERIES H" BENCH PACS

$369⁰⁰

Model	DC Output Volts	DC Output Amperes	Case Size Height x Width x Depth	Price	Shipping Weight
BP-10H	0-10	0-15	5³⁄₃₂ x 7½ x 16½	369.00	40.0 lbs.
BP-20H	0-20	0-8	5³⁄₃₂ x 7½ x 16½	369.00	40.0 lbs.
BP-40H	0-40	0-6.0	5³⁄₃₂ x 7½ x 16½	369.00	40.0 lbs.
BP-60H	0-60	0-3.25	5³⁄₃₂ x 7½ x 16½	369.00	40.0 lbs.

REGULATED POWER SUPPLY
REGULATED POWER SUPPLY

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PMC **POWER/MATE CORP.**
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Phone: (201) 343-6294 TWX: (710) 990-5023

PR HIGH CURRENT RACK POWER SUPPLIES

PRODUCT DIGEST

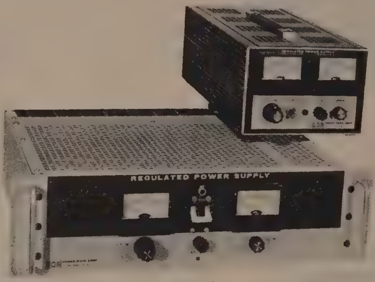
Power/Mate's new Power Rack "PR" Series, high current power supplies, consist of 16 different models in three all convection cooled package sizes (HM, K and L packages). The "PR" Series are both voltage and current regulated and can satisfy virtually every laboratory and systems power supply requirements. A complete range of outputs from 0-60 VDC with currents to 100 amperes are available as standard models.

Special features of the "PR" Series include high accuracy, adjustable current limiting, concentric controls for course and fine voltage adjustment, constant voltage and/or constant current, remote sensing, large easy to read precision meters and built-in short circuit and overload protection. Built-in overvoltage protection is offered on all models.

Power/Mate's unique "SIMAG" design concept (patent pending) allows the power supplies to be packaged in approximately 20% less space than equivalent conventional series power supplies.

The "PR" Series offer the same wide variety of options as the other Power/Mate Corporation systems power supplies. Typical available options are fungus proofing with MIL-173 varnish, wide input AC ranges, chassis slides, and overvoltage protection.

As with all Power/Mate power supplies, the new "PR" Series is backed by Power/Mate's Five Year Warranty.



REGULATED VOLTAGE:
Line— 0.015% + 1mV for line variations from 105-132 VAC.
Load— 0.015 % + 1mV for load variations from 0 to full load.

RIPPLE: Less than .5mV RMS with either positive or negative terminal grounded.

SPECIFICATIONS

AC INPUT: 105-132 VAC, 57-63HZ;
Package L 188-238 VAC, 57-63HZ.

OUTPUT VOLTAGE AND CURRENT: See respective tables.

REGULATED VOLTAGE:
Line— 0.015% + 1mV for line variations from 105-132 VAC.
Load— 0.015 % + 1mV for load variations from 0 to full load.

RIPPLE: Less than .5mV RMS with either positive or negative terminal grounded.

CURRENT REGULATION: Less than 0.05% of maximum rating, 0-95% DC Voltage change.

CURRENT RIPPLE: Less than 0.05% of maximum rating.

METERS: Voltmeter and ammeter, rated accurate of 2% of full scale value, are provided on the front panel.

POLARITY: The output may be "floated" up to 300 V peak above ground. Either polarity may be grounded to chassis by means of terminals provided.

FINISH: Front panel is finished with dual tone gray and black baked enamel with brushed aluminum handles. Panel marking is gray. All other finishes are appropriate paint, plating, or chemical film, as required.

TEMPERATURE COEFFICIENT: Better than 0.015%C.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

OVERLOAD AND SHORT CIRCUIT PROTECTION: Solid state protection gives instantaneous recovery and automatic reset. Cannot be damaged by prolonged short circuits or overloads.
Thermal—Thermostat; automatic reset when overtemperature condition is eliminated.

AMBIENT OPERATING TEMPERATURE: Continuous duty from 0 to +71°C ambient.

STORAGE TEMPERATURE: —55°C to +85°C.

INPUT AND OUTPUT CONNECTIONS: Heavy duty terminal block on rear of chassis.

OVERVOLTAGE PROTECTION: Optional

AVAILABLE OPTIONS

OVERVOLTAGE PROTECTION: Built-in overvoltage protection is optional on all models. To order OVP, add suffix "OV" to the model number and add $35 to the price for "H" package, $60 to the price for "K" package, and $100 to the price for "L" package.

5 Year Warranty

5-YEAR WARRANTY

To express our confidence in the skill and care with which our power supplies are designed and built — confidence based on an impressive 100,000 hour MTBF — we offer the POWER/MATE 5-Year Warranty.

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PR HIGH CURRENT RACK POWER SUPPLIES

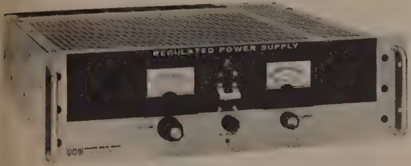
PACKAGE "H"

5-3/32" x 7-1/2" x 16-1/2"

Model	Adj. Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PR-8-HM	0-8	23.0	22.0	20.0	18.0	$ 410
PR-20-HM	0-20	15.0	12.0	11.0	8.0	410
PR-36-HM	0-36	10.0	9.0	8.0	6.5	410
PR-40-HM	0-40	10.0	9.0	8.0	6.5	415
PR-60-HM	0-60	6.0	5.2	4.5	4.0	415

PACKAGE "K"

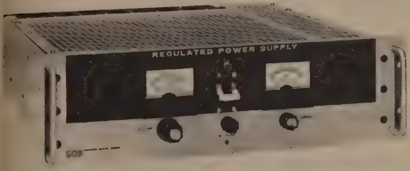
5-1/4" x 19" x 16-1/2"


REGULATED POWER SUPPLY

Model	Adj. Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PR-8-KM	0-8	70.0	60.0	50.0	40.0	$ 689
PR-20-KM	0-20	36.0	31.0	26.0	20.0	689
PR-36-KM	0-36	26.0	23.0	20.0	15.0	659
PR-40-KM	0-40	26.0	23.0	20.0	15.0	669
PR-60-KM	0-60	16.0	14.0	12.0	10.0	669

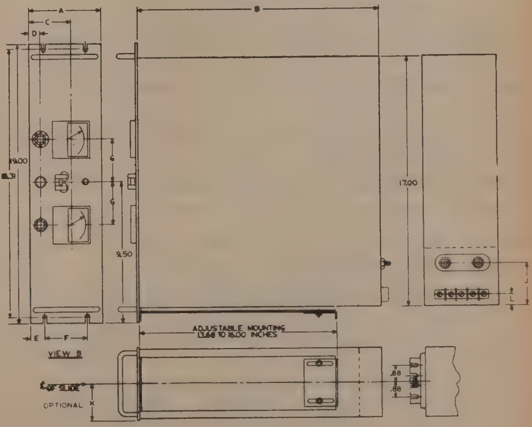
PACKAGE "L"

7" x 19" x 18-1/2"


REGULATED POWER SUPPLY

Model	Adj. Volt. Range VDC	Max. Amps. at Ambient of: 40°C	50°C	60°C	71°C	Price
PR-8-LM	0-8	100.0	85.0	70.0	55.0	$1050
PR-20-LM	0-20	70.0	60.0	50.0	40.0	1050
PR-36-LM	0-36	50.0	45.0	37.0	31.0	989
PR-40-LM	0-40	50.0	45.0	37.0	31.0	999
PR-60-LM	0-60	25.0	24.0	22.0	20.0	999

Dim.	PR K Case	PR L Case
A	5.22	6.97
*B	16.50	16.50
*C	3.12	4.68
*D	1.06	1.62
E	1.48	1.48
F	2.25	4.00
*G	2.94	2.94
*H		
*J	4.06	4.06
K	3.50	3.50
*L	1.12	1.12


A
C
D
B
19.00
18.31
G
G
9.50
17.00
J
L
E
F
VIEW B
ADJUSTABLE MOUNTING 13.68 TO 16.00 INCHES
℄ OF SLIDE
OPTIONAL
K
.88
.88

Note

1. * Denotes approximate dimensions.

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PMC POWER/MATE CORP.

514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

MM MINIATURE POWER SUPPLIES

PRODUCT DIGEST

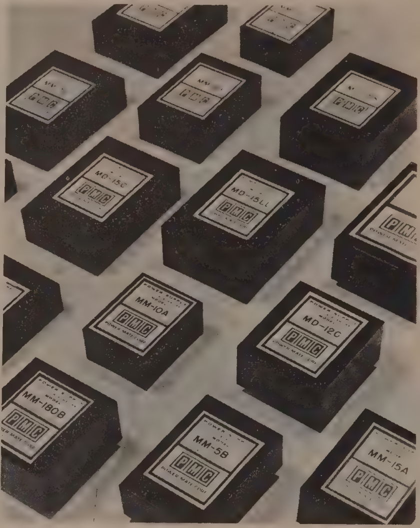
The Power/Mate "Mini/Mate" Series regulated power supplies are a minature encapsulated series of DC power supplies which, in addition to their high performance qualities, are ultra-reliable, compact, rugged and moderate in price.

All Mini/Mate encapsulated power supplies are "potted" with an aluminum oxide filled epoxy. This is among one of the many superior construction techniques which allow higher heat conduction to insure highly reliable operation and virtually any environmental condition.

The Mini/Mate Series contain both AC to DC and DC to DC power supplies, and are available with either single or dual outputs. The output voltage and current ranges of the Mini/Mate Series provide the user with maximum versatility. Over 165 models are available in voltages from 3.6 Vdc to 200 Vdc with current to 2 amp. The Mini/Mates are particularly appropriate for use in today's modern applications. Common uses for the Mini/Mate Series are the power Operational Amplifiers, Digital Logic, Shift Registers, ROM's, RAM's, A to D converters, D to A converters, and other signal conditioning instrumentation.

The Mini/Mate Series are packaged in either the standard rectangular case or Power/Mate's new space saving "Mini-Square" module that saves PC board area for more compact designs.

Whatever your choice, AC to DC, DC to DC, encapsulated or plug-in, each of these miniature DC power supplies is backed by Power/Mate's world-wide reputation for power supply excellence.



SPECIFICATIONS

INPUT VOLTAGE: 115 ±10VAC, 50-400 cps.

OUTPUT VOLTAGE: Up to 200VDC. (See charts).

OUTPUT CURRENT: Up to 2 Amps. (See charts).

LOAD REGULATION: ±0.015% (NL-FL) above 10VDC. ±0.035% (NL-FL) up to 10VDC.

LINE REGULATION: ±0.015% (NL-FL) above 10VDC. ±0.02% (NL-FL) up to 10VDC.

RIPPLE: Less than 500 microvolts up to 15VDC. Less than 1.0 mv above 15 VDC.

OPERATING TEMPERATURE RANGE: 0-71°C.

STORAGE TEMPERATURE: −25°C to +85°C.

OUTPUT IMPEDANCE: 0.2 ohms @ 10KHZ.

TEMPERATURE COEFFICIENT: 0.02%/°C Max.

OUTPUT CURRENT VC TEMPERATURE: Each output is rated for full current at temperatures between −20°C and +50°C and is linearly derated from +50° to 70% of the full output at +71°C.

SHORT CIRCUIT PROTECTION: The Mini/Mate Series power supplies are ruggedly constructed, and designed with built-in short circuit protection to withstand substantial overloads for reasonable periods of time. The output can be shorted without causing damage to the power supply. However, prolonged operation with the supply overloaded or shorted is not recommended.

PRECISION OUTPUT ADJUST: The output voltage of each supply is factory set to within ±2% of the specified voltage. The TRIM connection, where provided, allows a means of externally adjusting the output voltage precisely to the labeled voltage.

AVAILABLE OPTIONS

1. For 230VAC, add suffix "-230" to model number and add $5.00 to price.

SAME DAY SHIPMENT

Each MM unit is warranteed for 1 full year.

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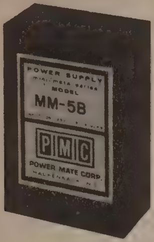
MM MINIATURE POWER SUPPLIES

"STANDARD" CASE IC LOGIC SINGLE OUTPUT POWER SUPPLIES


POWER SUPPLY
mini/mate series
MODEL
MM-5B
PMC
POWER MATE CORP
HACKENSACK, N.J.

Model	Output Voltage	Current (MA)	Case (FIG)	Price
MM-3.6B	3.6	250	11	39.95
MM-5AL	5	125	11	29.95
MM-5BL	5	250	11	37.95
MM-5CL	5	250	2	37.95
MM-5H-OV	5	500	2	43.95
MM-5J-OV	5	1000	3	63.95
MM-5M-OV	5	1500	3	89.95
MM-5P-OV	5	2000	5	99.95
MM-6B	6	200	11	39.95

"Standard Case" Models stocked in depth for **SAME DAY SHIPMENT.**

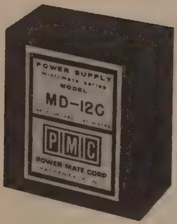
"STANDARD" CASE SINGLE OUTPUT GENERAL PURPOSE POWER SUPPLIES

POWER SUPPLY
mini/mate series
MODEL
MM-20A
PMC
POWER MATE CORP
HACKENSACK, N.J.

Model	Output Voltage	Current (MA)	Case (FIG)	Price
MM-10A	10	120	1	26.95
MM-12A	12	100	1	26.95
MM-15A	15	100	1	26.95
MM-18T	18	65	1	26.95
MM-20A	20	60	1	26.95
MM-24A	24	50	1	26.95
MM-28A	28	40	1	26.95

"Standard Case" Models stocked in depth for **SAME DAY SHIPMENT.**

"STANDARD" CASE DUAL OUTPUT OP AMP POWER SUPPLIES


POWER SUPPLY
mini/mate series
MODEL
MD-12C
PMC
POWER MATE CORP
HACKENSACK, N.J.

Model	Output Voltage	Current Each Side (MA)	Case (FIG)	Price
MD-10C	±10	120	2	54.95
MD-10D	±10	240	3	59.95
MD-12D	±12	120	2	54.95
MD-12E	±12	240	3	72.95
MD-15J	±15	25	2	26.95
MD-15B	±15	65	2	39.95
MD-15A	±15	100	2	43.95
MD-15W	±15	150	3	54.95
MD-15N	±15	200	3	69.95
MD-15P	±15	300	5	96.95
MD-18C	±18	65	3	59.95

"Standard Case" Models stocked in depth for **SAME DAY SHIPMENT.**

"MULTIPLE OUTPUT" SYSTEMS POWER SUPPLIES

Model	Output Voltage	Current Each Output	Case (FIG)	Price
MT-15/5	±15 ± 5	100 250	6	86.95
MT-15/5A	±15 ± 5	100 500	6	96.95
MT-15/5B	±15 ± 5	150 300	6	89.95

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DD MINIATURE POWER SUPPLIES

MINI/MATE DC TO DC CONVERTER — DESCRIPTION

Power/Mate's new DC Series dual output DC to DC converters is the result of Power/Mate's engineering development program to offer the OEM user a full line of high efficiency, low cost DC to DC power supplies.

These new units are designed for use in application that requires precise regulation from a DC source. The DD Series are ideally suited for use with brute force High Current DC power sources such as Power/Mate's FPS Series ferroresonant power supplies. By combining the advantages of a preregulated DC input, the DD Series converters provide isolation, high efficiency and excellent point of load regulation.

The mechanical design is compatible with today's PC Board pin spacing for proper mating with standard logic cards and op amps.

MINI/MATE DC TO DC SPECIFICATIONS

INPUT VOLTAGES: 5V, and 28VDC.

OUTPUT VOLTAGES: ±12, ±15, ±18, and ±24VDC.

OUTPUT CURRENT: 50mA, 100mA, and 200mA.

REGULATION: Line and Load 0.02% max.

INPUT RIPPLE: Less than 1% P-P of Nominal Input Voltage.

OUTPUT RIPPLE AND NOISE: 1mV RMS max.

OPERATING TEMPERATURE RANGE: −25°C to +71°C.

ISOLATION DIFFERENCE: 1/0 300VDC min.

TEMPERATURE COEFFICIENT: 0.02%/°C.

EFFICIENCY: Nominal line at full load (refer to charts).

DUAL OUTPUT DC TO DC CONVERTERS

POWER/MATE CORPORATION
HACKENSACK, NEW JERSEY
POWER SUPPLY MODEL

POWER/MATE CORPORATION
HACKENSACK, NEW JERSEY
POWER SUPPLY MODEL

Model	Input VDC	Output VDC	Output Cur. mA	Eff. %	Case	Price
DD5-12X	5 ±10%	±12	50	50	Fig. 11	$45.00
DD5-12Y	5 ±10%	±12	100	55	Fig. 11	85.00
DD5-12Z	5 ±10%	±12	200	60	Fig. 11	99.00
DD5-15X	5 ±10%	±15	50	50	Fig. 11	45.00
DD5-15Y	5 ±10%	±15	100	55	Fig. 11	85.00
DD5-15Z	5 ±10%	±15	200	60	Fig. 11	99.00
DD28-12X	28 ±10%	±12	50	55	Fig. 11	45.00
DD28-12Y	28 ±10%	±12	100	60	Fig. 11	85.00
DD28-12Z	28 ±10%	±12	200	65	Fig. 11	99.00
DD28-15X	28 ±10%	±15	50	55	Fig. 11	45.00
DD28-15Y	28 ±10%	±15	100	60	Fig. 11	85.00
DD28-15Z	28 ±10%	±15	200	65	Fig. 11	99.00

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MM MINIATURE POWER SUPPLIES

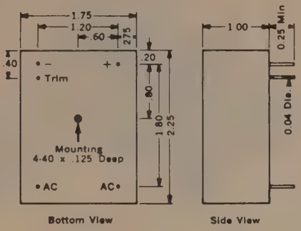
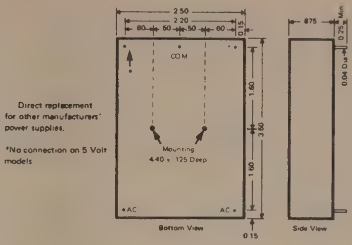

1.75
1.20
.60
.275
.40
.20
.80
1.80
2.25
• –
+ •
• Trim
Mounting
4-40 x .125 Deep
• AC
AC •
Bottom View
1.00
0.25 Min
0.04 Dia.
Side View

Fig. 1

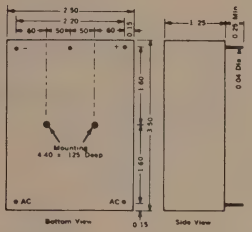

2.50
2.20
.60
.50
.50
.60
0.15
COM
Mounting
4-40 x .125 Deep
1.60
3.50
1.60
• AC
AC •
Bottom View
0.15
.875
0.25 Min
0.04 Dia
Side View

Direct replacement for other manufacturers' power supplies.

*No connection on 5 Volt models

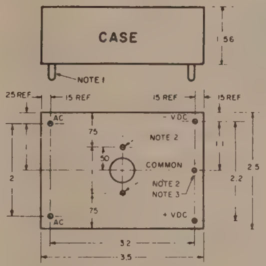
To reduce spacing on AC input from 2.2" centers to 2.0" centers add suffix "-2" to model nos.

Fig. 2


2.50
2.20
.60
.50
.50
.60
0.15
• –
•
+ •
Mounting
4-40 x .125 Deep
1.60
3.50
1.60
• AC
AC •
Bottom View
0.15
1.25
0.25 Min
0.04 Dia
Side View

To reduce spacing on AC input from 2.2" centers to 2.0" centers add suffix "-2" to model nos.

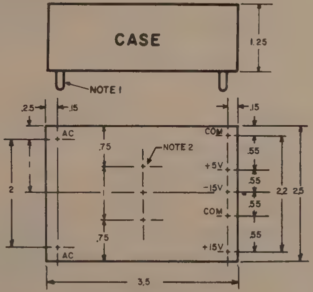
Fig. 3


CASE
1.56
NOTE 1
.25 REF
.15 REF
.15 REF
.15 REF
AC
- VDC
.75
NOTE 2
.50
COMMON
NOTE 2
NOTE 3
.75
+ VDC
AC
2
1.1
2.2
2.5
3.2
3.5

BOTTOM VIEW CASE

NOTES:
1. FIVE PINS,. 040 DIA. X .2LG MIN.
2. TWO MOUNTING INSERTS 4-40 X .10 DP MIN.
3. NO CONNECTION ON MODEL P1.5.2000

Fig. 5


CASE
1.25
NOTE 1
.25
.15
.15
AC
COM
.75
NOTE 2
+5V
-15V
COM
.75
+15V
AC
.55
.55
.55
.55
2
2.2
2.5
3.5

NOTES: **BOTTOM VIEW CASE**
1. SEVEN PINS .040DIA X .2LG MIN.
2. TWO MOUNTING INSERTS 4-40X.10 DP MIN.

Fig. 6

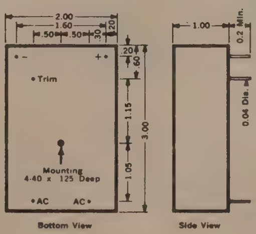

2.00
1.60
.50
.50
.30
.20
.20
.60
• –
+ •
• Trim
1.15
3.00
1.05
Mounting
4-40 x .125 Deep
• AC
AC •
Bottom View
1.00
0.2 Min.
0.04 Dia.
Side View

Fig. 11

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

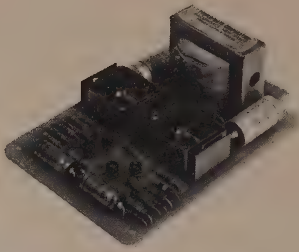
PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

CP CARD-PAC SERIES

PRODUCT DIGEST

The new CARD/PAC Series all-silicon P.C. board power supplies are among the most competitively priced power supplies in the industry and provide a compact, low-cost regulated DC voltage source. Using P.C. board construction for economy, these power supplies provide high performance in a unit compatible in packaging and price with the new generation lower cost integrated circuits, operational amplifiers, and digital function devices.

All components are high quality computer-rated for long life. The CARD/PAC Series cannot be damaged by prolonged short circuits or overloads. In addition, the CARD/PAC Series are backed by the same 5-year warranty given all POWER/MATE power supply products.



LINE REGULATION: 0.01% or 1 mV (whichever is greater).
LOAD REGULATION: 0.05%.
RIPPLE: Less than 1 mV RMS max.

SPECIFICATIONS

VOLTAGE INPUT: 105-125 VAC, 50-440 CPS.

CURRENT OUTPUT: Up to 1 amp.

VOLTAGE OUTPUT: 3 to 50 volts.

LINE REGULATION: 0.01% or 1 mV (whichever is greater).

LOAD REGULATION: 0.05%.

RIPPLE: Less than 1 mV RMS max.

TEMPERATURE COEFFICIENT: Better than 0.02%/°C (typical).

OVERLOAD PROTECTION: Power supply cannot be damaged by current overloads.

POLARITY: May be either positive , negative or floating.

AMBIENT OPERATING TEMPERATURE: Continuous duty from −25°C to +71°C ambient.

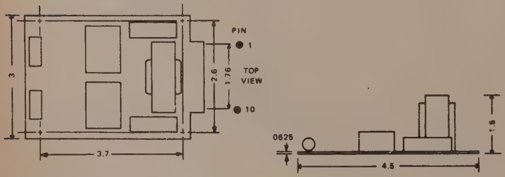
STORAGE TEMPERATURE: −25°C to +85°C.

OUTPUT CURRENT VS. TEMPERATURE: Rated for full current output at temperatures between −25°C to +71°C.

REMOTE OR LOCAL SENSING: Provision included for remote sensing of output voltage directly at the load, for improved overall regulation. Also may be connected for local sensing.

MECHANICAL DATA

CARD/PAC "A": 3"W x 4.5"L x 2"H
CARD/PAC "B": 3"W x 4.5"L x 1.5"H



AVAILABLE OPTIONS

1. Improved regulation, 0.01%, available at $5 per unit. Add suffix R to model number (Example: CP-9MR).
2. Ten-pin P.C. card connector. Order separately as CARD/PAC CONN at $3.00 ea.

CARD/PAC CONNECTIONS

FOR CARD/PAC "B" (9 VDC TO 15 VDC)

PIN 1	No. Conn.	PIN 6	−VDC out
2	No. Conn.	7	−Sense
3	AC in	8	AC in
4	No. Conn.	9	+VDC out
5	No. Conn.	10	+Sense

Connect Pin 6 with Pin 7, Connect Pin 9 with Pin 10, take output between Pins 6 and 9

TO OPERATE WITH REMOTE SENSING:

a. Connect Pin 9 to positive side of load.
b. Bring out a separate lead from Pin 10 to positive side of load.
c. Connect Pin 6 to negative side of load.
d. Bring out a separate lead from Pin 7 to negative side of load.

FOR CARD/PAC "B" (GREATER THAN 15 VDC OUTPUT)

PIN 1	−Sense	PIN 6	No Conn.
2	−VDC out	7	No Conn.
3	AC in	8	AC in
4	No Conn.	9	+VDC out
5	No Conn.	10	+Sense

Connect Pin 1 with Pin 2, Connect Pin 9 with Pin 10, take output between Pins 2 and 9

CARD/PAC A CONNECTIONS (LESS THAN 9VDC OUTPUT)

PIN 1	Positive Sense—Connect Pin 1 to Pin 2	8	AC Line
2	Positive VDC	9	Negative VDC—Connect Pin 9 to Pin 10
3	AC Line	10	Negative Sense
4, 5, 6 and 7	No Connections		

TO OPERATE WITH REMOTE SENSING:

a. Connect Pin 2 to positive side of load.
b. Bring out a separate lead from Pin 1 to positive side of load.
c. Connect Pin 9 to negative side of load.
d. Bring out a separate lead from Pin 10 to negative side of load.

CARD/PAC B CONNECTIONS (DUAL)

PIN 1	Negative Sense	6	Output Common
2	Negative VDC	7	Positive Sense—Common
3	AC Line	8	AC Lne
4	Negative Sense-Common	9	Positive VDC
5	Output Common	10	Positive Sense

NOTES:
A. Connect Pin 1 with Pin 2
B. Connect Pins 4, 5, 6, and 7 together
C. Connect Pin 9 with Pin 10

TO OPERATE WITH REMOTE SENSING:

a. Connect Pin 2 to negative side of load.
b. Bring out a separate lead from Pin 1 to negative side of load.
c. Connect Pin 5 or 6 to common point of load.
d. Bring out separate leads from Pins 4 and 7 to common point of load.
e. Connect Pin 9 to positive side of load.
f. Bring out a separate lead from Pin 10 to positive side of load.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

POWER/MATE CORP.

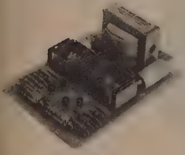
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

CP CARD-PAC SERIES

CARD/PAC "DUAL" SERIES 50

Model	DC Volts	Current (mA)	PAK Size	Price
DCP-6G	±6	50	B	$39.00
DCP-7G	±7	50	B	39.00
DCP-9G	±9	50	B	39.00
DCP-10G	±10	50	B	39.00
DCP-12G	±12	50	B	39.00
DCP-15G	±15	50	B	39.00
DCP-16G	±16	50	B	39.00
DCP-18G	±18	50	B	39.00
DCP-20G	±20	50	B	39.00
DCP-22G	±22	50	B	39.00
DCP-24G	±24	50	B	39.00
DCP-25G	±25	50	B	39.00
DCP-26G	±25	50	B	39.00
DCP-28G	±28	50	B	39.00
DCP-30G	±30	50	B	39.00

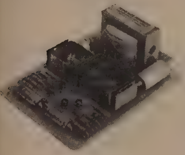
CARD/PAC "DUAL" SERIES 100



Model	DC Volts	Current (mA)	PAK Size	Price
DCP-6J	±6	100	B	$49.00
DCP-7J	±7	100	B	49.00
DCP-9K	±9	100	B	49.00
DCP-10K	±10	100	B	49.00
DCP-12K	±12	100	B	49.00
DCP-15K	±15	100	B	49.00
DCP-18H	±18	100	B	59.00
DCP-20H	±20	100	B	59.00
DCP-22H	±22	100	B	59.00
DCP-24H	±24	100	B	59.00
DCP-25H	±25	100	B	59.00
DCP-26H	±26	100	B	59.00
DCP-27H	±27	100	B	59.00
DCP-28H	±28	100	B	59.00
DCP-30H	±30	100	B	59.00

CARD/PAC "DUAL" SERIES 200

Model	DC Volts	Current (mA)	PAK Size	Price
DCP-6L	±6	200	B	$59.00
DCP-12M	±12	200	B	59.00
DCP-15M	±15	200	B	59.00



Model	DC Volts	Current (mA)	PAK Size	Price
CP-31G	31	50	B	$44.00
CP-32G	32	50	B	44.00
CP-33G	33	50	B	44.00
CP-34G	34	50	B	44.00
CP-35G	35	50	B	44.00
CP-36G	36	50	B	44.00
CP-37G	37	50	B	44.00
CP-38G	38	50	B	44.00
CP-39G	39	50	B	44.00
CP-40G	40	50	B	44.00
CP-41G	41	50	B	44.00
CP-42G	42	50	B	44.00
CP-43G	43	50	B	44.00
CP-44G	44	50	B	44.00
CP-45G	45	50	B	44.00
CP-46G	46	50	B	44.00
CP-47G	47	50	B	44.00
CP-48G	48	50	B	44.00
CP-49G	49	50	B	44.00
CP-50G	50	50	B	44.00

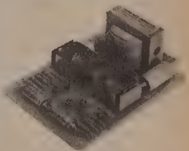
CARD/PAC "SINGLES" SERIES 50

Model	DC Volts	Current (mA)	PAK Size	Price
CP-4J	4	100	A	$38.00
CP-5J	5	100	A	38.00
CP-6J	6	100	A	38.00
CP-7J	7	100	A	38.00
CP-8J	8	100	A	38.00
CP-9K	9	100	B	38.00
CP-10K	10	100	B	38.00
CP-11K	11	100	B	38.00
CP-12K	12	100	B	38.00
CP-13K	13	100	B	38.00
CP-14K	14	100	B	38.00
CP-15K	15	100	B	38.00

CARD/PAC "SINGLES" SERIES 100

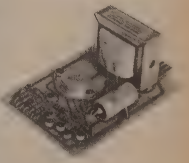
Model	DC Volts	Current (mA)	PAK Size	Price
CP-4L	4	200	A	$49.00
CP-5L	5	200	A	49.00
CP-6L	6	200	A	49.00
CP-7L	7	200	A	49.00
CP-8L	8	200	A	49.00
CP-9M	9	200	B	49.00
CP-10M	10	200	B	49.00
CP-11M	11	200	B	49.00
CP-12M	12	200	B	49.00
CP-13M	13	200	B	49.00
CP-14M	14	200	B	49.00
CP-15M	15	200	B	49.00

CARD/PAC "SINGLES" SERIES 200



Model	DC Volts	Current (mA)	PAK Size	Price
CP-16H	16	100	B	$49.00
CP-17H	17	100	B	49.00
CP-18H	18	100	B	49.00
CP-19H	19	100	B	49.00
CP-20H	20	100	B	49.00
CP-21H	21	100	B	49.00
CP-22H	22	100	B	49.00
CP-23H	23	100	B	49.00
CP-24H	24	100	B	49.00
CP-25H	25	100	B	49.00
CP-26H	26	100	B	49.00
CP-27H	27	100	B	49.00
CP-28H	28	100	B	49.00
CP-28H	29	100	B	49.00
CP-30H	30	100	B	49.00
CP-31H	31	100	B	49.00
CP-32H	32	100	B	49.00

CARD/PAC "SINGLES" SERIES 300



Model	DC Volts	Current (mA)	PAK Size	Price
CP-3.6X	3.6	1000	A	$49.00
CP-5X	5	1000	A	49.00

CARD/PAC "SINGLES" SERIES 100

SAME DAY SHIPMENT

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC
POWER/MATE CORP.
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

RA POWER MODULES

PRODUCT DIGEST

All Silicon Semiconductors Throughout
All Units Rated for Continuous Duty at −20° to +71°C Ambient
Short Circuit Proof — May be Shorted Indefinitely without Damage
Automatic Overload and Short Circuit Recovery
No External Heat Sink or Cooling Required up to +71°C
MTBI — Over 100,000 Hours
All Components Accessible and Replaceable for Maintenance
Top Quality Components and Rugged Construction
All Power Supplies Subjected to Rigorous QC Inspections

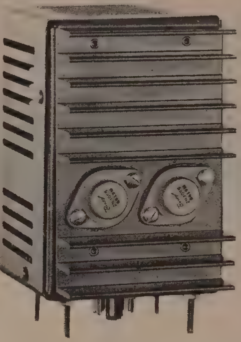
The RA Series of modular power supplies provide regulated voltage outputs between 0 and 400 volts at output currents up to 25 amperes, at regulations of 0.05 or 0.5%, according to the model selected.

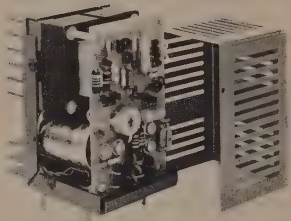
Silicon semiconductors are used exclusively in the power supply circuitry. This together with the internal heat sinking provided in the supply enables full load operation of the unit at ambient temperatures of 71°C without any additional cooling, heat sinking, and without derating.

The RA Series power supplies are completely short circuit proof. The output may be short circuited indefinitely without damage. A unique circuit reduces the output current and voltage if the full load rating of the supply is exceeded. This not only protects the power supply, but serves to protect the load against further damage due to excessive current flow. The power supply automatically restores itself to normal operation after the short or overload is removed.

All components are accessible and replaceable in the field if required. All components are conservatively rated and are of the highest quality. For example, the electrolytic capacitors are 85°C types and the transformers are MIL-T-27 quality.

Connections at the connector permit either internal or remote adjustment of the output voltages. External connections also permit the remote sensing of the voltage directly at the load for improved overall load regulation on the RA Series.





REGULATION: ±0.05% or 2 MV (whichever is greater) vs line and load for RA Series

RIPPLE: Less than 0.002%, or 1 MV RMS (whichever is greater) for RA Series

SPECIFICATIONS

INPUT: 105-125 VAC, 47-420 CPS.

OUTPUT: See Specific Model Listed.

REGULATION: ±0.05% or 2 MV (whichever is greater) vs line and load for RA Series.

RIPPLE: Less than 0.002%, or 1 MV RMS (whichever is greater) for RA Series.

RESPONSE TIME: 50 Microseconds.

OPERATING AMBIENT TEMPERATURE: −20° to +71°C.

TEMPERATURE COEFFICIENT: 0.015%/C or 1.8 MV, whichever is greater.

OUTPUT ADJUSTMENT: Either internal or external as desired.

COOLING: None required at specified ambients.

POLARITY: May be either positive, negative, or floating (up to 300 volts).

OVERLOAD PROTECTION: Solid state short circuit and overload protected, instantaneous recovery and automatic reset.

MEAN TIME BETWEEN FAILURES: 100,000 hours typical, calculated according to MIL Handbook 217A.

MILITARY SPECIFICATIONS: Designed to meet the environmental requirements of MIL-E-5272, and RFI requirements of MIL-I-6181.

OPTIONS

OVER-VOLTAGE PROTECTION: Additional charge 30% ($50.00 min.).

Solid-state crow-bar protection for voltage sensitive loads is available for all RA models. Trip point of crow-bar is adjustable. The addition of crow-bar circuitry generally requires next larger case size for N & R case supplies. Larger units can generally accommodate crow-bar circuitry. Consult factory for confirmation of case size when ordering. Add suffix V to model number when ordering.

ACCESSORIES

PANEL & CHASSIS MOUNTING ADAPTER: This adapter permits any standard **POWER/MATE** module to be surface mounted to either a chassis or panel. Includes socket. Order part no. A200- (—). Follow model no. with module case size with which adapter would be used. Cost — ANY TYPE $14.75.

POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC

POWER/MATE CORP.

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RA POWER MODULES

OUTPUT VOLTAGE ADJUST RANGE	OUTPUT CURRENT (AMPS)	CASE SIZE	0.05% REGULATION	
			MODEL NO.	PRICE
0-3	0.375	R	RA2- 0.375	$180
	0.750	R	RA2- 0.750	185
	1.5	R	RA2- 1.5	215
	3.0	RH	RA2- 3.0	255
	6.0	TH	RA2- 6.0	305
3-5	0.375	R	RA4- 0.375	135
	0.750	R	RA4- 0.750	150
	1.5	R	RA4- 1.5	170
	3.0	RH	RA4- 30	200
	6.0	TH	RA4- 6.0	245
5-7	0.375	R	RA6- 0.375	135
	0.750	R	RA6- 0.750	150
	1.5	R	RA6- 1.5	170
	3.0	RH	RA6- 3.0	200
	6.0	TH	RA6- 6.0	245
7-9	0.200	R	RA8- 0.200	130
	0.375	R	RA8- 0.375	145
	0.750	R	RA8- 0.750	160
	1.5	R	RA8- 1.5	170
	3.0	RH	RA8- 3.0	200
	6.0	TH	RA8- 6.0	255
9-11	0.200	R	RA10- 0.200	130
	0.375	R	RA10- 0.375	145
	0.750	R	RA10- 0.750	160
	1.5	R	RA10- 1.5	170
	3.0	RH	RA10- 3.0	200
	6.0	TH	RA10- 6.0	260
11-13	0.200	N	RA12- 0.200	130
	0.375	N	RA12- 0.375	150
	0.750	R	RA12- 0.750	160
	1.5	R	RA12- 1.5	180
	3.0	RH	RA12- 3.0	200
	6.0	TH	RA12- 6.0	275
13-15	0.100	N	RA14- 0.100	130
	0.200	N	RA14- 0.200	140
	0.375	N	RA14- 0.375	150
	0.750	R	RA14- 0.750	165
	1.5	R	RA14- 1.5	190
	3.0	TH	RA14- 3.0	230
14-16	0.100	N	RA15- 0.100	130
	0.200	N	RA15- 0.200	140
	0.375	N	RA15- 0.375	150
	0.750	R	RA15- 0.750	165
	1.5	R	RA15- 1.5	190
	3.0	TH	RA15- 3.0	230
15-17	0.100	N	RA16- 0.100	130
	0.200	N	RA16- 0.200	140
	0.375	N	RA16- 0.375	150
	0.750	R	RA16- 0.750	170
	1.5	R	RA16- 1.5	190
	3.0	TH	RA16- 3.0	235
17-19	0.100	N	RA18- 0.100	$130
	0.200	N	RA18- 0.200	140
	0.375	N	RA18- 0.375	150
	0.750	R	RA18 0.750	170
	1.5	R	RA18- 1.5	190
	3.0	TH	RA18- 3.0	235
19-22	0.100	N	RA20- 0.100	130
	0.200	N	RA20- 0.200	140
	0.375	N	RA20- 0.375	150
	0.750	R	RA20- 0.750	170
	1.5	R	RA20- 1.5	190
	3.0	TH	RA20- 3.0	235
22-25	0.100	N	RA23- 0.100	130
	0.200	N	RA23- 0.200	140
	0.375	R	RA23- 0.375	150
	0.750	R	RA23- 0.750	175
	1.5	RH	RA23- 1.5	195
	3.0	TH	RA23- 3.0	240
25-28	0.100	N	RA26- 0.100	130
	0.200	R	RA26- 0.200	140
	0.375	R	RA26- 0.375	150
	0.750	R	RA26- 0.750	175
	1.5	T	RA26- 1.5	205
	3.0	TH	RA26- 3.0	245
26.5-29.5	0.100	N	RA28- 0.100	130
	0.200	R	RA28- 0.200	145
	0.375	R	RA28- 0.375	155
	0.750	R	RA28- 0.750	180
	1.5	T	RA28- 1.5	205
	3.0	TH	RA28- 3.0	245
28-32	0.050	N	RA30- 0.050	125
	0.100	N	RA30- 0.100	135
	0.200	R	RA30- 0.200	145
	0.375	R	RA30- 0.375	155
	0.750	R	RA30- 0.750	180
	1.5	T	RA30- 1.5	205
	3.0	TH	RA30- 3.0	250
32-36	0.050	N	RA34- 0.050	125
	0.100	N	RA34- 0.100	135
	0.200	R	RA34- 0200	150
	0.375	R	RA34- 0.375	160
	0.750	R	RA34- 0.750	180
	1.5	T	RA34- 1.5	230
	3.0	TH	RA34- 3.0	275
36-40	0.050	N	RA38- 0.050	130
	0.100	N	RA38- 0.100	140
	0.200	R	RA38- 0.200	150
	0.375	R	RA38- 0.375	165
	0.750	R	RA38- 0.750	180
	1.5	T	RA28- 1.5	235
	3.0	TH	RA38- 3.0	290
40-45	0.050	N	RA42- 0.050	135
	0.100	N	RA42- 0.100	145
	0.200	R	RA42- 0.200	155
	0.375	R	RA42- 0.375	170

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RA POWER MODULES

OUTPUT VOLTAGE ADJUST RANGE	OUTPUT CURRENT (AMPS)	CASE SIZE	0.05% REGULATION	
			MODEL NO.	PRICE
40-45	0.750	T	RA42- 0.750	195
	1.5	T	RA42- 1.5	245
	3.0	TH	RA42- 3.0	300
45-50	0.050	N	RA47- 0.050	145
	0.100	N	RA47- 0.100	155
	0.200	R	RA47- 0.200	165
	0.375	R	RA47- 0.375	180
	0.750	T	RA47- 0.750	200
	1.5	T	RA47- 1.5	245
	3.0	TH	RA47- 3.0	315
50-56	0.050	N	RA53- 0.050	155
	0.100	N	RA53- 0.100	165
	0.200	R	RA53- 0.200	180
	0.375	R	RA53- 0.375	190
	0.750	T	RA53- 0.750	210
	1.5	TH	RA53- 1.5	245
	3.0	TH	RA53- 3.0	315
56-62	0.050	N	RA59- 0.050	160
	0.100	R	RA59- 0.100	170
	0.200	R	RA59- 0.200	185
	0.375	R	RA59- 0.375	195
	0.750	T	RA59- 0.750	215
	1.5	TH	RA59- 1.5	295
62-69	0.050	R	RA65- 0.050	185
	0.100	R	RA65- 0.100	195
	0.200	R	RA65- 0.200	210
	0.375	R	RA65- 0.375	220
	0.750	T	RA65- 0.750	240
	1.5	TH	RA65- 1.5	325
69-76	0.050	R	RA72- 0.050	190
	0.100	R	RA72- 0.100	200
	0.200	R	RA72- 0.200	215
	0.375	T	RA72- 0.375	225
	0.750	T	RA72- 0.750	250
	1.5	TH	RA72- 1.5	360
76-84	0.050	R	RA80- 0.050	195
	0.100	R	RA80- 0.100	205
	0.200	R	RA80- 0.200	220
	0.375	T	RA80- 0.375	235
	0.750	T	RA80- 0.750	265
	1.5	TH	RA80- 1.5	370
84-93	0.050	R	RA88- 0.050	200
	0.100	R	RA88- 0.100	210
	0.200	R	RA88- 0.200	230
	0.375	T	RA88- 0.375	245
	0.750	T	RA88 0.750	275
	1.5	TH	RA88- 1.5	390
93-103	0.050	R	RA98- 0.050	205
	0.100	R	RA98- 0.100	215
	0.200	R	RA98- 0.200	230
	0.375	T	RA98- 0.375	260
	0.750	T	RA98- 0.750	335
	1.5	TH	RA98- 1.5	400
103-114	0.050	R	RA108- 0.050	215
	0.100	R	RA108- 0.100	225
103-114	0.200	R	RA108- 0.200	235
	0.375	T	RA108- 0.375	285
	0.750	T	RA108- 0.750	375
114-126	0.050	R	RA120- 0.050	215
	0.100	R	RA120- 0.100	235
	0.200	R	RA120- 0.200	260
	0.375	T	RA120- 0.375	300
	0.750	T	RA120- 0.750	375
126-139	0.050	R	RA132- 0.050	225
	0.100	R	RA132- 0.100	235
	0.200	R	RA132- 0.200	260
	0.375	T	RA132- 0.375	310
	0.750	TH	RA132- 0.750	415
139-153	0.050	R	RA146- 0.050	225
	0.100	R	RA146- 0.100	245
	0.200	R	RA146- 0.200	260
	0.375	T	RA146- 0.375	310
	0.750	TH	RA146- 0.750	415
153-168	0.050	R	RA160- 0.050	230
	0.100	R	RA160- 0.100	260
	0.200	R	RA160- 0.200	270
	0.375	T	RA160- 0.375	310
	0.750	TH	RA160- 0.750	415
168-185	0.050	R	RA176- 0.050	235
	0.100	R	RA176- 0.100	265
	0.200	T	RA176- 0.200	315
	0.375	T	RA176- 0.375	360
	0.750	TH	RA176- 0.750	455
185-204	0.050	R	RA194- 0.050	240
	0.100	R	RA194- 0.100	275
	0.200	T	RA194- 0.200	230
	0.375	T	RA194- 0.375	415
	0.750	TH	RA194- 0.750	515
204-225	0.050	R	RA214- 0.050	255
	0.100	R	RA214- 0.100	290
	0.200	T	RA214- 0.200	355
	0.375	T	RA214- 0.375	440
225-250	0.050	R	RA236- 0.050	280
	0.100	R	RA236- 0.100	320
	0.200	T	RA236- 0.200	390
	0.375	TH	RA236- 0.375	480
250-275	0.050	R	RA262- 0.050	275
	0.100	T	RA262- 0.100	335
	0.200	T	RA262- 0.200	405
	0.375	TH	RA262- 0.375	490
275-315	0.050	T	RA295- 0.050	290
	0.100	T	RA295- 0.100	360
	0.200	T	RA295- 0.200	445
	0.375	TH	RA295- 0.375	520
315-340	0.050	T	RA327- 0.050	295
	0.100	T	RA327- 0.100	370
	0.200	T	RA327- 0.200	460
	0.375	TH	RA327- 0.375	540
340-370	0.050	T	RA355- 0.050	315
	0.100	T	RA355- 0.100	385
	0.200	T	RA355- 0.200	470
	0.375	TH	RA355- 0.375	555
370-400	0.050	T	RA385- 0.050	325
	0.100	T	RA385- 0.100	395
	0.200	T	RA385- 0.200	480
	0.375	TH	RA385- 0.375	565

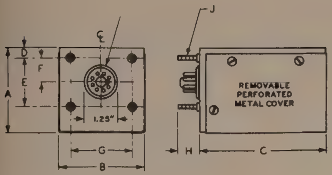
POWER/MATE IS THE WORLD'S LARGEST SUPPLIER OF QUALITY POWER SUPPLIES

PMC POWER/MATE CORP.
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

RA POWER MODULES

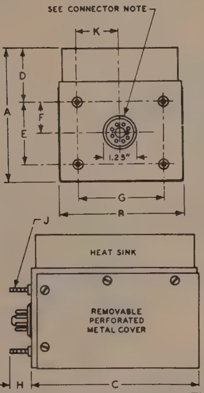
MECHANICAL DATA

CASE STYLES N R T *SEE CONNECTOR NOTE


℄
J
D
F
E
A
1.25"
G
B
REMOVABLE PERFORATED METAL COVER
H
C

Case Style	A	B	C	D	E	F	G	H	J
N	2.5	3.0	4.25	0.406	1.75	0.875	2.25	0.69	6-32
R	3.25	3.25	5.0	0.350	1.86	0.930	2.296	0.69	6-32
T	4.0	5.0	6.56	0.750	2.75	1.375	3.437	0.625	10-32

CASE STYLES RH TH BRH


SEE CONNECTOR NOTE
K
D
A
F
E
1.25"
G
B
J
HEAT SINK
REMOVABLE PERFORATED METAL COVER
H
C

Case Style	A	B	C	D	E	F	G	H	J	K
RH	4.125	3.25	5.0	1.22	1.86	0.93	2.296	0.69	6-32	1.148
TH	5.25	5.0	6.56	2.063	2.75	1.375	3.437	0.625	10-32	1.718
BRH	4.125	5.0	5.5	1.25	2.50	1.25	4.156	0.69	6-32	.656

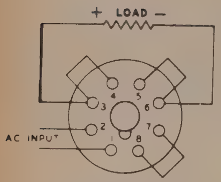
PMC **POWER/MATE CORP.**
514 S. RIVER STREET, HACKENSACK, N. J. 07601
Phone: (201) 343-6294 TWX: (710) 990-5023

RA POWER MODULES

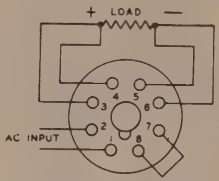
CONNECTIONS

RA SERIES

SEE NOTE


+ LOAD –
AC INPUT
1
2
3
4
5
6
7
8

LOCAL SENSING, INTERNAL ADJUST


+ LOAD —
AC INPUT
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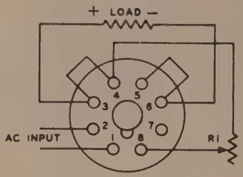
REMOTE SENSING, INTERNAL ADJUST


+ LOAD –
AC INPUT
RI
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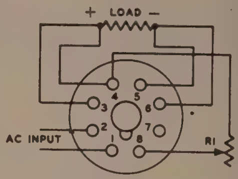
LOCAL SENSING, EXTERNAL ADJUST


+ LOAD –
AC INPUT
RI
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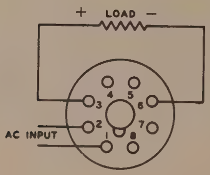
REMOTE SENSING, EXTERNAL ADJUST

RC/RD SERIES


+ LOAD –
AC INPUT
1
2
3
4
5
6
7
8

NOTE: For all models up to and including 6 amps, with octal output plug. Consult factory for 12 and 25 amp models. RI-500 ohm pot for models prefixed RA2 thru RA8, RA327 thru RA385. Use 5000 ohm pot for models prefixed RA10 thru RA295.

POWER SUPPLY WEIGHTS

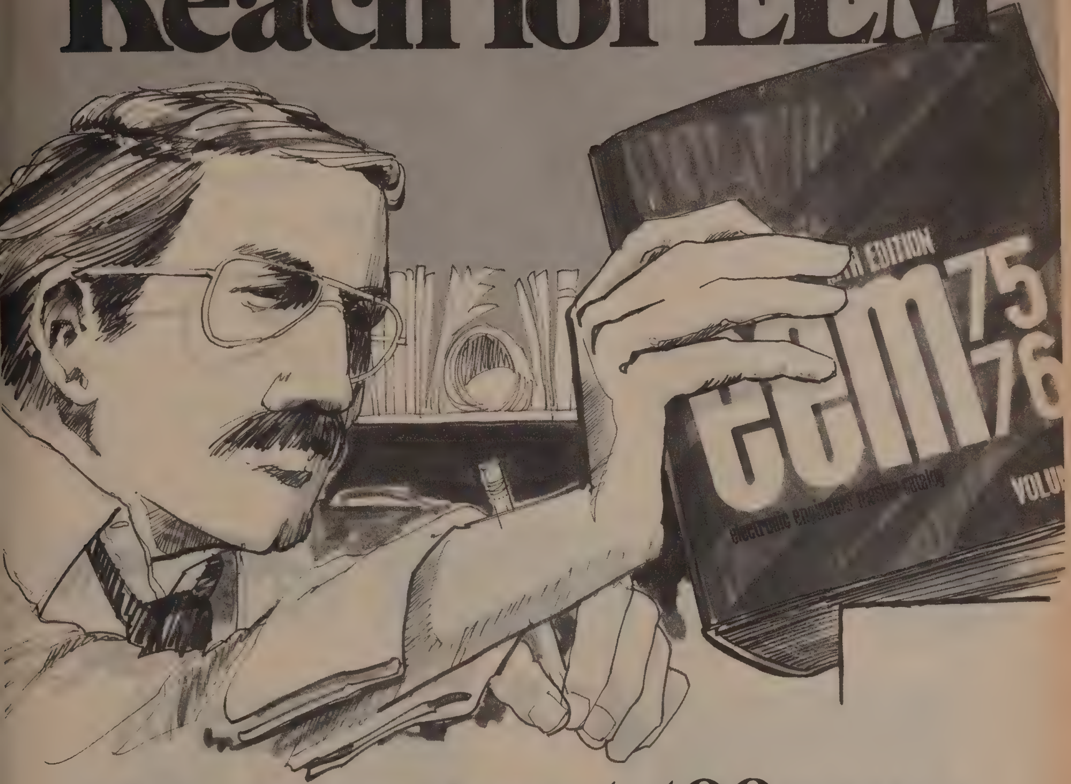
The approximate weight of POWER/MATE power supply modules is primarily determined by the case size as shown below. Consult the factory for the exact weight of any specific model.

For approximate shipping weight, increase the weights shown by one-third.

Case Size	Net Weight (pounds)
N	2¼
R	3¾
RH	4¾
BRH	5½
T	8¾
TH	9¼

There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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POWER-ONE, Inc.

(805) 484-2806
TWX 910-336-1297
531 DAWSON DRIVE • CAMARILLO, CALIF. 93010

D C POWER SUPPLIES

- 2 Year Warranty
- 2 Hour Burn In
- Full Rated to 50°C

Standard Units Feature:

Remote Sensing On All Units
105-125 VAC, 47-440 HZ Input
±.02% Regulation
Reverse Voltage Protection
Tracking on Dual Outputs

- I C Regulation
- Foldback Current Limit
- Popular Industry Sizes

HI-VOL Units Feature:

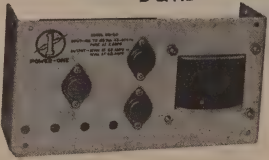
Built In OVP on 5V Units
115/230 VAC ± 10% 47-440 HZ Input
±.05% Regulation
Wider Variety of Outputs

SINGLES

B & HB

C & HC

D & HD



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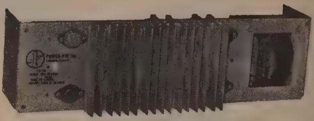
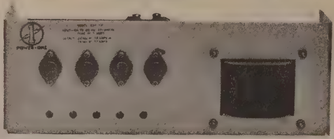


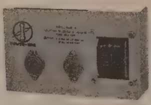
E & HE



G

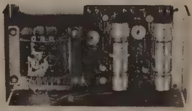
DUALS

AA & HAA



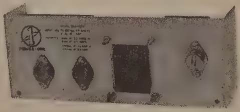
BB & HBB

CC & HCC

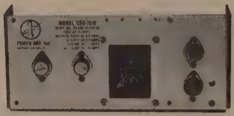


TRIPLES

BAA & HBAA



CBB & HCBB



DBB & HDBB

POWER-ONE, Inc.

(805) 484-2806
TWX 910-336-1297

531 DAWSON DRIVE • CAMARILLO, CALIF. 93010

STANDARD POWER SUPPLIES

SINGLE OUTPUT—5V-24V WITH REMOTE SENSING

MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE	
				1-9	100-249
5 VOLTS					
B5-3	5	3.0	B	$ 24.95	$ 20.00
C5-6	5	6.0	C	44.95	36.00
D5-12	5	12.0	D	74.95	60.00
E5-18	5	18.0	E	104.95	84.00
6 VOLTS					
B5-3	6	3.0	B	24.95	20.00
C5-6	6	6.0	C	44.95	36.00
D5-12	6	12.0	D	74.95	60.00
E5-18	6	18.0	E	104.95	84.00
12 VOLTS					
B15-1.5	12	1.7	B	24.95	20.00
C15-3	12	3.4	C	44.95	36.00
D15-6	12	6.8	D	74.95	60.00
E15-9	12	10.2	E	104.95	84.00
15 VOLTS					
B15-1.5	15	1.5	B	24.95	20.00
C15-3	15	3.0	C	44.95	36.00
D15-6	15	6.0	D	74.95	60.00
E15-9	15	9.0	E	104.95	84.00
18 VOLTS					
B24-1.2	18	1.3	B	24.95	20.00
C24-2.4	18	2.6	C	44.95	36.00
D24-4.8	18	5.2	D	74.95	60.00
E24-7.2	18	7.8	E	104.95	84.00
20 VOLTS					
B24-1.2	20	1.3	B	24.95	20.00
C24-2.4	20	2.6	C	44.95	36.00
D24-4.8	20	5.2	D	74.95	60.00
E24-7.2	20	7.8	E	104.95	84.00
24 VOLTS					
B24-1.2	24	1.2	B	24.95	20.00
C24-2.4	24	2.4	C	44.95	36.00
D24-4.8	24	4.8	D	74.95	60.00
E24-7.2	24	7.2	E	104.95	84.00

5V-28V to 280 WATTS

MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE 1-9	PRICE 100-249
5 VOLTS					
F5-25/OVP	5	25.0	F	$149.00	$119.00
G5-35/OVP	5	35.0	G	185.00	148.00
12 VOLTS					
F15-15	12	16.0	F	149.00	119.00
15 VOLTS					
F15-15	15	15.0	F	149.00	119.00
24 VOLTS					
F24-12	24	12.0	F	149.00	119.00
28 VOLTS					
F24-12	28	10.0	F	149.00	119.00

DUAL OUTPUT .1% TRACKING ACCURACY

MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE 1-9	PRICE 100-249
±12 VOLTS					
AA15-0.8	12/12	1.0/1.0	AA	$ 42.95	$ 34.00
BB15-1.5	12/12	1.7/1.7	BB	53.95	43.00
CC15-3	12/12	3.4/3.4	CC	84.95	68.00
±15 VOLTS					
AA15-0.8	15/15	0.8/0.8	AA	42.95	34.00
BB15-1.5	15/15	1.5/1.5	BB	53.95	43.00
CC15-3	15/15	3.0/3.0	CC	84.95	68.00

TRIPLE OUTPUT .1% TRACKING ACCURACY

MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE 1-9	PRICE 100-249
5 VOLTS and ±12 VOLTS					
BAA-40W	5/12/12	3.0/1.0/1.0	BAA	$ 69.95	$ 56.00
CBB-75W	5/12/12	6.0/1.7/1.7	CBB	91.95	74.00
DBB-105W	5/12/12	12.0/1.7/1.7	DBB	126.95	102.00
5 VOLTS and ±15 VOLTS					
BAA-40W	5/15/15	3.0/0.8/0.8	BAA	69.95	56.00
CBB-75W	5/15/15	6.0/1.5/1.5	CBB	91.95	74.00
DBB-105W	5/15/15	12.0/1.5/1.5	DBB	126.95	102.00

POWER-ONE, Inc.

(805) 484-2806
TWX 910-336-1297
531 DAWSON DRIVE · CAMARILLO, CALIF. 93010

HI-VOL POWER SUPPLIES

HI-VOL SINGLE 2V-200V 115-230 VAC INPUT

BUILT-IN OVP 5V MODELS

MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE	
				1-9	100-249
2 VOLTS					
HB2-3	2	3.0	B	$ 29.95	$ 24.00
HC2-6	2	6.0	C	49.95	40.00
HD2-12	2	12.0	D	79.95	64.00
HE2-18	2	18.0	E	109.95	88.00
5 VOLTS					
HB5-3/OVP	5	3.0	B	24.95	20.00
HC5-6/OVP	5	6.0	C	44.95	40.00
HD5-12/OVP	5	12.0	D	79.95	64.00
HE5-18/OVP	5	18.0	E	114.95	88.00
12 VOLTS					
HB12-1.7	12	1.7	B	24.95	20.00
HC12-3.4	12	3.4	C	44.95	36.00
HD12-6.8	12	6.8	D	74.95	60.00
HE12-10.2	12	10.2	E	104.95	84.00
15 VOLTS					
HB15-1.5	15	1.5	B	24.95	20.00
HC15-3	15	3.0	C	44.95	36.00
HD15-6	15	6.0	D	74.95	60.00
HE15-9	15	9.0	E	104.95	84.00
24 VOLTS					
HB24-1.2	24	1.2	B	24.95	20.00
HC24-2.4	24	2.4	C	44.95	36.00
HD24-4.8	24	4.8	D	74.95	60.00
HE24-7.2	24	7.2	E	104.95	84.00
28 VOLTS					
HB24-1.2	28	1.0	B	24.95	20.00
HC28-2	28	2.0	C	44.95	36.00
HD28-4	28	4.0	D	74.95	60.00
HE28-6	28	6.0	E	104.95	84.00
48 VOLTS					
HB48-0.5	48	0.5	B	29.95	24.00
180 VOLTS					
HB200-0.12	180	0.12	B	29.95	24.00
200 VOLTS					
HB200-0.12	200	0.12	B	29.95	24.00

HI-VOL DUAL OUTPUT

MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE 1-9	PRICE 100-249
±5 VOLTS					
HBB5-3/OVP	5/5	3.0/3.0	BB	$ 61.95	$ 50.00
HCC5-6/OVP	5/5	6.0/6.0	CC	92.95	74.00
±12 to 15 VOLTS					
HAA15-0.8	12-15/12-15	1, 0.8/1, 0.8	AA	39.95	32.00
HBB15-1.5	12-15/12-15	1.7, 1.5/1.7, 1.5	BB	49.95	40.00
HCC15-3.0	12-15/12-15	3.4, 3.0/3.4, 3.0	CC	79.95	60.00
5 VOLTS and 9-15 VOLTS (ISOLATED OUTPUTS)					
HBB512	5/9-15	3.0/1.25	BB	54.95	44.00
HCC512	5/9-15	6.0/2.5	CC	86.95	70.00

HI-VOL TRIPLE OUTPUT

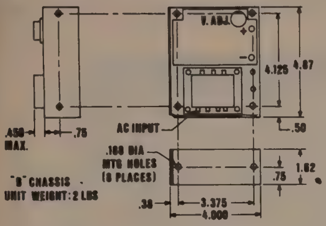
MODEL	VOLTAGE ±5%	CURRENT (AMPS)	CASE SIZE	PRICE 1-9	PRICE 100-249
5 VOLTS and ± 12 VOLTS					
HBAA-40W	5/12/12	3.0/1.0/1.0	BAA	$ 69.95	$ 56.00
HCBB-75W	5/12/12	6.0/1.7/1.7	CBB	91.95	74.00
HDBB-105W	5/12/12	12.0/1.7/1.7	DBB	126.95	102.00
5 VOLTS and ±15 VOLTS					
HBAA-40W	5/15/15	3.0/0.8/0.8	BAA	69.95	56.00
HCBB-75W	5/15/15	6.0/1.5/1.5	CBB	91.95	74.00
HDBB-105W	5/15/15	12.0/1.5/1.5	DBB	126.95	102.00

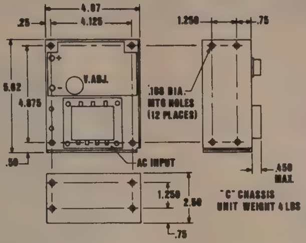
POWER-ONE, Inc.

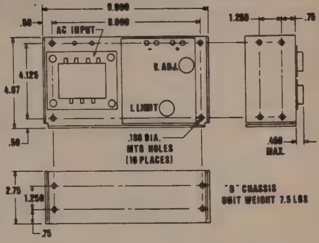
(805) 484-2806
TWX 910-336-1297

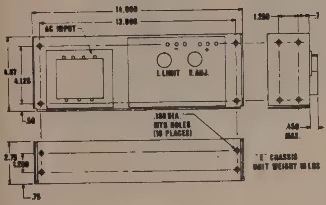
531 DAWSON DRIVE · CAMARILLO, CALIF. 93010

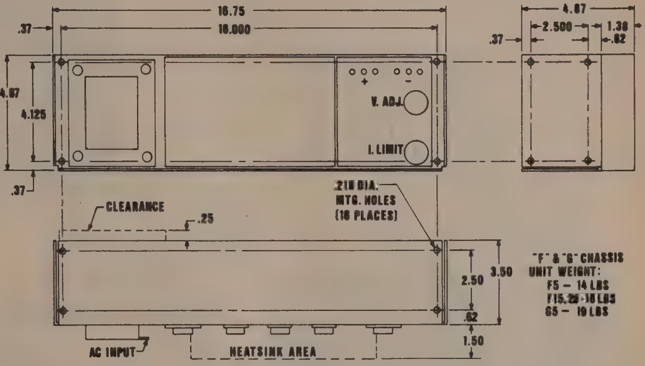
OUTLINE & MOUNTING DRAWINGS

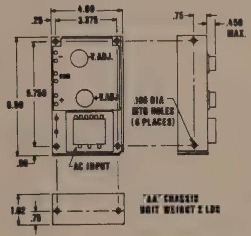

V. ADJ.
4.125
4.67
AC INPUT
.50
.450 MAX.
.75
.188 DIA MTG HOLES (8 PLACES)
1.62
.75
.38
3.375
4.000
"B" CHASSIS
UNIT WEIGHT: 2 LBS

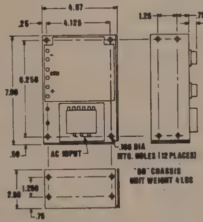

4.87
.25
4.125
1.250
.75
5.62
4.875
V.ADJ.
.188 DIA. MTG HOLES (12 PLACES)
.50
AC INPUT
.450 MAX
1.250
2.50
.75
"C" CHASSIS
UNIT WEIGHT 4 LBS

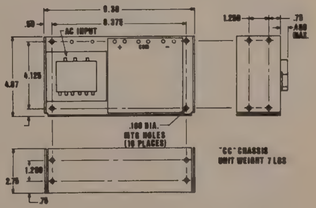

9.000
.50
8.000
AC INPUT
1.250
.75
4.125
4.67
V. ADJ.
I. LIMIT
.50
.188 DIA. MTG HOLES (16 PLACES)
.450 MAX.
2.75
1.250
.75
"D" CHASSIS
UNIT WEIGHT 7.5 LBS

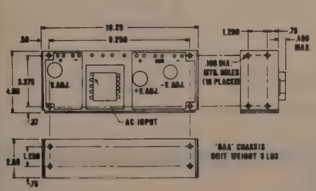

14.000
13.000
AC INPUT
1.250
.7
4.67
4.125
I. LIMIT
V. ADJ.
.50
.188 DIA. MTG HOLES (16 PLACES)
.450 MAX.
2.75
1.250
.75
"E" CHASSIS
UNIT WEIGHT 10 LBS

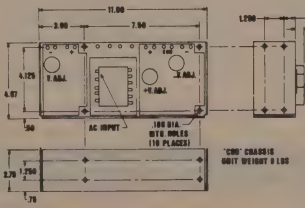

16.75
.37
16.000
4.87
2.500
1.38
.82
.37
4.67
4.125
V. ADJ.
I. LIMIT
.37
.218 DIA. MTG. HOLES (16 PLACES)
CLEARANCE
.25
2.50
3.50
.62
1.50
AC INPUT
HEATSINK AREA
"F" & "G" CHASSIS
UNIT WEIGHT:
F5 – 14 LBS
F15, 28 – 18 LBS
G5 – 19 LBS

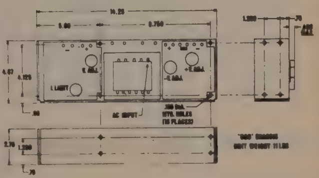

4.00
.25
3.375
.75
.450 MAX.
V.ADJ.
5.750
6.50
V.ADJ.
.188 DIA MTG HOLES (8 PLACES)
.50
AC INPUT
1.62
.75
"AA" CHASSIS
UNIT WEIGHT 2 LBS


4.87
.25
4.125
1.25
.75
.450 MAX.
6.250
7.00
.50
AC INPUT
.188 DIA MTG. HOLES (12 PLACES)
1.250
2.50
.75
"BB" CHASSIS
UNIT WEIGHT 4 LBS


9.38
.50
8.375
AC INPUT
1.250
.75
.450 MAX.
4.125
4.67
.188 DIA. MTG HOLES (16 PLACES)
1.250
2.75
.75
"CC" CHASSIS
UNIT WEIGHT 7 LBS


10.25
.50
9.250
1.250
.75
.450 MAX.
3.375
4.00
V.ADJ.
+V.ADJ.
-V.ADJ.
.188 DIA. MTG. HOLES (16 PLACES)
.37
AC INPUT
1.250
2.50
.75
"AAA" CHASSIS
UNIT WEIGHT 5 LBS


11.00
3.00
7.00
1.250
.75
.450 MAX.
4.125
4.67
V. ADJ.
+V.ADJ.
-V.ADJ.
.50
AC INPUT
.188 DIA. MTG. HOLES (10 PLACES)
2.75
1.250
.75
"BBB" CHASSIS
UNIT WEIGHT 8 LBS

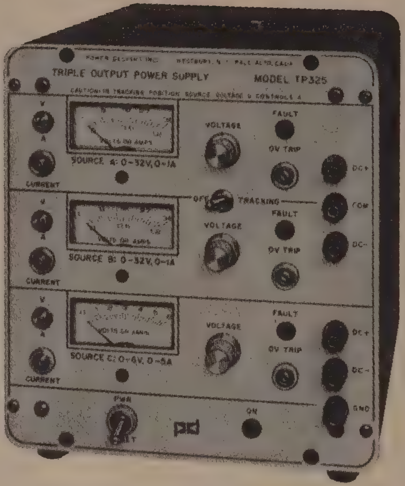

14.25
5.00
8.750
1.250
.75
.450 MAX.
4.67
4.125
V. ADJ.
I. LIMIT
-V.ADJ.
+V.ADJ.
.50
AC INPUT
.188 DIA. MTG. HOLES (16 PLACES)
2.75
1.250
.75
"CCC" CHASSIS
UNIT WEIGHT 11 LBS

See YELLOW SECTION for Local Sales Offices and Key Personnel

TECHNICAL DATA

TRIPLE OUTPUT LABORATORY POWER SUPPLY DIGITAL AND ANALOG APPLICATIONS

MODEL TP325



0-32 VDC, 0-1A*

0-32 VDC, 0-1A*

0-6 VDC, 0-5A

NOISE & RIPPLE LESS THAN 1.0 MILLIVOLT P-P

* Independent or 0.1% tracking with panel switch

features:

- No derating. All outputs may be operated simultaneously at full capacity for a maximum of 94 VA.
- Outputs are floating with respect to each other and chassis except for an internal connection between one negative terminal and one positive terminal of the 32 volt sources. The two 32 volt sources may be operated in series to provide 0-64 VDC, 0-1A in any polarity with respect to chassis or left floating. The 0-6 VDC source may be operated in any polarity with respect to chassis or left floating.
- Independent adjustment of each output voltage utilizing 10-turn potentiometers with .05% resolution.
- Separate current limiting adjustment for each output.
- Separately adjustable overvoltage crowbars on each output. Overvoltage crowbars on 0-32V outputs trip simultaneously at the lower voltage trip setting of either source.
- Three taut band suspension dual range meters individually selectable for voltage or current of each source.
- A "FAULT" indicator lamp on each output signals overload, short circuit, crowbar trip or current limit operation.
- Automatic voltage tracking of the 0-32 VDC sources to ±0.1% by means of a panel toggle switch. This switch is equipped with a locking lever to prevent accidental operation. Single potentiometer control of tracking outputs.
- Outputs may be shorted into each other in any polarity without damage.

electrical specifications:

PARAMETER:	0-32V, 0-1A (each output)	0-6V, 0-5A
INPUT:	105-125V, 55-440 Hz, 200 w	
OUTPUT:	0-32 VDC, 0-1A	0-6V, 0-5A
LOAD REGULATION:	.01% +1 MV	.01% +1MV per amp
LINE REGULATION:	.01% +0.5 MV	.01% +0.5 MV
STABILITY:	*.02% +3 MV	*.02% +3 MV
RECOVERY TIME:	**50 μs	**100 μs
CURRENT LIMIT:	10-105% of rated current	0-105% of rated current
TEMPERATURE:	0-50°C	0-50°C
TEMP. COEFFICIENT:	.02% +300 μV/°C	.02% +300 μV/°C
OV CROWBAR:	adj. 5-40V	adj. 2.5-8V
TRACKING:	.1% +5 MV by front panel switch	
SOURCE IMPEDANCE:	less than 1.0 ohm to 1 MHz	less than 1.0 ohm to 1 MHz
VOLTAGE CONTROLS:	10-turn potentiometers	single-turn potentiometer
FAULT INDICATORS:	lamp indicates short circuit and overload	lamp indicates short circuit and overload
METERING:	dual range volt/ammeter	dual range volt/ammeter

*24 hours at constant, line, load and ambient temperature.

**To recover within 15 millivolts of nominal for a 10-100% load change.

*** Both crowbars trip together independent of setting

mechanical specifications:

DIMENSIONS:	8¾″ H x 7¾″ W x 13½″ D.
WEIGHT:	20 lbs.
FINISH:	Natural anodized aluminum etched panels blue vinyl enamel cabinet, with carrying handle.

price:

$395.00

F.O.B. WESTBURY, N. Y.
Price subject to change without notice.

POWER DESIGNS

POWER DESIGNS INC.
1700 SHAMES DRIVE • WESTBURY, N.Y. 11590
Tel: 516-333-6200 • TWX 510-222-6561

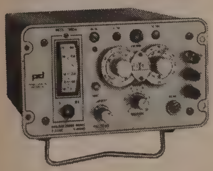
POWER DESIGNS PACIFIC INC.
3381 MIRANDA AVENUE • PALO ALTO, CALIF. 94304
Tel: 493-321-6111 • TWX 910-373-1251

CALIBRATED POWER SOURCES

CALIBRATED, STABLE, LOW NOISE, HIGH RESOLUTION POWER SOURCES FOR PRECISION LABORATORY APPLICATIONS

0-20 VDC/0-500 mA

MODEL 2005A

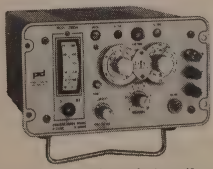


***$350.00**

• Two dual concentric switches (four decades) and a calibrated potentiometer provide digital readout to five significant figures • A toggle switch provides readout to six figures above 10 volts • Last-place potentiometer has 10 µV resolution • Source impedance is less than two milliohms at DC, less than 0.5 ohms at 1 MHz • Recovery time is less than 25 microseconds to return within a 100 µV band of the programmed voltage for an 80% load change • Front and rear access terminals.

• Better than 0.1% calibration accuracy • Critical components in temperature stabilized oven • 10 PPM plus 100 µV stability for 8 hours • Temperature coefficient better than 10 PPM or 50 µV per °C • Self-restoring overload and short circuit protection with adjustable current limit control and flashing limit indicator • 100 µV maximum peak-to-peak ripple (250 µV on Model C400) • Solid silver decade switch contacts • 100 hour minimum burn-in prior to calibration • Individual calibration data furnishd with each unit • Provisions for remote sensing and remote resistance programming at 1000 Ω/volt • Voltage or current metering.

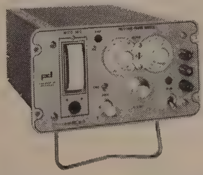
0-20 VDC/0-2 A



• Two dual concentric switches (four decades) and a calibrated potentiometer provide digital readout to five significant figures • A toggle switch provides readout to six figures above 10 volts • Last-place potentiometer has 10 µV resolution • Source impedance is less than two milliohms at DC, less than 0.5 ohms at 1 MHz • Recovery time is less than 25 microseconds to return within a 100 µV band of the programmed voltage for an 80% load change • Front and rear access terminals.

MODEL 2020A ***$395.00**

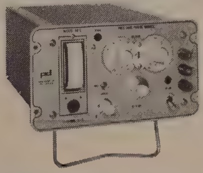
0-40 VDC/0-1 A



• Two dual concentric switches (4 decades) and a calibrated 10-turn potentiometer provide calibrated readout to six significant figures • Sixth place interpolation with 10 microvolt resolution • Dial accuracy is 0.1% plus one millivolt below one volt, 0.1% from one to forty volts • Front and rear access terminals • Bail/carrying handle tilts front panel for viewing ease • Electrical characteristics similar to Model 2005A.

MODEL 4010 ***$395.00**

0-100 VDC/0-400 mA



• Two dual concentric switches (4 decades) and a calibrated 10-turn potentiometer provide calibrated readout to six significant figures • Sixth place interpolation with 10 microvolt resolution • Dial accuracy is 0.1% plus one millivolt below one volt, 0.1% from one to 100 volts • Front and rear access terminals • Bail/carrying handle tilts front panel for viewing ease • Electrical characteristics similar to Model 2005A.

MODEL C400 ***$395.00**

PARTIAL LIST OF AVAILABLE PRECISION POWER SOURCES

Model	Range Volts	Current Amps	Regulation Line/Load	Max. Ripple Pk to Pk	Stability	TC Per °C	Size	Special Features	*Price
2005A	0-20	*0-0.5	.0005% +100 µV	100 µV	.001% +100 µV/8 hrs.	.001% or 50µV	8⅜ x 4¾ x $8\frac{27}{32}$	4 decade readout with .1% accuracy. Continuous current limiting with panel pushbutton setting. Remote grammable 1000Ω/V.	$350.00
2020A	0-20	0-2.0	.0005% +100 µV	100 µV	.001% +100 µV/8 hrs.	.001% or 50µV	8⅜ x 4¾ x $11\frac{5}{16}$	4 decade readout with .1% accuracy. Remote programmable 1000Ω/V.	$395.00
4010	0-40	0-1.0	.0005%	100 µV	.001% +100 µV/8 hrs.	.001% or 50µV	8⅜ x 4¾ x $11\frac{5}{16}$	Same as 2020A.	$395.00
C400	0-100	0-0.4	.001% +100 µV	250 µV	.001% +100 µV•8 hrs.	.001% or 50µV	8⅜ x 4¾ x $11\frac{5}{16}$	4 decade readout with 1% accuracy. Continuous current limiting. Remote programmable 1000Ω•V.	$395.00
3K10B	10-3000	0-0.01	.001% or 3 mV	3 mV	.005% +1V•8 hrs.	.005%	3 x 8½ x 11½	Calibrated readout to ¼%. Arc and short circuit proof.	$390.00

POWER DESIGNS

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POWER DESIGNS PACIFIC INC.
3381 MIRANDA AVENUE ■ PALO ALTO, CALIF. 94304
Tel: 493-321-6111 ■ TWX 910-373-1251

HIGH VOLTAGE POWER SOURCES

CALIBRATED POWER SOURCES FOR PHOTOMULTIPLIER PROPORTIONAL AND SOLID STATE DETECTORS, ELECTRON OPTICS, LASERS, CRT DISPLAYS

MODEL 1556B

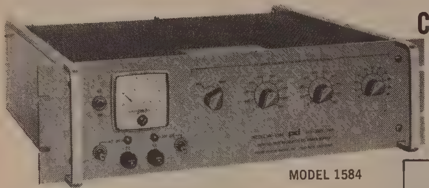
Calibrated high voltage power sources supplying tightly regulated DC for critical applications where stability, low noise and reliability are of prime consideration. • .25% calibration accuracy • 10 MV resolution • Sealed transformers and rectifiers • Self-restoring overload and short circuit protection • All solid state except for "Series" Pass Tube • Voltage and current metering.

PARTIAL LIST OF AVAILABLE UNITS

Model	Voltage	Current mA	Regulation Line or Load	Ripple Pk to Pk mV	Size Panel Ht.	*PRICE
2K20	1-2012	0-20	0.001% +2 mV	1.0	3½	$350.00
1570	1-3012	*0-40	0.001% +2 mV	1.0	5¼	$575.00
1556B	10-6021	0-20	0.001% +2 mV	1.0	7	$675.00
1543A	10-10021	0-10	0.001% +2 mV	5.0	10½	$995.00
****3K10B**	10-3000	0-10	.001% +3 mV	3.0	3.0	$390.00

**All Solid State. Write for specification sheets.
*Adj. current limiting 5-40 mA.

CALIBRATED POWER SOURCES FOR ELECTRON GUN, ION PROBE, SCANNING ELECTRON MICROSCOPE, MASS SPECTROMETER APPLICATIONS



MODEL 1584

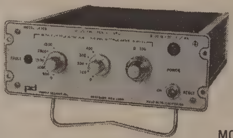
• High Stability: 25 PPM/hour, 100 PPM/day • Regulation: .0025% • Calibration Accuracy: 0.25% • Temperature Coefficient better than 50 PPM/°C • All high voltage circuits vacuum encapsulated in specially formulated epoxy to provide corona-free operation under adverse environmental conditions • Arc, overload and short circuit protection • Optional overvoltage protection • 50 KV mating connector supplied.

PARTIAL LIST OF AVAILABLE UNITS

Model	Output Voltage	Output Current	Ripple Pk to Pk	Polarity	*PRICE
1584	1 kV to 20 kV	0-3 mA	250 mV	Positive	$1950.00
1584R	1 kV to 20 kV	0-3 mA	250 mV	Reversible	$2325.00
1584M-5	1 kV to 20 kV	0-5 mA	250 mV	Positive	$2125.00
1584M-10	1 kV to 20 kV	0-5 mA	250 mV	Negative	$2175.00
1579	10 kV to 30 kV	0-1 mA	250 mV	Positive	$2325.00
1579R	10 kV to 30 kV	0-1 mA	250 mV	Reversible	$2700.00

PHOTOMULTIPLIER HIGH VOLTAGE CALIBRATED POWER SOURCE

10-3000 VDC 0-10 MA



MODEL 3K10B

The Model 3K10B is a calibrated laboratory power source ideally suited for photomultiplier and similar applications requiring high stability, low noise and superior regulation.

This all solid-state supply achieves high efficiency and unusually compact construction through the use of high frequency technology.

The Model 3K10B incorporates proprietary overvoltage and arc protection circuitry which prevents damage to the supply and its load in the event of failure or voltage transients generated by sustained arcing at the load. The power supply is automatically shut off and a fault indicator illuminated. Normal function is restored by turning the AC switch off then on again.

The Model 3K10B may be remote resistance or voltage programmed over its entire range. It may also be programmed over a limited range around a preset voltage by an analog signal to provide automatic amplitude or drift compensation control for a photomultiplier tube system. (See options.)

The power supply may be operated in either positive or negative output polarity by means of a reversing switch on the rear of the unit.

Two paralleled Safety High Voltage (SHV) BNC connectors provide dual output or meter monitoring at the rear panel. These connectors are National Bureau of Standards approved per DWG ND-545A.

High voltage transformers and critical circuit elements are environmentally isolated in vacuum encapsulated epoxy modules.

Model	Range Volts	Current Amps	Regulation Line/Load	Max. Ripple Pk to Pk	Stability	TC Per °C	Size	Special Features	*Price
3K10B	10-3000	0-0.01	.001% or 3 mV	3 mV	.005% +1V•8 hrs.	.005%	3 x 8½ x 11½	Calibrated readout to ¼%. Arc and short circuit proof.	$390.00

POWER DESIGNS

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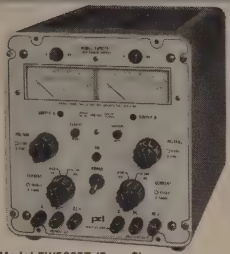
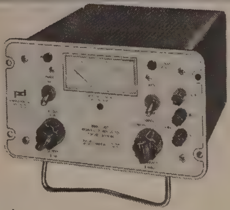
1700 SHAMES DRIVE ■ WESTBURY, N.Y. 11590
Tel: 516-333-6200 ■ TWX 510-222-6561

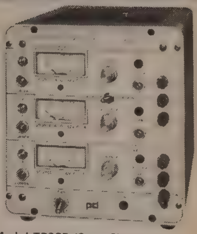
POWER DESIGNS PACIFIC INC.
3381 MIRANDA AVENUE ■ PALO ALTO, CALIF. 94304
Tel: 493-321-6111 ■ TWX 910-373-1251

LABORATORY/MODULAR POWER SUPPLIES

Model 5015T (Case B)
5¾″ w x 8⅝″ h x 10⅞″ d


Model TW5005T (Case C)
7¾″ w x 8⅝″ h x 13½″ d


Model 5005T (Case A)
8⅜″ w x 4¾″ h x 9″ d


Model TP325 (Case C)
7¾″ w x 8⅝″ h x 13½″ d

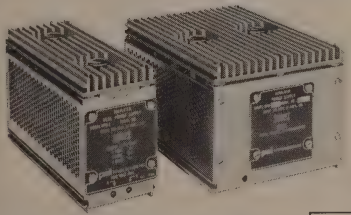
• Laboratory workhorse power supplies with over 12 years of field history • Continuously adjustable voltage, current or current limiting controls with limiter or current mode indicating lamps • No RFI generating SCR or switching circuits • Modular package construction suitable for bench or rack mounting • Processed under a "Predictable Reliability" Program for 5-year minimum operation to published specifications. This program features: Avalanche-controlled rectifiers, 100% stress testing of transistors, pre-aged zener references with maximum I/F noise specifications, computer grade capacitors, low T.C. 1% tin oxide film resistors in critical circuits, etc. • Supplies are burned in under full load for a minimum of 50 hours prior to test.

PARTIAL LIST OF AVAILABLE UNITS

Model	Voltage	Current Amps.	Voltage Regulation	Current Regulation	Ripple Pk to Pk mV	Case	*PRICE
5005T	0-50	0-0.5	0.005% +1 mV	better than 500 µA	1.0	A	$164.50
2015R	0-20	0-1.5	+0.03% or 5 mV†	0.02% or 200 µA	1.0	A	$175.00
5015T	0-50	0-1.5	+0.01% or 3 mV†	current limit only	1.0	B	$249.00
TW5005T (dual)	0-50, 0-.5 A each output 0-100 at 0.5 A series 0-50 at 1.0 A parallel		each output same as 5005T	each output same as 5005T	1.0	C	$319.00
4050	0-40	0-5.0	0.01% +3 mV	current limit only	3.0	C	$349.50
1120S	0-120	0-1.0	0.01% +3 mV	current limit only	1.0	C	$349.50
***TP325 Triple Output**	**0-32	0-1A	.01% +1 mV	adj. current limit	1.0	C	$395.00
	**0-32	0-1A	.01% +1 mV	adj. current limit	1.0		
	0-6	0-5A	.01% +1 mV per amp	adj. current limit	2.0		

†Whichever is greater
*Built-in adj. overvoltage crowbar

**Tracking or non-tracking operation by panel switch
Common output terminal



REDULE® UNIVERSAL MODULAR POWER SUPPLIES

• Single or dual outputs with choice of several output voltage levels in one package • Multi-turn incremental voltage adjustment potentiometer • Parallel or series operation with any terminal at ground potential • Remote sensing • Remote programming • Self-restoring fold-back overload and short protection • Thermal overload cutout • 100% inspected "reliability controlled" silicon semiconductors • 50 hours power supply pre-aging prior to test • 50 µs recovery time • 105-125 V, 57-440 Hz input • Mounts in any plane, to any surface • No external heat sink required • Connector keying system prevents mating errors • Complete maintainability, reliability and workmanship to most military standards • 0-60°C operating range.

PARTIAL LIST OF AVAILABLE UNITS

MODEL	OUTPUT RATING	NUMBER OUTPUTS	REGULATION LINE/LOAD	MAX. RIPPLE PK TO PK	INPUT POWER @ NOM. LINE	†PRICE
UPM-6	24V @ 1½A, 27V @ 1¼A, 30V @ 1A	1	.01% + 2mv	1mv	90w	$157.50
UPM-11	0-16V @ 1A	2	.01% + 1mv	1mv	80w	199.00
UPM-16*	5, 6V @ 5A	1	.01% + 2mv	1mv	85w	169.00
UPM-22	16-30V @ ½A, 30-60V @ ¼A	2	.01% + 1mv	1mv	70w	199.00
UPM-33	0-16V @ 2A	1	.01% + 1mv	1mv	80w	147.50
UPM-44	16-30V @ 1A, 30-60V @ ½A	1	.01% + 1mv	1mv	70w	147.50
UPMD-10	24V @ 3A	1	.04% + 2mv	2mv	180w	180.00
UPMD-11B	±15V @ 1A (precision tracking)	2	100 µv	150 µv	85w	275.00
UPMD-15	15V DC @ 2A	2	.01% + 2mv	1mv	125w	265.00
UPMD-15V	Same as UPMD-15 with overvoltage crowbar protection					290.00
UPMD-X9	100V DC @ ¼A	2	.03% + 1mv	1mv	90w	260.00
UPMD-56A*	5, 6V @ 10A	1	.01% + 2mv	1mv	170w	225.00
FPM-101	±15V @ 1A (precision tracking)	2	.01%	1mv	65w	164.00

*Includes built-in overvoltage crowbar protection.

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Uniply®

A Laboratory of Power Supplies in a Single Package

The UNIPLY® principle involves a regulator technique that provides a general purpose power source functionally replacing four conventional power supplies.

The regulator system comprises a number of unregulated DC sources, a number of power semiconductors selected for optimum voltage and current characteristics and a single control amplifier which selects through "OR" gates that combination of unregulated source and power semiconductors that satisfy the demands of the load and the panel control settings with minimum power supply losses.

Ranging is automatic and transient-free. Operation is electronic, without relays or manual switching and utilizes linear circuits only. No triacs, SCR's or switching circuits are employed.

A built-in front panel continuously adjustable overvoltage "crowbar" in conjunction with an inhibit switch limiting the automatic ranging to 6 volts provides completely safe operation with digital circuit loads. The UNIPLY® technique permits increased power supply capability with increasing AC line voltages. Up to 150% of panel ratings is available at line voltages over 105 volts. Useful output at reduced levels is available at line voltages as low as 85 volts. A flashing panel indicator signals loss of regulation if load demands exceed the regulator capability or AC input voltages are inadequate. Two voltage and current ranges are provided on the taut-band suspension panel meter to increase resolution. Ranges switch automatically with range switch setting.

Model 6050A: 0-7V at 5A / 0-15V at 3A / 0-25V at 2A / 0-60V at 1A *$229.00

SPECIFICATIONS

Input: 105-125 volts, 57-440 Hz, 100 watts nominal.

Line Regulation: 0.01% + 1 millivolt.

Load Regulation: 0.01% + 1 millivolt for load variations from 0-100% of rated output current.

Polarity: Either positive or negative output terminal may be operated at ground potential

Ripple and Noise: Less than 1 millivolt peak-to-peak.

Source Impedance: <0.005 Ω at DC, 0.1 Ω to 20 KHz, 1.0 to 1 MHz.

Recovery Time: Less than 50 microseconds to return to within a 15 millivolt band of the original voltage for a step change in rated load of 10% to 100% (1 microsecond rise time).

Stability: 0.02% +3 millivolts per 24 hours.

Operating Temperature: 0-50°C at full load. Storage: −20°C to +85°C.

Temperature Coefficient: 0.02% per degree C.

Current Limiting: Concentric switch/potentiometer provides continuous adjustment in two ranges: 0-500 milliamperes, 0-5 amperes.

Metering: Front panel taut-band meter and a selector switch permit monitoring voltage or current with an accuracy of ±3% of full scale. Voltage ranges 0-6V/0-60V change automatically with voltage range control. Current ranges 0-500 mA/0-5A change automatically with current range control.

Output Terminals: Front Panel: Three binding posts for positive, negative and ground.

Rear Panel: Seven terminal barrier strip for output voltage, sensing, voltage programming and parallel operation.

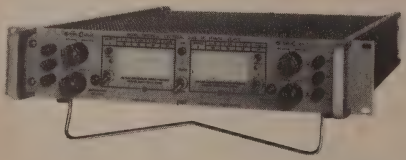
Dimensions: 8⅜" wide x 4¾" high x 11⁹⁄₁₆" deep.

Weight: 15½ lbs.

Overvoltage Crowbar: Built-in overvoltage crowbar adjustable from 2.0 V to 70 V from the front panel.

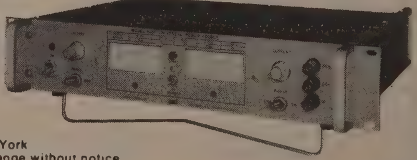
Model TW6050A: TWO MODEL 6050A SOURCES IN A 3-1/2" x 19" RACK MOUNTING PACKAGE *$449.00

More compact than two Model 6050A units, the Model TW6050A offers two independent sources which are electrically identical to the Model 6050A, but permit series operation to 120 V at 1 ampere or parallel operation to 7V at 10 amperes.



Model 6150: 0-7V at 15A / 0-15V at 7.5A 0-25V at 5A / 0-60V at 2A *$350.00

The Model 6150 offers more than twice the output power of the Model 6050A, with essentially the same electrical characteristics. Two taut-band meters are provided. Each instrument has two voltage and current ranges 0-6V/0-60V, 0-1.5A/0-15A. Ranges switch automatically with range switch setting. The Model 6150 mounts in a 19" rack, measures 3½" H x 16"D and is suitable for laboratory bench operation as well.



* FOB Westbury, New York
Prices subject to change without notice.

POWER DESIGNS

POWER DESIGNS INC.
1700 SHAMES DRIVE ▪ WESTBURY, N.Y. 11590
Tel: 516-333-6200 ▪ TWX 510-222-6561

POWER DESIGNS PACIFIC INC.
3381 MIRANDA AVENUE ▪ PALO ALTO, CALIF. 94304
Tel: 493-321-6111 ▪ TWX 910-373-1251

MODEL 6050A
UNIPLY
UNIVERSAL POWER SOURCE
FAULT
POWER ON
RESET
OUTPUT RATING
0-7V 5A
0-15V 3A
0-25V 2A
0-60V 1A
VOLTAGE AND CURRENT SWITCH POSITIONS INDICATE METER SCALE RANGE
METER
VOLTAGE
0V
60V
OVERVOLTAGE CROWBAR
CURRENT LIMIT
DC +
DC −
G
POWER DESIGNS INC.
WESTBURY, N.Y. PALO ALTO, CALIF.

Power Designs *Uniply® is a laboratory of new power supplies

0-7V at 5A | 0-15V at 3A | 0-25V at 2A | 0-60V at 1A

UNIQUE REGULATOR CONCEPT FEATURES:

- Multi-range output with automatic electronic ranging
- Useful power output up to 150% of ratings at line voltages over 105 VAC
- Flashing light signals regulator inability to support increased power output levels
- Continuous operation into an overload or short circuit without damage
- Four range, taut-band panel meter
- Front panel adjustable overvoltage crowbar
- Performance of a high quality regulated DC source: .01% regulation, 1 mv peak-to-peak noise and ripple, etc.

Model 6050A . . . . **$229.**

*PAT. [illegible]

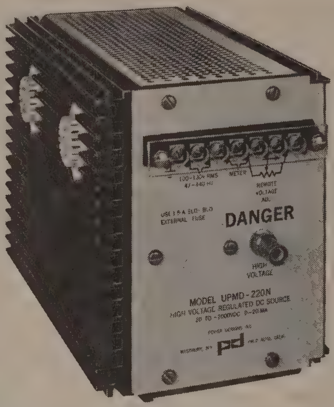
Write or call for detailed specifications.

Other Models Available

power designs inc.

WESTBURY, NEW YORK:
1700 Shames Drive, Westbury, New York 11590
Tel: 516-333-6200 • TWX 510-222-6561
PALO ALTO, CALIFORNIA:
3381 Miranda Avenue, Palo Alto, California 34303
Tel: 415-493-6111 • TWX 910-373-1251

MODULAR HIGH VOLTAGE PRECISION POWER SOURCES



10-2000 VDC, 0-20 MA
10-3000 VDC, 0-10 MA
10-5000 VDC, 0-5 MA

The UPMD series of high voltage sources are compact modular units designed for critical applications where high stability, low noise and flexibility of output voltage control are important considerations.

They are ideal for such applications as photomultipliers, Geiger-Muller counters, proportional detectors, CRT sources, high resolution video displays, electrostatic lenses, etc.

Remote control of the high voltage output is achieved by means of an external potentiometer operating at low potentials with respect to ground. Output voltage resolution is a function of the resolution of this control. Options are available for remote voltage control at any desired input/output voltage ratio or for digital operation with an external D/A converter.

A unique overvoltage/arc suppression system is incorporated to protect the supply and its load in the event of loss of output voltage control or an overvoltage due to L di/dt transients generated by sustained load arcing. The circuit operates to clamp the output voltage to approximately 200 volts above any setting, hold this clamp for approximately two seconds and shutting down the supply electronically if the fault persists. The supply may be manually reset by momentary interruption of the AC line.

An internal 1% multiplier permits connection of an external meter for monitoring. A zener diode across the metering terminals minimizes shock hazard.

The compact size (4½″ x 6″ x 7½″), excluding the high voltage connector and light weight (8 lbs.) is achieved through the use of high frequency inverter technology in conjunction with a fast series regulator. RFI and EMI is held to low levels through the use of careful shielding and low pass AC line and DC output filters.

High voltage transformers and high voltage components encapsulated in readily replaceable epoxy modules. Low voltage components are accessible on epoxy coated PC boards.

An SHV (Safety High Voltage) BNC receptacle is utilized for the output voltage. A mating connector is furnished with each unit.

Characteristics

INPUT: 105-125 V, 47-440 Hz, 60 w (115 V line)

OUTPUT: See Table

REGULATION: .001% or 10 MV (whichever is greater), for line or load variations.

NOISE AND RIPPLE: 10 MV peak-to-peak to 1 MHz

STABILITY: Less than .01% or 15 MV (whichever is greater)

TEMPERATURE: 0-50°C

TEMPERATURE COEFFICIENT: Less than 50 PPM/°C

PROTECTION: Current limiter and overvoltage system limits output to safe levels.

SIZE: 4½″ x 6″ x 7½″

WEIGHT: 8 lbs.

MOUNTING: In any plane

Table

MODEL	*OUTPUT POLARITY	VOLTAGE RANGE	OUTPUT CURRENT	**UNIT PRICE
UPMD-220N	NEGATIVE	10-2000 VDC	0-20 MA	$385.00
UPMD-220P	POSITIVE	10-2000 VDC	0-20 MA	395.00
UPMD-310N	NEGATIVE	10-3000 VDC	0-10 MA	385.00
UPMD-310P	POSITIVE	10-3000 VDC	0-10 MA	395.00
UPMD-550N	NEGATIVE	10-5000 VDC	0-5 MA	440.00
UPMD-550P	POSITIVE	10-5000 VDC	0-5 MA	450.00

*Corresponding output terminal connected to chassis. **Subject to change without notice. FOB Westbury, N.Y.

OPTIONS		
	1. Remote voltage programming (specify ratio)	**$50.00**
	2. Isolation up to 250V above chassis	**$50.00**

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3381 MIRANDA AVENUE ▪ PALO ALTO, CALIF. 94304
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TECHNICAL DATA

*NIM POWER SOURCES

***Per TID-20893, Rv. 4, Dtd JULY 1974, "STD. NUCLEAR INSTRUMENT MODULES"**

BIN POWER SOURCES

AEC-320-5A

The Model AEC-320-5A conforms to the requirements for a Type 1, Class A nuclear instrument modules bin power supply per TID-20893 (Rev. 4).

Plus... no power derating is necessary in this unit which can supply a full 96 va instead of the 72 va maximum rating of the specification.

Power input and output routing connectors permit interbin bussing of voltages not available in the power supply. An internal connector permits the field addition or removal of the routing connector assembly making it available as an option.

The Model AEC-320-5A provides four regulated outputs: ±12VDC at two amperes each and ±24VDC at 1 ampere each.

Special discounts are available to AEC laboratories, cost contractors and research and educational institutions.

AEC-320-7

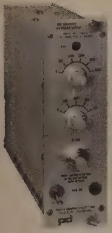
The Power Designs Model AEC-320-7 conforms to the requirements of a Type IV Bin Power Supply per TID-20893 (Rev. 4).

It provides three regulated outputs: ±6VDC at 10 amperes from either source and +12VDC at one ampere, with a maximum supply output rating of 72 VA. Built-in over-voltage crowbar circuits protect modules against damage.

Power input and output routing connectors permit interbin bussing of voltages not available in the power supply. An internal connector permits the field addition or removal of the routing connector assembly making it available as an option.

The Model AEC-320-7 is manufactured to the high quality standards demanded by on-line nuclear instrumentation. Discounts are available to AEC laboratories, cost contractors, research and educational institutions.

HIGH VOLTAGE PHOTOMULTIPLIER AND SOLID STATE DETECTOR SOURCES



MODEL AEC-315B

10-3000 VDC 0-10 MA

The Model AEC-315B is a calibrated high voltage power supply designed for use with photomultiplier systems requiring a high stability, low noise, well regulated power source. It mounts in a standard 8¾″ NIM Bin, and occupies two module widths. It is supplied with an integral three-wire power cord and NEMA plug and does not use the NIM Bin Power Supply.

Input: 103-129 VAC, 47-440 Hz, 65 watts

Calibration Accuracy: 0.25% of the dial settings from 500-3000 volts.

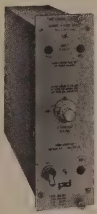
Resolution: 50 millivolts (10-turn vernier potentiometer with 100 volt range).

Noise and Ripple: 3 millivolts peak-to-peak to 15 MHz.

Regulation: .001% or 3 millivolts, whichever is greater, for line or load variations.

Stability: Drift is less than 100 PPM or 10 millivolts per hour, whichever is greater.

***$390.00**



MODEL AEC-1000

0-3000 VDC 0-1.0 MA

The Model AEC-1000 is a continuously adjustable, calibrated 0-3000 VDC power source designed for solid state nuclear detector applications where extremely low noise levels are necessary to avoid degradation of timing and energy level resolution. The high voltage output is guarded against stray fields and isolated from chassis to minimize ground loop and common mode noise.

Input: ±24 VDC, 200 mA, ±12 VDC, 35 mA derived from a standard Type 1, NIM Bin Power Source.

Regulation: Better than one ppm for input voltage variations (with a Type 1, Class A power supply) and better than 10 ppm/100 μA load change.

Noise and Ripple: Less than one mV peak-to-peak to 50 MHz. Linear circuits are used in the high voltage generating system.

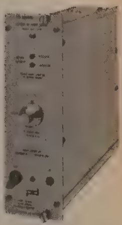
Calibration: 10-turn direct reading dial with an accuracy of better than 1% of maximum output voltage.

Stability: Output voltage drift is less than 50 ppm per hour and less than 200 ppm per day at constant load and ambient temperature after one hour warm-up.

***$375.00**

0-5000 VDC 0-0.5 MA

The Model AEC-5000 is a high voltage calibrated modular power source for operation with high resolution solid state detectors where low noise and stability is a prime consideration. The instrument occupies two module widths in a standard NIM Bin and operates from the ±24 VDC sources provided by the Bin power supply.



MODEL AEC-5000

Input: ±24 VDC, 165 MA for 100 μA output, 250 MA for 500 μA output derived from a standard Type 1 NIM Bin Power Supply.

Regulation: Better than one ppm for input voltage variations and better than 10 ppm/100μA load change.

Noise and Ripple: Less than one mV peak-to-peak to 50 MHz.

Calibration: 10-turn direct reading dial with an accuracy of better than 1% of maximum output voltage.

Stability: Output voltage drift is less than 50 ppm per hour and less than 200 ppm per day.

***$450.00**

*Prices subject to change without notice • F.O.B. Westbury, N.Y.

POWER DESIGNS

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9168 DeSoto Ave., Chatsworth, Calif. 91311
(213) 882-0004 • TWX (910) 494-2092

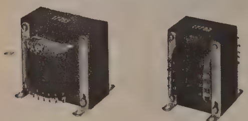
- Write or phone for complete details
- Prices and specifications subject to change without notice

From $15

SM SERIES Sub-Modular DC power supplies function as building-block power components for user in-house assembly of power supplies or custom requirements. 10 basic power packages, with 60 models to choose from — 1.2V to 30V, up to 75A. **FEATURES:** Built-in rectifier, filter, regulator, OVP • Adjustable voltage, current limit, OVP • Logic inhibit function • Remote sensing and programming • Computer-grade capacitors • UL recognized

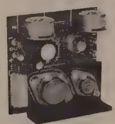
Contact factory

PK SERIES SM Series sub-modular power supplies combined with a single or multiple output transformer provide an almost unlimited variety of multiple output systems in power assembly kits. **FEATURES:** Minimum number of components • Completely engineered, tested, and documented • Maximum form factor flexibility • Easily spared and maintained • Sub-modules and transformer are only components • Minimal assembly costs



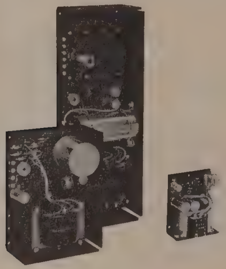
From $15

PT SERIES Power transformers provided with multi-tapped primaries and secondaries, each capable of powering any one of six SM Series sub-modules within the series for which it is rated. 60 different outputs available from 7 basic package sizes. **FEATURES:** 47-440 Hz operation • Low interwinding capacitance, primary to secondaries • Electrostatic shielding • Highest grade commercial materials used throughout • Lower cost than custom designs • Off-the-shelf delivery



From $16.95

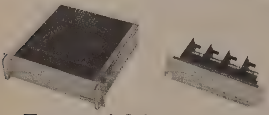
DCR SERIES Complete DC voltage regulators designed for use in custom DC power supplies or as point of load regulators in industrial or commercial OEM applications. For regulation of voltages up to 24 VDC and currents up to 12 amps.
FEATURES: 90/180 watt power rating • 6 models available in one mini-package size • Variable voltage output offers exceptional versatility • Excellent power/cost ratios • No external components required



From $24.95

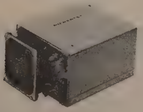
NEW EXPANDED LINE

OEM II SERIES The all-new second generation open-frame series regulated DC power supplies offering a total of 6 new packages and 54 new models. For a wide range of low and high power requirements, 70 different single outputs are available in 10 basic sizes. For analog and digital circuit requirements, there are 24 multiple output models to choose from, including 6 different packages and both dual and triple output configurations.
FEATURES: IC regulated design • Remote sensing and programming • Computer Grade capacitors • Adjustable current limiting • Metal film resistors • All hermetic semiconductors • 100% computer tested • Multi outputs fully isolated and interconnectable in any positive/negative configuration • Off-the-shelf delivery



From $60

PRA SERIES Rack Adapters in rugged all-steel frame construction with brushed aluminum front panels and handles. Unique interpanel configuration will accept almost any combination of single and multiple output OEM Series power supplies. **FEATURES:** Depths of 14", 17.5", and 21". • Standard 5¼" x 19" rack compatible • Hole pattern for standard 4½" fan • Input/output terminal strip hole patterns

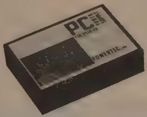


$695

SS SERIES Super Switchers incorporating transistor switching power supply design. Up to 24 V, up to 120 A. High efficiency enables size and weight improvement over present series regulator, SCR and phase control techniques. **FEATURES:** Over 3 years field proven • Efficiency up to 80% • Weight 15 lbs • 48-hour burn in • Logic inhibit function • Parallel operation of up to 5 units • High thruput fan, cooler operation • "Motherboard" eliminates cable harnessing • Delivery from stock

From $145

CR SERIES SCR regulated DC power modules for brute force applications at lowest possible cost. Up to 50V, up to 24A, with wide range adjustable output.
FEATURES: New simplified design • Variable outputs, 12 to 50 VDC • Open chassis with rugged, reliable construction • Top quality components throughout • Efficiency exceeding 75%

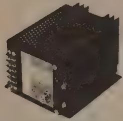


From $25

PC SERIES Fixed DC voltage card-mounted power supplies offering high performance and proven reliability in 12 miniature encapsulated models. Ideally suited for linear and digital IC applications.
FEATURES: Single or dual output models • Output ratings from 5 to 24 VDC • Current ratings from 50 mA to 1000 mA • Card mountable • Rugged construction • Low cost • Versatile design for wide application

From $49

XR SERIES Low-profile regulated DC power modules in single, dual, and wide range output models. 36 different outputs are available from three basic case sizes—up to 36V, up to 3A.
FEATURES: Highest grade military and computer components throughout • Main frame, peripheral, and instrument and test equipment rated • Fully adjustable and Nixie® models • Series regulated modular design • Built-in OVP

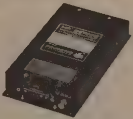


From $120

SR SERIES High-temperature rated, series regulated DC power modules provide outstanding power/cost ratios. 32 different outputs are available in four basic case sizes.
FEATURES: Up to 28V, up to 35A • Modular design, rugged construction • Built-in OVP • Main frame, peripheral, instrument and test equipment rated • 55°C rated • Highest grade components throughout

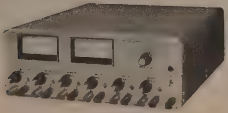
From $495

SX SERIES Series regulated DC power supplies in two full-rack mountable power packages—3½" and 5¼" high. 15 different models to choose from—up to 28 V, up to 120 A.
FEATURES: 115/208/230 VAC input • Master/slave operation of up to 3 units • Logic inhibit function • OVP and thermal overload protection • Remote programming • Fully metered output voltage and current



From $475

HP SERIES Militarized series regulated DC power modules designed to meet airborne specifications. Units are flat pack modular design for airborne applications.
FEATURES: Up to 28 V, up to 120 A • 30 different models • No switching spikes or RFI problems • Excellent power/cost ratios • Maximum power density up to 5 watts/in^3



From $295

LAB SERIES Single, triple and six output models with high power density, maximum convenience and versatility in a portable and attractive package.
FEATURES: R and D precision and accuracy • Small size, low weight • Least dollars per watt for lab supply • Self-locking bail bar, all models • Proven design for reliable performance

From $195

SMI SERIES DC-AC Inverter power systems providing custom power performance at standard off-the-shelf prices. May be used as a completely self-contained unit or as a "building block" for a complete DC to DC converter system. **FEATURES:** 3 power packages—150, 300, and 600 W outputs • 9 different models • Wide input range, nominal 24, 48 or 120 VDC input • Single or multiple outputs • Switching regulator for high efficiency • Modular design for high reliability • 500 Hz square wave output

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D. C. POWER SUPPLIES

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Reliability, Inc. DC-DC POWER SOURCES

DC-DC POWER SOURCES

Use your normal DC bus to supply voltage for RAM's, MOS, OpAmps, and other ICs.

COMPACT

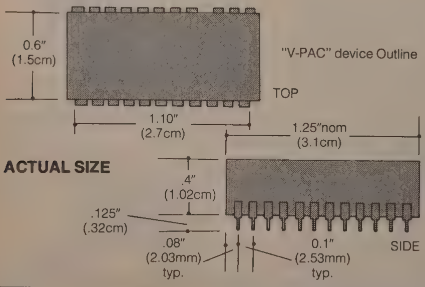
Small as 0.3 cubic inch. (4.1 cu.cm.)

Reliability, Inc.
VP 12/12

V-PAC* POWER SOURCES

- *INPUT:* 5 or 12v DC
- *OUTPUTS:* Single or dual, from 5 to 15v DC, regulated and unregulated.
- *OUTPUT POWER:* 1 watt, total
- *ISOLATION:* 10 Megohms at 50v
- *NOISE:* 100 mv max., P-P, regulated; 50 mv RMS, unregulated
- *EFFICIENCY:* 50% min. at full load
- *OPERATING TEMPERATURE:* 0 to 70°C, still air
- *SHORT CIRCUIT PROTECTION:* All units
- *PACKAGE:* Compatible with standard 24 pin DIP sockets, or mount directly to PC card

PACKAGE DIMENSIONS



UNREGULATED

5v DC INPUT

PART TYPE:	OUTPUT VOLTAGE (v DC):	OUTPUT CURRENT (ma):	UNIT PRICE (1 to 9):
VA 12-12	±12	80	$27.75
VA 12-6	+12, −6	80	27.75
VA 15-15	±15	70	27.75
VP 5	5	200	27.75
VP 10	10	100	27.75
VP 12	12	80	27.75
VP 15	15	70	27.75
VP 12/12	12,12	80	33.25
VP 15/15	15,15	70	33.25

12v DC INPUT

PART TYPE:	OUTPUT VOLTAGE (v DC):	OUTPUT CURRENT (ma):	UNIT PRICE (1 to 9):
V12A 12-12	±12	80	$27.75
V12A 12-6	+12, −6	80	27.75
V12A 15-15	±15	70	27.75
V12P 5	5	200	27.75
V12P 10	10	100	27.75
V12P 12	12	80	27.75
V12P 15	15	70	27.75
V12P 12/12	12, 12	80	33.25
V12P 15/15	15, 15	70	33.25

REGULATED

Outputs may be connected as positive or negative. Output voltage tolerance is ±5%, with line regulation ±.2%, and load regulation 150 mv, no load to full load. Output ripple is 100 mv P-P, max. over 20 mHz bandwidth. Temperature coefficient is ±3 mv/degree C.

5v DC INPUT

PART TYPE:	OUTPUT VOLTAGE (v DC):	OUTPUT CURRENT (ma):	UNIT PRICE (1 to 9):
V5R 3	3	90	$33.25
V5R 5	5	100	33.25
V5R 9	9	90	33.25
V5R 12	12	80	33.25
V5R 15	15	65	33.25
V5R 15-15	±15	65	38.20

12v DC INPUT

PART TYPE:	OUTPUT VOLTAGE (v DC):	OUTPUT CURRENT (ma):	UNIT PRICE (1 to 9):
V12R 3	3	90	$33.25
V12R 5	5	100	33.25
V12R 9	9	90	33.25
V12R 12	12	80	33.25
V12R 15	15	65	33.25
V12R 15-15	±15	65	38.20

V-PAC power sources are also available with extended temperature range. Ask for details.

Reliability, Inc. reserves the right to make changes in our products and prices at any time, without notice.

DC-DC POWER SOURCES **Reliability, Inc.**

VERSATILE

5, 12, 48v DC input; outputs from −15 to +15v, regulated and unregulated.

RELIABLE

Components burned in before assembly, finished units burned in before shipment.

ECONOMICAL

Eliminates need for one or more added power supplies.

RP 12-3/5
RAM-PAC
MEMORY
POWER SOURCE
Reliability, Inc.

RAM-PAC* POWER SOURCES

INPUT: 5v DC ±.25v

OUTPUTS: +12, −3, −5, −9v DC (depending upon type)

TOTAL LOAD: 6.7 watts

OUTPUT VOLTAGE TOLERANCE: ±5% for 12 v, ±10% for negative outputs

TEMPERATURE COEFFICIENT: ±3 mv/degree C, nominal

OUTPUT RIPPLE: 150 mv P-P maximum over 20 mHz bandwidth

LINE REGULATION: ±50 mv for 12v, ±150 mv for negative outputs

LOAD REGULATION: <175 mv for 12v, <100 mv for negative outputs

SIZE: 2.8 X 2.8 X .4 inches (7.1 X 7.1 X 1 cm)

OPTIONS: Triple output

PART TYPE:	OUTPUT VOLTAGE (v DC)	OUTPUT CURRENT (ma)	RAM USED WITH	UNIT PRICE (1 to 9)
RP12-3/5	+12 −3	550 10	TMS 4030	$64.50
RP12-5/5	+12 −5	550 10	2107A, 6103, 6605	64.50
RP12-9/5	+12 −9	550 10	MK 4096	64.50

TP-5/4812
T-PAC
POWER SOURCE
Reliability, Inc.

T-PAC* POWER SOURCES

INPUT: 35 to 60vDC

OUTPUTS: Regulated 5, 12, ±12, ±15

OUTPUT CURRENT: 0 to 400 mA continuous (2 watts, max)

RIPPLE: 50 mv P-P max. at 100 kHz min., 20 mHz bandwidth

ISOLATION: 100v

SIZE: 2.8 X 2.8 X .8 inches (7.1 X 7.1 X 2.03 cm)

PART TYPE:	OUTPUT VOLTAGE (v DC)	OUTPUT CURRENT (ma)	LINE REGULATION	LOAD REGULATION (No load to full load)	UNIT PRICE (1 to 9)
TP5/48/2	5	400	TTL COMPATIBLE		$49.50
TP12/48/2	12	160	.15%	.2%	49.50
TP12-12/48/2	±12	±80	.15%	.2%	64.50
TP15-15/48/2	±15	±65	.15%	.2%	64.50

For additional information, contact your authorized distributor or representative, or write or call Reliability, Inc. in Houston.

Reliability, Inc.
5325 Glenmont • Houston, Texas 77036 U.S.A.
(713) 666-3261 TWX: 910-881-1739
Manufacturing Facilities in Nenagh, Ireland

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RO ASSOCIATES

CONDENSED REFERENCE

SINGLE OUTPUTS

Volts DC	Amps	Line & Load Regulation	Model
1.5 to 6.0	5	0.1%	105
3.5 to 5.5	10	0.2%	210
4.5 to 5.5	1	0.11%	PC 5-1
	2.5	0.23%	517
	12	0.2%	612
	25	0.2%	625
	50	0.3%	450
5.0	0.5	0.15%	E12
	1	0.15%	E13
6 to 12	3	0.06%	108
6 to 30	1.5	0.06%	106
12 to 15	1	0.12%	518
	2.5	0.03%	107
	4	0.25%	250
	6	0.11%	301
24 to 28	0.5	0.22%	519
	2	0.25%	251
	3	0.11%	301

DUAL OUTPUTS

Volts DC	Amps	Line & Load Regulation	Model
±12 to ±15	±0.25	0.04%	PCD-15-250
	±0.5	0.04%	514
	±0.75	0.05%	115
	±3	0.11%	301
	±12	0.15%	452
±12 to ±24	±0.15	0.18%	506
±15	±0.05	0.03%	E22
	±0.1	0.03%	E23
	±0.2	0.03%	E24
±21 to ±28	±0.3	0.4%	513
±24	±0.06	0.4%	515

NOTE: ±15V on 213 can be set @ ±12V. 24V on 211 can be set @ 28V.

MULTI OUTPUTS

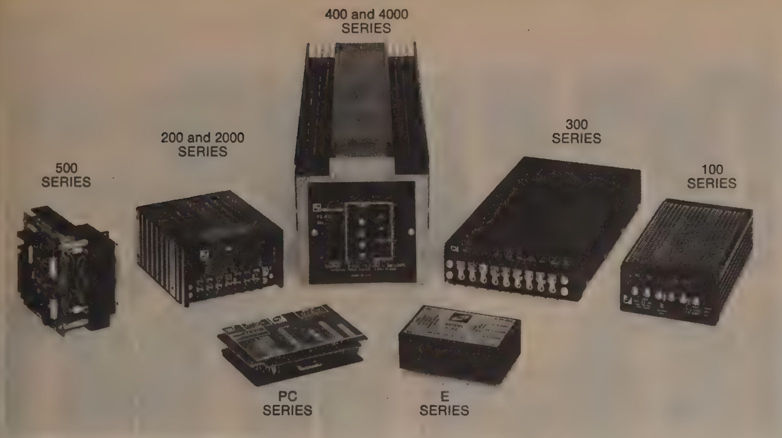
Volts DC @ Amps	Model
5V @ 0.5A & ±15V @ ±0.06A	E32
5V @ 5A & ±15V @ ±0.4A	213
5V @ 5A & 24V @ 1A	211
5V @ 25A & 24 to 28V @ 5A	458

DC TO DC CONVERTERS

Input Voltage	Output Voltage	Output Current	Line & Load Regulation	Model
10-20 VDC	4.5 to 5.5 VDC	50 A	0.3%	460
40-56 VDC	4.5 to 5.5 VDC	10 A	0.2%	2105
42-56 VDC	4.5 to 5.5 VDC	50 A	0.3%	4505
40-56 VDC	24 to 28 VDC	2 A	0.25%	2515
42-56 VDC	4.5 to 5.5 VDC	25 A	0.3%	4585
	24 to 28 VDC	5 A	0.3%	
42-56 VDC	±12 to ±15 VDC	±12 A	0.15%	4525

To obtain additional information and pricing dial 800-645-9200 TOLL FREE for the name of our local sales representative. Or consult the manufacturers' directory section for a complete listing.

RO ASSOCIATES, INCORPORATED / 3705 Haven Ave. / Menlo Park, CA 94025 / (415) 322-5321 / TWX 910-378-5929



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20kHz 'switchers'

with a five year warranty
now from the leader in *reliable* **20kHz switching power supplies**

This increase in warranty coverage is offered because of the success we have enjoyed in producing in excess of 25,000 SWITCHERS at a very low failure rate. It is proof of the confidence we have in our proven designs and production techniques. Extensive in-process quality control and 100% burn-in practically eliminates infant mortality, thus guaranteeing you long trouble-free operation.

Please consult the manufacturers' directory section for a listing of our sales representatives offices.

Call or write for our complete catalog which includes the informative article, "The Principles and Facts About Switching Power Supplies."

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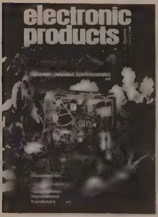

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more performance,
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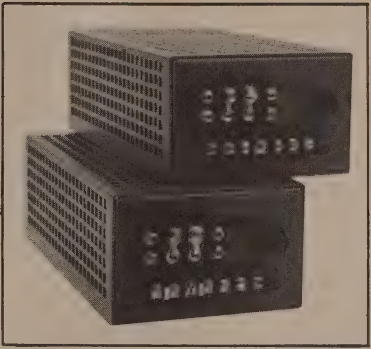
STM SERIES



These modular power supplies utilize advanced switching techniques to achieve high power outputs from small volume. They're favorably priced with excellent performance features, including a low temperature coefficient, low drift and ripple, and fine regulation. Computer-optimized input/output filtering for RFI performance closely approximates MIL-STD-461A.

Common Specifications:

Efficiency: to 75%

Volume: 160 in ^{3} for Module III:
238 in^3 for Module IIIA,
352 in^3 for Module IVA,
518.5 in^3 for Module VI.

Stability: .05% for 24 hours after warmup

Temperature Coefficient: .01% per °C

RFI: Minimized through computer-optimized input/output filtering. Meets most portions of MIL-STD 461A for both narrowband and broadband interference. Surpasses performance of conventional regulators. See representative test data below.

Transient Response: 1 millisecond for half-load to full-load change and return to a one-percent band.

Resolution: .05% V_{out} max

Adjustable Built-in Overvoltage Protection: All models.

Automatic Current Limiting: Adjustable from 50 to 125% rated full-load current.

Temperature Range: Operating: 0° to 71°C
Storage: −40° to +85°C

Programming: Resistance ≡ 1000 Ω/V
Signal ≡ Volt/Volt

Series Operation: to 200 Vdc

Turn on/off Overshoots: None

Isolation: 1300 Vdc, Input to Chassis
500 Vdc, Output to Chassis

Output Impedance (typical):
.005Ω at 10 kHz
.01Ω at 50 kHz
.015Ω at 100 kHz
.02Ω at 500 kHz

Fall Out: Will provide full output at regulated voltage for 15 milliseconds following removal of nominal input power, half output for 30 milliseconds.

Voltage Regulation (comb. line and load): .05%

Ripple (p—p): 50 mV (Worst case. Typically less than 30 mV)

Input Power: Vac: 105—132
Freq. (Hz): 50-440
Vdc: 150±15%

Electrical Specifications:

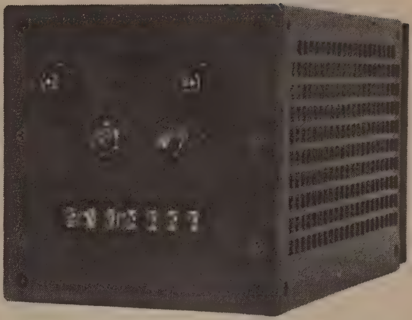
Model No.	Module Package	OUTPUT VOLTAGE		OUTPUT CURRENT				RIPPLE	INPUT POWER		LIST PRICE (USA)
		Set Range (Vdc)		(Adc)*					AC	DC	
		min.	max.	40°C	50°C	60°	71°C	(mVrms)	Amps at 115V	Amps at 150V	
STM3.5-24	III	3.0	4.5	24.0	19.4	14.9	9.6	10	1.8	1.5	$260
STM3.5-36	IIIA	3.0	4.5	36.0	29.1	22.3	14.4	10	3.8	2.2	340
STM3.5-60	IVA	3.0	4.5	60.0	48.0	36.0	24.0	10	5.2	2.7	495
STM3.5-100	VI	3.0	4.5	100.0	80.0	60.0	40.0	10	9.5	5.0	650
STM5-24	III	4.5	6.0	24.0	19.4	14.9	9.6	10	2.3	1.5	260
STM5-36	IIIA	4.5	6.0	36.0	29.1	22.3	14.4	10	4.2	2.5	340
STM5-60	IVA	4.5	6.0	60.0	48.0	36.0	24.0	10	6.4	3.4	495
STM5-100	VI	4.5	6.0	100.0	80.0	60.0	40.0	10	11.8	6.2	650
STM9-12	III	6.0	10.0	12.0	9.7	7.5	4.8	3	2.1	1.5	260
STM9-20	IIIA	6.0	10.0	20.0	16.2	12.4	8.0	3	3.8	2.2	320
STM9-30	IVA	6.0	10.0	30.0	24.0	18.0	12.0	3	5.5	2.9	495
STM9-50	VI	6.0	10.0	50.0	40.0	30.0	20.0	3	9.2	4.9	650
STM12-12	III	9.5	13.5	12.0	9.7	7.5	4.8	3	2.9	1.5	260
STM12-20	IIIA	9.5	13.5	20.0	16.2	12.4	8.0	3	4.8	2.8	320
STM12-30	IVA	9.5	13.5	30.0	24.0	18.0	12.0	3	7.1	3.8	475
STM12-50	VI	9.5	13.5	50.0	42.0	30.0	20.0	3	11.9	6.3	625
STM15-10	III	13.0	17.0	10.0	8.1	6.2	4.0	3	2.7	1.8	260
STM15-15	IIIA	13.0	17.0	15.0	12.1	9.3	6.0	3	4.3	2.6	320
STM15-24	IVA	13.0	17.0	24.0	19.2	14.4	9.6	3	7.2	3.8	475
STM15-32	VI	13.0	17.0	32.0	25.6	19.2	12.8	3	9.6	5.1	600
STM18-10	III	16.0	20.0	10.0	8.1	6.2	4.0	3	3.2	1.8	260
STM18-15	IIIA	16.0	20.0	15.0	12.1	9.3	6.0	3	5.0	3.0	320
STM18-24	IVA	16.0	20.0	4.0	19.2	14.4	9.6	3	8.2	4.3	495
STM18-32	VI	16.0	20.0	32.0	25.6	19.2	12.8	3	11.0	5.8	650
STM24-8.5	III	19.0	25.0	8.5	6.8	5.3	3.4	3	3.3	1.9	260
STM24-13	IIIA	19.0	25.0	13.0	10.5	8.0	5.2	3	5.5	3.2	320
STM24-21	IVA	19.0	25.0	21.0	16.8	12.6	8.4	3	9.0	4.7	475
STM24-28	VI	19.0	25.0	28.0	22.4	16.8	11.2	3	12.0	6.3	600
STM28-7	III	24.0	30.0	7.0	5.6	4.3	2.8	3	3.2	1.9	260
STM28-11	IIIA	24.0	30.0	11.0	8.9	6.8	4.4	3	5.5	3.2	320
STM28-18	IVA	24.0	30.0	18.0	14.4	10.8	7.2	3	9.0	4.7	475
STM28-24	VI	24.0	30.0	24.0	19.2	14.4	9.6	3	12.0	6.3	600
STM36-4	III	29.0	43.0	4.0	3.2	2.5	1.6	3	4.0	1.9	270
STM36-6	IIIA	29.0	43.0	6.0	4.8	3.7	2.4	3	4.5	2.6	340
STM36-10	IVA	29.0	43.0	10.0	8.0	6.0	4.0	3	7.2	3.8	495
STM36-14	VI	29.0	43.0	14.0	11.2	8.4	5.6	3	10.0	5.3	650
STM48-4	III	42.0	56.0	4.0	3.2	2.5	1.6	3	4.0	1.9	280
STM48-6	IIIA	42.0	56.0	6.0	4.8	3.7	2.4	3	5.5	3.2	340
STM48-10	IVA	42.0	56.0	10.0	8.0	6.0	4.0	3	9.1	4.8	495
STM48-14	VI	42.0	56.0	14.0	11.2	8.4	5.6	3	12.8	6.7	650

*FREE — AIR RATING — NO EXTERNAL HEATSINK.

SORENSEN PTM SERIES

SINGLE AND DUAL OUTPUT MODULAR POWER SUPPLIES

Excellent space saving over competitive models is offered with the PTM series-pass regulated DC power supplies. These rugged units are designed to deliver outstanding power per cubic inch at suprisingly modest cost. Quality components and material are used in each PTM, including computer-grade capacitors, ceramic, hermetically sealed plug-in IC's; plug-in power transistors; grain-oriented steel transformer laminations; bridge rectifier package. Convection cooling allows complete mounting flexibility. All models feature as standard built-in over-voltage protection.



Common Specifications:

	PTM Single	PTM Dual
Voltage Regulation (line and load comb.)	0.05% + 5 mV	0.02%
Voltage Ripple (PARD)[1]	1 mV rms, 5 mV peak-to-peak	
Temperature Coefficient .	0.01%/°C or 1 mV/°C whichever is greater	
Transient Response Time	50 μsec (for changes in load between 10-100% and 100-10% to recover to ±20 mV band)	
Tracking Accuracy	Adjustable to	0.2%
Drift (24 hours)	0.1% after 1 hour warmup	
Remote Programming ...	500 ohms/volt	500 ohms/volt
Remote Sensing	250 mV max. drop in each leg	
Power Factor (Typical) ...	80%	80%
Operating Temperature ..	0°C to 71°C	0°C to 71°C
Storage Temperature	−40°C to +85°C	−40°C to +85°C
Finish	Textured blue thermal paint	
Cooling	Convection	Convection

Current Foldback

PTM SINGLE — Automatic, adjustable; 50-130% of rated current; factory-set to 125% of rated (40°C) output current.

PTM DUAL — Automatic, adjustable; factory-set to 125% of rated (40°C) output current.

Overvoltage Protection

PTM SINGLE — Automatic, adjustable crowbar action; response time 100μsec typ. to avoid nuisance tripping.

PTM DUAL - DC outputs are protected from an overvoltage condition by an internally adjustable protection circuit. The outputs are sensed separately and in the event of an overvoltage condition in either output, both outputs are shorted by an internal SCR within 50 μsec. The SCR shorts the positive output to the negative output. This feature together with built-in reverse-polarity diodes on each output effectively keeps the outputs within 2.5 volts of the common after an OVP trip. The circuit is designed to tolerate the OVP tripped condition indefinitely.

NOTES:

(1) PARD — The "Periodic and Random Deviation" of the output power from its average value, with all external operational and environmental parameters maintained constant.

(2) 132 VAC at 20% reduced rating, reduce linearly from 125 VAC.

Module Package PTM Dual	Size (in.) H	W	L	Weight (lbs)	Input Power at 1ϕ 50-440 Hz AC volts/AC amps		
					105-125[2]	200-240V	210-250V
I	3.315	3.875	6.500	5.5	0.6	0.35	0.3
II	3.315	5.125	6.500	7.5	0.9	0.48	0.45
III	3.315	5.125	9.500	11	1.8	0.96	0.90
(Units shipped wired for nominal 115-VAC input)							

Module Package PTM Single	Size (in.) H	W	L	Weight (lbs)	Input Power at 1ϕ 50-440 Hz AC volts/AC amps		
					105—125V[2]	200—240V	210—250V
I	3.315	3.875	6.500	5	0.8	0.42	0.40
II	3.315	5.125	6.500	7.5	1.3	0.68	0.65
III	3.315	5.125	9.500	11	2.4	1.3	1.2
IIIB	5.125	5.125	9.500	13.5	3.0	1.6	1.5
(Units shipped wired for nominal 115-VAC input)							

Electrical Specifications:

Single Output Series

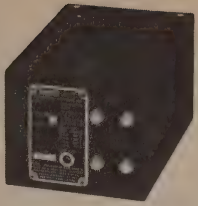
Model No.	Module Package	Adjustment Range (Vdc)		Current (Adc)				Output Adjust Resolution (mV typ.)	List Price (U.S.A)
		Min.	Max.	@40°C	@50°C	@60°C	@71°C		
PTM 3-4	I	2.8	3.5	4.0	3.6	2.8	1.6	10	$ 97
PTM 3-7	II	2.8	3.5	7.0	6.3	4.9	2.8	10	129
PTM 3-11	III	2.8	3.5	11.0	9.6	7.8	4.4	10	153
PTM 3-16	111B	2.8	3.5	16.0	14.0	11.0	6.5	10	205
PTM 5-4	I	4.8	5.5	4.0	3.6	2.8	1.6	10	97
PTM 5-7	II	4.8	5.5	7.0	6.3	4.9	2.8	10	129
PTM 5-11	III	4.8	5.5	11.0	9.6	7.8	4.4	10	153
PTM 5-16	IIIB	4.8	5.5	16.0	14.0	11.0	6.5	10	205
PTM 12-2.7	I	11.4	12.6	2.7	2.4	1.9	1.1	25	97
PTM 12-4.4	II	11.4	12.6	4.4	4.0	3.1	1.8	25	129
PTM 12-6.5	III	11.4	12.6	6.5	5.7	4.6	2.7	25	153
PTM 12-10.5	IIIB	11.4	12.6	10.5	9.5	7.0	4.0	25	205
PTM 15-2.4	I	14.25	15.75	2.4	2.1	1.7	0.95	25	97
PTM 15-3.5	II	14.25	15.75	3.5	3.1	2.5	1.6	25	129
PTM 15-5.5	III	14.25	15.75	5.5	4.9	3.9	2.5	25	153
PTM 15-9.5	IIIB	14.25	15.75	9.5	8.5	6.5	3.6	25	205
PTM 24-1.6	I	23	25	1.6	1.4	1.1	0.65	50	97
PTM 24-2.3	II	23	25	2.3	2.1	1.7	1.1	50	129
PTM 24-4	III	23	25	4.0	3.6	2.9	1.9	50	153
PTM 24-6.8	IIIB	23	25	6.8	6.0	4.5	2.7	50	205
PTM 28-1.4	I	27	29	1.4	1.2	1.0	0.55	50	97
PTM 28-2	II	27	29	2.0	1.8	1.5	1.0	50	129
PTM 28-3.5	III	27	29	3.5	3.1	2.6	1.8	50	153
PTM 28-6.0	IIIB	27	29	6.0	5.5	4.0	2.4	50	205

Dual Output Series

PTM 12-1D	I	+11, −11	+13, −13	1.0	0.9	0.7	0.4	25	134
PTM 12-1.6D	II	+11, −11	+13, −13	1.6	1.44	1.12	0.64	25	160
PTM 12-3D	III	+11, −11	+13, −13	3.0	2.7	2.1	1.2	25	185
PTM-15-.8D	I	+14, −14	+16, −16	0.8	0.72	0.56	0.32	25	129
PTM 15-1.5D	II	+14, −14	+16, −16	1.5	1.35	1.05	0.6	25	155
PTM 15-2.8D	III	+14, −14	+16, −16	2.8	2.52	1.96	1.12	25	180
PTM-5/12DI	I	+4.75, −11	+5.5, −13	2.0, 0.5	1.8, 0.45	1.4, 0.35	0.8, 0.2	10, 25	139
PTM-5/12DII	II	+4.75, −11	+5.5, −13	3.5, 1.0	3.15, 0.9	2.45, 0.7	1.4, 0.4	10, 25	165
PTM-5/12DIII	III	+4.75, −11	+5.5, −13	6.0, 1.5	5.4, 1.35	4.2, 1.05	2.4, 0.6	10, 25	190

SORENSEN QSA SERIES

Modular, Wide-Range, Convection-Cooled DC Power Supplies



Sorensen's QSA Series modular power supplies are U.L. listed and feature excellent regulation, ripple and response-time characteristics. The 22 models in the series provide 3-330 volts and up to 150 watts output.

A complete line of accessories — metered panels, rack adapters, chassis slides, filler panels, and overvoltage protectors — are available for the QSA Series. Thus, you can build your own multi-output system, or Sorensen can do it for you.

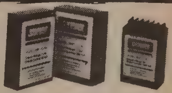
Electrical Specifications:

Model	Module Size	Output Voltage (Vdc)	Output Current (Adc)				Constant Voltage Regulation[2]	Resolution (mV Typ)
			40°C	50°C	60°C	71°C		
QSA10-1.4	I	0-10	0-1.5	0-1.4	0-1.2	0-.9	±.005% or ±.2mV[2]	28
QSA10-2.2	II	0-10	0-2.4	0-2.2	0-1.9	0-1.5	±.005% or ±.2mV[2]	28
QSA10-3.7	III	0-10	0-4.0	0-3.7	0-3.1	0-2.5	±.005% or ±.2mV[2]	28
QSA18-1.1	I	14-22	0-1.2	0-1.1	0-.9	0-.7	±.005%	45
QSA18-1.9	II	14-22	0-2.1	0-1.9	0-1.6	0-1.3	±.005%	45
QSA18-3.0	III	14-22	0-3.3	0-3.0	0-2.5	0-2.0	±.005%	45
QSA48-.4	I	35-60	0-.44	0-.4	0-.34	0-.27	±.005%	135
QSA48-.8	II	35-60	0-.88	0-.8	0-.68	0-.53	±.005%	135
QSA48-1.2	III	35-60	0-1.3	0-1.2	0-1.0	0-.8	±.005%	135
QSA75-.5	II	60-90	0-.55	0-.5	0-.42	0-.33	±.005%	115
QSA75-.8	III	60-90	0-.88	0-.8	0-.68	0-.53	±.005%	115
QSA120-.5	III	90-150	0-.55	0-.5	0-.42	0-.33	±.01%	145
QSA175-.25	III	150-200	0-.28	0-.25	0-.21	0-.17	±.01%	160
QSA265-.15	III	200-330	0-.17	0-.15	0-.13	0-.1	±01%	160

NOTES:

(1) With load change (NL-to-FL or FL-to-NL) and line-voltage change (±10%) combined.
(2) Whichever is greater.

MMT, MMS, MMD AND CMS, CMD SERIES



Compact, ultra-reliable units specifically designed to provide excellent regulation at a modest cost. Typical applications include drivers for displays, linear IC's reed relays, dynamic and static shift registers, ROM's RAM's, plus D/A and A/D converters. All units are fully warranted for a 24-month period.

Model	Output Power		Regulation		Ripple & Noise (mV RMS)	Temperature Coefficient (%/°C)	Derate mA/°C above 50°C	Package Size (Inches)	List Price (U.S.A.)
	Voltage (Vdc)	Current (mA)	Load (NL-FL)	Line (±10 Vac)					
MMT SERIES									
MMT5/15E	±15	100	±0.05%	±0.05%	1.0 mV	0.02	5.0 mA	2½ x 3½ x 1.88	$90
	5	500	±0.05%	±0.05%	1.0 mV	0.02	9.0 mA	2½ x 3½ x 1.88	$90
MMD SERIES									
MMD15-.025	±15	25	±0.2%	±0.2%	2.0 mV	0.02	1.0 mA	2½ x 3½ x ⅞	$23
MMD15-.065	±15	65	±0.02%	±0.02%	0.5 mV	0.02	1.0 mA	2½ x 3½ x ⅞	$42
MMD15-.100	±15	100	±0.02%	±0.02%	0.5 mV	0.02	5.0 mA	2½ x 3½ x ⅞	$48
MMD15-.200	±15	200	±0.05%	±0.01%	1.0 mV	0.02	8.0 mA	2½ x 3½ x 1¼	$65
MMD15-.300	±15	300	±0.025%	±0.05%	1.0 mV	0.02	8.0 mA	2½ x 3½ x 1.56	$98
MMD12-.120	±12	120	±0.02%	±0.02%	0.5 mV	0.02	8.0 mA	2½ x 3½ x ⅞	$48
MMD12-.240	±12	240	±0.05%	±0.01%	1.0 mV	0.02	9.0 mA	2½ x 3½ x 1¼	$65
MMS SERIES									
MMS5-.250	5	250	±0.05%	±0.05%	0.5 mV	0.05	9.0 mA	2½ x 3½ x ⅞	$35
MMS5-.500*	5	500	±0.1%	±0.05%	1.0 mV	0.02	9.0 mA	2½ x 3½ x ⅞	$44
MMS5-1.00*	5	1000	±0.1%	±0.05%	1.0 mV	0.02	9.0 mA	2½ x 3½ x 1¼	$65
MMS5-2.00	5	2000	±0.025%	±0.05%	1.0 mV	0.02	6.0 mA	2½ x 3½ x 1.56	$89
MMS10-.120	10	120	±0.02%	±0.02%	0.5 mV	0.02	6.0 mA	1¾ x 2¼ x 1	$24
MMS12-.100	12	100	±0.02%	±0.02%	0.5 mV	0.02	5.0 mA	1¾ x 2¼ x 1	$24
MMS15-.100	15	100	±0.02%	±0.02%	0.5 mV	0.02	5.0 mA	1¾ x 2¼ x 1	$24
MMS24-.050	24	50	±0.02%	±0.02%	1.0 mV	0.02	2.5 mA	1¾ x 2¼ x 1	$24
MMS28-.040	28	40	±0.02%	±0.02%	1.0 mV	0.02	2.0 mA	1¾ x 2¼ x 1	$24
CMD, CMS SERIES									
CMD15-.100	±15	100	±0.03%	±0.03%	—	—	5.0 mA[2]	—	$56
CMD15-.200	±15	200	±0.05%	±0.05%	—	—	8.0 mA[3]	—	$75
CMS5-.500[1]	5	500	±0.1%	±0.1%	—	—	9.0 mA[3]	—	$52
CMS5-1.00[1]	5	1000	±0.1%	±0.1%	—	—	9.0 mA[3]	—	$75

COMMON DATA — ALL MMT, MMS, MMD UNITS

Short Circuit Protection: Internal current limiting. **Overvoltage Protection:** Standard on Model MMS5-1.00 and MMS5-.500 — Should the output voltage exceed 6.8 volts, crowbar operates to reduce the output voltage. **Operating Temperature:** −25°C to +71°C. **Storage Temperature:** −25°C to +85°C.

COMMON DATA — ALL CMD, CMS UNITS

Chassis-mounted encapsulated power supplies. **Output Impedance:** 0.2Ω @ 10 KHz. **Ripple and Noise:** 2.0 mV rms. **Temperature Coefficient:** 0.02%/°C. **Operating Temperature Range:** −25°C to +71°C. **Storage Temperature:** −25°C to +85°C. **Input Voltage:** 115 ±10[4] Vac. **Input Frequency:** 50-400 Hz. **Setpoint Accuracy:** ±2.0%.

NOTES:

*220/230 Vac available at extra cost. [1]Overvoltage protection standard. [2]Does not require derating until 60°C. [3]Derating begins at 50°C. [4]220/230 Vac available; Add $5 to unit price.

TEL: (603) 668-4500 • TWX: 710-220-1339

Common Specifications:

Constant Voltage Ripple (PARD): 300 microvolts rms (3 miliovolts peak to peak).

Remote Sensing: 1.5 volts drop maximum per load lead.

Overload/Short Circuit Protection: Current foldback (current limiting for 10-volt models).

Overvoltage Protection (Optional): Should the output voltage tend to exceed the adjustable overvoltage trip level, a sensing/SCR crowbar circuit operates in 10 microseconds to reduce the output voltage to 2.5Vdc or less (see Optional Overvoltage Protection column in table).

Series Operation: Two units may be operated in series (10-volt models may be operated in series up to a total output of 200 volts).

Parallel Operation: Four units may be operated in parallel.

Drift: 0.025%/8 hours (after 30-minute warmup) with constant line, load and ambient temperature.

Remote Prog.: 1V/V

Input Power: 105-125V, 200-240V, 210-250V single phase, 47-440Hz

Operating Temperature Range: 0°C to +71°C

Storage Temperature Range: −40°C to +85°C (with VP)

Output Floating: Either side of the output may be grounded.

Cooling: Convection.

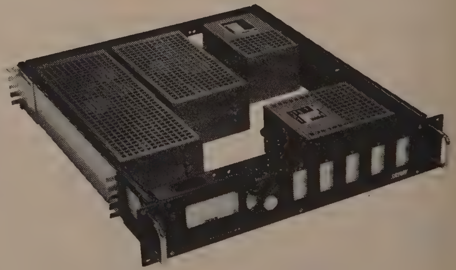
Isolation Voltage: 1000Vdc — input; 700 Vdc — output.

Finish: Case is finished in black wrinkle paint.

Optional Overvoltage Protection	Temperature Coefficient (%°C)	Transient Response (μs Typ)	Output Impedance (R + jωL)	Remote Prog. Ohms/V	Efficiency (% Typ)	Input Power Current Max (Aac)	Power Factor (Typ)	List Price (USA)
VP1	.01 (or .5mV/°C)^2	20^3	300μΩ + .2μH	100	29	.6, .3	.84	$102
VP1	.01 (or .5mV/°C)^2	20^3	200μΩ + .2μH	100	35	.8, .4	.83	123
VP1	.01 (or .5mV/°C)^2	20^3	100μΩ + .2μH	100	39	1.4, .7	.83	143
VP1	.01	20^3	750μΩ + .4μH	40	31	.8,.4	.83	102
VP1	.01	20^3	400μΩ + .4μH	40	33	1.3, .65	.83	117
VP1	.01	20^3	300μΩ + .3μH	40	38	1.8, .9	.82	139
VP3	.015	20^4	2.4mΩ + .8μH	40	38	.7, .35	.83	107
VP3	.015	20^4	2.4mΩ + .8μH	40	44	1.3, .65	.79	138
VP3	.015	20^4	2.4mΩ + .4μH	40	45	1.8, .9	.79	148
VP3	.015	20^4	3.8mΩ + .8μH	40	51	1.2, .6	.78	139
VP3	.015	20^4	3.8mΩ + .4μH	40	53	1.7, .85	.79	160
VP8	.015	20^5	6.0mΩ + .8μH	40	50	1.8, .9	.79	172
VP23	.015	20^5	40mΩ + 1.6μH	90	54	1.2, .6	.75	184
VP23	.015	20^5	70mΩ + 1.6μH	90	48	1.3, .65	.72	199

(3) To return to ±10mV band for a step-load change of NL-to-FL or FL-to-NL.
(4) To return to ±15mV for a step-load change of NL-to-FL or FL-to-NL.
(5) To return to ±20mV for a step-load change of NL-to-FL or FL-to-NL.

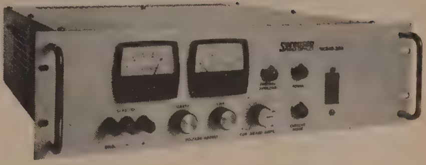
MULTI-OUTPUT RACK SYSTEMS



Sorensen rack assemblies offer a standard 19-inch width, two heights, three depths and are supplied both with and without slide adapters and with or without metering. Quarter-rack and full-rack metering schemes are available.

Any of Sorensen's modular power supplies may be inserted into single- or multiple-output rack systems. These modulars include the high-efficiency STM Series (40 models), the PTM's (singles and duals), the high-performance QSA Series and the encapsulated MMS, MMD, CMS and CMD Series.

SORENSEN DCR-A&B SERIES



The DCR series satisfies today's need for precision or general purpose power supplies from 400 to 20,000 watts. They feature voltage and current regulation, high efficiences, remote signal or resistance programming, and remote sensing to 200 feet. All silicon, solid state design is used throughout.

MODEL	RACK HEIGHT (IN)	VOLTAGE (VDC)	OUTPUT Current (adc)			CONSTANT CURRENT REGULATION	CONSTANT VOLTAGE REGULATION	CONSTANT VOLTAGE RIPPLE (PARD) rms	CONSTANT CURRENT RIPPLE (PARD) rms[5]	OPTIONAL OVERVOLTAGE PROTECTION	DRIFT (TYP) % I_o MAX	TEMP. COEFF. (TYP)	
			40°	55°	71°							(mV/°C)	(mA/°C)
DCR10-40B	3½	0-10	40	30	20	0.25%	0.03%	.65%	.65%	INTERNAL	0.15%	1.5	12
DCR10-80B	5¼	0-10	80	60	40	0.25%	0.03%	.65%	.65%	INTERNAL	0.15%	1.5	24
DCR10-120B	7	0-10	120	90	60	0.25%	0.03%	.65%	.65%	INTERNAL	0.15%	1.5	36
DCR10-170B	7 F	0-10	170	127	85	0.25%	0.03%	.65%	.65%	INTERNAL	0.15%	1.5	51
DCR20-25B	3½	0-20	25	19	13	0.25%	0.03%	.325%	.325%	INTERNAL	0.15%	3.0	7.5
DCR20-50B	5¼	0-20	50	37	25	0.25%	0.03%	.325%	.325%	INTERNAL	0.15%	3.0	15
DCR20-80B	7	0-20	80	60	40	0.25%	0.03%	.325%	.325%	INTERNAL	0.15%	3	24
DCR-20-115B	7 F	0-20	115	86	58	0.25%	0.03%	.325%	.325%	INTERNAL	0.15%	3	35
DCR20-250A	17½	0-20	275	250	165	.4%	±0.10% or ±8mV[2]	.8%E_o+60mV or 160mV[4]	0.8% I_o	VP 18	50%	8	500
DCR20-1000A	42½	0-20	1100	1000	66.0	.4%	''	''	0.8% I_o	—	.50%	8	2000
DCR40-13B	3½	0-40	13	9	6.6	0.25%	0.03%	.225%	.225%	INTERNAL	0.15%	6.0	3.9
DCR40-25B	5¼	0-40	25	19	13	0.25%	0.03%	.225%	.225%	INTERNAL	0.15%	6.0	7.5
DCR40-40B	7	0-40	40	30	20	0.25%	0.03%	.225%	.225%	INTERNAL	0.15%	6	12
DCR40-70B	7 F	0-40	70	55	40	0.25%	0.03%	.225%	.225%	VP 19	0.15%	6	21
DCR40-125A	17½	0-40	138	82.5	82.5	.2%	±0.10% or ±15mV[2]	.4%E_o+60mV or 160mV[4]	0.45% I_o	VP 19	.50%	16	250
DCR40-250A	22¾	0-40	275	165	165	.4%	''	''	0.45% I_o	—	.50%	16	500
DCR40-500A	42½	0-40	550	330	330	.4%	''	''	''	—	.50%	16	1000
DCR60-9B	3½	0-60	9	7	5	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	9.0	2.7
DCR60-18B	5¼	0-60	18	13	8.6	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	9.0	5.4
DCR60-30B	7	0-60	30	23	16.5	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	9	9
DCR60-45B	7 F	0-60	45	35	26.5	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	9	13.5
DCR80-6B	3½	0-80	6	4.5	3.3	0.25%	0.03%	.18%	.18%	INTERNAL	0.15%	12.0	1.8
DCR80-12B	5¼	0-80	12	9	6.3	0.25%	0.03%	.18%	.18%	INTERNAL	0.15%	12.0	3.6
DCR80-20B	7	0-80	20	15.5	11.9	0.25%	0.03%	.18%	.18%	INTERNAL	0.15%	12.0	6
DCR80-33B	7 F	0-80	33	26	20	0.25%	0.03%	.18%	.18%	INTERNAL	0.15%	12.0	9.9
DCR150-3B	3½	0-150	3	2.3	1.7	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	22.5	.9
DCR150-6B	5¼	0-150	6	4.5	3.3	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	22.5	1.8
DCR150-12B	7	0-150	12	9	6.6	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	22.5	3.6
DCR150-18B	7 F	0-150	18	14	10	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	22.5	5.4
DCR150-35A	17½	0-150	38.5	23	23	.4%	±0.10% or ±30mV[2]	.4%E_o+200mV or 500mV[4]	0.4% I_o	VP 20	.50%	60	70
DCR150-70A	22¾	0-150	77	47	47	4%	''	''	''	VP 20	.50%	60	140
DCR300-1.5B	3½	0-300	1.5	1.1	.8	0.25%	0.03%	.23%	.23%	INTERNAL	0.15%	45	.45
DCR300-3B	5¼	0-300	3	2.3	1.65	0.25%	0.03%	.23%	.23%	INTERNAL	0.15%	45	.9
DCR300-6B	7	0-300	6	4.5	3.3	0.25%	0.03%	.23%	.23%	INTERNAL	0.15%	45	1.8
DCR300-9B	7 F	0-300	9	7	5.5	0.25%	0.03%	.23%	.23%	INTERNAL	0.15%	45	2.7
DCR300-18A	17¼	0-300	19.8	12	12	.4%	or ± 10mV[2] or ±60mV[2]	4%	0.4% I_o	VP 21	.50%	120	36
DCR300-35A	22¾	0-300	38.5	23	23	.4%	''		0.4% I_o	VP 21	.50%	120	70
DCR600-.75B	3½	0-600	.75	.55	.4	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	90	.225
DCR600-1.5B	5¼	0-600	1.5	1.1	.83	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	90	.45
DCR600-3B	7	0-600	3	2.3	1.65	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	90	.9
DCR600-4.5B	7 F	0-600	4.5	3.5	2.5	0.25%	0.03%	.2%	.2%	INTERNAL	0.15%	90	1.35
DCR600-18A	22¾	0-600	19.8	12	12	.4%	±0.10% or ±120mV[2]		0.4% I_o	VP 22	.50%	240	36

Common Specifications (except as noted)

Resolution (voltage): 0.05% of E_0 max. (typical)

Resolution (current): 0.5% (DCR-A) 0.05% (DCR-B), typical

Remote sensing: Max. drop per load lead 3V (DCR-A), 8V (DCR-B)

Overload/short circuit protection: Adjustable. Current limiting with automatic recovery.

Series operation: To 200 Vdc max. (150 and 300V models — 2 in series)

Parallel operation: Master-slave, 4 units max.

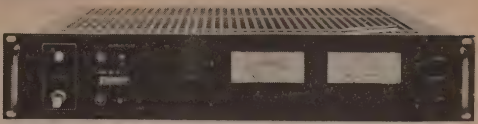
Operating temperature range: 0°C to +71°C

Storage temperature: +40°C to +85°C

Isolation voltage: 1000 Vdc input to output

TRANSIENT RESPONSE TIME (TYP)	OUTPUT IMP (OHMS) @ 1kHz (TYP)	REMOTE PROG. (TYP)		EFFICIENCY % (TYP)	METERS (2% accuracy)		INPUT POWER				PWR FACTOR (TYP)	SIGNAL (VOLT IN/ VOLT OUT)	LIST PRICE (USA)
		OHMS/	OHMS/A		VOLTMETER	AMMETER	VOLTAGE (VAC)	CURRENT MAX (Aac)	FREQUENCY^{11} (Hz)	PHASE			
50mSEC	.02	1200	10	61	0-12V	0-50A	103-127	8.7	50-63	1ϕ	.65	1/1	$460
50mSEC	.009	1200	5	62	0-12V	0-100A	103-127	16	50-63	1ϕ	.69	1/1	665
50mSEC	.007	1200	3.3	62	0-12V	0-150A	103-127	24.5	50-63	1ϕ	.67	1/1	865
50mSEC	.005	1200	2.35	63.5	0-12V	0-200A	187-229	20	50-63	1ϕ	.66	1/1	1145
50mSEC	.025	600	16	71	0-25V	0-30A	103-127	9.4	50-63	1ϕ	.65	1/2	460
50mSEC	.012	600	8	69	0-25V	0-60A	103-127	20	50-63	1ϕ	.62	1/2	640
50mSEC	.009	600	5	70	0-25V	0-100A	103-127	30	50-63	1ϕ	.66	1/2	840
50mSEC	.006	600	3.5	70.5	0-25V	0-120A	187-229	26.5	50-63	1ϕ	.60	1/2	1095
40ms	.008	160	0.6	66	0-25V	0-300A	187-229/ 207-253^{9}	37	50-63	3ϕ	.57	1/3.22	1950
40ms	.003	160	0.15	74	0-25V	0-1200A	414-506^{10}	60	57-63^{10}	3ϕ	.63	1/3.22	4990
50mSEC	.04	300	30	71	0-50V	0-15A	103-127	9.8	50-63	1ϕ	.65	1/4	420
50mSEC	.025	300	16	79	0-50V	0-30A	103-127	16	50-63	1ϕ	.68	1/4	585
50mSEC	.016	300	10	78	0-50V	0-50A	103-127	26.8	50-63	1ϕ	.66	1/4	790
50mSEC	.01	300	6	77	0-50V	0-100A	187-229	29.7	50-63	1ϕ	.58	1/4	1020
40ms	.006	80	1.2	72	0-50V	0-150A	187-229/ 207-253^{9}	35	50-63	3ϕ	.60	1/6.22	1825
40ms	.006	80	0.6	75	0.50V	0-300A	414-506^{10}	60$^{14}/_{27}$	57-63^{10}	3ϕ	.67	1/6.22	2575
40ms	.004	80	0.3	79	0.50V	0-600A	414-506^{10}	60	57-63^{10}	3ϕ	.59	1/6.22	4475
50mSEC	.06	200	46	75	0-80V	0-10A	103-127	9.7	50-63	1ϕ	.65	1/6	460
50mSEC	.04	200	22	81	0-80V	0-20A	103-127	19	50-63	1ϕ	.60	1/6	585
50mSEC	.022	200	13	84	0-80V	0-40A	103-127	27	50-63	1ϕ	.68	1/6	995
50mSEC	.014	200	9	79.9	0-80V	0-50A	187-229	29.0	50-63	1ϕ	.56	1/6	1120
50mSEC	.110	150	68	77	0-100V	0-8A	103-127	8.3	50-63	1ϕ	.65	1/8	460
50mSEC	.06	150	33	83	0-100V	0-15A	102-127	15	50-63	1ϕ	.65	1/8	690
50mSEC	.035	150	20	82	0-100V	0-30A	103-127	25.6	50-63	1ϕ	.66	1/8	995
50mSEC	.022	150	12	80.9	0-100V	0-40A	187-229	27.2	50-63	1ϕ	.57	1/8	1175
50mSEC	.53	80	134	74	0-200V	0-5A	103-127	8.2	50-63	1ϕ	.65	1/15	410
50mSEC	.30	80	66	84	0-200V	0-8A	103-127	15.5	50-63	1ϕ	.60	1/15	705
50mSEC	.16	80	33	84	0-200V	0-15A	103-127	27	50-63	1ϕ	.69	1/15	995
50mSEC	.057	80	22	83	0-200V	0-20A	187-229	27	50-63	1ϕ	.58	1/15	1145
40ms	.02	20	4.3	77	0-200V	0-50A	187-229/ 207-253	35	50-63	3ϕ	.64	1/17.66	1825
40ms	.02	20	2.2	81	0-200V	0-80A	414-506^{10}	69$^{14}/_{27}$	57-63^{10}	3ϕ	.69	1/17.66	2995
50mSEC	1.8	40	270	74	0-400V	0-2A	103-127	8.9	50-63	1ϕ	.60	1/30	485
50mSEC	1.1	40	133	82	0-400V	0-5A	103-127	15.7	50-63	1ϕ	.60	1/30	705
50mSEC	.65	40	66	84	0-400V	0-8A	103-127	27	50-63	1ϕ	.69	1/30	995
50mSEC	.34	40	44	83.3	0-400V	0-10A	187-229	27.4	50-63	1ϕ	.57	1/30	1145
40ms	.04	10	8.3	78	0-400V	0-20A	187-229/ 207-253^{9}	35	50-63	3ϕ	.69	1/33.22	1825
40ms	.02	10	4.3	82	0-400V	0-50A	414-506^{10}	60$^{14}/_{27}$	57-63^{10}	3ϕ	.68	1/33.22	2995
50mSEC	8	20	530	74	0-800V	0-1A	103-127	8.9	50-63	1ϕ	.60	1/60	460
50mSEC	4.3	20	266	86	0-800V	0-2A	103-127	15.2	50-63	1ϕ	.60	1/60	690
50mSEC	2.0	20	133	86	0-800V	0-5A	103-127	27.4	50-63	1ϕ	.66	1/60	945
50mSEC	.98	20	89	85	0-800V	0-5A	187-229	26.8	50-63	1ϕ	.57	1/60	1095
40ms	.35	5	8.3	81	0-800V	0-20A	414-506^{10}	60$^{14}/_{27}$	57-63^{10}	3ϕ	.68	1/67.66	2800

SORENSEN SRL SERIES



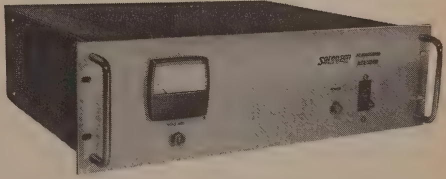
Instant front panel monitoring and adjustment of overvoltage set point without removing the load are just two of the unique features of Sorensen's new SRL Series of solid-state DC regulated power supplies.

Other user-oriented features include higher power density (watts/cu.in.), operation to 71°C, and designed-in reliability through the use of integrated circuits. These features, combined with traditional Sorensen quality, make the competitively priced SRL Series an ideal choice for medium power, low voltage systems and laboratory applications.

Model	Output Power				Constant Voltage Mode					Constant Current Mode		
	Voltage (Vdc)	Current (Adc)			Regulation[1]	Ripple (PARD)		Resolution (Typ.)	Transient Response Time (Typ.)[5]	Regulation[1]	Ripple[3] (PARD) rms (10 Hz to 7 MHz)	Resolution (Typ.)
		55°	60°	71°C		rms (10 Hz to 7 MHz)	p — p (7 Hz to 25 MHz)					
SRL10-25	0-10	25	22	16.7	.01% or 2mV[2]	350μV	20mV	5mV	150μs	.02% + 4mA	10mA	3.75mA
SRL10-50	0-10	50	44	33.5	.01% or 2mV[2]	300μV	10mV	1mV	150μs	.02% + 4mA	20mA	7.5mA
SRL10-100	0-10	100	88	67	.01% or 2mV[2]	300μV	20mV	5mV	150μs	.02% + 6mA	30mA	15mA
SRL20-12	0-20	12	10.5	8	.01% or 2mV[2]	200μV	20mV	2mV	70μs	.02% + 4mA	3mA	1.8mA
SRL20-25	0-20	25	22	16.7	.01% or 2mV[2]	300μV	20mV	5mV	150μs	.02% + 4mA	10mA	3.75mA
SRL20-50	0-20	50	44	33.5	.01% or 2mV[2]	500μV	40mV	5mV	150μs	.02% + 4mA	10mA	7.5mA
SRL40-6	0-40	6	5.3	4	.01% or 2mV[2]	200μV	20mV	4mV	70μs	.02% + 1mA	0.5mA	0.9mA
SRL40-12	0-40	12	10.5	8	.01% or 2mV[2]	300μV	20mV	5mV	150μs	.02% + 4mA	1mA	1.8mA
SRL40-25	0-40	25	22	16.7	.01% or 2mV[2]	500μV	10mV	4mV	150μs	.02% + 4mA	10mA	3.75mA
SRL40-50	0-40	50	44	33.5	.01% or 2mV[2]	700μV	40mV	5mV	150μs	.02% + 4mA	10mA	7.5mA
SRL60-4	0-60	4	3.5	2.68	.01% or 2mV[2]	300μV	20mV	6mV	70μs	.02% + 1mA	0.5mA	0.6mA
SRL60-8	0-60	8	7	5.36	.01% or 2mV[2]	300μV	20mV	5mV	70μs	.02% + 1mA	1mA	1.2mA
SRL60-17	0-60	17	14.9	11.4	.01% or 2mV[2]	500μV	10mV	6mV	150μs	.02% + 4mA	3mA	2.5mA
SRL60-35	0-60	35	31	23.4	.01% or 2mV[2]	700μV	40mV	5mV	150μs	.02% + 4mA	10mA	5.25mA

ACR SERIES

The solid state ACR series of AC line voltage regulators offers outstanding power, performance, and packaging. They are ideal for controlling the RMS voltage to a wide variety of loads requiring precision regulation, fast response time, and low distortion. They are one-half the size and weight of competitive regulators.



	Output Power*		Voltage Regulation		Response Time	Temp. Coeff.	Input Power			% Efficiency	List Price (U.S.A)
	Vac	kVa Range	Line	Load			V	Aac max	Freq.	full VA	
ACR500	↑	0-.50	↑	↑	↑	↑	↑	6	↑	88	$ 400
ACR1000		0-1.0	±0.1%	±0.1%	30ms[1]	0.015%		12		90	480
ACR2000	110 to	0-2.0				E_o/°C	95 To	24		90	610
ACR3000	120 Vac	0-3.0	↓	↓	↓	↓	130 Vac	36	50/60 Hz[2]	92	750
ACR5000	Single	0-5.0	↑	↑	↑	↑	Single	60		95	910
ACR7500	Phase	0-7.5	±0.15%	±0.15%	50ms[1]	0.03% E_o/°C	Phase	92		94	1095
ACR10,000		0-10.0						123		95	1555
ACR15,000	↓	0-15.0	↓	↓	↓	↓	↓	181	↓	95	1860

*ACR units may be connected in multiple to supply regulated three phase power (Write for Application Note AC 701).

Specifications:

- **Remote Programming:** 10 ohms per volt (Typ.)
- **Remote Sensing:** All models 1.5 volts drop maximum per load lead.
- **Input Power Factor (Typical):** 0.75
- **RFI:** Meets MIL-I-26600 specifications for Class III equipment.

Notes:

1. The speed to recover to 63% of the peak deviation of the transient caused by maximum line or load changes. Complete recovery may be from 1 to 8 cycles, depending on the magnitude of line or load change or up to 10 cycles for a simultaneous combination of worst-case line and load changes.
2. May be operated from 47 to 53 Hz or 57-63 Hz. All units are factory adjusted for optimum 60 Hz performance and may be readjusted for optimum 50 Hz performance.

- **Remote Sensing:** 1 volt per load lead (maximum allowable)
- **Series Operation:** Up to 200 Vdc output maximum
- **Parallel Operation:** 3 units maximum in parallel
- **Operating Temperature Range:** 0°C to 71°C
- **Storage Temperature:** −40°C to +85°C
- **Isolation voltage to Ground:** 1000 Vdc input; 200 Vdc output
- **RFI:** MIL-I-6181D
- **Output Voltage Turn-On/Turn-Off Overshoot:** None
- **Output Current Turn-On/Turn-Off Overshoot:** None
- **Overload/Short Circuit Protection:** Crossover to current mode or crossover to voltage mode
- **Overvoltage Protection:** 10 microsecond crowbar
- **Finish:** Case is finished in black semi-gloss baked enamel; front panel is finished in black semi-gloss enamel / white lettering.
- **Programming:** Adjustable resistance and voltage (gain) programming constants. Complete details are in Sorensen's Performance Note PAN-1.

Temperature Coefficient		(Drift^4 (Typ.)		Programming Constants				Meter (2% accuracy)		Input Power (single phase, 47-53/57-63 Hz)		Power Factor (Typ.)	List Price (USA)
				Voltage Mode^8		Current Mode							
Voltage (Δ/°C)	Current (Δ/°C)	Voltage (%)	Current	Ohms (±.5%)	Volts	Ohms (±10%)	Volts	Voltmeter	Ammeter	Voltage (Vac)	Current Max (Aac)		
.01%,+200μV	.01%+1ma	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	40ΩAmp	20mV/Amp	0-12V	0-30A	105-125^6	7.5	0.67	$ 560
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	20Ω/Amp	8mV/Amp	0-12V	0-60A	105-125^6	14.7	0.73	790
.01%,+200μV	.01%,+2mA	.025%,+500uV	.03%+10mA	200Ω/volt	1 volt/volt	10Ω/Amp	2.5mV/Amp	0-12V	0-120A	105-125^6	32.5	0.66	970
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	80Ω/Amp	80V/Amp	0-25V	0-15A	105-125^6	7.8	0.65	535
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	40Ω/Amp	20mV/Amp	0-25V	0-30A	105-125^6	13.6	0.64	610
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	20Ω/Amp	8mV/Amp	0-25V	0-60A	105-125^6	28.0	.064	920
.01%,+200μV	.01%,+0.5mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	150Ω/Amp	150V/Amp	0-50V	0-8A	105-125^6	6.3	0.58	510
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	80Ω/Amp	80mV/Amp	0-50V	0-15A	105-125^6	13.2	0.56	610
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	40Ω/Amp	20V/Amp	0-50V	0-30A	105-125^6	22.0	0.675	805
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	20Ω/Amp	8mV/Amp	0-50V	0-60A	190-230^7	25.0	0.66	970
.01%,+200μV	.01%,+0.5mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	250Ω/Amp	250mV/Amp	0-80V	0-5A	105-125^6	6.0	0.66	535
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	125Ω/Amp	125mV/Amp	0-80V	0-10A	105-125^6	12.5	0.54	635
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	60Ω/Amp	40mV/Amp	0-80V	0-20A	105-125^6	22.0	0.685	790
.01%,+200μV	.01%,+1mA	.025%,+500μV	.03%,+3mA	200Ω/volt	1 volt/volt	25Ω/Amp	15mV/Amp	0-80V	0-40A	190-230^7	26.0	0.6	1045

NOTES:

1. With load change (NL to FL or FL to NL) and line voltage change (±10%) combined.
2. Whichever is greater.
3. At full compliance voltage.
4. For 8 hours (after 30 min. warmup) with constant line, load and ambient temperature.
5. To return to a bandwidth of ±10mV for a step load change of NL to FL or FL to NL.
6. Standard model has 105-125 Vac input. Models with M1 suffix (example SRL10-50 M1) have 190-230 Vac input. Models with M2 suffix (example SRL10-50 M2) have 210-250 Vac input.
7. Models SRL40-50 and SRL60-35 have 190-230 Vac input. Models SRL40-50 M2 and SRL60-35 M2 have 210-250 Vac input.
8. Voltage-mode constants are factory selected. They may be altered at rear terminal board.

DAP SERIES

High Speed D-to-A Programmers

Directly Addressable / 10-Bit Accuracy / Data Storage / Photo-Isolation (1500 Vdc) / Deglitcher / High Speed (less than 25μs) / Programmable Shutdown / Data-Acknowledge Signal to Computer (flag)

Automatic test systems and process-control equipment are the primary applications of this new series of digital-to-analog programmers (DAP's). The programmer converts the output of all forms of digital devices to the analog signals required to program Sorensen's power supplies.

DC POWER SUPPLIES — REGULATED

QRD SERIES

General laboratory instruments featuring excellent voltage and current regulation, low noise and ripple, and high-speed programmability. Seven models from 30 to 90 watts, 15 to 60 volts, full range. Accessories include overvoltage protectors, rack adapters and calibrated ten-turn voltage and current controls.

OVERVOLTAGE PROTECTORS

OVP SERIES

Modular overvoltage protectors designed specifically for integrated and discrete solid state circuits and other voltage sensitive loads. Provides constant output voltage monitoring of solid state comparator signal, fast response SCR crowbar that triggers when voltage exceeds preset trip level.

Write or call today for your free copy of the informative Sorensen full line catalog. Sorensen Co., 676 Island Pond Road, Manchester, New Hampshire 03103.

TEL: (603) 668-4500
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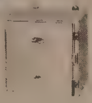
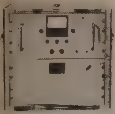
ALL PRICES LISTED SUBJECT TO CHANGE.

STABILINE® automatic VOLTAGE REGULATORS

TYPE IES9101


TYPE EMT10228


TYPE EMT4115B

Deliver a constant output voltage regardless of variations in input voltage or changes in line current. Types available from 0.25 to 275 kva. Submit specifications for ratings desired but not given in the charts. Input voltage ranges shown are at nominal output voltage; input range shifts with output voltage setting.

EMT SERIES – Electro Mechanical Transistorized types with virtually zero waveform distortion, 47-63 hertz frequency range, very low internal impedance, negligible phase shift and efficiency approximately 99%. Rated accuracy ±.75% for all line voltage or load current variations within unit stated range. Insensitive to load magnitude and power factor; no effect on system power factor.

EMS SERIES – Electro Mechanical Transistorized types for heavier load requirements. Same operating characteristics as EMT Series. Units with letter I before first digit in type number have individual control for each line-to-neutral voltage.

EMK SERIES – Electro Mechanical Transistorized types providing faster correction times than other electromechanical models.

IES SERIES – Instantaneous Electronic Solid-State types having extremely fast correction, no moving parts. Will maintain output voltage within a 100 millivolt rms band for any combination of rated input voltage and/or load from 1.0 to 0 power factor lagging. Efficiency to 95%. All units have provision for remote sensing and have plug-in solid-state circuit boards.

MILITARIZED – Meet requirements of applicable military specifications. Type EMTH41007MH is 3½ x 6 x 4½"; type EM4108MCR fits standard 19" relay rack. Accuracy ±1.0%.

EMT SERIES

NOMINAL OUTPUT VOLTAGE	OUTPUT VOLTAGE (ADJUSTABLE)	INPUT VOLTAGE RANGE‡‡	MAXIMUM OUTPUT AMPERES	RATED OUTPUT KVA	CORRECTION RATE AT 60 HERTZ (SECONDS/VOLT)	TYPE
50/60 HERTZ, SINGLE PHASE OPERATION						
115	110-120	95-135	20	2.3	0.075	EMT4102B†
			57	6.6	0.075	EMT4106C§
		90-115	52	6.0	0.12	EMT10228
		105-125	114	13.0	0.15	EMT4112B§*
		95-135	144	16.6	0.125	EMT4115B
120¶	110-120	108-137	35	4.2	0.10	EMT4104B††
230‡	220-240	195-255	36	8.3	0.083	EMT4207B
			93	21.4	0.083	EMT4220
		205-250	130	29.9	0.111	EMT4228C
240‡¶	220-240	228-256	35	8.4	0.10	EMT4104B††
460	440-480	400-520	20	9.2	0.041	EMT4407B
			45	20.7	0.041	EMT4418B
50/60 HERTZ, THREE PHASE OPERATION						
230‡	220-240	195-255	33	13.1	0.083	EMT6210YB
			48	19.1	0.083	EMT6215YB
			63	25.1	0.083	EMT6220YB
			145	57.8	0.25	EMT6245YB
			188	74.9	0.25	EMT6270DB
460	440-480	400-520	18	14.3	0.041	EMT6412YB
			24	19.1	0.041	EMT6417YB
			35	27.9	0.041	EMT6425YB
			75	59.8	0.125	EMT6450YB
			100	75.0	0.125	EMT6475YB
		420-500	148	118	0.188	EMT64100YB

EMS SERIES

60 HERTZ, SINGLE PHASE, 2-WIRE						
115	110-120	103.5-126.5	833	100	0.65	EMS41100
230‡	220-240	218.5-241.5	435	100	0.22	EMS42100‡
50/60 HERTZ. SINGLE PHASE, 3-WIRE, INDIVIDUAL LINE CONTROL						
240/120	230-250/115-125	204-276/102-138	104	25.0	.03/.06	EMSI4225
			250	60.0	.03/.06	EMSI4260
	220-240/110-120	228-252/114-126	417	100	.10/.21	EMSI42100
50/60 HERTZ, THREE PHASE, SINGLE CONTROL						
230‡	220-240	203-257	339	135	0.28	EMS62135Y‡
460	440-480	445-495	230	180	0.30	EMS64180Y
			347	275	0.30	EMS64275Y
50/60 CYCLE, THREE PHASE, INDIVIDUAL LINE CONTROL						
208/120	191-217/115-125	177-239/102-138	250	90.0	.08/.14	EMSI6290Y
		165-233/95-135	525	190	.37/.22	EMSI62190Y

EMK SERIES

50/60 CYCLE, SINGLE PHASE						
115	110-120	95-135	23	2.6	0.02	EMK4105†
		105-125	46	5.3	0.04	

IES SERIES

50 OR 60 CYCLE ±10%, SINGLE PHASE						
115	110-120	95-135**	4.4	0.5	—	IES91005
			8.7	1.0	—	IES9101
			26.1	3.0	—	IES9103
			52.2	6.0	—	IES9106
			130	15.0	—	IES9115
230	220-240	195-255**	13	3.0	—	IES9203
			26.1	6.0	—	IES9206
			65	15.0	—	IES9215

MILITARIZED TYPES

45-66 HERTZ, SINGLE PHASE						
120	115-125	105-135	66.6	8.0	0.10	EM4108MCR
380-420 HERTZ, SINGLE PHASE						
115	115	103.5-126.5	6	0.69	0.13▲	EMTH41007MH

▲At 400 Hertz
†Also available as rack model (suffix R when ordering).
¶For 60 Hertz operation only.
*Can also be operated on an input range of 95 to 135 volts with a rating of 57 amperes, 6.6 kva and a correction rate of 0.075 seconds per volt
§Also available as rack (suffix R when ordering) or wall mounted (suffix W when ordering) models.
‡Unit can be converted for 208 volt operation by simple tap changes. Input and output voltage ranges change proportionally.
**At nominal output. Shifts with output voltage setting but not proportionally.
††Also available in open construction (suffix U) and with screened and enclosed (suffix UT) construction.
‡‡At nominal output. Shifts proportionally with output voltage setting

STABILINE®

Full Range REGULATOR CONTROLLERS

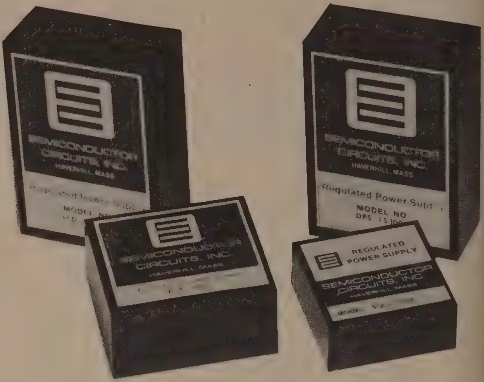
Designed for use with any motor-driven POWERSTAT Variable Transformer to provide full range regulation of a-c voltage, a-c current or d-c voltage. Output voltage will remain within a 2-volt band when used with 120 volt units and a 4-volt band when used with 240 volt models. Output current can be maintained within ±1% of maximum current setting with user supplied current transformer and Superior Electric transformer T6340. Type FR501DC and user supplied d-c power will provide regulated d-c voltage.

THE
SUPERIOR
ELECTRIC
COMPANY

1000 MIDDLE STREET, BRISTOL, CONN. 06010
PHONE: (203) 582-9561

Low Cost Miniature Power Supplys with Better than Average Performance

- **SHORT CIRCUIT PROTECTED**
- **NO DERATING THROUGH +71°C**
- **MTBF 150,000 HOURS AT 25°C**


SEMICONDUCTOR CIRCUITS, INC.
HAVERHILL, MASS
Regulated Power Supply
MODEL NO
DPS
REGULATED POWER SUPPLY

The SQ, P741, DPS and LCD Series units are designed and manufactured using the same techniques utilized in the manufacture of the P and SP5900 Series units described on page 7. These units are ideally suited to applications not requiring tight line and load regulation.

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac — 50 to 440 Hz

OUTPUT VOLTAGE TOLERANCE
1% (Fixed); +4%, -1% on 5V @ 200 mA Models

RIPPLE AND NOISE (PARD)
1 mV RMS

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

ORDERING INFORMATION

Model Number	Output Voltage (Vdc)	Output Current (mA)	Regulation Line (%)	Regulation Load (%)	Package (fig.)	Unit Price (1-9)
SQ1.5.200	5	200	0.25	0.4	1	$23.95
SQ1.12.100	12	100	0.25	0.25	1	23.95
SQ1.15.100	15	100	0.25	0.25	1	23.95
SQ2.12.30	±12	±30	0.25	0.25	1	23.95
SQ2.12.50	±12	±50	0.25	0.25	1	29.95
SQ2.15.30	±15	±30	0.25	0.25	1	23.95
SQ2.15.50	±15	±50	0.25	0.25	1	29.95
P741-5005	5	500	0.2	0.2	2	31.95
P741-1012	±12	±100	0.2	0.2	2	35.95
P741-1015	±15	±100	0.2	0.2	2	35.95
DPS1.5.750	5	750	0.5	0.5	3-A	31.95
DPS1.5.1000	5	1000	0.5	0.5	3-B	36.95
DPS1.5.1500	5	1500	0.5	0.5	3-B	44.95
DPS1.5.2000	5	2000	0.5	0.5	3-C	69.95
LCD1.5.200	5	200	0.2	0.4	3-A	23.95
LCD1.5.500	5	500	0.2	0.2	3-A	31.95
LCD1.5.1000	5	1000	0.2	0.2	3-B	44.95
LCD1.5.1500	5	1500	0.2	0.2	3-B	52.95
LCD1.5.2000	5	2000	0.2	0.2	3-C	75.95
LCD2.12.25	±12	±25	0.2	0.2	3-A	23.95
LCD2.12.50	±12	±50	0.2	0.2	3-A	30.95
LCD2.12.100	±12	±100	0.2	0.2	3-A	39.95
LCD2.12.200	±12	±200	0.2	0.2	3-B	59.95
LCD2.12.300	±12	±300	0.2	0.2	3-C	77.95
LCD2.15.25	±15	±25	0.2	0.2	3-A	23.95
LCD2.15.50	±15	±50	0.2	0.2	3-B	30.95
LCD2.15.100	±15	±100	0.2	0.2	3-C	39.95
LCD2.15.200	±15	±200	0.2	0.2	3-B	59.95
LCD2.15.300	±15	±300	0.2	0.2	3-C	77.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

MECHANICAL INFORMATION

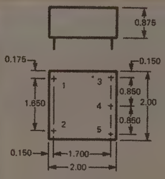

0.875
0.175
0.150
1.650
1
2
3
4
5
0.850
2.00
0.850
0.150
1.700
2.00

Fig. 1

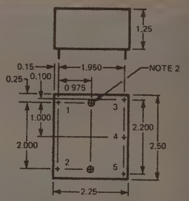

1.25
0.15
1.950
NOTE 2
0.25
0.100
0.975
1
3
1.000
4
2.200
2.000
2.50
2
5
2.25

Fig. 2

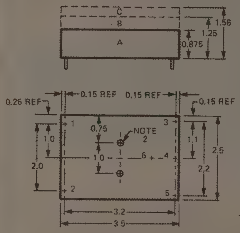

C
B
A
1.56
1.25
0.875
0.25 REF
0.15 REF
0.15 REF
0.15 REF
1
0.75
NOTE 2
3
1.0
1.0
6
4
1.1
2.0
2.5
2.2
2
5
3.2
3.5

Fig. 3

CONNECTIONS

Single Outputs

PIN	
1	AC in
2	AC in
3	-Vdc out
4	No Connection
5	+Vdc out
6	High Isolation (J Option Only)

Dual Outputs

PIN	
1	AC in
2	AC in
3	-Vdc out
4	Common
5	+Vdc out
6	High Isolation (J Option Only)

NOTES:
1. Five Pins, 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts No 4-40 x 0.10 Dp Min
3. All Dimensions are in Inches

Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

Industry Standard, High Performance & Militarized Power Supplys

- **REGULATION TO 0.01%**
- **FULL OPERATION UP TO 85°C (M OPTION)**
- **MTBF > 150,000 HOURS**

The **P and SP5900 Series** of high performance modular encapsulated power supplys are the standard of the industry with a proven record in the field since 1968. Continuous design improvements with respect to magnetics and regulator circuitry have led to an increased reliability (MTBF), a lower case temperature rise (up to 18°C cooler than other manufacturers units), and highest actual performance. The Militarized version (Suffix M) of these units is designed to meet the more demanding temperature, humidity and vibration requirements of military and critical industrial applications. These units include hermetically sealed components and tantalum capacitors for full rated operation through +85°C.

SEMICONDUCTOR CIRCUITS INC.
Regulated Power Supply
MODEL NO
SP5920
MODEL NO
P2.15.200

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac — 50 to 440 Hz
OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)
RIPPLE AND NOISE (PARD)
1mV RMS
TEMPERATURE COEFFICIENT
0.02%/°C (Typical)
OPERATING TEMPERATURE RANGE
-40°C to +85°C (M Option)
-25°C to +71°C (Standard)

STORAGE TEMPERATURE RANGE
-55°C to +125°C (M Option)
-25°C to +85°C (Standard)
SHORT CIRCUIT PROTECTION
Current Limiting
MTBF > 150,000 HOURS
Measured at 25°C, High Line and Full Load

ORDERING INFORMATION

Model Number	Output Voltage (Vdc)	Output Current (mA)	Regulation Line (%)	Regulation Load (%)	Option (M)	AC Pin Spacing (Inches)	Package Size (Fig. 1)	Unit Price (1-9)
P1.5.500 SP5903*	5	500	0.05	0.05	●	2.0 2.2	A	$37.95 43.95
P1.5.1000 SP5905*	5	1000	0.05	0.1	●	2.0 2.2	B	56.95 62.95
P1.5.1500 SP5940	5	1500	0.05	0.2	Consult Factory	2.0 2.2	B	64.95 65.95
P1.5.2000 SP5941	5	2000	0.05	0.2	Consult Factory	2.0 2.2	C	82.95 83.95
P2.12.25 SP5907	±12	±25	0.05	0.05	●	2.0 2.2	A	24.95 24.95
P2.12.60 SP5909	±12	±60	0.01	0.05	●	2.0 2.2	A	35.95 37.95
P2.12.100 SP5908-2	±12	±100	0.01	0.05	●	2.0 2.2	A	46.95 47.95
P2.12.100-2 SP5908	±12	±100	0.01	0.05	●	2.0 2.2	B	47.95 47.95
P2.12.200 SP5921	±12	±200	0.01	0.05	●	2.0 2.2	B	66.95 67.95
P2.12.300 SP5950	±12	±300	0.01	0.05	●	2.0 2.2	C	84.95 85.95
P2.15.25 SP5915	±15	±25	0.05	0.05	Consult Factory	2.0 2.2	A	24.95 24.95
P2.15.60 SP5904	±15	±60	0.01	0.05	●	2.0 2.2	A	35.95 37.95
P2.15.100 SP5902-2	±15	±100	0.01	0.05	●	2.0 2.2	A	46.95 47.95
P2.15.100-2 SP5902	±15	±100	0.01	0.05	●	2.0 2.2	B	47.95 47.95
P2.15.200 SP5920	±15	±200	0.01	0.05	●	2.0 2.2	B	66.95 67.95
P2.15.300 SP5951	±15	±300	0.01	0.05	Consult Factory	2.0 2.2	C	84.95 85.95
P2.120.20	±120	±20	0.01	0.05	Consult Factory	2.0	C	84.95

*Includes Clamp type Overvoltage Protection set at approximately 6.5 Vdc (see option —OV page 23).

MECHANICAL INFORMATION

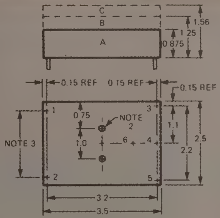


Fig. 1

CONNECTIONS

Single Outputs
2.0" AC Pin Spacing

PIN	
1	AC in
2	AC in
3	-Vdc out
4	No Connection
5	+Vdc out
6	High Isolation (J Option Only)

Single Outputs
2.2" AC Pin Spacing

PIN	
1	AC in
2	AC in
3	No Connection
4	Common
5	+Vdc out
6	High Isolation (J Option Only)

Dual Outputs
2.0" and 2.2" AC Pin Spacing

PIN	
1	AC in
2	AC in
3	-Vdc out
4	Common
5	+Vdc out
6	High Isolation (J Option Only).

NOTES:
1. Five Pins, 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts No 4-40 x 0.10 Dp Min
3. See Pin Spacing in Ordering Information
4. All Dimensions are in Inches

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

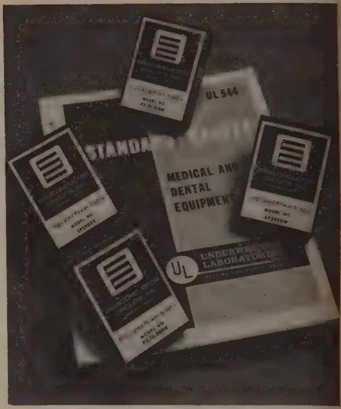
Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

Power Supplys Recognized Under UL 544C Standard For Safety — Medical & Dental Equipment

UL544C

- **PATIENT CONTACT RATED (W OPTION)**
- **2500 VOLT BREAKDOWN**
- **<10μ AMP LEAKAGE (W OPTION)**
- **FARADAY SHIELDED TRANSFORMERS**



These units have met the "Standard for Safety" for Medical and Dental Equipment, as established under UL 544C for patient contact and hazardous location applications by Underwriters Laboratories, Inc. and are recognized as such under the U.L. Component Recognition Program, File E50975. Patient Contact rating and Hazardous Location rating are designated by **SUFFIX** W and R, respectively.

The proper heat management of components has resulted in no internal "Hot Spots" that could adversely affect reliability. Effective transformer designs have resulted in achieving and surpassing the high voltage breakdown and low leakage current requirements necessary for patient protection. The above are just two factors that were considered with respect to patient safety.

Use of these modules eliminates the probability of rejection at the equipment level due to the power supply. Approval at the equipment level will be expedited. The real benefit comes once the product reaches the field. Because they operate more efficiently, these units dissipate less heat and are more reliable. This higher reliability and lower heat dissipation will result in a higher reliability of the overall equipment.

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac – 50 to 440 Hz

OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)

RIPPLE AND NOISE (PARD)
1 mV RMS

TEMPERATURE COEFFICIENT
0.02%/°C (Typical)

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

INPUT TO OUTPUT ISOLATION
2500 Volts (min)

AC LEAKAGE CURRENT
<10μ amps (W option – Patient Contact Rated)
<100μ amps (R Option – Hazardous Location Rated)

SHORT CIRCUIT PROTECTION
Current Limiting

ORDERING INFORMATION

Model Number ±12 Vdc Output	Model Number ±15 Vdc Output	Output Current (mA)	Regulation Line (%)	Regulation Load (%)	Input AC Pin Spacing (Inches)	Package Size (fig. 1)	Unit Price (1-9)
LCD2.12.25$^{R}_{W}$	LCD2.15.25$^{R}_{W}$	±25	0.2	0.2	2.0	A	$26.95 27.95
P2.12.25$^{R}_{W}$	P2.15.25$^{R}_{W}$	±25	0.05	0.05	2.0	A	27.95 28.95
SP5907$^{R}_{W}$	SP5915$^{R}_{W}$	±25	0.05	0.05	2.2	A	28.95 29.95
LCD2.12.50$^{R}_{W}$	LCD2.15.50$^{R}_{W}$	±50	0.2	0.2	2.0	A	39.95 43.95
P2.12.60$^{R}_{W}$	P2.15.60$^{R}_{W}$	±60	0.01	0.05	2.0	A	40.95 44.95
SP5909$^{R}_{W}$	SP5904$^{R}_{W}$	±60	0.01	0.05	2.2	A	41.95 45.95
LCD2.12.100$^{R}_{W}$	LCD2.15.100$^{R}_{W}$	±100	0.2	0.2	2.0	A	47.95 51.95
P2.12.100$^{R}_{W}$	P2.15.100$^{R}_{W}$	±100	0.01	0.05	2.0	A	50.95 54.95
SP5908$^{R}_{W}$	SP5902$^{R}_{W}$	±100	0.01	0.05	2.2	B	51.95 55.95
LCD2.12.200$^{R}_{W}$	LCD2.15.200$^{R}_{W}$	±200	0.2	0.2	2.0	B	62.95 66.95
P2.12.200$^{R}_{W}$	P2.15.200$^{R}_{W}$	±200	0.01	0.05	2.0	B	68.95 73.95
SP5921$^{R}_{W}$	SP5920$^{R}_{W}$	±200	0.01	0.05	2.2	B	69.95 73.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents – Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

MECHANICAL INFORMATION

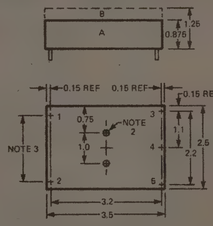


Fig. 1

CONNECTIONS

PIN 1 AC in (High)
2 AC in (Neutral)*
3 -Vdc out
4 Common
5 +Vdc out
*Faraday Shield Connected Internally

NOTES:
1. Five Pins 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts No 4-40 x 0.10 Dp Min
3. See Input AC Pin Spacing in Ordering Information
4. All Dimensions are in Inches

Options and Sockets – Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

Chassis Mount and Bench Type Power Supplys

- **SMALLEST AVAILABLE**

The CM and LCM Series are designed to meet application requirements where compact size and chassis mounting are factors. These units are equivalent electrically to the **P Series** units described on page 7. The **LCM Series** is identical to the **CM Series** except that a six foot long, three conductor line cord is provided for AC power. In addition, two terminals located on the barrier strip are in series with the AC input and can be used to turn power on and off from a remotely located switch.

The LP Series units are high performance bench type power supplys electrically identical to the **P Series** units described on page 7. These units are ideal for laboratory use, especially when designing equipment that will house and be powered by an equivalent unit. They take up almost no room on a busy work bench, provide reliable high performance power and are equipped with a six foot long, three conductor line cord, as well as an ON/OFF switch located up front next to the binding posts.

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac — 50 to 440 Hz

OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)

RIPPLE AND NOISE (PARD)
1 mV RMS

OPERATING TEMPERATURE RANGE
–25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
–25°C to +85°C

SHORT CIRCUIT PROTECTION
Current Limiting

MTBF > 150,000 HOURS
Measured at 25°C, High Line and Full Load

ORDERING INFORMATION

Model Number	Output Voltage (Vdc)	Output Current (mA)	Regulation Line (%)	Regulation Load (%)	Package Size (fig.)	Unit Price (1-9)
CM5S750 LCM5S750	5	750	0.05	0.2	1-B	$64.95 74.95
CM5S1000 LCM5S1000	5	1000	0.05	0.2	1-B	71.95 81.95
CM5S1500 LCM5S1500	5	1500	0.05	0.2	1-B	76.95 86.95
CM5S2000 LCM5S2000	5	2000	0.05	0.2	1-C	87.95 97.95
CM12D100 LCM12D100	±12	±100	0.05	0.2	1-B	52.95 62.95
CM12D200 LCM12D200	±12	±200	0.05	0.2	1-B	69.95 79.95
CM12D300 LCM12D300	±12	±300	0.05	0.2	1-C	92.95 99.95
CM15D100 LCM15D100	±15	±100	0.05	0.2	1-B	52.95 62.95
CM15D200 LCM15D200	±15	±200	0.05	0.2	1-B	69.95 79.95
CM15D300 LCM15D300	±15	±300	0.05	0.2	1-C	92.95 99.95
LP1.5.1000	5	1000	0.01	0.05	2	69.95
LP2.12.100	±12	±100	0.01	0.05	2	54.95
LP2.12.200	±12	±200	0.01	0.05	2	74.95
LP2.15.100	±15	±100	0.01	0.05	2	54.95
LP2.15.200	±15	±200	0.01	0.05	2	74.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

MECHANICAL INFORMATION

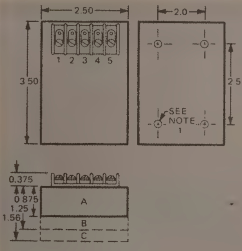


Fig. 1

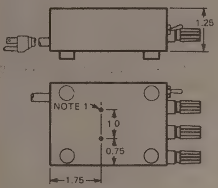


Fig. 2

CONNECTIONS

	CM	LCM
Single Outputs		
Term 1	AC (PWR)	AC (REM SW)*
2	AC (PWR)	AC (REM SW)*
3	+Vdc out	+ Vdc out
4	Do Not Connect	Do Not Connect
5	–Vdc out	–Vdc out
Dual Outputs		
Term 1	AC (PWR)	AC (REM SW)*
2	AC (PWR)	AC (REM SW)*
3	+Vdc out	+Vdc out
4	Common	Common
5	–Vdc out	–Vdc out

*For operation the REM SW TERMS must be connected by either a jumper or remote switch.

LP Series

	Single Outputs	**Dual Outputs**
Red Term	+5Vdc out	+Vdc out
Black Term	Common	Common
Purple Term	Not included	–Vdc out

NOTES:
1. Mounting Inserts 4-40 x 0.10 Dp Min
   Earth Ground Connected to Threaded Insert on LCM and LP Series, Only
2. All Dimensions are in Inches

Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

High Performance Triple Output Power Supplys

- POWER FOR BOTH "A & D" OUTPUTS
- TRI-POWER OUTPUTS TO 6.75 WATTS
- NO DERATING UP THROUGH +71°C

The **MP Series** triple output power supplys are ideal for those applications where space (P.C. Board real estate) is limited. Three outputs are available in the same area that is normally occupied by most single or dual output encapsulated modules. These units take advantage of the same design and manufacturing techniques used in the high performance **P SERIES** described on page 7.

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac – 50 to 440 Hz

OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)

RIPPLE AND NOISE (PARD)
1 mV RMS

TEMPERATURE COEFFICIENT
0.02%/°C (Typical)

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

SHORT CIRCUIT PROTECTION
Current Limiting

ORDERING INFORMATION

Model Number	Output Voltage (Vdc)	Output Current (mA)	Regulation		Package Size (fig. 1)	Unit Price (1-9)
			Line (%)	Load (%)		
MP 1.5.225/ 2.12.40	+5/ ±12	+225/ ±40	0.01 0.01	0.1 0.05	A	$55.95
MP 1.5.300/ 2.12.150	+5/ ±12	+300/ ±150	0.01 0.01	0.1 0.05	B	67.95
MP 1.5.500/ 2.12.100	+5/ ±12	+500/ ±100	0.01 0.01	0.1 0.05	B	67.95
MP 1.5.750/ 2.12.100	+5/ ±12	+750/ ±100	0.01 0.01	0.2 0.05	C	72.95
MP 1.5.225/ 2.15.40	+5/ ±15	+225/ ±40	0.01 0.01	0.1 0.05	A	55.95
MP 1.5.300/ 2.15.150	+5/ ±15	+300/ ±150	0.01 0.01	0.1 0.05	B	67.95
MP 1.5.500/ 2.15.100	+5/ ±15	+500/ ±100	0.01 0.01	0.1 0.05	B	67.95
MP 1.5.750/ 2.15.100	+5/ ±15	+750/ ±100	0.01 0.01	0.2 0.05	C	72.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents – Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

MECHANICAL INFORMATION

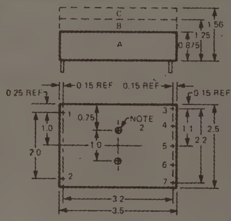


Fig. 1

NOTES:
1. Seven Pins 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts 4-40 x 0.10 Dp Min
3. All Dimensions are in Inches

CONNECTIONS

PIN	1	AC in
	2	AC in
	3	Common*
	4	+5 Vdc out
	5	-15 Vdc (-12 Vdc) out
	6	Common*
	7	+15 Vdc (+12 Vdc) out

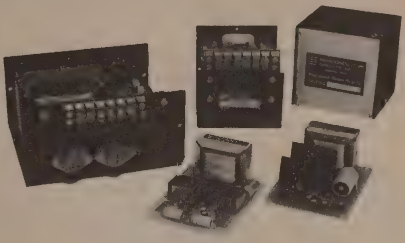
*Pins 3 and 6 are Internally Connected.

Options and Sockets – Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

High Performance P.C. Card, Open Frame and Packaged Power Supplys

- **REMOTE SENSING**
- **NO DERATING THROUGH +71°C**
- **FULL 5 YEAR WARRANTY**



The **PC, OF** and **C Series** power supplys are designed for general purpose applications requiring high performance at moderate prices. These series have a proven reliability, with up to six years of performance in the field.

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac – 50 to 440 Hz

OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)

TEMPERATURE COEFFICIENT
0.02%/°C (typical)

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

SHORT CIRCUIT PROTECTION
Continuous

ORDERING INFORMATION

Model Number	Output Voltage (Vdc)	Output Current (mA)	Regulation Line (%)	Regulation Load (%)	PARD (mVRMS)	Package Size (fig.)	Unit Price (1-9)
PC1.5.1000	5	1000	0.01	0.10	1	1	$35.95
PC2.12.50	±12	±50	0.01	0.05	1	1	30.95
PC2.12.100	±12	±100	0.01	0.05	1	1	36.95
PC2.12.200	±12	±200	0.01	0.05	1	1	54.95
PC2.15.50	±15	±50	0.01	0.05	1	1	30.95
PC2.15.100	±15	±100	0.01	0.05	1	1	36.95
PC2.15.200	±15	±200	0.01	0.05	1	1	54.95
OF1.5.2000	5	2000	0.01	0.10	2	3	39.95
OF1.5.3000	5	3000	0.01	0.10	2	3	44.95
OF1.5.5000	5	5000	0.01	0.10	2	2	64.95
OF1.5.7000	5	7000	0.01	0.10	2	2	69.95
OF2.12.500	±12	±500	0.01	0.10	2	3	67.95
OF2.15.500	±15	±500	0.01	0.10	2	3	67.95
C1.5.2000	5	2000	0.01	0.05	1	4	50.95
C1.5.3000	5	3000	0.01	0.05	1	4	54.95
C2.12.500	±12	±500	0.01	0.05	1	4	78.95
C2.15.500	±15	±500	0.01	0.05	1	4	78.95
C2.120.50	±120	±50	0.01	0.05	1	4	99.95

MECHANICAL INFORMATION

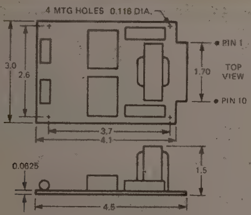


Fig. 1

CONNECTIONS (Figure 1)

PIN	Single Outputs	PIN	Dual Outputs
1	+Vdc Sense	1	-Vdc Sense
2	+ Vdc	2	-Vdc
3	AC in	3	AC in
4	No Connection	4	-Vdc Sense Com
5	No Connection	5	-Vdc Com
6	No Connection	6	+Vdc Com
7	No Connection	7	+Vdc Sense Com
8	AC in	8	AC in
9	-Vdc	9	+Vdc out
10	-Vdc Sense	10	+Vdc Sense

NOTE: Case Height on 200 mA Supplies 2.0" max

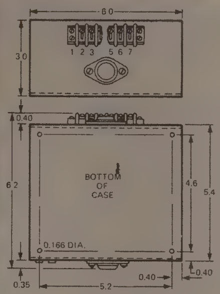


Fig. 2

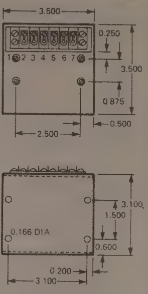


Fig. 3

CONNECTIONS (Figure 2 and 3)

PIN	Single Outputs	PIN	Dual Outputs
1	Case Ground	1	Ground
2	AC in	2	AC in
3	AC in	3	AC in
4	+Vdc out	4	+Vdc out
5	+Vdc Sense	5	Common
6	-Vdc Sense	6	-Vdc out
7	-Vdc out	7	No Connection

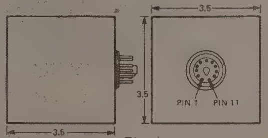


Fig. 4

CONNECTIONS (Figure 4)

PIN	Single Outputs	PIN	Dual Outputs
1	AC in	1	AC in
2	+Vdc out	2	+Vdc out
3	+Vdc Sense	3	+Vdc Sense
4	Common Sense	4	+Vdc Sense Com
5	Common	5	Common
6	Case Ground	6	Case Ground
7	No Connection	7	-Vdc Sense Com
8	No Connection	8	-Vdc Sense
9	No Connection	9	-Vdc out
10	No Connection	10	No Connection
11	AC in	11	AC in

MATING SOCKET – AMPHENOL 86C11 INCLUDED

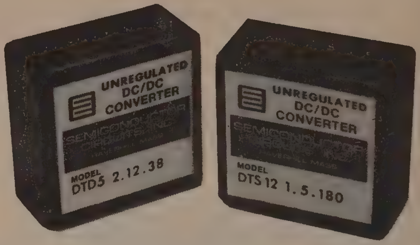
AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents – Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

Options and Sockets – Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

Miniature DC/DC Converters

- HIGHER EFFICIENCY UP TO 90%
- NO DERATING THROUGH +71°C
- SHORT CIRCUIT PROTECTED


UNREGULATED
DC/DC
CONVERTER
SEMICONDUCTOR CIRCUITS INC.
MODEL
DTD5 2.12.38
UNREGULATED
DC/DC
CONVERTER
SEMICONDUCTOR CIRCUITS INC.
MODEL
DTS 12 1.5.180

The DTS/DTD Series DC/DC Converters operate with a low case temperature rise. Packaged in a 1-1/8" square configuration, this series is convenient for use in applications where P.C. Board space is limited. The total rated power is available through any output.

GENERAL SPECIFICATIONS

INPUT VOLTAGE RANGE
Vin ±15%

OSCILLATOR FREQUENCY
5 to 20 KHz

OUTPUT VOLTAGE TOLERANCE
Vout ±3% at specified Vin and F.L.

REGULATION
Line: 1%/%
Load: See load curve

RIPPLE AND NOISE (PARD)
30 mV RMS

OPERATING TEMPERATURE
-25°C to +71°C

STORAGE TEMPERATURE RANGE
-25°C to +85°C

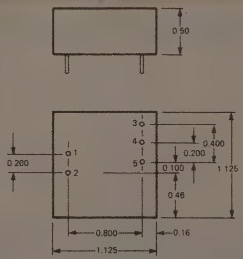
I/O ISOLATION
300 Vdc (min)

ORDERING INFORMATION

Model Number	Input Voltage (Vdc)	Output Voltage (Vdc)	Output Current (mA)	EFF (%)	Unit Price (1-9)
DTS5-1.5.180	5	5	180	80	$24.95
DTS5-1.12.75	5	12	75	85	24.95
DTD5-2.12.38	5	±12	±38	85	29.95
DTD5-2.15.30	5	±15	±30	85	29.95
DTD12-2.12.38	12	±12	±38	90	29.95
DTD12-2.15.30	12	±15	±30	90	29.95
DTD24-2.12.38	24	±12	±38	90	29.95
DTD24-2.15.30	24	±15	±30	90	29.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

MECHANICAL INFORMATION

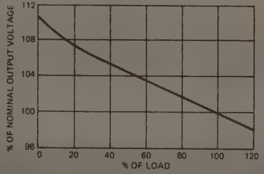

0 50
3
4
5
1
2
0 200
0.400
0.200
0 100
1 125
0 46
0.800
0.16
1.125

CONNECTIONS

PIN	Single Outputs	PIN	Dual Outputs
1	-Vdc in	1	-Vdc in
2	+Vdc in	2	+Vdc in
3	+Vdc out	3	+Vdc out
4	Common	4	Common
5	No Connection	5	No Connection

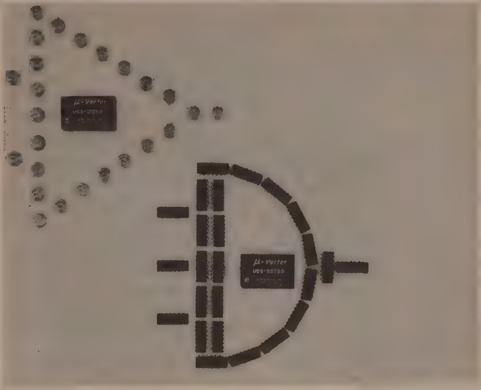
NOTES:
1. Five Pins 0.040 Dia x 0.20 Lg Min
2. All Dimensions are in Inches

LOAD CURVE



SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

24 Pin DIP DC/DC Converters



- **HIGH DENSITY 24 PIN DIP PACKAGING**
- **0.5″ ON CENTER P.C. BOARD MOUNTING**
- **SHORT CIRCUIT PROTECTED**

The μVERTER Series DC/DC converters are packaged in a 24 pin DIP configuration. They can drive up to 25 IC modules or OP-Amps and are suitable for P.C. card files requiring ½″ on center mounting.

GENERAL SPECIFICATIONS

INPUT VOLTAGE RANGE
Vin +15%, -10%

OUTPUT VOLTAGE TOLERANCE
Vout ±3% at specified Vin and F.L.

REGULATION
Line: 1%/%
Load: See load curve

RIPPLE AND NOISE (PARD)
30 mV RMS

OPERATING TEMPERATURE RANGE
-25°C to +71°C

STORAGE TEMPERATURE RANGE
-55°C to +85°C

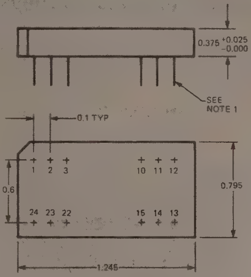
I/O ISOLATION
300 Vdc (min)

ORDERING INFORMATION

Model Number	Input Voltage (Vdc)	Output Voltage (Vdc)	Output Current (mA)	Unit Price (1-9)
UD5-5S220	5	5	220	$26.95
UD5-12D50	5	12 ±12 24	100 ±50 50	31.95
UD5-15D45	5	15 ±15 30	90 ±45 45	31.95

DUAL OUTPUT MODELS CAN PROVIDE A SINGLE OUTPUT WHEN WIRED AS SHOWN IN THE CONNECTING INSTRUCTIONS.

MECHANICAL INFORMATION

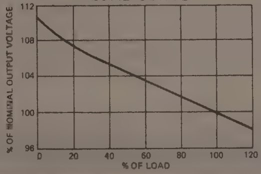


CONNECTIONS

PINS	5, 12 or 15 Vdc	±12 or ±15 Vdc	24 or 30 Vdc
1 & 24	+Vdc in	+Vdc in	+Vdc in
2 & 23	Do not connect	-Vdc out	Common out
3 & 22	Common out	Common out	Do not connect
10 & 15	Common out	Common out	Do not connect
11 & 14	+Vdc out	+Vdc out	+Vdc out
12 & 13	Common in	Common in	Common in

NOTES:
1. Pin Length 0.15″ Min
2. Pin Dia 0.02″
3. All Dimensions are in Inches

LOAD CURVE



AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

General Purpose Economy DC/DC Converters 3 to 20 Watts Output

RD, UD

- **EFFICIENCY TO 85%**
- **HIGH PERFORMANCE π INPUT FILTER**
- **SHORT CIRCUIT PROTECTED**

DC/DC CONVERTER
SEMICONDUCTOR CIRCUITS, INC.
MODEL RD48-5S1000
MODEL UD12-12D500
MODEL UD5-15D300

The RD Series DC/DC Converters are designed to meet most application requirements. They include a high performance π filter at the input to minimize input reflected ripple and use advanced techniques that reduce output noise current to less than 2.5mA (see page 13).

The UD Series DC/DC Converters include all of the features of the **RD Series** unit except that the output regulator is not provided. This series is economically priced and is ideal for applications where a stiff source of power is available. In addition, this series provides up to 20 watts of output power from a small package.

ORDERING INFORMATION

Model Number	Input Voltage (Vdc)	Output Voltage (Vdc)	Output Current (mA)	Package (fig. 1)	Unit Price (1-9)
RD5-5S600	5	5	600	B	$59.95
RD5-5S1000	5	5	1000	C	64.95
RD12-5S600	12	5	600	B	59.95
RD12-5S1000	12	5	1000	C	64.95
RD24-5S600	24	5	600	B	59.95
RD24-5S1000	24	5	1000	C	64.95
RD48-5S600	48	5	600	B	59.95
RD48-5S1000	48	5	1000	C	64.95
RD5-12S300	5	12	300	B	59.95
RD5-12S500	5	12	500	C	64.95
RD12-12S300	12	12	300	B	59.95
RD12-12S500	12	12	500	C	64.95
RD24-12S300	24	12	300	B	59.95
RD24-12S500	24	12	500	C	64.95
RD48-12S300	48	12	300	B	59.95
RD48-12S500	48	12	500	C	64.95
RD5-12D150	5	±12	±150	B	59.95
RD5-12D250	5	±12	±250	C	64.95
RD12-12D150	12	±12	±150	B	59.95
RD12-12D250	12	±12	±250	C	64.95
RD24-12D150	24	±12	±150	B	59.95
RD24-12D250	24	±12	±250	C	64.95
RD48-12D150	48	±12	±150	B	59.95
RD48-12D250	48	±12	±250	C	64.95
RD5-15D150	5	±15	±150	B	59.95
RD5-15D250	5	±15	±250	C	64.95
RD12-15D150	12	±15	±150	B	59.95
RD12-15D250	12	±15	±250	C	64.95
RD24-15D150	24	±15	±150	B	59.95
RD24-15D250	24	±15	±250	C	64.95
RD48-15D150	48	±15	±150	B	59.95
RD48-15D250	48	±15	±250	C	64.95
UD5-5S750	5	5	750	B	39.95
UD5-5S1000	5	5	1000	C	44.95
UD12-5S1000	12	5	1000	B	39.95
UD12-5S1300	12	5	1300	C	44.95
UD5-12S600	5	12	600	B	39.95
UD5-12S800	5	12	800	C	44.95
UD5-12D300	5	±12	±300	B	39.95
UD5-12D400	5	±12	±400	C	44.95
UD12-12D500	12	±12	±500	B	39.95
UD12-12D650	12	±12	±650	C	44.95
UD5-15D300	5	±15	±300	B	39.95
UD5-15D400	5	±15	±400	C	44.95
UD12-15D500	12	±15	±500	B	39.95
UD12-15D650	12	±15	±650	C	44.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

GENERAL SPECIFICATIONS

INPUT VOLTAGE RANGE
Ein (nom) ±10%

INPUT REFLECTED RIPPLE
1% Ein (max)

OUTPUT VOLTAGE TOLERANCE
RD Series ±1% (Fixed)
UD Series ±3% at specified Vin and F.L.

REGULATION
RD Series
Line: 0.05%
Load: 0.05%; 0.1% on 5V Output Models
UD Series
Line: 1%/%
Load: See load curve

RIPPLE AND NOISE
RD Series 1 mV RMS (max)
UD Series 30 mV RMS (max)

INPUT-OUTPUT ISOLATION
300 Vdc (min)

OPERATING TEMPERATURE RANGE
-25°C to +71°C

STORAGE TEMPERATURE
-55°C to +85°C

EFFICIENCY
RD Series Nominal Line at Full Load
50-65%
UD Series Nominal Line at Full Load
70-85%

MECHANICAL INFORMATION

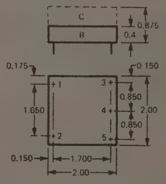
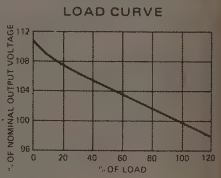


Fig. 1



CONNECTIONS

		Single Outputs	Dual Outputs
PINS	1	+Vdc in	+Vdc in
	2	Common in	Common in
	3	+Vdc out	+Vdc out
	4	No Connection	Common out
	5	Common out	-Vdc out

NOTES:
1. Five Pins 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts 4-40 x 0.10 Min
3. All Dimensions are in Inches

Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

High Performance, Regulated DC/DC Converters 0.9 to 10 Watts Output

9C, 30C 50C, 100C

- **HIGHLY REGULATED FLOATING OUTPUTS**
- **EXTREMELY LOW OUTPUT NOISE**
- **HIGH PERFORMANCE π INPUT FILTER**

DC/DC CONVERTER
SEMICONDUCTOR CIRCUITS, INC.
MODEL 50C24—12D210
Regulated Power Supply
MODEL NO. 100C12 15D330
DC/DC CONVERTER
MODEL 9C24—15D30

The 30C, 50C and 100C Models are equipped with a high performance π filter at the input to minimize input reflected ripple. This series of high performance DC/DC converters is especially suited for use with circuitry that requires output noise to be at a minimum. In every DC/DC converter, noise in the form of a current source is generated during normal switching as the magnetic material changes state. Because of proprietary state-of-the-art design considerations, the output noise of the **30C, 50C** and **100C models** is <2 mA—more than 10 to 30 dB lower than other designs that are presently available (see page 13). In use, noise will be minimized, if a low impedance return exists between input common and output common, for those applications not requiring input to output isolation; conversely, noise will also be minimized in applications requiring isolation, if no return exists between input and output common.

ORDERING INFORMATION

Model Number	Input Voltage (Vdc)	Output Voltage (Vdc)	Output Current (mA)	Package (fig.)	Unit Price (1-9)
9C5-12D35	4.5-5.5	±12	±35	1	$42.95
9C12-12D35	10.8-15.0	±12	±35	1	42.95
9C24-12D35	21.6-30.0	±12	±35	1	42.95
9C48-12D35	42.0-52.0	±12	±35	1	42.95
9C5-15D30	4.5-5.5	±15	±30	1	42.95
9C12-15D30	10.8-15.0	±15	±30	1	42.95
9C24-15D30	21.6-30.0	±15	±30	1	42.95
9C28-15D30	25.2-32.0	±15	±30	1	42.95
9C48-15D30	42.0-52.0	±15	±30	1	42.95
30C5-5S600	4.5-5.5	5	600	2-A	64.95
30C12-5S600	10.8-15.0	5	600	2-A	64.95
30C24-5S600	21.6-30.0	5	600	2-A	64.95
30C48-5S600	42.0-52.0	5	600	2-A	64.95
30C5-12D125	4.5-5.5	±12	±125	2-A	64.95
30C12-12D125	10.8-15.0	±12	±125	2-A	64.95
30C24-12D125	21.6-30.0	±12	±125	2-A	64.95
30C28-12D125	25.2-32.0	±12	±125	2-A	64.95
30C48-12D125	42.0-52.0	±12	±125	2-A	64.95
30C5-15D100	4.5-5.5	±15	±100	2-A	64.95
30C12-15D100	10.8-15.0	±15	±100	2-A	64.95
30C24-15D100	21.6-30.0	±15	±100	2-A	64.95
30C28-15D100	25.2-32.0	±15	±100	2-A	64.95
30C48-15D100	42.0-52.0	±15	±100	2-A	64.95
50C5-5S1000	4.5-5.5	5	1000	2-B	69.95
50C12-5S1000	10.8-15.0	5	1000	2-B	69.95
50C24-5S1000	21.6-30.0	5	1000	2-B	69.95
50C48-5S1000	42.0-52.0	5	1000	2-B	69.95
50C5-12D210	4.5-5.5	±12	±210	2-B	69.95
50C12-12D210	10.8-15.0	±12	±210	2-B	69.95
50C24-12D210	21.6-30.0	±12	±210	2-B	69.95
50C48-12D210	42.0-52.0	±12	±210	2-B	69.95
50C5-15D165	4.5-5.5	±15	±165	2-B	69.95
50C12-15D165	10.8-15.0	±15	±165	2-B	69.95
50C24-15D165	21.6-30.0	±15	±165	2-B	69.95
50C28-15D165	25.2-32.0	±15	±165	2-B	69.95
50C48-15D165	42.0-52.0	±15	±165	2-B	69.95
100C12-15D330	10.8-15.0	±15	±330	3	94.95
100C24-15D330	21.6-30.0	±15	±330	3	94.95
100C48-15D330	42.0-52.0	±15	±330	3	94.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

GENERAL SPECIFICATIONS

INPUT REFLECTED RIPPLE
<1% of Vin (max)

OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)

REGULATION
Line: 0.02% LL to HL
Load: 0.02% NL to FL
0.1% NL to FL
on 5 Vout Models

RIPPLE AND NOISE (PARD)
1 mV RMS

OPERATING TEMPERATURE RANGE
-25°C to +71°C

STORAGE TEMPERATURE RANGE
-55°C to +85°C

EFFICIENCY
55–65% at Nominal Vin and F.L.

I/O ISOLATION
300 Vdc (min)

INVERTER FREQUENCY RANGE
6 to 20 KHz

TEMPERATURE COEFFICIENT
0.02%/°C (typical)

MECHANICAL INFORMATION

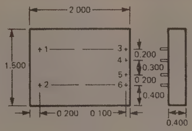


Fig. 1

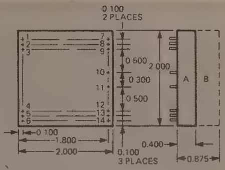


Fig. 2

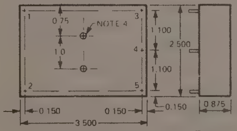


Fig. 3

CONNECTIONS

Single Outputs	Dual Outputs	PINOUT Fig. 1	PINOUT Fig. 2	PINOUT Fig. 3
+Vdc in	+Vdc in	1	1 to 3	1
Common in*	Common in*	2	4 to 6	2
+ Vdc out	+Vdc out	3	7 to 9	3
Do Not Connect	Common out	4 & 5	10 & 11	4
Common out	-Vdc out	6	12 to 14	5

NOTES:
1. All Dimensions in Inches
2. Connecting Pins 0.020 Dia x 0.150 Lg Min (Fig. 1 & 2)
3. Connecting Pins 0.040 Dia x 0.200 Lg Min (Fig. 3)
4. Two Mounting Inserts No 4-40 x 0.10 Dp Min

Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

OEM Design Capabilities, High Efficiency Modular Power Supplys and DC/DC Converters

BACKGROUND

Since 1966, Semiconductor Circuits, Inc., has been the largest producer of miniature power supply and DC/DC converter modules in the United States. During this period of time, SCI has developed many design innovations, which have become the standard within the industry. With over 350,000 units in operation throughout the world, SCI has the proven ability to design and manufacture products that pass the test of time in the field. As the number one manufacturer of these types of products, some of the innovations generated are as follows:

1967 ±15V at 50 and 100 mA card supply.
1968 a) ±15V at 200 mA card supply.
  b) 5V at 1 Amp card supply.
1969 a) ±15V at 100 mA encapsulated supply in a 2.5" x 3.5" x 0.875" module.
  b) 5V at 500 mA encapsulated supply in a 2.5" x 3.5" x 0.875" module.
1971 a) ±15V at 200 mA encapsulated supply in a 2.5" x 3.5" x 1.25" module.
  b) 5V at 1 Amp encapsulated supply in a 2.5" x 3.5" x 1.25" module.
1972 a) ±15V at 300 mA encapsulated supply in a 2.5" x 3.5" x 1.56" module.
  b) 5V at 2 Amps encapsulated supply in a 2.5" x 3.5" x 1.56" module.
  c) Logic Board compatible encapsulated DC to DC converters 1.5" x 2" x 0.4" and 2" x 2" x 0.4" modules.
  d) Multiple Output encapsulated supply in a 2.5" x 3.5" x 0.875" module.
1973 a) High efficiency Switching Regulators 24 Watts output in a 2.25" x 2.5" x 1.25" module.
  b) High efficiency DC/DC converters 1 Watt output in a 1" x 1" x 0.4" module.
1974 a) 5V at 2 Amp encapsulated supply in a 2.5" x 3.5" x 1.25" module.
  b) High efficiency DC/DC converters up to 20 Watts having up to a 2:1 input range.

SCI has the proven ability to design and manufacture reliable products for your specific application and production requirements. Before expending funds on power source development for use in your end product, contact SCI and allow us to propose the power system that best fits your needs. Your benefits will be a lower-per-unit cost and more time to adequately develop the unique portions of your equipment that will raise you above the competition. This combination can only result in a significant increase in the overall reliability and performance of your end products.

Regulated Power Supply
MODEL NO.
UD5-200S30
Regulated Power Supply
MODEL NO.
DR24-200S30
Regulated Power Supply
MODEL NO.
ED250S30
MODEL NO.
DC48-250S30

OEM CAPABILITIES DESCRIPTION

INPUT VOLTAGE
AC: 115 Vac; ±10, ±15, ±20 and ±25% Tolerance Ranges
Frequency 50 to 60, 50 to 440 and 47 to 440 Hz
DC: Min/max: 3 Vdc to 85 Vdc
Range: V nom ±5% to ±35% or up to a 2:1 Input Range

OUTPUT POWER
Up to 20 Watts Per Unit

EFFICIENCY
To 90%

OUTPUT VOLTAGE
Up to 1000 Vdc

OUTPUT CURRENT
Up to 7A

REGULATION
To 0.01% Line and Load

RIPPLE
To 1 mV RMS

OUTPUT VOLTAGE ACCURACY
Factory set at ±1% or ±2%

OUTPUT VOLTAGE VARIATION
Fixed, Trim Pin Variable or Potentiometer Adjustable

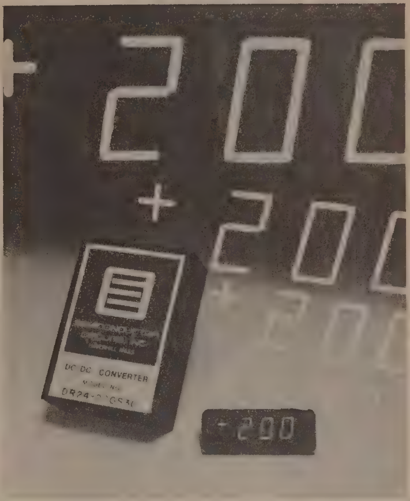
TEMPERATURE COEFFICIENT
To 0.005%/° C

CASE SIZES
2.5" x 3.5" x 1.25" for up to 12 Watts of Output
2.5" x 3.5" x 1.56" for up to 15 Watts of Output
2.5" x 3.5" x 2.0" for up to 20 Watts of Output

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

Plasma Digital Display Power Supplys and DC/DC Converters

- >75% EFFICIENCY
- UP TO 200% INPUT RANGE
- LOW CASE TEMPERATURE RISE



This family uses high efficiency techniques to develop a source of well regulated ionization voltage for plasma type digital displays. Models are available for AC inputs, as well as for regulated and unregulated sources of DC power.

GENERAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

CASE TEMPERATURE RISE
10 to 15°C above ambient

ORDERING INFORMATION

Model Number	Input Voltage	Output Voltage (Vdc)	Output Voltage Tolerance (±%)	Output Current (mA)	Regulation		I/O Isolated	Unit Price (1-9)
					Line (%)	Load (%)		
ED180S30	105-125 Vac	180	2	30	1	1	Yes	$49.95
ED250S30	105-125 Vac	250	2	30	1	1	Yes	54.95
UD5-180S30	5 Vdc ±5%	180	3	30	1%/% Vin	5	Yes	39.95
UD5-250S30	5 Vdc ±5%	250	3	30	1%/% Vin	5	Yes	44.95
DR12-180S30	9-18 Vdc	180	2	30	1	1	No	55.95
DR12-250S30	9-18 Vdc	250	2	30	1	1	No	59.95
DR24-180S30	18-36 Vdc	180	2	30	1	1	No	55.95
DR24-250S30	18-36 Vdc	250	2	30	1	1	No	59.95
DC48-180S30	35-70 Vdc	180	2	30	1	1	Yes	65.95
DC48-250S30	35-70 Vdc	250	2	30	1	1	Yes	69.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents — Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

MECHANICAL INFORMATION

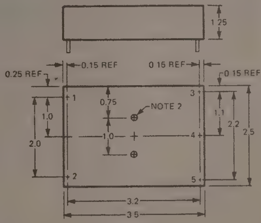


Fig. 1

CONNECTIONS

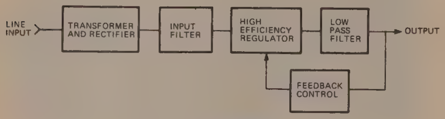
AC Input	DC Input
1. AC in	1. +Vdc in
2. AC in	2. -Vdc in
3. -Vdc out	3. +Vdc out
4. No Connection	4. No Connection
5. +Vdc out	5. -Vdc out

NOTES:
1. Five Pins, 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts No. 4-40 x 0.1 Dp Min
3. All Dimensions are in Inches

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

High Efficiency Single Output Power Supplys

- **EFFICIENCY >75%**
- **LINE TRANSIENT IMMUNITY >60 dB**
- **LOW CASE TEMPERATURE RISE <15oC**


LINE INPUT
TRANSFORMER AND RECTIFIER
INPUT FILTER
HIGH EFFICIENCY REGULATOR
LOW PASS FILTER
OUTPUT
FEEDBACK CONTROL

BLOCK DIAGRAM

The **E Series** power supplys use a high efficiency regulation technique. This design maintains nearly constant efficiency over the entire input voltage range. Less power is dissipated internally and the power supply runs cooler. The lower dissipation and cooler operation result in a higher overall system reliability. As an example, a conventional 5 Vdc output power supply dissipates 4 to 5 times as much power internally as would be dissipated by an equivalent **E Series** unit. These supplys offer line transient immunity not found in conventional power supply designs. The effects of line transients are significantly reduced by the low pass filter used within the high efficiency regulator.

ORDERING INFORMATION

Model Number	Output Voltage (Vdc)	Output Current (mA)	AC Pin Spacing (Inches)	Package (fig.)	Unit Price (1-9)
ES5S800 EA5S800	5	800	2.0 2.2	A	$52.95
ES5S1000 EA5S1000	5	1000	2.0 2.2	B	62.95
ES5S1500 EA5S1500	5	1500	2.0 2.2	B	69.95
ES5S2000 EA5S2000	5	2000	2.0 2.2	B	79.95
ES5S3000 EA5S3000	5	3000	2.0 2.2	C	99.95
ES12S800 EA12S800	12	800	2.0 2.2	B	79.95
ES15S650 EA15S650	15	650	2.0 2.2	B	79.95
ES24S400 EA24S400	24	400	2.0 2.2	B	79.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents
Different Pin Configurations — Chassis Mountable Configuration
Prices and Specifications Subject to Change Without Notice

Options and Sockets — Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
HAVERHILL, MASS.
Regulated Power Supply
MODEL NO.
ES5S3000
SEMICONDUCTOR CIRCUITS, INC.
HAVERHILL, MASS.
Regulated Power Supply
MODEL NO.
EA15S650

GENERAL SPECIFICATIONS

INPUT VOLTAGE AND FREQUENCY
105 to 125 Vac — 50 to 440 Hz

OUTPUT VOLTAGE TOLERANCE
±1% (Fixed)

REGULATION
0.15% Line and Load

RIPPLE AND NOISE
7 mV RMS

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

SHORT CIRCUIT PROTECTION
Current Limited

MECHANICAL INFORMATION

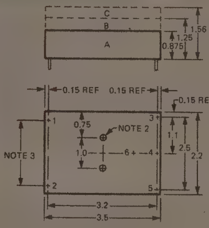

C
B
A
1.56
1.25
0.875
0.15 REF
0.15 REF
0.15 REF
1
2
3
4
5
6
0.75
NOTE 2
1.0
NOTE 3
1.1
2.5
2.2
3.2
3.5

Fig. 1

CONNECTIONS

2.0" AC Pin Spacing

PIN	
1	AC in
2	AC in
3	-Vdc out
4	No Connection
5	+Vdc out
6	High Isolation (J Option Only)

2.2" AC Pin Spacing

PIN	
1	AC in
2	AC in
3	No Connection
4	-Vdc out
5	+Vdc out
6	High Isolation (J Option Only)

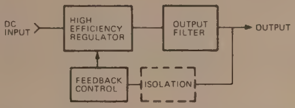
NOTES:
1. Five Pins 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts 4-40 x 0.10 Dp Min
3. See AC Pin Spacing in Ordering Information
4. All Dimensions are in Inches

SEMICONDUCTOR CIRCUITS, INC.
306 RIVER STREET • HAVERHILL, MASSACHUSETTS 01830
TEL. (617) 373-9104 • TWX. 710-347-0269

SW DC, DR

High Efficiency Single Output DC/DC Converters

- **HIGH EFFICIENCY – TO 90%**
- **WIDE INPUT RANGE – UP TO 200%**
- **SUITABLE FOR BATTERY OPERATION**


DC INPUT
HIGH EFFICIENCY REGULATOR
OUTPUT FILTER
OUTPUT
FEEDBACK CONTROL
ISOLATION

BLOCK DIAGRAM

SEMICONDUCTOR CIRCUITS, INC.
HAVERHILL, MASS.
MODEL NO DR24-200S30
SWITCHING REGULATOR
SEMICONDUCTOR CIRCUITS, INC.
HAVERHILL, MASS.
MODEL SW12-5S2000
SWITCHING REGULATOR
SEMICONDUCTOR CIRCUITS, INC.

This series of single output DC/DC converters uses proportional energy transfer high efficiency techniques that deliver a well regulated output voltage for applications requiring a wide input voltage range capability. This series is ideal for use in applications where the source of power is a battery or other source of poorly regulated DC power; such as a motor generator, a solar cell system or a fuel cell. Units can be configured into almost any form for OEM applications where size and shape are factors. Isolation can be provided **(DC Series)** or not provided **(DR and SW Series)** depending on the application. Input to output (I/O) isolation permits either output terminal to serve as the Output Common. This provides a simple method for obtaining positive or negative voltages from either input polarity.

GENERAL SPECIFICATIONS

OUTPUT VOLTAGE TOLERANCE
±2% (Fixed)

RIPPLE AND NOISE
7 mV RMS

OPERATING TEMPERATURE RANGE
-25°C to +71°C (No Derating)

STORAGE TEMPERATURE RANGE
-25°C to +85°C

SHORT CIRCUIT PROTECTION
SW Series – Current Limiting
DR and DC Series – Power Foldback

ORDERING INFORMATION

Model Number	Input Voltage Range (Vdc)	Output Voltage (Vdc)	Output Current (mA)	Efficiency (%)	Regulation Line (%)	Regulation Load (%)	I/O Isolated	Package (fig.)	Unit Price (1-9)
SW12-5S1000	+(9-16)	+5	+1000	65-70	0.2	0.2	No	1	$30.95
SW12-5S1500	+(9-16)	+5	+1500	65-70	0.2	0.2	No	1	34.95
SW12-5S2000	+(9-16)	+5	+2000	65-70	0.2	0.3	No	1	39.95
SW12-5S3000	+(9-16)	+5	+3000	65-70	0.2	0.5	No	3	64.95
SW24-5S1000	+(18-32)	+5	+1000	65-70	0.3	0.2	No	2	32.95
SW24-5S1500	+(18-32)	+5	+1500	65-70	0.3	0.2	No	2	36.95
SW24-5S2000	+(18-32)	+5	+2000	65-70	0.3	0.3	No	2	41.95
SW24-5S3000	+(18-32)	+5	+3000	65-70	0.3	0.5	No	3	66.95
DC48-5S1000	35-70	5	1000	65-70	1.0	1.0	Yes	3	75.95
DC48-5S1500	35-70	5	1500	65-70	1.0	1.0	Yes	3	79.95
DC48-5S2000	35-70	5	2000	65-70	1.0	1.0	Yes	3	85.95
DC48-5S3000	35-70	5	3000	65-70	1.0	1.0	Yes	3	94.95
DR12-12S1000	+(9-18)	+12	+1000	70-80	1.0	1.0	No	3	49.95
SW24-12S1000	+(18-32)	+12	+1000	70-80	0.2	0.2	No	2	41.95
SW24-12S2000	+(18-32)	+12	+2000	70-80	0.3	0.3	No	2	49.95
DC48-12S1000	35-70	12	1000	70-80	1.0	1.0	Yes	3	69.95
DR12-15S800	+(9-18)	+15	+800	70-80	1.0	1.0	No	3	49.95
SW24-15S1000	+(19-32)	+15	+1000	70-80	0.2	0.2	No	2	44.95
SW24-15S2000	+(19-32)	+15	+2000	70-80	0.3	0.3	No	2	50.95
DC48-15S800	35-70	15	800	70-80	1.0	1.0	Yes	3	69.95
DR12-24S500	+(9-18)	+24	+500	75-85	1.0	1.0	No	3	49.95
DR24-24S500	+(18-36)	+24	+500	75-85	1.0	1.0	No	3	49.95
DC48-24S500	35-70	24	500	75-85	1.0	1.0	Yes	3	69.95
DR12-180S30	+(9-18)	+180	+30	80-90	1.0	1.0	No	3	55.95
DR24-180S30	+(18-36)	+180	+30	80-90	1.0	1.0	No	3	55.95
DC48-180S30	35-70	180	30	80-90	1.0	1.0	Yes	3	65.95
DR12-250S30	+(9-18)	+250	+30	80-90	1.0	1.0	No	3	59.95
DR24-250S30	+(18-35)	+250	+30	80-90	1.0	1.0	No	3	59.95
DC48-250S30	35-70	250	30	80-90	1.0	1.0	Yes	3	69.95

AVAILABLE UPON REQUEST, PLEASE CONSULT FACTORY:
Other Voltages and Currents – Different Pin Configurations
Prices and Specifications Subject to Change Without Notice

MECHANICAL INFORMATION

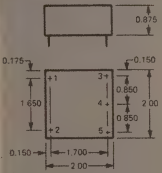

0.875
0.175
0.150
+1
3+
4+
+2
5+
1 650
0.850
0.850
2 00
0.150
1.700
2 00

Fig. 1

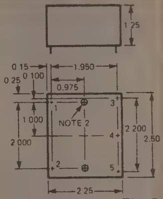

1 25
0 15
1.950
0 25
0 100
0.975
1
3
NOTE 2
1 000
2 000
4
2 200
2.50
2
5
2 25

Fig. 2

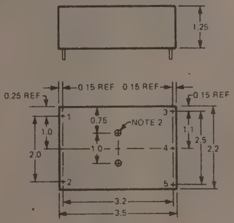

1.25
0.25 REF
0 15 REF
0 15 REF
0 15 REF
1
3
0.75
NOTE 2
1.0
1 0
2.0
4
1.1
2.5
2.2
2
5
3.2
3.5

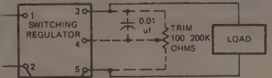
Fig. 3

CONNECTIONS

PIN	SW Series	DR and DC Series
1	+Vdc in	+Vdc In
2	-Vdc in	-Vdc in
3	+Vdc out	+Vdc out
4	Trim Adjust	No Connection
5	-Vdc out	-Vdc out

NOTES:

1. Five Pins 0.040 Dia x 0.20 Lg Min
2. Two Mounting Inserts No 4-40 x 0.10 Dp Min


1
3
SWITCHING REGULATOR
4
2
5
0.01 uf
TRIM 100 200K OHMS
LOAD

3. "SW" Series – For Trim, Use 100-200K Ohm Potentiometer
4. If leads to trim connection are more than 4" long, use a 0.01 uf capacitor up close to terminals 3 and 4

Options and Sockets – Refer to Pages 22 and 23 for Description and Prices

SEMICONDUCTOR CIRCUITS, INC.
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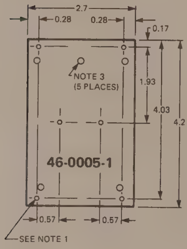
Sockets

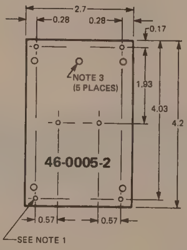
Sockets are provided to adapt standard P.C. mountable encapsulated modules to a mounting arrangement that are suitable for hard wired applications. For direct chassis mount applications refer to electrically equivalent CM, LCM, LP, PC, OF and C series units.

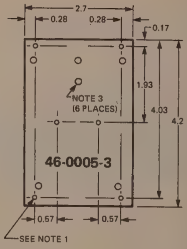
ORDERING INFORMATION

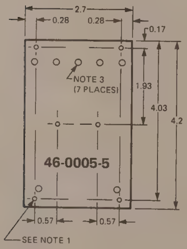
Standard Ordering Number	Obsolete Number	Description	Unit Price (1-9)
46-0003-1	483-000-000	Connector PC Series	$2.00
46-0005-1	483-000-001	Socket DPS, LCD, P, WS, ED DR, DC and ES Series	4.00
46-0005-2	483-000-002	Socket — SP5900 and EA Series	4.00
46-0005-3	483-000-003	Socket — J Option for LCD, P and ES Series	4.50
46-0005-5	483-000-005	Socket — MP Series	5.00
46-0006-1	483-000-006	Socket — SQ, UD and SW Series	4.00
46-0007-1	483-000-004	Socket — P741 and SW Series	4.00

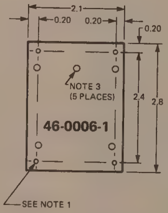
MECHANICAL INFORMATION

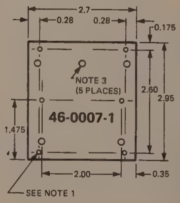

2.7
0.28
0.28
0.17
NOTE 3
(5 PLACES)
1.93
4.03
4.2
46-0005-1
0.57
0.57
SEE NOTE 1


2.7
0.28
0.28
0.17
NOTE 3
(5 PLACES)
1.93
4.03
4.2
46-0005-2
0.57
0.57
SEE NOTE 1


2.7
0.28
0.28
0.17
NOTE 3
(6 PLACES)
1.93
4.03
4.2
46-0005-3
0.57
0.57
SEE NOTE 1


2.7
0.28
0.28
0.17
NOTE 3
(7 PLACES)
1.93
4.03
4.2
46-0005-5
0.57
0.57
SEE NOTE 1


2.1
0.20
0.20
0.20
NOTE 3
(5 PLACES)
2.4
2.8
46-0006-1
SEE NOTE 1


2.7
0.28
0.28
0.175
NOTE 3
(5 PLACES)
2.60
2.95
1.475
46-0007-1
2.00
0.35
SEE NOTE 1

NOTES:
1. Six Mounting Holes 0.14 Dia
2. Board 0.09 Thick
3. Vector Cups extend 5/8" below bottom surface of board

Special Features

HIGHER REGULATION

Suffix "A" on a specific model number designates an improved Line and Load Regulation that is specified for the standard units as follows:

Standard Unit	Suffix "A"
Line Regulation	Line Regulation
0.01%	0.01%
0.05%	0.02%
Load Regulation	Load Regulation
0.05%	0.01%
0.1%	0.05%
0.2%	0.05%

CROWBAR OVERVOLTAGE PROTECTION

Suffix "C" on a specific model number designates a Crowbar Overvoltage Protection circuit. This feature applies to 5V output models, only, and is factory set at approximately 6.5 Vdc. Crowbar overvoltage protection is available for other voltages. The input should be fused when using overvoltage protection. For information, please consult factory.

COVER

Suffix "CVR" on a specific OF Series power supply designates that the unit is equipped with a metal dust cover. Covers are furnished as a standard part of the C Series units.

FOLDBACK OVERCURRENT PROTECTION

Suffix "FB" on a specific model number designates a supply having Foldback Overcurrent Protection rather than Current Limiting Overcurrent Protection. This feature is specifically suited for applications where short circuit conditions can occur for long periods of time.

FARADAY SHIELDED TRANSFORMER

Suffix "J" on a specific model number designates the supply is equipped with a Faraday Shielded transformer. This feature provides isolation of up to 1750 volts and a leakage current of less than 20μA at 60 Hz. The shield is available on pin 6. UL 544 Recognized Patient Contact rated models are equipped with a Faraday shield that provides isolation up to 2500 volts and a leakage current of less than 10μA at 60 Hz. The shield is connected to pin 2 internally.

200 to 252 Vac INPUT

Suffix "K" on a specific model number designates a power supply capable of operating from 200 to 252 Vac at 50 to 440 Hz. Operation to 264 Vac is also available. For further information, please consult the factory.

105 to 125/210 to 250 Vac INPUT

Suffix "K2" on a specific model number designates a power supply capable of operating from 105 to 125 Vac or 210 to 250 Vac at 50 to 440 Hz. Connection for either of these ranges is made via 4 AC input pins. For further information, please consult the factory.

MILITARIZED PM SERIES

Suffix "M" on a specific model number designates a power supply that has been ruggedized to meet the requirements of a more severe environment. Please refer to page 7 for additional information.

90 to 110 Vac INPUT

Suffix "N" on a specific model number designates a power supply capable of operating from 90 to 100 Vac at 50 to 440 Hz.

OVERVOLTAGE PROTECTION

Suffix "–OV" on a specific model number designates a clamp type Overvoltage Protection circuit. This feature applies to 5V output models, only, and is factory set at approximately 6.5 Vdc. This type of Overvoltage Protection is available for other voltages. The input should be fused when using overvoltage protection. For information, please consult the factory.

LOW TEMPERATURE COEFFICIENT

Suffix "T" on a specific model number designates a unit having a Temperature Coefficient of less than 0.005%/°C similar to the "WS" Series. Please refer to page 11.

UL 544C COMPONENT RECOGNITION

Suffix "W" or "R" on a specific model, as described on page 8, designates that the supply has been manufactured to meet all specifications required under UL 544C.

TABLE OF SPECIAL FEATURES

Series	Ref. Page	A	C	CVR	FB	J	K	K2	M	N	-OV	T	W or R
SQ	6						●			●	●		
P741	6						●		●	●	●		
DPS	6		●			●	●	●	●	●	●		
LCD	6		●		●	●	●	●	●	●	●		●
P	7	●	●		●	●	●	●	●	●	●	●	●
SP5900	7	●	●		●	●	●	●	●	●	●	●	●
CM	9	●	●		●	●	●		●	●	●	●	
LCM	9	●	●		●	●	●		●	●	●	●	
LP	9	●	●				●			●	●		
MP	10				●		●			●	●	●	
PC	12	●					●			●	●	●	
OF	12		●	●			●			●	●		
C	12	●	●	●			●			●	●		
ED	19		●				●			●			
ES	20		●			●	●	●		●	●		
EA	20		●			●	●	●		●	●		
DR	21		●								●		
DC	21		●								●		
SW	21		●								●		

NOTES: Some models within a series may not be available with single or multiple features as listed above. Please consult the factory.

Features	Prices
A	$ 5.00
C	8.50 <3A 12.50 >3A
CVR	10.00
FB	Consult Factory
J	12.50
K	3.50
K2	9.50
M	Consult Factory
N	3.50
-OV	5.00
T	Consult Factory
W or R	See Page 8

SPELLMAN
HIGH-VOLTAGE
ELECTRONICS
CORPORATION

Our Third Decade of Leadership in High-Voltage Technology
1930 ADEE AVENUE, BRONX, NEW YORK 10469 (212) 671-0300 TWX 710 593-4135

RHR LINE OF REGULATED HIGH VOLTAGE POWER SUPPLIES

APPLICATIONS

- CRT DISPLAYS
- CAPACITOR CHARGING
- LASERS
- ELECTRON MICROSCOPES
- IONIZATION CHAMBERS
- CORONA TESTING
- OEM
- ELECTROSTATIC FLOCKING AND SPRAYING
- INSULATION FAULT DETECTION
- X-RAY SUPPLIES
- ION IMPLANTATION
- ALL-PURPOSE LAB SUPPLIES
- ELECTRON BEAM ACCELERATORS

FEATURES

- ALL SILICON, SOLID STATE DESIGN
- 0.01% REGULATION/0.02% RIPPLE
- OVERLOAD AND SHORT CIRCUIT PROOF
- SMALL SIZE
- LIGHT WEIGHT
- LOW COST
- THREE YEAR WARRANTY

SPELLMAN
HIGH VOLTAGE DC SUPPLY

SPECIFICATIONS

OUTPUT VOLTAGE: Continuously adjustable over entire range from zero to rated voltage by means of ten-turn potentiometer. Resolution better than 250 ppm. Finer resolution available on special order.

INPUT VOLTAGE: 105-125 Volts AC, 55-65 Hz, single phase. Other inputs available on request. See options.

REGULATION: Load: 0.01% +1V, for full load change.
Line: ±0.01% ±1V, for ±10% change.

RIPPLE: 0.02% +2 volts, RMS. 0.1% RMS on 100KV models and above.

POLARITY: Positive, Negative, and Reversible with respect to ground available.

STABILITY: 0.02% +2 volts per hour, 0.05% +5 volts per eight hours.

TEMPERATURE COEFFICIENT (PER °C): 0.02% +2 volts.

TEMPERATURE RANGE: Operating: −20°C to +55°C
Storage: −40°C to +85°C

OVERLOAD PROTECTION: All units are overload, short circuit and arc protected by means of fast acting, self restoring, current limiting circuitry. Overload tripout (OL) option available. (See next page) Surge limiting resistors included.

AC POWER INPUT PROTECTION: Control Fuse.

CONTROLS: AC ON Toggle Switch. AC ON Indicator. Output Adjust—Ten-turn potentiometer with locking read-out dial.

METERING: Single range voltmeter, 2% accuracy. Single range ammeter, 2% accuracy.

PHYSICAL CHARACTERISTICS: All units in this series up to 100KVDC output are designed for rack mounting. Panels are 19" wide with standard notching. Units are fully enclosed for desk or table top operation. Optional bench mounting cabinet available. High voltage sections of higher voltage units are contained in a plexiglas tubular enclosure mounted on a base cabinet. The high voltage electrode is located at the top of the structure.

OUTPUT CABLE: All models up through 100KVDC are provided with 6 feet of shielded high voltage cable. The cables are designed with a plug arrangement so that they are easily removed from the mating receptacle located on the rear of the power supply.

CURRENT LIMITING: This is supplied as standard on all models. No suffix letters are required in the model number. This feature automatically limits the load current to approximately 110% of rated load regardless of the overload imposed upon the power supply. The power supply continues to operate at any overload condition including a short circuit by automatically reducing the output voltage as required to maintain the current limit. The unit is self-restoring to its normal operating level when the overload condition is removed. The voltage cut-off characteristic is quite sharp and approaches the ideal characteristic of a voltage-current regulator with automatic crossover.

FIXED POLARITY MODELS

Max. Ratings			Model Number	H x W x D	Wt. (lbs.)		Wt. (kg.)	
KV	MA	Watts			Net	Ship.	Net	Ship.
5	2	10	RHR-5P10 RHR-5N10		25	30	12	14
5	6	30	RHR-5P30 RHR-5N30	(133x483x419) 5¼x19x16½	30	35	14	16
5	10	50	RHR-5P50 RHR-5N50		30	35	14	16
5	20	100	RHR-5P100 RHR-5N100	(267x483x419) 10½x19x16½	55	65	25	30
10	1	10	RHR-10P10 RHR-10N10		25	30	12	14
10	3	30	RHR-10P30 RHR-10N30	(133x483x419) 5¼x19x16½	30	35	14	16
10	6	60	RHR-10P60 RHR-10N60		30	35	14	16
10	10	100	RHR-10P100 RHR-10N100		30	35	14	16
10	20	200	RHR-10P200 RHR-10N200	(267x483x419) 10½x19x16½	55	65	25	30
15	0.67	10	RHR-15P10 RHR-15N10		25	30	12	14
15	2	30	RHR-15P30 RHR-15N30	(133x483x419) 5¼x19x16½	25	30	12	14
15	4	60	RHR-15P60 RHR-15N60		30	35	14	16
15	8	120	RHR-15P120 RHR-15N120		30	35	14	16
15	15	225	RHR-15P225 RHR-15N225	(267x483x419) 10½x19x16½	55	65	25	30
20	0.50	10	RHR-20P10 RHR-20N10		25	30	12	14
20	1.5	30	RHR-20P30 RHR-20N30	(133x483x419) 5¼x19x16½	25	30	12	14
20	3	60	RHR-20P60 RHR-20N60		30	35	14	16
20	6	120	RHR-20P120 RHR-20N120	(133x483x419) 5¼x19x16½	30	35	14	16
20	12	240	RHR-20P240 RHR-20N240	(267x483x419) 10½x19x16½	55	65	25	30
30	0.33	10	RHR-30P10 RHR-30N10		25	30	12	14
30	1	30	RHR-30P30 RHR-30N30		25	30	12	14
30	2	60	RHR-30P60 RHR-30N60	(133x483x419) 5¼x19x16½	30	35	14	16
30	4	120	RHR-30P120 RHR-30N120		30	35	14	16
30	5	150	RHR-30P150 RHR-30N150		50	55	23	25
30	8	240	RHR-30P240 RHR-30N240	(267x483x419) 10½x19x16½	55	65	25	30
40	0.75	30	RHR-40P30 RHR-40N30		40	45	18	21
40	1.5	60	RHR-40P60 RHR-40N60	(133x483x419) 5¼x19x16½	40	45	18	21
40	3	120	RHR-40P120 RHR-40N120		40	45	18	21
40	6	240	RHR-40P240 RHR-40N240	(267x483x419) 10½x19x16½	60	70	27	32
50	5	25	RHR-50P25 RHR-50N25		40	45	18	21
50	1	50	RHR-50P50 RHR-50N50	(133x483x419) 5¼x19x16½	40	45	18	21
50	3	150	RHR-50P150 RHR-50N150		55	60	25	27
50	5	250	RHR-50P250 RHR-50N250	(267x483x419) 10½x19x16½	60	70	27	32
60	5	30	RHR-60P30 RHR-60N30	(133x483x419) 5¼x19x16½	40	45	18	21
60	1	60	RHR-60P60 RHR-60N60	(133x483x419) 5¼x19x16½	40	45	18	21
60	2	120	RHR-60P120 RHR-60N120		40	45	18	21
60	4	240	RHR-60P240 RHR-60N240	(267x483x419) 10½x19x16½	60	70	27	32
80	1	80	RHR-80P80 RHR-80N80	(222x483x419) 8¾x19x16½	52	62	24	28
80	3	240	RHR-80P240 RHR-80N240	(356x483x419) 14x19x16.5	72	82	33	38
100	1	100	RHR-100P100 RHR-100N100	(222x483x419) 8¾x19x16½	52	62	24	28
100	1.5	150	RHR-100P150 RHR-100N150		68	78	31	36
100	2	200	RHR-100P200 RHR-100N200	(356x483x419) 14x19x16½	72	82	33	38
150	1	150	RHR-150P150 RHR-150N150	(864x559x457) 34x22x18	125	300	57	136
150	2	300	RHR-150P300 RHR-150N300		145	320	66	145
200	5	100	RHR-200P100 RHR-200N100	(1016x559x457) 40x22x18	150	340	68	155
200	1	200	RHR-200P200 RHR-200N200		170	360	77	164
300	5	150	RHR-300P150 RHR-300N150	(1220x559x457) 48x22x18	175	370	80	168
300	1	300	RHR-300P300 RHR-300N300		200	400	91	182
400	.5	200	RHR-400P200 RHR-400N200	(1554x559x457) 60x22x18	225	450	102	205
400	1	400	RHR-400P400 RHR-400N400		225	450	102	205

REVERSIBLE POLARITY MODELS

5	6	30	RHR-5PN30	(133x483x419) 5¼x19x16½	25	30	12	14
5	10	50	RHR-5PN50		30	35	14	16
5	20	100	RHR-5PN100	(267x483x419) 10½x19x16½	60	70	27	32
10	3	30	RHR-10PN30	(133x483x419) 5¼x19x16½	25	30	12	14
10	6	60	RHR-10PN60		30	35	14	16
10	10	100	RHR-10PN100		30	35	14	16
10	20	200	RHR-10PN200	(267x483x419) 10½x19x16½	60	70	27	32
15	2	30	RHR-15PN30	(133x483x419) 5¼x19x16½	25	30	12	14
15	4	60	RHR-15PN60		30	35	14	16
15	8	120	RHR-15PN120		30	35	14	16
15	15	225	RHR-15PN225	(267x483x419) 10½x19x16½	60	70	27	32
20	1.5	30	RHR-20PN30	(133x483x419) 5¼x19x16½	25	30	12	14
20	3	60	RHR-20PN60	(133x483x419) 5¼x19x16½	30	35	14	16
20	6	120	RHR-20PN120		30	35	14	16
20	12	240	RHR-20PN240	(267x483x419) 10½x19x16½	60	70	27	32
30	1	30	RHR-30PN30	(133x483x419) 5¼x19x16½	25	30	12	14
30	2	60	RHR-30PN60		30	35	14	16
30	4	120	RHR-30PN120		30	35	14	16
30	5	150	RHR-30PN150		55	60	25	27
30	8	240	RHR-30PN240	(267x483x419) 10½x19x16½	60	70	27	32
40	.75	30	RHR-40PN30	(133x483x419) 5¼x19x16½	40	45	18	21
40	1.5	60	RHR-40PN60		40	45	18	21
40	3	120	RHR-40PN120		40	45	18	21
40	6	240	RHR-40PN240	(267x483x419) 10½x19x16½	60	70	27	32
50	.5	25	RHR-50PN25	(222x483x419) 8¾x19x16½	52	57	24	26
50	1	50	RHR-50PN50	(222x483x419) 8¾x19x16½	52	57	24	26
50	3	150	RHR-50PN150		70	75	32	34
50	5	250	RHR-50PN250	(356x483x419) 14x19x16½	75	85	34	39
60	5	30	RHR-60PN30	(222x483x419) 8¾x19x16½	52	57	24	26
60	1	60	RHR-60PN60		52	57	24	26
60	2	120	RHR-60PN120		52	57	24	26
60	4	240	RHR-60PN240	(356x483x419) 14x19x16½	75	85	34	39
80	1	80	RHR-80PN80	(222x483x419) 8¾x19x16½	52	57	24	26
80	3	240	RHR-80PN240	(356x483x419) 14x18x16½	75	85	34	39
100	1	100	RHR-100PN100	(222x483x419) 8¾x19x16½	52	57	24	26
100	1.5	150	RHR-100PN150		70	80	32	36
100	2	200	RHR-100PN200	(356x483x419) 14x19x16½	75	85	34	39

Notes:
All weights calculated in nearest lb. or kg. All measurements in parenthesis are in millimeters.

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RHR LINE OPTIONS

The RHR line is available with any combination of the options listed below. The appropriate code letters are suffixed to the model number.

● OVERLOAD TRIP-OUT	(OL)	● 100 VOLT INPUT (50-60 Hz)	(100)	● PARALLEL OPERATION	(PM)
● REMOTE VOLTAGE PROGRAMMING	(RVC)	● FOCUS TAP	(F)	● SLAVED BIPOLAR (±) OPERATION	(BPM)
● BENCH CABINET	(C)	● REMOTE RESISTANCE PROGRAMMING	(RC)	● FLOATING GROUND	(FG)
● CURRENT REGULATION	(CR)	● REMOTE MONITOR TERMINALS	(TP)	● INHIBIT CIRCUIT	(IC)
● 220 VOLT INPUT (50-60 Hz)	(220)	● REMOTE CONTROL PANEL	(RCP)	● SLOW START	(SS)

● OVERLOAD TRIPOUT (OL)

The OVERLOAD TRIPOUT protection feature rapidly "crowbars" the power supply when the load current exceeds approximately 110% of the rated load. A fast acting, latching circuit, removes power to the oscillator, thereby turning off the high voltage. The power supply must be reset by OFF-ON activation of the main AC power switch. **When the OVERLOAD TRIPOUT (OL) option is provided, it replaces the normally standard CURRENT LIMITING feature.** See CURRENT LIMITING section above for additional information.

Add Suffix letters (OL) at the end of the basic model number when this option is desired.

If an overload trip-out level less than the power supply rated current is desired, this limit, in milliamperes, is specified in parenthesis following OL; i.e. OL(4) = 4 milliamperes trip-out. NOTE: Values as low as 0.25 milliampere may be selected as standard.

● REMOTE VOLTAGE PROGRAMMING (RVC)

This option enables the power supply to be controlled either by the standard front panel control or by an external low voltage DC signal source. The output voltage is directly proportional to the input voltage with linearity and proportionality better than 1% of full scale. The programming voltage polarity is always positive, regardless of the output polarity of the power supply.

A barrier type terminal board is provided on the rear of the chassis for connection to the external source. When properly connected for remote programming, the front panel control serves as an adjustable voltage limit.

Add suffix letters RVC at the end of the basic model number when this option is desired.

Unless otherwise specified, the ratio of input to output is such that 0 to +6VDC controls the output from 0 to rated kilovolts. If a control voltage other than 6 volts is desired, any value desired between 6 and 250 volts DC may be specified in parenthesis after the option letters; i.e. RVC(10) specifies a 0 to 10 volt programming signal. The programming source must provide at least 100 microamperes at maximum input.

Slew rate of output is approx. 0.5 sec. "up" and 2 sec. "down."

● BENCH CABINET (C)

A deluxe styled rack cabinet is available for all models. The base dimensions are 22" wide x 18" deep. Height is selected to fit individual unit height. Two-tone blue-gray color scheme is standard. Carrying handles are located conveniently on the sides of the cabinet for easy handling.

Add suffix letter (C) at the end of the basic model number when this option is desired.

● CURRENT REGULATION (CR)

OUTPUT CURRENT AND VOLTAGE: Both current and voltage regulation with automatic cross-over are provided. The current and voltage ratings are the same as corresponding standard RHR model. Output current is adjustable from zero to rated current over the full voltage compliance range from zero to rated voltage. A front panel mounted 10-turn potentiometer provides resolution of 250 ppm for the current control. A single turn pot is provided for voltage adjustment.

CURRENT REGULATION: ±0.1% for any current setting between 25% and 100% of rated value for a load variation from 10% to 100% of full voltage compliance.

VOLTAGE REGULATION: ±0.05% for line and load variations.

PROTECTION: The power supply output is protected by the automatic cross-over circuitry and will operate safely into any load between open and short circuit.

RIPPLE: 0.1% RMS of output voltage.

Other characteristics are similar to standard RHR voltage regulation specifications.

This type of unit is particularly suitable for gas laser excitation since the supply can provide a relatively high open circuit voltage for starting the plasma discharge. Once the arc has formed, the supply automatically operates in a constant current mode at any preset level. Add suffix letters (CR) at the end of the basic model number when this option is desired.

● 220 VOLT INPUT (50-60 Hz) (220)

Nominal input voltage between 220 and 250 volts RMS, 50-60 Hz, single phase can be accommodated with this option. Input current must be calculated based on approximately 50% efficiency. Add suffix (220) at the end of basic model number when this option is desired.

● 100 VOLT INPUT (50-60 Hz) (100)

Nominal input voltage between 100 and 130 volts RMS, 50-60 Hz, single phase can be accommodated with this option. Input current must be calculated based on approximately 50% efficiency. Add suffix (100) at the end of basic model number when this option is desired.

● FOCUS TAP (F)

This option provides for a separate, supplementary output. The auxiliary voltage is obtained by including a DC to DC supply selected from the Spellman RM line of modules. Any 1.5 watt unit with voltage rating to 15KVDC may be selected. Specifications for this supplementary output are in accordance with RM line data.

Voltage control is provided on the front panel by means of a single turn potentiometer. If the RC, Remote Control, option is ordered for the main output, then provision is made for remote control of the auxiliary output also.

Suffix letter F(max KV) appears at the end of the basic model number when this option is provided. The number in the parenthesis is the rated maximum output voltage of the RM module. The polarity of the module is POSITIVE unless otherwise specified. The focus option is available on 30KV and 40KV models only.

● REMOTE RESISTANCE PROGRAMMING (RC)

This option permits the output voltage to be controlled by either an external potentiometer (3 terminals) or the front panel 10-turn control potentiometer. A barrier type terminal board is mounted on the rear of the chassis for connection to an external potentiometer. When wired in accordance with the appropriate schematic, the front panel control is switched out, and the remote potentiometer assumes control. A 5000 ohm potentiometer is required, although fixed resistor dividers of equivalent value may be used. A shielded, insulated cable with a twisted pair should be used, with the shield connected to common. Up to 100 feet of cable is permitted. Add suffix (RC) at the end of the basic model number when this option is desired.

● REMOTE MONITOR TERMINALS (TP)

BNC connectors are provided on the rear of the chassis for remote monitoring of voltage and current. The voltage monitor circuit provides a 1 volt signal corresponding to maximum rated voltage accurate to 1%. The current monitor circuit is taken across a 100 ohm resistor (100mV/mA). The current monitor reads true load current and does not include any internal bleeder or regulator drain. Add suffix letters (TP) at the end of the basic model number when this option is desired.

● REMOTE CONTROL PANEL (RCP)

Any standard model may be supplied with the control panel removed from the basic supply. Terminal boards are added to the basic supply on the rear of the chassis and to the control panel so that the two parts are readily interconnected. 15 feet of appropriately shielded interconnection cable is provided. The control panel contains an AC power switch, fuse, and pilot light, kilovoltmeter, milliammeter, and 10-turn control potentiometer. Add suffix letters (RCP) at the end of the basic model number when this option is desired. NOTE that all models with output voltage of 150KVDC or greater are supplied with the REMOTE CONTROL PANEL as standard.

● PARALLEL OPERATION (PM)

Any model in the RHR line can be used as a "master" controller for parallel operation of up to three "slave" units of the same rating from either the RHR or UHR line. Whether the "slave" units are from the RHR or UHR units, the overall characteristics of the parallel system are governed by the specifications of the RHR "master" supply and are the same as standard specifications except for ripple which will deteriorate to the UHR levels. Current imbalance between units is less than 10% and no derating is required for total current capability of the parallel system.

Each power supply unit may be used independently, if desired, by simple rearrangement of terminal board connections. Add suffix (PM) after the standard model number for the "master supply". Add suffix (PS) after the standard model number for the "slave" supplies. Up to three "slaves" can be controlled by one "master".

● SLAVED BI-POLAR (±) OPERATION (BPM) and (BPS)

Any positive polarity model in the RHR line can be used as a "master" for "tracking" control of the negative polarity equivalent RHR model. Thus, one control provides adjustment of both supplies from zero to rated output voltage. The negative polarity output "tracks" the positive output within ±1% from 10% to rated output voltage. All specifications for regulation, ripple, etc. are governed by individual unit characteristics. Add suffix (BPM) and (BPS) after standard model number for positive and negative polarity units respectively.

● FLOATING GROUND (FG)

The FLOATING GROUND feature isolates the "low end" return of the power supply with respect to ground. Nominal insulation of 70 volts RMS is provided for the "floating" terminal. The terminal is also bypassed to chassis ground by a one megohm resistance, a 0.1mfd. capacitance, and a neon glow lamp whose breakdown voltage is nominally 85 volts (type NE2).

The purpose and application of the FLOATING GROUND option is to permit the user to "ground" or "return" the low end of the power supply at a point within his system which will suppress undesirable ground loop currents.

In some instances, the user may desire to monitor the load current with accurate instrumentation. For this situation, the user can insert his own current monitoring circuitry between the "FLOATING GROUND" terminal and "system" ground. This may consist simply of an appropriate milliammeter or microammeter, or alternatively, a current sensing resistor which can be calibrated with a sensitive digital or differential voltmeter, as desired. It should be understood, however, that a low impedance return to ground must be provided by the user for proper operation of the power supply. One thousand ohms or less is quite appropriate, and ten thousand ohms would be an acceptable value, if necessary. Check with our Engineering Department for further information. Add suffix (FG) after the standard model number when the FLOATING GROUND option is desired.

● INHIBIT CURCUIT (IC)

The INHIBIT CIRCUIT option requires that a separate low DC signal voltage be applied to the appropriate terminals on the rear of the supply in order to enable the unit to turn on. Further, when the signal voltage is removed, the high voltage turns off. The signal level for ON is at least five (5) volts (but not higher than fifty (50) volts, unless otherwise specified), and for OFF, the signal level must drop below 0.5 volts. This is compatible with TTL logic and other computer interface arrangements. Add suffix (IC) after the standard model number when the INHIBIT CIRCUIT option is desired.

● SLOW START (SS)

The SLOW START option causes the output voltage of the power supply to ramp upwards to its operating voltage setting when the unit is turned on. The rise is fairly linear so that the time to reach the operating level is approximately proportional to the control setting. The normal rise time is approximately 30 seconds for maximum output, but other rise times from 10 to 60 seconds may be specified by adding the appropriate number after the suffix letters.

This option also has an additional feature in that after an overload has occurred, and the output voltage has been reduced by the current limiting protection circuit, the subsequent automatic recovery to normal operation when the overload condition has been removed, follows the same slow rise as the initial start-up. Add suffix (SS) after the standard model number when the SLOW START option is desired.

WARRANTY:

3 YEAR WARRANTY FOR ALL RHR/RHSR MODELS

● All parts ● All labor ● Consult factory for warranties on other Spellman products ● Copy of Warranty available on request

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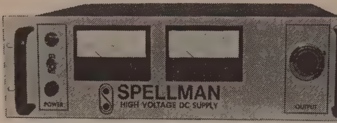
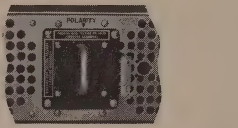
RHSR LINE FEATURING 10 PPM REGULATION AND RIPPLE





POLARITY REVERSING SWITCH LOCATED ON REAR OF CHASSIS

Output Voltage Range (KV)	Output Current (mA)	Watts	Model Number	Dimensions	Weight Lbs Net/Ship	Weight Kg Net/Ship
0-5	10.0	50	RHSR5PN50	5¼"x19"x16½" (133mmx483mmx419mm)	30/35	14/16
0-10	6.0	60	RHSR10PN60			
0-15	4.0	60	RHSR15PN60			
0-20	3.0	60	RHSR20PN60			
0-25	2.4	60	RHSR25PN60			
0-30	2.0	60	RHSR30P60 RHSR30N60			
0-40	1.5	60	RHSR40P60 RHSR40N60	8¾"x19"x16½" (222mmx483mmx419mm)	52/57	24/26
0-50	1.0	50	RHSR50P50 RHSR50N50			
0-60	1.0	60	RHSR60P60 RHSR60N60			

FEATURES:

The following features are standard on all RHSR models unless otherwise specified.

REVERSIBLE POLARITY:

The polarity of the output voltage may be reversed to either POSITIVE or NEGATIVE as desired on all units up to and including 25KV. This is readily accomplished from outside the unit by a manual switch on the rear of the chassis (Pictured above).

CURRENT LIMITING:

Automatically limits load current to approximately 110% of rated load regardless of overload imposed on power supply. Supply continues to operate at any overload condition, including short circuit, by automatically reducing output voltage as required to maintain the current limit. Unit is self-restoring to normal operating level when overload condition is removed. The voltage cut-off characteristic is quite sharp and approaches the ideal characteristic of a voltage—current regulator with automatic crossover. OVERLOAD TRIPOUT option also available. See below.

Application Notes: The current limit feature is desirable for capacitive load conditions. When used as a "capacitor charger", the power supply with its current limit circuitry provides essentially a constant current charge.

REMOTE VOLTAGE PROGRAMMING:

This feature enables the power supply to be controlled by either the standard front panel control or by an external low voltage DC signal source. The output voltage is directly proportional to the input voltage with linearity and proportionality better than 1% of full scale. The programming voltage polarity is always positive, regardless of the output polarity of the power supply. Programming terminals are located on a barrier type terminal board on the rear of the chassis. When appropriate connections are made for remote programming, the front panel control serves as an adjustable voltage limit.

Unless otherwise specified, the ratio of input to output is such that 0 to +6 volts DC controls the output from 0 to rated kilovolts. If a signal voltage other than 6 volts is desired, any value desired between 10 and 250 volts DC may be specified by adding RVC ( ) to the model number and placing the desired signal voltage within the parenthesis. The program source must be capable of delivering 100 microamperes to the input terminal at maximum output.

REMOTE RESISTANCE PROGRAMMING:

This feature permits output voltage to be controlled by either an external potentiometer (3 terminals) or the front panel 10-turn control potentiometer. Programming terminals are located on a barrier type terminal board on the rear of the chassis.

REMOTE MONITOR TERMINALS:

BNC connectors are provided on the rear of the chassis for remote monitoring of voltage and current. The voltage monitor circuit provides a 1 volt signal corresponding to maximum rated voltage with 1% accuracy. The current monitor circuit is taken across a 100 ohm resistor (100mV/mA). The current monitor reads **true load** current and does not include any internal bleeder or regulator drain.

SPECIFICATIONS:*

INPUT: 105-125 volts AC, 55-65 Hz, single phase. Other inputs available on request.

OUTPUT: Continuously adjustable over entire range from zero to rated voltage by means of 10-turn potentiometer. Resolution better than 250 ppm. Finer resolution available on special order.

REGULATION: Load: 0.001% for full load change.
Line: ±0.001% for ±10% change.

RIPPLE: 0.001% RMS.

STABILITY: 0.005% per hour, 0.01% per 8 hours.

TEMPERATURE COEFFICIENT: 0.005% per degree C.

TEMPERATURE RANGE: Operating: 0°C to +50°C. Storage: −40°C to +85°C.

RESETTABILITY: 0.05% of full scale.

OVERLOAD PROTECTION: All units are overload, short circuit and arc protected by means of fast acting, self-restoring, electronic circuitry. Other protection options available. Surge limiting resistors included.

AC POWER INPUT PROTECTION: Control Fuse.

CONTROLS: AC "ON" indicator; AC "ON" toggle switch. Output adjustable by means of ten-turn potentiometer with locking read-out dial.

METERING: Single range voltmeter, 2% accuracy. Single range ammeter, 2% accuracy.

PHYSICAL CHARACTERISTICS: All units in this line are designed for rack mounting. Panels are 19" wide with standard notching. Units are fully enclosed for desk or table top operation.

OUTPUT CABLE: All models are provided with 6 feet of shielded high voltage cable. The cables are designed with a plug arrangement so that they are easily removed from the mating receptacle located on the rear of the power supply.

*Characteristics hold from 10%-100% of range, unless otherwise specified.

OPTIONS:

OVERLOAD TRIPOUT (QL)

The OVERLOAD TRIPOUT protection feature rapidly "crowbars" the power supply when the load current exceeds approximately 110% of the rated load. A fast acting, latching circuit, removes power to the oscillator, thereby turning off the high voltage. The power supply must be reset by OFF-ON activation of the main Ac power switch.

When the OVERLOAD TRIPOUT (OL) option is provided, it replaces the normally standard CURRENT LIMITING feature. See CURRENT LIMITING section above for additional information.

Add suffix letters (OL) at the end of the basic model number when this option is desired.

If an overload trip-out level less than the power supply rated current is desired, this limit, in milliamperes, is specified in parenthesis following OL; i.e. OL(4) = 4 milliamperes trip-out. NOTE: Values as low as 0.25 milliampere may be selected as standard.

BENCH CABINET (C)

A deluxe styled rack cabinet is available for all models. The base dimensions are 22" wide x 18" deep. Height is selected to fit individual unit height. Two-tone blue-gray color scheme is standard. Carrying handles are located conveniently on the sides of the cabinet for easy handling. Add suffix letter (C) at the end of the basic model number when this option is desired.

220 VOLT INPUT (50-60 Hz) (220)

Nominal input voltage between 220 and 250 volts RMS, 50-60 Hz, single phase can be accommodated with this option. Input current must be calculated based on approximately 50% efficiency. Add suffix (220) at the end of basic model number when this option is desired.

100 VOLT INPUT (50-60 Hz) (100)

Nominal input voltage between 100 and 130 volts RMS, 50-60 Hz, single phase can be accommodated with this option. Input current must be calculated based on approximately 50% efficiency. Add suffix (100) at the end of basic model number when this option is desired.

REMOTE CONTROL PANEL (RCP)

Any standard model may be supplied with the control panel removed from the basic supply. Terminal boards are added to the basic supply on the rear of the chassis and to the control panel so that the two parts are readily interconnected. 15 feet of appropriately shielded interconnection cable is provided. The control panel contains an AC power switch, fuse, and pilot light, kilovoltmeter, milliammeter, and 10-turn control potentiometer. Add suffix letters (RCP) at the end of basic model number when this option is desired.

PARALLEL OPERATION (PM)

Any model in the RHSR line can be used as a "master" controller for parallel operation of up to three "slave" units of the same rating. Current imbalance between units is less than 10% and no derating is required for total current capability of the parallel system.

Each power supply unit may be used independently, if desired, by simple rearrangement of terminal board connections. Add suffix (PM) after the standard model number for the "master" supply. Add suffix (PS) after the standard model number for the "slave" supplies. Up to three "slaves" can be controlled by one "master".

SLAVED BI-POLAR (±) OPERATION (BPM) and (BPS)

Any positive polarity model in the RHSR line can be used as a "master" for "tracking" control of the negative polarity equivalent RHSR model. Thus, one control provides adjustment of both supplies from zero to rated output voltage. The negative polarity output "tracks" the positive output within ±1% from 10% to rated output voltage. All specifications for regulation, ripple, etc. are governed by individual unit characteristics. Add suffix (BPM) and (BPS) after standard model number for positive and negative polarity units respectively.

FLOATING GROUND (FG)

The FLOATING GROUND feature isolates the "low end" return of the power supply with respect to ground. Nominal insulation of 70 volts RMS is provided for the "floating" terminal. The terminal is also bypassed to chassis ground by a one megohm resistance, a 0.1mfd. capacitance, and a neon glow lamp whose breakdown voltage is nominally 85 volts (type NE2).

The purpose and application of the FLOATING GROUND option is to permit the user to "ground" or "return" the low end of the power supply at a point within his system which will suppress undesirable ground loop currents.

In some instances, the user may desire to monitor the load current with accurate instrumentation. For this situation, the user can insert his own current monitoring circuitry between the "FLOATING GROUND" terminal and "system" ground. This may consist simply of an appropriate milliammeter or microammeter, or alternatively, a current sensing resistor which can be calibrated with a sensitive digital or differential voltmeter, as desired. It should be understood, however, that a low impedance return to ground must be provided by the user for proper operation of the power supply. One thousand ohms or less is quite appropriate, and ten thousand ohms would be an acceptable value, if necessary. Check with our Engineering Department for further information. Add suffix (FG) after the standard model number when the FLOATING GROUND option is desired.

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SPELLMAN
HIGH-VOLTAGE
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CORPORATION

UHR LINE
SIMPLE AND ECONOMICAL

- RACK MOUNTED
- REGULATED
- AVAILABLE UP TO 400 KV

SPELLMAN
HIGH VOLTAGE DC SUPPLY

SPECIFICATIONS

INPUT: 105-125 volts AC, 55-65 Hz, single phase. Other inputs available on request.

OUTPUT: Continuously adjustable over entire range from zero to rated voltage by means of single turn potentiometer. Resolution better than 1%.

REGULATION: ±1% of rated voltage for line or load change.

RIPPLE: 0.1% RMS of rated voltage.

STABILITY AND TEMPERATURE COEFFICIENT (PER °C): 0.2% of rated voltage.

TEMPERATURE RANGE: Operating: 0°C to +50°C. Storage: −40°C to +85°C.

VOLTAGE CONTROL: Single turn potentiometer.

CURRENT LIMITING: On all UHR models (see description in RHR section).

AC POWER INPUT PROTECTION: Control Fuse.

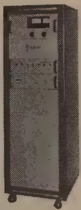
METERING: Single range voltmeter, 2% accuracy. Single range ammeter, 2% accuracy.

PHYSICAL CHARACTERISTICS: All units in this line are designed for rack mounting. Panels are 19" wide with standard notching. Units are fully enclosed for desk or table top operation

Output Voltage Range (KV)	Output Current mA	Watts	Model Number
0-5	2.00	10	UHR-5(*)10
0-5	6.00	30	UHR-5(*)30
0-5	10.00	50	UHR-5(*)50
0-10	1.00	10	UHR-10(*)10
0-10	3.00	30	UHR-10(*)30
0-10	6.00	60	UHR-10(*)60
0-10	10.00	100	UHR-10(*)100
0-15	0.67	10	UHR-15(*)10
0-15	2.00	30	UHR-15(*)30
0-15	4.00	60	UHR-15(*)60
0-15	8.00	120	UHR-15(*)120
0-20	0.50	10	UHR-20(*)10
0-20	1.50	30	UHR-20(*)30
0-20	3.00	60	UHR-20(*)60
0-20	6.00	120	UHR-20(*)120
0-30	0.33	10	UHR-30(*)10
0-30	1.00	30	UHR-30(*)30
0-30	2.00	60	UHR-30(*)60
0-30	4.00	120	UHR-30(*)120
0-40	0.75	30	UHR-40(*)30
0-40	1.50	60	UHR-40(*)60
0-40	3.00	120	UHR-40(*)120
0-60	0.50	30	UHR-60(*)30
0-60	1.00	60	UHR-60(*)60
0-60	2.00	120	UHR-60(*)120
0-100	1.00	100	UHR-100(*)100
0-150	1.00	150	UHR-150(*)150
0-200	0.75	150	UHR-200(*)150
0-300	0.50	150	UHR-300(*)150
0-400	0.25	100	UHR-400(*)100

*Available with either Positive or Negative polarity. Specify P (Positive) or N (Negative) in place of * in Model Number.
Size and Weight as per equivalently rated RHR.

SERIES REGULATED POWER SUPPLIES
HP SERIES



APPLICATIONS:

- GAS LASERS
- CAPACITOR CHARGERS
- SPUTTERING SUPPLIES
- MODULATORS
- GENERAL LABORATORY POWER SUPPLIES

SPECIFICATIONS

OUTPUT VOLTAGE—OUTPUT CURRENT: Continuously adjustable over full range by separate ten-turn potentiometers.

REGULATION: Both voltage and current regulated with automatic crossover in accordance with following characteristics.

Voltage Mode: Load: 0.01%, for full load changes. Line: 0.01%, for 10% line change. Specification holds down to 10% of rated output voltage.

Current Mode: Load: 0.01% +1 microampere, for 10% load change (i.e., 10% voltage compliance variation); 100 microamperes, maximum, for full load (full voltage compliance) change. Line: 0.01% +1 microampere for 10% line change.

TRANSIENT RESPONSE: Voltage Mode: Less than 1000 microseconds to recover to within 1% of maximum voltage level for 25% load step change, or 5% line voltage step change. Current Mode: Less than 1000 microseconds to recover to within 1% of maximum current level for 10% load (voltage complaince) step change, or 5% line voltage step change. (Consult factory for response time to greater changes).

RIPPLE: Voltage Mode: 0.01% +100 millivolts, peak to peak. Current Mode: 1% or 100 micro-amperes peak to peak.

INPUT VOLTAGE: See Chart.

POLARITY: Reversible on all models up to 20KVDC. Negative on all models above 20KVDC.

STABILITY: Voltage: 0.01% +100 millivolts per hour, 0.025% +250 millivolts per 8 hours. Current: Less than 100 microamperes, 8 hours.

METERS: Single range voltmeter, 2% accuracy. Single range ammeter, 2% accuracy.

PROTECTION: Units are inherently protected by the automatic crossover regulating system.

Model No.	Voltage Range (Kilovolts)	Current Range (mA)	Nom. Input Voltage (Volts RMS)	Input Phases	Line Current (Amps)	Size W" x D" x H"	Net Weight (Lbs.)	Gross Weight (Lbs.)	Net Weight (Kg)	Gross Weight (Kg)
HP2.5PN250SR	0-2.5	0-250	115	1	10	22 x 24 x 50	210	450	95	204
HP2.5PN500SR	0-2.5	0-500	115	1	20	22 x 24 x 50	290	600	132	273
HP5PN100SR	0-5	0-100	115	1	10	22 x 24 x 50	220	470	100	213
HP5PN250SR	0-5	0-250	115	1	20	22 x 24 x 50	305	650	138	295
HP5PN500SR	0-5	0-500	220	3	10	22 x 24 x 72	370	790	168	359
HP10PN50SR	0-10	0-50	115	1	10	22 x 24 x 50	225	490	102	223
HP10PN100SR	0-10	0-100	115	1	20	22 x 24 x 50	310	660	140	300
HP10PN250SR	0-10	0-250	220	3	10	22 x 24 x 72	370	790	168	359
HP10PN500SR	0-10	0-500	220	3	20	22 x 24 x 72	380	800	173	364
HP20PN25SR	0-20	0-25	115	1	10	22 x 24 x 50	295	600	134	273
HP20PN50SR	0-20	0-50	115	1	20	22 x 24 x 50	335	700	152	318
HP20PN100SR	0-20	0-100	220	3	10	22 x 24 x 72	375	800	170	364
HP20PN200SR	0-20	0-200	220	3	20	22 x 24 x 72	390	840	177	381
HP30N25SR	0-30	0-25	115	1	15	22 x 24 x 50	325	690	148	314
HP30N50SR	0-30	0-50	115	1	25	22 x 24 x 72	340	710	155	323
HP30N100SR	0-30	0-100	220	3	15	22 x 24 x 72	390	840	177	381

All weights approximate.

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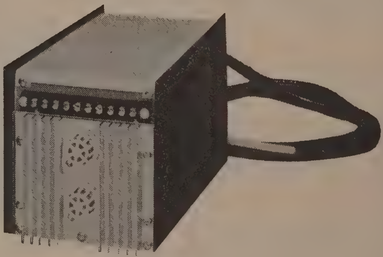
MODULE SELECTION GUIDE

SERIES	KEY SPECIFICATIONS	PAGE
SRM	Precision, 10ppm, wide range regulated module.	1.1464
FWRM	Narrow range, programmable, regulated "slot" supplies. 0.01% line regulation, 0.05% load regulation, 0.01%/watt ripple.	1.1465
WRM	Full range, programmable, regulated supplies. Characteristics per FWRM.	1.1465
FRM	Narrow range, programmable, regulated "slot" supplies. 0.01% line regulation, 1%/watt load regulation, 0.1%/watt ripple.	1.1466
RM	Full range, programmable, regulated, supplies. Characteristics per FRM.	1.1466
UM	DC to DC converter. Adjustable to near zero. 0.1% ripple.	1.1467
RMC	Multiple output CRT module. Provides anode, G_1, G_2 voltages.	1.1468
RV	Militarized CRT Modules	1.1468

See outline drawings on page 1.1467 for case size and weight information.

MODULAR HIGH VOLTAGE POWER SUPPLIES

SRM SUPER-REGULATED MODULES



SPECIFICATIONS

INPUT: 28 volts DC, ±10%. AC option available.

OUTPUT: Continuously adjustable over entire range from zero to rated output voltage. Programming terminals provided for connection to remote potentiometric or voltage input programming sources.

OUTPUT POLARITY: All models available with either positive or negative polarity with respect to ground.

REGULATION: LINE: 0.001% from 10% to maximum rated voltage.
LOAD: 0.001% from 10% to maximum rated voltage.

RIPPLE: 0.001% RMS, from 10% to maximum rated voltage.

STABILITY: 0.005% per hr.; 0.01% per 8 hrs.

TEMPERATURE COEFFICIENT: 0.005% per °C.

OVERLOAD PROTECTION: All models are overload, short circuit and arc protected by means of state-of-the art Spellman circuitry. All units are fully protected against high input programming voltage.

EFFICIENCY: Basic converter efficiency on all units exceeds 60%.

SERVICE CONDITIONS: 0-60°C.

MECHANICAL: The SRM module is built with a sub-assembly structure which is completely pluggable. This service feature permits quick breakdown of the unit to the individual sub-assembly level and is designed for interchangeability of parts so that servicing can be a matter of a few minutes.

CIRCUIT CONCEPT: High frequency power oscillator circuit enables low ripple to be achieved with small, low stored energy capacitors.

WEIGHT: Lbs. Net: 12. Lbs. Ship: 13. Kg. Net: 5.45. Kg. Ship. 5.91.

SIZE: 5-3/16" x 5-1/2" x 9-1/2" max.

OUTPUT RATINGS

KV	mA	Model Number
0-1.5	6.7	SRM1.5(*)10KD
0-3	3.3	SRM3(*)10KD
0-3	10.0	SRM3(*)30KD
0-6	1.7	SRM6(*)10KD
0-6	5.0	SRM6(*)30KD
0-9	1.1	SRM9(*)10KD
0-9	3.3	SRM9(*)30KD
0-12	0.8	SRM12(*)10KD
0-12	2.5	SRM12(*)30KD
0-15	0.67	SRM15(*)10KD
0-15	2.0	SRM15(*)30KD
0-18	0.56	SRM18(*)10KD
0-18	1.67	SRM18(*)30KD
0-20	0.5	SRM20(*)10KD
0-20	1.5	SRM20(*)30KD
0-24	0.4	SRM24(*)10KD
0-24	1.25	SRM24(*)30KD
0-30	0.3	SRM30(*)10KD
0-30	1.0	SRM30(*)30KD

*Specify "P" for Positive output polarity and "N" for Negative output polarity.

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SPELLMAN
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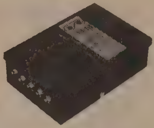
WRM- WELL REGULATED MODULES

SPECIFICATIONS



INPUT: +28VDC ±10%.

OUTPUT: All WRM models feature adjustability over the full range from zero to maximum rated output voltage (−0, +5% tolerance). All models are remote voltage and resistance programmable.

All FWRM models are variable over the narrow range specified for each output voltage level (−20% low end and +5% high end tolerance). All models are remote voltage and resistance programmable.

OUTPUT POLARITY: All models are available with either positive or negative output polarity with respect to ground. See table.

REGULATION: LINE:* ±0.01%, for ±10% line change.
LOAD:* 0.05% per watt output rating, full load change.

RIPPLE:* 0.01% of rated voltage per watt output rating, peak to peak.

OVERLOAD PROTECTION: All models are overload, short circuit, arc, and reverse voltage protected by means of state-of-the-art Spellman circuitry.

PROGRAMMING: Terminals are provided for remote voltage or resistance programming.

EFFICIENCY: Basic converter efficiency on all units exceeds 60%.

SERVICE CONDITIONS: 0-60°C.

*Specifications hold from 10%-100% of maximum rated output voltage.

WRM LINE

Output Voltage (KV)	Output Current (mA)	Model Number	Size**	Output Voltage (KV)	Output Current (mA)	Model Number	Size**
0-1.5	1.0	WRM1.5(*)1500D	IIIA	0-15	0.1	WRM15(*)1500D	IIIA
0-1.5	2.0	WRM1.5(*)3000D	IIIA	0-15	0.2	WRM15(*)3000D	IIIA
0-1.5	4.0	WRM1.5(*)6000D	IIIA	0-15	0.4	WRM15(*)6000D	IIIA
0-1.5	6.0	WRM1.5(*)10KD	IIIA	0-15	0.6	WRM15(*)10KD	IIIA
0-1.5	10.0	WRM1.5(*)15KD	IIIB	0-15	2.0	WRM15(*)30KD	VB
0-3	0.5	WRM3(*)1500D	IIIA	0-18	0.08	WRM18(*)1500D	VA
0-3	1.0	WRM3(*)3000D	IIIA	0-18	0.16	WRM18(*)3000D	VA
0-3	2.0	WRM3(*)6000D	IIIA	0-18	0.3	WRM18(*)6000D	VA
0-3	3.0	WRM3(*)10KD	IIIA	0-18	0.5	WRM18(*)10KD	VA
0-3	10.0	WRM3(*)30KD	VB	0-18	1.6	WRM18(*)30KD	VB
0-6	0.25	WRM6(*)1500D	IIIA	0-20	0.07	WRM20(*)1500D	VA
0-6	0.5	WRM6(*)3000D	IIIA	0-20	0.15	WRM20(*)3000D	VA
0-6	1.0	WRM6(*)6000D	IIIA	0-20	0.3	WRM20(*)6000D	VA
0-6	1.5	WRM6(*)10KD	IIIA	0-20	0.5	WRM20(*)10KD	VA
0-6	5.0	WRM6(*)30KD	VB	0-20	1.5	WRM20(*)30KD	VB
0-9	0.15	WRM9(*)1500D	IIIA	0-24	0.06	WRM24(*)1500D	VA
0-9	0.3	WRM9(*)3000D	IIIA	0-24	0.12	WRM24(*)3000D	VA
0-9	0.6	WRM9(*)6000D	IIIA	0-24	0.24	WRM24(*)6000D	VA
0-9	1.0	WRM9(*)10KD	IIIA	0-24	0.4	WRM24(*)10KD	VA
0-9	3.3	WRM9(*)30KD	VB	0-24	1.25	WRM24(*)30KD	VB
0-12	0.15	WRM12(*)1500D	IIIA	0-30	0.05	WRM30(*)1500D	VA
0-12	0.3	WRM12(*)3000D	IIIA	0-30	0.1	WRM30(*)3000D	VA
0-12	0.6	WRM12(*)6000D	IIIA	0-30	0.2	WRM30(*)6000D	VA
0-12	0.8	WRM12(*)10KD	IIIA	0-30	0.3	WRM30(*)10KD	VA
0-12	2.5	WRM12(*)30KD	VB	0-30	1.0	WRM30(*)30KD	VB

*Indicate "P" for Positive Polarity. Indicate "N" for Negative Polarity.
**See outline drawings on page 1.1467 for case size and weight information.

FWRM LINE

Output Voltage (KV)	Output Current (mA)	Model Number	Size**	Output Voltage (KV)	Output Current (mA)	Model Number	Size**
0.35-0.5	1.0	FWRM0.5(*)500D	IIIA	6-9	0.15	FWRM9(*)1500D	IIIA
0.35-0.5	2.0	FWRM0.5(*)1000D	IIIA	6-9	0.3	FWRM9(*)3000D	IIIA
0.35-0.5	4.0	FWRM0.5(*)2000D	IIIA	6-9	0.6	FWRM9(*)6000D	IIIA
0.35-0.5	6.0	FWRM0.5(*)3000D	IIIA	6-9	1.0	FWRM9(*)10KD	IIIA
0.35-0.5	10.0	FWRM0.5(*)5000D	IIIA	6-9	3.3	FWRM9(*)30KD	VB
0.5-0.75	1.0	FWRM0.75(*)750D	IIIA	9-12	0.1	FWRM12(*)1500D	IIIA
0.5-0.75	2.0	FWRM0.75(*)1500D	IIIA	9-12	0.25	FWRM12(*)3000D	IIIA
0.5-0.75	4.0	FWRM0.75(*)3000D	IIIA	9-12	0.5	FWRM12(*)6000D	IIIA
0.5-0.75	6.0	FWRM0.75(*)4500D	IIIA	9-12	0.8	FWRM12(*)10KD	IIIA
0.5-0.75	10.0	FWRM0.75(*)7500D	IIIA	9-12	2.5	FWRM12(*)30KD	VB
0.75-1	1.0	FWRM1(*)1000D	IIIA	12-15	0.1	FWRM15(*)1500D	IIIA
0.75-1	2.0	FWRM1(*)2000D	IIIA	12-15	0.2	FWRM15(*)3000D	IIIA
0.75-1	4.0	FWRM1(*)4000D	IIIA	12-15	0.4	FWRM15(*)6000D	IIIA
0.75-1	6.0	FWRM1(*)6000D	IIIA	12-15	0.6	FWRM15(*)10KD	IIIA
0.75-1	10.0	FWRM1(*)10KD	IIIA	12-15	2.0	FWRM15(*)30KD	VB
1-1.5	1.0	FWRM1.5(*)1500D	IIIA	15-18	0.07	FWRM18(*)1500D	VA
1-1.5	2.0	FWRM1.5(*)3000D	IIIA	15-18	0.14	FWRM18(*)3000D	VA
1-1.5	4.0	FWRM1.5(*)6000D	IIIA	15-18	0.3	FWRM18(*)6000D	VA
1-1.5	6.0	FWRM1.5(*)10KD	IIIA	15-18	0.5	FWRM18(*)10KD	VA
1-1.5	10.0	FWRM1.5(*)15KD	IIIB	15-18	1.5	FWRM18(*)30KD	VB
1.5-2	0.75	FWRM2(*)1500D	IIIA	18-20	0.06	FWRM20(*)1500D	VA
1.5-2	1.5	FWRM2(*)3000D	IIIA	18-20	0.15	FWRM20(*)3000D	VA
1.5-2	3.0	FWRM2(*)6000D	IIIA	18-20	0.3	FWRM20(*)6000D	VA
1.5-2	5.0	FWRM2(*)10KD	IIIA	18-20	0.5	FWRM20(*)10KD	VA
1.5-2	10.0	FWRM2(*)20KD	VB	18-20	1.5	FWRM20(*)30KD	VB
2-3	0.5	FWRM3(*)1500D	IIIA	20-24	0.05	FWRM24(*)1500D	VA
2-3	1.0	FWRM3(*)3000D	IIIA	20-24	0.1	FWRM24(*)3000D	VA
2-3	2.0	FWRM3(*)6000D	IIIA	20-24	0.2	FWRM24(*)6000D	VA
2-3	3.0	FWRM3(*)10KD	IIIA	20-24	0.4	FWRM24(*)10KD	VA
2-3	10.0	FWRM3(*)30KD	VB	20-24	1.2	FWRM24(*)30KD	VB
3-4	0.3	FWRM4(*)1500D	IIIA	24-30	0.05	FWRM30(*)1500D	VA
3-4	0.6	FWRM4(*)3000D	IIIA	24-30	0.1	FWRM30(*)3000D	VA
3-4	1.5	FWRM4(*)6000D	IIIA	24-30	0.2	FWRM30(*)6000D	VA
3-4	2.5	FWRM4(*)10KD	IIIA	24-30	0.3	FWRM30(*)10KD	VA
3-4	7.5	FWRM4(*)30KD	VB	24-30	1.0	FWRM30(*)30KD	VB
4-6	0.25	FWRM6(*)1500D	IIIA				
4-6	0.5	FWRM6(*)3000D	IIIA				
4-6	1.0	FWRM6(*)6000D	IIIA				
4-6	1.5	FWRM6(*)10KD	IIIA				
4-6	5.0	FWRM6(*)30KD	VB				

Indicate "P" for Positive Polarity.
Indicate "N" for Negative Polarity.
**See outline drawings on page 1.1467 for case size and weight information.

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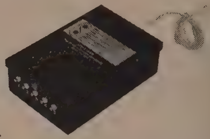
RM-FRM REGULATED MODULES

SPECIFICATIONS



INPUT: +28VDC ±10%. AC option available.

OUTPUT: All RM models feature adjustability over the full range from zero to maximum rated output voltage (−0, +5% tolerance). All models are remote resistance programmable.

All FRM models are variable over the narrow range specified for each output voltage level. (−20% low end and +5% high end tolerance). All models are remote resistance programmable. Fixed versions available, consult factory.

OUTPUT POLARITY: All models are available with either positive or negative output polarity with respect to ground. See table.

REGULATION: LINE:* ±0.01% for ±10% line change.

LOAD:* 1% per watt output rating, full load change.

RIPPLE:* 0.1% RMS per watt output rating.

OVERLOAD PROTECTION: All models are overload, short circuit, arc, and reverse voltage protected by means of state-of-the-art Spellman circuitry.

PROGRAMMING: Terminals are provided for remote resistance programming.

EFFICIENCY: Basic converter efficiency on all units exceeds 60%.

SERVICE CONDITIONS: 0-60°C.

*Specifications hold from 10%-100% of maximum rated output voltage.

FRM LINE

Output Voltage (KV)	Output Current (mA)	Model Number	Size**	Output Voltage (KV)	Output Current (mA)	Model Number	Size**
0.35-0.5	1.0	FRM0.5(*)500D	IIA	6-9	0.15	FRM9(*)1500D	IIA
0.35-0.5	2.0	FRM0.5(*)1000D	IIA	6-9	0.3	FRM9(*)3000D	IIA
0.35-0.5	4.0	FRM0.5(*)2000D	IIA	6-9	0.6	FRM9(*)6000D	IIA
0.35-0.5	6.0	FRM0.5(*)3000D	IIA	6-9	1.0	FRM9(*)10KD	IIA
0.5-0.75	1.0	FRM0.75(*)750D	IIA	9-12	0.1	FRM12(*)1500D	IIA
0.5-0.75	2.0	FRM0.75(*)1500D	IIA	9-12	0.25	FRM12(*)3000D	IIA
0.5-0.75	4.0	FRM0.75(*)3000D	IIA	9-12	0.5	FRM12(*)6000D	IIA
0.5-0.75	6.0	FRM0.75(*)4500D	IIA	9-12	0.8	FRM12(*)10KD	IIA
0.75-1	1.0	FRM1(*)1000D	IIA	12-15	0.1	FRM15(*)1500D	IIA
0.75-1	2.0	FRM1(*)2000D	IIA	12-15	0.2	FRM15(*)3000D	IIA
0.75-1	4.0	FRM1(*)4000D	IIA	12-15	0.4	FRM15(*)6000D	IIA
0.75-1	6.0	FRM1(*)6000D	IIA	12-15	0.6	FRM15(*)10KD	IIA
1-1.5	1.0	FRM1.5(*)1500D	IIA	15-18	0.07	FRM18(*)1500D	IIA
1-1.5	2.0	FRM1.5(*)3000D	IIA	15-18	0.14	FRM18(*)3000D	IIA
1-1.5	4.0	FRM1.5(*)6000D	IIA	15-18	0.3	FRM18(*)6000D	IIA
1-1.5	6.0	FRM1.5(*)10KD	IIA	15-18	0.5	FRM18(*)10KD	IIA
1.5-2	0.75	FRM2(*)1500D	IIA	18-20	0.06	FRM20(*)1500D	IIIA
1.5-2	1.5	FRM2(*)3000D	IIA	18-20	0.15	FRM20(*)3000D	IIIA
1.5-2	3.0	FRM2(*)6000D	IIA	18-20	0.3	FRM20(*)6000D	IIIA
1.5-2	5.0	FRM2(*)10KD	IIA	18-20	0.5	FRM20(*)10KD	IIIA
2-3	0.5	FRM3(*)1500D	IIA	20-24	0.05	FRM24(*)1500D	IIIA
2-3	1.0	FRM3(*)3000D	IIA	20-24	0.1	FRM24(*)3000D	IIIA
2-3	2.0	FRM3(*)6000D	IIA	20-24	0.2	FRM24(*)6000D	IIIA
2-3	3.0	FRM3(*)10KD	IIA	20-24	0.4	FRM24(*)10KD	IIIA
3-4	0.3	FRM4(*)1500D	IIA	24-30	0.05	FRM30(*)1500D	VA
3-4	0.6	FRM4(*)3000D	IIA	24-30	0.1	FRM30(*)3000D	VA
3-4	1.5	FRM4(*)6000D	IIA	24-30	0.2	FRM30(*)6000D	VA
3-4	2.5	FRM4(*)10KD	IIA	24-30	0.3	FRM30(*)10KD	VA
4-6	0.25	FRM6(*)1500D	IIA				
4-6	0.5	FRM6(*)3000D	IIA				
4-6	1.0	FRM6(*)6000D	IIA				
4-6	1.5	FRM6(*)10KD	IIA				

*Indicate "P" for positive polarity
Indicate "N" for negative polarity
**See outline drawings on page 1.1467 for case size and weight information.

RM LINE

Output Voltage (KV)	Output Current (mA)	Model Number	Size**	Output Voltage (KV)	Output Current (mA)	Model Number	Size**
0-1.5	1.0	RM1.5(*)1500D	IIA	0-15	0.1	RM15(*)1500D	IIA
0-1.5	2.0	RM1.5(*)3000D	IIA	0-15	0.2	RM15(*)3000D	IIA
0-1.5	4.0	RM1.5(*)6000D	IIA	0-15	0.4	RM15(*)6000D	IIA
0-1.5	6.0	RM1.5(*)10KD	IIA	0-15	0.6	RM15(*)10KD	IIA
0-3	0.5	RM3(*)1500D	IIA	0-18	0.07	RM18(*)1500D	IIA
0-3	1.0	RM3(*)3000D	IIA	0-18	0.14	RM18(*)3000D	IIA
0-3	2.0	RM3(*)6000D	IIA	0-18	0.3	RM18(*)6000D	IIA
0-3	3.0	RM3(*)10KD	IIA	0-18	0.5	RM18(*)10KD	IIA
0-6	0.25	RM6(*)1500D	IIA	0-20	0.06	RM20(*)1500D	IIIA
0-6	0.5	RM6(*)3000D	IIA	0-20	0.15	RM20(*)3000D	IIIA
0-6	1.0	RM6(*)6000D	IIA	0-20	0.3	RM20(*)6000D	IIIA
0-6	1.5	RM6(*)10KD	IIA	0-20	0.5	RM20(*)10KD	IIIA
0-9	0.15	RM9(*)1500D	IIA	0-24	0.05	RM24(*)1500D	IIIA
0-9	0.3	RM9(*)3000D	IIA	0-24	0.1	RM24(*)3000D	IIIA
0-9	0.6	RM9(*)6000D	IIA	0-24	0.2	RM24(*)6000D	IIIA
0-9	1.0	RM9(*)10KD	IIA	0-24	0.4	RM24(*)10KD	IIA
0-12	0.12	RM12(*)1500D	IIA	0-30	0.05	RM30(*)1500D	VA
0-12	0.25	RM12(*)3000D	IIA	0-30	0.1	RM30(*)3000D	VA
0-12	0.5	RM12(*)6000D	IIA	0-30	0.2	RM30(*)6000D	VA
0-12	0.8	RM12(*)10KD	IIA	0-30	0.3	RM30(*)10KD	VA

*Indicate "P" for Positive Polarity. Indicate "N" for Negative Polarity.
**See outline drawings on page 1.1467 for case size and weight information.

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UM LINE HIGH VOLTAGE ENCAPSULATED

SPECIFICATIONS

INPUT: +24 VDC ± 10% for rated maximum output voltage. AC option available.

REGULATION: LINE: Output voltage is approximately proportional to input voltage.
LOAD: 15% per watt load variation at max. voltage.

RIPPLE: 0.1% RMS.

EFFICIENCY: 50% minimum.

OUTPUT POLARITY: Available in positive or negative polarity with respect to ground (case). (Letter "P" or "N" in model number designates positive or negative polarity respectively).

VOLTAGE ADJUSTMENT: Output voltage is adjustable from near zero to rated voltage by adjustment of the DC input voltage. The output is approximately proportional to input voltage.

PROTECTION: Unit is fully protected against all overload and short circuit conditions.

MECHANICAL INFORMATION: See outline drawing for size. Terminals are provided for DC input and common. A 12" "flying" lead is provided for the high voltage output. The unit is encapsulated in a closed metal case with mounting inserts in the base.

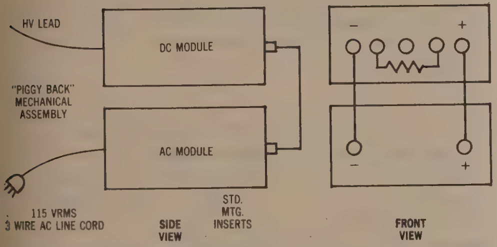
SERVICE CONDITIONS: 0-60°C.

CIRCUIT CONCEPT: High frequency power oscillator circuit enables low ripple to be achieved with small, low stored energy capacitors, resulting in greater safety as well as better performance. Oscillator frequency is well above the audio range.

Model Number*	Output Voltage Range (Kiolovolts)	Output Current (Microamperes)	Case Size**
UM1(*)1000D	0-1	1000	I
UM1.5(*)1500D	0-1.5	1000	I
UM3(*)1500D	0-3	500	I
UM6(*)1500D	0-6	250	I
UM9(*)1500D	0-9	150	I
UM12(*)1500D	0-12	100	I
UM15(*)1500D	0-15	75	IIB
UM18(*)1500D	0-18	60	IIB
UM24(*)1500D	0-24	50	IIIC

*Use "P" in model number for positive polarity.
Use "N" for negative polarity.
**See outline drawings below for case size and weight information.

AC ADAPTOR FOR RM, FRM, WRM, FWRM MODULES


HV LEAD
DC MODULE
"PIGGY BACK" MECHANICAL ASSEMBLY
AC MODULE
115 VRMS
3 WIRE AC LINE CORD
SIDE VIEW
STD. MTG. INSERTS
−
+
−
+
FRONT VIEW

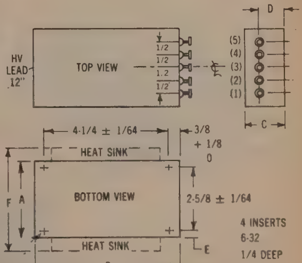
Model	Application	Case Size
AC10	For all modules up to 10 watts	IIIA
AC30	For all 30 watt modules	VA

See below for case size and weight information.

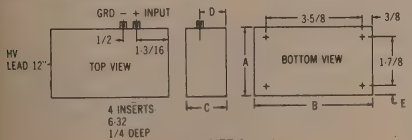
MODULAR CASE SIZE AND OUTLINE DRAWINGS

Case Size		A	B	C	D	E	F	Weight	
								Lbs.	Kg.
I	inches	2-5/8	4-1/2	1-9/16	1	3/8	N/A	1-1/4	.57
	mm	66.7	114.3	39.7	25.4	9.5			
IIA	inches	3-3/8	5-1/8	1-9/16	1	3/8	N/A	2	.91
	mm	85.7	130.2	39.7	25.4	9.5			
IIB	inches	3-3/8	5-1/8	1-9/16	1	3/8	N/A	2	.91
	mm	85.7	130.2	39.7	25.4	9.5			
IIIA	inches	3-5/8	6-5/8	2-1/16	1-1/2	1/2	N/A	3-1/4	1.48
	mm	85.7	168.3	52.4	38.1	12.7			
IIIB	inches	3-5/8	6-5/8	2-1/16	1-1/2	1/2	4-5/8	3-1/4	1.48
	mm	85.7	168.3	52.4	38.1	12.7	117.5		
IIIC	inches	3-5/8	6-5/8	2-1/16	1-1/2	1/2	N/A	3-1/4	1.48
	mm	85.7	168.3	52.4	38.1	12.7			
VA	inches	4-1/8	9-1/8	2-9/16	1-7/8	3/4	N/A	5-1/4	2.39
	mm	104.8	231.8	65.1	47.6	19.1			
VB	inches	4-1/8	9-1/8	2-9/16	1-7/8	3/4	5-1/8	5-1/4	2.39
	mm	104.8	231.8	65.1	47.6	19.1	130.2		

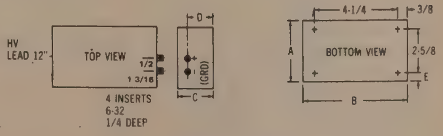
All dimensions given to nearest millimeter.


D
HV LEAD 12"
TOP VIEW
1/2
1/2
1.2
1/2
(5)
(4)
(3)
(2)
(1)
C
4-1/4 ± 1/64
3/8 + 1/8 0
HEAT SINK
F
A
BOTTOM VIEW
2-5/8 ± 1/64
4 INSERTS 6-32 1/4 DEEP
HEAT SINK
E
B

CASE SIZE
IIA, IIIA, IIIB, VA, VB


GRD − + INPUT
D
1/2
1-3/16
HV LEAD 12"
TOP VIEW
4 INSERTS 6-32 1/4 DEEP
C
3-5/8
3/8
A
BOTTOM VIEW
1-7/8
B
E

CASE SIZE I


HV LEAD 12"
TOP VIEW
1/2
1 3/16
4 INSERTS 6-32 1/4 DEEP
D
(GRD)
C
4-1/4
3/8
A
BOTTOM VIEW
2-5/8
E
B

CASE SIZE IIB, IIIC

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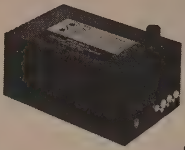
CATHODE RAY TUBE POWER SUPPLIES

FOR AIRBORNE, GROUND SUPPORT, MILITARY REQUIREMENTS— HIGHLY REGULATED, HIGHLY EFFICIENT



MODEL RV-16P8/F

MODEL RV-20P10

SPECIFICATIONS

DESIGN PHILOSOPHY: These compact, highly efficient, all solid state DC power supplies have been designed for commercial and military cathode ray tube applications, both airborne and ground support.

The units are built to achieve all environmental requirements of MIL-E-5400 (general specifications for airborne electronic equipment). The MTBF at 71°C per MIL-HDBK-217A is in excess of 60,000 hours.

ENVIRONMENTAL: The power supply meets all specifications given below when subjected to the environmental conditions specified:

TEMPERATURE RANGE: Operating: Minus 55°C to plus 71°C (ambient). Storage: Minus 65°C to plus 125°C (ambient)

SHOCK: 50G, 11 milliseconds. Per MIL-STD-810

VIBRATION: 10G, per MIL-STD 810, method 514, curve D, figure 514-1

ACCELERATION: MIL-STD-810, method 513

THERMAL SHOCK: Minus 55°C to plus 100°C, per MIL-STD-810

HUMIDITY: MIL-STD-810, method 507, procedure 1.

ALTITUDE: MIL-STD-810, method 504, procedure 1. Maximum altitude 60Kft. Maximum pressure change 1.25 inches of HG per second

SALT SPRAY: MIL-STD-202E, test condition A, method 101D

FUNGUS: MIL-STD-454C, requirement 4

EXPLOSION: MIL-STD-810, method 511, procedure 11

ACOUSTIC NOISE: MIL-STD-810, method 515, category A

PERFORMANCE SPECIFICATIONS:

ANODE:

Output voltage: Zero to +20KV. (Model RV-20P10).
Zero to +16KV. (Model RV-16P8/F).
Output current: 500μA—at all voltage levels.
Input voltage: 28VDC ±10%.
Input current: No load: 175mA. Full load: 550mA.

REGULATION:

Line: 0.005% (±10% change)
Load: 0.005% (full load change)
Dynamic: 10V/100UA
Ripple: 0.01% peak to peak at full load.
Output adjustability: A multiturn pot varies the output voltage over the available range.
Remote Trim: The output voltage may be remotely controlled by a voltage signal to the remote trim terminal. A zero volt programming signal corresponds to 100% output and a +13V programming signal.

PROTECTION: The unit is fully protected against short circuit, overload reverse input polarity. Special design care has assured that these units will withstand all CRT "arc over" conditions.

FOCUS: (Model RV16P8/F only)

Output voltage: +600VDC ±5% with anode at 12KV, +800VDC ±5% with anode at 16KV

Output current: Up to 10mA with reduced anode current

Regulation: Better than 3%

Ripple: 1% peak at 1mA

MATERIALS AND FINISH: The units are fully encapsulated and shielded in a black anodized aluminum case. Materials and finish are selected in accordance with MIL-E-5400.

PHYSICAL CHARACTERISTICS:

DIMENSIONS: 3.125" wide x 4.875" long x 2" high

VOLUME: 30.47 cubic inches

WEIGHT: 2 pounds

LOW VOLTAGE TERMINATIONS: A six pin MIL type connector can be provided

MATING CONNECTOR: LG-1 connector and LG-1/2 connector

CRT MULTIPLE OUTPUT POWER SUPPLIES RMC LINE

SPECIFICATIONS:

INPUT: +28VDC ±10%

EFFICIENCY: Basic converter efficiency greater than 60%

SIZE: 3-5/8" x 6-5/8" x 2-1/16" (mm)

WEIGHT: 2-1/2 lbs. (1.14 Kg.)

GENERAL INFORMATION: These power supplies have been specially designed for CRT applications. This design eliminates the space consuming, costly problem of incorporating several power supplies. Spellman's RMC provides grid-1 and grid-2 voltages as well as the anode voltage for the CRT—all in a single package, small, well regulated and very economical.

STANDARD MODELS

(For non-standard output voltages, please contact the factory)

Model	Fixed Anode Voltage	G-2 Voltage	G-1 Voltage
RMC10P	10KV	+400V	−100V
RMC12P	12KV	+400V	−100V
RMC15P	15KV	+400V	−100V

All voltages are fixed, within ±5% of rated value.

ELECTRICAL SPECIFICATIONS: ALL MODELS

	Anode	G-2	G-1
Output Current	200uA	1mA	1mA
Regulation· Line	0.01%	0.1%	0.1%
Load	0.05%	0.3%*	0.3%*
Ripple, p-p	0.1%	0.1%	0.1%
8 Hr. Stability	0.2%	0.2%	0.2%

*for 10% change

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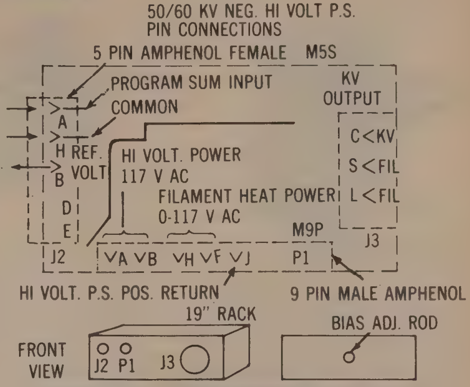
Spellman High Voltage Electronics Corporation takes great pride in the versatility and adaptability of its many high voltage power supplies. During the past three decades, we have solved many vexing problems in high voltage technology. The experience gained in providing solid solutions to these problems has given our Spellman engineers the greatest range of diversity in the high voltage industry. Not only has the standard Spellman line been designed to take advantage of this remarkable diversity (see the wide variety of options and features provided for the Spellman rack lines and the extensiveness of the Spellman module range), but also we have made it a point to continue the Spellman tradition of attacking new and challenging customer problems.

In the pages that follow, we show examples of sixteen types of power supplies designed to meet special customer problems and applications. We are always pleased to survey new horizons, so the next time you have a special high voltage problem—give Spellman a call.

SCANNING ELECTRON MICROSCOPE POWER SUPPLY THE SEM 60

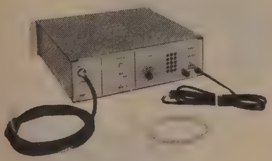


This power supply has been designed by our Spellman engineers to provide the high voltage, floating filament, and bias control necessary for many S.E.M. applications. The high voltage is adjustable from 0 to 60 KV at 250 UA. Regulation (line and load) is 10 PPM and ripple is 10 PPM as well. In addition the power supply features 15 minute stability of 10 PPM after a 30 minute warm up. The output is programmable by means of a remote resistance, and can be monitored remotely as well.

The auxiliary floating filament supply provides a 0.1% filtered, adjustable 0-6 VDC at 5 amperes. The bias control consists of a 10 megohm, 5 watt rheostat connected between the −60KV output and filament center tap.

The S.E.M. 60 is mechanically designed for mounting in a standard 19" rack and is only 5¼" high.

COMPUTER OUTPUT MICROFILM POWER SUPPLY



SPELLMAN MODEL
RHSR—25P25F(3)X582

This multiple output, super-regulated high voltage power supply has been designed to provide the anode, G-2 and filament voltages for the cathode ray tube section of a computer output microfilm system. Based on the Spellman RHSR line, this power supply features an anode voltage which is adjustable between +20KV and +25KV with regulation and ripple of 0.001%. The high voltage output current is rated for 1 ma. The G-2 voltage is adjustable from +1.5 KV to +3KV at 500μa and features 0.01% regulation and ripple. The filament voltage is rated for 6.5 vdc, 600mA and is filtered for ripple of 2% RMS max.

Transient response for the high voltage and G-2 outputs permits less than a 10 volt peak swing for full load change and the outputs recover to within 0.01% of their original value within 5 msec. In addition, the unit is provided with an inhibit circuit such that if the inhibit signal is present, anode and G-2 are operative while if the signal is absent anode and G-2 are not operative. The filament supply is always On if the AC in On. BNC monitor points are provided for anode voltage and current and G-2 voltage.

The RHSR-25P25F(3)X582 is designed for standard 19" rack mounting and occupies only 5¼" of rack space.

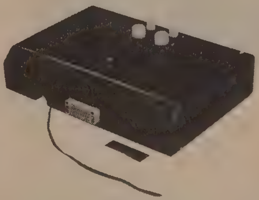
RACK MOUNTED MULTIPLE OUTPUT, ALL-PURPOSE CRT POWER SUPPLY

SPELLMAN
HIGH VOLTAGE DC SUPPLY
POWER
OUTPUT

CRT 40

This rugged, high performance power supply has been designed to be used by high production cathode ray tube manufacturers as well as cathode ray tube users. The CRT-40 can be used with the widest variety of cathode ray tubes. Both anode and focus voltage feature full adjustability (0-40KV and 0-6.5KV respectively), remote resistance programming, remote voltage monitoring, and remote current monitoring (optional for focus output). Regulation is 0.01% for line and load and ripple is 0.01% RMS. The unit is designed for standard 19" rack mounting and occupies only 5¼" of rack space. Model CRT30, a 30KV equivalent version, is also available.

MILITARIZED CATHODE RAY TUBE POWER SUPPLY SYSTEM FOR AIRBORNE RECORDING OF HIGH RESOLUTION RADAR DATA



SYSTEM FEATURES
ANODE, 2 FOCUS
and DYNAMIC FOCUS OUTPUTS

This militarized, airborne power supply features an anode voltage of +15KV (50 μa), 2 identical focus voltages—+4.1 to +4.5KV (100μa)—and a dynamic focus capability of between +20 and +200 volts above the static focus signal in response to a +5 v drive signal. The dynamic focus has a frequency response of DC to 60Khz (−3 dB).

The anode voltage has line regulation of 0.1% for ±10% change and load regulation of 0.05%. Ripple is less than 4 volts p-p. Each of the focus voltages has line and load regulation of 0.05% and ripple less than 4 v p-p.

This CRT power supply system is built to operate up to 50,000 feet and at an operating temperature range of −54°C to +71°C. All outputs are fully protected against short circuit, overload and CRT "arc-over" conditions.

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ELECTRONICS
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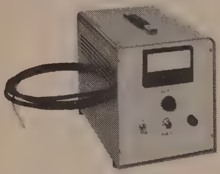
LOW COST 60 KV POWER SUPPLY FOR ELECTROSTATIC APPLICATIONS



SPELLMAN MODEL UHP60P10

This power supply provides an output voltage which is continuously adjustable from 0 to 60KVDC, operating from an input voltage of 115V RMS, 60 Hz. The output current of the Spellman UHP60P10 is 150 μa at 60 KV and increases to 250 μa below 20KV. The output is positive with respect to ground and has ripple of less than 0.5% RMS.

The UHP60P10 is controlled by an ON-OFF toggle switch and has a single turn continuously adjustable voltage control. A ±2% KV-meter reads the output voltage directly through a high voltage multiplier resistor. (Note: Model UHP60P10/L features an ammeter as well as the KV meter). The unit is provided with a 5', three wire grounded line cord and a grounding stud. A detachable 6' shielded hv-cable is provided for the main output. This Spellman power supply is current limited to 250 μa with automatic recovery to operating voltage when the overload condition is removed.

This low-cost unit is ideal for industrial applications since its small size (8"x9"x12") and light weight (16 pounds) lend themselves to portability. In addition, the UHP60P10 is housed in a portable carrying case.

ELECTROSTATIC QUADRUPOLE FOCUS POWER SUPPLY

SPELLMAN MODEL RHM10P10X

Spellman Model RHM10P10X is a specially packaged high voltage power supply designed for use with electrostatic quadrupole systems in a variety of accelerator and ion source applications. Each power supply consists of two pairs of Master/Slave modules. Each such pair of Master/Slave modules consists of a 10KV, 10 watt positive power supply and a 10KV, 10 watt negative power supply. These four modules are internally powered from a 28 volt dc source excited from the 115v, 60 hz line.

The specifications for each of the individual outputs is according to the standard catalog specifications for the RM line (see under modules) except that: 1) each positive/negative pair of outputs track each other to 1% or 50 volts, whichever is greater; 2) the output voltage is variable from 0.1 KV to 10 KVDC; 3) the maximum external load is 0.5 ma per module. The supplies are internally loaded to 0.5 ma at 10 KV to act as a sink when required.

Spellman Model RHM10P10X is designed for standard 19" rack mounting and occupies 5¼" of rack height.

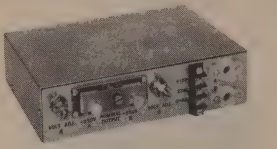
ELECTROSTATIC DYNAMIC FOCUS HIGH VOLTAGE POWER SUPPLY FOR CRT USE

RMD

The Spellman RMD is a multiple output CRT module with dynamic focusing capability. The RMD5P5D was designed to operate from 28VDC and provide not only a 3.5KV focus voltage, but also a 200 volts dynamic focus section riding on top if it. Dynamic focus rise and fall time meets the difficult specification of 3.5 microseconds. The unit measures only 3½" x 5" x 3" and weighs less than 4 lbs.

Please consult factory for further details.

DUAL OUTPUT H.V.P.S. FOR OPERATING TWO IDENTICAL PMT's



SPELLMAN MODEL WRMX—1.2N

This power supply provides two identical, well regulated high voltage outputs, each independently adjustable. In normal usage the system powers two identical photomultiplier tubes.

Each of the output voltages is adjustable from −600 to −1200 volts dc with a maximum current rating of 1 ma for each output. For an input voltage of 15 v ±10% line regulation is better than ±0.1%. Load regulation is better than 0.05% for full load change and ripple is less than 0.1% pp. After a 15 minute warm-up the unit will drift no more than ±1% for 8 hours and the temperature coefficient will not exceed 0.1%/°C. In addition, the difference in output voltages due to temperature does not exceed ±5 volts for any operating temperature in the +20°C to +55°C operating range of the power supply.

Voltage adjustment is accomplished by an easily accessible screw-adjust with resolution of better than 1% and an interlock has been provided so that one cannot remove the high voltage BNC connectors while the output voltage is present.

MILITARIZED HIGH VOLTAGE MODULAR POWER SUPPLY

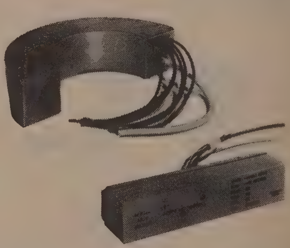
SPELLMAN MODEL RM14P7000DX

Designed to meet the environmental requirements of MIL-E-5400 and MIL-Std-810B, this power supply can operate at any of three output voltages (+10KV, +12KV, or +14KV) each voltage being rated for a maximum output current of 500 μa. Coded terminals are provided on the front of the module for simple output voltage selection.

Operated from either + or −24 vdc (and drawing less than 20 watts worst case) the power supply features line and load regulation of better than 0.5% and the ripple at full load is no worse than 0.5% RMS. The temperature coefficient of the power supply is better than 0.05%/°C for the temperature range of the power supply (−20°C to +71°C).

The power supply is housed in a cadmium plated steel case and measures 3-5/8"x6-5/8"x2-1/16".

X-RAY INTENSIFIER TUBE POWER SUPPLIES



TYPICAL SPELLMAN IMAGE TUBE POWER SUPPLIES

A variety of custom high voltage power supplies for x-ray image tube applications are available. Each of the above illustrated supplies is a multiple output device designed for a specific II tube. The rectangular supply provides outputs of 25KV, 2-3 KV, 250 vdc-1KV, and 100-300vdc. Ripple and regulation are better than 1% and the entire package measures only 1-3/4"x1-3/4"x8-3/32".

The annular shaped unit pictured above (which fits around the neck of a tube) provides the following output voltages: either 25KV or 30KV (preselectable), 2KV to 12KV (adjustable), 3KV or 3.5KV, 300vdc to 2KV (adjustable) and a fixed +400vdc. Ripple under load is better than 0.3% pp and anode, G-3, G-2, and G-1 voltages are regulated to better than ±1% for ±10% input change, 10°C ambient change and 8 hour drift after a 5 minute warm-up period.

Any of the Spellman X-Ray Image Intensifier power supplies can be designed to be consistent with U.L. approved standards according to **Standards for Safety,** X-Ray Equipment UL 187.

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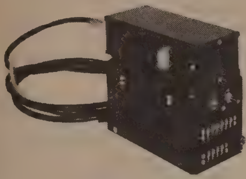
LINEAR ACCELERATOR ELECTRON GUN HIGH VOLTAGE POWER SUPPLY

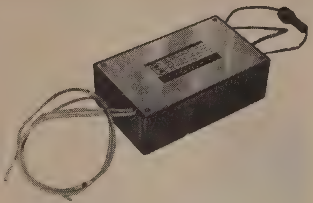


SPELLMAN MODEL RHM25N25AX

This high voltage power supply provides a regulated output for the electron gun (cathode) of a linear accelerator. The output voltage is from 0.5 to 25 KV DC in two ranges. The Low range is variable from 1-12 KV and the High range is adjustable from 15 to 25 Kv. Upon application of a 24-vdc command signal the output voltage increases towards the value set in the High mode and upon removal of this command signal the output voltage decreases to the Low mode setting. The output current capability at all voltage settings is 1 ma.

Ripple and noise for Spellman model RHM25N25 is less than 10 v pp and overall regulation/stability (temperature, line, load, time) is better than 1%. Terminals are provided for remote monitoring of the output voltage on a 100μa meter (10 volts full scale). Spellman model RHM25N25AX measures 4-1/2"x8-1/8"x6-1/2" and operates from 118v input.

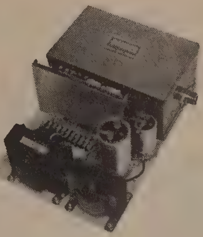
HIGH POWERED MODULAR PMT POWER SUPPLY FOR NUCLEAR AND AIRBORNE APPLICATIONS



SPELLMAN MODEL UHM1.5PN75

For airborne PMT work, the Spellman UHM1.5PN75 was designed to provide 1.5KV at 50ma and to fit in a 4"x6½"x2" case. Input requirements are 28VDC at 3.5 amps max. The output voltage is approximately proportional to the input voltage. Ripple is 5 volts peak-to-peak.

HIGHLY STABLE, HIGH VOLTAGE MODULE WITH HIGH POWER CAPABILITY



SPELLMAN MODEL RV50PX

This modular high voltage power supply operates from 115V, 50-60 hz and provides an output of from 1-50KV (continuously adjustable) at an output current rating of 1 ma.

Regulation of Spellman model RV-50PX is 0.001% for line and load variations over the operating range and ripple is 2 volts peak to peak, maximum. Drift is less than 0.005% per hour and less than 0.01%/8 hours (after a 30 minute warm-up). Repeatibility is better than 0.05% and the power supply features a temperature coefficient of 25 ppm per °C over the operating temperature range of 0 to 50°C.

Notable for the compact size from which the 50 watts of output power is delivered, this Spellman power supply measures only 10"x13"x5".

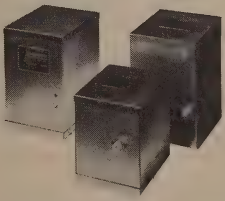
ULTOR POWER SUPPLY FOR AIRCRAFT SIMULATOR CATHODE RAY TUBE

SPELLMAN MODEL RV-40P30X

This stabilized, modular power supply was designed to provide the anode voltage for a cathode ray tube being used in an aircraft simulator. The power supply operates from 115 vac and provides +40Kv with a steady state current rating of 0.75 ma. Load regulation is ±0.05% for dynamic load variations and the power supply features an output voltage stability of better than ±0.1% independent of line, load and temperature variation for a period of at least 1 hour and better than ±0.2% for a period of 40 hours.

The power supply is provided with an output monitor voltage which is 10−4 ±5% of the actual output voltage. Peak to peak ripple of the RV-40P30X is less than 0.05% peak to peak. Per MIL-STD-454, the output decays to 30 volts within 11 seconds after turn off. This Spellman power supply measures 8.5"x8.5"x7.25" and weights less than 20 lbs.

MODULAR STYLE 10 & 30 WATT PROPORTIONAL UNREGULATED POWER SUPPLIES

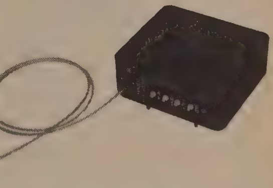


SPELLMAN MODEL UHM

Spellman engineers have built a line of 10 and 30 Watt unregulated modular style power supplies for either AC or DC input.

Spellman's UHM line was designed with 5, 10, 15, 20 and 30KV power supplies with either 10 or 30 Watt output power capability. UHM line can work from either 24VDC or 115VAC input and the output is controlled by varying the input voltage. Ripple is 0.1% of maximum voltage. The UHM line operates in air and is housed in heavy gauge aluminum cases.

MODULAR POWER SUPPLY MEETING STRICT MILITARY SPECIFICATIONS



SPELLMAN MODEL RM-10PX/MIL

A compact, light weight modular high voltage power supply was designed for use in Military applications with strict specification requirements.

The RM-10PX/MIL (one ±10KV output at up to 300 μA, one +400V output at 5 μA, together with a +400V monitor terminal capable of attachment to a microammeter to monitor the 400V output) was developed to meet strict military specifications. This model features ±0.1% line regulation and ±0.5% load regulation, with 0.25% ripple peak to peak on the 10KV output. The RM-10PX/MIL measures only 4½"x4"x2" and weights less than 2 lbs.

Standard Power Supplies Selector Guide

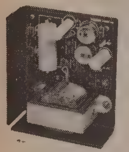
STANDARD POWER INCORPORATED

More than 200 different standard models featuring today's advanced designs...top quality components...priced to set new standards of value...guaranteed for up to 5 years. Your best buy today!

ON-THE-SHELF AT DISTRIBUTORS NATIONWIDE!

GENERAL SPECIFICATIONS:
BLUE LINE, DUAL AND TRIPLE OUTPUT, CONSTANT CURRENT MODELS:
Input Voltage: 115/230 Vac ±10% 47-440 Hz
Line Regulation: ±0.1%
Load Regulation: ±0.1%
Ripple: 0.1%
Short Circuit Protection: Fold-back type, Current Limiting. Adjustable.
Adjustable Voltage Range: ±10%
Operating Temp.: 0° to 50°C
BLACK LINE UNREGULATED MODELS:
Input Voltage: 115 Vac, 50/60 Hz
Maximum Ripple: 3%
Overcurrent Protection: Fuse

"BLUE LINE" SPS 15 SERIES



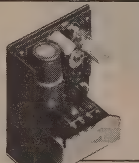
Minimum Cost, General Purpose Design

Adjustable current limiting.
U.L. Recognized Components

±0.1% Regulation
4.75" x 4" x 2.06"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 15-5	5	1.5	$24.95
SPS 15-12	12	0.8	24.95
SPS 15-15	15	0.7	24.95
SPS 15-24/28	24/28	0.5	24.95

"BLUE LINE" SPS 30 SERIES



More Power, Increased Savings

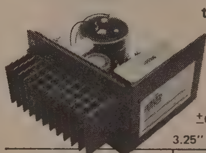
The same features as the SPS 15 Series

±0.1% Regulation
4.75" x 4" x 2.5"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 30-5	5	3.0	$29.00
SPS 30-10	10	1.8	29.00
SPS 30-12	12	1.8	29.00
SPS 30-15	15	1.6	29.00
SPS 30-24/28	24/28	1.2	29.00
SPS 30-30	30	1.0	29.00
SPS 30-48	48	0.6	36.00
SPS 30-120	120	0.15	49.00
SPS 30-250	250	0.05	49.00

"BLUE LINE" SPS 40 SERIES

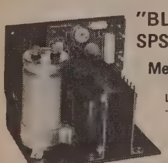
The best OEM buy in the industry



±0.1% Regulation
3.25" x 5.65" x 4.94"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 40-5	5	5.0	$49.50
SPS 40-12	12	3.5	49.50
SPS 40-15	15	3.0	49.50
SPS 40-24/28	24/28	1.8	49.50

"BLUE LINE" SPS 60/75 SERIES



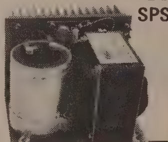
Medium Power Range

Low-drift, temperature-compensated output.

±0.1% Regulation
4.94" x 4.94" x 6"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 60-5	5	6.0	$64.50
SPS 60-12	12	5.0	64.50
SPS 60-15	15	4.0	64.50
SPS 60-24/28	24/28	2.5	64.50
SPS 60-48	48	1.2	75.00
SPS 75-5	5	10	$69.50

"BLUE LINE" SPS 120/180 SERIES



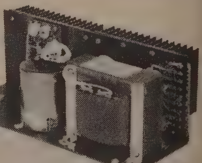
High Power Cool Performance

Remote sensing, added heat sinking for cool operation.
±0.1% Regulation
5" x 7" x 6.60"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 120-5	5	12	$ 99.50
SPS 120-12	12	10	99.50
SPS 120-15	15	8	99.50
SPS 120-24/28	24/28	6	99.50
SPS 120-48	48	3	110.00
SPS 120-120	120	1	125.00
SPS 120-250	250	0.5	125.00
SPS 180-5	5	18	$109.50

"BLUE LINE" SPS 220/320 SERIES

High Power, Convection-Cooled



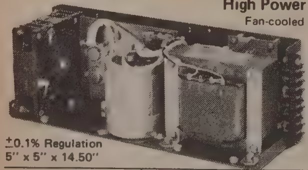
Remote sensing, and added heat sinking.

±0.1% Regulation
5"x 6.6"x 14.50"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 220-5	5	25	$169.00
SPS 220-12	12	20	169.00
SPS 220-15	15	18	169.00
SPS 220-24/28	24/28	12	169.00
SPS 320-5	5	35	$189.00

"BLUE LINE" SPS 250/350 SERIES

High Power
Fan-cooled

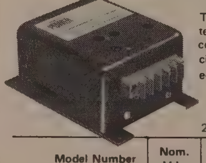


±0.1% Regulation
5" x 5" x 14.50"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 250-5	5	25	$179.00
SPS 250-12	12	20	179.00
SPS 250-15	15	18	179.00
SPS 250-24/28	24/28	12	179.00
SPS 350-5	5	35	$199.00

"BLUE LINE" CPS 15 SERIES

The Best Buy in a Universal Covered Design



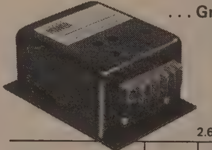
This low drift, temperature-compensated circuit design provides economical operation.

±0.1% Regulation
2.6" x 3.88" x 5.88"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 15-5	5	1.5	$41.00
CPS 15-12	12	0.8	41.00
CPS 15-15	15	0.7	41.00
CPS 15-24/28	24/28	0.5	41.00

"BLUE LINE" CPS 30 SERIES

More Power . . . Greater Savings

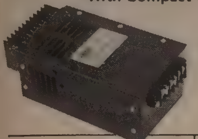


±0.1% Regulation
2.6" x 3.88" x 5.88"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 30-5	5	3	$46.00
CPS 30-12	12	1.8	46.00
CPS 30-15	15	1.6	46.00
CPS 30-24/28	24/28	1.2	46.00
CPS 30-48	48	0.6	54.00

"BLUE LINE" CPS 60/75 SERIES

A Medium Power Range— With Compact Covered Design



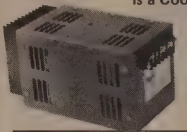
Fast response time, series-regulated, remote sensing standard.

3.30"x 4.95"x 9.9"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 60-5	5	6	$85.00
CPS 60-12	12	5	85.00
CPS 60-15	15	4	85.00
CPS 60-24/28	24/28	2.5	85.00
CPS 75-5	5	10	$89.00

"BLUE LINE" CPS 120/180 SERIES

This High Power Model is a Cool Performer . . .



for longer life. Remote sensing provides maximum regulation at load.

±0.1% Regulation

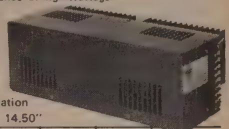
4.95"x 4.95"x 9.9"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 120-5	5	12	$130.00
CPS 120-12	12	10	130.00
CPS 120-15	15	8	130.00
CPS 120-24/28	24/28	6	130.00
CPS 180-5	5	18	$140.00

"BLUE LINE" CPS 220/320 SERIES

High Power and Efficiency

Full performance at high wattage.



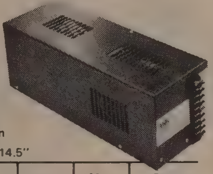
±0.1% Regulation

5" x 6.52" x 14.50"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 220-5	5	25	$189.00
CPS 220-12	12	20	189.00
CPS 220-15	15	18	189.00
CPS 220-24/28	24/28	12	189.00
CPS 320-5	5	35	$210.00

"BLUE LINE" CPS 250/350 SERIES

High Power



Built-in remote sensing.

Fan-cooled

±0.1% Regulation

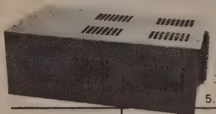
5.12" x 5.12" x 14.5"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 250-5	5	25	$199.00
CPS 250-12	12	20	199.00
CPS 250-15	15	18	199.00
CPS 250-24/28	24/28	12	199.00
CPS 350-5	5	35	$220.00

"BLUE LINE" CPS 500 SERIES

High Current

This fan-cooled series will provide maximum power without overheating. Has built-in remote sense capability.

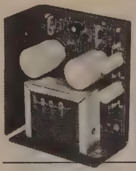


±0.1% Regulation

5.10" x 8" x 14.5"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 500-5	5	50	$315.00
CPS 500-12	12	40	315.00
CPS 500-15	15	33	315.00
CPS 500-24/28	24/28	20	315.00

DUAL OUTPUT SPS 30D SERIES



Compact design... low cost.

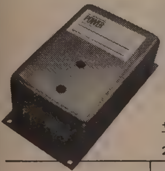
±0.1% Regulation

4" x 4.75" x 2.5"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 30D-12/15#	+12–15	0.7	$41.00
	-12–15	0.7	
SPS 30DA-5/12	±5	2.0	45.00
	10–12	0.6	
SPS 30DA-12/15	12–15	0.7	45.00
	12–15	0.7	

#Model has non-isolated output/common return.

DUAL OUTPUT CPS 30D SERIES



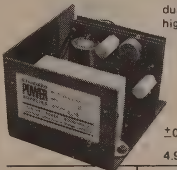
Covered 30D models also having isolated outputs.

±0.1% Regulation·

2.60" x 4" x 7.25"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
CPS 30DA-5/12	5	2.0	$60.00
	10–12	0.6	
CPS 30DA-12/15	12–15	0.7	60.00
	12–15	0.7	

DUAL OUTPUT SPS 40D SERIES



Provides series regulated dual DC voltages for higher power requirements.

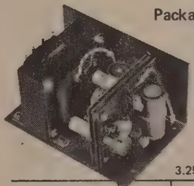
±0.1% Regulation

4.94" x 4.25" x 3.25"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 40D-5/5	5/5	2.0/2.0	$55.00
SPS 40D-5/12	5/10-12	2.0/.8-1.0	55.00
SPS 40D-12/15	12-15/12-15	1.2/1.2	55.00

DUAL OUTPUT SPS 60D SERIES

Packaging, Efficiency



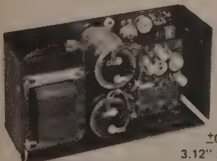
Economical, medium power, low cost.

±0.1% Regulation

3.25" x 4.12" x 6.10"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 60D-5/12	5	3	$69.00
	10–12	1.5/1.8	
SPS 60D-12/15	12–15	1.6/1.8	69.00
	12–15	1.6/1.8	

DUAL OUTPUT SPS 90D SERIES



Top performance, compact power, isolated outputs.

±0.1% Regulation

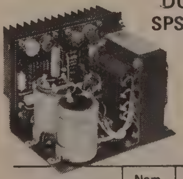
3.12" x 4.88" x 9.38"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 90D-5/12	5	6	$89.00
	10–12	2.5–3	
SPS 90D-12/15†	12–15	3/3	89.00
	12–15	3/3	

†Shipped with 15V transformer tap connected.

DUAL OUTPUT SPS 120D SERIES

Heavy Duty



Cool performance, maximum versatility.

±0.1% Regulation

5"x 7"x 6.6"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 120D-5/12	5	10	$139.00
	10–12	3.5/4	
SPS 120D-12/15†	12–15	5/4	139.00
	12–15	5/4	

†Shipped with 15V transformer tap connected. Requires special bracket #101868 or #101687 for overvoltage devices, @ $2.50.

DUAL OUTPUT SPS 250D SERIES

High power— high efficiency.

±0.1% Regulation

4" x 4.88" x 15"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 250D-5/12	5	12	$179.00
	10–12	7/8	
SPS 250D-12/15†	12–15	8/6	179.00
	12–15	8/6	

†Shipped with 15V transformer tap connected.

TRIPLE OUTPUT SPS 30TA MODEL

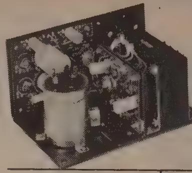
Compact power supply, provides optimum control from a single package.

±0.1 Regulation

3.44" x 4.75" x 4.12"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 30TA-5/12/15	5 12-15 12-15	2 0.25 0.25	$75.00

TRIPLE OUTPUT SPS 50T/60T MODELS



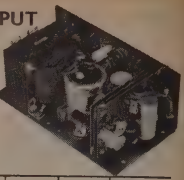
Building block power, top performance.

±0.1% Regulation

4" x 4.88" x 7.5"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 50T-5/12/15	5 12-15 12-15	3 0.7/0.7 0.7/0.7	$86.00
SPS 60T-5/12/15	5 12-15 12-15	5 0.7/0.7 0.7/0.7	89.00

TRIPLE OUTPUT SPS 70T/80T MODELS



Compact power, isolated outputs.

3.38" x 4.5" x 7.55"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 70T-5/12/15†	5 12-15 12-15	3 1.5/1 5 1.5/1.5	$92.00
SPS 80T-5/12/15†	5 12-15 12-15	5 1.6/1.8 1.6/1.8	99.00

†Require special bracket #101687 for third OVP device @ $2.50.

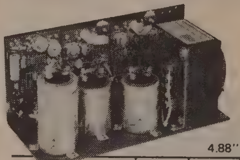
TRIPLE OUTPUT SPS 90T MODEL

Power logic and Op Amps with just one supply.

2.88" x 4.88" x 11"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 90T-5/12/15	5 12-15 12-15	7.0 1.6/1.8 1.6/1.8	$109.00

TRIPLE OUTPUT SPS 120T MODEL

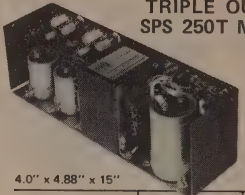


4.88" x 5" x 11"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 120T-5/12/15†	5 12-15 12-15	7.0 3.5/3.0 3.5/3.0	$139.00

†Shipped with 15V transformer tap connected. Requires two special brackets #101687 for second & third OVP device at $2.50.

TRIPLE OUTPUT SPS 250T MODEL

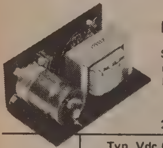


4.0" x 4.88" x 15"

Model Number	Nom. Vdc	Max. Amps	Price 1-9*
SPS 250T-5/12/15†	5 12-15 12-15	12 3.5/3.0 3.5/3.0	$159.00

†Shipped with 15V transformer tap connected.

"BLACK LINE" 15B SERIES



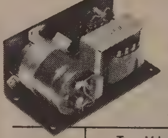
Most Economical

Smallest "Black Line" model for many lower-power applications.

2.09" x 2.75" x 4.62"

Model Number	Typ. Vdc Out (at 115 Vac In)† No Load	Half Load	Full Load	Amps Full Load	Unit Price 1-9*
15B7	11.0	9.0	7.5	1.8	$17.00
15B12	16.0	13.0	11.0	1.2	17.00
15B16	21.2	18.8	17.0	0.9	17.00
15B20	24.7	21.8	19.8	0.75	17.00
15B24	31.0	27.5	25.0	0.6	17.00
15B48	59	52	48	0.3	17.00
15B120	135	121	113	0.12	22.00
15B250	286	265	247	0.05	22.00

"BLACK LINE" 30B SERIES



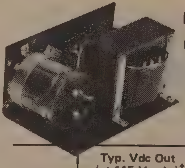
Additional Power

Step up in savings, step up in power.

2.72" x 3.25" x 5.88"

Model Number	Typ. Vdc Out (at 115 Vac in)† No Load	Half Load	Full Load	Amps Full Load	Unit Price 1-9*
30B7	10.0	8.5	7.5	3.0	$21.00
30B12	17.0	14.0	12.0	2.4	21.00
30B16	20.0	18.0	16.0	1.8	21.00
30B20	25.8	22.3	19.8	1.5	21.00
30B24	34.5	29.5	26.5	1.2	21.00
30B48	62	55	48	0.6	21.00
30B120	149	131	120	0.25	27.00
30B250	298	267	248	0.1	27.00

"BLACK LINE" 100B SERIES



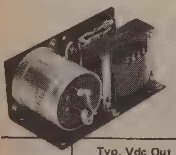
Medium Power

Higher powered supply, puts 100 watts of power into a small open frame.

3.25" x 4.00" x 7.12"

Model Number	Typ. Vdc Out (at 115 Vac In)† No Load	Half Load	Full Load	Amps Full Load	Unit Price 1-9*
100B7	11.0	9.5	8.5	10	$39.00
100B12	15.5	13.5	12.5	7.0	39.00
100B16	21.0	19.0	17.0	6.0	39.00
100B20	24.0	21.7	19.4	5.0	39.00
100B24	31.5	27.5	25.5	3.5	39.00
100B48	56	51	48	1.8	39.00

"BLACK LINE" 200B SERIES



Increased Savings

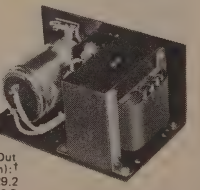
200 watts of power, for the big job.

3.88" x 5" x 8.10"

Model Number	Typ. Vdc Out (at 115 Vac In)† No Load	Half Load	Full Load	Amps Full Load	Unit Price 1-9*
200B7	11.0	10.0	9.0	20	$55.00
200B12	15.5	13.5	12.5	15	55.00
200B16	22.0	18.5	16.5	12.5	55.00
200B20	26.8	22.4	20.0	10	55.00
200B24	31.7	29.0	27.5	7.5	55.00
200B48	54	50	47	4	55.00

"BLACK LINE" MODEL 500B24

Raw Power— Priced Right



Typical Vdc Out
(at 115 Vac In):†
No Load – 29.2
Half Load – 26.8
Full Load – 24.6
Amps—Full Load: 20
Unit Price 1-9:* $110.00

4.62" x 5.62" x 9.00"

†Using taps 1 & 3. For 10% lower Vac, use taps 1 & 2. For 10% higher Vac, use taps 1 & 4.

"BLACK LINE" MODEL 750B24

Brute Power— Best Value

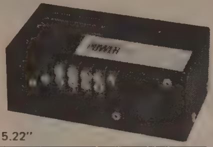
5.68" x 8.0" x 9.5"

Typical Vdc Out
(at 115 Vac In):†
No Load – 32.4
Half Load – 29.8
Full Load – 26.7
Amps—Full Load: 30
Unit Price 1-9:* $175.00

†Using taps 1 & 3. For 10% lower Vac, use taps 1 & 2. For 10% higher Vac, use taps 1 & 4.

"BLACK LINE" 15CB SERIES

Pure Power—
Smallest
Size—
Lowest
Price

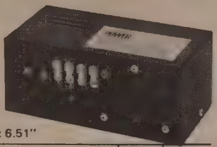


2.14" x 2.80" x 5.22"

Model Number	Typ. Vdc Out (at 115 Vac In)†			Amps Full Load	Unit Price 1-9*
	No Load	Half Load	Full Load		
15CB7	11.0	9.0	7.5	1.8	$29.00
15CB12	16.0	13.0	11.0	1.2	29.00
15CB24	31.0	27.5	25.0	0.6	29.00
15CB48	59.0	52.0	48.0	0.3	29.00

"BLACK LINE" 30CB SERIES

A Little More
Power—
A Little
More
Savings



2.77" x 3.32" x 6.51"

Model Number	Typ. Vdc Out (at 115 Vac In)†			Amps Full Load	Unit Price 1-9*
	No Load	Half Load	Full Load		
30CB7	10.0	8.5	7.5	3.0	$36.00
30CB12	17.0	13.0	12.0	2.4	36.00
30CB24	34.5	29.5	26.5	1.2	36.00
30CB48	62.0	55.0	48.0	0.6	36.00

"BLACK LINE" 100CB SERIES

Medium Power—A Real
Solid Workhorse

100 watts of
pure power

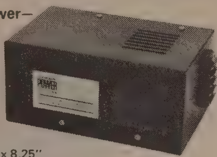
3.30" x 3.83" x 7.25"

Model Number	Typ. Vdc Out (at 115 Vac In)†			Amps Full Load	Unit Price 1-9*
	No Load	Half Load	Full Load		
100CB7	11.0	9.5	8.5	10	$51.00
100CB12	15.5	13.5	12.5	7	51.00
100CB24	31.5	27.5	25.5	3.5	51.00
100CB48	56.0	51.0	48.0	1.8	51.00

"BLACK LINE" 200CB SERIES

Highest Power—
Most in
Savings

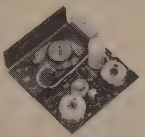
200 watts
of power
for the big,
tough jobs!



3.94" x 5.05" x 8.25"

Model Number	Typ. Vdc Out (at 115 Vac In)†			Amps Full Load	Unit Price 1-9*
	No Load	Half Load	Full Load		
200CB7	11.0	10.0	9.0	20	$67.00
200CB12	15.5	13.5	12.5	15	67.00
200CB24	31.7	29.0	27.5	7.5	67.00
200CB48	54.0	50.0	47.0	4	67.00

VCR-6 SERIES VCR-12 SERIES



Low cost
Point-of-use
regulators for
use with "Black
Line" unregulated
supplies.

1.06" x 2.75" x 2.90"

Model Number	Vdc Range	Amps @ Full Load	Unit Price 1-9*
VCR 5-6	4.5–6.5	6	$16.00
VCR 12/15-6	11.5–15.5	6	16.00
VCR 18/24-4.5	17.5–24.5	4.5	16.00
VCR 5-12	4.5–6.5	12	$22.00
VCR 12/15-12	11.5–15.5	12	22.00
VCR 18/24-8	17.5–24.5	8	22.00

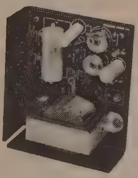
"ESP" SERIES

3 sizes:
A=1.75"x 1.0"x 2.25"
B=2.5"x 0.87"x 3.5"
C=2.5"x 1.25"x 3.5"

Output Type & Model No.	Voltage†	Current	Case Size	Unit Price 1-9*
Single Output Series				
ESP-5-500	5 Vdc	500 mA	B	$48.00
ESP-5-1000	5 Vdc	1000 mA	C	65.00
ESP-15-100	15 Vdc	100 mA	A	25.00
Dual Output Series				
ESP-12D-120	±12 Vdc	120 mA	B	48.00
ESP-12D-240	±12 Vdc	240 mA	C	65.00
ESP-15D-25	±15 Vdc	25 mA	B	28.00
ESP-15D-100	±15 Vdc	100 mA	B	48.00
ESP-15D-200	±15 Vdc	200 mA	C	65.00

† For other voltages, consult the factory.

CONSTANT CURRENT SCC 30 SERIES



Compliance voltages are 15 Vdc or 30 Vdc. Regulation ranges from 0.03 to 2 Amps.

4.75" x 2.5" x 4"

Model Number	Regulation Range (Amps) & Compliance Voltage		Unit Price 1-9*
	.03 to 1A	.05 to 2A	
SCC 30-1	30 Vdc		$55.00
SCC 30-2		15 Vdc	55.00

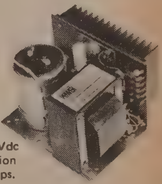
CONSTANT CURRENT SCC 60 SERIES

Compliance voltages also are 15 Vdc or 30 Vdc. Higher regulation ranges, from 0.05 to 4 Amps.

4.94" x 4.94" x 6.0"

Model Number	Regulation Range (Amps) & Compliance Voltage		Unit Price 1-9*
	.05 to 2A	0.1 to 4A	
SCC 60-2	30 Vdc		$84.00
SCC 60-4		15 Vdc	84.00

CONSTANT CURRENT SCC 120 SERIES

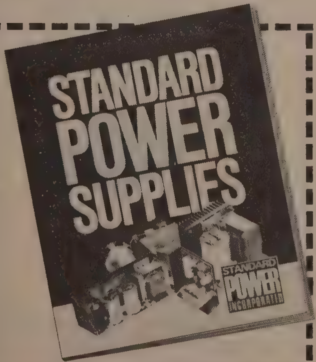


Compliance voltages are 8 Vdc or 30 Vdc. Greater regulation ranges—from 0.1 to 12 Amps.

5" x 7" x 6.60"

Model Number	Regulation Range (Amps) & Compliance Voltage		Unit Price 1-9*
	0.1 to 4A	0.1 to 12A	
SCC 120-4	30 Vdc		$125.00
SCC 120-12		8 Vdc	125.00

Also available: Model SCC 250-15. Range: 0.1 to 15A @ 15 Vdc. Price (1-9*): $225.00.



STANDARD
POWER
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Standard Power Supplies

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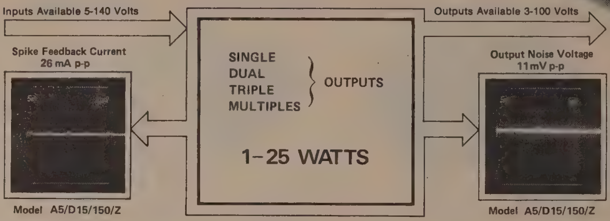
ISO-PAK™ DC/DC Converter Power Supplies are the Expert's Choice

A large part of our business consists of designing and building Specials. Phone us for Unregulated or Non-Isolated counterparts of types below. Up to 25W Single, Dual, Triple or *Multiple Outputs.*

- New Cost Saving Unregulated Series
- 6W Single or Dual Outputs
- Efficiencies to 90%
- 1" x 2" x .375"

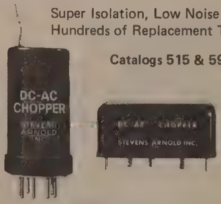

Inputs Available 5-140 Volts
Outputs Available 3-100 Volts
Spike Feedback Current 26 mA p-p
SINGLE
DUAL
TRIPLE
MULTIPLES
OUTPUTS
1–25 WATTS
Output Noise Voltage 11mV p-p
Model A5/D15/150/Z
Model A5/D15/150/Z

Selected Items Taken from 900 Stock Models. For Full Specifications—35 Parameters for each Item—Request Catalogs Listed.

Catalog	Inputs	Outputs	Series	Watts**	Eff.(FL)	Case	Price (1-9)	Applications
SINGLE OUTPUTS								
607	See Listing Below	5, 6, 8, 12, or 15 V	H	1.5	50%	W	$ 34*	Regulated, High Efficiency and Fast Recovery, Isolated Power for DTL/TTL, C-MOS Microprocessors, Memories, A-D/D-A Converters
606		5, 6, 8, 12, or 15 V	F	5	70%	Z	$ 89*	
608		5, 6, 8, 12, or 15 V	M	10	65%	X	$ 99	
609		5, 6, 8, 12, or 15 V	P	25	65%	V	$160	
DUAL OUTPUTS								
602	See Listing Below	±12 or ±15 V ±30 mA	A	0.9	45%	Z	$ 42*	Regulated, Low Noise, High Efficiency, Isolated Power for Linear IC's; Function Modules, A-D/D-A Converters, etc.
602		±12 or ±15 V ±60 mA	A	1.8	52%	Z	$ 52*	
602		±12 or ±15 V ±100 mA	A	3.0	60%	Z	$ 69*	
602		±12 or ±15 V ±150 mA	A	4.5	65%	Z	$ 79*	
610		±12 or ±15 V ±330 mA	N	10	65%	X	$ 99	
611		±12 or ±15 V ±830 mA	R	25	65%	V	$165	
602		±12 or ±15 V ±60 mA	B	1.8	52%	Y	$ 62*	Super-Isolation (8000VDC, 5pF) for Medical, Utility and Industrial Applications.
TRIPLE OUTPUTS								
604	See Listing Below	±15 V, ±165 mA/5 V, 750 mA	C	9	50%	X	$ 99	Regulated ±15 V, +5 V with Transformer Isolated Output Grounds for A-D/D-A Converters, Data Acquisition Systems and Modules.
612		±15 V, ±330 mA/5 V, 3 Amps	S	25	65%	V	$175	
Nominal Inputs	5, 6, 12 VDC 24, 28, 48 VDC	Case Size (W) 1" x 2" x 0.375 (Z) 2" x 2" x 0.375" (Y) 2" x 3" x 0.60" (X) 2.56" x 3" x 0.75" (V) 4" x 6" x 0.75"						* 48V INPUTS SLIGHTLY HIGHER ** RATINGS WITHOUT HEAT SINKS

Super Isolation, Low Noise Choppers
Hundreds of Replacement Types

Catalogs 515 & 592 & 594


DC-AC CHOPPER
STEVENS ARNOLD INC.
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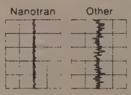
Super Isolation & Low Noise Signal Transformers • 200 dB Common-Mode Rejection
• Non-Microphonic

Publication 596



Super Isolation Power Transformers
Input/Output Capacitance 1 pF

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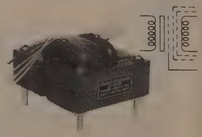


STEVENS INCORPORATED ARNOLD

The Super Isolation People

7 Elkins Street, South Boston, Mass. 02127
TEL: 617-268-1170
Cable Address Stearco

ISO-PAK™ The Miracle Module

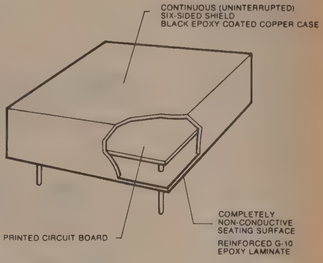
The properly designed and applied DC/DC Converter can be just the Miracle Module that will cause a troublesome Circuit to work properly and reliably. Stevens-Arnold understands this and our Converters have been designed with Reliability and ease of application as the foremost considerations. They will solve difficult System problems without creating new ones.

Our Iso-Pak Converters will increase Efficiency, reduce Size, and eliminate 115 VAC Harness and Pick Up problems. At the same time they will break up Ground Loops and provide superb isolation.

Ask for our Catalogs. Here you will find all of our Iso-Pak Specifications because we have nothing to hide and much to be proud of.

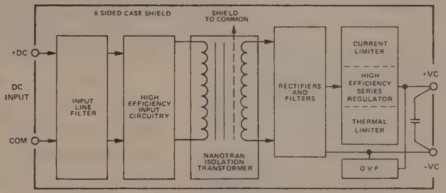
Note that we supply complete information on 35 Parameters including unretouched Oscilloscope photos of Noise Wave Forms plus detailed Graphs of important Specifications such as Output Voltage Temperature Coefficients, Efficiency vs. Load, and Module Surface Temperature.

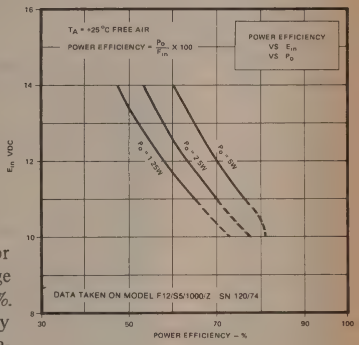
For 32 years our philosophy has been "More Creative Design produces a better Product at a Competitive Price."


CONTINUOUS (UNINTERRUPTED) SIX-SIDED SHIELD BLACK EPOXY COATED COPPER CASE
PRINTED CIRCUIT BOARD
COMPLETELY NON-CONDUCTIVE SEATING SURFACE
REINFORCED G-10 EPOXY LAMINATE

World's Smallest 5V, 1 Amp Supply– 0.375"H Module, 70% Efficiency

ISO-PAK™
F5/S5/1000/Z


6 SIDED CASE SHIELD
SHIELD TO COMMON
+DC
DC INPUT
COM
INPUT LINE FILTER
HIGH EFFICIENCY INPUT CIRCUITRY
NANOTRAN ISOLATION TRANSFORMER
RECTIFIERS AND FILTERS
CURRENT LIMITER
HIGH EFFICIENCY SERIES REGULATOR
THERMAL LIMITER
OVP
+VC
-VC



High Power Efficiency

A 50% Power Density improvement (3.3 watts/cubic inch) and profile reduction (0.375" H) is now a reality in comparison to competing devices having 1.4 watts/cubic inch and 0.875" H profile. The Stevens-Arnold special Package design and high Efficiency Converter and Regulator circuitry have reduced the internal Package Power dissipation by greater than 35%. This allows double the Power Density while still maintaining a Surface Temperature rise above ambient of less than 10 °C per package watt dissipated.

Applications Information

Get in touch with us today. Request this helpful information plus our Short Form Catalog which lists hundreds of Models.

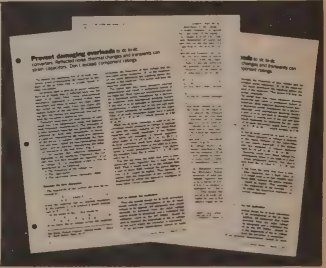
Tips on Specifying Modular Plug-in DC/DC Converter Power Supplies

Determine Noise of DC/DC Converters

Uninterruptable Power for Volatile Semiconductor Memories

Prevent Damaging Overloads to DC/DC Converters

DC/DC Converters for Strain Gage Applications



Prevent damaging overloads to dc to-dc converters. Reflected noise, thermal changes and transients can strain capacitors. Don't exceed component ratings.

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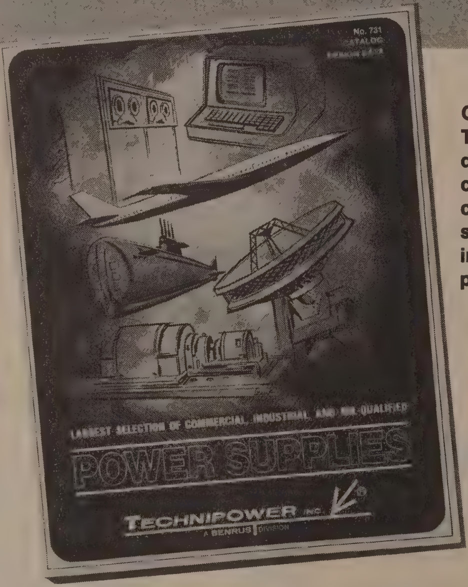
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TECHNIPOWER POWER SUPPLY LINE SUMMARY

EXTREME ENVIRONMENT MIL-QUALIFIED ENCAPSULATED SERIES

Series stabilized AC-DC power supplies for high temperature, high shock applications

PM-95 SERIES – 3-325 VDC, power up to 800 watts, base rated at 95°C.
F/FD-115 SERIES – 3-325 VDC, power up to 500 watts, base rated at 115°C.

MODERATE ENVIRONMENT ENCAPSULATED STABILIZED AC-DC SERIES

Lower cost lines designed for less stringent Mil-environment, industrial and commercial applications

P-80 SERIES – 3-325 VDC, power up to 800 watts, base rated at 80°C.
MC-65 SERIES – 3-152 VDC, power up to 750 watts, base rated at 65°C.
PL-80 SERIES – 3-152 VDC, power up to 75 watts, based rated at 80°C.
DP/TDP-80 SERIES – Dual output for op-amp applications. 6-150 VDC, power up to 10 watts, base rated at 80°C.
NP-80 SERIES – NON-STABILIZED – 3-1,000 VDC, power up to 975 watts, base rated at 80°C.

"THE PRACTICALS" OPEN FRAME STABILIZED AC-DC SERIES

Lowest cost, high performance lines designed for OEM applications

NLP/NLPC SERIES – Single and dual output. 5-28 VDC, power up to 28 watts, ambient rated to 71°C.
LP/LPC SERIES – Single and dual output. 5-28 VDC, power up to 224 watts, ambient rated to 71°C.

HIGH EFFICIENCY STABILIZED AC-DC SWITCHING SERIES

High density, wide output AC-DC units designed for tight packaging or critical thermal applications

HF/HFC-80 SERIES – Encapsulated 115 VAC or 150 VDC source primary switchers, 3-1,000 VDC, power up to 375 watts, base rated at 80°C with efficiencies to 80%.

CL/CLC SERIES – Open construction primary switchers for 115 and 230 VAC or 150 and 300 VDC sources. 3-32 VDC, power up to 256 watts, ambient rated at 71°C with efficiencies to 75%.

RA-80 SERIES – Encapsulated 115 VAC secondary switcher. 0-160 VDC, power up to 1,000 watts, base rated at 80°C with efficiencies up to 80%.

EF SERIES – Open construction 115/230 VAC primary switcher. 4.5-30 VDC, power up to 300 watts, ambient rated to 71°C with efficiencies of 70-80%.

HIGH EFFICIENCY STABILIZED DC-DC CONVERTERS

High density, isolated input to output units for vehicular, aircraft, marine and standby power applications

CD/CDC-95 SERIES – Encapsulated for extreme mil-environments. 3-1,000 VDC, power up to 280 watts, base rated at 95°C with efficiencies up to 80%.

CL/CLC SERIES – Open construction for 12, 28, 48, 150, 300 VDC source applications. 3-32 VDC, power up to 256 watts, ambient rated to 71°C with efficiencies to 75%.

DC-DC "POINT OF LOAD" SERIES STABILIZERS

Low cost, versatile miniaturized flat pack design permits card type mounting

CX-95 SERIES – Positive and negative series regulators. 3-24 VDC, power up to 96 watts, base rated at 95°C, ambient rated to 85°C.

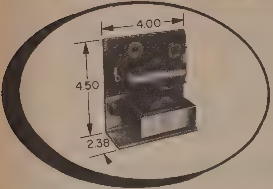
DC-AC ENCAPSULATED SINE WAVE INVERTERS

For UPS systems, frequency changers, and other applications requiring stabilized sine wave power from DC sources.

NAC/NACD-80 SERIES – For 24 and 28 VDC sources. 115 V rms output for 60 and 400 Hz applications, power up to 500 VA, base rated at 80°C.

This is Tele-Dynamics

Tele-Dynamics is an autonomous division of AMBAC Industries, Incorporated, Commercial and Aerospace Electronics Group. AMBAC Industries, listed on the New York Stock Exchange, is an international company with worldwide capabilities in several growing high-technology product areas. The Tele-Dynamics plant is a modern building located on 10 acres of land in the Fort Washington Industrial Park, Fort Washington, Pa. Power supplies and line conditioners, digital communications equipment, airborne telemetry components and systems, shipboard weapon switching systems, and other special applications equipment are many of the products designed and manufactured by the division. These products, the people who build them, and the plant are all integrated into an efficient team—geared to meet the challenge of today's expanding technologies.



DPS SERIES

20 watt OEM supplies UL listed.

MODEL	INPUT VOLTAGE	DC OUTPUT	PRICE 1-9	PRICE 10-24	PRICE 25-49	PRICE 50-99
DPS-1	115 VAC	5/6V,3/2 5A	$28.00	$26.60	$25.20	$23.80
DRS-2		12/15V, 1.5/1.2A				
DPS-3		24V, 0.8A				
DPS-8	220 VAC	5/6V, 3/2 5A	$30 50	$29.50	$27 45	$26 00
DPS-9		12/15V, 1 5/1.2A				
DPS-10		24V, 0 8A				
OVP-3	Overvoltage Protection (Option)		$ 9 45	$ 9.00	$ 8.50	$ 8 05

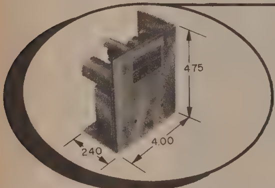
SPECIFICATIONS

AC input:
- **DPS-1, -2, -3:** 105-125 volts AC, 1φ, 47 to 63 Hz (derate 20% for 400 Hz operation)
- **DPS-8, -9, -10:** 200-240 volts AC, 1φ, 47 to 63 Hz

DC output: See table
- **Voltage:** 5-6, 12-15, and 24 volts, floating

Regulation:
- **Line:** ±0.25%
- **Load:** ±0.25%

Ripple: 0.3% +10 mv rms max
Overload protection: Adjustable foldback current limiting
Overvoltage protection: Optional OVP-3
Controls: Output voltage adjust ±2%, nominal, (±10% with 20% derating). Current limit adjust
Temperature: 0 to 40° C (derate current 2%/° C over 40° C)
Weight: 1.9 pounds



T12/15 SERIES DUAL OUTPUT DC POWER SUPPLIES

Series, parallel or independent output

QUANTITY	PRICE
1-9	$56.00
10-24	$53.00
25-49	$50.00
50-99	$48.00

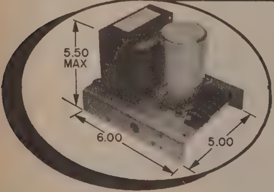
SPECIFICATIONS

AC Input: 105-125/210-250 volts AC, 1φ, 57-63 Hz (Derate output for 50 Hz & 400 Hz)

DC output:
- **Voltage:** 11.7 to 15.3 volts dc continuously adjustable, each output
- **Current:** 0.75 amperes, each output

Regulation:
- **Line:** ±0.1%
- **Load:** ±0.1%

Ripple: 0.05% rms max
Overload Protection: By foldback current limiting
Temperature: 0 to 50° C
Weight: 2.5 pounds



I-OEM SERIES

Built-in overload protection

MODEL	OUTPUT VOLTAGE	Max. Current for Ambient Temp. 50° C	60° C	70° C	PRICE 1-9	10-24	25-49	50-99
I-OEM-5-6	5V	6 0A	4 5A	3 0A	$73 00	$69 00	$66.00	$62 00
I-OEM-12-5	12V	5.0A	3 2A	2 0A				
I-OEM-15-4	15V	4 0A	3 0A	2 0A				
I-OEM-18-3	18V	3 3A	2.9A	2 0A				
I-OEM-24-2.5	24V	2.5A	2.2A	1.7A				
I-OEM-28-2	28V	2 1A	2.0A	1 5A				
OVP-3	Overvoltage Protection (Option)				$ 9.45	$ 9.00	$ 8.50	$ 8 05

SPECIFICATIONS

AC Input: 105-125/210-250 volts AC, 1φ, 57 to 63 Hz (derate output 20% at 50 Hz)

DC output: See table for models
- **Voltages:** 5 to 28 volts, floating
- **Current:** 6 amperes or 60 watts

Regulation:
- **Line:** ±1%
- **Load:** ±1%

Ripple: 0.1% plus 10 mv rms max
Overload protection: Adjustable foldback current limiting
Overvoltage protection: Optional OVP-3
Controls: Output voltage adjust ±5% (±10% with derating in current)
Temperature: 0 to 50° C (to 70° C with derating per table)
Weight: 5.5 pounds

AVAILABLE AT MORE THAN 110 DISTRIBUTOR LOCATIONS

TELE-DYNAMICS

DIVISION OF AMBAC

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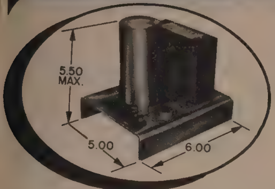


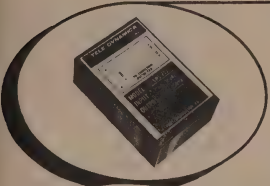
III-OEM SERIES

Low cost precision regulated

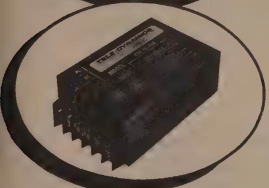
SPECIFICATIONS

AC input: 105-125/210-250 volts AC, 1Ø, 57 to 63 Hz (derate 15% for 50 or 400 Hz applications)
DC output: See table for models
  Voltage: 5 to 28 volts, floating
  Current: 60 watts or 5 amps
Regulation:
  Line: ±0.1% or 10 mv
  Load: ±0.1% or 10 mv
  Response time: 25 usec
Ripple: 0.01% or 1 mv rms max
Overload protection: Adjustable foldback current limiting
Overvoltage protection: Adjustable, crowbar type factory set at 120%
Controls: Output voltage adjust ±2%
  Current limit adjust
  Overvoltage adjust
Temperature: 0 to 50° C (to 70° C with 2%/° C derating from 50° C)
Weight: 5.5 pounds

MODEL NO.	DC OUTPUT	PRICE			
		1-9	10-24	25-49	50-99
III-OEM 5-5 III-OEM 12-5 III-OEM 15-4 III-OEM 18-3 III-OEM 24-2.5 III-OEM 28-2	5V, 5A 12V, 5A 15V, 4A 18V, 3A 24V, 2.5A 28V, 2A	$94.00	$89.30	$84.60	$79.90



TW SERIES



CT SERIES

TW/CT SERIES

MINIATURE DC POWER SUPPLIES

The TW and CT series of miniature power supplies are rugged modular assemblies that provide well-regulated, reliable DC power. The TW supplies are designed for mounting to PC boards. Electrical connections can be made either with connector pins or by soldering. The CT supplies are intended for chassis mounting and each CT supply is equipped with a terminal block for electrical connections. All models have threaded inserts for securing the units to the mounting surface.

APPLICATIONS	MODEL	OUTPUT		REGULATION		RIPPLE (mv rms)	CASE SIZE	PRICE		
		Voltage (volts)	Current (ma)	Line (%)	Load (%)			1-24	25-49	50-99
SINGLE OUTPUT LOGIC SUPPLIES	TW5-250	5.0	250	±0.02	±0.04	1.0	1	$ 35.00	$31.50	$29.75
	TW5-500 *	5.0	500	±0.02	±0.04	1.0	3	44.00	39.60	37.40
	TW5-1000 *	5.0	1000	±0.02	±0.04	1.0	4	65.00	58.50	55.25
	TW5-2000	5.0	2000	±0.02	±0.05	1.0	5	89.00	80.10	75.65
SINGLE OUTPUT GENERAL PURPOSE SUPPLIES	TW3.6-250	3.6	250	±0.05	±0.05	0.5	1	38.00	34.20	32.30
	TW6-200	6.0	200	±0.05	±0.05	0.5	1	38.00	34.20	32.30
	TW10-120	10	120	±0.02	±0.02	0.5	2	25.00	22.50	21.25
	TW12-120	12	120	±0.02	±0.02	0.5	2	25.00	22.50	21.25
	TW15-100	15	100	±0.02	±0.02	0.5	2	25.00	22.50	21.25
	TW18-65	18	65	±0.02	±0.02	1.0	2	25.00	22.50	21.25
	TW20-60	20	60	±0.02	±0.02	1.0	2	25.00	22.50	21.25
	TW24-50	24	50	±0.02	±0.02	1.0	2	25.00	22.50	21.25
	TW28-40	28	40	±0.02	±0.02	1.0	2	25.00	22.50	21.25
DUAL OUTPUT OP AMP SUPPLIES	TWD12-120	±12	120	±0.02	±0.02	0.5	3	49.00	44.10	41.65
	TWD12-240	±12	240	±0.02	±0.02	0.5	4	73.00	65.70	62.05
	TWD12-400	±12	400	±0.02	±0.02	0.5	5	92.00	81.80	78.20
	TWD15-25	±15	25	±0.2	±0.2	2.0	3	34.00	31.60	28.90
	TWD15-65	±15	65	±0.02	±0.02	0.5	3	37.00	33.30	31.45
	TWD15-100	±15	100	±0.02	±0.02	0.5	3	48.00	43.20	40.80
	TWD15-200	±15	200	±0.02	±0.02	0.5	4	73.00	65.70	62.05
	TWD15-350	±15	350	±0.02	±0.02	0.5	5	92.00	81.80	78.20
	TWD24-50	±24	50	±0.02	±0.02	0.5	3	49.00	44.10	41.75
	TWD26-45	±26	45	±0.02	±0.05	1.0	4	49.00	44.10	41.75
TRIPLE OUTPUT A/D AND D/A CONVERTER SUPPLIES	TWT155-1	±15	100	±0.02	±0.03	1.0	4	89.00	80.10	75.65
		5.0	250	±0.05	±0.05	1.0				
	TWT155-2	±15	100	±0.02	±0.03	1.0	6	109.00	98.10	92.65
		5.0	500	±0.02	±0.06	1.0				
SINGLE OUTPUT LOGIC SUPPLIES	CT5-500*	5.0	500	±0.05	±0.1	2.0	7	52.00	46.80	44.20
	CT5-1000*	5.0	1000	±0.05	±0.15	2.0	7	74.00	66.60	62.90
	CT5-2000	5.0	2000	±0.05	±0.15	2.0	7	99.00	89.10	84.15
DUAL OUTPUT OP AMP SUPPLIES	CTD12-120	±12	120	±0.05	±0.05	1.0	7	59.00	53.10	50.15
	CTD12-240	±12	240	±0.05	±0.05	1.0	7	78.00	70.20	66.30
	CTD12-400	±12	400	±0.05	±0.05	1.0	7	99.00	89.10	84.15
	CTD15-100	±15	100	±0.05	±0.05	1.0	7	55.00	49.50	4[illegible].75
	CTD15-200	±15	200	±0.05	±0.05	1.0	7	78.00	70.20	66.30
	CTD15-350	±15	350	±0.05	±0.05	1.0	7	99.00	89.10	84.15
	CTD15-500	±15	500	±0.05	±0.05	1.0	7	120.00	108.00	102.00

*With overvoltage protection. Overvoltage crowbar set to trip at 6.2 volts nominal.

Single, dual or triple output

GENERAL SPECIFICATIONS

Input voltage: 115 ±10 VAC*
Input frequency: 50 to 400 Hz
Input isolation: 50 megohms
Output impedance: 0.2 ohms at 10 kHz
Output voltage setting: ±2% of rated voltage
Storage temperature: -25 to +85° C
Operating temperature: -25 to +71° C
Temperature coefficient: 0.02%/° C

Output current vs temperature: Each output is rated for full current at temperatures between -25° and +70° C with no derating.

CASE SIZES

1. 2 x 3 x 1
2. 1.75 x 2.25 x 1
3. 2.50 x 3.50 x 0.88
4. 2.50 x 3.50 x 1.25
5. 2.50 x 3.50 x 1.62
6. 2.50 x 3.50 x 1.88
7. 2.70 x 4 (plus 0.38 for terminal block) x 1.44

*add $5.00 to unit price for 230 VAC input power

DISTRIBUTOR LOCATIONS IN ALL OF THE MAJOR CITIES OF THE U.S.

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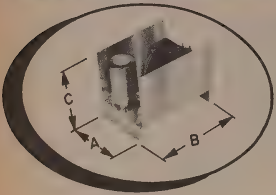


II-OEM SERIES

30, 60 and 120 Watt models

MODEL	DC OUTPUT	POWER GROUP	PRICE 1-9	PRICE 10-24	PRICE 25-49	PRICE 50-99
30-OEM-1	3.6 to 9V	30 watts or 2.5 amps max	$ 61.00	$ 58.00	$ 55.00	$ 52.00
30-OEM-2	9 to 17V					
30-OEM-3	17 to 30V					
30-OEM-4	30 to 60V					
60-OEM-1	3.6 to 9V	60 watts or 5 amps max	$ 69.00	$ 66.00	$ 62.00	$ 59.00
60-OEM-2	9 to 17V					
60-OEM-3	17 to 30V					
60-OEM-4	30 to 60V		$ 80.00	$ 76.00	$ 72.00	$ 68.00
120-OEM-1	3.6 to 9V	120 watts or 10 amps max	$113.00	$107.00	$102.00	$ 96.00
120-OEM-2	9 to 17V					
120-OEM-3	17 to 30V					
120-OEM-4	30 to 60V					

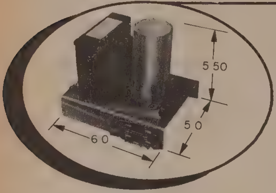
DIMENSIONS (IN.)

MODEL	A	B	C
30-OEM	5.0	5.0	5.0
60-OEM	5.0	7.0	5.38*
120-OEM	5.0	10.00	7.00

*7.0 for 60-OEM-4-only

SPECIFICATIONS

AC input: 105-125 volts AC, 1φ, 47 to 63 Hz
DC output: See table for models
  Voltage: Adjustable 3.6 to 60 volts in four ranges, floating
  Power: 30, 60, 120 watt models
Regulation:
  Line: ±1%
  Load: ±1%
Ripple: 0.1% +10 mv rms max
Controls: Output voltage adjust
Temperature: 0 to 45°C (to 65°C with 2%/°C derating from 45°C)
Weight:
  30-OEM: 5 pounds **60-OEM:** 7 pounds **120-OEM:** 12 pounds



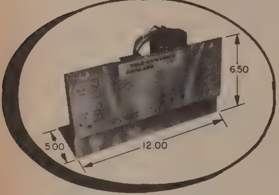
C214

DC RELAY POWER SUPPLY

QUANTITY	PRICE
1-9	$61.00
10-24	$58.00
25-49	$55.00
50-99	$52.00

SPECIFICATIONS

AC input: 105-125/210-250 volts AC, 1Φ, 57 to 63 Hz (derate output 20% at 50 Hz)
DC output:
  Voltage: 26 volts, floating (±2 volts factory tolerance)
  Current: 2.5 amps (designed for pulsed loading of up to 4 amps when operated with 1 amp continuous load pulsed at 20 ms intervals)
Regulation:
  Line: ±2%
  Load: ±2%
Ripple: 0.1% plus 10 mv rms max
Overload protection: Internally fused
Line fuse: Internally fused: 2 amps input; 3 amps slow blow output
Temperature: 0 to 40°C (to 70°C with 2%/°C derating from 40°C)
Weight: 5.5 pounds



III-OEM 5-10

5volts, 10 amps, precision regulated

QUANTITY	PRICE
1-9	$144.40
10-24	$137.15
25-49	$129.95
50-99	$122.75

For other power requirements, see III-OEM 60 Series.

SPECIFICATIONS

AC input: 115/230 volts AC ± 10%, 1φ, 57-63 Hz (derate 15% for 50 or 400 Hz applications)
DC output:
  Voltage: 5 volts, floating
  Current: 10 amperes
Regulation:
  Line: ±0.1% or 10 mv
  Load: ±0.1% or 10 mv
Ripple: 0.01% or 1 mv rms max
Overload protection: By adjustable current, foldback limiting
Overvoltage protection: Adjustable, crowbar type factory set at 120%
Controls: Output voltage adjust
  Current limit adjust
  Overvoltage adjust
Temperature: 0 to 50°C (to 70°C with 2%/°C derating from 50°C)
Weight: 14.5 pounds

IMMEDIATELY AVAILABLE OFF THE DISTRIBUTOR'S SHELF

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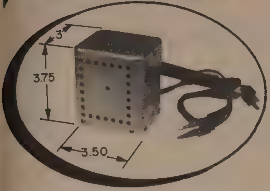


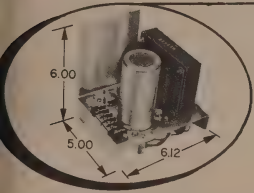
BE-12 BATTERY ELIMINATOR

Delivers up to 1.5 amps at 13 volts

SPECIFICATIONS

AC input: 105-125 volts AC, 1Φ, 60 Hz
DC output:
  Voltage: 13.0 volts, floating
  Current: 1.5 amps
Regulation:
  Line: ±2%
  Load: ±6%
Ripple: 0.1% or 12 mv rms max
Overload protection: Automatic recovery foldback current limiting provides overload and short circuit protection. Not internally fused, do not short circuit output for long periods of time.
Temperature: 0 to 40°C
Weight: 1.9 pounds

QUANTITY	PRICE
1-9	$38.00
10-24	$36.00
25-49	$34.00
50-99	$32.00



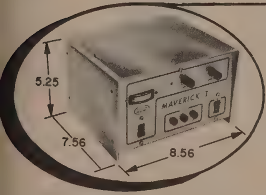
C656

Popular 5 volt, 8 amp supply

SPECIFICATIONS

AC input: 105-125/210-250 volts, 1ϕ, 57 to 63 Hz (derate output current 20% at 50 Hz)
DC output:
  Voltages: 5 volts, floating
  Current: 8 amperes
Regulation:
  Line: ± 1%
  Load: ± 1%
Ripple: 0.1% plus 10 mv rms max
Overload protection: Foldback current limiting
Overvoltage protection: Optional OVP-3
Controls: Output voltage adjust ±5% (±10% with derating in current)
Temperature: 0 to 50° C
Weight: 5.5 pounds

QUANTITY	PRICE
1-9	$81.00
10-24	$77.00
25-49	$73.00
50-99	$69.00



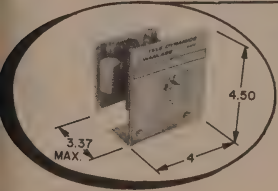
MAVERICK I DC LAB SUPPLY

IC, op-amp and MOS/FET applications

SPECIFICATIONS

AC input: 105-125 volts AC, 1ϕ, 47 to 63 Hz
DC output:
  Maverick I: 0 to 7 volts, floating, at 0 to 5A
Regulation:
  Line: ±0.1% or 5 mv rms
  Load: ±0.1% or 5 mv rms
Ripple: 0.01% or 1 mv rms max.
Overload protection: By adjustable current limiting, 20% to 100%
AC circuit breaker: Internal, 5 amps
Temperature: 0 to 45°C (to 70°C with 2%/°C derating from 45°C)
Weight: 9 pounds

QUANTITY	PRICE
1-9	$93.45
10-24	$88.80
25-49	$84.10
50-99	$79.45



DPS4 HIGH VOLTAGE DC POWER SUPPLY

Regulated 200 volts for nixie tubes

SPECIFICATIONS

AC input: 105-125 volts AC, 1Φ, 57 to 63 Hz
DC output:
  Voltage: 200 volts nominal ±20 volts factory tolerance
  Current: 100 ma
Regulation:
  Line: ±2%
  Load: ±12%
Ripple: 2% rms max
Power factor: (+0.7 to -0.7) ±1%
Response time: 10 to 50 microseconds
Controls: Output voltage adjust ±2%
Temperature: 0 to 50°C (derate 2%/°C over 50°C)
Weight: 1.6 pounds

QUANTITY	PRICE
1-9	$42.00
10-24	$40.00
25-49	$38.00
50-99	$36.00

OFF-THE-SHELF DELIVERY FROM MORE THAN 110 DISTRIBUTOR LOCATIONS

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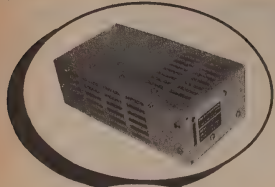
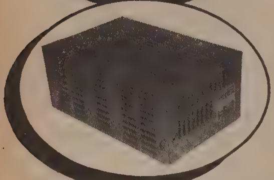
HR SERIES MODULAR DC POWER SUPPLIES





CASE SIZE B

DIMENSIONS (IN.) $3\frac{3}{16}$ x $4\frac{15}{16}$ x $6\frac{1}{2}$

MODEL	FIXED VOLT. RANGE VDC	MAX. AMPS AT AMBIENT OF:				PRICE			
		40°C	50°C	60°C	71°C	1-9	10-24	25-49	50-99
HR 5-3.7	5±5%	3.7	3.2	2.5	1.5	$125	$119	$113	$106
HR12-2.5	12±5%	2.5	2.3	2.1	1.3				
HR15-2.2	15±5%	2.2	2.0	1.8	1.3				
HR18-2.0	18±5%	2.0	1.8	1.7	1.3				
HR24-1.4	24±5%	1.4	1.3	1.2	1.1				
HR28-1.3	28±5%	1.3	1.2	1.1	1.0				

CASE SIZE C

DIMENSIONS (IN.) $3\frac{3}{16}$ x $4\frac{15}{16}$ x $9\frac{3}{8}$

MODEL	FIXED VOLT. RANGE VDC	MAX. AMPS AT AMBIENT OF:				PRICE			
		40°C	50°C	60°C	71°C	1-9	10-24	25-49	50-99
HR 5-5.1	5±5%	5.1	4.3	3.4	2.4	$147	$140	$132	$125
HR12-4.0	12±5%	4.0	3.5	2.9	1.9				
HR15-3.5	15±5%	3.5	3.2	2.8	1.9				
HR18-3.2	18±5%	3.2	3.0	2.7	1.9				
HR24-2.5	24±5%	2.5	2.4	2.2	1.5				
HR28-2.3	28±5%	2.3	2.1	2.0	1.4				

CASE SIZE CC

DIMENSIONS (IN.) $4\frac{15}{16}$ x $4\frac{15}{16}$ x $9\frac{3}{8}$

MODEL	FIXED VOLT. RANGE VDC	MAX. AMPS AT AMBIENT OF:				PRICE			
		40°C	50°C	60°C	71°C	1-9	10-24	25-49	50-99
HR 5-10.5	5±5%	10.5	9.0	8.0	5.5	$169	$161	$152	$144
HR12-7.3	12±5%	7.3	6.8	5.9	4.7				
HR15-6.0	15±5%	6.0	5.6	5.1	4.3				
HR18-5.5	18±5%	5.5	5.1	4.6	4.0				
HR24-4.0	24±5%	4.0	3.7	3.4	3.0				
HR28-3.5	28±5%	3.5	3.4	3.1	2.8				

CASE SIZE D

DIMENSIONS (IN.) $4\frac{15}{16}$ x $7\frac{1}{2}$ x $9\frac{3}{8}$

MODEL	FIXED VOLT. RANGE VDC	MAX. AMPS AT AMBIENT OF:				PRICE			
		40°C	50°C	60°C	71°C	1-9	10-24	25-49	50-99
HR 5-12.6	5±5%	12.6	10.8	9.2	6.1	$199	$189	$179	$169
HR12-10.0	12±5%	10.0	9.2	8.3	5.7				
HR15-9.0	15±5%	9.0	8.4	7.9	5.3				
HR18-7.9	18±5%	7.9	7.4	6.9	5.2				
HR24-6.7	24±5%	6.7	6.3	5.8	4.8				
HR28-6.0	28±5%	6.0	5.6	5.2	4.7				

CASE SIZE E

DIMENSIONS (IN.) $4\frac{15}{16}$ x $7\frac{1}{2}$ x $11\frac{3}{4}$

MODEL	FIXED VOLT. RANGE VDC	MAX. AMPS AT AMBIENT OF:				PRICE			
		40°C	50°C	60°C	71°C	1-9	10-24	25-49	50-99
HR 5-20.0	5±5%	20.0	18.0	16.4	10.0	$256	$243	$230	$218
HR12-15.0	12±5%	15.0	13.6	12.3	9.5				
HR15-14.0	15±5%	14.0	12.7	11.5	8.6				
HR18-13.0	18±5%	13.0	11.8	10.6	9.2				
HR24-11.0	24±5%	11.0	10.0	9.0	7.6				
HR28-10.0	28±5%	10.0	9.0	8.0	7.1				

Interchangeable with Lambda LM series

SPECIFICATIONS

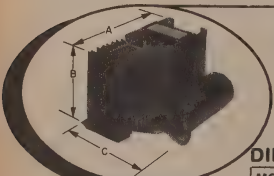
AC Input: 105-125/210-250,AC, 57-63 Hz (derate at 50 and 400 Hz)
Regulation:
Line: ±0.05%
Load: ±0.05%
Ripple: 1 millivolt rms
Ambient operating temperature: 0° to 71°C (see rating charts)
Storage temperature: -55° to +85°C

FEATURES

Current cutback, overload and short circuit protection
Remote sensing—Remote programming
Voltage adjust
Input/output connections via heavy duty terminal block
Optional OVP

BRUTE SERIES ADJUSTABLE DC POWER SUPPLIES

300, 600 and 1200 watt models



DIMENSIONS (IN.)

MODEL	A	B	C
BRUTE-I	11.00	6.75	7.65
BRUTE-II	12.00	6.75	7.65
BRUTE-III	14.00	10.00	11.12

MODEL	DC OUTPUT	PRICE			
		1-9	10-24	25-49	50-99
Brute I	5-50/2-25V. 6/12A	$215 00	$204 00	$194 00	$183.00
Brute II	5-50/2-25V. 12/24A	265 00	252 00	239 00	225 00
Brute III	5-50/2-25V. 25/50A	477 00	453 00	429 00	405 00
K1	Fine Voltage Adjust Kit (Option)	$ 23 00	$ 22 00	$ 21 00	$ 20 00
K2-I	Ripple Reduction Kit Brute I (Option)	29 00	27 00	26.00	25 00
K2-II	Ripple Reduction Kit Brute II (Option)	29 00	27 00	26 00	25 00
K2-III	Ripple Reduction Kit Brute III (Option)	52 00	49 00	47 00	44.00
K3	OVP-1 Overvoltage Protection (Option)	60 00	57 00	54 00	51 00

- Greater than 75% efficiency
- Remote sensing
- Adjustable constant current operation 0-100%

SPECIFICATIONS

AC input: 105-130/210-260 volts AC, 1ϕ, 47 to 63 Hz
DC output: See table for models
Voltage: Adjustable in two ranges, 5 to 50 volts or 2 to 25 volts (reconnectable)
Current: to 50 amperes
Regulation:
Line: ±0.1% or 50 mv
Load: ±0.1% or 50 mv
Ripple: 1% or 500 mv rms max
Overload protection: By adjustable current limiting
Overvoltage protection: Optional OVP-1
Controls: Current limit adjust 0 to 100%
Output voltage adjust 10 to 100%;
Ripple adjust
Temperature: 0 to 55°C with convection cooling
Weight: 300 watts-20 pounds; 600 watts-30 pounds; 1200 watts-50 pounds

DISTRIBUTOR LOCATIONS IN ALL OF THE MAJOR CITIES OF THE U.S.

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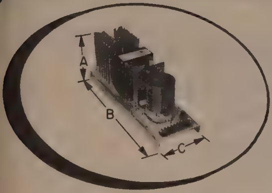


IC SERIES DC POWER SUPPLIES

For IC's, op-amps and MOS/FET's

DIMENSIONS (IN.)

MODEL	A	B	C
60-IC	5.75	11.50	5.22
120-IC	6.75	15.50	5.22
200-IC	8.00	17.00	6.22

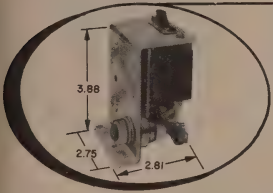
MODEL	DC OUTPUT	PRICE			
		1-9	10-24	25-49	50-99
60-IC-1 60-IC-2 60-IC-3 60-IC-4	3.6-6.3V, 7.5A 12-18V, 60W 24-36V, 60W 48-60V, 60W	$144.00	$137.00	$130.00	$122.00
120-IC-1	3.6-6.3V, 15A	$179.00	$170.00	$161.00	$152.00
120-IC-2 120-IC-3 120-IC-4	12-18V, 120W 24-36V, 120W 48-60V, 120W	$195.00	$185.00	$176.00	$166.00
200-IC-1	3.6-6.3V, 25A	$183.00	$174.00	$165.00	$156.00
200-IC-2 200-IC-3 200-IC-4	12-18V, 200W 24-36V, 200W 48-60V, 200W	$240.00	$228.00	$216.00	$204.00
1A/2A	Crowbar overvoltage protection device (option for -1 units only)	$ 26.00	$ 25.00	$ 23.00	$ 22.00

SPECIFICATIONS

AC input: 100-130 volts AC, 1Ø, 57-63 Hz (derate 20% at 50 Hz)
DC output: See table for models
  Voltage: 3.6 to 60 volts, floating
  Current: to 25 amps
Regulation:
  Line: ±0.10% or 10 mv
  Load: ±0.10% or 10 mv
Ripple: 5 mv rms max
Overload protection: Adjustable foldback current limiting
Overvoltage protection: Optional OVP crowbar
Line fuse: Internally fused at 2.5, 5, or 10 amps slow blow
Controls: Output voltage adjust ±5%
  Current limit adjust
Temperature: 0 to 45°C (70°C with 2%/°C derating from 45°C)
Response time: 50 to 100 microseconds (depending on model)
Weight: 60 watt-9 pounds; 120 watt-14 pounds; 200 watt-19 pounds
Remote sensing

OPTIONS

Crowbar overvoltage protection
  Model 1A—3.9 to 5.8
  Model 2A—6.4 to 8.0
Trip voltage: Adjustable over specified range



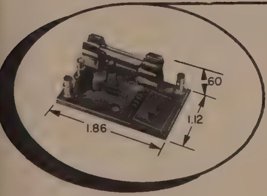
OVP OVERVOLTAGE PROTECTION DEVICES

OVP-1

QUANTITY	PRICE
1-9	$60.00
10-24	$57.00
25-49	$54.00
50-99	$51.00

SPECIFICATIONS

DC current range: 0.5 to 50 amperes dc (200 amperes peak with 8-millisecond surge).
Shutdown time: Protects power supply and line in 10 milliseconds (typical).
Response time (inverse time delay): Protects load in 2 microseconds when wired for dc-break, local-sense operation.
DC voltage range (supply output): 3.6 to 50 vdc.
Trip voltage range (adjustable): 6.5 to 60 vdc.
Circuit breaker ratings:
  DC line: 50 amps at 50 vdc
  AC line: 50 amps at 250 vdc



OVP-3

OVP MODEL	TRIP VOLTAGE RANGE	POWER SUPPLY MODEL	APPLICATION RATING	PRICE			
				1-9	10-24	25-49	50-99
OVP-3-53	5.5- 6.8	DPS-1, 8 (5V)	5V, 3A	$9.45	$9.00	$8.50	$8.05
OVP-3-56	5.5- 6.8	I-OEM 5-6	5V, 6A				
OVP-3-62	6.6- 8.0	DPS-1 8 (6V)	6V 2.5A				
OVP-3-65	6.6- 8.0	I-OEM 6-5	6V 5A				
OVP-3-122	12.8-15.2	DPS-2, -9 (12V)	12V, 1.5A				
OVP-3-125	12.8-15.2	I-OEM 12-5	12V, 5A				
OVP-3-152	15.7-18.3	DPS-2, 9 (15V)	15V 1.2A				
OVP-3-154	15.7-18.3	I-OEM 15-4	15V 4A				
OVP-3-183	19.5-22.5	I-OEM 18-3	18V, 3A				
OVP-3-241	26.0-30.0	DPS-3 -10 (24V)	24V 1A				
OVP-3-242	26.0-30.0	I-OEM 24-2	24V 2.5A				
OVP-3-282	29.0-33.0	I-OEM 28-2	28V 2.1A				

SPECIFICATIONS

Trip Voltage Ranges: See table of models ±5%
Response Time: Protects load in 2 microseconds
Shutdown Time: Protects power supply and line in 10 milliseconds

AVAILABLE OFF-THE-SHELF FROM DISTRIBUTORS THROUGHOUT THE U.S.

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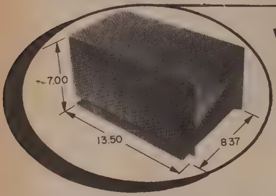
VARAX® AC LINE VOLTAGE REGULATORS

Solve brown-out problems

- Efficiency greater than 90% at full load
- High reliability; no semiconductors in AC path
- True rms regulation
- Insensitive to line frequency changes
- 1% Regulation, line and load

Varax employs a closed loop feedback system which utilizes the parametric energy concept to vary an inductor in series with the AC line. This increase or decrease in inductance permits control over wide ranges of line input fluctuations. This permits optimum performance of equipment under changing input conditions such as "brown-out", or in-plant line voltage variations.



Dimensions shown are for LR-500 and LR-1500 Series

VARAX® LR SERIES

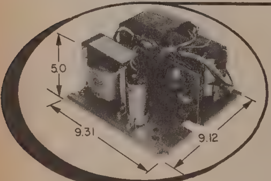
SPECIFICATIONS

AC input: See table of models
AC output: See table of models
Output Power:
LR-500 series: 500 VA
LR-1500 series: 1500 VA
LR-5000 series: 5000VA
Regulation:
Line: ±1%*
Load: ±1%*
Response time: 50 milliseconds
Power efficiency: Greater than 90%
Distortion: Less than 5%
Controls: Output voltage adjust ±3%
Operating Temperature: 0° to 55° C
Weight:
LR-500 series: 31 pounds
LR-1500 series: 49 pounds
LR-5000 series: 170 pounds

MODEL	AC INPUT*	AC OUTPUT	PRICE			
			1-9	10-24	25-49	50-99
LR-501	95 to 125V, 60 Hz	115V, 60 Hz	$194.00	$184.00	$175.00	$165.00
LR-502	85 to 115V, 50 Hz	100V, 50 Hz				
LR-503	190 to 250V, 60 Hz	230V, 60 Hz				
LR-504	190 to 250V, 50 Hz	220V, 50Hz				
LR-1501	95 to 125V, 60 Hz	115V, 60 Hz	$321.00	$305.00	$289.00	$273.00
LR-1502	85 to 115V, 50 Hz	100V, 50 Hz				
LR-1503	190 to 250V, 60 Hz	230V, 60 Hz				
LR-1504	190 to 250V, 50 Hz	230V, 50 Hz				
LR-5001	95 to 125V, 60 Hz	115V, 60 Hz	$955.00			
LR-5002	85 to 115V, 50 Hz	100V, 50 Hz				
LR-5003	190 to 250V, 60 Hz	230V, 60 Hz				
LR-5004	190 to 250V, 50 Hz	230V, 50 Hz				

*See table of extended regulation ranges for regulation at high input voltages.

MODEL	AC INPUT	REGULATION (LINE AND LOAD)	
		0-75% LOAD	76-100% LOAD
LR-501, LR-1501, LR-5001	125 to 130V	±4% to ±7%	±1%
LR-502, LR-1502, LR-5002	115 to 120V	±4% to ±7%	±1%
LR-503, LR-504 LR-1503, LR-1504, LR-5003, LR-5004	250 to 260V	±4% to ±7%	±1%



VARAX® C474

SPECIFICATIONS

AC input: 105-130 volts AC, 1Ø, 47-63 Hz
AC output:
Voltage: 120 volts AC, adjustable ±3%
Power: 2000 VA
Regulation:
Line: ±1%
Load: ±1.5% (25% to full load)
Type: True rms
Response time: 50 milliseconds
Efficiency: Up to 90% at full load
Temperature: 0 to 55°C
Weight: 38 pounds
Controls: Voltage adjust ±3%
Distortion: 20% max. at high line
Phase shift: Varies with load
Load requirements: Unique characteristics of unit require best operation with combination inductive/resistive load. Required inductive load is 1.8 to 3.6 amps. For purely resistive load, use BI-1500 ballast inductor to add inductance. Inductive load should have a lagging power factor of 0 to 0.75.

MODEL	PRICE			
	1-9	10-24	25-49	50-99
C474	$105.00	$ 99.00	$ 94.00	$ 89.00
C474/UL	$121.00	$115.00	$110.00	$103.00
BI-1500	$26.25			

AVAILABLE AT MORE THAN 110 DISTRIBUTOR LOCATIONS

TELE-DYNAMICS DIVISION OF AMBAC

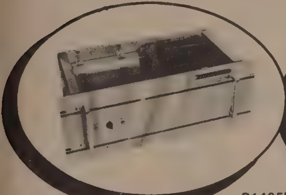
525 Virginia Drive, Fort Washington, Pa. 19034 • 215-643-3900/TWX 510-661-0654

PARAFORMER® AC LINE CONDITIONERS

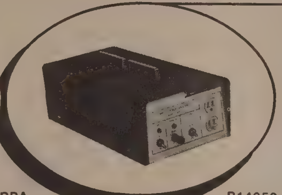
Transient-filtered line conditioning

- **Attenuates noise; filters 50 db to 1 MHz**
- **± 1.0% line regulation**
- **±1.5% load regulation**
- **Bilateral filtering**
- **Inherent short circuit and overload protection**

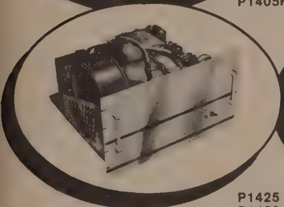
Tele-Dynamics Paraformer is a new and unique method of energy transfer which utilizes parametric coupling instead of magnetic coupling. This technique regulates and filters out noise, transients, and other unwanted spurious signals from AC lines, thus permitting optimum performance of end equipment.



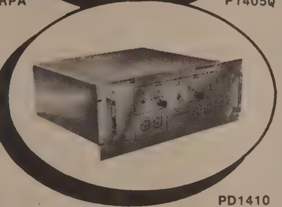
P1405RPA



P1405Q



P1425
P1450
(TWO P1425)



PD1410

P1400 SERIES

SPECIFICATIONS

AC input: See table
AC output: See table
Regulation:
  Line: ±1.0% for 10% line change
  Load: ±1.5% for 10% to full load changes
Response time: Instantaneous
Power efficiency: 65%
Temperature: 0 to 55°C
Protection: Inherent overload, overvoltage, undervoltage and short circuit
Line fuse: Internally fused at 15 amps per 500 VA line (P1405 /PD1410 only)
Noise attenuation: 50 db filtering to 1 MHz
Phase shift: 90 degrees
Differential mode rejection: 100 db isolation between outputs (PD1410 only)

Weight:
  P1405: 50 pounds
  PD1410: 97 pounds
  P1425: 150 pounds
  P1450: 320 pounds

MODEL	INPUT					WEIGHT (LBS.)	DIMEN. (IN.) W x H x D	OUTPUT		PRICE
	AC VOLTAGE	CURRENT		RECOMMENDED CIRCUIT BREAKER	RECOMMENDED WIRE SIZE (AWG)			AC VOLTAGE	POWER	
		START	RUN							
P1405Q	105-125V, 60 Hz	22A	12A*	20A	12	50	8.62x6.62x17.12	116 ± 3V	500 VA	$ 325 00
P1405RPA	105-125V, 60 Hz	22A	12A*	20A	12	50	19.00x7.00x8.50	116 ± 3V	500 VA	$ 350 00
PD1410	105-125V, 60 Hz	22/34A	12/24A*	35A	10	97	19.00x7.00x16.75	116 ± 3V	500/1000 VA	$ 550 00
P1425-1	105-125V, 60 Hz	80A	60A	70A	6	150	19.00x10.50x18.50	118 ± 2V	2500 VA	$ 750 00
P1425-2	105-125V, 60 Hz	80A	60A	70A	6			236 ± 4V		
P1425-3	105-125V, 60 Hz	80A	60A	70A	6			472 ± 8V		
P1425-4	210-250V, 60 Hz	40A	30A	50A	10			118 ± 2V		
P1425-5	210-250V, 60 Hz	40A	30A	50A	10			236 ± 4V		
P1425-6	210-250V, 60 Hz	40A	30A	50A	10			472 ± 8V		
P1425-7	420-500V, 60 Hz	20A	15A	30A	14			118 ± 2V		
P1425-8	420-500V, 60 Hz	20A	15A	30A	14			236 ± 4V		
P1425-9	420-500V, 60 Hz	20A	15A	30A	14			472 ± 8V		
P1450-1	105-125V, 60 Hz	160A	120A	150A	1 (or 2 x 6)	320	19.00x21.00x18.50	118 ± 2V	5000 VA	$1500 00
P1450-2	105-125V, 60 Hz	160A	120A	150A	1 (or 2 x 6)			236 ± 4V		
P1450-3	105-125V, 60 Hz	160A	120A	150A	1 (or 2 x 6)			472 ± 8V		
P1450-4	210-250V, 60 Hz	80A	60A	75A	6			118 ± 2V		
P1450-5	210-250V, 60 Hz	80A	60A	75A	6			236 ± 4V		
P1450-6	210-250V, 60 Hz	80A	60A	75A	6			472 ± 8V		
P1450-7	420-500V, 60 Hz	40A	30A	35A	10			118 ± 2V		
P1450-8	420-500V, 60 Hz	40A	30A	35A	10			236 ± 4V		
P1450-9	420-500V, 60 Hz	40A	30A	35A	10			472 ± 8V		

*Power factor correction same as for PEC-500.

DISTRIBUTOR LOCATIONS IN ALL OF THE MAJOR CITIES OF THE U.S.

TELE-DYNAMICS

DIVISION OF AMBAC

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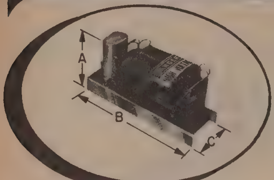


PEC SERIES

MODEL	DIMENSION A	DIMENSION B	DIMENSION C
PEC 60	4.25	9.00	4.00
PEC 150	6.00	12.00	4.00
PEC 500	7.50	17.00	5.00
PEC 1000	7.50	17.00	10.25

MODEL	POWER (VA)	WEIGHT (lb)	FUSE (amps)	PRICE 1-9	PRICE 10-24	PRICE 25-49	PRICE 50-99
PEC-60	60	9	2	$115.00	$109.00	$103.00	$ 98.00
PEC-150	150	21	5	$183.00	$174.00	$165.00	$156.00
PEC-500	500	50	10	$272.00	$258.00	$245.00	$231.00
PEC-1000	1000	90	20	$520.00	$494.00	$468.00	$442.00

SPECIFICATIONS

AC input: 105-125 volts AC, 1Φ, 60 Hz
AC output: See table of models
- **Voltage:** 117 ±2 volts AC, 1Φ, 60 Hz
- **Power:** 60 to 1000 VA

Regulation:
- **Line:** ±1.0%
- **Load:** ±2.0%

Response time: Instantaneous
Power Efficiency: 65%
Temperature: 0 to 55°C
Protection: Inherent overload and short circuit protection
Weight: See table of models, 9 to 90 pounds
Controls: Start pushbutton (some models)

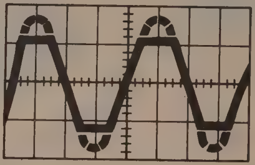
SPECIAL FEATURES

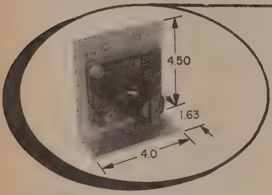
Noise attenuation (filtering): 50 db 0 to 1 MHz
Transient suppression: Suppresses transients with rise times as fast as 1 microsecond (50 db)
Phase shift: 90 degrees

CLIPAC® AC VOLTAGE REGULATORS

Models from 30 to 1000 VA

Clip-Ac is a line voltage regulator that symmetrically clips the peaks of unregulated input voltage to produce a constant output voltage. This results in a constant regulated output voltage to allow equipment to perform at optimum under varying line conditions.





CVR-120

QUANTITY	PRICE
1-9	$27.85
10-24	$26.45
25-49	$25.05
50-99	$23.65

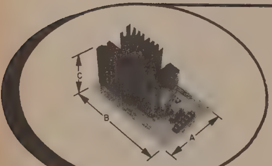
SPECIFICATIONS

AC input: 100-130 volts AC, 1Φ, 47-420 Hz
AC output:
- **Voltage:** 135 volts peak ±10% (270 volts peak to peak)
- **Power:** 120 VA

Regulation:
- **Line:** ±1.0% for 10% line variations
- **Load:** ±1.0%
- **Power factor:** ±1.0% (+0.7 to -0.7)
- **Type:** Peak clipping

Response time: 10-50 microseconds
Efficiency: 75% min. at nominal input voltage and full load
Temperature:
- **Operating range:** 0 to 40°C (to 70°C with 2%/°C derating from 40°C)
- **Temperature coefficient:** 0.025%/°C

Weight: 10 oz.
Controls: Output voltage adjust ±10%
Phase shift: None



C3000 SERIES

DIMENSIONS (IN.)

MODEL	A	B	C
C3003	4.00	3.00	2.87
C3006	4.15	3.00	4.00
C3012	4.15	3.00	4.50
C3025	6.12	9.50	5.00
C3050	6.12	10.88	7.25
C3100	6.12	16.00	7.25

MODEL	POWER (VA)	WEIGHT (lb)	FUSE (amps)	PRICE 1-9	PRICE 10-24	PRICE 25-49	PRICE 50-99
C3003	30	1.5	0.4	$ 53.00	$ 50.00	$ 48.00	$ 45.00
C3006	60	2.5	0.8	$ 53.00	$ 50.00	$ 48.00	$ 45.00
C3012	120	3.2	1.5	$ 67.00	$ 64.00	$ 60.00	$ 57.00
C3025	250	6.5	3	$103.00	$ 98.00	$ 93.00	$ 88.00
C3050	500	10.25	6	$157.00	$149.00	$141.00	$133.00
C3100	1000	17.5	12	$242.00	$230.00	$218.00	$206.00

SPECIFICATIONS

AC input: 100-125 volts AC, 1Φ, 47-420 Hz
AC output: See table of models
- **Voltage:** Adjustable 117 volts AC ±3%, 1Φ
- **Power:** 30 to 1000 VA

Regulation:
- **Line:** ±0.5% (10% line change)
- **Load:** ±0.5% (10% to full load)
- **Type:** True rms (uses peak clipping)

Response time: 10-50 microseconds
Efficiency: 75% nominal, full load
Temperature: -20° to +50°C (temperature coefficient +0.025%/°C)
Protection: Internally fused, (see table of models for values)
Weight: See table of models, 1.5 to 17.5 pounds
Controls: Output voltage adjust ±3%

High initial surge current capacity

IMMEDIATELY AVAILABLE OFF THE DISTRIBUTOR'S SHELF

OFF-THE-SHELF DELIVERY FROM MORE THAN 110 DISTRIBUTOR LOCATIONS

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(Electronics Supplies, Inc.)
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Cramer/EW Huntsville
Huntsville, Ala. 35805

ARIZONA

Cramer/Arizona
Phoenix, Ariz. 85006

CALIFORNIA

Newark Electronics
Brisbane, Calif. 94005

T. I. Supply
El Segundo, Calif. 90245

Allied Electronics
Garden Grove, Calif. 92641

RPS
Goleta, Calif. 93017

Newark Electronics
Inglewood, Calif. 90301

Cramer/Los Angeles
Irvine, Calif. 92705

RPS
Los Angeles, Calif. 90015

Testco
Palo Alto, Calif. 94303

Zack Electronics
Palo Alto, Calif. 94301

Cramer/San Diego
San Diego, Calif. 92123

RPS
San Diego, Calif. 92111

Zack Electronics
San Francisco, Calif. 94102

Patane Avionics, Inc.
Van Nuys, Calif. 91401

Cramer/San Francisco
Sunnyvale, Calif. 94086

T. I. Supply
Sunnyvale, Calif. 94086

COLORADO

Cramer/Denver
Denver, Colo. 80222

Newark Electronics
Denver, Colo. 80222

T. I. Supply
Denver, Colo. 80231

CONNECTICUT

Pioneer/New England
Bethel, Conn. 06801

Cramer/Connecticut
North Haven, Conn. 06473

Newark Electronics
Westport, Conn. 06880

FLORIDA

Allied Electronics
Fort Lauderdale, Fla. 33309

Newark Electronics
Fort Lauderdale, Fla. 33313

Cramer/EW Hollywood
Hollywood, Fla. 33020

Cramer/EW Orlando
Orlando, Fla. 32814

GEORGIA

Cramer/Atlanta
Atlanta, Ga. 30340

ILLINOIS

T. I. Supply
Arlington Hts., Ill. 60005

Newark Electronics
Chicago, Ill. 60624

Allied Electronics
Elgin, Ill. 60120

Cramer/Chicago
Mt. Prospect, Ill. 60056

INDIANA

Pioneer/Indiana
Indianapolis, Ind. 46250

IOWA

Newark Electronics
Cedar Rapids, Iowa 52404

Allied Electronics
(Warren Radio Co.)
Davenport, Iowa 52802

LOUISIANA

Ralph's of Lafayette
Alexandria, La. 71301

Ralph's of Lafayette
Baton Rouge, La. 70802

Ralph's of Lafayette
Lafayette, La. 70501

Ralph's of Lafayette
Lake Charles, La. 70601

Ralph's of Lafayette
Morgan City, La. 70380

Ralph's of Lafayette
New Iberia, La. 70560

MARYLAND

Newark Electronics
Beltsville, Md. 20705

Cramer/EW Washington
Gaithersburg, Md. 20760

Cramer/EW Baltimore
Hanover, Md. 21076

Pioneer Standard
Rockville, Md. 20850

Wilshire Electronics/
Washington
Rockville, Md. 20850

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Allied Electronics
Braintree, Mass. 02184

Cramer/Newton
Newton, Mass. 02159

T. I. Supply
Waltham, Mass. 02154

Newark Electronics
Woburn, Mass. 01801

MICHIGAN

Cramer/Detroit
Livonia, Mich. 48150

Pioneer Standard
Livonia, Mich. 48150

Newark Electronics
Oak Park, Mich. 48237

Newark Electronics
Wyoming, Mich. 49508

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Olive Industrial Electronics
St. Louis, Mo. 63130

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Allied Electronics
Omaha, Nebr. 68102

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T. I. Supply
Clark, N.J. 07066

Newark Electronics
Kenilworth, N.J. 07033

Cramer/New Jersey
Moonachie, N.J. 07074

Arrow/Angus
Moorestown, N.J. 08057

Cramer Electronics
Pennsauken, N.J. 08110

NEW MEXICO

Cramer/New Mexico
Albuquerque, N. Mex. 87108

Newark Electronics
Albuquerque, N. Mex.

NEW YORK

Summit Distributors
Buffalo, N.Y. 14202

Cramer/Syracuse
East Syracuse, N.Y. 13057

Cramer/Binghamton
Endwell, N.Y. 13760

T. I. Supply
Fishkill, N.Y.

Cramer/Long Island
Hauppauge, L.I., N.Y. 11746

Newark Electronics
Plainview, L.I., N.Y. 11803

Cramer/Rochester
Rochester, N.Y. 14623

Summit Distributors
Rochester, N.Y. 14623

NORTH CAROLINA

Pioneer/Carolina
Greensboro, N.C. 27406

Cramer/EW Winston-Salem
Winston-Salem, N.C. 27102

OHIO

Cramer/Tri-States
Cincinnati, Ohio 45215

Newark Electronics
Cincinnati, Ohio 45246

Cramer/Cleveland
Cleveland, Ohio 44139

Newark Electronics
Cleveland, Ohio 44103

Pioneer Standard
Cleveland, Ohio 44105

Pioneer Standard
Dayton, Ohio 45404

OKLAHOMA

T. I. Supply
Tulsa, Okla. 74115

PENNSYLVANIA

Pioneer/Pennsylvania
Horsham, Pa. 19044

Cramer/Pittsburgh
Monroeville, Pa. 15146

Allied Electronics
(Simco Electronics)
Philadelphia, Pa. 19140

Philadelphia Electronics
Philadelphia, Pa. 19107

Pioneer Standard
Pittsburgh, Pa. 15328

Allied Electronics
(Barbey Electronics)
Reading, Pa. 19603

TEXAS

T. I. Supply
Austin, Texas 78767

Ralph's of Lafayette
Beaumont, Texas 77704

Cramer/Texas
Dallas, Texas 75240

T. I. Supply
Dallas, Texas 75235

Allied Electronics
Fort Worth, Texas 76102

Newark Electronics
Garland, Texas 75040

Newark Electronics
Houston, Texas 77036

Ralph's of Lafayette
Houston, Texas 77017

T. I. Supply
Houston, Texas 77042

UTAH

Allied Electronics
(Kimball Electronics)
Salt Lake City, Utah 84101

Cramer/Utah
Salt Lake City, Utah 84115

Newark Electronics
Salt Lake City, Utah 84115

VIRGINIA

T. I. Supply
Arlington, Va. 22209

WASHINGTON

Testco
Bellevue, Wash. 98004

Cramer/Seattle
Seattle, Wash. 98108

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tecnetics
The Power Conversion Specialists

DC-DC HIGH EFFICIENCY REGULATED CONVERTERS, 28Vin and 48Vin

150 WATT/3150 SERIES
100 WATT/3100 SERIES
50 WATT/3050 SERIES
25 WATT/3025 SERIES

Tecnetics 3000 Series have efficiency up to 82%. Input voltages of either 48VDC or 28VDC with output voltages of from 5 to 48VDC are available. Low output impedance (both static and dynamic), input-output isolation, excellent line, load and temperature regulation, remote error sensing, together with short circuit and overload protection are some of the features of these units.
Stock to 6 weeks delivery

SPECIFICATIONS

Input:
Voltage: 3100-28-xxx
3050-28-xxx
3025-28-xxx
28VDC nominal
Range: 21.5 to 32VDC, continuous
36VDC for 5 sec. max.
Reverse protection to 100VDC
Voltage: 3150-48-xxx
3100-48-xxx
3050-48-xxx
3025-48-xxx
48VDC nominal
Range: 42 to 56VDC, continuous
65VDC for 5 sec. max.
Reverse protection 10 100VDC

Output:
Voltage and Current: (see chart)
Voltage adjustment: ±5% by screwdriver control accessible through hole in cover.

Regulation:

Line (Low to High):	0.3%
Load (1/2L to FL)	0.1%
Load (NL to FL)	0.4%
Temperature	0.005%/°C typical 0.01%/°C max.

Ripple:
V (peak to peak) less than ±1% of rated output voltage.
Frequency: 50KHz ±10%

Load Transient Recovery Time:
No load to full load recovery time < 150μsec. under shoot less than 5%.
Full load to 25% load recovery time < 150μsec. over shoot less than 4%.
Full load to 3% load recovery time < 1.0 msec.

Impedance:
0.003 ohms/volt output, 0-10KHz
Remote Error Sensing:
Separate remote sensing terminals are provided. This feature will correct for load lead voltage drops of ≤ 10% V out.

Polarity:
Output is isolated; either output terminal may be grounded.

Protection:
Overload and short circuit of any duration by current limit. Overvoltage (option)

Isolation:

Input to output	1000VDC
Input to case	500VDC
Output to case	500VDC

MTBF:
25,000 hrs.
Calculated per MIL-HDBK-217 at 70°C base plate temperature.

Environmental:
Operating temp. −55°C ambient to +90°C case
Storage temp. −55°C to +105°C
Vibration, shock, humidity and altitude: designed to meet the requirements of MIL-E-5400.

EMI:
Input filter reduces reflected power line ripple.

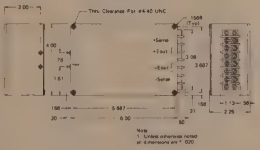
Mechanical (3150 and 3100):
Dimensions: 6 x 4 x 2¼ inches
Terminals: Turret solder type and barrier strip
Case: Aluminum with black anodize finish
Encapsulation: Elastomeric silicone
Weight: 60 oz. fully encapsulated

Mechanical (3050 and 3025):
Dimensions: 4x4x2 inches
Terminals: Turret solder type
Case: Aluminum with black anodize finish
Encapsulation: Elastomeric silicone
Weight: 36 oz. fully encapsulated

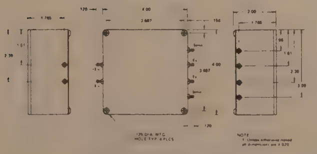
Price: (single quantity)

Model 3150-48-xxx	$500.00
3100-48-xxx	$450.00
3100-28-xxx	$450.00
3050-28-xxx	$425.00
3050-48-xxx	$425.00
3025-28-xxx	$395.00
3025-48-xxx	$395.00

Overvoltage option, add $25
(When ordering, indicate "OV" after dash number.)



Case Outline (150W and 100W)



Case Outline (50W and 25W)

Dash No.	Output Voltage Volts Nom.	48Vin Model 3150-48 Typical Efficiency FL	48Vin Model 3100-48 3050-48 3125-48 Typical Efficiency FL	28Vin Model 3100-28 3050-28 3125-48 Typical Efficiency FL
105	5	73%	66	66
106	6	75	71	71
107	7	78	74	74
108	8	80	76	76
109	9	80	76	76
110	10	80	76	76
112	12	80	76	76
115	15	81	77	77
118	18	82	78	78
120	20	83	79	79
124	24	84	80	80
128	28	85	81	81
148	48	86	82	82

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tecnetics
The Power Conversion Specialists

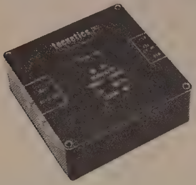
DC-DC REGULATED CONVERTER, 28Vin

10 WATT/9584 SERIES / 25 WATT/9525 SERIES

The Tecnetics 9525 Series is available in single, dual and triple outputs to operate from 28 or 48VDC input. The input filter reduces conducted EMI, thereby providing low noise reflected to the power source. It has excellent line, load and temperature regulation. The output is characterized by low impedance, both static and dynamic.

The 10 Watt 9584 Series provides output voltages 5 Volts up to 5000 Volts from a 28VDC source. Single and dual output voltages are available. These ruggedized units have 1.65 Watts per cubic inch resulting in a small package. Encapsulated in silicon rubber and designed to meet extreme environmental conditions encountered in military applications these units have demonstrated their capability and reliability in hundreds of systems.

Stock to 4 weeks



SPECIFICATIONS (9525 SERIES)

Isolation:
Input to output 1000VDC.

Efficiency:
50% typical at full load under nominal conditions.
(Vin = .28VDC, Vout = NOM., and Ta = 25°C).

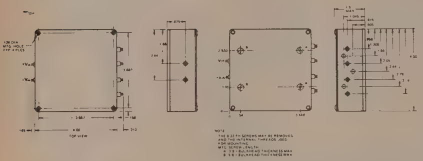
MTBF:
Calculated per MIL-HDBK-217 at 85°C case temperature.
Single output units 40,000 hours.
Double output units 30,000 hours.
Triple output units 20,000 hours.

Environmental:
Operating temp. −55°C ambient to +100°C case.
Storage temp. −55°C to +150°C.
Case rise 60°C in free air at full load.
Vibration, shock and altitude (designed to meet the requirements of MIL-E-5400).

EMI:
Input filter reduces reflected power line ripple 50 db from input voltage.

Price:

Single Output	$250.00 ea.
Dual Output	295.00 ea.
Triple Output	365.00 ea.



Single Output			Double Output			Triple Output		
Model 9525	Output Volts (VDC) Nom.	Output Current (A) Nom.	Model 9525	Each Output Volts (VDC) Nom.	Each Output Current (A) Nom.	Model 9525	Outputs Volts (VDC) Nom.	Outputs Current (A) Nom.
105	5.0	5.0	205	5.0	2.50	301	±15, +5	±0.500, 2
106	6.0	4.16	206	6.0	2.08	302	±15, +5	±0.330, 3
107	7.0	3.58	207	7.0	1.79	303	±15, +5	±0.167, 4
108	8.0	3.13	208	8.0	1.57	304	±12, +5	±0.625, 2
109	9.0	2.78	209	9.0	1.39	305	±12, +5	±0.415, 3
110	10.0	2.50	210	10.0	1.25	306	±12, +5	±0.208, 4
112	12.0	2.09	212	12.0	1.05			
115	15.0	1.67	215	15.0	0.84			
118	18.0	1.39	218	18.0	0.70			
120	20.0	1.25	220	20.0	0.63			
124	24.0	1.04	224	24.0	0.52			

SPECIFICATIONS (9584 SERIES)

Input Voltage:
28VDC ±VDC continuous
40VDC 1 sec. max.

Protection:
Reverse polarity protected to 50VDC

Input Current:
120 mA typical @300 mW load
750 mA typical @ full load

Minimum Load:
300 mW
Output Voltage Adjust:
±10% full load
−40% 3.3 watt (See "Power Derating Curve".)

Isolation Test Conditions:
Input terminals shorted to case. Output terminals shorted together.
Models 102-114, 121-124 1000VDC
Models 115-120 5000VDC

Polarity:
Inputs and outputs are isolated from each other. Filter is in positive leg. For negative filter, prefix part number with "N" (i.e., N9584-114).

Temperature Range:
Operating −55°C ambient to +100°C case
Storage −55°C to +150°C
Case Rise 30°C full load typical

Frequency:

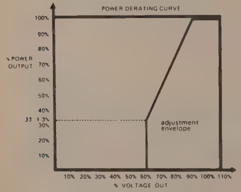
Operating	3KHz ±20%
Ripple	6KHz ±20%

Weight:
9.6 oz. fully encapsulated

Environment:
Designed to meet the requirements of MIL-E-5400

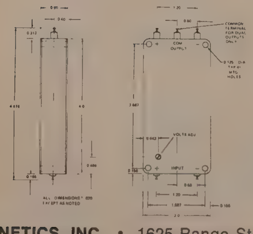
Modifications:
Contact field representative or phone Tecnetics for modifications such as different inputs, outputs and changes in termination.

Short Circuit Protection by Current Limit 9586 Series
To order specify 9586 and add appropriate model number from 9584 Model Specifications chart.
Example: 9586-102
Delivery: 4 weeks
Price: add $25 to comparable 9584 model. "Volts Adj." potentiometer is relocated on 9586 units.



MODEL SPECIFICATIONS

Model 9584	Output Voltage (VDC) Nom.	Output Current (mA) Max.	Output Ripple (Vp-p) Max.	Regulation (VDC) Line (Vin = 25 to 31 VDC) Typ.	Max.	Regulation (VDC) Load (½ to Full) Typ.	Max.	Regulation (VDC) Temp. (55°C to 100°C Case) Typ.	Price
102	5	2000	.030	.003	.008	.200	.260	.075	$210.00
103	7.5	1300	.045	.004	.010	.210	.270	.112	210.00
104	10	1000	.020	.005	.012	.250	.300	.150	210.00
105	15	670	.015	.008	.013	.290	.360	.225	210.00
106	30	330	.060	.011	.015	.500	.750	.450	210.00
107	50	200	.050	.025	.035	.700	1.10	.750	210.00
108	75	130	.075	.030	.045	1.10	1.50	1.13	210.00
109	100	100	.100	.037	.065	1.20	2.00	1.5	210.00
110	150	67	.150	.055	.080	2.20	3.00	2.25	210.00
111	300	33	.30	.100	.220	4.00	6.00	4.50	210.00
112	500	20	1.0	.200	.320	7.00	10.0	7.50	210.00
113	750	13	1.5	.300	.500	9.00	13.0	11.30	210.00
114	1000	10	2.5	.750	1.50	16.0	22.0	15.0	275.00
115	1500	6.7	4.0	1.00	1.60	20.0	30.0	22.5	275.00
116	2000	5.0	5.5	1.50	2.70	25.0	40.0	30.0	275.00
117	2500	4.0	7.0	2.00	3.30	60.0	75.0	38.0	310.00
118	3000	3.3	11.0	2.50	4.00	75.0	100.0	45.0	310.00
119	4000	2.5	14.0	2.50	4.50	85.0	125.0	60.0	310.00
120	5000	2.0	17.5	4.00	6.00	120.0	220.0	75.0	310.00
121	±15	±335	.030	.007	.017	.300	.450	.225	225.00
122	±25	±200	.050	.010	.030	.750	.850	.38	225.00
123	±50	±100	.100	.016	.030	1.25	1.50	.75	250.00
124	±100	± 50	.100	.040	.065	1.60	2.75	1.50	250.00


VOLTS ADJ
INPUT
COM OUTPUT
COMMON TERMINAL FOR DUAL OUTPUTS ONLY
ALL DIMENSIONS ± .020 EXCEPT AS NOTED

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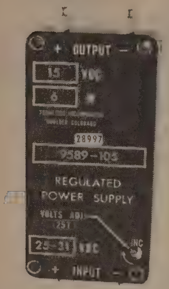
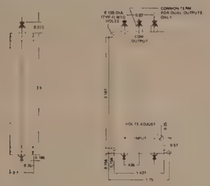
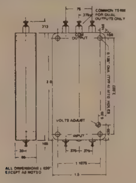


MODEL 9589 SERIES



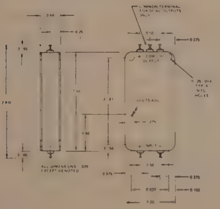
Input Current:
100 mA typical @ 200 mW load
400 mA typical @ full load
Minimum Load:
200mV

MODEL 9567 SERIES



Input Current
38 mA typical @ 100mW load
210 mA typical @ full load
Minimum Load:
100 mW

MODEL 9583 SERIES



Input Current:
27 mA typical @ 30 mW load
87 mA typical @ full load
Minimum Load:
30 mW

DC-DC REGULATED CONVERTER, 28Vin

6 WATT/9589 SERIES
3 WATT/9567 SERIES
1 WATT/9583 SERIES

SPECIFICATIONS:

Input Voltage:
28VDC ±3VDC continuous
40VDC 1 sec. max.
Protection:
Reverse polarity protected to 50VDC
Output Voltage Adjust:
±10% full load
–40% 2 watt load

Isolation Test Conditions:
Input terminals shorted to case. Output terminals shorted together.
Models 102-114, 121-124 1000VDC
Models 115-120 5000VDC
Temperature Range:
Operating –55°C ambient to +100°C case
Storage –55°C to +150°C

MODEL SPECIFICATIONS

	Output Voltage (VDC) Nom.	Output Current (mA) Max.	Output Ripple (Vp-p) Max.	Regulation (VDC) Line (Vin = 25 to 31 VDC) Typ.	Max.	Regulation (VDC) Load (½ to Full) Typ.	Max.	Regulation (VDC) Temp. (–55°C to 100°C case) Typ.	Price 1 ea.
MODEL 9589									
102	5	1200	.050	.003	.005	.150	.230	.075	$190.00
103	7.5	800	.060	.003	.006	.200	.300	.113	190.00
104	10	600	.120	.003	.006	.240	.325	.150	190.00
105	15	400	.090	.005	.013	.260	.380	.225	190.00
106	30	200	.090	.010	.016	.360	.450	.450	190.00
107	50	120	.250	.015	.025	.700	.850	.750	190.00
108	75	80	.430	.030	.050	1.00	1.50	1.13	190.00
109	100	60	.600	.040	.065	1.10	1.60	1.50	190.00
110	150	40	.900	.050	.070	1.50	2.00	2.25	190.00
111	300	20	1.80	.100	.125	2.75	4.00	4.50	190.00
112	500	12	2.50	.200	.250	5.00	7.00	7.50	190.00
113	750	8.0	4.10	.400	.550	7.00	11.0	11.3	190.00
114	1000	6.0	6.0	.450	.700	12.5	17.0	15.0	250.00
115	1500	4.0	9.0	.500	1.25	35.0	45.0	22.5	250.00
116	2000	3.0	12.0	1.25	2.00	35.0	45.0	30.0	250.00
117	2500	2.4	15.0	1.40	2.00	50.0	75.0	38.0	280.00
118	3000	2.0	25.0	1.50	3.00	85.0	115.0	45.0	280.00
119	4000	1.5	75.0	1.60	2.20	105.0	125.0	60.0	280.00
120	5000	1.2	30.0	3.00	5.00	125.0	165.0	75.0	280.00
121	± 15	±200	.090	.005	.012	.250	.300	.225	210.00
122	± 25	±120	.120	.007	.012	.410	.500	.38	210.00
123	± 50	± 60	.300	.025	.050	.800	1.10	.75	235.00
124	±100	± 30	.500	.025	.060	1.70	2.20	1.50	235.00
MODEL 9567									
101	3	1000	0.06	.016	.025	.145	.165	0.45	$180.00
102	5	600	0.05	.026	.035	.170	.210	0.10	180.00
103	7.5	400	0.08	.036	.045	.200	.260	0.15	180.00
104	10	300	0.20	.045	.055	.220	.265	0.20	180.00
105	15	200	0.60	.080	.080	.360	.410	0.30	180.00
106	30	100	0.15	.130	.175	.425	.500	0.80	180.00
107	50	60	0.10	.220	.270	.600	.700	1.0	180.00
108	75	40	0.38	.300	.350	.900	1.20	1.5	180.00
109	100	30	0.20	.450	.550	1.00	1.30	2.0	180.00
110	150	20	0.25	.650	.850	1.50	1.75	3.0	180.00
111	300	10	0.60	1.25	1.75	3.00	3.60	6.0	180.00
112	500	6	0.45	2.20	3.00	4.50	5.20	10.0	180.00
113	750	4	0.50	3.00	4.00	16.0	19.5	15.0	180.00
114	1000	3	0.55	4.00	5.50	16.5	20.0	20.0	240.00
115	1500	2	13.0	6.50	9.00	43.0	55.0	30.0	240.00
116	2000	1.5	16.0	8.00	10.0	39.0	55.0	40.0	240.00
117	2500	1.2	12.0	10.0	13.5	45.0	55.0	50.0	270.00
118	3000	1.0	33.0	12.5	17.0	130.0	160.0	60.0	270.00
119	4000	0.75	28.0	17.0	21.0	145.0	165.0	80.0	270.00
120	5000	0.60	45.0	20.0	32.0	140.0	170.0	100.0	270.00
121	± 15	±100	0.09	.060	.090	.350	.410	0.30	200.00
122	± 25	± 60	0.03	.100	.130	.500	.600	0.50	200.00
123	± 50	± 30	0.01	.200	.300	1.00	1.25	1.00	220.00
124	±100	± 15	0.05	.400	.500	1.50	2.00	2.00	220.00
MODEL 9583									
101	3	330	.020	.025	.035	.098	.110	0.09	$200.00
102	5	200	.015	.035	.045	.110	.130	0.15	200.00
103	7.5	130	.025	.035	.045	.150	.165	0.23	200.00
104	10	100	.030	.045	.055	.210	.230	0.30	200.00
105	15	67	.050	.075	.085	.250	.275	0.45	200.00
106	30	33	.050	.135	.160	.440	.480	0.90	200.00
107	50	20	.030	.210	.225	.800	.850	1.50	200.00
108	75	13	.020	.300	.350	1.20	1.60	2.25	200.00
109	100	10	.150	.390	.420	1.30	1.60	3.00	200.00
110	150	6.7	.200	.670	.750	2.60	3.10	4.50	200.00
111	300	3.3	.225	1.20	1.70	4.00	5.50	9.00	200.00
112	500	2.0	.300	2.00	2.60	6.00	8.00	15.0	200.00
113	750	1.3	8.0	3.00	3.50	19.0	28.0	22.5	200.00
114	1000	1.0	8.0	4.00	5.00	24.0	32.0	30.0	250.00
115	1500	0.67	33.0	6.00	7.50	40.0	60.0	45.0	250.00
116	2000	0.50	25.0	9.50	10.5	68.0	75.0	60.0	280.00
117	2500	0.40	20.0	10.0	13.0	68.0	75.0	75.0	280.00
118	3000	0.33	25.0	12.0	15.0	68.0	75.0	90.0	280.00
121	±15	±33	.010	.060	.090	.250	.280	0.30	220.00

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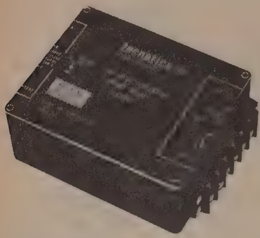


400Hz AC to DC POWER SUPPLIES

3 PHASE/25, 50, 100 WATT 4000–3 SERIES

This high technology, state-of-the-art 4000 Series provides efficiencies up to 86% in 25, 50 and 100 Watts of power conversion from 3 phase 400Hz 115VAC input. Three phase input provides for better power management. Easy to adjust controls for desired output voltage are provided on the upper surface of the units for convenience.

SINGLE PHASE/25, 50, & 100 WATT 4000 SERIES

The 4000 Series is a true high technology 400Hz AC input to DC output power supply. High efficiencies—up to 86%—are available in 5 to 48VDC output in 25, 50 and 100 Watts of power with excellent line, load and temperature regulation. All internal heat producing elements are heatsunk to the base plate and the unit is black anodized for improved heat radiation. Easy to adjust controls are on the upper surface for adjustment to the desired output voltage. Remote error sensing assures that this voltage is at the point of load, compensated for any drop in the cable. Low output impedance, both static and dynamic, are inherent in the design. Low noise is reflected back to the line as a result of input filters, which also reduce conducted EMI.

SPECIFICATIONS:

Input Voltage (rms):
103.5-126.5VAC (NL-FL)
92.0-126.5VAC (NL-½L)
180.0VAC for 0.1 sec. max.

Frequency:
360 to 440Hz, 3 phase, Y

Output:
Voltage & Current (See chart.)
Voltage Adjustment: ±5%—By screwdriver control. Accessible through hole in cover.
Regulation: Line (115V rms ±10%) 0.2%
Load (NL to FL) 0.5% (½L to FL) 0.1%
Temperature 0.005%/°C typical
0.01%/°C max.

Ripple:
V (peak to peak) 2%
Frequency 60KHz ±10%

Load transient recovery time:
No load to full load recovery time < 100 μSec under shoot < 4%
Full load to 25% load recovery time < 50 μSec over shoot < 3%
Full load to 2% load recovery time < 1ms over shoot < 3%

Impedance:
(0-10KHz): 0.002Ω/Vout

Remote Error Sensing:
Separate remote sensing terminals are provided. This feature will correct for load lead voltage drops of ≤ Vout.

Polarity:
Output is isolated; either output terminal may be grounded.

Protection:
Overload and Short Circuit:
115 to 130% of rated current
Overvoltage (option):
115 to 130% of nominal voltage

Isolation:

Input to output	1000VDC
Input to case	500VDC
Output to case	500VDC

(Note: Input terminals shorted together, output terminals shorted together)

Efficiency:
(see chart & graph)

MTBF:
30,000 hours.
Calculated per MIL-HDBK-217 at 70°C base plate temperature, airborne environmental factor.

Environmental:
Operating temp.: −55°C ambient to +100°C case
Storage temp.: −55°C to +125°C
Case Rise: See graph
Vibration, shock, humidity and altitude: Designed to meet the requirements of MIL-E-5400.

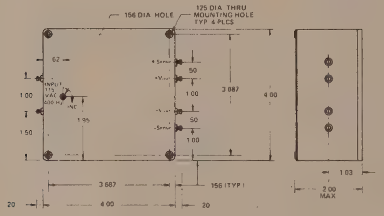
EMI:
Input filter reduces reflected power line ripple.

Mechanical:
Dimensions: Model 4025: 4x4x2 inches
Model 4050: 4x4x2 inches
Model 4100: 5x4x2 inches
Terminals: Teflon-insulated turret solder type. Or barrier strip for 4100-3
Encapsulant: Elastomeric silicone.
Weight: Model 4025: 36 oz.
Model 4050: 36 oz.
Model 4100: 44 oz.

Price (each):

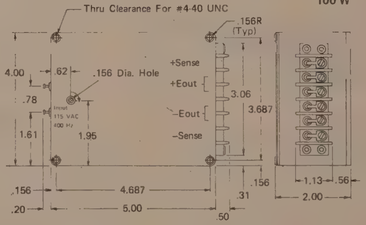
Model 4025-3-xxx	$395.00
4025-xxx	395.00
4050-3-xxx	425.00
4050-xxx	425.00
4100-3-xxx	450.00
4100-xxx	450.00

25 and 50W



Note:
1. Unless otherwise noted all dimensions are ± .020.

100 W



DASH NO.	OUTPUT VOLTAGE (VDC) Nom.	EFFICIENCY % Typical @ fl	25 WATTS MODEL 4025 Output Current (A) Nom.	50 WATTS MODEL 4050 Output Current (A) Nom.	100 WATTS MODEL 4100 Output Current (A) Nom.
105	5	70	5.00	10.00	20.00
106	6	75	4.16	8.33	16.67
107	7	78	3.58	7.14	14.29
108	8	80	3.13	6.25	12.50
109	9	80	2.78	5.56	11.11
110	10	80	2.50	5.00	10.00
112	12	80	2.09	4.17	8.33
115	15	81	1.67	3.33	6.67
118	18	82	1.39	2.78	5.56
120	20	83	1.25	2.50	5.00
124	24	84	1.04	2.08	4.17
128	28	85	.90	1.79	3.57
148	48	86	.52	1.04	2.08

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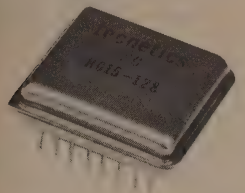


MINIATURE DC-DC CONVERTERS
HCN, HCH, HCE SERIES

Tecnetics new HC Series operates from an input range to optimize performance. A number of input and output voltages are available and can be selected from the chart for your application. Other voltages are available on special order at standard prices in an input voltage range of 5-28VDC and an output voltage range of 5-300VDC. Customized hybrid DC/DC Converters can also be supplied. Put these unique, small hybrid converters to work in your application.

SPECIFICATIONS:

Input:
Voltage: See Table

Output:
Minimum Load: 300 mW
Output voltage varies directly with the input voltage over specified range.
Regulation: Line Unregulated
Frequency, Nominal Operating:
14KHz (except 11KHz for 5V and 6V input models)

Polarity:
Single output units may be used as positive or negative voltage.
Double output units have common return.

Isolation:
Input to output 600VDC max.

Environmental:
Operating temp. −55°C ambient to +125°C case
Storage temp. −55°C to +125°C
Case Rise typical 40°C/W dissipation

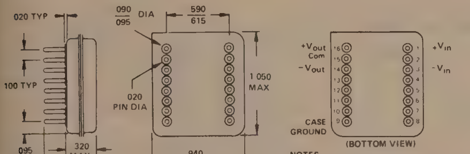
Mechanical:
Package: Nickel plated Kovar available in three options:
HCN—non-hermetic for industrial and commercial applications.
HCH—Hermetic for military, space and industrial applications which require protection from extreme environmental conditions such as called out in MIL-E-5400.
HCE—Encapsulated for applications which require protection from extreme shock and vibration.

Weight:
HCN, HCH-0= -0.35 oz. HCE—0.45 oz.

Prices and Ordering:
Single Quantity: Non-Hermetic (HCN) $49
Hermetic (HCH) $59
Encapsulated (HCE) $69

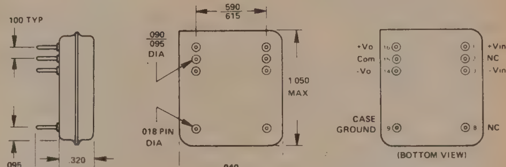
Modifications:
Input and output voltage modifications within the limits of tabulated values are made for no cost increase. Output voltage set point at other than full load or at increased accuracy available for slight cost increase.

HERMETIC AND ENCAPSULATED PACKAGE



NOTES
1. Pins 14 and 15 connected internally on single output versions.
2. Pins 2, 4, 5, 6, 7, 8, 10, 11, 12, and 13 are NC.

NON-HERMETIC PACKAGE



NOTE
Pins 14 and 15 connected internally on single output versions.

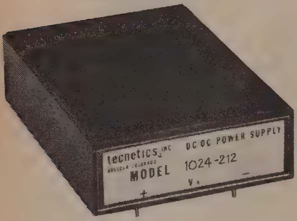
Model No.	Output Voltage VDC (Nom.)	Output Current mA (Max.)	Input Voltage (VDC)		Output Current mA (Max.)	Input Voltage (VDC)				
			5 ± 1	6 ± 1		12 ± 2	15 ± 2	20 ± 3	24 ± 4	28 ± 4
005	5	400	−105	−106	500	−112	−115	−120	−124	−128
006	6	345	│	│	428	│	│	│	│	│
007	7	306	│	│	377	│	│	│	│	│
008	8	276	│	│	339	│	│	│	│	│
009	9	253	│	│	309	│	│	│	│	│
010	10	235	│	│	285	│	│	│	│	│
012	12	208	│	│	250	│	│	│	│	│
015	15	167	│	│	200	│	│	│	│	│
018	18	139	│	│	167	│	│	│	│	│
020	20	125	│	│	150	│	│	│	│	│
024	24	104	│	│	125	│	│	│	│	│
028	28	89	│	│	108	│	│	│	│	│
030	30	83	│	│	100	│	│	│	│	│
050	50	50	│	│	60	│	│	│	│	│
075	75	33	│	│	40	│	│	│	│	│
100	100	25	│	│	30	│	│	│	│	│
150	150	17	│	│	20	│	│	│	│	│
200	200	13	−105	−106	15	│	│	│	│	│
300	300	X	X	X	10	−112	−115	−120	−124	−128
005	±5	±200	−205	−206	±250	−212	−215	−220	−224	−228
006	±6	±172	│	│	±214	│	│	│	│	│
007	±7	±153	│	│	±188	│	│	│	│	│
008	±8	±138	│	│	±169	│	│	│	│	│
009	±9	±126	│	│	±154	│	│	│	│	│
010	±10	±117	│	│	±142	│	│	│	│	│
012	±12	±104	│	│	±125	│	│	│	│	│
015	±15	±83	│	│	±100	│	│	│	│	│
018	±18	±69	│	│	±83	│	│	│	│	│
020	±20	±62	│	│	±75	│	│	│	│	│
024	±24	±52	−205	−206	±62	−212	−215	−220	−224	−228

TECNETICS, INC. • 1625 Range Street, P.O. Box 910, Boulder, Colorado 80302 • Phone (303) 442-3837 • TWX 910-940-3246

tecnetics

The Power Conversion Specialists

10 WATT 1000 SERIES
6 WATT 1600 SERIES
3 WATT 1300 SERIES
1 WATT 1100 SERIES



DC-DC REGULATED CONVERTERS

10 WATT 1000 SERIES

Tecnetics newest member of the 1000 Series boasts 10 Watts of power in the same small size package as our 6 Watt Series. Higher conversion frequency and improved circuitry make for this improved efficiency and smaller size while maintaining the quality features of the 1000 Series. Single, dual, and triple outputs, each post regulated, are available in from 5, 6, 12, 24, 28 and 48VDC inputs. Low output impedance (both static and dynamic) provide the near ideal power needed today. Excellent line, load and temperature regulation.

6 WATT 1600 SERIES

6 Watts of high performance at economy prices is available in Tecnetics 1600 Series DC to DC Converters. Post regulation provides excellent line/load regulation. A choice of PC mount or through the unit mount accommodate many applications in industry. All output voltages have individual returns with grounds isolated from each other and are also short circuit protected. Input filters reduce EMI. Units are available in single, dual or triple outputs from all popular voltages available for input.

3 WATT 1300 SERIES

The best mechanical package available in a high performance 3 Watt DC to DC Converter at economical prices characterizes the Tecnetics 1300 Series. Low output impedance (both static and dynamic) with the output voltages protected by current limiting make these units an ideal choice for commercial/industrial applications. Input filters reduce EMI. A wide range of input and output voltages are available as standard products. All internal heat generating devices are tied to the black anodized plate. Mounting of the unit may be by pins to a PC card or by use of through the case mounting holes provided.

1 WATT 1100 SERIES

High performance in an economical, small package is seen in the 1 Watt 1100 Series DC to DC Converter. All the popular input voltages 5, 6, 12, 24, 28 and 48VDC are available with output voltages from 3.6 to 24VDC together with dual output voltages. Each output voltage is regulated resulting in excellent line, load and temperature regulation. All output voltages are protected by current limiting. Input filters reduce EMI (conducted) radiation.

SPECIFICATIONS:

Input:
Voltage:
See table for value.
Reverse polarity protected to 100VDC (except on 5V & 6V input models.)
Reflected ripple voltage 80 mV (P-P) at 32 KHz ±20% with a source impedance of 0.1 Ohms.
Current: Varies with input voltage.

Output:
Voltage and Current (See chart.)
Voltage Adjustments: Set at factory within 0.5% of stated output.
Regulation:

Line (Low to High)	0.1% max.
Load (NL to FL)	0.3% max.
Temperature	0.007%/°C (typical) 0.015%/°C max.

Ripple: V (P-P) less than 1.0% of rated output voltage
All outputs may be used as either positive or negative supplies.
Protection
Overload.
Short circuit by current limiting.

Isolation:
Input to output

MTBF:
Single output units 35,000 hours.
Dual output units 25,000 hours.
Triple output units 15,000 hours.

EMI:
Input filter reduces reflected power line ripple.

Environmental:
Operating temp.: −20°C ambient to +100°C case
Storage temp. −55°C to +150°C.

Price:
Single Output
1000 Series—$115
1600 Series—$ 89
1300 Series—$ 79
1100 Series—$ 49
Dual Output
1000 Series—$125
1600 Series—$ 99
1300 Series—$ 89
1100 Series—$ 55
Triple Output
1000 Series—$140
1600 Series—$109
1300 Series—$ 99
1100 Series— —

Model 1000 10 Watt	Model 1600 6 Watt	Model 1300 3 Watt	Model 1100 1 Watt	Output Volts (VDC) Nom.			Input Voltage (VDC)					
							5 ± .5	6 ± 1	12 ± 2	24 ± 4	28 ± 4	48 ± 6
Single Output												
—	1603	1303	1103	3.6			−105	−106	−112	−124	−128	−148
1005	1605	1305	1105	5								
1006	1606	1306	1106	6								
1007	1607	1307	1107	7								
1008	1608	1308	1108	8								
1009	1609	1309	1109	9								
1010	1610	1310	1110	10								
1012	1612	1312	1112	12								
1015	1615	1315	1115	15								
1018	1618	1318	1118	18								
1020	1620	1320	1120	20								
1024	1624	1324	1124	24			−105	−106	−112	−124	−128	−148
Dual Output				V1	V2							
1010	1610	1310	1110	10	10		−205	−206	−212	−224	−228	−248
1012	1612	1312	1112	12	12							
1015	1615	1315	1115	15	15							
1018	1618	1318	1118	18	18							
1020	1620	1320	1120	20	20							
1024	1624	1324	1124	24	24		−205	−206	−212	−224	−228	−248
Triple Output				V1	V2	V3						
1015	1615	1315	—	5	15	15	−305	−306	−312	−324	−328	−348
1012	1612	1312	—	5	12	12	−305	−306	−312	−324	−328	−348

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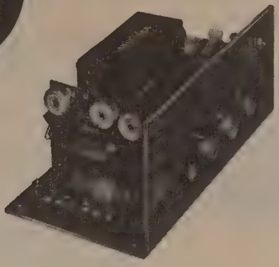
THE todd . . . hi-performance OEM type power supplies!

UX SERIES



OVERVOLTAGE PROTECTION:
Standard on all units thru 24 volts!

SPECIFICATIONS:

INPUT: 105-132 Volts AC 47-440 Hz.

OUTPUT: Floating, isolated from ground, 300 VDC max.

REGULATION: Line or Load .05% +5 MV for rated change

RIPPLE: 1 MV RMS, 5 MV P-P

TEMPERATURE COEFFICIENT: .02%/°C

OVERLOAD PROTECTION: Automatic electronic current limiting foldback

REMOTE SENSE: Sense terminals provided for compensation of external wiring drop for up to ½ volt.

UXA SERIES
3¹⁄₁₆″ x 4″ x 6¾″

Model	Voltage Range	50°C	60°C	71°C	Price
UXA-4-3.6	3.6-4.4	3.6	3.3	1.8	59.
UXA-5-3.5	4.5-5.5	3.5	3.2	1.8	59.
UXA-6-3.4	5.4-6.6	3.4	3.1	1.8	59.
UXA-7-3.1	6.3-7.7	3.1	2.8	1.8	59.
UXA-8-2.8	7.2-8.8	2.8	2.6	1.8	59.
UXA-10-2.4	9-11	2.4	2.2	1.7	59.
UXA-12-2.2	10.8-13.2	2.2	2.0	1.6	59.
UXA-15-2.0	13.5-16.5	2.0	1.8	1.4	59.
UXA-20-1.4	18-22	1.4	1.3	1.0	59.
UXA-24-1.2	21.6-26.4	1.2	1.1	.88	59.

UXB SERIES
3¹⁄₁₆″ x 4¹³⁄₁₆″ x 6¾″

Model	Voltage Range	50°C	60°C	71°C	Price
UXB-4-5.0	3.6-4.4	5	4.5	2.9	69.
UXB-5-5.0	4.5-5.5	5	4.5	2.9	69.
UXB-6-5.0	5.4-6.6	5	4.5	2.9	69.
UXB-7-4.6	6.3-7.7	4.6	4.2	2.9	69.
UXB-8-4.2	7.2-8.8	4.2	3.8	2.9	69.
UXB-10-3.8	9-11	3.8	3.5	2.8	69.
UXB-12-3.2	10.8-13.2	3.2	2.9	2.3	69.
UXB-15-2.8	13.5-16.5	2.8	2.6	2.1	69.
UXB-20-2.1	1.8-22	2.1	1.9	1.5	69.
UXB-24-1.8	21.6-26.4	1.8	1.6	1.3	69.

UXC SERIES
3¾″ x 4¹³⁄₁₆″ x 9¼″

Model	Voltage Range	50°C	60°C	71°C	Price
UXC-4-8	3.6-4.4	8	6.5	4.3	89.
UXC-5-8	4.5-5.5	8	6.5	4.3	89.
UXC-6-7.5	5.4-6.6	7.5	6.5	4.3	89.
UXC-7-7	6.3-7.7	7	6.4	4.3	89.
UXC-8-6.4	7.2-8.8	6.6	6.0	4.3	89.
UXC-10-5.9	9-11	5.9	5.4	4.3	89.
UXC-12-5.3	10.8-13.2	5.3	4.8	3.8	89.
UXC-15-4.8	13.5-16.5	4.8	4.4	3.5	89.
UXC-20-3.7	18-22	3.7	3.4	2.6	89.
UXC-24-3.4	21.6-26.4	3.4	3.1	2.5	89.

UXD SERIES
4¾″ x 7½″ x 9⅞″

Model	Voltage Range	30°C	60°C	71°C	Price
UXD-4-15	3.6-4.4	15	13	10	149.
UXD-5-15	4.5-5.5	15	13	10	149.
UXD-6-15	5.4-6.6	15	13	10	149.
UXD-7-14	6.3-7.7	14	11	9	149.
UXD-8-13	7.2-8.8	13	11	9	149.
UXD-10-12	9-11	12	10	8	149.
UXD-12-11	10.8-13.2	11	10	8	149.
UXD-15-10	13.5-16.5	10	9	8	149.
UXD-20-7.4	18-22	7.4	6.6	5.7	149.
UXD-24-7	21.6-26.4	7	6.2	5.1	149.

UXE SERIES
4¾″ x 7½″ x 12⅛″

Model	Voltage Range	50°C	60°C	71°C	Price
UXE-4-21	3.6-4.4	21	18.9	16.1	189.
UXE-5-20	4.5-5.5	20	18	15.3	189.
UXE-6-19	5.4-6.6	19	17	15	189.
UXE-7-18.5	6.3-7.7	18.5	16.6	14.1	189.
UXE-8-18	7.2-8.8	18	16.2	13.7	189.
UXE-10-16	9-11	16	14.4	12.2	189.
UXE-12-15	10.8-13.2	15	13.5	11.5	189.
UXE-15-14	13.5-16.5	14	12.6	10.7	189.
UXE-20-12	18-22	12	10.8	9.2	189.
UXE-24-11	21.6-26.4	11	9.9	8.4	189.

THE STANDARD TODD 5-YEAR WARRANTY ON PARTS AND LABOR APPLIES TO ALL UNITS

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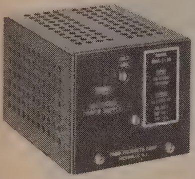
todd HI-PERFORMANCE MODULAR POWER SUPPLIES

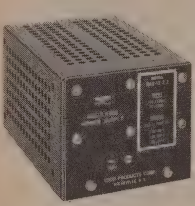
M SERIES

3 3/64" x 3 21/32" x 4 1/2"



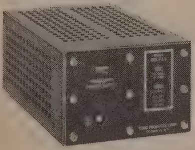
A SERIES

3 3/64" x 3 21/32" x 6 1/4"



B SERIES

3 3/64" x 4 27/32" x 6 1/4"



M SERIES

SLOT RANGE

MODEL	RATED OUTPUT V.*	OUTPUT CURRENT			UNIT PRICE
		50°C	60°C	71°C	
MMS-3-1.1	2.7-4.3	1.1	1.0	0.8	69.
MMS-3-1.6	2.7-4.3	1.6	1.4	1.2	79.
MMS-4-1.0	3.6-5.4	1.0	0.9	0.7	69.
MMS-4-1.5	3.6-5.4	1.5	1.3	1.1	79.
MMS-5-.88	4.5-6.5	.88	.80	.72	69.
MMS-5-1.3	4.5-6.5	1.3	1.1	1.0	79.
MMS-6-.82	5.4-7.6	.82	.75	.60	69.
MMS-6-1.2	5.4-7.6	1.2	1.0	.90	79.
MMS-7-.75	6.3-8.7	.75	.68	.54	69.
MMS-7-1.1	6.3-8.7	1.1	1.0	.80	79.
MMS-8-.69	7.2-9.8	.69	.63	.50	69.
MMS-8-1.0	7.2-9.8	1.0	.90	.76	79.
MMS-10-.59	9.0-12.0	.59	.54	.43	69.
MMS-10-.88	9.0-12.0	.88	.79	.67	79.
MMS-12-.53	10.8-14.2	.53	.48	.38	69.
MMS-12-.80	10.8-14.2	.80	.72	.61	79.
MMS-14-.46	12.6-16.4	.46	.42	.32	69.
MMS-14-.69	12.6-16.4	.69	.62	.52	79.
MMS-16-.42	14.4-18.6	.42	.38	.30	69.
MMS-16-.63	14.4-18.6	.63	.56	.48	79.
MMS-20-.35	18.0-23.0	.35	.32	.25	69.
MMS-20-.52	18.0-23.0	.52	.46	.40	79.
MMS-24-.32	21.6-27.4	.32	.29	.23	69.
MMS-24-.48	21.6-27.4	.48	.43	.36	79.
MMS-28-.26	25.2-31.8	.26	.24	.19	69.
MMS-28-.42	25.2-31.8	.42	.37	.32	79.
MMS-36-.21	32.4-40.6	.21	.19	.15	69.
MMS-36-.31	32.4-40.6	.31	.28	.24	79.
MMS-48-.16	43.2-53.8	.16	.15	.12	69.
MMS-48-.24	43.2-53.8	.24	.21	.18	79.
MMS-100-.08	90-111	.08	.07	.06	89.
MMS-100-.12	90-111	.12	.10	.09	99.
MMS-120-.06	108-133	.06	.06	.05	89.
MMS-120-.09	108-133	.09	.08	.07	99.
MMS-150-.05	135-166	.05	.05	.04	89.
MMS-150-.07	135-166	.07	.06	.05	99.

WIDE RANGE

MMW-8-.7	0-8	0.70	0.63	.53	79.
MMW-16-.38	0-16	0.38	0.34	.28	79.
MMW-32-.21	0-32	0.21	0.19	.16	79.

DUAL OUTPUT

MBT-514-A	4.5-6.5	1.5	1.3	1.1	155.
	11.5-15.5	1.5	1.3	1.1	
MBT-524-A	4.5-6.5	1.5	1.3	1.1	155.
	22-28	1.0	0.9	0.7	
MBT-15-1	11.5-15.5	1.0	0.9	0.7	155.
	11.5-15.5	1.0	0.9	0.7	
MBT-1220-A	10-14	.75	.68	.6	155.
	18-22	.75	.68	.6	

A SERIES

SLOT RANGE

MODEL	RATED OUTPUT V.*	OUTPUT CURRENT			UNIT PRICE
		50°C	60°C	71°C	
MAS-3-3.7	2.7-4.3	3.7	3.4	1.8	99.
MAS-4-3.6	3.6-5.4	3.6	3.3	1.8	99.
MAS-5-3.5	4.5-6.5	3.5	3.2	1.8	99.
MAS-6-3.4	5.4-7.6	3.4	3.1	1.8	99.
MAS-7-3.1	6.3-8.7	3.1	2.8	1.8	99.
MAS-8-2.8	7.2-9.8	2.8	2.6	1.8	99.
MAS-10-2.4	9.0-12.0	2.4	2.2	1.7	99.
MAS-12-2.2	10.8-14.2	2.2	2.0	1.6	99.
MAS-14-2.0	12.6-16.4	2.0	1.8	1.4	99.
MAS-16-1.8	14.4-18.6	1.8	1.7	1.3	99.
MAS-20-1.4	18.0-23.0	1.4	1.3	1.0	99.
MAS-24-1.2	21.6-27.4	1.2	1.1	.88	99.
MAS-28-1.1	25.2-31.8	1.1	1.0	.80	99.
MAS-36-.88	32.4-40.6	.88	.80	.64	99.
MAS-48-.70	43.2-53.8	.70	.63	.50	99.
MAS-100-.34	90-111	.34	.21	.25	119.
MAS-120-.28	108-133	.28	.26	.21	119.
MAS-150-.23	135-166	.23	.21	.12	119.

WIDE RANGE

MAW-8-2	0-8	2.0	1.8	1.5	99.
MAW-16-1.0	0-16	1.0	0.9	0.7	99.
MAW-32-.6	0-32	0.6	0.5	0.4	99.

B SERIES

SLOT RANGE

MODEL	RATED OUTPUT V.*	OUTPUT CURRENT			UNIT PRICE
		50°C	60°C	71°C	
MBS-3-5.0	2.7-4.3	5.0	4.5	2.9	115.
MBS-4-5.0	3.6-5.4	5.0	4.5	2.9	115.
MBS-5-5.0	4.5-6.5	5.0	4.5	2.9	115.
MBS-6-5.0	5.4-7.6	5.0	4.5	2.9	115.
MBS-7-4.6	6.3-8.7	4.6	4.2	2.9	115.
MBS-8-4.2	7.2-9.8	4.2	3.8	2.9	115.
MBS-10-3.8	9.0-12.0	3.8	3.5	2.8	115.
MBS-12-3.2	10.8-14.2	3.2	2.9	2.3	115.
MBS-14-2.8	12.6-16.4	2.8	2.6	2.1	115.
MBS-16-2.6	14.4-18.6	2.6	2.4	1.9	115.
MBS-20-2.1	18.0-23.0	2.1	1.9	1.5	115.
MBS-24-1.8	21.6-27.4	1.8	1.6	1.3	115.
MBS-28-1.5	25.2-31.8	1.5	1.4	1.1	115.
MBS-36-1.2	32.4-40.6	1.2	1.1	.88	135.
MBS-48-1.0	43.2-53.8	1.0	.91	.73	135.
MBS-100-.50	90-111	.50	.46	.37	135.
MBS-120-.42	108-133	.42	.38	.30	135.
MBS-150-.34	135-166	.34	.31	.25	135.

WIDE RANGE

MBW-8-2.9	0-8	2.9	2.6	2.2	115.
MBW-16-1.6	0-16	1.6	1.4	1.1	115.
MBW-32-.8	0-32	0.8	0.7	0.5	115.

***REMOTE SENSING:** The amplifier is capable of compensating for a 1 volt load lead loss and still maintain regulation at the load. An additional 1 volt is available at the output if local sensing is used.

THE STANDARD TODD 5-YEAR WARRANTY ON PARTS AND LABOR APPLIES TO ALL UNITS

todd PRODUCTS CORP. • 123 MILBAR BLVD., FARMINGDALE, N.Y. 11735 • (516) 293-3440 • TWX: 510-224-6584

TODD HI-PERFORMANCE MODULAR POWER SUPPLIES

SPECIFICATIONS

NPUT: 105-132 Volts AC 47-420 Hz.

UTPUT: Floating, isolated from ground, 300 VDC max.

EGULATION: LINE: .01% or 1 mv whichever is greater, for rated input line voltage-changes.
LOAD: .01% or 1 mv whichever is greater, for no-load to full-load change at any output within specification.

IPPLE: Less than .5 mv or .001% rms, 5 mv or .01% Peak o Peak.

TABILITY: .02% or 10 mv, whichever is greater, for 8 hrs., fter 30 min. warmup. Measured at constant input line, load nd Amb. Temp.

EMPERATURE COEFFICIENT: (.02% + 100 uv)/Deg. C.

EMPERATURE RANGE: OPERATING: — 20 to + 71 Deg. C. (see power rating chart)
NON-OPERATING: — 55 to + 85 Deg. Centigrade.

ECOVERY TIME: 50 Microseconds to within 50 mv of reguation spec for no-load to full-load change.

EMOTE PROGRAMMING: RESISTANCE: 1000 ohms/volt.
VOLTAGE: 1 volt/volt.

EMOTE SENSING: The amplifier is capable of compensating or a 1 volt load lead loss and still maintain regulation at the oad. An additional 1 volt is available at the output if local ensing is used.

VERLOAD PROTECTION: Fixed, automatic, electronic current imiting, limits output current for overload and short circuit onditions. Automatic recover upon removal of fault condition.

VERVOLTAGE PROTECTION (OPTIONAL): Adjustable overvoltge protection, mounts externally.

ODE OF OPERATION: Constant Voltage with automatic curent limit.

ONTROLS: Recessed screwdriver adjust over output range.

ONNECTIONS: Barrier Strip.

D SERIES

MODEL	RATED OUTPUT V.*	OUTPUT CURRENT			UNIT PRICE
		50°C	60°C	71°C	
SLOT RANGE					
DS-3-15	2.7-4.3	15	13	10	205.
DS-4-15	3.6-5.4	15	13	10	205.
DS-5-15	4.5-6.5	15	13	10	205.
DS-6-15	5.4-7.6	15	13	10	205.
DS-7-14	6.3-8.7	14	12	9	205.
DS-8-13	7.2-9.8	13	11	9	205.
DS-10-12	9.0-12.0	12	10	8	205.
DS-12-11	10.8-14.2	11	10	8	205.
DS-14-10	12.6-16.4	10	9	8	205.
DS-16-9	14.4-18.6	9	8.1	7	205.
DS-20-7.4	18.0-23.0	7.4	6.6	5.7	205.
DS-24-6.8	21.6-27.4	6.8	6.2	5.1	205.
DS-28-6.0	25.2-31.8	6	5.4	4.6	205.
DS-36-5.4	32.4-40.6	5.4	4.8	4.1	235.
DS-48-4.1	43.2-53.8	4.1	3.7	3.1	235.
DS-100-2.0	90-111	2	1.8	1.5	235.
DS-120-1.7	108-133	1.7	1.5	1.3	235.
DS-150-1.4	135-166	1.4	1.2	1	235.
WIDE RANGE					
DW-8-8.7	0-8	8.7	7.8	6.5	205.
DW-16-4.7	0-16	4.7	4.2	3.5	205.
DW-32-2.6	0-32	2.6	2.3	1.9	205.

C SERIES

MODEL	RATED OUTPUT V.*	OUTPUT CURRENT			UNIT PRICE
		50°C	60°C	71°C	
SLOT RANGE					
MCS-3-7.5	2.7-4.3	7.5	6.5	4.3	135.
MCS-4-7.5	3.6-5.4	7.5	6.5	4.3	135.
MCS-5-7.5	4.5-6.5	7.5	6.5	4.3	135.
MCS-5-10	4.7-5.3	10.0	9.0	5.5	155.
MCS-6-7.5	5.4-7.6	7.5	6.5	4.3	135.
MCS-7-7.0	6.3-8.7	7.0	6.4	4.3	135.
MCS-8-6.6	7.2-9.8	6.6	6.0	4.3	135.
MCS-10-5.9	9.0-12.0	5.9	5.4	4.3	135.
MCS-12-5.3	10.8-14.2	5.3	4.8	3.8	135.
MCS-14-4.8	12.6-16.4	4.8	4.4	3.5	135.
MCS-16-4.5	14.4-18.6	4.5	4.1	3.3	135.
MCS-20-3.7	18.0-23.0	3.7	3.4	2.6	135.
MCS-24-3.4	21.6-27.4	3.4	3.1	2.5	135.
MCS-28-3.0	25.2-31.8	3.0	2.7	2.2	135.
MCS-36-2.4	32.4-40.6	2.4	2.2	1.7	155.
MCS-48-2.0	43.2-53.8	2.0	1.8	1.3	155.
MCS-100-1.0	90-111	1.0	.94	.75	155.
MCS-120-.87	108-133	.87	.79	.63	155.
MCS-150-.70	135-166	.70	.64	.51	155.
WIDE RANGE					
MCW-8-4.3	0-8	4.3	3.9	3.2	135.
MCW-16-2.3	0.16	2.3	2.0	1.6	135.
MCW-32-1.3	0.32	1.3	1.1	0.9	135.

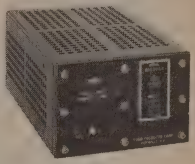
E SERIES

MODEL	RATED OUTPUT V.*	OUTPUT CURRENT			UNIT PRICE
		50°C	60°C	71°C	
SLOT RANGE					
MES-3-22	2.7-4.3	22.0	19.7	16.8	265.
MES-4-21	3.6-5.4	21.0	18.9	16.1	265.
MES-5-20	4.5-6.5	20.0	18.0	15.3	265.
MES-5-25	4.7-5.3	25.0	22.5	16.5	295.
MES-6-19	5.4-7.6	19.0	17.0	15.0	265.
MES-7-18.5	6.3-8.7	18.5	16.6	14.1	265.
MES-8-18	7.2-9.8	18.0	16.2	13.7	265.
MES-10-16	9.0-12.0	16.0	14.4	12.2	265.
MES-12-15	10.8-14.2	15.0	13.5	11.5	265.
MES-14-14	12.6-16.4	14.0	12.6	10.7	265.
MES-16-13	14.4-18.6	13.0	11.7	9.9	265.
MES-20-12	18.0-23.0	12.0	10.8	9.2	265.
MES-24-11	21.6-27.4	11.0	9.9	8.4	265.
MES-28-10	25.2-31.8	10.0	9.0	7.6	265.
MES-36-8	32.4-40.6	8.0	7.2	6.1	295.
MES-48-6	43.2-53.8	6.0	5.4	4.6	295.
MES-100-3	90-111	3.0	2.7	2.0	295.
MES-120-2.5	108-133	2.5	2.2	1.9	295.
MES-150-2.0	135-166	2.0	1.8	1.5	295.
WIDE RANGE					
MEW-8-11	0.8	11	9.9	8.3	265.
MEW-16-6	0.16	6	5.4	4.5	265.
MEW-32-3.3	0-32	3.3	3.0	2.5	265.

EMOTE SENSING: The amplifier is capable of compensating for a 1 volt load lead loss and still maintain regulation at e load. An additional 1 volt is available at the output if local sensing is used.

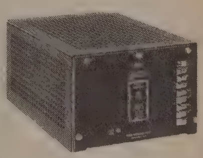
C SERIES

3⅐₆₄″ x 4²³⁄₃₂″ x 8¾″



D SERIES

4²⁵⁄₃₂″ x 7½″ x 9⅜″

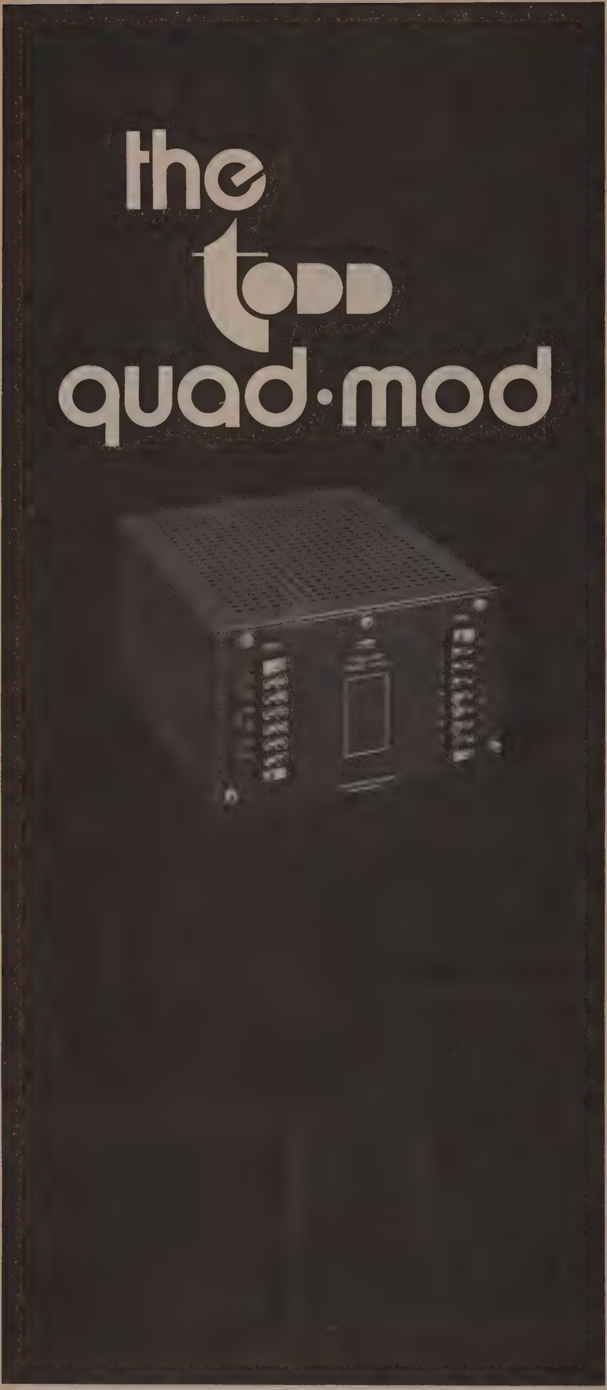


E SERIES

4²⁵⁄₃₂″ x 7½″ x 11⁹⁄₁₆″

THE STANDARD TODD 5-YEAR WARRANTY ON PARTS AND LABOR APPLIES TO ALL UNITS

TODD PRODUCTS CORP. • 123 MILBAR BLVD., FARMINGDALE, N.Y. 11735 • (516) 293-3440 • TWX: 510-224-6584



The Todd Quad-Mod Series is designed to provide a wide range of system power for multiple voltage level requirements. The incorporation of the Quad-Mod Series in a typical application will replace up to four separate power supplies with a single package, smaller in size, lighter in weight, and lower in cost. The single package reduces system complexity by the elimination of redundant power line wiring and multiple unit installations.

All power supplies in the Quad-Mod Series contain a dual tracking output providing a positive and negative tracking output voltage. The negative supply will track the positive supply, but does not have to be of the same current rating. Because of the tracking feature, only the positive supply is provided with a voltage adjustment. The negative supply is factory-set to within 2% of the positive.

... a new

The **two output module** consists of a dual tracking output.

The **three output module** consists of a dual tracking output plus an additional separately controlled positive output.

The **four output module** consists of a dual tracking output, a separately controlled positive output, and a floating output that is separately adjustable and can be operated either isolated from the system common, or connected as a positive or negative supply.

All outputs are provided as constant voltage outputs. Each output is protected against overload and short circuit by an electronic current limiting foldback circuit with automatic reset upon removal of the short circuit or overload.

Remote sense provisions are available for any or all outputs where critical correction of wire drops is required in the system. Protective circuits are incorporated to prevent the output voltage from becoming high unregulated if a sense lead is not terminated.

The unique "thermo-isolar" package design allows the Quad-Mod Series to operate in ambient temperatures up to 71°C without the use of supplementary heat sinking or forced air cooling.

TABLE I: Available Ratings

Nominal Voltage	Voltage Range	Current Ratings (50°C)				
		M	A	B	C	D
5	3.8-4.5	0.8	3.3	4.7	7.0	14
	4.5-5.5	0.8	3.5	5.0	7.5	15
	5.5-6.5	0.8	3.3	4.7	7.0	14
12	9-10	0.5	2.2	3.2	5.3	11
	10-12	0.5	2.4	3.5	5.8	12
	12-13	0.5	2.2	3.2	5.3	11
15	12-14	0.5	1.8	2.5	4.3	9
	14-16	0.5	2.0	2.8	4.8	10
	16-17	0.5	1.8	2.5	4.3	9
20	17-18.5	0.3	1.4	2.1	3.7	7.4
	18.5-20.5	0.3	1.5	2.25	4.0	8.0
	20.5-22	0.3	1.4	2.1	3.7	7.4
24	20-23	0.3	1.1	1.6	3.0	6.0
	23-27	0.3	1.2	1.8	3.4	6.8
	27-29	0.3	1.1	1.6	3.0	6.0

TABLE II: Available Output Combinations

Case Size	Two Outputs (±)	Three Outputs (+, ±)	Four Outputs (+,,±,,Floating)	Prices		
				1-4	5-9	10-24
"C"	2-A	1-A & 2-M	--	165	149	135
"D"	2-C	1-C & 2-A or 3-B	2-B & 1-A & 1M or 1-C & 1-B & 2M or 4-A	235	219	205
"E"	1-D & 1-C	1-D & 2-A or 3-C	2-C & 1-A & 1M or 1-D & 1-A & 2M or 4-B	295	279	265

power supply concept!

TABLE I: Shows the current ratings available for each nominal voltage. The shaded areas of the table show the reduced current ratings for extended output voltage range operation. The currents are tabulated by a letter series. To specify the rating of an output it is only necessary to specify the nominal voltage (ex. "5") and the current letter (ex. "C") to completely specify an output rating (ex. "5C" is a nominal 5 volts @ 7.5 Amps). Consult factory for ratings not shown.

TABLE II: Shows the combination of outputs that can be incorporated in each case size.

HOW TO ORDER—
(1) Select required output ratings from Table I
(2) Establish Case Size and Price from Table II
(3) Establish Model Number as follows:

Q 5C – 15A 15C – 24M

Series "QUAD-MOD"

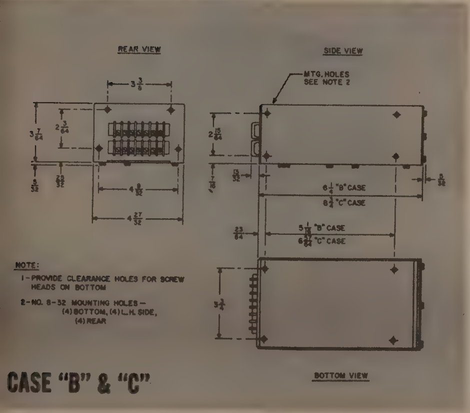
+ Individual Voltage and Current (Omit on 2 Output only)

+ Tracking Voltage and Current

– Tracking Voltage and Current

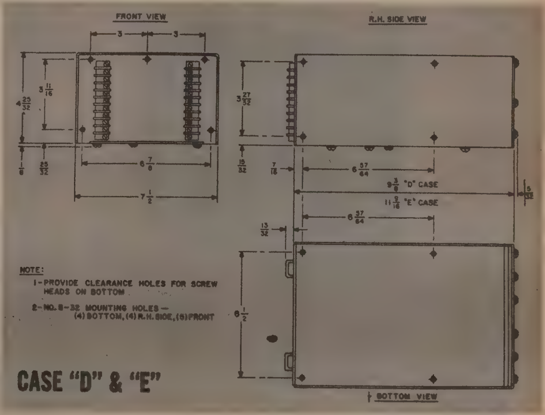
Floating Voltage and Current (4 Output only)

INPUT: 105-132 VRMS, 47-420 Hz single phase.
REGULATION, LINE: 0.1% or 10 mv for rated line change.
REGULATION, LOAD: 0.1% or 10 mv for rated load change.
RIPPLE and NOISE: 1 mvRMS, 10 mv P-P to 10 MHz.
TEMPERATURE COEFFICIENT: 0.03% per deg. C.
RECOVERY TIME: 50 micro sec to within 50 mv for no-load to full-load change.
OVERLOAD PROTECTION: Automatic current limiting foldback.
OPERATING TEMPERATURE: –20°C to +50°C rated current to; 60°C derate 10%; to 71°C derate 25%.
STORAGE TEMPERATURE: –55°C to +85°C.
REMOTE SENSE: Sense terminals provided for correction of up to 0.5 volt load lead drop.
INPUT-OUTPUT CONFIGURATION: Barrier strip.
OPTIONAL: Over-voltage protection on any or all outputs.
VOLTAGE ADJUST: Screwdriver control.


REAR VIEW
SIDE VIEW
MTG. HOLES SEE NOTE 2
$3\frac{3}{8}$
$3\frac{7}{64}$
$2\frac{3}{64}$
$\frac{5}{32}$
$\frac{23}{32}$
$4\frac{9}{32}$
$4\frac{27}{32}$
$2\frac{15}{64}$
$\frac{7}{16}$
$\frac{13}{32}$
$\frac{5}{32}$
$6\frac{1}{4}$ "B" CASE
$8\frac{3}{4}$ "C" CASE
$\frac{23}{64}$
$5\frac{1}{16}$ "B" CASE
$6\frac{47}{64}$ "C" CASE
$3\frac{3}{4}$
BOTTOM VIEW

NOTE:
1-PROVIDE CLEARANCE HOLES FOR SCREW HEADS ON BOTTOM
2-NO. 8-32 MOUNTING HOLES— (4) BOTTOM, (4) L.H. SIDE, (4) REAR

CASE "B" & "C"


FRONT VIEW
R.H. SIDE VIEW
3
3
$4\frac{25}{32}$
$3\frac{11}{16}$
$\frac{1}{8}$
$\frac{25}{32}$
$6\frac{7}{8}$
$7\frac{1}{2}$
$3\frac{27}{32}$
$\frac{15}{32}$
$\frac{7}{16}$
$6\frac{57}{64}$
$9\frac{3}{8}$ "D" CASE
$11\frac{9}{16}$ "E" CASE
$\frac{5}{32}$
$6\frac{57}{64}$
$\frac{13}{32}$
$6\frac{1}{2}$
BOTTOM VIEW

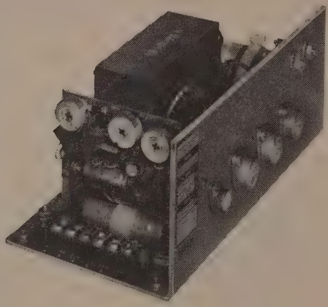
NOTE:
1-PROVIDE CLEARANCE HOLES FOR SCREW HEADS ON BOTTOM
2-NO. 8-32 MOUNTING HOLES— (4) BOTTOM, (4) R.H. SIDE, (8) FRONT

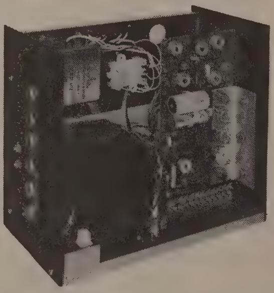
CASE "D" & "E"

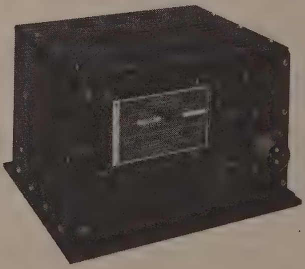
standard and custom designed single and multiple output power supplies.

todd

- OFF-LINE POWER CONVERTERS
- REDUNDANT POWER SYSTEMS
- HIGH EFFICIENCY SWITCHING REGULATORS
- DC-DC POWER CONVERTERS
- DC-AC POWER INVERTERS:
- UNINTERRUPTED POWER SOURCES
- PULSE LOAD POWER SOURCES
- AC-DC POWER PACKS







THE STANDARD TODD 5-YEAR WARRANTY ON PARTS AND LABOR APPLIES TO ALL UNITS

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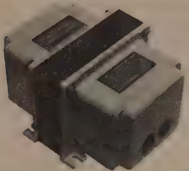
TOPAZ
ELECTRONICS
SOLUTIONS TO
POWER PROBLEMS
3855 Ruffin Road, San Diego, CA 92123–(714) 279-0831

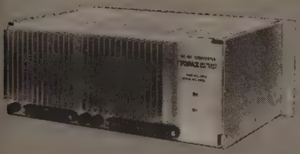
SHORT FORM CATALOG
LG 25
March 1975



ULTRA-ISOLATION TRANSFORMERS See page 4

Noise problems go away when noise-sensitive or noise-producing equipment is Ultra-Isolated. Common-mode and transverse-mode noise are attenuated more than 1,000,000:1 Models are available from 125 VA to 20 kVA, single-phase, and 1.5 kVA to 45 kVA, three-phase.

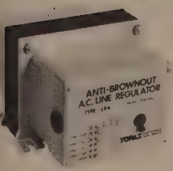
DC-DC CONVERTERS



- Fully protected
- Fully isolated
- 115 Vac, 60 Hz fan output (100 VA)
- ± 15 Vdc adjustable to ±12 V

Input VDC	Model Number	DC Outputs				List Price
24	250-DC-24	+5 V, 15 A	+15 V, 1 A	-15 V, 1 A	+24 V, 2 A	$1120
48	250-DC-48					$ 900
125	250-DC-125					$ 955
48	350-DC-48	+5 V, 30 A	+15 V, 2 A	-15 V, 2 A	+24 V, 2 A	$1010
125	350-DC-125					$1060

AC LINE REGULATORS 500 VA to 24 kVA*



ZERO DISTORTION
A.C. LINE REGULATOR
TYPE LRB
TOPAZ

SPECIFICATIONS

Operating Frequency
47 to 63 Hz, Sine Wave

Line Voltage Regulation:
±7% maximum for LRA Series
±3.3% maximum for LRB Series

Response Time:
1 cycle maximum

Output Distortion:
No spike; adds less than 1% THD

Load Regulation:
Less than 1% for load change of 10% to 100%

Efficiency:
98% minimum

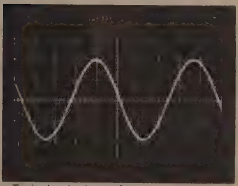
Operating Temperature:
0 to 50° C

Temperature Coefficient:
0.05%/° C maximum

Audible Noise:
Typically 2 dB increase

Offering the. . .
- Highest Efficiency
- Smallest Size
- Lowest Distortion
- Lowest Cost

. . .of all line regulators available



Typical output waveform.

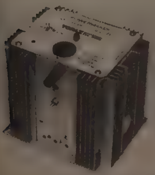
LRA SERIES

Model Number	Power KVA	Input VAC	Output VAC	List Price
Single-Phase				
500LRA117SN	0.5	85-125	117	$ 290
2LRA117SN	2			450
4LRA117SN	4			570
8LRA117SN	8			890
2LRA208SL	2	151-222	208	450
4LRA208SL	4			570
8LRA208SL	8			890
2LRA220SL	2	160-235	220	450
4LRA220SL	4			570
8LRA220SL	8			890
2LRA230SL	2	167-246	230	450
4LRA230SL	4			570
8LRA230SL	8			890
2LRA240SL	2	175-255	240	450
4LRA240SL	4			570
8LRA240SL	8			890
Three-Phase (Wye input-wye output)				
6LRA117TN	6	85-125	117L/N	1580
12LRA117TN	12			1880
6LRA230TN	6	165-245	230L/N	1580
12LRA230TN	12			1880

LRB SERIES

Model Number	Power KVA	Input VAC	Output VAC	List Price
Single-Phase				
500LRB115SN	0.5	105-125	115	$ 245
2LRB115SN	2			410
4LRB115SN	4			490
8LRB115SN	8			780
2LRB208SL	2	190-225	208	410
4LRB208SL	4			490
8LRB208SL	8			780
16LRB208SL	16			1080
2LRB220SL	2	202-239	220	410
4LRB220SL	4			490
8LRB220SL	8			780
16LRB220SL	16			1080
2LRB230SL	2	211-250	230	410
4LRB230SL	4			490
8LRB230SL	8			780
16LRB230SL	16			1080
2LRB240SL	2	220-260	240	410
4LRB240SL	4			490
8LRB240SL	8			780
16LRB240SL	16			1080
Three-Phase (Wye input-wye output)				
6LRB115TN	6	105-125	115L/N	1480
12LRB115TN	12			1780
6LRB230TN	6	210-250	230L/N	1480
12LRB230TN	12			1780
24LRB230TN	24			2670

*Ultra-Isolated AC Line Regulators combining the features of Topaz Line Regulators and Ultra-Isolation Transformers are also available.



POWERMAKERS

Versatile 300 VA, 60 Hz square wave inverter operates TVs, radios, small appliances, test equipment, recorders, etc. Models available for operation from 12 Vdc, 24 Vdc and 48 Vdc.

**Note: Prices are for negative ground units. Add $30 per unit for positive ground models.

Model Number	Input Voltage	**List Price
315-B-12	12VDC	$ 139
315-B-24	24VDC	189
315-B-48	48VDC	189

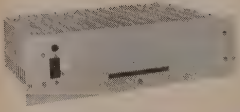
TOPAZ
ELECTRONICS

FREQUENCY CONVERTERS & DC-AC SINE WAVE INVERTERS

3855 Ruffin Road, San Diego, CA 92123–(714) 279-0831

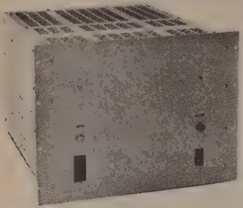
GZ & FZ SERIES

Input Protection:
High and low voltage
Reverse polarity
Static Regulation:
Line Regulation: ±1% maximum for line variations between low line and high line, at half load.
Load Regulation: ±2% maximum for load variations between no load and full load, at nominal line.
Regulation Envelope: ±5% maximum for any combination of line voltage, load current, and temperature within specifications.
Frequency Stability:
±0.5% of fixed frequency;
±0.01% optional
Output Protection:
Overload and short circuit
Total Harmonic Distortion:
Less than 5% at full load and nominal line
Operating Temperature:
-10° C to +55° C
Inverter Efficiency:
Typically 70% at full load



GP & FP SERIES

Input Protection:
Low voltage
Reverse polarity
Output Voltage Regulation:
Less than ±5% line and load
Frequency Stability:
±1% of fixed frequency;
Output Protection:
Overload and short circuit
Recovery Time:
Less than 100 milliseconds for 50% load change
Total Harmonic Distortion:
Less than 10% at worst case; 5% typical
Operating Temperature:
0° C to +55° C
Inverter Efficiency:
Typically 72% at full load



GX & FX SERIES

Input Protection:
High and low voltage and reverse polarity
Static Regulation:
Line Regulation: ±1% maximum for line variations between low line and high line, at half load.
Load Regulation: ±2% maximum for load variations between no load and full load, at nominal line.
Regulation Envelope: ±3% maximum for any combination of line voltage, load current, and temperature within specifications.
Frequency Stability:
±0.5% of fixed frequency;
±0.05% optional
Output Protection:
Overload and short circuit
Total Harmonic Distortion:
Less than 5% at full load and nominal line
Operating Temperature:
-10° C to +55° C
Inverter Efficiency:
Typically 75% at full load
Recovery Time:
50 milliseconds for 20% load change

INPUT SPECIFICATIONS

Nominal Input Voltage	Product Series	Voltage Range
12/24 VDC	GZ	11 to 15 or 22 to 30
12 VDC	GP	11 to 15
24 VDC	GP	22 to 30
28 VDC	GZ	24 to 32
48 VDC	All	42 to 56
125 VDC	All	105 to 140
250 VDC	GX	210 to 280
115 VAC	FZ	100 to 125
115 VAC	FP & FX	105 to 125
208 V, 3ϕ	FX	190 to 225
230 VAC	FZ & FX	200 to 250
240 V, 3 ϕ	FX	220 to 260
480 V, 3 ϕ	FX	440 to 520

INPUT FREQUENCY RANGES

FZ	45 to 500 Hz
FP & FX	48 to 420 Hz

SIZES (Inches)

Code	Height	Width	Depth
A	5¼	19	13½
B	7	19	14
C	7	19	13
D	7	19	18½
E	14	19	13
F	14	19	21
G	14	19	18½
H	21	19	18½
J	21	19	13
K	21	19	21
L	62	23¼	31

OPTIONS AVAILABLE

Precision frequency control
External frequency synchronization
Voltage and/or current meters
Automatic restart

INVERTERS

Output VA	Product Series	Input Voltage	Output Frequency	Output Voltage	Size	Weight (Lbs.)	List Price (See Note)
50 Hz Output Inverters							
200	GZ	12/24, 28, 48 or 125*	50	115/230	C	39	$ 845 ✓
200	GP	12, 24, 48 or 125*	50	115 or 230*	A	35	735 ✓
400	GZ	12/24, 28, 48 or 125*	50	115/230	C	65	1470 ✓
400	GP	12, 24, 48 or 125*	50	115 or 230*	B	55	925 ✓
800	GZ	12/24, 28, 48 or 125*	50	115/230	C	95	2020 ✓
1,600	GZ	12/24 or 28*	50	115/230	E	190	3490 ✓
2,000	GX	48 or 125*	50	115 or 230*	F	185	2730 ✓
2,400	GZ	12/24 or 28*	50	115/230	J	285	5120 ✓
4,000	GX	48 or 125*	50	115 or 230*	K	265	4250 ✓
8,000	GX	125 or 250*	50	115 or 230*	L	700	8230 ✓
60 Hz Output Inverters							
250	GZ	12/24, 28, 48 or 125*	60	115	C	39	760 ✓
250	GP	12, 24, 48 or 125*	60	115 or 230*	A	35	680 ✓
500	GZ	12/24, 28, 48, 125*	60	115	C	65	1300 ✓
500	GP	12, 24, 48 or 125*	60	115 or 230*	B	55	865 ✓
1,000	GZ	12/24, 28, 48 or 125*	60	115 or 115/230*	C	95	1910 ✓
1,500	GZ	12/24, 28, 48 or 125*	60	115	E	160	3050 ✓
2,000	GZ	12/24 or 28*	60	115 or 115/230*	E	190	3270 ✓
2,500	GX	48 or 125*	60	115 or 230*	F	185	2510 ✓
3,000	GZ	12/24 or 28*	60	115 or 115/230*	J	285	4800 ✓
5,000	GX	48 or 125*	60	115 or 230*	K	265	3820 ✓
10,000	GX	125 or 250*	60	115 or 230*	L	700	7960 ✓
400 Hz Output Inverters							
250	GZ	12/24, 28	400	115	C	29	900 ✓
500	GZ	12/24, 28	400	115	C	45	1580 ✓
1,000	GZ	12/24, 28	400	115	C	55	2180 ✓
2,000	GZ	12/24 or 28*	400	115	E	110	3700 ✓
2,500	GX	125	400	115	F	130	2730
3,000	GZ	12/24 or 28*	400	115	J	165	5450 ✓
5,000	GX	125	400	115	K	185	4250
10,000	GX	125	400	115	L	505	8230

*Specify with order

ORDERING INFORMATION

Model numbers are constructed by combining information in the order in which it is presented above. For example, Model 1000 GZ-12/24-60-115/230 designates a 1000 VA, GZ Series Inverter which will operate from either 12 or 24 VDC (selectable) and provides an output of 60 Hz at 115 or 230 V. **Three-phase output units also available.**

FREQUENCY CONVERTERS

Output VA	Product Series	Input Voltage	Output Frequency	Output Voltage	Size	Weight (Lbs.)	List Price (See Note)
50 Hz Output Frequency Converters							
200	FZ	115	50	115/230	C	45	$ 975
200	FZ	230	50	115/230	C	58	1085
200	FP	115	50	115 or 230*	A	45	815 ✓
400	FZ	115	50	115/230	D	73	1630
400	FZ	230	50	115/230	D	86	1740
400	FP	115	50	115 or 230*	B	73	1010 ✓
800	FZ	115	50	115/230	D	110	2230
800	FZ	230	50	115/230	D	135	2380
1,600	FZ	115	50	115/230	G	220	4030
1,600	FZ	230	50	115/230	G	270	4300
2,000	FX	115, 208, 230 or 240*	50	115 or 230*	F	240	3490
2,400	FZ	115	50	115/230	H	330	5610
2,400	FZ	230	50	115/230	H	405	5880
4,000	FX	115, 208, 230 or 240*	50	115 or 230*	K	325	4850
8,000	FX	115, 208, 230 or 240*	50	115 or 230*	L	850	9650
60 Hz Output Frequency Converters							
250	FZ	115	60	115	C	45	895
250	FZ	230	60	115	C	58	1010
250	FP	115	60	115 or 230*	A	45	755 ✓
500	FZ	115	60	115	D	73	1470
500	FZ	230	60	115	D	86	1580
500	FP	115	60	115 or 230*	B	73	975
1,000	FZ	115	60	115 or 115/230*	D	110	2010 ✓
1,000	FZ	230	60	115 or 115/230*	D	135	2160 ✓
2,000	FZ	115	60	115 or 115/230*	G	220	3820 ✓
2,000	FZ	230	60	115 or 115/230*	G	270	4105 ✓
2,500	FX	115, 208, 230 or 240*	60	115 or 230*	F	240	3270
3,000	FZ	115	60	115 or 115/230*	H	330	5450 ✓
3,000	FZ	230	60	115 or 115/230*	H	405	5850 ✓
5,000	FX	115, 208, 230 or 240*	60	115 or 230*	K	325	4630
10,000	FX	115, 208, 230 or 240*	60	115 or 230*	L	850	9320
400 Hz Output Frequency Converters							
250	FZ	115	400	115	C	35	975
250	FZ	230	400	115	C	48	1090
500	FZ	115	400	115	D	53	1630
500	FZ	230	400	115	D	66	1740
1,000	FZ	115	400	115	D	70	2230
1,000	FZ	230	400	115	D	95	2380
2,000	FZ	115	400	115	G	140	4030
2,000	FZ	230	400	115	G	190	4300
2,500	FX	115, 208, 230 or 240*	400	115	F	165	3490
3,000	FZ	115	400	115	H	210	5610
3,000	FZ	230	400	115	H	285	5880
5,000	FX	115, 208, 230 or 240*	400	115	K	260	4850
10,000	FX	115, 208, 230 or 240*	400	115	L	650	9650

PRICING INFORMATION

Prices shown are for the more popular voltage versions shown on that line. Prices followed by (✓) may vary slightly for different voltage ratings.

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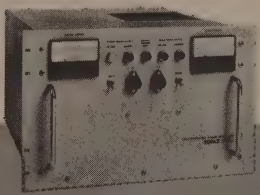
UNINTERRUPTIBLE POWER SYSTEMS

3855 Ruffin Road, San Diego, CA 92123—(714) 279-0831

10 kVA SYSTEM



1 kVA SYSTEM

SPECIFICATIONS

AC INPUT
105-130 V line to neutral or (210-260 V) normal range 95-105 V (or 190-210 V) extended range with reduced back-up time
60 Hz ± 5%

INPUT PROTECTION
Undervoltage and overvoltage protection on all inverters
Reverse polarity protection on all inverters
AC input failure indicated by relay contact closure

INVERTER OUTPUT
5% voltage regulation for line and load
0.5% frequency stability
Sinusoidal, with 5% total harmonic distortion at full load and nominal line
10% voltage overshoot/undershoot for 20% instantaneous load change

OUTPUT PROTECTION
Current limiting on all chargers
Overload and short-circuit protection on all inverters

AUTOMATIC LOAD TRANSFER
25 millisecond transfer (typical). Panel light indicates that load is powered by the ac line.
4 millisecond switch optional.

METERS
Battery voltage
System output voltage

OPERATING TEMPERATURE
0° C to +50° C

OPTIONS AVAILABLE
- AC Line Frequency and/or Phase Synchronization
- Static Transfer Switch with 4 milliseconds maximum transfer time, phase synchronized
- Float/Equalize Switch, mounted on front panel
- Low Battery Voltage Alarm and Indicator
- Special meters, switches, cabinetry and paint, etc.

Output Power (VA)	System Part Number	Input			Output				Battery	Full load Back-up Time	Recharge Time or Battery Charging Current	Size	Approx. Weight	List Price
		Vac	Phase	Hz	Vac	Phase	Hz	Current						
500	3151-1	115	1	60	115	1	60	4.3A	Internal 72 V (Note 1)	10 minutes minimum 12 minutes typical	Half charge in 3 hours	19" rack mount 12.25" H. 19" D.	140 lbs.	$ 1,890
500	3151-5	115	1	60	115	1	60	4.3A	Internal 72 V (Note 1)	55 minutes minimum 65 minutes typical	Half charge in 3 hours	19" rack mount 12.25" H. 19" D.	190 lbs.	$ 2,280
1,000	3152-9	115	1	60	115	1	60	8.7A	Internal 72V (Note 1)	10 minutes minimum 12 minutes typical	Half charge in 3 hours	19" rack mount 12.25" H. 19" D.	170 lbs.	$ 2,390
	3152-1	115	1	60	115	1	60	8.7A	Internal 72 V (Note 1)	25 minutes minimum 35 minutes typical	Half charge in 3 hours	19" rack mount 12.25" H. 19" D.	210 lbs.	$ 2,625
1,500	3202-1	115	1	60	115	1	60	13.0A	External 72V (Note 2)	Dependent on batteries	Half charge in 3 hours	19" rack mount 8.75" H. 20" D.	150 lbs. Plus batteries	$ 2,590
2,000	2517-1	115	1	60	115	1	60	17.4A	External 120 V (Note 2)	Dependent on batteries	5 Amperes	19" rack mount 14" H. 21" D.	235 lbs. Plus batteries	$ 2,980
	2529-1	115	1	60	115	1	60	17.4A	Internal 120 V (Note 1)	12 minutes minimum 15 minutes typical	Half charge in 3 hours	Cabinet with casters 37" H. 24" W. 27" D.	550 lbs.	$ 4,850
3,000	2534-1	115	1	60	115	1	60	26.0A	External 48 V (Note 2)	Dependent on batteries	25 Amperes	Cabinet with casters 37" H. 24" W. 27" D.	425 lbs. Plus batteries	$ 5,400
	2534-2	230	1	60	230	1	60	13.0A						
	2534-3	115	1	60	115	1	60	26.0A	External 120 V (Note 2)		10 Amperes			$ 4,450
	2534-4	230	1	60	230	1	60	13.0A						
5,000	2520-1	115	1	60	115	1	60	43.5A	External 120 V (Note 2)	Dependent on batteries	20 Amperes	Cabinet 55" H. 24" W. 25" D.	700 lbs. Plus batteries	$ 6,910
	2520-2	230	1	60	230	1	60	21.7A						
7,500	2620-1	208	3	60	115	1	60	65.0A	External 120 V (Note 2)	Dependent on batteries	30 Amperes	Cabinet 65.5" H 28.25" W 31" D.	1200 lbs. Plus batteries	$ 9,300
	2620-2	230	3	60	230	1	60	32.5A						
10,000	2570-1	208	3	60	115	1	60	87.0A	External 120 V (Note 2)	Dependent on batteries	40 Amperes	2 Cabinets each is 62.5" H. 23" W. 31" D.	1700 lbs. Plus batteries	$11,900
	2570-2	230	3	60	230	1	60	43.5A						

Notes:
1. Sealed internal batteries are supplied as part of this model. External batteries may be connected in parallel with the internal batteries, thus extending the back-up and recharge times. Battery information is available on request.
2. External batteries are not supplied with the basic system. External batteries may be procured from Topaz with the basic system or purchased from another source.
3. Back-up times for internal batteries are specified for 25° C operation. Shorter times can be expected at lower temperatures and longer times at higher temperatures.

ALSO AVAILABLE: Low Cost 300 VA Models (Full details on the 300 VA UPS are specified in separate data sheets.)

300	315-BK-12-60*	120	1	60	120*	1	60*	2.6A	External 12 V (Note 2)	Dependent on battery	3 Amperes	7" H. 7" W. 5.5" D.	13 lbs. Plus battery	$ 250
300	2645-1*	120	1	60	120*	1	60*	2.6A	Internal	10 minutes minimum 12 minutes typical	24 hours full charge	9.5" H. 8.5" W 16.0" D.	36 lbs.	$ 440
300	2645-2*	120	1	60	120*	1	60*	2.6A	Internal	27 minutes minimum 35 minutes typical	24 hours full charge	9.5" H. 8.5" W. 16.0" D.	53 lbs.	$ 520

*The 300VA models are square wave output, off-line forward transfer UPS. They are low cost alternatives for many less critical applications. They contain no meters.

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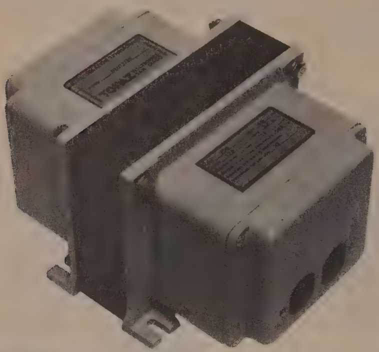
ULTRA-ISOLATION TRANSFORMERS

For eliminating power line noise problems associated with sensitive equipment



TOPAZ ULTRA - ISOLATION TRANSFORMERS are available in single-phase and three-phase versions, from 125 VA to 45,000 VA, and in step-up and step-down configurations, some with provisions for use on several different power line voltages. They are especially designed for these applications:

1. For isolating sensitive instrumentation from noisy power lines.
2. For isolating sensitive power lines from noisy equipment.
3. For isolating noisy equipment from noise-sensitive equipment when both share the same AC power source.
4. For maximum attenuation of common-mode noise (noise between ground and power lines).
5. For excellent attenuation of transverse-mode noise (line-to-line output noise) caused by common-mode noise at the input.
6. For completion of electrostatic guarding of equipment which is protected by an electrostatic shield.
7. For applications in which leakage currents must be kept below critical low levels.

Featuring. . .

- **Excellent Common-Mode Noise Rejection**
- **Very Low Leakage Current**
- **Unique Box-Shielded Design**
- **Single-Phase and Three-Phase Models**
- **50Hz, 60Hz and 400Hz Models**
- **Money-Back Guarantee**

TYPICAL SPECIFICATIONS

Common-Mode Noise Rejection:
.005 pF—greater than 125 dB
.001 pF—greater than 140 dB
.0005 pF—greater than 146 dB

Common-Mode to Transverse-Mode Noise Rejection:
Greater than 125 dB at 1 kHz

Electromagnetic Noise:
Less than 0.1 gauss (-20 dB) at 18 in. radius

Standard Voltage Ratings:
120 (for 110, 115, 120 V lines*)
240 (for 208, 220, 230, 240 V lines*)
480 (for 360 440, 480 V lines*)
*Maximum current = VA rating ÷ Nominal Voltage Rating

Operating Voltages:
To 110% of nominal

Operating Frequency:
57 to 63 Hz

STANDARD 60 Hz SINGLE-PHASE STOCK MODELS

MODEL NUMBER GUARANTEED EFFECTIVE CAPACITANCE				Primary VAC (Nominal)	Secondary VAC (Nominal)	Terminations	Wt. (Lbs.)	Price Each
Power Rating	≤ .005 pF	≤ .001 pF	≤ .0005 pF					
125 VA	1/811T25SR			120	120	Receptacle	11	$ 75
125		1/811T21SR		120	120	Receptacle	11	105
125			1/811T35SR	120	120	Receptacle	11	140
125	1/811T25ST			120	120	Terminals	10	75
125		1/811T21ST		120	120	Terminals	10	105
125			1/811T35ST	120	120	Terminals	10	140
500 VA	1/211T25SR			120	120	Receptacle	18	120
500		1/211T21SR		120	120	Receptacle	18	155
500			1/211T35SR	120	120	Receptacle	18	205
500	1/211T25ST			120	120	Terminals	17	120
500		1/211T21ST		120	120	Terminals	17	155
500			1/211T35ST	120	120	Terminals	17	205
1.0 kVA	0111T25SR			120	120	Duplex	32	200
1.0	0131T25SR			240	120	Duplex	32	200
1.0	0111T25ST			120	120	Terminals	30	200
1.0	0131T25ST			240	120	Terminals	30	200
1.0	0133T25ST			240	240	Terminals	30	200
1.0	0155T25FT			125/250■	115/230	Terminals	67	500
1.0	0111T25FT			120	120	Terminals	67	425
1.0		0111T21SR		120	120	Duplex	32	250
1.0		0131T21SR		240	120	Duplex	32	250
1.0		0111T21ST		120	120	Terminals	30	250
1.0		0131T21ST		240	120	Terminals	30	250
1.0		0133T21ST		240	240	Terminals	30	250
1.0		0155T21FT		125/250■	115/230	Terminals	67	625
1.0		0111T21FT		120	120	Terminals	67	510
1.0			0111T35SR	120	120	Duplex	32	335
1.0			0131T35SR	240	120	Duplex	32	335
1.0			0111T35ST	120	120	Terminals	30	335
1.0			0131T35ST	240	120	Terminals	30	335
1.0			0133T35ST	240	240	Terminals	30	335
1.0			0155T35FT	125/250■	115/230	Terminals	67	830
1.0			0111T35FT	120	120	Terminals	67	710

■Consists of (2) 125 coils with taps at 102, 110, and 118 volts

MODEL NUMBER GUARANTEED EFFECTIVE CAPACITANCE				Primary VAC (Nominal)	Secondary VAC (Nominal)	Terminations	Wt. (Lbs.)	Price Each
Power Rating	≤ .005 pF	≤ .001 pF	≤ .0005 pF					
2.5 kVA	0211T25SR			120	120	Duplex	45	305
2.5	0231T25SR			240	120	Duplex	45	305
2.5		0211T21SR		120	120	Duplex	45	380
2.5		0231T21SR		240	120	Duplex	45	380
2.5			0211T35SR	120	120	Duplex	45	51
2.5			0231T35SR	240	120	Duplex	45	51
2.5	0211T25ST			120	120	Terminals	44	305
2.5	0231T25ST			240	120	Terminals	44	305
2.5	0233T25ST			240	240	Terminals	44	305
2.5		0211T21ST		120	120	Terminals	44	380
2.5		0231T21ST		240	120	Terminals	44	380
2.5		0233T21ST		240	240	Terminals	44	380
2.5			0211T35ST	120	120	Terminals	44	510
2.5			0231T35ST	240	120	Terminals	44	510
2.5			0233T35ST	240	240	Terminals	44	510
5.0 kVA	0511T25FT			120	120	Terminals	111	565
5.0	0511T25ST			120	120	Terminals	66	460
5.0	0531T25ST			240	120	Terminals	66	460
5.0	0533T25ST			240	240	Terminals	66	460
5.0	0541T25ST			480	120	Terminals	66	460
5.0		0511T21FT		120	120	Terminals	111	710
5.0		0511T21ST		120	120	Terminals	66	575
5.0		0531T21ST		240	120	Terminals	66	575
5.0		0533T21ST		240	240	Terminals	66	575
5.0		0541T21ST		480	120	Terminals	66	575
5.0			0511T35FT	120	120	Terminals	111	945
5.0			0511T35ST	120	120	Terminals	66	770
5.0			0531T35ST	240	120	Terminals	66	770
5.0			0533T35ST	240	240	Terminals	66	770
5.0			0541T35ST	480	120	Terminals	66	770
10 kVA	1033T25ST			240	240	Terminals	164	820
10		1033T21ST		240	240	Terminals	164	1045
10			1033T35ST	240	240	Terminals	164	1390
10	1065T25BT			240/480	120/240	Conduit	222	1430
10		1065T21BT		240/480	120/240	Conduit	222	1800
10			1065T35BT	240/480	120/240	Conduit	222	2490
15 kVA	1533T25ST			240	240	Terminals	203	995
15		1533T21ST		240	240	Terminals	203	1245
15			1533T35ST	240	240	Terminals	203	1660
15	1565T25BT			240/480	120/240	Conduit	269	1640
15		1565T21BT		240/480	120/240	Conduit	269	2050
15			1565T35BT	240/480	120/240	Conduit	269	2730
20 kVA	2065T25BT			240/480	120/240	Conduit	332	1840
20		2065T21BT		240/480	120/240	Conduit	332	2300
20			2065T35BT	240/480	120/240	Conduit	332	3060

The models listed above are generally in stock; hundreds of other models are available on short notice.

LG 25
March 1975
Supersedes LG 19

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SOLUTIONS TO POWER PROBLEMS

3855 Ruffin Road, San Diego, CA 92123—(714) 279-0831

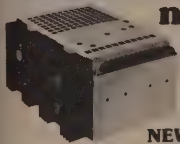
Power Supply Catalog
SYSTRON DONNER

the new Reference for Precision DC Power Supplies, Converters, & Switchers

Send for your FREE SYSTRON-DONNER Power Supply Catalog . . . featuring application notes, power supply terms, photos, easy-to-use selection chart, complete specs, and outline drawings on our complete line of:

laboratory, systems, and digital power supplies, and specialty products.

new products



NEW

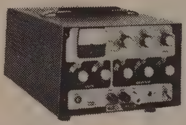
Triple Output DC Input Switching Regulators
DC3-E Series
24 or 48VDC Input
5 & ±15VDC Outputs
Priced from $470

NEW

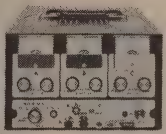
Full Rack Power Pack
VP Series
Nominal Voltages
Ranges 5, 8, 12, 15, 24, 28, 48VDC
Priced from $645

specialty products

Digitally Adjustable Precision Lab Supply
PLS50-1 $375
0 to 50VDC
@ 1 Amp



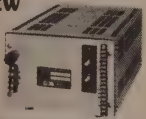
- 5 dial calibrated output
- Multiversatile remote programming in ohms/volt, volt/volt, analog voltage, current limiting.



Triple Output Lab Supply
TL8-3 $315
0 to 8VDC
@ 3 Amps
0 to ±32VDC
@ 1 Amp

- Each output independently adjustable
- Automatic Current Limiting
- Ideal for sensitive and critical IC Circuit testing

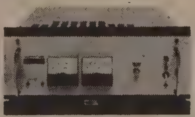
NEW



Switching Regulator Modules SHA Series
High Efficiency, High Power, Half Racks

- Up to 52VDC & 120 amps
- Brownout protection
- Fan option-high temperature operation
- DC inputs available • $650

NEW



High Current Full Racks
VPL Series

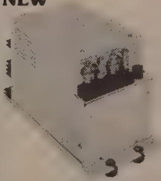
- Up to 300 amp outputs
- Nominal, 5, 12, 24VDC
- $1195

NEW

High Speed Digital Power Source for Automated Test Systems
Model DPS single output from $1695
dual output from $2260
Single or Dual 0 to 50VDC or 0 to 100VDC to 1 Amp

- Addressable Memory (16 possible addresses)
- Optional visual display
- Optional programmed polarity, overcurrent limit, overvoltage protection level

NEW



DC to DC
DC to AC
Converters

- High efficiency
- Low noise
- Single & Multiple output
- Precision performance
- Priced from $250

ASK ABOUT OUR COMPLETE SPECIALS CAPABILITY FOR ALL YOUR POWER SUPPLY NEEDS . . . FROM A MODULE TO A SYSTEM, SINGLE & MULTIPLE OUTPUTS.

Call your local Scientific Devices Sales Office or

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SUBSIDIARY
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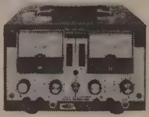
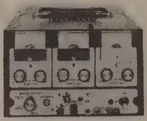
SYSTRON-DONNER

POWER SUPPLY SELECTOR & PRICE LIST

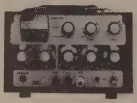
Wide Range Laboratory & Systems Applications



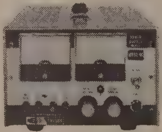
DL SERIES $375



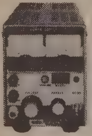
TL SERIES $315 $340 (OV)



PLS SERIES $375

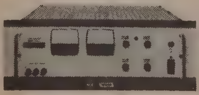


HR SERIES
From $425 to $575



HH SERIES
From $219
to $269

RS SERIES
From $575 to $730



MC/MP SERIES
From $795 to $1995

Voltage Range (VDC)	Max. Current (Amps)	Size	Load Regulation	Line Regulation	Ripple (RMS mV)	Remote Programming	CV/CC†	Price Metered ($)	OV Option ($)	Model
0 to 5	130	7'' Rack	0.005%	0.005%	1	√	√	1150	Std.	M7C5-130 OV
0 to 7	4	Qtr. Rack*	0.01%	0.01%	0.5	√	√	219	65	HH7-4
0 to 8	3						√			
0 to +32	1	Half Rack*	0.02%	0.02%	0.5	—	—	315	25	TL8-3 (3 output)
0 to −32	1									
0 to 8	50	5¼'' Rack	0.005%	0.005%	1	√	√	795	Std.	M5P8-50 OV
0 to 8	100	7'' Rack	0.005%	0.005%	1	√	√	1125	Std.	M7C8-100 OV
0 to 8	400	8¾'' Rack	0.005%	0.005%	1	√	√	1995	Std.	M8C8-400 OV
0 to 15	3	Qtr. Rack*	0.01%	0.01%	0.5	√	√	219	65	HH15-3
0 to 15	30	5¼'' Rack	0.005%	0.005%	1	√	√	795	Std.	M5P15-30 OV
0 to 15	50	5¼'' Rack	0.005%	0.005%	1	√	√	895	Std.	M5C15-50 OV
0 to 15	80	7'' Rack	0.005%	0.005%	1	√	√	1095	Std.	M7C15-80 OV
0 to 15	250	8¾'' Rack	0.005%	0.005%	1	√	√	1850	145	M8C15-250
0 to 20	12	Half Rack*	0.01%	0.01%	0.5	√	√	425	65	HR20-12C
0 to 20	20	3½'' Rack	0.01%	0.01%	0.5	√	√	575	65	RS20-20B
0 to 32	1.5	Qtr. Rack*	0.01%	0.01%	0.5	√	√	219	65	HH32-1.5
0 to 40	1	Half Rack*	0.01%	0.01%	0.25	√	△	375	—	DL40-1A
0 to 40	1									(2 outputs)
0 to 40	7	Half Rack*	0.01%	0.01%	0.5	√	√	425	65	HR40-7C
0 to 40	10	Half Rack*	0.01%	0.01%	0.5	√	√	475	65	HR40-10C
0 to 40	15	3½'' Rack	0.01%	0.01%	0.5	√	√	575	65	RS40-15B
0 to 40	30	5¼'' Rack	0.005%	0.005%	1	√	√	895	Std.	M5C40-30 OV
0 to 40	50	7'' Rack	0.005%	0.005%	1	√	√	945	Std.	M7C40-50 OV
0 to 40	100	8¾'' Rack	0.005%	0.005%	1	√	√	1850	145	M8C40-100
0 to 50	1	Half Rack*	0.001%	0.001%	0.25	√	△	375	—	PLS50-1**
0 to 50	1	Qtr. Rack*	0.01%	0.01%	0.5	√	√	219	65	HH50-1
0 to 60	4	Half Rack*	0.01%	0.01%	0.5	√	√	425	65	HR60-4C
0 to 60	8	Half Rack*	0.01%	0.01%	0.5	√	√	475	65	HR60-8C
0 to 60	12	3½'' Rack	0.01%	0.01%	0.5	√	√	590	65	RS60-12B
0 to 60	20	5¼'' Rack	0.005%	0.005%	1	√	√	895	Std.	M5C60-20 OV
0 to 60	30	7'' Rack	0.005%	0.005%	1	√	√	1050	Std.	M7C60-30 OV
0 to 60	65	8¾'' Rack	0.005%	0.005%	1	√	√	1850	145	M8C60-65
0 to 160	0.3	Qtr. Rack*	0.01%	0.01%	0.5	√	√	279	—	HH160-300
0 to 160	3	Half Rack*	0.01%	0.01%	0.5	√	√	575	65	HR160-3C
0 to 160	4	3½'' Rack	0.01%	0.01%	0.5	√	√	695	90	RS160-4B
0 to 160	8	5¼'' Rack	0.005%	0.005%	1	√	√	950	120	M5C160-8
0 to 160	15	7'' Rack	0.005%	0.005%	1	√	√	1790	150	M7C160-15
0 to 320	2	3½'' Rack	0.01%	0.01%	0.5	√	√	730	—	RS320-2C

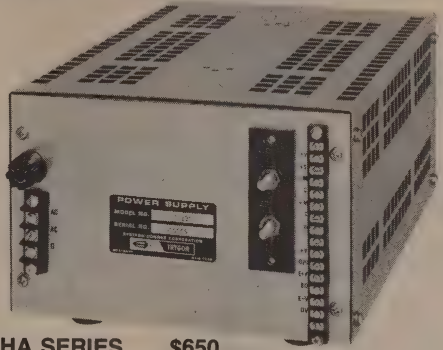
*All Half-Rack and Quarter-Rack supplies mount in 5¼'' panel height. Rack adapters are available.
**Digital dial settable, accuracy 0.1%.
†Constant voltage, adjustable constant current with automatic crossover.
△Adjustable current limiting.

SYSTRON-DONNER

SWITCHING REGULATOR MODULES

New! from the new leader in 20kHz Switchers

- High efficiency up to 82%
- High power up to 52VDC & 120 AMPS
- Soft start — low in-rush turn-on current
- Fan option for full rated high temperature operation
- Low conducted & radiated interference
- DC inputs available
- Brownout protection
- UPS applications



SHA SERIES $650
4⅞″ x 8″ x 13¾″

Voltage (Nominal)	Voltage Range (VDC)	Maximum Current (AMPS) at Nominal Voltage	Price $	OV Option $	Model	Efficiency %
1.25	1.1 to 1.4	120	650	Std	SHA 1.25-120 OV	60
3	2.7 to 3.3	120	650	Std	SHA 3-120 OV	68
5	4.5 to 5.5	120	650	Std	SHA 5-120 OV	75
12	11 to 13	56	650	50	SHA 12-56	77
15	13 to 16	45	650	50	SHA 15-45	77
24	22 to 26	30	650	50	SHA 24-30	80
28	26 to 30	25	650	50	SHA 28-25	80
48	44 to 52	15	650	50	SHA 48-15	82

SPECIFICATION HIGHLIGHTS

Input:
102-130/198-256VAC
47-440Hz, single phase

Load Effect: (Load Regulation)
0.1% for 0 to 100% of rated load

Source Effect: (Line Regulation)
0.1% for change over entire input voltage range

PARD (Ripple & Noise):
20mV RMS, 50mV Peak to Peak (20Hz to 10MHz)

Temperature Coefficient:
0.02%/°C max.

Drift:
Less than 0.1% over 8 hours

Load Effect Transient Recovery:
Less than 300usec for a 10% load step above 10% minimum load to return within regulation band

Transient Overshoot on Turn On or Turn Off:
None

Carryover Time:
30 milliseconds minimum at nominal line, full load

Operating Temperature:
−20 to +71°C
Derate 1%/°C above 40°C

Reverse Voltage Protection:
Yes

Thermal Protection with Automatic Reset:
Yes

AC Input Protection:
Fuse

Remote Sensing:
Yes

Standard Margin Voltage Programming:
±5%

Automatic Current Limiting:
Adjustable with automatic recovery

TTL Logic Inhibit Turn On/Turn Off:
Yes

SYSTRON - DONNER

POWER SUPPLY SELECTOR & PRICE LIST

Systems Modules AC to DC & DC to DC

DC to DC Converter Modules

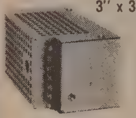
NEW

DC12-2
11″ x 7¹/₁₆″ x 6″

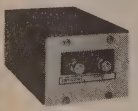
Voltage (Nominal)	Voltage Range (VDC)	Max. Current[3] (Amps)	Package Size	Load Regulation	Line Regulation	Ripple (RMS mV)	Remote Programming	Current Limiting	Price $ Non-Metered	OV Option $[2]	Model[1]
Multi-Output DC Input 24 or 48VDC	4.75 to 5.5 ± 15 Tracking	15 0.5	E	10mV	10mV	10	—	Adj.	470	30	DC3-E
DC Input 12VDC	12	2	11″ x 7¹/₁₆″ x 6″	12	12	1	—	Adj.	250	—	DC12-2

Systems Modules

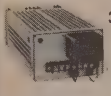
A Size Package
TP-A Super Trypack
TPZA Dual Output
3″ x 3-9/16″ x 6″


$115

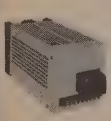
B Size Package
LV Liberator Sub Rack


LVS, LVW
3-1/8″ x 4″
x 6-1/2″
$145

C Size Package
TP-C Super Trypack
TPZC (with OVS)
3″ x 4-5/8″ x 9″


Priced from
$179 to $189

D Size Package
TP-D Super Trypack
TPZD (with OVS)
5″ x 4-5/8″
x 9-1/2″


Priced from
$189 to $195

E Size Package
TP-E Super Trypack
TPZE, TP3E, TP2E
5″ x 8″x 10″

Priced from
$249 to $289

Voltage (Nominal)	Voltage Range (VDC)	Max. Current[3] (Amps)	Package Size	Load Regulation	Line Regulation	Ripple (RMS mV)	Remote Programming	Current Limiting	Price $ Non-Metered	OV Option $[2]	Model[1]
Wide Range	0 to 12	1.4	B	0.01%	0.01%	1	√	Fixed	145	30	LVW12-1.4
	0 to 20	1	B	0.01%	0.01%	1	√	Fixed	145	30	LVW20-1
	0 to 50	0.32	B	0.01%	0.01%	1	√	Fixed	145	30	LVW50-.32
Multi Output	10 to 26 5 to 16 3.2 to 5.5	1.8 1.5 6	E	0.05%	0.05%	2	—	Fixed	289	Std.	(3 outputs[4]) TP3E
5	2.5 to 5.5	6.5	C	0.05%	0.02%	1	√	Fixed	179	Std.	TPZC5-6.5 OV
	2.5 to 5.5	10	D	0.05%	0.02%	1	√	Fixed	195	Std.	TPZD5-10 OV
	2.5 to 5.5	20	E	0.05%	0.02%	1	√	Fixed	259	Std.	TPZE5-20 OV
	3.5 to 6.5	5.4	C	0.05%	0.02%	1	√	Fixed	179	Std.	TPZC6-5.4 OV
	3.5 to 6.5	8	D	0.05%	0.02%	1	√	Fixed	195	Std.	TPZD6-8 OV
	3.5 to 6.5	16	E	0.05%	0.02%	1	√	Fixed	259	Std.	TPZE6-16 OV
	4.5 to 7.8	1.9	B	0.01%	0.01%	1	√	Fixed	145	30	LVS6-1.9
12	7.5 to 12.5	4	C	0.05%	0.02%	1	√	Fixed	179	30	TPZC12-4
	7.5 to 12.5	6	D	0.05%	0.02%	1	√	Fixed	189	45	TPZD12-6
	7.5 to 12.5	11	E	0.05%	0.02%	1	√	Fixed	249	45	TPZE12-11
	11 to 15	1.4	B	0.01%	0.02%	1	√	Fixed	145	30	LVS12-1.4
15	±11.5 to 15.5	2 X 0.5	A	0.05%	0.02%	1	—	Fixed	115	30	TPZA15D-.5[5]
	±11.5 to 15.5	2 X 1.8	C	0.05%	0.02%	1	—	Fixed	175	30	TPZC15D-1.8[5]
	11 to 16	3.6	C	0.05%	0.02%	1	√	Fixed	179	30	TPZC15-3.6
	11 to 16	5.5	D	0.05%	0.02%	1	√	Fixed	189	45	TPZD15-5.5
	11 to 16	9.5	E	0.05%	0.02%	1	√	Fixed	249	45	TPZE15-9.5
18/24	16 to 26	2.5	C	0.05%	0.02%	1	√	Fixed	179	30	TPZC24-2.5
	16 to 26	3.8	D	0.05%	0.02%	1	√	Fixed	189	45	TPZD24-3.8
	16 to 26	6.4	E	0.05%	0.02%	1	√	Fixed	249	45	TPZE24-6.4
28	22 to 33	0.75	B	0.01%	0.02%	1	√	Fixed	145	30	LVS28-.75
	20 to 30	2.4	C	0.05%	0.02%	1	√	Fixed	179	30	TPZC28-2.4
	20 to 30	3.6	D	0.05%	0.02%	1	√	Fixed	189	45	TPZD28-3.6
	20 to 30	6	E	0.05%	0.02%	1	√	Fixed	249	45	TPZE28-6
50	32 to 52	1.7	C	0.05%	0.02%	1	√	Fixed	179	30	TPZC48-1.7
	50 to 63	1.4	C	0.05%	0.02%	1	√	Fixed	179	30	TPZC60-1.4
100	60 to 110	0.6	C	0.05%	0.02%	1	√	Fixed	189	—	TPZC100-.6
150	110 to 160	0.35	C	0.05%	0.02%	1	√	Fixed	189	—	TPZC150-.35
200	160 to 210	0.24	C	0.05%	0.02%	1	√	Fixed	189	—	TPZC200-.24

1 Detailed specifications for these units on request.
2 OVS modules available for LVS, LVW and TP units. OVS modules mount externally.
3 For TP and LVW Series, current derates at low end of voltage range.
4 Incl. 3 outputs: +3.2 to +5.5 VDC (OV) @ 6A; +10 to +26 VDC @ 1.8A; —5 to —16 VDC @ 1.5A.
5 Dual output
6 Quantity prices available. Consult factory.

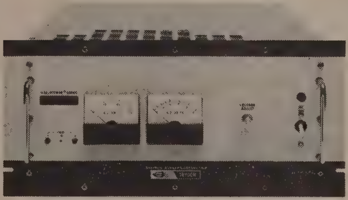
SYSTRON-DONNER

POWER SUPPLY SELECTOR & PRICE LIST

Valupower System Racks & Sub Racks

- **Low noise for IC & Systems applications**
- **Adjustable current limiting**
- **Positive convection cooling**
- **Remote sensing & programming**
- **High power up to 52VDC & 300 AMPS**
- **Low output impedance**
- **Overvoltage protection option**
- **UL design standards**
- **Automatic load share paralleling (except VPH)**

Full Rack VP SERIES
5¼″ x 19″ x 18⅛″
Priced from $645 to $725



Full Rack VPL SERIES
8¾″ x 19″ x 22″
$1195

Half Rack VPH SERIES
5¼″ x 7¾″ x 16¼″
Priced from $425 to $500

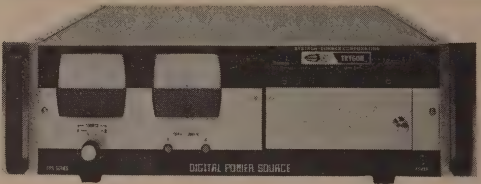
Voltage (Nominal)	Voltage Range (VDC)	Max. Current (Amps)	Package Size	Load Regulation	Line Regulation	Ripple (RMS mV)	Remote Programming	Current Limiting	Price $ Non-Metered	Price $ Metered	OV Option $	Model
5	4.75 to 5.5	60	Half Rack	0.02%	0.02%	1	√	Adj.	450	500	Std.	VPH5-60 OV
	4.75 to 5.5	135	5¼″ Rack	0.05%	0.02%	1	√	Adj.	645	695	80	VP5-135
	4.7 to 5.5	300	8¾″ Rack	0.05%	0.02%	1	√	Adj.	1195	1195	80	VPL5-300M
8	7.7 to 8.5	115	5¼″ Rack	0.05%	0.02%	1	√	Adj.	645	695	80	VP8-115
12	± 11.5 to 15.5	2x13	Half Rack	0.02%	0.02%	1	√	Adj.	450	500	50	VPHD15-13
	11 to 13	35	Half Rack	0.02%	0.02%	1	√	Adj.	425	475	50	VPH12-35
	11 to 13	90	5¼″ Rack	0.05%	0.02%	1	√	Adj.	645	695	80	VP12-90
	11 to 13	200	8¾″ Rack	0.05%	0.02%	1	√	Adj.	1195	1195	80	VPL12-200M
15	14 to 16	31	Half Rack	0.02%	0.02%	1	√	Adj.	425	475	50	VPH15-31
	14 to 16	85	5¼″ Rack	0.05%	0.02%	1	√	Adj.	645	695	80	VP15-85
	14 to 16	200	8¾″ Rack	0.05%	0.02%	1	√	Adj.	1195	1195	80	VPL15-200M
24	23 to 26	22	Half Rack	0.02%	0.02%	1	√	Adj.	435	485	50	VPH24-22
	23 to 26	60	5¼″ Rack	0.05%	0.02%	1	√	Adj.	660	710	80	VP24-60
	23 to 26	100	8¾″ Rack	0.05%	0.02%	1	√	Adj.	1195	1195	80	VPL24-100M
28	26 to 30	19	Half Rack	0.02%	0.02%	1	√	Adj.	435	485	50	VPH 28-19
	26 to 30	50	5¼″ Rack	0.05%	0.02%	1	√	Adj.	675	725	80	VP28-50
	26 to 30	100	8¾″ Rack	0.05%	0.02%	1	√	Adj.	1195	1195	80	VPL28-100M
48	46 to 52	30	5¼″ Rack	0.05%	0.02%	1	√	Adj.	675	725	80	VP48-30

SINGLE/DUAL CHANNEL DIGITAL POWER SOURCE

SYSTRON-DONNER Dual Power Supplies Digitally Controlled for OEM and Automated Test Systems

OUTSTANDING FEATURES

- Provides two independent 0 to 50V at 1 amp or 0 to 100V at 0.5 amp floating output precision power sources from digital computer input
- Programs each output independently
- Optional programmed polarity, overcurrent limit, overvoltage protection level
- Front panel meters
- Overcurrent mode indicator lights
- Addressable memory responds to only 1 preselected of 16 possible address codes. Reduces the number of total I/O circuits required.
- Fully optically isolated to eliminate ground loops and allows power supply outputs to be floated with respect to the digital inputs and one another.
- Digital input is 1 line/bit, 4 bits/digit BCD from a computer or digital tape programmer.
- Self-verification options available are data parity check flag, time delay ready flag, overcurrent alarm flag, power supply equilibration ready flag.
- Visual display of numerical input data command (optional)
- Manual programming (optional)
- One or two power sources in one 5¼" EIA cabinet



SPECIFICATION HIGHLIGHTS

Load Regulation:	+(0.001%+100uV) for 0 to full load
Line Regulation:	±(0.001%+100uV) for 10V RMS line change
Stability:	(8 hours) DPS-50 1mV DPS-100 2mV (1000 hours) DPS-50 50mV DPS-100 100mV
Temperature Coefficient:	±(0.005%+2mV)/°C, +10°C to 50°C
Recovery Time:	50usec. to within 25mV of final value for 75% rated load change
Programming Speed:	2 milliseconds max. for full scale, full load change
Linearity:	(0.005% full scale ±2mV)
Output Impedance: DC to 1kHz	0.002 ohm max.
Isolation:	300 volts DC

WRITE TODAY FOR FULL CATALOG OR CALL YOUR LOCAL SYSTRON-DONNER SALES OFFICE

How to Order:

Select the basic DPS unit, either single or dual channel and list the option(s) desired using the Option number shown

		Single Channel			
Model DPS-50 or DPS-100	$1695	Option—09 Overvoltage Programming	65	Option—19 Cable Continuity	20
Option—01 Digital Display, 3 digits	245	Option—11 Overcurrent Programming	55	Option—21 4 Digit BCD	250
Option—03 Range Control	15	Option—13 Overcurrent Flag	10	Option—23 Digital Display 4 digits	260
Option—05 Equilibration Flag	10	Option—15 Parity Check Flag	40	Option—25 12 Bit Binary	50
Option—07 Manual Control	75	Option—17 Time Delay Ready Flag	20	Option—27 Polarity Reversal (Sign)	200
		Dual Channel			
Model DPSD-50 or DPSD-100	$2260	Option—10 Overvoltage Programming	150	Option—20 Cable Continuity	40
Option—02 Dual Digital Display, 3 digits/channel	340	Option—12 Overcurrent Programming	105	Option—22 4 Digit BCD	495
Option—04 Range Controls	20	Option—14 Overcurrent Flags	15	Option—24 Digital Display 4 digits/channel	365
Option—06 Equilibriation Flags	15	Option—16 Parity Check Flags	40	Option—26 12 Bit Binary	75
Option—08 Manual Controls	75	Option—18 Time Delay Ready Flags	40	Option—28 Polarity Reversal (Sign)	250

All prices are F.O.B. Westbury, N.Y
For more information on Trygon/Systron-Donner Digital Programmers, contact your local Scientific Devices Sales Office or Trygon

5 Year Warranty on every Standard Power Supply

ORDERING INFORMATION BY MODEL

When ordering a power supply, ask for the Model number as listed in the charts and include the suffix that denotes the option desired, i.e., RS60-12B OV, that's a 60VDC, 12 amp, 3½", rack mounted unit with overvoltage protection built-in at the factory.

PRICES

Prices given for all standard models and options are FOB Factory, Westbury, New York. Any Federal, State or Local Taxes are extra. Terms are Net 30 days to rated accounts. Prices and specifications are current as of publication date. They are subject to change without notice as technical advances warrant.

DISCOUNTS

Generous quantity discounts are available on all power supplies. Contact the factory for a quotation on your specific requirements.

INSTRUCTION BOOKS

All power supplies are shipped with one copy of an instruction book. Extra instruction books may be ordered as required at $10.00 each for current models.

FORMS PREPARATION

Preparation of DD250 Forms, add $10.00 per Form Set.

SOURCE INSPECTION

For Government or Customer Source inspection, add 2%; $25.00 minimum per shipment.

FACTORY COMMUNICATIONS

Sales, Applications Engineering and Administration may be reached via any of the following.

Mail Address:

TRYGON ELECTRONICS,
Subsidiary of SYSTRON-DONNER CORP.
1200 Shames Drive, Westbury, N.Y. 11590
Telephone: (516) 997-6200
TWX Number: (510) 222-0492
WUX Address: Trygon Westbury, N.Y.
Cable Address: Trygon Westbury, N.Y.
or your local Scientific-Devices Sales Office

Most models available for European operation at slightly higher prices.

TRYGON ELECTRONICS
SUBSIDIARY

SYSTRON DONNER
CORPORATION
1200 Shames Drive, Westbury, N.Y. 11590 (516) 997-6200

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HIGH POWER FREQUENCY CONVERTERS

VTEL DIVISION • 1624 NORTH FIRST STREET • P.O. BOX 1331 • GARLAND, TEXAS 75040 • (AC 214) 276-8591 • TELEX 73-0644

CR Series 2.5 KVA to 50.0 KVA Sine Wave Output

GENERAL SPECIFICATIONS

ELECTRICAL INPUT

PARAMETER	LIMITS	NOTES
oltage Range	±10% of nominal	See detail specification below
requency Range	45-66 Hz.	
onfiguration	Three Phase	
vercurrent Protection		Circuit Breaker

ELECTRICAL OUTPUT

verload/Current limit	Up to 125%	Adjustable from 10-125%
onfiguration		See detail specification below
oltage Regulation	±1.0% under all conditions of load and temp.	Adjustable from 95-135V
requency Regulation	±0.5% under all conditions of load and temp.	Adjustable ±10% nom.; See detail specification below
armonic Distortion	2% maximum	Linear loads
ower Factor	0.70 lag to 0.70 lead for full rated power	0.2 P.F. with load ratings of 50%
ficiency	85% minimum at rated load	
otection	Overload; Short circuit; Overheat	

MECHANICAL

leters	Input/output voltmeter; output ammeter 1 φ	2% of full scale (lab models only)
dicators	Input power; Output power; Overload, Overheat	Front panel display
eight		See detail specification below
ze		See detail specification below
ooling	Self-cooled	
ontrols	Voltage, Current, and Frequency Adj.	Front panel access

ENVIRONMENTAL

mperature	Operation: 0°C to +50°C	Storage: −20°C to +71°C
oration and Shock	Normal transportation and handling	
/II	Conforms to good design practice	IAW Military requirements
midity	0 to 95% R.H., noncondensing	

equency Meter Optional — Lab models only

CR SERIES DETAIL SPECIFICATIONS

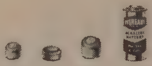
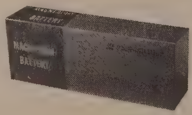
ODEL NO.	POWER RATING (KVA)	INPUT VOLTAGE (VRMS)	OUTPUT VOLTAGE (VRMS)	OUTPUT PHASE(S)	OUTPUT FREQ. (HZ)	SIZE (IN INCHES) 19" RACK MOUNT HEIGHT	SIZE (IN INCHES) 19" RACK MOUNT DEPTH	APPROX. WEIGHT (LBS.)
CR024-1	2.5	115/200	120	1 φ	400	17.5	21	185
CR054-1	5.0					17.5	21	205
CR074-1	7.5					31.5	24	240
CR104-1	10.0					31.5	24	330
CR024-3	2.5	115/200	120/208	3 φ	400	17.5	21	175
CR054-3	5.0					17.5	21	190
CR074-3	7.5					17.5	21	220
CR104-3	10.0					31.5	24	315
CR154-3	15.0					31.5	24	350
CR204-3	20.0					*82.0	*36	850
CR374-3	37.5	460	120/208	3 φ	400	*82.0	*36	2000
CR504-3	50.0					*82.0	*36	2200
CR026-1	2.5	115/200	120	1 φ	60	17.5	21	245
CR056-1	5.0					31.5	24	355
CR076-1	7.5	115/200	240	1 φ	60	31.5	24	435
CR106-1	10.0					*64.0	*36	1175
CR156-1	15.0					*64.0	*36	1400
CR206-1	20.0	460	240	1 φ	60	*82.0	*36	2000
CR026-3	2.5	115/200	120/208	3 φ	60	17.5	21	225
CR056-3	5.0					31.5	24	310
CR076-3	7.5					31.5	24	390
CR106-3	10.0					*64.0	*36	1100
CR156-3	15.0					*64.0	*36	1200
CR206-3	20.0	460	120/208	3 φ	60	*64.0	*36	1700
CR376-3	37.5	460	440	3 φ	60	**60.0	**36	3600
CR506-3	50.0					**82.0	**36	4500

Jnitized cabinets only; 25″ width.
Jnitized cabinets only; 48″ width.

Recommend The Right EVEREADY® Battery FOR THE RIGHT JOB!

"EVEREADY" BATTERY SYSTEMS AND THEIR PROMINENT FEATURES

...From the manufacturer of the most complete dry battery line in the world.

	FEATURES	APPLICATIONS
CARBON ZINC 915 950 935 216 732	Low cost, voltage drops gradually with use, variety of shapes and sizes ranging from 1.5 to 510 volts.	Radios, barricade flashers, telephone amplifiers, marine depth finders, toys, lighting systems, signaling circuits, novelties, flashlights, lanterns and fluorescent lights, cameras and flash guns, paging devices, laboratory instruments, alarm systems, remote controlled models.
HEAVY DUTY) (Zinc Chloride) 1215 1250 1235 1222 1209	Premium quality, extra life in heavy duty use, good shelf life, service life and resistance to leakage, good low temperature characteristics.	Flashlights and lanterns, transistor radios, cassette tape recorders and players, communications equipment, camera film drive, toys, pocket electronic calculators, other motor driven devices.
ALKALINE MANGANESE Primary-Secondary 	Good low temperature performance, voltage falls gradually with use, good shelf life, low impedance, 50 to 100 percent more energy than carbon-zinc batteries, high efficiency under continuous or heavy-duty high-drain conditions.	Radios, heated clothing, bicycle lights and horns, shavers, electronic photoflash, lighting systems, movie cameras, radio-controlled models, model-plane ignition, toys, television sets, cassette tape recorders and players. Pocket electronic calculators, oceanographic instruments and buoys. Portable communication systems.
MERCURIC OXIDE 	Excellent high-temperature performance, constant voltage under discharge, long shelf life, high energy density per unit volume.	Secondary voltage standard, radios walkie-talkies, paging devices, radiation detection, test equipment, hearing aids, transistorized instruments, electronic watches, clocks.
SILVER OXIDE 	Constant voltage under discharge, good low-temperature performance, excellent shelf life.	Hearing aids, electric / electronic / digital watches, reference voltage source, photoelectric exposure devices, instruments, wireless microphones, electronic thermometers.
MAGNESIUM 	Reliable, lightweight, high performance, excellent high temperature storage capabilities.	Military electronic communications and portable radar equipment.

Union Carbide Corporation provides a consulting service of experienced battery engineers as an aid to manufacturers in need of special battery designs. For help with your specific battery problems, call (212) 551-3833 or write Battery Engineering Dept. No. 18 in New York (address shown below.)

"Eveready", "Energizer", Cat with "Nine Lives", "Mini-Max", "Hot Shot", "Columbia", and "Gray Label" are trademarks of

UNION CARBIDE CORPORATION
BATTERY PRODUCTS DIVISION
270 Park Avenue, New York, N. Y. 10017
Sales Offices: Atlanta, Cherry Hill, N. J., Chicago, Cleveland, Dallas, Needham Heights, Mass., San Francisco, Westwood, N. J.

Recommend The Right EVEREADY® Battery FOR THE RIGHT JOB!

NICKEL-CADMIUM *Rechargeable* BATTERIES

- High rate energy source
- Rechargeable
- Stacks of button cells made to order
- High cycle life
- Fast Charge Types
- Rugged and dependable batteries
- Cylindrical cell batteries custom designed to your specifications

FEATURES Hermetically sealed high cycle life maintenance free, relatively constant discharge voltage, good high and low-temperature performance, competitive to other battery systems in terms of cost per hour of use, high resistance to shock and vibration, button and cylindrical configurations, long life, low self-discharge rate, high effective capacitance. Fast charge capabilities.

BATTERY PACKS: 6.25 Volts to 15 Volts

"Eveready" Battery No.	Voltage	Capacity	Dimensions			Weight	
			Length	Width	Height	lbs.	oz.
1007	10	4Ah	6 13/32	3 3/32	3 1/8	3	13.0
N64	14.4	500mAh	2 7/8	2 51/64	1 21/64	—	12.5
N65	15	1Ah	7.32	1.46	3.10	1	11.0
N67	6.25	900mAh	1 17/32	1 17/32	3 53/64	—	8.3
N70	6.25	1.5Ah	3 7/8	1 9/16	3 21/32	1	12.0
N86	12.5	1.2Ah	5 1/32	2 1/32	2 31/64	1	8.0
N88	8.75	90mAh	1 3/64	39/64	1 15/16	—	1.5
N91	6.25	1.2Ah	5 1/32	1 1/32	2 31/64	—	10.0
N310000	7.5	1.2Ah	2	3	1 29/32	—	11.5
N310001	6.25	1.2Ah	5	1	1 29/32	—	10.0

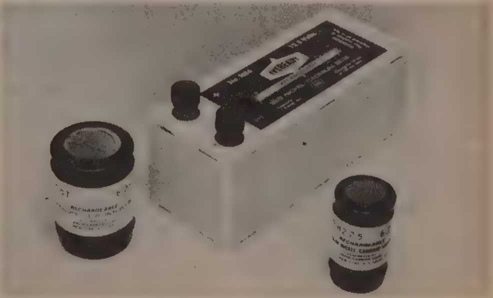
APPLICATIONS Portable lawn and garden tools and appliances, shavers, toothbrushes, photoflash equipment, dictating machines, movie cameras, instruments, portable communication equipment, tape recorders, slide projectors, radios, television sets, blenders, pocket electronic calculators, alarm systems, office equipment.

Union Carbide Corporation provides a consulting service of experienced battery engineers as an aid to manufacturers in need of special battery designs. For help with your specific battery problems, call (212) 551-3833 or write Battery Engineering Dept. No. 18 in New York (address shown below).

CYLINDRICAL CELLS: 150 mAh to 4 Ah High Rate (H) & Fast Charge (F) Types

"Eveready" Battery No.	Voltage	Capacity	Cell Type	Max. Dimensions		Approx. Weight (ounces)
				Diam. (inches)	Height (inches)	
CH150	1.25	150mAh	"N"	0.475	1.135	0.3
CF225	1.25	225mAh	—	0.675	0.646	0.4
CH225	1.25	225mAh	—	0.675	0.646	0.4
CF450	1.25	450mAh	—	0.675	0.116	0.72
CH450	1.25	450mAh	—	0.675	0.116	0.72
CF500	1.25	500mAh	"AA"	0.563	1.969	0.8
CH500	1.25	500mAh	"AA"	0.563	1.969	0.8
CF1	1.25	1Ah	"Short C"	1.034	1.165	1.8
CH1	1.25	1Ah	"Short C"	1.034	1.165	1.8
CF1.2	1.25	1.2Ah	"SUB C"	0.900	1.684	1.9
CH1.2	1.25	1.2Ah	"SUB C"	0.900	1.684	1.9
CH1.8	1.24	1.5Ah	"C"	1.031	1.969	2.3
CH2.2	1.25	2.2Ah	"1/2 D"	1.344	1.508	3.2
CF4	1.25	4Ah	"D"	1.31	2.400	5.4
CH4	1.25	4Ah	"D"	1.31	2.390	5.4

"Eveready" Fast Charge cells have the ability to accept high rate charge currents and become fully charged in three hours or less. These new cells can also withstand occasional overcharging, at the three hour rate, for up to three days without adversely affecting cell performance. To achieve this, regular nickel-cadmium battery chargers can be used. These cells may also be charged at the one hour rate with simple thermal controls. The use of the thermal control or cutout in our fast charge concept also permits various modes of charging operation.



BUTTON CELLS: 20 mAh to 1 Ah

"Eveready" Battery No.	Voltage	Capacity	Max. Dimensions		Approx. Weight (ounces)
			Diameter (inches)	Height (inches)	
B20	1.25	20mAh	0.457	0.213	0.04
B50	1.25	50mAh	0.610	0.235	0.12
OB90 (oval)	1.25	90mAh	1.012x-0.559	0.236	0.2
B150	1.25	150mAh	0.992	0.272	0.4
B225	1.25	225mAh	0.992	0.358	0.44
BH225	1.25	225mAh	0.992	0.358	0.46
BH500	1.25	500mAh	1.360	0.394	1.0
BH1	1.25	1Ah	1.980	0.394	2.0

"Eveready", "Energizer", Cat with "Nine Lives", "Mini-Max", "Hot Shot", "Columbia", and "Gray Label" are trademarks of

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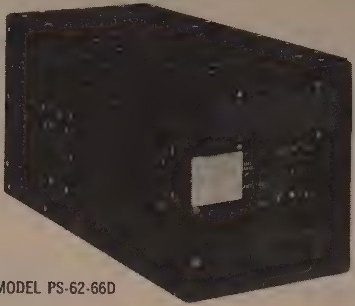
FREQUENCY CONVERTERS

400 Hz to 60 Hz

SINE WAVE OUTPUT

Meets Applicable MIL Specifications for Airborne and Ground Support Equipment



MODEL PS-62-66D

FEATURES

■ High efficiency ■ RFI protection ■ Short circuit and overload protection ■ Long, maintenance-free operation ■ Self-contained cooling ■ Light weight ■ Low distortion

APPLICATIONS

These converters provide a dependable source of 60 Hz sine wave power for airborne and air-transportable test equipment. They are also used with 60 Hz ground equipment wherever primary power available is 400 Hz. Applications include use with oscilloscopes, metering equipment, recorders, cryptographic machines, and teletypes.

MODEL	POWER	INPUT (VAC*)	OUTPUT (VAC†)	SIZE (Dim. in Inches)	WT. (Lbs.)
PS-65-225-7	400 VA	115/200	115 ± 5%	7.8 x 5.2 x 21.3	27
PS-64-162	750 VA	115/200	115 ± 5%	7.5 x 12.0 x 20.5	63
PS-69-359	2000 VA	115/200	115 ± 2.5%	10.0 x 9.0 x 21.6	80
PS-62-66D	3500 VA	115/200	115 ± 2.5%	10.0 x 9.0 x 21.6	95
PS-61-33D	8000 VA	115/200	115 ± 2.5%	12.2 x 20.0 x 23.5	230

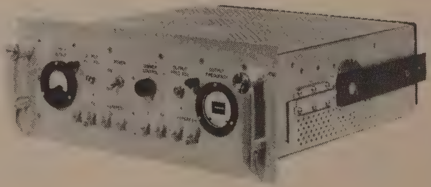
*All units available with other input voltages, and frequencies of 360-1000 Hz.
†All standard units available with frequency regulation of ±1.0%. Tighter regulation available on special request.

FREQUENCY CONVERTERS

60 Hz to 400 Hz

SINE WAVE OUTPUT

Meets Applicable MIL Specifications for Shipboard and Ground Support Equipment



MODEL PS-65-243-1

FEATURES

■ High efficiency ■ Small size ■ Light weight ■ Low distortion ■ Virtually no audible noise ■ Long, maintenance-free operation ■ Short circuit and overload protection ■ RFI protection

APPLICATIONS

Extremely stable and quiet-operating, these converters are excellent for flight simulators, and wherever 400 Hz power is required to operate airborne-type equipment. Other applications include ground support systems, design and test labs, and shipboard installations.

MODEL	POWER	INPUT (VAC)	OUTPUT (VAC†)	SIZE (Dim. in Inches)	WT. (Lbs.)
PS-65-243-1	1000 VA	115**	115 ± 2%	7.0 x 19.0 x 20.5	87
PS-67-325R	2000 VA	115/200**	115 ± 2%	17.5 x 19.0 x 21.5	150
PS-67-326R	2500 VA	115/200**	115/200 ± 2%	17.5 x 19.0 x 21.5	165
PS-68-346R	3500 VA	115/200**	115 ± 2%	17.5 x 19.0 x 21.5	190
PS-65-216-2	8000 VA	115/200§	115/200 ± 2%	19.3 x 19.0 x 21.8	264
PS-70-367R	10000 VA	115/200§	115/200 ± 2%	19.3 x 19.0 x 21.8	295

†All standard units available with frequency regulation of ±1.0%. Tighter regulation available on special request.
**Input frequency 47-63 Hz. §Input frequency 47-420 Hz.

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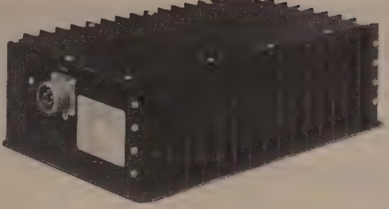
UNITRON
INCORPORATED

STATIC INVERTERS

28 VDC to 400 Hz

SINE WAVE OUTPUT

Meets Applicable MIL Specifications for Airborne and Ground Support Equipment



MODEL 4SI-500-1P

FEATURES

■ Overload and short-circuit protected ■ High efficiency ■ Light weight ■ Voltage-regulated ■ Low distortion ■ Stable output frequency ■ Long, maintenance-free operation ■ Virtually no audible noise ■ RFI protection

APPLICATIONS

These inverters are ideal for providing AC power from DC sources to one or more items of airborne equipment, and also are excellent sources of power for 400 Hz ground support equipment. Typical applications include use with weather radar, Doppler navigation systems, artificial horizons, omni's, autopilots, ADF, DME, transceivers, transponders, and engine analyzers.

MODEL	POWER	INPUT (VDC)	OUTPUT (VAC†)	SIZE (Dim. in Inches)	WT. (Lbs.)
4SI-125-1P	125 VA	24 to 32	115 ± 2%	3.4 x 6.0 x 9.7	9
4SI-250-1P	250 VA	24 to 32	115 ± 2%	4.2 x 6.5 x 11.2	14
4SI-500-1P	500 VA	24 to 32	115 ± 2%	4.2 x 8.7 x 14.7	25
4SI-750-3P	750 VA	24 to 32	115/200 ± 2%	7.7 x 10.2 x 17.4	47
PS-68-350	3000 VA	22.5 to 30	115/200 ± 3%	19.9 x 21.6 x 25.3	355

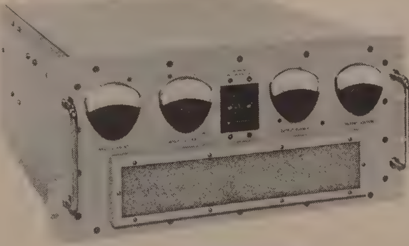
†All standard units available with frequency regulation of ±1.0%. Tighter regulation available on special request.

STATIC INVERTERS

28 VDC to 60 Hz

SINE WAVE OUTPUT

Meets Applicable MIL Specifications for Airborne and Ground Support



MODEL PS-67-324-1

FEATURES

■ High efficiency ■ Light weight ■ Small size ■ Low distortion ■ Virtually no audible noise ■ Long, maintenance-free operation ■ Short circuit and overload protection ■ RFI protection.

APPLICATIONS

For aircraft instrumentation systems with 28 VDC electrical systems, and for flying laboratories, these instruments provide an excellent source of 60 Hz power. Applications for these inverters include power for oscilloscopes, meters, cryptographic machines, teletypes, and recorders.

MODEL	POWER	INPUT (VDC)	OUTPUT (VAC†)	SIZE (Dim. in Inches)	WT. (Lbs.)
PS-65-178B	250 VA	24 to 32	115 ± 2%	7.9 x 10.4 x 14.0	35
PS-65-236	500 VA	24 to 32	115 ± 2%	7.9 x 10.4 x 17.3	65
PS-63-81A	1000 VA	24 to 32	115 ± 2%	8.8 x 19.0 x 20.2	100
PS-67-324-1	2000 VA	24 to 32	115 ± 5%	8.8 x 19.0 x 20.0	178
PS-64-154-1	3600 VA	24 to 32	115 ± 5%	13.0 x 22.8 x 24.4	260

†All standard units available with frequency regulation of ±1.0%. Tighter regulation available on special request.

"ALSO SEE PAGE 1•1513 FOR HIGH POWER FREQUENCY CONVERTERS"

UNITRON
INCORPORATED

AI & AC SERIES VERSATILE MODULAR INVERTERS AND CONVERTERS

UNITRON
INCORPORATED
SPECIALISTS IN SOLID
STATE POWER CONVERSION

STATIC INVERTERS

50, 60 and 400 Hz, SINGLE PHASE

AI Series 250 VA, 500 VA, 1000 VA 1 ϕ Sine Wave Output

GENERAL SPECIFICATIONS

PARAMETER	LIMITS	NOTES
ELECTRICAL INPUT		
Voltage Range	Normal: 21-32 VDC (meets specifications)	See detail specification below. Abnormal operation (degradation of specifications): 20-21 VDC and 32-33 VDC
Maximum Current		See detail specification
Over/Undervoltage protection	Turns off when ± 15% of nominal voltage is exceeded	
Transient protection	In accordance with MIL-STD-704A	
Reverse Voltage	No damage	
ELECTRICAL OUTPUT		
Overload/Current Limit	Up to 150%	Consult factory for possible effect on other standard electrical parameters
Configuration*	Single phase	
Voltage Regulation	±2.0% under all conditions of normal line, load and temperature	See also Option 7
Frequency Regulation	±0.05% under all conditions of normal line, load and temperature	See also Option 17
Harmonic Distortion		See detail specification
Power Factor	0.75 lagging to 0.90 leading	
Efficiency	80% minimum at rated load	
Overshoot/undershoot	100% load change: ± 10% of nominal voltage 10% input step: ±5% of nominal voltage	
Protection	Overload; Short circuit; overvoltage	
Response Time	50/60 Hz: 50 milliseconds; 400 Hz: 20 milliseconds	
MECHANICAL		
Weight		See detail specification
LWH	19" x 5¼" x 19" (rack mount)	See Option No. 21 for slides
Cooling	Self cooled	
ENVIRONMENTAL		
Temperature	Operation: −40°C to +55°C Storage: −62°C to +85°C	See also Option 1
Altitude	Operating: 10,000 ft. Storage: 50,000 ft.	For increased altitude requirements, contact factory
Vibration	Normal transportation and handling IAW MIL-STD 202, Method 201A	See also Options 4, 5 and 6
Shock	Normal transportation and handling IAW MIL-STD 202, Method 203A	
EMI	Conforms to good design practice	See also Option 2
Humidity	IAW MIL-STD 810B Method 507, Procedure 1	

*See Option 15 for 3-phase arrangement

"ALSO SEE PAGE 1•1513 FOR HIGH POWER FREQUENCY CONVERTERS"

50, 60 AND 400 Hz 1 ϕ STATIC INVERTERS

AI SERIES STATIC INVERTERS DETAIL SPECIFICATIONS

MODEL NO.	POWER RATING (VA)[1]	MAXIMUM CURRENT (Amps)(1)	HARMONIC DISTORTION	OUTPUT FREQUENCY (Hz)	OUTPUT VOLTAGE (V_{RMS})	APPROX. WEIGHT (LBS.)[2]
AI-2800-5102	250	27	THD 2.0%;	50	115	20
AI-2800-5105	500	52	no single harmonic			25
AI-2800-5110	1000	102	over 1.0%			30
AI-2801-5102	250	27	THD 2.0%;	50	230	20
AI-2801-5105	500	52	no single harmonic			25
AI-2801-5110	1000	102	over 1.0%			30
AI-2800-6102	250	27	THD 2.0%;	60	115	20
AI-2800-6105	500	52	no single harmonic			25
AI-2800-6110	1000	102	over 1.0%			30
AI-2800-4102	250	27	THD 3.0%;	400	115	20
AI-2800-4105	500	52	no single harmonic			25
AI-2800-4110	1000	102	over 2.0%			30

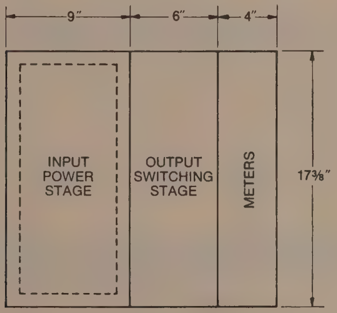
(1) At worst case condition. 21 VDC input, 150% load.

(2) All weights vary slightly depending on options.

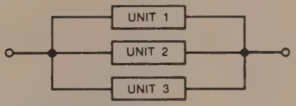
BUILT-IN SPECIAL FEATURES ALLOW VERSATILITY OF OPERATION

INCREASED POWER OUTPUT

By virtue of modular design of series AI and AC units, previously purchased inverters and converters can be factory modified for increased output power capability up to 1000 VA. This modification can be accomplished economically thereby maximizing the use of already procured units when power demands grow.

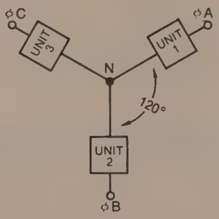


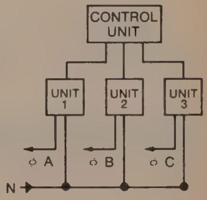
Units may also be connected in parallel for increased power output; e.g., three 1 KVA units for a 3 KVA, 1 ϕ output. See Option 18.



3-PHASE OPERATION

Single phase units may be arranged in a wye configuration for a 3-phase output. Necessary power distribution unit and keyed interconnection cables furnished on request. See Option 15.





POWER
UNITRON

UNITRON
INCORPORATED
SPECIALISTS IN SOLID
STATE POWER CONVERSION

FREQUENCY CONVERTERS

50, 60 AND 400 Hz, SINGLE PHASE

AC Series 250 VA, 500 VA, 1000 VA Sine Wave Output

GENERAL SPECIFICATIONS

PARAMETER	LIMITS	NOTES
ELECTRICAL INPUT		
Voltage Range	Normal (meets specification): ± 10% of nominal	See detail specification below. Abnormal operation (degradation of specifications): between ± 10% and ± 15% of nominal
Maximum Current		See detail specification below
Configuration*		See detail specification below
Over/undervoltage protection	Turns off when ± 15% of nominal voltage is exceeded	
Transient protection	In accordance with MIL-STD-704A	
Overcurrent Protection		Electronic sense and circuit breaker
ELECTRICAL OUTPUT		
Overload/Current limit	Up to 150%	Consult factory for possible effect on other standard electrical parameters
Configuration	Single phase	
Voltage Regulation	±2.0% under all conditions of normal line, load, and temperature	See also Option 7
Frequency Regulation	±0.05% under all conditions of normal line, load and temperature	See also Option 17
Harmonic Distortion		See detail specification below
Power Factor	0.75 lagging to 0.90 leading	
Efficiency	85% minimum at rated load	
Overshoot/undershoot	100% load change: ± 10% of nominal voltage 10% input step: ±5% of nominal voltage	
Protection	Overload; Short circuit; overvoltage	
Response Time	50/60 Hz: 50 milliseconds 400 Hz: 20 milliseconds	
MECHANICAL		
Weight		See detail specification below
LWH	19″ x 5¼″ x 19″ (rack mount)	See Option 21 for slides
Cooling	Self-cooled	
ENVIRONMENTAL		
Temperature	Operation: −40°C to +55°C Storage: −62°C to +85°C	See also Option 1
Altitude	Operating: 10,000 ft. Storage: 50,000 ft.	For increased altitude requirements contact factory
Vibration	Normal transportation and handling IAW MIL-STD 202, Method 201A	See also Option 4, 5, and 6
Shock	Normal transportation and handling IAW MIL STD 202, Method 203A	
EMI	Conforms to good design practice	See also Option 2
Humidity	IAW with MIL-STD 810B, Method 507, Procedure I	

*See Option 15 for 3 φ arrangement systems.

"ALSO SEE PAGE 1•1513 FOR HIGH POWER FREQUENCY CONVERTERS"

AC SERIES FREQUENCY CONVERTERS

DETAIL SPECIFICATIONS

50 Hz 1 ø FREQUENCY CONVERTER

MODEL NO.	POWER RATING (VA)	HARMONIC DISTORTION	INPUT DATA			OUTPUT VOLTAGE (V_{RMS})	APPROX. WEIGHT (LBS.)(1)
			VOLTAGE (V_{RMS})	PHASE(S)	FREQUENCY (Hz)		
AC-5100-5102	250	Total Harmonic Distortion of 2.0%, No single harmonic over 1.0%	115	1 φ	47-440	115	32
AC-5100-5105	500						38
AC-5100-5110	1000						44
AC-5300-5102	250		115/200	3 φ	47-440	115	27
AC-5300-5105	500						32
AC-5300-5110	1000						41
AC-4100-5102	250		115	1 φ	360-440	115	21
AC-4100-5105	500						23
AC-4100-5110	1000						27
AC-4300-5102	250		115/200	3 φ	360-440	115	20
AC-4300-5105	500						22
AC-4300-5110	1000						25
AC-5101-5102	250		115	1 φ	47-440	230	32
AC-5101-5105	500						38
AC-5101-5110	1000						44
AC-5301-5102	250		115/200	3 φ	47-440	230	27
AC-5301-5105	500						32
AC-5301-5110	1000						41
AC-4101-5102	250		115	1 φ	360-440	230	21
AC-4101-5105	500						23
AC-4101-5110	1000						27
AC-4301-5102	250		115/200	3 φ	360-440	230	20
AC-4301-5105	500						22
AC-4301-5110	1000						25
60 Hz 1 ø FREQUENCY CONVERTER							
AC-5100-6102	250	Total Harmonic Distortion of 2.0%, No single harmonic over 1.0%	115	1 φ	47-440	115	32
AC-5100-6105	500						38
AC-5100-6110	1000						44
AC-5300-6102	250		115/200	3 φ	47-440	115	27
AC-5300-6105	500						32
AC-5300-6110	1000						41
AC-4100-6102	250		115	1 φ	360-440	115	22
AC-4100-6105	500						23
AC-4100-6110	1000						27
AC-4300-6102	250		115/200	3 φ	360-440	115	20
AC-4300-6105	500						22
AC-4300-6110	1000						25
400 Hz 1 ø FREQUENCY CONVERTER							
AC-5100-4102	250	Total Harmonic Distortion of 3.0%, No single harmonic over 2.0%	115	1 φ	47-440	115	32
AC-5100-4105	500						38
AC-5100-4110	1000						44
AC-5300-4102	250		115/200	3 φ	47-440	115	27
AC-5300-4105	500						32
AC-5300-4110	1000						41
AC-4100-4102	250		115	1 φ	360-440	115	21
AC-4100-4105	500						23
AC-4100-4110	1000						27
AC-4300-4102	250		115/200	3 φ	360-440	115	20
AC-4300-4105	500						22
AC-4300-4110	1000						25

(1) All weights vary slightly depending on options.

"ALSO SEE PAGE 1•1513 FOR HIGH POWER FREQUENCY CONVERTERS"

AI AND AC SERIES OPTIONS*

OPTION NO.	DESCRIPTION
1.	Temperature Range: −54°C to +65°C IAW MIL-E-5400N, MIL-E-16400F, and MIL-E-4158E
2.	EMI IAW MIL-STD-461A (radiated and conducted)
3.	Shock: 15g for 11 milliseconds IAW MIL-STD-810B, Method 516.1, Procedure I, Figure 516. 1-2 (a) and (c)
4.	Vibration (Ground Equipment and Common Carrier) IAW MIL-STD-810B, Curve AX and AY, Procedure X.
5.	Vibration (Aircraft Equipment) IAW MIL-E-5400N, Curve II and III; and MIL-STD-810B, Curve C, Procedure I
6.	Vibration (Transport Equipment) IAW MIL-STD-167, Type I; and MIL-E-16400F
7.	Output Voltage Adjustable for 95-135 VRMS via front panel control (not available with paralleled, phase locked or externally synchronized units)
8.	Output Current Limit Adjustable from 10-150% of rated current via front panel control (not available with paralleled, phase locked, or externally synchronized units)
9.	Output Frequency Adjustable 15% of nominal (not available with paralleled, phase locked, or externally synchronized units)
10.	Multiple Fixed frequency operation, switch selected (not available with paralleled, phase locked, or externally synchronized units)
11.	230 VRMS, single phase input
12.	230 VRMS, three phase input
13.	230 VRMS, single phase output
14.	230/400 VRMS, three phase output
15.	115/200 VRMS, three phase output (phase-locked) system
16.	External synchronization from pulse, sine, or complex wave form (contact factory for specific signal)
17.	Precision frequency tolerance of .003%
18.	Parallel operation up to four units
19.	Output waveform — 1% THD
20.	Elapsed time indicator (internal)
21.	Slide Mounting
22.	Size; decreased depth on special request
	METERS (Limit four meters per panel)
23.	Frequency meter, dial and pointer
24.	Frequency meter, Reed type
25.	Running time meter
26.	Input ammeter, pointer type
27.	Output ammeter, pointer type
28.	Input voltmeter, pointer type, expanded scale
29.	Output voltmeter, pointer type, expanded scale
30.	Deluxe metering package: Four place digital LED readout for switch selectable input/output functions

*Consult factory for compatibility with other options and possible effect on other standard parameters.

PART NO. DEFINITION

AI - 2803 - 4110

INVERTER SERIES

POWER RATING
02 — 250 VA
05 — 500 VA
10 — 1000 VA

OUTPUT CONFIGURATION
1: Single phase
3: Three phase

OUTPUT FREQUENCY
4: 400 Hz
5: 50 Hz
6: 60 Hz

AC - 5301 - 6105

FREQUENCY CONVERTER SERIES

INPUT FREQUENCY
4: 400 Hz
5: 50/60 /400 Hz

INPUT PHASE
1: Single phase
3: Three phase

ASSIGNED BY FACTORY FOR OPTION GROUPING

"ALSO SEE PAGE 1•1513 FOR HIGH POWER FREQUENCY CONVERTERS"

UNITRON

SPECIALISTS IN SOLID STATE POWER CONVERSION

1624 NORTH FIRST STREET • P.O. BOX 1331 • GARLAND, TEXAS 75040 • (AC 214) 276-8591 • TELEX 73-0644

UNITRON
INCORPORATED

Specialist in Solid State Power Converters, Uninterruptible Power Systems and Adjustable Speed Motor Drives

SELECTING THE RIGHT POWER SOURCE

Frequency converter, 2500 VA continuous, 12 KVA intermittent. 60 pounds.

MINIMIZING SIZE, WEIGHT, AND COST

Unitron has for thirteen years specialized in the design and manufacture of power converters, uninterruptible power systems, and variable speed motor drives to meet exacting specifications for both industrial and defense/aerospace requirements of airborne, ground support, and facility environments. By providing units for use in such a variety of applications, it has become evident that over-specifying waveform and regulation characteristics is primarily responsible for undue penalties of size, weight, and cost of power conditioners. Unitron's experienced application engineers are anxious to assist the system designer in arriving at a specification which assures proper operation of end item equipment while avoiding needless penalties.

SINEWAVE SOURCES

A complete product line of inverters and frequency converters which provide precision sinewave power is available from Unitron. Some of these units are described on the following pages, each having proven themselves through many years of reliable performance under a multitude of operating conditions. Primarily sinewave power is necessary where distortion-sensitive loads such as computers, communication equipment, data collection and dissemination equipment, and video display equipment are being considered.

NON-SINUSOIDAL SOURCES

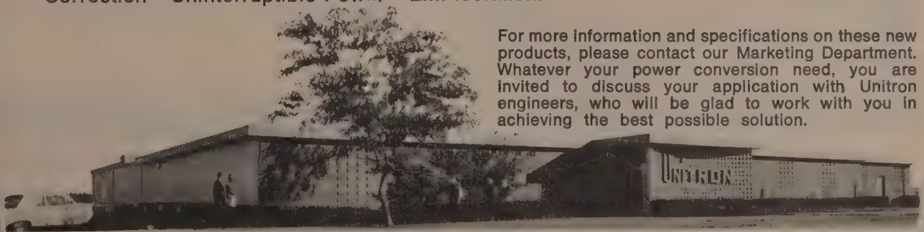
Most loads are specified in terms of sinusoidal, highly regulated power input which is not necessarily required for optimum operation. Unitron has available power conversion units which through the use of integrated circuits for complex waveform generation, provide a preconditioned, non-sinusoidal output that is particularly suitable for high-current-inrush-demanding loads such as various combinations of motors, fans, and/or heaters. Such loads generally do not require a sinewave source; thus maximum advantage of size, weight, efficiency, and cost can be taken by selecting the proper unit from Unitron's non-sinusoidal power sources. These units can be made available with either variable or fixed frequency and/or voltage outputs. They are capable of delivering high inrush currents when needed by systems containing air conditioning, galley equipment, teletypes, recorders, just to list a few examples.

OTHER CONSIDERATIONS

The proper selection of a solid state power conversion unit can also offer other advantages to an overall system capability and performance. Such advantages are:

Power Source Independence ▪ Environmental Control ▪ Reduction of Input Power Transients ▪ Extended Component Life ▪ Reduced Audio Noise Level ▪ Power Factor Correction ▪ Uninterruptible Power • EMI Isolation.

For more information and specifications on these new products, please contact our Marketing Department. Whatever your power conversion need, you are invited to discuss your application with Unitron engineers, who will be glad to work with you in achieving the best possible solution.



1624 N. FIRST ST. ▪ P.O. BOX 1331 ▪ GARLAND, TEXAS 75040 ▪ (214) 276-8591 ▪ TELEX 73-0644

ADJUSTABLE HIGH VOLTAGE DC POWER SUPPLIES

- **VOLTAGE RANGES TO 300,000 VOLTS DC**
- **CONSERVATIVELY RATED — HIGH RELIABILITY**
- **REVERSIBLE POLARITY**
- **FULLY SELF-PROTECTING**
- **OPTIONAL "APPLICATIONS ORIENTED" CONTROLS**

ADJUSTABLE OUTPUT POWER SUPPLIES

Series "BA" adjustable power supplies and series "BP" power packs are available at voltage ratings from 1 KVDC through 2000 KVDC at output power ratings from 1 watt to 250 kilowatts continuous. The adjustable series includes applications oriented control features and package design as shown in photos A and B. The power pack series (photos C and D) has many applications in OEM systems and for general laboratory use.

Every UVC power supply includes conservatively rated high voltage components designed and manufactured under the strict control of the specialized UVC technical staff to insure continuous duty, long term, trouble free operation. A one year factory backed and field supported warranty policy accompanies each shipment.

LOOK AT THESE FEATURES

1. Ripple. Each power supply offers a standard ripple specification of 5% maximum or better. Optional filters and attenuators are available for every UVC supply to reduce ripple to as low as .01% rms.

2. Polarity. Each power supply offers the flexibility of reversible output polarity performance.

3. Protection. Overvoltage and overcurrent protection features are available as both adjustable range and fixed value circuits. All access areas and doors are interlocked for personnel protection and all energy storage components and circuits are discharge protected for personnel protection.

4. Package. Rack mounted, floor and bench operable as well as portable design are among the packages available for UVC standard high voltage power supplies.

WRITE OR PHONE FOR THESE SPECIFIC BULLETINS FOR COMPLETE INFORMATION:

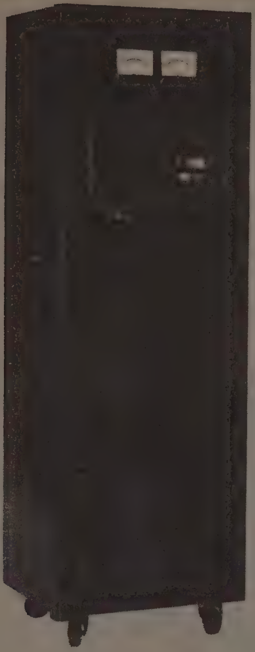
BA 70-10 ADJUSTABLE HIGH VOLTAGE DC POWER SUPPLIES

BPE 70-5 HIGH VOLTAGE DC POWER PACKS ENCAPSULATED

BPO 70-5 HIGH VOLTAGE DC POWER PACKS OIL IMMERSED

UNIVERSAL VOLTRONICS CORPORATION
27 Radio Circle Drive, Mount Kisco, N.Y. 10549
(914) 241-1300

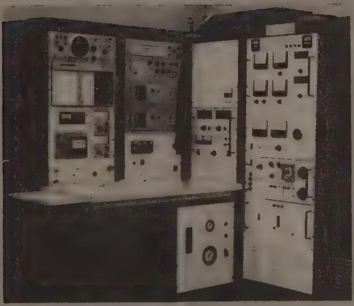
PRECISION REGULATED HIGH VOLTAGE DC POWER SUPPLIES



PRECISELY REGULATED EQUIPMENT

Precisely regulated performance over wide adjustment range, low ripple, fast response and high stability enable the series "BRE" power supplies to be used in exacting work for X-Ray Spectroscopy, electron microscopes, TWT's, ion bombardment experiments, particle separators.

These precisely regulated power supplies are available in voltage ratings from 1 KV through 500 KVDC at continuous duty output power up to 100 KW. Our regulation circuitry techniques realize performance specifications which are virtually independent of input line variations or no load-full load changes. Ripple in most cases is 0.01% rms and the output polarity is available as both fixed and reversible. Two voltage adjustment schemes are offered, namely digital dialable control for the most exacting applications and continuous coarse and vernier controls. In the digital dialable scheme, we allow for adjustment in increments of 10 KV, 1 KV, 100 volts, 10 volts, 1 volt and 0-1 volt vernier. This system provides the assurance that the actual output is always within 1% of the dial readings. As indicated you may select a coarse, and vernier voltage adjustment scheme and realize economic savings without sacrificing basic regulated performance. Regulation accuracy of ± 0.25%; ±0.1%; ±0.05% and ±0.01% for line or load changes is available on most series "BRE" power supplies.



TWT/CFA POWER SUPPLY SYSTEMS

Chances are your TWT tubes were production tested by a UVC Power Supply.

As a matter of record, UVC has been supplying power supplies to leading TWT manufacturers for low, medium and high power TWT's that not only satisfy the demanding requirements of TWT production, quality control and life testing, but in-the-field performance and reliability as well.

You can forget about power problems when you marry your TWT's to UVC Black Boxes.

They are available with Cathode, Heater, Collector, Anode and Helix outputs. Each UVC Black Box system features: PULSED OR CW OPERATION, TURN ON/OFF SEQUENCE CONTROL TO INSURE SAFE AND PROPER PERFORMANCE, FAST-ACTING CROWBAR PROTECTION.

WRITE OR PHONE FOR THESE SPECIFIC BULLETINS FOR COMPLETE INFORMATION:

BRE 70-10 REGULATED HIGH VOLTAGE DC POWER SUPPLIES

BRE 70-11 TWT TEST SETS

UNIVERSAL
VOLTRONICS
CORPORATION
27 Radio Circle Drive, Mount Kisco, N.Y. 10549
(914) 241-1300

HIGH VOLTAGE TERMINATIONS AND DIVIDERS

TERMINATIONS

UVC high voltage terminations and connection links have been designed and fabricated specifically for use in high voltage applications requiring careful attention to terminal and connection problems. The standard terminations have been manufactured in a variety of geometrical configurations which have been chosen for their well-defined corona and leakage onset characteristics. Accurate machining and polishing, along with adequate theoretical and field experience on these terminals have given UVC the ability to advise on a particular size, shape or spacing for a particular application or site condition.

Corona-free terminations are vital in high voltage work, as corona stress reduction eliminates generated radio interference and the deterioration of insulation. Carefully designed high voltage terminations represent the most fundamental and successful method of eliminating insulation break down and corona discharge problems. This is especially true with organic insulating materials such as varnishes, bonds, cellulose, natural rubber, neoprene, etc.

Basic electrostatic theory shows that sharp points, edges, corners, etc. represent discontinuities in the mapping of equipotential surfaces. It is precisely these discontinuities that create unpredictable high voltage performance. Capping these points with a simple conducting termination eliminates the high stress points (discontinuities) in favor of a more linear distribution of voltage gradients.

DIVIDERS

UVC offers five types of voltage dividers for measurement of various types and shapes of high voltages. Selection of a voltage divider type depends upon the shape of measured voltage and the kind of information required.

These dividers may also be used for measurement and/or sensing of special high voltage transients. They are optimized in such a way as to drain a minimum of power from the voltage source and can be placed within close proximity to grounded objects without significant interferences on the divider ratio.

The low voltage components are enclosed in the bottom cylinder, which is made of steel for the purpose of shielding. The BNC connector for connections of instruments and the attenuating switch are mounted directly on the steel cylinder. High voltage components are enclosed in phenolic type cylinders. Specially designed high voltage terminals facilitate high voltage connections.

WRITE OR PHONE FOR THESE SPECIFIC BULLETINS FOR COMPLETE INFORMATION:

C70-7 HIGH VOLTAGE TERMINATIONS

C70-6 HIGH VOLTAGE DIVIDERS

UNIVERSAL
VOLTRONICS
CORPORATION
27 Radio Circle Drive, Mount Kisco, N.Y. 10549
(914) 241-1300

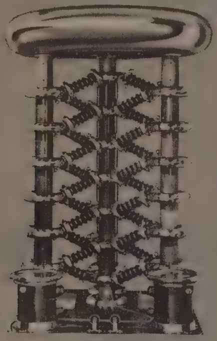
HIGH VOLTAGE UTILITY, CABLE, SWITCH GEAR PRODUCTS TESTING

AC INSULATION TESTERS

Designed for applications requiring AC testing of materials, these testers find wide use in the cable, transformers, bushings, potheads, etc., industry.

These AC testers offer a wide range of voltage and KVA capability to cover the case of "small" sample tests where lower voltage and where light KVA are required and up to "large" run high voltage testing requiring high voltages and high KVA's.

All testers are available with a variety of optional features including such things as memory meter, automatic programming of voltage, special mechanical arrangements and many other features specifically oriented toward the AC tester field.

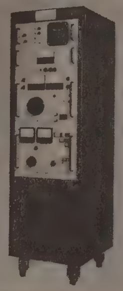


CORONA MEASUREMENT SYSTEMS

The UVC standard corona measurement system consists of AC test source, input line filter calibrating capacitor, power separation filter and corona detector. A 5" diameter oscilloscope provides a clear display and a selector switch allows one to select an elliptical display. Systems sensitivity is less than 1%.
AC/DC systems are available for special applications.

WRITE OR PHONE FOR THESE SPECIFIC BULLETINS FOR COMPLETE INFORMATION:

IG 870	LOW, MEDIUM, HIGH IMPULSE GENERATORS
CMS-870	CORONA MEASUREMENT SYSTEMS
GA 870	AC INSULATION TESTERS
BA 70-11	EXTRA HIGH VOLTAGE DC POWER SUPPLIES

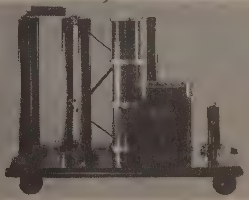


EXTRA HIGH VOLTAGE DC POWER SUPPLY

The specialized extra high voltage products offered by UVC fill the need for standard product availability and performance ratings above 300KV.

Standard models have been adapted for use with neutron source generators, ion implantation systems, electron microscopes and ion source injectors. Extensive use of special shaped terminal hardware; graded and compensated cable wells; and conservative insulation techniques yield long term trouble-free performance even under severe sparking load conditions. UVC offers the choice of air insulation, SF 6 gas insulation and oil insulation.

Equipment availability includes basic power pack construction (voltage multiplying assembly) or completely instrumented system inclusive of precision metering; complete control function flexibility; primary circuit and high voltage protection as well as output performance adjustment controls.



IMPULSE GENERATORS

Low, medium and high energy impulse generators are available for diverse laboratory tests and investigations. Both standard wave (1.5/40 and 1.2/50 μ seconds) and switching surge (200/2000 μ seconds) are available. Special application features include injection or self-triggering discharge, resistive and capacitive dividers, remote polarity reversal and memory meter.

UNIVERSAL VOLTRONICS CORPORATION
27 Radio Circle Drive, Mount Kisco, N.Y. 10549
(914) 241-1300

BIOMETRICS INSTRUMENT CORPORATION (a subsidiary of Varo, Inc.)

SPECIALIZED CUSTOM DESIGNED EQUIPMENT

The Biometrics Instrument Corporation, a subsidiary of Varo, Inc., has an unusual variety of expertise in the design of highly specialized power conversion equipment. Since 1946, Varo has continually advanced the development of more reliable, smaller, lighter, and more versatile power conversion equipment to meet exacting specifications for widely varied applications and environments. The systems shown on these pages represent only a sampling of Varo's many faceted capabilities. Additional assistance can be secured by contacting one of the regional sales offices listed below.

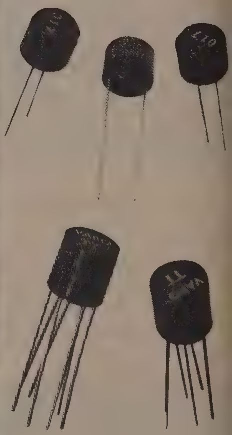
VARO FIELD OFFICES

WASHINGTON AREA OFFICE
727-23rd St., South
Suite 300, Arlington, Virginia 22202
Phone: (703) 920-4500

MIDWEST AREA OFFICE
4130 Linden Avenue
Suite 100, Dayton, Ohio 45432
Phone: (513) 253-8935

NORTHEAST AREA OFFICE
Crystal Brook Bldg., Highway 35
Eatontown, New Jersey 07724
Phone: (201) 299-1400

MAGNETIC COMPONENTS



As a result of 25 years of experience in the development of magnetics, Varo is capable of designing and manufacturing the full spectrum of magnetic components to your state-of-the-art parameters.

Facilities include a complete in-house laboratory to insure the ability to deliver products meeting the requirements of MIL-T-27C.

Custom designs developed by Varo include power transformers and filter inductors (specializing in high power 400 Hz); L-C filters — bandpass, low pass, high pass and notch types; pulse transformers, RF coils and transformers, and many more. Our engineers work closely with customers to assure meeting customers' needs, including MIL-specs, temperature requirements, size, efficiency, tight tolerances, and phase shift requirements. In addition, Varo has developed and patented the Varoformer®, a highly efficient, constant voltage transformer.

Varo also offers a broad line of standard audio transformers and miniature toroidal inductors for PC board mounting.

Whatever your need for magnetic devices, you are invited to discuss your requirements with our engineers.

BIOMETRICS INSTRUMENT CORPORATION
(a subsidiary of VARO, INC.)
Box 828, 2201 W. Walnut St., Garland, Texas 75040
(214) 276-6141 (TWX) 910-860-5093 (TELEX) 73-2294

VARO

BIOMETRICS INSTRUMENT CORPORATION (a subsidiary of Varo, Inc.)

SHIPBOARD POWER CONVERSION EQUIPMENT

5 KW UNINTERRUPTIBLE POWER SYSTEM

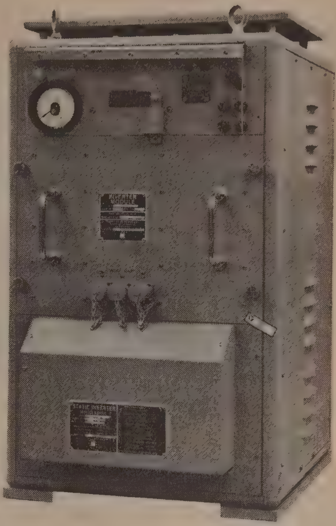
Our Model 4580 UPS has been used for many years in shipboard installations where critical load applications require a no-break power capability.

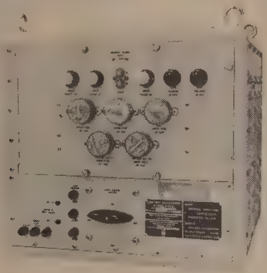
The system supplies 5 KVA, 115 VAC, ±400 Hz, 3φ output power from 115 VAC, 60 Hz or 400 Hz, 3φ primary input power sources. It will operate for a limited time from external storage batteries in the event of primary power failure.

The 4580 UPS System consists of two basic units, the Model 4345D Static Inverter and the Model 3172B Control Converter. The 3172B Converter is used as a regulated DC power source for the 4345D Static Inverter and as a battery charger for the external storage batteries. The 4345D Static Inverter converts the nominal 250 VDC output of the 3172B Converter into the three phase, 400 Hz output.

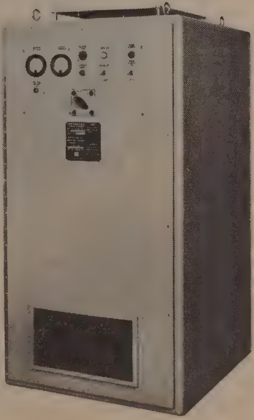
The 4345D Static Inverter has been used successfully for many years as a power source in applications where an input of from 210 to 355 VDC is the primary power. The output distortion is 4% maximum with a 0.6 lagging to unity power factor.

Both the 3172B Converter and the 4345D Static Inverter are designed to meet the shock and vibration requirements of MIL-S-901 and MIL-STD-167. The operating temperature range is 0°C to 50°C.





1 KVA UNINTERRUPTIBLE POWER SUPPLY



Designed to meet customer specifications to service a shipboard teletype system, this Model 4404 UPS is completely self-contained, including Ni-Cad batteries, static switch, and inverter. Batteries may be external if desired. A manual bypass allows for system servicing.

In the event of either inverter failure or a load fault, the static switch automatically transfers the AC line output in less than ½ cycle. This application requires a maximum harmonic distortion of 3%; the worst-case voltage transient in the inverter, no-load to full-load step change, does not exceed −28% in the first half-cycle, and less than 5% for the remainder of the 20 msec response time. However, a maximum harmonic distortion specification of 5% would allow reduction of this voltage transient to less than −14%.

Inverter input is 105-150 VDC; output 115 VAC ±1%, 60 Hz ±0.5%; 1 KVA; power factor, .7 lagging to unity.

5 KVA FREQUENCY CONVERTER

Typical of our accomplishments in lightweight, small-sized frequency converters is this 5 KVA unit designed for shipboard application, Model 4403. Only 17″ x 18″ x 22″, its weight is 250 pounds maximum. Input is 60 Hz ±5%, 3-phase, 400 V ±10%. Output is single phase, 5 KVA, 400 Hz ±0.5%, 115 V ±1%. Power factor, 0.8 lagging to 0.8 leading. Efficiency of the unit is 70% minimum, with a maximum harmonic distortion of 2%. The unit is designed to withstand shock per MIL-S-901C, vibration per MIL-STD-1678, Type 1, and humidity up to 95%. Operating temperature is 0°C to 50°C. Internal fan cooling is provided.

BIOMETRICS INSTRUMENT CORPORATION
(a subsidiary of VARO, INC.)
Box 828, 2201 W. Walnut St., Garland, Texas 75040
(214) 276-6141 (TWX) 910-860-5093 (TELEX) 73-2294

VARO

BIOMETRICS INSTRUMENT CORPORATION (a subsidiary of Varo, Inc.)

AIRBORNE INVERTERS

CONVERTER/INVERTERS FOR AIRBORNE APPLICATIONS

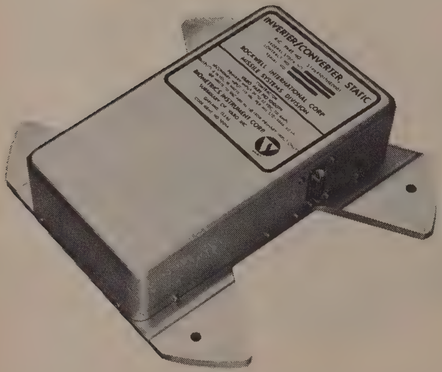
Typical of units designed for rugged airborne operating conditions is this Model 4380 converter/inverter designed to supply power for missile system electronics. All solid-state; calculated MTBF, worst-case, is 1500 hours. Modular construction reduces MTTR, which has been demonstrated at less than 0.8 hours. The unit weighs only 16 pounds and operates from a 24-32 VDC input, with a DC output of 150V, and an AC output of 115 VAC RMS, 1ϕ, 400 Hz, 275 VA. Protection includes over-and-under voltage for prolonged periods, and overload and reverse polarity protection.

MISSILE INVERTER

INVERTER, POWER, STATIC
NORTH AMERICAN ROCKWELL CORP.
COLUMBUS DIVISION
VARO, INC.
STATIC POWER DIVISION
PLANO, TEXAS
VARO

Varo Model 4384 Solid State Airborne Inverter provides precision 400 Hz AC power for the gyro-stabilized guidance system of a modular air-to-surface missile. The inverter uses 24-30 VDC primary power (Per MIL-STD-704A) from either the aircraft buss or missile on-board batteries. Output power is 115 +7.5 VAC, 400 ±8 Hz, 120 VA, power factor 0.8 lagging to unity. Inverter dimensions are 4″ x 6″ x 6″ and it weighs a maximum of 8 pounds. Operating temperature range is −55°C to +72°C per MIL-STD-810B.

MISSILE CONVERTER/INVERTER


INVERTER/CONVERTER, STATIC
ROCKWELL INTERNATIONAL CORP
MISSILE SYSTEMS DIVISION
BIOMETRICS INSTRUMENT CORP

Missile Converter/Inverter, Model 4405, was designed to provide guidance system power for an advanced electro-optically guided missile. It incorporates unique circuit designs to insure low output AC voltage modulation to prevent guidance system error. Input power of 28 ±4 VDC is provided by missile batteries. AC output is 115 ±2.3 VAC, 400 ±8 Hz, 100 Watts. Distortion is 6% maximum at power factor 0.7 lagging to unity. DC outputs are ±15, ±0.5 VDC, 18 Watts. Unit measures 10.25″ x 5.8″ x 2.8″ and weighs a maximum of 12 pounds. Operating temperature range is −55°C to +55°C.

AIRBORNE INVERTER

An advanced airborne inverter, the Model 4375 offers advantages of lightweight and high efficiency. Input power (MIL-STD-704, Category B) of 21-29 VDC permits using the Model 4375 for most military airborne applications. Output is 115 ±4.5 VAC, 1ϕ, 400 ±5 Hz, 250 VA. Distortion is 4% maximum at power 0.75 lagging to unity. Input polarity reversal and short circuit protection are provided. Unit measures 10″ x 4.5″ x 6.0″ with a maximum weight of 12 pounds. Operating temperature range is −40°C to +71°C.

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VARO

BIOMETRICS INSTRUMENT CORPORATION (a subsidiary of Varo, Inc.)

HIGH VOLTAGE POWER SUPPLIES

POWER SUPPLIES FOR FIRST GENERATION IMAGE INTENSIFIERS

Rugged, reliable high voltage power supplies are designed and produced by Varo for various First Generation Image Intensifier applications. Standard oscillator/multiplier configurations are available for single-, two-, and three-stage 18MM, 25MM and 40MM image intensifier assemblies. Automatic brightness control, positive or negative output, and other custom designs can be supplied.

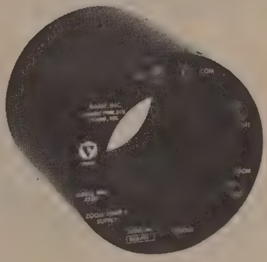
POWER SUPPLIES FOR SECOND GENERATION IMAGE INTENSIFIERS

Second Generation Image Intensifier power supplies are designed to meet the unique requirements of Second Generation Image Intensifiers. Automatic brightness control, manual gain control, bright-source protection and rapid-recovery response (flash recovery to 60% in 100 msec.) are some of the system requirements provided by these high voltage power supplies. Second Generation power supplies are offered for standard inverter tube configurations as well as for custom and gated designs.

GATED POWER SUPPLIES

Gated High-Voltage Power Supplies for a variety of Gated Image Intensifier applications have been developed at Varo. Applications include gated I-SIT camera systems, special purpose laser systems, and other gated imaging techniques. High speed rise/fall times of 70-100 ns typically, pulse widths of 300 nanoseconds minimum, externally adjustable output voltage control for Automatic Gain Control (slew rates 0.3 sec. typical), and floating gate configurations are examples of some of the features available. Many years of experience in Image Intensifier System design enables Varo to solve your high voltage system requirements.

SPECIAL PURPOSE POWER SUPPLIES



Varo has designed and produced many custom high voltage power supplies for a wide variety of specialized customer applications. The supply illustrated (Model 3220) is designed to operate an 80/40MM gated/Zoom Image Intensifier System. Operating modes include two-position Zoom, gate on/off/standby, and ABC. All control functions are TTL compatible. The unit weighs less than 4 pounds.

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VARO

HIGH-PERFORMANCE BRUSHLESS GENERATORS & GENERATOR SYSTEMS

VARO INC ELECTROKINETICS DIVISION

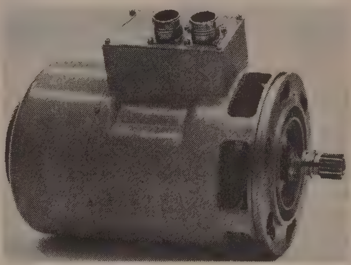
VARO

VARO EK DIVISION develops and manufactures lightweight AC and DC brushless generators and generator systems ranging from milliwatt to multi-kilowatt sizes. These units are being used in a wide variety of high performance military and commercial applications, including aircraft APU's and EPU's, missile, drone and RPV primary on-board electrical power, hand-crank power units, engine fuel control and engine ignition.

The product line includes heteropolar, homopolar and flux switch types operating at speeds up to 100,000 RPM. Complete systems include static devices such as regulators, TRU's and engine sequence and safety units.

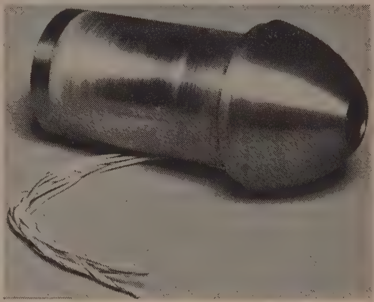
The units shown below represent a few of the types commonly designed and manufactured. We may have an existing design that will meet your requirements. Call or write Department 420, VARO INC EK DIVISION.

5071 GENERATOR



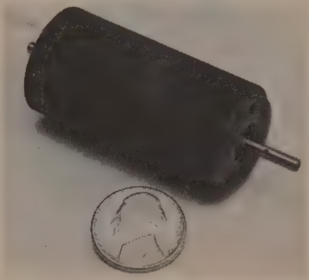
10 KVA Continuous Duty 400 HZ, 3 Phase, Brushless, Aircraft Emergency Power Generator.

4992 GENERATOR



4 KW, 28 VDC Generator for On-Board Missile Prime Power.

4978 GENERATOR



4 to 10 Watt, High Frequency, Single Phase Brushless Generator.

4955 GENERATOR

5 KVA Continuous Duty 400 HZ, 3 Phase Brushless Aircraft APU Generator with Integral Turbine Ignition Generator.

VARO

VARO INC ELECTROKINETICS DIVISION, Department 420
P.O. Box 1500, 402 East Gutierrez
Santa Barbara, CA 93102

Telephone:
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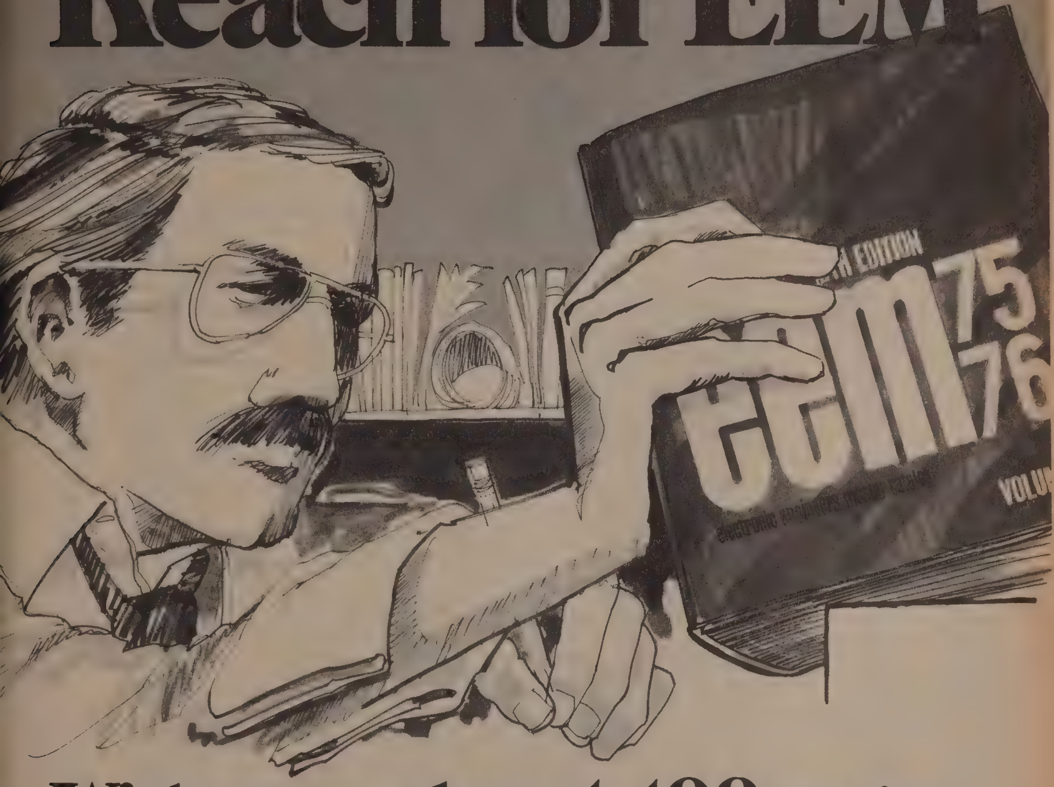

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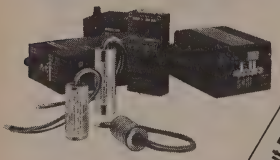
MINIATURE
HIGH VOLTAGE
POWER SUPPLIES

Venus Scientific Inc.

Electro-Optics • CRT Display • Night Vision Equipment

VENUS



STD PRODUCT (QUICK) SELECTION CHART

Unit Price	MODEL No.	Output Proportional To Input	Switching Penetron	Low Power Battery Operated	PMT	Focus	Dynamic Focus	CRT	Hi-Bright CRT	X-Ray Microscope	Volume in Cubic Inches
$680.00	H-30N							✓	✓	✓	48
680.00	H-30							✓	✓	✓	48
590.00	H-20							✓	✓	✓	31
590.00	H-20N							✓	✓	✓	31
590.00	H-16F					✓		✓			31
550.00	G-12							✓			15
490.00	G-10							✓			15
365.00	G-5					✓		✓			15
690.00	MG-12							✓			7
490.00	D-16					✓		✓			89
175.00	LR-20					✓		✓			40
159.00	LR-15					✓		✓			33
135.00	LR-6					✓					33
175.00	LR-2N				✓	✓					33
120.00	LU-15	✓				✓		✓			27
350.00	E-10				✓						45
285.00	F-50					✓	✓				7
260.00	F-25				✓	✓	✓				7
235.00	F-12				✓	✓	✓				7
209.00	F-6					✓	✓				7
158.00	K-30	✓			✓	✓	✓				2
149.00	K-15	✓			✓	✓	✓				2
99.00	C-15	✓			✓	✓	✓				3
105.00	C-30	✓			✓	✓	✓				3
168.00	Q-30	✓		✓	✓						2
168.00	Q-15	✓		✓	✓						2
249.00	ST-10N	✓		✓							7
1850.00	CS-14		✓					✓			62
125.00	O-6.75			✓							2
120.00	M-15N										3

- *Off the shelf delivery*
- *Proven economical designs*
- *Field tested by many companies*
- *No non-recurring engineering or development costs*
- *MIL and commercial power supplies available*
- *MIL-Q-9858A*

Venus Scientific Inc.

399 SMITH STREET, FARMINGDALE, NEW YORK 11735
• **Telephone** (516) 293-4100 • **TWX:** 510-224-6492

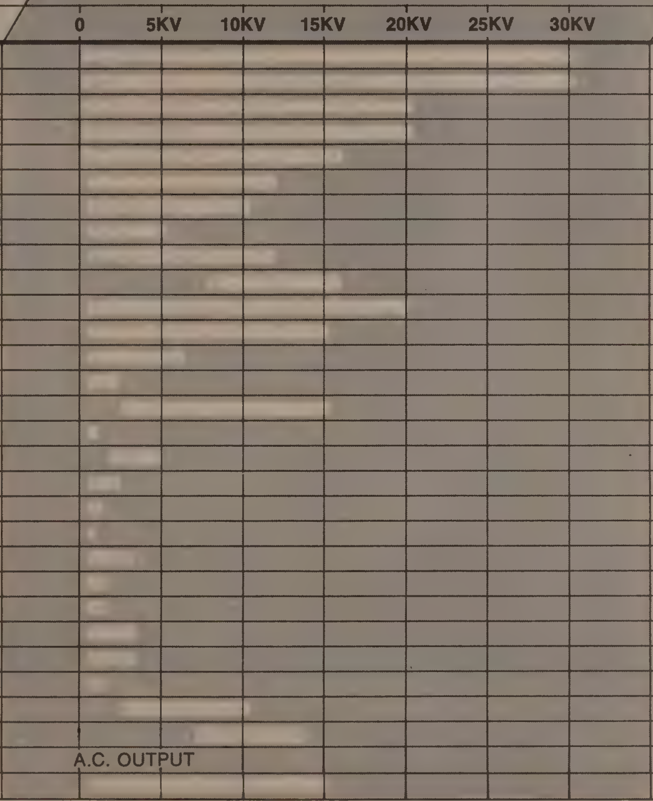
MINIATURE HIGH VOLTAGE POWER SUPPLIES

Venus Scientific Inc.

Electro-Optics • CRT Display • Night Vision Equipment

VENUS

STD PRODUCT (QUICK) SELECTION CHART



MODEL No.	OUTPUT VOLTAGE RANGE	−55° to +71°C Full Rating (−55° to +85°C Reduced Rating)*	0° to 55°C
H-30N		300 μa	*
H-30		300 μa	*
H-20		500 μa	*
H-20N		500 μa	*
H-16F		500 μa	*
G-12		500 μa	*
G-10		500 μa	*
G-5		500 μa	*
MG-12		500 μa	*
D-16		1 ma	*
LR-20		—	150 μa
LR-15		—	300 μa
LR-6		—	500 μa
LR-2N		—	5 ma
LU-15		—	300 μa
E-10		10 ma	*
F-50		2 ma	*
F-25		4 ma	*
F-12		8 ma	*
F-6		16 ma	*
K-30		500 μa	*
K-15		1 ma	*
C-15		—	1 ma
C-30		—	500 μa
Q-30		200 μa	*
Q-15		400 μa	*
ST-10N		10 μa	*
CS-14		4.5 watts	*
O-6.75	A.C. OUTPUT	—	*
M-15N		10 μa	*

***NOTE:** —*contact Factory*

Venus Scientific Inc.

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CUSTOM POWER SUPPLIES—VENUS SCIENTIFIC, INC. also will build custom power supplies to your specifications. Frequently an "off the shelf" power supply can be selected from stock, thus providing a considerable saving in cost and time, in addition to using a proven design.

If, however, a custom power supply is necessary, VENUS will be glad to offer a quote. Please contact our Engineering Sales Department for further details.

Wilmore Electronics Company, Inc.

SOLID-STATE POWER CONVERSION EQUIPMENT

INDUSTRIAL DC-TO-DC CONVERTERS

DC TO DC CONVERTER
INPUT 105-140 VDC
OUTPUT 48 VDC (NOM.)
12 A MAX
Wilmore
MODEL 1240-125-48-12
POWER ON
OUTPUT ADJUST

- HIGH EFFICIENCY
- ADJUSTABLE OUTPUT VOLTAGE
- GOOD VOLTAGE REGULATION
- INPUT-OUTPUT ISOLATION
- LOW OUTPUT RIPPLE
- CONSERVATIVELY DESIGNED

SERIES 1240 CONVERTERS

Specifically designed to meet the needs of industrial users and original equipment manufacturers, the twelve extremely-reliable Series 1240 dc-to-dc power converters operate from 48-V and 125-V batteries, and provide either 300 or 600 watts of well-regulated well-protected dc output. Units are rated for continuous operation throughout an ambient temperature range of −20°C to +70°C. They are particularly well suited for application within the electric-utility, telephone, mining, and other industries. Size 5¼" x 19" x 14"; weight 36 to 43 lbs. Request Bulletin 4011.

MODEL NUMBER	INPUT VOLTAGE	SETTABLE OUTPUT VOLTAGE RANGE	OUTPUT CURRENT	EFFICIENCY HALF TO FULL LOAD
1240-48-24-10	42 to 56 Vdc	22 to 27 Vdc	0 to 10 Adc	77%
1240-48-28-10		26 to 31.5 Vdc	0 to 10 Adc	78%
1240-48-36-6		33 to 40 Vdc	0 to 6 Adc	79%
1240-48-36-12		33 to 40 Vdc	0 to 12 Adc	80%
1240-48-48-6		43 to 53 Vdc	0 to 6 Adc	80%
1240-48-48-12		43 to 53 Vdc	0 to 12 Adc	81%
1240-125-24-10	105 to 140 Vdc	22 to 27 Vdc	0 to 10 Adc	83%
1240-125-28-10		26 to 31.5 Vdc	0 to 10 Adc	84%
1240-125-36-6		33 to 40 Vdc	0 to 6 Adc	85%
1240-125-36-12		33 to 40 Vdc	0 to 12 Adc	86%
1240-125-48-6		43 to 53 Vdc	0 to 6 Adc	87%
1240-125-48-12		43 to 53 Vdc	0 to 12 Adc	87%

SERIES 1260 CONVERTERS

Featuring dual, triple, and quadruple outputs, thirty of the growing Series 1260 industrial/OEM dc-to-dc converters are listed below. Three standard input voltages are available covering operation from 24-V, 48-V, or 125-V batteries. All units provide electrical isolation between output terminals, input terminals, and chassis ground; all are electronically protected against overloads and short circuits; and all employ only well-derated hermetically-sealed silicon semiconductors. These high-quality high-efficiency converters are ideally suited to power a broad array of sensitive communication, control, and protective equipment. For applications involving other input/output combinations, or higher or lower power levels, please contact our engineering applications group.

MODEL NUMBER	OUTPUT NO. 1		OUTPUT NO. 2		OUTPUT NO. 3		OUTPUT NO. 4	
	VOLTAGE RANGE	CURRENT	VOLTAGE RANGE	CURRENT	VOLTAGE RANGE	CURRENT	VOLTAGE RANGE	CURRENT
1261-V_{IN}	Single-Output Converters for V_{IN} = 24, 48, or 125 Vdc Input*							
-AA	+5 Vdc ±5%	20 Adc						
-CB	+10 to 18 Vdc	10 Adc						
1262-V_{IN}	Dual-Output Converters for V_{IN} = 24, 48, or 125 Vdc Input*							
-BC	+5 Vdc ±5%	5 Adc	+12 Vdc ±5%	10 Adc				
-AD	+5 Vdc ±5%	20 Adc	+15 Vdc ±5%	2.0 Adc				
-AE	+5 Vdc ±5%	20 Adc	+15 Vdc ±5%	4.0 Adc				
-BF	+12 Vdc ±5%	10 Adc	+15 Adc ±5%	3.0 Adc				
1263-V_{IN}	Triple-Output Converters for V_{IN} = 24, 48, or 125 Vdc Input*							
-BG	+5 Vdc ±5%	5 Adc	+12 Vdc ±5%	10 Adc	+15 Vdc ±5%	3.0 Adc		
-AH	+5 Vdc ±5%	20 Adc	+15 Vdc ±5%	2.0 Adc	−15 Vdc ±5%	2.0 Adc		
-BI	+12 Vdc ±5%	10 Adc	+15 Vdc ±5%	2.5 Adc	−15 Vdc ±5%	0.2 Adc		
1264-V_{IN}	Quadruple-Output Converters for V_{IN} = 24, 48, or 125 Vdc Input*							
-BJ	+5 Vdc ±5%	5 Adc	+12 Vdc ±5%	10 Adc	+15 Vdc ±5%	2.5 Adc	−15 Vdc ±5%	0.2 Adc

*24 Vdc input units operate over an input range of 20 to 30 Vdc, 48 Vdc units over a range 40 to 60 Vdc, and 125 Vdc units over 100 to 140 Vdc.

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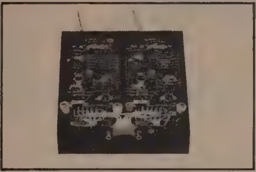
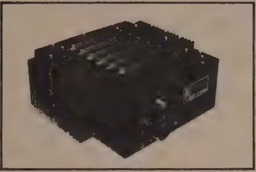
Wilmore Electronics Company, Inc.

SOLID-STATE POWER CONVERSION EQUIPMENT



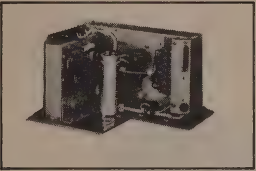
DC-TO-DC SPACECRAFT POWER CONVERTERS

Wilmore converters are being used in numerous unmanned spacecraft including OSO, IMP, LES-6, SAS and Pioneer 10. Proven in-depth circuit-design, mechanical-design, quality-assurance and program-management experience is provided for such requirements. Example shown is a dual-output 10Vdc-to-2500Vdc flight unit providing better than 0.1% regulation against combined effects of line, load and temperature.



HIGH-VOLTAGE LASER POWER SUPPLIES

Pictured is a 300-joule/sec capacitor-charging converter for pulse-discharge applications. Particularly well suited for high-pulse-repetition-rate applications, it provides a regulated output voltage selectable from below 1000 to over 2500 Vdc. A wide range of light-weight high-efficiency converters for both pulsed and CW laser applications is available including the new 1200-joule/sec unit. Wilmore laser power-supply products range from inexpensive industrial items to fully-qualified military equipment.

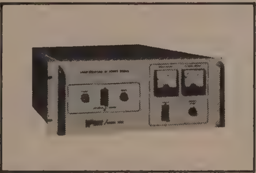


INDUSTRIAL SOLID-STATE POWER CONVERTERS AND CONTROLLERS

Often extrapolating directly from design techniques derived from its aerospace activities, Wilmore designs and manufactures a great variety of custom industrial power-processing equipment. Examples include custom dc to ac inverters, frequency changers, dc to dc converters, motor controls, nondissipative regulators, SCR controls of various types, special battery chargers, etc. Complete in-house design and manufacturing capability permits short delivery times and lower costs.

DC-TO-DC CONVERTER MODULES

Wilmore's quality dc-to-dc converter modules are designed for a variety of point-of-use situations. Typical input voltages are 12V, 24V, 28V, and 48V, although modules can be provided for any input voltage up to approximately 300 Vdc. Regulated and unregulated modules may be obtained with output voltages ranging from 5V for logic power to several thousand volts for laser applications. Modules can be supplied either encapsulated or unencapsulated and in essentially any mechanical configuration. Consult our engineering applications group for your converter module needs.



UNINTERRUPTIBLE AC POWER SOURCE (UPS)

Protects critical loads from temporary loss of commercial ac power. True no-interruption performance. Well-regulated 115-V sine-wave output. Completely self contained. Built-in "float" battery charger and sealed long-life batteries. Electronic overload protection. MODEL 1202 is rated 250 VA. Depending upon load, reserve time for internal-battery operation varies from a minimum of 10 min. to more than one hour. 7" x 19" x 19". 90 lbs. $975. Request Bulletin 3011.

OEM SWITCHING AC-TO-DC POWER SUPPLIES

Single-output and multiple-output transistor switching power supplies are smaller, run cooler and are more efficient than traditional series-pass supplies. Unit shown provides three different regulated output voltages, 75 watts of output power, weighs less than 2.5 pounds, and occupies a volume of less than 55 cubic inches. Contact our applications group for your switching power supply needs.

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Wilmore Electronics Company, Inc.

SOLID-STATE POWER CONVERSION EQUIPMENT

HIGH EFFICIENCY DC-TO-AC INVERTERS

Wilmore
MODEL 1057-12
300-WATT INVERTER
OUTPUT
INPUT
POS +
NEG −

Model 1057

- **ECONOMICAL ALTERNATIVE TO SINE WAVE INVERTERS**
- **DESIGNED TO POWER SENSITIVE INSTRUMENTS**
- **EXCELLENT FREQUENCY AND VOLTAGE STABILITY**
- **TYPICAL EFFICIENCY 85% TO 90%**

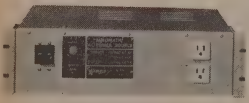
For years the Model 1057 DC-to-AC Inverter with its three level step approximation to a sine wave has been an inexpensive alternative to sine-wave power. The switching-mode wave-shaping technique used yields a wave shape that offers the same peak-to-rms ratio as a true sine wave, but with high efficiency, typically 85% to 90% from half to full load. Designed for users who need remote power for sensitive equipment of all kinds, including recorders, oscilloscopes and video tape recording equipment, the Model 1057 has proved in years of field testing to be a rugged and reliable source of high quality 60 Hz power. The Model 1057 is available in 12-volt, 24-volt and 28-volt input versions. Consult price page for more detailed specifications or request Bulletin 9091-B.

- **RUGGED INVERTER FOR HEAVY DUTY LOADS**
- **500 WATTS CONTINUOUS, 1000 WATTS SURGE**
- **MODULAR UNITS EASILY PARALLELED**
- **TYPICAL EFFICIENCY 80% TO 90%**

Model 1172

Many jobs require a heavy duty, but inexpensive ac power source. The Model 1172 was designed to start and to run refrigerator motor-compressor units, one of the most difficult inverter loads of all. It has been used routinely for powering small hand tools such as drills and saws and other difficult inverter loads. The 500-watt Model 1172 features a 1000-watt surge capability and, because of its modular design, two or more units may be paralleled for added continuous and surge power. Available as accessories are the paralleling kit and a mounting bracket to facilitate rapid transfer of the inverter between vehicles. The Model 1172 is available in 12-volt, 24-volt and 32-volt input versions. Consult price page for more detailed specifications or request Bulletin 1101.

NEW AUTOMATIC STANDBY AC POWER SOURCE



Model 1252

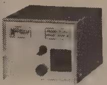
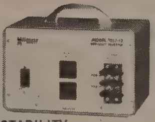
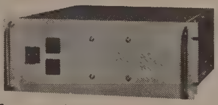
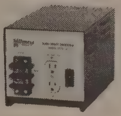
When commercial power is interrupted, the Model 1252 Automatic Standby AC Power Source continues to supply needed 60-Hertz power to critical loads by switching to inverter operation and drawing its power from external batteries. When ac power is restored, the Model 1252 automatically returns to normal operation, while the internal battery charger recharges the batteries. Units are available with an internal Model 1057 inverter or a Model 1172. Units are 5¼″ h by 19″ w by 14″ d and are available for bench or rack mounting. Prices begin at $475.00. Request Bulletin 5041.

WILMORE ELECTRONICS CO., INC. • P.O. BOX 2973 • DURHAM, N. C. 27705 • PHONE (919) 489-3318

Wilmore Electronics Company, Inc.

SOLID-STATE POWER CONVERSION EQUIPMENT

DC to AC INVERTERS

	INPUT			OUTPUT, 60 Hz							
	BATTERY TYPE (voltage)	DC RANGE (volts)	PRICE (1 PC)	NOMINAL AC VOLTAGE	POWER RATING	FREQUENCY REGULATION	WAVE SHAPE	VOLTAGE REGULATION*	EFFICIENCY, HALF-TO-FULL LOAD	SIZE	WEIGHT
MODEL 1124A **45 WATTS CONTINUOUS**  ALL SILICON, INDUSTRIAL QUALITY, EXCELLENT FREQUENCY STABILITY, LIGHT-WEIGHT, RUGGEDLY DESIGNED, INCORPORATES PROTECTION NORMALLY MISSING IN OTHER INEXPENSIVE UNITS	1124A-12 12 v	11-14.5	$78	115 volts	45 watts or volt-amps	±.15 Hz with line and load T.C. .01% per °F	Square	Proportional to dc line	70%	4"h 5¼"w 6⅝"d	6 lbs
	1124A-24 24 v	22-29	$78								
MODEL 1057 **290 WATTS CONTINUOUS**  MODERATELY PRICED, IDEAL FOR INSTRUMENTS REQUIRING EXTREME FREQUENCY STABILITY AND NORMALLY REQUIRING A SINE WAVE; i.e., OSCILLOSCOPES, VIDEO TAPE SYSTEMS, ETC.	1057-12 12 v	11-14.5	$260	115 volts	290 watts or volt-amps	±.15 Hz with line and load T.C. .01% per °F	3-level step approx. to sine wave	±3%	85% to 90%	8¼"h 11"w 8¾"d	25 lbs
	1057A-24 24 v	22-29	$280								
	1057A-28 28 v	24-32	$280								
MODEL 1081 **500 WATTS CONTINUOUS**  FINE FREQUENCY STABILITY, GOOD VOLTAGE REGULATION. APPLICABLE WHEN A SINE WAVE VOLTAGE IS ESSENTIAL	1081-12 12 v	11-14	$895	115 volts	500 watts or volt-amps	±.15 Hz with line and load T.C. .01% per °F	Sine	±2%	70% at full load	6¾"h 19"w 20½"d	105 lbs
	1081-24 24 v	22-28	$895								95 lbs
	1081-48 48 v	44-56	$895								95 lbs
	1081-120 120 v	105-140	$895								85 lbs
MODEL 1076A **500 WATTS CONTINUOUS** **1000 WATTS SURGE**  A WELL PROTECTED INVERTER SUITED FOR EXTREMELY SEVERE LOADS THAT REQUIRE BETTER THAN AVERAGE FREQUENCY STABILITY	1076A-12 12 v	11-14.5	$225	115 volts	500 watts or volt-amps 1000 watts surge	±.5 Hz	Square	Proportional to dc line	80% to 90%	6⅞"h 7¼"w 12⅞"d	30 lbs
	1076A-24 24 v	22-29	$295								
MODEL 1172 **500 WATTS CONTINUOUS** **1000 WATTS SURGE** INEXPENSIVE, WELL PROTECTED FOR SEVERE LOADS, MOTOR STARTING, COMPRESSORS, PORTABLE POWER TOOLS. MODULAR UNITS MAY BE PARALLELED FOR MORE POWER	1172-12 12 v	11-14.5	$225	120 volts	500 watts or volt-amps 1000 watts surge	±2 Hz	Square	Proportional to dc line	80% to 90%	7"h 8½"w 11½"d	33 lbs
	1172-24 24 v	22-29	$280								
	1172-32 32 v	30-37	$280								
MODEL 1207 **1.5 KILOWATTS CONTINUOUS** HIGH POWER, FREQUENCY STABLE, GOOD VOLTAGE REGULATION, CURRENT LIMIT AND SHORT CIRCUIT PROTECTION, SINE WAVE VOLTAGE OUTPUT	1207-36 36 v	33-45	$1950	115 volts or 230 volts	1500 watts or volt-amps	±.15 Hz with line and load T.C. .01% per °F	Sine	±2%	78% at full load	24½"h 22½"w 19"d	240 lbs
	1207-48 48 v	44-56	$1950								
	1207-120 120 v	105-140	$1950								

*Voltage regulation at fixed load due to input dc line variation as read by conventional ac voltmeter which responds to average voltage but is calibrated in rms volts.

WILMORE ELECTRONICS CO., INC. • P.O. BOX 2973 • DURHAM, N. C. 27705 • PHONE (919) 489-3318

SECTIONAL

Electronic

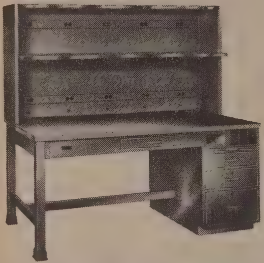
LABORATORY TEST FURNITURE

FOR

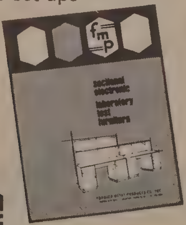
INDUSTRIAL • MILITARY • SCHOOL

APPLICATIONS

Formica's sectional electronic test furniture is designed *by* engineers *for* engineers to provide the utmost in serviceability. Individual prefabricated sections are constructed to afford the greatest possible number of combinations, then factory assembled to suit the exact requirements of your laboratory or classroom. Design features also provide at least 50% more available working area over other types now in use. Made of heavy gauge furniture steel, Formica's rugged construction means many extra years of service even in hard use.



For school purposes, the unusual adaptability of Formica's many specialized turrets and pedestals — whether for single or double set-ups



sectional electronic laboratory test furniture

Write for our new catalog and further specifications.

FORMICA METAL PRODUCTS COMPANY, INC.

CORPORATION WAY • MEDFORD, MASSACHUSETTS 02155

GARDNER DENVER Wire-Wrap* MACHINES

AND ELECTRONIC PRODUCTION EQUIPMENT

WIRE-WRAP * TERMINAL LOCATOR WITH WIRE STRIPPER

The Gardner-Denver 14YN Terminal Locator is designed as a completely self-supporting unit to meet production requirements that fall between hand wrapping and the fully automatic machine.

Increased productivity coupled with accuracy and quality, is now economically feasible for electrical equipment manufacturers. The Terminal Locator is also ideally suited for twisted-pair wiring and wire sizes not compatible to automatic wiring.

The coupling of the Gardner-Denver 14YA Wire Preparation Unit to the Terminal Locator has revolutionized semi-automatic wiring by placing the wire preparation where it should be, under the control of the machine operator.

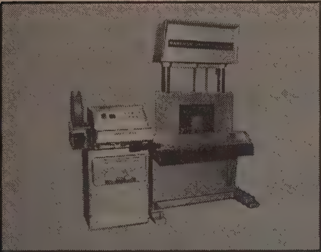
14YA

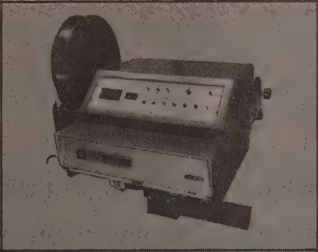
WIRE PREPARATION UNIT

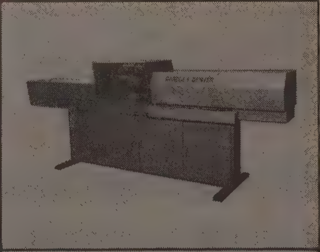
The 14YA Gardner-Denver Wire Preparation Unit is designed to provide precision wire cutting and stripping to low or high volume users. Throughout the past decade, millions of feet of various type insulated wire has been processed through its predecessor in the Gardner-Denver Automatic Wire-Wrap Machine.

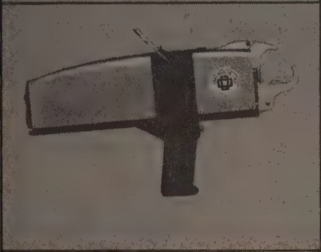
14YT1 TWISTED-PAIR WIRE PREPARATION UNIT

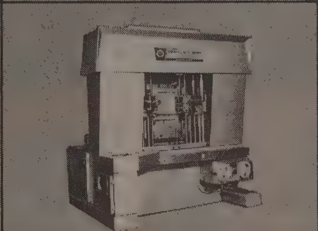
The Gardner-Denver 14YT1 Twisted-Pair Wire Preparation Unit is designed to give increased productivity to the growing demand for twisted-pair wires. The tedious job of preparing twisted-pair is now eliminated. The 14YT1 will automatically feed, cut-strip, and twist for a variety of applications at a fraction of the cost normally associated with this operation.



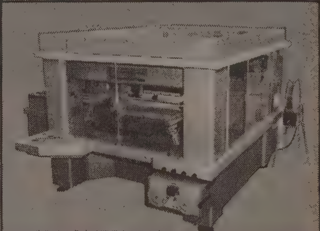








14FV VERTICAL



14FS HORIZONTAL

14-090A CABLE BINDING TOOL

The Model 14-090A Cable Binding Tool ties wire bundles up to 1" in diameter. One squeeze on the trigger of this hand-held pneumatic tool wraps nylon tape around bundle — tensions, locks, and cuts off . . . in only one second . . . with no waste. Tool automatically adjusts to size of bundle being tied, so only one size tape and closure is required. Tape is fed through the back of tool from a continuous roll and is sealed by a nylon closure.

AUTOMATIC WIRE-WRAP * MACHINES

Gardner-Denver now offers two Automatic Wire-Wrap Machines to the electronics industry.

The 14FV Vertical Wire-Wrap Machine is designed for use with wiring panels having a terminal wrap area up to 22 x 22 inches. The 14FS Horizontal Wire-Wrap Machine will accomodate the larger wiring panels having a terminal wrap area up to 27 x 27 inches, and panel wrap area to 27 x 47 inches. Depending on wiring requirements, these machines offer quality, low cost, high production advantages not previously available to the user. Automatic wire termination is now an economic reality for many companies, who in the past, may have overlooked the cost saving advantages of automatic equipment.

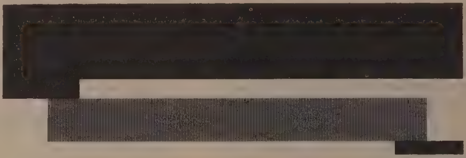
*Registered Trademark of Gardner-Denver Company

GARDNER-DENVER COMPANY, GRAND HAVEN DIVISION, GRAND HAVEN, MICHIGAN 49417 (616) 842-0200

Hutchinson Industrial Corporation

45 West Highland Park, Hutchinson, Minnesota 55350

(612) 879-2371

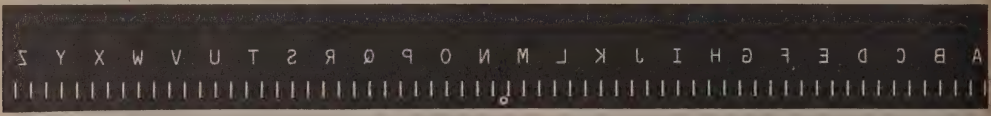


ENCODER SCALES

ENCODER DISKS

GLASS, METAL, PLASTIC disks and scales for OEM encoder positioning applications. Call us for help in selecting the best material for your application.

Computer generated grey, binary, incremental, or log patterns. Our circular dividing engine is accurate to 2 arc seconds. Our computerized measurement of linear scales is accurate to one part in 10^6.

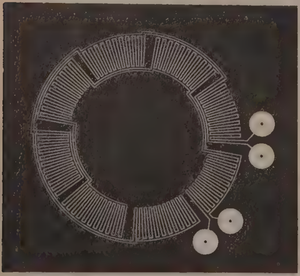


PRINTER FONTS

Etched metal font belts, drums, and disks for impact printers.

Photographic font arrays for optical printers.

Writing stylii for electrostatic printers.



PRECISION CIRCUITS Flexible - Rigid
RESISTIVE PATTERNS
TEMPERATURE SENSORS

High Density (.001″ lines, .001″ spaces)

Line Width Tolerance to ±.0002″

Line Spacing Tolerance to ±.0002″ in 3″

Mylar, Kapton, G-10, with Copper, Nichrome, Gold Conductors.

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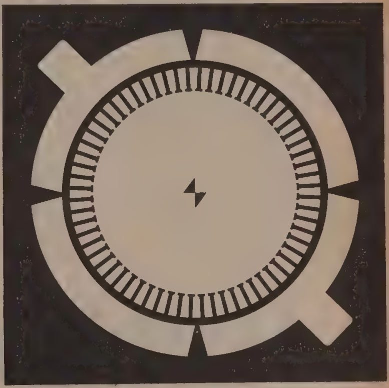
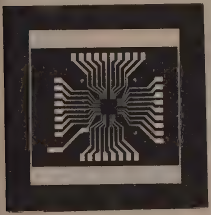
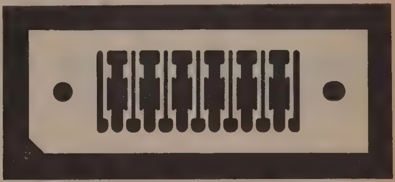


MAGNETIC CORES
MOTOR & SYNCHRO LAMINATIONS

We supply high permeability cores for data recording and high frequency use. Cores are of etched layers, laminated, and supplied in ready-to-wind condition.

Etched motor and synchro laminations with as many as 300 poles supplied adhesive coated, laminated, or individually.





MASKS AND ETCHED METAL PARTS

Copper
Berylium Copper
Stainless Steel
Nickel
Nichrome
Molybdenum
Tungsten
Niobium
HiMu 80
Invar
Inconel
Kovar

Etched Masks
Electroformed Masks
Bi-Metal Masks
Precision Photomasters
Metal Reticles
Chrome-on-glass Reticles
Spectrometer Slits
Precision Thin Parts
Encoders
Core Loading Plates
Precision Circuits
Magnetic Laminations

the buck stops here

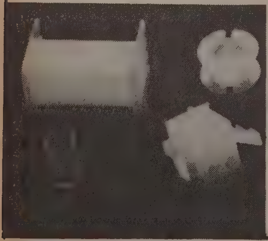
Single source responsibility with all in-plant facilities and services from concept to delivery. Complete design and engineering ability, precision tool making, production and quality control to meet or exceed customary tolerances.

Harbison does it all ....

Specializing in injection molding of electrical and electronic components including coil forms, bobbins and connector housings. Materials such as glass filled nylon, Zytel 101, Valox, Delrin, Noryl, and phenolics.

modular family molding !!!

The economies of multiple cavity molding with the precision and quality of custom molding . . . allow a mix or match with significant savings. All this and industry-beating delivery time!



Harbison customers are sold but **never** forgotten

HARBISON Industrial Products, Inc.
7205 Hibbs Lane Levittown, Penna. 19057

...people with a part in the future of Plastics.

OTTO® adhesive/epoxy/solder dispensers

• Air operated • Instant cut-off • Simple installation & set-up

OTTO dispensers comprise a wide range of types to automatically and precisely apply single and multi-component compounds. Whether dispensing precise droplets or volume encapsulations, OTTO's air operated positive displacement principle assures safe, accurate and tidy application without introducing air into the material.

All OTTO dispensers feature safe, air operation, instant material cutoff, effective and quick clean-up easy set-up and adjustment and improved time-motion productivity and operator morale.

We also design and manufacture complete automated production stations to your requirements.

injectors

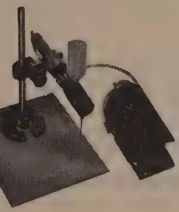
OTTO® Injectors apply single part or pre-mixed epoxies and other compounds, from minute droplets to encapsulation of complete assemblies, with minimum operator motion. A wide range of viscosities are handled equally well.

The nozzle design eliminates the chance of trapped air and bubbles in the finished product. Instant cutoff—no dripping—keeps the work area and product clean. Easy clean-up of reusable nozzles or no clean-up with disposable nozzles minimizes set-up and maintenance.

The A5 series consists of the bench mounted variable air metering control and foot control, nozzle-reservoir and pressure head. Complete specifications in Bulletin A5.

OTTO Model No.	Pressure Head Diameter	Nozzle		
		Type	Length	Capacity
A5-1	½"	Reusable	3 in.	.6 oz.
A5-2	½"	Reusable	6 in.	1.0 oz.
A5-4	1"	Disposable	5 in.	1.0 oz.
A5-6	1¼"	Reusable	4 in.	5 cu. in.
A5-7	1¾"	Disposable	10 in.	12 oz.

shotmeters

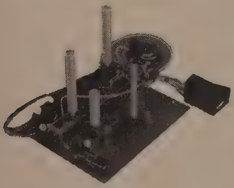


OTTO Shotmeters dispense precise and consistent amounts of adhesives and epoxies. Variable output is easily set while a measured shot or fractional shot can be pulsed at operator's option.

Because of the high pressures the OTTO A6 develops on the material, even heavy, thick compounds can be precisely dispensed. Five standard output sizes are available. Complete specifications in Bulletin A6.

OTTO Model No.	Max. Shot Size (cu. in.)	Max. Output Pressure 100 PSI (Input)
A6-1	0.0027	10,000
A6-2	0.011	7,000
A6-3	0.044	1,800
A6-4	0.100	800
A6-5	0.175	450

mixer/dispensers



OTTO mixer/dispensers take 2 and 3 part components from gravity containers, pressure pots or barrel pumps and dispenses precise amounts to the work.

A proven principle in valving, integral with the measuring cylinders, provides accurate measuring and mixing by insuring complete synchronization.

Shot size may be predetermined in a variety of volumes or controlled directly by the operator.

Simply plug into a 3/8" air line with pressure to 90 PSI. It's a turn-key machine, ready for immediate production. Bench area required is 18x36 inches. Complete specifications in Bulletin A3.

OTTO Model No.	Shot Size		Max. Output Pressure —100 PSI
	Min.	Max.	
A3-5	.2 cu. in.	40 cu. in.	500
A3-6	.001 cu. in.	.33 cu. in.	5000

OTTO-DOT T.M. micro dispenser

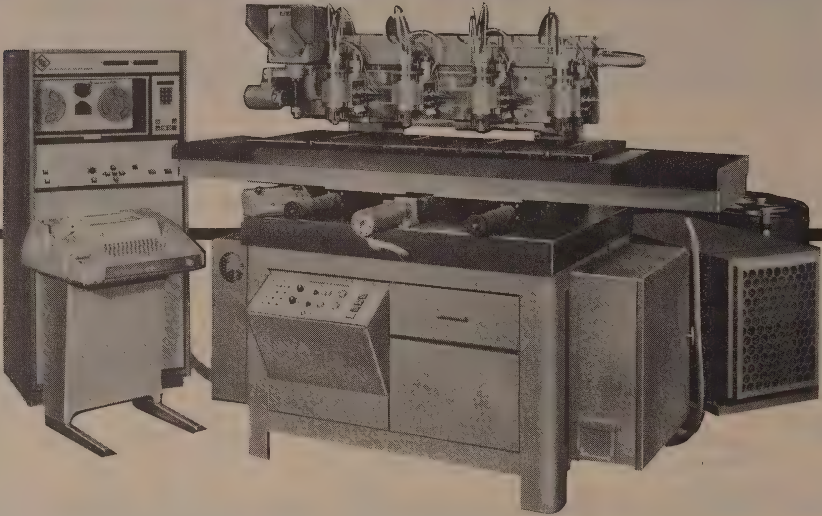
Micro spheres, .015" dia. to .625" dia., of single and pre-mixed dual component compounds can be applied to I.C. chips and other miniature electronic components. All contacts and settings for easy set-up and adjustment are on the front panel of the control unit. Also provided is a means for remote operation by photo electrics, limit switches, etc. Applies RTV, solder and brazing creams, adhesives, fluxes, solvents, cynoacrylates and greases.

A full range of nozzle capacities and special arrangements available. Requires 20-120 PSI and 115 VAC. Dimensions: 12"W x 5"H x 7"D. Complete specifications in Bulletin A4.

OTTO engineering, inc. • 36 Main St., Carpentersville, Illinois 60110 • 312/428-7171

US Pat. No. 3,684,250 and other U.S. and Foreign Patents Pending.

SLO-SYN®
NC DRILLING MACHINE & NC DRILLING/DIGITIZING MACHINES



- Models with digitizing capability available with 3 or 4 drilling heads; drilling only model has 4 heads.
- Heavy duty, high speed, liquid cooled spindles
- High capacity chip removal system
- Precision digitizing of undimensioned artwork or prototype eliminates manually writing and typing programs
- Numerically controlled drilling, to 150 cycles per minute
- Visual display of program block and table position
- Automatic target centering in grid mode
- Controls for manual positioning, program back-up and mirror imaging
- Abbreviated tape format for fast output and efficient storage

SPECIFICATIONS

TABLE

Table Travel	24 x 18 inches.
Positioning Resolution	.001 inch (0.0005 inch or 0.01mm optional).
Table Accuracy	±.001 inch/foot.
Table Repeatability	Within .0005 inch.
Table Dimensions	Top size 56 x 19 inches.
Positioning Elements	Ways — Ball bushings on 1¼ inches dia. ground steel rods continuously supported. Lead Screws — Preloaded ball. Drive — Direct coupled SLO-SYN motors
Load Limits	Vertical Top Force — Not to exceed 100 lbs. at any one point or 500 lbs. evenly distributed over the 56 x 19 inch top areas. Fixture and Workpieces — 150 lbs. evenly distributed over the 56 x 19 inch top area.

NUMERICAL CONTROL

Data Input	Punched paper tape, ASCII coded, word address, incremental; or manual dial with index and jog.
Display	Block number. Absolute X and Y position in digitizing model.
Control Output	Power to drive SLO-SYN motors. Actuation and interlock of spindle system.

SPINDLE SYSTEM

Drilling Capability	2 Panels — 24 x 18 inches 3 Panels — 18 x 18 inches 4 Panels — 12 x 18 inches
Working Speed Range	5,400 to 54,000 rpm.
Cooling	Liquid.
Protection	Electronic.
Collet	Precise Uni-Chuck ⅛ inch shank drills only.
Drilled Hole Range	0.0135 (No. 80) to ⅛ inch dia. (1¼ inch with P collet)
Rapid Rate	120 inches per minute at 80 to 100 psi.
Feed Rate	0-100% of rapid rate.

DIGITIZING SYSTEM

Position Control	Remote box with position control buttons and grid selector dial.
Position Display	X, Y and block number in numerical control.
Target Resolution	10X viewer with 6 inch dia. screen.
Date Input	Punched paper tape and printout at 10 cps on ASR33 teletypewriter.

TYPES

SNC2418D-4:	Includes numerical control, table and 4-head spindle system.
SNC2418DIG-3:	Includes numerical control, table, 3-head spindle system and digitizing system.
SNC2418DIG-4:	Includes numerical control, table, 4-head spindle system and digitizing system.

Write for complete literature or call George Scanlon

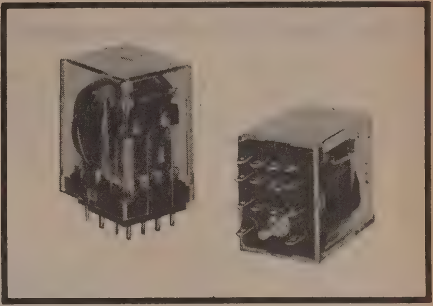
THE SUPERIOR ELECTRIC COMPANY
1000 MIDDLE STREET • BRISTOL, CONN. 06010 • PHONE: (203) 582-9561

Arco Electronics, Inc.

COMMUNITY DRIVE
GREAT NECK, NEW YORK 11022
(516) 487-0500

9822 INDEPENDENCE AVENUE
CHATSWORTH, CALIFORNIA 91311
(213) 882-8707

SIEMENS RELAYS



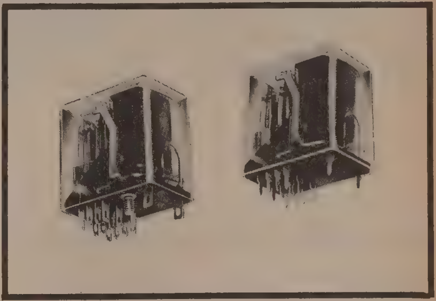
The MAT4 relay type is the widest used general purpose industrial relay today, slightly larger than 1 cubic inch. They are used in such applications as process controls, data processing, business machines, and alarm and signal circuits where reliability is important.

Interchangeable With All Comparable Types
POTTER & BRUMFIELD — Types: KHP, KHU, KHC and KHF
SIGMA — Type 67R
CORNELL-DUBILIER — Type A104

FEATURES

- UL File E51802
- 4 PDT Contact Arrangement
- 3 Amp Contacts
- AC or DC Coils
- Sockets With Solder or P.C. Terminals
- Low Cost
- Plug-in or P.C. Terminals
- Dust Proof Enclosure

CRADLE MODEL V23028

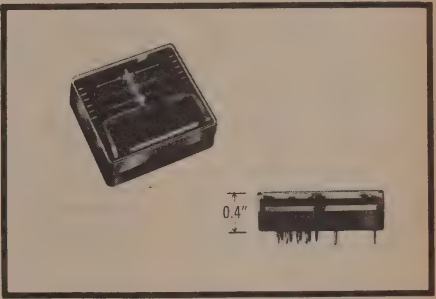


2PDT, 4PDT, 6PDT. Plug-in and printed circuit terminals. Magnetic latching and sensitive types. UL listed, 6, 12, 24, 48 and 115 VDC coils. Replacement for Allied Control Types T154, TP154, TPF154, T163 and TP163; Potter & Brumfield R10E; Sigma 62R and 70R; American Zettler AZ420, AZ421 and AZ431; Magnacraft (Hart-Advance) 67.

FEATURES

- UL File E48393
- High Reliability and Long Life at Low Cost
- 2 Amp & 5 Amp Designs
- Interchangeable With all Standard Cradle Relays

LOW PROFILE MODELS



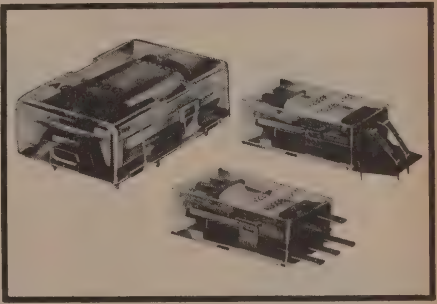
MODEL V23030 — 4PDT, 6PDT. Compact units with overall height of 0.4 in. Bifurcated contacts. 6, 12, 24 and 48 VDC coils.

MODEL V23027 — slim compact designs 8 amp contact rating SPDT contacts. P.C. Board Mounting on 0.1″ grid spacing. Low Cost.

FEATURES

- Low Cost Design
- Allows for 0.5″ Center-to-Center P.C. Board Spacing
- Ideal for Communication Systems, Data Processing and Automatic Control Systems

LOW PROFILE PRINTED CIRCUIT & POWER MODELS



MODEL V23012 — DPDT compact P.C. board types for 0.1 in. grid spacing. Overall height 0.401 in. above board. Single or bifurcated contacts. Low power consumption. 6, 12, 24 and 48 VDC coils.

MODEL V23016 — SPST-NO double make or SPDT contacts. Rated at 7.5 Amps steady state and 15 Amps in-rush. Printed circuit or fast-on terminals. 6, 12, 24 and 48 VDC coils.

FEATURES

- Low Cost
- High Reliability
- Low Operating Power
- Standard 0.1″ Grid Spacing for P.C. Terminals

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ELECTRONIC COMPONENTS FOR INDUSTRY SOLD NATIONALLY THROUGH Arco DISTRIBUTORS

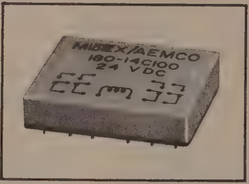
Type 180 4PDT

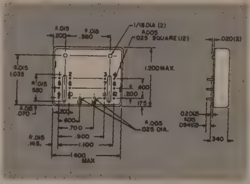
Miniature 2 Ampere Printed Circuit Mounting Industrial Relay

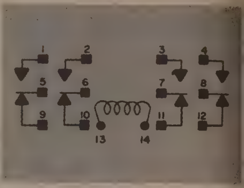
The Type 180 4PDT relay can provide low-level to in excess of 2 amperes at 28 VDC switching in a PCB package only 0.34 x 1.4 x 1.2 inches in size. The contacts can also readily switch 2 amperes at 120 VAC, 50% p.f.

The Type 180 provides a minimum of 1/16 inch clearance through air and 1/8 inch over-surface spacing between current carrying members. Low level gold, fine silver, or silver cad-oxide contacts are available. White nylon cover. Certain models U/L recognized

OUTLINE DIMENSIONS







The standard part number (e.g., 180-14C100) has a sensitive, full coil, dissipating only 0.72 watts nominally at 25°C. The U/L spaced versions (e.g.,180-14C1U0) require 1.20 watts nominally at 25°.

ELECTRICAL CHARACTERISTICS

CONTACTS:

Arrangement
Four Form C (4PDT)

Rating
Low Level (Gold Alloy, Fine Silver)
2 Amp, 28 VDC, resistive — 100,000 operations (Ag Cd O)
1 Amp, 48 VDC, inductive (suppressed) —500,000 operations (Ag Cd O)
2 Amp, 120 VAC, 50% pf-200,000 operations (Ag Cd O)

Contact Resistance (Ag CD O)
Initial 0.100 ohms. After life 0.200 ohms. (1 Amp, 14 VDC)

COILS:

Voltage Ratings
6 to 48 VDC

Pick-Up Voltage
75% nominal at 25° C
88% nominal at 70° C

Release Voltage
4% nominal at 25° C

Nominal Wattage
0.72 watts, nominal voltage 25°C: Non-U/L Coils
1.20 watts, nominal voltage 25°C: U/L spaced coils

Temperature Rise
33°C per watt, 25°C

GENERAL:

Mechanical Life
20 million operations minimum

Dielectric Breakdown
1000 VAC (RMS) coil to contacts or between poles.
750 VAC (RMS) across open contacts.

Insulation Resistance
100 K megohms at 500 VDC between all mutually insulated terminals

Timing Values
15 MS maximum operate at nominal voltage (includes bounce)
12 MS maximum release at nominal voltage, unsuppressed (includes bounce)

ENVIRONMENTAL:

Temperature Range
Operating: —45°C to +60°C
Storage: —40°C to +100°C

Shock
30G, 11MS pulses, ½ sinewave, 3 axes (non-operating)

Vibration
10G, 10-55Hz, simple harmonic motion in each major axis (operating)

U/L Recognition*
U/L Rating: 1.5 Amp full load, 9 Amp locked rotor at 120 VAC; 0.75 Amp full load, 4.5 Amp locked rotor at 240 VAC; 2 Amp at 120 VAC and 28 VDC; 1 Amp at 240 VAC, 60 Hz.

STANDARD PART NUMBERS

COILS		RELAY TYPE	(2 AMP) SILVER CADMIUM OXIDE	(DRY CKT) #1 GOLD ALLOY	(LOW LEVEL) FINE SILVER (Gold Flashed)
NOMINAL VOLTAGE	RESISTANCE (ohms ± 10%)				
NON-U/L SPACED					
6	45	180-	14A100	14A200	14A300
V 12	200		14B100	14B200	14B300
D 24	775		14C100	14C200	14C300
C 48	3300		14D100	14D200	14D300
5	42		14E100	14E200	14E300
U/L SPACED					
6	28	180-	14A1U0*	14A2U0	14A3U0
V 12	125		14B1U0*	14B2U0	14B3U0
D 24	480		14C1U0*	14C2U0	14C3U0
C 48	2100		14D1U0*	14D2U0	14D3U0
5	17		14E1U0	14E2U0	14E3U0

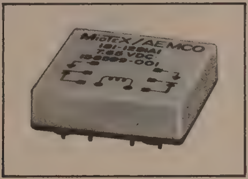
Type 181 2PDT

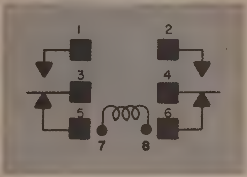
**Minature 2 Ampere
Printed Circuit Mounting
Industrial Relay**

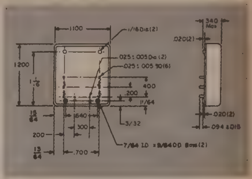
The Type 181 2PDT relay can provide low-level to in excess of 2 amperes at 28 VDC switching in a PCB package only 0.34 x 1.1 x 1.2 inches in size. The contacts can also readily switch 2 amperes at 120 VAC, 50° p.f.

The Type 181 provides a minimum of 1/16 inch clearance through air and 1/8 inch over-surface spacing between current carrying members. Low level gold, fine silver, or silver cad-oxide contacts are available. White nylon cover. Certain models U/L recognized.

OUTLINE DIMENSIONS







GENERAL FEATURES

The standard part number (e.g. 181-12C100) has a sensitive, full coil, dissipating only 0.72 watts nominally at 25° C. The U/L spaced versions (e.g. 181-12C1UO) require 1.20 watts nominally at 25°

ELECTRICAL CHARACTERISTICS

CONTACTS:

Arrangement
Two Form C (2PDT)

Rating
Low Level (Gold Alloy, Fine Silver)
2 Amp, 28 VDC, resistive — 100,000 operations (Ag Cd O)
1 Amp, 48 VDC, inductive (suppressed) —500,000 operations (Ag Cd O)
2 Amp, 120 VAC, 50% pf-200,000 operations (Ag Cd O)

Contact Resistance (Ag CD O)
Initial 0.100 ohms. After life 0.200 ohms. (1 Amp, 14 VDC)

COILS:

Voltage Ratings
6 to 48 VDC

Pick-Up Voltage
75% nominal at 25°C
88% nominal at 70° C

Release Voltage
5.2% nominal at 25° C

Nominal Wattage
0.72 watts, nominal voltage 25°C: Non-U/L Coils
1.20 watts, nominal voltage 25°C: U/L spaced coils

Temperature Rise
33°C per watt, 25°C

GENERAL:

Mechanical Life
20 million operations minimum

Dielectric Breakdown
1000 VAC (RMS) coil to contacts or between poles.
750 VAC (RMS) across open contacts.

Insulation Resistance
100 K megohms at 500 VDC between all mutually insulated terminals

Timing Values
15 MS maximum operate at nominal voltage (includes bounce)
12 MS maximum release at nominal voltage, unsuppressed (includes bounce)

ENVIRONMENTAL:

Temperature Range
Operating: —45°C to +60°C
Storage: —40°C to +100°C

Shock
30G, 11MS pulses, ½ sinewave, 3 axes (non-operating)

Vibration
10G, 10-55Hz, simple harmonic motion in each major axis (operating)

U/L Recognition*
U/L Rating: 1.5 Amp full load, 9 Amp locked rotor at 120 VAC; 0.75 Amp full load, 4.5 Amp locked rotor at 240 VAC; 2 Amp at 120 VAC and 28 VDC; 1 Amp at 240 VAC, 60 Hz.

STANDARD PART NUMBERS

COILS		RELAY TYPE	(2 AMP) SILVER CADMIUM OXIDE	(DRY CKT) #1 GOLD ALLOY	(LOW LEVEL) FINE SILVER (Gold Flashed)
NOMINAL VOLTAGE	RESISTANCE (OHMS ±10%)				
NON-U/L SPACED					
6	45	181—	12A100	12A200	12A300
V 12	200		12B100	12B200	12B300
D 24	775		12C100	12C200	12C300
C 48	3300		12D100	12D200	12D300
5	42		12E100	12E200	12E300
U/L SPACED					
6	28	181—	12A1U0*	12A2U0	12A3U0
V 12	125		12B1U0*	12B2U0	12B3U0
D 24	480		12C1U0*	12C2U0	12C3U0
C 48	2100		12D1U0*	12D2U0	12D3U0
5	17		12E1U0	12E2U0	12E3U0

Type 155 1, 2 & 3PDT

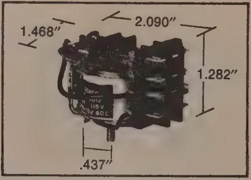
Open & Dust Covered
5 & 10 Amp
Industrial Relay
U/L & CSA Recognized

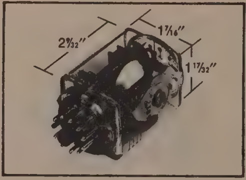
The Type 155 is a low cost 5 and 10 ampere industrial relay, available in either open or dust covered versions. A variety of solder lug, .187 quick connect, solderless wrap or plug-in terminals are available. All leads terminate on barrier for easy installation.

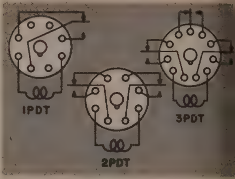
The type 155 is U/L recognized to 10 amperes, 1/3 H 115 VAC; 6 amperes, 1/2 HP, 240 VAC for silver cadmiu oxide contacts.

Silver contacts are 5 amp, 1/8 HP, 120 VAC; 3 am 1/4 HP, 240 VAC. (Also U/L recognized.)

OUTLINE DIMENSIONS







ELECTRICAL CHARACTERISTICS

CONTACTS
1, 2 & 3PDT
5 amp silver
10 amp silver cadmium oxide

COILS
6 to 110 VDC
6 to 240 VAC

Nominal Wattage
2.0 VA AC
1.2 Watts DC

GENERAL
Mechanical Life
15 million operations

Insulation Resistance
1500 Megohms min, 500 volts

Dielectric Breakdown
1780 VAC, RMS, coil and contacts to frame, coil to contacts, and between poles.

ENVIRONMENTAL CHARACTERISTICS

STORAGE
−65°C to +100°C

OPERATING
−55°C to +71°C

VIBRATION
10G, 10-55Hz operating

PHYSICAL CHARACTERISTICS

WEIGHT
2 ounces

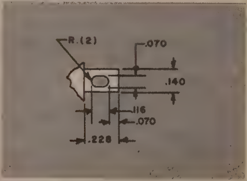
MARKING
Midtex name, part number and wiring diagram on dust cover. Customer marking optional.

MOUNTING
Open
6-32 x 5/16" stud

Dust Cover
Octal style plug

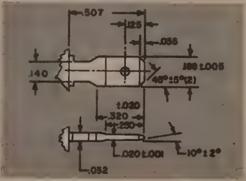
TERMINALS

MODEL 155-1



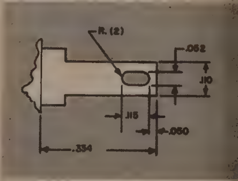
Solder Terminal

MODEL 155-2



3/16" Quick Disconnect Terminal

MODEL 155-8



.110 Quick Disconnect Termina

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

COILS		RELAY TYPE	OPEN, SOLDER TERMINAL				OPEN .187 QUICK CONNECT				DUST COVER OCTAL PLUG			
			SILVER (gold flash)		SILVER CADMIUM OXIDE (gold flash)		SILVER (gold flash)		SILVER CADMIUM OXIDE (gold flash)		SILVER (gold flash)		SILVER CADMIUM OXIDE (gold flash)	
NOMINAL VOLTAGE	RESISTANCE (Ohms ±10%)		2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole
6	30	155—	12A100	13A100	12A200	13A200	22A100	23A100	22A200	23A200	92A100	93A100	92A200	93A200
V 12	120		12B100	13B100	12B200	13B200	22B100	23B100	22B200	23B200	92B100	93B100	92B200	93B200
D 24	480		12C100	13C100	12C200	13C200	22C100	23C100	22C200	23C200	92C100	93C100	92C200	93C200
C 48	1800		12D100	13D100	12D200	13D200	22D100	23D100	22D200	23D200	92D100	93D100	92D200	93D200
110	10000		12F100	13F100	12F200	13F200	22F100	23F100	22F200	23F200	92F100	93F100	92F200	93F200
6	5	155—	12N100	13N100	12N200	13N200	22N100	23N100	22N200	23N200	92N100	93N100	92N200	93N200
V 12	18		12P100	13P100	12P200	13P200	22P100	23P100	22P200	23P200	92P100	93P100	92P200	93P200
A 24	75		12Q100	13Q100	12Q200	13Q200	22Q100	23Q100	22Q200	23Q200	92Q100	93Q100	92Q200	93Q200
C 120	2250		12T100	13T100	12T200	13T200	22T100	23T100	22T200	23T200	92T100	93T100	92T200	93T200
240	9000		12U100	13U100	12U200	13U200	22U100	23U100	22U200	23U200	92U100	93U100	92U200	93U200

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Type 156 4PDT

Miniature 5 Ampere
Industrial Relay
U/L & CSA Recognized

The Type 156 4PDT Relay is a compact and versatile industrial relay. Low level switching gold contacts, universal gold flashed silver, or silver cadmium oxide power contacts are available. Units are dust covered. Terminals are solder/plug-in, taper tab or printed circuit.

Various solder, PCB or the new solderless wrap sockets provide versatile mounting.

Type 156 options are pushbutton actuators, opposite pole barriers, indicator lamps, special mounting brackets and 2 PDT contacts.

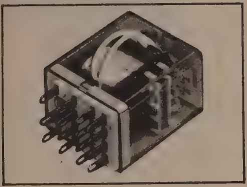
All Midtex/AEMCO dust covered Type 156 Relays with 3/32" silver or 3/32" silver cadmium oxide contacts have Underwriters' Laboratories Component Recognition for Motor Controllers through 240 VAC in accordance with Underwriters' Laboratories Standard 508 "Industrial Control Equipment." They provide through air spacing of 1/16" minimum and over-surface spacing of 1/8" minimum, and are recognized for 1/10 horsepower motor control applications at 120/240 VAC. Opposite polarity on adjacent poles U/L is also available.

Sockets are constructed to meet U/L requirements for these ratings.

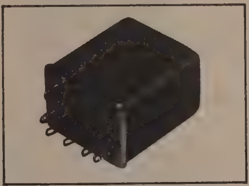
The gold alloy and palladium contact models meet the same spacing and insulation requirements, but are meant for lighter contact loads.

Certain hermetically sealed models are also U/L recognized.

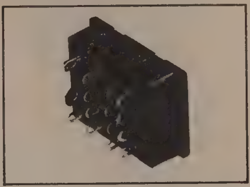
Dust Covered



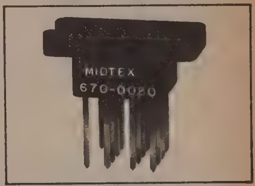
Hermetically Sealed

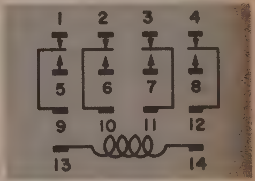


Solder or PCB Socket



Solderless Wrap Socket





Wiring Diagram

ELECTRICAL CHARACTERISTICS

CONTACTS:

Arrangement
4 Form C (4PDT)

Material
3/32" Silver (Gold Flash)
3/32" Silver Cadmium Oxide
Gold Alloy & Palladium Cross Bar
3/32" Palladium & Gold Alloy Buttons
Gold Alloy, Silver & Palladium Bifurcated

Rating
3/32" Silver (Gold Flash)*
3 amp, 28 VDC/120VAC 80% pf
1/10 hp, 120/240 VAC
3/32" Silver Cadmium Oxide*
5 amp, 28 VDC/120 VAC 80% pf
1/10 hp, 120/240 VAC
Gold Alloy Cross Bar
Low level/2 amps 28 VDC
3/32" Palladium
3 amp, 28 VDC/120 VAC
*(U/L Recognized)

Contact resistance
Initial 0.05 ohm max. After life 0.100 ohm max. (Measured at rated current)

Life expectancy
Mechanical—In excess of 50 million operations
Electrical—100,000 operations at rated loads

COILS:

Voltage ratings
6 to 240 VAC 50/60 Hz.
6 to 110 VDC
(See Part Number Table)

Pick-up voltage
AC — 85% of nominal, DC — 75% of nominal

Power ratings
Nominal
AC 1.2 VA
DC 0.9 Watts
Maximum continuous
AC 2.0 VA
DC 2.0 Watts

Temperature rise
Nominal voltage
AC 35°C
DC 33°C
25% overvoltage
AC 65°C
DC 45°C

Duty cycle
Rated for continuous duty operation at 25% overvoltage

GENERAL:

Dielectric breakdown
Greater than 500 VAC RMS 60 Hz across open contacts
Greater than 1500 VAC RMS 60 Hz all other mutually insulated elements

Insulation resistance
1500 Megohms minimum at 500 VDC

Timing values
13 MS max. operate make time
10 MS max. release make time
(Nominal voltage, no coil suppression)

Insulating material
Molded alkyd (glass reinforced)

Weight (approximate)
1-1/2 ounces (dust cover)
1-5/8 ounces (hermetically sealed)

Marking
Midtex/AEMCO name, part number, nominal voltage, wiring diagram and pin designation are standard. Customer marking optional.

Type 156 cont.

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

COIL		RELAY TYPE	CLEAR DUST COVER SOLDER/PLUG IN TERMINALS			NYLON DUST COVER PRINTED CIRCUIT TERMINALS			CLEAR DUST COVER TAPER TAB TERMINALS			HERMETICALLY SEALED SOLDER/PLUG-IN TERMINALS		
RESISTANCE (Ohms ±10%)	NOMINAL VOLTAGE		SILVER (gold flash)	SILVER CAD. OX. (gold flash)	GOLD ALLOY	SILVER (gold flash)	SILVER CAD. OX. (gold flash)	GOLD ALLOY	SILVER (gold flash)	SILVER CAD. OX. (gold flash)	GOLD ALLOY	SILVER (gold flash)	SILVER CAD. OX. (gold flash)	GOLD ALLOY
40	6	156–	14A100	14A200	14A300	24A100	24A200	24A300	34A100	34A200	34A300	44A100	44A200	44A300
160	V 12		14B100*	14B200	14B300	24B100	24B200	24B300	34B100	34B200	34B300	44B100	44B200	44B200
650	D 24		14C100*	14C200	14C300	24C100	24C200	24C300	34C100	34C200	34C300	44C100	44C200	44C300
2600	C 48		14D100	14D200	14D300	24D100	24D200	24D300	34D100	34D200	34D300	44D100	44D200	44D300
9000	90		14E100	14E200	14E300	24E100	24E200	24E300	34E100	34E200	34E300	44E100	44E200	44E300
11000	110		14F100	14F200	14F300	24F100	24F200	24F300	34F100	34F200	34F300	44F100	44F200	44F300
10	6	156–	14N100	14N200	14N300	24N100	24N200	24N300	34N100	34N200	34N300	44N100	44N200	44N300
40	V 12		14P100	14P200	14P300	24P100	24P200	24P300	34P100	34P200	34P300	44P100	44P200	44P300
155	A 24		14Q100*	14Q200	14Q300	24Q100	24Q200	24Q300	34Q100	34Q200	34Q300	44Q100	44Q200	44Q300
670	C 48		14R100	14R200	14R300	24R100	24R200	24R300	34R100	34R200	34R300	44R100	44R200	44R300
3900	120		14T100*	14T200	14T300	24T100	24T200	24T300	34T100	34T200	34T300	44T100	44T200	44T300
14900	240		14U100	14U200	14U300	24U100	24U200	24U300	34U100	34U200	34U300	44U100	44U200	44U300

* Stock Item
Standard Models in Stock

SOCKETS:

670-0001 3/16" solder terminals

670-0002 3/8" solder terminals

670-0003 PCB terminals

670-0020 solderless wrap

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE

Operating: –45°C to +75°C
Storage: –65°C to +100°C

SHOCK

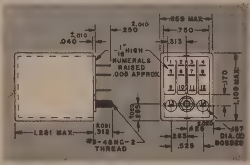
15 g's, 11 ± 1 ms, ½ sinewave (non operating test, no mechanical damage)

VIBRATION

0.1" DA or 10 g's, 10 to 55 Hz operating test, no contact chatter, hard mounted, 1 microsecond detection level)

ENCLOSURES

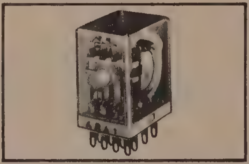
Dust Cover



.659 MAX.
.750
.313
±.010 .250
±.010 .040
1/16 HIGH NUMERALS RAISED .005 APPROX.
1.109 MAX.
.170
1.281 MAX.
.031 .312
#5-48NC-2 THREAD
.263
.525
.187 DIA. (2) BOSSES

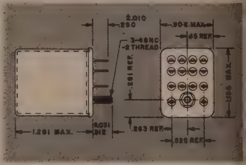
Clear polycarbonate standard on models with solder/plug-in terminals. Natural nylon standard on models with PCB terminals.

Pushbutton



Push-to-actuate button provides versatile feature for system maintenance and checkout.

Hermetically sealed

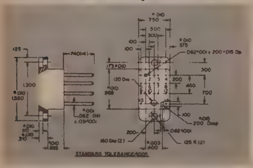


±.010 .250
.905 MAX.
.65 REF.
3-48NC-2 THREAD
.281 REF.
1.156 MAX.
1.281 MAX.
.031 .312
.263 REF.
.525 REF.

Glass to metal compression header. Lusterless gray enamel finish. Not U/L recognized.

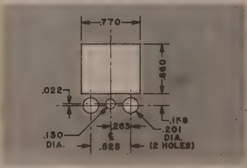
MOUNTING

Solderless Wrap Socket


STANDARD TOLERANCE

Models 156-1, -4
For interconnection economies. Up to 3 individual connections per terminal, 20-26 AWG

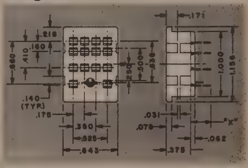
Direct chassis



.770
.860
.022
.130 DIA.
.263
.525
.156
.201 DIA. (2 HOLES)

Models 156 -1, -3, -4
For wired connection reliability.

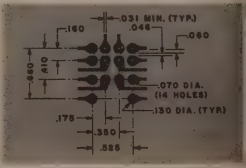
Plug-in



.218
.160
.410
.860
.171
1.000
1.156
.140 (TYP)
.175
.350
.525
.643
.031
.078
.375
.062
"X"

Models 156 -1, -4*
For ease of installation and replacement in severe duty applications.

Printed circuit board



.031 MIN. (TYP.)
.046
.160
.060
.410
.860
.070 DIA. (14 HOLES)
.130 DIA. (TYP)
.175
.350
.525

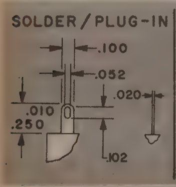
Model 156-2
For the economy inherent in PCB systems.

See part number table

TERMINALS

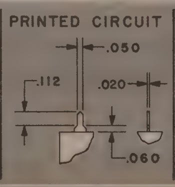
Relay

Model 156-1



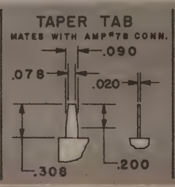
SOLDER/PLUG-IN
.100
.052
.020
.010
.250
.102

Model 156-2



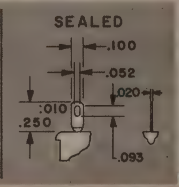
PRINTED CIRCUIT
.050
.112
.020
.060

Model 156-3



TAPER TAB
MATES WITH AMP#78 CONN.
.090
.078
.020
.308
.200

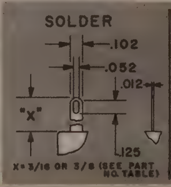
Model 156-4



SEALED
.100
.052
.020
.010
.250
.093

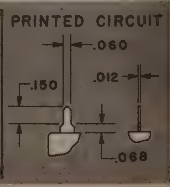
Socket

P/N 670-0001,2



SOLDER
.102
.052
.012
"X"
.125
X=3/16 OR 3/8 (SEE PART NO. TABLE)

P/N 680-0003



PRINTED CIRCUIT
.060
.150
.012
.068

Standard terminal finish is fused electro-tin.

**#731R chassis punch available from Greenlee Tool Co., Rockford, Illinois*

Type 157 1, 2 & 3 PDT

Open & Dust Covered
5 & 10 Amp
Industrial Relay
U/L & CSA Recognized.

The Type 157 3PDT Relay is a rugged power driver, offering superior 3/16" through air and 3/8" over-surface spacing. An interlocked frame and contact block prevents contact misalignment during plug-in. Open or dust covered. The relay is available with neon bulb indicator lamps and push-to-operate buttons.

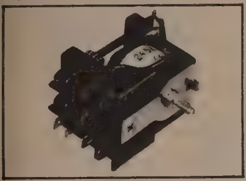
A magnetic latching version provides a unique switchable core, which cannot be falsely latched.

All Midtex/AEMCO catalog Type 157 Relays, except magnetic latching, have Underwriters' Laboratories Component Recognition as Motor Controllers through 600 VAC in accordance with U/L Standard 508 "Industrial Control Equipment." They provide through air spacing of 3/16" minimum and over-surface spacing of 3/8" minimum and are recognized for 1/2 HP motor controller applications at 240/480/600 VAC (1/3 HP at 120 VAC).

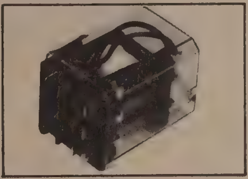
Sockets are constructed to meet U/L requirements for these ratings, except the P/C board socket.

Chassis mounted open relays must employ 1/32" additional insulation between mounting surface and relay, to insure 1/2" over-surface and through air to the mounting surface.

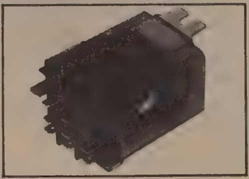
Open



Dust cover

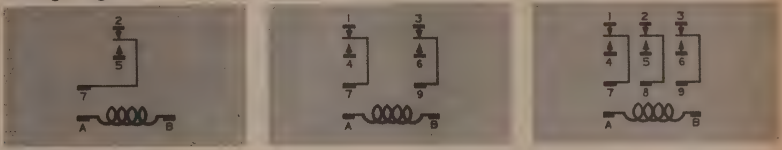


Flanged dust cover



Socket

Wiring diagrams



ELECTRICAL CHARACTERISTICS

CONTACTS

Arrangement
1, 2, and 3 Form C
(1, 2 & 3PDT)

Material
1/8" Fine Silver
(Gold Flash)

Rating

5 amp, 28 VDC/120 VAC, 80% pf	
3 amp	240 VAC, 80% pf
2 amp	600 VAC, 80% pf
1/8 hp	120 VAC

Material
3/16" Silver Cadmium Oxide

Rating

10 amp, 28 VDC/120 VAC, 80% pf	
1/3 hp	120 VAC
10 amp	240 VAC, 80% pf
1/2 hp	240 VAC
3 amp	480/600 VAC, 80% pf
1/2 hp	480/600 VAC

Contact resistance
Initial 0.05 ohm max. After life 0.100 ohm max. (Measured at rated current).

Life expectancy
Mechanical —
10 million operations.
Electrical —
100,000 operations at rated load.

COILS

Voltage ratings
6 to 240 VAC 50/60 Hz.
6 to 110 VDC.
(See Part Number Table).

Pick-up voltage
AC — 85% of nominal.
DC — 75% of nominal.

***Power ratings**
Nominal

1 & 2 Pole AC	
Nominal	1.7 VA
Maximum continuous	2.7 VA
3 Pole AC	
Nominal	2.0 VA
Maximum continuous	3.1 VA
DC	
Nominal	1.2 Watts
Maximum continuous	1.9 Watts

Temperature rise
1 & 2 Pole AC

	Open	Enc.
Nominal voltage	30° C	40° C

3 Pole AC

	Open	Enc.
Nominal voltage	45° C	55° C

DC

	Open	Enc.
Nominal voltage	30° C	40° C

Duty cycle
Rated for continuous duty operation at 25% overvoltage.

GENERAL

Dielectric breakdown
Greater than 750 VAC, RMS 60 Hz across open contacts.
Greater than 2500 VAC, RMS 60 Hz all other mutually insulted elements.

Insulation resistance
1000 Megohms minimum at 500 VDC.

Timing values
Operate make time —
15 MS nominal, 20 MS max.
Release make time —
6 MS nominal, 10 MS max.
(Nominal voltage, no coil suppression, DC relays only).

Insulating material
Phenolic

Weight (approximate)
Open relay 2.3 ounces.
Enclosed relay 3.0 ounces.

Marking
Midtex/AEMCO name, part number, nominal voltage, and terminal identification are standard. Customer marking optional.

Terminals
187" NEMA QDC
PCB

MIDTEX INC. • 1650 TOWER BLVD. • NORTH MANKATO, MINNESOTA 56001 • (507) 387-6521 • TWX: 910-565-2244

Type 157 cont.

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

COILS				RELAY TYPE	OPEN, SOLDER/PLUG-IN/ .187 QUICK CONNECT				PLAIN COVER, SOLDER/PLUG-IN/ .187 QUICK CONNECT				FLANGED COVER, SOLDER/ .187 QUICK CONNECT			
					SILVER (gold flash)		SILVER CADMIUM OXIDE (gold flash)		SILVER (gold flash)		SILVER CADMIUM OXIDE (gold flash)		SILVER (gold flash)		SILVER CADMIUM OXIDE (gold flash)	
	NOMINAL VOLTAGE	RESISTANCE (Ohms ±10%)			2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole	2 Pole	3 Pole
VDC	6	32		157—	12A100	13A100	12A200	13A200	22A100	23A100	22A200	23A200	32A100	33A100	32A200	33A200
	12	120			12B100	13B100	12B200	13B200	22B100	23B100	22B200	23B200	32B100	33B100	32B200	33B200
	24	470			12C100	13C100	12C200	13C200	22C100	23C100	22C200	23C200	32C100	33C100	32C200	33C200
	48	1800			12D100	13D100	12D200	13D200	22D100	23D100	22D200	23D200	32D100	33D100	32D200	33D200
	110	10000			12F100	13F100	12F200	13F200	22F100	23F100	22F200	23F200	32F100	33F100	32F200	33F200
		1 & 2 PDT	3 PDT													
VAC	6	6.0	4.2	157—	12N100	13N100	12N200	13N200	22N100	23N100	22N200	23N200	32N100	33N100	32N200	33N200
	12	21	18		12P100	13P100	12P200	13P200	22P100	23P100	22P200	23P200	32P100	33P100	32P200	33P200
	24	75	72		12Q100	13Q100	12Q200	13Q200	22Q100	23Q100	22Q200	23Q200	32Q100	33Q100	32Q200	33Q200
	120	2250	1700		12T100	13T100	12T200	13T200	22T100	23T100	22T200	23T200	32T100	33T100	32T200	33T200
	240	9100	7200		12U100	13U100	12U200	13U200	22U100	23U100	22U200	23U200	32U100	33U100	32U200	33U200

Standard Models in Stock

SOCKET

Part number 670-0009 (solder terminal). 670-0013 (P/C board mounted) 670-0012 (3/16 quick-connect terminal)

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE

*Operating:	Minimum	Maximum Open	Maximum Enclosed
1 & 2 Pole AC	−45°C	+75°C	+60°C
3 Pole AC	−45°C	+60°C	+45°C
1, 2, 3 Pole DC	−45°C	+80°C	+70°C

Storage:
−65°C to +100°C.

50/60 Hz operation, based on 105°C U/L limit.

SHOCK

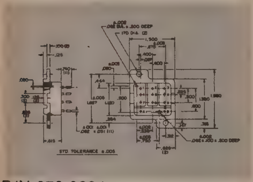
15 g's, 11 ± 1 MS
(non operating test, no mechanical damage).

VIBRATION

0.1" DA or 10 g's, 10 to 55 Hz
(operating test, no contact chatter).

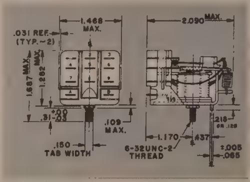
PHYSICAL CHARACTERISTICS

Solderless wrap socket


STD TOLERANCE ±.005

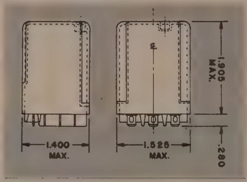
P/N 670-0034

Open


.031 REF.
(TYP.—2)
1.468 MAX.
2.090 MAX.
1.687 MAX.
1.282
.109 MAX.
.150 TAB WIDTH
1.170
.437
6-32UNC-2 THREAD
.218
±.005
.065

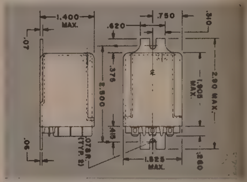
Model 157-1

Dust cover


1.905 MAX.
1.400 MAX.
1.525 MAX.
.280

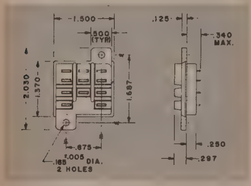
Model 157-2

Dust cover with flange


1.400 MAX.
.620
.750
.310
.07
2.500
.375
2.90 MAX.
1.905 MAX.
.415
.078 R. (TYP. 2)
.06
1.525 MAX.
.280

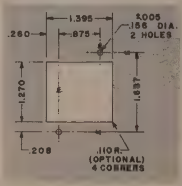
Model 157-3

Socket

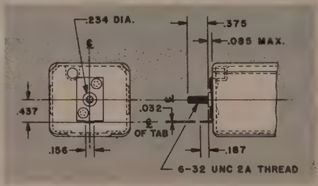

1.500
.500 (TYP.)
.125
.340 MAX.
2.030
1.370
1.687
.675
.165 ±.005 DIA. 2 HOLES
.250
.297

P/N 670-0009

Chassis cutout

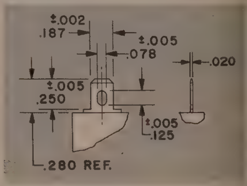

±.005
1.395
.156 DIA. 2 HOLES
.260
.875
1.270
1.687
.208
.110 R. (OPTIONAL) 4 CORNERS

Stud


.234 DIA.
.375
.085 MAX.
.437
.032
℄ OF TAB
.156
.187
6-32 UNC 2A THREAD

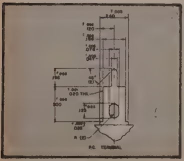
Model 157-4

Terminal


±.002
.187
±.005
.078
.020
±.005
.250
±.005
.125
.280 REF.

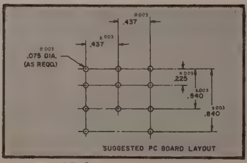
All models
Mates with sockets
Mates with .187" NEMA quick connect terminal
Suitable for solder connection

Terminal-PCB


P.C. TERMINAL

Model 157-9

PCB Hole Layout


±.003
.437
±.003
.437
±.003
.075 DIA.
(AS REQ'D.)
±.003
.225
±.003
.540
±.003
.840
SUGGESTED PC BOARD LAYOUT

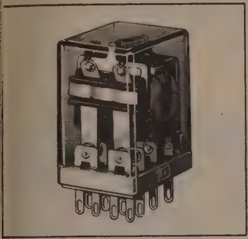
Model 157-9

Type 158 2PDT

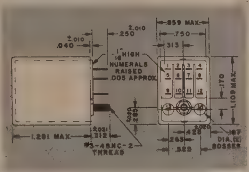
Miniature 10 Ampere Industrial Relay

DESIGNED FOR U/L RECOGNITION Midtex/AEMCO dust covered Type 158 Relays with 5/32" Silver Cadmium Oxide contacts are designed for Underwriters' Laboratories Component Recognition for Motor Controllers through 240 VAC in accordance with Underwriters' Laboratories Standard 508 "Industrial Control Equipment." They provide through air spacing of 1/16" minimum and over surface spacing of 1/8" minimum for 1/3 horsepower motor control applications at 120/240 VAC. Sockets are U/L recognized. This relay is physically identical to the Type 156 on pages 4 and 5.

OUTLINE DIMENSIONS

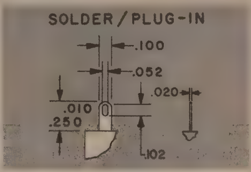


Dust Cover

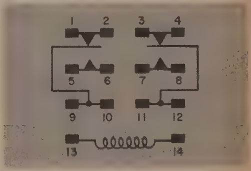


Clear polycarbonate is standard on all models with solder/plug-in terminals. Natural nylon is optional.

Terminals



Wiring



ELECTRICAL CHARACTERISTICS

CONTACTS

Arrangement
2 Form C (2PDT)

Material
5/32" Silver Cadmium Oxide*
(Gold Flashed)
5/32" Silver (Gold Flashed)

***Rating**
1/3 HP, 120/240 VAC, 10 Amp,
28 VDC/120VAC, 80% p.f.

Contact Resistance
Initial 0.05 ohms max. After life 0.10 ohms max. @ rated currents

Life Expectancy
Mechanical—in excess of 50 million ops.
Electrical—100,000 ops at rated load

COILS

Voltage ratings
6 to 240 VAC 50/60 Hz.
6 to 110 VDC

(See Part Number Table)

Pick-up voltage
AC—85% nominal, DC—75% of nominal

Power ratings

Nominal
AC 1.3 VA
DC 0.9 Watts

Maximum continuous
AC 2.0 VA
DC 2.0 Watts

Temperature rise

Nominal voltage
AC 40° C
DC 35° C

25% overvoltage
AC 65° C
DC 45° C

Duty cycle
Rated for continuous duty operation at 25% overvoltage.

GENERAL

Dielectric breakdown

Greater than 500 VAC RMS 60 Hz across open contacts
Greater than 1500 VAC RMS 60 Hz all other mutually insulated elements.

Insulation resistance
1500 Megohms minimum at 500 VDC

Timing values
13 MS maximum operate make time
10MS maximum release make time
(Nominal voltage, no coil suppression)

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

COIL		RELAY TYPE	CLEAR DUST COVER SOLDER/PLUG-IN TERMINALS		COIL		RELAY TYPE	CLEAR DUST COVER SOLDER/PLUG-IN TERMINALS	
Resistance (Ohms ±10%)	Nominal Voltage		Silver Cad. Ox. (gold flash)	Fine Silver (gold flash)	Resistance (Ohms ±10%)	Nominal Voltage		Silver Cad. Ox. (gold flash)	Fine Silver (gold flash)
40	6	158—	12A200	12A700	10	6	158—	12N200	12N700
160	V 12		12B200	12B700	40	V 12		12P200	12P700
650	D 24		12C200	12C700	155	A 24		12Q200	12Q700
2600	C 48		12D200	12D700	670	C 48		12R200	12R700
9000	90		12E200	12E700	3900	120		12T200	12T700
11000	110		12F200	12F700	14900	240		12U200	12U700

SOCKETS:

670-0001 3/16" solder terminals
670-0002 3/8" solder terminals
670-0003 PCB terminals
670-0020 solderless wrap

MIDTEX INC. • 1650 TOWER BLVD. • NORTH MANKATO, MINNESOTA 56001 • (507) 387-6521 • TWX: 910-565-2244

Type 159, 160, 166 1PDT

Mercury-Wetted Contact Relay
SPDT
Printed Circuit Module

The Mercury-Wetted Contact Relay is one of the most reliable relays on the market, and is used extensively in telephone communications, process computer interface, or any critical application requiring billions of operations life, stable contact resistance and faster than 2 millisecond operate speeds.

The type 159, 160 and 166 utilize a 2 ampere contact, Form C or Form D (specify) contact action.

See Midtex Engineering Bulletin 159/160 for proper contact protection requirements. Mounting within 30° of vertical required.

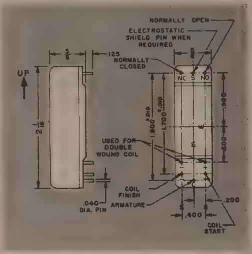
The adjustments available on the Type 159 and 160 Mercury-Wetted Relays are single-side-stable, bi-stable, or 1% dynamic balanced polar. The balanced polar adjustments provide less than 1% distortion in Neutral and Polar Telegraphy and Pulse Data Transmission applications. The low profile Type 166 is available in single-side-stable or bi-stable adjustments.

All types have single or dual coils, depending upon the requirement.

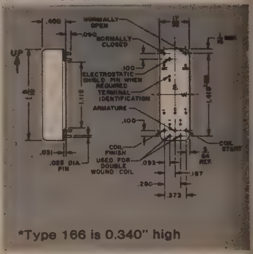
OUTLINE DIMENSIONS

MERCURY WETTED CONTACT RELAY
159-1752A00

TYPE 159


NORMALLY OPEN
ELECTROSTATIC SHIELD PIN WHEN REQUIRED
.125
NORMALLY CLOSED
UP
NC S NO
2 1/16
1.800 ±.010
1.700 ±.010
.900
.900
USED FOR DOUBLE WOUND COIL
COIL FINISH
.040 DIA. PIN
ARMATURE
.200
.400
COIL START

TYPE 160 and 166*


.400
NORMALLY OPEN
.090
NORMALLY CLOSED
UP
.100
ELECTROSTATIC SHIELD PIN WHEN REQUIRED
TERMINAL IDENTIFICATION
ARMATURE
.100
.031
.025 DIA. PIN
COIL FINISH
USED FOR DOUBLE WOUND COIL
.093
.187
.280
.373
5/64 REF.
COIL START

*Type 166 is 0.340" high

ELECTRICAL CHARACTERISTICS

CONTACTS

SPDT (Form C or Form D)

Material
Mercury-wetted platinum contacts
Hermetically sealed in an inert atmosphere

Rating
Switched Load:
2 amperes max
500 volts max
100 VA max

Carry Load:
5 amperes max
Not switched

Inrush Load:
20 amperes average for 10 microseconds
4 amperes average for 10 seconds
2 amperes average for 100 seconds

(NOTE: Suitable contact protection, must be provided.)

Bridging and transfer time
When operated by a single DC pulse, the bridging or transfer time will be greater than 50 microseconds but less than 500 microseconds.

Contact resistance
14 milliohms typical, 20 milliohms max
Stable within ±2 milliohms throughout life.

Life expectancy
1 billion operations minimum at rated load

COILS

Coil resistance
Type 159 Relay
Single wound up to 8600 ohms
Double wound up to 4275 ohms per winding

Power ratings
2 watts continuous

Temperature rise
30° C per watt

Type 160 Relay
Single wound up to 9000 ohms
Double wound up to 4500 ohms per winding

Power ratings
1.75 watts continuous

Temperature rise
35° C per watt

Type 166 Relay
Single wound up to 6100 ohms
Double wound up to 3000 ohms per winding

Power ratings
1.75 watts continuous

Temperature rise
35° C per watt

Operating characteristics
See Part Number Tables for specific operating parameters

GENERAL

Dielectric breakdown
Greater than 1000 VAC RMS 60 Hz all mutually insulated elements, except between windings of Bifilar Coils (See Coil Table).

Insulation resistance
1000 Megohms minimum at 500 VDC

Interelectrode capacitance
The capacitance across the switch capsule without external wires is approximately 1.5 pf.

Approximate capacitances in picofarads
Relay De-energized

	159	160-166
Open contact to armature	2.0 to 3.0	2.5 to 3.0
Open contact to coil	2.5 to 3.5	2.5 to 3.0
Armature to coil	7.5 to 9.0	7.0 to 9.0

Shielding
The module cover provides magnetic shielding.
An electrostatic shield between the switch element and the coil is also available.

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Type 159, 160, 166 cont.

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

TYPE 159

Note: All values at 25°C. Resistances specified are ±10%. Maximum voltages based on 1.75 watts continuous dissipation.

2 WINDINGS BISTABLE 20 MILLIWATTS PER WINDING

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc) (EITHER WINDING)	MUST NOT OPERATE VOLTAGE (vdc) (EITHER WINDING)	MUST OPERATE VOLTAGE (vdc) (EITHER WINDING)	MAXIMUM VOLTAGE (vdc) (ONE WINDING ONLY)	DIELECTRIC STANDOFF BETWEEN COILS	PART NUMBER FORM D	PART NUMBER FORM C
2L	115/115	12	.37	1.5	15	500	159-122 LOO	159-162 LOO
2R	1250/1250	3.6	1.2	5.0	50	400	159-122 ROO	159-162 ROO
2U	2760/2760	2.5	1.8	7.5	74	200	159-122 UOO	159-162 UOO

1 WINDING SINGLE-SIDE-STABLE 40 MILLIWATTS

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST OPERATE VOLTAGE (vdc)	MUST RELEASE VOLTAGE (vdc)	MAXIMUM VOLTAGE (vdc)	PART NUMBER FORM D	PART NUMBER FORM C
1G	34	32	1.2	.24	8.2	159-111 GOO	159-151 GOO
1L	225	12	2.9	.59	21	159-111 LOO	159-151 LOO
1N	620	7.0	4.8	.95	35	159-111 NOO	159-151 NOO
1R	2430	3.6	9.7	2.0	70	159-111 ROO	159-151 ROO
1T	3620	2.9	12	2.3	85	159-111 TOO	159-151 TOO

2 BIFILAR WINDINGS POLAR

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc) (EITHER WINDING)	MUST NOT OPERATE CURRENT (EITHER WINDING)	MUST OPERATE VOLTAGE (vdc) (EITHER WINDING)	MAXIMUM VOLTAGE (vdc) (ONE WINDING ONLY)	DIELECTRIC STANDOFF BETWEEN COILS	PART NUMBER FORM D	PART NUMBER FORM C
8A	135/135	7.5	3.5	—	16.4	500	—	159-178 AOO

TYPE 160

2 WINDINGS BISTABLE 20 MILLIWATTS PER WINDING

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc) (EITHER WINDING)	MUST NOT OPERATE VOLTAGE (vdc) (EITHER WINDING)	MUST OPERATE VOLTAGE (vdc) (EITHER WINDING)	MAXIMUM VOLTAGE (vdc) (ONE WINDING ONLY)	DIELECTRIC STANDOFF BETWEEN COILS (vdc)	PART NUMBER FORM D	PART NUMBER FORM C
2L	90/90	15	.38	1.5	13	400	160-122 LOO	160-162 LOO
2M	155/155	11	.49	1.9	16	400	160-122 MOO	160-162 MOO
2P	340/340	7.5	.73	2.8	24	400	160-122 POO	160-162 POO
2R	880/880	4.7	1.2	4.5	39	200	160-122 ROO	160-162 ROO
2T	1320/1320	3.8	1.4	5.5	48	200	160-122 TOO	160-162 TOO
2U	1980/1980	3.2	1.8	7.0	59	200	160-122 UOO	160-162 UOO

1 WINDING SINGLE-SIDE-STABLE 40 MILLIWATTS

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST OPERATE VOLTAGE (vdc)	MUST RELEASE VOLTAGE (vdc)	MAXIMUM VOLTAGE (vdc)	PART NUMBER FORM D	PART NUMBER FORM C
1H	50	25	1.4	.28	9.4	160-111 HOO	160-151 HOO
1K	125	16	2.3	.46	15	160-111 KOO	160-151 KOO
1L	185	14	2.9	.60	18	160-111 LOO	160-151 LOO
1M	325	11	3.8	.77	24	160-111 MOO	160-151 MOO
1P	680	7.5	5.7	1.1	35	160-111 POO	160-151 POO
1R	1750	4.6	8.8	1.7	55	160-111 ROO	160-151 ROO
1T	2650	3.8	11	2.2	68	160-111 TOO	160-151 TOO
1U	3900	3.2	14	2.7	83	160-111 UOO	160-151 UOO
1V	6100	2.6	17	3.5	103	160-111 VOO	160-151 VOO
1W	9000	2.1	21	4.2	125	160-111 WOO	160-151 WOO

TYPE 166

1 WINDING SINGLE-SIDE-STABLE 40 MILLIWATTS

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST RELEASE CURRENT (ma-dc)	MAXIMUM VOLTAGE (vdc)	PART NUMBER FORM D	PART NUMBER FORM C
1M	325	12	1.3	24	166-111 MOO	166-151 MOO
1P	680	9.2	1.0	35	166-111 POO	166-151 POO
1T	2650	4.1	.45	68	166-111 TOO	166-151 TOO

2 WINDINGS BIFILAR BISTABLE

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc) (EITHER WINDING)	MUST NOT OPERATE CURRENT (ma-dc) (EITHER WINDING)	MAXIMUM VOLTAGE (vdc) (ONE WINDING ONLY)	PART NUMBERS FORM D	PART NUMBERS FORM C
2P	340/340	±9.8	±1.5	24	166-122 POO	166-162 POO
2Q	560/560	±7.2	±1.1	31	166-122 QOO	166-162 QOO
2T	1320/1320	±4.3	±.65	48	166-122 TOO	166-162 TOO

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Type 161 & 162 DPDT

Mercury-Wetted Contact Relay DPDT Low Level PCB Module

The Mercury-Wetted Contact Relay is well known for its superior reliability and long life, coupled with fast response times. The Type 161 and 162 low level DPDT units provide bounce-free contact switching, with minimal thermal EMF. Contact noise on closure decays rapidly to a low level, providing ideal signal input switching in data acquisition systems.

Contact rating is low level: 0-100 microamperes, 0-300 millivolts. The same contacts will switch up to 2 amperes (100 VA max.) properly suppressed.

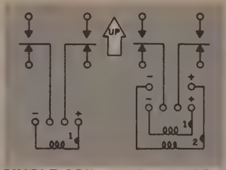
The Type 161 and 162 Relays are available with DPDT contacts either Form C or Form D (specify). The relays are offered with one or two windings, with an optional electrostatic shield. Contact adjustments are single-side-stable or bi-stable.

A special adjustment insuring common open time of 50 microseconds minimum on transfer can be provided, suitable for "flying capacitor transfer switching."

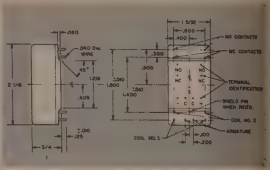
Mounting within 30° of vertical required.

OUTLINE DIMENSIONS

TYPE 161



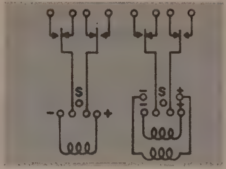
SINGLE COIL DOUBLE COIL


1 3/32
.800
.400
.080
.040 DIA. WIRE
NO CONTACTS
NC CONTACTS
.200
.900
45°
1.218
±.010 1.800
2 1/16
±.010 1.400
.609
NO
NC
S
C
TERMINAL IDENTIFICATION
SHIELD PIN WHEN REQ'D.
COIL NO. 2
ARMATURE
COIL NO. 1
±.010
.125
3/4
.100
.200

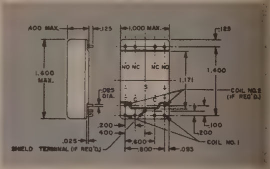
TYPE 162

Positive potential applied to the start of winding indicated by the symbol ◓ will close the contacts shown open on the electrical schematic.

For reset of Bistable Relays, reversed polarity must be applied.



SINGLE COIL DOUBLE COIL


.400 MAX.
.125
1.000 MAX.
.125
NO NC
NC NO
1.600 MAX.
1.400
1.171
.025 DIA.
S
C
COIL NO.2 (IF REQ'D.)
.200
.400
.100
.200
.025
.600
.800
.093
COIL NO. 1
SHIELD TERMINAL (IF REQ'D.)

ELECTRICAL CHARACTERISTICS

CONTACTS

DPDT (Form C or D)

Material
Mercury-Wetted platinum contacts.
Hermetically sealed in an inert atmosphere.

Rating
Switched Load:
2 amperes max
500 volts max
100 VA max

Carry Load:
5 amperes max
Not switched

Inrush Load:
20 amperes average for 10 microseconds

4 amperes average for 10 seconds

2 amperes average for 100 seconds

Bridging and transfer time
When operated by a single DC pulse, the bridging or transfer time will be greater than 50 microseconds but less than 500 microseconds.

Contact resistance
Type 161
20 milliohms typical, 26 milliohms max. Stable within ±2 milliohms throughout life.

Type 162
14 milliohms typical, 20 milliohms max. Stable within ±2 milliohms throughout life.

Life expectancy
1 billion operations minimum at rated load.

COILS

Coil resistance
Type 161
Single wound up to 43500 ohms.
Double wound up to 21700 ohms per winding.

Power rating
3 watts continuous.

Temperature rise
20°C per watt.

Type 162
Single wound to 3500 ohms.
Double wound to 1000 ohms per winding.

Power rating
2.5 watts continuous.

Temperature rise
35°C per watt.

GENERAL

Dielectric breakdown
Greater than 1000 VAC RMS 60 Hz all mutually insulated elements.

Insulation resistance
1000 Megohms minimum at 500 VDC. 10,000 Megohms minimum when specified.

Shielding
The module cover provides magnetic shielding. An electrostatic shield between the switch element and the coil is also available.

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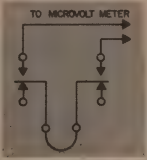
Type 161 & 162 cont.

ELECTRICAL CHARACTERISTICS cont.

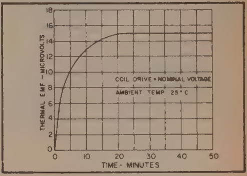
Approximate capacitances in picofarads

	TYPICAL VALUES				
	Across Open Contacts (pf)	Open Contacts to coil (pf)	Closed Contacts to coil (pf)	Open Contacts sw. 1 to open contacts sw. 2 (pf)	Closed Contacts sw. 1 to closed contacts sw. 2 (pf)
Unshielded	3.0	3.5	9.0	1.5	4.5
Shielded	1.5	0.5	1.0	0.5	1.0

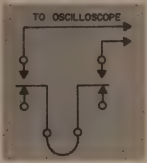
THERMAL EMF



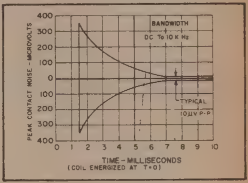
Thermally induced DC error signals occur as a result of temperature gradients within the switching device. Low Thermal Relays are designed to minimize the effect of thermal gradients. The chart at right shows maximum thermally generated EMF plotted against time. Coil duty cycle is 100%. Generated EMF maximum is linear with respect to duty cycle.



NOISE



High frequency AC error signals occur as a result of the transient vibration of the moving members of the switching devices. The curve shows the envelope of peak noise inherent in Low Thermal Relays.



STANDARD PART NUMBERS AND COIL CHARACTERISTICS

TYPE 161

Note: All values at 25°C. Resistances specified are ±10%. Maximum voltages based on 3.0 watts continuous dissipation.

1 WINDING SINGLE-SIDE-STABLE, 60 MILLIWATTS

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST OPERATE VOLTAGE (vdc)	MUST RELEASE VOLTAGE (vdc)	MAXIMUM VOLTAGE (vdc)	PART NUMBER FORM D 161-111□00	PART NUMBER FORM C 161-151□00
1A	1.80	167	.33	.05	2.30	AOO	AOO
1B	2.85	135	.42	.07	2.90	BOO	BOO
1C	4.5	106	.52	.08	3.70	COO	COO
1L	170	17.8	3.3	.55	22.5	LOO	LOO
1M	270	14.3	4.2	.68	28.5	MOO	MOO
1N	510	11.0	6.2	1.0	39.0	NOO	NOO
1P	800	8.73	7.7	1.2	49.0	POO	POO
1R	1950	5.62	12	1.9	76.5	ROO	ROO
1T	3000	4.46	15	2.4	95.0	TOO	TOO
1U	4700	3.57	18	3.0	120	UOO	UOO
1V	7300	2.90	23	3.8	150	VOO	VOO

2 WINDINGS BISTABLE, 30 MILLIWATTS PER WINDING

COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc) (EITHER WINDING)	MUST NOT OPERATE VOLTAGE (vdc) (EITHER WINDING)	MUST OPERATE VOLTAGE (vdc) (EITHER WINDING)	MAXIMUM VOLTAGE (vdc) (ONE WINDING ONLY)	PART NUMBER FORM D 161-122□00	PART NUMBER FORM C 161-162□00
2A	.90/.90	167	.03	.17	1.64	AOO	AOO
2B	1.43/1.43	135	.04	.21	2.07	BOO	BOO
2C	2.25/2.25	106	.05	.26	2.60	COO	COO
2L	85/85	17.9	.34	1.7	16.0	LOO	LOO
2M	135/135	14.3	.42	2.1	20.1	MOO	MOO
2N	255/255	10.9	.62	3.1	27.7	NOO	NOO
2P	400/400	8.73	.76	3.8	34.7	POO	POO
2R	975/975	5.60	1.2	6.0	54.0	ROO	ROO
2T	1500/1500	4.46	1.5	7.4	67.0	TOO	TOO
2U	2350/2350	3.57	1.8	9.2	84.0	UOO	UOO
2V	3650/3650	2.91	2.3	11.7	104	VOO	VOO

1 WINDING SINGLE-SIDE-STABLE LOW THERMAL

COILS	NOMINAL VOLTAGE	RESISTANCE	MUST OPERATE VOLTAGE (vdc)	MUST RELEASE VOLTAGE (vdc)	PART NUMBER FORM D	PART NUMBER FORM C	PART NUMBER FORM C COMMON OPEN TIME
3A	6 VDC	130	3.0	0.5	161-233AOO	161-273AOO	161-283AOO
3B	12 VDC	520	6.0	1.0	161-233BOO	161-273BOO	161-283BOO
3C	24 VDC	2200	12.0	2.0	161-233COO	161-273COO	161-283COO
3D	48 VDC	8000	24.0	4.0	161-233DOO	161-273DOO	161-283DOO

TYPE 162

NOTE: All valves at 25°C. Resistance specified ±10%. Maximum voltage based on 3.5 watts continuous dissipation

1 WINDING SINGLE-SIDE-STABLE

COIL	NOMINAL VOLTAGE DC	COIL RESISTANCE Ohms	MUST OPERATE VDC	MUST RELEASE VDC	MAXIMUM VOLTAGE DC	PART NUMBER 2 FORM C
1A	6	55	2.5	0.6	14	162-151A00
1B	12	250	5	1.2	30	-151B00
1C	24	870	10	2.5	56	-151C00
1D	48	3500	20	5.0	110	-151D00

1 WINDING SINGLE-SIDE-STABLE LOW THERMAL

COIL	NOMINAL VOLTAGE DC	COIL RESISTANCE Ohms	MUST OPERATE VDC	MUST RELEASE VDC	MAXIMUM VOLTAGE DC	PART NUMBER 2 FORM C
1A	6	55	2.5	0.6	14	162-271A00
1B	12	250	5	1.2	30	-271B00
1C	24	870	10	2.5	56	-271C00
1D	48	3500	20	5.0	110	-271D00

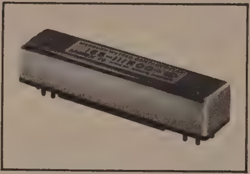
Type 165, 168, 169 SPDT

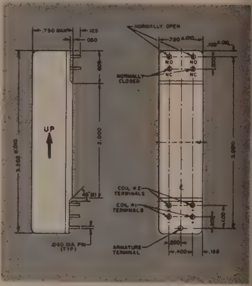
Mercury-Wetted Contact Relays 2 & 5 Ampere Modules

The Type 165 Relay employs the popular 5 ampere Form D Make-Before-Break, 250 volt-ampere Mercury-Wetted capsule. The Type 165 is a PCB module. Adjustments available are single-side-stable and bi-stable. Mounting within 30° of vertical required.

The Type 168 and 169 Octal Plug-in Relays employ the same 2 ampere SPDT switch, Form C or Form D, as shown previously for the Type 160 Relay. See page 8 for switch contact characteristics.

TYPE 165





ELECTRICAL CHARACTERISTICS

Arrangement
SPDT-DM-DB Contact on Armature, Form D Contacts (Make-Before-Break)

Material
Mercury-Wetted platinum contacts. Hermetically sealed in an inert atmosphere.

Rating

Switched Load:
5 amperes max
250 VA max
500 volts max

Carry Load:
10 amperes max. Not switched.

Inrush Load:
50 amperes average for 10 microseconds

10 amperes average for 10 seconds

5 amperes average for 100 seconds

NOTE:
Suitable contact protection must be provided. See Engineering Bulletin 159/160 for guide to contact protection requirements.

Bridging time
When operated by a single DC pulse, the bridging time will be greater than 50 microseconds but less than 500 microseconds.

Contact resistance
35 milliohms typical, 50 milliohms max.
Stable within ±2 milliohms throughout life.

Life expectancy
1 billion operations minimum at rated load.

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

	COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST RELEASE CURRENT (ma-dc)	MAXIMUM VOLTAGE (vdc)	PART NUMBER
1 WINDING SINGLE-SIDE-STABLE 250 MILLIWATTS	1E	70	84.5	37.0	16.7	165-111E00
	1H	265	42.3	18.6	32.0	165-111H00
	1M	1100	21.6	9.5	66.0	165-111M00
	1R	4300	13.8	6.1	131	165-111R00

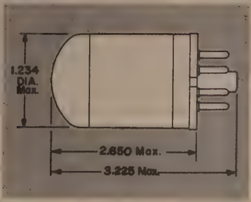
	COILS	COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST RELEASE CURRENT (ma-dc)	MAXIMUM VOLTAGE (vdc)	PART NUMBER
1 WINDING SINGLE-SIDE-STABLE POLARITY SENSITIVE	1L	960	9.3	.8	9.9	165-161L00
	1N	1500	8.3	1.3	13.8	165-161N00
	1P	2000	6.7	.6	14.9	165-161P00
	1R	4300	5.0	.4	21.4	165-161R00
1 WINDING BISTABLE 7 MILLIWATTS	1J	450	±5.9	—	42.0	165-141J00
	1R	4300	±2.4	—	131	165-141R00

Note: All values at 25°C. Resistances specified are ±10%. Maximum voltages based on 1.75 watts continuous dissipation.

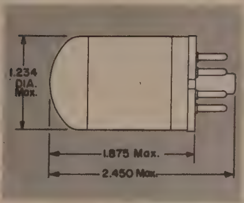
Type 165, 168, 169 cont.

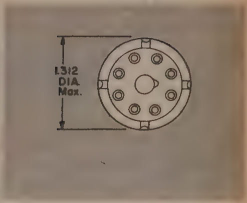
TYPE 168 AND TYPE 169

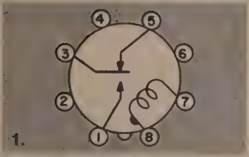
168



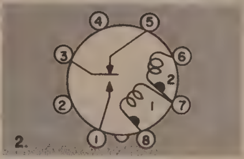
169



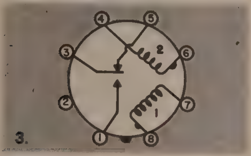




Single Wound Coils:



Double Wound Coils:



Double Coil

ELECTRICAL CHARACTERISTICS

Arrangement
SPDT Form C or Form D contacts

Material
Mercury-wetted platinum contacts.
Hermetically sealed in an inert atmosphere.

Rating

Switched Load
2 amperes max. 500 volts max.

Carry Load
5 amperes max. Not switched

Inrush Load
20 amperes average for 10 microseconds
4 amperes average for 10 seconds
2 amperes average for 100 seconds

Note:
Suitable contact protection must be provided. See Enginnering Bulletin 159/160 for guide to contact protection requirements.

Bridging and Transfer Time
When operated by a single DC pulse, the bridging or transfer time will be greater than 50 microseconds, but less than 500 microseconds.

Contact Resistance
25 milliohms typical, 35 milliohms maximum.
Stable within ±2 milliohms throughout life.

Life Expectancy
One billion operations minimum at rated load.

Dielectric Breakdown
Greater than 1000 VAC RMS 60 Hz all mutually insulated elements, except between windings of Bifilar Coils (See Coil Table).

Insulation Resistance
1000 Megohms minimum at 500 VDC.

TYPE 168 TYPICAL PART NUMBERS

COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST RELEASE CURRENT (ma-dc)	MAXIMUM VOLTAGE (VDC)	ADJUSTMENT	WIRING DIAGRAM	PART NUMBER FORM D	PART NUMBER FORM C
500	2.9	0.50	31	SSS	1	168-111M00	168-151M00
1000	2.2	0.38	44	SSS	1	-111R00	-151R00
2500	1.4	0.17	70	SSS	1	-111U00	-151U00
135/135	±4.5/±4.5	—	16/16	Bi-Stable	3	-325J00	-365J00

TYPE 169 TYPICAL PART NUMBERS

COIL RESISTANCE (Ohms)	MUST OPERATE CURRENT (ma-dc)	MUST RELEASE CURRENT (ma-dc)	MAXIMUM VOLTAGE (VDC)	ADJUSTMENT	WIRING DIAGRAM	PART NUMBER FORM D	PART NUMBER FORM C
70	11.0	2.50	12	SSS	1	169-111B00	169-151B00
440	4.3	.76	30	SSS	1	-111F00	-151F00
3850	1.6	.26	88	SSS	1	-111L00	-151L00
130/130	11/11	1.9/1.9	16/16	SSS	2	-212B00	-252B00
1000/1000	±2.7/±2.7	—	45/45	Bi-Stable	2	-222A00	-262A00

Type 615 & 616 Time Delay

Solid State
Time Delay Relays
DPDT
10 Ampere Output

Midtex/AEMCO electronic time delay relays are extremely dependable, accurate and flexible, long life, time delay relays, providing a wide selection of operational configurations. They provide rapid reset times and excellent reapeatability which are especially desirable when accurate recycling is required. Combining the inherent reliability of electronic components for timing, with the proven high power multi-contact switching performance of AEMCO relays, this broad family of time delay relays is designed for demanding industrial and commercial applications.

A variety of fixed, knob-adjustable or external fixed resistor timers in different practical mechanical configurations are available to suit your requirements. Non-standard or custom designed units are available upon inquiry.

Two basic types of timing circuits are employed, depending upon the accuracy, repeatability and environmental requirements. The economy version Type 616 Series utilizes an R-C solid state trigger circuit combination to energize the output relay. The Type 615, Type 617 and 618 Series utilize an R-C solid state trigger circuit to drive a secondary solid state switch, which in turn energizes the output relay.

DEFINITIONS

Repeatability — delay time of the second and following operations will be within specified percentage repeatability, under constant operating environments and input parameters.

Total timing variation — variation limits of delay from set value, over rated input voltage and ambient temperature extremes.

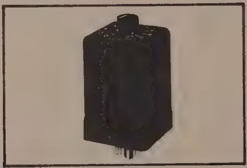
Recovery time — time the control voltage must be interrupted *during* timing interval to produce a subsequent delay within the limits specified under Total Timing Variation.

Reset time — the time, after removal of input voltage, that is required to return the output relay to the de-energized position.

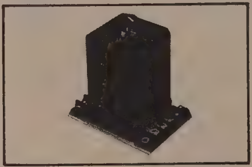
Recycle time — time the control voltage must be interrupted *after* timing interval, to produce subsequent delay within the limits specified under Total Timing Variation.

TYPE 615
ENCLOSURE AND WIRING

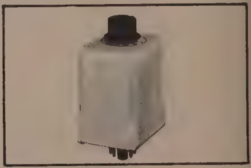
615-2



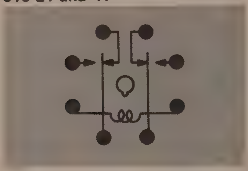
615-3



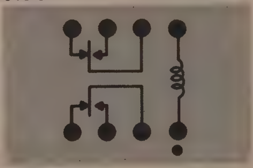
615-4



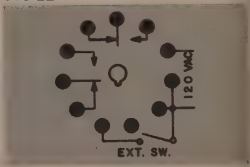
615-21 and 41



615-31



615-22



ELECTRICAL CHARACTERISTICS All ratings at 25°C ambient

Repeatability
±2%

Total Timing Variation
±10%

Reset Time (max.)
50 ms

Recycle Time (max.)
50 ms

Calibrated Dial Accuracy (Full Scale)
±10%

Input Voltage Limits
AC
120 VAC (105 to 125 VAC)
DC (±25%)
12, 24, 48 VDC

Power Requirements
AC (approx.)
3.5 VA at 120 VAC
DC (max.)
3 watts

Switching Action
2PDT

Switching Rating (max.)
10 amp, 120/240 VAC or 24 VDC

Delay Types
Delay on Operate & Delay on Rele

Others on special request

MIDTEX INC. • 1650 TOWER BLVD. • NORTH MANKATO, MINNESOTA 56001 • (507) 387-6521 • TWX: 910-565-2244

Type 615 & 616 cont.

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE

Operating:
−40°F to +150°F

Storage:
−55°F to +180°F

SHOCK

30 g's, 11 ± 1 ms, ½ sinewave.

VIBRATION

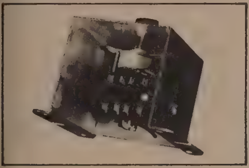
0.06" DA or 10 g's, 10 to 500 Hz (non-operating test).

STANDARD PART NUMBERS

INPUT VOLTAGE	DELAY ON	TERMINALS	TIME SET	TIMER TYPE	TIME DELAY (Sec.)			
					0.1 to 1	0.1 to 10	1 to 100	1 to 300
120 VAC	Operate	8 pin octal	Adj. Pot.	615	-21T100	-21T200	-21T400	-21T600
	Operate	Screw	Adj. Pot.		-31T100	-31T200	-31T400	-31T600
	Release	11 pin octal	Adj. Pot.		-22T100	-22T200	-22T400	-22T600
24 VDC	Operate	Octal	Adj. Pot.		-21C100	-21C200	-21C400	
	Operate	Screw	Adj. Pot.		-31C100	-31C200	-31C400	
					0.1 to 1	1 to 60	1 to 180	
120 VAC	Operate	8 pin octal	Adj. Pot.	615	-41T200	-41T300	-41T500	
24 VDC	Operate	8 pin octal	Adj. Pot.		-41T200	-41T300	-41T500	
24 VDC	Operate	8 pin octal	Adj. Pot.		-41C200	-41C300	-41C500	

TYPE 616
ENCLOSURE AND WIRING

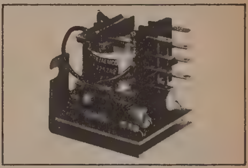
616-1



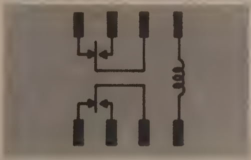
616-2

616-4

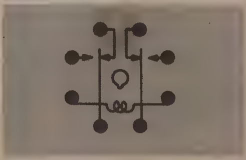
616-5



616-11 and 51



616-21 and 41



ELECTRICAL CHARACTERISTICS All ratings at 25°C ambient

Repeatability
±5%

Total Timing Variation
±10%

Reset Time (max.)
100 ms

Recycle Time (max.)
100 ms

Others on special request

Calibrated Dial Accuracy (Full Scale)
±10%

Input Voltage Limits
AC
120 VAC (105 to 125 VAC)
DC
24, 48 VDC

Power Requirements
AC (approx.)
3.5 VA at 120 VAC
DC (max.)
3 watts

Switching Action
2PDT

Switching Rating (max.)
10 amp, 120/240 VAC or 24 VDC

Delay Types
Delay on Operate

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE

Operating:
+10°F to +150°F

Storage:
−55°F to +180°F

SHOCK

30 g's, 11 ± 1 ms, ½ sinewave.

VIBRATION

0.06" DA or 10 g's, 10 to 500 Hz (non-operating test).

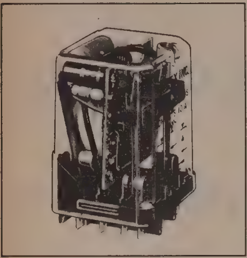
STANDARD PART NUMBERS

INPUT VOLTAGE	DELAY ON	TERMINALS	TIME SET	TIMER TYPE	TIME DELAY (Sec.)	
					1 to 10	1 to 100
120 VAC	Operate	Solder	Adj. Pot.	616	-11T200	-11T400
	Operate	8 pin octal	Adj. Pot.		-21T200	-21T400
24 VDC	Operate	8 pin octal	Adj. pot.		-21C200	-21C400
					1 to 10	1 to 180
120 VAC	Operate	8 pin octal	Adj. Pot.	616	-41T200	-41T500
24 VDC	Operate	8 pin octal	Adj. Pot.		-41C200	-41C500

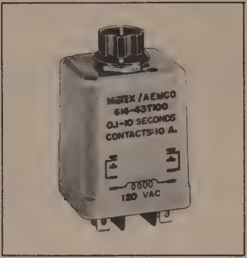
Type 613, 614, 618

Solid State
Time Delay Relays
SCR Output to 2 Amps
DPDT Contacts to 10 Amps

Type 613



Type 614

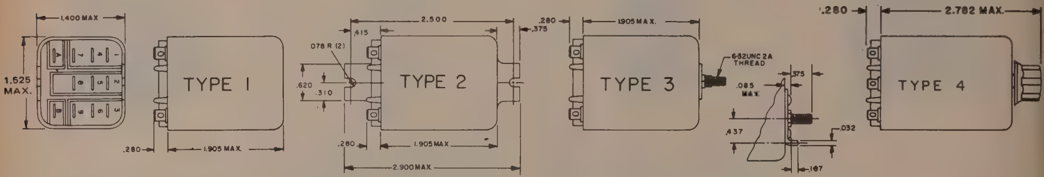

MIDTEX / AEMCO
614-43T100
0.1-10 SECONDS
CONTACTS 10 A.
120 VAC

Midtex electronic time delay relays are extremely dependable, accurate and flexible, long life, time delay relays, providing a wide selection of operational configurations. They provide rapid reset times and excellent repeatability which are especially desirable when accurate recycling is required. Combining the inherent reliability of electronic components for timing, with the proven high power multi-contact switching performance of Midtex relays, this broad family of time delay relays is designed for demanding industrial and commercial applications.

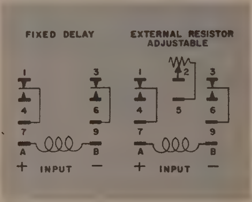
A variety of fixed, knob-adjustable or external resistor timers in different practical mechanical configurations are available to suit your requirements.

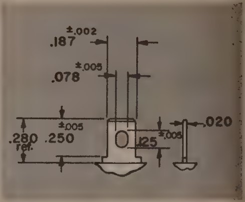
Two basic types of timing circuits are employed, depending upon the accuracy, repeatability and environmental requirements. The economy version Type 613 Series utilizes an R-C solid state trigger circuit combination to energize the output relay. The Type 614 Series utilizes an R-C solid state trigger circuit to drive a secondary solid state switch, which in turn energizes the integral output relay.

ENCLOSURES


1.400 MAX
1.525 MAX.
.280
1.905 MAX.
TYPE 1
2.500
.415
078 R (2)
.620
.310
.280
1.905 MAX
2.900 MAX
TYPE 2
.280
.375
1.905 MAX.
TYPE 3
6-32UNC 2A THREAD
.085 MAX
.375
.437
.032
.187
.280
2.782 MAX.
TYPE 4

WIRING AND TERMINALS


FIXED DELAY
EXTERNAL RESISTOR ADJUSTABLE
1
3
4
6
7
9
A
B
+ INPUT −
1
2
3
4
5
6
7
9
A
B
+ INPUT −


±.002
.187
±.005
.078
±.005
.280 ref.
.250
.125
±.005
.020

ELECTRICAL CHARACTERISTICS

	Type 613	Type 614
Repeatability	±3%	±3%
Total timing variation	±10%	±10%
Reset (release) time (max.)	200 ms	50 ms
Recycle time (max.)	200 ms	100 ms
Dial scale	Ref. only	Ref. only
Input voltage limits		
AC (±10%)	24, 120 VAC	24, 120 VAC
DC (±25%)	24 VDC	12, 24 VDC
Power requirements		
AC (approx.)	3.0 VA at 120 VAC	3.0 VA at 120 VAC
DC (approx.)	12 MA	3 watts
Switching action	2PDT	2PDT
Switching rating (max.)		
Fine silver contacts (gold flash)	5 amp, 28 VDC/120 VAC 3 amp, 240 VAC .80% pf ⅛ H.P., 120 VAC	5 amp, 28 VDC/120 VAC 3 amp, 240 VAC .80% pf ⅛ H.P., 120 VAC
Silver cadmium oxide (gold flash)	10 amp, 28 VDC, 120 VAC ⅓ H.P., 120 VAC 6 amp, 240 VAC .80% pf ½ H.P., 240 VAC	10 amp, 28 VDC, 120 VAC ⅓ H.P., 120 VAC 6 amp, 240 VAC .80% pf ½ H.P., 240 VAC
Delay types	Delay on operate	Delay on operate
Momentary transfer upon timing cycle interruption	Yes	No

Type 613, 614, 618 cont.

STANDARD PART NUMBERS (plain cover)

Type 613

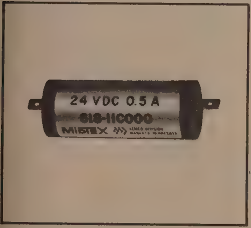
INPUT VOLTAGE	DELAY ON	TIME SET	TIME DELAY (Seconds) 1-10	1-30	1-60	1-120	3-300
24 VDC	Operate	Knob Adj.	613-43C100	613-43C200	613-43C300	613-43C400	613-43C600
24 VAC	Operate	Knob Adj.	613-43Q100	613-43Q200	613-43Q300	613-43Q400	613-43Q600
120 VAC	Operate	Knob Adj.	613-43T100	613-43T200	613-43T300	613-43T400	613-43T600
24 VDC	Operate	Ext. Res.	Use 0.1-120 Sec. Timer With Appropriate Value of Timing Resistor.			613-12C400	613-12C600
24 VAC	Operate	Ext. Res.				613-12Q400	613-12Q600
120 VAC	Operate	Ext. Res.				613-12T400	613-12T600

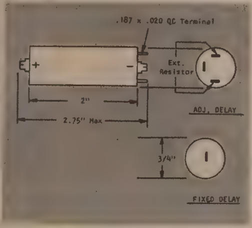
Type 614

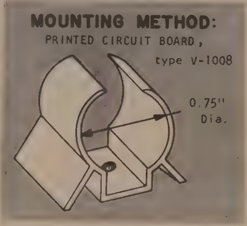
DELAY VOLTAGE	TIME ON	SET	TIME DELAY (Seconds) 0.1-10	0.3-30	0.6-60	1.2-120
24 VDC	Operate	Knob Adj.	614-43B100	614-43B200	614-43B300	614-43B400
24 VDC	Operate	Knob Adj.	614-43C100	614-43C200	614-43C300	614-43C400
24 VAC	Operate	Knob Adj.	614-43Q100	614-43Q200	614-43Q300	614-43Q400
120 VAC	Operate	Knob Adj.	614-43T100	614-43T200	614-43T300	614-43T400
12 VDC	Operate	Ext. Res.	Use 1-120 Sec. Timer With Appropriate Value of Timing Resistor.			614-12B400
24 VDC	Operate	Ext. Res.				614-12C400
24 VAC	Operate	Ext. Res.				614-12Q400
120 VAC	Operate	Ext. Res.				614-12T400

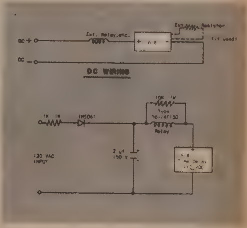
Type 618

The Type 618 is an electronic time delay module that provides a 0.5 or 2 ampere SCR output to drive relays, solenoids or lamps. By wiring in series with multipole power relays, a versatile timing function is attained. The module is available with 3/16" quick connect, solid axial or flying leads. Fixed and externally adjusted resistor units available.









ELECTRICAL CHARACTERISTICS

Delay function
delay on operate

Delay time
specify

Recycle time
25 milliseconds

Recovery time
25 milliseconds for .025 to 100 second ranges,
75 milliseconds for delays longer than 100 seconds.

Repeat accuracy
(±) 3% at constant voltage and temperature

Total timing variation
(±) 10% over voltage and temperature

Input voltage
12 to 110 VDC. DC must be filtered, max. ripple 5% at nominal voltage. If not, please consult factory. Relay may false pulse during recovery.

Switching action
SPST solid state output, 1.5V voltage drop max. when on.

Switching rating
Type 1
0.5 amp at +55°C
Type 2
2.0 amp at +25°C,
1.25 amp at +55°C continuous duty.

ENVIRONMENTAL

Temperature range:
−40°C to +55°C

STANDARD PART NUMBERS

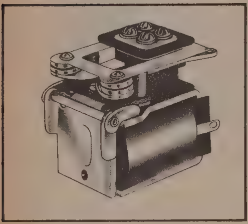
INPUT VOLTAGE	DELAY ON	TIME SET	OUTPUT	TIME DELAY (SECONDS) .1-10	1-100	3-300
12 VDC	Operate	Ext. Res.	0.5 Amp	618-11B200	618-11B400	618-11B600
24 VDC	Operate	Ext. Res.	0.5 Amp	-11C200	-11C400	-11C600
24 VDC	Operate	Ext. Res.	2.0 Amp	-12C200	-12C400	-12C600
110 VDC	Operate	Ext. Res.	0.5 Amp	-11F200	-11F200	-11F200

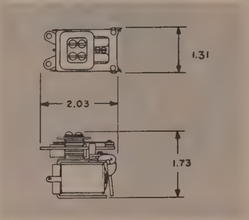
External resistor for 0.1-10 second is 200K Ohm/sec.; 1-100 second is 20K Ohm/sec.; 3-300 is 6.6K Ohm/sec. Above part numbers are for 3/16" quick connect type. For other terminals and fixed delays, consult factory.

Type 83 & 136

General Purpose
Power Relays
20 to 30 Amperes

Type 83 is an unusually compact medium power relay with 20 amp contacts. Also available as double make or double break. Hinge pin rugged construction.





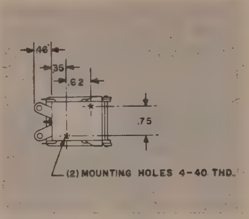
SPECIFICATIONS

Contacts
3/8" diameter silver cadmium oxide

Rating
20 amps at 26.5 VDC or 117 VAC resistive
Inrush 60 amps, 30 amps break
Inrush 60 amps, 30 amps break on DOUBLE MAKE CONTACTS
Carry 30 amps, break 50 amps on DOUBLE BREAK CONTACTS

Coil
Continuous duty. Max. power consumption is 10 VA AC, 3.5 watts DC

Terminals
Solder Terminals



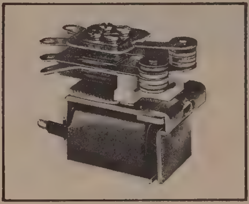
Weight
Approximately 6 oz.

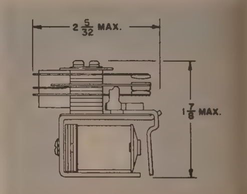
Mounting
Two holes tapped 4-40, on .62 centers

STANDARD PART NUMBERS

TYPE NO.	CONTACT FORM	COIL VOLTAGE
20 AMPERE RELAYS		
83-5023	SPDT	24ac
83-5024	SPDT	117ac
83-5027	DPDT	24ac
83-5028	DPDT	117ac
83-5032	SPDT	26.5dc
83-5035	DPDT	26.5dc
83-5036	DPDT	110dc
DOUBLE MAKE/DOUBLE BREAK RELAYS		
83-5041	SPST-DM	24ac
83-5042	SPST-DM	117ac
83-5043	SPST-DB	24ac
83-5044	SPST-DB	117ac

The Type 136 is a long life medium power 20 amp relay that will exceed 5,000,000 mechanical operations. The superior life is obtained by the use of a wide friction-free knife-edge frame and armature assembly. Also available as a double-make or double-break relay, for greater inrush or switching ratings.





SPECIFICATIONS

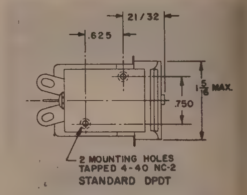
Contacts
3/8" diameter silver cadmium oxide

Rating
20 amps at 26.5 VDC or 117 VAC, resistive

Double Make Rating
Inrush 60 amps, break 30 amps (NI)

Double Break Rating
Carry 30 amps, break 50 amps (NI)

Coil
Continuous duty. Max. power consumption is 10 VA AC, 3.5 watts DC



Terminals
Solder terminals

Weight
Approximately 6 oz.

Mounting
Two holes tapped 4-40, on 0.62" centers

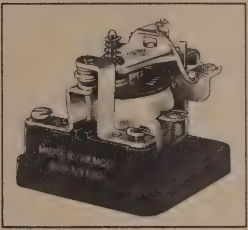
STANDARD PART NUMBERS

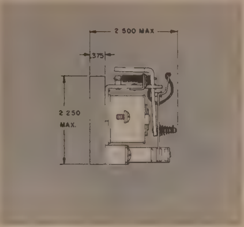
TYPE NO.	CONTACT FORM	COIL VOLTAGE
20 AMPERE RELAYS		
136-5023	SPDT	24ac
136-5024	SPDT	117ac
136-5027	DPDT	24ac
136-5028	DPDT	117ac
136-5032	SPDT	26.5dc
136-5033	SPDT	110dc
136-5035	DPDT	26.5dc
136-5036	DPDT	110dc
DOUBLE MAKE/DOUBLE BREAK RELAYS		
136-5041	SPST-DM	24ac
136-5042	SPST-DM	117ac
136-5043	SPST-DB	24ac
136-5044	SPST-DB	117ac

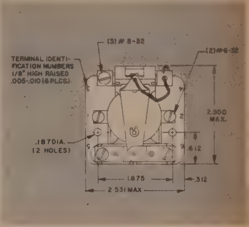
Type 301

General Purpose
Power Relays
30 Amperes

J/L RECOGNIZED The Type 201 is listed by U/L at oltages up to 300 VAC. Standard models are also esigned to be U/L recognized under U/L 508 as a motor controller up to 600 VAC. The 201 is a versatile and rugged power driver, controlling up to 8000 VA of AC power with an input of 2.0 watts DC or 9.8 VA AC to the coil. Contact arrangements are SPDT, DPST-NO, SPST-NO, SPST-NO-DM or SPST-NC. Contact materials are silver or silver-cadmium-oxide. Applications are elevator controls, motor starters, appliances and other heavy duty requirements.







ELECTRICAL CHARACTERISTICS

CONTACTS

Arrangement
SPDT
DPST-NO
SPST-NO
SPST-NO-DM
SPST-NC

Material
Silver
Silver-CAD-O

Rating
Silver-25 amps @ 277 VAC
1 HP @ 120/240 VAC
Sil-Cad-O-30 amps @ 277 VAC
1 HP @ 120/240 VAC

Life
Mechanical—1 million operations
Electrical—100,000 ops at rated load

COILS

Voltage Ratings
6-480 VAC
6-125 VDC

Pick-Up Voltage
AC—85% of nominal
DC—75% of nominal

Power Ratings
AC—9.8 VA sealed
DC—2.0 watts

GENERAL

Dielectric Breakdown
2,500 volts RMS minimum between all elements and ground

Weight
Approx. 10 oz.

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

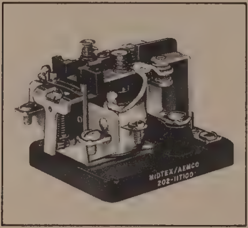
COIL		RELAY TYPE	SPDT		DPST-NO*		SPST-NO		SPST-NO-DM*		SPST-NC	
Resistance OHMS ± 10%	NOM. VOLT.		Silver	Silver Cad-O	Silver	Silver Cad-O	Silver	Silver Cad-O	Silver	Silver Cad-O	Silver	Silver Cad-O
18	6	201-	11A100	11A200	12A100	12A200	13A100	13A200	14A100	14A200	15A100	15A200
71	12 V		B	B	B	B	B	B	B	B	B	B
288	24 D		C	C	C	C	C	C	C	C	C	C
1150	48 C		D	D	D	D	D	D	D	D	D	D
6050	110		F	F	F	F	F	F	F	F	F	F
0.86	6	201-	11N100	11N200	12N100	12N200	13N100	13N200	14N100	14N200	15N100	15N200
3.20	12		P	P	P	P	P	P	P	P	P	P
12	24		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
48	48 V		R	R	R	R	R	R	R	R	R	R
290	120 A		T	T	T	T	T	T	T	T	T	T
1200	240 C		U	U	U	U	U	U	U	U	U	U
1600	277		W	W	W	W	W	W	W	W	W	W
4500	480		V	V	V	V	V	V	V	V	V	V

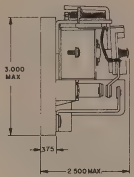
*Available with magnetic blowouts as optional.

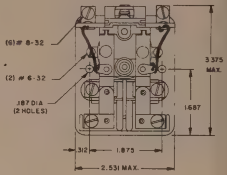
Type 302

**General Purpose
Power Relays
30 Amperes**

U/L RECOGNIZED The Type 202 is listed by U/L at voltages up to 300 VAC. Standard models are also designed to be U/L recognized under U/L 508 as a motor controller up to 600 VAC. The 202 is a versatile and rugged power driver, controlling up to 8000 VA of AC power with an input of 2.0 watts DC or 9.8 VA AC to the coil. Contact arrangements are DPDT, DPST-NO, DPST-NC, SPST-NC-DB or SPDT-DB-DM. Contact materials are silver or silver-cadmium-oxide. Applications are elevator controls, motor starters, appliances and other heavy duty requirements.







ELECTRICAL CHARACTERISTICS

CONTACTS

Arrangement
DPDT
DPST-NO
DPST-NC
SPST-NC-DB
SPDT-DB-DM

Material
Silver
Silver-Cad-O

Rating
Silver—
25 amps@ 240 VAC
1 HP @ 120/240 VAC

Sil-Cad-O—
30 amps @ 240 VAC
1 HP @ 120/240 VAC

Life
Mechanical — 1 million operations
Electrical — 100,000 op at rated load

COILS

Voltage Ratings
6-480 VAC
6-125 VDC

Pick-up Voltage
AC—85% of nominal
DC—75% of nominal

GENERAL

Dielectric Breakdown
2,500 volts RMS minimum between all elements and ground

Weight
Approx. 10 ounces

Power Ratings
AC—9.8 VA sealed
DC—2.0 watts

STANDARD PART NUMBERS AND COIL CHARACTERISTICS

COIL		RELAY TYPE	DPDT*		DPST-NO		DPST-NC*		SPST-NC-DB		SPDT-DB-DM	
Resistance OHMS ± 10%	NOM. VOLT.		Silver	Silver Cad-O	Silver	Silver Cad-O	Silver	Silver Cad-O	Silver	Silver Cad-O	Silver	Silver Cad-O
18	6	202-	11A100	11A200	12A100	12A200	13A100	13A200	14A100	14A200	15A100	15A200
71	12 V		B	B	B	B	B	B	B	B	B	B
288	24 D		C	C	C	C	C	C	C	C	C	C
1150	48 C		D	D	D	D	D	D	D	D	D	D
6050	110		F	F	F	F	F	F	F	F	F	F
0.86	6	202-	11N100	11N200	12N100	12N200	13N100	13N200	14N100	14N200	15N100	15N200
3.20	12		P	P	P	P	P	P	P	P	P	P
12	24		Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
48	48 V		R	R	R	R	R	R	R	R	R	R
290	120 A		T	T	T	T	T	T	T	T	T	T
1200	240 C		U	U	U	U	U	U	U	U	U	U
1600	277		W	W	W	W	W	W	W	W	W	W
4500	480		V	V	V	V	V	V	V	V	V	V

*Available with magnetic blowouts as optional.

MIDTEX INC. • 1650 TOWER BLVD. • NORTH MANKATO, MINNESOTA 56001 • (507) 387-6521 • TWX: 910-565-2244

630-631 Solid State Relays

4-15 Ampere
120/240 VAC
Panel or Plug-In
U/L Recognized

The type 630 and 631 solid state relays are reed relay input-Triac output devices. As such, they are hybrid solid tate relays.

A much more thorough circuit analysis is required, however, before a solid-state or hybrid relay can be safely applied. Specifically, the following items must be defined as a minimum, before a solid-state or hybrid relay can be elected: maximum operating temperature; inrush curent at closure time and the associated current time contant; type of load, and the power factor if the load is inductive; operating voltage; possibility of false turn-on from line transients.

The following definitions should benefit the selection and pplication of these devices.

olid-state hybrid relay: A relay that combines the adantageous features of a reed relay or other hard contact evice with solid-state components in the load switching circuit. The load switching device is generally a Triac, and he reed relay input control provides isolation to the output circuitry.

Continuous/current rating: The maximum steady-state current that the Triac in the solid-state or hybrid relay can carry at or below its maximum case or ambient temperature.

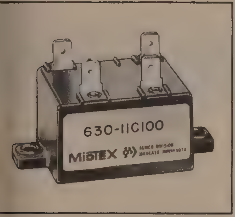
Surge current: The maximum value of inrush or overload current persisting for a short duration in which a properly heat-sinked device will handle and recover without damage.

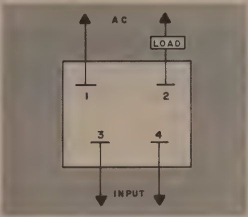
Minimum load current: The minimum current draw through the Triac which sustains proper Triac conduction.

Maximum load current: The maximum load current that the Triac can carry without damage at a given temperature in a properly heat-sinked assembly. The maximum load current is determined from the applicable derating graph for the type of heat removal employed.

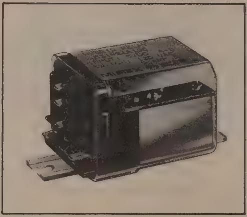
Snubber network: Protection circuitry built into the solid-state or hybrid relays which prevents Triac false turn-on when line transients exceed the forward blocking voltage of the device. The circuitry is generally an R-C network which minimizes the commutating rate-of-change of voltage with respect to time.

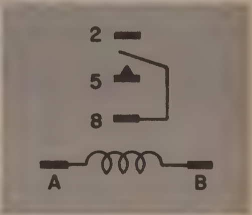
Type 630

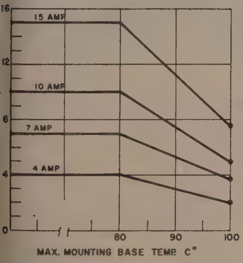




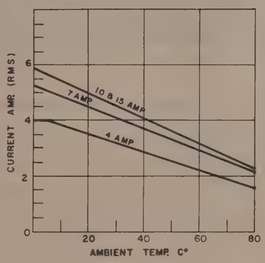
Type 631



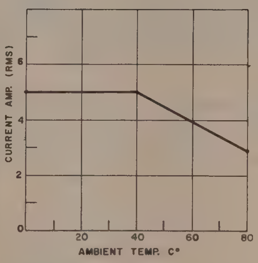




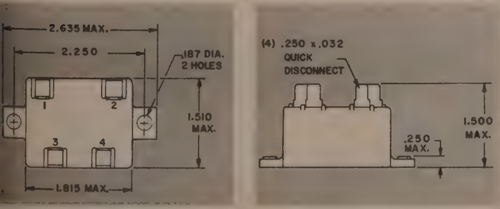
Type 630
Max. Load I vs. Allowable Case Temperature



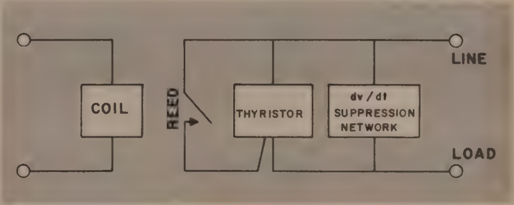
Type 630
Mounted in free air. The Derating is improved considerably with a heat sink.



Type 631
Max. load I vs. allowable ambient temp. The 631 does not require an external heat sink.



Type 630 Dimensions.
or 631 dimensions, see Page 6-7 on the 157 relay.



Type 630/631 Diagram

630-631 Solid State Relay Cont.

ELECTRICAL CHARACTERISTICS

Voltage
120 VAC, 50/60 Hz
(200 V maximum peak)
240 VAC, 50/60 Hz
(400 V maximum peak)

CURRENT

Type 630
4, 7, 10, 15 and 30 Amps
inductive or resistive

Type 631
5 Amps
inductive or resistive

Note: For Type 630, the internal heat sink will allow a maximum current of 5 amps at 25° C. The maximum switching current is a function of device rating, ambient temperature, type of load and method of external heat sink. To obtain ratings above 5 amps, select desired output current model, seal Type 630 to proper heat sink with silicon grease.

Voltage drop
1.6 V typical at
rated current.

Leakage Current
6 MA max., 120 VAC/12MA
max., 240 VAC

Minimum load current
200 MA, RMS

Non-recurrent surge
4 Amp—60 A., 1 cycle
7 Amp—100 A., 1 cycle
10 Amp—110 A., 1 cycle
15 Amp—150 A., 1 cycle

Inductive load
4 V/micro-sec. maximum, commutating dv/dt, at rated current.

Life
500 million operations

Contact type
1 Form A (SPST—NO)

For Type 630 and 631 models

DC Input (volts)	Resistance (ohms)	Nominal Current (ma)
5	165	30
6	240	25
12	960	12.5
24	3,840	6.2
48	15,400	3.1

Dielectric breakdown
1,000 VAC, 60 Hz minimum between all mutually insulated terminals and mounting plate.

Insulation resistance
Greater than 10^{10} ohms I/O isolation

Weight
Type 630 1.25 oz.
Type 631 3.5 oz.

STANDARD PART NUMBERS

TYPE	NOMINAL INPUT VOLT.	CURRENT RATINGS					
		4 AMPS		7 AMPS		10 AMPS	
		120 VAC	240 VAC	120 VAC	240 VAC	120 VAC	240 VAC
630	5	11A100	21A100	12A100	22A100	13A100	23A100
	6	B	B	B	B	B	B
	12	C	C	C	C	C	C
	24	D	D	D	D	D	D
	48	E	E	E	E	E	E

TYPE	NOMINAL INPUT VOLT.	PLAIN COVER		FLANGED COVER	
		120 VAC	240 VAC	120 VAC	240 VAC
631	5	11A100	12A100	21A100	22A100
	6	B	B	B	B
	12	C	C	C	C
	24	D	D	D	D
	48	E	E	E	E

Type 630 15 and 30 amp devices are available. Consult factory for details.

Type 620

Cyclemaster Program Time Switch

The Cyclemaster is a synchronous motor time switch that provides up to 48 ON-OFF operations per day — timing intervals as low as fifteen minutes.

A NEW 14-day Sunday and Holiday Skipper permits programming for two full weeks. Eliminates operations on unwanted days.

NEW ease of setting — just dial the desired time. NEW "decorator" design — compatible with almost any surroundings. NEW ease of installation — all connections to large easy-to reach screw terminals.

USER-IN-MIND DESIGNED

new DECORATOR DESIGN — never before a time switch of such eye-appeal

new EASE OF SETTING — just DIAL the desired time. (An anti-reverse feature prevents improper setting)

new EASY INSTALLATION — large, accessible screw terminal connections

new LOW PRICES — you compare!

versatile switching — usable THREE WAYS: SPST open; SPST closed; SP transfer

new 14 DAY SUNDAY & HOLIDAY SKIPPER — permits programming for two full weeks

UP TO 48 OPERATIONS PER DAY — programming for almost any ON-OFF requirement

OPERATING VOLTAGE	MOUNTING	MODEL NO.	PREVIOUS MODEL NO.	
117 VAC 60C	Surface enclosure	620-7595	CM90-01	(a)
230 VAC 60C	Surface enclosure	620-7596	CM90-02	
117 VAC 60C	No enclosure	620-7597	CM90-03	(b)
230 VAC 60C	No enclosure	620-7598	CM90-04	

SPECIFICATIONS

Timing action performed
Up to 48 ON-OFF operations in a single day. (A minimum interval of fifteen minutes is required between operations.)

Switching action
Single pole, double throw. (Usable three ways: SPST open; SPST closed; SP transfer.)

Load capacity
20 amperes at 125, 250, or 480 VAC. (1 H.P. at 125 VAC; 2 H.P. at 250 VAC.) (10 amperes at 125 VAC inductive.)

Terminals
Screw terminals conveniently located.

Method of programming
Trip pin. (12 supplied.)

Cyclemaster

Sunday and holiday skipper
Eliminates operations on unwanted days selected by inserting trip pins in the skipper wheel. A fourteen day wheel is standard. (Special Sunday and holiday skippers are available for all CYCLEMASTER models. Consult factory.)

Temperature range
—40°F. to +140°F.

Enclosure
Attractive hammertone gray cabinet with lockable hasp.

Dimensions
With enclosure 7-3/4"h x 4-7/8"w x 3-17/32"d; without enclosure 6-5/8"h x 4-1/2"w x 2-13/16"d.

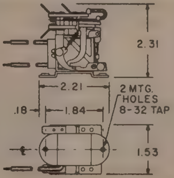
Shipping weight
with surface enclosure 5 lbs; without enclosure 3 lbs.

(a) U/L listed
(b) U/L Recognized

Type 48

Rugged 1 & 2 PDT Single Coil Latching Relay 15 Amperes

Especially designed for applications where it is desirable to eliminate continuous current to the relay coil. Relay contacts are changed from one position to another by a pulse to the single coil. Held in either position by a POSITIVE mechanical latching mechanism. An unlimited number of remote control points can be used with low voltage, low-cost interconnections. Fifteen and five ampere relays available. Fifteen ampere types meet UL or CSA spacing requirements. Quick-disconnect or solder terminals available on fifteen ampere relays. Leads terminate coils. Standard control voltages listed at right; others available on special order. Designed for U/L recognition. U/L 508, Industrial Control Equipment.



SPECIFICATIONS

Load rating
15 Amp, ½ HP at 120 VAC
10 AMP, 1 HP at 240 VAC

Switching action
Single pole, double throw; and double pole, double throw.

Contact data
¼" diameter pure fine silver.

Coil
Momentary duty type. Maximum power consumption: AC coils — 15 va. DC coils — 15 watts. Pull-in at 80% of nominal voltage.

Terminations
Contacts terminated by quick-disconnect terminals. Wire leads terminate coils.

Weight
Approximately 7 ounces.

TYPE NO.	SWITCHING ACTION	CONTROL VOLTAGE
48-11N100	SPDT	6ac
48-11P100	SPDT	12ac
48-11Q100	SPDT	24ac
48-11T100	SPDT	117ac
48-11U100	SPDT	230ac
48-12N100	DPDT	6ac
48-12P100	DPDT	12ac
48-12Q100	DPDT	24ac
48-12T100	DPDT	117ac
48-12U100	DPDT	230ac

Type 153 DPDT

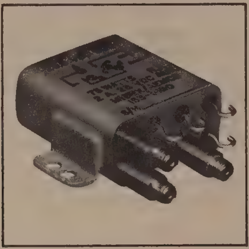
Crystal Can
Coaxial Relay
DPDT — 1000 Megacycles

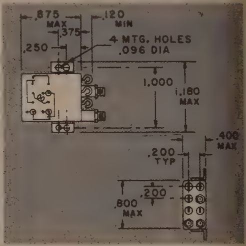
Micro-miniature coaxial relay offering the convenience of integral connectors. Packaged in the familiar 0.400" x0.800"x0.800" crystal can.

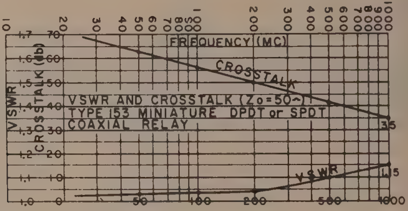
Relay connectors mate with Microdot ultra-miniature LEPRA/CON Connectors. Useable connecting cables are RG178 or RG196. **(Mating connectors not supplied)**

Relay is capable of switching more than 75 watts R. F. depending upon the system's VSWR. Available with either DPDT R. F. contacts; or SPDT R. F. contacts and a SPDT auxiliary contact. Meets applicable portions of MIL-R-5757 and MIL-S-3928.

Standard types listed. Other coils, mountings, etc., available on special order on an OEM basis.







ELECTRICAL CHARACTERISTICS

CONTACTS:

Arrangement
DPDT R.F.
SPDT R.F., SPDT Auxiliary

Rating
R.F. Contacts — 50 watts (depends on system VSWR)
Auxiliary — 2.0 to 5.0 amps, 26.5 VDC

Life expectancy
R.F. — depends on system VSWR
Auxiliary — 1 million operations at 2.0 amps 100,000 operations at 5.0 amps.

COILS:

Voltage
6 to 26.5 VDC

GENERAL:

Operate time
6.0 milliseconds at nominal voltage, 25°C.

Release time
6.0 milliseconds at nominal voltage, 25°C.

Temperature Range
—65°C to plus 125°C

Vibration
15 g's, 10 to 2,000 CPS

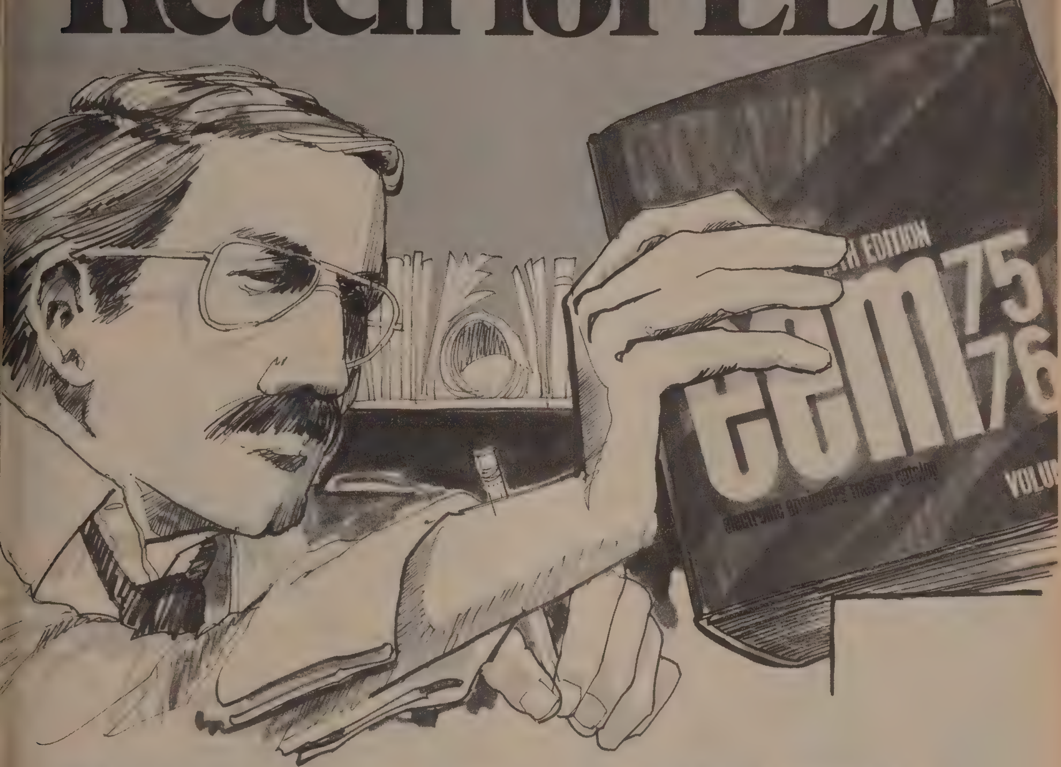
Shock
30 g's for 11 milliseconds

STANDARD PART NUMBERS

COILS		CONTACTS		RF TERMINALS	PART NUMBER
NOMINAL VOLTAGE (vdc)	RESISTANCE (Ohms ±10%)	RF	Aux		
12	150	1C	1C	RG188/AU	153-6093
12	150	2C	—	RG188/AU	153-6095
12	150	1C	1C	LEPRA/CON	153-6218
12	150	2C	—	LEPRA/CON	153-6219
26.5	600	1C	1C	RG188/AU	153-6092
26.5	600	2C	—	RG188/AU	153-6094
26.5	600	1C	1C	LEPRA/CON	153-6180
26.5	600	2C	—	LEPRA/CON	153-6181

There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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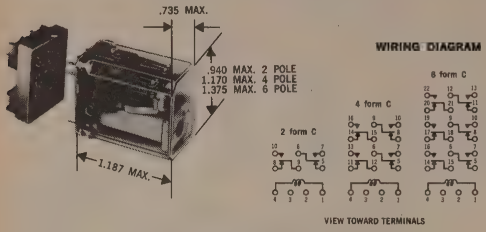
645 STEWART AVE., GARDEN CITY, N.Y. 11530 (516) 248-9700

Miniature General Purpose Relays/AZ420 Series

Up to 6PDT Contacts — Dry Circuit to 5 Amp

General purpose miniature relays in plastic dust cover —
Interchangeable with other comb-actuated relays —
Combination solder and plug-in terminals.
UL-version listed under UL Component Recognition File 43203.



ELECTRICAL SPECIFICATIONS

Contact Rating: Noninductive load
Light Duty (Code L): Fine silver goldplated — low level to 2 amps @ 26 VDC or 1 amp @ 115 VAC
Heavy Duty (Code H): Silver cadmium oxide — 5 amp @ 26 VDC or Electrical: 10^6 at rated load
Other contact material available

Life Expectancy: Mechanical Operations: 10^8
Electrical: 10^6 at rated load

Contact Resistance: 50 milliohms max. initially
200 milliohms at end of life

Operate Time: At nominal operate voltage or current ≤ 8ms

Release Time: At nominal operate voltage or current ≤ 3ms

Contact Bounce: At 10 ma contact current:
2ms typ. at operate, N.O. contacts
3ms typ. at release, N.C. contacts

Dielectric Strength: 1000 Vrms; 500 Vrms across contact gap

Insulation Resistance: 10,000 megohms minimum @ 25°C, 100 VDC, 50% RH; Special insulation with 10^{14} ohms available

Coil Temperature: Max. 105°C (220°F)
Max. continuous coil dissipation 2.3W at 20°C.

Ambient Temperature
Operating: −55°C (−72°F) to 80°C (175°F) @ nominal operating voltage
Storage: −55°C (−72°F) to 105°C (220°F)

Vibration: Operating: .062 DA @ 5-55 Hz; 10 g @ 55-110 Hz
Non-Operating: 10 g @ 5-500 Hz

Shock: Operating: 20 g @ 11ms
Non-Operating: 30 g @ 11ms

Weight: 23 to 35 grams (approx. 1 oz.)

SOCKET ORDER INFORMATION

AZ Type	Description	Use With	Contacts
ST 140-A1	Socket	AZ 420	DPDT
ST 342-A1	Right Angle for PC		DPDT
ST 349-A1	Right Angle for PC		DPDT
ST 140-1	Retainer		DPDT
ST 141-A1	Socket	AZ 421	4PDT
ST 343-A1	Right Angle for PC		4PDT
ST 350-A1	Right Angle for PC		4PDT
ST 141-1	Retainer		4PDT
ST 345-A1	Socket	AZ 431	6PDT
ST 354-A1	Right Angle for PC		6PDT
ST 345-1	Retainer		6PDT
ST 140-2	Ground Clip for all	All	

Order socket, retainer and grounding clip (if desired) by separate part numbers. To specify sockets with gold plated terminals, substitute -A2 for -A1.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

RELAY ORDER INFORMATION

1. Select basic relay type from Table I
2. Add coil code from Table IIa, b, c, or d
3. Add contact code from Table III
4. Add—U for UL version after P/N

FOR EXAMPLE

AZ 431 — 80 — 1L

Plug-in type, 6 pole — AZ 431
24 VDC, 430 ohm coil resistance — 80
6 PDT contacts single, light duty — 1L

Table I — Basic Types

Mounting	Configuration 2 Pole	 4 Pole	 6 Pole
Plug-in/Solder	AZ 420	AZ 421	AZ 431
PC Terminals	AZ 428	AZ 429	AZ 439

Table IIa — Standard DC Voltage Version

Nom. Oper. VDC	Must Oper. (Pick-up Max.) VDC	2 or 4 Form C or D Contacts Max. Cont. VDC	 Resist. Ohms ±10%	 Coil Code	6 Form C Contacts Max. Cont. VDC	 Resist. Ohms ±10%	 Coil Code
3	2.25	5	14	21	4.5	11	22
6	4.5	10	52	15	7	25	18
12	9	19	185	1011	14	90	13
18	13	29	430	80	22	230	10
20	16	34	600	08	26	360	09
24	18	37	700	70	29	430	80
26	21	44	1K	07	34	600	08
48	36	70	2.5K	56	59	1.8K	06
72	54	105	5.8K	40	83	3.6K	05
115	86	170	15K	035	130	9K	04

All Values at 20°C.

Table IIb — Sensitive DC Voltage Version

Nom. Oper. VDC	Must Oper. VDC	2 Form C or D Resist. Ohms	 Coil Code	4 Form C or D Resist. Ohms	 Coil Code	6 Form A, B or C Resist. Ohms	 Coil Code
3	2.25	50	V 15	30	V 18	20	V 19
6	4.5	200	V 10	110	V 12	80	V 13
12	9.0	800	V 70	450	V 80	320	V 09
24	18.0	3.2K	V 50	1.8K	V 05	1.2K	V 60
48	36.0	13K	V 04	7.5K	V 40	5.2K	V 045
72	54.0	28K	V 30	16K	V 035	13K	V 64
115	86.0	50K	V 02	40K	V 025	30K	V 03

Max. Continuous Coil Dissipation 2.3W at 20°C.

Table IIc — Sensitive DC Current Version

Coil Resist. Ohms ±10%	Coil Code	Must Operate Current (mA) 2 Form C or D Pick-up 85mW	 4 Form C or D Pick-up 175mW	 6 Form A, B or C Pick-up 250mW	Max. Coil Current mA
1K	C 07	8.5	13	16	46
2.5K	C 56	5.4	8.3	10	29
5K	C 045	4.1	6.2	7.2	20
10K	C 408	3.1	4.5	5.0	14
15K	C 035	2.4	3.5	4.2	12
30K	C 03	1.7	2.5	2.9	8.4

Table IId — Standard AC Voltage Version

Nom. Oper. VAC	Must Oper. (Pick-up Max.) VAC	Max. Cont. VAC	2 Form C Contacts Appr. AC Resist.	 Coil Code	4 Form C Contacts Appr. AC Resist.	 Coil Code
6	5	7.2	75	W16	33	W20
12	9	14.5	300	W11	120	W14
24	18	30	835	W08	480	W09
48	36	60	3.8K	W06	1.9K	W07
115	86	130	15K	W035	11K	W04

Table III — Contact Code

Contact Arrangement	Contact Type Light Duty 1mA to 2 Amp Single Silver Gold Plated	 Light Duty Dry Cir. to 2 Amp Bifurcated Silver Gold Plated	 Heavy Amp* 100mA to 5 Amp Single Silver Cadmium
2 Form C	4L	40L	4H
4 or 6 Form C	1L	10L	1H

*7.5 Amp contacts available.

AMERICAN ZETTLER, INC.

16881 HALE AVE. · IRVINE, CALIFORNIA 92705
PHONE 714-540-4190 · TELEX 67-8472

THINPAK™ Miniature Relays/AZ1530 Series

Up to 4PDT Contacts — 1, 2 or 5 Amp

For PC Board Mounting — 0.6″ center-to-center
Sealed plastic dust cover on 1 and 2 pole relay.

The AZ miniature THINPAK relay has been designed for applications with either demanding space limitations, such as 0.6″ center-to-center PC card mounting, or operating requirements that cannot be met by reed relays or conventional contact type relays. The high pressure 1, 2, or 5 amp contacts enables the unit to switch capacitance or lamp loads with current spikes that would normally weld the contacts of reed relays. The high sensitivity, long life and insulation resistance of more than 10^{10} ohms makes it an ideal unit for galvanic separation between electronic circuits.

The 1 and 2 pole relays have a plastic dust cover ultrasonically welded to the baseplate to protect the inside from flux and cleaning agents during machine soldering and spray or vapor cleaning.

Contact Rating: Noninductive load
Light Duty (1 Amp): Fine silver goldplated; 1 Amp @ 26 VDC or 0.5 Amp @ 115 VAC
Medium Duty (2 Amp): Silver Cadmium-Oxide; 2 Amp @ 26 VDC or 1 Amp @ 115 VAC
Heavy Duty (5 Amp): Silver Cadmium-Oxide; 5 Amp @ 26 VDC or 3 Amp @ 115 VAC or 2 Amp @ 220 VAC

Life Expectancy: Mechanical Operations: 10^7
Operations at Rated Load: 10^6

Contact Resistance: 50 milliohms max. initially

Operate Time: (Typical) 5 ms at Nominal Voltage

Release Time: (Typical) 6 ms at Nominal Voltage

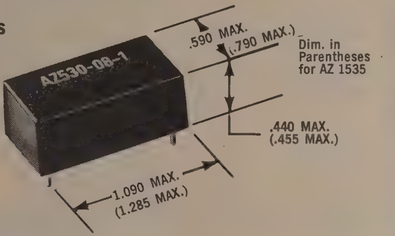
Contact Bounce: (Typical) at 10 mA contact current:
2 ms at operate N.O. side
6 ms at release N.C. side

Capacitance: (Typical)
N.C. to Movable 0.6 pF
N.O. to Movable 0.9 pF
contact to coil 12 pF

Dielectric Strength:	AZ 1530, 1531	AZ 1535	AZ 521
Contact — Contact	500 Vrms	1000 Vrms	500 Vrms
Contact — Coil	500 Vrms	2500 Vrms	500 Vrms

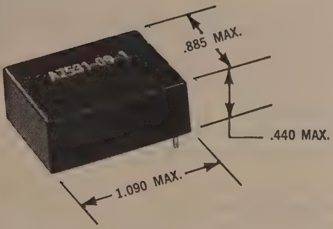
Insulation Resistance: 10,000 Megohms min. @ 20°C 100 VDC, 50% RH

SPDT Contacts



Dim. in Parentheses for AZ 1535

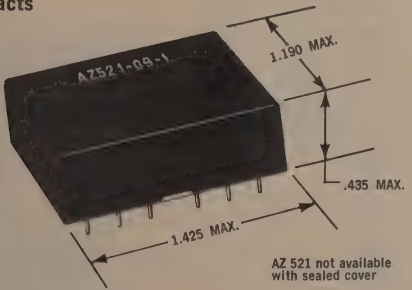
DPDT Contacts



Nom. Coil VDC	Max. Contin. VDC	Resist. Ohm ±10%	Must Operate mA	Must Operate VDC	Contact	Order No.
5	9.5	64	50	3.5	SPDT 1 Amp	AZ 1530-12-1
6	11	90	42	4.1		AZ 1530-11-1
12	21	310	23	7.7		AZ 1530-08-1
24	36	950	13	14	SPDT 1 Amp	AZ 1530-06-1
48	79	4,500	6.3	31		AZ 1530-04-1
100	140	14,000	3.5	55		AZ 1530-03-1
5	7.0	35	93	3.6	SPDT 2 Amp	AZ 1530-14-2
6	9.5	64	69	4.9		AZ 1530-12-2
12	16	200	41	9.0		AZ 1530-09-2
24	36	950	18	19	SPDT 2 Amp	AZ 1530-06-2
48	64	3,000	11	35		AZ 1530-045-2
100	140	14,000	4.8	75		AZ 1530-03-2
5	7.5	29	123	3.6	SPDT 5 Amp	AZ 1535-16-2
6	8.5	37	110	4.5		AZ 1535-15-2
12	16	125	61	8.5		AZ 1535-11-2
24	30	440	33	16	SPDT 5 Amp	AZ 1535-08-2
48	63	1,930	16	33		AZ 1535-055-2
100	147	10,500	7.2	83		AZ 1535-035-2
6	10	60	68	4.5	DPDT 1 Amp	AZ 1531-13-1
12	21	260	34	9.7		AZ 1531-09-1
24	34	670	21	16		AZ 1531-07-1
48	80	3,800	9.0	38	DPDT 1 Amp	AZ 1531-045-1
60	100	6,000	7.2	47		AZ 1531-04-1
100	180	19,000	4.0	48		AZ 1531-03-1
6	9	45	96	4.7	DPDT 2 Amp	AZ 1531-14-2
12	17	170	49	9.2		AZ 1531-10-2
24	34	670	25	19		AZ 1531-07-2
48	66	2,500	13	36	DPDT 2 Amp	AZ 1531-05-2
60	80	3,800	11	46		AZ 1531-045-2
100	130	10,000	7.0	76		AZ 1531-035-2

All values at 20°C

4PDT Contacts



AZ 521 not available with sealed cover

Nom. Coil VDC	Max. Contin. VDC	Resist. Ohms ±10%	Must Operate mA	Must Operate VDC	Contacts	2 Amp Contacts Order No.
6	9	52	75	4.3	4PDT	AZ 521-13-1
12	18	210	39	9.0		AZ 521-09-1
15	23	340	30	11		AZ 521-08-1
20	30	570	23	15		AZ 521-07-1
24	41	1,050	17	19	4PDT	AZ 521-06-1
48	72	3,200	10	36		AZ 521-045-1
60	90	5,100	8.0	45		AZ 521-04-1
110	160	16,000	4.5	79		AZ 521-03-1

VDC Coil Nom.	VDC Contin. Max.	Resist. Ohms ±10%	Must Operate mA	Must Operate VDC	Contact	2 Amp Bifurcated Contacts Order No.	3 Amp Contacts Order No.
6	8	38	108	4.4	4PDT	AZ 521-14-10	AZ 521-14-2
12	15	145	57	9.1		AZ 521-10-10	AZ 521-10-2
24	30	570	29	18		AZ 521-07-10	AZ 521-07-2
48	60	2,200	15	36	4PDT	AZ 521-05-10	AZ 521-05-2
60	72	3,200	13	44		AZ 521-045-10	AZ 521-045-2
110	160	16,000	5.6	99		AZ 521-03-10	AZ 521-03-2

All values at 20°C

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

AMERICAN ZETTLER, INC.
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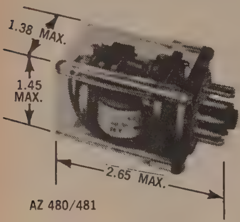
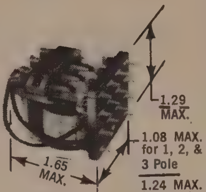
General Purpose Relays/AZ480 Series

Up to 4PDT Contacts — 10 Amp

U/L Recognized (File No. E44211)



AZ 480/481



AZ 488/487
AZ 482/483

AZ 480 relays are available in either an open or plastic enclosed version. The open relay, with either solder or PC terminals, can be mounted with an attached base plate or with a 6-32 tapped hole in the core. It also can be supplied with a 6-32 mounting stud and locating tab. The relay enclosed in a plastic dust-cover is available either as a plug-in version with octal type socket (8 or 11 pins), or with PC terminals.

Contact Rating: 10 amp @ 115 volts AC 60 Hz non inductive
Contact Material: Silver-cadmium-oxide
Contact Arrangement: 1, 2, 3 and 4 form C (up to 4PDT)
Life Expectancy: Mechanical: 10 million operations
Rated Load: ¼ million operations
Dielectric Strength: 1500 Vrms
500 Vrms across contact gap
Insulation Resistance: 100 megohms minimum
Coil Voltage: To 280 volts AC
Coil Power: Nominal — DC: 1.2 watts — AC: 2.5 VA
Max. Continuous Dissipation: 2.5 watts @ 35°C (95°F) ambient temperature

STANDARD RELAYS AC-ACTUATED

Coil Specifications					Order Number			
Voltage, VAC			Nom. Current (mA)	Con-tact	Open*		Enclosed	
Nom.	Max.	Min.			Wire Terminals	PC Terminals	Octal Plug In	PC Terminals
6AC	9	5	410	SPDT	AZ 483-2-1	AZ 487-2-1	AZ 481-2-1	AZ 487S-2-1
12AC	19	10	205	SPDT	AZ 483-3-1	AZ 487-3-1	AZ 481-3-1	AZ 487S-3-1
24AC	37	21	100	SPDT	AZ 483-4-1	AZ 487-4-1	AZ 481-4-1	AZ 487S-4-1
120AC	184	102	20	SPDT	AZ 483-7-1	AZ 487-7-1	AZ 481-7-1	AZ 487S-7-1
220AC	280	187	11	SPDT	AZ 483-9-1	AZ 487-9-1	AZ 481-9-1	AZ 487S-9-1
6AC	9	5	410	DPDT	AZ 483-2-2	AZ 487-2-2	AZ 481-2-2	AZ 487S-2-2
12AC	19	10	205	DPDT	AZ 483-3-2	AZ 487-3-2	AZ 481-3-2	AZ 487S-3-2
24AC	37	21	100	DPDT	AZ 483-4-2	AZ 487-4-2	AZ 481-4-2	AZ 487S-4-2
120AC	184	102	20	DPDT	AZ 483-7-2	AZ 487-7-2	AZ 481-7-2	AZ 487S-7-2
220AC	280	187	11	DPDT	AZ 483-9-2	AZ 487-9-2	AZ 481-9-2	AZ 487S-9-2
6AC	9	5	410	3PDT	AZ 483-2-3	AZ 487-2-3	AZ 481-2-3	AZ 487S-2-3
12AC	19	10	205	3PDT	AZ 483-3-3	AZ 487-3-3	AZ 481-3-3	AZ 487S-3-3
24AC	37	21	100	3PDT	AZ 483-4-3	AZ 487-4-3	AZ 481-4-3	AZ 487S-4-3
120AC	184	102	20	3PDT	AZ 483-7-3	AZ 487 7-3	AZ 481-7-3	AZ 487S-7-3
220AC	280	187	11	3PDT	AZ 483-9-3	AZ 487-9-3	AZ 481-9-3	AZ 487S-9-3
6AC	9	5	410	4PDT	AZ 483-2-8	AZ 487-2-8		AZ 487S-2-4
12AC	19	10	205	4PDT	AZ 483-3-8	AZ 487-3-8		AZ 487S-3-4
24AC	37	21	100	4PDT	AZ 483-4-8	AZ 487-4-8		AZ 487S-4-4
120AC	184	102	20	4PDT	AZ 483-7-8	AZ 487-7-8		AZ 487S-7-4
220AC	280	187	11	4PDT	AZ 483-9-8	AZ 487-9-8		AZ 487S-9-4

STANDARD RELAYS DC-ACTUATED

Coil Specifications					Order Number			
Voltage, VDC			Resist. (Ohms) ±10%	Con-tact	Open*		Enclosed	
Nom.	Max.	Min.			Wire Terminals	PC Terminals	Octal Plug In	PC Terminals
6DC	9	4.5	32	SPDT	AZ 482-2-1	AZ 488-2-1	AZ 480-2-1	AZ 488S-2-1
12DC	19	9	130	SPDT	AZ 482-3-1	AZ 488-3-1	AZ 480-3-1	AZ 488S-3-1
24DC	37	18	500	SPDT	AZ 482-4-1	AZ 488-4-1	AZ 480-4-1	AZ 488S-4-1
48DC	75	36	2,100	SPDT	AZ 482-6-1	AZ 488-6-1	AZ 480-6-1	AZ 488S-6-1
110DC	165	83	10,500	SPDT	AZ 482-9-1	AZ 488-9-1	AZ 480-9-1	AZ 488S-9-1
6DC	9	4.5	32	DPDT	AZ 482-2-2	AZ 488-2-2	AZ 480-2-2	AZ 488S-2-2
12DC	19	9	130	DPDT	AZ 482-3-2	AZ 488-3-2	AZ 480-3-2	AZ 488S-3-2
24DC	37	18	500	DPDT	AZ 482-4-2	AZ 488-4-2	AZ 480-4-2	AZ 488S-4-2
48DC	75	36	2,100	DPDT	AZ 482-6-2	AZ 488-6-2	AZ 480-6-2	AZ 488S-6-2
110DC	165	83	10,500	DPDT	AZ 482-9-2	AZ 488-9-2	AZ 480-9-2	AZ 488S-9-2
6DC	9	4.5	32	3PDT	AZ 482-2-3	AZ 488-2-3	AZ 480-2-3	AZ 488S-2-3
12DC	19	9	130	3PDT	AZ 482-3-3	AZ 488-3-3	AZ 480-3-3	AZ 488S-3-3
24DC	37	18	500	3PDT	AZ 482-4-3	AZ 488-4-3	AZ 480-4-3	AZ 488S-4-3
48DC	75	36	2,100	3PDT	AZ 482-6-3	AZ 488-6-3	AZ 480-6-3	AZ 488S-6-3
110DC	165	83	10,500	3PDT	AZ 482-9-3	AZ 488-9-3	AZ 480-9-3	AZ 488S-9-3
6DC	9	4.5	32	4PDT	AZ 482-2-8	AZ 488-2-8		AZ 488S-2-4
12DC	19	9	130	4PDT	AZ 482-3-8	AZ 488-3-8		AZ-488S-3-4
24DC	37	18	500	4PDT	AZ 482-4-8	AZ 488-4-8		AZ 488S-4-4
48DC	75	36	2,100	4PDT	AZ 482-6-8	AZ 488-6-8		AZ 488S-6-4
110DC	165	83	10,500	4PDT	AZ 482-9-8	AZ 488-9-8		AZ 488S-9-4

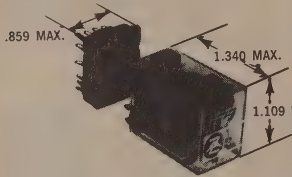
* Also available with #6-32 UNC-2A mounting stud and locating tab (add letter "A" to part no.) or with #6-32 UNC-2B tapped core and locating tab (add Letter "B" to part no.)

Miniature AC, DC Relays/TEC1300 Series

4PDT Contacts — 5 Amp

U/L Recognized (File No. E45020) / CSA File No. 31387

The miniature relay series 1300 with AC or DC coils and 4PDT contacts, available with either plug-in or PC terminals, is ideally suited for use in alarm systems, communications, and data processing equipment.



Contact Rating: Resistive Load 5 amp at 26 VDC or 115 VAC*

Contact Material: Silver gold plated. Other contact material available

Contact Arrangement: 4 form C (4PDT)

Life Expectancy: Mechanical Operations: 10^8

Electrical Operations: At Rated Load: 5 x 10^4
At 3 Amp 26 VDC or 115 VAC: 10^6

Dielectric Strength: 1500 Vrms; 500 Vrms across contact gap

Insulation Resistance: 1500 Megohms min. @ 20°C, 100 VDC, 50% RH

Coil Power at 20°C:
AC: 1.20 Va nom. ; 2 Va max. continuous
DC: .90 Watts nom.; 2 Watts max. continuous

Coil Temperature: Max. 105°C

Weight: Approx. 42 gr. (1.5 oz)

Terminals: Solder lug/plug-in or PC on relay
Solder lug or PC on socket

Enclosure: Clear, high impact polycarbonate cover

STANDARD RELAYS AC ACTUATED

Coil Specifications			Nom. Curr. (Average (mA)	Order No.	
Voltage VAC				Plug in Terminals	PC Terminals
Nom.	Max.	Min.			
6VAC	7.1	5.1	200	1309-4191	1309-4193
12VAC	14.2	10.2	100	1309-4291	1309-4293
24VAC	28.5	20.4	50	1309-4391	1309-4393
36VAC	42	30.6	33	1309-4491	1309-4493
48VAC	57	40.8	25	1309-4591	1309-4593
60VAC	71	51	20	1309-4691	1309-4693
115VAC	130	94	11	1309-4791	1309-4793
127VAC	150	108	9.5	1309-4891	1309-4893

STANDARD RELAYS DC ACTUATED

Coil Specifications				Order No.	
Voltage VDC			Resistance	Plug in	PC
Nom.	Max.	Min.	(ohms) ±10%	Terminals	Terminals
6VDC	8	4.5	40	1309-8191	1309-8193
12VDC	16	9	160	1309-8291	1309-8293
24VDC	32	18	650	1309-8391	1309-8393
36VDC	48	27	1400	1309-8491	1309-8493
48VDC	64	36	2600	1309-8591	1309-8593
60VDC	80	45	3600	1309-8691	1309-8693
110VDC	146	83	13000	1309-8791	1309-8793

All data at 20°C
ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

SOCKET ORDER INFORMATION:		
	Pierced Solder Terminals:	ROF14
	PC Terminals:	RS14
	Retainer for Relay:	HF163

AMERICAN ZETTLER, INC.

16881 HALE AVE. · IRVINE, CALIFORNIA 92705
PHONE 714-540-4190 · TELEX 67-8472

THINPAK™ Miniature Relays/AZ1630 Series Magnetic Latching

Up to DPDT Contacts — Dry Circuit to 2 Amp

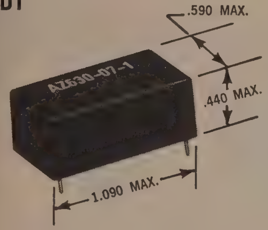
For PC Board Mounting — 0.6″ center-to-center.
Sealed Plastic Dust Cover.

The THINPAK Series AZ 1630 magnetic latching relay, is a miniature memory relay which can be operated with an impulse of more than 10 ms and store the information indefinitely without power consumption. This makes it an ideal component for economical low-bit memory systems such as that needed for tool machines, elevators, packaging and vending machines, aircraft and car simulators, etc. The construction of the relay and selection of materials assures that the status of the relay cannot be changed by mechanical vibrations or shock, up to specified limitations. The N.O. side of the contact closes after energizing the operating coil with a DC pulse. The contact switches to the opposite position by energizing the release coil. In standard versions, both coils use the same operating voltage, which allows energizing and de-energizing the relay from the same voltage source. The high pressure 1 or 2 amp contact enables the unit to switch capacitance or lamp loads with current spikes that would normally weld the contacts of a reed relay. The high insulation resistance of more than 10^{10} ohms and the low contact resistance of less than 50 mΩ make it ideal for galvanic separation between electronic circuits.

The relays have a plastic dust cover ultrasonically welded to the baseplate to protect the inside from flux and cleaning agents during machine soldering and spray or vapor cleaning. Cleaning by immersion is not recommended.

Contact Rating:	Noninductive load.
Light Duty:	(Fine silver goldplated.) 1 Amp @ 26 VDC or 0.5 Amp @ 115 VAC.
Medium Duty:	(Silver cadmium oxide.) 2 Amps @ 26 VDC or 1 Amp @ 115 VAC.
Dry Circuit:	(Silver hard gold overlay.) Dry circuit or low level to 0.2 Amp @ 26 VDC or AC.
Life Expectancy:	Mechanical Operations: 10^5 Operations at Rated Load: 10^6.
Contact Resistance:	50 milliohms maximum initially.
Operate Time: (Typical)	3 ms at nominal voltage.
Release Time: (Typical)	2 ms at nominal voltage.
Contact Bounce: (Typical)	At 10 mA contact current: 2 ms at operate N.O. side. 4 ms at reset N.C. side.
Capacitance: (Typical)	N.C. to movable 0.6 pF. N.O. to movable 0.9pF. Contact to coil 12 pF.
Dielectric Strength:	Contact-to-contact 500 Vrms. Contact-to-coil 500 Vrms.
Insulation Resistance:	10,000 megohms min. @ 20°C. 100 VDC, 50% RH.
Coil Temperature:	Maximum 105°C (220°F).
Ambient Temperature:	
Operating:	(at intermittent duty 20 sec. maximum on time. 100 sec. minimum off time). −5°C (23°F) to 40°C (104°F).
Storage:	−55°C (−72°F) to 105°C (220°F).
Vibration:	0.062 DA @ 10.55 Hz. 10 g @ 55-300 Hz.
Shock:	30 g.

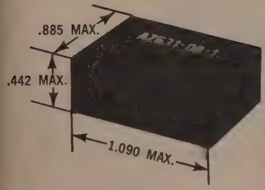
SPDT



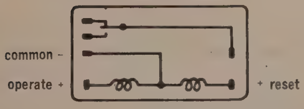
Coil Specifications						Order Number		
Operate or Reset VDC			Resistance Ohm ±10%					
Nom.	Max.	Min.	Operate	Reset	Contact	1 Amp Contacts	2 Amp Contacts	Dry Circuit Contacts
6	6.6	4.8	30	40	SPDT	AZ 1630-14-1	AZ 1630-14-2	AZ 1630-14-3
12	13.2	9.5	112	125		AZ 1630-10-1	AZ 1630-10-2	AZ 1630-10-3
24	26.4	19	400	1,120		AZ 1630-07-1	AZ 1630-07-2	AZ 1630-07-3
48	53	38	1,650	1,650		AZ 1630-05-1	AZ 1630-05-2	AZ 1630-05-3
60	66	48	2,100	3,500		AZ 1630-045-1	AZ 1630-045-2	AZ 1630-045-3
6	6.6	4.8	17.5	42	DPDT	AZ 1631-16-1	AZ 1631-16-2	AZ 1631-16-3
12	13.2	9.5	65	95		AZ 1631-12-1	AZ 1631-12-2	AZ 1631-12-3
24	26.4	19	270	640		AZ 1631-08-1	AZ 1631-08-2	AZ 1631-08-3
48	53	38	1,050	1,050		AZ 1631-06-1	AZ 1631-06-2	AZ 1631-16-3
60	66	48	1,650	3,600		AZ 1631-05-1	AZ 1631-05-2	AZ 1631-05-3

All values at 20°C

DPDT

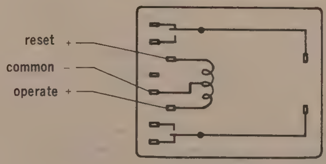


WIRING DIAGRAM AZ 1630
(View Toward Terminals)



Reset Position Shown

WIRING DIAGRAM AZ 1631
(View Toward Terminals)



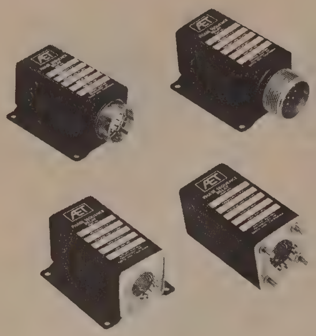
Reset Position Shown

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

AMERICAN ZETTLER, INC.

16881 HALE AVE. · IRVINE, CALIFORNIA 92705
PHONE 714-540-4190 · TELEX 67-8472

PHASE SEQUENCE RELAYS



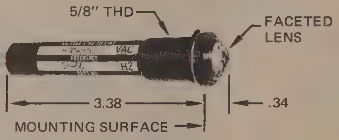
- HERMETICALLY SEALED
- OPERATING TEMP: –55°C TO +71°C
- CONTACT RATING: 2 AMP RES OR 10 AMP RES

PRICES ARE FOR FLANGE MTG WITH SOLDER HOOK TERMINALS

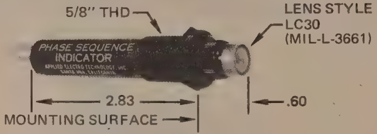
VOLTAGE RMS LINE TO LINE ±10%	FREQ (Hz) 60 ±10% 400 ±20%	2 AMP DPDT PART NO.	2 AMP DPDT PRICE 1 – 9	10 AMP DPDT PART NO.	10 AMP DPDT PRICE 1 – 9
120	60	1A-2A1	$103.87	1A-2B1	$114.43
120	400	1A-2A2		1A-2B2	
200	50	1A-2A3		1A-2B3	
200	60	1A-2A4		1A-2B4	
200	400	1A-2A5		1A-2B5	
220	50	1A-2A6		1A-2B6	
220	60	1A-2A7		1A-2B7	
240	50	1A-2A8	$108.73	1A-2B8	$119.29
240	60	1A-2A9		1A-2B9	
416	400	1A-2A10		1A-2B10	
420	50	1A-2A11		1A-2B11	
440	60	1A-2A12		1A-2B12	
480	50	1A-2A13		1A-2B13	
480	60	1A-2A14		1A-2B14	
380	50	1A-2A15		1A-2B15	

A phase sequence relay monitors the phase sequence of three phase power being supplied to electrical equipment. The relay picks up when all input terminals are energized and phase sequence is A-B-C. Relay drops out if one or more power leads are grounded, opened or if the phase sequence is C-B-A.

PHASE SEQUENCE INDICATORS



STYLE A



STYLE B

LENS COLOR:	A – RED	C – CLEAR
	B – AMBER	D – GREEN

- LEADS: 18" LONG, TEFLON INSUL COLOR CODED
- OPERATING TEMP: –55°C TO +125°C
- MOUNTING: 5/8" DIA HOLE

VOLTAGE (V) ±10%	FREQ (Hz) ±10%	STYLE A PART NO.	STYLE B PART NO.	PRICE 1-9
120	60	2A-5____1	2B-____1	$35.00
120	400 ± 20%	2A-5____2	2B-____2	
200	50	2A-5____3	2B-____3	
200	47–63	2A-5____4	2B-____4	
200	60	2A-5____5	2B-____5	
200	400 ± 20%	2A-5____6	2B-____6	
220	50	2A-5____7	2B-____7	
220	60	2A-5____8	2B-____8	
240	50	2A-5____9	2B-____9	
240	60	2A-5____10	2B-____10	
380	50	2A-5____11	2B-____11	
418	50	2A-5____12	2B-____12	
418	47–63	2A-5____13	2B-____13	
418	400±10%	2A-5____14	2B-____14	
440	60	2A-5____15	2B-____15	
480	50	2A-5____16	2B-____16	
480	60	2A-5____17	2B-____17	
520	22.5–27.5	2A-5____18	2B-____18	
520	50	2A-5____19	2B-____19	

ENTER LETTER FOR LENS COLOR

A unique, passive element circuit within the barrel assembly allows the indicator to illuminate only when the phase sequence of power being monitored is A-B-C. The indicator will not illuminate if the phase sequence is C-B-A, or any one or more leads are disconnected. Ideal for Airborne or Ground Equipment, the indicator will provide trouble-free instantaneous indication with no warm-up time required.

PHASE SEQUENCE TESTER

COLOR CODED CLIPS
ϕA – RED
ϕB – YELLOW
ϕC – BLUE

The phase sequence tester is used to determine the proper sequence of power lines being hooked up to equipment.

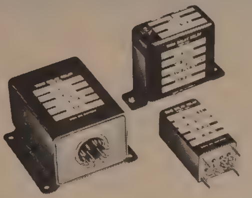
MODEL NO.	VOLTAGE (V)	FREQ (Hz) ±10%	PRICE 1-9
A600	100–600	400	$46.80
C600	100–600	60	
E600	100–600	50	

◆All prices subject to change without notice.◆

Applied Electro Technology, Inc.

2220 S. Anne St./Santa Ana, Cal 92704/Tel (714) 556-6570/TWX 910-595-1797

TIME DELAY RELAYS



Delayed Pull-in: On application of control power, the time delay begins. At the end of the time delay, the output relay operates.

Delayed Drop-out One Shot: Applying control power operates the output relay. At the end of the time delay period, the output relay returns to normal.

Delayed Drop-out Maintained: Closing a control switch operates the output relay; opening it starts the time delay. Any control switch closure before the end of the time period immediately recycles the timer.

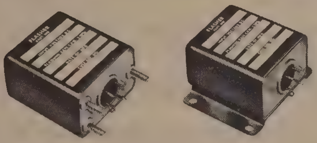
Table lists Time Delay Relays with factory preset time intervals (fixed) with accuracy of ±10% with ±2% repeatability. Flange mounted with solder hook terminals, hermetically sealed. Input voltage is 18-32 VDC with 2 amp or 10 amp relay contacts DPDT.

OPERATING MODE	TIMING RANGE (SEC)	2 AMP DPDT FIXED TIME		10 AMP DPDT FIXED TIME	
		PART NO.	PRICE 1–9	PART NO.	PRICE 1–9
DELAYED PULL-IN	.05–.50	3A-1B25(*)	$96.65	3A-1B32(*)	$107.93
	.50–1.0	3A-1B26(*)		3A-1B33(*)	
	1–10	3A-1B27(*)		3A-1B34(*)	$111.13
	10–50	3A-1B28(*)	$99.79	3A-1B34(*)	
DELAYED DROP-OUT MAINTAINED	.05–.50	3A-2B25(*)	$106.52	3A-2B32(*)	$117.80
	.50–1.0	3A-2B26(*)		3A-2B33(*)	
	1–10	3A-2B27(*)		3A-2B34(*)	$121.00
	10–50	3A-2B28(*)	$109.69	3A-2B34(*)	
DELAYED DROP-OUT ONE SHOT	.05–.50	3A-3B25(*)	$99.74	3A-3B32(*)	$111.02
	.50–1.0	3A-3B26(*)		3A-3B33(*)	
	1–10	3A-3B27(*)		3A-3B34(*)	$114.22
	10–50	3A-3B28(*)	$102.91	3A-3B34(*)	

***ENTER TIME REQUIRED IN SECONDS WITHIN RANGE SPECIFIED**

The Time Delay Relays are manufactured with factory pre-set time intervals or with externally adjustable time intervals or with an internally adjustable potentiometer. Time delays to 600 seconds are also available. The units can be purchased with ±10% or ±5% accuracy with many mounting styles and terminals including connectors per MIL-C-38999.

SOLID STATE FLASHERS . . . when power is applied, a flashing signal is given

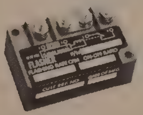


- INPUT VOLTAGE: 18 TO 32 VDC
- OPERATING TEMP: -55°C TO +71°C
- LIFE EXPECTANCY: 10,000 HRS MIN
- HERMETICALLY SEALED
- OTHER STYLES ARE AVAILABLE

PRICES ARE FOR POSITIVE SWITCHING TYPE, STUD MOUNTED.

PART NO.	PRICE 1–9	LAMP OR RELAY LOAD	FLASHING RATE ±10%	ON:OFF RATIO ±20%
4A-2A1K8	$69.89	200 mA	CUSTOMER MAY SPECIFY WITHIN RANGE 15 CPM TO 300 CPM	CUSTOMER MAY SPECIFY WITHIN RANGE 1:1 TO 1:5
4A-2A2K8	$73.20	500 mA		
4A-2A3K8	$120.93	2 AMP		
4A-2A4K8	$120.93	5 AMP		

FLASHER—RELAY TYPE

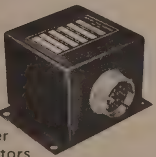


- INPUT VOLTAGE: 18 TO 32 VDC
- OPERATING TEMP: -65°F TO +160°F
- CONTACT RATING: .5 AMP INDUCTIVE OR LAMP LOAD

This flasher unit is designed to provide more than 10 million cycles of trouble-free operation over a wide voltage and temperature range. The flasher is used with a warning light. When power is applied, a flashing signal is given. A completely transistorized control circuit is used, the only moving parts are the relay contacts.

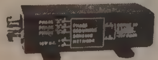
PART NO.	FLASHING RATE ±10%	ON:OFF RATIO ±20%	PRICE 1–9
4C-10	CUSTOMER MAY SPECIFY WITHIN RANGE 15 CPM TO 300 CPM	CUSTOMER MAY SPECIFY WITHIN RANGE 1:1 TO 1:5	$55.70

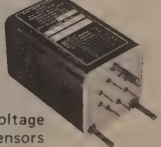
◆ **All prices subject to change without notice.** ◆



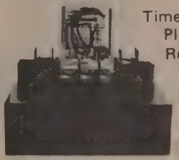
Power Monitors

Phase Sequence Sensing Network





Voltage Sensors



Timers with Plug-in Relays

Applied Electro Technology, Inc.

2220 S. Anne St./Santa Ana, Cal 92704/Tel (714) 556-6570/TWX 910-595-1797

Arrow Hart

RELAYS

AC & DC MAGNETIC RELAYS

ARROW-HART AC and DC Magnetic Control Relays are Pilot-Duty Devices designed to switch coil currents of contactors, starters, solenoids and other control relays. Applications include machine tool control, refrigeration control and a wide variety of other industrial and commercial uses.

Available in a number of pole configurations to 8 poles maximum and in 10 and 15 ampere ratings to 300 volts maximum, these relays will provide long life and dependable operation.

MACHINE TOOL RELAYS

TYPE MTS & MTU

Type MTS and MTU Gold Bonded Relays are available with combinations of contact configurations, normally open, normally closed, normally open and normally closed to six poles maximum and ratings up to 10 amperes 300 volts AC and 2 amperes 125 volts DC or .5 amperes 250 volts DC. Both the surface mounting type MTS, and receptacle mounting type MTU are available in two basic types:

ELECTRICALLY HELD: The relay coil is energized to operate the contacts and the current to the coil is maintained to hold the contacts in the operating position. This is the most common type of relay, and is most often used in 2 and 3 wire control circuits.

MECHANICALLY HELD: The relay coil is energized momentarily to operate the contacts which are then held in the operating position by means of a mechanical latch. A second coil is energized to trip the latch and open the relay contacts. No power is consumed while the relay is in the closed or latched position.

PLUG-IN STYLE

This relay is designed primarily for use with plug-in receptacle, but can also be used by itself as a back-wired unit for through-panel mounting, or cover mounted for front connectability. The plug-in receptacle is an exceptionally sturdy industrial-type unit of 1-piece molded construction. It is equipped with flat stab-in connections having broad contact surfaces to assure positive contacting. These are NOT ordinary pin-type connections. Back is totally enclosed, eliminating the need for additional insulation when mounting on a panel. Rubber snubbers minimize transfer of machine vibration to the relay. Terminals for screw-type connections are clearly marked for easy identification. Heavy retaining prongs hold the relay securely to the receptacle. If desired (in applications involving exceptionally heavy vibrations), the relay can be locked to the receptacle.

SURFACE MOUNTED STYLE

Electrically identical to the plug-in model, this surface mounting relay is front wired and is equipped with quick-connect terminals. Rubber snubbers on the base (similar to those on the plug-in receptacle) assure firm mounting and reduce transmission of machine vibration to the relay.

PAY-STACK MOUNTING

Two or more Gold Bonded Relays can be stacked one on top of the other — bottom-to-top or top-to-bottom as desired — providing the maximum number of control circuits in the smallest possible envelope. A few of the many possible stacking arrangements are shown here. This is utilized by a thru-rod arrangement. The necessary parts are available in a pay-stacking hardware kit consisting of 2 bushings, 2 screws, 2 nuts, and 2 lockwashers. See Field Modifications.

SPECIFICATIONS

RELAY DESIGN: Class A coils, vacuum impregnated on mylar bobbin. Low mass, clapper-type electromagnets, laminated core with shaded pole. Fully enclosed, multi-pole circuits with direct terminal contact, terminals epoxy anchored. Flexible contacting blades with single break Gold Bonded silver base contact buttons. Guided nylon blade operator. Full vision casing with circuit diagram identification label.

CONTACTING CONFIGURATIONS: Two forms of circuiting with 4 and 6 movable blade types.
4 blade — 4 Type C (N.O.-N.C.)
6 blade — 2 Type C (N.O.-N.C.), 4 Type A (N.O.)
Special contact configuration data may be obtained from factory.

RELAY MOUNTING CONFIGURATIONS: **Surface mounting type** with side projecting spade terminals available in either of the two contacting forms. **Panel mounting type** with rear extending spade terminals, or **cover mounted** with front extending spade terminals.

MOUNTING POSITIONS: Unlimited.

CONTACT BOUNCE: Negligible. Bounce was measured by using a 3 volt DC source on an oscilloscope.

CONTACT RESISTANCE: 10 Milliohms or less. Resistance was determined by using a 110V, 60 cycle 10 amp supply and reading the millivolt drop on an oscilloscope.

PICK UP AND DROP OUT TIME: **Pick up** — 20 milliseconds or less. **Drop out** — 12 milliseconds or less.

HEAT RISE: 30°C maximum contact temperature rise with full load and coil at rated volts.

OPERATING LIFE: In excess of 10 million cycles. Normal testing — 4 cps., in gravity drop out position.

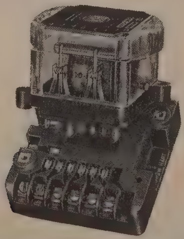
COIL DATA (Nominal Values):
Watts: Inrush — 7 watts. Sealed — 3.5 watts.
Volt Amps: Inrush — 15 V.A. Sealed — 5.5 V.A.
Class A coils — 50°C rise at rated voltage at 40°C.
Pick up is 85% of rated volts or less.
Drop out is 75% of rated volts or less.
Operating range is +150°F to −65°F.

RELAY RATINGS: 10 amp. 300VAC maximum.

Horsepower and Ampere Ratings:

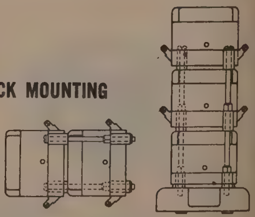
HP	Volts	Amps Per Pole	Two In Series
½	110 AC	10	
½	220 AC	10	
Max. Interrupting rating	125 DC	.5	2.0
	250 DC	.25	.5

PLUG-IN



SURFACE MOUNTED

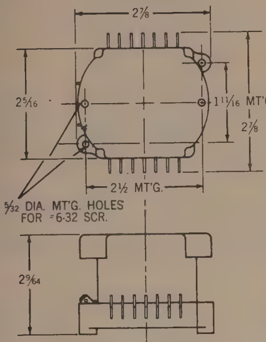
PAY-STACK MOUNTING



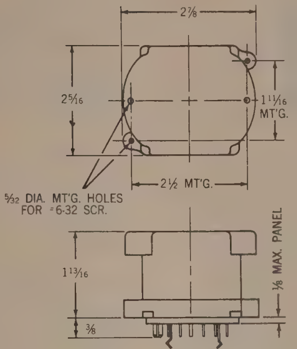
ARROW-HART INC. / INDUSTRIAL CONTROL PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

Arrow Hart RELAYS

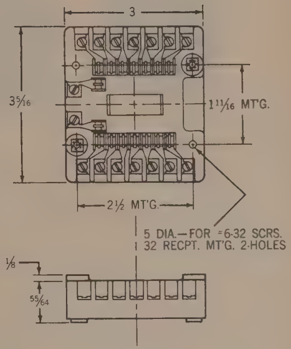
DIMENSIONS



*SURFACE MOUNTED RELAY



*PLUG-IN OR PANEL MOUNTED RELAY



RECEPTACLE

*AMP pre-insulated receptacle, series 205, Cat. No. 42727-2 or equivalent may be used on quick connect terminals.

APPROXIMATE DIMENSIONS, NOT SUITABLE FOR CONSTRUCTION

HOW TO ORDER

1. Specify CATALOG NUMBER of relay required from the appropriate selection table below.
2. Specify COIL CODE for the required control circuit voltage and frequency from the Coil Selection Table below.
3. Order and price by complete Catalog Number.
4. Specify Catalog Number of RECEPTACLE ONLY required for receptacle mounting units. Order and price by individual Catalog Number.
5. Order FIELD MODIFICATIONS required by selecting applicable Catalog Number of field modification kit from tables below.

EXAMPLE:

Receptacle Mounting Relay Catalog Number	+	Code Coil	=	Complete Receptacle Mounting Relay Catalog Number	Receptacle Only Required For Mounting
MTU-402		20		MTU-402-20 $36.40	MTRS-402 $5.60

MECHANICALLY LATCHED

No. of Poles	CONTACT CONFIGURATION Type A N.O.	Type B N.C.	Type C N.O. & N.C.	RECEPTACLE MOUNTING[1] Cat. No.	List	SURFACE MOUNTING Cat. No.	List
2	—	—	2	MTU-002-L	$44.40	MTS-002-L	$44.40
4	—	4	—	MTU-040-L	52.40	MTS-040-L	52.40
4	—	—	4	MTU-004-L	54.40	MTS-004-L	54.40
4	2	2	—	MTU-220-L	52.40	MTS-220-L	52.40
4	4	—	—	MTU-400-L	48.40	MTS-400-L	48.40

[1] For RECEPTACLE ONLY (2 & 4 poles, any combination of contact configuration) order Receptacle CAT. NO. MTRS-402, List $5.60.

ELECTRICALLY HELD, RECEPTACLE MOUNTING

No. of Poles	CONTACT CONFIGURATION Type A N.O.	Type B N.C.	Type C N.O. & N.C.	RELAY Cat. No.	List	RECEPTACLE ONLY Cat. No.	List
4	—	—	4	MTU-004	$30.40	MTRS-004	$4.80
6	4	—	2	MTU-402	36.40	MTRS-402	5.60

ELECTRICALLY HELD, SURFACE MOUNTING

No. of Poles	CONTACT CONFIGURATION Type A N.O.	Type B N.C.	Type C N.O. & N.C.	Relay Cat. No.	List
4	—	4	—	MTS-040	$28.40
4	—	—	4	MTS-004	30.40
4	2	2	—	MTS-220	28.40
4	4	—	—	MTS-400	24.40
6	4	—	2	MTS-402	36.40

COIL SELECTION TABLE

AC Voltage	Frequency	Code[1]	DC Voltage	Code[2]
6	60 Hz	01	8	AB
12	60 Hz	02	12/15	AC
24	60 Hz	10	24	AE
110/120	60 Hz	20	28	AF
220/230	60 Hz	40	48/50	AJ
			115/125	AO
			230/250	AR

[1] For VOLTAGE & FREQUENCY not listed specify CODE 99 and required voltage and frequency.
[2] For VOLTAGE not listed specify CODE YY and required voltage.

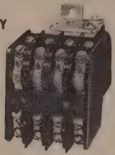
FIELD MODIFICATIONS

Description	Cat. No.	List
Pay-Stack Mounting Kit. Contains necessary hardware to stack two relays, one on top of another. See illustration on page 1•1580	28240-312	$3.00

Arrow Hart RELAYS

CONTROL CIRCUIT RELAYS

DC RELAY



AC RELAY

TYPE FPR & FPRL

Type FPR and FPRL Relays are available with combinations of contact configurations, normally open or normally closed to eight poles maximum and ratings up to 15 amperes 300 volts AC and 10 amperes 125 volts DC or 5 amperes 250 volts DC.

Type FPR Relays are designed for switching control circuit loads where hi-cycling and long life are required. The contacts are designed for power circuits up to 15 amperes.

Type FPRL Relays are of the same basic construction as the FPR Relays, except that the contacts are designed for "Low-Energy" circuits up to 10 amperes.

Contacts are vertically mounted and operate directly from the movable armature which is free-floating via silicone rubber coupling for self-alignment and vibration control. Double break contacts are silver alloy and coils are of molded construction. Line and load wiring is straight through and accessible from the front. Standard relays can be mounted in any position on the vertical plane. Relay coils will pick up at 85% of rated voltage or less. Relays are available with up to 8 poles maximum. These can be furnished with up to 8 poles normally open, or in combination with up to 4 poles maximum normally closed. Either power or low-energy contacts are available.

In AC models **FPR** and **FPRL Model N**, the AC magnets are laminated. In DC models **FPR-DC** and **FPRL-DC Model N**, the DC magnets are plunger type for noiseless operation.

SPECIFICATIONS

CONTACT RATINGS (Per Pole)

AC Ratings (Type FPR): 15A, 20V min., 250V max. 90A locked rotor at 240V.

AC Ratings (resistive) for Low Energy Applications (Type FPRL): Max. amps — 10. Max. volts — 250. Min. V.A. — 0.01. Max. V.A. — 150.

DC Ratings (Non-Inductive) (Type FPR): 1A, 250V — 5A, 125V — 15A, 32V. **2 Poles In Series:** 5A, 250V — 10A, 125V.

DC Ratings (Resistive) for Low Energy Applications (Type FPRL): Max. amps — 10. Max. volts — 250. Min. V.A. — 0.01. Max. V.A. — 150.

CONTACT RESISTANCE

Type FPR: 0.10 ohms at 1A, 10V.

Type FPRL: 0.02 ohms at 1A, 25V.

Note: Silver cadmium oxide contact buttons not recommended for services below 10V.

TERMINAL CAPACITIES

Tvpe FPR and FPRL: #14 wire, 6-32 screw.

COILS

Class A molded coils are standard. All coils are designed to operate from 85% (80% for DC relays) or less of lower value through 110% of higher value. Temperature rises safe up to 55°C ambient.

COIL SPECIFICATIONS (Cont'd)

Description	AC COIL VOLTAGE 24V 60 Hz	110/120V 60 Hz	208/220V 60 Hz
Min. pick-up volts (or less)	20	94	175
Max. drop-out volts (or less)	15	65	135
Avg. DC resistance ±10% cold 20°C	3.4	158	670
Max. inrush VA (or less)	50	50	50
Max. sealed VA (or less)	15	15	15
Max. sealed watts (or less)	7.5	7.5	7.5
Approx. power-factor (sealed)	50%	50%	50%

Description	DC COIL VOLTAGE 6V	12V	24V	48V	115V	230V
Min. pick-up volts (or less)	4.8	9.6	19	38	92	185
Max. drop-out volts (or less)	1.2	2.4	4.8	9.6	23	46
Avg. DC resistance ±10% cold 20°C	3.8	15	66	245	1541	5837
Approx. inrush & sealed current amps	1.6	0.8	0.37	0.2	0.08	0.04
Approx. sealed watts	12	12	12	12	12	12

HOW TO ORDER

1. Specify CATALOG NUMBER of relay required from the catalog number selection table below.
2. Specify COIL CODE for the required control circuit voltage and frequency from the soil selection table below.
3. Order and price by complete catalog number.

EXAMPLE:

Relay Catalog Number	+	Coil Code	=	Complete Relay Catalog Number	
FPR-22-UN		**20**		**FPR-22-UN-20**	**For an AC Relay**
FPR-22-UNDC		**AJ**		**FPR-22-UNDC-AJ**	**For a DC Relay**

COIL SELECTION TABLE — AC RELAYS

Voltage	Frequency	Code[1]
24	50/60 Hz	10
115	50/60 Hz	22
230	50/60 Hz	41
110/120	60 Hz	20
220/240	60 Hz	40

[1] For VOLTAGE & FREQUENCY not listed specify CODE 99 and required voltage and frequency.

COIL SELECTION TABLE — DC RELAYS

Voltage	Frequency	Code[1]
6	DC	AA
12	DC	AC
24	DC	AE
48	DC	AJ
115	DC	AN
230	DC	AP

[1] For VOLTAGE not listed specify CODE YY and required voltage.

CATALOG NUMBER SELECTION TABLE

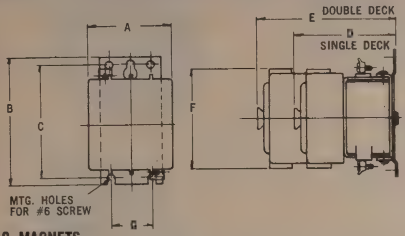
Number of Poles[1]	CONTACT CONFIGURATION		AC RELAYS				DC RELAYS			
			15 AMP RELAY		10 AMP RELAY		15 AMP RELAY		10 AMP RELAY	
	Type..A N.O.	Type B N.C.	Cat. No.	List	Cat. No.	List	Cat. No.	List	Cat. No.	List
1	1	0	FPR-10-UN	$21.00	FPRL-10-UN	$22.00	FPR-10-UNDC	$29.00	FPRL-10-UNDC	$30.00
1	0	1	FPR-01-UN	23.00	FPRL-01-UN	24.00	FPR-01-UNDC	31.00	FPRL-01-UNDC	32.00
2[1]	1	1	FPR-11-UN	24.00	FPRL-11-UN	26.00	FPR-11-UNDC	32.00	FPRL-11-UNDC	34.00
2	2	0	FPR-20-UN	23.00	FPRL-20-UN	25.00	FPR-20-UNDC	31.00	FPRL-20-UNDC	33.00
2	0	2	FPR-02-UN	24.00	FPRL-02-UN	26.00	FPR-02-UNDC	32.00	FPRL-02-UNDC	34.00
3	2	1	FPR-21-UN	28.00	FPRL-21-UN	30.00	FPR-21-UNDC	36.00	FPRL-21-UNDC	38.00
3	1	2	FPR-12-UN	28.00	FPRL-12-UN	30.00	FPR-12-UNDC	36.00	FPRL-12-UNDC	38.00
4[1]	2	2	FPR-22-UN	28.00	FPRL-22-UN	31.00	FPR-22-UNDC	36.00	FPRL-22-UNDC	39.00
3	3	0	FPR-30-UN	26.00	FPRL-30-UN	28.00	FPR-30-UNDC	34.00	FPRL-30-UNDC	36.00
3	0	3	FPR-03-UN	28.00	FPRL-03-UN	30.00	FPR-03-UNDC	36.00	FPRL-03-UNDC	38.00
4	3	1	FPR-31-UN	32.00	FPRL-31-UN	35.00	FPR-31-UNDC	40.00	FPRL-31-UNDC	43.00
4	1	3	FPR-13-UN	32.00	FPRL-13-UN	35.00	FPR-13-UNDC	40.00	FPRL-13-UNDC	43.00
6[1]	3	3	FPR-33-UN	32.00	FPRL-33-UN	37.00	FPR-33-UNDC	40.00	FPRL-33-UNDC	45.00
4	4	0	FPR-40-UN	30.00	FPRL-40-UN	33.00	FPR-40-UNDC	38.00	FPRL-40-UNDC	41.00
4	0	4	FPR-04-UN	32.00	FPRL-04-UN	35.00	FPR-04-UNDC	40.00	FPRL-04-UNDC	43.00
6	4	2	FPR-42-UN	36.00	FPRL-42-UN	41.00	FPR-42-UNDC	44.00	FPRL-42-UNDC	49.00
6	2	4	FPR-24-UN	36.00	FPRL-24-UN	41.00	FPR-24-UNDC	44.00	FPRL-24-UNDC	49.00
8[1]	4	4	FPR-44-UN	36.00	FPRL-44-UN	42.00	FPR-44-UNDC	44.00	FPRL-44-UNDC	50.00
6	6	0	FPR-60-UN	34.00	FPRL-60-UN	39.00	FPR-60-UNDC	42.00	FPRL-60-UNDC	47.00
6	5	1	FPR-51-UN	36.00	FPRL-51-UN	41.00	FPR-51-UNDC	44.00	FPRL-51-UNDC	49.00
8	8	0	FPR-80-UN	42.00	FPRL-80-UN	48.00	FPR-80-UNDC	50.00	FPRL-80-UNDC	56.00
8	7	1	FPR-71-UN	44.00	FPRL-71-UN	50.00	FPR-71-UNDC	52.00	FPRL-71-UNDC	58.00
8	6	2	FPR-62-UN	44.00	FPRL-62-UN	50.00	FPR-62-UNDC	52.00	FPRL-62-UNDC	58.00
8	5	3	FPR-53-UN	44.00	FPRL-53-UN	50.00	FPR-53-UNDC	52.00	FPRL-53-UNDC	58.00

[1] Universal type relay. May be used to replace any preceding relay in listing having fewer poles in any standard contact configuration.

ARROW-HART INC. / INDUSTRIAL CONTROL PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

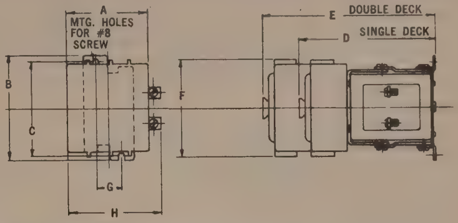
Arrow Hart RELAYS

DIMENSIONS FOR CONTROL CIRCUIT RELAYS



WITH AC MAGNETS

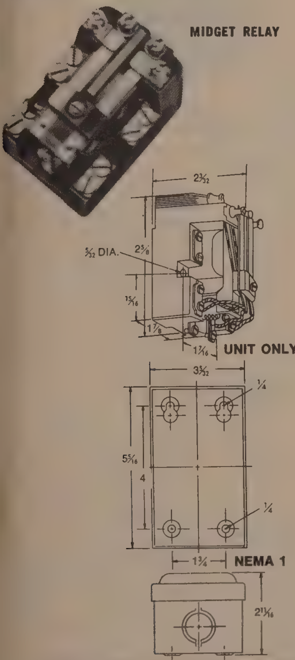
Poles	Dimensions in Inches						
	A	B	C	D	E	F	G
3	1 9/16	3 3/16	2 13/16	2 7/16	3 5/16	2 7/16	1
4	2 1/16	3 3/16	2 13/16	2 7/16	3 5/16	2 7/16	1
6	1 9/16	3 3/16	2 13/16	2 7/16	3 5/16	2 7/16	1
8	2 1/16	3 3/16	2 13/16	2 7/16	3 5/16	2 7/16	1



WITH DC MAGNETS

Poles	Dimensions in Inches							
	A	B	C	D	E	F	G	H
3	1 9/16	2 11/16	2 13/16	3 3/8	4 5/16	2 7/16	1	1 9/16
4	2 1/16	2 11/16	2 13/16	3 3/8	4 5/16	2 7/16	1	2 1/16
6	1 9/16	2 11/16	2 13/16	3 3/8	4 5/16	2 7/16	1	1 9/16
8	2 1/16	2 11/16	2 13/16	3 3/8	4 5/16	2 7/16	1	2 1/16

MIDGET RELAYS



APPROXIMATE DIMENSIONS, NOT SUITABLE FOR CONSTRUCTION

TYPE "MR" RELAYS are midget types designed specifically for 2-wire control systems. They provide efficient control of single-phase fractional horsepower motors, and other light loads including pilot lights, signalling devices, and a variety of circuit control duties.

Available as open and closed types, they are principally used to control 2-wire circuits. The enclosed type, housed in a compact metal enclosure, is designed for installation where space is limited. Mounting and contact screws are in full view, and readily accessible. Type "MR" relays are available with either one or two poles, single or double throw construction, for both AC and DC use. Three- and four-pole types are available for AC use only, and offer a variety of normal contact positions to meet specific requirements. Double throw contacts not suitable for opposite polarity. On three- and four-pole relays, contacts located one above the other must not be used on opposite polarity.

ARROW-HART magnetic relays are built for mounting in limited space, and offer low wattage consumption and high power factor.

The clapper type magnet is equipped with a continuous duty shading coil that reduces magnetic hum.

Removable silver-to-silver contact tips are easy to install, and inexpensively maintained. Small moving tips abut against large, flat-faced stationary tips, insuring proper contact. Make and break contact is instantaneous.

Control relays are available in open types for surface or panelboard mounting, and enclosed types with metal housing, General Purpose NEMA 1 Enclosures.

HORSEPOWER AND AMPERE RATINGS

HP Single Phase	Volts	Amps Per Pole	Two In Series
½	110 AC	10	10
½	220 AC	10	10
—	115 DC	0.5	2.5
—	230 DC	0.3	0.5

Double throw contacts not suitable for opposite polarity. On 3- and 4-pole relays, contacts located one above the other must not be used on opposite polarity.

CATALOG NUMBER SELECTION TABLE

No. of Poles	CONTACT CONFIGURATION	OPEN TYPE Unit Only		NEMA 1 General Purpose Enclosure	
		Cat. No.	List	Cat. No.	List
1	OPEN	MR-10-U	$10.90	MR-10-G	$15.90
	CLOSED	MR-01-U	10.90	MR-01-G	15.90
	OPEN & CLOSED	MR-1T-U	16.80	MR-1T-G	21.80
2	OPEN	MR-20-U	16.60	MR-20-G	21.60
	CLOSED	MR-02-U	19.60	MR-02-G	24.60
	OPEN & CLOSED	MR-2T-U	23.00	MR-2T-G	28.40
	1 OPEN — 1 CLOSED	MR-11-U	16.60	MR-11-G	21.60
3	OPEN	MR-30-U	23.60	MR-30-G	29.20
	CLOSED	MR-03-U	23.60	MR-03-G	29.20
	2 OPEN — 1 CLOSED	MR-21-U	23.60	MR-21-G	29.20
	1 OPEN — 2 CLOSED	MR-12-U	23.60	MR-12-G	29.20
4	OPEN	MR-40-U	28.20	MR-40-G	33.80
	CLOSED	MR-04-U	28.20	MR-04-G	33.80
	3 OPEN — 1 CLOSED	MR-31-U	28.20	MR-31-G	33.80
	2 OPEN — 2 CLOSED	MR-22-U	28.20	MR-22-G	33.80
	1 OPEN — 3 CLOSED	MR-13-U	28.20	MR-13-G	33.80

HOW TO ORDER

1. Specify CATALOG NUMBER of relay required from the catalog number selection table below.
2. Specify COIL CODE for the required control circuit voltage and frequency from the coil selection table below.
3. Order and price by complete catalog number.

EXAMPLE:

Relay Catalog Number	+	Coil Code	=	Complete Relay Catalog Number
MR-20-U		20		MR-20-U-20

AC COIL SELECTION TABLE

Voltage	Frequency	Code[1]
6	50/60 Hz	01
12	50/60 Hz	02
24	50/60 Hz	10
48	50/60 Hz	11
110	50/60 Hz	20
220	50/60 Hz	40

[1] For VOLTAGE & FREQUENCY not listed specify CODE 99 and required voltage and frequency.

[2] For VOLTAGE not listed specify CODE YY and required voltage.

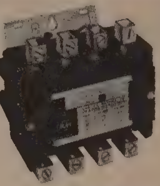
DC COIL SELECTION TABLE

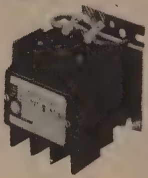
Voltage	Frequency	Code[2]
6	DC	AA
12	DC	AC
24	DC	AE
28	DC	AF
36	DC	AH
50	DC	AJ
75	DC	AL
115	DC	AN
230	DC	AP

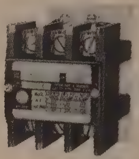
ARROW-HART INC. / INDUSTRIAL CONTROL PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

ARROW HART CONTACTORS DEFINITE PURPOSE CONTROLS

Designed for the control of compressors and resistive heating elements the ARROW-HART type ACC line of contactors offers the user flexibility, improved performance and dependability with reduced maintenance in a host of applications. Now available in 25, 30, 40, 50, 60, 75, 90, and 120 ampere sizes this comprehensive line will meet a very wide range of the industry's exacting needs. All of the ARROW-HART type ACC contactors are available in general purpose type enclosures, and with factory additions to meet a variety of application requirements. In addition, ARROW-HART makes available to the user the broadest line of field modification kits in the industry.







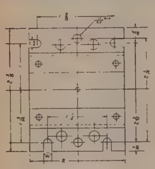
FEATURES

1. Complete line, from 25 through 120 Amps with 4 specific frame sizes, assures the user of maximum economy within design limits of quality.
2. Ratings and performance characteristics equal or better than requirements established by any compressor or air conditioning manufacturer.
3. 6:5:4 lock rotor ratings with standard inductive and full load ampere ratings equal or higher than any major competitor.
4. Complete interchangeability with all previous ARROW-HART designs and all major competitors.
5. Straight thru wiring — saves installation time and labor.
6. Compact design saves valuable panel space.
7. Contacts accessible from the front for rapid inspection and replacement.
8. Complete line of optional accessories to provide maximum flexibility.
9. Positive contact alignment and vertical position to prevent accumulation of breakdown material.

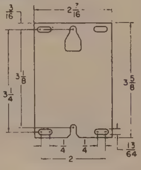
CONSTRUCTION TYPE ACC

ARROW-HART Type ACC Contactors are available in 4 basic frame sizes with ratings from 25 through 120 Amps. Construction features include silver cadmium oxide contacts, firmly anchored and generous terminals, wide range dual hertz coils, no-kiss operation. These features assure dependable performance even under the most adverse operating conditions. In addition, the range of ampere sizes combined with a complete line of field and factory modifications offers great selection flexibility to the designer and assurance of availability to the user.

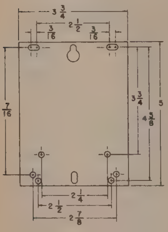
MOUNTING PLATE DIMENSIONS



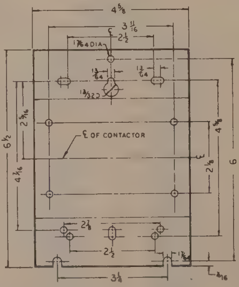
25 Ampere


3/16
2 7/16
3 1/8
3 1/4
3 5/8
1/4
1/4
13/64
2

30 & 40 Ampere


3 3/4
3/16
2 1/2
3/16
4 7/16
3 3/4
5
4 3/8
2 1/4
2 1/2
2 7/8

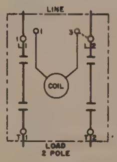
50, 60 & 75 Ampere

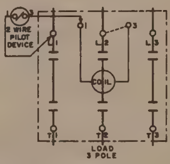

4 5/8
3 11/16
2 1/2
℄ OF CONTACTOR
6 1/2
6
2 1/2
3 1/2

90 & 120 Ampere

Approximate Dimensions,
not Suitable for Construction

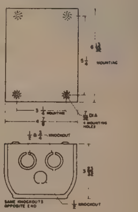
TYPICAL WIRING DIAGRAMS


LINE
1
3
L1
L2
COIL
T1
T2
LOAD
2 POLE

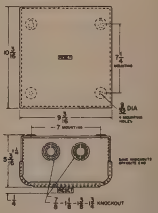

2 WIRE PILOT DEVICE
1
3
L1
L2
L3
COIL
T1
T2
T3
LOAD
3 POLE

ENCLOSURE DIMENSIONS

25, 30 & 40 Ampere


MOUNTING
DIA
KNOCKOUT
SAME KNOCKOUTS OPPOSITE END

50, 60 & 75 Ampere

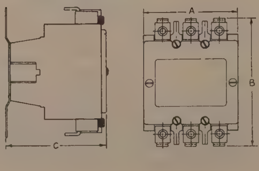

10 3/16
7 1/4
MOUNTING
DIA
9 3/4
7
5 7/16
SAME KNOCKOUTS OPPOSITE END
KNOCKOUT

90 & 120 Ampere Enclosures: Consult Factory

DON'T MISS THESE OTHER A-H PRODUCTS IN EEM

WIRING DEVICES (CONNECTORS) p. 2•621
INDUSTRIAL TIMERS p. 1•233
SWITCHES p. 1•1934

UNIT DIMENSIONS



Amps	Dimensions in Inches (approx.)			
	A (2 & 3 Pole)	A (4 Pole)	B	C
25	2	—	2¹⁵⁄₁₆	2⅝
30 & 40	2½	3¼	3⅝	3
50, 60 & 75	3¾	4⅞	5⁹⁄₃₂	4¹⁄₁₆
90 & 120	4⅝	—	6¹¹⁄₃₂	5

Arrow Hart

CONTACTORS/DEFINITE PURPOSE CONTROLS

HOW TO ORDER

1. Specify TYPE NUMBER from the Type Number Selection Table.
2. Specify COIL NUMBER from the Coil Selection Table.

TYPE NUMBER SELECTION TABLE

MAXIMUM RATINGS					DESCRIPTION		ORDER NO. CONTACTOR UNIT LESS ENCLOSURE[1]
INDUCTIVE (BREAK ALL LINES)				RESISTIVE PER POLE	Wire Size Min.-Max.	Number of Poles	Type Number
Full Load Amps	Locked Rotor Amps						
600 VAC	240 VAC	480 VAC	600 VAC	600 VAC			
20	120	100	80	25	16-8	1[2] 2 3	ACC-110-UM ACC-120-UM ACC-130-UM
25	150	125	100	30	16-8	1[2] 2 3	ACC-210-UM ACC-220-UM ACC-230-UM
30	180	150	120	40	16-8	2 3 4	ACC-320-UM ACC-330-UM ACC-340-UM
40	240	200	160	50	14-4	2 3 4	ACC-420-UM ACC-430-UM ACC-440-UM
50	300	250	200	62	14-3	2 3	ACC-520-UM ACC-530-UM
60	360	300	240	75	8-2	2 3	ACC-620-UM ACC-630-UM
75	450	375	300	93	8-1/0	2 3	ACC-720-UM ACC-730-UM
90	540	450	360	112	14-1/0	2 3	ACC-920-UM ACC-930-UM
120	720	600	480	150	2-4/0	2 3	ACC-1220-UM ACC-1230-UM

COIL SELECTION TABLE

CONTACTOR FRAME SIZE 20, 25, 30, 40		CONTACTOR FRAME SIZE 50, 60, 75		CONTACTOR FRAME SIZE 90, 120		COIL CODE Order No. Suffix
Volts	Hz	Volts	Hz	Volts	Hz	
24	50/60	24	50/60	24	50/60	10
110-120	50/60	110-120 110	60 50	110-120	50/60	20
200-230	50/60	200-230 200-208	60 50	200-230	50/60	31
240	50/60	240	50/60	240	50/60	40
277	50/60	277	50/60	—	—	50
440-480	50/60	440-480	60	440-480	50/60	60
550-600	50/60	550-600	60	550-600	50/60	70

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[1] U.L. Guide #NLDX2/File #E9788.

[2] Maximum ratings also apply for 1 pole break, single phase.

COIL DATA, DUAL FREQUENCY COILS, 50/60 Hz TYPE ACC

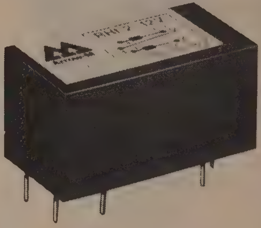
Coil Voltage	Hz	20 & 25 AMPERE				30 & 40 AMPERE				50. 60 & 75 AMPERE				90 & 120 AMPERE			
		Inrush		Sealed		Inrush		Sealed		Inrush		Sealed		Inrush		Sealed	
		V.A.	Watts	V.A.	Watts	V.A.	Watts	V.A.	Watts	V.A.	Watts	V.A.	Watts	V.A.	Watts	V.A.	Watts
24	50	44	33	7.0	2.4	115	58	19	4.5	318	120	54	10.9	470	170	38	10.5
	60	41	27	5.5	1.9	100	44	11	2.9	255	80	27	7.2	400	130	30	8.5
110-120	50	52	37	8.1	2.8	140	66	25	5.7	—	—	—	—	600	160	58	12.8
	60	46	32	6.4	2.2	125	48	14	3.5	330	100	45	10.2	510	115	43	10.2
200-230	50	52	37	8.1	2.8	140	66	25	5.7	—	—	—	—	600	160	58	12.8
	60	46	32	6.4	2.2	125	48	14	3.5	330	100	45	10.2	510	115	43	10.2
200-208	50	—	—	—	—	—	—	—	—	330	100	50	10.2	—	—	—	—
240	50	52	37	8.1	2.8	140	66	25	5.7	340	98	58	11	—	—	—	—
	60	46	32	6.4	2.2	125	48	14	3.5	255	65	31	7.5	—	—	—	—
277	50	45	33	6.5	2.5	125	59	20	4.5	340	98	58	11	—	—	—	—
	60	40	28	5.2	2.0	110	44	14	2.9	255	65	31	7.5	—	—	—	—
440-480	50	52	37	8.1	2.8	140	66	25	5.7	—	—	—	—	600	160	58	12.8
	60	46	32	6.4	2.2	125	48	14	3.5	330	100	45	10.2	510	115	43	10.2
550-600	50	52	37	8.1	2.8	140	66	25	5.7	—	—	—	—	600	160	58	12.8
	60	46	32	6.4	2.2	125	48	14	3.5	330	100	45	10.2	510	115	43	10.2

R SERIES
1 AMP/20 WATTS DC

Arrow-M
R E L A Y
Arrow-M

UNIQUE HIGH SPEED SPDT REED RELAY

Low operate power, high speed (up to 500Hz operation), latching and non-latching versions, bifurcated contact and extremely long life (>10^9 mechanical operations) are but a few of the features of this unique relay. Permanent magnet bias provides high contact pressure. Available in both power type (1A 20W DC) or dry circuit type (current as low as 100μA). Simultaneous molding techniques firmly anchor all terminals and parts of this relay into a rigid block. This means no parts can loosen even after long use. High contact pressure—min. of 5g gives vibration/shock resistance of 10/100G. Breakdown voltage is a min. of 500VDC. Ambient temperature range is −55 to +65°C. All models are available with or without magnetic shielding.



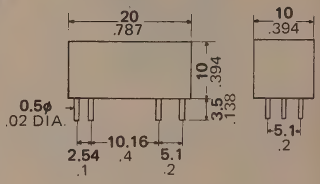
COIL DATA

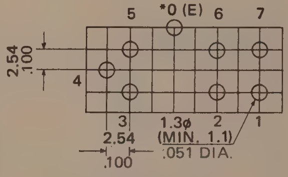
Nominal coil voltage DC (V)	Pull-in voltage DC (V) (25°C)	Drop-out voltage DC (V) (25°C)	Coil resistance (±10%Ω) (25°C)	Nominal operating power (mW)
SINGLE SIDE STABLE (RHD, RSD, RH, RS)				
3	2.0	0.3	37	243
5	3.5	0.5	170	147
6	4.3	0.6	220	164
12	8.4	1.2	890	162
24	16	2.4	2,000	288
28	19	2.8	4,500	174
35	24	3.5	6,000	204
42	28	4.2	8,000	221
60	40	6.0	12,000	300
1COIL BISTABLE (LATCHING) (RHLD, RSLD, RHL, RSL)				
1.5	1.0	—	24	94
3	2.0	—	90	100
5	3.5	—	340	74
6	4.3	—	450	80
12	7.5	—	1,500	96
24	16	—	6,000	96
35	19	—	8,000	153
42	23	—	12,000	147
2 COIL BISTABLE (LATCHING) (RHL2D, RSL2D, RHL2, RSL2)				
1.5	1.0	—	each coil 12	188
3	2.0	—	45	200
5	3.5	—	170	147
6	4.3	—	225	160
12	7.5	—	650	230
24	17.0	—	2,700	213
35	19.0	—	3,700	331
42	23.0	—	5,500	321

DIMENSIONS

(View from the copper foil)

each coil





(View from the copper foil)

Nomenclature

ex. R S L 2 D 12 V

R: reed relay

Sealing method
H: plastic hermetically sealed — S: magnetically shielded

Operating function
Nil: single side stable — L: bistable (latching)

Number of coil
Nil: 1 coil — 2: 2 coil (for bistable type)

Contact capacity
Nil: power type (20 W) — D: dry circuit type (1.2 W)

Coil voltage
Single side stable: 3, 5, 6, 12, 24, 28, 35, 42, 60VDC — Bistable (Latching): 1.5, 3, 5, 6, 12, 24, 35, 42VDC

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Telephone: 201-232-4260 Cable: AROM-NJ Telex: 138-213

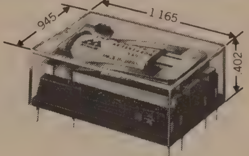
Arrow-M

Arrow-M
RELAY
Arrow-M

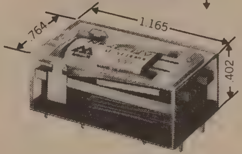
NF SERIES
2 AMP/60 WATTS

NEW FLATPACK WITH HIGH SENSITIVITY AND RELIABILITY

- Low profile—Stands 10.2mm (.402 inches) off P/C Board
  Ideal for High density packaging
- Available in 2 and 4 Form C contact arrangements
- Long Life—2PDT/3 x 10^8, 4PDT/10^8 mechanical operations
- High sensitivity and reliability insured by uniquely designed magnet and armature assembly
- UL component recognition File No. E43149
- VDE approval VDE—Reg.—Nr. 4811.2010
- Available in hermetically-sealed version (NFE) back-filled with dry nitrogen

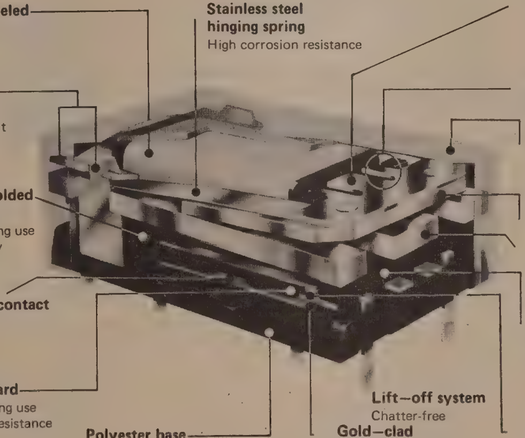


NF4 (4PDT)



NF2 (DPDT)

Patented or pending in 10 countries



Polyurethane enameled copper wire coil
High heat resistance

Stainless steel holding spring
Screwless design won't loosen after long use

Simultaneously molded spring block
No looseness after long use
High thermal stability

Independent twin contact
High reliability

Plastic actuating card
No looseness after long use
High heat and wear resistance
Good insulation

Polyester base
High heat and insulation resistance
Large mechanical strength

Stainless steel hinging spring
High corrosion resistance

Lift—off system
Chatter-free

Gold—clad moving contact
Low contact resistance
High corrosion resistance

Shock absorber
Shock absorbing when the armature touches the yoke
Negligible chattering

Rebound absorbing clearance
Negligible chattering

Clear polycarbonate dust cover
High heat and shock resistance

Armature

Yoke
Flat type magnetic structure,
Large attractive force,
Higher magnetic efficiency

Simultaneously molded stationary contact block
High stability after long use
Good insulation

Gold—clad stationary contact
Stabilized contact resistance for long life

DPDT

Type	Coil Voltage (V)			*Coil resistance at 25°C (Ω)	Nominal operating power at 25°C (mW)	Inductance (H)	
	Pull-in at 25°C (initial)	Drop-out at 25°C (initial)	Max. allowable at 40°C			Armature Close	Armature Open
NF2E- 6V	4.8	0.6	10.5	137	260	0.094	0.093
NF2E-12V	9.6	1.2	21	500	290	0.344	0.338
NF2E-24V	19.2	2.4	42	2,000	290	1.31	1.29
NF2E-48V	38.4	4.8	84	7,000	330	4.18	4.12
NF2E-60V	48.0	6.0	105	9,700	370	5.38	5.29

4PDT

NF4E- 6V	4.8	0.6	8.5	90	400	0.071	0.070
NF4E-12V	9.6	1.2	17.0	330	440	0.23	0.22
NF4E-24V	19.2	2.4	34	1,200	480	0.79	0.77
NF4E-48V	38.4	4.8	68	4,200	550	2.25	2.22
NF4E-60V	48.0	6.0	85	7,000	510	4.18	4.12

LIFE

LOAD	NF	NFE
Mechanical	1 x 10^8	1 x 10^8
2A, 30VDC	1 x 10^6	2 x 10^5
1A, 30VDC	5 x 10^6	1 x 10^6

ARROW-M CORP. 250 Sheffield St., Mountainside, N.J. 07092
Telephone: 201-232-4260 Cable: AROM-NJ Telex: 138-213

Arrow-M

K SERIES

2 AMP/250 VOLT

Arrow-M
RELAY
Arrow-M

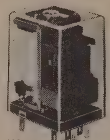
HIGH-RELIABILITY HIGH-PERFORMANCE SERIES K-RELAY

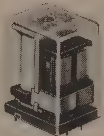
These high sensitive K relays are applicable to many applications, and have a versatile range. There are AC types, 4 amp types for larger loads, plastic sealed types for use in the adverse ambient conditions and MBB (Make Before Break) Contact types in addition to the standard 2 amp relays for DC applications. Typical uses are as follows.

General electronic equipment, Measuring devices, Alarm equipment, Remote control devices, Office machines, Communication equipment, Computers, Sequence control circuits for general industrial machinery, etc.

- **High-Reliability and Composition**

The Series-K relay consists of a patented lift-off type contact spring assembly and a unique magnetic unit with superior attraction characteristics. To make reliability high, production easy, and adjustment unnecessary, this relay is built up by applying a precision-parts simultaneous-molding method and a heat riveting system and also by using standardized parts and a screwless mechanism.

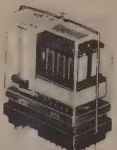

K2


K2P

K4

K4P

inch


K6

K6

FEATURES

- **Patented Magnetic System**
- **Screwless Design**
- **Chatter Free Lift Off System**
- **High Stability Against Vibration**
- **Stabilized Contact Pressure**
- **Simultaneously Molded Spring Block**
- **Polyurethane Enameled Copper Magnet Wire**
- **Glass Fibre Reinforced 66 Nylon Card And Coil Bobbin**
- **Unique Independent Twin Contact Design For High Reliability**

- **Interchangeable with existing cradle relays**
- **100 times more reliable with simplified design**
- **Extra long life—Mechanical: more than 10^8, Electrical (1A 30W): more than 10^7 operations**
- **Patented high-sensitive magnetic system—Patented or pending in 6 countries**
- **Versatile range for all applications—Plug-in/Solder & P/C terminal, Single & Bifurcated contact, 2, 4 & 6C, 2, 3 & 5 amp., DC & AC, Plastic sealed type**
- **UL recognition File No. E43149, CSA approval File No. LR26550**

■ CHARACTERISTICS (at 20°C, 50% R.H; sea level)

Max. operating frequency	50Hz
Operate time (*)	Approx. 15m sec.
Release time (*)	Approx. 5m sec.
Bounce time (at nominal voltage)	
Single contact	Approx. 3m sec.
Bifurcated contacts	Approx. 1m sec.
Breakdown voltage	
Between open contacts, contact sets	750Vrms
Between live parts and ground	750Vrms
Between contacts and coils	750Vrms
Initial insulation resistance	1,000MΩ at 500VDC
Ambient temperature (**)	
K2, K4 series except K2E, K4E series	−40 to +80°C
K6 series	−40 to +60°C
K2E, K4E plastic sealed series	−10 to +60°C
Ambient pressure	
K2E, K4E plastic sealed series	760mmHg ± 20% (1013mb ± 20%)
Shock/Vibration resistance	10G/10G to 55Hz

■ CONTACT RATINGS

Arrangements	2, 4, 6C
Rating (resistive)	(Bifurcated) 2A220V (50W 120VA) (5 Amp.) 5A250V (100W 500VA)
UL, CSA rating	1A 125V AC 2A 28V DC
Life (min. operations) *Mechanical *Electrical (at rated load)	10^8 10^7 (1A 30W)
Pull-in/Drop-out time (approx. ms)	10～15/5
Material	(Bifurcated) Ag/Au-clad (5A Single) Ag

■ NOMENCLATURE

Ex. K 2 Y T – 24 V– 1

Type of relay: K relay

Contact arrangement: 2, 4, 6 Form C

Classification of types:
Nil = Standard bifurcated contacts, DC relays
Y = Single contacts, DC relays/A = AC relays, K2A, K2YA
F = 4 Amp. contacts, K2F/E = Plastic sealed, K2E, K4E

Terminal: Nil = Plug-in, Solder terminals/T = Printed circuit terminals

Coil voltage

Sensitivity of coil: 1 = Ordinary sensitive coils/2 = On special request
9 = Interchangeable coils with comparable types

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Arrow-M
RELAY
Arrow-M

K SERIES
2 AMP/250 VOLT

STANDARD DC K RELAYS

UL, CSA, VDE recognized

■ DPDT

*Less than 1,000Ω: ±10% More than 1,000Ω: ±15%

Bifurcated contacts		Single contacts		Coil voltage (V)				*Coil resistance (Ω) (at nom.)	Coil power (mW) Closed	Inductance (H)	
Plug-in and Solder	For P/C board	Plug-in and Solder	For P/C board	Nominal (DC)	Pull-in (max.) (at 20°C)	Drop-out (min.) (at 20°C)	Max. allowable (at 40°C)			Armature	
										Open	
K2- 3V-1	K2T- 3V-1	K2Y- 3V-1	K2YT- 3V-1	3	1.8	0.27	6.7	28	320	0.52	0.26
K2- 3V-9	K2T- 3V-9	K2Y- 3V-9	K2YT- 3V-9	3	2.25	0.225	4.0	10	900	0.2	0.1
K2- 6V-1	K2T- 6V-1	K2Y- 6V-1	K2YT- 6V-1	6	3.9	0.58	12.0	110	330	2.1	1.1
K2- 6V-9	K2T- 6V-9	K2Y- 6V-9	K2YT- 6V-9	6	4.5	0.45	9.0	52	690	0.8	0.4
K2- 12V-1	K2T- 12V-1	K2Y- 12V-1	K2YT- 12V-1	12	8.0	1.2	30.0	530	270	11	5.6
K2- 12V-9	K2T- 12V-9	K2Y- 12V-9	K2YT- 12V-9	12	9.0	0.9	17.0	185	780	2.9	1.5
K2- 24V-1	K2T- 24V-1	K2Y- 24V-1	K2YT- 24V-1	24	16.5	2.5	47.0	1,700	340	35	18
K2- 24V-9	K2T- 24V-9	K2Y- 24V-9	K2YT- 24V-9	24	18.0	1.8	33.0	700	820	12	6
K2- 36V-1	K2T- 36V-1	K2Y- 36V-1	K2YT- 36V-1	36	25.0	3.7	71.0	3,200	410	54	28
K2- 48V-1	K2T- 48V-1	K2Y- 48V-1	K2YT- 48V-1	48	39.0	5.9	100.0	7,600	300	120	62
K2- 48V-9	K2T- 48V-9	K2Y- 48V-9	K2YT- 48V-9	48	36.0	3.6	63.0	2,500	920	39	20
K2-110V-1	K2T-110V-1	K2Y-110V-1	K2YT-110V-1	110	60.0	9.0	180.0	16,000	760	270	138
K2-115V-9	K2T-115V-9	K2Y-115V-9	K2YT-115V-9	115	86.0	8.6	154.0	15,000	880	246	126

■ 4PDT

K4- 3V-1	K4T- 3V-1	K4Y- 3V-1	K4YT- 3V-1	3	2.3	0.35	5.0	18	500	0.36	0.18
K4- 3V-9	K4T- 3V-9	K4Y- 3V-9	K4YT- 3V-9	3	2.25	0.225	4.0	10	900	0.2	0.1
K4- 6V-1	K4T- 6V-1	K4Y- 6V-1	K4YT- 6V-1	6	4.2	0.63	9.0	58	620	1.0	0.5
K4- 6V-9	K4T- 6V-9	K4Y- 6V-9	K4YT- 6V-9	6	4.5	0.45	9.0	52	690	0.8	0.4
K4- 12V-1	K4T- 12V-1	K4Y- 12V-1	K4YT- 12V-1	12	8.7	1.3	18.5	250	580	5.2	2.6
K4- 12V-2	K4T- 12V-2	K4Y- 12V-2	K4YT- 12V-2	12	6.6	1.0	14.5	150	960	2.9	1.5
K4- 12V-9	K4T- 12V-9	K4Y- 12V-9	K4YT- 12V-9	12	9.0	0.9	17.0	185	780	2.9	1.5
K4- 24V-1	K4T- 24V-1	K4Y- 24V-1	K4YT- 24V-1	24	18.0	2.7	35.0	890	650	15	7.5
K4- 24V-9	K4T- 24V-9	K4Y- 24V-9	K4YT- 24V-9	24	18.0	1.8	33.0	700	820	12	6
K4- 36V-1	K4T- 36V-1	K4Y- 36V-1	K4YT- 36V-1	36	25.0	3.7	52.0	1,700	760	35	18
K4- 48V-1	K4T- 48V-1	K4Y- 48V-1	K4YT- 48V-1	48	36.0	5.4	64.0	3,200	720	54	28
K4- 48V-9	K4T- 48V-9	K4Y- 48V-9	K4YT- 48V-9	48	36.0	3.6	63.0	2,500	920	39	20
K4-110V-1	K4T-110V-1	K4Y-110V-1	K4YT-110V-1	110	85.0	12.8	160.0	16,000	760	270	138
K4-115V-9	K4T-115V-9	K4Y-115V-9	K4YT-115V-9	115	86.0	8.6	154.0	15,000	880	246	126

■ 6PDT

K6- 6V-9	K6T- 6V-9	K6Y- 6V-9	K6YT- 6V-9	6	4.5	0.45	6.6	25	1,440	0.47	0.24
K6- 12V-9	K6T- 12V-9	K6Y- 12V-9	K6YT- 12V-9	12	9.0	0.9	13.2	90	1,600	1.5	0.8
K6- 24V-9	K6T- 24V-9	K6Y- 24V-9	K6YT- 24V-9	24	18.0	1.8	26.4	430	1,340	8.8	4.5
K6- 48V-9	K6T- 48V-9	K6Y- 48V-9	K6YT- 48V-9	48	36.0	3.6	52.8	1,500	1,540	28	14.5
K6-115V-9	K6T-115V-9	K6Y-115V-9	K6YT-115V-9	115	86.0	8.6	126.5	9,000	1,340	129	66

POWER TYPE K RELAYS

■ DPDT 5 AMP

Single contacts		*Coil resistance (Ω) (at 20°C)	Coil power (mW) (at nom.)
Plug-in and Solder	Nominal (DC)		
K2F- 6V-9	6	52	690
K2F- 12V-9	12	185	780
K2F- 24V-9	24	700	820
K2F- 36V-9	36	1,500	860
K2F- 48V-9	48	2,500	920
K2F-115V-9	115	15,000	880

- DPDT available in AC voltages—Models K2A, K2AT, K2YA, K2YAT
- DPDT-4PDT available in plastic hermetically sealed—Models K2E, K4E
- Sockets Available
  Solder Term: K2SS, K4SS, K6SS
  Printed Circuit: K2PS, K4PS, K6PS

ARROW-M CORP. 250 Sheffield St., Mountainside, N.J. 07092
Telephone: 201-232-4260 Cable: AROM-NJ Telex: 138-213

Arrow-M

HC SERIES
10 AMP/250 VOLT

Arrow-M
R E L A Y
Arrow-M

LARGE CAPACITY SMALL SIZE

Small in size but large in capacity—1.2 cubic inches. Available with bifurcated contacts in the four pole version for use at low levels (HC4-D). Hermetically sealed version meets leak rate of mil std. 883 at 85°C (add suffix E to type number). Sockets for soldering, for p/c board and screw terminal type are available, all supplied with hold down clips. Printed circuit option identified by P suffix.

HC1

HC2

HC3

HC4

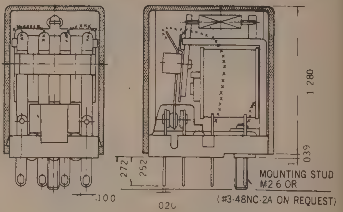
HC4-P

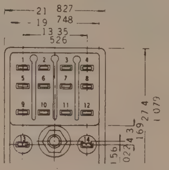
HC4-TM

FEATURES

- Glass fiber reinforced 66 nylon coil bobbin.
- Stainless steel release spring.
- Clear polycarbonate dust cover.
- Contact springs molded into one block.
- Beryllium copper contact springs.
- Gold flashed AgCdO contacts with special surface treatment.
- Arc barrier type available in 3PDT, 4PDT.
- Terminals and base molded into one block.
- Debris well between contacts.

- **Extra long life—more than 10^8 mechanical operations**
- **4 types of contact arrangement—4PDT (for 5A 250VAC), 3PDT (for 7A 250VAC), DPDT (for 7A 250VAC), SPDT (for 10A 250VAC)**
- **Applicable to loads from low to high level**
- **UL component recognition File No. E43028, CSA approval File No. LR26550, VDE Reg.-Nr. 4811.209 (2011)**



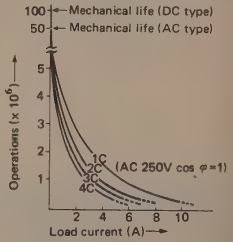


CHARACTERISTICS

Breakdown voltage	
Between open contacts	700 Vrms
Between live parts and ground	1,500 Vrms
Insulation resistance (at 500V DC)	1,000 MΩ
Pull-in/Drop-out time (approx.)	DC: 13/10 msec. AC: 13/16 msec.
Temperature range	−50∼+50°C−58∼+122°F
Shock/Vibration resistance	10/5 G at 55Hz
Weight (approx.)	34g 1.2oz

Life curve (AC 250V Resistive load)

Life curve (AC 250V Resistive load)



NOMENCLATURE

Ex. HC 2 – P – 220VAC

Type of relay: HC relay

Number of changeover contacts: 1, 2, 3, 4C

Terminal arrangements:
Nil = Plug-in
P = For P/C board
TM = Slotted flange enclosure for direct-chassis mounting, HC-TM (Top-side Mounting)

Coil voltage:
AC 6, 12, 24, 48, 115, 220, 240V/DC 6, 12, 24, 48, 110V

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RELAY
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HC SERIES
10 AMP/250 VOLT

■ COIL DATA

DC coils at 20°C 68°F

HC1 (SPDT) HC2 (DPDT) HC3 (3PDT) HC4 (4PDT)	Coil voltage at 20°C			Coil resistance (Ω±10%)	Nominal coil current (mA)	Operating power (W)		Temperature rise (at nominal voltage)
	Pull-in	Drop-out	Max. allowable			Nominal	Minimum	
6 VDC	80% of Nominal voltage	10% of Nominal voltage	110% of Nominal voltage	40	150	approx. 0.90	approx. 0.58	approx. 33°C
12 VDC				160	75			
24 VDC				650	37			
48 VDC				2600	18.5			
110 VDC				11000	10			

AC coils (50/60 Hz) at 60 Hz

HC1 (SPDT) HC2 (DPDT) HC3 (3PDT) HC4 (4PDT)	Coil voltage at 20°C			Nominal coil current (mA)	Operating power (VA)		Temperature rise (at nominal voltage)
	Pull-in	Drop-out	Max. allowable		Nominal	Minimum	
6 VAC	80% of Nominal voltage	30% of Nominal voltage	110% of Nominal voltage	200	approx. 1.20	approx. 0.77	approx. 35°C
12 VAC				100			
24 VAC				50			
48 VAC				25			
115 VAC				10.5			
220 VAC				6			
240 VAC				6			

■ CONTACT RATING AND EXPECTED LIFE

	125V AC		250V AC		Life (min. Operations)
	Resistive (Cos ζ= 1)	Inductive (Cos ζ=0.4)	Resistive (Cosζ=1)	Inductive (Cosζ=0.4)	
SPDT HC1	10 A	5 A	10 A	3 A	2 x 10^5
	7 A	3 A	7 A	2.5A	5 x 10^5
	5 A	2 A	5 A	1.5A	1 x 10^6
	3 A	1 A	3 A	0.8A	2 x 10^6
DPDT HC2	7 A	3.5A	7 A	2 A	2 x 10^5
	5 A	2.5A	5 A	1.5A	5 x 10^5
	3 A	1.5A	3 A	1 A	1 x 10^6
	1.5A	0.8A	1.5A	0.5A	2 x 10^6
3PDT HC3	7 A	3.5A	7 A	2 A	2 x 10^5
	5 A	2.5A	5 A	1.5A	5 x 10^5
	3 A	1.5A	3 A	1 A	1 x 10^6
	1.5A	0.8A	1.5A	0.5A	2 x 10^6
4PDT HC4	5 A	2.5A	5 A	1.5A	2 x 10^5
	3 A	1.5A	3 A	1 A	5 x 10^5
	2 A	1 A	2 A	0.6A	1 x 10^6
	1 A	0.5A	1 A	0.3A	2 x 10^6

UL, CSA rating

HC1 (SPDT)	10A, 1/4 HP	125, 250VAC, 3A 30VDC
HC2 (DPDT)	7A, 1/6 HP	125, 250VAC, 3A 30VDC
HC4 (4PDT)	5A, 1/10 HP	125, 250VAC, 3A 30VDC

Material.........Gold flashed silver-cadmium oxide

VDE rating
10 (3) A 250VAC, 3A 30VDC
7 (2) A 250VAC, 3A 30VDC
5 (3) A 65VAC, 3A 30VDC

Expected life (at 20 operations/one min.)
Electrical
(HC1/7A, HC2/5A, HC3/5A, HC4/3A): more than 500,000
Mechanical
DC type: more than 100,000,000
AC type: more than 50,000,000

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RELAY
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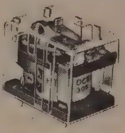
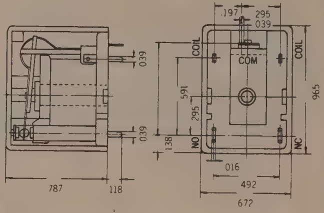
HT SERIES
2 AMP/12.5 VAC

ECONOMICAL SUBMINIATURE RELAY WITH HIGH RELIABILITY

Economical subminiature relay with high reliability. UL/CSA rating (resistive load) 2A/125VAC, 2A/30VDC, VDE rating 2A/65VAC, 2A/30VDC. Contact material gold flashed silver. Breakdown voltage min. 750 Vrms across contacts. Operate power 800 mW nominal. Maximum pull-in voltage 75% of nom. Min. drop-out voltage 10% of nom.



- Low and stable contact resistance.
- Small size.
- UL File No. E43149.
- CSA File No. LR26550.
- VDE-Reg.-Nr. 4811.2010
- When ordering UL, CSA and VDE types, please add the suffix to the type.



COIL DATA

Model	DC Coil		
	Nom. Volts	Nom. Current (MA)	Resistance
HTC- 3VDC	3	274	11
HTC- 6VDC	6	134	45
HTC- 9VDC	9	90	100
HTC-12VDC	12	67	180
HTC-24VDC	24	33.5	720

CONTACT RATINGS

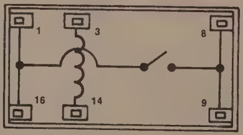
I	E	Min. Life
2A	125VAC	2×10^5
2A	30VDC	2×10^5
Mechanical		2×10^7

DL SERIES
1 AMP/24 VOLTS DC

NO BOUNCE, NON-POSITION SENSITIVE

Extreme long life and reliability characterize this bounce-free relay. The breakdown voltage between open contacts is 500VDC. Pull-in/drop-out time 2/2 ms max. Shock resistance >50G for 11 ms. Vibration resistance >30G at 10 to 300 Hz, >5G at 300 to 600 Hz, >30G at 600 to 6000 Hz. Fits in standard DIP socket.

- No bounce, no chatter: Mercury film contacts
- Non-position sensitive mounting
- Switching range: 1 A 24 VDC; 0.2 A, 110 VAC; 10 μA, 100 mVDC
- Extremely long life
- Welded internal construction
- Constant contact resistance over life
- DIP terminal arrangement
- Magnetically shielded
- Hermetically sealed



BOTTOM VIEW

COIL DATA

Type No.	Coil Voltage (V)				Coil resistance at 20°C (ohms)
	Nominal Coil Voltage	Maximum pull-in at 20°C	Minimum dropout at 20°C	Maximum allowable	
DL-1A-5V	5VDC	3.5VDC	0.5VDC	6.5VDC	65
DL-1A-6V	6	4.8	0.6	8.0	90
DL-1A-12V	12	9.6	1.2	15.0	350
DL-1A-24V	24	19.2	2.4	30.0	1,300

CONTACT RATINGS (Resistive)

DC	AC	LIFE
1A, 24V	.2A, 110V	10^7
.5A, 24V	.1A, 110V	5×10^7
.02A, 5V	—	10^8
10μA, 100MV	—	10^8
Mechanical		10^9

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Arrow-M

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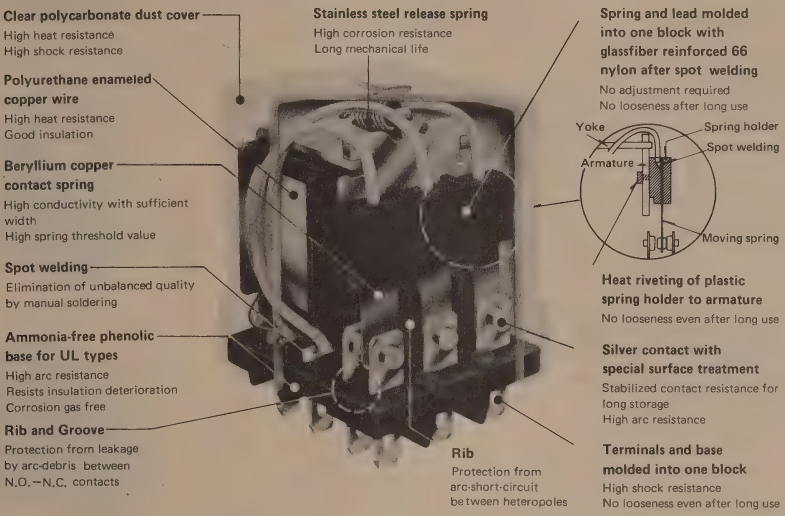
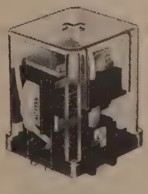
HP SERIES
10 AMP/250 VOLT

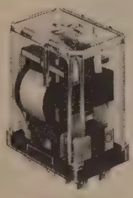
HIGHLY RELIABLE, 10 AMP POWER RELAYS

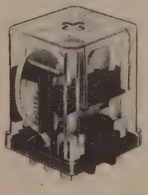
- Simplified construction through permanent bonding of contact springs and terminals in plastic.
- Versatile mounting through choice of plug-in, solder, or Q.C. terminals.
- High quality is insured through mass production employing simultaneous molding, heat riveting and spot welding.
- Wide variety of sockets are available.

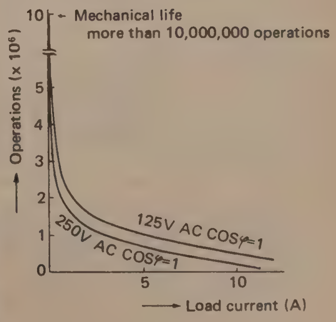
- DIMENSIONS
  HP1, 2, 3: 1.49" L x 1.42" W x 1.89" H
  HP4: 1.97" x 1.42" W x 1.73" H

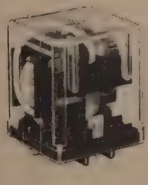

Clear polycarbonate dust cover
High heat resistance
High shock resistance
Polyurethane enameled copper wire
High heat resistance
Good insulation
Beryllium copper contact spring
High conductivity with sufficient width
High spring threshold value
Spot welding
Elimination of unbalanced quality by manual soldering
Ammonia-free phenolic base for UL types
High arc resistance
Resists insulation deterioration
Corrosion gas free
Rib and Groove
Protection from leakage by arc-debris between N.O.–N.C. contacts
Stainless steel release spring
High corrosion resistance
Long mechanical life
Spring and lead molded into one block with glassfiber reinforced 66 nylon after spot welding
No adjustment required
No looseness after long use
Yoke
Spring holder
Spot welding
Armature
Moving spring
Heat riveting of plastic spring holder to armature
No looseness even after long use
Silver contact with special surface treatment
Stabilized contact resistance for long storage
High arc resistance
Terminals and base molded into one block
High shock resistance
No looseness even after long use
Rib
Protection from arc-short-circuit between heteropoles

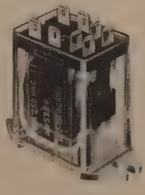

HP31(SPDT)

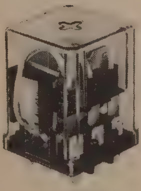

HP2(DPDT)

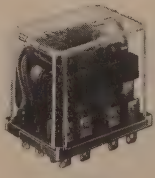

HP32(DPDT)




HP31-M(SPDT)


HP2-TM(DPDT)


HP33(3PDT)


HP4(4PDT)

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Arrow-M

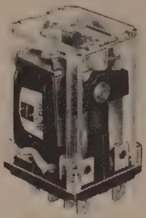
HG SERIES

20 AMP/250 VOLT

Arrow-M
R E L A Y
Arrow-M

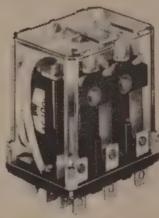
SUPER COMPACT, LARGE CAPACITY RELAYS

This incredible super compact relay series has a mechanical life of 1x10^7 for the AC type and 1x10^6 for the DC type. It can be operated at 20 operations per minute at maximum rating and has >10G shock resistance (except contact moving direction). Screw terminal sockets for front wiring, solder terminal sockets and brackets for direct mounting are available. Hold down clips are supplied with each socket.

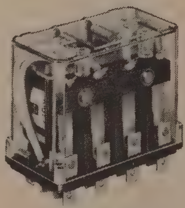

H G 2 (DPDP)

FEATURES

- Clear polycarbonate dust cover
- Polyurethane enameled copper wire
- Ribbed groove—Protection from leakage by arc-debris between N.O.-N.C. contacts
- Phenolic resin for UL (CSA) types Polyester resin base for ordinary types
- Stainless steel release spring
- Silicon steel layer core
- Silver-cadmium-oxide contact
- Terminals and base molded into one block
- Arc-barrier
- Simultaneously molded spring block


H G 3 (3PDT)

- **Large capacity up to 20A 250VAC resistive 1.5KW 3 phase 220VAC motor**
- **Available with plug-in, soldering and Q.C. terminals**
- **Contact form 2C, 3C, 4C**
- **UL component recognition File No. E43028**
- **CSA approval File No. LR26550**


H G 4 (4PDT)

COIL DATA

AC coil			DC coil			
Type	Nominal coil current (mA 60Hz)	Operating power (VA)	Type	Nominal coil current (mA)	Operating power (W)	Coil resistance (±10%Ω)
DPDT						
HG2- 6VAC	600	(approx.) 3.6	HG2- 6VDC	230	(approx.) 1.4	26.4
HG2- 12VAC	300		HG2- 12VDC	119.6		100
HG2- 24VAC	150		HG2- 24VDC	57.6		416
HG2- 48VAC	75		HG2- 48VDC	30.3		1585
HG2-115VAC	31.3		HG2-110VDC	14.4		7650
HG2-220VAC	16.4					
HG2-240VAC	15					
3PDT						
HG3- 6VAC	864	(approx.) 5.2	HG3- 6VDC	264	(approx.) 1.6	22.7
HG3- 12VAC	432		HG3- 12VDC	134		89.5
HG3- 24VAC	216		HG3- 24VDC	66		364
HG3- 48VAC	108		HG3- 48VDC	33.1		1450
HG3-115VAC	45.2		HG3-110VDC	16.5		6670
HG3-220VAC	23.6					
4PDT						
HG4- 6VAC	1264	(approx.) 7.6	HG4- 6VDC	325	(approx.) 2.1	18.5
HG4- 12VAC	632		HG4- 12VDC	168		71.4
HG4- 24VDC	316		HG4- 24VDC	81.2		296
HG4- 48VAC	158		HG4- 48VDC	45.7		1050
HG4-115VAC	66.1		HG4-110VDC	20.3		5420
HG4-220VAC	34					
HG4-240VAC	31.6					

CONTACT RATINGS

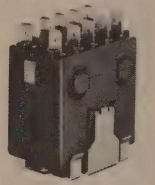
Voltage	Current	Life
Resistive		
125VAC	20A	5 x 10^5
	15A	7.5 x 10^5
250VAC	20A	2 x 10^5
	15A	5 x 10^5
	10A	7.5 x 10^5
Inductive cos ϕ = 0.4		
125VAC	15A	2 x 10^5
	10A	5 x 10^5
250VAC	10A	2 x 10^5
	7.5A	5 x 10^5
Motor 1ϕ		
125VAC	.75KW	2 x 10^5
250VAC	.4KW	5 x 10^5
Motor 3ϕ		
250VAC	1.5KW	2 x 10^5
	.75KW	5 x 10^5

Arrow-M
RELAY
Arrow-M

VC SERIES
20 AMP/250 VOLT

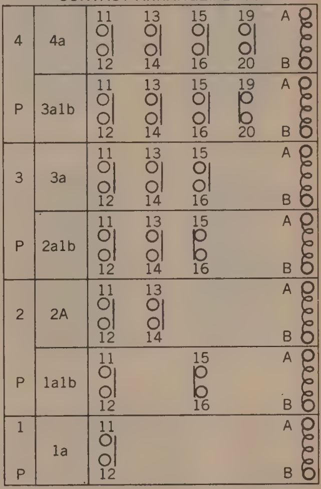
HEAVY DUTY, LONG LIFE, TROUBLE FREE

Lever action mechanism provides heavy duty switching for motor loads. Expected life at max. rating is 300,000 operations. Dielectric strength is 2500VAC for one minute. Easy mounting is provided through a snap-in bracket. Relay may be installed in any position. Screw type terminals and Q.C. terminals are available. Note, max. current for normally closed auxiliary contact is 3A.



			VC15 TYPE		VC20 TYPE		
			VC15F-(3P)-(4P)	VC15S-(4P)	VC20F-(1P)-(2P)-(3P)		Remarks
Switching capacity	Motor	1 phase, 120V	0.4KW(8A)	1/3HP	0.75KW(16A)	1HP	
		1 phase, 240V	0.75KW(8A)	1HP	1.5KW(16A)	2HP	
		3 phase, 240V	1.5KW(16A)	2HP	3.7KW(16A)	5HP	For (3P), (4P) only
		3 phase, 380V	1.5KW(4A)		3.7KW(8A)		For (3P), (4P) only
	Resistive (AC)	1 phase, 120V	15A	15A	20A	20A	
		1 phase, 240V	15A	15A	20A	20A	
		3 phase, 240V	15A	15A	20A	20A	For (3P), (4P) only
	Lamp	1 phase, 120V	6A	6A	12A	12A	
	Breaking capacity ("a" contact)	3 phase, 240V (p.f.=0.4)	80A		160A		IEC AC3
		3 phase, 380V (p.f.=0.4)	40A		80A		
	Making capacity ("a" contact)	3 phase, 240V (p.f.=0.4)	80A		160A		IEC AC3
		3 phase, 380V (p.f.=0.4)	40A		80A		

CONTACT ARRANGEMENTS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4a
11 12 13 14 15 16 19 20 A B
P
3a1b
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3
3a
11 12 13 14 15 16 A B
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2a1b
11 12 13 14 15 16 A B
2
2A
11 12 13 14 A B
P
1a1b
11 12 15 16 A B
1
1a
P
11 12 A B

Example: VC 15 F 3alb AC 220V

■ NOMENCLATURE

15 : 15A Frame/20 : 20A Frame

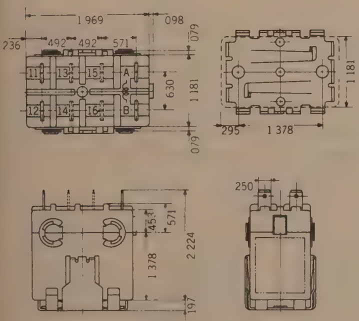
F : Q.C. terminal type/S : Screw terminal type

Contact arrangement : 4a, 3a1b, 3a, 2a1b, 2a, 1a1b, 1a

Coil voltage : AC24, 48, 100, 110, 115, 120, 200, 220, 230, 240V

VC20F-(1P-2P-3P)
VC15F-(3P)

mm : inch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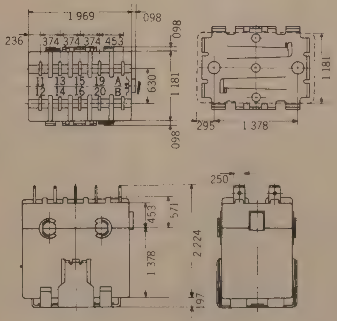
VC15F-(4P)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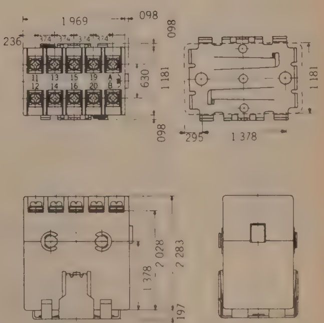
VC15S-(4P)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1 378
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Arrow-M

CLARE
a GENERAL INSTRUMENT company

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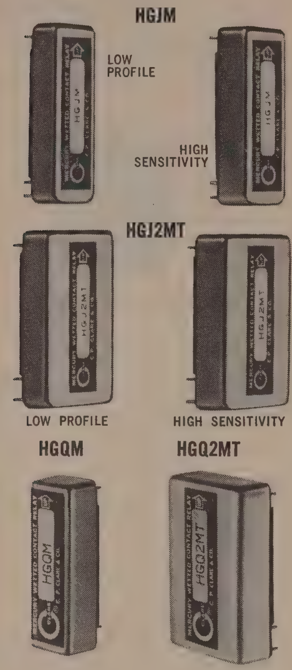
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

MERCURY-WETTED CONTACT RELAYS


HGJM
LOW PROFILE
HIGH SENSITIVITY
HGJ2MT
LOW PROFILE
HIGH SENSITIVITY
HGQM
HGQ2MT
MERCURY WETTED CONTACT RELAY
HGJM
HGJ2MT
HGQM
HGQ2MT
C. P. CLARE & CO.

HGJM

Clare HGJM relays have established new industry standards for quiet, fast and stable operation. HGJM Series SPDT relays have the 100VA load and multi-billion operation reliability characteristic of our HGSM and are recommended for all new applications.

Response times approach 1ms speeds, noise levels are less than 5µV at 5ms after coil energization (10kHz bandwidth) and the relays are ultra-stable to 250Hz. The 1 Form C contact will switch µV, nanoampere loads to 2A or 500V loads (100VA max, ac or dc). The relays are offered in 0.400″ height high sensitivity models and 0.350″ height low profile versions. Both mount on staggered 0.100″ PCB grid patterns. The low profile models permit 0.5″ board centers.

HGJ2MT

Clare HGJ2MT relays feature the same outstanding electrical characteristics as the HGJM relays in a DPDT (2 Form C) package. High sensitivity HGJ2MT relays have common open time durations to 50µs at 100Hz for capacitor transfer technique applications. Electrostatic shielding is standard on all models.

HGQM

Clare HGQM relays for PCB mounting have the fastest response times in the industry for mercury-wetted relays. The contact form is a SPDT transfer-contact configuration. Typical response times range from 0.8 to 1.0ms and noise levels are under 5µV within 1.5ms after coil energization (1000Hz bandwidth). HGQM relays are ultra-stable at switching speeds to 500Hz (bistable) and 400Hz (single-side-stable). Switching capabilities range from signal levels to 1A or 500V loads (50VA max).

The HGQM package is only 0.580″ high and mounts on convenient staggered 0.100″ grid patterns. An ideal companion for HGJM relays in many applications requiring low level sensor-based analog signal switching or process control for data logging/acquisition.

HGQ2MT

The HGQ2MT relays feature the same electrical characteristics as the HGQM relay with transfer contact switching but in a DPDT package. This ultra-high speed two pole relay is ideal for low level switching applications.

Contact noise is less than 10µV within 2ms after coil energization — three times faster than the industry standard. Thermal emf levels are 15µV maximum.

SPECIFICATIONS — HGJM & HGJ2MT

CONTACT RATING (Resistive Load): Power — 100VA, max. Voltage — 500V, dc or ac, max. Current — 2A switched, max., 5A carry only, max.

CONTACT RESISTANCE (ON impedance): 15 to 25 milliohms, ±2.0 millioms

LIFE EXPECTANCY: Greater than 10 x 10⁹ operations at rated load

OPERATE TIME: 1.25ms response time — Switching up to 250Hz (4.0ms period)

BREAKDOWN VOLTAGE: 1,000V rms 60Hz min. between all mutually insulated terminals, except between windings of double wound coils, 200Vdc

INSULATION RESISTANCE (OFF impedance): HGJM Series, Standard Value 100 megohms. Available, 100,000 megohms — HGJ2MT Series, Standard Value, 10,000 megohms. Available 100,000 megohms (Measured across open contacts at 25°C, 40% relative humidity)

ENVIRONMENTAL: Vibration — 10 to 500Hz 0.06″ d.a. or 5g's. Shock — 30g, 11 ±1ms, ½ sinewave (no mechanical damage, non-operating test). Temperature — −38.8°C to +105°C (operating)

SPECIFICATIONS — HGQM & HGQ2MT

CONTACT RATING (Resistive Load): Power — 50VA, max. Voltage — 250V, dc or ac, max. Current — 1A switched, max. 5A carry only, max.

CONTACT RESISTANCE (ON impedance): Initial — 15 to 25 milliohms, ±2.0 milliohms

LIFE EXPECTANCY: Greater than 2 x 10⁹ operations at rated load

OPERATE TIME: 1000µs. Switching up to 500Hz (2.0ms period) bistable and to 400Hz single-side-stable

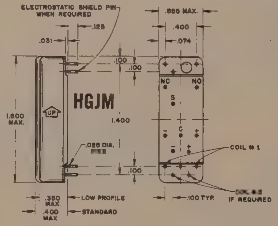
BREAKDOWN VOLTAGE: 1,000V rms 60Hz min. between all mutually insulated terminals, except between windings of double wound coils, 200Vdc

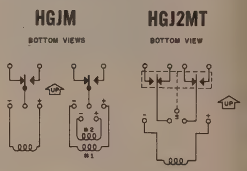
INSULATION RESISTANCE (OFF impedance): HGQM Series — Standard Value, 100 megohms. Available 100,000 megohms — HGQ2MT Series, Standard Value, 10,000 megohms. Available 100,000 megohms (Measured across open contacts at 25°C, 40% relative humidity)

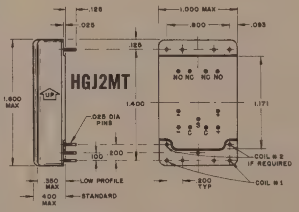
ENVIRONMENTAL: Vibration — 10 to 500Hz 0.06″ d.a. or 5g's. Shock — 30g, 11 ±1ms, ½ sinewave (non-operating). Temperature — −38.8°C to +105°C (operating)

Part No.	List Price	Nom. Coil Voltage (Vdc)	Coil Res. ±10% at 25°C (Ohms)	Operate Voltage (Vdc)	Release Voltage (Vdc)	Max. Voltage (Vdc)	Typical Relay Ind. (mH)
SPDT LOW PROFILE SINGLE-SIDE-STABLE							
HGJM 51131 J00	$15.15	5.0	68	2.7	.58	11	7.4
HGJM 51131 N00	15.15	12	375	6.5	1.4	26	45
HGJM 51131 R00	15.15	24	1425	13	2.7	50	155
SPDT HIGH SENSITIVITY SINGLE-SIDE-STABLE							
HGJM 51111 K00	$14.45	5.0	125	2.9	.61	15	34
HGJM 51111 P00	14.45	12	685	7.1	1.5	35	161
HGJM 51111 T00	14.45	24	2650	14	3.0	68	630
DPDT LOW PROFILE SINGLE-SIDE-STABLE							
HGJ2MT 51231 E00	$28.20	5.0	27	2.6	.54	9.7	2.1
HGJ2MT 51231 K00	28.20	12	230	6.7	1.4	28	24
HGJ2MT 51231 N00	28.20	24	750	12	2.4	53	90
DPDT HIGH SENSITIVITY SINGLE-SIDE-STABLE							
HGJ2MT 54211 G00	$17.10	5.0	55	2.6	.55	14	11
HGJ2MT 54211 L00	17.10	12	370	6.7	1.4	36	75
HGJ2MT 54211 P00	17.10	24	1370	13	2.7	69	277
SPDT SINGLE-SIDE-STABLE							
HGQM 91111 J00	$16.45	5	86	2.5	0.5	11.6	32
HGQM 91111 N00	16.45	12	620	6	1.25	31.3	260
HGQM 91111 R00	16.45	24	2430	12	2.5	61.9	980
DPDT SINGLE-SIDE-STABLE							
HGQ2MT 91211 F00	$29.50	5	48	2.75	0.5	12	19
HGQ2MT 91211 K00	29.50	12	280	7	1.25	30	105
HGQ2MT 91211 N00	29.50	24	1240	14	2.5	62	475

Part No.	List Price	Nom. Coil Voltage (Vdc)	Coil Res. ±10% (Ohms)	Set Volt., Either Wind. (Vdc)	Reset Volt., Either Wind. (Vdc)	Max. Volt., One Wind. Only (Vdc)	Typ. Relay Ind. (mH)
SPDT HIGH SENSITIVITY BISTABLE (DOUBLE WOUND COIL)							
HGJM 52112 N00	$14.45	5.0	205/205	15	15	19	26
SPDT BISTABLE (DOUBLE WOUND COIL)							
HGQM 92112 M00	$16.45	5	190/190	12	12	17	40


ELECTROSTATIC SHIELD PIN WHEN REQUIRED
.585 MAX.
.400
.125
.074
.031
.100
.100
NO
NO
S
C
HGJM
UP
1.600 MAX.
1.400
.025 DIA. PINS
.100
COIL #1
COIL #2 IF REQUIRED
.100 TYP.
.350 MAX.
.400 MAX
LOW PROFILE
STANDARD


HGJM
BOTTOM VIEWS
HGJ2MT
BOTTOM VIEW
UP
#2
#1
S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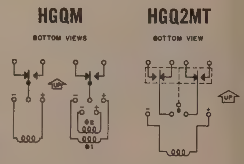
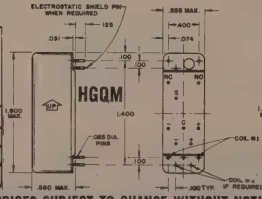
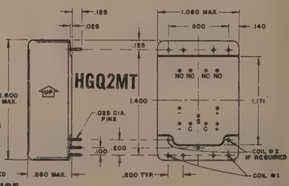
.025
1.000 MAX
.800
.093
.125
NO NC
NC NO
HGJ2MT
UP
1.600 MAX
1.400
1.171
.025 DIA PINS
.100
.200
COIL #2 IF REQUIRED
COIL #1
.350 MAX
.400 MAX
LOW PROFILE
STANDARD
.200 TYP


HGQM
BOTTOM VIEWS
HGQ2MT
BOTTOM VIEW
UP
#2
#1


ELECTROSTATIC SHIELD PIN WHEN REQUIRED
.585 MAX.
.400
.125
.074
.031
.100
.100
NO
NO
S
C
HGQM
UP
1.600 MAX
1.400
.025 DIA. PINS
COIL #1
.100
COIL #2 IF REQUIRED
.100 TYP
.580 MAX.


.125
.025
1.080 MAX.
.800
.140
.125
NO NC
NC NO
HGQ2MT
UP
1.600 MAX.
1.400
1.171
.025 DIA. PINS
.100
.200
COIL #2 IF REQUIRED
COIL #1
.580 MAX.
.200 TYP

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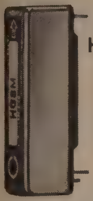
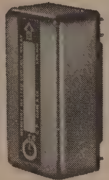
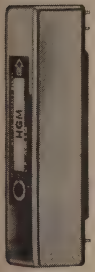
MERCURY-WETTED CONTACT RELAYS


HGSM


HGS2MT


HGM

HG2M

HGSM

Clare HGSM relays are PCB mount models with 2A or 500V (100VA max.) switching capabilities. The HGSM series SPDT relay is recommended for replacement applications only. New applications should specify the faster HGJM series with the same load switching capabilities, life expectancy and lower noise. The HGSM package is ⅝″ high and mounts on staggered 0.100″ grid patterns.

HGS2MT

Clare HGS2MT relays have the same ratings and life expectancy as the HGSM series in a DPDT model. The HGS2MT relay is also recommended for replacement purposes only. HGJ2MT relays are recommended for all new applications requiring 100VA (per pole) switching capabilities in DPDT configurations.

HGM

HGM relays are Clare standard HG switch capsules in module form, are provided with plated steel covers for excellent mechanical protection and magnetic shielding. The standard HG switch in the HGM is not polarity sensitive. Contacts are SPDT make-before-break rated at 5 amps, 500 Volts, 250VA maximum. Life expectancy is 22 x 10⁹ at specified ratings.

HG2M

HG2M has the same characteristics as the HGM but contains 2 capsules to give you double-pole, double-throw configuration make-before-break. This results in saving space and cost over single element units. Contacts are rated at 5 amps 500 Volts, 100VA maximum with life expectancy of 22 x 10⁹.

SPECIFICATIONS — HGSM, HGS2MT, HGM, HG2M

CONTACT RATING (resistive load):

Power Voltage	250VA max., HGM, HG2M 100VA max., HGSM, HGS2MT
Current	5A max; HGM, HG2M 2A max; HGSM, HGS2MT

CONTACT RESISTANCE (ON impedance):
30 milliohms typical

LIFE EXPECTANCY:
22 x 10⁹ operations

OPERATE TIME:
3ms typical

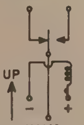
BREAKDOWN VOLTAGE:
1000Vac, rms, 60Hz between all mutually insulated terminals

ENVIRONMENTAL:

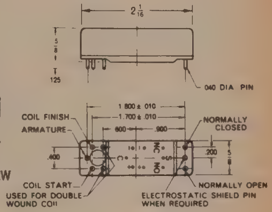
Vibration:	10-500Hz, 0.06″ d.a. or 10g's
Shock:	30g's, 11 ±1ms, ½ sinewave
Temperature:	−38° to +105°C (operating)

DIMENSIONS

HGSM

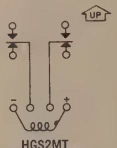


HGSM BOTTOM VIEW

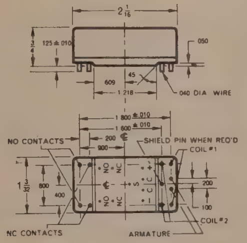

2 1/16
5/8
125
040 DIA PIN
1 800 ± 010
1.700 ± .010
600
900
COIL FINISH
ARMATURE
NORMALLY CLOSED
.400
200
5/8
NC
NO
COIL START
USED FOR DOUBLE WOUND COIL
NORMALLY OPEN
ELECTROSTATIC SHIELD PIN WHEN REQUIRED

Stock Form D Part No.	Stock Form C Part No.	Rec. Nom. Coil Vdc	Coil Res. (Ohms)	Must Operate Vdc	Max. Vdc	List Price
SPDT SINGLE-SIDE-STABLE						
HGSM 1008	HGSM 5008	5	115	3.8	15.1	$13.35
HGSM 1009	HGSM 5035	12	275	5.2	23.4	13.35
HGSM 1010	HGSM 5009	12	450	6.4	30.0	13.35
HGSM 1011	HGSM 5010	12	675	8.6	36.7	13.35
HGSM 1002	HGSM 5011	15	940	10.5	43.3	13.35
HGSM 1001	HGSM 5001	24	1425	13	53.4	13.35
HGSM 1003	HGSM 5064	24	2400	20.6	69.2	13.35
SPDT BISTABLE (DOUBLE WOUND COIL)						
HGSM 12112 N00	HGSM 52112 N00	—	325/ 325	±2.5 (Either Winding)	26.0 (One Winding Only)	$13.35
HGSM 1016	HGSM 5003	—	1100/ 1100	±8.77/ ±6.9	46.9	13.35

HGS2MT

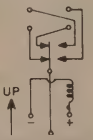


HGS2MT BOTTOM VIEW

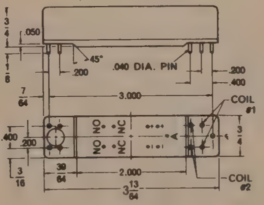

2 1/16
3/4
125 ± 010
050
609
45
1 218
040 DIA WIRE
1 800 ± .010
1 600 ± 010
200
900
NO CONTACTS
SHIELD PIN WHEN REQ'D
COIL #1
1 3/32
800
400
NO
NC
C
S
200
100
COIL #2
NC CONTACTS
ARMATURE

New Part Number	Old Part Number (Reference Only)	Nom. Volts (dc)	Coil Resistance	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	List Price
HGS2MT51111F00	HGS2MT5001	6	130	3.0	0.5	$25.10
HGS2MT51111J00	HGS2MT5008	12	520	5.3	1.1	25.10
HGS2MT51111M00	HGS2MT5009	24	2200	11.0	2.2	25.10

HGM

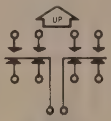


HGM BOTTOM VIEW

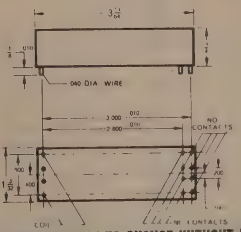

3/4
.050
45°
.200
.040 DIA. PIN
1/8
7/64
3.000
.200
.400
COIL #1
NO
NC
.400
.200
3/4
3/16
39/64
2.000
3 13/64
COIL #2

Part No.	Rec. Nom. Coil Volt. (dc)	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	List Price
HGM 1005	12	40	5.24	12.6	$15.55
HGM 1008	—	150	8.75	24	15.55
HGM 1002	24	450	16.3	42	15.55
HGM 1001	24	750	15.4	55	15.55
HGM 1012	—	1100	26.2	66	15.55

HG2M



HG2M SINGLE WOUND COIL BOTTOM VIEW


3 13/64
1/8
010
040 DIA WIRE
3 000 010
2 800 010
NO CONTACTS
900
400
1 3/32
200
COIL
NC CONTACTS

Part No.	Rec. Nom. Coil Voltage (dc)	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	List Price
HG2M 1007	12	90	8.2	19	$21.15
HG2M 1008	24	350	16.2	37	21.15
HG2M 1020	—	580	20.7	48	21.15
HG2M 1026	—	1250	31.8	70	21.15

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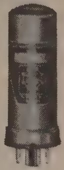
MERCURY-WETTED CONTACT RELAYS

HG

HG2A
HG3A

HG4A

HGS


HGP

HG, HG2A, HG3A, HG4A

HG relays have SPDT make-before-break form D contacts rated at 5 amps, 500 volts, 250VA max. Operating time can be as short as 2 milliseconds. The Series HG2 relay utilizes two switch capsules to furnish DPDT operating time can be as short as 2¼ milliseconds. Series HG3 relay utilizes three capsules providing 3 PDT, operating time can be as short as 2½ milliseconds. Series HG4 relay utilizes four capsules providing 4 PDT, operating time can be as short as 3¾ milliseconds. Life expectancy is 22 x 10^9 at specified ratings. Resistance, ±10% tolerance at 25 degrees C. Typical applications include computers, data logging and low-level dry circuits.

HGS

HGS Mercury-wetted relay offer increased speed and reliability along with high sensitivity. HGS 1000 Series provide SPDT make-before-break and HGS 5000 Series provides SPDT break-before-make. Both are rated at 2 amps, 500 Volts, 100VA max. Operate time as fast as 1 millisecond. Standard design available only in single element assemblies, they come in the following, single-side-stable, bi-stable and chopper. Life expectancy is 22 x 10^9 at specified ratings.

HGP

HGP is similar to the HG series except for the inclusion of permanent magnets making a slight increase in height. Magnets provide increased sensitivity. Contacts are SPDT make-before-break rated at 5 amps, 500 Volts, 250VA maximum with operate time as short as 2 milliseconds. Life expectancy is 22 x 10^9 at specified rating.

SPECIFICATIONS — HG, HGS, HGP

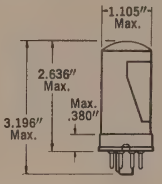
CONTACT RATING (Resistive Load): Power — HG, HG2A, HG3A, HG4A, HGP, 250VA; HGS, 100VA. Voltage — HG, HG2A, HG3A, HG4A, HGP & HGS, 500V. Current — HG, HG2A, HG3A, HG4A, HGP, 5A; HGS, 2A. CONTACT RESISTANCE (On Impedance): 40 milliohms typical. LIFE EXPECANCY: 22 x 10^9 Operations. OPERATE TIME: See description. BREAKDOWN VOLTAGE: 1000Vac, rms, 60Hz between mutually insulated terminals. ENVIRONMENTAL: Vibration: 10-500 Hz, 0.06" d.a. or 10g's. Shock: 30g's, 11 ±1ms. Temperature: −38.8° to +100°C.

Stock Part No.	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	Base Figure	List Price
HG					
HG 1019	40	2.9	11	4	$20.00
HG 1012	130	5.4	20	4	20.00
HG 1026	500	11	39	1	20.00
HG 1004	700	15	45	1	20.00
HG 1051	700	15	45	1	20.00
HG 1043	1000	17	55	1	20.00
HG 1001	2500	28	87	1	20.00
HG 1002	4000	33	110	1	12.25
HG 1017	4000	33	110	4	20.00
HG 1009	7000	45	145	1	20.00
HG 1011	11,000	61	180	1	20.00
HG 1024	25,000	94	275	1	20.00
HG 1003†	700/3300	25/47	46/99	2	20.00
HG2A 1008	50	6	14	2A2	32.45
HG2A 1042	140	10	24	2A1	32.45
HG2A 1003	315	15	36	2A2	32.45
HG2A 1017	500	19	45	2A2	32.45
HG2A 1009	700	24	53	2A1	32.45
HG2A 1002	700	24	53	2A2	32.45
HG2A 1015	1250	30	71	2A2	32.45
HG2A 1068	2500	46	100	2A1	32.45
HG2A 1001	5000	62	142	2A1	32.45
HG2A 1004	5000	62	142	2A2	32.45
HG2A 1013	10,000	94	200	2A2	32.45
HG3A 1004	315	15	36	2A1	42.10
HG3A 1006	500	19	45	2A2	42.10
HG3A 1002	700	24	53	3A1	42.10
HG3A 1008	1250	30	71	3A1	42.10
HG3A 1005	2500	46	100	3A1	42.10
HG3A 1003	5000	62	142	3A1	42.10
HG3A 1010	10,000	94	200	3A1	42.10
HG4A 1013	65	7.2	16	4A1	54.10
HG4A 1011	390	18	40	4A1	54.10
HG4A 1001	700	27	53	4A1	54.10
HG4A 1007	1400	35	75	4A1	54.10
HG4A 1003	4000	69	126	4A1	54.10
HG4A 1006	10,000	94	200	4A1	54.10

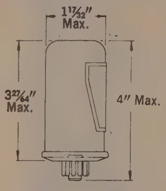
HGS

Stock Part No.	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	Base Figure	List Price
HGS 1015‡	90	.63	13	S1	$16.55
HGS 1045‡	350	1.4	26	S1	16.55
HGS 1018‡	500	1.6	31	S1	16.55
HGS 1009‡	600	1.9	34	S1	16.55
HGS 1046‡	700	2.2	37	S1	16.55
HGS 1014‡	1000	2.4	44	S1	16.55
HGS 1019	1100/1100	±2.2	47	S3	16.55
HGS1010‡	1900	3.3	61	S4	16.55
HGS 1006‡	2500	3.9	70	S1	16.55
HGS 1005‡	4000	5.5	90	S1	16.55
HGS 1048‡	4000	5.5	90	S4	16.55
HGS 1016‡	7000	6.7	118	S1	16.55
HGS 1017‡	11,000	8.7	148	S1	16.55
HGS 1113*	1000	1.4	45	S1	16.55
HGS 1114*	2500	2.3	70	S1	16.55
HGS 1026*	4000	2.1	90	S1	16.55
HGS 1056*	7000	3.7	118	S1	16.55
HGS 1096*	25,000	3.0	223	S1	16.55
HGS 1004§	600	6.3 Vac	—	S1	16.55
HGS 5009	40	.43	8.9	S1	16.55
HGS 5011‡	350	1.4	26	S1	16.55
HGS 5031‡	600	1.9	34	S4	16.55
HGS 5015‡	1000	2.4	44	S1	16.55
HGS 5003‡	2500	3.9	70	S1	16.55
HGS 5008‡	4000	5.5	90	S5▲	16.55
HGS5014‡	7000	6.7	118	S4	16.55
HGS 5047‡	11,000	8.7	148	S1	16.55
HGS 5016‡	25,000	14.3	224	S1	16.55
HGS 5006*	1000	1.4	45	S1	16.55
HGS 5004*	4000	2.1	90	S1	16.55
HGS 5017§	600	6.3 Vac	—	S1	16.55

† Double Wound. ‡ Single-Side-Stable. * Bi-Stable. § Chopper.
▲ S5 same as S1 except pin 6 connected to case.



HG



HG2A, HG3A

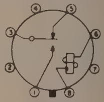


FIG. S4

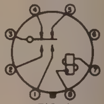
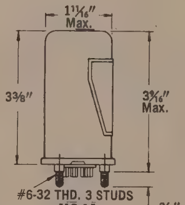
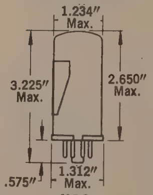


FIG. 1



HG4A



HGS

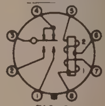


FIG. 2

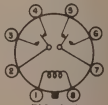
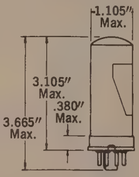
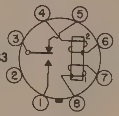


FIG. 2A1



HGP

FIG. S3



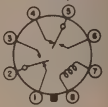
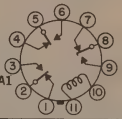


FIG. 2A2

FIG. 3A1



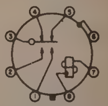


FIG. 4

Stock Part No.	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	Base Figure	List Price
HGP					
HGP 1001‡	90	1.6	16	1	$21.75
HGP 1005‡	1000	6.2	55	1	21.75
HGP-1002‡	4000	13	110	1	21.75
HGP 1008‡	4000	21	110	1	21.75
HGP 1055‡	7000	17	145	1	21.75
HGP 1052‡	11,000	23	180	1	21.75
HGP 1050‡	25,000	36	275	1	21.75
HGP 1006†‡	700/3300	11/21	46/99	1	21.75
HGP 1047*	600	±2.2	43	1	21.75
HGP 1003*	4000	±6.6	110	1	21.75
HGP 1012†	700/3300	4.6/3.7	46/99	3	21.75
HGP 1031†*	7500/7500	±14/14	150/150	3	21.75
HGP 1028§	500	6.3Vac	—	4	21.75
HGP 1009§	4000	18.5Vac	—	4	21.75

† Double Wound. ‡ Single-Side-Stable. * Bi-Stable.
†‡ Single-Side-Stable Double Wound. § Chopper.
†* Double Wound Bi-Stable.

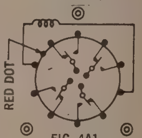


FIG. 4A1

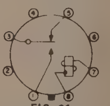


FIG. S1

NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

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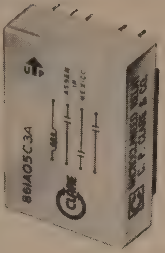
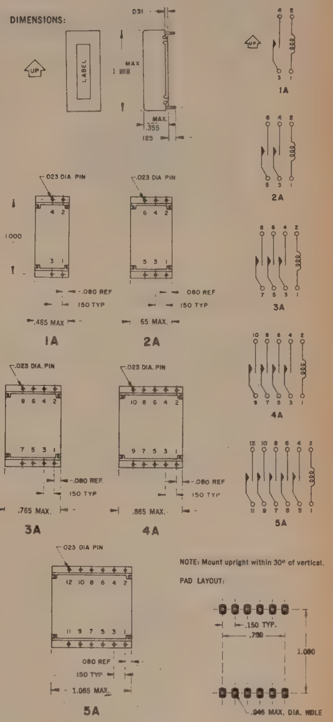
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

MERCURY-WETTED REED RELAYS

861 SERIES


861A05C3A
CLARE

Clare 861 series Mercury-Wetted Microclareed relays are superior when compared to dry reed relays of the same size. The relay has a reliable reed capsule with a no-bounce mercury-wetted armature. You obtain some of the mercury-wetted contact relay advantages at a slight price premium over dry reed relays.


DIMENSIONS:
UP
LABEL
MAX
.355
125
.023 DIA PIN
1.000
.080 REF
150 TYP
.465 MAX
65 MAX.
1A
2A
3A
4A
5A
.765 MAX.
.865 MAX.
1.065 MAX.
NOTE: Mount upright within 30° of vertical.
PAD LAYOUT:
.150 TYP.
.750
1.000
.046 MAX. DIA. HOLE

SPECIFICATIONS

CONTACT RATING (Resistive load): Power 35VA, max. Voltage 500Vdc, max. Current .75A, max.

CONTACT RESISTANCE (ON impedance): 50 milliohms, max. initial, total circuit

INSULATION RESISTANCE (OFF impedance): 1000 x 10⁶ ohms min. at 100Vdv, +25°C, 50% rel. hum.

DRAIN TIME: 30 seconds, max.

BREAKDOWN VOLTAGE: 2000Vac, rms, 60 Hz min. across open contacts, 500Vdc all other points

OPERATING TIME: 3 ms, max. (No bounce on closure)

RELEASE TIME: 3 ms, max. with nominal clamping

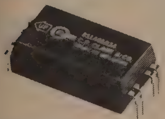
TEMPERATURE RANGE (Operating): −38.8°C to +50°C

LIFE EXPECTANCY: 20 x 10⁶ operations at rated load with proper contact protection.

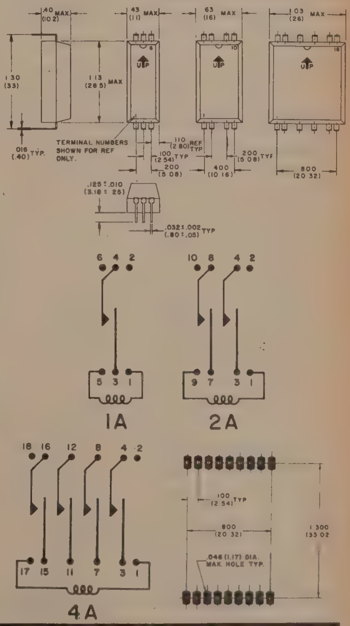
Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Must Release (Vdc)	Maximum Voltage (Vdc)	Coil Resistance (Ohms, ±10%)	List Price
861A05C1A	1A	5	3.75	0.15	10	95	$6.30
861A12C1A		12	9.0	0.70	18	405	6.30
861A24C1A		24	18	1.4	36	2210	6.70
861A05C2A	2A	5	3.75	0.15	7.5	55	8.55
861A12C2A		12	9.0	0.70	18	250	8.55
861A24C2A		24	18	1.4	36	1000	8.90
861A05C3A	3A	5	3.75	0.15	7.5	46	10.75
861A12C3A		12	9.0	0.70	18	325	10.75
861A24C3A		24	18	1.4	28	810	11.15
861A05C4A	4A	5	3.75	0.15	7.5	31	13.00
861A12C4A		12	9.0	0.70	18	200	13.00
861A24C4A		24	18	1.4	28	600	13.35
861A05C5A	5A	5	3.75	0.15	7.5	22	15.20
861A12C5A		12	9.0	0.70	18	150	15.20
861A24C5A		24	18	1.4	28	420	15.60

Note: All values at 25°C

NEW 851 SERIES



Clare's 851 relay series represents new design dimensions and offers freedom in the solution of switching problems. They provide billion operation bounce-free mercury-wetted switching performance, load handling capability from signal-level to 50 VA, multipole flexibility, epoxy molded construction, and a cost approaching dry reed relays. 851 series relays are designed for printed circuit board mounting.


.40 MAX (10.2)
.43 MAX (11)
.63 MAX (16)
1.03 MAX (26)
1.30 (33)
1.13 MAX (28.5)
UP
TERMINAL NUMBERS SHOWN FOR REF ONLY.
.016 (.40) TYP.
.110 REF (2.80) TYP
.100 (2.54) TYP
.200 (5.08)
.400 (10.16)
.200 (5.08) TYP
.800 (20.32)
.125 ±.010 (3.18 ±.25)
.032 ±.002 (.80 ±.05) TYP
1A
2A
4A
.100 (2.54) TYP
.800 (20.32)
1.300 (33.02)
.046 (1.17) DIA. MAX. HOLE TYP.

SPECIFICATIONS

CONTACT RATING (Resistive load with proper contact protection):
- Power — 50 volt-amperes, max.
- Voltage — 350 Vdc or peak ac max.
- Current — 1 ampere, max., switched
  3 amperes, max., carry only

CONTACT RESISTANCE (On impedance): 40 milliohms maximum, ±2 milliohms throughout life

INSULATION RESISTANCE (Off impedance): 500 megohms over open contacts, 10,000 megohms between coil and contacts at 100 Vdc, +25°C, 20-50% relative humidity

DRAIN TIME: 30 seconds after reaching upright vertical position plus at least one no-load operation to clear the contacts.

BREAKDOWN VOLTAGE: 1500 Vac, rms 50/60 Hz or 2000 Vdc across open contacts, 1000 Vac, rms, 50/60 Hz or 1400 Vdc between all mutually insulated terminals

OPERATING TIME: 3 milliseconds, maximum (No bounce on closure).

RELEASE TIME: 3 milliseconds, maximum with nominal clamping

ENVIRONMENTAL:
- Vibration — 10-500 Hz, 0.06″ double amplitude or 10 g's (non-operating)
- Shock: 30 g's, 11 ±1 ms, ½ sinewave (non-operating)
- Temperature — −40° to +65°C (operating)

LIFE EXPECTANCY (With proper contact protection): 1 x 10⁹ operations at max. contact rating

Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Must Release (Vdc)	Maximum Voltage (Vdc)	Coil Resistance (Ohms, ±10%)
852A05B1A	$6.30	1A	5	3.75	0.5	15	120
851A12B1A	6.30		12	9	1.3	31	490
851A24B1A	6.70		24	18	2.6	61	1870
851A05B2A	8.55	2A	5	3.75	0.4	9	32
851A12B2A	8.55		12	9	0.9	23	184
851A24B2A	8.90		24	18	2.0	47	744
851A05B4A	13.00	4A	5	3.75	0.4	9	20
851A12B4A	13.00		12	9	1.0	23	126
851A24B4A	13.35		24	18	2.1	47	510

NOTE: All voltage, current and resistance values are measured at 25°C.

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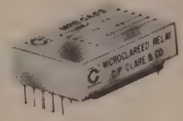
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

DRY REED RELAYS

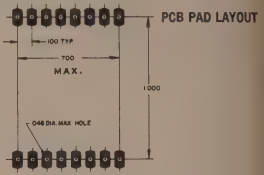
MRB SERIES MICROCLAREED®



Clare's MRB Microreed relays offer versatile signal level to 10VA switching capabilities, total input/output isolation, 800 microsecond typical switching speeds in the miniature sized relay family.

The MRB relays operate with coil power requirements as low as 10 milliwatts. The ultra-reliable operation will exceed 100 x 10⁶ operations at signal level loads or 10 x 10⁶ operations at the rated load.

Optional MRB relays are available in 3 or 5 Form A, 2 Form B, 3 or 4 Form C, 1A latching or 2A latching and 2A2B contact forms. UL recognized versions in all but Form C are available as listed in UL File E43775. The relays have molded epoxy bases with stamped metal covers and convenient 1.000″ x 0.100″ grid mounting centers for printed circuit board mounting. This low profile package will mount on 0.5″ PCB centers. Electrostatic shielding is available. 1.000″ x 0.150″ grid mounting models are available in 1 to 5 Form A versions. Consult the factory for details.



SPECIFICATIONS — MRB

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 200 Volts dc or peak a.c. max. Current: 0.75 amperes, switched, max. 2.0 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

LIFE EXPECTANCY: 100 x 10⁶ operations at signal levels. 10 x 10⁶ operations at full rated load

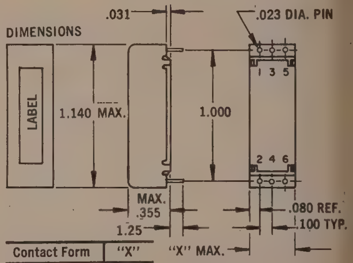
TYPICAL OPERATE TIME: Less than 800µs including bounce

BREAKDOWN VOLTAGE: 250Vac, rms, 60Hz across open contacts or 350Vdc max.

INSULATION RESISTANCE (OFF Impedance): 10¹⁰ ohms min. at 100Vdc +25°C, 40% rel. hum.

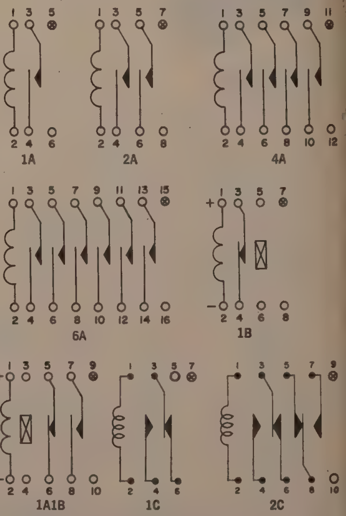
ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 10g's, 10 - 2000Hz. Shock: 20g's, 11 ±1ms, ½ sinewave. Temperature: −40° to +85°C.

Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10% @ 25°C)
MRB 1A05	$2.65	1A	5	3.75	0.15	15	225
MRB 1A06	2.65		6	4.5	0.15	18	340
MRB 1A12	2.65		12	9	0.7	36	1400
MRB 1A24	3.00		24	18	1.4	60	4340
MRB 2A05	3.75	2A	5	3.75	0.15	11	105
MRB 2A06	3.75		6	4.5	0.15	14	180
MRB 2A12	3.75		12	9	0.7	26	730
MRB 2A24	4.10		24	18	1.4	48	2500
MRB 4A05	5.95	4A	5	3.75	0.15	9	60
MRB 4A06	5.95		6	4.5	0.15	11	100
MRB 4A12	5.95		12	9	0.7	18	275
MRB 4A24	6.30		24	18	1.4	36	1090
MRB 6A05	8.15	6A	5	3.75	0.15	7	32
MRB 6A06	8.15		6	4.5	0.15	9	50
MRB 6A12	8.15		12	9	0.7	18	210
MRB 6A24	8.50		24	18	1.4	36	900
MRB 1B05	3.75	1B	5	3.75	0.4	7.5	300
MRB 1B06	3.75		6	4.5	0.5	9	450
MRB 1B12	3.75		12	9	1	18	1240
MRB 1B24	4.10		24	18	2	36	5800
MRB 1N05	4.85	1A1B	5	3.75	0.4	7.5	50
MRB 1N06	4.85		6	4.5	0.5	9	82
MRB 1N12	4.85		12	9	1	18	230
MRB 1N24	5.20		24	18	2	36	900
922A05C1C	5.95	1C	5	3.75	0.4	20	350
922A06C1C	5.95		6	4.5	0.5	25	560
922A12C1C	5.95		12	9	1	45	1900
922A24C1C	6.30		24	18	2	93	7800
922A05C2C	10.35	2C	5	3.75	0.4	16	220
922A06C2C	10.35		6	4.5	0.5	21	365
922A12C2C	10.35		12	9	1	32	880
922A24C2C	10.70		24	18	2	75	4660



Contact Form	"X"
1A	.365
2A, 1B, 1C	.465
1A1B, 2C	.565
4A	.665
6A	.865

BOTTOM VIEW SCHEMATICS



NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

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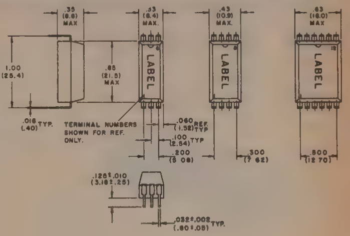
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

DRY REED RELAYS

951 SERIES

The Clare 951 series dry reed relays offer signal level to 10 VA switching capabilities, standard contact arrangements of 1, 2 and 4 Form A configurations, total input/output isolation, and rugged epoxy molded construction. Clare manufactured capsules and their demonstrated switching reliability provide 100 million operations at signal-level loads or 5 million operations at rated loads.


.33 (8.8) MAX
.33 (8.4) MAX.
.43 (10.9) MAX.
.63 (16.0) MAX
1.00 (25.4)
.85 (21.5) MAX
LABEL
LABEL
LABEL
.016 (.40) TYP.
TERMINAL NUMBERS SHOWN FOR REF. ONLY.
.060 (1.52) REF. TYP
.100 (2.54) TYP
.200 (5.08)
.300 (7.62)
.500 (12.70)
.125±.010 (3.18±.25)
.032±.002 (.80±.05) TYP.

SPECIFICATIONS

CONTACT RATING (Resistive Load):
Power — 10 volt-amperes, max.
Voltage — 150 Vdc, or peak ac, max.
Current — 0.75 ampere, switched, max.,
1.0 ampere, carry only, max.

CONTACT RESISTANCE (On impedance): 200 milliohms, max. initial

LIFE EXPECTANCY: 100 x 10⁶ operations at signal levels, 5 x 10⁶ operations at 750 mA, 12 Vdc, resistive, 5 x 10⁶ operations at 360 mA, 28 Vdc, resistive

INSULATION RESISTANCE (Off impedance): 10,000 megohms between all insulated points at 100 Vdc, +25°C, 20-50% relative humidity

CAPACITANCE: 0.6 pF across open contacts, 1.4 pF open contacts to coil, 2.5 pF closed contacts to coil

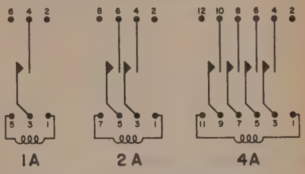
DIELECTRIC WITHSTANDING VOLTAGE: 175 Vac, rms, 50/60 Hz or 250 Vdc across open contacts, 1000 Vac, 50/60 Hz or 1400 Vdc all other points

TIMING (at nominal voltage):

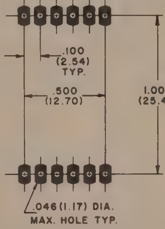
Form	Operate (typical)	Bounce (typical)	Release (with diode)
1A	175 μs	120 μs	250 μs
2A	250 μs	120 μs	250 μs
4A	350 μs	120 μs	250 μs

ENVIRONMENTAL: Vibration — 0.125″ da or 20g's, 0-5000 Hz (non-operating)
Shock — 100g, 11 ±1 ms, ½ sinewave (non-operating)
Temperature — −40° to +105°C (operating)

SCHEMATICS (Bottom view):


6 4 2
5 3 1
1A
8 6 4 2
7 5 3 1
2 A
12 10 8 6 4 2
11 9 7 5 3 1
4A

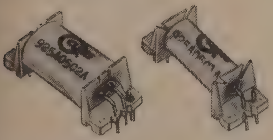
PAD LAYOUT (Bottom view):


.100 (2.54) TYP.
.500 (12.70)
1.000 (25.40)
.046 (1.17) DIA. MAX. HOLE TYP.

Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Must Release (Vdc)	Maximum Voltage (Vdc)	Coil Resistance (Ohms, ±10%)
951A05B1A	$2.65	1A	5	3.75	0.4	16	190
951A12B1A	2.65		12	8.60	1.0	39	1150
951A24B1A	3.00		24	17.1	2.0	74	4200
951A05B2A	3.75	2A	5	3.75	0.4	12	105
951A12B2A	3.75		12	8.60	1.0	31	630
951A24B2A	4.10		24	17.1	2.0	59	2300
951A05B4A	5.95	4A	5	3.75	0.3	11	60
951A12B4A	5.95		12	9.20	0.9	28	370
951A24B4A	6.30		24	18.0	1.5	56	1400

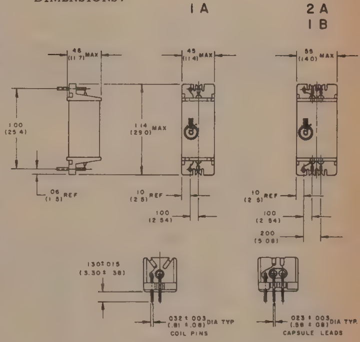
NOTE: All voltage, current and resistance values are measured at 25°C.

925 SERIES



Clare's new 925 series dry reed relays utilize an economical open type construction and the reliable Microclareed® miniature dry reed switch which gives up to 10 million operations at rated load. The relay frame is formed in a single molded piece for greater strength and rigidity. The relays are available in 1 Form A, 2 Form A and 1 Form B contact arrangements with 5/6, 12, or 24 Vdc coils.

DIMENSIONS:


1 A
2 A
1 B
.46 (11.7) MAX
.45 (11.4) MAX
.55 (14.0) MAX
1.00 (25.4)
1.14 (29.0) MAX
.06 (1.5) REF
.10 (2.5) REF
.10 (2.5) REF
.100 (2.54)
.100 (2.54)
.200 (5.08)
.130±.015 (3.30±.38)
.032±.003 (.81±.08) DIA TYP
COIL PINS
.023±.003 (.58±.08) DIA TYP.
CAPSULE LEADS

SPECIFICATIONS

CONTACT RATING (Resistive load):
Power — 10 volt-amperes, max.
Voltage — 200 Vdc, max.
Current — 0.75 ampere, switched, max.
2.0 amperes, carry only, max.

CONTACT RESISTANCE (On impedance): 250 milliohms, max. initial total circuit, measured at 10 mA, 1000 Hz

LIFE EXPECTANCY: 100 x 10⁶ operations at signal levels, 10 x 10⁶ operations at full rated load

INSULATION RESISTANCE (Off impedance): 10^{10} ohms min. between all insulated points at 100 Vdc, ±25°C, 40% relative humidity

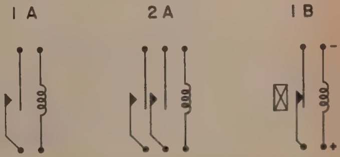
DIELECTRIC WITHSTANDING VOLTAGE: 250 Vdc, min.

TIMING (at nominal voltage):
Operate — Less than one millisecond including bounce
Release — Less than one millisecond with nominal voltage zener clamping

ENVIRONMENTAL (Operating): Temperature — −40°C to +85°C

PHYSICAL:
Mounting — Any position
Contact — Rhodium over gold
Terminals — Solderable

SCHEMATICS (Bottom view):



Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Must Release (Vdc)	Maximum Voltage (Vdc)	Coil Resistance (Ohms, ±10%)
925A05C1A	$1.65	1A	5/6	3.75	0.35	10	260
925A12C1A	1.65	1A	12	9.0	0.70	18	800
925A24C1A	1.65	1A	24	18.0	1.40	36	2670
925A05C2A	2.25	2A	5/6	3.75	0.35	10	200
925A12C2A	2.25	2A	12	9.0	0.70	18	800
925A24C2A	2.25	2A	24	18.0	1.40	36	3050
925A05C1B	2.25	1B	5/6	3.75	0.35	9	200
925A12C1B	2.25	1B	12	9.0	0.70	18	800
925A24C1B	2.25	1B	24	18.0	1.40	36	3050

NOTE: All values are measured at 25°C.

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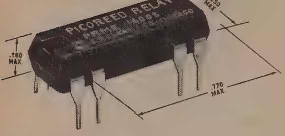
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

DRY REED RELAYS

PRME SERIES PICOREED®


PICOREED RELAY
PRME 1A005
.250 MAX.
.180 MAX.
.770 MAX.

Clare's new dual-in-line package PRME Picoreed relay represents a significant addition to the microminiature Picoreed relay family packaging. The relays feature 600 microsecond typical response times, signal level to 10VA switching capabilities, total input/output isolation, epoxy molded construction and an IC compatible TO-116 DIP package. Traditional Clare reliability gives 100 x 10^6 operations at signal level loads or 5 x 10^6 operations at the rated load.

The PRME one Form A switching arrangement is compatible with most DTL/TTL drive IC's. The coil draws only 13 milliamperes from standard 5 volt logic supplies. Low contact noise and low thermal emf characteristics make the PRME ideal for electronic process control equipment and low level switching applications.

The 0.180″ height optimizes the industry trend toward high density packaging by allowing PRME mounting on 0.375″ PCB centers compatible with IC components. The PRME adapts to either automatic insertion equipment techniques for direct PCB mounting on 0.30″ x 0.100″ grid patterns or to mounting in standard 14 pin DIP sockets.

SPECIFICATIONS — PRME

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 100 volts dc or peak ac, max. current .5 ampere max, switched. 1.5 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

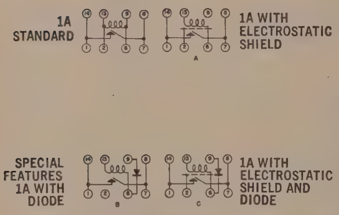
LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 5 x 10^6 operations at full rated load

TYPICAL OPERATE TIME: As low as 600 μs including bounce

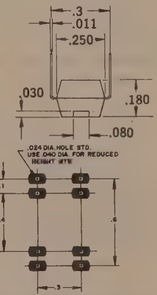
BREAKDOWN VOLTAGE: 200Vac, rms, 60Hz across open contacts or 275Vdc, max.

INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

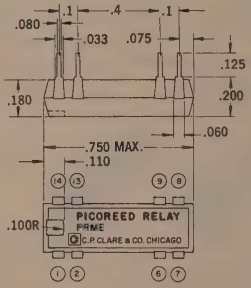
ENVIRONMENTAL (Operating): Vibration: 0.125″ d.a. or 20g's 10-5000Hz. Shock: 100g's, 8 ±1ms, ½ sinewave. Temperature: −40° to +85°C.


1A STANDARD
1A WITH ELECTROSTATIC SHIELD
A
SPECIAL FEATURES 1A WITH DIODE
B
1A WITH ELECTROSTATIC SHIELD AND DIODE
C
14
13
9
8
1
2
6
7

TOP VIEW SCHEMATICS


.3
.011
.250
.030
.180
.080
.024 DIA. HOLE STD. USE .040 DIA. FOR REDUCED HEIGHT SITE
.1
.4
.6
.3

PCB PAD LAYOUT


.1
.4
.1
.080
.033
.075
.125
.180
.200
.060
.750 MAX.
.110
.100R
14
13
9
8
1
2
6
7
PICOREED RELAY
PRME
C.P. CLARE & CO. CHICAGO

DIMENSIONS

Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Max. Voltage (Vdc)	Coil Resis. (Ohms ±10%)	Power mW	List Price
PRME 1A005	1A	5	3.75	0.9	15	380	65	$3.30
PRME 1A006		6	4.5	0.9	15	380	95	3.30
PRME 1A012		12	9	2	18	530	270	3.30
PRME 1A024		24	18	4	32	2000	290	3.30

Add to List Price	Special Features Suffix: Add to the part number
$ .50	A: Electrostatic shield between coil and capsule
1.00	B: Diode between pins 6 and 9; cathode to pin 6
1.50	C: Both electrostatic shield and diode

Example: The PRME 1A024 with electrostatic shield becomes a PRME 1A024A

NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

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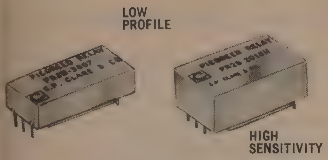
DRY REED RELAYS

PRB & PRBH SERIES PICOREED®



Clare's micro-miniature PRB and PRBH series Picoreed relays offer signal level to 10VA switching characteristics, power requirements ranging from 48 to 500 milliwatts (dependent on relay configuration) and operate times typically less than 500 microseconds in economical space saving packages. The low profile PRB series permits 0.375″ PCB mounting centers and the high sensitivity PRBH series will mount on 0.5″ PCB centers.

The 5 volt PRB/PRBH relays are fully compatible with the standard 5 volt DTL/TTL logic families and will solve many interface application problems.

Both series have molded epoxy bases with stamped metal covers and mount on 0.70″ x 0.100″ grid patterns. The PRB low profile models are also available in 6 Form A, 1B, 1A1B and 1A latching contact configurations. Electrostatic shielding is available.

SPECIFICATIONS — PRB & PRBH

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 100 volts dc or peak ac, max. Current: .5 ampere, switched, max. 2 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

LIFE EXPECTANCY: 100 x 10⁶ operations at signal levels. 5 x 10⁶ operations at full rated load

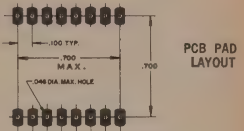
TYPICAL OPERATE TIME: As low as 500 μs including bounce

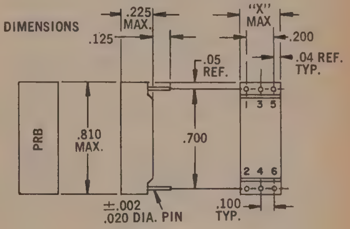
BREAKDOWN VOLTAGE: 200Vac, rms, 60Hz across open contacts or 275Vdc, max.

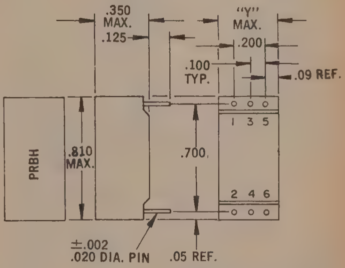
INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 20g's, 10 - 5000Hz. Shock: 100g's, 11 ±1ms, ½ sinewave. Temperature: −40° to +85°C.

Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10%)
LOW PROFILE PRB SERIES							
PRB 3510	$3.35	1A	5	3.75	0.5	12	385
PRB 2510	3.05		6	4.5	0.5	12	385
PRB 2513	3.05		12	9	1	24	1200
PRB 2516	3.35		24	18	2	48	5380
PR2B 3007	4.75	2A	5	3.75	0.5	12	135
PR2B 2007	4.40		6	4.5	0.5	12	135
PR2B 2011	4.40		12	9	1	24	740
PR2B 2014	4.75		24	18	2	48	3040
PR3B 3006	6.15	3A	5	3.75	0.5	10	115
PR3B 2006	5.80		6	4.5	0.5	10	115
PR3B 2009	5.80		12	9	1	22	480
PR3B 2013	6.15		24	18	2	46	2250
PR4B 3005	7.50	4A	5	3.75	0.5	10	90
PR4B 2005	7.15		6	4.5	0.5	10	90
PR4B 2008	7.15		12	9	1	22	350
PR4B 2012	7.50		24	18	2	46	1860
PR5B 3005	8.90	5A	5	3.75	0.5	10	105
PR5B 2005	8.55		6	4.5	0.5	10	105
PR5B 2008	8.55		12	9	1	22	420
PR5B 2011	8.90		24	18	2	46	1420
HIGH SENSITIVITY PRBH SERIES							
PRB 3009H	$3.75	1A	5	3.75	0.5	12	535
PRB 2009H	3.30		6	4.5	0.5	12	535
PRB 2013H	3.30		12	9	1	24	2870
PRB 2016H	3.75		24	18	2	48	11,900
PR2B 3007H	4.75	2A	5	3.75	0.5	12	295
PR2B 2007H	4.65		6	4.5	0.5	12	295
PR2B 2010H	4.65		12	9	1	24	1180
PR2B 2013H	5.15		24	18	2	48	3780
PR3B 3006H	6.15	3A	5	3.75	0.5	12	230
PR3B 2006H	6.05		6	4.5	0.5	12	230
PR3B 2009H	6.05		12	9	1	24	875
PR3B 2013H	6.50		24	18	2	48	4700
PR4B 3005H	7.90	4A	5	3.75	0.5	12	155
PR4B 2005H	7.15		6	4.5	0.5	12	155
PR4B 2008H	7.15		12	9	1	24	660
PR4B 2012H	7.90		24	18	2	48	3620
PR5B 3005H	9.25	5A	5	3.75	0.5	12	180
PR5B 2005H	8.80		6	4.5	0.5	12	180
PR5B 2008H	8.80		12	9	1	24	770
PR5B 2011H	9.25		24	18	2	48	3150

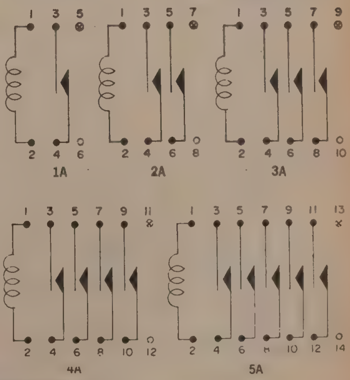






Contact Form	"X"	"Y"
1A	.285	.385
2A	.385	.485
3A	.485	.585
4A	.585	.685
5A	.685	.785

BOTTOM VIEW SCHEMATICS



NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

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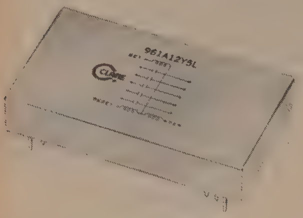
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

DRY REED RELAYS

961 SERIES


961A12Y5L
CLARE

Clare's 961 series Self-Latching Relays offer proven reed reliability plus bistable switching in one through six pole configurations. The heart of the relay is a new self-latching switch that provides the magnetic memory function without the external biasing magnets used in conventional latching relays.

The relays are designed to operate on the recommended one millisecond pulse at the specified nominal voltage. The pulse duration is limited only by coil heating and may be as long as one second. The 961 series relays are not subject to the over-drive limitations of conventional latching reed devices. Once pulsed into a set (closed) or reset (open) state, the relay will remain in that state until the opposite mode is selected.

SPECIFICATIONS

CONTACT FORMS: 1, 2, 3, 4, 5 or 6 poles, self-latching

CONTACT RATING: 5 volt-amperes, max., switched, 250Vac, max., switched, .5A, max., switched, 1.0A, max. carry

CONTACT RESISTANCE (Initial): 100 milliohms, max.

LIFE EXPECTANCY: 5 x 10^6 operations at 24Vdc, 200 mA, switched 10^7 operations at 48 Vdc, 100 mA, carry only, 10^8 operations at signal levels

SET/RESET PULSE DURATION: 0.5 millisecond min., at nominal voltage, 1.0 millisecond pulse recommended

SET TIME: 1.5 millisecond max., including bounce

RESET TIME: 0.1 millisecond max.

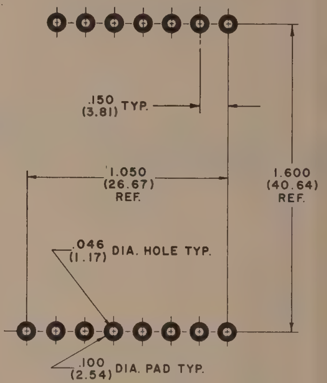
DIELECTRIC WITHSTANDING VOLTAGE: 600 Vdc min. across contacts, 150 Vdc max. between coils, 1000 Vdc min. contacts to coil and all points to cover.

INSULATION RESISTANCE: 10^9 ohms min. at 100 Vdc, +25°C, 40% relative humidity

ENVIRONMENTAL: Vibration — 10g, 2 to 2000 Hz
Shock — 50g, 11 ±1 milliseconds
Temperature — −10 to +85°C operating
−40 to +105°C storage

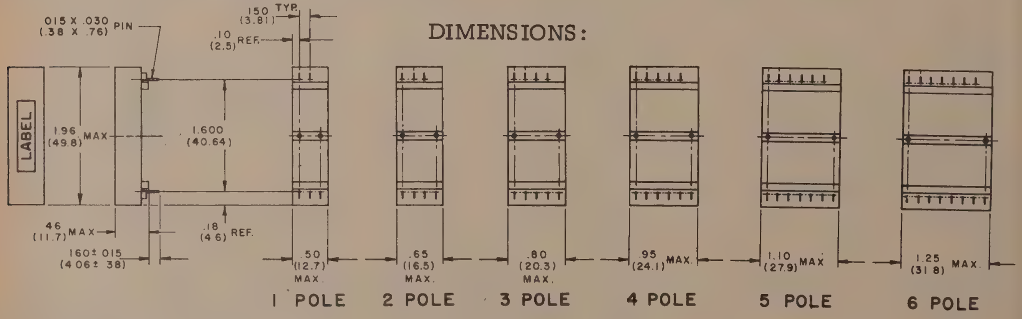
Stock Part Number	List Price	Number of Poles	Nominal Set/Reset Voltage (Vdc)	Must Set/Reset Voltage with 1ms pulse (Vdc)	Coil Resistance (Ohms, ±10%)
961A06Y1L	$5.50	1	6	4.8	55
961A12Y1L	5.50		12	9.6	210
961A06Y2L	6.75	2	6	4.8	33
961A12Y2L	6.75		12	9.6	130
961A06Y3L	8.00	3	6	4.8	25
961A12Y3L	8.00		12	9.6	100
961A06Y4L	9.25	4	6	4.8	19
961A12Y4L	9.25		12	9.6	75
961A06Y5L	10.50	5	6	4.8	15
961A12Y5L	10.50		12	9.6	55
961A06Y6L	11.75	6	6	4.8	9.5
961A12Y6L	11.75		12	9.6	45

NOTE: All voltages, currents and resistance values are measured at 25°C.

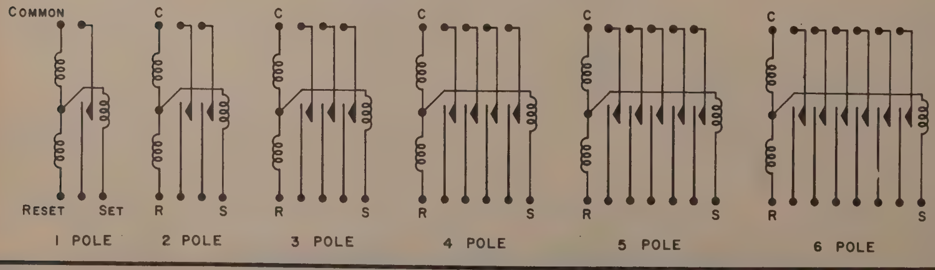

.150 (3.81) TYP.
1.050 (26.67) REF.
1.600 (40.64) REF.
.046 (1.17) DIA. HOLE TYP.
.100 (2.54) DIA. PAD TYP.

PAD LAYOUT

DIMENSIONS:


.015 X .030 (.38 X .76) PIN
.150 (3.81) TYP.
.10 (2.5) REF.
LABEL
1.96 (49.8) MAX
1.600 (40.64)
.46 (11.7) MAX
.18 (4.6) REF.
.160± .015 (4.06± .38)
.50 (12.7) MAX.
.65 (16.5) MAX.
.80 (20.3) MAX.
.95 (24.1) MAX.
1.10 (27.9) MAX
1.25 (31.8) MAX.
1 POLE
2 POLE
3 POLE
4 POLE
5 POLE
6 POLE

SCHEMATICS (Bottom View):


COMMON
RESET
SET
1 POLE
C
R
S
2 POLE
C
R
S
3 POLE
C
R
S
4 POLE
C
R
S
5 POLE
C
R
S
6 POLE

CLARE
a GENERAL INSTRUMENT company

DRY REED RELAYS

CRTN SERIES CLAREED® DRY REED RELAYS

CLAREED RELAY
CRTN-1006
C. P. CLARE & CO.
CHICAGO, ILL.

Clare's economical CRTN standard size reed relays offer signal level to 15VA power handling capabilities, total input/output isolation, and low millisecond switching speeds. CRTN relays are direct replacements for our CRT series relays. Like all Clare reed relays, they are immune to false operation and are insensitive to overload transients that affect solid state devices. Clareed relays are rated for millions of reliable, trouble free operations.

Optional CRTN series contact configurations are 3 & 5 Form A, 1B or 2B, 1C or 2C, and 1A latching or 2A latching. Special relays are available with up to twelve contacts. UL recognized versions of our 1 to 12 Form A relays are available as listed in UL File E43775. The relays feature open assembly construction and PCB 2.5″ x .218″ grid mounting centers.

SPECIFICATIONS — CRTN

CONTACT RATING (Resistive Load): Power: 15 volt-amperes, max. Voltage: 250 volts dc or peak ac, max. Current 1 ampere, switched, max. 5 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 70 milliohms max., measured at 100mA, 1000Hz

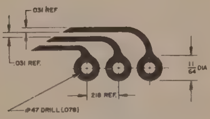
LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 20 x 10^6 operations at full rated load

TYPICAL OPERATE TIME: Less than 4.0ms including bounce

BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz across open contacts or 750Vdc, max.

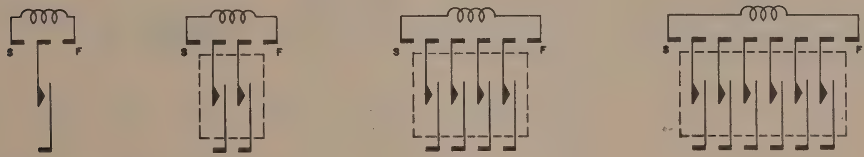
INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 10g's, 10-750Hz. Shock: 30g's, 11 ±1ms, ½ sinewave. Temperature: −65°C to +85°C



PCB PAD LAYOUT

BOTTOM VIEW SCHEMATICS

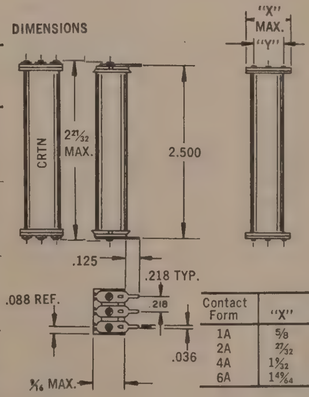


1A 2A 4A 6A

CRTN

Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10%)	List Price
CRTN 1007	1A	6	4.5	0.6	20	160	$3.70
CRTN 1010		12	9	1.2	35	600	3.70
CRTN 1013		24	18	2.5	75	2500	4.70
CRTN 1016		48	36	4.8	150	9450	6.30
CR2TN 1004	2A	6	4.5	0.5	18	90	4.70
CR2TN 1007		12	9	1.1	35	350	4.70
CR2TN 1010		24	18	2.2	65	1400	5.80
CR2TN 1013		48	36	4.4	130	5400	7.35
CR4TN 1104	4A	6	4.5	0.4	13	35	6.80
CR4TN 1107		12	9	0.8	26	135	6.80
CR4TN 1110		24	18	1.7	53	545	7.90
CR4TN 1113		48	36	3.4	105	2200	9.45
CR6TN 1003	6A	6	4.5	0.4	15	31	8.90
CR6TN 1006		12	9	0.9	30	120	8.90
CR6TN 1009		24	18	1.9	60	510	10.00
CR6TN 1012		48	36	3.8	115	1900	11.55

DIMENSIONS



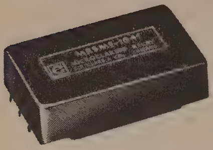
Contact Form	"X"	"Y"
1A	5/8	.436
2A	27/32	.654
4A	1 9/32	1.090
6A	1 49/64	1.566

CLARE
a GENERAL INSTRUMENT company

3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

DRY REED RELAYS

MRME TYPE MICROCLAREED®



Clare's MRME Microclareed relays feature signal level to 10VA switching characteristics, and 800 microsecond typical response speeds in a miniature size package. The rugged MRME molded epoxy construction is ideal for critical environmental applications. MRME relays are direct electrical and mechanical replacements for our MRMC series relays.

MRME relays will handle simultaneous signal and power level switching in the same device over a wide band. Total input/output isolation and immunity to false operation by overload transients that affect solid state devices are characteristics of MRME relays.

Optional MRME relays are available in 5 Form A, 1 or 2 Form B, 1A1B or 2A2B, and 1A latching or 2A latching contact configurations. The pins are arranged in a 1.000″ x 0.100″ staggered offset grid mounting pattern. The MRME relay package readily mounts on 0.5″ PCB centers. Electrostatic shielding is available.

SPECIFICATIONS — MRME

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 200 Volts dc or peak a.c. max. Current: 0.75 amperes, switched, max. 2.0 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 10 x 10^6 operations at full rated load

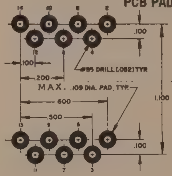
TYPICAL OPERATE TIME: Less than 800μs including bounce

BREAKDOWN VOLTAGE: 250Vac, rms, 60Hz across open contacts or 350Vdc, max.

INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 10g's, 10 - 2000Hz. Shock: 20g's, 11 ±1ms, ½ sinewave. Temperature: −40° to +85°C.

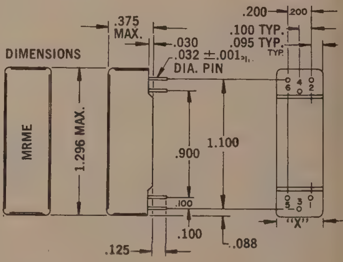
PCB PAD LAYOUT



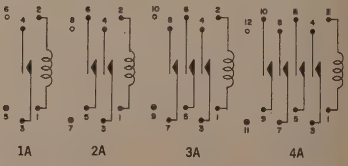
Contact Form	"X"
1A	.390
2A	.490
3A	.590
4A	.690

Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10% @ 25°C)	Price List
MRME 1540	1A	5	3.75	0.15	11	130	$3.85
MRME 1041		6	4.5	0.15	15	220	3.85
MRME 1042		12	9	0.7	29	790	3.85
MRME 1043		24	18	2.5	55	3060	4.45
MR2ME 1540	2A	5	3.75	0.15	10	100	5.35
MR2ME 1041		6	4.5	0.15	13	170	5.35
MR2ME 1042		12	9	0.7	26	635	5.35
MR2ME 1043		24	18	2.5	53	2580	5.95
MR3ME 1540	3A	5	3.75	0.15	9	80	6.85
MR3ME 1041		6	4.5	0.15	12	125	6.85
MR3ME 1042		12	9	0.7	24	510	6.85
MR3ME 1043		24	18	2.5	47	1950	7.45
MR4ME 1540	4A	5	3.75	0.15	8	60	8.35
MR4ME 1041		6	4.5	0.15	11	95	8.35
MR4ME 1042		12	9	0.7	22	410	8.35
MR4ME 1043		24	18	2.5	43	1500	8.95

DIMENSIONS



BOTTOM VIEW SCHEMATICS

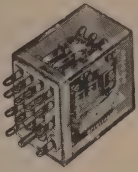


NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

CLARE
a GENERAL INSTRUMENT company
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

GENERAL PURPOSE RELAYS

354 SERIES



The 354 relay handles motor, lamp and solenoid switching requirements in everything from vending machines to disc drive applications. They also switch signal levels in intercoms, two-way radios and small telephone exchanges plus input multiplexing in control systems.

The options make it all possible. Contact ratings up to 5 amperes, ac or dc coils, plus solder lug/plug-in, taper tab or pcb terminals. The relays have UL recognition, File E47012, as Magnetic Motor Controllers for use in industrial applications.

SPECIFICATIONS

CONTACT RATINGS:

Contact Types	Ratings
Gold Flashed Silver Button	3A. at 28 Vdc or 120 Vac resistive or 1/10 H.P. at 120 Vac
Gold Flashed Silver Cadmium Oxide Button	5A. at 28 Vdc or 120 Vac resistive or 1/10 H.P.at 120 Vac

LIFE EXPECTANCY:
Electrical — 100,000 operations min. at rated load
Mechanical — 50 million operations

TYPICAL OPERATE TIME:
Operate — 15 milliseconds max., not including bounce
Release — 6 milliseconds max., not including bounce

BREAKDOWN VOLTAGE: 700 Vac, rms, 60 Hz min. between open contacts, 1500 Vac, rms, 60 Hz between all other mutually insulated elements

INSULATION RESISTANCE (OFF impedance): 1000 megohms min., at 500 Vdc, +25°C, 50% relative humidity

CONTACT RESISTANCE (ON impedance): 50 milliohms max. initially

U.L. RECOGNITION: File Number E47012 under Bulletins 508 "Industrial Control Equipment", 114 "Office Appliances and Business Equipment", 478 "Electronic Data Processing Units and Systems" and 751 "Vending and Amusement Machines"

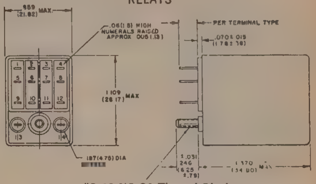
ENVIRONMENTAL: Vibration — 6g's, 10 to 55 Hz (operating test, no contact chatter, hard mounted, 10 microsecond detection level)
Shock — 10g's, 11 ±1ms, ½ sinewave (non-operating test, no mechanical damage)
Temperature Range: −45°C to +50C° ac models
−45°C to +60°C dc models

PHYSICAL:
Weight: Approx. 1.5 oz.
Enclosure: Polycarbonate
Insulating material: High dielectric molded phenolic
Marking: Nominal voltage, part number, schematic, contact rating
Terminals: Solder lug/plug-in, taper tab or pcb

Part Number	List Prices	Terminal Type	Nominal Coil	Contact Material	Coil Resist. Ohms	Must Operate	Must Release
354A12A2C 354A14A2C 354A17A2C	$5.60 5.60 6.45	Plug-in/ Solder	12 Vdc 24 Vdc 110 Vdc	Silver	160 ±10% 650 ±10% 11000 ±10%	9.0 Vdc 18.0 Vdc 82.5 Vdc	1.2 Vdc 2.4 Vdc 11.0 Vdc
354A12A1C 354A14A1C	5.75 5.75	Plug-in/ Solder	12 Vdc 24 Vdc	Silver Cad. Oxide	160 ±10% 650 ±10%	9.0 Vdc 18.0 Vdc	1.2 Vdc 2.4 Vdc
354A14B2C	5.60	PCB	24 Vdc	Silver	650 ±10%	18.0 Vdc	2.4 Vdc
354A24A2C 354A27A2C	6.45 6.95	Plug-in/ Solder	24 Vac 120 Vac	Silver	157 ±15% 4100 ±15%	20.4 Vac 102.0 Vac	7.2 Vac 36.0 Vac
354A24A1C 354A27A1C	6.60 7.10	Plug-in/ Solder	24 Vac 120 Vac	Silver Cad. Oxide	157 ±15% 4100 ±15%	20.4 Vac 102.0 Vac	7.2 Vac 36.0 Vac

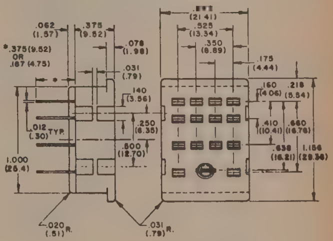
NOTE: All electrical values are measured at 25°C.

RELAYS

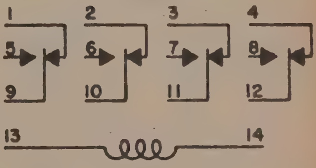

.859 (21.82) MAX.
.06(1.5) HIGH NUMERALS RAISED APPROX .005(.13)
PER TERMINAL TYPE
.070±.015 (1.78±.38)
1 2 3 4
5 6 7 8
9 10 11 12
13 14
1.109 (28.17) MAX
.187(4.75) DIA
1.031
.246 (6.25 ±.79)
1.370 (34.80) MAX

#3-48 NC-2A Thread Stud
on Solder Lug or Taper Tab Models Only

SOCKETS


(21.41)
.062 (1.57)
.375 (9.52)
.525 (13.34)
.350 (8.89)
.078 (1.98)
*.375(9.52) OR .187 (4.75)
.031 (.79)
.175 (4.44)
140 (3.56)
.160 (4.06)
.218 (5.54)
.012 (.30) TYP.
.250 (6.35)
.410 (10.41)
.660 (16.76)
.500 (12.70)
.638 (16.21)
1.156 (29.36)
1.000 (25.4)
.020 (.51) R.
.031 (.79) R.

SCHEMATIC


1
2
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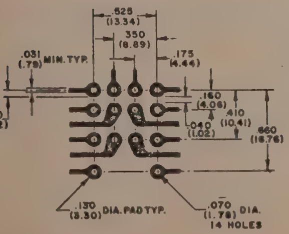
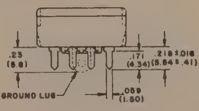
14

PAD LAYOUT


.525 (13.34)
350 (8.89)
.031 (.79) MIN. TYP.
.175 (4.44)
.160 (4.06)
.410 (10.41)
.040 (1.02)
.660 (16.76)
.060 (1.52)
.130 (3.30) DIA. PAD TYP.
.070 (1.78) DIA. 14 HOLES

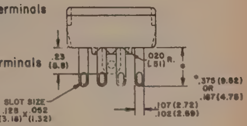
SOCKET PCB TERMINALS

GPS 1003 —
PCB socket
with ground lug
GPS 1005 —
PCB socket
without ground
lug


.23 (5.8)
.171 (4.34)
.218±.016 (5.54±.41)
GROUND LUG
.059 (1.50)

SOCKET SOLDER LUG TERMINALS

GPS 1001 —
.375 (9.52) terminals
with retaining
spring
GPS 1002 —
.187 (4.75) terminals
with retaining
spring


.23 (5.8)
.020 (.51) R.
*.375 (9.52) OR .187 (4.75)
SLOT SIZE .125 x .052 (3.18) x (1.32)
.107 (2.72)
.102 (2.59)

CLARE
a GENERAL INSTRUMENT company

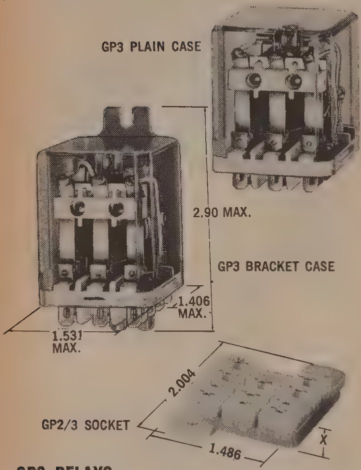
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

GENERAL PURPOSE RELAYS

GP3 SERIES

UL CSA

The GP3 (Lexan® dust cover) Relays are UL bulletin 508 recognized (UL File E47012) and CSA listed (File LR26727) as magnetic motor controllers. The rugged AC or DC relays are available in SPDT, DPDT and 3PDT configurations with Gold flashed Silver Cadmium Oxide contacts rated at either 10 amperes at 28Vdc resistive or 120/150Vac, .8 power factor. The GP3 plain case models are available with matching molded nylon sockets for plug-in applications. The GP3 bracket case model is available for direct chassis mounting only. Mechanical life expectancy is 10 million operations, electrical life 100,000 operations minimum at rated load .187" quick connect terminals standard.



SPECIFICATIONS — GP3

CONTACT RATING: 10 Amperes at 28Vdc resistive or 120/150Vac, .8 power factor. 6 amperes at 240/300Vac, .8 power factor. ⅓ hp at 120Vac, ½ hp at 240Vac

CONTACT RESISTANCE: Initial — 50 milliohms max. at rated current

LIFE EXPECTANCY: Electrical: 100,000 operations minimum at rated load. Mechanical: 10,000,000 operations

OPERATE TIME: Pickup: 15ms typical. Dropout: 11ms typical

BREAKDOWN VOLTAGE: 600Vac, rms, 60Hz minimum between open contacts. 1600Vac, rms, 60Hz all other mutually insulated elements

INSULATION RESISTANCE: 1000 megohms minimum at 500Vdc

	X
GPS 3003	.294"
GPS 3001,2	.542"

ENVIRONMENTAL: Shock: 15g for 11 ±1ms (Non-op.) Vibration: 0.1" d.a. or 10g, 10 to 55Hz (oper.) Temperature Range: −45° to +60°C (AC). −45° to +70°C (DC)

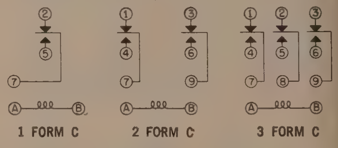
OPTIONS	List Price Change
BRACKET CASE To order, change 8th character from "A" to "N". Example: GP3R231AA2000 becomes GP3R231NA2000.	No Charge

NOTE: Options include neon indicator lamp, external push-to-test button, various mounting modifications for GP2R and GP3R relays, and special contact and special contact materials. Contact your local Clare Sales Office for details.

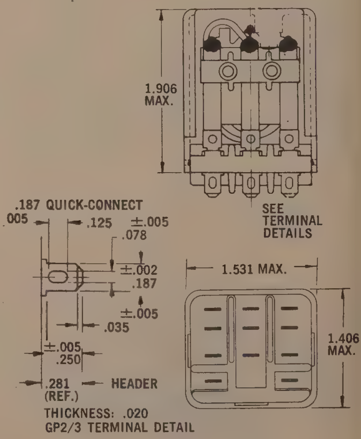
GP3 RELAYS

Coil Voltage	Contacts	AC (50/60HZ) Stock Part Number	AC (50/60HZ) List	DC Stock Part Number	DC List
6	SPDT	GP3R211AA0000	$4.60	GP3R211AD0000	$4.40
12	SPDT	GP3R211AA1000	4.60	GP3R211AD1000	4.40
24	SPDT	GP3R211AA2000	4.60	GP3R211AD2000	4.40
48	SPDT	GP3R211AA3000	4.60	GP3R211AD3000	4.40
90	SPDT	————		GP3R211AD4000	4.40
110	SPDT	————		GP3R211AD5000	4.40
120	SPDT	GP3R211AA6000	4.60	————	
6	DPDT	GP3R221AA0000	5.65	GP3R221AD0000	5.05
12	DPDT	GP3R221AA1000	5.65	GP3R221AD1000	5.05
24	DPDT	GP3R221AA2000	5.65	GP3R221AD2000	5.05
48	DPDT	GP3R221AA3000	5.65	GP3R221AD3000	5.05
90	DPDT	————		GP3R221AD4000	5.05
110	DPDT	————		GP3R221AD5000	5.05
120	DPDT	GP3R221AA6000	5.65	————	
6	3PDT	GP3R231AA0000	6.40	GP3R231AD0000	5.80
12	3PDT	GP3R231AA1000	6.40	GP3R231AD1000	5.80
24	3PDT	GP3R231AA2000	6.40	GP3R231AD2000	5.80
48	3PDT	GP3R231AA3000	6.40	GP3R231AD3000	5.80
90	3PDT	————		GP3R231AD4000	5.80
110	3PDT	————		GP3R231AD5000	5.80
120	3PDT	GP3R231AA6000	6.40	————	
GPS3001	Socket, solder terminals				$ .95
GPS3002	Socket, quick-connect terminals				1.05
GPS3003	Socket, PCB terminals				1.05
GPA3050	Hold down spring clip, box of 50 ea.				6.50

SCHEMATICS



DIMENSIONS



NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

CLARE
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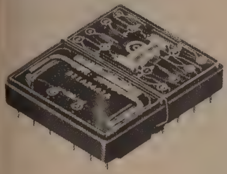
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

TELEPHONE TYPE RELAYS

511 SERIES



Clare's new 511 series Modern Telephone relays offer reliable low level to 2 ampere switching capabilities in 2 and 4 Form C models. The low profile package is only 0.35″ (8.9mm) high and allows PCB mounting on standard 0.5 inch (12.7mm) centers.

The 511 series enclosures feature an amber polycarbonate dust cover and a molded base of thermosetting electrical grade plastic material. This box type base with molded-in terminal pins fully protects the inside of the relay during wave soldering and subsequent partial immersion cleaning operations.

SPECIFICATIONS

CONTACT ARRANGEMENT:
2 or 4 Form C (Bifurcated) Standard
2 or 4 Form D (Bifurcated) or Form C/D combinations are optional.

CONTACT MATERIAL: Gold alloy over Palladium alloy mated with Palladium alloy

CONTACT RESISTANCE (On impedance):
Before Life: 100 milliohms max.
After Life: 200 milliohms max. (measured at rated load)

COIL DATA (at 25°C):
Voltage — 6, 12, 24, 48 Vdc
Power — 2.4 watts max. continuous, 1.3 watts nom., (typical), 0.8 watts pickup, (typical)
Resistance — See How to Order
Temperature Rise — 34°C per watt

LIFE EXPECTANCY:
Electrical — See Contact ratings
Mechanical — 100 x 10^6 operations
Operate Time (Including bounce): 15 ms max.

RELEASE TIME (Including bounce): 15 ms max.

BREAKDOWN VOLTAGE: 500 Vac, rms, 50/60 Hz min. between all mutually insulated elements

INSULATION RESISTANCE (Off impedance): 50,000 megohms min. at 500 Vdc, +25°C, 50% relative humidity

ENVIRONMENTAL: Temperature range (operating) −45°C to +65°C

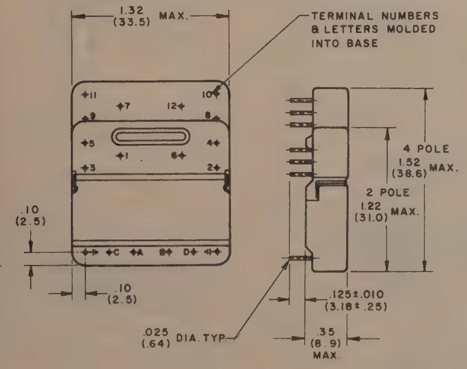
CONTACT RATING (Resistive load at 25°C):

Current	Voltage	Life (Operations)
1.0A	28 Vdc	5,000,000
1.0A	48 Vdc	750,000
2.0A	28 Vdc	100,000
.1A	48 Vdc	50,000,000
.5A	115 Vac, 50/60Hz	750,000

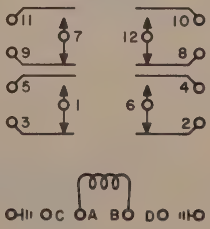
Stock Part Number	List Prices	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Must Release (Vdc)	Coil Resistance (Ohms ±10%)
511A06A2C	$4.70	2C	6	4.5	0.6	40
511A12A2C	4.70	2C	12	9.0	1.2	175
511A24A2C	4.70	2C	24	18.0	2.4	700
511A48A2C	4.95	2C	48	36.0	4.8	2370
511A06A4C	6.90	4C	6	4.5	0.6	25
511A12A4C	6.90	4C	12	9.0	1.2	100
511A24A4C	6.90	4C	24	18.0	2.4	435
511A48A4C	7.15	4C	48	36.0	4.8	1800

Note: All voltage and resistance values are measured at 25°C.

DIMENSIONS:

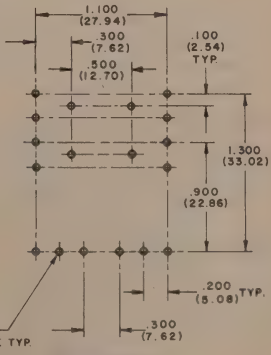

1.32
(33.5) MAX.
TERMINAL NUMBERS
& LETTERS MOLDED
INTO BASE
11
7
12
10
9
8
5
4
1
6
3
2
C
A
B
D
4 POLE
1.52
(38.6) MAX.
2 POLE
1.22
(31.0) MAX.
.10
(2.5)
.10
(2.5)
.125±.010
(3.18±.25)
.025
(.64) DIA. TYP.
.35
(8.9)
MAX.

SCHEMATIC: Neutral relay de-energized.
For polar relays positive on "A" will
switch contacts from position shown.


11
7
10
12
9
8
5
1
4
6
3
2
C
A
B
D

(BOTTOM VIEW)

PAD LAYOUT:

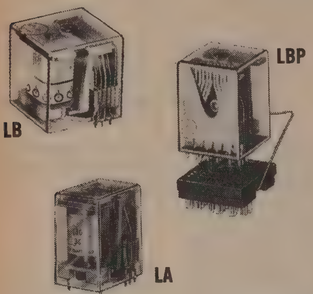

1.100
(27.94)
.300
(7.62)
.500
(12.70)
.100
(2.54)
TYP.
1.300
(33.02)
.900
(22.86)
.200
(5.08) TYP.
.300
(7.62)
.046
(1.17) DIA.
HOLE TYP.

CIRCUIT BOARD
HOLE LAYOUT

CLARE
a GENERAL INSTRUMENT company
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

TELEPHONE TYPE RELAYS

LA/LB SERIES



Designed for the user who must have high quality at a reasonable price. The LA relays have 4PDT contacts and the LB/LBP relays have 6PDT contacts. These miniature relays have extraordinary switching capacity and versatility for their size. Contacts rated 2 amps at 28Vdc. LA/LB Series is for direct P.C.B. mounting; and the LBP Series is for direct plug into socket mounting. These relays are ideal components for military, industrial and commercial applications.

SPECIFICATIONS — LA/LB SERIES

CONTACT RATING (Resistive Load): 2A at 28Vdc

CONTACT MATERIAL: Palladium, with Gold overlay on bifurcated make and break springs

CONTACT RESISTANCE (ON Impedance): 100 milli-ohms max. initial

LIFE EXPECTANCY: 100,000 operations at rated load min. 100,000,000 operations mechanical life min.

OPERATE TIME: 10-25ms typical

RELEASE TIME: 5ms max.

BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz between all mutually insulated points

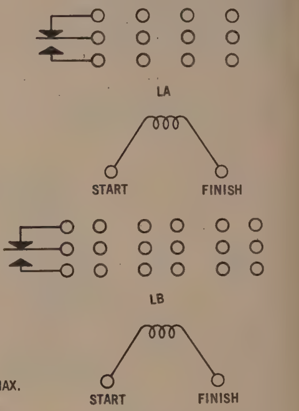
INSULATION RESISTANCE (OFF Impedance): 500K Megohms min. at 25°C, 50% rel. hum.

ENVIRONMENTAL (Operating, 10 µs max. contact chatter): Vibration: 5-2000Hz, 10g's. Shock: 15g's, 11ms, ½ sinewave

Stock Part Number	Volts (dc)	Coil Resistance	Contact Form	List Price
LB0060A00, LBP0060A00	6	35	6 Form C	$7.00
LB0060B00, LBP0060B00	12	130	6 Form C	7.00
LB0060H00, LBP0060H00	12	200	6 Form C	7.00
LB0060C00, LBP0060C00	12	330	6 Form C	7.00
LB0060D00, LBP0060D00	24	590	6 Form C	7.00
LB0060K00, LPB0060K00	24	915	6 Form C	7.00
LB0060J00, LBP0060J00	24	1150	6 Form C	7.00
LB0060N00, LBP0060N00	48	2100	6 Form C	7.00
LB0060M00, LBP0060M00	48	3000	6 Form C	7.00
RP 15450G5 Socket, Solder lug for LBP w/Cover Clip				1.60
RP 15450G6 Socket, PCB for LBP w/Cover Clip				1.60
LA0040A00	6	35	4 Form C	6.35
LA0040B00	12	130	4 Form C	6.35
LA0040D00	24	590	4 Form C	6.35
LA0400K00	24	915	4 Form C	6.35
LA0400N00	48	2100	4 Form C	6.35
LA0400M00	48	3000	4 Form C	6.35

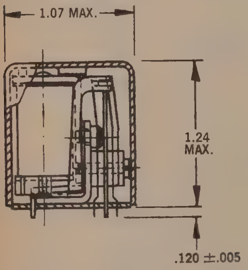
NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

SCHEMATICS

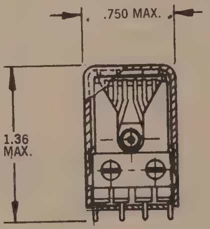

LA
START
FINISH
LB
START
FINISH

DIMENSIONS

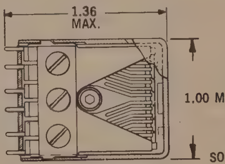
LA/LB SIDE VIEW


1.07 MAX.
1.24 MAX.
.120 ±.005

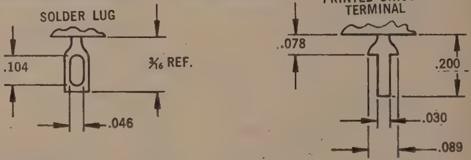
LA


.750 MAX.
1.36 MAX.

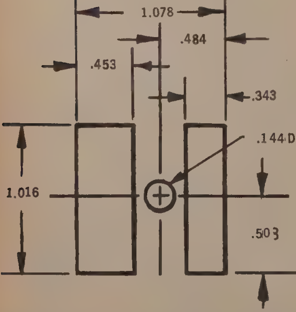
LB


1.36 MAX.
1.00 MAX.

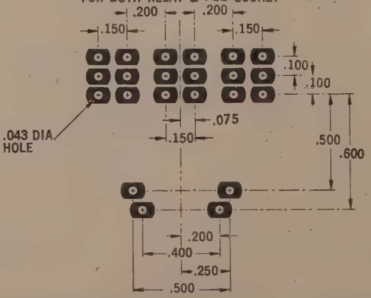
SOCKET TERMINALS


SOLDER LUG
.104
3/16 REF.
.046
PRINTED CIRCUIT TERMINAL
.078
.200
.030
.089

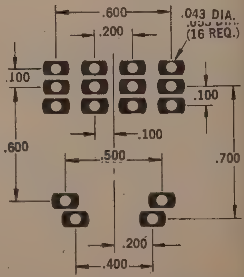
LBP SOCKET CUTOUT


1.078
.484
.453
.343
.144 DIA. HOLE
1.016
.503

LB & LBP PCB PAD LAYOUT FOR BOTH RELAY & PCB SOCKET


.200
.200
.150
.150
.100
.100
.043 DIA. HOLE
.075
.150
.500
.600
.200
.400
.250
.500

LA PCB PAD LAYOUT


.600
.043 DIA. (16 REQ.)
.200
.100
.100
.100
.600
.500
.700
.200
.400

CLARE
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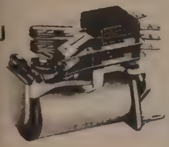
(312) 262-7700 / CABLE: CLARELAY, CHICAGO
ENERAL INSTRUMENT company

TELEPHONE TYPE RELAYS

J & JDP SERIES


J

JDP

J & JDP relays are compact telephone type relays for applications ranging from simple switching in alarm circuits to complex computer functions. Contact combinations of 4, 6 & 8 pole double throw are rated 4A at 120Vac, 60Hz or 30Vdc resistive. Mechanical life exceeds 70 x 10^6 operations.

Type J relays are open type construction for direct chassis mounting. Series JDP relays are furnished with a relay, a socket with solder lug terminals and a dust cover enclosure.

SPECIFICATIONS — J & JDP

CONTACT RATING (Resistive Load): 4A at 120Vac, 60Hz or 30Vdc

CONTACT MATERIAL: Twin Palladium (bifurcated make-and-break springs)

CONTACT RESISTANCE: 100 milliohms max. initial

LIFE EXPECTANCY: 1 x 10^6 operations min. at rated load, mechanical life 70 x 10^6 operations

OPERATE TIME: 10-40ms typical

RELEASE TIME (Coil unsuppressed): 1-10ms typical

BREAKDOWN VOLTAGE: 1000Vac, 60Hz

Stock Part Number	Volts (dc)	Coil Resistance	Contact Form	Figure	List Price
J SERIES					
J124C24	12	80	4PDT	A	$8.60
J126C24	12	50	6PDT	A	9.95
J128C24	12	50	8PDT	A	11.55
J244C24	24	500	4PDT	A	8.80
J246C24	24	300	6PDT	A	10.30
J248C24	24	200	8PDT	A	11.75
J484C24	48	1300	4PDT	A	9.20
J486C24	48	1000	6PDT	A	10.65
J488C24	48	800	8PDT	A	12.25
J1104C24	110	6500	4PDT	A	9.70
J1106C24	110	5000	6PDT	A	11.15
J1108C24	110	3600	8PDT	A	12.70
JDP SERIES					
JDP124C24	12	80	4PDT	B1	$9.40
JDP126C24	12	50	6PDT	B2	11.20
JDP128C24	12	50	8PDT	B2	12.75
JDP244C24	24	500	4PDT	B1	9.65
JDP246C24	24	300	6PDT	B2	11.45
JDP248C24	24	200	8PDT	B2	13.00
JDP484C24	48	1300	4PDT	B1	10.05
JDP486C24	48	1000	6PDT	B2	11.80
JDP488C24	48	800	8PDT	B2	13.40
JDP1104C24	110	6500	4PDT	B1	10.55
JDP1106C24	110	5000	6PDT	B2	12.35
JDP1108C24	110	3600	8PDT	B2	13.90

DIMENSIONS
"J"

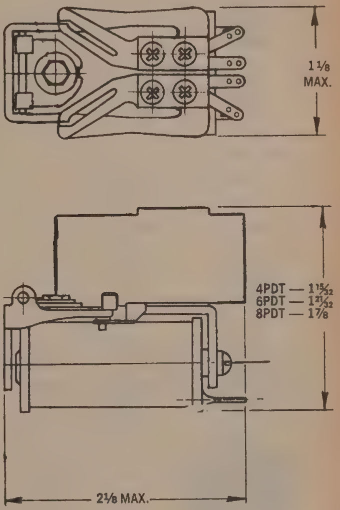
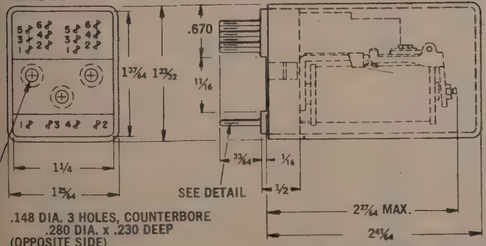

1⅛
MAX.
4PDT — 1 15/32
6PDT — 1 21/32
8PDT — 1⅞
2⅛ MAX.

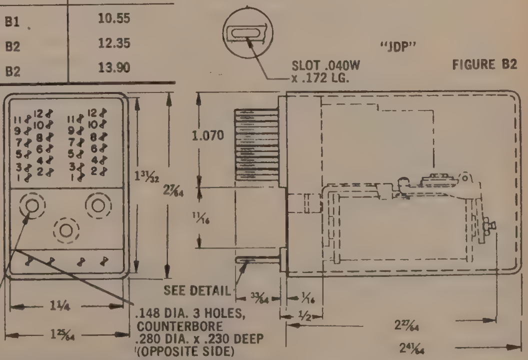
FIGURE A

FIGURE B1


5 6 5 6
3 4 3 4
1 2 1 2
1 3 4 2
1 37/64
1 23/32
.670
11/16
1¼
1 25/64
33/64
1/16
1/2
SEE DETAIL
2 27/64 MAX.
2 41/64
.148 DIA. 3 HOLES, COUNTERBORE
.280 DIA. x .230 DEEP
(OPPOSITE SIDE)

"JDP"

FIGURE B2


SLOT .040W
x .172 LG.
11 12 11 12
9 10 9 10
7 8 7 8
5 6 5 6
3 4 3 4
1 2 1 2
1 31/32
2 7/64
1.070
11/16
1¼
1 25/64
SEE DETAIL
33/64
1/16
1/2
.148 DIA. 3 HOLES,
COUNTERBORE
.280 DIA. x .230 DEEP
(OPPOSITE SIDE)
2 27/64
2 41/64

NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

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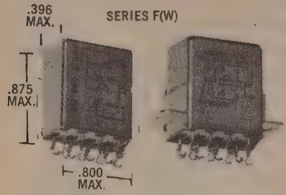
a GENERAL INSTRUMENT company

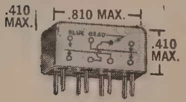
CRYSTAL CAN RELAYS

TYPE F(W) & HF(W)

SERIES F(W)



SERIES HF(W)



Clare provides full and half-size crystal can relays of unusual versatility, capable of reliable long life operation under adverse environments. The relays are available in both solder seal versions (F & HF) and welded seal models (FW & HFW). These relays are ideal for use in industrial application as well as military and aerospace. Relays employ a rigid frame to maintain permanent alignment of all elements. Contact arrangements are 2 form C. These relays are manufactured to meet Mil-R-5757/10 and 5757/9.

SPECIFICATIONS — F(W) & HF(W)

CONTACT RATING (Resistive Load): 2A at 28Vdc

CONTACT RESISTANCE (ON Impedance): 50 milliohms max. at 6Vdc, 100mA

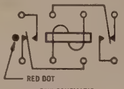
LIFE EXPECTANCY: F & FW: 250,000 operations at rated load. HF & HFW: 100,000 operations at rated load

OPERATE TIME: F & FW: 5ms max. HF & HFW: 4ms max.

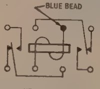
BREAKDOWN VOLTAGE: 1000Vac, rms, 60Hz between all terminals and case

INSULATION RESISTANCE (OFF Impedance): 1000 Megohms min.

ENVIRONMENTAL: Vibration: 5 - 2000 Hz, 0.125″ d.a. or 30g peak (HF & HFW). 10 - 3000Hz, 0.125″ d.a. or 30g peak (F & FW). Shock: 65g peak, 11 ±1ms Temperature range: −65° to +125°C



F(W) SCHEMATIC

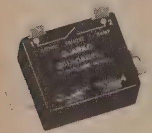


HF(W) SCHEMATIC

Stock Part No.		List Price	Nom. Volt. (dc)	Coil Res. (Ohms)	Contacts		Terminal Type	Enclosure Variations
Welded Header	Soldered Header				Arrangement	Rating (Amps)		
FW	**F**							
FW1111G00	RP7631G12	$11.35	26.5	675	DPDT	2	S. H.	Side Plate Mtg.
FW1105G00	RP7632G1	11.35	26.5	675	DPDT	2	S. H.	Std. Ear Brkts.
FW1102G00	RP7633G4	11.35	26.5	675	DPDT	2	S. H.	Stud Mtg. Top
FW1104G00	RP7640G1	11.35	26.5	675	DPDT	2	S. H.	Stud Mtg. Side
FW1301G00	RP7641G2	11.35	26.5	675	DPDT	2	3″ Leads	Plain Case
FW1201G00	RP7641G8	11.35	26.5	675	DPDT	2	3/16″ plug in	Plain Case
FW1207G00	RP9809G1	11.35	26.5	675	DPDT	2	3/16″ plug in	Std. Ear Brkts.
*FW1106G02	RP9817G1	11.35	26.5	675	DPDT	2	S. H.	Std. Ear Brkts.
HFW	**HF**							
HFW1201D00	HF1201D00	$14.20	26.5	1250	DPDT	2	3/16″ plug in	Plain Case
†HFW1201K01	HF1201K01	14.20	26.5	700	DPDT	2	3/16″ plug in	Plain Case

QPL Numbers * Mil-R-5757E/10-141 † Mil-R-5757E/9-003

CLARAC^{T.M.} AC POWER RELAYS



The Clarac relay is an ultra-reliable hybrid relay featuring a reed input and a triac solid state output. The relays are very sensitive and operate with less than 200mW power inputs. Rugged construction, low cost and long life make the Clarac an excellent choice for tough circuit applications such as switching solenoids, ac motors, lamps and other industrial loads.

The units maximum ratings are 4, 8 or 15A at 240Vac, 50/60Hz when mounted on a 8″ x 8″ x 1/8″ aluminum heat sink for optimum operation. The relays must be derated when used without heat sink (free air) or at elevated temperatures (consult Clare Data Sheet 222 for surge current capabilities and additional details). The relays have dust and explosion proof nylon covers, quick-connect terminals and an average shipping weight of 2 oz.

Stock New Part Number	(Reference Only) Old Part No.	Nom. Coil Input Voltage (Vdc)	Must Operate Voltage (Vdc)	Coil Res. (Ohms)	Max. Load Current with heat sink	Load Current (Free air, 25°C)	List Price
201A06B2A	NR1D404AAD2000	6	3.75	218	4	2.5	$13.40
201A06D2A	NR1D407AAD2000	6	3.75	218	8	3.5	14.10
201A06F2A	NR1D415AAD2000	6	3.75	218	15	5.0	17.30
201A12B2A	NR1D404AAD4000	12	9.0	790	4	2.5	13.40
201A12D2A	NR1D407AAD4000	12	9.0	790	8	3.5	14.10
201A12F2A	NR1D415AAD4000	12	9.0	790	15	5.0	17.30
201A24B2A	NR1D404AAD5000	24	18.0	3060	4	2.5	13.40
201A24D2A	NR1D407AAD5000	24	18.0	3060	8	3.5	14.10
201A24F2A	NR1D415AAD5000	24	18.0	3060	15	5.0	17.30
201A48B2A	NR1D404AAD6000	48	36.00	12,200	4	2.5	15.80
201A48D2A	NR1D407AAD6000	48	36.00	12,200	8	3.5	16.50
201A48F2A	NR1D415AAD6000	48	36.00	12,200	15	5.0	19.70
201A05B2A	———	5	3.75	425	4	2.5	14.60
201A05D2A	———	5	3.75	425	8	3.5	15.30
201A05F2A	———	5	3.75	425	15	5.0	18.50

SPECIFICATIONS

LOAD RATING: 4, 8 or 15A at 240Vac, 50/60Hz (400V max. peak)

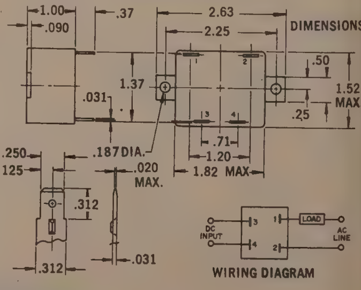
ELECTRICAL ISOLATION: Greater than 10^{10} ohms input/output isolation

LIFE EXPECTANCY: 100 x 10^6 operations min. with random switching during the cycle

TYPICAL OPERATE TIME: Turn On: 1ms max. Turn Off: At 1st zero amplitude current point of the sinewave after coil de-energization

BREAKDOWN VOLTAGE: 1000Vac, 60Hz min. between all mutually insulated terminals and the mounting plate

ENVIRONMENTAL: Operating temperature from 0° to 70°C (with adequate heat sink)



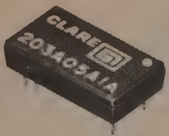
NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

CLARE
a GENERAL INSTRUMENT company

3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

SOLID STATE RELAYS

NEW 203 SERIES


CLARE
203A05A1A

Clare's new SPST (N.O.) 203 series Solid State Relay features a zero-switching trigger circuit, photo-isolation and heavy duty ac power switching in a compact DIP package. The ¾ ampere rating at 0.35 power factor is unmatched in the industry. This device, will switch solenoid, motor starter, heater, incandescent loads and telecommunication ringer frequency loads with ease and reliability.

SPECIFICATIONS

INPUT:

Nominal — +4 to 12 Vdc
Continuous — +13.5 Vdc Max.

OUTPUT (Max. Ratings):

Repetitive Peak Offstate Voltage (Note 5) — ±400 Vdc
RMS Working Voltage (Note 1) — 140 Vac
RMS Output Current (Figure 1) — 0.750A
Peak One-Cycle Surge Current (Note 2 & Fig. 2) — 7.50A
Peak One-Second Surge Current (Note 2 & Fig. 2) — 3.75A

STORAGE TEMPERATURE: −40°C to +125°C

OPERATING TEMPERATURE: 0°C to +85°C

INPUT:

	Min.	Max.
Pickup Voltage (Must operate)	—	4.0 Vdc
Drop Out (Must release)	1.0 Vdc	—
Input Current (V_{input} = +4.5 Vdc)	—	12.5 mAdc
Input Current (V_{input} = +13.5 Vdc)	—	50 mAdc

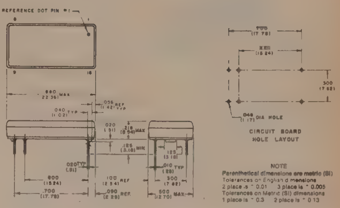
Note: All engineering data subject to change without notice:

OUTPUT:

	Min.	Max.
RMS Load Voltage (Note 3)	6.3 Vac	140 Vac
RMS Load Current (Figure 1)	10 mAac	750 mAac
Load Power Factor (Note 4)	0.35	1.0
Load Frequency	20 Hz	63 Hz
Offstate Leakage Current (Load Voltage @ 120 Vac)		3 mAac
Output Voltage Drop (I_{Load}) = ¾A		1.7 V peak
Source Voltage (At 1st Turn On)		10 Vacpeak
Turn On Time (Zero Voltage Turn On)		½ cycle
Turn Off Time (Zero Current Turn Off)		½ cycle

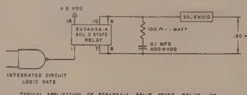
ISOLATION (Input to output, input to case or output to case):

Dielectric Withstanding Voltage — 1500 Vac, rms, min.
Insulation Resistance — 10^{10} ohms
Capacitance - Input to Output — 10 pF

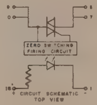

REFERENCE DOT PIN #1
8
1
9
16
.880 (22.36) MAX
.056 (1.42) REF TYP
.040 (1.02) TYP
.020 (.51)
.218 (5.54) MAX
.125 (3.18) MIN
.125 (3.18)
.020 TYP (.51)
.010 TYP (.25)
.600 (15.24)
.100 (2.54) REF
.300 (7.62)
.700 (17.78)
.090 (2.29) REF
.500 (12.70) MAX
.700 (17.78)
.600 (15.24)
.300 (7.62)
.046 (1.17) DIA HOLE
CIRCUIT BOARD HOLE LAYOUT

NOTE
Parenthetical dimensions are metric (SI)
Tolerances on English dimensions
2 place is ± 0.01 3 place is ± 0.005
Tolerances on Metric (SI) dimensions
1 place is ± 0.3 2 place is ± 0.13

CIRCUIT SCHEMATIC & APPLICATION:


+5 VDC
16
10
9
203A05A1A SOLID STATE RELAY
1
7
8
100 Ω - ½ WATT
0.1 MFD 400 WVDC
SOLENOID
120 VAC
INTEGRATED CIRCUIT LOGIC GATE

TYPICAL APPLICATION OF 203A05A1A SOLID STATE RELAY. AN EXTERNAL RC FILTER IS RECOMMENDED WHENEVER DRIVING INDUCTIVE LOADS


9
10
8
7
ZERO SWITCHING FIRING CIRCUIT
16
1
+
−

CIRCUIT SCHEMATIC TOP VIEW

List Price $16.00

NEW 212 SERIES

Clare's new SPST (N.O.) 212 series AC Solid State Relays have heavy duty switching capabilities with 10 or 25 ampere ratings at 140 or 250 Vac. The opto-isolator provides total input/output isolation and the sensitive input is fully compatible with DTL/TTL logic. The 212 series relays are ideally suited for computer peripheral, process control and inductive load applications. One cycle surge current rating is 1000%. Arc free switching is suited for explosive atmospheres.

SPECIFICATIONS

INPUT at 25°C:

Control voltage — 3 Vdc min., 28 Vdc max.
Pickup voltage (must operate) — 3.0 Vdc max.
Dropout voltage (must release) — 1.0 min.
Input current at 5 Vdc input — 4 mAdc typ., 6 mAdc max.
Input current at 28 Vdc input — 35 mAdc typ.

OUTPUT at 25°C:

RMS load voltage — 12 Vac min., 140 or 250 Vac max.
RMS load current — .05 A min., 10 or 25 A max.
One cycle surge current — 10 times rated current max.
Repetitive peak offstate voltage (140 V rating) — 200 V peak-peak max.
Repetitive peak offstate voltage (250 V rating) — 400 V peak-peak max.
Output transient immunity (dv/dt) — 100 V/us min, 200 V/us typ.
Frequency range — 50 Hz min., 70 Hz max.
Offstate leakage current @ 140 V (140 V rating) — 8 mAac max.
Offstate leakage current @ 250 V (250 V rating) — 13 mAac max.

Load voltage at turn on — ±6 V peak typ.
Turn on time at 60 Hz — 8.3 ms max.
Turn off time at 60 Hz — 16.6 ms max.

ISOLATION (input to output, input and output to case):

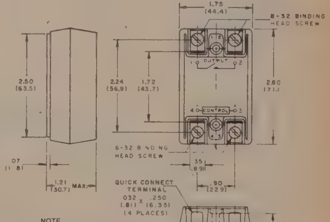
Dielectric withstanding voltage (60 Hz) — 1500 Vac min.
Insulation resistance — 10^9 ohms min.
Capacitance input to output only — 8 pF typ., 10 pF max.

TEMPERATURE RANGE:

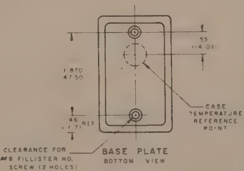
Operating and storage — −40°C min., +80°C max.

PHYSICAL:

Weight — 4 ounces
Case material — Self extinguishing Charcoal grey plastic
Base plate — Aluminum


1.75 (44.4)
8-32 BINDING HEAD SCREW
2.50 (63.5)
2.24 (56.9)
1.72 (43.7)
2.80 (71.1)
1
OUTPUT
2
4
CONTROL
3
6-32 BINDING HEAD SCREW
.07 (1.8)
1.21 (30.7) MAX.
.35 (8.9)
.90 (22.9)
QUICK CONNECT TERMINAL .032 (.81) x .250 (6.35) (4 PLACES)
1.03 (26.2)

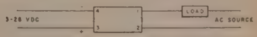
NOTE
Parenthetical dimensions are metric (SI)
Tolerances on English dimensions
2 place is ± 0.01 3 place is ± 0.005
Tolerances on Metric (SI) dimensions:
1 place is ± 0.3 2 place is ± 0.13


.55 (14.0)
1.870 47.50
.46 (11.7) REF
CASE TEMPERATURE REFERENCE POINT
CLEARANCE FOR #8 FILLISTER HD. SCREW (2 HOLES)

BASE PLATE
BOTTOM VIEW

Weight: 4 ounces
Case material: Self extinguishing Charcoal grey plastic.
Base plate: Aluminum

CIRCUIT SCHEMATIC & APPLICATION:


3-28 VDC
4
1
3
2
+
LOAD
AC SOURCE

TYPICAL APPLICATION OF 212 SERIES SOLID STATE RELAY

Part Number	Contact Form	Input Voltage (Vdc)	Pickup Voltage (Vdc)	Dropout Voltage (Vdc)	RMS Output Current (A)	RMS Output Voltage (Vac)	List Price
212B11D1E	SPST (N.O.)	3-28	3.0	1.0	10	140	$23.00
212B11D2E	SPST (N.O.)	3-28	3.0	1.0	10	250	25.00
212B11D1F	SPST (N.O.)	3-28	3.0	1.0	25	140	29.00
212B11D2F	SPST (N.O.)	3-28	3.0	1.0	25	250	32.00

CLARE
a GENERAL INSTRUMENT company

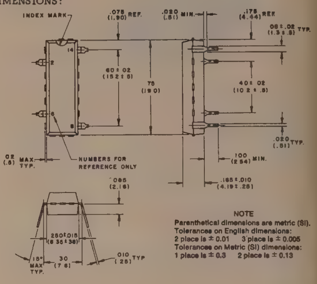
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO

SOLID STATE DIP RELAYS

233 SERIES

The small 233 Solid State DIP Relays give you a choice of dc switching: 60 volts at 400 mA or 250 volts at 100 mA. Provides pure solid state features. Fast, 1 microsecond response time, compatibility with 5 V digital logic, total input/output isolation. 10 billion operations. Standard 14 pin dual in-line package. Ideal for isolated line, lamp drivers and data couplers.

DIMENSIONS:


INDEX MARK
.075 (1.90) REF.
.020 (.51) MIN.
.175 (4.44) REF
.05 ± .02 (1.3 ± .5) TYP.
14
2
6
8
.60 ± .02 (15.2 ± .5)
.75 (19.0)
.40 ± .02 (10.2 ± .5)
.020 (.51) TYP.
.02 (.5) MAX. TYP.
NUMBERS FOR REFERENCE ONLY
.100 (2.54) MIN.
.165 ± .010 (4.19 ± .26)
.085 (2.16)
.250 ± .015 (6.35 ± .38)
15° MAX. TYP.
.30 (7.6)
.010 (.25) TYP

NOTE
Parenthetical dimensions are metric (SI).
Tolerances on English dimensions:
2 place is ± 0.01 3 place is ± 0.005
Tolerances on Metric (SI) dimensions:
1 place is ± 0.3 2 place is ± 0.13

SPECIFICATIONS

INPUT at 25°C:
- Control voltage — 3.8 Vdc min., 10 Vdc max.
- Pickup voltage (Must operate) — 3.8 Vdc max.
- Dropout voltage (Must release) — 0.4 Vdc min.
- Input current at 5 Vdc — 9 mA typ., 15 mA max.

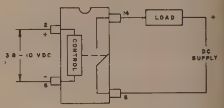
ISOLATION (input to output):
- Dielectric withstanding voltage (60 Hz) — 1500 Vac (p-p) min.
- Insulation resistance — 10^9 ohms min.
- Capacitance — 5 pF max.

TEMPERATURE RANGE:
- Operating and storage — −20°C min., +100°C max.

Note: All engineering data subject to change without notice.

OUTPUT at 25°C:	233B11A1B Max.	233B11A2A Max.
Output voltage	60 Vdc	250 Vdc
Output current at 5 V input	200 mA	50 mA
Output current at 10 V input	400 mA	100 mA
Drive frequency (100 ohm resistive load)	30 KHz	30 KHz
Offstate leakage current @ 100% rated output voltage	60 µA	60 µA
Contact "On" voltage @ 100% rated output voltage, 10 Vdc input voltage	1.5 Vdc	1.5 Vdc
Capacitance across contacts	15 pF	40 pF
Rise time $V_L = 20$ V, $R_L = 100$ ohms, $V_{in} = 5$V	1.0 µs	1.0 µs
Fall time $V_L = 20$ V, $R_L = 100$ ohms, $V_{in} = 5$V	5.0 µs	5.0 µs

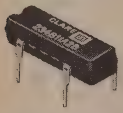
CIRCUIT SCHEMATIC:


14
LOAD
+
2
+
CONTROL
3.8 - 10 VDC
6
8
DC SUPPLY

Stock Part Number	Contact Form	Input Voltage (Vdc)	Pickup Voltage (Vdc)	Dropout Voltage (Vdc)	Output Voltage (Vdc)	Output Current (mA)	List Price
233B11A1B	SPST (N.O.)	3.8-10	3.8	0.4	60	400	$10.50
233B11A2A	SPST (N.O.)	3.8-10	3.8	0.4	250	100	13.00

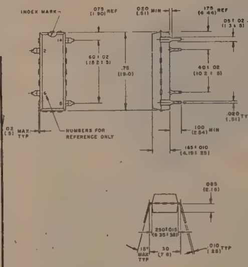
Note: All electrical values are measured at 25°C.

234 SERIES



Clare's small 234 Solid State DIP relays provide pure solid state features: Fast, 10 microsecond response time, compatibility with 5 V digital logic, bipolar output, total input/output isolation. Standard 14 pin dual in-line package. Ideal for isolated line and lamp drivers, data couplers, and analog-transducer signal switching.

DIMENSIONS:


INDEX MARK
.075 (1.90) REF
.020 (.51) MIN
.175 (4.44) REF
.05 ± .02 (1.3 ± .5) TYP
14
2
6
8
.60 ± .02 (15.2 ± .5)
.75 (19.0)
.40 ± .02 (10.2 ± .5)
.020 (.51) TYP
.02 (.5) MAX TYP
NUMBERS FOR REFERENCE ONLY
.100 (2.54) MIN
.165 ± .010 (4.19 ± .25)
.085 (2.16)
.250 ± .015 (6.35 ± .38)
15° MAX TYP
.30 (7.6)
.010 (.25) TYP

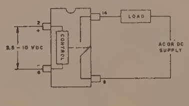
NOTE
Parenthetical dimensions are metric (SI).
Tolerances on English dimensions:
2 place is ± 0.01 3 place is ± 0.005
Tolerances on Metric (SI) dimensions:
1 place is ± 0.3 2 place is ± 0.13

SPECIFICATIONS

	234B11A1A Minimum	234B11A1A Typical	234B11A1A Maximum	234B11A2B Minimum	234B11A2B Typical	234B11A2B Maximum
INPUT at 25°C						
Control voltage	3.8 Vdc	—	6 Vdc	3.8 Vdc	—	10 Vdc
Pickup voltage (Must operate)	—	—	3.8 Vdc	—	—	3.8 Vdc
Dropout voltage (Must release)	0.4 Vdc	—	—	0.4 Vdc	—	—
Input current at 5 Vdc input	—	15 mAdc	18 mAdc	—	18 mAdc	22 mAdc
Input current at 10 Vdc input	—	20 mAdc	—	—	27 mAdc	—
OUTPUT at 25°C						
Load voltage	—	—	±5 V peak	—	—	±50 V peak
Load current at 5 V input	—	—	±5 mA peak	—	—	±40 mA peak
Load current at 10 V input	—	—	—	—	—	±80 mA peak
Drive frequency (1K ohm resistive load	—	30 KHz	—	—	100 KHz	—
Offstate leakage current — at ±25 V	—	—	.01 µA	—	—	.006 µA
at ±50 V	—	—	—	—	—	60 µA
Offset voltage	—	±100 µV	±150 µV	—	±1.0 mV	±5.0 mV
Contact on resistance	—	12 ohms	15 ohms	—	2.0 ohms	5.0 ohms
Turn on time $V_{in} = 5$ V $V_L = 20$ V $R_L = 1000$ ohms	—	10 µs	—	—	—	1.0 µs
Turn off time $V_L = 20$ V $R_L = 1000$ ohms	—	8 µs	—	—	8 µs	10 µs
Capacitance across contacts	—	7 pF	10 pF	—	7 pF	10 pF
Maximum surge across contacts (See Note 3)	—	—	—	—	—	0.1 Joule
ISOLATION (input to output)						
Dielectric withstanding voltage 60 Hz	750 V peak	—	—	750 V peak	—	—
Insulation resistance	10^9 ohms	—	—	10^9 ohms	—	—
Capacitance	—	—	5 pF	—	—	5 pF
TEMPERATURE RANGE						
Operating and storage	−20°C	—	100°C	−20°C	—	100°C

All engineering data subject to change without notice

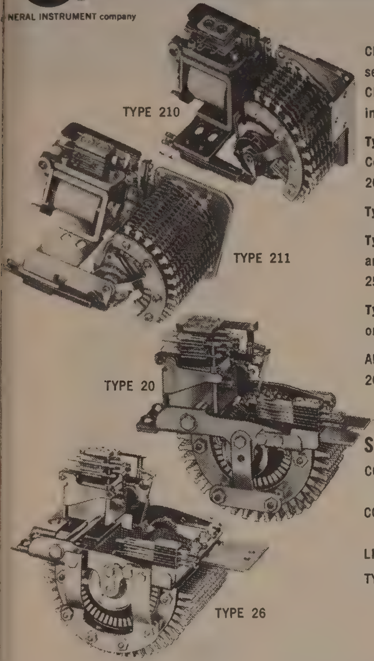
CIRCUIT SCHEMATIC:


14
LOAD
2
+
CONTROL
3.8 - 10 VDC
6
8
AC OR DC SUPPLY

Stock Part Number	Contact Form	Input (Vdc) Voltage	Pickup Voltage (Vdc)	Dropout Voltage (Vdc)	Peak Output Current A ac/dc	Peak Output Voltage ac/dc	List Price
234B11A1A	SPST (N.O.)	3.8-6	3.8	0.4	.005	±5 V	$15.50
234B11A2B	SPST (N.O.)	3.8-10	3.8	0.4	.08	±50 V	10.50

CLARE
3101 PRATT BLVD. / CHICAGO / ILLINOIS 60645
(312) 262-7700 / CABLE: CLARELAY, CHICAGO
NERAL INSTRUMENT company

STEPPING SWITCHES



Clare stepping switches offer an economical alternative to solid state switching. Multiplexing, counting and sequencing problems are easily solved by providing the most working capacity in the smallest space. Clare stepping switches allow you to select, interrupt or change connections in a succession of circuits in response to current pulses.

Type 210 offers 3, 6 & 12 levels of 10 points with a life expectancy of 100 million steps at 12 levels. Contacts are rated 0.1A at 115Vac or 30Vdc resistive with a 3A carry rating. Operate time is approx. 20ms at 25°C and release time is 10ms. Solder lug terminals are standard.

Type 211 has the same electrical characteristics as the type 210 but in 3, 6, & 12 levels of 11 points.

Type 20 offers 4 & 8 levels of 20 points with a life expectancy of 180 million steps at 8 levels. Contacts are rated 0.1A at 115Vac or 30Vdc resistive with a 3A carry rating. Operate time is approx. 20ms at 25°C and release time is approx. 10ms at 25°C. Solder lug terminals are standard.

Type 26 has the same electrical characteristics as the type 20 but is offered in 4 & 8 levels of 26 points or 6 levels of 52 points.

ALL SWITCHES LISTED HAVE 1 BRIDGING LEVEL WITH THE REMAINING LEVELS BEING NON-BRIDGING. 2C OFF-NORMAL AND 2C INTERRUPTER CONTACTS ARE STANDARD.

SPECIFICATIONS

CONTACT RATINGS (Resistive Load): 0.1A at 115Vac or 30Vdc switched, 3A carry only; max.

CONTACT RESISTANCE (ON Impedance): 0.15 ohm typical

LIFE EXPECTANCY: (See description)

TYPICAL OPERATE TIME: Approximately 20ms at 25°C, release time approx. 10ms

BREAKDOWN VOLTAGE: 1000Vac, 60Hz across open contacts

INSULATION RESISTANCE (OFF Impedance): 10^{11} ohms at 500Vdc between levels

ENVIRONMENTAL: Vibration: 0.06″ d.a., 10 - 55Hz. Shock: 30g's, 11 ±1ms. Temperature: 0°C to +85°C

Stock Part No.	Nom. Volt. (dc)	Coil Resistance (ohms)	Levels	Points	Dimensions H	Dimensions W	Dimensions D	List Price
210-2403A	24	24	3	10	2¾	4 5/16	1 19/64	$27.80
210-2406A	24	24	6	10	2¾	4 5/16	1 13/16	31.75
210-2412A	24	20	12	10	2¾	4 5/16	2 13/16	51.60
210-4803A	48	100	3	10	2¾	4 5/16	1 19/64	27.80
210-4806A	48	100	6	10	2¾	4 5/16	1 13/16	31.75
210-4812A	48	70	12	10	2¾	4 5/16	2 13/16	51.60
210-11003A	110	600	3	10	2¾	4 5/16	1 19/64	28.35
210-11006A	110	600	6	10	2¾	4 5/16	1 13/16	32.35
210-11012A	110	400	12	10	2¾	4 5/16	2 13/16	52.15
211-2403A	24	24	3	11	2¾	4 5/16	1 19/64	27.80
211-2406A	24	24	6	11	2¾	4 5/16	1 13/16	31.75
211-2412A	24	20	12	11	2¾	4 5/16	2 13/16	51.60
211-4803A	48	100	3	11	2¾	4 5/16	1 19/64	27.80
211-4806A	48	100	6	11	2¾	4 5/16	1 13/16	31.75
211-4812A	48	70	12	11	2¾	4 5/16	2 13/16	51.60
211-11003A	110	600	3	11	2¾	4 5/16	1 19/64	28.35
211-11006A	110	600	6	11	2¾	4 5/16	1 13/16	32.35
211-11012A	110	400	12	11	2¾	4 5/16	2 13/16	52.15
20-2404A	24	35	4	20	4⅝	5 5/16	2⅛	39.65
20-2408A	24	35	8	20	4⅝	5 5/16	2⅛	49.90
20-4804A	48	100	4	20	4⅝	5 5/16	2⅛	39.65
20-4808A	48	100	8	20	4⅝	5 5/16	2⅛	49.90
20-11004A	110	600	4	20	4⅝	5 5/16	2⅛	40.25
20-11008A	110	600	8	20	4⅝	5 5/16	2⅛	50.45
26-2404A	24	35	4	26	4⅞	6 9/16	2½	41.35
26-2408A	24	35	8	26	4⅞	6 9/16	2½	51.00
26-4804A	48	100	4	26	4⅞	6 9/16	2½	41.35
26-4808A	48	100	8	26	4⅞	6 9/16	2½	51.00
26-11004A	110	600	4	26	4⅞	6 9/16	2½	41.95
26-11008A	110	600	8	26	4⅞	6 9/16	2½	51.60
26-11026A	110	600	6	52	4⅞	6 9/16	2¾	64.65
RP8047G4	Rectifier Unit							14.20
RP9466	Standard Lubrication Kit							10.00
RP11375	Tool Kit							50.00

NOTE: ALL SPECIFICATIONS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

COMPUTER COMPONENTS INC.

88-06 Van Wyck Expressway, Jamaica, New York 11418 (212) 291-3500

REED RELAYS

Computer Components Inc. HP Series of dry reed and mercury wetted relays offers the design engineer miniature, low profile, plug-in devices, with magnetically shielded coils.

Fast switching speeds and low power consumption make them applicable to control and instrumentation, low level switching, counting, high speed sampling, computers and associated peripheral equipment.

In addition to the company's standard dry reed and mercury wetted designs, CCI also produces exact replacements for IBM plug-in reed relays. (See Equivalency Chart on back page of catalog for specifications and cross reference part numbers.) Write or phone for catalog.

CONTACT RATING — HP-A SERIES — SINGLE POLE, SINGLE THROW, DRY REED

Contact Dash No.	Resistive Load				Max. Initial Contact Res. (Ohms)	Min. Break-down Voltage D.C.	Min. I.R. (Ohms)	Life @ Rated Load x 10^6	Contact Material Plating	Suggested Application
	Max. Amps D.C.	Max. Volts D.C.	Max. Watts D.C.	V.A. A.C.						
1	.5	28	10	10	.100	300	10^{10}	10	Rhodium over Gold	Instrument Grade Low Thermal EMF
2	.5	200	10	12	.200	300	10^{10}	10	Rhodium or Dimet	General Purpose D.C. to 30MHz
3	.5 @ 20V .01 @ 1000V	1000	10	10	.100	1500	10^{10}	10	Rhodium	High Voltage

CONTACT RATING — HP-C SERIES — SINGLE POLE, DOUBLE THROW, DRY REED

Contact Dash No.	Resistive Load				Max. Initial Contact Res. (Ohms)	Min. Break-down Voltage D.C.	Min. I.R. (Ohms)	Life @ Rated Load x 10^6	Contact Material Plating	Suggested Application
	Max. Amps D.C.	Max. Volts D.C.	Max. Watts D.C.	V.A. A.C.						
1	.25	28	3	3	.150	250	10^9	10	Rhodium over Gold	Instrument Grade
2	.25	150	4	4	.200	200	10^9	10	Rhodium	General Purpose
3	.50	150	6	10	.150	200	10^9	10	Gold Rhodium	General Purpose

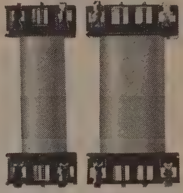
CONTACT RATING — MWHP-A SERIES — SINGLE POLE, SINGLE THROW, MERCURY WETTED REED

Contact Dash No.	Resistive Load				Max. Initial Contact Res. (Ohms)	Min. Break-down Voltage D.C.	Min. I.R. (Ohms)	Life @ Rated Load x 10^6	Contact Material Plating	Suggested Application
	Max. Amps D.C.	Max. Volts D.C.	Max. Watts D.C.	V.A. A.C.						
1	1.0	100	28	28	.100	1000	10^{10}	100	Mercury Wetted	No Bounce
2	1.0 Derate to .02 @ 500V	500	50	50	.100	1500	10^{10}	50	Mercury Wetted	No Bounce

OPERATING PARAMETERS — HP-A, HP-C, MWHP-A SERIES

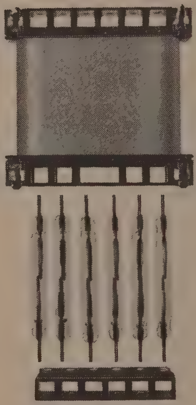
Contact Arrangement†	Nominal Coil Voltage V.D.C.*	Coil Resistance @ 25°C Ohms ±10%	Max. Pick-up Voltage @ 25°C	Min. Release Voltage @ 25°C	Operate Power @ 25°C Milliwatts	Nominal Power @ 25°C Milliwatts	Max. Pick-up Time Milliseconds		Max. Release Time Milliseconds**	
							Contact Form		Contact Form	
							A	B, C, MW	A	B, C, MW
1A	6	150	4.5	1.0	140	240	1.0	1.75	0.5	2.0
	12	600	9.0	2.0						
	24	2400	18.0	4.0						
2A	6	110	4.5	1.0	190	330	1.0	1.75	0.5	2.0
2B	12	440	9.0	2.0						
1C	24	1760	18.0	4.0						
4A	6	90	4.5	1.0	230	400	1.5	2.0	0.75	2.5
4B	12	360	9.0	2.0						
2C	24	1440	18.0	4.0						
6A	6	50	4.5	1.0	410	720	1.5	2.5	0.75	2.5
6B	12	200	9.0	2.0						
3C	24	800	18.0	4.0						

NOTES: †Available in mixed arrangements. *Available with 3, 5, 9, 18 and 48 volt coils. **With coil unsuppressed.



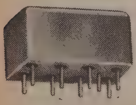
LOW PROFILE

PLUG-IN



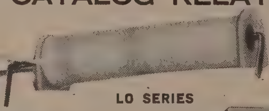
REPLACEABLE SWITCHES

STANDARD CATALOG RELAYS



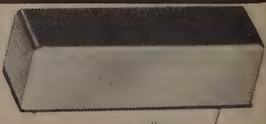
MG SERIES

HVPC SERIES



LO SERIES

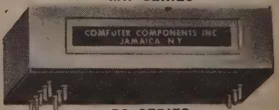
CCR SERIES



MW SERIES

COMPUTER COMPONENTS INC JAMAICA, N.Y.

MPC SERIES



PC SERIES

All Relays above are available with the following features:

- 6, 12, 24 and 48 VDC coils.
- Magnetic and/or electrostatic shielding.
- Higher insulation resistance.
- Available for +125°C operation (standard temperature −55°C to +85°C).

For detailed information write or phone for our latest catalog.

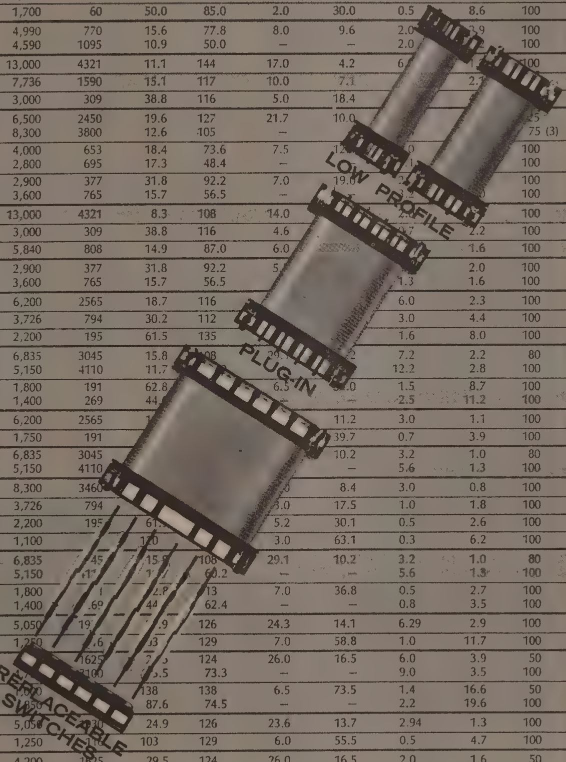
COMPUTER COMPONENTS INC.

88-06 Van Wyck Expressway, Jamaica, New York 11418 (212) 291-3500

Specifications

CCI/IBM REED RELAY EQUIVALENCY CHART

	Type	Rated Coil Voltage (Vdc) ±10%	No. of Turns	Nominal Resistance (ohms) ±7%	Nominal Current (mA)	Nominal NI	Must Pickup Voltage(1) (Vdc @ 25°C)	Must Pickup Current(1) (mA)	Minimum Dropout Voltage(2) (Vdc @ 25°C)	Minimum Dropout Current(2) (mA)	Duty Cycle in %	Cross Reference Part Numbers CCI	IBM
1 POLE	**1-Position Form A, Pickup**	48	19,500	7385	6.5	126	16.9	2.6	5.0	0.7	100%	101186	766086
		24	16,500	4190	5.7	94.5	11.0	3.0	3.0	0.8	100	101168	766068
		18	10,560	2195	8.2	86.6	10.0	4.7	3.0	1.3	100	101165	766065
		12	6,800	966	12.4	84.3	6.5	7.5	2.3	2.0	100	101140	766040
		6	3,400	244	24.6	83.6	3.2	15.0	1.0	4.0	100	101160	766060
		3	1,700	60	50.0	85.0	2.0	30.0	0.5	8.6	100	101159	766059
	1-Position Form A, Pickup & Hold	12	4,990	770	15.6	77.8	8.0	9.6	2.0	[illegible]	100	101142	766042
		12	4,590	1095	10.9	50.0	–	–	2.0	[illegible]	100		
2 POLE	**2-Position Form A, Pickup**	48	13,000	4321	11.1	144	17.0	4.2	[illegible]	[illegible]	100	101272	766072
		24	7,736	1590	15.1	117	10.0	7.1	[illegible]	[illegible]	[illegible]	101267	766067
		12	3,000	309	38.8	116	5.0	18.4	[illegible]	[illegible]	[illegible]	101243	766043
	2-Position Form A, Pickup & Hold	48	6,500	2450	19.6	127	21.7	10.0	[illegible]	[illegible]	25	101287	766087
		48	8,300	3800	12.6	105	–	[illegible]	[illegible]	[illegible]	75 (3)		
		12 (4)	4,000	653	18.4	73.6	7.5	[illegible]	[illegible]	[illegible]	100	101257	766057
		12	2,800	695	17.3	48.4	–	[illegible]	[illegible]	[illegible]	100		
		12	2,900	377	31.8	92.2	7.0	19.0	[illegible]	[illegible]	100	101244	766044
		12	3,600	765	15.7	56.5	–	[illegible]	[illegible]	[illegible]	100		
	2-Position Form B, Pickup	24	13,000	4321	8.3	108	14.0	[illegible]	[illegible]	[illegible]	100	101280	766080
		12	3,000	309	38.8	116	4.6	[illegible]	[illegible]	2.2	100	101256	766056
		12	5,840	808	14.9	87.0	6.0	[illegible]	[illegible]	1.6	100	101241	766041
	2-Position Form B, Pickup & Hold	12	2,900	377	31.8	92.2	[illegible]	[illegible]	[illegible]	2.0	100	101245	766045
		12	3,600	765	15.7	56.5	[illegible]	[illegible]	1.3	1.6	100		
4 POLE	**4-Position Form A, Pickup**	48	6,200	2565	18.7	116	[illegible]	[illegible]	6.0	2.3	100	101471	766071
		24	3,726	794	30.2	112	[illegible]	[illegible]	3.0	4.4	100	101466	766066
		12	2,200	195	61.5	135	[illegible]	[illegible]	1.6	8.0	100	101446	766046
	4-Position Form A, Pickup & Hold	48	6,835	3045	15.8	[illegible]	[illegible]	[illegible]	7.2	2.2	80	101479	766079
		48	5,150	4110	11.7	[illegible]	[illegible]	[illegible]	12.2	2.8	100		
		12	1,800	191	62.8	[illegible]	6.5	[illegible]	1.5	8.7	100	101447	766047
		12	1,400	269	[illegible]	[illegible]	–	–	2.5	11.2	100		
	4-Position Form B, Pickup	48	6,200	2565	[illegible]	[illegible]	[illegible]	11.2	3.0	1.1	100	101481	766081
		12	1,750	191	[illegible]	[illegible]	[illegible]	39.7	0.7	3.9	100	101448	766048
	4-Position Form B, Pickup & Hold	48	6,835	3045	[illegible]	[illegible]	[illegible]	10.2	3.2	1.0	80	101482	766082
		48	5,150	4110	[illegible]	[illegible]	[illegible]	–	5.6	1.3	100		
	2-Position Form A, (5) 2-Position Form B, Pickup	48	8,300	3460	[illegible]	[illegible]	[illegible]	8.4	3.0	0.8	100	101473	766073
		24	3,726	794	[illegible]	[illegible]	[illegible]	17.5	1.0	1.8	100	101469	766069
		12	2,200	195	[illegible]	[illegible]	5.2	30.1	0.5	2.6	100	101449	766049
		6	1,100	[illegible]	[illegible]	[illegible]	3.0	63.1	0.3	6.2	100	101461	766061
	2-Position Form A, (5) 2-Position Form B, Pickup & Hold	48	6,835	[illegible]	[illegible]	108	29.1	10.2	3.2	1.0	80	101474	766074
		48	5,150	[illegible]	[illegible]	[illegible]	–	–	5.6	1.3	100		
		12	1,800	[illegible]	[illegible]	[illegible]	7.0	36.8	0.5	2.7	100	101453	766053
		12	1,400	[illegible]	[illegible]	62.4	–	–	0.8	3.5	100		
6 POLE	**6-Position Form A, Pickup**	48	5,050	[illegible]	[illegible]	126	24.3	14.1	6.29	2.9	100	101670	766070
		12	1,250	[illegible]	[illegible]	129	7.0	58.8	1.0	11.7	100	101636	766036
	6-Position Form A, Pickup & Hold	48	[illegible]	1625	[illegible]	124	26.0	16.5	6.0	3.9	50	101684	766084
		48	[illegible]	[illegible]	[illegible]	73.3	–	–	9.0	3.5	100		
		12	[illegible]	[illegible]	138	138	6.5	73.5	1.4	16.6	50	101652	766052
		12	[illegible]	[illegible]	87.6	74.5	–	–	2.2	19.6	100		
	6-Position Form B, Pickup	48	[illegible]	[illegible]	24.9	126	23.6	13.7	2.94	1.3	100	101683	766083
		12	1,250	[illegible]	103	129	6.0	55.5	0.5	4.7	100	101650	766050
	6-Position Form B, Pickup & Hold	48	4,200	1625	29.5	124	26.0	16.5	2.0	1.6	50	101685	766085
		48	4,730	3100	15.5	73.3	–	–	4.0	1.4	100		
		12	1,000	87	138	138	6.5	71.4	0.5	5.8	50	101654	766054
		12	850	137	87.6	74.5	–	–	0.8	6.9	100		
	4-Position Form A, (5) 2-Position Form B, Pickup	48	5,050	1930	29.4	126	24.3	14.1	2.9	1.3	100	101676	766076
		12	1,250	116	103	129	6.0	58.8	0.5	4.7	100	101651	766051
	4-Position Form A, (5) 2-Position Form B, Pickup & Hold	48	4,200	1625	29.5	124	28.0	18.0	2.0	1.4	50	101678	766078
		48	4,730	3100	15.5	73.3	–	–	4.0	1.2	100		
		12	1,000	87	138	138	6.5	74.5	0.5	4.9	50	101655	766055
		12	850	137	87.6	74.5	–	–	0.8	5.7	100		
	(5) 4-Position Form B, 2-Position Form A, Pickup	48	5,050	1930	24.9	126	24.3	14.1	2.94	1.3	100	101675	766075
		12	1,250	116	103	129	7.0	57.1	0.5	4.7	100	101658	766058
	(5) 4-Position Form B, 2-Position Form A, Pickup & Hold	48	4,200	1625	29.5	124	28.0	17.5	2.0	1.6	50	101677	766077
		48	4,730	3100	15.5	73.3	–	–	4.0	1.4	100		



(1) The voltage (or current) at or below which the relay assumes its fully operated position. (2) The maximum voltage (or current) at which the relay must restore to its unoperated position. (3) Hold coil 100% if energized alone. Duty cycles less than 100% are based on a 3 sec. total cycle time, with maximum continuous energized time of 1.5 sec. (4) ±4% rated voltages. (5) Form B contacts are in center of A/B relays.

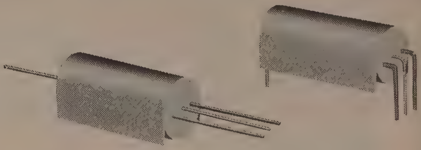
REED RELAYS

COTO
Coto SINCE 1917

High Quality Low-Cost
REED RELAYS

Series CR-4000

DESCRIPTION



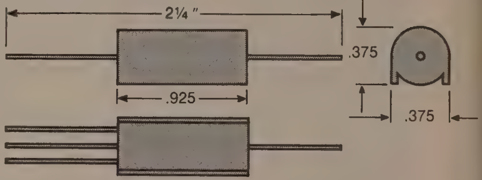
These new uniquely-designed reed relays are manufactured and tested by the most advanced production techniques, which result in minimum customer costs, and a high standard of quality and performance.

- Husky 115 amp-turn coil allows use of a wide range of reed switches
- Only premium grade catalogued reed switches used throughout
- 100% testing of switches, coils and completed relays
- Relays are completely encased in a tough flame-retardant shell. The switch and coil leads are sealed with epoxy to provide strain relief and handling protection
- Wide variety of contact types to fit most switching applications

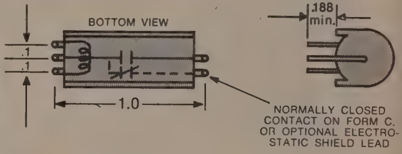
OPTIONS AVAILABLE:

Special Coil Resistance	Formed Leads for PC Board Insertion
Magnetic Shielding	Special Operating Parameters
	Electrostatic Shielding

AXIAL LEADS


2¼″
.375
.925
.375

LEADS BENT and CUT (1.0 x .100″ Centers)


BOTTOM VIEW
.1
.1
1.0
.188 min.
NORMALLY CLOSED CONTACT ON FORM C. OR OPTIONAL ELECTRO-STATIC SHIELD LEAD

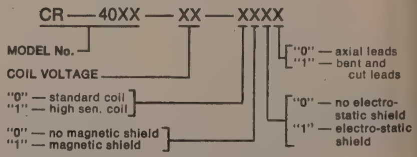
Relay Contact Type	Model Number and Coil Voltage	Initial Contact Resist. Ohms Max.	Contact Rating Watts Max.	Switch Volts DC Max.	Switch Amps Max. Resist.	Break-down Volts DC Min.
1A Low Cost	CR-4002-5, 6, 12, 24	.500	10	100	.5	250
1A Standard	CR-4003-5, 6, 12, 24	.150	10	100	.5	300
1A High Reliability	CR-4004-5, 6, 12, 24	.100	10	200	.5	300
1C Low Cost	CR-4010-5, 6, 12, 24	.500	3	28	.110	250
1C Standard	CR-4011-5, 6, 12, 24	.150	3	28	.250	250
1A* Mercury Wet	CR-4020-5, 6, 12, 24	.050	28	100	1.0	1000
1A High Voltage Low Cost	CR-4030-5, 6, 12, 24	.150	10	240 VAC	.5	600
1A High Voltage Standard	CR-4031-5, 6, 12, 24	.150	10	500	.5	1000

*Standard coil only. Mount Hg Wet relay vertically with coil leads down.

OPERATING PARAMETERS @ 25°C				
Nominal Volts	5	6	12	24
Must Operate Volts	3.7	4.5	9.0	18.0
Must Release Volts	0.4	0.5	1.0	2.0
Standard Coil Resistance Ohms	65	105	500	1800
High Sensitivity Coil Resistance Ohms	175	300	1000	4000

Insulation Resistance 10^9 Ohms min
@ 100VDC, 25°C, 40% Rel. Humidity

ORDERING INFORMATION


CR — 40XX — XX — XXXX
MODEL No.
COIL VOLTAGE
"0" — standard coil
"1" — high sen. coil
"0" — no magnetic shield
"1" — magnetic shield
"0" — axial leads
"1" — bent and cut leads
"0" — no electro-static shield
"1" — electro-static shield

If all options are "0" omit last four digits.

Specifications subject to change without notice.

Coto's staff of reed relay specialists will be pleased to assist you in designing and specifying the proper relay for any special application. Write for information on our complete line of stock reed relays.

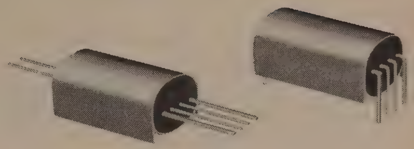
COTO High Quality Low-Cost

REED RELAYS

Series CR-4200

DESCRIPTION

The CR-4200 series reed relays, like the one pole CR-4000 type, have been designed to minimize customer costs without sacrificing quality and performance. These high-quality, low-cost relays are manufactured and tested with the most modern production techniques, and utilize premium grade standard reed switches.



- Husky 120 amp-turn coil allows use of a wide range of reed switches
- Only premium grade catalogued reed switches used throughout
- 100% testing of switches, coils and completed relays
- Relays are completely encased in a tough flame-retardant shell. The switch and coil leads are sealed with epoxy to provide strain relief and handling protection
- Wide variety of contact types to fit most switching applications

OPTIONS AVAILABLE:

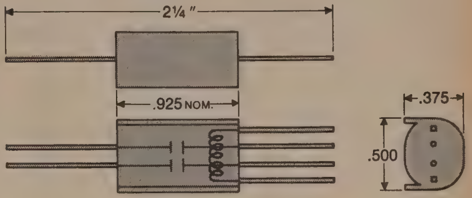
Special Coil Resistance
Magnetic Shielding
Formed Leads for PC Board Insertion
Special Operating Parameters
Electrostatic Shielding

Relay Contact Type	Model Number and Coil Voltage	Initial Contact Resist. Ohms Max.	Contact Rating Watts Max.	Switch Volts DC Max.	Switch Amps Max. Resist.	Break-down Volts DC Min.
2A Low Cost	CR-4202-5, 6, 12, 24	.500	10	100	.5	250
2A Standard	CR-4203-5, 6, 12, 24	.150	10	200	.5	300
2A High Reliability	CR-4204-5, 6, 12, 24	.100	10	200	.5	300
2C Standard	CR-4211-5, 6, 12, 24	.150	3	28	.250	250
2A High Voltage Low Cost	CR-4230-5, 6, 12, 24	.150	10	240 VAC	.5	600
2A High Voltage Standard	CR-4231-5, 6, 12, 24	.150	10	1000	.5	1200
1B Standard	CR-4240-5 6, 12, 24	.150	10	200	.5	300
1A Latch Single Coil	CR-4245-5, 6, 12, 24	.200	10	200	.5	300

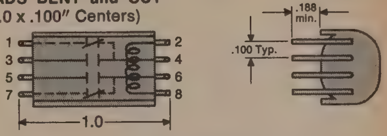
1. Available with 1000 ohm coil only.
2. External series limiting resistance recommended:
   5 or 6V — None 12V — 1000 ohms 24V — 3000 ohms
3. Coil polarity must be reversed to set and reset latch.
4. External coil suppression recommended for proper latch operation.

For 1 Form A and 1 Form C relays see Series CR-4000, Bulletin MR-12.1

AXIAL LEADS



LEADS BENT and CUT
(1.0 x .100" Centers)



Pins 1 & 7 — Normally Closed Contacts on 2 Form C
Pin 1 — Optional Electrostatic Shield Terminal on Form A and Form B Relays
Pin 2 — Positive Coil Terminal to Actuate 1 Form B or to Set Latch Relay
Pins 3 & 4 — 1 Form B or Latch Contact Terminals

OPERATING PARAMETERS @ 25°C				
Nominal Volts	5	6	12	24
Must Operate Volts	3.7	4.5	9.0	18.0
Must Release Volts	0.4	0.5	1.0	2.0
Standard Coil Resistance Ohms	60	100	400	1600
High Sensitivity Coil Resistance Ohms	150	250	1000	4000

Insulation Resistance 10^9 Ohms min
@ 100VDC, 25°C, 40% Rel. Humidity

ORDERING INFORMATION

CR — 42XX — XX — XXXX

MODEL No.
COIL VOLTAGE
"0" — standard coil
"1" — high sen. coil
"0" — no magnetic shield
"1" — magnetic shield
"0" — no electro-static shield
"1" — electro-static shield
"0" — axial leads
"1" — bent and cut leads

If all options are "0" omit last four digits.

Specifications subject to change without notice.

Coto's staff of reed relay specialists will be pleased to assist you in designing and specifying the proper relay for any special application. Write for information on our complete line of stock reed relays.

COTO

COTO-COIL COMPANY, INC.

65 Pavilion Avenue. Providence, R. I. 02905 • Telephone (401) 467-4777

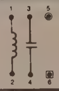
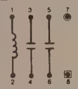
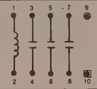
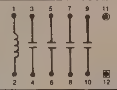
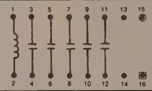
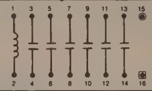
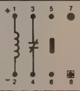
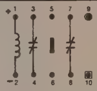
Coto

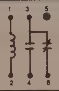
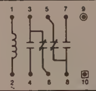
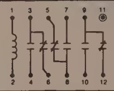
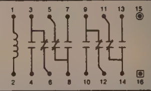
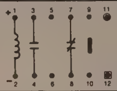
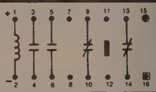
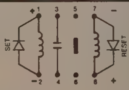
MINIATURE REED RELAYS

Series CR-2000 • • 1″ x .100″ Grid

DESCRIPTION Coto-Coil's Series CR-2000 is a new family of relays which have a pin termination on the popular 1″ x .100″ grid pattern. They are economical and available with a large variety of options (see reverse side).

The CR-2000 can be completely epoxy-encapsulated in a phenolic shell for maximum environmental protection and high insulation resistance. They are also available in a covered but non-encapsulated form for maximum economy.

Contact Form	Nominal Volts	mW	Res. Ohms ±10% @ 25°C	PART NO.	DWG.	Pin Diagram Bottom View
1A	5 6 12 24	125	175 300 1100 4200	CR-2001-5 -6 -12 -24	A	
2A	5 6 12 24	230	100 150 640 2450	CR-2002-5 -6 -12 -24	B	
3A	5 6 12 24	350	65 100 490 1550	CR-2003-5 -6 -12 -24	C	
4A	5 6 12 24	475	55 80 315 1350	CR-2004-5 -6 -12 -24	D	
5A	5 6 12 24	525	45 73 275 1100	CR-2005-5 -6 -12 -24	E	
6A	5 6 12 24	525	45 73 275 1100	CR-2006-5 -6 -12 -24	E	
1B *	5 6 12 24	125	100 150 640 2450	CR-2021-5 -6 -12 -24	B	
2B *	5 6 12 24	350	65 100 490 1550	CR-2022-5 -6 -12 -24	C	

Contact Form	Nominal Volts	mW	Res. Ohms ±10% @ 25°C	PART NO.	DWG.	Pin Diagram Bottom View
1C	5 6 12 24	125	175 300 1100 4200	CR-2041-5 -6 -12 -24	A	
2C	5 6 12 24	350	65 100 490 1550	CR-2042-5 -6 -12 -24	C	
3C	5 6 12 24	475	55 80 315 1350	CR-2043-5 -6 -12 -24	D	
4C	5 6 12 24	525	45 73 275 1100	CR-2044-5 -6 -12 -24	E	
1A 1B *‡	5 6 12 24	475	55 80 315 1350	CR-2060-5 -6 -12 -24	D	
2A 2B *‡	5 6 12 24	525	45 73 275 1100	CR-2061-5 -6 -12 -24	E	
1A Latch *	5 6 12 24	65	550/550	CR-2052-5 -6 -12 -24	B	

External Resistors to limit coil current

Nominal Volts	12	24
Ohms (¼ watt)	500	1500

Internal diode suppression standard

◉ Electro-static shield pin ▣ Alternate coil pin

‡ Break before make not guaranteed.

* These relays contain bias magnets and correct input polarity must be observed. Magnetic shield standard.

RELAY SPECS:

Nominal Operating Volts	5	6	12	24
Must Operate Volts	3.75	4.5	9	18
Must Release Volts	0.4	0.5	1.0	2.0

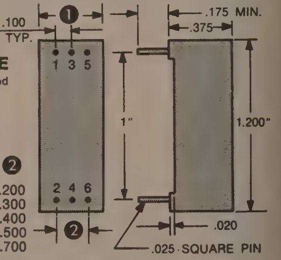
NOTE: Measurements taken at 25°C. Max. coil volts are 50% greater than nom. volts for 10 min.

ISOLATION RESISTANCE

10^9 ohms minimum — non-encapsulated

10^{12} ohms minimum — encapsulated

100VDC, 25°C, 40% relative humidity. Measured between coil & contact and contact & contact.



DRAWINGS

	①	②
A	.410	.200
B	.510	.300
C	.660	.400
D	.760	.500
E	.990	.700

SWITCH SPECIFICATIONS	Form A & B	Form C
Contact Rating — DC	10 watts max.	3 watts max.
Switching Voltage — DC or peak AC	200 volts max.	28 volts max.
Maximum Current — DC or peak AC — Resistive	0.500 amps	0.250 amps
Initial Contact Resistance	0.2 ohms max.	0.2 ohms max.
Breakdown Voltage — DC or peak AC	250 volts min.	200 volts min.
Actuating Time — average — incl. Bounce	1.5 milliseconds	1.5 milliseconds
Release Time	1.0 millisecond	2.0 milliseconds
Life expectancy	100x10⁶ operations at signal level; 10x10⁶ operations at rated load	

ORDERING INFORMATION

CR — 20XX — XX — XXXX

MODEL No.

COIL VOLTAGE

"0" — not encapsulated
"1" — encapsulated

"0" — no magnetic shield
"1" — magnetic shield

"0" — standard
"1" — high reliability

"0" — no electro-static shield
"1" — electro-static shield

If all options are "0" omit last four digits.

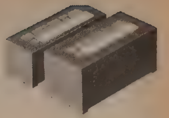
AVAILABLE OPTIONS

- Relay — non-encapsulated — for economy
- Relay — encapsulated — for maximum protection and high insulation resistance
- Electro-static shield and/or magnetic shield
- Breakdown volts DC or peak AC — 1000 volts minimum
- High-reliability relays which have been conditioned by a special run-in and dynamic testing
- Other relay sensitivities and operating voltages

Specifications subject to change without notice

COTO

LOW THERMAL EMF REED RELAYS



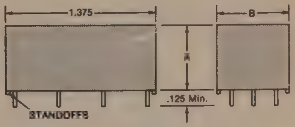
Series CR-3200

Coto-Coil has developed a unique new method* that virtually eliminates offsets caused by thermal emf's in almost any type of reed switch. This design now allows the entire spectrum of reed relays to be used for very low signal switching. These new COTO relays are especially designed for scanning low-level analog and digital signals, multiplexing, data acquisition, and automatic testing of components and systems. They offer all the advantages of an encapsulated reed relay, such as high isolation, speed and long lifetime under practically any environmental conditions, in addition to a very low and stable offset.

*Patented

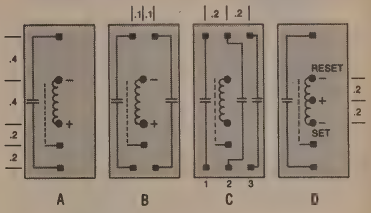
COTO's new line of low-offset relays is offered with a large variety of contact combinations, switch types and thermal offset ratings, in order to meet each customer's requirement with maximum performance at a minimum cost. The relays are encapsulated in an epoxy-filled shell, and the offsets that are present are remarkably independent of ambient temperature and external environment.

RELAYS	MODEL NO	COIL (Nominal) VOLT. (volts)	COIL (Nominal) RESIS. (ohms)	POWER (watts)	CONTACT FORMS	THERMAL EMF RATINGS*	PIN CONFIG.	PKG.
Dry Miniature	CR-3201-5 or -6 -12	5 or 6 12	1000 4000	.035	1A	5, 7, 8	A	I
	CR-3202-5 or -6 -12	5 or 6 12	450 2200	.075	2A	5, 7, 8, 9	B	I
	CR-3203-5 or -6 -12	5 or 6 12	350 1750	.100	3A	7, 8, 9	C	II
	CR-3204-5 or -6 -12	5 or 6 12	450 2200	.075	1B	5, 7, 8, 9	A	I
	CR-3205-5 or -6 -12	5 or 6 12	350 1750	.100	2B	7, 8, 9	B	II
	CR-3206-5 or -6 -12	5 or 6 12	350 1750	.100	1A1B	7, 8, 9	B	II
	CR-3207-5 or -6 -12	5 or 6 12	780/780 3000/3000 Bifilar	.045	Single Pole Latch	4, 7	D	I
	CR-3250-5 or -6 -12	5 or 6 12	350 1750	.100	3A (2 low therm. 1 high ")	5, 7, 8, 9	C	II
High Voltage Miniature	CR-3221-5 or -6 -12	5 or 6 12	450 2200	.075	1A	8, 9	A	I
	CR-3222-5 or -6 -12	5 or 6 12	325 1200	.120	2A	8, 9	B	I
	CR-3223-5 or -6 -12	5 or 6 12	450 2200	.075	1B	8, 9	A	I
Hg Wet Miniature	CR-3231-5 or -6 -12	5 or 6 12	150 600	.240	1A	9	A	II
	CR-3232-5 or -5 -12	5 or 6 12	90 350	.400	2A	9	B	II
	CR-3233-5 or -6 -12	5 or 6 12	90 350	.400	1B	9	A	II



Package I: 1.375 x .500(A) x .500(B)
Package II: 1.375 x .600(A) x .650(B)
Shield and switch pins are .025" square, tinned copper.
Coil pins are .036" dia., nickel copper.
Pin pattern is centered within the case by ±.010".
Relays are encapsulated in a phenolic case, epoxy-filled.

PACKAGE and PIN CONFIGURATION (Bottom View)



Relays 3204, 3205, 3206, 3223 and 3233 contain a bias magnet, and coil polarity shown above must be observed.

Mercury-wetted Relays 3231, 3232 and 3233 must be mounted vertically with the arrow pointing up and shield pin at the bottom.

Switches 2 and 3 in Diagram C are the low-thermal switches in Relay 3250.

*Thermal Offset Ratings Per Switch:

4 <200nV	8 <3μV
5 <500nV	9 <5μV
7 <1μV	0 <100μV

Thermal offset measurements are made across each switch, except in Relays 3202, 3205, 3250, 3222 and 3232 where measurements are made differentially between the two low-thermal switches.

NOTES:
1) All relays are magnetically shielded.
2) Unless otherwise specified, all relays are electrostatically shielded.
3) Isolation resistance of 10^{10} or 10^{12} ohms is available.

CONTACTS	DRY	HIGH VOLTAGE	MERCURY WET
Max. Power (Volt-Amps)	10	10	28
Max. Voltage (DC or Peak AC)	200	1000	100
Max. Current (Amps)	.500	.500*	1.0
Initial Contact Resis. (Ohms)	.300	.300	.300
Min. Breakdown Voltage (DC or Peak AC)	300	1000	800
Isolation Resis. (Ohms)	10^{10}	10^{10}	10^{10}
Operate Time (Typ. —msec)	1.5	1.5	2.0
Release Time (Typ. —msec)	.2	.2	.5
Average Life at Full Rating (# operations)	50×10^6	50×10^6	100×10^6

*0.010 Amperes max. @ 1000 VDC

INSULATION RESISTANCE
10^{10} ohms minimum at 100VDC, +25°C, 50% relative humidity between all isolated pins. 10^{12} ohms is also available.

CAPACITANCE
The contact-to-contact capacitance for low thermal contacts is approximately 2.0pf. This value is composed of 0.2pf from the reed contacts and 1.8pf from the low thermal offset circuitry. With the electrostatic shield the contact-to-coil capacitance is typically 2.0pf.

MUST OPERATE and RELEASE VOLTAGES
Must-operate voltages at 25°C:
5v relay — 3.8; 6v relay — 4.5; 12v relay — 9.0
Must-release voltages at 25°C:
5v relay — 0.4; 6v relay — 0.5; 12v relay — 1.0

INITIAL CONTACT RESISTANCE
The maximum initial contact resistance for each contact is 0.3 ohms. Typically the initial contact resistance measures to be 0.250 ohms and is composed of 0.070 ohms from the reed contacts and 0.180 ohms from the low thermal offset circuitry.

TESTING and RELIABILITY
The low thermal emf reed relays are most commonly used under essentially dry circuit conditions. For these low-level loads the life of a clean contamination-free switch can exceed 500 million operations. In order to assure the highest possible reliability each switch and completed relay is subjected to an extensive series of cycling and dynamic testing. In addition each isolated pin is checked against every other pin for insulation resistance at the rated breakdown voltage. Finally a thermal offset test at the rated voltage is performed.

THERMAL TESTING. Care must be exercised in setting up in-house testing procedures for measuring thermal offsets of the CR-3200 relays. Without properly designed test circuitry and instrumentation, far greater thermal EMF offsets can be generated external to the relay than internally. Coto's engineering department will be pleased to assist in recommending testing circuitry and components for Q/C testing.

EFFECT OF AMBIENT TEMPERATURES. One of the specific design features of the CR-3200 low thermal relay is its exceptional stability with ambient temperature changes. For the purpose of rating, all standard CR-3200 relays are tested at a nominal 25°C ambient. However, temperature excursions from 0°C to 50°C will result in no more than a 500 nanovolt offset change in a 1μV rated relay.

Specifications subject to change without notice

ORDERING INFORMATION

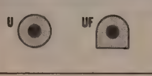
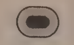
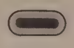
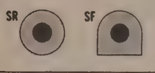
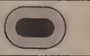
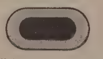
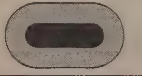
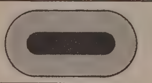
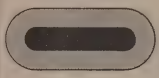
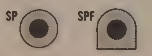
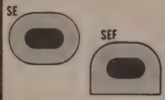
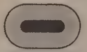
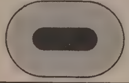
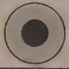
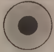
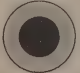
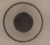
CR — XXXX — XX — XXX
Model No.
Coil Voltage
Thermal
Contact Isolation (Ohms)
10^{10} — Suffix "0"
10^{12} — Suffix "1"
Electrostatic Shield
Include — Suffix "1"
Omit — Suffix "0"

To order a COTO LOW THERMAL RELAY a part number can be assembled from the data sheet to describe the desired parameters as shown above. EXAMPLE: Typical part number for a 5 volt relay, 1 Form A with 1 μV offset, 10^{12} isolation and electrostatic shield: CR-3201-5-711.

COTO-COIL CO., INC.

57 PAVILION AVE., PROVIDENCE, R. I. 02905
Telephone (401) 467-4777
Export Dept.: 13 E. 40th St., New York, N. Y. 10016

COTO REED COILS

	COTO REED COILS								REED SWITCHES		
	END DRAWING (Actual Size)	TYPE	DIMENSIONS Nominal	D.C. VOLTS	RESIS. Ohms Nominal	COIL CURRENT mA	mW Nominal	AMP/TURNS Nominal	No. REEDS	REED TYPES	CONTACT FORMS
MINIATURE		U	OD .375 Lg .800 ID .140	6 12 24 32 48	150 625 2500 4000 8600	40 20 9.6 8 5.5	240	125	1 1	1 or 2 3	1A 1C
		UF	Ht .437 Wd .375 Lg 800 ID 140								
		UD	Ht .375 Wd .500 Lg .800 ID .140 x .287	6 12 24 32 48	86 350 1320 2250 5500	69.7 34 18 14 2 8	400	125	3 2 2 2 2 2	1 1 1 1 2 3	3A 2B* 1A & 1B* 1C* 2A 2C
		UT	Ht .350 Wd .710 Lg .725 ID .130 x .500	6 12 24 32 48	85 340 1300 2550 5300	70.5 35.2 18.4 12.5 9	420	105	6 5 5 5 4 4 4	•1 1 1 1 1 2 3	6A 5A 4A & 1B* 3A & 2B* 4B* 4A 4C
MICRO MINIATURE		UM	OD .300 Lg .400 ID .090	3 6 12 24	55 215 850 3500	55 28 14 7	170	70	1	7	1A
		UMM	OD .290 Lg .435 ID .112	3 6 12 24	55 215 850 3500	55 28 14 7	170	70	1	8 or 9	1A or 1C
		UMD	Ht. .200 Wd .315 Lg .450 ID .071x 168	3 6 12 24	40 150 600 2400	75 40 20 10	240	70	1 2 1	8 8 8 & 9	1B* 2A 1A & 1C
STANDARD		SR	OD 500 Lg 2.00 ID 220	6 12 24 32 48	113 450 1650 2840 5890	53 26.5 14.5 11 8.2	330	200	1 1	4 or 5 6	1A 1C
		SF	Ht .500 Wd .500 Lg 2.00 ID .220								
		SD	Ht .500 Wd .720 Lg 2.00 ID .220 x .440	6 12 24 32 48	84 335 1290 2165 5700	66 36 18.5 15 8.5	430	200	1 2 2 2	4 or 5 4, 5, 6 5 & 6 4 & 6	1B* 2A or 2C 1A & 1C 1A & 1C
		SG3	Ht .500 Wd 1.00 Lg 2.00 ID .220 x .660	6 12 24 32 48	52 205 850 1430 3800	86 58.5 28 22 13	700	210	2 3	4 or 5 4, 5, 6	2B* 1B & 1A* 3A or 3C 1A & 2C 2A & 1C
		SH4	Ht .750 Wd 1.375 Lg 2.00 ID .220 x .800	6 12 24 32 48	40 160 650 1090 2500	150 75 37 29.4 19	900	260	4 3	4, 5, 6 4 or 5	4A or 4C 1A & 3C 2A & 2C 3A & 1C 2B & 1A* 1B & 2A*
		SJ5	Ht .750 Wd 1.500 Lg 2.00 ID .220 x 1.020	6 12 24 32 48	33 130 520 830 1950	182 92 46 38 24	1150	280	5 4	4, 5, 6 4 or 5	5A or 5C 1A & 4C 2A & 3C 3A & 2C 4A & 1C 2B & 2A* 1B & 3A*
		SK6	Ht .750 Wd 1.750 Lg 2.00 ID .220 x 1.220	6 12 24 32 48	25 100 400 680 1575	240 120 60 47 30	1450	310	6 5	4, 5, 6 4 or 5	6A or 6C 1A & 5C 2A & 4C 3A & 3C 4A & 2C 5A & 1C 4B* 2B & 3A* 1B & 4A*
COMPACT		SP	OD .470 Lg 1.450 ID .220	6 12 24 32 48	150 600 2400 4000 9200	40.6 20 10 8 5.2	250	150	1	5 or 6	1A or 1C
		SPF	Ht .500 Wd .470 Lg 1.450 ID 220								
		SE	Ht .625 Wd .812 Lg 1.450 ID .220 x .450	6 12 24 32 48	117 433 1610 2740 7200	51 28 14.9 11.6 6.7	350	160	2 1 2	5 or 6 5 5 & 6	2A or 2C 1B* 1A & 1C
		SEF	Ht .655 Wd 812 Lg 1.450 ID 220 x .450								
		T	Ht 500 Wd .875 Lg .690 ID .136 x .490	6 12 24 32 48	100 400 1600 2800 5800	60 30 15 11.4 8.2	350	125	6 5 4	1 1 2 or 3	6A 5A 4A or 4C
		UH	Ht 875 Wd 1.375 Lg .718 ID .250x 750	6 12 24 32 48	45 180 720 1400 2640	133 67 33 23 18	800	200	Combinations to 23 12	1 2	23A 12A or 12C
OTHER		SA	OD .700 Lg 1 187 ID 320	6 12 24 32 48	65 255 965 1810 3660	92 47 25 17.6 13	575	200	Jumbo Reed Swt. Coil		
		S	OD 562 Lg 2.00 ID 220	6 12 24 32 48	105 360 1400 1930 5150	57 33 17 16.5 9.5	400	250	1 1	4 or 5 6	1A 1C
		M	OD .843 Lg 2.00 ID .468	6 12 24 32 48	50 175 820 1400 3120	120 69 29 23 15	700	250	3 Drive Coil for High Voltage Reed Switches—Above 10KV (Order with Bore Bushing)	4, 5, 6	3A or 3C
		SPH	OD .470 Lg 1 450 ID 220	6 12 24 32 48	70 260 1070 1690 4000	86 46 23 19 12	575	225	Drive Coil for High Voltage Reed Switches—To 10KV		

◀ COTO REED COILS

*Bias Magnet Required

COTO REED SWITCHES ▼

TYPES	CONTACTS	CONT. FORM w/magnet bias	GLASS DIAMETER	GLASS LENGTH	MOUNTING POSITION	NOM. POWER RATING
1	Dry Form A High Frequency A	Form B —	.090 Max .090 Max	.800 Max .800 Max	Any Any	10 Watt .3 Watt
2	Dry Form A Hg/Wet A Low Thermal A High Isolation A	Form B Form B — —	.130 Max .130 Max .130 Max .130 Max	.800 Max .800 Max .800 Max .800 Max	Any Vert to 30° Any Any	10 Watt 28 Watt .3 Watt 10 Watt
3	Dry Form C	—	.130 Max	.800 Max	Any	3 Watt
4	Dry Form A Hg/Wet A High Voltage	Form B Form B Form B	.210 Max .210 Max .210 Max	1.950 Max 1.950 Max 1.950 Max	Any Vert to 30° Any	To 450 Watt 50 Watt 50 Watt
5	Dry Form A	Form B	.210 Max	1.425 Max	Any	To 100 Watt
6	Dry Form C	—	.218 Max	1.562 Max	Any	To 20 Watt
7	Dry Form A	Form B	.090 Max	.375 Max	Any	.3 Watt
8	Dry Form A	Form B	.070 Max	.470 Max	Any	3 Watt
9	Dry Form C	—	.070 x .110 Max	.435 Max	Any	.1 Watt

Dimensions subject to change without notice.

The above listing of magnetic reed switches does not constitute a complete listing of all switches commercially available to fit Coto Coil reed relay coils. It does indicate the most common types and sizes manufactured by various companies. Coto's sales department will be pleased to assist you in recommending a source for your switch requirements or supplying the complete relay for your application.

SEE PAGE OPPOSITE FOR COMPLETE REED RELAYS ▶

COTO-COIL CO., INC.

57 PAVILION AVE.,
PROVIDENCE, R. I. 02905
Telephone (401) 467-4777
Export Dept.: 13 E. 40th St.,
New York, N. Y. 10016

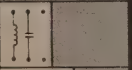
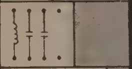
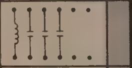
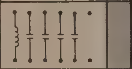
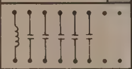
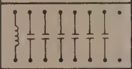
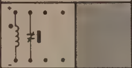
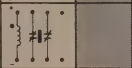
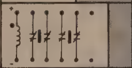
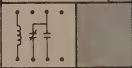
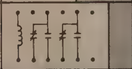
COTO-COIL MINIATURE REED RELAYS

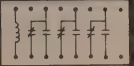
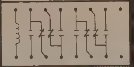
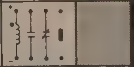
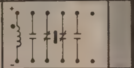
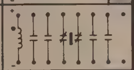
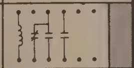
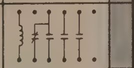
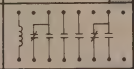
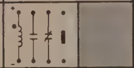
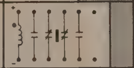
Series 1000

Dry and Mercury-Wetted

Contact ratings are maximum for resistive loads only and no single parameter should be exceeded.				
TYPE REED	CONTACT (CLOSED)		CONTACT (OPEN)	
	RATING	RES. (OHMS)	INS. RES. (OHMS)	CAP. (pF)
A-B (DRY)	10W DC/12 VA AC (200V or 500mA)	.10	10^{12} MIN.	.2 NOM.
C (DRY)	3W DC/4 VA AC (50V or 250mA)	.15	10^{9} MIN.	.8 NOM.
A-B (Hg)	28W DC/30VA AC (125V or 1 AMP)	.05	10^{9} MIN.	.3 NOM.

DRY REED TYPES

Contact Form	Nominal Volts	Nominal mW	Res. Ohms	PART NO.	DWG.	Pin Diagram Bottom View
1A	6 12 24 32 48	210	170 680 2730 4800 10400	CR-1001-6 -12 24 32 48	A	
2A	6 12 24 32 48	340	105 420 1680 2950 6720	CR-1002-6 -12 24 32 -48	B	
3A	6 12 24 32 48	575	63 250 1000 1760 4000	CR 1003-6 -12 24 -32 -48	C	
4A	6 12 24 32 48	575	63 250 1000 1760 4000	CR 1004-6 -12 -24 -32 -48	C	
5A	6 12 24 32 48	1000	36 144 576 1030 2300	CR-1005-6 -12 -24 -32 -48	D	
6A	6 12 24 32 48	1000	36 144 576 1030 2300	CR 1006-6 12 -24 -32 -48	D	
1B *	6 12 24 32 48	340	105 420 1680 2950 6720	CR-1021-6 -12 -24 -32 -48	B	
2B *	6 12 24 32 48	340	105 420 1680 2950 6720	CR-1022-6 -12 -24 -32 -48	B	
4B *	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1024-6 -12 -24 -32 -48	C	
1C **	6 12 24 32 48	220	160 640 2560 4500 10240	CR-1041 6 -12 24 -32 -48	B	
2C **	6 12 24 32 48	360	100 400 1600 2800 6400	CR-1042-6 -12 -24 -32 -48	C	

Contact Form	Nominal Volts	Nominal mW	Res. Ohms	PART NO.	DWG.	Pin Diagram Bottom View
3C **	6 12 24 32 48	650	55 220 880 1550 3520	CR-1043-6 -12 -24 -32 -48	D	
4C **	6 12 24 32 48	650	55 220 880 1550 3520	CR-1044-6 -12 -24 -32 -48	D	
1A-1B *‡	6 12 24 32 48	340	105 420 1680 2950 6720	CR 1060 6 -12 -24 -32 -48	B	
2A-2B *‡	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1061-6 -12 -24 -32 -48	C	
4A-2B *‡	6 12 24 32 48	1000	36 144 576 1030 2300	CR-1062-6 -12 -24 -32 -48	D	
1A-1C **	6 12 24 32 48	360	100 400 1600 2800 6400	CR-1070-6 -12 -24 -32 -48	C	
2A-1C **	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1071-6 -12 -24 -32 -48	C	
2A-2C **	6 12 24 32 48	650	55 220 880 1550 3520	CR-1072-6 -12 -24 -32 -48	D	
Hybrid 1C (1A-1B) *†	6 12 24 32 48	340	105 420 1680 2950 6720	CR-1080-6 -12 -24 -32 -48	B	
Hybrid 2C (2A-2B) *†	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1081-6 -12 -24 -32 48	C	

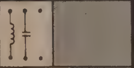
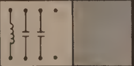
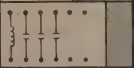
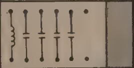
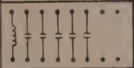
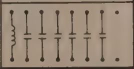
*These relays contain bias magnets and correct input polarity must be observed. Red terminal indicates (+) coil input.

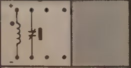
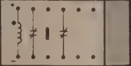
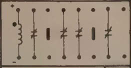
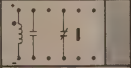
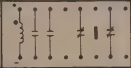
**These relays carry true Form C switches.

†Positive break before make for Form C switching when joined as pairs.

‡Break before make not guaranteed.

MERCURY-WETTED TYPES (Must be mounted within 35° of vertical)

Contact Form	Nominal Volts	Nominal mW	Res. Ohms	PART NO.	DWG.	Pin Diagram Bottom View
1A	6 12 24 32 48	210	170 680 2730 4800 10400	CR-1101-6 -12 -24 -32 -48	A	
2A	6 12 24 32 48	340	105 420 1680 2950 6720	CR-1102-6 -12 -24 -32 -48	B	
3A	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1103-6 -12 -24 -32 -48	C	
4A	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1104-6 -12 -24 -32 -48	C	
5A	6 12 24 32 48	1000	36 144 576 1030 2300	CR-1105-6 -12 -24 -32 -48	D	
6A	6 12 24 32 48	1000	36 144 576 1030 2300	CR-1106-6 -12 -24 -32 -48	D	

Contact Form	Nominal Volts	Nominal mW	Res. Ohms	PART NO.	DWG.	Pin Diagram Bottom View
1B *	6 12 24 32 48	340	105 420 1680 2950 6720	CR-1121-6 -12 -24 -32 -48	B	
2B *	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1122-6 -12 -24 -32 -48	C	
4B *	6 12 24 32 48	1000	36 144 576 1030 2300	CR-1124-6 12 -24 -32 -48	D	
1A-1B *‡	6 12 24 32 48	575	63 250 1000 1760 4000	CR-1160-6 -12 -24 -32 -48	C	
2A-2B *‡	6 12 24 32 48	1000	36 144 576 1030 2300	CR-1161-6 -12 -24 -32 48	D	

*These relays contain bias magnets and correct input polarity must be observed. Red terminal indicates (+) coil input.

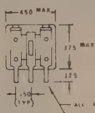
‡Break before make not guaranteed.

The Coto Series 1000 Miniature PCB Reed Relays offer the most comprehensive choice of switching parameters with pin terminations on the popular grid pattern of 1" x .015". Included are 21 contract combinations of Form A, B and C dry reeds and 11 combinations of Form A and B in mercury wetted types. The latter offer greatly expanded switching capability, and eliminate all contact bounce. Up to 6 poles per relay and 5 standard coil voltages are optional. In addition, special purpose reed switches, windings and terminal pin options, electrostatic and magnetic shielding may be specified.

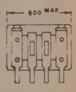
Drive coil windings have been carefully optomized to assure fast contact transfer. This is particularly important in relays carrying several reeds, since the first to close shunts out a disproportionate percent of flux unless adequate overdrive is available. Typical pull-in and drop-out is 1 mil/sec. and .5 mil/sec. respectively, including bounce and coil rise and fall time. Hg wetted reeds are somewhat slower, averaging 2 mil/sec. and 1 mil/sec. Operate times are exclusive of any delay introduced by contact protection devices. Reactive or high inrush loads will require contact protection, as with any type relay if maximum reliability and life are to be realized.

For information on contact protection request Technical Bulletin No. CS-1. For engineering assistance address Sales Engineering Dept. and include full details.

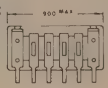
A



B



C



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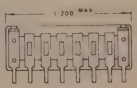
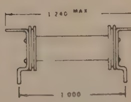


ALL



COTO-COIL CO., INC.

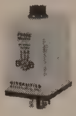
57 PAVILION AVE., PROVIDENCE, R. I. 02905
Telephone (401) 941-3355
Export Dept.: 13 E. 40th St., New York, N. Y. 10016

PAGE 1 TOTAL RESPONSIBILITY

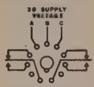
PHASE MONITORS

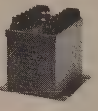
PHASE SEQUENCE, PHASE LOSS & UNDER VOLTAGE MONITOR/RELAY — SL SERIES 3ϕ

The **SL SERIES** is designed for use in applications where motor rotation or connection to the power line is critical, or where loss of one or more phases will cause damage to electrical equipment. If Phase Sequence is correct and full line voltage is present on all three phases, internal control relay will energize.

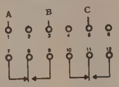


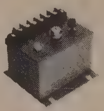
ENCLOSURE A



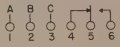


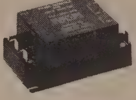
ENCLOSURE F



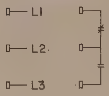


ENCLOSURE H





ENCLOSURE N



Response Time: Pick-Up: A, F. 30 m. sec., H, N. 60 m. sec. Drop-Out: 0.5 sec.

Temperature: Operating: 0°C to +55°C. Storage: −45°C to +85°C.

Rated Output:
A, F. DPDT Relay — 10A @ 24VDC or 120VAC — 5A @ 240VAC Resistive.
H. SPDT Relay — 10A @ 120VAC — 5A @ 240VAC Resistive.
N. SPDT Relay — 5A @ 24VAC — 3A @ 120VAC — 2A @ 220VAC Resistive.

AC FIXED

Catalog No.	3ϕ Voltage	Drop-Out Voltage One Phase Low	Drop-Out Voltage All Phases Low
SLA-120-AFA	120	99.6	108
SLA-208-AFA	208	172.6	187.2
SLA-220-AFA	220	182.6	198
SLA-240-AFA	240	199.2	216
SLA-440-AFF	440	365.2	396
SLA-480-AFN	480	398.4	432
SLA-208-AFN	208	172.6	187.2
SLA-220-AFN	220	182.6	198
SLA-240-AFN	240	199.2	216
SLA-440-AFJ	440	365.2	396
SLA-460-AFJ	460	381.8	414
SLA-480-AFJ	480	398.4	432
SLA-575-AFM	575	477.2	517.5

AC KNOB ADJUSTABLE

SLA-230-ALA	208-240	160-240
SLA-230-ALF	208-240	160-240
SLA-440-ALF	430-480	340-480
SLA-230-ALH	208-240	160-240
SLA-440-ALH	430-480	340-480
SLA-440-ALJ	430-480	340-480

Available in 50 and 60 Hz.

Dimensions:
Excluding Flanges,
Knobs & Conectors.
A. 1.75x2.38x 3.0 H.
F. 3.6 x2.63x3.1 H.
H. 3.6 x2.63x2.40 H.
N. 2.18x3.70x1.5 H.
J. 3.60x2.63x4.10 H.
M. 4.10x2.63x4.35 H.

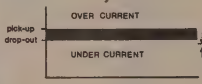
Reset:
H. Pushbutton

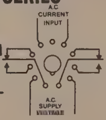
Power Required:
3 watts (Approx.)

TOTAL RESPONSIBILITY

CURRENT MONITORS

CURRENT MONITOR/RELAY • CM SERIES





The **CM SERIES** consists of an electro-magnetic current detector which senses a current level. When the monitored current exceeds the trip point setting for a period greater than the response time, an internal 10 amp. DPDT relay will operate. A current decrease of at least 5% of trip point is required for relay to de-energize. The monitors are equipped with appropriate time delays to accommodate start-up transients and short-time line variations.

AC KNOB ADJUSTABLE:

Catalog No.	Supply Voltage	Trip Point (Amps)
CMA-120-AKA- 1	120VAC	0.2- 1.0
CMA-120-AKA- 5	120VAC	1.0- 5.0
CMA-120-AKA-10	120VAC	5.0-10.0

Also available for 240AC supply voltage.

RESPONSE TIME: Operate: 1 sec. Release: 30m.sec.

CURRENT DIFFERENTIAL: 5% of Trip Point

TRIP POINT (FIXED): ±10% of setting

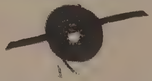
TEMPERATURE: Operating: 0°C to +55°C. Storage: −45°C to +85°C

RATED OUTPUT: DPDT Relay — Resistive 10A @ 28VDC or 120VAC — 5A @ 240 VAC

SUPPLY POWER (AUXILIARY): 3 Watts (Approx.)

ENCLOSURE: A. 1.75 x 2.38 x 3.0 H.

CURRENT TRANSFORMER • CT SERIES



The **CT Series** designed to be used with the CM Series monitors, when AC currents above 10 amps. are to be detected. This toroidal transformer is used to extend the range of the 5 amp. current monitor. The transformer slips over a conductor and is provided with a secondary lead length of 24 in.

CT SERIES — CURRENT TRANSFORMER

Catalog No.	Current Ratio	Accuracy	Capacity	Max. Dia. of Primary
CT 50/5	50/5	6.0%	2V.A.	1″
CT 100/5	100/5	3.0%	2V.A.	1″

Also available in 25, 500, 1000 and 2500 ratios.

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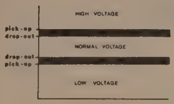
PAGE 2 TOTAL RESPONSIBILITY

SPECIAL CONTROLS



VOLTAGE MONITORS

VOLTAGE BAND MONITOR/RELAY — VB SERIES

The VB SERIES offers protection to equipment which is required to operate between two voltage limits. The solid state monitor determines pre-selected under or over voltage conditions and de-energizes an internal 10A DPDT relay if these limits are exceeded. The VB SERIES is equipped with a time delay to accommodate start-up transients. Both AC and DC units are available.

AC KNOB ADJUSTABLE*

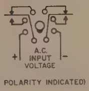
Catalog No.	Nominal Voltage	Low-Limit Pick-Up	Hi-Limit Pick-Up	Hyst. Voltage
VBA- 24-AKA	24VAC	19- 24	24- 29	2
VBA-120-AKA	120VAC	90-120	120-150	5
VBA-208-AKA	208VAC	185-208	208-240	8
VBA-240-AKA	240VAC	200-240	240-270	10

DC KNOB ADJUSTABLE*

VBA- 12-DKA	12VDC	10- 12	12- 15	1
VBA- 24-DKA	24VDC	19- 24	24- 29	1
VBA- 28-DKA	28VDC	22- 28	28- 34	1
VBA- 48-DKA	48VDC	38- 48	48- 58	2
VBA-110-DKA	110VDC	85-110	110-135	5

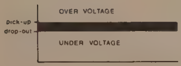
*Also available with locking pot.

A ENCLOSURE



UNDER VOLTAGE OR OVER VOLTAGE MONITOR/RELAY UO SERIES

The **UO SERIES** consists of a solid state voltage detector that senses a voltage greater than a pre-set "pick-up" voltage and causes an internal DPDT relay to operate. When the voltage drops to the pre-set "drop-out" voltage, the output relay will de-energize. A hysteresis is set into each unit to allow a differential between pick-up and drop-out. UO SERIES, adjustable, with close differential between pick-up and drop-out. Both AC and DC units available.



AC KNOB ADJUSTABLE*

Catalog No.	Drop-Out Voltage	Pull-In Voltage	Hyst. Voltage
UOA- 24-AKA	19- 27VAC	21- 29VAC	2
UOA-120-AKA	97-130VAC	102-135VAC	5
UOA-208-AKA	177-222VAC	185-230VAC	8
UOA-240-AKA	205-250VAC	215-260VAC	10
UOA-440-ALF	370-462VAC	388-480VAC	18

AC FIXED

UOA-120-AFN	100VAC	105VAC	5
UOA-230-AFN	190VAC	198VAC	8
UOA-240-AFN	202VAC	210VAC	8

DC KNOB ADJUSTABLE*

UOA- 12-DKA	9- 14VDC	10- 15VDC	1
UOA- 24-DKA	19- 27VDC	21- 29VDC	2
UOA- 48-DKA	38- 53VDC	40- 55VDC	2
UOA-110-DKA	92-125VDC	97-130VDC	5
UOA-240-DLF	205-250VDC	215-260VDC	10

*Also available with locking pot.

APPLICABLE TO ALL VOLTAGE MONITORS

Response Time: Pick-Up: 30 m. sec. Drop-Out: 0.5 sec.

Temperature: Operating: 0°C to +55°C. Storage: −45°C to +85°C.

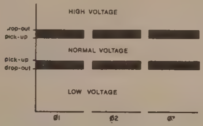
Rated Output: DPDT Relay — 10A @ 24VDC or 120VAC —5A @ 240VAC Resistive.

Power Required: 3 watts (Approx.).

Enclosure: A: 1.75 x 2.38 x 3.0 H. Drop-out time to 2.5 sec. In "A" enclosure, to 5.0 sec. In "F" enclosure available on request. F. 3.6 x 2.63 x 3.1 H.

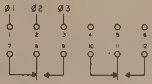
THREE PHASE VOLTAGE BAND MONITOR/RELAY PB SERIES

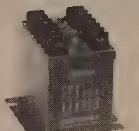
The **PB SERIES** offers protection to three phase equipment which is required to operate between two voltage limits. The three phases are monitored for a pre-selected under or over limit. An internal control relay is de-energized when the voltage goes outside of these limits. This device provides both under and over voltage monitoring of each phase of a Delta or Wye system in one package. The monitors are equipped with a drop-out time delay to accommodate start-up transients. With normal operating voltages on all phases, an internal relay will be energized. If the voltage on any phases goes above or below the drop-out limit, the signal to the time delay will be removed. If this out-of-limit condition exists on any phase for a period longer than the release time or the time delay, the output relay will de-energize. PB SERIES is offered in AC only.

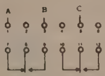


AC LOCKING POT ADJUSTABLE: ALL VOLTS ϕ TO ϕ

Catalog No.	Low-Limit	Hi-Limit	Hyst. Voltage
PBA-120-ALM-D	90-120	120-150	5
PBA-208-ALM-D	185-208	208-240	8
PBA-240-ALM-D	200-240	240-270	8
PBA-208-ALJ-Y	185-208	208-240	8





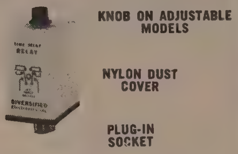


PAGE 3 TOTAL RESPONSIBILITY

TIME DELAY RELAYS

DIVERSIFIED ELECTRONICS TIME DELAY RELAYS NOW AVAILABLE UP TO 900 SECONDS

Diversified Electronics offers a wide variety of solid state time delay relays designed to meet the severe environment and timing applications encountered in industry. The time delay relay combines a solid state timing circuit and a heavy-duty 10 amp DPDT relay in a single package. Timing is accomplished by charging a capacitor through a resistor. When the voltage across the capacitor reaches a triggering point, a solid state trigger circuit turns on and energizes the coil of an internal relay. For ordering refer to **ORDER INFORMATION CODE.**


KNOB ON ADJUSTABLE MODELS
NYLON DUST COVER
PLUG-IN SOCKET

TDB
TDC
TDF

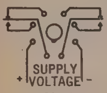

SUPPLY VOLTAGE
+
-

FIG. 1

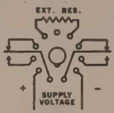

EXT. RES.
SUPPLY VOLTAGE
+
-

FIG. 2

TDD
TDE

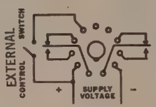

EXTERNAL
CONTROL SWITCH
SUPPLY VOLTAGE
+
-

FIG. 3

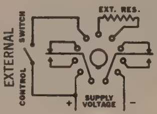

EXTERNAL
CONTROL SWITCH
EXT. RES.
SUPPLY VOLTAGE
+
-

FIG. 4

DC POLARITY INDICATED

FIXED	KNOB ADJ. AND LOCKING POT ADJ.	
Sec.	Min. Time (sec.)	Max. Time (sec.)
10	.1	10
30	.3	30
60	.6	60
100	1	100
200	2	200
300	3	300
600	6	600
900*	9	900*

EXT. RES. ADJ.

Min. Time Sec.	Max. Time Sec.	Ext. Res. Max. Time
.1	10	1 meg
.3	30	500 K
.6	60	1 meg
1	100	2 meg
2	200	2 meg
3	300	3 meg
6	600	5 meg
9	900*	7.5 meg

*Does not apply to the TDF Series.

SPECIFICATIONS COMMON TO ALL SERIES

Voltage Ranges:
24VDC, 24VAC, 120VAC, 50 or 60 Hz.

Temperature: Operating: 0°C to +55°C.
Storage: −45°C to +85°C.

Rated Output: DPDT Relay — 10A @ 24VDC or 120VAC resistive.

Accuracy: ±10%.

Tolerance:
Adjustable Time Delays:
Lower Time: +0 to −20%
Upper Time: −0 to +20%
Fixed Time Delays: ±5%

Repeatability: ±1%

Reset Time: Before Time Out: 100 m. sec.
After Time Out: 50 m. sec.

Recycle: 40 m. sec.

False Transfer: No

Reverse Polarity Protection: Yes

Power Consumption: 3 Watts

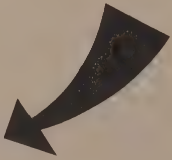
Duty Cycle: Continuous

Enclosure Style: "A"

ORDER INFORMATION

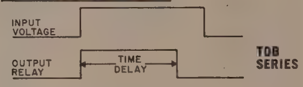
TDX — XXX — XXX — XXX

Time Delay
Series
Nominal Voltage
Type of Voltage
  A — AC
  D — DC
Type of Operation
  F — Fixed
  K — Knob Adjustable
  L — Locking Pot. Adj.
  R — Resistor Adj.
Enclosure Style "A"
Time Delay (in seconds)
  010 = 10 sec. 030 = 30 sec.
  060 = 60 sec. 100 = 100 sec.
  200 = 200 sec. 300 = 300 sec.
  600 = 600 sec. 900 = 900 sec.

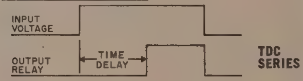


TIMING ACTION

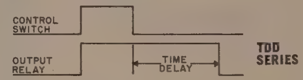
INTERVAL ON OPERATE


INPUT VOLTAGE
OUTPUT RELAY
TIME DELAY
TDB SERIES

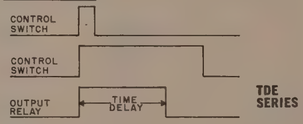
DELAY ON OPERATE


INPUT VOLTAGE
OUTPUT RELAY
TIME DELAY
TDC SERIES

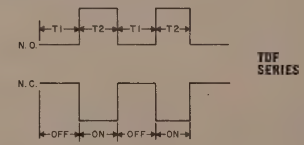
DELAY ON RELEASE


CONTROL SWITCH
OUTPUT RELAY
TIME DELAY
TDD SERIES

SINGLE SHOT


CONTROL SWITCH
CONTROL SWITCH
OUTPUT RELAY
TIME DELAY
TDE SERIES

REPEAT CYCLE


T1
T2
T1
T2
N. O.
N. C.
OFF
ON
OFF
ON
TDF SERIES

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PAGE 4 TOTAL RESPONSIBILITY

AC SERIES

Diversified Electronics, Inc. offers a full line of protection monitors for Air Conditioning and Refrigeration equipment. These monitors protect equipment against damage caused by low voltage, phase loss and short cycling. The monitors are offered in several combinations. The following is a description of each series. All units are in the "N" enclosure.

ANTI-SHORT CYCLE TIMERS

AC-100 Series

The **AC-100 Series** is an anti-short cycle timer used on equipment with 24VAC control circuit. The AC-100 prevents compressor motor damage by not allowing it to re-start for 5 minutes if momentary power or thermostat interruption occurs. The input monitors the 24VAC control circuit. The output interrupts the 24VAC control circuit.

SPECIFICATIONS AND RATINGS

Operating Voltage: 24VAC ±15%
Relay Contact: 2 amps resistive @ 24VAC
Terminations: ¼" quick connect terminals

TABLE 1

Part No.	Delay Time ±20%
AC-100-3	3 Minutes
AC-100-4	4 Minutes
AC-100-5	5 Minutes

AC-200 Series

The **AC-200 Series** is an anti-short cycle timer used on equipment with 24,120, or 240VAC control circuits. The AC-200 prevents damage to compressor motors caused by short cycling. The input monitors the control circuit. The output interrupts the control circuit.

SPECIFICATIONS AND RATINGS

Part No.	AC-200-5-24	AC-200-5-120	AC-200-5-240
Operating Voltage	24VAC	120VAC	240VAC
Relay Contact Rating (AC Resistive)	2.0 amps @ 24 VAC	3.0 amps @ 120VAC	2.0 amps @ 240VAC
Delay Time	All 5 minutes ±20%		
Terminations	All ¼" quick connect terminals		

VOLTAGE MONITOR AND ANTI-SHORT CYCLE TIMER COMBINATION

AC-103 Series Under Voltage Monitor with Built-In Anti-Short Cycle Timer

The **AC-103 Series** is a combination of the AC-100 Series Anti-Short Cycle Timer and under voltage monitor, used on equipment with 24VAC control circuit. The AC-103 Series prevents compressor motor damage by removing primary power from the compressor for five minutes if the supply voltage drops below the drop-out voltage and remains longer than 0.5 second, or if thermostat interruptions occur. The input monitors the primary power. The output interrupts the 24VAC control circuit.

SPECIFICATIONS AND RATINGS AC-103-230

Anti-Short Cycle Timer
Control Voltage: 24VAC ±15%
Delay Time: 5 minutes ±20%
Power Required: 0.5 watts nominal
General:
Internal Relay Contact Rating: 2 amps @ 24VAC resistive Terminations: ¼" quick connect terminals

TABLE I

Part No.	Operational Voltage	Drop-Out Voltage	Pick-Up Voltage
AC-103-230	280/240VAC	190VAC	198VAC
AC-103-240	230/240VAC	202VAC	210VAC

AC-107 Series Sequence, Phase Loss and Under Voltage Monitor with Built-In Anti-Short Cycle Timer

The **AC-107 Series** is a combination of the AC-100 Series and the 3 Phase Monitor used on equipment with 24VAC control circuit. The AC-107 prevents compressor motor damage by removing primary power from the compressor if any one or more of the following four "fault conditions" exist.
1. Single Phasing (Phase Loss) 2. Improper Phase Sequence 3. Under Voltage (Brownout)
4. Thermostat Interruption

The input monitors 3 phase primary power. The output interrupts 24VAC control circuit.

When the phase sequence is correct and full power is present on all three phases, the internal relay energizes. When any one or more of the four "fault conditions" occur, the internal relay de-energizes. This action opens the 24VAC control circuit, dropping the compressor motor off the line for five minutes, allowing the head pressure to equalize.

SPECIFICATIONS AND RATINGS

Anti-Short Cycle Timer
Control Voltage: 24VAC ±15%
Delay Time: 5 minutes ±20%
Power Required: 0.5 watts nominal
General
Internal Relay Contact Rating: 2 amps resistive @ 24VAC Terminations: ¼" quick connect terminals

TABLE 1

Part No.	Operating Voltage	Drop-Out Voltage 1 ϕ Low	Drop-Out Voltage All ϕ Low
AC-107-208	208VAC	173VAC	187VAC
AC-107-220	220VAC	183VAC	198VAC
AC-107-240	240VAC	199VAC	216VAC

NEW PRODUCTS

AVAILABLE IN '75

VOLTAGE UNBALANCE MONITOR/RELAY — SLB SERIES 3 ϕ

The **SLB SERIES** is designed for use in three phase applications where phase voltage unbalance may damage polyphase motors or electrical equipment. If the phase voltage unbalance is less than the "volts unbalance" setting and the sequence is correct, the internal relay will energize. Unit will be available in F enclosure for 120, 240 and 440VAC with adjustable unbalance. Also available with manual reset.

CURRENT UNBALANCE MONITOR/RELAY — SMB SERIES 3 ϕ

The **SMB SERIES** is designed for use in three phase applications where unbalanced phase currents may damage polyphase motors or electrical equipment. If the phase current unbalance is less than the "amps unbalance" setting and the sequence is correct, the internal relay will energize. Unit will be available in F enclosure for 120, 240 and 440VAC with adjustable unbalance.

OVER CURRENT MONITOR/RELAY — CMO SERIES

The **CMO SERIES** internal relay energizes when the monitored current exceeds the preset current level for longer than the preset time delay period. Relay de-energizes when the monitored current drops 5 percent below the preset current level for longer than 0.5 seconds. Standard adjustable current ranges are: .05 to .25, .2 to 1.0, 1.0 to 5.0, and 2.0 to 10.0 amps. Pick-up time delay is adjustable from 0.1 to 5.0 seconds.

UNDER CURRENT MONITOR/RELAY — CMU SERIES

The **CMU SERIES** internal relay de-energizes when the monitored current drops below the preset current level for longer than the preset time delay period. Relay energizes when the monitored current is 5 percent above the adjustable current level for longer than 0.5 seconds. Standard adjustable current ranges are: 0.5 to .25, .2 to 1.0 to 5.0, and 2.0 to 10.0 amps. Drop-out time delay period is adjustable from 0.1 to 5.0 seconds.

OVER CURRENT LOCKOUT/RELAY — CML SERIES

The **CML SERIES** internal relay energizes when the monitored current exceeds the preset current level for longer than the preset time delay period. The internal relay remains energized until the reset button is pushed. If the monitored current is below the preset current level when the reset button is released, the relay will de-energize. If the monitored current is above when the reset button is released, the relay will re-energize. Standard adjustable current ranges are: .05 to .25, .2 to 1.0, 1.0 to 5.0, and 2.0 to 10.0 amps. Pick-up time delay is adjustable from 0.1 to 5.0 seconds.

CONTACT US!

The DEI products shown are standard types currently in production. For more detail write for technical data. For "specials" contact our Applications Engineers.

812/426-2806

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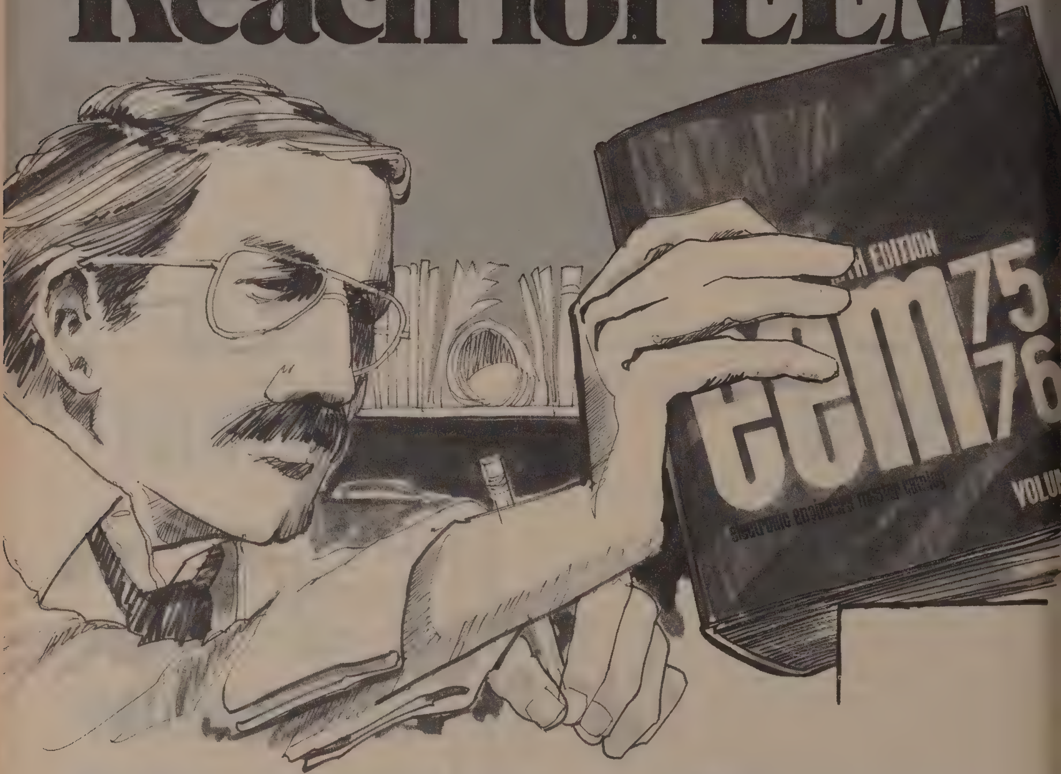
P. O. BOX 6231, EVANSVILLE, INDIANA 47712

There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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Douglas Randall

REED RELAYS

DIVISION OF WALTER KIDDE & COMPANY, INC. • 6 PAWCATUCK AVE., PAWCATUCK, CONN. 02891 • (203) 599-1750

Kidde

SPECIAL DESIGNS

Douglas Randall makes custom designed relays to solve difficult problems. A few models are shown below to illustrate the variety of variations available. Special molding techniques make it possible to manufacture unusual sizes, shapes and terminal arrangements with low tooling costs.

The electrical variations possible with Reed Relays are practically limitless. A few are listed here:

Double Coil Relays.

Relays to operate with coil currents as high as 10 Amperes.

Mixed dry and Mercury wet switch combinations, or mixed High Power and Low Power switches.

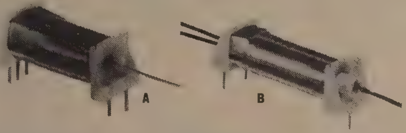
Multipole relays with different pull in or drop out levels for the switches.

Low voltage relays — operate @ .5VDC.

Controlled operate and/or release voltages.

Douglas Randall will gladly review your applications and offer rapid engineering and prototype service.

HIGH INSULATION RESISTANCE RELAYS



Two typical designs are shown above:

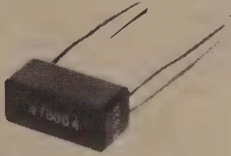
A — A miniature reed relay with a floating lead to maintain high IR.

B — This is a relay using Form A and Form B switches timed to provide a Form C (break before make) function with flying leads to maintain 10^{13} ohms. Up to 5 Form A contacts are available @ 10^{13} ohms.

PROXIMITY SWITCH

FORM B

This is a Form B switch and magnet assembly, .7″L x .150″ sq. The normally closed switch opens, when approached by an ⅛″ square steel rod.

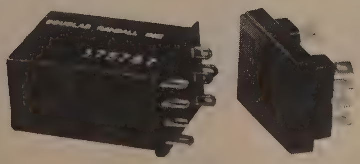


Epoxy molded switch and magnet assemblies are available in many sizes, contact ratings and terminal arrangements.

SPECIAL HIGH VOLTAGE RELAY

This relay has three separate coils, each containing a 5,000VDC and a 10,000VDC switch. The package is molded with a flame retardant epoxy and constructed to withstand 15,000VDC between the switches and all other conductors. The relay is 3⅞″L x 2⅜″W x 1½″H.

CRADLE RELAY



Using special headers, Douglas Randall designed a Reed Relay to plug into cradle relay sockets. This application called for faster operating speeds than cradle relays were able to meet, less than 3 msec.

SNAP-IN RELAYS

This 4 pole relay mounts in Berg-clips, like the Series SI on page 000. Douglas Randall can now duplicate the following discontinued IBM models:

1 — Position: 766040, 766042, 766059, 766060, 766065, 766068 and 766086

2 — Position: 766043, 766044, 766057, 766067, 766072 and 766087

4 — Position: 766046, 766047, 766066, 766071 and 766079

HIGH TEMPERATURE RELAYS

Use of Class H insulation throughout and design of the coil to provide good contact pressure over a wide temperature range make this relay suitable for 180°C operation.

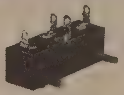
HIGH SENSITIVITY RELAYS

The relays shown will operate at 10 MW coil power.

PLUG-IN RELAYS

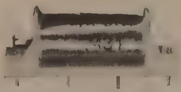
Reed relays are easily adapted to standard style headers for socket mounting.

SPECIAL TERMINALS & MOUNTING SCREWS



The relay shown has terminals to accept #16 lead wire and mounting screws. Entire package is epoxy encapsulated for mechanical strength.

IN-LINE TERMINALS



This relay is open construction with four in-line terminals for P.C. mounting. Using a special mounting plate, this relay can meet 10^{13} ohms insulation resistance.

Douglas Randall REED RELAYS

Kidde

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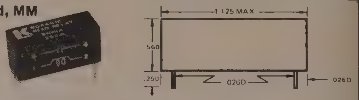
MINIATURE REED RELAYS

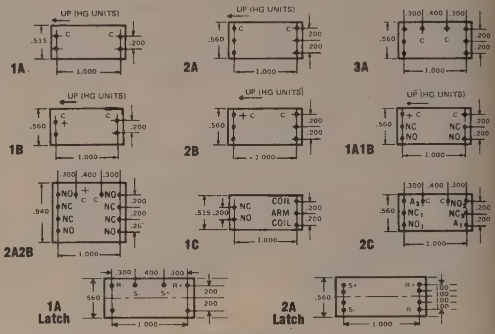
Molded — MM Series
Open — MG Series*

			MM Series	MG Series
Form	Nominal Voltage	DCR Ohms ±10%	Part Number	Part Number
1A	6 12 24	250 1000 4000	6MM1A 12MM1A 24MM1A	6MG1A 12MG1A * 24MG1A
2A	6 12 24	170 675 2700	6MM2A 12MM2A 24MM2A	6MG2A 12MG2A 24MG2A
3A	6 12 24	110 450 1800	6MM3A 12MM3A 24MM3A	6MG3A 12MG3A 24MG3A
1B	6 12 24	170 675 2700	6MM1B 12MM1B 24MM1B	6MG1B 12MG1B 24MG1B
2B	6 12 24	110 450 1800	6MM2B 12MM2B 24MM2B	6MG2B 12MG2B 24MG2B
1A1B	6 12 24	110 450 1800	6MM1A1B 12MM1A1B 24MM1A1B	6MG1A1B 12MG1A1B 24MG1A1B
2A2B	6 12 24	50 200 800	6MM2A2B 12MM2A2B 24MM2A2B	
1C	6 12 24	250 1000 4000	6MM1C 12MM1C 24MM1C	6MG1C 12MG1C 24MG1C
2C	6 12 24	170 675 2700	6MM2C 12MM2C 24MM2C	6MG2C 12MG2C 24MG2C
1A Latch	6 12 24	85/85 340/340 1350/1350	6MML1A 12MML1A 24MML1A	6MGL1A 12MGL1A 24MGL1A
2A Latch	6 12 24	55/55 225/225 900/900	6MML2A 12MML2A 24MML2A	6MGL2A 12MGL2A 24MGL2A

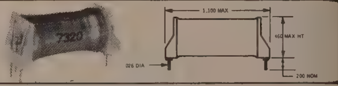
Miniature Molded, MM


1.125 MAX
.560
.250
.026D
.026D

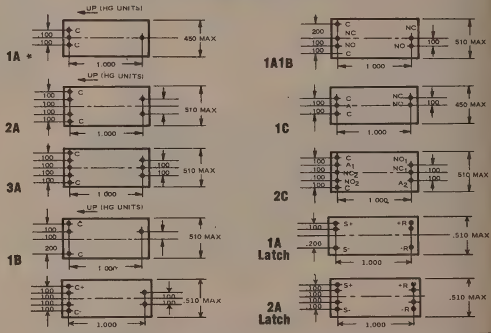
Terminal Layout Series MM (Bottom View)


1A
2A
3A
1B
2B
1A1B
2A2B
1C
2C
1A Latch
2A Latch
UP (HG UNITS)
C
NC
NO
COIL
ARM
R+
R-
S+
S-
1.000
.560
.515
.940
.200
.300
.400
.100

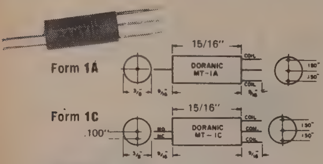
Miniature Open, MG


7320
1.100 MAX
.450 MAX HT
.026 DIA
.200 NOM

Terminal Layout Series MG (Bottom View)


1A *
2A
3A
1B
2A Latch
1A1B
1C
2C
1A Latch
2A Latch
UP (HG UNITS)
C
NC
NO
S+
S-
+R
-R
C+
C-
1.000
.100
.200
450 MAX
510 MAX

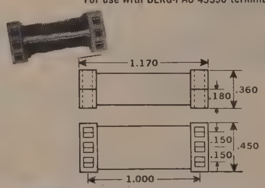
TUBULAR RELAYS SERIES MT


Form 1A
Form 1C
15/16"
15/16"
DORANIC MT-1A
DORANIC MT-1C
COIL
NO
NC
.100"
3/8"
9/16"
.150"

Form	Nominal Voltage	Part Number	DCR Ohms ±10%
1A	6 12 24	6MT1A 12MT1A 24MT1A	185 750 3000
1C	6 12 24	6MT1C 12MT1C 24MT1C	185 750 3000

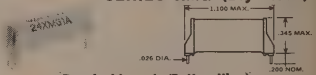
SNAP IN RELAYS SERIES SI

For use with BERG-PAC 45590 terminals

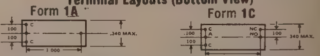

1.170
.180
.360
.150
.150
.450
1.000

Form	Nominal Voltage	Part Number	DCR Ohms ±10%
1A	6 12 24	6SI1A 12SI1A 24SI1A	250 1000 4000

LOW PROFILE OPEN RELAYS SERIES XMG (Dry Reed)


24XMG1A
1.100 MAX.
.345 MAX.
.026 DIA.
.200 NOM.

Terminal Layouts (Bottom View)


Form 1A
Form 1C
C
A
NC
NO
.100
1.000
.340 MAX.

Form	Nominal Voltage	Part Number	DCR Ohms ±10%
1A*	6 12 24	6XMG1A 12XMG1A 24XMG1A	168 675 2700
1C	6 12 24	6XMG1C 12XMG1C 24XMG1C	168 675 2700

Note: Nylon Cover Available.
* Hg wet switches available.

CONTACT DATA — All Series

Form	Max. Resistive Load	Initial Resistance
A, B	10W, 12VA, .5A, 250VDC	.15 Ohms
C	3W, 3VA, .25A, 100VDC	.20 Ohms

1. Hg switches rated 28W, 1A, 28VDC available.
2. E/M shields std. all series MM and all Form B and Form L.
3. E/S shields optional.
4. 1000VDC switches available all Form A and B relays.
5. Premium run-in switches available all models.
6. Ultra sensitive relays available.
7. Series MML/1A, MML/2A have internal diodes.
8. Series MM available up to 8 Form A, 4 Form C.

OPERATING DATA — All Series

Must Operate — 70% Nominal
Must Release — 10% Nominal
Maximum Voltage —
  Form A and C — 200% Nominal
  Form B and Latching — 130% Nominal
Environmental Data: −20°C to +65°C; vibration 35g to 2000 cps: shock, 30g.

*CERTAIN MGIA RELAYS ARE RECOGNIZED UNDER UNDERWRITERS LABORATORIES COMPONENT LISTING PROGRAM.

Douglas Randall REED RELAYS

Kidde

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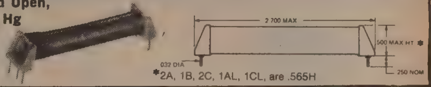
STANDARD SIZE REED RELAYS

Molded — SM, HPG*, HgG*
Open — SG, HP*, Hg*

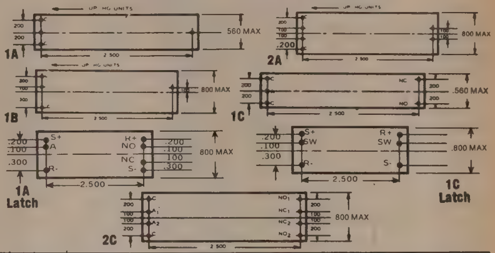
		SM Series		SG Series	
Form	Nominal Voltage	Part Number	DCR Ohms ±10%	Part Number	DCR Ohms ±10%
1A	6 12 24	6SM1A 12SM1A 24SM1A	180 725 2900	6SG1A 12SG1A 24SG1A	180 720 2880
2A	6 12 24	6SM2A 12SM2A 24SM2A	175 700 2750	6SG2A 12SG2A 24SG2A	110 440 1760
1B	6 12 24	6SM1B 12SM1B 24SM1B	175 700 2750	6SG1B 12SG1B 24SG1B	110 440 1760
2B	6 12 24	6SM2B 12SM2B 24SM2B	140 550 2200		
1C	6 12 24	6SM1C 12SM1C 24SM1C	180 725 2900	6SG1C 12SG1C 24SG1C	180 720 2880
2C	6 12 24	6SM2C 12SM2C 24SM2C	175 700 2750	6SG2C 12SG2C 24SG2C	110 440 1760
1A Latch	6 12 24	6SML1A 12SML1A 24SML1A	85/85 340/340 1350/1350	6SGL1A 12SGL1A 24SGL1A	85/85 340/340 1350/1350
1C Latch	6 12 24	6SML1C 12SML1C 24SML1C	85/85 340/340 1350/1350	6SGL1C 12SGL1C 24SGL1C	85/85 340/340 1350/1350

*For part numbers and DCR values contact factory.
See specification table for contact ratings.

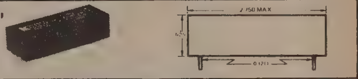
Standard Open, SG, HP, Hg


2.700 MAX
.500 MAX HT
.032 DIA
250 NOM
*2A, 1B, 2C, 1AL, 1CL, are .565H

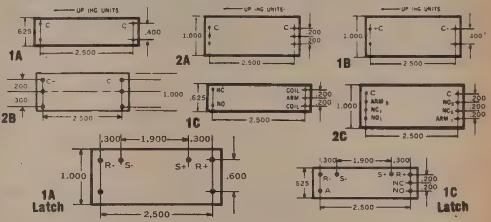
Terminal Layout Series SG (Bottom View)


1A
2A
1B
1C
1A Latch
1C Latch
2C
UP HG UNITS
560 MAX
800 MAX
.560 MAX
.800 MAX
2.500
S+
S-
R+
R-
SW
H+
NO
NC
NO1
NC1
NC2
NO2
.200
.100
.300

Standard Molded, SM, HPG†, HgG

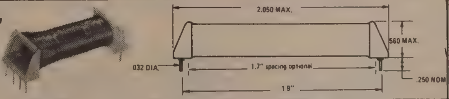


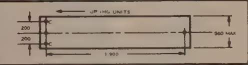
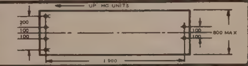
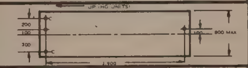
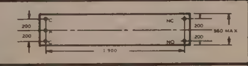
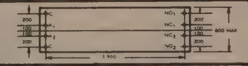
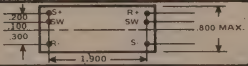
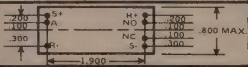
Terminal Layout Series SM (Bottom View)


1A
2A
1B
2B
1C
2C
1A Latch
1C Latch
UP HG UNITS
.625
.400
1.000
2.500
.200
.300
1.900
.600
525
C
C+
C-
NC
NO
COIL
ARM
S+
S-
R+
R-

COMPACT OPEN REED RELAYS

CG Dry Reed, HPCG, High Power.


2.050 MAX.
.560 MAX.
.032 DIA
1.7" spacing optional
1.9"
.250 NOM

Form	Nom. Volt.	Part Number	DCR Ohms ±10%	Part Number	DCR Ohms ±10%	Terminal Layout (Bottom View)
1A	6 12 24	6CG1A 12CG1A 24CG1A	165 660 2640	6HPCG1A 12HPCG1A 24HPCG1A	105 420 1680	
2A	6 12 24	6CG2A 12CG2A 24CG2A	100 400 1600	6HPCG2A 12HPCG2A 24HPCG2A	65 260 1040	
1B	6 12 24	6CG1B 12CG1B 24CG1B	100 400 1600	6HPCG1B 12HPCG1B 24HPCG1B	65 260 1040	
1C	6 12 24	6CG1C 12CG1C 24CG1C	165 660 2640	6HPCG1C 12HPCG1C 24HPCG1C	105 420 1680	
2C	6 12 24	6CG2C 12CG2C 24CG2C	100 400 1600	6HPCG2C 12HPCG2C 24HPCG2C	65 260 1040	
1A Latch	6 12 24	6CGL1A 12CGL1A 24CGL1A	60/60 250/250 1000/1000			
1C Latch	6 12 24	6CGL1C 12CGL1C 24CGL1C	60/60 250/250 1000/1000			

Common Specifications, All Series

OPERATING DATA

Must Operate — 70% Nominal
Must Release — 10% Nominal
Max. Voltage — Form A & C — 200% Nominal
Form B & Latch — 130% Nominal

ENVIRONMENTAL DATA

Temperature — 20°C to +65°C
Shock — 30g
Vibration — 35g to 2000 Hz

CONTACT RATINGS
Series SM, SG, CG (Standard)

Form	Max. Res. Load	Initial Contact Resistance
A & B	15W, 1.0A, 400VDC	.100Ω
C	10W, .5A, 200VDC	.150Ω

Series Hg, HgG (Mercury Wet)

A & B	50W, 3.0A, 400VDC	.050Ω

Series HP, HPG, HPCG *

Form	Suffix	Max. Res. Load	Initial Contact Resistance
A & B	−25	25W, 1.0A, 1000VDC	.100Ω
A & B	−50	50W, 3.0A, 1000VDC	—
A & B	−100	110VA, 1.0A, 110VAC	—
C	—	20W, 1.5A, 500VDC	.200Ω

† CERTAIN MODEL HPGIA RELAYS ARE RECOGNIZED UNDER UNDERWRITERS LABORATORIES COMPONENT LISTING PROGRAM, AND ARE CERTIFIED UNDER CSA COMPONENT CERTIFICATION PROGRAM

Douglas Randall REED RELAYS

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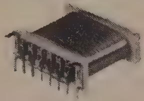
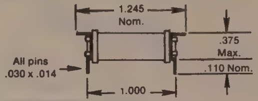
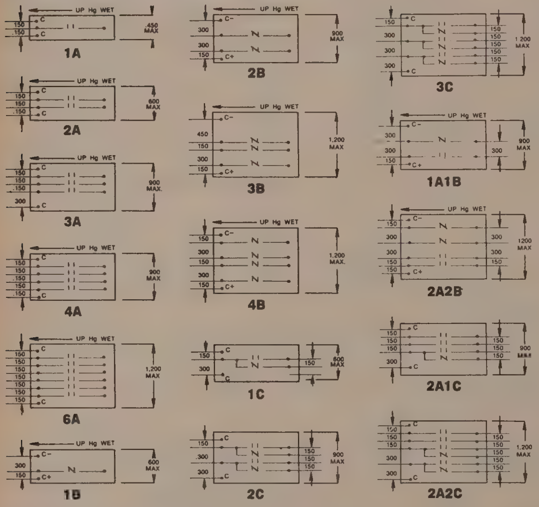
LOW PROFILE—LP, HgLP* SERIES





Form	Nominal Voltage	Part Number	DCR Ohms ±10%	Form	Part Number	DCR Ohms ±10%
*1A	6	6LP1A	240	*4B	6LP4B	45
	12	12LP1A	950		12LP4B	180
	24	24LP1A	3800		24LP4B	700
*2A	6	6LP2A	155	1C	6LP1C	155
	12	12LP2A	625		12LP1C	625
	24	24LP2A	2500		24LP1C	2500
*3A	6	6LP3A	80	2C	6LP2C	80
	12	12LP3A	325		12LP2C	325
	24	24LP3A	1300		24LP2C	1300
*4A	6	6LP4A	80	3C	6LP3C	45
	12	12LP4A	325		12LP3C	180
	24	24LP4A	1300		24LP3C	700
*6A	6	6LP6A	45	*1A1B	6LP1A1B	80
	12	12LP6A	180		12LP1A1B	325
	24	24LP6A	700		24LP1A1B	1300
*1B	6	6LP1B	155	*2A2B	6LP2A2B	45
	12	12LP1B	625		12LP2A2B	180
	24	24LP1B	2500		24LP2A2B	700
*2B	6	6LP2B	80	2A1C	6LP2A1C	80
	12	12LP2B	325		12LP2A1C	325
	24	24LP2B	1300		24LP2A1C	1300
*3B	6	6LP3B	45	2A2C	6LP2A2C	45
	12	12LP3B	180		12LP2A2C	180
	24	24LP3B	700		24LP2A2C	700

TERMINAL LAYOUT (Bottom View)



OPERATING DATA — Series LP, HgLP and VR

Must Operate — 70% Nominal Voltage
Must Release — 10% Nominal Voltage
Maximum Voltage — Form A and C — 200% Nominal
Form B and Latching — 130% Nominal
Duty — Continuous
* HgLP has mercury wet contacts.

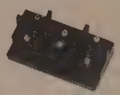
CONTACT DATA — Series LP, HgLP and VR

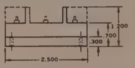
Series	Form	Maximum Resistive Rating				Initial Resistance
LP & VR	A or B	10W	12VA	.5A	250VDC	.150 Ohms
	C	3W	4VA	.25A	28VDC	.200 Ohms
HgLP	A,B	28W	—	1A	1000VDC	.050 Ohms

ENVIRONMENTAL DATA

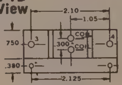
Temperature	Vibration	Shock
−20°C to 65°C	35g to 2000cps	50g

HIGH VOLTAGE RELAYS — HV SERIES

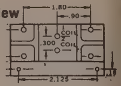




1A or 1B Top View



2A Top View



Form	Nom. Volt.	Part Number	DCR Ohms ±10%
1A (1B*)	6	6HV1A	25
	12	12HV1A	100
	24	24HV1A	400
2A	6	6HV2A	20
	12	12HV2A	80
	24	24HV2A	320

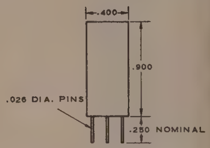
OPTION:
* Relays available in Form B up to 7,500V.

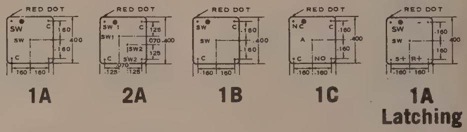
Note: To order, specify as follows: 6HV1A 35 is a 6HV1A relay with 3,500VDC switch.

CONTACT DATA

Series	Maximum Resistive Rating			Breakdown Voltage (min.)	Initial Resistance
35	3,500VDC	3.0A	50W	5,000VDC	.100 Ohms
75	7,500VDC	3.0A	50W	10,000VDC	.100 Ohms
100	10,000VDC	3.0A	50W	12,500VDC	.100 Ohms

VERTI REED RELAYS SERIES VR





COIL DATA

Contact Arrangement	Nominal Voltage	Part Number	DCR Ohms ±10%
1A	6	6VR1A	225
	12	12VR1A	900
	24	24VR1A	3600
2A	6	6VR2A	145
	12	12VR2A	575
	24	24VR2A	2300
1B	6	6VR1B	225
	12	12VR1B	900
	24	24VR1B	3600
1C	6	6VR1C	225
	12	12VR1C	900
	24	24VR1C	3600
1A Latching	6	6VRL1A	105/105
	12	12VRL1A	425/425
	24	24VRL1A	1700/1700

NOTES AND OPTIONS — Series LP, HgLP and VR

*1. These relays are available with Mercury Wetted switches.
2. Magnetic shields standard on Form B Relays. Optional on Form A and Form C Relays.
3. 1,000VDC switches (to 2,000VDC breakdown) available on Form A and Form B Dry Reed Relays.

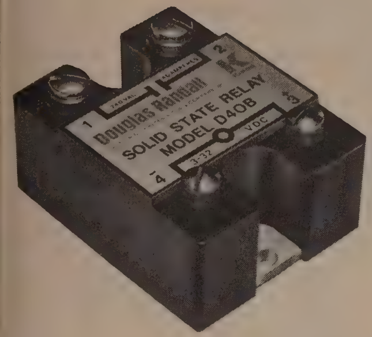
Douglas Randall SOLID STATE RELAYS

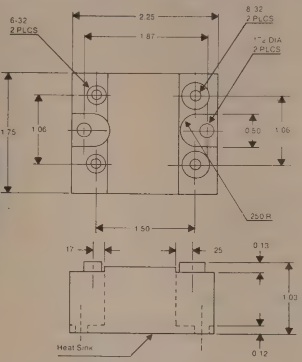
Kidde

DIVISION OF WALTER KIDDE & COMPANY, INC. • 6 PAWCATUCK AVE., PAWCATUCK, CONN. 02891 • (203) 599-1750

RATINGS TO 40 AMPERES / OPTO-ISOLATED / ZERO VOLTAGE SWITCHING

MECHANICAL ARRANGEMENT





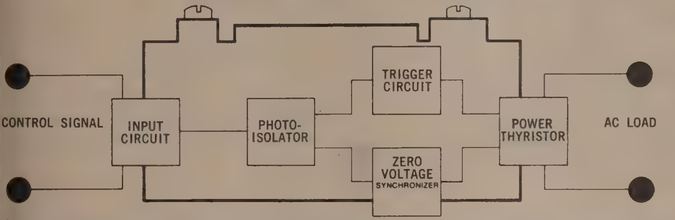
Size:
2¼"L x 1¾"W x 1⅛"H maximum

Weight:
4 ounces maximum.

Termination:
Standard Models —
Control Signal: 6-32 screws
Output: 8-32 screws

Standard Models are furnished with ¼" Quick Connect adapters.

Special Models can be provided with lead wires or other types of termination in OEM quantities. Consult the factory for details.



Douglas Randall offers 20 SOLID STATE RELAY models to switch 120VAC or 240VAC loads at 4A, 8A, 12A, 25A or 40A, the broadest line in the industry. In addition these options are available:

- Thermal Overload Protection
- Form B (SPST-NC) Switching — Form A (SPST-NO) is Standard
- Constant DC Signal Current
- 400Hz Switching

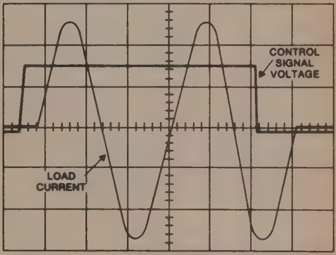
Douglas Randall SOLID STATE RELAYS combine Opto-Isolation and zero voltage turn-on, zero current turn-off to switch high power AC loads. **Improved design and internal construction has resulted in models capable of switching 40 Amps, 120VAC or 240VAC.** DC control signal relays operate from 3 to 32VDC inputs and are ideally suited for low level control systems or DTL, TTL and MOS logic. AC control signal relays operate from 90 to 260VAC or 80 to 140VDC inputs.

Opto-isolator coupling and zero cross-over switching combine to give completely solid state operation and eliminate any moving parts which could wear out, arc or oxidize. Since only a tiny light source provides coupling between the input and output, sensitive control signal circuits are completely isolated from load circuit transients, making Douglas Randall SOLID STATE RELAYS the optimum choice for power switching. Opto-isolator coupling also gives additional advantages:

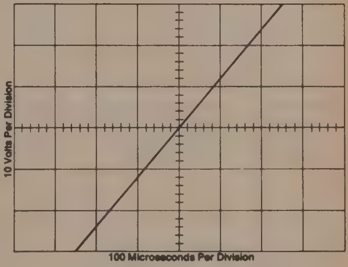
a) High Isolation — 2500V or 10^{10} ohms DC
b) High Sensitivity — 10mW at 3VDC Input
c) TTL, DTL logic compatibility with no need for drive transistors
d) No need for electrostatic or magnetic shielding
e) Inputs are not damaged by reverse polarity

Zero voltage switching makes Douglas Randall SOLID STATE RELAYS superior to electro mechanical or non-synchronous solid state models. Figure 1 shows the operation when a DC control signal is applied. Regardless of when the DC signal is applied, current does not flow in the load until the load circuit voltage goes through zero. When the DC signal is removed, load current continues to flow until it goes through the zero point (up to ½ cycle) at which point the relay opens the load circuit. Figures 2 and 3 show the load current wave form for resistive and inductive loads respectively. The time scale has been expanded to illustrate the area near zero cross-over in greater detail. It can be seen that switching time is less than 200 micro seconds — 10 to 100 times faster than electro-mechanical power relays. In addition to fast operation, zero crossover switching gives many other advantages:

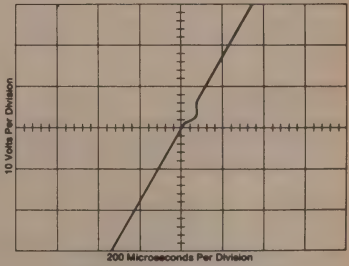
a) Infinite life at rated current for inductive, capacitive and lamp loads as well as resistive loads
b) No RFI, contact bounce or arcing noise.
c) Reduced inrush currents extend lamp life
d) Operation is not affected by load phase angle
e) High reliability
f) No moving contacts to ignite explosive gases
g) Protected against dv/dt



ZERO VOLTAGE SWITCHING
(Control signal voltage and load current vs. time)
FIGURE 1



ZERO VOLTAGE SWITCHING — INDUCTIVE LOAD (45° lagging)
FIGURE 2



ZERO VOLTAGE SWITCHING — RESISTIVE LOAD
FIGURE 3

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OUTPUT DATA

Maximum Current	4A	8A	12A	25A	40A
One Cycle Surge Current	50A	75A	100A	250A	400A
Overload (1 sec., RMS)	25A	35A	40A	40A	75A
Minimum Current	10mA Typ. 20mA Max.	10mA Typ. 20mA Max.	10mA Typ. 20mA Max.	10mA Typ. 25mA Max.	10mA Typ. 25mA Max.
AC Line Voltage	90/140V or 200/280V[1] @ 47-63Hz[2]				
Voltage Drop @ Rated Current	1.6V Max.				
Typical Turn-on Voltage	5V				
Response Time (DC Signal)	½ Cycle Max.				
dv/dt[6] Off State Commutating	100V/μsec 5V/μsec				
Off State Leakage Current 90/140VAC 200/280VAC	 4.5mA Typ. 5.5mA Typ.				
Isolation Output to Base	1,500V, 10^{10}Ω DC[3]				
Contact Form	SPST (NO)[4]				

INPUT SIGNAL DATA

	DC	AC
Range	3-32V[5]	90-260VAC (80-140VDC)
Must Operate	3VDC	90VAC (80VDC)
Must Release	1VDC	10VAC (10VDC)
Input Impedance	1000Ω Min.,	40KΩ Min.
Isolation Signal to Load Signal to Base	 1500V, 10^{10}Ω DC 1500V, 10^{10}Ω DC	
Capacitance	15pF Signal to Load	
Temperature Range	−30°C to +80°C	

MODEL NUMBERS

Output Rating		DC Signal	AC Signal
90-140VAC	4A	D04A	A04A
	8A	D08A	A08A
	12A	D12A	A12A
	25A	D25A	A25A
	40A	D40A	A40A
200-280VAC	4A	D04B	A04B
	8A	D08B	A08B
	12A	D12B	A12B
	25A	D25B	A25B
	40A	D40B	A40B

NOTES & OPTIONS

1. Special wide range models can be made which will switch loads from 18V to 140V. These relays can handle either 24VAC or 120VAC loads.
2. Special models are available which switch loads at 400Hz.
3. 2500VAC isolation can be supplied on request.
4. Form A (SPST-NO) relays are standard. Form B (SPST-NC) switching is optional. Models incorporating this feature are designated by NC. e.g. A40B-NC.
5. All DC models are TTL compatible over the full operating temperature range.
6. All relays incorporate an RC snubber network which prevents false operation from transients up to the dv/dt level shown. More severe transients may require additional external protection. We will review your application and recommend the additional protection needed.

THERMAL OVERLOAD PROTECTION

Douglas Randall Solid State Relays can now be obtained with Thermal Overload Protection, a unique feature which turns the relay off before long thermal overloads damage it. Whether the thermal overload is caused by excessive current, an improper heat sink, or rise in ambient temperature, the relay will turn off in time to prevent internal damage. The thermal protection is fully automatic and self-resetting after the relay cools to a safe operating temperature. This added feature will be especially valuable where ambient temperature is uncertain, such as prototype applications. Models incorporating thermal overload protection are designated by a "TC" as D12A-TC.

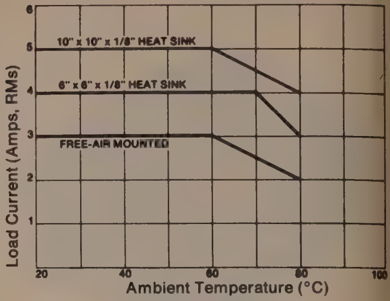
CONSTANT SIGNAL CURRENT

Solid State Relays can be made with constant signal current circuitry. Any DC signal relay with this option will draw 3.5mA signal current over the entire voltage range of 3-32VDC. Relays with this option are designated by CC. e.g. D12A-CC.

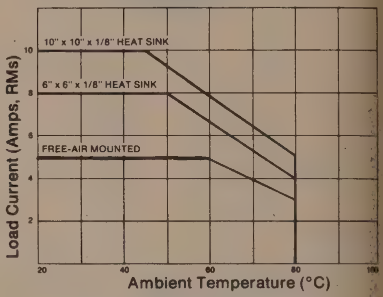
SPECIAL DESIGNS

Douglas Randall has designed many special solid state relays, such as a polarized, latching, SPDT unit which will switch 12A at 28VDC. We also have the capability of making special package sizes and terminal arrangements for our solid state relays at moderate tool cost. Your inquiries will be reviewed promptly.

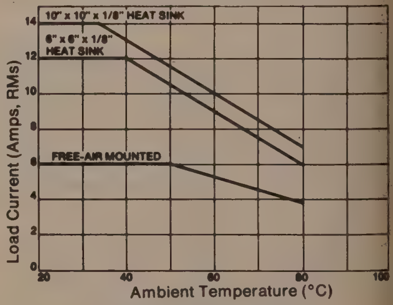
LOAD CURRENT vs TEMPERATURE
4 AMP RELAYS:
MODELS D04A, D04B, A04A, A04B



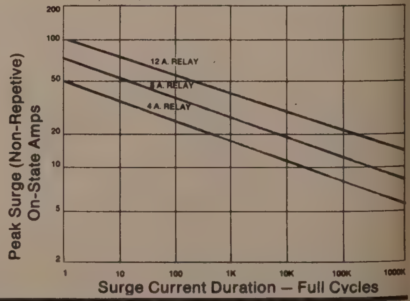
LOAD CURRENT vs TEMPERATURE
8 AMP RELAYS:
MODELS D08A, D08B, A08A, A08B



LOAD CURRENT vs TEMPERATURE
12 AMP RELAYS:
MODELS D12A, D12B, A12A, A12B



SURGE CURRENT vs TIME
4, 8 & 12 AMP RELAYS



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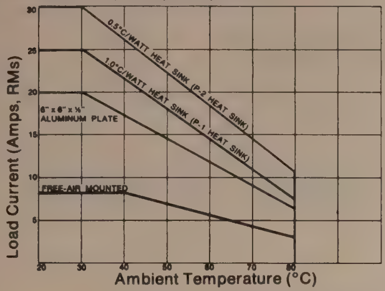
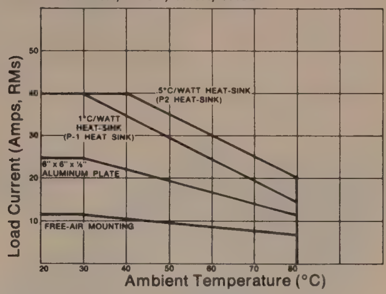
LOAD CURRENT vs TEMPERATURE
25 AMP RELAYS:
MODELS D25A, D25B, A25A, A25B

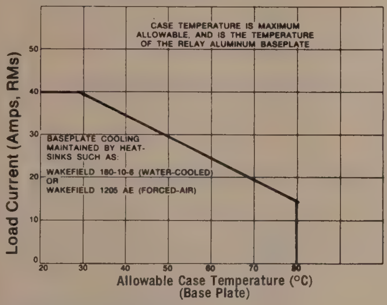


LOAD CURRENT vs TEMPERATURE
40 AMP RELAYS:
MODELS D40A, D40B, A40A, A40B

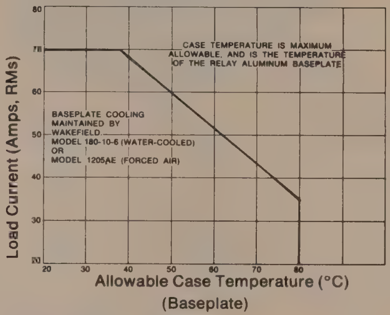


NOTE: Relay must be mounted with thermally conductive silicone grease, on a smooth flat mounting surface.

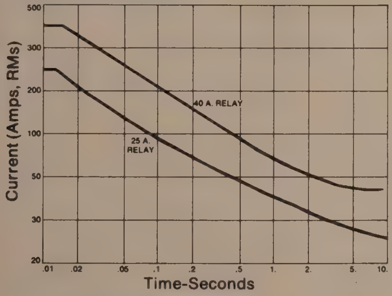
CURRENT vs BASEPLATE TEMPERATURE
25 AMP RELAYS



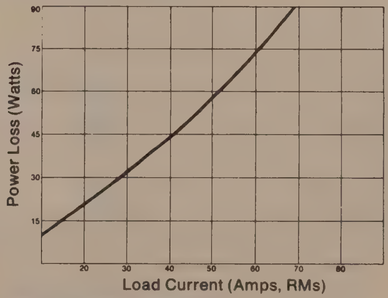
CURRENT vs BASEPLATE TEMPERATURE
40 AMP RELAYS



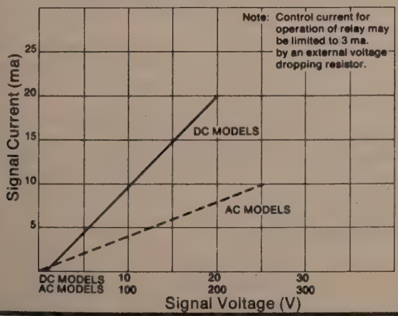
SURGE CURRENT vs TIME
25 & 40 AMP RELAYS



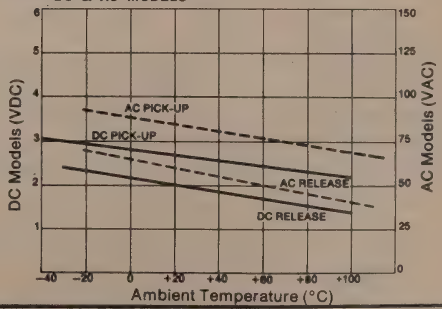
POWER LOSS vs CURRENT
25 & 40 AMP RELAYS



CONTROL SIGNAL CURRENT DRAIN
DC & AC MODELS



CONTROL SIGNAL SENSITIVITY
DC & AC MODELS



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SERIES K — DC OUTPUT RELAYS

Series K relays switch DC loads of 4, 8 or 12 Amperes at 24VDC or 48VDC at speeds well in excess of 50 microseconds. Like Douglas Randall AC relays they are epoxy encapsulated in a small, rugged phenolic case and contain an integral heat sink. They have convenient mounting holes and can accommodate screw or spade terminals.

MODEL NUMBERS

Output Voltage	Current	Model
2-32VDC	4 Amp 8 Amp 12 Amp	K04A K08A K12A
2-55VDC	4 Amp 8 Amp 12 Amp	K04B K08B K12B

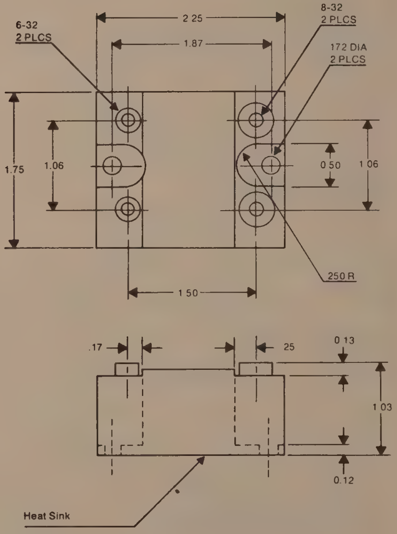
INPUT SIGNAL DATA

Range	3-32VDC
Must Operate	3VDC
Must Release	1VDC
Isolation	
Signal to Load	1500V
Signal to Base	1500V
Temperature Range	−30°C to +80°C

OUTPUT DATA

Continuous Current	4A	8A	12A
Peak Current	7A	14A	20A
DC Line Voltage	2-32VDC or 2-55VDC		
Voltage Drop @ Rated Current	2V		
Response Time	50μsec Max.		

MECHANICAL ARRANGEMENT



SIZE:
2¼L x 1¾W x 1⅛H maximum.

WEIGHT:
4 ounces maximum.

TERMINATION:
Standard Models—
Control Signal:
6-32 screws
Output:
8-32 screws

Standard Models are furnished with ¼" Quick Connect adapters.

Special Models can be provided with lead wires or other types of termination in OEM quantities. Consult the factory for details.

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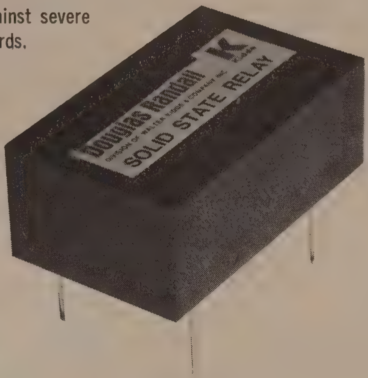
DOUGLAS RANDALL SERIES CV CONVERTER RELAYS

These relays interface between computer logic and AC or DC power lines. Models **CV1** and **CV2** are AC Output versions which incorporate Zero-Crossover switching. Model **CV3**, **CV4** and **CV5** are DC Output Units, Models **CV3** and **CV4** operating from DC Inputs, while Model **CV5** operates from a 120VAC Input.

All models are epoxy encapsulated in phenolic cases for protection against severe environments and have terminals for installation on printed circuit boards.



SOLID STATE CONVERTER RELAYS

AC OUTPUT MODELS CV1 & CV2

INPUT DATA			OUTPUT DATA	
	CV1	CV2		CV1 and CV2
Nominal Voltage	5.5VDC	28VDC	Current	3A RMS
Voltage Range	4-10VDC	10-32VDC	Surge Current	60A Peak
Must Operate	4VDC	10VDC	Minimum Current	10mA
Must Release	.4VDC	.4VDC	Off State Leakage	8mA
Current @ Nom. Voltage	10mA	15mA	Voltage	24 to 240VAC @ 47 to 63Hz
Isolation	1500V	1500V	Voltage Drop	2.0VAC
			Off State dv/dt	100V/μsec

DC OUTPUT MODEL CV3

INPUT DATA		OUTPUT DATA	
Nominal Voltage	5.5VDC	Max. Current	3A DC
Voltage Range	4-10VDC	Voltage Range	11-55VDC
Must Operate	4VDC	Voltage Drop	2VDC
Must Release	.4VDC	Off State Leakage	10mA DC
Current @ 5.5VDC	10mA Max.		

DC OUTPUT MODELS CV4 & CV5

INPUT DATA			OUTPUT DATA	
	CV4	CV5		CV4 and CV5
Voltage Range	10-55VDC	90-130VAC	Voltage	30VDC
Current	10mA	10mA	Current	16mA Max.
Must Not Operate	3mA DC	.8mA RMS	Leakage	100mA
Isolation	1500V	1500V	Voltage Drop	4VDC

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SOLID STATE CONTROLS

SOLID STATE PROPORTIONAL CONTROLS

DESCRIPTION

Douglas Randall Proportional Control Modules provide a variable AC output voltage to loads up to 15 amperes. They are solid state, full wave SCR phase angle control units, which offer a reliable, compact method of controlling motors, heaters, incandescent lamps, and other AC devices.

Six models are available, rated 5, 10 and 15A at 120VAC or 240VAC. Standard units provide output voltage variation from 0% to 80% of full voltage. Optional high range models provide a control range from 20% to 95% of output voltage.

The units are epoxy molded in compact phenolic cases giving maximum environmental protection. All solid state circuits provide infinite life. Optimum heat transfer is obtained by use of integrally molded heat sinks — the same as on Douglas Randall's Solid State Relays. Two hole screw mounting and screw or spade terminals provide ease of installation.

OPTIONS

High Range Units:
20% to 95% of output.

Preset Minimum/Maximum:
Set internally at the factory to any value in the control range.

Preset Output:
Not variable — fixed output is preset internally to any value in the control range.

Special Ranges, Control Potentiometers and 400Hz Load Controls are available as special designs.

MODEL NUMBERS

Output Voltage	90-140VAC			200-280 VAC		
Model Number	R05A	R10A	R15A	R05B	R10B	R15B
Current	5A	10A	15A	5A	10A	15A

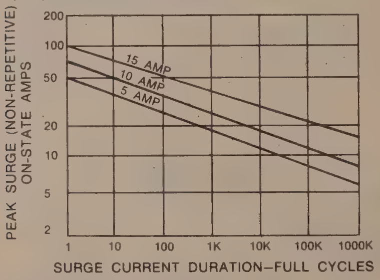
OUTPUT DATA

Maximum Current	5A	10A	15A
One Cycle Surge Current	50A	75A	100A
Overload (1 sec., RMS)	25A	45A	65A
Minimum Current	.040A	.040A	.040A
AC Line Voltage	90/140V or 200/280V @ 47-63Hz		

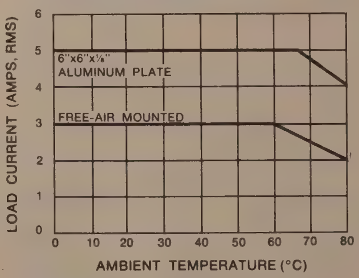
INPUT

Variable Resistor (150,000Ω, 1 watt) — For 120VAC or 240VAC

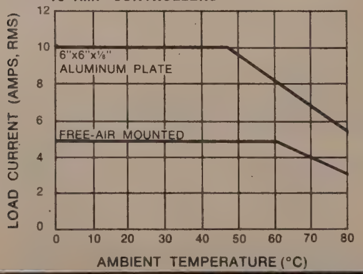
SURGE CURRENT vs TIME
5, 10, 15 AMP CONTROLLERS



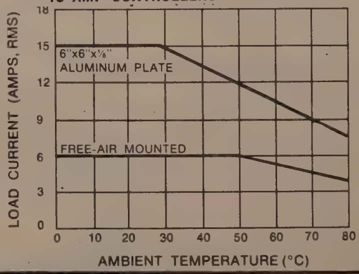
LOAD CURRENT vs TEMPERATURE
5 AMP CONTROLLERS



LOAD CURRENT vs TEMPERATURE
10 AMP CONTROLLERS



LOAD CURRENT vs TEMPERATURE
15 AMP CONTROLLERS



durakool

• Mercury time delay relays • Contactors • Tip and tilt switches

Unsurpassed for long life, durability and quietness of operation– the durakool difference

Durakool products, while varied in application and end-use, share many common construction features. All are designed and manufactured for maximum durability and quietness of operation.

Mercury-to-mercury units on all time delay relays and contactors through 35 amps utilize two pools of mercury for the contacts, with one pool electrically a part of the center insulated electrode. Both pools are in a hermetically sealed hydrogen atmosphere. Contacts are open when the pools are separated by a ceramic barrier and closed when the two pools flow together.

Mercury-to-metal contacts (on contactors 60 amp and over and certain tip & tilt switches) operate similarly except that one pool of mercury is replaced by a refractory electrode.

Some of our unique construction features are:

1. **A single moving** part contributes greatly to trouble-free operation over long periods of time.
2. **Time Delay Relays:**All are of fixed-delay or tamper-proof design. Timing can be field-adjusted only by replacing the tube. A single moving part actuated by the magnetic field of the coil accomplishes this action. . .insuring long trouble-free operations. Timing is accomplished by the metering of mercury through a precision orifice.
3. **All-Steel Construction:** Our deep-drawn cans and rugged hermetic seal when welded together provide an unbreakable unit. The metal enclosed contacts provide added insurance against danger of explosion and fires; and the "all-steel body" acts as one side of the circuit, eliminating one inside electrode.
4. **Hermetic Seals:** We construct our own hermetic seals to engineering specifications so exacting that our units retain high-pressure hydrogen indefinitely. Further, this construction keeps the contacts 100% free of all foreign matter throughout the life of the unit.
5. Hypressure Hydrogen Gas is permanently retained inside the all-steel body by using a hermetic glass-to-metal seal. Hydrogen's superior arc-quenching properties drastically reduces the "make and break" arcing and dissipates the heat. This allows the overall size of the unit to be smaller than conventional contactors.
6. **Unequalled Quality and Durability:** Because of our rugged construction the switching of heavy loads, tungsten loads and highly inductive circuit loads is much more readily handled by a Durakool product as in contrast to conventional open contactors or easily-damaged solid state units that can't withstand high transients.
7. **Low Contact Resistance** is insured throughout the life of the product because of the overall design and extremely high product quality.
8. **Product choices include:** 1, 2 and 3 pole combinations; contact ratings of 10, 15, 20, 35, 60, 80, 100, and 150 amps; timed open and/or timed closed contacts; normally open or normally closed contacts; various types of contact terminations or lead wires; insulated or uninsulated tubes; various lead wire insulations, lengths and terminations; a wide range of coil voltages and frequencies; many class "B" (130° C) coils; wiring terminals or lead wires for coils, insulating back panels for mounting; and NEMA type cases for enclosing the units.
9. **Easy Replacement:** Replacement of the entire Durakool contactors and tilt switches is simple and easy. As good as Durakool products are, nothing lasts forever. With a Durakool relay, timer or contactor, any part can be replaced within minutes. This means the user buys only the replacement item needed.
10. **U.L. and C.S.A. Ratings:** Durakool contactors are listed by U.L. under the classification of "Switches, Magnetically Operated" and reports have been filed under E 35126. At C.S.A., the listing is under the classification "Switches-Automatic Magnetic Type," and reports have been filed under 22416. Many of our units have been listed for applications where an increased endurance test is required. Durakool contactors which carry a 700 or 7000 series number are U.L. listed. Most of these, as well as some 300 series numbers, are C.S.A. certified. Ask for our ES-497 for U.L. listed units and ES-498 for C.S.A. certified units to obtain full information. New ratings are constantly being added to our listings. Underwriters' Laboratories do not approve any mercury tilt switches except on the application where they are used. Durakool switches are designed to pass U.L. tests when properly applied.
11. **Multiple Ratings:** Each product series carries a multiple general purpose load rating. All ratings are subject to change without notice.
12. **WARRANTY:** Durakool shall replace any of its products which contain defective material or workmanship. Durakool makes no warranty of merchantability or of fitness of its products, nor does it make any other implied or express warranties beyond the foregoing promise to replace any of its products which contain defects in material or workmanship.

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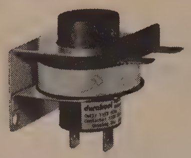
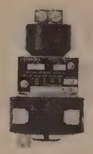
durakool inc., 1010 N. Main St. • Elkhart, Ind. 46514 • (219) 264-1116

durakool
single pole contactors



Model AF — 10, 15 and 20 AMP

Size: 1¾″ x 1¾″ x 2″



Model BF7000 — 35 AMP
Size: 3¾″ x 2″ x 2¼″

Model BFC700 — 60 AMP
Size: 5⅜″ x 2″ x 2¼″

Model CF700 — 80 AMP
Size: 5 9/16″ x 2 33/64″ x 2⅝″

Model CFC700 — 100 AMP
Size: 5 9/16″ x 2 33/64″ x 2⅝″

Model DFC — 150 AMP
Size: 6 5/16″ x 3″ x 3⅛″

ELECTRICAL RATINGS OF NORMALLY OPEN SINGLE POLE CONTACTORS

BASIC CATALOG DESIGNATION	GENERAL PURPOSE LOAD RATINGS								UL TUNGSTEN LAMP LOAD AT 120V 60 Hz		AC MOTOR RATINGS IN HP SINGLE PHASE		**COIL CURRENT & POWER AT 115V 60 Hz***	
	AMPERES*													
	AC						DC							
	120V	208V	240V	277V	480V	600V	120V	240V	AMP	KW	120V	240V	AMPS	VA
BF	35	31	30	30	20	15	25	15	30	4	2	3	.047	5.5
BFC	60	54	52	50	40	25	30	20	60	6.6	3	5	.054	6.0
CF	80	68	65	63	50	40	35	25	75	8	5	7½	.148	17.0
CFC	100	92	90	88	75	70	50	30	100	10	7½	10	.170	19.5
DFC	150	140	135	130	120	110	—	—	For other than listed ratings contact Durakool					
AF10	10	7	6	5	2	1.5	—	—						
AF15	15	12	11	10	7	6.5	—	—						
AF20	20	17	16	15	12	11.5	—	—						

**Inrush Current — Approx. 150% of values shown ***Any AC-DC Coil voltage available.

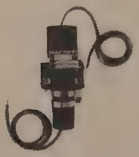
ELECTRICAL RATINGS OF NORMALLY CLOSED SINGLE POLE CONTACTORS

BASIC CATALOG DESIGNATION	GENERAL PURPOSE LOAD RATINGS								UL TUNGSTEN LAMP LOAD AT 120V 60 Hz		AC MOTOR RATINGS IN HP SINGLE PHASE		**COIL CURRENT & POWER AT 115V 60 Hz***	
	AMPERES*													
	AC						DC							
	120V	208V	240V	277V	480V	600V	120V	240V	AMP	KW	120V	240V	AMPS	VA
BB	30	22	20	18	10	8	20	10	20	2.5	1½	2	.039	4.5
BBC	60	47	45	45	35	25	30	20	55	6.6	3	5	.048	5.5
CB	80	68	65	63	50	40	35	25	75	8	5	7½	.156	18.0
CBC	100	92	90	88	75	70	50	30	90	10	7½	10	.150	17.5

**Inrush Current — Approx. 150% of values shown ***Any AC-DC Coil voltage available.

Ratings subject to change without notice.

high voltage contactors



Size: 5¾″ x 2½″ x 2⅝″

Our "high voltage" contactors are ideally suited on applications requiring 3500 volts and over. The units are available with both field wiring terminals or leads.

Typical applications are in high intensity lamp loads, ultraviolet curing equipment and welder controls.

How to Order Contactors

Specify the following applicable information when ordering single-pole contactors.

Quantity_____ Catalog Designation_____
Coil Voltage_____ Coil Frequency_____
Load - Amps: AC_____ DC_____ @ _____ Volts
Type of Load
(Resistive, Inductive, Tungsten, etc.)_____
Ambient Temperature (if other than room)_____
NEMA enclosure required: Yes_____ No_____
Other comments or requirements_____

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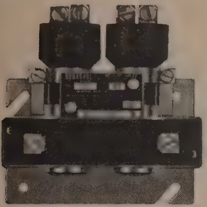
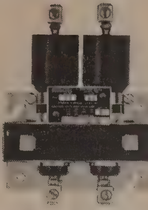
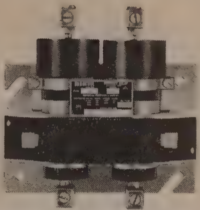
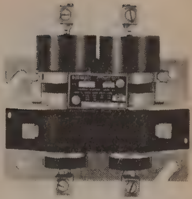
durakool
double pole contactors


Model BF2 7000 — 35 AMP
Size: 4⁵⁄₃₂″ x 4″ x 2⅝″


Model BFC2 700 — 60 AMP
Size: 3¾″ x 4″ x 2⅝″


Model CF2 700 — 80 AMP
Size: 5⁹⁄₁₆″ x 5²³⁄₃₂″ x 3⅜″


Model CFC2 700 — 100 AMP
Size: 5⁹⁄₁₆″ x 5²³⁄₃₂″ x 3⅜″

ELECTRICAL RATINGS PER POLE OF NORMALLY OPEN TWO POLE CONTACTORS

(Combinations of Normally Open and Normally Closed available on request.)

BASIC CATALOG DESIG-NATION	GENERAL PURPOSE LOAD RATINGS								AC MOTOR RATINGS IN HP TWO PHASE		**COIL CURRENT & POWER AT 115V*** 60 Hz	
	AMPERES*											
	AC						DC					
	120V	208V	240V	277V	480V	600V	120V	240V	240V	480V	AMPS	VA
BF2	35	31	30	30	20	15	25	15	5	7½	098	11.0
BFC2	60	54	52	50	40	25	30	20	7½	10	.110	12.5
CF2	80	68	65	63	50	40	35	25	10	15	.415	47.5
CFC2	100	92	90	88	75	70	50	30	15	20	.380	43.5

**Inrush Current — Approx. 150% of values shown ***Any AC-DC Coil voltage available.

ELECTRICAL RATINGS PER POLE OF NORMALLY CLOSED TWO POLE CONTACTORS

BASIC CATALOG DESIG-NATION	GENERAL PURPOSE LOAD RATINGS								AC MOTOR RATINGS IN HP TWO PHASE		**COIL CURRENT & POWER AT 115V 60 Hz***	
	AMPERES*											
	AC						DC					
	120V	208V	240V	277V	480V	600V	120V	240V	240V	480V	AMPS	VA
BB2	30	22	20	18	10	8	20	10	3	5	.090	10.5
BBC2	60	47	45	45	35	25	30	20	7½	10	.105	12.0
CB2	80	68	65	63	50	40	35	25	10	15	375	43.0
CBC2	100	92	90	88	75	70	50	30	15	20	365	42.0

**Inrush Current — Approx. 150% of values shown ***Any AC-DC Coil voltage available.
Ratings subject to change without notice.

NOTE:
Double-pole contactors are often arranged with one Normally Open contact and one Normally Closed contact.

How to Order Contactors
Specify the following applicable information when ordering double-pole contactors.

Quantity______

Catalog Designation______

Coil Voltage_____ Coil Frequency_____

Load - Amps:
AC______ DC______ @ ______ Volts

Type of Load (Resistive, Inductive, Tungsten, etc.)______

Ambient Temperature (if other than room)______

NEMA enclosure required:
Yes______ No______

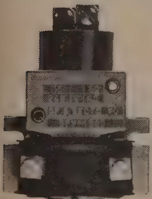
Other comments or requirements

____

time delay relays

TIMERS FOR HEAVIER LOADS

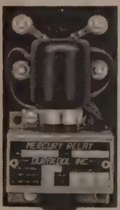
Any of the timers can be combined with any of the contactors . . . normally open or normally closed . . . to provide the equivalent of a timer with the contact action and contact rating of the contactor with which it is combined. Units can be supplied on a panel (as shown above) or as individual units, and be mounted and connected in the field. The diagram at left shows the connections used in the illustrated unit.


Model BFV 1500
Less case and panel
Size: 6⁵⁄₁₆″ x 3″ x 3⅛″

CONTACT ACTION & AVAILABLE DELAYS

BASIC CATALOG DESIG-NATION	NORMAL CONDITION OF CONTACT	CONTACT ACTION		MIN. SECS. DELAY*	MAX. SECS. DELAY*
		Coil Energized	Coil De-energized		
BFT	Open	Quick to Close	Delay to Open	¼	20
BFU	Open	Delay to Close	Slow to Open**	¼	10
BFV	Open	Delay to Close	Quick to Open	¼	10
BBT	Closed	Quick to Open	Delay to Close	½	2
BBU	Closed	Delay to Open	Slow to Close**	⅛	10

* Timings shown are available at regular prices. Other delays are available to customer specs and will be quoted.
** ½ to full delay time of "coil energized" delay.


Model BFT 236
Panel mounted
Size: 4½″ x 2½″ x 2¾″

ELECTRICAL RATINGS OF TIMER RELAYS

BASIC CATALOG DESIG-NATION	GENERAL PURPOSE LOAD RATINGS					TUNGSTEN LAMP LOAD at 120V. 60 HZ	MOTOR RATING HP		COIL CURRENT POWER AT 115V 60 Hz	
	AMPERES						AC (60 HZ)	DC	STANDARD	
	AC			DC					Amps	VA
	120V	240V	480V	125V	250V		120V-480V	125V-250V		
BFT	20	15	10	6	3	750W	½	¼	.104	12.0
BFU	15	10	6	6	3	750W	½	¼	.090	10.5
BFV	15	10	6	6	3	750W	½	¼	097	11.0
BBT	15	10	6	6	3	750W	½	¼	.105	12.0
BBU	15	10	6	6	3	750W	½	¼	.065	7.5

Ratings subject to change without notice.

How to Order Time Delay Relays
Specify the following applicable information when ordering Time Delay Relays.

Quantity______

Catalog Designation______

Coil Voltage_____ Coil Frequency_____

Time Delay in Seconds______

Less Case and Panel (1 C&P)
Yes______ No______

Panel Mounted: Yes______ No______

NEMA enclosure required:
Yes______ No______

Load - Amps:
AC______ DC______ @ ______ Volts

Type of Load (Resistive, Inductive, Tungsten, etc.)______

Ambient Temperature (if other than room)______

Other comments or requirements

____

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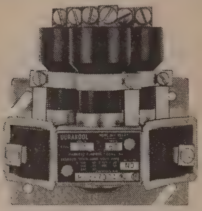
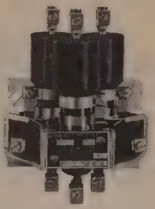
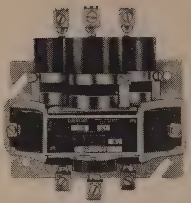
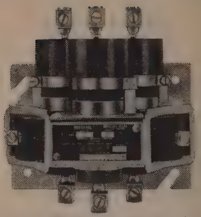
durakool
triple pole contactors


Model BF3 7000 — 35 AMP
Size: 4$\frac{5}{32}$" x 4" x 3¾"


Model BFC3 700 — 60 AMP
Size: 5⅜" x 4" x 3¾"


Model CF3 700 — 80 AMP
Size: 5$\frac{5}{16}$" x 5$\frac{23}{32}$" x 5"


Model CFC3 700 — 100 AMP
Size: 5$\frac{5}{16}$" x 5$\frac{23}{32}$" x 5"

ELECTRICAL RATINGS PER POLE OF NORMALLY OPEN THREE POLE CONTACTORS

(Combinations of Normally Open and Normally Closed available on request.)

BASIC CATALOG DESIGNATION	GENERAL PURPOSE LOAD RATING								AC MOTOR RATINGS IN HP THREE PHASE		**COIL CURRENT & POWER AT 115V 60 Hz***	
	AMPERES*											
	AC						DC					
	120V	208V	240V	277V	480V	600V	120V	240V	240V	480V	AMPS	VA
BF3	35	31	30	30	20	15	25	15	5	7½	.200	23.0
BFC3	60	54	52	50	40	25	30	20	7½	10	.230	26.5
CF3	80	68	65	63	50	40	35	25	10	15	.690	79.5
CFC3	100	92	90	88	75	70	50	30	15	20	.700	80.5

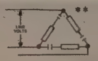
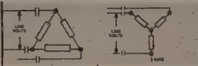
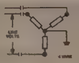
**Inrush Current — Approx. 150% of values shown ***Any AC-DC Coil voltage available.

ELECTRICAL RATINGS PER POLE OF NORMALLY CLOSED THREE POLE CONTACTORS

BASIC CATALOG DESIGNATION	GENERAL PURPOSE LOAD RATING								AC MOTOR RATINGS IN HP THREE PHASE		**COIL CURRENT & POWER AT 115V 60 Hz***	
	AMPERES*											
	AC						DC					
	120V	208V	240V	277V	480V	600V	120V	240V	240V	480V	AMPS	VA
BB3	30	22	20	18	10	8	20	10	3	5	.175	20.0
BBC3	60	47	45	45	35	25	30	20	7½	10	.200	23.0
CB3	80	68	65	63	50	40	35	25	10	15	.645	74.0
CBC3	100	92	90	88	75	70	50	30	15	20	.640	73.5

**Inrush Current — Approx. 150% of values shown ***Any AC-DC Coil voltage available.

K.W. RATINGS FOR 3 PHASE BALANCED HEATER LOADS BASED ON U.L. LISTED AMPS

3 PHASE CONTACTOR IN CIRCUIT		 **					
CATALOG DESIGNATION	LINE VOLTS	AMPS PER POLE	TOTAL KW HEATER LOAD	AMPS PER POLE	TOTAL KW HEATER LOAD	AMPS PER POLE	TOTAL KW HEATER LOAD
BF3	208 240 480	30 30 20	18.7 21.6 28.8	30 30 20	10.8 12.4 16.6	30 30 30	10.8 12.4 24.9
BFC3	208 240 480	50 50 40	31.2 36.0 57.6	50 50 40	17.9 20.7 33.2	60 50 50	21.5 20.7 41.5
CFC3	208 240 480	90 90 60	56.1 64.8 86.4	90 90 60	32.3 37.3 49.8	100 90 60	35.9 37.3 49.8

**Interrupting device for line voltage required.

Ratings subject to change without notice.

NOTE:
Three-pole contactors are primarily used in three-phase applications and multiple single-phase circuit arrangements.

How to Order Contactors
Specify the following applicable information when order three-pole contactors.

Quantity______ Catalog Designation______
Coil Voltage______
Coil Frequency______
Load - Amps: AC______ DC______ @ ______ Volts

Type of Load (Resistive, Inductive, Tungsten, etc.)______
Ambient Temperature (if other than room)______
NEMA enclosure required: Yes______ No______
Other comments or requirements______

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durakool
tip & tilt switches

General
Durakool manufactures thousands of custom switches for specialized O.E.M. applications. These include horizontally-mounted tilt switches; vertically-mounted tip switches; and SPDT which control two different circuits on the same switch.

Mercury-to-mercury — All Durakool G line switches have mercury-to-mercury contact action. Contacts are made and broken between two pools of mercury, separated by a ceramic insulator. This design insures clean snap-action make and break with no chatter and little erosion, even under heavy loads when properly applied.

Mercury-to-metal — Durakool A line switches are made in the mercury-to-metal contact design. Contact is made between a pool of mercury and a metal electrode.

Uninsulated switches — are without lead wires, except on special order. These uninsulated all steel, mercury tilt switches save space, permit flexibility in design and speed bench assembly. They are recommended to wiring harness and component manufacturers for applications involving potting or encapsulating in plastic or rubber.

Insulated switches — May be obtained insulated in molded phenolic (regularly furnished) or in a variety of other casings on special order.

Leads — All insulated switches are supplied with extra flexible cotton or neoprene lead wires with ring type terminals.

U.L. Approved — Underwriters' Laboratories do not approve any mercury tilt switches except on the application where they are used. Durakool switches are designed to pass U.L. tests when properly applied.

INSULATED TILT SWITCHES

	ELECTRICAL RATINGS AND OPERATING ANGLES										PHYSICAL DIMENSIONS			
*CATALOG DESIG-NATION	AMPERES					TUNGSTEN LAMP LOADS AT 120V 60 Hz	MOTOR RATINGS HP		**MINIMUM RECOMMENDED OPERATING ANGLE		LENGTH	LARGEST DIAMETER	TERMINAL DATA	
	AC (60 Hz)			DC			AC (60 Hz) 120-480V	DC 120-240V					SCREW SIZE	HOLE SIZE
	120V	240V	480V	120V	240V									
A1	1	.7	—	.5	.4	100W	—	—	16°		1 21/64	½	#8	.170
G5Z	5	4	—	3	2	400W	¼	⅛	16°		1 53/64	17/32	#8	.170
G8Z	10	8	5	5	4	800W	⅓	⅙	14°		2 1/64	⅝	#10	.203
G10Z	20	16	10	10	8	1600W	¾	⅓	13°		2 31/64	25/32	#10	.203
G20Z	35	28	18	18	14	2800W	1½	¾	9°		3 9/64	⅞	#10	.203
G20SZ	35	28	18	18	14	2800W	1½	¾	12°		2 19/32	⅞	#10	.203
G35Z	65	52	33	33	26	5200W	3	1½	9°		3¾	1¼	¼	.265

*For cotton leads, add "-1" and for rubber leads add "-2" to catalog number, e.g. G5Z-2
**Includes a safety factor in degrees to insure a "make" and "break" of the mercury contacts.

Ratings subject to change without notice.

UNINSULATED TILT SWITCHES

	ELECTRICAL RATINGS AND OPERATING ANGLES									PHYSICAL DIMENSIONS	
CATALOG DESIG-NATION	AMPERES					TUNGSTEN LAMP LOADS AT 120V 60 Hz	MOTOR RATINGS HP		*MINIMUM RECOMMENDED OPERATING ANGLE	LENGTH	LARGEST DIAMETER
	AC (60 Hz)			DC			AC (60 Hz) 120-480V	DC 120-240V			
	120V	240V	480V	120V	240V						
AIS	(1 Ampere 6V-24VAC/DC)					24W	—	—	20°	39/64	13/32
AIN	1	.7	—	.5	.4	100W	—	—	16°	1 1/64	13/32
G5N	5	4	—	3	2	400W	¼	⅛	16°	1 33/64	27/64
G8N	10	8	5	5	4	800W	⅓	⅙	14°	1 55/64	½
G10N	20	16	10	10	8	1600W	¾	⅓	13°	2 9/64	39/64
G20N	35	28	18	18	14	2800W	1½	¾	9°	2 53/64	49/64
G20SN	35	28	18	18	14	2800W	1½	¾	12°	2 5/16	49/64
G35N	65	52	33	33	26	5200W	3	1½	9°	3 7/16	63/64

*Includes a safety factor in degrees to insure a "make" and "break" of the mercury contacts.

Ratings subject to change without notice.

How to Order Tip & Tilt Switches

Specify the following applicable information when ordering Tip & Tilt Switches.

Quantity_____
Catalog Designation_____
Insulated_____ Uninsulated_____
Cotton Covered Leads_____
Neoprene Leads_____
Load - Amps: AC_____ DC_____ @ _____Volts
Type of Load (Resistive, Inductive, Tungsten, etc.)_____
Other comments or requirements_____

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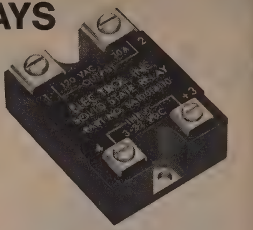
ELEC-TROL SOLID STATE RELAYS



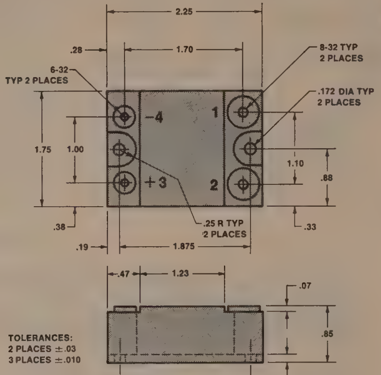
General Description:

Elec-Trol Solid State Relays offer zero cross-over (synchronous) switching of high power AC reactive loads with 1500 VRMS photo isolation between the input and output. Capable of being driven directly by TTL logic, DC models include reverse polarity protection and Elec-Trol's new FET current limiting input circuit which prevents uncontrolled output operation when noise transients appear at the input. It also provides limited input current across the range of input voltages. Available in both AC and DC models, these totally solid state relays provide trouble free operation in both sensitive and hostile environments.

MODEL SELECTION

PART NUMBER	INPUT VOLTAGE	OUTPUT SWITCHING ABILITY	
		MAX. VOLTAGE (VRMS)	MAX. CURRENT (AMPS)
SA10014106	3-32 VDC	140	6
SA10014110	3-32 VDC	140	10
SA10014125	3-32 VDC	140	25
SA10014206	3-32 VDC	280	6
SA10014210	3-32 VDC	280	10
SA10014225	3-32 VDC	280	25
SA10029106	90-280 VRMS	140	6
SA10029110	90-280 VRMS	140	10
SA10029125	90-280 VRMS	140	25
SA10029206	90-280 VRMS	280	6
SA10029210	90-280 VRMS	280	10
SA10029225	90-280 VRMS	280	25

PHYSICAL DIMENSIONS



TOLERANCES:
2 PLACES ±.03
3 PLACES ±.010

All dimensions are in inches

INPUT RATINGS

INPUT VOLTAGE	MAX. PICK UP VOLTAGE @ 25°C	MIN. DROP OUT VOLTAGE @ 25°C	MIN. INPUT RESISTANCE (OHMS)	MAX. INPUT CURRENT —30°C TO +100°C	
				MA	@ V INPUT
3-32 VDC	2.8 VDC	1.0 VDC	500 @ 5 VDC See Fig. 2	10	5-32 VDC
90-280 VRMS or 40-110 VDC	80 VRMS	10 VRMS	20,000	14	280 VRMS
	32 VDC	3 VDC	20,000	5.5	110 VDC

OUTPUT RATINGS (140V or 280V Units)

MAX. CURRENT (AMPS)	MIN. CURRENT (AMPS)	MIN. VOLTAGE (VRMS)	LINE FREQUENCY (Hz)	MAX. VOLTAGE DROP @ RATED CURRENT (VRMS)	OFF-STATE LEAKAGE CURRENT (MA)	OVERLOAD	
						MAX. CURRENT FOR 1 CYCLE (AMPS)	MAX. CURRENT FOR 1 SECOND (AMPS)
6	.05	12.0	47-63	1.7	5 MA @ 140 V 10 MA @ 280 V	80	35
10	.05	12.0	47-63	1.7	5 MA @ 140 V 10 MA @ 280 V	100	40
25	.05	12.0	47-63	2.0	5 MA @ 140 V 10 MA @ 280 V	250	70

GENERAL SPECIFICATIONS

- Operating temperature:
  —30°C to +100°C
- Max on or off response time:
  DC Input: ½ Cycle
  AC Input: 1½ Cycle
- Peak off state voltage:
  140 VRMS Unit: ±200 Volts
  280 VRMS Unit: ±400 Volts
- Max output peak on voltage:
  6 Volts (see fig. 1)
- Isolation — input to output:
  1500 VRMS
  10^{10} OHMS
  8 PF
- DV/DT:
  Off state: 100 v/μsec.
  Commutating: 5 v/μsec.
- Weight: 4 oz. or 114 gm. max.

ELEC-TROL SOLID STATE RELAYS

Zero Crossover Switching (Synchronous Switching):

Elec-Trol Solid State Relays provide zero crossover switching. After the application of the input voltage, the power triac turns on at the next zero voltage crossover point of the AC load voltage. Upon removal of the input voltage the power triac turns off on the next zero current crossover point of the AC load current (see figure 1).

The benefits of zero crossover are such that all switching is done at zero voltage or current so there is a minimum of RF noise generated by the device. Also, capacitive, inductive and lamp loads do not have either high instantaneous inrush currents or high voltage kickbacks as would occur with random instantaneous on-off switching.

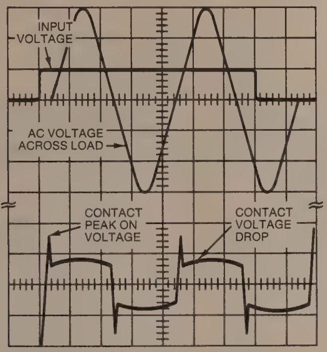


Fig. 1 ZERO CROSSOVER SWITCHING

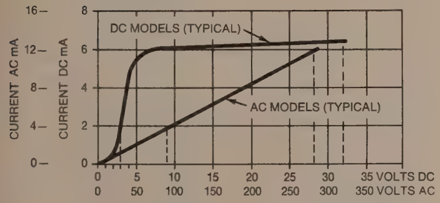


Fig. 2 INPUT VOLTAGE vs. CURRENT

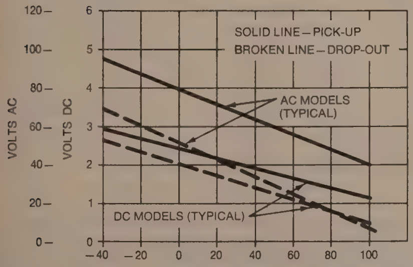


Fig. 3 INPUT VOLTAGE vs. TEMPERATURE

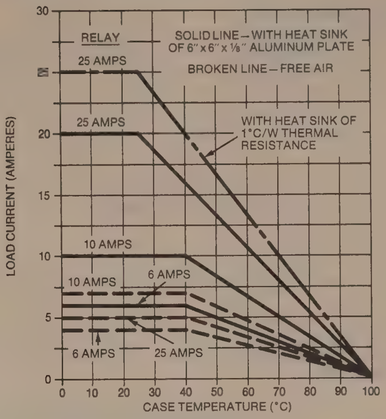


Fig. 4 LOAD CURRENT vs. TEMPERATURE

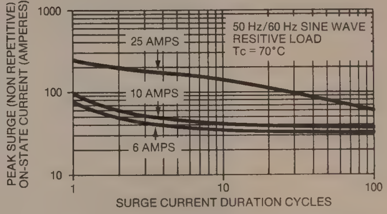


Fig. 5 PEAK SURGE ON-STATE CURRENT vs. SURGE CURRENT DURATION

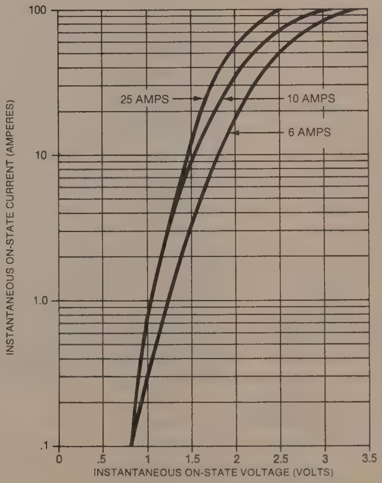
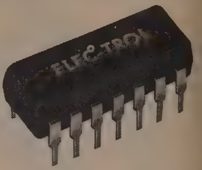


Fig. 6 ON-STATE VOLTAGE vs. ON-STATE CURRENT

ELEC-TROL, INC.

26477 NO. GOLDEN VALLEY ROAD • SAUGUS, CALIFORNIA 91350
TELEPHONE: (805) 252-8330, (213) 788-7292 • TWX: 910-336-1556

ELEC-TROL DIP REED RELAYS



General Description:

Elec-Trol DIP reed relays are epoxy encapsulated and furnished in the standard 14 pin dual inline package style capable of insertion in standard 14 pin DIP sockets or automatic insertion in P.C. boards. A complete line (not all shown here) of form A, B, and C Elec-Trol DIP reed relays are available with 8 or 14 terminals, with or without internal clamping diode across the coil and with optional electrostatic shielding and contact run-in. The internal lead frame serves as a magnetic shield. Temperature rating is −55°C to +85°C.

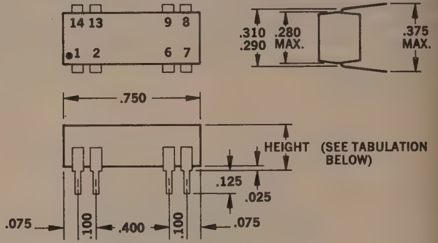
OPTIONAL FEATURES

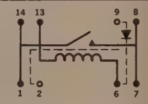
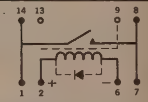
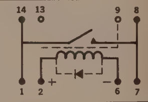
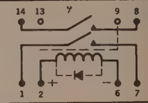
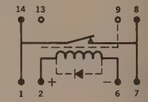
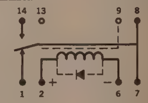
Electrostatic Shielding:

Electrostatic shielding between the coil and reed switch contact may be specified by adding suffix -02 to the relay part number.

Contact Run-in:

The reed switch contact can be run-in for one million operations at low level load. To specify this run-in, change the last digit of the relay part number from 1 to 2.



CONTACT FORM	CONTACT RATING		PART NUMBER		COIL V.D.C.	COIL RES. (ohms) @ 20°C	MAX. PICK-UP V.D.C. @ 20°C	MIN. DROP-OUT V.D.C. @ 20°C	HEIGHT	CIRCUIT DIAGRAM (Top View of Relay)
	MAX. LOAD	TABLE A	NO DIODE	WITH DIODE						
1A SPST-NO	3W .11A 28V	A1	RA30921051	RA31201051	5	500	3.8	1.0	.225″	
			RA30921061	RA31201061	6	500	4.0	1.0		
			RA30921121	RA31201121	12	500	8.0	2.0		
			RA30921241	RA31201241	24	1400	16.0	4.0		
			RA30381051	RA30391051	5	500	3.8	1.0	.225″	
			RA30381061	RA30391061	6	500	4.0	1.0		
			RA30381121	RA30391121	12	500	8.0	2.0		
			RA30381241	RA30391241	24	1400	16.0	4.0		
1A SPST-NO	10W .5A 100V	A2	RA30451051	RA30461051	5	500	3.8	1.0	.275″	
			RA30451061	RA30461061	6	500	4.0	0.5		
			RA30451121	RA30461121	12	500	8.0	1.0		
			RA30451241	RA30461241	24	2150	16.0	2.0		
2A DPST-NO	3W .11A 28V	A1	RA30982051	RA31232051	5	200	3.8	1.0	.275″	
			RA30982061	RA31232061	6	200	4.0	1.0		
			RA30982121	RA31232121	12	500	8.0	2.0		
			RA30982241	RA31232241	24	2150	16.0	4.0		
1B SPST-NC	10W .5A 100V	A2	RA30511051	RA30521051	5	500	3.8	1.0	.275″	
			RA30511061	RA30521061	6	500	4.0	0.5		
			RA30511121	RA30521121	12	500	8.0	1.0		
			RA30511241	RA30521241	24	2150	16.0	2.0		
1C SPDT	3W .25A 28V	A3	RA30421051	RA30441051	5	200	4.0	0.5	.275″	
			RA30421061	RA30441061	6	80	4.0	0.5		
			RA30421121	RA30441121	12	500	8.0	1.0		
			RA30421241	RA30441241	24	2000	16.0	2.0		

CONTACT RATINGS — Table A

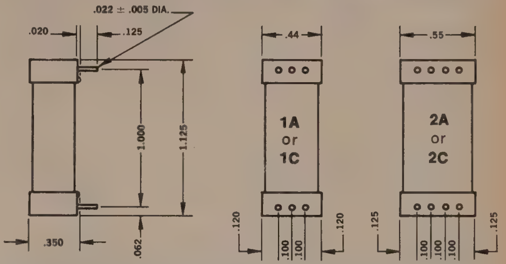
TABLE	CONTACT FORM	RATINGS (Res. Load)			LIFE (X10⁶ Operations)		MAX. INITIAL CONTACT RES. (ohms)	MIN. BREAK-DOWN V.D.C.	MIN. INS. RES. @ 20°C (ohms)	ACTUATE TIME NOMINAL (Millisec.)	DE-ACTUATE TIME NOMINAL (Millisec.)	BOUNCE TIME NOMINAL (Millisec.)
		WATTS D.C.	MAX. AMPS	MAX. VOLTS	RATED LOAD	LOW LEVELS						
A1	A or B	3	0.110	28	10	200	0.3	200	10^{10}	0.25	0:25	0.15
		10	0.50	50	0.1							
A2	A or B	10	0.50	100	10	200	0.3	200	10^{10}	0.25	0.25	0.15
A3	C	3	0.25	28	5	50	0.3	200	10^{9}	0.25	0.25	NO=0.5 NC=1.5

ELEC-TROL OPEN LINE REED RELAYS

General Description:

A complete line of Elec-Trol Open-Line Reed Relays (not all shown here) are available with greater numbers of contacts, .1″ and .15″ terminal spacing and with coil terminals at the same end or opposite ends of the relay. They are available with form A, B, and C dry reed contacts, and form A mercury wetted reed contacts.

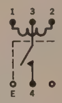
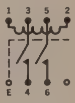
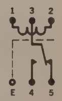
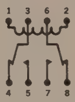
OPTIONAL FEATURES



Shielding:
Magnetic shielding and/or electrostatic shielding (only in relays with E.S. designation) may be included as an option. To specify shield options, add suffix to part numbers as follows:

-01 Magnetic Shield
-02 Electrostatic Shields
-03 Both Magnetic and Electrostatic Shield

Contact Run-in:
The reed switch contact can be run-in for one million operations at low level load. To specify this run-in, change the last digit of the relay part number from 1 to 2.

CONTACT FORM	PART NUMBER .100″ TERMINAL SPACING	COIL V.D.C.	COIL RES. (ohms) @ 20°C	MAX. PICK-UP V.D.C. @ 20°C	MIN. DROP-OUT V.D.C. @ 20°C	NOMINAL TIMING (Milliseconds) ACTUATE	DE-ACTUATE	BOUNCE	E.S. OPTION	CIRCUIT DIAGRAM (Top View of Relay)
1A SPST-NO	RA30311051	5	500	3.8	0.5	0.4	0.2	0.25	YES	
	RA30311061	6	125	4.0	0.5	0.25	0.1			
	RA30311121	12	500	8.0	1.0					
	RA30311241	24	2000	16.0	2.0					
	RA30311481	48	8000	32.0	4.0					
2A DPST-NO	RA30312051	5	200	3.8	0.5	0.5	0.2	0.25	YES	
	RA30312061	6	110	4.0	0.5	0.3	0.1			
	RA30312121	12	440	8.0	1.0					
	RA30312241	24	1750	16.0	2.0					
	RA30312481	48	7000	32.0	4.0					
1C SPDT	RA30321051	5	500	3.8	0.5	0.5	0.4	N.O. 0.5 N.C. 1.5	YES	
	RA30321061	6	125	4.0	0.5	0.25	0.25			
	RA30321121	12	500	8.0	1.0					
	RA30321241	24	2000	16.0	2.0					
	RA30321481	48	8000	32.0	4.0					
2C DPDT	RA30322051	5	200	3.8	0.5	0.6	0.4	N.O. 0.5 N.C. 1.5	NO	
	RA30322061	6	80	4.0	0.5	0.3	0.25			
	RA30322121	12	310	8.0	1.0					
	RA30322241	24	1250	16.0	2.0					
	RA30322481	48	5000	32.0	4.0					

CONTACT RATINGS

CONTACT FORM	RATINGS (Res. Load) WATTS D.C.	MAX. AMPS	MAX. VOLTS	LIFE (X10^6 Operations) RATED LOAD	LOW LEVELS	MAX. INITIAL CONTACT RES. (ohms)	MIN. BREAK-DOWN V.D.C.	MIN. INS. RES. @ 20°C (ohms)
A	10	0.5	200	10	200	0.20	300	10^{10}
C	3	0.25	28	5	50	0.20	250	10^9

Other Elec-Trol Reed Relays Available:
A complete line of Elec-Trol Encased-Line Reed Relays are available with the same contacts and configurations as the Open-Line relays. The Encased-Line relays are furnished in either enclosed dust tight epoxy cases or with the cases totally epoxy sealed. Consult Elec-Trol for further information on these or any of your needs for special reed relays.

ELEC-TROL, INC.

26477 NO. GOLDEN VALLEY ROAD, SAUGUS, CALIFORNIA 91350
TELEPHONE: (805) 252-8330, (213) 788-7292 • TWX: 910-336-1556

PLUG-IN RELAYS
FULLY ENCAPSULATED

REED RELAYS

GENERAL
SPECIFICATIONS

HIGH RELIABILITY TYPES (H)

Contact Ratings	Form A	Form B	Form C
VOLTAGE (MAX. SWITCHING)	250 VDC	250 VDC	150 VDC
VOLTAGE (MIN. BREAKDOWN)	500 VDC	300 VDC	300 VDC
CURRENT (MAX. SWITCHING)	750 MA	750 MA	250 MA
CURRENT (MAX. GATING OR CARRY)	2 AMPS	2 AMPS	1.5 AMPS
POWER (RESISTIVE LOAD)	10 WATTS	10 WATTS	4 WATTS
CAPACITANCE (TYPICAL)	0.2 PF	0.2 PF	0.8 PF
CONTACT RESISTANCE (MAX. INITIAL)	.100 OHMS	.100 OHMS	.150 OHMS
OPERATE TIME (TYPICAL)	½ MS	½ MS	½ MS
LIFE (LOW LOAD) OPERATIONS	100 x 10^6 MIN.	100 x 10^6 MIN.	20 x 10^6 MIN.
LIFE (HALF LOAD) OPERATIONS	50 x 10^6 MIN.	50 x 10^6 MIN.	10 x 10^6 MIN.
LIFE (FULL LOAD) OPERATIONS	20 x 10^6 MIN.	20 x 10^6 MIN.	5 x 10^6 MIN.

Nominal Oper-VDC	Contact Form	Coil Resistance	Standard Package & Schematc
1V	1A (SPST) N.O.	10	X1, Y1, Z1, X2, Y2, A1, B1, C1
	2A (2PST) N.O.	7.5	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	5	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	3.75	X5, Y5, Z4
	5A (5PST) N.O.	3.0	X6, Y6, Z5
	6A (6PST) N.O.	2.5	X7, Y7, Z6
	1C (SPDT)	10	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	5	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	10	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	7	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	10	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	5	X13, Y13, A8, B8
3V	1A (SPST) N.O.	100	X1, Y1, Z1, X2, Y2, A1, B1, C1
	2A (2PST) N.O.	75	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	50	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	37.5	X5, Y5, Z4
	5A (5PST) N.O.	30	X6, Y6, Z5
	6A (6PST) N.O.	25	X7, Y7, Z6
	1C (SPDT)	100	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	75	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	100	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	75	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	100	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	50	X13, Y13, A8, B8
5V	1A (SPST) N.O.	400	X1, Y1, Z1, X2, Y2, A1, B1, C1
	2A (2PST) N.O.	300	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	200	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	150	X5, Y5, Z4
	5A (5PST) N.O.	125	X6, Y6, Z5
	6A (6PST) N.O.	100	X7, Y7, Z6
	1C (SPDT)	200	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	100	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	400	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	300	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	400	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	200	X13, Y13, A8, B8
6V	1A (SPST) N.O.	250	X1, Y1, Z1, X2, Y2, A1, B1, C1
	2A (2PST) N.O.	180	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	125	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	90	X5, Y5, Z4
	5A (5PST) N.O.	75	X6, Y6, Z5
	6A (6PST) N.O.	60	X7, Y7, Z6
	1C (SPDT)	250	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	180	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	250	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	180	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	250	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	125	X13, Y13, A8, B8

ECONOMY TYPES (E)

Contact Ratings	Form A	Form B	Form C
VOLTAGE (MAX. SWITCHING)	200 VDC	200 VDC	28 VDC
VOLTAGE (MIN. BREAKDOWN)	500 VDC	300 VDC	300 VDC
CURRENT (MAX. SWITCHING)	500 MA	500 MA	250 MA
CURRENT (MAX. GATING OR CARRY)	1 AMP	1 AMP	.5 AMPS
POWER (RESISTIVE LOAD)	10 WATTS	10 WATTS	3 WATTS
CAPACITANCE (TYPICAL)	0.2 PF	0.2 PF	0.8 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS	.100 OHMS	.150 OHMS
OPERATE TIME (TYPICAL)	½ MS	½ MS	½ MS
LIFE (LOW LOAD) OPERATIONS	50 x 10^6 MIN.	50 x 10^6 MIN.	10 x 10^6 MIN.
LIFE (HALF LOAD) OPERATIONS	20 x 10^6 MIN.	20 x 10^6 MIN.	5 x 10^6 MIN.
LIFE (FULL LOAD) OPERATIONS	10 x 10^6 MIN.	10 x 10^6 MIN.	1 x 10^6 MIN.

Nominal Oper-VDC	Contact Form	Coil Resistance	Standard Package & Schematc
12V	1A (SPST) N.O.	1000	X1, Y1, Z1, X2, Y2, A1, B1, C1
	2A (2PST) N.O.	750	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	500	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	375	X5, Y5, Z4
	5A (5PST) N.O.	300	X6, Y6, Z5
	6A (6PST) N.O.	250	X7, Y7, Z6
	1C (SPDT)	1000	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	750	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	1000	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	750	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	1000	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	500	X13, Y13, A8, B8
15V †	1A (SPST) N.O.	1500	X1, Y1, Z1, X2, Y2, A1, B1, C1
	2A (2PST) N.O.	1000	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	750	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	600	X5, Y5, Z4
	5A (5PST) N.O.	400	X6, Y6, Z5
	6A (6PST) N.O.	375	X7, Y7, Z6
	1C (SPDT)	1500	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	1000	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	1500	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	1000	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	1500	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	750	X13, Y13, A8, B8
24V †	1A (SPST) N.O.	2000	X2, Y2, A1, B1, C1
	2A (2PST) N.O.	1500	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	1000	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	750	X5, Y5, Z4
	5A (5PST) N.O.	600	X6, Y6, Z5
	6A (6PST) N.O.	500	X7, Y7, Z6
	1C (SPDT)	2000	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	1500	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	2000	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	1500	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	2000	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	1000	X13, Y13, A8, B8
48V †	1A (SPST) N.O.	6000	X2, Y2, A1, B1, C1
	2A (2PST) N.O.	4500	X3, Y3, Z2, A2, B2, C2
	3A (3PST) N.O.	3000	X4, Y4, Z3, A3, B3, C3
	4A (4PST) N.O.	2250	X5, Y5, Z4
	5A (5PST) N.O.	1800	X6, Y6, Z5
	6A (6PST) N.O.	1500	X7, Y7, Z6
	1C (SPDT)	6000	X8, Y8, Z8, A4, B4, C4
	2C (2PDT)	4500	X9, Y9, Z9, X10, A5, B5, C5
	1B (SPST) N.C.	6000	X11, Y11, Z11, A6, B6, C6
	2B (2PST) N.C.	4500	X12, Y12, Z12, A7, B7, C7
	1AL LATCHING SINGLE COIL	6000	X11, Y11, Z11, A6, B6, C6
	1AL LATCHING DUAL COIL	3000	X13, Y13, A8, B8

† SEE PRICE INFORMATION — SPECIAL FEATURES

ALL ELECTRIC SPECIFICATIONS @ 20°C

EAC
ELECTRONIC APPLICATIONS CO.
4918 SANTA ANITA AVENUE / El MONTE, CALIFORNIA 91734 / (213) 442-3212

PLUG-IN RELAYS
FULLY ENCAPSULATED

REED RELAYS

GENERAL SPECIFICATIONS

OPERATING CHARACTERISTICS

PICK-UP VDC — 80% OF NOMINAL VDC (MAX.)
DROP-OUT — 10% OF NOMINAL VDC (MIN.)
OVERVOLTAGE — 150% OF RATED (MIN.)

THE ABOVE SPECIFICATIONS ARE ALL SPECIFIED @ 20°C RH 95% NON-CONDENSATING.

GENERAL SPECIFICATIONS

OPERATING TEMPERATURE — −55°C TO +85°C
SHOCK* — 150G @ 11 MS DURATION
INSULATION RESISTANCE — 10^{10} OHMS MIN.

ORDERING INFORMATION

WHEN ORDERING, THE FOLLOWING INFORMATION WILL BE REQUIRED: TYPE: HIGH RELIABILITY (H) OR ECONOMY (E), NOMINAL OPERATING VDC, CONTACT FORM, PACKAGE STYLE AND SPECIAL FEATURES. SEE PART NUMBER EXAMPLE BELOW:

H 12 1A XI M E S T

- T — 150°C OPERATION
- S — SILICONE TREATMENT
- E — ELECTROSTATIC SHIELD
- M — ELECTROMAGNETIC SHIELD
- XI — PACKAGE STYLE
- 1A — CONTACT FORM
- 12 — OPERATING VOLTAGE
- H — TYPE (HIGH RELIABILITY)

(T, S, E, M:) SEE SPECIAL FEATURES FOR PRICES

PRICING INFORMATION

Relay Type Contact Form	List Prices (1-24)			Quantity Discounts		Special Features	
	Package	H-Type High Reliability	E-Type Economy			Description	Price Adder
1A	X1, V1, Z1	4.28	—	1-24	LIST	15 & 24 VOLT RELAYS	ADD 10%
1A	ALL OTHER	3.80	2.75	25-49	LESS 10%	48 VOLT RELAYS	ADD 15%
2A	ALL	5.47	3.52	50-99	LESS 20%	150°C OPERATION	ADD 50%
3A	ALL	7.13	4.51	100-499	LESS 30%	ELECTROSTATIC SHIELD	ADD 50¢
4A	ALL	8.32	5.39	500-999	LESS 40%	ELECTROMAGNETIC SHIELD	ADD 25¢
5A	ALL	9.62	6.28	1000 UP	CONSULT FACTORY	SILICONE TREATMENT	ADD 25¢
6A	ALL	11.29	7.16				
1C	ALL	7.60	5.67				
2C	ALL	11.17	9.46				
1B	ALL	5.35	3.93				
2B	ALL	7.13	5.34				
1AL SINGLE COIL	ALL	5.58	4.95				
1A2L DUAL COIL	ALL	6.77	6.05				

TERMS: 1% 10 DAYS, NET 30 DAYS, F.O.B. SO. EL MONTE, CALIF.

HIGH RELIABILITY TESTED THRU 1,000,000 OPERATION RUN-IN ALSO AVAILABLE. CONSULT FACTORY FOR PRICES.

MAGNETIC SHIELD (Encapsulated Inside Package)
RECOMMENDED IN HIGH DENSITY PACKAGING TO REDUCE RELAY INTERACTION OR IN HIGH MAGNETIC FIELD ENVIRONMENTS.

ELECTROSTATIC SHIELDING
RECOMMENDED IN HIGH IMPEDANCE, LOW LEVEL APPLICATIONS WHERE LOW LEVEL NOISE PICK-UP IS UNDESIRABLE.

SILICONE TREATMENT
USED TO IMPROVE INSULATION RESISTANCE UNDER SEVERE ENVIRONMENT CONDITIONS.

* SHOCK AND VIBRATION ON LATCHING RELAY MUST BE DERATED 50%

SEE NEXT PAGE FOR PHYSICAL LAYOUT.

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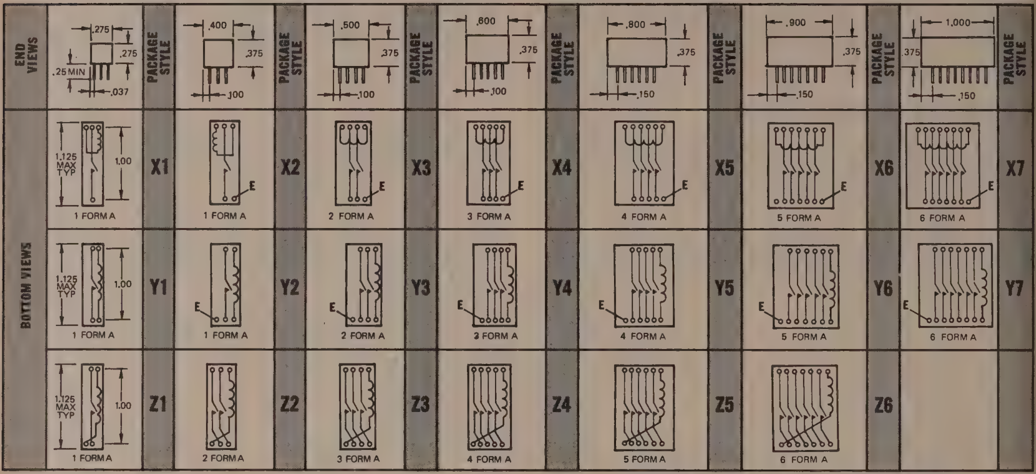
PLUG-IN RELAYS
FULLY ENCAPSULATED

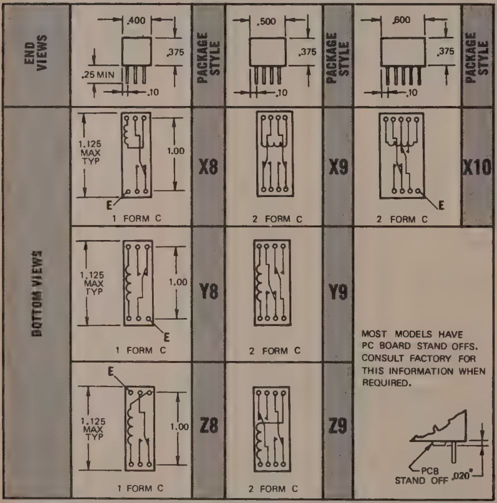
REED RELAYS

PACKAGE STYLES AVAILABLE
.100" GRID
LEAD SPACING

FORM A CONFIGURATIONS


END VIEWS
BOTTOM VIEWS
PACKAGE STYLE
.275
.275
.25 MIN
.037
.400
.500
.600
.800
.900
1.000
.375
.100
.150
1.125 MAX TYP
1.00
E
1 FORM A
2 FORM A
3 FORM A
4 FORM A
5 FORM A
6 FORM A
X1
X2
X3
X4
X5
X6
X7
Y1
Y2
Y3
Y4
Y5
Y6
Y7
Z1
Z2
Z3
Z4
Z5
Z6

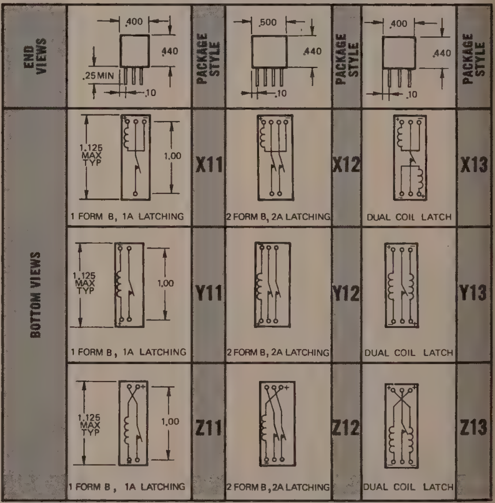
FORM C CONFIGURATIONS


END VIEWS
BOTTOM VIEWS
PACKAGE STYLE
.400
.500
.600
.375
.25 MIN
.10
1.125 MAX TYP
1.00
E
1 FORM C
2 FORM C
X8
X9
X10
Y8
Y9
Z8
Z9
PCB STAND OFF
.020"

MOST MODELS HAVE PC BOARD STAND OFFS. CONSULT FACTORY FOR THIS INFORMATION WHEN REQUIRED.

"E" REPRESENTS ELECTROSTATIC SHIELD WHEN SPECIFIED

FORM B AND LATCHING CONFIGURATIONS


END VIEWS
BOTTOM VIEWS
PACKAGE STYLE
.400
.500
.440
.25 MIN
.10
1.125 MAX TYP
1.00
1 FORM B, 1A LATCHING
2 FORM B, 2A LATCHING
DUAL COIL LATCH
X11
X12
X13
Y11
Y12
Y13
Z11
Z12
Z13
+

(+) TERMINAL IDENTIFIED WITH RED DOT FOR LATCHING RELAYS

TOLERANCE ±.015

TERMINAL DIAMETER .022 ±.005

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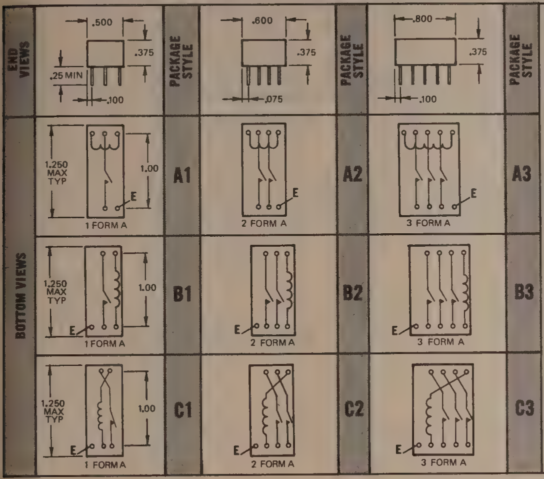
PLUG-IN RELAYS
FULLY ENCAPSULATED

REED RELAYS

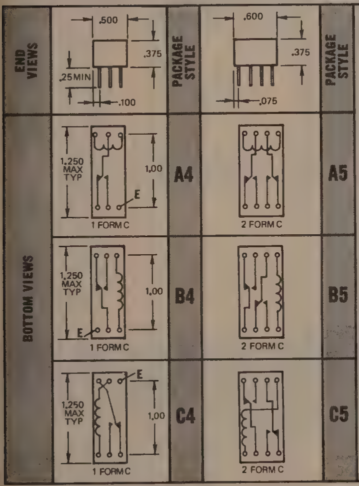
PACKAGE STYLES AVAILABLE
.150" GRID
LEAD SPACING

FORM A CONFIGURATIONS

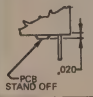

END VIEWS
BOTTOM VIEWS
PACKAGE STYLE
.500
.375
.25 MIN
.100
.600
.075
.800
1.250 MAX TYP
1.00
E
1 FORM A
2 FORM A
3 FORM A
A1
A2
A3
B1
B2
B3
C1
C2
C3

NOTES:

FORM C CONFIGURATIONS

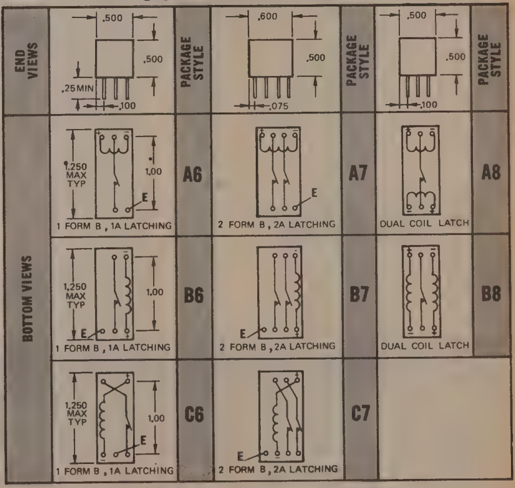

END VIEWS
BOTTOM VIEWS
PACKAGE STYLE
.500
.375
.25MIN
.100
.600
.075
1.250 MAX TYP
1.00
E
1 FORM C
2 FORM C
A4
A5
B4
B5
C4
C5

MOST MODELS HAVE PC BOARD STAND OFFS. CONSULT THE FACTORY FOR THIS INFORMATION WHEN REQUIRED.


.020
PCB STAND OFF

"E" REPRESENTS ELECTROSTATIC SHIELD WHEN SPECIFIED

FORM B AND LATCHING CONFIGURATIONS


END VIEWS
BOTTOM VIEWS
PACKAGE STYLE
.500
.25MIN
.100
.600
.075
1.250 MAX TYP
1.00
E
1 FORM B, 1A LATCHING
2 FORM B, 2A LATCHING
DUAL COIL LATCH
A6
A7
A8
B6
B7
B8
C6
C7

(+) TERMINAL IDENTIFIED WITH RED DOT FOR LATCHING RELAYS

TOLERANCE ±.015

TERMINAL DIAMETER .022 ±.005

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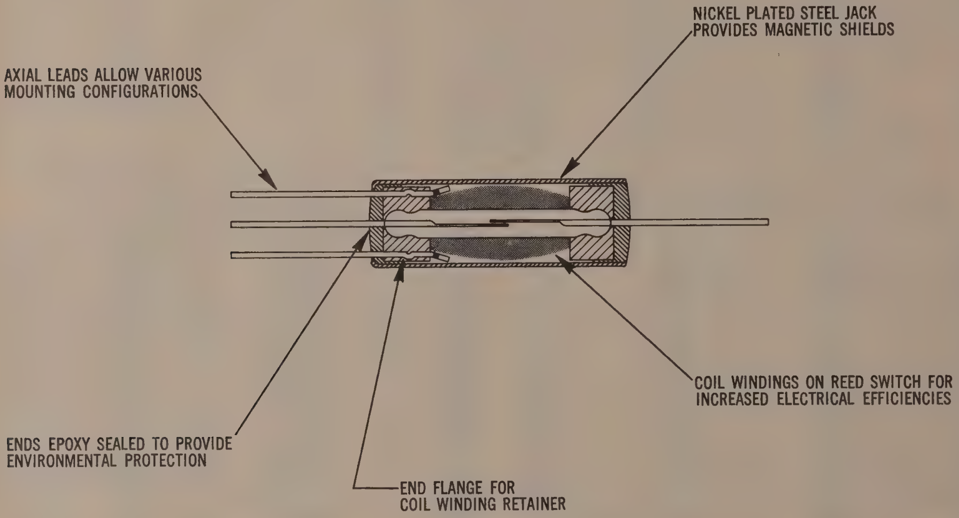
TUBULAR REED RELAYS
GENERAL INFORMATION

GENERAL DESCRIPTION

The tubular reed relay offers many design application advantages. Due to its unique package design, many of the electrical and physical characteristics of this reed relay are far superior when compared to standard reed relay configurations. One of the EAC advantages is our method of winding the coil directly on the reed switch capsule. This offers many improved electrical characteristics due to the increased efficiency. The result of this increased efficiency provides for very low typical contact resistance as well as generally faster operating speeds; the molded end flange allows for high volume production capabilities and is the real secret of the EAC tubular line; the epoxy end seals insure environmental protection; the nickel plated steel jacket (the outer protective shell) provides magnetic shielding as well as protects against mishandling in production; axial leads allow for various mounting configurations which PC board designers find desirable. Many added features such as plastic insulating sleeves, electrostatic shield and optional coil terminal locations make the tubular reed relay line one of the most versatile reed relay product lines in the industry today.


NICKEL PLATED STEEL JACK PROVIDES MAGNETIC SHIELDS
AXIAL LEADS ALLOW VARIOUS MOUNTING CONFIGURATIONS
COIL WINDINGS ON REED SWITCH FOR INCREASED ELECTRICAL EFFICIENCIES
ENDS EPOXY SEALED TO PROVIDE ENVIRONMENTAL PROTECTION
END FLANGE FOR COIL WINDING RETAINER

SPECIAL FEATURES AVAILABLE

FEATURES	PART NUMBER IDENTIFICATION	PRICE ADDER
• COIL LAYOUT OPTIONAL	SEE CATALOG PAGE	N/A
• 150°C CONSTRUCTION	ADD "T" AFTER P/N	ADD 50%
• PLASTIC INSULATING SLEEVE	ADD "-1" AFTER P/N	ADD 10¢
• ELECTROSTATIC SHIELD	ADD "E" AFTER P/N	CONSULT FACTORY*
• LEADS BENT ON 1.0" CENTERS FOR DIRECT PRINTED CIRCUIT BOARD INSERTION	ADD "-3" AFTER P/N	CONSULT FACTORY

* NOT AVAILABLE ON ALL MODELS

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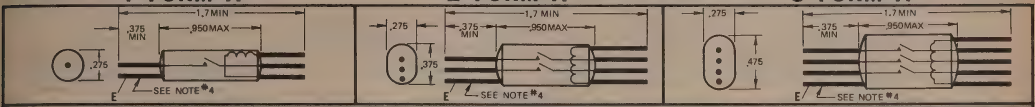
TUBULAR SERIES
AXIAL TERMINALS

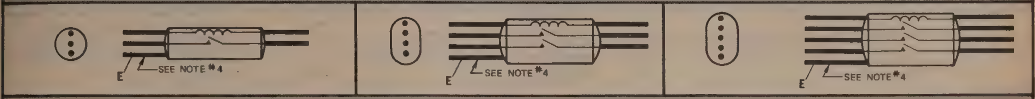
TUBULAR REED RELAYS

HI-REL
FORM A SERIES
HIGH POWER LOADS

1 FORM A	2 FORM A	3 FORM A



STANDARD LAYOUT



Y OPTIONAL LAYOUT

NOTES:
(1) WHEN Y OPTION LAYOUT IS REQUIRED ADD Y TO PART NUMBER AFTER A. E.G. 1A5A ^{Y}HH-X.
(2) TERMINAL DIAMETER .022 ±.005.
(3) TERMINAL SPACING .100 ±.025.
(4) TERMINAL FOR ELECTROSTATIC SHIELD WHEN SPECIFIED (E).

CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	250 VDC
CURRENT (MAX. SWITCHING)	1½ AMP
POWER (MAX. SWITCHING)	30 WATTS
CURRENT (MAX. CARRY)	2 AMPS
CAPACITANCE (TYPICAL)	.2 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS
OPERATE TIME (TYPICAL)	½ MS
RELEASE TIME (TYPICAL)	¼ MS

GENERAL SPECIFICATIONS

TEMPERATURE	−55°C TO +85°C
SHOCK	200G @ 11 MS DURATION
VIBRATION	50G @ 0-2000 HZ
INSULATION RESISTANCE	10^{10} OHMS MIN. @ 20°

COIL RATINGS

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	1 Form A		2 Form A		3 Form A	
			Part Number	Coil Resistance ±10% @ 20°C	Part Number	Coil Resistance ±10% @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1A1A-X	3	2A1A-X	2	3A1A-X	1.5
			1A1AH-X	10	2A1AH1X	7.5	3A1AH-X	5
			1A1AHH-X	30	2A1AHH-X	20	3A1AHH-X	15
3	2.25	.3	1A3A-X	30	2A3A-X	20	3A3A-X	15
			1A3AH-X	100	2A1AH-X	7.5	3A3AH-X	50
			1A3AHH-X	250	2A3AHH-X	175	3A3AHH-X	125
5	3.75	.5	1A5A-X	100	2A5A-X	75	3A5A-X	50
			1A5AH-X	400	2A5AH-X	300	3A5AH-X	200
			1A5AHH-X	700	2A5AHH-X	500	3A5AHH-X	350
6	4.5	.6	1A6A-X	125	2A6A-X	100	3A6A-X	75
			1A6AH-X	400	2A6AH-X	300	3A6AH-X	200
			1A6AHH-X	1000	2A6AHH-X	750	3A6AHH-X	500
10	7.5	1.0	1A10A-X	400	2A10A-X	300	3A10A-X	200
			1A10AH-X	1000	2A10AH-X	750	3A10AH-X	500
			1A10AHH-X	2000	2A10AHH-X	1500	3A10AHH-X	1000
12	9	1.2	1A12A-X	500	2A12A-X	375	3A12A-X	250
			1A12AH-X	1000	2A12AH-X	750	3A12AH-X	500
			1A12AHH-X	2000	2A12AHH-X	1500	3A12AHH-X	1000
15‡	12	1.5	1A15A-X	750	2A15A-X	600	3A15A-X	375
			1A15AH-X	1500	2A15AH-X	1200	3A15AH-X	750
			1A15AHH-X	3000	2A15AHH-X	2000	3A15AHH-X	1500
24‡	18	2.4	†1A24A-X	1000	†2A24A-X	750	†3A24A-X	500
			1A24AH-X	2000	2A24AH-X	1500	3A24AH-X	1000
			1A24AHH-X	4000	2A24AHH-X	3000	3A24AHH-X	2000

PRICE INFORMATION

Quantity	1 FORM A			2 FORM A			3 FORM A		
	1A*A-X	1A*AH-X	1A*AHH-X	2A*A-X	2A*AH-X	2A*AHH-X	3A*A-X	3A*AH-X	3A*AHH-X
1-24	2.85	3.13	3.42	4.74	5.22	5.69	7.12	7.83	8.54
25-49	2.57	2.82	3.08	4.27	4.70	5.12	6.40	7.05	7.69
50-99	2.28	2.51	2.74	3.79	4.17	4.56	5.69	6.26	6.84
100-499	2.00	2.19	2.40	3.32	3.65	3.99	4.98	5.49	5.98
500-999	1.71	1.88	2.05	2.84	3.13	3.41	4.27	4.70	5.13
1000-2499	1.43	1.57	1.72	2.38	2.61	2.85	3.56	3.92	4.28
2500-4999	1.29	1.41	1.54	2.14	2.34	2.56	3.21	3.52	3.84
5000-9999	1.14	1.25	1.37	1.90	2.08	2.28	2.85	3.13	3.41
10000-24999	.99	1.10	1.20	1.66	1.83	1.99	2.49	2.74	2.99
25000-UP	.85	.94	1.03	1.43	1.57	1.71	2.14	2.35	2.56

* VOLTAGE ‡ ADD 10% FOR 15 AND 24 VOLT RELAYS. † NOT RECOMMENDED FOR CONTINUOUS DUTY CYCLE APPLICATIONS.

EAC

ELECTRONIC APPLICATIONS CO.

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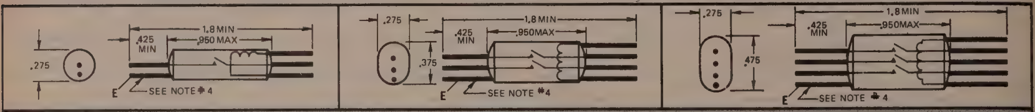
TUBULAR SERIES
AXIAL TERMINALS

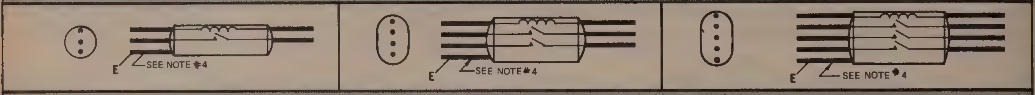
TUBULAR REED RELAYS

LOW COST COMMERCIAL
FORM A SERIES

1 FORM A **2 FORM A** **3 FORM A**



STANDARD LAYOUT



Y OPTIONAL LAYOUT

NOTES:
(1) WHEN Y OPTION LAYOUT IS REQUIRED ADD Y TO PART NUMBER AFTER A. E.G. 1A5A^{Y}HH.
(2) TERMINAL DIAMETER .022 ±.005.
(3) TERMINAL SPACING .100 ±.025.
(4) TERMINAL FOR ELECTROSTATIC SHIELD WHEN SPECIFIED (E).

CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	250 VDC
CURRENT (MAX. SWITCHING)	1AMP
POWER (MAX. SWITCHING)	20 WATTS
CURRENT (MAX. CARRY)	2 AMPS
CAPACITANCE (TYPICAL)	.2 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS
OPERATE TIME (TYPICAL)	½ MS
RELEASE TIME (TYPICAL)	¼ MS

GENERAL SPECIFICATIONS

TEMPERATURE	−55°C to +85°C
SHOCK	200G @ 11 MS DURATION
VIBRATION	30G @ 0-2000 HZ
INSULATION RESISTANCE	10^{10} OHMS MIN. @ 20°C

COIL RATINGS

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	1 Form A		2 Form A		3 Form A	
			Part Number	Coil Resistance ±10% @ 20°C	Part Number	Coil Resistance ±10% @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1A1A 1A1AH 1A1AHH	3 10 30	2A1A 2A1AH 2A1AHH	2 7.5 20	3A1A 3A1AH 3A1AHH	1.5 5 15
3	2.25	.3	1A3A 1A3AH 1A3AHH	30 100 250	2A3H 2A3AH 2A3AHH	20 75 175	3A3A 3A3AH 3A3AHH	15 50 125
5	3.75	.5	1A5A 1A5AH 1A5AHH	100 400 700	2A5A 2A5AH 2A5AHH	75 300 500	3A5A 3A5AH 3A5AHH	50 200 350
6	4.5	.6	1A6A 1A6AH 1A6AHH	125 400 1000	2A6A 2A6AH 2A6AHH	100 300 750	3A6A 3A6AH 3A6AHH	75 200 500
10	7.5	1.0	1A10A 1A10AH 1A10AHH	400 1000 2000	2A10A 2A10AH 2A10AHH	300 750 1500	3A10A 3A10AH 3A10AHH	200 500 1000
12	9	1.2	1A12A 1A12AH 1A12AHH	500 1000 2000	2A12A 2A12AH 2A12AHH	375 750 1500	3A12A 3A12AH 3A12AHH	250 500 1000
15‡	12	1.5	1A15A 1A15AH 1A15AHH	750 1500 3000	2A15A 2A15AH 2A15AHH	600 1200 2000	3A15A 3A15AH 3A15AHH	375 750 1500
24‡	18	2.4	†1A24A 1A24AH 1A24AHH	1000 2000 4000	†2A24A 2A24AH 2A24AHH	750 1500 3000	†3A24A 3A24AH 3A24AHH	500 1000 2000

PRICE INFORMATION

Quantity	1 FORM A			2 FORM A			3 FORM A		
	1A*A	1A*AH	1A*AHH	2A*A	2A*AH	2A*AHH	3A*A	3A*AH	3A*AHH
1-24	1.90	2.10	2.28	3.23	3.55	3.88	4.85	5.34	5.82
25-49	1.71	1.89	2.05	2.90	3.20	3.49	4.36	4.81	5.24
50-99	1.52	1.67	1.82	2.58	2.84	3.10	3.88	4.27	4.66
100-499	1.32	1.47	1.60	2.26	2.48	2.71	3.39	3.74	4.07
500-999	1.15	1.25	1.37	1.93	2.13	2.32	2.91	3.19	3.49
1000-2499	.95	1.05	1.15	1.62	1.78	1.94	2.43	2.67	2.92
2500-4999	.85	.94	1.03	1.46	1.60	1.75	2.18	2.40	2.62
5000-9999	.76	.84	.91	1.30	1.43	1.56	1.94	2.14	2.33
10000-24999	.67	.73	.80	1.13	1.24	1.36	1.70	1.87	2.04
25000-UP	.57	.63	.68	.97	1.07	1.17	1.46	1.60	1.75

* VOLTAGE ‡ ADD 10% FOR 15 AND 24 VOLT RELAYS. † NOT RECOMMENDED FOR CONTINUOUS DUTY CYCLE APPLICATIONS.

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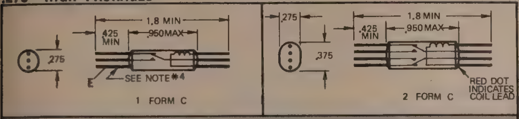
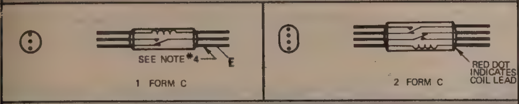
MICRO REED RELAY TUBULAR SERIES LOW COST COMMERCIAL
FORM C SERIES AXIAL TERMINALS FORM C SERIES

M MICRO SERIES (SEE NOTE NO. 5)
.275" HIGH PACKAGES

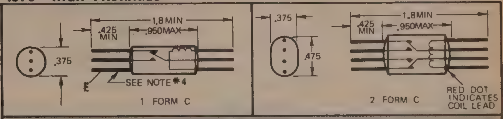

.425 MIN
1.8 MIN
.950MAX
.275
SEE NOTE #4
E
1 FORM C
.275
.425 MIN
1.8 MIN
.950 MAX
.375
RED DOT INDICATES COIL LEAD
2 FORM C

STANDARD LAYOUT

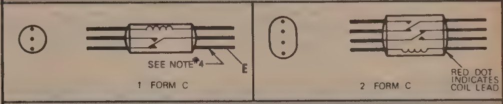

SEE NOTE #4
E
1 FORM C
RED DOT INDICATES COIL LEAD
2 FORM C

Y OPTIONAL LAYOUT

S STANDARD SERIES (SEE NOTE NO. 5)
.375" HIGH PACKAGES


.425 MIN
1.8 MIN
.950MAX
.375
SEE NOTE #4
E
1 FORM C
.375
.475
.425 MIN
1.8MIN
.950MAX
RED DOT INDICATES COIL LEAD
2 FORM C

STANDARD LAYOUT


SEE NOTE #4
E
1 FORM C
RED DOT INDICATES COIL LEAD
2 FORM C

Y OPTIONAL LAYOUT

NOTES:
(1) WHEN Y OPTION LAYOUT IS REQUIRED ADD Y TO PART NUMBER AFTER A. E.G. S1C5A$\overset{Y}{\wedge}$H.
(2) TERMINAL DIAMETER .022 ±.005.
(3) TERMINAL SPACING .100 ±.025.
(4) TERMINAL FOR ELECTROSTATIC SHIELD WHEN SPECIFIED (E).
(5) SERIES IDENTIFICATION M OR S TO PREFIX PART NUMBER (E.G. M1C5AH IS MICRO SERIES — S1C5AH IS STANDARD SERIES).

CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	200 VDC
CURRENT (MAX. SWITCHING)	500 MA
POWER (MAX. SWITCHING)	10 WATTS
CURRENT (MAX. CARRY)	1 AMP
CAPACITANCE (TYPICAL)	.8 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS
OPERATE TIME (TYPICAL)	½ MS
RELEASE TIME (TYPICAL)	¼ MS

GENERAL SPECIFICATIONS

TEMPERATURE	−50°C TO +85°C
SHOCK	200G @ 11 MS DURATION
VIBRATION	30G @ 0-200 HZ
INSULATION RESISTANCE	10^{10} OHMS MIN. @ 20°C

COIL RATINGS

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	1 Form C (See Note No. 5)		2 Form C (See Note No. 5)	
			Part Number	Coil Resistance ±10% @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1C1A	3	2C1A	2
			1C1AH	10	2C1AH	7.5
			1C1AHH	30	2C1AHH	20
3	2.25	.3	1C3A	30	2C3A	20
			1C3AH	100	2C3AH	75
			1C3AHH	250	2C3AHH	175
5	3.75	.5	1C5A	100	2C5A	75
			1C5AH	200	2C5AH	150
			1C5AHH	400	2C5AHH	300
6	4.5	.6	1C6A	125	2C6A	100
			1C6AH	250	2C6AH	175
			1C6AHH	500	2C6AHH	375
10	7.5	1.0	1C10A	400	2C10A	300
			1C10AH	1000	2C10AH	750
			1C10AHH	1600	2C10AHH	1200
12	9	1.2	1C12A	500	2C12A	375
			1C12AH	1000	2C12AH	750
			1C12AHH	2000	2C12AHH	1500
15‡	12	1.5	1C15A	750	2C15A	600
			1C15AH	1500	2C15AH	1200
			1C15AHH	3000	2C15AHH	2000
24‡	18	2.4	†1C24A	1000	†2C24A	750
			1C24AH	2000	2C24AH	1500
			1C24AHH	4000	2C24AHH	3000

PRICE INFORMATION

Quantity	(M) Micro Series						(S) Standard Series					
	M1C*A	M1C*AH	M1C*AHH	M2C*A	M2C*AH	M2C*AHH	S1C*A	S1C*AH	S1C*AHH	S2C*A	S2C*AH	S2C*AHH
1-24	6.12	6.73	7.35	11.01	12.10	13.22	4.71	5.18	5.65	8.47	9.31	10.17
25-49	5.50	6.07	6.60	9.91	10.89	11.91	4.23	4.67	5.08	7.62	8.38	9.16
50-99	4.90	5.40	5.86	8.80	9.69	10.58	3.77	4.15	4.51	6.77	7.45	8.14
100-499	4.28	4.72	5.14	7.71	8.46	9.26	3.29	3.63	3.95	5.93	6.51	7.12
500-999	3.68	4.04	4.41	6.60	7.25	7.93	2.83	3.11	3.39	5.08	5.58	6.10
1000-2499	3.06	3.37	3.68	5.50	6.06	6.62	2.35	2.59	2.83	4.23	4.66	5.09
2500-4999	2.76	3.03	3.30	4.95	5.45	5.95	2.12	2.33	2.54	3.81	4.19	4.58
5000-9999	2.44	2.69	2.94	4.41	4.85	5.29	1.88	2.07	2.26	3.39	3.73	4.07
10000-24999	2.30	2.52	2.77	3.85	4.24	4.63	1.77	1.94	2.13	2.96	3.26	3.56
25000-UP	2.22	2.44	2.67	3.29	3.64	3.98	1.71	1.88	2.05	2.53	2.80	3.06

* VOLTAGE ‡ ADD 10% FOR 15 AND 24 VOLT RELAYS. † NOT RECOMMENDED FOR CONTINUOUS DUTY CYCLE APPLICATIONS.

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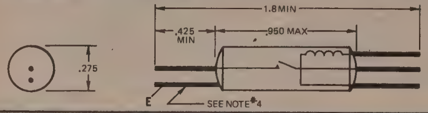
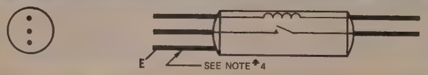
HI VOLTAGE REED RELAYS TUBULAR SERIES AXIAL TERMINALS MERCURY-WETTED REED RELAYS

1 FORM A (HIGH VOLTAGE)

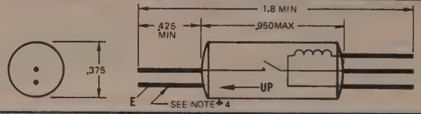


STANDARD LAYOUT

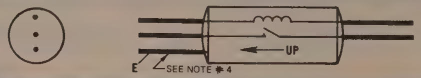


Y OPTIONAL LAYOUT

1 FORM A (MERCURY WETTED)



STANDARD LAYOUT



Y OPTIONAL LAYOUT

NOTES:
(1) WHEN Y OPTION LAYOUT IS REQUIRED ADD Y TO PART NUMBER AFTER A. E.G. 1A5A^{Y}H-HV.
(2) TERMINAL DIAMETER .022 ±.005.
(3) TERMINAL SPACING .100 ±.025.
(4) TERMINAL FOR ELECTROSTATIC SHIELD WHEN SPECIFIED (E).

HI VOLTAGE CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	1000 VDC
CURRENT (MAX. SWITCHING)	750 MA
POWER (MAX. SWITCHING)	15 WATTS
CURRENT (MAX. CARRY)	2 AMP
CAPACITANCE (TYPICAL)	.2 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS
INSULATION RESISTANCE	10^{12} OHMS @ 20°C
OPERATE TIME (TYPICAL)	½ MS
RELEASE TIME (TYPICAL)	¼ MS

MERCURY WETTED CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	250 VDC
CURRENT (MAX. SWITCHING)	2 AMP
POWER (MAX. SWITCHING)	50 WATTS
CAPACITANCE (TYPICAL)	.2 PF
CONTACT RESISTANCE (TYPICAL)	.050 OHMS
INSULATION RESISTANCE	10^{12} OHMS @ 20°
OPERATE TIME (TYPICAL)	½ MSC
RELEASE TIME (TYPICAL)	½ MSC

NOTE: MOUNTING POSITION VERTICAL ±30°.

COIL RATINGS — HIGH VOLTAGE

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1A1A-HV 1A1AH-HV	3 10
3	2.25	.3	1A3A-HV 1A3AH-HV	30 100
5	3.75	.5	1A5A-HV 1A5AH-HV	100 400
6	4.5	.6	1A6A-HV 1A6AH-HV	125 400
10	7.5	1.0	1A10A-HV 1A10AH-HV	400 1000
12	9	1.2	1A12A-HV 1A12AH-HV	500 1000
15‡	12	1.5	1A15A-HV 1A15AH-HV	750 1500
24‡	18	2.4	1A24A-HV† 1A24AH-HV	1000 2000

COIL RATINGS — MERCURY WETTED

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1AHG1A 1AHG1AH	3 30
3	2.25	.3	1AHG3A 1AHG3AH	30 100
5	3.75	.5	1AHG5A 1AHG5AH	100 200
6	4.5	.6	1AHG6A 1AHG6AH	125 250
10	7.5	1.0	1AHG10A 1AHG10AH	400 1000
12	9	1.2	1AHG12A 1AHG12AH	500 1000
15‡	12	1.5	1AHG15A 1AHG15AH	750 1500
24‡	18	2.4	1AHG24A† 1AHG24AH	1000 2000

PRICE LIST

Quantity	1A*A-HV	1A*AH-HV
1-24	5.18	5.65
25-49	4.67	5.09
50-99	4.15	4.51
100-499	3.63	3.95
500-999	3.11	3.39
1000-2499	2.54	2.83
2500-4999	2.33	2.54
5000-9999	2.07	2.26
10000-24999	1.94	2.13
25000-UP	1.88	2.05

PRICE LIST

Quantity	1AHG*A	1AHG*AH
1-24	9.42	10.37
25-49	8.48	9.33
50-99	7.54	8.29
100-499	6.59	7.26
500-999	5.65	6.22
1000-2499	4.71	5.18
2500-4999	4.23	4.67
5000-9999	3.77	4.15
10000-24999	3.54	3.90
25000-UP	3.42	3.76

GENERAL SPECIFICATIONS

TEMPERATURE — −55°C TO +85°C
SHOCK — 200G @ 11 MS DURATION
VIBRATION — 50G @ 0-200 HZ

* VOLTAGE
‡ ADD 10% FOR 15 AND 24 VOLT RELAYS.
† NOT RECOMMENDED FOR CONTINUOUS DUTY CYCLE APPLICATIONS.

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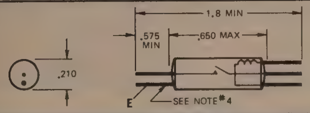
ULTRA MICRO REED RELAYS

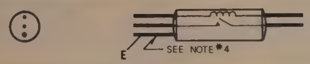
TUBULAR SERIES AXIAL TERMINALS

ULTRA SENSITIVE REED RELAYS

ULTRA MICRO 1 FORM A

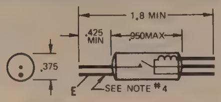


STANDARD LAYOUT

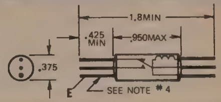


Y OPTIONAL LAYOUT

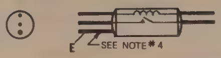
ULTRA SENSITIVE 1 FORM A

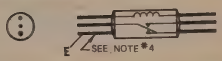


ULTRA SENSITIVE 1 FORM C



STANDARD LAYOUT





Y OPTIONAL LAYOUT

NOTES:
(1) WHEN Y OPTION LAYOUT IS REQUIRED ADD Y TO PART NUMBER. E.G. 1A3^{Y}H.
(2) TERMINAL DIAMETER .022 ±.005.
(3) TERMINAL SPACING .100 ±.025.
(4) TERMINAL FOR ELECTROSTATIC SHIELD WHEN SPECIFIED (E).

ULTRA MICRO CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	250 VDC
CURRENT (MAX. SWITCHING)	.5 AMP
POWER (MAX. SWITCHING)	10 WATTS
CURRENT (MAX. CARRY)	1 AMP
CAPACITANCE (TYPICAL)	.2 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS
INSULATION RESISTANCE	10^{10} OHMS @ 20°C
OPERATE TIME (TYPICAL)	½ MS
RELEASE TIME (TYPICAL)	¼ MS

ULTRA SENSITIVE CONTACT RATINGS

	Form A	Form C
VOLTAGE (MAX. SWITCHING)	200 VDC	150 VDC
CURRENT (MAX. SWITCHING)	500 MA	250 MA
POWER (MAX. SWITCHING)	10 WATTS	4 WATTS
CURRENT (MAX. CARRY)	1 AMP	1 AMP
CAPACITANCE (TYPICAL)	.2 PF	.2 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS	.100 OHMS
OPERATE TIME (TYPICAL)	½ MSC	½ MSC
RELEASE TIME (TYPICAL)	¼ MSC	¼ MSC

COIL RATINGS

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1A1 1A1H	3 10
3	2.25	.3	1A3 1A3H	30 100
5	3.75	.5	1A5 1A5H	100 400
6	4.5	.6	1A6 1A6H	125 400
10	7.5	1.0	1A10 1A10H	400 1000
12	9	1.2	1A12 1A12H	500 1000
15‡	12	1.5	1A15 1A15H	750 1500
24‡	18	2.4	†1A24 1A24H	1000 2000

COIL RATINGS (1 FORM A)

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1A1-10MW	100
3	2.25	.3	1A3-10MW	900
5	3.75	.5	1A5-10MW	2500
6	4.5	.6	1A6-10MW	3500
10	7.5	1.0	1A10-10MW	10000
12	9	1.9	1A12-10MW	14500

COIL RATINGS (1 FORM C)

1	.75	.1	1C1-20MW	50
3	2.25	.3	1C3-20MW	450
5	3.75	.5	1C5-20MW	1250
6	4.5	1.0	1C6-20MW	1800
10	7.5	1.0	1C10-20MW	5000
12	9	1.2	1C12-20MW	7000

PRICE LIST

Quantity	1A*	1A*H
1-24	3.42	3.77
25-49	3.08	3.39
50-99	2.74	3.01
100-499	2.40	2.64
500-999	2.05	2.26
1000-2499	1.72	1.89
2500-4999	1.54	1.70
5000-9999	1.37	1.51
10000-24999	1.20	1.32
25000-UP	1.03	1.13

PRICE LIST

		LIST PRICES			
Quantity	Discount	1 Form A		1 Form C	
1-24	LIST PRICE	1A1-10MW	3.22	1C1-20MW	6.45
25-49	LESS 10%	1A3-10MW	3.67	1C3-20MW	6.45
50-99	LESS 20%	1A5-10MW	4.43	1C5-20MW	7.10
100-499	LESS 30%	1A6-10MW	5.45	1C6-20MW	7.97
500-999	LESS 40%	1A10-10MW	5.83	1C10-20MW	9.27
1000-2499	LESS 50%	1A12-10MW	10.50	1C12-20MW	10.01
2500-4999	LESS 55%				
5000-9999	LESS 60%				
10000-24999	LESS 65%				
25000-UP	LESS 70%				

GENERAL SPECIFICATIONS

TEMPERATURE — −55°C TO +85°C

SHOCK — 200G @ 11 MS DURATION

VIBRATION — 50G @ 0-2000 HZ

* VOLTAGE

‡ ADD 10% FOR 15 AND 24 VOLT RELAYS.

† NOT RECOMMENDED FOR CONTINUOUS DUTY CYCLE APPLICATIONS.

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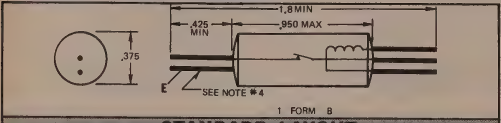
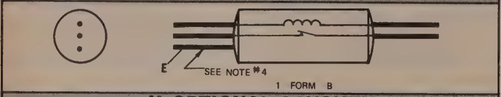
FORM B TUBULAR SERIES AXIAL TERMINALS MAGNETIC LATCHING

TUBULAR FORM B SERIES

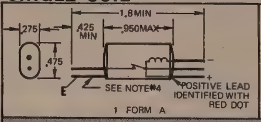

1.8MIN
.425 MIN
.950 MAX
.375
E
SEE NOTE #4
1 FORM B

STANDARD LAYOUT

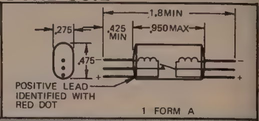

E
SEE NOTE #4
1 FORM B

Y OPTIONAL LAYOUT

MAGNETIC LATCHING SINGLE COIL


1.8MIN
.275
.425 MIN
.950MAX
.475
E
SEE NOTE#4
+
POSITIVE LEAD IDENTIFIED WITH RED DOT
1 FORM A

MAGNETIC LATCHING DUAL COIL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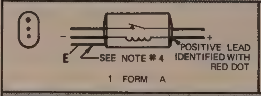
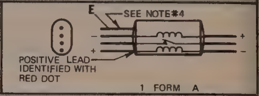
POSITIVE LEAD IDENTIFIED WITH RED DOT
1 FORM A

STANDARD LAYOUT


E
SEE NOTE # 4
+
POSITIVE LEAD IDENTIFIED WITH RED DOT
1 FORM A


E
SEE NOTE#4
+
POSITIVE LEAD IDENTIFIED WITH RED DOT
1 FORM A

Y OPTIONAL LAYOUT

NOTES:
(1) WHEN Y OPTION LAYOUT IS REQUIRED ADD Y TO PART NUMBER AFTER A. E.G. 1B5AYH.
(2) TERMINAL DIAMETER .022 ±.005.
(3) TERMINAL SPACING .100 ±.025.
(4) TERMINAL FOR ELECTROSTATIC SHIELD WHEN SPECIFIED (E).

CONTACT RATINGS

VOLTAGE (MAX. SWITCHING)	200 VDC
CURRENT (MAX. SWITCHING)	500 MA
POWER (MAX. SWITCHING)	10 WATTS
CURRENT (MAX. CARRY)	1 AMP
CAPACITANCE (TYPICAL)	.2 PF
CONTACT RESISTANCE (TYPICAL)	.100 OHMS
OPERATE TIME (TYPICAL)	½ MS
RELEASE TIME (TYPICAL)	½ MS
INSULATION RESISTANCE (TYPICAL)	10^9 OHMS @ 20°C

GENERAL SPECIFICATIONS

TEMPERATURE	−55°C to +85°C
SHOCK	200G @ 11 MS DURATION
VIBRATION — FORM B	50G @ 0-2000 HZ
VIBRATION — LATCHING	25G @ 0-1000 HZ

FORM B COIL RATINGS

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1B1A	3
			1B1AH	10
			1B1AHH	30
3	2.25	.3	1B3A	30
			1B3AH	100
			1B3AHH	250
5	3.75	.5	1B5A	100
			1B5AH	400
			1B5AHH	700
6	4.5	.6	1B6A	125
			1B6AH	400
			1B6AHH	1000
10	7.5	1.0	1B10A	400
			1B10AH	1000
			1B10AHH	2000
12	9	1.2	1B12A	500
			1B12AH	1000
			1B12AHH	2000
15‡	12	1.5	1B15A	750
			1B15AH	1500
			1B15AHH	3000
24‡	18	2.4	†1B24A	1000
			1B24AH	2000
			1B24AHH	4000

PRICE LIST

Quantity	1B*A	1B*AH	1B*AHH
1-24	3.80	4.19	4.56
25-49	3.42	3.77	4.10
50-99	3.05	3.35	3.65
100-499	2.66	2.94	3.19
500-999	2.28	2.52	2.73
1000-2499	1.90	2.10	2.28
2500-4999	1.71	1.89	2.05
5000-9999	1.52	1.67	1.83
10000-24999	1.33	1.47	1.60
25000-UP	1.14	1.25	1.37

LATCHING COIL RATINGS

Nominal Coil Voltage	Pick-Up VDC Max. @ 20°C	Drop-Out VDC Min. @ 20°C	Single Coil		Dual Coil	
			Part Number	Coil Resistance ±10% @ 20°C	Part Number	Coil Resistance ±10% @ 20°C
1	.75	.1	1A1AL	3	1A1A2L	5
			1A1AHL	10	1A1AH2L	10
			1A1AHHL	30	1A1AHH2L	30
3	2.25	.3	1A3AL	30	1A3A2L	30
			1A3AHL	100	1A3AH2L	50
			1A3AHHL	250	1A3AHH2L	200
5	3.75	.5	1A5AL	100	1A5A2L	50
			1A5AHL	400	1A5AH2L	200
			1A5AHHL	700	1A5AHH2L	350
6	4.5	.6	1A6AL	125	1A6A2L	125
			1A6AHL	400	1A6AH2L	200
			1A6AHHL	1000	1A6AHH2L	500
10	7.5	1.0	1A10AL	400	1A10A2L	200
			1A10AHL	1000	1A10AH2L	500
			1A10AHHL	2000	1A10AHH2L	1000
12	9	1.2	1A12AL	500	1A12A2L	500
			1A12AHL	1000	1A12AH2L	1000
			1A12AHHL	2000	1A12AHH2L	2000
15‡	12	1.5	1A15AL	750	1A15A2L	750
			1A15AHL	1500	1A15AH2L	1500
			1A15AHHL	3000	1A15AHH2L	3000
24‡	18	2.4	†1A24AL	1000	†1A24A2L	1000
			1A24AHL	2000	1A24AH2L	2000
			1A24AHHL	4000	1A24AHH2L	4000

PRICE LIST

Quantity	Single Coil			Dual Coil		
	1A*AL	1A*ALH	1A*ALHH	1A*A2L	1A*AH2L	1A*AHH2L
1-24	4.18	4.61	5.01	4.60	5.07	5.52
25-49	3.76	4.15	4.51	4.14	4.56	4.97
50-99	3.35	3.69	4.01	3.68	4.05	4.42
100-499	2.93	3.23	3.51	3.22	3.54	3.87
500-999	2.51	2.76	3.00	2.76	3.03	3.32
1000-2499	2.10	2.31	2.51	2.30	2.54	2.76
2500-4999	1.88	2.07	2.26	2.07	2.28	2.48
5000-9999	1.67	1.85	2.01	1.84	2.03	2.20
10000-24999	1.46	1.62	1.75	1.61	1.77	1.93
25000-UP	1.25	1.37	1.50	1.38	1.52	1.65

* VOLTAGE ‡ ADD 10% FOR 15 AND 24 VOLT RELAYS. † NOT RECOMMENDED FOR CONTINUOUS DUTY CYCLE APPLICATIONS.

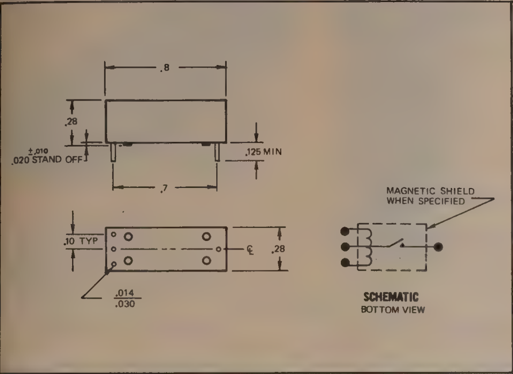
EAC

ELECTRONIC APPLICATIONS CO.

4918 SANTA ANITA AVENUE / El MONTE, CALIFORNIA 91734 / (213) 442-3212

LOW PROFILE SERIES — PLUG-IN 1 FORM A

LOW PROFILE 1 FORM A


.8
.28
±.010
.020 STAND OFF
.125 MIN
.7
.10 TYP
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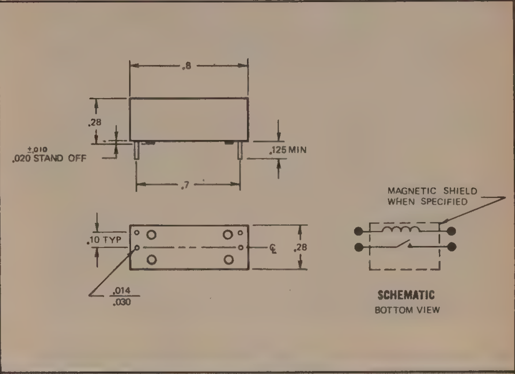
.030
MAGNETIC SHIELD WHEN SPECIFIED
SCHEMATIC
BOTTOM VIEW

FIG. X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.125 MIN
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.10 TYP
℄
.28
.014
.030
MAGNETIC SHIELD WHEN SPECIFIED
SCHEMATIC
BOTTOM VIEW

FIG. Y

CONTACT RATINGS

SWITCHING VOLTAGE — 30 VDC MAX.
SWITCHING CURRENT — .5 AMPS MAX.
CURRENT — 2.0 AMPS MAX.
POWER — 10 WATTS, DC MAX.
CONTACT RESISTANCE (TYP.) — .2 OHMS

GENERAL SPECIFICATIONS

INSULATION RESISTANCE (MIN.) — 10^{11} OHMS @ 20°C
SHOCK — 200G AT 11 MS DURATION
VIBRATION — 50G, 0-0200Hz
TEMPERATURE — −55°C TO +85°C
TOLERANCES — BODY, ±.030, LEAD SPACING, ±.010

OPERATING CHARACTERISTICS

Nominal Coil Voltage DC	Coil Resistance RMS ±10 @ 20°C	Pick-Up VDC Max.	Drop-Out VDC Min.	Operate Time (Milliseconds) Typ.	
				Actuate	De-actuate
1	10	.75	.10	.5	.75
3	100	2.25	.25	.5	.75
5	500	3.75	.50	.5	.75

ORDERING INFORMATION

Part Number			
No Magnetic Shield		With Magnetic Shield	
Fig. X	Fig. Y	Fig. X	Fig. Y
LPX1	LPY1	LPX1M	LPY1M
LPX3	LPY3	LPX3M	LPY3M
LPX5	LPY5	LPX5M	LPY5M

PRICE INFORMATION

Quantity	No Magnetic Shield	With Magnetic Shield
1-24	3.80	4.30
25-49	3.42	3.87
50-99	3.04	3.44
100-499	2.66	3.01
500-999	2.28	2.58
1000-2499	1.90	2.15
2500-4999	1.71	1.94
5000-9999	1.52	1.72
10000-24999	1.33	1.51
25000-up	1.14	1.29

EAC
ELECTRONIC APPLICATIONS CO.
4918 SANTA ANITA AVENUE / El MONTE, CALIFORNIA 91734 / (213) 442-3212

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

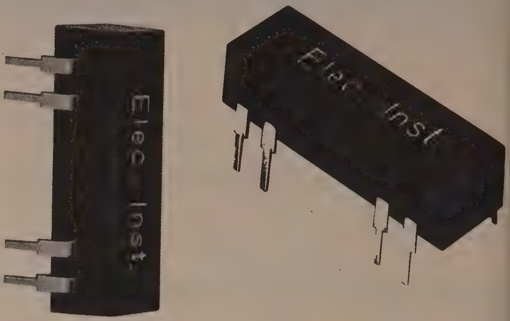
DIP Reed Relays Epoxy Molded

Form A and C Dry Reed

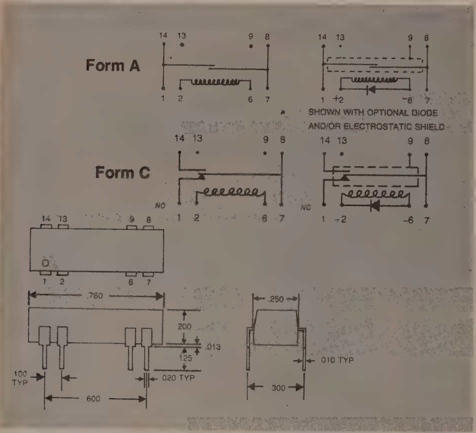
Now high-performance DIP reed relays available in low-cost Lead-Frame configuration. Offering extremely easy access, these superbly engineered relays are made to provide reliable, trouble-free operation at inexpensive prices.

- **Low Profile**
- **Automatic Insertion**
- **Improved Accessibility**
- **Driven Directly from TTL & DTL Logic**

Electronic instrument and Specialty Corporation is a leading producer of reed relays for industrial and commercial applications. EI&S Corp. assures highest quality and superior performance from all reed relays under the most demanding conditions.



Contact Rating:	Form A	Form C
Amp. max. DC	½	¼
Volts max. DC	100	28
Ohm max. initial contact resistance	.150	.200
Watts max. DC power limitation	10	3
Volts min. DC breakdown voltage	200	200



All Values @ 20°C

Form A Cat. No.	Volts	Coil Resist. ±10%	Max. Pull-In	Min. Drop-Out	Price 100 Qty.
DL1A05	5	500	3.8	.8	$1.98
DL1A06	6	500	4.8	.9	1.98
DL1A12	12	1000	9.6	1.8	2.23
DL1A 24	24	1500	19.2	3.6	2.52

Form C Cat. No.	Volts	Coil Resist. ±10%	Max. Pull-In	Min. Drop-Out	Price 100 Qty.
DL1C05	5	200	3.8	.8	$5.01
DL1C06	6	200	4.8	.9	5.01
DL1C12	12	600	9.6	1.8	5.35
DL1C24	24	1500	19.2	3.6	6.19

OPTIONS:

Coil Pins @ 6 & 13 - add suffix C

For Electrostatic Shield, Form A only add Suffix S (connected to pin #9)

For Diode across coil, add suffix D (Pin #2 positive; Pin #6 negative)

General Specifications:	Form A	Form C
Insulation Resistance	10^{12} Ohm Typical	10^{10}
Life Expectancy	$100\text{x}10^6$ Operations at low level	$50\text{x}10^6$
	$10\text{x}10^6$ Operations at rated load	$5\text{x}10^6$
Operate Temperature	0 to +65°C	
Storage Temperature	−55°C to +100°C	
Typical Operating Time	<.350 ms	<.500 ms
Typical Release Time	.100 ms	.100 ms

Prices subject to change without notice.

Terms 1% 10 days, net 30, F.O.B. factory.

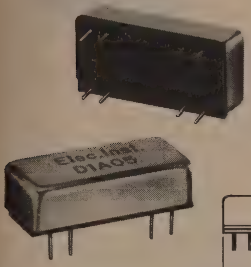
42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

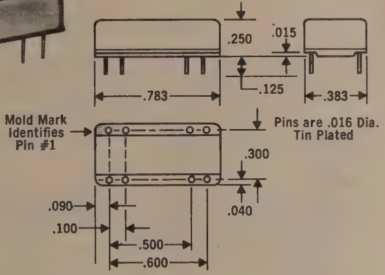
DIP Reed Relays

- **Dry Reed**
- **Mercury Wetted**
- **Magnetically Shielded**

Featuring high performance in a compact, low profile package, these DIP reed relays can be driven directly from TTL and DTL circuits. Magnetic shielding is standard with this line. Careful engineering and manufacturing ensures stress free encapsulation.

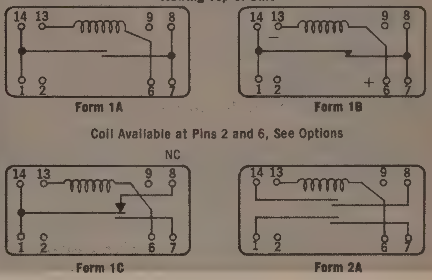


DIMENSIONS



DIP RELAY SCHEMATICS

Viewing Top of Unit



Coil Available at Pins 2 and 6, See Options

GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time (excluding bounce)
Dry Reed, Form A	.3 ms	.1 ms
Dry Reed, Form B	.1 ms	.3 ms
Dry Reed, Form C	.5 ms	.1 ms
Mercury Wetted Form A	2.0 ms	2.0 ms

Insulation Resistance: Typically greater than 1 x 10^{12} ohms except Form C (1 x 10^{10})

Life Expectancy: 100 x 10^6 operations at low level; 10 x 10^6 at rated load, mercury wetted 10 times higher

CONTACT RATING

Dry Reed, Form 1A, 2A, 1B: ½ amp max., 100 volts max., within 10 watt power limitation. Initial contact resistance .150 ohm max.

Dry Reed, Form 1C: ¼ amp max., 28 volts max., within 3 watt power limitation. Initial contact resistance .200 ohm max.

Mercury Wetted, Form 1A: 1 amp max., 100 volts max., within 28 watt power limitation. Initial contact resistance .050 ohm max.

*Consult factory or local representative for performance details.

OPTIONS

Coil Pins @ 2 & 6, Add Suffix C

For Electrostatic Shield, Add Suffix S (connected to Pin #9)

For Diode Across Coil, Add Suffix D (Pin #13 Negative, Pin #6 Positive)

For Coil Polarity of +2 & −6, Add Suffix P

Cat. No.	Contact Arrangement	Volts	All Values @ 20°C Coil Resistance ±10%	Max. Pull-in Volts	Min. Drop out Volts	Price 100 Qty.
DRY REED CONTACTS						
D1A05	1A	5	500	4.0	.8	$2.30
D1B05	1B	5	500	4.0	.8	3.09
D1C05	1C	5	200	4.0	.8	5.01
D1A06	1A	6	500	4.8	.9	2.30
D1B06	1B	6	500	4.8	.9	3.09
D1C06	1C	6	200	4.8	.9	5.01
D1A12	1A	12	1000	9.6	1.8	2.46
D1B12	1B	12	1000	9.6	1.8	3.24
D1C12	1C	12	750	9.6	1.8	5.35
D1A24	1A	24	4000	19.2	3.6	2.94
D1B24	1B	24	4000	19.2	3.6	3.69
D1C24	1C	24	3000	19.2	3.6	6.19
D2A05	2A	5	200	4.0	.8	3.34
D2A06	2A	6	200	4.8	.9	3.34
D2A12	2A	12	800	9.6	1.8	3.51
D2A24	2A	24	3000	19.2	3.6	3.97
MERCURY WETTED CONTACTS						
*MD1A05	1A	5	80	4.0	.8	4.47
*MD1A06	1A	6	100	4.8	.9	4.47
*MD1A12	1A	12	400	9.6	1.8	4.63
*MD1A24	1A	24	1600	19.2	3.6	4.83

*NOTE: Must be mounted vertically, Pins 1 & 14 at top.

Prices subject to change without notice.

Terms: 1% 10 Days / Net 30 F.O.B. Factory

42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

General Purpose Reed Relays

- .15″ x 1.35″ Grid
- Dry Reed
- Magnetically Shielded
- Epoxy Encapsulated

These ruggedly reliable general purpose reed relays are designed for "workhorse" applications. Capable of handling 10 watts at ½ amp, they are widely used in industrial systems such as machine tool controls. Metal cases provide excellent magnetic shielding. Available in a wide variety of contact configuration. Stress free encapsulation is ensured by careful engineering and manufacturing.

SCHEMATICS/DIMENSIONS

Note: All Views are Top of Unit — Pins on Bottom

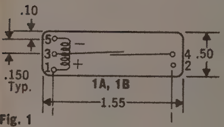


Fig. 1

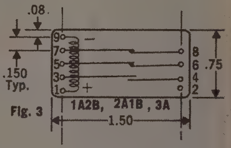


Fig. 3

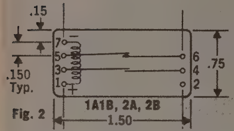


Fig. 2

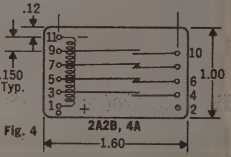


Fig. 4

GENERAL SPECIFICATIONS

† **Operate Time:**
Form A in the order of 1.0 ms including bounce.
Form B in the order of .1 ms.

† **Release Time:**
Form A in the order of .1 ms.
Form B in the order of 1.0 ms including bounce.

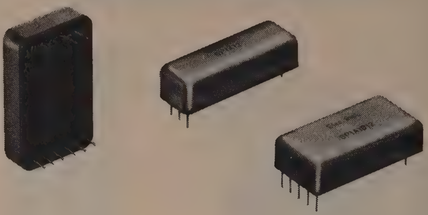
Insulation Resistance:
Typically greater than 1 x 10^{12} ohms.

Life Expectancy:
100 x 10^6 operations at low level.
10 x 10^6 at rated load.

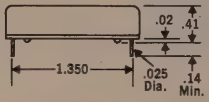
Operate Temperature: 0°C to +65°C.

Storage Temperature: −55°C to +85°C.

†Consult Factory for Performance Details.



Dimensions Typical of All Units



CONTACT RATING

Form A, B

½ amp max., 200 volts max. with 10 watt power limitation. Initial contact resistance .100 ohms max. Breakdown voltage 300 volts min.

OPTIONS

For Electrostatic Shield, Add Suffix S connected to Pin #2)

Contact Arrangement	Schematics/ Dimensions Fig.	Table of Coil Resistance Values @ 20°C Coil Voltages 5V Ohms	6V Ohms	12V Ohms	24V Ohms	Price 100 Qty. Any Voltage
1A	1	290	290	1080	4100	$2.59
1B	1	465	465	1900	4100	3.08
2A	2	145	145	650	2600	3.34
2B	2	95	95	400	1480	3.85
*1A1B	2	95	95	400	1480	3.85
1A2B	3	75	75	280	1170	4.73
2A1B	3	75	75	280	1170	4.73
3A	3	115	115	490	1800	3.83
4A	4	80	80	300	1250	4.46
2A2B	4	49	49	300	830	5.61
Max. Pull-in Voltage @ 20°C	—	4.0	4.8	9.6	19.2	—
Min. Drop-out Voltage @ 20°C	—	.8	.9	1.8	3.6	—

Prices subject to change without notice.
*Form C action.

ORDERING INFORMATION

To order, specify Series Number, Contact Arrangement, Coil Voltage and optional electrostatic shield if required.

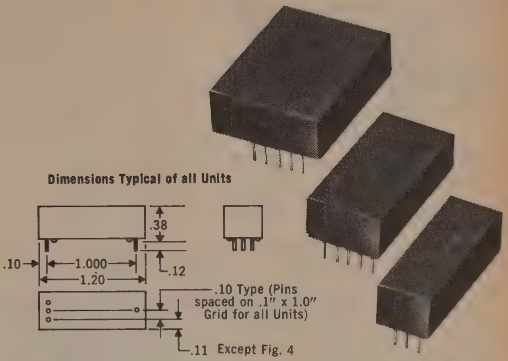
GP	1A	05	S
General Purpose	Contact Arrangement	Coil Voltage	With Electrostatic Shielding

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

Mini-Inch Reed Relays

- **.10″ x 1.00″ Grid**
- **Dry Reed**
- **Mercury Wetted**
- **Epoxy Encapsulated**

Featuring stress free encapsulation, the Mini-inch series has both dry reed and mercury wetted contacts available. More compact than the general purpose relay, and with a .10″ pin grid, these relays have wide acceptance for PC board mounting.

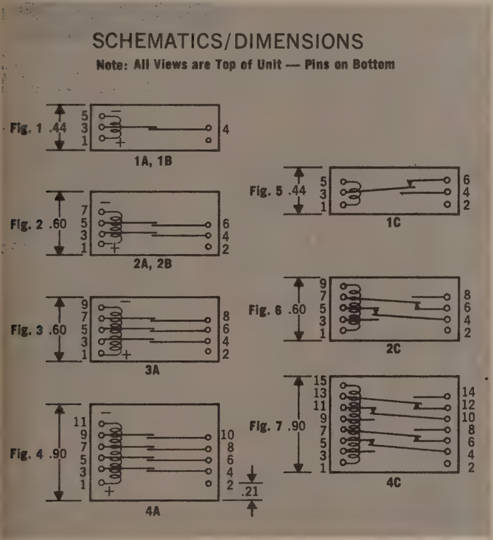


Dimensions Typical of all Units

Pins are .022/.027 Dia. Tinned

SCHEMATICS/DIMENSIONS

Note: All Views are Top of Unit — Pins on Bottom



CONTACT RATING

Dry Reed, Form A, B:
½ amp. max., 200 volts max. with 10 watts power limitation. Initial contact resistance .10 ohm max. Breakdown voltage 300 volts min.

DRY Reed, Form C:
¼ amp. max., 28 volts max. with 3 watts power limitation. Initial contact resistance .15 ohm max. Breakdown voltage 250 volts min.

Mercury Wetted Form A:
1 amp max., 100 volts max. with 28 watts power limitation. Initial contact resistance .05 ohm max. Breakdown voltage 1000 volts min.

OPTIONS

For Electrostatic Shield, add Suffix S (connected to Pin #2)
For Magnetic Shield, add Suffix H

GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time (excluding bounce)
Dry Reed, Form A	.3 ms	.1 ms
Dry Reed, Form B	.1 ms	.3 ms
Dry Reed, Form C	.5 ms	.1 ms
Mercury Wetted, Form A	2.0 ms	2.0 ms

Insulation Resistance:
1 x 10^{12} ohms typical, except Form C (1 x 10^{10})

Life Expectancy:
100 x 10^6 operations at low level
10 x 10^6 at rated load, Mercury Wetted 10 X higher

Operate Temperature: 0°C to +65°C

Storage Temperature: −55°C to +85°C

* Consult factory or local representative for performance details.

Switch Type	Contact Arrangement	Schematics/ Dimensions Fig.	Table of Coil Resistance Values @ 20°C Coil Voltages 5V Ohms	6V Ohms	12V Ohms	24V Ohms	Price 100 Qty. Any Voltage
Dry Reed	1A	1	100	125	500	2000	$2.19
	2A	2	85	110	440	1750	3.19
	3A	3	65	85	340	1350	3.97
	4A	4	45	60	250	1000	4.75
	1B	1	100	125	500	2000	2.94
	2B	2	85	110	440	1750	3.68
	1C	5	100	125	500	2000	4.47
	2C	6	60	80	310	1250	7.46
	4C	7	22	30	125	500	13.36
Mercury† Wetted	1A	1	70	95	375	1500	4.60
	2A	2	45	60	250	1000	7.04
	4A	4	18	25	100	400	12.54
Max. Pull-in Voltage @ 20°C	—	—	4.0	4.8	9.6	19.2	—
Min. Drop-out Voltage @ 20°C	—	—	.8	.9	1.8	3.6	—

Prices subject to change without notice.

† Must be mounted vertically. Coil pins at bottom.

ORDERING INFORMATION

To order specify Series Number (MS), Contact Arrangement, Coil Voltage, Mercury Wetted Contacts if required (Suffix M), and electrostatic shielding if required (Suffix S).

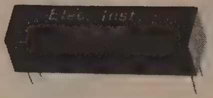
MS	1A	05	M	S
Series	Contact Arrangement	Coil Voltage	Mercury Wetted	Electrostatic Shielding

42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

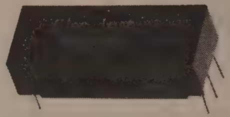
ELECTRONIC INSTRUMENT & SPECIALTY CORP.

Pico Series Reed Relays

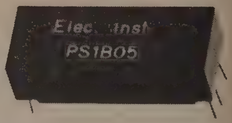
- .10″ x .70″ Grid
- Dry Reed
- Epoxy Molded
- Ultraminiature Reed Relays



FORM 1A



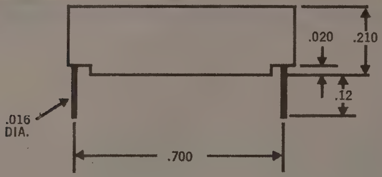
FORM 2A



FORM 1B

SCHEMATICS/DIMENSIONS

Note: All Views are Top of Unit — Pins on Bottom



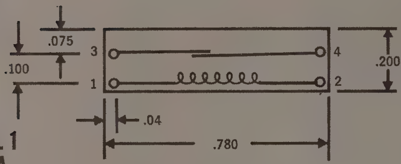


Fig. 1 1A

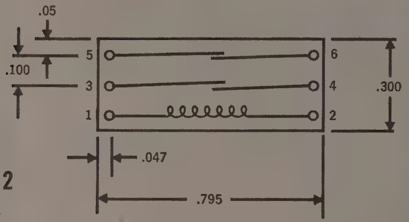


Fig. 2 2A

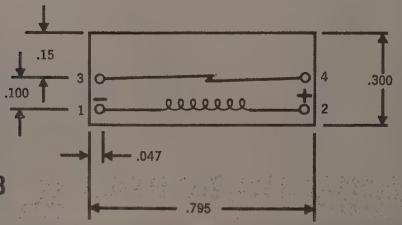


Fig. 3 1B

CONTACT RATING

Form 1A:
¼ amp. max., 100 volts max., within 10 watt power limitation, initial contact resistance .150 ohms max.

Form 2A and 2B:
½ amp., 100 volts max., within 10 watt power limitation, initial contact resistance .100 ohms max.

GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time (excluding bounce)
Form 1A	0.3 ms	0.1 ms
Form 2A	1.0 ms	0.1 ms
Form 1B	0.1 ms	1.0 ms

Insulation Resistance:
1 x 10^{11} ohms typical.

Life Expectancy:
100 x 10^6 operations at low level.
10 x 10^6 operations at rated load

Operate Temperature: 0°C to 65°C.

Storage Temperature: −55°C to +85°C.

*Consult factory for performance details.

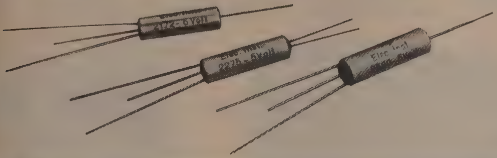
ALL VALUES AT 20°C

Cat. No.	Fig.	Volts	Coil Resist. ±10%	Max. Pull-In	Min. Drop-Out	Price 100 Qty.
PS1A05	1	5	390	4.0	.8	$2.46
PS1A06	1	6	390	4.8	.9	2.46
PS1A12	1	12	1125	9.6	1.8	2.74
PS1A24	1	24	3800	19.2	3.6	3.27
PS2A05	2	5	200	4.0	.8	3.49
PS2A06	2	6	200	4.8	.9	3.49
PS2A12	2	12	400	9.6	1.8	3.63
PS2A24	2	24	1200	19.2	3.6	3.69
PS1B05	3	5	390	4.0	.8	3.32
PS1B06	3	6	390	4.8	.9	3.32
PS1B12	3	12	1125	9.6	1.8	3.59
PS1B24	3	24	3800	19.2	3.6	4.11

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

Axial Reed Relays

- Microminiature
- Dry Reed
- Mercury Wetted
- Magnetically Shielded



These **tiny** axial reed relays, available in dry reed or mercury wetted configurations, are fast to operate, take up a minimum of space, yet can carry a big load. Ideal for applications where low contact resistance, fast operation and long life in a midget packet are required.

SCHEMATICS/DIMENSIONS

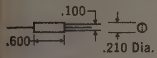


Fig. 1

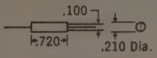


Fig. 2

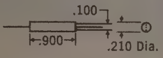


Fig. 3

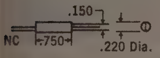


Fig. 4

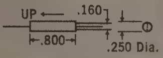


Fig. 5

GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time
Dry Reed, Form 1A	.2 to .5 ms	.1 ms
Dry Reed, Form 1C (N.O.)	.4 ms	.1 ms
Mercury Wetted, Form 1A	2 ms	2 ms

Insulation Resistance: Typically greater than 1 x 10^{12} ohms except Form C (1 x 10^{10})

Life Expectancy: 100 x 10^6 operations at low level; 10 x 10^6 at rated load, Mercury Wetted 10 X higher

Operate Temperature: 0°C to +65°C

Storage Temperature: −55°C to +85°C

*Consult factory for performance details.

OPTIONS

For Electrostatic Shield, add Suffix S

Cat. No.	**2160S**			**2160R**				**2172***				**2190**				**2275**				**2580****			
Dimensions	Fig. 1			Fig. 1				Fig. 2				Fig. 3				Fig. 4				Fig. 5			
Contact Type	DRY REED																			Mercury Wetted			
Contact Arrangement	1A			1A				1A				1A				1C				1A			
Nominal Voltage	5	6	12	5	6	12	24	5	6	12	24	5	6	12	24	5	6	12	24	5	6	12	24
Coil Resist., Ohms	750	1000	3800	375	500	2100	4800	400	630	2800	5500	400	630	2800	5500	240	325	1200	5000	105	105	400	1700
	Contact Ratings																						
Current, Max.	10 ma			10 ma				¼ amp.				½ amp.				¼ amp.				1 amp.			
Voltage, Max.	28 volts			28 volts				100 volts				200 volts				28 volts				100 volts			
Power, Max.	.3 watts			.3 watts				10 watts				10 watts				3 watts				28 watts			
Initial Contact Resistance Max.	.200 ohms			.200 ohms				.150 ohms				.100 ohms				.150 ohms				.050 ohms			
Price 100 Qty., $	4.21	4.21	4.84	3.66	3.66	4.21	5.49	3.66	3.66	4.21	5.49	3.66	3.66	4.21	5.49	5.68	5.68	6.24	7.37	4.64	4.64	5.21	6.41
Pull-in Voltage Max. @ 20°C	80% of nominal voltage																						
Drop-out Voltage Min. @ 20°C	15% of nominal voltage																						

*Available RF switch (low resistive loss to 100 MHz).
**Available in dry reed contacts for 1000 VDC or 2000 VDC breakdown.
Prices subject to change without notice.

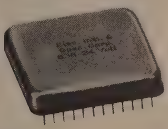
ORDERING INFORMATION
To order, specify Catalog Number, Coil Voltage and Optional Electrostatic Shield if required.

Example:	**2160S**	**12**	**S**
	Catalog Number	Coil Voltage	Electrostatic Shield

SPECIAL PURPOSE RELAYS

Electronic Instrument has produced a wide assortment of tailored relays beyond its standard lines. Some of these styles are shown below and are available with almost off-the-shelf delivery. If your requirement is not a standard, send us your specifications and let us prove our capability to produce **the** relay for **your** application at economical prices.

MULTIPLE FLAT PACK

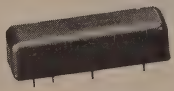


Relay designed to permit 0.5 inch PC board stacking; will insert easily in standard contact strip.

VRM (MERCURY-WETTED VERTICAL)

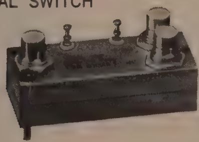
Solution to problems encountered when printed circuit boards must be mounted horizontally — yet require stable contact resistance with no bounce.

HIGH TEMPERATURE



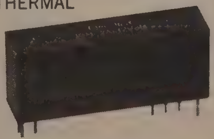
A wide selection of high temperature relays capable of operating up to 150°C are available.

COAXIAL SWITCH



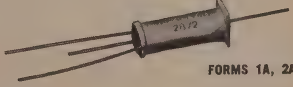
Fast switching, low power to operate and miniature size are several outstanding features offered in this series.

LOW THERMAL



This relay illustrates one of many low thermal relays available. Differential thermals as low as 2 microvolts.

LOW COST



FORMS 1A, 2A, 1B

Axial Leads
Size: ⅜ dia. x ⅞ long (bobbin) **Form 1A only**
Rating: ½ amp., 200 VDC, 10 watts

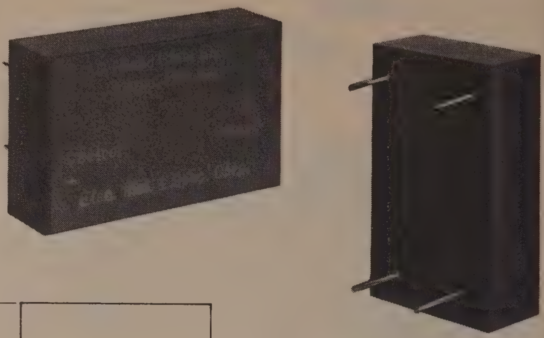
42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

3 Amp Solid State AC Relay

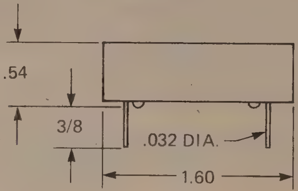
MODELS 905 & 906

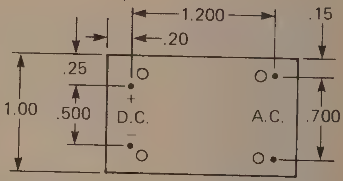
- **Zero Voltage Crossover**
- **Contacts AC SPST (Normally Open)**
- **Optoelectronic Isolation**
- **Requires Little Power; TTL, MOS Logic or even a Photocell Provides Ample Power**



APPLICATIONS

- **Machine Tool Controls**
- **Process Control Systems**
- **Traffic Control Systems**
- **Computer Peripherals**
- **Resistive Loads Such as Heaters, Lamps**
- **Inductive Loads Such as Motors, Solenoids Transformers**





ELECTRICAL SPECIFICATIONS

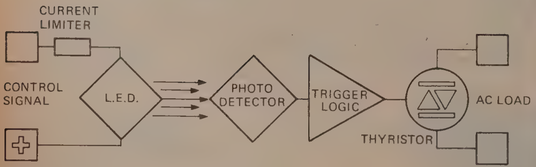
(25°C Unless Otherwise Specified)

Input Control Voltage (DC)

Model	Min.	Max.
905	3.5	15
906	9	32

INPUT (control) . Models 905 & 906

Specifications	Min.	Typ.	Max.	Units
Input Current at 5V control voltage		10	12	MA
Turn-Off-Voltage	1.0			VDC
Isolation (input to output)	10^9			OHMS
Dielectric Strength (input-output)	1500			VAC (rms) 60 Hz



Typical Unit Price at 100 Quantity $8.48.
Prices Subject to Change Without Notice.
Terms: 1% 10 Days, Net 30, F.O.B. Factory.

OUTPUT (load) Models 905 & 906

Specifications	Min.	Typ.	Max.	Units
Output Current Rating	.05		3	AMPS (rms)
Load Voltage Rating	6		140	VAC (rms)
Frequency Range	50		70	Hz
Surge Current Rating (one full cycle)			20	AMPS
Contact Voltage Drop at rated current		.8	1.2	VAC
Turn-On Time (60 Hz)		3.0	8	MS
Turn-Off Time (60 Hz)		5.0	16	MS
Off-State Leakage ($-40°C \leq Ta \leq 100°C$)		8		MA (rms)
Voltage Across Load at Turn-On			±5	V (peak)
Output Transient Protection (off-state dv/dt)		200		V/μsec

Specifications shown herein subject to change without notice.

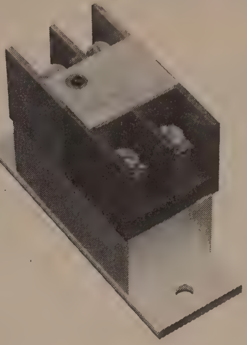
42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

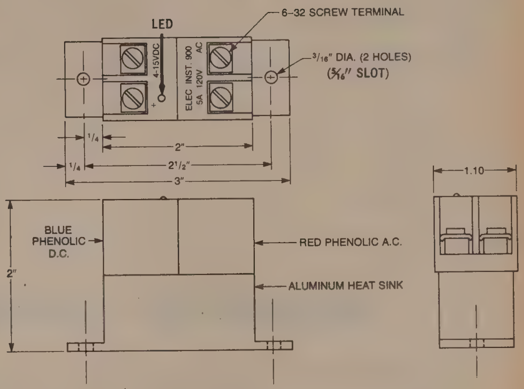
ELECTRONIC INSTRUMENT & SPECIALTY CORP.

5 Amp Solid State AC Relays

MODELS 900 & 901

- Zero Voltage Crossover
- Contacts AC SPST (Normally Open)
- Optoelectronic Isolation
- Requires Little Power; TTL, MOS Logic or even a Photocell Provides Ample Power
- Color-coded Input-Output
- Physically Isolated AC and DC Connectors
- Saddle Clamp Sems Eliminate Expensive Lugs
- Built-in Sink Dissipates Heat Effectively
- LED Indicates On Position





APPLICATIONS

- Machine Tool Controls
- Process Control Systems
- Traffic Control Systems
- Computer Peripherals
- Resistive Loads Such as Heaters, Lamps
- Inductive Loads Such as Motors, Solenoids Transformers

ELECTRICAL SPECS.

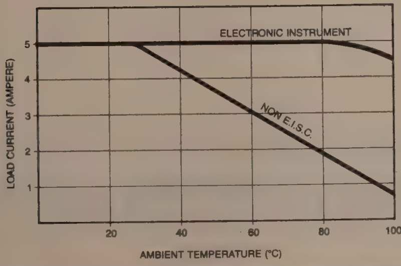
(25°C Unless Otherwise Specified)

Input Control Voltage (DC)

Model	Min.	Max.
900	4	15
901	9	32

INPUT (control) Models 900 & 901

Specifications	Min.	Typ.	Max.	Units
Input Current at 5V control voltage		10	12	MA
Turn-Off-Voltage	1.0			VDC
Isolation (input to output)	10^9			OHMS
Dielectric Strength (input-output)	1500			VAC (rms) 60 Hz



OUTPUT (load) Models 900 & 901

Specifications	Min.	Typ.	Max.	Units
Output Current Rating	.05		5	AMPS (rms)
Load Voltage Rating	6		140	VAC (rms)
Frequency Range	50		70	Hz
Surge Current Rating (one full cycle)			60	AMPS
Contact Voltage Drop at rated current		.8	1.2	VAC
Turn-On Time (60 Hz)		3.0	8	MS
Turn-Off Time (60 Hz)		5.0	16	MS
Off-State Leakage (−40°C ≤ Ta ≤ 100°C)		8		MA (rms)
Voltage Across Load at Turn-On			±5	V (peak)
Output Transient Protection (off-state dv/dt)		200		V/μsec

Specifications shown herein subject to change without notice.

42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

U.L./C.S.A. FILE NUMBERS

When requiring U.L. and/or C.S.A. approval, refer to the file number which will save you time and money. Approval is simplified when product includes components having prior approvals. Regulations then require that a component be checked only for the application within its approved ratings. If a component does not have prior approval — the component must undergo complete testing to determine if it meets U.L. requirements. This entails added expense and time. The following A.C. Controls have U.L. and C.S.A. recognition.

RBM Type	*U.L. Recognition File #	*C.S.A. Recognition File #
75	E12139	LR13360
84	E12139 or E22381	LR13360
84 & 184	E12139	LR13360
91	E12139	LR13360
192	E12139	LR13360

RBM Type	*U.L. Recognition File #	*C.S.A. Recognition File #
93	E12139	LR13360-31
129, 129AR	E12139	LR13360
143	E12139	LR13360-36
154	E12139	LR13360
175	E33034	LR13360-32

* U.L. and C.S.A. listing covers RBM production part number stamped on relay. Production part number (not standard catalog part number) should be submitted with file number. RBM will supply report date when required. CONSULT FACTORY FOR POSSIBLE U.L. AND C.S.A. RECOGNITION FOR OTHER THAN ABOVE.

ANNOUNCING A CHANGE IN BRAND NAME

RBM has long been a familiar brand name for electrical contactors and relays in the OEM and Distributor markets and is identified with the Controls Division of Essex International, Incorporated. They will continue to make custom components for the OEM market but the stock catalog line of RBM products will now be sold under the familiar trade name STANCOR as part of the ESSEX marketing system for standard catalog items available from stock.

STANCOR contactors and relays are available through a select group of distributors located from coast to coast and covering all major marketing areas.

Contact STANCOR-CHICAGO for any additional information not shown in the catalog listings.

GUARANTEE THE COMPANY MAKES NO WARRANTY CONCERNING THE UTILITY OR FITNESS OF THE PRODUCTS FOR THE PURCHASER'S PURPOSE NOR ANY OTHER WARRANTY, EXPRESS OR IMPLIED. Defective material will be repaired or replaced for a period of one year from date of shipment unless otherwise stated. This repair or replacement will be made from our factory on material proving defective. We do not assume any expense or liability for repairs to our apparatus made outside our own factories, without written consent. In no case will our responsibility extend to apparatus not made by us. The Company is not responsible for damage to apparatus through improper installation or through attempts to operate it above its rated capacity, intentional or otherwise. Under no circumstances shall the Company be liable for loss of profits or other special damages.

ESSEX STANCOR

ENGINEERING DESIGN DATA

ALTERNATING CURRENT CONTROLS

Type	Magnet Coil Rating (Volt Amperes)			Operation in % of Nom. Coil Rating		Breakdown Voltage All Terminals - 60 Hz RMS			Contact Material		Electrical Life		Mechanical Life§		Max. Oper. Amb. °F
	Inrush	Sealed Nom.	Sealed Max.	Pick-up	Max.* Safe Operate	Opposite Polarity	Open Contacts Same Polarity	To Ground	Power	Pilot	Oper. At Rated Load	Oper. Per Min.	Oper. At No Load	Oper. Per Min.	
75	16	10	12	85%	110%	1500	1000	1500	Silver Alloy	—	100,000†	6	1,000,000	60	140
84	4	2.8	3	85%	110%	1500	1000	1500	Silver Alloy	Fine Silver	100,000†	6	1,000,000	60	140
84T	9	2.8	3	85%	110%	1500	1000	1500	—	Gold Alloy	100,000	6	1,000,000	60	140
85	90	19	23	85%	110%	2200	2200	2200	Silver Alloy	—	100,000	6	500,000	10	130
91	22	8	10	85%	110%	1500	1000	1500	Fine Silver	Gold Alloy‡	100,000†	6	750,000	60	130
92	24	8.9	12	85%	110%	1500	1000	1500	Fine Silver	Gold Alloy‡	100,000†	6	750,000	60	130
93	4.5	3.0	4	85%	110%	1500	1000	1500	Fine Silver	Gold Alloy‡	100,000†	6	10,000,000	60	160
129	10	4.5	5	85%	110%	1500	1000	1500	Silver Alloy	—	100,000	6	500,000	60	130
129AR	10	4.5	5	85%	110%	1500	1000	1500	Silver Alloy	—	100,000†	3	500,000	60	130
143	24	8.9	12	85%	110%	1500	1000	1500	Silver Alloy	—	100,000†	3	500,000	30	130
154	80	6.5	7.5	85%	110%	1500	1000	1500	Silver Alloy	—	100,000†	6	500,000	30	155
175	40 VA Transformer and Relay Package								Silver	—	100,000†	6	500,000	60	120
187	1.3	1.3	1.5	85%	110%	1000	1000	1000	—	Silver Alloy	100,000†	6	10,000,000	60	150
C	90	18	21	85%	110%	2200	2200	2200	Silver Alloy	—	100,000†	6	1,000,000	10	130
CR	90	18	21	85%	110%	2200	2200	2200	Silver Alloy	—	100,000†	6	1,000,000	10	130
184	4	2.8	3	85%	110%	1500	1000	1500	Silver Alloy	Fine Silver	100,000†	6	1,000,000	60	150

DIRECT CURRENT CONTROLS

Type	Coil Rating	Operation in % of Nom. Coil Rating		Breakdown Voltage All Terminals - 60 Hz RMS			Contact Material		Electrical Life		Mechanical Life§		Max. Oper. Amb. °F
	Nominal Magnetic Coil Rating (Watts)	Pick-up	Max.* Safe Operate	Opposite Polarity	Open Contacts Same Polarity	To Ground	Power	Pilot	Oper. At Rated Load	Oper. Per Min.	Oper. At No Load	Oper. Per Min.	
60	2	75%	110%	1000	1000	1000	Fine Silver	—	100,000	4	250,000	4	122
70	9	75%	110%	500	500	500	Copper or Silver	—	100,000	4	250,000	4	122
84D	3	75%	110%	1500	1000	1500	—	Silver Alloy	100,000	6	1,000,000	60	140
91D	6.5	75%	110%	1500	1000	1500	Fine Silver	—	100,000	6	750,000	60	140
92D	7	75%	110%	1500	1000	1500	Fine Silver	—	100,000	6	750,000	60	140
93	1.5	75%	110%	1500	1000	1500	Fine Silver	Gold Alloy‡	100,000	6	10,000,000	60	160
150	3	75%	110%	500	500	500	Silver Alloy	—	500,000	12	1,000,000	12	122
BRM	Switch Only — No Magnet Coil			500	250	250	—	Special Alloy	5,000,000	60	2,000,000,000	7200	185
BRS	Switch Only — No Magnet Coil			500	250	250	—	Special Alloy	20,000,000	60	2,000,000,000	7200	185
MS	Current Sensitive			1000	1000	1000	Silver Alloy	Gold Alloy‡	100,000	60	50,000,000	180	185
164	Current Sensitive			1000	1000	1000	Silver Alloy	Gold Alloy‡	50,000	60	25,000,000	180	185
TRM	Switch Only — No Magnet Coil			250	250	250	—	Special Alloy	2,000,000	60	2,000,000,000	7200	185

* Magnet coils designed for continuous duty. Do not operate at rate higher than indicated under Mechanical Life.

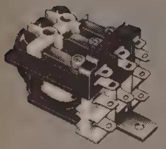
§ Based on steady state test under laboratory environmental conditions. Consult factory if application involves unusual load, speed of operation, off-on ratio, environmental or operating conditions. Electric life substantially greater when operated below rated load.

† Load tests — making inrush ratings (0.4 to 0.5 P.F.) — breaking 125% continuous rating (0.65 to 0.8 P.F.).

‡ Cross-bar contacts.

A.C. D.C. GENERAL PURPOSE RELAYS

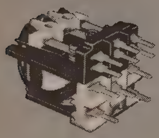
ESSEX STANCOR



TYPE 93 SOLDER TERMINALS

Size:
1 15/16" x 1 5/16" x 1 5/16"

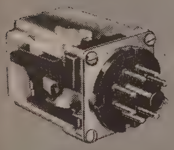
FIGURE 1



TYPE 93 PRINTED CIRCUIT

Size:
1 15/16" x 1 5/16" x 1 5/16"

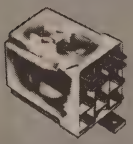
FIGURE 2



TYPE 93 8 & 11 PIN PLUG-IN

Size:
2⅛" x 1 7/16" x 1 9/16"

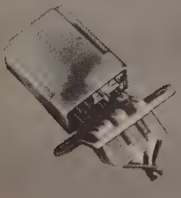
FIGURE 3



TYPE 93 3/16" QUICK CONNECT

Size:
2⅛" x 1 7/16" x 1 9/16"

FIGURE 4



TYPE 93 RELAY RECEPTACLE 93-185-1

Hardware Included

DESIGN DATA PAGE 1•1669

SINGLE POLE DOUBLE THROW
TWO AND THREE POLE DOUBLE THROW

Coil Voltage	D.C. Resistance in Ohms @ 25°C	Contact Form	Open Type		
			Solder Terminals (Fig.1)		Printed Circuit (Fig. 2)
			10 Amp. Button Contacts	5 Amp. Cross-Bar Contacts	5 Amp. Cross-Bar Contacts
			Catalog Number	Catalog Number	Catalog Number
24 (50/60 Hz)	55	1PDT	93-904	93-934	*93-964
		2PDT	93-905	93-935	*93-965
		3PDT	93-906	93-936	*93-966
120 (50/60 Hz)	1400	1PDT	93-907	93-937	*93-967
		2PDT	93-908	93-938	*93-968
		3PDT	93-909	93-939	*93-969
208/240 (50/60 Hz)	4850	1PDT	93-910	93-940	—
		2PDT	93-911	93-941	—
		3PDT	93-912	93-942	—
12 D.C.	96	1PDT	93-916	93-946	*93-976
		2PDT	93-917	93-947	*93-977
		3PDT	93-918	93-948	*93-978
24 D.C.	384	1PDT	93-919	93-949	*93-979
		2PDT	93-920	93-950	*93-980
		3PDT	93-921	93-951	*93-981

The Type 93 relays are used in vending machines, heating, air conditioning, business machines, control panels, appliances, data processing equipment, office machines, communications systems and instruments.

The coil bobbin and contact terminal block are molded plastic and is resistant to arc tracking. The contact terminal allows - (a) easy insertion and removal of connectors, (b) stresses caused by wiring hook-up cannot change relay adjustment. The contact springs are molded as an integral assembly and gives excellent stability in all environmental conditions. The armature contact springs are connected to the terminals by flexible insulated leads welded to the terminals. Connections for the contacts and coil are located on the front of the relay.

Solder terminal type has combined front, single hole screw and stud mounting. Printed*circuit type may be controlled by SCR if firing angle is no more than 10 degrees.

The plug-in relay has high impact case and standard pin connections.

Quick connect type designed for front mounting or polarized socket mounting. Use 93-185-1 socket kit. Relay has .20 x .187 terminals. UL & CSA recognized under Component Recognition Program: Hardware included with relays in boxed units only.

Coil Voltage	D.C. Resistance in Ohms @ 25°C	Contact Form	Enclosed Type			
			Plug-In (Fig.3)		Quick Connect Terminals (Fig. 4)	
			10 Amp. Button Contacts Catalog Number	5 Amp. Cross-Bar Contacts Catalog Number	10 Amp. Button Contacts Catalog Number	5 Amp. Cross-Bar Contacts Catalog Number
24 (50/60 Hz)	55	1PDT	93P-904	93P-934	93Q-904	93Q-934
		2PDT	93P-905	93P-935	93Q-905	93Q-935
		3PDT	93P-906	93P-936	93Q-906	93Q-936
120 (50/60 Hz)	1400	1PDT	93P-907	93P-937	93Q-907	93Q-937
		2PDT	93P-908	93P-938	93Q-908	93Q-938
		3PDT	93P-909	93P-939	93Q-909	93Q-939
208/240 (50/60 Hz)	4850	1PDT	93P-910	93P-940	93Q-910	93Q-940
		2PDT	93P-911	93P-941	93Q-911	93Q-941
		3PDT	93P-912	93P-942	93Q-912	93Q-942
12 D.C.	96	1PDT	93P-916	93P-946	93Q-916	93Q-946
		2PDT	93P-917	93P-947	93Q-917	93Q-947
		3PDT	93P-918	93P-948	93Q-918	93Q-948
24 D.C.	384	1PDT	93P-919	93P-949	93Q-919	93Q-949
		2PDT	93P-920	93P-950	93Q-920	93Q-950
		3PDT	93P-921	93P-951	93Q-921	93Q-951

CONTACT RATINGS						
A.C. CURRENT					D.C. CURRENT	
A.C. Voltage	Fine Silver Button		Gold-Alloy Cross Bar		Button	Cross Bar
	Inductive	Resistive	Inductive	Resistive	@ 28 V.D.C.	@ 28 V.D.C.
120	⅙ H.P.	10 Amp.	1/10 H.P.	5 Amp.	5 Amp. Resistive	5 Amp. Resistive
240	⅓ H.P.	5 Amp.	⅙ H.P.	3 Amp.	Consult Factory on U.L. and C.S.A.	

ESSEX STANCOR

A.C. D.C. GENERAL PURPOSE RELAYS

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number Figure 1		Contact Rating 125/250 V.A.C.	
	1PNO	1PDT	Inductive	Resistive
6	84-901	84-905	N.O. 8 Amps. Continuous 25 Amps. Inrush D.T. 8 Amps. Continuous 18 Amps. Inrush	N.O. 16 Amps. Continuous D.T. 8 Amps. Continuous
24	84-902	84-906		
120	84-903	84-907		
230/240	84-904	84-908		
Coil Voltage A.C.	Catalog Number Figure 2			
	1PNO	1PDT		
24	84-912	84-916		
120	84-913	84-917		
230/240	84-914	84-918		
24	84-922	84-926	3 Amps. @ 125 V.A.C. or 1.5 Amps. @ 250 V.A.C. Pilot Duty	
120	84-923	84-927		
230/240	84-924	84-928		
Coil Voltage D.C.	Resistance in Ohms @ 25°C	Catalog Number Figure 1	D.C. Contact Rating Inductive	
			Voltage	Current
12	90	84D-902	12	3 Amp.
24	280	84D-903	24	1.5 Amp.

TYPE 84

Totally Enclosed

Low Cost

Screw or ¼" Quick Connect Termination Except 6 V.A.C.

Hardware Included in Boxed Units Only

Operates Any Position

Isolated Coil

I or T Mounting Brackets

A.C. Coils Rated 50/60 Hz

U.L. and C.S.A.

Size: 2⅜" x 1⅝" x 1½"

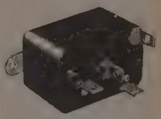


Figure 1

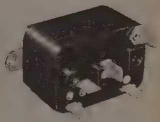


Figure 2

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number Figure 1		Contact Rating	
	1PNO	1PDT	Inductive	Resistive
6	184-901	184-905	12 Amps. Continuous 60 Amps. Inrush @ 125 V.A.C. 8 Amps. Continuous 48 Amps. Inrush @ 250 V.A.C. 7 Amps. Continuous 42 Amps. Inrush @ 277 V.A.C.	18 Amps. Continuous @ 277 V.A.C.
24	184-902	184-906		
120	184-903	184-907		
208/240	184-904	184-908		
Coil Voltage A.C.	Catalog Number Figure 2			
	1PNO	1PDT		
24	184-912	184-916		
120	184-913	184-917		
208/240	184-914	184-918		
24	184-922	184-926	3 Amps. @ 277 V.A.C. 125 VA @ 125 V.A.C. 277 VA @ 277 V.A.C.	
120	184-923	184-927		
208/240	184-924	184-928		

TYPE 184

Totally Enclosed

Low Cost

Screw or ¼" Quick Connect Termination

Hardware Included in Boxed Units Only

Operates Any Position

Isolated Coil

I Mounting Brackets

A.C. Coils Rated 50/60 Hz

U.L. and C.S.A.

Size: 2⅜" x 1⅝" x 1½"

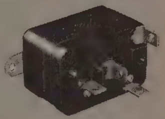


Figure 1

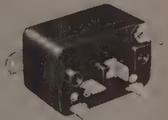


Figure 2

TWO POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number	Circuit Rating Terminals		Power Rating	
		1-2-3	4-5-6	Inductive	Resistive
24	91-901	Power	Power	12 Amp. Cont. 60 Amp. Inrush 125 V.A.C. 6 Amp. Cont. 35 Amp. Inrush 250 V.A.C.	15 Amp. 277 V.A.C. Max.
120	91-902				
230/240	91-903				
24	91-904	Power	Pilot		
120	91-905				
230/240	91-906			Pilot Rating	
				Inductive	Resistive
24	91-907	Pilot	Pilot	125 V.A. 1/10 H.P. 125/250 V.A.C.	3 Amp. 277 V.A.C. Max.
120	91-908				
230/240	91-909				
Coil Voltage D.C.	Catalog Number	Resistance in Ohms @ 25°C		D.C. Contact Rating - Resistive	
12	91D-912	29		10 Amps. @ 32 V. Max.	
24	91D-913	115			

TYPE 91

¼" Quick Connect Termination

U.L. and C.S.A.

Enclosed Contacts

Operates Any Position

Solenoid Action

Wiring Terminals Included in Boxed Units Only

A.C. Coils Rated 50/60 Hz

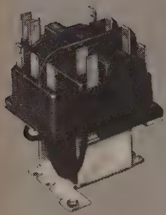
Can Be Panel Mounted

Separate 91-180-1 Socket and Terminal Kit

Size: 2⅛" x 1⅞" x 2⅜"

DESIGN DATA PAGE 1•1669

A.C. D.C. GENERAL PURPOSE RELAYS



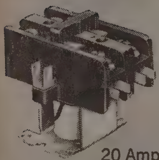
TYPE 92

¼″ Quick Connect Termination
U.L. and C.S.A.
Enclosed Contacts Operates Any Position
Solenoid Action
Wiring Terminals Included in Boxed Units Only
Manual Operating Button
A.C. Coils Rated 50/60 Hz
Size: 2⅜″ x 2⅜″ x 2¾″

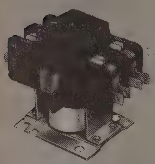
THREE POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number	Circuit Rating Terminals			Power Rating	
		1-2-3	4-5-6	7-8-9	Inductive	Resistive
24	92-901	Power	Power	Power	12 Amp. Cont. 60 Amp. Inrush 125 V.A.C. 6 Amp. Cont. 35 Amp. Inrush 250 V.A.C.	15 Amp. 277 V.A.C. Max.
120	92-902					
230/240	92-903					
24	92-904	Power	Pilot	Power	**Pilot Rating**	
120	92-905				**Inductive**	**Resistive**
230/240	92-906				120 V.A. $^{1}/_{10}$ H.P. 125/250 V.A.C.	3 Amp. 277 V.A.C. Max.
Coil Voltage D.C.	**Catalog Number**	**Resistance in Ohms @ 25°**			**D.C. Contact Rating - Resistive**	
12	92D-912	26			10 Amps. @ 32 V. Max.	
24	92D-913	104				

A.C. POWER CONTACTORS



20 Amp



25-30 Amp

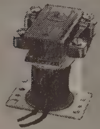
TYPE 143

Straight-Thru Wiring
Low Cost
¼″ Auxiliary Quick-Connect Terminals
U.L. and C.S.A.
Hardware Included in Boxed Units Only
Screw Power Terminals For #10 Solid Wire Max.
25 & 30 Amp Units Have Cover
Double-Make Contacts
Small Size
Size: 3¼″ x 2⅜″ x 2½″

TWO POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating	
		Inductive	Resistive
24	143-901	20 Amp. Cont. 100 Amp. Inrush @ 277 V.A.C. Per Pole	25 Amp. @ 277 V.A.C. 15 Amp. @ 480 V.A.C. 10 Amp. @ 600 V.A.C.
120	143-902		
208/240	143-903		
24	143-914	25 Amp. Cont. 150 Amp. Inrush @ 277 V.A.C. Per Pole With Cover	35 Amp. @ 277 V.A.C. 22 Amp. @ 480 V.A.C. 10 Amp. @ 600 V.A.C.
120	143-915		
208/240	143-916		
24	143-906	30 Amp. Cont. 150 Amp. Inrush @ 277 V.A.C. Per Pole With Cover	35 Amp. @ 600 V.A.C. Per Pole With Cover
120	143-907		
208/240	143-908		

Figure 1



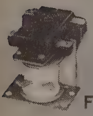


Figure 2

TYPE 75

Contact Cover
Screw Power Termination
#8 Solid Wire Max.
Low Wattage Coil
13″ Lead Wire or Quick Connect Coil Terminals
Hardware Included in Boxed Units Only
Size: 2½″ x 2⅛″ x 2¼″

TWO POLE NORMALLY OPEN

Coil Voltage (60 Hz)	Catalog Number Fig. 1	Catalog Number Fig. 2	Contact Rating (A.C.)	
			Inductive	Resistive
24	75-901	75-904	1 H.P. Per Pole 115/230 V.	25 Amp. 240 V. Per Pole .75 P.F.
115/120	75-902	75-905	2 Pole Rating 2 H.P. — 230 V. or 18 Amp. Cont. 90 Amp. Inrush	
230/240	75-903	75-906		

TYPE 85

Screw Terminals
#8 Solid Wire Max.
Double Make Contacts
¼″ Auxiliary Wiring Terminals
Straight-Thru Wiring
Hi-Dielectric Materials
Size: 3½″ x 3⅛″ x 2⅝″

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.) — Inductive	
		250 V.	600 V.
24	85-901	25 Amp. Cont. 150 Amp. Inrush	12.5 Amp. Cont. 75 Amp. Inrush
120	85-902		
208/240	85-903		

No kiss position. Mounts any position.

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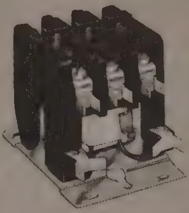
A.C. POWER CONTACTORS

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating Per Pole	
		Inductive	Resistive
24	154-901	Continuous 20 Amps. @ 600 V. Inrush 120 Amps. @ 277 V. 100 Amps. @ 480 V. 80 Amps. @ 600 V.	30 Amps @ 600 V. A.C. Max.
120	154-902		
208/240	154-903		

Screw Connectors line and load sides for #14 thru #8 wire. 1/4" Double Quick Connect auxiliary and coil terminals.



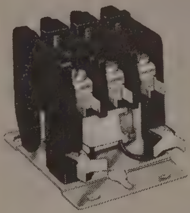
TYPE 154
20 AMPS

Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Size: 3 1/8" x 3 3/4" x 2 3/4"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating Per Pole	
		Inductive	Resistive
24	154-904	Continuous 25 Amps. @ 600 V. Inrush 150 Amps. @ 277 V. 125 Amps. @ 480 V. 100 Amps. @ 600 V.	35 Amps. @ 600 V. A.C. Max.
120	154-905		
208/240	154-906		

Screw Connectors line and load sides for #14 thru #8 wire. 1/4" Double Quick Connect auxiliary and coil terminals.



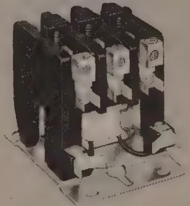
TYPE 154
25 AMPS

Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Hardware Included Boxed Units Only
Size: 3 1/8" x 3 3/4" x 2 3/4"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating Per Pole	
		Inductive	Resistive
24	154-907	Continuous 30 Amps. @ 600 V. Inrush 180 Amps. @ 277 V. 150 Amps. @ 480 V. 120 Amps. @ 600 V.	40 Amps. @ 600 V. A.C. Max.
120	154-908		
208/240	154-909		

Pressure Connectors on line side for #14 thru #4 wire. Screw Connectors on load side. 1/4" Double Quick Connect auxiliary and coil terminals.



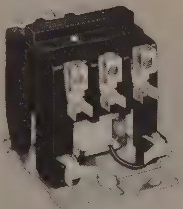
TYPE 154
30 AMPS

Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Hardware Included Boxed Units Only
Size: 3 1/8" x 3 3/4" x 2 3/4"

TWO AND THREE POLE NORMALLY OPEN

Coil Voltage (50/[illegible] Hz)	Catalog Number		Contact Rating Per Pole	
	2PNO	3PNO	Inductive	Resistive
24	154-913	154-910	Continuous 40 Amps. @ 600 V. Inrush 240 Amps. @ 277 V. 200 Amps. @ 480 V. 160 Amps. @ 600 V.	50 Amps. @ 600 V. A.C. Max.
120	154-914	154-911		
208/240	154-915	154-912		

Pressure Connectors on line and load side for #14 thru #4 wire. 1/4" Double Quick Connect auxiliary and coil terminals.



TYPE 154
40 AMPS

Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Hardware Included Boxed Units Only
Size: 3 1/4" x 3 3/4" x 2 3/4"

DESIGN DATA PAGE 1•1669

A.C. INDUSTRIAL CONTACTORS

ESSEX STANCOR

UNIQUE DESIGN PERMITS COMMON BASE, COIL & MAGNET FOR CONTACTOR RATINGS FROM 10 TO 50 AMPERES • DOUBLE BREAK "NO-KISS" CONTACT ACTION • REPLACEABLE CONTACTS & COIL • EPOXY SEALED MOLDED MAGNET COIL HOUSING • LAMINATED CORROSION RESISTANT E-TYPE MAGNET & SELF-ALIGNING ARMATURE • HI-DIELECTRIC ARC RESISTANT MOLDED CONTACT BLOCK & CARRIER • 50/60 CYCLE MAGNET COIL • RESILIENT MOUNTING

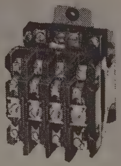
TYPE C10

10 Amp. 600 Volts

Pressure Type
Power Terminals
#10 Solid Wire Max.

All Contacts Convert to N.C. See Page 8

Size: 3⅝" x 2¾" x 3⅜"



FOUR POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.)		
			Horsepower	
		Voltage	Single Phase	Three Phase
110	C10-902	110	½	¾
		220	¾	1
		600	1	1
220	C10-903	Resistive		
		10 Amp. 600 V. Max. (Per Pole)		

SEE PAGE 8 FOR REPAIR PARTS

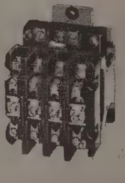
TYPE C15

15 Amp. 600 Volts

Pressure Type
Power Terminals
#10 Solid Wire Max.

All Contacts Convert to N.C. See Page 8

Size: 3⅝" x 2¾" x 3⅜"



FOUR POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.)		
			Horsepower	
		Voltage	Single Phase	Three Phase
110	C15-902	110	1	1½
		220	1½	2
		600	1½	2
220	C15-903	Resistive		
		15 Amp. 600 V. Max. (Per Pole)		

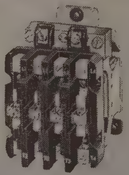
SEE PAGE 8 FOR REPAIR PARTS

TYPE C30

30 Amp .600 Volts

Pressure Type
Power Terminals
#8 Solid Wire Max.

Size: 3⅝" x 2¾" x 3⅜"



FOUR POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.)		
			Horsepower	
		Voltage	Single Phase	Three Phase
110	C30-902	110	2	3
		220	3	7½
		600	5	10
220	C30-903	Resistive		
		30 Amp. 600 V. Max. (Per Pole)		

SEE PAGE 8 FOR REPAIR PARTS

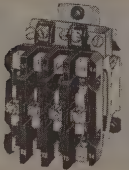
TYPE C50R

50 Amp. 480 Volts

Pressure Type
Power Terminals
#6 Stranded Wire Max.

Double Break

Size: 3⅝" x 2¾" x 3⅜"



FOUR POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.)
110	C50R-902	Resistive Only For Electric Heating 50 Amp. — 480 Volt Max.
220	C50R-903	

SEE PAGE 8 FOR REPAIR PARTS

A.C. REVERSING CONTACTORS

TYPE CR15

15 Amp. 600 Volt

Pressure Type
Power Terminals
#10 Solid Wire Max.

All Contacts Convert to N.C. See Page 8

Double Break Contacts

Size: 3⅝" x 5⁵⁄₁₆" x 3⅜"

FOUR POLE NORMALLY OPEN REVERSING

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.)		
			Horsepower	
		Voltage	Single Phase	Three Phase
110	CR15-901	110	1	1½
220	CR15-902	220	1½	2

SEE PAGE 8 FOR REPAIR PARTS

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8 ESSEX STANCOR

TYPE C REPLACEMENT PARTS

MAGNETIC COILS — FIGURE 4

Voltage (50/60 Hz)	Standard†		Special†	
	Catalog No.	Replaces	Catalog No.	Replaces
24	MC-901	45225-5	MC-911	45225-35
110	MC-902	45225-1	MC-912	45225-31
220	MC-903	45225-2	MC-913	45225-32
440	MC-904	45225-3	MC-914	45225-33
550	MC-905	45225-4	MC-915	45225-34

† Do not substitute standard for special coils or vice versa.

CONTACT ASSEMBLIES — FIGURE 1

Used on Type	Catalog No.	Contact Rating	Replaces
C10, C15, CR15	CA-901	15 Amp. - 4 Pole	45997-3 45997-4
C50R	CA-903	50 Amp. - 4 Pole Resistive	45997-22
109153 109453 C30, CR30	CA-904	30 Amp. - 4 Pole 50 Amp. - 2 Pole 30 Amp. - 4 Pole	45997-16 45997-20 45997-5

ARMATURE AND MAGNET FIGURE 3

Catalog No.
RP-901

CONTACT BLOCK AND CARRIER FIGURE 2

4 Pole Catalog No.	5 Pole Catalog No.
RP-902	RP-903

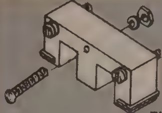


FIGURE 3

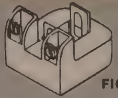


FIGURE 4

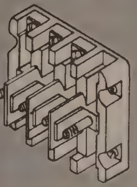


FIGURE 2

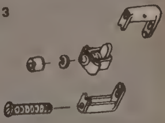


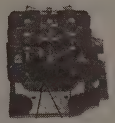
FIGURE 1 *

* 4 Movable — 8 Stationary per kit. reversing contactors require two kits.

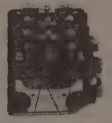
CONVERSIONS INSTRUCTIONS

All 10 and 15 ampere contact assemblies on standard type C contactors are normally open. To convert to normally closed, use screwdriver. No special parts needed.

1. Remove movable contact assembly and lock washer by backing off terminal nut "A".
2. Loosen screws "B" and remove stationary contact assemblies.
3. Invert movable contact assembly, and replace on contactor with flat "I" spring resting on contact block. Contacts facing out.
4. Remove screws "B" from, and reinsert into opposite end of, stationary contact assembly. Re-install stationary contact assemblies; holding contacts in alignment with movable contacts while tightening screws.



Normally Open



Normally Closed

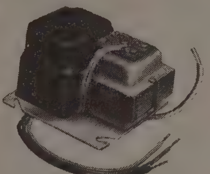
FAN RELAY AND TRANSFORMER PKG.

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

White card listing — U.L. File E33034 fits standard 4-inch junction box. Transformer rated 40 V.A., 120 V.A.C. primary, 24 V.A.C. secondary. 7 inch lead wires.

Catalog Number	Pole Form	Contact Rating — 250 V.A.C. Max.	
		Inductive	Resistive
175-901	SPNO	1 H.P. - 125 V. 1½ H.P. - 250 V.	18 Amps. Continuous
175-902	SPDT		
175-903	SPNO	¾ H.P. at 125/250 V.A.C. Max.	15 Amps at 277 V.A.C. Max.
175-904	SPDT		

Consult Factory. Resistive loads and U.L. Circuit diagram stamped on unit.



TYPE 175

True Form C
Class 2
Energy Limiting
Transformer
Suitable for
Remote Mounting
No Additional
Enclosure Required
Wires Pre-stripped
Low Cost
Easy to Install
Size: 4½" x 4⅛" x 2½"

A.C. POWER RELAYS

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage (50/60 Hz)	Catalog Number				Contact Rating 250 V.A.C. Max.	
	Figure 1		Figure 2			
	1PNO	1PDT†	1PNO	1PDT†	Inductive	Resistive
6	129-901	129-905			18 Amp. Continuous 1 H.P. - 125 V. 2 H.P. - 250 V. Single Phase	25 Amp. Continuous
24	129-902	129-906	129-911	129-914		
120	129-903	129-907	129-912	129-915		
208/230	129-904	129-908	129-913	129-916		

† All contact terminals must be wired same polarity.

FIGURE 1

FIGURE 2

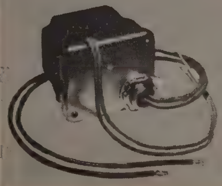
TYPE 129

Double-Break Contacts
Totally Enclosed
Hi-Impact Case
Screw or ¼" Quick
Connect Termination
Hardware Included
U.L. and C.S.A.
Non-Positional
Size: 2⅜" x 1⅞" x 1⅞"

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage (50/60 Hz)	Catalog Number		Contact Rating — 250 V.A.C. Max.	
	IPNO	1PDT†	Inductive	Resistive
24	129AR-901	129AR-904	18 Amp. Continuous 1 H.P. - 120 V. 1½ H.P. - 250 V. Single Phase	25 Amp. Continuous
120	129AR-902	129AR-905		
208/230	129AR-903	129AR-906		

FIT ANY ½" KNOCK-OUT. MEETS STANDARD CODE REQUIREMENTS.
Underwriters Lab. white card listed. File E121139D 184N13.13 7/17/63.
Aluminum die-cast base and bushing. High impact phenolic enclosure.
Locknuts and position locking washer included. Color coded 8" lead wires.
† All contact terminals must be wired same polarity.



TYPE 129AR

Totally Enclosed
Hi-Impact Case
Double-Break Contacts
Easy to Mount
U.L. and C.S.A.
Pre-Wired
No Enclosure Required
Low Cost
Size: 2¾" x 2 $^{9}/_{16}$" x 3 $^{1}/_{16}$"

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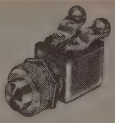
D.C. SWITCH

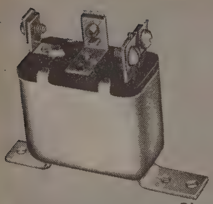
PART NO. 5385-1



LOW VOLTAGE DC PUSHBUTTON

- ⅝″ Bushing Mount
- Screw Connection
- Rating 15 Amps. at 12 VDC
- Life - 25,000 Cycles.

D.C. POWER RELAYS



TYPE 60

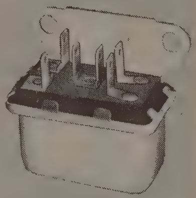
Metal Case
Totally Enclosed
Isolated Coil
Screw Terminals
Screws Included
Low Cost
Size: 2⅞″ x 1⅛″ x 2⅝″

SINGLE POLE NORMALLY OPEN

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Rating D.C. Inductive Voltage	Contact Rating D.C. Inductive Current
6	11	60-901	6	15 Amp.
12	35	60-902	12	15 Amp.
24	160	60-903	24	7.5 Amp.

TYPE 150

Metal Case
Totally Enclosed
Isolated Coil
Side Bracket
¼″ Quick-Connect Termination
Hardware Included in Boxed Units Only
Low Cost
Size: 2¼″ x 1½″ x 2″



SINGLE POLE NORMALLY OPEN

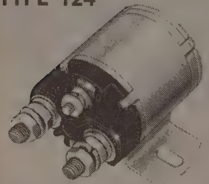
D.C. Coil Voltage	Resistance in Ohms	Catalog Number	Contact Rating Voltage	Contact Rating Current
6	18	150-901	6	25 Amp.
12	44	150-902	12	25 Amp.
24	176	150-903	24	12 Amp.

SINGLE POLE DOUBLE THROW

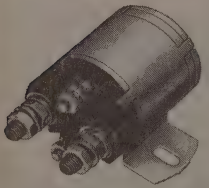
D.C. Coil Voltage	Resistance in Ohms	Catalog Number	Contact Rating Voltage	Contact Rating Current
6	18	150-904	6	15 Amp.
12	44	150-905	12	15 Amp.
24	176	150-906	24	7.5 Amp.

HEAVY DUTY D.C. POWER CONTACTOR

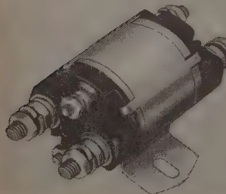
TYPE 124



4 Terminal
Size: 3⁹⁄₁₆″ x 2³⁄₁₆ x 1¹⁵⁄₁₆



3 Terminal
Size: 3⁹⁄₁₆″ x 2³⁄₁₆ x 1¹⁵⁄₁₆



6 Terminal
Size: 4¾″ x 2³⁄₁₆ x 1¹⁵⁄₁₆

Coil Voltage D.C.	Coil Resistance +8% 25°	SPNO 4 Terminal Isolated Coil
6 V	3.3	124-901
12 V	13.2	124-902
24 V	53	124-903
36 V	120	124-904

Voltage DC	Contact Rating D.C. Inductive Load Continuous	Contact Rating D.C. Inductive Load Inrush
6	100 Amps.	400 Amps.
12	100 Amps.	400 Amps.
24	100 Amps.	400 Amps.
36	100 Amps.	400 Amps.

Coil Voltage D.C.	Coil Resistance +8% 25°	SPNO 3 Terminal Isolated Coil
6 V	3.3	124-905
12 V	13.2	124-906
24 V	53	124-907
36 V	120	124-908

Coil Voltage D.C.	Coil Resistance +8% 25°	SPDT 6 Terminal Isolated Coil
6 V	3.3	124-909
12 V	13.2	124-910
24 V	53	124-911
36 V	120	124-912

- Max. Pick-Up 70% rated coil voltage.
- Design Ambient −40°C to +65°C
- Maximum Continuous coil watts: 12 @ rated voltage.
- Recommended Mounting Position: Unit in vertical plane with coil terminals up. Horizontal plane is acceptable.
- Design meets U.L. 583 Industrial Truck Standard. Dust and splash proof cover.
- Application: Controlling D.C. starting motors on gasoline engine driven auxiliaries. Battery charging power circuits, motor reversing circuits as found in winch applications.
- The 124 is also applicable where ruggedness and high current capacity is required for D.C. mobile equipment; such as: in-plant lifts, industrial equipment, recreational vehicles - golf carts, camp trailers, motor homes.

NEW 124 HEAVY DUTY D.C. CONTACTOR

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D.C. POWER CONTACTORS

CONTACT RATING

D.C. INDUCTIVE LOAD — 36 V. MAX.

Voltage (D.C.)	Normally Open		Normally Closed	
	Continuous	Inrush	Continuous	Inrush
6	80 Amp.	300 Amp.	60 Amp.	100 Amp.
12	80 Amp.	150 Amp.	60 Amp.	60 Amp.
24-36	50 Amp.	50 Amp.	30 Amp.	30 Amp.

NON-TURNING STUDS
DRAWN STEEL DUST PROOF ENCLOSURE
COPPER STUD POWER & COIL TERMINALS
DOUBLE BREAK ROTATING DISC MOVABLE CONTACT
SOLENOID ACTUATED
SUGGESTED MOUNTING — CAP DOWN

SINGLE POLE NORMALLY OPEN
4 TERMINAL

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Material
6	4	70-901	Copper
12	16	70-902	
24	60	70-903	
36	114	70-904	
6	4	70-905	Silver
12	16	70-906	
24	60	70-907	
36	114	70-908	

SINGLE POLE NORMALLY OPEN
3 TERMINAL

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Material
6	4	70-913	Copper Coil Grounded to Case
12	16	70-914	
24	60	70-915	
36	114	70-916	
6	4	70-917	Copper Coil Common to Load
12	16	70-918	
24	60	70-919	
36	114	70-920	

SINGLE POLE DOUBLE THROW
6 TERMINAL

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Material
6	4	70-909	N.O. and N.C. Silver
12	16	70-910	
24	60	70-911	
36	114	70-912	
6	4	70-921	N.O. Copper and N.C. Silver
12	16	70-922	
24	60	70-923	
36	114	70-924	

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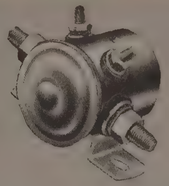


TYPE 70
4 TERMINAL

Isolated Coil

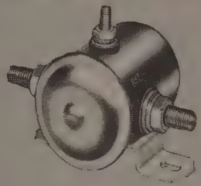
Silver or Copper Contacts

Hardware Included

Continuous Duty Coil

Ease In Wiring

Size: 2½″ x 3½″ x 2½″



TYPE 70
3 TERMINAL

Continuous Duty Coil

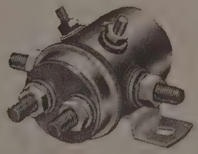
Copper Contacts

Hardware Included

Coil Common to Case or Coil Common to Battery

Rugged Construction

Size: 2½″ x 3½″ x 2½″



TYPE 70
6 TERMINAL

Continuous Duty Coil

Isolated Coil

Hardware Included

Choice of 2 Types Contacts

Size: 3⅜″ x 3³⁄₁₆″ x 2½″

MINIATURE D.C. SENSITIVE RELAYS

ESSEX STANCOR

TYPE MS64 2 AMPS

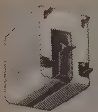


Figure 1

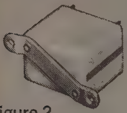


Figure 2

Printed Circuit Terminals or Bracket Mounting
Long Life
Isolated Contacts
Low Cost
Snap-on Cover
Gold Alloy Contacts
Molded Construction
Size: 1³⁄₁₆" x ¾" x 1⅛"

SINGLE POLE DOUBLE THROW — ENCLOSED TYPE

Contact Rating	Coil Power	
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.	Minimum Required	0.050 Watts
	Maximum Capacity	1.0 Watts

D.C. Magnet Coil At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage or Current*	Resistance in Ohms†	Catalog Number Fig. 1	Catalog Number Fig. 2
6 V.	4.5 V.	400	MS64-901	MS64-911
12 V.	9.0 V.	1600	MS64-902	MS64-912
24 V.	18.0 V.	6500	MS64-903	MS64-913
3 MA.	2.3 MA.	10000	MS64-904	MS64-914

* D.O. Approx. 35% of PU. † Nominal ±10%.

TYPE MS64 5 AMPS

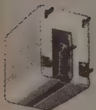


Figure 1

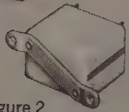


Figure 2

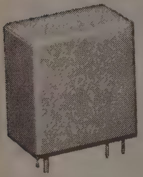
Printed Circuit Terminals or Bracket Mounting
Long Life
Isolated Contacts
Low Cost
Snap-on Cover
Silver Alloy Contacts
Molded Construction
Size: 1³⁄₁₆" x ¾" x 1⅛"

SINGLE POLE DOUBLE THROW — ENCLOSED TYPE

Contact Rating	Coil Power	
5 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.	Minimum Required	0.060 Watts
	Maximum Capacity	1.0 Watts

D.C. Magnet Coil At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage*	Resistance in Ohms†	Catalog Number Fig. 1	Catalog Number Fig. 2
6 V.	4.5 V.	350	MS64-930	MS64-933
12 V.	9.0 V.	1300	MS64-931	MS64-934
24 V.	18.0 V.	5000	MS64-932	MS64-935

* D.O. Approx. 35% of PU. † Nominal ±10%.



TYPE 164

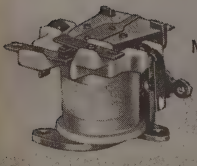
2 Amp and 5 Amp
Printed Circuit Terminals
Molded Construction
Isolated Contacts
Snap-on Cover
Long Life
Low Cost
Size: 1¼" x ¾" x 1³⁄₁₆"

TWO POLE DOUBLE THROW — ENCLOSED TYPE

D.C. Magnet Coil At 25°C			Contact Rating	
Voltage Nominal	Max. Pick-up Voltage	Resistance in Ohms ±10%	2 Amp. Non-Inductive 28 V.D.C.—115 V.A.C.	5 Amp. Non-Inductive 28 V.D.C.—115 V.A.C.
6 V.	4.5 V.	130	MS164-901	MS164-921
12 V.	9.0 V.	500	MS164-902	MS164-922
18 V.	13.5 V.	1300	MS164-903	MS164-923
24 V.	18.0 V.	2200	MS164-904	MS164-924

Min. Operate Power: 50 Milliwatts
Max. Operate Power: 1 Watt
Mechanical Life: 25,000,000
Contacts: 2 Amp. — Gold Alloy Crossbar
5 Amp. — Silver Alloy Button

TYPE MS40



Solder Terminals
Very Sensitive
Molded Construction
4-40 Mounting
Armature Common to Frame
Long Life
Low Cost
Gold Alloy Contacts
Size: 1⅛" x 1⅛" x ¹⁵⁄₁₆"

SINGLE POLE DOUBLE THROW — OPEN TYPE

Contact Rating	Coil Power	
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.	Minimum Required	0.050 Watts
	Maximum Capacity	1.0 Watts

D.C. Magnet Coil At 25°C			
Nominal Voltage or Current	Max. Pick-up Voltage or Current	Resistance in Ohms ±10%	Catalog Number
6 V.	3.5 V.	250	MS40-901
13.5 MA.	10 MA.	500	MS40-902
11.0 MA.	8.2 MA.	750	MS40-903
12 V.	7.0 V.	1000	MS40-904
7.7 MA.	5.8 MA.	1500	MS40-905
6.0 MA.	4.5 MA.	2500	MS40-906
4.3 MA.	3.2 MA.	5000	MS40-907
24 V.	19.5 V.	7500	MS40-908
3 MA.	2.3 MA.	10000	MS40-909

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ESSEX STANCOR

MINIATURE D.C. SENSITIVE RELAYS

SINGLE POLE DOUBLE THROW — OPEN TYPE & PLUG IN

Contact Rating		Coil Power		Contacts
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.		Minimum Required Maximum Capacity	0.040 Watts 1.5 Watts	Gold Alloy Cross Bar
D.C. Magnet Coil At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage or Current*	Resistance in Ohms†	Catalog Number Figure 1	Catalog Number Figure 2
6 V.	4.5 V.	510	MS25-901	MS25P-901
12 V.	9.0 V.	2025	MS25-902	MS25P-902
24 V.	18.0 V.	8100	MS25-903	MS25P-903
3.7 MA.	2.8 MA	5000	MS25-904	MS25P-904
2.7 MA.	2.0 MA.	10000	MS25-905	MS25P-905
2.1 MA.	1.6 MA	15000	MS25-906	MS25P-906

* D.O. Approx. 35% of PU. † Nominal ±10%.

TWO POLE DOUBLE THROW — OPEN TYPE & PLUG IN

Contact Rating		Coil Power		Contacts
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.		Minimum Required Maximum Capacity	0.125 Watts 1.5 Watts	Gold Alloy Cross Bar
D.C. Magnet Coil At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage or Current*	Resistance in Ohms†	Catalog Number Figure 3	Catalog Number Figure 4
6 V.	4.5 V.	160	MS50-901	MS50P-901
12 V.	9.0 V.	650	MS50-902	MS50P-902
24 V.	18.0 V.	2600	MS50-903	MS50P-903
6.7 MA.	5.0 MA.	5000	MS50-904	MS50P-904
4.7 MA.	3.5 MA.	10000	MS50-905	MS50P-905
3.9 MA.	2.9 MA.	15000	MS50-906	MS50P-906

* D.O. Approx. 35% of PU. † Nominal ±10%.

THREE POLE DOUBLE THROW — OPEN TYPE & PLUG IN

Contact Rating		Coil Power		Contacts
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.		Minimum Required Maximum Capacity	0.200 Watts 1.5 Watts	Gold Alloy Cross Bar
D.C. Magnet Coil At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage or Current*	Resistance in Ohms†	Catalog Number Figure 3	Catalog Number Figure 4
6 V.	4.5 V.	100	MS50-921	MS50P-921
12 V.	9.0 V.	400	MS50-922	MS50P-922
24 V.	18.0 V.	1600	MS50-923	MS50P-923
8.5 MA.	6.4 MA	5000	MS50-924	MS50P-924
6.0 MA.	4.5 MA.	10000	MS50-925	MS50P-925
4.9 MA.	3.7 MA.	15000	MS50-926	MS50P-926

* D.O. Approx. 35% of PU. † Nominal ±10%.

TYPE MS25

Open Type
Solder Terminals
Isolated Contacts
Long Life
Low Cost
Size: 1 9/16″ x 1½″ x 1 7/16″

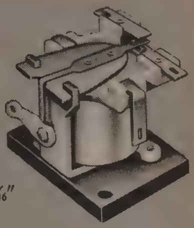


FIGURE 1

TYPE MS25P

Plug In —
Standard 8 Pin Octal
Isolated Contacts
Long Life
Low Cost
Plug In — Zytel
101 Nylon Case
Molded Construction
Size: 2″ x 1⅜″ x 1⅜″

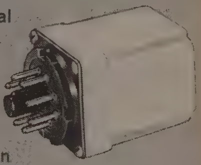


FIGURE 2

TYPE MS50

Open Type
Solder Terminals
Isolated Contacts
Long Life
Low Cost
Size: 1⅝″ x 1⅛″ x 1¼″

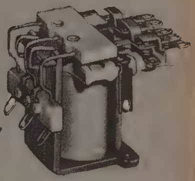


FIGURE 3

TYPE MS50P

Plug In —
Standard 11 Pin Octal
Isolated Contacts
Long Life
Low Cost
Plug In — Zytel
101 Nylon Case
Molded Construction
Size: 2″ x 1⅜″ x 1⅜″

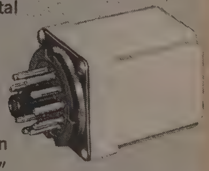


FIGURE 4

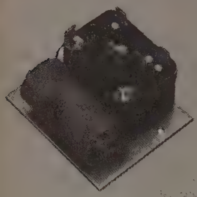
SINGLE POLE DOUBLE THROW — TWO POLE DOUBLE THROW — THREE POLE DOUBLE THROW

Electrical Life				Mechanical Life	Operate Time (Incl. Bounce)	Vibration	Shock	Operating Ambient
NON-INDUCTIVE LOAD	0.5 Amp.	1.0 Amp.	2.0 Amp.	50,000,000 At 180 Operations Per Minute (No Load)	20 Milliseconds	2G 10-55 Cycles	2G Operate 10G Non-Operate	−55°C to +85°C
NUMBER OPERATIONS	1,000,000	300,000	100,000					

DESIGN DATA PAGE 1•1669

A.C. TIME DELAY RELAYS

ESSEX STANCOR **13**

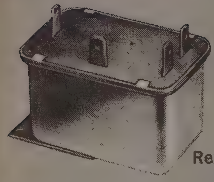


TYPE 84T

Fixed Timing
¼″ Quick-Connect Termination
Wiring Terminals Included in Boxed Units Only
Totally Enclosed
Approx. Reset Time 4 Seconds
Size: 2⅝″ x 2¼″ x 1½″

RECTIFIER/CAPACITOR TYPE SINGLE POLE DOUBLE THROW

Coil (50/60 Hz)	Contact Action: Delay After Coil Energized	Contact Action: Delay After Coil De-Energized	Catalog Number	Time Delay in Seconds ±25%	Contact Rating (A.C.) Inductive
115/120	X		84TE-902	2	3 Amp. 125 V. 1.5 Amp. 250 V. Continuous
230/240	X		84TE-903	2	
115/120		X	84TD-902	2	
230/240		X	84TD-903	2	



TYPE 187

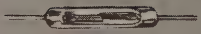
Metal Case
Totally Enclosed
Flat Bracket
¼″ Quick-Connect Termination
Repeat ±2% @ 25°C and Nom. Voltage
Size: 3″ x 1¾″ x 2¼″

SOLID STATE — FIELD ADJUSTABLE TYPE SINGLE POLE NORMALLY OPEN

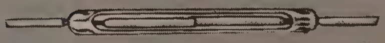
Coil Voltage (50/60 Hz)	Time Delay on Pick-up	Catalog Number	Contact Rating Inductive
24 V.	.5 - 90 seconds	187-901	1 Amp. @ 120 V.A.C.
120 V.	.5 - 90 seconds	187-902	

Hidden trimming resistor for tamper-proof field timing adjustment. Reset time 100 M.S. Can use Types 93, 84, 91, 92, 129, 143 or 75 as slave relay. Hardware included in boxed units only.

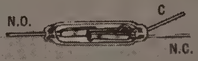
GLASS REED SWITCHES AND RELAYS



BRM-902 MINIATURE BI-REED®



BRS-901 STANDARD BI-REED®



TRM-901 MINIATURE TRI-REED®

Contact Form		Single Pole Normally Open						Single Pole Double Throw		
Miniature or Standard		Miniature			Standard			Miniature		
Catalog Number		BRM-902			BRS-901			TRM-901		
Non-Inductive Contact Rating	Make and Break	15 VA. A.C. — 10 Watts D.C. .5 Amp. Maximum 250 Volts Max.			15 VA. A.C. — 15 Watts D.C. 1.0 Amp. Maximum 250 Volts Max.			10 VA. A.C. — 5 Watts D.C. ¼ Amp. Maximum up to 125 V.A.C. or 32 V.D.C.		
	No Make or Break	1.0 Amp. 250 V.			5 Amp. 250 V.			1 Amp. 125 V.A.C. or 32 V.D.C.		
Contact Life Based on 10 Ohm Miss Test	Resistive Load D.C.	10 Micro-Amp @ 10 Milli-Volts		⅛ Amp. @ 32 Volts	10 Micro-Amp @ 10 Milli-Volts		⅛ Amp. @ 32 Volts	10 Micro-Amp @ 10 Milli-Volts		⅛ Amp. @ 32 Volts
	Number Operations	100,000,000		10,000,000	200,000,000		125,000,000	100,000,000		1,000,000
Approximate Overall Dimensions		Over Leads	Glass Length	Glass Diameter	Over Leads	Glass Length	Glass Diameter	Over Leads	Glass Length	Glass Diameter
		1.5″	0.77″	0.100″	3.20″	2.1″	0.200″	1.36″	0.60″	0.125″
Minimum Breakdown Voltage (60 Hz R.M.S.)		250 V.			500 V.			200 V.		
Minimum Insulation Resistance (Megohms)		500,000			500,000			100,000		
Initial Contact Resistance (Milliohms Max.)		100			100			150		
Maximum Operate Time (Milliseconds)		Pull-In (Including Bounce)		Release	Pull-In (Including Bounce)		Release	Pull-In (Including Bounce)		Release
		1.0		0.5	2.0		0.5	1.0		0.5
Ampere-Turns To Operate		Pull-In		Nominal Drop Out	Pull-In		Nominal Drop Out	Pull-In		Nominal Drop Out
		Nominal	Minimum		Nominal	Minimum		Nominal	Minimum	
		40 ±15	20	50% of P.U.	80 ±15	60	45% of P.U.	50 ±15	35	70% of P.U.
Vibration		15G — 2000 C.P.S.			20G — 750 C.P.S.			15G — 2000 C.P.S.		
Shock (JAN S-44)		50G (Min.)			40G (Min.)			50G (Min.)		
Ambient Temperature Range		−55° to +85°C			−55° to +85°C			−55° to +85°C		
	Wire Size	#44			#36			#44		
	Number Turns	10,000			10,000			10,000		
	Tube I.D.	0.150″			0.210″			0.150″		
	Tube O.D.	0.183″			0.375″			0.200″		
	Tube Length	0.75″			1.75″			0.75″		

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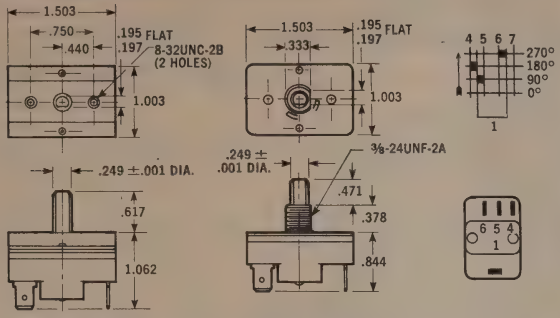
GENERAL PURPOSE SWITCHES

ROTARY SWITCH

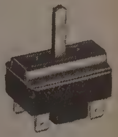

1.503
.750
.440
.195 FLAT
.197
8-32UNC-2B
(2 HOLES)
1.003
.249 ±.001 DIA.
.617
1.062
1.503
.333
.195 FLAT
.197
1.003
.249 ±
.001 DIA.
3/8-24UNF-2A
.471
.378
.844
4 5 6 7
270°
180°
90°
0°
1
6 5 4
1

635-2 SCREW MOUNT

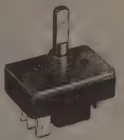
635-1 BUSHING MOUNT

TYPE 635

Single "D" ¼" Shaft
¼" Quick Connects
Bushing or Screw Mounting
4 Position with 90° Detents
Life 25000 Cycles at:
25 Amps 125/250 Volts or
½ HP 125/250 Volts



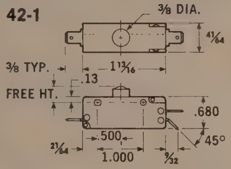
635-1



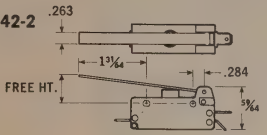
635-2

SNAP SWITCHES

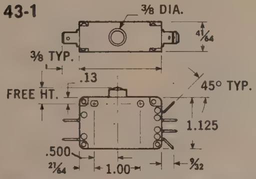
42-1


3/8 DIA.
41/64
3/8 TYP.
1 13/16
.13
FREE HT.
.680
.500
45°
21/64
1.000
3/32

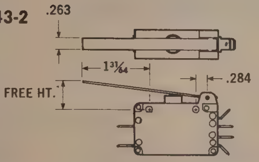
42-2


.263
1 31/64
.284
FREE HT.
59/64

43-1

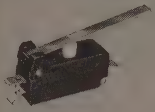

3/8 DIA.
41/64
3/8 TYP.
.13
FREE HT.
45° TYP.
1.125
.500
21/64
1.00
3/32

43-2

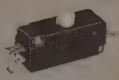

.263
1 31/64
.284
FREE HT.

Part No.	Type of Switch	Max. Pre-Travel	Min. Over-Travel	Max. Diff.	Max. Operating Force (oz.)	Lever Arm	Min. Cycles Thousands
42-1	SPDT	.080	.100	.030	20	No	50
42-2	SPDT	.080	.100	.030	20	Yes	50
43-1	DPDT	.125	.090	.060	40	No	100
43-2	DPDT	.125	.090	.060	40	Yes	100

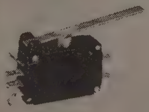
TYPE 42 & 43



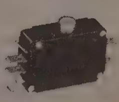
42-1



42-2



43-1

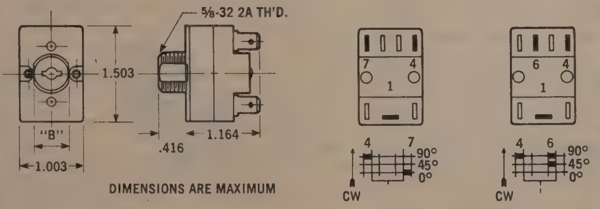


43-2

Type 42 - SPDT
Type 43 - 2PDT
¼" Quick
Connects

Ratings:
25 Amps 125/250 VAC
1 HP 125 VAC
1½ HP 250 VAC

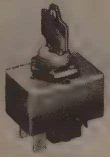
KEY SWITCHES


5/8-32 2A TH'D.
1.503
"B"
1.003
1.164
.416
7 4
1
4 7
90°
45°
0°
CW
6 4
1
4 6
90°
45°
0°
CW

DIMENSIONS ARE MAXIMUM

Part No.	Description
639-1	Off-On Momentary
639-2	On-Off Momentary

TYPE 639



⅝" x 32 Double "D" Bushing
¼" Quick Connect
Metal Key
45° Detents
Ratings at 25,000 Cycles:
25 Amps 125/250 VAC
½ HP 125 VAC

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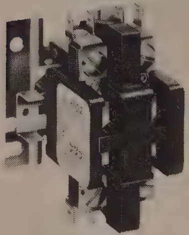
ELMWOOD SENSORS

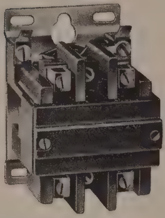
DEFINITE PURPOSE CONTACTORS

20-25-30-40 Ampere — 600 Volts — Full Load

20-30-35-40-50 Ampere — 600 Volts — Resistive Per Pole



25 Amp. Res.
20 Amp. F.L.
2 Pole
AO Series



50 Amp. Res.
40 Amp F.L.
2 Pole
FO Series

- Interchangeable Mounting
- Small Size
- Low Coil Inrush VA
- Straight-Through Wiring

CONSTRUCTION DESIGN

Base, hood, and carrier are of molded melamine-phenolic, which provides superior arc suppression. Contacts are of a silver-cadmium oxide and are field replaceable.

Holding coils insure clean pickup at 80% of lower voltage, and satisfactory performance at 110% of higher voltage. A variety of modifications is available.

Specify coil voltage and frequency.

All contactors are for two-wire control.

Auxiliary pole has screw terminals on power pole contact set.

U.L. File E 42105

C.S.A. File 21048

DO, EO and FO Series also available with S.P.D.T. side-mounted auxiliary switch, rated 10 Amps, 250 Volts max. 3-lead D.C. coils and dual-voltage A.C. coils are available.

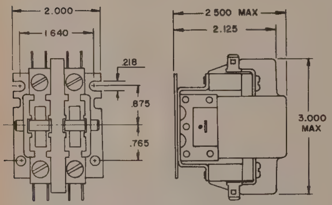
RATINGS AND CATALOG INFORMATION

RESISTIVE per pole Amps 600V	INDUCTIVE Full Load Amps Per Pole			LOCKED ROTOR AMPS			Poles		Cat. No. Open Type	Cat. No. Enclosed Type
				Per Pole	1φ 2 Pole — 3φ 3 Pole					
	240V	480V	600V	240V	480V	600V	Main	Aux.		
25	20	10	10	100	50	50	2	—	30AO-20	30AE-20
30	20	17	14	120	100	80	2	—	30BO-20	30BE-20
35	25	21	17	150	125	100	2	—	30CO-20	30CE-20
35	30	21	17	150	125	100	2	—	30CDO-20	30CDE-20
35	25	25	25	150	125	100	2 3	— —	30DO-20 30DO-30	30DE-20 30DE-30
40	30	30	30	180	150	120	2 3	— —	30EO-20 30EO-30	30EE-20 30EE-30
50	40	40	40	240	200	160	2 2 3	— 1 —	30FO-20 30FO-21 30FO-30	30FE-20 30FE-21 30FE-30

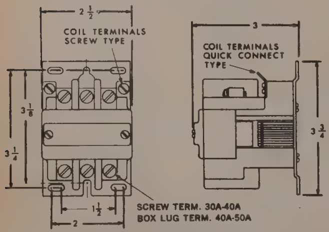
COIL DATA

Cat. Series	Coil Volts	60 Cycle				50 Cycle			
		Inrush (max)		Sealed (max)		Inrush (max)		Sealed (max)	
		V.A.	Watts	V.A.	Watts	V.A.	Watts	V.A.	Watts
AO, BO, CO and CDO	24	30	15	7.5	3	35	20	8	3.5
	110-120	35	20	8	4	40	25	8.5	4.5
	208-240	35	20	8	4	40	25	8.5	4.5
	277	35	20	8	4	40	25	8.5	4.5
DO, EO and FO	24	50	25	5	1.5	55	35	6.5	2.75
	110-120	55	30	5.5	1.75	60	40	7	3.25
	208-240	55	30	5.5	1.75	60	40	7	3.25
	277	55	30	5.5	1.75	60	40	7	3.25
	440-480	55	30	5.5	1.75	60	40	7	3.25
	550-600	55	30	5.5	1.75	60	40	7	3.25

Pick-up volts — 80% or less of lower voltage rating. Other standard voltages and frequencies available

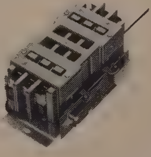


SERIES AO, BO, CO and CDO



SERIES EO and FO
Series DO less arc hood

NEW REVERSING CONTACTOR



Ideal for doors, hoists, valves, elevators . . . wherever reversing operation is needed. Elmwood's 2 or 3 pole 20 amp Reversing Contactor, with mechanical interlock, and optional electrical interlock, to prevent simultaneous closure of both contactors. One hp single-phase or 2 hp three-phase models, for 120, 240 or 440-550 volt operation. U.L. and C.S.A. listed. Only 2.9″ x 5.9″ x 3.3″

For contactors or motor starters with higher ratings or special features not included above, please contact factory.

NOTATIONS: Electrical ratings, life cycles and performance characteristics have been established after testing and review of standard operating conditions. The specifications outlined in this bulletin suggest the performance characteristics when the units are subject to these standard conditions. To assure that our laboratory test conditions duplicate the performance requirements for the application, all contactors should be tested for each application. For specials which are not specified or standard, please consult the factory. Warranty is limited as provided in Elmwood Sensors Inc. standard terms of sale.

ELMWOOD SENSORS INC.
1653 ELMWOOD AVENUE, CRANSTON, RHODE ISLAND 02907, U. S. A.
PHONE (401) 781-6500 ● TWX (710) 381-6413

Printact data

SPECIFICATIONS AT 25°C

Coil Power: 0.5 watt "G" Series
1.0 watt "LD" Series
Contact Rating: Gold Contacts — Low level
Palladium Contacts 2A-24vd-c
Cont. Res: .050 ohm initial
Insulation: 1000 megohms
Dielectric: 1000 Vrms
Mech. Life: 100 x 10^6 cycles
Temperature: 30°C to +50°C
Thermal EMF: 2 microvolts
Cross Talk: 70-45 Db

CATALOG NUMBERS

Volts	2 Blades	3 Blades	4 Blades
Standard Non-Latching — Gold Contacts			
6vd-c	6-BW2-G	6-BW3-G	6-BW4-G
12vd-c	12-BW2-G	12-BW3-G	12-BW4-G
24vd-c	24-BW2-G	24-BW3-G	24-BW4-G
Dual Coil Magnetic Latch — Gold Contacts			
6/6vd-c	6-BW2-LD	6-BW3-LD	6-BW4-LD
12/12vd-c	12-BW2-LD	12-BW3-LD	12-BW4-LD
24/24vd-c	24-BW2-LD	24-BW3-LD	24-BW4-LD

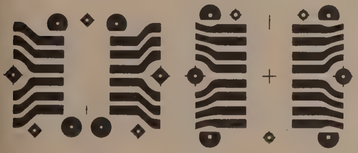
For Palladium Contacts Substitute BP for BW
Single Coil Latching Relays LS Also Available

BEAD PIN PC BOARD HEADER

PRINTACT
RELAY
PART NO.
12 BW36

For applications where the conductor pattern is not etched on your custom printed circuit board, the bead pin header has been designed for use as a solder-in socket: P/N 40300-1 (Rhodium), P/N 40300-2 (Gold).

FREE PC BOARD DESIGN AIDS

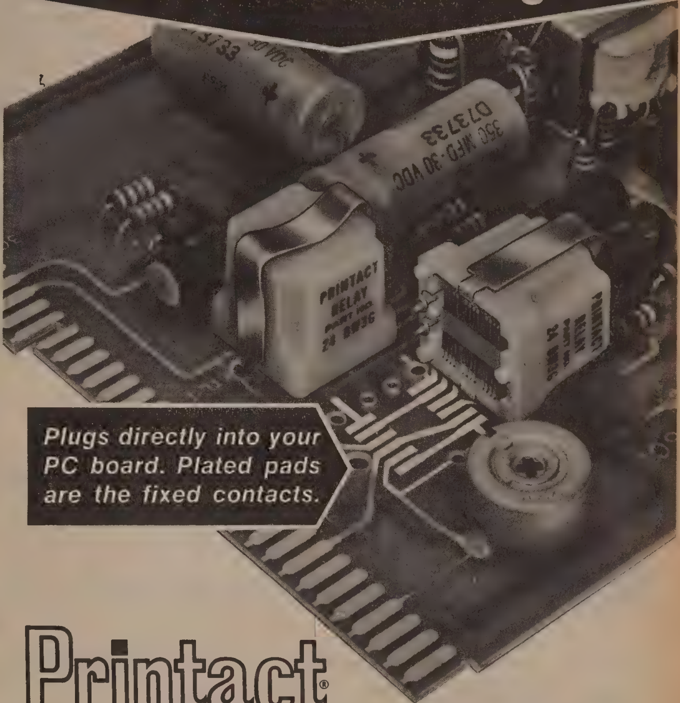


Send for Technical Notes PR262-D which details artwork, layout and board processing procedures and offers stick-on conductor patterns to overlay on the mylar providing switching configuration layouts for relay areas.

GENERAL PURPOSE MODULES

Where a custom board is not planned, send for catalog illustrating a variety of general purpose PC boards with etched and plated switching patterns to accommodate single or multiple relays. Can be chassis mounted with standoff bushings or bead pins. Solder pads for point-to-point wiring or edge-connector terminals are available.

PRINTED CIRCUIT RELAYS
Without Socket or Soldering



Plugs directly into your PC board. Plated pads are the fixed contacts.

Printact®
MAGNETIC LATCHING AND NON-LATCHING RELAYS

Fully utilizing printed circuit technology Printact provides custom features. This compact low cost general purpose relay can be used in RF, Thermocouple and other specialized circuitry. The pivoting contact armature, hinged to a permanent magnet, is the only moving part. Elimination of pigtails, return springs, and mechanical inter-connections assures long life and reliability for millions of cycles.

Relays with 6, 12, or 24 Vdc 500 mw coils have 2, 3, or 4 double break contact blades. Each blade can switch a form C or A *and* B in separate circuits, up to 2 amps. These small lightweight highly reliable Printact relays can save you space, time, money and manhours.

General purpose PC Boards for point-to-point wiring or solder-in mounting for multi-pole switching, cost less than plug-in sockets.

For a sample and catalog NOW write direct or call (212) EX 2-4800 for specs, design aids, and cost data on relays and PC boards.

Inherent Custom Features:

- **Low Thermal EMF**
  Less than 2 micro-volts
- **Cross Talk Isolation**
  70-50 db. over 50-500 Mhz
- **Characteristic Impedance**
  75 ohms PC board pads
- **Low Contact Bounce**
  Less than 0.5 ms
- **Bifurcated Blades**
  Contact resistance stability
- **Encapsulated Coil**
  Corrosion protection
- **Switching Versatility**
  Blade functions as 2 poles
- **Plug-In Replacement**
  Without solder or socket

Executone
PRINTACT RELAY DIVISION • Box 1430 EM, Long Island City, N.Y. 11101 • (212) EX 2-4800

HERMETICALLY SEALED RELAYS

Unmatched for reliability, the light weight, thermal capabilities, and high resistance to shock of these hermetically sealed relays make them ideally suited for military and industrial electronic applications.

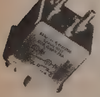
The reliability factor stems from exacting assembly (in a "White Room" where necessary), rigid quality control, well-equipped lab facilities and precise testing procedures. These manufacturing techniques, combined with GE's advanced engineering design, produce top-quality relays with dependable characteristics exceeding those of static switching devices.

Contact resistance is held to a minimum by silver contacts (with gold flash) combined with high contact forces.

All high-temperature components allow the operation of these relays in ambient temperatures between −65°C to +125°C.

Units are available with studs or brackets for mounting. All types available for printed-circuit board application. Headers can be furnished with solder hooks, three-inch leads, plug-in (with socket availability information) and many special terminals.

Write for Bulletin GEA-6628

		Contact Form	Contact Rating	Sensitivity	Size & Weight	Vibration Capabilities	Shock	Operate Time	Release Time
	TRANSISTOR SIZE TO-5² (3SBS) High contact forces, overtravel Low contact resistance Industrial versions available Hybrid versions available Meets Mil-R-39016/9	2PDT	1A at 28 Vd-c 0.2A at 28 Vd-c Ind.	120 mw	0.37″x0.37″x0.275″ 0.09 oz.	30 G's to 3000 Hz	100 G's for 11 ms	2 ms max	1 ms max
	150 GRID-SPACE (3SBM, 3SBH) 4PDT latch and non-latch Qualified to MIL-R-39016/14,31 Qualified to MIL-R-5757/80,85 Smallest 2-amp magnetic latch	4PDT	2A at 28Vd-c	50 mw (3SBM) 250 mw (3SBH)	0.32″x0.61″x0.61″ 0.24 oz.	30G's to 3000 Hz	50 G's for 11 ms	4 ms max	4 ms max
	150 GRID-SPACE (3SBC) Low profile — only 0.32″ high Terminals on 0.150″ centers Meets MIL-5757/37 Meets Mil-R-39016/13	2PDT	2A at 28Vd-c ½ at 115Va-c 1 Form A/B	135 mw 50 mw	0.32″x0.61″x0.31″ 0.13 oz.	30G's to 3000 Hz	50 G's for 11 ms	4 ms max	4 ms max
	HALF-SIZE MICRO (3SAV) Terminals on 0.2″ centers Power or low-level switching Meets MIL-5757/9 Meets Mil-R-39016/6 100 mw available	2PDT	2A at 28 Vd-c 1A at 115Va-c	260 mw	0.4″x0.8″x0.4″ 0.35 oz.	30 G's to 3000 Hz	50 G's for 11 ms	4 ms max	4 ms max
	HALF-SIZE MICRO (3SCV) INDUSTRIAL TYPE 100 million life at low level Low contact resistance Normal overload capability Replaces reeds at lower cost	2PDT	10^5 at 2A 28Vd-c 10^8 low level	340 mw	0.4″x0.8″x0.4″ 0.35 oz.	10 G's to 2000 Hz		6 ms max	6 ms max
	4-POLE MICRO (3SAH) All-welded construction No solder, solder flux Power or low-level switching Terminals on 0.2″ centers Meets MIL-5757/12	4PDT	2A at 26.5 Vd-c 1A at 115 Va-c	400 mw	0.81″x1.01″x0.61″ 1.0 oz.	30 G's to 3000 Hz	50 G's for 11 ms	6 ms max	5 ms max
	HALF-SIZE RF Frequency 0 to .5 GHz Co-ax or PCB terminations Low cost RF and auxiliary contacts 50-ohm impedance	2PDT	10^6 at 15W RF 10^5 at 25W RF 2A at 28 Vd-c	260 mw	0.4″ x 0.8″ x 0.4″ 0.35 oz.	20 G's to 2000 Hz	— —	4 ms	4 ms
	**RF RELAY** Frequency 0 to 2.0 GHz 50-ohm impedance RF and auxiliary contacts SMA, co-ax and PCB termination Low cost	1PDT RF 1PDT Aux	2 x 10^5 at 15W RF 4 x 10^4 at 150W RF Aux 2A at 28 Vd-c	250 mw	1.15″ x 0.95″ x 0.840″ 1.0 oz.	10 G's to 500 Hz	— —	10 ms	10 ms

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Relay Sales, Waynesboro, Va. 22980.

GENERAL ELECTRIC

TYPE 3SAV RADIO FREQUENCY RELAY

FEATURES

- All features of the standard 3SAV relay
- Micro strip or stripline models available
- 50 ohm RG 316U coaxial cable is standard
- Easy access to PC boards
- Form A, B, C and D models available
- Higher RF power switching models are available
- 100 million operation models are available
- Meets requirements of MIL-R-39016/33

DESCRIPTION

The 3SAV Radio Frequency Relay is a high integrity RF version of the military half-size relay. Excellent cable to relay RF matching is provided by a strong attachment feature. It will perform well in transmission lines from 25 to 75 ohms up to 500 megahertz. RF and auxiliary contacts provide low contact resistance for millions of trouble-free operations in radio and test equipment applications. Long life stability in dry, low level and power switching makes this little relay a big item for you to consider.

SPECIFICATIONS

RF contacts — up to 500 MHz
Dry switching to 100 watts — 1,000,000 oper.
Hot switching to 10 watts — 1,000,000 oper.
Hot switching to 40 watts — 100,000 oper.

All contacts — up to 100,000 operations
2.0 amps — 28 VDC Res.
0.5 amps — 28 VDC Ind.
1.0 amps — 115 VAC Res. — ungrounded case
0.15 amps — 115 VAC Res. — case grounded
0.10 amps — 1 VDC low level — 1,000,000 oper.

Contact Resistance — .050 ohms max. at header

Operate Time — 4 ms. max.

Release Time — 4 ms. max.

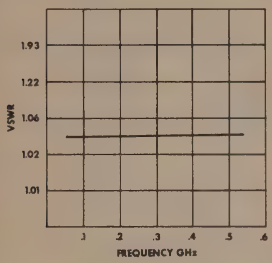
Insulation Res. — 1000 megohms min.

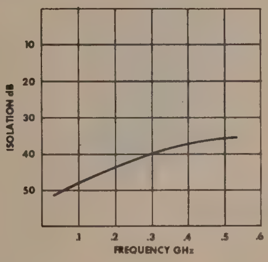
Dielectric Strength — 1000 VAC
Except: Contact gap — 500 VAC
Coil to case — 500 VAC

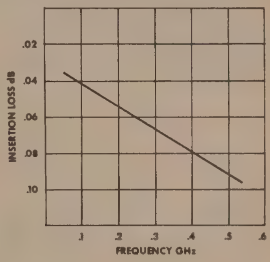
Ambient Temperature — −65°C to +125°C

RF RESPONSE DATA

Values shown are typical for both normally open and normally closed contacts. Measurements are pin to pin at glass (does not include cables).







NOTE: Typical Cable Attenuation = 0.2 dB/ft @ 400 MHz

COIL TABLE (All Values dc)*

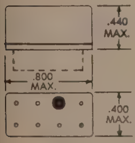
260 MW SENSITIVITY

Coil Resistance at 25°C (ohms)	Voltage Calibrated,				Current Calibrated,			
	Suggested Source Volts†	Maximum Operate Volts at 25°C	Release Voltage Range at 25°C		Maximum Continuous Current at 125°C (MA)	Maximum Operate Current at 25°C (MA)	Release Current Range at 25°C (MA)	
			Max.	Min.			Max.	Min.
47 ± 10%	4.8-7	3.2	2.0	0.35	95.0	68.0	41.5	7.4
75 ± 10%	6.1-9	4.1	2.5	0.4	77.0	55.0	33.0	5.3
120 ± 10%	7.7-12	5.2	3.2	0.5	64.0	43.5	26.0	4.1
180 ± 10%	9.5-15	6.4	4.0	0.7	53.5	35.5	22.0	3.8
310 ± 10%	12.5-20	8.2	5.0	0.9	41.5	26.5	16.0	2.9
440 ± 10%	15.0-23	9.9	6.0	1.1	33.5	22.5	13.5	2.5
700 ± 10%	20.0-30	13.5	8.0	1.5	27.5	19.5	11.5	2.1
1030 ± 10%	24.0-35	16.0	9.6	1.8	22.0	15.5	9.3	1.7
1620 ± 10%	30.0-44	20.0	12.0	2.2	17.5	12.5	7.5	1.3
2640 ± 10%	39.0-56	26.0	15.5	2.9	13.5	10.0	6.0	1.1

* Values listed are Factory test and inspection values. User should allow for meter variations.

† Applicable over the operating temperature range in circulating air.

ENCLOSURES



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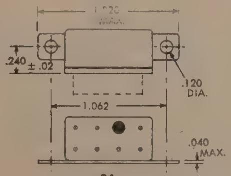

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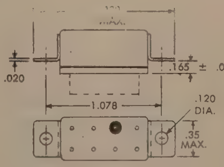

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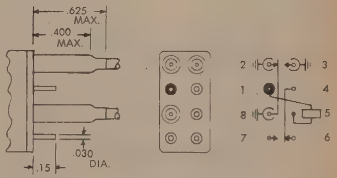
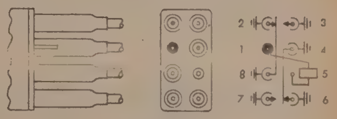
HEADER STYLES AND ELECTRICAL DIAGRAM



1 PDT — RF
1 PDT — AUX



2 PDT — RF

Note: Terminal spacing is 0.2 inch.
Terminal Numbers are not on Relay

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Relay Sales, Waynesboro, Va. 22980.

GENERAL ELECTRIC

GOULD **ALLIED CONTROL**

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

PRODUCT CATALOG

DISTRIBUTION . . .
The key to customer service

The nationwide network of Allied Franchised Distributors offers specifiers of Gould-Allied products faster application information, specification data and of course, local off-the-shelf deliveries. But of greater importance is a staff of some 700 distributor salesmen who are well versed in the Allied product line and eager to serve.

Distributors and distributor salesmen are, in turn, supported by The Gould-Allied plant with engineering expertise, detailed product data, current price information and new product development.

In addition to nationwide distribution, Gould-Allied also enjoys representation and distribution on every continent. The world-wide acceptance of the name Gould-Allied is evidence of product quality, aggressive service policies and the fulfillment of market needs through new product introduction.

The products covered in this catalog are listed below.

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  AC relays.................... p. 1.1688
  Magnetic latch.............. p. 1.1689
Miniature PC Relays.......... p. 1.1693
Solid State Relays .... p. 1.1694-1.1695
  E11, E19, E20
    and E22 Series .... p. 1.1694
  E3 and E4 Series............ p. 1.1695
Timers—Solid State.......... p. 1.1693
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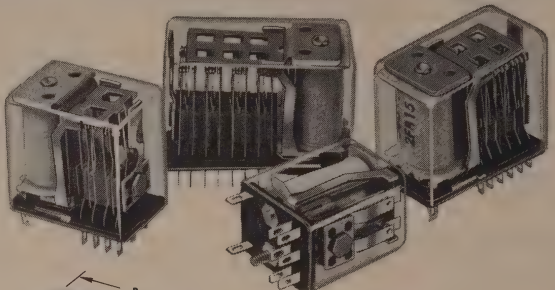
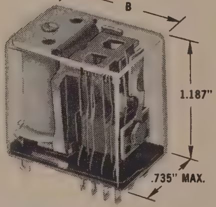
  ½ Crystal Can .... p. 1.1690
  Round Can .... p. 1.1691
Industrial/Commercial Relays
  Open frame................. p. 1.1692
  Hermetically sealed .... p. 1.1692
Sockets (for Cradle® Relays) ....
p. 1.1689

CRADLE® SERIES RELAYS

T154/T163 industrial relays with versatile mounting means including solder, printed circuit board and socket options. (Refer to Socket Guide) Sensitivity selection to match applications ranging from 20 to 140mW per pole. Contact selection to meet load switching requirements. U/L Recognized File #E206041.

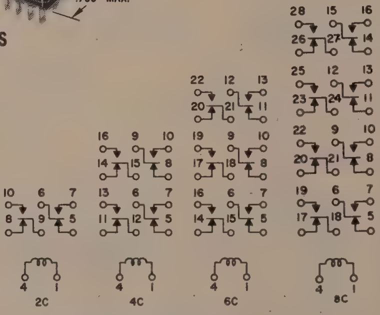
Voltage relays adjusted for maximum pickup of 75% of nominal coil voltage.
Weight: 1.0 to 6.0 ounces.




B
1.187"
.735" MAX.

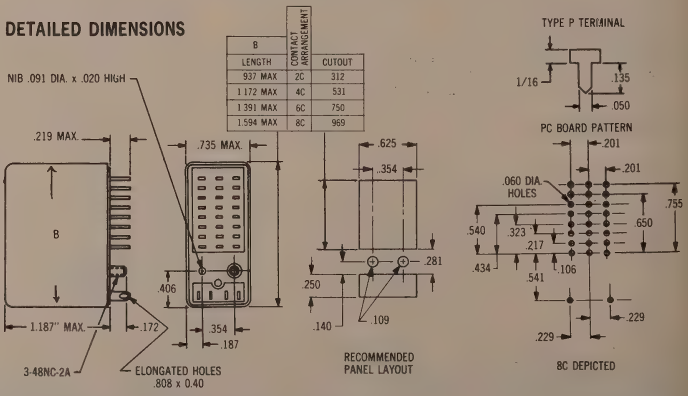
DIMENSION B	
2C	.937
4C	1.172
6C	1.391
8C	1.594

WIRING DIAGRAMS


10 6 7
8 9 5
4 1
2C
16 9 10
14 15 8
13 6 7
11 12 5
4 1
4C
22 12 13
20 21 11
19 9 10
17 18 8
16 6 7
14 15 5
4 1
6C
28 15 16
26 27 14
25 12 13
23 24 11
22 9 10
20 21 8
19 6 7
17 18 5
4 1
8C

CIRCUIT DIAGRAMS-UNENERGIZED

DETAILED DIMENSIONS


NIB .091 DIA. x .020 HIGH
.219 MAX.
B
1.187" MAX.
.172
3-48NC-2A
ELONGATED HOLES
.808 x 0.40
.735 MAX.
.406
.354
.187
.625
.354
.281
.250
.140
.109
RECOMMENDED
PANEL LAYOUT
TYPE P TERMINAL
1/16
.135
.050
PC BOARD PATTERN
.201
.201
.060 DIA.
HOLES
.755
.650
.540
.323
.217
.434
.541
.106
.229
.229
8C DEPICTED

B LENGTH	CONTACT ARRANGEMENT	CUTOUT
937 MAX	2C	312
1 172 MAX	4C	531
1 391 MAX	6C	750
1.594 MAX	8C	969

GOULD **ALLIED CONTROL**

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

CRADLE® SERIES RELAYS

DC RELAYS—VOLTAGE ADJUSTED

STANDARD/SINGLE POINT CONTACTS

		Coils			Catalog Numbers Mounting Style		
Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
2 Amp	2Form C	6VDC	52	690mW	T154-2C-6VDC	TP154-2C-6VDC	$3 70
		12VDC	185		**T154-2C-12VDC**	**TP154-2C-12VDC**	3 70
		24VDC	700		**T154-2C-24VDC**	**TP154-2C-24VDC**	3 70
		48VDC	2,500		T154-2C-48VDC	TP154-2C-48VDC	3 70
		115VDC	15,000		T154-2C-115VDC	TP154-2C-115VDC	5 90
	4Form C	6VDC	52	690mW	T154-4C-6VDC	TP154-4C-6VDC	4.10
		12VDC	185		**T154-4C-12VDC**	**TP154-4C-12VDC**	4 10
		24VDC	700		**T154-4C-24VDC**	**TP154-4C-24VDC**	4.10
		28VDC	2,500		T154-4C-48VDC	TP154-4C-48VDC	4.10
		115VDC	15,000		T154-4C-115VDC	TP154-4C-115VDC	6 25
	6Form C	6VDC	25	1.4W	T154-6C-6VDC	TP154-6C-6VDC	5.30
		12VDC	90		**T154-6C-12VDC**	**TP154-6C-12VDC**	5.30
		24VDC	430		**T154-6C-24VDC**	**TP154-6C-24VDC**	5.30
		48VDC	1,550		T154-6C-48VDC	TP154-6C-48VDC	5.30
		115VDC	9,000		T154-6C-115VDC	TP154-6C-115VDC	6.25
	8Form C	6VDC	20	1.9W	T154-8C-6VDC	TP154-8C-6VDC	8.15
		12VDC	75		**T154-8C-12VDC**	**TP154-8C-12VDC**	8 15
		24VDC	430		**T154-8C-24VDC**	**TP154-8C-24VDC**	8 15
		48VDC	1.275		T154-8C-48VDC	TP154-8C-48VDC	8.15
		115VDC	9,000		T154-8C-115VDC	TP154-8C-115VDC	9 10
5 Amp	2Form C	6VDC	52	690mW	TF154-2C-6VDC	TFP154-2C-6VDC	$3 85
		12VDC	185		**TF154-2C-12VDC**	**TFP154-2C-12VDC**	3.85
		24VDC	700		**TF154-2C-24VDC**	**TFP154-2C-24VDC**	3.85
		48VDC	2,500		TF154-2C-48VDC	TFP154-2C-48VDC	3 85
		115VDC	15,000		TF154-2C-115VDC	TFP154-2C-115VDC	6.00
	4Form C	6VDC	52	690mW	TF154-4C-6VDC	TFP154-4C-6VDC	4 35
		12VDC	185		**TF154-4C-12VDC**	**TFP154-4C-12VDC**	4 35
		24VDC	700		**TF154-4C-24VDC**	**TFP154-4C-24VDC**	4.35
		48VDC	2,500		TF154-4C-48VDC	TFP154-4C-48VDC	4 35
		115VDC	15,000		TF154-4C-115VDC	TFP154-4C-115VDC	6 55
	6Form C	6VDC	25	1.4W	TF154-6C-6VDC	TFP154-6C-6VDC	5.75
		12VDC	90		**TF154-6C-12VDC**	**TFP154-6C-12VDC**	5.75
		24VDC	430		**TF154-6C-24VDC**	**TFP154-6C-24VDC**	5.75
		48VDC	1,550		TF154-6C-48VDC	TFP154-6C-48VDC	5 75
		115VDC	9,000		TF154-6C-115VDC	TFP154-6C-115VDC	6.70
	8Form C	6VDC	20	1.9W	TF154-8C-6VDC	TFP154-8C-6VDC	8 75
		12VDC	75		**TF154-8C-12VDC**	**TFP154-8C-12VDC**	8 75
		24VDC	430		**TF154-8C-24VDC**	**TFP154-8C-24VDC**	8 75
		48VDC	1,275		TF154-8C-48VDC	TFP154-8C-48VDC	8.75
		115VDC	9,000		TF154-8C-115VDC	TFP154-8C-115VDC	9 70

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

SENSITIVE/SINGLE POINT CONTACTS

		Coils			Catalog Numbers Mounting Style		
Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
2 Amp	2Form C	6VDC	185	100mW	TS154-2C-6VDC	TSP154-2C-6VDC	$4 05
		12VDC	800		**TS154-2C-12VDC**	**TSP154-2C-12VDC**	4 05
		24VDC	3,200		**TS154-2C-24VDC**	**TSP154-2C-24VDC**	4 55
		48VDC	13,000		TS154-2C-48VDC	TSP154-2C-48VDC	6.20
	4Form C	6VDC	110	175mW	TS154-4C-6VDC	TSP154-4C-6VDC	4.45
		12VDC	430		**TS154-4C-12VDC**	**TSP154-4C-12VDC**	4.45
		24VDC	1,800		**TS154-4C-24VDC**	**TSP154-4C-24VDC**	4 45
		48VDC	7,500		TS154-4C-48VDC	TSP154-4C-48VDC	5 40
	6Form C	6VDC	75	250mW	TS154-6C-6VDC	TSP154-6C-6VDC	5 75
		12VDC	350		**TS154-6C-12VDC**	**TSP154-6C-12VDC**	5 75
		24VDC	1,275		**TS154-6C-24VDC**	**TSP154-6C-24VDC**	5 75
		48VDC	5,200		TS154-6C-48VDC	TSP154-6C-48VDC	6 25
	8Form C	6VDC	52	400mW	TS154-8C-6VDC	TSP154-8C-6VDC	8 65
		12VDC	190		**TS154-8C-12VDC**	**TSP154-8C-12VDC**	8 65
		24VDC	800		**TS154-8C-24VDC**	**TSP154-8C-24VDC**	8 65
		48VDC	3,200		TS154-8C-48VDC	TSP154-8C-48VDC	9 20

Note· **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors

ULTRA-SENSITIVE RELAYS/SINGLE POINT CONTACTS

		Coils			Catalog Numbers Mounting Style		
Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
1 Amp	2Form C	6VDC	500	40mW	TSS154 2C-6VDC	TSSP154-2C-6VDC	$4 35
		12VDC	2,000		TSS154-2C-12VDC	TSSP154-2C-12VDC	4 35
		24VDC	7,500		**TSS154-2C-24VDC**	**TSSP154-2C-24VDC**	5 30
	4Form C	6VDC	250	80mW	TSS154-4C-6VDC	TSSP154-4C-6VDC	5 40
		12VDC	1,000		TSS154-4C-12VDC	TSSP154-4C-12VDC	5 40
		24VDC	3,700		**TSS154-4C-24VDC**	**TSSP154-4C-24VDC**	5 95

Note **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors

STANDARD/BIFURCATED CONTACTS

		Coils			Catalog Numbers Mounting Style		
Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
2 Amp	2Form C	6VDC	52	690mW	T163-2C-6VDC	TP163-2C-6VDC	$4 15
		12VDC	185		**T163-2C-12VDC**	**TP163-2C-12VDC**	4 15
		24VDC	700		**T163-2C-24VDC**	**TP163-2C-24VDC**	4 15
		48VDC	2,500		T163-2C-48VDC	TP163-2C-48VDC	4 15
		115VDC	15,000		T163-2C-115VDC	TP163-2C-115VDC	6.30
	4Form C	6VDC	52	690mW	T163-4C-6VDC	TP163-4C-6VDC	4 65
		12VDC	185		**T163-4C-12VDC**	**TP163-4C-12VDC**	4.65
		24VDC	700		**T163-4C-24VDC**	**TP163-4C-24VDC**	4 65
		48VDC	2,500		T163-4C-48VDC	TP163-4C-48VDC	4 65
		115VDC	15,000		T163-4C-115VDC	TP163-4C-115VDC	6 80
	6Form C	6VDC	25	1.4W	T163-6C-6VDC	TP163-6C-6VDC	6.00
		12VDC	90		**T163-6C-12VDC**	**TP163-6C-12VDC**	6 00
		24VDC	430		**T163-6C-24VDC**	**TP163-6C-24VDC**	6.00
		48VDC	1,550		T163-6C-48VDC	TP163-6C-48VDC	6 00
		115VDC	9,000		T163-6C-115VDC	TP163-6C-115VDC	6 85
	8Form C	6VDC	20	1.9W	T163-8C-6VDC	TP163-8C-6VDC	8.85
		12VDC	75		**T163-8C-12VDC**	**TP163-8C-12VDC**	8.85
		24VDC	430		**T163-8C-24VDC**	**TP164-8C-24VDC**	8 85
		48VDC	1,275		T163-8C-48VDC	TP163-8C-48VDC	8 85
		115VDC	9,000		T163-8C-115VDC	TP163-8C-115VDC	9 80

Note· **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors

SENSITIVE/BIFURCATED CONTACTS

		Coils			Catalog Numbers Mounting Style		
Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
2 Amp	2Form C	6VDC	185	100mW	TS163-2C-6VDC	TSP163-2C-6VDC	$4 45
		12VDC	800		**TS163-2C-12VDC**	**TSP163-2C-12VDC**	4 45
		24VDC	3,200		**TS163-2C-24VDC**	**TSP163-2C-24VDC**	4 45
		48VDC	13,000		TS163-2C-48VDC	TSP163-2C-48VDC	6 65
	4Form C	6VDC	110	175mW	TS163-4C-6VDC	TSP163-4C-6VDC	5 00
		12VDC	430		**TS163-4C-12VDC**	**TSP163-4C-12VDC**	5 00
		24VDC	1,800		**TS163-4C-24VDC**	**TSP163-4C-24VDC**	5 00
		48VDC	7,500		TS163-4C-48VDC	TSP163-4C-48VDC	5 95
	6Form C	6VDC	75	250mW	TS163-6C-6VDC	TSP163-6C-6VDC	6 30
		12VDC	350		**TS163-6C-12VDC**	**TSP163-6C-12VDC**	6 30
		24VDC	1,275		**TS163-6C-24VDC**	**TSP163-6C-24VDC**	6 30
		48VDC	5,200		TS163-6C-48VDC	TSP163-6C-48VDC	6.95
	8Form C	6VDC	52	400mW	TS163-8C-6VDC	TSP163-8C-6VDC	9 35
		12VDC	190		**TS163-8C-12VDC**	**TSP163-8C-12VDC**	9 35
		24VDC	800		**TS163-8C-24VDC**	**TSP163-8C-24VDC**	9 35
		48VDC	3,200		TS163-8C-48VDC	TSP163-8C-48VDC	9 85

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

ULTRA-SENSITIVE RELAYS/BIFURCATED CONTACTS

		Coils			Catalog Numbers Mounting Style		
Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
1 Amp	2Form C	6VDC	500	40mW	TSS163-2C-6VDC	TSSP163-2C-6VDC	$4 75
		12VDC	2,000		TSS163-2C-12VDC	TSSP163-2C-12VDC	4 75
		24VDC	7,500		**TSS163-2C-24VDC**	**TSSP163-2C-24VDC**	5 75
	4Form C	6VDC	250	80mW	TSS163-4C-6VDC	TSSP163-4C-6VDC	5 95
		12VDC	1,000		TSS163-4C-12VDC	TSSP163-4C-12VDC	5 95
		24VDC	3,700		**TSS163-4C-24VDC**	**TSSP163-4C-24VDC**	6.50

Note **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

CRADLE® SERIES RELAYS (CONT'D.)

DC RELAYS—CURRENT ADJUSTED

SENSITIVE/SINGLE POINT CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers		List Price
					Mounting Style		
		Input	Res. in Ohms	Nom. Power	Solder/Plug-In	PC Mount	
2 Amp	2Form C	8.5 Madc	1,000	85mW	TS154-2C-8.5 Madc	TSP154-2C-8.5 Madc	$4.00
		5.8 Madc	2,500		**TS154-2C-5.8 Madc**	**TSP154-2C-5.8 Madc**	4.00
		4.1 Madc	5,000		**TS154-2C-4.1 Madc**	**TSP154-2C-4.1 Madc**	4.55
		3.1 Madc	10,000		TS154-2C-3.1 Madc	TSP154-2C-3.1 Madc	4.95
		2.6 Madc	15,000		TS154-2C-2.6 Madc	TSP154-2C-2.6 Madc	6.15
	4Form C	13.0 Madc	1,000	175mW	TS154-4C-13.0 Madc	TSP154-4C-13.0 Madc	4.40
		8.4 Madc	2,500		**TS154-4C-8.4 Madc**	**TSP154-4C-8.4 Madc**	4.40
		6.2 Madc	5,000		**TS154-4C-6.2 Madc**	**TSP154-4C-6.2 Madc**	4.95
		4.5 Madc	10,000		TS154-4C-4.5 Madc	TSP154-4C-4.5 Madc	5.35
		3.5 Madc	15,000		TS154-4C-3.5 Madc	TSP154-4C-3.5 Madc	6.60
	6Form C	16.0 Madc	1,000	250mW	TS154-6C-16.0 Madc	TSP154-6C-16.0 Madc	5.70
		10.0 Madc	2,500		**TS154-6C-10.0 Madc**	**TSP154-6C-10.0 Madc**	5.70
		7.2 Madc	5,000		**TS154-6C-7.2 Madc**	**TSP154-6C-7.2 Madc**	6.20
		5.0 Madc	10,000		TS154-6C-5.0 Madc	TSP154-6C-5.0 Madc	6.65
		4.2 Madc	15,000		TS154-6C-4.2 Madc	TSP154-6C-4.0 Madc	7.85
	8Form C	20.0 Madc	1,000	400mW	TS154-8C-20.0 Madc	TSP154-8C-20.0 Madc	8.60
		13.0 Madc	2,500		**TS154-8C-13.0 Madc**	**TSP154-8C-13.0 Madc**	8.60
		9.0 Madc	5,000		**TS154-8C-9.0 Madc**	**TSP154-8C-9.0 Madc**	9.15
		6.4 Madc	10,000		TS154-8C-6.4 Madc	TSP154-8C-6.4 Madc	9.55
		5.3 Madc	15,000		TS154-8C-5.3 Madc	TSP154-8C-5.3 Madc	10.80

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

SENSITIVE/BIFURCATED CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers		List Price
					Mounting Style		
		Input	Res. in Ohms	Nom. Power	Solder/Plug-In	PC Mount	
2 Amp	2Form C	8.5 Madc	1,000	85mW	TS163-2C-8.5 Madc	TSP163-2C-8.5 Madc	$4.40
		5.8 Madc	2,500		**TS163-2C-5.8 Madc**	**TSP163-2C-5.8 Madc**	4.40
		4.1 Madc	5,000		**TS163-2C-4.1 Madc**	**TSP163-2C-4.1 Madc**	4.95
		3.1 Madc	10,000		TS163-2C-3.1 Madc	TSP163-2C-3.1 Madc	5.35
		2.6 Madc	15,000		TS163-2C-2.6 Madc	TSP163-2C-2.6 Madc	6.60
	4Form C	13.0 Madc	1,000	175mW	TS163-4C-13.0 Madc	TSP163-4C-13.0 Madc	4.95
		8.4 Madc	2,500		**TS163-4C-8.4 Madc**	**TSP163-4C-8.4 Madc**	4.95
		6.2 Madc	5,000		**TS163-4C-6.2 Madc**	**TSP163-4C-6.2 Madc**	5.45
		4.5 Madc	10,000		TS163-4C-4.5 Madc	TSP163-4C-4.5 Madc	5.90
		3.5 Madc	15,000		TS163-4C-3.5 Madc	TSP163-4C-3.5 Madc	7.10
	6Form C	16.0 Madc	1,000	250mW	TS163-6C-16.0 Madc	TSP163-6C-16.0 Madc	6.25
		10.0 Madc	2,500		**TS163-6C-10.0 Madc**	**TSP163-6C-10.0 Madc**	6.25
		7.2 Madc	5,000		**TS163-6C-7.2 Madc**	**TSP163-6C-7.2 Madc**	6.80
		5.0 Madc	10,000		TS163-6C-5.0 Madc	TSP163-6C-5.0 Madc	7.20
		4.2 Madc	15,000		TS163-6C-4.2 Madc	TSP163-6C-4.2 Madc	8.45
	8Form C	20.0 Madc	1,000	400mW	TS163-8C-20.0 Madc	TSP163-8C-20.0 Madc	9.30
		13.0 Madc	2,500		**TS163-8C-13.0 Madc**	**TSP163-8C-13.0 Madc**	9.30
		9.0 Madc	5,000		**TS163-8C-9.0 Madc**	**TSP163-8C-9.0 Madc**	9.80
		6.4 Madc	10,000		TS163-8C-6.4 Madc	TSP163-8C-6.4 Madc	10.25
		5.3 Madc	15,000		TS163-8C-5.3 Madc	TSP163-8C-5.3 Madc	11.45

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

ULTRA-SENSITIVE/SINGLE POINT CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers		List Price
					Mounting Style		
		Input	Res. in Ohms	Nom. Power	Solder/Plug-In	PC Mount	
1 Amp	2Form C	6.5 Madc	1,000	40mW	TSS154-2C-6.5 Madc	TSSP154-2C-6.5 Madc	$4.30
		4.1 Madc	2,500		**TSS154-2C-4.1 Madc**	**TSSP154-2C-4.1 Madc**	4.30
		2.9 Madc	5,000		**TSS154-2C-2.9 Madc**	**TSSP154-2C-2.9 Madc**	4.85
		2.0 Madc	10,000		TSS154-2C-2.0 Madc	TSSP154-2C-2.0 Madc	5.25
		1.7 Madc	15,000		TSS154-2C-1.7 Madc	TSSP154-2C-1.7 Madc	6.50
	4Form C	9.0 Madc	1,000	80mW	TSS154-4C-9.0 Madc	TSSP154-4C-9.0 Madc	5.35
		5.8 Madc	2,500		**TSS154-4C-5.8 Madc**	**TSSP154-4C-5.8 Madc**	5.35
		4.1 Madc	5,000		**TSS154-4C-4.1 Madc**	**TSSP154-4C-4.1 Madc**	5.90
		3.0 Madc	10,000		TSS154-4C-3.0 Madc	TSSP154-4C-3.0 Madc	6.30
		2.4 Madc	15,000		TSS154-4C-2.4 Madc	TSSP154-4C-2.4 Madc	7.55

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

ULTRA-SENSITIVE/BIFURCATED CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers		List Price
					Mounting Style		
		Input	Res. in Ohms	Nom. Power	Solder/Plug-In	PC Mount	
1 Amp	2Form C	6.5 Madc	1,000	40mW	TSS163-2C-6.5 Madc	TSSP163-2C-6.5 Madc	$4.70
		4.1 Madc	2,500		**TSS163-2C-4.1 Madc**	**TSSP163-2C-4.1 Madc**	4.70
		2.9 Madc	5,000		**TSS163-2C-2.9 Madc**	**TSSP163-2C-2.9 Madc**	5.25
		2.0 Madc	10,000		TSS163-2C-2.0 Madc	TSSP163-2C-2.0 Madc	5.70
		1.7 Madc	15,000		TSS163-2C-1.7 Madc	TSSP163-2C-1.7 Madc	6.90
	4Form C	9.0 Madc	1,000	80mW	TSS163-4C-9.0 Madc	TSSP163-4C-9.0 Madc	5.95
		5.8 Madc	2,500		**TSS163-4C-5.8 Madc**	**TSSP163-4C-5.8 Madc**	5.95
		4.1 Madc	5,000		**TSS163-4C-4.1 Madc**	**TSSP163-4C-4.1 Madc**	6.95
		3.0 Madc	10,000		TSS163-4C-3.0 Madc	TSSP163-4C-3.0 Madc	6.85
		2.4 Madc	15,000		TSS163-4C-2.4 Madc	TSSP163-4C-2.4 Madc	8.05

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

AC RELAYS—VOLTAGE ADJUSTED

SINGLE POINT CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers		List Price
					Mounting Style		
		Input	Res. in Ohms	Nom. Power	Solder/Plug-In	PC Mount	
2 Amp	2PDT	6VAC	14	1.3VA	T154-2C-6VAC	TP154-2C-6VAC	$4.55
		12VAC	65	1.3VA	T154-2C-12VAC	TP154-2C-12VAC	4.55
		24VAC	280	1.3VA	T154-2C-24VAC	TP154-2C-24VAC	4.55
		48VAC	1,250	1.3VA	T154-2C-48VAC	T154-2C-48VAC	4.55
		115VAC	6,000	1.3VA	**T154-2C-115VAC**	**TP154-2C-115VAC**	4.55
		220VAC	15,000	2.2VA	T154-2C-220VAC	TP154-2C-220VAC	5.10
	4PDT	6VAC	14	1.3VA	T154-4C-6VAC	TP154-4C-6VAC	5.20
		12VAC	65	1.3VA	T154-4C-12VAC	TP154-4C-12VAC	5.20
		24VAC	280	1.3VA	T154-4C-24VAC	TP154-4C-24VAC	5.20
		48VAC	1,250	1.3VA	T154-4C-48VAC	TP154-4C-48VAC	5.20
		115VAC	6,000	1.3VA	**T154-4C-115VAC**	**TP154-4C-115VAC**	5.20
		220VAC	15,000	2.2VA	T154-4C-220VAC	TP154-4C-220VAC	5.75
5 Amp	2PDT	6VAC	14	1.3VA	TF154-2C-6VAC	TFP154-2C-6VAC	4.70
		12VAC	65	1.3VA	TF154-2C-12VAC	TFP154-2C-12VAC	4.70
		24VAC	280	1.3VA	TF154-2C-24VAC	TFP154-2C-24VAC	4.70
		48VAC	1,250	1.3VA	TF154-2C-48VAC	TFP154-2C-48VAC	4.70
		115VAC	6,000	1.3VA	**TF154-2C-115VAC**	**TFP154-2C-115VAC**	4.70
		220VAC	15,000	2.2VA	TF154-2C-220VAC	TFP154-2C-220VAC	5.20

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised Distributors.

SINGLE POINT CONTACTS (Cont.)

Contact Rating	Contact Arrangement	Coils			Catalog Numbers		List Price
					Mounting Style		
		Input	Res. in Ohms	Nom. Power	Solder/Plug-In	PC Mount	
5 Amp	4PDT	6VAC	14	1.3VA	TF154-4C-6VAC	TFP154-4C-6VAC	$5.40
		12VAC	65	1.3VA	TF154-4C-12VAC	TFP154-4C-12VAC	5.40
		24VAC	280	1.3VA	TF154-4C-24VAC	TFP154-4C-24VAC	5.40
		48VAC	1,250	1.3VA	TF154-4C-48VAC	TFP154-4C-48VAC	5.40
		115VAC	6,000	1.3VA	**TF154-4C-115VAC**	**TFP154-4C-115VAC**	5.40
		220VAC	15,000	2.2VA	TF154-4C-220VAC	TFP154-4C-220VAC	5.95

BIFURCATED CONTACTS

2 Amp	2PDT	6VAC	14	1.3VA	T163-2C-6VAC	—	5.00
		12VAC	65	1.3VA	T163-2C-12VAC	—	5.00
		24VAC	280	1.3VA	T163-2C-24VAC	—	5.00
		48VAC	1,250	1.3VA	T163-2C-48VAC	—	5.00
		115VAC	6,000	1.3VA	**T163-2C-115VAC**	**—**	5.00
		220VAC	15,000	2.2VA	T163-2C-220VAC	—	5.55
	4PDT	6VAC	14	1.3VA	T163-4C-6VAC	—	5.75
		12VAC	65	1.3VA	T163-4C-12VAC	—	5.75
		24VAC	280	1.3VA	T163-4C-24VAC	—	5.75
		48VAC	1,250	1.3VA	T163-4C-48VAC	—	5.75
		115VAC	6,000	1.3VA	**T163-4C-115VAC**	**—**	5.75
		220VAC	15,000	2.2VA	T163-4C-220VAC	—	6.25

GOULD **ALLIED CONTROL**

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

CRADLE® SERIES/MAGNETIC LATCH RELAYS

T351/T362 Bi-Stable and Magnetic Latch industrial relays. Single or Dual Coil construction. Versatile mounting means, including solder, printed circuit board and socket options. (Refer to Socket Guide). Contact selection to meet Load Switching Requirements. **T351** has single point contacts. The **T362** has bifurcated contacts. Dimensions and appearance are same as for 2C and 4C cradle relays, see page 1.1686

Input voltage: standard 12 and 24 VDC. Other voltages available on request.

U/L Recognized File #E-206041

Weight: 1.5 to 4.0 ounces.

DC RELAYS—VOLTAGE ADJUSTED

SINGLE COIL

SINGLE POINT CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers Mounting Style		List Price
		Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	
2 Amp	2Form C	12VDC 24VDC	166 630	300mW	T351-2C-12VDC **T351-2C-24VDC**	TP351-2C-12VDC **TP351-2C-24VDC**	$5.50 5.50
	4Form C	12VDC 24VDC	166 630	300mW	T351-4C-12VDC **T351-4C-24VDC**	TP351-4C-12VDC **TP351-4C-24VDC**	6.05 6.05
5 Amp	2Form C	12VDC 24VDC	166 630	300mW	TF351-2C-12VDC **TF351-2C-24VDC**	TFP351-2C-12VDC **TFP351-2C-24VDC**	5.60 5.60
	4Form C	12VDC 24VDC	166 630	300mW	TF351-4C-12VDC **T351-4C-24VDC**	TFP351-4C-12VDC **TFP351-4C-24VDC**	6.30 6.30

BIFURCATED CONTACTS

Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
2 Amp	2Form C	12VDC 24VDC	166 630	300mW	T362-2C-12VDC **T362-2C-24VDC**	TP362-2C-12VDC **TP362-2C-24VDC**	5.95 5.95
	4Form C	12VDC 24VDC	166 630	300mW	T362-4C-12VDC **T362-4C-24VDC**	TP362-4C-12VDC **TP362-4C-24VDC**	6.90 6.90

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

DUAL COIL

SINGLE POINT CONTACTS

Contact Rating	Contact Arrangement	Coils			Catalog Numbers Mounting Style		List Price
		Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	
2 Amp	2Form C	2/12VDC 2/24VDC	134/134 485/485	600mW	T351-2C-2/12VDC **T351-2C-2/24VDC**	TP351-2C-2/12VDC **TP351-2C-2/24VDC**	$6.60 6 60
	4Form C	2/12VDC 2/24VDC	134/134 485/484	600mW	T351-4C-2/12VDC **T351-4C-2/24VDC**	TP351-4C-2/12VDC **TP351-4C-2/24VDC**	6.90 6.90
5 Amp	2Form C	2/12VDC 2/24VDC	134/134 485/485	600mW	TF351-2C-2/12VDC **TF351-2C-2/24VDC**	TFP351-2C-2/12VDC **TFT351-2C-2/24VDC**	6 70 6 70
	4Form C	2/12VDC 2/24VDC	134/134 485/485	600mW	TF351-4C-2/12VDC **TF351-4C-2/24VDC**	TFP351-4C-2/12VDC **TFP351-4C-2/24VDC**	7 40 7 40

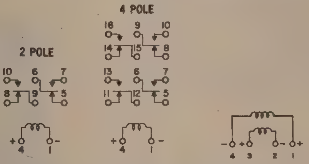
BIFURCATED CONTACTS

Contact Rating	Contact Arrangement	Input	Res. in Ohms	Nom. Power	Solder/ Plug-In	PC Mount	List Price
2 Amp	2Form C	2/12VDC 2/24VDC	134/134 485/485	600mW	T362-2C-2/12VDC **T362-2C-2/24VDC**	TP362-2C-2/12VDC **TP362-2C-2/24VDC**	7.00 7 00
	4Form C	2/12VDC 2/24VDC	134/134 485/485	600mW	T362-4C-2/12VDC **T362-4C-2/24VDC**	TP362-4C-2/12VDC **TP362-4C-2/24VDC**	7.95 7.95

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

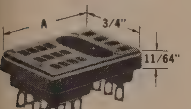
MAGNETIC LATCH WIRING DIAGRAMS
(Reset Position Shown)

SINGLE WINDING
CIRCUIT DIAGRAMS
TO OPERATE REVERSE POLARITY

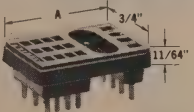


DUAL WINDING
CIRCUIT DIAGRAMS
1-4 OPERATE 2-3 RESET

CRADLE® SOCKETS AND HARDWARE



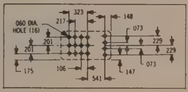
SOLDER LUG



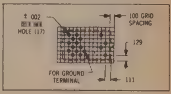
PC MOUNT

Dimensions	
Poles	A
2 Pole	31/32"
4 Pole	1-13/64"
6 Pole	1-13/32"
8 Pole	1-41/64"

TYPICAL
PC MOUNT
TERMINAL LAYOUT
(for 4-POLE)



TYPICAL
.1 x .1 GRID
TERMINAL LAYOUT
(for 4-POLE)



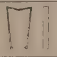
		Without Hold Down Spring		With Hold Down Spring	
Selection Guide		New Cat. No.	Superseded Cat. No.	New Cat. No.	Superseded Cat. No.
	Terminal Options	0211-011-	30054-	0211-012-	30055-
2 Pole	Solder Lug	-001-000	-1	**-001-000**	**-1**
	PC Mount	-005-000	-5	**-005-000**	**-5**
	.1 x .1 Grid	-003-000	-3	-003-000	-3
List Price Per 20		$11.50	$11.50	$12.50	$12.50
4 Pole	Solder Lug Special*	-008-000	-8	**-008-00**	**-8**
	Solder Lug	-002-000	-2	**-002-00**	**-2**
	PC Mount	-006-000	-6	**-006-000**	**-6**
	1 x .1 Grid	-004-000	-4	-004-00	-4
List Price Per 20		$15.50	$15.50	$16 50	$16.50
6 Pole	Solder Lug	-020-000	-20	**-020-000**	**-20**
	PC Mount	-024-000	-24	**-024-000**	**-24**
	1 x 1 Grid	-028-000	-28	-028-000	-28
List Price per 20		$20.50	$20.50	$21 50	$21.50
8 Pole	Solder Lug	-030-000	-30	**-030-000**	**-30**
	PC Mount	-031-000	-31	-031-000	-31
	.1 x .1 Grid	-032-000	-32	-032-000	-32
List Price Per 20		$27 50	$27 50	$28 50	$28.50

*These sockets have longer than standard center terminals Cost per 20 is $18 50 and $19 50 without and with hold down spring respectively

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

Individual Parts

PART NAME	PART NO.	DIAGRAM	LIST PRICE
GROUND WIRE For Solder and standard spaced printed circuit	30052-1 **(0256-002-001)**	to be inserted into socket recess under mounting screw head	$1.00 per 20
GROUND WIRE for .100 grid spaced printed circuit sockets	30174-1 **(0256-003-001)**	to be inserted into socket recess	$1 00 per 20

FOR	RETAINER PART NO.	DIAGRAM	LIST PRICE
2 Pole	30040-1 **(0228-001-001)**	to be inserted into recesses on narrow sides of sockets	$1 00 per 20
4 Pole	30040-2 **(0228-001-002)**		
6 Pole	30040-3 **(0228-001-003)**		
8 Pole	0330-031-001 Flat Retainer		$1 00 per 20

U/L Recognized File #E-206041

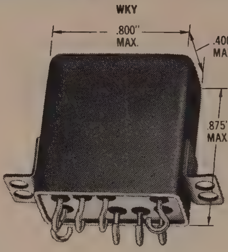
GOULD ALLIED CONTROL

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

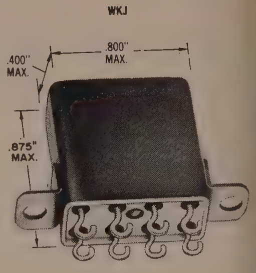
MILITARY RELAYS/CRYSTAL CAN

CRYSTAL CAN/SERIES WKJ/WKY

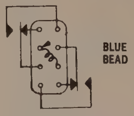
High performance military crystal can relay. Bifurcated contacts make relay ideal for dry circuit loads up to 3 amperes. All welded construction provides for maximum protection against contamination and increases reliability. MIL-R-5757/10 as applicable. WKY has a slightly different header arrangement than WKJ, see illustration.



CRYSTAL CAN



CRYSTAL CAN



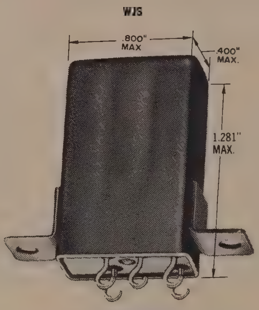
DC Only	Contact Rating	Contact Arrange-ment	Coils		Catalog No.	List Price
			Input	Coil Res.		
	3 Amp	DPDT	12VDC	150	WKJ-6D-12VDC	$12.16
			26.5VDC	600	**WKJ-6D-26.5VDC**	12.16
			115VDC	10,000	WKJ-6D-115VDC	13.66
		DPDT	12VDC	150	WKY-6D-12VDC	12.93
			26.5VDC	600	WKY-6D-26.5VDC	12.93
			115VDC	10,000	WKY-6D-115VDC	13.86

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

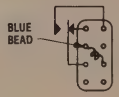
SENSITIVE, LONG CRYSTAL CAN/SERIES WJS

High performance and current sensitive military crystal can relay. SPDT (WJS-3D) operate sensitivity 22mW. DPDT (WJS-6D) operate sensitivity 40mW.

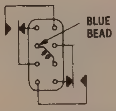
Bifurcated contacts make relay ideal for dry circuit loads up to 3 amperes. All welded construction provides for maximum protection against contamination and increases reliability. MIL-R-5757/13 as applicable.



LONG CRYSTAL CAN



SPDT



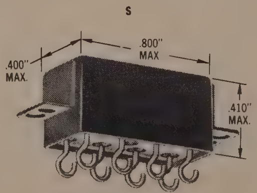
DPDT

DC Only	Contact Rating	Contact Arrange-ment	Coils		Catalog No.	List Price
			Input	Coil Res.		
	3 Amp	SPDT	5.0 Madc	1,000	WJS-3D-5.0 Madc	$14.43
			3.2 Madc	2,500	WJS-3D-3.2 Madc	14.43
			1.6 Madc	10,000	WJS-3D-1.6 Madc	15.74
		DPDT	6.3 Madc	1,000	WJS-6D-6.3 Madc	13.78
			4.0 Madc	2,500	WJS-6D-4.0 Madc	13.78
			2.0 Madc	10,000	WJS-6D-2.0 Madc	15.90

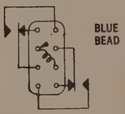
Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

½ SIZE CRYSTAL CAN/SERIES S

High performance military half size crystal can relay. Bifurcated contacts make relay ideal for dry circuit loads up to 2 amperes. All welded construction provides for maximum protection against contamination and increases reliability. Specification MIL-R-5757/9 as applicable.



HALF SIZE CRYSTAL CAN



DC Only	Contact Rating	Contact Arrange-ment	Coils		Catalog No.	List Price
			Input	Coil Res.		
	2 Amp	DPDT	12VDC	140	S6A1-12VDC	$12.15
			26.5VDC	700	**S6A1-26.5VDC**	12.15

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

GOULD ALLIED CONTROL

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

MILITARY RELAYS/MINIATURE ROUND CAN STYLE

5 AMP/SERIES MH/MHB/MHJ

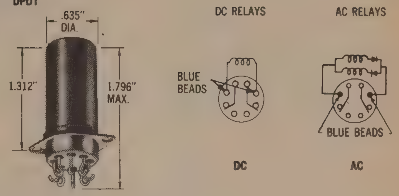
Miniature 2 Pole, 4 Pole and 6 Pole Double Throw Relays for Military and Aerospace applications. Contacts for load switching up to 5 amperes. Meets MIL-R-5757 as applicable. AC and DC models. AC relays have split coil construction with diodes for minimum EMI.

	Contact Rating	Temp. Range	Contact Arrange-ment	Coils Input	Coils Coil Res.	Catalog No.	List Price
DC Relays	5 Amp	−55°C to +85°C	DPDT	12VDC	82	MH-6D-12VDC	$15.85
				26.5VDC	400	**MH-6D-26.5VDC**	15.85
				115VDC	6,500	MH-6D-115VDC	18.55
			4 PDT	12VDC	60	MH-12D-12VDC	23.80
				26.5VDC	300	**MH-12D-26.5VDC**	23.80
				115VDC	5,000	MH-12D-115VDC	23.80
			6 PDT	12VDC	48	MH-18D-12VDC	29.00
				26.5VDC	240	**MH-18D-26.5VDC**	29.00
				115VDC	3,500	MH-18D-115VDC	29.00
	5 Amp	−65°C to +125°C	DPDT	12VDC	65	MHB-6D-12VDC	15.85
				26.5VDC	325	**MHB-6D-26.5VDC**	15.85
				115VDC	6,000	MHB-6D-115VDC	18.55
			4 PDT	12VDC	50	MHB-12D-12VDC	23.80
				26.5VDC	250	MHB-12D-26.5VDC	23.80
				115VDC	5,000	MHB-12D-115VDC	23.80
			6 PDT	12VDC	40	MHB-18D-12VDC	29.00
				26.5VDC	200	**MHB-18D-26.5VDC**	29.00
				115VDC	3,500	MHB-18D-115VDC	29.00
	5 Amp	−65°C to +125°C Note 1	4 PDT	12VDC	50	MHJ-12D-12VDC	26.40
				26.5VDC	250	**MHJ-12D-26.5VDC**	26.40
				115VDC	5,000	MHJ-12D-115VDC	26.40
			6 PDT	12VDC	40	MHJ-18D-12VDC	29.00
				26.5VDC	200	**MHJ-18D-26.5VDC**	29.00
				115VDC	3,500	MHJ-18D-115VDC	29.00
AC Relays	5 Amp	−65°C to +125°C	DPDT	115VAC	4215/4215	MHB-6A-115VAC	29.25
		−65°C to +125°C Note 1	4 PDT	115VAC	2765/2765	MHJ-12A-115VAC	36.60
			6 PDT	115VAC	2635/2635	MHJ-18A-115VAC	40.00

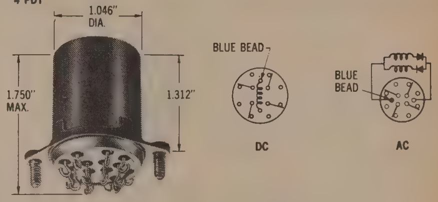
Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

Note 1: Vibration capabilities 20G to 2000Hz.

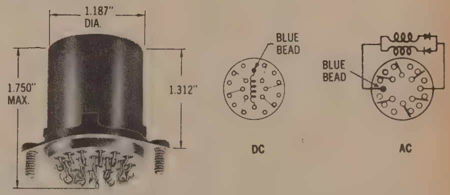
DPDT



4 PDT



6 PDT



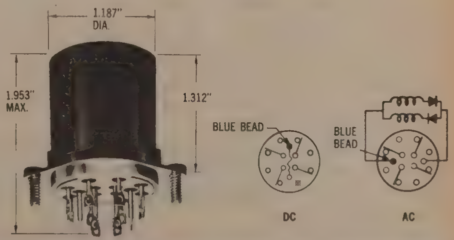
10 AMP/SERIES MHY

Miniature 4 Pole Double Throw Relays for Military and Aerospace applications. Contacts for load switching up to 10 amperes. Split coil construction with diodes for AC operation and minimized EMI. Meets MIL-R-5757 as applicable.

Voltage	Contact Rating	Temp. Range	Contact Arrange-ment	Coils Input	Coils Coil Res.	Catalog No.	List Price
AC	10 Amp	−55°C to +85°C	4 PDT	115VAC	2635/2635	MHY-12A-115VAC	$41.50
DC	10 Amp	−65°C to +125°C	4 PDT	12VDC	40	MHY-12D-12VDC	28.25
				26.5VDC	200	**MHY-12D-26.5VDC**	28.25
				115VDC	3,500	MHY-12D-115VDC	28.25

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

4 PDT



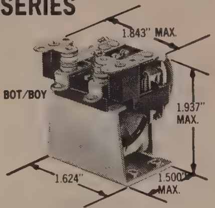
GOULD **ALLIED CONTROL**

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

INDUSTRIAL/COMMERCIAL RELAYS

OPEN FRAME—BOT/BOY SERIES

Low Cost DPDT industrial relay. Heavy duty contact switching up to 15 amperes. AC versions use shading ring for 50/60 Hz operation. Weight: 5.0 to 9.0 ounces.

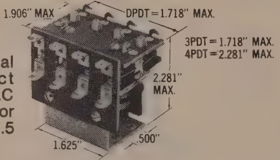


Description	Contact Rating	Contact Arrangement	Coils		Catalog No.	List Price
			Input	Coil Res.		
AC	15 Amp	DPDT	12VAC	4.10	BOT-6A-12VAC	$7.75
			24VAC	17	**BOT-6A-24VAC**	7.75
			115VAC	445	BOT-6A-115VAC	7.75
DC	15 Amp	DPDT	12VDC	70	BOT-6D-12VDC	7.45
			26.5VDC	230	**BOT-6D-26.5VDC**	7.45
			110/120VDC	5,000	BOT-6D-110/120VDC	7.45
Sensitive DC	10 Amp	DPDT	26.5VDC	900	BOY-6D-26.5VDC	10.10
			87VDC	10,000	**BOY-6D-87VDC**	10.10

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

OPEN FRAME, HEAVY DUTY—PO SERIES

Low cost, up to 4 PDT, industrial relay. Heavy duty contact switching up to 15 amperes. AC versions use shading ring for 50/60 Hz operation. Weight: 7.5 to 15.0 ounces.

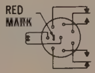


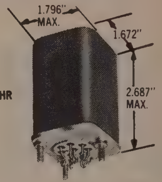
Description	Contact Rating	Contact Arrangement	Coils		Catalog No.	List Price
			Input	Coil Res.		
AC	15 Amp	DPDT	12VAC	1.5	PO-6A-12VAC	$9.00
			24VAC	8	**PO-6A-24VAC**	9.00
			110/120VAC	145	PO-6A-110/120VAC	9.00
	15 Amp	3PDT	12VAC	1.5	PO-9A-12VAC	9.80
			24VAC	8	PO-9A-24VAC	9.80
			110/120VAC	145	PO-9A-110/120VAC	9.80
	15 Amp	4PDT	12VAC	1.5	PO-12A-12VAC	11.15
			24VAC	8	**PO-12A-24VAC**	11.15
			110/120VAC	145	PO-12A-110/120VAC	11.15
DC	15 Amp	DPDT	12VDC	.70	PO-6D-12VDC	8.60
			26.5VDC	230	**PO-6D-26.5VDC**	8.60
			110/120VAC	5,000	PO-6D-110/120VDC	8.60
	15 Amp	3PDT	12VDC	70	PO-9D-12VDC	9.45
			26.5VDC	230	PO-9D-26.5VDC	9.45
			110/120VDC	5,000	PO-9D-110/120VDC	9.45
	15 Amp	4PDT	12VDC	70	PO-12D-12VDC	10.75
			26.5VDC	230	**PO-12D-26.5VDC**	10.75
			110/120VDC	5,000	PO-12D-110/120VDC	10.75

Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

HERMETICALLY SEALED—BOHR SERIES

Hermetically sealed DPDT relay for industrial application in hostile environments. 50/60 Hz operation of AC version.

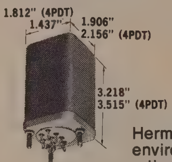


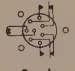


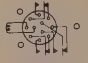
Description	Contact Rating	Contact Arrangement	Coils		Catalog No.	List Price
			Input	Coil Res.		
AC	15 Amp	DPDT	12VAC	4.10	BOHR-6A-12VAC	$17.00
			24VAC	17	BOHR-6A-24VAC	17.00
			110/120VAC	445	BOHR-6A-110/120VAC	17.00
DC	15 Amp	DPDT	12VDC	70	BOHR-6D-12VDC	16.30
			26.5VDC	230	BOHR-6D-26.5VDC	16.30
			110/120VDC	5,000	BOHR-6D-110/120VDC	16.30

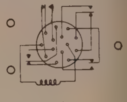
Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

HERMETICALLY SEALED POHR SERIES




2 pole


3 pole


4 pole

Hermetically sealed against hostile industrial environments. Up to 4PDT. Heavy duty, 15 amp rating. AC versions for 50/60 Hz operation.

Description	Contact Rating	Contact Arrangement	Coils		Catalog No.	List Price
			Input	Coil Res.		
AC	15 Amp	DPDT	12VAC	1.5	POHR-6A-12VAC	$19.30
			24VAC	8	POHR-6A-24VAC	19.30
			110/120VAC	145	POHR-6A-110/120VAC	19.30
	15 Amp	3PDT	12VAC	1.5	POHR-9A-12VAC	25.00
			24VAC	8	POHR-9A-24VAC	25.00
			110/120VAC	145	POHR-9A-110/120VAC	25.00
	15 Amp	4PDT	12VAC	1.5	POHR-12A-12VAC	26.75
			24VAC	8	POHR-12A-24VAC	26.75
			110/120VAC	145	POHR-12A-110/120VAC	26.75
DC	15 Amp	DPDT	12VDC	70	POHR-6D-12VDC	18.60
			26.5VDC	230	POHR-6D-26.5VDC	18.60
			110/120VDC	5,000	POHR-6D-110/120VDC	18.60
	15 Amp	3PDT	12VDC	70	POHR-9D-12VDC	23.95
			26.5VDC	230	POHR-9D-26.5VDC	23.95
			110/120VDC	5,000	POHR-9D-110/120VDC	23.95
	15 Amp	4PDT	12VDC	70	POHR-12D-12VDC	26.25
			26.5VDC	230	POHR-12D-26.5VDC	26.25
			110/120VDC	5,000	POHR-12D-110/120VDC	26.25

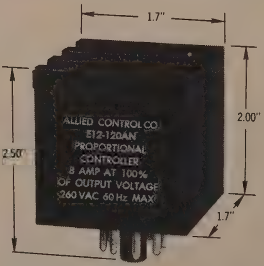
Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.

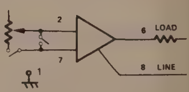
SOLID STATE PRODUCTS

PROPORTIONAL CONTROLLER—SERIES E12

Type E12 solid state proportional controllers control loads up to 8 amperes. When terminal pins 2 and 7 of the octal plug connector are shorted, the unit provides 100% output voltage. When a resistance is substituted for the short the unit will provide as low as 10% full output voltage. By varying the resistance, the output voltage can be varied from 10% to 100% of the full line voltage. This is especially useful for dimming lamps, controlling heaters, and controlling motor speeds.

Built-in transient capability and thermal conductive epoxy encapsulation make Type E12 controllers ideal for use in adverse industrial environments. High current inrush capability permits control of either inductive or resistive loads without derating. No heat sinking is required when the unit is used with specified ratings.





Wiring Diagram

Maximum resistance across Pins 2 & 7 for minimum output
120V line, 250K, ½ watt
240V line, 500K, ½ watt

Catalog Number E12-120AN
Max. Load Current .... 8 Amp
Output Voltage .... 260 VAC
List Price $21.20

GOULD **ALLIED CONTROL**

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

MINIATURE PRINTED CIRCUIT RELAYS—SERIES MPC

MPC-SERIES features low profile high density packaging with unique hingeless armature for longlife, gold plated silver contacts for switching low level up to 2 amperes (50 watts maximum per pole). Interlocking housing provides maximum protection from contamination and increases reliability. Available in 1, 2 and 4 pole configurations.

Relays are adjusted for:

Pickup—Maximum—75% of Nominal Coil Voltage.

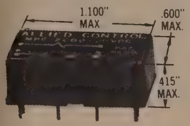
Drop-out—Minimum—10% of pickup maximum.

Maximum Power Dissipation 1.3 watts at 25°C.

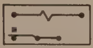
Weight 8 to 11 grams.

Contact Rating	Contact Arrange-ment	Coils			Catalog Number	List Price
		Input	Res. in Ohms	Nom. Power		
2 Amp	SPDT	5VDC	35	720mW	MPC-1C-5VDC	$2 80
		6VDC	50		**MPC-1C-6VDC**	2.80
		12VDC	200		**MPC-1C-12VDC**	2.80
		24VDC	800		**MPC-1C-24VDC**	2.95
		48VDC	3,200		MPC-1C-48VDC	2.95
	DPDT	5VDC	35	720mW	MPC-2C-5VDC	3.70
		6VDC	50		**MPC-2C-6VDC**	3.70
		12VDC	200		**MPC-2C-12VDC**	3.70
		24VDC	800		**MPC-2C-24VDC**	3.80
		48VDC	3,200		**MPC-2C-48VDC**	3.80
	4PDT	5VDC	26	960mW	MPC-4C-5VDC	4.98
		6VDC	38		**MPC-4C-6VDC**	4.98
		12VDC	150		**MPC-4C-12VDC**	4.98
		24VDC	600		**MPC-4C-24VDC**	4.98
		48VDC	2,400		**MPC-4C-48VDC**	4 98

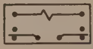
Note: **Bold Type** indicates relays normally stocked by all Gould-Allied Control franchised distributors.


1.100" MAX
.600" MAX.
.415" MAX.
ALLIED CONTROL

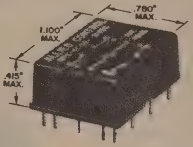
TOP VIEW

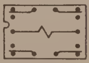


ONE POLE



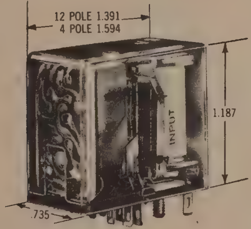
TWO POLE


.780" MAX.
1.100" MAX.
.415" MAX.



FOUR POLE

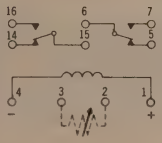
TIMERS, DPDT 5 AMP—SERIES TD10


12 POLE 1.391
4 POLE 1.594
1.187
.735
INPUT

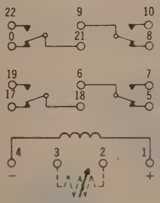
The TD10 utilizes the service proved T154 Cradle® relay with a solid state timing circuit to provide timing from 0.1 to 100 seconds with + 2% repeat accuracy. (Up to 300 seconds on special order).

Available as "time delay to make" or "interval" timing models with optional operating and mounting features.

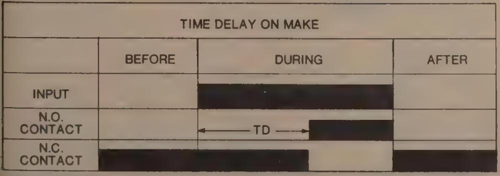
Catalog Number	Time Range (in seconds)	Input Volt	List Price
INTERVAL			
TD10NA-2C-12DNB	0.1 to 10	12VDC	$21.80
TD10NA-2C-24DNB	0.1 to 10	24VDC	21 80
TD10NA-2C-115ANB	0.1 to 10	115VAC 50/60Hz	26.00
TD10NA-2C-12DND	1 to 100	12VDC	27 80
TD10NA-2C-24DND	1 to 100	24VDC	27 80
TD10NA-2C-115AND	1 to 100	115VAC 50/60Hz	32 00
DELAY TO MAKE			
TD10DA-2C-12DNB	0.1 to 10	12VDC	22.40
TD10DA-2C-24DNB	0.1 to 10	24VDC	22.40
TD10DA-2C-115ANB	0.1 to 10	115VAC 50/60Hz	26.60
TD10DA-2C-12DND	1 to 100	12VDC	28.40
TD10DA-2C-24DND	1 to 100	24VDC	28.40
TD10DA-2C-115AND	1 to 100	115VAC 50/60Hz	32.60

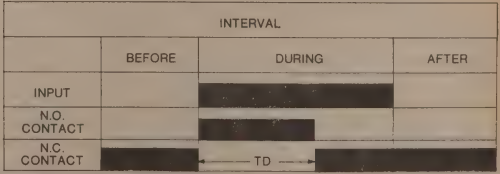

16
6
7
14
15
5
4
3
2
1
-
+

2 POLE


22
9
10
0
21
8
19
6
7
17
18
5
4
3
2
1
-
+

4 POLE


TIME DELAY ON MAKE
BEFORE
DURING
AFTER
INPUT
N.O. CONTACT
TD
N.C. CONTACT


INTERVAL
BEFORE
DURING
AFTER
INPUT
N.O. CONTACT
N.C. CONTACT
TD

GOULD ALLIED CONTROL

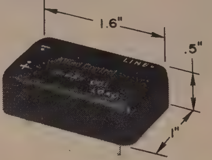
GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

SOLID STATE PRODUCTS/SOLID STATE RELAYS

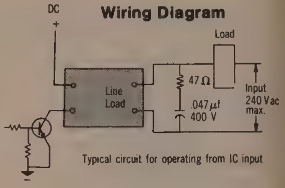
PRINTED CIRCUIT, 4 AMP, SINGLE POLE—SERIES E22

Type E22 miniature solid state relays are full-wave power switches which control either resistive or inductive ac loads up to 4 amperes. They control over the **full** wave cycle, beginning one-half cycle after initial turn-on. When input is removed, the relay de-energizes the load when the current crosses zero. These features virtually eliminate electrical noise, and make the relay ideal for use on computer logic circuit boards having low noise immunity. A toroidal transformer isolates input and output, thereby eliminating interfacing problems. DC input relay models are reverse polarity protected as well.

The solid state circuitry using the most advanced silicon devices, is enclosed in a thermal-conductive epoxy filled aluminum housing. This complete encapsulation permits direct use in explosive or otherwise hostile atmospheres.



Wiring Diagram



Typical circuit for operating from IC input

Input Voltage	Catalog Number	Output
DC		
3-7VDC 7-15VDC 15-30VDC	E22-1201N E22-1202N E22-1203N	260VAC 4 Amp 50-60 Hz

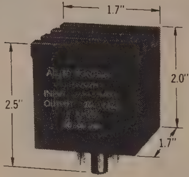
List Price $16.60

PLUG-IN 8 AMP, SINGLE POLE—SERIES E11

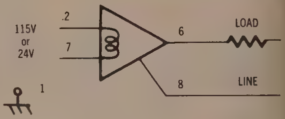
Type E11 solid state relays are full-wave power switches which control either resistive or inductive ac loads up to 8 amperes. They control over the **full** wave cycle, beginning one-half cycle after initial turn-on. When input is removed, the relay de-energizes the load when the current crosses zero. These features virtually eliminate electrical noise.

Electrical isolation of the input from the output provides inherent immunity against noise from the load side. This, coupled with the ability to withstand transients as high as 100 amps makes Type E11 relays ideal for adverse industrial applications especially those where long life and high switching rates are required.

The solid state circuitry using the most advanced silicon devices, is enclosed in a thermal-conductive epoxy filled aluminum housing. This complete encapsulation permits direct use in explosive or otherwise hostile atmospheres. Reverse polarity protection is another feature of Type E11 dc input relays. They are especially suited for switching motors, solenoids or incandescent lamps.



Wiring Diagram



Input Voltage		Catalog Number	Output
AC	DC		
	3-7VDC	E11-1201N	260VAC
	7-15VDC	E11-1202N	3 Amp
	15-30VDC	E11-1203N	50-60 Hz
20-28VAC		E11-1200N	
100-135VAC		E11-1204N	
200-260VAC		E11-1206N	

List Price $22.60

PANEL MOUNT 15/24 AMP, SINGLE POLE—SERIES E19/E20

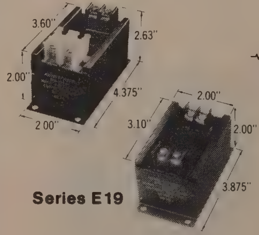
Type E19 and E20 solid state relays are full-wave power switches which control either resistive or inductive ac loads up to 24 amperes. They control over the **full** wave cycle, beginning one-half cycle after initial turn-on. When input is removed, the relay de-energizes the load when the current crosses zero. These features virtually eliminate electrical noise.

Electrical isolation of the input from the output provides inherent immunity against noise from the load side. This, coupled with protection against voltage transients make Types E19 and E20 relays ideal for adverse industrial applications especially those where long life and high switching rates are required.

The solid state circuitry using the most advanced silicon devices, is enclosed in a thermal-conductive epoxy filled aluminum housing. This complete encapsulation permits direct use in explosive or otherwise hostile atmospheres. The relay's high current inrush capabilities enable it to control loads of any power factor and all dc input models are reverse polarity protected as well. An added benefit of Types E19 and E20 relays is their modular construction which permits simple field replacement or modification when used in multiple switching circuits.

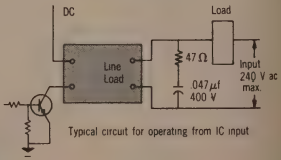
Types E19 and E20 relays are particularly suited to heavy duty industrial applications which require long life and high switching rates. For switching heavy duty solenoids, for example, they can replace 150A and 350A rated electromechanical relays respectively.

Series E20



Series E19

Wiring Diagram



Typical circuit for operating from IC input

Input Voltage		Series E19 15 Amp	Series E20 24 Amp	Output
AC	DC			
	3-7VDC	E19-1201N	E20-1201N	260VAC
	7-15VDC	E19-1202N	E20-1202N	
	15-30VDC	E19-1203N	E20-1203N	
100-135VAC		E19-1204N	E20-1204N	

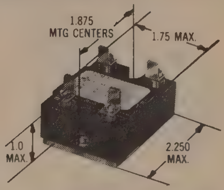
List Price $28.50 (15 Amp) $32.50 (24 Amp)

GOULD **ALLIED CONTROL**

GOULD INC., ALLIED CONTROL DIVISION
100 Relay Road, Plantsville, Connecticut 06479
Telephone (203) 628-9654

SOLID STATE PRODUCTS/SOLID STATE RELAYS

OPTO ISOLATED POWER RELAYS—SERIES E-3



This new line of solid state relays offer the following advanced design concepts for flexible application.

ZERO VOLTAGE SWITCHING—All Series E-3 Power Relays are designed for True Zero Voltage switching. Power is applied to load at zero-voltage cross-over. Power is removed from load at zero-current cross-over.

HIGH NOISE IMMUNITY—Gould—Allied Control has virtually eliminated misfiring due to RFI transients. Our testing shows the Series E-3 Power Relay to be superior to competitive units under identical test conditions.

HIGH IN-RUSH CAPABILITIES—The Series E-3 Solid State Power Relay has been tested to and is guaranteed to meet in-rush loads of 1000% of rated current.

PHOTO-ISOLATED—Input-Output circuitry is isolated by the use of latest state of the art technology. The use of light emitting diode and the photo detector provide circuit isolation of 1560 VAC.

INTEGRATED CIRCUIT COMPATABLE—The Series E-3 Solid State Relay operates directly from and is compatable with the computer age integrated technology allowing a wide range of design applications.

SIGNAL VERSATILITY—The Series E-3 Solid State Power Relay is available in three input signal models allowing wide versatility in application selection.

ONE MODEL FOR ALL OUTPUT VOLTAGES—One model of the Series E-3 Solid State Relay is used to cover all commonly used voltages providing the user with a single model inventory in commercial applications. (Output voltage: 80 to 280 VAC, 47-63 Hz).

SELECTION GUIDE

Max. Load Current	Control Signal Range	Catalog No. Form A Contact	Catalog No. Form B Contact	List Price
10 Amp	3-32 VDC	E3-10D-1A	E3-10D-1B	$24.75
25 Amp		E3-25D-1A	E3-25D-1B	33.88
40 Amp		E3-40D-1A	E3-40D-1B	47.12
10 Amp	20-28 VAC	E3-10A-0A	E3-10A-0B	26.25
25 Amp		E3-25A-0A	E3-25A-0B	35.38
40 Amp		E3-40A-0A	E3-40A-0B	48.62
10 Amp	100-135 VAC	E3-10A-4A	E3-10A-4B	26.25
25 Amp		E3-25A-4A	E3-25A-4B	35.38
40 Amp		E3-40A-4A	E3-40A-4B	48.62

ELECTRICAL SPECIFICATIONS

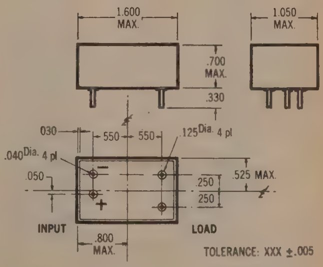
		Model Numbers E3-																	
		10D1		25D1		40D1		10A0		25A0		40A0		10A4		25A4		40A4	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
A. CONTACT SIDE (OUTPUT)																			
Contact Arrangement (SPST)		NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC
AC Line Operation		100-280 VAC 47-63 Hz																	
Max Load Current I max.		10A		25A		40A		10A		25A		40A		10A		25A		40A	
One Cycle Surge (non repetitive) on state current	50 Hz	90A		200A		350A		90A		200A		350A		90A		200A		350A	
	60 Hz	100A		250A		400A		100A		250A		400A		100A		250A		400A	
Max Contact Voltage Drop at I max.		1.6V		2V		2V		1.6V		2V		2V		1.6V		2V		2V	
Max. Holding Current	Tc = +25°C	50mA		60mA		60mA		50mA		60mA		60mA		50mA		60mA		60mA	
	Tc = −30°C	90mA						90mA						90mA					
Off State Leakage Current		2mA		4mA		4mA		2mA		4mA		4mA		2mA		4mA		4mA	
Response Time						Max. ½ cycle (next zero crossing): 60 Hz: max. 8.3 ms; 50 Hz: max 10 ms													
Input to Output Isolation	Voltage	2500 VDC																	
	Resist	10(11) ohms at 500 VDC																	
B. SIGNAL SIDE (INPUT)																			
Control Signal Range				3-32 VDC						20-28 VAC						100-135 VAC			
Pick Up Voltage				3.0 VDC max.						18 VAC max						90 VAC max.			
Drop Out Voltage				1.0 VDC min.						10 VAC min.						10 VAC min.			
Input Impedance				2200 ohms						10k ohms						40k ohms			
Operating Temperature Range										−30 to + 80°C									
Storage Temperature Range										−40 to +125°C									

MINIATURE, ENCAPSULATED, PRINTED CIRCUIT SOLID STATE RELAY—SERIES E4

The E4 Solid State relay has been designed to interface with integrated logic circuit outputs. As an input-output device used for inductive motor loads it is ideally suited for Point of Sale equipment.

The Series E4 Solid State Relay is torroidal isolated and has been isolation tested to 1560 volts by Underwriters Laboratories.

UL Approved—File No. E57093.



ELECTRICAL SPECIFICATIONS

Characteristic	Min.	Max.	Unit
Input Current, $V_{IN}=4.0V$	—	15	mA
$V_{IN}=10.0V$	—	50	mA
RMS Output Voltage	40	280	V
Zero-Voltage Crossing	—	+40	V
Peak Forward Voltage Drop $I_{TM}=0.42A$	—	2.5	V
Off State Current V_D (RMS)=280V $T_A=25°C$	—	1.0	mA
$T_A=100°C$	—	3 0	mA
Minimum Holding Current V_T (RMS)=10V	—	1 0	mA
Critical Rate Of Rise	4.0	—	V/us

Characteristic	Min.	Max.	Unit
Repetitive Peak Off-State Voltage	—	400	VDC
RMS Working Voltage	—	280	VAC
RMS On State Current $T_A=60°C$		300	mA
Peak One Cycle Surge On-State Current (Non-Repetitive)	—	4.0	A
Input Voltage	—	10	V
Operating Temperature	—	0 to +70	°C
Storage Temperature	—	−40 to +125	°C
Pick-up Voltage, Logic "1"	—	4.0	V
Drop-out Voltage, Logic "0"	0 7	—	V

Maximum Ratings: (TA=0 to +70°C Unless Otherwise Noted)
Power Factor: 0.5 Minimum (Lagging Current)
Dielectric Withstanding Voltage: 2000 VRMS Minimum, maximum leakage current=50uA per VDE.
Insulation Resistance: 10^{10} Ohms minimum.
Shock: 15g.
Vibration: 10 to 2000 Hz.
Encapsulated unit—impervious to environment

Grayhill

SOLID STATE RELAYS

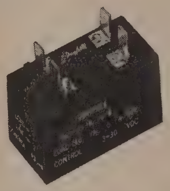
TWO BASIC CONTROL TYPES AVAILABLE

DC CONTROL OF AC LOAD — OPTICALLY ISOLATED
TRANSFORMER ISOLATED
HYBRID (REED RELAY ISOLATED)

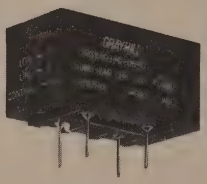
DIRECT CONTROL (NON-ISOLATED) — AC TYPE
DC TYPE

- LOAD SWITCHING BY SOLID STATE DEVICE ELIMINATES CONTACT DETERIORATION
- EXTREMELY LONG LIFE, VIRTUALLY ELIMINATES REPLACEMENT
- MANY TYPES DIRECTLY COMPATIBLE WITH LOGIC CIRCUITS
- DESIGNED-IN TRANSIENT AND OVER-VOLTAGE PROTECTION
- RELIABLE SWITCHING OF INDUCTIVE LOADS
- SUPERIOR HEAT TRANSFER CHARACTERISTICS PROVIDES SMALL SIZE PER AMPERAGE CAPACITY
- ZERO VOLTAGE TURN-ON DESIGNED-IN OR OPTIONAL

PACKAGE CHOICES



PACKAGE "B"
APPROX. 2.1" x 1.1" x 1.4"



PACKAGE "C"
PC MOUNT — 6 AMP MAX.
APPROX. 2.1" x 1.1" x 1.4"

OPTICALLY (LED) ISOLATED SOLID STATE RELAYS DC CONTROL OF AC LOADS

- DIRECTLY COMPATIBLE WITH LOGIC CIRCUITRY
- NO EXTERNAL DRIVE OR CURRENT LIMITING CIRCUITRY REQUIRED
- SWITCHES 0.25 TO 15 AMP LOAD CURRENT
- ZERO VOLTAGE TURN-ON DESIGNED-IN

Control Voltage	Load Voltage	Load Current	Zero Voltage Turn-On	Package Type	Part Number
3-30 VDC	50-140 VAC	.250 to 6A	Yes	B	70S2-03-B-06-B
3-30 VDC	50-140 VAC	.250 to 6A	Yes	C	70S2-03-B-06-C
3-30 VDC	50-140 VAC	.250 to 10A	Yes	B	70S2-03-B-10-B
3-30 VDC	50-140 VAC	.250 to 15A	Yes	B	70S2-03-B-15-B
3-30 VDC	100-240 VAC	.250 to 6A	Yes	B	70S2-03-C-06-B
3-30 VDC	100-240 VAC	.250 to 6A	Yes	C	70S2-03-C-06-C
3-30 VDC	100-240 VAC	.250 to 10A	Yes	B	70S2-03-C-10-B
3-30 VDC	100-240 VAC	.250 to 15A	Yes	B	70S2-03-C-15-B
3-30 VDC	50-140 VAC	.250 to 6A	Yes	D	70S2-03-B-06-D
3-30 VDC	50-140 VAC	.250 to 10A	Yes	D	70S2-03-B-10-D
3-30 VDC	50-140 VAC	.250 to 15A	Yes	D	70S2-03-B-15-D
3-30 VDC	100-240 VAC	.250 to 6A	Yes	D	70S2-03-C-06-D
3-30 VDC	100-240 VAC	.250 to 10A	Yes	D	70S2-03-C-10-D
3-30 VDC	100-240 VAC	.250 to 15A	Yes	D	70S2-03-C-15-D

Price: Approximately $14.75 each in 100 piece lots dependent on package, load voltage and current capacity.

✻ Available locally through your Grayhill distributor

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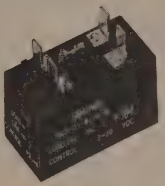
SOLID STATE RELAYS

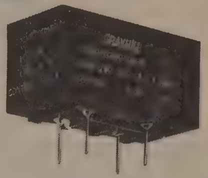
Grayhill

TRANSFORMER ISOLATED SOLID STATE RELAYS DC CONTROL OF AC LOADS

- COMPLETE ELECTRICAL ISOLATION
- CONTROL CURRENTS AS LOW AS 1 MA.
- SWITCHES 0.25 TO 15 AMP LOAD CURRENT
- ZERO VOLTAGE TURN-ON OPTION

PACKAGE CHOICES


PACKAGE "B"
APPROX. 2.1" x 1.1" x 1.4"


PACKAGE "C"
PC MOUNT — 6 AMP MAX.
APPROX. 2.1" x 1.1" x 1.4"

Control Voltage	Load Voltage	Load Current	Zero Voltage Turn-On	Package Type	Part Number
4.5-10 VDC	50 to 140 VAC	.250 to 6A	No	B	70SI-01-B-06-B
4.5-10 VDC	50 to 140 VAC	.250 to 6A	No	C	70SI-01-B-06-C
10 -30 VDC	50 to 140 VAC	.250 to 6A	No	B	70SI-02-B-06-B
10 -30 VDC	50 to 140 VAC	.250 to 6A	No	C	70SI-02-B-06-C
10 -30 VDC	50 to 140 VAC	.250 to 10A	No	B	70SI-02-B-10-B
10 -30 VDC	50 to 140 VAC	.250 to 15A	No	B	70SI-02-B-15-B
10 -30 VDC	100 to 240 VAC	.250 to 6A	No	B	70SI-02-C-06-B
10 -30 VDC	100 to 240 VAC	.250 to 6A	No	C	70SI-02-C-06-C
10 -30 VDC	100 to 240 VAC	.250 to 10A	No	B	70SI-02-C-10-B
10 -30 VDC	100 to 240 VAC	.250 to 15A	No	B	70SI-02-C-15-B
4.5-30 VDC	50 to 140 VAC	.250 to 6A	Yes	B	70SI-03-B-06-B
4.5-30 VDC	50 to 140 VAC	.250 to 6A	Yes	C	70SI-03-B-06-C
4.5-30 VDC	50 to 140 VAC	.250 to 10A	Yes	B	70SI-03-B-10-B
4.5-30 VDC	50 to 140 VAC	.250 to 15A	Yes	B	70SI-03-B-15-B
4.5-30 VDC	100 to 240 VAC	.250 to 6A	Yes	B	70SI-03-C-06-B
4.5-30 VDC	100 to 240 VAC	.250 to 6A	Yes	C	70SI-03-C-06-C
4.5-30 VDC	100 to 240 VDC	.250 to 10A	Yes	B	70SI-03-C-10-B
4.5-30 VDC	100 to 240 VAC	.250 to 15A	Yes	B	70SI-03-C-15-B

Price: Approximately $13.25 each in 100 piece lots dependent on package, load voltage and current capacity.

DIRECT CONTROL (NON-ISOLATED) SOLID STATE RELAYS / AC TYPE OR DC TYPE

- UTILIZES SAME VOLTAGE SOURCE FOR CONTROL AND LOAD
- TRIGGERED BY LOW CURRENT CONTACTS
- SWITCHES 0.25 TO 6 AMP LOAD CURRENT

PACKAGE "A"
APPROX. 2" x 1.25" x 0.5"

Control Voltage	Load Voltage	Load Current	Zero Voltage Turn-On	Package Type	Part Number
50-140 VAC	50 to 140 VAC	.250 to 6A	No	A	70C1-01-B-06-A
100-240 VDC	100 to 240 VDC	.250 to 6A	No	A	70C1-01-C-06-A
6- 48 VDC	6 to 48 VDC	.250 to 6A	No	A	70C2-01-A-06-A

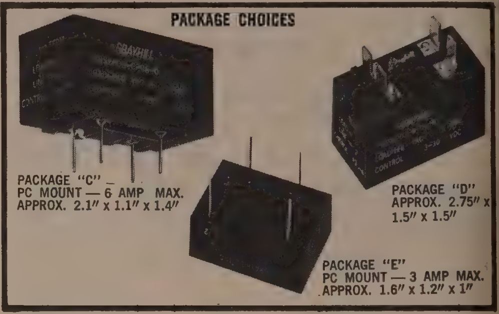
Price: Approximately $6.25 each in 100 piece lots dependent on type of control and load voltage.

Grayhill

SOLID STATE RELAYS

HYBRID (REED RELAY ISOLATED) SOLID STATE RELAYS DC CONTROL OF AC LOADS

— THE ECONOMICAL CHOICE OF ISOLATED RELAYS
— REQUIRES APPROXIMATELY 12.5 MA DRIVE CURRENT
— SWITCHES 10 MA TO 15 AMP LOAD CURRENT
— ZERO VOLTAGE TURN-ON OPTION


PACKAGE CHOICES

PACKAGE "C" — PC MOUNT — 6 AMP MAX. APPROX. 2.1″ x 1.1″ x 1.4″

PACKAGE "D" APPROX. 2.75″ x 1.5″ x 1.5″

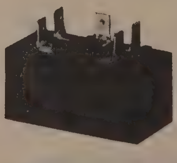
PACKAGE "E" PC MOUNT — 3 AMP MAX. APPROX. 1.6″ x 1.2″ x 1″

Control Voltage	Load Voltage	Load Current	Zero Voltage Turn-On	Package Type	Part Number
5 VDC Nom.	50-140 VAC	.010 to 2A	No	E	70H1-01-B-02-E
5 VDC Nom.	50-140 VAC	.200 to 3A	No	E	70H1-01-B-03-E
5 VDC Nom.	50-140 VAC	.250 to 6A	No	C	70H1-01-B-06-C
5 VDC Nom.	50-140 VAC	.250 to 6A	No	D	70H1-01-B-06-D
5 VDC Nom.	50-140 VAC	.250 to 10A	No	D	70H1-01-B-10-D
5 VDC Nom.	50-140 VAC	.250 to 15A	No	D	70H1-01-B-15-D
5 VDC Nom.	100-240 VAC	.010 to 2A	No	E	70H1-01-C-02-E
5 VDC Nom.	100-240 VAC	.200 to 3A	No	E	70H1-01-C-03-E
5 VDC Nom.	100-240 VAC	.250 to 6A	No	C	70H1-01-C-06-C
5 VDC Nom.	100-240 VAC	.250 to 6A	No	D	70H1-01-C-06-D
5 VDC Nom.	100 240 VAC	.250 to 10A	No	D	70H1-01-C-10-D
5 VDC Nom.	100-240 VAC	.250 to 15A	No	D	70H1-01-C-15-D
12 VDC Nom.	50-140 VAC	.010 to 2A	No	E	70H1-02-B-02-E
12 VDC Nom.	50-140 VAC	.200 to 3A	No	E	70H1-02-B-03-E
12 VDC Nom.	50-140 VAC	.250 to 6A	No	C	70H1-02-B-06-C
12 VDC Nom.	50-140 VAC	.250 to 6A	No	D	70H1-02-B-06-D
12 VDC Nom.	50-140 VAC	.250 to 10A	No	D	70H1-02-B-10-D
12 VDC Nom.	50-140 VAC	.250 to 15A	No	D	70H1-02-B-15-D
12 VDC Nom.	100-240 VAC	.010 to 2A	No	E	70H1-02-C-02-E
12 VDC Nom.	100-240 VAC	.200 to 3A	No	E	70H1-02-C-03-E
12 VDC Nom.	100-240 VAC	.250 to 6A	No	C	70H1-02-C-06-C
12 VDC Nom.	100-240 VAC	.250 to 6A	No	D	70H1-02-C-06-D
12 VDC Nom.	100-240 VAC	.250 to 10A	No	D	70H1-02-C-10-D
12 VDC Nom.	100-240 VAC	.250 to 15A	No	D	70H1-02-C-15-D
5 VDC Nom.	50-140 VAC	.250 to 6A	Yes	D	70H1-03-B-06-D
5 VDC Nom.	50-140 VAC	.250 to 10A	Yes	D	70H1-03-B-10-D
5 VDC Nom.	50-140 VAC	.250 to 15A	Yes	D	70H1-03-B-15-D
5 VDC Nom.	100-240 VAC	.250 to 6A	Yes	D	70H1-03-C-06-D
5 VDC Nom.	100-240 VAC	.250 to 10A	Yes	D	70H1-03-C-10-D
5 VDC Nom.	100-240 VAC	.250 to 15A	Yes	D	70H1-03-C-15-D

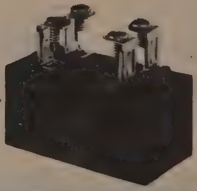
Price: Approximately $10.25 each in 100 piece lots dependent on package, load current and current capacity.

SCREW TERMINAL ADAPTER FOR 0.25 TAB TERMINAL

WITHOUT ADAPTER



WITH ADAPTER



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reedac™ relays

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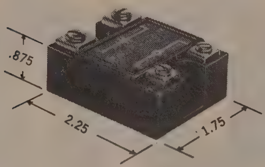
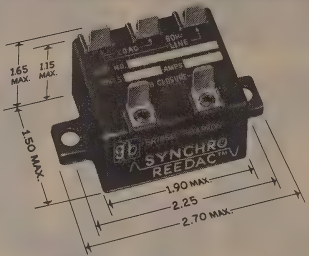
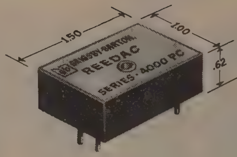
Basic Package Dimensions



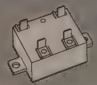
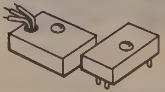
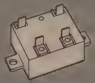
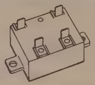
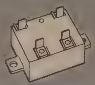
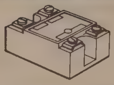
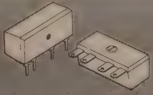
GB15000 SERIES



GB2000, 5000, 9000, 12000 SERIES



GB4000

DESCRIPTION		LOAD VOLTAGE AC	LOAD CURRENT AMPS 60 Hz	INPUT VDC
	**GB2000 Series Reedac** — A random turn-on hybrid relay. Clamp diode available on reed relay input. Optional suppression networks for inductive loads and line transient protection of triac. Low cost. UL recognized.	24-240	10, 25	5 (TTL) 12 24 switch closure
	**GB4000 Series Miniature Reedac** — Designed for medium power loads. Random turn-on hybrid relay. RC network and clamp diode options. UL recognized.	24-240	1.5	5 (TTL) 12 24 switch closure
	**GB5000 Series Phase Controller** — Solid state diac-triac combination for motor speed and heater control external potentiometer input required.	120-240	10, 25	Potentiometer
	**GB9000 Series Synchro-Reedac** — 4 terminal zero voltage switching hybrid relay. Reduces inrush, minimizes RFI. Options available for inductive load and line transient protection of triac. UL recognized.	24-240	10, 25	5 (TTL) 12 24 switch closure
	**GB12000 Series** — All solid state voltage switching relay. Photo-coupled input. With line transient protection option not available in other true solid state relays. UL recognized.	24-240	10, 25	3-32
	**GB15000 Series** — Solid state zero voltage switching relay photo-coupled input. RC protection on output standard 1500 VAC isolation. Epoxy molded package. UL recognized.	24-240	5, 10, 15, 25	3-32
	**GB18000 Series** — Solid state relay. Photo-coupled input, zero voltage switching. Molded package with PC or quick connect terminal option. Screw down mounting.	24-240	.3, 1.5	3-32

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GORDOS CORPORATION

series 83 8-pin standard DIP reed relays

- Standard TO-116 terminal grid fits all standard DIP sockets.
- Interface directly with RTL, DTL, TTL, HTL logic.
- Molded epoxy package for environmental immunity; auto-insertion-compatible.
- Series 82 14-pins optional

TERMINAL IDENTIFICATION
Viewed from topside of relay

RELAY CHARACTERISTICS AND OPERATING VALUES

Form	Model Number	Coil Resistance Ohms ±10% @ 25°C	Nom. VDC	Max. VDC	Must Operate VDC	Must Release VDC	Clamp Diode	Fig. No.
1A	831A-1	380	5	7.5	4.0	.4	No	1
	831A-2	380	5	7.5	4.0	.4	Yes	1
	831A-3	500	5	7.5	4.0	.4	No	1
	831A-4	500	5	7.5	4.0	.4	Yes	1
	831A-5	500	12	15.0	9.6	1.2	No	1
	831A-6	500	12	15.0	9.6	1.2	Yes	1
	831A-7	2150	24	32.0	19.6	2.0	No	1
	831A-8	2150	24	32.0	19.6	2.0	Yes	1
	831A-9	380	5	7.5	4.0	.4		2
	831A-10	500	12	15.0	9.6	1.2		2
	831A-11	2150	24	32.0	19.6	2.0		2

FIG. 1

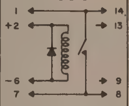
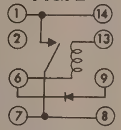


FIG. 2



Form	Model Number	Coil Resistance ±10% @ 25°C	Nom. VDC	Max. VDC	Must Operate VDC	Must Release VDC	Clamp Diode	Fig. No.
2A	832A-1	150	5	7.5	4.2	.5	No	3
	832A-2	150	5	7.5	4.2	.5	Yes	3
	832A-3	450	12	15.0	9.6	1.0	No	3
	832A-4	450	12	15.0	9.6	1.0	Yes	3
	832A-5	1750	24	32.0	20.0	2.0	No	3
	832A-6	1750	24	32.0	20.0	2.0	Yes	3
1B	831B-1	380	5	7.5[1]	4.0	.4	No	4
	831B-2	380	5	7.5[1]	4.0	.4	Yes	4
	831B-3	450	5	7.5[1]	4.0	.4	No	4
	831B-4	450	5	7.5[1]	4.0	.4	Yes	4
	831B-5	450	12	15.0[1]	9.6	1.2	No	4
	831B-6	450	12	15.0[1]	9.6	1.2	Yes	4
	831B-7	1750	24	27.5[1]	19.6	2.4	No	4
	831B-8	1750	24	27.5[1]	19.6	2.4	Yes	4

[1] Excessive voltage will cause contact reclosure.

FIG. 3

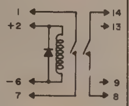
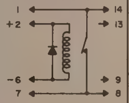


FIG. 4



Form	Model Number	Coil Resistance Ohms ±10% @ 25°C	Nom. VDC	Max. VDC	Must Operate VDC	Must Release VDC	Clamp Diode	Fig. No.
1C	831C-1	150	5	7.5	4.0	.5	No	5
	831C-2	150	5	7.5	4.0	.5	Yes	5
	831C-3	450	12	15.0	9.6	1.0	No	5
	831C-4	450	12	15.0	9.6	1.0	Yes	5
	831C-5	1750	24	32.0	20.0	2.0	No	5
	831C-6	1750	24	32.0	20.0	2.0	Yes	5
	835C-1	150	5	7.5	4.0	.5	No	6
	835C-2	150	5	7.5	4.0	.5	Yes	6
	835C-3	450	12	15.0	9.6	1.0	No	6
	835C-4	450	12	15.0	9.6	1.0	Yes	6
	835C-5	1750	24	32.0	20.0	2.0	No	6
	835C-6	1750	24	32.0	20.0	2.0	Yes	6

FIG. 5

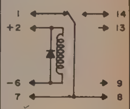
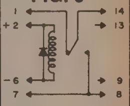
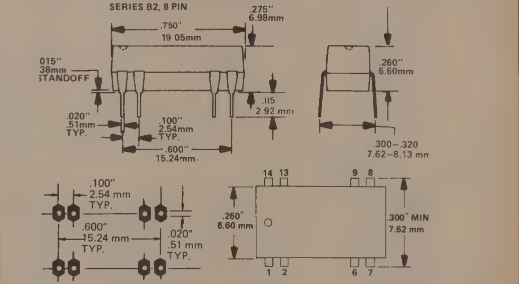


FIG. 6



OUTLINE DIMENSIONS



CONTACT RATINGS

Type	Maximum Switching Watts	Maximum Switching Volts	Maximum Current Switch	Maximum Current Carry	Maximum[1] Initial Contact Resistance	Min. Breakdown Voltage Across Contacts	Min. Breakdown Voltage Contacts–Coil	Capacitance (Typical) Across Contacts–	Capacitance (Typical) Contacts–Coil	Insulation Resistance (Typical)	Life Expectancy[3] Full Rating	Life Expectancy[3] ½ Rating	Life Expectancy[3] Signal Level
831A	10	100	.250	1.5	.200	250	500	.2	2.0[2]	10^{10}	10	50	100
831B	10	100	.250	1.5	.200	250	500	.2	2.0[2]	10^{10}	10	50	100
832A	3	28	.250	1.0	.200	150	500	.2	2.0[2]	10^{10}	5	50	100
831C	3	28	.250	1.0	.200	250	500	.8	2.0	10^{9}	5	20	50
835C	4	100	.110	1.0	.200	250	500	.8	2.0	10^{9}	5	20	100
UNIT	DC		AMPS	AMPS	OHMS	VDC	VDC	pF	pF	OHMS	MILLIONS OF OPERATIONS		

[1] Measured with nominal coil voltage applied (except Form B); 12VDC 100 MA applied to contacts, switched wet.

[2] With relay contacts closed value is 3.5pF.

[3] End of life is defined as failure to make or break within specified limits or contact resistance exceeding 2½% of the load resistance or impedance. Values shown are for resistive loads runs at 25°C with 50% duty cycle. Relay life is reduced at elevated temperature. Contact protection must be provided on inductive or high inrush current loads.

OPERATING CHARACTERISTICS

Operate Time, Including Bounce Form A and Form B	0.5 MS Max.
Form C	1.5 MS Max.
Release Time, Coil unsupressed Form A and Form B	0.35 MS Max.
Coil Supressed Form A and Form B	0.45 MS Max.
Coil unsupressed Form C	1.50 MS Max.
Coil Supressed Form C	1.70 MS Max.

Note: Release time for Form B and Form C includes bounce.

ENVIRONMENTAL CHARACTERISTICS

Temperature, Operating	–40°C-+ 85°C
Storage	–55°C-+125°C

Shock, 100G, 8Ms±1 Ms; ½ sine wave.

Vibration, 10-2000Hz. 20G or .125 in. displacement, whichever is less.

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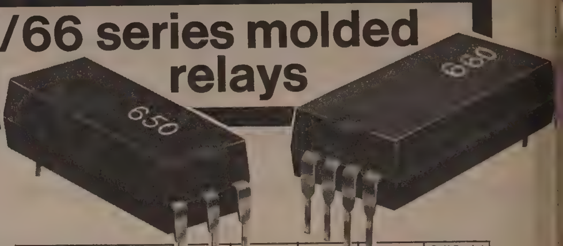
GORDOS CORPORATION

65/66 series molded relays

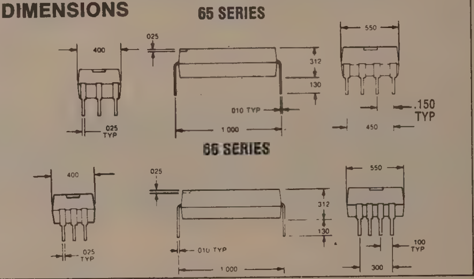


Form	Model Number	Nominal VDC	Must Operate VDC	Must Release VDC	Maximum VDC	Coil Resistance Ohms +20% ±10% @ 25°C
1. STANDARD CONTACTS						
1A SPST N.O.	651A-05-1	5	4.0	.5	7.5	150
	651A-12-1	12	9.6	1.0	15.0	575
	651A-24-1	24	19.0	2.0	32.0	2150
2A DPST N.O.	652A-05-1	5	4.0	.5	7.5	80
	652A-12-1	12	9.6	1.0	15.0	320
	652A-24-1	24	19.0	2.0	32.0	1500
1C SPDT	651C-05-1	5	4.0	.5	7.5	100
	651C-12-1	12	9.6	1.0	15.0	450
	651C-24-1	24	19.0	2.0	32.0	1750
2C DPDT	652C-05-1	5	4.0	.5	7.5	60
	652C-12-1	12	9.6	1.0	15.0	280
	652C-24-1	24	19.0	2.0	32.0	1000
2. INSTRUMENT GRADE**						
1A SPST N.O.	651A-05-2	5	4.0	.5	7.5	150
	651A-12-2	12	9.6	1.0	15.0	575
	651A-24-2	24	19.6	2.0	32.0	2150
2A DPST N.O.	652A-05-2	5	4.0	.5	7.5	80
	652A-12-2	12	9.6	1.0	15.0	320
	652A-24-2	24	19.6	2.0	32.0	1500
1C SPDT	651C-05-2	5	4.0	.5	7.5	100
	651C-12-2	12	9.6	1.0	15.0	450
	651C-24-2	24	19.6	2.0	32.0	1750
2C DPDT	652C-05-2	5	4.0	.5	7.5	60
	652C-12-2	12	9.6	1.0	15.0	280
	652C-24-2	24	19.0	2.0	32.0	1000
4. HIGH VOLTAGE						
1A SPST N.O.	651A-05-4	5	4.0	.5	7.5	70
	651A-12-4	12	9.6	1.0	15.0	320
	651A-24-4	24	19.0	2.0	32.0	1600
2A DPST N.O.	652A-05-4	5	4.0	.5	7.5	40
	652A-12-4	12	9.6	1.0	15.0	170
	652A-24-4	24	19.0	2.0	32.0	725

Form	Model Number	Nominal VDC	Must Operate VDC	Must Release VDC	Maximum VDC	Coil Resistance Ohms +20% −10% @ 25°C
5. MERCURY WETTED						
1A SPST N.O.	651A-05-5	5	4.0	.5	7.5	77
	651A-12-5	12	9.6	1.0	15.0	320
	651A-24-5	24	19.0	2.0	32.0	1600
2A DPST N.O.	652A-05-5	5	4.0	.5	7.5	40
	652A-12-5	12	9.6	1.0	15.0	170
	652A-24-5	24	19.0	2.0	32.0	725
6. ULTRA SENSITIVE						
1A SPST N.O.	651A-05-6	5	4.0	.5	7.5	500
	651A-12-6	12	9.6	1.0	15.0	2000
	651A-24-6	24	19.0	2.0	32.0	6000
2A DPST N.O.	652A-05-6	5	4.0	.5	7.5	350
	652A-12-6	12	9.6	1.0	15.0	1400
	652A-24-6	24	19.0	2.0	32.0	5600

[1] To specify diode add "D" after Model Number.
[2] 660 series characteristics identical to those shown for 650 series above.

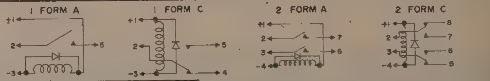
DIMENSIONS



TERMINAL IDENTIFICATION

Viewed from topside of relay

1. Indent in case terminal 1.
2. See coil characteristic table for relays containing diodes.



CONTACT RATINGS

Form	Type*	Maximum Switching		Maximum Current		Maximum[1] Initial Contact Resistance	Min. Breakdown Voltage		Capacitance (Typical)		Insulation Resistance (Typical)	Life Expectancy[3]		
		Watts	Volts	Switch	Carry		Across Contacts	Contacts–Coil	Across Contacts	Contacts–Coil		Full Rating	½ Rating	Signal Level
A	1 & 6	10	200	.500	1.5	.200	300	1000	.2	2.0[2]	10^{10}	10	50	100
	4	10	500	.500	1.5	.200	1000	1000	.2	2.0[2]	10^{10}	10	50	100
	5	50	100	1.000	1.0	.050	1000	1000	.2	2.0[2]	10^{10}	25	100	200
C	1	3	28	.250	1.0	.200	250	1000	.8	2.0	10^{8}	5	20	50
	UNIT	DC		AMPS	AMPS	OHMS	VDC	VDC	pF	pF	OHMS	MILLIONS OF OPERATIONS		

*1) Standard Contacts, 2) Instrument Grade, 4) High Voltage, 5) Mercury, 6) Ultra Sensitive

[1] Measured with nominal coil voltage applied 12VDC 100 MA applied to contacts, switched wet.

[2] With relay contacts closed value is 3.5pF

[3] End of life is defined as failure to make or break within specified limits or contact resistance exceeding 2½% of the load resistance or impedance. Values shown are for resistive loads run at 25°C with 50% duty cycle. Relay life is reduced at elevated temperature. Contact protection must be provided on inductive or high inrush current loads.

**NOTE: For information regarding instrument grade relays consult factory.

OPERATING CHARACTERISTICS

Operate Time, Including Bounce Form A .... 0.5 MS Max.
Form C .... 1.5 MS Max.
Release Time, ... Coil unsupressed Form A .... 0.35 MS Max.
Coil Supressed Form A .... 0.45 MS Max.
Coil unsupressed Form C .... 1.50 MS Max.
Coil Supressed Form C .... 1.70 MS Max.

Note: Release time for Form C includes bounce.

ENVIRONMENTAL CHARACTERISTICS

Temperature, Operating .... −40°C-+ 85°C
Storage .... −55°C-+125°C

Shock, 100G, 8Ms±1Ms; ½ sine wave.

Vibration, 10-2000Hz. 20G or .125 in. displacement, whichever is less.

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GORDOS
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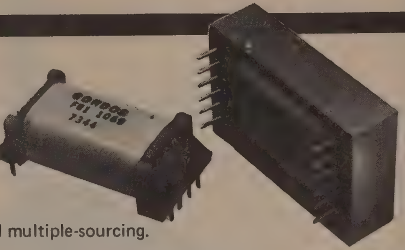
miniature reed relays



Series G1: 1" x .150" grid, 1.240" long
Series G2: 1" x .100" grid, 1.240" long
Series G3 : 1" x .150" grid, 1.140" long
Series G4 : 1" x .100" grid, 1.140" long

- Low .350" profile enables stacking of PC boards on ½" centers.
- Magnetic box shield is standard.
- Industry-standard terminal grids assure maximum interchangeability and multiple-sourcing.

CONTACT OPTIONS

Contact Option Code Contact Type	A Dry Standard Form A	B Dry Standard Form B	C Dry True From C	E Dry High Voltage Form A	F Dry High Speed Form A	H Heavy Duty Mercury Form A
Current Rating, Amperes DC, Max.	.500	.500	.250	.200	.250	1.0
Voltage Rating, Volts DC, Max.	200	200	28	1000	28	1000
Breakdown Voltage, DC, Minimum	350	350	250	1700	250	2000
Operate Time; Msec. Typical	.700	.700	.800	.750	.250	2.0
Bounce Time, Msec. Typical	.300	.300	.400	.200	.750	None
Initial Contact Resistance, Ω, Max.	.200	.200	.200	.200	.200	.050
†Life @ Max. Load, 10^6 Opers., Typ.	20	20	5	10	10	50
†Life @ Signal Load, 10^6 Opers., Typ.	100	100	50	100	100	200
Open Contact Capacitance, PF, Typ.	.2	.2	.8	.2	.2	.3

†Load/Life data available on request.

POLE OPTIONS

Configuration	Contact Form	Rated Coil Voltage	Coil Resistance Ω @ 25°C	Operate Power mW	Must Operate Voltage DC	Min. Release Voltage DC
1 Form A Dry	1A	5	225	71	4.0	.5
1 Form C Dry	1C	12	1400	66	9.6	1.2
1 Form A Mercury	1A	24	4340	85	19.2	2.4
2 Form A Dry	2A	5	105	152	4.0	.5
1 Form B Dry	1B	12	730	126	9.6	1.2
1 Form C Dry	1C	24	2500	147	19.2	2.4
3 Form A Dry 2 Form B Dry 2 Form C Dry 2 Form A Mercury	3A 2B 2C 2A	5 12 24	82 570 1540	195 162 239	4.0 9.6 19.2	.5 1.2 2.4
4 Form A Dry	4A	5	60	267	4.0	.5
3 Form C Dry	3C	12	275	335	9.6	1.2
3 Form A Mercury	3A	24	1090	338	19.2	2.4
5 Form A Dry	5A	5	45	356	4.0	.5
4 Form C Dry	4C	12	320	288	9.6	1.2
4 Form A Mercury	4A	24	790	467	19.2	2.4
All		Operating temperature: –40° to +85°C Coil to contact breakdown voltage: 1000 DC @ < 50% RH Coil to contact capacitance (code 4 shielding): .4 picofarads typ.				

RELAY OPTIONS AVAILABLE

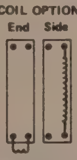
(refer to page 2 for descriptions)

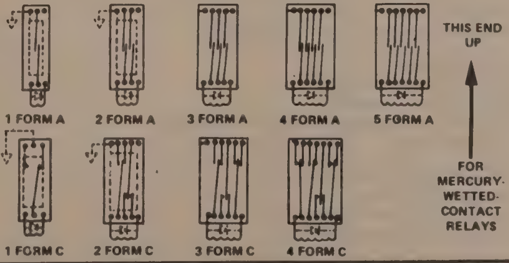
Coil Terminal Location
1– End (standard)
2– Side

Shielding Combinations
0– No Shielding
1– Magnetic Box Shield (standard)
2– Magnetic Foil Shield
3– Grounded Electrostatic
4– 1 + 3 above
5– 2 + 3 above

Clamping Diode
0– No Diode
D– Diode Installed

SCHEMATIC DIAGRAMS (Bottom View)





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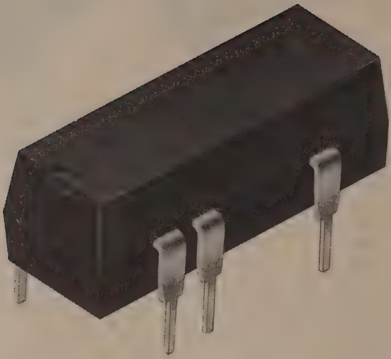


GORDOS

REED RELAY DIVISION

MINIATURE HIGH VOLTAGE DIP

Form A Reed Relay

846 SERIES

The 6-pin high voltage DIP relay is an important building block where high voltage isolation is desirable and space is at a premium.

COIL CHARACTERISTICS

PART NUMBER	CONTACT FORM	NOMINAL VOLTAGE VDC	MUST OPERATE VDC	MUST RELEASE VDC	COIL RESISTANCE ±10%	DIODE
846A1	1A	5	4	0.5	77	No
846A2	1A	5	4	0.5	77	Yes
846A3	1A	12	9	1.0	490	No
846A4	1A	12	9	1.0	490	Yes
846A5	1A	24	18	2.0	1870	No
846A6	1A	24	18	2.0	1870	Yes

ELECTRICAL SPECIFICATIONS

- Initial contact resistance: 200 Ω maximum
- Breakdown voltage: 1200 VRMS minimum
- Capacitance: 0.2 pF typical
- Insulation resistance: 1 x 10^{10} Ω typical

CONTACT RATINGS

- Switching voltage: 1000 VDC
- DC resistive load: 10 watts
- Current: .5 amp maximum switching, 2 amp maximum carrying

OPERATE CHARACTERISTICS

- Operate time: 1.5 msec
- Bounce time: 200 μsec typical
- Release time: 400 μsec typical

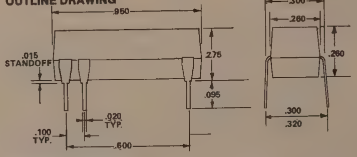
ENVIRONMENTAL SPECIFICATIONS

- Shock: 50 G's @ 11 msec
- Vibration: 35 G's 50-2000 Hz
- Operating Temperature: -40°C to +85°C

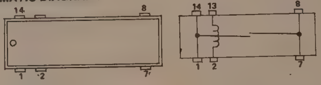
LIFE EXPECTANCY

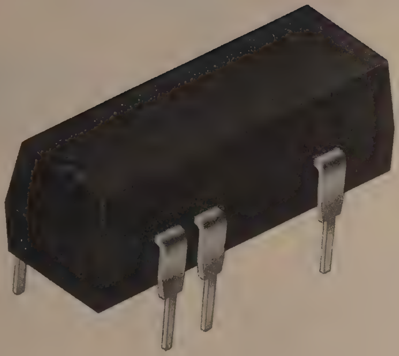
- At maximum load: 10 million
- Signal load: 100 million

OUTLINE DRAWING



SCHEMATIC DIAGRAMS





GORDOS

REED RELAY DIVISION

MINIATURE MERCURY-WETTED DIP

Form A Reed Relay

847 SERIES

The 6-pin Gordos mercury-wetted DIP reed relay has all the advantages of speed, stable contact resistance, long life and small size. Its optimum utilization is in telephone switching and multiplexing equipment.

COIL CHARACTERISTICS

PART NUMBER	CONTACT FORM	NOMINAL VOLTAGE VDC	MUST OPERATE VDC	MUST RELEASE VDC	COIL RESISTANCE ±10%	DIODE
847A1	1A	5	4	0.5	77	No
847A2	1A	5	4	0.5	77	Yes
847A3	1A	12	9	1.0	490	No
847A4	1A	12	9	1.0	490	Yes
847A5	1A	24	18	2.0	1870	No
847A6	1A	24	18	2.0	1870	Yes

ELECTRICAL SPECIFICATIONS

- Initial contact resistance: 50 mΩ maximum
- Breakdown voltage: 1500 VRMS minimum @ 60 Hz for 10 seconds
- Capacitance: 0.3 pF typical
- Insulation resistance: 1 x 10^{10} Ω minimum[1]

CONTACT RATINGS

- Switching voltage: 1000 VDC maximum
- DC resistive load: 50 watts @ 500 VDC
- AC resistive load: 50 VA
- Current: 1[2] amp maximum switching; 2 amp maximum carrying
- Lamp: de-rate by ⅔

OPERATE CHARACTERISTICS

- Operate time: 2 msec nominal
- Bounce time: none
- Release time: .8 msec nominal
- Operating Temperature: –30°C to +65°C

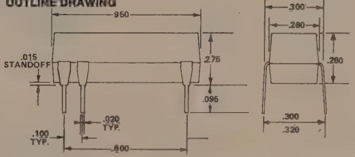
LIFE EXPECTANCY

- 50 VDC, 1 amp resistive—50 million
- 50 MVDC, 1 microamp resistive—5 billion

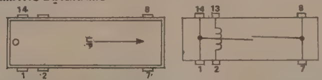
SPECIAL NOTES

1. Measured @ 30% R.H.
2. De-rate to .002 amps @ 1000 VDC

OUTLINE DRAWING



SCHEMATIC DIAGRAMS



Mounting position—within 30° of vertical

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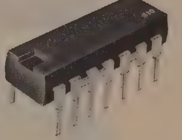
GORDOS CORPORATION

DIP reed relays

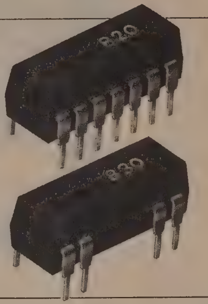
810 Series/T0116 Case

Compatible mechanically with all standard DIP-IC packages and conforming to JEDEC T0116 specifications. They mate with conmentional 14-pin receptacles, as well as fit automatic insertion equipment. **Models listed:** Consult factory for characteristics.



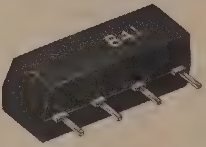
830 Series

830 models have standard 8 pin configuration, and 820 14 pins. Package height of .275 allows use of standard miniature switches and larger coils to increase sensitivity, current-carrying capability, and contact rating, as well as reduce cost. Can be automatically inserted. **Models listed:** 821A, 831A, 822A, 832A, 821B, 831B, 821C, 831C, 825C, 835C.



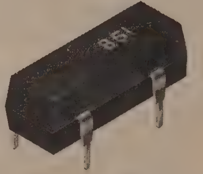
841 Series

These edge-mounted IC relays are designed for ultra high-density assemblies. They can also be used to "double up" by inserting them side by side in standard DIP sockets. **Models listed:** 841A, 841B.



851 Series

These four terminal relays are designed for high-density IC assemblies. Staggered terminals (see drawing) permit tightest possible spacing. 1500 VAC minimum installation breakdown between coil and switch. **Models listed:** 851A, 851B.



COIL CHARACTERISTICS AND RELAY OPERATING VALUES

From	Model Number	Coil Suffix No.	Coil Resistance Ohms +20% −10% @ 25°C	Nom. VDC	Max. VDC	Must Operate VDC	Must Release VDC	Clamp Diode
1A	821A 831A 841A 851A	-3	500	5-12	15.0	3.7	.5	No
		-4	500	5-12	15.0	3.7	.5	Yes
		-7	2150	24	32.0	18.0	2.0	No
		-8	2150	24	32.0	18.0	2.0	Yes
2A	822A 832A	-1	150	5	7.5	4.2	.5	No
		-2	150	5	7.5	4.2	.5	Yes
		-3	450	12	15.0	9.6	1.0	No
		-4	450	12	15.0	9.6	1.0	Yes
		-5	1750	24	32.0	20.0	2.0	No
		-6	1750	24	32.0	20.0	2.0	Yes
1B	821B 831B 841B 851B	-3	450	5	7.5[1]	3.7	.5	No
		-4	450	5	7.5[1]	3.7	.5	Yes
		-5	450	12	15.0[1]	8.0	1.0	No
		-6	450	12	15.0[1]	8.0	1.0	Yes
		-7	1750	24	27.5[1]	18.0	2.0	No
		-8	1750	24	27.5[1]	18.0	2.0	Yes
1C	821C 831C 825C 835C	-1	150	5	7.5	4.0	.5	No
		-2	150	5	7.5	4.0	.5	Yes
		-3	450	12	15.0	9.6	1.0	No
		-4	450	12	15.0	9.6	1.0	Yes
		-5	1750	24	32.0	20.0	2.0	No
		-6	1750	24	32.0	20.0	2.0	Yes

[1] Excessive voltage will cause contact reclosure.

CONTACT RATINGS

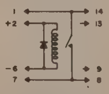
Type	Maximum Switching		Maximum Current		Maximum Initial Contact Resistance	Minimum Breakdown Voltage	
	Watts	Volts	Switch	Carry		Across Contacts	Contacts–Coil
1A	10	100	.250	1.5	.200	250	1000
1B	10	100	.250	1.5	.200	250	1000
2A	3	28	.110	1.0	.200	150	1000
1C	3	28	.250	1.0	.200	250	1000
5C	4	100	.110	1.0	.200	250	1000
UNIT		DC	AMPS	AMPS	OHNS	VDC	VAC

TERMINAL IDENTIFICATION

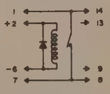
Viewed from topside of relay

1. Indent in case terminal 1.
2. See coil characteristic table for relays containing diodes.

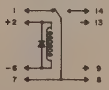
SERIES 83-"A"



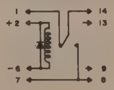
SERIES 83-"B"



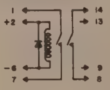
SERIES 83-"C"



SERIES 83-"C"



SERIES 83-"8A"



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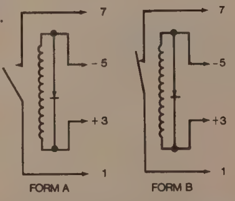

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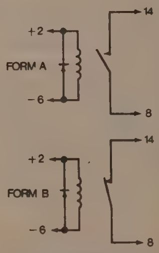
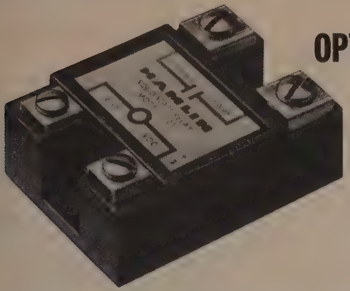


GORDOS CORPORATION
Headquarters & Eastern Regional: 250 Glenwood Ave., Bloomfield, N.J. 07003 • Telephone: (201) 743-6800
Mid-West Regional: 3831 Industrial Dr., Rolling Meadows, Ill. 60008 • Telephone: (312) 392-5900
West Regional: 347 Commercial St., San Jose, Calif. 95112 • Telephone: (408) 293-1533

HAMLIN INC

628 LAKE STREET • LAKE MILLS, WISCONSIN 53551
PHONE: SALES 414/648-2361 • TWX 910-260-3740

REED SWITCHES • INDUSTRIAL SENSORS • LIQUID CRYSTAL DISPLAYS



OPTO-ISOLATED SOLID STATE RELAY

The technology that made Hamlin the leading manufacturer of reed switches and reed switch devices has developed an entirely new Opto-Isolated Solid State AC Relay. The circuit design is unique enabling us to lower the "zero" level switching. Our turn on voltage is about as low as possible in the AC cycle. Our window has been established as 4-10V with a threshold voltage of 4V. It is this that makes for noise-free operation. Input voltage 3-32 Vdc. Input/output isolation is 1500 Vac, maximum turn-on and turn-off time is 8.5 msec. A molded package protects the unit against vibration, shock, oils, chemicals, etc. It measures only 1.75 x 2.25 x .875 inches.

Model	AC Line Voltage 47 to 63 Hz	Peak Repetitive Blocking Voltage, Max.	Load Current Max.‡	One Cycle Surge (60 Hz), Max.	List Price Quant. 1-9
7521	120 Vac (24-140 Vac)†	200 Volts	10 amps RMS	100 amps	15.95
7522	240 Vac (24-280 Vac)†	400 Volts	10 amps RMS	100 amps	17.55
7523	240 Vac (24-280 Vac)†	400 Volts*	10 amps RMS	100 amps	21.60
7531	120 Vac (24-140 Vac)†	200 Volts	25 amps RMS	100 amps	20.80
7532	240 Vac (24-280 Vac)†	400 Volts	25 amps RMS	100 amps	22.80
7533	240 Vac (24-280 Vac)†	400 Volts*	25 amps RMS	100 amps	32.85
7551	120 Vac (24-140 Vac)†	200 Volts	40 amps RMS	100 amps	26.95
7552	240 Vac (24-280 Vac)†	400 Volts	40 amps RMS	100 amps	29.10
7553	240 Vac (24-280 Vac)†	400 Volts*	40 amps RMS	100 amps	38.00

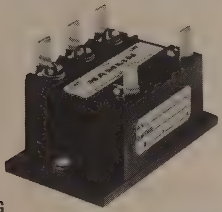
* 600V Peak Overvoltage Blocking for up to 5 sec. max. Time between overvoltage applications must be at least 10 times as long as the overvoltage duration.
† Low voltage operation results in some waveform distortion.
‡ At 40°C — derated at higher temperature.

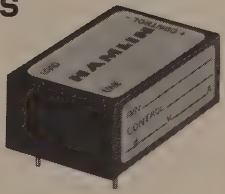
The new Hamlin units are interchangeable with any of the following:

Hamlin	Crydom	General Electric	Monsanto	Grigsby-Barton
7521	D1210	GSR10AU10	MSR100B	GB15210
7522	D2410	—	MSR200B	GB15410

SOLID STATE AC RELAYS U.L. RECOGNIZED*

MODEL 700 FOR LOADS UP TO 6 AND 12 AMPS
MODEL 701 FOR PRINTED CIRCUIT BOARDS

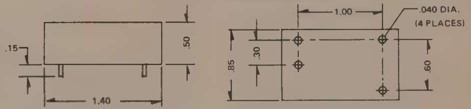




ON/OFF OR ZERO VOLTAGE SWITCHING

The 700 Series is a "family" of rapid response self-contained hybrid solid state AC Relays (HSSRs) designed for switching loads up to 12 amps. Completely self-contained, these relays insure protection against contamination, moisture, vibration and shock. They are capable of controlling inductive, capacitive, hi-inrush or resistive loads. These relays provide reliable, arcless, bounceless, maintenance-free switching with an expected life in excess of 100 million operations. Available in either on/off or zero voltage switching models. For further information please contact your local Hamlin representative.

HAMLIN SOLID STATE AC RELAYS



Model 701 is a hybrid solid state AC relay (HSSR) rated at 1.5 amps and designed for PCB mounting on an industry standard 0.100 grid. This relay comes complete with internal RC network for commutating dv/dt compensation to insure compatability with inductive loads.

Output and General Specifications		Basic Model Numbers				Basic Model Numbers	
		723-11-A 723-21-A 733-11-A 773-11-A	723-12-A 723-22-A 733-12-A 773-12-A	724-11-A 724-21-A	724-12-A 724-22-A	701-11-A	701-12-A
AC Line Voltage, 50/60 Hz.		120V RMS	240V RMS	120V RMS	240V RMS	120V RMS	240V RMS
Blocking Voltage, Max.		200V Peak	400V Peak	200V Peak	400V Peak	200V Peak	400V Peak
On-State Voltage Drop @ Rated Curent, Max.		2.2V Peak		2.2V Peak		2.2V Peak	
Load Current, Max.		6 Amps RMS		12 Amps RMS		1.5 Amps RMS	
One Cycle Surge Current, Non-Repet., Max.		60 Amps Peak		120 Amps Peak		15 Amps Peak	
One Second Overload Current, Max.		24 Amps Peak		48 Amps Peak		6 Amps Peak	
Off-State Leakage Current, Max.		6 MA RMS	11 MA RMS	6 MA RMS	11 MA RMS	6 MA RMS	11 MA RMS
Operate Time, Max.	On/Off Switching	1 Millisecond				1 Millisecond	
	Zero Voltage Switching	1 Cycle of the AC Line					
Release Time, Max.	On/Off Switching	½ Cycle of the AC Line				½ Cycle of the AC Line	
	Zero Voltage Switching	1 Cycle of the AC Line					
Isolation, Min.		1500V RMS to Heatsink and Control Circuit[1]				1500V RMS to Control Circuit[1]	

TO ORDER: Substitute the control option number for the letter A in basic model number; 0 — external switch contact, 1-6 Vdc, 2-12 Vdc, 3-24 Vdc, 5-5V logic. [1]DC and Logic Control Operations only. No Isolation to Control Circuit with External Switch Option.

MAGNETEC

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BLOOMFIELD, CONN. 06002
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SUBSIDIARY OF HI-G, INCORPORATED

TECHNICAL INFORMATION

INTRODUCTION

The Magnetec "G" Series, referred to as "The Interchangeables", represents selected solenoids found to be widely accepted for use in numerous applications in industry today. Important mechanical characteristics such as configuration, size and mounting have been maintained and constructional features are state-of-the-art. The optimized designs provide the ultimate in performance.

"The Interchangeables" provide the following.

- Four standard coil voltage ratings.
- Three standard wattage ratings providing four standard duty cycles.
- Choice of two plunger clevis options.
- Push type available on all models.
- Switch types available as standard.

DESIGN FEATURES

A. MAGNETIC CIRCUIT — High permeability materials are used in all magnetic circuit paths to maximize the efficiency of the solenoid for a given work function. Minimized air gaps thru the use of a welded end plate, rather than the normal staked on type, further capitalizes on the high flux density potential of the magnetic materials.

B. BEARING LIFE — The bearing surface is glass filled nylon which in combination with the surface finish of the plunger provides excellent life characteristics. The natural lubricity of the nylon results in very low sliding friction. Three channels are incorporated in the nylon bearing to relieve air compression in the plunger cavity to minimize response time.

C. CONCENTRICITY OF PLUNGER AND STOP — The mechanics of the solenoid have been carefully designed to insure seating of the plunger in the stop. The end position of the stroke is therefore accurately defined and the holding force predictably constant. When the alignment of these parts is not accurately held, "double-seating" occurs in which the plunger completes its stroke in less than intimate contact with the stop. Close tolerance machined parts are used in a self-jigging configuration to minimize this problem.

D. COIL CONSTRUCTION — The "G" Series coils are wound on glass filled nylon bobbins. Automatic winding provides an accurate, reliable coil. Kilovolt isolation of coils from metal parts is assured by bobbin construction and the use of high grade insulating materials. An outer layer of self-bonding insulating material protects the windings and provides an attractive finish.

AVAILABLE OPTIONS

Options available are not limited to those offered by other producers or to those shown in this catalog. Numerous additional features, already designed, are available and are a result of the company's vast application experience. Typical options include the following:

A. PLUNGER OPTIONS — Tapped hole in linkage end, flat stamped yoke, special finishes, tailored conical pole face angles, special pushrods and internal springs.

B. ACTION FEATURES — Shock dampeners (with or without spring return), anti-rotation, captive plunger, sealed plunger cavity, dashpot control, power surge operation, and special assemblies such as push-pull tandem operation.

C. COIL VARIATIONS — Windings designed for specific voltage and duty cycle combinations, choice of materials consistent with the need of special requirements, special terminations, encapsulation, multiple windings, printed circuit board mounting, built-in thermal cutouts, and fungus resistant construction.

D. PACKAGE OPTIONS — Special mounting holes, additional tapped holes, threaded bushing at "push end" or "pull end."

COIL RATINGS

The Series G solenoids are designed to operate in a 40°C. max. ambient with the total average coil temperature not to exceed 130°C. (Class B). The resistance of the coil will rise by 30% with a coil temperature change of 90°C. (130 minus 40) and conversely, the current will drop to 70% of its original value. These facts are useful in determining the operating safety of a coil under different ambient temperatures, duty cycles, on and off times, heat sinking, etc.

The THERMAL TIME CONSTANT shown on each data sheet is defined as the length of time required for a coil to reach 63% of the final continuous duty temperature rise. The maximum permissible "on time" for an intermittent duty cycle will be proportional to this value.

It should be noted that any voltage can be applied to any coil providing temperature limitations are not exceeded. Consequently, the designer has much latitude when continuous duty is not required.

THE CONTINUOUS DUTY coils specified in this catalog cannot, however, be operated continuously at voltages above the rating unless heat sinking is applied. Because of the known relationship between the resistance of a coil and its average temperature, the easiest way to evaluate operational safety is by measurement of resistance change under operating conditions. The following formula may be used to determine safe operation within maximum temperature limits:

1.3 x Coil Resistance* = Max. Coil Resistance Hot
* From catalog (nominal 25°C value)

Resistance above the maximum value would indicate the coil was operating beyond its temperature rating. In some cases, an excessive rise in temperature for a very short duration may not be damaging.

Under INTERMITTENT DUTY conditions, more power may be applied to the coil without overheating thus resulting in more work available from the solenoid. For operation under these conditions, maximum "on time" must be observed within the limits determined by the above formula.

As noted previously, there is considerable latitude left to the user in selecting coils, applied voltages and "on time", the proviso being that current or resistance be monitored to insure that under actual operation a safe temperature is not exceeded.

FORCE-STROKE CHARACTERISTICS

Three Force-Stroke graphs are provided for each solenoid duty cycle. They represent the gross pull available under the following conditions:

Curve 1 — Nominal coil voltage at 25°C.
Curve 2 — Nominal coil voltage at max. temperature rise.
— 80% of nominal voltage at 25°C.
Curve 3 — 80% of nominal voltage at max. temperature rise.

The user is cautioned to take into account the weight of the plunger when, because of orientation, gravity may be a factor. Similarly, if the use of a return spring is planned, the net pulling force above the spring should be checked for adequacy.

RESPONSE TIME

The response time is specified as the time required for the plunger to move from a given position to the stop after power is applied. The total plunger motion is specified at one plunger diameter. This parameter is provided only for reference because the ultimate operational parameters provide an infinite number of combinations.

ENGINEERING ASSISTANCE

Solenoid technology has become highly specialized. Our laboratories are equipped with the latest sophisticated equipment and our Engineering Staff is second to none. Call upon us for any help you may need with your application problems.

MAGNETEC CORPORATION

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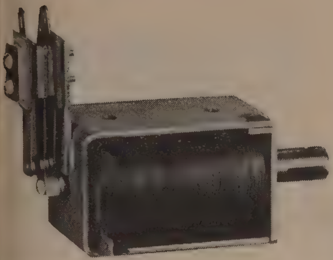
SUBSIDIARY OF HI-G, INCORPORATED

MAGNETEC SERIES G-11



ORDERING INFORMATION

G 11 A 24 D 2

- "G" Series — G
- Unit Size — 11
- Style — A
- Voltage — 24
- Denotes DC — D
- Duty Cycle — 2

— Style —
A: Pull Type — Machined Hole & Slot
B: Pull Type — Spring Clip
P: Push Type
S: Switch Type — Machined Hole & Slot
T: Switch Type — Spring Clip

— Duty Cycle —
1. Continuous
2: Intermittent 25/50%
3: Intermittent 10%

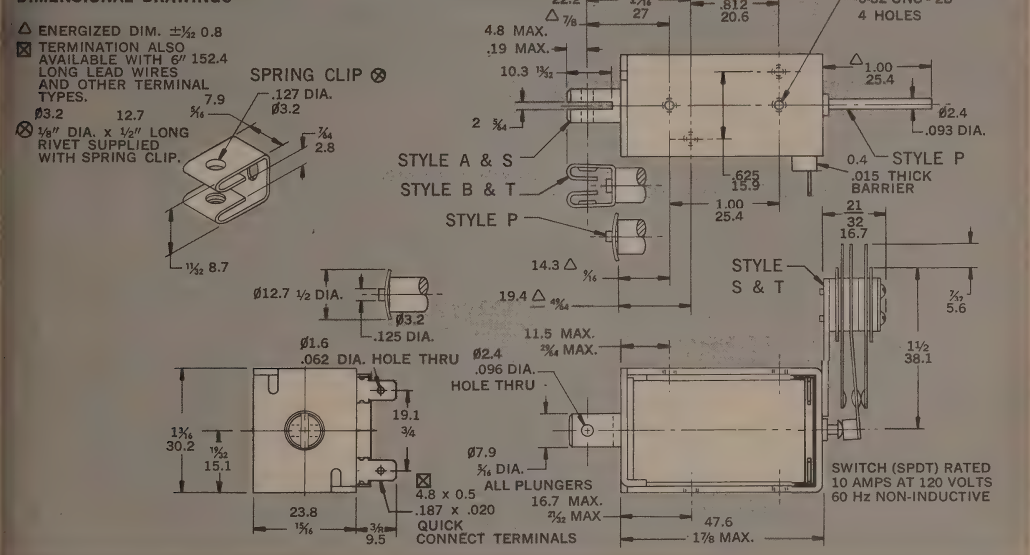
— Voltage (DC) —
6, 12, 24, 120

COIL RESISTANCE AT 25°C (OHMS)

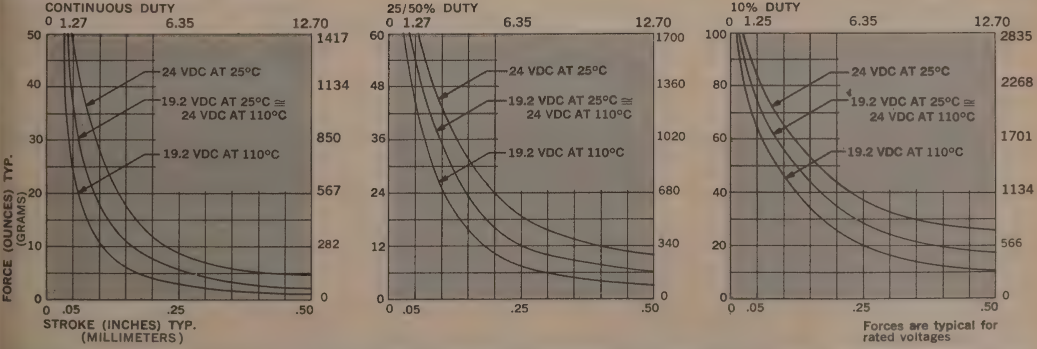
Duty Cycle	6VDC	12VDC	24VDC	120VDC
Continuous	4.5	18	72	1800
25%/50%	2	8	31	800
10%	0.67	2.67	10.67	266.67

Response Time (Milliseconds):
Cont. 20, 25/50% 15, 10% 11
Thermal Time Constant at Rated Volts:
630 Seconds
(GRAMS) 147.4 19.8
Weight (Ounces): Total, 5.2 Plunger, 0.7

DIMENSIONAL DRAWINGS


△ ENERGIZED DIM. ±1/32 0.8
☒ TERMINATION ALSO AVAILABLE WITH 6" 152.4 LONG LEAD WIRES AND OTHER TERMINAL TYPES.
⊗ 1/8" DIA. x 1/2" LONG RIVET SUPPLIED WITH SPRING CLIP.
SPRING CLIP ⊗
.127 DIA.
Ø3.2
7.9
5/16
Ø3.2
12.7
7/64
2.8
11/32 8.7
22.2
△ 7/8
1 1/16
27
.812
20.6
6-32 UNC - 2B
4 HOLES
4.8 MAX.
.19 MAX.
10.3 13/32
2 5/64
△ 1.00
25.4
Ø2.4
.093 DIA.
STYLE A & S
STYLE B & T
STYLE P
0.4
STYLE P
.015 THICK
BARRIER
.625
15.9
1.00
25.4
21/32
16.7
14.3 △ 9/16
19.4 △ 49/64
STYLE S & T
7/32
5.6
1 1/2
38.1
Ø12.7 1/2 DIA.
Ø3.2
.125 DIA.
Ø1.6
.062 DIA. HOLE THRU
Ø2.4
.096 DIA.
HOLE THRU
11.5 MAX.
29/64 MAX.
1 3/16
30.2
19/32
15.1
19.1
3/4
Ø7.9
5/16 DIA.
ALL PLUNGERS
☒
4.8 x 0.5
.187 x .020
QUICK
CONNECT TERMINALS
16.7 MAX.
21/32 MAX
47.6
1 7/8 MAX.
23.8
15/16
3/8
9.5
SWITCH (SPDT) RATED
10 AMPS AT 120 VOLTS
60 Hz NON-INDUCTIVE

FORCE STROKE CHARACTERISTICS



Forces are typical for rated voltages

MAGNETEC
SERIES G-22

MAGNETEC CORPORATION

96 GRANBY STREET
BLOOMFIELD, CONN. 06002
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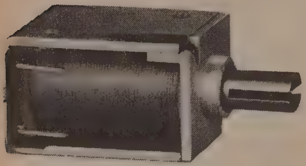


ORDERING INFORMATION

G 22 A 24 D 2

"G" Series — G
Unit Size — 22
Style — A
Voltage — 24
Denotes DC — D
Duty Cycle — 2

— Style —
A: Pull Type — Machined Hole & Slot
P: Push Type
S: Switch Type — Machined Hole & Slot

— Duty Cycle —
1. Continuous
2: Intermittent 25/50%
3: Intermittent 10%

— Voltage (DC) —
6, 12, 24, 120

COIL RESISTANCE AT 25°C (OHMS)

Duty Cycle	6VDC	12VDC	24VDC	120VDC
Continuous	9	36	144	3600
25%/50%	4	16	64	1600
10%	1.33	5.32	21.3	532

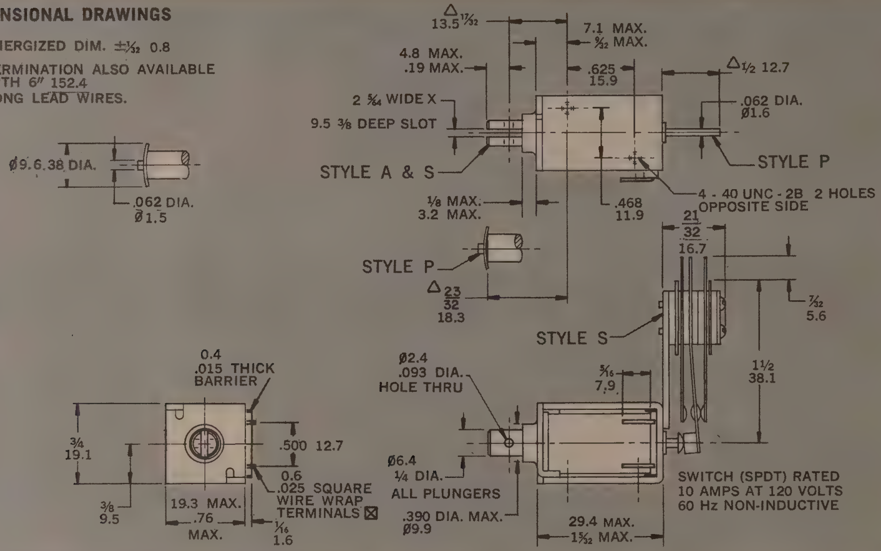
Response Time (Milliseconds):
Cont. 17, 25/50% 12, 10% 8
Thermal Time Constant at Rated Volts:
315 Seconds

	(GRAMS) 49.9	6.8
Weight (Ounces):	Total, 1.76	Plunger, 0.24

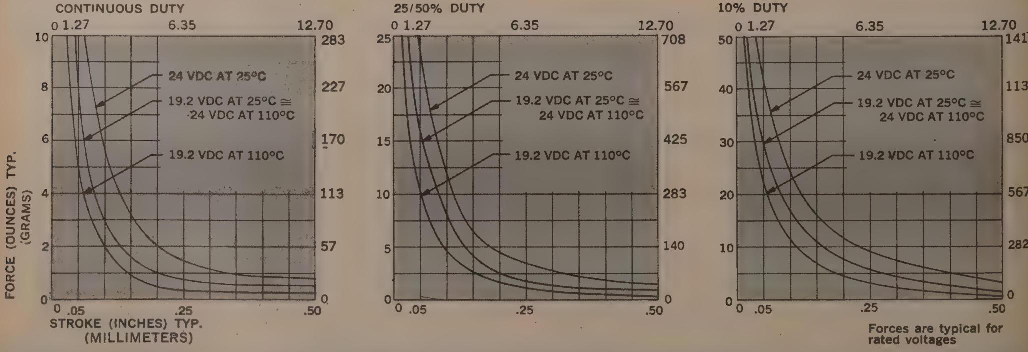
DIMENSIONAL DRAWINGS

△ ENERGIZED DIM. ±1/32 0.8

☒ TERMINATION ALSO AVAILABLE WITH 6" 152.4 LONG LEAD WIRES.


△ 13.5 17/32
7.1 MAX.
9/32 MAX.
4.8 MAX.
.19 MAX.
.625
15.9
△ 1/2 12.7
2 3/64 WIDE X
9.5 3/8 DEEP SLOT
.062 DIA.
Ø1.6
STYLE P
STYLE A & S
Ø9.6 .38 DIA.
.062 DIA.
Ø1.5
1/8 MAX.
3.2 MAX.
.468
11.9
4 - 40 UNC - 2B 2 HOLES OPPOSITE SIDE
21/32
16.7
STYLE P
△ 23/32
18.3
7/32
5.6
STYLE S
0.4
.015 THICK BARRIER
Ø2.4
.093 DIA.
HOLE THRU
5/16
7.9
1 1/2
38.1
3/4
19.1
.500 12.7
0.6
.025 SQUARE WIRE WRAP TERMINALS ☒
Ø6.4
1/4 DIA.
ALL PLUNGERS
3/8
9.5
19.3 MAX.
.76 MAX.
1/16
1.6
.390 DIA. MAX.
Ø9.9
29.4 MAX.
1 5/32 MAX.
SWITCH (SPDT) RATED 10 AMPS AT 120 VOLTS 60 Hz NON-INDUCTIVE

FORCE STROKE CHARACTERISTICS


CONTINUOUS DUTY

25/50% DUTY

10% DUTY

Forces are typical for rated voltages

MAGNETEC

SERIES G-28

MAGNETEC CORPORATION
96 GRANBY STREET
BLOOMFIELD, CONN. 06002
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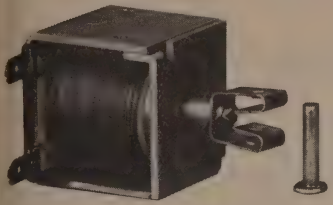


ORDERING INFORMATION

G 28 A 24 D 2

- "G" Series — G
- Unit Size — 28
- Style — A
- Voltage — 24
- Denotes DC — D
- Duty Cycle — 2

— Style —
A: Pull Type — Machined Hole & Slot
B: Pull Type — Spring Clip
P: Push Type
S: Switch Type — Machined Hole & Slot
T: Switch Type — Spring Clip

— Duty Cycle —
1. Continuous
2: Intermittent 25/50%
3: Intermittent 10%

— Voltage (DC) —
6, 12, 24, 120

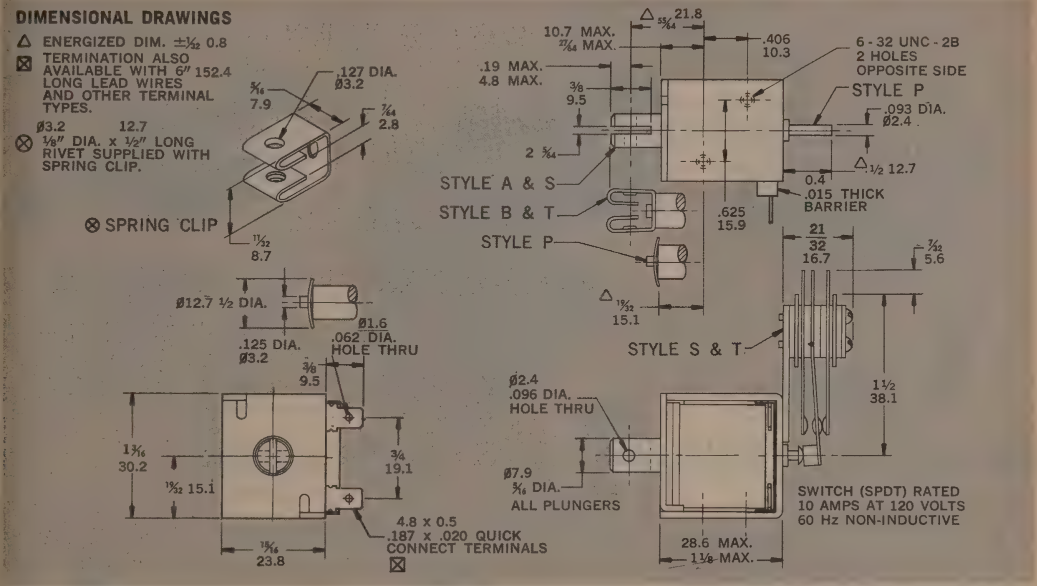
COIL RESISTANCE AT 25°C (OHMS)

Duty Cycle	6VDC	12VDC	24VDC	120VDC
Continuous	7.7	27	104	2600
25%/50%	3.3	13	50	1300
10%	1.14	4	15.4	385

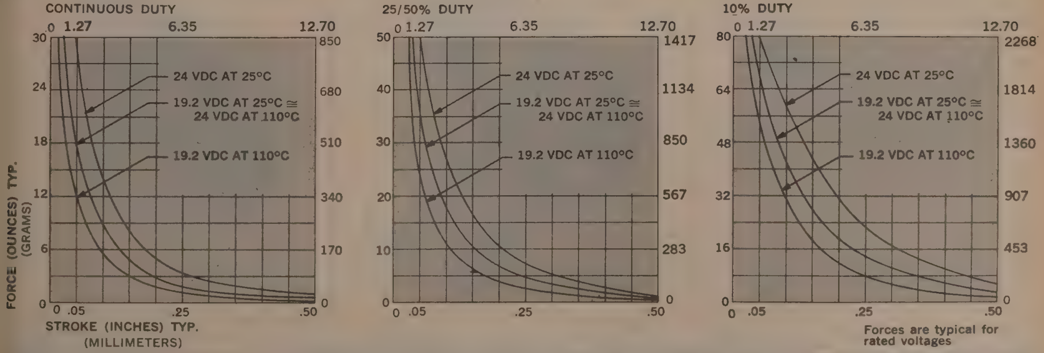
Response Time (Milliseconds):
Cont. 19, 25/50% 14, 10%, 10
Thermal Time Constant at Rated Volts:
740 Seconds

	(GRAMS)	99.2	11.3
Weight (Ounces):		Total, 3.5	Plunger, 0.4

DIMENSIONAL DRAWINGS


△ ENERGIZED DIM. ±1/32 0.8
☒ TERMINATION ALSO AVAILABLE WITH 6" 152.4 LONG LEAD WIRES AND OTHER TERMINAL TYPES.
⊗ 1/8" DIA. x 1/2" LONG RIVET SUPPLIED WITH SPRING CLIP.
Ø3.2 12.7
5/16 7.9
.127 DIA. Ø3.2
7/64 2.8
⊗ SPRING CLIP
11/32 8.7
Ø12.7 1/2 DIA.
Ø1.6 .062 DIA. HOLE THRU
.125 DIA. Ø3.2
3/8 9.5
1 3/16 30.2
19/32 15.1
3/4 19.1
15/16 23.8
4.8 x 0.5 .187 x .020 QUICK CONNECT TERMINALS ☒
△ 55/64 21.8
10.7 MAX. 27/64 MAX.
.406 10.3
6-32 UNC-2B 2 HOLES OPPOSITE SIDE
.19 MAX. 4.8 MAX.
3/8 9.5
STYLE P
.093 DIA. Ø2.4
2 5/64
△ 1/2 12.7
0.4 .015 THICK BARRIER
STYLE A & S
STYLE B & T
STYLE P
.625 15.9
△ 19/32 15.1
21/32 16.7
7/32 5.6
STYLE S & T
Ø2.4 .096 DIA. HOLE THRU
1 1/2 38.1
Ø7.9 5/16 DIA. ALL PLUNGERS
SWITCH (SPDT) RATED 10 AMPS AT 120 VOLTS 60 Hz NON-INDUCTIVE
28.6 MAX. 1 1/8 MAX.

FORCE STROKE CHARACTERISTICS



Forces are typical for rated voltages

MAGNETEC

MAGNETEC CORPORATION

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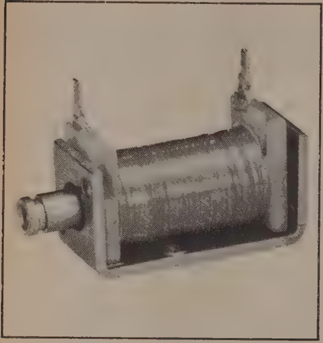
SUBSIDIARY OF HI-G, INCORPORATED

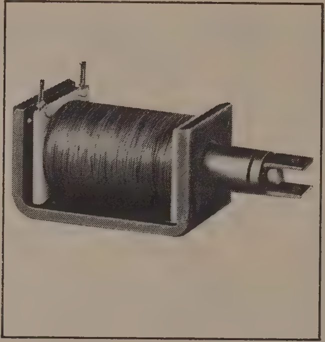
OTHER PROBLEM SOLVERS

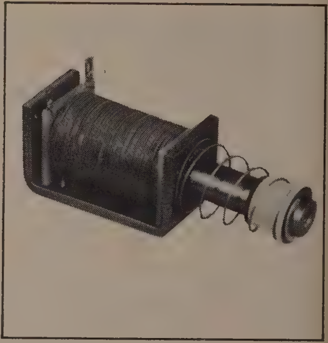
SERIES S

Magnetec has available a family of open frame industrial solenoids referred to as "The Problem Solvers". The well known Series S comes in eight sizes ranging in length from .825 inches to 2.480 inches. Available for immediate "off-the-shelf" delivery are more than 2300 combinations of size, coil voltage, duty cycle, and coupling options. Each size is available in one of four standard D.C. coil voltages — 6, 12, 24, or 120 — and in one of three standard duty cycles — 100%, a combination 50% and 25%, or 10%. The mechanical options include a clevis, a push rod with or without plastic tip, a shock dampener, a return spring, and combinations of these options . . . all standard! **Magnetec's Series S solenoids are fully described in catalog S101A which is available upon request.**

Magnetec offers a unique design engineer's solenoid kit for $19.95 . . . the SK2 valued at $48.00. The kit enables the user to design, customize, and test in the application — all on the spot. Included in the kit are all eight Series S frame sizes along with all standard mechanical options, thus providing 192 combinations! The solenoids utilize 24 VDC continuous duty cycle coils.







MAGNETEC'S TUBULARS..........WITH A TWIST

Magnetec has available tubular solenoids completely interchangeable with popular industry recognized standards and is able to offer design flexibility within a popular standard size. As an example, our popular ¾" diameter T75 model is available as either a push or pull type. In addition to the popular case length of 1½" for the T75, Magnetec also offers case lengths of 1⅛" and 1¼". Performance characteristics are optimized. Contact Magnetec for more information on both standard and custom designed tubulars.

MAGNETEC

MAGNETEC CORPORATION

96 GRANBY STREET
BLOOMFIELD, CONN. 06002
Tel: (203) 243-8941 TWX: HIGINC 710-420-0592
SUBSIDIARY OF HI-G, INCORPORATED

CUSTOMIZED PROBLEM SOLVERS

Magnetec has custom designed numerous special solenoids. The following applications are among those in which these are being utilized.

Business Machines:
- Needle printer heads.
- Interposers for impact printers.
- Paper advance mechanisms.
- Printer ribbon direction selectors.
- Card punching, sorting, and feeding mechanisms.
- Pen recorders.

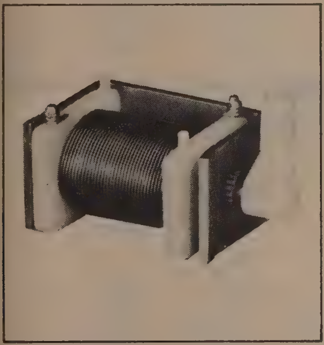
Photography:
- Camera shutter actuators.
- Microfilm copiers.
- Automatic film processors.

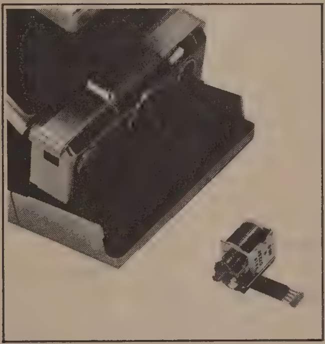
Automotive:
- Solenoid operated door locks.
- Emission control systems.
- Adaptive braking systems.

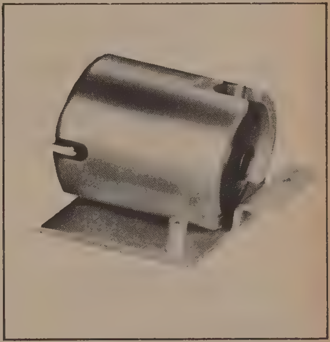
Aircraft:
- Actuator for cabin air control valves.
- Missile direction control systems.
- Machine gun firing mechanisms.
- Jet engine thrust reversers.

Safety:
- Ground fault interrupters.
- Industrial machine safety mechanisms.

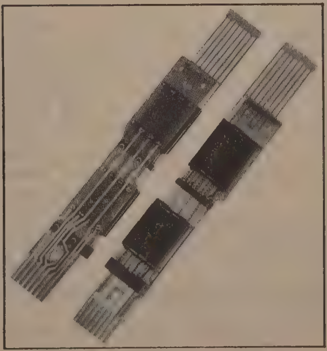
Other:
- Machine controls.
- Vending equipment.
- Coin changer mechanisms.
- Automatic music systems.
- Industrial scales.
- Vent controls for heating systems.
- Actuator mechanisms.
- Solenoid actuated diaphrams for valve flow control.
- Cash drawer latches.
- Locking devices and alarms for security systems.


Tripper solenoid used in a ground fault interruptor.


Shutter actuator with integral switch for a camera.


Linear to rotary power translator for key punch equipment.

Pilot operator for a pneumatic valve used in a "Hot Melt" applicator.


Solenoid bank for interposer service in data processing equipment.

High speed print head solenoid for dot matrix impact printers.

MA & MS TO-5 SERIES RELAY

Qualified
MIL-R-5757

GENERAL SPECIFICATIONS

CONTACT CAPABILITIES

RATING
10,000,000 operations at low level. 1,000,000 operations at 0.5 amp, 28V d-c resistive load. 100,000 operations at 1.0 amp, 28V d-c resistive load.

CONTACT RESISTANCE
0.1 ohm maximum before life (measured ⅛″ from header). 0.2 ohm maximum after life at maximum rated current (measured ⅛″ from header).

CONTACT BOUNCE
1.5 milliseconds maximum

OVERLOAD
2 amps at 28V d-c for 100 operations minimum

INSULATION RESISTANCE
10,000 megohms minimum between mutually insulated terminals

ENCLOSURE
Hermetically sealed. All welded.

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE
—65°C to +125°C. (Higher temperature ratings on special order)

VIBRATION
.06″ DA or 30G, 10-3000 cps.

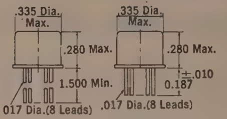
SHOCK
80 G's

MILITARY SPECIFICATIONS

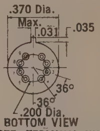
All Hi-G MA and MS Series relays are manufactured in accordance with Military Specification MIL-R-5757 and its applicable detail specification.

MA

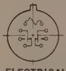
DPDT CONTACTS


.335 Dia. Max.
.280 Max.
1.500 Min.
017 Dia.(8 Leads)
.335 Dia. Max.
.280 Max.
±.010
0.187
.017 Dia.(8 Leads)

ENCLOSURE AND HEADER STYLES


.370 Dia. Max.
.031
.035
36°
36°
.200 Dia.

BOTTOM VIEW

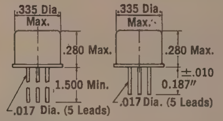


ELECTRICAL DIAGRAM

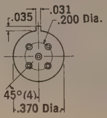
NOTE: TERMINAL NUMBERS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.

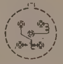
1MA

SPDT CONTACTS


.335 Dia. Max.
.280 Max.
1.500 Min.
.017 Dia. (5 Leads)
.335 Dia. Max.
.280 Max.
±.010
0.187″
.017 Dia. (5 Leads)

ENCLOSURE AND HEADER STYLES

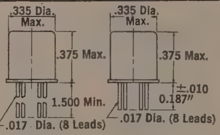

.035
.031
.200 Dia.
45°(4)
.370 Dia.



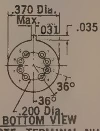
ELECTRICAL DIAGRAM

MS

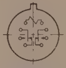
DPDT CONTACTS


.335 Dia. Max.
.375 Max.
1.500 Min.
.017 Dia. (8 Leads)
.335 Dia. Max.
.375 Max.
±.010
0.187″
.017 Dia. (8 Leads)

ENCLOSURE AND HEADER STYLES


.370 Dia. Max.
.031
.035
36°
36°
.200 Dia.

BOTTOM VIEW

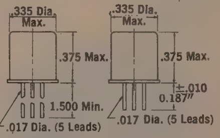


ELECTRICAL DIAGRAM

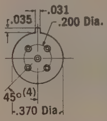
NOTE: TERMINAL NUMBERS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.

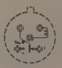
1MS

SPDT CONTACTS


.335 Dia. Max.
.375 Max.
1.500 Min.
.017 Dia. (5 Leads)
.335 Dia. Max.
.375 Max.
±.010
0.187″
.017 Dia. (5 Leads)

ENCLOSURE AND HEADER STYLES


.035
.031
.200 Dia.
45°(4)
.370 Dia.



ELECTRICAL DIAGRAM

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

Qualified

Sensitivity:
130 milliwatts

Operate Time:
3.0 milliseconds maximum at nom. coil voltage over temperature range.

Release Time:
2.5 milliseconds maximum at nom. coil voltage over temperature range.
With diode suppression 4.0 millisec.

Dielectric Strength:
500V RMS 60 cycles at sea level
125V RMS 60 cycles at 70,000 feet

Weight:
0.07 ounce with leads trimmed to ⅛", add 0.02 ounce for leads

Hi-G Part No.		Military Part M5757		Coil Voltage (VDC)		DC Coil Resistance Ohms ±10% @ 25°C	Pull In Voltage (VDC) Max*	Drop Out Voltage (VDC)	
Wire Term.	Pin Term.	Wire Term.	Pin Term.	Nom.	Max.			Max.	Min.
MAW-5	MAP-5	/40-041	/40-043	5	5.8	50	3.5	2.5	.12
MAW-6	MAP-6	/40-001	/40-006	6	8	98	4.5	3.2	.18
MAW-9	MAP-9	/40-002	/40-007	9	12	220	6.8	4.9	.35
MAW-12	MAP-12	/40-003	/40-008	12	16	390	9.0	6.5	.41
MAW-18	MAP-18	/40-004	/40-009	18	24	880	13.5	10.0	.59
MAW-26	MAP-26	/40-005	/40-010	26.5	32	1560	18.0	13.0	.89

*Over temperature range

For diode suppression add "D" Example: MAWD-5

Qualified

Sensitivity:
100 milliwatts

Operate Time:
2.0 milliseconds maximum at nom. coil voltage over temperature range.

Release Time:
2.0 milliseconds maximum at nom. coil voltage over temperature range.
With diode suppression 4.0 millisec.

Dielectric Strength:
500V RMS 60 cycles at sea level
300V RMS 60 cycles at 70,000 feet

Weight:
0.06 ounce with leads trimmed at ⅛", add 0.02 ounce for leads

Hi-G Part No.		Military Part M5757		Coil Voltage (VDC)		DC Coil Resistance Ohms ±10% @ 25°C	Pull In Voltage (VDC) Max*	Drop Out Voltage (VDC)	
Wire Term.	Pin Term.	Wire Term.	Pin Term.	Nom.	Max.			Max.	Min.
1MAW-5	1MAP-5	/38-011	/38-012	5	6	63	3.5	2.5	.12
1MAW-6	1MAP-6	/38-003	/38-008	6	8	125	4.5	3.2	.18
1MAW-9	1MAP-9	/38-004	/38-009	9	12	280	6.8	4.9	.35
1MAW-12	1MAP-12	/38-002	/38-007	12	16	500	9.0	6.5	.41
1MAW-18	1MAP-18	/38-001	/38-006	18	24	1130	13.5	10.0	.59
1MAW-26	1MAP-26	/38-005	/38-010	26.5	32	2000	18.0	13.0	.89

*Over temperature range

For diode suppression add "D" Example: 1MAWD-5

Qualified

Sensitivity:
60 milliwatts

Operate Time:
4.5 milliseconds maximum at nom. coil voltage over temperature range.

Release Time:
2.5 milliseconds maximum at nom. coil voltage over temperature range.
With diode suppression 7.5 millisec.

Dielectric Strength:
500V RMS 60 cycles at sea level
125V RMS 60 cycles at 70,000 feet

Weight:
0.10 ounce with leads trimmed to ⅛", add 0.02 ounce for leads

Hi-G Part No.		Military Part M5757		Coil Voltage (VDC)		DC Coil Resistance Ohms ±10% @ 25°C	Pull In Current (MA) Max.	Drop Out Current (MA)	
Wire Term.	Pin Term.	Wire Term.	Pin Term.	Nom.	Max.			Max.	Min.
MSW-5	MSP-5	/70-011	/70-012	5	7	100	24.5	12.2	2.45
MSW-6	MSP-6	/70-001	/70-006	6	10	200	17.5	8.75	1.75
MSW-9	MSP-9	/70-013	/70-014	9	15	400	12.3	6.1	1.23
MSW-12	MSP-12	/70-002	/70-007	12	20	850	8.4	4.2	0.8
MSW-18	MSP-18	/70-015	/70-016	18	30	1600	6.1	3.0	0.6
MSW-26	MSP-26	/70-003	/70-008	26	40	3300	4.2	2.1	0.4
MSW-36	MSP-36	/70-004	/70-009	36	57	6500	3.0	1.5	0.3
MSW-48	MSP-48	/70-005	/70-010	48	75	11000	2.4	1.2	0.24

For diode suppression add "D" Example: MSWD-5

Qualified

Sensitivity:
40 milliwatts

Operate Time:
4.0 milliseconds maximum at nom. coil voltage over temperature range

Release Time:
2.5 milliseconds maximum at nom. coil voltage over temperature range
With diode suppression 7.5 millisec.

Dielectric Strength:
500V RMS 60 cycles at sea level
300V RMS 60 cycles at 70,000 feet

Weight:
.08 ounce with leads trimmed to ⅛", add 0.02 ounce for leads

Hi-G Part No.		Military Part M5757		Coil Voltage (VDC)		DC Coil Resistance Ohms ±10% @ 25°C	Pull In Current (MA) Max.	Drop Out Current (MA)	
Wire Term.	Pin Term.	Wire Term.	Pin Term.	Nom.	Max.			Max.	Min.
1MSW-5	1MSP-5	/69-011	/69-012	5	8	125	17.9	8.9	1.87
1MSW-6	1MSP-6	/69-001	/69-006	6	11	255	12.5	6.25	1.2
1MSW-9	1MSP-9	/69-013	/69-014	9	16	630	8.0	4.0	0.8
1MSW-12	1MSP-12	/69-002	/69-007	12	22	1025	6.25	3.12	0.6
1MSW-18	1MSP-18	/69-015	/69-016	18	33	2300	4.2	2.1	0.4
1MSW-26	1MSP-26	/69-003	/69-008	26	45	4000	3.16	1.58	0.3
1MSW-36	1MSP-36	/69-004	/69-009	32	57	6500	2.47	1.23	0.2
1MSW-48	1MSP-48	/69-005	/69-010	40	75	11000	1.91	0.96	0.15

For diode suppression add "D" Example: 1MSWD-5

Ordering Information: Standard items may be ordered by part number shown. For variation consult factory.

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

CRYSTAL CAN RELAYS

RADIO FREQUENCY RELAYS

RF contacts are terminated with RG-196/U Teflon insulated coaxial cable, 6″ in length. Other lengths, types of cable, or coaxial connector terminations available on special order. These relays meet or exceed the applicable portions of MIL-R-5757 and MIL-S-3928.

RADIO FREQUENCY CHARACTERISTICS

Frequency Range	0 - 500 MHz*
Voltage Standing Wave Ratio (VSWR)	<1.1:1 typical
Insertion Loss	0.16db typical
Characteristic Impedance	50 ohms†
Crosstalk	−50db typical

** Usable to 1000 MHz with reduced RF characteristics*
† Other impedances available on special order

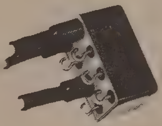
DICE CUBE RADIO FREQUENCY RELAY — SERIES RFC PRODUCT BULLETIN 159

Operate Power 150 mW

Relay Type	RFC
Size	0.5-inch cube
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.3 ounce (without terminations)

NOTE: Electrical characteristics & housing same as series C

HALF SIZE CRYSTAL-CAN RADIO FREQUENCY RELAY — SERIES RFK PRODUCT BULLETIN 156



Operate Power 250 mW

Relay Type	RFK
Size	.4 x .8 x .4 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.37 ounce (without terminations)

NOTE: Electrical characteristics & housing same as series K

CRYSTAL-CAN RADIO FREQUENCY RELAY — SERIES RFB PRODUCT BULLETIN 157

Operate Power 250 mW

Relay Type	RFB
Size	.875 x .800 x .400 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.95 ounce (without terminations)

NOTE: Electrical characteristics & housing same as series B

HIGH SENSITIVITY RADIO FREQUENCY RELAY — SERIES RFBC PRODUCT BULLETIN 158

Operate Power 40 mW

Relay Type	RFBC
Size	1.275 x .800 x .400 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	1.0 ounce (without terminations)

NOTE: Electrical characteristics & housing same as series BC

ENVIRONMENTAL CHARACTERISTICS FOR STANDARD CRYSTAL CAN SERIES

Life: 100,000 operations at 125°C and rated load.
Temperature: −65°C to +125°C, operating.
Vibration: 10 to 2000 Hz, 20G min.
Shock: 100 G
Sealing: Hermetic, to 80,000′

Insulation Resistance: 1000 megohms min., except coil-to-case at high temperature 500 megohms min.

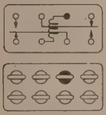
Dielectric Strength: Contacts-to-case: 1000 volts rms, 60 Hz, mutually insulated terminals: 500 volts rms standard.

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

CRYSTAL CAN RELAYS

150 GRID RELAY — SERIES G Product Bulletin 95

Qualified MIL-R-5757/37



CONTACT RATING

- 1 ampere resistive at 30 volts DC max.
- 0.125 ampere resistive at 115 volts RMS, 400 Hz, case grounded.
- Low level 0 to 0.1 ampere at 50 mV DC or AC.
- Minimum Current per MIL-R-5757/37 (100,000 operations min.).
- 2 ampere resistive at 30 volts DC max. (50,000 operations min.).

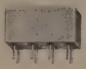
VIBRATION: 0.5" DA from 5-34 Hz, 30G from 34-3000 Hz, 10μs max. contact opening.

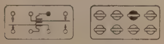
Voltage Code	Coil Voltage (Vdc)		DC Coil Resistance (ohms ±10% @ 25°C)	Max. Pull-in Voltage (Vdc)		Min. Drop-out Voltage (Vdc)	
	Max.	Nom.		25°C	125°C	25°C	−65°C
106	8	6	56	2.7	3.6	0.30	0.17
112	16	12	210	5.4	7.2	0.60	0.35
126	32	26.5	1350	13.5	18.0	1.50	0.88

See Page 1•1721 for general specifications & housing details

HALF-SIZE CRYSTAL CAN RELAY — SERIES 2K Product Bulletin 102

Qualified MIL-R-5757/9





CONTACT RATING

2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded and dry circuit.

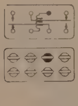
ALL WELDED CONSTRUCTION

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.25	.35	40
112	12	14.4	6.5	.75	150
126	26.5	32	13.5	1.5	675

See Page 1•1721 for general specifications & housing details

2 AMP CRYSTAL CAN RELAY —SERIES 2B Product Bulletin 120

Qualified MIL-R-5757/10



CONTACT RATING

2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded and dry circuit.

NOTE: BR types for operation at 60 to 400 Hz with specifications shown. Units may be used at higher frequencies, but individual values of voltage may change.
2-pole units only available as standard catalog item.

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
2B (DC only, 2-Pole Only)					
106	6	7.2	3.1	.5	40
112	12	14.4	6.3	.75	160
126	26.5	32	13.0	1.5	675
148	48	58	25.0	2.5	2500
176	76	90	35.0	3.0	5000
2BR (AC Only, 2-Pole Only)					
126	26.5	32	15	2	600
148	48	58	28	3	2500
176	76	90	44	4	5000
215	115	125	66	5	10000

See Page 1•1721 for general specifications & housing details

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

CRYSTAL CAN RELAYS

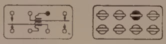
CURRENT SENSITIVE CRYSTAL CAN RELAYS—40 mW—SERIES BC Product Bulletin 135 BK Product Bulletin 136

BC

BK

CONTACT RATING

2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded.



Qualified MIL-R-5757/13

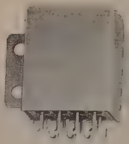
	2 BC/BK RELAY — DPDT — 40 mW					1 BC/BK RELAY — SPDT — 25 mW			
Voltage Code	Coil Res. at 25°C	Nominal Coil Voltage (VDC)	Nominal Coil Current (mA)	Max P.I. Current (mA)	Min D.O. Current (mA)	Nominal Coil Voltage (VDC)	Nominal Coil Current (mA)	Max P.I. Current (mA)	Min D.O. Current (mA)
101	20	1.8	89.2	44.6	4.5	1.4	70.6	35.3	3.5
102	30	2.2	73.0	36.5	3.7	1.8	57.6	28.8	2.9
103	50	2.8	56.6	28.3	2.8	2.2	44.6	22.3	2.3
104	75	3.5	46.2	23.1	2.3	2.8	36.6	18.3	1.8
105	100	4.0	40.0	20.0	2.0	3.2	31.6	15.8	1.6
106	200	5.7	28.4	14.2	1.4	4.5	22.4	11.2	1.2
107	300	7.0	23.0	11.5	1.2	5.5	18.2	9.1	.90
109	500	9.0	17.8	8.9	.90	7.1	14.2	7.1	.70
112	875	12.0	13.5	6.8	.70	9.4	10.7	5.34	.54
113	1000	12.6	12.6	6.5	.65	10.0	10.0	5.0	.50
118	2000	18.0	8.9	4.5	.50	14.2	7.1	3.53	.36
120	2500	20.0	8.0	4.0	.40	15.8	6.3	3.2	.32
128	5000	28.0	5.6	2.8	.30	22.5	4.5	2.23	.23
135	8000	36.0	4.5	2.3	.23	29.0	3.6	1.77	.18
140	10000	40.0	4.0	2.0	.20	32.0	3.2	1.58	.16

Series BK same as BC except max. height of .875″ & compatible with M5757/13

See Page 1•1721 for general specifications & housing details

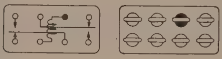
10 AMP CRYSTAL CAN RELAY — SERIES T Product Bulletin 150

Qualified MIL-R-5757/23 & 28



CONTACT RATING

Standard rating 10 amperes resistive at 30 VDC, 5 ampere resistive at 115 V or 115 V, 400 Hz, case grounded.



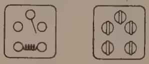
Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.3	.5	22
112	12	14.4	6.7	1.0	90
126	26.5	32	13.0	2.0	330
215	115	125	52.0	5	5500

See Page 1•1721 for general specifications & housing details

DICE CUBE® — MINIATURE RELAY — SERIES C Product Bulletin 101

CONTACT RATING

2 amperes resistive at 30 volts DC, 1 ampere 400 Hz, case grounded and dry circuit.



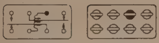
Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.5	.5	80
112	12	14.4	7	1.0	325
126	26.5	32	15	2	1500

See Page 1•1721 for general specifications & housing details

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

HI-G CRYSTAL CAN RELAYS

HALF-PINT® MINIATURE 4 AMP RELAY — SERIES 2HA Product Bulletin 100



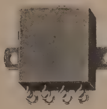
CONTACT RATING
4 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded

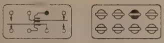
Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.4	.35	40
112	12	14.4	6.5	.75	150
126	26.5	32	13.0	1.5	600

See Page 1•1721 for general specifications & housing details

5 AMP CRYSTAL CAN RELAYS — SERIES 2BN SERIES 2BCN

	Sensitivity	Height	Product Bulletin
SERIES 2BN	280 MW	.900″	120A
SERIES 2BCN	80 MW	1.281″	135A





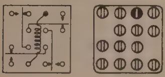
CONTACT RATING
5 amperes resistive at 30 volts DC; 3 ampere resistive at 115 volts rms, 400 Hz, case grounded; 2 ampere resistive at 115 volts rms, 60 Hz, case grounded.

NOTE: For AC operation BNR types are available on request.

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
Series 2BN					
106	6	7.2	3.1	.5	35
112	12	14.4	6.3	.75	140
126	26.5	32	13.0	1.5	600
148	48	58	25.0	2.5	2200
176	76	90	35.0	3.0	4400
Series 2BCN					
106	6	54.5	27.3	3.0	110
112	12	26.7	13.4	1.4	450
128	28	11.2	5.6	.6	2500
140	40	8.0	4.0	.4	5000

See Page 1•1721 for general specifications & housing details

4PDT CRYSTAL CAN RELAY — SERIES 4B Product Bulletin 122

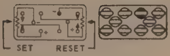


CONTACT RATING
2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded.

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.5	.5	30
112	12	14.4	7	1.0	125
126	26.5	32	15	2	570
148	48	58	28	3	2000
176	76	90	44	4	4500
215	115	125	66	5	9500

See Page 1•1721 for general specifications & housing details

HALF-SIZE LATCHING RELAY — DUAL COIL — DPDT — SERIES KL Product Bulletin 103



CONTACT RATING
2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz case grounded and dry circuit.

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Set/Reset Voltage @ + 25°C	DC Coil Resistance Ohms ±10% @ 25°C
112	12	14.4	6.5	250
126	26.5	32	13.5	1000

See Page 1•1721 for general specifications & housing details

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

CRYSTAL CAN RELAYS

GENERAL SPECIFICATION CRYSTAL CAN RELAY

ENVIRONMENTAL CHARACTERISTICS FOR STANDARD CRYSTAL CAN SERIES

Life: 100,000 operations at 125°C and rated load.
Temperature: −65°C to +125°C, operating.
Vibration: 10 to 2000 Hz, 20G min.
Shock: 100 G
Sealing (welded): Hermetic, to 80,000′

Insulation Resistance: 1000 megohms min., except coil-to-case at high temperature 500 megohms min.

Dielectric Strength: Contacts-to-case: 1000 volts rms, 60 Hz, mutually insulated terminals: 500 volts rms standard.

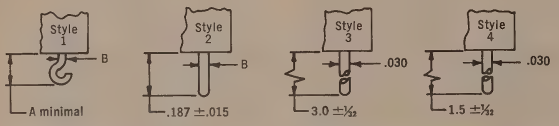
HOW TO ORDER BY PART NUMBER

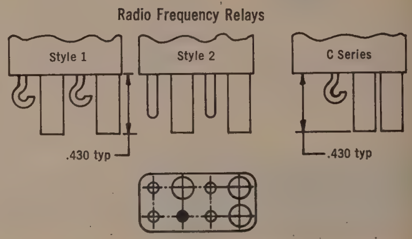
2BC	—	1	A	—	128
Series		Terminal Style	Enclosure Style		Voltage Code

Variations of Terminals and Enclosure styles are available from the factory on special order.

Q.P.L. products may be ordered by their military type designation using the appropriate dash number.

Terminal Styles


Style 1
B
A minimal
Style 2
B
.187 ±.015
Style 3
.030
3.0 ±1/32
Style 4
.030
1.5 ±1/32


Radio Frequency Relays
Style 1
Style 2
C Series
.430 typ
.430 typ

Styles 1 & 2
Available for all relay series

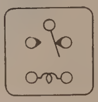
	A	B
G Series	.130″	.030″
T Series	.250″	.050″
4B Series	.250″	.030″
All others	.187″	.030″

Style 3
Not Available
T Series
KL Series

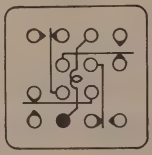
Style 4
Not Available
T Series
KL Series
BN Series
BCN Series
G Series

Schematics & Terminal Locations

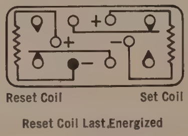
Series C



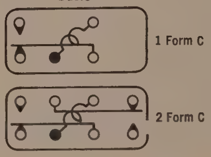
Series 4B

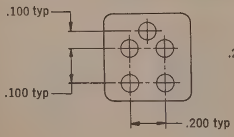


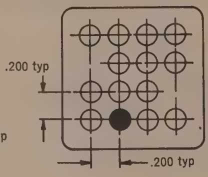
Series KL

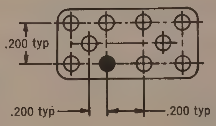

Reset Coil
Set Coil
Reset Coil Last Energized

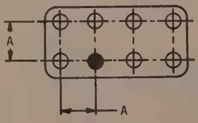
Basic


1 Form C
2 Form C


.100 typ
.100 typ
.200 typ


.200 typ
.200 typ


.200 typ
.200 typ
.200 typ



DIM. A
G Series .150 typ
All others .200 typ

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

HI G CRYSTAL CAN RELAYS

Crystal Can Enclosures

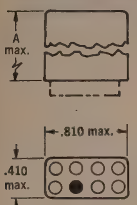

A max.
.810 max.
.410 max.

Fig. 1

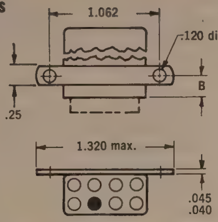

1.062
.120 dia.
B
.25
1.320 max.
.045
.040

Fig. 2

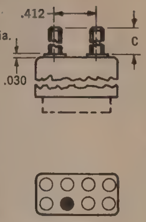


Fig. 3

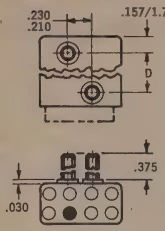

.230
.210
.157/1.77
D
.375
.030

Fig. 4

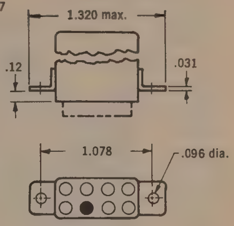
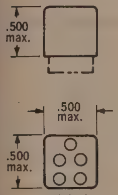

1.320 max.
.12
.031
1.078
.096 dia.

Fig. 5

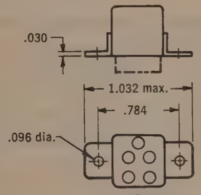
Relay Series	Enclosure Style					Dimensions			
	Fig. 1	Fig. 2	Fig. 3	Fig. 4	Fig. 5	A	B	C	D
B, BK, BN, BNR, BR, RFB	Style A	Style B	Style C	Style D	Style E	.900	.370	.375	.498 .478
BC, BCN, RFBC	Style A	Style B	Style C	Style D	Style E	1.281	.370	.375	.885 .865
K, RFK	Style A	Style B	*	NA	Style C	.410	.250	*	*
HA	Style A	Style B	*	NA	Style C	.450	.250	*	*
KL	Style A	Style B	Style D	NA	Style C	.410	.250	.313	*

Notes: Stud thread size 4-40 NC 2A * Available special order NA — Not Available

C-RFC Series Enclosures

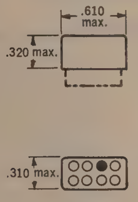

.500 max.
.500 max.
.500 max.

Style A

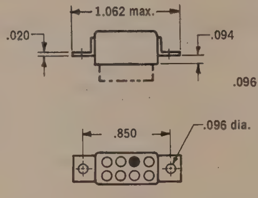

.030
1.032 max.
.784
.096 dia.

Style B

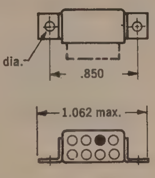
G Series Enclosures


.610 max.
.320 max.
.310 max.

Style A

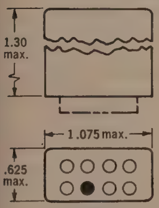

1.062 max.
.020
.094
.850
.096 dia.

Style B

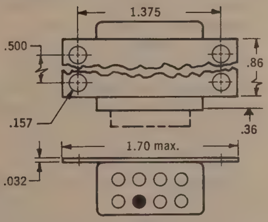

.096 dia.
.850
1.062 max.

Style C

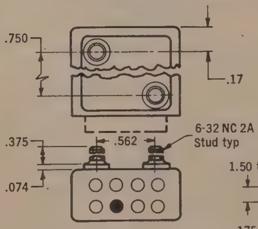
T Series Enclosures


1.30 max.
1.075 max.
.625 max.

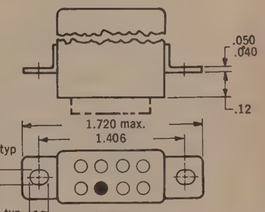
Style A


1.375
.500
.86
.157
.36
1.70 max.
.032

Style B

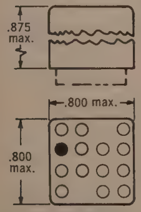

.750
.17
.375
.562
6-32 NC 2A
Stud typ
.074

Style C

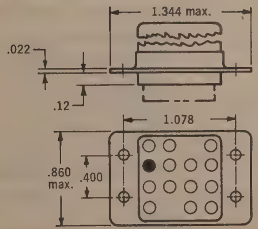

.050
.040
.12
1.720 max.
1.406
1.50 typ
.175 typ

Style D

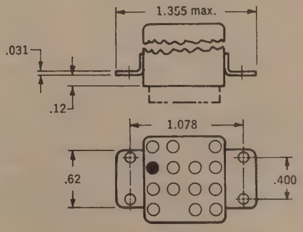
4 B Series Enclosures


.875 max.
.800 max.
.800 max.

Style A


1.344 max.
.022
.12
1.078
.860 max.
.400

Style B


1.355 max.
.031
.12
1.078
.62
.400

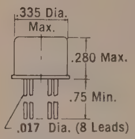
Style C

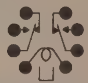
HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

INDUSTRIAL TO5 SERIES

- Standard Version
- Sensitive Version

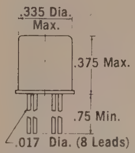
CAW SERIES DPDT

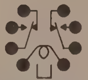




Relay Part No.	CAW-5	CAW-6	CAW-9	CAW-12	CAW-18	CAW-26
Coil Nominal	5VDC	6VDC	9VDC	12VDC	18VDC	26.5VDC
Coil Resistance ±10%	50	100	200	390	880	1560
Pull-in (max.) VDC	3.0	4.3	6.0	8.5	12.8	17.0

CSW SERIES DPDT





Relay Part No.	CSW-5	CSW-6	CSW-9	CSW-12	CSW-18	CSW-26
Coil Nominal	5VDC	6VDC	9VDC	12VDC	18VDC	26.5VDC
Coil Resistance ±10%	100	200	400	850	1600	3300
Pull-in (max.) VDC	3.0	4.3	6.0	8.5	12.8	17.0

The Hi-G CA & CS Series relays are manufactured to the same exacting standards as its Military counterpart. Each relay boasts an all welded construction to afford hermeticity of seal and insurance of chamber cleanliness. This low price TO5 type relay will comply to all of your switching requirements between dry circuit and 1.0 ampere.

GENERAL SPECIFICATIONS

OPERATE POWER: CA Series, 185mw; CS Series, 90mw.

OPERATE TIME: CA, 4.0ms; CS, 6.0ms @ nominal volt.

RELEASE TIME: CA, 3.0ms; CS, 3.0ms.

DIELECTRIC STRENGTH: 350VRMS 60 Hz.

INSULATION RESISTANCE: 1,000 Megohms min.

VIBRATION: .06″ DA 10-55 Hz, 10G to 500 Hz.

SHOCK: 30G Mil-Std 202 Method 213.

TEMPERATURE −55° to +71°C.

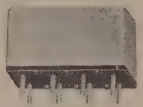
LIFE: 10,000,000 ops, mechanical,
1,000,000 ops, 0.5A 28VDC
100,000 ops, 1.0A 28VDC.

WEIGHT: CA-0.08 oz., CS-0.15 oz.

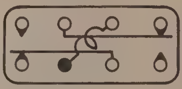
ORDERING INFORMATION

CAW — 26
Series — Coil Voltage

INDUSTRIAL 2CK SERIES

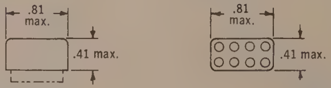


2 Form C

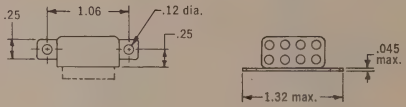


Enclosure Styles

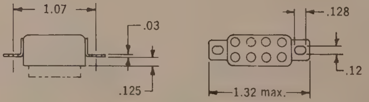
Style A



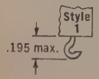
Style B

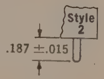


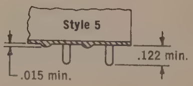
Style G



Terminal Styles







The Hi-G 2CK series represents a dynamic approach to the industrial switching market. A hermetically sealed device permitting total submersibility and assuring long life, trouble free operation and sharply reducing maintenance and service costs. Ideal for data processing, communications, machine control and remote station operation in the low level and power switching range, regardless of the environment. Available with a transipad mounting to facilitate cleaning and protection of dual sided circuit board wiring.

GENERAL SPECIFICATIONS

OPERATE POWER: 350 MW Max.

OPERATE TIME: 4.0 MS Max.

RELEASE TIME: 2.0 MS Max.

TEMPERATURE: −55°C to +71°C

DIELECTRIC STRENGTH: 500 VRMS All Points

INSULATION RESISTANCE: 1000 Megohms Min.

VIBRATION: 10G 10-500 Hz

SHOCK: 50G 11 MS

ELECTRICAL SPECIFICATIONS

Voltage Code	106	112	124	136	148
Nominal Coil Voltage	6 VDC	12 VDC	24 VDC	36 VDC	48 VDC
Nominal Coil Resistance	55	218	870	1960	3480
Maximum Pickup Voltage	4.4 VDC	8.7 VDC	17.5 VDC	26.0 VDC	35.0 VDC

SWITCHING SPECIFICATIONS

CONFIGURATION: 2 Form C — DPDT

LOAD RATING: Low Level — 2 Amps 28 VDC, 0.5 Amps, 115 VAC, 60-400 Hz

SWITCHING LIFE: 100,000 operations minimum at maximum rated load

CONTACT RESISTANCE: 0.05 ohms maximum initial at maximum rated load

ORDERING INFORMATION

2CK — 1 A — 124
Series — Voltage Code
Terminal — Enclosure

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

TIME DELAY RELAYS

MODEL TDP-1 — FIELD PROGRAMMABLE
MODEL TDO — DELAY ON OPERATE
MODEL TDR — DELAY ON RELEASE

SERIES **TD**

DESCRIPTION

The TD series of time delay relays are designed for a wide range of industrial control and sequencing operations. Enclosed in a plastic dust cover, they provide the highest quality components and construction at a low overall cost. The new field programmable model is ideally suited for R & D, low volume and production requirements. A substantial reduction in inventory can be achieved when a variety of models are necessary. The standard line also includes conventional adjustable and fixed, single mode timers for delay on operate or delay on release operation.

FEATURES

- CMOS digital circuitry
- Transient and reverse polarity protected
- No "false" operation in delay on operate mode

SPECIFICATIONS FOR STANDARD MODELS

FREQUENCY: 50/60 Hz on all AC inputs.
CONTACTS: DPDT relay, 10 amp/115 VAC resistive.
ACCURACY: ±10% over voltage and temperature range.
REPEATABILITY: ±2%.
RECYCLE TIME: 100 milliseconds max.
RESET TIME: Less than 100 milliseconds.
CURRENT DRAIN: Less than 150 milliamps.
TEMPERATURE RANGE: Operational −10°C to +55°C. Storage −55°C to +85°C.

DELAY TIMES	**Model TDO**	**Model TDR**	**Model TDP-1**
Adjustable	0.3 to 10 sec. 3 to 80 sec. 10 to 300 sec.	Same as TDO	All three*
Fixed	10, 60, 180 or 300 seconds	Same as TDO	Not Applicable
INPUT VOLTAGE	24 VDC, 24 VAC or 120 VAC	Same as TDO	All three*
MODE	Delay on Operate	Delay on Release	Both*

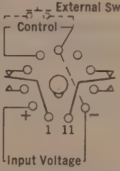
* Model TDP-1 field selectable from a factory setting of delay on operate, 0.3 to 10 sec. and any of the three voltages listed.

AVAILABLE OPTIONS

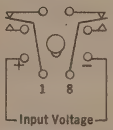
- Repeatability ±1%
- Accuracy ±5%
- Delay times — Millisec. or hours
- Input voltage as required
- Interval type timers
- Repeat cycle timers

WIRING DIAGRAMS

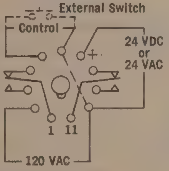
MODEL TDR
(11 Pin Base)

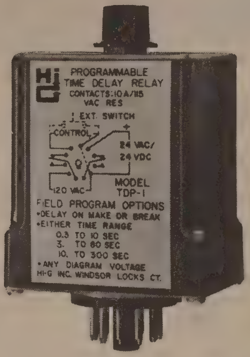

External Switch
Control
+
−
1
11
Input Voltage

MODEL TDO
(8 Pin Base)


+
1
8
Input Voltage

MODEL TDP-1
(11 Pin Base)


External Switch
Control
+
24 VDC
or
24 VAC
1
11
120 VAC


Hi G
PROGRAMMABLE
TIME DELAY RELAY
CONTACTS: 10 A/115 VAC RES
EXT. SWITCH
CONTROL
24 VAC/
24 VDC
120 VAC
MODEL
TDP-1
FIELD PROGRAM OPTIONS
•DELAY ON MAKE OR BREAK
•EITHER TIME RANGE
0.3 TO 10 SEC
3. TO 80 SEC
10. TO 300 SEC
•ANY DIAGRAM VOLTAGE
HI-G INC. WINDSOR LOCKS CT.

PROGRAMMABLE MODEL

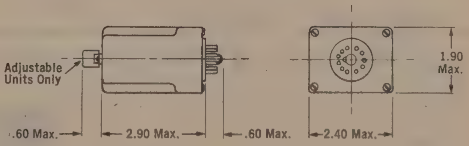
Model TDP-1, shown above, is new in concept by virtue of its field programmable features of MODE, TIMING RANGE AND VOLTAGE. Initially, the unit is factory set for Delay on Operate, 0.3 to 10 seconds and 120 VAC, 24 AC or 24 DC through appropriate pin selection. To change mode or timing range merely requires switching an internal jumper for each selection. This is easily accomplished via a hinged side door. Where field programmability is not required or desired the same CMOS digital circuitry is used to provide the more conventional adjustable or fixed models, operating mode and specific input voltage.

CONVENTIONAL MODELS

Model TDO is a delay on operate device available in adjustable or fixed time selections, any specific input voltage and utilizes an octal plug base.

Model TDR is identical to Model TDO except for delay on release mode and an 11 pin plug base.

DIMENSIONS OF BOTH 8 and 11 PIN MODELS


Adjustable Units Only
.60 Max.
2.90 Max.
.60 Max.
2.40 Max.
1.90 Max.

ORDERING INFORMATION

TD O — A — 24 D — 80 S

Series — TD
O - Operate
R - Release
A - Adjustable
F - Fixed
Voltage — 24
A - AC
D - DC
Fixed Delay or Adjustable Max. — 80
M - Milliseconds
S - Seconds
H - Hours

Typical part number: TDR-A-120A-300S

This part number defines a delay on release model with an adjustable range of 10 to 300 seconds and an input voltage of 120 VAC/50/60 Hz.

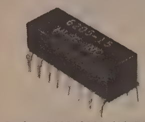
For Programmable Model order Model TDP-1.

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

TIMING MODULES

INDUSTRIAL-HYBRID THICK-FILM

DELAY ON OPERATE — SERIES 6200
INTERVAL (SINGLE SHOT) — SERIES 6300
LOGIC NORMALIZER — MCG-5



Series 6200/6300 (16 Pins)
MCG-5 (14 Pins)

DESCRIPTION

The standard versions of these compact, solid-state timers provide a path from the negative input to the load terminal. Similarly, the "P" versions provide a path from the positive input.

GENERAL SPECIFICATIONS

DELAY ACCURACY: ±10% over temperature and voltage range.

REPEATABILITY: ±2%.

RECYCLE TIME: 100 milliseconds maximum.

DELAY SET POINT: Fixed - No external components required.
Adjustable - External resistor required.

OUTPUT: SPSTNO - Solid-state.
Standard model - Switches to minus input.
P Characteristic - Switches to plus input.

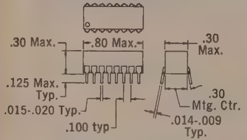
TEMPERATURE RANGE: 0°C to +71°C.

TERMINALS: Tin Dipped Phosphorous Bronze.

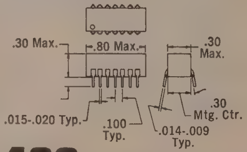
CASE MATERIAL: Diathialate.

Model Number	Timing Logic Diagram	V_{cc} Nominal Range	I_{cc} Current Drain	I_o Load Current Min.	I_o Load Current Max.	V_f Forward Drop	Pin Out
MCG-5	Fig. 2	5 VDC 4.5 V to 5.5 V	25 ma MAX	N/A	20 ma	0.25V	A
6205	Fig. 1				All 5 VDC Models have 2K Internal Pull-up Res.		B
6205-P	Fig. 1						B
6305	Fig. 2						B
6305-P	Fig. 2						B
6212	Fig. 1	12 VDC 10 V to 14 V	10 ma MAX	10 ma	200 ma	2.0 V	C
6212-P	Fig. 1			N/A	100 ma	0.7 V	C
6312	Fig. 2					2.0 V	C
6312-P	Fig. 2					0.7 V	C
6224	Fig. 1	24 VDC 18 to 31 V		10 ma	200 ma	2.0 V	C
6224-P	Fig. 1			N/A	100 ma	0.7 V	C
6324	Fig. 2					2.0 V	C
6324-P	Fig. 2					0.7 V	C
6248	Fig. 1	48 VDC 45 to 51		10 ma	200 ma	2.0 V	C
6248-P	Fig. 1			N/A	100 ma	0.7 V	C
6348	Fig. 2					2.0 V	C
6348-P	Fig. 2					0.7 V	C

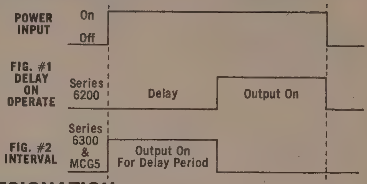
SERIES 6200/6300


.30 Max.
.80 Max.
.30 Max.
.125 Max. Typ.
.015-.020 Typ.
.100 typ
.30 Mtg. Ctr.
.014-.009 Typ.

MODEL MCG-5


.30 Max.
.80 Max.
.30 Max.
.015-.020 Typ.
.100 Typ.
.30 Mtg. Ctr.
.014-.009 Typ.

LOGIC DIAGRAMS


POWER INPUT
On
Off
FIG. #1 DELAY ON OPERATE
Series 6200
Delay
Output On
FIG. #2 INTERVAL
Series 6300 & MCG5
Output On For Delay Period

TIMING DESIGNATION

CODE	105	11	13	15	110	130	230
TIME	0.5	1.0	3.0	5.0	10	30	0-30

TIMING CODE 230 — Provides a device that may be adjusted using external resistance, over an approximate range of 15-30 milliseconds to 30 seconds. Lower Limit R_T is restricted to 5K minimum. With less resistance, erratic or no time-out may result. 600-700K approximate, will provide a 30 second delay, with intermediate, resistance vs. time, being a linear curve.

PART NUMBER DEFINITION

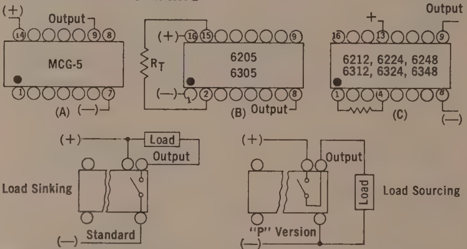
62 05 P - 1 10

Basic Output Logic Type — 62
Input Voltage — 05
Switching Characteristic (no letter denotes standard switching characteristic) — P
Timing Mode — 1
Delay Time — 10

HOW TO ORDER

A complete part number is formed with a model number and timing code. The model number is selected to provide the desired combination of timing logic, input voltage, and switching characteristic, listed in Table I. Extract the timing code representing the desired time from Table II, and combine. i.e. 6348P-130.

PIN OUT DIAGRAMS


(+)
Output
14
9
8
MCG-5
1
7
(A)
(—)
R_T
(+)
16
15
9
6205
6305
(—)
1
2
8
(B)
Output
+
Output
16
13
9
6212, 6224, 6248
6312, 6324, 6348
1
4
8
(C)
(—)
(+)
Load
Output
Load Sinking
Standard
(—)
(+)
Output
Load
Load Sourcing
"P" Version
(—)

MODEL 6400

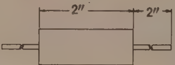
TWO TERMINAL "SERIES" CONNECTED SOLID STATE TIMING MODULE

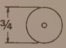
ECONOMY and CONVENIENCE of installation are foremost in a solid state, (2) lead, cylindrical cased timer, providing a DELAY-ON-OPERATE control function for electromechanical devices.

HI-G, INC.
MODEL-6400
TIMER

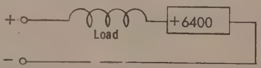
FEATURES

- Input voltages of 12 VDC, 24 VDC, and 48 VDC
- Fixed delay times of 1.0, 5.0, 10, 30, and 60 seconds
- Series connected with load
- Accuracy, ±10% (over temperature range)
- Repeatability, ±2%
- Output rating (inductive), 0.5 amperes at the rated input voltage
- Reverse polarity protection provided
- Operating temperature range 32°F to +125°F





WIRING DIAGRAM



HOW TO ORDER

Form a part number by the following method, using code numbers shown in the tabulation below.

BASIC NUMBER **64XX - XX - XX**

Input Voltage — 64XX
Output Rating — XX
Physical Configuration — XX
Delay Time — XX

Part number code determination			
Input Voltage	**Output Rating**	**Physical Conf.**	**Delay Time**
12 = 12 VDC 24 = 24 VDC 48 = 48 VDC	A = 0.5 amp	A = Wire leads	1 = 1.0 seconds 5 = 5.0 seconds 10 = 10 seconds 30 = 30 seconds 60 = 60 seconds

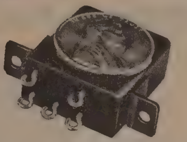
Example part number: 6424-AA-5 = A 24 VDC timer with a 5 second delay time.

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

CRYSTAL CAN MOUNTED SOLID STATE TIMER

FIXED SERIES **1800**

ADJUSTABLE SERIES **1900**



TIMING DIAGRAM — Delay-On-Make

The 1800 and 1900 Series are all Solid-State Timers that offer excellent reliability over a useful life well in excess of one million operations. They have a fast reset time, are remarkably stable over a wide temperature range, and can provide delays down to the millisecond range.
Each unit is hermetically sealed and encapsulated with a standard crystal-can header which results in an extremely rugged, high performance assembly. All units are available in a choice of standard mounting configurations. The 1860 version is directly interchangeable with a crystal can relay.

SERIES CHART

Type	Delay Times	Reset Time (Microsec)	Output	Max.Forward Leakage
1860	10 ms to 10 sec. Factory Set	20	S.P.N.O. 250 ma @ 25°C	1 milliamp
1800	10 ms to 120 sec. Factory Set	100	S.P.N.O. 1.0 Amp @ 25°C	2 milliamp
1900	10 ms to 90 sec. Adjustable	100	S.P.N.O. 1.0 Amp @ 25°C	2 milliamp

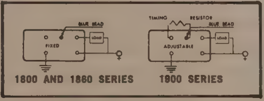
ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 18 to 31 Volts DC
DELAY TIME TOLERANCE: ±10% at Set Point or 10 milliseconds, whichever is greater.
RECOVERY TIME: 100 milliseconds maximum.
RECYCLE TIME: 20 milliseconds maximum.
OUTPUT DERATING FOR 125°C: 75%.
INDUCTIVE LOADING: Use external diode.

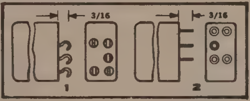
ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: −55°C to +85°C.
VIBRATION: 20g's, 10 to 2000 Hz
SHOCK: 50g's, 11 ±1 milliseconds duration.
INSULATION RESISTANCE: 1000 megohms @ 500 volts DC, all terminals to case.
DIELECTRIC STRENGTH: 500 volts rms, 60 Hz, all terminals to case.
SEALING: Hermetic, 1.3 inches mercury.
LIFE: Over 1,000,000 operations.

ELECTRICAL DIAGRAMS

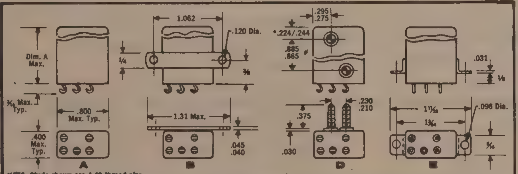


HEADER STYLES



NOTE Terminal Spacing 0.2 inch, all headers with terminal diameter 0.030 inch.

MOUNTING STYLES



NOTE: Studs shown are 4-40 thread size.
*.224/.244 is for 1.45" and 1.275" housings; the .875" housing dimensions is .157/.177. #.498/.478 for type 1860 housing.

TIMING MODULE TYPES

Series Type	Type	Timing Range	Temperature Range	Housing Length (Dim. "A")
1801	Fixed	10 ms to 60 sec.	−55°C to +85°C	1.275"
1802	Fixed	60 to 120 sec.	−55°C to +85°C	1.45"
1851	Fixed	10 ms to 40 sec.	−55°C to +125°C	1.275"
1852	Fixed	40 to 80 sec.	−55°C to +125°C	1.45"
1860	Fixed	10 ms to 10 sec.	−55°C to +85°C	.875"
1901	Adjust.*	10 ms to 45 sec.	−55°C to +85°C	1.275"
1902	Adjust.*	45 to 90 sec.	−55°C to +85°C	1.45"
1951	Adjust.*	10 ms to 30 sec.	−55°C to +125°C	1.275"
1952	Adjust.*	30 to 60 sec.	−55°C to +125°C	1.45"

* Refer to Model 1700 for Adjustable Timing Formula.

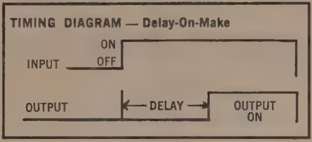
DETERMINATION OF MODULE PART NUMBER

The timing code number consists of four digits with the first three significant figures and the last digit the number of zeros following the significant figures; thus, 0100 would be 10 milliseconds, 1101 is the code for 1.1 seconds, and 6001 would be 6.0 seconds. A typical part number for the Hi-G solid-state timing module is 1860-1A-1002; this is a fixed timing module designed to operate in the −55°C to +85°C temperature range, with hook terminals and a style A mounting, and a delay of 10 seconds.

1860 — SERIES
1A — HEADER STYLE, MOUNTING STYLE
1002 — TIMING CODE

DUAL-IN-LINE HYBRID TIMING MODULE

TRIMMABLE SERIES **6100**



FEATURES

- Time delays from 50 ms to 60 sec.
- State-of-the-art reliability.
- Package less than ⅜" x ½" x ⅞".
- Delay-on-make-operation.
- Dual-in-line compatible.
- Life 1,000,000 operations minimum.
- External time adjustment possible.

ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 18 to 32 volts DC, reverse polarity protection provided.
DELAY TIME: 50 milliseconds to 60 seconds. Factor set, fixed time.
DELAY TIME TOLERANCE: ±10%.
RECYCLE TIME: 0.5% (nominal delay time) = max. recycle time @ 25°C.
RECOVERY TIME: 100 milliseconds max.
OUTPUT SWITCH: S.P.N.O. — solid-state.
OUTPUT RATING: .25 amp resistive @ 28 VDC derates to .1 amp @ 85°C. Minimum load required, 10 ma.
CURRENT DRAIN: 6 ma @ 28 VDC (25°C) plus load current.
OUTPUT LEAKAGE: 1 ma max. in non-conducting state.
FORWARD DROP: 2 VDC max. in conducting state.

ENVIRONMENTAL CHARACTERISTICS

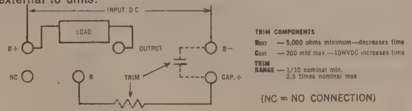
TEMPERATURE RANGE: −55°C to +85°C.
VIBRATION: 20g's, 10 to 2,000 Hz.
SHOCK: 50g's, 11 ±1 millisecond duration.
LIFE: 1,000,000 cycles minimum.

PHYSICAL DATA

HEIGHT: 0.370 inches.
WIDTH: 0.460 inches.
LENGTH: 0.800 inches.
FOOTPRINT: Dual-in-Line (0.3" wide x 0.1" grid).
CONNECTIONS: Solder pins, ½" long.
ENCAPSULATION: Epoxy.
WEIGHT: Approx. 0.2 ounces.

ELECTRICAL DIAGRAM

* Units can be trimmed in timing to allow custom fitting into systems prior to finalization of timing requirements, by connecting components external to units.


INPUT D C
LOAD
B+
OUTPUT
B−
NC
R
TRIM
CAP. +
TRIM COMPONENTS
REXT — 5,000 ohms minimum—decreases time
CEXT — 200 mfd max.—10WVDC increases time
TRIM RANGE — 1/10 nominal min. 2.5 times nominal max
(NC = NO CONNECTION)

OTHER MODELS

6150 — HERMETICALLY SEALED
TEMPERATURE RANGE: −55°C to +125°C.
TIMING TOLERANCE: ±15%
SEALING: 72,000 feet
ENCLOSURE: Base: .58 x .92.
(DIMENSIONS MAX.) Height: .42.

6155 AND 6105 — TTL COMPATIBLE
INPUT VOLTAGE: 5 V ±0.5 VDC
OUTPUT: Fanout of 10. (20 ma sink current).
FORWARD DROP: 0.1 VDC maximum.
LEAKAGE: 1.0 μa maximum.
TRIM FEATURE: Not applicable.

Unless otherwise specified, characteristics are per 6100 model. (MODEL 6155 IS HERMETICALLY SEALED)

PHYSICAL DATA

6100 — Plastic shell epoxy encapsulated; terminals (6) are 0.018 dia. gold plated arranged in .1 x .3 grid pattern (DIP). Overall dimensions, base .475 x .815, height .405 inches max.
6150 — Metal case, hermetically sealed, terminals (14) are 0.018 dia. gold plated arranged in .1 x .3 grid pattern (DIP). Overall dimensions, base .58 x .92, height .42 inches max.

DETERMINATION OF MODULE PART NUMBER

A complete part number consists of 2 elements.
1) Series Number — This number establishes the function and enclosure style, i.e., Seris 6100 is a solid-state output with solder pins for printed circuit board mounting.
2) Timing Code Determination — The timing code consists of four digits and denotes time in milliseconds. The first three digits are significant figures and the last digit is the number of zeros to follow. Thus 100 milliseconds is coded 1000; 1.1 seconds is 1101 (1100 milliseconds); and 60 seconds is 6002 (60,000 milliseconds).

Example: 6100 — SERIES NUMBER; 6002 — TIMING CODE

This number designates a solid-state output timer with 60 seconds (60,000 milliseconds) time delay.

ORDERING INFORMATION

Series	Contact Config.	Rating	Temperature Range	Delay Min. Max.
6100*	SPNO	.25 Amp	−55° to +85°C	0.05 to 60 sec.
6105*	SPNO	TTL - 10 fanout	−55° to +85°C	0.05 to 60 sec.
6150	SPNO	.25 Amp	−55°C to +125°C	.05 to 60 sec.
6155*	SPNO	TTL - 10 fanout	−55° to +125°C	0.05 to 60 sec.

* Add timing code designation

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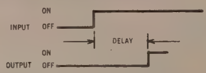
MINIATURE TIMING MODULE

FIXED TIME DELAY

SERIES **2400**

TIMING DIAGRAM — Delay-On-Make



FEATURES

The Series 2400 Time Delay Relay combines a solid-state timing circuit and a Hi-G relay in a package only slightly longer than a standard crystal-case housing. This combination provides the current-carrying capacity and the environmental immunity of Hi-G's electromechanical relays with the long life and quick response of electronic circuits. Delays from 50 milliseconds up to 120 seconds can be specified for this rugged DC timing module. The solid-state circuit has a voltage regulator circuit that permits the use of unregulated power sources.

HOW TO ORDER

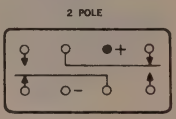
The part number for a Hi-G miniature time delay module consists of four elements: the series number, the header style, the mounting style, and the timing code number. The timing code number consists of four digits and gives the time in milliseconds. The first three digits are the significant figures and the last digit is the number of zeroes following the significant fgures; thus, 0500 would be 50 milliseconds, 1101 is the code for 1.1 seconds, and 5002 would be 50 seconds. A typical part number for the Hi-G miniature delay module is 2401-1A-1102; this is a time delay module designed to operate in the −55°C to +85°C temperature range, hook terminals, style A mounting, providing a delay of 11 seconds. Specify 2402 for +125°C.

2401 1A 1102
TIMING CODE
MOUNTING STYLE
SERIES
HEADER STYLE

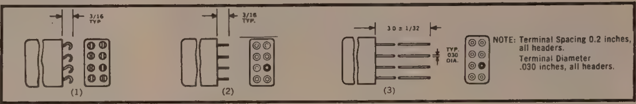
STANDARD OPTIONS

1. **TEMPERATURE RANGE:**
   Model 2401, −55°C to +85°C
   Model 2402, −55°C to +125°C
2. Transient protection

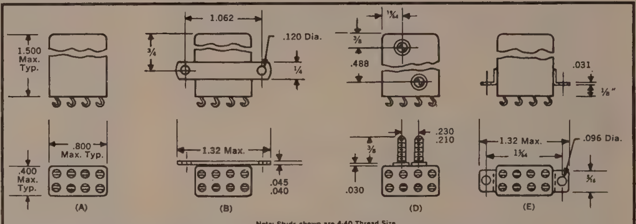
ELECTRICAL DIAGRAM



HEADER STYLES


3/16 TYP
3/16 TYP.
30 ± 1/32
TYP. .030 DIA.
(1)
(2)
(3)
NOTE: Terminal Spacing 0.2 inches, all headers.
Terminal Diameter .030 inches, all headers.

MOUNTING STYLES



Note: Studs shown are 4-40 Thread Size.

ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 18 to 31 volts DC. Reverse polarity protection provided.

DELAY TIME: 50 milliseconds to 120 seconds Delay-on-make.

DELAY TIME TOLERANCE: ±10%.

RESET TIME: 10 milliseconds maximum.

RECYCLE TIME: .5% (nominal delay time) = recycle time maximum @ 25°C.

RECOVERY TIME: 0.1 second maximum up to 20 seconds delay, 0.5 seconds maximum to 120 seconds.

CONTACT RATING: 2 amperes resistive at 30 VDC or 0.125 amp at 115 V, 400 Hz.

CONTACT ARRANGEMENT: 2-pole, double-throw.

CURRENT DRAIN: 85 ma maximum @ 31 VDC (25°C).

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: −55°C to +85°C.

VIBRATION: 20 G's, 10 to 2000 Hz.

SHOCK: 50 G's, 11 ±1 milliseconds duration.

INSULATION RESISTANCE: 1000 megohms @ 500 volts DC, all terminals to case.

DIELECTRIC STRENGTH: 500 volts rms, 60 Hz, terminals to case.

SEALING: Hermetic, 1.3 inches mercury.

LIFE: 50,000 operations minimum.

WEIGHT: 1.2 oz. maximum.

FLASHER

SERIES **2600**

APPLICATION

The Hi-G Series 2600 Flasher can be used wherever warning or indicating light, navigation or position lights, panel or control lights must be operated with a maximum of reliability in severe environments. The Series 2600 can also be used to interrupt Tone Generators or other Signaling Devices at a predetermined frequency.

DESCRIPTION

The Series 2600 Flasher is a completely Solid State Device. Cycling of the unit commences with application of input power, or the unit can be actuated by a control line when standby power is available. Electronic circuitry provides a precise flash rate which is stable over a wide temperature range. Flash cycle available from 30 to 600 per minute.

ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 18 to 32 Volts DC.

OUTPUT: S.P.N.O., 100 ma (Solid-state).

CURRENT DRAIN: 30 ma @ 28 Volts DC.

DUTY CYCLE: 1:10 to 10:1.

STABILITY: ±10% over temperature and voltage input.

ENVIRONMENTAL

OPERATING TEMPERATURE: −55°C to +100°C.

VIBRATION: 20 G's, 10 to 2000 Hz.

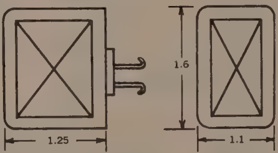
SHOCK: 50 G's, 11 ±1 MS.

ALTITUDE: 70,000 feet.

LIFE: 10 x 10^6 cycles.

CASE: Hermetically sealed.

DIMENSIONS



OPTIONS AVAILABLE

- Higher Output Rating
- AC Input
- Operatng Temperature to 125°C
- Transient Protection per MIL-STD-704
- Smaller Packaging
- Commercial Versions

ORDERING INFORMATION

- 2600 Series
- Flash Rate
- Duty Cycle

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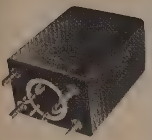
ADJUSTABLE TIMING MODULE SERIES 1700
FIXED TIMING MODULE SERIES 1600



4 AND 10 AMPERES RATING CHART

Type	DC, 10 Amp	AC or DC, 4 Amp
Input Voltages	18 to 31 VDC, unregulated	DC Units, 18 to 31 volts, Unregulated AC Units, 105 to 125 volts, 400 Hz or 60 Hz
Delay Time	50 milliseconds to 180 seconds	50 milliseconds to 180 seconds
Contact Rating at 30 Volts DC	10 amperes, Resistive 5 amperes, Inductive	4 amperes, Resistive
Contact Configuration	1, 2 Poles, double-throw	1-, 2-, 3- and 4-pole, double throw
Current Drain at 25°C at 28 Volts DC	135 ma maximum	1-pole: 100 ma maximum; 2-pole: 150 ma maximum; 3 and 4 pole: 200 ma maximum

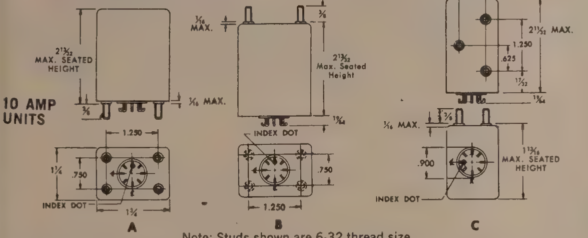
ELECTRICAL SPECIFICATIONS

INPUT VOLTAGES: Refer to above chart.
DELAY TIMES: 50 milliseconds to 180 seconds.
FUNCTION: Delay on operate.
DELAY TIME TOLERANCE: ±10% or 10 milliseconds, whichever is greater.
RECYCLE TIME: 0.5% T (sec.) = T recycle max. @ 25°C.
RECOVERY TIME: 0.1 second maximum from 50 milliseconds to 90 seconds; 0.5 second maximum from 90 seconds to 180 seconds.
RESET TIME: 10 milliseconds maximum for DC units and 40 milliseconds maximum for AC units.

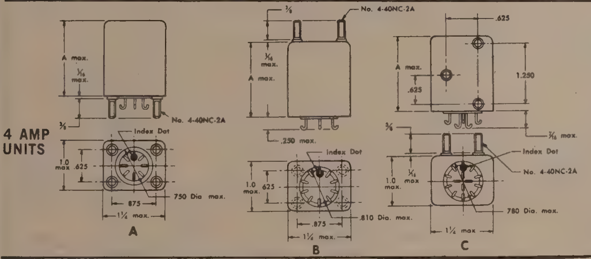
ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: −55°C to +85°C or −55°C to +125°C.
VIBRATION: 20 G's; 10 to 2000 Hz.
SHOCK: 50 G's, 11 ±1 millisecond duration.
INSULATION RESISTANCE: 1000 megohms at 500 volts DC, all terminals to case.
DIELECTRIC STRENGTH: 1000 volts rms, 60 Hz, all terminals to case.
SEALING: Hermetic, 1.3 inches mercury.
LIFE: 100,000 operations minimum.

MOUNTING STYLES


10 AMP UNITS
2 13/32 MAX. SEATED HEIGHT
3/8
1/16 MAX.
1.250
1 1/4
.750
INDEX DOT
1 3/4
A
1/16 MAX.
3/8
2 13/32 Max. Seated Height
1 3/64
INDEX DOT
.750
1.250
B
.625
2 11/32 MAX.
1.250
.625
1 7/32
1/16 MAX.
1 13/16 MAX. SEATED HEIGHT
.900
INDEX DOT
C

Note: Studs shown are 6-32 thread size


4 AMP UNITS
A max.
1/16 max.
No. 4-40NC-2A
Index Dot
1.0 max
.625
.875
1 1/4 max.
750 Dia max.
A
No. 4-40NC-2A
1/16 max.
A max.
.250 max.
Index Dot
1.0 max.
.625
.875
1 1/4 max.
.810 Dia. max.
B
.625
A max.
1.250
.625
1/16 max.
Index Dot
No. 4-40NC-2A
1.0 max.
780 Dia. max.
1 1/4 max
C

ADJUSTABLE TIMING FORMULA

The resistance required to obtain timing within this range is determined by using the formula:

Rx = 400K (T/T max.) −40K
Rx = External Res. in OHMS
T = Desired time in seconds
T max. = Maximum time (code)

A high quality deposited carbon ±1%, .1w (min.) resistor is recommended for external resistance.

10 AMPERE MODULE SERIES NUMBER — TABLE

Series	Function	Contact Arrangement
1610	Fixed	1 PDT
1611	Fixed	2 PDT

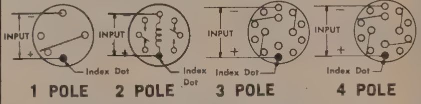
Series	Contact Arrangement	Adjustable Range	Timing Code
1710	1 PDT	.1 to 1.0 sec.	1001
1711	1 PDT	.5 to 5 sec.	5001
1712	1 PDT	1.0 to 10 sec.	1002
1713	1 PDT	5 to 50 sec.	5002
1714	1 PDT	18 to 180 sec.	1803
1715	2 PDT	.1 to 1.0 sec.	1001
1716	2 PDT	.5 to 5 sec.	5001
1717	2 PDT	1.0 to 10 sec.	1002
1718	2 PDT	5 to 50 sec.	5002
1719	2 PDT	18 to 180 sec.	1803

4 AMPERE MODULE SERIES NUMBER — FIXED & ADJUSTABLE TABLE

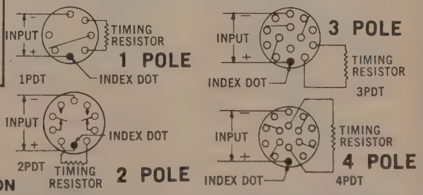
Series	Input	Temperature Range	Housing Length (Dim. "A")	Contact Arrangement
1601	DC	−55° to +85°C	$1\frac{9}{16}$	1 PDT
1602	DC	−55° to +85°C	$1\frac{21}{32}$	2 PDT
1603	DC	−55° to +85°C	2	3 PDT
1604	DC	−55° to +85°C	2	4 PDT
1621	DC	−55° to +125°C	$1\frac{9}{16}$	1 PDT
1622	DC	−55° to +125°C	$1\frac{21}{32}$	2 PDT
1623	DC	−55° to +125°C	2	3 PDT
1624	DC	−55° to +125°C	2	4 PDT
1651	AC	−55° to +85°C	2	1 PDT
1652	AC	−55° to +85°C	2	2 PDT
1653	AC	−55° to +85°C	$2\frac{3}{8}$	3 PDT
1654	AC	−55° to +85°C	$2\frac{3}{8}$	4 PDT
1671	AC	−55° to +125°C	2	1 PDT
1672	AC	−55° to +125°C	2	2 PDT
1673	AC	−55° to +125°C	$2\frac{3}{8}$	3 PDT
1674	AC	−55° to +125°C	$2\frac{3}{8}$	4 PDT
1701	DC	−55° to +85°C	$1\frac{9}{16}$	1 PDT
1702	DC	−55° to +85°C	$1\frac{21}{32}$	2 PDT
1703	DC	−55° to +85°C	2	3 PDT
1704	DC	−55° to +85°C	2	4 PDT
1721	DC	−55° to +125°C	$1\frac{9}{16}$	1 PDT
1722	DC	−55° to +125°C	$1\frac{21}{32}$	2 PDT
1723	DC	−55° to +125°C	2	3 PDT
1724	DC	−55° to +125°C	2	4 PDT
1751	AC	−55° to +85°C	2	1 PDT
1752	AC	−55° to +85°C	2	2 PDT
1753	AC	−55° to +85°C	$2\frac{3}{8}$	3 PDT
1754	AC	−55° to +85°C	$2\frac{3}{8}$	4 PDT
1771	AC	−55° to +125°C	2	1 PDT
1772	AC	−55° to +125°C	2	2 PDT
1773	AC	−55° to +125°C	$2\frac{3}{8}$	3 PDT
1774	AC	−55° to +125°C	$2\frac{3}{8}$	4 PDT

NOTE: Shaded series are adjustable.

ELECTRICAL DIAGRAM — FIXED DELAY 1600


INPUT
Index Dot
1 POLE
INPUT
Index Dot
2 POLE
INPUT
Index Dot
3 POLE
INPUT
Index Dot
4 POLE

ADJUSTABLE DELAY — 1700


INPUT
TIMING RESISTOR
1 POLE
1PDT
INDEX DOT
INPUT
3 POLE
TIMING RESISTOR
INDEX DOT
3PDT
INPUT
INDEX DOT
2PDT
TIMING RESISTOR
2 POLE
INPUT
TIMING RESISTOR
4 POLE
INDEX DOT
4PDT

DETERMINATION OF MODULE PART NUMBER — ORDERING INFORMATION

Hi-G Adjustable Time Delay Modules cover one decade, e.g., 62 milliseconds to 620 milliseconds; you may select any decade that best suits your application within the range of 50 milliseconds to 180 seconds. (Of course, longer ranges are available on special order.) The upper decade limit is $T_{max.}$ in the timing formula and is the timing code number in the part number described in the following paragraph.

The part number for a Hi-G Time Delay Module consists of three elements: the series number (from the Table), a letter signifying mounting style, and the timing code number. The timing code number consists of four digits and gives the time in milliseconds. The first three digits are the significant figures and the last digit is the number of zeroes following the significant figures; thus, 50 milliseconds would be coded 0500, 1.1 seconds would read 1101, and 1 minute (60 seconds) would be 6002.

A typical part number for an adjustable timing module is 1722-C-1102; this is a DC unit in the −65°C to +125°C temperature range with a 2 pdt contact arrangement, in a style C mounting, and with a time delay range of 1.1 to 11 seconds.

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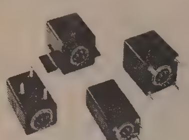
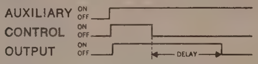
DELAY ON RELEASE TIMING MODULE

FIXED SERIES **5600**
ADJUSTABLE SERIES **5700**



FUNCTION

Apply auxiliary power. Upon application of control power, the output will energize. Remove control power to initiate delay period.



ELECTRICAL PARAMETERS

INPUT: Units will not be damaged by reverse application of input voltage.
Auxiliary — 18 - 31 VDC
Control — 10 - 31 VDC. Ground common to aux. power line.
10 volts minimum must be applied for a minimum duration of 20 milliseconds to energize output and arm the timing circuit.

DELAY TIMES: Overall, 50 msec to 300 seconds. Units rated 10 ampere, minimum delay 100 milliseconds. Units rated 125°C, maximum delay 180 seconds.

TIMING TOLERANCE: ±10%, applicable over rated temperature and input voltage ranges.

CURRENT DRAIN: (@25°C @ 28 VDC).
Control line — 15 ma typical, 25 ma maximum.
Auxiliary — Deenergized (after completion of delay period) 25 ma Energized. (See Tabulation).

Configuration	2 & 5 amp	10 amp
1PDT	100 ma	150 ma
2PDT	150 ma	240 ma

RESPONSE TIME:
Operate — rated 2 & 5 amp, 10 msec max. 10 amp, 20 msec max.
Recycle — 0.5% maximum of specified delay.
Reset — 20 milliseconds maximum.

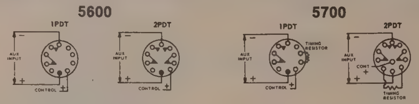
CONTACT RATINGS:

Specified Rating	Amperes @ 30 VDC Res	Amperes @ 30 VDC Ind	Amperes @ 115 V 400 Hz Res	Amperes @ 115 V 400 Hz Ind
2 amps	2	1	1	0.3
5 amps	5	1.5	3	1
10 amps	10	5	5	3

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: −55°C to +85°C or −55°C to +125°C.
VIBRATION: 10-20,000 Hz @ 20g except 10 amp rated units 15g.
SHOCK: 50g 11 ±1 millisecond.
INSULATION RESISTANCE: 1000 Megohms minimum @ 500 VDC.
DIELECTRIC STRENGTH: 1000 Vrms, 60 Hz @ Sea Level. All terminals tied together to case, and across open contacts.
SEALING: Hermetic 1.3 inches mercury.
LIFE: 2 & 5 amp rated - 100,000 operations minimum. 10 amp rated - 50,000 operations minimum.

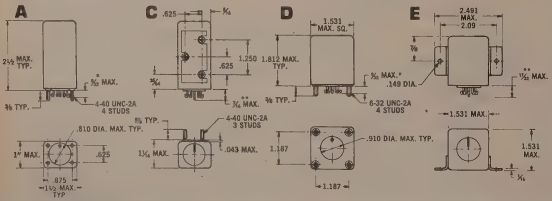
Series Fixed	Series Adjustable	Contact Configuration	Rating	Temperature Range	Available Enclosure	Delay Min. Max.
5601	5701	1PDT	2 amp	−55°C to +85°C	A-C-D-E	0.05-300 sec.
5602	5702	2PDT	2 amp	↕	A-C-D-E	↕
5605	5705	1PDT	5 amp	↕	D-E	↕
5606	5706	2PDT	5 amp	↕	D-E	↕
5610	5710	1PDT	10 amp	↕	D-E	0.10-300 sec.
5611	5711	2PDT	10 amp	↕	D-E	↕
5621	5721	1PDT	2 amp	−55°C to +125°C	A-C-D-E	0.05-180 sec.
5622	5722	2PDT	2 amp	↕	A-C-D-E	↕
5625	5725	1PDT	5 amp	↕	D-E	↕
5626	5726	2PDT	5 amp	↕	D-E	↕



HOW TO ORDER

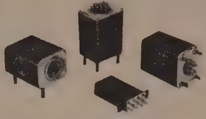
5621 — A 1003 — Zeros Multiplier
Series Designator
Timing in Milliseconds
Enclosure Style

MOUNTING STYLES



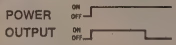
INTERVAL TIMER

FIXED SERIES **4600** (RELAY OUTPUT)
ADJUSTABLE SERIES **4700** (RELAY OUTPUT)
FIXED SERIES **4800** (SOLID STATE OUTPUT)



FUNCTION

Apply power and the output will energize. After time out, the output will revert to De-Energized State. Remove and Reapply power to Recycle.



SERIES 4600 - 4700 - 4800 (except where noted) ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 18-31 VDC. AC units 105-125 VAC 400 Hz DC units will not be damaged by reverse application of input voltage.

DELAY TIMES: 100 milliseconds to 300 sec. Series 4800 — See Table.

TIMING TOLERANCE: ±10% over voltage and temperature ranges.

OPERATE TIME: 4 amp. rated units: 7 ms. maximum 10 amp. rated units: 15 ms. maximum. Series 4800 — 100 microsec. max.

CURRENT DRAIN: Steady state (after timeout) 75 ma maximum @ 28 VDC @ 25°C. See tabulation for current drain during time out. Series 4800 — 25 ma max. + actual load.

RECYCLE TIME: 0.5% maximum of the specified delay time.

CONTACT RATING: See tabulation. Choice of ratings. 10 amperes resistive 5 amperes inductive @ 28 VDC 115 VAC 400 Hz, or 4 amperes resistive 1 ampere inductive @ 28 VDC. 2 amperes resistive 1 ampere inductive @ 115 VAC 400 Hz.

SERIES 4800

OUTPUT: SPSTNO rated 0.5 ampere @ 25°C derating to 250 ma @ 125°C.

FORWARD DROP: 1.0 volt maximum @ .5 amperes, .3 volts maximum @ 150 ma @ 25°C. Maximum leakage 10 microamps (in non-conducting state) @ 125°C. Inductive loads require diode suppression externally.

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: −55°C to +125°C (+85°C for Delays over 180 seconds). Series 4800 — Either and specify. **VIBRATION:** 20g's 10-2000 Hz. **SHOCK:** 50g's 11 ms. Duration. **SEALING:** Hermetic. 1.3 inches mercury. **INSULATION RESISTANCE:** 1000 Megohms @ 500 VDC. **DIELECTRIC STRENGTH:** 1000 Vrms, 60 Hz @ Sea Level. **LIFE:** 4 Ampere rated - 100,000 operations Min. 10 Ampere rated - 50,000 operations Min. Series 4800 — Over 10^6 operations Min.

HOW TO ORDER

4610
4710 — 2 B — 1003
4801

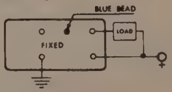
Series
Header (4800 only)
Mounting
Time in millisec. Also, max. time on adjustable (4700) with min. a decade lower.
Zeros Multiplier

Schematics and mounting styles of Series 4600 and 4700 are same as Series 1600 and 1700 on Page 1•1727. Similarly, Series 4800 is same as Series 2400 except output (no. of terminals).

SERIES TYPES		
Series	**Timing Range**	**Temperature Range**
4801	10 ms. to 50 sec.	−55°C to +85°C
4802	51 sec. to 100 sec.	−55°C to +85°C
4851	10 ms. to 40 sec.	−55°C to +125°C
4852	41 sec. to 80 sec.	−55°C to +125°C

Type	Series	Contacts	Rating	Current Drain	Physical Housing Dim. "A"
DC	4610-4710	1PDT	10 Amp	140 ma	2 13/32
	4611-4711	2PDT	10 Amp	140 ma	
	4621-4721	1PDT	4 Amp	100 ma	1 23/32
	4622-4722	2PDT	4 Amp	100 ma	
	4624-4724	4PDT	4 Amp	150 ma	2 3/64
AC	4671-4771	1PDT	4 Amp	100 ma	2 3/64
	4672-4772	2PDT	4 Amp	100 ma	
	4674-4774	4PDT	4 Amp	150 ma	2 3/8

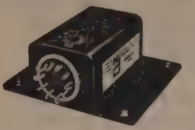
MODEL 4800 SCHEMATIC



HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

VOLTAGE LEVEL SENSOR

AC AND DC MONITORING



FEATURES

DC SENSOR — SERIES 1310

The Hi-G 1310 Series DC Voltage Sensor is essentially a voltage monitoring device operating a snap-action transistor circuit with low drift and inherent temperature compensation. This device will either open or close a circuit when a predetermined voltage is present at the input. By using a Hi-G electro-mechanical relay as the output of the voltage sensor, a positive switching action can be achieved with very close difference between pull-in and drop-out voltages.

AC SENSOR — SERIES 1350

The Hi-G 1350 Series AC Voltage Sensor provides an output "signal" when the monitored power line voltage reaches a predetermined level. This rugged unit with reliable solid state design, provides precise, repeatable operation over a wide temperature range.

The input voltage is fed into a temperature compensated comparator circuit. When the input reaches the pre-set level, transistor amplifiers switch the output relay to provide a "signal." This output may control any external device, process, or warning system to protect expensive equipment.

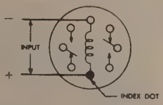
The units for both series are potted and hermetically sealed and are designed to meet the environmental requirements of airborne applications. The following are available for both the 1310 and 1350:

STANDARD OPTIONS

1. Solid-State Output.
2. Two Stage Sensing (Voltage Band).
3. Up to 10 Amp Relay Output.
4. Other Voltage Sensing Levels from 5 to 240V.
5. Controlled Drop-out Differential.
6. Operate with Auxiliary Control Voltage.

1350 ONLY: Special 3 Phase Version Available.

ELECTRICAL DIAGRAM



−
INPUT
+
INDEX DOT

PART TYPE CHARACTERISTICS

Specification	Part Number	
	1310	1350
Pull-in Voltage Smallest Increment Drop-out Voltage (Rel. to Pull-in) Current Drain @ 25°	17.0 to 33.0 VDC 0.1 Volt −0, +0.5 Volts 15 ma Max.	90 to 120 V, 60 or 400 Hz 1.0 Volt +0, −3.0 Volts 100 ma Max.

ELECTRICAL SPECIFICATIONS

ACCURACY: ±2½% of set point over temperature range.

MAXIMUM ALLOWABLE APPLIED VOLTAGE: 150% of specified pull-in voltage.

AUXILIARY VOLTAGE: None required.

OPERATE AND RELEASE TIMES: 50 milliseconds maximum over the temperature range.

LIFE: 100,000 operations minimum.

CONTACT ARRANGEMENT: 2PDT.

CONTACT RATING: 2 amperes resistive @ 30 volts DC; 0.3 amperes resistive at 115 volts RMS, 400 Hz.

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE: −55°C to +125°C.

VIBRATION: 20 G's, 10 to 2000 Hz.

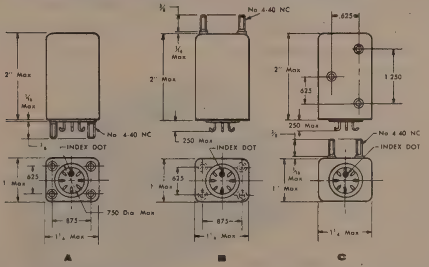
SHOCK: 50g's, 11 ±1 milliseconds duration.

INSULATION RESISTANCE: 1000 megohms minimum @ 500 volts DC, all terminals to case.

DIELECTRIC STRENGTH: 1000 volts RMS, 60 Hz @ sea level, all terminals to case.

SEALING: Hermetic, 1.3 inches of mercury.

MOUNTING STYLES — 1310 AND 1350



2" Max
⅛ Max
No 4-40 NC
INDEX DOT
.625
1 Max
.750 Dia Max
.875
1¼ Max
A
¾
⅛ Max
.250 Max
B
.625
2" Max
1.250
No 4-40 NC
C

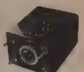
HOW TO ORDER

1310	2	A	24.5
Type	2PDT	Mounting Style	Pull-In Voltage

ADDITIONAL CAPABILITIES INCLUDE
SERIES 7000 FREQUENCY SENSORS

PHASE SENSOR

3 φ POWER SYSTEM MONITOR



TWO STANDARD TYPES

P TYPE FOR STATIC LOAD

With line voltages and frequency within operating limits, P-Type units will energize only when output phase are in sequence A-B-C. They will de-energize only when power is removed. The P-Type unit is best suited to applications where static loads are used and where regenerated voltage will not be present if a phase opens.

Q TYPE FOR MOTOR LOADS

Q-Type units perform the same function as the P-Type since they will energize only when input phases are in sequence A-B-C. In addition, the units will de-energize when any phase is disconnected or grounded provided the voltage input to the unit is below 50% of the nominal phase-to-phase voltage input. Q-Type units are suitable for motor loads where a regenerated voltage is produced.

NO NEUTRAL CONNECTION

Neither P- or Q-Type units require connection to neutral leg.

For high-current applications, phase sensors are used with slave relays having heavy duty contact ratings.

For applications having special requirements as to voltage, frequency, contact arrangements, and ratings, consult the factory.

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE: −55°C to +85°C.

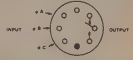
VIBRATION: 20g's, 10 to 2000 Hz.

SHOCK: 50g's, 11 ±1 milliseconds

INSULATION RESISTANCE: 1000 megohms minimum @ 500 volts DC, all terminals to case.

DIELECTRIC STRENGTH: 1000 volts rms, 60 Hz, @ sea level, all terminals to case.

ELECTRICAL SPECIFICATIONS



INPUT
OUTPUT

OPERATE TIME: 50 milliseconds maximum.

RELEASE TIME: 100 milliseconds maximum.

CONTACTS: 1PDT.

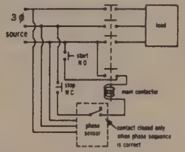
CONTACT RATING: 2 amperes resistive @ 30 volts DC. 0.5 ampere inductive @ 30 volts DC. 0.25 ampere resistive or inductive @ 115 volts, 60 or 400 Hz.

STANDARD MODELS

Basic Model No.	Load Type	Line to Line Voltage ±10%	Frequency ±10%	Max. Power Required	Mounting	Refer Mounting Figure Styles
1407	P	115 V	60 Hz	4 Watts	A, B, C	3
1408	P	115 V	400 Hz	4 Watts	A, B, C	1
1409	P	208 V	60 Hz	6 Watts	A, B, C	3
1410	P	208 V	400 Hz	6 Watts	A, B, C	3
1437	Q	115 V	60 Hz	6 Watts	A, B	2
1438	Q	115 V	400 Hz	6 Watts	A, B	3
1439	Q	208 V	60 Hz	9 Watts	B	4
1440	Q	208 V	400 Hz	9 Watts	B	4

HOW TO ORDER

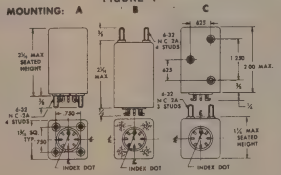
1408	-1	A
Type	Output 1PDT	Mounting



3φ
source
load
start NO
stop NC
main contactor
phase sensor
contact closed only when phase sequence is correct

MOUNTING STYLES

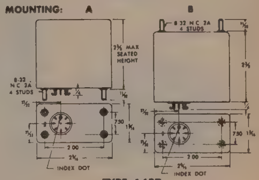
FIGURE 1



MOUNTING: A
B
C
2⅞ MAX SEATED HEIGHT
2⅞ MAX
6-32 NC 2A 4 STUDS
6-32 NC 2A 3 STUDS
1.250
2.00 MAX.
1⅞ MAX SEATED HEIGHT
INDEX DOT

TYPE 1408

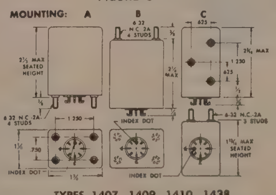
FIGURE 2



MOUNTING: A
B
6-32 NC 2A 4 STUDS
2⅝ MAX SEATED HEIGHT
2⅝
2.00
3.00
INDEX DOT

TYPE 1437

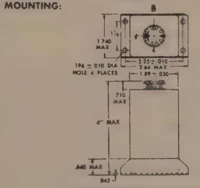
FIGURE 3



MOUNTING: A
B
C
6-32 NC 2A 4 STUDS
2⅞ MAX SEATED HEIGHT
2⅞ MAX
1.250
6-32 N.C.-2A 3 STUDS
1⅞ MAX SEATED HEIGHT
INDEX DOT

TYPES 1407, 1409, 1410, 1438

FIGURE 4



MOUNTING:
B
1.740 MAX
.196 ± .010 DIA HOLE 4 PLACES
.710 MAX
4" MAX
.640 MAX

TYPES 1439, 1440

HI-G INCORPORATED
SPRING STREET AND ROUTE 75, WINDSOR LOCKS, CONN. 06096 / PHONE: (203) 623-2481 / TWX: 710-420-0592

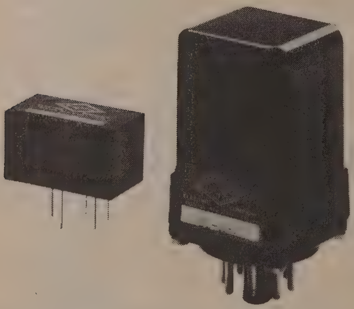
HEiNEMANN

SOLID-STATE DC AND AC RELAYS FOR HIGH-SPEED COMMUNICATIONS AND COMPUTER USES

These new, completely encapsulated solid-state relays represent the highest attainment in switching technology for applications requiring maximum speed and repetition rate, maximum pulse-shape conformity between control and output circuits, and maximum immunity to noise and other spurious signals without need for external suppression.

General-purpose models available in dc load ranges from 300mA to 6A; ac loads to 10A. These relays have practically unlimited life, with no moving parts, no contacts to wear or burn, and none of the limitations in mounting position normally imposed on conventional switching devices.

Directly compatible with TTL for computer-peripheral applications; no bias necessary when used with control signals of 5V or more. Repetition rate averages 2,000/sec.



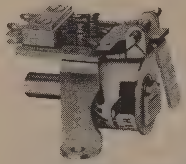
Transmit, receive, and transceive relays for communications, in octal plug-in or PC-mount pack, available in a wide choice of input/output configurations (TTL, polar, neutral, flip-flop, complementary, side-stable, etc.). Compatible with all digital communications systems.

Complete information in Bulletin Q-5400.

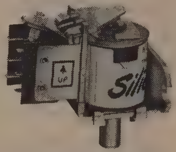
SILIC-O-NETIC TIME-DELAY RELAYS CAN CARRY CONTINUOUS LOADS TO 5A, ELIMINATE LOAD RELAY

You can often eliminate the need for two relays in timing applications. Heinemann Silic-O-Netic® time-delay relays can do both the timing and the load switching, because they have a continuous-duty coil and gold-plated 5-amp SPDT or DPDT contacts. If your application, like most time-delay relay applications, can manage with a timing accuracy of ±50% of the delay period, one of the three Heinemann Silic-O-Netic relays would be an economical and reliable choice for you.

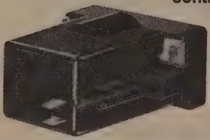
Available in a range of sixteen time delays from ¼ sec to 120 sec. Complete information in Bulletin 5006.



***Type A*—open frame, greatest economy for appliances and other mass-produced equipment.**

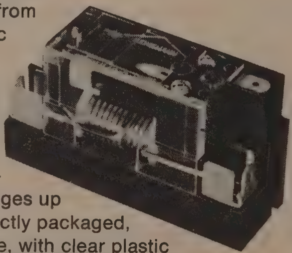


***Type B*—open frame with enclosed snap-action contacts for protection against contamination.**



***Type C*—enclosed in durable phenolic case; quick-on terminals for both coil and contact circuits.**

HEINEMANN OVERLOAD RELAYS FOR CLOSE-TOLERANCE MOTOR PROTECTION



The Type PJ overload relay acts fast, within close tolerances, to protect modern motors which are designed with running current close to locked-rotor current. A choice of three delay curves from slow trip (3 to 9 sec at 450% rated load) to fast trip (0.6 to 2.5 sec at 150% rated load). UL listed for AC motor running current to 65A at voltages up to 600VAC. Compactly packaged, stackable, dust-free, with clear plastic cover to facilitate examination of coil and contacts. Complete information in Bulletin 5104.

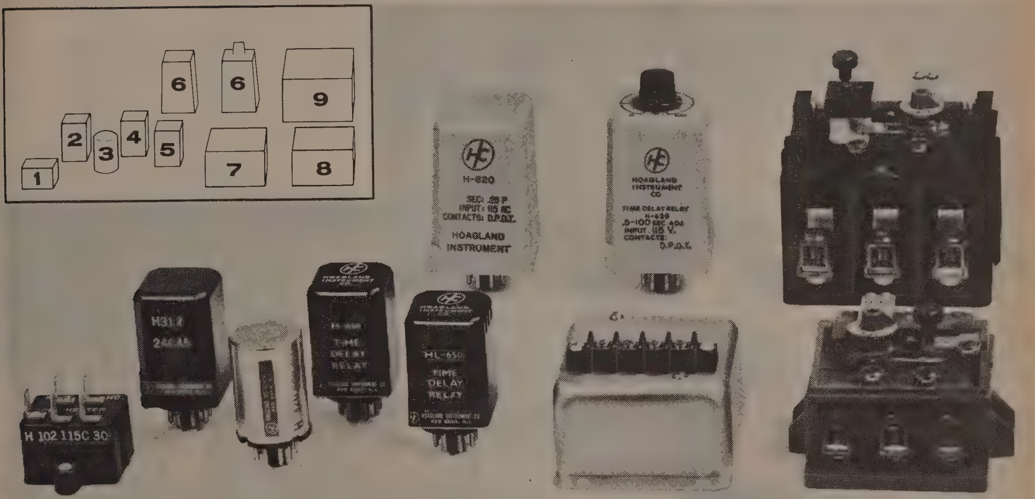
We keep you out of trouble.

HEiNEMANN ELECTRIC COMPANY **TRENTON, NEW JERSEY 08602** 6306

HOAGLAND

HOAGLAND INSTRUMENT COMPANY
P.O. BOX 550A, CULVER ROAD,
DAYTON, NEW JERSEY 08810
TELEPHONE: (201) 329-4681
TWX: 710-480-5674

THERMAL TIME DELAY RELAYS
ELECTRONIC TIME DELAY RELAYS
MOTOR OVERLOAD RELAYS

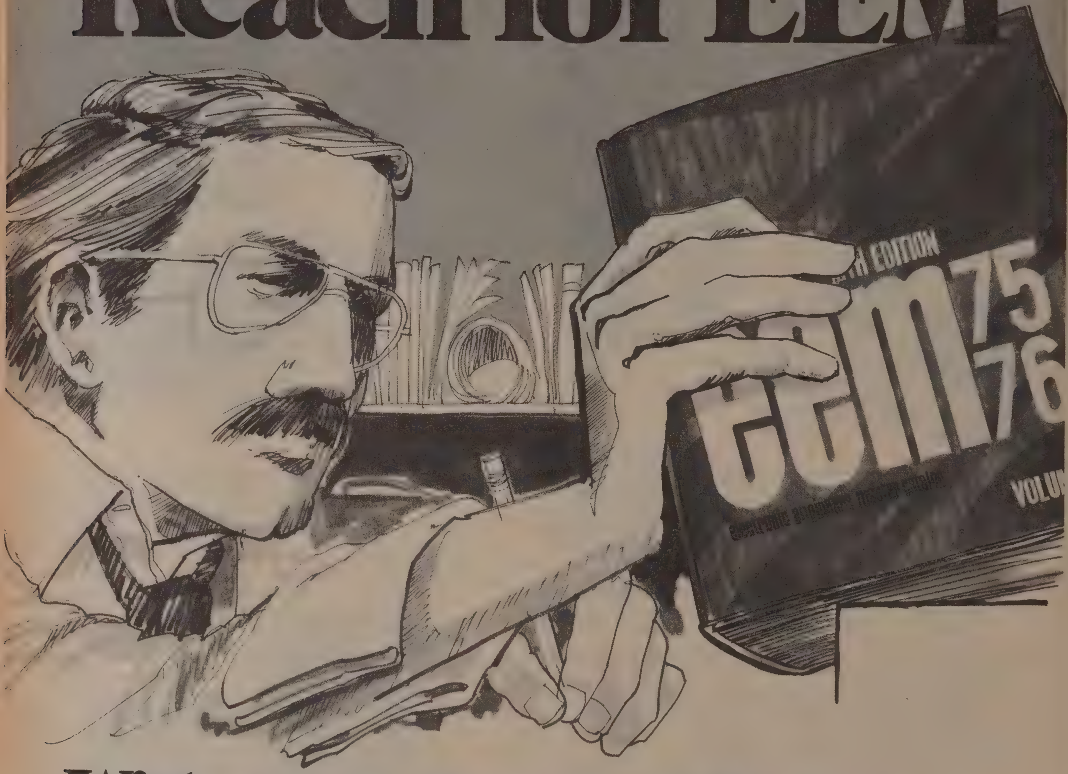


ITEM	DESCRIPTION
	THERMAL TIME DELAY RELAYS
1	**H-101 Series.** Panel mount. Standard time delays available over a range of values from 5 sec. to 180 sec. Other delays available on special request. Standard heater voltages available 6.3, 12, 24, 48, 115 and 230. Other heater voltages available on special request. Contacts, snap action: SPNO, SPNC and SPDT, 2 amp at 115V resistive. Temperature compensated from 0° to 160°F.
2	**H-310 Series.** Plastic, octal plug. Specifications same as H-101 Series.
3	**H-320 Series.** Metal, octal plug. Specifications same as H-101 Series.
	ELECTRONIC TIME DELAY RELAYS
4	**H-650 Series.** Miniature plug-in type. Load capacity 2 amps at 28V DC. Operating voltage 24V AC and 24 and 48V DC. Standard time delays available over a range of values from 0.5 to 100 sec. Other delays available on special request. **General Specifications:** Contact arrangement: SPNO, SPNC, SPDT, DPDT. Repeat accuracy: ±2% timing, ±10% voltage, ±20°F. variation. Life: 1,000,000 cycles (minimum). Adjustments: screwdriver or preset. Also remote potentiometer to customer specifications. Reset time: 0.1 to 0.025 sec. based on initial delay.
5	**HL-650 Series.** Miniature plug-in type. Load capacity 2 amp at 120V AC. Operating voltage 115V AC. Standard time delays available over a range of values from 0.5 to 100 sec. Other delays available on request. Adjustments: screwdriver or preset. Also remote potentiometer to customer specifications. General specifications same as H-650 Series.
6	**H-620 Series.** Heavy-duty plug-in type. Load capacity 5 and 10 amps at 115V AC. Operating voltage 24 and 115V AC and 24, 30 and 48V DC. Standard time delays available over a range of values from 0.5 to 100 sec. Other delays available on request. Available with knob adjust, screwdriver lock, or preset. Also remote potentiometer to customer specifications. General specifications same as H-650 Series except heavier duty.
7	**H-600 Series.** Heavy-duty panel mount type. Barrier-strip, screw or quick connect terminals. Load capacity 5 and 10 amps at 115V AC. Standard time delays available from 0.5 to 100 sec. 230 volt AC input and other delays available on request. Available with knob adjust, screwdriver lock, or preset. Also remote potentiometer to customer specifications. General specifications same as H-650 Series except heavier duty.
	MOTOR OVERLOAD RELAYS
8	**H-400 Series.** Standard full load current ranges available in 27 different models from 1.0 to 50 amps. Other non-standard ranges available on request. Choice of either automatic or manual reset. Full load current setting is adjustable over the range of the relay or may be factory preset. Relays available with trip time characteristics from "super" fast to slow to match your motor curve. Temperature compensation available from −60°F. to 160°F.
9	**H-410 Series.** Same characteristics as H-400 Series except full load current range is from 25 to 150 amps in 12 different models.

For additional information on any of the above devices, write for Engineering Data Sheets.

There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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VOLU

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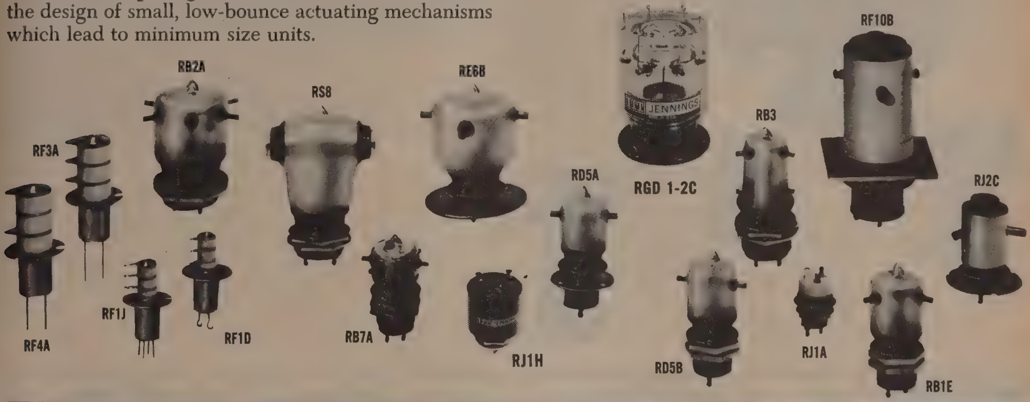
vacuum relays

INTRODUCTION: Vacuum relays as manufactured by ITT Jennings are available for utilization in the control of high power equipment and circuits. Standard units are available for current ratings of 75 amps, peak voltage levels to 30 kv, and transferring power at frequencies through the VHF band.

ADVANTAGES: Because of the higher dielectric strength of the vacuum relay (1000 volts/mil working), small contact spacing and lower resultant travel allows the design of small, low-bounce actuating mechanisms which lead to minimum size units.

APPLICATIONS: The majority of applications of these units include the switching of antennas, frequency bands, transmit-receive modes, power circuits, and elements in pulse forming networks.



		RATED OPERATING VOLTAGE			CONTINUOUS CURRENT			CONTACT CAPACITY		CONTACT RESIST-ANCE	OPERATE TIME	RELEASE TIME	COIL RESIST-ANCE
RELAY TYPE	CONTACT ARRANGE-MENT	DC or 60 Hz (KV Peak)	2.5 MHz (KV Peak)	16 MHz (KV Peak)	DC or 60 Hz (Amps RMS)	2.5 MHz (Amps RMS)	16 MHz (Amps RMS)	Open Contact to Ground (pf)	Between Open Contacts (pf)	(Max. Ohms)	Max. (MS)	Max. (MS)	26.5 V +10% (Ohms)
RF1D	SPDT	2	2	2	8	6	4	2.0	2.0	.020	10	10	920
RF1J	SPDT Latching	2	2	2	8	6	4	2.0	2.0	.020	10	N/A	18.3
RF2A*	SPST N/C	6	N/A	N/A	5	N/A	N/A	N/A	N/A	.030	11	11	920
RF3A	SPDT	6	6	6	N/A	25	15	4.0	4.0	.015	18 10	18 N/A	156 6.7
RF4A	SPST N/C	6	6	6	N/A	25	15	2.5	2.5	.015	18 10	18 N/A	156 6.7
RGD1-2C**	DPDT	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17	17	25 @ 12 Volts
RJ1A	SPDT	3.5	2.5	2.0	N/A	14	7	2.5	2.0	.010	8	8	335
RJ1H*	SPDT	10	N/A	N/A	25	N/A	N/A	N/A	N/A	.020	10	10	335
RJ2C	SPDT	12	10	8	50	22	15	1.0	0.7	.012	18	9	270
RF10B	SPDT	15	13	10	50	22	15	1.5	0.5	.012	35	10	225
RB7B	DPDT	7	4	3	14	9	4	2.0	1.0	.020	15	5	270
RB1E	SPDT	12	10	8	15	10	6	1.0	0.5	.012	18	9	265
RD6A	SPST N/C	12	10	8	15	10	6	1.0	0.5	.012	18	9	265
RD5B RD6B	SPST N/O SPST N/C	12	10	8	15	10	6	1.0	0.5	.012	18	8	265
RB3	DPDT	12	10	8	15	10	6	2.5	1.0	.010	20	8	120
RB2A	DPDT	20	15	10	20	12	6	2.5	1.0	.010	20	10	225
RB4	4PDT	15	12	10	20	10	6	2.5	1.0	.010	45	10	131
RE6B	SPDT	25	15	12	25	13	8	2.5	1.0	.010	25	10	120
RS8 RS10	SPST N/O SPST N/C	28	25	12	75	35	22	1.5	0.7	.003	30	10	120

*For Load Switching **Defibrillator Relay

ITT JENNINGS 970 McLaughlin Ave. • San Jose, Calif. 95116 • (408) 292-4025

DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

vacuum coaxial relays

RC21
RC53
RC41
RC5

INTRODUCTION: The principal feature of the ITT Jennings coaxial vacuum relay is its high power handling capability at frequencies up to 1.7 ghz, where it is desired to contain circuit currents completely within a coax system.

ADVANTAGES: Coaxial relay advantages include low insertion VSWR, high rf power capability, high isolation, fast operation, low and stable contact resistance, and wide pass band characteristics.

APPLICATIONS: Typical applications for this type of unit include antenna and load switching external to a transmitter, crossbar switching matrices, and general coaxial instrumentation.

MODEL NUMBER	RC41	RC53	RC5	RC6	RC10	RC21	RC31
POWER RATING	3 KW CW at 30 MHz	4 KW CW at 30 MHz	25 KW CW at 30 MHz	25 KW CW at 30 MHz	90 KW CW at 30 MHz	90 KW CW at 30 MHz 3 MW Peak Spec. Order	325 KW CW at 30 MHz
FREQUENCY RANGE	0 to 500 MHz	0 to 600 MHz	0 to 100 MHz	0 to 400 MHz	0 to 100 MHz	0 to 500 MHz	0 to 150 MHz
VSWR WITH RESPECT TO 50 OHMS	1.1:1 Max.	1.1:1 Max.	1.02:1 Max. to 30 MHz 1.05:1 Max. to 60 MHz	1.1:1 Max. to 150 MHz	1.02:1 Max. to 30 MHz 1.05:1 Max. to 60 MHz	1.1:1 Max. to 400 MHz	1.1:1 Max.
CROSSTALK	Greater than 30 dB isolation at 300 MHz	Greater than 75 dB isolation at 30 MHz	Greater than 70 dB isolation at 30 MHz	Greater than 65 dB isolation at 30 MHz	Greater than 65 dB isolation at 30 MHz	Greater than 60 dB isolation at 30 MHz	Greater than 57 dB isolation at 30 MHz
INSERTION LOSS	0.1 dB Max.	0.1 dB Max.	0.02 dB Max.	0.01 dB Max.	0.02 dB Max.	0.01 dB Max.	0.01 dB Max.
COIL RESISTANCE ±10% 26.5 VDC COIL	265 Ohms	18 Ohms	18.8 Ohms	15.4 Ohms	8.3 Ohms	4.8 Ohms	7.8 Ohms
CONTACT CONFIGURATION	SPDT	2 pole, 2 position crossover transfer	SPST	SPDT	SPST	SPDT	SPDT
LINE/CONNECTOR SIZE	C	SC	1⅝"	1⅝"	3⅛"	3⅛"	6⅛"
ACTUATION	Non-latching continuous duty coil	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching
OPERATE TIME	25 Millisecs Max.	15 Millisecs Typ. 30 Millisecs Max.	15 Millisecs Typ. 30 Millisecs Max.	50 Millisecs Max.	15 millisecs Typ. 30 Millisecs Max.	40 Millisecs Max.	50 Millisecs Max.
WEIGHT	14.5 oz.	2 lbs., 12 oz.	1 lb., 13 oz.	8 lbs.	3 lbs., 12 oz.	14 lbs.	48 lbs., 8 oz.

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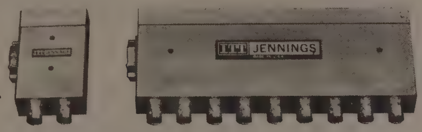
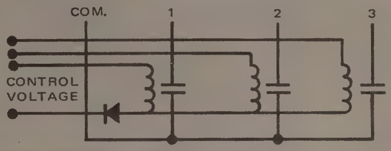
coaxial switch modules

RC1100 SERIES





APPLICATIONS

- Electrically controlled switching of wideband signals, DC—300 MHz.
- Design of complex switching circuits such as SP42T, 9P3T and other unusual switching trees.
- CATV and CCTV distribution switching.
- Telemetry and data handling networks.
- Satellite communications.
- Microwave trunks (base band and IFF frequency).
- Automatic switching of computer controlled measuring systems.
- Network analyzing digital pulse information.

FEATURES

- One to eight throws.
- Sealed RF contacts for long life, stable contact resistance.
- Designed for over 1800 switchings/day for 30 years.
- Special contact material prevents "sticking" due to feedback currents or dry circuit operation.
- DC coils are diode protected against effects of transient voltages or use of wrong polarity.
- All-aluminum flatpack housing is easily stacked to provide multi-pole, multi-throw operation.
- Low RF leakage input and output assured up to 300 MHz.

Specifications	Model 1100
Bandwidth (1x1, 1x2, 1x3)	DC — 300 MHz
(1x4)	DC — 250 MHz
(1x5, 1x6, 1x7, 1x8)	DC — 100 MHz
VSWR (typ)	
@ 50 MHz	1.1:1
100 MHz	1.25:1
300 MHz	1.50:1
Insertion Loss (typ)	
@ 50 MHz	.25 dB
100 MHz	.30 dB
300 MHz	.50 dB
Isolation (typ)	
@ 50 MHz	−45 dB
100 MHz	−50 dB
300 MHz	−30 dB

Specifications	Model 1100
Impedance	50 or 75 ohms
RF Power, CW (nom)	10 Watts
RF Peak Voltage	250 VDC
Switching Time (max)	1 millisecond
Control Voltage (nom)	12-28 VDC
Connector Type	BNC (Quick Disconnect)
Mounting	Any Position
Life	20×10^6
Temperature Range	
Operating	−55 to 75°C (−67 to 167°F)
Storage	−65 to 85°C (−85 to 185°F)

OPTIONS AVAILABLE
Control Voltage
6 or 48 VDC

	Model Numbers			
	Non-Latching		Latching	
Configuration	50-Ohm	75-Ohm	50-Ohm	75-Ohm
1 x 1	RC1101A	RC1101B	RC1101AL	RC1101BL
1 x 2	RC1102A	RC1102B	RC1102AL	RC1102BL
1 x 3	RC1103A	RC1103B	RC1103AL	RC1103BL
1 x 4	RC1104A	RC1104B	RC1104AL	RC1104BL
1 x 5	RC1105A		N/A	N/A
1 x 6	RC1106A		N/A	N/A
1 x 7	RC1107A		N/A	N/A
1 x 8	RC1108A		N/A	N/A

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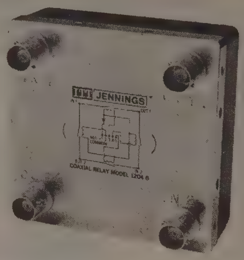
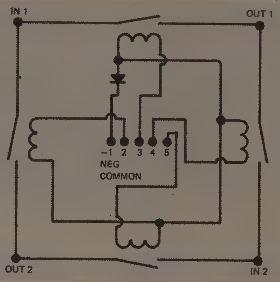
DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

2 x 2 high isolation coaxial switches

2RC1204 SERIES





APPLICATIONS

- Switch wideband signals, DC-300 MHz.
- Electrically controlled switching in circuits requiring high isolation (such as IF video circuits) or very high isolation (such as RF video circuits.)
- CATV and CCTV.
- Computer controlled measuring systems.
- Non-duplication switching in RF head-end networks.
- Communications Systems.

FEATURES

- Minimum open circuit leakage over entire frequency range.
- Broadband frequency response — DC to 300 MHz range.
- Universal mounting design for panels, railings or brackets.
- Control connector adaptable to flexible ribbon for stripline or PC board interface.
- Rugged two-part housing — aluminum die casting and molded polycarbonate cover.
- Silver-plated signal paths shielded for maximum EMI protection.
- Reed switch elements hermetically sealed in nitrogen atmosphere.
- Rhodium-plated contacts prevent "sticking" due to feedback currents or dry circuit operation.
- DC coils are diode protected against effects of transients or use of wrong polarity.
- DC coils can be independently controlled or sequenced in pairs.

Specifications	Model 1204	
Bandwidth	DC — 300 MHz	
VSWR	Model "BH"	Model "B"
(max)	1.5	1.5
(typ)	1.25	1.25
Insertion Loss (typ)	1.0 dB	0.8 dB
Isolation (min)	−70 dB	−45 dB
Impedance	75 ohms	
RF Power, CW (nom)	3 Watts	
RF Peak Voltage	250 V	

Specifications	Model 1204
Switching Time (max)	1 millisecond
Control Viltage (nom)	12-28 VDC
Connector Type	BNC (Quick Disconnect)
Mounting	Any Position
Life	20 x 10⁶
Temperature Range	
Operating	−55 to +75°C (−67 to +167°F)
Storage	−65 to +85°C (−85 to +185°F)

OPTIONS AVAILABLE

Control Voltage
6 or 48 VDC

Configuration	Isolation	Model Number
2 x 2	High (−45 dB)	1204B
2 x 2	Very High (−70 dB)	1204BH

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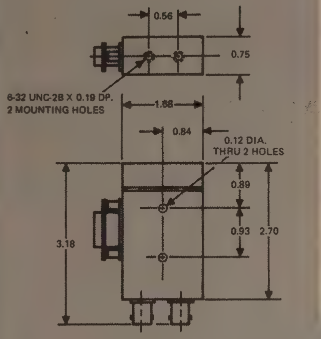
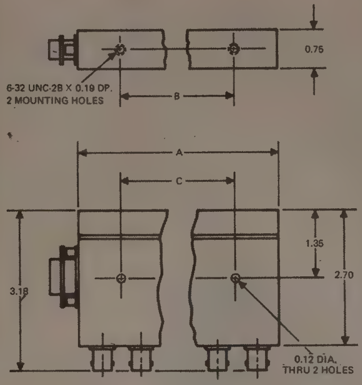
RC1101

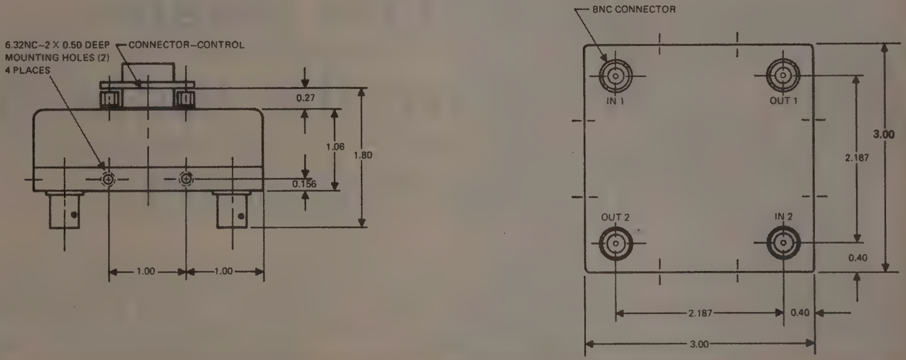

0.56
0.75
6-32 UNC-2B X 0.19 DP.
2 MOUNTING HOLES
1.68
0.84
0.12 DIA.
THRU 2 HOLES
0.89
0.93
2.70
3.18

RC1102-1108


0.75
6-32 UNC-2B X 0.19 DP.
2 MOUNTING HOLES
B
A
C
1.35
2.70
3.18
0.12 DIA.
THRU 2 HOLES

MODEL	DIMENSION A	B	C
RC1102	2.44	.75	.75
RC1103	3.19	1.50	1.50
RC1104	3.94	2.25	2.25
RC1105	4.68	3.00	3.00
RC1106	5.44	3.75	3.75
RC1107	6.18	4.50	4.50
RC1108	6.94	5.25	5.25

RC1204


6.32NC–2 X 0.50 DEEP
MOUNTING HOLES (2)
4 PLACES
CONNECTOR–CONTROL
0.27
1.06
1.80
0.156
1.00
1.00
BNC CONNECTOR
IN 1
OUT 1
OUT 2
IN 2
3.00
2.187
0.40
2.187
0.40
3.00

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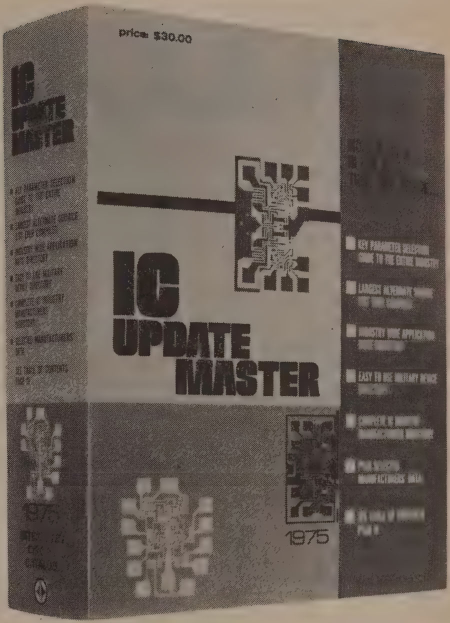

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vacuum relays mean reliability ...reliability means KILOVAC

ki´lo·vac *n.* (F. *kilo*, thousand. L. *vacuus*)
1. That technology which offers reliable performance in high voltage relays resulting from operation at kilovolt levels in a vacuum dielectric.
2. *adj.*, pertaining to short contact travel, low contact mass, contacts free of oxides/pitting, and minimum contact bounce.

KILOVAC TYPE	**H-8**	**H-9**	**H-11/S2**	**H-12**	**H-14**	**H-16**	**H-17**	**H-18**	**H-19**	**H-23#**	**H-25/S10**	**H-26**
Contact arrangement	SPDT	SPST, N.C.	SPST, N.O.	SPDT	DPDT	DPDT	SPDT	DPDT	DPDT	SPST, N.C.	SPDT	4PDT
Rated operating voltage (KV dc or 60 Hz peak)	15	15	9	8	12	12	25	8	20	30	50	15
Test voltage (KV dc)	20	20	12	12	15	15	30	10	25	35	60	17
Continuous current, contacts closed, max. (amps dc or 60 Hz RMS)	15	15	15	15	30	30	30	10	30	30	30	30
*Max. current at rated voltage switching under load (amps dc)	0.5	0.5	0.1	0.1	0.3	0.5	0.1	0.1	0.1	0.1	0.1	0.1
Contact resistance, max. (ohms)	0.015	0.015	0.015	0.015	0.015	0.030	0.015	0.020	0.015	0.015	0.015	0.02
Operating time, max. (ms)	15	15	18	18	20	20	25	15	40	30	60	30
Coil resistance (ohms ±10% @ 25°C)	265	265	250	250	120	120	120	265	225	120	120	120
Coil voltage (Vdc, nominal)	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Nominal dimensions (inches)	1D x 3H	1¼D x 2¾H	1D x 1⅝H	1D x 1¾H	1¼D x 2¾H	1D x 3¼H	2D x 3½H	1D x 2H	2D x 3¼H	2D x 3¾H	3D x 7½H	2D x 4H
Nominal weight (oz)	3	3	2	2	8	5	5	4	7	7	30	16
Mounting style**	threaded base	solder flange	threaded base	threaded base	threaded base	threaded base	flange base	threaded base	threaded base	threaded base	threaded base	threaded base
Approximate unit price (1-9 pcs)	$98	$108	$108	$108	$140	$140	$140	$148	$148	$150	factory quote	$215

* All ratings are for pure resistive circuits. Contact factory for other circuits vs. ratings.   ** Other styles available.

# H-24, same spec as H-23, except H-24 is SPST, N.O.

KILOVAC vacuum relays (ceramic or glass) are specified by design engineers for performance and reliability not available in conventional relays:

HIGH VOLTAGE ISOLATION: 2000 volts per mil of contact gap with predictable, repeatable isolation well in excess of rated values.

LOW AND STABLE CONTACT RESISTANCE: 0.015 ohms typical, with no contact oxidation or maintenance.

FAST SWITCHING TIME: 10 ms typical, due to small contact gap and short armature travel.

LONG LIFE: Millions of cycles with minimum degradation in electrical performance.

Any one of these standard features will justify your selection of KILOVAC vacuum relays. KILOVAC design and years of production experience permits immediate off-the-shelf delivery from a broad product line with voltages up to 100 KV. Special modifications provided in extremely short order.

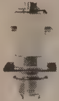
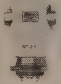
High vacuum technology has made high voltage switching practical with considerable savings in space and weight. KILOVAC uses the latest in vacuum pumping techniques, utilizing the "ion" type pump and achieving, in production, hard vacuums to 10^{-8} mm of mercury or better. Special manufacturing techniques include kovar-to-glass seals, final assembly in a dust and contaminant free area, specially selected glass and specially developed KILOVAC high voltage aging techniques.

KILOVAC relays are widely used in ECM, communications, sonar, radar, pulse-forming networks, medical electronics, and other high voltage equipment, or low voltage equipment where extreme reliability is a must. Many KILOVAC models are interchangeable with other manufacturers' types.

KILOVAC's broad line and "Quick Reaction Time" is geared to your most critical delivery schedule.

For complete technical information call your nearest KILOVAC sales-engineering representative or write directly to us.

KILOVAC, a company small enough to be responsive, large enough to be responsible.

												
KILOVAC TYPE	**HC-1†**	**KC-2†**	**KC-3†**	**KM-14**	**KC-10†**	**KC-20†**	**KM-15**	**HVS-1**	**HVS-10**	**H-4**	**KM-6**	**H-35**
Contact arrangement	SPDT	SPDT	SPDT	DPDT	SPDT	SPST, N.O.	DPDT	SPDT	SPDT	SPDT	SPST N.C.	SPDT
Rated operating voltage (KV dc or 60 Hz peak)	2.5	15	8	7.5	15	28	8	17	17	5	10	35
Test voltage (KVdc)	5	18	11	14	20	30	18	22	25	7.5	12	40
Continuous current, contacts closed, max. (amps dc or 60 Hz RMS)	18	50	25	30	75	110	10	7	8	10	5	10
*Max. current at rated voltage switching under load (amps dc)	0.5	0.5	0.1	5.0	0.1	0.1	5.0	3.0	4.0	5.0	2.0	5.0
Contact resistance, max. (ohms)	0.010	0.012	0.015	0.100	0.012	0.005	0.100	0.015	0.015	0.02	0.035	0.015
Operating time, max. (ms)	6	18	18	20	35	30	25	25	20	10	10	30
Coil resistance (ohms ±10% @ 25°C)	335	265	220	12	225	120	65	128	65	250	100	50
Coil voltage (Vdc, nominal)	26.5	26.5	26.5	12	26.5	26.5	40	26.5	40	26.5	12	26.5
Nominal dimensions (inches)	¾D x 1½H	1⅝D x 2⅜H	¾D x 2¾H	2D x 3H	1⅝D x 4⅝H	1⅝D x 3¾H	2½D x 3⅝H	4¾L x 5H	5L x 3¼H	1⅞L x ⅞H	2¼L x 1¹⁄₁₆H	8¼L x 5¼H
Nominal weight (oz)	1	3	2.5	10	16	10	12	15	14	1	3	15
Mounting style**	threaded base	flange base	flange base	foot bracket	flange	threaded	flanged	foot bracket	foot bracket	flange	foot bracket	foot bracket
Approximate unit price (1-9 pcs)	$59	$110	$105	$135	$175	$250	$135	$65	$65	$60	$75	$145

* All ratings are for pure resistive circuits. Contact factory for other circuits vs. ratings.   ** Other styles available.
† Ceramic envelope.

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CORPORATION

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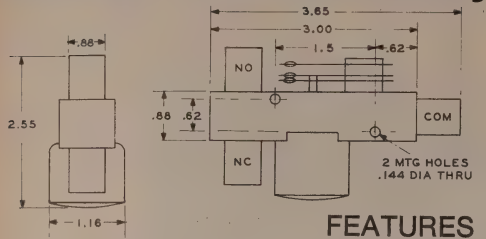
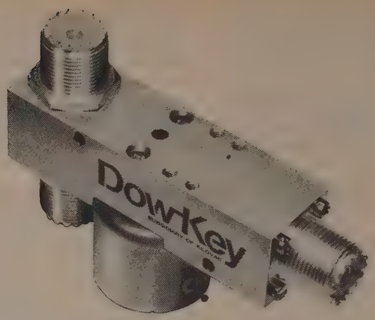
SERIES 60 SPDT Remote Coaxial Relay





FEATURES

The Series 60 are remotely operated, ruggedly constructed, SPDT coaxial relays designed for operation to one Kw. They are available with or without two Form C auxiliary contacts. For transmit-receive applications, they are available with a special high-isolation "G" connector at the NC or receive position. The "G" connector increases the isolation to greater than −100 dB at frequencies up to 500 MHz, but reduces the power rating of the normally-closed connector to 20 watts. "G" connectors will increase VSWR above 400 MHz. Data given for the Series 60 is applicable when used in a 50-ohm transmission line. UHF connectors are not recommended above 400 MHz. Standard coils are 12 Vdc (48 ohms), 26 Vdc (245 ohms) and 115 Vac (5000 ohms).

SPECIFICATIONS

Operating Time .... 25 ms. max.
Auxiliary Contact Rating .... 5 Amps., 115 Vac

MECHANICAL DATA

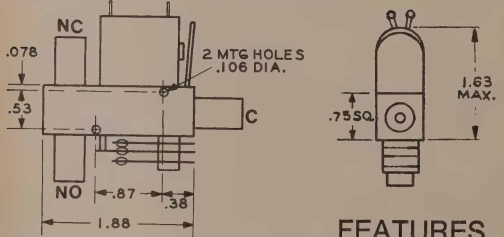
Life Expectancy .... 1,000,000 cycles
Weight .... 10 oz. Approx.
Finish
  R.F. Contacts .... Gold Plated Fine Silver
  Auxiliary Contacts .... Gold Plated Fine Silver

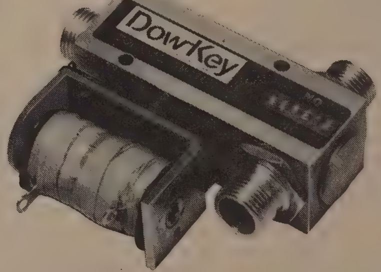
CONNECTORS & PART NUMBERS

Connector Type	Std. SPDT	With 2C Aux. Contacts	With NC "G" Conn.	With 2C Aux. & NC "G"
UHF	60-XX04	60-XX0442	60-XX28	60-XX2842
50 ohm N	60-XX01	60-XX0142	60-XX25	60-XX2542

See ordering information for coil data.

SERIES 77 SPDT Remote Coaxial Relay





FEATURES

The Series 77 are medium size, light-weight coaxial relays for industrial and less critical military applications. The "T" shaped connector configuration has the common connector at one end and the NO and NC connectors 180° apart at the other end. Available with or without one set of Form C auxiliary contacts. Coils are available in 12 Vdc (70 ohms), 26 Vdc (290 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time .... 15 ms. max.

MECHANICAL DATA

Weight .... 3 Oz.
Life Expectancy .... 1,000,000 cycles
Finish
  Connectors .... Silver Plated
  Body .... Irridite
  R.F. Contacts .... Gold Plated Fine Silver

CONNECTORS & PART NUMBERS

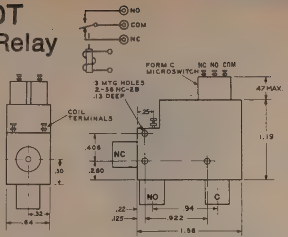
Connector Type	Standard SPDT	With IC Aux. Contacts
BNC	77-XX02	77-XX0232
"F"	77-XX32	77-XX3232

See ordering information for coil data.

A special 75-ohm version is available. Contact factory for Series 77F information.

DowKey
DIVISION OF KILOVAC CORPORATION
P.O. BOX 4422 • SANTA BARBARA, CALIF. 93103 • (805) 684-4560 • TWX 910/336-1141

SERIES 61 SPDT
Remote Coaxial Relay


NO
COM
NC
FORM C MICROSWITCH
NC NO COM
3 MTG HOLES 2-56 NC-2B .13 DEEP
COIL TERMINALS
.47 MAX.
.25
1.19
.406
.280
NC
.30
NO
C
.32
.64
.22
.125
.94
.922
1.56

FEATURES

The Series 61 are small SPDT relays for military and severe-environment applications. The balanced armature actuator prevents contact chatter under high-frequency vibration and severe shock. They are offered with one or two Form C microswitch auxiliary contacts. Gold-finished R.F. contacts provide reliable operation at low levels. Coils are available for 12 Vdc (60 ohms), 26 Vdc (275 ohms) and 110 Vdc (5000 ohms).

SPECIFICATIONS

Operating Time .... 15 ms. max.
Auxiliary Contact Rating .... 5 amps, 115 Vac

MECHANICAL DATA

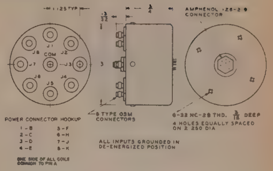
Life Expectancy .... 1,000,000 cycles
Weight .... 4½ Oz., max.
Finish
Connectors .... Silver Plated
Magnetic Parts .... Nickel Plated

CONNECTORS AND PART NUMBERS

Connector Type	SPDT	With 1C Microswitch	With 2C Microswitch
BNC	61-XX02	61-XX0212	61-XX0222

See ordering information for coil data.

SERIES 74 SP8T
Remote Coaxial Relay


1.25 TYP
AMPHENOL 126-2 CONNECTOR
COM
POWER CONNECTOR HOOKUP
1-B 5-F
2-C 6-H
3-D 7-J
4-E 8-K
ONE SIDE OF ALL COILS COMMON TO PIN A
8 TYPE OSM CONNECTORS
6-32 NC-2B THD. DEEP
4 HOLES EQUALLY SPACED ON 2.250 DIA
ALL INPUTS GROUNDED IN DE-ENERGIZED POSITION

FEATURES

The Series 74 are small, 8-position, single-pole coaxial relays intended for use in 50-ohm circuits at frequencies up to 2 GHz, where multiple sources are to be switched to a common output. All unused relay terminals are grounded to provide maximum isolation. Coils are available for 12 Vdc (60 ohms), 26 Vdc (275 ohms) and 110 Vdc (5000 ohms).

SPECIFICATIONS

Operating Time .... 15 ms. max.

MECHANICAL DATA

Life Expectancy .... 1,000,000 cycles
Weight .... 15 Oz.
Finish
Connectors .... Silver Plated
Contacts .... Gold Plated Fine Silver

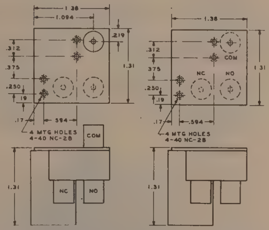
CONNECTORS AND PART NUMBERS

Connector Type*	Part Number
BNC TNC OSM	74-XX02 74-XX03 74-XX08

* Others on request, contact factory.

See ordering information for coil data.

SERIES 163/164 SPDT
Remote Coaxial Relay


1.38
1.094
.219
.312
.375
.250
.19
.17
.594
1.31
4 MTG HOLES 4-40 NC-2B
COM
NC
NO
1.31

FEATURES

These are general purpose coaxial relays for use up to 1 GHz, and are intended for military and other applications where reliability is important. The Series 163 has the common connector passing through the mounting surface, while the Series 164 has all connectors opposite the mounting surface. Gold plated contacts are used for reliability at low signal levels. Standard coil voltages are 12 Vdc (70 ohms), 26 Vdc (290 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time .... 10 ms. max.

MECHANICAL DATA

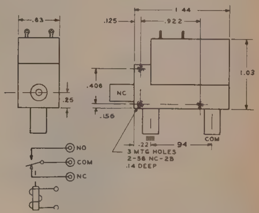
Life Expectancy .... 1,000,000 cycles
Weight .... 4 Oz. Approx.
Finish
R.F. Surfaces .... Siver Plated
Magnetic Parts .... Nickel Plated
R.F. Contacts .... Gold Plated Fine Silver

CONNECTORS AND PART NUMBERS

Connector Type	Series 163	Series 164
BNC	163-XX02	164-XX02

See ordering information for coil data.

SERIES 169 SPDT
Remote Coaxial Relay


.63
1.44
.125
.922
1.03
.406
NC
.25
.156
.22
.94
COM
3 MTG HOLES 2-56 NC-2B .14 DEEP
NO
COM
NC

FEATURES

The Series 169 are small relays for use up to 1 GHz. Gold-finished contacts provide reliable operation at low levels. Coils are available in 12 Vdc (70 ohms), 26 Vdc (290 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time .... 12 ms. max.

MECHANICAL DATA

Life Expectancy .... 1,000,000 cycles
Weight .... 3.5 Oz., max.
Finish
Body and Connectors .... Silver Plated
Magnetic Parts .... Nickel Plated

CONNECTORS AND PART NUMBERS

Connector Type	Part Number
BNC F	169-XX02 169-XX32

See ordering information for coil data.

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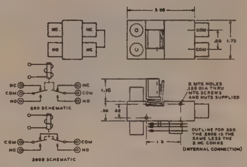
SERIES 260/260B DPDT
Remote Coaxial Relay


3.00
NO
NC
NO
NC
COM
COM
.88
1.73
NC
COM
NO
260 SCHEMATIC
COM
NO
260B SCHEMATIC
1.16
.56
.62
2 MTG HOLES .156 DIA THRU MTG SCREWS AND NUTS SUPPLIED
OUTLINE FOR 260. THE 260B IS THE SAME LESS THE 2 NC CONNS (INTERNAL CONNECTION)
1.5

FEATURES

These are remote operation, ruggedly constructed coaxial relays designed for use from low level to one KW. There are two basic types: The 260 is a standard DPDT switch with six connectors. The 260B is similar, except for an internal connection between the NC contacts, leaving only four connectors. The 260B is widely used for inserting a circuit element, such as a power amplifier, between two normally connected elements, such as an exciter and antenna. Both types are available with or without Form 2C auxiliary contacts. Coils are available in 12 Vdc (48 ohms), 26 Vdc (245 ohms) and 115 Vac (5000 ohms).

SPECIFICATIONS

Operating Time .... 25 ms.
Auxiliary Contact Rating .... 5 amps, 115 Vac

MECHANICAL DATA

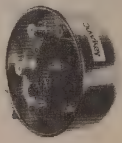
Life Expectancy .... 1,000,000 cycles
Weight .... 12 Oz. approx.
Finish
R.F. Contacts .... Gold Plated Fine Silver
Auxiliary Contacts .... Gold Plated Fine Silver

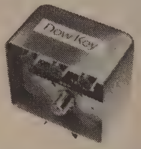
CONNECTORS AND PART NUMBERS

Connector Type	Series 260		Series 260B	
	Standard	With Aux. Contacts	Standard	With Aux. Contacts
UHF	260-XX04	260-XX0442	260B-XX04	260B-XX0442
BNC	260-XX02	260-XX0242	260B-XX02	260B-XX0242

See ordering information for coil data.

SERIES 71/72
Multi-Position Coaxial Switch





FEATURES

The Series 71 and 72 are high power, multi-position relays commonly used for switching antennas, transmitters or receivers at frequencies up to 500 MHz. They are available with shorting or non-shorting contacts, and have a separate actuating coil for each position. Any one or more inputs or outputs may be connected to the common. Coils are available in 12 Vdc (48 ohms), 26 Vdc (245 ohms) and 115 Vac (5000 ohms).

SPECIFICATIONS

Operating Time .... 25 ms.

MECHANICAL DATA

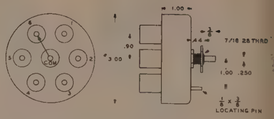
Life Expectancy .... 500,000 cycles per position
Weight .... Series 72, 1.5 lbs.; Series 71, 3 lbs.

CONNECTORS AND PART NUMBERS

Connector Type	3 Position		6 Position	
	Shorting	Non-Shorting	Shorting	Non-Shorting
UHF	72-XX0401	72-XX0402	71-XX0401	71-XX0402

See ordering information for coil data.

SERIES 78
Multi-Position Coaxial Switch



FEATURES

Series 78 are manually operated switches using coaxial switching members rather than wafer switches. They are offered in SPDT, DPDT, 3, 4, and 6 position types. The unused connectors are of the open, non-shorting type.

MECHANICAL DATA

Life Expectancy ....100,000 cycles, min.
Weight .... 10 Oz.
Finish
Connectors .... Silver Plated
Cover .... Clear Irridite
Contacts .... Gold Plated Fine Silver

Mounting: Clearance hole for 7/16 thread and 9/64 hole for locating pin. Supplied with mounting nut, lock washer, knob and escutcheon plate.

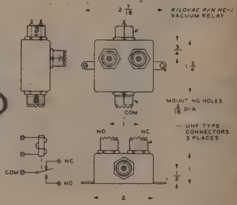
CONNECTOR LOCATIONS VS. FUNCTION

Function	Connector Location
SPDT	1, 6, & C
1P3T	1, 3, 5 & C
1P4T	1, 2, 3, 6 & C
1P6T	1, 2, 3, 4, 5, 6 & C
DPDT	1, 2, 3, 4, 5 & 6

CONNECTORS AND PART NUMBERS

Connector Type	SPDT	1P3T	1P4T	1P6T	DPDT
UHF	78-0204	78-0304	78-0404	78-0604	———
BNC	———	78-0302	———	78-0602	78-0702

MODEL 220-2304 SPDT
Vacuum Coaxial Relay



FEATURES

This compact relay, which incorporates a Kilovac HC-1 ceramic vacuum relay as the switching element, is intended for use in antenna, transmitter, and receiver switching applications. It is capable of carrying two KW of R.F. power at 30 MHz and one KW at 250 MHz. The relay is fitted with UHF connectors, and is designed for continuous operation. R.F. impedance is 50 ohms. Standard coil voltage is 26 Vdc (335 ohms), but other coil voltages are available on special order.

SPECIFICATIONS

Switching Time .... 6 ms. max.

MECHANICAL DATA

Life Expectancy .... 1,000,000 cycles
Weight .... 4 Oz.
Finish
Body .... Nickel Plated
R.F. Connectors .... Silver Plated

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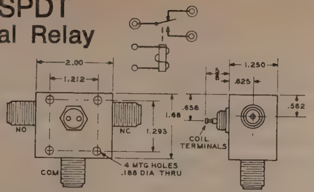
SERIES 310 SPDT
Vacuum Coaxial Relay



FEATURES

Series 310 relays have high power capability in a small package, with continuous rating of 3000 watts at frequencies up to 30 MHz. At 400 MHz, the relay will carry 1000 watts. Reliable vacuum-enclosed contacts minimize noise and losses. Standard coils are 12 Vdc (120 ohms), 26 Vdc (340 ohms), 48 Vdc (900 ohms), 110 Vdc (6000 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time .... 6 ms. max.

ELECTRICAL DATA

Peak Voltage
At 30 MHz .... 1500 V
At 400 MHz ...... 1000 V

Peak Current - 1 μsec. Pulse
At 30 MHz .... 40 amps
At 400 MHz .... 10 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight .... 8 Oz.

Finish
Connectors .. Silver Plated
Block .... Silver Plated

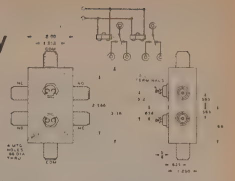
CONNECTORS AND PART NUMBERS

Connector Types	Part Numbers	Connector Types	Part Numbers
N	310-XX01	SC	310-XX53
HN	310-XX51	BNC*	310-XX02
C	310-XX05	TNC*	310-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

SERIES 311 DPDT
Vacuum Coaxial Relay



FEATURES

Series 311 relays are capable of handling three KW of R.F. power at 30 MHz and one KW at 400 MHz. The use of vacuum-enclosed contacts provides reliable, low contact resistance operation. Typical applications for the Series 311 relays include switching R.F. power and radar pulse-forming networks. Standard coils are 12 Vdc (60 ohms), 26 Vdc (170 ohms), 48 Vdc (450 ohms), 110 Vdc (3000 ohms), and 115 Vac (3000 ohms). (Resistance values are for parallel-connected coils.)

SPECIFICATIONS

Operating Time .... 6 ms. max.

ELECTRICAL DATA

Peak Voltage
At 30 MHz .... 1500 V
At 400 MHz ...... 1000 V

Peak Current - 1 μsec. Pulse
At 30 MHz .... 40 amps
At 400 MHz .... 10 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight .... 12 Oz.

Finish
Connectors .. Silver Plated
Block .... Silver Plated

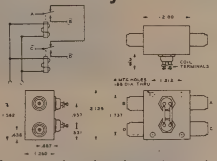
CONNECTORS AND PART NUMBERS

Connector Types	Part Numbers	Connector Types	Part Numbers
N	311-XX01	SC	311-XX53
HN	311-XX51	BNC*	311-XX02
C	311-XX05	TNC*	311-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

SERIES 312
Vacuum Coaxial By-Pass Relay



FEATURES

Series 312 relays are intended for use in circuits where it is desired to by-pass an RF power amplifier and connect the driving source directly to the amplifier load. Reliable, low contact resistance is provided by the vacuum-enclosed contacts. Standard coils are 12 Vdc (60 ohms), 26 Vdc (170 ohms), 48 Vdc (450 ohms), 110 Vdc (3000 ohms), and 115 Vac (3000 ohms). Resistance values are for parallel-connected coils.

SPECIFICATIONS

Operating Time .... 6 ms. max.

ELECTRICAL DATA

Peak Voltage
At 30 MHz .... 1500 V
At 400 MHz ...... 1000 V

Peak Current - 1 μsec. Pulse
At 30 MHz .... 40 amps
At 400 MHz .... 10 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight .... 12 Oz.

Finish
Connectors .. Silver Plated
Block .... Silver Plated

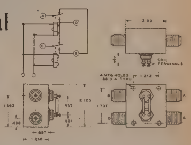
CONNECTORS AND PART NUMBERS

Connector Types	Part Numbers	Connector Types	Part Numbers
N	312-XX01	SC	312-XX53
HN	312-XX51	BNC*	312-XX02
C	312-XX05	TNC*	312-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

SERIES 313
Transfer/Crossover Coaxial Vacuum Relay



FEATURES

These remotely operated, ruggedly constructed transfer relays are designed for high-power, high voltage use. The Series 313 also features Kilovac vacuum-enclosed contacts for high reliability, low contact resistance and long life. Applications include interchanging two transmitters between an antenna and a dummy load, reversing feed phase for directional antenna, and similar applications. Standard coils are 12 Vdc (60 ohms), 26 Vdc (170 ohms), 48 Vdc (450 ohms), 110 Vdc (3000 ohms), and 115 Vac (3000 ohms). (Resistance values are for parallel-connected coils.)

SPECIFICATIONS

Operating Time .... 6 ms. max.

ELECTRICAL DATA

Isolation Loss (at 30 MHz)..35 db min.
Insertion Loss .... 0.2 db max.
R.F. Power Rating .... 3 KW

Peak Voltage .. 1500 V
Peak Current (1 μsec. Pulse) ...... 40 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight .... 12 Oz.

Finish
Connectors .. Silver Plated
Block .... Silver Plated

CONNECTORS AND PART NUMBERS

Connector Types	Part Numbers	Connector Types	Part Numbers
N	313-XX01	SC	313-XX53
HN	313-XX51	BNC*	313-XX02
C	313-XX05	TNC*	313-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

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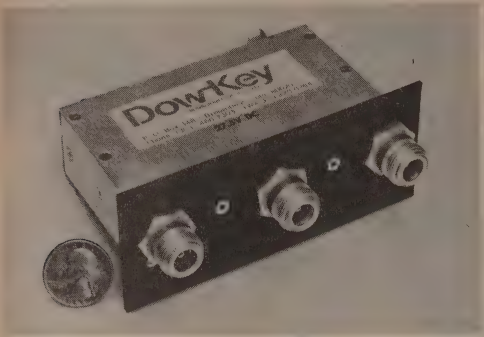
OEM SPECIALS

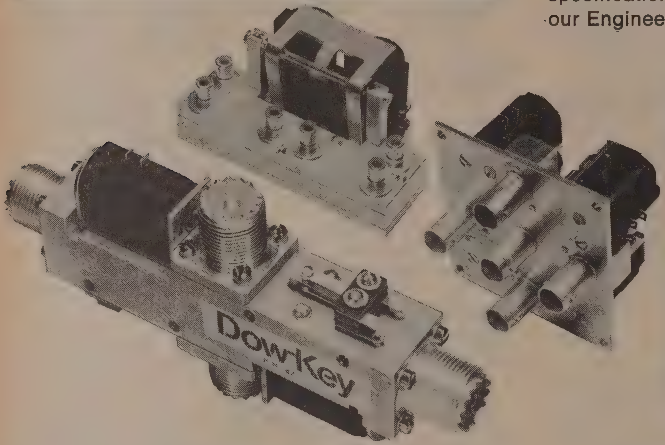


This catalog covers only the standard, most popular Dow-Key relays. We manufacture many more products than shown, and invite your inquiries.

Dow-Key offers the original equipment manufacturer a diverse background of designing and producing special relays to exacting specifications.

Latching relays, hermetically sealed relays and a wide variety of switching arrangements, non-standard connectors, attached cables of various types (with or without connectors) and special coils are available.

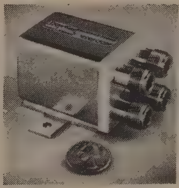
Your inquiries regarding relays designed to your specifications will receive prompt attention from our Engineering and Marketing Departments.



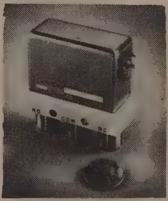
Series 400 Remote Coaxial Relays

The Dow-Key Series 400 coaxial relays are designed to meet all requirements for high reliability, high performance, broadband coaxial RF switching. These relays are designed for use with cable and connector sizes of your choice.

Series 400 coaxial relays provide excellent electrical characteristics over frequency ranges of dc to 12.4 GHz and dc to 18.0 GHz and can be optimized for maximum performance at any narrower band of interest. The relays are designed to provide a wide variety of optional RF and power connectors to satisfy the requirements of nearly any application. The Dow-Key engineering department will be pleased to work with you on your requirements and problems.



Dow-Key
401-2308



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Ordering Information

In the data given for each Dow-Key relay series, the first two or three digits denote the series or basic relay type. The "XX" following the hyphen represents the coil voltage; refer to the coil data table and replace XX with the appropriate coil number. The next two digits designate the type of connector. The final two digits, when used, indicate auxiliary contacts or special terminations.

Using the Series 60 SPDT remote coaxial relay as an example, assume a relay with UHF connectors and 2C auxiliary contacts, with a 12 Vdc coil is wanted. The numbers shown in the Connectors and Part Numbers table are 60-XX0442. Referring to the Coil Data, the coil number is found to be 22. Thus, the part number would be 60-220442.

Various other coils and connectors, as well as certain other modifications, are available in addition to the standard series shown in this catalog. Please contact the factory for your special requirements.

Coil Data

Standard coil voltages are 12 Vdc, 26 Vdc, and 115 Vac, except for vacuum coaxial relays, which are also available at 48 Vdc and 110 Vdc in standard models. Other voltages listed in the table right are available on special order at a slight premium price or in minimum-order quantities.

Part No. Digits	Nominal Volts	Part No. Digits	Nominal Volts
21	6 Vdc	25**	110 Vdc
22*	12 Vdc	26*†	115 Vac
23*	26 Vdc	64††	220 Vac
24**	48 Vdc		

* Standard Coils

** Also standard for vacuum coaxial relays only.

† External diode rectifier supplied with vacuum coaxial relays (not required with other models).

†† Not available on vacuum coaxial relays.

(Within normal temperature and voltage ranges, all the listed coils are rated for continuous duty.)

Connector Data

Connectors are 50-ohm female jack type, unless otherwise specified. The dimensions, materials and finishes are in accordance with applicable military specifications. In many cases, standard 50-ohm relays and switches may be used without introducing significant discontinuities in 75 and 90-ohm impedance circuits at the frequencies where the higher impedance cables are normally employed.

Only the most popular connector types are listed with each coaxial relay or switch described in this catalogue. Within available space limitations, a number of other connectors are available on special order. These include types TNC, HN, C, SC, OSM, and others. Contact the factory for your special connector requirements.

Environmental Data

Design characteristics of Dow-Key relays and switches are generally based on the requirements of specification MIL-S-3928 and the test procedures of MIL-STD-202. In general, the criteria for shock and vibration resistance are operational requirements of no contact opening in excess of 10 microseconds. Non-operating tests may be performed at much higher acceleration levels with no subsequent electrical or mechanical impairment. Shock capability ranges from 15 to 50 g, and vibration capability from 10 g at 55 Hz to 10 g at 2000 Hz. Temperature tolerances are from −55° to +125°C, with most relays bracketed between −55° and +85°C. Complete, detailed information for individual relays and switches is available on request.

VSWR and Isolation Data

Listed below are typical VSWR and isolation values for Dow-Key coaxial relays and switches. The VSWR figures indicate the discontinuity introduced by the addition of the relay or switch in a matched system. Isolation data are in decibels, and indicate the magnitude of leakage to an open terminal when that terminal is terminated in a resistive load equal to characteristic impedance of the system. Type UHF connectors are not recommended for use at frequencies above 400 MHz. Their use above that frequency may cause a substantial increase in VSWR.

VSWR

Frequency, MHz	Series 60	Series 61	Series 71/72	Series 74	Series 77	Series 78	Series 163/164	Series 169	Series 220	Series 260/260B	Series 310	Series 311	Series 312	Series 313
50	1.05	1.03	1.06	1.03	1.03	1.05	1.03	1.05	1.1	1.05	1.05	1.05	1.05	1.05
200	1.08	1.06	1.18	1.06	1.07	1.08	1.07	1.08	1.15	1.08	1.08	1.08	1.08	1.08
400	1.12	1.12	1.2	1.12	1.1	1.15	1.12	1.15	—	1.12	1.1	1.1	1.1	1.1
1000	1.3	1.2	—	1.2	1.25	1.3	1.25	1.3	—	1.3	—	—	—	—

Isolation, dB

50	45	60	58	65	55	60	60	55	35	45	35	35	35	35
200	37	42	42	60	45	50	45	48	25	37	28	28	28	28
400	30	32	32	55	40	45	40	42	—	30	20	20	20	20
1000	25	—	—	50	33	30	30	32	—	25	—	—	—	—

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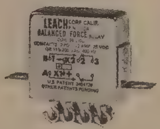
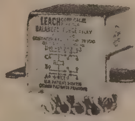
Leach Subminiature Relays Dry Circuit to 25 Amps

LEACH
CORPORATION
RELAY DIVISION

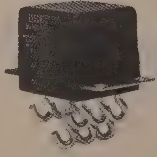
5915 Avalon Boulevard
Los Angeles, California
Tel: (213) 232-8221

		Contact Rating (Amps)												
		28 VDC												
		Resistive	Inductive	Motor	Lamp	115, 400 Hz, 3ø Resistive	Nominal Coil Voltage(s)	Coil Resistance(s)	Operate Time (MS)	Release Time (MS)	Bounce Time (MS)	Shock – Minimum, G	Vibration, Sine – Min., G	Weight, Maximum, Oz.
10A, 2PDT **Series C** An ideal relay with full DC & AC switching capabilities for medium environmental applications. 5 mounting & 4 terminal types. 1.015″ x 0.515″ x 0.885″ Designed to MIL-R-6106.		10	4	3	2	Same as DC	6.0 12.0 28.0 VDC	18 70 300	10	10	2,NO 5,NC	50	20	1.2
10 A, 2PDT **Series D** A reliable relay for full DC capabilities and case ungrounded AC applications. Medium environmental ratings. 5 mounting & 3 terminal types. 1.015″ x 0.515″ x 0.885″. Designed to MIL-R-5757.		10	6	–	–	Same as DC except case ungrounded	6.0 12.0 26.5 26.5 VDC	18 70 300 390	10	10	2	50	20	1.2
Low Level to 12A, 2PDT **Non-Latch & Latch** **Series J, JA & JL** Balanced Force* all welded high environment relay. The most rugged & reliable relay of its size. Circuit breaker compatibility, internal coil suppression, and other special models available. 4 mounting & 3 terminal types. DC – 1.015″ x 0.515″ x 1.000″ AC – 1.015″ x 0.515″ x 1.125″ Non-Latch applicable to MS27401 Latch applicable to MS27744. Sockets available: DC, Non-Latch SO-1049-8309(#16 Crimp) SO-1049-8526(#20 Crimp) AC–115VAC SO-1049-8772(#16 Crimp) 28VAC SO-1049-8774(#16 Crimp) DC, Latch SO-1055-8690(#16 Crimp)		DC Coil 12	8	4	2	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 20 80 320	DC Non-Latch 10	DC Non-Latch 10	1 1	200 200	30 30	DC Coil 1.4
		AC Coil 10					DC Latch 6 12 28	DC Latch 38 150 600	DC Latch 10	DC Latch N/A				
							AC Coil (400 Hz) 28 115 (60 Hz) 28 115	AC Coil I, Max .240 .040 .100 .024	AC Coil 15	AC Coil 50				AC Coil 1.6
Low Level to 12A, 4PDT **Non-Latch & Latch** **Series K, KA & KL** Balanced Force* all welded high environment relay. Same rugged design as Series J except 4 poles. Circuit breaker compatibility, internal coil suppression, and other special models available. 4 mounting & 3 terminal types. 1.015″ x 1.015″ x 1.000″. Non-Latch applicable to MS27400 Latch applicable to MS27745 Sockets available: DC, Non-Latch SO-1048-8308(#16 Crimp) SO-1048-8518(#20 Crimp) AC–115VAC SO-1048-8776(#16 Crimp) 28VAC SO-1048-8779(#16 Crimp) DC, Latch SO-1056-8691(#16 Crimp)		DC Coil 12	8	4	2	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 18 70 290	DC Non-Latch 15	DC Non-Latch 15	1 1	200 200	30 30	DC Coil 2.5
		AC Coil 10					DC Latch 6 12 28	DC Latch 28 112 450	DC Latch 15	DC Latch N/A				
							AC Coil (400 Hz) 28 115 (60 Hz) 28 115	AC Coil I, Max .225 .040 .120 .028	AC Coil 20	AC Coil 50				AC Coil 2.7

*Patented and T.M. Leach Corp.

Leach Subminiature Relays continued

LEACH
CORPORATION
RELAY DIVISION
5915 Avalon Boulevard
Los Angeles, California
Tel: (213) 232-8221

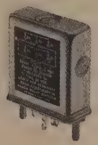
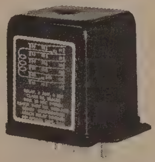
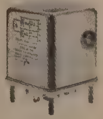
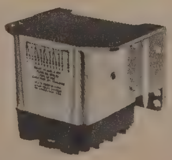
		Contact Rating (Amps)												
		28 VDC				115, 400 Hz, 3φ Resistive	Nominal Coil Voltage(s)	Coil Resistance(s)	Operate Time (MS)	Release Time (MS)	Bounce Time (MS)	Shock, Minimum, G	Vibration, Sine – Min., G	Weight, Maximum, Oz.
		Resistive	Inductive	Motor	Lamp									
Low Level to 25A, 1 PDT Non-Latch & Latch Series JC, JCA & JCL JS & JSA***** Balanced Force* all welded high environment relay. A contactor in a ½ cubic inch can. The same proven design as the Series J. 50 ADC & 80A, 400 Hz overload capabilities. JS Series 20A overload capabilities. Special Models available. 3 mounting & 2 terminal types. DC - 1.015" x 0.515" x 1.000" AC - 1.015" x 0.515" x 1.125". Applicable MS, MIL-R-6106. Sockets available: DC, Non-Latch SO-1063-9033 AC SO-1063-9034 DC, Latch SO-1063-9036		**JC, JCA & JCL 25	12	10	5	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 20 80 320	DC Non-Latch 10	DC Non-Latch 10	1	200	30	1.7
		***JS & JSA Series Only 115V, 60 Hz Case Grounded 10	10	8	4	N/A	DC Latch 6 12 28	DC Latch 38 150 600	DC Latch 10	DC Latch N/A				
							AC Coil (400 Hz) 115 (60 Hz) 115	AC Coil I, Max .040 .024	AC Coil 20	AC Coil 50				
Low Level to 25A, 3PDT Non-Latch & Latch Series KC, KCA & KCL Balanced Force* all welded high environment relay. A contactor in a 1 cubic inch can. The same proven design as the Series K. 50ADC & 80A, 400 Hz overload capabilities. Special Models available. 3 mounting & 2 terminal types. 1.015" x 1.015" x 1.000". DC, Non-Latch applicable to MS27743. Latch applicable to MS27742. Sockets available: DC, Non-Latch SO-1057-8912 AC SO-1062-8917 DC, Latch SO-1058-8913		25	12	10	5	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 18 70 290	DC Non-Latch 15	DC Non-Latch 15	1	200	30	3.0
							DC Latch 6 12 28	DC Latch 28 112 450	DC Latch 15	DC Latch N/A				
							AC Coil (400 Hz) 115 (60 Hz) 115	AC Coil I, Max .040 .028	AC Coil 20	AC Coil 50				
Low Level to 25A, 3PST/NO, 2A 1PDT Aux. Non-Latch & Latch Series KD, KDA & KDL Balanced Force* all welded high environment relay. An ideal 3φ contactor where contact closure indication is required. Same design as the Series KC with added auxiliary pole. Special Models available. 3 mounting & 2 terminal types. DC, Non-Latch applicable to MIL-R-6106/13. Latch applicable to MIL-R-6106/12. Sockets available: DC, Non-Latch SO-1059-8914 AC SO-1061-8916 DC, Latch SO-1060-8915		25	12	10	5	Same as DC Rating	DC Non-Latch 6 12 28	DC Non-Latch 18 70 290	DC Non-Latch 15	DC Non-Latch 15	1 Aux- 4	200	30	DC Coil 2.9
		Aux 2	Aux 1		Aux 0.5		DC Latch 6 12 28	DC Latch 28 112 450	DC Latch 15	DC Latch N/A				
							AC Coil (400 Hz) 115 (60 Hz) 115	AC Coil I, Max .040 .028	AC Coil 20	AC Coil 50				AC Coil 3.0

*Patented and T.M. Leach Corp.

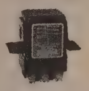
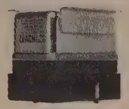
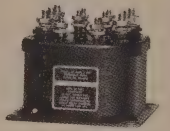
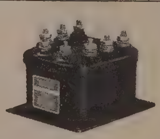
Leach Power and Control Relays 5 to 15 Amps

LEACH
CORPORATION
RELAY DIVISION

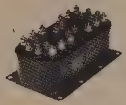
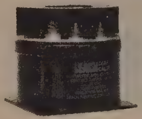
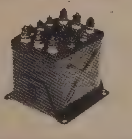
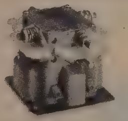
5915 Avalon Boulevard
Los Angeles, California
Tel: (213) 232-8221

Relay		Contact Rating, Amps – Resistive	Contact Configuration	Nominal Operating Voltages	Resistance, Ohms ±10% @ 25°C for 28 VDC	Maximum Release Time, Seconds	Maximum Operate Time, Seconds	Bounce Time, Seconds, Maximum	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Lbs.
5 Amp, 2PDT **Series 9229** **Series 9235; Magnetic Latch** Contact rating @ 28 VDC or 115 VAC, 400 Hz. Resistive; 5 amps; Inductive: 3 amps. 1.750" x 1.531" x .687". Applicable to MS25395 & MS25455.		5	2PDT	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	9229 248Ω	AC Coils .050 DC Coils .020	AC Coils .020	.002	10	25	.18
					9235 310Ω	N.A.	DC Coils .020				.20
5 Amp, 4PDT **Series 9220** **Series 9228; Magnetic Latch** Contact rating @ 28 VDC or 115 VAC, 400 Hz. Resistive: 5 amps; Inductive: 3 amps 1.750" x 1.531" x 1.032". Applicable to MS25267 & MS25467.		5	4PDT	28VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	9220 248Ω	AC Coils .050 DC Coils .020	AC Coils .020	.002	10	25	.30
					9228 200Ω	N.A.	DC Coils .020				.30
5 Amp, 6PDT **Series 9226** **Series 9223; Magnetic Latch** Contact rating @ 28 VDC or 115 VAC, 400 Hz. Resistive: 5 amps; Inductive: 3 amps. 1.812" x 1.531" x 1.531". Applicable to MS25269 & MS25469.		5	6PDT	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	9226 180Ω	AC Coils .050 DC Coils .020	AC Coils .020	.002	10	25	.40
					9223 200Ω	N.A.	DC Coils .020				.67
10 Amp, 2PDT **Series 9227** **Series 9237; Magnetic Latch** Contact rating @ 28 VDC or 3 phase 115/200 VAC, 400 Hz. Resistive: 10 amps; Inductive: 6 amps DC and 10 amps AC. 1.781"x1.531"x1.032". Applicable to MS25273 & MS25466.		10	2PDT	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	9227 175Ω	AC Coils .050 DC Coils .020	AC Coils .020	.002	10	25	.30
					9237 200Ω	N.A.	DC Coils .020				.30
10 Amp, 4PDT **Series 9224** **Series 9225; Magnetic Latch** Contact rating @ 28 VDC or 3 phase 115/200 VAC, 400 Hz. Resistive: 10 amps; Inductive: 6 amps DC and 10 amps AC. 1.812" x 1.531" x 1.531". Applicable to MS25271 & MS25461.		10	4PDT	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	9224 110Ω	AC Coils .050 DC Coils .020	AC Coils .020	.002	10	25	.43
					9225 200Ω	N.A.	DC Coils .020				.40
15 Amp, 4PDT **Series 9274** Contact rating @ 28 VDC or 3 phase 115/200 VAC, 400 Hz. Resistive: 10 amps DC and 15 amps AC; Inductive: 10 DC and AC. 1.80" x 2.06" x 2.06" Applicable to MS24568.		15	4PDT	28 VDC 115 VAC, 400 Hz 115 VAC, 60 Hz	92Ω	AC Coils .050 DC Coils .020	AC Coils .025 DC Coils .025	N.O. .003 N.C. .005	10	25	.80

Leach Power Contactors 20 to 400 Amps

LEACH CORPORATION **RELAY DIVISION** 5915 Avalon Boulevard Los Angeles, California Tel: (213) 232-8221		Contact Ratings, Amps—Resistive	Contact Configuration	Nominal Operating Voltages	Resistance—Ohms ± 10% or Current @ 25° C—	Bounce Time, Seconds, Maximum	Release Time, Seconds, Maximum	Operating Time, Seconds, Maximum	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Oz./Lbs.	Latch Model Available
20 Amp **Series 9324—3PST/NO** 25g shock, 10g vibration. 1.47" x 2.50" x 2.40". Applicable to MS27418.		20	3PST/NO	28 VDC; 115 VAC, 400 Hz; 115 VAC, 60 Hz	160	.002	AC Coils .050 DC Coils .010	AC Coils .025 DC Coils .020	10	25	.60	No
20 Amp **Series 9325—3PDT/NO** Mechanical interlock version of 9324. 3.71" x 3.00" x 3.20". Applicable to MS27706.		20	3PDT/NO	28 VDC; 115 VAC, 400 Hz; 115 VAC, 60 Hz	160	.005	AC Coils .050 DC Coils .010	AC Coils .025 DC Coils .020	10	25	1.4	Mech. Interlock
25 Amp **Series 9123—3PST/NO** 50g shock, 15g vibration. Auxiliary 5 amp contacts available. 3.30" x 3.73" x 2.50". Repairable models available. Applicable to MS27997.		25	3PST/NO	28 VDC; 115 VAC, 400/60 Hz	50	.002	AC Coils .050 DC Coils .010	.025	15	50	1.25	No
50 Amp **Series "H"** Auxiliary contacts 5 amps. Repairable models available. Basic unit: 2.50" Dia. x 3.13". Applicable to MS27751.		AC 50 DC 25	3PDT 3PDT SPST/NO Aux. 3PST/NO SPST/NO SPST/NC Aux.	6, 12, 28 VDC 115VAC, 400 Hz 115VAC, 60 Hz	6VDC 12Ω 12VDC, 50Ω 28 VDC, 200 Ω 115 VAC, .09A	.003	.025	.050	10	50	13.5 Oz.	N/A
50 Amp **Series "HC"** **Center-Off** Repairable models available. Basic unit: 2.50" Dia. x 3.13". Applicable to MS27750.		AC 50 DC 25	3PDT	6, 12, 28 VDC	6 VDC, 12Ω 12 VDC, 50Ω 28 VDC, 200Ω	.003	.025	.035	10	50	14.0 Oz.	N/A
50 Amp **Series "HL"** **Magnetic Latch** Repairable models available. Basic unit: 2.50" Dia. x 3.13". Applicable to MS27749.		AC 50 DC 25	3PDT	6, 12, 28 VDC	6 VDC, 12Ω 12 VDC, 50Ω 28 VDC, 200Ω	.003	–	.035	10	50	14.0 Oz.	Yes
50 Amp **Series 9124—3PST/NO** 50g shock, 15g vibration. Auxiliary 5 amp contacts available. Applicable to MS27222. 3.30" x 3.73" x 2.50". Repairable models available.		50	3PST/NO	28 VDC; 115 VAC, 400/60 Hz	50	.002	AC Coils .050 DC Coils .010	.025	15	50	1.25	No

Leach Power Contactors continued

LEACH CORPORATION **RELAY DIVISION** 5915 Avalon Boulevard Los Angeles, California Tel: (213) 232-8221		Contact Ratings, Amps—Resistive	Contact Configuration	Nominal Operating Voltages	Resistance—Ohms ± 10% @ 25°C— or Current	Bounce Time, Seconds, Maximum	Release Time, Seconds, Maximum	Operate Time, Seconds, Maximum	Sinusoidal Vibration, Minimum, G	Shock, Minimum, G	Weight, Maximum, Oz./Lbs.	Latch Model Available
50 Amp **Series 9125–6PST/NO** Mecnanical interlock version of 9124. Design to MIL-R-6106. Aux. 5 amp contacts available. 6.21" x 3.80" x 2.70".		50	6PST/NO	28 VDC: 115 VAC, 400/60 Hz	50	.002	AC Coils .050 DC Coils .010	.030	10	50	2.90	Mech. Interlock
120 Amp **Series "Z"** Auxiliary contacts - 5 amp. Available in many models of contact. Configuration - consult factory. Available in repairable models. Design to MIL-R-6106. Basic unit: 3.65" Dia. x 4.28".		AC 120 DC 50	3PDT 3PST/NO 3PST/NO SPST/NO SPST/NC Aux. 3PDT W/SPST/NO or SPST/N.C. Aux.	6, 12, 28 VDC 115 VAC 400 Hz 115 VAC 60 Hz	6 VDC, 1.2 A 12 VDC, .6 A 28 VDC, .31 A 115 VAC, .12 A	.004	.040	.060	5 70 500 Hz	15	2.0 lb.	N/A
100 Amp **Series "ZC"** **Center-Off** Repairable models available. Design to MIL-R-6106. Basic unit: 3.65" Dia. x 4.28".		AC 100 DC 50	3PDT 3PST	6, 12, 28 VDC 115 VAC 400 Hz 115 VAC 60 Hz	6 VDC, .8 A 12 VDC, .4 A 28 VDC, .23 A 115 VAC, .09 A	.004	.040	.060	5 70 500 Hz	15	2.0 lb.	N/A
120 Amp **Series "ZL"** **Magnetic Latch** Repairable models available. Design to MIL-R-6106. Basic unit: 3.65" Dia. x 4.28".		AC 120 DC 50	3PDT	6, 12, 28 VDC 115 VAC 400 Hz 115 VAC 60 Hz	28 VDC, .215 A	.004			5 70 500 Hz	15	2.0 lb.	YES
100 Amp **Series 9213** Sealed rotary, 1, 2, 3 and 4 pole. Auxiliary contacts from 5 amps. Design to MIL-R-6106. 4.22" x 4.23" x 4.53".		100	3PST/NO 4PST/NO	28 VDC; 115 VAC, 400 Hz; 115 VAC, 60 Hz	44.5	.010	AC Coils .060 DC Coils .020	AC Coils .040 DC Coils .030	10	25	2.7	NO
25 to 100 Amp **Series 9207** Unsealed rotary, 1, 2, 3 and 4 pole. Auxiliary contacts from 5 amps. Design to MIL-R-6106.		25 50 100	3PST/NO 4PST/NO	28 VDC; 115 VAC, 400 Hz 115 VAC, 60 Hz	44.5	.010	AC Coils .050 DC Coils .020	.030	10	50	1.6	NO
25 to 400 Amp **Solenoid Type Power Contactors** Types shown: 3PST/NO 25 amps. Design to MIL-R-6106.		25 25 & 50 50 200 400	3PST/NO 1PDT 1PST/NO 1PST/NO 1PST/NO	28 VDC	Varying	N/A	.015	.040	2	25	2.6	NO

Leach Electronics

LEACH
CORPORATION
RELAY DIVISION

5915 Avalon Boulevard
Los Angeles, California
Tel: (213) 232-8221

CUSTOM CAPABILITIES

I CUSTOM DESIGN OF TIMING AND SENSING SYSTEMS UTILIZING LEACH MIL-STANDARD RELAYS OR SPECIAL SOLID STATE OUTPUTS MAY BE MANUFACTURED BY DISCRETE CIRCUITRY OR THICK FILM HYBRID TECHNIQUES

II COMBINATIONS OF VOLTAGE, FREQUENCY, AND PHASE SEQUENCE DETECTION WITH BUILT-IN TIME DELAYS ARE AVAILABLE FOR SYSTEMS MONITORING

III CUSTOM THICK FILM HYBRID CIRCUITS MANUFACTURED TO, MIL-STD-883 CLASS B REQUIREMENTS

IV SOLID STATE RELAYS WITH UP TO 3PNO CONTACTS AND RATINGS TO 25 AMPERES AC, 3ϕ, 400Hz FOR USE WITH MIL-STD-704 POWER REQUIREMENTS

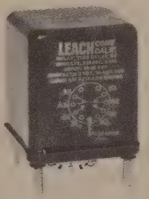
V RELAY DRIVERS FOR MULTIPLEX INTERFACE AND ISOLATION, INCLUDING INTEGRAL RELAYS, WHICH CONFORM TO MIL-R-28776

VI SOLID STATE SWITCHING DEVICES INCLUDING BOTH AC AND DC MOTOR CONTROLLERS

VII SOLID STATE CIRCUIT BREAKERS, CURRENT SENSORS, AND REMOTE POWER CONTROLLERS

ENCLOSURE TYPES

TYPE 10



1.5"x
1.5"x
1.8"

MATING SOCKET:
SO-1021-7127

TYPE 10

1.5"x
1.5"x
2.3"

MATING SOCKET:
SO1021-7127
(SENSORS)

TYPE 20

1.2"x
1.0"x
1.8"

MATING SOCKET:
SO-1048-8308

TYPE 30

1.0"x
1.0"x
1.3"

MATING SOCKET:
SO-1048-8308

TYPE 40

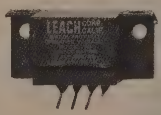
1.0"x
0.5"x
1.1"

MATING SOCKET:
SO-1049-8309

TYPE 01

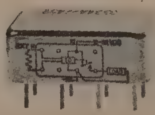
2.1"x
0.8"x
1.3"

TYPE 02



2.1"x
1.0"x
1.0"

TYPE E – (HALF SIZE XTAL CAN)



0.8"x
0.4"x
0.4"

Leach Electronics

LEACH
CORPORATION
RELAY DIVISION
5915 Avalon Boulevard
Los Angeles, California
Tel: (213) 232-8221

	LEACH Series Number	Enclosure Types Available	Timing Range (1)	Accuracy (1)	Contact Configuration	Contact Ratings	Temperature Range	Input Voltage	Transient Protection
Time Delay Relays									
Time Delay On Operate* Relay Output*	R300	10, 20, 30	100MS TO 300 SEC	±2% TO ±10%	2PDT 4PDT	2 AND 10 AMP	-55°C TO +125°C	18VDC TO 32VDC	PER MIL-STD 704A
Solid State Output	S300	20, 30, 40			SPNO	0.25A			
Time Delay On Release Positive Or Negative Control									
Relay Output*	R400	10, 20, 30	100MS TO 300 SEC	±2% TO ±10%	1PDT 3PDT	2 AND 10 AMP			
Solid State Output	S400	20, 30			SPNO	0.25A			
Hybrid Construction* Time Delay On Operate	S5100	1/2 XTAL CAN	50MS TO 500 SEC						
Repeat Cycle Timer*	S5200								
Voltage, Frequency, and Phase Sensors									
DC Relay Output	V110	10	N/A	±2% TO ±10%	2PDT AND 4 PDT	2 AND 10 AMP	-55°C TO +125°C	18VDC TO 32VDC	PER MIL-STD 704A
AC Undervoltage, Relay Output	V210							90VAC TO 124VAC 400 Hz	
AC Overvoltage, Relay Output	V310								
AC Frequency, Relay Output	F410								
AC Phase Sequence, Relay Output	P510			N/A					
Proximity Sensors									
Solid State Output (2)	PS100	01 02	N/A	±.03"	SPNO SPNC	0.20A	-55°C TO +125°C	18VDC TO 32VDC	PER MIL-STD 704A

(1) EXTENDED TIMING RANGES AND GREATER ACCURACIES ARE AVAILABLE ON SPECIAL ORDER

(2) AVAILABLE FOR BOTH FERROUS AND NON FERROUS TARGET SENSING
SHORT CIRCUIT PROTECTION AVAILABLE
PACKAGES FOR MULTIPLE SENSORS AND HIGHER OUTPUT RATINGS ON SPECIAL ORDER

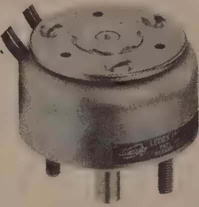
***TIME DELAY UNITS AVAILABLE QUALIFIED TO MIL-R-83726**

LEDEX

PRODUCT DIRECTORY

ROTARY SOLENOIDS ... direct rotary action

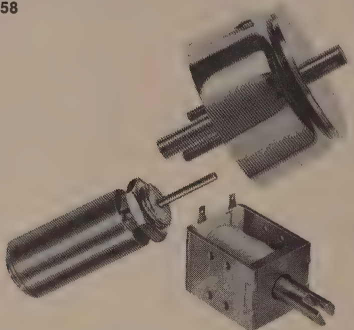
See Vol. I Page 1•1757
Section 4500



Step, turn, pull, push, index, hammer, punch, or trigger — the Ledex rotary solenoid gives you fast, dependable, direct rotary action. Choose from eight basic sizes, right or left hand strokes from 25 to 95 degrees. Torque output to 117 pound-inches. Endurance engineered models have life of 100,000,000 cycles.

PUSH-PULL SOLENOIDS ... short and medium strokes

See Vol. 1 Page 1•1758
Section 4500



Pancake shaped Ledex push-pull solenoids give you high force and fast response. Form factor minimizes size for best efficiency. Flat face models are best for short strokes, to about .060″. Conical face plungers have greater pole surface area — to extend the useful range to .390″.

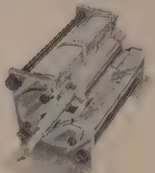
long strokes

For strokes up to .750 inches — Ledex tubular solenoids offer smooth, efficient, long term performance. Included among the Ledex quality features are built-in impact cushions to absorb energy at the end of the stroke, and electroless nickel plated plungers for smooth travel and long wear. Slotted and cross drilled plungers on the pull models simplify your load attachment.

Ledex D-Frame solenoids offer economical, long term service for users whose needs must be matched by a dependable product and reliable source. Eight standard models are available from stock with strokes up to 1.25″. Quick connect terminals and high temperature class "B" coils are standard.

ELECTRO PROPORTIONAL SYSTEMS ... infinitely variable positioning

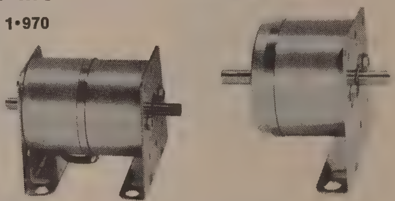
See Vol. I Page 1•262
Section 2200



Accurately positioning mechanical loads from electrical control signals can be economically achieved with a Ledex closed loop electro proportional positioning system. The system contains an EP solenoid, a controller and a feedback device. Stock models available for immediate delivery.

STEPPING MOTORS ... incremental positioning

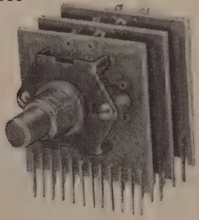
See Vol. I Page 1•970
Section 3500



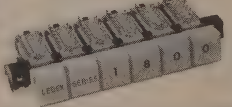
Powerful Ledex Series 50-L Stepping Motors position loads in precise increments of 10, 15, 20, or 30 degrees, accurate to ±1° non-accumulative. Highlights include unidirectional and bidirectional models, shafts on both ends that can be manually turned in either direction, and a tooth clutch drive that gives positive grip stepping action while doubling as a brake to stop overdrive. The new Series 50-L extended life designs provide over 10,000,000 maintenance free steps.

SWITCHES ... multi-pole circuit switching

See Vol. I Page 1•2092
Section 5100



Versatile Ledex solenoid driven stepping switches permit multiple switching functions with a single component, in very little space. They are used for transfer switching, sequencing of complex switching arrangements, and in programming of checkout and sequential operations. There's a wide choice of multi-pole designs in 2, 4, 6, 8, 10, 12, 18, and 24 electrical positions.



manual switching

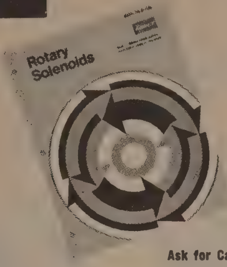
Rotary or pushbutton gives you flexibility and choice in designing switching combinations. Quality engineered for efficiency and long term dependability. Pushbutton switches are available in momentary . . . push/pull . . . reciprocal release . . . master release . . . switching combinations or single pushbutton and indicator lights. Manual rotary switches are available in 6, 8, 12, 18, 20 and 24 position.

LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

LEDEX

ROTARY SOLENOIDS



Ask for Catalog C-1000

230 stock models for quick prototype starts
Fast, direct rotary action

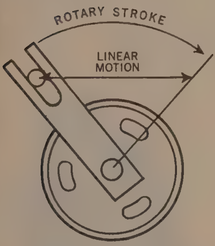
Ledex Rotary Solenoids step, turn, pull, push, index, hammer, punch or trigger — whenever there's a need for fast and dependable direct rotary action. Known for high force-to-size, ability to resist shock. Family of 8 basic sizes with right and left hand strokes from 25 to 95 degrees. Torque to 117 pound-inches. Wide choice of stock models offer economy and quick starts on prototypes. LIFE: 100,000,000 actuations with special endurance engineered models.

GROSS TORQUE IN POUND-INCHES

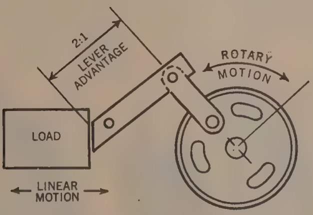
Rotary Stroke			25°		35°		45°		67½°		95°	
Duty Cycle			1/10	1/20	1/10	1/20	1/10	1/20	1/10	1/20	1/10	1/20
Size	Diam. (in.)	Ht. (in.)										
1E	1	5/8	.8	1.1			.43	.62				
2E	1 1/8	21/32	1.4	1.7	1.1	1.3	.72	.89				
3B*	1 5/16	7/8	2.7	3.2	2.0	2.3	1.4	1.7	.65	.8		
3E		51/64	2.7	3.2	2.0	2.3	1.44	1.8	.70	.89		
4E	1 9/16	61/64	4.5	5.2	3.1	3.5	2.6	3.1	1.6	1.9	1.0	1.2
5B*	1 7/8	1 13/64	8.3	10.0	6.9	8.3	5.0	6.0	3.3	4.0	1.6	1.9
5S		1 3/64	12.1	13.2	7.8	9.2	6.3	6.9	3.9	4.9	1.9	2.6
6S	2 1/4	1 27/64	27.8	30.6	18.6	20.5	11.0	12.1	8.8	9.7	5.2	5.7
7S	2 3/4	1 55/64	42.4	46.6	38.0	42.0	29.8	32.8	17.5	19.3	10.5	11.6
8S	3 3/8	2 5/16	98.0	117	64.0	77.0	54.0	65.0	29.0	35.0	17.0	20.0

* 3B and 5B have random wound coils; all other are precision wound.

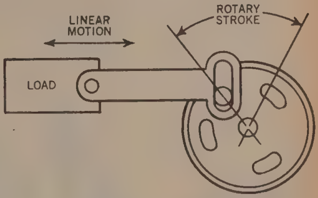
Rotary Solenoid as a Linear Actuator For Longer Strokes



SHAFT BAR LINK



ARMATURE LEVER



ARMATURE DRIVE PIN

When the stroke length is beyond the range of Ledex straight pull solenoids, a rotary solenoid may be the best solution.

Ledex rotary solenoids have raceways coined in the armature and stator. With precision ball bearings riding on inclined raceways, the solenoid provides direct, almost friction-free rotary motion. In the beginning of the stroke, where the output of a linear solenoid is low, the raceways are steep. Toward the closed end, where the magnetic attraction reaches maximum force, the raceways taper off. The effect is to evenly distribute the force.

Ledex solenoids can help you get a lot of work done in places where you don't have much room. We make both push/pull and rotary solenoids in a wide variety of shapes and sizes to solve just about any actuating problem you have.

Call Ledex when you need a lot of power in a small space to push, pull, turn, twist, step, index, hammer, punch or trigger. For a quick start on your prototype, choose from 230 different stock model designs. Or, send details and we'll custom design a space-saving solenoid for you.

LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

LEDEX

PUSH & PULL SOLENOIDS

You name the job.
Short, medium or long stroke. High speed.
Tight space. Unusual load. Ledex has the
solenoid for you, usually on the shelf. Expert design
assistance for your toughest custom requirements.

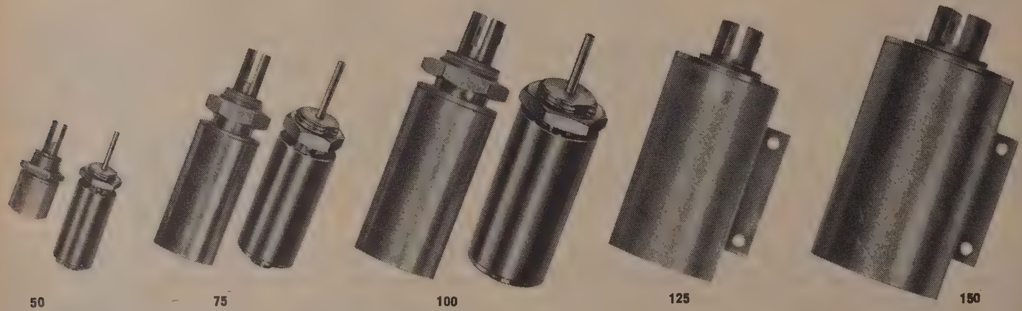
Pancake shaped Ledex push/pull solenoids are built for high force to size and fast response. Better than 10ms response. Form factor minimizes size, provides maximum pole face surface for best efficiency. Two types available. Flat face is for short stroke, rapid response. Conical face gives more mid-range punch.

TYPICAL OUTPUT, 1/10 DUTY

Model	0		1		2		3		4		5		6	
Size	.75″D x ½″		1″D x 17/32″		1.2″D x 27/64″		1.3″D x 11/16″		1.6″D x 55/64″		1.9″D x 1 1/64″		2.3″D x 1 21/64″	
	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face
Stroke (In.)	.020	—	.020	.010	.020	.010	.020	.010	.020	.010	.020	.010	.020	—
Force (Lbs.)	4.4	—	7.8	17	11	23	16	35	17	55	35	110	85	—
Stroke (In.)	.120	—	.120	.060	.120	.060	.120	.060	.200	.100	.250	.100	.250	—
Force (Lbs.)	1	—	2.4	3.3	3.3	4.5	8	10	6	12	16	20	52	—
Weight	1½ oz.		1½ oz.		2¼ oz.		3¾ oz.		6 oz.		10 oz.		1 lb. 5½ oz.	

(For detail performance curves, ask for Catalog C-1100)

Quality engineered for efficiency and long term dependability, the Ledex long stroke solenoid has a built-in impact cushion pad to absorb energy at the end of the power stroke. For smooth travel and long wear, the solenoid plunger is electroless nickel plated. It rides in a smooth bushing track designed for positive alignment and low friction. Slotted and cross drilled plungers on all stock models simplify load attachment. Off-the-shelf models available for 12, 28 and 100 VDC operations.



TYPICAL OUTPUT 1/10 DUTY

Model	Size 50		Size 75	Size 100	Size 125	Size 150
Size	½″D x ½″	½″D x 1″	¾″D x 1½″	1″D x 2″	1¼″D x 2¼″	1½″ x 2½″
Force, .050 Stroke	4.5 oz.	15 oz.	3 lbs.	7 lbs.	11.5 lbs.	16.5 lbs.
Force, .750 Stroke	—	—	.6 lbs	2 lbs.	4 lbs.	7 lbs.
Shaft Diameter, pull	.187″	.187″	.312″	.437″	.500″	.625″
Shaft Diameter, push	.062″	.062″	.094″	.125″	—	—
Mounting	Thr'd Bushing	Thr'd Bushing	Thr'd Bushing	Thr'd Bushing	Saddle	Saddle
Weight	14 grams	24 grams	3 oz.	6¾ oz.	9 oz.	1 lb. ½ oz.

When it comes to actuating, Ledex has both the people and products to give you the quickest and best solution. There's a wide choice of stock models for a fast start on your prototype. And our expert application staff is always glad to custom engineer to your exact stroke, force, speed and size requirements. Other models (not shown) are available on made-to-order basis with force outputs in excess of 350 pounds. Ask for Catalog C-1100.

LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

LEDEX

D-FRAME SOLENOID

Ledex D-Frame solenoids offer several benefits. The simplified design allows construction methods that result in a more cost effective product.

All solenoids provided with quick connect terminals for fast hook-up. Leads can be provided if desired.

Load attachment through slotted and cross drilled electroless nickel plated plunger for simplified attachment and longer life.

The plunger cavity is an integral part of the bobbin which is constructed of glass filled nylon to meet or exceed class "B" NEMA standard insulation requirements.

The frame is cadmium plated with a supplementary dichromate treatment for added corrosion resistance. Multiple, tapped mounting holes provide for easy installation and interchangeability.

MODEL L6-22 AC OR DC

Holding Force: D.C. Continuous @ 24 VDC cold 35 oz. @ 24 VDC hot 32 oz.
D.C. Intermittent @ 24 VDC cold 37 oz. @ 24 VDC hot 35 oz.
A.C. Continuous @ 120 VAC cold 9 oz. @ 120 VAC hot 6 oz.
A.C. Intermittent @ 120 VAC cold 8 oz. @ 120 VAC hot 7 oz.

Voltages: 6, 12, 24, 120 VAC or DC.
AC Operating Frequency: Std. 60Hz.
Insulation Material: Class "B" (130°C) standard UL recognized materials used in construction.
Dielectric strength: 1000 V (RMS).
Termination: Quick connect terminals standard
Pull Type Operation: Standard Available — Push type on DC units only.
Plunger Mass: 6.3 grams (.22 ozs.)
Total Mass: 48.2 grams (1.70 ozs.)

POWER REQUIREMENTS

Model L6-22	AC	DC
DUTY CYCLE:		
$\left(f=\frac{\text{"on" time}}{\text{"on" time}+\text{"off" time}}\right)$ "on" time = length of longest pulse during one cycle		
Intermittent (f = ¼, "on" time = 300 seconds (max.)	9VA	8.5W
Continuous (f = 1)	5.5VA	4.0W
Expected No. of cycles @ 25°C and 50% of full stroke	5 x 10⁶	

MODEL L44-02H AC OR DC

Holding Force: D.C. Continuous @ 24 VDC cold 144 oz. @ 24 VDC hot 133 oz.
D.C. Intermittent @ 24 VDC cold 180 oz. @ 24 VDC hot 158 oz.
A.C. Continuous @ 120 VAC cold 60 oz. @ 120 VAC hot 55 oz.
A.C. Intermittent @ 120 VAC cold 75 oz. @ 120 VAC hot 70 oz.

Voltages: 6, 12, 24, 120, 240 VAC or DC.
AC Operating Frequency: Std. 60Hz.
Insulation Material: Class "B" (130°C) standard UL recognized materials used in construction.
Dielectric Strength: 1000 V (RMS).
Termination: Quick connect terminals standard. Available — Leads.
Pull Type Operation: Standard. Available — Push type.
Plunger Mass: 35 grams (1.25 ozs.).
Total Mass: 368 grams (13 ozs.)

POWER REQUIREMENTS

Model L44-02H	AC	DC
DUTY CYCLE:		
$\left(f=\frac{\text{"on" time}}{\text{"on" time}+\text{"off" time}}\right)$ "on" time = length of longest pulse during one cycle		
Intermittent (f = ¼, "on" time = 300 seconds (Max.)	66VA	31W
Continuous (f = 1)	16.5VA	10W
Expected No. of cycles @ 25°C and 50% of full stroke	20 x 10⁶	

MODEL L25-11H AC OR DC

Holding Force: D.C. Continuous @ 24 VDC cold 7 lbs. @ 24 VDC hot 5 lbs.
D.C. Intermittent @ 24 VDC cold 8 lbs. @ 24 VDC hot 5½ lbs.
A.C. Continuous @ 120 VAC cold 59 oz. @ 120 VAC hot 50 oz.
A.C. Intermittent @ 120 VAC cold 90 oz. @ 120 VAC hot 85 oz.

Voltages: 6, 12, 24, 120, 240 VAC or DC.
AC Operating Frequency: Std 60Hz.
Insulation Material: Class "B" (130°C) standard UL recognized materials used in construction.
Dielectric Strength: 1000 V (RMS).
Termination: Quick connect terminals standard. Available — Leads.
Pull Type Operation: Standard. Available — Push type.
Plunger Mass: 43 grams (1.50 ozs.).
Total Mass: 177 grams (6.25 ozs.).

POWER REQUIREMENTS

Model L25-11H	AC	DC
DUTY CYCLE:		
$\left(f=\frac{\text{"on" time}}{\text{"on" time}+\text{"off" time}}\right)$ "on" time = length of longest pulse during one cycle		
Intermittent (f = ¼, "on" time = 300 seconds (max.)	40VA	19.5W
Continuous (f = 1)	16VA	8.5W
Expected No. of cycles @ 25°C and 50% of full stroke	1 x 10⁷	

MODEL L51-04H AC OR DC

Holding Force: D.C. Continuous @ 24 VDC cold 176 oz. @ 24 VDC hot 152 oz.
D.C. Intermittent @ 24 VDC cold 260 oz. @ 24 VDC hot 250 oz.
A.C. Continuous @ 120 VAC cold 50 oz. @ 120 VAC hot 43 oz.
A.C. Intermittent @ 120 VAC cold 110 oz. @ 120 VAC hot 88 oz.

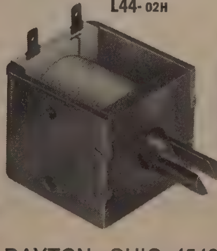
Voltages: 6, 12, 24, 120, 240 VAC or DC.
AC Operating Frequency: Std. 60Hz.
Insulation Material: Class "B" (130°C) standard UL recognized materials used in construction.
Dielectric Strength: 1000 V (RMS).
Termination: Quick connect terminals standard. Available — Leads.
Pull Type Operation: Standard. Available — Push type on DC units.
Plunger Mass: 66 grams (2.3 ozs.).
Total Mass: 425 grams (15 ozs.).

POWER REQUIREMENTS

Model L51-04H	AC	DC
DUTY CYCLE:		
$\left(f=\frac{\text{"on" time}}{\text{"on" time}+\text{"off" time}}\right)$ "on" time = length of longest pulse during one cycle		
Intermittent (f = ¼, "on" time = 300 seconds (Max.)	171VA	36W
Continuous (f = 1)	31VA	12W
Expected No. of cycles @ 25°C and 50% of full stroke	5 x 10⁶	

L51-04H

L44-02H



L25-11H

L6-22

LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

SOLID FRAME SOLENOIDS

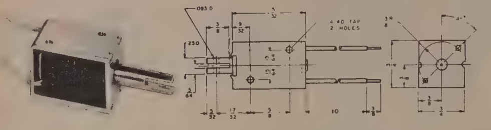
LIBERTY CONTROLS, INC.

Liberty Controls, Inc. has a complete line of solid frame solenoids which can be tailored to fit your needs. These shown below are the standard line which cover a variety of applications. Each of the below pull solenoids are complimented by a push type with similar characteristics. Plungers and plunger stops are made from a special steel annealed after all machining for maximum efficiency.

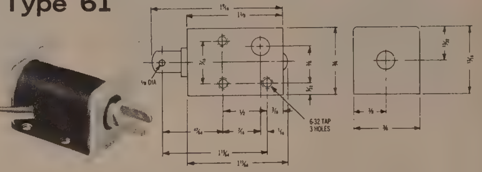
Continuous rated units should be used whenever possible. When the mechanical push/pull required exceeds the capabilities of a continuous rated coil, it is important to give us complete information regarding the intended duty cycle so that we may design and supply the best coil for your application. When one of these units will be energized for a period of four (4) minutes or longer, a continuous duty coil **must** be used. Where intermittent coils are to be used the per cent of "on time" is related to this four (4) minute period.

We have designed and built many **special solenoids** including push and pull, very large, and very small units. We are interested in looking at your special requirements.

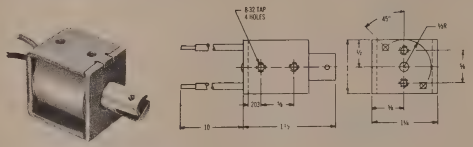
Type 60


.093 D
.230
4-40 TAP
2 HOLES
10

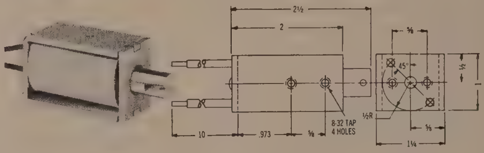
Type 61


⅛ DIA
6-32 TAP
3 HOLES

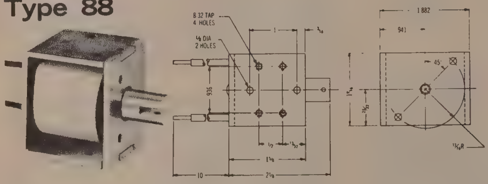
Type 81


8-32 TAP
4 HOLES
45°
½R
.203
10
1¼

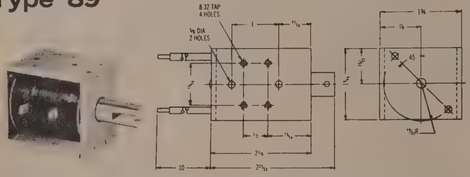
Type 82


2½
2
⅝
45°
8-32 TAP
4 HOLES
½R
10
.973
1¼

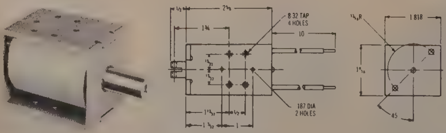
Type 88


8-32 TAP
4 HOLES
¼ DIA
2 HOLES
1.882
.941
45
.936
10
2⅛

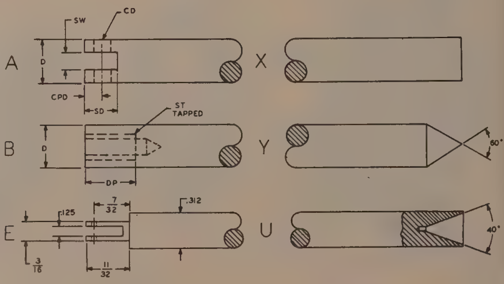
Type 89


8-32 TAP
4 HOLES
¼ DIA
2 HOLES
1¾
45
10

Type 90


8-32 TAP
4 HOLES
1.818
45
.187 DIA
2 HOLES
10

Plunger Details


A
SW
CD
D
CPD
SD
X
B
ST
TAPPED
D
DP
Y
60°
E
.125
7/32
.312
3/16
11/32
U
40°

DIMENSIONS (Refer to Drawings Above)

TYPE	A					B		
	D	SW	SD	CD	CDP	D	ST	DP
60	¼″	⁵⁄₆₄″	⅜″	³⁄₃₂″	⁵⁄₃₂″	¼″	6-32	¼″
81 & 82	⁷⁄₁₆″	⁹⁄₆₄″	⅜″	³⁄₃₂″	⁵⁄₃₂″	⁷⁄₁₆″	10-32	¼″
88, 89 & 90	½″	⁹⁄₆₄″	⅜″	³⁄₃₂″	⁵⁄₃₂″	½″	10-32	¼″

Liberty Controls, Inc. 500 Brookforest Avenue, Shorewood, Illinois 60431 815/725-2241

SOLID FRAME SOLENOIDS

LIBERTY CONTROLS, INC.

PUSH/PULL CHARACTERISTICS OF SOLID FRAME SOLENOIDS

DISTANCE FROM STOP IN INCHES (PUSH/PULL IN OZ.)

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"
CONTINUOUS DUTY									
AC 60	8	4	2	1	.5	—	—	—	—
61	8	6	4	3	2.5	—	—	—	—
81	6	4	2	1	—	—	—	—	—
82	20	6	3	2	1	—	—	—	—
88	17	14	9	4	3	—	—	—	—
89	16	8	6	5	5	5	—	—	—
90	14	7	4	3	3	2	2	2	—
DC 60	10	3	.5	—	—	—	—	—	—
61	7	2	1	—	—	—	—	—	—
81	6	4	2	1	—	—	—	—	—
82	30	20	10	6	4	2	2	—	—
88	96	40	14	7	3	—	—	—	—
89	80	40	12	4	2	1	—	—	—
90	110	64	27	12	6	3	2	1	—
INTERMITTENT DUTY									
AC 60	12	6	3.5	2	1	—	—	—	—
61	16	11	8	6	5	—	—	—	—
81	20	16	8	4	2	—	—	—	—
82	33	21	12	9	7	6	4	—	—
88	54	40	24	16	12	—	—	—	—
89	58	40	28	24	20	20	—	—	—
90	50	40	24	18	17	17	17	17	17
DC 60	15	6	2	1.5	.5	—	—	—	—
61	20	12	9	7	6	—	—	—	—
81	27	18	10	5	3	—	—	—	—
82	67	48	32	20	11	6	3	—	—
88	190	140	70	40	20	10	—	—	—
89	184	140	100	60	40	26	16	—	—
90	190	140	96	65	45	30	20	—	—

HOW TO ORDER

When ordering any of the above solid frame solenoids, the part number should be specified as follows:

TYPE	DUTY	VOLTAGE	PLUNGER	
			Front	Back
60 61 81 82 88 89 90	C - Continuous I - 25% On time compared to 4 min. continuous duty cycle P - Pulse - Less than 10% on time	6VDC or AC 12VDC or AC 24VDC or AC 48VDC or AC 115VDC or AC 230VDC or AC	A B E	U X Y

SPECIAL SOLENOIDS

In addition to the standard solenoids above, Liberty Controls has tailored many units to our customers' needs. Whether we design the solenoid entirely, or manufacture it to your specifications, the flexibility offered allows for a quality economical product. In that we have our own tool and die making facilities, wind our own coils, and make the fabricated and screw machine parts in our own plant, we can fill any solenoid requirement.

SPECIAL 82 OPEN

This special design with heavy steel washers on each end of the coil allows for a relatively level pull force throughout the entire plunger travel. Note also the felt pad for quiet operation.

PANEL MOUNT TYPE 60

This unit utilized our Type 60 solenoid characteristics; however it can be panel mounted. Many tubular solenoids are used only because of the ability to panel mount them. Here is a panel mount solenoid with a low cost solid frame design.

Liberty Controls, Inc. 500 Brookforest Avenue, Shorewood, Illinois 60431 815/725-2241

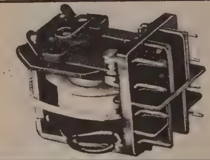
GENERAL PURPOSE TYPE RELAYS

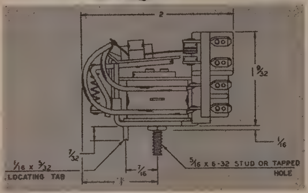
LIBERTY CONTROLS, INC.

Liberty Controls has an outstanding reputation for its line of General Purpose Relays. These relays perform dependably in many diverse applications including light to medium switching and plate circuit operations, in process controls and communication equipment. More recently many of these types of relays have been used as safety features on power equipment, such as, line monitoring for stray currents, discharging voltage on shutdown, and equipment shutdown through fault detection.

A wide variety of contact arrangements and ratings are available in our general purpose relay family. Minimum contact pressures of 25 grams are maintained on the smaller relays while the larger power relays perform at upwards of 200 grams contact pressure. Standard contacts are made of Silver Cadmium Oxide for low resistance qualities and then gold flashed to prevent corrosion and retard pitting which generally occurs with inductive loads.

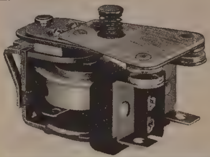
SERIES 210

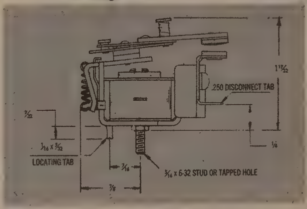




ELECTRICAL CHARACTERISTICS:
CONTACTS: Rated at 5 or 10 amps using silver cadmium oxide as standard. U/L approved. ACTION: SPDT thru 3PDT. OPERATING VOLTAGES: 6, 12, 24, 115, 230 VAC; 6, 12, 24, 110 VDC. TERMINALS: Tab, solder, or printed circuit type. MOUNTING: Frame drilled and tapped for one (1) 6-32 screw and locating tab. Optional with 5/16" X 6-32 stud and w/o locating tab. SPECIAL: Available with SPST normally open or normally closed action. Also available as a manual reset or latching relay. Special plate circuit coils can be provided. See special applications.

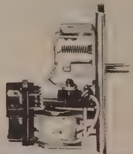
SERIES 250

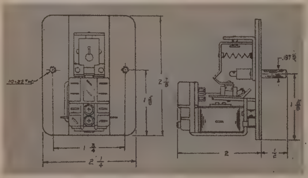




ELECTRICAL CHARACTERISTICS:
CONTACTS: Rated at 25 amps @ 120-240 VAC resistive and 1 HP @ 120-240 VAC. ACTION: SPST Normally open, double break. OPERATING VOLTAGES: 6, 12, 24, 115, 230 VAC; 6, 12, 24, 110 VDC. TERMINALS: 1/4" quick connect for contacts, 3/16" quick connect for coil. MOUNTING: Frame drilled and tapped for one (1) 6-32 screw and locating tab. Optional with 5/16" X 6-32 stud and w/o locating tab. SPECIAL: Available with 5 amps SPDT auxiliary switch.

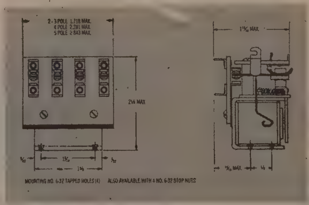
SERIES 218





ELECTRICAL CHARACTERISTICS:
CONTACTS: Rated at 5 or 10 amps using silver cadmium oxide as standard. ACTION: SPST thru 3PDT: OPERATING VOLTAGES: 6, 12, 24, 115, 230, VAC; 5, 6, 12,,24, 110 VDC. TERMINALS: Combination 3/16" quick connect, or solder, or printed circuit type. MOUNTING: 2 holes 10-32 tapped in front plate as shown or 6-32 tapped hole in base of relay. APPLICATION: This relay is typically used in safety circuits and unit shutdown circuits where a pulse to the coil will operate the relay and then the unit bar to be released manually through the reset button.

SERIES 630



ELECTRICAL CHARACTERISTICS:
CONTACTS: Rated at 15 amps. 120V 60 Hz. resistive using gold plated silver contacts as standard. ACTION: DPDT thru 5PDT. OPERATING VOLTAGES: 6, 12, 24, 48, 115, 230 VAC; 3, 6, 12, 24, 48, 110 VDC. TERMINALS: Solder or screw type. MOUNTING: Frame drilled and tapped for four (4) 6-32 screws. SPECIAL: Available in ST normally open or normally closed action. Also provided in 8, 12, & 18 pin Jones Plug or 8, 12, and 20 pin octal type plug.

Liberty Controls, Inc. 500 Brookforest Avenue, Shorewood, Illinois 60431 815/725-2241

TELEPHONE TYPE RELAYS

LIBERTY CONTROLS, INC.

Liberty Controls makes high quality telephone type relays for many special applications as indicated below. Contact materials of the finest quality are used to make any of the contact form arrangements. Special engineering is available for any type of telephone relay application.

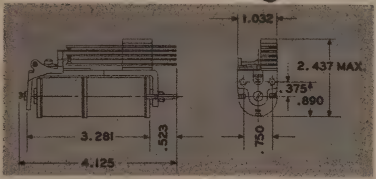
Coil characteristics are tailored to meet your needs and are available as single wound, double wound, concentric wound, and high resistance wound. Copper slugs and sleeves can be used to meet your special operate and release timing needs.

Specially annealed heelpieces and armatures are used to give the most efficient magnetic properties available and bearing pins are used throughout our entire line of telephone relays.

Liberty Controls builds several sizes of relays so that we can offer the most suitable combination of size versus sensitivity. The B and C series offer the maximum sensitivity along with maximum contact arrangements. Then the M series offers similar pile-up arrangements to the C but the coil has been shortened for a smaller space requirement. The G series offers a small relay with multiple terminal applications and is extremely versatile.

We carry other sizes of telephone relays, so contact us with your requirements.

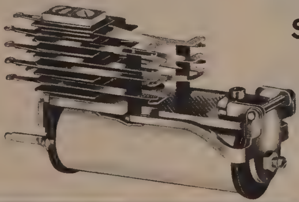
SERIES B

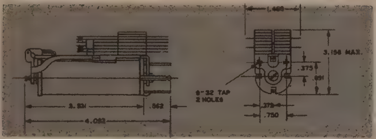


ELECTRICAL CHARACTERISTICS:

CONTACTS: Bifurcated contacts standard but single contacts available. Specify the electrical characteristics you desire. PILEUPS: Maximum of 20 springs in each pileup (one or two pileups). OPERATING VOLTAGES: Up to 230 V AC or DC. VOLTAGE BREAKDOWN: 1500 V RMS 60 Hz. (higher is required). TERMINALS: Solder Type. MOUNTING: Heelpiece drilled and tapped for two 8-32 screws. SPECIAL: Mounting hardware and cover are available. Can be provided as a socket plug-in relay. Also available hermetically sealed. See special applications.

SERIES C

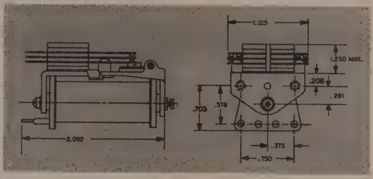




ELECTRICAL CHARACTERISTICS:

CONTACTS: Many contact materials are availáble. Please specify your rating needs. PILEUPS: Maximum of 20 springs in each pileup (one or two pileups) Micro-switch available. OPERATING VOLTAGES: CQA up to 230 VDC, CSO & CSR up to 135 VDC, CAC up to 220 VAC. VOLTAGE BREAKDOWN: 1500 V RMS 60 Hz (higher if required) TERMINALS: Solder Type. MOUNTING: Heelpiece drilled and tapped for two 8-32 screws. SPECIAL: Mounting hardware and cover are available. Can be provided as a socket plug-in relay. Also available hermetically sealed. See special applications.

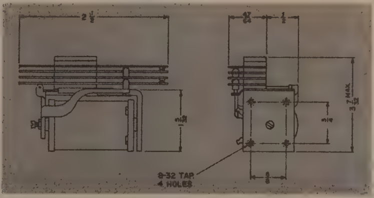
SERIES G



ELECTRICAL CHARACTERISTICS:

CONTACTS: Standard contacts are bifurcated, but many materials are available to meet your specifications. PILEUPS: Maximum of 20 springs in each pileup (one or two pileups). OPERATING VOLTAGE: GQA up to 150 VDC; GSO and GSR up to 110 VDC; GAC up to 220 VAC. TERMINALS: Solder Type, printed circuit type, or GQIN insertable terminals for socket mounting. MOUNTING: Heelpiece drilled and tapped for two 6-32 screws. SPECIAL: Available in 16 pin or 28 pin cover and socket arrangement. See special applications. Hermetically sealed relays also available.

SERIES M



ELECTRICAL CHARACTERISTICS:

CONTACTS: Many contact materials are available. Please specify your rating needs. PILEUP: Maximum of 12 springs in pileup (single pileup only) Micro-switch available. OPERATING VOLTAGE: MQA up to 135 VDC; MSO and MSR up to 115 VDC; MAC up to 220 VAC. VOLTAGE BREAKDOWN: 1500 V RMS 60 Hz. (higher if required). TERMINALS: Solder type. MOUNTING: Heelpiece is drilled and tapped for four 8-32 screws. SPECIAL: Hermetically sealed relays also available.

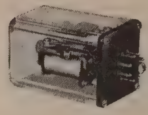
Liberty Controls, Inc. 500 Brookforest Avenue, Shorewood, Illinois 60431 815/725-2241

SPECIALS

LIBERTY CONTROLS, INC.

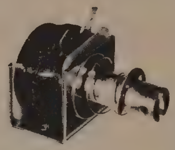
"G" SERIES INSERT TYPE

The series GQIN is a G Relay with a mating flush mounted socket and clear plastic cover which snaps over the socket. Outstanding benefits include pre-wiring socket possibilities, quick installation and removal of relay, environmental protections, and cost savings.



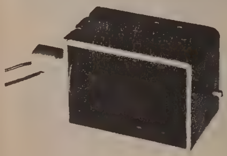
"G" OCTAL TYPE PLUG-IN

In this design, the relay is prewired to an octal type plug to provide yet another means of quick installation and removal. The cover can be Lexan, metal, or hermetically sealed.



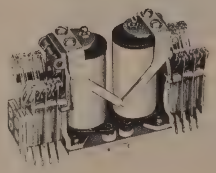
CASH DRAWER SOLENOID

This solenoid was specially designed for releasing a latch to open a cash drawer in an automated check-out counter operation at a department store. The plunger and stop have a special conical design to increase the pull force and the spring then resets the unit when power is cut off.



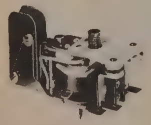
EXTENDED LIFE TYPE 90

The Solenoid shown is a push type with special delrin bushings in the front and rear to support the plunger. This design was conceived to increase the life on the unit as well as allow for shorter cycle time.



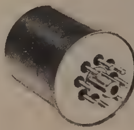
LATCHING RELAYS

The Latch Relay is made up of two relays (available in 210, and G Series) with provision for mechanical interlock. It provides the best features of our relay with a memory. Its twin relay construction permits it to remain locked in either position (independent of possible power supply failure) until the opposite relay is energized. The latching action makes this type of relay ideal for such applications as registry systems or any other system requiring storage of data from an intermittent or short pulse input.



251

This unit uses the standard 250 Series Relay with an auxiliary switch attached. This auxiliary switch is a snap-action switch with 5 ampere rating in a SPDT arrangement. The mounting is the same as that of the standard 250 Series. The auxiliary switch feature enhances the usefulness of the standard relay in that it can be used for switching a light and medium load concurrently.



"S" OCTAL TYPE PLUG-IN

This octal plug-in Series S Relay is an example of how the telephone type, as well as, general purpose type relays can be mounted on a standard octal type plug. Depending on contact arrangements these can be provided in 8, 12, and 20 pin configurations. Hermetic sealing is also available on most series.

Liberty Controls, Inc. 500 Brookforest Avenue, Shorewood, Illinois 60431 815/725-2241

THIS IS LIBERTY CONTROLS

Coil Winding

Liberty Controls manufactures several lines of quality products generally classified as electronic components. Solenoids, general purpose relays and telephone type relays are the quality products we produce.

The company has been in operation since 1960 and we are presently housed in our own 20,000 Sq. ft. building. From this plant we are supplying many major companies including appliance, computer, control and aerospace manufacturers.

Here are some of our capabilities:

Tool and Die Division–We have our own tool and die shop so we can offer prototype product models for new designs. This also gives us a flexibility of design as well as a quick turnaround on new items that must be tooled.

Fabrication–Most of the fabricated parts used in our product are made in plant–offering high quality finished products at very competitive prices.

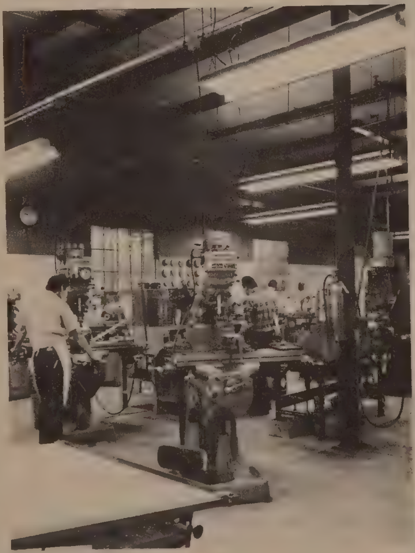
Coil Winding–All coils used in Liberty Controls are wound "in-house"–giving us high quality and flexibility on special coils not offered by large manufacturers. We have high speed equipment for big volume jobs.

General Assembly–Final product assembly is done completely at our plant. All parts are inspected and only after passing sub-assembly tests are they assembled into the final product. Most of the assembly equipment is designed and built in our facility.

We pride ourselves in having the flexibility to adapt our standard products to your special needs. Tied with this flexibility are production techniques and capabilities to satisfy large volume requirements. You will find that Liberty Controls can handle almost any kind of problem dealing with solenoids, relays or electromechanical devices. Contact our factory or our representative in your area for your special needs in any of our product areas.

General Assembly

Fabrication



Tool and Die

LIBERTY CONTROLS, INC.
500 Brookforest Avenue
Shorewood, Illinois 60431
815/725-2241

Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

LOW PROFILE RELAYS

CLASS 63

LOW PROFILE P.C. BOARD RELAY

NEW

DPDT — 1 AMP

SINGLE & BIFURCATED CONTACTS

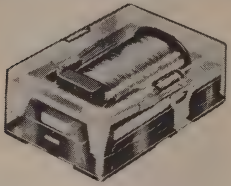
LONG LIFE — HIGH RELIABILITY

DUST PROOF COVER

STANDARD .1 INCH GRID SPACING FOR TERMINALS

DC OPERATION ONLY

LATCHING VERSION AVAILABLE ON SPECIAL ORDER



The Class 63 was designed to fulfill the need for a truly compact low cost printed circuit board relay. The overall height of the relay is .4″ above the P.C. board. DPDT contacts are rated at 1 amp, with a low coil power consumption. Because of the extremely efficient space utilization, the Class 63 is particularly suited for applications where multiple switching functions are needed. Among these applications where dense rack mounting is essential are communication systems, data processing equipment, and automatic control systems.

SPECIFICATIONS

Contact Arrangement: DPDT, single and bifurcated contacts.

Contact Ratings: 1 amp @ 24VDC resistive; .3 amps @ 115VAC/DC resistive.

Capacitance: Contact/Contact — .3 pF. Open Contact/Frame — .6 pF. Closed Contact/Frame — 1.6 pF.

Maximum Ambient Temperature at Nominal Coil Power: 70°C.

Avg. Pull-In Coil Power: 250mW.

Nominal Coil Power: 450mW.

Maximum Coil Power at 20°C Ambient Temperature: 1.5W.

Maximum Switching Rate: 50/second.

Dielectric Strength: Winding/Frame — 500VRMS.

Insulation Resistance: 10,000 Megohms minimum.

Operate Time: 8 msec.

Release Time: 6 msec.

Contact Material: Gold-flashed silver.

Shock: No contact discontinuity—12 G's; Mechanically — 20 G's.

Vibration — 10 to 55 Hz: 10 G's.

Mechanical Life: 2×10^8 operations

Life, under Resistive Load: 12W — 2×10^7 operations; 24W — 6×10^6 operations.

Enclosure: Plastic Dust Cover.

Weight: 15 grams.

Above values are "typical" and are intended to guide the engineer, but are not absolute.

CLEANING BY IMMERSION NOT RECOMMENDED

Stock Part No.	Coil Nom. Volts	Coil Ohms	Must Operate Voltage	Max. Coil Volts	Prices 1-24
BIFURCATED CONTACTS DPDT					
W63TPCX-1	6	81	4.2	11	4.65
W63TPCX-2	12	322	8.3	22	4.65
W63TPCX-3	24	1045	17.0	44	4.65
W63TPCX-4	48	5350	32.8	88	4.95
SINGLE CONTACTS DPDT					
W63PCX-1	6	81	4.2	11	4.45
W63PCX-2	12	322	8.3	22	4.45
W63PCX-3	24	1045	17.0	44	4.45
W63PCX-4	48	5350	32.8	88	4.75

The above values are at 25°C.

Coil resistances are ±15% (24 to 48V coils). ±10% (6 to 12V coils).

CLASS 64

LOW PROFILE P.C. BOARD RELAY

NEW

4PDT AND 6PDT — 1 AMP

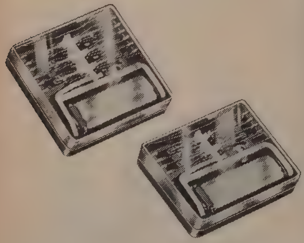
LONG LIFE — HIGH RELIABILITY

BIFURCATED CONTACTS

DUST PROOF COVER

STANDARD .1 INCH GRID SPACING FOR TERMINALS

DC OPERATION ONLY



The Magnecraft Class 64 is the lowest profile electromechanical relay available where close rack mounting of P.C. boards is required. The relay height of .4″ above the P.C. board permits minimum center-to-center P.C. board spacing. Bifurcated contacts are rated at 1 amp for 4PDT and 6PDT applications. The base design protects against flux or solder from entering the relay, thus allowing automated wave soldering processes for simplification and economy. The relay is suited for applications such as communication systems, data processing, and automatic control systems. The low cost Class 64 offers high quality dependable performance and long life.

SPECIFICATIONS

Contact Arrangement (Bifurcated): 4PDT and 6PDT.

Contact Ratings: 1 amp @ 24VDC resistive; .3 amps @ 115VAC/DC resistive.

Capacitance: Contact/Contact — <2pF. Open Contact/Frame — <1.8pF. Closed Contact/Frame — <2.3pF.

Maximum Ambient Temperature at Nominal Coil Power: 70°C.

Maximum Switching Rate: 30/second.

Nominal Coil Power: 700mW.

Average Pull-In Coil Power: 250mW. (4-PDT); 450mW (6PDT).

Maximum Continuous Coil Power Dissipation @ 20°C Ambient Temperature: 2.5W.

Insulation Resistance: 10,000 megohms minimum.

Operate Time: 8 msec.

Release Time: 2 msec.

Contact Material: Gold-flashed silver.

Dielectric Strength: Contact/Contact — 1000 VRMS; Contact/Frame — 1000-VRMS; Winding/Frame — 1000VRMS.

Mechanical Life: 1×10^8 operations.

Enclosure: Plastic dust cover.

Weight: 25 grams (4PDT) 30 grams (6-PDT).

Above values are "typical" and are intended to guide the engineer, but are not absolute.

CLEANING BY IMMERSION NOT RECOMMENDED

Stock Part No.	Coil Nom. Volts	Coil Ohms	Must Operate Voltage	Max. Coil Volts	Prices 1-24
BIFURCATED CONTACTS 4PDT					
W64TPCX-1	6	50	3.9	12.4	6.11
W64TPCX-2	12	185	7.8	24.0	6.11
W64TPCX-3	24	730	15.5	47.0	6.11
W64TPCX-4	48	2700	32.0	88.0	6.54
BIFURCATED CONTACTS 6PDT					
W64TPCX-5	6	50	4.6	12.4	7.72
W64TPCX-6	12	185	9.5	24.0	7.72
W64TPCX-7	24	730	18.5	47.0	7.72
W64TPCX-8	48	2700	37.0	88.0	8.11

The above values are at 25°C.

Coil resistances are ±10% up to and including 730 ohms; ±15% for 2.7k ohms and up.

Magnecraft®

5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

LOW PROFILE RELAYS

CLASS 65

MINIATURE P.C. BOARD POWER RELAY

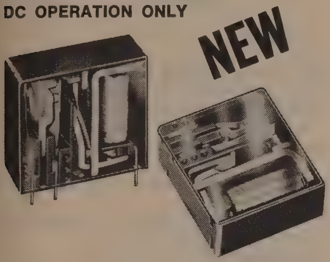
SPDT — 8 AMPS

HORIZONTAL AND VERTICAL STYLES

DUST PROOF COVER

STANDARD .1 INCH GRID SPACING FOR TERMINALS

DC OPERATION ONLY



Magnecraft Class 65 miniature P.C. board power relay fills the needs for a low cost power relay to switch heavy current loads at a lower coil power. The relay's SPDT contacts are rated at 8 amps. The versatile thin pack horizontal and vertical styles can be very important to a design engineer when space is a factor. Typical applications are in heating systems, automotive and consumer electronics, process control, communications and data processing.

SPECIFICATIONS

Contact Arrangement: SPDT

Contact Rating: Maximum Continuous Current — 8 amps; Maximum Switching Current — 8 amps; Surge Rating at 10% Duty Cycle with 4 sec. on-time maximum — 15 amps; Maximum Continuous Volts — 250VRMS.

Power Rating: 100W/500VA

Capacitance: Contact/Contact — 1.6pF; Contact/Winding — 1.0pF; Contact/Frame — <1.25pF.

Maximum Ambient Temperature at Nominal Coil Power: 60°C.

Nominal Coil Power: 450mW.

Average Pull-In Coil Power: 200mW.

Maximum Continuous Coil Power Dissipation @ 20°C Ambient Temperature: 1W.

Maximum Switching Rate: 20/second.

Insulation Resistance: >100Mohms.

Contact Material: Silver cadmium oxide gold flashed — in stock, other contacts available.

Operating Time: 6 msec.

Release Time: 4 msec.

Dielectric Strength: Contact/Contact — 500VRMS; Contact/Winding — 2500VRMS; Contact/Frame — 2500VRMS; Winding/Frame — 500VRMS.

Contact Life, Resistive Load: 100VAC/8 amps — 1 x 10^5; 100VAC/5 amps — 2 x 10^5/ 24VDC/8 amps — 1 x 10^5; 250VDC/0.4 amps — 5 x 10^6.

Mechanical Life: 2 x 10^7.

Enclosure: Plastic dust cover.

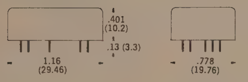
Weight: 12 grams.

Above values are "typical" and are intended to guide the engineer, but are not absolute.

CLEANING BY IMMERSION NOT RECOMMENDED

Stock Part No.	Coil Nom. Volts	Coil Ohms	Must Operate Voltage	Max. Coil Volts	Prices 1-24
SPDT CONTACTS (FLATPACK)					
W65RPCX-1	6	80±8	4.2	10.6	3.40
W65RPCX-2	12	330±33	8.3	21.5	3.40
W65RPCX-3	24	1200±180	16.8	40.0	3.40
W65RPCX-4	48	4750±700	32.8	79.0	4.52
SPDT CONTACTS (UPRIGHT)					
W65RPCX-201	6	80±8	4.2	10.6	3.40
W65RPCX-202	12	330±33	8.3	21.5	3.40
W65RPCX-203	24	1200±180	16.8	40.0	3.40
W65RPCX-204	48	4750±700	32.8	79.0	4.52

CLASS 63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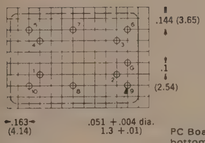
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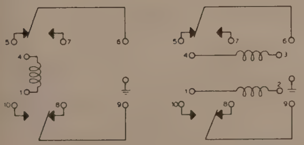
.163
(4.14)
.051 +.004 dia.
1.3 +.01)

PC Board layout from bottom view.
Standard grid spacing .1"
G = Ground Terminal


5
7
6
4
1
2
10
8
9
5
7
6
4
3
1
2
10
8
9

Pin Numbering

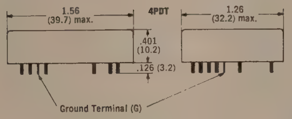
Relay with one winding

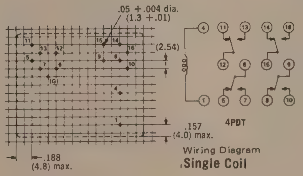
Relay with two windings

Dimensions in inches and (mm) for reference only.
All dimensions max. unless noted.

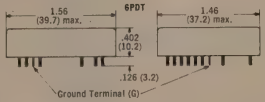
* Double wound coils available on special order.

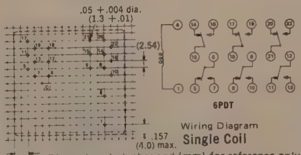
CLASS 64


1.56
(39.7) max.
4PDT
1.26
(32.2) max.
.401
(10.2)
.126 (3.2)
Ground Terminal (G)


.05 +.004 dia.
(1.3 +.01)
(2.54)
.157
(4.0) max.
.188
(4.8) max.
4PDT
Wiring Diagram
Single Coil

PC Board layout from bottom view.
Standard grid spacing .1"
G = Ground Terminal

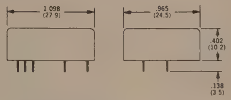

1.56
(39.7) max.
6PDT
1.46
(37.2) max.
.402
(10.2)
.126 (3.2)
Ground Terminal (G)

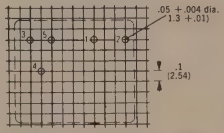

.05 +.004 dia.
(1.3 +.01)
(2.54)
6PDT
Wiring Diagram
Single Coil
.157
(4.0) max.
.188
(4.8) max.

Dimensions in inches and (mm) for reference only.
All dimensions max. unless noted.

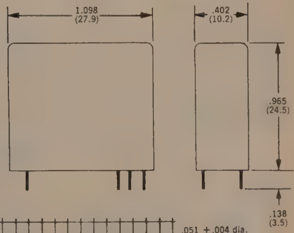
* Double wound coils available on special order.

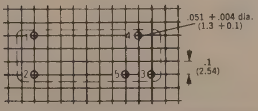
CLASS 65


1.098
(27.9)
.965
(24.5)
.402
(10.2)
.138
(3.5)


.05 +.004 dia.
1.3 +.01)
3
5
1
2
4
.1
(2.54)

PC BOARD LAYOUT VIEWED FROM BOTTOM SIDE.


1.098
(27.9)
.402
(10.2)
.965
(24.5)
.138
(3.5)


.051 +.004 dia.
(1.3 +0.1)
4
2
5
3
.1
(2.54)

PC BOARD LAYOUT VIEWED FROM BOTTOM SIDE.

Dimensions in inches and (mm) for reference only.
All dimensions max. unless noted.

*NOTE:

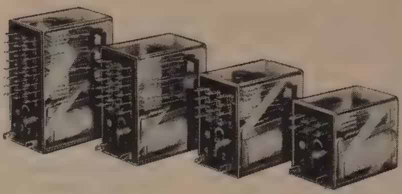
Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

MINIATURE INDUSTRIAL RELAYS

CLASS 67

MINIATURE INDUSTRIAL RELAYS

3 AND 5 AMP CONTACTS
DPDT, 4PDT, 6PDT, AND 8PDT CONTACTS
ENCLOSED PLUG-IN AND P.C.
BIFURCATED CONTACTS AVAILABLE



The Magnecraft Class 67 miniature industrial relays are engineered and designed for applications requiring 2 to 8 form C contacts where space, weight and low cost are of prime importance. Ideal for use in business machines, communication equipment, vending machines and all applications requiring long life and reliable performance. Available with P.C., solder terminal, and plug-in mountings. Single and bifurcated, crossbar contacts of silver alloy gold flashed are rated 3 and 5 amps at 28VDC or 115/120VAC resistive load. All Class 67 relays feature see-thru plastic dust covers and combination solder/plug-in terminals (sockets listed below) with 3-48 NC stud. Voltage specified versions operate at 80% of nominal coil voltage or less with a coil dissipation of 1.8 watts max. The relay has a design feature of extra wide contact blades for greater current carry capacity and cooler operation.

Another Class 67 design feature is the minimum iron to iron hinge gap for maximum magnetic efficiency. AC, sensitive and ultra sensitive versions are also available.

UL listed versions of the standard relays are available on special order. UL File No. E52197.

SPECIFICATIONS

Nominal Coil Voltage: See table on each type for standard voltages.

Contact Combination: DPDT, 4PDT, 6PDT, and 8PDT.

Contact Rating: 3 or 5 amps @ 28VDC or 115VAC resistive load.

Contact Material: Gold flashed silver alloy.

Contact Forms: Bifurcated or non-bifurcated crossbar contacts.

Coil Dissipation: 2.2 watts max.

Dielectric Strength: 1000 volts RMS, contacts to ground, 500 volts RMS between open contacts.

Contact Resistance: .050 ohms max. before life, .200 ohms max. after life.

Nominal Power: See table on each type.

Insulation Resistance: 1000 megohms minimum at 25°C.

Ambient Temperature: −55° to +71°C.

Operate: 80% of nominal coil voltage and 85% AC.

Terminals: Printed circuit, plug-in or solder (solder lug or printed circuit sockets available).

Enclosure: Clear, crackproof cover.

Mounting: Printed circuit, chassis or plug-in.

Weight: 2C — 1.00 oz., 4C — 1.2 oz., 6C 1.3 oz., 8C — 1.4 oz. max.

VARIATIONS

Chassis Or Socket Mounting	67CS
Twin Contact Relays	67TC
5 Amp Power Relays	67R
Twin Contact Power Relays	67TR
Sensitive Adjust Relays	67J
AC Operated Relays	67A
AC Operated Power Relays	67AR
Ultra Sensitive Adjust Relays	67S
Printed Circuit Terminals	67PC
Printed Circuit Terminals — Power	67RPC
AC Operated Printed Circuit Terminal	67APC
AC Operated Printed Circuit Terminal Power	67ARPC

STANDARD DC VOLTAGE ADJUSTMENT DPDT

Stock Part No.	Contact Rating	Coil Volts	Coil Ohms	Prices 1-24
W67CSX-1	3 Amps	6	52	3.82
W67CSX-2		12	185	3.82
W67CSX-3		24	700	3.82
W67CSX-4		48	2,500	3.82
W67CSX-5		115	15,000	6.08
W67RCSX-1	5 Amps	6	52	3.98
W67RCSX-2		12	185	3.98
W67RCSX-3		24	700	3.98
W67RCSX-4		48	2,500	3.98
W67RCSX-5		115	15,000	6.23
W67TCSX-1	3* Amps	6	52	4.29
W67TCSX-2		12	185	4.29
W67TCSX-3		24	700	4.29
W67TCSX-4		48	2,500	4.29
W67TCSX-5		115	15,000	6.54
W67TRCSX-1	5* Amps	6	52	4.35
W67ARCSX-2		12	185	4.35
W67TRCSX-3		24	700	4.35
W67TRCSX-4		48	2,500	4.35
W67TRCSX-5		115	15,000	6.38

STANDARD DC VOLTAGE ADJUSTMENT 4PDT

Stock Part No.	Contact Rating	Coil Volts	Coil Ohms	Prices 1-24
W67CSX-6	3 Amps	6	52	4.25
W67CSX-7		12	185	4.25
W67CSX-8		24	700	4.25
W67CSX-9		48	2,500	4.25
W67CSX-10		115	15,000	6.50
W67RCSX-6	5 Amps	6	52	4.57
W67RCSX-7		12	185	4.57
W67RCSX-8		24	700	4.57
W67RCSX-9		48	2,500	4.57
W67RCSX-10		115	15,000	6.80
W67TCSX-6	3* Amps	6	52	4.82
W67TCSX-7		12	185	4.82
W67TCSX-8		24	700	4.82
W67TCSX-9		48	2,500	4.82
W67TCSX-10		115	15,000	7.10
W67TRCSX-6	5* Amps	6	52	5.22
W67TRCSX-7		12	185	5.22
W67TRCSX-8		24	700	5.22
W67TRCSX-9		48	2,500	5.22
W67TRCSX-10		115	15,000	7.25

STANDARD DC VOLTAGE ADJUSTMENT 6PDT

Stock Part No.	Contact Rating	Coil Volts	Coil Ohms	Prices 1-24
W67CSX-11	3 Amps	6	25	5.50
W67CSX-12		12	90	5.50
W67CSX-13		24	430	5.50
W67CSX-14		48	1,550	5.50
W67CSX-15		115	9,000	6.52
W67RCSX-11	5 Amps	6	25	5.97
W67RCSX-12		12	90	5.97
W67RCSX-13		24	430	5.97
W67RCSX-14		48	1,550	5.97
W67RCSX-15		115	9,000	6.99
W67TCSX-11	3* Amps	6	25	6.26
W67TCSX-12		12	90	6.26
W67TCSX-13		24	430	6.26
W67TCSX-14		48	1,550	6.26
W67TCSX-15		115	9,000	7.26
W67TRCSX-11	5* Amps	6	25	6.63
W67TRCSX-12		12	90	6.63
W67TRCSX-13		24	430	6.63
W67TRCSX-14		48	1,550	6.63
W67TRCSX-15		115	9,000	7.71

*Denotes Bifurcated Contacts.

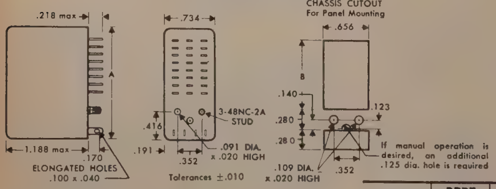
STANDARD DC VOLTAGE ADJUSTMENT 8PDT

Stock Part No.	Contact Rating	Coil Volts	Coil Ohms	Prices 1-24
W67CSX-16	3 Amps	6	20	8.87
W67CSX-17		12	72	8.87
W67CSX-18		24	350	8.87
W67CSX-19		48	1,250	8.87
W67CSX-20		115	8,000	9.96
W67RCSX-16	5 Amps	6	20	9.36
W67RCSX-17		12	72	9.36
W67RCSX-18		24	350	9.36
W67RCSX-19		48	1,250	9.36
W67RCSX-20		115	8,000	10.45
W67TCSX-16	3* Amps	6	20	9.78
W67TCSX-17		12	72	9.78
W67TCSX-18		24	350	9.78
W67TCSX-19		48	1,250	9.78
W67TCSX-20		115	8,000	10.88
W67TRCSX-16	5* Amps	6	20	10.02
W67TRCSX-17		12	72	10.02
W67TRCSX-18		24	350	10.02
W67TRCSX-19		48	1,250	10.02
W67TRCSX-20		115	8,000	11.12

*Denotes Bifurcated Contacts.

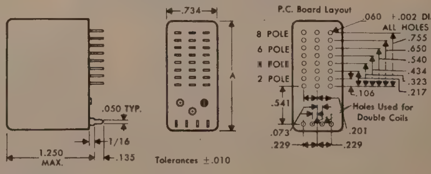
Note: Voltage specified relays pick-up at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C. Resistive values ±10%, measured at 25°C.

STANDARD VERSION



	DPDT	4PDT	6PDT	8PDT
A Max.	.938	1.156	1.374	1.592
B	.344	.562	.780	1.000

PRINTED CIRCUIT VERSION



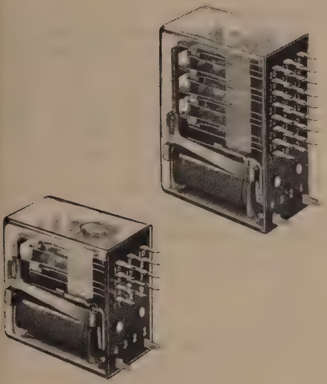
Magnecraft® MINIATURE INDUSTRIAL RELAYS

5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

CLASS 67AC
AC VERSIONS

NOMINAL POWER: 1W — DPDT & 4PDT, 1.5W — 6PDT

Stock Part No.	Contact Rating	Con-tacts	Coil		Prices 1-24
			Volts	Ohms	
STANDARD AC OPERATED RELAYS					
W67ACSX-5	3 Amps	DPDT	115	5000	6.46
W67ACSX-10		4PDT	115	2x5800	7.96
W67ACSX-15		6PDT	115	2x5800	11.18
W67ARCSX-5	5 Amps	DPDT	115	5000	6.60
W67ARCSX-10		4PDT	115	2x5800	8.08
W67ARCSX-15		6PDT	115	2x5800	11.26



CLASS 67J
SENSITIVE VERSIONS

NOMINAL POWER: 260mW — DPDT, 520mW — 4PDT

Stock Part No.	Contact Rating	Ohms	Max. Pick-up Cur. mA	Prices 1-24
SENSITIVE DC CURRENT ADJUSTMENT—DPDT				
W67JCSX-1	3 Amps	1,000	13.7	4.01
W67JCSX-2		2,500	9.1	4.01
W67JCSX-3		5,000	6.5	4.53
W67JCSX-4		10,000	5.0	4.97
W67JCSX-5		15,000	4.3	5.34
SENSITIVE DC CURRENT ADJUSTMENT—4PDT				
W67JCSX-6	3 Amps	1,000	19.3	4.45
W67JCSX-7		2,500	12.9	4.45
W67JCSX-8		5,000	9.1	4.97
W67JCSX-9		10,000	7.0	5.41
W67JCSX-10		15,000	5.9	5.79

CLASS 67PC
PRINTED CIRCUIT VERSIONS

NOMINAL POWER: 1W — DPDT & 4PDT, 1.5W — 6PDT, 2W — 8PDT

Stock Part No.	Contact Rating	Coil		Prices 1-24
		Volts	Ohms	
PCB DC VOLTAGE ADJUSTMENT—DPDT				
W67PCX-2	3 Amps	12	185	3.84
W67PCX-3		24	700	3.84
W67RPCX-2	5 Amps	12	185	3.99
W67RPCX-3		24	700	3.99
PCB DC VOLTAGE ADJUSTMENT—4PDT				
W67PCX-7	3 Amps	12	185	4.25
W67PCX-8		24	700	4.25
W67RPCX-7	5 Amps	12	185	4.70
W67RPCX-8		24	700	4.70
PCB DC VOLTAGE ADJUSTMENT—6PDT				
W67PCX-12	3 Amps	12	90	5.50
W67PCX-13		24	430	5.50
W67RPCX-12	5 Amps	12	90	5.97
W67RPCX-13		24	430	5.97

CLASS 67S
ULTRA SENSITIVE VERSIONS

NOMINAL POWER: 135mW — DPDT, 260mW — 4PDT

Stock Part No.	Contact Rating	Ohms	Max. Pick-up Current	Prices 1-24
ULTRA SENSITIVE DC CURRENT ADJUSTMENT—DPDT				
W67SCSX-1	3 Amps	1,000	9.4	4.21
W67SCSX-2		2,500	6.4	4.21
W67SCSX-3		5,000	4.5	4.76
W67SCSX-4		10,000	3.5	5.22
W67SCSX-5		15,000	3.0	5.78
ULTRA SENSITIVE DC CURRENT ADJUSTMENT—4PDT				
W67SCSX-6	3 Amps	1,000	13.7	4.67
W67SCSX-7		2,500	9.1	4.67
W67SCSX-8		5,000	6.5	5.22
W67SCSX-9		10,000	5.0	5.68
W67SCSX-10		15,000	4.3	6.26

Stock Part No.	Contact Rating	Coil		Prices 1-24
		Volts	Ohms	
PCB DC VOLTAGE ADJUSTMENT—8PDT				
W67PCX-17	3 Amps	12	72	8.87
W67PCX-18		24	350	8.87
W67RPCX-17	5 Amps	12	72	9.36
W67RPCX-18		24	350	9.36

CLASS 67APC
AC VERSIONS

NOMINAL POWER: 1W — DPDT & 4PDT, 1.5W — 6PDT

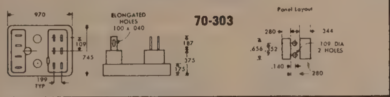
Stock Part No.	Contact Rating	Con-tacts	Coil		Prices 1-24
			Volts	Ohms	
PCB AC OPERATED RELAYS					
W67APCX-2	3 Amps	DPDT	115	5000	6.59
W67APCX-3		4PDT	115	2x5800	8.11
W67APCX-4		6PDT	115	2x5800	11.40
W67ARPCX-1	5 Amps	DPDT	115	5000	6.74
W67ARPCX-2		4PDT	115	2x5800	8.25
W67ARPCX-3		6PDT	115	2x5800	11.48

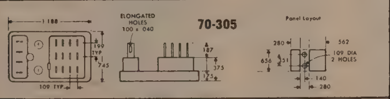
NOTE: Voltage specified relays pick-up at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C. Resistive values ±10%, measured at 25°C.

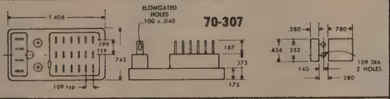
W prefix indicates model in stock for immediate shipment.

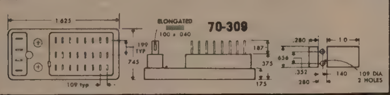
SOCKETS

SOLDER TYPE


970
ELONGATED HOLES 100 x 040
70-303
Panel Layout
280
344
109
745
187
375
175
.656
.552
109 DIA 2 HOLES
.140
280
199 TYP


1 188
ELONGATED HOLES 100 x 040
70-305
Panel Layout
280
562
199 TYP
745
187
375
656
551
109 DIA 2 HOLES
140
280
109 TYP


1 406
ELONGATED HOLES .100 x .040
70-307
.280
780
199 TYP
745
187
375
175
.656
352
140
109 DIA 2 HOLES
280
109 typ


1 625
ELONGATED
100 x 040
70-309
.280
1 0
199 TYP
745
187
375
175
656
.352
140
280
109 DIA 2 HOLES
109 typ

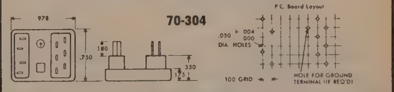
RETAINING CLIP

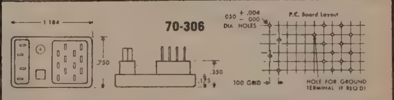
16-1120-2	DPDT
16-1120-4	4PDT
16-1120-6	6PDT
16-1120-8	8PDT

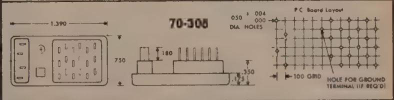
70-305 SOLDER TYPE

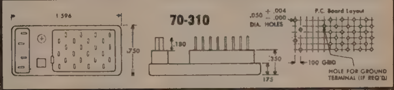
70-306 STAGGERED P.C.

PRINTED CIRCUIT TYPE


978
70-304
P.C. Board Layout
.050 + 004 − 000 DIA HOLES
.750
180
350
175
100 GRID
HOLE FOR GROUND TERMINAL (IF REQ'D)


1 184
70-306
050 + .004 − 000 DIA HOLES
P.C. Board Layout
.750
.350
175
100 GRID
HOLE FOR GROUND TERMINAL (IF REQ'D)


1.390
70-308
050 + 004 − 000 DIA HOLES
P C Board Layout
750
180
350
175
100 GRID
HOLE FOR GROUND TERMINAL (IF REQ'D)


1 596
70-310
.050 + .004 − .000 DIA HOLES
P.C. Board Layout
.750
180
350
175
100 GRID
HOLE FOR GROUND TERMINAL (IF REQ'D)

Part No.	Description	P.C. Type	Prices 1-24
70-303	2 Pole Solder Terminal	—	.64
70-304	2 Pole P.C. Terminal	Staggered	.64
70-305	4 Pole Solder Terminal	—	.82
70-306	4 Pole P.C. Terminal	Staggered	.82

Part No.	Description	P.C. Type	Prices 1-24
70-307	6 Pole Solder Terminal	—	1.10
70-308	6 Pole P.C. Terminal	Staggered	1.10
70-309	8 Pole Solder Terminal	—	2.00
70-310	8 Pole P.C. Terminal	Staggered	2.00

Magnecraft®

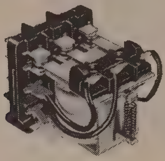
5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

GENERAL PURPOSE RELAYS

NOW UL RECOGNIZED

Magnecraft's Class 388 is a versatile, low cost, general purpose relay designed to meet UL and CSA standards. Class 388 relays are "Component Recognized" under the Component Program of Underwriters' Laboratories, Inc., File No. E43641, and classified "Industrial Control Equipment-Component, Magnetic Motor Controller."

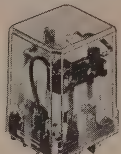
CLASS 388
OPEN TYPE RELAY



3 WAY TERMINALS
PLUG-IN — SOLDER
QUICK CONNECT

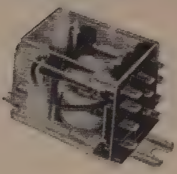
- SPDT-DPDT-3PDT Silver alloy, gold flashed contacts rated 11-13 amps at 28VDC, 120VAC or 240VAC resistive load; ⅓ HP at 120VAC; ½ HP at 240-VAC.
- Dielectric withstanding voltage of 500-VRMS between open contacts; 1500-VRMS between all other elements.
- Terminals are 3-way for plug-in, solder, or .187″ quick connect.
- One #6-32 tapped mounting hole with locating boss.
- Weight — 2.3 ozs. approx.

CLASS 388CP
ENCLOSED PLUG-IN RELAY



- SPDT-DPDT-3PDT Silver alloy, gold flashed contacts rated 11-13 amps at 28VDC, 120VAC or 240VAC resistive load; ⅓ HP at 120VAC; ½ HP at 240-VAC.
- Dielectric withstanding voltage of 500-VRMS between open contacts; 1500-VRMS between all other elements.
- Plug-in mounting, mates with Industrial Screw Terminal Sockets or chassis mount nylon sockets shown on page 13.
- Tough, clear, crackproof cover.
- Weight — 3 ozs. approx.

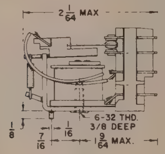
CLASS 388CQ
ENCLOSED FLANGE MOUNT RELAY

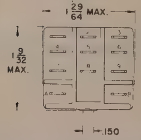


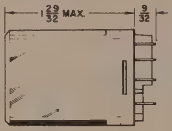
- SPDT-DPDT-3PDT Silver alloy, gold flashed contacts rated 11-13 amps at 28VDC, 120VAC or 240VAC resistive load; ⅓ HP at 120VAC; ½ HP at 240-VAC.
- Dielectric withstanding voltage of 500-VRMS between open contacts; 1500-VRMS between all other elements.
- Solder or .187″ quick connect terminals. Sockets available.
- Tough, clear, crackproof cover with flange mount.
- Weight — 3 ozs. approx.

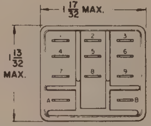
AC OR DC OPERATION

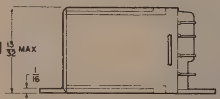
SPDT — 13 AMPS DPDT — 12 AMPS 3PDT — 11 AMPS

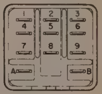


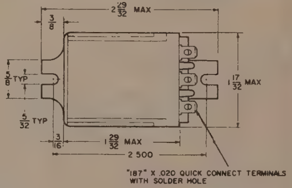












SCREW, SOLDER, QUICK CONNECT & PRINTED SOCKETS AVAILABLE

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Nom. Power	Prices 1-9
AC VOLTAGE SPECIFIED 50/60 Hz					
W388AX-1	SPDT	6VAC	—	2.5VA	4.52
W388AX-2	13	12VAC	—	prox.	4.52
W388AX-3	Amps	24VAC	—		4.52
W388AX-4		120VAC	—		4.52
W388AX-5		240VAC	—		5.06
W388AX-6	DPDT	6VAC	—	2.5VA	5.60
W388AX-7	12	12VAC	—	prox.	5.60
W388AX-8	Amps	24VAC	—		5.60
W388AX-9		120VAC	—		5.60
W388AX-10		240VAC	—		6.14
W388AX-11	3PDT	6VAC	—	2.5VA	6.33
W388AX-12	11	12VAC	—	prox.	6.33
W388AX-13	Amps	24VAC	—		6.33
W388AX-14		120VAC	—		6.33
W388AX-15		240VAC	—		6.89
DC VOLTAGE SPECIFIED					
W388X-1	SPDT	6VDC	32	1.2W	4.32
W388X-2	13	12VDC	120		4.32
W388X-3	Amps	24VDC	470		4.32
W388X-4		110VDC	10,000		5.15
W388X-5	DPDT	6VDC	32	1.2W	4.96
W388X-6	12	12VDC	120		4.96
W388X-7	Amps	24VDC	470		4.96
W388X-8		110VDC	10,000		5.84
W388X-9	3PDT	6VDC	32	1.2W	5.78
W388X-10	11	12VDC	120		5.78
W388X-11	Amps	24VDC	470		5.78
W388X-12		110VDC	10,000		6.33

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Nom. Power	Prices 1-9
AC VOLTAGE SPECIFIED 50/60 Hz					
W388ACPX-1	SPDT	6VAC	—	2.5VA	4.78
W388ACPX-2	13	12VAC	—	prox.	4.78
W388ACPX-3	Amps	24VAC	—		4.78
W388ACPX-4		120VAC	—		4.78
W388ACPX-5		240VAC	—		5.36
W388ACPX-6	DPDT	6VAC	—	2.5VA	5.84
W388ACPX-7	12	12VAC	—	prox.	5.84
W388ACPX-8	Amps	24VAC	—		5.84
W388ACPX-9		120VAC	—		5.84
W388ACPX-10		240VAC	—		6.42
W388ACPX-11	3PDT	6VAC	—	2.5VA	6.54
W388ACPX-12	11	12VAC	—	prox.	6.54
W388ACPX-13	Amps	24VAC	—		6.54
W388ACPX-14		120VAC	—		6.54
W388ACPX-15		240VAC	—		7.11
DC VOLTAGE SPECIFIED					
W388CPX-1	SPDT	6VDC	32	1.2W	4.63
W388CPX-2	13	12VDC	120		4.63
W388CPX-3	Amps	24VDC	470		4.63
W388CPX-4		110VDC	10,000		5.40
W388CPX-5	DPDT	6VDC	32	1.2W	5.28
W388CPX-6	12	12VDC	120		5.28
W388CPX-7	Amps	24VDC	470		5.28
W388CPX-8		110VDC	10,000		6.07
W388CPX-9	3PDT	6VDC	32	1.2W	6.05
W388CPX-10	11	12VDC	120		6.05
W388CPX-11	Amps	24VDC	470		6.05
W388CPX-12		110VDC	10,000		6.56

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Nom. Power	Prices 1-9
AC VOLTAGE SPECIFIED 50/60 Hz					
W388ACQX-1	SPDT	6VAC	—	2.5VA	4.78
W388ACQX-2	13	12VAC	—	prox.	4.78
W388ACQX-3	Amps	24VAC	—		4.78
W388ACQX-4		120VAC	—		4.78
W388ACQX-5		240VAC	—		5.36
W388ACQX-6	DPDT	6VAC	—	2.5VA	5.84
W388ACQX-7	12	12VAC	—	prox.	5.84
W388ACQX-8	Amps	24VAC	—		5.84
W388ACQX-9		120VAC	—		5.84
W388ACQX-10		240VAC	—		6.42
W388ACQX-11	3PDT	6VAC	—	2.5VA	6.54
W388ACQX-12	11	12VAC	—	prox.	6.54
W388ACQX-13	Amps	24VAC	—		6.54
W388ACQX-14		120VAC	—		6.54
W388ACQX-15		240VAC	—		7.11
DC VOLTAGE SPECIFIED					
W388CQX-1	SPDT	6VDC	32	1.2W	4.63
W388CQX-2	13	12VDC	120		4.63
W388CQX-3	Amps	24VDC	470		4.63
W388CQX-4		110VDC	10,000		5.40
W388CQX-5	DPDT	6VDC	32	1.2W	5.28
W388CQX-6	12	12VDC	120		5.28
W388CQX-7	Amps	24VDC	470		5.28
W388CQX-8		110VDC	10,000		6.07
W388CQX-9	3PDT	6VDC	32	1.2W	6.05
W388CQX-10	11	12VDC	120		6.05
W388CQX-11	Amps	24VDC	470		6.05
W388CQX-12		110VDC	10,000		6.56

*Resistance values ±10%, measured at 25°C. W prefix indicates relay in stock.

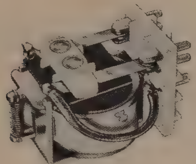
†Voltage specified relays pull in at 75% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

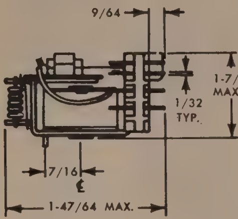
Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

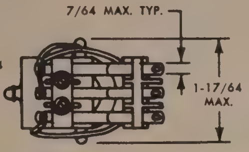
GENERAL PURPOSE RELAYS

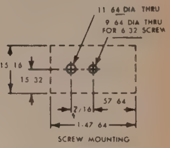
CLASS 588
OPEN TYPE RELAY

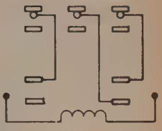
UL RECOGNIZED (File No. E43641)
SPDT-DPDT-3PDT
5 AMP OR 10 AMP
1/10, 1/6 OR 1/3 HP
AC OR DC OPERATION











WIRING LAYOUT FROM FRONT OF LAYOUT BOARD

The Class 588's are low cost UL recognized continuous duty general purpose relays, engineered for maximum efficiency and reliable performance at lowest cost. These relays are ideal for use in test equipment, business machines, automation, and communication equipment.

Contacts are silver alloy, gold flashed rated 5 or 10 amps at 115VAC resistive load. These open type relays have axial type solder lugs for easy wiring and are mounted by a single 6-32 threaded mounting hole with a locating boss for ease of mounting.

AC VOLTAGE SPECIFIED

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Prices 1-24
W588AX-1	1/10HP 120V 5 Amp SPDT	6VAC	—	4.55
W588AX-2		12VAC	—	4.55
W588AX-3		24VAC	—	4.55
W588AX-4		115VAC	—	4.55
W588AX-5	1/10HP 120V 5 Amp DPDT	6VAC	—	5.56
W588AX-6		12VAC	—	5.56
W588AX-7		24VAC	—	5.56
W588AX-8		115VAC	—	5.56
W588AX-9	1/10HP 120V 5 Amp 3PDT	6VAC	—	6.00
W588AX-10		12VAC	—	6.00
W588AX-11		24VAC	—	6.00
W588AX-12		115VAC	—	6.00
W588AX-13	1/6HP 120V 1/3HP 240V 10 Amp SPDT	6VAC	—	4.61
W588AX-14		12VAC	—	4.61
W588AX-15		24VAC	—	4.61
W588AX-16		115VAC	—	4.61
W588AX-17	1/6HP 120V 1/3HP 240V 10 Amp DPDT	6VAC	—	5.68
W588AX-18		12VAC	—	5.68
W588AX-19		24VAC	—	5.68
W588AX-20		115VAC	—	5.68
W588AX-21	1/6HP 120V 1/3HP 240V 10 Amp 3PDT	6VAC	—	6.23
W588AX-22		12VAC	—	6.23
W588AX-23		24VAC	—	6.23
W588AX-24		115VAC	—	6.23

Note: Nominal Power — 2VA

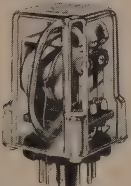
DC VOLTAGE SPECIFIED

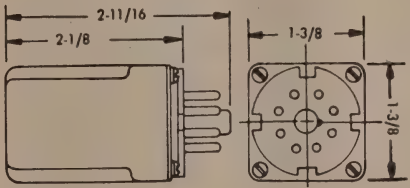
Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Prices 1-24
W588X-1	1/10HP 120V 5 Amp SPDT	6VDC	30	4.41
W588X-2		12VDC	120	4.41
W588X-3		24VDC	480	4.41
W588X-4		110VDC	10,080	5.17
W588X-5	1/10HP 120V 5 Amp DPDT	6VDC	30	4.83
W588X-6		12VDC	120	4.83
W588X-7		24VDC	480	4.83
W588X-8		110VDC	10,080	5.71
W588X-9	1/10HP 120V 5 Amp 3PDT	6VDC	30	5.50
W588X-10		12VDC	120	5.50
W588X-11		24VDC	480	5.50
W588X-12		110VDC	10,080	6.30
W588X-13	1/6HP 120V 1/3HP 240V 10 Amp SPDT	6VDC	30	4.46
W588X-14		12VDC	120	4.46
W588X-15		24VDC	480	4.46
W588X-16		110VDC	10,080	5.23
W588X-17	1/6HP 120V 1/3HP 240V 10 Amp DPDT	6VDC	30	5.02
W588X-18		12VDC	120	5.02
W588X-19		24VDC	480	5.02
W588X-20		110VDC	10,080	5.90
W588X-21	1/6HP 120V 1/3HP 240V 10 Amp 3PDT	6VDC	30	5.71
W588X-22		12VDC	120	5.71
W588X-23		24VDC	480	5.71
W588X-24		110VDC	10,080	6.53

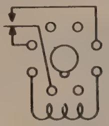
Note: Nominal Power — 1.2W

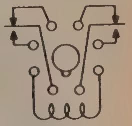
CLASS 588CP
ENCLOSED PLUG-IN RELAY

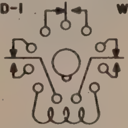
UL RECOGNIZED (File No. E43641)
SPDT-DPDT-3PDT
5 AMP OR 8.5 AMP
1/10, 1/6, OR 1/3 HP @ 120VAC
AC OR DC OPERATION






WD-1


WD-2


WD-3

The Class 588CP are low cost UL recognized continuous duty general purpose relays. The relays are similar to the Class 588 types but utilize a see-thru plastic cover that protects against dust, damage, tampering and is shatter resistant.
The Class 588CP also has a plug-in base. SPDT and DPDT contacts have 8 pin octal plug-in bases while the 3PDT types use 11 pin plug-in bases. Magnecraft's standard 70-170, 11 pin and 70-169, 8 pin octal sockets are available. The 8 pin type also mates with a chassis mounted socket, Amphenol type 77-MIP-8 and the 11 pin type mates with Amphenol type 77-MIP-11 or equivalents.

AC VOLTAGE SPECIFIED

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Prices 1-24
W588ACPX-1	1/10HP 120V 5 Amps SPDT	6VAC	—	7.76
W588ACPX-2		12VAC	—	7.76
W588ACPX-3		24VAC	—	7.76
W588ACPX-4		115VAC	—	7.76
W588ACPX-5	1/10HP 120V 5 Amps DPDT	6VAC	—	8.64
W588ACPX-6		12VAC	—	8.64
W588ACPX-7		24VAC	—	8.64
W588ACPX-8		115VAC	—	8.64
W588ACPX-9	1/10HP 120V 5 Amps 3PDT	6VAC	—	10.71
W588ACPX-10		12VAC	—	10.71
W588ACPX-11		24VAC	—	10.71
W588ACPX-12		115VAC	—	10.71
W588ACPX-13	1/6HP 120V 1/3HP 240V 8.5 Amps SPDT	6VAC	—	7.79
W588ACPX-14		12VAC	—	7.79
W588ACPX-15		24VAC	—	7.79
W588ACPX-16		115VAC	—	7.79
W588ACPX-17	1/6HP 120V 1/3HP 240V 8.5 Amps DPDT	6VAC	—	8.73
W588ACPX-18		12VAC	—	8.73
W588ACPX-19		24VAC	—	8.73
W588ACPX-20		115VAC	—	8.73
W588ACPX-21	1/6HP 120V 1/3HP 240V 8.5 Amps 3PDT	6VAC	—	10.85
W588ACPX-22		12VAC	—	10.85
W588ACPX-23		24VAC	—	10.85
W588ACPX-24		115VAC	—	10.85

Note: Nominal Power — 2VA

DC VOLTAGE SPECIFIED

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Prices 1-24
W588CPX-1	1/10HP 120V 5 Amps SPDT	6VDC	30	7.54
W588CPX-2		12VDC	120	7.54
W588CPX-3		24VDC	480	7.54
W588CPX-4		110VDC	10,080	8.58
W588CPX-5	1/10HP 120V 5 Amps DPDT	6VDC	30	8.58
W588CPX-6		12VDC	120	8.58
W588CPX-7		24VDC	480	8.58
W588CPX-8		110VDC	10,080	9.46
W588CPX-9	1/10HP 120V 5 Amps 3PDT	6VDC	30	10.56
W588CPX-10		12VDC	120	10.56
W588CPX-11		24VDC	480	10.56
W588CPX-12		110VDC	10,080	11.40
W588CPX-13	1/6HP 120V 1/3HP 240V 8.5 Amps SPDT	6VDC	30	7.68
W588CPX-14		12VDC	120	7.68
W588CPX-15		24VDC	480	7.68
W588CPX-16		110VDC	10,080	8.56
W588CPX-17	1/6HP 120V 1/3HP 240V 8.5 Amps DPDT	6VDC	30	8.68
W588CPX-18		12VDC	120	8.68
W588CPX-19		24VDC	480	8.68
W588CPX-20		110VDC	10,080	9.57
W588CPX-21	1/6HP 120V 1/3HP 240V 8.5 Amps 3PDT	6VDC	30	10.78
W588CPX-22		12VDC	120	10.78
W588CPX-23		24VDC	480	10.78
W588CPX-24		110VDC	10,080	11.67

Note: Nominal Power — 1.2W

*Resistance values ±10%, measured at 25°C. W prefix indicates relay in stock.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

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GENERAL PURPOSE RELAYS

Class 88 Magnecraft Relays are an abrupt departure in clapper type relay design. Dimensionally interchangeable with relays made by others, the 88 has been developed to provide Telephone Type Relay reliability at general purpose relay prices.

Unique in relays of this type, Magnecraft 88 Relays have rugged, precision-built hinge-pin armature bearings with oversize bearing surfaces — the same construction used in the finest telephone type relays for lowest friction and maximum contact effectiveness with stabilized adjustment over long life.

Glass melamine insulation provides high dielectric strength, essentially unaffected by humidity and temperature changes. Molded nylon bobbins with ruggedized coil terminal inserts eliminate possibility of shorts.

Built-in contact wipe with riveted contacts further enhance reliability through long life.

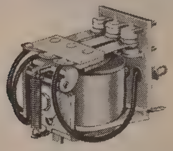
CLASS 88

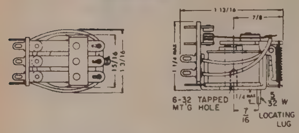
OPEN TYPE RELAYS

SPDT-DPDT-3PDT

10 AMPS, AC AND DC OPERATION

AC RELAYS 50/60 Hz





- Silver alloy gold flashed contacts rated at 10 amps.
- Solder terminals for easy wiring.
- One #6-32 tapped mounting hole with locating boss.
- Weight — 2 ozs. approx.

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Nom. Power	Prices 1-9
AC VOLTAGE SPECIFIED					
W88AX-1	SPDT	6VAC	—	3VA	4.82
W88AX-2		12VAC	—		4.82
W88AX-3		24VAC	—		4.82
W88AX-4		115VAC	—		4.82
W88AX-34		230VAC	—		5.45
W88AX-5	DPDT	6VAC	—	3VA	5.64
W88AX-6		12VAC	—		5.64
W88AX-7		24VAC	—		5.64
W88AX-8		115VAC	—		5.64
W88AX-32		230VAC	—		6.25
W88AX-9	3PDT	6VAC	—	3VA	6.27
W88AX-10		12VAC	—		6.27
W88AX-11		24VAC	—		6.27
W88AX-12		115VAC	—		6.27
W88AX-36		230VAC	—		6.92
DC VOLTAGE SPECIFIED					
W88X-2	SPDT	6VDC	25	1.5W	4.31
W88X-3		12VDC	100		4.31
W88X-4		24VDC	400		4.31
W88X-5		110VDC	8,000		5.07

Stock Part No.	Contacts	Coil †Volts	Coil *Ohms	Nom. Power	Prices 1-9
DC VOLTAGE SPECIFIED, CONT'D.					
W88X-6	DPDT	6VDC	25	1.5W	4.99
W88X-7		12VDC	100		4.99
W88X-8		24VDC	400		4.99
W88X-9		110VDC	8,000		5.75
W88X-10	3PDT	6VDC	25	1.5W	5.55
W88X-11		12VDC	100		5.55
W88X-12		24VDC	400		5.55
W88X-13		110VDC	8,000		6.28
DC CURRENT SPECIFIED FOR ELECTRONIC OPERATION					
W88X-14	SPDT	7.2mA	2,500	125mW	4.96
W88X-15		5.0mA	5,000		5.05
W88X-16		3.6mA	10,000		5.61
W88X-17	DPDT	10.0mA	2,500	250mW	5.29
W88X-18		7.2mA	5,000		5.42
W88X-19		5.0mA	10,000		5.94
W88X-20	3PDT	12.3mA	2,500	375mW	5.85
W88X-21		8.7mA	5,000		5.99
W88X-22		6.1mA	10,000		6.52

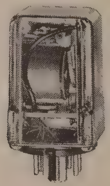
CLASS 88CP

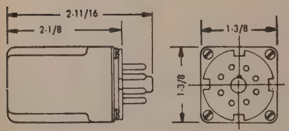
ENCLOSED PLUG-IN RELAYS

SPDT-DPDT-3PDT

10 AMPS, AC AND DC OPERATION

SEE SOCKET PAGE





- Silver alloy gold flashed contacts rated at 10 amps.
- Furnished with 8- or 11-pin standard octal plug.
- Encl. 40-279 crackproof dust cover of polycarbonate resins — tough, clear.
- Weight — 3 ozs. approx.

Stock Part No.	Contacts 10 Amps	Coil †Volts or †Cur.	Coil *Res. Ohms	Plug	Prices 1-9
AC VOLTAGE SPECIFIED					
W88ACPX-1	SPDT WD-1	6VAC	—	8-pin	7.58
W88ACPX-2		12VAC	—		7.58
W88ACPX-3		24VAC	—		7.58
W88ACPX-4		115VAC	—		7.58
W88ACPX-76		230VAC	—		8.43
W88ACPX-5	DPDT	6VAC	—	8-pin	8.45
W88ACPX-6		12VAC	—		8.45
W88ACPX-7		24VAC	—		8.45
W88ACPX-8		115VAC	—		8.45
W88ACPX-32		230VAC	—		9.33
W88ACPX-9	3PDT WD3	6VAC	—	11-pin	10.55
W88ACPX-10		12VAC	—		10.55
W88ACPX-11		24VAC	—		10.55
W88ACPX-12		115VAC	—		10.55
W88ACPX-39		230VAC	—		11.38
Note: Nominal Power — 3VA					
DC VOLTAGE SPECIFIED					
W88CPX-1	SPDT WD-1	6VDC	25	8-pin	7.44
W88CPX-2		12VDC	100		7.44
W88CPX-3		24VDC	400		7.44
W88CPX-4		110VDC	8,000		8.27
Note: Nominal Power — 1.5W					

Stock Part No.	Contacts 10 Amps	Coil †Volts or †Cur.	Coil *Res. Ohms	Plug	Prices 1-9
DC VOLTAGE SPECIFIED, CONT'D.					
W88CPX-5	DPDT WD-2	6VDC	25	8-pin	8.40
W88CPX-6		12VDC	100		8.40
W88CPX-7		24VDC	400		8.40
W88CPX-8		110VDC	8,000		9.24
W88CPX-9	3PDT WD-3	6VDC	25	11-pin	10.43
W88CPX-10		12VDC	100		10.43
W88CPX-11		24VDC	400		10.43
W88CPX-12		110VDC	8,000		11.28
Note: Nominal Power 1.5W					
DC CURRENT SPECIFIED FOR ELECTRONIC OPERATION					
W88CPX-13	SPDT WD-1	7.2mA	2,500	8-pin	8.04
W88CPX-14		5.0mA	5,000		8.14
W88CPX-15		3.6mA	10,000		8.63
Note: Nominal Power — 125mW					
W88CPX-16	DPDT WD-2	10.0mA	2,500	8-pin	8.52
W88CPX-17		7.2mA	5,000		8.60
W88CPX-18		5.0mA	10,000		9.17
Note: Nominal Power — 250mW					
W88CPX-19	3PDT WD-3	12.3mA	2,500	11-pin	10.50
W88CPX-20		8.7mA	5,000		10.65
W88CPX-21		6.1mA	10,000		11.19
Note: Nominal Power — 375mW					

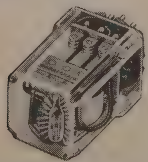
CLASS 88ANCP

ENCLOSED PLUG-IN WITH NEON "ON" LIGHT

SPDT-DPDT-3PDT

10 AMPS, AC OPERATION

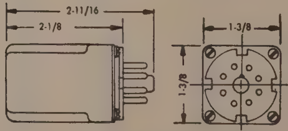
SEE SOCKET PAGE

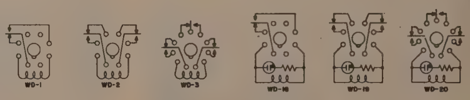


- Silver alloy gold flashed contacts rated at 10 amps.
- Built-in neon circuit indicator light comes on when coil is energized. Eliminates need for expensive pilot lamp assemblies, saves panel space and shows circuit condition at a glance.
- Weight — 3 ozs. approx.
- Encl. 40-279 crackproof dust cover of polycarbonate resins — tough, clear.

Stock Part No.	Contacts 10 Amps	Wiring Diagrams	†Volts	Prices 1-9
W88ANCPX-1	SPDT	WD-18	115VAC	8.87
W88ANCPX-2	DPDT	WD-19		9.74
W88ANCPX-3	3PDT	WD-20		11.80

Note: Nominal Power — 3VA





VIEWED FROM PIN END OF PLUG

*Resistance values ±10%, measured at 25°C. W prefix indicates relay in stock.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

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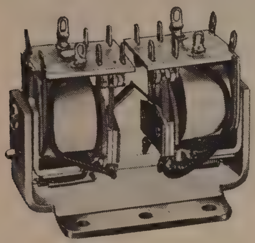
GENERAL PURPOSE RELAYS

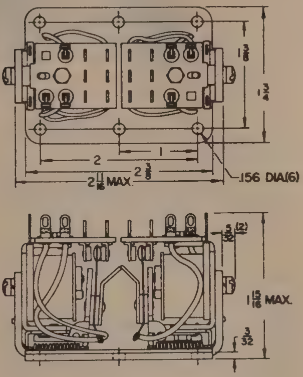
CLASS 88L
LATCHING RELAY

4PDT-6PDT
10 AMPS
AC OR DC OPERATION



The Class 88L general purpose relay is a mechanical latching relay whose design combines two Class 88 relays with interlocking latch-in levers mounted on a common base. An added feature of the 88L are the rugged hinge-pin armature bearings which stabilizes the latching mechanism.

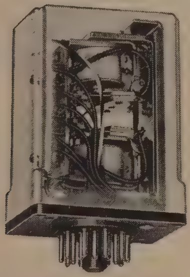
- Silver alloy gold flashed conacts are rated at 10 amps.
- Armature latches when pulled in.
- Energizing one armature releases or rests the other.
- Each relay is complete with independent operating coil.
- Stronger magnetic system designed for intermittent actuation.
- Weight — 6½ ozs. approx.



Stock Part No.	Contacts 10 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W88ALX-2	4PDT	6VAC	—	6VA prox.	13.71
W88ALX-3		24VAC	—		13.71
W88ALX-4		115VAC	—		13.71
W88ALX-5	6PDT	6VAC	—	6VA prox.	16.50
W88ALX-6		24VAC	—		16.50
W88ALX-7		115VAC	—		16.50
W88LX-1	4PDT	6VDC	12	3W	12.46
W88LX-2		12VDC	50		12.46
W88LX-3		24VDC	200		12.46
W88LX-4		110VDC	4,000		14.08
W88LX-5	6PDT	6VDC	12	3W	15.14
W88LX-6		12VDC	50		15.14
W88LX-7		24VDC	200		15.14
W88LX-8		110VDC	4,000		16.73

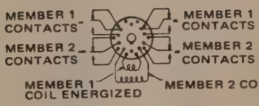
CLASS 88LCP
ENCLOSED PLUG-IN LATCHING RELAY

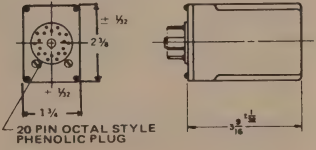
4PDT
10 AMPS
AC OR DC OPERATION



The Class 88LCP general purpose latching relay is basically identical to the 88L with the exception that it is only available in a 4PDT version with a 10 amp contact rating and has a tough, see-through polycarbonate plastic enclosure. Mounting is by molded phenolic 20-pin octal style plug. Mates with standard 20-pin octal style socket. (Amphenol No. 77-MIP-20 or equivalent.)

- Armature latches when pulled in.
- Energizing one armature releases or rests the other.
- Each relay is complete with independent operating coil.
- Stronger magnetic system designed for intermittent actuation.
- Weight — 8 ozs. approx.



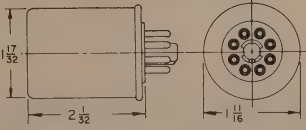


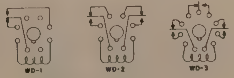
Stock Part No.	Contacts 10 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W88ALCPX-10	4PDT	6VAC	—	6VA prox.	22.17
W88ALCPX-11		24VAC	—		22.17
W88ALCPX-12		115VAC	—		22.17
W88LCPX-9	4PDT	6VDC	12	3W	20.68
W88LCPX-10		12VDC	50		20.68
W88LCPX-11		24VDC	200		20.68
W88LCPX-12		110VDC	4,000		20.99

CLASS 88HP
HERMETICALLY SEALED PLUG-IN RELAYS

DPDT-3PDT
10 AMPS
AC OR DC OPERATION

The Class 88HP general purpose relay is available in two contact combinations. DPDT or 3PDT with a 10 amp contact rating. A unique feature of the 88HP is its metal enclosure with heavy duty glass to metal plug pins. Standard is an 8 or 11 pin octal style plug. Also the 88HP is hermetically sealed to afford maximum protection in severe ambient conditions.





VIEWED FROM PIN END OF PLUG

Stock Part No.	Contacts 10 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W88AHPX-21	DPDT WD-2	6VAC	—	3VA	16.93
W88AHPX-22		12VAC	—		16.93
W88AHPX-23		24VAC	—		16.93
W88AHPX-24		115VAC	—		16.93
W88HPX-32	DPDT WD-2	6VDC	25	1.5W	16.31
W88HPX-33		12VDC	100		16.31
W88HPX-34		24VDC	400		16.31
W88HPX-35		110VDC	8,000		17.66
W88AHPX-36	3PDT WD-3	115VAC	—	3VA	19.43
W88HPX-51		24VDC	400	1.5W	18.78

*Resistance values ±10%, measured at 25°C. W prefix indicates relay in stock.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

Magnecraft®   GENERAL PURPOSE RELAYS

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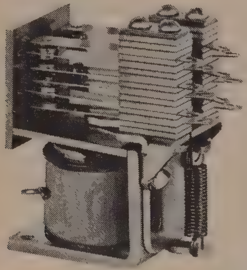
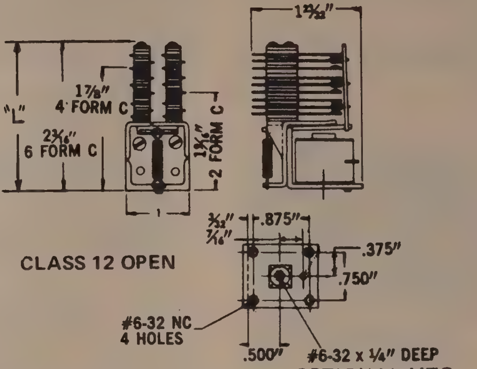
CLASS 12

OPEN TYPE RELAY

LOW COST, MULTIPLE CONTACTS
DPDT-3PDT-4PDT-6PDT
10 AMPS
AC OR DC OPERATION





CLASS 12 OPEN

L= 1-9/16 DPDT, 1-7/8 3PDT & 4PDT, 2-3/16 6PDT

The compact Class 12 is an efficient and low cost general purpose relay with multiple contact combinations. Available as standard in 2, 3, 4, and 6PDT silver alloy contacts rated 10 amps at 120 volts AC or 28 volts DC non-inductive load. This is an unusually heavy power control relay for its size.

The Class 12 relay incorporates many new features for longer life and better performance at lower cost. An example of this is a new improved lifter with individual slots to hold each movable contact blade. The contact blade stays in alignment and each slot holds each blade securely in position. The mounting consists of four 6-32 tapped holes on ¾″ x ⅞″ centers. An optional mounting hole tab 6-32 x ¼″ deep is available.

DC VOLTAGE SPECIFIED

Stock Part No.	Contacts 10 Amps	Coil †Volts	Coil *Ohms	Nominal Power	Prices 1-9
W12X-1	DPDT	6VDC	17	2.5W	6.02
W12X-2		12VDC	64		6.02
W12X-3		24VDC	215		6.02
W12X-4		110VDC	5,000		6.78
W12X-5	3PDT	6VDC	17	2.5W	7.37
W12X-6		12VDC	64		7.37
W12X-7		24VDC	215		7.37
W12X-8		110VDC	5,000		8.11
W12X-9	4PDT	6VDC	17	2.5W	8.71
W12X-10		12VDC	64		8.71
W12X-11		24VDC	215		8.71
W12X-12		110VDC	5,000		9.45
W12X-13	6PDT	6VDC	17	2.5W	11.38
W12X-14		12VDC	64		11.38
W12X-15		24VDC	215		11.38
W12X-16		110VDC	5,000		12.14

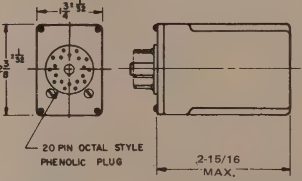
AC VOLTAGE SPECIFIED

Stock Part No.	Contacts 10 Amps	Coil †Volts	Coil *Ohms	Nominal Power	Prices 1-9
W12AX-1	DPDT	6VAC	—	5-9VA prox.	6.02
W12AX-2		12VAC	—		6.02
W12AX-3		24VAC	—		6.02
W12AX-4		120VAC	—		6.02
W12AX-5	3PDT	6VAC	—	5-9VA prox.	7.37
W12AX-6		12VAC	—		7.37
W12AX-7		24VAC	—		7.37
W12AX-8		120VAC	—		7.37
W12AX-9	4PDT	6VAC	—	5-9VA prox.	8.71
W12AX-10		12VAC	—		8.71
W12AX-11		24VAC	—		8.71
W12AX-12		120VAC	—		8.71
W12AX-13	6PDT	6VAC	—	5-9VA prox.	11.38
W12AX-14		12VAC	—		11.38
W12AX-15		24VAC	—		11.38
W12AX-16		120VAC	—		11.38

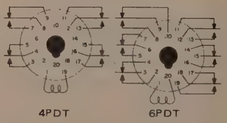
CLASS 12CP

ENCLOSED PLUG-IN RELAY

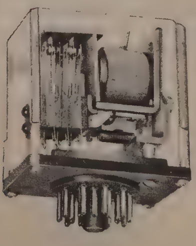
LOW COST, MULTIPLE CONTACTS
4PDT-6PDT
10 AMPS
AC OR DC OPERATION



WIRING DIAGRAMS



4PDT   6PDT



Also available is an enclosed plug-in version, the Class 12CP, with 4PDT and 6-PDT combinations rated 10 amps, AC or DC operation. Mounting is by molded phenolic 20 pin octal style plug. Mates with standard 20 pin octal style socket. (Amphenol No. 77-MIP-20 or equivalent.) A stronger magnetic system is designed for intermittent actuation.

Stock Part No.	Contacts 10 Amps	Coil †Volts	Coil *Ohms	Nom. Power	Prices 1-9
AC VOLTAGE SPECIFIED					
W12ACPX-5	4PDT	120VAC	—	5-9VA prox.	16.20
W12ACPX-10	6PDT	120VAC	—	5-9VA prox.	21.13
DC VOLTAGE SPECIFIED					
W12CPX-3	4PDT	24VDC	205	2.5W	16.20
W12CPX-7	6PDT	24VDC	205	2.5W	21.13

*Resistance values ±10%, measured at 25°C.   W prefix indicates relay in stock.

†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

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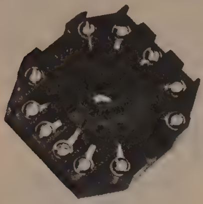
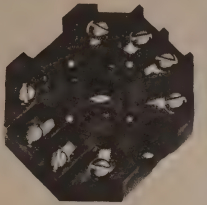
GENERAL PURPOSE RELAY ACCESSORIES

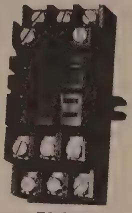
INDUSTRIAL SCREW TERMINAL SOCKETS

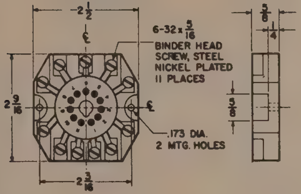
These heavy duty molded thermoplastic screw terminal sockets have closed back construction and requires no insulation. 70-170 and 70-169 rated 10 amps, 70-233 rated 13 amps.

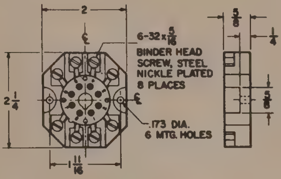
Part No.	Type	Prices 1-9
70-170	Screw Terminal 11-pin Octal	4.15
70-169	Screw Terminal 8-pin Octal	2.75
70-233-1	Screw Terminal 11-pin accepts Class 388 Relays	4.44

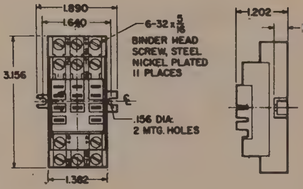

70-170


70-169


70-233-1


2 1/2
6-32 x 5/16 BINDER HEAD SCREW, STEEL NICKEL PLATED 11 PLACES
2 9/16
.173 DIA. 2 MTG. HOLES
2 3/16
5/8
1/4
5/8

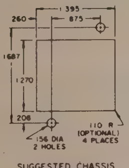

2
6-32 x 5/16 BINDER HEAD SCREW, STEEL NICKLE PLATED 8 PLACES
2 1/4
.173 DIA. 6 MTG. HOLES
1 11/16
5/8
1/4
5/8

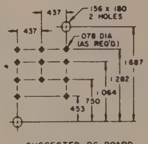

1.890
1.640
6-32 x 5/16 BINDER HEAD SCREW, STEEL NICKEL PLATED 11 PLACES
3.156
.156 DIA. 2 MTG. HOLES
1.362
1.202
.312

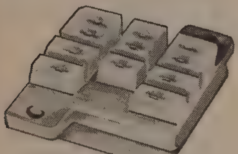
NYLON SOCKETS

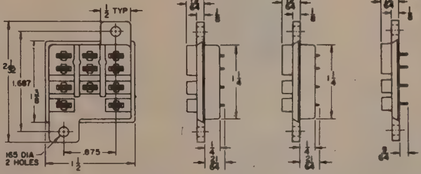
U.L. recognized for use with 388 Relays File No. E43641. These heavy duty molded thermoplastic sockets rated at 13 amps have no need for separate insulation.

Part No.	Type	Prices 1-9
70-124-1	Nylon Solder Terminal	.88
70-124-2	Nylon Quick-Connect	1.35
70-178-1	Nylon Printed Circuit	1.00

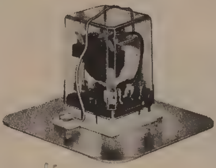

1.395
.260
.875
1.687
1.270
.206
.156 DIA 2 HOLES
.110 R (OPTIONAL) 4 PLACES
SUGGESTED CHASSIS LAYOUT

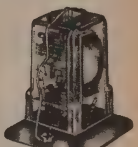

.437
.437
.156 x .180 2 HOLES
.078 DIA (AS REQ'D)
1.687
1.282
1.064
.750
.453
SUGGESTED PC BOARD LAYOUT




1/2 TYP
2 1/2
1.687
.165 DIA 2 HOLES
.875
1 1/2

HOLD DOWN CLIPS

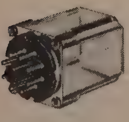

16-722-1 HOLD DOWN CLIP FOR 388CP AND 388ANCP $9.50 PER BOX OF 50

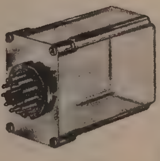

16-715-1 HOLD DOWN CLIP FOR 88CP AND 88ANCP $8.00 PER BOX OF 50

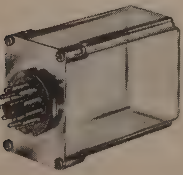
CLEAR PLASTIC PLUG-IN DUST ENCLOSURES FOR ELECTRONIC ASSEMBLIES

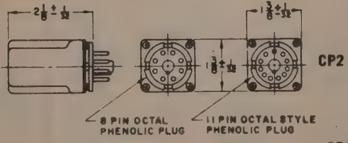
- Tough
- Lower cost
- Crackproof polycarbonate resin
- Clear

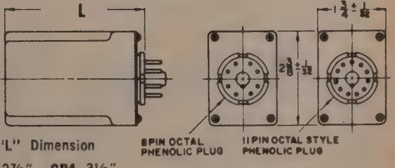
Stock Part No.	Plug Style	Weight	Prices 1-24
WCP2X-1 WCP2X-2	8-pin 11-pin	2 oz. approx.	.75 .94
WCP3X-1 WCP3X-2	8-pin 11-pin	3 oz. approx.	1.09 1.29
WCP4X-1 WCP4X-2	8-pin 11-pin	4 oz. approx.	1.90 2.48


CP2


CP3


CP4


2 1/8 ± 1/32
1 3/8 ± 1/32
1 3/8 ± 1/32
8 PIN OCTAL PHENOLIC PLUG
11 PIN OCTAL STYLE PHENOLIC PLUG
CP2


L
1 3/4 ± 1/32
2 3/8 ± 1/32
8 PIN OCTAL PHENOLIC PLUG
11 PIN OCTAL STYLE PHENOLIC PLUG
"L" Dimension
CP3 2 7/8" CP4 3 1/2"

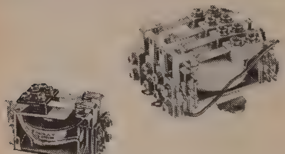
Magnecraft®

5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

POWER RELAYS

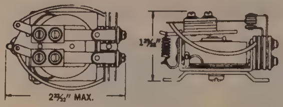
CLASS 94
POWER RELAYS

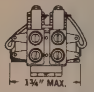
15 AMPS — SPDT TO 4PDT
AC OR DC OPERATION



The Class 94 relays are compact and positive-acting for either AC or DC. Used in air conditioning and lighting systems, small motor starting, transformers, garage door openers — wherever dependable circuit switching is necessary. The ¼" dia. silver alloy contacts are rated at 15 amps resistive, 5 amps inductive at 115VAC or 28VDC. The large contact surfaces are kept clean by good wiping action. Mounting Data: 2 tapped holes 6-32 NC-2; 2" centers.

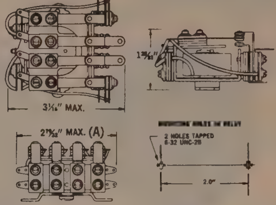
- Weight — 8 ozs. approx.


1⅝"
2²³⁄₃₂" MAX.



3PDT TYPE FIGURE A IS 2¹³⁄₃₂ MAX.

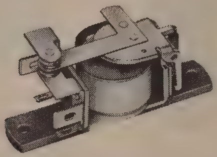
Stock Part No.	15 Amp Contacts	Coil		Prices 1-9
		†Volts	*Ohms	
W94X-1	SPDT	6VDC	16	7.13
W94X-2		12VDC	63	7.13
W94X-3		24VDC	250	7.13
W94X-4		110VDC	4,000	8.72
W94X-5	DPDT	6VDC	16	10.49
W94X-6		12VDC	63	10.49
W94X-7		24VDC	250	10.49
W94X-8		110VDC	4,000	12.10
W94X-11	3PDT	6VDC	16	15.53
W94X-12		12VDC	63	15.53
W94X-13		24VDC	250	15.53
W94X-14		110VDC	4,000	15.85
W94X-15	4PDT	6VDC	16	20.45
W94X-16		12VDC	63	20.45
W94X-17		24VDC	250	20.45
W94X-18		110VDC	4,000	22.03


1⅝"
3⅛" MAX.
2²⁹⁄₃₂" MAX. (A)
2 HOLES TAPPED 6-32 UNC-2B
2.0"

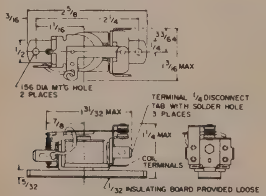
Stock Part No.	15 Amp Contacts	Coil		Prices 1-9
		†Volts	*Ohms	
W94AX-1	SPDT	6VAC	—	7.13
W94AX-2		12VAC	—	7.13
W94AX-3		24VAC	—	7.13
W94AX-4		115VAC	—	7.13
W94AX-5		220VAC	—	8.09
W94AX-6	DPDT	6VAC	—	10.49
W94AX-7		12VAC	—	10.49
W94AX-8		24VAC	—	10.49
W94AX-9		115VAC	—	10.49
W94AX-10		220VAC	—	11.46
W94AX-11	3PDT	6VAC	—	15.53
W94AX-12		12VAC	—	15.53
W94AX-13		24VAC	—	15.53
W949X-14		115VAC	—	15.53
W94AX-15		220VAC	—	16.49
W94AX-16	4PDT	6VAC	—	20.43
W94AX-17		12VAC	—	20.43
W94AX-18		24VAC	—	20.43
W94AX-19		115VAC	—	20.43
W94AX-20		220VAC	—	21.40

CLASS 88K
LOW COST RELAYS

SPDT — 15 AMPS
AC AND DC OPERATION
AC RELAYS ARE 50/60 Hz



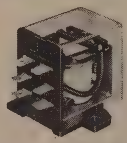
- Silver alloy, gold flashed contacts.
- Terminal boards designed to accept AMP Faston "250" series receptacles on contacts and "110" series on coil or equivalent.
- Standard soldering connections can be used.
- Mounting base insulator furnished.
- Weight — 3 ozs. approx.


3/16
2⅝
2¼
1¹/₁₆
3³/₆₄
1¼
1/2
1³/₁₆ MAX
.156 DIA MTG HOLE 2 PLACES
1³¹/₃₂ MAX
7/8
1¼ MAX
TERMINAL ¼ DISCONNECT TAB WITH SOLDER HOLE 3 PLACES
COIL TERMINALS
5/32
1/32 INSULATING BOARD PROVIDED LOOSE

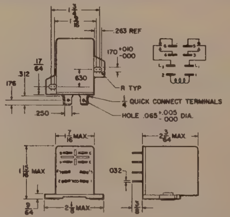
Stock Part No.	Contacts 15 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W88AKX-1	SPDT	24VAC	—	3VA	6.14
W88AKX-2		115VAC	—		6.14
W88AKX-3		230VAC	—		7.43
W88KX-1	SPDT	6VDC	25	1.5W	5.88
W88KX-2		12VDC	100		5.88
W88KX-3		24VDC	400		5.88
W88KX-4		110VDC	8,000		6.80

CLASS 89CQ
LOW COST SURFACE MOUNTED POWER RELAY

DPDT — 20 AMPS.
AC AND DC OPERATION



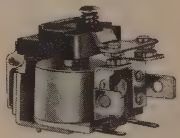
- DPDT contacts rated 20 amps at 120-VAC or 16 amps at 240VAC resistive load.
- Quick connect terminals (¼" x ⅓₂").
- Clear polycarbonate crackproof dust cover.
- Weight — 4.5 ozs. approx.


.263 REF
.170 +.010 −.000
.312
17/64
.176
.630
R TYP
¼ QUICK CONNECT TERMINALS
.250
HOLE .065 +.005 −.000 DIA.
7/16 MAX
2³/₆₄ MAX
1¹³/₁₆ MAX
.032
9/64
2⅛ MAX
3/8

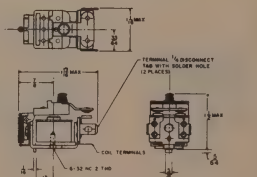
Stock Part No.	Contacts 20 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W89ACQX-1	DPDT	6VAC	—	6.6VA	9.19
W89ACQX-2		12VAC	—		9.19
W89ACQX-3		24VAC	—		8.37
W89ACQX-4		120VAC	—		8.37
W89ACQX-5		240VAC	—		8.95
W89CQX-1	DPDT	6VDC	14	3W	9.06
W89CQX-2		12VDC	53		9.06
W89CQX-3		24VDC	210		9.06
W89CQX-4		110VDC	4,400		9.36

CLASS 88KD
LOW COST SMALL POWER RELAYS

SPST-NO-DM — 50 AMPS — 1 HP
AC AND DC OPERATION
AC RELAYS ARE 50/60 Hz



- Heavy duty silver alloy, gold flashed contacts.
- Terminal boards designed to accept AMP Faston "250" series receptacles on contacts and "110" series on coil or equivalent.
- Standard soldering connections can be used.
- One #6-32 tapped mounting hole and locating boss.


TERMINAL ¼ DISCONNECT TAB WITH SOLDER HOLE (2 PLACES)
COIL TERMINALS
6-32 NC 2 THD

Stock Part No.	Contacts 50 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W88KDX-1	SPST-NO-DM	6VDC	25	1.5W	5.64
W88KDX-2		12VDC	100		5.64
W88KDX-3		24VDC	400		5.64
W88KDX-4		110VDC	8,000		6.69
W88KADX-1	SPST-NO-DM	24VAC	—	3VA	6.35
W88KADX-2		115VAC	—		6.35
W88KADX-3		230VAC	—		6.80

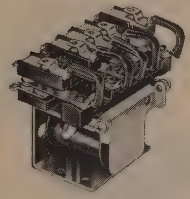
*Resistance values ±10%, measured at 25°C. W prefix indicates relay in stock.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

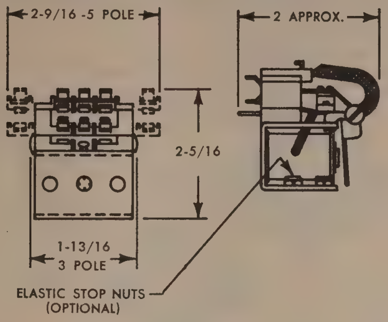
Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

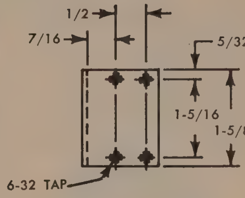
POWER RELAYS

CLASS 93
POWER RELAY

3PDT OR 5PDT IN STOCK
WITH 20 AMP CONTACTS
AC OR DC OPERATION







The Class 93 is a compact power relay designed for versatility and long life. It is available as a unit with 3 through 5 poles with contact ratings of up to 20 amps. Available enclosures add to its versatility. Contacts and terminals are mounted on molded phenolic blocks with integral barriers. Moveable contact blades are made of spring temper copper alloy for high conductivity and long life. Adjusting screws on each blade permit close adjustment and maximum contact pressures with built in contact wipe. Armature pivots on machined bearing pins and pivot holes. All these features contribute to the sensitivity and longevity of this relay.

SPECIFICATIONS

Nominal Coil Voltage: See tables of relay part numbers for standard voltages. Intermediate values available up to 220VDC or 277VAC, 60 Hz.

Contact Combinations: SPDT, DPDT, 3PDT, 4PDT and 5PDT standard. Other contact combinations available.

Maximum Dissipation: 6 watts.

Contacts (10 amp type): Silver alloy gold flashed, 3/16" dia. standard, rated 10 amps at 120VAC, resistive load.

Contacts (20 amp type): Silver alloy gold flashed, 1/4" dia. standard, rated 20 amps at 120VAC, resistive load.

DC Coil Resistance: Up to 35,000 ohms on AC operated relays and up to 60,000 ohms on DC operated relays.

Dielectric Withstanding Voltage: 1000VRMS between mutually insulated conductive elements.

Typical Operate Time (5PDT): 35 milliseconds max. with nominal coil voltage.

Typical Release Time (5PDT): 20 milliseconds max. with nominal coil voltage.

Mounting: Four 6-32 threaded holes.

Terminals: Solder type standard.

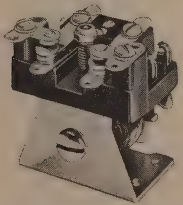
Optional Enclosure: Metal dust resistant or hermetically sealed available, solder terminals or plug-in.

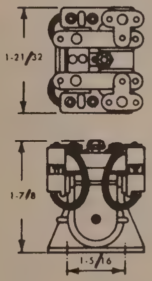
- Weight (open style) — 8 ozs. approx.

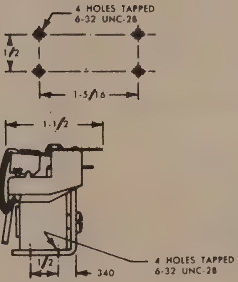
Stock Part No.	Contacts 20 Amps	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
AC VOLTAGE SPECIFIED					
W93AX-3	3PDT	24VAC	—	—	9.43
W93AX-5		120VAC	—	—	9.43
W93AX-4	5PDT	24VAC	—	—	13.76
W93AX-6		120VAC	—	—	13.76
DC VOLTAGE SPECIFIED					
W93X-1	3PDT	6VDC	14	2.6W	9.43
W93X-3		24VDC	220		9.43
W93X-5		110VDC	4,580		9.80
W93X-2	5PDT	6VDC	10	3.6W	13.76
W93X-4		24VDC	165		13.76
W93X-6		110VDC	3,440		14.14

CLASS 96
POWER RELAY

15 AMP DPDT
30 AMP SPDT-DB-DM
AC OR DC OPERATION







The Class 96 is a continuous duty general purpose power relay, available in AC or DC with DPDT (2C) and SPDT-DBDM and (1Z) contact arrangements. This product is excellent for general industrial power control circuits. Silver cadmium oxide contacts are rated at 15 or 30 amps at 28VDC or 115VAC resistive. A variety of enclosures are available for the relay. Contacts and terminals are mounted on molded phenolic blocks with integral barriers. Moveable contact blades are made of spring temper copper alloy for high conductivity and long life. Armature pivots on machined bearing pins and pivot holes are precision reamed. All these features add to this quality built Magnecraft product which is in stock for immediate delivery.

SPECIFICATIONS

Contact Rating: 15 amps resistive at 115VAC or 28VDC, 30 amps resistive for Form X, Y, or Z.

Contact Combinations: 2 Form A, B, or C max., or 1 X, Y, or Z max.

Contact Material: 1/4" dia. silver alloy, gold flashed.

Contact Resistance: .100 ohms max.

Temperature Range: −30°C to +65°C.

Coil Dissipation: 5 watts maximum at 25°C.

Insulation Resistance: 100 megohms min.

Nominal Power: 2.5 watts, Maximum Dissipation: 5 watts.

Dielectric Withstanding Voltage: 500VRMS.

Mounting: Four 6-32 tapped holes.

Terminals: Solder lugs.

Enclosure: Open, dustite, or hermetically sealed.

- Weight — 4.5 ozs.

Cat. No.	Contacts		Coil		Prices 1-9
	Form	Amps	†Volts	*Ohms	
W96AX-2	DPDT	15	24VAC	28.8	9.94
W96AX-3			115VAC	661	9.94
W96AX-4			230VAC	2,647	10.43
W96X-1	DPDT	15	6VDC	14	9.64
W96X-2			12VDC	56	9.64
W96X-3			24VDC	230	9.64
W96X-4	SPDT-DB-DM	30	6VDC	14	10.00

*Resistance values ±10%, measured at 25°C.

†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221 **HEAVY DUTY POWER RELAYS**

CLASS 99 — HEAVY DUTY INDUSTRIAL CONTROL POWER RELAYS

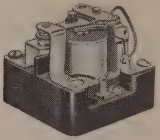
UL LISTED

The three Class 99 Power Relays featured in this section are listed by Underwriters' Laboratories under Motor Controllers, Magnetic, Across-the-line starters: Open (File No. E43641). The one exception is the Class W99AX-7 DPDT 440VAC relay indicated below with two asterisks (**).

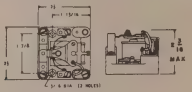
CLASS 99

SPDT
25 AMP — 1 HP
AC OR DC OPERATION

- Weight — 8 ozs. approx.



Dimensionally interchangeable with relays made by others. Superior quality hinge-pin design, molded nylon bobbin and adjustment stability features give it longer life. 5⁄16" contacts of silver alloy, gold flash. Standard dielectric strength: 1500VAC, RMS. Screw type terminals and molded phenolic base.

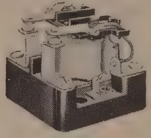


Stock Part No.	Contacts 25 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W99AX-1 W99AX-2 W99AX-3	SPDT	24VAC 115VAC 230VAC	— — —	10VA	6.53 6.56 6.77
W99X-1 W99X-2 W99X-3 W99X-4	SPDT	6VDC 12VDC 24VDC 110VDC	18 70 290 6,000	2.0W	6.43 6.43 6.45 6.92

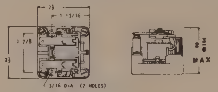
CLASS 99

DPST-NO
25 AMP — 1 HP
AC OR DC OPERATION

- Weight — 9 ozs. approx.



Dimensionally interchangeable with relays made by others. Superior quality hinge-pin design, molded nylon bobbin and adjustment stability features give it longer life. 5⁄16" contacts of silver alloy, gold flash. Standard dielectric strength: 1500VAC, RMS. Screw type terminals and molded phenolic base.

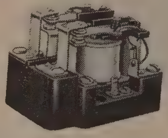


Stock Part No.	Contacts 25 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W99AX-8 W99AX-9 W99AX-10	DPST-NO	24VAC 115VAC 230VAC	— — —	10VA	7.19 7.21 7.41
W99X-9 W99X-10 W99X-11 W99X-12	DPST-NO	6VDC 12VDC 24VDC 110VAC	18 70 290 6,000	2.0W	7.21 7.21 7.24 7.68

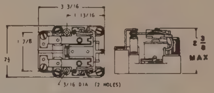
CLASS 99

DPDT
25 AMP — 1 HP
AC OR DC OPERATION

- Weight — 11 ozs. approx.



Dimensionally interchangeable with relays made by others. Superior quality hinge-pin design, molded nylon bobbin and adjustment stability features give it longer life. 5⁄16" contacts of silver alloy, gold flash. Standard dielectric strength: 1500VAC, RMS. Screw type terminals and molded phenolic base.



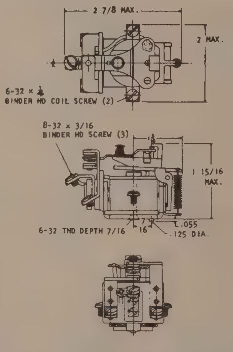
Stock Part No.	Contacts 25 Amps	Coil		Nom. Power	Prices 1-9
		†Volts	*Ohms		
W99AX-4 W99AX-5 W99AX-6 W99AX-7**	DPDT	24VAC 115VAC 230VAC 440VAC	— — — —	10VA	9.20 9.20 9.42 9.47
W99X-5 W99X-6 W99X-7 W99X-8	DPDT	6VDC 12VDC 24VDC 110VDC	18 70 290 6,000	2.0W	9.30 9.30 9.32 9.77

**W99AX-7 440VAC Relay Not UL Listed.

CLASS 99S

SPACE-SAVER POWER RELAYS

SPDT
25 AMP — 1 HP
AC OR DC OPERATION



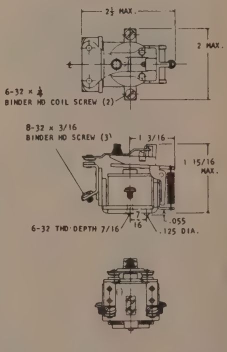
- Designed for power switching in small space.
- SPDT silver alloy — gold flashed contacts rated @ 25 amps or 1 HP.
- Highly reliable power relay for industrial control applications.
- Screw terminals—(no soldering).
- Easy mounting — one #6-32 tapped mounting hole and locating boss.
- Weight — 6 ozs. approx.

Stock Part No.	Contacts 50 Amps	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
W99SAX-1 W99SAX-2 W99SAX-3	SPDT	24VAC 115VAC 230VAC	— — —	10VA	8.26 8.31 8.56
W99SX-1 W99SX-2 W99SX-3 W99SX-4	SPDT	6VDC 12VDC 24VDC 110VDC	18 70 290 6,000	2.0W	7.99 8.00 8.04 8.39

CLASS 99SD

SPACE-SAVER POWER RELAYS

SPST-NO-DM
50 AMP — 2 HP
AC OR DC OPERATION



- Designed for power switching in small space.
- SPST-NO-Double Make silver alloy—gold flashed contacts rated @ 50 amps or 2 HP.
- Highly reliable power relay for industrial control applications.
- Screw terminals—(no soldering).
- Easy mounting — one #6-32 tapped mounting hole and locating boss.
- Weight — 6 ozs. approx.

Stock Part No.	Contacts 50 Amps	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
W99SADX-1 W99SADX-2 W99SADX-3	SPST-NO-DM	24VAC 115VAC 230VAC	— — —	10VA	7.03 7.13 7.37
W99SDX-1 W99SDX-2 W99SDX-3 W99SDX-4	SPST-NO-DM	6VDC 12VDC 24VDC 110VDC	18 70 290 6,000	2.0W	6.85 6.85 6.89 7.23

*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

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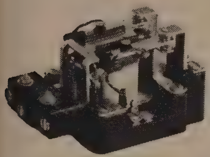
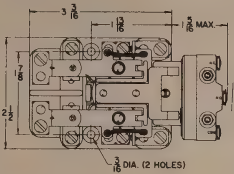
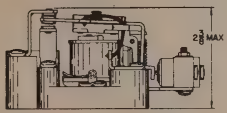
HEAVY DUTY POWER RELAYS

CLASS 99
POWER RELAYS

25 AMP — 1 HP
WITH 22 AMP AUX. SNAP SWITCH
AC RELAYS 50/60 Hz





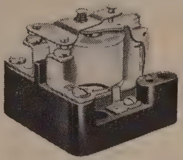


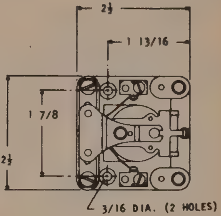
- Basic Class 99 relay equipped with SPDT snap switch.
- DPDT Power Contacts rated 25 amps or 1 HP, SPDT snap switch rated 22 amps.
- Availability of snap switch increases relay switching capabilities.
- Panel or chassis mtg. — Two 3/16″ dia. mtg. holes.
- Screw terminals.
- Weight — 11.5 ozs. approx.

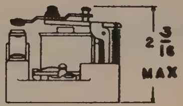
Stock Part No.	Contacts 25 Amps	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
W99AX-88	DPDT	115VAC	—	10VA	16.84
W99AX-89	(Relay)	230VAC	—		17.60

CLASS 99D
POWER RELAYS

SPST-NO-DM
50 AMP — 2 HP
AC RELAYS 50/60 Hz







Dimensionally interchangeable with relays made by others. Superior quality hinge-pin design, molded nylon bobbin and adjustment stability features give it longer life. 5/16″ contacts of silver alloy, gold flash. Standard dielectric strength: 1500VAC, RMS. Screw type terminals and molded phenolic base.

- Weight — 8 ozs. approx.

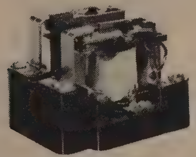
30 AMP U/L LISTED VERSIONS AVAILABLE

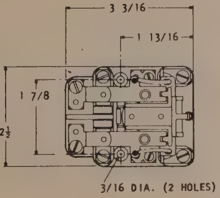
Stock Part No.	Contacts 50 Amps	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
W99ADX-1	SPST-NO-DM	24VAC	—	10VA	6.22
W99ADX-2		115VAC	—		6.22
W99ADX-3		230VAC	—		6.45
W99DX-1	SPST-NO-DM	6VDC	18	2.0W	6.18
W99DX-2		12VDC	70		6.18
W99DX-3		24VDC	290		6.20
W99DX-4		110VDC	6,000		6.63

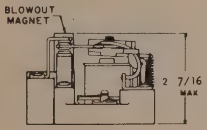
HEAVY DUTY POWER

CLASS 99B
POWER RELAYS

WITH BLOWOUT MAGNET FOR DC ARC-QUENCHING
DPDT AC OR DC OPERATION
10 AMP AT 110VDC — AC RELAYS 50/60 Hz







Magnetic blowouts and the resulting extended DC switching capability enable the use of the Class 99B in applications where larger relays are usually used. The net result is a significant reduction in size and cost.

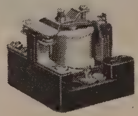
Contact Ratings: 10 amps at 110VDC res.; 4 amps at 220VDC, res.; 2 amps at 325VDC, res. For inductive loads, contacts must be derated accordingly. Capacitive loads must have current-limiting to insure that inrush current will not exceed 50 amps.

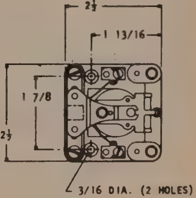
- Weight — 11 ozs. approx.

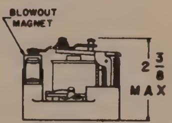
Stock Part No.	Contacts 10 Amps @ 110VDC	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
W99ABX-6	DPDT	115VAC	—	10VA	14.87
W99ABX-7		230VAC	—		15.23
W99BX-10	DPDT	110VDC	6,000	2.0W	15.05
W99BX-11		220VDC	20,000		17.72

CLASS 99DB
POWER RELAYS

WITH BLOWOUT MAGNET FOR DC ARC-QUENCHING
SPST-NO-DM AC OR DC OPERATION
20 AMP AT 110VDC — AC RELAYS 50/60 Hz







Magnetic blowouts with double make contacts and the resulting extended DC switching capability enable the use of the Class 99DB in applications where larger relays are usually used. The net result is a significant reduction in size and cost.

Contact Ratings: 20 amps at 110VDC, res.; 8 amps at 220-VDC, res.; 4 amps at 325VDC, res.; 2 amps at 500VDC, res. For inductive loads, contacts must be derated accordingly. Capacitive loads must have current limiting to insure that inrush current will not exceed 100 amps.

- Weight — 8 ozs. approx.

Stock Part No.	Contacts 20 Amps @ 110VDC	Coil		Nominal Power	Prices 1-9
		†Volts	*Ohms		
W99ADBX-2	SPST-NO-DM	115VAC	—	10VA	9.94
W99ADBX-3		230VAC	—		10.31
W99DBX-5	SPST-NO-DM	110VDC	6,000	2.0W	10.12
W99DBX-6		220VDC	20,000		12.80

*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

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HEAVY DUTY POWER & SOLID STATE

CLASS 97

ENCLOSED POWER RELAY

25 AMPS — COMPACT
AC OR DC OPERATION
UL RECOGNIZED (U.L. File No. E43641)

The Class 97 is a low cost 25 amp relay for 1 and 2 pole, 120/240VAC applications. It is available with socket for use with standard quick-connect terminals for simplicity and ease in wiring. The Class 97 relay offers high quality, dependable performance and long life.

The latch function is accomplished by means of a "Hold" coil in series with a "Hold" contact. De-latch is accomplished by breaking current in the "Hold" circuit.

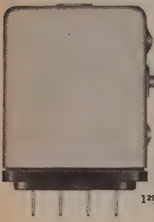
"Pick-up" adjustment screw pre-set and locked at the factory.

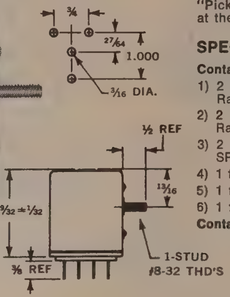
SPECIFICATIONS

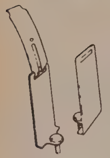
Contact Combination and Rating:

1) 2 form X (double make or SPST-NO-DM) Rated at 25 amps.
2) 2 form Y (double break or SPST-NC-DM) Rated at 25 amps.
3) 2 form Z (double break, double make, SPDT-NC-NO-(DB-DM) Rated at 15 amps.
4) 1 form X, 1 form Y Rated at 25 amps.
5) 1 form X, 1 form Z Rated at 15 amps
6) 1 form Y, 1 form Z Rated at 15 amps

Contact Material: Silver.

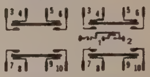




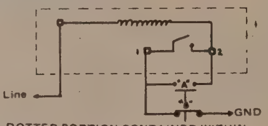


HOLD DOWN HARDWARE (Supplied with all Sockets)

WIRING DIAGRAMS



RELAY UNENERGIZED TYPE 1 **RELAY UNENERGIZED TYPE 2**



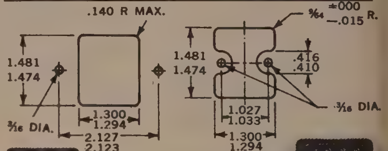
DOTTED PORTION CONTAINED WITHIN RELAY

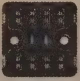
CLASS 97 HOLDING CIRCUIT

Switches "A" and "B" are customer provided switches. Switch "A", normally open, momentary and used to latch relay. Switch "B", normally closed, momentary and used to un-latch relay.

Part No.	Sockets	Prices 1-9
70-311	Type I Standard	2.16
70-312	Type II Standard	2.47
70-313	Type II Holding Circuit	3.29
70-314	Type II UL Recognized	3.34

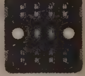
Part No.	Coil †Volts	Coil Ohms	Wiring Diagram	Prices 1-9
STUD MOUNTING				
W97ACSX-1	12VAC	—	1	12.72
W97ACSX-2	24VAC	—	1	12.60
W97ACSX-3	115VAC	—	1	12.72
W97ACSX-4	220VAC	—	1	12.60
W97CSX-1	12VDC	58	1	12.41
W97CSX-2	24VDC	220	1	12.41
PLUG-IN				
W97ACPX-1	12VAC	—	1	12.41
W97ACPX-2	24VAC	—	1	12.17
W97ACPX-3	115VAC	—	1	12.41
W97ACPX-4	220VAC	—	1	12.60
W97CPX-1	12VDC	58	1	12.17
W97CPX-2	24VDC	220	1	12.17
HOLDING CIRCUIT (PLUG-IN)				
W97ALCPX-1	115VAC	—	2	14.42
W97ALCPX-2	220VAC	—	2	14.71





70-311

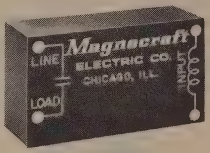
70-312
70-313
70-314



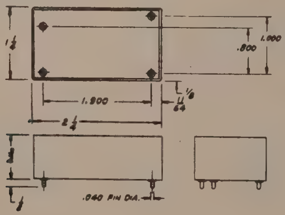
CLASS 501QPC

SOLID STATE HYBRID POWER RELAY

- Printed circuit package.
- IC Compatible.
- Load rating 3 amps at 120VAC RMS or 200VDC peak at 25°C.
- Surge rating: 100 amps for .016 seconds.
- SPST-NO (1 Form A) solid state output.
- Operate time: .003 seconds.
- Weight — 2 ozs. approx.



The Class 501QPC is a reed triggered triac assembly encapsulated in a low profile printed circuit package. It features the long life and isolation of a reed relay to trigger a triac capable of switching the high inrush currents of such devices as lamps, motors, capacitors and heaters. The expected life of the Class 501QPC is approximately 25 million operations.

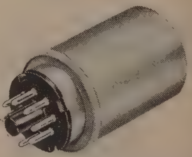


Stock Part No.	Input VDC	Input Ohms	Input Watts	VAC Switching Capability	Prices 1-9
W501QPCX-1	5	1,000	40mW	3 Amps @ 120	13.74
W501QPCX-7	24	1,500	400mW	3 Amps @ 120	13.74
W501QPCX-11	5	1,000	40mW	3 Amps @ 240	14.36
W501QPCX-17	24	1,500	400mW	3 Amps @ 240	14.36

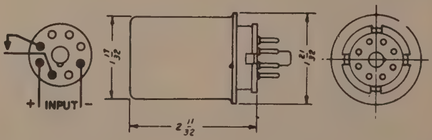
CLASS 501QCP

SOLID STATE HYBRID POWER RELAY

- 8 pin octal plug-in.
- IC Compatible.
- SPST-NO (1 Form A) solid state output.
- Load rating: 6 amps at 120VAC RMS or 200VDC peak at 25°C.
- Surge rating: 100 amps for .016 seconds.
- Operate time: .003 seconds.
- Weight — 3 ozs. approx.



The Class 501QCP is a reed triggered triac assembly mounted in a metal, electrically isolated 8 pin octal plug-in enclosure for maximum protection and the most efficient heat transfer characteristics possible. It features the long life and isolation of a reed relay to trigger a triac capable of switching the high inrush currents of such devices as lamps, motors, capacitors, and heaters. The expected life of the Class 501QCP is approximately 25 million operations.



Stock Part No.	Input VDC	Input Ohms	Input Watts	VAC Switching Capability	Prices 1-9
W501QCPX-2	5	1,000	40mW	6 Amps @ 120	18.39
W501QCPX-5	24	1,500	400mW	6 Amps @ 120	18.39
W501QCPX-7	5	1,000	40mW	6 Amps @ 240	19.21
W501QCPX-10	24	1,500	400mW	6 Amps @ 240	19.21

*Resistance values ±10%, measured at 25°C. W prefix indicates relay in stock.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

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MERCURY DISPLACEMENT POWER RELAYS

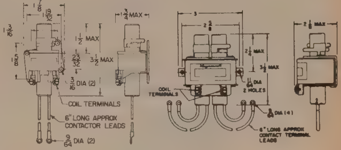
CLASS ASX

MINIATURE ARMORED ENCAPSULATED POWER RELAYS

20 AMP
SPST OR DPST

Hi-Power 20 amp Mercury-to-Mercury Relay, equipped with armored encapsulated tubes. These tubes are made with the finest precision-made alumina ceramics, thus providing the greatest possible insulation strength and the ultimate in resistance to wear. Like other Magnecraft Mercury Displacement Relays, these contactors are pressurized with hydrogen for effective arc-suppression.

Stock Part No.	Contacts 20 Amp	Coil Volts* 50/60 Hz	Prices 1-9
WASX-1	SPST-NO	120VAC	15.91
WASX-1	SPST-NO	240VAC	16.69
WASX-2	SPST-NC	120VAC	16.43
WASX-11	DPST-NO	120VAC	29.35


1 7/8
1 19/32
1 3/16
1 5/8
1 1/2 MAX
23/32
3 1/2 MAX
3/16 DIA (2)
COIL TERMINALS
6" LONG APPROX CONTACTOR LEADS
9/64 DIA (2)
1 3/4 MAX
3
2 5/8
2 1/4 MAX
3 1/2 MAX
11/64 DIA 2 HOLES
COIL TERMINALS
3/64 DIA (4)
6" LONG APPROX CONTACT TERMINAL LEADS
2 1/8 MAX

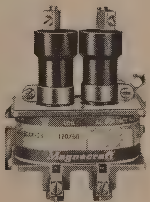
STEEL TUBE MERCURY DISPLACEMENT RELAYS

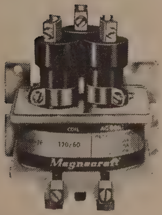
M35 — 35 AMPS
M60 — 60 AMPS
LOW COST
1, 2, OR 3 POLES N.O. OR N.C.
U.L. RATED (File No. E52197)

NEW STEEL TUBE DESIGN!

Type of Load	AC Volts					DC Volts			
	120	240	277	480	600	24	48	125	250
CONTACT LOAD RATING — CLASS M35									
General Purpose and Tungsten**Amps	35**	35	35	35	30	35	35	30	20
Inductive Amps at 75 pF	30	30	30	25	15	*	*	*	*
CONTACT LOAD RATING — CLASS M60									
General Purpose and Tungsten**Amps	60**	60	60	60	50	60	60	50	40
Inductive Amps at 75 pF	50	50	50	45	35	*	*	*	*

*Contact factory for recommendations.





The Class M35 and M60 are newly designed stainless steel enclosed, hermetically welded, high capacity, compact size Mercury Displacement Relays. Each part has been carefully designed by experienced engineers to optimize performance and minimize costs. A rigorous relay test program is in continuous progress to insure absolute compliance with every design criteria. These steel enclosed MDR's with improved plunger design in a highly effective inert gas atmosphere are capable of switching rated loads for millions of operations. If your application is too tough for a conventional relay, consider our MDR. These unique contactors are capable of switching more than 20 times the published ratings under special conditions. Contact our Engineering Department for more information.

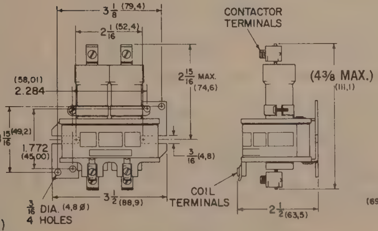
ORDERING INFORMATION — CLASS M35

Part No.	Contacts 35 Amps	Coil Volts 50/60 Hz	Prices 1-9
WM35A-120A	SPST-NO	120VAC	13.35
WM35B-120A	SPST-NC	120VAC	14.39
WM35A-240A	SPST-NO	240VAC	13.35
WM35AA-120A	DPST-NO	120VAC	23.76
WM35AAA-120A	3PST-NO	120VAC	35.27

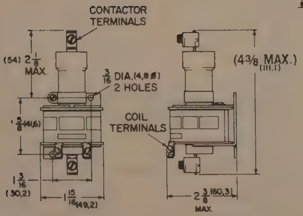
ORDERING INFORMATION — CLASS M60

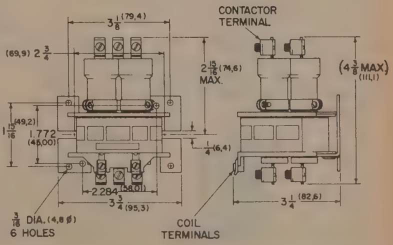
Part No.	Contacts 60 Amps	Coil Volts 50/60 Hz	Prices 1-9
WM60A-120A	SPST-NO	120VAC	21.42
WM60B-120A	SPST-NC	120VAC	22.49
WM60A-240A	SPST-NO	240VAC	21.42
WM60AA-120A	DPST-NO	120VAC	38.54
WM60AAA-120A	3PST-NO	120VAC	57.66

ALL POPULAR COIL VOLTS AVAILABLE


3 1/8 (79,4)
2 1/16 (52,4)
CONTACTOR TERMINALS
(58,01) 2.284
2 15/16 MAX. (74,6)
(4 3/8 MAX.) (111,1)
1 15/16 (49,2)
1.772 (45,00)
3/16 (4,8)
3/16 DIA. (4,8 ∅) 4 HOLES
3 1/2 (88,9)
COIL TERMINALS
2 1/2 (63,5)

M60 DIMENSION CHANGE
M35 = 4⅜ MAX.
M60 INCREASES TO 4¾


CONTACTOR TERMINALS
(54) 2 1/8 MAX.
3/16 DIA. (4,8 ∅) 2 HOLES
(4 3/8 MAX.) (111,1)
1 3/8 (41,6)
COIL TERMINALS
1 3/16 (30,2)
1 15/16 (49,2)
2 3/8 (60,3) MAX.


3 1/8 (79,4)
CONTACTOR TERMINAL
(69,9) 2 3/4
2 15/16 (74,6) MAX.
(4 3/8 MAX) (111,1)
1 15/16 (49,2)
1.772 (45,00)
1/4 (6,4)
2.284 (58,01)
3 3/4 (95,3)
3 1/4 (82,6)
3/16 DIA. (4,8 ∅) 6 HOLES
COIL TERMINALS

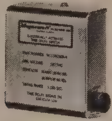
Magnecraft®

5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

AIR DASHPOT & SOLID STATE HYBRID TIME DELAY

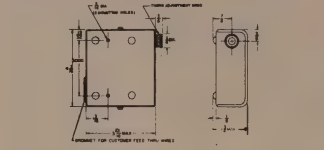
CLASS 112C
AIR DASHPOT TIME DELAY RELAY

DPDT 10 AMPS
±10% REPEATABILITY
OPERATE AND RELEASE DELAY
ADJUSTABLE 1 TO 150 SECONDS
- Weight — 20 ozs. approx.



Class 112C features rugged all metal enclosure with grommet for customer feed through wires. Internally wired by customer to .187 quick disconnect terminals. The solenoid assembly added to air dashpot/snap switch combination initiates time switching function by electrical actuation.

Available in operate or release delay. Release delay accomplished without standby power. Time repeat accuracy ±10%. Mounting: Two 3⁄16″ diameter holes on 3″ centers.

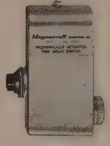


Stock Part No.	Contacts 10 Amps	Coil †Volts	Coil *Ohms	Prices 1-9
		Slow Operate		
W112ACSOX-4	DPDT	120VAC	—	49.17
W112CSOX-3		24VDC	80	49.17
		Slow Release		
W112ACSRX-4	DPDT	120VAC	—	49.17
W112CSRX-3		24VDC	80	49.17

Operate and release delay adjustable 1-150 sec.

CLASS 113C
AIR DASHPOT TIME DELAY SWITCH

SPDT 10 AMPS
±10% REPEATABILITY
PUSHBUTTON RELEASE BUTTON
TIME DELAY IS ON
- Weight — 8 ozs. approx.



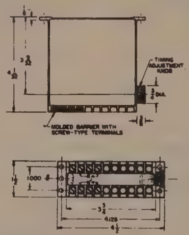
The Class 113C Time Delay Switch is a classic case of simplicity in design. Few moving parts, no standby power required to perform timing function. Single hole panel mounting with 5⁄8″ threaded bushing. Easily installed and wired by customer through grommet. Button diameter 1⁄2″. Overall Size: 2 1⁄16 x 3 5⁄8 x 1 5⁄32″.

Stock Part No.	Contacts 10 Amps	Timing Range	Prices 1-9
W113CX-1	SPDT	1-180 Sec.	36.57

CLASS 112M
AIR DASHPOT TIME DELAY RELAY

DPDT 10 AMPS
±10% REPEATABILITY
PLASTIC ENCLOSURE
SCREW TYPE TERMINALS
OPERATE AND RELEASE DELAY
ADJUSTABLE 1 TO 150 SECONDS
- Weight — 14 ozs. approx.

Class 112M comes in molded high impact plastic enclosure and built-in screw type terminals for easy customer wiring. The solenoid assembly added to air dashpot/snap switch combination initiates time switching function by electrical actuation. Available in operate or release delay. Release delay accomplished without standby power. Timing adjustable with knob or capped Allen screw. Flange mounting: Six 3⁄16″ diameter holes 1⁄2″ x 4 1⁄8″ centers.



Stock Part No.	Coil †Volts	Coil *Ohms	Adj. Type	Prices 1-9
	SLOW OPERATE			
W112MASOX-1	120VAC	—	Knob	54.88
W112MASOX-2	120VAC	—	Screw	54.88
W112MSOX-2	24VDC	80	Knob	54.88
W112MSOX-3	24VDC	80	Screw	54.88
	SLOW RELEASE			
W112MASRX-1	120VAC	—	Knob	54.88
W112MASRX-2	120VAC	—	Screw	54.88
W112MSRX-1	24VDC	80	Knob	54.88
W112MSRX-2	24VDC	80	Screw	54.88

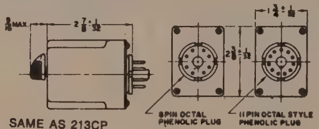
Operate and Release Delay Adjustable 1-150 sec.

CLASS 211CP
LOW COST SOLID STATE (HYBRID) TIME DELAY RELAY

DPDT 10 AMP CONTACTS
±2% REPEATABILITY
AC RELAYS ARE 50/60 Hz
- Weight — 7 ozs. approx.

- 4 Adjustable Timing Ranges
- Operate or Release Delay
- AC and DC Operation
- Transient Protection Twice Nominal Input Voltage for 8 ms. Polarity Protection on DC Relays Only.

Contact Rating: 10 amps at 28VDC or 115VAC.
Reset Time: 100 ms ave.
Mounting: Plug-in mates with standard 8 or 11 pin octal style socket.
Enclosure: Molded dust cover.



SAME AS 213CP

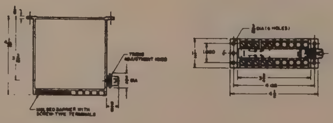
Stock Part No.	Contacts 10 Amps	Coil Voltage	Time Delay (Second)	Prices 1-9
OPERATE DELAY				
W211ACPSOX-18	DPDT 8-pin	120VAC	.2-1	22.85
W211ACPSOX-5			1-10	22.85
W211ACPSOX-7			1-180	22.85
W211ACPSOX-8			2-300	22.85
W211CPSOX-10	DPDT 8-pin	24VDC	.2-1	22.85
W211CPSOX-3			1-10	22.85
W211CPSOX			1-180	22.85
W211CPSOX-4			2-300	22.85
RELEASE DELAY				
W211ACPSRX-14	DPDT 11-pin	120VAC	.2-1	27.97
W211ACPSRX-5			1-10	27.97
W211ACPSRX-7			1-180	27.97
W211ACPSRX-8			2-300	27.97
W211CPSRX-9	DPDT 11-pin	24VDC	.2-1	27.97
W211CPSRX-1			1-10	27.97
W211CPSRX-3			1-180	27.97
W211CPSRX-4			2-300	27.97

CLASS 211M
SOLID STATE (HYBRID) TIME DELAY RELAY

DPDT 10 AMP
±2% REPEATABILITY
4 ADJUSTABLE TIMING RANGES
OPERATE OR RELEASE DELAY
AC RELAYS ARE 50/60 Hz
- Weight — 10 ozs. approx.

- AC and DC Operation.
- Low Cost Multi-Modular Package.
- Space Saving Surface Mounting.
- Easy Screw Type Terminals.
- Transient Protection Twice Nominal Input Voltage for 8 ms. Polarity Protection on DC Relays Only.

Reset Time: 100 ms ave.
Contact Rating: 10 amps at 28VDC or 115VAC.



Stock Part No.	Contacts 10 Amps	Nom. Input Voltage	Timing Range (Second)	Prices 1-9
TIME DELAY ON OPERATE				
W211MASOX-1	DPDT	120VAC	.2-1	32.01
W211MASOX-2			1.0-10	32.01
W211MASOX-3			1.0-180	32.01
W211MASOX-4			2.0-300	32.01
W211MSOX-1	DPDT	24VDC	.2-1	32.01
W211MSOX-2			1.0-10	32.01
W211MSOX-3			1.0-180	32.01
W211MSOX-4			2.0-300	32.01
TIME DELAY ON RELEASE				
W211MASRX-1	DPDT	120VAC	.2-1	37.50
W211MASRX-2			1.0-10	37.50
W211MASRX-3			1.0-180	37.50
W211MASRX-4			2.0-300	37.50
W211MSRX-1	DPDT	24VDC	.2-1	37.50
W211MSRX-2			1.0-10	37.50
W211MSRX-3			1.0-180	37.50
W211MSRX-4			2.0-300	37.50

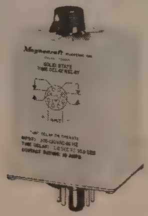
Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

SOLID STATE HYBRID TIME DELAY

CLASS 213CP

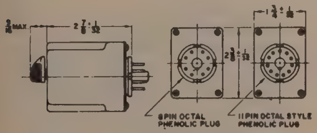
PRECISION SOLID STATE (HYBRID) TIME DELAY RELAY

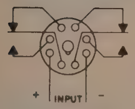
WITH ±1% REPEATABILITY AND IMMUNITY TO FALSE OPERATION
DPDT 10 AMPS
AC RELAYS ARE 50/60 Hz
ENCLOSED PLUG-IN



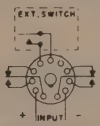
Will meet the increased demands for highly reliable, precision accurate, industrial electronic control components. Utilizes precise components for close tolerance of operation with 1% repeatability and immune to false operation.

- Adjustable to 300 seconds.
- 1% Repeatability.
- 10 amp DPDT Output Switching.
- Calibrated Dial.
- Fast Reset Time.
- Transient Protection Four Times Nominal Input Voltage for 8 ms. Polarity Protection on DC Relays Only.
- Available for AC Operation.
- Versatile.
- Immune to False Operation.
- Operate Delay.
- Release Delay.
- Molded Plastic Enclosure for Plug-In.





TIME DELAY ON OPERATE
SAME AS 211CP



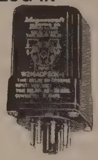
TIME DELAY ON RELEASE

Stock Part No.	Contacts	Input Voltage	Time Delay (Second)	Prices 1-9
SLOW OPERATE				
W213ACPSOX-7	DPDT	120VAC	1-10	49.24
W213ACPSOX-9	8-pin		1-180	49.24
W213ACPSOX-10			2-300	49.24
SLOW RELEASE				
W213ACPSRX-4	DPDT	120VAC	1-10	58.89
W213ACPSRX-6	11-pin		1-180	58.89
W213ACPSRX-7			2-300	58.89

CLASS 214CP

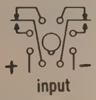
PLUG-IN SOLID STATE (HYBRID) TIME DELAY RELAY

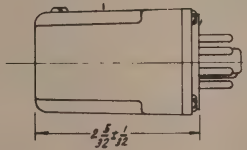
DPDT 5 AMP CONTACTS
±2% REPEATABILITY
AC RELAYS ARE 50/60 Hz
ENCLOSED PLUG-IN

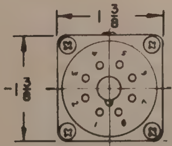


Now Magnecraft offers, in a package no larger than an untimed general purpose relay, a fully adjustable Solid State Hybrid Time Delay Relay with octal style plug. This new Class 214CP is a composite of the finest fully adjustable solid state timing, isolated from a high quality general purpose relay.

- Repeat Accuracy: ±5% at nominal voltage, 25°C.
- Contacts: DPDT, 5 amps at 32VDC or 115VAC resistive.
- Steady State Current: 20 mA.
- Mode of Time Delay: Delay on operate.
- Convenient Top Screw Driver Time Adjustment.
- Reset and Recycle Time: Typically 100 ms.
- Transient Protection to Twice Input Voltage for 8 ms.
- Enclosure: Molded dust cover.
- Mounting: Standard 8 pin octal style plug-in.
- Weight — 3 ozs. approx.
- Polarity Protection (DC Models).





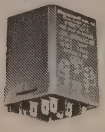


Stock Part No.	5 Amp Contacts	Input Voltage	Timing Range (Second)	Prices 1-9
W214ACPSOX-1	DPDT	120VAC	.3-30	26.09
W214ACPSOX-2			3-240	26.09
W214CPSOX-3		24VDC	.3-30	26.09
W214CPSOX-4			3-240	26.09

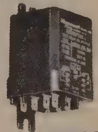
CLASS 388CP

LOW COST SOLID STATE (HYBRID) TIME DELAY RELAYS

PLUG-IN OR FLANGE MOUNT
±3% REPEATABILITY
DPDT 10 AMP
IMMUNE TO FALSE OPERATION
SLOW OPERATE
AC RELAYS ARE 50/60 Hz
- Weight — 3 ozs. approx.



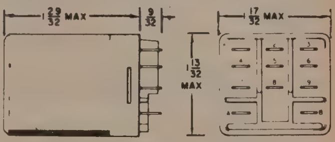
388CP



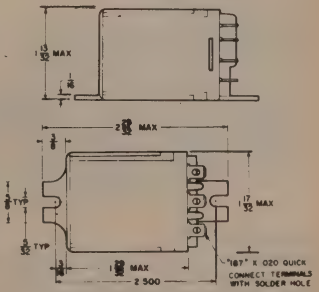
388CQ

- ±3% Repeatability Under Fixed Conditions (25°C, 120VAC) ±10% Over Voltage and Temperature Extremes.
- 10 amp DPDT at 28VDC or 115VAC resistive.
- Immune to False Operation.
- Transient Protection to Twice Nominal Input Voltage for 8 ms.
- Polarity Protection DC Models Only.
- Reset and Recycle Time Typically 100 ms.
- External Pot Gives Adjustable Timing Range.
- Tough, Crackproof Dust Cover.
- Designed for Easy Plug-in Mounting. See Choice of Sockets Listed Elsewhere in This Catalog. Screw, Solder, Quick-Connect, and P.C. Sockets Available.
- Designed for Easy Panel or Surface Mounted Installation.

PLUG-IN



FLANGE MOUNT



Stock Part No.	Input Voltage	Timing Range (Second)	External* Resistor	Prices 1-9
PLUG-IN VERSION				
W388ACPSOX-1	120VAC	1-10	200K	16.32
W388ACPSOX-2		1-120	2.4 MEG	17.76
W388CPSOX-1	24VDC	1-10	160K	18.80
W388CPSOX-2		1-120	2 MEG	20.40
FLANGE MOUNT				
W388ACQSOX-1	120VAC	1-10	200K	16.32
W388ACQSOX-2		1-120	2.4 MEG	17.76
W388CQSOX-1	24VDC	1-10	160K	18.80
W388CQSOX-2		1-120	2 MEG	20.40

*Resistor not furnished.

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SOLID STATE HYBRID TIME DELAY

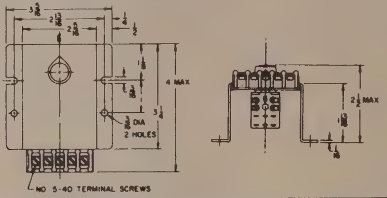
CLASS 218

LOW COST PANEL MOUNTED SOLID STATE (HYBRID) TIME DELAY RELAY WITH CALIBRATED DIAL

AC RELAYS ARE 50/60 Hz

10 AMP—SPDT—SCREW TERMINALS—2% REPEATABILITY

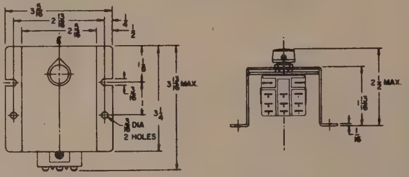
- ±2% repeatability under fixed conditions — ±10% under voltage and temperature extremes.
- Calibrated dial with accuracy to ±10% of full scale.
- Three fully adjustable timing ranges.
- Reset and recycle time 100 ms.
- Time Delay on operate.
- Designed to meet demands of National Electrical Code users in a panel mounted package. Ideal for industrial timing applications.
- Transient protection to twice input voltage for 8 ms.
- Polarity protection DC models only.


3 5/16
2 13/16
2 5/16
1/4
1/2
1 1/8
3/16
4 MAX
3 1/4
3/16 DIA
2 HOLES
NO 5-40 TERMINAL SCREWS
2 1/2 MAX
1 13/16
1/16

Stock Part No.	Nominal Input Voltage	Contacts 10 Amps	Minimum Time (Second)	Maximum Time (Second)	Prices 1-9
W218ACSOSX-2	120VAC	SPDT	1	10	22.61
W218ACSOSX-4			1	180	22.61
W218ACSOSX-5			2	300	22.61

10 AMP—DPDT—SOLDER TERMINALS—2% REPEATABILITY

- ±2% repeatability under fixed conditions (25°C, 120VAC) ±10% over voltage and temperature extremes.
- Calibrated dial with accuracy to ±10% of full scale.
- Three fully adjustable timing ranges.
- Reset and recycle time 100 ms.
- Time Delay on operate.
- Three-way terminals, solder, plug-in or quick connect.
- Transient protection to twice input voltage for 8 ms.
- Polarity protection DC models only.

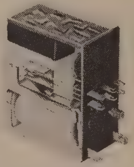

3 5/16
2 13/16
2 5/16
1/4
1/2
1 1/8
3/16
3 13/16 MAX.
3 1/4
3/16 DIA
2 HOLES
2 1/2 MAX.
1 13/16
1/16

Stock Part No.	Nominal Input Voltage	Contacts 10 Amps	Minimum Time (Second)	Maximum Time (Second)	Prices 1-9
W218ACSOX-9	120VAC	DPDT	1	10	21.53
W218ACSOX-10			1	180	21.53
W218ACSOX-11			2	300	21.53

CLASS 67CP

MINIATURE SOLID STATE (HYBRID) TIME DELAY

DPDT 5 AMPS (STD)
±2% REPEATABILITY
DC OPERATION
SLOW OPERATE

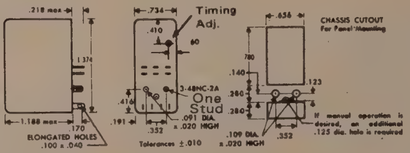


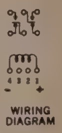
SPECIFICATIONS

Repeatability: ±2% of setting at nominal voltage at 25°C — ±10% over the voltage and temperature.
Nominal Input or Coil Voltage: 12 and 24VDC as standard (other voltages available on special order).
Timing Range: Available as standard: .1 sec. to 30 sec.; 1.0 sec. to 240 sec.; 1.0 sec. to 300 sec. (with external resistor only).
Contact Combination: DPDT as standard.
Contact Rating: 5 amps at 28VDC or 115VAC resistive load.
Reset Time and Recycle Time: Typically 100 ms.
Transient Protection: Twice nominal input for 8 millisecond.
Polarity Protection: Standard.
Temperature Range: Operate: −10 to 55°C. Storage: −50 to 85°C.
Time Delay Mode: Delay on operate.

- External resistor or switch not furnished (can also be external potentiometer).

The Class 67 time delay relay makes use of hybrid circuitry, combining a solid state circuit for the timing function with a miniature industrial relay for up to 4PDT 5 ampere output switching. This relay is engineered and designed for applications requiring 2 form C to 4 form C contacts where space, weight and low cost are of prime importance. Ideal for use in business machines, communication equipment, vending machines and applications requiring long life and reliable performance.


.218 max
1.374
1.188 max
.170
ELONGATED HOLES
.100 x .040
.734
Timing Adj.
.410
.60
3-48NC-2A
One Stud
.416
.191
.352
.091 DIA.
x .020 HIGH
Tolerances ±.010
.656
CHASSIS CUTOUT
For Panel Mounting
.780
.140
.280
.280
.123
.109 DIA.
x .020 HIGH
.352
If manual operation is desired, an additional .125 dia. hole is required


4 3 2 1
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WIRING DIAGRAM

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Input VDC	Timing Range (Slow Operate) (Second)	External Resistance	Prices 1-9
W67CPSOX-1	12	.1-30	Internal Adjustable Potentiometer Included	21.98
W67CPSOX-2	24	.1-30		21.98
W67CPSOX-3	12	1-240		23.78
W67CPSOX-4	24	1-240		23.78
W67CPSOX-5	12	.1-30	External Resistor Needed	18.07
W67CPSOX-6	24	.1-30		17.71
W67CPSOX-7	12	1-240		19.91
W67CPSOX-8	24	1-240		19.91

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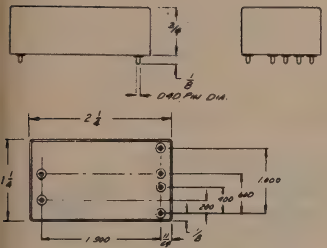
PRINTED CIRCUIT TIME DELAYS

CLASS 502PCSO
SLOW OPERATE P.C. TIME DELAY RELAY

ADJUSTABLE TO 5 MINUTES
SPST-NO (Form A) 1 AMP 15VA, 250VAC

Magnecraft ELECTRIC CO.
CHICAGO
NEG.
POS
MAGNETIME DELAY RELAY



The Class 502PCSOX and 503PCSOX Time Delays make use of hybrid circuitry combining a monolythic silicon structure in the control function with a dry reed relay performing isolated circuit switching. The following outstanding features are offered:

- Time delay on operate, adjustable to 5 minutes.
- Two fully adjustable timing ranges using a remote pot or fixed resistor.
- Encapsulated fully protected construction.
- Polarity protection standard.
- Printed circuit low profile package.

SPECIFICATIONS

Contacts: Two combinations available:—
502PCSOX, SPST-NO, 1 amp, 15VA or 250VAC maximum, resistive.
503PCSOX, SPDT, .5 amp, 10VA or 250VAC maximum, resistive.

Mode of Operation: Time delay on operate.

Timing Ranges: 100 millisecond to 100 second using approximately 50k ohm/sec. external resistor.
3 seconds to 5 minutes using approximately 10k ohm/sec. external resistor.

Timing Repeatability: ±5% at nominal voltage at 25°C after the first cycle and ±10% over voltage range or temperature range indicated.

Nominal Input: 12 and 24VDC standard.

Protection: Transient to twice input voltage for 8 ms. Polarity protection standard DC models.

Steady State Current: 25 mA typical.

Temperature Range: Operate — 10°C to 55°C. Storage — 55°C to 85°C.

Size: 2.25 x 1.25 x .75 inches.

Label: Bottom pin view.

CLASS 503PCSO
SLOW OPERATE P.C. TIME DELAY RELAY

ADJUSTABLE TO 5 MINUTES
SPDT (Form C) .5 AMP 10VA, 250VAC

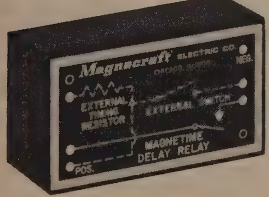
Magnecraft ELECTRIC CO.
CHICAGO
NEG.
POS
MAGNETIME DELAY RELAY

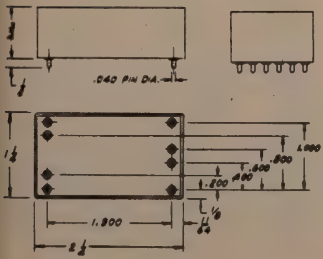
Stock Part No.	VDC ± 15%	Timing Range	*External-Adjust. (Ohm/Sec.)	Prices 1-9
SPST-NO (Form A)				
W502PCSOX-2	12	100 mSec. to 100 Sec.	50k	21.96
W502PCSOX-3	24	100 mSec. to 100 Sec.	50k	21.96
W502PCSOX-5	12	3 Sec. to 5 Min.	10k	24.66
W502PCSOX-6	24	3 Sec. to 5 Min.	10k	24.66
SPDT (Form C)				
W503PCSOX-2	12	100 mSec. to 100 Sec.	50k	24.10
W503PCSOX-3	24	100 mSec. to 100 Sec.	50k	24.10
W503PCSOX-5	12	3 Sec. to 5 Min.	10k	25.83
W503PCSOX-6	24	3 Sec. to 5 Min.	10k	25.83

*External Resistor and/or switch, not furnished.

CLASS 502PCSR
SLOW RELEASE P.C. TIME DELAY RELAY

ADJUSTABLE TO 5 MINUTES
SPST-NO (Form A) 1 AMP 15VA, 250VAC





The Class 502PCSRX and 503PCSRX Time Delays make use of hybrid circuitry combining a monolythic silicon structure in the control function with a dry reed relay performing isolated circuit switching. The following outstanding features are offered:

- Time delay on release, adjustable to 5 minutes.
- Two fully adjustable timing ranges using a remote pot or fixed resistor.
- Encapsulated fully protected construction.
- Precise repeatability.
- Printed circuit low profile package.

SPECIFICATIONS

Contacts: Two combinations available:—
502PCSRX, SPST-NO, 1 amp, 15VA or 250VAC maximum, resistive.
503PCSRX, SPDT, .5 amp, 10VA or 250VAC maximum, resistive.

Mode of Operation: Time delay on release.

Timing Ranges: 200 millisecond to 100 second using approximately 50k ohm/sec. external resistor.
1 second to 5 minutes using approximately 10k ohm/sec. external resistor.

Timing Repeatability: ±2% at nominal voltage at 25°C and ±4% over voltage range or temperature range indicated.

Nominal Input: 12 and 24VDC standard.

Reset Time: Typically less than 100 milliseconds.

Protection: Transient to twice input voltage for 8 ms. Polarity protection standard DC models.

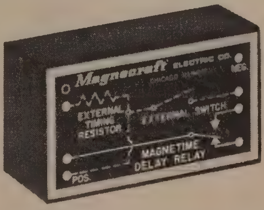
Temperature Range: Operate — 10°C to 55°C. Storage — 55°C to 85°C.

Size: 2.25 x 1.25 x .75 inches.

Label: Bottom pin view.

CLASS 503PCSR
SLOW RELEASE P.C. TIME DELAY RELAY

ADJUSTABLE TO 5 MINUTES
SPDT (Form C) .5 AMP 10VA, 250VAC



Stock Part No.	VDC ± 15%	Timing Range	*External-Adjust. (Ohm/Sec.)	Prices 1-9
SPST-NO (Form A)				
W502PCSRX-2	12	200 mSec. to 100 Sec.	50k	30.94
W502PCSRX-3	24	200 mSec. to 100 Sec.	50k	30.94
W502PCSRX-5	12	1 Sec. to 5 Min.	10k	34.55
W502PCSRX-6	24	1 Sec. to 5 Min.	10k	34.55
SPDT (Form C)				
W503PCSRX-2	12	200 mSec. to 100 Sec.	50k	33.10
W503PCSRX-3	24	200 mSec. to 100 Sec.	50k	33.10
W503PCSRX-5	12	1 Sec. to 5 Min.	10k	36.70
W503PCSRX-6	24	1 Sec. to 5 Min.	10k	36.70

*External Resistor and/or switch, not furnished.

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DIPS DUAL-INLINE PACKAGE REED

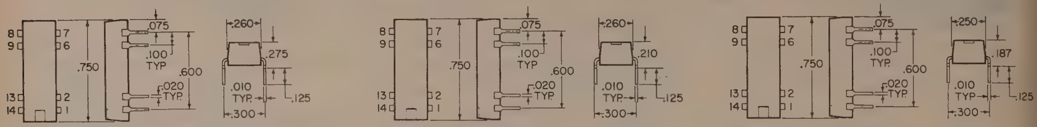
DRY REED DIPS

Magnecraft has always been proud of it's DIP (dual-inline-package) line of 8 and 14 pin reed relays. Now we are even prouder of the latest DIP variations: high voltage, high reliability, and mercury wetted types are now available on special order. All the DIP relays are designed not only to be compatible with the standard packaging developed for integrated circuits, but to offer Magnecraft quality at a low cost. This unique design gives further savings by offering the user the optimum in automated insertion and other economical installation techniques associated with printed circuit applications.

These fantastic, new, epoxy-molded, reed relays are offered in three height profiles (see figure below) and are ideal for use in circuits where high density packaging is essential. The 5VDC IC compatible versions of these relays will operate directly from TTL or DTL circuits.

Other standard coil voltages are available from stock in 6, 12, and 24VDC as well as contact configurations in 1 form A, 2 form A, 1 form B, 1 form C**, and 2 form C**. Most versions are listed with a choice of an internal clamping diode. See wiring diagrams as well as specific information given on each relay for complete details.

THREE STANDARD PROFILE HEIGHTS



SMALL (LOWER COST)
CLASS 171 & 172

SMALLER
CLASS 118 & 117

SMALLEST
CLASS 107

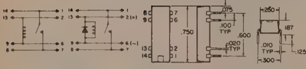
**Under certain drive and load conditions dynamic bridging can occur. The user should protect the circuit.

CLASS 107DIP

8-PIN

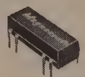
SPST-NO
.200 AMPS AT 5VA
LOWEST PROFILE

Contact Load Rating: 5VA at .200 amps max. or 50VDC max. resistive.
Contact Combination: SPST-NO (1 form A).
Operate Time: 200 microseconds typical.
Dielectric Strength Between Contacts: 200VDC min.
Insulation Resistance: 10^9 ohms.
Contact Resistance: 200 milliohms ave.
Typical Life at Rated Load: 10 million operations, longer at reduced loads.
Mechanical Characteristics: Shock 100 g's; at ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to +85°C.
Epoxy Molded Construction



Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W107DIP-1	3.8VDC	5	500	50mW	4.41
W107DIP-2	4.5VDC	6	500	75mW	3.86
W107DIP-3	9.0VDC	12	500	300mW	3.86
W107DIP-4	18.0VDC	24	1,200	500mW	4.14
Internal Clamping Diode* — NO					
W107DIP-5	3.8VDC	5	500	50mW	5.19
W107DIP-6	4.5VDC	6	500	75mW	4.63
W107DIP-7	9.0VDC	12	500	300mW	4.63
W107DIP-8	18.0VDC	24	1,200	500mW	4.90
Internal Clamping Diode* — YES					

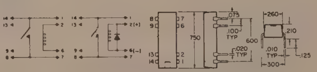
CLASS 117DIP



8-PIN

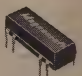
SPST-NO
.500 AMPS AT 10VA

Contact Load Rating: 10VA at .500 amps max. or 100VDC max. resistive.
Contact Combination: SPST-NO (1 form A)
Operate Time: 500 microseconds, typical.
Dielectric Withstanding Voltage Between Contacts: 200VDC min.
Insulation Resistance: 10^9 ohms.
Contact Resistance: 150 milliohms ave.
Typical Life at Rated Load: 25 million operations, longer at reduced loads. Higher rating up to .5 amp at reduced life.
Mechanical Characteristics: Shock 100 g's; at ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to+85°C.
Epoxy Molded Construction



Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W117DIP-1	3.8VDC	5	200	125mW	3.92
W117DIP-2	4.5VDC	6	200	180mW	3.56
W117DIP-3	9.0VDC	12	500	300mW	3.56
W117DIP-4	18.0VDC	24	1,200	500mW	3.78
Internal Clamping Diode* — NO					
W117DIP-5	3.8VDC	5	200	125mW	4.75
W117DIP-6	4.5VDC	6	200	180mW	4.33
W117DIP-7	9.0VDC	12	500	300mW	4.33
W117DIP-8	18.0VDC	24	1,200	500mW	4.60
Internal Clamping Diode* — YES					

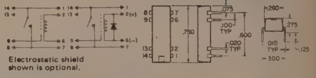
CLASS 171DIP



8-PIN

SPST-NO
.500 AMPS AT 10VA
LOWEST COST DIP

Contact Load Rating: 10VA or .500 amps max. or 150VDC max., 10VA max. resistive.
Contact Combination: SPST-NO (1 form A).
Operate Time: 500 microseconds average at nominal drive.
Contact Bounce: Less than 200 microseconds ave.
Dielectric Withstanding Voltage: Across open contacts, 250VDC min.; Coil to contact, 750VAC.
Contact Resistance: 150 milliohms ave.
Insulation Resistance: 10^{11} ohms min.
Typical Life at Rated Load: 25 million operations, longer at reduced loads.
Mechanical Characteristics: Shock 100 g's; at ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to +85°C.
Epoxy Molded Construction



Electrostatic shield shown is optional.

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W171DIP-2	3.8VDC	5	500	50mW	3.51
W171DIP-3	4.5VDC	6	500	75mW	3.09
W171DIP-4	9.0VDC	12	500	290mW	3.09
W171DIP-5	18.0VDC	24	2,200	270mW	3.48
Internal Clamping Diode* — NO					
W171DIP-7	3.8VDC	5	500	50mW	4.12
W171DIP-8	4.5VDC	6	500	75mW	3.74
W171DIP-9	9.0VDC	12	500	290mW	3.74
W171DIP-10	18.0VDC	24	2,200	270mW	4.12
Internal Clamping Diode* — YES					

*This diode prevents back flow of high voltage transients.

**Resistance values ±10% measured at 25°C.

Magnecraft® DIPS DUAL-INLINE PACKAGE REED

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CLASS 117DIP

8-PIN

SPST-NC

.250 AMPS AT 8VA

Contact Load Rating: 8VA at .250 amp max. or 100VDC max. resistive.

Contact Combination: SPST-NC (1 form B)

Operate Time: 200 microseconds typical.

Dielectric Withstanding Voltage: Across open contacts, 200VDC min.; Coil to contact, 750VAC.

Insulation Resistance: 10^9 ohms.

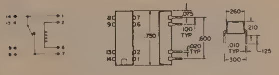
Contact Resistance: 200 milliohms ave.

Typical Life at Rated Load: 10 million operations, longer at reduced loads. Higher ratings up to .5 amp at reduced life.

Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction



Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W117DIP-13	3.8VDC	5	500	50mW	4.80

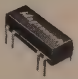
Internal Clamping Diode* — NO

CLASS 171DIP

8-PIN

SPST-NC

.250 AMPS AT 10VA



Contact Load Rating: 10VA or .250 amps max. or 100VDC max. resistive.

Contact Combination: SPST-NC (1 form B)

Operate Time: 400 microseconds ave.

Contact Bounce: Less than 100 microseconds ave.

Dielectric Withstanding Voltage: Across open contacts, 250VDC min.; Coil to contact, 750VAC.

Contact Resistance: 150 milliohms ave.

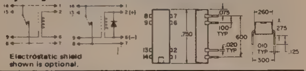
Insulation Resistance: 10^{11} ohms min.

Typical Life at Rated Load: 10 million operations, longer at reduced loads.

Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction



Electrostatic shield shown is optional.

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W171DIP-12	3.8VDC	5	500	50mW	4.17
W171DIP-13	4.5VDC	6	500	75mW	3.95
W171DIP-14	9.0VDC	12	1,200	120mW	3.95
W171DIP-15	18.0VDC	24	2,200	270mW	4.14

Internal Clamping Diode* — NO

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W171DIP-17	3.8VDC	5	500	50mW	4.46
W171DIP-18	4.5VDC	6	500	75mW	4.24
W171DIP-19	9.0VDC.	12	1,200	120mW	4.24
W171DIP-20	18.0VDC	24	2,200	270mW	4.45

Internal Clamping Diode* — YES

CLASS 117DIP

8-PIN

DPST-NO

.110 AMPS AT 3VA

Contact Load Rating: 5VA at .110 amp max. or 28VDC max. resistive.

Contact Combination: DPST-NO (2 form A)

Operate Time: 500 microseconds typical.

Dielectric Withstanding Voltage: Across open contacts, 200VDC min.; Coil to contact, 750VAC; Between contact, 750VAC.

Insulation Resistance: 10^9 ohms.

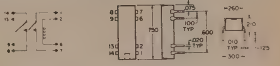
Contact Resistance: 200 milliohms ave.

Typical Life at Rated Load: 10 million operations, longer at reduced loads.

Mechanical Characteristics: Shock 100 g's; at ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction



Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W117DIP-9	3.8VDC	5	200	125mW	6.34
W117DIP-10	4.5VDC	6	200	180mW	5.82
W117DIP-11	9.0VDC	12	500	300mW	5.82
W117DIP-12	18.0VDC	24	1,200	500mW	6.17

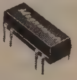
Internal Clamping Diode* — NO

CLASS 171DIP

8-PIN

DPST-NO

.110 AMPS AT 3VA



Contact Load Rating: 3VA or .110 amps max. or 28VDC max. resistive.

Contact Combination: DPST-NO (2 form A)

Operate Time: 700 microseconds ave.

Contact Bounce: Less than 500 microseconds ave.

Dielectric Withstanding Voltage: Across open contacts, 200VDC min.; Coil to contact, 750VAC; Between contact, 750VAC.

Contact Resistance: 200 milliohms ave.

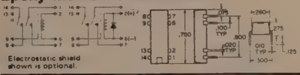
Insulation Resistance: 10^{10} ohms min.

Typical Life at Rated Load: 10 million operations, longer at reduced loads.

Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction



Electrostatic shield shown is optional.

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W171DIP-21	3.8VDC	5	200	125mW	5.71
W171DIP-22	4.5VDC	6	200	180mW	5.49
W171DIP-23	9.0VDC	12	500	290mW	5.49
W171DIP-24	18.0VDC	24	2,200	270mW	6.51

Internal Clamping Diode* — NO

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W171DIP-25	3.8VDC	5	200	120mW	6.67
W171DIP-26	4.5VDC	6	200	180mW	6.56
W171DIP-27	9.0VDC	12	500	290mW	6.56
W171DIP-28	18.0VDC	24	2,200	270mW	6.81

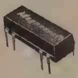
Internal Clamping Diode* — YES

CLASS 118DIP

8-PIN

SPDT

.250 AMPS AT 6VA



Contact Load Rating: 8VA at .250 amps max. or 100VDC max. resistive.

Contact Combination: SPDT (1 form C).

Operate Time: 500 microseconds, typical.

Dielectric Withstanding Voltage Between Contacts: 200VDC min.; Coil to contact, 750VAC.

Insulation Resistance: 10^9 ohms.

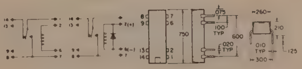
Contact Resistance: 200 milliohms ave.

Typical Life: 5 million at rated load. Longer at reduced loads.

Mechanical Characteristics: Shock 100 g's; at ½ sine wave, 11 milliseconds. Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction



Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W118DIP-1	3.8VDC	5	200	125mW	8.60
W118DIP-2	4.5VDC	6	200	180mW	8.05
W118DIP-3	9.0VDC	12	500	290mW	8.05
W118DIP-4	18.0VDC	24	1,200	480mW	8.27

Internal Clamping Diode* — NO

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W118DIP-5	3.8VDC	5	200	125mW	9.38
W118DIP-6	4.5VDC	6	200	180mW	8.82
W118DIP-7	9.0VDC	12	500	290mW	8.82
W118DIP-8	18.0VDC	24	1,200	480mW	9.09

Internal Clamping Diode* — YES

CLASS 172DIP

8-PIN

SPDT

.250 AMPS AT 8VA

Contact Load Rating: 8VA at .250 amps max. or 100VDC max. resistive.

Contact Combination: SPDT (1 form C).

Operate Time: 600 microseconds ave.

Contact Bounce: Less than 200 microseconds ave.

Dielectric Withstanding Voltage: Across open contacts, 250VDC min.; Coil to contact, 750VAC.

Contact Resistance: 200 milliohms ave.

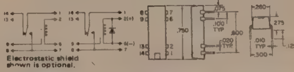
Insulation Resistance: 10^{10} ohms min.

Typical Life at Rated Load: 10 million operations, longer at reduced loads.

Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction



Electrostatic shield shown is optional.

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W172DIP-1	3.8VDC	5	200	125mW	5.79
W172DIP-2	4.5VDC	6	200	180mW	5.48
W172DIP-3	9.0VDC	12	500	290mW	5.48
W172DIP-4	18.0VDC	24	2,200	270mW	5.83

Internal Clamping Diode* — NO

Stock Part No.	Coil			Typical Power Required	Prices 1-24
	Max. Pick-up Voltage	Nom. Volts	** Ohms		
W172DIP-5	3.8VDC	5	200	125mW	6.17
W172DIP-6	4.5VDC	6	200	180mW	5.93
W172DIP-7	9.0VDC	12	500	290mW	5.93
W172DIP-8	18.0VDC	24	2,200	270mW	6.29

Internal Clamping Diode* — YES

*This diode prevents back flow of high voltage transients.

**Resistance values ±10% measured at 25°C.

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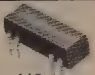
MICRO-MINIATURE & MINIATURE REEDS

CLASS 172DIP



8 PIN, DPDT, .110 AMPS

Contact Load Rating: 2VA or .110 amps max. or 28VDC max. resistive.

Contact Combination: DPDT (2 form C).

Operate Time: 750 microseconds ave.

Contact Bounce: Less than 300 microseconds ave.

Dielectric Withstanding Voltage: Between contacts, 750VAC; Across open contacts, 115VDC min; Coil to contact, 750VAC.

Contact Resistance: 200 milliohms ave.

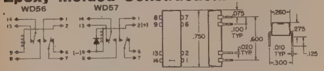
Insulation Resistance: 10^9 ohms min.

Typical Life at Rated Load: 5 million operations, longer at reduced loads.

Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.

Temperature Range: −55°C to +85°C.

Epoxy Molded Construction.

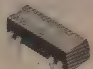


SHIPPED PROMPTLY ON SPECIAL ORDER

	Coil			Typical	
Stock Part No.	**Max. Pick-up Voltage**	**Volts**	**** Ohms**	**Power Required**	**Prices 1-24**
W172DIP-17§	3.8VDC	5	60	420MW	16.35
W172DIP-18§	4.5VDC	6	60	600MW	14.32
W172DIP-19§	9.0VDC	12	200	720MW	14.32
W172DIP-20§	18.0VDC	24	800	720MW	16.18
W172DIP-21¶	3.8VDC	5	60	420MW	18.31
W172DIP-22¶	4.5VDC	6	60	600MW	16.63
W172DIP-23¶	9.0VDC	12	200	720MW	16.63
W172DIP-24¶	18.0VDC	24	800	720MW	18.31

*Internal Clamping Diode — §No.
*Internal Clamping Diode — ¶Yes.

CLASS 174DIP



8-PIN, SPST-NO, 1 AMP MERCURY WETTED

Contact Load Rating: 25VA or 1 amp max. or 100VDC max. resistive.

Contact Combination: SPST-NO (1 form A).

Operate Time: 1.5 milliseconds ave.

Contact Bounce: None, with diode suppressed coil.

Dielectric Withstanding Voltage: Across open contacts, 1000VDC min., Coil to contact, 750VAC.

Contact Resistance: 100 milliohms ave.

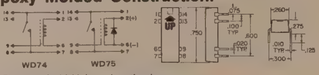
Insulation Resistance: 10^{11} ohms min.

Typical Life at Rated Load: 40 million operations, longer at reduced loads.

Operation Position: Upright. Not more than 30° from vertical.

Temperature Range: −38°C to +85°C.

Epoxy Molded Construction.



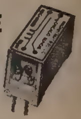
Electrostatic shield shown is optional.

SHIPPED PROMPTLY ON SPECIAL ORDER

	Coil			Typical	
Stock Part No.	**Max. Pick-up Voltage**	**Volts**	**** Ohms**	**Power Required**	**Prices 1-24**
W174DIP-1§	3.8VDC	5	55	500MW	9.33
W174DIP-2§	4.5VDC	6	55	650MW	8.17
W174DIP-3§	9.0VDC	12	300	500MW	8.17
W174DIP-4§	18.0VDC	24	1100	500MW	9.23
W174DIP-5¶	3.8VDC	5	55	500MW	10.03
W174DIP-6¶	4.5VDC	6	55	650MW	9.12
W174DIP-7¶	9.0VDC	12	300	500MW	9.12
W174DIP-8¶	18.0VDC	24	1100	500MW	10.03

*Internal Clamping Diode — §No.
*Internal Clamping Diode — ¶Yes.

CLASS 105MPC
MICRO-MINIATURE REED RELAY



SPST-NO, 10 mA
PRINTED CIRCUIT MTG.
NOMINAL POWER 300mW
MPC HIGH RELIABILITY
PRINTED CIRCUIT CONSTRUCTION

Operate: ¼ ms ave.

Release: ½ ms ave.

Contact Bounce: ½ ms ave.

Contact Load Rating: 0.1VA max. at 10 mA max. or 12V max. resistive.

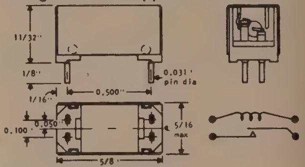
Contact Resistance: 200 milliohms ave. Capacitance across contacts, 0.5 pF ave.

Life Expectancy: 10 million cycles at rated load.

Operating Position: Any.

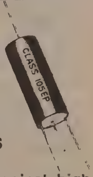
Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Contacts	Coil		Prices
		†Volts	***Ohms**	**1-24**
W105MPCX-1	SPST-NO	6VDC	120	6.31
W105MPCX-2		12VDC	500	6.33
W105MPCX-3		24VDC	2,000	6.46

CLASS 105EP
MICRO-MINIATURE ENCAPSULATED REED RELAY



SPST-NO, 10 mA
WITH IN-LINE AXIAL LEADS
NOMINAL POWER 400mW

- Encapsulated to protect against high humidity and corrosive atmosphere.
- Highly resistant to shock.

Operate: ¼ ms ave.

Release: ½ ms ave.

Contact Bounce: ½ ms ave.

Contact Load Rating: 0.1VA max. at 10 mA max. or 12V max. resistive.

Contact Resistance: 200 milliohms ave.

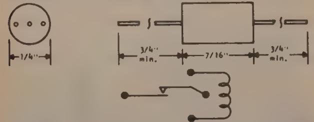
Capacitance Across Contacts: 0.5 pF ave.

Life Expectancy: 10 million cycles at rated load.

Operating Position: Any.

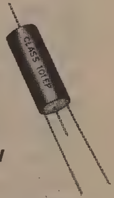
Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Contacts	Coil		Prices
		†Volts	***Ohms**	**1-24**
W105EPX-1	SPST-NO	6VDC	90	7.15
W105EPX-2		12VDC	350	7.15
W105EPX-3		24VDC	1,300	7.30

CLASS 101EP
ENCAPSULATED MINIATURE REED RELAY



IN-LINE AXIAL LEADS
SPST-NO, .5 AMP
NOMINAL POWER 600mW

Operate: 1 ms ave.

Release: ½ ms ave.

Contact Bounce: Less than ½ ms ave.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.

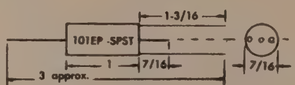
Contact Resistance: 150 milliohms ave.

Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

Capacitance Across Contacts: 0.5 pF ave.

Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Contacts	Coil		Prices
		†Volts	***Ohms**	**1-24**
W101EPX-5	SPST-NO	6VDC	65	3.80
W101EPX-6		12VDC	225	3.80
W101EPX-7		24VDC	1,000	4.45
W101EPX-8††		—	5,000	4.91

††8mA—Current operated relays pull in at specified value or less.

CLASS 101MPC
LOW COST MINIATURE REED RELAY

SPST-NO, .5 AMP
NOMINAL POWER 500mW
PRINTED CIRCUIT MOUNTING

Contact Load Rating: 10VA at .5 amp or 200VDC max. resistive.

Operate Time: 1 ms ave.

Release Time: .5 ms ave.

Contact Bounce: Less than .5 ms ave.

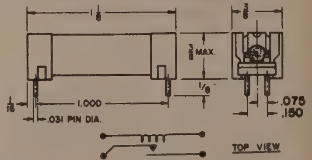
Contact Resistance: 150 milliohm ave.

Life at Rated Load: 5 million cycles; 20 million at half load.

Capacitance Across Contacts: .8 pF ave.

Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



		Coil		Prices
Stock Part No.	**Contacts**	**†Volts**	***Ohms**	**1-24**
W101MPCX-122	SPST-NO	6VDC	70	2.92
W101MPCX-123		12VDC	300	2.92
W101MPCX-124		24VDC	1,100	2.92

*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays, at 25°C.
‡Current specified relays pull in at specified value or less.

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CLASS 101M

MINIATURE REED RELAY

IN-LINE AXIAL LEADS
SPST-NO .5 AMP
IC COMPATIBLE

Operate Time: 1 ms ave.

Release Time: .5 ms ave.

Contact Bounce: Less than .5 ms ave.

Contact Load Rating: 10VA at .5 amp max. or 100VDC max. resistive.

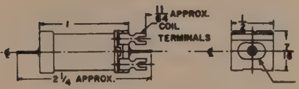
Contact Resistance: 150 milliohms ave.

Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

Capacitance Across Contacts: .5 pF ave.

Insulation Resistance: 10^9 ohms min.

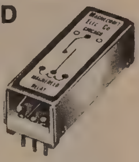
- Weight — 1 oz. approx.



Stock Part No.	Nom. Power	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W101MX-41	50mW	—	3VDC	250	2.95
W101MX-35	50mW	—	5VDC	500	2.95
W101MX-1	600mW	—	6VDC	100	2.20
W101MX-2	600mW	—	12VDC	250	2.25
W101MX-3	600mM	—	24VDC	500	2.25
W101MX-4	600mW	9	—	2,500	2.43

CLASS 101MPC

MINIATURE REED RELAY



PRINTED CIRCUIT MTG.
SPST-NO .5 AMP
IC COMPATIBLE

Operate Time: 1 ms ave.

Release Time: .5 ms ave.

Contact Bounce: Less than .5 ms ave.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.

Contact Resistance: 150 milliohms ave.

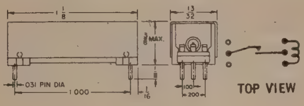
Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

Capacitance Across Contacts: .8 pF ave.

- Molded bobbin and steel cover provide protection and magnetic shielding.

Insulation Resistance: 10^9 ohms min.

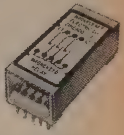
- Weight — 1 oz. approx.



Stock Part No.	Nom. Power	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W101MPCX-104	50mW	—	5VDC	450	4.55
W101MPCX-1	500mW	—	6VDC	70	3.60
W101MPCX-2	500mW	—	12VDC	300	3.60
W101MPCX-3	500mW	—	24VDC	1,100	3.63
W101MPCX-4	500mW	—	48VDC	4,300	3.77

CLASS 101MPC

MINIATURE REED RELAY



PRINTED CIRCUIT MTG.
3PST-NO .5 AMP
NOMINAL POWER 700mW

Operate: 1 ms ave.

Release: ½ ms ave.

Contact Bounce: Less than ½ ms ave.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.

Contact Resistance: 150 milliohms ave.

Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

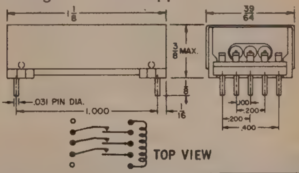
Capacitance Across Contacts: 1.0 pF ave.

Operates: In any position.

- Molded bobbin and steel cover provide protection and magnetic shielding.

Insulation Resistance: 10^9 ohms min.

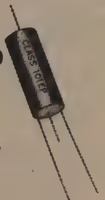
- Weight — 2 ozs. approx.



Stock Part No.	Con-tacts	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W101MPCX-5	3PST-NO	—	6VDC	50	6.75
W101MPCX-6		—	12VDC	220	6.75
W101MPCX-7		—	24VDC	850	6.77
W101MPCX-8		—	48VDC	3,300	6.85

CLASS 101EP

ENCAPSULATED MINIATURE REED RELAY



IN-LINE AXIAL LEADS
SPST-NO .5 AMP
NOMINAL POWER 600mW

Operate: 1 ms ave.

Release: ½ ms ave.

Contact Bounce: Less than ½ ms ave.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.

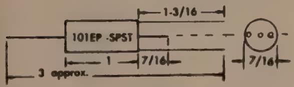
Contact Resistance: 150 milliohms ave.

Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

Capacitance Across Contacts: .5 pF ave.

Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Con-tacts	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W101EPX-5	SPST-NO	—	6VDC	65	3.80
W101EPX-6		—	12VDC	225	3.80
W101EPX-7		—	24VDC	1,000	4.45
W101EPX-8		8	—	5,000	4.91

CLASS 101PC

ULTRA-RELIABLE ENCAPSULATED REED RELAY

MAGNECRAFT

PRINTED CIRCUIT MTG.
SPST-NO .5 AMP
NOMINAL POWER 600mW

Operate: 1 ms ave.

Release: ½ ms ave.

Contact Bounce: Less than ½ ms ave.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.

Contact Resistance: 150 milliohms ave.

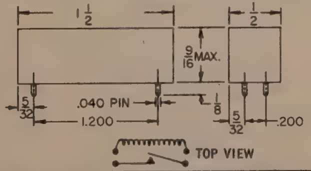
Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

Capacitance Across Contacts: .8 pF ave.

Operates: In any position.

Insulation Resistance: 10^9 ohms min.

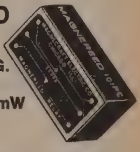
- Weight — 1 oz. approx.



Stock Part No.	Con-tacts	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W101PCX-5	SPST-NO	—	6VDC	65	5.64
W101PCX-6		—	12VDC	250	5.69
W101PCX-7		—	24VDC	1,000	5.80
W101PCX-8		8	—	5,000	6.26

CLASS 101PC

ULTRA-RELIABLE ENCAPSULATED REED RELAY



PRINTED CIRCUIT MTG.
DPST-NO .5 AMP
NOMINAL POWER 900mW

Operate: 1 ms ave.

Release: ½ ms ave.

Contact Bounce: Less than ½ ms ave.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.

Contact Resistance: 150 milliohms ave.

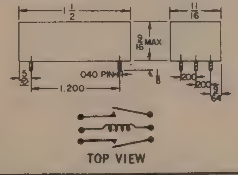
Life Expectancy: 5 million cycles at full load; 20 million at ½ load.

Capacitance Across Contacts: 1.0 pF ave.

Operates: In any position.

Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Nom. Power	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W101PCX-9	DPST-NO	—	6VDC	40	7.89
W101PCX-10		—	12VDC	150	7.92
W101PCX-11		—	24VDC	650	7.98
W101PCX-12		8	—	5,000	8.47

*Resistance values ±10%, measured at 25°C.

†Voltage specified relays pull in at 80% of nominal or less for DC relays at 25°C.

††Current operated relays pull in at specified value or less.

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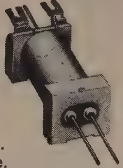
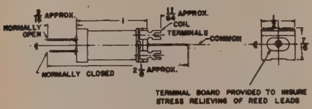
CLASS 104M MINIATURE REED RELAY



IN-LINE AXIAL LEAD SPDT .25 AMP MOLDED BOBBIN IC COMPATIBLE

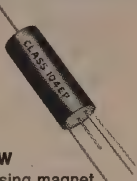
Operate Time: 1 ms ave.
Release Time: 1 ms ave.
Contact Bounce: Less than .5 ms ave. NO contacts; less than 2 ms ave. NC contacts.
Contact Load Rating: 3VA max. at .25 amp max. or 28V max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 1.5 pF ave.
Life Expectancy: 10 million cycles at full load.
Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Nom. Power	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W104MX-10	50mW	—	3VDC	250	6.84
W104MX-9	50mW	—	5VDC	500	6.84
W104MX-1	500mW	—	6VDC	100	5.91
W104MX-2	500mW	—	12VDC	250	5.96
W104MX-3	500mW	—	24VDC	500	5.96
W104MX-4	500mW	9	—	2,500	6.16

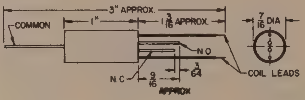
CLASS 104EP ENCAPSULATED MINIATURE REED RELAY



IN-LINE AXIAL LEAD SPDT .25 AMP NOMINAL POWER 600mW

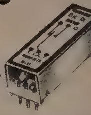
SPDT, true form C, no biasing magnet.
Operate Time: 1 ms ave.
Release Time: 1 ms ave.
Contact Bounce: Less than ½ ms ave. NO contacts; less than 2 ms ave. NC contacts.
Contact Load Rating: 3VA max. at .25 amp max. or 28V max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 1.5 pF ave.
Life Expectancy: 10 million cycles at full load.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.



Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W104EPX-2	SPDT	—	6VDC	65	7.74
W104EPX-3		—	12VDC	225	7.74
W104EPX-4		—	24VDC	1,000	8.45
W104EPX-5		8	—	5,000	8.98

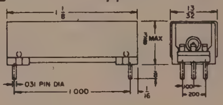
CLASS 104MPC MINIATURE REED RELAY

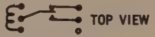


PRINTED CIRCUIT MTG. SPDT .25 AMP IC COMPATIBLE

SPDT, true form C, no biasing magnet.
Operate Time: 1 ms ave.
Release Time: .5 ms ave.
Contact Bounce: Less than .5 ms ave. NO contacts; less than 2 ms ave. NC contacts.
Contact Load Rating: 8VA max. at .25 amp max. or 100VDC max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 1.5 pF ave.
Life Expectancy: 10 million cycles at full load.
Insulation Resistance: 10^9 ohms min.

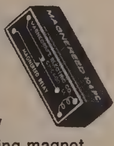
- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 1 oz. approx.





Stock Part No.	Nom. Power	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W104MPCX-46	80mW	—	5VDC	300	7.91
W104MPCX-1	500mW	—	6VDC	70	6.82
W104MPCX-2	500mW	—	12VDC	300	6.83
W104MPCX-3	500mW	—	24VDC	1,100	6.85
W104MPCX-4	500mW	—	48VDC	4,300	6.98

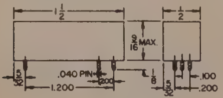
CLASS 104PC ULTRA-RELIABLE ENCAPSULATED REED RELAY

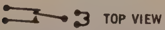


PRINTED CIRCUIT MTG. SPDT .25 AMP NOMINAL POWER 600mW

SPDT, true form C, no biasing magnet.
Operate Time: 1 ms ave.
Release Time: 1 ms ave.
Contact Bounce: Less than ½ ms ave. NO contacts; less than 2 ms ave. NC contacts.
Contact Load Rating: 8VA max. at .25 amp max. or 100VDC max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 1.5 pF ave.
Life Expectancy: 10 million cycles at full load.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.

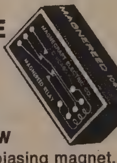
- Weight — 1 oz. approx.





Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W104PCX-7	SPDT	—	6VDC	65	10.57
W104PCX-8		—	12VDC	225	10.63
W104PCX-9		—	24VDC	1,000	10.73
W104PCX-10		8	—	5,000	11.17

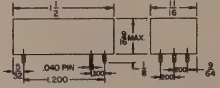
CLASS 104PC ULTRA-RELIABLE ENCAPSULATED REED RELAY

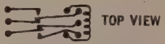


PRINTED CIRCUIT MTG. DPDT .25 AMP NOMINAL POWER 900mW

DPDT, true 2 Form C, no biasing magnet.
Operate Time: 1 ms ave.
Release Time: 1 ms ave.
Contact Bounce: Less than ½ ms ave. NO contacts; less than 2 ms ave. NC contacts.
Contact Load Rating: 8VA max. at .25 amp max. or 100VDC max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 2.0 pF ave.
Life Expectancy: 10 million cycles at full load.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.

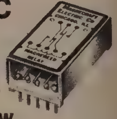
- Weight — 3 ozs. approx.





Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W104PCX-3	DPDT	—	6VDC	40	15.32
W104PCX-4		—	12VDC	150	15.35
W104PCX-5		—	24VDC	650	15.41
W104PCX-6		8	—	5,000	15.89

CLASS 104MPC MINIATURE REED RELAY



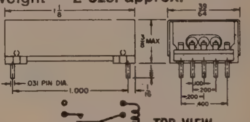
PRINTED CIRCUIT MTG. DPDT .25 AMP NOMINAL POWER 700mW

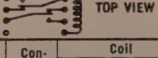
DPDT, true Form C, no biasing magnet.
Operate Time: 1 ms ave.
Release Time: 1 ms ave.
Contact Bounce: Less than ½ ms ave. NO contacts; less than 2 ms ave. NC contacts.
Contact Load Rating: 8VA max. at .25 amp max. or 100VDC max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 2.0 pF ave.
Life Expectancy: 10 million cycles at full load.
Operating Position: Any.

- Molded bobbin and steel cover provide protection and magnetic shielding.

Insulation Resistance: 10^9 ohms min.

- Weight — 2 ozs. approx.





Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W104MPCX-5	DPDT	—	6VDC	50	11.62
W104MPCX-6		—	12VDC	220	11.63
W104MPCX-7		—	24VDC	850	11.65
W104MPCX-8		—	48VDC	3,300	11.73

*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays at 25°C.
††Current operated relays pull in at specified value or less.

Magnecraft® STANDARD & IC COMPATIBLE REEDS

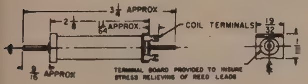
5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

CLASS 102M STANDARD SIZE REED RELAY

IN-LINE AXIAL LEADS
MOLDED BOBBIN
SPST-NO 1 AMP
IC COMPATIBLE

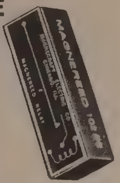
Operate Time: 3 ms ave.
Release Time: .5 ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Load Rating: 15VA at 1 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 20 million cycles at full load; 100 million at ½ load.
Capacitance Across Contacts: .9 pF ave.
Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.


3 1/4 APPROX
2 1/64 APPROX
COIL TERMINALS
19/32
1/16 APPROX
TERMINAL BOARD PROVIDED TO INSURE STRESS RELIEVING OF REED LEADS

Stock Part No.	Nom. Power	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102MX-27	50mW	—	5VDC	450	3.10
W102MX-1	300mW	40	—	100	2.52
W102MX-2	300mW	—	6VDC	200	2.60
W102MX-3	300mW	—	12VDC	500	2.60
W102MX-4	300mW	—	24VDC	2,000	2.86
W102MX-5	300mW	5.5	—	5,000	3.05

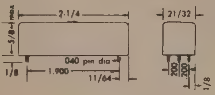
CLASS 102PC ULTRA-RELIABLE ENCAPSULATED STANDARD SIZE REED RELAY

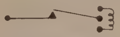


PRINTED CIRCUIT MTG.
SPST-NO 1 AMP
IC COMPATIBLE

Operate Time: 3 ms ave.
Release Time: .5 ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Load Rating: 15VA at 1 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 20 million cycles at full load; 100 million at ½ load.
Capacitance Across Contacts: 1.0 pF ave.
Insulation Resistance: 10^9 ohms min.

- Weight — 1 oz. approx.

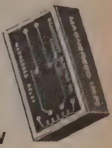




TOP VIEW

Stock Part No.	Nom. Power	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102PCX-63	50mW	—	5VDC	500	6.09
W102PCX-1	400mW	—	6VDC	100	5.52
W102PCX-2	400mW	—	12VDC	400	5.59
W102PCX-3	400mW	—	24VDC	1,500	5.64
W102PCX-4	400mW	6.5	—	5,000	6.16

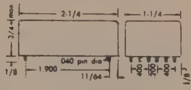
CLASS 102PC ULTRA-RELIABLE ENCAPSULATED STANDARD SIZE REED RELAY

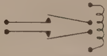


PRINTED CIRCUIT MTG.
DPST-NO 1 AMP
NOMINAL POWER 700mW

Operate Time: 3 ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Load Rating: 15VA at 1 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 20 million cycles at full load; 100 million at ½ load.
Capacitance Across Contacts: 1.2 pF ave.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.

- Weight — 2 ozs. approx.

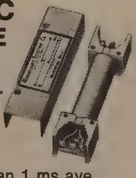




TOP VIEW

Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102PCX-5	DPST-NO	—	6VDC	50	7.20
W102PCX-6		—	12VDC	200	7.27
W102PCX-7		—	24VDC	800	7.33
W102PCX-8		9	—	5,000	7.85

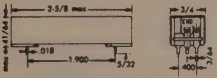
CLASS 102MPC STANDARD SIZE REED RELAY

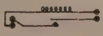


PRINTED CIRCUIT MTG.
SPST-NO 1 AMP
IC COMPATIBLE

Operate Time: 3 ms ave.
Release Time: .5 ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Load Rating: 15VA at 1 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 20 million cycles at full load; 100 million at ½ load.
Capacitance Across Contacts: 1.0 pF ave.
Insulation Resistance: 10^9 ohms min.

- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 1 oz. approx.

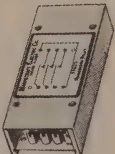




TOP VIEW

Stock Part No.	Nom. Power	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102MPCX-190	50mW	—	5VDC	450	4.30
W102MPCX-5	500mW	140	—	30	3.80
W102MPCX-6	500mW	—	6VDC	70	3.80
W102MPCX-7	500mW	—	12VDC	250	3.80
W102MPCX-8	500mW	—	24VDC	1,000	3.80
W102MPCX-9	500mW	—	48VDC	4,000	4.00
W102MPCX-10	500mW	9	—	7,000	4.80

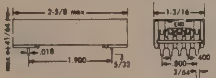
CLASS 102MPC STANDARD SIZE REED RELAY

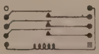


PRINTED CIRCUIT MTG.
3PST-NO 1 AMP
NOMINAL POWER 750mW

Operate Time: 3 ms ave.
Release Time: ½ ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Load Rating: 15VA at 1 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 20 million cycles at full load; 100 million at ½ load.
Capacitance Across Contacts: 1.2 pF ave.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.

- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 2 ozs. approx.

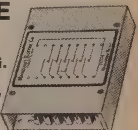




TOP VIEW

Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102MPCX-48	3PST-NO	—	6VDC	50	6.51
W102MPCX-49		—	12VDC	175	6.51
W102MPCX-50		—	24VDC	750	6.68
W102MPCX-51		—	48VDC	3,000	6.91

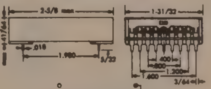
CLASS 102MPC STANDARD SIZE REED RELAY

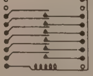


PRINTED CIRCUIT MTG.
6PST-NO 1 AMP
NOMINAL POWER 1.5W

Operate Time: 3 ms ave.
Release Time: ½ ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Load Rating: 15VA at 1 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 20 million cycles at full load; 100 million at ½ load.
Capacitance Across Contacts: 1.2 pF ave.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.

- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 3 ozs. approx.





TOP VIEW

Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102MPCX-52	6PST-NO	—	6VDC	25	10.63
W102MPCX-53		—	12VDC	100	10.77
W102MPCX-54		—	24VDC	375	10.83
W102MPCX-55		—	48VDC	1,500	10.92

*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays at 25°C.
††Current operated relays pull in at specified value or less.

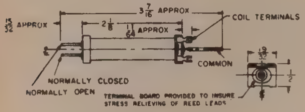
Magnecraft® STANDARD & IC COMPATIBLE REEDS

5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

CLASS 103M STANDARD SIZE REED RELAY

IN-LINE AXIAL LEADS
MOLDED BOBBIN
SPDT .5 AMPS
IC COMPATIBLE

SPDT, true Form C, no biasing magnet.
Operate Time: 2 ms ave.
Release Time: .5 ms ave.
Contact Bounce: 4 ms ave. on release, normally closed contacts.
Contact Load Rating: 10VA at .5 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 25 million cycles at full load; 50 million at ½ load.
Capacitance Across Contacts: 3.0 pF ave.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.



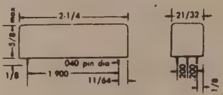
Stock Part No.	Nom. Power	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W103MX-21	50mW	—	5VDC	500	5.39
W103MX-1	300mW	—	6VDC	200	4.89
W103MX-2	300mW	—	12VDC	500	4.89
W103MX-3	300mW	—	24VDC	2,000	5.15
W103MX-4	300mW	5.5	—	5,000	5.34

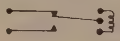
CLASS 103PC ULTRA-RELIABLE ENCAPSULATED REED RELAY

MAGNECRAFT
MAGNE REED 103 PC

PRINTED CIRCUIT MTG.
SPDT .5 AMPS
IC COMPATIBLE

SPDT, true Form C, no biasing magnet.
Operate Time: 2 ms ave.
Release Time: .5 ms ave.
Contact Bounce: 4 ms ave. on release, normally closed contacts.
Contact Load Rating: 10VA at .5 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 25 million cycles at full load; 50 million at ½ load.
Capacitance Across Contacts: 3.0 pF ave.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.





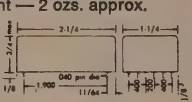
TOP VIEW

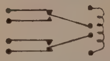
Stock Part No.	Nom. Power	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W103PCX-77	50mW	—	5VDC	500	8.91
W103PCX-1	400mW	—	6VDC	100	8.36
W103PCX-2	400mW	—	12VDC	400	8.41
W103PCX-3	400mW	—	24VDC	1,500	8.47
W103PCX-4	400mW	6.5	—	5,000	8.99

CLASS 103PC ULTRA-RELIABLE ENCAPSULATED REED RELAY

PRINTED CIRCUIT MTG.
DPDT .5 AMPS
NOMINAL POWER 700mW

DPDT, true 2 Form C, no biasing magnet.
Operate Time: 2 ms ave.
Release Time: ½ ms ave.
Contact Bounce: 4 ms ave. on release, normally closed contacts.
Contact Load Rating: 10VA at ½ amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 25 million cycles at full load; 50 million at ½ load.
Capacitance Across Contacts: 3.5 pF ave.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.
- Weight — 2 ozs. approx.

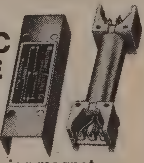




TOP VIEW

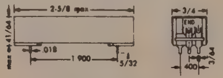
Stock Part No.	Contacts	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W103PCX-5	DPDT	—	6VDC	50	12.47
W103PCX-6		—	12VDC	200	12.50
W103PCX-7		—	24VDC	800	12.55
W103PCX-8		9	—	5,000	13.09

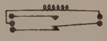
CLASS 103MPC STANDARD SIZE REED RELAY



PRINTED CIRCUIT MTG.
SPDT .5 AMPS
IC COMPATIBLE

SPDT, true Form C, no biasing magnet.
Operate Time: 2 ms ave.
Release Time: .5 ms ave.
Contact Bounce: 4 ms ave. on release, normally closed contacts.
Contact Load Rating: 10VA at .5 amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 25 million cycles at full load; 50 million at ½ load.
Capacitance Across Contacts: 2.0 pF ave.
Insulation Resistance: 10^9 ohms min.
- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 1 oz. approx.

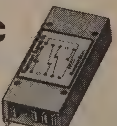




TOP VIEW

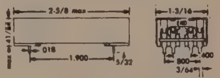
Stock Part No.	Nom. Power	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W103MPCX-124	50mW	—	5VDC	450	7.25
W103MPCX-1	500mW	140	—	30	6.75
W103MPCX-2	500mW	—	6VDC	70	6.75
W103MPCX-3	500mW	—	12VDC	250	6.75
W103MPCX-4	500mW	—	24VDC	1,000	6.75
W103MPCX-5	500mW	—	48VDC	4,000	6.95
W103MPCX-6	500mW	9	—	7,000	7.73

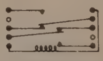
CLASS 103MPC STANDARD SIZE REED RELAY



PRINTED CIRCUIT MTG.
DPDT .5 AMPS
NOMINAL POWER 750mW

DPDT, true 2 Form C, no biasing magnet.
Operate Time: 2 ms ave.
Release Time: ½ ms ave.
Contact Bounce: 4 ms ave. on release, normally closed contacts.
Contact Load Rating: 10VA at ½ amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 25 million cycles at full load; 50 million at ½ load.
Capacitance Across Contacts: 3.0 pF ave.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.
- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 2 ozs. approx.

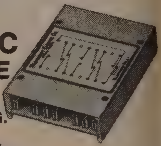




TOP VIEW

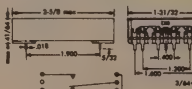
Stock Part No.	Contacts	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W103MPCX-30	DPDT	—	6VDC	50	9.65
W103MPCX-31		—	12VDC	175	9.65
W103MPCX-32		—	24VDC	750	9.80
W103MPCX-33		—	48VDC	3,000	10.04

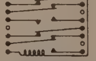
CLASS 103MPC STANDARD SIZE REED RELAY



PRINTED CIRCUIT MTG.
4PDT .5 AMPS
NOMINAL POWER 1.5W

4PDT, 4 true Form C, no biasing magnets.
Operate Time: 2 ms ave.
Release Time: ½ ms ave.
Contact Bounce: 4 ms ave. on release, normally closed contacts.
Contact Load Rating: 10VA at ½ amp max. or 250V max. resistive.
Contact Resistance: 100 milliohms ave.
Life Expectancy: 25 million cycles at full load; 50 million at ½ load.
Capacitance Across Contacts: 3.0 pF ave.
Operating Position: Any.
Insulation Resistance: 10^9 ohms min.
- Molded bobbin and steel cover provide protection and magnetic shielding.
- Weight — 3 ozs. approx.





TOP VIEW

Stock Part No.	Contacts	Coil ††mA	Coil †Volts	Coil *Ohms	Prices 1-24
W103MPCX-34	4PDT	—	6VDC	25	16.91
W103MPCX-35		—	12VDC	100	17.02
W103MPCX-36		—	24VDC	375	17.10
W103MPCX-37		—	48VDC	1,500	17.22

*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays at 25°C. ††Current operated relays pull in at specified value or less.

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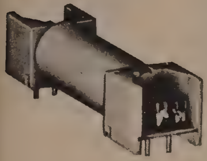
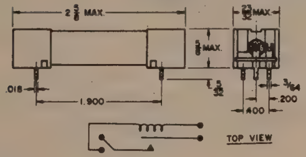
STANDARD & POWER REEDS

CLASS 102MPC
LOW COST!

SPST-NO 1 AMP
NOMINAL POWER 500mW
PRINTED CIRCUIT MTG.



Contact Load Rating: 15VA at 1 amp max. or 250VDC max. resistive.
Operate Time: 3 ms ave.
Release Time: .5 ms ave.
Contact Bounce: Less than 1 ms ave.
Contact Resistance: 100 milliohms.
Life at Rated Load: 20 million cycles; 100 million cycles at ½ load.
Capacitance Across Contacts: 1 pF ave.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.

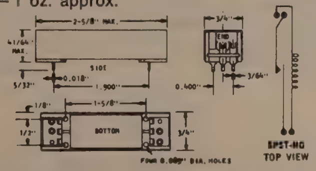


Stock Part No.	Contacts	Coil		Prices 1-24
		†Volts	*Ohms	
W102MPCX-145	SPST-NO	6VDC	70	3.04
W102MPCX-146		12VDC	250	3.04
W102MPCX-147		24VDC	1,000	3.04

CLASS 102RMPC
POWER REED RELAY STANDARD SIZE

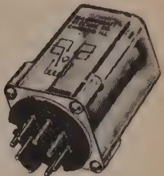
SPST-NO 3 AMP
PRINTED CIRCUIT MTG.
NOMINAL POWER 500mW

Developed especially to switch higher currents with reed relay reliability and the **MPC** low circuit board profile. **SPST-NO contacts of special material.**
Operate Time: 1 ms ave.
Release Time: 1 ms ave.
Contact Bounce: 0.5 ms ave.
Contact Resistance: 500 milliohms ave.
Contact Load Rating: 100VA, 3 amp max., or 250V max.
Operating Position: Any.
Dielectric Strength: Across switch 300VRMS, switch to coil 500-VRMS.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.

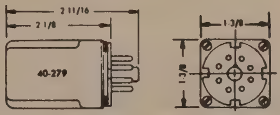


Stock Part No.	Contacts	Coil		Prices 1-24
		†Volts	*Ohms	
W102RMPCX-1	SPST-NO	6VDC	70	9.10
W102RMPCX-2		12VDC	250	9.10
W102RMPCX-3		24VDC	1,000	9.19
W102RMPCX-4		48VDC	4,000	9.47

CLASS 103CP
DRY REED RELAY PLUG-IN MOUNTING



DPDT AND 3PDT .5 AMP
Each plug-in assembly includes two or three standard size, Form C, break before make switching capsules with operating coil in plastic dust cover.
Operate Time: 2 ms ave.
Release Time: ½ ms ave.
Contact Bounce: 4 ms ave. on release (normally closed contact).
Contact Load Rating: 10VA at ½ amp max., or 250VAC max. resistive.
Contact Resistance: 100 milliohms ave.
Capacitance Across Contacts: 4.0 pF ave.
Life Expectancy: 25 million cycles at rated load; longer at reduced load.
Nominal Power: DPDT 500mW, 3PDT 800mW.
Insulation Resistance: 10^9 ohms min.
- Weight — 5 ozs. approx.

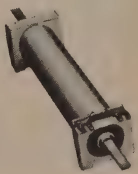


Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W103CPX-7	DPDT	—	6VDC	75	15.68
W103CPX-8	WD-2	—	12VDC	300	15.71
W103CPX-9		—	24VDC	1,000	15.77
W103CPX-10		8	—	5,000	16.46
W103CPX-11	3PDT	—	6VDC	40	20.34
W103CPX-12	WD-3	—	12VDC	150	20.41
W103CPX-13		—	24VDC	650	20.56
W103CPX-14		10	—	5,000	21.23

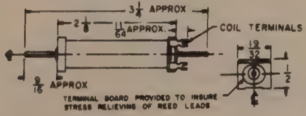
††Current operated relays pull in at specified value or less.

CLASS 102RM
POWER REED RELAY IN-LINE AXIAL LEADS STANDARD SIZE

SPST-NO 3 AMP
MOLDED BOBBIN
NOMINAL POWER 300mW
LOW COST!



SPST-NO contacts of special material.
Contact Load Rating: 100VA at 3 amps max. or 250VAC max.
Operate Time: 1.5 ms ave.
Release Time: 1 ms ave.
Contact Bounce: 1 ms ave.
Operating Position: Any.
Contact Resistance: 500 milliohms typ.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.


3 1/4 APPROX
2 1/4
11/64 APPROX.
COIL TERMINALS
13/32
1/2
1/16 APPROX
TERMINAL BOARD PROVIDED TO INSURE STRESS RELIEVING OF REED LEADS

Stock Part No.	Contacts 3 Amps	Coil		Prices 1-24
		†Volts	*Ohms	
W102RMX-5	SPST-NO	6VDC	200	5.07
W102RMX-6		12VDC	500	5.12
W102RMX-7		24VDC	2,000	5.26
W102RMX-8		48VDC	5,000	5.50

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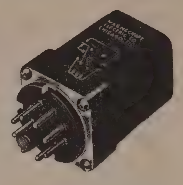
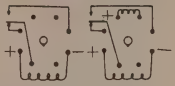
LATCHING REED RELAYS

CLASS 103LCP
PLUG-IN LATCHING REED RELAY

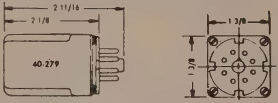


BI-STABLE SPDT .2 AMP

Magnetic latching action requires no coil current to hold either of two latching positions. In the case of the single wound coil switching is achieved by reversing coil current polarity. The double wound coil has separate polarized winding; switching is achieved by use of dual input.

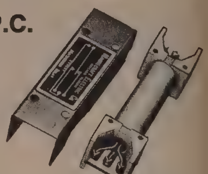


Operate Time: 2 ms ave.
Contact Bounce: 2 ms ave.
Contact Load Rating: 10VA at 0.2 amp. max. or 200V max. resistive.
Contact Resistance: 150 milliohms ave.
Capacitance Across Contacts: 4.0 pF ave.
Typical Life Expectancy: 25 million operations, longer at reduced loads.
Nominal Power: Single coil 150mW, double coil 300mW.
Insulation Resistance: 10^9 ohms min.
- Weight — 5 ozs. approx.



Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
SINGLE WOUND COILS					
W103LCPX-7	SPDT	—	6VDC	250	10.08
W103LCPX-8	WD-1	—	12VDC	1,000	10.11
W103LCPX-9		—	24VDC	4,000	10.40
W103LCPX-10		4	—	7,000	10.67
DOUBLE WOUND COILS					
W103LCPX-11	SPDT	—	6VDC	120/120	11.97
W103LCPX-12	WD-14	—	12VDC	460/460	12.09
W103LCPX-13		—	24VDC	1,800/1,800	12.16
W103LCPX-14		8	—	3,000/3,000	12.52

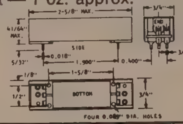
CLASS 103LMPC
BI-STABLE LATCHING P.C. RELAY — DRY REED

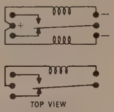


MAGNETIC LATCHING RELAY

Ideal for memory applications. Bi-stable SPDT Contacts — biased permanent magnet holds either contact position **without coil power until polarity is reversed.**

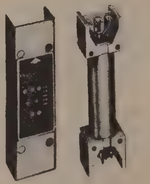
Operate Time: 2 ms ave.
Contact Bounce: 3 ms ave.
Contact Resistance: 150 milliohms ave.
Contact Load Rating: 10VA, 0.2 amp max. or 200V max. non-inductive.
Life Expectancy: 25 million cycles at rated load; longer at reduced loads.
Operating Position: Any.
Nominal Power: Single coil 150mW, double coil 300mW.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.





Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
SINGLE WOUND COILS					
W103LMPCX-3	SPDT	40	—	70	8.57
W103LMPCX-4		—	6VDC	250	8.57
W103LMPCX-5		—	12VDC	1,000	8.57
W103LMPCX-6		—	24VDC	4,000	8.80
W103LMPCX-7		4	—	7,000	9.71
DOUBLE WOUND COILS					
W103LMPCX-8	SPDT	80	—	30/30	9.97
W103LMPCX-9		—	6VDC	120/120	10.11
W103LMPCX-10		—	12VDC	460/460	10.11
W103LMPCX-11		—	24VDC	1,800/1,800	10.91
W103LMPCX-12		8	—	3,000/3,000	12.18

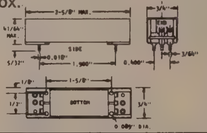
CLASS 133LMPC
STANDARD SIZE PRINTED CIRCUIT

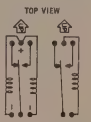


MAGNETIC LATCHING RELAY
MERCURY WETTED
SPDT 2 AMP.

Ideal for memory applications. Bi-stable SPDT Contacts—biased permanent magnet holds either contact position without coil power until coil polarity is reversed.

Operate Time: 2 ms ave.
Contact Bounce: None.
Contact Load Rating: 50VA at 2.0 amps max. or 400V max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 3.0 pF ave.
Life Expectancy: 25 million cycles at full load, longer at reduced load.
Nominal Power: Single coil 150mW, double coil 300mW.
Operating Position: Upright, not more than 30° from vertical.
Insulation Resistance: 10^9 ohms min.
- Weight — 2 ozs. approx.

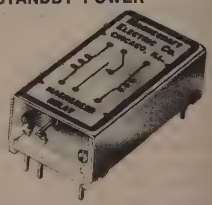




Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
SINGLE WOUND COILS					
W133LMPCX-17	SPDT	40	—	70	13.06
W133LMPCX-18		—	6VDC	250	13.06
W133LMPCX-19		—	12VDC	1,000	13.13
W133LMPCX-20		—	24VDC	4,000	13.32
W133LMPCX-21		4	—	7,000	13.45
DOUBLE WOUND COILS					
W133LMPCX-22	SPDT	80	—	30/30	14.86
W133LMPCX-23		—	6VDC	120/120	14.88
W133LMPCX-24		—	12VDC	460/460	14.98
W133LMPCX-25		—	24VDC	1,800/1,800	15.11
W133LMPCX-26		8	—	3,000/3,000	15.22

††Current operated relays pick-up at specified value or less.

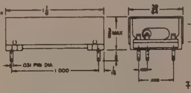
CLASS 101LMPC
MAGNETIC LATCHING REED RELAY

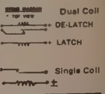


DUAL OR SINGLE COIL — NO STANDBY POWER
SPST (1 form A) .5 amp max.
Vibration and Shock Resistant
Coil Voltages 3VDC to 12VDC
PRINTED CIRCUIT MTG.

The Class 101LMPC is ideal for interfacing with logic circuits, solid state circuits, or industrial control applications. This small relay has a stable memory, even with a power failure. The relay has high output power capability while offering low power input, compatible with T²L and DTL direct drive logic systems. It's available in single and dual voltage power supply systems.

Contact Load Rating: 10VA at .5 amp max. or 200VDC max. resistive.
Capacitance Across Contacts: .3 pF typical.
Typical Operate Time: .5 ms.
Contact Resistance: 200 milliohms ave.
Dielectric Withstanding Voltage Between Contacts: 400VDC.
Typical Life at Rated Load: 1 million operations.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.





Stock Part No.	Ohms	Nom. VDC	Max. Pick-up	Max. VDC	Prices 1-24
SINGLE COIL					
W101LMPCX-18	350	±3	±2.3	±10	5.93
W101LMPCX-19	870	±5	±3.8	±15	5.93
W101LMPCX-20	5,100	±12	±9.0	±30	6.35
DUAL COIL					
W101LMPCX-15	160/160	+3	+2.3	±10	8.96
W101LMPCX-16	425/425	+5	+3.8	±15	8.96
W101LMPCX-17	2,500/2,500	+12	+9.0	±30	9.26

Magnecraft® 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

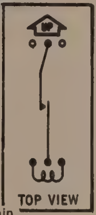
MERCURY-WETTED REED RELAYS

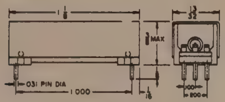
CLASS 131MPC
MINIATURE MERCURY-WETTED RELAY

Printed Circuit Mtg.
SPST-NO 1 Amp
Nom. Power 500mW
- Wt. — 1 oz approx.

Operate: 1 ms ave.
Release: 1 ms ave.
Contact Bounce: None.
Contact Load Rating: 28VA at 1.0 amps max. or 100V max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 1.2 pF ave.
Dielectric Strength: 500VAC, RMS.
Life Expectancy: 50 million cycles at full load, longer at reduced load.
Operating Position: Upright, not more than 30° from vertical.
- Snap-on Steel Cover provides protection, magnetic shielding and no interaction.

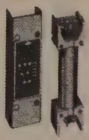
Insulation Resistance: 10⁹ ohms min.





Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W131MPCX-2	SPST-NO	—	6VDC	70	7.41
W131MPCX-3		—	12VDC	300	7.50
W131MPCX-4		—	24VDC	1,100	7.56
W131MPCX-5		—	48VDC	4,300	8.09

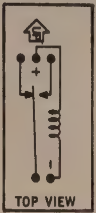
CLASS 133MPC
STANDARD SIZE MERCURY-WETTED RELAY

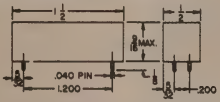


Printed Circuit Mtg.
SPDT 2 Amp
Nom. Power 500 mW
- Wt. — 2 ozs. approx.

Operate: 2 ms ave.
Release: 2 ms ave.
Contact Bounce: None.
Contact Load Rating: 100VA at 2.0 amps max. or 500VDC max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 3.0 pF ave.
Life Expectancy: 20 billion cycles at full load, longer at reduced load.
Operating Position: Upright, not more than 30° from vertical.
- Magnetically biased, observe coil polarity.
- Snap-on Steel Cover provides protection, magnetic shielding and no interaction.

Insulation Resistance: 10⁹ ohms min.





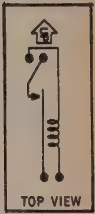
Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W133MPCX-61	SPDT	140	—	30	11.83
W133MPCX-62		—	6VDC	70	11.83
W133MPCX-63		—	12VDC	250	11.83
W133MPCX-64		—	24VDC	1,000	11.83
W133MPCX-65		—	48VDC	4,000	12.35
W133MPCX-66		9	—	7,000	14.41

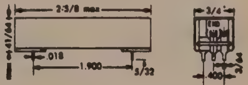
CLASS 132MPC
STANDARD SIZE MERCURY-WETTED RELAY

Printed Circuit Mtg.
SPST-NO 3 Amp
Nom. Power 500mW
- Wt. — 2 ozs. approx.

Operate: 2 ms ave.
Release: 2 ms ave.
Contact Bounce: None.
Contact Load Rating: 50VA at 3.0 amps max. or 400V max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 1.0 pF ave.
Life Expectancy: 50 million cycles at full load, longer at reduced load.
Operating Position: Upright, not more than 30° from vertical.
- Snap-on Steel Cover provides protection, magnetic shielding and no interaction.

Insulation Resistance: 10⁹ ohms min.



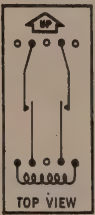


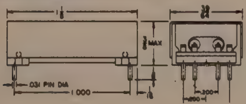
Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W132MPCX-1	SPST-NO	140	—	30	6.75
W132MPCX-2		—	6VDC	70	6.75
W132MPCX-3		—	12VDC	250	6.75
W132MPCX-4		—	24VDC	1,000	6.75
W132MPCX-5		—	48VDC	4,000	6.95
W132MPCX-6		9	—	7,000	7.73

CLASS 131MPC
MINIATURE MERCURY-WETTED RELAY

Printed Circuit Mtg.
DPST-NO 1 Amp
Nom. Power 700mW
- Wt. — 2 ozs. approx.

Operate: 1 ms ave.
Release: 1 ms ave.
Contact Bounce: None.
Contact Load Rating: 28VA at 1.0 amps max. or 100V max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 1.2 pF ave.
Dielectric Strength: 500VAC, RMS.
Life Expectancy: 50 million cycles at full load, longer at reduced load.
Operating Position: Upright, not more than 30° from vertical.
Insulation Resistance: 10⁹ ohms min.



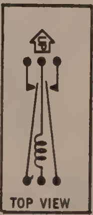


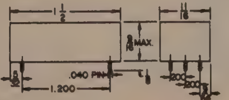
Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W131MPCX-6	DPST-NO	—	6VDC	50	13.36
W131MPCX-7		—	12VDC	220	13.41
W131MPCX-8		—	24VDC	850	13.48
W131MPCX-9		—	48VDC	3,300	13.82

CLASS 131PC
ENCAPSULATED MERCURY-WETTED RELAY

Printed Circuit Mtg.
DPST-NO 1 Amp
Nom. Power 900mW
- Wt. — 2 ozs. approx.

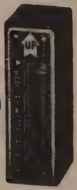
Operate: 1 ms ave.
Release: 1 ms ave.
Contact Bounce: None.
Contact Load Rating: 28VA at 1.0 amps max. or 100V max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 1.0 pF ave.
Life Expectancy: 50 million cycles at full load, longer at reduced load.
Operating Position: Upright, not more than 30° from vertical.
Insulation Resistance: 10⁹ ohms min.





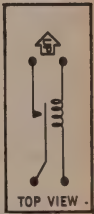
Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W131PCX-12	DPST-NO	—	6VDC	40	12.30
W131PCX-13		—	12VDC	150	12.34
W131PCX-14		—	24VDC	650	12.40
W131PCX-15		8	—	5,000	12.98

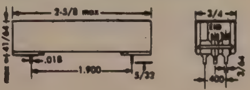
CLASS 131PC
ENCAPSULATED MINIATURE MERCURY-WETTED RELAY



Printed Circuit Mtg.
SPST-NO 1 Amp
Nom. Power 600mW
- Wt. — 1 oz approx.

Operate: 1 ms ave.
Release: 1 ms ave.
Contact Bounce: None.
Contact Load Rating: 28VA, 1 amp max. or 100V max. resistive.
Contact Resistance: 50 milliohms ave.
Capacitance Across Contacts: 1.0 pF ave.
Life Expectancy: 50 million cycles at full load, longer at reduced load.
Operating Position: Upright, not more than 30° from vertical.
Insulation Resistance: 10⁹ ohms min.





Stock Part No.	Contacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W131PCX-8	SPST-NO	—	6VDC	65	9.70
W131PCX-9		—	12VDC	250	9.77
W131PCX-10		—	24VDC	1,000	9.90
W131PCX-11		8	—	5,000	10.43

††Current operated relays pull in at specified value or less.

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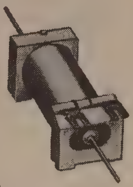
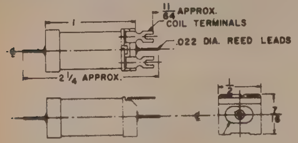
HIGH VOLTAGE RELAYS

CLASS 101VM
MINIATURE HIGH VOLTAGE REED RELAY



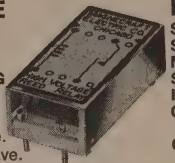
SPST-NO 1000V
MOLDED BOBBIN
IN-LINE AXIAL LEADS
NOM. POWER 600mW

Operate Time: 1 ms ave.
Release Time: 0.5 ms ave.
Contact Load Rating: 1VA max., 1000V peak at .001 amp max. resistive.
Contact Resistance: 100 milliohms ave.
Capacitance Across Contacts: 0.2 pF ave.
Life Expectancy: 1 million cycles at rated load; longer at reduced loads.
Insulation Resistance: 10^9 ohms min.
- Weight — 1 oz. approx.



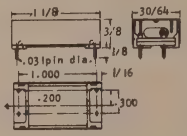
Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W101VMX-1	SPST-NO	—	6VDC	100	12.62
W101VMX-2		—	12VDC	250	12.65
W101VMX-3		—	24VDC	500	12.65
W101VMX-4		9	—	2,500	12.87

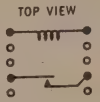
CLASS 101VMPC
MINIATURE HIGH VOLTAGE REED RELAY



SPST-NO 1000V
PRINTED CIRCUIT MTG
MOLDED BOBBIN
NOM. POWER 700mW

Operate Time: 1 ms ave.
Release Time: 0.5 ms ave.
Contact Load Rating: 1VA max., 1000V peak at .001 amp max. resistive.
Contact Resistance: 100 milliohms ave.
Capacitance Across Contacts: 0.2 pF ave.
Life Expectancy: 1 million cycles at rated load; longer at reduced loads.
Insulation Resistance: 10^9 ohms min.
- Weight — 2 ozs. approx.



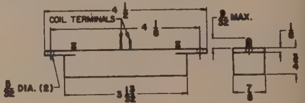


Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W101VMPCX-1	SPST-NO	—	6VDC	50	13.79
W101VMPCX-2		—	12VDC	220	13.86
W101VMPCX-3		—	24VDC	850	13.89
W101VMPCX-4		—	48VDC	3,300	14.14

CLASS 102V
HIGH VOLTAGE REED RELAY

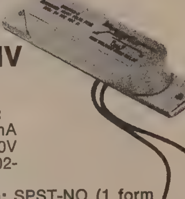
SPST-NO, SPST-NC
SOLDER TERMINALS
MOLDED CONSTRUCTION
SWITCHING VOLTAGE AS HIGH AS 5000V PEAK

Contact Combination: SPST-NO, SPST-NC.
Contact Load Rating: 50VA at 3 amps max. or 5000V peak, max. resistive.
Nominal Coil Power: SPST-NO, 500mW; SPST-NC, 200mW.
Operation Time: 3 ms typical.
Release Time: 1.5 ms typical.
Contact Bounce: 1.5 ms typical.
Contact Resistance: 100 milliohms ave.
Capacitance Across Contacts: 1.0 pF ave.
Life at Rated Load: 10 million operations, longer at reduced loads.
Insulation Resistance: 10^9 ohms min.
- Weight — 2 ozs. approx.



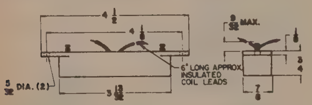
Stock Part No.	Con-tacts	Coil			Prices 1-24
		††mA	†Volts	*Ohms	
W102VX-49	SPST-NO	—	6VDC	70	20.75
W102VX-50		—	12VDC	250	20.81
W102VX-51		—	24VDC	1,000	20.88
W102VX-52		—	48VDC	4,000	21.41
W102VX-55	SPST-NC	—	24VDC	2,900	25.12

CLASS 102UHV
HIGH VOLTAGE REED RELAY
20,000V
CLASS 102HV
10,000V

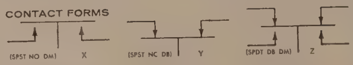


SPST-NO

Contact Load Rating: 20,000V peat at 1 mA for 102UHV, 10,000V peak at 1 mA for 102-HV.
Contact Combination: SPST-NO (1 form A).
Nominal Coil Power: 1.5W ave.
Operate Time: Typically 25 ms including bounce — 12 ms typically.
Contact Resistance: 100 milliohms ave.
Typical Life at Rated Load: 1 million — longer at reduced loads.
Insulation Resistance: 10^9 ohms min.

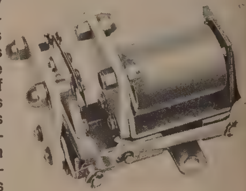


Stock Part No.	Coils		Prices 1-24
	†Volts	*Ohms	
10,000 VOLTS			
W102HVX-1	6VDC	25	27.23
W102HVX-2	12VDC	100	27.23
W102HVX-3	24VDC	400	27.23
20,000 VOLTS			
W102UHVX-1	6VDC	25	39.50
W102UHVX-2	12VDC	100	39.50
W102UHVX-3	24VDC	400	39.50

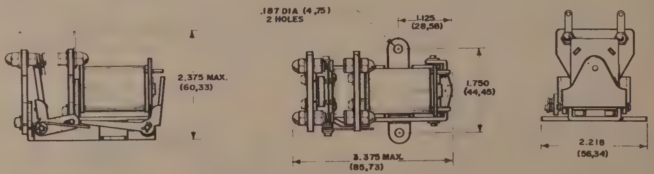


CLASS 158
HIGH VOLTAGE RELAYS

SWITCHING UP TO 5000V @ 200 mA DC OPERATION ONLY
SPDT-DB-DM



The Class 158 relay was developed especially for making and breaking high voltage circuits of low current capacities. Its excellent insulation characteristics will permit the relay to handle high voltages than relays of comparable size. A system of levers operating the armature provides the necessary wide gap for high voltage switching, but keeps the size of the relay to a minimum. The contact assembly is mounted on ceramic to insure high insulation plus strength and low energy loss. The specially designed contact assembly provides for minimum bounce. The ¼″ diameter silver cadmium oxide contacts will break up to 5000VRMS at 200 milliamps current.



DIMENSIONS IN INCHES(MM) FOR REFERENCE ONLY

Stock Part No.	200mA Contacts	Coil		Prices 1-24
		†Volts	*Ohms	
W158HVX-1	SPDT-DB-DM	24VDC	120	27.58
W158HVX-2	SPDT-DB-DM	110VDC	3,000	28.58

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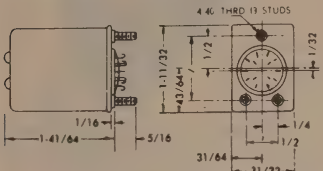
TELEPHONE TYPE & COAXIAL RELAYS

CLASS 33HS

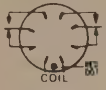
HERMETICALLY SEALED SUB-MINIATURE DC DPDT, 4PDT 5 AMP SILVER ALLOY CONTACTS

- Maximum telephone type relay reliability.
- Fast operate and release time.
- One of the smallest hermetically sealed telephone type relays.
- Highly adaptable to applications involving shock, vibration and severe atmospheric conditions.
- Full 5 amp 4PDT switching capability.
- Weight — 3 ozs. approx.

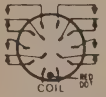
NOTE: 53/64" dia. CHASSIS CUTOUT recommended for terminal cluster.


4-40 THRD (3 STUDS)
1/2
1-11/32
43/64
1/32
1/16
1-41/64
5/16
1/4
1/2
31/64
31/32

8 or 14 pin solder terminal header


COIL
RED DOT

WD-8 DPDT


COIL
RED DOT

WD-9 4PDT

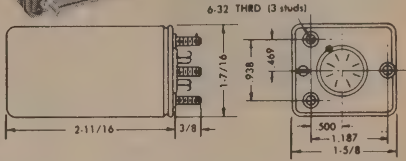
VIEWED FROM TERMINAL END OF SOCKET

Stock Part No.	Contacts 5 Amps	Coil †Volts	Coil *Ohms	Nominal Power	Prices 1-9
W33HSX-177	DPDT	6VDC	17	2.0W	17.47
W33HSX-178	WD-8	12VDC	75		17.47
W33HSX-179		24VDC	280		17.54
W33HSX-180		110VDC	6,500		18.35
W33HSX-181	4PDT	6VDC	17	2.0W	22.02
W33HSX-182	WD-9	12VDC	75		22.02
W33HSX-183		24VDC	280		22.10
W33HSX-184		110VDC	6,500		22.97

CLASS 22HS

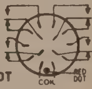
HERMETICALLY SEALED — SMALL AC & DC — 4PDT 5 AMP SILVER ALLOY CONTACTS

- Exceptionally long life.
- High contact pressures assure positive switching.
- Reliable hinge pin construction.
- Very efficient, greater sensitivity up to 4PDT.
- Available to meet military specifications for shock, vibration and temperature extremes.
- Weight — 7 ozs. approx.


6-32 THRD (3 studs)
1-7/16
.938
.469
2-11/16
3/8
.500
1.187
1-5/8

14-pin Solder Terminal Header.

NOTE: 7/8" dia. chassis cut-out recommended for terminal cluster.


COIL
RED DOT

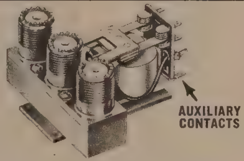
WD-9 4PDT

VIEWED FROM TERMINAL END OF SOCKET

Stock Part No.	Contacts 5 Amps	Coil †Volts	Coil *Ohms	Nominal Power	Prices 1-9
AC VOLTAGE SPECIFIED					
W22AHSX-32	4PDT WD-9	115VAC	—	5VA	22.90
DC VOLTAGE SPECIFIED					
W22HSX-144	4PDT WD-9	6VDC	20	2.0W	22.49
W22HSX-145		12VDC	80	2.0W	22.49
W22HSX-146		24VDC	375	1.5W	22.56

CLASS 128

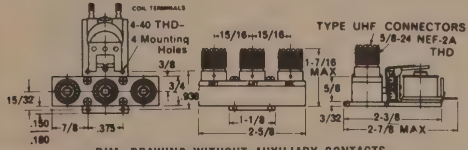
SPDT & DPDT AUXILIARY CONTACTS AC OR DC OPERATION PANEL MOUNT WITH UHF CONNECTORS


AUXILIARY CONTACTS

Small compact relay combining a heavy duty coaxial cavity and the MAGNECRAFT 88 Relay structure described on page 8. The precision-built, hinge-pin type armature bearings of the Class 88 assure consistent pull-in stability with maximum reliability over long life.

The coaxial contact structure is enclosed in a heavy duty precision machined brass cavity with removable plug for convenient inspection of contacts.

SPDT contacts for switching RF circuits are silver alloy, gold flashed, conservatively rated 500 watts of RF power; impedance matched to 50 ohm cable using standard type UHF connectors. VSWR 1.25: 1 maximum from 0 to 500 megacycles.

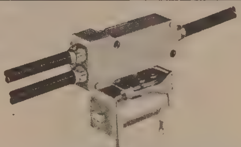

COIL TERMINALS
4-40 THD-
4 Mounting Holes
3/8
3/4
.938
15/32
.150
.180
7/8
.375
15/16
15/16
1-7/16 MAX
5/8
1-1/8
2-5/8
TYPE UHF CONNECTORS
5/8-24 NEF-2A THD
3/32
2-3/8
2-7/8 MAX

DIM. DRAWING WITHOUT AUXILIARY CONTACTS

Stock Part No.	Coaxial Contacts	Coil †Volts	Coil *Ohms	Prices 1-9
CLASS 128 RELAY WITHOUT AUXILIARY CONTACTS				
W128AX-7	SPDT	115VAC	—	31.77
W128X-9		12VDC	100	31.34
W128X-10		24VDC	400	31.43
CLASS 128 RELAY WITH DPDT AUXILIARY CONTACTS				
W128AX-11	SPDT	115VAC	—	34.79
W128X-14		12VDC	100	33.74
W128X-15		24VDC	400	33.81

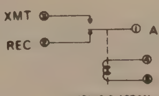
CLASS 120

SPDT DC OPERATION SMALLEST SIZE

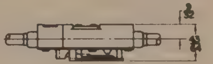


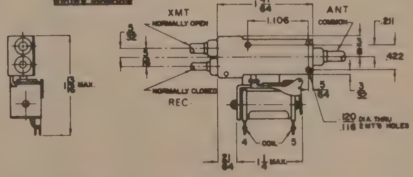
A Class 120 Coaxial Relay consists of the MAGNECRAFT standard Coaxial cavity integrally assembled to a Class 33 Relay basic structure. The Class 120 is ideally suited for applications where space and weight must be kept to a minimum.

SPDT contacts for switching RF circuits are silver alloy, gold flashed, conservatively rated 100 watts of RF power; impedance matched to 50 ohm cable. VSWR 1.25: 1 maximum from 0 to 500 megacycles. Standard RG-58A/U cable, 12 inches long.



WIRING DIAGRAM




1 47/64
XMT
NORMALLY OPEN
1.106
ANT
COMMON
.211
3/8
.422
NORMALLY CLOSED
REC
5/64
3/32
.120 DIA. THRU
.116 2 MT'G HOLES
4
COIL
5
21/64
1 1/4 MAX.
MAX.

CABLES ARE RG58A/U 12" LONG UNTERMINATED

Stock Part No.	Coaxial Contacts	Coil †Volts	Coil *Ohms	Prices 1-9
W120X-14	SPDT	12VDC	100	11.22

*Resistance values ±10%; measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

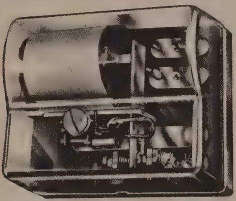
Magnecraft®

5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

SENSITIVE & SPECIAL RELAYS

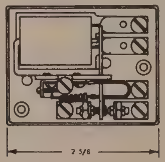
CLASS 62
ULTRA-SENSITIVE RELAYS

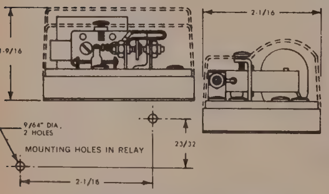
1 AMP SPDT CONTACTS 5mW
DUST COVER
SOLDER TERMINAL CONNECTORS



The Class 62 is an ultra-sensitive, durable, dustite and fully adjustable relay incomparable for use in any DC circuit restricted to a few thousandths of a watt power consumption. The counter-balanced armature design permits excellent operation in any position. The transparent, molded plastic cover guards against dust or dirt reaching the contacts or other working parts — yet allows immediate visual inspection. The sturdy molded bakelite base has both screw and solder terminal connectors, and convenient means of mounting is provided. Contacts: 1 amp resistive at 115VAC or 28-VDC.

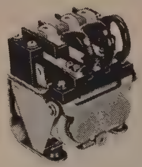
Stadard factory adjustment is 5 milliwatt sensitivity and field adjustments are easily made by using the vernier screws. The silver contacts and spring tension can be accurately and permanently set — yet easily changed. Mounting Data: 2 holes 9/64" dia.





Stock Part No.	COIL MUST OPERATE @ 25°C			Prices 1-24
	†DC Volts	‡DC Cur. (mA)	*Ohms	
W62SCX-1	0.005	1000	.005	13.09
W62SCX-3	2.87	1.80	1,600	13.62
W62SCX-4	3.34	1.52	2,200	13.62
W62SCX-5	4.26	1.22	3,500	13.85
W62SCX-6	5.33	0.97	5,500	14.41
W62SCX-7	6.70	0.77	8,700	15.50
W62SCX-8	7.20	0.72	10,000	15.50
W62SCX-9	8.55	0.61	14,000	16.64
W62SCX-10	10.2	0.51	20,000	18.29
W62SCX-11	12.6	0.42	30,000	18.29
W62SCX-12	14.0	0.35	40,000	19.57

CLASS 27
SENSITIVE POWER RELAY

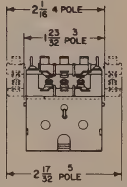


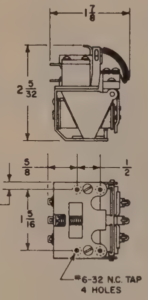
20 AMPS
275mW PER POLE
DC OPERATION ONLY

The Class 27 relay is a sensitive power relay. It is similar to the Class 93 relay except it has dual coils. The relay is available only for DC operation. The contacts are rated 20 amps at 28VDC or 115VAC, resistive for 3PDT and 5PDT. This two coil design increases the sensitivity of the relay because of the greater ampere turns. The consequent low power requirement coupled with the high load carrying capacity, makes this relay adaptable to a wide variety of industrial applications.

SPECIFICATIONS

Contact Rating: 20 amps resistive at 115VAC or 28VDC.
Contact Combination: SPDT, DPDT, 3PDT, 4PDT, 5PDT.
Contact Material: ¼" dia. silver cadmium oxide gold plated.
Contact Resistance: .100 ohms max.
Insulation Resistance: 100 megohms min.
Dielectric Withstanding Voltage: 1000V min.
Mounting: Four 6-32 tapped holes.
Terminals: Solder lugs.
Enclosure: Available on special order.
Weight: 5 ozs. typical.

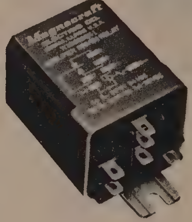




Stock Part No.	Contact Rating 20 Amps Sensitivity (Watts)	Coil Resistance *(Ohms)	Operate Current ‡(mA)	Prices 1-24
W27SX-17	SPST	150	42.8	22.64
W27SX-18	.275	600	21.4	22.64
W27SX-20		5,600	7.0	23.55
W27SX-21		13,400	4.5	24.93
W27SX-24	DPDT	150	60.5	25.07
W27SX-25	.550	600	30.3	25.07
W27SX-27		5,600	9.9	25.98
W27SX-28		13,400	6.4	27.36
W27SX-3	3PDT	150	74.2	27.04
W27SX-4	.825	600	37.0	27.04
W27SX-6		5,600	12.1	27.95
W27SX-7		13,400	7.8	29.33
W27SX-31	4PDT	150	85.6	29.47
W27SX-32	1.1	600	42.8	29.47
W27SX-34		5,600	14.0	30.38
W27SX-35		13,400	9.0	31.76
W27SX-10	5PDT	150	95.7	31.67
W27SX-11	1.375	600	47.9	31.67
W27SX-13		5,600	15.7	32.58
W27SX-14		13,400	10.1	33.96

CLASS 388SS
AMPLIFIER DRIVEN GENERAL PURPOSE RELAY

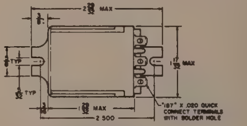
SPDT-DPDT 10 AMPS
DC OPERATION ONLY
SURFACE MOUNT & PLUG-IN

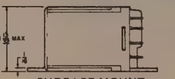


New Super Sensitive solid state hybrid device allows full 10 amps switching with extremely low power (70 microwatts) control.

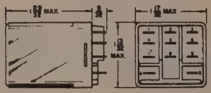
Classes 388CPX and 388CQX combine "state of the art" high impedance input amplifiers with the proven reliability of our 388 general purpose relay to offer you minimal control circuit loading plus unsurpasses electro-mechanical stability. A control voltage as small as 2.4VDC will signal the amplifier to energize the relay, provided the 24VDC driver supply voltage is maintained. Relay drop out occurs when the control voltage decreases to 1.5VDC or less. Operating temperature range is −10 degrees centigrade to +55 degrees centigrade.

This solid state hybrid device is provided with either SPDT or DPDT configuration capable of switching 10 amps at 28VDC 115VAC resistive load through silver alloy gold flash, 0.187" diameter standard contacts to insure long and reliable life.

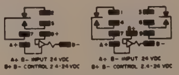




SURFACE MOUNT



PLUG-IN

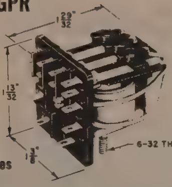


Stock Part No.	Contacts 10 Amp	Control Voltage	Prices 1-9
PLUG-IN			
W388SSCPX-1	SPDT	2.5 to 24VDC	15.11
W388SSCPX-2	DPDT		15.60
SURFACE MOUNT			
W388SSCQX-1	SPDT	2.5 to 24VDC	15.11
W388SSCQX-2	DPDT		15.60

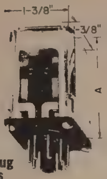
*Resistance values ±10%, measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays, at 25°C.
‡Current specified relays pull in at specified value or less.

OHMITE® electro-mechanical relays

MODEL GPR



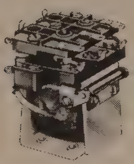
GPR Series 4-Pole

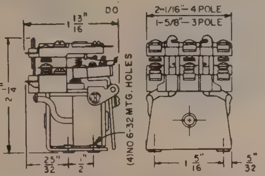


For Octal Plug GPR Series

Simple, rugged, low cost relays handling substantial power for small size. Uncomplicated design provides unusual flexibility for making and changing connection and mounting.

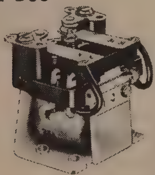
MODEL DO

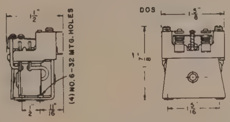




Particularly adaptable to aircraft and mobile equipment applications where severe shock and vibration are encountered. Design of molded parts around contact arms protects against mechanical injury. Stocked in 3-pole or 4-pole type, and also in hermetic enclosures and in latching types.

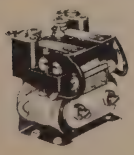
MODEL DOS

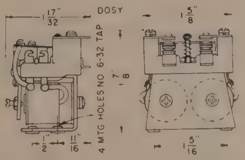




Wide application, general purpose relay, compact and lightweight. Handles loads usually demanded of much larger relays. Meets rigorous aircraft relay standards.

SENSITIVE MODEL DOSY





Similar in construction to Model DOS relay but equipped with twin coils for increased sensitivity. The DOSY relay is adaptable to a wide range of electronic control applications such as plate circuit controls, or as overload or underload controls in D.C. circuits to signal attainment of predetermined current levels.

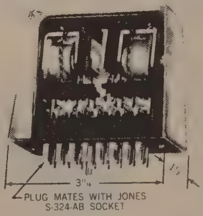
SPECIFICATIONS

	Coil Data				
Model	GPR	DO	DOS	GPR Latching	DOSY
6 VAC	.334-650 Amps	2.33 Amps	.890 Amps	.650 Amps	
12 VAC	.167-.309 Amps	1.28 Amps	.460 Amps	.309 Amps	
24 VAC	.084-.155 Amps	5.7 Amps	.269 Amps	.155 Amps	
115 VAC	.0174-.0325 Amps	1.10 Amps	.043 Amps	.0325 Amps	Maximum Pull In Current = 5 MA to 11 MA
230 VAC	.007-.0147 Amps	.070 Amps	.030 Amps	.0147 Amps	
6 VDC	.230 Amps	.487 Amps	.450 Amps	.350 Amps	
12 VDC	.114 Amps	.231 Amps	.210 Amps	.185 Amps	
24 VDC	.060 Amps	.105 Amps	.105 Amps	.093 Amps	
110 VDC	.011 Amps	.022 Amps	.022 Amps	.022 Amps	
220 VDC	——	.014 Amps	.013 Amps	——	
Coil AC	1.6-2.4 W.	6 W.	3 W.	1.6-2.4 W.	1 W.
Wattage DC	1.4 W.	3 W.	2.5 W.	2.4 W.	1 W.

Maximum Contact Arrangement	4PDT	4PDT	DPDT	6PDT	DPDT
Contact Rating	5 Amp & 10 Amp	10 Amp & 20 Amp	15 Amp & 25 Amp	5 Amp	15 Amp
Weight (Unenclosed)	2.5-3.5 oz.	5-6 oz.	4 oz.	7 oz.	4.5 oz.
Enclosures Available	Yes	Yes	Yes	Yes	No

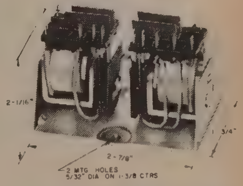
MANY MODELS ARE UL RECOGNIZED AND CSA LISTED

MODEL GPR LATCHING RELAYS



Enclosed Latching Relay

Relay 6PDT Latching



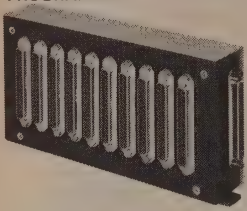
Latching relays consist of two GPR relays with armatures linked so that the n.o. contacts of one are mechanically latched in closed position when, and after, this relay is energized. When 2nd relay is energized, first relay restores and latches 2nd. Permits switching of twice the number of circuits and holding without coil current.

FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX

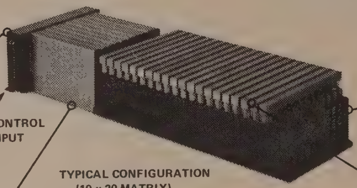
MATRIX
SYSTEMS CORPORATION
9411 Lurline Avenue • Chatsworth, California 91311
(213) 882-2008

COAXIAL SWITCHING SYSTEMS

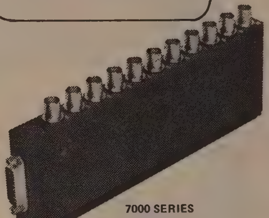
PROGRAMMABLE – COAXIAL RELAY MATRIX



MODEL 6310 DECODE MODULE
- Computer controllable
- 16 bit parallel or ASCII input
- TTL/DTL compatible
- Decodes 200 switchpoints
- Expandable

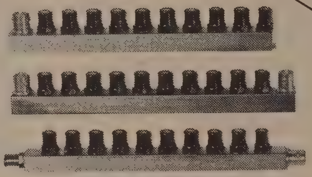


TYPICAL CONFIGURATION
(10 x 20 MATRIX)



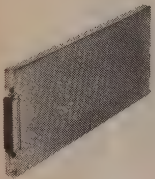
7000 SERIES COAXIAL RELAY MODULE
- 2-20 throws
- 106 dB isolation @ 100 MHz
- 100 watt switching
- DC-300 MHz
- Switched shield
- Self terminating
- 50 or 75 ohm
- Machined housing
- 28 V control

6100 SERIES LOGIC MODULE
- Controls 2-20 switchpoints
- TTL/DTL compatible
- X - Y addressable
- 28 VDC control output
- Latching
- J - K flipflops
- Hex gate drivers



CROSS STRAPS INTERCONNECT COAXIAL RELAYS TO FORM CROSSBAR CONFIGURATION.

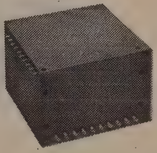
TWO WIRE AUDIO RELAY MODULE



FEATURES:
- Programmable
- Two pole-twenty throw
- Contains four independent two pole, five throw relays
- Dry reed or mercury wetted contacts available
- Independent control
- Compatible with 6100 series latching and drive module
- May be connected in a 2 x 10 or 4 x 5 matrix configuration
- Reed switches easily accessible
- 28 V control

MODEL 6157

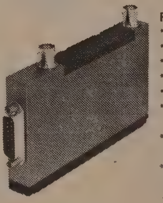
10 x 10 VIDEO RELAY MATRIX



FEATURES:
- Any of ten inputs may be connected to any of ten outputs
- Computer programmable
- Random addressable
- Low VSWR
- Signal circuits isolated from control circuitry
- Switchpoints individually field replaceable
- Stripline construction
- SMA connectors
- 28 V control

MODEL 6160

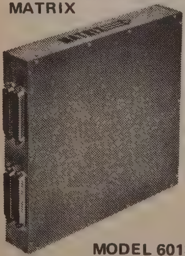
PROGRAMMABLE COAXIAL ATTENUATOR



FEATURES:
- 0 - 63 dB Range
- One dB steps - .5 dB optional
- Pure six bit binary control
- Low VSWR
- Continuous shield continuity
- Signal circuits isolated from control circuitry
- Attenuator elements field replaceable
- Compatible with 6100 series latching logic
- 28 V control

MODEL 6152

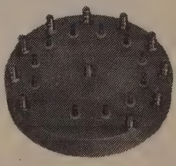
10 x 10 x 2 LEVEL AUDIO RELAY MATRIX



FEATURES:
- Random access
- Balanced switching
- Flexible format
- 1 ms switching
- Scanner capability
- Programmable
- DC - 100 KHz
- 28 V control

MODEL 6013

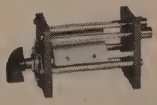
RADIAL RELAY



FEATURES:
- 10 throws
- Matched port to port delay
- Low VSWR
- 5 VDC control
- 50 ohm
- Machined housing
- Coaxical construction
- SMA connectors

MODEL 6210

R.F. ROTARY SWITCH



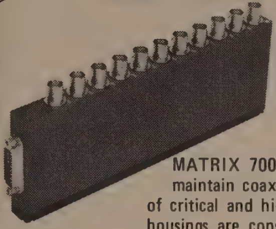
FEATURES:
- Two throw
- Center off
- Self terminating
- 50 or 75 ohm
- Hermetically sealed contacts
- Panel mount
- BNC connectors
- Low VSWR
- High Isolation

MODEL 6172

Matrix Systems Corporation manufactures a variety of Switching Devices. Whether you are Switching VHF, Video, Pulse or Audio or your control requirements are programmable or manual. Give us a call. We specialize in specials. (213) 882-2008

MATRIX
SYSTEMS CORPORATION
9411 Lurline Avenue • Chatsworth, California 91311
(213) 882-2008

COAXIAL SWITCH MODULE



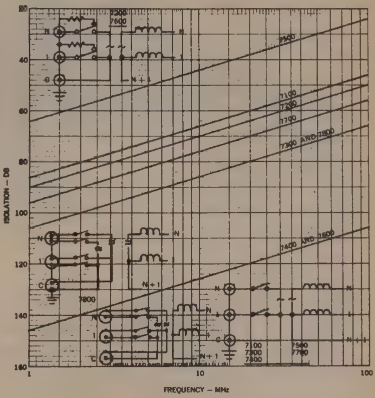
FEATURES

- Two to twenty throws
- Continuous shield continuity
- Rugged machined aluminum housing
- Crosstalk always less than isolation
- Switchpoints individually field replaceable
- Extremely low EMI
- Low VSWR
- Matrix configuration easily assembled using 9000 series cross straps
- Signal circuits isolated from control circuitry

MATRIX 7000 Series Switch Modules are designed to maintain coaxial switching continuity over a wide range of critical and high environmental applications. The switch housings are constructed on precision machined aluminum alloy for structural integrity and hard anodized for durability. All signal shield paths are silver plated with covers gasketed for maximum EMI protection. The basic reed switch elements are hermetically sealed in nitrogen filled gas envelopes and employ rhodium plated contacts to insure non-stick operation. Applications for MATRIX 7000 Series include:

- R.F. and I.F. switching where a low VSWR is required.
- CCTV, base band video and pulse switching where low phase distortion and high pulse fidelity are required.
- Applications requiring a high degree of shielding integrity and low contact and induced noise such as pre amp input switching or the switching of high impedance operational amplifier inputs.

Matrix and hybrid switching systems are easily constructed by using Series 9000 (no output), 9100 (one output) or 9200 (two output) push-on cross straps which mate with the BNC connectors on the switch modules. The cross strap output connectors are BNC female type UG 1094/U. The model number of the cross strap is assigned by replacing the two zeros of the series number with the number of inputs desired. For example, a Model 9108 has eight inputs and one output.



SERIES 7000

7100 –	Standard
7200 –	Self-terminating
7300 –	High isolation
7400 –	Highest isolation
7500 –	High power
7600 –	Highest isolation self-terminating
7700 –	Mercury wetted contacts
7800 –	Twinax

MODEL NUMBER ASSIGNMENT

7 X XX – X

Series

Number of throws

Coil suppression diodes – D
TNC connectors – T
Self-terminating resistance – ohms
Insulated shield – I
Insulated and switched shield – IS
Expander output – E

Any of the above options may be combined

SPECIFICATIONS

FREQUENCY RANGE:	0 - 300 MHz
CHARACTERISTIC IMPEDANCE:	50 ohms - 75 ohm optional
SWITCHING CONFIGURATION:	Single or double pole, two thru twenty throws
SWITCHING SPEED:	Less than one millisecond
ISOLATION:	See graph
CONTROL - CONNECTOR:	28 VDC, 30 MA D type - subminiature connector
SIGNAL CONNECTOR:	BNC - UG 1094/U, TNC optional
OPERATING TEMPERATURE AND HUMIDITY RANGE:	– 30°F to + 150°F, 0 to 98 percent R.H.
OPERATING SHOCK AND VIBRATION:	50 G's - 1 MS, 2 G's p-p 20-2000 Hz
DIMENSIONS:	.625" W x 3.25" H x 1.44" + .625" x Number of throws
MOUNTING:	Three 6-32 tapped holes in base

	7100	7200	7300	7400	7500	7600	7700	7800
CONTACT RATING:	100 vdc .250 amp 10 W	28 vdc .250 amp 3W	100 vdc .250 amp 10 W	28 vdc .250 amp 3 W	400 vdc 1 amp 15 W	28 vdc .250 amp 3 W	100 vdc 1.0 amp 28 W	100 vdc .250 amp 10 W
CONTACT RESISTANCE:	.150ohm	.300ohm	.300ohm	.300ohm	.060ohm	.300ohm	.050ohm	.300ohm

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MATRIX

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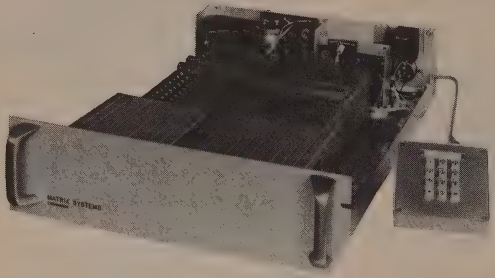
(213) 882-2008

COAXIAL SWITCHING SYSTEMS

TOUCH KEYSET CONTROLLED SWITCHING SYSTEMS



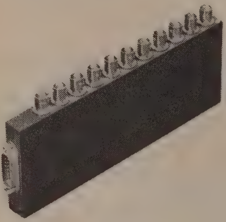
FEATURES:

- 40X40 Addressing Format
- Controls up to 1600 switchpoints
- Coaxial and/or Balanced Audio
- Modular Assemblies
- Turn Key Systems
- Standard Twelve Tone Pairs
- Remote Phone Line Operation
- Compatible with Matrix 7000, 8000 Series or 6157 Relays.

Matrix System Touch Keyset controlled switching systems are available in Rectangular or Folded Matrices, Multipole-Multithrow and Scanner configurations. Reed Relay Modules are employed with frequency responses of DC-Audio, DC-Video, DC-30 MHz and DC-300 MHz.

Touch Keyset control is a two digit input select two digit output select format with # Set, * Reset and # X * Clear.

SOLID STATE SWITCHING



FEATURES:

- Two to twenty throw
- Programmable
- Microsecond Switching
- ±10 volt signal levels
- Compatible with 6100 Series Control Logic
- Modular construction.

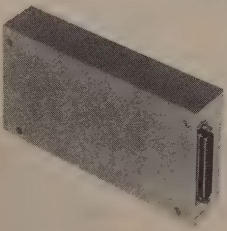
8100 SERIES

FET Switching
30 Ohm "ON" resistance
DC — 100 MHz
60 db isolation @ 10 MHz

8500 SERIES

Diode Switching
High Conductance
1 KHz — 30 MHz
60 db isolation @ 30 MHz

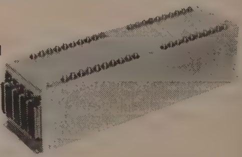
ASCII INTERFACE MODULE



Model 6224 interfaces with Matrix Programmable Switching Systems with Programmable calculators having a negative true ASCII I/O buss. Module is plug compatible with System Logic.

5X20 COAXIAL MATRIX

FEATURES:



- Any of five inputs may be connected to any of twenty outputs
- DC-60 MHz
- Computer programmable
- Random addressable
- Low VSWR
- Signal circuits isolated from control circuitry
- Switchpoints individually field replaceable
- Stripline construction
- SMA connector
- 28 V control.

Matrix Systems Corporation manufactures a variety of Switching Devices. Whether you are Switching VHF, Video, Pulse or Audio or your control requirements are programmable or manual. Give us a call. We specialize in specials. (213) 882-2008

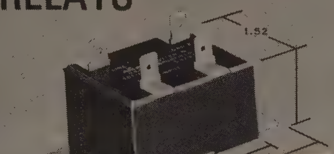
POTTER & BRUMFIELD RELAYS

ALL SOLID STATE RELAYS

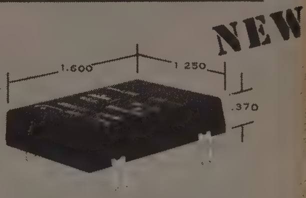
OPTO-ISOLATED
SWITCH UP TO 20 AMPS

EOT SERIES consists of a solid-state switch controlled and isolated by an opto-electronic coupler. The EOT features zero voltage turn on and zero current turn off. Life expectancy is greater than 100 million operations at rated values. Current rating is at 25° C, 120V AC, 50/60 Hz. Maximum load current derating is linear between 25° C and 55° C ambient. At 55° C, the rating is 60% of that at 25° C. The referenced heatsink in the listing at right is 10" x 10" x .062" aluminum to which the EO is securely mounted, using silic the equivalent betwee The EOT may be driven ECL, HTL, or MOS logi protection and .250 Approximate weigh

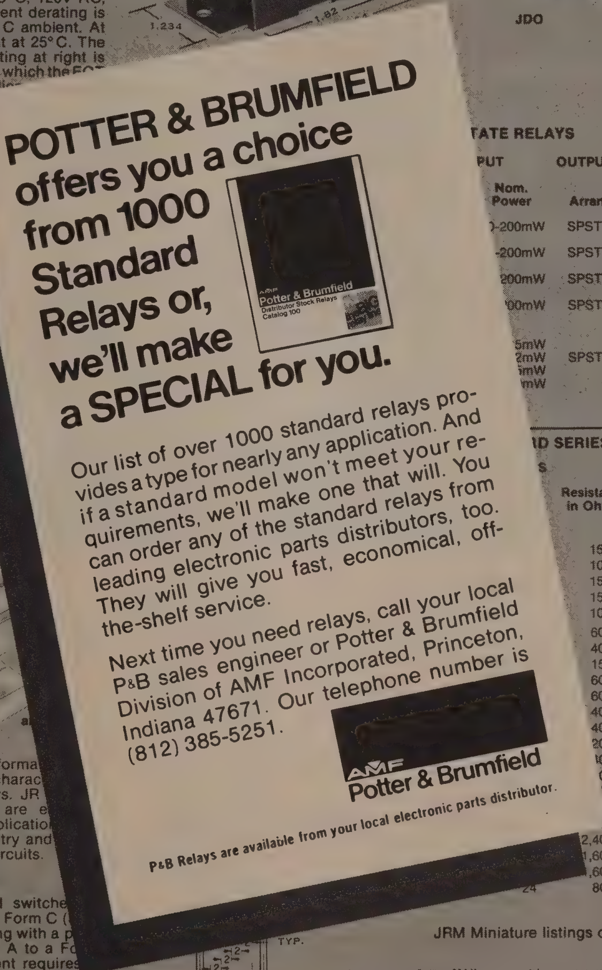
JDO low profile rela switch controlled a electronic coupler. turn on and zero c minimizing EMI and just .370" high, allow on 0.5" centers. It ma DTL, T²L, ECL, and H at 25° C, 120 V rms, 50/ current derating is line 55° C ambient. At 55° C that at 25° C. Printed cir a 0.1" grid. Approxima



NEW



JDO



AMF
Potter & Brumfield
Distributor Stock Relays
Catalog 100

POTTER & BRUMFIELD offers you a choice from 1000 Standard Relays or, we'll make a SPECIAL for you.

Our list of over 1000 standard relays provides a type for nearly any application. And if a standard model won't meet your requirements, we'll make one that will. You can order any of the standard relays from leading electronic parts distributors, too. They will give you fast, economical, off-the-shelf service.

Next time you need relays, call your local P&B sales engineer or Potter & Brumfield Division of AMF Incorporated, Princeton, Indiana 47671. Our telephone number is (812) 385-5251.

AMF
Potter & Brumfield

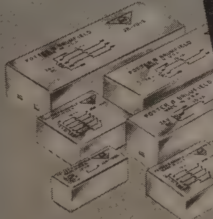
P&B Relays are available from your local electronic parts distributor.

TATE RELAYS

PUT	OUTPUT		
Nom. Power	Arrange.	Amp Rat-ing	SUGG. RE-SALE PRICE
-200mW	SPST-NO	2 4*	$16.20
-200mW	SPST-NO	4 8*	20.50
200mW	SPST-NO	5 12*	23.65
00mW	SPST-NO	7 20*	27.80
5mW			17.00
2mW	SPST-NO	1.7	17.00
mW			17.00
mW			17.00

DRY REE

JR STANDARD/JRM



Fast response, reliable performa sensitivity and long life are charac the JR Series dry reed relays. JR and JRM miniature relays are e suited for data processing applicatio puter equipment, logic circuitry and other sophisticated control circuits.

TWO TYPES OF CAPSULES

JR and JRM relays have reed switche either Form A (SPST-NO) or Form C (contact configuration. Biasing with a p nent magnet changes Form A to a Fo (SPST-NC). This arrangement require coil polarity be observed. Combining one Form A with one Form B results in a single Form C (SPDT) break-before-make. A "true" Form C (SPDT) uses a reed switch with two stationary and one movable contact. The movable contact is normally closed until the coil is energized.

JR specifications continued next page.

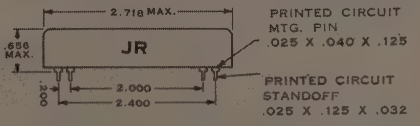
D SERIES

S

	Resistance in Ohms	Reed Rating Watts	SUGG. RE-SALE PRICE
	150	15	$4.20
	100	15	5.65
	150	50	5.65
	150	10	9.45
	100	10	10.15
	600	15	4.40
	400	15	5.70
	150	15	8.80
	600	50	5.85
	600	10	9.45
	400	10	12.40
	400	15	5.40
	200	15	7.55
	00	15	4.80
	00	15	5.95
	0	15	8.95
	0	50	6.25
		50	8.85
	2,400	10	9.40
	1,600	10	10.50
	,600	15	5.85
24	800	15	7.70

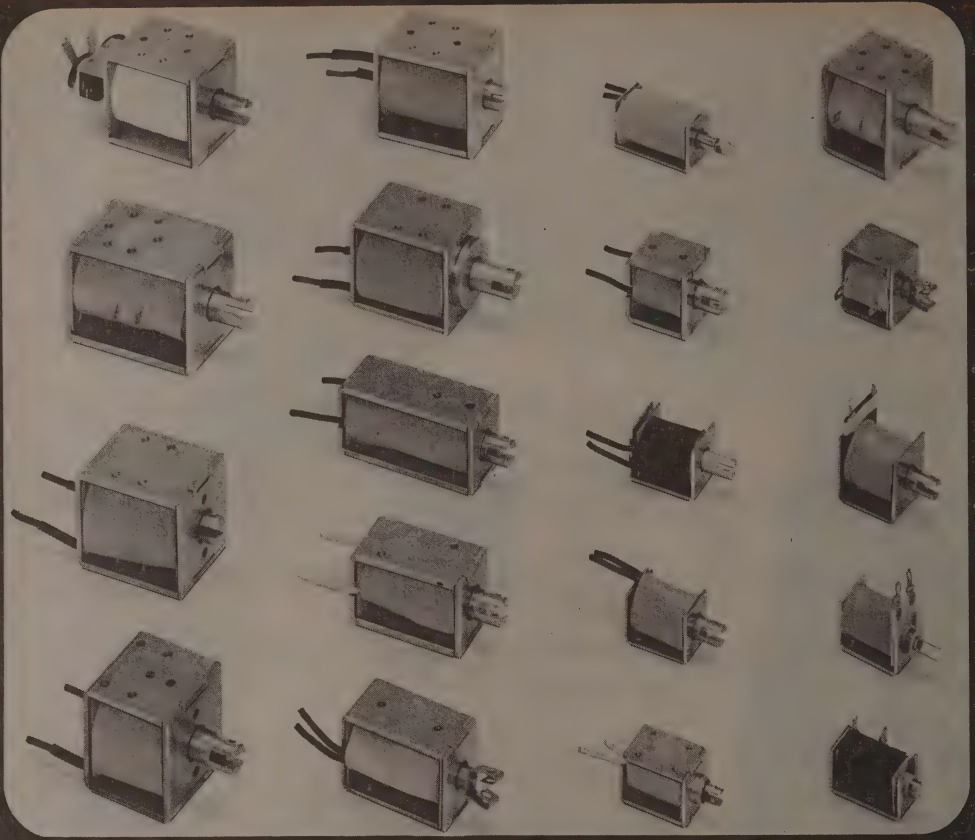
JRM Miniature listings continued next page.

JR
3 CAVITIES



2.718 MAX.
.656 MAX.
JR
.200
2.000
2.400
PRINTED CIRCUIT MTG. PIN .025 X .040 X .125
PRINTED CIRCUIT STANDOFF .025 X .125 X .032

• Denotes U/L §Enclosed Relay *With factory recommended heatsink (see EOT description).



minimum — force stroke — maximum

608 HD

2-7/8 x 1-9/16 x 1-13/16 h

C/DC	13 lbs @ 1/16	3 lbs @ 5/8

610

2-5/8 x 1-9/16 x 1-13/16 h

C/DC	67 oz @ 1/8	6 oz @ 1/2
I/DC	140 oz @ 1/8	20 oz @ 3/4
C/AC	7 oz @ 1/8	2 oz @ 3/4
I/AC	40 oz @ 1/8	16 oz @ 3/4

930

2-1/16 x 1-7/16 x 1-5/8 h

C/DC	55 oz @ 1/8	2 oz @ 7/8
I/DC	100 oz @ 1/8	4 oz @ 1″
C/AC	8 oz @ 1/8	6 oz @ 1″
I/AC	24 oz @ 1/8	22 oz @ 1″

960

1-5/8 x 1-7/16 x 1-5/8 h

C/DC	4 oz @ 1/8	2 oz @ 3/4
I/DC	100 oz @ 1/8	5 oz @ 3/4
C/AC	10 oz @ 1/8	3 oz @ 7/8
I/AC	33 oz @ 1/8	9 oz @ 7/8

Sales Representatives in major cities

minimum — force stroke — maximum

608

2-1/8 x 1-9/16 x 1-13/16 h

C/DC	40 oz @ 1/8	2 oz @ 5/8
I/DC	140 oz @ 1/8	15 oz @ 3/4
C/AC	8 oz @ 1/8	2 oz @ 5/8
I/AC	40 oz @ 1/8	20 oz @ 5/8

940

2-3/16 x 1-7/16 x 1-5/8 h

C/DC	70 oz @ 1/8	4 oz @ 3/4
I/DC	155 oz @ 1/8	21 oz @ 3/4
C/AC	25 oz @ 1/8	8 oz @ 1-1/4
I/AC	100 oz @ 1/8	30 oz @ 1-1/4

410

2-5/8 x 1″ x 1-7/32 h

C/DC	40 oz @ 1/16	3 oz @ 3/4
I/DC	80 oz @ 1/16	10 oz @ 3/4

408

2″ x 1″ x 1-7/32 h

C/DC	26 oz @ 1/16	2 oz @ 1/2
I/DC	64 oz @ 1/16	10 oz @ 1/2
C/AC	10 oz @ 1/16	1 oz @ 3/8
I/AC	32 oz @ 1/16	7 oz @ 1/2

827

1-7/8 x 15/16 x 1-3/16 h

C/DC	25 oz @ 1/8	1 oz @ 3/4
I/DC	40 oz @ 1/8	2 oz @ 3/4
C/AC	12 oz @ 1/8	1 oz @ 1″
I/AC	25 oz @ 1/8	6 oz @ 1″

minimum — force stroke — maximum

5 U 7

1-3/4 x 27/32 x 15/16 h

C/DC	36 oz @ 1/16	1.5 oz @ 1/2
I/DC	65 oz @ 1/16	3 oz @ 3/4
C/AC	13 oz @ 1/16	4 oz @ 5/8
I/AC	28 oz @ 1/16	3 oz @ 7/8

404

1-1/4 x 1″ x 1-7/32 h

C/DC	8 oz @ 1/16	1 oz @ 3/8
I/DC	30 oz @ 1/16	6 oz @ 3/8
C/AC	8 oz @ 1/16	1 oz @ 3/8
I/AC	20 oz @ 1/16	4 oz @ 3/8

5 U 5

1-1/4 x 27/32 x 15/16 h

C/DC	18 oz @ 1/16	1/2 oz @ 1/2
I/DC	36 oz @ 1/16	3 oz @ 1/2
C/AC	10 oz @ 1/16	2 oz @ 5/8
I/AC	16 oz @ 1/16	3 oz @ 5/8

3 U 4

1-1/8 x 3/4 x 1-13/32 h

C/DC	6 oz @ 1/8	2 oz @ 1/2
I/DC	30 oz @ 1/8	10 oz @ 1/2
C/AC	6 oz @ 1/8	2 oz @ 1/2
I/AC	18 oz @ 1/8	8 oz @ 1/2

312

1-5/32 x 3/4 x 3/4 h

C/DC	12 oz @ 1/16	1/2 oz @ 3/8
I/DC	24 oz @ 1/16	2 oz @ 3/8

minimum — force stroke — maximum

606

1-5/8 x 1-9/16 x 1-13/16 h

C/DC	40 oz @ 1/8	2 oz @ 1/2
I/DC	140 oz @ 1/8	20 oz @ 1/2
C/AC	14 oz @ 1/8	2 oz @ 1/2
I/AC	40 oz @ 1/8	9 oz @ 1/2

809

1-1/8 x 15/16 x 1-3/16 h

C/DC	24 oz @ 1/16	1 oz @ 3/8
I/DC	35 oz @ 1/16	2 oz @ 1/2
C/AC	20 oz @ 1/16	2.5 oz @ 1/2
I/AC	35 oz @ 1/16	5 oz @ 1/2

5 U 4

1-1/8 x 1″ x 1-7/8 h

C/DC	12 oz @ 1/8	2 oz @ 1/2
I/DC	60 oz @ 1/8	15 oz @ 1/2
C/AC	12 oz @ 1/8	5 oz @ 1/2
I/AC	42 oz @ 1/8	18 oz @ 1/2

3 U 4 A

1-1/8 x 3/4 x 1-1/8 h

C/DC	8 oz @ 1/16	1 oz @ 1/4
I/DC	17 oz @ 1/16	1 oz @ 3/8
C/AC	7 oz @ 1/16	1 oz @ 3/8
I/AC	13 oz @ 1/16	2 oz @ 3/8

3 U 6

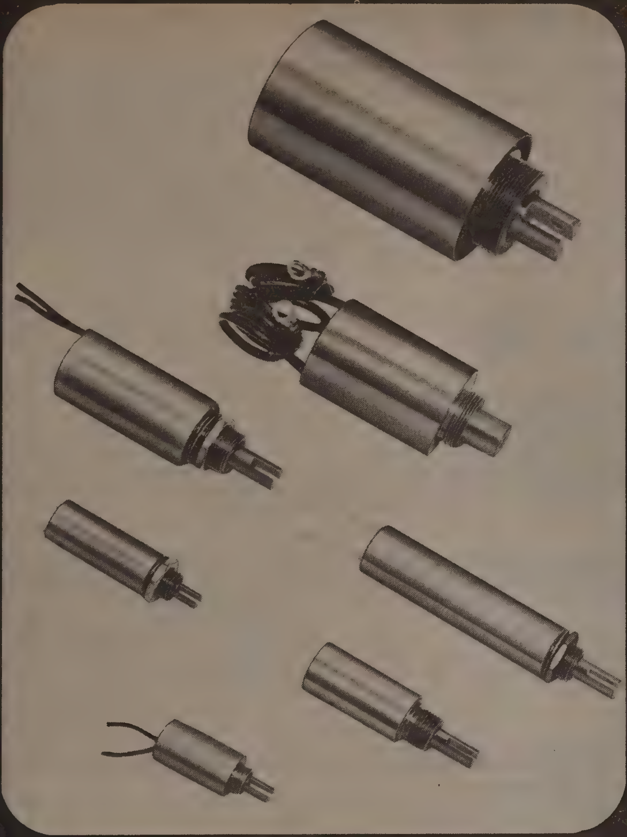
1.218 x 60 x 1-1/16 h

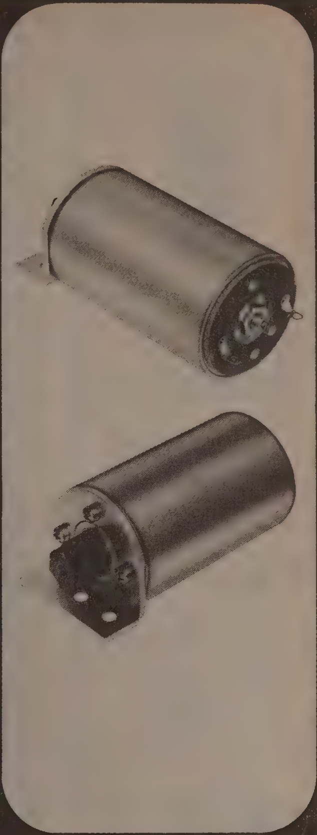
C/DC	8 oz @ 1/16	2 oz @ 3/8
I/DC	20 oz @ 1/16	7 oz @ 3/8

regdon\solenoids

CORPORATION

3715 GRAND BLVD / BROOKFIELD IL 60513 / 312/485-5152



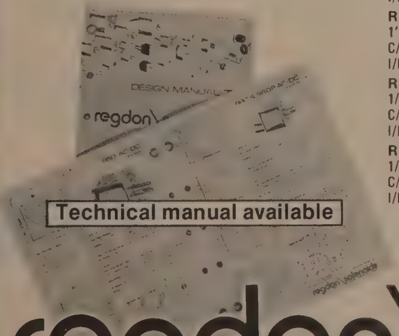


R 12 x 12
3/4 diameter x 1-1/2 long

C/DC	13 oz @ 1/16	1 oz @ 1/2
I/DC	25 oz @ 1/16	1.5 oz @ 7/8

R 7 x 9
7/16 diameter x 1-1/8 long

C/DC	4 oz @ 1/32	1/4 oz @ 5/16
I/DC	11 oz @ 1/32	1 oz @ 1/2



Technical manual available

R 7 x 8
7/16 Dia x 3/4 Lg

C/DC	3 oz @ .015	1/4 oz @ .105
I/DC	6 oz @ .015	1/2 oz @ .105

R 24 x 13
1-1/2" Dia x 1-5/8" Lg

C/DC	45 oz @ 1/8	1 oz @ 3/4
I/DC	145 oz @ 1/8	7 oz @ 7/8

R 24 x 19
1-1/2" Dia x 2-3/8" Lg

C/DC	75 oz @ 1/8	3 oz @ 1-1/4
I/DC	160 oz @ 1/8	7 oz @ 1-1/2

R 16 x 16
1" Dia x 2" Lg

C/DC	30 oz @ 1/16	3 oz @ 3/4
I/DC	75 oz @ 1/16	5 oz @ 1"

R 8 x 12
1/2 Dia x 1-1/2" Lg

C/DC	7 oz @ 1/32	1/2 oz @ 1/4
I/DC	14 oz @ 1/32	1 oz @ 5/8

R 8 x 7
1/2 Dia x 7/8 Lg

C/DC	4 oz @ 1/32	1/2 oz @ 3/16
I/DC	9 oz @ 1/32	1/2 oz @ 5/16

RAD 32 x 30

Cylindrical Solenoid with silent Air Damped Feature

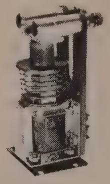
This unique solenoid is manufactured with a close tolerance fit between the plunger and the plunger guide, which along with an adjustable air release valve allows the plunger and guide assembly to function as an adjustable aid dash pot. If control of operational speed, or the elimination of noise is your problem — the air damped solenoid provides the ideal solution. At present the air damped feature is availableonly on the 2 inch diameter (RAD 32 x 30) and diameter (RAD 24 x 24) cylindrical solenoids.

regdon\solenoids

CORPORATION

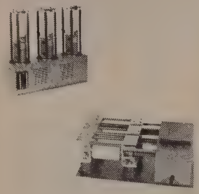
3715 GRAND BLVD / BROOKFIELD IL 60513 / 312/485-5152

HIGH VOLTAGE DEVICES 1 to 600 KV



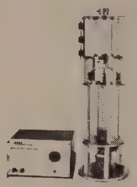
HV RELAYS, E SERIES

Broad line of rugged, air insulated, single or multi-pole HV relays for both low and high current, in either air, oil or gas atmospheres. Used for HV transfer, safety grounding, tap or load selection. 2 to 300 KV PK. Ratings from 1 to 200 A continuous, 100 to 10,000 A momentary and capacitor discharge. NO, NC and DT. Spring return-mount any position or gravity return-mount base up and mount base down designs. Highly conductive, weld-resistant contacts. Withstand high shock and vibration. Specially sealed G-10 Epoxy glass laminate used for support insulation. Low loss G-7 Silicone glass insulation for RF applications. Heavy-duty contacts. Standard 115 V, 60 Hz, or other voltage DC to 800 Hz actuators as specified. SPDT auxiliary contacts available.



THREE-PHASE VACUUM CONTACTORS/CIRCUIT BREAKERS

Compact, lightweight vacuum contactors and circuit breakers. Upright or low profile, and multi-pole designs. For AC high power and industrial controls, ½- to 2-cycle total trip and interrupt or transfer time. NC, NO, DT, latching and trip free types. 1 & 2 pole also available. HV operation: 208 V to 300 KV; 50 to 2,000 A continuous; 2,000 to 31,000 A interrupt; to 60,000 A momentary. Also high speed 1 to 4 millisecond contact parting time, interrupting at first current zero with properly matched Ross SCR controlled drivers and actuators triggered by pulse or other signal voltages. Direct control line actuated or stored mechanical and electrical energy actuated types. Can be equipped with anti-pump or automatic reset actuators.



SINGLE & MULTI-POLE VACUUM CONTACTORS/RELAYS & SOLENOID DRIVERS/ENERGY STORAGE UNITS

Extra high speed contactors/relays used in power supplies for interrupting and crowbarring, capacitor bank charging/discharging, transfer, tap or load selection. Single/multi-pole, NO, NC, DT and latching types. 5 to 300 KV AC/DC; 50 to 36,000 A continuous; 2,000 to 28,000 A AC interrupt; and 10 to 12,500 A DC interrupt. Operate time: 1 to 10 milliseconds when matched with Ross driver. **SOLENOID DRIVERS.** For high speed or loss of power automatic breaker trip and high speed activation of contactor or breaker. Also energy storage and discharge pulse use. Energy storage units: 150 to 700 V, or more. Provides vacuum contact closing or opening times of 0.5 to 10 milliseconds. SCR control triggered by 10 to 100 V pulse or other signal voltage.

HV ROTARY SWITCHES

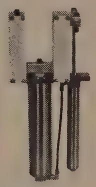
Multi-pole, multi-position. For use in air, oil or insulating gas. Standard to 5 poles, 2 to 12 positions. More are optional. 2 to 100 KV; 1 mA to 100 A and as high as 10,000 A momentary. Manually or electrically operated. Position detents. Safety interlocks to prevent opening under load.

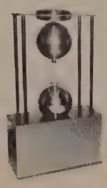
HIGH CURRENT SWITCHES— G SERIES

For min. inductance for power, RF or capacitor discharge pulse, transfer. To 36,000 A continuous. Over 500,000 A pulse. 6 V to 300 KV PK. Air cylinder or motor operated for high contact force. Compact.

HV-RF SWITCHES— RF SERIES

Low loss G-7 Silicone glass or Steatite insulation and non-magnetic materials are generally used. Available up to 50 MHz, high power; 1 to 50 KV; 1 to 800 A. Air, hydraulic, solenoid or motor actuated.



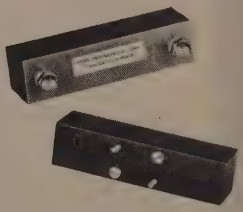


HV GROUNDING RELAYS—D SERIES

Air insulated, extra high voltage low corona types. To 600 KV PK at 100 A continuous. Positive closure. Solenoid, motor or air cylinder operated. Spring or gravity return. Energy dissipating assemblies.

HV REED RELAYS

From 5 to 30 KV, 1 mA to 3 A continuous. Actuator voltages: 6 to 230 V AC or DC are available. Over ten million operations. With terminals or fully insulated HV leads. PC board or chassis mounting.



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ROSS ENGINEERING CORP.

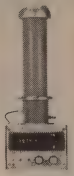
559 WESTCHESTER DRIVE, CAMPBELL, CA. 95008 PHONE (408) 377-4621 24 HR. (408) 253-1572

1 to 600 KV

HIGH VOLTAGE DEVICES

HV & LV DIGITAL MULTIMETERS

Measures both high and low voltages. 4½ and 3½ digit planar display units. AC/battery operated. Measures AC, DC, RF and pulse from 0.01 mV to 450 KV, AC or DC, or 750 KV impulse, 0.05% to 3% accuracy. LV range also has Ohms, Megohms, AC and DC milliamps. Peak memory hold for transients as short as 1 uSEC. Instantaneous freeze display. Also follows positive and negative peaks of sine, square, other waves, pulse trains, DC and AC average, and true RMS from 10 uV to 1,000 V basic and to 450 KV, or more, with choice of divider. RF capacity with proper probe, DC to 250 MC, or more. LV range reads 10 uV to 1,000 V DC/AC at 0.05% to 0.2% accuracy; resistance, 0.1 Ohm to 20 Megohms, 0.07% to 0.2% accuracy; current, 1 uA to 2 A DC and AC, 0.1% to 0.3% accuracy.



HV & LV DIGITAL MULTIMETER PROBES

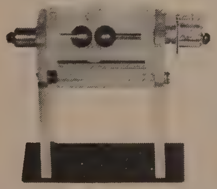
HV probes and digital multimeters. Hand held probe types, both HV and LV measurement with accuracies of 0.05% to 5%, from 100 uV to 200 KV DC or 60 Hz. Provided with collapsible 3 to 7½ ft. insulated safety handles. HV probe can be used with any digital meter or VTVM. Probe is matched for 1,000, 100, 10 or 1 Megohm input and is available to 200 KV DC or 60 Hz. Also available as a complete 4½ digit multimeter, 5 KV to 200 KV, which also reads 0.01 mV to 1 KV DC; 0.01 mV to 500 V AC; 1 uA to 2 A DC; 1 uA to 2 A AC; and 0.1 Ohm to 20 Megohms. LV accuracies vary from 0.05% to 0.3%; HV from 0.1% to 5%. Wide-band resistance-capacitance probe types also available to read sine and square waves, pulse trains, RF and other waves when used with Ross type VMD HV digital multimeters, or oscilloscopes. Multimeter type has removable portable DMM. Bat/AC.

HV VOLTAGE DIVIDERS

Lightweight, compact, resistance-capacitance or portable capacitive or resistive dividers/meter multipliers for use with digital meter, VTVM, oscilloscope, panel meter or recorder. For viewing and recording DC, CW AC, pulse or modulated HV RF. Calibration is matched for 1 Megohm, 20 to 50 PF load impedance or other impedances as required; DC to 5 MHz; to 450 KV DC or PK AC; to 750 KV impulse. Accuracy/stability on most models is generally better than ± 1% DC, ± 3% AC with ± 0.1% DC and ± 1% AC on some models. Units can be built to withstand −65° C to +75° C ambient and shock/vibration to 50 G's, or more. Hermetically sealed design. Filled with corona-reducing gas. Can be ordered with corona rings and used in oil or other atmospheres.

Hi-Z™ HV VOLTMETERS SAFE POWER LINE USE AC-DC

Portable, solid state, 2% to 5% accuracy. Taut-band shielded HV measurement with min. circuit loading. 0.0001 V to 240 KV, AC and DC. Ideal for accurate use with underground elbow capacitance tap voltage test points. For any cable test point or direct line voltage and phasing, or differential measurement.

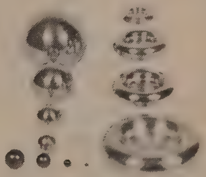


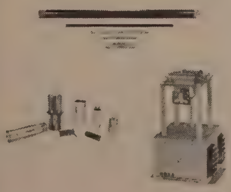
HV ADJUSTABLE SPARK GAPS

Non-melting carbon spheres, 1 to 30 cm, and heavy wall aluminum spheres, 10 to 100 cm. Dust tight transparent covers, 1 to 88 KV. Open style to 670 KV. Direct reading calibrating devices.

TOROIDS, SPHERES, CORONA SHIELDS

For shielding/balancing electrostatic fields to better increase withstand voltage and reduce corona. Avoids excessive gradients at connecting points and other areas. International standard metric diameters to 106 cm.



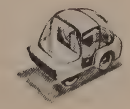


HV SAFETY & ACCESSORIES

Metal film HV resistors, HV capacitors. HV instantaneous overload relays. HV door interlocks, HV grounding rods. Insulation sheet, rod and tube. Solenoids and related equipment. Hot sticks. Many in-stock.

ELECTRIC VEHICLE ENGINEERING

Engineering and manufacturing of LV/HV devices and control units for elec. vehicles, high speed trains and ships.



- **Registered engineers with certified high voltage and high current testing facilities and services.**

ROSS ENGINEERING CORP.

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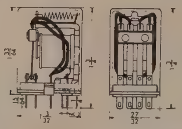
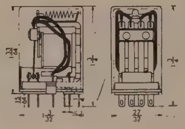
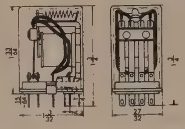
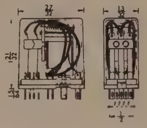
559 WESTCHESTER DRIVE, CAMPBELL, CA. 95008 PHONE (408) 377-4621 24 HR. (408) 253-1572

SCHRACK RELAYS

RELAY	MIDGET RELAY	OPPOSITE POLARITY MIDGET RELAY	SINGLE COIL MINI-MAGNETIC LATCHING	MINI-SIX
TYPE	RA	RAX	RR	RE
ILLUSTRATION				
				
DESIGN	Enclosed with dust cover	Enclosed with dust cover	Plastic dust cover plug in	Enclosed with clear dust cover
TERMINALS	Plug-in relay Solder lugs Printed circuit	Plug-in relay Solder lugs Printed circuit	Same as RA	Plug in relay Solder lugs
CONTACTS Number & Form	4 form "C" contacts (change over)	4 form "C" contacts (change over) Plastic barrier between movable arms	4 form "C"	6 form "C" contacts (change over)
Contact Material	Fine silver Gold flashed	Fine silver Gold flashed	Same as RA	Fine silver Gold flashed
Max. Rated Contact Voltage	110 VDC 220 VAC	110 VDC 220 VAC	Same as RA	60 VAC
Max. Rated Contact Current	3A @ rated E	Same as RA	Same as RA	2A
Max. Rated Contact Load	350 V, 90 W	Same as RA	Same as RA	120 VA (60 VAC) 90 W (30 VDC)
Special Contact Material	AgCdO, AuNi/3 PdAg 60/40 PdAg 30/70	Same as RA	Same as RA	—
COIL Coil Voltage	6-110 VDC 6-220 VAC	Same as RA	24-220 VAC 12-110 VDC	6-60 VDC
Coil Resistance	40-11000Ω 7.9-10 500 Ω	Same as RA	72-6050Ω	33-3170Ω
Voltage Range	75-110% DC 80-110% AC	Same as RA	75-110% DC 80-110% AC	80-110% DC 85-110% AC
Rated Power	0.9 W 1.65 VA	Same as RA	—	1.1 W 1.6 VA
MAX. AMBIENT TEMP.	—		—	—
Standard	70° C (158° F)	Same as RA	70° C (158° F)	70° C
with Heat Resistant Case	—		—	—
MAX. SWITCHING RATE Continuously	3000~/hr.	Same as RA	3000~/hr.	3000~/hr.
For Short Times	5000~/hr.	Same as RA	5000~/hr.	5000~/hr.
OTHER DATA Operate Time	9-11 ms	Same as RA	9-11 ms	8-12 ms
Release Time	3-6 ms	Same as RA	3-6 ms	3-8 ms
Test Voltage	1240 Veff	Same as RA	500 Veff (1000 Veff)	500 Veff
Mechanical Life	100 x 10⁶	Same as RA	100 x 10⁶	100 x 10⁶
OPTIONAL RELAYS AVAILABLE	Chassis mounting by means of 3/48 threaded stud or choice of three different sockets or printed circuit terminals Both RA & RR U.L. File E38891 CSA File LR31000	See general description RAX only U.L. File E38891 CSA File LR31000	See general description RR only U.L. File E38891 CSA File LR31000	For printed circuits use socket RE 78702
For more technical data request catalog No.	S404	S404	S404	S408

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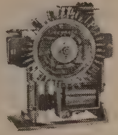
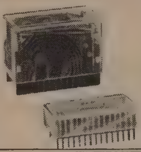
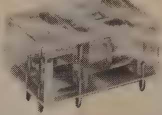
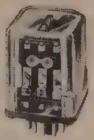
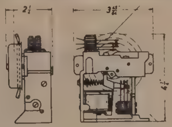
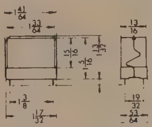
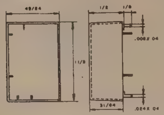
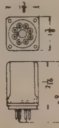
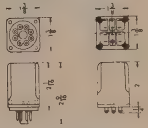
SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N.Y. 10001

SCHRACK RELAYS

ROTARY STEPPING	MINIATURE STEPPING	MINIATURE FOR PCB MOUNTING	SENSITIVE	SINGLE COIL MAGNETIC LATCHING
RT	RTM	RU 110	CMD/CSD	CRD/CRF
				
				
Plastic dust cover die cast metal frame	Plastic dust cover	Enclosed with clear dust cover	Enclosed with Clear Dust Cover or Open Frame (CA)	Enclosed with clear dust cover
Pierced terminals suitable for soldering or .110 faston	Complete relay plugs into pc board or socket Other sockets available	Complete relay plugs into pc board	Same as CA or CAD	Plug-in relay CRD for Octal or 11 pin CRF pierced for Solder or .110 Faston or pc board
1 pole – 40 or 48 positions 2 pole – 20 or 24 positions 4 pole – 10 or 12 positions	2 pole – 10 position 2 pole – 12 position	1 Form "C" (change over)	1. 2. or 3 form "C" (change over)	2 or 3 form "C"
—	Gold alloy wiper tips Gold plated bank & socket contacts	AgCdO	Gold-flashed Silver	—
110 VDC-115 VAC	60 VDC 60 VAC	250 VAC	—	250 VAC
.5A	1 amp, continuously	6 amps	2 amp	5 amps 10 amps*
.2 amp @ 115 VAC	400 MA @ 24 VAC or VDC	1320 VA	—	1250A 2500 VA
—	—	—	—	—
6-110 VDC	6-110 VDC	5-110 VDC	5-200 VAC 4.9-100 VDC	24-220 VAC 12-110 VDC
17-Ω	18-6050	44.5-15,500Ω	54-6900Ω 450-10,000Ω	54Ω-4500Ω
80-110%	85%-110% nom.	75%-120%		80-110%
10 watts (Short time)	2.2 watts (short time)	800 MW	40-300 MW-DC 250 MVA-AC	—
— —	— 45° C	45°C	45° C	5 A 10A 45° C 40° C
—	—	—		60° C
Impulse controled 22 steps/sec. stepping 60-70/sec.	Ext. impulse 25 steps/sec. self stepping 60/sec.	1000 ~/hr.	—	3000~/hr.
—	—	—	6000~/hr.	6000~/hr.
—	20 ms	5.5 ms	10 ms-30 ms	Pull-in 30 ms
—	20 ms	5.5 ms	8 ms-25 ms	Release 25 ms
—	—	2000 Veff	2000 Veff	2000 Veff
200 x 10^6 Self-stepping	—	100 x 10^6	20 x 10^6	20 x 10^6
—		—	Open frame similar to CA available	*10 amp relays in stock 5 amp available on order. For printed circuits Aluminum dust cover for CRF only
S401	S413	S420	GP	S405

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FOR FURTHER INFORMATION ASK FOR CATALOG

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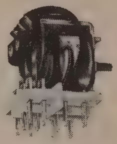
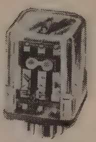
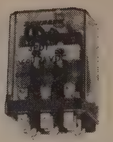
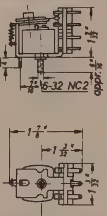
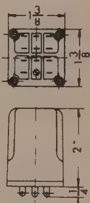
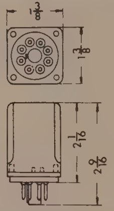
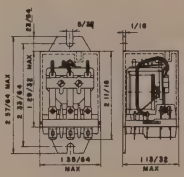
SCHRACK RELAYS

RELAY	GENERAL PURPOSE	GENERAL PURPOSE	GENERAL PURPOSE	POWER
TYPE	CA*	CAF	CAD*	RM
ILLUSTRATION				
DIMENSIONS IN INCHES	 1 1/32" 1/4" 7/16" 6-32 NC2 appr. 5/16" 1 7/8" 1 3/32" 1 3/32"			 23/64 5/32 1/16 2 57/64 MAX 2 33/64 1 29/32 MAX 2 11/16 1 35/64 MAX 1 13/32 MAX
DESIGN	Open Type	Enclosed with clear Dust Cover or Open Frame	Enclosed with Clear Dust Cover	Enclosed with Clear Plug-In Dust Cover or available with Slotted Flanges for screw mounting.
TERMINALS	Pierced terminals – soldering or .110 faston or printed circuit. Also mates with socket RD78700.	Same as CA terminals also for plug-in socket No. RD78700	8 or 11 Pin Base to mate with standard tube sockets	Pierced .187 terminals suitable for solderless connectors or soldering sockets available
CONTACTS Number & Form	1, 2, or 3 form "C" (change over)	1, 2, or 3 form "C" (change over)	1, 2, or 3 form "C" (change over)	2 or 3 form "C" (change over)
Contact Rating	5 or 10 amp.	5 or 10 amp.	5 or 10 amp.	15 or 10 amp.
Contact Material	AgCdO, Hard Silver	AgCdO, Hard Silver	AgCdO, Hard Silver	AgCdO 90/10
COIL Coil Voltage	6-230 VAC 6-110 VDC	6-230 VAC 6-110 VDC	6-230 VAC 6-110 VDC	6-380 VAC 6-220 VDC
Coil Resistance	5.3-8200Ω 32-10,000Ω	5.3-8200Ω 32-10,000Ω	5.3-8200Ω 32-10,000Ω	3.2-16,500Ω 32-10,000Ω
Min. Oper. Voltage	80% AC 75% DC	80% AC 75% DC	80% AC 75% DC	80% AC 75% DC
Rated Power	2.0 VA 1.2 W	2.0 VA 1.2 W	2.0 VA 1.2 W	2.7 VA 1.2 W
MAX. AMBIENT TEMP.	5A 10A	5A 10A	5A 10A	Min: –45°C Max: +55°C-A.C.-D.P.D.T. +45°C-A.C.-3 P.D.T. +60°C-D.C.-2 & 3 P.D.T.
Standard	75° C 70° C	45° C 40° C	45° C 40° C	
With Heat Resist. Case		60° C 60° C	60° C 60° C	
MAX. SWITCHING RATE Continuous	3000~/hr.	3000~/hr.	3000~/hr.	3000~/hr.
For Short Time	6000~/hr.	6000~/hr.	6000~/hr.	—
OTHER DATA Operate Time	10 ms	10 ms	10 ms	15 ms
Release Time	8 ms	8 ms	8 ms	10 ms
Test Voltage	2000 Veff	2000 Veff	2000 Veff	2500 Veff
Mechanical Life	20 x 10^6	20 x 10^6	20 x 10^6	20 x 10^6
OPTIONAL RELAYS AVAILABLE	For cold cathode tubes With printed circuit terminals * U.L. File E38891 CSA File LR 31000	Highly sensitive relays (from 40mW) For cold cathode tubes With built-in neon lamp For printed circuits With Aluminum case	For cold cathode tubes With built-in neon lamp * CSA file LR 31000	with push-to-test button with push-to-test button and neon lamp with neon lamp U.L. File #38891 CSA File LR31000
For more technical data request catalog No.	GP	GP	GP	S 418

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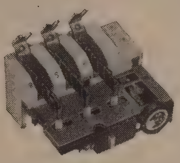
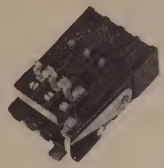
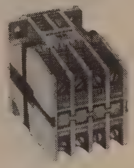
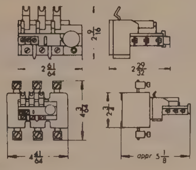
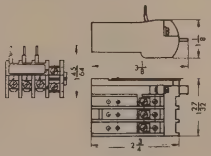
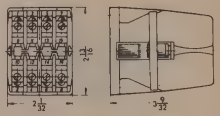
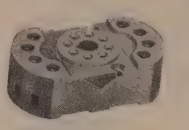
SCHRACK RELAYS

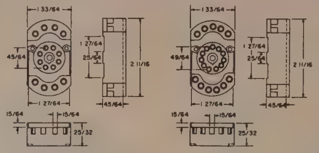
RELAY	OVERLOAD RELAY*	OVERLOAD RELAY*	CONTACTOR
TYPE	FA	FK	M
ILLUSTRATION			
DIMENSION IN INCHES	 2 9/16 2 61/64 2 29/32 4 3/64 2 1/4 4 41/64 appr 5 1/8		
DESIGN	Open frame	Open frame	Open frame 2 screw mounting
CONTACTS	3 pole	3 pole	up to 8 pole
Contact Material	—	—	—
Max. Rated Cont. Voltage	500 VAC/220 VDC	230 VAC	500 VAC
Max. Rated Cont. Current	.35 amps-100 amps	.12 amps-9.0 amps	10-15 amps
Max. Rated Contact Load	—	—	1.5-5.0
Special Contact Materials	—	—	—
COIL **Coil Voltage**	—	—	48, 110, 220, 440 VDC 110, 220, 380, 500 VAC
Coil Resistance	—	—	—
Voltage Range	—	—	AC 80%-110% of rated DC 80%-110% of rated
Hold-In Power	—	—	AC 12VA DC 8 watts
MA. AMBIENT TEMP.	−40°C to +50°C	+45°C	+35°C
MAX. SWITCH TIME (RATE)	—	—	3000/hr. continuous 6000/hr. intermittent
OTHER DATA **Operate Time**	—	—	AC 12-18 ms DC 8-15 ms
Release Time	—	—	AC 7-15 ms DC 10-15 ms
Mechanical Life	—	—	10 x 10⁶
SPECIAL NOTES	*Prevents single phasing in three phase circuit	*Prevents single phasing in three phase circuit. Fastens directly to contactor series M	Compact in size Reversible contacts *AC in stock DC available on order
For more technical data request catalog No.	HD 70	HD 70	HD 70

SEND FOR DISCOUNT SCHEDULES **FOR FURTHER INFORMATION ASK FOR CATALOG**

SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N.Y. 10001

SCHRACK RELAYS

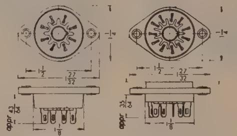



1 33/64
1 27/64
25/64
2 11/16
45/64
48/64
1 27/64
45/64
15/64
15/64
25/32

RELAY SOCKETS WITH SCREW TYPE TERMINALS

No. RN 78724-8 Pin **No. RN 78725-11 Pin**

For surface type installations and prototype work where screw terminals are convenient. Adequate barriers for hi-voltage installations.
Body Material: Noryl SE1
Special attachment for snap-on mounting of socket available.

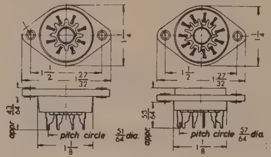

1 1/2
27/32
1 1/8
appr

STANDARD SOLDER LUG SOCKET

No. RN 78710 — 8 Pin

No. RN 78711 — 11 Pin

Conventional type molded socket with numbered pins — screw mounting.

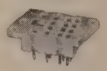

1 1/2
27/32
appr
pitch circle 51/64 dia.
pitch circle 57/64 dia.
1 1/8

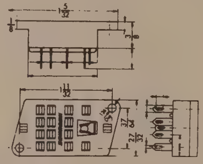
PRINTED CIRCUIT LUG SOCKET

No. RN 78712 — 8 Pin

No. RN 78713 — 11 Pin

Standard type for conventional circuit board assemblies — black molded with numbered pins.



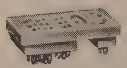

1 5/32
1 11/32
27/32

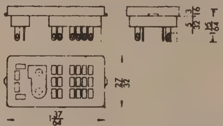
MINIATURE SOCKETS FOR RA RELAYS

No. RA 78700 — for screw mounting, made specially for mounting Schrack RA type relays but may be used for miniature modular circuitry with plug base and dust cover available on request. Precision type with spring-hold grounding terminal.

No. RA 78701 — for spring mounting.

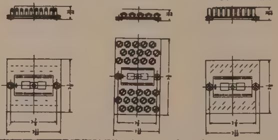
No. RA 78702 — for printed circuit mounting.





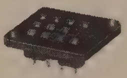
SOCKETS AND ACCESSORIES FOR RE RELAYS

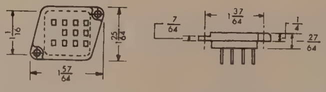
No. RE 78700 Standard Socket
RE 78702 Printed Circuit Socket
RE 28800 Hold-down Spring



SOCKET FOR TYPE RTM

No. RT 78704 for printed circuits
RT 78703-screw type term.
RT 78701-w/solder lugs

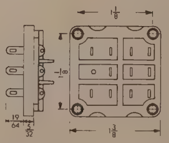



1 1/16
25/64
1 57/64
7/64
1 37/64
1/4
27/64

SPECIAL SOCKET FOR CAF SERIES

No. RD 78700 — 8 or 11 Pin

Exclusive with Schrack. This socket accommodates either 8 or 11 pin base. Its small size and design provides for strip mounting with no loss of space.


1 1/8
1 1/8
19/64
5/32
1 3/8

BASE FOR SCHRACK CAF SERIES

No. RD 78600 — 11 Pins

May be used with above socket and dust cover for building modular component requiring U. L. specs for spacing.
for 8 or 11 wiring

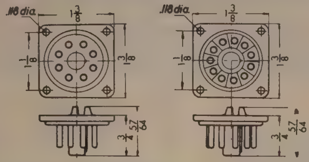
No. RD 78601 — same as above but with printed circuit pins.

SEND FOR DISCOUNT SCHEDULES

FOR FURTHER INFORMATION ASK FOR CATALOG

SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N.Y. 10001

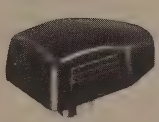
SCHRACK RELAYS

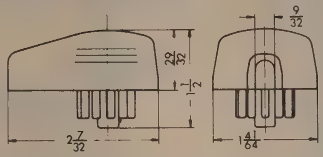

.118 dia
1 3/8
1 1/8
3/4
57/64
.118 dia
1 3/8
1 1/8
3/4
57/64

STANDARD MOLDED PLUG

No. RN 78600 — 8 Pin
No. RN 78704 — 11 Pin

Accommodates RN 16035 or RN 16019 Dust Covers for building plug in modular circuitry.

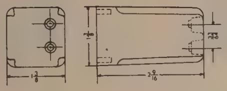



29/32
1 1/2
2 7/32
9/32
1 41/64

SCHRACK TYPE HOODED PLUG

No. RN 78714 — 8 Pin
No. RN 78715

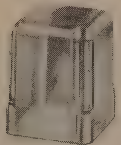
Permits any relay or component to be mounted remotely and to be plugged into standard socket in circuitry.

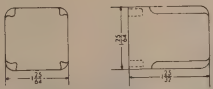


HIGH POLYSTYRENE DUST COVER

No. RN 16020

May be used with CAD Series.
Two holes in top for ventilation.




1 25/64
1 25/64
1 25/32

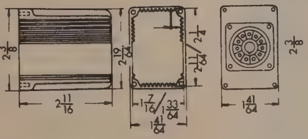
DUST COVER FOR CAD & CAF SERIES

No. RN 16035 POLYSTYRENE with holes in base for screw mounting.

No. RN 16019 — Same as above but molded of Macralone*.

METAL DUST COVER FOR CAF SERIES ONLY

No. RD 10701 on request.


2 3/8
2 11/16
2 19/64
1 7/16
33/64
1 41/64
2 1/4
1 41/64
2 3/8

PLUG MOUNTED ON METAL PLATE

No. RN 74221 — 8 Pin
No. RN 74104 — 11 Pin

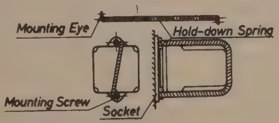
Metal plate provides base for oversize dust cover in order to install components for modular circuitry.

LARGE DUST COVER FOR METAL PLATE

No. RN 16022 Polystyrene
No. RN 16039 Gray Opaque

Internal grooves provide means for mounting circuit boards with components.

No. RN 16034
Same as No. RN 16022 and RN 16039 but made of Macralone*.


Mounting Eye
Hold-down Spring
Mounting Screw
Socket

HOLD DOWN SPRING

No. RN 28623

HOLD DOWN CLIP

No. RN 28611

Provides quick removal of dust cover — fastens to mounting screws of standard type socket.

*Macralone is a polycarbonate resistant to high temperatures.

Self tapping screws for dust covers available on order.

Stock available for immediate delivery from New York warehouse.

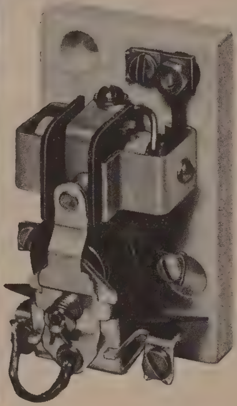
SEND FOR DISCOUNT SCHEDULES

FOR FURTHER INFORMATION ASK FOR CATALOG

SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N.Y. 10001

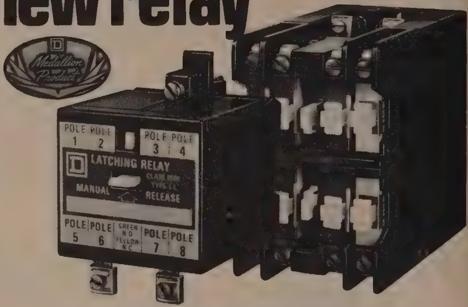
D Relays, Timers & Overloads
INDUSTRIAL RATED

Small rugged DC control relay.



- **Rated up to 15 amps @ 115 VDC**
- **Horsepower rated—¾ hp @ 115 and 230 VDC**
- **Blow-out coils and arc barriers**
- **U/L listed**

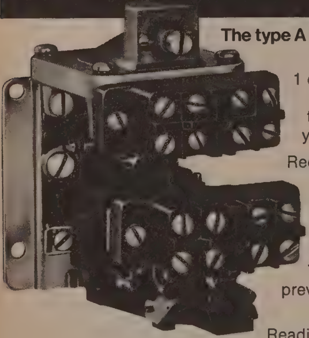
A new latch for a new relay



Any Medallion™ Line Type L 600 Volt Control Relay from Square D can be easily converted to a latching relay. The top mounting latching attachment uses a two coil system with continuous duty coils. So you don't need coil clearing contacts. Up to eight poles are available for customer use. The relay uses unique color-coded plug-in contacts making it the fastest convertible on the market.

The most flexible pneumatic timer

The type A pneumatic timing relay.



1 or 2PDT timed contacts and 1 or 2PDT instantaneous contacts which you can add in the field.

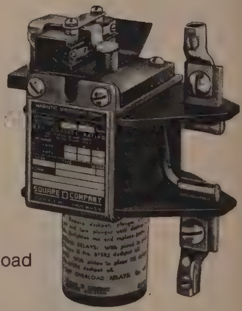
Requires only 10.6 square inches of panel space.

You can easily convert from ON DELAY to OFF DELAY and back.

The closed timing head prevents dirt from clogging up the Type A timer.

Readily available parts make this timer easy to service.

Motor load sensing with magnetic current relays



Square D has three types of load sensing relays for all your wastes compactors, paper shredders, hammer mills or conveyor systems.

Type A Time Delay:
Used mainly to sense motor running overcurrents.

Type B Underload Trip:
Used widely to stop or start one motor by sensing the load in another motor. Resets automatically when load is decreased.

Type N Instantaneous Trip:
Used often to stop conveyors when jam conditions occur.

Featuring:
- Adjustable Trip Current—2:1 Range
- Wide Adjustable Trip Time

World Wide Distribution
For complete listings, prices and application data, contact your nearby Square D field office.
Or, write Square D Company, Dept. SA,
Milwaukee. Wisconsin 53201.

SQUARE D COMPANY
Wherever Electricity is Distributed and Controlled

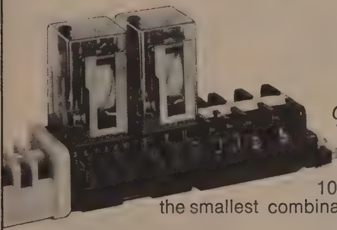
General Purpose Relays

Type K

Extended relay life.
New standard of reliability.

Variety of terminations. 2PDT or 3PDT. AC or DC operation. 10 amp contacts. Options include pilot light and manual operator.

Socket Mounted Version
The Type K general purpose relay is designed for multi-pole switching below 150 volts. Its small size makes it perfect for industrial or commercial control equipment. Troublesome solder connections and pigtail wires have been eliminated to give you an extremely reliable device.



Compact Mounting
Takes up less than 3 square inches of panel space . . . 10 amp relay/socket the smallest combination on the market.

Tube-Type Version
Designed to fit all standard 8 or 11 pin sockets. Interchangeable with other tube-type general purpose relays.

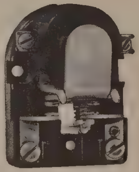
Type J Timing Relay

Integral Type K relay and solid state timing circuit.

Solid state timing relays give ±1% accuracy. .05 to 180 sec. knob adjustable, factory fixed or external resistor adjustable. 150 volt. 10 amp DPDT output contacts. Plug-in tube-type mount.

Type C

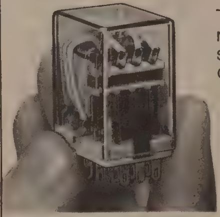
Most available relay.
Low cost.



600 volts maximum. Rated up to 1½ HP. 1 or 2 poles. Stocked by over 400 distributors.

Type R

the dependable miniature relay.



The new Type R miniature relay from Square D is very small, but very superior. It is designed to deliver reliable performance over an extremely long life.

It is the only one to offer all this:

1. Quality inspection and testing before shipment for dependable operation from the start.
2. A standard polarity barrier between each pole which allows the relay to be used where opposite polarity is present on adjacent poles.
3. A complete line of relays and sockets—and we mean complete—which makes the Type R ideal in a wide variety of applications.

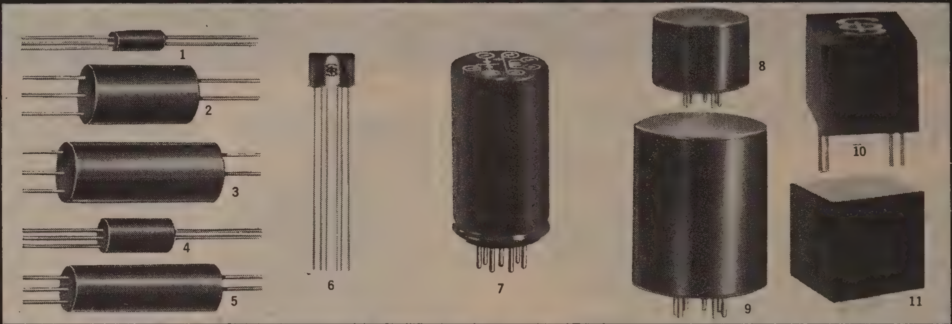
In addition you get: 4 poles; double-throw contacts; 5 amp rating at 120VAC; an optional manual operator and a pilot light.

World Wide Distribution
For complete listings, prices and application data, contact your nearby Square D field office.
Or, write Square D Company, Dept. SA,
Milwaukee, Wisconsin 53201.

SQUARE D COMPANY
Wherever Electricity is Distributed and Controlled

SOLID STATE CHOPPERS, ANALOG SWITCHES, RELAYS

FREQUENCY SENSITIVE, TIME DELAY, HIGH VOLTAGE ALSO ELECTROMECHANICAL AND REED



microminiature
non-mechanical

lightweight
inertialess

low power
low level

high speed
high efficiency

rugged
linear

indefinitely long life
temperature stable

The transistor chopper (or modulator) is a solidly encapsulated unit designed to alternately connect and disconnect a load from a signal source. It may also be used as a demodulator to convert an a.c. signal to d.c. It is capable of linearly switching or chopping voltages over a wide dynamic range which extends down to a fraction of a millivolt and up to 150 volts or more. Unlike mechanical choppers which can only be designed to operate over a narrow and comparatively low frequency range due to mechanical limitations, the transistorized chopper is an inertialess device that can be driven from d.c. to hundreds of kilocycles.

The switching circuitry used, operates the transistors in a manner which provides stability and freedom from drift over a wide temperature range. Only carefully selected and matched transistors are utilized.

The Model NS8000A chopper is transformer isolated, operates up to 1.5 MHz and is a replacement for the discontinued National Semiconductor NS8000 (INCH CHOPPER).

The Models 30, 33, 33P, 40, 40P, 50, 50P, 60, 60P, 70 and 70P are direct-coupled so as to provide the circuit designer with the most basic chopper from which to synthesize solutions to special circuit problems. The Models 33 and 33P are basic field-effect chopper-relays providing exceptional linearity, stability, low noise and offset. The Models 64, 66, 75 and 150 are transformer-coupled for isolation purposes. The Model 150 is for high-level signals. The Models 64 and 66 are for operation from 400 cps and 60 cps sine wave drive at 115 volts a.c. The Models 80, 81, 90 and 91 VIBRACHOPPERS are unique since they require d.c. rather than a.c. drive. The Model 98 has complete isolation and insulation between drive and contacts, even with d.c. drive. The Series 6000 Choppers are interchangeable with Airpax units. The Model TCD-101 Transistor Chopper Driver provides suitable square wave drive voltages for transistorized choppers and synchronous demodulators.

These units are practically immune to the effects of shock and vibration making them ideal for military, space vehicle and portable applications; or where power conservation, miniaturization and elimination of maintenance are a necessity.

CHOPPER MODEL SPECIFICATIONS

Model	Switching	Max. Signal Voltage (Volts)	Max. Signal Current (MA)	Drive Frequency Range	Max. Drive Voltage (600Ω Source) (AC Volts)	Drive Input Impedance (Ohms)	Ambient Temp. Range (°C)	Size (Inches)	Weight (Grams)	Fig.	Remarks
NS8000A	SPST	±10	±10	DC to 1.5 mc	10 pk-pk	100	−55 to +100	.45x.375 Dia.	1	6	Shielded Hi-Freq
30	SPDT	±10	±10	DC to 100 kcps	25 pk-pk	200	−55 to +90	.38x.16 Dia.	½	1	Micro-Min Hi-Freq
33	SPDT	±7	±5	DC to 500 kcps	30 pk-pk	10M	−55 to +175	.7x.44 Dia.	2	2	FET, Lo-Offset Hi-Temp
33P	SPDT	±7	±5	DC to 500 kcps	30 pk-pk	10M	−55 to +175	.5x.75 Dia.	8	8	FET, Lo-Offset Hi-Temp
40	SPDT	±15	±40	DC to 50 kcps	40 pk-pk	600	−55 to +150	.7x.44 Dia.	2	2	Sub-Min Hi-Temp
40P	SPDT	±15	±40	DC to 50 kcps	40 pk-pk	600	−55 to +150	½x¾ Dia.	8	8	Plug-in Hi-Temp
50	SPDT	±10	±10	DC to 100 kcps	25 pk-pk	600	−55 to +90	1¼x.44 Dia.	3	3	Sub-Min Hi-Freq
50P	SPDT	±10	±10	DC to 100 kcps	25 pk-pk	600	−55 to +90	½x¾ Dia.	8	8	Plug-in Hi-Freq
60	SPDT	±10	±50	DC to 100 kcps	50 pk-pk	600	−55 to +90	½x¼ Dia.	1	4	Micro-Min Hi-Freq
60P	SPDT	±10	±50	DC to 100 kcps	50 pk-pk	600	−55 to +90	½x¾ Dia.	8	8	Plug-in Hi-Freq
64	SPDT	±10	±50	.04 to 12 kcps	300 pk-pk	10K	−55 to +90	1¼x1 Dia.	44	9	115V/400 cps Xfmr-in
66	SPDT	±5	±50	.02 to 12 kcps	300 pk-pk	7K	−55 to +90	1¼x1 Dia.	44	9	115V/60 cps Xfmr-in
70	SPDT	±10	±40	DC to 100 kcps	4 pk-pk	600	−55 to +150	1⅛x5⁄16 Dia.	2	5	Hi-Freg Hi-Temp
70P	SPDT	±10	±40	DC to 100 kcps	4 pk-pk	600	−55 to +150	½x¾ Dia.	8	8	Plug-in Hi-Freq
71	SPDT	±10	±5	.04 to 70 kcps	10 pk-pk	300	−55 to +150	.84x.84x.75	30	10	Xfmr-in Plug-in
75	SPDT	±2	±30	0.27 to 100 kcps	10 pk-pk	100	−55 to +150	¾x¾ Dia.	12	8	Xfmr-in Hi-Temp
80	SPDT	±15	±50	1.5 to 6.5 kcps	6 to 32 DC	2K	−55 to +90	1¼x1 Dia.	32	9	DC-Drive Plug-in
81	DPDT	±15	±50	1.5 to 6.5 kcps	6 to 32 DC	2K	−55 to +90	1¼x1 Dia.	32	9	DC-Drive DPDT
90	SPDT	±6	±50	1.2 to 3.0 kcps	12 to 32 DC	2K	−55 to +150	½x1 Dia.	40	9	DC-Drive Plug-in
91	DPDT	±6	±50	1.2 to 3.0 kcps	12 to 32 DC	2K	−55 to +150	1¾x1 Dia.	40	9	DG Drive Hi-Temp DPDT
98	SPST	±20	±2	DC to 5.0 kcps	6 to 12 pk-pk	850	−55 to +100	.75x.75x.84	16	10	DC or AC isolated Drive
150	SPDT	±150	±40	0.27 to 30 kcps	20 pk-pk	100	−55 to +150	1¼x1 Dia.	30	9	Hi-Volt Hi-Temp Xfmr-in
171	SPDT	±1	±5	.2 to 50 kcps	10 pk-pk	100	−55 to +150	.9x9x1.25 Dia.	30	11	Full-Wave Vfmr In-out
6015	SPDT	5	0.5	50 cps to 5 kc	*5.7 to 14 volts	2K	−40 to +85	1.438x.75 Dia.	55	7	Xfmr-in Replacement
6020	SPST	30	3.0	50 cps to 5 kc	*5.7 to 14 volts	1.5K	−55 to +125	1.438x.75 Dia.	55	7	Xfmr-in Hi-Temp
6021	SPST	10	1.0	50 cps to 5 kc	*5.7 to 14 volts	3K	−40 to +125	1.438x.75 Dia.	55	7	Xfmr-in Hi-Temp
6022	SPDT	30	3.0	50 cps to 5 kc	*5.7 to 14 volts	2K	−55 to +125	1.438x.75 Dia.	55	7	Xfmr-in Hi-Temp
6025	SPDT	100	10.0	50 cps to 5 kc	*5.7 to 14 volts	2K	−40 to +55	1.438x.75 Dia.	55	7	Xfmr-in Hi-Volt
6035	SPDT	20	2.0	50 cps to 5 kc	*5.7 to 14 volts	2K	−40 to +85	1.438x.75 Dia.	55	7	Xfmr-in Replacement
6036	SPDT	20	1.0	50 cps to 5 kc	*5.7 to 14 volts	2K	−40 to +85	1.438x.75 Dia.	55	7	Xfmr-in Replacement
6045	SPST	15	3.0	50 cps to 5 kc	*5.7 to 14 volts	1.5K	−55 to +125	1.438x.75 Dia.	55	7	Xfmr-in Hi-Temp

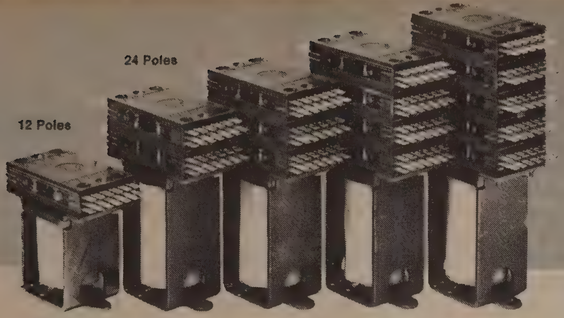
*sine or square wave

Phone, wire or write for specifications and application literature describing above units cr consult your microfilm files (VSMF or Thomas Supplementary).

SOLID STATE ELECTRONICS CORP.
15321 RAYEN STREET
SEPULVEDA, CALIFORNIA
Area Code 213 — 894-2271

OTHER PRODUCTS — SEE EEM SECTION 1900

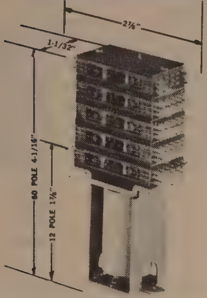
- FREQMETERS (MODULAR & VISUAL)
- DC DIFFERENTIAL OPERATIONAL AMPLIFIER
- XTAL PULSE GENERATORS
- VOLTAGE CONTROLLED OSCILLATORS
- TONE OSCILLATORS-TRANSFORMERS
- RELAYS (SOLID STATE, TIME DELAY, REED, LIGHT)
- MINIATURE TELEMETER SYSTEMS
- PRESSURE TRANSDUCERS
- DIGITAL LOGIC MODULES



T*bar®
RELAYS for Multipole High Density Switching

Switch from 4 to 60 circuits with only one T-Bar Relay. Available in configurations of 4, 8, 12, 24, 36, 48 and 52 poles with "A" or "C" contacts and 60 poles with "A" form contacts. For low level applications specify the 901 Series. For general purpose applications specify the 801 Series.

SPECIFICATIONS



Contacts:	Series 800—general purpose gold plated Series 900—low-level bifurcated gold plated
Contact Rating:	Series 800—5 amps max. resistive to 150 watts Series 900—1 amp max. resistive to 50 watts
Life Expectancy: at 20 CPM	Series 800—30,000,000 mechanical (latching limited to 1,000,000) 20,000,000 @ 100 mw 100,000 @ 5 amps 28 VDC Series 900—30,000,000 mechanical 20,000,000 @ 100 mw 100,000 @ 1 amp at 28 VDC
Contact Resistance:	20 milliohms typical
Ambient Temperatures:	—55° to plus 85°C
Terminals:	Mate with T-Bar Connectors
Dielectric Strength:	1000 VRMS @ 60 cycles/sec. (higher available)
Insulation Resistance:	5000 megohms min. (higher available)

Power @ 25°C:

Poles	Form	Watts
4, 8 or 12	A, B or C	3
24	A, B or C	3.4
36	A, B or C	5.2
48	A	5.2
48	B or C	6.5
52	A, B or C	6.5
60	A	6.5
4, 8 or 12	D	3.4
24	D	5.2
36	D	6.5

NOTE: On all latching standard pulse coil power is 6 watts, except on bifilar coils, which is 10 watts.

Operate and Release Time Typical (at nominal voltage 25°C):

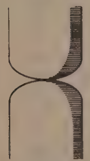
Operate (Refer to factory for faster operation):
4, 8 or 12 poles: 15 MS max.
24 poles: 25 MS max.
36 poles: 30 MX max.
48 poles: 35 MX max.
52 or 60 poles: 45 MS max.
For latching types: latch and unlatch times are 15 MS typical, all sizes.

Release: 5 MS typical

Contact Bounce:
2 MS typical N.O. contacts
6 MS typical N.C. contacts
4 MS typical for latching units (both ways)

Take your choice of 2 contacts!

800 SERIES
for reliable General Purpose Switching



The 800 Series contact is a highly reliable gold-plated button contact. With its high contact pressure and positive wiping action, it is used in control type applications and in general purpose switching, such as relays, valves, lamps, etc. Contact Rating: up to 5 AMPS max.

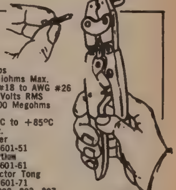
900 SERIES
for reliable Low Level Switching

The 900 Series DATA-RITE™ contact has the reliability of a bifurcated contact with the added feature of two degrees of wiping action. The unique EDGE-TO-DOME contact guarantees a clean surface, which is critical for low level signals. The 900 Series is typically used in computer I/O signals; voice and data-grade communications; thermocouple and strain gauge outputs; all low level switching, whenever reliability is a premium, or whenever slight variations in contact resistance cannot be tolerated. Contact Rating: Microvolts up to 1 AMP max.

T-BAR CONNECTORS

The T-Bar Series 88601 Connector has been specifically designed for use with T-Bar switches and relays. The connector contacts are crimp type which are snapped into a plastic insulator block. After installation, connectors are held in place against shock and vibration by use of a retaining clip.

Current Carrying Capacity	5 Amps
Contact Resistance	5 Milliohms Max.
Wire Accommodated	AWG #18 to AWG #26
Dielectric Strength	1000 Volts RMS
Insulation Resistance	100,000 Megohms Min.
Ambient Temperature	−55°C to +85°C
Weight	0.3 Oz.
Recommended Tools	Crimper P/N 8601-51 Extraction P/N 8601-61 Connector Tong P/N 8601-71
Use 88601 With	801, 802, 803, 807, 901, 902, 907



8601-51 Crimping Tool

HOW TO ORDER

1. Specify Series **2.** Specify Number of Poles and Contact Form **3.** If A Relay, Specify Coil Voltage

Don't forget to order the mating T-Bar Series 88601 Connector! One for each 6 poles.

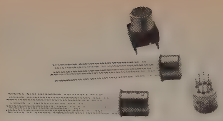
901 — 12 C — 24

SERIES	Application	No. of Poles	Contact Form*	Actuating Mechanism	Coil Voltage
801	General Purpose	4 to 52 60 Pole Unit "A" Form Only	"A" or "C"	CONTINUOUS DUTY COIL	6, 12, 24, 28, 48, 110 VDC 115 VAC
901	Low Level				
807	General Purpose	12 to 52	"C"	MAGNETIC LATCHING COIL (Pulse to latch, pulse in opposite polarity to unlatch.)	6, 12, 24, 28, 48, 110 VDC
907	Low Level				

*Form "A"—normally open contacts. Form "C"—double throw, break-before-make.

Manufactured under 1 or more of the

T-bar INCORPORATED
SWITCHING COMPONENTS DIV.
144 Danbury Road, Wilton, Conn. 06897 • (203) 762-8351



TELEDYNE RELAYS

Military TO-5 Relays

The most versatile line of subminiature relays in the industry. Featuring all welded construction, hermetic sealing, and high force/mass ratios for excellent resistance to environmental extremes. Gold plated precious metal contacts assure reliable switching of loads from dry circuit to 1 ampere. Contact geometry and low inter-contact capacitance provide RF switching capability up to 500 MHz. Most models qualified to MIL-R-5757 and MIL-R-39016.

Available in following versions:

- **SPDT & DPDT,** with optional internal suppression and steering diodes
- **SPDT & DPDT Sensitive,** with optional internal suppression and steering diodes
- **SPDT & DPDT Hybrid** (both standard and sensitive coil versions) with internal transistor driver and suppression diode
- **SPDT, DPDT, & 4PST Magnetic Latching,** with optional internal suppression and steering diodes
- **SPDT & DPDT Bifilar**

Special models available on request.

SERIES*		CONTACT DATA		COIL DATA			APPLICABLE MIL. SPEC. SHEET
		ARRANGEMENT	MAX. RATING (AMPS @ 28 VDC)	NOMINAL VOLTAGE (VDC)	NOMINAL RESISTANCE (Ω)	MUST-OPERATE POWER (MW)	
411		1 FORM C	1	5, 6, 9, 12, 18, 26.5	63, 125, 280, 500, 1130, 2000	100	M39016/7 M5757/38
411D		1 FORM C	1	5, 6, 9, 12, 18, 26.5	63, 125, 280, 500, 1130, 2000	100	M39016/23 M5757/97
411DD		1 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 98, 280, 500, 1130, 2000	100	M39016/24 M5757/91
411T		1 FORM C	1	5, 6, 9, 12, 18, 26.5	63, 125, 280, 500, 1130, 2000	100	NA
412		2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 98, 220, 390, 880, 1560	130	M39016/9 M5757/40
412D		2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 98, 220, 390, 880, 1560	130	M39016/15
412DD		2 FORM C	1	5, 6, 9, 12, 18, 26.5	39, 78, 220, 390, 880, 1560	130	M39016/20
412T		2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 98, 220, 390, 880, 1560	130	M28776/1
431	SENSITIVE	1 FORM C	1	5, 6, 9, 12, 18, 26.5, 32, 40	125, 255, 630, 1025, 2300, 4000, 6500, 11000	40	M39016/10 M5757/69
431D		1 FORM C	1	5, 6, 9, 12, 18, 26.5, 32, 40	125, 255, 630, 1025, 2300, 4000, 6500, 11000	40	M39016/25 M5757/100
431DD		1 FORM C	1	5, 6, 9, 12, 18, 26.5, 32, 40	100, 200, 630, 1025, 2300, 4000, 6500, 11000	40	M39016/26 M5757/94
431T		1 FORM C	1	5, 6, 9, 12, 18, 26.5, 32, 40	125, 255, 630, 1025, 2300, 4000, 6500, 11000	40	NA
432		2 FORM C	1	5, 6, 9, 12, 18, 26.5, 36, 48	100, 200, 400, 850, 1600, 3300, 6500, 11000	60	M39016/11 M5757/70
432D		2 FORM C	1	5, 6, 9, 12, 18, 26.5, 36, 48	100, 200, 400, 850, 1600, 3300, 6500, 11000	60	M39016/16
432DD		2 FORM C	1	5, 6, 9, 12, 18, 26.5, 36, 48	64, 125, 400, 850, 1600, 3300, 6500, 11000	60	M39016/21
432T		2 FORM C	1	5, 6, 9, 12, 18, 26.5, 36, 48	100, 200, 400, 850, 1600, 3300, 6500, 11000	60	NA
421	MAGNETIC LATCHING	1 FORM C	0.5	5, 6, 9, 12, 18, 26.5	61, 120, 280, 500, 1130, 2000	100	M39016/8 M5757/39
421D		1 FORM C	0.5	5, 6, 9, 12, 18, 26.5	61, 120, 280, 500, 1130, 2000	100	M39016/27
421DD		1 FORM C	0.5	5, 6, 9, 12, 18, 26.5	48, 97, 280, 500, 1130, 2000	100	M39016/28
420/422		2 FORM C	1	5, 6, 9, 12, 18, 26.5	61, 120, 280, 500, 1130, 2000	100	M39016/12 M5757/71
420D/422D		2 FORM C	1	5, 6, 9, 12, 18, 26.5	48, 97, 280, 500, 1130, 2000	100	M39016/29
420DD/422DD		2 FORM C	1	5, 6, 9, 12, 18, 26.5	61, 120, 280, 500, 1130, 2000	100	M39016/30
424A		4 FORM A	0.5	5, 6, 9, 12, 18, 26.5	61, 120, 280, 500, 1130, 2000	125	NA
424AD		4 FORM A	0.5	5, 6, 9, 12, 18, 26.5	61, 120, 280, 500. 1130, 2000	125	NA
441	BI-FILAR	1 FORM C	1	6, 12, 26.5	90, 360, 1450	145	NA
442		2 FORM C	1	6, 12, 26.5	90, 360, 1450	145	NA

General Specifications:
Contact Resistance: 0.1Ω max. initial/0.2Ω max. after life at max. load
Life: 100,000 operations @ max. rated contact load (life expectancy 10^7 operations at low level)
Temperature: −65°C to +125°C
Vibration: 30 g's to 3000 Hz.
Shock: 80 g's for 11 ms. (some maglatch models higher)

Terminal and Spreader Pad Options:

1. Standard terminal lengths: 1.5″ (38.10 mm) wire leads or .187″ (4.75 mm) pins (pin versions designed for use with plug-in sockets)
2. All models except 411 & 431 series (including D & DD versions) and 441 series can be supplied with spreader pads installed and cemented in place. Spreader pad P/N 192-10 for direct mounting on PC boards; P/N 192-59 designed for use with standard DIP sockets.

*Suffix D denotes internal suppression diode, DD suppression & steering diodes, and T transistor driver & suppression diode.

TELEDYNE RELAYS

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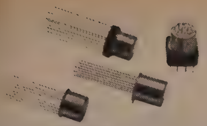
Detailed specifications on any of our products or a complete catalog are available on request.



TELEDYNE RELAYS

Commercial/Industrial TO-5 Relays

Low cost versions of DPDT MIL qualified TO-5 relays. Hermetic sealing, all welded construction, and gold plated precious metal contacts assure reliable switching of loads from dry circuit to 1 ampere. Contact geometry and low intercontact capacitance provide RF switching capability up to 500 MHz.

Available in following versions:

- **DPDT,** with optional internal suppression diode
- **DPDT Sensitive,** with optional internal suppression diode
- **DPDT Hybrid** (both standard and sensitive coil versions) with internal transistor driver and suppression diode

Special models available on request.

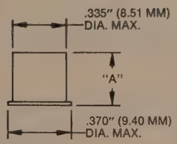
SERIES	CONTACT DATA			COIL DATA	
	ARRANGEMENT	MAX. RATING (AMPS @ 28 VDC)	NOMINAL VOLTAGE (VDC)	NOMINAL RESISTANCE (Ω)	MUST-OPERATE POWER (MW)
712	2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 100, 220, 390, 880, 1560	185
712D	2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 100, 220, 390, 880, 1560	185
712TN	2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 100, 220, 390, 880, 1560	185
732	2 FORM C	1	5, 6, 9, 12, 18, 26.5	100, 200, 400, 850, 1600, 3300	90
732D	2 FORM C	1	5, 6, 9, 12, 18, 26.5	100, 200, 400, 850, 1600, 3300	90
732TN	2 FORM C	1	5, 6, 9, 12, 18, 26.5	100, 200, 400, 850, 1600, 3300	90
732-1000*	2 FORM C	1	12	940	60
732D-1000*	2 FORM C	1	12	940	60

General Specifications:
Contact Resistance: .125 Ω initial/.250 Ω max. after life at max. load
Life: 100,000 operations at max. rated load (life expectancy 10^7 operations at low level loads)
Temperature: −55°C to +71°C (operating)

Spreader Pad Options:
All models can be supplied with spreader pad mounted and cemented in place. Spreader pad P/N 192-10 for direct mounting on PC boards; P/N 192-59 designed for use with standard DIP sockets.

*Ultra-sensitive 732-1000 series designed specifically for use in battery-operated radio transceivers.

TO-5 Relay Case Dimensions



RELAY SERIES	"A" DIM.	
	INCHES	MM
411 412 421 420/422 712	.275	6.99
424A	.325	8.26
431 432 441 442 732	.375	9.53

Spreader Pads for TO-5 Relays

Preform and spread leads to grid patterns compatible with printed circuit board layouts and DIP sockets, with minimum additional profile height.

P/N 192-10

- Preforms and spreads leads to .200" x .300" grid at .100" spacing
- Serves as spacer and insulator for printed circuit board applications
- Simplifies insertion of leads into printed circuit boards
- Reduces stress on glass seals
- Aids visual inspection of solder flow
- Fits all TO-5 relays except 411 and 431 series (including D and DD versions) and 441 series

P/N 192-59

- Preforms and spreads leads to .300" grid at .100" spacing
- Designed for use with standard DIP sockets
- Fits the following TO-5 relay series: 412, 421, and 432 (including D and DD versions), 712 and 732 (including D versions), 431T, and 442

Notes:

1. Relays can be supplied with spreader pads installed and cemented in place.
2. To order relays with 192-10 spreader pads installed, add M to part number (for example: 412D-26 with 192-10 pad installed is 412DM-26).
3. To order relays with 192-59 spreader pads installed, add M2 to part number (for example: 412D-26 with 192-59 pad installed is 412DM2-26). Leads are trimmed to .130" below pad for plugging directly into DIP sockets.
4. Material (both types): Diallyl Phthalate.

TELEDYNE RELAYS

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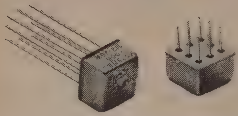
Detailed specifications on any of our products or a complete catalog are available on request.



TELEDYNE RELAYS

Centigrid® Military Relays

The smallest subminiature relay available. Low profile, .225″ (5.72 mm) high by .370″ (9.40 mm) square, with .100″ grid spaced leads. Features all welded construction, hermetic sealing, and high force/mass ratios for excellent resistance to environmental extremes. Gold plated precious metal contacts assure reliable switching of loads from dry circuit to 1 ampere. Contact geometry and low inter-contact capacitance provide RF switching capability up to 500 MHz. Standard models qualified to MIL-R-5757 and MIL-R-39016. Also available with internal suppression and steering diodes.

SERIES	CONTACT DATA		COIL DATA			APPLICABLE MIL. SPEC.
	ARRANGEMENT	MAX. RATING (AMPS @ 28 VDC)	NOMINAL VOLTAGE	NOMINAL RESISTANCE	MUST-OPERATE POWER (MW)	
112	2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 98, 220, 390, 880, 1560	130	M39016/17 M5757/89
112D	2 FORM C	1	5, 6, 9, 12, 18, 26.5	39, 78, 220, 390, 880, 1560	130	NA
112DD	2 FORM C	1	5, 6, 9, 12, 18, 26.5	50, 98, 220, 390, 880, 1560	130	NA

General Specifications:

Contact Resistance: 0.1Ω max. initial; 0.2 Ω max. after life at max. load.
Life: 100,000 operations @ max. rated contact load (life expectancy 10^7 operations at low level)
Temperature: −65°C to +125°C
Vibration: 30 g's to 3000 Hz.
Shock: 80 g's for 11 ms. min.

Mini-T
Subminiature General Purpose Industrial Relay

Smallest 5 amp general purpose relay for commercial/industrial applications. Available with AC coils for 6, 12, 24, 48, 120 and 220 volt operation and DC coils for 6, 12, 24, 48 and 110 volt operation. 2 form C contact arrangement. Optional choice of contact materials: Type Y fine silver for low level to 2.0 amp loads, and Type G silver alloy for 1.0 to 5.0 amp loads. Tight fitting transparent plastic dust cover protects against harsh industrial environments. Mating sockets available for chassis and PC board mounting. Size: .690″ (17.53 mm) square x .875″ (22.23 mm) high.

SERIES	CONTACT DATA		COIL DATA		
	ARRANGEMENT	MAX. CURRENT	NOMINAL VOLTAGE	NOMINAL RESISTANCE	MUST-OPERATE POWER
T-DG	2 FORM C	5	6, 12, 24 48, 110	25, 100, 400, 1.6K, 8.5K	750 MW
T-DY	2 FORM C	2	6, 12, 24 48, 110	25, 100, 400, 1.6K, 8.5K	750 MW
T-AG	2 FORM C	5	6, 12, 24, 48, 120, 220	12.5, 50, 200, 800, 5K, 20K	1.6 VA
T-AY	2 FORM C	2	6, 12, 24, 48, 120, 220	12.5, 50, 200, 800, 5K, 20K	1.6 VA

General Specifications:

Temperature Range: −40°C to +70°C
Life: 100,000 operations at max. rated load (life expectancy 10,000,000 operations, mechanical)

Terminal Options:

- Plug-in terminals for chassis or PC board sockets
- PC board terminals on .200″ grid for direct PC board mounting

Sockets:

- Model TS-1 Socket for Chassis mounting
- Model TS-2 Socket for PC Board mounting

UL Recognized — File #E47991

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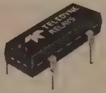
TELEDYNE RELAYS

SERENDIP® Commercial/Industrial DIP Solid State Relays



Subminiature solid state relays in standard TO-116 DIP packages. Featuring all solid state circuitry with hybrid microcircuit construction, and high input/output isolation (up to 2500 volts/10^9 ohms). Six models available providing choice of output: bipolar (ac or dc), ac (triac), and dc (transistor). Bipolar (640/644 series) and dc (643 series) are direct pin-for-pin replacements for standard DIP reed relays. AC versions (641 series) are UL Recognized — File #E55197.

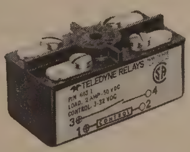
PART NUMBER	INPUT DATA		OUTPUT (LOAD) RATINGS			
				CURRENT		
	VOLTAGE (VDC)	MAX. CURRENT (MADC @ 5V)	AC/DC	@ 10V INPUT	@ 5V INPUT	VOLTAGE
640-1	3.8-10	22	BIPOLAR (AC or DC)	80 MA	40 MA	±50 V_{PEAK}
641-1	3.8-10	15	AC	0.5 A (Note 1)	0.5 A	140 V_{RMS}
641-2	3.8-10	15	AC	0.5 A (Note 1)	0.5 A	280 V_{RMS}
643-1	3.8-10	15	DC	400 MA	200 MA	60 V_{DC}
643-2	3.8-10	15	DC	100 MA	50 MA	250 V_{DC}
644-1	3.8-6	18	BIPOLAR (AC or DC) (Note 2)	5 MA	5 MA	±5 V_{PEAK}

Notes:

1. 1 amp with heat sink. Standard DIP heat sink, Model 640HS, available as accessory.
2. Features low offset voltge (100 microvolts typical).

Solid State DC Relay

603 Series - Optically Isolated



Solid state DC relays featuring LED optical isolation. SPST, normally open. Available in 2 and 5 amp steady state current ratings, up to 50 vdc. Sensitive 3-32 vdc control input is compatible with both low and high level logic systems. As an added option, controlled rise and fall time is offered to limit in-rush currents for lamp loads and switching transients for inductive loads. Package configuration provides either screw or quick disconnect terminals for chassis or panel mounting or solder pins for direct PC board mounting.

Size: 1″ (25.4 mm) x 2″ (50.8 mm) x .9″ (22.9 mm).

PART NUMBER	OUTPUT CURRENT RATING (AMPS)	
603-1	2	
603-2	5	
603-21	2	Controlled Rise & Fall Time
603-22	5	

Basic part number provides screw terminals.
Add suffix "P" for PC board pins, "Q" for quick disconnect terminals.

TELEDYNE RELAYS

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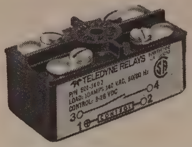
TELEDYNE RELAYS

Solid State AC Relays

601-1400 Series - Optically Isolated



Solid state AC relays featuring LED optical isolation and synchronous/zero voltage turn-on for reducing RFI. Available in 5 or 10 amp steady state current ratings for 120 or 240 volt loads. SPST, normally open. Sensitive 3-32 vdc control input is TTL compatible. The versatile "adaptive" package design of the 601-1400 series provides either screw or quick-disconnect terminals for chassis or panel mounting, or solder pins for direct PC board applications. 1″ (25.4 mm) x 2″ (50.8 mm) x .9″ (22.9 mm) package size makes it the smallest 10 amp AC solid state relay available.

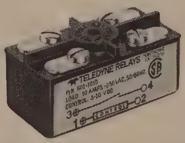
PART NUMBER	OUTPUT CURRENT RATING (AMPS)	OUTPUT VOLTAGE RATING (VRMS)
601-1401	5	140
601-1402	10	140
601-1403	5	250
601-1404	10	250

Basic part number provides screw terminals.
Add suffix "P" for PC board pins, "Q" for quick disconnect terminals

UL Recognized — File #E47991

CSA Certified — File #31043

601-1000 Series — Transformer Isolated



Transformer isolated version of the 601-1400 series. High input/output isolation (1000 v/10^9 ohms) achieved through magnetic coupling. Asynchronous turn-on; zero current turn-off. SPST, available in 3 and 10 amp ratings for 120 or 240 volt loads. Features "adaptive" package design, providing choice of either screw or quick disconnect terminals for chassis or panel mounting or solder pins for direct PC board mounting.

INPUT (CONTROL) VOLTAGE RANGE	OUTPUT VOLTAGE RATING (VRMS)	OUTPUT CURRENT RATING & PART NUMBERS	
		3 AMP	10 AMP
3-10 VDC	140/250	601-1007	601-1010
6-32 VDC or 15-45 VAC	140/250	601-1017	601-1020
60-140 VAC	140/250	601-1027	601-1030

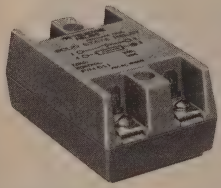
Basic part number provides screw terminals.
Add suffix "P" for PC board pins, "Q" for quick disconnect terminals.

UL Recognized — File #E47991

CSA Certified — File #31043

611 Series - Optically Isolated

High power solid state AC relays, available in 10, 25, and 40 amp ratings, for 120 and 240 volt loads. Features LED optical isolation and synchronous/zero voltage turn-on for reducing RFI. High output transient immunity — 200 volts/µsec. typical. Choice of logic compatible 3-32 vdc or AC line voltage input. Provided with multi-purpose screw and quick disconnect terminals.



UL Recognized — File #E47991

INPUT (CONTROL) VOLTAGE RANGE	OUTPUT VOLTAGE RATING (VRMS)	OUTPUT CURRENT RATING & PART NUMBERS		
		10 AMP	25 AMP	40 AMP
3-32 VDC	140	611-3	611-1	611-5
	250	611-4	611-2	611-6
90-140 VAC	140	611-13	611-11	611-15
200-250 VAC	250	611-14	611-12	611-16

TELEDYNE RELAYS

3155 West El Segundo Boulevard, Hawthorne, California 90250 • Telephone (213) 973-4545

Detailed specifications on any of our products or a complete catalog are available on request.

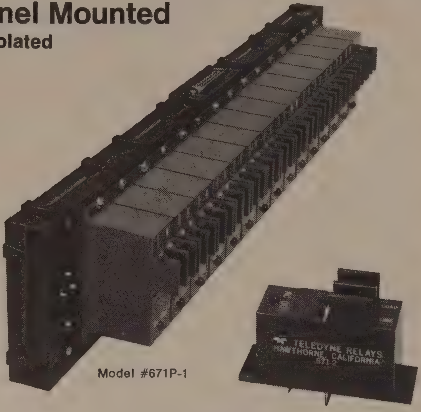
TELEDYNE RELAYS

Solid State AC & DC I/O Converters

671 Series — Panel Mounted

Optically Isolated

Designed for use in programmable controllers, computerized process control systems, machine tool controls, etc. All solid state circuitry — optically isolated — with high transient and noise immunity to withstand severe industrial environments without false triggering. Unique single circuit modular package design with logic terminals physically isolated from power wiring, and high barriered power terminals providing for side by side panel mounting thus eliminating the need for additional interconnecting terminal strips. This modular I/O interface concept facilitates installation and maintenance and offers substantially greater system flexibility when compared to conventional multicircuit PC card systems. Integral LED status indicators are included for easy troubleshooting. There are 5 different converter modules in the series as shown on the adjacent table.



Model #671P-1

P/N	DESCRIPTION
671-1	AC Input Converter
671-4	AC Output Converter, 4-10 VDC Input 3 amps/250 VAC (zero voltage turn-on)
671-5	AC Output Converter, 10-32 VDC Input 3 amps/250 VAC (zero voltage turn-on)
671-21	DC Input Converter
671-22	DC Output Converter, 3 amps/55 VDC
671P-1	Mounting Panel

675 Series — PC Board Mounted

Optically Isolated

Functionally identical to 671 Series but featuring low profile PC board compatible potted module construction for greater packaging density and close card spacing. Designed to replace discrete I/O interface circuitry, this modular PC board concept facilitates installation and maintenance. Utilizes all solid state circuitry — optically isolated — with high transient and noise immunity. There are 5 different converter modules in the series as shown on the table.

P/N	DESCRIPTION
675-1	AC Input Converter
675-4	AC Output Converter, 4-10 VDC Input 3 amps/250 VAC (zero voltage turn-on)
675-5	AC Output Converter, 10-32 VDC Input 3 amps/250 VAC (zero voltage turn-on)
675-21	DC Input Converter
675-22	DC Output Converter, 3 amps/55 VDC

TELEDYNE RELAYS
AC INPUT CONVERTER
675-1
TELEDYNE RELAYS
AC OUTPUT CONVERTER
675-4

TELEDYNE RELAYS

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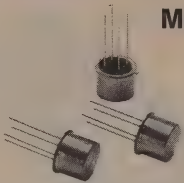
TELEDYNE RELAYS

Military Solid State Relays

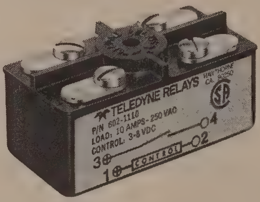
M640 Series Solid State TO-5 Relays



Hermetically sealed subminiature solid state relays in TO-5 package. SPST normally open. Features all solid state circuitry utilizing hybrid microcircuit techniques, with high input/output isolation (1000 v/10^9 ohms). Available with bipolar output for ac or dc loads up to 40 v/60 Ma or dc output for loads up to 40 vdc/300 Ma or 250 vdc/100 Ma. Designed to meet applicable requirements of MIL-STD-883 and MIL-R-28750.

PART NUMBER	OUTPUT RATING
M640-1	40 v/60 MA (bipolar, AC or DC)
M643-1	40 VDC/300 MA
M643-2	250 VDC/100 MA

602 Series 10 Amp/280 Volt Solid State AC Relays

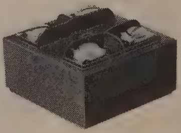


Features all solid state circuitry with high input/output isolation (1000 v/10^{11} ohms). Available in 10 amp rating, at 280 VAC, 50-500 Hz. Synchronous/zero voltage turn-on to minimize RFI is standard. Available with choice of logic compatible dc input ranges or AC line voltage input. Designed to meet applicable requirements of MIL-R-28750 and MIL-STD-704.

INPUT (CONTROL) VOLTAGE RANGE	OUTPUT VOLTAGE RATING	OUTPUT (LOAD) CURRENT RATING & PART NUMBERS
		10 AMP
3-8 VDC	140/250 VAC	602-1110
7-85 VDC	140/250 VAC	602-1120
90-280 VAC	140/250 VAC	602-1130

Basic part number provides screw terminals.
Add suffix "P" for PC board pins.

61A Series 20 Amp/280 Volt Solid State AC Power Relays



Features all solid state circuitry with high input/output isolation (1800 v/10^{11} ohms). Output rating 20 amps/280 vac, 50-500 Hz, with synchronous/zero voltage turn-on to minimize RFI.

Available with choice of logic compatible dc input ranges or AC line voltage input. Designed to meet applicable requirements of MIL-R-28750 and MIL-STD-704.

PART NUMBER	CONTROL VOLTAGE RANGE
61A-20B2-9Z	3-8 VDC
61A-20B2-10Z	7-85 VDC
61A-20B2-11Z	90-280 VAC

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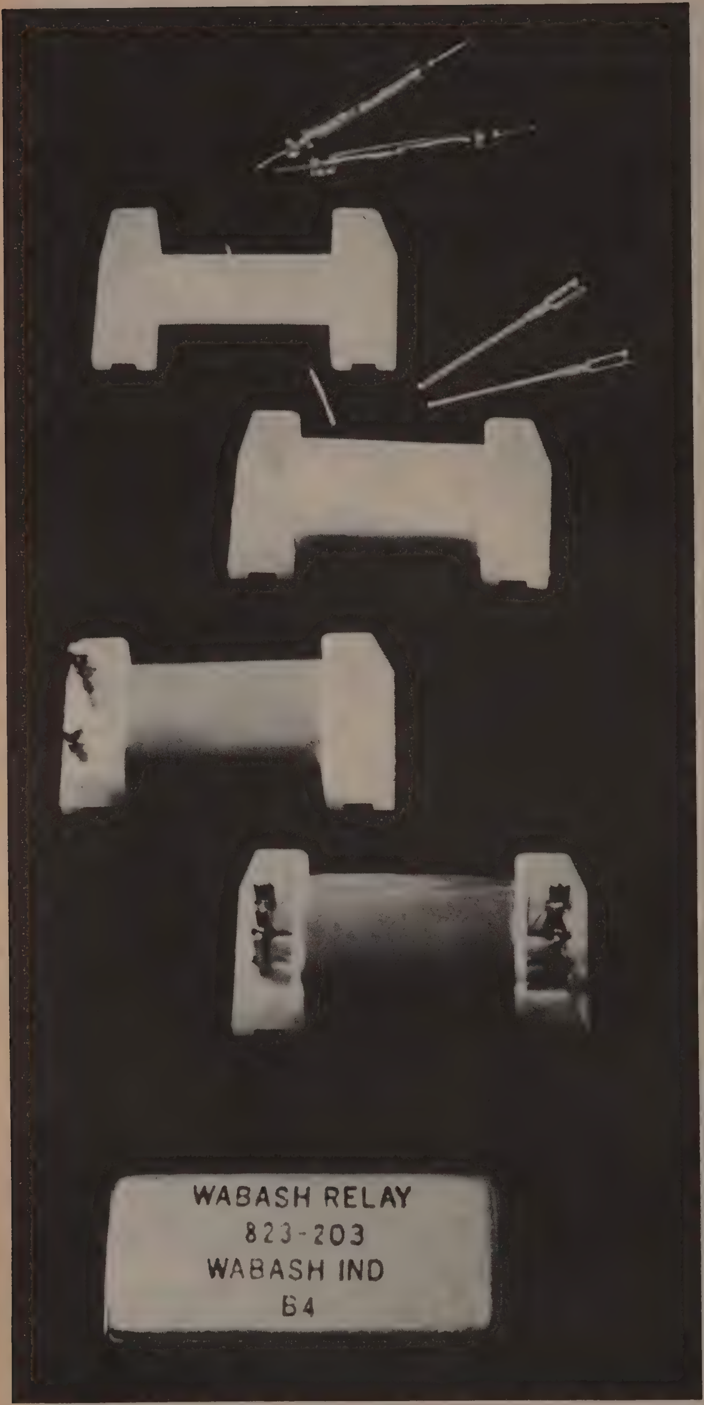
3155 West El Segundo Boulevard, Hawthorne, California 90250 • Telephone (213) 973-4545

Detailed specifications on any of our products or a complete catalog are available on request.

Manufacturer of
Dry Reed Relays
Mercury Wetted Relays
Solid-State Relays
wabash



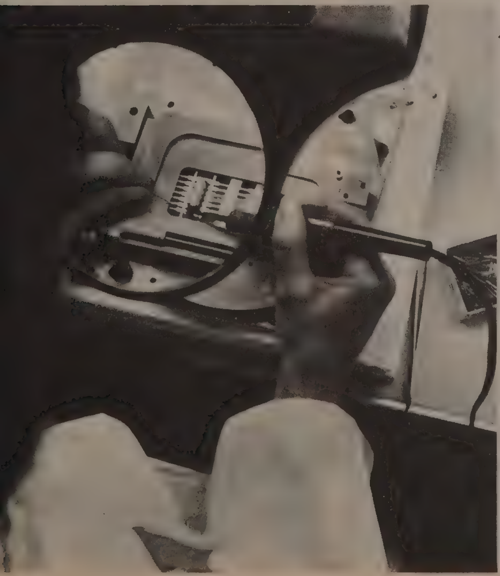
Wabash Magnetics, Inc.— The Company Wabash Magnetics, Inc. is listed on the American Stock Exchange under the letters WMI. The principle products of the company include a wide variety of electrical coils, transformers, reed, mercury wetted and solid-state relays as well as magnetic coated products such as computer tape, magnetic cards, video and audio tape. The Company has in total nine plants located in five states from which its broad line of products are produced and shipped. Wabash offers years of technical and manufacturing excellence to its growing list of customers and has made the name Wabash synonymous with quality.

Wabash Relay & Electronics, Inc.— A Subsidiary Wabash Relay & Electronics, Inc., a subsidiary of Wabash Magnetics, is primarily located in the state of Indiana. This subsidiary is one of the few companies in the industry manufacturing the glass sealed switches, mercury capsules and relay assemblies. This unique manufacturing capability controls quality performance in their reed and mercury wetted relays. At the same time, the same high quality standards are built into Wabash's solid-state relays.

Front Cover Photo: A common thimble holds 75 Wabash manufactured mini-switches used to activate a burglar alarm. Unlike many manufacturers, Wabash controls quality performance because of their ability to produce their own switches.

A. Viewing a DIP through a large magnifying glass, a Wabash employee solders a switch into final position.

B. Shown is a close-up of one of the production stages of a mercury switch. It is here that a final glass-to-metal seal is made prior to a vacuum being pulled and mercury inserted.



A

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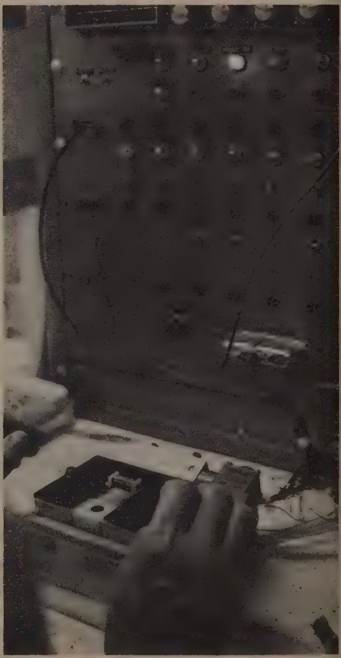


Over 6,000 Variations Available

Vith over 6,000 variations, Wabash is sure o offer the relay you require. Here are out a few highlights:

Dry Reed Relay: Available in standard, miniature and sub-miniature with several variations of pin configuration including DIP.

Mercury Wetted Contact Relays: Comes n standard and miniature sizes in both PC mountable and octagonal base package.

Solid-State Relays: These hybrid relays are available in current ranges from 3 AMPS to 10 AMPS. Ultra-reliability in AC switching applications is the outstanding feature of these relays.

Switches: Dry Reed switches are available in standard, miniature and sub-miniature sizes with varying AMP turn ranges and lead lengths. RF switches are available in the miniature size with varying AMP turn ranges and lead lengths.

Wabash Relay Introduces "The Econo-Miser" Wabash production engineers just perfected a new product system and special equipment that produces a *quality* reed relay at an unheard of price. They are made available in 1 Form A, 2 Form A and 1 Form B, with 1" x .1" or 1" x .15" pin spacing. Wabash needs surprisingly little lead time to deliver.

Quality Assurance and Reliability

With over three billion test cycles run daily, Wabash Relay maintains their reputation for high quality assurance standards. At the same time, each switch is assembled and sealed into glass in hospital-like clean rooms where heat, humidity and dust are controlled.

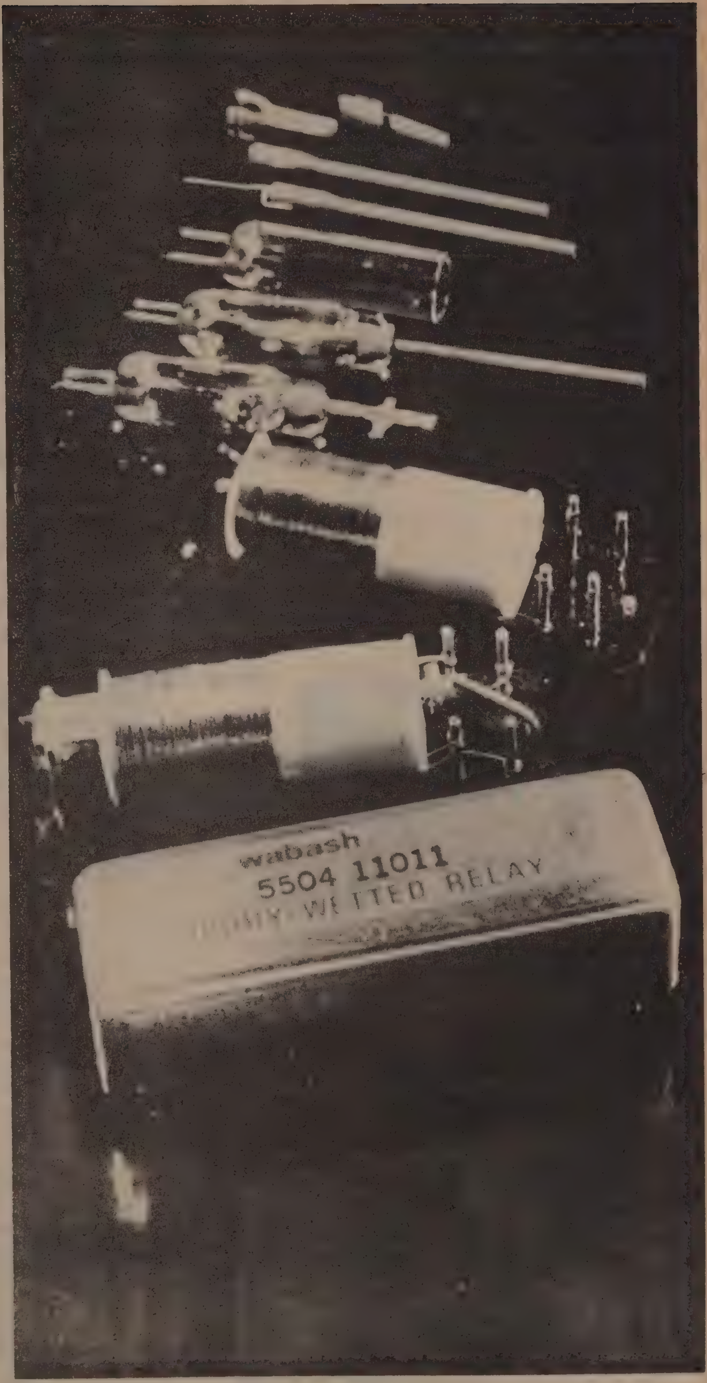
Wabash engineers are working daily with customer specifications helping to produce or recommend a quality relay that assures top performance. Whatever your needs, look to Wabash for quality, service and delivery.

C. Featured is a photo of Wabash Relay's automatic test station in which three billion test cycles are run per day assuring quality performance.

D. A final electrical check is made before packaging and shipment to one of the many customers who utilize a Wabash relay.

E. Wabash engineers closely reviewing a drawing prior to determining what product best meets the customer's need.

F. To illustrate the many intricate steps that make up a mercury wetted relay, it has been arranged from top to bottom the way it is assembled.

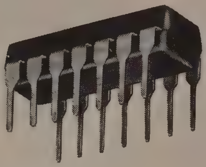


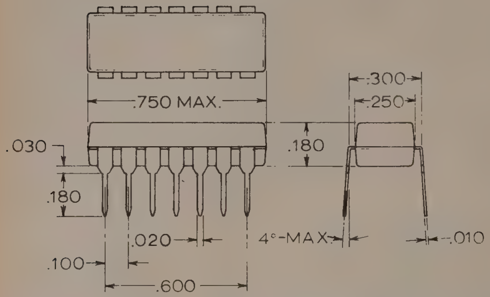
F

wabash First and Webster Streets / Wabash, Indiana 46992 / (219) 563-2191 / TWX 810-290-2722
WABASH RELAY AND ELECTRONICS, INC.

DIP PACKAGE DRY REED RELAYS

814 SERIES





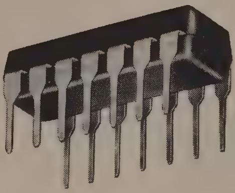
The 814 Series offers dry reed reliability and total isolation in a low profile IC type package, with DTL/TTL compatible coil drive available in most configurations.

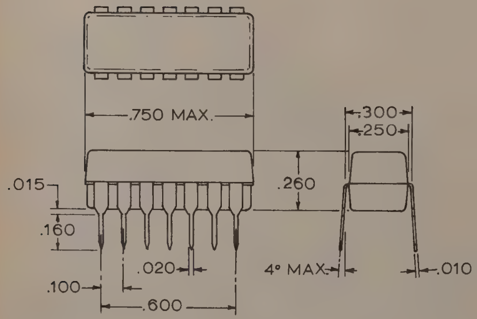
SPECIFICATIONS — Contact Rating: 28 VDC or 0.110 Amps (switching); 3 watts; 200 milliohms max. initial contact resistance; 200 Volt pk. bkdn. **Temperature:** −55°C to +105°C. **Shock:** 100G max., 8±1 mSec. ½ wave. **Vibration:** 20G @ 10-5000 Hz. **Insulation Resistance:** 10^{10} Ohms min. **Capacitance:** 0.2 pf. **Operate Time (Typical):** to 0.5 mSec. **Release Time (Typical):** 0.1 mSec. **Life Expectancy:** 50 x 10^6 operations at signal level; 1 x 10^6 operations at rated load.

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	5	16	365	814-101
	5	19	500	814-102
	6	19	500	814-103
	12	24	800	814-104
	24	30	1,250	814-105

▲Measured at 25°C.

815 SERIES





The 815 Series, with a profile slightly higher than the 814, offers increased versatility while maintaining the DIP package approach to hi-density printed circuit applications. Standard part numbers listed are subject to specifications shown for the 814 Series, however, the 815 has the capacity to offer dry reed switches to ½ Amp rating. Optional features include diode suppression, magnetic shielding and electrostatic shielding.

Contact Form	Nom. VDC	Max. VDC	Coil Ohms ±10%	Part Number	Contact Form	Nom. VDC	Max. VDC	Coil Ohms ±10%	Part Number
1A	5	14.1	200	815-101	1B	5	14.1	200	815-221
	5	19	500	815-102		12	16	500	815-222
	12	19	500	815-103		24	32	2,000	815-223
	24	40	2,150	815-104					
2A	5	14.1	200	815-201	1C	5	7.75	80	815-241
	12	19	500	815-202		12	19	500	815-242
	24	38	2,000	815-203		24	38	2,000	815-243

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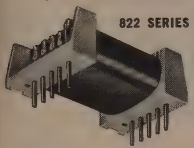
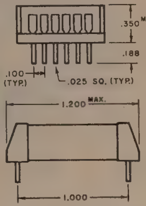
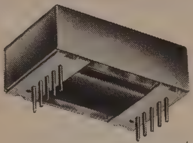
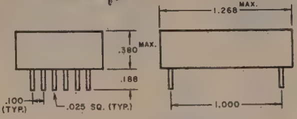
MINIATURE DRY REED RELAYS
822 / 823 SERIES









SPECIFICATIONS — Contact Ratings: (max.) 100 VDC, 150 VAC, 0.5 Amp (switching), 3 Amp (Carry), 15 Watts DC, 25 V-A (AC suppressed), 300 Volts peak breakdown, 200 milliohms max. initial contact resistance. **Temperature:** −55°C to +105°C. **Shock:** 200 G max., 11±1 mSec. **Vibration:** 30 G max. @ 0 to 1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 0.5 pf. **Life Expectancy:** 500 x 10^6 ops @ dry ckt.; 100 x 10^6 ops @ signal levels; 20 x 10^6 ops @ rated load.

822 SERIES

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	3	8	50	822-101
	6	16	200	822-102
	12	33	800	822-103
	24	67	3,200	822-104
	48	75	6,400	822-105
	5	26	500	822-110
2A	3	8	50	822-201
	6	16	200	822-202
	12	33	800	822-203
	24	67	3,200	822-204
	48	75	6,400	822-205
3A	3	5	20	822-301
	6	10	75	822-302
	12	21	300	822-303
	24	42	1,200	822-304
	48	75	6,400	822-305
4A	3	5	20	822-401
	6	10	75	822-402
	12	21	300	822-403
	24	42	1,200	822-404
	48	75	6,400	822-405
1B†	3	4	50	822-210
	6	8	200	822-211
	12	16	800	822-212
	24	32	3,200	822-213
	48	64	6,400	822-214
2B†	3	4	50	822-310
	6	8	200	822-311
	12	16	800	822-312
	24	32	3,200	822-313
	48	64	6,400	822-314
1A1B†	3	4.5	15	822-323
	6	9	60	822-324
	12	18	240	822-325
	24	36	960	822-326
	48	72	3,840	822-327
1C† (1A1B guarantee break-before-make)	3	4	15	822-315
	6	8	60	822-316
	12	16	240	822-317
	24	32	960	822-318
	48	64	3,840	822-319
1A‡ (magnetic latch)	6	12	300	822-222
	6	12	300	
	12	24	1,200	822-223
	12	24	1,200	
	24	48	4,800	822-224
	24	48	4,800	
2A‡ (magnetic latch)	6	12	300	822-332
	6	12	300	
	12	24	1,200	822-333
	12	24	1,200	
	24	48	4,000	822-334
	24	48	4,000	

Note: Complete electrical data available on request.

822 Series relays can be provided that are recognized under the Component Program of Underwriters Laboratories, Inc. Please consult factory for more information.

Special Coil Terminations available — consult factory.

823 SERIES

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	3	8	50	823-101
	6	16	200	823-102
	12	33	800	823-103
	24	67	3,200	823-104
	48	75	6,400	823-105
	5	26	500	823-110
2A	3	8	50	823-201
	6	16	200	823-202
	12	33	800	823-203
	24	67	3,200	823-204
	48	75	6,400	823-205
3A	3	5	20	823-301
	6	10	75	823-302
	12	21	300	823-303
	24	42	1,200	823-304
	48	75	6,400	823-305
4A	3	5	20	823-401
	6	10	75	823-402
	12	21	300	823-403
	24	42	1,200	823-404
	48	75	6,400	823-405
1B†	3	4	50	823-210
	6	8	200	823-211
	12	16	800	823-212
	24	32	3,200	823-213
	48	64	6,400	823-214
2B†	3	4	50	823-310
	6	8	200	823-311
	12	16	800	823-312
	24	32	3,200	823-313
	48	64	6,400	823-314
1A1B†	3	4.5	15	823-323
	6	9	60	823-324
	12	18	240	823-325
	24	36	960	823-326
	48	72	3,840	823-327
1C† (1A1B guarantee break-before-make)	3	4	15	823-315
	6	8	60	823-316
	12	16	240	823-317
	24	32	960	823-318
	48	64	3,840	823-319
1A‡ (magnetic latch)	6	12	300	823-222
	6	12	300	
	12	24	1,200	823-223
	12	24	1,200	
	24	48	4,800	823-224
	24	48	4,800	
2A‡ (magnetic latch)	6	12	300	823-332
	6	12	300	
	12	24	1,200	823-333
	12	24	1,200	
	24	48	4,000	823-334
	24	48	4,000	

▲ Measured at 25°C. * Not including bounce. ** No coil suppression.

† All relays containing magnets for Form B operation (including the break-before-make 1C) are polarity sensitive and correct polarity must be observed. Dot on relays indicates positive terminal.

‡ A positive voltage must be applied to either dot terminal to close the contact(s) of a latch relay.
A negative voltage must be applied to either dot terminal to open the contact(s) of a latch relay.

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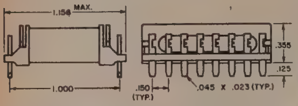
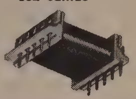
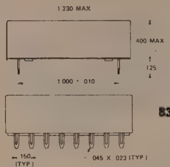
WABASH RELAY AND ELECTRONICS, INC.
First and Webster Streets / Wabash, Indiana 46992 / (219) 563-2191 / TWX 810-290-2722

MINIATURE DRY REED RELAYS
832 / 833 SERIES



832 SERIES





833 SERIES

SPECIFICATIONS — Contact Ratings: (max.) 100 VDC, 150 VAC, 0.5 Amp (switching), 3 Amp (Carry), 15 Watts DC, 25 V-A (AC suppressed), 300 Volts peak breakdown, 200 milliohms max. initial contact resistance. **Temperature:** −55°C to +105°C. **Shock:** 200 G max., 11±1 mSec. **Vibration:** 30 G max. @ 0 to 1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 0.5 pf. **Life Expectancy:** 500 x 10^6 ops @ dry ckt.; 100 x 10^6 ops @ signal levels; 20 x 10^6 ops @ rated load.

832 SERIES

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	3	8	50	832-101
	6	16	200	832-102
	12	33	800	832-103
	24	67	3,200	832-104
	48	75	6,400	832-105
	5	26	500	832-106
2A	3	8	50	832-201
	6	16	200	832-202
	12	33	800	832-203
	24	67	3,200	832-204
	48	75	6,400	832-205
3A	3	5	20	832-301
	6	10	75	832-302
	12	21	300	832-303
	24	42	1,200	832-304
	48	75	6,400	832-305
4A	3	5	20	832-401
	6	10	75	832-402
	12	21	300	832-403
	24	42	1,200	832-404
	48	75	6,400	832-405
5A	3	5	20	832-606
	6	10	75	832-607
	12	21	300	832-608
	24	42	1,200	832-609
	48	75	6,400	832-600
6A	3	5	20	832-601
	6	10	75	832-602
	12	21	300	832-603
	24	42	1,200	832-604
	48	75	6,400	832-605
1B†	3	4	50	832-211
	6	8	200	832-212
	12	16	800	832-213
	24	32	3,200	832-214
	48	64	6,400	832-215
2B†	3	4	50	832-221
	6	8	200	832-222
	12	16	800	832-223
	24	32	3,200	832-224
	48	64	6,400	832-225
1A1B†	3	4	15	832-331
	6	8	60	832-332
	12	16	240	832-333
	24	32	960	832-334
	48	64	3,840	832-335
1C† (1A1B guarantee break-before-make)	3	4	15	832-341
	6	8	60	832-342
	12	16	240	832-343
	24	32	960	832-344
	48	64	3,840	832-345
1A‡ (magnetic latch)	6	12	300	832-272
	6	12	300	
	12	24	1,200	832-273
	12	24	1,200	
	24	48	4,800	832-274
	24	48	4,800	
2A‡ (magnetic latch)	6	12	300	832-382
	6	12	300	
	12	24	1,200	832-383
	12	24	1,200	
	24	48	4,800	832-384
	24	48	4,800	

833 SERIES

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	3	8	50	833-101
	6	16	200	833-102
	12	33	800	833-103
	24	67	3,200	833-104
	48	75	6,400	833-105
	5	26	500	833-106
2A	3	8	50	833-201
	6	16	200	833-202
	12	33	800	833-203
	24	67	3,200	833-204
	48	75	6,400	833-205
3A	3	5	20	833-301
	6	10	75	833-302
	12	21	300	833-303
	24	42	1,200	833-304
	48	75	6,400	833-305
4A	3	5	20	833-401
	6	10	75	833-402
	12	21	300	833-403
	24	42	1,200	833-404
	48	75	6,400	833-405
5A	3	5	20	833-606
	6	10	75	833-607
	12	21	300	833-608
	24	42	1,200	833-609
	48	75	6,400	833-600
6A	3	5	20	833-601
	6	10	75	833-602
	12	21	300	833-603
	24	42	1,200	833-604
	48	75	6,400	833-605
1B†	3	4	50	833-211
	6	8	200	833-212
	12	16	800	833-213
	24	32	3,200	833-214
	48	64	6,400	833-215
2B†	3	4	50	833-221
	6	8	200	833-222
	12	16	800	833-223
	24	32	3,200	833-224
	48	64	6,400	833-225
1A1B†	3	4	15	833-331
	6	8	60	833-332
	12	16	240	833-333
	24	32	960	833-334
	48	64	3,840	833-335
1C† (1A1B guarantee break-before-make)	3	4	15	833-341
	6	8	60	833-342
	12	16	240	833-343
	24	32	960	833-344
	48	64	3,840	833-345
1A‡ (magnetic latch)	6	12	300	833-272
	6	12	300	
	12	24	1,200	833-273
	12	24	1,200	
	24	48	4,800	833-274
	24	48	4,800	
2A‡ (magnetic latch)	6	12	300	833-382
	6	12	300	
	12	24	1,200	833-383
	12	24	1,200	
	24	48	4,800	833-384
	24	48	4,800	

▲ Measured at 25°C. * Not including bounce. ** No coil suppression.

† All relays containing magnets for Form B operation (including the break-before-make 1C) are polarity sensitive and correct polarity must be observed. Dot on relays indicates positive terminal.

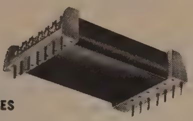
‡ A positive voltage must be applied to either dot terminal to close the contact(s) of a latch relay.
A negative voltage must be applied to either dot terminal to open the contact(s) of a latch relay.

wabash
WABASH RELAY AND ELECTRONICS, INC.

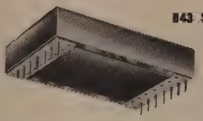
First and Webster Streets / Wabash, Indiana 46992 / (219) 563-2191 / TWX 810-290-2722

STANDARD REED RELAYS

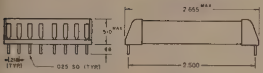
842 / 843 SERIES

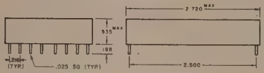


842 SERIES



843 SERIES



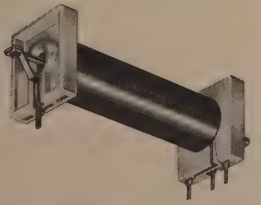


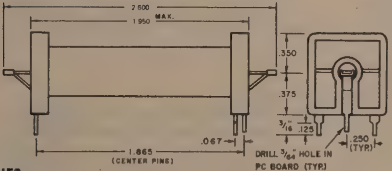
SPECIFICATIONS — **Contact Ratings:** 150 VDC, 250 VAC, 1.5 Amp (switching) 6 Amp (carry), 25 Watts, 40 V-A (AC suppressed) 50 milliohm max. initial contact resistance 500 volts peak breakdown. **Temperature:** −55°C to +105°C. **Shock:** 100 G max., 11±1 mSec. **Vibration:** 30 G max. @ 0-1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 1.5 pf. **Life Expectancy:** Dry ckt., 500 x 10^6 ops; signal level, 100 x 10^6 ops; rated power, 20 x 10^6 ops.
Available to 12 form A. True form C also available.

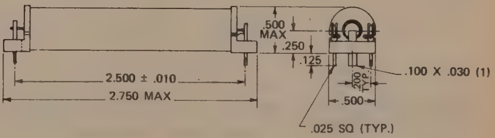
Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	6	22	150	842/843-101
	12	45	600	842/843-102
	24	90	2,400	842/843-103
	48	175	9,000	842/843-104
2A	6	20	100	842/843-201
	12	41	400	842/843-202
	24	82	1,600	842/843-203
	48	165	6,400	842/843-204
3A	6	15	50	842/843-301
	12	30	200	842/843-302
	24	60	800	842/843-303
	48	121	3,200	842/843-304
4A	6	16	50	842/843-401
	12	33	200	842/843-402
	24	66	800	842/843-403
	48	132	3,200	842/843-404
5A	6	12	25	842/843-501
	12	24	100	842/843-502
	24	48	400	842/843-503
	48	97	1,600	842/843-504
6A	6	14	25	842/843-601
	12	28	100	842/843-602
	24	56	400	842/843-603
	48	112	1,600	842/843-604

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1B†	6	9	100	842/843-209
	12	18	400	842/843-211
	24	36	1,600	842/843-213
	48	72	6,400	842/843-215
2B†	6	9	100	842/843-309
	12	18	400	842/843-313
	24	36	1,600	842/843-317
	48	72	6,400	842/843-321
1C† (1A1B guarantee break-before-make)	6	9	100	842/843-311
	12	18	400	842/843-315
	24	36	1,600	842/843-319
	48	72	6,400	842/843-323
1A‡ (magnetic latch)	6	9	200	842/843-221
	6	9	200	
	12	18	800	842/843-222
	12	18	800	
	24	36	3,200	842/843-223
	24	36	3,200	
	48	72	4,500	842/843-224
	48	72	4,500	

852 / 854 SERIES







852 SERIES

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	6	8	74	852-306
	12	16	290	852-312
	24	33	1,200	852-324

▲ Measured at 25°C. * Not including bounce. ** No coil suppression.

854 SERIES

Contact Form	Nom. Voltage	Max. Voltage	Coil Resistance ±10% ▲	Part Number
1A	6	18	100	854-101
	12	36	415	854-102
	24	72	1,700	854-103

▲ Measured at 25°C. * Not including bounce. ** No coil suppression.

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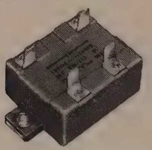
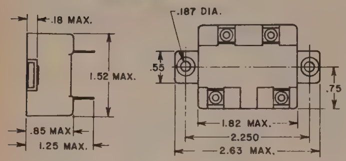
930 SERIES SSR

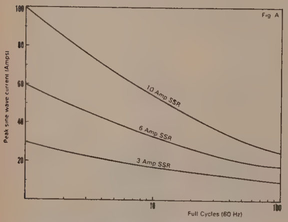




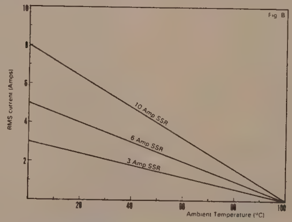
SPECIFICATIONS — Temperature: −25°C to +70°C operating; −40°C to +100°C storage. **Isolation Breakdown Voltage:** 1500 VDC min. DC control circuit to AC circuit; 1500 VDC min. DC control circuit to heatsink; 1500 VDC min. AC control circuit to heatsink. **Operate Time:** 1 millisecond. **Release Time:** ½ cycle max. of AC load waveform. **dV/dT:** All units have dV/dT communication of 1 Volt per microsecond. **Life:** 500 x 10^6 operations. **Terminations:** Quick connect, screw or solder type. **Mounting:** Two #8 screws on 2.25″ centers. **Low Profile:** Case height is only .850″. **Heatsink:** Extra heatsinking is required on the 6A and 10A modules. **Reliability:** The semi-Solid State Relay combines the reliability of a Solid State Triac and the high quality NPE Reed Relay. This combination offers an excellent heavy-duty AC Relay that can be controlled by an isolated, low-level signal.

CONTROL RATINGS		Part Number
Nom. Voltage (Volts DC)	Max. Power (Milliwatts)	
200 Vpk, 3 AMP MAX. LOAD		
5	312	930-101
6	350	930-102
12	350	930-103
24	350	930-104
48	350	930-105
400 Vpk, 3 AMP MAX. LOAD		
5	312	930-106
6	350	930-107
12	350	930-108
24	350	930-109
48	350	930-110
200 Vpk, 6 AMP MAX. LOAD		
5	312	930-111
6	350	930-112
12	350	930-113
24	350	930-114
48	350	930-115

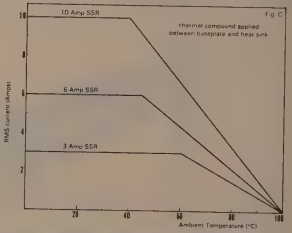
CONTROL RATINGS		Part Number
Nom. Voltage (Volts DC)	Max. Power (Milliwatts)	
400 Vpk, 6 AMP MAX. LOAD		
5	312	930-116
6	350	930-117
12	350	930-118
24	350	930-119
48	350	930-120
200 Vpk, 10 AMP MAX. LOAD		
5	312	930-121
6	350	930-122
12	350	930-123
24	350	930-124
48	350	930-125
400 Vpk, 10 AMP MAX. LOAD		
5	312	930-126
6	350	930-127
12	350	930-128
24	350	930-129
48	350	930-130



MAXIMUM ALLOWABLE SURGE CURRENT
(SSR PROPERLY HEATSINKED)

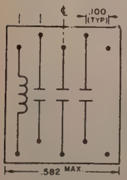


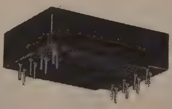
MAXIMUM CURRENT CARRYING CAPACITY
(SSR HELD IN FREE AIR)

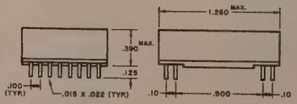


MAXIMUM CURRENT CARRYING CAPACITY
(SSR MTD. ON 6″ x 6″ x ⅛″ ALUMINUM HEATSINK)

824 SERIES RR







The 824 Series miniature reed relay is available in 1 pole through 6 pole standard configurations of forms A, B, or C, offering staggered sin spacing to minimize PC board space required. (3A pinout illustrated.) Call Wabash Relay for complete details.

SPECIFICATIONS — Contact Ratings: (max.) 100 VDC, 150 VAC, 0.5 Amp (switching), 3 Amp (Carry), 15 Watts DC, 25 V-A (AC suppressed), 300 Volts peak breakdown, 200 milliohms max. initial contact resistance. **Temperature:** −55°C to +105°C. **Shock:** 200 G max., 11±1 mSec. **Vibration:** 30 G max. @ 0 to 1700 Hz. **Insulation Resistance:** 10^9 Ohms min. **Capacitance:** 0.5 pf. **Life Expectancy:** 500 x 10^6 ops @ dry ckt.; 100 x 10^6 ops @ signal levels; 20 x 10^6 ops @ rated load.

wabash
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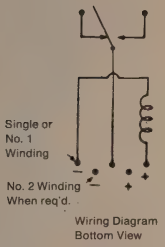
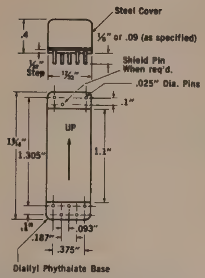
WABASH RELAY AND ELECTRONICS, INC.

MERCURY WETTED CONTACT RELAYS / FORM C AND FORM D

5501 / 5101 SERIES

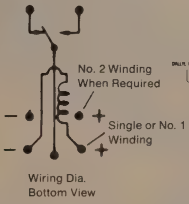

Single or No. 1 Winding
No. 2 Winding When req'd.
−
+
Wiring Diagram Bottom View

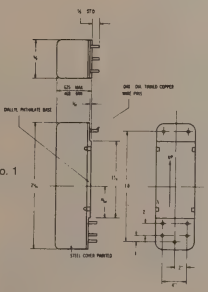

Steel Cover
⅛″ or .09 (as specified)
.4
⅛″ Step
1⅜″
Shield Pin When req'd.
.025″ Dia. Pins
.1″
UP
1¾″
1.305″
1.1″
.1″
.093″
.187″
.375″
Diallyl Phythalate Base

The 5501/02, 5101/02 Series Relays are PCB mount with 2 Amp or 500 Volt (100 V-A max.) capsules available in one form C or D, single side stable or Bi-stable, single or dual wound configurations. Pin lengths of 0.09″ and 0.125″ are Standard. Part numbers listed to the right are representative of a complete line available.

Form C P/N	Form D P/N	Nom. Coil VDC	Max. Coil VDC	Must Operate VDC	Coil Res. Ohms ±10%
SINGLE SIDE STABLE, SINGLE WOUND COILS					
5501-11001	5101-11001	1.0	2.0	0.27	2.2
5501-11006	5101-11006	2.8	5.7	0.81	18.7
5501-11011	5101-11011	9.0	18	2.6	185
5501-11020	5101-11020	63	125	20	9,000
BI-STABLE, SINGLE WOUND COILS					
5501-12001	5101-12001	1.0	2.0	±0.14	2.2
5501-12008	5101-12008	4.7	9.4	±0.66	50
5501-12014	5101-12014	18	35	±2.3	680
5501-12020	5101-12020	63	125	±9.6	9,000
SINGLE SIDE STABLE, DUAL WOUND COILS					
5501-21001	5101-21001	5	10	2.0	60/60
5501-21011	5101-21011	44	89	19	4500/4500
BI-STABLE, DUAL WOUND COILS					
5501-22001	5101-22001	5	10	±1.0	60/60
5501-22011	5101-22011	44	89	±9.4	4500/4500

5504 / 5104 SERIES

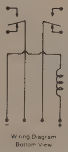

No. 2 Winding When Required
−
+
−
Single or No. 1 Winding
Wiring Dia. Bottom View

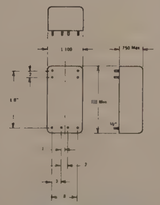

DIALLYL PHTHALATE BASE
STEEL COVER PAINTED

The 5504, 5104 Series is PCB mount with the 2 Amp or 500 Volt (100 V-A max.) capsule. Parameters are comparable to those of the 5501 Series. The physical differences allow versatility in meeting your space requirements. Part numbers listed are representative. Consult factory for complete listing.

Form C P/N	Form D P/N	Nom. Coil VDC	Max. Coil VDC	Must Operate VDC	Coil Res. Ohms ±10%
SINGLE SIDE STABLE, SINGLE WOUND COILS					
5504-11001	5104-11001	1.0	2.0	0.5	2
5504-11006	5104-11006	6.5	13	3.1	85
5504-11011	5104-11011	15	30	6.4	450
5504-11031	5104-11031	86.5	173	21.5	15,000
BI-STABLE, SINGLE WOUND COILS					
5504-12001	5104-12001	1.0	2.0	±.22	2
5504-12008	5104-12008	7.6	15.1	±1.8	115
5504-12014	5104-12014	18.4	36.7	±4.0	675
5504-12031	5104-12031	86.5	173	±16.5	15,000
SINGLE SIDE STABLE, DUAL WOUND COILS					
5504-21001	5104-21001	3.9	7.8	2.4	30/30
5504-21020	5104-21020	46	92	18	4275/4275
BI-STABLE, DUAL WOUND COILS					
5504-22001	5104-22001	3.9	7.8	±1.13	30/30
5504-22020	5104-22020	46	92	±9.2	4275/4275

5505 / 5105 SERIES

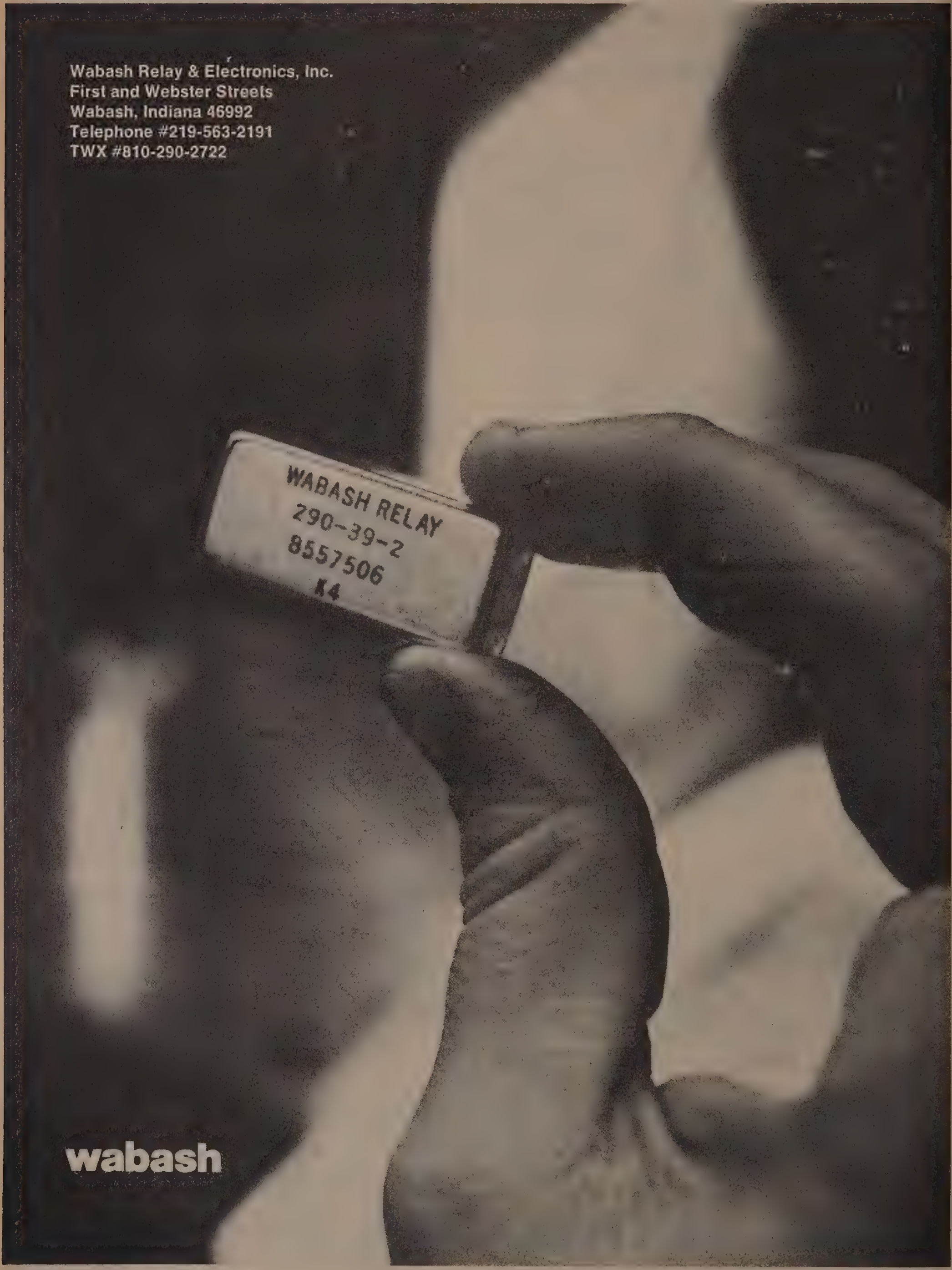

Wiring Diagram Bottom View



The 5505, 5105 Series offers 2 form C or 2 form D operation, using 2 Amp or 500 Volt (100 V-A max.) capsules in a single PCB mount package. Part numbers listed are representative of a complete line available.

Form C P/N	Form D P/N	Nom. Coil VDC	Max. Coil VDC	Must Operate VDC	Coil Res. Ohms ±10%
SINGLE SIDE STABLE, SINGLE WOUND COILS (2 SWITCH)					
5505-11001	5105-11001	3.3	7.3	1.1	18
5505-11010	5105-11010	174	360	58	43,500
BI-STABLE, SINGLE WOUND COILS (2 SWITCH)					
5505-12001	5105-12001	3.3	7.3	±0.50	18
5505-12010	5105-12010	174	360	±28.7	43,500

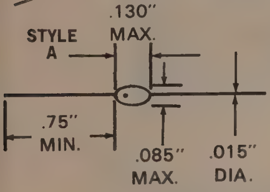
Note: Contact ratings dependent upon proper contact suppression. For complete specifications, please consult our OEM office. Octal mount versions available upon request.

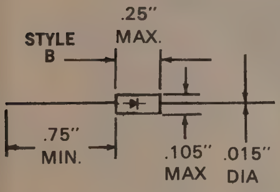

WABASH RELAY
290-39-2
8557506
K4

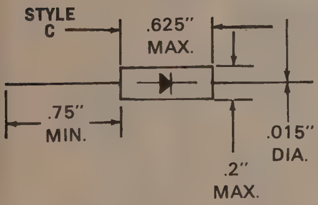
Wabash Relay & Electronics, Inc.
First and Webster Streets
Wabash, Indiana 46992
Telephone #219-563-2191
TWX #810-290-2722

wabash

ERIE TECHNOLOGICAL PRODUCTS, INC.
ERIE, PENNSYLVANIA 16501 (613) 392-2581


STYLE A
.130" MAX.
.75" MIN.
.085" MAX.
.015" DIA.


STYLE B
.25" MAX.
.75" MIN.
.105" MAX
.015" DIA

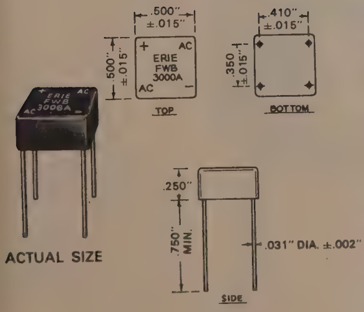

STYLE C
.625" MAX.
.75" MIN.
.015" DIA.
.2" MAX.

HIGH VOLTAGE SILICON RECTIFIERS

These High Voltage Silicon Rectifiers incorporate the latest technologies in diffusion and fabrication. Erie's proprietary surface passivation ensures low leakage currents with long term stability and reliability.

STANDARD RECOVERY					FAST RECOVERY				
Series	P.R.V.	Average Forward Current	Max. Reverse Current @ 25°C	Style	Series	P.R.V.	Average Forward Current	Max. Reverse Current @ 25°C	Style
HV50P	1KV Thru 5KV	50mA	.01μA	A	HX50P	1KV Thru 5KV	40mA	.1μA	A
HV50M	1KV Thru 5KV	50mA	.01μA	B	HX50M	1KV Thru 5KV	40mA	.1μA	B
HV50E	1KV Thru 5KV	50mA	.02μA	C	HX50E	1KV Thru 5KV	40mA	.1μA	C
HV80ML	5KV Thru 8KV	20mA	.05μA	B	HX80ML	5KV Thru 8KV	15mA	.1μA	B
HV80EL	6KV Thru 8KV	25mA	.05μA	C	HX80EL	6KV Thru 8KV	20mA	.1μA	C
HV140EO	10KV Thru 14KV	8mA	.05μA	C	HX140EO	10KV Thru 14KV	6mA	.1μA	C
HV200EP	16KV Thru 20KV	5mA	.05μA	C	HX200EP	16KV Thru 20KV	4mA	.1μA	C
HTV150S *	12.5KV & 15KV	5mA	.1μA	C					

* SPECIFICALLY DESIGNED FOR USE IN TV VOLTAGE MULTIPLIERS


ERIE FWB 3006A
AC
ACTUAL SIZE
.500" ±.015"
.500" ±.015"
+
AC
ERIE FWB 3000A
AC
TOP
.410" ±.015"
.350 ±.015"
BOTTOM
.250"
.750" MIN.
.031" DIA. ±.002"
SIDE

FULL WAVE BRIDGE RECTIFIERS

Erie Full Wave Bridge Rectifiers are a series of miniature bridges — double-sealed modules designed for printed circuit applications. Available with working voltage from 100 to 1000 volts per leg. Operating temperature range from −55°C to +100°C. Double seal ensures moisture resistance to MIL-STD-750A, Method 1021.1.

ERIE Part Number	Minimum Peak Repetitive Reverse Voltage Per Arm (P.R.V.)	Maximum Applied R.M.S. Voltage
FWB3001A	100 V	70 V
FWB3002A	200 V	140 V
FWB3004A	400 V	280 V
FWB3006A	600 V	420 V
FWB3008A	800 V	560 V
FWB3010A	1000 V	700 V

ELECTRICAL SPECIFICATIONS

Average rectified forward current.... 1.5A
Single cycle 60Hz surge cur... 25A (min.)
V_f per leg @ 25°C........................ 1.1Vdc
I_r per leg @ P.R.V. & 25°C................ 5μA
Operating temp......... −55°C to +100°C

There's nothing semiconductor ex

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semi about Delco's perience.

1 **Transportation**—Rail Locomotive Power, Electrostatic Painting, Signal Systems, Switches, Ignition Systems, Charging Systems, Heater/AC Controls
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8 **Induction Ranges**
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11 **Navigation**—Flight Simulators, Sonar Buoys, VLF Transmitters, Phased Array Radar.

You'd be surprised to know in how many industries Delco Electronics has firsthand power semiconductor application experience. They include, among others, transportation and medical, computers and communication, with products that range from motor speed controls to ultrasonic equipment. And the list goes on.

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Delco Electronics
Division of General Motors

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Kokomo, Ind.
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(317) 459-2175

Delco Electronics.
The Power Specialists.

DELCO POWER SEMICONDUCTORS

Transistors

NPN SILICON TO-3 (TO-204MA) HIGH VOLTAGE

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE} @ I_C Amps		V_{CE} (sat) @ I_C Volts @ Amps	
DTS-310	10.0		225	20/	1.0		
DTS-311	10.0		250	40/	1.0		
DTS-401	2.0	400	400	20/100	0.5	0.8	1.0
DTS-402	3.5	400	400			0.8	1.0
DTS-403	3.5	400	400	—	—	2.0	3.5
DTS-409	3.5	400	400	15/	1.0	1.2	1.0
DTS-410	3.5	200	200	30/90	1.0	0.8	1.0
DTS-411	3.5	300	300	30/90	1.0	0.8	1.0
DTS-413	2.0	400	400	20/80	0.5	0.8	0.5
DTS-423	3.5	400	400	30/90	1.0	0.8	1.0
DTS-424	3.5	700⑥	500	30/90	1.0	0.8	1.0
DTS-425	3.5	700⑥	500	30/90	1.0	0.8	1.0
DTS-430	5.0	400	400	15/45	2.5	0.9	2.5
DTS-431	5.0	400	400	15/35	2.5	0.7	2.5
DTS-515	10.0	300	250	15/80	3.0	1.8	3.0
DTS-516	10.0	400	250	20/80	3.0	1.5	3.0
DTS-517	10.0	500	250	20/80	3.0	1.2	3.0
DTS-518	10.0	600	275	25/75	3.0	1.0	3.0
DTS-519	10.0	700	300	25/75	3.0	1.0	3.0
DTS-701	1.0	—	800	20/	0.15	—	—
DTS-702	3.0	1200⑥	1000	2.5/	2.0	—	—
DTS-704	3.0	1400⑥	1000	2.5/	2.0	—	—
DTS-708	3.0	900	900	—	—	2.0	1.0
DTS-709	3.0	900	900	—	—	1.0	2.0
DTS-710	3.0	900	900	7	1.0	—	—
DTS-712	3.0	1200⑥	900	2.5/	2.0	—	—
DTS-714	3.0	1400⑥	900	2.5/	2.0	—	—
DTS-720	3.0	1000	1000	18/54	0.15		
DTS-721	3.0	1000⑥	1000	20/60	0.15	—	—
DTS-723	3.0	1200⑥	1000	10/	0.5	0.8	1.0
DTS-801	2.0	1000	800	20/	0.2	—	—
DTS-802	5.0	1200⑥	1000	2.2/	3.5	—	—
DTS-804	5.0	1400⑥	1000	2.2/	3.5	—	—
DTS-812	5.0	1200⑥	900	2.2/	3.5	—	—
DTS-814	5.0	1400⑥	900	2.2/	3.5	—	—
2N3902	3.5	400	400	30/90	1.0	0.8	1.0
JAN2N3902Δ	3.5	700⑥	400	30/90	1.0	0.8	1.0
2N5157	3.5	700⑥	500	30/90	1.0	0.8	1.0
JAN2N5157Δ	3.5	700⑥	500	30/90	1.0	0.8	1.0
2N5241	5.0	400	400	15/35	2.5	0.7	2.5
JAN2N5241Δ	5.0	400	400	15/35	2.5	0.7	2.0

NPN SILICON TO-36 (TO-207MA) HIGH VOLTAGE

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE} @ I_C Amps		V_{CE} (sat) @ I_C Volts @ Amps	
2N2580	10.0	400	400	10/40 4 min	5.0 10.0	0.7	5.0
2N2581	10.0	400	400	25/65 10 min	5.0 10.0	1.0	10.0
2N2582	10.0	500	500	10/40 4 min	5.0 10.0	0.7	5.0
2N2583	10.0	500	500	25/65 10 min	5.0 10.0	1.0	1.0
2N3079	5.0	200	200	10/50	5.0	0.7	5.0
2N3080	5.0	300	300	10/50	5.0	0.7	5.0

NPN SILICON TO-66 (TO-213MA) HIGH VOLTAGE

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE} @ I_C Amps		V_{CE} (sat) @ I_C Volts @ Amps	
DTS-660	3.5	200	200	30/90	1.0	0.8	1.0
DTS-663	3.5	400	400	30/90	1.0	0.8	1.0
DTS-665	3.5	700	500	30/90	1.0	0.8	1.0

PNP GERMANIUM TO-3 (TO-204MA) NU-BASE

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE} @ I_C Amps		V_{CE} (sat) @ I_C Volts @ Amps	
2N5155	25.0	140⑥	120⑦	25/100	8.0	0.9	25.0
DTG-110A	25.0	110⑥	70	50/300	1.0	0.5	5.0
DTG-110B	25.0	90⑥	40⑦	65/300	1.0	0.5	5.0
DTG-600	25.0	90⑥	50⑦	50/115⑤	5.0	0.75	25.0
DTG-601	25.0	90⑥	60⑦	50/115⑤	5.0	0.75	25.0
DTG-602	25.0	100⑥	70⑦	50/115⑤	5.0	0.75	25.0
DTG-603	25.0	90⑥	80⑦	50/	5.0	0.75	25.0
DTG-603M†	25.0	90⑥	80⑦	50/	5.0	0.75	25.0
DTG-1010	15.0	325⑥	110⑦	100⑤	8.0	0.5	12.0
DTG-1110	15.0	200⑥	80⑦			0.5	10.0
DTG-1200	15.0		120⑦	27.5	8.0	0.5	12.0
DTG-2000	25.0	60⑥	30⑦	25/	8.0	0.9	25.0
DTG-2100	25.0	80⑥	60⑦	25/	8.0	0.9	25.0
DTG-2200	25.0	100⑥	80⑦	25/	8.0	0.9	25.0
DTG-2300	25.0	120⑥	100⑦	25/	8.0	0.9	25.0
DTG-2400	25.0	140⑥	120⑦	25/	8.0	0.9	25.0
DTG-2400M†	25.0	140⑥	120	25/125	10.0	0.9	25.0

PNP GERMANIUM TO-41 (TO-204MB) NU-BASE

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE} @ I_C Amps		V_{CE} (sat) @ I_C Volts @ Amps	
2N1073	10.0	40②	40②	20/60	5.0	0.6	5.0
2N1073A	10.0	80②	80②	20/60	5.0	0.6	5.0
2N1073B	10.0	120②	120②	20/60	5.0	0.6	5.0

PNP GERMANIUM TO-3 (TO-204MA) ALLOY BASE

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE} @ I_C Amps		V_{CE} (sat) @ I_C Volts @ Amps	
2N301	3.0	40	32	62.5	0.7		
2N301A	3.0	60	32	62.5	0.7		
2N379	7.0	80⑨	40	20/90	2.0	1.0	2.0
2N380	7.0	60⑨	30	20/90	2.0	1.0	2.0
2N392	5.0	60	45	60/150	3.0	0.5	3.0
2N456A	7.0	40	20	30/90	5.0	0.5	5.0
2N456B	7.0	40	30	30/90	5.0	0.5	5.0
2N457A	7.0	60	30	30/90	5.0	0.5	5.0
2N457B	7.0	60	40	30/90	5.0	0.5	5.0
2N458A	7.0	80	40	30/90	5.0	0.5	5.0
2N458B	7.0	80	45	30/90	5.0	0.5	5.0
2N554	5.0	15	30	30	1.0		
2N669	3.0	30⑧	30①	250④	0.5	0.4⑤	3.0
2N1159	5.0	80	60	30/75	3.0	1.0	3.0
2N1160	7.0	80	60	20/50	5.0	1.0	5.0
2N1168	5.0	50	30	60⑤	3.0	0.25⑤	3.0
2N1534	5.0	40	20	35/70	3.0	1.2	3.0
2N1535	5.0	60	30	35/70	3.0	1.2	3.0
2N1536	5.0	80	40	35/75	3.0	1.2	3.0
2N1539	5.0	25	20	50/100	3.0	0.3	3.0
2N1540	5.0	40	30	50/100	3.0	0.3	3.0
2N1542	5.0	65	50	50/100	3.0	0.3	3.0
2N1544	5.0	25	20	75/150	3.0	0.2	3.0
2N1546	5.0	55	40	75/150	3.0	0.2	3.0
2N5156	10.0	100	60⑦	25/60	5.0	1.0	10.0
DTG-110	7.0	40	40②	74/250	1.0	5.0	2.0

① V_{CES} ② V_{CER} ③ Power gain db ④ Max. ⑤ Typical ⑥ V_{CEX} ⑦ V_{CE} Sus ⑧ @ 90° C-R_{EB} = 100 ohm ⑨ V_{CBX} †Military Type Spec. Δ JANTX Type Available

Delco Electronics

GENERAL MOTORS CORPORATION, KOKOMO, INDIANA

DELCO POWER SEMICONDUCTORS

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE}	@ I_C Amps	V_{CE} (sat) Volts	@ I_C Amps
PNP GERMANIUM TO-36 (TO-207MA) ALLOY BASE							
2N173	15.0	60	45	35/70	5.0	1.0	12.0
2N174	15.0	80	55	25/50	5.0	0.9	12.0
JAN2N174A	15.0	80	40	40/80	1.2	0.7	12.0
2N277	15.0	40	25	35/70	5.0	0.3③	12.0
2N278	15.0	50	30	35/70	5.0	1.0	12.0
2N441	15.0	40	25	20/40	5.0	0.3③	12.0
2N442	15.0	50	30	20/40	5.0	0.3③	12.0
2N443	15.0	60	45	20/40	5.0	1.0	12.0
2N1099	15.0	80	55	35/70	5.0	0.7	12.0
2N1358	15.0	80	40	40/80	1.2	0.7	12.0
JAN2N1358	15.0	80	40	25/50	5.0	0.7	12.0
2N2075	15.0	80	65	20/40	5.0	0.7	12.0
2N2076	15.0	70	55	20/40	5.0	0.7	12.0
2N2077	15.0	50	45	20/40	5.0	0.9	12.0
2N2078	15.0	40	25	20/40	5.0	0.9	12.0
2N2079	15.0	80	65	35/70	5.0	0.7	12.0
2N2080	15.0	70	55	35/70	5.0	0.7	12.0
2N2081	15.0	50	45	35/70	5.0	0.9	12.0
2N2082	15.0	40	25	35/70	5.0	0.9	12.0
2N2490	15.0	70	50	20/40	5.0	0.7	12.0
2N2491	15.0	60	40	35/70	5.0	0.7	12.0
2N2492	15.0	80	65	25/50	5.0	0.5	12.0

Darlingtons

Type	I_C Amps	V_{CBO} Volts	V_{CEO} Volts	h_{FE}	@ I_C Amps	V_{CE} (sat) Volts	@ I_C Amps
NPN SILICON TO-92 EPOXY LOW VOLTAGE							
DTS-2000	0.6	40		2k/30k	0.6	1.2	0.6
NPN SILICON TO-3 (TO-204MA) HIGH VOLTAGE							
DTS-4010	1.0		250	150/	1.0		
DTS-4025	5.0		400	150/	5.0	1.8	5.0
DTS-4026	5.0		600	150/	5.0	1.8	5.0
DTS-1010	10.0		120	500/	3.0	1.8	5.0
DTS-1020	10.0		120	1000/	3.0	1.5	5.0
DTS-4039	15.0		400	200/	3.0	5.0	15.0
DTS-4041	15.0		400	250/	3.0	2.2	15.0
DTS-4059	15.0		600	200/	3.0	5.0	15.0
DTS-4061	15.0		600	250/	3.0	2.2	15.0

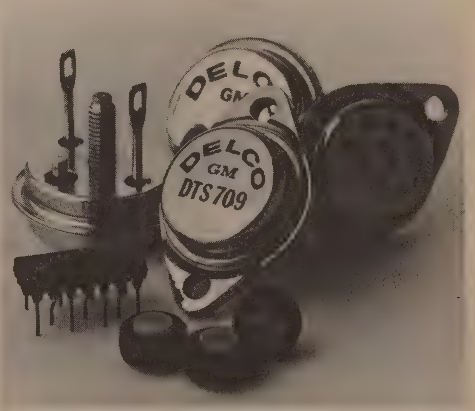
Silicon Rectifiers

TYPE	MAXIMUM FORWARD CURRENT	REVERSE WORKING VOLTAGE	REVERSE CURRENT	FORWARD VOLTAGE DROP	REPETITIVE PEAK FORWARD CURRENT
BUTTON DIODES					
DBD101	2A-22AΔ	100V	0.25mA	0.9V	Δ
DBD102	2A-22AΔ	200V	0.25mA	0.9V	Δ
DBD104	2A-22AΔ	400V	0.25mA	0.9V	Δ

TYPE	MAXIMUM FORWARD CURRENT	PEAK REVERSE VOLTAGE	PEAK TRANSIENT REVERSE VOLTAGE	REVERSE CURRENT	FORWARD VOLTAGE DROP	REPETITIVE PEAK FORWARD CURRENT
250 AMPERE STUD BASE㉛						
DRS250	250A	800V	1050V	10 mA	1.55V	4500A㉚
DRS251	250A	1000V	1300V	10 mA	1.55V	4500A㉚
DRS252	250A	1200V	1600V	10 mA	1.55V	4500A㉚
DRS253	250A	1400V	2000V	10 mA	1.55V	4500A㉚
DRS254	250A	1600V	2400V	10 mA	1.55V	4500A㉚

Zener Diodes

TYPE	MIN. ZENER VOLTAGE V_Z @ 0.25 Adc	MAX. ZENER VOLTAGE PULSE WIDTH = 1ms	MAXIMUM CLAMPING FACTOR	MAXIMUM REVERSE CURRENT I_R(mA)
30 KW POWER ZENERS DO-9 CASE				
DPZ30-30R	30	43 Vdc @ 700 A	1.4	5.0
DPZ30-33R	33	47 Vdc @ 604 A	1.4	5.0
DPZ30-36R	36	52 Vdc @ 580 A	1.4	5.0
DPZ30-39R	39	56 Vdc @ 535 A	1.4	5.0
DPZ30-43R	43	62 Vdc @ 485 A	1.4	5.0
DPZ30-45R	45	65 Vdc @ 460 A	1.4	5.0
DPZ30-47R	47	68 Vdc @ 440 A	1.4	5.0
DPZ30-50R	50	72 Vdc @ 420 A	1.4	5.0



A complete listing of Delco Electronics Semiconductor Distributors can be found in the Manufacturers & Sales Office Directory.

㉛ Add R to part number for reverse polarity ㉚ ½ Cycle non-repetitive
Δ Current rating depends on mounting (see data sheet)

Sales Offices

Union, New Jersey 07083,
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(201) 687-3770.

Van Nuys, CA 91404
Box 2968
(213) 988-7550

Kokomo, Ind. 46901, 700 E.
Firmin, (317) 459-2175
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ZENERS • BRIDGES • SEMICONDUCTORS FUSES

SILICON CONTROLLED RECTIFIERS–4 to 470 Amps (RMS)

$I_{T(RMS)}$ (A)	4.0	8.0	25	35	80	110	235	470
$I_{T(AV)}$ (A) @ Max. T_C = (°C)	2.55 @ 30°	5.1 @ 85°	16 @ 95°	22.3 @ 35°	50 @ 87°	70 @ 80°	150 @ 85°	300 @ 75°
Max. I_{GT} @ 25°C (mA)	0.2	25	25	40	110	150	150	150
dv/dt (V/µs)	8 typ.	50 min.	20 typ	10 min.	25 min.	200 min.	200 min.	100 min.
Case Style	TO-202AA	A-7	A-17	A-1	TO-65	A-11	TO-93	TO-118
PRV								
15 Volts	IR106Q1	—	—	—	—	—	—	—
25 Volts	—	—	IR32U	—	—	—	—	—
30 Volts	IR106Y1	—	—	—	—	—	—	—
50 Volts	IR106F1	IR122F	IR32F	16RC5A	50RCS5	—	—	—
100 Volts	IR106A1	IR122A	IR32A	16RC10A	50RCS10	—	—	—
200 Volts	IR106B1	IR122B	IR32B	16RC20A	50RCS20	—	—	—
300 Volts	IR106C1	IR122C	IR32C	16RC30A	50RCS30	—	—	—
400 Volts	IR106D1	IR122D	IR32D	16RC40A	50RCS40	—	—	—
500 Volts	—	—	—	16RC50A	50RCS50	71RA50	151RA50	300RA50
600 Volts	—	—	—	16RC60A	50RCS60	71RA60	151RA60	300RA60
700 Volts	—		—	—	50RCS70	—	—	—
800 Volts	—	—	—	16RC80A	50RCS80	71RA80	151RA80	300RA80
900 Volts	—	—	—	—	50RCS90	—	—	—
1000 Volts	—	—	—	16RC100A	50RCS100	71RA100	151RA100	300RA100
1100 Volts	—	—	—	16RC110A	50RCS110	71RA110	151RA110	300RA110
1200 Volts	—	—	—	16RC120A	50RCS120	71RA120	151RA120	300RA120
1300 Volts	—	—	—	—	—	71RA130	151RA130	300RA130
1400 Volts	—	—	—	—	—	71RA140	151RA140	300RA140
1500 Volts	—	—	—	—	—	71RA150	151RA150	300RA150
1600 Volts	—	—	—	—	—	71RA160	151RA160	300RA160
1700 Volts	—	—	—	—	—	—	—	300RA170

SILICON RECTIFIERS–1 to 300 Amps (AV)

$I_{F(AV)}$ (A) @ Max. T_C (°C)	1 @ 75°	1 @ 75°	1.5 @ 40°	2 @ 100°	3 @ 125°	6 @ 95°	40 @ 140°	70 @ 125°	150 @ 150°	300 @ 120°
I_{FSM} – (A) Surge	30	50	50	50	150	400	500	1,200	3,000	5,000
Case Style	DO-41	DO-39	DO-39	DO-39	C-12	C-15	DO-5	DO-5	DO-8	DO-9
PRV										
50 Volts	1N4001	—	1N4816	—	—	60S05	40HF5	—	—	—
100 Volts	1N4002	10D1	1N4817	20D1	30S1	60S1	40HF10	70H10A	150K10A	300U10A
150 Volts	—	—	—	—	—	—	40HF15	70H15A	150K15A	300U15A
200 Volts	1N4003	10D2	1N4818	20D2	30S2	60S2	40HF20	70H20A	150K20A	300U20A
250 Volts	—	—	—	—	—	—	—	70H25A	150K25A	300U25A
300 Volts	—	10D3	1N4819	20D3	30S3	60S3	40HF30	70H30A	150K30A	300U30A
400 Volts	1N4004	10D4	1N4820	20D4	30S4	60S4	40HF40	70H40A	150K40A	300U40A
500 Volts	—	10D5	1N4821	20D5	30S5	60S5	40HF50	70H50A	150K50A	300U50A
600 Volts	1N4005	10D6	1N4822	20D6	30S6	60S6	40HF60	70H60A	150K60A	300U60A
700 Volts	—	—	1N5052	—	—	—	40HF70	70H70A	150K70A	300U70A
800 Volts	1N4006	10D8	1N5053	20D8	30S8	60S8	40HF80	70H80A	150K80A	300U80A
900 Volts	—	—	—	—	—	—	40HF90	70H90A	150K90A	300U90A
1000 Volts	1N4007	10D10	1N5054	20D10	30S10	60S10	40HF100	70H100A	150K100A	300U100A
1200 Volts	—	—	—	—	—	—	—	—	150K120A	300U120A

POWER TRANSISTORS

High Voltage-High Gain Power Transistors

IR Part No.	$V_{CEO(sus)}$ (Max. V)	I_C cont. (Max. A)	h_{FE} (Min./Max.)	@ I_C (A)	$V_{CE(sat)}$ (Max. V)	@ I_C (A)	P_D (W)	f_T (MHz)
401	300	5.0	20/100	0.5	0.8	0.5	100	2.5
402	325	7.0	—	—	2.0	3.0	125	2.5
403	325	7.0	—	—	1.1	3.5	125	—
409	300	7.0	15	1.0	1.2	1.0	100	2.5
410	200	5.0	30/90	1.0	0.8	1.0	100	2.5
411	300	5.0	30/90	1.0	0.8	1.0	100	2.5
413	325	5.0	20/80	0.5	0.8	0.5	125	4.0
423	325	7.0	30/90	1.0	0.8	1.0	125	2.5
424	350	5.0	30/90	1.0	0.8	1.0	100	2.5
425	400	5.0	30/90	1.0	0.8	1.0	100	2.5
430	300	7.0	15/45	2.5	0.9	2.5	125	2.5
431	325	7.0	15/35	2.5	0.7	2.5	125	2.5

Power Darlingtons

IR Part No.	$V_{CEO(sus)}$ (Max. V)	I_C (Max. A)	h_{FE}	@ I_C (A)	$V_{CE(sat)}$ (V)	@ I_C (A)	@ I_B (A)	P_D (W)
IR 4040	325	15	250	3	1.4	5	0.5	125
IR 4045	325	15	500	3	1.4	5	0.5	125
IR 4050	350	15	250	3	1.4	5	0.5	125
IR 4055	350	15	500	3	1.4	5	0.5	125
IR 4060	400	15	250	3	1.4	5	0.5	125
IR 4065	400	15	500	3	1.4	5	0.5	125
IR 5000	300	15	100	10	2.0	15	1.5	125
IR 5001	350	15	100	10	2.0	15	1.5	125
IR 5002	400	15	100	10	2.0	15	1.5	125
IR 5060	300	20	100	15	2.0	20	2.0	125
IR 5061	350	20	100	15	2.0	20	2.0	125
IR 5062	400	20	100	15	2.0	20	2.0	125
IR 5251	350	10	100	5	2.0	10	2.0	100
IR 5252	400	10	100	5	2.0	10	2.0	100
IR 5253	450	10	100	5	2.0	10	2.0	100

Fast Switching Power Transistors

IR Part No.	$V_{CEO(sus)}$ (Max V)	I_C Peak (A)	h_{FE} (min/max)	@ I_C (A)	$V_{CE(sat)}$ (Max V)	@ I_c (A)	P_d (W)	t_r/t_f (µs)
2N6306	250	16	15/75	3.0	0.8	3.0	125	.6/.4
2N6307	300	16	15/75	3.0	1.0	3.0	125	.6/.4
2N6308	350	16	12/60	3.0	1.5	3.0	125	.6/.4
2N6542	300	10	7/35	3.0	1.0	3.0	100	.7/.8
2N6543	400	10	7/35	3.0	1.0	3.0	100	.7/.8
2N6544	300	16	7/35	5.0	1.5	5.0	125	1/1
2N6545	400	16	7/35	5.0	1.5	5.0	125	1/1

ZENER VOLTAGE REGULATORS

Power Rating	400mW@175°C		400mW @175°C		500mW@200°C		1W @175°C		1W@200°C		5W @200°C		10W@175°C		50W @175°C	
Case Style	DO-7 ①		DO-7 ②		DO-7 ②		DO-13 ②		DO-41 ①		C-12 ②		DO-4 ②③		C-8 ②③	
V_Z ④	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)	Part No.	I_{ZT} (mA)
2.4	1N4370	20	–	–	1N5221	20	–	–	–	–	–	–	–	–	–	–
2.7	1N4371	20	–	–	1N5223	20	–	–	–	–	–	–	–	–	–	–
3.0	1N4372	20	–	–	1N5225	20	–	–	–	–	–	–	–	–	–	–
3.3	1N746	20	–	–	1N5226	20	–	–	1N4728	76	1N5333	380	–	–	–	–
3.6	1N747	20	–	–	1N5227	20	–	–	1N4729	69	1N5334	350	–	–	–	–
3.9	1N748	20	–	–	1N5228	20	–	–	1N4730	64	1N5335	320	–	–	1N4549	3200
4.3	1N749	20	–	–	1N5229	20	–	–	1N4731	58	1N5336	290	–	–	1N4550	2900
4.7	1N750	20	–	–	1N5230	20	–	–	1N4732	53	1N5337	260	–	–	1N4551	2650
5.1	1N751	20	–	–	1N5231	20	–	–	1N4733	49	1N5338	240	–	–	1N4552	2450
5.6	1N752	20	–	–	1N5232	20	–	–	1N4734	45	1N5339	220	–	–	1N4553	2250
(6.0)	–	–	–	–	1N5233	20	–	–	–	–	1N5340	200	–	–	–	–
6.2	1N753	20	–	–	1N5234	20	–	–	1N4735	41	1N5341	200	–	–	1N4554	2000
6.8 ⑤	1N754	20	1N957	18.5	1N5235	20	1N3016	37	1N4736	37	1N5342	175	1N2970	370	1N3305	1850
6.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1N4555	1850
7.5 ⑥	1N755	20	1N958	16.5	1N5236	20	1N3017	34	1N4737	34	1N5343	175	1N2971	335	1N3306	1700
7.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1N4556	1650
8.2	1N756	20	1N959	15.0	1N5237	20	1N3018	31	1N4738	31	1N5344	150	1N2972	305	1N3307	1500
(8.7)	–	–	–	–	1N5238	20	–	–	–	–	1N5345	150	–	–	–	–
9.1	1N757	20	1N960	14.0	1N5239	20	1N3019	28	1N4739	28	1N5346	150	1N2973	275	1N3308	1370
10	1N758	20	1N961	12.5	1N5240	20	1N3020	25	1N4740	25	1N5347	125	1N2974	250	1N3309	1200
11	–	–	1N962	11.5	1N5241	20	1N3021	23	1N4741	23	1N5348	125	1N2975	230	1N3310	1100
12	1N759	20	1N963	10.5	1N5242	20	1N3022	21	1N4742	21	1N5349	100	1N2976	210	1N3311	1000
13	–	–	1N964	9.5	1N5243	9.5	1N3023	19	1N4743	19	1N5350	100	1N2977	190	1N3312	960
(14)	–	–	–	–	1N5244	9.0	–	–	–	–	1N5351	100	1N2978	180	1N3313	890
15	–	–	1N965	8.5	1N5245	8.5	1N3024	17	1N4744	17	1N5352	75	1N2979	170	1N3314	830
16	–	–	1N966	7.8	1N5246	7.8	1N3025	15.5	1N4745	15.5	1N5353	75	1N2980	155	1N3315	780
(17)	–	–	–	–	1N5247	7.4	–	–	–	–	1N5354	70	1N2981	145	1N3316	740
18	–	–	1N967	7.0	1N5248	7.0	1N3026	14.0	1N4746	14.0	1N5355	65	1N2982	140	1N3317	700
(19)	–	–	–	–	1N5249	6.6	–	–	–	–	1N5356	65	1N2983	130	1N3318	660
20	–	–	1N968	6.2	1N5250	6.2	1N3027	12.5	1N4747	12.5	1N5357	65	1N2984	125	1N3319	630
22	–	–	1N969	5.6	1N5251	5.6	1N3028	11.5	1N4748	11.5	1N5358	50	1N2985	115	1N3320	570
24	–	–	1N970	5.2	1N5252	5.2	1N3029	10.5	1N4749	10.5	1N5359	50	1N2986	105	1N3321	520
(25)	–	–	–	–	1N5253	5.0	–	–	–	–	1N5360	50	1N2987	100	1N3322	500
27	–	–	1N971	4.6	1N5254	4.6	1N3030	9.5	1N4750	9.5	1N5361	50	1N2988	95	1N3323	460
(28)	–	–	–	–	1N5255	4.5	–	–	–	–	1N5362	50	–	–	–	–
30	–	–	1N972	4.2	1N5256	4.2	1N3031	8.5	1N4751	8.5	1N5363	40	1N2989	85	1N3324	420
33	–	–	1N973	3.8	1N5257	3.8	1N3032	7.5	1N4752	7.5	1N5364	40	1N2990	85	1N3325	380
36	–	–	1N974	3.4	1N5258	3.4	1N3033	7.0	1N4753	7.0	1N5365	30	1N2991	70	1N3326	350
39	–	–	1N975	3.2	1N5259	3.2	1N3034	6.5	1N4754	6.5	1N5366	30	1N2992	65	1N3327	320
43	–	–	1N976	3.0	1N5260	3.0	1N3035	6.0	1N4755	6.0	1N5367	30	1N2993	60	1N3328	290
47	–	–	1N977	2.7	1N5261	2.7	1N3036	5.5	1N4756	5.5	1N5368	25	1N2995	55	1N3330	270
51	–	–	1N978	2.5	1N5262	2.5	1N3037	5.0	1N4757	5.0	1N5369	25	1N2997	50	1N3332	245
56	–	–	1N979	2.2	1N5263	2.2	1N3038	4.5	1N4758	4.5	1N5370	20	1N2999	45	1N3334	220
62	–	–	1N980	2.0	1N5265	2.0	1N3039	4.0	1N4759	4.0	1N5372	20	1N3000	40	1N3335	200
68	–	–	1N981	1.8	1N5266	1.8	1N3040	3.7	1N4760	3.7	1N5373	20	1N3001	37	1N3336	180
75	–	–	1N982	1.7	1N5267	1.7	1N3041	3.3	1N4761	3.3	1N5374	20	1N3002	33	1N3337	170
82	–	–	1N983	1.5	1N5268	1.5	1N3042	3.0	1N4762	3.0	1N5375	15	1N3003	30	1N3338	150
(87)	–	–	–	–	1N5269	1.4	–	–	–	–	1N5376	15	–	–	–	–
91	–	–	1N984	1.4	1N5270	1.4	1N3043	2.8	1N4763	2.8	1N5377	15	1N3004	28	1N3339	140
100	–	–	1N985	1.3	1N5271	1.3	1N3044	2.5	1N4764	2.5	1N5378	12	1N3005	25	1N3340	120
110	–	–	–	–	–	–	1N3045	2.3	1ZT110	2.3	–	–	1N3007	23	–	–
120	–	–	–	–	–	–	1N3046	2.0	1ZT120	2.0	–	–	1N3008	20	–	–
130	–	–	–	–	–	–	1N3047	1.9	1ZT130	1.9	–	–	1N3009	19	–	–
(140)	–	–	–	–	–	–	–	–	–	–	–	–	1N3010	18	–	–
150	–	–	–	–	–	–	1N3048	1.7	1ZT150	1.7	–	–	1N3011	17	–	–
160	–	–	–	–	–	–	1N3049	1.6	1ZT160	1.6	–	–	1N3012	16	–	–
180	–	–	–	–	–	–	1N3050	1.4	1ZT180	1.4	–	–	1N3014	14	–	–
200	–	–	–	–	–	–	1N3051	1.2	1ZT200	1.2	–	–	1N3015	12	–	–

① Basic = 10%, "A" = 5% ② Basic = 20%, "A" = 10%, "B" = 5% ③ "R" = Cathode to stud. ④ Contact factory for other available voltages. ⑤ Also available, 50W 1N4555. ⑥ Also available, 50W 1N4456.

KLIP-SELS – Transient Voltage Suppressors

Device Voltage Rating (V)	Transient Voltage Rating (V)	Max. Rated RMS Operating Voltage (V)	For Individual Rectifier Rated Thru 3 Amp	For Individual Rectifier Rated Thru 16 Amp	For Individual Rectifier Rated Thru 60 Amp	For Individual Rectifier Rated Thru 250 Amp	Device Voltage Rating (V)	Transient Voltage Rating (V)	Max. Rated RMS Operating Voltage (V)	For Individual Rectifier Rated Thru 3 Amp	For Individual Rectifier Rated Thru 16 Amp	For Individual Rectifier Rated Thru 60 Amp	For Individual Rectifier Rated Thru 250 Amp
100	150	52	KY2DPF	KZ2DPF	KSA2DAF	KSL2DAF	600	360	130	KY10DPF	KZ10DPF	KSA10DAF	KSL10DAF
150	250	78	KY3DPF	KZ3DPF	KSA3DAF	KSL3DAF	800	1000	364	KY14DPF	KZ14DPF	KSA14DAF	KSL14DAF
300	360	130	KY5DPF	KZ5DPF	KSA5DAF	KSL5DAF	1000	1200	442	KY17DPF	KZ17DPF	KSA17DAF	KSL17DAF
500	650	234	KY9DPF	KZ9DPF	KSA9DAF	KSA9DAF							

Note: The types listed above are now polarized for AC usage. For Polarized units for DC usage, add P to P/N (thus KY = KYP).

For other ratings contact IR sales offices and distributors.

TEMPERATURE COMPENSATED VOLTAGE REFERENCES

Power Rating (mW)	V_Z – Zener Voltage (V)	I_{ZT} – Test Current (mA)	Z_Z – Zener Impedance (Ω) @ I_{ZT}	Case Style	Nom. Temp. Coefficient (%/°C)	IR Part No.
400	5.9-6.5	7.5	15	DO-7	0.01 0.005 0.002 0.001 0.0005	1N821 ① 1N823 1N825 1N827 1N829
500	8.55-9.45	7.5	20	DO-7	0.01 0.005 0.002 0.001 0.0005	1N935 ② 1N936 1N937 1N938 1N939

SINGLE PHASE BRIDGES

DC Output Current (A)	1.8	2.2	7.5	10	15	25	30	40	50
@ °C	T_A 50°C	T_A 50°C	T_C 75°C	T_C 75°C	T_C 75°C	T_C 75°C	T_C 75°C	T_C 75°C	T_C 75°C
I_{FSM} (A)	50	50	75	100	150	300	350	500	600
V_{RRM} (V)									
50	–	–	75JB05L	100JB05L	150JB05L	250JB05L	300JB05L	400JB05L	500JB05L
100	–	–	75JB1L	100JB1L	150JB1L	250JB1L	300JB1L	400JB1L	500JB1L
200	18DB2A	22DB2A	75JB2L	100JB2L	150JB2L	250JB2L	300JB2L	400JB2L	500JB2L
300	18DB3A	22DB3A	75JB3L	100JB3L	150JB3L	250JB3L	300JB3L	400JB3L	500JB3L
400	18DB4A	22DB4A	75JB4L	100JB4L	150JB4L	250JB4L	300JB4L	400JB4L	500JB4L
500	18DB5A	22DB5A	75JB5L	100JB5L	150JB5L	250JB5L	300JB5L	400JB5L	500JB5L
600	18DB6A	22DB6A	75JB6L	100JB6L	150JB6L	250JB6L	300JB6L	400JB6L	500JB6L
700	18DB7A	22DB7A	–	–	–	–	–	–	–
800	18DB8A	22DB8A	–	–	–	–	–	–	–
1000	18DB10A	22DB10A	–	–	–	–	–	–	–

SEMICONDUCTOR PROTECTIVE FUSES

Max. RMS Voltage	130	250	500	600	700	Max. RMS Voltage	130	250	500	600	700
Max. DC Voltage	130	210	450	550	700	Max DC Voltage	130	210	450	550	700
Max. Arc Voltage	220	410	850	1,050	1,200	Max Arc Voltage	220	410	850	1,050	1,200
RMS Current (A)						RMS Current (A)					
5	SF13X5	SF25X5	–	SF60C5	–	125	SF13X125	SF25X125	SF50P125	SF60C125	SF70P125
10	SF13X10	SF25X10	–	SF60C10	SF70P10	150	SF13X150	SF25X150	SF50P150	SF60C150	SF70P150
15	SF13X15	SF25X15	–	SF60C15	SF70P15	175	–	SF25X175	SF50P175	SF60C175	SF70P175
20	SF13X20	SF25X20	–	SF60C20	SF70P20	200	SF13X200	SF25X200	SF50P200	SF60C200	SF70P200
25	SF13X25	SF25X25	–	SF60C25	SF70P25	225	–	SF25X225	–	SF60C225	–
30	SF13X30	SF25X30	–	SF60C30	SF70P30	250	SF13X250	SF25X250	SF50P250	SF60C250	SF70P250
35	SF13X35	–	SF50P35	SF60C35	SF70P35	300	SF13X300	SF25X300	SF50P300	SF60C300	SF70P300
40	SF13X40	SF25X40	SF50P40	SF60C40	SF70P40	350	SF13X350	SF25X350	SF50P350	SF60C350	–
45	–	–	SF50P45	SF60C45	–	400	SF13X400	SF25X400	SF50P400	SF60C400	SF70P400
50	SF13X50	SF25X50	SF50P50	SF60C50	SF70P50	450	–	SF25X450	SF50P450	SF60C450	–
60	SF13X60	SF25X60	SF50P60	SF60C60	SF70P60	500	SF13X500	SF25X500	SF50P500	SF60C500	SF70P500
70	SF13X70	SF25X70	SF50P70	SF60C70	SF70P70	550	–	–	SF50P550	–	–
80	SF13X80	SF25X80	SF50P80	SF60C80	SF70P80	600	SF13X600	SF25X600	SF50P600	SF60C600	SF70P600
90	–	–	SF50P90	SF60C90	SF70P90	700	–	–	SF50P700	SF60C700	–
100	SF13X100	SF25X100	SF50P100	SF60C100	SF70P100	800	SF13X800	–	SF50P800	SF60C800	–

GENERAL INSTRUMENT CORPORATION
SEMICONDUCTOR PRODUCTS GROUP

600 West John Street, Hicksville, N.Y. 11802 • (516) 733-3333

SILICON RECTIFIERS 50 to 1000 PRV

- Glass–Passivated Glass–Amp II® 1A–3A, Medium & Fast Recovery
- Glass–Passivated Mini Glass–Amp II® 1A
- Miniature Plastic 0.5A–1.5A
- Plastic 0.5A–3A

SILICON DIODES 50 to 1000 PRV

- Glass Passivated
- General Purpose
- UHF Detector and Mixer Diodes
- General Purpose, Low Leakage

SILICON BRIDGE RECTIFIERS 0.75A–25A

CENTER TAP & DOUBLER UNITS

HIGH VOLTAGE RECTIFIERS to 18kV PRV

- Glass–Passivated Glass–Amp II®
- Glass–Passivated Glass–Amp II® Fast Recovery
- Glass–Passivated, Low Current, Fast Recovery
- Power Rectifiers
- Military Type Cartridges
- High Voltage Modules
- Custom Assemblies
- High Voltage Units for Use in TV & Other Cathode-Ray Tube Applications
- Multipliers

SELENIUM RECTIFIERS

- Stacks & Cells

MATERIALS

- Silicon Wafers
- Silicon Epitaxial Wafers

CAPACITORS

- Mica
- Electrolytic
- Film

MOSFETS

- P-Channel Enhancement
- Dual P-Channel Enhancement
- N-Channel Enhancement
- N-Channel Depletion
- MULTIFET™ Switches (Multiple MOSFETs)

C/MOS PRODUCTS

- Quad Bilateral Switches
- Dual Pair Plus Inverter
- Quad MULTIFET™/Multiplex Driver (TTL Compatible)

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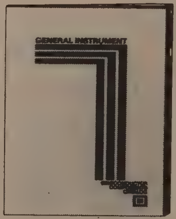
- Voltage Regulators
- Reference Generators
- Voltage Comparators

POWER/HYBRID PRODUCTS



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FUNCTION GENERATORS

XR-205	WAVEFORM GENERATOR
XR-2206	MONOLITHIC FUNCTION GENERATOR
XR-2207	CURRENT-CONTROLLED OSCILLATOR

TONE DECODERS

XR-567	TONE DECODER
XR-2567	DUAL TONE DECODER

VOLTAGE REGULATORS

XR-1468/ 1568	DUAL ±15 VOLT TRACKING REGULATOR

CONSUMER CIRCUITS

XR-1310	FM STEREO DEMODULATOR
XR-1310E	FM STEREO DEMODULATOR

COMMUNICATIONS CIRCUITS

XR-S200	MULTIFUNCTION COMMUNICATION CIRCUIT
XR-1488	QUAD LINE DRIVER
XR-1489A	QUAD LINE RECEIVER
XR-2208	FOUR-QUADRANT OPERATIONAL MULTIPLIER

CUSTOM CIRCUITS

XR-C100	INTEGRATED CIRCUIT DESIGN KIT

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CK-06
CK-13
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ENERGY CONVERSION — IR — DEVICE MATERIALS

Semiconductor compounds and alloys of the following types, covering a wide range of controlled electronic properties for applications such as INFRA-RED DETECTORS, MAGNETIC SENSORS, THERMOELECTRIC COOLING/POWER GENERATION, OPTICAL AND INFRA-RED COATINGS/FILTERS, AND CRYOGENIC SENSORS, are available from stock. High quality electronically characterized materials suitable for PHOTOCONDUCTIVE and PHOTOVOLTAIC sensors are available.

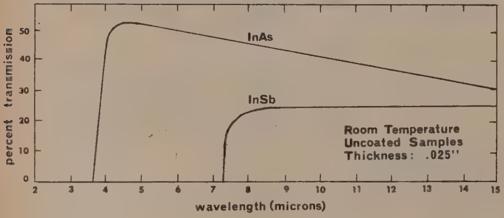
Material	Carrier Concentration/cm³
InAs	10^{15} - 10^{19}
InSb	10^{14} - 10^{19}
Bi-Te alloys	10^{18} - 10^{19}
PbTe and PbTe alloys	As Desired

These materials are available in ingot, rod, slice and polished wafer form. Oriented single crystals of InSb having dislocation densities well below 100/cm² are available for infra-red sensor construction. High figure of merit p and n type Bi-Te alloys are in stock for thermoelectric applications. InAs with Hall coefficients at R.T. in the range from 10 to 1000 cm³/coulomb is immediately available for many device applications.

Any feasible high purity alloy or compound consisting of Pb, Bi, Tl, Tn, As, Sn, Sb, Se or Te with selective doping can be manufactured and supplied on request.

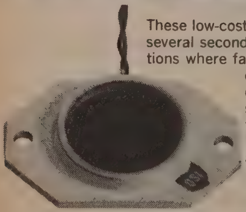
High purity zone refined ingots of most of the above elements used in our electronically characterized compounds can be delivered on request.

INFRARED WINDOWS



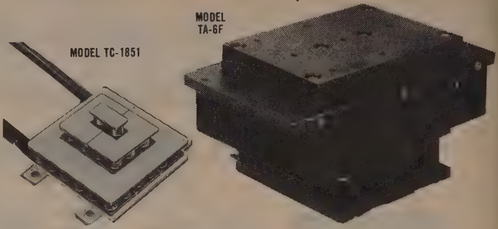
Polished IR windows of single crystal and polycrystalline InSb and polycrystalline InAs are available in sizes up to 1" in square or circular shapes and any desired thickness. Applications include broad band transmission for IR detectors and sources at wave lengths above the cutoff value. Anti-reflective coatings are available, on quantity orders, to increase peak transmission to about 90% for InAs and 80% for InSb.

RADIATION SENSORS

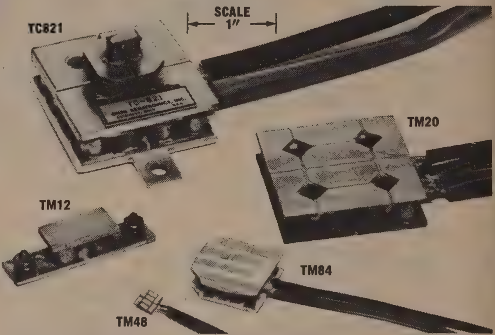


These low-cost, broad-band radiation sensors with several seconds time constant find many applications where fast response is not essential. These detectors are of the thermopile type operating over the IR and visible spectrum. Applications include thermal monitoring and registering. Photo conductive IR InSb detectors are also available.

THERMOELECTRIC DEVICES



(Above Photos Not To Scale)



O.S.I. offers a variety of thermoelectric cooling units ranging from the TC Series, used in spot cooling applications where up to 115 degree Centigrade temperature depression is needed, to the TA Series which can remove up to 85 watts from chemical bath, electronic package, or enclosure. The controllable, reversible heat pumping properties of thermoelectric devices make them ideally suited for temperature control. The MTM48 and TM84 are suited to IR detector cooling. Two and three stage coolers are also available for lower temperature IR detector cooling.

MODEL	ΔT DEG. C.	HEAT PUMP WATTS AT ΔT = 0	MAX. INPUT CURRENT AMPERES
TM-20	65	20	30
TC-44	90	6	30
TM-12	65	2.4	30
TA-6F	55	85	30
TC-1851	115	3	25
TC-821	115	1.3	25
TM-318	60	20	8
MTM-48	60	1.7	5
TM-84	65	1	4.4

THERMOELECTRIC COOLED IR DETECTOR ASSEMBLIES

MODEL RTM-164B

Complete IR detector assemblies include mounting base, thermoelectric cooler, cold plates, thermistor, IR detector, window and/or filter. Assemblies may be bare (as shown), sealed or vacuum encapsulated. Customer engineering service is provided to accommodate specified IR detector and filter types. Applications include surveillance, security, instrumentation and industrial process control.

OSI OHIO SEMITRONICS, INC.

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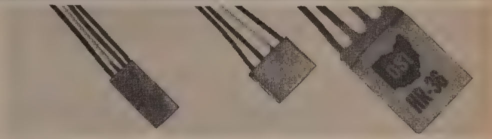
OSI SEMICONDUCTOR MATERIALS AND DEVICES HALL EFFECT — INFRARED — THERMOELECTRIC

HALLTRON, MAGNETIC FIELD SENSORS



OSI offers a wide variety of standard Hall Effect probes for magnetic sensing or measuring applications. The high linearity, low noise, excellent stability and ruggedness permit optimum use in your most critical applications. Reliability has been proved by years of continuous operation in industrial and military systems. Large quantity production enables OSI to offer high quality units at attractive prices.

MODEL NO.	HALL OUTPUT, V_H, MILLIVOLTS ±25% B = 10Kg, I_C = NOMINAL)	NOMINAL CONTROL CURRENT, I_C, mA	OHMIC RESIDUAL V_{RO}, MILLIVOLTS		INPUT RESISTANCE R_{IN}, OHMS (NOMINAL)	OUTPUT RESISTANCE R_{OUT}, OHMS (NOMINAL)	DIMENSIONS L/W/T, INCHES	LEAD INSULATION	TEMPERATURE COEFFICIENT OF V_H IN%/°C (AVG.)
			(B = 0 I_C = 10mA.)	(B = 0 I_C = 100mA.)					
HP150	70	100	—	1	2.0	2.0	.200 .250 .025	Enamel	.04
HP316*	100	100	—	0.5	2	1	.125 dia. .250	PVC	−0.2
HP318*	250	100	—	0.5	5	4	.250 dia. .5	Teflon	−0.2
HP325	200	25	0.5	—	15	10	.187 .075 .015	Enamel	−0.25
HP330	150	25	0.5	—	15	7.5	.040 .040 .012	Enamel	−0.25
HP340	100	25	0.2	—	3	2	.250 .125 .020	Enamel	−0.2
HP374	200	25	0.5	—	15	10	.300 .150 .030	PVC	−0.25
HR36	350	350	—	0.15	1.5	1.5	.500 .375 .025	PVC	−0.1
HR66	500	200	—	0.5	5	4	.250 .200 .028	Enamel	−0.15
HR67	200	25	0.2	—	9	5	.300 .150 .020	Teflon	−0.25
HR70	340	200	—	0.5	2	2	.250 .200 .028	PVC	−0.1
HR72	700	100	0.2	—	9	6	.250 .200 .028	Enamel	−0.25
HR77	550	100	—	1	10	10	.250 .200 .035	Enamel	−0.25
HR78	80	100	—	0.15	2	1.5	.100 .300 .020	Enamel	−0.15
HR88	400	300	—	4	2.5	2	.375 .340 .023	Enamel	−.015
HR120	75	100	—	5	1.5	1.5	.250 .200 .030	Enamel	−.05
HR125	100	100	—	0.5	1.7	1.4	.150 .200 .030	Enamel	−.05
HR170	10	100	—	0.03	1.2	.6	.250 .200 .025	Enamel	−.005
HS55	250	100	—	0.5	1.2	1	.500 .375 .025	PVC	

* Denotes Axial Type Probes. All others are Transverse. Operating Temperature Range: −65°C to +85°C.

OSI has a unique position in the U.S. Hall probe manufacturing indus-ry in that they process their own Hall probe semiconductor materials hus providing the special capability of designing and manufacturing custom probes for any application and to meet any feasible set of specifications.

In addition to the standard probes listed, OSI supplies high-reliability probes with appropriate test documentation for critical industrial and military applications.

Write or call OSI, the recognized leader in Hall effect technology, for assistance in meeting your requirements.

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MICROMINIATURE HIGH VOLTAGE SILICON DIODES

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Average Forward Cur. @ 25°C (MA)	Max. Rev. Cur. @ PIV @ 25°C (Nano Amp)	Case Size
NV10	1,000	20	10	A
3NV10	1,000	20	10	B
3NV15	1,500	20	10	B
NV20	2,000	20	10	A
3NV20	2,000	20	10	B
NV30	3,000	20	10	A
3NV30	3,000	20	10	B
NV40	4,000	20	10	A
NV50	5,000	20	10	A
NV60	6,000	20	10	A
NV70	7,000	20	10	A

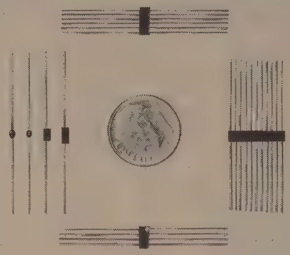
ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ PIV @ 100°C	5 Micro A
Avg. Forward Current @ 100°C	10 MA
Max. 8 MS Surge	0.5 AMPS
Max. Forward Voltage @ 10 MA	6 Volts
Max. Capacitance @ 0 Volts (Case A)	1 Picofarad
Max. Capacitance @ 0 Volts (Case B)	2 Picofarad

For applications requiring very low reverse leakage and low capacitance (less than 10 nanoamperes and 1 picofarad at operating PIV).

These reliable microminiature diodes were first designed to meet the special requirements of Image Intensifiers for first and second generation Night Vision sights for the U.S. Armed Services.

Custom "Bank" constructions, containing 4 to 12 diodes make power supply designs smaller, and assembly simpler. Details available in request.



FAST RECOVERY

M & H Part No.	PIV (Volts)	Average Forward Cur. @ 25°C (MA)	Max. Rev. Cur. @ PIV @ 25°C (Nano Amp)	Case Size
NV10F	1,000	20	20	A
3NV10F	1,000	20	20	B
3NV15F	1,500	20	20	B
NV20F	2,000	20	20	A
3NV20F	2,000	20	20	B
NV30F	3,000	20	20	A
3NV30F	3,000	20	20	B
NV40F	4,000	20	20	A
NV50F	5,000	20	20	A
NV60F	6,000	20	20	A
NV70F	7,000	20	20	A

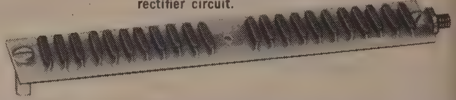
ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ PIV @ 90°C	10 Micro A
Avg. Forward Current @ 90°C	10 MA
Max. 8 MS Surge	0.5 AMPS
Max. Forward Voltage @ 10 MA	7 Volts
Max. Capacitance @ 0 Volts (Case A)	1 Picofarad
Max. Capacitance @ 0 Volts (Case B)	2 Picofarad
Reverse Recovery Time, T_{rr} @ I_F= 2 MA to I_R=4 MA	300 NS TYP

HIGH VOLTAGE RECTIFIERS for X-RAY EQUIPMENT and other VERY HIGH VOLTAGE APPLICATIONS.

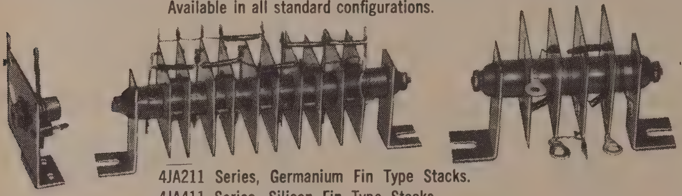
	506-682-1	506-682-2	506-682-3
Peak Reverse Voltage—Operative	100 KV	125 KV	150 KV
Peak Reverse Voltage—Test	150 KV	175 KV	200 KV
Av. Forward Current—55°C Oil	110 mA Max	110 mA Max	110 mA Max
Reverse current @ Test PRV @ 25°C	1 μA	1 μA	1 μA
Operating and Storage Temp. Range	−55°C to +125°C	−55°C to +125°C	−55°C to +125°C

Avalanche silicon diodes are connected in series on a PC board, arranged for immersion in electrical grade insulating oil.
Each board is a H.V. diode which is then connected into a full wave rectifier circuit.



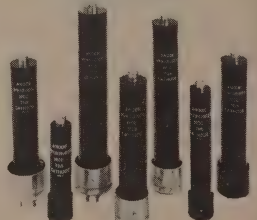
SILICON and GERMANIUM RECTIFIER STACKS

Available in all standard configurations.



4JA211 Series, Germanium Fin Type Stacks.
4JA411 Series, Silicon Fin Type Stacks.
4JA1011 Series, Silicon Fin Type Stacks.

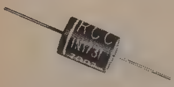
SILICON RETRO-FIT



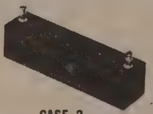
RECTIFIERS

SILICON RETRO-FIT RECTIFIERS
Type Numbers
HVK1248/3B24
HVK1255/3B29
HVK1143/250R
HVK1130/371
HVK1115/575
HVK1144/575
HVK1145/576
HVK1126/673
HVK1109/866
HVK1139/866
HVK1110/872
HVK1139/872
HVK1121/8008
HVK1146/8008
HVK1129/8020

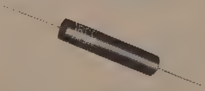
SILICON HIGH VOLTAGE RECTIFIERS



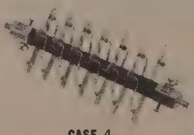
CASE 1



CASE 2



CASE 3



CASE 4

0.2 AMP/25°C 2.5Apk SURGE			0.5 AMP/25°C 50Apk SURGE			1.0 AMP/55°C 50Apk SURGE			1.0 AMP/55°C 80Apk SURGE			1.0 AMP/55°C 50Apk SURGE			1.0 AMP/25°C 80Apk SURGE			TRV Series* 2.3 AMP/50°C 50Apk SURGE		
Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV
IN1731	1	1500	RC1731	1	1500	RC5482	3	2000	IN5482	3	2000	RC5477	2	5000	IN5477	2	5000	RC3405	4	5000
IN1732	1	2000	RC1732	1	2000	RC5483	3	3000	IN5483	3	3000	RC5478	2	6000	IN5478	2	6000	RC3410	4	10,000
IN1733	1	3000	RC1733	1	3000	RC5484	3	4000	IN5484	3	4000	RC5479	2	7000	IN5479	2	7000	RC3415	4	15,000
IN1734	1	5000	RC1734	1	5000	RC5485	3	5000	IN5485	3	5000	RC5480	2	8000	IN5480	2	8000	RC3420	4	20,000
—	—	—	—	—	—	—	—	—	—	—	—	RC5481	2	10,000	IN5481	2	10,000	RC3425	4	25,000

* TRV: Transient Rated Voltage = 2 × TRV Rating.

RECT A CELL

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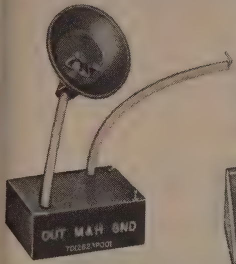
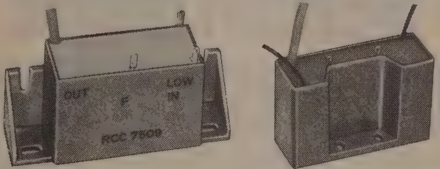
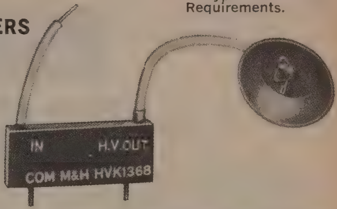
DOUBLERS • TRIPLERS • QUADRUPLERS

A Type to Fit Your Requirements.







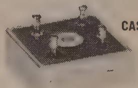
SPECIALLY DESIGNED DOUBLERS, TRIPLERS, AND QUADRUPLERS FOR MANY APPLICATIONS INCLUDING CRT TERMINAL DISPLAY SYSTEMS, ELECTROSTATIC POWER SUPPLIES, MEDICAL MONITORS, TELEVISION SETS AND PRECIPITATORS.

SILICON BRIDGE RECTIFIERS

CASE 1

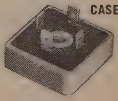
CASE 2

CASE 3



CASE 4

CASE 5



CASE 6

	CASE 1	CASE 2	CASE 3	CASE 1	CASE 3	CASE 5	CASE 4	CASE 5	CASE 6
Peak Reverse Voltage	3 Amp 75A Pk Surge	3 Amp 50A Pk Surge	3 Amp 50A Pk Surge	6 Amp 100A Pk Surge	6 Amp 125A Pk Surge	12 Amp 160A Pk Surge	16 Amp 125A Pk Surge	20 Amp 250A Pk Surge	35 Amp 300A Pk Surge
50	3B05	—	BRH300.5	6B05	BRH600.5	12B05	BRH1600.0	20B05	35B05
100	3B10	—	—	6B10	BRH601	12B10	BRH1601	20B10	35B10
200	3B20	BRE302	BRH302	6B20	BRH602	12B20	BRH1602	20B20	35B20
400	3B40	BRE304	BRH304	6B40	BRH604	12B40	BRH1604	20B40	35B40
600	3B60	BRE306	BRH306	6B60	RRH606	12B60	BRH1606	20B60	—
800	3B80	BRE308	BRH308	6B80	BRH608	12B80	BRH1608	—	—
1000	3B100	—	BRH310	6B100	—	—	—	—	—

HIGH VOLTAGE RECTIFIERS

The MH Series and 20 MH Series High Voltage Rectifiers are both rated at 20 MA continuous current and are available for both standard and high frequency applications to 50MHz. Applications for these types are electrostatic copiers, room electrostatic air cleaners, electrostatic paint spray, and television receivers.

The 350 MH Series High Voltage Rectifiers are rated at 350 MA continuous current in both standard and high frequency applications to 50MHz. Applications for these types are lasers, precipitators, medical defibrillators, and transmitter power supplies.

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Avg. Fwd. Cur. @ 25°C (MA)	Max. Fwd. Volt. @ 20 MA	Case Style
20MH8	8,000	20	15	A
20MH10	10,000	20	15	A
20MH15	15,000	20	30	B
20MH20	20,000	20	30	B
20MH25	25,000	20	30	E
20MH30	30,000	20	45	D & F
20MH45	45,000	20	60	G

ELECTRICAL CHARACTERISTICS

Max Reverse Cur. @ 25°C	0.2 Micro A
Max. Reverse Cur. @ 100°	10 Micro A
Avg. Forward Current @ 100°C	10 MA
Max. 8 MS Surge	3 AMP
Storage Temperature	−55°C to150°C

FAST RECOVERY

M & H Part No.	PIV (Volts)	Avg. Fwd. Cur. @ 25°C (MA)	Max. Fwd. Volt. @ 20 MA	Case Style
20MH8F	8,000	20	18	A
20MH10F	10,000	20	18	A
20MH15F	15,000	20	36	B
20MH20F	20,000	20	36	B
20MH25F	25,000	20	36	E
20MH30F	30,000	20	54	D & F
20MH45F	45,000	20	72	G

ELECTRICAL CHARACTERISTICS

Max. Reverse Cur. @ 25°C	1 Micro A
Max. Reverse Cur.@ 90°C	10 Micro A
Avg. Forward Cur. @ 90°C	10 MA
Max. 8 MS Surge	3 AMP
Storage Temperature	−55°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=2 MA to I_R=4 MA	250 NS TYP

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Avg. Fwd. Cur. @ 25°C (MA)	Max. Fwd. Volt. @ 350 MA	Case Lgth. (L) (In.)
350MH3	3,000	350	3	0.5
350MH5	5,000	350	6	1.0
350MH8	8,000	350	9	1.5
350MH10	10,000	350	12	1.5
350MH15	15,000	350	15	2.0
350MH20	20,000	350	18	2.5
350MH25	25,000	350	24	3.0
350MH30	30,000	350	30	3.0

ELECTRICAL CHARACTERISTICS

Max. Rev. Cur. @ 25°C	1 Micro A
Max. Rev. Cur. @ 100°C	10 Micro A
Avg. Forward Cur. @ 100°C	175 MA
Max. 8 MS Surge	15 AMP
Storage Temperature	−55°C to 150°C

FAST RECOVERY

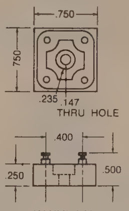
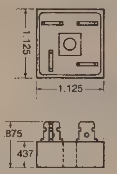
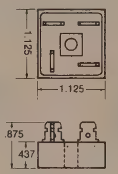
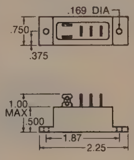
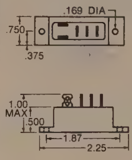
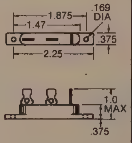
M & H Part No.	PIV (Volts)	Avg. Fwd. Cur. @ 25°C (MA)	Max. Fwd. Volt. @ 350 MA	Case Lgth. (L) (In.)
350MH3F	3,000	350	4	0.5
350MH5F	5,000	350	8	1.0
350MH8F	8,000	350	12	1.5
350MH10F	10,000	350	16	1.5
350MH15F	15,000	350	20	2.0
350MH20F	20,000	350	24	2.5
350MH25F	25,000	350	32	3.0
350MH30F	30,000	350	40	3.0

ELECTRICAL CHARACTERISTICS

Max. Rev. Cur. @ PIV @25°C	2 Micro A
Max. Rev. Cur. @ PIV @ 90°C	20 Micro A
Avg. Forward Cur. @ 90°C	175 MA
Max. 8 MS Surge	12 AMP
Reverse Recovery Time, T_{rr} @ I_F= 2 MA to I_R=4 MA	300 NS TYP
Storage Temperature	−55°C to 150°C

SENSITRON SEMICONDUCTOR
A DIVISION OF RSM ELECTRON POWER, INC.
221 West Industry Court ▪ Deer Park, N. Y. 11729
Telephone: (516) 586-7600 ▪ Telex 96-7737

RSM SENSITRODE BRIDGE RECTIFIER

MAXIMUM RATINGS	S6A05 SERIES (Single Phase)	S12A05 SERIES (Single Phase)	S25A05 SERIES (Single Phase)	S15A-3-05 SERIES (3-Phase)	S25A-3-05 SERIES (3-Phase)	SCDA-05 SERIES SCPA-05 SERIES SCNA-05 SERIES Doublers and Center Taps
	 (ALUMINUM)	 (ALUMINUM)	 (ALUMINUM)	 (ALUMINUM)	 (ALUMINUM)	 (ALUMINUM)
PIV per leg Volts	50 to 1000V	50 to 1000V	50 to 1000V	50 to 1000V	50 to 1000V	50 to 1000V
Average forward current DC Amps	6 Amps @ 55°C	12 Amps @ 55°C	25 Amps @ 55°C	15 Amps @ 55°C	25 Amps @ 55°C	15 Amps @ 55°C
Pk 1 cycle fwd surge Amps	100A	200A	300A	250A	300A	300A
Oper Temp Range	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C

RSM Sensitrode Bridge Rectifiers are available in both general purpose and fast recovery versions. For complete specifications and unit pricing, call or write:

SENSITRODE SAMPLES:
For your free Sensitrode Bridge Rectifier evaluation sample, write request on your company letterhead.

SILICON POWER RECTIFIERS / JAN / JANTX

Type	Peak Inverse Voltage (Volts)	Max. Full Cycle Average Forward Curr. @ T_A (°C) (Amps)	Max. Peak Reverse Curr. @ PIV @ 25°C (μA)	Max. ½ Cycle Surge @ T_A (°C) & I_O (Amps)	Max. Forward Voltage Drop DC @ 25°C @ I_F (Volts) (Amps)
1N3611	200	1.0 @ 100	1	20 @ 150 & .3*	1.1 @ 1.0
1N3612	400	1.0 @ 100	1	20 @ 150 & .3*	1.1 @ 1.0
1N3613	600	1.0 @ 100	1	20 @ 150 & .3*	1.1 @ 1.0
1N3614	800	1.0 @ 100	1	20 @ 150 & .3*	1.1 @ 1.0
1N3957	1000	1.0 @ 100	1	20 @ 150 & .3*	1.1 @ 1.0
1N5614	200	1.0 @ 55	0.5	30 @ 100 & .750*	1.3 @ 3.0†
1N5616	400	1.0 @ 55	0.5	30 @ 100 & .750*	1.3 @ 3.0†
1N5618	600	1.0 @ 55	0.5	30 @ 100 & .750*	1.3 @ 3.0†
1N5620	800	1.0 @ 55	0.5	30 @ 100 & .750*	1.3 @ 3.0†
1N5622	1000	1.0 @ 55	0.5	30 @ 100 & .750*	1.3 @ 3.0†
1N4245	200	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3†
1N4246	400	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3†
1N4247	600	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3†
1N4248	800	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3†
1N4249	1000	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3†
1N5550	200	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9†
1N5551	400	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9†
1N5552	600	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9†
1N5553	800	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9†
1N5554	1000	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9†

* 10 surges of 1/120 sec. duration.

† Peak voltage at I_F pulsed, with 1/120 sec. duration pulses at 2% duty cycle.

RSM SENSITRON

HIGH VOLTAGE SILICON RECTIFIERS / JAN / JANTX

Type	Peak Inverse Voltage (Volts)	Max. Full Cycle Average Forward Current @ T_A (°C) (Amps)	Max. Peak Reverse Current @ PIV @ 25°C (μA)	Max. ½ Cycle Surge @ T_A (°C) & I_o (Amps)	Max. Forward Voltage Drop DC @ 25°C @ I_f (Volts) (Amps)
1N3644	1500	.100 @ 100	5.0	14 @ 25 & .25	5.0 @ .250
1N3645	2000	.100 @ 100	5.0	14 @ 25 & .25	5.0 @ .250
1N3646	2500	.100 @ 100	5.0	14 @ 25 & .25	5.0 @ .250
1N3647	3000	.100 @ 100	5.0	14 @ 25 & .25	5.0 @ .250

FAST RECOVERY SILICON POWER RECTIFIERS / JAN / JANTX

Type	Peak Inverse Voltage (Volts)	Max. Full Cycle Average Forward Current @ T_A (°C) (Amps)	Max. ½ Cycle Surge @ T_A (°C) & I_o (Amps)	Max. Forward Voltage Drop DC @ 25°C @ I_f (Volts) (Amps)	t_{rr} nsec
1N4942	200	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	150
1N4944	400	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	150
1N4946	600	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	250
1N4947	800	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	250
1N4948	1000	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	500
1N5186	100	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	150
1N5187	200	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	200
1N5188	400	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	250
1N5190	600	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	400
1N5415	50	3.0 @ 55	80 @ 100 & 2.0	1.5 @ 9†	150
1N5416	100	3.0 @ 55	80 @ 100 & 2.0	1.5 @ 9†	150
1N5417	200	3.0 @ 55	80 @ 100 & 2.0	1.5 @ 9†	150
1N5418	400	3.0 @ 55	80 @ 100 & 2.0	1.5 @ 9†	150
1N5419	500	3.0 @ 55	80 @ 100 & 2.0	1.5 @ 9†	250
1N5420	600	3.0 @ 55	80 @ 100 & 2.0	1.5 @ 9†	400
1N5615	200	1.0 @ 55	25 @ 100 & .75*	1.6 @ 3†	150
1N5617	400	1.0 @ 55	25 @ 100 & .75*	1.6 @ 3†	150
1N5619	600	1.0 @ 55	25 @ 100 & .75*	1.6 @ 3†	250
1N5621	800	1.0 @ 55	25 @ 100 & .75*	1.6 @ 3†	300
1N5623	1000	1.0 @ 55	25 @ 100 & .75*	1.6 @ 3†	500

FAST RECOVERY SILICON POWER RECTIFIERS / EPOXY PKG.

1N4933	50	1.0 @ 25	30 @ 100 & .75	1.2 @ 1	200
1N4934	100	1.0 @ 25	30 @ 100 & .75	1.2 @ 1	200
1N4935	200	1.0 @ 25	30 @ 100 & .75	1.2 @ 1	200
1N4936	400	1.0 @ 25	30 @ 100 & .75	1.2 @ 1	200
1N4937	600	1.0 @ 25	30 @ 100 & .75	1.2 @ 1	200

*10 surges of 1/120 sec. duration. †Peak voltage at i_F pulsed, with 1/120 sec. duration pulses at 2% duty cycle.

RSM

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NPN SILICON POWER TRANSISTORS / JAN / JANTX

Type JAN	V_{CEO} (Volts)	I_C (Amps)	Power Dissipation (W @ T_C°C)	Package	$\theta_{J\text{-}C}$ °C/W	V_{EBO} (Volts)
2N389	60	3	85 @ 25	TO-53	2.2	10
2N424	80	3	85 @ 25	TO-53	2.2	10
2N1016B	100	7.5	150 @ 45	TO-82	0.7	25
2N1016C	150	7.5	150 @ 45	TO-82	0.7	25
2N1016D	200	7.5	150 @ 45	TO-82	0.7	25
2N1047A	80	5	40 @ 45	TO-57	—	10
2N1048A	120	5	40 @ 45	TO-57	—	10
2N1049A	80	5	40 @ 45	TO-57	—	10
2N1050A	120	5	40 @ 45	TO-57	—	10
•2N1483	40	3	25 @ 25	TO-8	7	12
•2N1484	55	3	25 @ 25	TO-8	7	12
•2N1485	40	3	25 @ 25	TO-8	7	12
•2N1486	55	3	25 @ 25	TO-8	7	12
2N1487	40	6	75 @ 25	TO-3	2.33	10
2N1488	55	6	75 @ 25	TO-3	2.33	10
2N1489	40	6	75 @ 25	TO-3	2.33	10
2N1490	55	6	75 @ 25	TO-3	2.33	10
•2N1722	80	5	50 @ 100	TO-53	1.5	10
•2N1724	80	5	50 @ 100	TO-61	1.5	10
•2N3055	70	15	117 @ 25	TO-3	1.5	7
2N3442	140	10	117 @ 25	TO-3	1.5	7

•TX version available.

For information on additional JEDEC types and high voltage, high gain triple diffused mesa devices, contact the local RSM representative.

SINGLE DIFFUSED MESA POWER TRANSISTORS

These rugged single diffused mesa transistors exhibit low saturation voltage and are extremely well suited in applications where freedom from secondary breakdown is desirable. All devices are 100% safe operating area tested (S.O.A.R.) at maximum BV_{CEO}, wattage, and I_C condition for one second.

Type	BV_{CEO} (Volts)	V_{EBO} (Volts)	h_{FE} Min./Max. @ I_C (Amps)	V_{CE} (SAT) (Volts) @ I_C (Amps)	$\theta_{J\text{-}C}$ °C/W	I_C (Amps)	Power Dissipation (W @ T_C °C)	Package
2N3055C	120	10	25/70 @ 4	.75 @ 4	1.17	30	150 @ 25	TO-3
2N37772	60	7	15/60 @ 10	1.4 @ 10	1.17	30	150 @ 25	TO-3
2N3772C	125	10	15/60 @ 10	.9 @ 10	1.17	30	150 @ 25	TO-3
2N3773	140	7	15/60 @ 8	1.4 @ 8	1.17	30	150 @ 25	TO-3
2N4347	120	7	20/70 @ 2	1.0 @ 2	1.5	10	100 @ 25	TO-3
2N4348	120	7	15/60 @ 5	1.0 @ 5	1.17	30	120 @ 25	TO-3
2N5629	100	7	25/100 @ 8	1.0 @ 10	.87	20	200 @ 25	TO-3
2N5630	120	7	20/80 @ 8	1.0 @ 10	.87	20	200 @ 25	TO-3
2N5631	140	7	15/60 @ 8	1.0 @ 10	.87	20	200 @ 25	TO-3
2N5632	100	7	25/100 @ 5	1.0 @ 7.5	1.17	15	150 @ 25	TO-3
2N5633	120	7	20/80 @ 5	1.0 @ 7.5	1.17	15	150 @ 25	TO-3
2N5634	140	7	15/60 @ 5	1.0 @ 7.5	1.17	15	150 @ 25	TO-3
2N6259	150	7	15/60 @ 8	1.0 @ 8	.7	30	250 @ 25	TO-3

RSM

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Tel: (516) 586-7600 Telex: 96-7737

RSM SENSITRON

Sensitrode®

THE MOST RELIABLE RECTIFIER AVAILABLE TODAY!

SENSITRODE RELIABILITY FEATURES:

- **Lowest Leakage**

The Sensitrode process provides reverse leakage currents as low as 0.1 microamps at peak inverse voltage.

- **True Avalanche Characteristics**

Due to the extremely low surface leakage, avalanche breakdown in the Sensitrode rectifier occurs uniformly across the entire junction area offering the best protection against transient voltage spikes.

- **High Operating and Storage Temperature**

Sensitrode glass passivated rectifier chips are metallurgically brazed to the leads allowing maximum operating junction temperature of 200°C and maximum storage temperature of 300°C. Conventional rectifier chips are soldered to the leads and passivated with organic materials limiting their maximum operating temperature to 150°C and storage temperature to 200°C.

- **Temperature Cycling and Thermal Shock**

The unique Sensitrode method of glass passivation makes possible the widest range of temperature cycling available. The glass formula used provides the closest match to the thermal coefficient of silicon.

- **Life-time Warranty**

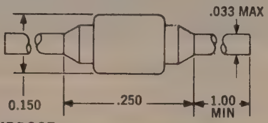
The Sensitrode rectifier is unconditionally warranted for the life of the equipment. For specific warrantee conditions, write or call factory.

- **Sensitrode Samples**

For your free Sensitrode evaluation sample, write request on your company letterhead.

HERMETICALLY SEALED −195°C TO +300°C TEMPERATURE RANGE

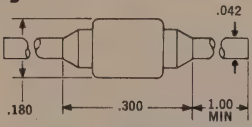
PACKAGE OUTLINE "A"



GENERAL PURPOSE

Type	Peak* Inverse Voltage (Volts)	Max. Fwd. Current @ 75°C (Amps)	Maximum One Cycle Surge (Amps)	Trr Micro Seconds	Package Outline
SRS 105 thru SRS 1100	50 thru 1000	1.0	60	5	A
SRS 205 thru SRS 2100	50 thru 1000	2.0	100	5	A
SRS 305 thru SRS 3100	50 thru 1000	3.0	150	5	B

PACKAGE OUTLINE "B"



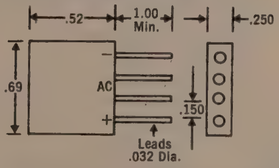
FAST RECOVERY

SRSFR 105 thru SRSFR 1100	50 thru 1000	1.0	50	.1	A
SRSFR 205 thru SRSFR 2100	50 thru 1000	2.0	80	.15	A
SRSFR 305 thru SRSFR 3100	50 thru 1000	3.0	125	.2	B

*Voltages above 1000V available, consult factory.

SILICON RECTIFIER SINGLE PHASE FAST RECOVERY BRIDGE ASSEMBLIES

MECHANICAL OUTLINE



ABSOLUTE MAXIMUM RATINGS	SEN 2A1 FR-100 Volts SEN 2A2 FR-200 Volts SEN 2A4 FR-400 Volts SEN 2A6 FR-600 Volts SEN 2A8 FR-800 Volts	SEN 3A1 FR-100 Volts SEN 3A2 FR-200 Volts SEN 3A4 FR-400 Volts SEN 3A6 FR-600 Volts SEN 3A8 FR-800 Volts	3A1-100 Volts 3A2-200 Volts 3A4-400 Volts 3A6-600 Volts 3A8-800 Volts
Forward Current Rating @ 25°C	2.0 Amps	3.0 Amps	3.0 Amps
@ 100°C	1.0 Amps	1.5 Amps	1.5 Amps
Peak Repetitive Surge Current	10.0 Amps	15 Amps	15 Amps
Peak Surge Current (½ cycle, 60 Hz)	30.0 Amps	50 Amps	50 Amps
Operating Temperature	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C
Storage Temperature	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C

ELECTRICAL CHARACTERISTICS

Max. Forward Voltage Drop (per Leg)	@ 1.0 Amps 1.3 VDC	@ 2.0 Amps 1.4 VDC	@ 2.0 Amps 1.2 VDC
Max. Reverse Leakage Current			
@ Rated P.I.V. 25°C	10 μA	10 μA	10 μA @ 200 V
@ Rated P.I.V. 100°C	100 μA	100 μA	100 μA @ 200 V
Max. Reverse Recovery Time	200 ns	200 ns	—
Recovery Conditions: 0.5 Amp Forward Current to 1.0 Amp Reverse Current	✓	✓	—
Recovery Time Measured When Rectifier Recovers to .25 Amp	✓	✓	—

RSM

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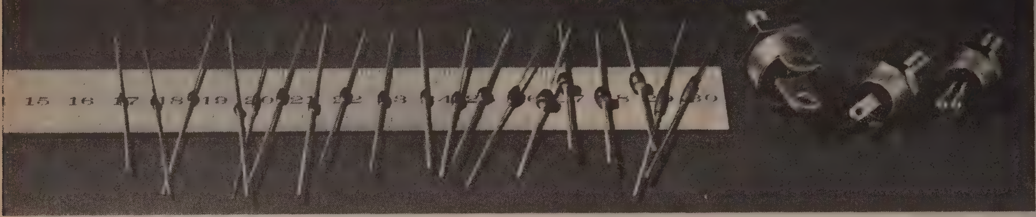
SEMTECH Metoxilite Silicon Rectifiers, Stud Rectifiers, Zeners, Transient Suppressors and Miniature High Voltage Rectifiers



METOXILITE SILICON RECTIFIERS

Metoxilite (metal oxides) is fused to the metallurgically bonded junction-tungsten pin assembly forming a "tough" sub-miniature package. Metoxilite, the material that pushed Semtech to the foreground of the industry for sub-miniature medium power silicon rectifiers, now makes its debut in a whole new spectrum of "state-of-the art" devices.

EIA types are available in JAN and JANTX, and some JANTXV and SIN (NASA) types.

• METOXILITE MEDIUM CURRENT

GENERAL PURPOSE
1N3611, 12, 13, 14 & 1N3957
PIV: 240, 480 720, 920 & 1150 V
Average Rectified Current @ 55°C: 1 A

MEDIUM RECOVERY (Trr) 2 µs
1N4245, 6, 7, 8 & 9
PIV: 200, 400, 600, 800 & 1000 V
Average Rectified Current @ 55°C: 1 A

FAST RECOVERY (Trr) 150 to 500 ns
1N4942, 4, 6, 7 & 8
PIV: 200, 400, 500, 600, 800 & 1000 V
Average Rectified Current @ 55°C: 1 A

MEDIUM RECOVERY (Trr) 2 µs
1N5614, 16, 18, 20 & 22
PIV: 200, 400, 600, 800 & 1000 V
Forward Current @ 55°C: 1 A

FAST RECOVERY (Trr) 150 to 500 ns
1N5615, 17, 19, 21 & 23
PIV: 200, 400, 600, 800 & 1000 V
Forward Current @ 55°C: 1 A

MEDIUM RECOVERY: (Trr) 2 µs
1N5550, 1, 2, 3, & 4
PIV: 200, 400, 600, 800 & 1000 V
Average Rectified Current @ 55°C: 3 A

FAST RECOVERY (Trr) 150 ns
1N5415, 6, 7, 8 & 9
PIV: 50, 100, 200, 400 & 500 V.
Average Rectified Current @ 55°C : 3 A

VERY FAST RECOVERY (Trr) 100 ns
1N5835 & 1N5836
PIV: 30 & 50 V
Average Rectified Current @ 55°C : 3 A

SUPER FAST (Trr) 30 ns
1N6076, 77 & 78
PIV: 50, 100 & 150 V
Forward Current @ 25°C: 3 A

SUPER FAST (Trr) 30 ns
1N6079, 80 & 81
PIV: 50, 100 & 150 V
Forward Current @ 25°C: 5 A

• MINI-METOXILITE — LOW CURRENT

GENERAL PURPOSE (Trr) 2 µs
1N645, 6, 7, 8 & 9
PIV: 225, 300, 400, 500 & 600 V
Forward Current @ 55°C: 0.5 A

MEDIUM RECOVERY (Trr) 2 µs
M2, M4, M6, M8 & M0
PIV: 200, 400, 600, 800 & 1000 V
Forward Current @ 55°C: 0.5 A

FAST RECOVERY (Trr) 150 ns
F1, F2, F4 & F5
PIV: 100, 200, 400 & 500 V
Forward Current @ 55°C: 0.5 A

VERY FAST RECOVERY (Trr) 100 ns
T1, T2, T3 & T4
PIV: 100, 200, 300 & 400 V
Forward Current @ 55°C: 0.5 A

SUPER FAST RECOVERY (Trr) 30 ns
1N6073, 74 & 75
PIV: 50, 100 & 150 V
Forward Current (@ 25°C :1.5 A

• VOLTAGE REGULATORS

SX6.8, 7.5, 8.2, 9.1, 10, 11, 12, 13, 15, 16, 18 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91, 100, 110, & 120
Nominal Voltage: 6.8 to 120 V
Low dynamic impedance.

• ZENERS (5 Watt)

1N4954 through 1N4984
Nominal Voltage: 6.8 to 120 V
Low dynamic impedance.

• B1-POLARITY TRANSIENT SUPPRESSORS

L10A, 20A, 30A, 39A, 51A, 60A, 82A, 100A & 110A
Peak Pulse Power: 500 Watts
Breakdown Voltage (I_{dc}) BV Max.: 11 to 121 V

• RADIATION RESISTANT RECTIFIERS

(Trr) 500 ns
R1, R2, R3 & R4
PIV: 100, 200, 300 & 400 V
Average Rectified Current @ 55°C : 1000 mA

SEMTECH
CORPORATION

652 Mitchell Road, Newbury Park, California 91320
(805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

• SILICON STUD RECTIFIERS

DO-5 MEDIUM RECOVERY (Trr) 2 µs
ST1M, 2M, 3M, 4M & 6M
PIV: 100, 200, 300, 400 & 600 V
V_F @ 50A, 100°C: 1.17V

DO-5 FAST RECOVERY (Trr) 150 ns
STF1, F2, F3 & F4
PIV: 100, 200, 300 & 400 V
V_F @ 50A, 100°C: 1.35V

DO-5 LO-VF (Trr) 100 ns
STL03 & STL05
PIV: 30 & 50 V
V_F @ 50A, 100°C: .97V

DO-5L SUPER FAST (Trr) 30 ns
STFF05, 10 & 15
PIV: 50, 100, & 150 V
V_F @ 50A, 100°C: .93V

DO-4 SUPER FAST POWER (Trr) 30 ns
SFF 05, 10 & 15 and 2SFF05, 10 & 15
PIV: 50, 100 & 150 V
SFF = V_F @ 12A, 100°C: .82V
2SFF = V_F @ 20A, 100°C: 1.0V.

DO-4 SUPER FAST CENTER TAPS & DOUBLERS (Trr) 30 ns
SNFF05, 10 & 15; SPFF05, 10 & 15 and SDFF05, 10 & 15
PIV: 50, 100 & 150 V
V_F @ 10A/1eg, 100°C: .82V

DO-4 FAST RECOVERY (Trr) 150 ns
1SF1, 2 & 4; 2SF1, 2 & 4
PIV: 100, 200 & 400 V
1SF = V_F @ 8A, 100°C: 1.35V
2SF = V_F @ 16A, 100°C: 1.35V

• METOXILITE SUB-MINIATURE HIGH VOLTAGE RECTIFIERS

MEDIUM RECOVERY
SM20, 25 & 30
PIV: 2000, 2,500 & 3000 V
Average Rectified Current @ 55°C: 250 mA

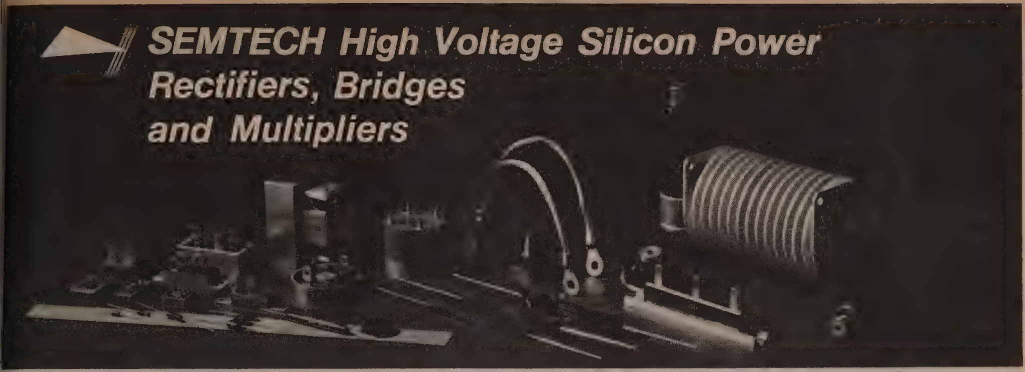
FAST RECOVERY (Trr) 300 ns
S15F, 20F & 25F
PIV: 1,500, 2,000 & 2,500 V
Average Rectified Current @ 55°C: 250 mA

METOXILITE MINISTAC (Trr) 2 µs & 5 µs
M20, 30, 40, 50 A & 60 A
PIV: 2,000, 3,000, 4,000, 5,000 & 6,000 V
Average Rectified Current @ 55°C: 125 mA & 50 mA

Semtech products are available in quantity for immediate delivery.

Ask for our 1975-76 catalog.

SEMTECH High Voltage Silicon Power Rectifiers, Bridges and Multipliers

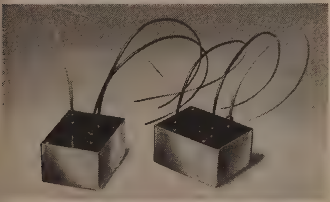


CUPAC RECTIFIERS
150 SILICON POWER RECTIFIERS
FAST RECOVERY (Trr) 200 ns
SCSF05, 1, 2, 4 & 6
PIV: 50, 100, 200, 400 & 600 V
V_F @ 100 A 100°C: 1.35V
MEDIUM RECOVERY (Trr) 2 μs
SCSM05, 1, 2, 4 & 6
V_F @ 100 A 100°C: 1.17V

- **MINISTAC SUB-MINIATURE HIGH VOLTAGE**
SEM30, 40, 50, 60, 70, 80, 100, 120 & 140
PIV: 3,000 to 14,000V
Average Rectified Current @ 25°C: 10 mA
FAST RECOVERY (Trr) 150 ns
SEF30, 40, 50, 60, 70, 80, 100, 120 & 140

- **MINISTIC HIGH VOLTAGE**
SCMS 10K, 15K, 20K, 30K & 40K
PIV: 10,000, 15,000, 20,000, 30,000 & 40,000 V
Average Rectified Current @ 55°C: 10 mA
FAST RECOVERY (Trr) 150 ns
SFMS 10K, 15K, 20K, 30K & 40K

- **COMPAC BRIDGES**
SBR05, 1, 2, 4, 6, 8, 10, 15, 20, 25 & 30
PIV: 50, 100 200 400, 600, 800, 1,000, 1,500, 2,000, 2,500 & 3,000 V
Average Rectified Current @ 55°C: SBR05 thru 10 = 1.5 A, SBR15 thru 30 = .36 A



- **CRT PAC HIGH VOLTAGE MULTIPLIERS**
An aluminum cased multiplier which is shielded from RFI and can be mounted anywhere on the chassis.
SCMA 500, 600, 700 & 800
Output Current: 2.0 mA
Output voltages to 36KV
Also available: Custom designed doublers, triplers and quadruplers, etc.

- **MULTI-PURPOSE BRIDGES**
FAST RECOVERY (Trr) 150 ns
SCBRO 5F, 1F, 2F, 4F & 6F
PIV: 50, 100, 200, 400 & 600 V
Average Rectified Current @ 25°C: 1.5 A

- **ALPAC BRIDGES**
SCBA 05, 1, 2, 3, 4 & 6
PIV: 50, 100, 200, 300, 400 & 600 V
Average Output Current @ 55°C: 25 A dc

ALPAC-JR
SCAJ05, 1, 2, 3, 4 & 6
PIV: 50, 100, 200, 300, 400 & 600 V
Average Output Current @ 55°C: 5 A dc

ALPAC-T
Type: SCBH05, 1, 2, 3, 4 & 6
PIV: 50, 100, 200, 300, 400 & 600 V
Average Output Current @ 55°C: 10 A dc

ALPAC-3T
3-PHASE BRIDGE
SC3BH05, 1, 2, 3, 4 & 6
PIV: 50, 100, 200, 300. 400 & 600 V
Average Output Current @ 55°C: 10 A dc

ALPAC-50
SCBAR05, 1, 2, 3, 4, 6, 8, 10
PIV: 50, 100, 200, 300, 400, 600, 800 & 1,000 V
Average Rectified Current @ 75°C: 50 A

ALPAC-R50
BRIDGE RECTIFIERS
SCBK05, 1, 2, 3, 4 & 6
PIV: 50, 100, 200, 300, 400 & 600 V
Average Rectified Current @ 55°C: 50 A

ALPAC-SR
HIGH CURRENT BRIDGES
1φ FWB: SCAS05A, 1A, 2A, 3A, 4A & 6A
3φ1/2WB: SC3HAS05A, 1A, 2A, 3A, 4A & 6A
3φ FWB: SC3AS05A, 1A, 2A, 3A, 4A & 6A
PIV: 50, 100, 200, 300, 400 & 600 V
Average Rectified Current @ 55°C:
1φFWB = 150 A; 3φ1/2WB = 250 A & 3φ FWB = 190 A

- **HIGH VOLTAGE CERAMIC CAPACITORS**
Corona free, available in voltages up to 20KV. Capacitance values from 250pf to 23,000pf. Also available are monolithic capacitors.

SEMTECH
CORPORATION
652 Mitchell Road, Newbury Park, California 91320
(805) 498-2111, (213) 628-5392 TWX: 910-336-1264

- **SLIMPAC HIGH VOLTAGE,**
SCH5000, 7500, 10,000, 12,500, 15,000, 20,000 & 25,000
PIV: 5, 7.5, 10, 12.5, 15, 20 & 25KV.
Average Rectified Current @ 55°C: .5A

SLIMPAC JR
SCHJ15K, 22.5K, 30K, 37.5K & 45K
PIV: 15,000, 22,500, 30,000, 37,500 & 45,000 V
Average Rectified Current @ 55°C: 50 mA

SLIMPAC SR
SCHS2,500, 5,000, 7,500, 10,000 12,500 & 15,000
PIV: 2,500, 5,000, 7,500, 10,000, 12,500 & 15,000 V
Average Rectified Current @ 55°C: 2 A

- **KV-PAC**
RECTIFIERS, DOUBLERS & CENTER TAPS
SDH10K, 15K, C5K, D5K, C10K, D10K, C15K, D15K
PIV: 5,000, 10,000 & 15,000 V
Average Rectified Current @ 50°C Mtg. 0.6 & 1.2 A

- **HIGH VOLTAGE MODULES**
S & S2HVM15, 12.5, 10, 7.5, 5 & 2.5
S3HVM10, 7.5, 5 & 2.5; S6HVM5 & 2.5; S9HVM2.5
PIV: 2,500, 5,000, 7,500, 10,000, 12,500 & 15,000 V
Average Rectified Current @ 55°C (Oil): 0.5, 2, 3, 6 & 10 A

- **KILOVOLT — STAC**
SCKV100K3, 150K3, 200K3, 50K6, 75K6, 100K6, 33K12, 45K12, 66K12, 12.5K30, 18K30, 12.5K40, 18K40 & 25K40
PIV: 12, 18, 25, 33, 45, 50, 66, 75, 100, 150 & 200 KV
Average Rectified Current @ 55°C (Oil): 0.3, 0.6, 1.2, 3 & 4A

- **STACPAC HIGH POWER**
SCPH2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48 & 50
PIV: (Per Leg) 1 through 25 KV
Average Rectified Current @ 55°C: 5.5 A

Semtech products listed above are also available in other popular voltages, current ranges and recovery characteristics (medium, fast & super-fast). Ask for our 1975-76 catalog.

Siemens Voltage Reference (TC) Diode Jedec Series

SERIES	REFERENCE VOLTAGE	PACKAGE
*1N429	6.2V	Case A
1N430	8.4V	Case B
†□*1N821-1N829	6.2V	DO-7
†□*1N935-1N940B	9.0V	DO-7
□*1N941-1N946B	11.7V	DO-7
1N1735-1N1742	6.2 thru 49.6	Cases 1,2,3 & 4
1N2163-1N2171A	9.4V ±.04	DO-13
1N2620-1N2624B	9.3V	DO-13
1N2765-1N2770A	See Data Sheet	See Data Sheet
□*1N3154-1N3157A	8.4V	DO-7
1N3496-1N3500	6.2V	DO-7
□**1N3501-1N3504	6.35V	DO-7
1N3553	6.3V	DO-7
1N3580-1N3584	11.7V	DO-13
1N3763	20.0V	Case CC

*JAN and JANTX available
†JANTXV available
**Certified Stability
□Preferred Series

SERIES	REFERENCE VOLTAGE	PACKAGE
1N3779-1N3784	6.5V	DO-7
1N4010	6.2V	DO-7
□ 1N4057-1N4085A	12.4V to 200V	Case CC, DD, & EE
1N4295	10V	DO-7
1N4296	10V	DO-13
1N4297-1N4298	8.8V	DO-4
1N4299-1N4300	11.4V	DO-4
1N4301-1N4302	8.8V	DO-5
1N4303-1N4304	11.4V	DO-5
†□* 1N4565-1N4574A	6.4V	DO-7
□ 1N4575-1N4584A	6.4V	DO-7
1N4765-1N4774	9.1V	DO-7
1N4775-1N4784	8.5V	DO-7
□**1N4890-1N4895A	6.35V	DO-7
1N4896-1N4915A	12.8V	DO-7
1N4916-1N4932A	19.2V	DO-7

Siemens Voltage Regulator (Zener) Diode Jedec Series

SERIES	POWER RATING	PACKAGE
1N225-1N235	150mW Double Anode	Case A
1N465-1N470	200mW Zener	Case A
1N471-1N475	200mW Double Anode	Case A
1N702-1N707	250mW	DO-7
1N708-1N745	250mW	DO-7
†□*1N746-1N759	400mW	DO-7
1N761-1N769	250mW	DO-7
†□*1N957-1N992	400mW	DO-7
1N1313-1N1327	150mW	Case A
1N1351-1N1375	10 Watt Stud	DO-4
1N1507-1N1517	750mW	DO-13
1N1518-1N1528	1 Watt	DO-3
1N1588-1N1598	3.5 Watt Stud	DO-4
1N1599-1N1609	10 Watt Stud	DO-4
1N1765-1N1802	1 Watt	DO-13
1N1803-1N1815	10 Watt Stud	DO-4
1N1816-1N1836	10 Watt Stud	DO-4
1N1875-1N1888	1 Watt	DO-13
1N1981-1N2003	150mW	Case A
1N2008-1N2012	10 Watt Stud	DO-4
1N2032-1N2040	750mW	DO-13
1N2041-1N2049	10 Watt Stud	DO-4
1N2214	1 Watt	DO-13
1N2498-1N2500	10 Watt Stud	DO-4
†□*1N2804-1N2846	50 Watt Dia.	TO-3
1N2937	10 Watt	DO-4
†□*1N2970-1N3015	10 Watt Stud	DO-4
†□*1N3016-1N3051	1 Watt	DO-13
†□*1N3305-1N3350	50 Watt Stud	DO-5
1N3477	250 mW	DO-7
1N3506-1N3534	400mW	DO-7
1N3537	1 Watt	DO-13
1N3675-1N3710	1 Watt	Case J

*JAN and JANTX available
†JANTXV available
□Preferred Series

SERIES	POWER RATING	PACKAGE
†□*1N3821-1N3830	1 Watt	DO-13
1N3949	10 Watt	DO-4
1N3984-1N3985	10 Watt	DO-4
1N3986	10 Watt	DO-4
†□*1N3993-1N4000	10 Watt Stud	DO-4
1N4095	275mW	DO-7
†□*1N4099-1N4135	400mW	DO-7
1N4240-1N4241	10 Watt	DO-4
1N4323-1N4358	1 Watt	Case J
1N4360	250mW	DO-7
†□*1N4370-1N4372	400mW	DO-7
1N4535	500mW Double Anode	DO-7
†□*1N4549-1N4556	50 Watt Stud	DO-5
□1N4557-1N4564	50 Watt Dia.	TO-3
†□*1N4614-1N4627	250mW	DO-7
1N4628-1N4648	600mW	Case J
1N4649-1N4677	1 Watt	Case J
□1N4678-1N4717	250mW	DO-7
□1N4728-1N4764	1 Watt	Case J
1N4831-1N4860	1.2 Watt	Case J
□1N5221-1N5281	500mW	DO-7
□1N5333-1N5388	5 Watt	Case T-18
1N5518-1N5546	400mW	DO-7
1N5728-1N5757	400mW	DO-7
SIEMENS SERIES		
□1EZ3.3-1EZ200	1 Watt	Case J
□2EZ3.3-2EZ200	2 Watt	Case J
□3EZ3.3-3EZ200	3 Watt	Case J
5EZ3.3-5EZ200	5 Watt	Case T-18
DO-35 2.4-200V	400mW	DO-35

SIEMENS also offers thousands of custom or proprietary devices in one of the most extensive lines of commercial and military zeners available.

The three quick reference charts shown on the following pages include industry "preferred" Voltage Regulating Diodes. The power dissipation, package type and applications are listed horizontally. Nominal voltage breakdown is listed vertically.

To find the proper device, simply locate the required power dissipation and package type and read **down** until you locate the device number opposite the required nominal voltage.

Siemens Corporation
Components Group
P.O. Box 1390, Scottsdale, Arizona 85252
(602) 947-2231 TWX 910-950-1292 Telex 667-406

SIEMENS

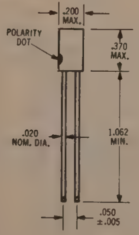
LOW POWER
500 MW*
Zener Diodes

NOMINAL VOLTAGE Vz	STANDARD APPLICATIONS		LOW LEAKAGE APPLICATIONS	LOW LEAKAGE LOW NOISE LOW OPERATING CURRENT APPLICATIONS		VERY LOW OPERATING CURRENT APPLICATIONS
1.8				1N4614		1N4678
2.0				1N4615		1N4679
2.2				1N4616		1N4680
2.4	1N4370		1N5221	1N4617		1N4681
2.5			1N5222			
2.7	1N4371		1N5223	1N4618		1N4682
2.8			1N5224			1N4683
3.0	1N4372		1N5225	1N4619		1N4683
3.3	1N746		1N5226	1N4620		1N4684
3.6	1N747		1N5277	1N4621		1N4685
3.9	1N748		1N5228	1N4622		1N4686
4.3	1N749		1N5229	1N4623		1N4687
4.7	1N750		1N5230	1N4624		1N4688
5.1	1N751		1N5231	1N4625		1N4689
5.6	1N752		1N5232	1N4626		1N4690
6.0			1N5233			
6.2	1N753		1N5234	1N4627		1N4691
6.8	1N754	1N957	1N5235		1N4099	1N4692
7.5	1N755	1N958	1N5236		1N4100	1N4693
8.2	1N756	1N959	1N5237		1N4101	1N4694
8.7			1N5238		1N4102	1N4695
9.1	1N757	1N960	1N5239		1N4103	1N4696
10	1N758	1N961	1N5240		1N4104	1N4697
11		1N962	1N5241		1N4105	1N4698
12	1N759	1N963	1N5242		1N4106	1N4699
13		1N964	1N5243		1N4107	1N4700
14			1N5244		1N4108	1N4701
15		1N965	1N5245		1N4109	1N4702
16		1N966	1N5246		1N4110	1N4703
17			1N5247		1N4111	1N4704
18		1N967	1N5248		1N4112	1N4705
19			1N5249		1N4113	1N4706
20		1N968	1N5250		1N4114	1N4707
22		1N969	1N5251		1N4115	1N4708
24		1N970	1N5252		1N4116	1N4709
25			1N5253		1N4117	1N4710
27		1N971	1N5254		1N4118	1N4711
28			1N5255		1N4119	1N4712
30		1N972	1N5256		1N4120	1N4713
33		1N973	1N5257		1N4121	1N4714
36		1N974	1N5258		1N4122	1N4715
39		1N975	1N5259		1N4123	1N4716
43		1N976	1N5260		1N4124	1N4717
47		1N977	1N5261		1N4125	
51		1N978	1N5262		1N4126	
56		1N979	1N5263		1N4127	
60			1N5264		1N4128	
62		1N980	1N5265		1N4129	
68		1N981	1N5266		1N4130	
75		1N982	1N5267		1N4131	
82		1N983	1N5268		1N4132	
87			1N5269		1N4133	
91		1N984	1N5270		1N4134	
100		1N985	1N5271		1N4135	
110		1N986	1N5272			
120		1N987	1N5273			
130		1N988	1N5274			
140			1N5275			
150		1N989	1N5276			
160		1N990	1N5277			
170			1N5278			
180		1N991	1N5279			
190			1N5280			
200		1N992	1N5281			

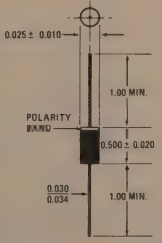
NOTES: SHADED AREA INDICATES JAN, JANTX AND JANTXV QUALIFIED Vz IS AT THE JEDEC SPECIFIED CURRENT

*RATED BY INDUSTRY AT 250 TO 500 MW

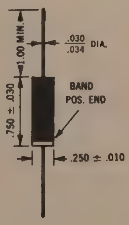
Case A


.200 MAX.
POLARITY DOT
.370 MAX.
.020 NOM. DIA.
1.062 MIN.
.050 ±.005

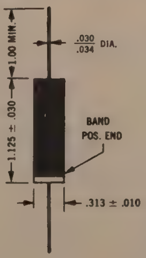
Case CC


0.025 ± 0.010
1.00 MIN.
POLARITY BAND
0.500 ± 0.020
0.030 0.034
1.00 MIN.

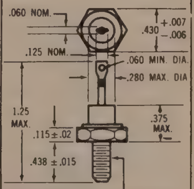
Case DD


1.00 MIN.
.030 .034 DIA.
.750 ± .030
BAND POS. END
.250 ± .010

Case EE


1.00 MIN.
.030 .034 DIA.
1.125 ± .030
BAND POS. END
.313 ± .010

DO-4


.060 NOM.
.430 +.007 −.006
.125 NOM.
.060 MIN. DIA.
.280 MAX. DIA
1.25 MAX.
.375 MAX.
.115 ± .02
.438 ± .015

10-32 UNF-2A (MOD) PITCH DIA. MIN. 1658 MAX. .1697
TO WITHSTAND A TORQUE UP TO 30 IN-LB. WHEN NUT IS TIGHTENED ON STUD

SIEMENS

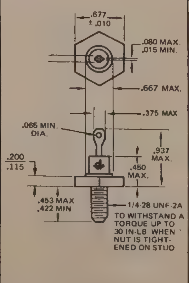
MEDIUM POWER 1 Through 5 Watt Zener Diodes (Axial Lead)

NOTES: SHADED AREA INDICATES JAN, JANTX AND JANTXV QUALIFIED Vz IS AT THE JEDEC SPECIFIED CURRENT

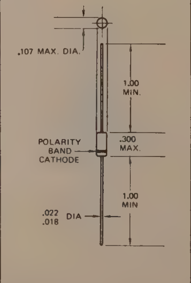
*DIRECT REPLACEMENT FOR COMPONENTS INC LMZ 2 WATT EPOXY SERIES

NOMINAL VOLTAGE Vz	1 WATT METAL DO-13 HERMETIC SEAL MILITARY APPLICATIONS		1 WATT EPOXY CASE J COMMERCIAL AND INDUSTRIAL APPLICATIONS		2 WATT EPOXY* CASE J COMMERCIAL AND INDUSTRIAL APPLICATIONS	3 WATT EPOXY CASE J COMMERCIAL AND INDUSTRIAL APPLICATIONS	5 WATT EPOXY CASE T-18 COMMERCIAL AND INDUSTRIAL APPLICATIONS
3.3	1N3821		1N4728				1N5333
3.6	1N3822		1N4729		2EZ3.6D5		1N5334
3.9	1N3823		1N4730		2EZ3.9D5	3EZ3.9D5	1N5335
4.3	1N3824		1N4731		2EZ4.3D5	3EZ4.3D5	1N5336
4.7	1N3825		1N4732		2EZ4.7D5	3EZ4.7D5	1N5337
5.1	1N3826		1N4733		2EZ5.1D5	3EZ5.1D5	1N5338
5.6	1N3827		1N4734		2EZ5.6D5	3EZ5.6D5	1N5339
6.0							1N5340
6.2	1N3828		1N4735		2EZ6.2D5	3EZ6.2D5	1N5341
6.8	1N3829	1N3016	1N4736		2EZ6.8D5	3EZ6.8D5	1N5342
7.5	1N3830	1N3017	1N4737		2EZ7.5D5	3EZ7.5D5	1N5343
8.2		1N3018	1N4738		2EZ8.2D5	3EZ8.2D5	1N5344
8.7							1N5345
9.1		1N3019	1N4739		2EZ9.1D5	3EZ9.1D5	1N5346
10		1N3020	1N4740		2EZ10D5	3EZ10D5	1N5347
11		1N3021	1N4741		2EZ11D5	3EZ11D5	1N5348
12		1N3022	1N4742		2EZ12D5	3EZ12D5	1N5349
13		1N3023	1N4743		2EZ13D5	3EZ13D5	1N5350
14					2EZ14D5	3EZ14D5	1N5351
15		1N3024	1N4744		2EZ15D5	3EZ15D5	1N5352
16		1N3025	1N4745		2EZ16D5	3EZ16D5	1N5353
17					2EZ17D5	3EZ17D5	1N5354
18		1N3026	1N4746		2EZ18D5	3EZ18D5	1N5355
19					2EZ19D5	3EZ19D5	1N5356
20		1N3027	1N4747		2EZ20D5	3EZ20D5	1N5357
22		1N3028	1N4748		2EZ22D5	3EZ22D5	1N5358
24		1N3029	1N4749		2EZ24D5	3EZ24D5	1N5359
25							1N5360
27		1N3030	1N4750		2EZ27D5	3EZ27D5	1N5361
28							1N5362
30		1N3031	1N4751		2EZ30D5	3EZ30D5	1N5363
33		1N3032	1N4752		2EZ33D5	3EZ33D5	1N5364
36		1N3033	1N4753		2EZ36D5	3EZ36D5	1N5365
39		1N3034	1N4754		2EZ39D5	3EZ39D5	1N5366
43		1N3035	1N4755		2EZ43D5	3EZ43D5	1N5367
47		1N3036	1N4756		2EZ47D5	3EZ47D5	1N5368
51		1N3037	1N4757		2EZ51D5	3EZ51D5	1N5369
56		1N3038	1N4758		2EZ56D5	3EZ56D5	1N5370
60						3EZ60D5	1N5371
62		1N3039	1N4759		2EZ62D5	3EZ62D5	1N5372
68		1N3040	1N4760		2EZ68D5	3EZ68D5	1N5373
75		1N3041	1N4761		2EZ75D5	3EZ75D5	1N5374
82		1N3042	1N4762		2EZ82D5	3EZ82D5	1N5375
87							1N5376
91		1N3043	1N4763		2EZ91D5	3EZ91D5	1N5377
100		1N3044	1N4764	1EZ100D5	2EZ100D5	3EZ100D5	1N5378
110		1N3045		1EZ110D5	2EZ110D5	3EZ110D5	1N5379
120		1N3046		1EZ120D5	2EZ120D5	3EZ120D5	1N5380
130		1N3047		1EZ130D5	2EZ130D5	3EZ130D5	1N5381
140				1EZ140D5	2EZ140D5	3EZ140D5	1N5382
150		1N3048		1EZ150D5	2EZ150D5	3EZ150D5	1N5383
160		1N3049		1EZ160D5	2EZ160D5	3EZ160D5	1N5384
170				1EZ170D5	2EZ170D5	3EZ170D5	1N5385
180		1N3050		1EZ180D5	2EZ180D5	3EZ180D5	1N5386
190				1EZ190D5	2EZ190D5	3EZ190D5	1N5387
200		1N3051		1EZ200D5	2EZ200D5	3EZ200D5	1N5388

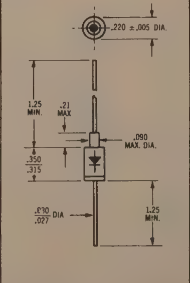
DO-5


.677
±.010
.080 MAX.
.015 MIN.
.667 MAX.
.375 MAX
.065 MIN.
DIA.
.200
.115
.937
MAX.
.450
MAX.
.453 MAX
.422 MIN
1/4-28 UNF-2A
TO WITHSTAND A TORQUE UP TO 30 IN-LB WHEN NUT IS TIGHTENED ON STUD

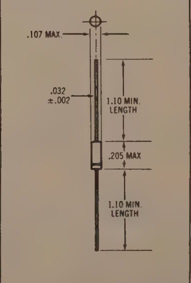
DO-7


.107 MAX. DIA.
1.00
MIN.
POLARITY
BAND
CATHODE
.300
MAX.
1.00
MIN
.022
.018
DIA

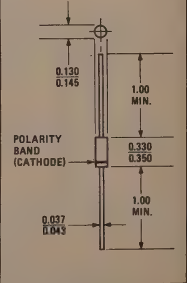
DO-13


.220 ±.005 DIA.
1.25
MIN.
.21
MAX
.090
MAX. DIA.
.350
.315
.030
.027
DIA
1.25
MIN.

Case J (DO-41)


.107 MAX.
.032
±.002
1.10 MIN.
LENGTH
.205 MAX
1.10 MIN.
LENGTH

T-18

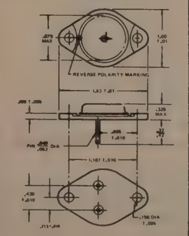

0.130
0.145
1.00
MIN.
POLARITY
BAND
(CATHODE)
0.330
0.350
1.00
MIN.
0.037
0.043

HIGH POWER
10 Through 50 Watt Zener Diodes

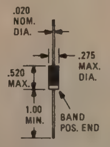
NOMINAL VOLTAGE V_Z	10 WATT STUD PACKAGE DO-4 INDUSTRIAL & MILITARY APPLICATIONS		50 WATT STUD PACKAGE DO-5 INDUSTRIAL & MILITARY APPLICATIONS		50 WATT DIAMOND PACKAGE TO-3 INDUSTRIAL & MILITARY APPLICATIONS	
3.9		1N3993	1N4549		1N4557	
4.3		1N3994	1N4550		1N4558	
4.7		1N3995	1N4551		1N4559	
5.1		1N3996	1N4552		1N4560	
5.6		1N3997	1N4553		1N4561	
6.2		1N3998	1N4554		1N4562	
6.8	1N2970	1N3999	1N4555	1N3305	1N4563	1N2804
7.5	1N2971	1N4000	1N4556	1N3306	1N4564	1N2805
8.2	1N2972			1N3307		1N2806
9.1	1N2973			1N3308		1N2807
10	1N2974			1N3309		1N2808
11	1N2975			1N3310		1N2809
12	1N2976			1N3311		1N2810
13	1N2977			1N3312		1N2811
14	1N2978			1N3313		1N2812
15	1N2979			1N3314		1N2813
16	1N2980			1N3315		1N2814
17	1N2981			1N3316		1N2815
18	1N2982			1N3317		1N2816
19	1N2983			1N3318		1N2817
20	1N2984			1N3319		1N2818
22	1N2985			1N3320		1N2819
24	1N2986			1N3321		1N2820
25	1N2987			1N3322		1N2821
27	1N2988			1N3323		1N2822
30	1N2989			1N3324		1N2823
33	1N2990			1N3325		1N2824
36	1N2991			1N3326		1N2825
39	1N2992			1N3327		1N2826
43	1N2993			1N3328		1N2827
45	1N2994			1N3329		1N2828
47	1N2995			1N3330		1N2829
50	1N2996			1N3331		1N2830
51	1N2997			1N3332		1N2831
52	1N2998			1N3333		
56	1N2999			1N3334		1N2832
62	1N3000			1N3335		1N2833
68	1N3001			1N3336		1N2834
75	1N3002			1N3337		1N2835
82	1N3003			1N3338		1N2836
91	1N3004			1N3339		1N2837
100	1N3005			1N3340		1N2838
105	1N3006			1N3341		1N2839
110	1N3007			1N3342		1N2840
120	1N3008			1N3343		1N2841
130	1N3009			1N3344		1N2842
140	1N3010			1N3345		
150	1N3011			1N3346		1N2843
160	1N3012			1N3347		1N2844
175	1N3013			1N3348		
180	1N3014			1N3349		1N2845
200	1N3015			1N3350		1N2846

NOTES: SHADED AREA INDICATES JAN, JANTX AND JANTXV QUALIFIED
V_Z IS AT THE JEDEC SPECIFIED CURRENT

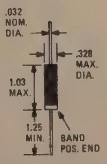
TO-3


REVERSE POLARITY MARKING

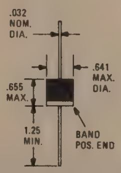
Case 1


.020
NOM.
DIA.
.275
MAX.
DIA.
.520
MAX.
1.00
MIN.
BAND
POS. END

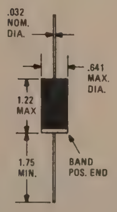
Case 2


.032
NOM.
DIA.
.328
MAX.
DIA.
1.03
MAX.
1.25
MIN.
BAND
POS. END

Case 3


.032
NOM.
DIA.
.641
MAX.
DIA.
.655
MAX.
1.25
MIN.
BAND
POS. END

Case 4


.032
NOM.
DIA.
.641
MAX.
DIA.
1.22
MAX
1.75
MIN.
BAND
POS. END

SIEMENS

QUICK REFERENCE GUIDE

Siemens Voltage Reference (TC) Diodes

MIL TYPES

Mil type Voltage Reference (T.C.) Diodes are noted with a tint background.

NOMINAL VOLTAGE V_Z @ I_{ZT}	TEST CURRENT I_{ZT} mA	CASE TYPE	OPERATING TEMPERATURE RANGE, °C	0.01%/°C		0.005%/°C		0.002%/°C		0.001%/°C		0.0005%/°C		0.0002%/°C	
				TYPE NUMBER	△VZ MV	TYPE NUMBER	△VZ MV	TYPE NUMBER	△VZ MV	TYPE NUMBER	△VZ MV	TYPE NUMBER	△VZ MV	TYPE NUMBER	△VZ MV
6.2	7.5	DO-7	−55 to +100	1N821	96	1N823	48	1N825	19	1N827	9	1N829	5		
6.2	7.5	DO-7	−55 to +100	1N821A	96	1N823A	48	1N825A	19	1N827A	9	1N829A	5		
6.2†	7.5	Case A	−55 to +100	1N429	96										
6.4	0.5	DO-7	0 to + 75	1N4565	48	1N4566	24	1N4567	10	1N4568	5	1N4569	2.2		
	0.5		−55 to +100	1N4565A	99	1N4566A	50	1N4567A	20	1N4568A	10	1N4569A	5		
	1.0		0 to + 75	1N4570	48	1N4571	24	1N4572	10	1N4573	5	1N4574	2.2		
	1.0		−55 to +100	1N4570A	99	1N4571A	50	1N4572A	20	1N4573A	10	1N4574A	5		
	2.0		0 to + 75	1N4575	48	1N4576	24	1N4577	10	1N4578	5	1N4579	2.2		
	2.0		−55 to +100	1N4575A	99	1N4576A	50	1N4577A	20	1N4578A	10	1N4579A	5		
	4.0		0 to + 75	1N4580	48	1N4581	24	1N4582	10	1N4583	5	1N4584	2.2		
	4.0		−55 to +100	1N4580A	99	1N4581A	50	1N4582A	20	1N4583A	10	1N4584A	5		
8.4	10	DO-7	−55 to +100	1N3154	130	1N3155	65	1N3156	26	1N3157	13				
8.4	10	DO-7	−55 to +150	1N3154A	172	1N3155A	86	1N3156A	34	1N3157A	17				
8.5	0.5	DO-7	0 to + 75	1N4775	64	1N4776	32	1N4777	13	1N4778	6	1N4779	3.2		
	0.5		−55 to +100	1N4775A	132	1N4776A	66	1N4777A	26	1N4778A	13	1N4779A	6.6		
	1.0		0 to + 75	1N4780	64	1N4781	32	1N4782	13	1N4783	6	1N4784	3.2		
	1.0		−55 to +100	1N4780A	132	1N4781A	66	1N4782A	26	1N4783A	13	1N4784A	6.6		
9.0	7.5	DO-7	0 to + 75	1N935	67	1N936	33	1N937	13	1N938	6	1N939	3	1N940	1.3
	7.5		−55 to +100	1N935A	139	1N936A	69	1N937A	27	1N938A	13	1N939A	7	1N940A	2.7
	7.5		−55 to +150	1N935B	184	1N936B	92	1N937B	37	1N938B	18	1N939B	9	1N940B	3.7
9.1	0.5	DO-7	0 to + 75	1N4765	68	1N4766	34	1N4767	14	1N4768	7	1N4769	3		
	0.5		−55 to +100	1N4765A	141	1N4766A	70	1N4767A	28	1N4768A	14	1N4769A	7		
	1.0		0 to + 75	1N4770	68	1N4771	34	1N4772	14	1N4773	7	1N4774	3		
	1.0		−55 to +100	1N4770A	141	1N4771A	70	1N4772A	28	1N4773A	14	1N4774A	7		
9.3	10	DO-13	0 to + 75	1N2620	70	1N2621	35	1N2622	14	1N2623	7	1N2624	4		
	10	DO-13	−55 to +100	1N2620A	144	1N2621A	72	1N2622A	29	1N2623A	14	1N2624A	7		
	10	DO-13	−55 to +150	1N2620B	190	1N2621B	95	1N2622B	38	1N2623B	19	1N2624B	10		
9.4 ± 0.4	10	DO-13	0 to + 70			1N2163, A	33			1N2166, A	7	1N2169, A	4		
(Suffix A is ± 0.2V)	10	DO-13	−55 to +125			1N2164, A	85			1N2167, A	17	1N2170, A	9		
	10	DO-13	−55 to +185			1N2165, A	113			1N2168, A	23	1N2171, A	12		
11.7	7.5	DO-7	0 to + 75	1N941	88	1N942	44	1N943	18	1N944	9	1N945	4	1N946	1.8
	7.5	DO-7	−55 to +100	1N941A	181	1N942A	90	1N943A	36	1N944A	18	1N945A	9	1N946A	3.6
	7.5	DO-7	−55 to +150	1N941B	233	1N942B	120	1N943B	47	1N944B	24	1N945B	12	1N946B	4.7
12.8	0.5	DO-7	+25 to +100	1N4896	96	1N4897	48	1N4898	19	1N4899	10				
	0.5		−55 to +100	1N4896A	198	1N4897A	99	1N4898A	40	1N4899A	20				
	1.0		+25 to +100	1N4900	96	1N4901	48	1N4902	19	1N4903	10				
	1.0		−55 to +100	1N4900A	198	1N4901A	99	1N4902A	40	1N4903A	20				
	2.0		+25 to +100	1N4904	96	1N4905	48	1N4906	19	1N4907	10				
	2.0		−55 to +100	1N4904A	198	1N4905A	99	1N4906A	40	1N4907A	20				
	4.0		+25 to +100	1N4908	96	1N4909	48	1N4910	19	1N4911	10				
	4.0		−55 to +100	1N4908A	198	1N4909A	99	1N4910A	40	1N4911A	20				
	7.5		+25 to +100	1N4912	96	1N4913	48	1N4914	19	1N4915	10				
	7.5		−55 to +100	1N4912A	198	1N4913A	99	1N4914A	40	1N4915A	20				
19.2	0.5	DO-7	+25 to +100	1N4916	144	1N4917	72	1N4918	29						
	0.5		−55 to +100	1N4916A	298	1N4917A	149	1N4918A	60						
	1.0		+25 to +100	1N4919	144	1N4920	72	1N4921	29						
	1.0		−55 to +100	1N4919A	298	1N4920A	149	1N4921A	60						
	2.0		+25 to +100	1N4922	144	1N4923	72	1N4924	29						
	2.0		−55 to +100	1N4922A	298	1N4923A	149	1N4924A	60						
	4.0		+25 to +100	1N4925	144	1N4926	72	1N4927	29	1N4928	14				
	4.0		−55 to +100	1N4925A	298	1N4926A	149	1N4927A	60	1N4928A	30				
	7.5		+25 to +100	1N4929	144	1N4930	72	1N4931	29	1N4932	14				
	7.5		−55 to +100	1N4929A	298	1N4930A	149	1N4931A	60	1N4932A	30				
12.4† to 200	10 to 2.5	Epoxy Case CC DD & EE	−55 to +100			1N4057 to 1N4085		1N4057A to 1N4085A							

NOTE: SHADED AREA INDICATES JAN, JANTX AND JANTXV QUALIFIED. †SEE DATA SHEET FOR DETAILS.

Siemens Corporation
Components Group
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(602) 947-2231 TWX 910-950-1292 Telex 667-406

DIRECTRON INDUSTRIAL SELENIUM RECTIFIERS,

FULL WAVE BRIDGE RECTIFIERS, SINGLE PHASE, RESISTIVE-INDUCTIVE LOADS

Max. Amps	18V In— 14V Out No.	Price	36V In— 28V Out No.	Price	54V In— 42V Out No.	Price	130V In— 100V Out No.	Price	160V In— 130V Out No.	Price	260V In— 200V Out No.	Price
½	A18	$1.50	A36	$2.25	A54	$3.50	A130	$7.50	A160	$11.00	A260	$12.25
1	B18	1.75	B36	3.25	B54	4.50	B130	12.25	B160	18.25	B260	19.50
2	C18	3.25	C36	4.50	C54	6.25	C130	14.75	C160	22.00	C260	24.25
3	D18	4.00	D36	6.25	D54	8.50	D130	19.50	D160	29.25	D260	34.25
4	E18	5.00	E36	10.00	E54	13.25	E130	30.25	E160	45.75	E260	58.50
6	F18	7.25	F36	14.25	F54	17.00	F130	41.25	F160	61.75	F260	65.50
10	G18	10.00	G36	18.25	G54	24.25	G130	48.50	G160	72.75	G260	82.50
12	H18	12.25	H36	22.00	H54	29.25	H130	56.25	H160	*	H260	94.75
15	J18	15.00	J36	27.50	J54	35.25	J130	67.25	J160	*	J260	120.00
20	K18	18.25	K36	36.50	K54	48.50	K130	97.00	K160	*	K260	175.00
24	L18	20.50	L36	42.00	L54	56.25	L130	103.50	L160	*	L260	190.00
30	M18	26.50	M36	50.75	M54	72.75	M130	*	M160	*	M260	*
36	P18	32.00	P36	62.75	P54	*	P130	*	P160	*	P260	*
50	R18	39.75	R36	78.00	R54	*	R130	198.00	R160	*	R260	*

220V Single Phase available . . . up to 1000 amps.
HALF-WAVE, CENTER-TAP, DOUBLER, TRIPLER or 3-PHASE — Quotations on request.
Minimum Order — $15.00 *Prices on Request — Quantity Discount — Prices Subject to Change

FREE CATALOG
FAST QUOTATIONS

24 HOUR SERVICE ON CUSTOM BUILT RECTIFIERS.
SEND US YOUR SAMPLES.

IN STOCK

RECTIFIER TRANSFORMERS, HIGH CURRENT CHOKES, INVERTERS;

DC POWER SUPPLIES: 115V-220V Input
0-48VDC Output
Current: 0-500 Amps

Complete Secondary Facilities for Specialized Equipment.
Custom Built Transformers and Chokes.
Power Supplies to Your Specifications.

DIRECTRON ELEVATOR CONTROL RECTIFIERS

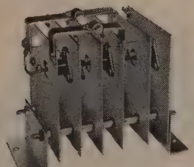
Part No.	AC Input Volts Up To	Phase	Amps	Units Re-quired	List Price Unit	Set
CD260	260	1φ	1.5	2	$12.00	$24.00
		3φ	2.2	3	12.00	36.00
DD260	260	1φ	2.2	2	14.00	28.00
		3φ	3.3	3	14.00	42.00
ED260	260	1φ	3.4	2	17.00	34.00
		3φ	5.1	3	17.00	51.00
FD260	260	1φ	6.6	2	21.00	42.00
		3φ	10.	3	21.00	63.00
COMPACT	UNIT (Double Decker)					
3D260	260	3φ	3.	1	38.00	

	Directron Part No.	Otis Part No.	List Price
HW (Blocking)	CT101	230AV1	$ 20.00
	HW101	230AR1	6.00
	HW102	230AR3	6.00
	HW103	230AZ2	12.00
1φ BRIDGE	1P101	230AR1	6.00
	1P102	230AZ1	12.00
	1P105	230AY1	30.00
3φ BRIDGE	3P101	230AL2	20.00
	3P102	230AW1	30.00
	3P103	230AL1	36.00
	3P104	230AG1	90.00
	3P105	230AJ1	100.00
	3P106	230BJ5	120.00
	3P107	230BA1	130.00
	3P108	230BJ4	90.00
	3P109	230BJ3	45.00
	3P110	230AL3	120.00

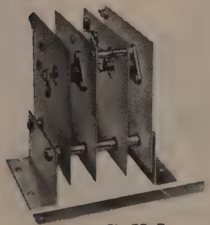
HY-A-SIL HIGH-AMPERE SILICON RECTIFIERS

FEATURES

- High Operating Temperature, 190°C (Up to 120°C ambient)
- High Operating Voltage (Up to 600 p.i.v.)
- High Efficiency (99% compared to about 75% for selenium)
- Excellent Regulation (4% compared to about 15% for selenium)



SL—PH—F



SL—BR—F

CENTER-TAP

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled	Size & Weight	User Net Price
SI-CT-A	18-0-18	16	40	80	B	$18.75
SI-CT-B	36-0-36	32	40	80	B	24.25
SL-CT-A	18-0-18	16	50	100	B	22.00
SL-CT-B	36-0-36	32	50	100	B	27.50
SL-CT-D	72-0-72	64	50	100	B	44.00
SL-CT-F	140-0-140	125	50	100	B	54.00
SK-CT-A	18-0-18	16	100	200	C	36.50
SK-CT-B	36-0-36	32	100	200	C	42.00
SK-CT-D	72-0-72	64	100	200	C	45.25
SK-CT-F	140-0-140	125	100	200	C	58.50
SM-CT-A	18-0-18	16	200	400	D	55.00
SM-CT-B	36-0-36	32	200	400	D	72.75
SM-CT-D	72-0-72	64	200	400	D	76.00
SM-CT-F	140-0-140	125	200	400	D	92.50
SO-CT-B	36-0-36	32	400	800	E	121.00

3φ BRIDGE

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled	Size & Weight	User Net Price
SL-PH-A	36	48	75	150	N	$72.75
SL-PH-B	72	96	75	150	N	103.50
SL-PH-C	105	144	75	150	N	146.50
SL-PH-D	140	188	75	150	N	220.00
SL-PH-E	220	290	75	150	M	264.00
SK-PH-E	220	290	100	200	M	300.00
SM-PH-E	220	290	200	400	M	365.00
SO-PH-E	220	290	400	800	M	450.00

All above ratings based on 30°C ambient. Fan-cooled ratings based on air velocity of 1000 linear ft/minute. For resistive or inductive loads, as rated. For capacitive or battery loads, derate amperage 20%. Doublers, triplers, 3 phase half wave and 3 phase center-tap also available. Custom-built stacks, 24 hour service.

1φ BRIDGE

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled	Size & Weight	User Net Price
SA-BR-D	140	125	1	*	—	$11.00
SA-BR-F	280	250	1	*	—	13.25
SC-BR-D	140	125	2	*	—	13.25
SC-BR-F	280	250	2	*	—	15.50
SD-BR-A	36	32	6	12	F	22.00
SD-BR-D	140	125	6	12	F	36.50
SD-BR-F	280	250	6	12	F	47.50
SE-BR-A	36	32	10	20	G	26.50
SE-BR-D	140	125	10	20	G	44.00
SE-BR-F	280	250	10	20	G	54.00
SF-BR-A	36	32	20	40	H	29.75
SF-BR-D	140	125	20	40	H	48.50
SF-BR-F	280	250	20	40	H	58.50
SI-BR-A	36	32	40	80	J	36.50
SI-BR-B	72	64	40	80	J	44.00
SI-BR-C	105	90	40	80	J	72.75
SI-BR-D	140	125	40	80	J	77.00
SI-BR-F	280	250	40	80	J	115.50
SL-BR-A	35	32	50	100	J	40.75
SL-BR-B	72	64	50	100	J	47.50
SL-BR-D	140	125	50	100	J	84.75
SL-BR-F	280	250	50	100	J	133.00
SG-BR-A	36	32	70	140	J	48.50
SG-BR-B	72	64	70	140	J	60.50
SG-BR-D	140	125	70	140	J	97.00
SG-BR-F	280	250	70	140	J	157.50
SK-BR-A	36	32	100	200	K	72.75
SK-BR-B	72	64	100	200	K	82.50
SK-BR-D	140	125	100	200	K	110.00
SK-BR-F	280	250	100	200	K	182.00
SM-BR-A	36	32	200	400	L	121.00
SM-BR-B	72	64	200	400	L	145.50
SM-BR-D	140	125	200	400	L	220.00
SM-BR-F	280	250	200	400	L	313.50
SO-BR-B	72	64	400	800	M	330.00
SO-BR-F	280	250	400	800	M	580.00

MANUFACTURED BY **SANFORD-MILLER** CORP. DEPT. EM76, 89 THROOP AVENUE, BROOKLYN, NEW YORK 11206
TELEPHONE: (212) EV 7-0600

EPION™

FAST SWITCHING RECTIFIER SELECTION GUIDE:

ULTRA-FAST RECOVERY RECTIFIERS

...FOR FAST SWITCHING POWER APPLICATIONS

A truly unique, State-of-the-Art, **EPION™ ION-IMPLANTATION PROCESS** has enabled the development of these single-chip rectifiers, in current ratings from 1-100 AMPS, eliminating the inherent reliability problems experienced with competitive multiple-junction rectifiers.

- **10-50 ns MAXIMUM RECOVERY FROM 1-100 AMP RATINGS**
- **SINGLE-CHIP GEOMETRY ELIMINATES MULTIPLE-JUNCTIONS**
- **LOWEST AVERAGE FORWARD VOLTAGE DROP AT RATED CURRENT AND TEMPERATURE (from 600 mv)**
- **PEAK INVERSE VOLTAGES TO 150 VOLTS AVAILABLE**
- **-55°C TO +200°C STORAGE AND OPERATING TEMPERATURE**
- **ALL DEVICES HERMETICALLY SEALED**

These EPION units feature single-junctions, mono-metallic metalization, and are hermetically sealed with glass-to-metal seals instead of epoxy encapsulants. Because of the unique EPION process, greater economies in manufacturing costs will assure the designer and user of continued competitive pricing and greater reliability.

The rugged, single-die construction of the EPION rectifier results in ultra-fast recovery and lower forward voltage drop. Standard units meet the thermal shock requirements of MIL-STD-202, Method 107 (10 cycles, −55° to +200°C) without degradation, which cannot be found in competitive multiple-junction devices now available.

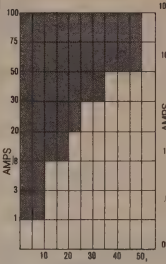
The EPION rectifier is the **only** rectifier available from 1-100 AMPS in single-chip JEDEC packages. And, all units are supplied in standard JEDEC configurations–without modifications. Of course, special packages are available on request.

All units are radiation hardened in addition to ultra-fast recovery (10-50 ns max.), extremely low forward voltage drop and low reverse leakage, making them ideal for military applications; yet EPION rectifiers are competitively priced and stocked for volume use in industrial and commercial applications.

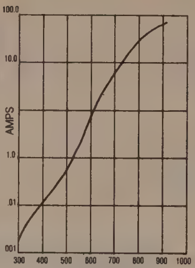
Complete specifications and pricing on request.

SOLID STATE DEVICES, INC. · 14830 Valley View Avenue, La Mirada, California 90638. Tel: (213) 921-9660. TWX: 910-583-4807

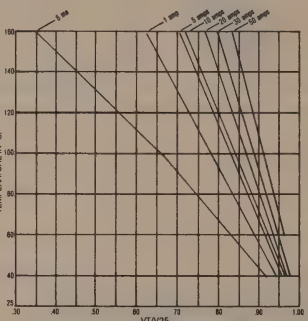
EPION™ is an exclusive SSDI Ion Implantation Process



MAXIMUM
REVERSE RECOVERY TIME Trr (ns)
(I_F−1.0 AMP to V_R−30 Vdc)



DIODE VOLTAGE (Millivolts)
TYPICAL FORWARD CONDUCTION
(VOLTAGE vs. CURRENT RATINGS)
HSR 8 Series



VT/V25
FORWARD CONDUCTION—INSTANTANEOUS VALUES
RATIO OF VOLTAGE AT TEMPERATURE TO 25°C VOLTAGE
V_T—Voltage at given Temperature and Forward Current
V_{25}—Voltage at 25°C and same Forward Current as V_T

EPION ™ *HSR 5, 6, 8 Series* **30, 50, 100 AMPS**	**DO-5**	**TO-3**
RATED CURRENT (Io)	30, 50, 100	30, 50, 100
PEAK INVERSE VOLTAGE @ 25°C	20-150	20-150
THERMAL RESISTANCE, Junction to Case ($R_{\theta JC}$)	1°C/W	.5°C/W
INSTANTANEOUS FORWARD VOLTAGE DROP (V_f) @ 25°C	900 mv max.	900 mv max.
MAXIMUM RECOVERY TIME (Trr)	35,50,50ns	35,50,50ns

20 AMPS *HSR 4 Series*	**DO-4**	**TO-3**
RATED CURRENT (Io)	20	20
PEAK INVERSE VOLTAGE @ 25°C	20-150	20-150
THERMAL RESISTANCE, Junction to Case ($R_{\theta JC}$)	1.2°C/W	.8°C/W
INSTANTANEOUS FORWARD VOLTAGE DROP (V_f) @ 25°C	900 mv max.	900 mv max.
MAXIMUM REVERSE RECOVERY TIME (Trr)	25 ns	25 ns

8 AMPS *HSR 3 Series*	**DO-4**	**TO-66**
RATED CURRENT (Io)	8	8
PEAK INVERSE VOLTAGE @ 25°C	20-150	20-150
THERMAL RESISTANCE, Junction to Case ($R_{\theta JC}$)	1.5°C/W	2°C/W
INSTANTANEOUS FORWARD VOLTAGE DROP (V_f) @ 25°C	900 mv max.	900 mv max.
MAXIMUM REVERSE RECOVERY TIME (Trr)	20 ns	20 ns

1 AMP *HSR 0 Series* **3 AMP** *HSR 2 Series*	(1 AMP) **TO-46**	(3 AMPS) **TO-66/DO-4**
RATED CURRENT (Io)	1	3
PEAK INVERSE VOLTAGE @ 25°C	20-150	20-150
THERMAL RESISTANCE, Junction to Case ($R_{\theta JC}$)	.044°C/mW	.7°C/W
INSTANTANEOUS FORWARD VOLTAGE DROP (V_f) @ 25°C	900 mv max.	900 mv max.
MAXIMUM REVERSE RECOVERY TIME (Trr)	10 ns	10 ns

NOTE: All JEDEC dimensions and notes apply.

SSDI **SOLID STATE DEVICES, INC.**

FAST SWITCHING TRANSISTOR SELECTION GUIDE:

EPITAXIAL POWER TRANSISTORS

...FOR FAST SWITCHING POWER APPLICATIONS

These high speed SSDI epitaxial base transistors feature fast turn-on and turn-off for switching efficiency at high operating frequencies. The high linear gain of these devices across the entire current range can eliminate or reduce driver transistor requirements. This line of fast-switching NPN power transistors consists of three basic series rated 10 amps, 40 amps and 90 amps, peak I_C.

- **t_{on} 300-600 ns MAX.**
- **t_{fall} 300-450 ns MAX.**
- **VOLTAGES TO 375 $V_{CEO(SUS)}$**
- **LOW SATURATION VOLTAGES**
- **BROAD LINEAR GAIN**
- **MAXIMUM PEAK I_C TO 90 AMPS**
- **UNIFORM t_r AND t_f**
- **f_T FROM 20-60 MHz**

$V_{CEO(SUS)}$ to 375 volts provides increased voltage safety margins; excellent S.O.A. permits applications where high forward bias peak power is required. All devices are hard solder construction to withstand extreme thermal variation.

These features coupled with availability of a variety of popular TO packages make SSDI epitaxial transistors ideal for use in these applications:

Power Supplies / Voltage Regulators
Switching Regulators / DC to AC inverters
DC to DC converters / Oscillators
Pulse Generators / Modulators
Industrial Controls / Switching Circuits
Amplifiers / Constant Current Regulators

SSDI ALSO MANUFACTURES:

a wide selection of popular, "off the shelf" semiconductor devices which will meet a wide variety of applications in military and commercial electronic equipment. SSDI also manufactures and stocks many silicon semiconductor devices not listed here. Refer to the D.A.T.A. BOOK for complete listings.

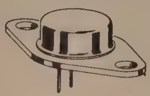
AXIAL LEAD RECTIFIERS
HIGH VOLTAGE RECTIFIERS
FAST RECOVERY RECTIFIERS
T.C. ZENERS
BRIDGE RECTIFIER ASSEMBLIES
DIFFUSED PNP & NPN HIGH VOLTAGE & POWER TRANSISTORS
SMALL SIGNAL TRANSISTORS

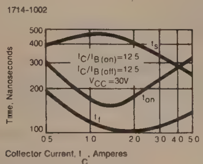
Complete specifications and pricing on request.

SOLID STATE DEVICES, INC. 14830 Valley View Avenue, La Mirada, California 90638.
Tel: (213) 921-9660. TWX: 910-583-4807

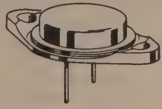
TYPICAL SWITCHING SPEEDS

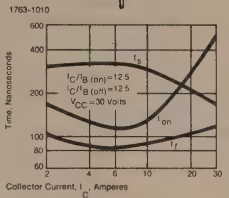
10 AMP (PEAK)
Series 1714, 1716, 1718, 1814



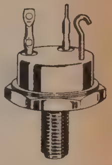


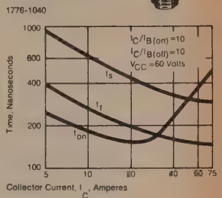
20-40 AMP (PEAK)
Series 1723, 1743, 1748, 1763, 1768, 1843





65-90 AMPS (PEAK)
Series 1756, 1776, 1781, 1856





CHARACTERISTICS

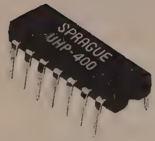
Jedec or Type No.	Pkg.	Peak Current I_C, Amps	Voltage $V_{CEO(SUS)}$	P_D@T_C=25°C /T_C=100°C	h_{FE}@I_C/V_{CE}	f_T typical	Additional* Features
1714	TO-66	10	40-180	44/25	20@2A/2V 20@5A/2V	60MHz	Low Cost
1716	TO-61	10	60-180	88/50	20@2A/2V 20@5A/2V	60MHz	Military Copper Base
1718	TO-111	10	60-180	58/33	20@2A/2V 20@5A/2V	60MHz	Isolated Collector Copper Base
1814	TO-66	10	200-375	44/25	20@1A/2V 20@2A/2V 20@5A/2V	50MHz	High Voltage
1723	TO-3	20	40-180	150/85	20@5A/4V 20@10A/4V	40MHz	Low Cost
2N5038	TO-3	30	90	140/80	20@12A/5V	60MHz	Low Cost
2N5039	TO-3	30	75	140/80	20@10A/5V	60MHz	Low Cost
2N5929-31	TO-3	40	80-160	175/100	20@10A/4V	40MHz	Guaranteed gain at 30 amps
2N5932-34	TO-3	40	60-140	175/100	20@20A/4V	40MHz	Guaranteed gain at 30 amps
2N5935-37	TO-3	40	80-160	175/100	20@30A/4V	40MHz	Guaranteed gain at 40 amps
1743	TO-3	40	40-180	175/100	20@10A/4V 20@20A/4V 20@30A/4V	40MHz	Guaranteed gain at 30 amps (1)
1763	TO-3	40	40-180	175/100	20@10A/2V 20@20A/2.5V 20@30A/3V	40MHz	Low Leakage Military
2N6046-48	TO-63	40	60-140	200/114	20@20A/4V	40MHz	New JEDEC Series
1748	TO-63	40	40-180	200/114	20@10A/4V 20@20A/4V 20@30A/4V	40MHz	Popular TO-63 package
2N1936	TO-63	40	60	200/150	10@10A/10V	40MHz	Low Leakage, Military
2N1937	TO-63	40	80	200/150	10@10A/10V	40MHz	Low Leakage, Military
1768	TO63	40	40-180	200/114	20@10A/2V 20@20A/2.5V 20@30A/3V	40MHz	Low Leakage Military
1843	TO-3	30	200-375	175/100	20@5A/5V 15@10A/5V 10@20A/5V	25MHz	High Voltage
1756	TO-63	75	60-180	250/150	15@40AV3V 15@60A/3V	30MHz	Single Chip
1776	TO-63	75	60-180	250/150	15@40A/3V 15@60A/3V	30MHz	Low Leakage Military, Single Chip
1781	TO-114	90	60-180	350/200	15@50A/3V 15@70A/3V 10@90A/4V	30MHz	Single Chip High Power
1856	TO-63	65	200-350	250/150	15@30A/3V 15@40A/3V	20MHz	High Voltage Single Chip

*All 20 amp and above have copper base.
(¹) 20@30A/4V has guaranteed gain at 40 amps.

SOLID STATE DEVICES, INC.

SPRAGUE SEMICONDUCTORS

DIGITAL INTERFACE QUAD POWER DRIVERS



- Monolithic interface circuits incorporating logic gates and high-current switching transistors on the same chip.
- Ideally suited for driving incandescent lamps, relays, solenoids, and other interface devices up to 1A output current per package.
- In the OFF state, Series, UHP-400 devices will sustain 40V; Series UHP-400-1, 70V; Series UHP-500, 100V.
- Inputs compatible with DTL/TTL.
- Pinning compatible with 54/74 networks.
- 500mA output sink current capability.
- High voltage output capability per driver.
- Transient protected outputs on relay driver Types 403, 406, 407, 433, 503, 506, 507, 533.
- 14-pin dual in-line plastic packages. Hermetic DIPs and flat-packs available on special request.
- Operating temperature range: plastic packages, 0C to +70 C; hermetically-sealed packages, –55 C to +125 C.

Order by Complete Catalog Number:

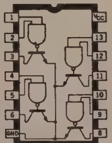
U H P — 4 0 7

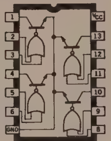
Basic Type

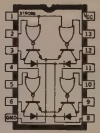
P = Plastic DIP
C = Hermetic Flat Pak
D = Hermetic DIP

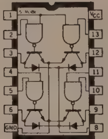
4 = 40V Breakdown Voltage
5 = 100V Breakdown Voltage
(for 70V add –1 at end of Cat. No,.)

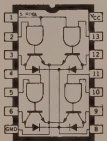
Circuit (See 8 Logic Diagrams)

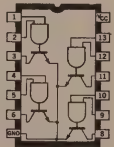

00-Quad 2-INPUT AND

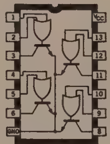

02-Quad 2-INPUT OR

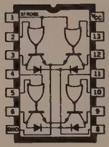

03-Quad OR


06-Quad AND


07-Quad NAND


08-Quad 2-INPUT NAND


32-Quad 2-INPUT NOR


33-Quad NOR

DIGITAL INTERFACE DISPLAY DRIVERS

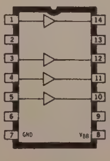
SPRAGUE
UDN-6144A

SPRAGUE
UDN-6164A

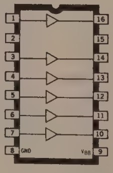
SPRAGUE
UDN-6184A

- Monolithic high-voltage, bipolar ICs for interfacing between MOS or other low-voltage circuitry and gas discharge displays.
- Reduce the number of discrete components normally required with panels, such as in calculator, clock, and instrumentation applications.
- High output breakdown voltage, low power, minimum size.
- Series UDN-6100 gas discharge display digit drivers have appropriate level shifting, signal amplification, off-stage voltage bias, and 70mA output current sourcing for sequential addressing of display panel anodes.
- In Series UDN-7100 (cathode drivers), Type UDN-7183A is designed for use with 0.7″ clock and 0.4″ calculator panels. Type UDN-7186A is for use with 0.25″ calculator panels.

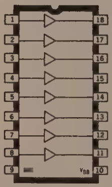
Cat. No.	No. of Leads	Drivers per Package	Input Voltage V_{in}	Supply Voltage
UDN-6144A	14	4	+30	+120
UDN-6164A	16	6	+30	+120
UDN-6184A	18	8	+30	+120
UDN-7183A	18	8	+30	–120
UDN-7186A	18	8	+30	–120



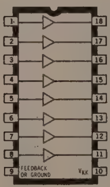
TYPE UDN-6144A



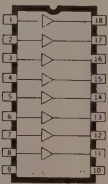
TYPE UDN-6164A



TYPE UDN-6184A



TYPE UDN-7183A


TYPE UDN-7186A

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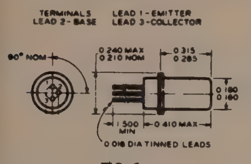
IND-EEM-85-EFAI

Sizes subject to change without notice.

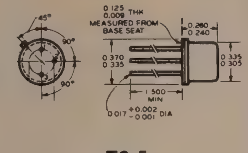
SPRAGUE SEMICONDUCTORS

SILICON and GERMANIUM TRANSISTORS

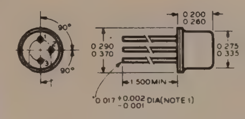
- For commercial, industrial, military applications.
- Molded plastic as well as metal cases.
- For complete data see latest issue of Sprague Catalog IND-841.


TERMINALS LEAD 2 - BASE
LEAD 1 - EMITTER LEAD 3 - COLLECTOR
90° NOM
0.240 MAX 0.210 NOM
0.315 0.285
0.190 0.160
1.500 MIN
0.410 MAX
0.018 DIA TINNED LEADS

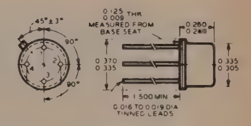
TO-1


45°
0.125 0.009 THK MEASURED FROM BASE SEAT
0.260 0.240
90°
0.370 0.335
0.335 0.305
1.500 MIN
0.017 +0.002 -0.001 DIA

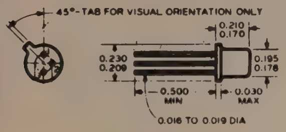
TO-5


90°
0.200 0.260
0.290 0.370
0.275 0.335
1.500 MIN
0.017 +0.002 -0.001 DIA (NOTE 1)

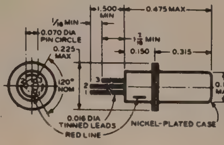
TO-9


45° ± 3°
0.125 0.009 THK MEASURED FROM BASE SEAT
0.280 0.240
90°
0.370 0.335
0.335 0.305
1.500 MIN
0.016 TO 0.019 DIA TINNED LEADS

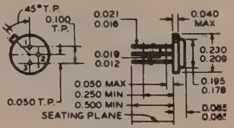
TO-12


45°-TAB FOR VISUAL ORIENTATION ONLY
0.210 0.170
0.230 0.209
0.195 0.178
0.500 MIN
0.030 MAX
0.016 TO 0.019 DIA

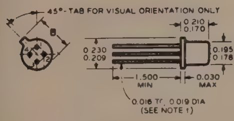
TO-18


1.500 MIN
0.475 MAX
1/16 MIN
0.070 DIA PIN CIRCLE
0.225 MAX
1/8 MIN
0.150
0.315
120° NOM
0.180 MAX
0.016 DIA TINNED LEADS
RED LINE
NICKEL-PLATED CASE

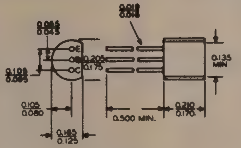
TO-24


45° T.P.
0.100 T.P.
0.021 0.016
0.040 MAX
0.019 0.012
0.230 0.209
0.195 0.178
0.050 MAX
0.250 MIN
0.500 MIN
0.050 T.P.
SEATING PLANE

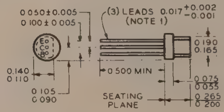
TO-46


45°-TAB FOR VISUAL ORIENTATION ONLY
0.210 0.170
0.230 0.209
0.195 0.178
1.500 MIN
0.030 MAX
0.016 TO 0.019 DIA (SEE NOTE 1)

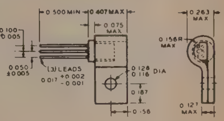
TO-72


0.135 MIN
0.500 MIN.
0.210 0.170
0.165 0.125

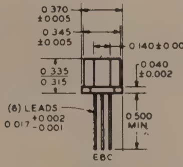
TO-92


0.050±0.005
0.100±0.005
(3) LEADS 0.017 +0.002 -0.001 (NOTE 1)
0.190 0.165
0.140 0.110
0.500 MIN
0.105 0.090
SEATING PLANE
0.075 0.055
0.265 0.200

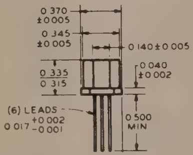
TO-98


0.500 MIN
0.407 MAX
0.263 MAX
0.075 MAX
0.158R MAX
0.100 ±0.005
0.050 ±0.005
(3) LEADS 0.017 +0.002 -0.001
0.128 0.116 DIA
0.187
0.156
0.127 MAX

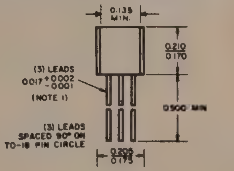
TO-98HS


0.370 ±0.005
0.345 ±0.005
0.140±0.005
0.335 0.315
0.040 ±0.002
(6) LEADS 0.017 +0.002 -0.001
0.500 MIN.
EBC

BN


0.370 ±0.005
0.345 ±0.005
0.140±0.005
0.335 0.315
0.040 ±0.002
(6) LEADS 0.017 +0.002 -0.001
0.500 MIN

BP


0.135 MIN.
0.210 0.170
(3) LEADS 0.017 +0.002 -0.001 (NOTE 1)
0.500 MIN
(3) LEADS SPACED 90° ON TO-18 PIN CIRCLE
0.205 0.175

BR

Type No.	Case	Description
2N128*	TO-24	Silicon Surface Barrier PNP Switch
2N231	TO-24	Silicon Surface Barrier PNP Switch
2N240*	TO-24	Silicon Surface Barrier PNP Switch
2N344	TO-24	Silicon Surface Barrier PNP Switch
2N345	TO-24	Silicon Surface Barrier PNP Switch
2N346	TO-24	Silicon Surface Barrier PNP Switch
2N393*	TO-24	Germanium Micro-Alloy PNP Switch
2N499*	TO-1	Germanium Micro-Alloy Diffused PNP Communication
2N499A*	TO-1	Germanium Micro-Alloy Diffused PNP Communication
2N501	TO-1	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N501A*	TO-1	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N502	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N502A*	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N502B*	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N503	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N504	TO-1	Germanium Micro-Alloy Diffused PNP Communication
2N588	TO-1	Germanium Micro-Alloy Diffused PNP Communication
2N588A	TO-1	Germanium Micro-Alloy Diffused PNP Communication
2N779A	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N794	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N795	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N796	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N846A	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N979	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N980	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N982	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N983	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N984	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N1122	TO-24	Germanium Micro-Alloy PNP Switch
2N1122A	TO-24	Germanium Micro-Alloy PNP Switch
2N1300	TO-5	Germanium Micro-Alloy Diffused PNP G/P Amplifier
2N1301	TO-5	Germanium Micro-Alloy Diffused PNP G/P Amplifier
2N1411*	TO-24	Germanium Micro-Alloy PNP Switch
2N1427	TO-24	Germanium Micro-Alloy PNP Switch
2N1469	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N1469A	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N1499A*	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N1499B	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N1500*	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N1726	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1727	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1728	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1742	TO-9	Silicon Micro-Alloy Diffused PNP VHF/UHF
2N1743	TO-9	Silicon Micro-Alloy Diffused PNP VHF/UHF
2N1744	TO-9	Silicon Micro-Alloy Diffused PNP VHF/UHF
2N1745	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1746	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1747	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1748	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1748A	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1749	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1752	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1754	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N1785	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1786	TO-9	Germanium Micro-Alloy Diffused PNP Communication

*Available to MIL specification

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EEM-67B-EFAI

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SPRAGUE SEMICONDUCTORS

SILICON and GERMANIUM TRANSISTORS, continued

Type No.	Case	Description
2N1787	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1788	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1789	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1864	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1865	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1866	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1867	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N1868	TO-9	Germanium Micro-Alloy Diffused PNP Communication
2N2048	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2168	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2169	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2170	TO-9	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2199	TO-9	Germanium Micro-Alloy Diffused PNP G/P Amplifier
2N2200	TO-9	Germanium Micro-Alloy Diffused PNP G/P Amplifier
2N2218	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2218A	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2219	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2219A	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2221	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2221A	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2222	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2222A	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2360	TO-12	Silicon Micro-Alloy Diffused PNP VHF/UHF
2N2361	TO-12	Germanium Micro-Alloy Diffused PNP VHF/UHF
2N2362	TO-12	Germanium Micro-Alloy Diffused PNP VHF/UHF
2N2369	TO-18	Germanium NPN Hi-Speed Med.-Current Switch/Amplifier
2N2398	TO-12	Silicon Micro-Alloy Diffused PNP VHF/UHF
2N2399	TO-12	Silicon Micro-Alloy Diffused PNP VHF/UHF
2N2400	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2401	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2402	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2451	TO-24	Germanium Micro-Alloy PNP Switch
2N2484	TO-18	Silicon NPN Low Noise Amplifier/Switch
2N2487	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2488	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2489	TO-18	Germanium Micro-Alloy Diffused PNP Hi-Speed Switch
2N2711	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N2712	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N2713	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N2714	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N2904	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2904A	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2905	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2905A	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2906	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2906A	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2907	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2907A	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N2923	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N2924	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N2925	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N2926	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N2944	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N2945	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N2946	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N2951	TO-5	Silicon NPN Power Amplifier
2N2952	TO-18	Silicon NPN Power Amplifier
2N2958	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N2959	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N3058	TO-46	Silicon NPN Switch/Amplifier/Chopper
2N3059	TO-46	Silicon NPN Switch/Amplifier/Chopper
2N3960	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3061	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3115	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N3116	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N3133	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N3134	TO-5	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N3135	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N3136	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
2N3217	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3218	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3219	TO-46	Silicon PNP Switch/Amplifier/Chopper

Type No.	Case	Description
2N3390	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3391	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N3391A	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N3392	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3393	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3394	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3395	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3396	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3397	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3398	TO-98	Silicon NPN General Purpose Small Signal Amplifier
2N3402	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3403	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3404	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3405	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3414	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3415	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3416	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3417	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3439	TO-5	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
2N3440	TO-5	Silicon NPN Hi-Voltage Video Output
2N3563	BR	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3565	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP3566	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
TP3638	BR	Silicon PNP General Purpose Amplifier/Switch
TP3638A	BR	Silicon PNP General Purpose Amplifier/Switch
2N3639	BR	Silicon PNP Switch
2N3640	BR	Silicon PNP Switch
TP3644	TO-92	Silicon PNP General Purpose Amplifier/Switch
TP3645	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N3646	BR	Silicon NPN Switch
2N3677	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3702	TO-92*	Silicon PNP General Purpose Small Signal Amplifier
2N3703	TO-92*	Silicon PNP General Purpose Small Signal Amplifier
2N3704	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3705	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3706	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3707	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3708	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3709	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3710	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3711	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3721	TO-92*	Silicon NPN General Purpose Small Signal Amplifier
2N3724	TO-5	Silicon NPN High Current Core Driver
2N3725	TO-5	Silicon NPN High Current Core Driver
2N3840	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3843	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3843A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3844	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3844A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3845	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3845A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3854	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3854A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3855	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3855A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3856	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3856A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3858	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3858A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3859	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3859A	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3860	TO-98	Silicon NPN Hi-Frequency Amplifier/Oscillator
2N3877	TO-98	Silicon NPN Hi-Voltage Indicator Driver
2N3877A	TO-98	Silicon NPN Hi-Voltage Indicator Driver
2N3900	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N3900A	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N3901	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N3903	TO-92	Silicon NPN General Purpose Amplifier/Switch
2N3904	TO-92	Silicon NPN General Purpose Amplifier/Switch
2N3905	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N3906	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N3975	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N3976	TO-98	Silicon NPN General Purpose Amplifier/Switch

*With ECB pinning

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EEM-64-EFA1

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SPRAGUE SEMICONDUCTORS

SILICON and GERMANIUM TRANSISTORS, continued

Type No.	Case	Description
2N3977	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3978	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N3979	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N4007	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N4008	TO-46	Silicon PNP Switch/Amplifier/Chopper
2N4013	TO-18	Silicon NPN Hi-Current Core Driver
2N4014	TO-18	Silicon NPN Hi-Current Core Driver
2N4058	TO-92*	Silicon PNP General Purpose Small-Signal Amplifier
2N4059	TO-92*	Silicon PNP General Purpose Small-Signal Amplifier
2N4060	TO-92*	Silicon PNP General Purpose Small-Signal Amplifier
2N4061	TO-92*	Silicon PNP General Purpose Small-Signal Amplifier
2N4062	TO-92*	Silicon PNP General Purpose Small-Signal Amplifier
2N4123	TO-92	Silicon NPN General Purpose Amplifier/Switch
2N4124	TO-92	Silicon NPN General Purpose Amplifier/Switch
2N4125	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N4126	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N4256	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N4257	BR	Silicon PNP Switch
2N4258	BR	Silicon PNP Switch
2N4274	BR	Silicon NPN Switch
2N4275	BR	Silicon NPN Switch
2N4383	TO-5	Silicon NPN Low Noise Amplifier/Switch
2N4384	TO-18	Silicon NPN Low Noise Amplifier/Switch
2N4385	TO-5	Silicon NPN Low Noise Amplifier/Switch
2N4386	TO-18	Silicon NPN Low Noise Amplifier/Switch
2N4400	TO-92	Silicon NPN General Purpose Amplifier/Switch
2N4401	TO-92	Silicon NPN General Purpose Amplifier/Switch
2N4402	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N4403	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N4412	TO-5	Silicon PNP Low Noise Amplifier/Switch
2N4412A	TO-5	Silicon PNP Low Noise Amplifier/Switch
2N4413	TO-18	Silicon PNP Low Noise Amplifier/Switch
2N4413A	TO-18	Silicon PNP Low Noise Amplifier/Switch
2N4414	TO-5	Silicon PNP Low Noise Amplifier/Switch
2N4414A	TO-5	Silicon PNP Low Noise Amplifier/Switch
2N4415	TO-18	Silicon PNP Low Noise Amplifier/Switch
2N4415A	TO-18	Silicon PNP Low Noise Amplifier/Switch
2N4424	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N4425	TO-98HS	Silicon NPN General Purpose Amplifier/Switch
2N4951	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N4952	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N4953	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N4954	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N5133	BR	Silicon NPN Small-Signal Low Noise Amplifier
2N5134	BR	Silicon NPN Switch
TP5135	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
TP5136	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
2N5137	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5138	BR	Silicon PNP Small-Signal Low Noise Amplifier
2N5139	BR	Silicon PNP General Purpose Small-Signal Amplifier
TP5142	TO-92	Silicon PNP General Purpose Amplifier/Switch
2N5143	BR	Silicon PNP General Purpose Small-Signal Amplifier
2N5172	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
2N5209	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
2N5210	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
2N5219	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
2N5220	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
2N5221	TO-92	Silicon PNP Small-Signal Low Noise Amplifier
2N5222	TO-92	Silicon NPN High Frequency Amplifier/Oscillator
2N5223	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
2N5224	TO-92	Silicon NPN Switch
2N5225	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
2N5226	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
2N5227	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
2N5228	TO-92	Silicon PNP Switch
2N5232	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N5232A	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
2N5305	TO-98	Silicon NPN Darlington Amplifier
2N5306	TO-98	Silicon NPN Darlington Amplifier
2N5306A	TO-98	Silicon NPN Darlington Amplifier
2N5307	TO-98	Silicon NPN Darlington Amplifier
2N5308	TO-98	Silicon NPN Darlington Amplifier
2N5308A	TO-98	Silicon NPN Darlington Amplifier
2N5309	TO-98	Silicon NPN Low Level Amplifier
2N5310	TO-98	Silicon NPN Low Level Amplifier

Type No.	Case	Description
2N5354	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N5355	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N5356	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N5365	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N5366	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N5367	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N5368	BR	Silicon NPN General Purpose Amplifier/Switch
2N5369	BR	Silicon NPN General Purpose Amplifier/Switch
2N5370	BR	Silicon NPN General Purpose Amplifier/Switch
2N5371	BR	Silicon NPN General Purpose Amplifier/Switch
2N5372	BR	Silicon PNP General Purpose Amplifier/Switch
2N5373	BR	Silicon PNP General Purpose Amplifier/Switch
2N5374	BR	Silicon PNP General Purpose Amplifier/Switch
2N5375	BR	Silicon PNP General Purpose Amplifier/Switch
2N5376	BR	Silicon NPN Small-Signal Low Noise Amplifier
2N5377	BR	Silicon NPN Small-Signal Low Noise Amplifier
2N5378	BR	Silicon PNP Small-Signal Low Noise Amplifier
2N5379	BR	Silicon PNP Small-Signal Low Noise Amplifier
2N5380	BR	Silicon NPN General Purpose Amplifier/Switch
2N5381	BR	Silicon NPN General Purpose Amplifier/Switch
2N5382	BR	Silicon PNP General Purpose Amplifier/Switch
2N5383	BR	Silicon PNP General Purpose Amplifier/Switch
2N5418	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N5419	TO-98	Silicon NPN General Purpose Amplifier/Switch
2N5420	TO-98	Silicon NPN General Purpose Amplifier/Swtich
2N5447	BR	Silicon PNP General Purpose Small-Signal Amplifier
2N5448	BR	Silicon PNP General Purpose Small-Signal Amplifier
2N5449	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5450	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5451	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5810	BR	Silicon NPN General Purpose Amplifier/Switch
2N5811	BR	Silicon PNP General Purpose Amplifier/Switch
2N5812	BR	Silicon NPN General Purpose Amplifier/Switch
2N5813	BR	Silicon PNP General Purpose Amplifier/Switch
2N5814	BR	Silicon NPN General Purpose Amplifier/Switch
2N5815	BR	Silicon PNP General Purpose Amplifier/Switch
2N5816	BR	Silicon NPN General Purpose Amplifier/Switch
2N5817	BR	Silicon PNP General Purpose Amplifier/Switch
2N5818	BR	Silicon NPN General Purpose Amplifier/Switch
2N5819	BR	Silicon PNP General Purpose Amplifier/Switch
2N5824	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5825	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5826	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5827	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5828	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N5998	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
2N5999	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N6008	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
2N6009	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N6076	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
2N6222	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N6223	BR	Silicon PNP General Purpose Small-Signal Amplifier
2N6224	BR	Silicon NPN General Purpose Small-Signal Amplifier
2N6225	BR	Silicon PNP General Purpose Small-Signal Amplifier
MPS-404	TO-92	Silicon PNP Switch
MPS-404A	TO-92	Silicon PNP Switch
MPS-706	TO-92	Silicon NPN Switch
MPS-706A	TO-92	Silicon NPN Switch
MPS-918	TO-92	Silicon NPN High Frequency Amplifier/Switch
MPS-2369	TO-92	Silicon NPN Switch
MPS-2711	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-2712	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-2713	TO-92	Silicon NPN General Purpose Amplifier/Switch
MPS-2714	TO-92	Silicon NPN General Purpose Amplifier/Switch
MPS-2923	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-2924	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-2925	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-2926	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3390	TO-92	Silicon NPN General Purpose Amplifier Switch
MPS-3391	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
MPS-3391A	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
MPS-3392	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3393	TO-92	Silicon NPN General Purpose Small-Signal Amplifier

*With ECB pinning

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SILICON and GERMANIUM TRANSISTORS, continued

Type No.	Case	Description
MPS-3394	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3395	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3396	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3563	TO-92	Silicon NPN High Frequency Amplifier/Oscillator
MPS-3638	TO-92	Silicon PNP General Purpose Amplifier/Switch
MPS-3638A	TO-92	Silicon PNP General Purpose Amplifier/Switch
MPS-3639	TO-92	Silicon PNP Switch
MPS-3640	TO-92	Silicon PNP Switch
MPS-3646	TO-92	Silicon NPN Switch
MPS 3702	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3703	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3704	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3705	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3706	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3707	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3708	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3709	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3710	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3711	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-3721	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-5172	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-5305	TO-92	Silicon NPN Darlington Amplifier
HS-5305	TO-98HS	Silicon NPN Darlington Amplifier
MPS-5306	TO-92	Silicon NPN Darlington Amplifier
HS-5306	TO-98HS	Silicon NPN Darlington Amplifier
MPS-5306A	TO-92	Silicon NPN Darlington Amplifier
HS-5306A	TO-98HS	Silicon NPN Darlington Amplifier
MPS-5307	TO-92	Silicon NPN Darlington Amplifier
HS-5307	TO-98HS	Silicon NPN Darlington Amplifier
MPS-5308	TO-92	Silicon NPN Darlington Amplifier
HS-5308	TO-98HS	Silicon NPN Darlington Amplifier
MPS-5308A	TO-92	Silicon NPN Darlington Amplifier
HS-5308A	TO-98HS	Silicon NPN Darlington Amplifier
HS-6512	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
HS-6513	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
HS-6514	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
HS-6515	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
HS-6516	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
HS-6517	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
HS-6518	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
HS-6519	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
HS-6520	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
HS-6521	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
HS-6522	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
HS-6523	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
MPS-6530	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6531	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6532	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6533	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
MPS-6534	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
MPS-6535	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
MPS-6560	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6561	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6562	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
MPS-6563	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
MPS-6565	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6566	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-6571	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
MPS-A05	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-A09	TO-92	Silicon NPN Small-Signal Low Noise Amplifier
MPS-A12	TO-92	Silicon NPN Darlington Amplifier
MPS-A13	TO-92	Silicon NPN Darlington Amplifier
MPS-A14	TO-92	Silicon NPN Darlington Amplifier
MPS-A20	TO-92	Silicon NPN General Purpose Small-Signal Amplifier
MPS-A55	TO-92	Silicon PNP Small-Signal Low Noise Amplifier
MPS-A70	TO-92	Silicon PNP General Purpose Small-Signal Amplifier
MPS-K20	—	Three-Transistor Kit of MPS-A20 Devices
MPS-K21	—	Five-Transistor Kit of MPS-A20 Devices
MPS-K22	—	Nine-Transistor Kit of MPS-A20 Devices
MPS-K70	—	Three-Transistor Kit of MPS-A70 Devices
MPS-K71	—	Five-Transistor Kit of MPS-A70 Devices
MPS-K72	—	Nine-Transistor Kit of MPS-A70 Devices
TC-3114	TO-72	Silicon NPN Small-Signal Video IF
TC-3200	TO-72	Silicon NPN Small-Signal Video IF
TD-100	BP	Silicon NPN/NPN Dual Differential Amplifier
TD-101	BP	Silicon NPN/NPN Dual Differential Amplifier
TD-102	BP	Silicon NPN/NPN Dual Transistor
TD-200	BN	Silicon NPN/NPN Dual Differential Amplifier
TD-201	BN	Silicon NPN/NPN Dual Differential Amplifier
TD-202	BN	Silicon NPN/NPN Dual Transistor
TD-250	BN	Silicon NPN/NPN Dual Differential Amplifier
TD-400	BP	Silicon PNP/PNP Dual Differential Amplifier
TD-401	BP	Silicon PNP/PNP Dual Differential Amplifier
TD-402	BP	Silicon PNP/PNP Dual Transistor
TD-500	BN	Silicon PNP/PNP Dual Differential Amplifier
TD-501	BN	Silicon PNP/PNP Dual Differential Amplifier
TD-502	BN	Silicon PNP/PNP Dual Transistor
TD-550	BN	Silicon PNP/PNP Dual Differential Amplifier
TD-600	BP	Silicon NPN/PNP Complementary Pair
TD-601	BP	Silicon NPN/PNP Complementary Pair
TD-602	BP	Silicon NPN/PNP Dual Transistor
TD-700	BN	Silicon NPN/PNP Complementary Pair
TD-701	BN	Silicon NPN/PNP Complementary Pair
TD-702	BN	Silicon NPN/PNP Dual Transistor
TD-2219	BP	Silicon NPN/NPN Dual Transistor
TD-2905	BP	Silicon PNP/PNP Dual Transistor
TN-3903	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
TN-3904	TO-18	Silicon NPN Hi-Speed Med.-Current Switch/Amplifier
TN-3905	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
TN-3906	TO-18	Silicon PNP Hi-Speed Med.-Current Switch/Amplifier
TP-107	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-107A	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-107B	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-108	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-108A	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-108B	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-108C	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-109	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-109A	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-109B	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-109C	BR	Silicon NPN Small-Signal Low Noise Amplifier
TP-251A	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-251B	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-252A	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-252B	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-252CA	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-253A	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-253B	BR	Silicon PNP Small-Signal Low Noise Amplifier
TP-253CA	BR	Silicon PNP Small-Signal Low Noise Amplifier
TZ-81	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
TZ-82	TO-98	Silicon NPN Small-Signal Low Noise Amplifier
TZ-551	TO-98	Silicon PNP General Purpose Amplifier/Switch
TZ-552	TO-98	Silicon PNP General Purpose Amplifier/Switch
TZ-553	TO-98	Silicon PNP General Purpose Amplifier/Switch
TZ-581	TO-98	Silicon PNP Small-Signal Low Noise Amplifier
TZ-582	TO-98	Silicon PNP Small-Signal Low Noise Amplifier
D16P1	TO-98	Silicon NPN Darlington Amplifier
D29A4	TO-98	Silicon PNP General Purpose Amplifier/Switch
D29A5	TO-98	Silicon PNP General Purpose Amplifier/Switch
D29E1	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
D29E1-J1	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
D29E2	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
D29E2-J1	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
D29E4	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
D29E4-J1	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
D29E5	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
D29E5-J1	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
D29E6	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
D29E6-J1	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
D29E7	TO-98	Silicon PNP General Purpose Small-Signal Amplifier
D29E7-J1	TO-98HS	Silicon PNP General Purpose Small-Signal Amplifier
D33D21	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
D33D21-J1	TO-98HS	Silicon NPN General Purpose SmallSignal Amplifier
D33D22	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
D33D22-J1	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
D33D24	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
D33D24-J1	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
D33D25	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
D33D25-J1	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
D33D26	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
D33D26-J1	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier
D33D27	TO-98	Silicon NPN General Purpose Small-Signal Amplifier
D33D27-J1	TO-98HS	Silicon NPN General Purpose Small-Signal Amplifier

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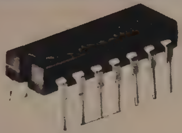
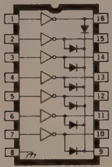
SPRAGUE SEMICONDUCTORS

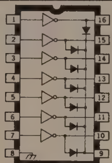


TRANSISTOR ARRAYS

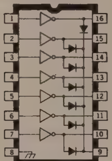
- Special selection of linear integrated circuits.
- Monolithic active-device arrays which combine the performance and versatility of discrete devices with the inherent reliability and matching of integrated circuits.
- Power dissipation, Ta to +55 C is 300mW for each transistor and 750mW for the total package.
- Plastic dual in-line package, 14 or 16 leads.
- Operating Temperature range, 0°C to +85°C.



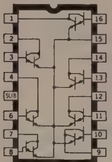
ULN-2001A
High-Current Darlingtons
7 silicon NPN pairs



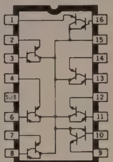
ULN-2002A
High-Current Darlingtons
inputs have zener diode,
resistor



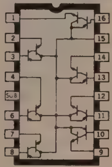
ULN-2003A
High-Current Darlingtons
series base resistor with
ea. pair



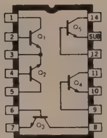
ULN-2031A
High-Current Darlingtons
NPN – (hfe – 500> <5000)



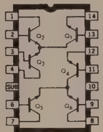
ULN-2032A
High-Current Darlingtons
PNP – (hfe – 500> <5000)



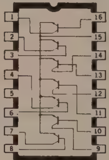
ULN-2033A
High-Current Darlingtons
PNP – (hfe – 50> <500)



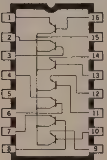
ULN-2046A
3 isolated transistors
and 1 differential amplifier



ULN-2054A
Dual independent
differential amplifiers



ULN-2081A
7 transistors
with common emitters



ULN-2082A
7 transistors
with common collectors

ECONOLINE® SILICON ZENER DIODES

- Offer 500mW power dissipation.
- Low-cost TO-92 package.
- Silicon-Oxide passivated junction.
- Operating junction temp. range, –65C to +150C.
- Zener Tolerances, ±5%, ±10% and ±20%.
- In-line leads for easy insertion.

Type Number*	Nom. Zener Volt. V_{ZT} (V)	at I_{ZT} (mA)	Max. Zener Impedance Z_{ZT} at I_{ZT} (Ω)	Z_{ZK} at 250nA (Ω)
1N5837	2.4	20	50	2100
1N5838	2.5	20	50	2100
1N5839	2.7	20	50	2200
1N5840	2.8	20	50	2200
1N5841	3.0	20	50	2300
1N5842	3.3	20	50	2500
1N5843	3.6	20	48	2700
1N5844	3.9	20	40	2800
1N5845	4.3	20	25	2900
1N5846	4.7	20	19	2600
1N5847	5.1	20	17	2400
1N5848	5.6	20	15	2100
1N5849	6.0	20	13	1900
1N5850	6.2	20	14	1500
1N5851	6.8	20	17	780
1N5852	7.5	20	23	700
1N5853	8.2	20	34	700
1N5854	8.7	20	44	700
1N5855	9.1	20	50	700
1N5856	10	20	62	700
1N5857	11	20	68	700
1N5858	12	20	70	700
1N5859	13	9.5	70	700
1N5860	14	9.0	70	700
1N5861	15	8.5	34	700
1N5862	16	7.8	38	700
1N5863	17	7.4	42	700
1N5864	18	7.0	48	700
1N5865	19	6.6	52	700
1N5866	20	6.2	57	700
1N5867	22	5.6	68	700
1N5868	24	5.2	78	700
1N5869	25	5.0	85	700
1N5870	27	4.6	98	700
1N5871	28	4.5	106	700
1N5872	30	4.2	117	700
1N5873	33	3.8	140	700
1N5874	36	3.4	160	700
1N5875	39	3.2	190	800
1N5776	43	3.0	225	900
1N5777	47	2.7	260	1000
1N5878	51	2.5	300	1100
1N5879	56	2.2	360	1300
1N5880	60	2.1	410	1500
1N5881	62	2.0	430	1600
1N5882	68	1.8	520	1900
1N5883	75	1.7	600	2300
1N5884	82	1.5	700	2700

*Type numbers shown are for zener voltage tolerance of ±20%. For ±10% tolerance, add the suffix 'A' to type number. For ±5% tolerance, add the suffix 'B' to type number.

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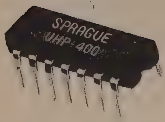
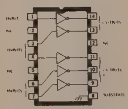
SPRAGUE SEMICONDUCTORS

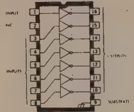
DIGITAL INTERFACE DISPLAY DRIVERS

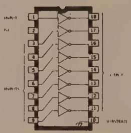


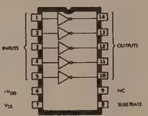
- Bipolar devices for interface applications.
- Cut component count by replacing most discrete components typically required between MOS/TTL logic and gas discharge displays such as Burroughs Panaplex®.
- Reliable monolithic integrated construction.
- Low output leakage currents.
- High output breakdown voltages.
- Plastic (UHP) and hermetic (UHD) dual in-line packages. Hermetic package available on special request.
- Drivers in plastic DIPs have operating temperature range of −0 C to +85 C; drivers in hermetic DIPs have operating temperature range of −55 C to +125 C.

Cat. No.	No. of Leads	Drivers per Package	Input Voltage	Diode Forward Current (mA)	Output Voltage
UHD-480	14	5	30	50	130
UHP-480	14	5	30	50	130
UHD-481	16	7	30	50	130
UHP-481	16	7	30	50	130
UHD-482	18	8	30	50	130
UHP-482	18	8	30	50	130
UHD-490	14	5	−30	30	−80
UHP-490	14	5	−30	30	−80
UHD-491	16	6	−30	30	−80
UHP-491	16	6	−30	30	−80
UHD-495	14	6	−30	30	−80
UHP-495	14	6	−30	30	−80

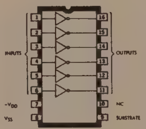

SERIES 480


SERIES 482

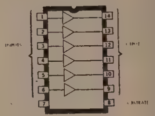

SERIES 491



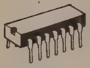
SERIES 481

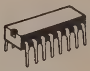


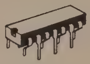
SERIES 490

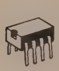

SERIES 495

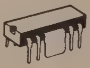
LINEAR INTEGRATED CIRCUITS


Package A
14 pins


Package A
16 pins


Package N
14 pins


Package M
8 pins


Package P
8 pins & 2 tabs

- Consumer entertainment integrated circuits with "state-of-the-art" design and process capability.
- Performance advantages not previously available with discrete fabrication techniques, while reducing component count.
- Ion-implanted devices save space, provide time and cost savings to radio and audio equipment manufacturers.
- Devices for preamplifier, general purpose audio, F-M/I-F amplifier, stereo decoder, and complete A-M radio applications.
- The 21 ICs shown below are standard off-the-shelf units which fit a particular function most economically. See table for brief description and package information.

Cat. No.	Description	Package Pins	Package Case
	FOR PREAMPLIFIER APPLICATIONS†		
ULN-2126	Dual Audio Preamplifier	14	A, N
ULN-2231	Dual Audio Preamplifier	14	A
	FOR GENERAL PURPOSE AUDIO†		
ULN-2274	Dual 1 Watt Audio Amplifier	8*	P
ULN-2275	Dual 1 Watt Audio Amplifier	8*	P
ULN-2277	Dual 2 Watt Audio Amplifier	8*	P
ULN-2278	Dual 2 Watt Audio Amplifier	8*	P
ULN-2280	2 to 4 Watt Audio Amplifier	14	A
	FOR F-M/I-F AMPLIFIER APPLICATIONS†		
ULN-2111	F-M Detector Limiter	14	A, N
ULN-2113	F-M Detector Limiter	14	A, N
ULN-2129	F-M Sound Channel	14	A, N
ULN-2136	F-M Detector and Limiter w/VR	14	A

Cat. No.	Description	Package Pins	Package Case
	FOR F-M/I-F AMPLIFIER APPLICATIONS (cont'd.)		
ULN-2208	I-F Gain Block w/VR	8	M
ULN-2209	I-F Gain Block w/VR	8	M
ULX-2289	F-M/I-F System	16	A
	FOR STEREO DECODER APPLICATIONS†		
ULN-2120	Stereo Decoder	14	A, N
ULN-2121	Stereo Decoder	14	A, N
ULN-2122	Stereo Decoder	14	A, N
ULN-2128	Stereo Decoder	14	A, N
ULN-2210	Phase Locked Loop Stereo Decoder	14	A
ULN-2244	Phase Locked Loop Stereo Decoder	16	A
	FOR COMPLETE A-M RADIO APPLICATIONS†		
ULN-2137	R-F/I-F Amplifier	14	A, N

*Package with heat tabs.

†ICs for TV use also available. Consult factory for data.

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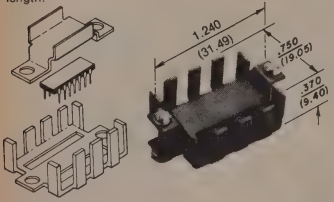
CIRCUIT BOARD COOLERS

Thermalloy, Inc.
Post Office Box 34829 · 2021 West Valley View Lane
Dallas, Tex 75234 · (214) 243-4321 · TWX 910-860-5542
NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

For Dip Packages

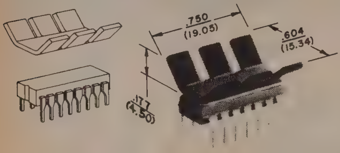
6007A

Two piece for 14, 16 Pin DIPS up to .82"/(20.82) in length.


1.240
(31.49)
.750
(19.05)
.370
(9.40)

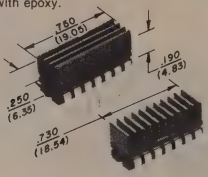
6010B

Bond to DIP with epoxy.


.750
(19.05)
.604
(15.34)
.177
(4.50)

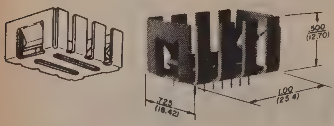
6011-6012B

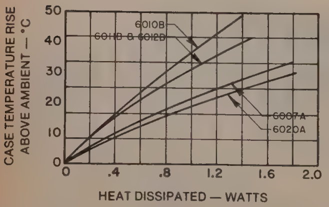
Bond to DIP with epoxy.


.750
(19.05)
.190
(4.83)
.250
(6.35)
.730
(18.54)

6020A

14 Pin, Jedec case 116 DIP snaps into place under spring clip.

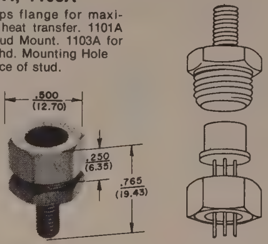

.500
(12.70)
1.00
(25.4)
.723
(18.42)



For TO-5 Packages

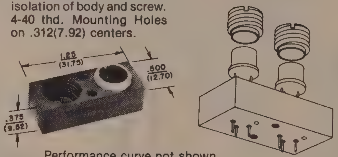
1101A, 1103A

Clamps flange for maximum heat transfer. 1101A for Stud Mount. 1103A for 4-40 thd. Mounting Hole In place of stud.

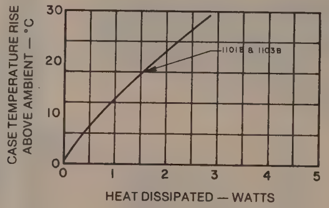

.500
(12.70)
.250
(6.35)
.765
(19.43)

3005A

Temperature equalization for matched pairs. Electrical isolation of body and screw. 4-40 thd. Mounting Holes on .312(7.92) centers.

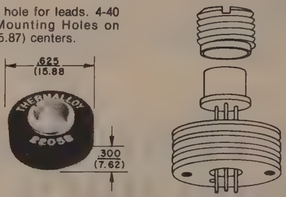

1.25
(31.75)
.500
(12.70)
.375
(9.52)

Performance curve not shown.



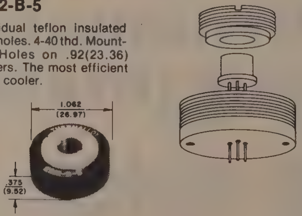
2205B

Single hole for leads. 4-40 thd. Mounting Holes on .625(15.87) centers.


.625
(15.88)
THERMALLOY
2205B
.300
(7.62)

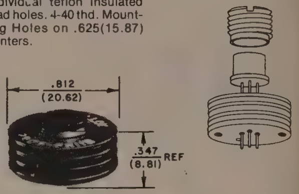
2212-B-5

Individual teflon insulated lead holes. 4-40 thd. Mounting Holes on .92(23.36) centers. The most efficient TO-5 cooler.


1.062
(26.97)
.375
(9.52)

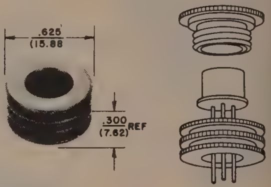
2207/PR11B

Individual teflon insulated lead holes. 4-40 thd. Mounting Holes on .625(15.87) centers.


.812
(20.62)
.347
(8.81)
REF

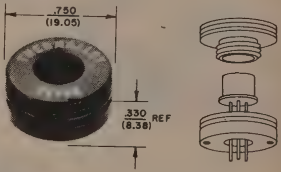
2211B

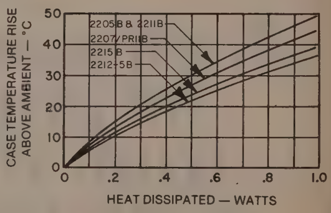
Economy two piece lead mounted cooler.


.625
(15.88)
.300
(7.62)
REF

2215B

Large fin area. 4-40 thd. Mounting Holes on .625 (15.87) centers.


.750
(19.05)
.330
(8.38)
REF



NOTE: Dimensions in inches/(mm) Max. tolerance ± .017(.43)
Suffix A = Hard Anodize
Suffix B = Black Anodize

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CIRCUIT BOARD COOLERS

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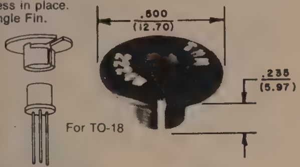
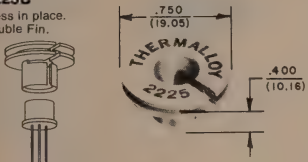
2224B

Press in place.
Single Fin.


.500
(12.70)
.235
(5.97)
For TO-18

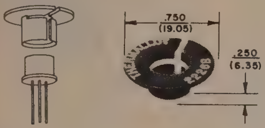
2225B

Press in place.
Double Fin.


.750
(19.05)
THERMALLOY
2225
.400
(10.16)

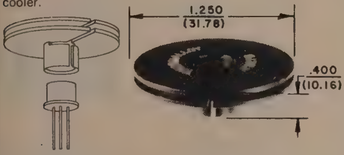
2226B

Press in place. Single Fin.


.750
(19.05)
.250
(6.35)

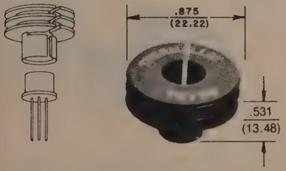
2227B

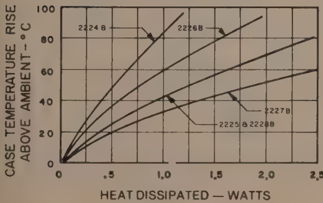
Most efficient press—on cooler.


1.250
(31.78)
.400
(10.16)

2228B

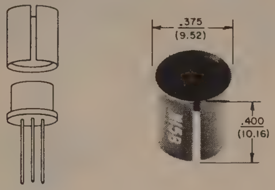
Press in place. Large triple fins.


.875
(22.22)
.531
(13.48)



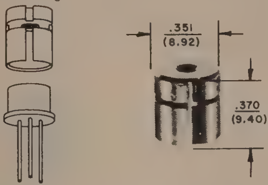
1115B

Press in place.


.375
(9.52)
.400
(10.16)

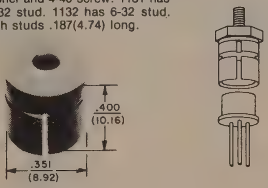
1116B

Low cost press-on. 4-40 thd. Mounting Hole.


.351
(8.92)
.370
(9.40)

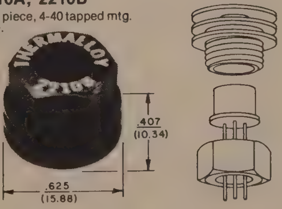
1130, 1131, 1132

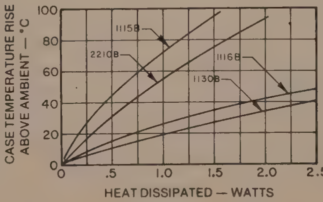
Same as 1116 except bonded BeO insulator. All are black oxide finish. 1130 includes nylon shoulder washer and 4-40 screw. 1131 has 10-32 stud. 1132 has 6-32 stud. Both studs .187(4.74) long.


.400
(10.16)
.351
(8.92)

2210A, 2210B

Two piece, 4-40 tapped mtg. hole.

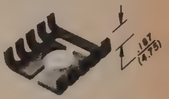

THERMALLOY
.407
(10.34)
.625
(15.88)

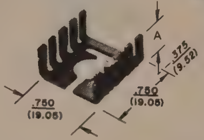


1134, 1136

Part No.	A
1134B	.187(4.75)
1136B	.375(9.53)

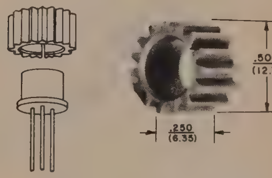
Outperforms featherweights at lower cost.




A
.375
(9.52)
.750
(19.05)
.750
(19.05)

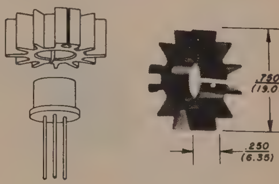
2257R

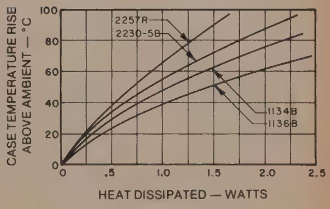
Low cost press on.


.500
(12.70)
.250
(6.35)

2230B-5

Press—on with boss for No. 4 screw.


.750
(19.05)
.250
(6.35)



NOTE: Dimensions in inches/(mm) Max. tolerance ± .020(.50)
Suffix A = Hard Anodize
Suffix B = Black Anodize
Suffix R = Red Anodize

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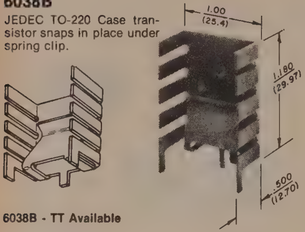
POWER SEMICONDUCTOR COOLERS

Thermalloy, Inc.
Post Office Box 34829 • 2021 West Valley View Lane
Dallas Tex 75234 • (214) 243-4321 • TWX 910-860-5542
NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

For Plastic Package

6038B

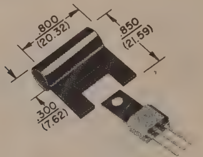
JEDEC TO-220 Case transistor snaps in place under spring clip.


1.00
(25.4)
1.180
(29.97)
.500
(12.70)

6038B - TT Available

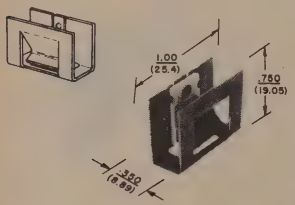
6047B "Slip·Clip"

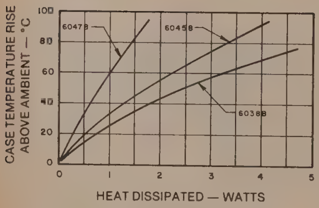
Slips in place on JEDEC 202 or Motorola Case 152.


.800
(20.32)
.850
(21.59)
.300
(7.62)

6045B

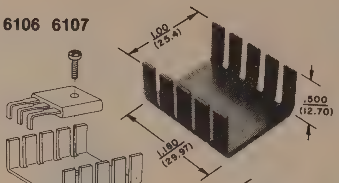
Snaps on JEDEC TO-220 case from top or bottom.

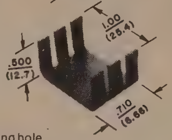

1.00
(25.4)
.750
(19.05)
.350
(8.89)



NOTE: Dimensions in inches/(mm) Max. tolerance ± .017(.43)
Suffix B = Black Anodize
Suffix C = Gold Chromate
Suffix D = Nickel Plate
Suffix B-TT = Black Anodized. Tinned Tabs

6106 6107


1.00
(25.4)
.500
(12.70)
1.180
(29.97)

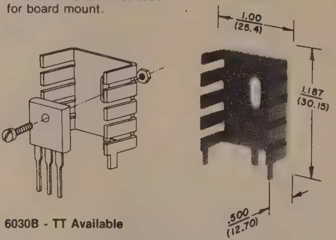

1.00
(25.4)
.500
(12.7)
.710
(6.66)

For two devices
6106B without holes
6106 B or C-13 two holes

For one device
6107B without holes
6107 B or C-14 one mounting hole

6030B

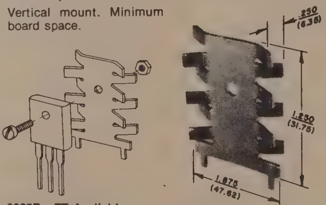
Vertical mount. Twist tabs for board mount.


1.00
(25.4)
1.187
(30.15)
.500
(12.70)

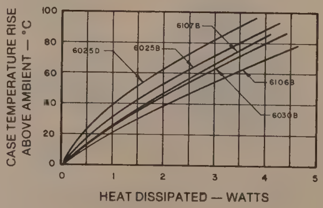
6030B - TT Available

6025B, 6025D

Vertical mount. Minimum board space.


.250
(6.35)
1.250
(31.75)
1.875
(47.62)

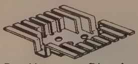
6025B - TT Available

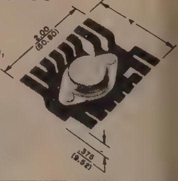


For TO-3 or TO-66

6060

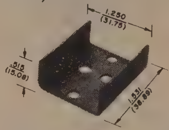
For TO-3. Lowest profile, high efficiency.

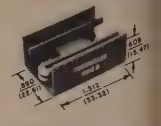



2.00
(50.80)
.375
(9.52)

Part No.	Dim. A
6060B	1.70(43.18)
6061B	2.25(57.15)

6103, 6166


1.250
(31.75)
.515
(15.08)
1.531
(38.89)


.609
(15.47)
.890
(22.61)
1.312
(33.32)

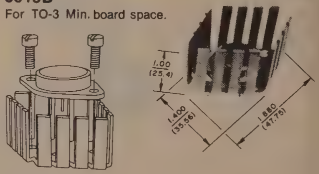
6103B Base for TO-3.

6103C Top (Not Shown).
Top is Gold Chromate for electrical contact.

6166B for TO-66. Two Piece.
NOTE: 6166B designates complete two piece assembly for TO-66. 6103B designates complete two piece assembly for TO-3.
To order top or base only add the word "top" or "base" to part no.

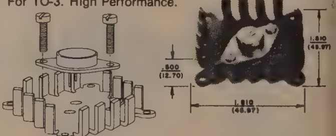
6015B

For TO-3 Min. board space.


1.00
(25.4)
1.400
(35.56)
1.880
(47.75)

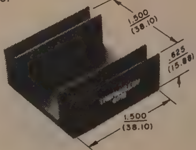
6001-B-2

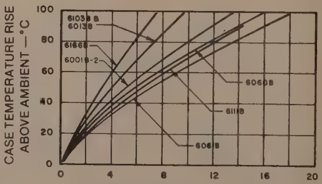
For TO-3. High Performance.


.500
(12.70)
1.810
(45.97)
1.810
(45.97)

6111B

For TO-66.


1.500
(38.10)
.625
(15.88)
1.500
(38.10)



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SEMICONDUCTOR ACCESSORIES

Thermalloy, Inc.
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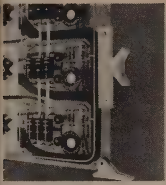
Dallas Tex 75234 · (214) 243-4321 · TWX 910-860-5542
NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

Pullers, Ejectors for PC Cards



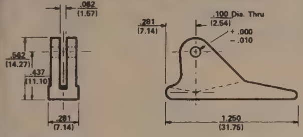
5005-08N Ejector

- .100" (2.54mm) diameter x ¼" (6.35mm) long roll pin supplied
- White nylon material

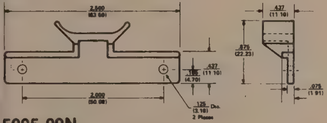
5005-09N Puller

- White nylon material

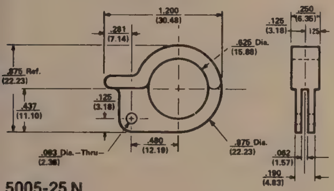
5005-25N Ejector-Puller


.062
(1.57)
.562
(14.27)
.437
(11.10)
.281
(7.14)
.281
(7.14)
.100 Dia. Thru
(2.54)
+ .000
− .010
1.250
(31.75)

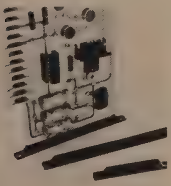
5005-08N


2.500
(63.50)
2.000
(50.80)
.185
(4.70)
.437
(11.10)
.125 Dia.
(3.18)
2 Places
.437
(11.10)
.875
(22.23)
.075
(1.91)

5005-09N

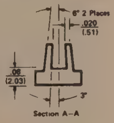

1.200
(30.48)
.281
(7.14)
.875 Ref.
(22.23)
.437
(11.10)
.125
(3.18)
.625 Dia.
(15.88)
.093 Dia.–Thru–
(2.36)
.480
(12.19)
.875 Dia.
(22.23)
.125
(3.18)
.250
(6.35)
.125
.062
(1.57)
.190
(4.83)

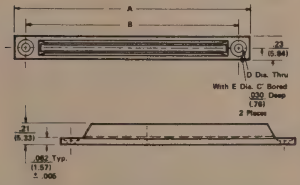
5005-25 N



8827-5 Guides

- For .062" (1.57mm) Boards
- Black nylon


6° 2 Places
.020
(.51)
.08
(2.03)
3°
Section A–A


A
B
.23
(5.84)
D Dia. Thru
With E Dia. C' Bored
.030 Deep
(.76)
2 Places
.21
(5.33)
.062 Typ.
(1.57)
± .005

Part No	Dia A		Dia B		Dia D		Dia E	
	Inches	MM	Inches	MM	Inches	MM	Inches	MM
8827-5	5.00	127 00	4 75	120 65	095	2 41	185	4 69

Epoxy and Thermalcote

Thermalbond

Thermally Conductive Epoxy Adhesive

THERMALBOND
THERMALBOND
Thermalloy

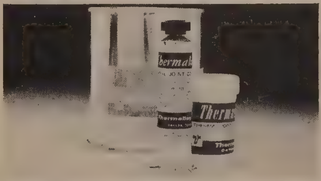
Thermalbond is a thermally conductive, high strength epoxy adhesive. It provides exceptional adhesion to copper, aluminum, steel, glass, ceramics, and most plastics. Thermalbond also has a coefficient of thermal expansion compatible with aluminum, copper, and brass making it particularly well suited for thermally bonding semiconductors and other components to chassis or heat sinks. It has good electrical insulating qualities and is one of the few epoxy adhesives suitable for cryogenic applications.

	SIZE
4951*	3½ oz. (100 Grams)
4952*	7 oz. (200 Grams)

*Matched Quan. of RT-7 Hardener included.

Thermalcote

Thermal Joint Compound


Thermal
Thermalloy

Thermalcote is a superior thermal joint compound for use with all heat sinks. It improves the transfer of thermal energy across the metal-to-metal interfaces between the transistor or rectifier case and the heat sink.

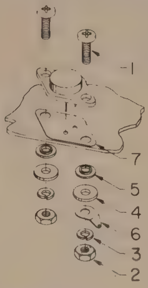
Thermalcote conducts heat approximately 30 times better than air and more than 4 times better than silicone grease. It is non-toxic, an excellent insulator, and extremely stable; neither caking nor running, from -40°F. to +400°F.

Typical Properties

Color	Opaque White
Working Temperature	-40 to +400°F
Maximum Temperature	800°F
Thermal Conductivity	0.430 Btu/(ft)(hr)(F°) 0.00178 CAL/(cm)(sec)(C°) 0.00745 watts/(cm)(C°) 0.0189 watts/(in)(C°)
Dielectric Strength (.050 gap)	300 volts/mil
Volume Resistivity	4 x 10^{14} ohm-cm
Solvent	Trichloroethylene

STOCK NO.	NET WEIGHT
249	1 oz. tube
250	2 oz. jar
251	1 lb.

Mounting Kits without Sockets



4801 & 4810

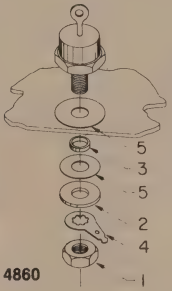
4801 for TO-3

Item	Description
1	Screw 6-32 x ½ Phil Pan Hd. Stainless Steel
2	Nut 6-32 Stainless Steel
3	Lock Washer No. 6 Stainless Steel
4	Flatwasher No. 6 Stainless Steel
5	Shoulder Washer
6	Solder Lugs, Tinned Brass
7	Thermalfilm I Insulator

NOTE: Clearance hole in chassis or heatsink must clear .200"(5.08) maximum shoulder O. D. (Part #5 above)

4810 for TO-66

- Same parts as 4801 except insulator for TO-66. 4-40 screws.

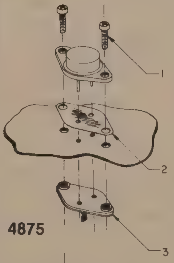


4860

4860 for DO-4 CASE

Item	Description
1	Nut 10-32, Stainless Steel
2	Flatwasher, Stainless Steel
3	Bushing, Teflon
4	Locking Terminal, Stainless Steel
5	Thermalfilm I Insulator

Mounting Kits with Sockets



4875

4875 for TO-3 CASE

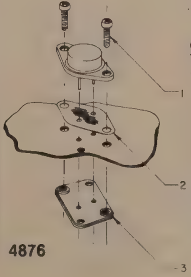
Item	Description
1	6-20 Screws
2	Thermalfilm I Insulator
3	Diamond Shaped Socket

NOTE: Clearance holes for socket shoulder insulator. .205(5.21)

4876 for TO-3 CASE

Item	Description
1	6-20 Screws
2	Thermalfilm I Insulator
3	Square Socket

NOTE: Clearance holes for socket shoulder insulator. .221(5.61)



4876

CONSIDER
THESE ADVANTAGES:

- Simplifies semiconductor mounting.
- Pre-packaged in heat sealed plastic bags for easy use by individual or assembly line.
- Repairs made more economical.
- Stock mounting hardware using one number for better control and identification. Your part number can be printed on plastic bag if requested.

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MOUNTING PADS AND LEAD CONVERSION PADS

Thermalloy, Inc.
Post Office Box 34829 • 2021 West Valley View Lane
Dallas, Tex. 75234 • (214) 243-4321 • TWX 910 860-5542
NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

Mounting Pads

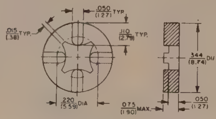
- Prevent heat damage during soldering
- Facilitate board clean up
- Prevent solder bridges
- Assure uniform device height
- Simplify board repair

Dimensions in inches ± .015(mm + .38).

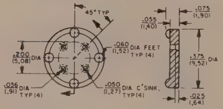
NOTE: Dimensions in inches/(mm) Max. tolerance ± .017(.43)

For TO-5

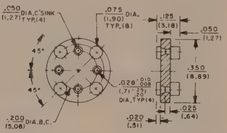
7717-3



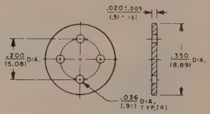
7717-4



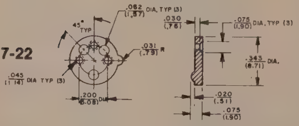
7717-5



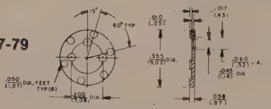
7717-15



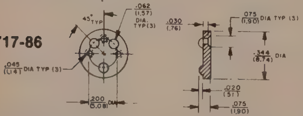
7717-22



7717-79

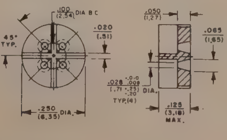


7717-86

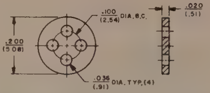


For TO-18

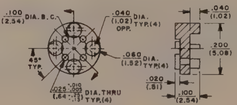
7717-7



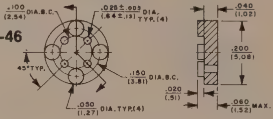
7717-16



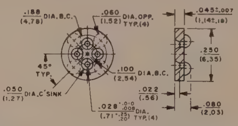
7717-18



7717-46

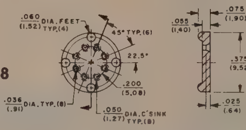


7717-89

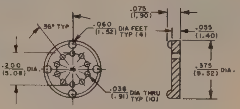


For IC

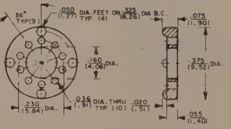
7717-8



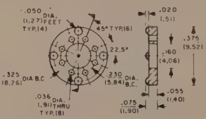
7117-10



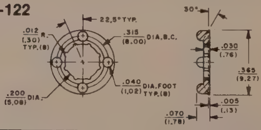
7117-30



7117-38

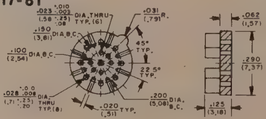


7117-122



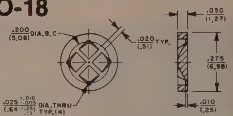
Universal

7717-81

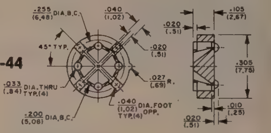


Lead Conversion For TO-18

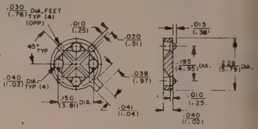
7717-43



7717-44

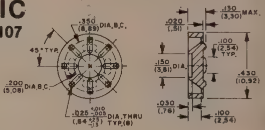


7717-93

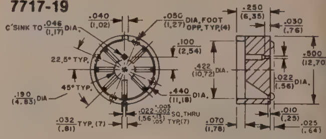


For IC

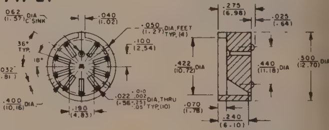
7717-107



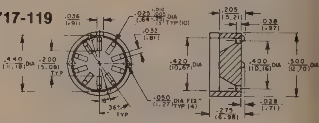
7717-19



7717-21

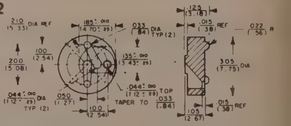


7717-119

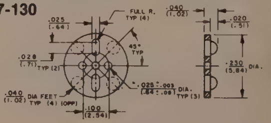


For Epoxy Transistor

7717-2



7717-130



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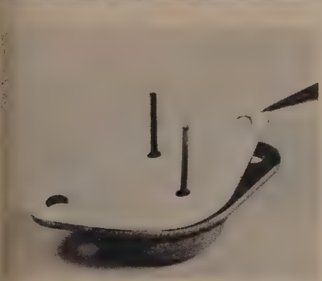
INSULATORS FOR SEMICONDUCTOR DEVICES

Thermalloy, Inc.
Post Office Box 34829 • 2021 West Valley View Lane
Dallas Tex 75234 • (214) 243-4321 • TWX 910-860 5542
NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

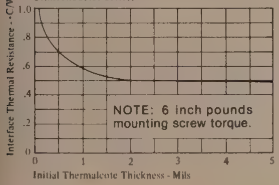
Insul-cote



- Pre-coated insulators for fast installation.
- Saves money by elimination of hand application of thermal grease.
- Provides uniform coating for maximum heat transfer (one mil minimum).

INSUL-COTE consists of a reliable THERMALFILM, Mica or other insulator PRE-COATED with Thermalcote thermal grease, neatly packaged and heat sealed as necessary between two strips of 2¾" wide tape. One side of the tape is separated into pull tabs for easy opening, or the tape may be "peeled" lengthwise exposing the Insulators.

Interface Thermal Resistance versus average initial Thermalcote thickness for a TO-3 Semiconductor device.



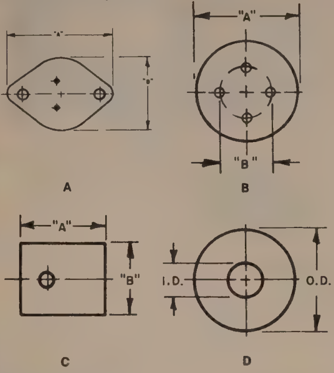
HOW TO ORDER

A partial listing of Insul-cote Insulators is shown below. Please consult Thermalloy, Inc.'s insulator listing for insulator descriptions. The insulator part number is denoted by the 5 or 6 digits of the insul-cote part number. AP denotes "Ammo Pack".

Insul-Cote with Thermalfilm I		Insul-Cote with .002" Mica
43-03-1 AP	43-03-4 AP	56-03-2AP
43-03-2 AP	43-66-1 AP	56-66-2 AP
43-03-3 AP	43-66-2 AP	56-77-2 AP
	43-77-2 AP	

- For individual packets, mica insulators or other INSUL-COTE pre-coated insulators or production dispenser, consult factory.

Insulator Shapes

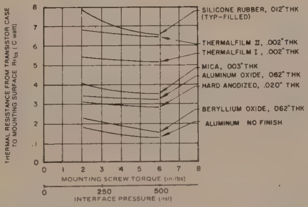


Thermalfilm

Thermalfilm I plastic film insulators are .002"(.051mm) thick and will not crack, peel, chip or fracture. 5400 volts/mil. -260°C to +400°C. Amber color. Thermalfilm II plastic film insulators have the same attractive qualities except are limited to device temperatures of 125°C. Green color.

Thermalfilm I Part No.	Thermalfilm II Part No.	Fig.	For Case.	Size A	Size B
43-03-1	46-03-1	A	TO-3	1.730"/(43.94)	1.250"/(31.75)
43-03-2	46-03-2	A	TO-3	1.655"/(42.04)	1.063"/(27.00)
43-03-3	46-03-3	A	TO-3	1.655"/(42.04)	1.063"/(27.00)
43-03-4		A	TO-3	1.563"/(39.70)	1.050"/(26.67)
43-05-1		B	TO-5	.390"/(9.91)	.200"/(5.08)
43-18-1		B	TO-18	.250"/(6.35)	.100"/(2.54)
43-66-1*		A	TO-66	1.312"/(33.32)	.762"/(19.35)
43-66-2*	46-66-2	A	TO-66	1.312"/(33.32)	.762"/(19.35)
43-77-2	46-77-2	C	Pl Pr	.687"/(17.45)	.562"/(14.27)
				I.D.	O.D.
43-02-10		D	Stud	.203"/(5.16)	.562"/(14.27)
43-02-23		D	Stud	.265"/(6.73)	.812"/(20.62)

* lead holes .062(1.57) for -1
.093(2.36) for -2



Interface Thermal Resistance versus Mounting Screw Torque and Interface Pressure for a TO-3 semiconductor device using various insulating materials. Thermalcote Thermal Joint Compound used in interface area.

Beryllium Oxide** Ceramic Insulators

Part Number	Figure	For Case	A	B
4005	B*	TO-5	.360"/(9.44)	.360"/(9.44)
4003	A	TO-3	1.561"/(39.65)	1.050"/(26.67)
4066	A	TO-66	1.250"/(31.75)	.700"/(17.78)
B 470-235-40	D	Washer	.470"/(11.938)	.235"/(5.969)
B 800-260-62	D	Washer	.800"/(20.320)	.260"/(6.604)

* 3 holes
**Also available in Aluminum Oxide. Contact factory for part no.

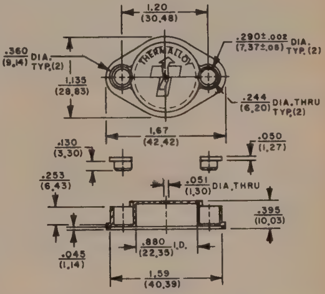
Hard Anodized Aluminum

Hard coated per Mil - A8625 Type III . . . 020(.508) Thick Aluminum. 400 V. D.C.

Part Number	Figure	For Case	A	B
4726A	A	TO-3	1.793"/(45.54)	1.063"/(27)
.220"/(5.59)	Pin Holes			
4703	A	TO-3	1.793"/(45.54)	1.063"/(27)
.090"/(2.29)	Pin Holes			

Insulator Cover

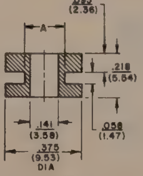
8903NB TO-3 Insulating Cover



- Black nylon
- Lock washers furnished for electrical connection of mounting screws to collector.
- Test probe hole. Screw covers.
- For red 94V-O self-extinguishing material, consult factory.

103, 109 Teflon Insulators

- Model 109 fits all Thermalloy, Inc. coolers except Texas size.
- Model 105 fits Texas size.



FOR EXTRUDED HEAT SINKS

MODEL	FITS NOTCH In.	FITS NOTCH mm.
103	.190	4.83
109	.250	6.35

Dim	Inches	Millimeters
103		
A	.193 +.006 -.000	4.90 +.15 -.00
109		
A	.250 +.006 -.000	6.35 +.15 -.00

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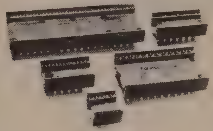
SOCKETS

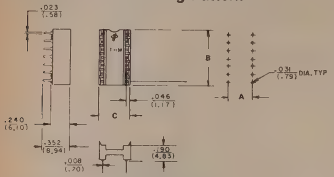
Thermalloy, Inc.
Post Office Box 34829 • 2021 West Valley View Lane
Dallas Tex 75234 • (214) 243-4321 • TWX 910-860-5542
NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

8204 Series — Low Profile DIP Sockets. 8, 14, 16, 24, 40 Pin.



- Phosphor Bronze pre-tinned contacts
- Anti-solder wicking design
- High contact force for electrical integrity
- Maximum packaging density
- Stand-off projections allow easy rinsing
- Accept full range of IC pin sizes
- Wide angle lead-in for easy IC insertion
- Visual marking assures proper insertion

Dimensions and Drilling Pattern



TOLERANCE $\frac{.xxx}{(.xx)} = \frac{\pm .005''}{(\pm .13mm)}$

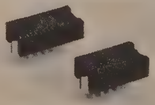
Part Numbers and Dimensions

Part Number	No. Pins	A	B	C
8204 NF 408-1	8	.300"/(7.62)	.400"/(10.16)	.400"/(10.16)
8204 NF 414-1	14	.300"/(7.62)	.700"/(17.78)	.400"/(10.16)
8204 NF 416-1	16	.300"/(7.62)	.800"/(20.32)	.400"/(10.16)
8204 NF 424-1	24	.600"/(15.24)	1.200"/(30.48)	.700"/(17.78)
8204 NF 440-1	40	.600"/(15.24)	2.000"/(50.8)	.700"/(17.78)

MATERIALS AND SPECIFICATIONS

Body	Glass filled Nylon
Contacts	PhBr - Tin/Lead pre-plate
Contact Resistance	30 milliohms
Interlead Capacitance	1.0 picofarad
Maximum Current	1.5 amperes/contact
Voltage Breakdown	1000 volts minimum
Temperature Range	-55°C to +105°C

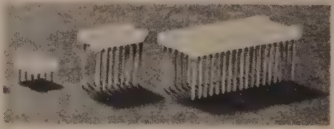
8200 Series — DIP Sockets.



- Same quality features and dimensions as 8204 Series except .240"(6.09) IC base above PC Board.

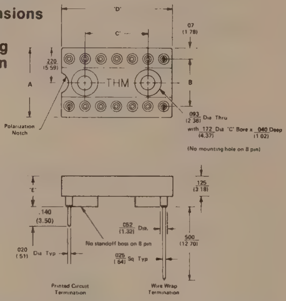
Part Number	No. Pins	Contact Material	Length
8200 NF 414	14	Ph Br	.700(17.78)
8200 NF 416	16	Ph Br	.800(20.32)

8201 Series — High Rel Low Profile DIP Sockets



- Recessed body for easy IC Removal
- Machined Be Cu Contact Springs for low contact resistance and good device retention
- Closed contact cup precludes solder wicking

Dimensions and Drilling Pattern



	A	B
8-18 Pin	.440/(11.18)	.300/(7.62)
24-40 Pin	.740/(18.80)	.600/(15.24)

NOTE: 24-40 Pin have mounting slots.

Part Number	No. of Contacts	+.010(.25) C	+.010(.25) D	+.010(.25) E	Contact Plating	Sleeve Plating
8201 WE 608-1 8201 WE 308-3	8	— (—)	.400 (10.2)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 614-1 8201 WE 314-3	14	.400 (10.2)	.700 (17.8)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 616-1 8201 WE 316-3	16	.500 (12.7)	.800 (20.3)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 618-1 8201 WE 318-3	18	.600 (15.2)	.900 (22.9)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 624-1 8201 WE 324-3	24	.650 (16.5)	1.200 (30.5)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 628-1 8201 WE 328-3	28	.650 (16.5)	1.400 (35.6)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 636-1 8201 WE 336-3	36	.750 (19.1)	1.800 (45.7)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold
8201 WE 640-1 8201 WE 340-3	40	.750 (19.1)	2.000 (50.8)	.150/(3.81) .200/(5.08)	Gold Gold	Tin Gold

-1 suffix denotes solder tail. -3 denotes W. W. post. P C contact sockets (-1) also available with Gold plated sleeve. (Part #8201 WE 3xx-1.)

INSULATOR — Glass filled nylon (105°C Maximum operating temp.)
CONTACT — Beryllium Copper, gold over nickel plated
SLEEVE — Brass

8113 Series Molded TO-3 Socket

- 5 Amperes continous, 15 peak.
- 6-32 threads in mounting plate.
- For heat sinks to ¼" thick. Length 1 9/16 (39.69). Width 11/16 (17.46). Phenolic body. Cad plated. Ph Br Contacts.

Part # 8113 PF 603

8120 Series — Fluorocarbon TO-5 Sockets.

Style 1 Style 2

- for TO-5 package size.
- Gold plated Be Cu contacts.

Part Number	No. of Contacts	Style	Pin Circle
8120 TE 303-2	3	1	.200"(5.08mm)
8120 TE 303-4	3	1	.200"(5.08mm)
8120 TE 304-2	4	1	.200"(5.08mm)
8120 TE 306-2	6	1	.200"(5.08mm)
8120 TE 308-2	8	1	.230"(5.84mm)
8120 TE 308-4	8	1	.230"(5.84mm)
8121 TE 308-1	8	2	.230"(5.84mm)
8122 TE 308-2	8	1	.200"(5.08mm)
8122 TE 308-4	8	1	.200"(5.08mm)
8122 TE 310-2	10	1	.230"(5.84mm)
8122 TE 310-4	10	1	.230"(5.84mm)
8122 TE 312-4	12	1	.280"(7.11mm)
8123 TE 308-1	8	2	.200"(5.08mm)
8123 TE 310-1	10	2	.230"(5.84mm)
8123 TE 312-1	12	2	.280"(7.11mm)

Suffixes = -1. PC Mount -2 long solder pin. -4 solder cup.

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NUMBER ONE IN SEMICONDUCTOR ACCESSORIES

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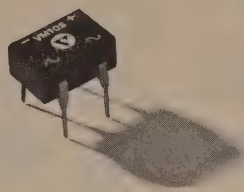
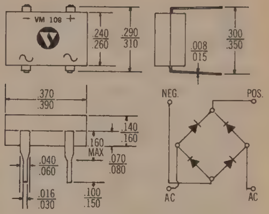
VARO SEMICONDUCTOR, INC.

VARO
P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

DIB 1 AMP DUAL IN-LINE BRIDGE

- **Glass-passivated diode chips**
- **Standard .10″ grid DIP lead spacing 2 DIB's will fit in standard 14 pin DIP socket**
- **25V, 50V, 100V, 200V, 400V, 600V, 800V & 1000V (V_{RRM})**
- **25A peak one-half cycle surge current**



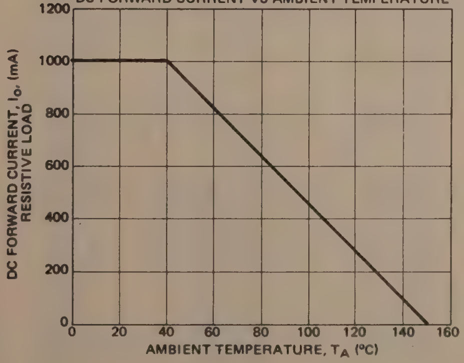


SPECIFICATIONS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

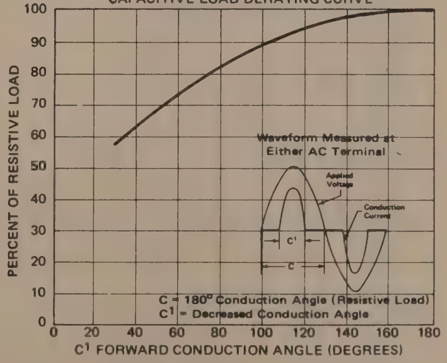
Varo Part Number	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	RMS Reverse Voltage [$V_{R(RMS)}$] (Volts)	Peak Surge Current ½ Cycle @ 60 Hz (I_{FSM}) (Amps)	DC Fwd. Current @ $T_A = 40°C$ (I_O) (Amps)	Junction Oper. & Stg. Temp. Range (T_J, T_{STG}) (°C)	Max. Inst. Fwd. Voltage Drop @ I_O (V_{FM}) (Volts/Leg)	Max. Rev. Current @ Rated V_{RRM} & $T_A = 40°C$ (I_{RM}) (μA/Leg)	Pricing 1-99	Pricing 100-999
VM25	25	17	25	1	−50 to +150	1.2	5.0	**$0.71**	**$0.46**
VM08	50	35	25	1	−50 to +150	1.2	5.0	**.73**	**.48**
VM18	100	70	25	1	−50 to +150	1.2	5.0	**.77**	**.52**
VM28	200	140	25	1	−50 to +150	1.2	5.0	**.83**	**.55**
VM48	400	280	25	1	−50 to +150	1.2	5.0	**.89**	**.58**
VM68	600	420	25	1	−50 to +150	1.2	5.0	**.97**	**.64**
VM88	800	560	25	1	−50 to +150	1.2	5.0	**1.29**	**.85**
VM108	1000	700	25	1	−50 to +150	1.2	5.0	**1.40**	**.95**

Write for Data Sheet DLS051

DC FORWARD CURRENT VS AMBIENT TEMPERATURE



CAPACITIVE LOAD DERATING CURVE



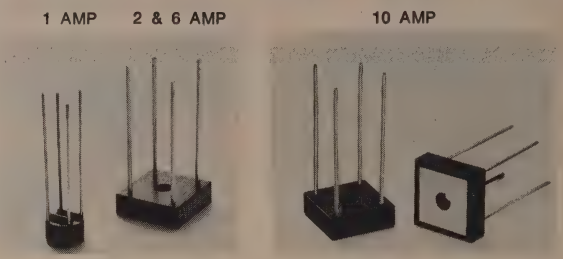
VARO SEMICONDUCTOR, INC.

P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

EBR EPOXY BRIDGE RECTIFIERS

- **Controlled Avalanche series has 250V, 450V, 650V and 850V minimum avalanche voltages (V_{BR})**
- **Non-controlled Avalanche series with 50V, 100V, 200V, 400V, 600V and 800V, and 1000 (V_{RRM})**
- **Fast recovery series with 200 nanosec. max. reverse recovery (t_{rr}).**

The EBR bridge rectifiers combine economical cost, high reliability and circuit-to-case electrical isolation. They are available in a wide range of current and voltage ratings.



MAXIMUM RATINGS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

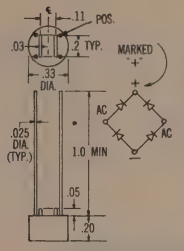
Varo Part Number	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	RMS Reverse Voltage [$V_{R(RMS)}$] (Volts)	Power Dissipation (100 µsec sq. wave) (P_{RM}) (Watts)	Peak Surge Current (½ cycle @ 60 Hz, Non-Rep) (I_{FSM}) (Amps)	DC Forward Current (I_O) (Amps)	Junction Operating Stg. Temp. Range (T_J, T_{STG}) (°C)
1 AMP CONTROLLED AVALANCHE						
VE27	200	140	200	25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE47	400	280	200	25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE67	600	420	200	25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE87	800	560	200	25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
1 AMP NON-CONTROLLED AVALANCHE						
W110	25	17	NA	25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE08	50	35		25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE18	100	70		25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE28	200	140		25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE48	400	280		25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE68	600	420		25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE88	800	560		25 @ T_A = 65°C	1 @ T_A = 65°C	−50 to +150
VE108	1000	700		25 @ T_A = 65°C	1 @ T_A =65°C	−50 to +150
1 AMP FAST RECOVERY						
VE08X	50	35	NA	17 @ T_A = 40°C	1 @ T_A = 40°C	−50 to +125
VE18X	100	70		17 @ T_A = 40°C	1 @ T_A = 40°C	−50 to +125
VE28X	200	140		17 @ T_A = 40°C	1 @ T_A = 40°C	−50 to +125
VE48X	400	280		17 @ T_A = 40°C	1 @ T_A = 40°C	−50 to +125
VE68X	600	560		17 @ T_A = 40°C	1 @ T_A = 40°C	−50 to +125
2 AMP CONTROLLED AVALANCHE						
VS247 *	200	140	300	50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS447 *	400	280	300	50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS647 *	600	420	300	50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS847 *	800	560	300	50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
2 AMP NON-CONTROLLED AVALANCHE						
VS048 *	50	35	NA	50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS148 *	100	70		50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS248 *	200	140		50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS448 *	400	280		50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS648 *	600	420		50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS848 *	800	560		50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
VS1048 *	1000	700		50 @ T_A = 60°C	2 @ T_A = 60°C	−50 to +150
2 AMP FAST RECOVERY						
VS048X *	50	35	NA	35 @ T_A = 45°C	2 @ T_A = 45°C	−50 to +135
VS148X *	100	70		35 @ T_A = 45°C	2 @ T_A = 45°C	−50 to +135
VS248X *	200	140		35 @ T_A = 45°C	2 @ T_A = 45°C	−50 to +135
VS448X *	400	280		35 @ T_A = 45°C	2 @ T_A = 45°C	−50 to +135
VS648X *	600	420		35 @ T_A = 45°C	2 @ T_A = 45°C	−50 to +135
6 AMP CONTROLLED AVALANCHE (See Note 1)						
VH247 *	200	140	400	100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH447 *	400	280	400	100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH647 *	600	420	400	100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH847 *	800	560	400	100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH1048 *	1000	700	400	100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
6 AMP NON-CONTROLLED AVALANCHE (See Note 1)						
VH048 *	50	35	NA	100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH148 *	100	70		100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH248 *	200	140		100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH448 *	400	280		100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH648 *	600	420		100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
VH848 *	800	560		100 @ T_{HS} = 80°C	6 @ T_{HS} = 80°C	−50 to +150
5 AMP FAST RECOVERY (See Note 1)						
VH048X *	50	35	NA	65 @ T_{HS} = 60°C	5 @ T_{HS} = 60°C	−50 to +135
VH148X *	100	70		65 @ T_{HS} = 60°C	5 @ T_{HS} = 60°C	−50 to +135
VH248X *	200	140		65 @ T_{HS} = 60°C	5 @ T_{HS} = 60°C	−50 to +135
VH448X *	400	280		65 @ T_{HS} = 60°C	5 @ T_{HS} = 60°C	−50 to +135
VH648X *	600	560		65 @ T_{HS} = 60°C	5 @ T_{HS} = 60°C	−50 to +135
10 AMP CONTROLLED AVALANCHE						
VJ247	200	140	400	100 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ447	400	280	400	100 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ647	600	420	400	100 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ847	800	560	400	100 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
10 AMP NON-CONTROLLED AVALANCHE						
VJ048	50	35	NA	100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
VJ148	100	70		100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
VJ248	200	140		100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
VJ448	400	280		100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
VJ648	600	420		100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
VJ848	800	560		100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
VJ1048	1000	700		100 @ T_C = 60°C	10 @ T_C = 80°C	−50 to +150
10 AMP FAST RECOVERY						
VJ048X	50	35	NA	75 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ148X	100	70		75 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ248X	200	140		75 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ448X	400	280		75 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150
VJ648X	600	420		75 @ T_C = 60°C	10 @ T_C = 60°C	−50 to +150

NOTE 1: Mount to heat sink as shown on next page for full rated I_O.

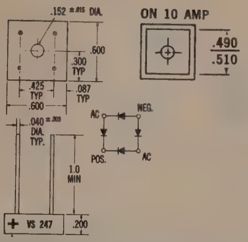
*Asterisk indicates recognition under Component Program of Underwriter's Laboratories, Inc.

VARO
VARO SEMICONDUCTOR, INC.
P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

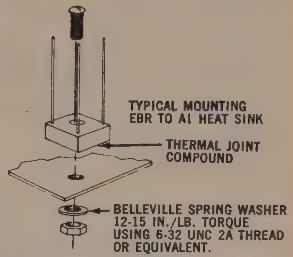
EBR EPOXY BRIDGE RECTIFIERS



1 AMP



2A, 6A & 10A


TYPICAL MOUNTING EBR TO Al HEAT SINK
THERMAL JOINT COMPOUND
BELLEVILLE SPRING WASHER 12-15 IN./LB. TORQUE USING 6-32 UNC 2A THREAD OR EQUIVALENT.

HEAT SINK MOUNTING

ELECTRICAL CHARACTERISTICS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Avalanche Voltage (V_{BR})		Max. Inst. Forward Voltage Drop @ Io (V_{FM})	Max. Reverse Current @ Rated V_{RRM} (I_{RM})		Max. Reverse Recovery Time (t_{rr})	Write For Data Sheet Number	PRICING		
	Min. Volts	Max. Volts	(Volts/Leg)	($T_A = 40°C$) (µA/Leg)	($T_A = 150°C$) (mA/Leg)	(Nanosec.)		1-24	25-99	100-999
1 AMP CONTROLLED AVALANCHE										
VE27	250	700	1.2	5	0.1	NA	DLS-028	$1.73	$1.46	$1.21
VE47	450	900	1.2	5	0.1		DLS-028	1.88	1.58	1.32
VE67	650	1100	1.2	5	0.1		DLS-028	2.30	1.93	1.60
VE87	850	1300	1.2	5	0.1		DLS-028	2.59	2.17	1.76
1 AMP NON-CONTROLLED AVALANCHE										
W110	NA	NA	1.2	5	0.1	NA	DLS-028	1.19	1.00	.81
VE08			1.2	5	0.1		DLS-028	1.24	1.04	.85
VE18			1.2	5	0.1		DLS-028	1.32	1.10	.90
VE28			1.2	5	0.1		DLS-028	1.44	1.21	1.00
VE48			1.2	5	0.1		DLS-028	1.38	1.32	1.10
VE68			1.2	5	0.1		DLS-028	1.95	1.64	1.35
VE88			1.2	5	0.1		DLS-028	2.15	1.81	1.48
VE108			1.2	5	0.1		DLS-028	2.36	1.98	1.63
1 AMP FAST RECOVERY (See Note 2)										
VE08X	NA	NA	1.5	10	2.0	200	DLS-043	1.75	1.47	1.21
VE18X			1.5	10	2.0	200	DLS-043	1.96	1.65	1.35
VE28X			1.5	10	2.0	200	DLS-043	2.16	1.82	1.50
VE48X			1.5	10	2.0	200	DLS-043	2.36	1.98	1.65
VE68X			1.5	10	2.0	200	DLS-043	2.60	2.18	1.82
2 AMP CONTROLLED AVALANCHE										
VS247	250	700	1.2	5	0.1	NA	DLS-021	1.82	1.52	1.27
VS447	450	900	1.2	5	0.1		DLS-021	1.77	1.65	1.39
VS647	650	1100	1.2	5	0.1		DLS-021	2.42	2.03	1.73
VS847	850	1300	1.2	5	0.1		DLS-021	2.81	2.36	1.90
2 AMP NON-CONTROLLED AVALANCHE										
VS048	NA	NA	1.2	5	0.1	NA	DLS-021	1.30	1.09	.89
VS148			1.2	5	0.1		DLS-021	1.38	1.16	.94
VS248			1.2	5	0.1		DLS-021	1.51	1.27	1.05
VS448			1.2	5	0.1		DLS-021	1.65	1.39	1.15
VS648			1.2	5	0.1		DLS-021	2.06	1.73	1.47
VS848			1.2	5	0.1		DLS-021	2.26	1.90	1.61
VS1048			1.2	5	0.1		DLS-021	2.49	2.09	1.78
2 AMP FAST RECOVERY (See Note 2)										
VS048X	NA	NA	1.5	10	4.0	200	DLS-044	1.94	1.63	1.35
VS148X			1.5	10	4.0	200	DLS-044	2.16	1.81	1.50
VS248X			1.5	10	4.0	200	DLS-044	2.38	2.00	1.65
VS448X			1.5	10	4.0	200	DLS-044	2.60	1.90	1.81
VS648X			1.5	10	4.0	200	DLS-044	2.90	2.44	1.99
6 AMP CONTROLLED AVALANCHE										
VH247	250	700	1.3	5	0.1	NA	DLS-029	2.97	2.48	2.04
VH447	450	900	1.3	5	0.1		DLS-029	3.42	2.85	2.34
VH647	650	1100	1.3	5	0.1		DLS-029	3.93	3.29	2.70
VH847	850	1300	1.3	5	0.1		DLS-029	4.46	3.72	3.03
6 AMP NON-CONTROLLED AVALANCHE										
VH048	NA	NA	1.3	5	0.1	NA	DLS-029	2.08	1.73	1.43
VH148			1.3	5	0.1		DLS-029	2.32	1.93	1.58
VH248			1.3	5	0.1		DLS-029	2.58	2.15	1.75
VH448			1.3	5	0.1		DLS-029	2.99	2.49	2.03
VH648			1.3	5	0.1		DLS-029	3.46	2.88	2.35
VH848			1.3	5	0.1		DLS-029	3.70	3.08	2.50
VH1048			1.3	5	0.1		DLS-029	4.06	3.38	2.75
5 AMP FAST RECOVERY (See Note 2)										
VH048X	NA	NA	1.4	10	4.0	200	DLS-040	2.59	2.16	1.78
VH148X			1.4	10	4.0	200	DLS-040	2.88	2.40	1.98
VH248X			1.4	10	4.0	200	DLS-040	3.23	2.69	2.20
VH448X			1.4	10	4.0	200	DLS-040	3.55	2.96	2.46
VH648X			1.4	10	4.0	200	DLS-040	3.91	3.26	2.71
10 AMP CONTROLLED AVALANCHE										
VJ247	250	700	1.3	5	0.1	NA	DLS-042	3.25	2.71	2.22
VJ447	450	900	1.3	5	0.1		DLS-042	3.75	3.12	2.56
VJ647	650	1100	1.3	5	0.1		DLS-042	4.33	3.61	2.78
VJ847	850	1300	1.3	5	0.1		DLS-042	4.73	3.94	3.08
10 AMP NON-CONTROLLED AVALANCHE										
VJ048	NA	NA	1.3	5	0.1	NA	DLS-042	2.32	1.93	1.58
VJ148			1.3	5	0.1		DLS-042	2.54	2.12	1.74
VJ248			1.3	5	0.1		DLS-042	2.83	2.36	1.92
VJ448			1.3	5	0.1		DLS-042	3.29	2.74	2.23
VJ648			1.3	5	0.1		DLS-042	3.82	3.18	2.43
VJ848			1.3	5	0.1		DLS-042	4.06	3.38	2.63
VJ1048			1.3	5	0.1		DLS-042	4.45	3.71	2.89
10 AMP FAST RECOVERY (See Note 2)										
VJ048X	NA	NA	1.5	10	2.0	200	DLS-046	2.84	2.37	1.96
VJ148X			1.5	10	2.0	200	DLS-046	3.17	2.64	2.18
VJ248X			1.5	10	2.0	200	DLS-046	3.55	2.96	2.42
VJ448X			1.5	10	2.0	200	DLS-046	3.91	3.26	2.71
VJ648X			1.5	10	2.0	200	DLS-046	4.31	3.59	2.98

NOTE 2: t_{rr} measured at I_F = 1 Amp, I_R = 2 Amps, Recovery to $I_{R(REC)}$ = .2 Amps.

VARO SEMICONDUCTOR, INC.

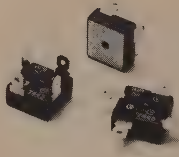
VARO

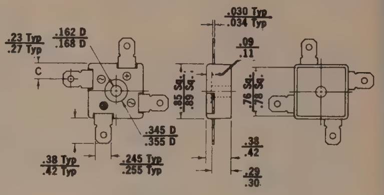
P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

EBR™

EPOXY BRIDGE RECTIFIERS
15A and 30A Single Phase, Full Wave

- **Controlled Avalanche series has 250V, 450V, 650V and 850V minimum avalanche voltages (V_{BR})**
- **Non-controlled Avalanche series with 50V, 100V, 200V, 400V, 600V, 800V and 1000V (V_{RRM})**
- **Fast recovery series with 200 nanosec. maximum reverse recovery (t_{rr}).**
- **1500V min. circuit-to-case insulation strength.**





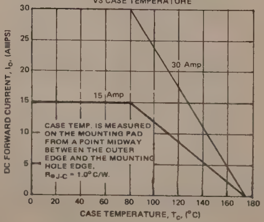
MAXIMUM RATINGS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	RMS Reverse Voltage [$V_{R(RMS)}$] (Volts)	Power Dissipation (100 µsec square wave) (P_{RM}) (Watts)	Peak Surge Current (½ Cycle @ 60 Hz Non-Rep) (I_{FSM}) (Amps)	Peak Surge Current (1 sec @ 60 Hz & Tc = 80°C) (I_{FRM}) (Amps)	DC Forward Current @ Tc = 80°C (I_O) (Amps)	Junction Oper & Stg. Temp. Range (T_J, T_{STG}) (°C)
15 AMP CONTROLLED AVALANCHE							
VL247	200	140	600	100	30	15	−50 to +175
VL447	400	280	600	100	30	15	−50 to +175
VL647	600	420	600	100	30	15	−50 to +175
VL847	800	560	600	100	30	15	−50 to +175
15 AMP NON-CONTROLLED AVALANCHE							
VL048	50	35	NA	100	30	15	−50 to +175
VL148	100	70		100	30	15	−50 to +175
VL248	200	140		100	30	15	−50 to +175
VL448	400	280		100	30	15	−50 to +175
VL648	600	420		100	30	15	−50 to +175
VL848	800	560		100	30	15	−50 to +175
VL1048	1000	700		100	30	15	−50 to +175
30 AMP CONTROLLED AVALANCHE							
VK247	200	140	1500	300	75	30	−50 to +175
VK447	400	280	1500	300	75	30	−50 to +175
VK647	600	420	1500	300	75	30	−50 to +175
VK847	800	560	1500	300	75	30	−50 to +175
30 AMP NON-CONTROLLED AVALANCHE							
VK048	50	35	NA	300	75	30	−50 to +175
VK148	100	70		300	75	30	−50 to +175
VK248	200	140		300	75	30	−50 to +175
VK448	400	280		300	75	30	−50 to +175
VK648	600	420		300	75	30	−50 to +175
VK848	800	560		300	75	30	−50 to +175
VK1048	1000	700		300	75	30	−50 to +175

ELECTRICAL CHARACTERISTICS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

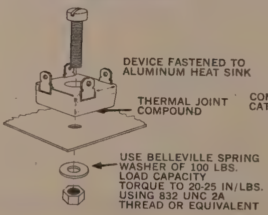
Varo Part Number	Avalanche Voltage (V_{BR}) (Min. Volts)	Avalanche Voltage (V_{BR}) (Max. Volts)	Max. Inst. Fwd. Voltage Drop @ Io (V_{FM}) (Volts/Leg)	Max. Rev. Cur. @ Rated V_{RM} & T_J = 40°C (I_{RM}) (µ/Leg)	Max. Rev. Cur. @ Rated V_{RM} & T_J = 175°C (I_{RM}) (mA/Leg)	Max. Thermal Resist. Junction to Case ($R_{\theta J\text{-}C}$) (°C/W)	Write For Data Sheet Number	PRICING 1-24	PRICING 25-99	PRICING 100-999
15 AMP CONTROLLED AVALANCHE										
VL247	250	700	1.4	5	0.5	1.5	DLS-054	$4.41	$3.67	$2.94
VL447	450	900	1.4	5	0.5	1.5	DLS-054	4.54	3.79	3.03
VL647	650	1100	1.4	5	0.5	1.5	DLS-054	5.12	4.27	3.33
VL847	850	1300	1.4	5	0.5	1.5	DLS-054	5.48	4.57	3.63
15 AMP NON-CONTROLLED AVALANCHE										
VL048	NA		1.4	5	0.5	1.5	DLS-054	3.41	2.84	2.29
VL148			1.4	5	0.5	1.5	DLS-054	3.55	2.96	2.38
VL248			1.4	5	0.5	1.5	DLS-054	3.65	3.04	2.44
VL448			1.4	5	0.5	1.5	DLS-054	3.76	3.13	2.51
VL648			1.4	5	0.5	1.5	DLS-054	4.23	3.53	2.77
VL848			1.4	5	0.5	1.5	DLS-054	4.53	3.78	3.01
VL1048			1.4	5	0.5	1.5	DLS-054	4.78	3.98	3.19
30 AMP CONTROLLED AVALANCHE										
VK247	250	700	1.4	10	1.0	1.0	DLS-055	5.00	4.16	3.32
VK447	450	900	1.4	10	1.0	1.0	DLS-055	5.20	4.33	3.47
VK647	650	1100	1.4	10	1.0	1.0	DLS-055	5.56	4.63	3.67
VK847	850	1300	1.4	10	1.0	1.0	DLS-055	6.38	5.31	4.19
30 AMP NON-CONTROLLED AVALANCHE										
VK048	NA		1.4	10	1.0	1.0	DLS-055	3.92	3.27	2.62
VK148			1.4	10	1.0	1.0	DLS-055	4.02	3.35	2.68
VK248			1.4	10	1.0	1.0	DLS-055	4.14	3.45	2.76
VK448			1.4	10	1.0	1.0	DLS-055	4.31	3.59	2.88
VK648			1.4	10	1.0	1.0	DLS-055	4.60	3.83	3.05
VK848			1.4	10	1.0	1.0	DLS-055	5.27	4.39	3.48
VK1048			1.4	10	1.0	1.0	DLS-055	5.57	4.64	3.68

DC FORWARD CURRENT VS CASE TEMPERATURE

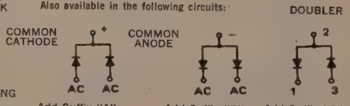


DC Forward Current at T_A=40°C and no heat sink=5 Amps.

TYPICAL MOUNTING


DEVICE FASTENED TO ALUMINUM HEAT SINK
THERMAL JOINT COMPOUND
USE BELLEVILLE SPRING WASHER OF 100 LBS. LOAD CAPACITY TORQUE TO 20-25 IN/LBS. USING 832 UNC 2A THREAD OR EQUIVALENT

Also available in the following circuits:

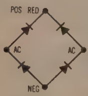


Add Suffix "A" to Part No.

Add Suffix "B" to Part No.

Add Suffix "C" to Part No.

IBR®



SILICON AVALANCHE INTEGRATED BRIDGE RECTIFIERS

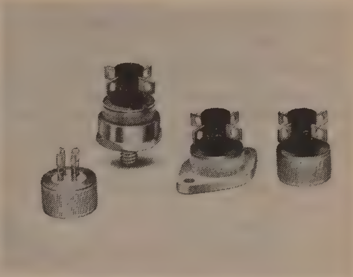
10 AMP & 25 AMP SINGLE PHASE, FULL WAVE

- Operation to full rated load at 100°C, T_C
- 250V, 450V, 650V & 850V minimum avalanche voltages (V_{BR})
- Fast recovery series with 200 nanosec recovery time (t_{rr})
- 2000 V minimum circuit-to-case isolation.

The IBR offers full wave rectification in a rigidly constructed, hermetically sealed, welded package. The controlled avalanche characteristics permit the use of lower PRV safety factors for junction protection from transient over voltages. Proper heat sinking allows great flexibility in DC output current ranges.

These characteristics plus the electrically isolated case allows the IBR to be used in applications where space, current and cost requirements have previously not allowed the use of semiconductors.

Three mounting options available, press-fit, stud mount, TO-3 outline flange.



MAXIMUM RATINGS @ 60 Hz RESISTIVE AND INDUCTIVE LOAD, $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	RMS Reverse Voltage [$V_{R(RMS)}$] (Volts)	Power Dissipation (100 μsec sq. wave) (P_{RM}) (Watts)	Peak Surge Current (½ cycle @ 60 Hz, Non-Rep) (I_{FSM}) (Amps)	DC Forward Current @ $T_C = 100°C$ (I_O)[1] (Amps)	Junction Operating Stg. Temp. Range (T_J, T_{STG}) (°C)
10 AMP CONTROLLED AVALANCHE						
IN4436	200	140	600	100	10	−65 to +160
IN4437	400	280	600	100	10	−65 to +160
IN4438	600	400	600	100	10	−65 to +160
IN4439	800	560	600	100	10	−65 to +160
10 AMP FAST RECOVERY (See Note 4)						
VR100X	100	70	NA	75	10	−65 to +150
VR200X	200	140		75	10	−65 to +150
VR400X	400	280		75	10	−65 to +150
VR600X	600	400		75	10	−65 to +150
25 AMP CONTROLLED AVALANCHE						
VT200	200	140	1500	250	25	−65 to +180
VT400	400	280	1500	250	25	−65 to +180
VT600	600	400	1500	250	25	−65 to +180
VT800	800	560	1500	250	25	−65 to +180
25 AMP FAST RECOVERY (See Note 4)						
VY100X	100	70	NA	150	25	−65 to +150
VY200X	200	140		150	25	−65 to +150
VY400X	400	280		150	25	−65 to +150
VY600X	600	400		150	25	−65 to +150

ELECTRICAL CHARACTERISTICS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Avalanche Voltage (V_{BR}) (Min. Volts)	Avalanche Voltage (V_{BR}) (Max. Volts)	Max. Inst. Forward Voltage Drop at I_O (V_{FM}) (Volts/Leg)	Max. Reverse Current @ Rated V_{RRM} & Indicated T_C (I_{RM}) (mA/Leg)	Max. Reverse Recovery Time (t_{rr})[2] (nanosec.)	Max. Thermal Res. Junction-to-Case ($R\theta_{J-C}$) (°C/Watt)	Write For Data Sheet Number	Pricing[3] 1-24	Pricing[3] 1-99	Pricing[3] 100-999
10 AMP CONTROLLED AVALANCHE										
IN4436	250	700	1.2	0.2 @ 160°C	NA	1.5	DLS-022	$4.98	$4.15	$3.05
IN4437	450	900	1.2	0.2 @ 160°C		1.5	DLS-022	6.54	5.45	4.00
IN4438	650	1100	1.2	0.2 @ 160°C		1.5	DLS-022	8.94	7.45	5.45
IN4439	850	1300	1.2	0.2 @ 160°C		1.5	DLS-022	10.73	8.94	6.54
10 AMP FAST RECOVERY										
VR100X	NA	NA	1.5	5 @ 150°C	200	1.5	DLS-024	7.56	6.30	5.05
VR200X			1.5	5 @ 150°C	200	1.5	DLS-024	8.94	7.45	5.95
VR400X			1.5	5 @ 150°C	200	1.5	DLS-024	13.80	10.90	8.00
VR600X			1.5	5 @ 150°C	200	1.5	DLS-024	14.34	11.95	8.80
25 AMP CONTROLLED AVALANCHE										
VT200	250	700	1.5	5 @ 180°C	NA	1.0	DLS-025	6.40	5.35	3.95
VT400	450	900	1.5	5 @ 180°C		1.0	DLS-025	8.40	7.00	5.30
VT600	650	1100	1.5	5 @ 180°C		1.0	DLS-025	11.82	9.85	7.10
VT800	850	1300	1.5	5 @ 180°C		1.0	DLS-025	14.18	11.82	8.52
25 AMP FAST RECOVERY										
VY100X	NA	NA	1.8	5 @ 150°C	200	1.0	DLS-032	9.80	8.16	6.54
VY200X			1.8	5 @ 150°C	200	1.0	DLS-032	11.52	9.60	7.70
VY400X			1.8	5 @ 150°C	200	1.0	DLS-032	16.80	1.400	10.60
VY600X			1.8	5 @ 150°C	200	1.0	DLS-032	18.48	15.40	11.66

NOTE 1: Case temperature is measured on the bottom of the case within 0.125 inches of center.

NOTE 2: At $I_F = 1$ Amp, $I_R = 2$ Amps, Recovery to $I_{R(REC)} = .2$ Amps.

NOTE 3: Also see mounting adapter price adders.

NOTE 4: For V_{RM} (Non-Rep), Add 20% to device V_{RRM}.

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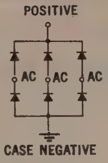
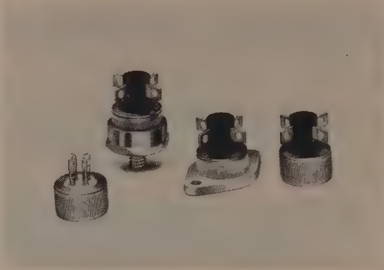


SILICON AVALANCHE INTEGRATED BRIDGE RECTIFIERS

■ 15 AMP & 36 AMP THREE PHASE, FULL WAVE

- Operation to full rated load at 100°C, T_C
- Controlled Avalanche series with 250V, 450V, 650V & 850V minimum avalanche voltages (V_{BR})
- Non-controlled avalanche series with 100V, 200V, 400V, 600V and 800V (V_{RRM})
- Fast recovery series with 200 nanosec recovery time (t_{rr})



MAXIMUM RATINGS @ 60 Hz RESISTIVE AND INDUCTIVE LOAD, $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	RMS Reverse Voltage [$V_{R(RMS)}$] (Volts)	Power Dissipation (100 µsec sq. wave) (P_{RM}) (Watts)	Peak Surge Current (½ cycle @ 60 Hz, Non-Rep) (I_{FSM}) (Amps)	DC Forward Current (I_O)[1] (Amps)	Junction Operating Stg. Temp. Range (T_J, T_{STG}) (°C)
15 AMP CONTROLLED AVALANCHE						
R602	200	140	600	100	15	−65 to +160
R604	400	280	600	100	15	−65 to +160
R606	600	420	600	100	15	−65 to +160
R608	800	560	600	100	15	−65 to +160
15 AMP NON-CONTROLLED AVALANCHE						
R611	100	70	NA	100	15	−65 to +160
R612	200	140		100	15	−65 to +160
R614	400	280		100	15	−65 to +160
R616	600	420		100	15	−65 to +160
R618	800	560		100	15	−65 to +160
15 AMP FAST RECOVERY (See Note 4)						
R611X	100	70	NA	75	15	−65 to +150
R612X	200	140		75	15	−65 to +150
R614X	400	280		75	15	−65 to +150
R616X	600	420		75	15	−65 to +150
36 AMP CONTROLLED AVALANCHE						
R622	200	140	1500	250	36	−65 to +150
R624	400	280	1500	250	36	−65 to +160
R626	600	420	1500	250	36	−65 to +160
R628	800	560	1500	250	36	−65 to +160
36 AMP NON-CONTROLLED AVALANCHE						
R631	100	70	NA	250	36	−65 to +160
R632	200	140		250	36	−65 to +160
R634	400	280		250	36	−65 to +160
R636	600	420		250	36	−65 to +160
R638	800	560		250	36	−65 to +160
36 AMP FAST RECOVERY (See Note 4)						
R631X	100	70	NA	150	36	−65 to +150
R632X	200	140		150	36	−65 to +150
R634X	400	280		150	36	−65 to +150
R636X	600	420		150	36	−65 to +150

ELECTRICAL CHARACTERISTICS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Avalanche Voltage (V_{BR})		Max. Inst. Forward Voltage Drop at I_O (V_{FM})	Max. Reverse Current @ Rated V_{RRM} & Indicated T_C (I_{RM})	Max. Reverse Recovery Time (t_{rr})[2]	Max. Thermal Res. Junction-to-Case ($R_{\theta J\text{-}C}$)	Write For Data Sheet Number	PRICING		
	(Min. Volts)	(Max. Volts)	(Volts/Leg)	(mA/Leg)	(nanosec.)	(°C/Watt)		1-24	25-99	100-999
15 AMP CONTROLLED AVALANCHE										
R602	250	500	1.3 @ Io = 10A	0.2 @ 160°C	NA	1.0	DLS-035	$6.18	$5.15	$3.95
R604	450	700	1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	7.92	6.60	5.10
R606	650	900	1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	11.04	9.20	7.15
R608	850	1100	1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	13.25	11.04	8.58
15 AMP NON-CONTROLLED AVALANCHE										
R611	NA	NA	1.3 @ Io = 10A	0.2 @ 160°C	NA	1.0	DLS-035	5.29	4.41	3.38
R612			1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	5.57	4.64	3.56
R614			1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	7.13	5.94	4.59
R616			1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	9.94	8.28	6.44
R618			1.3 @ Io = 10A	0.2 @ 160°C		1.0	DLS-035	11.93	9.94	7.73
15 AMP FAST RECOVERY										
R611X	NA	NA	1.5 @ Io = 10A	5 @ 150°C	200	1.0	DLS-035	9.24	7.70	5.92
R612X			1.5 @ Io = 10A	5 @ 150°C	200	1.0	DLS-035	11.16	9.30	7.12
R614X			1.5 @ Io = 10A	5 @ 150°C	200	1.0	DLS-035	14.22	11.85	9.18
R616X			1.5 @ Io = 10A	5 @ 105°C	200	1.0	DLS-035	15.48	12.90	9.98
36 AMP CONTROLLED AVALANCHE										
R622	250	700	1.5 @ Io = 25A	5 @ 180°C	NA	0.75	DLS-036	7.80	6.50	4.90
R624	450	900	1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	10.08	8.40	6.35
R626	650	1100	1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	14.16	11.80	8.85
R628	850	1300	1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	17.00	14.16	10.62
36 AMP NON-CONTROLLED AVALANCHE										
R631	NA	NA	1.5 @ Io = 25A	5 @ 180°C	NA	0.75	DLS-036	6.67	5.56	4.19
R632			1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	7.02	5.85	4.41
R634			1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	9.07	7.56	5.72
R636			1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	12.74	10.62	7.97
R638			1.5 @ Io = 25A	5 @ 180°C		0.75	DLS-036	15.29	12.74	9.56
36 AMP FAST RECOVERY										
R631X	NA	NA	1.8 @ Io = 25A	5 @ 150°C	200	0.75	DLS-036	11.70	9.75	7.35
R632X			1.8 @ Io = 25A	5 @ 150°C	200	0.75	DLS-036	13.98	11.65	8.80
R634X			1.8 @ Io = 25A	5 @ 150°C	200	0.75	DLS-036	18.12	15.10	11.45
R636X			1.8 @ Io = 25A	5 @ 150°C	200	0.75	DLS-036	19.62	16.35	12.50

NOTE 1: Case temperature is measured on the bottom of the case within 0.125 inches of center.
NOTE 2: At $I_F = 1$ Amp, $I_R = 2$ Amps, Recovery to $I_{R(REC)} = .2$ Amps.
NOTE 3: Also see mounting adapter price adders.
NOTE 4: For V_{RM} (Non-Rep), Add 20% to device V_{RRM}.

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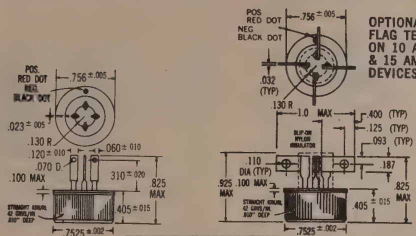
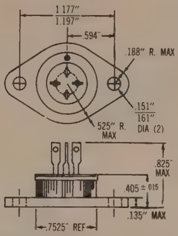
INTEGRATED BRIDGE RECTIFIERS

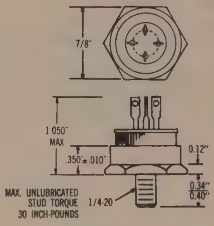
AVAILABLE CASE STYLES *


POS. RED DOT
NEG. BLACK DOT
.756 ± .005
.023 ± .005
.130 R
.120 ± .010
.060 ± .010
.070 D.
.100 MAX
310 ± 020
.825 MAX
STRAIGHT KNURL 42 GRVS/IN. .010" DEEP
.405 ± .015
.7525 ± .002
POS RED DOT
NEG BLACK DOT
.756 ± .005
OPTIONAL FLAG TERM. ON 10 AMP & 15 AMP DEVICES.
.032 (TYP)
.130 R
1.0 MAX
.400 (TYP)
.125 (TYP)
.093 (TYP)
SLIP-ON NYLON INSULATOR
.110 DIA (TYP)
.187
.925 MAX
.100 MAX
STRAIGHT KNURL 42 GRVS/IN. .010" DEEP
.405 ± .015
.825 MAX
.7525 ± .002

PRESS MOUNTING
(Standard)


1.177"
1.197"
.594"
.188" R. MAX
.151"
.161"
DIA (2)
.525" R. MAX
.825" MAX
.405 ± .015
.135" MAX
.7525" REF

TO-3 OUTLINE
MOUNTING FLANGE
(Optional)


7/8"
1.050" MAX
.350" ± .010"
0.12"
0.34"
0.40"
MAX. UNLUBRICATED STUD TORQUE 30 INCH-POUNDS
1/4-20

STUD MOUNT
(Optional)

TO ORDER OPTIONAL MOUNTS OR TERMINALS.

Flag Terminals: Standard .187" flag terminals on all 25A and 36A devices. Optional at no charge on 10A and 15A devices. Specify by adding "F" to Part No. Example, VR200XF.

Large .250" flag terminals optional at no charge. On 25A and 36A devices, add "L" to Part No. Example, VT200L. On 10A and 15A devices, add "L" instead of "F." Example, VR200XL.

TO-3 Mount: Add suffix "T" to Part No.

Stud Mount: Add suffix "S" to Part No.

MOUNTING ADAPTOR PRICE ADDERS (Factory Installed)

TYPE	1-99	100-999
TO-3	$0.25	$0.20
STUD MOUNT	$0.40	$0.30

OTHER CIRCUITS AVAILABLE IN ABOVE CASE STYLES.

The circuits shown are available in the 10A and 25A; standard and fast recovery series.

Contact products sales manager for ordering information and prices.

Fig.	Type
A	Center Tap Common Cathode
B	Center Tap Common Anode
C	Three Phase Common Cathode
D	Three Phase Common Anode
E	Doubler
F	Tripler
G	Quadrupler
H	Three Phase, Full Wave Bridge*

FIG. A

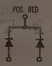


FIG. B

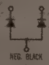


FIG. C

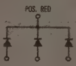


FIG. D

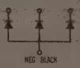


FIG. E

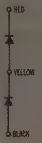

RED
YELLOW
BLACK

FIG. F

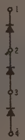


FIG. G

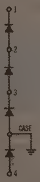
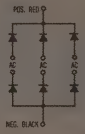
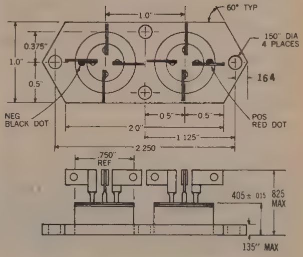


FIG. H

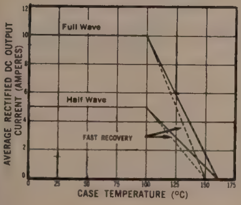

POS. RED
AC
AC
AC
NEG. BLACK


60° TYP
1.0"
150" DIA 4 PLACES
0.375"
1.0"
0.5"
164
NEG BLACK DOT
POS RED DOT
0.5"
0.5"
2.0"
1.125"
2.250
.750" REF
405 ± 015
825 MAX
135" MAX

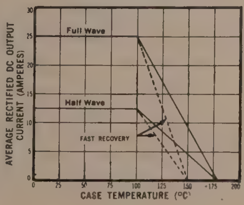
*** CASE STYLE FOR**
THREE PHASE, FULL WAVE BRIDGE

DERATING CURVES/MAXIMUM ALLOWABLE DC OUTPUT CURRENT

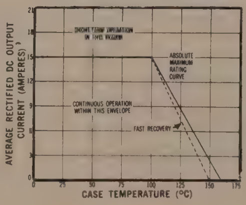
10 AMP RECTIFIERS



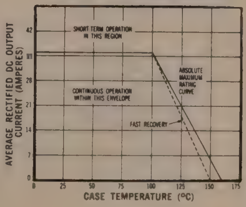
25 AMP RECTIFIERS



15 AMP, 3 PHASE, BRIDGES



36 AMP, 3 PHASE, BRIDGES



VARO

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SCHOTTKY BARRIER RECTIFIERS
1 Amp, 3 Amp, 5 Amp and 15 Amp

- 20V and 30V (V_{RRM})
- Extremely fast recovery
- Very low forward voltage drop

With very low forward voltage drop and fast switching time, this family of Schottky rectifiers are ideally suited for application in low voltage computer power supplies, free-wheeling diode applications, flyback diode applications and polarity protection in high speed switching circuits.

MAXIMUM RATINGS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Peak Repetitive Reverse Voltage (V_{RRM}) (Volts)	RMS Reverse Voltage [$V_{R(RMS)}$] (Volts)	Average Rectified Forward Current (I_O) (Amps)	Ambient Temp. @ Rated V_{RM} (T_A) (°C)		Peak Surge Cur. (Non-Rep) 300 µsec Pulse Width (I_{FSM}) (Amps)	Peak Surge Current (Non-Rep) ½ Cycle, 60 Hz (I_{FSM}) (Amps)	Junction Operating Temp. (T_J) (°C)	Storage Temp. (T_{STG}) (°C)
1 AMP									
VSK120	20	14	1.0	85	$R\theta_{JA} \le 50°C/W$	100	40	−65 to +125	−65 to +150
VSK130	30	21	1.0	80		100	40	−65 to +125	−65 to +150
								(Note 1)	
3 AMP									
VSK320	20	14	3.0	80	$R\theta_{JA} \le 24°C/W$	250	150	−65 to +125	−65 to +150
VSK330	30	21	3.0	75		250	150	−65 to +125	−65 to +150
								(Note 2)	
5 AMP									
VSK520	20	14	5.0	65	$R\theta_{JA} \le 16°C/W$	500	250	−65 to +125	−65 to +150
VSK530	30	21	5.0	60		500	250	−65 to +125	−65 to +150
								(Note 3)	
15 AMP									
VSK1520	20	14	15.0	95	$R\theta_{JA} \le 4.5°C/W$	500	300	−65 to +125	−65 to +150
VSK1530	30	21	15.0	90		500	300	−65 to +125	−65 to +150
								(Note 4)	

ELECTRICAL CHARACTERISTICS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Maximum Instantaneous Forward Voltage Drop (V_F) (Volts)			Maximum Instantaneous Reverse Current @ Rated V_{RM} (Note 5) (I_R) (mA)		Write for Data Sheet Number	Pricing 1-99	Pricing 100-999
1 AMP								
VSK120	.320, i_F = 0.1A	.450, i_F = 1A	.750, i_F = 3A	1.0, T_L = 25°C	10, T_L = 100°C	DLS060	$2.60	$1.80
VSK130	.330, i_F = 0.1A	.550, i_F = 1A	.875, i_F = 3A	1.0, T_L = 25°C	10, T_L = 100°C	DLS060	3.52	2.35
3 AMP								
VSK320	.370, i_F = 1A	.475, i_F = 3A	.850, i_F = 10A	3.0, T_L = 25°C	30, T_L = 100°C	DLS061	4.20	2.80
VSK330	.380, i_F = 1A	.500, i_F = 3A	.900, i_F = 10A	3.0, T_L = 25°C	30, T_L = 100°C	DLS061	5.13	3.41
5 AMP								
VSK520	.350, i_F = 3A	.380, i_F = 5A	.520, i_F = 15A	10, T_L = 25°C	75, T_L = 100°C	DLS062	4.39	2.93
VSK530	.350, i_F = 3A	.380, i_F = 5A	.520, i_F = 15A	10, T_L = 25°C	75, T_L = 100°C	DLS062	5.17	3.45
15 AMP (Note 6)								
VSK1520	.450, i_F = 8A	.550, i_F = 15A	1.0, i_F = 45A	10, T_C = 25°C	75, T_C = 100°C	DLS063	5.34	3.56
VSK1530	.450, i_F = 8A	.550, i_F = 15A	1.0, i_F = 45A	10, T_C = 25°C	75, T_C = 100°C	DLS063	6.87	4.58

ALSO SEE NEXT PAGE

NOTES:

1. $V_{RM} \le 0.1\ V_{RM}$ Max., $R\theta_{JA} \le 35°C/W$
2. $V_{RM} \le 0.1\ V_{RM}$ Max., $R\theta_{JA} \le 32°C/W$
3. $V_{RM} \le 0.1\ V_{RM}$ Max., $R\theta_{JA} \le 12°C/W$
4. $V_{RM} \le 7V$ on VSK 1520 and VSK 1530, $R\theta_{JA} \le 4.5°C/W$
5. Pulse Test: Pulse width = 300 µsec, duty cycle = 2%
6. Thermal Resistance, Junction-to-Case ($R\theta_{JC}$) = 2.5°C/W

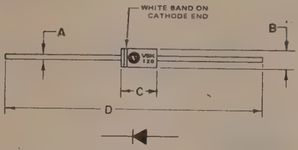
VARO
VARO SEMICONDUCTOR, INC.
P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

SCHOTTKY BARRIER RECTIFIERS

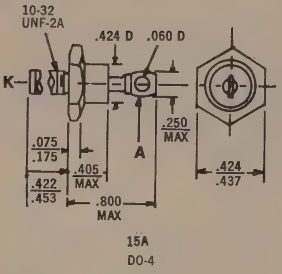
1 Amp, 3 Amp, 5 Amp and 15 Amp

The current flow in a Schottky barrier rectifier is due to majority carrier conduction and is not affected by reverse recovery transients due to stored charge and minority carrier injection as in conventional PN diodes.

The Schottky barrier rectifier may be considered for purposes of circuit analysis, as an ideal diode in parallel with a variable capacitance equal in value to the junction capacitance.

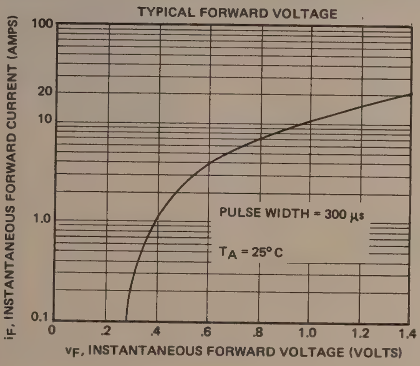

WHITE BAND ON CATHODE END
A
B
C
D
VSK 120

LTR	1 AMP INCHES	3A & 5A INCHES
A	.030-.034D	.048-.052D
B	.10-.107D	.20D
C	.185-.205	.38D
D	.240	2.75

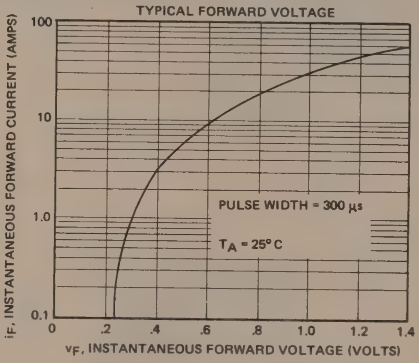

10-32
UNF-2A
.424 D
.060 D
K
.075
.175
.422
.453
.405 MAX
.800 MAX
A
.250 MAX
.424
.437
15A
DO-4

TYPICAL FORWARD VOLTAGE

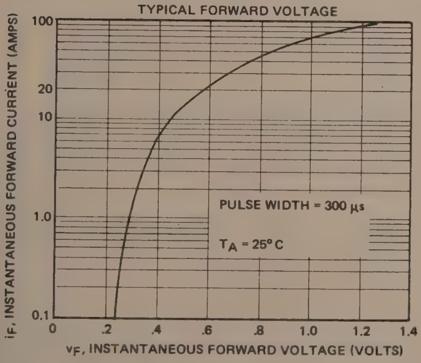
1 AMP



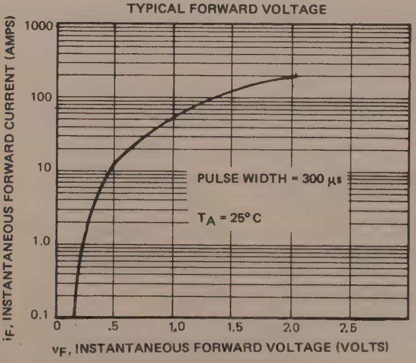
3 AMP



5 AMP



15 AMP



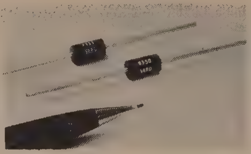
VARO

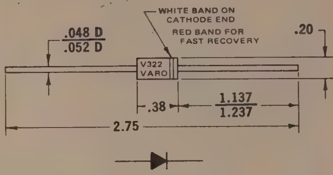
VARO SEMICONDUCTOR, INC.

P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

3 AMP AXIAL LEAD DIFFUSED SILICON RECTIFIERS

- 100A and 200A peak surge current
- Controlled avalanche series has 250V, 450V, 650V and 850V min. avalanche voltages (V_{BR})
- Non-controlled avalanche series with 50V, 100V, 200V, 400V, 600V, 800V and 1000V (V_{RRM})
- Fast recovery series with 200 nanosec. max. reverse recovery (t_{rr})





100 AMP PEAK SURGE RATING
MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS @ T = 25°C (UNLESS OTHERWISE SPECIFIED)

Varo Part No.	Peak Repetitive Reverse Voltage (Volts) V_{RRM}	RMS Reverse Voltage (Volts) $V_{R(RMS)}$	Power Dissipation in $V_{(BR)}$ Region For 100 µsec Sq. Wave (Watts) P_{RM}	Peak Surge Current, ½ Cycle @ 60 Hz (non-Rep) (Amps) I_{FSM}	DC Forward Current @ $T_A = 40°C$ (Amps) I_O	Junction Operating & Storage Temp. Range (°C) T_J, T_{STG}	Minimum Avalanche Voltage (Volts) $V_{(BR)}$	Maximum Avalanche Voltage (Volts) $V_{(BR)}$	Maximum Instantaneous Forward Voltage Drop @ 3 Amps (Volts) V_{FM}	Maximum Reverse Current @ Rated V_{RM} (mA) I_{RM}	Maximum Reverse Recovery Time @ $I_F = 1$ Amp $I_R = 2$ Amp (nsec) t_{rr}	Pricing	
												1-99	100-999
CONTROLLED AVALANCHE													
V322	200	140	500	100	3	−50 to +150	250	700	1.2	0.1 @ $T_J = 150°C$	NA	$0.62	$0.43
V324	400	280					450	900				.69	.45
V326	600	420					650	1100				.75	.53
V328	800	560					850	1300				.93	.66
NON-CONTROLLED AVALANCHE													
V330	50	35	NA	100	3	−50 to +150	NA	NA	1.2	0.1 @ $T_J = 150°C$	NA	.39	.27
V331	100	70										.40	.28
V332	200	140										.42	.30
V334	400	280										.44	.34
V336	600	420										.48	.34
V338	800	560										.53	.38
V3310	1000	700										.70	.50
FAST RECOVERY													
V330X	50	35	NA	75	3	−50 to +135	NA	NA	1.4	4.0 @ $T_J = 135°C$	200	.59	.41
V331X	100	70										.55	.42
V332X	200	140										.63	.44
V334X	400	280										.67	.47
V336X	600	420										.82	.58

Write for Data Sheet DLS-052

200 AMP PEAK SURGE RATING

Varo Part No.	Peak Repetitive Reverse Voltage (Volts) V_{RRM}	RMS Reverse Voltage (Volts) $V_{R(RMS)}$	Power Dissipation in $V_{(BR)}$ Region For 100 µsec Sq. Wave (Watts) P_{RM}	Peak Surge Current, ½ Cycle @ 60 Hz (non-Rep) (Amps) I_{FSM}	DC Forward Current @ $T_A = 40°C$ (Amps) I_O	Junction Operating & Storage Temp. Range (°C) T_J, T_{STG}	Minimum Avalanche Voltage (Volts) $V_{(BR)}$	Maximum Avalanche Voltage (Volts) $V_{(BR)}$	Maximum Instantaneous Forward Voltage Drop @ 3 Amps (Volts) V_{FM}	Maximum Reverse Current @ Rated V_{RM} (mA) I_{RM}	Maximum Reverse Recovery Time @ $I_F = 1$ Amp $I_R = 2$ Amp (nsec) t_{rr}	Pricing 1-99	Pricing 100-999
CONTROLLED AVALANCHE													
V342	200	140	900	200	3	−50 to +150	250	700	1.1	0.1 @ $T_J = 150°C$	NA	.73	.53
V344	400	280					450	900				.77	.54
V346	600	420					650	1100				.87	.63
V348	800	560					850	1300				1.07	.76
NON-CONTROLLED AVALANCHE													
V350	50	35	NA	200	3	−50 to +150	NA	NA	1.1	0.1 @ $T_J = 150°C$	NA	.48	.35
V351	100	70										.49	.36
V352	200	140										.51	.37
V354	400	280										.53	.38
V356	600	420										.57	.40
V358	800	560										.63	.46
V3510	1000	700										.81	.58
FAST RECOVERY													
V350X	50	35	NA	150	3	−50 to +135	NA	NA	1.4	4.0 @ $T_J = 135°C$	200	.76	.55
V351X	100	70										.78	.56
V352X	200	140										.80	.58
V354X	400	280										.86	.62
V356X	600	420										.96	.71

Write for Data Sheet DLS-053

VARO SEMICONDUCTOR, INC.

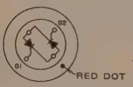
VARO
P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

VCB CONTROLLED BRIDGES AND POWER SWITCHES

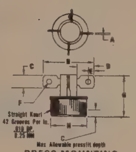
Available in single and three phase with 60V, 120V, and 230V AC input. Typical applications: DC motor speed control, battery chargers, inverters, solid state relays, light and temperature controls, frequency changers, servo systems, and electric brakes. The barrier pack terminals are isolated by an epoxy barrier strip — eliminating ribbing and waffling which can become clogged with dirt and grease.

25 AMP PRESS PACK

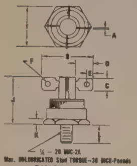
AC POWER SWITCH
(2 ANTI-PARALLEL SCR UNITS)
VARO PART NOS.
VCB 252-1, VCB 254-1, VCB 256-1


G2
G1
RED DOT

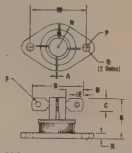
MOUNTING OPTIONS


A
C
B
D
E
F
G
I
H
Straight Knurl 42 Grooves Per In. .010 DP. 0.25 MM
C Max. Allowable pressfit depth

PRESS MOUNTING


A
F
B
D
E
C
J
K
L
¼ — 28 UNF-2A
Max. UNLUBRICATED Stud TORQUE—30 INCH-Pounds

SINGLE STUD


M
N
P
Q (2 Holes)
A
F
B
D
E
C
G
I
R

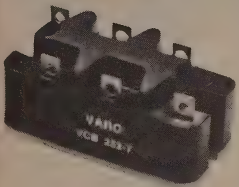
MOUNTING FLANGE

TO ORDER TO-3 MOUNT, ADD SUFFIX "T" TO PART NO.
TO ORDER SINGLE STUD MOUNT, ADD SUFFIX "S" TO PART NO.

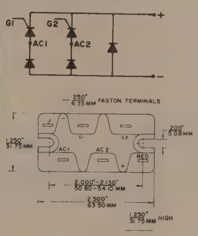
Ltr.	Inches
A	.032 TYP.
B	1.150 MAX.
C	.252 TYP.
D	.310 MIN.
E	.155 TYP.
F	.147 DIA. TYP.
G	.930 MAX.
H	.750-.755 DIA.
I	.875
J	1.20 MAX.
K	.120
L	.34-.40
M	1.177-1.197
N	.525R MAX.
P	.187 TYP.
Q	.151-.161 DIA.
R	.135 MAX.

25 AMP BARRIER PACKS

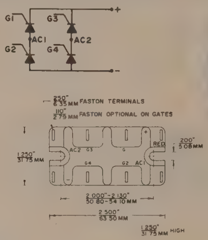
SINGLE PHASE


VARO
VCB 252-7

COMMON CATHODE CONTROLLED BRIDGE
(WITH FREE WHEELING DIODE)
VARO PART NOS.
VCB 252-7, VCB 254-7, VCB 256-7


G1
G2
AC1
AC2
+
−
.250" 6.35 MM FASTON TERMINALS
.200" 5.08MM
1.250" 31.75MM
G1
G2
AC1
AC 2
RED
+
2.000"-2.130" 50.80-54.10 MM
2.500" 63.50 MM
1.250" 31.75 MM HIGH

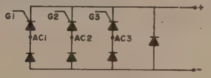
ALL SCR CONTROLLED BRIDGE
VARO PART NOS.
VCB 252-9, VCB 254-9, VCB 256-9

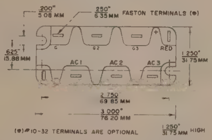

G1
G3
AC1
AC2
G2
G4
+
−
.250" 6.35 MM FASTON TERMINALS
.110" 2.79 MM FASTON OPTIONAL ON GATES
.200" 5.08MM
1.250" 31.75 MM
AC2
G3
G
RED
G4
G2
AC1
2.000"-2.130" 50.80-54.10 MM
2.500" 63.50 MM
1.250" 31.75 MM HIGH

VARO
VCB 252-9

THREE PHASE

COMMON CATHODE CONTROLLED BRIDGE
(WITH FREE WHEELING DIODE)
VARO PART NOS.
VCB 252-10, VCB 254-10, VCB 256-10


G1
G2
G3
AC1
AC2
AC3
+
−


.200" 5.08 MM
.250" 6.35 MM FASTON TERMINALS (●)
.625" 15.88 MM
G
G2
G3
RED
1.250" 31.75 MM
AC1
AC2
AC3
2.750" 69.85 MM
3.000" 76.20 MM
(●) #10-32 TERMINALS ARE OPTIONAL
1.250" 31.75 MM HIGH

VARO
VCB 252-10

SPECIFICATIONS @ $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	AC Input Voltage	Peak Repetitive Off-State Voltage	DC Output Current @ T_C = 80°C, Max.	Peak Surge Current, 1 Cycle @ 60 Hz	Reverse and Forward Leakage Current @ V_{DROM} and T_J = 100°C, Max.	Holding Current, Max.	Gate Trigger Current, Max.	Gate Trigger Current, Typ.	Gate Trigger Voltage, Max.	Forward Voltage Drop @ 1.414 x I_T (per Leg), Max.	Thermal Resistance, Case to Heat Sink	Thermal Resistance, Junction to Case	Minimum Cricital Rate of Rise of Off-State Voltage	Maximum Rate of Rise of Turned on Current	Maximum Junction Operating Temperature	Maximum Storage Temperature	Pricing	
Symbol	V_{RMS}	V_{DROM}	$I_{T(AV)}$	I_{TSM}	I_{RROM} I_{FOM}	I_{HO}	I_{GT}	I_{GT}	V_{GT}	V_T	$R\theta_{C-HS}$	$R\theta_{J-C}$	dv/dt	di/dt	T_J	T_{STG}		
Units	Volts	Volts	Amps	Amps	mA	mA	mA	mA	Volts	Volts	°C/W	°C/W	V/µs	A/µs	°C	°C	1-9	10-24
VCB252-1	60	200	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	$6.42	$5.84
VCB254-1	120	400	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	7.98	7.26
VCB256-1	230	600	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	10.92	9.96
VCB252-7	60	200	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	15.75	11.25
VCB254-7	120	400	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	19.50	14.50
VCB256-7	230	600	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	27.50	18.50
VCB252-9	60	200	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	17.32	12.37
VCB254-9	120	400	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	21.45	15.95
VCB256-9	230	600	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	30.25	20.35
VCB252-10	60	200	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	23.62	16.87
VCB254-10	120	400	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	29.25	21.75
VCB256-10	230	600	25	250	2.0	30	50	15	1.5	1.5	0.5	1.0	200	100	125	150	41.25	27.75

Write for Catalog No. 74 VCB-1

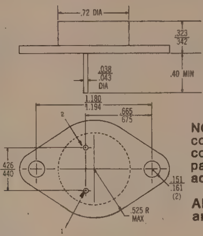
VARO SEMICONDUCTOR, INC.

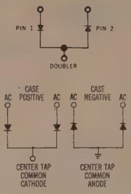
VARO
P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

30AMP CENTER TAPPED SILICON INTEGRATED RECTIFIER

TO-3 CASE

- Controlled Avalanche series: 250V, 450V & 650V min. avalanche ratings (V_{BR})
- Non-controlled avalanche series: 100V, 200V, 400V, 600V (V_{RRM})
- 250 Amp peak one-half cycle surge current
- Fast recovery series: 200 nanosec, recovery time (t_{rr})


.72 DIA
.323
.342
.038
.043
DIA
.40 MIN
1.180
1.194
.665
.675
2
.426
.440
.151
.161
(2)
.525 R
MAX
1


PIN 1
PIN 2
DOUBLER
AC
CASE POSITIVE
AC
AC
CASE NEGATIVE
AC
CENTER TAP COMMON CATHODE
CENTER TAP COMMON ANODE

NOTE: Standard device is common cathode. To order common anode add "/A" to part no. To order doubler add "/E" to part no.

All JEDEC TO-3 dimensions and notes are applicable.

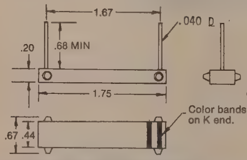
SPECIFICATIONS AT $T_A = 25°C$ (UNLESS OTHERWISE SPECIFIED)

Varo Part Number	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	Avalanche Voltage (V_{BR}) (Min. Volts)	(Max. Volts)	Peak Surge Current ½ cycle @ 60 Hz (I_{FSM}) (Amps/Leg)	DC Fwd. Current @ $I_C = 100°$ (I_O) (Amps/Leg)	Junction Oper. & Stg. Temp. Range (T_J, T_{STG}) (°C)	Max. Inst. Fwd. Voltage Drop @ I_O (V_{FM}) (Volts/Leg)	Max. Reverse Current @ Rated V_{RRM} & $T_C = 100°C$ (I_{RM}) (mA/Leg)	PRICING 1-24	25-99	100-999
CONTROLLED AVALANCHE											
R702	200	250	700	250	15	−65 to +150	1.2	1.0	$2.22	$1.85	$1.43
R704	400	450	900	250	15	−65 to +150	1.2	1.0	2.39	1.99	1.54
R706	600	650	1100	250	15	−65 to +150	1.2	1.0	2.71	2.26	1.73
NON-CONTROLLED AVALANCHE											
R711	100	NA		250	15	−65 to +150	1.2	1.0	1.75	1.46	1.12
R712	200			250	15	−65 to +150	1.2	1.0	1.84	1.53	1.18
R714	400			250	15	−65 to +150	1.2	1.0	1.98	1.65	1.27
R716	600			250	15	−65 to +150	1.2	1.0	2.23	1.86	1.43
FAST RECOVERY											
R711X	100	NA		150	15	−65 to +150	1.4	5.0	2.42	2.02	1.56
R712X	200			150	15	−65 to +150	1.4	5.0	2.60	2.17	1.68
R714X	400			150	15	−65 to +150	1.4	5.0	2.95	2.46	1.88
R716X	600			150	15	−65 to +150	1.4	5.0	3.54	2.95	2.25

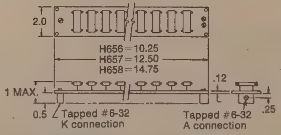
Write for Data Sheet DLS-048

HIGH VOLTAGE RECTIFIER ASSEMBLIES FOR POLLUTION CONTROL EQUIPMENT

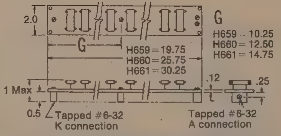
(PICTURED ABOVE H656 ASSEMBLY)


1.67
.040 D
.20
.68 MIN
1.75
Color bands on K end.
.67
.44

SERIES H655 SUBASSEMBLY


2.0
H656=10.25
H657=12.50
H658=14.75
.12
1 MAX.
0.5
Tapped #6-32 K connection
Tapped #6-32 A connection
.25

SERIES H656, H657, H658 ASSEMBLIES


2.0
G
G
H659 -- 10.25
H660 = 12.50
H661 = 14.75
H659 = 19.75
H660 = 25.75
H661 = 30.25
.12
.25
1 Max
0.5
Tapped #6-32 K connection
Tapped #6-32 A connection

SERIES H659, H660, H661 ASSEMBLIES (CENTER TAPPED)

VARO PART NO.*	PRV (Oper.) (1)	PRV (Test)	Peak Surge Current, ½ Cycle @ 60 Hz (Non-rep.)	Peak Surge Current, 10 Cycles at 60 Hz	DC Fwd. Current in 50°C 011 (1)	Avalanche Energy, 100 µsec. pulse width	Max. Inst. Fwd. Voltage Drop @ $I_F = 2A$	Max. Rev. Current @ V_R (Test)	No. Diodes per board
SYMBOL	$V_{R(oper.)}$	$V_{R(test)}$	I_{FSM}	I_{FRM}	I_O		V_{FM}	I_{RM}	
UNITS	KV	KV	Amps	Amps	Amps	Joules	Volts	µAmps	
H655	8.3	10	50	15	2	0.42	15	1	
H656	100	120	50	15	2	5.	170	1	12
H657	125	150	50	15	2	6.3	220	1	15
H658	150	180	50	15	2	7.5	260	1	18
H659	200	240	50	15	2	10.0	340	1	24
H660	250	300	50	15	2	12.6	440	1	30
H661	300	360	50	15	2	15.0	520	1	36

Note 1: To Achieve Rated Current and Voltage, Diodes must be submerged in Shell Diala Oil AX Electrical Insulating Oil or Equivalent.

*PRICES ON REQUEST

VARO SEMICONDUCTOR, INC.

P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

HIGH VOLTAGE DIFFUSED SILICON RECTIFIERS

VA

VB, 1N4441

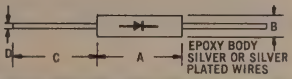
VG

Varo high voltage and high voltage fast recovery time diffused silicon rectifiers are designed for industrial and commercial applications that require high reliability at an economical cost.

These rectifiers offer high voltage ranges in minimum-sized, epoxy-encapsulated packages with low leakage current. All ratings are obtained without the use of special heat sinks or mounting techniques (except VC Series).

They are designed to withstand 500 G's shock and vibration of 100 Hz with a peak acceleration of 10 G's.

Applications: television receivers, electrostatic power supplies, electrostatic copiers, electrostatic air filters and precipitators, cathode ray tube power supplies, transmitters, and microwave ovens.



	A	B	C	D
Case Style	Pkg. Length	Dia.	Min. Wire Length	Nominal Wire Dia.
VA	.150	.060	.400	.010
VB	.400	.100	.400	.020
VG	.600	.160	.750	.020

Electrical Characteristics (@ T_A = 25°C Unless Otherwise Specified)	Series VA & VB and 1N4441*	Series VF	Series VG	Series VC & VCX*
Max. DC Reverse Current @ PIV and 25°C, I_{RM}	.05μA 0.3μA*	1μA	1μA	1μA 2μA*
Max. DC Reverse Current @ PIV and 100°C/85°C*, I_{RM}	5.0μA 60μA*	40μA 60μA*	40μA 60μA*	10μA 20μA*
Max. Reverse Recovery Time, t_{rr}, Recovery to 1.0 mA	250 nanosec* (I_F = 2mA & I_R = 4mA)	250 nanosec* (I_F = 2 mA & I_R = 4 mA)	250 nanosec* (I_F = 2 mA & I_R = 4 mA)	300 nanosec* (I_F = 1A & I_R = 2A
Ambient Operating Temperature Range, T_A	+150°C +85°C*	−55°C to +150°C +85°C*	−55°C to +150°C +85°C*	−50°C to +125°C
Max. One-Half Cycle Surge Current, I_{FSM} @ 60 Hz	3 Amps	3 Amps	3 Amps	50 Amps 35 Amps*

*Fast Recovery Series.

SERIES VA • VB • IN4441

Part No.	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	Avg. Fwd. Current I_O @ 40°C (mA)	Max. Fwd. Voltage Drop @ 25°C & I_O V_{FM} (Volts)	PRICING 1-99	PRICING 100-999
VA10	1,000	50	4	$1.36	$1.02
VA15	1,500	50	4	1.44	1.08
VA20	2,000	50	4	1.55	1.16
VA25	2,500	50	4	1.66	1.25
VA30	3,000	25	6	1.93	1.45
VA35	3,500	25	6	2.70	2.02
VA10X	1,000	40	6	1.80	1.35
VA15X	1,500	40	6	1.93	1.45
VA20X	2,000	40	6	2.07	1.55
VA25X	2,500	20	8	2.20	1.65
VA30X	3,000	20	8	2.85	2.13
VB10	1,000	100	5	1.41	1.07
VB15	1,500	100	5	1.51	1.15
VB20	2,000	100	5	1.59	1.20
VB25	2,500	100	5	1.72	1.30
VB30	3,000	50	10	1.88	1.42
VB40	4,000	50	10	2.05	1.56
VB50	5,000	50	10	2.40	1.82
VB60	6,000	50	10	2.62	1.99
VB10X	1,000	50	6	1.88	1.43
VB15X	1,500	50	6	2.01	1.53
VB20X	2,000	50	6	2.12	1.60
VB25X	2,500	25	12	2.30	1.73
VB30X	3,000	25	12	2.50	1.90
VB40X	4,000	25	12	2.74	2.08
VB50X	5,000	25	12	3.20	2.42
1N4441	1,500	25	4	2.01	1.53

Write for Data Sheet DLS-027

SERIES VG

Part No.	Peak Rep. Reverse Voltage (V_{RRM}) (Volts)	Avg. Fwd. Current I_O @ 40°C (mA)	Max. Fwd. Voltage Drop @ 25°C & I_O V_{FM} (Volts)	PRICING 1-99	PRICING 100-999
VG1	1,000	100	5	$ .80	$ .65
VG2	2,000	100	5	.85	.68
VG3	3,000	50	10	.97	.77
VG4	4,000	50	10	1.04	.83
VG5	5,000	50	12	1.22	.97
VG7	7,000	25	14	1.30	1.03
VG10	10,000	25	20	1.49	1.18
VG12	12,000	10	24	1.58	1.25
VG15	15,000	10	30	1.76	1.40
VG20	20,000	10	40	2.08	1.65
VG1X	1,000	50	6	.85	.68
VG2X	2,000	50	6	.89	.71
VG3X	3,000	25	12	.99	.79
VG4X	4,000	25	12	1.14	.91
VG5X	5,000	25	14	1.35	1.07
VG7X	7,000	10	16	1.42	1.13
VG10X	10,000	10	24	1.64	1.30
VG12X	12,000	5	30	1.74	1.38
VG15X	15,000	5	36	1.94	1.54
VG20X	20,000	5	50	2.29	1.82

NOTES:

1. Suffix (X) denotes Fast Recovery Series.
2. Maximum lead and terminal temperature for soldering, ⅜ inch from case, 5 seconds at 250°C.
3. If operated over 10,000 V/inch in length, devices should be immersed in oil or re-encapsulated.

Write for Data Sheet DLS-034

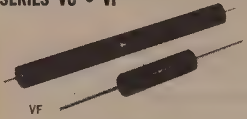
VARO

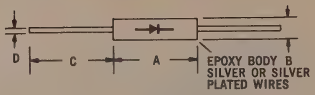
VARO SEMICONDUCTOR, INC.

P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

HIGH VOLTAGE DIFFUSED SILICON POWER RECTIFIERS

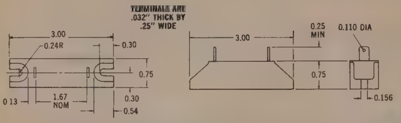
SERIES VC • VF





Case Style	A Pkg. Length	B Dia.	C Min. Wire Length	D Nominal Wire Dia.
VF	1.000	.250	1.500	.032
VF*	2.000	.300	1.500	.032
VF*	3.000	.300	1.500	.032

*Ferrule End Caps Available.



VARO VC
7209
VC

SERIES VC

Part No.	Peak Rep. Reverse Voltage (VRRM) (Volts)	Avg. Fwd. Current Io @ 40°C (Amps)	Max. Fwd. Voltage Drop @ 25°C & Io VFM (Volts)	PRICING 1-99	100-999
VC20	2,000	2	4	$5.20	$4.00
VC30	3,000	2	4	5.52	4.25
VC40	4,000	2	4	5.85	4.50
VC50	5,000	1.5	6	6.18	4.75
VC60	6,000	1.5	6	6.50	5.00
VC70	7,000	1.5	8	6.82	5.25
VC80	8,000	1	8	7.15	5.50
VC20X	2,000	2	4.8	5.98	4.60
VC30X	3,000	2	7.2	6.34	4.88
VC40X	4,000	2	9.6	6.72	5.17
VC50X	5,000	1.5	12.0	7.10	5.45
VC60X	6,000	1.5	14.4	7.47	5.75
VC70X	7,000	1.5	14.4	7.85	6.03
VC80X	8,000	1	16.8	8.22	6.32

Write for Data Sheet DLS-030

NOTES:

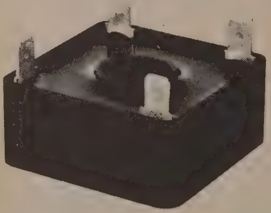
1. Suffix (X) denotes Fast Recovery Series.
2. Maximum lead and terminal temperature for soldering, ⅜ inch from case, 5 seconds at 250°C.
3. If operated over 10,000 V/inch in length, devices should be immersed in oil or re-encapsulated.

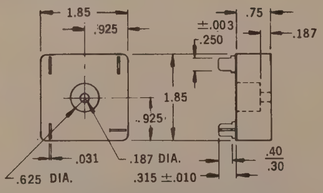
SERIES VF

Part No.	Peak Rep. Reverse Voltage (VRRM) (kV)	Max. Fwd. Voltage Drop @ 25°C and Io VFM (Volts)	Case Style	Avg. Fwd. Current Io @ 40°C (mA)	PRICING 1-99	100-999
VF5-5	5	12	A	5	$1.60	$1.08
VF5-7	7	12	A	5	1.71	1.15
VF5-10	10	18	A	5	1.96	1.32
VF5-12	12	18	A	5	2.22	1.49
VF5-15	15	35	B	5	2.30	1.55
VF5-20	20	35	B	5	2.97	2.00
VF5-25	25	35	B	5	3.72	2.50
VF5-30	30	50	C	5	4.46	3.00
VF5-40	40	50	C	5	5.95	4.00
VF5-5X	5	15	A	5	1.77	1.19
VF5-7X	7	15	A	5	1.89	1.27
VF5-10X	10	30	A	5	2.16	1.45
VF5-12X	12	30	A	5	2.44	1.64
VF5-15X	15	60	B	5	2.54	1.71
VF5-20X	20	60	B	5	3.27	2.20
VF5-25X	25	60	B	5	4.09	2.75
VF5-30X	30	90	C	5	4.91	3.30
VF5-40X	40	90	C	5	6.54	4.40
VF10-5	5	12	A	10	1.77	1.50
VF10-7	7	12	A	10	1.89	1.60
VF10-10	10	18	A	10	2.16	1.83
VF10-12	12	18	A	10	2.44	2.07
VF10-15	15	35	B	10	2.54	2.15
VF10-20	20	35	B	10	3.27	2.77
VF10-25	25	35	B	10	4.09	3.47
VF10-30	30	50	C	10	4.91	4.16
VF10-40	40	50	C	10	6.54	5.54
VF10-5X	5	15	A	10	1.95	1.65
VF10-7X	7	15	A	10	2.08	1.76
VF10-10X	10	30	A	10	2.38	2.02
VF10-12X	12	30	A	10	2.68	2.27
VF10-15X	15	60	B	10	2.80	2.37
VF10-20X	20	60	B	10	3.60	3.05
VF10-25X	25	60	B	10	4.51	3.82
VF10-30X	30	90	C	10	5.39	4.57
VF10-40X	40	90	C	10	7.20	6.10
VF25-5	5	12	A	25	1.95	1.65
VF25-7	7	12	A	25	2.08	1.76
VF25-10	10	18	A	25	2.38	2.02
VF25-12	12	18	A	25	2.68	2.27
VF25-15	15	35	B	25	2.80	2.37
VF25-20	20	35	B	25	3.60	3.05
VF25-25	25	35	B	25	4.51	3.82
VF25-30	30	50	C	25	5.39	4.57
VF25-40	40	50	C	25	7.20	6.10
VF25-5X	5	15	A	25	2.14	1.81
VF25-7X	7	15	A	25	2.29	1.94
VF25-10X	10	30	A	25	2.62	2.22
VF25-12X	12	30	A	25	2.94	2.49
VF25-15X	15	60	B	25	3.08	2.61
VF25-20X	20	60	B	25	3.95	3.35
VF25-25X	25	60	B	25	4.96	4.20
VF25-30X	30	90	C	25	5.94	5.03
VF25-40X	40	90	C	25	7.91	6.70

Write for Data Sheet DLS-033

HIGH VOLTAGE SILICON FULL WAVE BRIDGES





Terminals are standard .250 spade

SPECIFICATIONS

I_{FSM} Peak Surge Current, ½ Cycle @ 60 Hz	20 Amps
Storage Temperature Range	−30°C to 150°C
Operating Temperature Range	−30°C to 100°C

Part No.	VRRM (kV)	Avg. Fwd. Current, Io @ TA = 50°C (mA)	PRICING 1-99	100-999
H439	2	1500	$7.62	$6.35
H440	4	650	8.28	6.90
H441	6	650	8.98	7.48
H442	8	500	9.43	7.86
H443	10	500	9.79	8.16

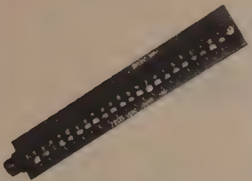
Write for Data Sheet DLS-041

VARO

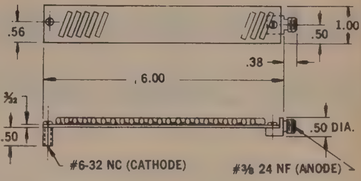
VARO SEMICONDUCTOR, INC.

P.O. BOX 676, 1000 N. SHILOH, GARLAND, TEX. 75040 (214) 272-4551 TWX 910-860-5178

HIGH VOLTAGE RECTIFIERS FOR X-RAY APPARATUS



The required peak reverse voltage determines the number of individual diode packages used in series for the completed, unencapsulated rectifier. Each diode package contains a stack of controlled avalanche chips. In order to achieve the rated voltage and current, the diodes should be submerged in Shell Diala Oil AX electrical insulating oil or equivalent. The diodes used, Varo type H463 may be purchased separately.


.56
1.00
.50
.38
6.00
3/32
.50
.50 DIA.
#6-32 NC (CATHODE)
#3/8 24 NF (ANODE)

SPECIFICATIONS

I_F Average in 55°C Oil*	220 mA Max.
I_F Peak 10 Cycles @ 60 Hz Rate	6 A Max.
Max. ½ Cycle Surge Current @ 60 Hz, Non-Rep, I_{FSM}	20 A Max.
Max. DC Reverse Current @ PRV Test, I_{RM}	1 μA Max.
Operating and Storage Temperature Range	−55°C to +125°C

*Derate linearity from 55°C to zero current @ 125°C.

Part No.	$V_{R(oper.)}$ (kV)	$V_{R(test)}$ (kV)	V_{FM} (Max.) I_F = 50 mA	No. of Individual Diode Packages	PRICING 1-99	PRICING 100-249
H466	100	125	160	16	$39.00	$28.50
H467	125	150	190	19	42.00	32.50
H468	150	175	220	22	45.00	40.00

All specifications at T_C = 25°C unless noted.

Write for Data Sheet DLS-047

HIGH VOLTAGE MULTIPLIERS

APPLICATIONS: CRT terminal display systems, electrostatic power supplies, television receivers, monitors and other high voltage applications.

RATINGS

	Doubler (T_A = 60°C)	Tripler (T_A = 75°C)	Quad (T_A = 65°C)
DC Forward Current Output	0.25 mA	0.25 mA	0.25 mA
DC Forward Current at Focus Tap	1.5 mA	2.0 mA	2.25 mA
Input Voltage Under No Load	10KV MAX.	10KV MAX.	8KV MA X.

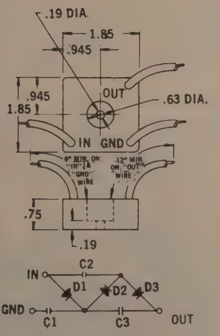
TYPICAL REGULATION AT TA = 25°C (TV TYPE GENERATOR) NOMINAL OUTPUT VOLTAGE WITH SPECIFIED PEAK-TO-PEAK MAINTAINED

	Pk to Pk	No Load	1 mA Load
Doubler — Varo P/N MH911*	10KV	19.0KV	18.0KV
Tripler — Varo P/N MH919*	8KV	24.0KV	22.0KV
Quad — Varo P/N MH353*	6KV	24.0KV	23.0KV

*Prices on request.

CASE STYLE AND CIRCUIT FOR:

DOUBLER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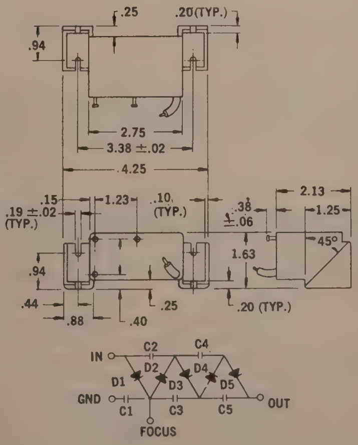
1.85
.945
.945
1.85
OUT
.63 DIA.
IN
GND
6" MIN. ON "IN" & "GND" WIRE
12" MIN. ON "OUT" WIRE
.75
.19
IN
C2
D1
D2
D3
GND
C1
C3
OUT

TRIPLER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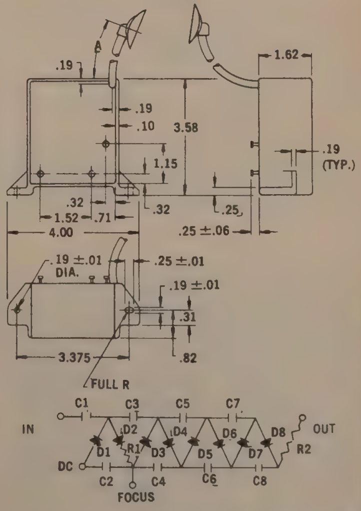
.20 (TYP.)
.94
2.75
3.38 ±.02
4.25
.15
1.23
.10 (TYP.)
.38 ±.06
2.13
1.25
.19 ±.02 (TYP.)
1.63
45°
.94
.44
.88
.25
.40
.20 (TYP.)
IN
C2
C4
D2
D4
D1
D3
D5
GND
C1
C3
C5
OUT
FOCUS

QUAD


A
.19
1.62
.19
.10
3.58
1.15
.19 (TYP.)
.32
1.52
.71
.32
.25
4.00
.25 ±.06
.19 ±.01 DIA.
.25 ±.01
.19 ±.01
.31
3.375
.82
FULL R
C1
C3
C5
C7
IN
D2
D4
D6
D8
OUT
R1
R2
D1
D3
D5
D7
DC
C2
C4
C6
C8
FOCUS

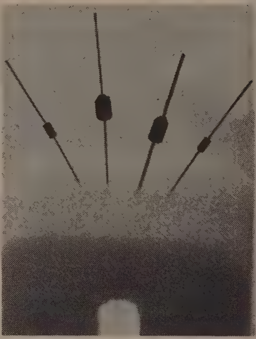
Westinghouse

Westinghouse Electric Corporation
Semiconductor Division, Youngwood, Pa. 15697
(412) 925-7272 • TWX 510-468-2840

phase control/standard applications circuit board rectifiers — 1 thru 25 amp

1 THRU 3 AMPERE "LEAD MOUNT/AXIAL LEAD" RECTIFIERS

Type	R040	R140	R150	R240
$I_{F(AV)}$ (Amps)	1.0	1.5	1.5	3.0
I_{FSM} (Amps)	30	50	50	200
Old Type No.	......	359	384	398
50 (Volts V_{RRM})	1N4001	1N4816	1N5391	1N5400
100	1N4002	1N4817	1N5392	1N5401
200	1N4003	1N4818	1N5393	1N5402
300	....	1N4819	1N5394	1N5403
400	1N4004	1N4820	1N5395	1N5404
500	....	1N4821	1N5396	1N5405
600	1N4005	1N4822	1N5397	1N5406
700	....	1N5052	R1500715	R2400730
800	1N4006	1N5053	1N5398	1N5407
1000	1N4007	1N5054	1N5399	1N5408
T Ambient	75°C	40°C	40°C	50°C
Package Outline (Page 22)	A	B	C	D
Technical Data (Page 25)	← D-1 →			



SAVE IN DESIGN, TESTING AND ASSEMBLY TIME —
USE PRE-DESIGNED AND PREPACKAGED . . .

2 THRU 25 AMPS MODULAR FULL WAVE RECTIFIER ASSEMBLIES

- Save in assembly time since one assembly replaces 4 rectifiers.
- Save in board space by using Westinghouse Modular pre-packaged circuits.
- Reduce soldering time with silver plated copper leads on MB11 designs.
- Save on assembly costs because Modular Assemblies are electrically insulated, and no insulating material is needed.
- Other features include a wide voltage range availability (up to 1000V), high surge currents, low leakage, and good availability.

Type	MB11 (.6″ sq.)	MB12 (1.125″ sq.)	
$I_{F(AV)}$ (Amps)	2	10	25
I_{FSM} (Amps)	50	200	300
50 (Volts V_{RRM})	MB11A02V05	MB12A10V05	MB12A25V05
100	MB11A02V10	MB12A10V10	MB12A25V10
200	MB11A02V20	MB12A10V20	MB12A25V20
300	MB11A02V30	MB12A10V30	MB12A25V30
400	MB11A02V40	MB12A10V40	MB12A25V40
600	MB11A02V60	MB12A10V60	MB12A25V60
800	MB11A02V80	MB12A10V80	MB12A25V80
1000	MB11A02W10	MB12A10W10	MB12A25W10
T Case	50°C	50°C	50°C
Package Outline (Page 22)	G	← H →	
Technical Data (Page 25)	← D-3 →		

For All Page Number References — See WESTINGHOUSE CATALOG #54-000 / Dated Jan. 1975

Pathways to Power

phase control/standard applications stud mount rectifiers — 3 thru 70 amp

3 THRU 16 AMPERES DO-4 STUD MOUNT RECTIFIERS

Type	R310 (10-32 stud)										
$I_{F(AV)}$ (Amps)	3	3.3	3	5	6	6	6	12	12	12	16
I_{FSM} (Amps)	25	25	40	150	150	150	160	240	240	250	300
50 Volts	....	....	1N1581	1N1612	1N1341	1N1341A	1N1341B	1N1199	1N1199A	1N1199B	1N3615
100	....	....	1N1582	1N1613	1N1342	1N1342A	1N1342B	1N1200	1N1200A	1N1200B	1N3616
150	....	....	....	....	1N1343	1N1343A	1N1343B	1N1201	1N1201A	1N1201B	1N3617
200	1N1124	1N1124A	1N1583	1N1614	1N1344	1N1344A	1N1344B	1N1202	1N1202A	1N1202B	1N3618
300	1N1125	1N1125A	1N1584	....	1N1345	1N1345A	1N1345B	1N1203	1N1203A	1N1203B	1N3619
400	1N1126	1N1126A	1N1585	1N1615	1N1346	1N1346A	1N1346B	1N1204	1N1204A	1N1204B	1N3620
500	1N1127	1N1127A	1N1586	....	1N1347	1N1347A	1N1347B	1N1205	1N1205A	1N1205B	1N3621
600	1N1128	1N1128A	1N1587	1N1616	1N1348	1N1348A	1N1348B	1N1206	1N1206A	1N1206B	1N3622
700	....	....	....	....	....	1N3987	....	1N3670	1N3670A	....	....
800	....	....	....	1N4458	....	1N3988	....	1N3671	1N3671A	....	1N3623
900	....	....	....	....	....	1N3989	....	1N3672	1N3672A	....	....
1000	....	....	....	1N4459	....	1N3990	....	1N3673	1N3673A	....	1N3624
T Case	50°C	50°C	150°C	150°C	150°C	150°C	150°C	150°C	150°C	150°C	150°C
Package Outline (Page 22)	E										
Technical Data (Page 25)	D-2										

15 THRU 70 AMPERES DO-5 STUD MOUNT RECTIFIERS

Type	R410 (¼″ stud)									R404 (¼″ stud)	
$I_{F(AV)}$ (Amps)	15	18	20	20	20	22	25	35	40	60	70
I_{FSM} (Amps)	250	220	300	300	350	500	400	500	800	1200	1200
50 Volts	1N3208	1N1191	1N248A	1N248B	1N248C	1N1191A	1N2154	1N1183	1N1183A	R4040060	R4040070
100	1N3209	1N1192	1N249A	1N249B	1N249C	1N1192A	1N2155	1N1184	1N1184A	R4040160	R4040170
150	....	1N1193	....	....	....	1N1193A	....	1N1185	1N1185A	....	....
200	1N3210	1N1194	1N250A	1N250A	1N250C	1N1194A	1N2156	1N1186	1N1186A	R4040260	R4040270
300	1N3211	1N1195	....	....	....	1N1195A	1N2157	1N1187	1N1187A	R4040360	R4040370
400	1N3212	1N1196	....	....	....	1N1196A	1N2158	1N1188	1N1188A	R4040460	R4040470
500	1N3213	1N1197	....	....	....	1N1197A	1N2159	1N1189	1N1189A	R4040560	R4040570
600	1N3214	1N1198	....	....	....	1N1198A	1N2160	1N1190	1N1190A	R4040660	R4040670
700	....	....	....	....	....	....	....	1N3765	....	R4040760	R4040770
800	....	....	....	....	....	R4100822	....	1N3766	R4100840	R4040860	R4040870
900	....	....	....	....	....	....	....	1N3767	....	R4040960	R4040970
1000	....	....	....	....	....	R4101022	....	1N3768	R4101040	R4041060	R4041070
T Case	150°C	150°C	150°C	150°C	150°C	150°C	145°C	140°C	150°C	200°C	200°C
Package Outline (Page 22)	F										
Technical Data (Page 25)	D-2										

NOTE: Fast-recovery inverter types available — see inverter section, Page 16. Reverse polarity devices available for all products shown — for ordering information, see next page.

- Minimize over-rating costs with the wide range of selection of devices, Current (up to 70 A) Voltage (up to 1000V). Complete Alphanumeric listing page 2.
- Reduce transient protection costs due to Westinghouse "soft recovery" characteristics.
- Westinghouse color-coded seals indicate polarity, and help prevent production and inventory mishandling.

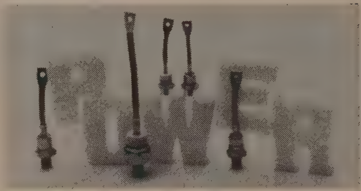
Westinghouse

phase control/standard applications stud mount rectifiers — 100 thru 550 amp and scr's (JEDEC) — 16 thru 470 amp

REVERSE POLARITY DEVICES

To specify and order reverse polarity stud diodes, follow these steps:

A. JEDEC Devices — Add suffix "R" to device.
B. Westinghouse Numbers — Increase the **fourth digit** (the third number) by "1."
Example: Forward Polarity R7001603
Reverse Polarity R7011603
C. Complete Alpha-Numeric Listing on Page 2



RECTIFIERS — 100 THRU 550 AMPS — STUD MOUNT

Type	R500/510 (3/8" stud)		R600/610 (3/4" stud)								R700 (3/4" stud)		
$I_{F(AV)}$ (Amps)	100	150	160	240	250	250	275	200	250	300	300	450	550
I_{FSM} (Amps)	2300	3000	2000	3000	4500	4500	5000	5500	6000	6500	6000	8500	10000
50 Volts	....	....	1N3260	1N3161	....	1N2054	1N4044	....	....	....	....	....	....
100	1N3288A	1N4587	1N3261	1N3162	1N3735	1N2055	1N4045	R6100120	R6100125	R6100130	R7000103	R7000104	R7000105
150	....	....	1N3262	1N3163	....	1N2056	1N4046	....	....	....	....	....	....
200	1N3289A•	1N4588	1N3263	1N3164•	1N3736	1N2057	1N4047	R6100220	R6100225	R6100230	R7000203	R7000204	R7000205
250	....	....	1N3264	1N3165	....	1N2058	1N4048	....	....	....	....	....	....
300	1N3290A	1N4589	1N3265	1N3166	1N3737	1N2059	1N4049	R6100320	R6100325	R6100330	R7000303	R7000304	R7000305
350	....	....	1N3266	1N3167	....	1N2060	....	....	....	....	....	....	....
400	1N3291A•	1N4590	1N3267	1N3168•	1N3738	1N2061	1N4050	R6100420	R6100425	R6100430	R7000403	R7000404	R7000405
500	1N3292B	1N4591	1N3268	1N3169	1N3739	1N2063	1N4051	R6100520	R6100525	R6100530	R7000503	R7000504	R7000505
600	1N3293A	1N4592	1N3269	1N3170•	1N3740	1N2064	1N4052	R6100620	R6100625	R6100630	R7000603	R7000604	R7000605
700			1N3270	1N3171	....	1N2065	1N4053	R6100720	R6100725	R6100730	R7000703	R7000704	R7000705
800	1N3294A•	1N4593	1N3271	1N3172•	1N3741	1N2066	1N4054	R6100820	R6100825	R6100830	R7000803	R7000804	R7000805
900	....	....	1N3272	1N3173	....	1N2067	1N4055	R6100920	R6100925	R6100930	R7000903	R7000904	R7000905
1000	1N3295A•	1N4594	1N3273	1N3174•	1N3742	1N2068	1N4056	R6101020	R6101025	R6101030	R7001003	R7001004	R7001005
1200	1N3296A	1N4595	1N3274	....	1N3743	....	....	R6001220	R6001225	R6001230	R7001203	R7001204	R7001205
1400	1N3297A	1N4596	1N3275	....	1N3744	....	....	R6001420	R6001425	....	R7001403	R7001404	....
1600	....	....	1N3276	....	....	....	....	R6001620	R6001625	....	R7001603	R7001604	....
1800	....	....	....	....	....	....	....	R6001820	R6001825	....	R7001803	R7001804	....
2000	....	....	....	....	....	....	....	R6002020	R6002025	....	R7002003	R7002004	....
2200	....	....	....	....	....	....	....	R6002220	....	....	R7002203	....	....
2400	....	....	....	....	....	....	....	R6002420	....	....	R7002403	....	....
2600	....	....	....	....	....	....	....	R6002620	....	....	R7002603	....	....
2800	....	....	....	....	....	....	....	R6002820	....	....	R7002803	....	....
3000	....	....	....	....	....	....	....	R6003020	....	....	R7003003	....	....
3200	....	....	....	....	....	....	....	....	....	....	R7003203	....	....
3400	....	....	....	....	....	....	....	....	....	....	R7003403	....	....
3600	....	....	....	....	....	....	....	....	....	....	R7003603	....	....
3800	....	....	....	....	....	....	....	....	....	....	R7003803	....	....
4000	....	....	....	....	....	....	....	....	....	....	R7004003	....	....
Package Outline (Pages 22-23)	← I →		← J →								← K →		
Technical Data (Page 25)	← D-4 →												

NOTE: • Indicates JAN Product Available.

JEDEC SCR'S — 16 THRU 470 AMP

I_T (RMS) Amps	16	25	125	125	125	125	125	275	470
I_T (AV) Amps	10	16	80	80	80	80	80	175	300
I_{TSM} (1/2 cycle) Amps	125	150	1600	1600	1600	1600	1600	5500	5500
25 Volts	2N1842A	2N681	....	2N1909	2N2023	....	....	....	....
50	2N1843A	2N682	2N1792	2N1910	2N2024	....	....	2N3884	2N3530
100	2N1844A	2N683	2N1793	2N1911	2N2025	2N4361	2N4371	2N3885	2N3531
150	2N1845A	2N684	2N1794	2N1912	2N2026	....	....	....	....
200	2N1846A	2N685	2N1795	2N1913	2N2027	2N4362	2N4372	2N3886	2N3532
250	2N1847A	2N686	2N1796	2N1914	2N2028	....	....	....	....
300	2N1848A	2N687	2N1797	2N1915	2N2029	....	....	2N3887	2N3533
400	2N1849A	2N688	2N1798	2N1916	2N2030	2N4363	2N4373	2N3888	2N3534
500	2N1850A	2N589	2N1799	2N1805	....	....	....	2N3889	2N3535
600	....	2N690	2N1800	2N1806	....	2N4364	2N4374	2N3890	2N3536
700	....	....	2N1801	2N1807	....	....	....	2N3891	2N3537
800	....	....	2N1802	....	....	2N4365	2N4375	2N3892	2N3538
900	....	....	2N1803	....	....	....	....	2N3893	2N3539
1000	....	....	2N1804	....	....	2N4366	2N4376	2N3894	2N3540
1100	....	....	....	....	....	....	....	....	2N3541
1200	....	....	....	....	....	2N4367	2N4377	2N3895	....
1400	....	....	....	....	....	2N4368	2N4378	2N3896	....
I^2t For Fusing	60	90	10700	10700	10700	10700	10700	120000	120000
t_q (μsec) Typical	50	50	100	100	120	40	40	100	100
dv/dt	100	100	300	300	300	100	100	300	300
di/dt	25	25	50	50	50	50	50	100	100
I_{GT} (ma) @ 25°C	80	40	100	100	100	100	100	150	150
Package Outline (Page 23)	← L →		M	← N →			M	O	Q
Technical Data (Page 25)	← D-5 →								

Westinghouse

phase control/standard applications stud mount scr's — 16 thru 550 amp

- Reduce thermal failure rate in cyclic applications with Westinghouse Compression Bonded Encapsulation.
- Reduce the cost and complexity of your firing circuit package with the soft-fire" capability of di/namic Gate design.
- Insure uniform, repeatable electrical characteristics with the all-diffused fusion design.
- Reduce device costs by tight design specifications since all Westinghouse SCR's are 100% tested, twice, during manufacture.

16 THRU 125 AMP STUD MOUNT SCR'S

Type	T400 (¼″ STUD)			T500 (½″ STUD)		T510 (½″ STUD)	
I_T (RMS) Amps	16	25	35	63	125	80	125
I_T (AV) Amps	10	16	22	40	80	50	80
I_{TSM} surge (½ cycle)	150	250	360	1200	1600	1000	1400
50 Volts	T400001008	T400001608	T400002208	....	....	T510005007	T510008007
100	T400011008	T400011608	T400012208	T500014005	T500018005	T510015007	T510018007
200	T400021008	T400021608	T400022208	T500024005	T500028005	T510025007	T510028007
300	T400031008	T400031608	T400032208	T500034005	T500038005	T510035007	T510038007
400	T400041008	T400041608	T400042208	T500044005	T500048005	T510045007	T510048007
500	T400051008	T400051608	T400052208	T500054005	T500058005	T510055007	T510058007
600	T400061008	T400061608	T400062208	T500064005	T500068005	T510065007	T510068007
700	....	....	....	T500074005	T500078005	....	....
800	....	....	....	T500084005	T500088005	....	....
900	....	....	....	T500094005	T500098005	....	....
1000	....	....	....	T500104005	T500108005	....	....
1200	....	....	....	T500124005	T500128005	....	....
1400	....	....	....	T500144005	T500148005	....	....
1600	....	....	....	T500164005	T500168005	....	....
1800	....	....	....	....	....	....	....
2000	....	....	....	....	....	....	....
2200	....	....	....	....	....	....	....
2400	....	....	....	....	....	....	....
I^2t for Fusing	90	260	540	6000	10700	4160	8150
t_q (μsec) Typical	....	....	....	100	100	50	50
dv/dt	100	100	100	300	300	50	50
di/dt	150	150	150	50	50	100	100
I_{GT} (ma) @ 25°C	40	40	40	100	100	70	70
Package Outline (Page 23)	← L →			← Available with "Flag" leads — Package Outline "M" Available with "Flex" leads — Package Outline "N" →			
Technical Data (Page 25)	← D-5 →						

200 THRU 550 AMP STUD MOUNT SCR'S

Type	T600 (¾″ STUD)			T700 (¾″ STUD)		
I_T (RMS) Amps	200	235	275	400	470	550
I_T (AV) Amps	125	150	175	250	300	350
I_{TSM} surge (½ cycle) Amps	3300	4000	5500	7000	8400	10000
50 Volts	....	....	....	....	....	....
100	T600011304	T600011504	T600011804	T700012504	T700013004	T700013504
200	T600021304	T600021504	T600021804	T700022504	T700023004	T700023504
300	T600031304	T600031504	T600031804	T700032504	T700033004	T700033504
400	T600041304	T600041504	T600041804	T700042504	T700043004	T700043504
500	T600051304	T600051504	T600051804	T700052504	T700053004	T700053504
600	T600061304	T600061504	T600061804	T700062504	T700063004	T700063504
700	T600071304	T600071504	T600071804	T700072504	T700073004	T700073504
800	T600081304	T600081504	T600081804	T700082504	T700083004	T700083504
900	T600091304	T600091504	T600091804	T700092504	T700093004	T700093504
1000	T600101304	T600101504	T600101804	T700102504	T700103004	T700103504
1200	T600121304	T600121504	T600121804	T700122504	T700123004	T700123504
1400	T600141304	T600141504	T600141804	T700142504	T700143004	T700143504
1600	T600161304	T600161504	T600161804	T700162504	T700163004	T700163504
1800	....	....	....	T700182504	T700183004	....
2000	....	....	....	T700202504	T700203004	....
2200	....	....	....	T700222504	....	....
2400	....	....	....	T700242504	....	....
I^2t for Fusing	45000	66000	120000	205000	295000	416000
t_q (μsec) Typical	100	100	100	150	150	150
dv/dt	300	300	300	300	300	300
di/dt	100	100	100	100	100	100
I_{GT} (ma) @ 25°C	150	150	150	150	150	150
Package Outline (Page 23)	← O →			← P →		
Technical Data (Page 25)	← D-5 →					

* If you have high-frequency, inverter type applications, use Westinghouse Di-Namic Gate SCR's. See Page 17.

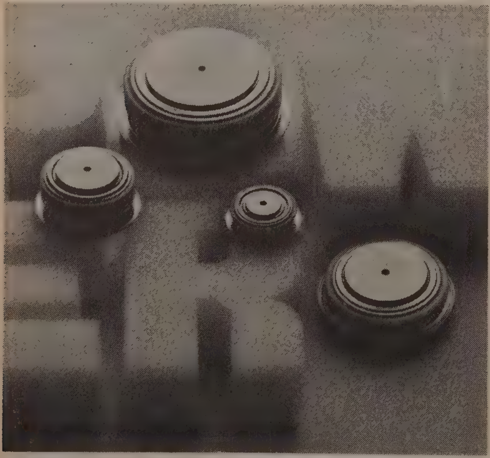
Complete Alpha-Numeric Products Listing on Page 2.

Westinghouse

phase control/standard applications pow-r-disc rectifiers — 300 thru 2400 amp

300 THRU 2400 POW-R-DISC RECTIFIER

Type	R620 (23mm Element)			R720 (33mm Element)			R920 (50mm Element)			R9H0 (50mm Element)	
$I_{F(AV)}$ (Amps)	300	400	500	600	900	1200	1100	1600	2000	1500	2400
I_{FSM} (Amps)	5500	6000	6500	7000	8500	12500	16200	21500	30000	16200	30000
100 Volts	R6200130	R6200140	R6200150	R7200106	R7200109	R7200112	R9200111	R9200116	R9200120	....	....
200	R6200230	R6200240	R6200250	R7200206	R7200209	R7200212	R9200211	R9200216	R9200220	....	....
300	R6200330	R6200340	R6200350	R7200306	R7200309	R7200312	R9200311	R9200316	R9200320	....	....
400	R6200430	R6200440	R6200450	R7200406	R7200409	R7200412	R9200411	R9200416	R9200420	....	....
500	R6200530	R6200540	R6200550	R7200506	R7200509	R7200512	R9200511	R9200516	R9200520	....	....
600	R6200630	R6200640	R6200650	R7200606	R7200609	R7200612	R9200611	R9200616	R9200620	....	....
800	R6200830	R6200840	R6200850	R7200806	R7200809	R7200812	R9200811	R9200816	R9200820	....	....
1000	R6201030	R6201040	R6201050	R7201006	R7201009	R7201012	R9201011	R9201016	R9201020	....	....
1200	R6201230	R6201240	R6201250	R7201206	R7201209	R7201212	R9201211	R9201216	R9201220	....	....
1400	R6201430	R6201440	....	R7201406	R7201409	....	R9201411	R9201416	R9201420	....	....
1600	R6201630	R6201640	....	R7201606	R7201609	....	R9201611	R9201616	R9201620	....	....
1800	R6201830	R6201840	....	R7201806	R7201809	....	R9201811	R9201816	R9201820	....	....
2000	R6202030	R6202040	....	R7202006	R7202009	....	R9202011	R9202016	R9202020	R9H02015	R9H02024
2200	R6202230	....	....	R7202206	....	....	R9202211	....	....	R9H02215	....
2400	R6202430	....	....	R7202406	....	....	R9202411	....	....	R9H02415	....
2600	R6202630	....	....	R7202606	....	....	R9202611	....	....	R9H02615	....
2800	R6202830	....	....	R7202806	....	....	R9202811	....	....	R9H02815	....
3000 ↓	R6203030	....	....	R7203006	....	....	R9203011	....	....	R9H03015	....
Package Outline (Page 23)	← R →			← S →			← T →			← U →	
Technical Data (Pg. 25)	← D-8 →										



- Minimize surge failures and the number of devices used due to the high surge capacity available (up to 30,000A).
- Reduce transient protection costs with Westinghouse "soft recovery" characteristics.
- Decrease over-rating costs and minimize series-ing devices due to the high voltage (up to 3000V) and high current (up to 2400A) capability available.
- Pow-R-Disc Rectifiers are available in factory assembled and tested heat sink assemblies from Westinghouse.

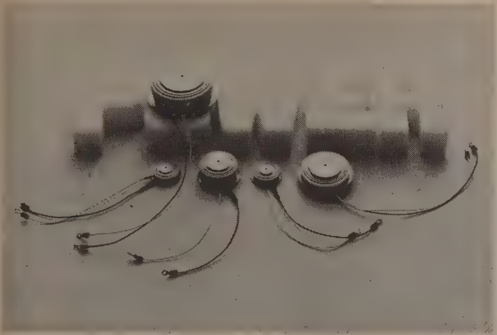
THE WESTINGHOUSE DESIGNER'S DIRECT READ-OUT NUMBERING SYSTEM BENEFITS YOU

The device number is its rating! Why memorize many sets of numbers and ratings?

Rectifier example: R6201230 **R** = rectifier **620** = basic 23mm element Pow-R-Disc package **12** = 1200 Volts PRV **30** = 300 Amps

Westinghouse

phase control applications
pow-r-disc scr's — 200 thru 1570 amp



- Reduce thermal failure rate — Compression Bonded Encapsulation construction reduces thermal fatigue in cycling applications.
- Reduce firing circuit Package costs due to the "soft firing" characteristics of the di/namic Gate design.
- Save by using tighter design specifications since Westinghouse SCR's are 100% tested, twice, during manufacture.

FOR HIGH-FREQUENCY, INVERTER TYPE APPLICATIONS, USE WESTINGHOUSE DI/NAMIC GATE SCR'S. SEE PAGE 17 THRU 19.

200 THRU 470 AMP POW-R-DISC SCR's

Type	T520	T620 (23mm Element)		
I_T (RMS)	200	200	315	470
I_T (AV)	125	125	200	300
I_{TSM} surge (½ cycle)	1600	3300	4000	5500
100 Volts	T520011305	T620011304	T620012004	T620013004
200	T520021305	T620021304	T620022004	T620023004
300	T520031305	T620031304	T620032004	T620033004
400	T520041305	T620041304	T620042004	T620043004
500	T520051305	T620051304	T620052004	T620053004
600	T520061305	T620061304	T620062004	T620063004
700	T520071305	T620071304	T620072004	T620073004
800	T520081305	T620081304	T620082004	T620083004
900	T520091305	T620091304	T620092004	T620093004
1000	T520101305	T620101304	T620102004	T620103004
1200	T520121305	T620121304	T620122004	T620123004
1400	T520141305	T620141304	T620142004	T620143004
1600	T520161305	T620161304	T620162004	T620163004
I^2t for Fusing	10700	45000	64400	120000
t_q (μsec) Typical	100	100	100	100
dv/dt	300	300	300	300
di/dt	50	100	100	100
I_{GT} (ma) @ 25°C	100	150	150	150
Package Outline (Page 24)	← V →	← V →		
Technical Data (Page 25)	← D-9 →			

550 THRU 1570 AMP POW-R-DISC SCR'S

Type	T720 (33mm Element)			T920 (50mm Element)						T9H0
I_T (RMS) Amps	550	700	850	940	1100	1255	1415	1570	940
I_T (AV) Amps	350	450	550	600	700	800	900	1000	600
I_{TSM} surge (½ cycle) Amps	7000	8400	10000	13000	15000	17000	25000	27000	13000
100 Volts	T720013504	T720014504	T720015504	T920010603	T920010703	T920010803	T920010903	T920011003	....
200	T720023504	T720024504	T720025504	T920020603	T920020703	T920020803	T920020903	T920021003	....
300	T720033504	T720034504	T720035504	T920030603	T920030703	T920030803	T920030903	T920031003	....
400	T720043504	T720044504	T720045504	T920040603	T920040703	T920040803	T920040903	T920041003	....
500	T720053504	T720054504	T720055504	T920050603	T920050703	T920050803	T920050903	T920051003	....
600	T720063504	T720064504	T720065504	T920060603	T920060703	T920060803	T920060903	T920061003	....
700	T720073504	T720074504	T720075504	T920070603	T920070703	T920070803	T920070903	T920071003	....
800	T720083504	T720084504	T720085504	T920080603	T920080703	T920080803	T920080903	T920081003	....
900	T720093504	T720094504	T720095504	T920090603	T920090703	T920090803	T920090903	T920091003	....
1000	T720103504	T720104504	T720105504	T920100603	T920100703	T920100803	T920100903	T920101003	....
1200	T720123504	T720124504	T720125504	T920120603	T920120703	T920120803	T920120903	T920121003	....
1400	T720143504	T720144504	T720145504	T920140603	T920140703	T920140803	T920140903	T920141003	....
1600	T720163504	T720164504	T720165504	T920160603	T920160703	T920160803	T920160903	T920161003	....
1800	T720183504	T720184504	....	T920180603	T920180703	T920180803	T920180903	....	....
2000	T720203504	T720204504	....	T920200603	T920200703	T920200803	....	....	T9H0200603
2200	T720223504	....	....	T920220603	T920220703	T920220803	....	....	T9H0220603
2400	T720243504	....	....	T920240603	....	....	....	....	T9H0240603
2600	....	....	....	T920260603	....	....	....	....	T9H0260603
2800	....	....	....	T920280603	....	....	....	....	T9H0280603
3000	....	....	....	T920300603	....	....	....	....	T9H0300603
I^2t for Fusing	205000	295000	416000	700000	937000	1203000	2500000	2925000	700000
t_q (μsec) Typical	150	150	150	250	250	250	150	150	250
dv/dt	300	300	300	200	300	300	300	300	200
di/dt	100	100	100	800	800	800	800	800	800
I_{GT} (ma) @ 25°C	150	150	150	200	200	200	200	200	200
Package Outline (Page 24)	← W →			← X →					← Y →
Technical Data (Page 25)	← D-9 →								

Westinghouse

standard applications/rectifier, half, full control pre-designed, stud mount assemblies

THESE STANDARD "CUSTOM" ASSEMBLIES UTILIZE QUALITY WESTINGHOUSE STUD MOUNT DEVICES

GOLD LINE ASSEMBLIES

12 to 1670 Amps

100 - 2,000 Volts

GAIN VALUABLE DESIGN TIME FOR OTHER SEGMENTS OF YOUR EQUIPMENT AND SAVE INDIVIDUAL DEVICE AND HARDWARE PROCUREMENT COSTS AS WELL AS MULTIPLE INCOMING INSPECTIONS AND HANDLING COSTS.

ENGINEER YOUR DESIGN AROUND THESE BASIC CIRCUIT "BUILDING BLOCKS" FROM WESTINGHOUSE. THESE GOLD-LINE ASSEMBLIES ARE THE RESULT OF THOUSANDS OF DESIGN HOURS AND HAVE MILLIONS OF PROVEN OPERATING HOURS "IN THE FIELD."

THE POWER PATHWAYS:

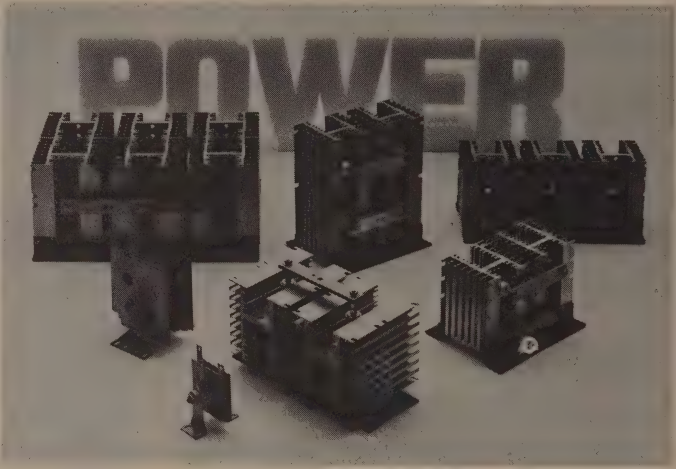
ENGINEERING — Save time in design of your circuit and device selection by choosing one of 2,000 pre-tested assemblies from Westinghouse.

Engineer in increased productivity for your production line — buy the complete assembly.

PURCHASING — Save delivery time while reducing purchasing requirements from up to 26 components down to one.

Speed delivery to your production floor by reducing incoming inspection by the same ratio.

WESTINGHOUSE AIR- AND WATER-COOLED POW-R-DISC ASSEMBLIES HAVE EVEN GREATER CURRENT HANDLING CAPABILITY — SEE PAGE 15.



APPROXIMATELY 2,000 "STANDARD" ASSEMBLIES ARE AVAILABLE FROM WESTINGHOUSE SEMICONDUCTOR, THEREFORE, ONLY THE BASIC CAPABILITIES ARE SHOWN BELOW.

CIRCUIT CONFIGURATION	AVAILABLE CURRENT RANGE Output Current (40°C)	
	Natural Convection	1,000 LFM
Rectifier Control		
Single Rectifier	12-190	22-300
Doubler	12-190	20-300
Center Tap	26-380	45-610
Single Phase Bridge	26-380	45-610
Three Phase Bridge	35-520	61-830
Six Phase Star	114-850	195-1360
Three Phase Wye (with interphase transformer)	140-1040	240-1670
Half Control		
Doubler	12-77	19-140
Single Phase AC Switch	28-180	46-320
Single Phase Bridge	26-161	41-290
Three Phase Bridge	37-232	58-420
Three Phase AC Switch	28-180	46-320
Full Control		
Single SCR	17-98	22-150
Doubler	15-95	20-150
Single Phase AC Switch	34-222	49-340
Single Phase Bridge	34-196	44-310
Three Phase Bridge	45-285	60-440
Three Phase AC Switch	34-222	49-340

For complete application and rating information, send for Westinghouse 36-page Catalog 54-300 by checking Data Ref. D-6 on the Data Request Form on Page 25.

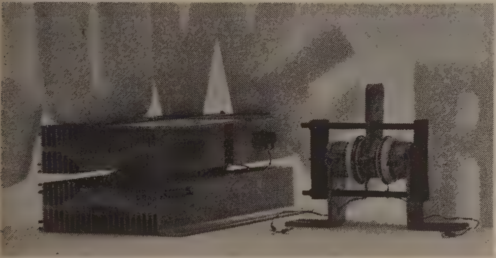
Westinghouse

rectifier and full control pow-r-disc assemblies air and water cooled/custom designed

WESTINGHOUSE POW-R-DISC ASSEMBLIES

- 147-7350 AMPERES
- 100-3000 VOLTS
- WATER AND AIR COOLING AVAILABLE

Higher current and voltage ratings are available by paralleling and seriesing modules. Other circuit configurations are also available on request.



QUALITY WESTINGHOUSE POW-R-DISC DEVICES UTILIZED EXCLUSIVELY

FEATURING:

AIR COOLED

- Aluminum Extrusion Patterns optimized for Forced Air Cooling

WATER COOLED

- Solid Cast Copper Sinks
- R-C Tabs Optional

MORE DATA ON ALL POW-R-DISC ASSEMBLIES — DATA REF. D-10, PAGE 25.

THE RATINGS — MODULAR DESIGN

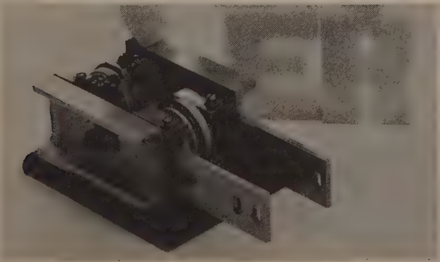
Save valuable design time and source selection time by using these standard units or request additional design help by completing and mailing the data on the "Assembly Requirements" section of the Data/Action Card on Page 25.

THE COOLING METHOD

You achieve total design approach flexibility since Westinghouse can supply the finest quality heat-sink components, assembled, tested and ready for your application, for both air-cooled and water-cooled requirements.

	Output Current (Ave. Amps)			
	AIR COOLED 40°C Air		WATER COOLED 25°C Water	
Rectifier Control	**Natural Convection**	**1500 LFM**	**1 GPM**	**5 GPM**
Single Rectifier	197-945	407-1860	588-2185	626-2460
Single Phase Bridge	394-1390	814-3720	1176-4370	1252-4920
Three Phase Bridge	566-2693	1142-5229	1642-6495	1745-7353
Data Reference (Page 25) ←	D-10 →			
Full Control				
Single SCR	73-286	183-840	269-1057	288-1192
Single Phase Bridge	146-573	376-1680	538-2113	575-2385
Three Phase Bridge	209-828	535-2433	768-3057	816-3478
Single Phase AC Switch	160-630 (RMS)	413-1848 (RMS)	593-2324 (RMS)	634-2623 (RMS)
Data Reference (Page 25) ←	D-10 →			

SPECIAL MANIFOLD AC SWITCH



- 1200A-2600 Amps RMS (1.2 GPM/10 P.S.I.G)
- 600V-3000 Volts
- Isolated Mounting Base
- Built-in Water Paths — 18" water path between polarities
- ¼-⅛ N.P.T. Brass Water Connections (2)
- New "Bolt With the Brain" Loading Indicator
- JEDEC REGISTERED TYPES
  3N221 (1200A RMS/1400V PRV)
  3N222 (1200A RMS/1700V PRV)

For complete rating data, send for the Westinghouse Air & Water Cooled POW-R-DISC Assembly Data Book. (Contains all Rectifier and SCR POW-R-DISC device data sheets plus complete assembly rating data.) Data Reference (D-10), page 25.

Westinghouse

fast recovery/inverter applications stud mount fast recovery rectifiers — 6 thru 250 amp

6-30 AMP STUD MOUNT FAST-RECOVERY RECTIFIERS

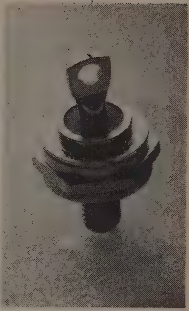
Type	R302 (10-32 stud)		R402 (¼″ stud)	
$I_{F(AV)}$	6	12	20	30
I_{FSM} (Amps)	75	150	225	300
50 Volts (200 ns Recovery Time)	1N3879	1N3889	1N3899	1N3909
100	1N3880	1N3890	1N3900	1N3910
200	1N3881	1N3891	1N3901	1N3911
300	1N3882	1N3892	1N3902	1N3912
400	1N3883	1N3893	1N3903	1N3913
500	R3020506	R3020512	R4020520	R4020530
600	R3020606	R3020612	R4020620	R4020630
T_{CASE}	100°C	100°C	100°C	100°C
Pkg. (Page 22)	← E →		← F →	
Data (Page 25)	← D-11 →			

Reverse Polarity Available — See Page 8.

REVERSE SWITCHING RECTIFIER

A four-layer PNPN switch ideal for radar modulators and laser pulsers due to high di/dt and fast switching ability.

Type	T40R (¼″ stud)	
Volts	Current (22 Amps I_{TA})	di/dt
600	T40R062202	2000A/μsec
	T40R062203	3000
	T40R062204	4000
800	T40R082202	2000
	T40R082203	3000
	T40R082204	4000
1000	T40R102202	2000
	T40R102203	3000
	T40R102204	4000
Pkg. Outl. (Pg. 22)	F	
Tech. Data (Pg. 25)	D-14	



80-250 AMP STUD MOUNT FAST RECOVERY DIODES

Type		R502 (⅜″ stud)							
I_F (AV)		80 Amps				100 Amps			
I_{FSM} (Amps)		2200				2500			
Voltage Range	Recovery Time	Device Type	Volt.	Curr.	Rec. Time	Device Type	Volt.	Curr.	Rec. Time
100 to 1200	1.5 μsec	R502		08	FJ	R502		10	FJ
100 to 1200	2.0 μsec	R502		08	EJ	R502		10	EJ
100 to 1200	3.0 μsec	R502		08	CJ	R502		10	CJ
Pkg. Outline (Pg. 22)		← I →							
Tech. Data (Pg. 25)		← D-12 →							

Type		R602 (¾″ stud)							
I_F (AV)		200 Amps				250 Amps			
I_{FSM} (Amps)		4500				5000			
Voltage Range	Recovery Time	Device Type	Volt.	Curr.	Rec. Time	Device Type	Volt.	Curr.	Rec. Time
100 to 1200	1.5 μsec	R602		20	FJ	R602		25	FJ
100 to 1600	2.0 μsec	R602		20	EJ	R602		25	EJ
100 to 1600	3.0 μsec	R602		20	CJ	R602		25	CJ
Pkg. Outline (Pg. 22)		← J →							
Tech. Data (Pg. 25)		← D-12 →							

Reverse Polarity Available — See Below.

ORDERING INFORMATION
FAST RECOVERY STUD MOUNT OR POW-R-DISC RECTIFIERS

Procedure

The Westinghouse descriptive numbering system allows you to specify the Stud Mount or Pow-R-Disc Rectifier you want.

From each product chart determine the device and current you need and turn-off capability.

Pick the voltage code you need from the shaded column in the chart, right, and the recovery time code from that shaded column.

Insert these codes in the corresponding shaded areas in the product charts and you have completely specified your device.

Type	Voltage		Current		Recovery Time	
Code	V_{RRM} (V)	Code	I_F(av)(A)	Code	trr μsec	Code
R502 (Standard Polarity)	100	01	80	08	1.5	F J
	200	02				
	300	03	100	10	2.0	E J
R503 (Reverse Polarity)	400	04				
	500	05			3.0	C J
	600	06				
	700	07				
	800	08				
R602 (Standard Polarity)	900	09	200	20	1.5	F J
	1000	10				
R603 (Reverse Polarity)	1100	11	250	25	2.0	E J
	1200	12				
	1400	14			3.0	C J
	1600	16				

Example: You need a 100 Amp, 1000 Volt fast-recovery rectifier with a recovery time of 2.0 μsec. The device best suited for a 100 Amp need is the type R502....10..... The voltage code for 1000 Volts (V_{RRM}) is "10" and for a recovery item of 2.0 μsec is "EJ." Your device is R5021010EJ.

Westinghouse

Pathways to Power

fast-switch/inverter applications
stud mount fast-switch scr's—63 thru 475 amp

63-125 AMPS (RMS) DI/NAMIC GATE STUD MOUNT

Type		T507 (½" stud)														
I_T (RMS)		63A					110A					125A				
I_T (AV)		40A					70A					80A				
I_{TSM}		1000					1200					1400				
Voltage Range	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q	
100 to 600	10-60	T507		40		4AA/AQ	T507		70		4AA/AQ	T507		80		4AA/AQ
100 to 1000	15-60	T507		40		4AA/AQ	T507		70		4AA/AQ	T507		80		4AA/AQ
100 to 1400	20-60	T507		40		4AA/AQ	T507		70		4AA/AQ	T507		80		4AA/AQ
100 to 1500	30-60	T507		40		4AA/AQ	T507		70		4AA/AQ	T507		80		4AA/AQ
100 to 1500	40-60	T507		40		4AA/AQ	T507		70		4AA/AQ	T507		80		4AA/AQ
I^2t		4000 A²sec					6000 A²sec					8150 A²sec				
di/dt		800A/µsec					800A/µsec					800A/µsec				
dv/dt		← 200V/µsec exp to V_{DRM} T_J = 125°C →														
I_{GT}		← 150 ma T_J = 25°C max. V_D = 12V →														
Pkg. Outline (Pg. 23)		← "Flag" Lead (AA) = Outline M/"Flex" Lead (AQ) = Outline N →														
Tech. Data (Pg. 25)		← D-13 →														

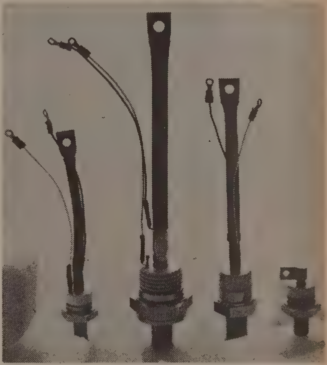
200-275 AMPS (RMS) DI/NAMIC GATE STUD MOUNT

Type		T607 (¾" stud)														
I_T (RMS)		200A					235A					275A				
I_T (AV)		125A					150A					175A				
I_{TSM}		3500					4000					4500				
Voltage Range	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q	
100 to 600	10-60	T607		13		4BT	T607		15		4BT	T607		18		4BT
100 to 1000	15-60	T607		13		4BT	T607		15		4BT	T607		18		4BT
100 to 1400	20-60	T607		13		4BT	T607		15		4BT	T607		18		4BT
100 to 1500	30-60	T607		13		4BT	T607		15		4BT	T607		18		4BT
100 to 1500	40-60	T607		13		4BT	T607		15		4BT	T607		18		4BT
I^2t		50,000 A²sec					65,000 A²sec					84,000 A²sec				
di/dt		800A/µsec					800A/µsec					800A/µsec				
dv/dt		← 200V/µsec exp to V_{DRM} T_J = 125°C →														
I_{GT}		← 150 ma T_J = 25°C max. V_D = 12V →														
Pkg. Outline (Pg. 23)		← O →														
Tech. Data (Pg. 25)		← D-13 →														

315-475 AMPS (RMS) DI/NAMIC GATE STUD MOUNT

Type		T707 (¾" stud)														
I_T (RMS)		315A					400A					475A				
I_T (AV)		200A					250A					300A				
I_{TSM}		4000					5000					7000				
Voltage Range	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q	
100 to 600	10-60	T707		20		4BT	T707		25		4BT	T707		30		4BT
100 to 800	15-60	T707		20		4BT	T707		25		4BT	T707		30		4BT
100 to 1000	20-60	T707		20		4BT	T707		25		4BT	T707		30		4BT
100 to 1200	30-60	T707		20		4BT	T707		25		4BT	T707		30		4BT
100 to 1400	40-60	T707		20		4BT	T707		25		4BT	T707		30		4BT
I^2t		66,000 A²sec					100,000 A²sec					200,000 A²sec				
di/dt		800A/µsec					800A/µsec					800A/µsec				
dv/dt		← 200V/µsec exp to V_{DRM} T_J = 125°C →														
I_{GT}		← 150 ma T_J = 25°C max. V_D = 12V →														
Pkg. Outline (Pg. 23)		← P →														
Tech. Data (Pg. 25)		← D-13 →														

- Reduce the cost of protective circuitry and increase efficiency due to high di/dt and surge capability.
- The cost of proper device selection in the "prototype" stage can be reduced by using the Westinghouse Application Simulator in conjunction with Westinghouse Pulse Rating Data and engineering assistance.
- The costs and complexity of "firing packages" can be reduced due to the "soft fire" characteristic of Westinghouse di/namic Gate Design SCR's.
- You insure that all devices you specify and purchase have electrical repeatability because of the "all-diffused" fusion process.



ORDERING INFORMATION FOR INVERTER SCR'S

Select the proper device for your current requirements from the product charts and determine voltage/turn-off matches. Select the appropriate voltage code and turn-off code from the charts below, and insert them in the corresponding shaded area in the product charts. You have completely specified your device.

Voltage	
V_{DRM} V_{RRM} (V)	Code
100	01
200	02
300	03
400	04
500	05
600	06
700	07
800	08
900	09
1000	10
1100	11
1200	12
1400	14
1600	16

Turn-off	
t_q (µsec)	Code
60	2
50	3
40	4
30	5
20	6
15	7
10	8

Westinghouse

fast recovery/inverter applications pow-r-disc diodes and scr's — 350 thru 800 amp rectifiers/200 thru 400 amp scr's

350-400 AMP FAST-RECOVERY POW-R-DISC RECTIFIERS

Type		R622 (23mm Element)							
I_F (AV)		350 Amp				400 Amp			
I_{FSM}		4500				5000			
Voltage Ranges	Recovery Time	Device Type	Volt.	Curr.	Rec. Time	Device Type	Volt.	Curr.	Rec. Time
100 to 1200	1.5 µsec	R622		35	FJ	R622		40	FJ
100 to 1600	2.0 µsec	R622		35	EJ	R622		40	EJ
100 to 1600	3.0 µsec	R622		35	CJ	R622		40	CJ
Package Outline (Page 23)	← R →								
Technical Data (Page 25)	← D-12 →								

Maximize your design function and minimize over-rating due to the wide current range available (350-800A) and high voltage capability (Pp to 2500V) from Westinghouse, with Recovery Times of 1.5 to 5.0 µsec. Guarantee the Recovery time you require — Westinghouse Trr ratings are made to JEDEC specifications.

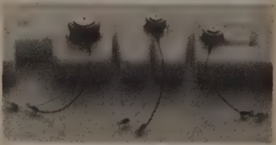
500-800 AMP FAST-RECOVERY POW-R-DISC RECTIFIERS

Type		R722 (33mm Element)											
I_F (AV)		500 Amp				600 Amp				800 Amp			
I_{FSM}		7000				9500				11000			
Voltage Ranges	Recovery Time	Device Type	Volt.	Curr.	Rec. Time	Device Type	Volt.	Curr.	Rec. Time	Device Type	Volt.	Curr.	Rec. Time
100 to 1200	2.0 µsec	R722		05	EJ	R722		06	EJ	R722		08	EJ
100 to 1600	3.0 µsec	R722		05	CJ	R722		06	CJ	R722		08	CJ
100 to 2500	5.0 µsec	R722		05	AJ	Consult Factory				Consult Factory			
Package Outline (Page 23)	← S →												
Technical Data (Page 25)	← D-12 →												

ORDERING INFORMATION: For rectifiers use the procedure outlined on page 16.
For SCR's use the procedure outlined on page 17.

200-400 AMP (RMS) FAST-SWITCH POW-R-DISC SCR'S

Type		T527					T627 (23mm Element)														
I_T (RMS)		200A					235A					315A					400A				
I_T (AV)		150A					150A					200A					250A				
I_{TSM}		1400					3500					4000					4500				
Voltage Ranges	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q			Volts		t_q	
100- 600	10-60	T527		13		4DN	T627		15		4DN	T627		20		4DN	T627		25		4DN
100-1000	15-60	T527		13		4DN	T627		15		4DN	T627		20		4DN	T627		25		4DN
100-1400	20-60	T527		13		4DN	T627		15		4DN	T627		20		4DN	T627		25		4DN
100-1500	30-60	T527		13		4DN	T627		15		4DN	T627		20		4DN	T627		25		4DN
100-1500	40-60	T527		13		4DN	T627		15		4DN	T627		20		4DN	T627		25		4DN
I^2t		8150A²sec					50,000A²sec					65,000A²sec					84,000A²sec				
di/dt		800A/sec					800A/sec					800A/sec					800A/sec				
dv/dt		← 200V/sec exp. to V_{DRM} $T_J = 125°C$ →																			
I_{GT}		← 150 ma $T_J = 25°C$ max. $V_D = 12V$ →																			
Pkg. Outl. (Pg. 24)		← V →																			
Tech. Data (Pg. 25).		← D-13 →																			



- Insure complete design flexibility and maximize circuitry limits by using the wide range of Westinghouse Pow-R-Disc Inverter Type SCR's for Inverters, Uninterruptible Power Supply and Pulse Width Modulator applications.
- Current capability is 200 to 700A
- Voltage capability Up to 1500V

FOR PHASE CONTROL APPLICATIONS

Use Westinghouse Lifetime Guaranteed Standard Product —

Rectifiers	(Stud-Mount)	Pages 7 & 8
Rectifiers	(Pow-R-Disc)	Page 10
SCR's	(Stud-Mount)	Page 8 & 9
SCR's	(Pow-R-Disc)	Page 11

Save time and money by buying a pre-designed Westinghouse assembly. See pages 12-15.

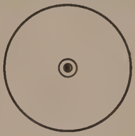
Westinghouse

fast switch/inverter application
fast switch pow-r-disc scr's — 157 thru 700 amp

400-700 AMP (RMS) DI/NAMIC GATE POW-R-DISC SCR'S

Type		T727 (33mm Element)														
I_T (RMS)		400A					550A					700A				
I_T (AV)		250A					350A					450A				
I_{TSM}		4000					5500					8000				
Voltage Ranges	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q	
100 to 600 V_{DRM}	10-60	T727		25		4DN	T727		35		4DN	T727		45		4DN
100 to 800 V_{RRM}	15-60	T727		25		4DN	T727		35		4DN	T727		45		4DN
100 to 1000	20-60	T727		25		4DN	T727		35		4DN	T727		45		4DN
100 to 1200	30-60	T727		25		4DN	T727		35		4DN	T727		45		4DN
100 to 1400	40-60	T727		25		4DN	T727		35		4DN	T727		45		4DN
I^2t		66,000A²sec					120,000A²sec					265,00A²sec				
di/dt		800A/µsec					800A/µsec					800A/µsec				
dv/dt		← 200V/µsec exp. to V_{DRM} $T_J = 125°C$ →														
I_{GT}		← 150 ma max. $T_J = 25°C$ $V_D = 12V$ →														
Package Outline (Page 24)		← W →														
Technical Data (Page 25)		← D-13 →														

THREE "INVERTER" PATHWAYS TO POWER



- T5, T6, T7 Fast-Switching Inverter Type SCR's feature di/namic Gate Design
- This all-diffused design insures inherent "device repeatability"; provides high surge and high di/dt which allows reduction of circuit protection costs.

157-315 AMP (RMS) SNO-FLAKE GATE POW-R-DISC SCR'S

Type		T62J (23mm Element)														
I_T (RMS)		157A					235A					315A				
I_T (AV)		100A					150A					200A				
I_{TSM}		2400					2800					3200				
Voltage Ranges	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q	
100 to 800 V_{DRM}	10-60	T62J		10		2DN	T62J		15		2DN	T62J		20		2DN
100 to 1000 V_{RRM}	15-60	T62J		10		2DN	T62J		15		2DN	T62J		20		2DN
100 to 1200	20-60	T62J		10		2DN	T62J		15		2DN	T62J		20		2DN
100 to 1200	30-60	T62J		10		2DN	T62J		15		2DN	T62J		20		2DN
I^2t		24,000A²sec					1600A/µsec					42,500A²sec				
di/dt		1600A/µsec					33,800A²sec					1600A/µsec				
dv/dt		← 400V/µsec exp. to .8 V_{DRM} $T_J = 125°C$ →														
I_{GT}		← 300 ma $T_J = 25°C$ $V_D = 12V$ →														
Package Outline (Page 24)		← V →														
Technical Data (Page 25)		← D-13 →														

- T62J Fast-Switching High Frequency SCR's incorporate a new innovation in thyristor date design, the di/namic sno-Flake Design.

It features capabilities best for:

- Low duty cycle operation (peak efficiency with pulse width less than 70 µsec).
- Lower watt/sec per pulse

400-700A (RMS) DUAL-RING GATE POW-R-DISC SCR'S

Type		T72H (33mm Element)														
I_T (RMS)		400A					550A					700A				
I_T (AV)		250A					350A					450A				
I_{TSM}		6000					7000					7500				
Voltage Ranges	Turn-Off t_q µsec		Volts		t_q			Volts		t_q			Volts		t_q	
100 to 600 V_{DRM}	10-60	T72H		25		4DN	T72H		35		4DN	T72H		45		4DN
100 to 800 V_{RRM}	15-60	T72H		25		4DN	T72H		35		4DN	T72H		45		4DN
100 to 1000	20-60	T72H		25		4DN	T72H		35		4DN	T72H		45		4DN
100 to 1200	30-60	T72H		25		4DN	T72H		35		4DN	T72H		45		4DN
100 to 1200	40-60	T72H		25		4DN	T72H		35		4DN	T72H		45		4DN
I^2t		150,000A²sec					205,000A²sec					234,000A²sec				
di/dt		1200A/µsec					1200A/µsec					1200A/µsec				
dv/dt		← 300V/µsec exp. to .8 V_{DRM} $T_J = 125°C$ →														
I_{GT}		← 150 ma $T_J = 25°C$ $V_D = 12V$ →														
Package Outline (Page 24)		← W →														
Technical Data (Page 25)		← D-13 →														

- T72H Fast-Switching High Frequency SCR's use a new gate design — the di/namic Dual-Ring Gate.
- This "inside-outside" design gives improved turn-on characteristics without major sacrifice to average current rating; Reduce power loss in "snubber" circuit; Optimized efficiency for PWM commutation thyristor.

NOTE: For **standard** and **phase control** applications, use Westinghouse standard and phase control Pow-R-Disc thyristors found on page 11.
The comparable rectifiers are on page 10.

Westinghouse

linear, switching, amplification applications single diffused and alloy npn transistors

DIFFUSED PROCESS TRANSISTORS

- High power handling capability (up to 150 watts)
- Plated steel cases for ruggedness and reliability
- 100% power tested
- Wide range of gain and voltage ratings available

Westinghouse uses a medium speed process to produce transistors for linear and switching applications. These devices have been used extensively in voltage regulators, inverters, and amplifiers because of their economy and power capability.

The Westinghouse Lifetime Guarantee is available on all JEDEC types in this family.

4-30 AMPERE TRANSISTORS . . . LOW COST PER WATT

Style	D390		D480				
I_C Rating	4 Amperes		15 Amperes		30 Amperes		
Type No.	1571	1571	1561	1561	1561	1561	1561
V_{ceo} (sus) 40 60 80 100 120 140	1571-0420 1571-0620 1571-0820 1571-1020 1571-1220 2N3441	1571-0425 2N3054 1571-0825 1571-1025 1571-1225 1571-1425	1561-0403 2N3232 1561-0803 2N3233 2N4347 2N3442	1561-0404 2N3055 1561-0804 2N3236 2N4348 1561-1404	1561-0408 1561-0608 1561-0808 1561-1008 1561-1208 2N3773	1561-0410 2N3772 1561-0810 1561-1010 1561-1210 1561-1410	2N3771 1561-0615 1561-0815 1561-1015 1561-1215 ....
h_{FE} min. V_{ce} (sat) max. f_T typical	20 @ ½ Amp 1.0 V 1.0 MHz	25 @ ½ Amp 1.0 V 1.0 MHz	20 @ 3A 1.1 V 1.0 MHz	20 @ 4A 1.1 V 1.0 MHz	15 @ 8A 1.4 V 1.0 MHz	15 @ 10A 2.0 V 1.0 MHz	15 @ 15A 2.0 V 1.0 MHz
Max. Ratings	$V_{EB} = 7$ V, $I_B = 2$A, $T_J = -65°$C to $+200°$C, $P_T = 29$ W @ $T_C = 25°$C, $R\theta_{JC} = 6°$C/Watt		$V_{EB} = 7$ V, $I_B = 7$A, $T_J = -65°$C to $+200°$C, $P_T = 115$ W @ $T_C = 25°$C, $R\theta_{JC} = 1.5°$C/Watt		$V_{EB} = 7$ V, $I_B = 7$A, $T_J = -65°$C to $+200°$C, $P_T = 150$ W @ $T_C = 25°$C, $R\theta_{JC} = 1.17°$C/Watt		
Package Outline (Page 24)	←AA→		←BB→				
Technical Data (Page 25)	←D-15→						

ALLOY PROCESS TRANSISTOR

- Up to 75% more Safe Operating Area (SOA) than other devices
- Increased thermal cycling endurance
- Darlingtons ($h_{FE} = 100$ @ 10 Amperes) available
- Power dissipation capability up to 200 watts @ 75°C

The Westinghouse alloy transistor has been the preferred power device on defense, aerospace, and critical industrial projects since 1960. Its freedom from secondary breakdown (over most of its voltage range) and its ability to resist thermal fatigue make it one of the most reliable semiconductors available today. Every device in this series features a copper stud and a molybdenum "hard solder" wafer attachment system for optimum power dissipation and thermal cycling ability. Each device is 100% power tested and the JEDEC types are available with the Westinghouse Lifetime Guarantee.

7.5 TO 10 AMPERE TRANSISTORS — MILITARY TYPE

Style	A50H		A51H	A60G		A67G	
I_C Rating	7.5 Amperes		7.5 Amperes	10 Amperes (High Gain)		10 Amperes (High Gain)	
Type No.	107	108	113	118	118	120	120
V_{ceo} (sus) 30 50 100 150 200	2N1015 2N1015A 2N1015B 2N1015C 2N1015D	2N1016 2N1016A 2N1016B 2N1016C 2N1016D	.... 2N3429 2N3430 2N3431 2N3432	.... 2N2226 2N2227 2N2228 2N2229	.... 2N2230 2N2231 2N2232 2N2233	.... 2N3470 2N3471 2N3472 2N3473	.... 2N3474 2N3475 2N3476 2N3477
h_{FE} min. V_{ce} (sat) max. f_T typical	10 @ 2A 1.5 V 0.5 MHz	10 @ 5A 2.5 V 0.5 MHz	10 A 5A 1.0 V 0.5 MHz	100 @ 10A 3.5 V 0.5 MHz	400 @ 10A 3.5 V 0.5 MHz	100 @ 10A 3.5 V 0.5 MHz	400 @ 10A 3.5 V 0.5 MHz
Max. Ratings	$V_{EB} = 25$ V, $I_B = 5$A $T_{J\&STG} = -65°$C to $+150°$C $P_T = 150$ W @ 45°C $R\theta_{JC} = 0.7°$C/Watt		$V_{EB} = 25$ V, $I_B = 3$A $T_{J\&STG} =$ $-65°$C to $+175°$C $P_T = 150$ W @ 60°C $R\theta_{JC} =$ 0.75°C/W	$V_{EB} = 15$ V, $I_B = 1$A $T_{J\&STG} = -65°$C to $+150°$C $P_T = 150$ W @ 75°C $R\theta_{JC} = 0.5°$C/Watt		$V_{EB} = 15$ V, $I_B = 1$A $P_T = 150$ W @ 75°C $T_{J\&STG} = -65°$C to $+150°$C $R\theta_{JC} = 0.5°$C/Watt	
Package Outline (Page 24)	←DD→		←CC→	←DD→		←EE→	
Technical Data (Page 25)	←D-16→						

Westinghouse

Westinghouse Electric Corporation
Semiconductor Division, Youngwood, Pa. 15697
(412) 925-7272 • TWX 510-468-2840

linear, switching, amplification applications alloy npn transistors

6 TO 30 AMPERE ALLOY TRANSISTORS—HIGH SAFE OPERATING AREA

Style	A500		A510		A670	
I_C Rating	6 Amperes	6 Amperes	7.5 Amperes	7.5 Amperes	20 Amperes	20 Amperes
Type No.	151	152	153	154	163	164
V_{ceo} (sus) 40	151-04	152-04	153-04	154-04	163-04	164-04
50	151-05	152-05	153-05	154-05	163-05	164-05
60	151-06	152-06	153-06	154-06	163-06	164-06
70	151-07	152-07	153-07	154-07	163-07	164-07
80	151-08	152-08	153-08	153-08	163-08	164-08
90	151-09	152-09	153-09	154-09	163-09	164-09
100	151-10	152-10	153-10	154-10	163-10	164-10
120	151-12	152-12	153-12	154-12	163-12	164-12
140	151-14	152-14	153-14	154-14	163-14	164-14
160	151-16	152-16	153-16	154-16	163-16	164-16
180	151-18	152-18	153-18	154-18	163-18	164-18
200	151-20	152-20	153-20	154-20	163-20	164-20
220	151-22	152-22	153-22	154-22	163-22	164-22
h_{FE} min.	11 @ 1.5A	18-@-1.5A	15 @ 1.5A	25 @ 1.5A	15 @ 5A	25 @ 5A
V_{ce} (sat) max.	1.3 V	1.25 V	1.3 V	1.25 V	1.1 V	1.0 V
f_T typical	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
Maximum Ratings	V_{EB} = 25 V, I_B = 3A $T_{J\&TSG}$ = −65°C to +150°C P_T = 100 W @ 80°C $R\theta_{JC}$ = 0.7°C/Watt		V_{EB} = 25 V, I_B = 3A $T_{J\&TSG}$ = −65°C to +175°C P_T = 200 W @ 25°C $R\theta_{JC}$ = 0.75°C/Watt		V_{EB} = 25 V, I_B = 7.5A $T_{J\&TSG}$ = −65°C to +175°C P_T = 200 W @ 75°C $R\theta_{JC}$ = 0.5°C/Watt	
Package Outline (Page 24)	DD		CC		EE	
Technical Data (Page 25)	D-16					

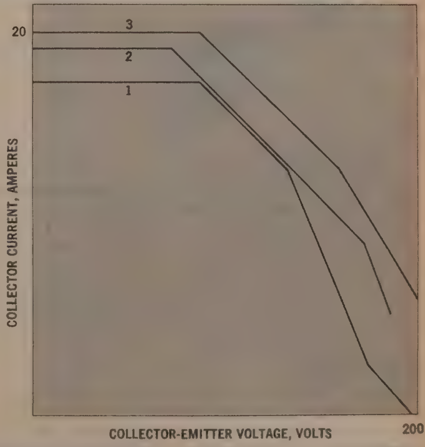
Style	A67H			
I_C Rating	30 Amperes			
Type No.	110	110	110	110
V_{ceo} (sus) 50	2N2757	2N2763	2N2769	2N2775
100	2N2758	2N2764	2N2770	2N2776
150	2N2759	2N2765	2N2771	2N2777
200	2N2760	2N2766	2N2772	2N2778
250	2N2761	....	....	....
h_{FE} min.	10 @ 10A	10 @ 15A	10 @ 20A	10 @ 25A
V_{ce} (sat) max.	1.5 V	1.5 V	1.5 V	1.5 V
f_T typical	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
Maximum Ratings	V_{EB} = 25 V, I_B = 7.5A $T_{J\&TSG}$ = −65°C to +175°C P_T = 200 W @ 75°C $R\theta_{JC}$ = 0.5°C/Watt			
Package Outline (Page 24)	EE			
Technical Data (Page 25)	D-16			

SAFE OPERATING AREA COMPARISON

Westinghouse alloy process transistors feature an extensive Safe Operating Area (SOA). This power handling capability means that the circuit designer's job can be simplified in the areas of heat sink design, transient and over-current protection, and safety margin. Both Westinghouse alloy and single diffused types are more tolerant of high voltage and current conditions than the so-called "high speed" types of devices. In many inverter, regulator, and amplifier circuits this can mean a savings in heat sink size, protective devices, or elimination of paralleling transistors.

Maximum D.C. Operating Areas @ Case Temperature T_C = 75°C

1. "High Speed" Transistors
2. Single Diffused Transistor
3. Westinghouse Alloy Transistor



BULOVA®

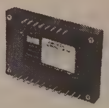
D.C. Servo Amplifiers

25 TO 1000 WATTS

Here's a complete, versatile line of DC Servo Amplifiers with the inherent quality of a Bulova product and value engineered for low cost. Specially designed to meet the many diverse requirements of today's control systems, the units are small in size and provide a large power to volume ratio.

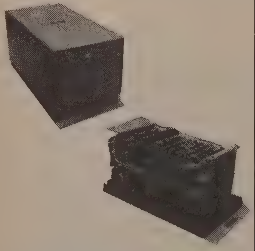
From configuration to current/voltage/power ratings, these Bulova DC Amps provide a full measure of flexibility to make the circuit and systems designer's job easier. Simple tradeoffs are built into the design parameters to permit operation in various modes and gains.

TYPICAL CONFIGURATIONS



DCA 25/60
DCA 50/60

Models DCA 200 & 300



Models DCA 1000 to DCA 2500

SPECIFICATIONS (Nominal @ 25°C)	DCA 25	DCA 25/60	DCA 50/60
OUTPUT (at nominal power supply voltage)			
Voltage, peak (Volts)	±20	±50	±50
Current, continuous (Amperes)	±1.25	±0.5	±1
Current, peak (Amperes)	±1.25	±0.5	±1
Current Limit Adjust Range, (Amperes)	0.4 to 1.25	0.2 to .5	0.2 to 1
INPUT			
Supply Voltage (VDC)	+28 ±3	+60 ±5	+60 ±5
Supply Quiescent Current (ADC)	0.05	0.05	0.05
Bias Supply Voltage (VDC)	−15 ±2	−15 ±2	−15 ±2
Bias Supply Current (MADC)	20	20	20
POWER AMPLIFIER PARAMETERS			
Input Impedance (Kohms)	10	10	10
Gain (adjustable) As voltage amplifier (V/V)	20	20	20
As current amplifier (A/V)	0.5	0.5	0.5
Frequency Response (KHz) Small signal	10	10	10
Full output	1	1	1
Output Impedance (Dynamic, ohms)	0.1	0.1	0.1
Output Offset Null (MVDC)	100	100	100
Offset Drift (micro V/°C) (4)	10	10	10
DC Dead Band (micro volts)	±50	±50	±50
PREAMPLIFIER	(7)	(7)	(7)
INTERNAL DISSIPATION			
Continuous, at 25°C (watts)	25 (5)	25 (5)	50 (5)
Derating for Temperature (watts/°C)	.15	.15	.3
Operating Temp. Range (°C)	−55 to +125 (5)	−55 to +125 (5)	−55 to +125 (5)

(1) Internally mounted pot adjustable
(2) For detailed electrical parameters see individual data sheet
(3) Internally mounted pot null adjust
(4) Referred to input
(5) Mounting base temperature
(6) Ambient temperature
(7) Not Available
(8) Not Required

Bulova DC Servo Amplifiers are designed to drive–

- DC Torque Motors
- Deflection Coils
- Servo Valves
- DC Servo Motors
- Low Inertia Motors

To meet the application requirements of

- NC Systems
- Instrument Systems
- Tape Drives
- Production Test Stands
- Camera Drives
- Rate Tables

FEATURES

- Adjustable Gain–For optimum servo accuracy and stability
- Current Limiting–To maintain at acceptable levels during motor plugging
- Voltage or Current Feedback–For speed or torque control
- Wide Bandwidth–For fast response and loop stability
- Power Sharing–For maximum utilization of power transistors
- Short Circuit Protection–To prevent accidental shorts or motor plug

DCA 200	DCA 300	DCA 300/60	DCA 600/60	DCA 1000-1,2,3	DCA 1500-1,2,3	DCA 2000-1,2,3	DCA 2500-1,2,3
±20	±20	±50	±50	±65	±65	±90	±90
±5	±6	±6	±6	±15.5	±23	±22.5	±28
±10	±15	±6	±12	±20	±30	±30	±35
0.4 to 10	0.4 to 15	0.2 to 6	0.2 to 12	2-20 (1)	3-30 (1)	3-30 (1)	3.5-35 (1)
				−1 −2 −3	−1 −2 −3	−1 −2 −3	−1 −2 −3
+28 ±3	+28 ±3	+60 ±5	+60 ±5	+75 ±75 +75	+75 ±75 +75	+75 ±75 +75	+75 ±75 +75
0.05	0.05	0.05	0.05	.1	.1	.1	.1
−15 ±2	−15 ±2	−15 ±2	−15 ±2	−15	−15	−15	−15
20	20	20	20	25	25	25	25
10	10	10	10	10	10	10	10
20	20	20	20	10	10	10	10
0.5	0.5	0.5	0.5	2.5	2.5	2.5	2.5
10	10	10	10	10	10	10	10
1	1	1	1	1	1	1	1
0.1	0.1	0.1	0.1	.05	.05	.05	.05
100	100	100	100	100	100	100	100
10	10	10	10	.2	.2	.2	.2
±50	±50	±50	±50	±50	±50	±50	±50
(7)	(7)	(7)	(7)	μA 741 (2) (3)	μA 741 (2) (3)	μA 741 (2) (3)	μA 741 (2) (3)
				−1 −2 −3	−1 −2 −3	−1 −2 −3	−1 −2 −3
200 (5)	300 (5)	300 (5)	600 (5)	1 (6)	1.5 (6)	2 (6)	2.5 (6)
1.25	1.75	1.75	3.5	20	30	40	50
−55 to +125 (5)	−55 to +125 (5)	−55 to +125 (5)	−55 to +125 (5)	0 to 50 (6)	0 to 50 (6)	0 to 50 (6)	0 to 50 (6)

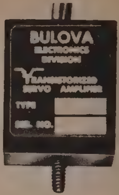
From Bulova Electronics Division: Frequency Control Components • Crystals • Crystal Oscillators • Monolithic Crystal Filters • Fork Oscillators • DC Servo Amplifiers • 400 Hz Servo Amplifiers • Optical Devices • Choppers and Scanners • Frequency Changers • Inverters • Lock-in Amplifiers

BULOVA sp

BULOVA® SERVO PRODUCTS

ELECTRONICS DIVISION, OF BULOVA WATCH COMPANY, INC.
61-20 WOODSIDE AVENUE, WOODSIDE, N.Y. 11377, (212) 335-6000

BULOVA®



Minature Solid State, 400 Hz Servo Amplifiers — 2 to 40 Watts

POWER OUTPUT		2 WATT		3.5 WATT		6 WATT			
PHASE SHIFT		0°	90°	0°	90°	0°		90°	
MODEL NUMBER		S4121 — — S4131 — — S4141 — — S4161 — —	S5121 — — S5131 — — S5141 — — S5161 — —	S4221 — — S4231 — — S4241 — — S4261 — —	S5221 — — S5231 — — S5241 — — S5261 — —	S4321 — — S4331 — — S4341 — — S4351 — —	S4322 — — S4332 — — S4342 — —	S5321 — — S5331 — — S5341 — — S5351 — —	S5322 — — S5332 — — S5342 — —
OPERATING SIGNAL FREQUENCY (Hz)		400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20
INPUT SIGNAL (VRMS max. at max. gain)		26	26	26	26	26	26	26	26
VOLTAGE OUTPUT (vrms nominal)	(linear region)	0-25	0-25	0-25	0-25	0-25	0-18	0-25	0-18
	(at rated power)	40	40	40	40	40	26	40	26
VOLTAGE GAIN ±ldb (see note 3) (v/v max, adjustable down)		Model No. Gain S4121 1000 S4131 2500 S4141 5000 S4161 25000	Model No. Gain S5121 1000 S5131 2500 S5141 5000 S5161 25000	Model No. Gain S4221 1000 S4231 2500 S4241 5000 S4261 25000	Model No. Gain S5221 1000 S5231 2500 S5241 5000 S5261 25000	Model No. Gain S4321 1000 S4331 2500 S4341 5000 S4351 10000	Model No. Gain S4322 1000 S4332 2500 S4342 5000	Model No. Gain S5321 1000 S5331 2500 S5341 5000 S5351 10000	Model No. Gain S5322 1000 S5332 2500 S5342 5000
GAIN STABILITY (db, over environment)		± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2
PHASE SHIFT (degrees)	(linear region)	0 ± 10	90 ± 10	0 ± 10	90 ± 10	0 ± 10	0 ± 10	90 ± 10	90 ± 10
	(through saturation)	0 ± 20	90 ± 20	0 ± 20	90 ± 20	0 ± 20	0 ± 20	90 ± 20	90 ± 20
INPUT IMPEDANCE (ohms minimum)		10K	10K	10K	10K	10K	10K	10K	10K
OUT IMPEDANCE (OHMS TYP)		100	100	100	100	100	10	100	10
DEADBAND (mv, no output referred to input)		$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$
NOISE (mv, max., output with input shorted)		250	250	250	250	250	250	250	250
BANDWIDTH (Hz minimum)		200	200	200	200	200	200	200	200
POWER SUPPLY (voltage ±10%)		28 V DC	28 V DC	28 V DC	28 V DC	28 V DC	26 VRMS*	28 V DC	26 VRMS*
INPUT POWER (watts)	(at zero signal)	1	1	1	1	2	2	2	2
	(at rated load)	5	5	7	7	12	12	12	12
MOTOR LOAD	winding	TCT**	TCT**	TCT**	TCT**	TCT**	USE***	TCT**	USE***
	voltage	33-40	33-40	33-40	33-40	33-40	26	33-40	26
	eff resistance	800 ± 25%	800 ± 25%	460 ± 25%	460 ± 25%	270 ± 25%	100-350	270 ±25%	100-350
AMBIENT TEMPERATURE RANGE	operating	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C
	storage	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C

Notes

1. The above chart represents standard preferred types of servo amplifiers. Bulova's quick-reaction capability in custom designing to specifications at minimum cost enables you to request variations at costs which are not prohibitive.

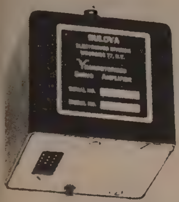
2. Unless otherwise stated, all amplifiers listed have isolated DC and signal grounds. An external common between these two points is required for proper operation.

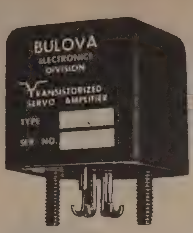
3. All gains are listed as maximum and all input impedances minimum. An external resistor in series with the input terminal will reduce the gain if required and will also allow higher maximum input signal level.

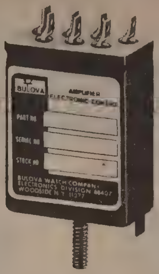
The value of this resistor may be calculated by use of the approximate equation:

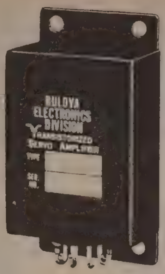
$$\text{Required Gain} = \frac{(\text{maximum gain from chart}) \quad (\text{input impedance})}{(\text{input impedance}) + (\text{external series resistor})}$$

4. Tuning of all loads is required for proper operation of the amplifiers, except where single ended untuned load is called out. This is accomplished by use of a capacitor across the output terminals or by split tuning (two capacitors) each having a capacitance twice that recommended by the motor manufacturer and positioned between the amplifier output terminals and either B+ or B− ... NOT ACROSS THE MOTOR. The split tuning has an additional advantage acting as a transient suppression network. In addition, smaller tantalytic capacitors may be used (using correct polarity).


BULOVA
TRANSISTORIZED SERVO AMPLIFIER
SERIAL NO.
MODEL NO.


BULOVA
ELECTRONICS DIVISION
TRANSISTORIZED SERVO AMPLIFIER
TYPE
SER. NO.


BULOVA
AMPLIFIER ELECTRONIC CONTROL
PART NO
SERIAL NO
STOCK NO
BULOVA WATCH COMPANY ELECTRONICS DIVISION WOODSIDE N.Y. 11377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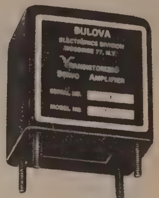
TRANSISTORIZED SERVO AMPLIFIER
TYPE
SER. NO.


BULOVA
ELECTRONICS DIVISION WOODSIDE 77, N.Y.
TRANSISTORIZED SERVO AMPLIFIER
SERIAL NO.
MODEL NO.

9 WATT		16 WATT		25 WATT		40 WATT			
0°	90°	0°	90°	0°	90°	0°		90°	
S4421 _ _ S4431 _ _ S4441 _ _ S4461 _ _	S5421 _ _ S5431 _ _ S5441 _ _ S5461 _ _	S4521 _ _ S4531 _ _ S4541 _ _ S4551 _ _	S5521 _ _ S5531 _ _ S5541 _ _ S5551 _ _	S4621 _ _ S4631 _ _ S4641 _ _ S4651 _ _	S5621 _ _ S5631 _ _ S5641 _ _ S5651 _ _	S4721 _ _ S4731 _ _ S4741 _ _ S4751 _ _	S4722 _ _ S4732 _ _ S4742 _ _	S5721 _ _ S5731 _ _ S5741 _ _ S5751 _ _	S5722 _ _ S5732 _ _ S5742 _ _
400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20	400 ± 20
26	26	26	26	26	26	26	26	26	26
0-25	0-25	0-25	0-25	0-25	0-25	0-25	0-18	0-25	0-18
40	40	40	40	40	40	40	26	40	26
Model No. Gain S4421 1000 S4431 2500 S4441 5000 S4461 25000	Model No. Gain S5421 1000 S5431 2500 S5441 5000 S5461 25000	Model No. Gain S4521 1000 S4531 2500 S4541 5000 S4551 10000	Model No. Gain S5521 1000 S5531 2500 S5541 5000 S5551 10000	Model No. Gain S4621 1000 S4631 2500 S4641 5000 S4651 10000	Model No. Gain S5621 1000 S5631 2500 S5641 5000 S5651 10000	Model No. Gain S4721 1000 S4731 2500 S4741 5000 S4751 10000	Model No. Gain S4722 1000 S4732 2500 S4742 5000	Model No. Gain S5721 1000 S5731 2500 S5741 5000 S5751 10000	Model No. Gain S5722 1000 S5732 2500 S5742 5000
± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2
0 ± 10	90 ± 10	0 ± 10	90 ± 10	0 ± 10	90 ± 10	0 ± 10	0 ± 10	90 ± 10	90 ± 10
0 ± 20	90 ± 20	0 ± 20	90 ± 20	0 ± 20	90 ± 20	0 ± 20	0 ± 20	90 ± 20	90 ± 20
10K	10K	10K	10K	10K	10K	10K	10K	10K	10K
50	50	50	50	40	40	25	2	25	2
$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$	$\frac{500}{\text{V. Gain}}$
250	250	250	250	250	250	250	250	250	250
200	200	200	200	200	200	200	200	200	200
28 V DC	28 V DC	28 V DC	28 V DC	28 V DC	28 V DC	28 V DC	26VRMS*	28 V DC	26VRMS*
3	3	3	3	3	3	3	3	3	3
20	20	32	32	50	50	100	100	100	100
TCT**	TCT**	TCT**	TCT**	TCT**	TCT**	TCT**	USE***	TCT**	USE***
33-40	33-40	33-40	33-40	33-40	33-40	33-40	26	33-40	26
177 ± 25%	177 ± 25%	100 ± 25%	100 ± 25%	60 ± 25%	60 ± 25%	40 ± 20%	20-100	40 ± 20%	20-100
-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C	-55°C to 125°C
-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C	-65°C to 150°C

From Bulova Electronics Division: Frequency Control Components ● Crystals ● Crystal Oscillators ● Monolithic Crystal Filters ● Fork Oscillators ● DC Servo Amplifiers ● 400 Hz Servo Amplifiers ● Optical Devices ● Choppers and Scanners ● Frequency Changers ● Inverters ● Lock-in Amplifiers

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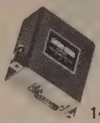
SERVO ELECTRONICS

STANDARD AND CUSTOM DESIGNED

A.C. Servo Amplifiers
D.C. Servo Amplifiers
D.C. Torquer Amplifiers
Demodulators
Modulators
Servo Valve Amplifiers
Digital Controllers
Clutch Control Amplifiers
Relay Control Amplifiers
Resolver Booster Amplifiers
Isolation Amplifiers

- Standard units available which will meet applicable MIL Specs.
- Amplifiers available which utilize state of the art Integrated Circuits, Chips and Hybrids.
- Units for industrial applications available
- SPECIAL electronics designed to your detailed specification

200 HP*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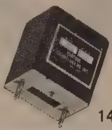
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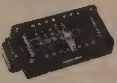
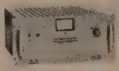
416-3


916 (Flat Pack)


980-1S

	MODEL	Output Power	Output Voltage	Output Frequency	Input Signal Frequency	Input Impedance	Gain	Power Required	Temperature Range
AMPLIFIERS FOR A.C. SERVO MOTORS	**200-HP**	3.5 W	40 VCT	400 CPS	400 CPS	10K	2,500	28VDC	—55°C +125°C
	200-5	3.5 W	40 VCT	400 CPS	400 CPS	10K	5,000	28VDC	—55°C +125°C
	930	3.5 W	40 VCT	400 CPS	400 CPS	250K	2,000	28VDC	—55°C +125°C
	200-8	3.5 W	40 VCT	400 CPS	400 CPS	10K	2,500	115V 400CPS	—55°C +125°C
	216B	6 W	40 VCT	60 CPS	60 CPS	10K	1,000	28VDC	—55°C +85°C
	140	6 W	40 VCT	400 CPS	400 CPS	50K	1,000	28VDC	—55°C +125°C
	141	6 W (90°)	40 VCT	400 CPS	400 CPS	30K	1,000	28VDC	—55°C +125°C
	416-3	16 W	40 VCT	400 CPS	400 CPS	10K	1,000	28VDC	—55°C +71°C
	416A/D	16 W (0°/90°)	40 VCT	400 CPS	400 CPS (2)	10K	1,000	28VDC	—55°C +100°C
	416E	16 W (90°)	40 VCT	400 CPS	DC (2)	50K	1000	28 VDC 115V 400 CPS	−55°C +125°C
	159	16 W	40 VCT	60 CPS	60 CPS	10K	1,000	28VDC	—55°C +100°C
	159A	16 W	40 VCT	60 CPS	DC	100K	1000	28 VDC	−55°C +100°C
	174	40 W (90°)	40 VCT	60 CPS	60 CPS	20K	1000	28 VDC	−55°C +71°C
	956B	40 W (90°)	40 VCT	400 CPS	400 CPS	10K	1,000	28VDC	—55°C +100°C
	956C	40 W (90°)	40 VCT	400 CPS	DC	10K	500	28VDC 115V 400 CPS	—55°C +100°C
	170-1	100 W (90°)	40 VCT	400 CPS	400 CPS	10K	1000	28VDC	—55C° +85°C
	MODIFICATIONS to gain, input impedance, signal frequency, and power level are available. Matching transformers for driving motors at other voltages in stock.								
AMPLIFIERS FOR D.C. TORQUERS	**916**	110W (Flat Pack - Short Circuit Proof)	20 V	DC	DC (2)	10K	3x10⁵	28 VDC −15 VDC	−55°C +100°C
	996-5	20 W	22V	DC	DC (2)	10K	500	28VDC	—55°C +85°C
	998-6	40 W (Short Proof)	22V	DC	DC (2)	10K	500	28VDC	—55°C +85°C
	987	125 W (Short Proof)	20V	DC	DC (1)	100K	10	28VDC	—55°C +71°C
	914-3	220 W (Short Proof)	20V	DC	DC (2)	25K	200	28VDC 115V 50-400CPS	—55°C +71°C
	980-1S	500 W (Short Proof)	50V	DC	DC	10K	100	115V 50-400CPS	—55°C +71°C
	980-8	800 W	50V	DC	DC	10K	100	50-400 CPS 3 Phase (1 Phase Available.)	—55°C +71°C
	MODIFICATIONS to gain, input impedance, signal frequency, power level and operating temperature available.								
AMPLIFIERS FOR SERVO VALVES AND CLUTCHES	**985**	6.5 W	23 VDC	DC	DC	10K	20	28VDC 115V 400CPS	—55°C +71°C
	Provisions for Balance and Null current adjustment. Will drive either a single center tapped coil or two separate coils.								
MODULATORS AND DEMODULATORS	**312**	Full Wave	10V	DC	60 CPS	10K	100	28VDC 115V Reference	—55°C +125°C
	334-1	Full Wave	50V	DC	400 CPS	10K	180	28VDC 115V 400 CPS	—55°C +125°C
	312-1	Full Wave	10V	DC	60 to 5000 CPS	10K	10	28VDC 115V Reference	—55°C +125°C
	350-1	Full Wave	15V	DC	400 CPS	10K	10	28VDC 115V 400 CPS	—55°C +125°C
	MODIFICATIONS to gain, output voltage and input impedance available.								
RESOLVER BOOSTER & ISOLATION AMPLIFIER	**328**	0.1% Accuracy	10V	400 CPS	400 CPS	200K	1 ±.1%	28VDC	—55°C +125°C
	Available as single channel or dual channel unit. Will operate size 8 or size 11 resolvers. Amplifiers with modifications to above parameters available.								
TEM-PERATURE CON-TROLLERS	**703**	Will drive heaters with power ranges up to 500 watt. Operates directly from 115 volt power line. Noise free switching with built in over current protection.							
	MODIFICATIONS to sensing circuit, accuracy and power output available.								

CONTROL TECHNOLOGY CO., inc., 41-16 29th Street, Long Island City, N.Y. 11101 • 212 EMpire 1-2133

DIGITAL • ANALOGUE CONTROL SYSTEMS

STANDARD AND CUSTOM DESIGNED

Servo Indicators
Servo Actuators
Servo Repeaters
Two Speed Servos
Servo Computers
Data Transmission Systems
Computer Interface Systems
Analogue to Digital Converters
Nuclear Control Rod Indicators
Process Controllers
Special Control Systems

CTC
SERVO ELECTRONICS • INDICATORS • SPECIAL SYSTEMS • ACTUATORS

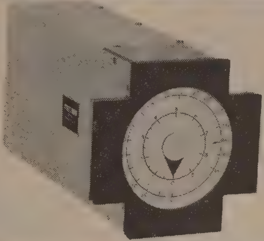
- Units available which will meet applicable MIL Specifications
- Devices designed to operate with A.C., D.C., synchro or resolver command signals.
- All units feature self-contained transistorized high reliability electronics and power supplies.
- Units now in use on numerous systems involving:

Simulators	Ground Support	Aircraft instrumentation
Fire Control	Missile Tracking	Missile instrumentation
ASW	High Accuracy Positioning	Stable Platforms

- Special systems can be designed in accordance to your detailed specifications. CTC will also design "Interface" equipment to integrate major control systems.

INDICATORS

CS-106 Single Pointer Indicator



CS-109 Dual Pointer Indicator

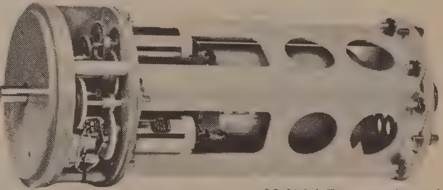
SIMULATED INSTRUMENTS

Altimeter

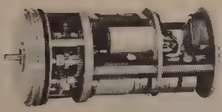
Air Speed Indicator

SERVO ACTUATORS

CS-202-2 300 lb. in. actuator

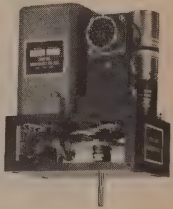


CS-202-1 Two speed synchro high accuracy actuator



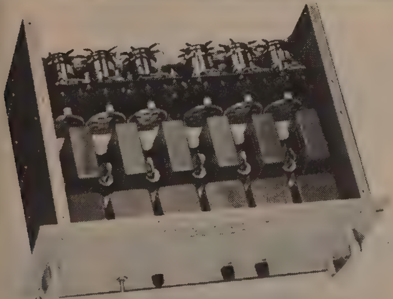
CS-198 250 oz. in. 0.1% accuracy actuator

Although CTC is best known for its system engineering, a most significant part of the company is in the field of CUSTOMIZING of electronics and electromechanical assemblies for control systems applications. By using the off-the-shelf modules shown in this short form catalogue, we can accomplish such MODIFICATIONS in a short time and in most cases without extra cost.

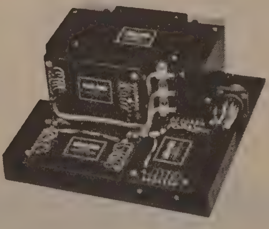


Custom Servo Actuator

SPECIAL SYSTEMS



Control System used in ASW



Digital Control System

SIMULATOR CONTROL SYSTEM

CONTROL TECHNOLOGY CO., Inc., 41-16 29th Street, Long Island City, N.Y. 11101 • 212 EMpire 1-2133

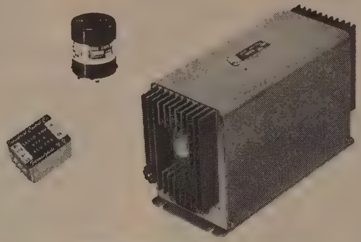
SERVO COMPONENTS

INSTRUMENTS, AMPLIFIERS and ACCESSORIES

FOR MILITARY AND INDUSTRIAL CONTROL SYSTEMS

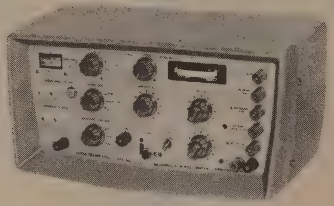
SERVO AMPLIFIERS

- *DC, pot and synchro inputs*
- *60 and 400∼ outputs*
- *Hybrid 972A (.5 cu in, 9 watts) to Triac 893A (800 watts)*
- *160 different models*



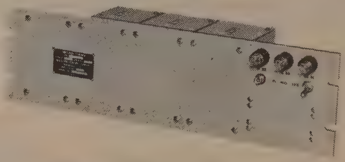
SERVO TESTERS

- *100C, general purpose use*
- *103A, prod and field test*
- *Frequency and transient response*
- *For DC and AC servos*



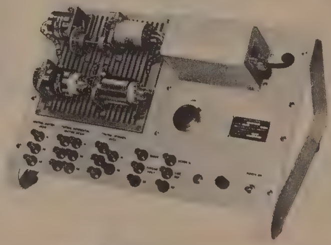
SYNCHRO AMPLIFIERS

- *929R, 90V./line, 400∼ stators*
- *820A, 90V./line, 60∼ stators*
- *Buffer CX's from CT and TR loads*
- *High accuracy and fast response*



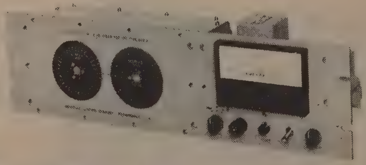
SERVO DEMONSTRATORS

- *Laboratory experiments*
- *Industrial training*
- *Synchro and pot data*
- *60 and 400∼ models.*



SYNCHRO DIRECTORS

- *Generate 1 and 36 speed stator voltages*
- *Constant velocity and harmonic motion modes*
- *Computer programmed*
- *60 and 400∼ stator outputs.*



Write for Catalog of our COMPLETE Servo Line.

INDUSTRIAL CONTROL COMPANY

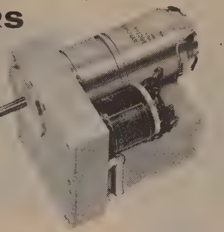
CENTRAL AVENUE AT PINELAWN • FARMINGDALE, L.I., N.Y. 11735 • 516-694-3000

SERVO SYSTEMS

STANDARD MODULES or SPECIALS

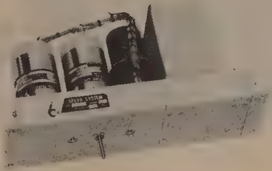
MIL-GRADE AND FAST DELIVERY

High Torque SYNCHRO REPEATERS



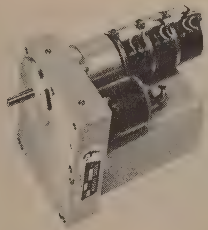
- *770 Series for 400~*
- *847 Series for 60~*
- *8′ error*
- *300 oz in shaft torque*
- *117V. line power*

Two Speed SYNCHRO REPEATERS



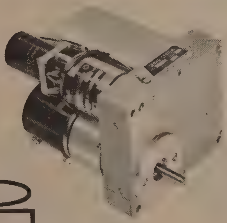
- *771 Series for 400~*
- *921 Series for 60~*
- *16, 25 and 36 speed*
- *Shaft at hi speed*
- *117V. line power*

DC and AC POT FOLLOWERS



- *900 Series*
- *DC, 60 or 400 ~ inputs*
- *1, 3 or 10 turn pots*
- *Torques to 300 oz in*
- *117V. 60 or 400 ~ power*

Precision DC VELOCITY SERVOS



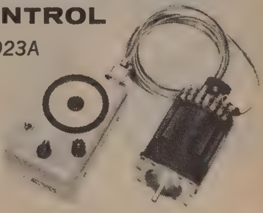
- *982 Series for 60~*
- *983 Series for 400~*
- *±10V. DC command*
- *117V. line power*
- *Wide range of torques and speed.*

3 Axis SERVO INDICATOR

- *type 909A*

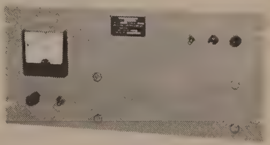
Bi-Directional PRECISION SPEED CONTROL

- *type 923A*



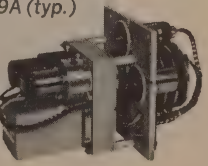
Process Control DELAYED SIGNAL GENERATOR

- *type 849B*



Custom Assemblies TO CUSTOMER SPECS.

- *type 869A (typ.)*



Modifications from Standards readily available.

INDUSTRIAL CONTROL COMPANY

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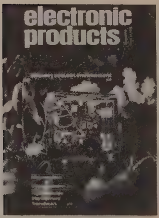

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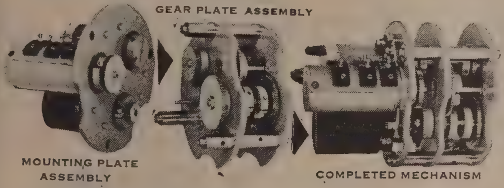
PMC SERVO MECHANISMS & COMPONENTS

PREDESIGNED MECHANISMS

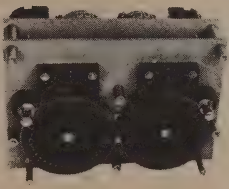
A complete line of off-the-shelf components for assembling an unlimited variety of geared mechanisms. Gear ratios to 78,125:1, zero-backlash spring-loaded gears and torque-limiting slip clutches are featured. Assembled units meet design and materials requirements of MIL-E-5400 and MIL-E-16400.

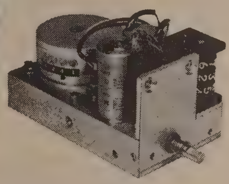


For complete data and catalog of stocked components, request Bulletin 102.

CUSTOM DESIGNS

PMC specializes in design and manufacture servo mechanisms and mechanical modules to user requirements for airborne, ground support, communications, fire control and other critical applications. The units shown below are typical of the mechanisms designed and manufactured for military and industrial equipments.

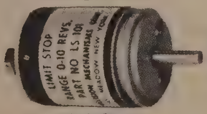




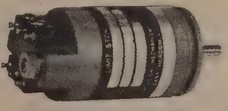
Short lead time delivery on both prototypes and production quantities.

ADJUSTABLE LIMIT SWITCHES & STOPS

0-10, -20, -40 revolutions without snap action switch, 0-25 revolutions with snap action switches actuated just before mechanical stops. All models infinitely adjustable with single external screw. SPDT snap action switch rated 7A, 250V.



Limit Stop
Series LS 100
⅝ and ⅞" dia.



Limit Stop And Switch
Series LS 300
$^{15}/_{16}$" dia.

For complete data, request Bulletins 103 and 104

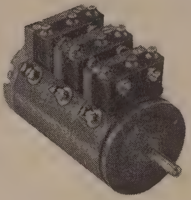
CAM SWITCHES

Adjustable-In-Motion

PMC's patented cam switch design incorporates in a single component all the functions of a conventional plate cam, cam follower and snap-action switch, eliminating the need for separately-mounted cam mechanisms and switches and their associated hardware. Externally-adjustable dwell angles can be set to any position with respect to the shaft. All models available as single- or multi-switch types, with ganged switches independently adjustable.

Model CS 402 Miniature Cam Switches

Miniature units designed and manufactured to military and aerospace specifications.



Diameter: 1-1/16", equivalent to to BuOrd Size 11
Length: 0.8", one switch, plus 0.5" per switch
Dwell Angle: 3° to 357°
Switch: SPDT
Rating: 5A, 250VAC, 30VDC
Multi-Switch Models: up to 10 switches
Shaft: 0.125" dia.

For complete data, request Bulletin 106

Model CS 601 Subminiature Cam Switches

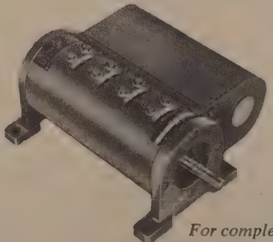
Subminiature units for airborne, space vehicle and other applications where size and weight are critical.

Diameter: 0.75", equivalent to BuOrd Size 8
Length: 0.730" one switch, plus 0.437" per switch
Dwell Angle: 3° to 357°
Switch: SPDT
Rating: 7A, 250VAC, 30VDC
Shaft: 0.125" dia.
Multi-Switch Models: up to 8 switches

For complete data, request Bulletin 109

Model CS 501 High-Power Cam Switches

Industrial types for control, cycling and sequencing of machine operations. End- or side-mounting, with or without switch covers. Dials permit visual adjustment of switching points and dwell angles.



Dwell Angle: 5° to 355°
Diameter: 3.5"
Length: 3" one switch, plus 1.5" per switch
Shaft: 0.5" dia.
Switches: SPDT, DPDT. Special types to requirements.
Ratings: to 25A and 600 V, inrush current to 75A.

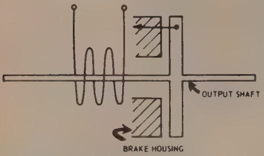
For complete data, request Bulletin 108

PMC

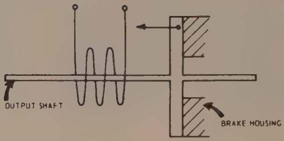
PRECISION MECHANISMS CORPORATION
44 BROOKLYN AVENUE, WESTBURY, L.I., NEW YORK 11590 • (516) ED 3-5955

SCHEMATICS

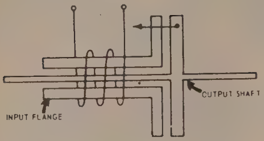
TYPE — MB
TYPE — WMB


OUTPUT SHAFT
BRAKE HOUSING

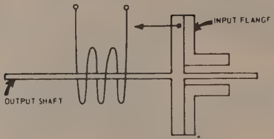
TYPE — SB
TYPE — WSB


OUTPUT SHAFT
BRAKE HOUSING

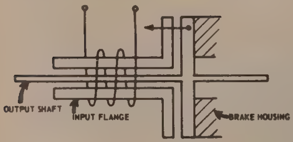
TYPE — MC
TYPE — WMC


OUTPUT SHAFT
INPUT FLANGE

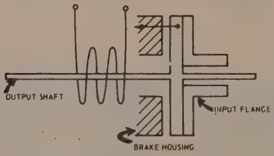
TYPE — SC
TYPE — WSC


INPUT FLANGE
OUTPUT SHAFT

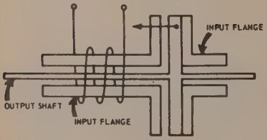
TYPE — MCSB
TYPE — WMCSB


OUTPUT SHAFT
INPUT FLANGE
BRAKE HOUSING

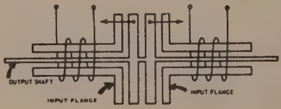
TYPE — SCMB
TYPE — WSCMB


OUTPUT SHAFT
INPUT FLANGE
BRAKE HOUSING

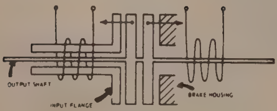
TYPE — MCSC
TYPE — WMCSC


INPUT FLANGE
OUTPUT SHAFT
INPUT FLANGE

TYPE — MCMC
TYPE — WMCMC


OUTPUT SHAFT
INPUT FLANGE
INPUT FLANGE

TYPE — MCMB
TYPE — WMCMB


OUTPUT SHAFT
INPUT FLANGE
BRAKE HOUSING

VERNITECH DIVISION OF
VERNITRON CORPORATION

DYNAMIC* CLUTCH AND BRAKE

* FORMERLY DIVISION OF
DYNAMIC INSTRUMENT CORP.

A COMPLETE LINE OF FRICTION CLUTCH AND BRAKE

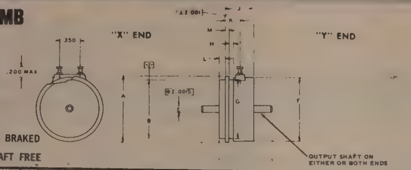
- **Precision** Instrument Type
  Standard Length
- **Precision** Instrument Type
  Wafer Length
- **Industrial Type** (Enclosed Frame)
- **Industrial Type** (Open Frame)
- **Unitized Modules** (In-line Servo
  Assemblies)
- **Special** Application Units

For complete information ask for our Brake & Clutch Catalog

VERNITECH
DIVISION OF VERNITRON CORPORATION

MODEL **WMB**

WAFER MAGNETIC BRAKE


"X" END
"Y" END
.350
.200 MAX
A
B
E
F
G
H
J
K
L
M
⊥Z .001
⊘Z .0015
OUTPUT SHAFT ON EITHER OR BOTH ENDS

ENERGIZED - SHAFT BRAKED
DE-ENERGIZED - SHAFT FREE

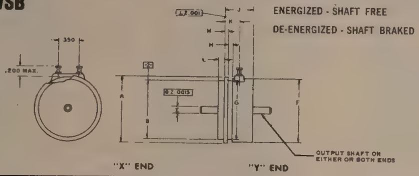
MODEL WMB WAFER MAGNETIC BRAKE

WMB	FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%		275	169	165	151	138
TORQUE (OZ. IN. MIN.) MAGNETIC BRAKE		8	48	50	80	200
BREAKAWAY DRAG TORQUE						
ENERGIZED — BRAKED DE-ENERGIZED (OZ. IN. MAX.)		.10	.10	.15	.20	.20

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005			+.0000 −.0003	±.005	±.005	±.005		±.015	REF.	±.005	+.003 −.000		
8	.877	.7500			.1248	.800	.800	—		.500	.190	.100	.047		
11	1.115	1.0000			.1248	1.025	1.025	—		.500	.180	.100	.060		
13	1.370	1.2500			.1873	1.350	1.255	.080		.625	.245	.125	.060		
15	1.620	1.5000			.2498	1.600	1.505	.080		.750	.248	.125	.060		
18	1.740	1.5620			.2498	1.650	1.650	—		1.000	.320	.125	.090		

MODEL **WSB**

WAFER SPRING BRAKE


.350
.200 MAX.
A
B
E
F
G
H
J
K
L
M
⊥Z .001
⊘Z .0015
OUTPUT SHAFT ON EITHER OR BOTH ENDS
"X" END
"Y" END

ENERGIZED - SHAFT FREE
DE-ENERGIZED - SHAFT BRAKED

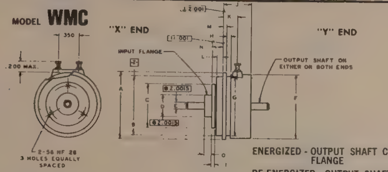
MODEL WSB WAFER SPRING BRAKE

WSB	FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%		275	169	165	151	138
TORQUE SPRING BRAKE (OZ. IN. MIN.)		5	12	16	32	100
BREAKAWAY DRAG TORQUE						
ENERGIZED — (OZ. IN. MAX.) DE-ENERGIZED BRAKED		.10	.15	.20	.25	.30

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005			+.0000 −.0003	±.005	±.005	±.005		±.015	REF.	±.005	+.003 −.000		
8	.877	.7500			.1248	.800	.800	—		.500	.190	.100	.047		
11	1.115	1.0000			.1248	1.025	1.025	—		.500	.180	.100	.060		
13	1.370	1.2500			.1873	1.350	1.255	.080		.625	.245	.125	.060		
15	1.620	1.5000			.2498	1.600	1.505	.080		.750	.248	.125	.060		
18	1.740	1.5620			.2498	1.650	1.650	—		1.000	.320	.125	.090		

MODEL **WMC**

WAFER MAGNETIC CLUTCH


"X" END
"Y" END
.350
.200 MAX.
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS
2-56 NF 28
3 HOLES EQUALLY SPACED
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
⊥Z .001
⊥Z .001
⊘Z .0015
⊘Z .0015

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE
DE-ENERGIZED - OUTPUT SHAFT FREE
INPUT FLANGE FREE

MODEL WMC WAFER MAGNETIC CLUTCH

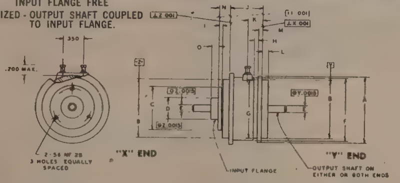
WMC	FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%		275	169	165	151	138
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.)		6	32	40	72	180
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)						
ENERGIZED — BOTH SHAFTS		.15	.20	.25	.30	.35
DE-ENERGIZED — OUTPUT SHAFT		.15	.15	.20	.25	.25
INPUT FLANGE		.15	.15	.20	.25	.25

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.500	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.500	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.625	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.750	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.000	.320	.125	.090	.230	.177

ENERGIZED - OUTPUT SHAFT FREE
INPUT FLANGE FREE
DE-ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT FLANGE.

MODEL **WSC**

WAFER SPRING CLUTCH


.350
.200 MAX.
2-56 NF 28
3 HOLES EQUALLY SPACED
"X" END
"Y" END
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
⊥Z .001
⊥X .001
⊘Z .0015
⊘Z .0015
⊘Y .0015

MODEL WSC WAFER SPRING CLUTCH

WSC	FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%		275	169	165	151	138
TORQUE SPRING CLUTCH (OZ. IN. MIN.)		5	12	16	32	100
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)						
ENERGIZED — OUTPUT SHAFT		.10	.15	.20	.25	.30
INPUT FLANGE		.20	.20	.25	.30	.35
DE-ENERGIZED — BOTH SHAFTS		.30	.35	.50	.75	1.0

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.532	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.532	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.659	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.801	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.042	.320	.125	.090	.230	.177

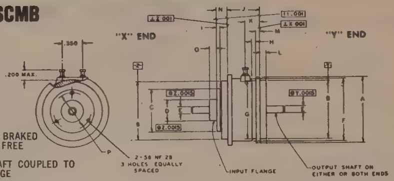
300 MARCUS BOULEVARD / DEER PARK, LONG ISLAND, NEW YORK 11729 / (516) 586-5100 / TWX 510-227-6079

VERNITECH
DIVISION OF VERNITRON CORPORATION

MODEL **WSCMB**

WAFER SPRING CLUTCH

MAGNETIC BRAKE


.350
.200 MAX.
"X" END
"Y" END
N
J
K
I
M
H
L
O
⊥ Z .001
11 .001
⊥ X .001
Z
Y
◎ Z .0015
◎ Y .0015
C
D
E
B
G
A
F
P
2-56 NF 2B
3 HOLES EQUALLY SPACED
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS

ENERGIZED - OUTPUT SHAFT BRAKED
INPUT FLANGE FREE

DE-ENERGIZED - OUTPUT SHAFT COUPLED TO
INPUT FLANGE

MODEL WSCMB WAFER SPRING CLUTCH MAGNETIC BRAKE

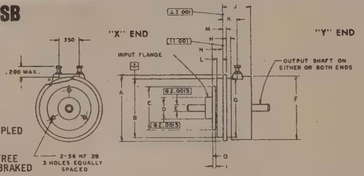
WSCMB FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE MAGNETIC BRAKED (OZ. IN. MIN.) SPRING CLUTCH (OZ. IN. MIN.)	6 5	16 12	16 16	32 32	100 80
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — INPUT FLANGE DE-ENERGIZED — BOTH SHAFTS	.20 .30	.20 .35	.25 .50	.30 .75	.30 1.0

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.532	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.532	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.659	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.801	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.042	.320	.125	.090	.230	.177

MODEL **WMCSB**

WAFER MAGNETIC CLUTCH

SPRING BRAKE


.350
.200 MAX.
"X" END
"Y" END
INPUT FLANGE
OUTPUT SHAFT ON EITHER OR BOTH ENDS
⊥ Z .001
11 .001
◎ Z .0015
◎ Z .0015
J
K
M
H
N
L
I
A
B
C
D
E
G
F
O
2-56 NF 2B
3 HOLES EQUALLY SPACED

ENERGIZED - OUTPUT SHAFT COUPLED
TO INPUT FLANGE

DE-ENERGIZED - INPUT FLANGE FREE
OUTPUT SHAFT BRAKED
TO HOUSING

MODEL WMCSB WAFER MAGNETIC CLUTCH SPRING BRAKE

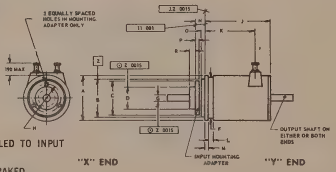
WMCSB FRAME SIZE	8	11	13	15	18
COIL RESISTANCE ±10%	275	169	165	151	138
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.) SPRING BRAKE (OZ. IN. MIN.)	6 5	16 12	16 16	32 32	100 80
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — BOTH SHAFTS DE-ENERGIZED — INPUT FLANGE OUTPUT SHAFT (BRAKED)	.15 .25	.20 .30	.25 .45	.30 .70	.30 .95

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005	+.0000 −.0003	±.005	±.005	±.005	±.002	±.015	REF.	±.005	+.003 −.000	±.005	±.005
8	.877	.7500	.740	.3750	.1248	.800	.800	—	.061	.500	.190	.100	.047	.175	.120
11	1.115	1.0000	.740	.3750	.1248	1.025	1.025	—	.061	.500	.180	.100	.060	.175	.120
13	1.370	1.2500	.934	.5000	.1873	1.350	1.255	.080	.064	.625	.245	.125	.060	.203	.177
15	1.620	1.5000	1.200	.6250	.2498	1.600	1.505	.080	.090	.750	.248	.125	.060	.230	.177
18	1.740	1.5620	1.200	.6250	.2498	1.650	1.650	—	.090	1.000	.320	.125	.090	.230	.177

MODEL **MCSB**

MAGNETIC CLUTCH

SPRING BRAKE


3 EQUALLY SPACED HOLES IN MOUNTING ADAPTER ONLY
.190 MAX
⊥ Z .0015
11 .001
◎ Z .0015
◎ Z .0015
Z
H
J
O
K
P
R
A
B
C
D
G
F
M
H
OUTPUT SHAFT ON EITHER OR BOTH ENDS
INPUT MOUNTING ADAPTER
"X" END
"Y" END

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT
FLANGE

DE-ENERGIZED - OUTPUT SHAFT BRAKED
INPUT FLANGE FREE

MODEL MCSB MAGNETIC CLUTCH SPRING BRAKE

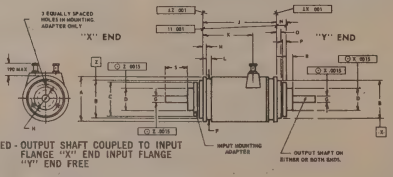
MCSB FRAME SIZE	5	8	11	13	18
COIL RESISTANCE ±10% OHMS	300	205	180	150	120
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.) SPRING BRAKE (OZ. IN. MIN.)	2.5 2.25	10 9	20 18	38 35	75 70
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — BOTH SHAFTS DE-ENERGIZED — OUTPUT SHAFT INPUT FLANGE	.10 BRK .10	.15 BRK .15	.20 BRK .35	.25 BRK .55	.30 BRK .75

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	M	N	O	P	R
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005		±.005	+.0000 −.0003	±.005		±.015	+.003 −.000	±.005	±.005	±.002	±.005
5	.594	.5000	.450	.2190		.531	.0935	.344		.882	.047	.126	.060	.056	.079
8	.827	.7500	.740	.3750		.750	.1248	.625		1.240	.060	.171	.100	.061	.120
11	1.090	1.0000	.934	.5000		1.000	.1248	.750		1.485	.060	.178	.100	.064	.177
13	1.370	1.2500	.934	.5000		1.250	.1873	.750		1.620	.060	.204	.125	.064	.177
18	1.750	1.5620	.934	.5000		1.625	.1873	.750		1.930	.093	.252	.172	.064	.177

MODEL **MCSC**

MAGNETIC CLUTCH

SPRING CLUTCH


3 EQUALLY SPACED HOLES IN MOUNTING ADAPTER ONLY
"X" END
"Y" END
⊥ Z .001
⊥ X .001
11 .001
.190 MAX
Z
◎ Z .0015
◎ X .0015
◎ X .0015
◎ Z .0015
X
J
H
M
N
O
P
K
R
S
A
B
C
D
G
H
F
INPUT MOUNTING ADAPTER
OUTPUT SHAFT ON EITHER OR BOTH ENDS

ENERGIZED - OUTPUT SHAFT COUPLED TO INPUT
FLANGE "X" END INPUT FLANGE
"Y" END FREE

DE-ENERGIZED - OUTPUT SHAFT COUPLED TO
INPUT FLANGE "Y" END, INPUT
FLANGE "X" END FREE.

MODEL MCSC MAGNETIC CLUTCH SPRING CLUTCH

MCSC FRAME SIZE	5	8	11	13	18
COIL RESISTANCE ±10% OHMS	300	205	180	150	120
TORQUE MAGNETIC CLUTCH (OZ. IN. MIN.) SPRING CLUTCH (OZ. IN. MIN.)	2.5 2.25	10 9	20 18	38 35	75 70
BREAKAWAY "DRAG" TORQUE (OZ. IN. MAX.)					
ENERGIZED — ("X") BOTH SHAFTS ("Y") INPUT SHAFT D-ENERGIZED — ("Y") BOTH SHAFTS ("X") SHAFT	.10 .10 .10 .10	.20 .15 .20 .15	.30 .25 .40 .35	.35 .30 .55 .50	.50 .45 .75 .70

FRAME SIZE	A	B	C	D	E	F	G	H	I	J	M	N	O	P	R
	+.000 −.005	+.0000 −.0005	±.005	+.0000 −.0005		±.005	+.0000 −.0003	±.005		±.015	+.003 −.000	±.005	±.005	±.002	±.005
5	.594	.5000	.450	.2190		.531	.0935	.344		.965	.047	.126	.060	.056	.079
8	.827	.7500	.740	.3750		.750	.1248	.625		1.350	.060	.171	.100	.061	.120
11	1.090	1.0000	.934	.5000		1.000	.1248	.750		1.628	.060	.178	.100	.064	.177
13	1.370	1.2500	.934	.5000		1.250	.1873	.750		1.740	.060	.204	.125	.064	.177
18	1.750	1.5620	.934	.5000		1.625	.1873	.750		2.042	.093	.252	.172	.064	.177

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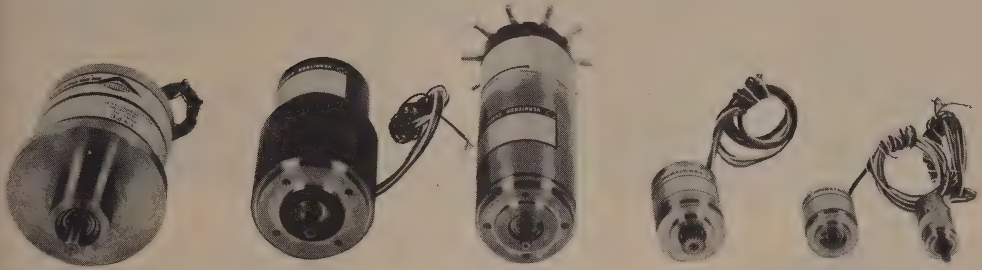

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the full range of motors

TYPES		Servomotors Viscous Damped Motors Inertially Damped Motors	Hysteresis Synchronous Motors Stepper Motors Motor Generators Rate Motor Tachometers	Computing Motor Tachometers Integrating Motor Tachometers Spin (Gyro) Motors
SIZES	BuOrd Size 5 (0.5″ Dia.) to BuOrd Size 23 (2.250″ Dia.)			
SPEEDS	900 RPM to 36,000 RPM (Stepper Motors in Steps of 7.5°, 15°, 45°, and 90°)			
FREQUENCY	50, 60, 80, 400, 420, 480, 1000, and 1200 (Sine or Square Wave) Variable Frequency Motors are also standard at Vernitron			
VOLTAGES	6.3V (Filament) to 280V			
PHASES	1, 2, and 3 (In Stepper Motors — 2, 3, and 4)			

PLUS THE NEW 14M4B SERIES INDUSTRIAL GRADE INDUCTION MOTORS

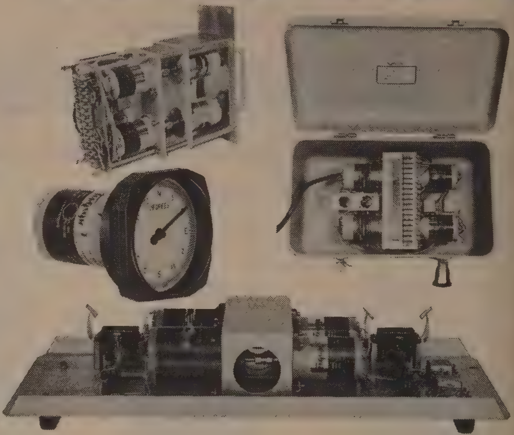
typical data

SIZE	1.375″ Dia. x 2.5″	**VOLTAGE**	115 VAC, Single ϕ
BREAKDOWN TORQUE	1.0 Oz.-In.	**POWER**	27 Watts
NO LOAD SPEED	11,000 RPM	**FREQUENCY**	400 Hz

Also available in 60 Hz, 26 VAC versions. Ask about our industrial synchronous motors.

VERNITRON
DIVISION OF VERNITRON CORPORATION
300 Marcus Boulevard, Deer Park, New York 11729 / (516) 586-5100, TWX: 510-227-6079

VERNITRON

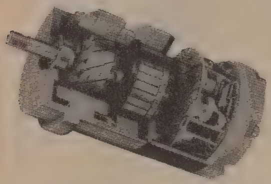


Torqsyn® REMOTE POSITIONERS & ELECTROMECHANICAL ASSEMBLIES

The Torqsyn Remote Positioner is a complete gearless servo system in one small package. It is an integrated system that combines a synchro transformer, torque motor, amplifier, stabilization network in a single package. The Torqsyn thus can simplify design, procurement, assembly and maintenance, and improve reliability.

Torqsyn converts input synchro data into accurate shaft position. High input impedance allows it to be driven by low power signal sources. The Torqsyn Remote Positioner may be used to drive potentiometers, encoders, resolvers, indicators, etc. Size 11, 23 and 37 housings are available.

Complete subsystems and assemblies incorporating Torqsyn units can be designed and or produced to requirements. These include synchro signal amplifiers, synchro signal position-indicators and error detectors. In most cases, these subsystem packages are more compact and reliable than conventional systems.

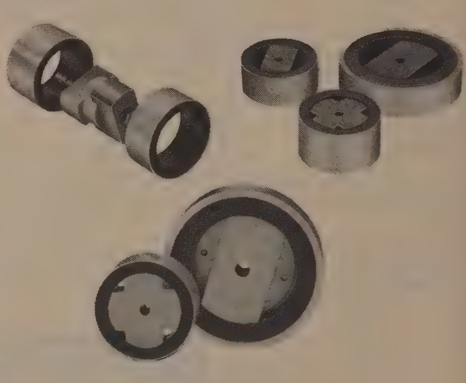


Typical Torqsyn Performance Characteristics @ 25° C

MODEL	DIAM (In)	LENGTH (In)	VOLTS Primary	VOLTS Signal	FREQ. (Hz)	STATIC Acc. (± Min.)	STALL Torque (Oz - In)	TORQUE Gradient (Oz - In)	POWER Stall (Watts)	POWER Quiescent (Watts)	NO LOAD Speed (Rpm)	INPUT Impedance (Ohms)	VELOCITY Constant (1/Sec)
VTSN11-4B1	1.062	4.124	26.0	11.8	400	12	3.0	10.0	15✱	2.0✱	1200	500	– – –
VTSN23-4A2	2.250	3.445	26.0	11.8	360-440	15	3.0	7.0	4	2.5	400	2200	4,000
VTSN23-64N2	2.250	3.576	115	90	50-440	10	4.4/5.3	20/24	16	5.0	500	4,600/24,500	13,000/17,000
VTSN37-64B1	3.625	7.283	115	90	50-440	10	50	115	†	†	200	4,600/24,000	– – –

NOTE: Length is from front face to terminal block, not including terminal screws.
✱ 28VDC @ 0.550 amps max. external power required.
† 45VDC @ 1.5 amps max. external power required.

Vernitorq® BRUSHLESS DC LIMITED ROTATION TORQUE MOTORS



These versatile, wide angle, two and four-pole motors combine accuracy, quality and economy for positioning, drive, actuation or tensioning systems.

Their high torque to power ratio and rapid acceleration at slow speeds allows direct coupling without gears, with resulting smooth, quiet, reliable operation and compact packaging.

Brushless design of VERNITORQ motors provides infinite resolution, high linearity and sensitivity. Ripple slot-lock effect, electrical/mechanical noise and wear are eliminated.

Many models are available with peak torque ratings from 2 to 500 oz-in. Typical angular excursions are approximately 50 degrees for four-pole designs and 120 degrees for two-pole designs.

Space saving pancake units are only 1.7 to 5.2 inches in diameter. Housed versions also are available. Special designs to individual requirements can be provided.

Brushless AC tachs are also available in these same sizes.

VERNITRON SYNCHROS, RESOLVERS AND SELSYNS

Mil-Spec designs housed in all standard and existing frame sizes, plus Selsyn replacement type units are available with accuracies down to 20 seconds on housed synchros and resolvers. Additional features include temperature compensation, varying voltage, frequency and impedance levels.

Pancake synchros and resolvers are available in single speed, multi-speed (2X to 72X), and dual or triple combinations of speeds. Single speed units have accuracies to 10 seconds, multi-speed units have accuracies to 3 seconds.

VERNITRON CONTROL COMPONENTS
A Division of Vernitron Corp.
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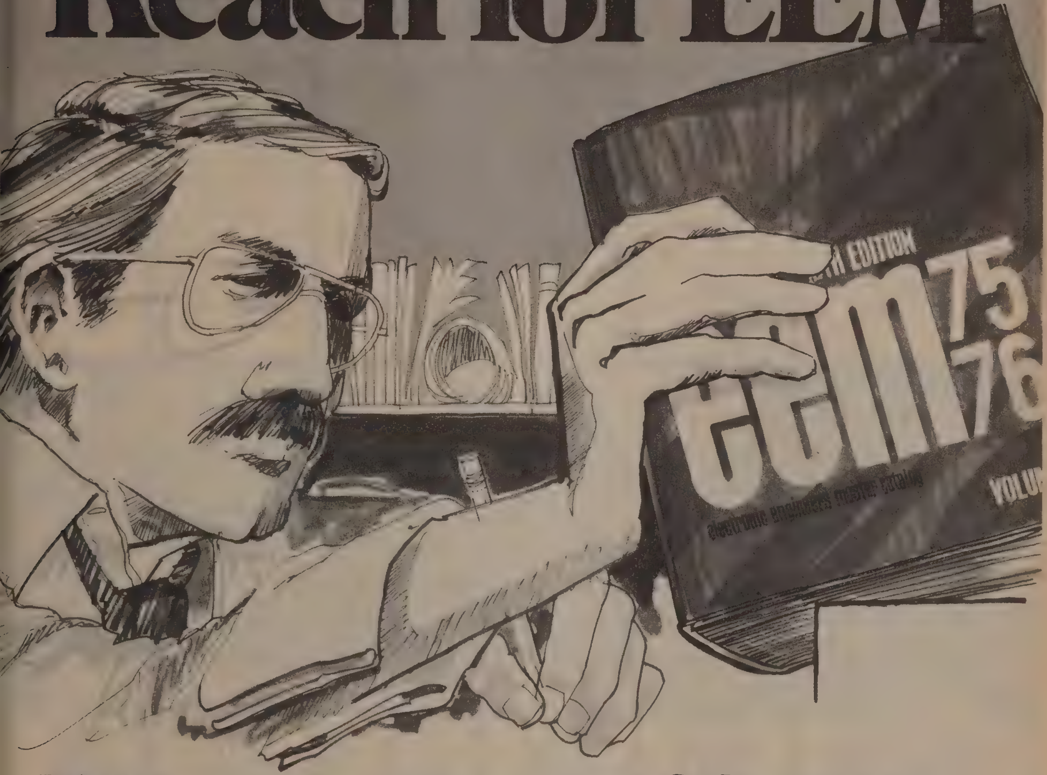
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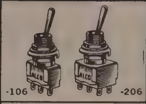
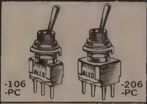
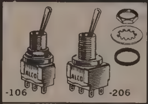
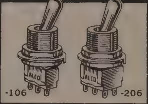
ALCOSWITCH

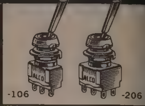
MINIATURE TOGGLE SWITCHES











					STANDARD		PC TERMINALS	
POLE	CODE			Keyway	MTA	ONE-24 UNIT PRICE	MTA-PC	ONE-24 UNIT PRICE
1	D	On	None	On	MTA-106D	1.75	MTA-106D-PC	1.85
	E	On	Off	On	MTA-106E	2.05	MTA-106E-PC	2.15
	F	On	None	(On)	MTA-106F	2.05	MTA-106F-PC	2.15
	G	(On)	Off	(On)	MTA-106G	2.05	MTA-106G-PC	2.15
	H	On	Off	(On)	MTA-106H	2.05	MTA-106H-PC	2.15
2	N	On	None	On	MTA-206N	2.35	MTA-206N-PC	2.55
	P	On	Off	On	MTA-206P	2.70	MTA-206P-PC	2.90
	R	On	None	(On)	MTA-206R	2.70	MTA-206R-PC	2.90
	S	(On)	Off	(On)	MTA-206S	2.70	MTA-206S-PC	2.90
	T	On	Off	(On)	MTA-206T	2.70	MTA-206T-PC	2.90
	PA	On	On	On	MTA-206PA	2.95	MTA-206PA-PC	3.15
	SA	(On)	On	(On)	MTA-206SA	3.25	* * *	P.U.R.
	TA	On	On	(On)	MTA-206TA	3.25	* * *	P.U.R.
3	D	On	None	On	MTA-306D	3.90	MTA-306D-PC	4.20
	E	On	Off	On	MTA-306E	4.20	MTA-306E-PC	4.50
	F	On	None	(On)	MTA-306F	4.20	MTA-306F-PC	4.50
	H	On	Off	(On)	MTA-306H	4.20	MTA-306H-PC	4.50
4	N	On	None	On	MTA-406N	5.00	MTA-406N-PC	5.40
	P	On	Off	On	MTA-406P	5.40	MTA-406P-PC	5.80
	PA	On	On	On	MTA-406PA	6.15	MTA-406PA-PC	6.55

		WATERPROOF		MUSTANG 15/32" BUSHING		FLAT LEVER	
POLE	CODE	MTE	ONE-24 UNIT PRICE	MTG	ONE-24 UNIT PRICE	MTF	ONE-24 UNIT PRICE
1	D	MTE-106D	2.15	MTG-106D	2.30	MTF-106D	2.25
	E	MTE-106E	2.45	MTG-106E	2.60	MTF-106E	2.55
	F	MTE-106F	2.45	MTG-106F	2.60	MTF-106F	2.55
	G	MTE-106G	2.45	MTG-106G	2.60	MTF-106G	2.55
	H	MTE-106H	2.45	MTG-106H	2.60	MTF-106H	2.55
2	N	MTE-206N	2.75	MTG-206N	2.90	MTF-206N	2.85
	P	MTE-206P	3.10	MTG-206P	3.25	MTF-206P	3.20
	R	MTE-206R	3.10	MTG-206R	3.25	MTF-206R	3.20
	S	MTE-206S	3.10	MTG-206S	3.25	MTF-206S	3.20
	T	MTE-206T	3.10	MTG-206T	3.25	MTF-206T	3.20
	PA	MTE-206PA	3.35	MTG-206PA	3.50	MTF-206PA	3.45
	SA	* * *	P.U.R.			MTF-206SA	3.45
	TA	* * *	P.U.R.				
3	D	MTE-306D	4.30	MTG-306D	4.45	MTF-306D	4.40
	E	MTE-306E	4.60	MTG-306E	4.75	* * *	P.U.R.
	F	* * *	P.U.R.			This Series Supplied with Matte Finish Lever and a Decorative Nut.	
	H	* * *	P.U.R.				
4	N	MTE-406N	5.40	MTG-406N	5.55	MTF-406N	5.50
	P	MTE-406P	5.80	MTG-406P	5.95	* * *	P.U.R.
	PA						

MOST RELIABLE

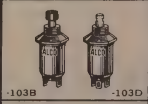
The ALCOSWITCHES listed in these two pages offer the most-asked-for premium features as standard, with no hidden costs! Use this quick and easy reference guide to compare the various series and select the switch most suitable for your applications.

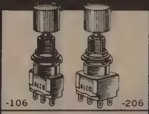
Three outstanding features must be emphasized because they solve industry's recurrent problems, namely: (1) Contact contamination from solder flux, dust and cleaning agents, now totally eliminated through Alco's exclusive "molded-in" terminal construction. (2) These switches are designed to be compatible with today's International market needs for high line voltage applications. (3) Oxidation on terminals and contacts is totally inhibited by gold flash for ease in soldering, as well as dependability when switches are used infrequently.

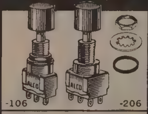
These new series are ideally suited for most applications with high density requirements and where a need exists for high quality and performance. An extremely wide choice of actuator options is offered to satisfy varying cosmetic and tactile requirements in the many segments of the electronics, computer, medical equipment, business machine, communications and production control industries.

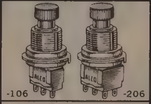
QUANTITY PRICING QUOTED UPON REQUEST

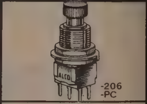
MINIATURE PUSHBUTTON SWITCHES











				SUB-MINIATURES		STANDARD	
POLE	CODE	TYPE	ACTION	MPA-3	ONE-24 UNIT PRICE	MPA-6	ONE-24 UNIT PRICE
						MPA Switch supplied with BLACK C-22 Button unless otherwise specified.	
1	B	SPST	N.C. Mom.	MPA-103B	1.40		
	C	SPST	N.O. Mom.	MPA-103C	1.40		
	D	SPDT	Push On/Off	MPA-103D	2.75	MPA-106D	2.65
	F	SPDT	Momentary	MPA-103F	2.75	MPA-106F	2.65
2	N	DPDT	Push On/Off	Supplied & Usable less caps. Order separately, see below.		MPA-206N	3.55
	R	DPDT	Momentary			MPA-206R	3.55
3	D	3PDT	Push On/Off	C-5	.08	MPA-306D	4.85
	F	3PDT	Momentary	C-8	.10	MPA-306F	4.85
4	N	4PDT	Push-On/Off	SPECIFY: Black, Red, Green or White		MPA-406N	5.85
	R	4PDT	Momentary			MPA-406R	5.85

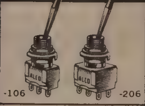
		WATERPROOF		MUSTANG 15/32" BUSHING		MUSTANG – PC	
POLE	CODE	MPE	ONE-24 UNIT PRICE	MPG	ONE-24 UNIT PRICE	MPG-PC	ONE-24 UNIT PRICE
		MPE Switch supplied with BLACK C-22 Button unless otherwise specified.		MPG Switch supplied with Black cap ONLY.		MPG-PC Switch supplied with Black cap ONLY.	
1	D	MPE-106D	3.05	MPG-106D	2.90	* * *	P.U.R.
	F	MPE-106F	3.05	MPG-106F	2.90	* * *	P.U.R.
2	N	MPE-206N	3.95	MPG-206N	3.80	MPG-206N-PC	3.95
	R	MPE-206R	3.95	MPG-206R	3.80	MPG-206R-PC	3.95
3	D	MPE-306D	5.25	MPG-306D	5.10	MPG-306D-PC	5.30
	F	MPE-306F	5.25	MPG-306F	5.10	MPG-306F-PC	5.30
4	N	MPE-406N	6.25	MPG-406N	6.10	MPG-406N-PC	6.35
	R	MPE-406R	6.25	MPG-406R	6.10	MPG-406R-PC	6.35

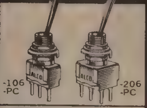
ALCO® ELECTRONIC PRODUCTS, INC.
1551E OSGOOD ST. NO. ANDOVER, MASS. 01845 U.S.A.
TEL: (617) 685-4371
TWX: 710 342-0552

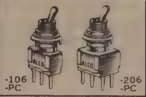
A SUBSIDIARY OF
AUGAT INC.

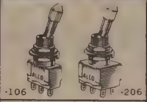
ALCOSWITCH

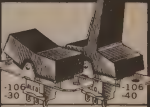
MINIATURE TOGGLE SWITCHES











					BATON LEVER		LONG LEVER		SHORT LEVER		LOCKING LEVER		ROCKER&PADDLE	
POLE	CODE			Keyway	MTB	ONE-24 UNIT PRICE	MTT-PC	ONE-24 UNIT PRICE	MTM-PC	ONE-24 UNIT PRICE	MTL	ONE-24 UNIT PRICE	MRL	ONE-24 UNIT PRICE
	D	On	None	On	MTB-106D	1.85	MTT-106D-PC	1.90	MTM-106D-PC	1.85	MTL-106D	3.00	MRL-106D-30/40	2.10
	E	On	Off	On	MTB-106E	2.15	MTT-106E-PC	2.20	MTM-106E-PC	2.15	MTL-106E	3.30	MRL-106E-30/40	2.40
	F	On	None	(On)	MTB-106F	2.15	MTT-106F-PC	2.20	MTM-106F-PC	2.15	• • •	P.U.R.	MRL-106F-30/40	2.40
	G	(On)	Off	(On)	MTB-106G	2.15	MTT-106G-PC	2.20	MTM-106G-PC	2.15	• • •	P.U.R.		
	H	On	Off	(On)	MTB-106H	2.15	MTT-106H-PC	2.20	MTM-106H-PC	2.15				
2	N	On	None	On	MTB-206N	2.45	MTT-206N-PC	2.60	MTM-206N-PC	2.55	MTL-206N	3.60	MRL-206N-30/40	2.70
	P	On	Off	On	MTB-206P	2.80	MTT-206P-PC	2.95	MTM-206P-PC	2.90	MTL-206P	3.95	MRL-206P-30/40	3.05
	R	On	None	(On)	MTB-206R	2.80	MTT-206R-PC	2.95	MTM-206R-PC	2.90	• • •	P.U.R.	MRL-206R-30/40	3.05
	S	(On)	Off	(On)	MTB-206S	2.80	MTT-206S-PC	2.95	MTM-206S-PC	2.90	MTL-206S	3.95	Specify Color Add Code #: **Black - 0** **Green - 5** **Red - 2** **White - 9** (Example: MRL-106D-30-0)	
	T	On	Off	(On)	MTB-206T	2.80	MTT-206T-PC	2.95	MTM-206T-PC	2.90				
	PA	On	On	On	MTB-206PA	3.05	MTT-206PA-PC	3.20	MTM-206PA-PC	3.15	MTL-206PA	4.20		
3	D	On	None	On	MTB-306D	4.00	MTT-306D-PC	4.25	MTM-306D-PC	4.20	MTL-306D	5.15	MRL-306D-30/40	4.25
	E	On	Off	On	• • •	P.U.R.	• • •	P.U.R.	• • •	P.U.R.	• • •	P.U.R.	• • •	P.U.R.
													Indicate Lever Type Add Code #: **Rocker - 30** **Paddle - 40** (Example: MRL-106D-30-0)	
4	N	On	None	On	MTB-406N	5.10	MTT-406N-PC	5.45	MTM-406N-PC	5.40	MTL-406N	6.25	MRL-406N-30/40	5.35
	P	On	Off	On	• • •	P.U.R.	• • •	P.U.R.	• • •	P.U.R.	• • •	P.U.R.	• • •	P.U.R.
	PA	On	On	On							MTL-406PA	7.40		

SUB-MINIATURES

ELECTRICAL RATING: MPA-103B & C 1A @ 125 VAC
MPA-103D & F 3A @ 125 VAC
MRC Series 500 ma @ 125 VAC
All Others 6A @ 125 VAC
3A @ 250 VAC

TERMINALS: Exclusive Molded-In terminals, gold flash overall on copper or brass. Featuring a combination "solder/quick connect" with elongated holes accepting two No. 20 AWG wires or Faston® terminals may be utilized for quick disconnect. (® Amp).

CONTACTS: Fine silver clad stationary and moving contacts, with gold.

CASE: Diallyl Phthalate (DAP), green.

TOGGLE LEVER: Chrome-plated brass.

BUSHING: Nickel-plated brass.

ANTI-ROTATION MOUNT: Keyway slot or "D" flat bushing prevents rotation.

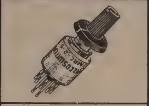
MOUNTING HARDWARE: Typically, two nickel-plated brass hex nuts, one nickel-plated brass locking ring and one zinc-plated steel lockwasher provided unassembled in a separate compartment of the switch package.

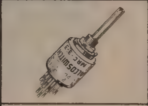
LEVER/CIRCUIT INTERFACE: All ALCO switches are double throw. The keyway is a helpful guide when switching "momentary" positions. When the lever is thrown, the center terminal is connected to the furthest terminal and vice versa. On three position switches, circuits are "OFF" in the center except for "PA" types which uniquely provide three "ON" positions.

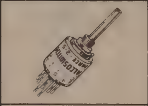
ELECTRICAL AND ENVIRONMENTAL CHARACTERISTICS: Available on request or supplied with switch prints.

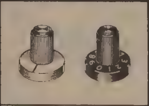
QUANTITY PRICING QUOTED UPON REQUEST

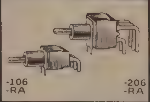
MINIATURE ROTARY SWITCHES











								MATING KNOBS		RT. ANGLE TERM.	
POLE	ADJUSTABLE POSITIONS	MRC	ONE-24 UNIT PRICE	MRC-S	ONE-24 UNIT PRICE	MRCE-S	ONE-24 UNIT PRICE	KBS	ONE-99 UNIT PRICE	MTM-RA	ONE-24 UNIT PRICE
ONE	2 to 10 Positions	MRC-1-10	6.65	MRC-1-10S	6.65	MRCE-1-10S	7.35	KBS-500A-1/8	1.50	MTM-106D-RA	2.10
TWO	2 to 5 Positions	MRC-2-5	6.95	MRC-2-5S	6.95	MRCE-2-5S	7.65	KBS-500A-1/4	1.50	MTM-106E-RA	2.40
THREE	2 to 3 Positions	MRC-3-3	7.25	MRC-3-3S	7.25	MRCE-3-3S	7.95	KBS-500B-1/8	1.50	MTM-106F-RA	2.40
FOUR	2 Positions	MRC-4-2	7.85	MRC-4-2S	7.85	MRCE-4-2S	8.55	KBS-500B-1/4	1.50		
								Suffix "A" — Natural Suffix "B" — Black			
								KBS-500A-10-1/8	1.75	MTM-206N-RA	3.05
								KBS-500A-10-1/4	1.75	MTM-206P-RA	3.40
								KBS-500B-10-1/8	1.75	MTM-206R-RA	3.40
								KBS-500B-10-1/4	1.75		
								Suffix "1/8" or 1/4" — Shaft Hole Diameters			

This group of ALCOSWITCH rotaries feature an adjustable stop. Terminals are permanently molded into a DAP base to assure that solder flux or other contaminants will not seep into the switching mechanism. Available in 1 through 4 poles with a 36° angle of throw between positions. Adjustable stops are implemented by the position of a supplied stop washer.

Two shaft styles are available. 1/8" diameter x .75 long with standard screw driver slot at the end of the shaft, less knob, or a black phenolic knob with a white hairline indicator. Cylindrical aluminum cases are .610 in diameter. Switch depth behind the panel is .620, less terminals. Contacts are silver. Volume quantity quotations directly from factory.

ALCO®
ELECTRONIC PRODUCTS, INC.
1551E OSGOOD ST., NO. ANDOVER, MASS. 01845 U.S.A.
TEL: (617) 685–4371
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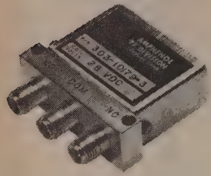
A SUBSIDIARY OF
AUGAT INC.

303 Series/High Isolation Miniature & Standard Size Microwave Coaxial Switches



AMPHENOL 303 SERIES
High Isolation Miniature
Fail-Safe 1P2T

Broadband Miniature Switch Series Offering State-of-the-Art Characteristics through 18 GHz

Ideally suited for applications where crosstalk interference must be kept to an absolute minimum, Amphenol's miniature 303 Series provides uniform characteristics through KU band (18 GHz) with isolation of 60 dB minimum, VSWR of 1.5:1 maximum and insertion loss of 0.5 dB maximum. When operating at lower frequencies, isolation can be greater than 90 dB with 0.2 dB insertion loss and VSWR of 1.2:1.

New Amphenol SMA connectors . . . offering significantly better electrical and mechanical performance than competitive designs . . . contribute to the switch's high reliability and fine electrical performance. The miniature 1P2T weight only 2 ozs. and, excluding terminals, is less than 1½ inches high by 1¹¹⁄₃₂ inches wide by ½ inch. In addition to its compact design and reliable RF performance, this switch is capable of operating in environments where temperatures reach 100°C.

Standard Size 303 Series Switches offering High Isolation Qualities through 12.4 GHz

Amphenol's 303 Series of standard size switches is constantly expanding. Cataloged here are a representative collection of the more popular variations. Many combinations of these basic items are available. The ideal switching device tailored for your specific application can be selected from the options described in the table of General Characteristics. This is true of the miniature size 303 Series as well. Whatever combination of specifications you select . . . whether other coil voltage, hermetic sealing, auxiliary contacts, cut-throat latching, etc. . . . the same high isolation and uniform RF performance characteristic of Amphenol's 303 Switch Series will prevail.

RF PERFORMANCE

Frequency (GHz)	VSWR (Max.)	Isolation (dB)	Insertion Loss (Max.)
MINIATURE SIZE			
0-3.0	1.2	>90 dB	0.2 dB
3.0-8.0	1.3	>80 dB	0.3 dB
8.0-12.4	1.4	>70 dB	0.4 dB
12.4-18.0	1.5	>60 dB	0.5 dB
STANDARD SIZE			
0-3.0	1.3	>80 dB	0.25 dB
3.0-6.0	1.4	>75 dB	0.35 dB
6.0-10.0	1.5	>65 dB	0.50 dB
10.0-12.4	1.5	>60 dB	0.50 dB
MINIATURE ECONOMY AND 1P1T SHUTTER			
0-3.0	1.3	>80 dB	0.25 dB
3.0-8.0	1.4	>70 dB	0.35 dB
8.0-12.4	1.5	>60 dB	0.50 dB

RF POWER @ STP (watts CW)

Freq. (GHz)	SMA	N & TNC	Freq. (GHz)	SMA	N & TNC
0.1	400W	1000W	5.0	50W	100W
0.4	200W	500W	10.0	35W	70W
1.0	120W	280W	12.0	30W	60W
3.0	70W	145W	18.0	24W	45W

GENERAL CHARACTERISTICS

ELECTRICAL

FREQUENCY RANGE

Miniature Size:	0-18.0 GHz
Others:	0-12.4 GHz

CONNECTORS

Miniature Size:	SMA
Standard Size:	N, TNC, SMA

SWITCHING TIME: 15 mS (maximum)

SWITCHING ACTION: Break before make

28 VDC COIL RESISTANCE

1P2T Fail-Safe:	Miniature 250 ohms Standard 200 ohms
1P2T Latching:	Miniature 150 ohms
Transfer:	Miniature Latching 18 ohms Standard Fail-Safe 90 ohms
1P2T Economy:	200 ohms
1P1T Shutter:	135 ohms

(Also available with 6, 12, 48, 110 VDC and 115 VAC coils.)

MECHANICAL

LIFE: 1 x 10^6 cycles minimum

WEIGHT

1P2T: Miniature 2 oz., standard 7 oz.
Transfer: Miniature 5 oz., standard 8 oz.
1P2T economy 3½ oz.
1P1T shutter 4 oz.

ENVIRONMENTAL (MIL-S-3928B)

TEMPERATURE RANGE

1P2T Miniature −55°C to 100°C. Others −55°C to 85°C (higher temperature operation available upon request).

MOISTURE RESISTANCE: 10 day cycle

SHOCK

MIL-STD-202D, Method 202C
Test Condition A, 15 G's peak

VIBRATION

Test Condition A
55 to 2000 Hz @ ± 10 G's

HERMETIC SEALING: Available when required

MINIATURE SIZE (28 VDC COIL■)

Connector	Function	Fail-Safe (Non-Latching)	Cut-Throat Latching	Fail-Safe with Aux. Contacts	Manual
		AMPHENOL PART NUMBERS			
SMA	1P2T	303-10179-3	303-10179-23	303-10179-53	—
	1P2T Economy	303-10116-3	—	—	—
	Transfer	303-11022-3	303-11022-23	303-11022-53	303-11028

STANDARD SIZE (28 VDC COIL■)

Connectors	Function	Fail-Safe (Non-Latching)	Fail-Safe with Aux. Contacts	Manual
		AMPHENOL PART NUMBERS		
TNC	1P1T Shutter	303-10969-3	—	—
	1P2T	303-10168-3	303-10168-53	303-10171
	Transfer	303-11020-3	303-11020-53	—
N	1P2T	303-10167-3	303-10167-53	303-10170
	Transfer	303-11017-3	303-11017-53	—
SMA	1P2T	303-10166-3	303-10166-53	303-10175
	Transfer	303-11016-3	303-11016-53	—

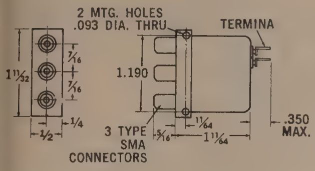
■ Also available with 6, 12, 48, 110 VDC and 115 VAC Coils.

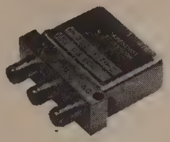
COAXIAL SWITCHES

BUNKER RAMO AMPHENOL

303 Series/High Isolation Miniature & Standard Size Microwave Coaxial Switches (cont'd)

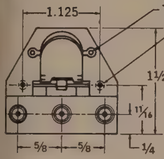
MINIATURE SIZE 1P2T FAIL-SAFE

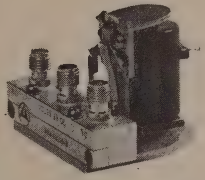

2 MTG. HOLES
.093 DIA. THRU
TERMINA
1 11/32
7/16
7/16
1.190
1/4
1/2
3 TYPE SMA CONNECTORS
5/16
11/64
1 11/64
.350 MAX.



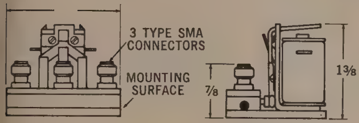
303-10179-3

MINIATURE SIZE 1P2T ECONOMY VERSION

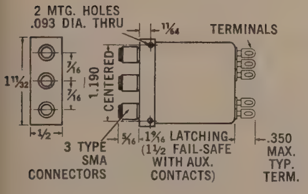

1.125
TERMINALS
#4-40 NC-2B TH'D.
2 MTG. HOLES
1 1/2
11/16
5/8
5/8
1/4



303-10116-3

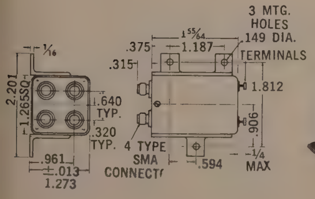

3 TYPE SMA CONNECTORS
MOUNTING SURFACE
7/8
1 3/8

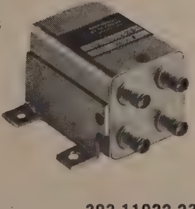
MINIATURE SIZE 1P2T LATCHING AND FAIL-SAFE WITH AUXILIARY CONTACTS


2 MTG. HOLES
.093 DIA. THRU
11/64
TERMINALS
1 11/32
7/16
7/16
1.190 CENTERED
1/2
3 TYPE SMA CONNECTORS
5/16
1 9/16 LATCHING
(1 1/2 FAIL-SAFE WITH AUX. CONTACTS)
.350 MAX. TYP. TERM.

303-10179-23

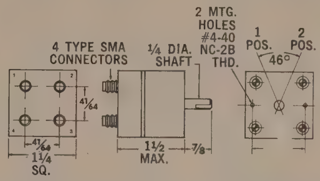
MINIATURE SIZE TRANSFER LATCHING


1/16
3 MTG. HOLES
.149 DIA.
1 55/64
.375
1.187
.315
TERMINALS
2.201
1.265SQ.
1.812
.640 TYP.
.906
.320 TYP.
4 TYPE SMA CONNECT
.961
±.013
1.273
.594
1/4 MAX



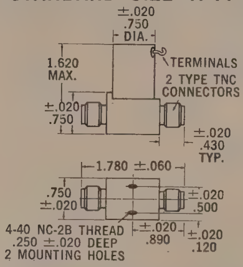
303-11022-23

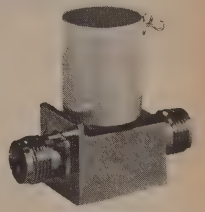
MINIATURE SIZE TRANSFER MANUAL


2 MTG. HOLES
#4-40 NC-2B THD.
4 TYPE SMA CONNECTORS
1/4 DIA. SHAFT
1 POS.
2 POS.
46°
41/64
41/64
1 1/4 SQ.
1 1/2 MAX.
7/8

303-11028

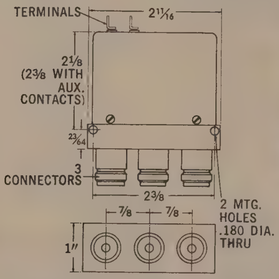
STANDARD SIZE 1P1T SHUTTER

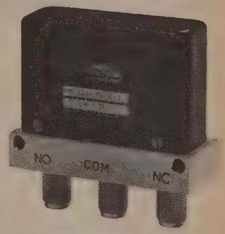

±.020
.750 DIA.
1.620 MAX.
TERMINALS
2 TYPE TNC CONNECTORS
±.020
.750
±.020
.430 TYP.
1.780 ±.060
.750
±.020
±.020
.500
4-40 NC-2B THREAD
.250 ±.020 DEEP
2 MOUNTING HOLES
±.020
.890
±.020
.120



303-10969-3

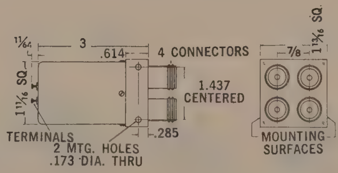
STANDARD SIZE 1P2T FAIL-SAFE AND AUXILIARY CONTACT VERSION


TERMINALS
2 11/16
2 1/8
(2 3/8 WITH AUX. CONTACTS)
23/64
3 CONNECTORS
2 3/8
2 MTG. HOLES
.180 DIA. THRU
7/8
7/8
1"



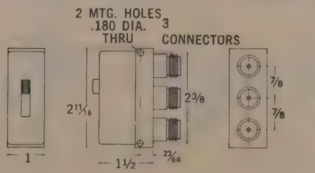
303-10168-3

STANDARD SIZE TRANSFER


11/64
3
.614
4 CONNECTORS
7/8
1 11/16 SQ.
1 11/16 SQ.
1.437 CENTERED
.285
TERMINALS
2 MTG. HOLES
.173 DIA. THRU
MOUNTING SURFACES

303-11017-3

STANDARD SIZE 1P2T MANUAL


2 MTG. HOLES
.180 DIA. THRU
3 CONNECTORS
2 11/16
2 3/8
7/8
7/8
1
1 1/2
23/64

303-10170

COAXIAL SWITCHES

BUNKER RAMO AMPHENOL

MINIform / Sub-Miniature, High Power, Microwave Coaxial Switches

For Applications Requiring Minimum Size, High Power, Minimum Crosstalk and Low Cost

GENERAL CHARACTERISTICS

ELECTRICAL

Frequency Range: 0-6.0 GHz
Connectors: SMA, SUB-Minax 27 Series and Printed Circuit Pins
Switching Time: 15 ms Maximum
Switching Action: Break Before Make
Coil Resistance:
12 VDC Coil: 65 ohms, 28 VDC Coil: 250 ohms
(Also available in other DC coil voltages)
Function: 1P2T Failsafe

ENVIRONMENTAL (per MIL-S-3928B)

Temperature Range: −55°C to 100°C
Moisture Resistance: 10 Day Cycle
Shock: MIL-STD-202D, Method 202C, Test Condition A, 15 G's Peak
Vibration: MIL-STD-202D, Test Condition A, 55 to 2000 Hz at ±10 G's

RF PERFORMANCE (SMA)

VSWR
0-2 GHz: 1.1 max.
2-4 GHz: 1.2 max.
4-6 GHz: 1.3 max.

Isolation
0-1 GHz: >80 dB
1-3 GHz: >70 dB
3-6 GHz: >50 dB

Insertion Loss
0-3 GHz: 0.1 dB max.
3-5 GHz: 0.2 dB max.
5-6 GHz: 0.3 dB max.

RF Power
0.1 GHz: 400 watts
1.0 GHz: 120 watts
3.0 GHz: 70 watts
6.0 GHz: 45 watts

MECHANICAL

Life: 1 million cycles min.
Weight: 1.2 oz.

Amphenol 303 Series MINIform is the industry's most inexpensive miniature high-power, high-performance line of microwave coaxial switches — offering for the first time superior operational performance through six GHz in an economical unit weighing only 1.2 ounces.

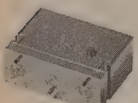
The switches are the smallest and least expensive of this type ever introduced by Amphenol and are designed to outperform all comparable offerings by industry available until now. Displacing less than one-half cubic inch volume, the tiny switches' ratings include performance through 150 watts below specified frequency limitations, offering immediate physical and operational compatibility for a host of signalling, communications and EDP matrix switching applications.

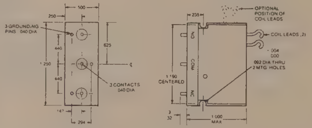
Amphenol 303 Series MINIform switches are 1P2T configurations offered in choice of three popular termination styles: SMA connectors, Amphenol SUB-Minax 27 Series connectors, or printed circuit contacts suitable for solder and solderless wrap board termination. All switches can be provided with coil voltages of 6, 12, 26, 48 and 120 VDC.

Although ideal for typical microwave applications through six GHz where 60 dB isolation is offered by new units, Amphenol's MINIform switches also offer unusually high power handling capabilities for communciations applications for the first time. Through 0 to 1.0 GHz, for example, the MINIform can switch up to 150 watts CW while maintaining maximum VSWR of only 1.1, 0.1 dB insertion loss and 80 dB minimum crosstalk attenuation. Over the range of 1.1 through 3 GHz, VSWR climbs only to 1.2 with power handling capacity of up to 70 watts CW while maintaining 75 dB minimum crosstalk attenuation and 0.1 dB maximum insertion loss.

PRINTED CIRCUIT

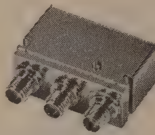
Coil Volts	AMPHENOL Part No.
12 VDC	303-10001-2
28 VDC	303-10001-3

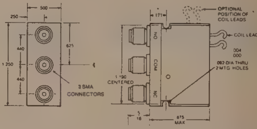




CONNECTORS (SMA shown)

Coil Volts	SMA Conn.	27 Series
12 VDC	303-10002-3	303-10003-2
28 VDC	303-10002-3	303-10003-3





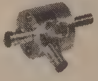
Coaxial Relays

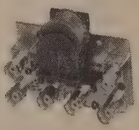
Precision coax units. Maximum time to operate and release is 20 milliseconds. Gold-plated, fine silver contacts assure reliable low-level operation. Minimum life expectancy is 1,000,000 cycles, when switch is operated at speeds of less than 10 Hz. Switches are impedance matched to 50-ohm cable, though loss is negligible with 75-ohm cable. Operation is break-before-make. All materials are corrosion resistant.

Units meet applicable portions of military connector specs as follows: BNC — Mil-C-3608 and N — Mil-C-71.

323

315


319


321

316

318

317

Part No.	Termination	Function	Connectors	Frequency (MHz)	RF Power (W)	Coil Volts	Coil Ohms
315-10002-3	Open	SPDT	BNC	1000	100	26 DC	280
316-10082-3	Short	SPDT	BNC	2000	100	26 DC	280
316-10082-6	Short	SPDT	BNC	2000	100	120 DC	6000
316-10102-8	Short	SPDT	BNC	2000	100	115 AC	550
317-10202-3	Short	SPDT	BNC	2000	100	26 DC	280
317-10215-8	Short	SPDT	BNC	2000	100	115 AC	550
317-10242-3	Short	SPDT	N	2000	100	26 DC	280
317-10255-8	Short	SPDT	N	2000	100	115 AC	550
318-10407-3	Open	SPDT	BNC	2000	100	26 DC	280
318-10381	Short	SPDT	BNC	2000	100	lever manual	—
318-10382-3	Short	SPDT	BNC	2000	100	26 DC	280
318-11165-3	Res.	SPDT	BNC	2000	100	26 DC	280
318-11576-8	Res.	SPDT	BNC	2000	100	115 AC	550
319-11141	Open	SPDT	BNC	2000	100	rotary manual	—
320-10931-3	Open	SPDT	N	3000	1000	26 DC	200
321-11062	Open	DPDT	BNC	1000	100	lever manual	—
321-11064-3	Open	DPDT	BNC	1000	100	26 DC	200
322-11431	Open	1P4T	BNC	3000	100	rotary manual	—
323-11651-3	Open	1P4T	BNC	1000	100	26 DC	280
322-11442	Open	1P6T	BNC	3000	100	rotary manual	—
325-11635-3	Short	1P6T	BNC	400	100	26 DC	280
325-11641-3	Open	1P6T	BNC	400	100	26 DC	280

Series 360 DYNAFORM FUNCTIONS AND PART NUMBERS

Conn.	Term.	Schematic	Coil Volts	SPDT Outline Dwg. A	SPDT Outline Dwg. B	DPDT Outline Dwg. C	DPDT Outline Dwg. D	Transfer Outline Dwg. E
BNC	SH	1	26 DC 110 DC 115 AC	360-11891-12 360-11891-34 360-11891-45	360-11891-13 360-11891-35 360-11891-46	360-11896-12 360-11896-34 360-11896-45	360-11896-13 360-11896-35 360-11896-46	
	NS	2	26 DC 110 DC 115 AC	360-11891-14 360-11891-36 360-11891-47	360-11891-15 360-11891-37 360-11891-48	360-11896-14 360-11896-36 360-11896-47	360-11896-15 360-11896-37 360-11896-48	
	50 Ω RT	3	26 DC 110 DC 115 AC	360-11891-16 360-11891-38 360-11891-49	360-11891-17 360-11891-39 360-11891-50	360-11896-16 360-11896-38 360-11896-49	360-11896-17 360-11896-39 360-11896-50	
	75 Ω RT	3	26 DC 110 DC 115 AC	360-11891-18 360-11891-40 360-11891-51	360-11891-19 360-11891-41 360-11891-52	360-11896-18 360-11896-40 360-11896-51	360-11896-19 360-11896-41 360-11896-52	
	95 Ω RT	3	26 DC 110 DC 115 AC	360-11891-20 360-11891-42 360-11891-53	360-11891-21 360-11891-43 360-11891-54	360-11896-20 360-11896-42 360-11896-53	360-11896-21 360-11896-43 360-11896-54	
	TRANS	4	26 DC 110 DC 115 AC					360-11891-22 360-11891-44 360-11891-55
TNC	SH	1	26 DC 110 DC 115 AC	360-11892-12 360-11892-34 360-11892-45	360-11892-13 360-11892-35 360-11892-46	360-11897-12 360-11897-34 360-11897-45	360-11897-13 360-11897-35 360-11897-46	
	NS	2	26 DC 110 DC 115 AC	360-11892-14 360-11892-36 360-11892-47	360-11892-15 360-11892-37 360-11892-48	360-11897-14 360-11897-36 360-11897-47	360-11897-15 360-11897-37 360-11897-48	
	50 Ω RT	3	26 DC 110 DC 115 AC	360-11892-16 360-11892-38 360-11892-49	360-11892-17 360-11892-39 360-11892-50	360-11897-16 360-11897-38 360-11897-49	360-11897-17 360-11897-39 360-11897-50	
	75 Ω RT	3	26 DC 110 DC 115 AC	360-11892-18 360-11892-40 360-11892-51	360-11892-19 360-11892-41 360-11892-52	360-11897-18 360-11897-40 360-11897-51	360-11897-19 360-11897-41 360-11897-52	
	95 Ω RT	3	26 DC 110 DC 115 AC	360-11892-20 360-11892-42 360-11892-53	360-11892-21 360-11892-43 360-11892-54	360-11897-20 360-11897-42 360-11897-53	360-11897-21 360-11897-43 360-11897-54	
	TRANS	4	26 DC 110 DC 115 AC					360-11892-22 360-11892-44 360-11892-55
N	SH	1	26 DC 110 DC 115 AC	360-11890-12 360-11890-34 360-11890-45	360-11890-13 360-11890-35 360-11890-46	360-11895-12 360-11895-34 360-11895-45	360-11895-13 360-11895-35 360-11895-46	
	NS	2	26 DC 110 DC 115 AC	360-11890-14 360-11890-36 360-11890-47	360-11890-15 360-11890-37 360-11890-48	360-11895-14 360-11895-36 360-11895-47	360-11895-15 360-11895-37 360-11895-48	
	50 Ω RT	3	26 DC 110 DC 115 AC	360-11890-16 360-11890-38 360-11890-49	360-11890-17 360-11890-39 360-11890-50	360-11895-16 360-11895-38 360-11895-49	360-11895-17 360-11895-39 360-11895-50	
	75 Ω RT	3	26 DC 110 DC 115 AC	360-11890-18 360-11890-40 360-11890-51	360-11890-19 360-11890-41 360-11890-52	360-11895-18 360-11895-40 360-11895-51	360-11895-19 360-11895-41 360-11895-52	
	95 Ω RT	3	26 DC 110 DC 115 AC	360-11890-20 360-11890-42 360-11890-53	360-11890-21 360-11890-43 360-11890-54	360-11895-20 360-11895-42 360-11895-53	360-11895-21 360-11895-43 360-11895-54	
	TRANS	4	26 DC 110 DC 115 AC					360-11890-22 360-11890-44 360-11890-55

COIL CHARACTERISTICS

@ 20°C

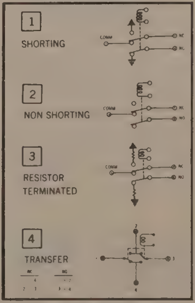
Nominal Voltage	Operating Range	Resistance, ohms ±10%
26 DC	20 - 32	260 ohms
110 DC	85 - 130	5100 ohms
115 AC (50 - 400 Hz)	90- 130	1500 ohms thru diodes

ELECTRICAL CHARACTERISTICS

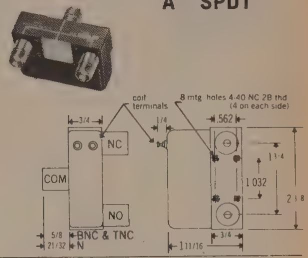
Conn.	Term.	Typical VSWR (Frequency GHz)							Typical Crosstalk - db (Frequency GHz)						
		.03	0.2	0.4	1.0	2.0	4.0	6.0	.03	0.2	0.4	1.0	2.0	4.0	6.0
BNC	SH	1.03	1.06	1.08	1.10	1.20	1.25	1.35	70	66	60	53	42	30	20
	NS	1.03	1.06	1.08	1.10	1.21	1.27	1.40	50	45	41	30	27	24	18
	50 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	75 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	95 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	TRANS	1.05	1.10	1.15	1.20	1.50	—	—	45	38	32	24	17	—	—
TNC	SH	1.03	1.06	1.08	1.10	1.20	1.25	1.35	70	66	60	53	42	35	25
	NS	1.03	1.06	1.08	1.10	1.21	1.27	1.40	51	43	41	30	27	26	21
	50 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	75 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	95 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	TRANS	1.05	1.10	1.15	1.20	1.50	—	—	45	38	32	24	17	—	—
N	SH	1.03	1.04	1.07	1.10	1.15	1.18	1.30	70	66	60	53	42	35	25
	NS	1.03	1.04	1.07	1.10	1.17	1.20	1.35	51	43	41	30	27	26	21
	50 Ω RT	1.03	1.05	1.08	1.12	1.18	1.50	—	41	35	31	24	17	14	—
	75 Ω RT	1.03	1.05	1.08	1.12	1.18	1.50	—	39	32	30	23	16	14	—
	95 Ω RT	1.03	1.05	1.08	1.12	1.18	1.50	—	37	31	29	22	15	14	—
	TRANS	1.05	1.10	1.15	1.20	1.50	—	—	45	38	32	24	17	—	—

NOTE: High frequency electrical characteristics are typical values (not maximum) as measured in a 50 ohm circuit and may be used for most design analyses. For more exacting applications, maximum values in the frequency range may be obtained upon request. SWR measured to common with a matched 50 ohm termination. **For additional specifications request Amphenol RF Switches Catalog SS-1.**

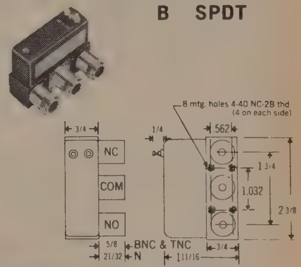
SCHEMATICS


1
SHORTING
COMM
NC
NO
2
NON SHORTING
COMM
NC
NO
3
RESISTOR TERMINATED
COMM
NC
NO
4
TRANSFER

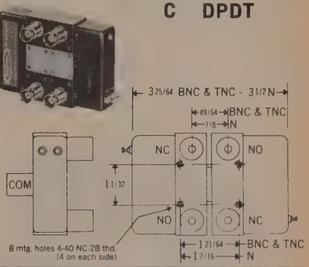
A SPDT


coil terminals
8 mtg. holes 4-40 NC 2B thd (4 on each side)
3/4
1/4
.562
NC
COM
NO
1 3/4
1.032
2 3/8
5/8 BNC & TNC
21/32 N
3/4
1 11/16

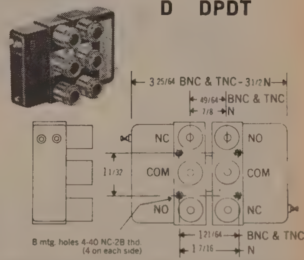
B SPDT


8 mtg. holes 4-40 NC-2B thd (4 on each side)
3/4
1/4
.562
NC
COM
NO
1 3/4
1.032
2 3/8
5/8 BNC & TNC
21/32 N
3/4
1 11/16

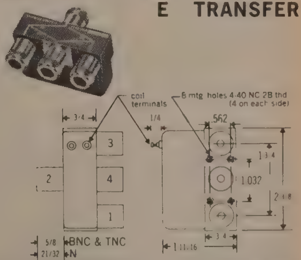
C DPDT


3 25/64 BNC & TNC - 3 1/2 N
49/64 BNC & TNC
7/8 N
NC
NO
COM
1 1/32
NO
NC
8 mtg. holes 4-40 NC-2B thd. (4 on each side)
1 21/64 BNC & TNC
1 7/16 N

D DPDT


3 25/64 BNC & TNC - 3 1/2 N
49/64 BNC & TNC
7/8 N
NC
NO
COM
COM
1 1/32
NO
NC
8 mtg. holes 4-40 NC-2B thd. (4 on each side)
1 21/64 BNC & TNC
1 7/16 N

E TRANSFER


coil terminals
8 mtg. holes 4-40 NC 2B thd (4 on each side)
3/4
1/4
.562
3
2
4
1
1 3/4
1.032
2 3/8
5/8 BNC & TNC
21/32 N
3/4
1 11/16

Pushbutton Switches/K500 Series

Up to 6PDT — 1 Amp

For chassis or PC board mounting only. No front panel screws. Six PDT silver alloy self-cleaning slide-action contacts. Occupies less than one square inch of panel space. Only 1½" depth behind panel. Long-life special nylon parts used throughout. Pushbutton switches can be furnished with round ⅜" diameter or ¾" square button in white (W), black (BK), red (R), yellow (Y), green (G), or blue (B). Square buttons may be engraved or hot stamped. Illuminated pushbutton switches are available using lamps which are accessible from front. Special unbased lamps in 6, 12, 24 v 1 watt are available all over the world. Prices from $2.30 to $6.00 (1-24 pcs).

SPECIFICATIONS

Contact Rating: 1 amp at 30 vdc or 0.2 amp at 115 vac

Contact Arrangement: Two, four, and six form C contacts

Life Expectancy: 10^6 mechanical; 5 x 10^4 at rated load

Ambient Temperature Range: −20°C to 60°C

Dielectric Strength: Under room conditions, 500v rms

Insulation Resistance: Under room conditions, 10^9 ohms.

Terminals: Solder lugs or PC pins

HOW TO ORDER

Your part number consists of the switch part number, color of button, contact arrangement and PC if printed circuit terminals are desired. Add letters "PC" at end of part number.

For example: to order a pushbutton switch with a push lock, push release function, a non-illuminated square black button, four form C contacts, and printed circuit terminals, the following part number would be used: **K560 BK-4C-PC.**

Note: Solder temperature: Max. 270°C (500°F) Solder time: Max. 5 sec.

PART NUMBERS FOR PUSHBUTTON SWITCHES

Function	Non-Illuminated		Illuminated	
	Round	Square	Round	Square
Momentary	K 500	K 520	K 600	K 620
Push Lock, Push Release	K 540	K 560	K 640	K 660
Push Lock, Reset Solenoid*	K 502	K 522	K 602	K 622

PART NUMBERS

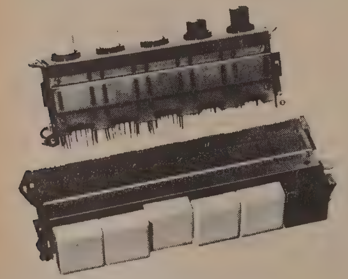
For Incandescent Lamps and Accessories

P/N	Description
2305	6 - 7V, 1W Unbased Lamp
2321	12 - 15V, 1W Unbased Lamp
2341	24 - 30V, 1W Unbased Lamp
LTa110Z1	Lamp Inserter
Z1693	Button Remover

* Standard solenoid is for 24 vac or vdc (200 ohms); other coils can be supplied to special order.

Multiple Switches/T596 Series

Up to 6PDT Per Station — 1 Amp



SERIES T596 MULTIPLE SWITCHES

For front panel, chassis, or PC board mounting using 4-40 screws. Up to 6 PDT silver-nickel self-cleaning slide-action contacts. Occupies less than one square inch of panel space. Only 1½" depth behind panel. Long-life special nylon parts used throughout. Pushbutton switch can be furnished with round ⅜" diameter or square ⅞" x 13/16" with 0.827" center-to-center spacing, in white, black, red, yellow, green, or blue buttons. Square buttons may be engraved or hot stamped. Illuminated pushbutton switches are available using lamps, which are accessible from front. Special unbased lamps in 6, 12, 24 v 1 watt are available all over the world.

SPECIFICATIONS

Contact Rating: 1 Amp at 30 VDC or 0.2 Amp at 115 VAC.

Contact Arrangement: Two, four and six form C contacts.

Life expectancy: 10^5 mechanical; 5 x 10^4 at rated load.

Ambient Temperature Range: −20°C to 60°C.

Dielectric Strength: Under room conditions, 500 v RMS.

Insulation Resistance: Under room conditions, 10^9 ohms.

Terminals: Solder lugs or PC terminals.

SWITCH CHARACTERISTICS

Switch Function	Frame Part Number
Non-lock (momentary) Push lock, push release	T596.10
Interlock	T596.20
Interlock with one non-locking reset button	T596.30

STATION PART NUMBERS

Function	Non-illuminated Round	Non-illuminated Square	Illuminated Round	Illuminated Square
Non-lock (momentary)	500.1	520.1	600.1	620.1
Interlock	500.2	520.2	600.2	620.2
Push lock, push release	540.4	560.4	640.4	660.4
Reset	500.0	520.0	600.0	620.0

FOR EXAMPLE, TO ORDER:

A multiple-station pushbutton switch with: Ten interlock, non-illumnated stations with white round buttons, four form C contacts, and printed circuit terminals, the following part number would be developed: (See example at right)

T 596.20-10 / 500.2 W / 4C / PC

Frame #
Number of stations
Station part #
Color of buttons
Contacts on each station
PC pins

Note: Solder temp.: Max. 270°C (500°F) Solder time: Max. 5 sec.

AMERICAN ZETTLER, INC.

16881 HALE AVE. · IRVINE, CALIFORNIA 92705
PHONE 714-540-4190 · TELEX 67-8472

ARROW HART has been a leading manufacturer of standard and custom designed Specialty Switches for over fifty years.

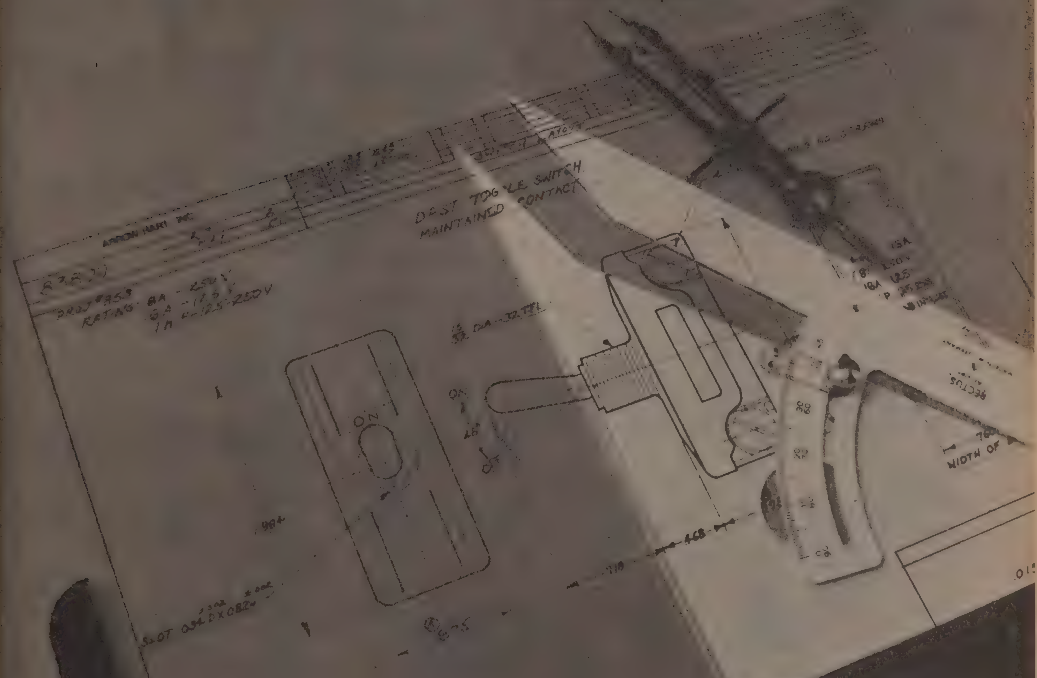
The Specialty Switch products illustrated and identified on the following pages are currently being produced and shipped in volume to both ARROW-HART authorized distributors for resale and to original equipment manufacturers for use in their products.

These catalog items do not represent all of the switches manufactured by ARROW-HART. They are typical of the products being used in industry at this time.

Many catalog items as shown are available for immediate delivery from our authorized distributors. Others are manufactured on special order only and require manufacturing lead time.

ARROW-HART welcomes inquiries for controls to meet special requirements and will consider the design and tooling of new products where volume warrants.

Contact the nearest ARROW-HART district sales office regarding price, delivery, or any other information required



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DON'T MISS THESE OTHER A-H PRODUCTS IN EEM.

Wiring Devices (Connectors)	[illegible]
Industrial Timers	[illegible]
Relays	[illegible]
Contactors	[illegible]

Specifications subject to change without notice. Arrow-Hart assumes no responsibility for errors or omissions in this catalog.

Arrow Hart

SNAP-IN MINIATURE ROCKER SWITCHES

- ***Low cost.***
- ***Compact design with popular snap-in fixing.***
- ***Choice of color and termination.***
- ***Complementary indicator lights.***
- ***Slow, make and break action.***
- ***Choice of single pole 1600 Series or double pole 2600 Series.***

Compact design with popular snap-in mounting feature.
UL, CSA, BS and VDE listed, 16 amp 250 VAC. Manufactured to meet specification CEE-24. Other European approvals applied for.

Specifications

Operation: Rocker Lever action, 2 and 3 position, maintained or momentary, with or without illumination.

Function: 1600 Series — single pole, single throw (SPST) and single pole, double throw (SPDT).
2600 Series — double pole, single throw (DPST) and double pole, double throw (DPDT).

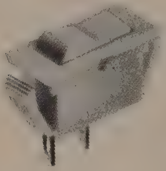
Mounting: Snap-in feature (see cutout dimensions).

Termination: Combination Quick Connect, Solder Lug (.250 spade).

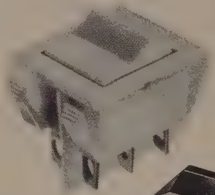
Color — lever and base: Standard color stocked presently — Black. Special color base and lever available on special order only.

Insulation Resistance: 50,000 megohms.

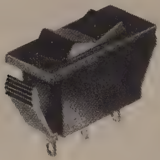
Operating Temperature Range: —40° to 55°C.



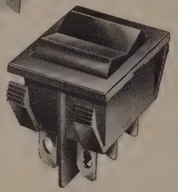
SINGLE POLE
TWO POSITION



DOUBLE POLE
TWO POSITION



SINGLE POLE
THREE POSITION



DOUBLE POLE
THREE POSITION

Dimensions

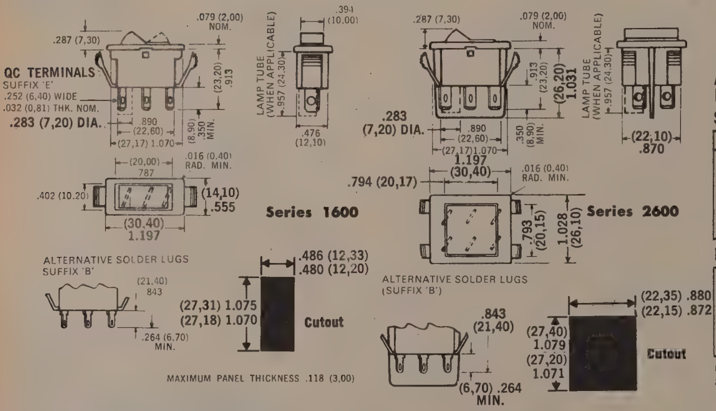

.287 (7,30)
.079 (2,00) NOM.
QC TERMINALS
SUFFIX 'E'
.252 (6,40) WIDE
.032 (0,81) THK. NOM.
.283 (7,20) DIA.
.890 (22,60)
(27,17) 1.070
(8,90) .350 MIN.
(23,20) .913
LAMP TUBE (WHEN APPLICABLE)
.957 (24,30)
.394 (10,00)
.476 (12,10)
(20,00) 787
.016 (0,40) RAD. MIN.
.402 (10.20)
(14,10) .555
(30,40) 1.197
Series 1600
ALTERNATIVE SOLDER LUGS
SUFFIX 'B'
(21,40) 843
.264 (6,70) MIN.
.486 (12,33)
.480 (12,20)
(27,31) 1.075
(27,18) 1.070
Cutout
MAXIMUM PANEL THICKNESS .118 (3,00)
.287 (7,30)
.079 (2,00) NOM.
.913 (23,20)
(26,20) 1.031
.283 (7,20) DIA.
.890 (22,60)
(27,17) 1.070
.350 (8,90) MIN.
LAMP TUBE (WHEN APPLICABLE)
.957 (24,30)
(22,10) .870
1.197 (30,40)
.794 (20,17)
.016 (0,40) RAD. MIN.
.793 (20,15)
1.028 (26,10)
Series 2600
ALTERNATIVE SOLDER LUGS
(SUFFIX 'B')
.843 (21,40)
(6,70) .264 MIN.
(22,35) .880
(22,15) .872
(27,40) 1.079
(27,20) 1.071
Cutout

TABLE I
Standard Stocked Models (Switches)

All are equipped with a Black Base, a Black Rocker and .250" Quick Connect Terms.

SINGLE POLE

Circuit	Action	Cat. No.
SPST	off-on	160011E
SPDT	on-on	160211E
SPDT	on-off-on	160411E
SPST	off-mom. on	160111E
SPDT	on-mom. on	160311E

DOUBLE POLE

Circuit	Action	Cat. No.
DPST	off-on	260011E
DPDT	on-on	260211E
DPDT	on-off-on	260411E
DPST	off-mom. on	260111E
DPDT	on-mom. on	260311E

Optional circuit colors, functions, terminations available on special order. Consult factory.

HOW TO ORDER NON-STOCKED ITEMS

To the basic catalog numbers, a number is added to denote the color of both the body and rocker moldings, the body number first. In addition a letter, relating to the type of terminal required, is included.

BASIC CAT. No.
Series 1600 — 1 pole
Series 2600 — 2 pole
(Indicate actual number for circuit required, see Table II)

1600-11E

→TERMINAL VARIATIONS
B = Solder lug — Special.
E = Quick connect — Standard.

→LEVER COLOR

→BASE COLOR
1 = Black →Standard
2 = White
3 = Red
4 = Green
5 = Grey
→Special
(Permutations of base and lever colors can be offered where quantity warrants.)

TABLE II — Optional Circuits

Circuit	Action	Cat. No. Prefix
SPST	on-mom. off	1605-( )( )( )
SPDT	mom. on-off-mom. on	1606-( )( )( )
SPDT	on-off-mom. on	1607-( )( )( )
DPST	on-mom. off	2605-( )( )( )
DPDT	mom. on-off-mom. on	2606-( )( )( )
DPDT	on-off-mom. on	2607-( )( )( )

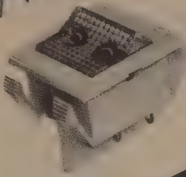
ARROW-HART INC. / SPECIALTY SWITCH PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

Arrow Hart

LIGHTED SNAP-IN ROCKER SWITCHES

Specifications and dimensions are the same as for the non-lighted version.

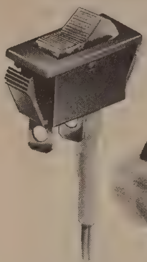
SINGLE POLE
TWO POSITION
(In Single Pole Base)



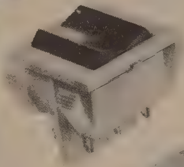
DOUBLE POLE
TWO POSITION

Indicators

PILOT LIGHT
MATCHES SINGLE
POLE SIZE



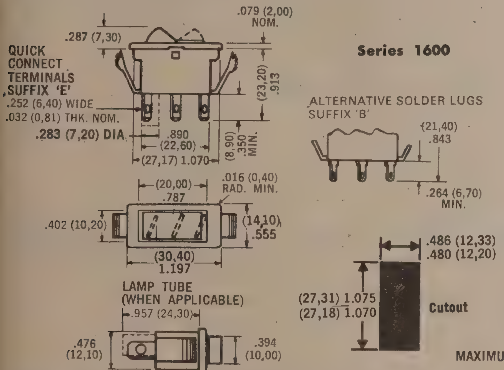
SINGLE POLE
TWO POSITION
WITH FIELD ADDED LAMP
(Option T)



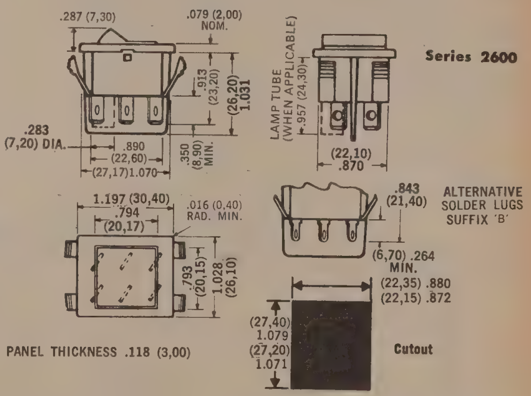
SINGLE POLE
TWO/THREE POSITION
(In Double Pole Base)

Dummy Plugs

DUMMY PLUG
CAN BE EITHER
ALL BLACK OR WHITE



Series 1600
.287 (7,30)
.079 (2,00) NOM.
QUICK CONNECT TERMINALS SUFFIX 'E'
.252 (6,40) WIDE
.032 (0,81) THK. NOM.
.283 (7,20) DIA.
.890 (22,60)
(27,17) 1.070
(23,20) .913
(8,90) .350 MIN.
ALTERNATIVE SOLDER LUGS SUFFIX 'B'
(21,40) .843
.264 (6,70) MIN.
(20,00) .787
.016 (0,40) RAD. MIN.
.402 (10,20)
(14,10) .555
(30,40) 1.197
LAMP TUBE (WHEN APPLICABLE)
.957 (24,30)
.476 (12,10)
.394 (10,00)
.486 (12,33)
.480 (12,20)
(27,31) 1.075
(27,18) 1.070
Cutout



Series 2600
.287 (7,30)
.079 (2,00) NOM.
.913 (23,20)
(26,20) 1.031
.283 (7,20) DIA.
.890 (22,60)
(27,17)1.070
.350 (8,90) MIN.
LAMP TUBE (WHEN APPLICABLE)
.957 (24,30)
(22,10) .870
1.197 (30,40)
.794 (20,17)
.016 (0,40) RAD. MIN.
.793 (20,15)
1.028 (26,10)
.843 (21,40)
ALTERNATIVE SOLDER LUGS SUFFIX 'B'
(6,70) .264 MIN.
(22,35) .880
(22,15) .872
(27,40) 1.079
(27,20) 1.071
Cutout

MAXIMUM PANEL THICKNESS .118 (3,00)

HOW TO ORDER LIGHTED SWITCHES AND INDICATORS

To the basic catalog numbers, suffix letters and numbers are added to denote color of body and rocker, lamp voltage and termination.

1600 R 2 1 E

BASIC CAT. NO.

Series 1600 — 1 Pole
Series 2600 — 2 Pole
(Indicate actual number for switch circuit required, see Table III)
Series 1609 — Indicator or Dummy Plug

TRANSLUCENT ROCKER/LENS COLORS

A = Amber.
G = Green.
R = Red.
W = White.

BODY COLOR

1 = Black
2 = White
Standard Colors.

3 = Red
4 = Green
5 = Grey
Supplied to special order.

LAMP VOLTAGE

0 = No lamp.
1 = 110V
2 = 240V
Neon.
4 = 6V
5 = 12V
6 = 24V
Filament.

TERMINAL VARIATION

B = Solder lug.
E = Quick Connect (Push-on).

Note: All lamps are assembled integral with the base, except for a switch or indicator with Green translucent rocker/lens. These are fitted with a 110V or 240V fluorescent lamp. These particular lamps are inserted into a tube at the rear of the base.

Other switches with the tube in the base can be supplied to special order to enable lamps to be fitted on site and catalog numbers should be amended to include the letter T, e.g. 1600TR11E.

An all black or all white dummy unit cataloged as 1609DUM11 or 1609DUM22 can be supplied as a blanking plug. Dimensions are as for the 1609 series indicator less terminals.

SPST switches only are built on single pole base. All other circuits are on double pole base.

TABLE III — Circuits Available

SINGLE POLE

Circuit	Action	Cat. No. Prefix
SPST	off-on	1600-( )( )( )
SPDT	on-on	*1622-( )( )( )
SPDT	on-off-on	*1624-( )( )( )
SPST	off-mom. on	1601-( )( )( )
SPDT	on-mom. on	*1623-( )( )( )
SPST	on-mom. off	*1625-( )( )( )
SPDT	mom. on-off-mom. on	*1626-( )( )( )
SPDT	on-off-mom. on	*1627-( )( )( )

DOUBLE POLE

DPST	on-mom. off	2605-( )( )( )
DPST	off-on	2600-( )( )( )
DPST	off-mom. on	2601-( )( )( )

*On two pole base.

Arrow Hart

TOGGLE SWITCHES/GENERAL PURPOSE

General purpose toggle switches by Arrow-Hart offer the designer a wide selection of styles, sizes, ratings and termination options. Some of these switches have been the standard of the industry for over 30 years. Proven popularity. Proven dependability. Check, too, the Arrow-Hart Subminiature toggles and Pushbuttons starting on page 9.

CANOPY SERIES

2 POSITION/3 AMP

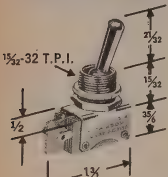


Fig. GT1.
SPST Bat lever.
Shown 20994LH.

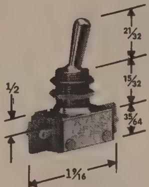


Fig. GT2.
DPST Bat lever.
Shown 20902CX.

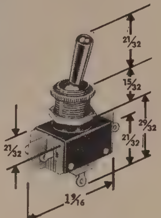


Fig. GT3.
DPDT Bat lever.
Shown 20905FR.

This unique design, dating back to 1925, still offers a full selection of circuits on a small base. Time proven roller mechanism. Long life dependability. Ideally suited for small motor applications. For standard levers available see page 23 Figs. A and B.

OPTIONS (CONSULT FACTORY)

- Screw terminals
- Wire Leads
- Optional levers (Fig. C and E, see page 23)
- Special finishes, metal levers
- Special colors, molded levers
- Slotted and custom machined levers

COMMON SPECIFICATIONS

FOR GENERAL PURPOSE TOGGLES

Exposed metal parts: Bright nickel
Dielectric breakdown: Exceeds 1000 V rms
Contact material: Bronze silver plated
Terminals: Bronze silver plated
Standard hardware: 1 hex nut, 1 knurled nut (unassembled)
Packaging: **Ind.** Each switch and hardware individually packaged (see page 24). **Blk.** Quantity packaged for large volume users (see page 24)

050 SERIES

2 POSITION/LOW LEVEL

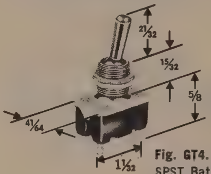


Fig. GT4.
SPST Bat lever.
Shown 83050.

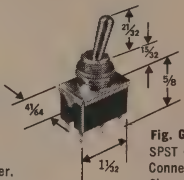


Fig. GT5.
SPST Quick
Connect Terminal.
Shown 83054P.

This small space saving switch has a "quick make/break" **knife** wiping action. This contact mechanism meets the rigid reliability standards established by the Data Processing, Communications, Consumer electronics, and Instrumentation industries. The best choice for low-level switching. Standard models have silver plated bronze contacts. Gold plated and silver alloy are available. For standard levers available see page 23 Figs. B, C, D, E and F.

OPTIONS (CONSULT FACTORY)

- Gold plated contacts
- Silver alloy contacts (type P terminals only)
- Special finishes, metal levers
- Special colors, molded levers
- Silicone rubber seal in sleeve assembly
- Momentary action available

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Lever Description	Lever Figure See Page 23	Slotted Sleeve Length, inches 15/32″ dia.	Termination Note 1	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. GT-
Canopy	SPST	off-on	3	1	Ball	A	15/32	Solder Lug	20994CS	04	Ind	1
		off-on	3	1	Bat	B	15/32	Solder Lug	20994LH	04	Ind	
		off-on	3	1	Ball	A	1	Solder Lug	21615BD	04	Ind	
		off-on	3	1	Bat	B	1	Solder Lug	21615BE	04	Ind	
		off-mom-on	3	1	Bat	B	15/32	Solder Lug	80054S	04	Ind	
	SPDT	on-on	3	1	Ball	A	15/32	Solder Lug	21350BF	04	Ind	2
		on-on	3	1	Bat	B	15/32	Solder Lug	21350EH	04	Ind	
		on-mom-on	3	1	Bat	B	15/32	Solder Lug	21827GA	04	Ind	
	DPST	off-on	3	1	Ball	A	15/32	Solder Lug	20902N	04	Ind	2
		off-on	3	1	Bat	B	15/32	Solder Lug	20902CX	04	Ind	
	DPDT	on-on	3	1	Ball	A	15/32	Solder Lug	20905BX	04	Ind	3
		on-on	3	1	Bat	B	15/32	Solder Lug	20905FR	04	Ind	
		on-on	3	1	Ball	A	1	Solder Lug	20905C	05	Ind	
		on-on	3	1	Bat	B	1	Solder Lug	20905KA	04	Ind	
		on-mom-on	3	1	Bat	B	15/32	Solder Lug	21858X	04	Ind	
050	SPST	off-on	3	1	Bat	B	15/32	Solder Lug	83050*	04	Ind	4
		off-on	3	1	Bat	B	15/32	CSQC	83050P*	05	Blk	
		off-on	3	1	Metal Paddle	C	15/32	Solder Lug	83050CG	04	Ind	
Cont'd on pg. 3		off-on	3	1	Metal Paddle	C	15/32	CSQC	83050PCG	06	Blk	
		off-on	3	1	Molded Taper	D	13/32	Solder Lug	83050SB	04	Ind	

* Standard hardware supplied. All others; 1 hex and 1 dress nut. See Fig. D page 23.

Note 1. CSQC is a combination Solder Lug Quick Connect terminal.

Arrow Hart TOGGLE SWITCHES/GENERAL PURPOSE

CLASSIC 015 SERIES

STANDARD OF THE INDUSTRY

2 POSITION/LOW LEVEL TO 6 AMP

(Specs on page 4)

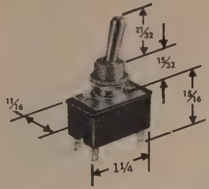


Fig. GT6.
DPST Ball Joint Bat lever.
Shown 81024GB.

This deluxe line, for more than 30 years the standard of the industry, gives maximum reliability in both low-level and rated power (6 amps) applications. The wide selection of options available makes these switches the "classic" choice in many, many applications. Standard lever is a bat handle, see page 23 Fig. B.

OPTIONS (CONSULT FACTORY)

- Wire leads (see page 23 Fig. T3)
- End connected solder lugs (see page 23 Fig. T1)
- Gold plated contacts
- Optional levers (Fig. A, C-F, see page 23)
- Screw terminals (see page 23 Fig. T2)
- Special finishes, metal levers
- Special colors, molded levers
- Slotted and custom machined levers
- Silicone seal in sleeve assembly
- Momentary action

591 SERIES

2 POSITION/6 - 8 AMPS

(Specs on page 4)

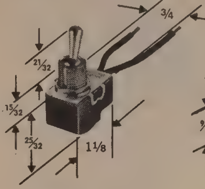


Fig. GT7.
SPST Wire lead.
Shown 80591HDR.

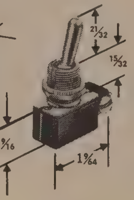


Fig. GT8.
SPST Screw terminal.
Shown 86964E.

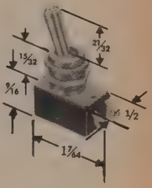


Fig. GT9.
SPST Solder lug.
Shown 86994N.

This series offers a limited selection of medium current (up to 8 amps) in a small molded base. Quick make-break wiping mechanism. Frequently used in small home appliances and consumer electronic applications. Standard lever is a bat handle, see page 23, Fig. B.

OPTIONS (CONSULT FACTORY)

- Optional levers (Figs. A, C, E, F, see page 23)
- Special finishes, metal levers
- Special colors, molded levers
- Momentary action available (6 Amp models only)

Series	Circuit	Action	UL Listed AC/DC		Lever		Slotted Sleeve Length, inches 15/32" dia.	Termination Note 1	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. GT-
			125 V Amp	250 V Amp	Description See Page 23	Figure						
050 Cont'd from pg. 2	SPST	off-on	3	1	Molded Taper	D	13/32	CSQC	83050PSB	06	Blk	4
		off-on	3	1	Molded Paddle	E	15/32	Solder Lug	83050BK	06	Blk	
		off-on	3	1	Molded Paddle	E	15/32	CSQC	83050PBK	06	Blk	
		off-on	3	1	Molded Straight	F	15/32	Solder Lug	83050FK	06	Blk	
		off-on	3	1	Molded Straight	F	15/32	CSQC	83050PFK	06	Blk	
	SPDT	on-on	3	1	Bat	B	15/32	Solder Lug	83052*	04	Ind	4
		on-on	3	1	Bat	B	15/32	CSQC	83052P*	06	Blk	
		on-on	3	1	Metal Paddle	C	15/32	Solder Lug	83052CG	04	Ind	
		on-on	3	1	Metal Paddle	C	15/32	CSQC	83052PCG	06	Blk	
		on-on	3	1	Molded Taper	D	13/32	Solder Lug	83052SG	04	Ind	
		on-on	3	1	Molded Taper	D	13/32	CSQC	83052PSG	06	Blk	
		on-on	3	1	Molded Paddle	E	15/32	Solder Lug	83052BK	06	Blk	
		on-on	3	1	Molded Paddle	E	15/32	CSQC	83052PBK	06	Blk	
		on-on	3	1	Molded Straight	F	15/32	Solder Lug	83052FK	06	Blk	
		on-on	3	1	Molded Straight	F	15/32	CSQC	83052PFK	06	Blk	
	DPST	off-on	3	1	Bat	B	15/32	Solder Lug	83053*	04	Ind	4
		off-on	3	1	Bat	B	15/32	CSQC	83053P*	05	Blk	
		off-on	3	1	Metal Paddle	C	15/32	Solder Lug	83053CG	04	Ind	
		off-on	3	1	Metal Paddle	C	15/32	CSQC	83053PCG	06	Blk	
		off-on	3	1	Molded Taper	D	13/32	Solder Lug	83053SG	04	Ind	
		off-on	3	1	Molded Taper	D	13/32	CSQC	83053PSG	06	Blk	
		off-on	3	1	Molded Paddle	E	15/32	Solder Lug	83053BK	06	Blk	
		off-on	3	1	Molded Paddle	E	15/32	CSQC	83053PBK	06	Blk	
		off-on	3	1	Molded Straight	F	15/32	Solder Lug	83053FK	06	Blk	
		off-on	3	1	Molded Straight	F	15/32	CSQC	83053PFK	06	Blk	
Cont'd on pg. 4	DPDT	on-on	3	1	Bat	B	15/32	Solder Lug	83054*	04	Ind	4
		on-on	3	1	Bat	B	15/32	CSQC	83054P*	05	Blk	

Note 1. CSQC is a combination Solder Lug Quick Connect terminal.

Arrow Hart

TOGGLE SWITCHES GENERAL PURPOSE

104 SERIES

3 POSITION/3 AMP

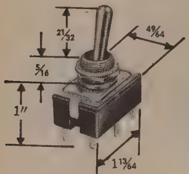


Fig. GT10.
DPDT Combination Solder lug, Quick Connect. Shown 84104.

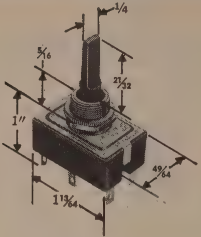


Fig. GT11.
DPDT Molded paddle. Shown 84104CB.

Three-position wiping contact action in a small molded body. Well suited to low-level circuit applications. Widely used in computer, instrumentation, biomedical and business machine applications. Standard levers available are bat handle or molded paddle, see page 23 Figs. B and E.

OPTIONS (CONSULT FACTORY)

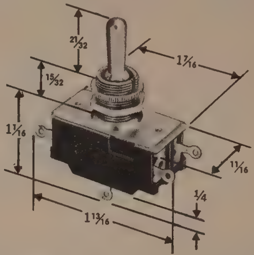
Special finishes, metal levers
Special colors, molded levers

Gold plating on current-carrying parts

024 SERIES

3 POSITION/6 AMP

Fig. GT12.
DPDT Bat lever. Shown 82024HD.



Wiping action in fully enclosed molded base with heavy silver-plated contacts. Three-position, center-off. End connected solder terminals standard. Standard lever is a bat handle, see page 23 Fig. B.

OPTIONS (CONSULT FACTORY)

Screw terminals
Special colors on molded paddle

Optional levers (Fig. A and E, see page 23)

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Lever Description See Page 23	Lever Figure	Slotted Sleeve Length, inches 15/32″ dia.	Termination Note 1	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. GT-
050 Cont'd from pg. 3	DPDT	on-on	3	1	Metal Paddle	C	15/32	Solder Lug	83054CG	04	Ind	4
		on-on	3	1	Metal Paddle	C	15/32	CSQC	83054PCG	06	Blk	
		on-on	3	1	Molded Taper	D	13/32	Solder Lug	83054SG	04	Ind	
		on-on	3	1	Molded Taper	D	13/32	CSQC	83054PSG	06	Blk	
		on-on	3	1	Molded Paddle	E	15/32	Solder Lug	83054BK	06	Blk	
		on-on	3	1	Molded Paddle	E	15/32	CSQC	83054PBK	06	Blk	
		on-on	3	1	Molded Straight	F	15/32	Solder Lug	83054FK	06	Blk	
		on-on	3	1	Molded Straight	F	15/32	CSQC	83054PFG	06	Blk	
104	SPDT	on-off-on	3	1	Bat	B	5/16	CSQC	84105	04	Ind	10
	DPDT	on-off-on	3	1	Bat	B	5/16	CSQC	84104	04	Ind	10
		on-off-on	3	1	Molded Paddle	E	5/16	CSQC	84104CB	06	Blk	
	3 Cir. SP	on-on-on	3 AC 1 DC	1 AC ½ DC	Bat	B	5/16	CSQC	84222	05	Blk	10
591 Description on pg. 3	SPST	off-on	6	3	Bat	B	15/32	Wire Lead	86599QE	04	Ind	9
		off-on	6	3	Bat	B	15/32	Screw	86964E	04	Ind	9
		off-on	6	3	Bat	B	15/32	Solder Lug	86994N	04	Ind	9
		off-on	8	4	Bat	B	15/32	Wire Lead	80591HDR	06	Blk	7
015 Description on pg. 3	SPST	off-on	6	3	Bat	B	15/32	Solder Lug	81015AW	04	Ind	6
	SPDT	on-on	6	1	Bat	B	15/32	Solder Lug	81021AV	04	Ind	
	DPST	off-on	6	3	Bat	B	15/32	Solder Lug	81024GB	04	Ind	
	DPDT	on-on	6	3	Bat	B	15/32	Solder Lug	81027CE	04	Ind	
	SPST	off-mom-on	6	3	Bat	B	15/32	Solder Lug	81045FB	04	Ind	
	SPDT	on-mom-on	6	1	Bat	B	15/32	Solder Lug	81051GE	05	Blk	
	DPST	off-mom-on	6	3	Bat	B	15/32	Solder Lug	81054H	04	Ind	
	DPDT	on-mom-on	6	3	Bat	B	15/32	Solder Lug	81057N	04	Ind	
024	SPDT	on-off-on	6	3	Bat	B	15/32	Solder Lug	82022HD	04	Ind	12
	DPDT	on-off-on	6	3	Bat	B	15/32	Solder Lug	82024HD	04	Ind	

Note 1. CSQC is a combination Solder Lug Quick Connect terminal.

Arrow Hart

POWER TOGGLE SWITCHES/10 AMP TO 60 AMP

Presented in the next four pages is a wide selection of toggle switches for power applications. AC/DC and AC only models are covered with ratings ranging from 10 Amps at 125 VAC to as high as 60 Amps at 250 VAC. Horsepowers to 2 HP are possible with certain models.

COMMON SPECIFICATIONS FOR ALL POWER TOGGLES

Exposed metal parts: Bright nickel

Dielectric breakdown: Exceeds 1000 V rms

Standard hardware: 1 hex nut, 1 knurled nut unassembled

Packaging: **Ind.** Each switch and hardware individually packaged (see page 24). **Blk.** Quantity packaged for large volume users (see page 24)

608 SERIES/AC ONLY

2 - 3 POSITION/1 HORSEPOWER/20 AMP

SPST through 4PDT — Slow make and break utility size. The 608 series is designed to offer high capacity (AC only) on a small size phenolic base with butt type (fine silver buttons) contact and ball joint lever construction for long life expectancy. Available in 2 or 3 position (with or without OFF in center) and momentary contact in one or both sides of the center position.

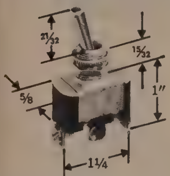


Fig. PT1.
SPDT Screw terminal.
Shown 82602.

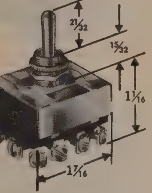


Fig. PT3.
Represents 3 and 4 pole dimensions.
Shown 82633.

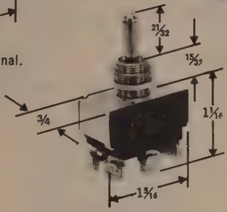


Fig. PT2.
DPDT Bat lever.
Shown 82608.

AVAILABLE TERMINATIONS

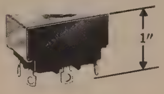


Fig. PT4.
Solder lug termination.

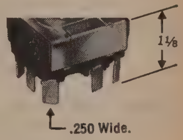


Fig. PT5.
Quick connect termination.

Series	Circuit	Action	UL Listed AC Only		Lever		Slotted Sleeve Length, inches 15/32" dia.	Termination See Illust.	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. PT-
			125 V Amp	250 V Amp	Description	Figure See Page 23						
608	SPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82600	04	Ind	1
	SPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Solder	82601	04	Ind	
	SPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	QC	82601P	04	Ind	
	SPST	off-on	20 A 1 HP	10 A 1 HP	Bat	B	15/32	Screw	82779SA	04	Ind	
	SPDT	on-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82604	04	Ind	
	SPDT	on-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Solder	82605	04	Ind	
	SPDT	on-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	QC	82605P	05	Blk	
	SPDT	on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82602	04	Ind	
	SPDT	on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Solder	82603	04	Ind	
	SPDT	on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	QC	82603P	05	Blk	
	SPDT	mom mom on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82726	04	Ind	
	DPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82606	04	Ind	2
	DPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Solder	82607	04	Ind	
	DPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	QC	82607P	05	Blk	
	DPDT	on-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82610	04	Ind	
	DPDT	on-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Solder	82611	04	Ind	
	DPDT	on-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	QC	82611P	05	Blk	
	DPDT	on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82608	04	Ind	
	DPDT	on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Solder	82609	04	Ind	
	DPDT	on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	QC	82609P	04	Ind	
	DPDT	mom mom on-off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	82736	04	Ind	
	3PST	off-on	15 A 1 HP	10 A	Bat	B	15/32	Screw	82612	04	Ind	3
	3PDT	on-on	15 A 1 HP	10 A	Bat	B	15/32	Screw	82616	04	Ind	
	3PDT	on-on	15 A 1 HP	10 A	Bat	B	15/32	Solder	82617	04	Ind	
	3PDT	on-off-on	15 A 1 HP	10 A	Bat	B	15/32	Screw	82614	04	Ind	
	3PDT	on-off-on	15 A 1 HP AC	10 A	Bat	B	15/32	Solder	82615	04	Ind	
	4PDT	on-on	½ HP	10 A ½ HP	Bat	B	15/32	Screw	82635	04	Ind	
	4PDT	on-on	½ HP	10 A ½ HP	Bat	B	15/32	Solder	82636	04	Ind	
	4PDT	on-on	½ HP	10 A ½ HP	Bat	B	15/32	QC	82636P	05	Blk	
	4PDT	on-off-on	½ HP	10 A ½ HP	Bat	B	15/32	Screw	82633	04	Ind	
	4PDT	on-off-on	½ HP	10 A ½ HP	Bat	B	15/32	Solder	82634	04	Ind	

Arrow Hart POWER TOGGLE SWITCHES/10 AMP TO 60 AMP

800 SERIES FOR DOUBLE INSULATION DESIGNS

MEDIUM DUTY/1 HORSEPOWER/16 AMP

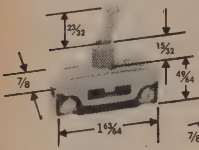


Fig. PT6.
DPST All molded construction.
Shown 83800.

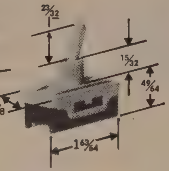


Fig. PT7.
DPST New press fit termination.
Shown 83806.

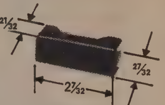


Fig. PT8.
Insulator, optional.
Order Cat. No. 83801.

The all-molded construction of this new series of medium duty switches allows them to be applied where double insulation is desirable — or mandatory. And a new type of press-fit termination alternate offers production economies for large volume users. Use AMP. INC. terminal lug 62008-1 Right hand and 62009-1 Left hand. Molded insulator (see figure) available, order Cat. No. 83801.

OPTIONS (CONSULT FACTORY)

Special colors on levers.

600 SERIES

MEDIUM DUTY/ 1 HORSEPOWER/16 AMP

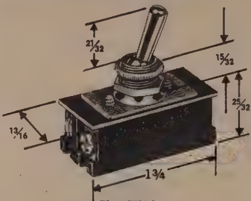


Fig. PT11.
DPST 600 Series.
Shown 80600BJ.

602 SERIES

HEAVY DUTY/ 1½ HORSEPO /ER/20 AMP

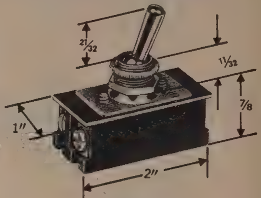


Fig. PT12.
DPST 602 Series.
Shown 80602CA.

These medium and heavy duty switches, available with several lever options and screw or wire termination, are good general purpose controls.

OPTIONS (CONSULT FACTORY)

- Optional levers (Fig. A-F)
- Wire lead terminals
- Special finishes, metal levers
- Special colors, molded levers
- Slotted and custom machined levers

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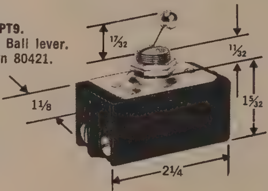
421 SERIES

RUGGED DUTY/2 HORSEPOWER/ 20 AMP/250 V

These quick make quick break AC/DC switches are built to handle rugged applications up to 20 Amp and 2 HP at 250 V. Widely used in industrial power tools and floor cleaning and polishing equipment.

Fig. PT9.
DPST Ball lever.
Shown 80421.



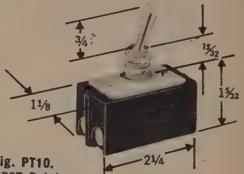


Fig. PT10.
DPST Bat lever.
Shown 80421U.

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Lever Description	Lever Figure See Page 23	Slotted Sleeve Length, inches ¾" dia.	Termination See Illust.	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. PT-
638	DPDT	on-off-on	14	7	Ball	Note 1	13/32	Screw	80638D	04	Ind	13
	DPDT	on-off-on Internal Shunt	10	5	Ball		13/32	Screw	80639	05	Blk	13
	3PDT	on-off-on	10 ½ HP-125-230	5	Ball		13/32	Screw	80983	04	Ind	14
	4PDT	on-off-on	10 ½ HP-125-230	5	Ball		13/32	Screw	80985	04	Ind	14
	4PDT	3P on-off-on 1P off-on-off	10 ½ HP-125-230	5	Ball		13/32	Screw	81828	05	Blk	14
	3P Special	2 P on-off-on 1P off-on-off	10 ½ HP-125-230	5	Ball		13/32	Screw	82873	05	Blk	14
	DPDT	on-off-on	20	†10	Square	Note 2	Not sleeve mounted	Screw	80634	04	Ind	15
	DPDT	on-on	20	†10	Square			Screw	80975	04	Ind	15
	DPDT	off-1-2	12	6	Square			Screw	81321	05	Blk	15
	DPDT	on-off-on	30	20	Square			Screw	80988	04	Ind	16
	3PDT	on-off-on	30	20	Square			Screw	80898	04	Ind	17
	4PDT	on-off-on	30	20	Square			Screw	80899	04	Ind	17
	3 Circuit	on-on-on	30	20	Square			Screw	82347	08	Blk	17
							15/32" dia.					
600	SPST	off-on	12	6	Bat	B	15/32	Screw	80607BJ	04	Ind	11
	SPDT	off-on	12	6	Bat	B	15/32	Screw	80618K	04	Ind	
	DPST	off-on	16 A 1 HP	8 A 1 HP	Ball	A	5/16	Screw	80600	04	Ind	
	DPST	off-on	16 A 1 HP	8 A 1 HP	Ball	A	15/32	Screw	80600B	04	Ind	
	DPST	off-on	16 A 1 HP	8 A 1 HP	Bat	B	15/32	Screw	80600BJ	04	Ind	

† 1½ HP 250 DC — 2 HP 230 AC.

Note 1: See figure PT13, page 7. Note 2: See figure PT15, page 7.

ARROW-HART INC. / SPECIALTY SWITCH PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

Arrow Hart POWER TOGGLE SWITCHES 10 AMP TO 60 AMP

638 SERIES POSITIVE CENTER OFF

HEAVY DUTY/2 HP/30 AMP

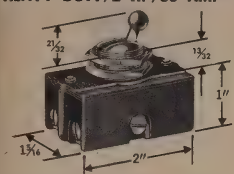


Fig. PT13.
DPDT ¾″ dia. sleeve. Shown 80638D.

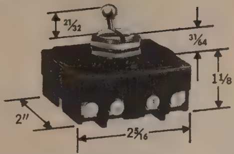


Fig. PT14.
Represents 3 and 4 pole base.
Shown 80985.

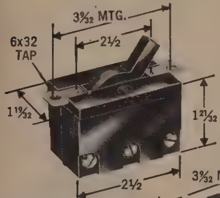


Fig. PT15.
DPDT Square lever.
Shown 80634.

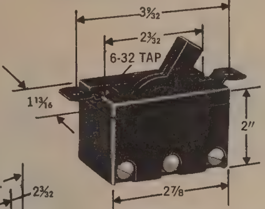


Fig. PT16.
DPDT Flush mounting.
Shown 80988.

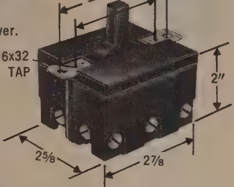


Fig. PT17.
Represents 3 and 4
pole base. Shown 80899.

The 3-position, positive center-off feature assures that the lever cannot be moved from one side through the center position without stopping. This unique feature makes these switches ideal for motor reversing applications. Sleeve and flush mounting available. Can be provided without center stop. Consult factory.

EXTRA HEAVY DUTY

FOR RATINGS, SEE INDIVIDUAL MODEL

Individual switch designs for special application where high current (60A), high voltage (600 V), and 2 HP (up to 250 V) switching is required. See next page for 9 more switches.

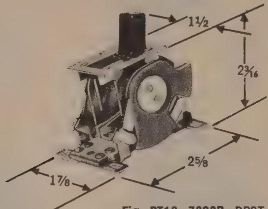


Fig. PT18. 7828B, DPST 60 Amp.

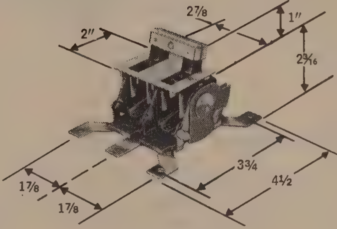


Fig. PT19. 7830, 3PST 60 Amp.

* ½ dia. sleeve.
Note 3: See figure PT6, page 6. Note 4: See figures PT9, PT10, page 6.

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Lever Description	Lever Figure See Page 23	Slotted Sleeve Length, inches 15/32″ dia.	Termination See Illust.	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. PT-
800	DPST	off-on	16 A 1 HP	8 A 1 HP	Molded Bat	Note 3	15/32	Screw	83800D	04	Ind	6
	DPST	off-on	16 A 1 HP	8 A 1 HP	Molded Bat		15/32	Screw	83800	06	Blk	
	DPST	off-on	16 A 1 HP	8 A 1 HP	Molded Bat		15/32	Press Fit	83806	06	Blk	
602	SPST	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	80601BD	04	Ind	12
	SPDT	off-on	15 A ¾ HP	10 A ¾ HP	Bat	B	15/32	Screw	80609CA	04	Ind	
	DPST	off-on	20 A 1½ HP	10 A 1½ HP	Ball	A	11/32	Screw	80602	04	Ind	
	DPST	off-on	20 A 1½ HP	10 A 1½ HP	Ball	A	15/32	Screw	80602C	04	Ind	
	DPST	off-on	20 A 1½ HP	10 A 1½ HP	Bat	B	15/32	Screw	80602CA	04	Ind	
421	DPST	off-on	1½ HP	20 A 2 HP	Ball	Note 4	11/32*	Screw	80421	04	Ind	9
	DPST	off-on			Bat		15/32	Screw	80421U	04	Ind	
			250 V	600 V								
Extra Heavy Duty Description on pgs. 7 & 8	DPST	off-on	30	N/A	Square	See Model Illustrations	Not sleeve mounted	Screw	100006	04	Blk	See Model Illustrations
	DPST	off-on	30	N/A	Special			Screw	100011ZW	06	Blk	
	DPST	off-on	30	20	Square			Screw	80093	04	Blk	
	DPST	off-on	30	N/A	Square			Screw	82044A	06	Blk	
	SPST	off-on	30	N/A	Square			Screw	8684U	04	Blk	
	DPST	off-on	30	N/A	Square			Screw	8686U	04	Blk	
	3PST	off-on	30	20	Square			Screw	80404	04	Blk	
	DPST	off-on	60	25	Square			Screw	7828B	04	Blk	
	3PST	off-on	60	N/A	Square			Screw	7830	05	Blk	
	DPST	off-on	60 A 2 HP	N/A	Square			Screw	80770K	04	Blk	
	3PST	off-on	60 A 2 HP	N/A	Square			Screw	80771	06	Blk	

Arrow Hart

POWER TOGGLE SWITCHES/10 AMP TO 60 AMP MILITARY TOGGLE SWITCHES

EXTRA HEAVY DUTY (Cont'd)

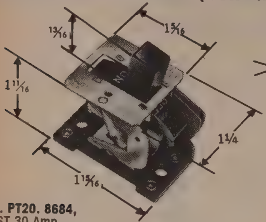

13⁄16
15⁄16
11⁄16
11⁄4
11⁵⁄16

Fig. PT20. 8684, SPST 30 Amp.

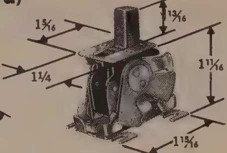

15⁄16
13⁄16
11⁄4
11¹⁄16
11⁵⁄16

Fig. PT21. 8686U, DPST 30 Amp.

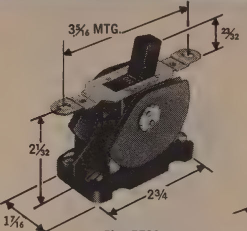

35⁄16 MTG.
23⁄32
21⁄32
23⁄4
17⁄16

Fig. PT22. 80093, DPST 30 Amp

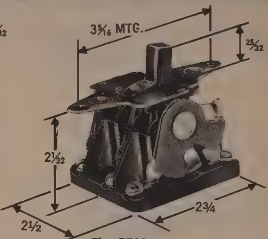

35⁄16 MTG.
25⁄32
21⁄32
21⁄2
23⁄4

Fig. PT23. 80404, 3PST 30 Amp.

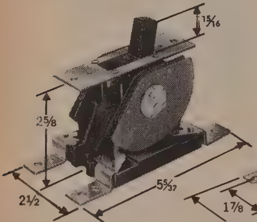

15⁄16
25⁄8
21⁄2
55⁄32

Fig. PT24. 80770K, DPST 60 Amp, 2 HP.

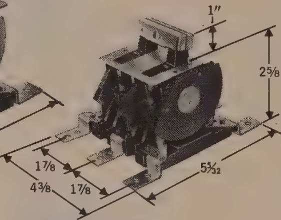

1"
25⁄8
17⁄8
43⁄8
17⁄8
55⁄32

Fig. PT25. 80771, 3PST 60 Amp, 2 HP.

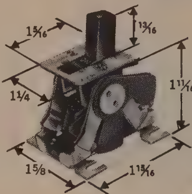

15⁄16
13⁄16
11⁄4
11¹⁄16
15⁄8
11⁵⁄16

Fig. PT26. 82044A, DPST 40 Amp.

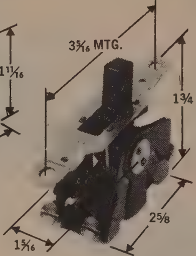

35⁄16 MTG.
13⁄4
25⁄8
15⁄16

Fig. PT27. 100006, DPST 30 Amp.

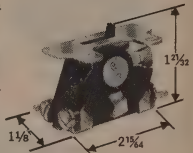
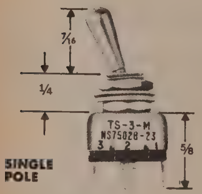

12¹⁄32
11⁄8
21⁵⁄64

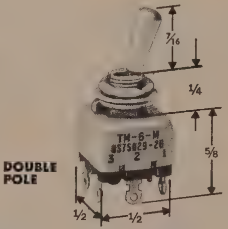
Fig. PT28. 100011ZW, DPST Special lever, 30 Amp.

MILITARY TOGGLE SWITCHES

These toggle switches are manufactured in accordance with MIL spec MIL-S-3950 and MIL-S-83731. Switches supplied with two hex nuts, one locating ring and one shakeproof lockwasher.

MS75028/MS75029

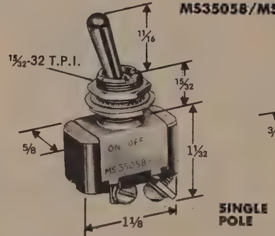

7⁄16
1⁄4
TS-3-M
MS75028-23
3 2 1
5⁄8
SINGLE POLE

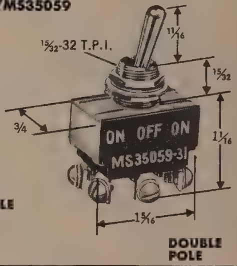

7⁄16
1⁄4
TM-6-M
MS75029-26
3 2 1
5⁄8
1⁄2
1⁄2
DOUBLE POLE

Discount Schedule 12

Circuit	Single Pole Cat. No.	Single Pole MS Part No.	Double Pole Cat. No.	Double Pole MS Part No.
on-none-on	TS1M	MS-75028-22	TS2M	MS-75029-22
on-off-on	TC3M	MS-75028-21	TC6M	MS-75029-21
mom on-off-maint. on	TE3M	MS-75028-31	TE6M	MS-75029-31
mom on-off-mom on	TG3M	MS-75028-27	TG6M	MS-75029-27
mom on-none-on	TM3M	MS-75028-26	TM6M	MS-75029-26
on-none-on	TS3M	MS-75028-23	TS6M	MS-75029-23

MS35058/MS35059


15⁄32-32 T.P.I.
11⁄16
15⁄32
5⁄8
ON OFF
MS 35058-
11⁄32
11⁄8
SINGLE POLE


15⁄32-32 T.P.I.
11⁄16
15⁄32
3⁄4
ON OFF ON
MS35059-31
11⁄16
15⁄16
DOUBLE POLE

Discount Schedule 04

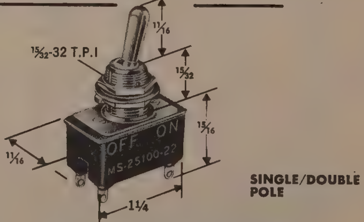
Circuit	Single Pole Cat. No.	Single Pole MS Part No.	Double Pole Cat. No.	Double Pole MS Part No.
on-off-on	35058EM	MS-35058-21	35059EM	MS-35059-21
on-none-off	35058WM	MS-35058-22	35059WM	MS-35059-22
on-none-on	35058DM	MS-35058-23	35059DM	MS-35059-23
on-off-none	35058AM	MS-35058-24	35059AM	MS-35059-24
on-mom off-none	35058CM	MS-35058-25	35059CM	MS-35059-25
on-none-mom on	35058FM	MS-35058-26	35059FM	MS-35059-26
mom on-off-mom on	35058GM	MS-35058-27	35059GM	MS-35059-27
none-off-mom on	35058BM	MS-35058-28	35059BM	MS-35059-28
on-none-mom off	35058XM	MS-35058-29	35059XM	MS-35059-29
off-none-mom on	35058YM	MS-35058-30	35059YM	MS-35059-30
on-off-mom on	35058HM	MS-35058-31	35059HM	MS-35059-31

Screw terminals are assembled

MS25098/MS25100

Discount Schedule 04

Circuit	Single Pole Cat. No.	Single Pole MS Part No.	Double Pole Cat. No.	Double Pole MS Part No.
on-none-off	25098AM	MS-25098-22	25100AM	MS-25100-22
on-none-mom off	25098BM	MS-25098-29	25100BM	MS-25100-29
off-none-mom-on	25098CM	MS-25098-30	25100CM	MS-25100-30
on-none-on	25098DM	MS-25098-23	25100DM	MS-25100-23


15⁄32-32 T.P.I
11⁄16
15⁄32
15⁄16
11⁄16
OFF ON
MS-25100-22
11⁄4
SINGLE/DOUBLE POLE

Arrow Hart

SUBMINIATURE SWITCHES/TOGGLE AND PUSHBUTTON

The subminiature switches presented in the next 3 pages give the designer extreme flexibility in selection of performance, actuator styles (lever or push), terminations, and circuits. Two families are available: the Quality Grade for high reliability applications and the Utility Grade for less critical use.

"QUALITY GRADE" SMT/SMP SERIES

These quality grade subminiature toggle and momentary pushbutton switches are ideally suited for applications requiring the highest standards of quality and uniformity. The gold plated contacts permit dependable use in low level circuits especially where long shelf life is critical.

GENERAL SPECIFICATIONS

Exposed metal parts: Gold anodized aluminum

Dielectric breakdown: Exceeds 1000 V rms

Contact material: Gold-plated silver buttons

Movable contact arm: Rhodium-plated silver

Terminals: Gold finish

Standard hardware (omitted on switches with PC terminations): 2 gold-anodized hexnuts, 1 lockwasher, 2 locating rings, unassembled

Packaging: **Ind.** Each switch with hardware individually packaged (see page 24).

Base: Molded diallyl phthalate

Contact mechanism (see illustrations) **TS type** — knee action. **TC, TE, TG, TM type** — Rocker action. **PM type** — Leaf blade with wiping action. **PMQ type** — Snap acting butt type.

Terminations: Standard solder lugs are available. Also three types of P.C. Terminations — Gold plated brass sword shaped terminals which can be connected directly to printed circuit boards — as follows:

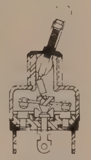
Right Angle — Permits mounting switch with lever operation parallel to circuit board, terminals perpendicular to lever.

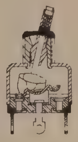
Straight — Permits mounting switch with lever perpendicular to circuit board, terminals parallel to lever.

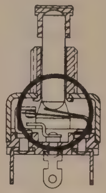
End Connected — Permits mounting switch with lever operation at right angles to circuit board, terminals perpendicular to lever.

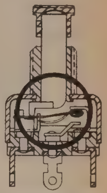
CONTACT MECHANISMS

The Knee-Action Contact Mechanism found on Type TS switches offer advantages not found on other two position subminiature switches. These advantages are more positive snap, less creep, definite positioning, longer life, and lighter operating force.

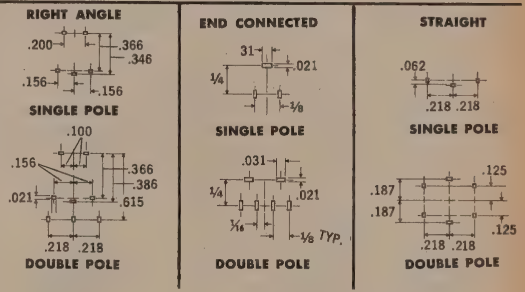

KNEE ACTION


ROCKER ACTION


LEAF BLADE WITH WIPING ACTION


SNAP-ACTING BUTT TYPE

PC TERMINAL SPACINGS


RIGHT ANGLE
.200
.366
.346
.156
.156
SINGLE POLE
.100
.156
.366
.386
.021
.615
.218 .218
DOUBLE POLE
END CONNECTED
31
.021
¼
⅛
SINGLE POLE
.031
¼
.021
1/16
⅛ TYP.
DOUBLE POLE
STRAIGHT
.062
.218 .218
SINGLE POLE
.125
.187
.187
.125
.218 .218
DOUBLE POLE

TYPICAL MODELS

(Specs on pages 10 and 11)

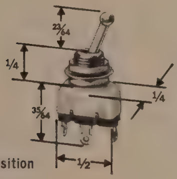

23/64
¼
35/64
¼
½

Fig. SS1.
SPST 2-position Ball lever.
Shown TS3.

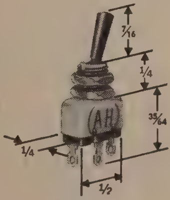

7/16
¼
(AH)
35/64
¼
½

Fig. SS2.
SPDT with Bat lever adapter assembled.

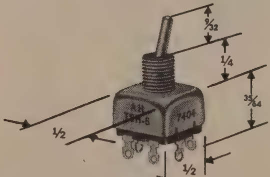

5/32
¼
AH TSH-6
7404
35/64
½
½

Fig. SS3.
DPDT lever to accept colored bat lever adapter.
Shown TSH6.

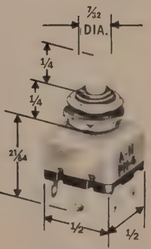

7/32 DIA.
¼
¼
21/64
A-H PM-6
½
½

Fig. SS4.
DPDT Solder lug pushbutton.
Shown PM6.

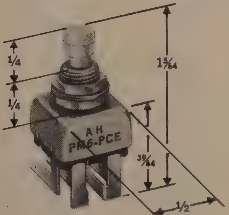

¼
¼
1 5/64
AH PM6-PCE
35/64
½

Fig. SS5.
DPDT End connected PC terminal.
Shown PM6PCE.

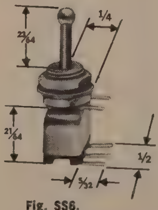

¼
23/64
21/64
½
5/32

Fig. SS6.
SPDT Right angle PC terminal.
Shown TS3PC.

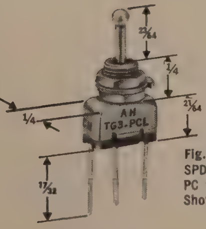

23/64
¼
AH TG3-PCL
21/64
¼
17/32

Fig. SS7.
SPDT Straight PC terminals.
Shown TG3PCL.

Arrow Hart SUBMINIATURE SWITCHES/TOGGLE AND PUSHBUTTON

QUALITY GRADE CONT'D

OPTIONS (SEE PAGE 23 AND PAGE 24 FOR ORDERING INFORMATION)

Colored levers: Adapter available for straight lever configuration
Colored caps: .215 and .375″ dia. color caps available
Dress nuts: Knurled or tapered
Rubber boots: Partial enclosing, total enclosing

OPTIONS (CONSULT FACTORY)

Optional levers (Fig. SS11A, Fig. SS11B)
Sleeve length: ⅜″ on TS type (knee action)
5⁄16″ available on all

Available Terminations

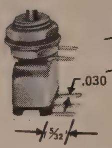


Fig. SS12. Printed circuit. Right angle.

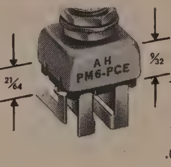


Fig. SS13. Printed circuit. End connected.

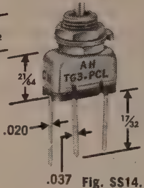


Fig. SS14. Printed Circuit. Straight

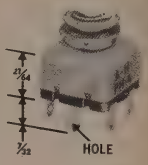


Fig. SS15. Solder lug.

Available Actuators

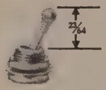


Fig. SS8. Ball lever.

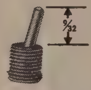


Fig. SS9A. Straight lever.

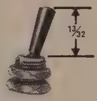


Fig. SS10. Straight lever with color adapter.

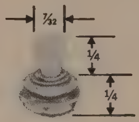


Fig. SS11. Pushbutton (.215″ dia.).

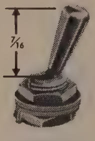


Fig. SS11A. Regular bat style. Consult factory.

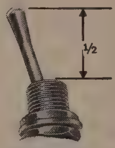


Fig. SS11B. Long bat style. Consult factory.

Series	Circuit	Action	Rating AC/DC		Lever		Slotted Sleeve Length, inches ¼″ Dia.	Termination	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. SS-
			125 VAC Amp	29 VDC Amp	Desc.	Fig. SS-						
SMT	SPDT	on-on	5	5	Straight	9A	¼	Solder	TSH3	12	Ind	1
		on-on	5	5	Ball	8	¼	Solder	TS3	12	Ind	
		on-on	5	5	Ball	8	¼	RA	TS3PC	13	Ind	
		on-on	5	5	Ball	8	¼	Straight	TS3PCL	13	Ind	
		on-on	5	5	Ball	8	¼	End	TS3PCE	13	Ind	
	SPDT	on-off-on	5	5	Straight	9A	¼	Solder	TCH3	12	Ind	1
		on-off-on	5	5	Ball	8	¼	Solder	TC3	12	Ind	
		on-off-on	5	5	Ball	8	¼	RA	TC3PC	13	Ind	
		on-off-on	5	5	Ball	8	¼	Straight	TC3PCL	13	Ind	
		on-off-on	5	5	Ball	8	¼	End	TC3PCE	13	Ind	
	SPDT	mom on-off-maint. on	5	5	Straight	9A	¼	Solder	TEH3	12	Ind	1
		mom on-off-maint. on	5	5	Ball	8	¼	Solder	TE3	12	Ind	
		mom on-off-maint. on	5	5	Ball	8	¼	RA	TE3PC	13	Ind	
		mom on-off-maint. on	5	5	Ball	8	¼	Straight	TE3PCL	13	Ind	
		mom on-off-maint. on	5	5	Ball	8	¼	End	TE3PCE	13	Ind	
	SPDT	mom on-off-mom on	5	5	Straight	9A	¼	Solder	TGH3	12	Ind	1
		mom on-off-mom on	5	5	Ball	8	¼	Solder	TG3	12	Ind	
		mom on-off-mom on	5	5	Ball	8	¼	RA	TG3PC	13	Ind	
		mom on-off-mom on	5	5	Ball	8	¼	Straight	TG3PCL	13	Ind	
		mom on-off-mom on	5	5	Ball	8	¼	End	TG3PCE	13	Ind	
	SPDT	mom on-maint. on	5	5	Straight	9A	¼	Solder	TMH3	12	Ind	1
		mom on-maint. on	5	5	Ball	8	¼	Solder	TM3	12	Ind	
		mom on-maint. on	5	5	Ball	8	¼	RA	TM3PC	13	Ind	
		mom on-maint. on	5	5	Ball	8	¼	Straight	TM3PCL	13	Ind	
		mom on-maint. on	5	5	Ball	8	¼	End	TM3PCE	13	Ind	
	DPST	off-on	5	5	Straight	9A	¼	Solder	TSH2	12	Ind	3
		off-on	5	5	Ball	8	¼	Solder	TS2	12	Ind	
		off-on	5	5	Ball	8	¼	RA	TS2PC	13	Ind	
		off-on	5	5	Ball	8	¼	Straight	TS2PCL	13	Ind	
		off-on	5	5	Ball	8	¼	End	TS2PCE	13	Ind	
	DPDT	on-on	5	5	Straight	9A	¼	Solder	TSH6	12	Ind	3
		on-on	5	5	Ball	8	¼	Solder	TS6	12	Ind	
		on-on	5	5	Ball	8	¼	RA	TS6PC	13	Ind	
		on-on	5	5	Ball	8	¼	Straight	TS6PCL	13	Ind	
		on-on	5	5	Ball	8	¼	End	TS6PCE	13	Ind	
	DPDT	on-off-on	5	5	Straight	9A	¼	Solder	TCH6	12	Ind	3
		on-off-on	5	5	Ball	8	¼	Solder	TC6	12	Ind	
		on-off-on	5	5	Ball	8	¼	RA	TC6PC	13	Ind	
		on-off-on	5	5	Ball	8	¼	Straight	TC6PCL	13	Ind	
		on-off-on	5	5	Ball	8	¼	End	TC6PCE	13	Ind	
	DPDT	mom on-off-maint. on	5	5	Straight	9A	¼	Solder	TEH6	12	Ind	3
		mom on-off-maint. on	5	5	Ball	8	¼	Solder	TE6	12	Ind	
		mom on-off-maint. on	5	5	Ball	8	¼	RA	TE6PC	13	Ind	
		mom on-off-maint. on	5	5	Ball	8	¼	Straight	TE6PCL	13	Ind	
Cont'd on pg. 11		mom on-off-maint. on	5	5	Ball	8	¼	End	TE6PCE	13	Ind	

Arrow Hart

SUBMINIATURE SWITCHES, TOGGLE AND PUSHBUTTON

Series	Circuit	Action	Rating AC/DC 125 VAC Amp	29 VDC Amp	Lever Desc.	Fig. SS-	Slotted Sleeve Length, inches ¼″ Dia.	Termination	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. SS-
SMT Cont'd from pg. 10	DPDT	mom on-off-mom on	5	5	Straight	9A	¼	Solder	TGH6	12	Ind	3
		mom on-off-mom on	5	5	Ball	8	¼	Solder	TG6	12	Ind	
		mom on-off-mom on	5	5	Ball	8	¼	RA	TG6PC	13	Ind	
		mom on-off-mom on	5	5	Ball	8	¼	Straight	TG6PCL	13	Ind	
		mom on-off-mom on	5	5	Ball	8	¼	End	TG6PCE	13	Ind	
	DPDT	mom on-maint. on	5	5	Straight	9A	¼	Solder	TMH6	12	Ind	3
		mom on-maint. on	5	5	Ball	8	¼	Solder	TM6	12	Ind	
		mom on-maint. on	5	5	Ball	8	¼	RA	TM6PC	13	Ind	
		mom on-maint. on	5	5	Ball	8	¼	Straight	TM6PCL	13	Ind	
		mom on-maint. on	5	5	Ball	8	¼	End	TM6PCE	13	Ind	
PUSH SWITCHES			**115 VAC**	**29 VDC**	**Button Style**							
SMP Push	SPDT	on-mom on	1	2	Standard	11	¼	Solder	PM3	12	Ind	1
		on-mom on	1	2	Standard	11	¼	RA	PM3PC	13	Ind	
		on-mom on	1	2	Standard	11	¼	Straight	PM3PCL	13	Ind	
		on-mom on	1	2	Standard	11	¼	End	PM3PCE	13	Ind	
	DPDT	on-mom on	1	2	Standard	11	¼	Solder	PM6	12	Ind	4
		on-mom on	1	2	Standard	11	¼	RA	PM6PC	13	Ind	
		on-mom on	1	2	Standard	11	¼	Straight	PM6PCL	13	Ind	
		on-mom on	1	2	Standard	11	¼	End	PM6PCE	13	Ind	
	3PST	off-mon on	1	2	Standard	11	¼	Solder	PM7	12	Ind	4
		on-mom off	1	2	Standard	11	¼	Solder	PM8	12	Ind	
			125 VAC	**250 VAC 29 VDC**								
	SPDT	on-mom on	7	5	Standard	11	¼	Solder	PMQ3	12	Ind	1
		on-mom on	7	5	Standard	11	¼	RA	PMQ3PC	13	Ind	
		on-mom on	7	5	Standard	11	¼	Straight	PMQ3PCL	13	Ind	
		on-mom on	7	5	Standard	11	¼	End	PMQ3PCE	13	Ind	

UTILITY GRADE

TOGGLE SWITCHES ONLY

Now UL Listed AC Only

ISMT SERIES

These general purpose subminiature utility switches are suited for applications where low cost dependability is important. Because switches meet Continental European Standards (International Electrotechnical Commission) they are ideal for use in products destined for sale in Canada and Europe. These switches are Underwriters listed.

GENERAL SPECIFICATIONS

Exposed metal parts: Chrome-plated steel frame and lockwasher. Chrome-plated brass bushing, nuts, and lever
Dielectric breakdown: 2,000 V rms
Contact material: Silver
Movable arm: Silver
Terminals: Silver
Base: Phenolic
Standard hardware: 2 hexnuts, 1 locating ring, unassembled
Packaging: Ind. Each switch separately
Contact mechanism: Rocker (same as "Quality Grade" see page 9)
Weight: SP is 4 grms. DP is 8 grms.

OPTIONS (SEE PAGES 23 AND 24 FOR ORDERING INFORMATION)

Colored levers: Adapter available for straight lever configuration
Dress nuts: Knurled or tapered
Rubber Boots: Partial enclosing and total enclosing

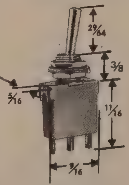


Fig. SS16. SPDT Bat lever. Shown CTS3.

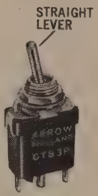


Fig. SS17. SPDT Straight lever for color adapter. Shown CTS3P.

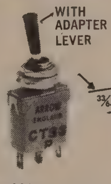


Fig. SS18. SPDT Equipped with color adapter.

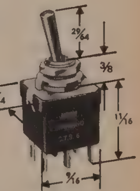


Fig. SS19. DPDT 2-position Bat lever. Shown CTS6.

Series	Circuit	Action	29 VDC		Lever Desc.	Slotted Sleeve Length, inches ¼″ Dia.	Termination	Catalog Number	Discount Schedule	Std. Packaging	Body Dimensions Fig. SS-
			125 VAC Amp	250 VAC Amp							
ISMT	SPDT	on-on	5	2	Bat	⅜	Solder	CTS3	12	Ind	16
		on-on	5	2	Straight	⅜	Solder	CTS3P	12	Ind	
		on-mom on	5	2	Bat	¼	Solder	CTM3	12	Ind	
		on-mom on	5	2	Straight	¼	Solder	CTM3P	12	Ind	
		on-off-on	5	2	Bat	⅜	Solder	CTC3	12	Ind	
		on-off-on	5	2	Straight	⅜	Solder	CTC3P	12	Ind	
		on-off-mom on	5	2	Bat	¼	Solder	CTE3	12	Ind	
		on-off-mom on	5	2	Straight	¼	Solder	CTE3P	12	Ind	
		mom on-off-mom on	5	2	Bat	¼	Solder	CTG3	12	Ind	
		mom on-off-mom on	5	2	Straight	¼	Solder	CTG3P	12	Ind	
	DPDT	on-on	5	2	Bat	⅜	Solder	CTS6	12	Ind	19
		on-on	5	2	Straight	⅜	Solder	CTS6P	12	Ind	
		on-mom on	5	2	Bat	¼	Solder	CTM6	12	Ind	
		on-mom on	5	2	Straight	¼	Solder	CTM6P	12	Ind	
		on-off-on	5	2	Bat	⅜	Solder	CTC6	12	Ind	
		on-off-on	5	2	Straight	⅜	Solder	CTC6P	12	Ind	
		on-off-mom on	5	2	Bat	¼	Solder	CTE6	12	Ind	
		on-off-mom on	5	2	Straight	¼	Solder	CTE6P	12	Ind	
		mom on-off-mom on	5	2	Bat	¼	Solder	CTG6	12	Ind	
		mom on-off-mom on	5	2	Straight	¼	Solder	CTG6P	12	Ind	

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PUSHBUTTON SWITCHES/GENERAL PURPOSE/POWER

The pushbutton switches portrayed in the next 2 pages are suitable for a wide range of switching — all the way from AC only through AC/DC, for power and low level applications. Termination options such as wire lead, quick connect, solder lug and screw are available with some series. Colored snap-on buttons available (see accessory page 23).

GENERAL SPECIFICATIONS

Exposed metal parts: Bright nickel (except 511 Series)
Aluminum (511 Series only)
Dielectric Breakdown: Exceeds 1000 V rms
Contact material: Bronze silver plated
Terminal material: Bronze silver plated
Standard hardware: 1 hex nut, 1 knurled nut, unassembled
Packaging: **Ind.** Each switch and hardware individually packaged (see page 24). **Blk.** Quantity packaged for large volume users (see page 24).

CANOPY SERIES **LOW OPERATING PRESSURE**

AC ONLY/1 AMP

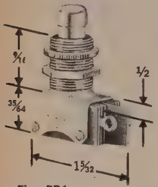

Fig. PB1.
SPST Standard button.
Shown 3391.

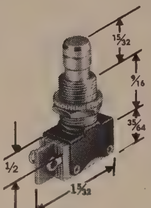

Fig. PB2.
Grooved button.
Takes snap on colored button.
Shown 3391GLB.

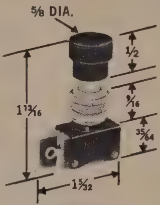

Fig. PB3.
SPST with snap-on button.
Shown 3391GJ.

These AC only butt type contact switches feature low operating pressure. Rated (UL) at 1 Amp 125 VAC they can be obtained with a variety of snap-on buttons.

OPTIONS (CONSULT FACTORY)

Special button colors
Wire lead termination
Screw terminals

OPTIONS (SEE PAGE 23 FOR ORDERING INFORMATION)

Snap-on caps: ⅝″ dia. and 1″ dia.

511 SERIES **LOW OPERATING PRESSURE**

AC ONLY/3 AMP

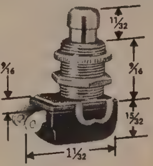

Fig. PB4.
SPST Standard metal button.
Shown 80511.

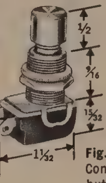

Fig. PB5.
Concave metal button.
Shown 80511CE.

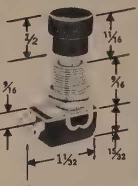

Fig. PB6.
Black snap-on button.
Shown 80541E.

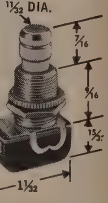

Fig. PB7.
Grooved button.
For snap-on button.
Shown 80541L.

Similar to the Canopy series these AC only butt type contact switches have a molded bakelite base. Rated (UL) at 3 amp 125 VAC they come with a variety of snap-on buttons and terminations. Concave button is brass with bright nickel finish.

OPTIONS (CONSULT FACTORY)

Screw terminals
Special button colors
Wire lead terminations
Quick connect terminals

OPTIONS (SEE PAGE 23 FOR ORDERING INFORMATION)

Snap-on caps: ⅝″ dia. and 1″ dia.

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Button Style Description	Button Style Fig. PB-	Slotted Sleeve Length, in. 15/32″ dia.	Termination	Catalog Number	Discount Schedule	Std. Packaging	Body Dimensions Fig. PB-
			AC Only									
Canopy	SPST	on-mom off	1	N/A	Standard	1	9/16	Solder	3391	04	Ind	1
		on-mom off	1	N/A	Black	3	9/16	Solder	3391GJ	04	Ind	
		on-mom off	1	N/A	Red	3	9/16	Solder	3391GJR	04	Ind	
	SPST	off-mom on	1	N/A	Standard	1	9/16	Solder	3391E	04	Ind	1
		off-mom on	1	N/A	Black	3	9/16	Solder	3391GL	04	Ind	
		off-mom on	1	N/A	Red	3	9/16	Solder	3391GLR	04	Ind	
		off-mom on	1	N/A	Grooved*	2	9/16	Solder	3391GLB	04	Ind	
	Z Circuit	1 N.O.-1 N.C.	1	N/A	Standard	1	9/16	Solder	3392	04	Ind	
		1 N.O.-1 N.C.	1	N/A	Black	3	9/16	Solder	3392AE	04	Ind	
		1 N.O.-1 N.C.	1	N/A	Red	3	9/16	Solder	3392AER	04	Ind	
		1 N.O.-1 N.C.	1	N/A	Grooved*	2	9/16	Solder	3392AEB	04	Ind	
511	SPST	on-mom off	3	1	Standard	4	9/16	Solder	80511	04	Ind	4
		on-mom off	3	1	Black	6	9/16	Solder	80541	04	Ind	
		on-mom off	3	1	Red	6	9/16	Solder	80541R	04	Ind	
		on-mom off	3	1	Grooved*	7	9/16	Solder	80541L	04	Ind	
		on-mom off	3	1	Concave	5	9/16	Solder	80511C	04	Ind	
	SPST	off-mom on	3	1	Standard	4	9/16	Solder	80511E	04	Ind	4
		off-mom on	3	1	Black	6	9/16	Solder	80541E	04	Ind	
		off-mom on	3	1	Red	6	9/16	Solder	80541ER	04	Ind	
		off-mom on	3	1	Grooved*	7	9/16	Solder	80541EL	04	Ind	
		off-mom on	3	1	Concave	5	9/16	Solder	80511CE	04	Ind	
		off-mom on	†	†	Standard	4	9/16	Solder	80584A	06	Blk	
			AC/DC	AC/DC								
094	SPST	off-mom on	3	1	Standard	8	15/32	Solder	83090	04	Ind	8
Cont'd on pg. 13		off-mom on	3	1	Standard	8	15/32	QC	83090P	06	Blk	

* A snap-on plastic button (see page 23) should be ordered for "grooved" models
† 1 A at 277 VAC

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PUSHBUTTON SWITCHES/GENERAL PURPOSE/POWER

094 SERIES

SPACE SAVING/LOW LEVEL

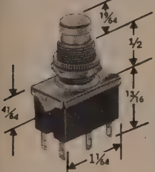


Fig. PB8.
DPDT Standard metal button.
Shown 83094P.

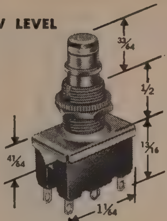


Fig. PB9.
Grooved. For snap-on button.
Shown 83094C.

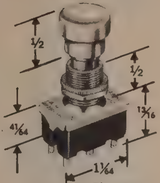


Fig. PB10.
Black snap-on button.
Shown 83094CR.

This space saving switch with quick make quick break wiping contacts is ideal for low level AC/DC switching. Standard models have silver plated bronze contacts. Gold plated and silver alloy are optional.

OPTIONS (CONSULT FACTORY)

Gold plating on current carrying parts
Silver alloy on current carrying parts
Special button colors

OPTIONS (SEE PAGE 23 FOR ORDERING INFORMATION)

Snap-on caps: ⅝″ dia. and 1″ dia.

630 SERIES

MEDIUM DUTY/
1 HORSEPOWER/16 AMP

938 SERIES

HEAVY DUTY/
1½ HORSEPOWER/20 AMPS

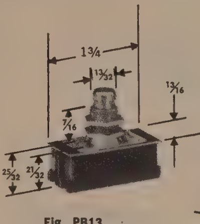


Fig. PB13.
SPST Standard metal button.
Shown 80631.

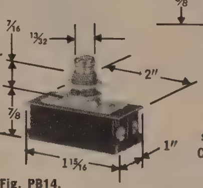


Fig. PB14.
DPST Standard metal button. Shown 80938.

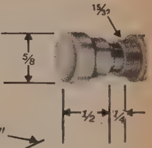


Fig. PB15.
Optional snap-on button.
Consult factory.

These medium and heavy duty switches available with several pushbuttons and screw or wire termination options are good general purpose controls. Wiping action.

OPTIONS (CONSULT FACTORY)

Snap-on buttons
Special overtravel buttons
Wire lead termination
Two circuits and SPDT models

CLASSIC 087 SERIES

STANDARD OF THE INDUSTRY

LOW LEVEL TO 6 AMP

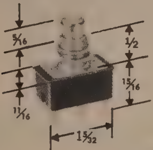


Fig. PB11.
DPDT Standard metal button.
Shown 81087J.

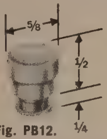


Fig. PB12.
Optional snap-on button.
Consult factory.

This series is the pushbutton equivalent of the 015 Series of toggle switches. Gives maximum reliability in both power and low-level circuits. A variety of options allows these switches to be tailored to the most demanding specifications. That's why these switches have been the "classic" choice for over 30 years.

OPTIONS (CONSULT FACTORY)

Screw terminals (See page 23 Fig. T2)
Wire leads (See page 23 Fig. T3)
Gold plating, current carrying parts
Overtravel button (Fig. I page 23)
Snap-on buttons
End connect solder lugs (Fig. T1)

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Button Style Description	Button Style Fig. PB-	Slotted Sleeve Length, in. 15/32″ dia.	Termination	Catalog Number	Discount Schedule	Std. Packaging	Body Dimensions Fig. PB-
094 Cont'd from pg. 12	SPST	off-mom on	3	1	Grooved*	9	15/32	Solder	83090C	04	Ind	8
		off-mom on	3	1	Grooved*	9	15/32	QC	83090PC	06	Blk	
	SPDT	on-mom on	3	1	Standard	8	15/32	Solder	83092	05	Blk	8
		on-mom on	3	1	Standard	8	15/32	QC	83092P	05	Blk	
		on-mom on	3	1	Grooved*	9	15/32	Solder	83092C	05	Blk	
		on-mom on	3	1	Grooved*	9	15/32	QC	83092PC	05	Blk	
	DPST	off-mom on	3	1	Standard	8	15/32	Solder	83093	05	Blk	8
		off-mom on	3	1	Standard	8	15/32	QC	83093P	06	Blk	
		off-mom on	3	1	Grooved*	9	15/32	Solder	83093C	04	Ind	
		off-mom on	3	1	Grooved*	9	15/32	QC	83093PC	05	Blk	
	DPDT	on-mom on	3	1	Standard	8	15/32	Solder	83094	05	Blk	8
		on-mom on	3	1	Standard	8	15/32	QC	83094P	05	Blk	
		on-mom on	3	1	Grooved*	9	15/32	Solder	83094C	04	Ind	
		on-mom on	3	1	Grooved*	9	15/32	QC	83094PC	06	Blk	
087	SPST	off-mom on	6	3	Standard	11	15/32	Solder	81075BV	04	Ind	11
	SPDT	on-mom on	6	1	Standard	11	15/32	Solder	81081G	04	Ind	
	DPST	off-mom on	6	3	Standard	11	15/32	Solder	81084G	04	Ind	
	DPDT	on-mom on	6	3	Standard	11	15/32	Solder	81087J	04	Ind	
630	SPST	off-mom on	16 1 HP	8 1 HP	Standard	13	15/32	Screw	80631	04	Ind	13
	DPST	off-mom on	16 1 HP	8 1 HP	Standard	13	15/32	Screw	80630	04	Ind	
938	DPST	off-mom on	20 1½ HP	10 1½ HP	Standard	13	15/32	Screw	80938	04	Ind	14
	DPST	off-mom on	20 1½ HP	10 1½ HP	Overthrow	‡	15/32	Screw	80938FA	06	Blk	

* A snap-on plastic button (see page 23) should be ordered for "grooved" models
‡ See page 23 Fig I

Arrow Hart

PUSHBUTTON SWITCHES/DOUBLE ACTING

CANOPY SERIES

GENERAL PURPOSE/3 AMP

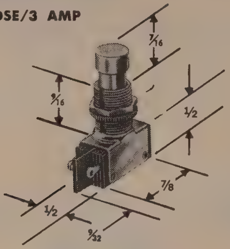


Fig. PB16.
SPDT Standard metal button.
Shown 80711.

Time proven roller mechanism. Choice of many circuits (factory options). Long life dependability. Suited for small motor applications.

OPTIONS (CONSULT FACTORY)

- Screw terminals
- Wire leads
- Snap-on buttons
- Circuitry, optional configurations
- Extra low operating pressure

117 SERIES

DPDT/6 AMPS

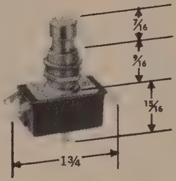


Fig. PB17.
DPDT Solder lug.
End connected.
Shown 81117.

Arrow Hart's unique double acting DPDT switch rated at 6 amps at 125 V. Cataloged is one model from a flexible family of high reliability power and low level rated switches. Many variations are possible similar to those available with the Classic 015 and 087 Series of toggle and pushbutton switches. Consult factory.

403 SERIES

SMALL APPLIANCE/6 AMP

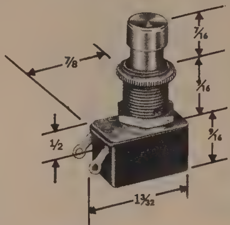


Fig. PB18.
Solder lug terminals. Shown 82403.

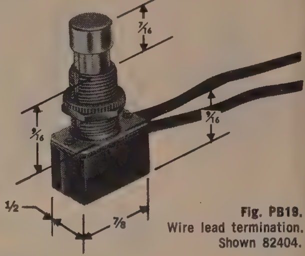


Fig. PB19.
Wire lead termination.
Shown 82404.

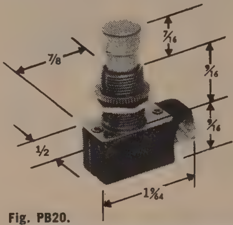


Fig. PB20.
Screw terminal. Shown 82405.

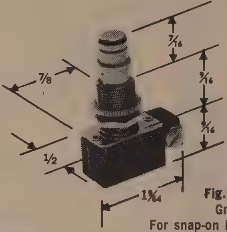


Fig. PB21.
Grooved.
For snap-on button.
Shown 82405CL.

These single pole single throw switches handle 6 amps in a small molded base. Available with screw, solder or wire terminations.

OPTIONS (CONSULT FACTORY)

- Special color buttons
- Extra low operating pressures

OPTION (SEE PAGE 23 FOR ORDERING INFORMATION)

Snap-on buttons: 5/8" dia and 1" dia.

863 SERIES

HEAVY DUTY/ 1 - 1½ HORSEPOWER/ 16 - 20 AMP

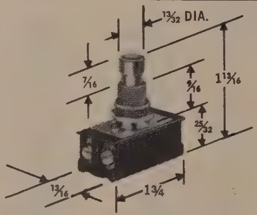


Fig. PB22.
DPST Standard metal button.
Shown 80863.

These heavy duty workhorse switches have quick make quick break wiping action. Factory options include snap-on buttons and wire lead terminations.

OPTIONS (CONSULT FACTORY)

- Snap-on buttons
- Wire lead terminations

Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Button Style Desc.	Button Style Fig. PB-	Slotted Sleeve Length, inches 15/32" Dia.	Termination	Catalog Number	Discount Schedule	Standard Pack-aging	Body Dimen-sions Fig. PB-
Canopy	SPDT	on-on	3	1	Standard	16	9/16	Solder	80711	04	Ind	16
	DPDT	on-on	3	1	Standard	16	9/16	Solder	80714	04	Ind	
403	SPST	off-on	6	3	Standard	18	9/16	Solder	82403	04	Ind	18
		off-on	6	3	Grooved*	21	9/16	Solder	82403CL	04	Ind	18
		off-on	6	3	Standard	18	9/16	6" Wire	82404	04	Ind	19
		off-on	6	3	Standard	18	9/16	Screw	82405	04	Ind	20
		off-on	6	3	Grooved*	21	9/16	Screw	82405CL	04	Ind	20
117	DPDT	on-on	6	3	Standard	17	9/16	Solder	81117	04	Ind	17
863	DPST	off-on	16 A 1 HP	8 A 1 HP	Standard	22	9/16	Screw	80863	04	Ind	22
		off-on	20 A 1½ HP	10 A 1½ HP	Standard	22	9/16	Screw	81951	04	Ind	

* A snap-on plastic button (see page 23) should be ordered for "grooved" models

Arrow Hart

ROTARY SWITCHES/2-4 POSITION

These time proven 2 position through 4 position rotary switches are suitable for a wide range of applications from low-level up to 2 HP at 240 volts. Locking versions of most models available.

GENERAL SPECIFICATIONS

Exposed metal parts: Bright nickel
Dielectric breakdown: Exceeds 1000 V rms
Standard hardware (except locking versions): 2 hex nuts, unassembled
Standard hardware (locking type): 1 hex nut, 1 dress nut, unassembled
Packaging: **Ind.** Each switch and hardware individually packaged (see page 24). **Blk.** Quantity packaged for large volume users (see page 24)
Contact materials: See individual series

CANOPY SERIES

TWO POSITION/GENERAL PURPOSE

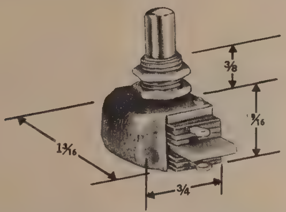


Fig. RS1.
SPST ⅜" shaft projection.
Shown 1561B.

These roto-power switches with silver-plated roller action contacts on a laminated base offer a complete selection of circuits ideal for switching small motor loads. Standard shaft lengths are ⅜", ½" and 1⅛"

OPTIONS (CONSULT FACTORY)

Screw terminals	Custom machined shafts
Wire leads	Special sleeve lengths
Special shaft lengths	

CLASSIC 715 SERIES

2 POSITION/HIGH RELIABILITY

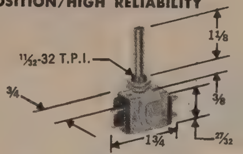


Fig. RS2.
DPDT 1⅛" shaft projection.
Shown 81727J.

This series of 2 position quick make, quick break wiping action in a small molded body. Good for low energy and power applications. Equivalent to the 015 Series of toggle switches. Contact material silver plated bronze.

OPTIONS (CONSULT FACTORY)

Screw terminals	Custom machined shafts
Wire leads	Special sleeve lengths
Special shaft lengths	

702 SERIES/AC ONLY

HEAVY DUTY/2 - 4 POSITIONS

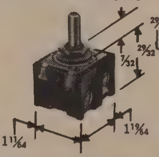


Fig. RS3.
DPST Slotted flatted shaft.
Shown 70302A.

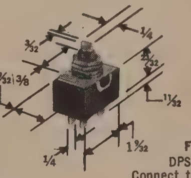


Fig. RS4.
DPST Quick Connect terminal.
Shown 82787D.

With slow make, slow break contacts these heavy duty AC switches can be obtained with 2, 3, or 4 positions. Heavy silver button contacts provide a high current switching capability in a small size body. Ratings up to 20 amps, 2 HP at 240 volts.

OPTIONS (CONSULT FACTORY)

Special circuits
Special shafts
Custom machined shafts

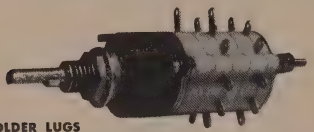
Series	Circuit	Action	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	11/32" Dia. Unslotted Sleeve Length inches	Shaft Dia. Inches	Shaft Length inches	Termination	Catalog Number	Discount Schedule	Standard Packaging	Body Dimensions Fig. RS-
Canopy	SPST	off-on	3	1	⅜	¼	⅜	Solder	1561B	04	Ind	1
		off-on	3	1	⅜	¼	1⅛	Solder	1561BS	04	Ind	1
	SPDT	on-on	3	1	⅜	¼	⅜	Solder	1565B	05	Blk	
	DPDT	on-on	3	1	⅜	¼	⅜	Solder	1575	05	Blk	
		on-on	3	1	⅜	¼	1⅛	Solder	1575AG	05	Blk	
		on-on	3	1	1	¼	½	Solder	1575VA	04	Ind	
715	SPST	off-on	6	1	⅜	¼	⅜	Solder	81715	04	Ind	2
		off-on	6	1	⅜	¼	1⅛	Solder	81715J	04	Ind	
	SPDT	on-on	6	1	⅜	¼	⅜	Solder	81721	04	Ind	
		on-on	6	1	⅜	¼	1⅛	Solder	81721J	04	Ind	
	DPDT	on-on	6	1	⅜	¼	⅜	Solder	81727	04	Ind	
		on-on	6	1	⅜	¼	1⅛	Solder	81727J	04	Ind	
			AC Only 120 V	AC Only 240 V	⅜" Unslotted Sleeve Length inches							
702	DPST	off-on	20 A 1 HP 5L	20 A 2 HP	7/32	¼	11/16	Screw	70302A	04	Ind	3
		off-on	20 A 1 HP 5L	20 A 2 HP	7/32	¼	⅛	Screw	70302AF	06	Blk	3
		on-off	20 A 1 HP 5L	20 A 2 HP	7/32	¼	1 13/32	Screw	70302AJ	06	Blk	3
		off-on	20 A 1 HP 5L	20 A 2 HP	7/32	¼	1 7/32	Screw	70302AQ	06	Blk	3
	DP Special	hi-med-lo-off	20 A 1 HP 10L	20 A 2 HP	7/32	¼	1 7/32	Screw	70303D	06	Blk	3
	DPST	off-on	20 A 1½ HP	20 A 2 HP	7/32	¼	1 7/64	Screw	70307AB	06	Blk	3
		off-on-off-on	20 A 1½ HP	20 A 2 HP	⅜	11/32	13/64	QC	82787D	06	Blk	4

Arrow Hart

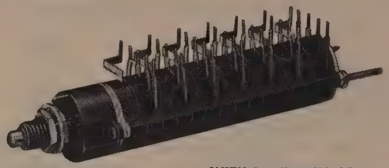
MINIATURE ROTARY SWITCHES/MULTIPOSITION

845 SERIES

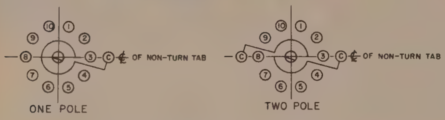
One to 12 decks/Two to 10 positions/One to 24 poles



WITH SOLDER LUGS

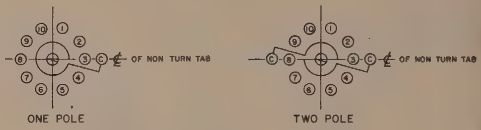


WITH PC TERMINALS


10
1
2
3
4
5
6
7
8
9
C
℄ OF NON-TURN TAB
ONE POLE
TWO POLE

Circuit Diagram, Solder Lugs

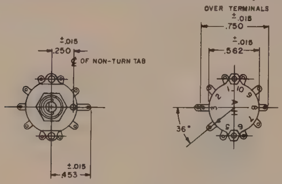
Switch viewed from shaft end and shown in position 1


℄ OF NON TURN TAB
ONE POLE
TWO POLE

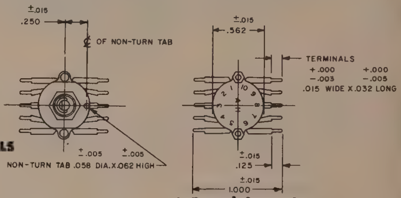
Circuit Diagram, PC Terminals

Switch viewed from shaft end and shown in position 1

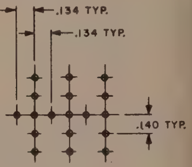
END VIEW, SOLDER LUG


OVER TERMINALS
±.018
.750
±.015
.562
±.015
.250
℄ OF NON-TURN TAB
36°
±.015
.453

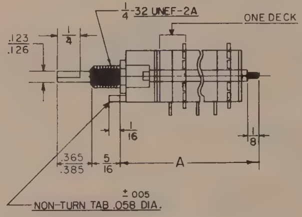
END VIEW, PC TERMINALS


±.015
.250
℄ OF NON-TURN TAB
±.015
.562
TERMINALS
+.000 −.003
+.000 −.005
.015 WIDE X .032 LONG
±.005
±.005
NON-TURN TAB .058 DIA.X.062 HIGH
±.015
.125
±.015
1.000

PC Board Layout


.134 TYP.
.134 TYP.
.140 TYP.

Overall Dimensions, PC and Solder Lug


1/4-32 UNEF-2A
ONE DECK
.123
.126
1/4
1/16
1/8
.365
.385
5/16
A
±.005
NON-TURN TAB .058 DIA.

No. of Decks	Dim. A, inches	No. of Decks	Dim. A, inches
1	.960	7	2.818
2	1.228	8	3.086
3	1.496	9	3.354
4	1.764	10	3.622
5	2.032	11	3.890
6	2.550	12	4.158

ORDERING INFORMATION

Please specify on order:

Series No. 845
No. of Decks: 1 to 12
No. of Poles per Deck: 1 or 2
No. of Positions: 2 to 10
Type of Contacts: Shorting or Non-Shorting
Terminals: Solder Lug or P.C. Mounting

SPECIFICATIONS

- OPERATION MEANS: 1/8" Dia. flat shaft or Screw Driver Slot
- MOUNTING METHOD: Sleeve 5/16" Long; 1/4-32-NS-2A thread. Ebony Black Finish
- MOUNTING HARDWARE: 2 Mounting Hexagon Nuts 1/16" thick by 5/16" across flats. 1 Lock Washer with internal teeth
- SWITCH SLEEVE AND INDEX HOUSING: Zinc Die Casting. Ebony Black Finish

CONSTRUCTION

- SWITCH BODY: Molded Melamine Thermosetting Plastic per MIL-M-14, Type CMG
- CONTACTS: Wiping Type, Coin Silver with Gold Plating
- CONSTRUCTION: 1 to 12 Decks, 1 or 2 Poles Per Deck, 2 to 10 Positions Per Pole (10 Position Switches furnished with continuous rotation unless otherwise specified), 36° angle of throw. Fully enclosed
- WEIGHT: 14 to 42 Grams depending on number of decks

CHARACTERISTICS

- RATED: To make and break the following loads:
  1/4 Amp. at 115 VAC resistive
  1/4 Amp. at 6-28 VDC resistive
  20 Ma. 115 VDC resistive
  50 Ma. 115 VAC inductive
  Carries 4 Amps. continuous
- CONTACT RESISTANCE: .01 OHMS initial. After 25,000 cycles of operation .020 OHMS, maximum. Typical values are in the range of .010 OHMS
- INSULATION RESISTANCE: Exceeds 200 MEG OHMS at 1000 VDC, 70°F
- DIELECTRIC-STRENGTH: 1000 VAC (500 VAC or better after standard commercial environmental tests)
- LIFE EXPECTANCY: 50,000 operations minimum
- STOP STRENGTH: 15 pounds, minimum
- ROTATIONAL TORQUE: 8-48 ounce-inches, depending on the number of poles per deck and number of decks
- TEMPERATURE RANGE: −85°C to +85°C

ARROW-HART INC. / SPECIALTY SWITCH PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

Arrow Hart

ROTARY SWITCHES/LOCKING

These locking rotary switches are identical in construction to the rotary switches shown on page 15, except they have a locking feature. Security and High Security versions are available in the 715L and 702L Series.

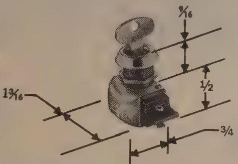
SECURITY TYPE (S LEVEL)

Provides limited protection from unauthorized operation

CANOPY SERIES AC/DC GENERAL PURPOSE

Fig. RS5.
SPST With solder lugs,
3 Amp.
Shown 1561L.

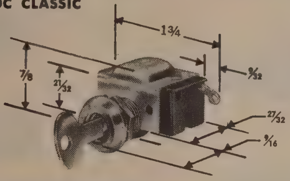
Note: All keyed alike



715L SERIES AC/DC CLASSIC

Fig. RS6.
SPST Solder lugs,
6 Amp.
Shown 81715L.

Note: All keyed alike



702L SERIES AC ONLY/HEAVY DUTY

Note: All keyed alike

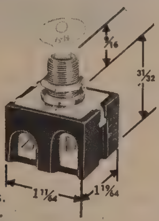


Fig. RS7.
DPST AC only
Screw terminals.
Shown 70307LA.

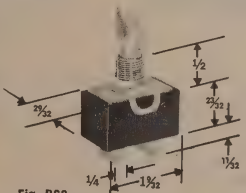


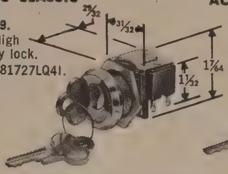
Fig. RS8.
DPST Quick connect. Shown 82787B.

HIGH SECURITY TYPE (HS LEVEL)

Switches are equipped with commercial lock assemblies provided by leading American lock companies.

715L SERIES
AC/DC CLASSIC

Fig. RS9.
DPDT High
security lock.
Shown 81727LQ41.



702L SERIES
AC ONLY/HEAVY DUTY

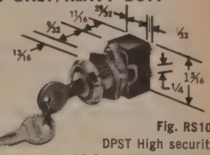


Fig. RS10.
DPST High security
20 Amp. Quick Connect.
Shown 82787LB.

Note: Special keying available, consult factory

LOCKING BRACKETS FOR TOGGLE SWITCHES

These lock brackets provide a flexible way to convert toggle switches to rotary locking switches. All styles are High Security locks. Hardware provided is 1 dress nut, 1 hex nut, 2 keys unassembled.

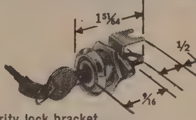


Fig. RS11.
High security lock bracket.
Shown 8947-400.

Cat. No.	Description	Keying	Discount Sched.
8947-400* 8947-410	Key removable in counterclock position	Alike Different	04 04
8947-401* 8947-411	Key removable in center position	Alike Different	04 04
8947-404* 8947-414	Key removable in clockwise position	Alike Different	04 04
8947-405* 8947-415	Key removable in either extreme position	Alike Different	04 04
8947-406* 8947-416	Key removable in counterclock position when using AC only momentary single throw switch	Alike Different	04 04
8947-407* 8947-417	Key removable in any one of three positions	Alike Different	04 04

* Replacement key is stock item. Order Catalog No. 82787-55 (See page 23, Fig. K6).

Series	Security Level	Circuit	Action	UL Listed AC/DC		Slotted Sleeve Length inches	Sleeve Dia. inches	Key Removal Positions	Key Style Fig.	Termination	Catalog Number	Discount Schedule	Standard Packaging	Body Dimension Fig. RS-
				125 V Amp	250 V Amp									
Canopy	S	SPST	off-on	3	1	9/16	15/32	Off	K2	Solder	1561L	04	Ind	5
	S	SPST	off-on	3	1	9/16	15/32	Both	K1	Solder	1561LE	04	Ind	5
	S	SPDT	on-on	3	1	9/16	15/32	Both	K1	Solder	1565L	04	Ind	
	S	DPST	off-on	3	1	9/16	15/32	Off	K2	Solder	1572L	04	Ind	
	S	DPDT	on-on	3	1	9/16	15/32	Both	K1	Solder	1575L	04	Ind	
715L	S	SPST	off-on	6	3	9/16	15/32	Off	K2	Solder	81715L	04	Ind	6
	S	SPST	off-on	6	3	9/16	15/32	Both	K1	Solder	81715LE	04	Ind	6
	HS	SPST	off-on	6	3	45/64	7/8	Off	K3	Solder	81715LQ61	04	Ind	9
	HS	SPST	off-on	6	3	45/64	7/8	Both	K3	Solder	81715LQ41	04	Ind	9
	S	SPDT	on-on	6	3	9/16	15/32	Both	K2	Solder	81721L	04	Ind	6
	HS	SPDT	on-on	6	3	45/64	7/8	CC on	K3	Solder	81721LQ61	04	Ind	9
	HS	SPDT	on-on	6	3	45/64	7/8	Both	K3	Solder	81721LQ41	04	Ind	9
	S	DPST	off-on	6	3	9/16	15/32	Off	K2	Solder	81724L	04	Ind	6
	S	DPST	off-on	6	3	9/16	15/32	Both	K1	Solder	81724LC	04	Ind	9
	HS	DPST	off-on	6	3	45/64	7/8	Off	K3	Solder	81724LQ61	04	Ind	9
	HS	DPST	off-on	6	3	45/64	7/8	Both	K3	Solder	81724LQ41	04	Ind	9
	S	DPDT	on-on	6	3	9/16	15/32	Both	K2	Solder	81727L	04	Ind	6
	HS	DPDT	on-on	6	3	45/64	7/8	CC on	K3	Solder	81727LQ61	04	Ind	9
	HS	DPDT	on-on	6	3	45/64	7/8	Both	K3	Solder	81727LQ41	04	Ind	9
				Ac Only										
				125 VAC	240 VAC									
702L	S	DPST	off-on-off-on	20 A 1½ HP	20 A 2 HP	15/32	15/32	Off	K4	QC	82787B	04	Ind	8
	HS	DPST	off-on	20 A 1½ HP	20 A 2 HP	15/32	15/32	Both	K6	QC	82787LB	05	Blk	10
	S	SPDT	on-on	20 A 1½ HP	20 A 2 HP	15/32	15/32	Both	K5	QC	83788	06	Blk	8
	S	DPST	off-on	20 A 1½ HP	20 A 2 HP	9/16	15/32	Off	K2	Screw	70307LA	04	Ind	7
	S	Single Pole Two Circuit	one-off-two	20 A 1½ HP	20 A 2 HP	9/16	15/32	CC on	K2	Screw	70321LA	06	Blk	7

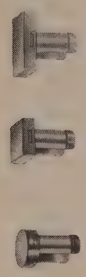
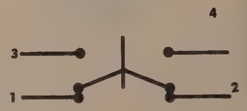
Arrow Hart ILLUMINATED PUSHBUTTON SWITCHES

ADAPT-A-SWITCH

31 STOCK COMPONENTS BUILD 25,344 DIFFERENT VARIATIONS

Use any of 6 colored lens in three shapes with two actuators (momentary or alternate action). Two contact blocks (standard duty and low energy) allow you to build up to 4-pole switches. Additional hardware includes metal bezels, indicator snap-on clips, and opaque buttons. Now designers may build from standard stock components thousands of variations to meet human factor and functional requirements. Different lens markings give the designer infinite choice. Designers have complete freedom of selection, backed up by immediate delivery from stocked components. Adapt-a-Switch capabilities are only limited by your imagination.

SNAP-ON CONTACT BLOCK

	Rectangular Square Round	 	Single Double* Triple* Quad*
	3 Lens Shapes	3 Actuator Shapes	4 Contact Block Assemblies
	White Red Green Blue Yellow Amber Black (Opaque)†	Momentary Action Use with 1-4 contact blocks Alternate Action Use with 1-3 contact blocks	
	7 Colors	2 Actions	1 Form Z Circuit

† Order black opaque lens when no illumination is required

* Bolted together assemblies

HOW TO ORDER DISCOUNT SCHEDULE 12

1. Determine lens shape and color. Specify Catalog Number.
2. Determine shape and action of actuator required. Specify Catalog Number.
3. Determine number of poles required. Select either standard duty or low energy. Specify Catalog Number.
4. Determine additions or modifications. Specify.

HOW TO ORDER EXAMPLE

REQUIRED	Round Green Lens	Round Lighted Momentary Contact Actuator	3 Pole Form Z Contacts
PARTS	1 pc. 83500-92	1 pc. 83503	3 pcs. 83500-30

ORDER READS
1 pc. — 83500-92 round green lens
1 pc. — 83503 round actuator momentary action
3 pcs. — 83500-30 standard duty contact block

CATALOG NUMBERS

LENSES

Color	Rectangular	Square	Round
White	83500-70	83500-80	83500-90
Red	83500-71	83500-81	83500-91
Green	83500-72	83500-82	83500-92
Blue	83500-73	83500-83	83500-93
Yellow	83500-74	83500-84	83500-94
Amber	83500-75	83500-85	83500-95
Black	83500-76	83500-86	83500-96

ACTUATORS

Action	Rectangular	Square	Round
Momentary	83501	83502	83503
Alternate	83504	83505	83506

CONTACT BLOCKS

Type	Low Level	Standard
Single	83600-30	83500-30
Double	Consult Factory	83500-230
Triple	Consult Factory	83500-330
Quad	Consult Factory	83500-430

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Arrow Hart

ILLUMINATED PUSHBUTTON SWITCHES

ADDITIONS

ROUND SNAP ON BEZEL

Bright chrome Cat. No. 83500-46.
Other finishes available on request. Contact Factory.

Lamps not supplied — use standard T1¾ incandescent groove base. (6 V. #337; 14 V. #336; 28V. #334).

Mounting wrench Cat. No. 83500-45

SPECIFICATIONS

Actuator —
Terminals: Tin plated solder type accepts #18 wire
Weight: 8 grms.
Plunger Travel: .094 inches

Contact Block —
Terminals: Solid fine silver solder type. Accepts #18 wire
Weight: 4 grms.
Contacts: Positive snap, wiping action

Contact Ratings —
Standard Duty (Fine Silver): 5 Amp. 125 VAC Resistive — 2 Amp. 250 VAC Resistive — 5 Amp. 28 VDC Resistive

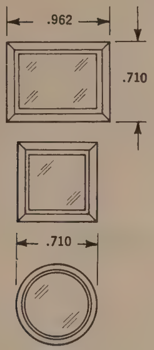
Low Energy (Gold Plated): Minimum rating for dry circuit application is 10 Micro Amp. 50MV. Gold Plated Contacts are for applications under 100 milliwatts

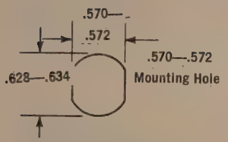
Life: Mechanical and Electrical at full ratings: 100,000 cycles min.

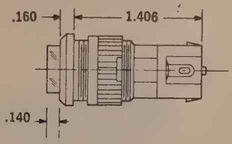
Max. Operating Force:

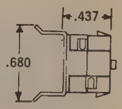
Poles	Momentary		Alternate action	
1	12 Oz.	341. Gms.	16 Oz.	454. Gms.
2	24 Oz.	682. Gms.	32 Oz.	909. Gms.
3	36 Oz.	1022. Gms.	48 Oz.	1363. Gms.
4	48 Oz.	1363. Gms.	Do not use	

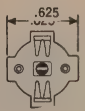
DIMENSIONS



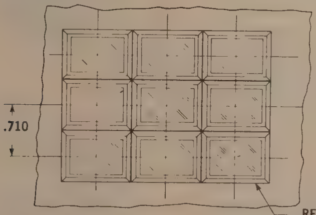




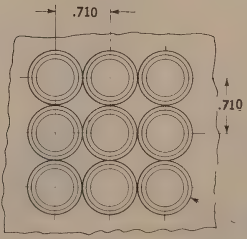




HIGH DENSITY MOUNTING



RECTANGULAR LENS SPACING



ROUND AND SQUARE LENS SPACING

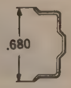
MIX AND MATCH

INDICATORS FOR MATCHING ILLUMINATED SWITCHES

Indicators are available that are identical in appearance to the illuminated switches featured here. Same lens shapes and colors, same body styles and dimensions. To order an indicator specify catalog number for indicator body and shape and color for lens (see lens catalog numbers for switches on page 18).

Indicator Bodies	Catalog Number
Rectangular	83507
Square	83508
Round	83509

Note: An actuator can be converted to an indicator only by a snap-on clip Catalog No. 83500-51.



INDICATOR SNAP-ON CLIP

Arrow Hart POWER TOOL SWITCHES SLIDE AND TRIGGER

SLIDE SWITCHES

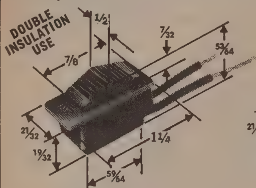
These slide switches have been designed especially for handling fractional horsepower motors. Their quick make, quick break snap action suits them to AC/DC applications.

GENERAL SPECIFICATIONS

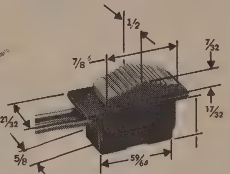
Exposed metal parts: Bright nickel
Dielectric breakdown: 1000 V rms
Packaging: **Ind.** Each switch individually packaged. **Blk.** Quantity packaged for large volume users (see page 24).
Contact materials: Silver plated

SPST OFF-ON CIRCUIT

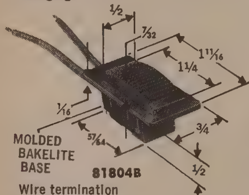
6 AMP 125 V/3 AMP 250 V/AC-DC


DOUBLE INSULATION USE
1/2
7/32
53/64
7/8
21/32
19/32
1 1/4
59/64

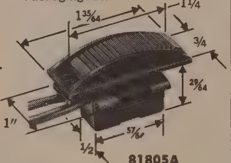
82200C
Wire termination
Black short slide
Molded Frame for double insulation applications
Discount Schedule 06
Packaging: Blk


1/2
7/8
7/32
17/32
21/32
5/8
59/64

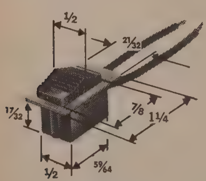
81804 AND 81804A
Wire termination
Black short slide 81804
Red short slide 81804A
Molded Frame for double insulation applications
Discount Schedule 06
Packaging: Blk


1/2
7/32
1 11/16
1 1/4
1/16
MOLDED BAKELITE BASE
57/64
3/4
1/2

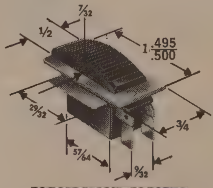
81804B
Wire termination
Black long slide
Molded Frame for double insulation applications
Discount Schedule 06
Packaging: Blk


1 35/64
1 1/4
3/4
29/64
1"
57/64
1/2

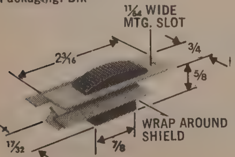
81805A
Wire lead
Black long slide
Molded Frame for double insulation applications
Discount Schedule 06
Packaging: Blk


1/2
21/32
17/32
7/8
1 1/4
1/2
59/64

82200
Wire termination
Black short slide
Metal frame
Discount Schedule 06
Packaging: Blk


7/32
1/2
1 .495/.500
29/32
3/4
57/64
9/32

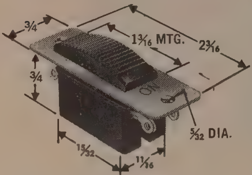
81564PA AND 81568DB
Wire lead (81564PA)
Quick Connect (81568DB)
Black short slide
Metal frame
Discount Schedule 06
Packaging: Blk


11/64 WIDE MTG. SLOT
2 3/16
3/4
5/8
WRAP AROUND SHIELD
11/32
7/8

81569
Screw terminals
Black long slide
Metal frame
Discount Schedule 04
Packaging: Ind

CLASSIC 144 SERIES

2 POSITION/LOW LEVEL TO 6 AMP


3/4
1 3/16 MTG.
2 3/16
3/4
5/32 DIA.
15/32
11/16

OPTIONS (CONSULT FACTORY)
Screw terminals (see page 23 Fig. T2)
Wire leads (see page 23 Fig. T3)
Custom color slide levers
Special finish on metal plates

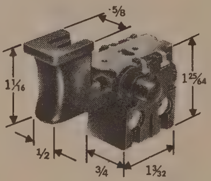
DPST WITH SOLDER LUGS SHOWN IS 81144C

Circuit	Action	UL Listed AC/DC 125 V Amp	250 V Amp	Slide Style	Color	Termination	Catalog Number	Discount Schedule	Std. Packaging
SPST	off-on	6	3	Long	Red	24" Wire	81136CA	06	Blk
DPST	off-on	6	3	Long	Black	Solder	81144C	05	Blk
DPST	off-on	6	3	Long	Black	6" Wire	81145C	06	Blk
DPDT	on-on	6	3	Long	Black	Solder	81147C	05	Blk
DPDT	on-on	8	4	Long	Black	Solder	82323	06	Blk

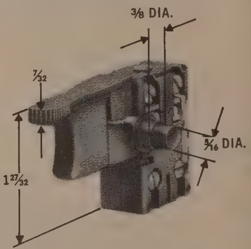
TRIGGER SWITCHES FOR POWER TOOLS

DOUBLE INSULATION USE

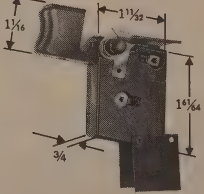
All the switches shown below are interchangeable physically with each other, yet perform different switching or control functions. All are designed for double insulation application. The switches are organized in ascending order of functional additions to portable electric tools all the way from simple off-on switch to off-on variable speed with reversing and adjustable feature.


5/8
1 1/16
1 25/64
1/2
3/4
1 3/32

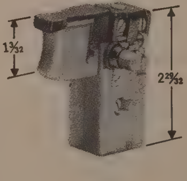
83320DI
OFF-MOM-ON
6 Amp 125 V AC/DC
3 Amp 250 V AC/DC


3/8 DIA.
7/32
3/16 DIA.
1 27/32

83321DIA
OFF-MOM ON W REVERSING
6 Amp 125 V AC/DC
3 Amp 250 V AC/DC


1 1/16
1 11/32
1 61/64
3/4

ICS120
OFF-MOM ON VARIABLE SPEED
5 Amp 120 VAC



ICS121
OFF-MOM ON VARIABLE SPEED W REVERSING
5 Amp 120 VAC

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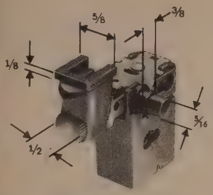
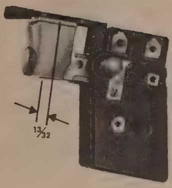
POWER TOOL SWITCHES EXTENDED TRIGGER

TRIGGER SWITCHES (Cont'd)



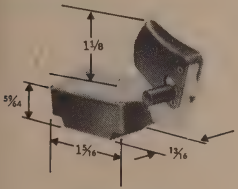
IC5124
OFF-MOM ON
VARIABLE SPEED
W ADJUSTABLE FEATURE
5 Amp 120 VAC



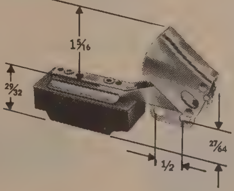
IC5126
OFF-MOM ON
VARIABLE SPEED
W REVERSING
W ADJUSTABLE FEATURE

EXTENDED TRIGGER SWITCHES

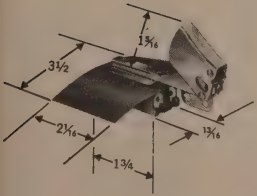
DPST. Off-mom-on. Ratings: 16 amp 125 V AC/DC, 8 amp 250 V AC/DC, 1 HP 125 V thru 250 V AC/DC.



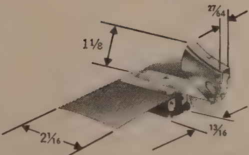
PUSH-IN TERMINALS
83167NBD — Discount Schedule 06
Packaging: Blk
Molded construction
Black molded trigger
with locking latch



PUSH-IN TERMINALS
83167S — Discount Schedule 06
Packaging: Blk
Molded construction
Metal trigger



SCREW TERMINALS
80615DR With latch
80615DW Less latch
80615DWS High metal trigger — no latch
Discount Schedule 06
Packaging: Blk
Metal frames and triggers



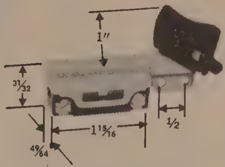
SCREW TERMINALS
80615NAM — Discount Schedule 06
Packaging: Blk
Molded frame and trigger

NEW EXTENDED TRIGGER SWITCHES

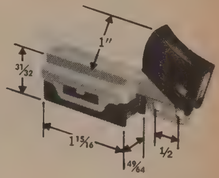
DOUBLE INSULATION USE

DPST. Off-mom-on. 16 amp 125 V AC/DC, 8 amp 26 V AC/DC, 1 HP 125 V thru 250 V AC/DC.

Durable molded construction — black triggers, special colors available.

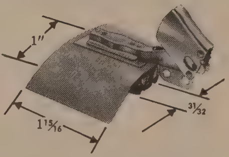


SCREW TERMINALS
83815 — Discount Schedule 06
Packaging: Blk
83815D & 83815DL (with locking latch) — Discount Schedule 04
Packaging: Ind



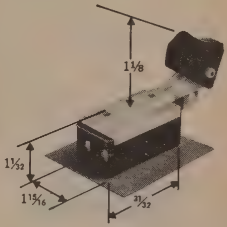
PRESS FIT TERMINALS
83816 — Discount Schedule 06
Packaging: Blk
Use Amp. Inc.
Terminal Lug 62008-1 right hand and 62009-1 left hand

EXTENDED TRIGGER SWITCHES — HEAVY DUTY



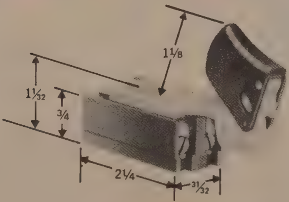
AC/DC

20 Amp 125 V AC/DC
10 Amp 250 V AC/DC
1½ HP 125 V thru 250 V AC/DC
80617DWB — Discount Schedule 06 —
Packaging: Blk
Metal frame and trigger
Screw terminals
DPST, Off-Mom On



AC ONLY

25 Amp 125 V and 250 VAC
2 HP 125 VAC thru 250 VAC
Molded frame and trigger (black)
Screw terminals
DPST, Off-Mom On
83197 — Discount Schedule 06 —
Packaging: Blk



SPECIAL CIRCUIT AC ONLY

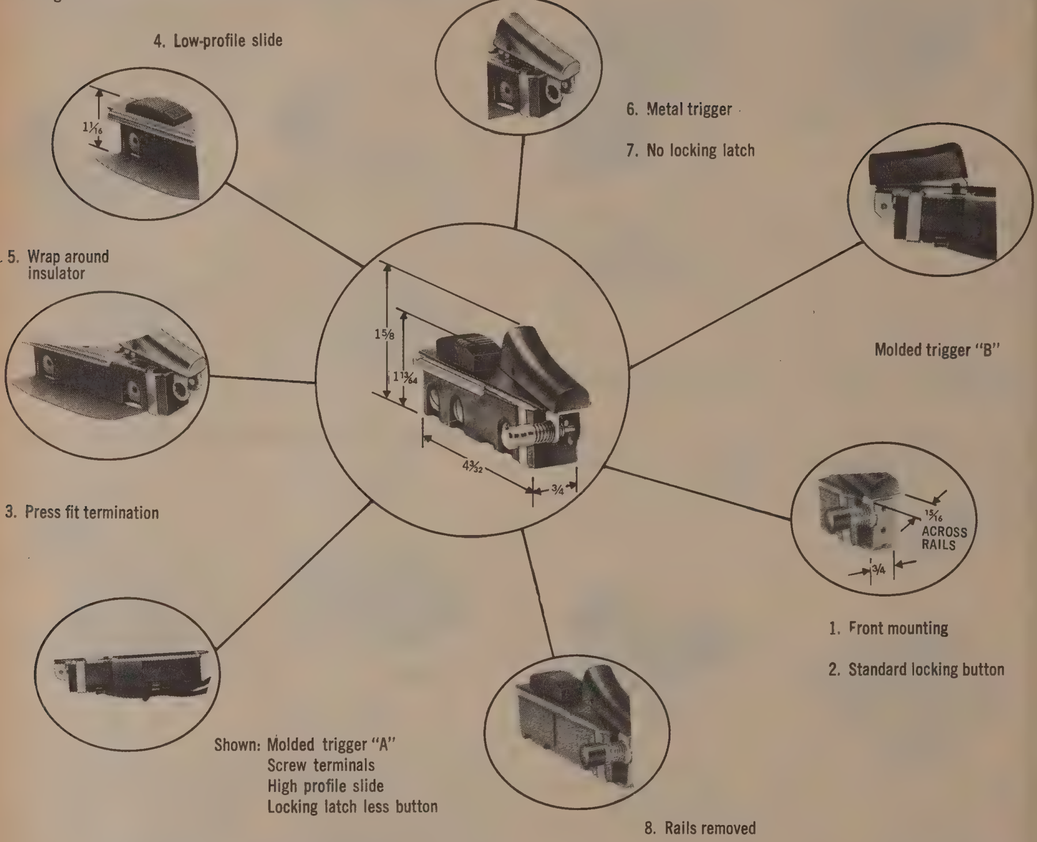
On-Mom-On for dynamic braking applications
20 Amp 125 VAC
10 Amp 250 VAC
1½ HP 125 VAC thru 250 VAC
Molded frame and trigger (black)
Screw terminals
81766 — Discount Schedule 06 — Packaging: Blk

Arrow Hart

TANDEM INTERLOCKING TRIGGER SWITCHES

INDUSTRIAL GRADE
HEAVY DUTY

For reversing series-wound motors—or for providing a two-speed feature in a portable tool. Many configurations are possible as illustrated in the diagram.


4. Low-profile slide
1¹⁄₁₆
6. Metal trigger
7. No locking latch
5. Wrap around insulator
1⅝
1¹³⁄₆₄
4³⁄₃₂
¾
Molded trigger "B"
3. Press fit termination
¹⁵⁄₁₆ ACROSS RAILS
¾
1. Front mounting
2. Standard locking button
8. Rails removed

Shown: Molded trigger "A"
Screw terminals
High profile slide
Locking latch less button

Circuit	*Interlocking Slide Selection	UL Listed AC/DC 125 V Amp	UL Listed AC/DC 250 V Amp	Slide Color	Slide Profile	Trigger	Lock Latch	Termination	Catalog Number	Discount Schedule	Packaging
Single Pole	Fwd./Rev.	12	8 A 1 HP	Orange	Low	Metal	Yes	Screw	80540AD	06	Blk
Single Pole	Fwd./Rev.	12	8 A 1 HP	Red	Low	Metal	No	Screw	80540AF	06	Blk
Single Pole	Fwd./Rev.	12	8 A 1 HP	Black	High	Metal	Yes	Screw	80540EA	06	Blk
SP on-off	N/A	12	8 A 1 HP	N/A	N/A	Metal	Yes	Screw	82551AG	06	Blk
Single Pole	Two Speed	12	8 A 1 HP	Black	High	Metal	No	Screw	83069AC	06	Blk
Double Pole	Fwd./Rev.	12	8 A 1 HP	Red	High	Metal	No	Screw	83540AE	06	Blk
Double Pole	Fwd./Rev.	12	8 A 1 HP	Black	High	Molded "A"	Yes	Screw	83540DIA	06	Blk
Double Pole	Two Speed	12	8 A 1 HP	Red	High	Metal	Yes	Screw	83541BD	06	Blk
Double Pole	Fwd./Rev.	12	8 A 1 HP	Black	High	Molded "B"	Yes	Press Fit	84540DIA	06	Blk
Double Pole	Fwd./Rev.	12	8 A 1 HP	Black	High	Molded "B"	No	Press Fit	84540DIRL	06	Blk
Double Pole	Fwd./Rev.	12	8 A 1 HP	Black	High Special	Molded "B"	Yes	Press Fit	84540RIAR	06	Blk
Double Pole	Two Speed	12	8 A 1 HP	Black	High	Molded "B"	Yes	Press Fit	84541DIA	06	Blk
Double Pole	Two Speed	12	8 A 1 HP	Black	High	Molded "B"	Yes	Press Fit	84541DIAR	06	Blk
Double Pole	Two Speed	12	8 A 1 HP	Black	High	Molded "B"	No	Press Fit	84541DIRL	06	Blk

* Trigger action off-mom on

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STANDARD OPTIONS FOR ALL SWITCHES

LEVER AND BUTTON OPTIONS

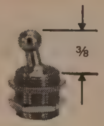


FIG. A
BALL

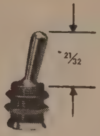


FIG. B
BAT

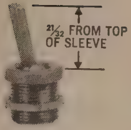


FIG. C
METAL PADDLE

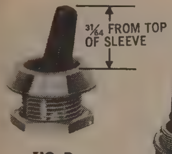


FIG. D
MOLDED,
TAPERED

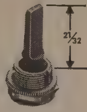


FIG. E
MOLDED
PADDLE

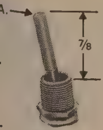


FIG. F
MOLDED
STRAIGHT

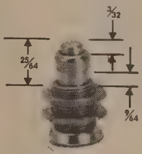


FIG. G
TYPICAL
OVERTRAVEL
BUTTON

TERMINATION OPTIONS

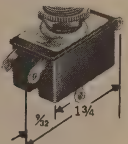


FIG. T1
END CONNECTED
SOLDER LUGS

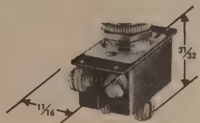


FIG. T2
SCREW TERMINALS

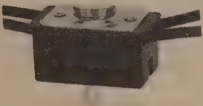
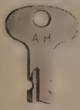
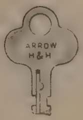


FIG. T3
WIRE LEADS IN DPDT
CONFIGURATION

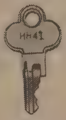
KEY STYLES FOR LOCKING SWITCHES



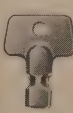
1561-487
1561-488
FIG. K1



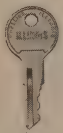
1561-1487
1561-1488
FIG. K2



81715-41
81715-61
FIG. K3



82787-10
FIG. K4



82787-55
FIG. K6

5/32″ ALLEN WRENCH (NOT AVAILABLE FROM A-H)
FIG. K5 (NOT SHOWN)

KEYS FOR LOCK SWITCHES

Catalog	Key Removal Positions	Style	Security Level	Material & Finish	Disc. Sched.	Std. Pack.
1561-487	Both Positions	Fig. K1	Security	Steel-Chromate	04	25
1561-488	One (CC Position)	Fig. K1	Security	Steel-Chromate	04	25
1561-1487	Both Positions	Fig. K2	Security	Steel-Chromate	04	25
1561-1488	One (CC Position)	Fig. K2	Security	Steel-Chromate	04	25
81715-41	Both Positions	Fig. K3	Hi-Security	Brass	04	25
81715-61	One (CC Position)	Fig. K3	Hi-Security	Brass	04	25
82787-10	Off Position	Fig. K4	Hi-Security	Diecast Zinc	04	25
82787-55	Both Positions	Fig. K6	Hi-Security	Brass	04	25
5/32 Allen Wrench Not Supplied		Fig. K5	Hi-Security	N/A	04	25

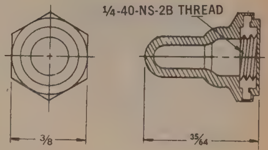
SUBMINIATURE TOGGLE SWITCH OPTIONS

LEVER ADAPTERS

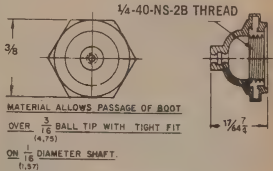
Catalog Number	Description	Discount Code	Standard Package
18500-11	White	12	25
18500-13	Blue	12	25
18500-14	Red	12	25
18500-15	Yellow	12	25
18500-16	Green	12	25
18500-17	Brown	12	25
18500-18	Black	12	25
18500-22BE	Anodized Aluminum	12	25

RUBBER BOOTS

TOTALLY ENCLOSING BOOT
BLACK RUBBER
CATALOG NUMBER 18578-2



PARTIALLY ENCLOSING BOOT
BLACK RUBBER
CATALOG NUMBER 19003-12



MATERIAL ALLOWS PASSAGE OF BOOT OVER $\frac{3}{16}$ (4,75) BALL TIP WITH TIGHT FIT ON $\frac{1}{16}$ (1,57) DIAMETER SHAFT.

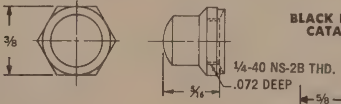
SUBMINIATURE PUSHBUTTON OPTIONS

COLORED CAPS

Colors	.215″ Dia.	3/8″ Dia.	Discount Schedule	Standard Package
White (Natural)	18567-61	18567-71	12	25
Black	18567-62	18567-72	12	25
Blue	18567-63	18567-73	12	25
Red	18567-64	18567-74	12	25
Yellow	18567-65	18567-75	12	25
Green	18567-66	18567-76	12	25
Brown	18567-67	18567-77	12	25

When rubber boots are required button caps cannot be used. Caps may be lifted from button plunger and boot may then be mounted.

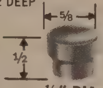
RUBBER BOOTS



BLACK RUBBER
CATALOG NO. 18577-2

STANDARD PUSHBUTTON OPTIONS

SNAP-ON CAPS



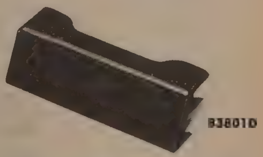
1/2″ DIA.

1″ DIA.

Catalog Number	Button Size	Description	Discount Schedule	Standard Package
3391-194	1/2″ dia.	Black Molded	04	25
3391-372	1/2″ dia.	Red Molded	04	25
3391-378	1″	Red Transparent	05	500

MISCELLANEOUS

Insulator for 83800/83806/83815/83816 type switches. Discount Schedule 04. Minimum quantity 25.



83801D

Arrow Hart

HARDWARE AND PACKAGING

All sleeve mounted switches are furnished with two mounting nuts. One nut goes behind panel to prevent the bushing or sleeve being distorted by overtightening the front panel nut. Arrow-Hart accepts no responsibility for damage to switches that are mounted without the backup nuts.

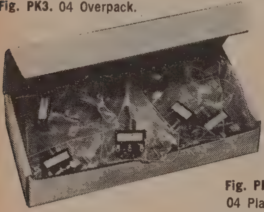
PACKAGING METHODS

IND (SCHEDULE 04): One switch individually packed (with hardware unassembled) in plastic bag, Fig. PK1 or Fig. PK2. Note, extra large switches are individually packed in cardboard boxes. Schedule 04 items overpacked 25 units to a carton, Fig. PK3.

IND (SCHEDULE 12 AND SCHEDULE 13): One switch individually packed (with hardware unassembled) in plastic bag, Fig. PK4. Subminiature switches overpacked 25 units to a tray, Fig. PK5.

BLK (BULK PACKS): Shipped in cartons of 100, 200 or 250 units based on size and weight, Fig. PK6. Hardware (nuts, washers, terminal screws) will be bulk packed separately in plastic bag.

Fig. PK3. 04 Overpack.



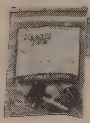


Fig. PK2. 04 Plastic.

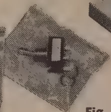


Fig. PK1. 04 Plastic.

Fig. PK5. Submin Tray.

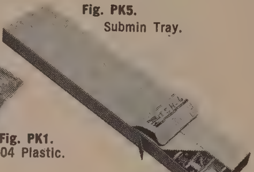


Fig. PK4. 12-13 Plastic.

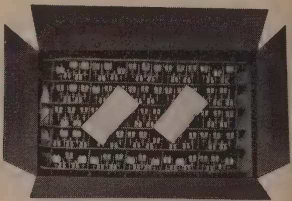
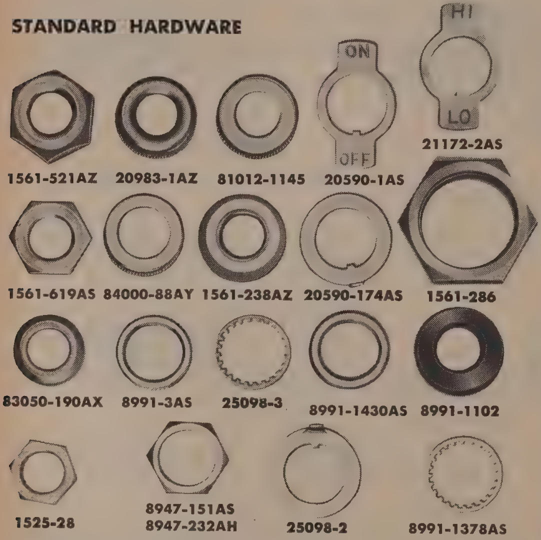
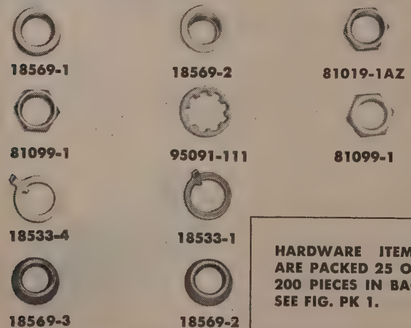


Fig. PK6. Blk carton.

STANDARD HARDWARE



SUBMINIATURE HARDWARE



HARDWARE ITEMS ARE PACKED 25 OR 200 PIECES IN BAG SEE FIG. PK 1.

Catalog	Description	Thread or I.D. ins.	Material	Finish	Disc. Sched.	Std. Pack.
STANDARD MOUNTING HARDWARE						
8947 151AS	Std. Hex	15/32-32	Brass	Tin Dip	04	200
8947 232AH	Std. Hex	15/32-32	Steel	Chromate	04	200
1561 521AZ	Thick Hex	15/32-32	Brass	Nickel	04	200
8991 3AS	Std. Knurled	15/32-32	Brass	Tin Dip	04	200
8991 35AZ	Dress Knurled	15/32-32	Brass	Nickel	04	200
1561 238AZ	Top Nut	15/32-32	Brass	Nickel	04	200
83050-190AX	Dress Nut	15/32-32	Brass	Satin Chrome	04	200
8991 1378AS	Lockwasher	15/32	Bronze	Tin Dip	04	200
20983 1AZ	Dress Nut	15/32-32	Brass	Nickel	05	500
20590 174AS	Std. Locating Ring	15/32	Brass	Tin Dip	04	200
20590 1AS	On-Off Dial	15/32	Brass	Tin Dip	04	200
21172-2AS	Hi-Lo Dial	15/32	Brass	Tin Dip	04	200
SUBMINIATURE MOUNTING HARDWARE						
81019 1AZ	Std. Hex	¼-40	Brass	Nickel	12	200
81099 1BF	Std. Hex	¼-40	Aluminum	Gold Anodized	12	200
81099 1BE	Std. Hex	¼-40	Aluminum	Clear Anodized	12	200
18569 1BF	Std. Knurled	¼-40	Aluminum	Gold Anodized	12	200
18569 1BE	Std. Knurled	¼-40	Aluminum	Clear Anodized	12	200
18569 3	Dress Nut	¼-40	Stainless	Steel	12	200
18569 2BF	Dress Nut	¼-40	Aluminum	Gold Anodized	12	200
18569 2BE	Dress Nut	¼-40	Aluminum	Clear Anodized	12	200
95091 111	Internal Tooth Lockwasher	¼	Steel	Zinc	12	200
18533 1	Locking Ring Short Tab	¼	Steel	Chromate	12	200
18533 4AG	Locking Ring Long Tab	¼	Steel	Zinc	12	200
MISCELLANEOUS NUTS						
1561-28AZ	Hex	11/32-32	Brass	Nickel	04	200
1561-619AZ	Hex	⅜-24	Brass	Nickel	04	200
80638-53AZ	Hex	¾-32	Brass	Nickel	04	200

ARROW-HART INC. / SPECIALTY SWITCH PRODUCTS / 103 HAWTHORN STREET / HARTFORD, CONN. 06106 / (203) 249-8471

ARCOLECTRIC SWITCH CORPORATION

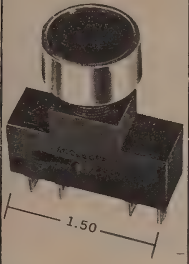
P. O. Box 348 / North Hollywood, California 91603 / Phone (213) 985-3130 / TELEX 65-1349

REFER TO OTHER EEM PAGE FOR ARCOLECTRIC INDICATOR LIGHTS

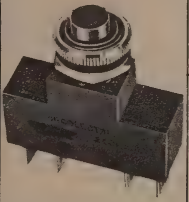
For further details on these and other items, request our catalog.

290

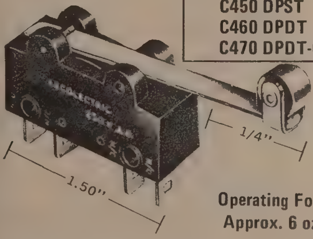
15A 125/250V AC
.50 DIA MTG
MOMENTARY
2-CIR NO/NC



C290/K1



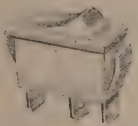
C290/P1



Operating Force
Approx. 6 oz.

400

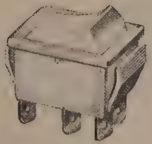
10A 125/250V AC
MTG .452 x 1.11
SINGLE POLE



C400 SPST
C410 SPDT
C420 SPDT-C-OFF

LIGHTED VERSION
C403/12V
C403/125V

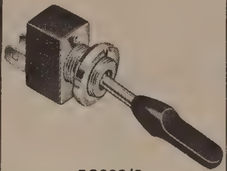
DOUBLE POLE
MTG .88 x 1.11



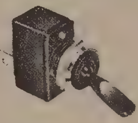
C450 DPST
C460 DPDT
C470 DPDT-C-OFF

600

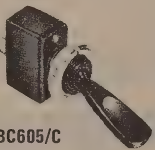
3A 125/250V AC
.50 DIA MTG
SINGLE POLE
.250 TAB TERM



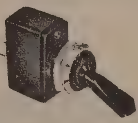
BC602/C
Lever Length 1.63"



BC603/C
Lever Length .69"



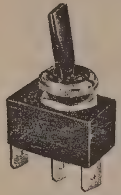
BC605/C
Lever Length 1.06"



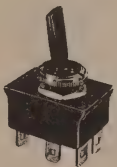
BC606/C
Lever Length .72"

800

10A 125/250V AC
.50 DIA MTG
CASE .50 x 1.00
SINGLE POLE



8006 SPST
8106 SPDT
8206 SPDT-C-OFF

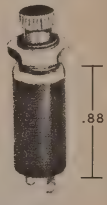


CASE 1.00 x 1.28
8506 DPST
8606 DPDT
8706 DPDT-C-OFF

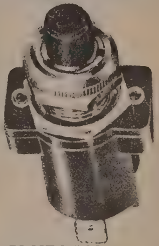
THIS SERIES
IS AVAILABLE
WITH VARIOUS
LEVER STYLES
AND OTHER
CIRCUITS

900

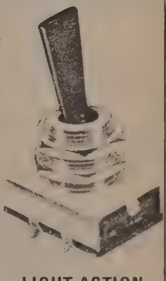
1A 125/250V AC
MOMENTARY
SINGLE POLE



.28 MTG DIA
T906 N. OPEN
T908 N. CLOSED

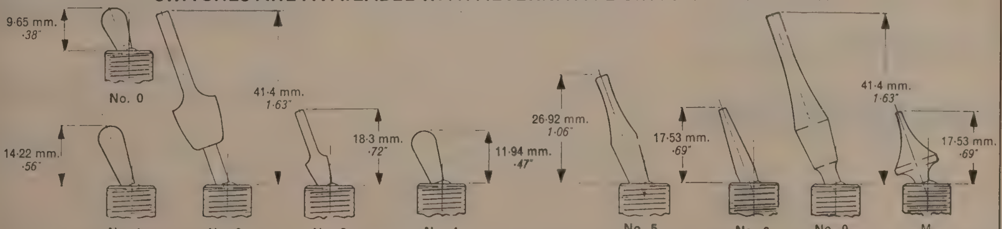


.50 MTG DIA
T936 N. OPEN
T938 N. CLOSED



LIGHT ACTION
SLIDE DPDT
T9576

SWITCHES ARE AVAILABLE WITH ALTERNATIVE CIRCUITS AND LEVERS



ALL ITEMS SUBJECT TO DESIGN CHANGE WITHOUT NOTICE

bussmann manufacturing div.

University at Jefferson • St. Louis, Mo. 63107 • Tel: (314) 421-1740

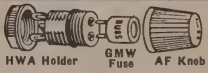
fuses and holders

TRON® SUBMINIATURE PIG-TAIL FUSES

Glass-tube construction with 1-1/2" leads of #24 tinned copper for 1/100-5 amp ratings, #18 tinned copper for 7-15 amp ratings. Hermetically sealed. Color coded to indicate amp ratings. For circuits with fault current of 50 amps or less (1/100-5 amps for 125 V or less, 7-15 amps for 32 V or less). GLN, GLX body size, .140" x .3"; GFA body size, .145" x .3".

Buss No.	Amperes	Net Price For	
		Ten	100
GLN	1/100	$15.70	$131.00
GLN	1/32, 1/20, 1/16, 1/10, 1/8, 3/10, 4/10, 7, 8, 15	13.20	110.00
GLX	15/100, 2/10, 1/4, 1/2, 6/10, 3/4, 1, 1-1/2, 2, 3, 4, 5	17.00	142.00
GFA	1/100, 1/32, 1/20, 1/16, 1/10, 1/8, 15/100, 2/10, 1/4, 3/10, 4/10, 1/2, 6/10	5.60	47.00
GFA	3/4, 1, 1-1/2, 2, 3, 4, 5, 7, 8, 15	4.80	40.00

SUBMINIATURE PRONG TYPE UNIT



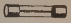
Rated 125 V or less, fault current not over 300 amps; open at 200% within 10 sec or less. Use AF knob for waterproof. Size, .270" dia., .250" lg. (body).

Buss No.	Amperes	Net Price For	
		Ten	100
GMW	1/200, 1/100, 1/64, 1/32, 1/16	$9.40	$79.00
GMW	1/10, 2/10, 1/4, 3/10, 4/10, 1/2, 6/10, 3/4, 1, 1-1/2, 2, 3, 4, 5	7.20	60.00
HWA*	Holder, fits all GMW	9.20	76.70
HWA†	Holder, fits all GMW	8.00	67.00
AF	Knob only, fits HWA	1.20	9.70

*With AF knob. †Without AF knob.

13/64 x 45/64 inch FUSES

(5mm x 20mm)



Protection of miniaturized circuits — commonly used in foreign equipment. Carry 100%, open at 200% in 10 sec.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
GMA	1/8	125	$2.10	$35.00
GMA	1/4, 1/2, 7/10	125	1.70	29.00
GMA	1, 1-2/10, 1-1/2, 2, 3, 4, 5, 6, 10	125	1.40	24.00

1/4 x 5/8 inch FUSES

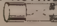
FAST ACTING FUSE

Glass tube, 1/4" x 5/8". Carry 110%, open at 135% in 1 hour.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
AGA	1, 1-1/2, 2, 2-1/2	32	$0.50	$8.70
AGA	8	32	.50	8.70
AGA	5, 6, 7-1/2, 10, 15, 20	32	.39	6.70
AGA	25, 30	32	.39	6.70

1/4 x 7/8 inch FUSES

FAST ACTING FUSE

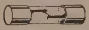


Glass tube, carry 110%, open at 135% in 1 hour.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
AGW	1, 2-1/2, 3, 4	32	$0.50	$8.70
AGW	5, 6, 7-1/2, 15, 20, 30	32	.39	6.70

1/4 x 1 inch FUSES

FAST ACTING FUSES



Glass tube, 1/4" x 1". Carry 100%, open at 200% in 5 seconds. 1/500 to 1/32 amp sizes have bridge construction; all others straight-through element. U/L Approved.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
AGX	1/500	250	$7.60	$127.00
AGX	1/200	250	3.30	55.00
AGX	1/100	250	2.80	47.00
AGX	1/32	250	2.40	40.00
AGX	1/16	250	1.60	27.00
AGX	1/10, 1/8, 3/16, 2/10	250	1.20	20.00
AGX	1/4, 3/8, 4/10, 1/2, 3/4	250	.73	12.50
AGX	1, 1-1/2, 2, 3, 4	125*	.50	8.70
AGX	5, 8, 10, 15, 20	32†	.39	6.70
AGX	25, 30	32	.39	6.70

*1 A, 250. †5 A, 125.

1/4 x 1-1/4 inch FUSES

FAST ACTING FUSES

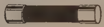
Glass tube, 1/4" x 1-1/4". Carry 110%, open at 135% in 1 hour or less. 1/500 to 2 amp sizes will open at 200% in 5 seconds or less. 1/500 to 1/32 amp have bridge construction; all others straight-through element. U/L Approved.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
AGC	1/500	250	$7.60	$127.00
AGC	1/200	250	3.30	55.00
AGC	1/100	250	2.80	47.00
AGC	1/32	250	2.40	40.00
AGC	1/16, 1/8, 15/100, 175/1000, 3/16, 1/10, 2/10	250	1.20	20.00
AGC	1/4, 3/10, 3/8, 45/100, 1/2, 6/10, 3/4	250	.73	12.50
AGC	1, 1-1/4, 1-1/2, 1-6/10, 2	250	.50	8.70
AGC	2-1/2, 3	250	.50	8.70
AGC	4	32‡	.50	8.70
MTH	4, 5, 6	250	.60	10.00
AGC	5, 6, 7-1/2, 8, 10, 15	32‡	.39	6.70
AGC	20	32‡	.39	6.70
AGC	25, 30	32‡	.39	6.70

‡Not U/L listed.

1/4 x 1-1/4 inch FUSES

CERAMIC TUBE FUSES



High interrupting capacity for use on circuit delivering as high as 25,000 amps at 125 V, or 10,000 amps at 250 V. 1/4" x 1-1/4". Carry 110%, open at 135% in 1 hour. Up to 15 amp size U/L Approved.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
ABC	1/4	250	$1.00	$17.00
ABC	1, 2, 3	250	1.00	17.00
ABC	5, 6, 8, 10	250	.85	15 00
ABC	12, 15, 20	250	1.00	17.00
ABC	25, 30	125	1.30	22.00

1/4 x 1-1/4 inch FUSES

VISUAL INDICATING FUSES

For use with HLD fuseholder. Bright red dot on indicating pin extends from end of fuse when fuse is open even after power is off. Rated 125 V or less, carries 110%, opens at 135% in 1 hour or less. Only 1/4" x 1-1/4".

Buss No.	Amperes	Net Price For	
		Five	100
GBA	3/4	$3.30	$55.00
GBA	1, 1-1/2, 2, 3, 4, 5	2.40	40.00

Fiber tube with silver plated indicating pin which extends when fuse is blown. May be used to actuate a signal when used in HKA fuseholder or Signal Fuse Block. Dual tube construction in sizes larger than 5 amps (cannot be used in HKA fuseholder). Voltage, 125 volts, except 8 amp and over which are 32 volts. Size, 1/4" x 1-1/4".

Buss No.	Amperes	Net Price For	
		Five	100
GLD	3/4	$3.00	$50.00
GLD	1, 1-1/2, 2, 3, 4, 5	2.30	39.00
GLD	6, 8, 10, 12, 15, 20	3.30	55.00

1/4 x 1-1/4 inch FUSES

FUSETRON PIG-TAIL FUSES

Body 1/4" x 1-1/4", #20 tinned leads, 1-1/4". 1/100 to 2-8/10 same as MDL type; 3 to 7 amps same as MDX type. U/L Approved.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
MDV	1/100, 1/32	250	$2.50	$42.00
MDV	1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 3/4, 8/10, 1	250	1.90	32.00
MDV	1-1/4, 1-1/2, 1-6/10, 2	125	1.80	30.00
MDV	2-1/2, 2-8/10, 3, 3-2/10, 4, 5, 6-1/4, 7	125	1.60	27.00

FAST ACTING FUSE

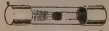
PIG-TAIL FUSES

Glass tube 1/4" x 1-1/4" with 1-1/4" leads of #20 tinned wire. Carry 110%, open 135% in 1 hour. 250 V. U/L Approved.

Buss No.	Amperes	Net Price For	
		Five	100
GJV	1/16	$1.90	$32.00
GJV	1/8	1.50	25.00
GJV	1/4, 3/10, 3/8, 1/2, 3/4	1.20	20.00
GJV	1, 1-1/2, 2, 3	.90	15.00
GJV	4, 5, 6	.95	16.00

1/4 x 1-1/4 inch FUSES

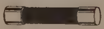
FUSETRON GLASS TUBE FUSES



Dual-element slow-blowing type, 1/4" x 1-1/4". Fuse link operates only on very high overloads or short-circuits; thermal cutout functions on low overloads (cannot operate quickly on any load, thus providing long time-lag). Carry 110%, open at 135% in 1 hour. MDL 1/100 to 2-8/10 amp and MDX 3 to 7 amp sizes. U/L Approved. MDL type has longer time-lag than MDX type.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
MDL	1/100, 1/32	250	$2.10	$35.00
MDL	1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 7/10, 3/4, 8/10, 1		1.60	27.00
MDX	1-1/4, 1-1/2, 1-6/10, 2	250	1.70	29.00
MDL	1-2/10, 1-1/4, 1-1/2, 1-6/10, 2	125	1.50	25.00
MDL	2-1/2, 2-8/10	125	1.20	20.00
MDX	3, 3-2/10, 4, 5	125	1.20	20.00
MDX	6-1/4, 7	125	1.40	24.00
MDL	3, 3-2/10, 4, 5, 6-1/4, 8, 10, 15, 20, 25, 30	32	1.20	20.00

1/4 x 1-1/4 inch FUSES



Fusetron dual-element fuse, slow-blowing type, ceramic tube. Carry 110%, open at 135% in 1 hour.

Buss No.	Amperes	Volts	Net Price For	
			Five	100
MDA	1/100, 1/32	250	$2.60	$44.00
MDA	1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 3/4, 8/10, 1, 1-1/4, 1-1/2, 1-6/10, 2	250	2.20	37.00
MDA	2-1/2, 2-8/10, 3, 3-2/10, 4, 5, 6-1/4, 7, 8, 10, 15, 20	250	1.60	27.00
MDA	25, 30	125	1.60	27.00

bussmann manufacturing div.

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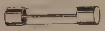
fuses and holders

9/32 x 1-1/4 inch FUSES

AGS GLASS TUBE FUSES

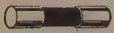


Test specification; carry, 110%, open at 135% within 1 hour except 35 and 40 amp units which open at 300% in 2 to 4 seconds when tested in standard 30-amp test circuit. **Note:** These units in sizes larger than 30 amps are not recommended for use in fuse clips or fuseholders as clips will not carry the high currents.

Buss No.	Amperes	Volts	Net Price For Five	100
AGS	1/16	250	$2.20	$37.00
AGS	1/8	250	1.70	29.00
AGS	1/4, 1/2	250	.80	13.00
AGS	1, 2, 2-1/2, 3	250	.75	13.00
AGS	5, 10, 15, 20 ,25, 30	32	.65	11.00
AGS	35, 40, 50	32	.75	13.00

9/32 x 1-1/4 inch FUSES

CERAMIC TUBE FUSES

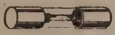


Carrry 110%, at 135% in 1 hour. 35 and 40 amp. open at 300% in 2 to 4 seconds when tested in a standard 30 amp. test circuit.

Buss No.	Amperes	Volts	Net Price For Five	100
ABS	1, 2, 3	250	$1.60	$27.00
ABS	5, 8, 10, 15, 20	250	1.50	25.00
ABS	25, 30	125	1.50	25.00
ABS	35, 40	32	1.60	27.00

9/32 x 1-1/4 inch FUSES

FUSETRON DUAL-ELEMENT FUSES

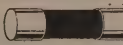


Glass tube, slow-blowing. Avoid needless blows from starting currents or surges, yet provides protection against short-circuits or continuous overloads. Carry 110%, open at 135% in 1 hour. Approximate blowing time: at 200% load, 25 seconds; at 300% load, 8 seconds; at 500% load, 3 seconds.

Buss No.	Amperes	Volts	Net Price For Five	100
MDM	1/10, 15/100, 2/10, 1/4, 3/10, 4/10, 1/2, 6/10, 3/4, 8/10, 1	250	$2.00	$34.00
MDM	1-1/4, 1-6/10, 2	125	2.00	34.00
MDM	2-1/2, 2-8/10, 3	125	1.60	27.00
MDM	3-2/10, 4, 5, 6-1/4, 8, 10, 10, 15, 20, 25, 30, 35, 40	32	1.60	27.00

13/32 x 1-3/8 inch FUSES

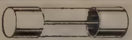
"QUICK-BLOWING" 600 V FUSES



Designed to protect control circuits, fluorescent lighting circuits or similar uses where quick-blowing characteristics are desired. Use HPC-L fuseholder or 3845 fuse block. U/L Approved. Fiber tube 13/32" x 1-3/8".

Buss No.	Amperes	Net Price For Ten	100
BBS	4/10, 3/4, 8/10	$2.90	$24.00
BBS	1, 2, 3, 4, 5	2.70	23.00

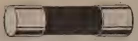
13/32 x 1-1/2 inch FUSES



Glass tube, carry 110%, open at 135% in 1 hour. 3 amp. and smaller sizes U/L listed.

Buss No.	Amperes	Volts	Net Price For Ten	100
AGU	1, 2, 3, 4	250	$1.90	$16.00
AGU	5, 10, 15, 20, 25, 30	32	1.90	16.00

13/32 x 1-1/2 inch FUSES



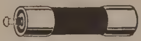
MIDGET TYPE FUSES

Up to 15 amp size U/L Approved.

Buss No.	Amperes	Volts	Net Price For Ten	100
BAF	1, 3, 5, 6, 10	250	$1.60	$14.50
BAF	15, 20, 25, 30	125	1.60	14.50

13/32 x 1-1/2 inch FUSES

INDICATING, LAMINATED TUBE FUSES



Red button on indicating pin extends from end of fuse when fuse is blown. Units are built in accordance with Navy Specifications. These units may be used in Buss HPC-C fuseholders. Voltage, (1-15 amps), 250, others, 125 V.

Buss No.	Amperes	Net Price For Ten	100
MIN	1, 2, 3, 5, 10, 15, 20, 25, 30	$4.80	$40.00

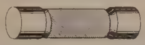
SIGNAL OR VISUAL INDICATING FUSES

MIC fuses have silver-plated indicating pin. Pin may be used as visual indicator or may be used to actuate a signal. **MIJ** fuses are similar to MIC types except they have been specially designed for complex circuitry as in computers. Voltage, 250 except 20 amps and over which are 32 V.

Buss No.	Amperes	Net Price For Ten	100
MIC	1, 2, 3, 5, 10, 15, 20, 25, 30	$5.60	$47.00
MIJ	1, 2, 3, 5, 10, 15, 20, 25, 30	6.60	55.00

13/32 x 1-1/2 inch FUSES

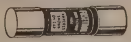
HIGH INTERRUPTING CAPACITY FUSES



Type KTK — For use on circuits as high as 100,000 amps and sand filler surrounding a silver fuse at 600 volts or less, AC only. Glass fiber melamine tubes element. **Amperes:** 1/10, 1/8, 2/10, 1/4, 3/10, 1/2, 3/4, 1, 1-1/2, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 25, 30. Lot of 10, Net **$12.30**. Lot of 100, Net **$103.00**.

13/32 x 1-1/2 inch FUSES

FUSETRON FIBER TUBE FUSES



Dual-element slow-blowing type, 13/32" x 1-1/2" overall. Fuse link operates only on very high overloads or short circuits; thermal cutout functions on low overloads (cannot operate quickly on any overload, thus providing longer time lag). Carry 110%, open at 135% in 1 hour. 125 and 250 volt sizes U/L Approved.

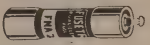
Buss No.	Amperes	Volts	Net Price For Ten	100
FNM	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1-1/8, 1-1/4, 1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3-2/10, 3-1/2, 4, 4-1/2, 5, 5-6/10, 6-1/4, 7, 8, 9, 10	250	$4.30	$36.00
FNM	12, 15	125	4.30	36.00
FNM	20, 25, 30	32	4.30	36.00

Same as series FNM above, except glass tube instead of fibre tube.

Buss No.	Amperes	Volts	Net Price For Ten	100
MDR	1/10, 15/100, 2/10, 3/10 4/10, 1/2, 6/10, 8/10	250	$4.80	$40.00
MDR	1, 1/2, 1-6/10	125	4.80	40.00
MDR	2-1/2, 3, 3-2/10, 4, 5, 6-1/4, 8, 10, 15, 20	32	4.00	34.00
MDR	25, 30, 35, 40	32	4.40	37.00

13/32 x 1-1/2 inch FUSES

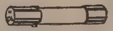
INDICATING FUSETRON FUSES



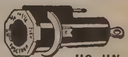
Similar to FNM types. Indicating pin extends from fuse when fuse blows. Use in signal fuse block or HPC-C fuseholder (larger than 10 amps units cannot be used in HPC-C). U/L Approved in 0-15 amp sizes.

Buss No.	Amperes	Net Price For Ten	100
FNA	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1-1/8, 1-1/4,1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3, 3-2/10, 2-1/2, 4, 4-1/2, 5, 5-6/10, 6, 6-1/4, 7, 8, 10	$8.00	$67.00
FNA	12, 15, 20, 25, 30	9.00	75.00

TYPE C AND N FUSES, HOLDERS



C, N



HC, HN

Matched glass fuses and fuseholders for specific size ranges. **Type N** fuses are dual-element time-delay or slow-blowing type. 0 to 1-1/4 amp sizes, 1/4" x 1-1/4"; 1-3/10 to 7 amp sizes, 1/4" x 1-7/16". **Type C** fuses are single-element quick-blowing type. 0 to 3-1/2 amp sizes, 1/4" x 1-1/16"; 3-6/10 to 10 amp sizes, 1/4" x 1-1/4". Holders rated at 250 volts.

TYPE N FUSES

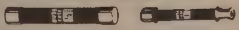
Amperes	Holder No. HN-	Volts	Net Price For Five	100
1/100, 1/32	0 to 3/10	250	$2.10	$35.00
1/16, 1/10, 15/100, 2/10, 1/4, 3/10	0 to 3/10	250	1.60	27.00
4/10	3/10 to 1/2	250	1.60	27.00
1/2	3/10 to 1/2	250	1.60	27.00
6/10	1/2 to 3/4	250	1.60	27.00
7/10, 3/4	1/2 to 3/4	250	1.60	27.00
8/10, 1	3/4 to 1-1/4	250	1.60	27.00
1-1/4	3/4 to 1-1/4	250	1.50	25.00
1-6/10	1-3/10 to	125	1.50	25.00
1-3/4	1-3/4	125	1.50	25.00
2	1-3/4 to 2-1/2	125	1.50	25.00
2-1/2	1-3/4 to 2-1/2	125	1.50	25.00
2-8/10	2-1/2 to 3-1/2	125	1.50	25.00
3-2/10	2-1/2 to 3-1/2	125	1.50	25.00
3-1/2	2-1/2 to 3-1/2	125	1.50	25.00
4	3-1/2 to 5	125	1.50	25.00
5	3-1/2 to 5	125	1.50	25.00
6-1/4	5 to 7	125	1.50	25.00
7	5 to 7	125	1.50	25.00

TYPE C FUSES

Amperes	Holder No. HC-	Volts	Net Price For Five	100
1/32	0 to 3/10	250	$2.30	$39.00
1/16	0 to 3/10	250	1.60	27.00
1/8, 3/16	0 to 3/10	250	1.20	20.00
1/4	0 to 3/10	250	.95	16.00
3/10	0 to 3/10	250	.95	16.00
3/8	3/10 to 1/2	250	.95	16.00
1/2	3/10 to 1/2	250	.95	16.00
3/4	1/2 to 3/4	250	.95	16.00
1	3/4 to 1-1/4	250	.60	9.70
1-1/4	3/4 to 1-1/4	250	.60	9.70
1-1/2	1-1/4 to 1-3/4	250	.60	9.70
1-3/4	1-1/4 to 1-3/4	250	.60	9.70
2	1-3/4 to 2-1/2	250	.60	9.70
2-1/2	1-3/4 to 2-1/2	250	.60	9.70
3	2-1/2 to 3-1/2	250	.60	9.70
3-1/2	2-1/2 to 3-1/2	250	.65	11.00
4	3-6/10 to 5	250	.65	11.00
5	3-6/10 to 5	250	.65	11.00
6	5 to 7	250	.65	11.00
7	5 to 7	250	.65	11.00
8	7 to 10	250	1.00	17.00
10	7 to 10	250	1.00	17.00

Type HC and **Type HN Fuseholders** — All sizes (specify). Net for 10 **$2.20**, Net for 100 **$18.00**.

HIGH VOLTAGE FUSES



Designed for protection of circuits up to 20 kW on DC and 30 kVA on AC.

Buss No.	Amperes	Volts	Net Price For Ten	100
HVA	3/8, 1/2, 3/4, 1, 1-1/2, 2	1000	$3.40	$28.00
HVB	1/2, 3/4, 1, 1-1/2, 2	2500	4.80	40.00
HVJ	1/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1-1/2, 2	5000	8.70	72.00
HVL	1/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1-1/2, 2	10K	16.80	140.00

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fuses and holders

SFE STANDARD FUSES

Different amperages are different lengths, making it impossible to over-fuse. Glass tube, 1/4" dia. Carry 110%, open at 135% in 1 hour. Made to SAE specifications and U/L Approved. 32 volts or less.

Buss No.	Amperes	Length In.	Net Price For Five	Net Price For 100
SFE	[illegible]	5/8	$0.39	$6.70
SFE	6	3/4	.39	6.70
SFE	7-1/2, 9	7/8	.39	6.70
SFE	14	1-1/16	.39	6.70
SFE	20	1-1/4	.39	6.70
SFE	30	1-7/16	.39	6.70

SIGNAL-INDICATING ALARM ACTIVATING TYPE UNIT

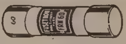
HLT
Holder
GMT
Fuse

Takes only 1/4" x 1-15/32" space. Color indicator. Rated 300 V or less; 100% for 10 min.; open at 150% within 5 min.

Buss No.	Amperes and Color of Indicator	Net Price For Ten	Net Price For 100
GMT	18/100*, 1/4†, 1/2‡, 65/100§, 3/4#, 1•, 1-1/3∧, 2⊓, 3◀, 5∞, 7-1/2♁, 10**	$5.20	$44.00
HLT	Holder, fits all GMT	5.60	47.00

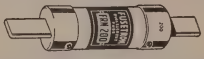
Color of Indicator: *Yellow; †violet; ‡red; §black; #brown; •gray; ∧white; ⊓orange; ◀blue; ∞green; ♁black-white; **red-white.

FUSETRON DUAL-ELEMENT FUSES



Long time-lag prevents useless shut-downs caused by ordinary fuses opening on starting currents or other harmless overloads, yet protects against short-circuits. On normal installations will guard motors against burn-out from overloads or single phasing. U/L Listed for motor running and circuit protection up to 250 volts.

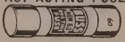
Buss No.	Amperes	Net Price For Ten	Net Price For 100
FRN	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1-1/8, 1-1/4, 1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3-2/10, 3-1/2, 4, 4-1/2, 5, 5-6/10, 6-1/4, 7, 8, 9	$6.00	$50.00
	10, 12, 15, 17-1/2, 20, 25, 30	6.60	47.00
FRN	35, 40, 45, 50, 60	10.20	85.00



Buss No.	Amperes	Net Price For Ten	Net Price For 100
FRN	70, 80, 90, 100	$23.00	$191.00

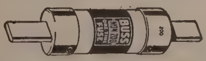
BUSS ONE-TIME FUSES

FAST ACTING FUSE



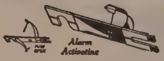
Get same care in engineering and manufacture as other BUSS products. Each can be depended upon to operate as intended under all service conditions. Carry U/L label. For voltage up to 250.

Buss No.	Amperes	Net Price For Ten	Net Price For 100
NON	1, 3, 6, 10, 15, 20, 25, 30	$1.60	$14.50
NON	35, 40, 45, 50, 60	3.00	25.50



Buss No.	Amperes	Net Price For Ten	Net Price For 100
NON	70, 80, 90, 100	$12.50	$105.00

GRASSHOPPER FUSES



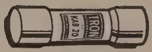
Alarm activating and signal indicating. Length: 1-43/64", except 35D (1-5/8"), 35E (1-63/64").

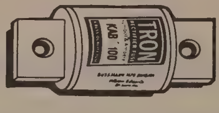
Buss No.	Amperes	Blowing Time Amp	Blowing Time Sec.	Net Price For Ten	Net Price For 100
35A*	1-1/3#	2	90	$3.80	$32.00
35B*	1-1/3**	2	90	3.80	32.00
35B*	2**	3	180	3.80	32.00
35C*	2#	3	180	3.80	32.00
35D*	1-1/3**	2	90	7.20	60.00
35E	3**	4	300	4.00	34.00
35F*	1/2#	3/4	9	3.80	32.00
35G*	3**	4-1/2	300	3.80	32.00
35H*	5**	6-1/2	300	3.80	32.00
35J†	1/2#	3/4	90	5.20	44.00
35K†	1-1/3#	2	180	7.20	60.00
35L†	2#	3	180	7.20	60.00
35M†	3**	4-1/2	300	6.60	55.00
35N†	5**	6-1/2	300	6.60	55.00
35P†	3/4#	1-1/8	90	4.80	40.00
35R*	18/100#	.270	90	4.80	40.00
35S†	1/4#	.375	90	5.20	44.00
35T*	65/100#	1.1	180	5.20	44.00

Volts: *90 or less. †160 or less. Mounting Screw: #No. 10. **No. 6.

TRON RECTIFIER FUSES

For Protection of Semiconductor Rectifiers and Similar Applications





Especially designed for protection of semiconductor rectifiers, thyristors and other solid state devices. High interrupting capacity and very fast clearing to restrict let-through current and energy to very low values. Give safe short-circuit protection for systems with fault current to 200 kA at 600 volts or less. Carry 100%, open at 1000 secs between 150% and 180% of rating; open within 1 sec at 250% of rating.

GBB SERIES

Size, 1-1/4" length x 1/4" diameter.

Buss No.	Amperes	Max. Volts	Net Each
GBB	1, 1-1/4, 2, 3, 4, 5, 6, 7, 8, 9, 10	130	$0.84
GBB	12, 15, 20, 25, 30	65	.84

KAA SERIES

Size, 1-1/2" length x 13/32" diameter. Also available up to 1000 amps; prices on request.

KAA	1/2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30	130	$1.12

KAW SERIES

Size, 1-1/2" length x 13/32" diameter.

KAW	1, 2, 3, 4, 5, 7, 8, 10, 12, 15, 20, 25, 30	130	$1.15

KAB SERIES

Size, 9/16" diameter x 2" length, values to 30 amps; 1-7/32" diameter x 3-1/8" length, 70 amps to 200 amps. Also available up to 800 amps; prices on request.

KAB	1/2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 17-1/2, 20, 25, 30	250	$1.30
KAB	70, 80, 90, 100, 150, 200	250	5.75

KAC SERIES

Size, 2-7/8" length x 9/16" diameter. Also available up to 800 amps; prices on request.

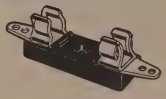
KAC	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 17-1/2, 20, 25, 30	600	$1.92

BLOCKS FOR TRON RECTIFIER FUSES

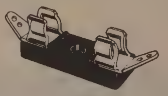
Buss No.	No. Poles	For Fuse* Symbol Amp.	Base Size In.	Net Each
4515	1	KAA or KAW 1 to 30	3/4 x 2-9/16	$0.72
4525	2		1-5/16 x 2-9/16	1.38
4535	3		2-1/16 x 2-9/16	2.05
4386	1	KAB 1 to 30	3/4 x 3-1/4	1.04
4287	2		2 x 3-1/2	2.05
3959	3		3 x 3-1/2	3.19
3556	1	KAB 70 to 100	1-1/2 x 3-1/8	2.33
3521	3		5-23/32 x 3-1/8	6.96
3595	1	KAC 1 to 30	1-1/4 x 3-1/2	1.68
3528	2		2-1/2 x 3-1/2	3.37
2795	3		3-1/2 x 3-1/2	? ?

*GBB series — use any BUSS block for 1/4" x 1-1/4" fuse.

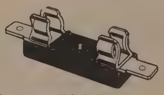
BLOCKS FOR 1/4 x 1 inch FUSES



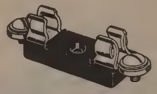
No. 4520 — 1 pole, small bakelite base, solder terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.26



No. 3992 — 1 pole, small bakelite base, one piece solder terminals and spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.31

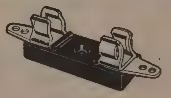


No. 2698 — 1 pole, small bakelite base, ¼ in. quick-connect terminals, spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.33



No. 4399 — 1 pole, small bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.38

BLOCKS FOR 1/4 x 1-1/4 inch FUSES



No. 4405 — 1 pole, small bakelite base, solder terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.26

No. 3998 — 1 pole, small bakelite base, one piece solder terminals and suring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.26

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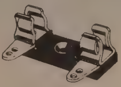
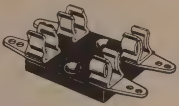
fuses and holders

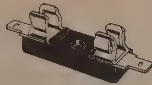
BLOCKS FOR 1/4 x 1-1/4 inch FUSES (cont'd)



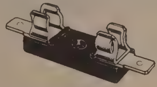
No. 4406 — 1 pole, small bakelite base, side solder terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.26



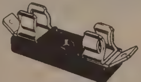
No. 4408 — 2 pole, small bakelite base, solder terminals. Spring bronze albaloy plated clips. Base dimensions, 1.000 x 1.625 inches. Net Each $0.44



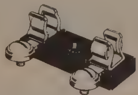
No. 2799 — 1 pole, small bakelite base, 3/16 in. quick-connect terminals. Beryllium copper albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.49



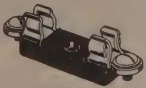
No. 2841 — 1 pole, small bakelite base, 1/4 in. quick-connect terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.33



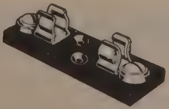
No. 2839 — 1 pole, small bakelite base, 1/4 in. quick-connect terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.33



No. 2958 — 1 pole, small bakelite base, screw side terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.40

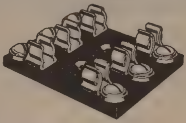


No. 4407 — 1 pole, small bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.652 inches. Net Each $0.38

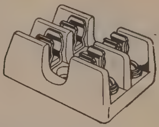


No. 4512 — 1 pole, full bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .750 x 2.1875 inches. Net Each $0.46

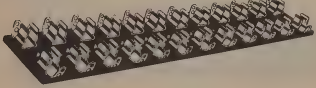
BLOCKS FOR 1/4 x 1-1/4 inch FUSES (cont'd)



No. 4532 — 3 pole, full bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, 1.6875 x 2.1875 inches. Net Each $1.40



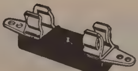
No. 4161 — 2 pole, full porcelain base with side barriers, screw terminals. Spring bronze albaloy plated clips. Base dimensions, 1.3125 x 2.2500 inches. Net Each $1.09



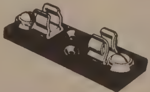
Molded black phenolic base; Albaloy plated spring clips for strong grip, high corrosion resistance. * x 1-5/8", 3823 Series.

Buss No.	No. Poles	Base Size* In.	Net Each
3823-1	1	1/2	$0.26
3823-2	2	1-1/8	.44
3823-3	3	1-3/4	.70
3823-4	4	2-3/8	.86
3823-5	5	3	1.03
3823-6	6	3-5/8	1.28
3823-7	7	4-1/4	1.44
3823-8	8	4-7/8	1.61
3823-9	9	5-1/2	1.85
3823-10	10	6-1/8	2.05
3823-11	11	6-3/4	2.25
3823-12	12	7-3/8	2.47

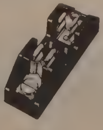
BLOCKS FOR 13/32 x 1-1/2 inch FUSES



No. 4421 — 1 pole, small bakelite base, solder terminals. Beryllium copper silver plated clips. Base dimensions, .6250 x 2.3125 inches. Net Each $0.54

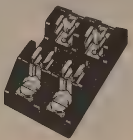


No. 4515 — 1 pole, full bakelite base, screw terminals. Beryllium copper silver plated clips. Base dimensions, .7500 x 2.5625 inches. Net Each $0.72

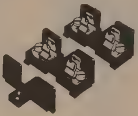


No. 2807 — 1 pole, molded phenolic base with side barriers, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .859 x 3.000 inches. Net Each $0.72

BLOCKS FOR 13/32 x 1-1/2 inch FUSES (cont'd)



No. 2808 — 2 pole, molded phenolic base with side barriers, screw terminals. Spring bronze albaloy plated clips. Base Dimensions, 1.625 x 3.000 inches. Net Each $1.20

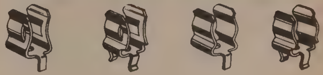


Add-On Fuse Block — Each pole locks into each other. New poles can be added at any time, each has end barrier. Net Each $0.15

No. 3742 Specify End Barrier Only. Net Each $1.09

No. 3743 Specify One-Pole Only — Base dimensions, .787 x2.562 inches. Marking strip in 50 inch lengths. Net Each $0.48

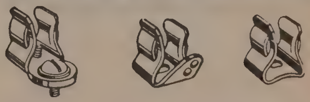
TRON FUSE CLIPS FOR P.C. BOARDS



For ¼" diameter fuses — offer economical way to mount fuses on printed circuit boards. Clips with two tabs, especially bowed that snap in P.C. board to hold clip firmly while being wane soldered, eliminates riveting. Clips available with end stops and single tabs.

BUSS No.	No. Tabs	Clip Material	Clip Finish	Net Each
1A1310-05	1	Beryllium Copper	Tin	$0.13
1A0581-01	1	Spring Bronze	Albaloy	.13
1A0581-05	1	Beryllium Copper	Tin	.13
1A1119-05	2	Beryllium Copper	Silver	.12
1A1119-10	2	Spring Bronze	Albaloy	.039
1A1120-05	2	Beryllium Copper	Silver	.10
1A1120-10	2	Spring Bronze	Albaloy	.087

BUSS FUSE CLIPS



Buss No.	Description	For Dia Fuse In.	Net Each
3434	Insulated Twin Clip	1/4	$.20
5681-15	Clip	1/4	.04
5678-14	Clip and Terminal	1/4	.046
4431	Clip Assembly	1/4	.12
4432	Clip Assembly	1/4	.145
5682-01	Clip	1/4	.07
5682-41	Clip	1/4	.036
5682-44	Clip	1/4	.036
4567	Clip Assembly	1/4	.12
4583	Clip Assembly	1/4	.135
5682-02	Clip	1/4	.07
5672-11	Clip	9/32	.06
5674-41	Clip	9/32	.06
4560	Clip Assembly	9/32	.18
4585	Clip Assembly	9/32	.26
5674-01	Clip	9/32	.12
5956-16	Clip	13/32	.06
5960-61	Clip	13/32	.078
5960-07	Clip	13/32	.18
5960-63	Clip	13/32	.078
4561	Clip Assembly	13/32	.19
4586	Clip Assembly	13/32	.32
5960-09	Clip	13/32	.18

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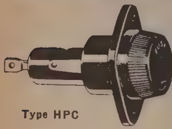
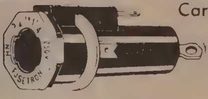
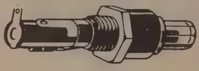
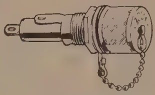
BUSS FUSEHOLDERS

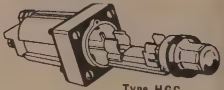
Carton Quantity 10 on all Fuseholders

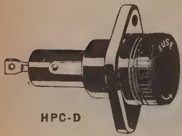

Type HPC

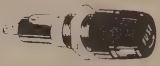

Type HC and HN

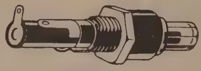

Type HKL


Type HMR and HMS


Type HGC (FHL12U)


HPC-D


Series HJ and HK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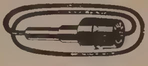
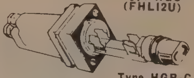
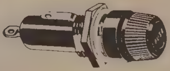
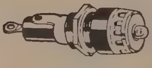

Series HR


Type HGB-C (FHL11U)


Series HCM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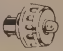
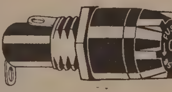

No. 5487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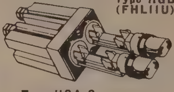
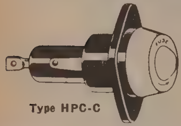
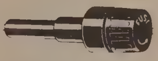
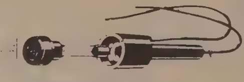

Type HGA-C (FHL10U)


Type HPC-C


Series HH and HI


Type HLQ and HLR

*VOLTAGE: On lamp indicating holders shows operating range for lamp indication. On non-indicating holders shows maximum voltage of fuses commercially available that will fit holders.

NON-INDICATING FOR 1/4 x 1 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HDI	In-line	250 or less	15A	$0.20
HHI	In-line	250 or less	15A	.30
HJM	Panel	125 or less	30A	.50
HJM-CC	Panel	125 or less	30A	.50
HJM-H	Panel	125 or less	30A	.54
9969	Spring nut for panel mounting in-line holder			.04

LAMP-INDICATING FOR 1/4 x 1 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HJL	Panel	100 to 250	20A	$2.17

SHIELDED NON-INDICATING FOR 1/4 x 1 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HMS	Panel	250 or less	30A	$6.00

SHIELDED NON-INDICATING FOR 1/4 x 1-1/4 INCH FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HMR	Panel	250 or less	30A	$6.00

SIGNAL ACTIVATING-LAMP INDICATING FOR 1/4 x 1-1/4 inch INDICATING FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HKA	Panel	125 or less	5A	$4.72

LAMP INDICATING FOR 1/4 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HGA	Panel	100 to 250	30A	$5.67
HGA-C	Panel	100 to 250	30A	6.24
HGB	Panel	100 to 250	30A	4.82
HGB-C	Panel	100 to 250	30A	5.30
HKL	Panel	100 to 250	20A	2.17
HKL-X	Panel	100 to 250	20A	2.17
HKR	Panel	24 to 32	20A	3.51
HKT	Panel	10 to 14	20A	3.51
HKU	Panel	4 to 6	20A	3.51
HKX	Panel	24 to 32	20A	3.51

VISUAL INDICATING FOR 1/4 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HLD	Panel	125 or less	30A	$0.56
5487	Knob assembly for HLD holder			.30

NON-INDICATING FOR 1/4 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HCM	Panel	250 or less	18A	$0.74
HCM-H	Panel	250 or less	18A	.78
HDJ	In-line	250 or less	15A	.20
HHJ	In-line	250 or less	15A	.30
HKP	Panel	250 or less	30A	.50
HKP-CC	Panel	250 or less	30A	.50
HKP-H	Panel	250 or less	30A	.54
HLF	Panel	250 or less	30A	.50
HMB	Panel	250 or less	30A	.50
HMJ	HDJ holder w/SFE 20 fuse & wire leads			.40
HRJ	HHJ holder w/SFE 20 fuse & wire leads			.50
HTA	Panel	250 or less	15A	.50
9969	Spring nut for panel mounting in-line holders			.04

NON-INDICATING FOR 9/32 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HCM	Panel	250 or less	18A	$0.74
HCM-H	Panel	250 or less	18A	.78

NON-INDICATING FOR 13/32 x 1-3/8 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HPC-L	Panel	600 or less	5A	$0.80

NON-INDICATING FOR 13/32 x 1-1/2 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HPC	Panel	250 or less	30A	$0.80
HPC-D	Panel	250 or less	30A	1.63

VISUAL INDICATING FOR 13/32 x 1-1/2 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HPC-C	Panel	250 or less	30A	$0.83

LAMP INDICATING FOR 13/32 x 1-1/2 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HGC	Panel	200 to 500	30A	$4.70

OTHER STANDARD AND SPECIAL FUSES, BLOCKS AND HOLDERS

If the fuses, fuse blocks and holders shown do not fit your requirements ask for information on other types. Fuses and fuse mountings to meet JAN and Military specifications also available. If you have a special problem in protection, send description or sketch giving number of circuits, type of fuse, terminals, etc., desired. We welcome such inquiries.

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military fuses and holders

BUSS FUSES LISTED UNDER MIL-F-15160D

Suffix S on Military type designation (e.g., F01A250V1/500A-S) indicates silver plating; if silver plating is not required, omit (e.g., F01A250V1/500A).

Military Type Designation	Nearest Buss Equiv.	Price Each
F01A250V1/500A S	AGX1/500	$1.52*
F01A250V1/200A-S	AGX1/200	.66*
F01A250V1/100A-S	AGX1/100	.56*
F01A250V1/32A-S	AGX1/32	.48*
F01A250V1/16A-S	AGX1/16	.32*
F01A250V1/8A-S	AGX1/8	.24*
F01A250V1/4A-S	AGX1/4	.145*
F01A250V3/8A-S	AGX3/8	.145*
F01A250V1/2A-S	AGX1/2	.145*
F01A125V3/4A-S	AGX3/4	.145*
F01A125V1A-S	AGX1	.10*
F01A125V-1/2A-S	AGX1-1/2	.10*
F01A125V2A-S	AGX2	.10*
F02A250V1/100A-S	AGC1/100	.56*
F02A250V1/32A-S	AGC1/32	.48*
F02A250V1/16A-S	AGC1/16	.24*
F02A250V	AGC1/8	.24*
F02A250V1/4A-S	AGC1/4	.145*
F02A250V3/8A-S	AGC3/8	.145*
F02A250V1/2A-S	AGC1/2	.145*
F02A250V3/4A-S	AGC3/4	.145*
F02A250V1A-S	AGC1	.10*
F02A250V1-1/2A-S	AGC1-1/2	.10*
F02A250V2A-S	AGC2	.10*
F02A250V3A-S	AGC3	.10*
F02A250V4A-S	MTH4	.12*
F02A250V5A-S	MTH5	.12*
F02A250V6A-S	MTH6	.12*
F02A125V10A-S	GLH10	.18*
F02A32V15A-S	AGC15	.078*
F02A32V20A-S	AGC20	.078*
F02B250V1/100A-S	MDL1/100	.42*
F02B250V1/32A-S	MDL1/32	.42*
F02B250V1/16A-S	MDL1/16	.32*
F02B250V1/8A-S	MDL1/8	.32*
F02B250V1/4A-S	MDL1/4	.32*
F02B250V3/8A-S	MDL3/8	.32*
F02B250V1/2A-S	MDL1/2	.32*
F02B250V3/4A-S	MDL3/4	.32*
F02B250V1A-S	MDL1	.32*
F02B250V1-1/2A-S	MDX1-1/2	.34*
F02B250V2A-S	MDX2	.34*
F02B125V3A-S	MDX3	.24*
F02B125V5A-S	MDX5	.24*
F02B32V8A-S	MDL8	.24*
F02B32V10A-S	MDL10	.24*
F02B32V15A-S	MDL15	.24*
F02B32V20A-S	MDL20	.24*
F03A250V1A-S	ABC1	.20*
F03A250V3A-S	ABC3	.20*
F03A250V5A-S	ABC5	.17*
F03A250V8A-S	ABC8	.17*
F03A250V10A-S	ABC10	.17*
F03A250V12A-S	ABC12	.20*
F03A250V15A-S	ABC15	.20*
F03A125V20A-S	ABC20	.20*
F03A125V30A-S	ABC30	.26*
F03B250V1/100A-S	MDA1/100	.52*
F03B250V1/32A-S	MDA1/32	.52*
F03B250V1/16A-S	MDA1/16	.44*
F03B250V1/8A-S	MDA1/8	.44*
F03B250V15/100A-S	MDA15/100	.44*
F03B250V3/16A-S	MDA3/16	.44*
F03B250V1/4A-S	MDA1/4	$0.44*
F03B250V3/8A-S	MDA3/8	.44*
F03B250V1/2A-S	MDA1/2	.44*
F03B250V3/4A-S	MDA3/4	.44*
F03B250V1A-S	MDA1	.44*
F03B125V3A-S	MDA3	.32*
F03B125V5A-S	MDA5	.32*
F03B125V8A-S	MDA8	.32*
F03B125V10A-S	MDA10	.32*
F03B125V12A-S	MDA12	.32*
F03B125V15A-S	MDA15	.32*
F03B125V20A-S	MDA20	.32*
F03B125V30A-S	MDA30	.32*
F05A32V10A-S	AGS10	.13*
F05A32V15A-S	AGS15	.13*
F05A32V20A-S	AGS20	.13*
F05A32V25A-S	AGS25	.13*
F05A32V30A-S	AGS30	.13*
F05B32V10A-S	MDM10	.32*
F05B32V15A-S	MDM15	.32*
F05B32V20A-S	MDM20	.32*
F05B32V25A-S	MDM25	.32*
F05B32V30A-S	MDM30	.32*
F06A250V1A-S	ABS1	.32*
F06A250V2A-S	ABS2	.32*
F06A250V3A-S	ABS3	.32*
F06A250V5A-S	ABS5	.30*
F06A250V10A-S	ABS10	.30*
F06A250V15A-S	ABS15	.30*
F07A250V1A-S	AGU1	.19*
F07A250V2A-S	AGU2	.19*
F07A250V3A-S	AGU3	.19*
F07A32V5A-S	AGU5	.19*
F07A32V10A-S	AGU10	.19*
F07A32V15A-S	AGU15	.19*
F07A32V20A-S	AGU20	.19*
F07A32V30A-S	AGU30	.19*
F07B125V1A-S	MDR1	.48*
F07B125V2A-S	MDR2	.48*
F07B125V3A-S	MDR3	.40*
F07B32V5A-S	MDR5	.40*
F07B32V10A-S	MDR10	.40*
F07B32V15A-S	MDR15	.40*
F07B32V20A-S	MDR20	.40*
F07B32V30A-S	MDR30	.44*
F09A250V1A-S	BAN1	.18
F09A250V2A-S	BAN2	.18
F09A250V3A-S	BAN3	.18
F09A250V3-1/2A-S	BAN3-1/2	.18
F09A250V5A-S	BAN5	.18
F09A250V6A-S	BAN6	.18
F09A250V6-1/4A-S	BAN6-1/4	.18
F09A250V7A-S	BAN7	.18
F09A250V8A-S	BAN8	.18
F09A250V10A-S	BAN10	.18
F09A250V10A-S	BAN15	.18
F09A250V20A-S	BAN20	.18
F09A250V25A-S	BAN25	.18
F09A250V30A-S	BAN30	.18
F09B250V1/10A-S	FNM1/10	.43
F09B250V15/100A-S	FNM15/100	.43
F09B250V2/10A-S	FNM2/10	.43
F09B250V3/10A-S	FNM3/10	.43
F09B250V4/10A-S	FNM4/10	.43
F09B250V1/2A-S	FNM1/2	.43
F09B250V6/10A-S	FNM6/10	.43
F09B250V8/10A-S	FNM8/10	.43
F09B250V1A-S	FNM1	.43
F09B250V1-1/4A-S	FNM1-1/4	$0.43
F09B250V1-6/10A-S	FNM1-6/10	.43
F09B250V2A-S	FNM2	.43
F09B250V2-1/2A-S	FNM2-1/2	.43
F09B250V3-2/10A-S	FNM3-2/10	.43
F09B250V4A-S	FNM4	.43
F09B250V5A-S	FNM5	.43
F09B250V6-1/4A-S	FNM6-1/4	.43
F09B250V8A-S	FNM8	.43
F09B250V10A-S	FNM10	.43
F09B125V15A-S	FNM15	.43
F09B32V20A-S	FNM20	.43
F09B32V25A-S	FNM25	.43
F09B32V30A-S	FNM30	.43
F15A250V1A-S	NFA1	.20
F15A250V3A-S	NFA3	.20
F15A250V6A-S	NFA6	.20
F15A250V10A-S	NFA10	.20
F15A250V15A-S	NFA15	.20
F15A250V20A-S	NFA20	.20
F15A250V25A-S	NFA25	.20
F15A250V30A-S	NFA30	.20
F15B250V1A-S	FRN1	.60
F15B250V1-1/10A-S	FRN1-6/10	.60
F15B250V2A-S	FRN2	.60
F15B250V2-1/2A-S	FRN2-1/2	.60
F15B250V1-6/10A-S	FRN3-2/10	.60
F15B250V4A-S	FRN4	.60
F15B250V5A-S	FRN5	.60
F15B250V6-1/4A-S	FRN6-1/4	.60
F15B250V8A-S	FRN8	.60
F15B250V10A-S	FRN10	.66
F15B250V12A-S	FRN12	.66
F15B250V15A-S	FRN15	.66
F15B250V20A-S	FRN20	.66
F15B250V25A-S	FRN25	.66
F15B250V30A-S	FRN30	.66
F60C500V1/8A-S	KLM1/8	1.14
F60C500V1/4A-S	KLM1/4	1.14
F60C500V3/8A-S	KLM3/8	1.14
F60C500V1/2A-S	KLM1/2	1.14
F60C500V3/4A-S	KLM3/4	1.14
F60C500V1A-S	KLM1	1.14
F60C500V3A-S	KLM3	1.14
F60C500V6A-S	KLM6	1.14
F60C500V8A-S	KLM8	1.14
F60C500V10A-S	KLM10	1.14
F60C500V15A-S	KLM15	1.14
F60C500V20A-S	KLM20	1.14
F60C500V25A-S	KLM25	1.14
F60C500V30A-S	KLM30	1.14

*Add $9.00 Stamping Charge and a minimum $6.00 per thousand Silver Plating Charge per item.

FUSE CLIPS LISTED MIL-F-21346 DATED 24 APRIL 1958

FC21AN	5682-11	$0.074
FC21BN	5674-10	.13
FC21CN	5960-23	.19
FC22AN	5678-05	.13
FC22CN	5623-11	.29

INSTRUMENT TYPE FUSES LISTED UNDER MIL-F-23419A, DATED 19 DEC. 1966

Part No.	Type Designation	Nearest Buss Equivalent	Price Each
M23419/1-001	FM01 1/200A	GMU 1/200A	$1.03
M23419/1-002	FM01 1/100A	GMU 1/100A	1.03
M23419/1-003	FM01 1/64A	GBU 1/64A	1.03
M23419/1-004	FM01 1/32A	GMU 1/32A	1.03
M23419/1-005	FM01 1/16A	GMU 1/16A	1.03
M23419 1-006	FM01 1/10A	GMU 1/10A	.79
M23419/1-007	FM01 1/8A	GMU 1/8A	.79
M23419/1-008	FM01 2/10A	GMU 2/10A	.79
M23419/1-009	FM01 1/4A	GMU 1/4A	.79
M23419/1-010	FM01 3/10A	GMU 3/10A	.79
M23419/1-011	FM01 4/10A	GMU 4/10A	.79
M23419/1-012	FM01 1/2A	GMU 1/2A	.79
M23419/1-013	FM01 6/10A	GMU 6/10A	.79
M23419/1-014	FM01 3/4A	GMU 3/4A	.79
M23419/1-015	FM01 1A	GMU 1A	.79
M23419/1-016	FM01 1-1/2A	GMU 1-1/2A	.79
M23419/1-017	FM01 2A	GMU 2A	.79
M23419/1-018	FM01 3A	GMU 3A	.79
M23419/1-019	FM01 4A	GMU 4A	.79
M23419/1-020	FM01 5A	GMU 5A	.79

FM03 listed under MIL-F-23419A, 1/100 to 25 amps.

OTHER BUSS MIL FUSES AND BLOCKS

Fuses to MIL-F-15160D also available in styles:

F10A
F11A
F14A
F14B
F15B
F16A
F16B
F19A
F19B
F20A
F20B
F21A
F21B
F22A
F22B
F27A
F28A
F29A
F30A
F36A
F36B
F37A
F37B
F38A
F39A
F39B
F40A
F40B
F50A
F61C
F62C
F63C
F64C
F65C
F66C

Fuse Blocks to MIL-F-21346, Aircraft Limiters to MIL-F-5372C and Aircraft Blocks to MIL-F-5372C are also available.

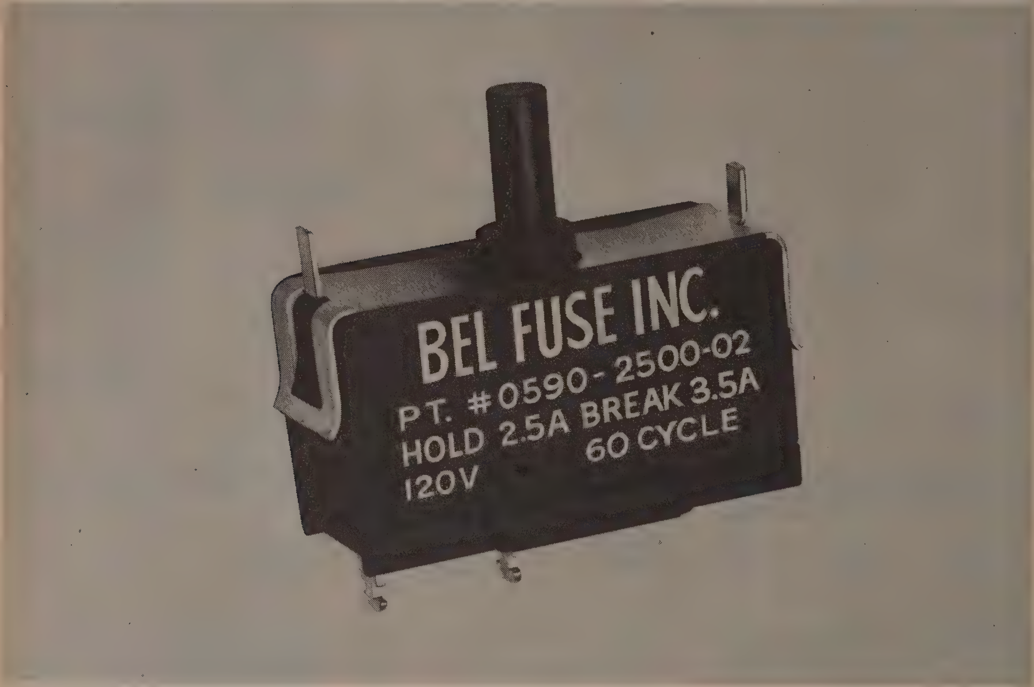
BUSS FUSEHOLDERS LISTED UNDER MIL-F-19207B, DATED 31 AUG. 1966

Extractor post, blown fuse indicating and non-indicating types.

Buss and Military Type Designation	Electrical Rating	Price Each, Lots of 1-99	100-499	500-999
FHL10U	30A, 90-250V	$4.39	$3.81†	—
FHL11U	30A, 90-250V	3.53	2.94†	—
FHL12U	30A, 90-500V	4.01	3.48†	—
FHL17G1	20A, 90-250V	2.27	1.96	$1.63
FHL18G1-1	20A, 12-22V	3.47	2.99	2.49
FHL18G1-2	20A, 23-33V	3.47	2.99	2.49
FHL18G1-3	20A, 34-45V	3.47	2.99	2.49
FHL18G1-4	20A, 46-60V	3.47	2.99	2.49
FHL18G1-5	20A, 61-80V	3.47	2.99	2.49
FHL18G1-6	20A, 81-90V	3.47	2.99	2.49
FHL18G1-7	20A, 2.5-4V	3.47	2.99	2.49
FHL18G1-8	20A, 5-7V	3.47	2.99	2.49
FHL18G1-9	20A, 8-12V	3.47	2.99	2.49
FHN19G	15A, 250V	1.09	.94	.79
FHL22W	20A, 250V	1.56	1.35	1.13
FHN23W	30A, 250V	1.86	1.59	1.34
FHN26G1	30A, 250V	.86	.74	.61
FHL29G-1	30A, 12-22V	5.76	5.01†	—
FHL29G-2	30A, 23-33V	5.76	5.01†	—
FHL29G-3	30A, 34-45V	5.76	5.01†	—
FHL29G-4	30A, 46-60V	5.76	5.01†	—
FHL29G-5	30A, 61-80V	5.76	5.01†	—
FHL29G-6	30A, 81-90V	5.76	5.01†	—
FHL30G-1	30A, 12-22V	5.94	4.95†	—
FHL30G-2	30A, 23-33V	5.94	4.95†	—
FHL30G-3	30A, 34-45V	5.94	4.95†	—
FHL30G-4	30A, 46-60V	5.94	4.95†	—
FHL30G-5	30A, 61-80V	5.94	4.95†	—
FHL30G-6	30A, 81-90V	5.94	4.95†	—
FHN31G1	5A, 250V	1.07	.91	.73
FHN42W	5A, 125V	1.14	.95	.76

†Lots 100 Up.

bel defining a degree of excellence


BEL FUSE INC.
P.T. #0590-2500-02
HOLD 2.5A BREAK 3.5A
120V 60 CYCLE

CIRCUIT BREAKERS by BEL FUSE

FEATURES

- ★ Break currents from 1 ampere to 5 amperes
- ★ "Type 1" — Hold-break differential is 150% of rated current.
- ★ "Type 2" — Hold-break differential is 140% of rated current.
- ★ Temperature compensated from 0° to 80°C.

WRITE FOR COMPLETE CATALOG.

bel **BEL FUSE INC.** 203 Van Vorst Street • Jersey City, N. J. 07302 • (201) 432-0463 • TWX 710-730-5301

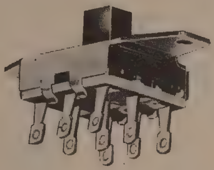
CW INDUSTRIES

SLIDE SWITCHES

QUALITY PRODUCTS THROUGH CREATIVE ENGINEERING

STANDARD SLIDE SWITCHES

Wide Range of Basic Types Available

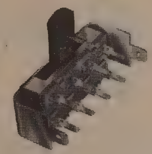


TOP ACTUATED SLIDE SWITCHES

Available from current rating of 3.0 amps AC 0.5 amps DC at 125 volts to 11.0 amps AC at 125 volts, and 8.0 amps DC at 12 volts.

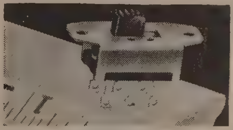
Types include 1 pole, 2 pole, 3 pole and 4 pole in two positions, three positions and four positions. Detent or spring return action.

Variety of mounting options, terminal choice and supplemental features available.



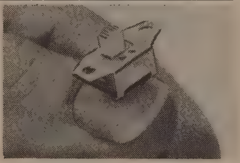
"SYDEWYNDER®" SIDE-ACTUATED SLIDE SWITCHES

Available as single and double pole in 2 positions or 3 positions. Current rating 3.0 amps AC 0.5 amp DC at 125 volts. Mount with two mounting holes on 1⅛″ centers or snap into printed circuit board. Variety of knob lengths and colors available. Particularly suitable for applications where switch actuation from side of switch saves extra mechanical assembly.



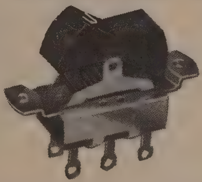
SWIDGET® MINIATURE SLIDE SWITCHES

Available in types having up to 3 poles and 4 positions. 2-position switches mount on .812″ centers; other switches have slightly longer mounting centers. Side or top actuated. Detent or spring return. Variety of terminals and knob sizes. Rated at 0.5 amp AC/DC at 125 volts.



"SWIDGET® JR." SUB-MINIATURE SLIDE SWITCHES

Available as SPDT and DPDT. Mount on 0.562″ centers. Overall length .762″. Rated 0.5 amp AC/DC at 125 volts.



ROCKER SWITCHES

Dress up your unit with handsome CW rocker switches. Four basic rocker superstructures can be added to most CW models. Types include 2-position switches with one, two, three or four poles, in a variety of mountings, rocker knobs and features. Rated from 3.0 amps AC 0.5 amp DC at 125 volts, to 11.0 amps AC at 125 volts and 8.0 amps DC at 12 volts.

Other components manufactured by CW INDUSTRIES include Precision Film Resistors, Wire Wound Potentiometers and Connectors for Flat Flexible Cables. Precision Resistors are available in 1/10 watt through 1/4 watt (RN55, RN60 and RN65) and are fully described in CW Bulletin 2094. Wire Wound Potentiometers described in CW Bulletin 2080 (¾″ diameter) are designed for commercial applications requiring exacting electrical characteristics at competitive price. CW "CEE-WEE" Connectors for Flat Flexible Cables having round and flat conductors are described in EEM Section 2100. Full engineering details are furnished in CW Bulletin 2097.

CW research and engineering facilities are always at your service, to consult with you on any engineering or development problem. Engineering bulletins describing in detail CW products are available upon request. Call or write at any time for consultation.

CW INDUSTRIES

550 DAVISVILLE ROAD · WARMINSTER, PA. 18974
Phone: 215-355-7080 / TWX 510-667-1875

C & K Switches

C & K Components produces a wide variety of switches to meet many electrical and mechanical requirements. The major product lines consist of **Toggles, Rocker and Lever Handles,** three families of **Pushbuttons and Illuminated Rockers.** Many actuator, mounting, and terminal options, including printed circuit configurations, offer the possibility for a wide variety of panel styles consistent with efficient assembly and the "human factor" requirements.

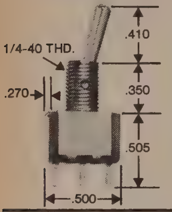
Shown here are a few examples of C & K switches. Samples of these switches can be obtained by contacting the factory directly and specifying the appropriate EEM-number. For more complete information ask for our new 24-page catalog 703 (EEM).

TOGGLES

SPECIFICATIONS: Contact rating: 5 amp resistive at 120 VAC or 28 VDC, 2 amp resistive at 250 VAC. **Gold Plated Brass Contact:** 0.4 volt-amps (VA) max. at 20 V max. AC or DC. **Electrical life:** 100,000 make and break cycles at full load on all models ending in 01. All other models 40,000 cycles.

SPDT EEM-1

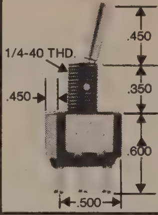
7101 SPZQ



7101: On-none-or
S: Standard toggle
P: Pinning
Z: Solder terminal
Q: Coin silver contacts

DPDT EEM-2

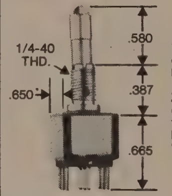
7203 P3CQE



7203: On-off-on
P3: Flatted toggle
C: PC terminal
E: Terminal seal
Q: Coin silver contacts

3PDT EEM-3

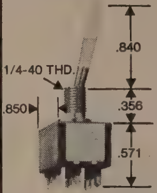
7305 KZ3B



7305: (On)-off-(on)
K: Locking lever
Z3: Quick connect terminal
B: Gold plated brass contacts

4PDT EEM-4

7407 L3HZQ



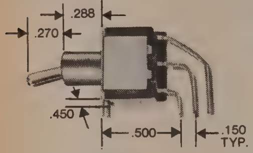
7407: On-off-(on)
L3: Plastic toggle
H: High torque bushing
Z: Solder terminal
Q: Coin silver contacts

PC MOUNTED

SPECIFICATIONS: Contract rating: 0.4 volt-amp (VA) max at 20 V max (AC or DC). **Electrical life:** 100,000 make and break cycles at full load on all models ending in 01. All other models 40,000 cycles.

DPDT EEM-5

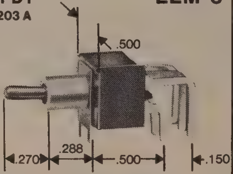
7201 AV2



7201: On-none-on
AV2: Vertical mounting

DPDT EEM-6

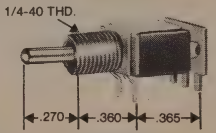
7203 A



7203: On-off-on
A: Vertical mounting

SPDT EEM-7

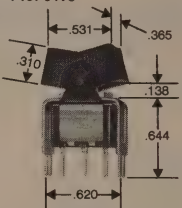
7105 R



7105: (On)-off-(on)
R: Right angle mounting

SPDT EEM-8

7107 J1V3



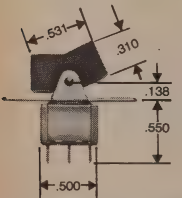
7107: On-off-(on)
J1: Rocker
V3: Vertical support

ROCKERS

SPECIFICATIONS: Contact rating: 5 amp resistive at 120 VAC or 28 VDC, 2 amp resistive at 250 VAC. **Gold Plated Brass Contact:** 0.4 volt-amps (VA) max. at 20 V max. AC or DC. **Electrical life:** 100,000 make and break cycles at full load on all models ending in 01. All other models 40,000 cycles.

SPDT EEM-9

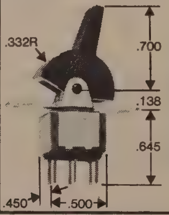
7101 J1ZQ



7101: On-none-on
J1: Rocker
Z: Solder terminal
Q: Coin silver contacts

DPDT EEM-10

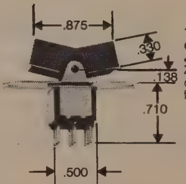
7203 J2CQE



7203: On-off-on
J2: lever handle
C: PC terminal
E: Terminal seal
Q: Coin silver contacts

3PDT EEM-11

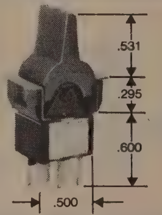
7305 J3Z3



7305: (On)-off-(on)
J3: Rocker
Z3: Quick connect terminal

2PDT EEM-12

7207 J60CQ



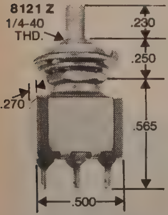
7207: On-off-(on)
J60: Snap-in lever handle
C: PC Terminal
Q: Coin silver contacts

PUSH BUTTONS

SPECIFICATIONS: Contact rating (except 8631): 1 amp resistive at 120 VAC or 28 VDC. **Contact rating (8631 only):** ½ amp resistive at 120 VAC or 28 VDC. **Electrical life (8121 and 8221):** 60,000 cycles at full load. **Electrical life (8532 and 8631):** 1 million cycles full load.

SPDT EEM-13

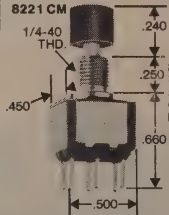
8121 Z



8121: Momentary snap-acting
Z: Solder terminals

DPDT EEM-14

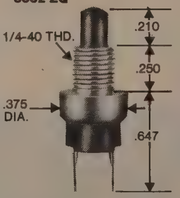
8221 CM



8221: Momentary snap-acting
C: PC terminal
M: Medium cap

SPST EEM-15

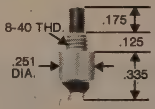
8532 ZQ



8532: Momentary subminiature (N.O.)
Z: Solder terminal
Q: Coin silver contacts

SPST EEM-16

8631 QE



8631: Momentary microminiature (N.O.) with solder terimals
E: Terminal seal
Q: Coin silver contacts

C & K COMPONENTS, INC. • 103 MORSE ST. • WATERTOWN, MASS. 02172 • (617) 926-0800 • TWX: 710-327-0460

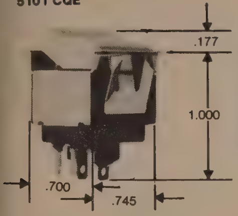
C & K Switches

SPECIFICATIONS: Contact rating: 5 amp resistive at 120 VAC or 28 VDC, 2 amp resistive at 250 VAC. **Gold Plated Brass Contact:** 0.4 volt-amps (VA) max. at 20 V max. AC or DC. **Electrical life:** 100,000 make and break cycles at full load on all models ending in 01. All other models 40,000 cycles.

ILLUMINATED ROCKERS

EEM-17

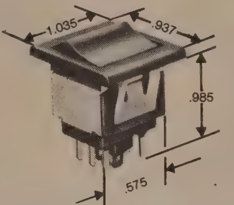
SPDT
5101 CQE


.177
1.000
.700
.745

5101: On-none-on
C: PC terminal
E: Terminal seal
Q: Coin silver contacts

EEM-18

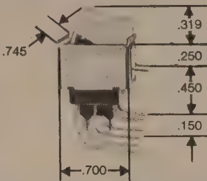
DPDT
5203 J11CQ


1.035
.937
.985
.575

5203: On-off-on
J11: Bezel
Z: Solder terminal
C: PC Terminal
Q: Coin silver contacts

EEM-19

DPDT
5205 AV2


.745
.319
.250
.450
.150
.700

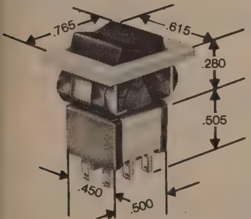
5205: (On)-off-(on)
AV2: Right angle PC mounting

Contact rating: 0.4 volt-amps (VA) max. at 20 V max. (AC or DC).

AVAILABLE BEZEL OPTIONS

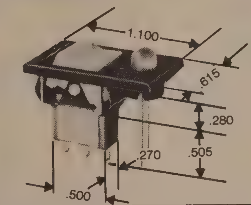
EEM-20

Bezels
J51
Snap-in bezel with rocker


.765
.615
.280
.505
.450
.500

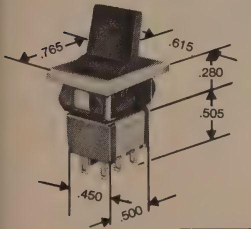
EEM-23

Snap-in Bezel for L.E.D.'s
J52
Snap-in rocker with bezel for L.E.D.


1.100
.615
.280
.270
.505
.500

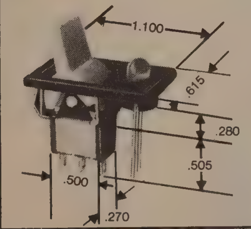
EEM-21

J61
Snap-in bezel with lever handle


.765
.615
.280
.505
.450
.500

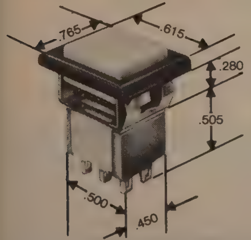
EEM-24

J62
Snap-in lever handle with bezel for L.E.D.


1.100
.615
.280
.505
.500
.270

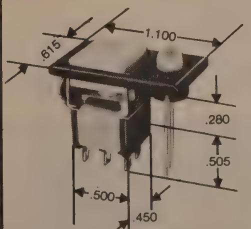
EEM-22

J81
Snap-in bezel for snap acting push buttons


.765
.615
.280
.505
.500
.450

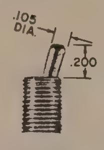
EEM-25

J82
Snap-in pushbutton with bezel for L.E.D.

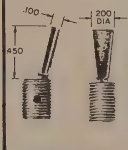

.615
1.100
.280
.505
.500
.450

OTHER TOGGLE OPTIONS

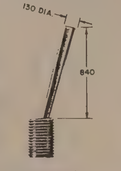
Actuators



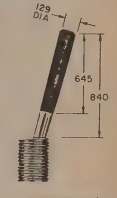
M: Short toggle


.100
.200 DIA
.450

P3: Flatted toggle

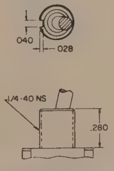


L: Long toggle

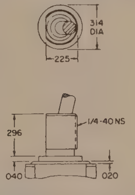

.129 DIA
.645
.840

L3: Plastic toggle

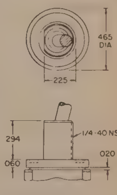
Bushings


.040
.028
1/4-40 NS
.280

D: Short bushing

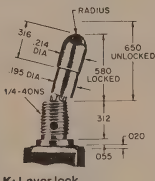

.314 DIA
.225
1/4-40 NS
.296
.040
.020

H: High torque bushing


.465 DIA
.225
1/4-40 NS
.294
.060
.020

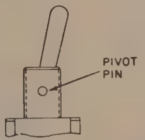
CW: Splash proof

Lever Locks


RADIUS
.316
.214 DIA
.650 UNLOCKED
.195 DIA
.580 LOCKED
1/4-40NS
.312
.020
.055

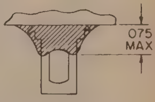
K: Lever lock

Pinning



P: Pinning

Sealing



E: Terminal seal

Contact Material

Q-Coin Silver (Standard for toggles, rocker and lever handles)
B-Brass, gold plated (Standard for PC mounted)
G-Coin silver, gold plated

Switching Toggle, PC Mounted and Rockers—Functions

C & K No.	Circuit	Function	C & K No.	Circuit	Function
7101	SPDT	On-none-on	7301	3PDT	On-none-on
7103	SPDT	On-off-on	7303	3PDT	On-off-on
7105	SPDT	(On)-off-(on)	7305	3PDT	(On)-off-(on)
7107	SPDT	On-off-(on)	7307	3PDT	On-off-(on)
7108	SPDT	On-none-(on)	7308	3PDT	On-none-(on)
7109	SPDT	None-on-(on)	7309	3PDT	None-on-(on)
7201	DPDT	On-none-on	7401	4PDT	On-none-on
7203	DPDT	On-off-on	7403	4PDT	On-off-on
7205	DPDT	(On)-off-(on)	7405	4PDT	(On)-off-(on)
7207	DPDT	On-off-(on)	7407	4PDT	On-off-(on)
7208	DPDT	On-none-(on)	7408	4PDT	On-none-(on)
7209	DPDT	None-on-(on)	7409	4PDT	None-on-(on)
7211	DPDT*	On-on-on	7411	4PDT*	On-on-on
7213	DPDT*	On-on-(on)	7413	4PDT*	On-on-(on)
7215	DPDT*	(On)-on-(on)	7415	4PDT*	(On)-on-(on)

*Special purpose, three position on-on-on types. ( ) Momentary positions.

C & K COMPONENTS, INC. • 103 MORSE ST. • WATERTOWN, MASS. 02172 • (617) 926-0800 • TWX: 710-327-0460

CAPITOL

CIRCUIT SELECTOR SWITCHES

CAPITOL SWITCHES are designed for long trouble free life.

GENERAL SPECIFICATIONS (All Switches except R Series)

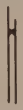
MATERIALS & FINISHES

Aluminum parts (used wherever practical to achieve light weight) are anodized.
Steel & Brass parts are heavily plated to prevent corrosion.
Phenolics:
Jack spacers — standard grade XXXP.
Other phenolic parts are grade XX or better.
All phenolic parts are fungus resistant.
Leaf Springs standard — 18% B nickel silver.
Contacts & material standard, welded palladium discs.
Other Contact Material: Gold Alloy (WE #1) or Fine Silver.
Contact Ratings: Standard — 3 amp 110 volts AC non-inductive or 1 amp at 28V DC.
Terminals: Standard are hot tin dipped to accommodate two #18 wires. On request, right angle terminals can be provided. Taper tab terminals (to take AMP #78) available. Also PC terminals.

STANDARD CONTACT ASSEMBLIES AVAILABLE

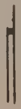
The versatility of Capitol designs enables you to use a wide variation of combinations of the contact assemblies listed above, to operate from the same position. ie. a stack consisting of 2 Form A's, 1 Form B, 1 Form C.

FORM "A"



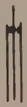
Single Pole Make

FORM "B"



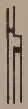
Single Pole Break

FORM "C"



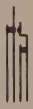
Single Pole Double Throw

FORM "D"



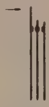
Make Before Break

FORM "E"



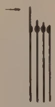
Break Make Break

FORM "H"



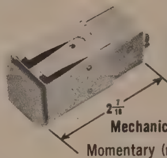
Single Pole Make-Make

FORM "J"



Single Pole Make-Make-Make

R-SERIES SINGLE UNIT ILLUMINATED SWITCHES AND INDICATORS (PILOT LIGHTS)



R Series - metal dress frame (bezel) and U clamp.

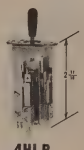
R-F Series - flush mounted from the front of panel.

R-R Series - barrier mounted from rear of panel.

Mechanical actions available	Model
Momentary (non-locking)	RN, RNF, RNR
Alternate Action (push to lock—push to release)	RL, RLF, RLR
Indicators (pilot lite unit)	RI, RIF, RIR

R-F Series

LEVER SWITCHES



4HLB

HLB-S

HLB

HLL

- Steel and brass parts are heavily plated to prevent corrosion. ● Positive detent feel.
- All have the same mechanical and electrical capabilities. The basic difference is in the size and method of mounting.
- Lever actions in any combination: Lock, Non-lock, No throw.
- Wide combination of contact assemblies. This allows for a varied circuitry arrangement.
- Can be supplied (on request, at no additional charge) with right angle terminals. This cuts down on the depth requirement behind the panel.
- The model HLL features color coded positions. Filters available for position 1 and 2 are red, green, yellow and amber.
- Neutral position is also illuminated but is not color coded. Take T2 Short Lamp.

ILLUMINATED

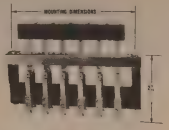
Model HPC rugged aluminum frame. Accommodates standard T-2 telephone slide base lamp. Lamp easily replaced from front by removing lens.

Standard buttons furnished are clear lucite. Transparent colors are available on request, (red, green, blue, amber).

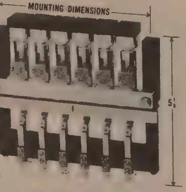
CAPITOL

S-SERIES

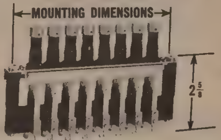
MULTI POSITION PUSH BUTTON
STRIP SWITCHES
ILLUMINATED & NONILLUMINATED



S



S-ID



S-WITH WATERPROOF BOOT SEALS

Capitol Model "S" series represents the largest selection of illuminated and non-illuminated multiple position strip switches. They offer many variations in mechanical action, methods of illumination and a wide range of contact combinations. The versatility of these switches will meet most any switching requirement.

The non-illuminated switch measures only 2-9/16″ behind the panel. It features a nylon actuator molded on a 5/32″ square metal plunger shaft. Because the shaft is metal rather than plastic, it is extremely rugged.

The illuminated switches are ideal for applications requiring positive knowledge of a position in operation. They will eliminate (in many cases) the need for independent pilot lites. Each position has an independent lamp assembly illuminated either by an external circuit or directly from the switch, depending on how wired. These switches are constructed so that the lamp does not travel when a position is engaged, thus eliminating excessive shock of the lamp. All lamps are easily removed from the top without having to take the assembly apart. If the lamp is to be energized when a position is engaged, an extra set of contacts is usually required for wiring from the lamp terminals to the contact terminals.

SERIES DESIGNATIONS

100	button centers on 5/8″
200	button centers on 1/2″ (non-illuminated only)
300	button centers on 3/4″
400	button centers on 7/8″
500	button centers on 9/16″

MECHANICAL ACTIONS

BASIC MODEL	ACTION
MODEL S	INTERLOCKING
MODEL SP	POSITIVE LOCK-OUT (no two operate)
MODEL SN	MOMENTARY non-locking)
MODEL SPN	MOMENTARY (non-locking) but with LOCKOUT feature.
MODEL SA	ACCUMULATIVE LOCK-UP
MODEL SL	PUSH TO LOCK — PUSH TO RELEASE (not available in 200 and 500 series)
MODEL SLP	PUSH TO LOCK — PUSH TO RELEASE (alternate action). Same as above (Model SL) except it has a lock-out feature so that only one position in the strip may be engaged at one time.

These mechanical actions are available on either the illuminated or Non-illuminated Switch. Combinations of mechanical features described on these switches can be furnished on any one switch for special applications. These switches can also be banked with mechanical interlock and positive lockout between all positions in the bank. A solenoid release can be furnished for remote control of any of these switches (except model SL and SLP), either single strips or banks. Contact assemblies may be mounted on either or both sides of the stack assembly bar (except models SL and SLP) for maximum flexibility of electrical control. Standard contact assemblies have underlapping action — a released position will return to normal before contacts of a newly operated position are actuated.

MODEL "S" SERIES

NUMBER OF POSITIONS

PLUNGER TRAVEL FOR ALL "S" SERIES

Model	Full Travel	Lock In
S	5/16	1/4
SA	5/16	1/4
SL	11/32	1/4
SN	5/16	—
SP	9/32	1/4
SPN	9/32	—

Mounting Dimensions

POSITIONS	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
100 SERIES	2.125	2.750	3.375	4.000	4.625	5.250	5.875	6.500	7.125	7.750	8.375	9.000	9.625	10.250	10.875	11.500	12.125	12.750	13.375
200 SERIES	1.750	2.250	2.750	3.250	3.750	4.250	4.750	5.250	5.750	6.250	6.750	7.250	7.750	8.250	8.750	9.250	9.750	10.250	10.750
300 SERIES	2.250	3.000	3.750	4.500	5.250	6.000	6.750	7.500	8.250	9.000	9.750	10.500	11.250	12.000	12.750	13.500	14.250		
400 SERIES	2.375	3.250	4.125	5.000	5.875	6.750	7.625	8.500	9.375	10.250	11.125								
500 SERIES	2.062	2.625	3.187	3.750	4.312	4.875	5.437	6.000	6.562	7.125	7.687	8.250	8.812	9.375	9.937	10.500	11.062	11.625	12.187

CAPITOL

THE CAPITOL MACHINE AND SWITCH CO.
87 Newtown Road, Danbury, Conn. 06810

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28 PAGE
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Representatives in principal cities Tel: 203-744-3300

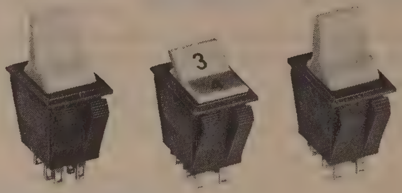
CARLINGSWITCH

THE BIGGEST SINGLE NAME IN SWITCHES

Here are some recent additions to our switch line.

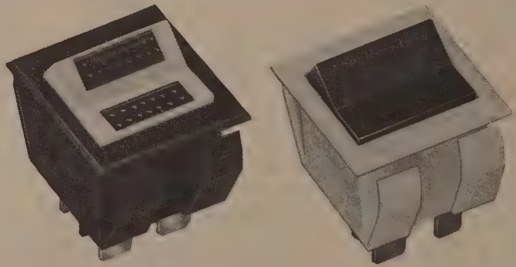
They have new features, new materials, new designs, new ease of installation.

All, however, maintain our standards of quality, reliability, and performance.

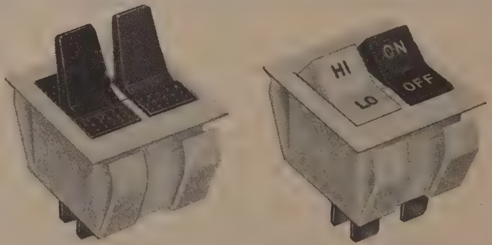


SUBMINIATURE TIPPETTES
Fully insulated nylon body, bracket and actuator. 10 amps, 125 VAC.

CURVED ROCKER TIPPETTES
Fully insulated nylon body, bracket and actuator. Plain (smooth) or lighted versions. May be imprinted.



DOUBLE POLE MINI TIPPETTES
Molded nylon. Lighted and unlighted versions. Imprinting available.



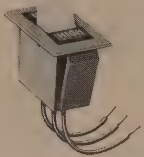
TWO SINGLE POLE TIPPETTES IN COMMON BASE
Paddle and rocker versions available in lighted and unlighted styles. Imprinting available.

CARLINGSWITCH, INC.
505 New Park Avenue, West Hartford, Ct. 06110. Tel. 203/233-5551 TWX 810-845-5150

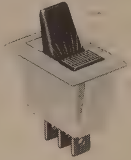
CARLINGSWITCH

THE BIGGEST SINGLE NAME IN SWITCHES

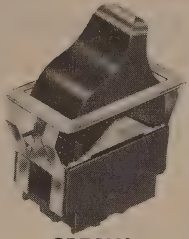
MINI TIPPETTE SERIES



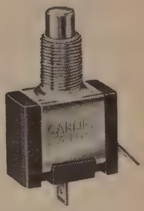
MINI TIPPETTE SERIES



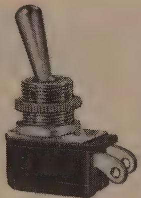
LIGHTED MINI TIPPETTE SERIES



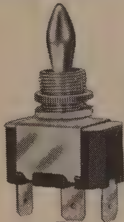
SPECIAL LIGHTED TIPPETTE



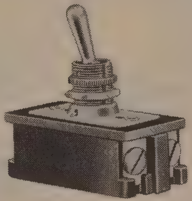
300 SERIES



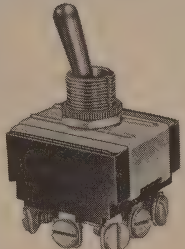
110 SERIES



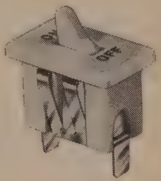
F SERIES



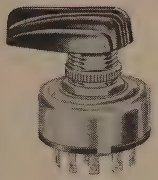
D & F SERIES



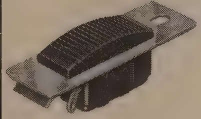
H SERIES



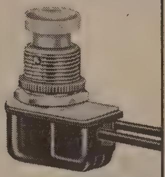
215 SERIES



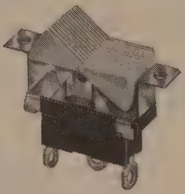
800 SERIES



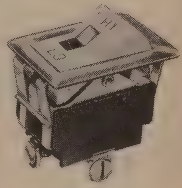
SL-110 SERIES



P-27 SERIES



TIPPETTE SERIES



LIGHTED TIPPETTE SERIES

PUSH • SLIDE • TOGGLE • ROTARY • TRIGGER • TIPPETTE and LIGHTED TIPPETTE SWITCHES

for Appliance, Aircraft, Automotive, Electronic, Marine, Military, Motor Control, Special Applications

In addition to the items shown above are thousands of variations and adaptations designed for our customers' specific needs. We are constantly engaged in the development of new products and welcome the opportunity to serve your needs. Please contact one of our distributors to discuss your requirements in detail or write for our latest catalog.

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Wheaton, Ill. 60187

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Hialeah, Fla. 33014

TEXASWITCH, INCORPORATED
2942 Congressman Lane
Dallas, Texas 75220

CHERRY®

NOTICE: Due to unstable market conditions on precious metals which are used for contact surfaces on switches and printed circuit boards, all list prices shown here are subject to a surcharge to compensate for increases in Silver and Gold prices since January 10, 1974. The base prices for these two metals on January 10, 1974, were: Gold $117.00 Troy Ounce, Silver $3.35 Troy Ounce.

FOR COMPLETE SPECIFICATIONS ON ALL CHERRY PRODUCTS REQUEST FULL LINE CATALOG

DISCOUNT SCHEDULE FOR ALL SNAP-ACTION SWITCHES

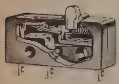
Quantity	Discount	Multiplier
1 to 50	List	1.00
51 to 100	27%	0.73
101 to 500	37%	0.63
501 to 1000	43%	0.57
1001 to 2000	48%	0.52
2001 to 5000	54%	0.46

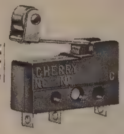
For quantities greater than those shown consult factory for quotation.

NOTES: (Apply To ALL Products In This Product/Price List)

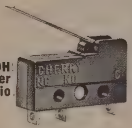
1. Cash Terms: ½% 10 days, net 30 days.
2. Shipments: F.O.B. Shipping Point, Waukegan, Illinois.
3. Prices and Discounts: Effective from date shown and are subject to change without notice.
4. Multiplier: Net price can be determined by multiplying list price and multiplier shown in appropriate discount schedule except where net price is shown, i.e. Keyboards, Keyboard Housing Kits and Spacebars.
5. Discounts: Are offered on the basis of volume production. To warrant discount, each shipment must consist of 2000 pieces minimum, or complete order if less than 2000 pieces.
6. Minimum Order — All orders subject to a minimum billing charge of $35.00 net.

SUBMINIATURE SERIES E61-LIGHT FORCE/

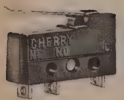

E61-00A
Basic



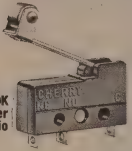
E61-00K
Roller
Std. Ratio



E61-50H
Lever
High Ratio



E61-00H
Lever
Std. Ratio

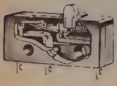


E61-50K
Roller
High Ratio

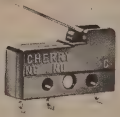
E61 SERIES — 5 AMPS., 125/250 VAC
SWITCH BODY — 25/32" x 23/64" x 1/4"

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E61-00A	SPDT	QC .093"	$1.34	E61-30K	SPDT	.110" QC	$1.66
E61-01A	SPST NO	QC .093"	1.34	E61-31K	SPST NO	.110" QC	1.66
E61-02A	SPST NC	QC .093"	1.34	E61-32K	SPSA NC	.110" QC	1.66
E61-00H	SPDT	QC .093"	1.46	E61-50H	SPDT	QC .093"	1.46
E61-01H	SPST NO	QC .093"	1.46	E61-51H	SPST NO	QC .093"	1.46
E61-02H	SPST NC	QC .093"	1.46	E61-52H	SPST NC	QC .093"	1.46
E61-00K	SPDT	QC .093"	1.66	E61-50K	SPDT	QC .093"	1.66
E61-01K	SPST NO	QC .093"	1.66	E61-51K	SPST NO	QC .093"	1.66
E61-02K	SPST NC	QC .093"	1.66	E61-52K	SPST NC	QC .093"	1.66
E61-10A	SPDT	Solder	1.34	E61-60H	SPDT	Solder	1.46
E61-11A	SPST NO	Solder	1.34	E61-61H	SPST NO	Solder	1.46
E61-12A	SPST NC	Solder	1.34	E61-62H	SPST NC	Solder	1.46
E61-10H	SPDT	Solder	1.46	E61-60K	SPDT	Solder	1.66
E61-11H	SPST NO	Solder	1.46	E61-61K	SPST NO	Solder	1.66
E61-12H	SPST NC	Solder	1.46	E61-62K	SPST NC	Solder	1.66
E61-10K	SPDT	Solder	1.66	E61-80H	SPDT	.110" QC	1.46
E61-11K	SPST NO	Solder	1.66	E61-81H	SPST NO	.110" QC	1.46
E61-12K	SPST NC	Solder	1.66	E61-82H	SPST NC	.110" QC	1.46
E61-30A	SPDT	.110" QC	1.34	E61-80K	SPDT	.110" QC	1.66
E61-31A	SPST NO	.110" QC	1.34	E61-81K	SPST NO	.110" QC	1.66
E61-32A	SPST NC	.110" QC	1.34	E61-82K	SPST NC	.110" QC	1.66
E61-30H	SPDT	.110" QC	1.46				
E61-31H	SPST NO	.110" QC	1.46				
E61-32H	SPST NC	.110" QC	1.46				

SUBMINIATURE SERIES


E62-00A
Basic

CHERRY
NC NO
C
E62-00K
Roller
Std. Ratio



E62-50H
Lever
High Ratio

CHERRY
NC NO
C
E62-00H
Lever
Std. Ratio

CHERRY
NC NO
C
E62-50K
Roller
High Ratio

E62 SERIES — 10.1 AMPS., 125/250 VAC., 1/4 H.P., 125 VAC
SWITCH BODY — 25/32" x 23/64" x 1/4"

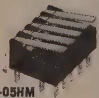
Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E62-00A	SPDT	QC .093"	$1.47	E62-30K	SPDT	QC .110"	$1.82
E62-01A	SPST NO	QC .093"	1.47	E62-31K	SPST NO	QC .110"	1.82
E62-02A	SPST NC	QC .093"	1.47	E62-32K	SPST NC	QC .110"	1.82
E62-00H	SPDT	QC .093"	1.60	E62-50H	SPDT	QC .093"	1.60
E62-01H	SPST NO	QC .093"	1.60	E62-51H	SPST NO	QC .093"	1.60
E62-02H	SPST NC	QC .093"	1.60	E62-52H	SPST NC	QC .093"	1.60
E62-00K	SPDT	QC .093"	1.82	E62-50K	SPDT	QC .093"	1.82
E62-01K	SPST-NO	QC .093"	1.82	E62-51K	SPST NO	QC .093"	1.82
E62-02K	SPST NC	QC .093"	1.82	E62-52K	SPST NC	QC .093"	1.82
E62-10A	SPDT	Solder	1.47	E62-60H	SPDT	Solder	1.60
E62-11A	SPST-NO	Solder	1.47	E62-61H	SPST NO	Solder	1.60
E62-12A	SPST NC	Solder	1.47	E62-62H	SPST NC	Solder	1.60
E62-10H	SPDT	Solder	1.60	E62-60K	SPDT	Solder	1.82
E62-11H	SPST NO	Solder	1.60	E62-61K	SPST NO	Solder	1.82
E62-12H	SPST NC	Solder	1.60	E62-62K	SPST NC	Solder	1.82
E62-10K	SPST	Solder	1.82	E62-80H	SPDT	QC .110"	1.60
E62-11K	SPST NO	Solder	1.82	E62-81H	SPST NO	QC .110"	1.60
E62-12K	SPST NC	Solder	1.82	E62-82H	SPST NC	QC .110"	1.60
E62-30A	SPDT	QC .110"	1.47	E62-80K	SPDT	QC .110"	1.82
E62-31A	SPST NO	QC .110"	1.47	E62-81K	SPST NO	QC .110"	1.82
E62-32A	SPST NC	QC .110"	1.47	E62-82K	SPST NC	QC .110"	1.82
E62-30H	SPDT	QC .110"	1.60				
E62-31H	SPST NO	QC .110"	1.60				
E62-32H	SPST NC	QC .110"	1.60				

SUBMINIATURE MODULES/SERIES E61/SERIES E62

E61-02HM
E62-02HM
2PDT

E61-03HM
E62-03HM
3PDT

E61-04HM
E62-04HM
4PDT


E61-05HM
E62-05HM
5PDT

ELECTRICAL RATING:
E61 SERIES — 5 AMPS., 125/250 VAC
E62 SERIES — 10.1 AMPS., 125/250 VAC 1/4 H.P. 125 VAC

Note: To specify 10 amp E62 series, change part number prefix from E61 to E62 (example: E61-02HM 5 amp becomes E62-02HM for 10 amp). Prices for E62 series are 31 cents more for 2 pole, 49 cents more for 3 pole, 67 cents more for 4 pole and 86 cents more for 5 pole.

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E61-02HM	2PDT	QC .093"	$3.29	E61-52HM	2PDT	QC .093"	$3.29
E61-12HM	2PDT	Solder	3.29	E61-62HM	2PDT	Solder	3.29
E61-32HM	2PDT	.110" QC	3.29	E61-82HM	2PDT	.110" QC	3.29
E61-03HM	3PDT	QC .093"	5.10	E61-53HM	3PDT	QC .093"	5.10
E61-13HM	3PDT	Solder	5.10	E61-63HM	3PDT	Solder	5.10
E61-33HM	3PDT	.110" QC	5.10	E61-83HM	3PDT	.110" QC	5.10
E61-04HM	4PDT	QC .093"	7.07	E61-54HM	4PDT	QC .093"	7.07
E61-14HM	4PDT	Solder	7.07	E61-64HM	4PDT	Solder	7.07
E61-34HM	4PDT	.110" QC	7.07	E61-84HM	4PDT	.110" QC	7.07
E61-05HM	5PDT	QC .093"	9.03	E61-55HM	5PDT	QC .093"	9.03
E61-15HM	5PDT	Solder	9.03	E61-65HM	5PDT	Solder	9.03
E61-35HM	5PDT	.110" QC	9.03	E61-85HM	5PDT	.110" QC	9.03

CHERRY ELECTRICAL PRODUCTS CORPORATION
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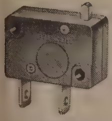
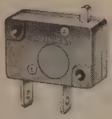
CHERRY product / price list

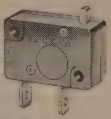
ENCLOSED-SINGLE THROW/E10/E15/E16/E18 SERIES



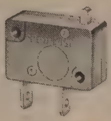
E10-00M



E15-00M



E16-00M



E18-00M

A single pole, single throw switch with light force and large overtravel. Solderable QC ¼″ terminals. Switch body: 1⅛″ x 47/64″ x 7/16″.

E10-00M—NC, 10 AMPS., ⅓ H.P., 125 VAC — 5 AMPS., 250 VAC

E15-00M—NC, 6 AMPS., 125 VAC — 3 AMPS., 250 VAC

E16-00M—NO, 2 AMPS., 125 VAC — 1 AMP., 250 VAC

E18-00M—NO, 3¼ AMPS., 125 VAC

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E10-00M	SPST NC	$1.10	E16-00M	SPST NO	$1.10
E15-00M	SPST NC	1.10	E18-00M	SPST NO	1.10

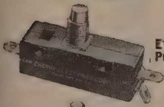
GENERAL PURPOSE-SINGLE POLE E13 SERIES/E14

E13-00E
Basic

E13-00H
Lever
Std. Ratio

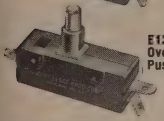
E13-00R
Reset Type

E13-50H
Lever
High Ratio

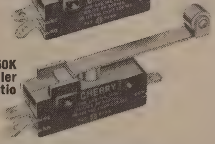


E13-00J
Push Button

E13-00K
Roller
Std. Ratio



E13-00M
Overtravel
Push Button



E13-50K
Roller
High Ratio

A rugged switch with large overtravel, wear resistant nylon button, many integral hinged actuator variations, and choice of two electrical ratings.

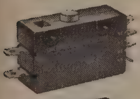
E13 SERIES — 15 AMPS., 125-250 VAC, ¾ H.P., 125 VAC — 1½ H.P., 250 VAC

E14 SERIES — 25 AMPS., 125-250 VAC, 1 H.P., 125 VAC — 2 H.P., 250 VAC

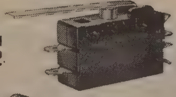
SWITCH BODY — 1 13/16″ x 41/64″ x 41/64″

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E13-00E	SPDT	$0.99	E13-50K	SPDT	$1.79
E13-01E	SPST NO	.96	E13-51K	SPST NO	1.76
E13-02E	SPST NC	.96	E13-52K	SPST NC	1.76
E13-00R	SPDT	2.20	E14-00A	SPDT	1.38
E13-01R	SPST NO	2.17	E14-01A	SPST NO	1.35
E13-02R	SPST NC	2.17	E14-02A	SPST NC	1.35
E13-00J	SPDT	1.12	E14-00H	SPDT	1.80
E13-01J	SPST NO	1.09	E14-01H	SPST NO	1.77
E13-02J	SPST NC	1.09	E14-02H	SPST NC	1.77
E13-00M	SPDT	1.38	E14-50H	SPDT	1.80
E13-01M	SPST NO	1.35	E14-51H	SPST NO	1.77
E13-02M	SPST NC	1.35	E14-52H	SPST NC	1.77
E13-00H	SPDT	1.43	E14-00K	SPDT	2.18
E13-01H	SPST NO	1.40	E14-01K	SPST NO	2.15
E13-02H	SPST NC	1.40	E14-02K	SPST NC	2.15
E13-50H	SPDT	1.43	E14-50K	SPDT	2.18
E13-51H	SPST NO	1.40	E14-51K	SPST NO	2.15
E13-52H	SPST NC	1.40	E14-52K	SPST NC	2.15
E13-00K	SPDT	1.79			
E13-01K	SPST NO	1.76			
E13-02K	SPST NC	1.76			

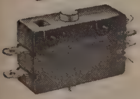
GENERAL PURPOSE-DOUBLE POLE E19 SERIES/E20



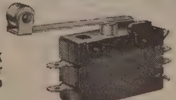
E19-00A
Basic
Double Pole



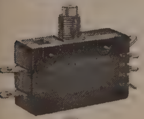
E19-00H
Std. Ratio
Lever



E19-00R
Reset Type



E19-50K
Roller
High Ratio



E19-00J
Push Button

E19-50H
Lever
High Ratio

E19-00M
Overtravel
Push Button

E19-00K
Roller
Std. Ratio

A compact switch with double pole electrical control, large overtravel, sturdy construction and wide range of actuators in two electrical ratings.

E19 SERIES — 15 AMPS., 125-250 VAC, ¾ H.P., 125 VAC — 1½ H. P., 250 VAC

E20 SERIES — 20 AMPS., 125-250 VAC, 1 H.P., 125 VAC — 2 H.P., 250 VAC

SWITCH BODY — 1 13/16″ x 1⅛″ x 41/64″

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E19-00A	DPDT	$2.16	E19-00M	DPDT	$2.52
E19-01A	DPST NO	2.10	E19-01M	DPST NO	2.46
E19-02A	DPST NC	2.10	E19-02M	DPST NC	2.46
E19-00R	DPDT	3.17	E20-00A	DPDT	3.20
E19-01R	DPST NO	3.11	E20-01A	DPST NO	3.14
E19-02R	DPST NC	3.11	E20-02A	DPST NC	3.14
E19-00H	DPDT	2.40	E20-00H	DPDT	3.44
E19-01H	DPST NO	2.34	E20-01H	DPST NO	3.38
E19-02H	DPST NC	2.34	E20-02H	DPST NC	3.38
E19-50H	DPDT	2.40	E20-50H	DPDT	3.44
E19-51H	DPST NO	2.34	E20-51H	DPST NO	3.38
E19-52H	DPST NC	2.34	E20-52H	DPST NC	3.38
E19-00K	DPDT	2.56	E20-00K	DPDT	3.60
E19-01K	DPST NO	2.50	E20-01K	DPST NO	3.54
E19-02K	DPST NC	2.50	E20-02K	DPST NC	3.54
E19-50K	DPDT	2.56	E20-50K	DPDT	3.60
E19-51K	DPST NO	2.50	E20-51K	DPST NO	3.54
E19-52K	DPST NC	2.50	E20-52K	DPST NC	3.54
E19-00J	DPDT	2.28	E20-00J	DPDT	3.32
E19-01J	DPST NO	2.22	E20-01J	DPST NO	3.26
E19-02J	DPST NC	2.22	E20-02J	DPST NC	3.26

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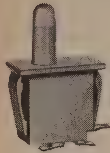
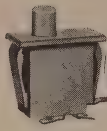
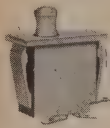
CHERRY

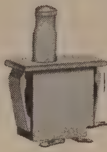
PANEL MOUNT PUSHBUTTON-SINGLE POLE/E69 SERIES

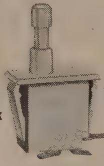

E69-00A
Basic
Momentary


E69-40A
Short Button
Momentary

E69-50A
For Auxiliary
Pushbutton


E69-20A
Push-Pull
(Reset)


E69-30A
Momentary
Cheat Interlock


E69-60A
Push-Push
(Alt. Atcion)

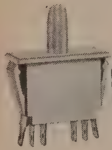
ELECTRICAL RATING: 10 AMP., ⅓ H.P. 125/250 VAC

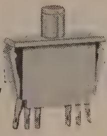
SWITCH BODY — 1¼" x 1" x 11/16"

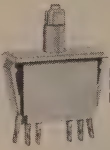
Exclusive stainless steel coil spring, long-life mechanism. Snap-in mounting in choice of momentary contact action, push-pull (reset), momentary "cheat" interlock, push-push (alternate action).

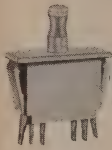
Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E69-00A	SPDT	$1.10	E69-40A	SPDT	$1.17
E69-01A	SPST NO	1.10	E69-41A	SPST NO	1.17
E69-02A	SPST NC	1.10	E69-42A	SPST NC	1.17
E69-20A	SPDT	1.07	E69-50A	SPDT	1.10
E69-21A	SPST NO	1.07	E69-51A	SPST NO	1.10
E69-22A	SPST NC	1.07	E69-52A	SPST NC	1.10
E69-30A	SPDT	1.45	E69-60A	SPDT	2.55
E69-31A	SPST NO	1.45	E69-61A	SPST NO	2.55
E69-32A	SPST NC	1.45	E69-62A	SPST NC	2.55

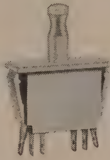
PANEL MOUNT PUSHBUTTON - DOUBLE POLE/E79 SERIES

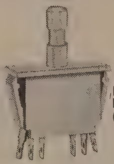

E79-00A
Basic
Momentary


E79-40A
Short Button
Momentary


E79-50A
For Auxiliary
Pushbutton


E79-20A
Push-Pull
(Reset)


E79-30A
Momentary
"Cheat"
Interlock


E79-60A
Push-Push
(Alt. Action)

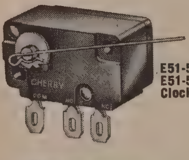
ELECTRICAL RATING — 10 AMP., 125/250 VAC ⅓ H.P., 125/250 VAC

SWITCH BODY — 1½" x 1" x 11/16"

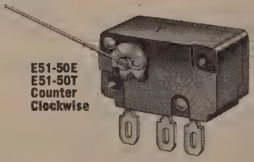
Two circuit controls from a single actuator is contained in this snap-in panel mount switch. White nylon switch case, rock-wipe contact action, large overtravel, white acetal actuating button and long-life coil spring mechanism.

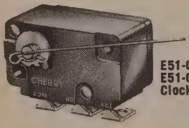
Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E79-00A	DPDT	$1.80	E79-40A	DPDT	$1.86
E79-01A	DPST NO	1.80	E79-41A	DPST NO	1.86
E79-02A	DPST NC	1.80	E79-42A	DPST NC	1.86
E79-20A	DPDT	1.76	E79-50A	DPDT	1.80
E79-21A	DPST NO	1.76	E79-51A	DPST NO	1.80
E79-22A	DPST NC	1.76	E79-52A	DPST NC	1.80
E79-30A	DPDT	2.61	E79-60A	DPDT	3.25
E79-31A	DPST NO	2.61	E79-61A	DPST NO	3.25
E79-32A	DPST NC	2.61	E79-62A	DPST NC	3.25

LOW TORQUE/E51 SERIES

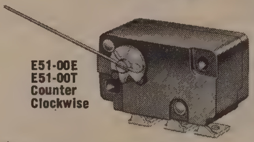


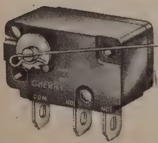
E51-50B
E51-50R
Clockwise


E51-50E
E51-50T
Counter
Clockwise

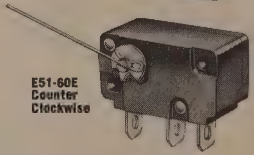


E51-00B
E51-00R
Clockwise


E51-00E
E51-00T
Counter
Clockwise



E51-60B
Clockwise


E51-60E
Counter
Clockwise

ELECTRICAL RATING — 5 AMP., 125/250 VAC ⅓ H.P. 125/250 VAC

SWITCH BODY — 1½" x 1" x 11/16"

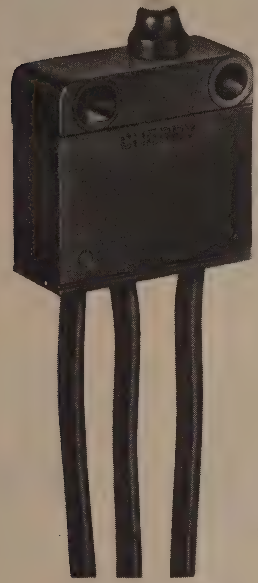
Rotary action, coin switch with sensitive feather light operation. Same coil spring, long-life Cherry mechanism. Available in clockwise or counter clockwise actuation and a wide choice of terminal configurations.

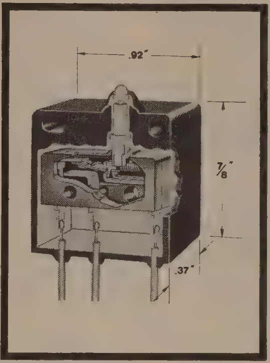
Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E51-00B	SPDT	$2.65	E51-50E	SPDT	$2.65
E51-01B	SPST NO	2.65	E51-51E	SPST NO	2.65
E51-02B	SPST NC	2.65	E51-52E	SPST NC	2.65
E51-00E	SPDT	2.65	E51-50R	SPDT	2.65
E51-01E	SPST NO	2.65	E51-51R	SPST NO	2.65
E51-02E	SPST NC	2.65	E51-52R	SPST NC	2.65
E51-00R	SPDT	2.65	E51-50T	SPDT	2.65
E51-01R	SPST NO	2.65	E51-51T	SPST NO	2.65
E51-02R	SPST NC	2.65	E51-52T	SPST NC	2.65
E51-00T	SPDT	2.65	E51-60B	SPDT	2.65
E51-01T	SPST NO	2.65	E51-61B	SPST NO	2.65
E51-02T	SPST NC	2.65	E51-62B	SPST NC	2.65
E51-50B	SPDT	2.65	E51-60E	SPDT	2.65
E51-51B	SPST NO	2.65	E51-61E	SPST NO	2.65
E51-52B	SPST NC	2.65	E51-62E	SPST NC	2.65

CHERRY ELECTRICAL PRODUCTS CORPORATION
3600 SUNSET AVENUE / WAUKEGAN, ILLINOIS 60085 / (312) 689-7700 / TWX (910) 235-1572 / CABLE: CHERRY, WAUKEGAN

CHERRY®

NEW FROM CHERRY — A SWITCH WITHIN A SWITCH — E72 SERIES SEALED SWITCH





Note: For low energy switching applications, the E73 series of this switch is available with gold "crosspoint" contacts.

We built an umbrella around a switch . . . by putting our subminiature snap-action switch inside a sturdy housing and injection molding epoxy plastic that encapsulates the switch and leads to seal out dirt and moisture. The result? A switch you can splash, spray, freeze, subject to all kinds of weather.

Because it's watertight and weatherproof. Making it the ideal switch for use in autos, trucks, boats, snowmobiles, power mowers, outdoor vending machines . . . just about any type of product that is subjected to extreme weather, dust, dirt, grit, grease, grime or spray.

The watertight, weatherproof "inside switch" is our good old reliable E62 subminiature, proven over more than a decade in millions of demanding applications. In this new sealed switch design, its stainless steel coil spring mechanism and reliable rock-wipe contact action are protected by a double enclosure plus a rubber boot on the actuator. So that when it rains . . . it works!

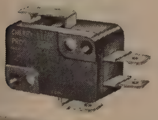
Ideal for use in autos, trucks, boats, snowmobiles and lawn mowers. The E72's protect normal switches from the moisture to which these products are continually subjected. Other applications could be in equipment normally left unprotected from the weather, such as vending machines.

Precision features include a stainless steel coil spring mechanism and reliable rock-wipe contact action that prolongs life and increases reliability. A very compact, functional size, it comes with insulated, 10 inch, 16 gauge leads attached. The E72-40A is rated at 10.1 AMP, ¼ HP and 125/250 VAC.

Part No.	Circuitry	List Price
E72-40A	SPDT	$2.96
E72-41A	SPST NO	2.96
E72-42A	SPST NC	2.96

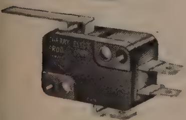
STANDARD FORCE-MINIATURE SERIES E22/E23/E33/E34

-00A Basic



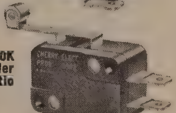
-00H Short Lever

-50H Lever Std. Ratio



-50HL Lever High Ratio

-00K Short Roller



-50K Roller Std. Ratio

-50KL Roller High Ratio

-50P One-Way Actuator

E22 — 3 AMPS., 125 VAC
E23 — 5 AMPS., ¼ H.P., 125/250 VAC
E33 — 10 AMPS., ½ H.P., 125/250 VAC
E34 — 15 AMPS., ½ H.P., 125/250 VAC
SWITCH BODY — 13/32″ x 5/8″ x 13/32″

Compact miniature switch with long-life coil spring mechanism, integral hinged actuators, choice of three terminal types and four force rating ranges.

(E22 series switches are 20 cents higher than those shown in the table below for E23 series)

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E23-00A	SPDT	QC	$0.90	E23-00K	SPDT	QC	$1.27
E23-01A	SPST NO	QC	.87	E23-01K	SPST NO	QC	1.24
E23-02A	SPST NC	QC	.87	E23-02K	SPST NC	QC	1.24
E23-10A	SPDT	Screw	1.44	E23-10K	SPDT	Screw	1.81
E23-11A	SPST NO	Screw	1.26	E23-11K	SPST NO	Screw	1.63
E23-12A	SPST NC	Screw	1.26	E23-12K	SPST NC	Screw	1.63
E23-20A	SPDT	Solder	.90	E23-20K	SPDT	Solder	1.27
E23-21A	SPST NO	Solder	.87	E23-21K	SPST NO	Solder	1.24
E23-22A	SPST NC	Solder	.87	E23-22K	SPST NC	Solder	1.24
E23-00H	SPDT	QC	1.06	E23-50K	SPDT	QC	1.27
E23-01H	SPST NO	QC	1.03	E23-51K	SPST NO	QC	1.24
E23-02H	SPST NC	QC	1.03	E23-52K	SPST NC	QC	1.24
E23-10H	SPDT	Screw	1.60	E23-60K	SPDT	Screw	1.81
E23-11H	SPST NO	Screw	1.42	E23-61K	SPST NO	Screw	1.63
E23-12H	SPST NC	Screw	1.42	E23-62K	SPST NC	Screw	1.63
E23-20H	SPDT	Solder	1.06	E23-70K	SPDT	Solder	1.27
E23-21H	SPST NO	Solder	1.03	E23-71K	SPST NO	Solder	1.24
E23-22H	SPST NC	Solder	1.03	E23-72K	SPST NC	Solder	1.24
E23-50H	SPDT	QC	1.06	E23-50KL	SPDT	QC	1.27
E23-51H	SPST NO	QC	1.03	E23-51KL	SPST NO	QC	1.24
E23-52H	SPST NC	QC	1.03	E23-52KL	SPST NC	QC	1.24
E23-60H	SPDT	Screw	1.60	E23-60KL	SPDT	Screw	1.81
E23-61H	SPST NO	Screw	1.42	E23-61KL	SPST NO	Screw	1.63
E23-62H	SPST NC	Screw	1.42	E23-62KL	SPST NC	Screw	1.63
E23-70H	SPDT	Solder	1.06	E23-70KL	SPDT	Solder	1.27
E23-71H	SPST NO	Solder	1.03	E23-71KL	SPST NO	Solder	1.24
E23-72H	SPST NC	Solder	1.03	E23-72KL	SPST NC	Solder	1.24
E23-50HL	SPDT	QC	1.06	E23-50P	SPDT	QC	1.64
E23-51HL	SPST NO	QC	1.03	E23-51P	SPST NO	QC	1.61
E23-52HL	SPST NC	QC	1.03	E23-52P	SPST NC	QC	1.61
E23-60HL	SPDT	Screw	1.60	E23-60P	SPDT	Screw	2.18
E23-61HL	SPST NO	Screw	1.42	E23-61P	SPST NO	Screw	2.00
E23-62HL	SPST NC	Screw	1.42	E23-62P	SPST NC	Screw	2.00
E23-70HL	SPDT	Solder	1.06	E23-70P	SPDT	Solder	1.64
E23-71HL	SPST NO	Solder	1.03	E23-71P	SPST NO	Solder	1.61
E23-72HL	SPST NC	Solder	1.03	E23-72P	SPST NC	Solder	1.61

Note: To specify E33, 10 amp. series, E34, 15 amp. series or E22, 3 amp. series, merely change the E23 series prefix to the desired series (i.e. E22, E33, E34). Prices on E33 and E34 are the same as the E23 series.

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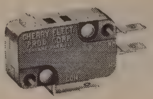
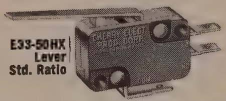
CHERRY®

LIGHT FORCE - MINIATURE/E22/E23/E33/E34 SERIES


E33-00AX
Basic

E33-50KX
Roller
Std. Ratio


E33-50HX
Lever
Std. Ratio

E33-75KX
Roller
High Ratio

E33-75HX
Lever/
High Ratio

E33-55HX
Extended Lever
Std. Ratio

E33-85HX
Extended Lever
High Ratio

Added internal actuator increases life range, reduces operating force while maintaining high contact pressure.

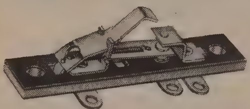
ELECTRICAL RATINGS	SERIES	OPERATING FORCE
3 AMP., 125 VAC	E22	15 GRAMS, MAX.
5 AMP., ¼ H.P., 125/250 VAC	E23	45 GRAMS, MAX.
10 AMP., ½ H.P., 125/250 VAC	E33	75 GRAMS, MAX.
15 AMP., ½ H.P., 125/250 VAC	E34	100 GRAMS, MAX.

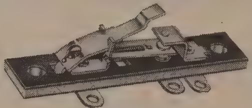
SWITCH BODY — 1³⁄₃₂″ x ⅝″ x 1³⁄₃₂″

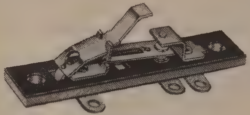
Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E33-00AX	SPDT	QC	$0.98	E33-75HX	SPDT	QC	$1.14
E33-01AX	SPST NO	QC	.95	E33-76HX	SPST NO	QC	1.11
E33-02AX	SPST NC	QC	.95	E33-77HX	SPST NC	QC	1.11
E33-10AX	SPDT	Screw	1.54	E33-85HX	SPDT	QC	1.20
E33-11AX	SPST NO	Screw	1.35	E33-86HX	SPST NO	QC	1.17
E33-12AX	SPST NC	Screw	1.35	E33-87HX	SPST NC	QC	1.17
E33-20AX	SPDT	Solder	.98	E33-50KX	SPDT	QC	1.37
E33-21AX	SPST NO	Solder	.95	E33-51KX	SPST NO	QC	1.33
E33-22AX	SPST NC	Solder	.95	E33-52KX	SPST NC	QC	1.33
E33-50HX	SPDT	QC	1.14	E33-60KX	SPDT	Screw	1.93
E33-51HX	SPST NO	QC	1.11	E33-61KX	SPST NO	Screw	1.74
E33-52HX	SPST NC	QC	1.11	E33-62KX	SPST NC	Screw	1.74
E33-60HX	SPDT	Screw	1.71	E33-70KX	SPDT	Solder	1.37
E33-61HX	SPST NO	Screw	1.52	E33-71KX	SPST NO	Solder	1.33
E33-62HX	SPST NC	Screw	1.52	E33-72KX	SPST NC	Solder	1.33
E33-70HX	SPDT	Solder	1.14	E33-75KX	SPDT	QC	1.37
E33-71HX	SPST NO	Solder	1.11	E33-76KX	SPST NO	QC	1.33
E33-72HX	SPST NC	Solder	1.11	E33-77KX	SPST NC	QC	1.33
E33-55HX	SPDT	QC	1.20				
E33-56HX	SPST NO	QC	1.17				
E33-57HX	SPST NC	QC	1.17				

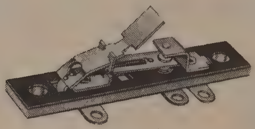
Note: To specify 3 amp E22 series, 5 amp E23 series or 15 amp E34 series, merely change the E33 series prefix to the desired series (i.e. E22, E23, E34). The E23 series is 7 cents more, the E34 series is 14 cents more and the E22 series is 22 cents more than the E33 series on every switch.

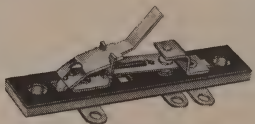
BASIC OPEN SWITCH - S23/S25 SERIES


S23-00T


S23-30T


S23-20T


S23-40T


S23-60T

Many variations in actuators, terminals, and panels.

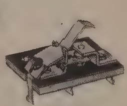
LIGHT FORCE - S23 SERIES — 5 AMPS., 125 VAC
SWITCH PANEL — 2⅛″ x ⁷⁄₁₆″ x ³⁄₃₂″
STANDARD FORCE - S25 SERIES — 10 AMPS., 125 VAC — 5 AMPS., 250 VAC — ¼ H.P., 125/250 VAC
SWITCH PANEL — 2⅛″ x ⁷⁄₁₆″ x ³⁄₃₂″

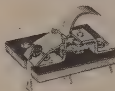
Part No.	Circuitry	Descrip- tion	List Price	Part No.	Circuitry	Descrip- tion	List Price
S23-00T	SPDT	Flat solder	$1.10	S23-30W	SPDT	Int. solder	$1.10
S23-01T	SPST NO	Flat solder	1.10	S23-31W	SPST NO	Int. solder	1.10
S23-02T	SPST NC	Flat solder	1.10	S23-32W	SPST NC	Int. solder	1.10
S23-00Z	SPDT	QC	1.10	S23-40T	SPDT	Flat solder	1.10
S23-01Z	SPST NO	QC	1.10	S23-41T	SPST NO	Flat solder	1.10
S23-02Z	SPST NC	QC	1.10	S23-42T	SPST NC	Flat solder	1.10
S23-00W	SPDT	Int. solder	1.10	S23-40Z	SPDT	QC	1.10
S23-01W	SPST NO	Int. solder	1.10	S23-41Z	SPST NO	QC	1.10
S23-02W	SPST NC	Int. solder	1.10	S23-42Z	SPST NC	QC	1.10
S23-20T	SPDT	Flat solder	1.10	S23-40W	SPDT	Int. solder	1.10
S23-21T	SPST NO	Flat solder	1.10	S23-41W	SPST NO	Int. solder	1.10
S23-22T	SPST NC	Flat solder	1.10	S23-42W	SPST NC	Int. solder	1.10
S23-20Z	SPDT	QC	1.10	S23-60T	SPDT	Flat solder	1.10
S23-21Z	SPST NO	QC	1.10	S23-61T	SPST NO	Flat solder	1.10
S23-22Z	SPST NC	QC	1.10	S23-62T	SPST NC	Flat solder	1.10
S23-20W	SPDT	Int. solder	1.10	S23-60Z	SPDT	QC	1.10
S23-21W	SPST NO	Int. solder	1.10	S23-61Z	SPST NO	QC	1.10
S23-22W	SPST NC	Int. solder	1.10	S23-62Z	SPST NC	QC	1.10
S23-30T	SPDT	Flat solder	1.10	S23-60W	SPDT	Int. solder	1.10
S23-31T	SPST NO	Flat solder	1.10	S23-61W	SPST NO	Int. solder	1.10
S23-32T	SPST NC	Flat solder	1.10	S23-62W	SPST NC	Int. solder	1.10
S23-30Z	SPDT	QC	1.10				
S23-31Z	SPST NO	QC	1.10				
S23-32Z	SPST NC	QC	1.10				

Note: To specify 10 amp. S25 series merely change the S23 prefix to S25. For example, S23-01T SPST NO 5 amp becomes S25-01T SPST NO 10 amp. Prices are the same on S23 and S25 series.

MINIATURE OPEN - S30 SERIES

S30-00W


S30-20W


S30-50W

S30-20P

ELECTRICAL RATINGS
10 AMPS., 125 VAC — 5 AMPS. 250 VAC — ⅙ HP 125/250 VAC
SWITCH PANEL — 1¹⁄₁₆″ x ¾″ x ³⁄₃₂″
Many variations in actuators, terminals, and panels.

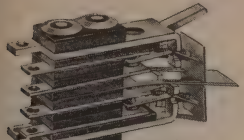
Part No.	Circuitry	Descrip- tion	List Price	Part No.	Circuitry	Descrip- tion	List Price
S30-00W	SPDT	Int. solder	$1.10	S30-50W	SPDT	Int. solder	$1.10
S30-01W	SPST NO	Int. solder	1.10	S30-51W	SPST NO	Int. solder	1.10
S30-02W	SPST NC	Int. solder	1.10	S30-52W	SPST NC	Int. solder	1.10
S30-00T	SPDT	Flat solder	1.10	S30-50T	SPDT	Flat solder	1.10
S30-01T	SPST NO	Flat solder	1.10	S30-51T	SPST NO	Flat solder	1.10
S30-02T	SPST NC	Flat solder	1.10	S30-52T	SPST NC	Flat solder	1.10
S30-00Z	SPDT	QC	1.10	S30-50Z	SPDT	QC	1.10
S30-01Z	SPST NO	QC	1.10	S30-51Z	SPST NO	QC	1.10
S30-02Z	SPST NC	QC	1.10	S30-52Z	SPST NC	QC	1.10
S30-20W	SPDT	Int. solder	1.10	S30-20P	SPDT	PC Term.	1.10
S30-21W	SPST NO	Int. solder	1.10	S30-21P	SPST NO	PC Term.	1.10
S30-22W	SPST NC	Int. solder	1.10	S30-22P	SPST NC	PC Term.	1.10
S30-20T	SPDT	Flat solder	1.10	S30-20T	SPDT	Flat solder	1.10
S30-21T	SPST NO	Flat solder	1.10	S30-21T	SPST NO	Flat solder	1.10
S30-22T	SPST NC	Flat solder	1.10	S30-22T	SPST NC	Flat solder	1.10
S30-20Z	SPDT	QC	1.10	S30-50Z	SPDT	QC	1.10
S30-21Z	SPST NO	QC	1.10	S30-51Z	SPST NO	QC	1.10
S30-22Z	SPST NC	QC	1.10	S30-52Z	SPST NC	QC	1.10

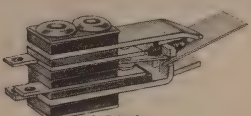
CHERRY ELECTRICAL PRODUCTS CORPORATION
3600 SUNSET AVENUE / WAUKEGAN, ILLINOIS 60085 / (312) 689-7700 / TWX (910) 235-1572 / CABLE: CHERRY, WAUKEGAN

CHERRY®

NOTICE: Due to unstable market conditions on precious metals which are used for contact surfaces on switches and printed circuit boards, all list prices shown here are subject to a surcharge to compensate for increases in Silver and Gold prices since January 10, 1974. The base prices for these two metals on January 10, 1974, were: Gold $117.00 Troy Ounce, Silver $3.35 Troy Ounce.

STACK SWITCHES/S36/S37 SERIES


S36 Series
Double Pole


S37 Series
Single Pole

7½ AMPS., 125 VAC
5 AMPS., 250 VAC

Available in single or double pole with momentary or reset (maintained) contact action.

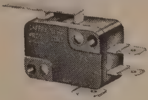
SWITCH BODY: 1$\frac{41}{64}$" x $\frac{37}{64}$" x $\frac{5}{16}$"

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
S36-20E	DPDT (R)	$3.11	S37-10E	SPDT (R)	$1.98
S36-21E	DPST NO (R)	3.04	S37-11E	SPST NO (R)	1.94
S36-22E	DPST NC (R)	3.04	S37-12E	SPST NC (R)	1.94
S36-40E	DPDT (M)	3.11	S37-20E	SPDT (M)	1.98
S36-41E	DPST NO (M)	3.04	S37-21E	SPST NO (M)	1.94
S36-42E	DPST NC (M)	3.04	S37-22E	SPST NC (M)	1.94

Note: (R) Denotes reset (maintained) contact action.
(M) Denotes momentary contact action.

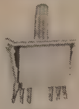
CHERRY GOLD "CROSSPOINT" CONTACT SWITCHES

E21-00A

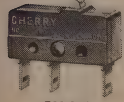

E21-50H

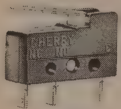
E21-50K

E68-00A


E78-00A

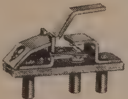
G13-00E


E63-00A

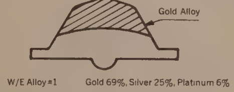

E63-00H

E63-00K

E53-00B


S31-20P

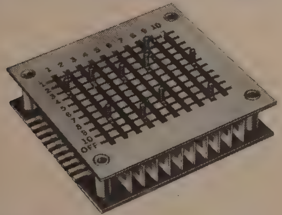
CROSS SECTION OF CONTACT



Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E21-00A	SPDT	QC	$1.76	E68-40A	SPDT	QC	$2.03
E21-01A	SPST NO	QC	1.44	E68-41A	SPST NO	QC	2.03
E21-02A	SPST NC	QC	1.44	E68-42A	SPST NC	QC	2.03
E21-20A	SPDT	Solder	1.76	E68-60A	SPDT	QC	3.41
E21-21A	SPST NO	Solder	1.44	E68-61A	SPST NO	QC	3.41
E21-22A	SPST NC	Solder	1.44	E68-62A	SPST NC	QC	3.41
E21-50H	SPDT	QC	1.92	E78-00A	SPDT	QC	3.40
E21-51H	SPST NO	QC	1.60	E78-01A	SPST NO	QC	3.40
E21-52H	SPST NC	QC	1.60	E78-02A	SPST NC	QC	3.40
E21-70H	SPDT	Solder	1.92	E78-20A	SPDT	QC	3.36
E21-71H	SPST	Solder	1.60	E78-21A	SPST NO	QC	3.36
E21-72H	SPST NC	Solder	1.60	E78-22A	SPST NC	QC	3.36
E21-50K	SPDT	QC	2.14	E78-30A	SPDT	QC	4.21
E21-51K	SPST NO	QC	1.82	E78-31A	SPST NO	QC	4.21
E21-52K	SPST NC	QC	1.82	E78-32A	SPST NC	QC	4.21
E21-70K	SPST	Solder	2.14	E78-60A	SPDT	QC	4.85
E21-71K	SPST NO	Solder	1.82	E78-61A	SPST NO	QC	4.85
E21-72K	SPST NC	Solder	1.82	E78-62A	SPST NC	QC	4.85
E21-00AX	SPDT	QC	2.06	G13-00E	SPDT	QC	1.95
E21-01AX	SPST NO	QC	1.74	G13-01E	SPST NO	QC	1.54
E21-02AX	SPST NC	QC	1.74	G13-02E	SPST NC	QC	1.54
E21-50HX	SPDT	QC	2.22	S31-20P	SPDT	PC	1.72
E21-51HX	SPST NO	QC	1.90	S31-21P	SPST NO	PC	1.32
E21-52HX	SPST NC	QC	1.90	S31-22P	SPST NC	PC	1.32
E21-50KX	SPDT	QC	2.44	E53-00B	SPDT	QC.093"	3.44
E21-51KX	SPST NO	QC	2.12	E53-01B	SPST NO	QC.093"	3.44
E21-52KX	SPST NC	QC	2.12	E53-02B	SPST NC	QC.093"	3.44
E68-00A	SPDT	QC	1.96	E63-00A	SPDT	QC.093"	2.26
E68-01A	SPST NO	QC	1.96	E63-01A	SPST NO	QC.093"	2.20
E68-02A	SPST NC	QC	1.96	E63-02A	SPST NC	QC.093"	2.20
E68-20A	SPDT	QC	1.93	E63-00H	SPDT	QC.093"	2.38
E68-21A	SPST NO	QC	1.93	E63-01H	SPST NO	QC.093"	2.32
E68-22A	SPST NC	QC	1.93	E63-02H	SPST NC	QC.093"	2.32
E68-30A	SPDT	QC	2.31	E63-00K	SPDT		2.59
E68-31A	SPST NO	QC	2.31	E63-01K	SPST NO		2.53
E68-32A	SPST NC	QC	2.31	E63-02K	SPST NC		2.53

Cherry Gold "Crosspoint" Contact switches are available in a wide variety of switch types and mountings as shown above. These provide extremely low insertion resistance and long life . . . measured in millions of operations. The contact material is W/E Alloy #1 . . . 69% Gold, 25% Silver, 6% Platinum.

MATRIX SELECTOR SWITCH



Manual programming and switching for complex control equipment. Each of two standard types is expandable up to five modules, providing 500 to 1,000 crosspoints. Custom design available up to 2,784 crosspoints.

Electrical capacity:

1. Make and break 48 volts DC at 0.50 Amp. 125 Volts AC at 0.15 Amp.
2. Current carrying only (no make and break) 2 Amp. AC or DC.

Insertion Resistances:

50 milliohms plus 6 milliohms per inch of printed circuit.

Note: Overall width of basic 10 x 10 and 20 x 10 Selector Switch is 3½ inches. For each 10 sliders added to the basic unit add 3 inches to overall width. A 20 slider unit measures 6½ inches wide; a 30 slider unit measures 9½ inches wide; a 40 slider unit measures 12½ inches wide and a 50 slider unit measures 15½ inches wide.

DISCOUNT SCHEDULE

Quantity	Discount	Multiplier
1-9	List	1.00
10-24	10%	0.90
25-49	15%	0.85
50-99	20%	0.80
100-249	25%	0.75
250-499	30%	0.70

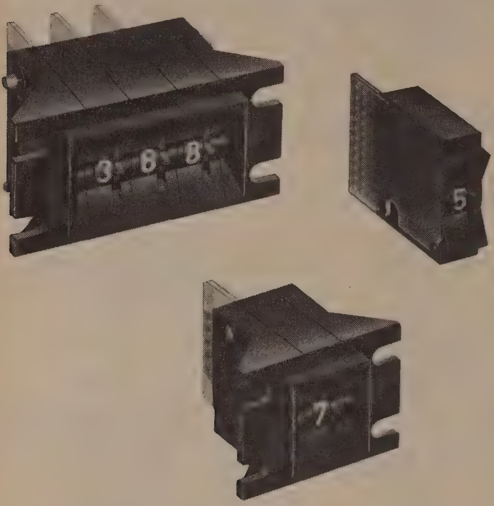
For quantities of 500 and over consult factory or contact nearest representative.

Switch No.	Circuitry	List Price	Switch No.	Circuitry	List Price
C10-01A	20 x 10	$42.67	C10-20A	10 x 10	$30.48
C10-02A	20 x 20	48.74	C10-42A	10 x 20	39.62
C10-03A	20 x 30	73.14	C10-43A	10 x 30	52.42
C10-04A	20 x 40	79.24	C10-44A	10 x 40	67.05
C10-05A	20 x 50	91.43	C10-45A	10 x 50	81.67
			C10-56A	48 x 58	248.68

CHERRY ELECTRICAL PRODUCTS CORPORATION
3600 SUNSET AVENUE / WAUKEGAN, ILLINOIS 60085 / (312) 689-7700 / TWX (910) 235-1572 / CABLE: CHERRY, WAUKEGAN

CHERRY®

NEW FROM CHERRY:
THE SMALLEST THUMBWHEEL SWITCH OF THEM ALL



Unique, compact Series T-50 sub-subminiature back mount thumbwheel switch takes only a .315″ x .709″ front panel space . . . just .984″ depth back of panel. This, the smallest version of the extensive line of Cherry thumbwheel switches, is available in a choice of BCD (Binary Coded Decimal), 10 position decimal, single pole repeating (+, −), BCD/Extended P.C. Board and many other of the most commonly used codes.

Even though the new T-50 is the smallest thumbwheel made, the .158″ average height white characters are easily readable. The case is available immediately in black gloss finish, with grey or white finishes available on special order.

SPECIFICATIONS

- Inline readout.
- Modular construction.
- Variations in coding, termination and readout symbols available.

MATERIALS

Case, Levers, End Caps, Wheels — Polycarbonate for high impact, high strength (standard).

Printed Circuit Board — G10 glass filled epoxy per MIL-P-13949. Gold Plated per MIL-G-45204B, Type I, Grade C, Class 1, over Nickel Plate.

Contacts — WE Alloy No. 1 (69% gold, 25% silver, 6% platinum).

Wipers — Beryllium Copper.

SWITCH CHARACTERISTICS

Operating Force	7-10 Ounces
Contact Resistance	0.1 Ohms
Insulation Resistance	10^3 Megohms
Dielectric Strength	500 Volt AC
Vibration	15 G's 10 = 2000 Hz
Shock	50 G's 11 MS
Weight	⅛ Oz.
Electrical Rating	50 Volts AC or DC @ .125 Amps
Maximum Current	Non-Switching Current Carrying Only 3 Amps
Life at Nominal Load	1 x 10^6 Detent Operations

READOUT WINDOW SIZE

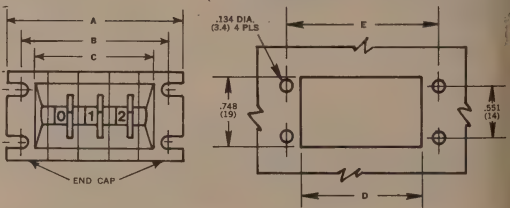
Positions	Readout Window Size	Dial Character Height
10	X = .138 Y = .197	.158

NUMBER OF MODULES

Number of Modules	A	B	C	D	E
1	1.260	0.945	0.630	0.670	0.984
2	1.575	1.260	0.945	0.985	1.299
3	1.890	1.575	1.260	1.300	1.614
4	2.205	1.890	1.575	1.615	1.929
5	2.520	2.205	1.890	1.930	2.244
6	2.835	2.520	2.205	2.245	2.559
7	3.150	2.835	2.520	2.560	2.874
8	3.465	3.150	2.835	2.875	3.189
9	3.780	3.465	3.150	3.190	3.504
10	4.095	3.780	3.465	3.505	3.819

Positions in assembly are numbered from left to right.
For assemblies with more than 10 modules, consult factory.

T-50 RECOMMENDED PANEL CUTOUT



THUMBWHEEL AND LEVER SWITCHES

DISCOUNT SCHEDULE

Quantity (Individual Switches)	Discount	Multiplier
1-50	List	1.00
51-100	20%	.80
101-200	25%	.75
201-500	27%	.73
501-1000	30%	.70
1001-2000	32%	.68

For quantities greater than those shown consult factory or nearest representative for quotation.

COMPUTATION OF ASSEMBLY PRICE

(Items may be purchased individually)

1. Add the list price for each switch plus the options.
2. Add the spacer and end cap list price.
3. Add the assembly charge (see item 9 on next page).
4. Compute the total number of individual switches to be purchased and refer to the discount schedule for the correct multiplier.
5. Multiply the assembly list price (from 1, 2 and 3 above) by the multiplier (4) to arrive at the discounted assembly price.

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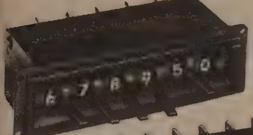
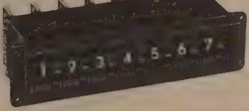
CHERRY®

THUMBWHEEL AND LEVER SWITCHES

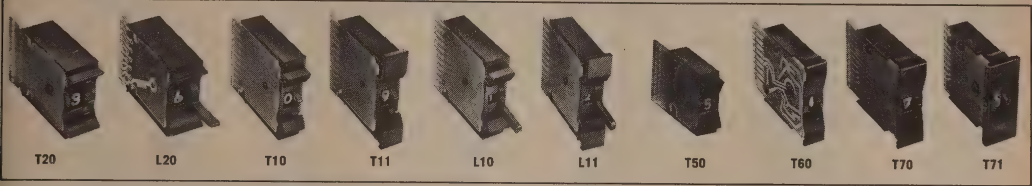


Leverwheel
L20
Back Mount
Subminiature
6 Gang Assembly



Thumbwheel
T20
Back Mount
Subminiature
7 Gang Assembly

No.	Item	Price
1.	Stops (to limit wheel rotation)	$0.50/switch
2.	Matte Finish (per switch)	.30/switch
3.	Spacers (all sizes; blank, gloss or matte)	.50 each
4.	Imprinting on Switch or Spacer (see 10)	.50 each
5.	Component Installation (excluding component cost)	.20/comp.
6.	Pin Terminals on Circuit Board	Consult Factory
7.	End Caps	.70/set (.35 each)
8.	Assembly Hardware (charged only when shipped unassembled)	
	T20, L20, T60, T70	.30/set
	T10, T11, L10, L11	.50/set
9.	Assembly of Switches (price includes hardware but not end caps)	
	First Switch in each assembly	.50/switch
	Each Additional Switch	.30
	Maximum	3.00/assembly
10.	Special Wheel Imprinting — Setup Charge	$25.00
11.	Nonstandard Hot Stamp Type Face One Time Tooling	5.00/character
12.	Function Switch Double. Add 2.50 to list price of standard code listing in available series	2.50/switch
13.	Special Color Wheel	
	Imprinting	.25/switch
	Setup	25.00
14.	Colored Switches or Wheels	Consult Factory
15.	T64 Series Circuit Board (mount switch without PC board)	List Price
	10 position	2.00
	16 position	2.50
16.	T71 Series Front Mount Snap-in. Pricing is same as T60 Series. Note 16 position is not available.	
17.	Nonstandard Circuit Board Codes or Configurations	Consult Factory



NOTE: All list prices shown in the following table are subject to discount schedule shown on preceding page.

Suf. No.	Pos.	Description	Read Out	T20	L20	T10	T11	L10	L11	T50	T60	T70
-01A	10	Decimal	(0-9)	*4.00	*5.00	*4.50	*4.50	*5.10	*5.10	*3.50	*3.00	*3.00
-02A	10	Binary Coded Decimal (BCD)	(0-9)	*4.00	*5.00	*4.50	*4.50	*5.10	*5.10	*3.50	*3.00	*3.00
-03A	16	Hexadecimal	(0-15)	*6.50		*7.50	*7.50				*5.50	5.50
-04A	10	BCD plus complement, 1 common	(0-9)	*5.00	*6.00	*6.80	*6.80	7.80	*7.80	*4.50	*4.00	*4.00
-05A	10	BCD plus complement, 2 commons	(0-9)					9.50	*9.50			
-06A	10	BCD plus odd parity	(0-9)	*5.15	*6.10						5.00	5.00
-07A	8	Binary Coded Octal (BCO)	(0-7)	*4.00	*5.00	*5.00	*5.00	*5.50	*5.50		*3.50	*3.50
-08A	16	Hex plus complement, 1 common	(0-15)	*7.50		*8.50	*8.50					
-09A	16	Hex plus complement, 2 commons	(0-15)	*8.50		*9.50	*9.50					
-10A	10	BCD plus even parity	(0-9)	*5.15	*6.10			*7.10	*7.10		5.00	5.00
-11A	10	Double pole decimal	(0-9)	*8.60	*9.20	*8.60	*8.60	*9.20	*9.20			
-12A	10	BCD complement only	(0-9)	*4.50	*5.50					*4.50	*4.00	*4.00
-13A	16	Hexadecimal	(0-9, A-F)	*6.50		*7.50	*7.50				*5.50	5.50
-14A	10	9's complement of BCD	(0-9)	5.00	6.00							
-15A	10	BCD with sep. C to not true bits	(0-9)	*7.50	*8.50							
-17A	8	Decimal	(0-7)	4.00	5.00							
-19A	16	Hex plus complement, 2 commons	(0-9, A-F)			*9.50	*9.50					
-20A	12	Decimal	(0-11)		*5.00							
-47A	8	BCO with sep. C to not true bits	(0-7)	7.50	8.50							
-49A	10	Excess 3 gray code negative	(0-9)								5.00	5.00
-50A	10	Excess 3 gray code positive	(0-9)								5.00	5.00
-52A	10	BCD with diode provisions	(0-9)	*5.00	*6.00	*5.50	*5.50				*4.00	*4.00
-53A	16	Hex with diode provision	(0-15)	*7.50								
-54A	10	BCD plus comp., 1 com with diode provision	(0-9)	*6.00	*7.00	*7.80	*7.80					
-57A	8	BCO with diode provision	(0-7)	5.00	6.00							
-62A	10	9's complement of BCD	(0-9)	*4.00	*5.00							
-63A	16	Hex with diode provision	(0-9, A-F)	7.50								
-65A	10	Kelvin-Varley voltage divider	(0-9)	8.50	9.50							
-67A	10	1-2-2-2-2 resistive decade	(0-9)	8.00	9.00							
-68A	10	2 out of 5 code with diode provision	(0-9)	6.00	7.00							
-69A	10	Decimal, make before break	(0-9)	4.00	5.00							
-70A	10	Aiken code 1-2-4-2′	(0-9)								5.00	5.00
-71A	10	Aiken code modern 1-2-4-2′	(0-9)								5.00	5.00
-72A	10	Comp. of 9's comp. with diode provision	(0-9)	6.00	7.00							
-77A	8	BCO complement only	(0-7)	4.50	5.50						*4.00	*4.00
-88A	16	Hex plus complement, 1 common	(0-9, A-F)	7.50								
-89A	16	Hex plus complement, 2 commons	(0-9, A-F)	8.50								
-94A	2	Single pole, repeating	(−, +)	*4.00	*5.00	*4.50	4.50	*5.00	*5.00	*4.00	*3.50	*3.50
-95A	2	Single pole, repeating	(0-1)	*4.00	*5.00	*4.50	4.50	*5.00	*5.00	*4.00	*3.50	*3.50
-96A	2	Single pole, repeating	(0-5)	*4.00	*5.00	*4.50	4.50	*5.00	*5.00	*4.00	*3.50	*3.50
-97A	2	Double pole, repeating	(+, −)								*4.50	*4.50

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CHERRY®

KEYBOARD SWITCHES

For modern electronic desk top calculators . . . computer terminals . . . credit card validators. NEW Gold "Crosspoint" contact key.

This proven design concept (crossed knife edge contact configuration) provides high force per unit of contact area, and virtually eliminates contact closure interference by contaminates. Contacts are normally held apart for greater shock resistance. No microphonics or bounce during turn-off or at rest.

Three types with straight or angled stems for sloped or stepped keyboards.

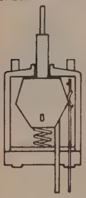
DISCOUNT SCHEDULE FOR KEYBOARD SWITCHES ONLY

Quantity	Discount	Multiplier
1-49	List	1.00
50-99	27%	0.73
100-499	37%	0.63
500-999	43%	0.57
1000-1999	48%	0.52
2000-4999	54%	0.46

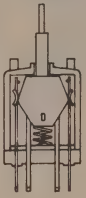
For quantities greater than those shown consult factory.

THREE TYPES TO CHOOSE FROM WITH STRAIGHT OR ANGLED STEMS FOR SLOPED OR STEPPED KEYBOARDS

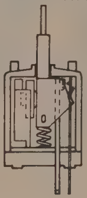
M61-0100
MOMENTARY
FORM A
(SPST-NO)
2½ oz. operating force
STRAIGHT PLUNGER STEM
FOR 10° ANGLE
PLUNGER STEM
SPECIFY PART NO. M61-0110



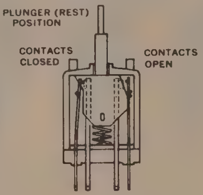
M62-0100
MOMENTARY
DUAL FORM A
(DPST-NO)
2½ oz. operating force
STRAIGHT PLUNGER STEM
FOR 10° ANGLE
PLUNGER STEM
SPECIFY PART NO. M62-0110



M61-0800
ALTERNATE ACTION
(SPST)
2½ oz. operating force
STRAIGHT PLUNGER STEM

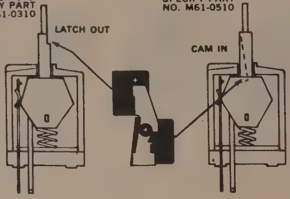


M62-0900
MOMENTARY
FORM A Plus FORM B
(SPST-NO Plus SPST-NC)



SHIFT
M61-0300
MOMENTARY
FORM A
(SPST-NO)
2½ oz. operating force
STRAIGHT PLUNGER STEM
FOR 10° ANGLE
PLUNGER STEM
SPECIFY PART
NO. M61-0310

SHIFT LOCK
M61-0500
MOMENTARY/LATCH
(SPST-NO)
2½ oz. operating force
STRAIGHT PLUNGER STEM
FOR 10° ANGLE
PLUNGER STEM
SPECIFY PART
NO. M61-0510



SPECIFICATIONS

MECHANICAL

Operating Force .... 2½ oz. ±½ oz. Std. (Also available with 6 oz. Operating Force)

Pretravel .... .085 ±.030 Std. (Alternate action version pretravel .030 ±.055)

Total Travel .... .160 ±.020 Std.

Key Module Case Material .... Thermoplastic (Nylon)

External Terminal .... Tin Plated Brass Alloy

Temperature
- Operating .... 0°/60°C
- Storage .... −35°C/65°C

ELECTRICAL

Contact Rating (Form A contacts)
- DC Resistive .... 3W max.
- AC Resistive .... 3VA max.
- Current .... 0.125 amp. max. switching 0.5 amp. max. carry
- Voltage .... 28V max.

Initial Contact Resistance .... 200 milliohms max. (typically 25 milliohms)

Part No.	Contacts	Oper. Force (oz.)	Stem Angle	Stem Design	List Price
M51-0101	A	6	Str.	Plain	$1.27
M51-0106	A	3	Str.	Plain	1.27
M51-0107	A	3	10°	Plain	1.27
M61-0100	A	2½	Str.	Plain	1.27
M61-0110	A	2½	10°	Plain	1.27
M61-0120	A	2½	Str.	T	1.27
M61-0800	A (Alt.)	2½	Str.	Plain	2.02
M62-0100	A+A	2½	Str.	Plain	1.79
M62-0900	A+B	3½	Str.	Plain	1.97
M61-XXXX▲	A	(Shift)	Str.	Plain	1.98
M41-0100▲▲	A	(Lighted)	Str.	Plain	2.15
M41-0800▲▲	A (Alt.)	(Lighted)	Str.	Plain	2.76

▲If application requires SHIFT and SHIFT LOCK mechanism, two shift keys should be specified. The part number will be determined by factory after reviewing row offset dimensions.

▲▲Does not include lamp. Uses standard industry size T-1 Bi-Pin bulb.

CHERRY ELECTRICAL PRODUCTS CORPORATION
3600 SUNSET AVENUE / WAUKEGAN, ILLINOIS 60085 / (312) 689-7700 / TWX (910) 235-1572 / CABLE: CHERRY, WAUKEGAN

CHERRY®

KEYBOARDS

17 STANDARD "OFF-THE-SHELF" KEYBOARDS — INCLUDING FIVE STANDARD KEYBOARDS WHICH MAY BE FACTORY MODIFIED

B70-54AA
53-Key QUAD MODE
ASCII (ASR33)
Housed

B70-4753
53-Key QUAD MODE
ASCII (ASR33) Without Housing

NEW CHERRY ELECTRONIC DATA ENTRY KEYBOARDS FEATURE

- Low Cost
- Long Life
- Low Profile
- Inherent 2 Key Rollover
- Wire "OR" Able Output
- Low Power Consumption

RUGGED CONSTRUCTION

Keys are mounted in rugged metal frame for increased protection of printed circuit board against mechanical abuse.

TWO KEY ROLLOVER

Standard keyboard units have 2 key rollover between all data keys, control, shift, and shift lock keys to simulate true typewriter sequencing.

KEYBOARD FLEXIBILITY

Standard keyboard units include:

66 Key Tri Mode ASCII, negative logic
 (with provision to add 4 extra keys)
53 Key Quad Mode ASCII (ASR 33), positive logic
12 Key Numeric, straight output
16 Key Numeric, straight output

In addition, custom designs in mono, dual, tri and quad mode operation available on volume applications, with modest engineering, tooling, and artwork charges.

SPECIAL FEATURES AVAILABLE

Positive logic resting "low" outputs or Negative logic resting "high" outputs. Open collector buffer outputs for hard wire "OR"ing available at no extra cost. Buffer output capable of driving terminated twisted pair or 90 ohm coaxial is optional. Repeating strobe is optional. Key locations may be geographically mixed. Special mono mode encoded keys may be added to configuration. Any of parity and/or data outputs optional may be later changed for modest revision charges.

WE CAN CUSTOM DESIGN YOUR KEYBOARD

If you do not see the keyboard you want among the standard stock units shown here, why not check our custom design capabilities. We specialize in custom designed units and make all our own key caps, switches, printed circuit boards and hardware. Our keyboard electronics utilizes a scanning technique which readily adapts to any keyboard configuration and format. Because of this, and our in-house capability, we can usually provide a custom designed keyboard to meet your application requirements at less than the cost of a standard. Send us your specs and we'll be glad to quote. To help you get started ask for our handy six-page Keyboard Designers' Specification Sheet.

KEYBOARD ELECTRONICS UTILIZES SCANNING TECHNIQUE

The keyboard encoder is based on a scanning technique employing an 8 bit counter, a multiplexer and a 4 to 16 line decoder. Encoded keys form a crosspoint matrix with each key connected to the decoder output and the multiplexer input. The decoder is addressed by the 4 least significant bits and the multiplexer by the 3 most significant bits of the counter.

When a key is depressed a matrix connection between the decoder and multiplexer is accomplished. When the counter reaches the appropriate key code, the multiplexer output goes high and a retriggerable one-shot is fired on the trailing edge of the counter clock stopping the counter. The one-shot is continually refreshed until the key is released. The bit-shift logic translates the counter address into an upper case data word if the shift and/or control key is depressed.

STANDARD KEYBOARDS SPECIFICATIONS CHART

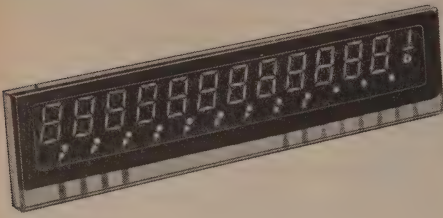
Cherry Part No.	Key Legend Format Similar to	No. of Keys	Code	No. of Modes	Data Bits	Strobe Goes	Logic	Power Requirements	Net Price 1-249 Pcs.
B70-4753	ASR-33	53	SPECIAL	4	7	HIGH	POS.	5 V 350 MA	$119.00
B70-54AA	ASR-33	53	SPECIAL	4	7	HIGH	POS.	5 V 350 MA	169.00
B70-60AA	ASR-33	53	SPECIAL	4	7	HIGH	POS.	5 V 350 MA	119.00
B70-61AA	ASR-33	53	SPECIAL	4	7	HIGH	POS.	5 V 350 MA	169.00
B80-3766	ASCII TRI-MODE	66	ASCII	3	7	LOW	NEG.	5 V 350 MA	127.00
B80-31AA	ASCII TRI-MODE	66	ASCII	3	7	LOW	NEG.	5 V 350 MA	177.00
B80-48AA	ASCII TRI-MODE	66	ASCII	3	7	LOW	NEG.	5 V 350 MA	127.00
B80-49AA	ASCII TRI-MODE	66	ASCII	3	7	LOW	NEG.	5 V 350 MA	177.00
B80-65AA	ASCII TRI-MODE	67	ASCII	3	7	LOW	NEG.	5 V 350 MA	131.00
B79-17AA	IBM 029	54	SPECIAL	2	7	HIGH	POS.	5 V 450 MA	152.00
B60-02AA	TOUCH TONE	12	Partial ASCII	1	7	1 HIGH 1 LOW	POS.	5 V 150 MA	54.90
B64-03AA	—	11	BCD	1	4	1 HIGH 1 LOW	POS.	5 V 150 MA	43.70
B64-10AA	—	12	BCD	1	4	1 HIGH 1 LOW	POS.	5 V 150 MA	40.30
B65-1712	3 x 4	12	NONE	—	—	—	—	—	18.05
B65-52AA	3 x 4	12	NONE	—	—	—	—	—	18.05
B65-1716	4 x 4	16	NONE	—	—	—	—	—	23.00
B65-53AA	4 x 4	16	NONE	—	—	—	—	—	23.00

B99-82AA Keyboard Housing Kit — $50.00. For quantities greater than those shown consult factory.

CHERRY ELECTRICAL PRODUCTS CORPORATION
3600 SUNSET AVENUE / WAUKEGAN, ILLINOIS 60085 / (312) 689-7700 / TWX (910) 235-1572 / CABLE: CHERRY, WAUKEGAN

CHERRY®

PLASMA-LUX™ LIGHTED DISPLAY PANELS



"The Bright Ones" are totally new from Cherry. Totally new from the company that brought gold "crosspoint" contact switching to keyboards and calculators in 1968. The same company, too, that introduced a new standard of reliability to snap-action switches with unique coil spring mechanism in 1953.

Now, Cherry brings you a bright new family of digital readout panels called Plasma-Lux. Especially designed and engineered for electronic desk top calculators, for automotive and consumer digital clocks, digital voltmeters and a whole range of electronic instrumentation and equipment requiring high quality digital readouts.

THE NEWEST GAS DISCHARGE DIGITAL DISPLAY PANELS . . . WITH THE FEATURES YOU'VE BEEN LOOKING FOR

- Lighted digital readouts with . . .
- Halo effect backlight gives a more continuous line for greater visibility and clarity
- Greater contrast
- Flicker-free uniform brightness
- Large, 0.40" high size digits are readable from distances of up to 25 feet
- Neon orange color that is easy on the eyes, readily filtered
- Low power ratio to character size (typically 7 mw. per segment)
- Low cost per digit
- AND, they're totally interchangeable with the panels you are now using
- Also available: Custom designs in from 3 to 16 digit formats

Pad No.	Connection	Pad No.	Connection
1	—	21	ANODE 7
2	a	22	—
3	ANODE 1	23	ANODE 8
4	f	24	—
5	ANODE 2	25	—
6	MEMORY	26	—
7	—	27	ANODE 9
8	MINUS	28	—
9	ANODE 3	29	ANODE 10
10	OVERFLOW	30	—
11	ANODE 4	31	—
12	c	32	d
13	—	33	ANODE 11
14	DECIMAL PT.	34	e
15	ANODE 5	35	ANODE 12
16	COMMA	36	g
17	ANODE 6	37	—
18	—	38	b
19	—	39	ANODE 13
20	—	40	—

Connections are numbered from right to left. Special symbols are covered by Anode 1 (Pad No. 3). Anode connections are discernible with the aid of reflected light on face plate.

ELECTRICAL CHARACTERISTICS AT 25°C

Panel Voltage Drop
With Segment Cathode Current of 500 μA.... 145 VDC Typical
With Segment Cathode Current of 1500 μA.. 165 VDC Typical

Initial Ionization Time .... 5 Sec. Maximum

Peak Cathode Voltage .... −180 to −240 VDC (−200 VDC Typical)

(Prior to ionization, voltage between the anode and any cathode may equal this voltage and panel damage will not occur. Peak cathode current must, however, be limited to the absolute maximum rating stated.)

Cathode Off Voltage .... −35 to −120 VDC (−100 VDC Typical)

Cathode On Time is Digit Period Minus Total Blanking Time

Anode Off Voltage .... −30 to −120 VDC (−100 VDC Typical)

Cathode Blanking Interval .... 20 μSec. Minimum
(Interval between turn off of the previous cathode and turn on of corresponding next digit cathode)

Cathode Blanking Overlap .... 10 μSec. Minimum (25 μSec. Typical)
(Interval between turn off of anode for previous digit and turn on of cathodes for next digit)

Voltages are referenced to anode On voltage. All electrical ratings are absolute maximum values beyond which life of device may be reduced. Operating limits do not apply simultaneously — for example: Operation at maximum Segment Cathode Current of 1500 μA may require a longer blanking interval than the 20 μSec. minimum specified.

OPERATING CHARACTERISTICS

Plasma-Lux cold cathode, glow discharge display panels are designed for operation in a multiplexed mode. This is accomplished by the cathode drive and decoder circuitry time sharing among all digit positions. Like cathode segments for all digit positions are bussed. This results in only 12 cathode connections to the display: 7 **segment** connections, 1 **decimal point**, 1 **memory**, 1 **overflow**, 1 **comma** and 1 **minus** connection. There is a separate anode connection for each digit position. Characters are displayed by successively applying positive signals in sequence to the anodes corresponding to each of the digit positions. At the same time, negative signals are applied to the appropriate cathode busses.

OPTICAL CHARACTERISTICS

Color .... Neon Orange

Light Output .. 50 lm/ft² typical at typical operating conditions

TEMPERATURE

Ambient operating temperature .... 0 to +55°C

Ambient storage temperature .... −40 to +70°C

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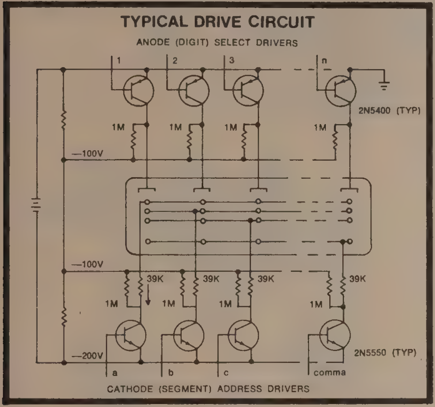
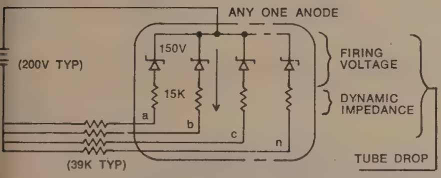
CHERRY®

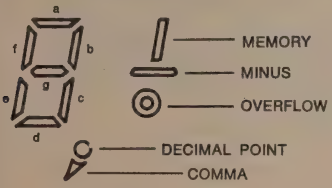
TYPICAL DRIVE CIRCUIT


TYPICAL DRIVE CIRCUIT
ANODE (DIGIT) SELECT DRIVERS
1
2
3
n
2N5400 (TYP)
1M
1M
1M
1M
—100V
—100V
39K
39K
39K
39K
1M
1M
1M
1M
—200V
2N5550 (TYP)
a
b
c
comma
CATHODE (SEGMENT) ADDRESS DRIVERS

EQUIVALENT CIRCUIT


ANY ONE ANODE
(200V TYP)
150V
15K
a
b
c
n
(39K TYP)
FIRING VOLTAGE
DYNAMIC IMPEDANCE
TUBE DROP

CATHODE DESIGNATIONS

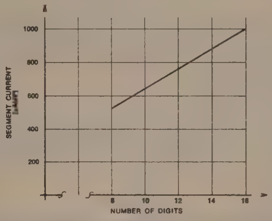

a
b
c
d
e
f
g
MEMORY
MINUS
OVERFLOW
DECIMAL POINT
COMMA

TYPICAL SEGMENT CURRENT VS. DIGITS

CONDITIONS

Cathode Supply Voltage..	−200V	Digit Period	300 µSec.
Cathode Off Voltage........	−100V	Cathode Blanking Interval	50 µSec.
Anode Off Voltage............	−100V	Cathode Blanking Overlap	25 µSec.

At specified current, segment will glow uniformly over its entire surface with no glow visible on any other part of the panel. Current indicated is the value existing during the digit period.

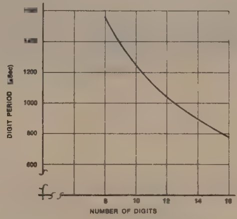


Current for Decimal Point, Comma, Memory, Overflow and Minus sign, is same as Segment Current.

MAXIMUM DIGIT PERIOD VS. DIGITS

CONDITIONS

Maximum Digit Period for Flicker-Free Operation (80 Hz Scan Rate)



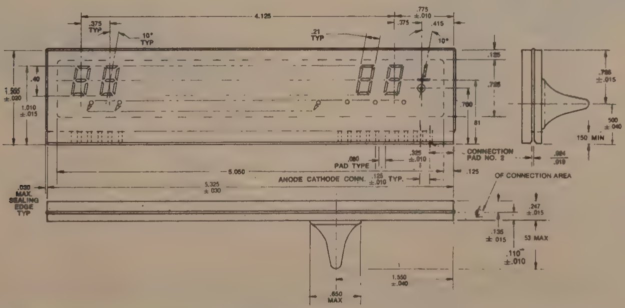
PLASMA-LUX PRICE LIST

Net prices shown are for Model No. W12-0001 basic 12-digit display with 0.40″ high characters with memory, minus and overflow symbols as illustrated.

Quantity	W12-0001 Panel Net Cost	W12-0001 Panel plus W12-1001 Connector* Net Cost	W12-0001 Panel & W12-1001 Connector plus W12-2001 Mounting Bracket* Net Cost
1-5	$21.38	$23.60	$25.36
6-99	15.61	17.24	18.52
100-249	13.47	14.87	15.98
250-499	12.83	14.16	15.22
500-999	12.19	13.46	14.46
1000-1999	11.12	12.27	13.19
2000-4999	9.83	10.85	11.66
5000-9999	8.77	9.68	10.40
10,000-24,999	7.38	8.15	8.76

*Prices include cost of assembly procedure.

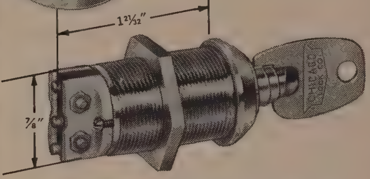
For quantities greater than those shown, contact factory for quotations.


4.125
.375 TYP
10° TYP
.21 TYP
.775 ±.010
.375
.415
10°
.40
1.010 ±.015
.125
.725
.700
.785 ±.015
.500 ±.040
150 MIN
CONNECTION PAD NO. 2
.080 PAD TYPE
.325 ±.010
5.050
5.325 ±.030
ANODE CATHODE CONN.
.125 ±.010 TYP.
.125
OF CONNECTION AREA
.030 MAX. SEALING EDGE TYP
.247 ±.015
.135 ±.015
.53 MAX
.110 ±.010
1.550 ±.040
.650 MAX

Maximum Security Switch Locks for Every Application

ACE® UL Switch Locks

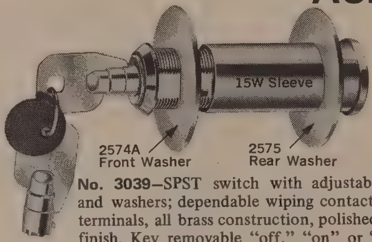
4900 Series
Underwriter's Listed
Ace Locks
20 tumblers



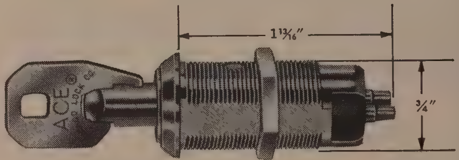
No. 4902—SPDT switch lock. Hardened steel cylinder mounted in a brass barrel 7/8" diameter; solder terminals, polished chrome finish.

No. 4901—(not shown) Same specs as 4902, except with adjustable sleeve and washers. Adjustable 1 7/8" to 2 3/4" thickness.

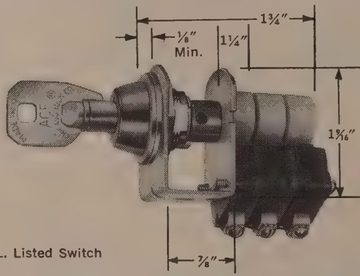
ACE® Switch Locks



No. 3039—SPST switch with adjustable sleeve and washers; dependable wiping contacts. Solder terminals, all brass construction, polished chrome finish. Key removable "off," "on" or "off-on." Also available in die cast outer barrel.

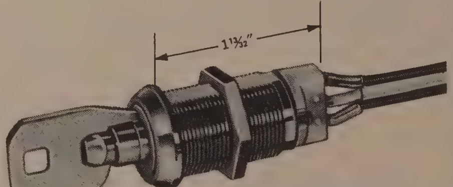


No. 4073—Maintaining contact switch. Key removable "off", "on" or "off-on". Also available as 4073-70 with momentary contact switch Barrel brass. Also available with die cast barrel.



U.L. Listed Switch

No. EXA-112-3—Heavy duty switch lock designed for applications requiring UL Listed switch. Snap action switch actuated by an eccentric cam when key turned 90 degrees. Multi pole combinations available.

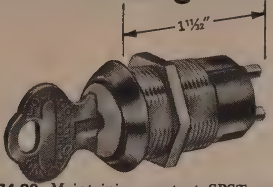


U.L. Listed Switch

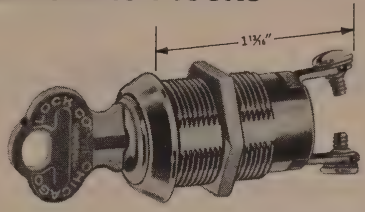
No. 4235—Easy to mount, UL Listed switch available with silver plated contacts and 10" wire leads.

CHICAGO LOCK CO.

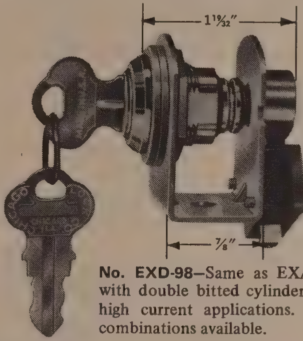
Chicago double bitted switch locks



No. 2274-80—Maintaining contact SPST switch employs wiping contacts. Polished chrome finish. Available with solder terminals as shown or with screw type terminals (No. 2174). Key removable "off", "on" or "off-on". Outer barrel available brass or die cast.

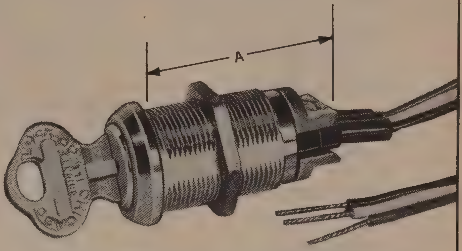


No. 2174-70—Momentary contact switch. Built-in spring returns switch to "off" as key is withdrawn. Outer barrel available brass or die cast.



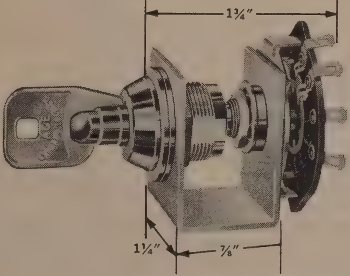
U.L. Listed Switch

No. EXD-98—Same as EXA-112, except with double bitted cylinder. Designed for high current applications. Multiple pole combinations available.

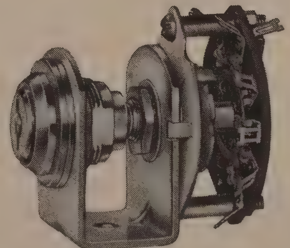


No. 3535—UL Listed switch, SPDT. Furnished with silver plated contacts and 10" wire leads. Same as 4235 except has double bitted cylinder.

Switch locks with wafer type switches



No. 4188—Key operated with bracket mounting and Ace cylinder. Switch designed for low voltage applications. Multiple poles and various throw arrangements available with stacked wafers. Available with double bitted lock No. 2242.



No. 2242—11 blade criss-cross tumblers. Lock unit assembled to wafer switch with bracket mounting. Shown with 2 pole 5 position switch, 2-way 180° key pull.

Same Dimensions as 4188

Current Ratings	Lock Numbers
*125-250VAC, 5 AMP; 30 VDC, 3 AMP	4901, 4902
*125-250VAC, 7 AMP; 28 VDC, 7 AMP	3535, 4235
110-120VAC, 10 AMP; 10 VDC, 10 AMP	2174, 2174-70, 3039, 4073, 4073-70
125 VDC, ½ AMP	EXD-98, EXA-112†
125-250 VAC, 10 AMP	EXD-98-25
125-250 VAC — Over 10 AMP	EXD-112-25

†When ordering, specify if for appliances requiring T.V. approved switches. Only available on EXD-98 or EXA-112 series.

CURRENT RATINGS for 4188, 2242 and 4903

Voltage	AC amps Resistive	DC amps Resistive
6V	5.5	5.5
12V	3.5	3.5
24V	1.75	1.55
48V	.8	.65
115V	.23	.21

*Silver plated contacts. Also suited for low energy circuits.

CHICAGO LOCK CO.

4311 West Belmont Ave., Chicago, Illinois 60641 • Phone 312-282-7177

CONTROL SYSTEMS & COMPONENTS

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Lampholder Sockets .... 1•2008

CUSTOM PRODUCTS

Assorted Switches .... 1•2009

policy governing blanket orders and scheduled shipments

Chicago Switch offers a lower price to induce you to place a larger order, scheduled over a period of time. This allows us to plan ahead. Long range planning affords economies of scale and economies of flexibility. WE OFFER TO SHARE THESE ECONOMIES WITH YOU. You may change your schedule if necessary, however a delay may cost you at least the price of money and possibly reflect the rising cost of materials and labor.

customer's responsibility

Blanket orders must be based upon a total quantity. Price quotations are applicable only to the total quantity. We reserve the right to fabricate and assemble the entire quantity at one time.

minimum shipments

When a shipping schedule is applied, the minimum quantity per monthly shipment shall be 10% of the total order, and valued at not less than $300.00. The resultant maximum schedule period does not exceed 10 months.

changes in shipping schedule

The entire quantity shall initially be scheduled by agreement. Schedules may be changed during the period to accommodate the customer's requirements. However, minimum monthly shipments must be maintained and prices may be subject to "shipping date increment" to cover cost increases. The entire residual balance must be shipped and billed at the end of the period.

decrease in quantity

If a decrease in quantity is negotiated before manufacture is completed, a revision of the prices may be required (as to quantities already invoiced, as well as to order balances) to conform to our existing price schedules. Also, a possible additional amount may be required to cover work in process.

Special Note: Unless otherwise specified, 2 place decimal tolerances are ±.010. 3 place decimal tolerances are ±.005.

minimum order $25.00

In order to maintain Chicago Switch's high standard of quality, prices and specifications subject to change without notice.

CONTROL SYSTEMS & COMPONENTS

engineering data

The conservative load and life specifications presented as part of this catalog serve as a guide in the selection of switches. Yet, in the majority of applications, one cannot find the specifications which precisely match his load — the variety and mix of parameters render such a listing impossible.

To find what you need, ask the switch manufacturer. Outline your load and life requirements:

- We will test to your parameters, if necessary.
- There is no need to under-design or over-design. Under certain conditions, a 1 amp switch may carry 5 amps; the reverse limitation may also be true. In effect, special criteria may expand the range or impose limitations on rated load and life expectancy specifications.

Our data files continue to grow. As we enter our third decade of experience, we offer increased efficiency and expertise in the design of small, miniature and sub-miniature switches.

DEFINITION OF TERMS

actuation force: See operating force.

ambient: The environment in which a switch operates.

breakdown voltage: (dielectric strength) The highest voltage the insulator can withstand without breaking down.

contact bounce: The time during switching in which electrical instability caused by the rebound of the contacts is observed (millisecond range).

contact rating: The capacity to carry an electrical load.

contact resistance: The resistance of a pair of contacts, measured at the terminals, which effectively appears in series with the load (milliohm range).

dielectric strength: See breakdown voltage.

dry circuit: See low energy.

duty cycle: The ratio of on-time to off-time.

end of life criteria: See life expectancy.

insulation resistance: (leakage resistance) The resistance between two normally insulated parts measured at a specified high D.C. potential (megohm range).

leakage resistance: See insulation resistance.

life expectancy: (useful life) Depends upon the end of life criteria for a specific application. In order to determine your failure criteria, the following parameters should be known:

- — breakdown voltage
- — duty cycle
- — mechanical breakdown
- — contact resistance
- — insulation resistance
- — operating force

low energy: (dry circuit, signal circuit) Definitions vary from a few microamps at a few microvolts to that power level at which no electrical effects such as arcing, melting or softening of contacts are associated with the switching. Low energy as listed in the catalog refers to test data obtained at 5-10 milliamps at 5-6 volts D.C. resistive. As in all our specifications, a conservative safety factor is included.

maintained switch: A switch which maintains the mode or position to which it is actuated.

momentary switch: (spring return) A switch which automatically returns to its original or at rest position.

operating force: (actuation force) The force required to transfer the switch from one position to another (gram range).

signal circuit: See low energy.

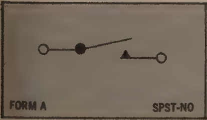
snap-action switch: A switch design whose characteristics tend to remove the control of the actual contact transfer (anti-tease) from the operator or actuator (generally for the purpose of quick make and break).

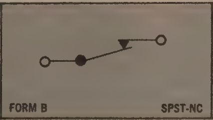
useful life: See life expectancy.

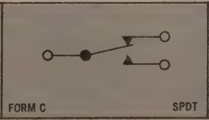
In summary, switches may be rated for a range of applications with electrical loads from low energy up to many amps. A single switch structure may cover a wide segment of the range with or without special contacts.

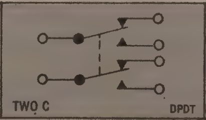
Tell us your needs. Given the details of the electrical load, we can probably supply your switch to live as long as your application requires. We will consider end of life criteria and environment in which the switch must operate.

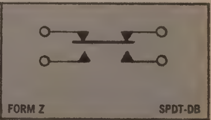
common switch circuits











Special Note: Unless otherwise specified, 2 place decimal tolerances are ±.010. 3 place decimal tolerances are ±.005.

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

introduction

Chicago Switch Inc., located in Chicago, has been producing and supplying a broad line of quality switches for over 20 years. Advanced design engineering, automated assembly techniques and a rigid quality assurance program allows us to offer you the same fine quality at competitive prices, that we have provided for a select group of OEM users for over 2 decades.

Besides the large selection of stock switches offered, our engineering services are available to help custom design the exact switch for your application. Depending on quantities a custom switch may be ultimately less expensive.

All specifications listed in this catalog are subject to change without notice.

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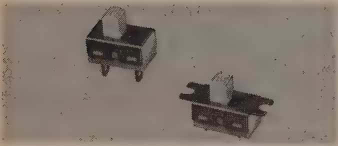
the mini mike™ line



low bounce spst slide action switches maintained

specifications

general information

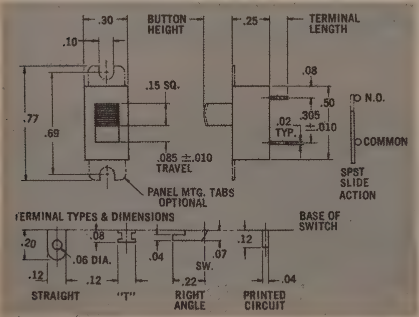
(U.L. File No. E 43318)
Stroke: .085″
Breakdown Voltage: 1000 V 60 Hz
Insulation Resistance: 60,000 megohms
Operating Force: 200-500 grams initially
Temperature Range: −40°C to +100°C
Contact Bounce: 1 millisecond max. initially; less than 2 milliseconds after 100,000 actuations

low energy*

Contact Rating: From 1 volt 10 ma to 1.0 amps inductive at 125 VAC
Contact Material: hard gold over barrier
Contact Resistance: 20 milliohms max. initially
Life Expectancy: 100,000 actuations
End of Life Criteria: 100 milliohms contact resistance

power range

Contact Rating: 3.0 amps inductive at 125 VAC
Contact Material: silver
Life Expectancy: 10,000 actuations
Consult factory



low energy switches

Part Number	Terminal Type	Panel Mtg. Tabs	Button Height	Button Color	Terminal Length
23-021-013	Straight	No	.20	Black	.20
23-021-017	Straight	Yes	.20	Black	.20
23-021-019	Straight	Yes	.20	White	.20
23-021-020	Straight	No	.20	White	.20
23-021-023	"T"	Yes	.20	White	.08
23-021-024	"T"	No	.20	White	.08
23-021-025	"T"	Yes	.20	Black	.08
23-021-026	"T"	No	.20	Black	.08
23-021-031	Rt. Angle	No	.20	Black	.07
23-021-032	Rt. Angle	Yes	.20	Black	.07
23-021-033	Rt. Angle	No	.20	White	.07
23-021-034	Rt. Angle	Yes	.20	White	.07
23-021-040	P.C.	No	.20	Black	.12
23-021-041	P.C.	No	.20	White	.12
23-021-045	"T"	Yes	.20	Black	.08
23-021-047	"T"	Yes	.20	Black	.08

Consult factory for other versions, colors and white dots.

*See Page 1•1989 for Engineering Data.

MADE IN U.S.A.

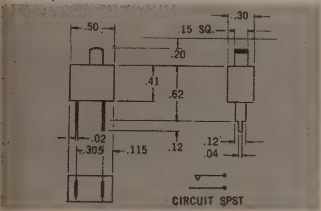
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

the mini mike™ line

low bounce spst slide action switches for p-c applications momentary (spring return) or maintained

specifications

general information
Stroke: .085″
Breakdown Voltage: 1000 V 60 Hz
Insulation Resistance: 60,000 megohms
Operating Force: 150-300 grams initially
Temperature Range: −40°C to +100°C
Contact Bounce: 1 millisecond max. initially; less than 2 milliseconds after 100,000 actuations



low energy*
Contact Material: hard gold over barrier
Contact Resistance: 20 milliohms max. initially
Life Expectancy: 100,000 actuations
End of Life Criteria: 100 milliohms contact resistance

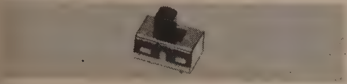
power range
Contact Rating: 2.5 amps inductive at 125 VAC
Contact Material: silver
Life Expectancy: 10,000 actuations
Consult factory

low energy switches

Part Number	Type	Button Height	Button Color	Terminal Length
23-021-601	Momentary	.20	Black	.12
23-021-602	Maintained	.20	Black	.12

*See Page 1•1989 for Engineering Data.

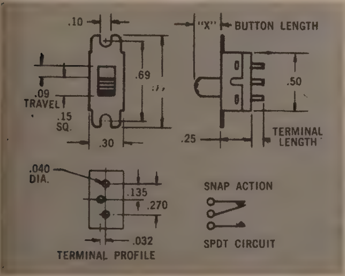
MADE IN U.S.A.



spdt slide switches with snap action contacts

specifications

general information
Stroke: .085″
Operating Force: 100-500 grams
Breakdown Voltage: 1500 V 60 Hz
Insulation Resistance: 15,000 megohms
Temperature Range: −40°C to +100°C
Contact Bounce: 2 milliseconds**



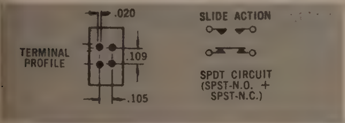
low energy*
Contact Material: hard gold over barrier
Contact Resistance: 20 milliohms max. initially
Life Expectancy: 100,000 actuations
End of Life Criteria: 100 millioms contact resistance
250 milliamps resistive at 30 VDC with hard gold over barrier contact material

power range
1 amp resistive at 125 VAC with silver contact material
Life Expectancy: 50,000 actuations
Consult factory
Right angle terminal versions available

low energy switches — insert molded pins

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length	Contacts
23-021-103	Panel	.20	Black	.08	Gold
23-021-105	P.C.	.20	Black	.12	Gold
23-021-106	P.C.	.20	Black	.08	Gold
23-021-109	Panel	.25	Black	.12	Gold
23-021-112	Panel	.20	Black	.12	Gold
23-021-126	P.C.	.20	White	.12	Gold
23-021-127	Panel	.20	White	.12	Gold
23-021-142†	P.C.	.20	Black	.12	Gold

† Meets Telephone Industry Specification KS20400L3



insert molded pins — "form Z"

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length	Contacts
23-021-304	P.C.	.14	Black	.12	Gold

** Does not apply to 23-021-304

*See Page 1•1989 for Engineering Data.

MADE IN U.S.A.

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

the mini mike™ line

dpdt slide switches with snap action contacts

specifications

general information

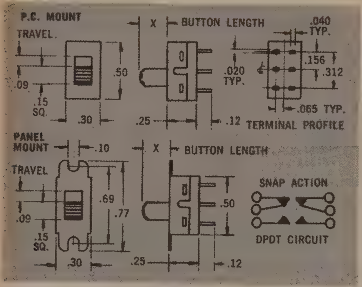
Stroke .085″
Operating Force: 200-500 grams
Breakdown Voltage: 1000 V 60 Hz
Insulation Resistance: 50,000 megohms
Temperature Range: −40°C to +100°C
Contact Bounce: 2 milliseconds max. initially

low energy*

Contact Material: hard gold over barrier
Contact Resistance: 20 milliohms max. initially
Life Expectancy: 500,000 actuations
End of Life Criteria: 50 milliohms contact resistance

power range

Contact Rating: 250 milliamps resistive at 125 VAC
Contact Material: silver
Life Expectancy: 25,000 actuations
Consult factory


P.C. MOUNT
TRAVEL
X
BUTTON LENGTH
.040 TYP.
.156
.312
.50
.020 TYP.
.09
.15 SQ.
.30
.25
.12
.065 TYP.
TERMINAL PROFILE
PANEL MOUNT
.10
X
BUTTON LENGTH
TRAVEL
SNAP ACTION
.69
.77
.50
.09
.15 SQ.
DPDT CIRCUIT
.30
.25
.12

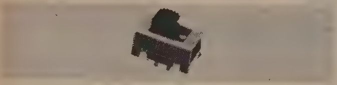
low energy switches — insert molded pins

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length
23-021-113	Panel	.20	Black	.12
23-021-114	P.C.	.20	Black	.12
23-021-118**	Panel	.25	Black	.12
23-021-124	Panel	.20	White	.12
23-021-125	P.C.	.20	White	.12
23-021-305†	P.C.	.20	Black	.12

** White Dot
† Meets Telephone Industry Specification KS20400L2

*See Page 1•1989 for Engineering Data

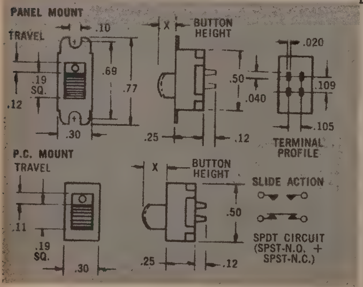
MADE IN U.S.A.



spdt 4 terminal "form z" slide switches spst, n.o. + spst, n.c. "alternate circuit" slide switches

general information

Stroke: .120″
Operating Force: 100-500 grams initially
Breakdown Voltage: 250 Volts 60 Hz
Insulation Resistance: 75,000 megohms initially
Temperature Range: −40°C to +100°C


PANEL MOUNT
TRAVEL
.10
X
BUTTON HEIGHT
.020
.69
.77
.19 SQ.
.12
.50
.040
.109
.30
.25
.12
.105
TERMINAL PROFILE
P.C. MOUNT
TRAVEL
X
BUTTON HEIGHT
SLIDE ACTION
.50
.11
.19 SQ.
.30
.25
.12
SPDT CIRCUIT (SPST-N.O. + SPST-N.C.)

specifications

low energy*

Contact Material: hard gold over barrier
Contact Resistance: 20 milliohms max. initially
Life Expectancy: 50,000 actuations
End of Life Criteria: 100 milliohms contact resistance

power range

Contact Rating: 2 amps resistive at 125 VAC
Contact Material: silver
Life Expectancy: 10,000 actuations
Consult factory

low energy switches

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length	Contacts
23-021-005	P.C.	.20	Black	.12	Gold
23-021-006	Panel	.14	Black	.12	Gold
23-021-008	P.C.	.14	Black	.12	Gold
23-021-009	Panel	.20	Black	.12	Gold
23-021-016†	Panel	.14	Black	.12	Heavy Gold

† Meets Telephone Industry Specification KS20400L1

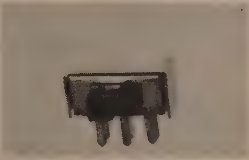
*See Page 1•1989 for Engineering Data.

MADE IN U.S.A.

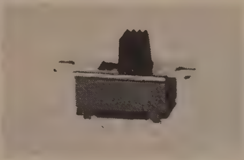
the econometer™ line

low cost miniature slide switches

43-000-121

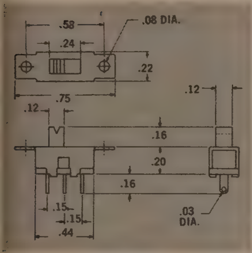


43-200-227

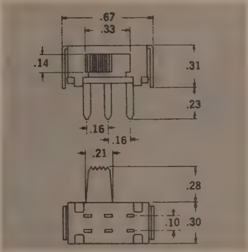


43-200-124

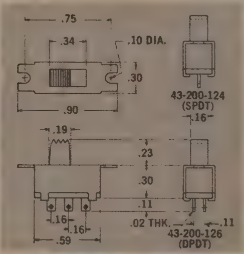
43-100-111


.58
.08 DIA.
.24
.22
.75
.12
.12
.16
.20
.16
.15
.15
.44
.03 DIA.

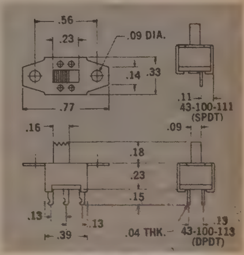
43-000-121


.67
.33
.14
.31
.23
.16
.16
.21
.28
.10
.30

43-200-227


.75
.34
.10 DIA.
.30
.90
43-200-124 (SPDT)
.16
.19
.23
.30
.11
.16
.16
.59
.02 THK.
.11
43-200-126 (DPDT)

43-200-124 (SPDT)
43-200-126 (DPDT)


.56
.23
.09 DIA.
.14
.33
.77
.11
43-100-111 (SPDT)
.16
.09
.18
.23
.15
.13
.13
.39
.04 THK.
.13
43-100-113 (DPDT)

43-100-111 (SPDT)
43-100-113 (DPDT)

- Nominal rating — 300 milliamps 125 VAC for 10,000 actuations
- Slide action switches
- SPDT, SP3Position, DPDT and DP4Position circuits available
- Dimensional tolerance ±.010
- Black button — various heights available
- Low cost
- Silver plate contacts standard Gold plate contacts optional

Part Number	Circuit	Mounting	Button Height*
43-000-121	SPDT	Panel	.15
43-000-132	SP3Position	P.C.	.15
43-100-111	SPDT	Panel	.18
43-100-113	DPDT	Panel	.18
43-200-124	SPDT	Panel	.22
43-200-126	DPDT	Panel	.22
43-200-223	DPDT	P.C. (Standoff)	.35
43-200-227	DPDT	P.C. (Side Mount)	.28
43-210-241	DP4Position	P.C.	.18
43-300-221	DPDT	Panel	.35
43-300-223	DPDT 3 Position	Panel	.39
43-300-224	SPDT	Panel	.39

* Other button heights available, consult factory

43-000-132

43-210-241

43-200-223

43-300-221 (DPDT)
43-300-223 (DPDT 3-pos.)
43-300-224 (SPDT)

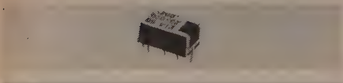
FOR PRICING ON ECONOMITE™ SWITCHES, CONSULT FACTORY.

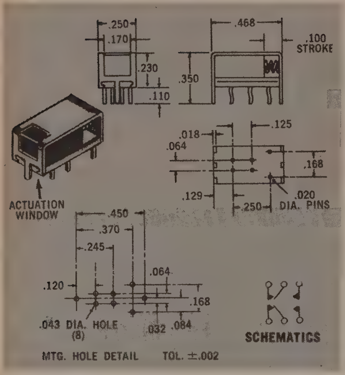
MADE IN THE ORIENT

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

module series

momentary subminiature slide switch spdt or dpdt




.250
.170
.230
.110
.468
.350
.100 STROKE
.018
.064
.125
.168
.129
.250
.020 DIA. PINS
ACTUATION WINDOW
.450
.370
.245
.064
.120
.168
.043 DIA. HOLE (8)
.032
.084
SCHEMATICS
MTG. HOLE DETAIL
TOL. ±.002

MADE IN U.S.A.

specifications

Stroke: .090″

Operating Force: 100-500 grams

Life: 150,000 actuations

Contacts*: solid silver

Contact Rating: 250 milliamps resistive at 9 VDC

Contact Resistance: 0.02 ohms max. initially

Leakage Resistance: 100,000 megohms min.

Voltage Breakdown: 250 Volts 60 Hz

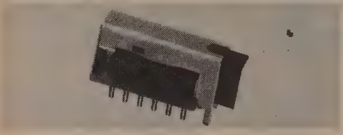
Temperature Range: −30°C to +65°C

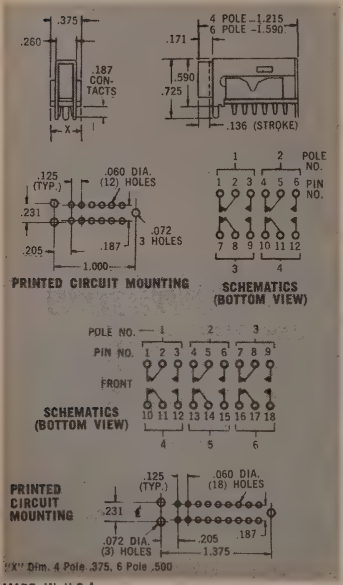
Humidity: 200 hrs. at 90% relative and 40°C

Part Number	Description
23-020-002	Fine Silver Contacts, DPDT
23-020-003	Fine Silver Contacts, SPDT

* Special contact material available on request.

4 pdt and 6 pdt, p-c mount




.375
.260
.187 CONTACTS
X
4 POLE – 1.215
6 POLE – 1.590
.171
.590
.725
.136 (STROKE)
.125 (TYP.)
.060 DIA. (12) HOLES
.231
.072
3 HOLES
.205
.187
1.000
PRINTED CIRCUIT MOUNTING
1 2 POLE NO.
1 2 3 4 5 6 PIN NO.
7 8 9 10 11 12
3 4
SCHEMATICS (BOTTOM VIEW)
POLE NO. 1 2 3
PIN NO. 1 2 3 4 5 6 7 8 9
FRONT
10 11 12 13 14 15 16 17 18
4 5 6
SCHEMATICS (BOTTOM VIEW)
PRINTED CIRCUIT MOUNTING
.125 (TYP.)
.060 DIA. (18) HOLES
.231
.072 DIA. (3) HOLES
.205
.187
1.375
"X" Dim. 4 Pole .375, 6 Pole .500

MADE IN U.S.A.

specifications

general information

Stroke: .136″

Breakdown Voltage: 750 Volts 60 Hz

Initial Resistance: 75,000 megohms initially

low energy*

Contact Material: hard gold over barrier

Contact Resistance: 25 milliohms max. initially

Life Expectancy: 250,000 actuations

End of Life Criteria: 100 milliohms contact resistance

power range

Contact Material: silver

Contact Rating: 1 amp at 125 VAC

Life Expectancy: 10,000 actuations

Consult factory

part no. identification chart

Shown below are non-shorting (break before make) variations only. All shorting (make before break) and combinations of shorting and non-shorting are available.

Part Number	Poles	Description
23-004-000	4	Momentary Action, Basic Switch Module, Plug-In
23-006-000	6	Momentary Action, Basic Switch Module, Plug-In
23-010-021†	4	Push-On — Push-Off, Alternate Action, Plug-In
23-011-021‡	6	Push-On — Push-Off, Alternate Action, Plug-In
23-012-000	4	Push Button, Panel Mount, Momentary, Round Button
23-013-000	6	Push Button, Panel Mount, Momentary, Round Button
23-016-000	4	Push-On, Push-Off, Panel Mount, Round Button
23-017-000	6	Push-On, Push-Off, Panel Mount, Round Button
23-024-000	4	Rocker Actuated, Momentary, Plug In
23-025-000	6	Rocker Actuated, Momentary, Plug In
23-026-000	4	Rocker Actuated, Push-On, Push-Off, Plug-In
23-027-000	6	Rocker Actuated, Push-On, Push-Off, Plug-In

† Meets Telephone Industry Specification KS20400L5
‡ Meets Telephone Industry Specification KS20400L4

*See Page 1•1989 for Engineering Data.

tapit™ keyboard subminiature pushbutton switch

4 terminal printed circuit momentary switch

specifications

general information

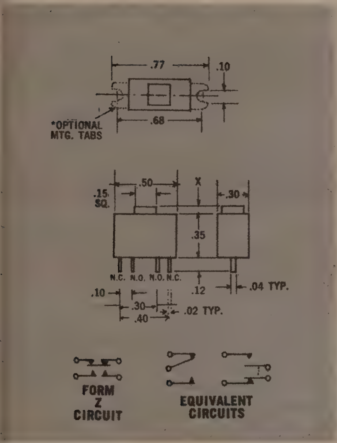
Stroke: .080″
Operating Force: 100-300 grams
Breakdown Voltage: 500 Volts 60 Hz
Insulation Resistance: 50,000 megohms
Temperature Range: −40°C to +100°C
Circuit: SPST - N.O. & SPST - N.C. "Form Z" alternate circuits

low energy*

Contact Material: hard gold over barrier-bifurcated contacts for high reliability
Contact Resistance: 50 milliohms initially
Life Expectancy: 5,000,000 actuations
End of Life Criteria: 500 milliohms contact resistance

power range

Contact Rating: 250 milliamps resistive at 125 VAC
Contact Material: silver
Life Expectancy: 10,000 actuations
Consult factory



MADE IN U.S.A.

low energy switches

Part Number	Description	"X" Button Height**	Stroke
34-500-001	With Mounting Tabs	.09	.080
34-500-002	P.C. Mount	.09	.080
34-500-003	With Mounting Tabs	.68	.080
34-500-004	P.C. Mount	.68	.080

** Other lengths available upon request.

*See Page 1•1989 for Engineering Data.

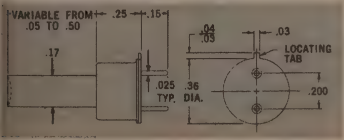
TO-5 pushbutton spasaver™ switch

spst n.o. circuit momentary switch printed circuit applications

specifications

general information

Stroke: .055″
Operating Force: 100-300 grams
Breakdown Voltage: 500 Volts 60 Hz
Insulation Resistance: 500,000 megohms
Temperature Range: −30°C to +65°C



MADE IN U.S.A.

low energy*

Contact Material: hard gold over barrier
Contact Resistance: 50 milliohms max. initially
Life Expectancy: 1,000,000 actuations
End of Life Criteria: 100 milliohms contact resistance

power range

Contact Material: silver
Contact Rating: consult factory

Part Number	Shaft Length	Description
34-550-001	.06	SPST-NO momentary
34-550-002	.50	SPST-NO momentary
34-001-001	.20 over bushing	SPST-NO with bushing**

** Includes: (1) ¼″ internal tooth lock-washer—(2) ¼-40 nuts (not shown).

*See Page 1•1989 for Engineering Data.

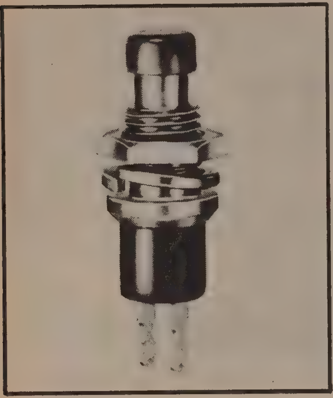
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CONTROL SYSTEMS & COMPONENTS

CSI

the economite™ line

low cost miniature pushbutton switches



spst n.o. circuit momentary switch for panel mounting

specifications

GENERAL INFORMATION

Stroke: .060″
Operating Force: 100 - 300 grams
Breakdown Voltage: 500 volts 60 Hz
Insulation Resistance: 500,000 megohms
Temperature Range: −30°C to +68°C
Contact Combination: SPST-NO
Mounts: ⁹⁄₃₂″ dia. panel hole

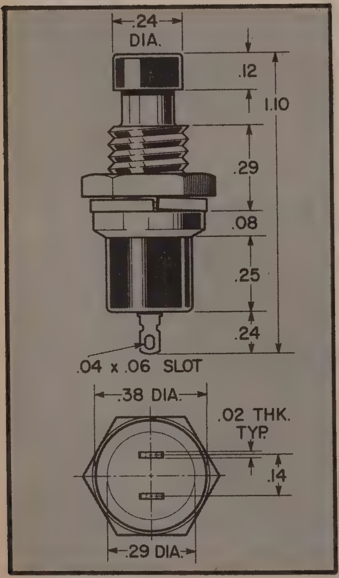
LOW ENERGY

Contact Material: Gold
Contact Resistance: 20 milliohms initially
Life Expectancy: 50,000 actuations
End of Life Criteria: 1 ohm

POWER RANGE

Contact Rating: 1 amp
Contact Material: Silver

dimensions



DIMENSIONS IN INCHES

These attractive miniature pushbutton switches are ideal for use in applications requiring a SPST momentary action, such as business machines, appliances, communication equipment, vending machines and all applications where space, weight and low cost are of prime importance. These reliable switches are available in a variety of pushbutton colors and include necessary panel mounting hardware.

small quantities available from stock

PART NO.	CONTACTS	BUTTON COLOR
44-111-001	SPST-NO 1 AMP SILVER	WHT
44-111-011		BLK
44-111-021		RED
44-111-031		GRN
44-111-041		BLU
44-111-051		YEL

available on special order

PART NO.	CONTACTS	BUTTON COLOR
44-111-000	SPST-NO LOW ENERGY GOLD	WHT
44-111-010		BLK
44-111-020		RED
44-111-030		GRN
44-111-040		BLU
44-111-050		YEL

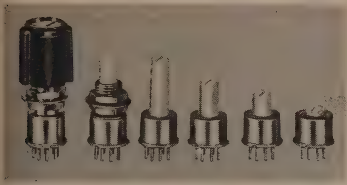
MADE IN THE ORIENT

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CONTROL SYSTEMS & COMPONENTS

CSI

TO-5 rotary spasaver™ switch



- UP TO 8 POSITIONS
- WAVE SOLDERABLE
- GOLD CONTACTS
- COMPACT SIZE

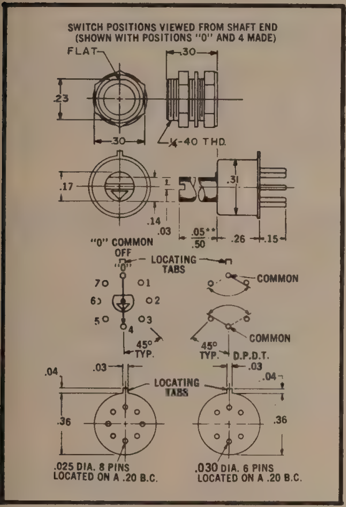
This new sub-miniature rotary switch gets up to 8 positions into a TO-5 can. Gold contacts assure reliable switching over a long life. Mounting can be accomplished by wave soldering directly to P.C. board, by means of board sockets, or panel mounted with optional bushing. The actuator moves through 360° in detented steps of 45°. Also available with stops as required from 2 to 8 positions. Contacts will switch 0.5 amps at 125 VAC (will carry 3 amps) with an operating temperature range of −30°C to 100°C. The exploded drawing will give you an indication of the quality and engineering features of this switch.

The small compact size offers a distinct advantage, particularly in view of the increasing cost of P.C. board real estate and the premium on front or rear panel space. Now you know why we call it a SPASAVER™. With the hand wiring eliminated, the savings are even greater.

The use of glass to metal contact pin seals eliminates any contamination when using the latest wave soldering techniques. This method of soldering not only reduces the time of connecting, removes the possibility of connection errors, but assures uniformly good solder joints as well. A savings in itself.

Applications of switches of this type are widely varied. One of the more popular uses is in manually programming a single standardized P.C. board for test or multifunction usage. With the switch mounted near the access edge, using a thumb wheel, the board does not have to be removed to change function or program. This type of application is used in test equipment, process control equipment, computer peripherals input terminals and telephone switching equipment.

The panel mount bushing version also offers some unique advantages which are cost saving. After the switch or switches are P.C. mounted, the board can be panel mounted via the switch bushings.


SWITCH POSITIONS VIEWED FROM SHAFT END
(SHOWN WITH POSITIONS "0" AND 4 MADE)
FLAT
.30
.23
.30
¼-40 THD.
.17
.31
.14
.03
.05**
.50
.26
.15
"0" COMMON
OFF
"0"
LOCATING TABS
COMMON
7
1
6
2
5
3
4
45° TYP.
45° TYP.
COMMON
D.P.D.T.
.04
.03
LOCATING TABS
.03
.04
.36
.36
.025 DIA. 8 PINS LOCATED ON A .20 B.C.
.030 DIA. 6 PINS LOCATED ON A .20 B.C.

specifications

general information

Angle of Throw: 45°/position — 8 position max.

Breakdown Voltage: 500 Volts 60 Hz

Insulation Resistance: 500,000 megohms

Temperature Range: −30°C to +100°C

low energy*

Contact Material: hard gold over barrier

Contact Resistance: 80 milliohms max. initially

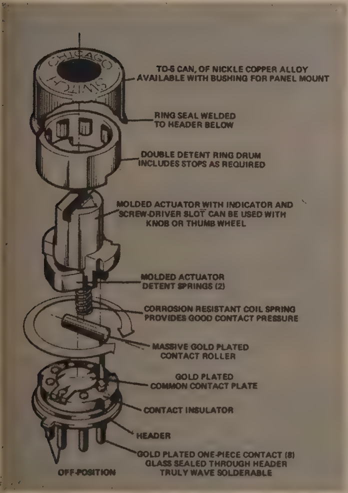
Life Expectancy: 10,000 actuations

End of Life Criteria: 100 milliohms contact resistance

power range

Contact Material: silver or silver alloys

Contact Rating: consult factory


CHICAGO SWITCH
TO-5 CAN, OF NICKLE COPPER ALLOY AVAILABLE WITH BUSHING FOR PANEL MOUNT
RING SEAL WELDED TO HEADER BELOW
DOUBLE DETENT RING DRUM INCLUDES STOPS AS REQUIRED
MOLDED ACTUATOR WITH INDICATOR AND SCREW-DRIVER SLOT CAN BE USED WITH KNOB OR THUMB WHEEL
MOLDED ACTUATOR DETENT SPRINGS (2)
CORROSION RESISTANT COIL SPRING PROVIDES GOOD CONTACT PRESSURE
MASSIVE GOLD PLATED CONTACT ROLLER
GOLD PLATED COMMON CONTACT PLATE
CONTACT INSULATOR
HEADER
GOLD PLATED ONE-PIECE CONTACT (8) GLASS SEALED THROUGH HEADER TRULY WAVE SOLDERABLE
OFF-POSITION

how to order: (low energy versions)

30-XXX-XXX

Code	Positions
2	2 (45°)
3	3 (90°)
4	4 (135°)
5	5 (180°)
6	6 (225°)
7	7 (270°)
8	8 (360°)

Code	Switch Positions**
02	1,2
03	1,2,3
04	1,2,3,4
05	1,2,3,4,5
06	1,2,3,4,5,6
07	1,2,3,4,5,6,7
08	1,2,3,4,5,6,7,0

Code	Std. Shaft Lengths**
05	.05″
18	.18″
30	.30″
50	.50″

Code	Bushing
0	NONE
1	¼-40 THD.*** w/flat

Knob (optional) CS#55-000-529

*See Page 1•1989 for Engineering Data.

** Different shaft lengths and switch positions available on a special order basis — consult factory.

*** Includes: (1) ¼″ internal tooth lockwasher — (2) ¼-40 nuts .06″ thick. Hardware shipped bulk.

dpdt rotary: 30-222-XXX

BUSHING CODE

SHAFT LENGTH CODE

MADE IN U.S.A.

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

standard leaf switch design guide

- **Infinite variety from modular tooling — standard**
- **Quality switching at low cost**
- **Fast delivery**
- **Field tested**

CHICAGO SWITCH custom designed leaf switches provide for low-cost, long life switching in phonographs, hi-fi's, radios, tv's, computers, business machines, electronic organs, vending machines and appliances. We would be pleased to custom-design standard switches to fit your application — without costly retooling or special designing. Because of our engineering, production and design facilities — and the versatility of our tooling — you can get the exact leaf switch to meet your requirements.

Actuation can be furnished in cam, roller, push button, rotor actuated — or any mechanical situation you require.

Contacts and lifters can be located on your switch anywhere along the blade length with increments of .001 of an inch, if necessary.

Contacts can be made of palladium, gold, silver, silver cadmium, 90-10, silver-plated — whatever material will do the best job.

Blade profile — Most industry standards and many specials are available from stock. Any profile can be made to your specifications. Blade material can be any of either the standard or exotic materials.

No matter what your requirements — CHICAGO SWITCH has the experience and facilities to produce leaf switches for you on both large and small orders — switches that are guaranteed to perform and produce to blueprint.

our design...

If CHICAGO SWITCH is to do the designing, give us as much of the following data as possible:

A. circuit

Number and kind of circuits required. When you need a SPST circuit, be sure to specify whether normally open (N.O.) or normally closed (N.C.); if SPDT, whether break-before-make (non-shorting) or make-before-break (shorting).

B. actuation

Kind of actuation required. Will you need a lifter . . . roller . . . cam follower? Will actuation be directly against a metal blade? A fiber-insulator blade?

C. load

Note the load each circuit in the switch is to carry. It determines contact size and material.

D. ambient

Required shelf life, duty cycle, ambient environment conditions — particularly if unusual. Contact material and, perhaps, plating might make a big, favorable difference.

E. stroke

Any critical places within the stroke — if there are any — where switching must occur or actuation force reach a specified level. How far will switch be stroked?

F. mounting

The side of the stack that is to be on the mounting surface, and the relationship to the point of actuation to the mounting surface and front mounting hole (the spacer hole nearest the blades).

G. stack height

Any limits there may be to height of stack.

H. U.L.

Whether the end use of your product requires U.L. approval.

or your design

If you want to do your own designing, you specify the prototype and we'll supply the samples for your approval, then handle the production runs.
What to Specify:

1. mounting centers

You have your choice of ¼″ mounting center with small spacers or with larger spacers, or ⅜″ mounting center or our new, miniature 3⁄16″ line (see page 1•2000).

2. blades

a. Length of each blade
b. Lug position of each blade
c. Thickness and material of each blade
d. Number of blades per switch
e. Preforms

3. contacts

a. Size and shape of each contact
b. Material of each contact
c. Which particular blade each contact goes on and the contact position on the blade

4. lifters

a. Shape of each lifter b. Length of each lifter
c. Which particular blade each lifter goes on and the lifter position on the blade

5. spacers

a. Size of each spacer
b. Position of each spacer in the stack

6. tubing

a. Inside diameter of tubing
NOTE: Only a #3 screw clearance diameter is available in ¼″ x ½″ spacers.

7. other information

a. Forms in blades (if any)
b. Sequence of switching (if necessary)
c. Brackets (if any)
d. Flexible fibre insulators (if any)

8. application information

a. Load c. Life requirement
b. Duty cycle d. Adverse ambient conditions

9. a sketch of the suggested prototype

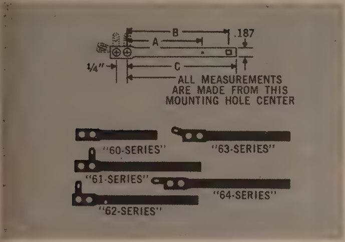
90% of all leaf switches can be built by using these standard, already-tooled parts. By familiarizing yourself with them you can put together virtually any combination of switching circuits with low-cost leaf switches. Please use decimal-inch or fractional-inch dimensions, if possible . . . other notation if necessary.

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

standard leaf switch design guide

blades

¼″ mounting center


B
.187
A
¼″
C
ALL MEASUREMENTS ARE MADE FROM THIS MOUNTING HOLE CENTER
"60-SERIES"
"63-SERIES"
"61-SERIES"
"64-SERIES"
"62-SERIES"

blade lengths: Any blade length, contact position, lifter position, or form can be had in any .001″ from .156″ to 2.500″ from the center of the front mounting hole.

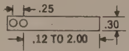
thickness: Any blade thickness from .006″ to .020″ can be had.

material: Both nickel-silver, and tinned phosphor bronze, the best all-around long-life spring materials, can be readily soldered to without pre-treatment.

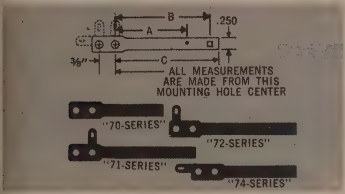
For use with .250″ x .500″ spacers, the mounting holes are .156″ dia.

For use with .296″ x .562″ spacers, the mounting holes are .187″ dia.

fibre insulators: Flexible vulcanized fibre insulators for ¼″ mounting centers can be had in .010″ and .015″ thicknesses. Length from .125″ to 2.000″. .005″ thick insulators can be had in lengths up to 1.312″ maximum.


.25
.30
.12 TO 2.00

⅜″ mounting center

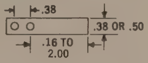

B
.250
A
⅜″
C
ALL MEASUREMENTS ARE MADE FROM THIS MOUNTING HOLE CENTER
"70-SERIES"
"72-SERIES"
"71-SERIES"
"74-SERIES"

blade lengths: 1,500 different blade lengths can be had from .875″ to 2.375″ from the center of the front mounting hole. The same wide choice is available in contact hole positions (dimension "A"), lifter hole positions (dimension "B"), and form positions.

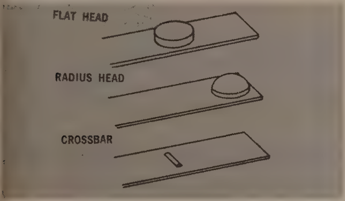
thickness: Any blade thickness from .006″ to .020″ can be had.

material: Both nickel-silver and tinned phosphor-bronze are available.

fibre insulators: Flexible vulcanized fibre insulators for ⅜″ mounting center can be had in .010″ and .015″ thicknesses and any length from .156″ to 2.000″.


.38
.38 OR .50
.16 TO 2.00

contacts


FLAT HEAD
RADIUS HEAD
CROSSBAR

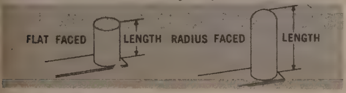
sizes: .017″ to .062″ thick, .109″ to .187″ dia. for round contacts, .019″ thick, .032″ to .125″ long for cross bar contacts.

material: Fine silver for commercial applications, No. 1 gold alloy or palladium for low-energy circuits, silver-cadmium or silver-cadmium oxide for weld and arc resistance, gold flash for shelf life.

stakings: Rivet head contacts are staked into holes in the blades. The staked shank itself can serve as a contact on the other side of the blade, behind the head. You may specify a flat, radiused or point stake, as you wish.

lifters

standard lifters are nylon, .187″ diameter


FLAT FACED
LENGTH
RADIUS FACED
LENGTH

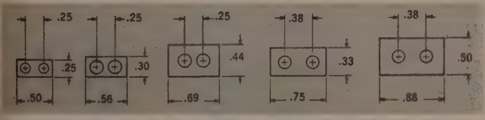
(BASIC SHAPES SHOWN)

lengths available: 1/16″ to 7/16″ in increments of 1/32″.

Lifters can be positioned anywhere on the blade.

note: Designate position of contacts, lifter preforms, and other components in terms of distance from the front mounting hole center. Self extinguishing (SE grades) material available. Special lifter shapes available.

spacers


.25
.25
.50
.25
.30
.56
.25
.44
.69
.38
.33
.75
.38
.50
.88

AVAILABLE IN .032″, .047″, .062″, .078″, and .093″ THICKNESSES AND IN THE ABOVE PROFILES. SELF EXTINGUISHING (SE GRADES) MATERIAL AVAILABLE.

header plates: Available for ¼″ and ⅜″ mounting center switches

mounting: Right angle brackets are available

nut plates: Available for ¼″ mounting center switches

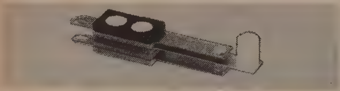
tubing: Tubing can be had with an I.D. of: .105/.115 (for #3 screw), .114/.123 (for #4 screw), and .128/.137 (for #5 screw)

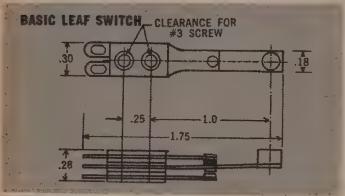
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CSI

just a few standards...

- Infinite variety from modular tools




BASIC LEAF SWITCH
CLEARANCE FOR #3 SCREW
.30
.18
.25
1.0
1.75
.28

MADE IN U.S.A.

1/4″ mtg. center leaf switch

specifications

Stroke: .125″

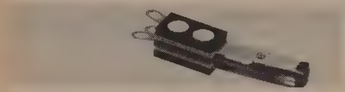
Contacts: fine silver

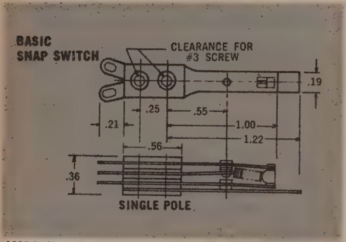
Contact Rating: 3 amps, 120 Volts, 60 Hz, 360 watts resistive

Voltage Breakdown: 1000 VRMS, 60 Hz

Contact Arrangements: May be stacked in any combination

Part Number	Contact Form
20-001-333	SPST-NO (1A)
20-001-334	SPST-NC (1B)
20-001-335	SPDT (1C)




BASIC SNAP SWITCH
CLEARANCE FOR #3 SCREW
.19
.21
.25
.55
1.00
1.22
.56
.36
SINGLE POLE

MADE IN U.S.A.

1/4″ mtg. center leaf-snap switch

specifications

Contacts: silver cad. oxide

Contact Rating: 5 amps inductive at 120 VAC, 60 Hz

Voltage Breakdown: 500 VRMS, 60 Hz

Transfer Time: 4 ms max.

Actuating Force: 60 grams max. per pole

Operating Differential: .031″ (single pole)

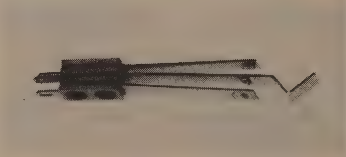
Variations Available:

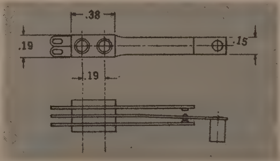
- Low energy (100,000,000 actuations at low energy)*
- Maintained
- Low bounce

Part Number	Contact Form	Action
20-000-051	SPDT (1C)	Momentary
20-000-052	DPDT (2C)	Momentary
20-000-053	3PDT (3C)	Momentary
20-000-058	SPDT (1C)	Maintained

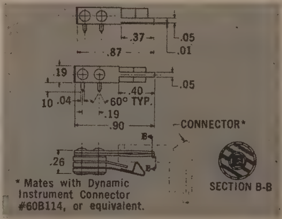
*See Page 1•1989 for Engineering Data.

3/16″ mtg. center spacesaver™ leaf





jak-switch™ jack adapter


.37
.05
.87
.01
.19
.05
.40
10
.04
60° TYP.
.19
.90
CONNECTOR*
B
.26
B
SECTION B-B

* Mates with Dynamic Instrument Connector #60B114, or equivalent.

- versatility
- miniature
- quality
- long life
- low cost

CONSULT FACTORY
FOR DETAILS

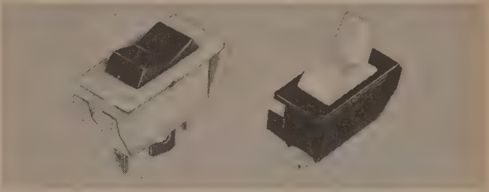
MADE IN U.S.A.

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CONTROL SYSTEMS & COMPONENTS

single-pole rocker and paddle switches

26 series and P26 series—unlighted



- U.L. and C.S.A. listed rocker switches (26 Series unlighted) (U.L. File No. E 43318)
- Snap-in Installation
- Modern styling
- Wide range of color combinations
- Special colors, hot stamping and metal bezels available
- Matching panel lights and lighted switches available
- Solder, screw or slip-on terminals
- Low Cost

specifications

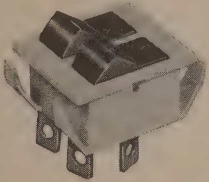
Contacts: silver-cadmium

Contact Rating: 26 series — 10 Amps inductive at 120 VAC
P26 series — 10 Amps inductive at 120 VAC

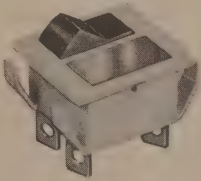
Breakdown Voltage: 2,000 V, 60 Hz min.
Features: heavy duty versions available

also available

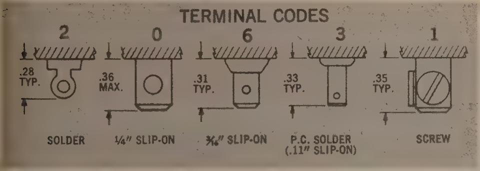
- Two switches in one case. Specify by two part numbers. Such as: "26-290-102 + 26-280-103." Panel cutout 1.08″ x .96″.



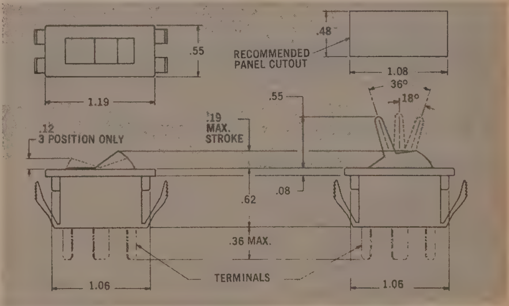
- Switch plus a lens in one case.



terminal dimensions


TERMINAL CODES
2
0
6
3
1
.28 TYP.
.36 MAX.
.31 TYP.
.33 TYP.
.35 TYP.
SOLDER
¼″ SLIP-ON
3/16″ SLIP-ON
P.C. SOLDER (.11″ SLIP-ON)
SCREW

outline dimensions


.55
1.19
.48
RECOMMENDED PANEL CUTOUT
1.08
36°
18°
.55
.19 MAX. STROKE
.12 3 POSITION ONLY
.08
.62
.36 MAX.
TERMINALS
1.06
1.06

Panel Thickness: Snaps into panels from .031″ to .125″ thick.

how to order:

P26-XXX-10X

ADD "P" FOR PADDLE SWITCH

TERMINAL CODE
- 0—¼″ wide slip-on
- 1—Screw
- 2—Solder
- 3—P.C. solder (.11″ slip-on)
- 6—3/16″ wide slip-on
- 8—See Series 26-8

* Rocker color only.

ROCKER & PADDLE COLOR CODE
- 0—White
- 2—Red
- 4—Ivory*
- 5—Green*
- 6—Blue
- 8—Gray*
- 9—Black

CASE COLOR CODE
- 0—White
- 1—CHROME BEZEL
- 2—Red
- 3—GOLD BEZEL
- 4—Ivory
- 5—Green
- 6—Light Blue
- 8—Gray
- 9—Black

CIRCUIT CODE
- 0—SPST on-off
- 1—SPST N.O. Momentary-on
- 2—SPDT Maintained
- 3—SPDT Momentary Transfer
- 4—SPDT 3 Position Center-off
- 5—SPST N.C. Momentary-off
- 6—SPDT 3-Position Center-off Momentary-both sides†
- 8—Refer to lighted rocker switch series
- 9—SPDT 3-Position Center-off Momentary-one side†

† Rocker versions only

MADE IN EUROPE

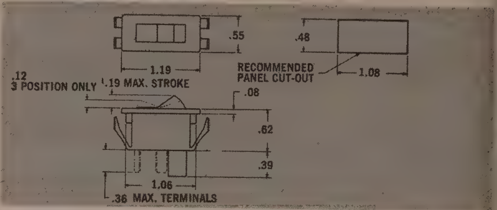
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

single-pole lighted rocker switches

26 series (neon & incandescent)

- U.L. listed 6 amps inductive at 120 VAC (U.L. File No. E 43318)
- Snap-in Installation
- Positive Actuation
- Silver Cadmium Contacts
- Available with slip-on connectors, solder lugs, screw terminals and metal bezels.

outline dimensions



Panel Thickness: Snaps into panels from .031″ to .125″ thick.

how to order:

26-XXX-XX8

TERMINAL CODE
0 — ¼″ slip-on
1 — Screw
2 — Solder
3 — P.C. solder (.11″ slip-on)
6 — 3⁄16″ slip-on
8 — See Series No. 26-8

ROCKER COLOR CODE
0 — White
2 — Red
3 — Clear
4 — Amber
5 — Green†

CASE COLOR CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light Blue
8 — Gray
9 — Black

CIRCUIT CODE
1 — SPST on-off
3 — SPST N.O. Momentary-on
4 — SPST N.C. Momentary-off

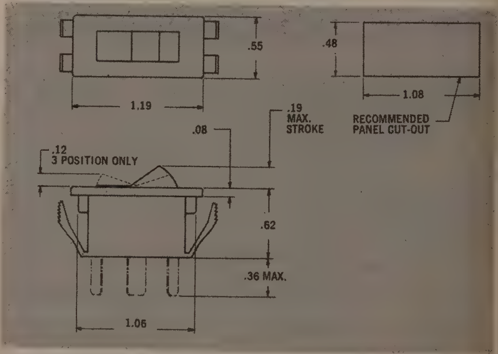
LAMP CODE
2 — 4-6 V incandescent & standard termination*
3 — 18-28 V incandescent & standard termination*
4 — 9-14 V incandescent & standard termination*
6 — 125 V neon, high intensity 5,000 hour life
7 — 250 V neon, medium intensity
8 — 125 V neon, medium intensity 25,000 hour life
9 — NO LAMP

† Cosult factory for neon versions in green.
* Standard Lamp Terminations: Klipstocket 40-000-001 on incandescents, no lamp leads on "lightable" (no-lamp) versions.
MADE IN EUROPE

26-8 series—internally lighted (neon)

- U.L. listed 6 amps inductive at 120 VAC (U.L. File No. E 43318)
- Snap-in Installation
- Positive Actuation
- Silver Cadmium Contacts
- Available with slip-on connectors, solder lugs, screw terminals and metal bezels.

outline dimensions



Panel Thickness: Snaps into panels from .031″ to .125″ thick.

how to order:

26-8XX-XXX

CIRCUIT CODE
1 — SPST on-off
3 — SPST N.O. Momentary-on
4 — SPST N.C. Momentary-off

LAMP CODE
0 — 110 V neon
1 — 220 V neon

TERMINAL CODE
0 — ¼″ wide slip-on
1 — Screw
2 — Solder
3 — P.C. solder (.11″ slip-on)
6 — 3⁄16″ wide slip-on

ROCKER CODE
0 — White
2 — Red
3 — Clear
4 — Amber

CASE CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light Blue
8 — Gray
9 — Black

MADE IN EUROPE

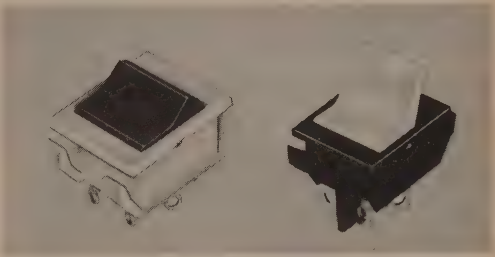
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CONTROL SYSTEMS & COMPONENTS

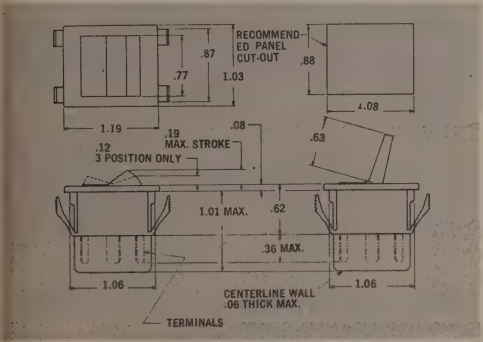
double-pole rocker and paddle switches

27 series and P27 series—unlighted

- U.L. listed (U.L. File No. E 43318)
- Snap-in Installation
- Attractive Styling
- Matching lighted switches and panel lights available
- Special colors, hot stamping and metal bezels available
- Compact size, numbered terminals
- Solder, Screw or slip-on terminals



outline dimensions


RECOMMENDED PANEL CUT-OUT
.87
.77
1.03
.88
1.08
1.19
.08
.19
MAX. STROKE
.12
3 POSITION ONLY
.63
1.01 MAX.
.62
.36 MAX.
1.06
CENTERLINE WALL
.06 THICK MAX.
1.06
TERMINALS

Panel Thickness: Snaps into panels from .031″ to .125″ thick.

specifications

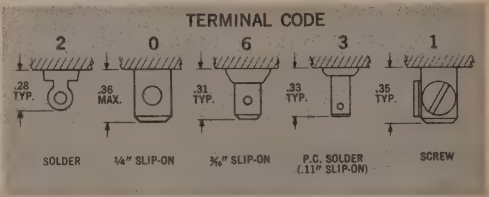
Contacts: silver-cadmium

Contact Rating: 27 series—6 Amps inductive at 120 VAC
P27 series—6 Amps inductive at 120 VAC

Breakdown Voltage: 2,000 V, 60 Hz min.

Features: heavy duty versions available

terminal dimensions


TERMINAL CODE
2
0
6
3
1
.28 TYP.
.36 MAX.
.31 TYP.
.33 TYP.
.35 TYP.
SOLDER
¼″ SLIP-ON
³⁄₁₆″ SLIP-ON
P.C. SOLDER (.11″ SLIP-ON)
SCREW

how to order:

P27-1XX-XXX

ADD "P" FOR PADDLE SWITCH

CIRCUIT CODE

00—SPST on-off
01—SPST N.O. Momentary-on*
02—SPDT Maintained
03—SPDT Momentary Transfer*
04—SPDT 3-Position Center-off
05—SPST N.C. Momentary-off*
06—SPDT 3-Position Center-off Momentary-both sides
10—DPST on-off
11—DPST N.O. Momentary-on*
12—DPDT Maintained
13—DPDT Momentary Transfer*
14—DPDT 3-Position Center-off
15—DPST N.C. Momentary-off*
16—DPDT 3-Position Center-off Momentary-both sides
17—DPDT 3-Position Center-off Momentary-one side

TERMINAL CODE

0—¼″ wide slip-on
1—Screw
2—Solder
3—P.C. solder (.11″ slip-on)
6—³⁄₁₆″ wide slip-on

ROCKER & PADDLE COLOR CODE

0—White
2—Red
4—Ivory
5—Green
6—Light Blue
8—Gray
9—Black

CASE COLOR CODE

0—White
1—CHROME BEZEL
2—Red
3—GOLD BEZEL
4—Ivory
5—Green
6—Light Blue
8—Gray
9—Black

* Rocker switch circuits only

MADE IN EUROPE

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

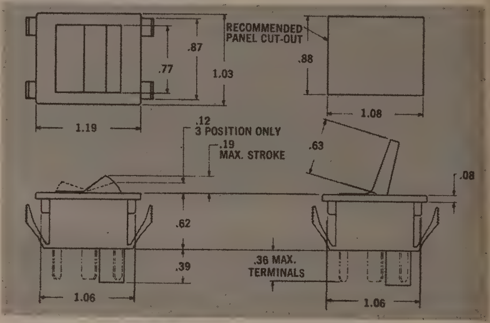
CONTROL SYSTEMS & COMPONENTS

double-pole and single-pole lighted rocker and paddle switches

27 series
P27 series
(neon & incandescent)

- U.L. listed 6 amps inductive at 120 VAC (U.L. File No. E 43318)
- Snap-in Installation
- Positive Actuation
- Silver Cadmium Contacts
- Available with slip-on connectors, solder lugs, screw terminals and metal bezels.

outline dimensions



Panel Thickness: Snaps into panels from .031″ to .125″ thick.

how to order:

P27-XXX-XXX

ADD "P" FOR PADDLE SWITCH

CIRCUIT CODE
70 — SPST on-off
71 — SPST N.O. momentary-on**
72 — SPDT maintained
73 — SPDT momentary transfer**
74 — SPDT 3-position center-off
75 — SPST N.C. momentary-off**
76 — SPDT 3-position momentary-both sides
80 — DPST on-off
81 — DPST N.O. momentary-on**
85 — DPST N.C. momentary-off**

MADE IN EUROPE

LAMP CODE
2 — 4-6 V incandescent & standard termination*
3 — 18-28 V incandescent & standard termination*
4 — 9-14 V incandescent & standard termination*
6 — 125 V neon, high intensity 5,000 hour life
7 — 250 V neon, medium intensity
8 — 125 V neon, medium intensity 25,000 hour life
9 — NO LAMP

TERMINAL CODE
0 — ¼″ slip-on
1 — Screw
2 — Solder
3 — P.C. solder (.11″ slip-on)
6 — 3⁄16″ slip-on

ROCKER AND PADDLE COLOR CODE
0 — White
2 — Red
3 — Clear
4 — Amber
5 — Green†

CASE COLOR CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light Blue
8 — Gray
9 — Black

† Consult factory for neon versions in green.

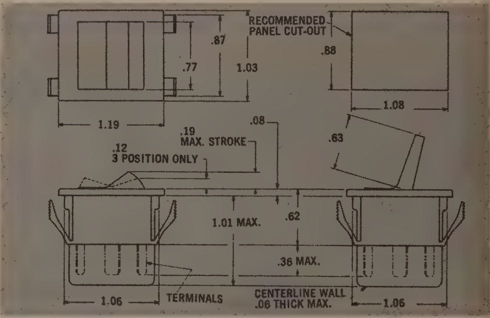
* Standard Lamp Terminations: Klipsocket 40-000-001 on incandescents, no lamp leads on "lightable" (no-lamp) versions.

**Rocker switch circuits only.

27-3 series — internally lighted
P27-3 series — internally lighted (neon)

- U.L. listed (U.L. File No. E 43318)
- Attractive Styling
- Matching panel lights available
- Special colors, hot stamping and metal bezels available
- Compact size, numbered terminals
- Solder, Screw or slip-on terminals

outline dimensions



Panel Thickness: Snaps into panels from .031″ to .125″ thick.

specifications

Contacts: silver-cadmium
Contact Rating: 27 series — 6 Amps inductive at 120 VAC
P27 series — 6 Amps inductive at 120 VAC
Breakdown Voltage: 2,000 V, 60 Hz min.

how to order:

P27-3XX-XXX

ADD "P" FOR PADDLE SWITCH

CIRCUIT CODE
0 — SPST (on-off)
1 — SPST N.O. momentary-on*
2 — SPDT
3 — SPDT momentary transfer*
4 — SPDT 3-position center-off
5 — SPST N.C. momentary-off*
6 — SPDT 3-position center-off momentary-both sides
7 — SPDT 3-position center-off momentary-one side
8 — DPST
9 — DPST N.O. momentary-on*

(* Rocker switch circuits only.)

MADE IN EUROPE

LAMP CODE
0 — 110 V neon
1 — 220 V neon
6 — 380 V neon

(† Consult factory for neon versions in green.)

TERMINAL CODE
0 — ¼″ wide slip-on
1 — Screw
2 — Solder
3 — P.C. solder (.11″ slip-on)
6 — 3⁄16″ wide slip-on

ROCKER AND PADDLE COLOR CODE
0 — White
2 — Red
3 — Clear
4 — Amber
5 — Green†

CASE COLOR CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light Blue
8 — Gray
9 — Black

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

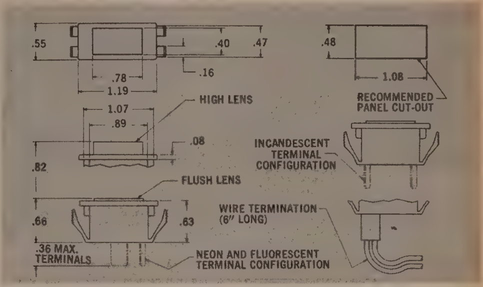
panel indicator lights

15 series

Matches 26 and 27 series rocker and paddle switches — Snaps In — Holds Fast

- U.L. listed versions available (U.L. File No. E 43668)
- Available with protruding lenses, transparent lenses, and two separate panel lights in one "double case"
- Hot Stamping available

outline dimensions


.55
.40
.47
.78
1.19
.16
.48
1.08
RECOMMENDED PANEL CUT-OUT
HIGH LENS
1.07
.89
.08
.82
INCANDESCENT TERMINAL CONFIGURATION
FLUSH LENS
WIRE TERMINATION (6" LONG)
.66
.63
.36 MAX. TERMINALS
NEON AND FLUORESCENT TERMINAL CONFIGURATION

Panel Thickness: Snaps into panels from .031" to .125" thick.

how to order:

15-XXX-1X9

TERMINAL CODE
0 — ¼" wide slip-on
1 — Screw
2 — Solder
3 — P.C. solder (.11" slip-on)
4 — Wire (6" long)
6 — 3/16" wide slip-on

LENS CODE
0 — White, flush type*
1 — White, high type*
2 — Red, flush type*
3 — Red, high type*
4 — Yellow, flush type*
5 — Green, flush type†
6 — Green, high type
7 — Amber, high type*
8 — Clear, flush type
9 — Blue, flush type**

CASE COLOR CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Light Green
6 — Light Blue
8 — Gray
9 — Black

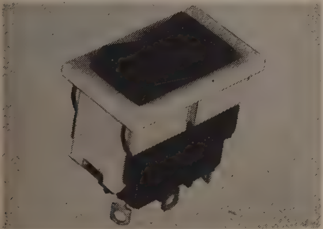
LAMP CODE
0 — 125 V Neon, high intensity, 5,000 hour life
1 — 250 V Neon, medium intensity
2 — 4-6.3 V Incandescent, 600,000 - 3,000 hours life
3 — 18-28 V Incandescent, 1,760,000 - 10,000 hours life
4 — 9-14 V Incandescent, 180,000 - 1,000 hours life
5 — 125 V Neon, medium intensity, 25,000 hours life
6 — 380 V Neon, medium intensity
7 — 125 V Fluorescent‡
8 — 250 V Fluorescent‡
9 — 380 V Fluorescent‡

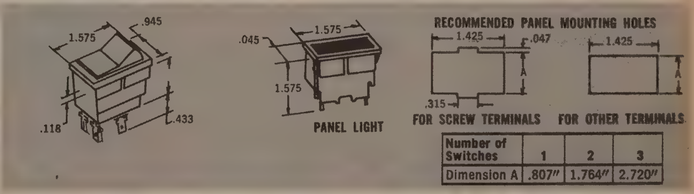
* Incandescent and Neon only.
** Incandescent only.
† Incandescent and Fluorescent only.
‡ Green or clear lens only.

MADE IN EUROPE

rocker switches and panel lights

42 series lighted and unlighted-10 and 20 amp





Number of Switches	1	2	3
Dimension A	.807"	1.764"	2.720"

Note: In Unlighted Switches, Smooth Rockers Are Standard. In Lighted Switches, Serrated Rockers Are Standard. Serrated Rockers For Unlighted Switches May Be Obtained On Special Request.

how to order:

42-XXX-XXX

CIRCUIT CODE
00 — SPST 2-Position Maintained (on-off)
01 — SPST N.O. 2-Position Momentary-on
02 — SPDT 2-Position Maintained
03 — SPDT 2-Position Momentary **Transfer**
04 — SPDT 3-Position Maintained Center-off
05 — SPST N.C. 2-Position Momentary-off
06 — SPDT 3-Position Momentary-both sides Center-off
07 — SPDT 3-Position Momentary-one side Center-off
10 — DPST 2-Position Maintained
11 — DPST N.O. 2-Position Momentary-on
12 — DPDT 2-Position Maintained
13 — DPDT 2-Position Momentary **Transfer**
14 — DPDT 3-Position Maintained Center-off
15 — DPST N.C. 2-Position Momentary-off
16 — DPDT 3-Position Momentary-both sides Center-off
17 — DPDT 3-Position Momentary-one side Center-off

PANEL LIGHTS
86 — One-Lamp Panel Light—Use Terminal Code 0, 1, or 2
87 — Two-Lamp Panel Light—Use Terminal Code 0, 1, or 2

MADE IN EUROPE

LAMP CODE
0 — 120 V Neon
1 — 240 V Neon
2 — 4-6 V
3 — 18-28 V
4 — 8-12 V
9 — Unlighted Switch

TERMINAL & CONTACT CODE
0 — 25 Amp, 120 VAC, ¼" Wide Slip-on Terminals
1 — 25 Amp, 120 VAC, Screw Terminals
2 — 25 Amp, 120 VAC, Solder Terminals
3 — 15 Amp, 120 VAC, ¼" Wide Slip-on Terminals
4 — 15 Amp, 120 VAC, Screw Terminals
5 — 15 Amp, 120 VAC, Solder Terminals
6 — 6 Amp, 120 VAC, ¼" Wide Slip-on Terminals
7 — 6 Amp, 120 VAC Screw Terminals
8 — 6 Amp, 120 VAC Solder Terminals

BEZEL COLOR CODE
0 — White
2 — Red
4 — Ivory
5 — Green
6 — Blue
8 — Gray
9 — Black

ROCKER & LENS COLOR CODE
0 — White**
1 — White*
2 — Red
3 — Clear*
4 — Ivory**
5 — Green†
6 — Blue**
7 — Amber*
8 — Gray**
9 — Black**

† Not for neon.
* For lighted rockers or panel light lenses only.
** For unlighted rockers only.
For Pricing on Rocker Switches and Panel Lights, Consult Factory.

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CONTROL SYSTEMS & COMPONENTS

econolite™ panel indicator lights

17-00 series

- Long life
- High Brilliance
- Temperature range to 100°C
- Mounts in .319-.325" Dia. Hole

how to order:

17-00X-XXX

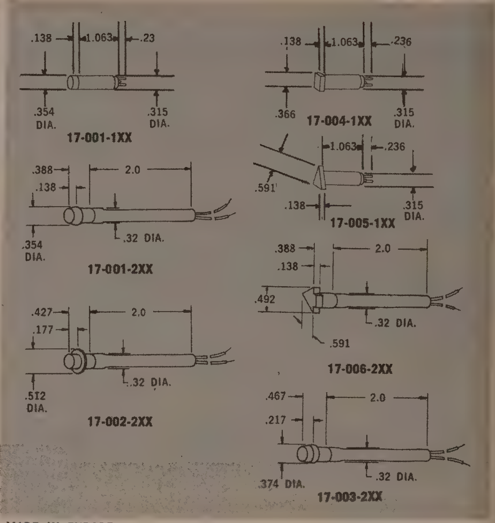
LENS STYLE CODE
- 1 — Round lens
- 2 — Round lens + chrome flange
- 3 — Round lens + chrome flange
- 4 — Square lens
- 5 — Triangular lens
- 6 — Arrow lens

TERMINAL CODE
- 1 — Solder
- 2 — Wire (6" long)
- 3 — Pins for socket insertion

COLOR CODE
- 0 — White
- 2 — Red
- 4 — Amber
- 5 — Green (not w/neon)
- 8 — Clear

VOLTAGE CODE
- 0 — 110 V neon
- 1 — 220 V neon
- 2 — 4-6 V incandescent
- 3 — 18-28 V incandescent
- 4 — 8-12 V incandescent
- 6 — 380 V neon
- 7 — 110 V fluorescent*
- 8 — 220 V fluorescent*
- 9 — 380 V fluorescent*

* For green or clear lenses only.

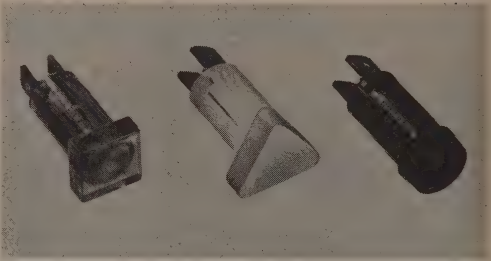

.138
1.063
.23
.354 DIA.
.315 DIA.
17-001-1XX
.138
1.063
.236
.366
17-004-1XX
.315 DIA.
.388
.138
2.0
.32 DIA.
.354 DIA.
17-001-2XX
1.063
.236
.591
.138
.315 DIA.
17-005-1XX
.388
.138
2.0
.492
.32 DIA.
.591
17-006-2XX
.427
.177
2.0
.32 DIA.
.512 DIA.
17-002-2XX
.467
.217
2.0
.374 DIA.
.32 DIA.
17-003-2XX

MADE IN EUROPE

17-11 series

- U.L. listed versions available (U.L. File No. E 43668)
- ¼" wide slip on terminals — standard
- Available with square, triangular or round lenses
- Colors: red, clear, amber, green and white
- Chrome bezels available for round-faced versions

Also available: Versions with wire leads, solder terminals, and with two separate neon lamps.
Also other lamp ratings, 240 V neon versions, and hot stamping.



how to order:

17-11X-XXX

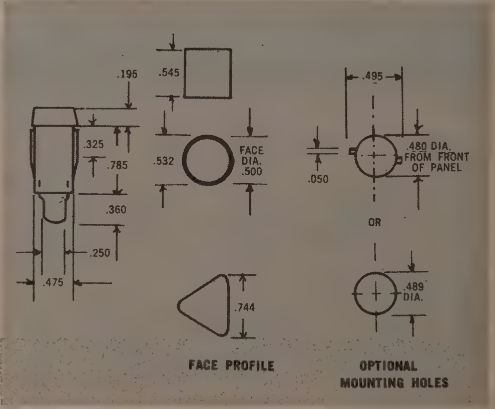
LENS STYLE CODE
- 1 — Round flat lens
- 2 — Round flat lens + chrome bezel
- 3 — Round flat lens + chrome ring
- 4 — Square lens
- 5 — Triangular lens
- 7 — Round concave lens
- 8 — Round concave lens + chrome bezel

TERMINAL CODE
- 0 — ¼" wide slip-on
- 1 — Solder
- 2 — Wire (6" long)
- 6 — 3/16" wide slip-on
- 7 — P.C. solder (.11" slip-on)

COLOR CODE
- 0 — White
- 2 — Red
- 4 — Amber
- 5 — Green (not w/neon)
- 8 — Clear

VOLTAGE CODE
- 0 — 125 V neon, high intensity 5,000 hour life
- 1 — 250 V neon, medium intensity
- 2 — 4-6.3 V incandescent, 600,000 - 3,000 hours life
- 3 — 18-28 V incandescent, 1,760,000 - 10,000 hours life
- 4 — 9-14 V incandescent, 180,000 - 1,000 hours life
- 5 — 125 V neon, medium intensity, 25,000 hours life
- 6 — 380 V neon, medium intensity
- 7 — 125 V fluorescent*
- 8 — 250 V fluorescent*
- 9 — 380 V fluorescent*

* For green or clear lenses only.


.195
.545
.325
.785
.360
.250
.475
.532
FACE DIA. .500
.744
FACE PROFILE
.495
.050
.480 DIA. FROM FRONT OF PANEL
OR
.489 DIA.
OPTIONAL MOUNTING HOLES

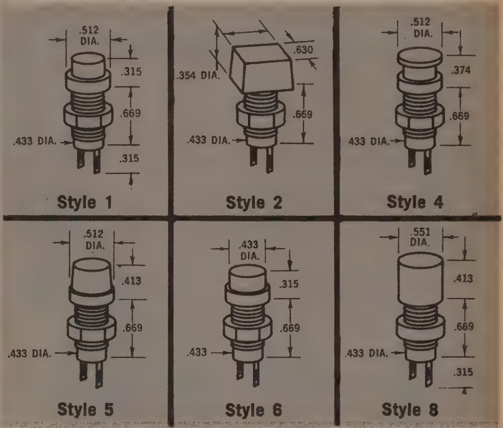
MADE IN EUROPE

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

panel indicator lights

33-400 series relampable snap-in/snap-out lens

- For lamp-replacement from front of panel by snap-in/snap-out lens
- For T-1¾ midget flange-based lamps
- Hot stamping available
- Nylon body mounts in 7⁄16″ dia. panel hole (hexnut supplied)



Note: Unless heat sink is used, do not solder to relampable lampholders with lamp inside.

how to order:

33-40X-XXX

BODY CODE
0 — Black bezel
1 — Black bezel watertight*
2 — Chrome bezel†

LENS STYLE CODE
1 — Round lens - visibility 180°*†
2 — Square lens - .63″ center
3 — Round lens - 180° w/chrome bezel*
4 — Panel section illumination
5 — Round polycarbonate lens - 180°*†
6 — Round lens - .433″ - opaque shroud*
7 — Round polycarbonate lens - 180° w/chrome bezel*
8 — Round lens - .551″ - opaque shroud*

LENS COLOR CODE
0 — White
2 — Red
4 — Yellow (not styles 5 or 7)
5 — Green
6 — Blue
7 — Amber (lens styles 5 and 7 only)
8 — Clear (lens styles 5 and 7 only)

MADE IN EUROPE

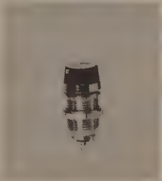
LAMP CODE
2 — 4-6 V incandescent
3 — 18-28 V incandescent
4 — 9-14 V incandescent
9 — No lamp (standard - for those who wish to assemble their own)

* Watertight versions.

* Watertight versions available with lens style 1, 5, 6 or 8 only
† Chrome bezel version available with lens style 1 or 5 only

33-70 series submidget-relampable

- For T-1 submidget flange-based lamps
- Hot stamping available
- Each has two sets of threads — one for lamp and lens replacing and one for panel mounting
- Mounts in 9⁄32″ dia. panel hole (hexnut supplied).



how to order:

33-70X-XX

BODY CODE
0 — Special long 2-terminal body (watertight w/neoprene washer)
1 — Special long 2-terminal body accepts T-⅞ as well as T-1 lamp
2 — Standard 2-terminal body
3 — Special body for watertight applications one neoprene washer)
4 — Special P.C. side-mount
6 — Special body with two insulated leads ½″ min. long. For lens styles 2 or 5 only. Built-in lamp non-replaceable *(see below).

LENS STYLE CODE
1 — Model S (standard) chrome ring
2 — Model T (standard) plain lens
3 — Model U (special) black side shroud
4 — Model V (special) fan-shaped panel illumination
5 — Model W (standard) chrome ring
6 — Model X (special) no lens for photoelectric applications - long cylinder
7 — Model Y (special) no lens for photoelectric applications
9 — Model P (special) has extended black side shroud

LENS COLOR CODE
0 — White
2 — Red
4 — Yellow (not in style 5)
5 — Green
6 — Blue
7 — Amber (in style 5 only)
8 — Clear (in style 5 only)
9 — No lens (in styles 6 and 7)

* **Also Available:** Commercial quality wire versions with built-in lamps (not replaceable) Lamp Code: 0 — 110 V neon, 1 — 220 V neon, 2 — 6 V, 3 — 28 V, 4 — 12 V. Green or blue lenses will not pass neon light.
Note: Unless heat sink is used, do not solder to relampable versions with lamp in lampholder.

MADE IN EUROPE

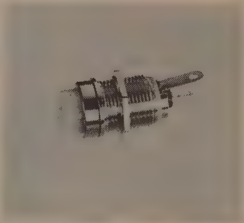
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

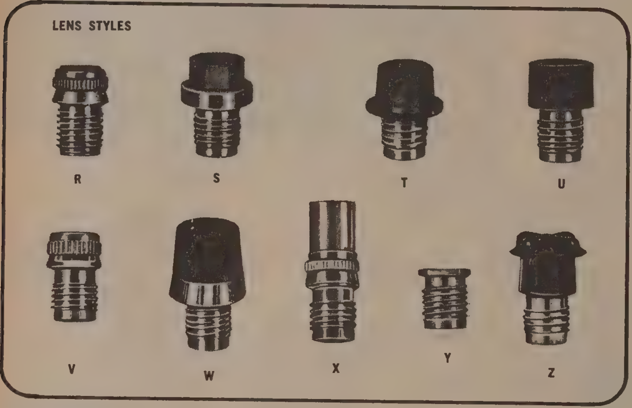
CONTROL SYSTEMS & COMPONENTS

panel indicator lights

33-89 series midget-relampable

- For lamp-replacement from front of panel
- For T-1¾ Midget Flange-Based lamps
- Hot stamping available
- Each has two sets of threads — one for lamp and lens replacing and one for panel mounting
- Replacement lenses available
- Mounts in ⁷⁄₁₆″ dia. panel hole (hexnut supplied)




LENS STYLES
R
S
T
U
V
W
X
Y
Z

MADE IN EUROPE

Note: Unless heat sink is used, do not solder to relampable lampholders with lamp inside.

how to order:

33-89X-XXX

BODY CODE
LENS STYLE CODE
LAMP CODE
LENS COLOR CODE

LENS STYLE CODE

0 — Model R (special)
1 — **Model S (standard)** chrome ring
2 — **Model T (standard)** plain lens
3 — Model U (special) has black side shroud
4 — Model V (special) for fan-shaped panel illumination
5 — **Model W (standard)** chrome ring
6 — Model X (special) no lens
7 — Model Y (special) no lens
8 — Model Z (special) for behind-panel lighting of translucent panels
9 — Model P (special) has extended black side shroud

BODY CODE

1 — Standard 2-terminal body (for ⁷⁄₁₆″ dia. panel hole)
2 — Same as body no. 1 except has one neoprene washer added for watertight applications
3 — Special 1-terminal grounded body (⅜″ dia. panel hole)
4 — "Economy" non-relampable w/2-.71″ wire leads*

LAMP CODE

2 — 4-6 V
3 — 18-28 V
4 — 9-14 V
9 — No lamp (standard— for those who wish to assemble their own lamp)

LENS COLOR CODE

0 — White
2 — Red
4 — Yellow (not in style 5)
5 — Green (not w/neon)
6 — Blue (not w/neon)
7 — Amber (in style 5 only)
8 — Clear (in style 5 only)
9 — No Lens (in styles 6 and 7)

* Lens styles 1, 2, 3 or 5 only.

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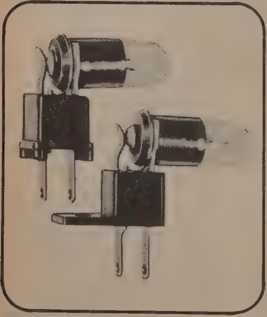
klipsocket™

For all T-1¾ Midget Flange Based Incandescent and Neon lamps.

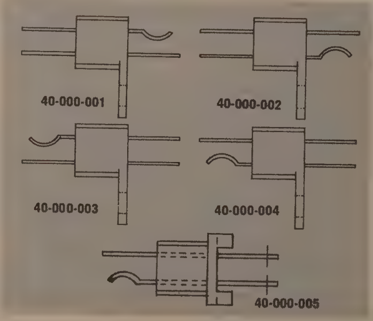
Engage and disengage from the glass filled nylon lamp base with a snap. Nickel silver terminals are designed for soldering or quick-connectors such as AMP terminal no. 61005-1.

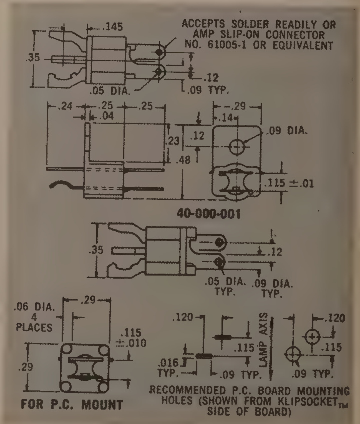
specifications

Holding Force: 1 lb. min.
Breakdown Voltage: 2000 V, 60 Hz



MADE IN U.S.A.


40-000-001
40-000-002
40-000-003
40-000-004
40-000-005


ACCEPTS SOLDER READILY OR AMP SLIP-ON CONNECTOR NO. 61005-1 OR EQUIVALENT
.145
.35
.05 DIA.
.12
.09 TYP.
.24
.25
.25
.04
.29
.14
.12
.23
.48
.09 DIA.
.115 ±.01
40-000-001
.35
.12
.05 DIA. TYP.
.09 DIA. TYP.
.06 DIA. 4 PLACES
.29
.115 ±.010
.29
FOR P.C. MOUNT
.120
.016 TYP.
.115
.09 TYP.
LAMP AXIS
.120
.115
.09 TYP.
RECOMMENDED P.C. BOARD MOUNTING HOLES (SHOWN FROM KLIPSOCKET™ SIDE OF BOARD)

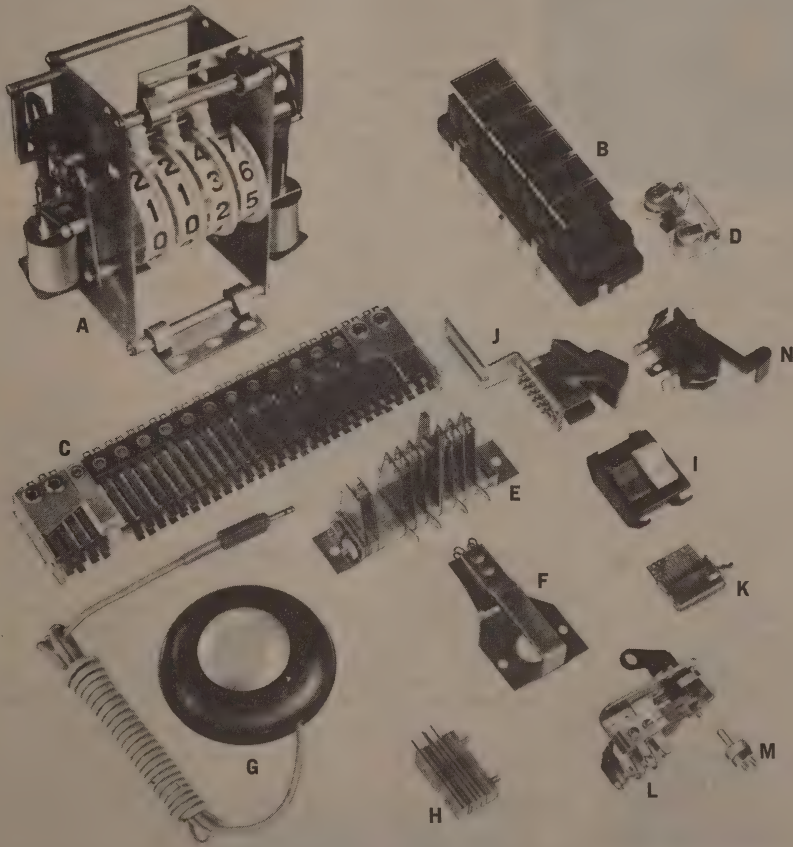
CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

CONTROL SYSTEMS & COMPONENTS

CSC

custom-engineered custom-manufactured

for your "special" requirements
contact our factory engineers



A — Add & Subtract Counters

B — Light Push-Button TV Tuner Switch

C — Space Saving Switch

D — Aircraft Carbon Brush Holder

E — High Energy Switch

F — Motor Switch

G — Foot Switch

H — Army Telephone Handset Switch

I — Twin Rocker Switch

J — Multi-Pole Rocker Switch

K — Sequencing Communications Switch

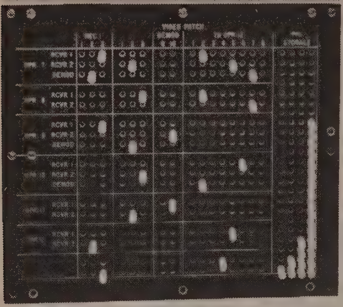
L — Custom Stack Switch

M — TO-5 Disturb Switch

N — Door Operated Switch

CO-ORD SWITCH
A DIVISION OF LVC INDUSTRIES INC.
135-25 37th AVENUE • FLUSHING, NEW YORK 11354 • TEL: (212) 939-9777

MATRIX PROGRAM BOARDS



CO-ORD Matrix Program Boards are composed of 2 to 8 decks of contacts that are bussed on .250 centers. The contact rows of one deck are usually oriented perpendicular to the rows of adjacent deck(s) so as to obtain switching crosspoints. Electrical connections of the bussed contact rows are effected by inserting shorting pins at the desired crosspoints; "CO-AX", phone plug type pins are available for networks which require component insertion (Diodes, resistors, etc.). Single board matrices of up to 11,000 crosspoints are available in standard or special arrangements. Bussed and isolated contacts can be had alone or in combination. Panels may be screened, engraved, or fitted with pre-punched templates for rapid program changing.

U. S. Patent No. 3,349,361

APPLICATIONS

- Computer memories
- Cordless patch panels
- Function generators (Analog/Digital)
- Power distributors
- Thermocouple signal selectors
- Circuit/Component test programmers
- Lighting systems (Special effects)
- Variable sequence selectors
- Variable diode matrices
- Code generators
- Traffic control panels
- Decade switches
- Vending machine control
- Numeric controlled machinery
- Data channeling and logging
- Communications distributors

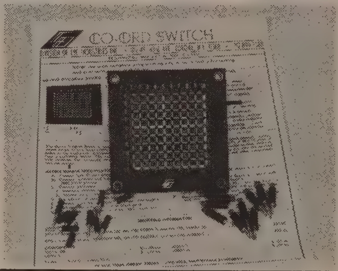
FEATURES

- Closed entry contacts
- High mechanical environment capacity
- Low interlead capacitance
- Attractive and uncluttered
- Compact package
- Standard sizes available
- Permits insertion of components into network without soldering
- Wide variety of switching combinations

SPECIFICATIONS

- Contact Resistance
  - a Total Pin Resistance: .004 OHM MAX.
  - b Volume Resistivity of Strip: .003 OHM/IN
- Breakdown Voltage: 1000 VRMS MIN.
- Current Capacity: 5 AMPS Continuous (up to 100 amps on special application)
- Materials:
  - a Plastic Parts: Black Phenolic XXX
  - b Flexible Contacts: Heat Treated Beryllium Copper
  - c Terminals: Brass
  - d Finishes: Gold, Silver or Nickel

PROGRAM BOARD KITS



KIT BPS-1 consists of a 10 x 10 matrix board similar to #63014-1, below. 10 shorting pins and 10 "CO-AX" diode pins with 1N270's installed $27.00

KIT BPS-2 is the same as BPS-1 but without diodes $22.25

10 x 10 matrix board	$17.00 ea.
Shorting pin	.12 ea.
Diode pin w/1N270	.99 ea.
Diode pin w/o diode	.51 ea.

AVAILABLE FROM STOCK

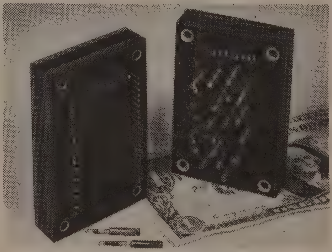
STANDARD MATRIX BOARDS — SERIES 63014

DASH	-1	-2	-3	-4	-5	-6	-7	-8	-9
MATRIX	10 x 10	10 x 15	10 x 20	10 x 25	15 x 20	15 x 25	20 x 20	10 x 50	25 x 25

AVAILABLE FROM STOCK. ADD DASH NO. (1 Thru 9) MATRIX SIZE.

MINIATURE PROGRAM BOARD

.100 and .125 inch Center Line



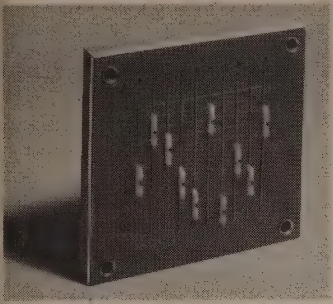
TENTH INCH MATRIX
AT $.08 PER POINT

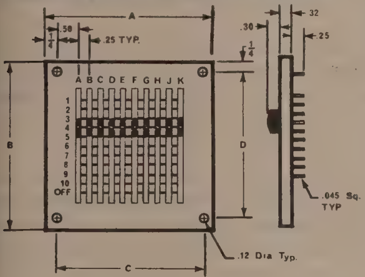
These Matrix Program Boards are designed to meet the increased technological requirements for miniaturization in electronic systems and equipment. They have all the same features of the larger matrices and can be supplied in from 2 to 4 decks of bussed contacts. Single matrix boards of up to 2500 crosspoints can be furnished in one solid unit, with rugged Shorting and CO-AX (diode) pins available for programming functions. A standard 2 deck matrix measures .315 inches thick from the front to rear panel; program pins are .280 inches long by .063 inches in diameter. Termination of the bussed contacts are to .040 diameter pin terminals, which allow the matrix to be plugged into mating female receptacles or connected to directly by wave, dip, or hard soldering. Contact resistance is only .005 ohms per crosspoint; breakdown voltage 600 VRMS; current capacity 3 amps continuous.

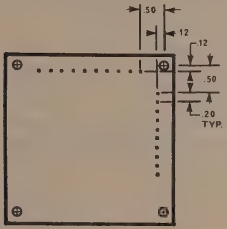
See Our BLOC-LITE Lighting Devices • Section 2450

CO-ORD SWITCH
A DIVISION OF LVC INDUSTRIES INC.
135-25 37th AVENUE • FLUSHING, NEW YORK 11354 • TEL: (212) 939-9777

MATRIX SLIDE SWITCHES







CO-ORD Matrix Slide Switches are designed to provide reliable, low cost matrix switching for applications requiring manual data entry operations. These simplified, versatile switches are available in various ranges of standard sizes, with capacities including up to 25 outputs per switching line. Each output is controlled by a separate contact slider which in turn can provide as many as 25 positions (variations). Special designed Matrix Slide Switches can be supplied with as many as 5000 switching positions.

Switching quality and reliability is achieved through such advanced designed features as; positive detent positioning resulting from the unique individual GSD (Guide-Slide-Detent) Housing, panoramic viewing of the switching functions facilitating rapid circuit selection and minimizing data entry error, rugged solid block closed construction containing each contact and slider in a basic unitized assembly, electrical and mechanical integrity assured through the use of only the highest quality materials.

Matrix Slide Switch quick connections/disconnecting to the various input and output lines are accomplished with .045 square wire wrap terminals; these terminals can be either wire wrapped, wave solder on printed circuit cards, plugged into using standard female receptacles, or individually hard solder. Optional terminals can be offered to meet customers specifications. All Matrix Slide Switches are especially compact in size and can be mounted through four convenient mounting holes, one located at each corner of the switch.

The combined features of the CO-ORD Matrix Slide Switch makes it ideally suited for applications where data is to be entered at remote terminals such as test equipment programming, machine tool controls, programming of process controls, as well as numerious other applications.

MATRIX SLIDE SWITCH — Series No. 85000-

DASH NUMBER	MATRIX SIZE	NUMBER OF SLIDERS	NUMBER OF POSITIONS	DIMENSIONS			
				A	B	C	D
1	10 X 10	10	10	3.75	3.75	3.25	3.25
2	10 X 20	10	20	3.75	5.75	3.25	5.25
3	20 X 10	20	10	6.25	3.75	5.75	3.25
4	20 X 20	20	20	6.25	5.75	5.75	5.25
5	25 X 25	25	25	7.50	6.75	7.00	6.25

SPECIFICATIONS

Electrical:

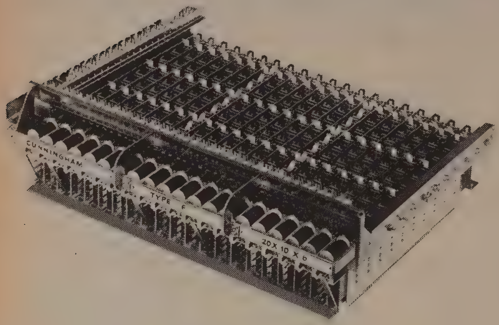
1. **Contact Life Expectancy .... 500,000 crosspoint operations**
2. **Contact Resistance @ 500 Ma, 6 VDC .... 15 Milliohms (Gold plated)**
   35 Milliohms (Nickel plated)
3. **Capacitance, between adjacent circuits .. 50 Picofarids (max.)**
   (Typical for standard 10x10 switch)
4. **Contact Current Rating: Switching .... 0.5 A, DC (max.)**
   Nonswitching .... 2.0 A per contact
5. **Insulation Resistance @ 500 VDC .... 1 x 10" Ohms**
6. **Dielectric Strength: AC .... 1.0 Kv (rms)**
   DC .... 1.5 Kv

Materials:

1. **Slide Contacts: Beryllium Copper, Alloy 25, Condition XHMS.**
2. **Slider: Nylon.**
3. **Face Plate: Brushed finished Aluminum.**
4. **PC Board and Conductor Strips: XXX Phenolic, 2oz. Copper Clad.**
5. **GSD Housing: Nylon.**
6. **Terminals: Phosphor Bronze.**
7. **Finish: Nickel .0001 (min.), or Gold/Nickel .00005 Gold over Nickel Flash.**
8. **Hardware: Nickel plated Brass.**

Write for Bulletin 1474

crossbar matrix switches



Cunningham crossbar switches have a minimum operating life of 20 million operations per crosspoint, due largely to their gold-alloy, self-wiping contacts. These, together with the beryllium-copper coordinate conductors, provide extremely low path resistance and minimal EMF. Insulation resistance is very high, while induced noise is virtually nonexistent. The crossbar actually covers a wider frequency band than any other comparable switching device, and handles low-level to high-power signals. Matrix switches from ten to three hundred 6 wire crosspoints.

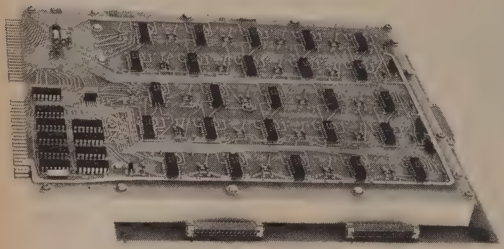
The Type A crossbar is a broadband group-to-group signal routing switch with coordinate actuation of the crosspoints.

The Type F crossbar is a coordinately actuated group-to-one matrix with the capability of connecting any one of a number of inputs to a single output or vice-versa.

The Type P crossbar is a broadband frequency group-to-group signal routing switch with direct actuator coils positioned above each crosspoint.

The Type T crossbar is a group-to-one switch that is ideal for handling low-level (microvolt) signals. Direct actuator coils are mounted above each crosspoint.

reed matrix switches



Two reed matrix models are available for high and intermediate frequencies. They are supplied in the 5x10 (50 crosspoint) configuration only. Crosspoints are interconnected to form a group-to-group switching matrix.

The high frequency (HF) model is a single-pole matrix for switching signals up to 60 MHZ. The multilayer signal board provides shielded signal paths with 50 ohm characteristic impedance. Input and output are through subminiature coaxial connectors. The coaxial cable shields are all tied together through the connector shells to a common ground. Only the center conductor is switched.

The intermediate frequency (IF) model can have one, two, or three poles at each crosspoint and can handle signals from DC to 4 MHz. Multipin connectors are used for input and output signal connections. For general purpose switching applications where the signal frequencies do not need the heavy shielding of the H.F. model.

for applications assistance call (716) 624-2000

SPECIFICATION	TYPICAL CROSSBAR MATRIX	TYPICAL REED MATRIX
Minimum Life:	2×10^7 operations per crosspoint.	10^8 operations per crosspoint.
Current Rating:	Switch 100 mA @ 50 VDC, carry 1.0 A.	Switch 100 MA @ 12 VDC, carry 1.0 A.
Contact Material:	Gold alloy 0.005″ thick.	Rhodium plated.
Contact Resistance:	Less than 30 milliohms.	Less than 300 milliohms.
Contact Stability:	Better than ±5 milliohms.	Better than ±150 milliohms.
Longest Path Resistance:	Less than 400 milliohms—in 30x10 matrix.	Less than 300 milliohms—in 5x10 matrix.
Thermal EMF's:	Less than 0.1 microvolt per °C.	Less than 1.0 microvolt per °C.
Insulation Resistance:	Greater than 100,000 megohms @ 45% R.H.	Greater than 100,000 megohms @ 45% R.H.
Breakdown Voltage:	1000 VAC, rms @ 60 Hz, 1500 VDC between conductors and frame or across open contacts at humidity below 45% R.H.	500 VDC between conductors or to ground, 250 VDC across open contacts at humidity below 45% R.H.
Frequency Range:	To 10 MHz w/—50 db cross-talk and 60 db isolation.	HF Series—to 50 MHz w/—60 db crosstalk and 60 db isolation. IF Series—to 4 MHz w/—60 db crosstalk and 60 db isolation.
Operate Time:	Less than 30 millisec.	Less than 4 millisec.
Release Time:	Less than 10 millisec.	Less than 2 millisec.
Contact Bounce:	Less than 400 microsec on make, not measurable on break.	Less than 100 microsec on make, not measurable on break.
Induced Noise:	Less than 5.0 millivolt.	Less than 100 microvolt.

Cunningham Corporation

SUBSIDIARY OF GLEASON WORKS / HONEOYE FALLS / NEW YORK 14472 / TEL.: (716) 624-2000

matrix controller

The 1020 Controller interfaces a switch matrix to any 16 bit address device. Crosspoint connections can be programmed to latch or unlatch as required. CMOS logic is used to insure high noise immunity and low power consumption. Both local and remote control are featured. This standard interface component facilitates a wide variety of matrix applications as in automated testing or telemetry switching.

Cunningham Corporation
MODEL 1020 CONTROLLER
2 4 0 2
MASTER
POWER
LOCAL
REMOTE
LATCH
UNLATCH
EXECUTE

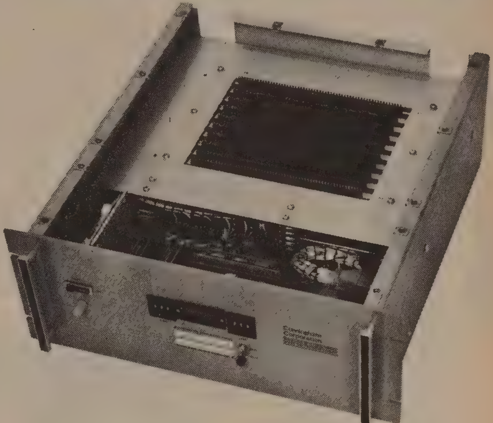
for applications assistance call (716) 624-2000

data acquisition scanners

Cunningham has developed two versions of the 2000 Series scanner for sequentially or randomly reading a number of instrument-level signals. One of these uses a crossbar while the other uses SC-10 reed cards for switching. The crossbar matrix switch is ideal for extremely low signal levels (Microvolts). The reed cards are best applied where scanning speeds exceed 50 channels per second.

Control, logic, and interfacing for both versions are performed by integrated circuitry to ensure compatibility with peripheral instruments. All levels are DTL and TTL compatible and each input represents only one standard load. Each output can accommodate 10 standard loads.

Front panel controls include single channel random access, single scan, continuous scan, scan limit switches, and single channel advance. A three-digit display shows which channel is being sampled, Either scanner can be remotely controlled, in which case the unnecessary controls may be omitted from the front panel.



SPECIFICATION 2000 SERIES	REED SCANNER	CROSSBAR SCANNER
Number of data channels	10-100 three-wire in increments of ten channel per plug in scanner card	600 one-wire, 300 two-wire, 200 three-wire, 100 six-wire
Contact resistance	< 100 milliohms	< 50 milliohms
Contact stability at maximum ratings over life	± 2.0 Ohms	±10 milliohms
Initial data path resistance	< 300 milliohms	< 250 milliohms
Thermal EMF's +25°C — +50°C	< 1.0 microvolts/ °C	< 0.1 microvolts/ °C
Open contact capacitance	0.2 pf	0.3 pf
Contact ratings resistive loads	500 milliamps at 200 VDC	100 milliamps at 50 VDC
Open contact breakdown voltage	250 VDC	1500 VDC
Insulation resistance at 95% R.H.	100,000 Megohms	100,000 Megohms
Scan rate	to 200 ch./Sec.	to 40 ch./Sec.
Contact bounce	< 500 microseconds	< 400 microseconds
Contact dwell time at maximum speed	> 2.3 milliseconds	> 7 milliseconds
Expected life at rated loads	10 Million closures/ch.	20 Million closures/ch.
Logic levels	Logic "1" = 4.0 ±1.0 Volts Logic "0" = 0.4 ±0.4 Volts	Logic "1" = 4.0 ±1.0 Volts Logic "0" = 0.4 ±0.4 Volts
Power consumption	45 Watts	50 Watts
Operating temperature range	0°C to 70°C	0°C to 60°C
Signal input connectors*	1 Winchester 50 Pin/Card	20 Cunningham SP-1173
Signal output connectors*	Winchester 4 Pin	20 Pin
Control connectors*	56 Pin	56 Pin
Dimensions	3.5″ High, 22″ Deep, 19″ Wide - front panel	7″ High, 22″ Deep, 19″ Wide-front panel
Weight	21 Lbs.	30 Lbs.
Weight - Packed for shipment	36 Lbs.	45 Lbs.
Contact material	Rhodium plate	Solid gold — .005 in. thick.

* Mating connectors are supplied.

Cunningham Corporation

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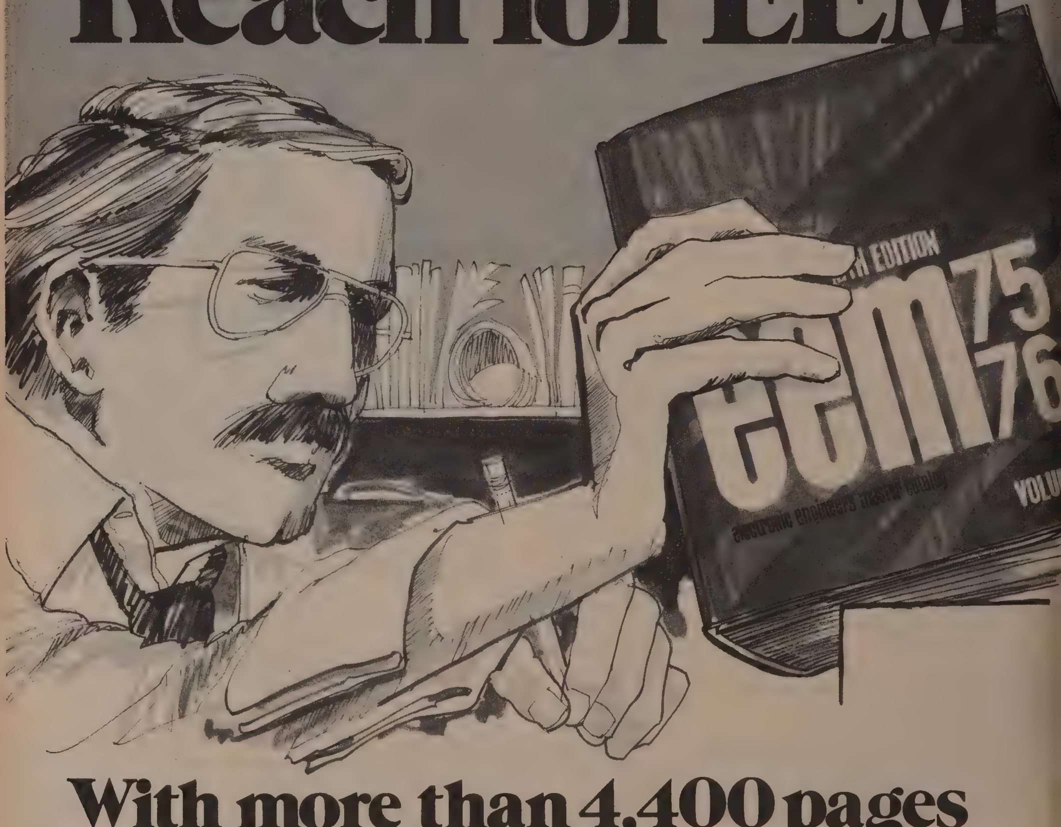
There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM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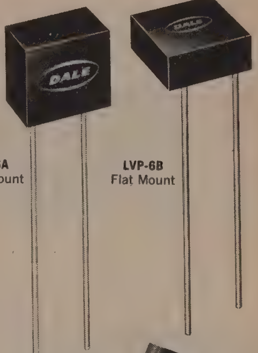
DEPENDABLE DALE® SURGE ARRESTERS

SERIES LVP-6 *Low Voltage Protector*



Designed to mount on printed circuit boards to protect solid state circuitry from transients appearing on low voltage DC circuits. Nanosecond response. Automatically restores circuit to normal when transient has passed. Transients substantially above rated surge current cause failure of the LVP-6 in a shorted condition—still safeguarding valuable circuit components.

PROTECTIVE CAPABILITIES

Clamping Voltage: 6.2, 6.8, 7.5, 8.2, 9.1, 10, 11, 12, 13, 15 volts.
Shunt Capacity: 15 μf.
Operating Temperature: −55° C to 85° C
Storage Temperature: −55° C to 125° C

PHYSICAL SPECIFICATIONS

Body Dimensions = .500″ L x .500″ W x .312″ H.
Lead Dimensions = 1″ ± 1/32″ L x .032″ dia.

SERIES SPA *Secondary Power Arrester—UL Listed* (Model SPA-100)

Designed for fuse or junction box mounting to protect against direct or indirect lightning and other transient voltages. Unit has hermetically sealed pre-ionized spark gap for increased sensitivity and stable breakdown voltage level. Exceeds applicable NEMA, USAS, and IEEE standards. Conforms to lightning protection requirements of **Occupational Health and Safety Act.**

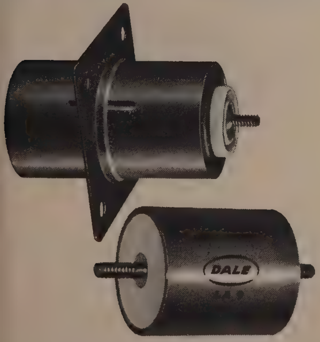
PROTECTIVE CAPABILITIES

DC Arc-Over Voltage: SPA-100 (120 VAC) < 700 VDC; SPA-200 (277 VAC) < 900 VDC; SPA-400 (400 VAC) < 3000 VDC. **Fast Rise Arc-Over Characteristics:** Typically 1500 volts with 10KV/μsec. pulse applied; **Bypass Capability:** Will withstand repeated 10KA, (10x20 μsec.) current surges. Power follow current extinguished in ½ cycle or less. Voltage between terminals less than 2000 volts (2500 volts SPA-400) when conducting 10,000 amps of surge current. **Insulation Resistance:** Greater than 100 megohms. **Shunt Capacity:** Less than 25 pf.

PHYSICAL SPECIFICATIONS

Overall dimensions: (SPA-100 & SPA-200) 1¾″ D x 2-15/16″ L; (SPA-400) 1-55/64″ D x 3⅞″ L. Two 18″ leads provided for circuit connection. Has ½″-14 NPSL conduit fitting with nut for mounting in any position indoors or outdoors

SERIES LA *Miniature Size—Maximum Circuit Protection*



Patented design insures much greater reliability and repeatability than standard spark gap designs. Widely used to protect communications equipment from lightning and to guard industrial controls and electronic equipment from heavy transient spikes.

PROTECTIVE CAPABILITIES

Spark-Gap Arc-Over Voltage: LA20 = Factory adjustable from 500 to 6000 VDC, ±20% standard (10% available). LA9 = Factory adjustable from 500 to 5000 VDC, ±20% (10% available). **Bypass Capability:** LA20 = 50 current surges of 2000 amps peak 1x2 millisecond wave shape (2 coulombs). LA9 = 100 current surges of 300 amps peak 2x4 millisecond wave shape. **Insulation Resistance:** Greater than 1000 megohms initially and greater than 10 megohms after rated current surges. **Shunt Capacity:** LA20 = 8 mmfd, LA9 = 3.5 mmfd.

PHYSICAL SPECIFICATIONS

LA20 = 3-3/8″ outside length. Body 2-1/16″ L x 1-1/4″ D. Weight: 5 oz. LA9 = 1-5/8″ outside length. Body: 1″ L x 3/4″ D. Weight: 2 oz. **Mounting:** Clip, stud or flange. **Terminal:** LA20 = 6-32, 8-32, 10-32 stud or wire; LA9 = 4-40 stud or wire. **Seal:** LA20 and LA9 hermetic.

ADDITIONAL MODELS

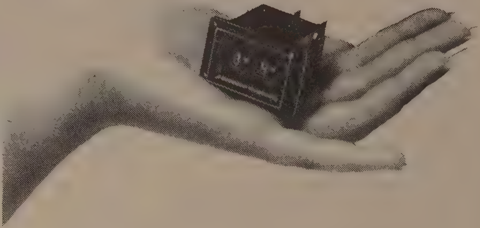
- Aircraft lightning arresters of all types
- Arresters for high voltage circuits
- Miniature transient suppressors for circuit board mounting.

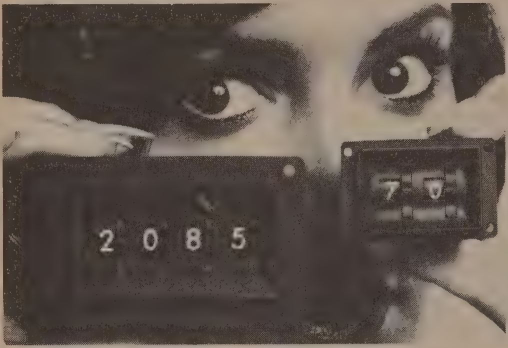
Submit your specifications to
DALE ELECTRONICS, INC.
Box 180, Yankton, South Dakota 57078 • Phone: 605—665-9301

Complete lightning laboratory facilities and engineering assistance available to develop your applications.

DIGITRAN® DIGITAL

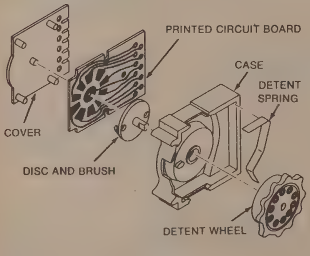
From Hi Rel, QPL Listed Items to Low Cost Commercial Switches, The DIGITRAN® Company, Originators of the DIGISWITCH,® the first Switch of its Type Anywhere, Manufactures the Broadest Line of Digital Switches in the World.





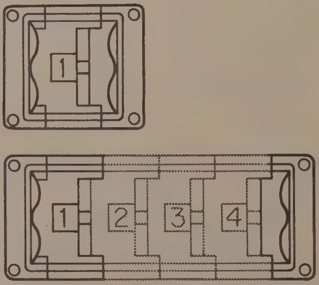
The trademarks DIGISWITCH and MINISWITCH have become almost generic terms for thumbwheel switches. The name DIGISWITCH came first. MINISWITCH was developed later to fill the growing demand for miniaturized devices. Both are popular standards, and some versions are QPL approved to MIL-S-22710.

Construction



The simplicity of design using the least possible number of moving parts provides excellent reliability. A single printed circuit board contains the commutator and output terminations. All electrical surfaces are precious metal alloy for low contact resistance and long shelf life.

Modular Units



Each self contained switching unit locks perfectly with another of the same style. Standard end brackets fit at each end, and the assembly is held together by either threaded shafts or with a snap-on stainless strap. You don't have to assemble them. We do it for you at the factory by standard part number and provide the mounting hardware too.

Codes

Our thumbwheels provide direct conversion from dial settings to coded electrical outputs. Single pole, or multi-pole, shorting or non-shorting, binary-coded octal, binary-coded decimal, with or without complement, and straight decimal output are standard off-the-shelf conversions available in most series of Digitran switches.

Hundreds of difficult coding requirements have been solved for our customers. Special requirements of all kinds are designed and put into production. If you have a unique coding problem, let us help you solve it. In fact, we may already have the code you want in our files . . . ready to use.

Send for our wall chart which depicts over 50 of the codes available.

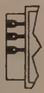
SWITCHES

NATIONWIDE REPRESENTATIVES AND DISTRIBUTORS!

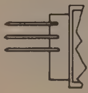
THE LARGEST SELECTION OF CODES AVAILABLE!

Options

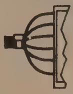
Printed Circuit Board Terminations



- Mate with P/C connector
- Plated thru-holes or eyelets



- .025″ square Wire Wrap* posts.
- Tapered tab terminals.
- Turret terminals.
- Special pin terminals for dip soldering.



- Wire leads

*A Registered Trademark of the Gardner Denver Company.

Replaceable Dial Lighting

If you need dial lighting, it is readily available. Our replaceable lighting system meets the high intensity requirements of MIL-P-7788D. And standard MS-24515 lamps or commercial grade lamps at your option may be supplied with the switch.

Special Dial Markings

Mathematical symbols, [±, X, ÷], directional characters or alphabetical letters, and multiple characters [10's, 100's, ON, and OFF] are available as options on most series.

In addition to special dial markings, switch cases and spacers can be ordered with any desired special marking. Degree, second and minute signs are common requests.

FEATURES AND OPTIONS CHART

This chart is only a guide to assist in determining which switch series outlined is available with the features and options suited to your application. For details contact Digitran.

OPTION DESCRIPTION DESIGNATION		SWITCH SERIES											
		200	300	700	8000	9000	12000	13000	19000	23000	24000	28000	29000
Dial Positions (without stops)	8	●	●	●	●	●	●	●	●	–	–	–	–
	10	●	●	●	●	●	●	●	●	●	●	●	●
	12	●	●	●	–	●	–	●	●	–	–	●	●
	16	–	●	–	●	●	–	●	●	–	–	–	–
	Specials available	●	●	●	●	●	●	●	●	●	●	●	●
Dial stops to limit dial positions		●	●	●	●	●	–	●	●	●	●	●	●
Assembly spacers	.250 wide	●	●	●	●	–	–	●	–	–	–	●	–
	.315 wide	–	–	–	–	–	–	–	–	●	–	–	–
	.350 wide	–	–	–	–	–	–	–	–	–	–	–	●
	.400 wide	–	–	–	–	●	–	–	●	–	–	–	–
	.500 wide	–	●	–	●	●	–	●	●	–	–	●	–
Message units	3/4″ wide	●	–	●	–	–	–	–	–	–	–	–	–
	1″ wide	●	●	●	●	●	–	●	●	–	–	●	–
	1 3/4″ wide	–	●	–	–	–	–	–	–	–	–	–	–
	1.050 wide	–	–	–	–	–	–	–	–	–	–	–	●
Special markings on spacers & switches		●	●	●	●	●	●	●	●	●	●	●	●
Special dial characters		●	●	●	●	●	●	●	●	●	●	●	●
Sealing capability	Fully sealed switch chamber	●	–	●	–	●	–	–	–	–	●	–	–
	Dust sealed switch chamber	–	–	●	–	–	–	–	●	–	–	–	●
	Panel sealing	●	–	●	–	●	●	–	–	–	●	–	–
RFI shielding		●	●	●	●	●	●	●	●	–	●	●	–
Double modules (one actuator)		●	●	●	–	–	–	●	–	–	–	●	–
Replaceable lighting		●	●	●	●	●	●	–	●	–	●	–	–
Lighted decimal point on case		–	●	–	●	–	–	●	–	–	–	●	–
Lighted decimal point on spacer		●	●	●	●	●	N/A	●	●	●	N/A	●	●
Provision for mounting components on output terminals or special P.C. boards		N/A	●	●	●	●	●	●	●	●	●	●	●
Wire wrap terminals		N/A	●	●	●	●	●	●	●	●	●	●	●
Pin terminals		N/A	●	●	●	●	●	●	●	●	●	●	●
Special terminations		●	●	●	●	●	●	●	●	●	●	●	●
Back mounting (w/hardware)		●	●	●	●	●	●	–	●	–	●	●	●
Front mounting (w/hardware)		–	–	–	–	–	–	●	–	–	–	–	–
Snap-in mounting (w/o hardware)		–	–	–	–	–	–	–	–	●	–	–	–
Assembled together by studs		●	●	●	●	●	N/A	●	●	–	N/A	●	–
Assembled together w/assy. straps		–	–	–	–	–	N/A	–	–	●	N/A	–	●
Panel mounting hardware included		●	●	●	●	●	●	●	●	N/A	●	●	●
QPL approved		●	●	●	–	●	–	●	–	–	●	–	–

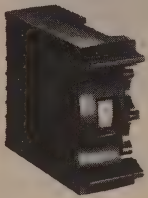
DIGITRAN® DIGITAL

SERIES 200 & 700

MINISWITCH®

8, 10, 12 DIAL POSITIONS

QPL approved to MIL-S-22710/15 & /20



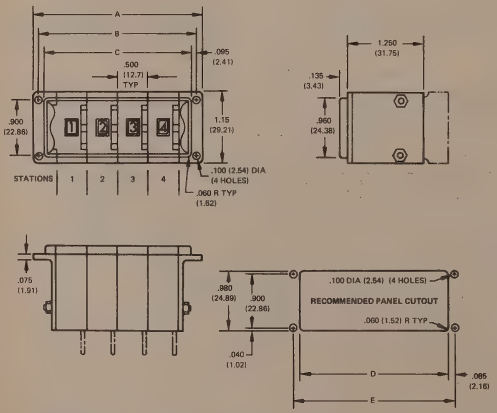
The Series 200 has potted wire lead terminations, and the Series 700 has a P/C board extending from the rear of the switch. Both can be completely sealed. The 700 Series can be furnished unsealed but with the dust proof feature for commercial or non-critical applications. Note that both are physically identical, and therefore may be mixed in one complete assembly with end mounting brackets.

Price range in 1,000 piece quantities (Series 200): $12.00 - $16.00 each.

Price range in 1,000 piece quantities (Series 700): $6.40 - $16.00 each.

SPECIFICATIONS

Operating Force	7 to 12 ounces
Rated Electrical Loads	115 volts A.C. or 28 volts D.C. at 125 milliamps. Non-switching load 3 amps max.
Initial Contact Resistance	(Series 200) 0.2 ohms max. (Series 700) 0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	750 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 100G
Life	Over 1,000,000 detent operations
Operating Temperature	—65°C to +85°C
Weight	2/5 ounce per module (approx.)
Standard Color	Non-glare, matte black case and end brackets. Satin black wheel and dial with white characters.
Dial Character Height	0.170 (8 or 10 position)
Moisture Resistance	Per MIL-STD-202, method 106
Thermal Shock	Per MIL-STD-202, method 107, test condition A
Salt Spray	Per MIL-STD-202, method 101, test condition B
Series 200 and 700 are QPL approved to	MIL-S-22710C/15
Series 700 dual lamped units are QPL approved to	MIL-S-22710C/20


A
B
C
.500
(12.7)
TYP
.095
(2.41)
.900
(22.86)
1.15
(29.21)
1
2
3
4
STATIONS
1
2
3
4
.100 (2.54) DIA
(4 HOLES)
.060 R TYP
(1.52)
1.250
(31.75)
.135
(3.43)
.960
(24.38)
.075
(1.91)
.980
(24.89)
.900
(22.86)
.040
(1.02)
.100 DIA (2.54) (4 HOLES)
RECOMMENDED PANEL CUTOUT
.060 (1.52) R TYP
D
E
.085
(2.16)

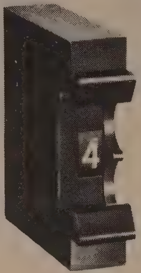
Number of .5"(12.7) Stations	A	B	C	D	E
1	1 26(32 0)	1.09(27.7)	.90(22.9)	.92(23.4)	1.09(27.7)
2	1.76(44.7)	1.59(40.4)	1.40(35.6)	1.42(36.1)	1.59(40 4)
3	2.26(57 4)	2.09(53.1)	1.90(48.3)	1.92(48.8)	2.09(53.1)
4	2.76(70.1)	2.59(65.8)	2.40(61.0)	2 42(61.5)	2.59(65.8)
5	3.26(82 8)	3.09(78.5)	2.90(73.7)	2.92(74.2)	3.09(78.5)
6	3.76(95 5)	3.59(91.2)	3.40(86.4)	3.42(86.9)	3 59(91.2)
7	4.26(108.2)	4.09(103.9)	3.90(99.1)	3.92(99.6)	4.09(103 9)
8	4.76(120.9)	4.59(116.6)	4.40(111.8)	4.42(112.3)	4.59(116.6)
9	5.26(133.6)	5.09(129.3)	4.90(124.5)	4.92(125.0)	5.09(129.3)
10	5.76(146.3)	5.59(142.0)	5.40(137.2)	5.42(137.7)	5.59(142.0)

SERIES 300

DIGISWITCH®

8, 10, 12, 16 DIAL POSITIONS

QPL approved to MIL-S-22710/11

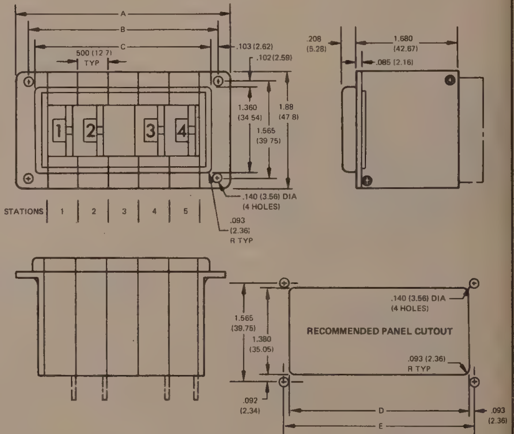


This one module shown is our standard, general purpose unit. When grouped together with end brackets, the assembly is installed through a cut-out from the rear of the panel. Simple mounting screws are required. Note that the DIGISWITCH, which is the largest of all our switches, can be supplied with up to 16 dial positions.

Price range in 1,000 piece quantities: $4.00 - $9.60 each.

SPECIFICATIONS

Operating Force	7 to 10 ounces
Rated Electrical Loads	28 volts A.C. or 28 volts D.C. at 125 milliamps. Non-switching load 3 amps max.
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	1000 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 100G
Life	Over 1,000,000 detent operations
Operating Temperature	—65°C to +85°C
Weight	¾ ounce per module (approx.)
Standard Color	Glossy black case, end brackets, wheel and dial with white dial characters
Dial Character Height	0.235 (8-10 or 12 position)
QPL approved to	MIL-S-22710/11


A
B
C
500 (12 7)
TYP
.103 (2.62)
.102 (2.59)
1
2
3
4
1.360
(34 54)
1.88
(47 8)
1.565
(39 75)
STATIONS
1
2
3
4
5
.140 (3.56) DIA
(4 HOLES)
.093
(2.36)
R TYP
.208
(5.28)
1.680
(42.67)
.085 (2.16)
1.565
(39.75)
1.380
(35.05)
.140 (3.56) DIA
(4 HOLES)
RECOMMENDED PANEL CUTOUT
.093 (2.36)
R TYP
.092
(2.34)
D
E
.093
(2.36)

Number of .5"(12.7) Stations	A	B	C	D	E
1	1.41(35 8)	1.08(27.3)	.87(22 1)	.89(22.6)	1.08(27.3)
2	1.91(48.5)	1.58(40.0)	1 37(34.8)	1.39(35.3)	1.58(40.0)
3	2.41(61.2)	2.08(52.7)	1.87(47.5)	1.89(48.0)	2.08(52.7)
4	2.91(73.9)	2.58(65.4)	2.37(60.2)	2.39(60.7)	2.58(65.4)
5	3.41(86.6)	3.08(78.1)	2.87(72.9)	2.89(73.4)	3.08(78.1)
6	3.91(99.3)	3 58(90.8)	3.37(85.6)	3.39(86.1)	3.58(90.8)
7	4.41(112.0)	4.08(103.5)	3.87(98.3)	3.89(98.8)	4.08(103.5)
8	4.91(124.7)	4.58(116.2)	4.37(111.0)	4.39(111.5)	4.58(116.2)
9	5.41(137.4)	5.08(128.9)	4.87(123.7)	4.89(124.2)	5.08(128.9)
10	5.91(150.1)	5.58(141.6)	5.37(136.4)	5.39(136.9)	5.58(141.6)

SWITCHES

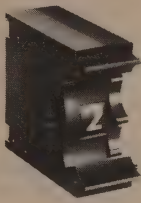
NATIONWIDE REPRESENTATIVES AND DISTRIBUTORS!

THE LARGEST SELECTION OF CODES AVAILABLE!

SERIES 8000

MINISWITCH®

8, 10, 16 DIAL POSITIONS

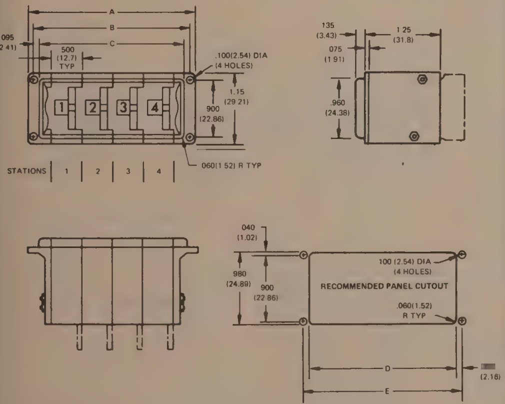


This switch is a miniaturized version of the Series 300 DIGISWITCH. It is mounted from the rear of the panel with four mounting screws and, like the DIGISWITCH, can be grouped with end mounting brackets into as many switching units in a row as desired. Like most of our thumbwheel switches, the MINISWITCH will give you over 1,000,000 reliable detent operations.

Price range in 1,000 piece quantities: $3.60 - $6.40

SPECIFICATIONS

Operating Force	6 to 11 ounces
Rated Electrical Loads	115 volts A.C. or 28 volts D.C. at 125 milliamps. Non-switching load 3 amps max.
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	750 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 100G
Life	Over 1,000,000 detent operations
Operating Temperature	—65°C to +85°C
Weight	⅓ ounce per module (approx.)
Standard Color	Non-glare matte black case, end brackets, wheel and dial with white dial characters
Dial Character Height	0.200 (8 or 10 position)
Designed to meet	MIL-S-22710/19



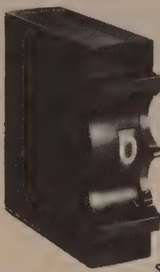
Number of 5"(12 7) Stations	A	B	C	D	E
1	1.26(32.0)	1.09(27.7)	.90(22.9)	.92(23.4)	1.09(27.7)
2	1.76(44.7)	1.59(40.4)	1.40(35.6)	1.42(36.1)	1.59(40.4)
3	2.26(57.4)	2.09(53.1)	1.90(48.3)	1.92(48.8)	2.09(53.1)
4	2.76(70.1)	2.59(65.8)	2.40(61.0)	2.42(61.5)	2.59(65.8)
5	3.26(82.8)	3.09(78.5)	2.90(73.7)	2.92(74.2)	3.09(78.5)
6	3.76(95.5)	3.59(91.2)	3.40(86.4)	3.42(86.9)	3.59(91.2)
7	4.26(108.2)	4.09(103.9)	3.90(99.1)	3.92(99.6)	4.09(103.9)
8	4.76(120.9)	4.59(116.6)	4.40(111.8)	4.42(112.3)	4.59(116.6)
9	5.26(133.6)	5.09(129.3)	4.90(124.5)	4.92(125.0)	5.09(129.3)
10	5.76(146.3)	5.59(142.0)	5.40(137.2)	5.42(137.7)	5.59(142.0)

SERIES 9000 & 19000

DIGISWITCH®

8,10,12,16 DIAL POSITIONS

SERIES 9000, QPL approved to MIL-S-22710/12



All switching characteristics are the same as the Series 300 above, only these two modified standards are sealed as follows:

The Series 9000 is completely sealed. Excellent for use on machines or equipment that are exposed to heavy concentrations of liquids such as oils or water. Further, on, you will see that our MINISWITCH also comes in a sealed version. Consider this, however, if your application requires the operator to wear heavy protective gloves, this larger (.6" wide) switch might be more practical. The Series 9000 is QPL approved to MIL-S-22710.

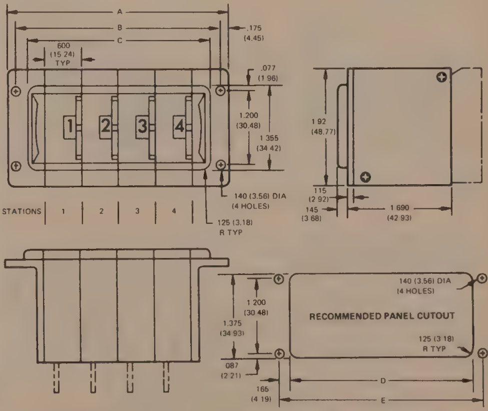
Series 19000 is unsealed, but is considered "dust proof".

Price range in 1,000 piece quantities: (Series 9000): $7.20 - $15.20 each.

Price range in 1,000 piece quantities (Series 19000): $4.80 - $12.80 each.

SPECIFICATIONS

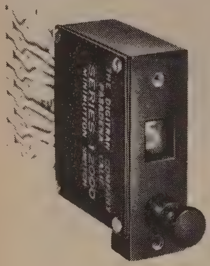
Operating Force	7 to 10 ounces
Rated Electrical Loads	28 volts A.C. or 28 volts D.C. at 125 milliamps. Non-switching load 3 amps max.
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	1000 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 100G
Life	Over 1,000,000 detent operations
Operating Temperature	—65°C to +85°C
Weight	1 ounce (approx.)
Standard Color	Non-glare, matte black case and end brackets. Satin black wheel and dial with white characters.
Dial Character Height	0.235 (8-10 or 12 position)
Moisture Resistance	Per MIL-STD-202, method 106
Thermal Shock	Per MIL-STD-202, method 107, test condition A
Salt Spray	Per MIL-STD-202, method 101, test condition B
Series 19000 is designed to meet	MIL-S-22710
Series 9000 is QPL approved to	MIL-S-22710C/12



NUMBER OF .6"(15 2) STATIONS	A	B	C	D	E
1	1.80(45.7)	1.54(39.0)	1.19(30.1)	1.21(30.6)	1.54(39.0)
2	2.40(61.0)	2.14(54.2)	1.79(45.3)	1.81(45.8)	2.14(54.2)
3	3.00(76.2)	2.74(69.5)	2.39(60.6)	2.41(61.1)	2.74(69.5)
4	3.60(91.4)	3.34(84.7)	2.99(75.8)	3.01(76.3)	3.34(84.7)
5	4.20(106.7)	3.94(100.0)	3.59(91.1)	3.61(91.6)	3.94(100.0)
6	4.80(121.9)	4.54(115.2)	4.19(106.3)	4.21(106.8)	4.54(115.2)
7	5.40(137.2)	5.14(130.4)	4.79(121.5)	4.81(122.1)	5.14(130.4)
8	6.00(152.4)	5.74(145.7)	5.39(136.8)	5.41(137.3)	5.74(145.7)
9	6.60(167.6)	6.34(160.9)	5.99(152.0)	6.01(152.5)	6.34(160.9)
10	7.20(182.9)	6.94(176.2)	6.59(167.3)	6.61(167.8)	6.94(176.2)

DIGITRAN® DIGITAL

SERIES 12000
MINIBUTTON
8, 10 DIAL POSITIONS

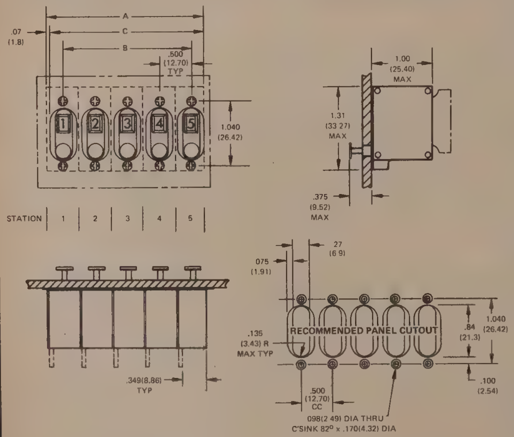


The pushbutton switch has been used on a great number of military applications. Gloved pilots can easily make precise settings with a push of the finger. Each push of the button actuates the switch to the next digit in rotation. The case is metal for grounding purposes, and can be completely sealed. As is the case with most of our switches, dial lighting is available.

Price range in 1,000 piece quantities: $12.80 - $13.50 each.

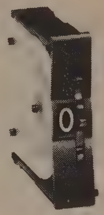
SPECIFICATIONS

Operating Force	30 to 60 ounces
Rated Electrical Loads	28 volts A.C. or 28 volts D.C. at 125 milliamps. Non-switching load 3 amps max.
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	750 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 100G
Life	1,000,000 strokes at +85°C
Operating Temperature	—65°C to +125°C
Weight	½ ounce (approx.)
Standard Color	Non-glare matte black with white dial characters
Dial Character Height	0.170
Moisture Resistance	Per MIL-STD-202, method 103
Thermal Shock	Per MIL-STD-202, method 107, test condition A
Salt Spray	Per MIL-STD-202, method 101, test condition B
Designed to Meet	MIL-S-22710/17



NUMBER OF .5"(12.7) STATIONS	A	B	C
1	.48(12.2)		.41(10.4)
2	.98(24.9)	.50(12.7)	91(23.1)
3	1.48(37.6)	1.00(25.4)	1.41(35.8)
4	1.98(50.3)	1.50(38.1)	1.91(48.5)
5	2.48(63.0)	2.00(50.8)	2.41(61.2)
6	2.98(75.7)	2.50(63.5)	2.91(73.9)
7	3.48(88.4)	3.00(76.2)	3.41(86.6)
8	3.98(101.1)	3.50(88.9)	3.91(99.3)
9	4.48(113.8)	4.00(101.6)	4.41(112.0)
10	4.98(126.5)	4.50(114.3)	4.91(124.7)
N	N/2-.02(.5)	N/2 -.50(12.7)	N/2-.09(2.3)

SERIES 23000
"SNAP-IN" SLIMSWITCH
10 DIAL POSITIONS



Our newest addition to the MINISWITCH line. Series 23000 is the economy leader of the digital switch industry. They cost less to buy, less to assemble, less to install. They conserve panel space, too. Using our unique assembly strap, switch assemblies are quickly and easily put together without using tools.

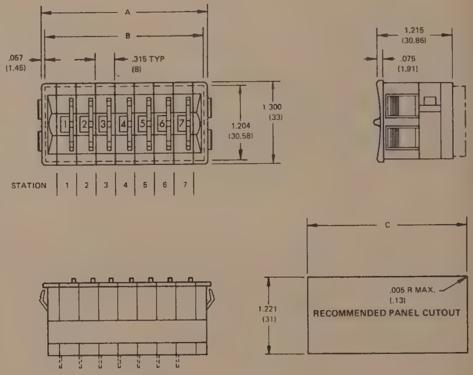
SNAP-IN panel mounting eliminates the need for installation hardware and tools and allows you to relax panel cut out tolerances. The molded-on bezels cover irregular panel cut outs, chipped paint and surface abrasions.

Switch module width is only .315" (8mm) so you can put more switches into a given space with better readability. That's why we call the Series 23000-the SLIMSWITCH.

Price range in 1,000 piece quantities: $2.00 - $3.20 per assembly.

SPECIFICATIONS

Operating Force	4 to 8 ounces
Rated Electrical Loads	28 volts A.C. or 28 volts D.C. at 50 milliamps resistive, at 25°C (77°F). Non-switching current limit: 2 amps
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	500 volts RMS
Vibration	5 G's 70-2000 cps; .06 in. double amplitude, 10-70 cps
Shock	100 G's, 6 millisecond duration, sawtooth.
Life	Over 1,000,000 detent operations at 25°C (77°F)
Operating Temperature	−20°C to 65°C
Standard Color	Case, wheel and end brackets, black or Grey semi-matte as molded. Dial markings, white on black or black on Grey hot-stamped per detail specifications.
Dial Character Height	0.170"



NUMBER OF MODULES	A	B	C
1	.745 (19)	.649 (16.5)	.669 (17)
2	1.060 (27)	.964 (24.5)	.984 (25)
3	1.375 (35)	1.279 (32.5)	1.299 (33)
4	1.690 (43)	1.594 (40.5)	1.614 (41)
5	2.005 (51)	1.909 (48.5)	1.929 (49)
6	2.320 (59)	2.224 (56.5)	2.244 (57)
7	2.635 (67)	2.539 (64.5)	2.559 (65)
8	2.950 (75)	2.854 (72.5)	2.874 (73)
9	3.265 (83)	3.169 (80.5)	3.189 (81)
10	3.580 (91)	3.484 (88.5)	3.504 (89)
N	N x .315 + .430 N x (8) + (11)	N x .315 + .334 N x (8) + (8.5)	N x .315 + .354 N x (8) + (9)

SWITCHES

NATIONWIDE REPRESENTATIVES AND DISTRIBUTORS!

THE LARGEST SELECTION OF CODES AVAILABLE!

SERIES 24000

DIGILEVER®

10 DIAL POSITIONS

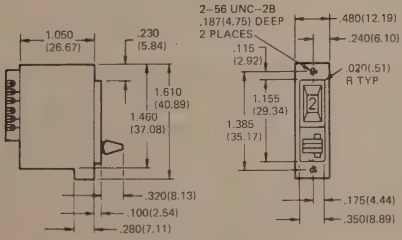
QPL approved to MIL-S-22710/24

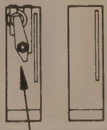
Brand new for 1972. This little toggle or paddle handle switch mounts in a panel cut-out with two screws. You can mount a row of them in one large cut-out, or mount them in a series of individual cut-outs. By actuating the toggle in either direction, the digits click in view, in sequence. And, you will like the short arc between each position. It's faster than ordinary toggle and thumbwheel switches. The front face is completely sealed so that with a mounting gasket, your equipment will be properly protected against contamination from the front of the panel.

Price range in 1,000 piece quantities: $12.80 - $13.60 each.

SPECIFICATIONS

Operating Force	15 to 30 ounces
Rated Electrical Loads	28 volts D.C. at 125 milliamps. Non-switching load 3 amps max.
Initial Contact Resistance	< 100 milliohms between common terminal and output terminal
Insulation Resistance	1000 megohms
Dielectric Strength	750 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 100G
Life	Over 1,000,000 detent operations
Operating Temperature	—65°C to +75°C
Weight	3/5 ounce per module (approx.)
Standard Color	Non-glare black. Dial: Satin black. Dial Markings: White.
Dial Character Height	0.200″
Moisture Resistance	Per MIL-STD-202, method 103
Thermal Shock	Per MIL-STD-202, method 107, test condition A
Salt Spray	Per MIL-STD-202, method 101, test condition B
QPL approved to	MIL-S-22710/24


1.050
(26.67)
.230
(5.84)
1.610
(40.89)
1.460
(37.08)
.320(8.13)
.100(2.54)
.280(7.11)
2–56 UNC–2B
.187(4.75) DEEP
2 PLACES
.115
(2.92)
.480(12.19)
.240(6.10)
.020(.51)
R TYP
1.155
(29.34)
1.385
(35.17)
2
.175(4.44)
.350(8.89)

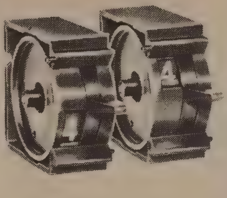


VIEW WITH LAMP ATTACHMENT

SERIES 28000

MINILEVER®

10, 12 DIAL POSITIONS

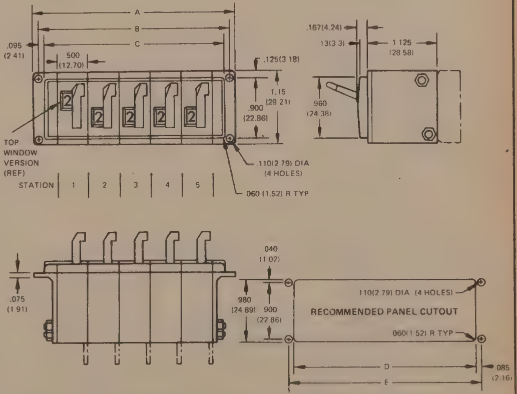


The MINILEVER is a comparatively new innovation to thumbwheel switches. Each module is actuated by a geared type lever. By moving the lever in either direction, you can instantly position the digits from zero (0) to ten (10), or zero (0) to twelve (12). For instance, they have been used on credit checking machines. The operator can set up the customers' credit card number rapidly, then push a button and check the customers' credit. He can then instantly reset all digits back to zero with one sweep of the hand. We also have a special version where the reset of all digits back to zero is done with one separate lever. A great switch for peripheral computer equipment.

Price range in 1,000 piece quantities: $4.00 - $8.00 each.

SPECIFICATIONS

Operating Force	4 to 8 ounces
Rated Electrical Loads	28V (D.C.), 50 m.a. per common terminal. Non-switching current limit: one amp. All specs applicable after life at rated load.
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	500 volts RMS
Vibration	MIL-STD-202 method 204, test condition B 15G
Shock	MIL-STD-202, method 213, test condition 1 50G
Life	Over 1,000,000 detent operations
Operating Temperature	—40°C to +71°C
Weight	½ ounce per module (approx.)
Standard Color	Case, end brackets, detent lever: Non-glare black. Dial: Satin black. Dial Markings: White.
Dial Character Height	0.200 (10 or 12 position)


A
B
C
.095
(2 41)
500
(12.70)
.125(3 18)
1.15
(29 21)
.900
(22.86)
2
TOP WINDOW VERSION (REF)
STATION 1 2 3 4 5
.110(2 79) DIA
(4 HOLES)
060 (1.52) R TYP
.167(4.24)
13(3 3)
1 125
(28 58)
960
(24 38)
040
(1 02)
.075
(1 91)
980
(24 89)
900
(22 86)
110(2 79) DIA (4 HOLES)
RECOMMENDED PANEL CUTOUT
060(1 52) R TYP
D
E
085
(2 16)

Number of .5″ (12.7) Stations	A ±.03(7.62)	B	C	D	E
1	1.26(32.0)	1.09(27.7)	.90(22.9)	.92(23.4)	1.09(27.7)
2	1.76(44.7)	1.59(40.4)	1.40(35.6)	1.42(36.1)	1.59(40.4)
3	2.26(57.4)	2.09(53.1)	1.90(48.3)	1.92(48.8)	2.09(53.1)
4	2.76(70.1)	2.59(65.8)	2.40(61.0)	2.42(61.5)	2.59(65.8)
5	3.26(82.8)	3.09(78.5)	2.90(73.7)	2.92(74.2)	3.09(78.5)
6	3.76(95.5)	3.59(91.2)	3.40(86.4)	3.42(86.9)	3.59(91.2)
7	4.26(108.2)	4.09(103.9)	3.90(99.1)	3.92(99.6)	4.09(103.9)
8	4.76(120.9)	4.59(116.6)	4.40(111.8)	4.42(112.3)	4.59(116.6)
9	5.26(133.6)	5.09(129.3)	4.90(124.5)	4.92(125.0)	5.09(129.3)
10	5.76(146.3)	5.59(142.0)	5.40(137.2)	5.42(137.7)	5.59(142.0)
11	6.26(159.0)	6.09(154.7)	5.90(149.9)	5.92(150.4)	6.09(154.7)

DIGITRAN® DIGITAL

SERIES 29000

ECONOMY MINISWITCH®

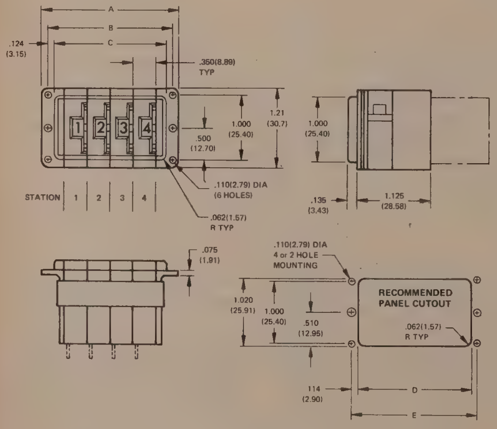
10, 12 DIAL POSITIONS

Here is our new little money saver. Although slightly derated electrically from our Series 8000 MINISWITCH, certain mechanical and material changes have reduced the selling price considerably without reducing quality. If you have an application where the ultimate in low cost is mandatory, this is the switch. This switch is also sealed against normal exposure to dust and other dry contaminants.

Price range in 1,000 piece quantities: $2.40 - $3.60 each.

SPECIFICATIONS

Operating Force	4 to 8 ounces
Rated Electrical Loads	28 Vac or 28 Vdc at 50 m.a. at 25°C (77°F). Non-switching load 2 amp max.
Initial Contact Resistance	0.1 ohms max.
Insulation Resistance	1000 megohms
Dielectric Strength	500 volts RMS
Vibration	15 G's 70-2000 cps; .06 in. double amplitude, 10-70 cps
Shock	100 G's, 6 millisecond duration, sawtooth.
Life	Over 1,000,000 detent operations at 25°C (77°F)
Operating Temperature	0°C to +65°C
Weight	¼ ounce per module (approx.)
Standard Color	Beige case and end brackets with black dial characters. Black case with white dial characters on special order.
Dial Character Height	0.200″



NUMBER OF .35″(8.9) STATIONS	A	B	C	D	E
1	1.10(27.9)	.91(23.1)	.66(16.8)	.68(17.3)	.91(23.1)
2	1.45(36.8)	1.26(32.0)	1.01(25.7)	1.03(26.2)	1.26(32.0)
3	1.80(45.7)	1.61(40.9)	1.36(34.6)	1.38(35.1)	1.61(40.9)
4	2.15(54.6)	1.96(49.8)	1.71(43.5)	1.73(44.0)	1.96(49.8)
5	2.50(63.5)	2.31(58.7)	2.06(52.4)	2.08(52.9)	2.31(58.7)
6	2.85(72.4)	2.66(67.6)	2.41(61.3)	2.43(61.8)	2.66(67.6)
7	3.20(81.3)	3.01(76.5)	2.76(70.2)	2.78(70.7)	3.01(76.5)
8	3.55(90.2)	3.36(85.3)	3.11(79.0)	3.13(79.6)	3.36(85.3)
9	3.90(99.1)	3.71(94.2)	3.46(87.9)	3.48(88.4)	3.71(94.2)
10	4.25(108.0)	4.06(103.1)	3.81(96.8)	3.83(97.3)	4.06(103.1)

DIGIVIDER/DIGIDECADE

DIGIVIDER is a thumbwheel switch that has been converted into a voltage divider. When you dial the voltage setting you desire, that's precisely what you get as an output. You can also order a model that provides high resolution trimming in the least significant digit.

DIGIDECADE is also a thumbwheel switch, only it has been converted to a resistance decade. You dial the output resistance you want and that's precisely what you get.

Why a DIGIVIDER or a DIGIDECADE? Easy. Displaying a series of large digits is generally more accurate than fine line settings required on a potentiometer.

Where precise, repeatable digital setting of voltages or resistances are desired, DIGIVIDER voltage dividers and DIGIDECADE resistance decades provide an optimum design solution well within the limits of equipment design budgets. In addition to presenting a more attractive and sophisticated appearance on your control panel, the DIGIVIDER and DIGIDECADE provide much tighter accuracies than can be achieved with a 10-turn potentiometer.

The unique, error-free *digital setting* wheel provides positive detent action for setting ease and absolute resettability. *Parallel entry* provides a speed of setting unknown to serial entry type devices, while *inline readout* reduces both reading and setting errors. *Modular construction* offers additional design flexibility, as well as ease of installation and savings in control panel space.

In addition, DIGIVIDERS and DIGIDECADES provide *excellent contact resistance stability* and *MIL-Spec switching reliability* (MIL-S-22710.) Reliability, stability and long life are assured through use of redundant precious metal alloy contacts and special printed circuit boards in certain series of switches.

Design flexibility is a feature of both DIGIVIDER and DIGIDECADE, with virtually unlimited choice of electrical characteristics, plus all the additional features of standard DIGITRAN thumbwheel switches. Specify dial stops, decimal points, lighted dials, lighted or movable decimal points, spacers with special markings or symbols. Banks of DIGIVIDERS or DIGIDECADES in a single assembly may be visually separated by spacers or vertical lines, colons or words. RFI shielding and panel sealing are also available. DIGIVIDERS and DIGIDECADES are available in all Digitran Switch Series.

Price range in 1,000 piece quantities (both DV & DD): $18.11 and up.

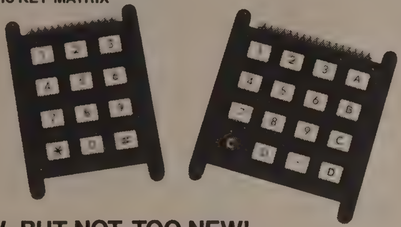
SWITCHES

NATIONWIDE REPRESENTATIVES AND DISTRIBUTORS!

THE LARGEST SELECTION OF CODES AVAILABLE!

SERIES KL
MINIKEY

LOW PROFILE KEYBOARDS
12 OR 16 KEY MATRIX



NEW, BUT NOT TOO NEW!

After producing 100's of thousands of these highly reliable, miniature keyboards for the Electronic Calculator Industry, Digitran is now releasing two standard versions of the MINIKEY for general sale.

Low profile . . .
MINIKEYS are less than 5/16" high from the top of the key to the rear surface, yet key stroke is almost 1/16".

Tactile Feel . . .
Key operation is positive, natural and quiet . . . the ideal "tactile feel" for keyboards of this type. This excellent tactile feel is the result of "keyswitch design" instead of adding simulator mechanisms.

Reliability . . .
MINIKEYS are made to last over 1,000,000 operations per key, (MTBF) when switching a 50 milliamp resistive load at 28VDC. Precious metal contacts ensure contact closure and reliable performance in "dry circuits" and "logic circuits" as well as at maximum load carrying capacity. A moisture barrier protects the contacts from liquids and dust.

Versatility . . .
MINIKEYS may be used just about anywhere Key operated digital control is required.

- Mounting provisions may be standard or optional within standard dimensions.
- Frame and key colors may be specified by the user, at extra cost.
- Special key legends may be specified by the user, at additional cost.
- Two basic frame designs provide the user with a maximum of 12 Keys in a 3 x 4 Key matrix or 16 Keys in a 4 x 4 Key matrix.
- Electrical terminations with Printed Circuit or Pin terminations are standard. Special terminations provided at additional cost.

SPECIFICATIONS

Electrical Data

Contact rating	50 ma @ 28VDC resistive
Contact resistance	500 milliohms max @ .2 ma @ 17VDC
Insulation resistance	250 megohms min.
Dielectric Strength	250 VAC min @ 60Hz
Contact bounce	3 milliseconds, max.
Operating life	1,000,000 operations per Key, MTBF, @ 28VDC, 50 milliamp resistive load

Mechanical Data

Terminations	Per detailed specifications
Key actuation force	90 ±30 grams
Key travel	.050" nominal
Key overtravel	30% of Key travel, nominal

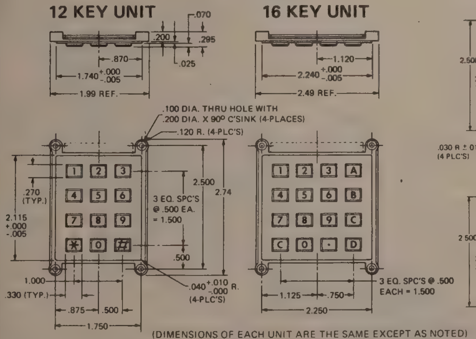
Materials & Finishes

Keytops	2-shot molded ABS with white keys and black legends are standard.
Housing	Molded ABS, black with textured finish is standard.

Environmental Data

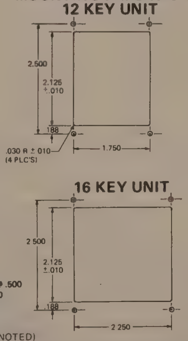
Operating temperature	+32°F, (0°C) to +131°F, (+55°F)
Storage temperature	–40°F, (-40°C) to +160°F, (+71°C)
Relative humidity	0 to 95% (Non-condensing)

OUTLINE DRAWING

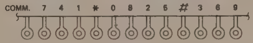

12 KEY UNIT
16 KEY UNIT
.070
.200
.295
.025
.870
1.740 +.000 -.005
1.99 REF.
1.120
2.240 +.000 -.005
2.49 REF.
.100 DIA. THRU HOLE WITH .200 DIA. X 90° C'SINK (4-PLACES)
.120 R. (4-PLC'S)
.270 (TYP.)
2.115 +.000 -.005
3 EQ. SPC'S @ .500 EA. = 1.500
2.500
2.74
.500
1.000
.330 (TYP.)
.875
.500
1.750
.040 +.010 -.000 R. (4-PLC'S)
1.125
.750
2.250
3 EQ. SPC'S @ .500 EACH = 1.500
1 2 3 4 5 6 7 8 9 * 0 #
1 2 3 A 4 5 6 B 7 8 9 C C 0 · D

(DIMENSIONS OF EACH UNIT ARE THE SAME EXCEPT AS NOTED)

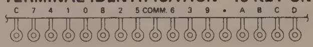
MOUNTING DIMENSIONS


12 KEY UNIT
2.500
2.125 ±.010
.188
.030 R ± .010 (4 PLC'S)
1.750
16 KEY UNIT
2.500
2.125 ±.010
.188
2.250

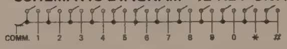
TERMINAL IDENTIFICATION 12 KEY UNIT


COMM. 7 4 1 * 0 8 2 5 # 3 6 9

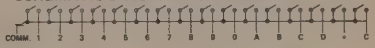
TERMINAL IDENTIFICATION 16 KEY UNIT


C 7 4 1 0 8 2 5 COMM. 6 3 9 • A B C D

SCHEMATIC DIAGRAM 12 KEY UNIT


COMM. 1 2 3 4 5 6 7 8 9 0 * #

SCHEMATIC DIAGRAM 16 KEY UNIT


COMM. 1 2 3 4 5 6 7 8 9 0 A B C D • C

**DIMENSIONS SUBJECT TO CHANGE.
CONTACT FACTORY FOR DETAILS.**

NOTE: PRICES VARY ACCORDING TO TYPE OF SWITCHES USED, ITS OUTPUT CHARACTERISTICS OR CODE, ELECTRICAL TERMINATIONS, AND SWITCH COLOR OR FINISH.

CONSULT THE FACTORY OR OUR LOCAL SALES OFFICE FOR SPECIFIC PRICING AND OUT LIBERAL QUANTITY DISCOUNTS.

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THE **DIGITRAN®** COMPANY

A Division of Becton, Dickinson and Company BD

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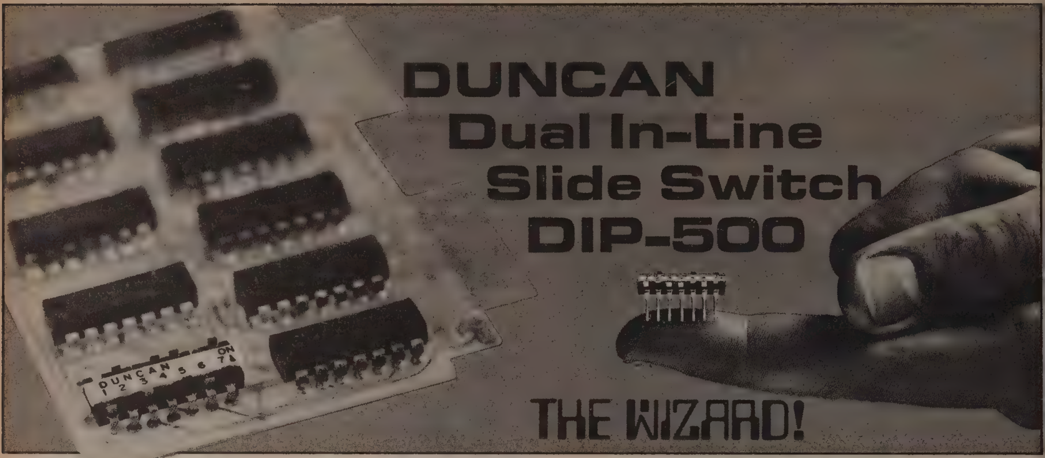


DUNCAN Dual In-Line Slide Switch DIP-500

THE WIZARD!

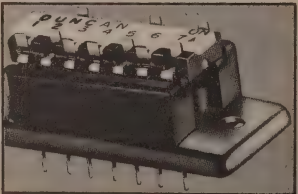
DIP-500 Slide Switch consists of multiple slider-type single pole, single throw switches, in a DIP package with leads on .100 by .300 centers.

For greater convenience and economy, the Duncan Dual In-Line Slide Switch is designed to be serviced or test probed from the top of a PC board. This completely eliminates awkward maintenance and testing from beneath. And once in place, it can be tested without removal from the PC board.

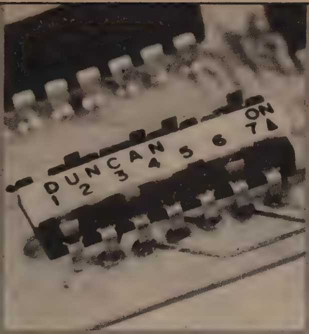
Another unique feature — Duncan's DIP-500 Sliders can be mechanically programmed. This is a major advantage particularly in highly complex circuitry. With its standardized DIP dimensions, it ideally lends itself to **automatic insertion** into circuit boards — and is available in plastic tube holders for automatic insertion equipment.

Model DIP-500 is a high density low profile switch which mounts in the same space as IC DIP packages. It may be wave or dip soldered directly to a PC board, or inserted into a DIP socket, and is available in a wide range of sizes — from 4 to 10 poles. It features a housing of Diallyl-Phthalate which resists cleaning solvents.

The new DIP-500 is especially useful as a selector switch in high density packaged equipment; in automated test equipment, as a programming switch where frequent changes of programs are necessary and programming is set manually; in filter network frequency response and bandwidth adjustment; in time delay relays; and in delay line matching equipment. Applications of this switch are virtually unlimited.

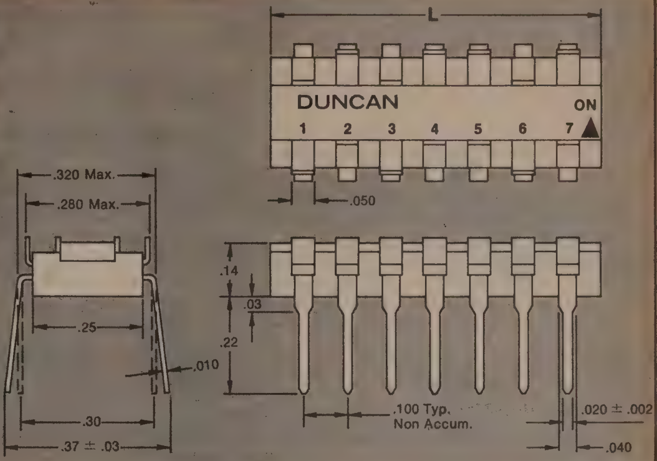


DUNCAN
1 2 3 4 5 6 7
ON


DUNCAN
ON
1 2 3 4 5 6 7

DUNCAN DIP-500 DIMENSIONS:

Tolerances: XX ± .01″
XXX ± .005″

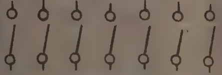

L
DUNCAN
ON
1
2
3
4
5
6
7
.050
.320 Max.
.280 Max.
.25
.010
.30
.37 ± .03
.14
.03
.22
.100 Typ.
Non Accum.
.020 ± .002
.040

SPECIFICATIONS:

Current/voltage ratings — switching:	5v DC @ 100 mA 30vDC @ 30mA
— non-switching:	50v 250 mA
Contact resistance (50 mV/2mA):	100 milliohms max.
Insulation Resistance (@ 100 VDC):	1x10^{11} ohms min.
Breakdown voltage:	500 v min.
Capacitance:	Open contacts 5 pf
	Adjacent switches 5 pf
Housing:	Diallyl-Phthalate
Leads:	Gold-plated
Slider:	Paliney® #6
Protective Cover:	Optional

FOR ORDERING:

No. of Poles	L (MAX)	Part Number
4	.48	500-104
5	.58	500-105
6	.68	500-106
7	.78	500-107
8	.88	500-108
9	.98	500-109
10	1.08	500-110



Typical contact circuit arrangement, 7-pole switch (switches shown in open position)

DUNCAN ELECTRONICS
SUBSIDIARY
SYSTRON DONNER
2865 FAIRVIEW ROAD • COSTA MESA, CALIFORNIA 92626
PHONE: (714) 545-8261 TWX 910-595-1128

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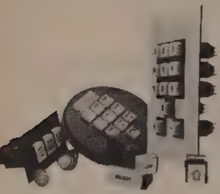
COMPONENTS, INC.

MINIATURE AND STANDARD SIZE MODELS
MULTIPLE-FUNCTION SWITCHES
MULTI-IMAGE PUSH-BUTTONS

LIGHTED PUSH-BUTTON SWITCHES / INDICATORS



IDEAL FOR APPLICATIONS REQUIRING QUALITY, VERSATILITY, AND DEPENDABILITY

ELECTRO-MECH provides a perfect blend of quality standard products with in-depth experience in answering unique requirements. Proven engineering designs are illustrated by the excellent performance characteristics of each ELECTRO-MECH lighted push-button switch, indicator, and display assembly. Low-bounce, long-life contacts, new innovations in legends, displays, field-service, packaging — all standard features. Whatever your applications, ELECTRO-MECH is prepared to answer your specific needs. Choose from any of the most popular models.

- ☐ COMMUNICATIONS
- ☐ INSTRUMENTATION
- ☐ INDUSTRIAL CONTROLS
- ☐ COMPUTER/PERIPHERALS
- ☐ MEDICAL/TESTING

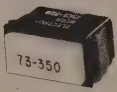
Standard Electro-Mech Models
SERIES 65, 73, 85, 600, 61

TECHNICAL SPECIFICATIONS (TYPICAL)

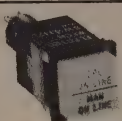
RATING:	30 Volts DC or 115 Volts AC 2 Amps Resistive, 1 Amp Inductive
WEIGHT:	0.8 oz. (Approx.)
OPERATING PRESSURE:	2 lbs. ±1 lb.
PLUNGER TRAVEL:	3/16″ (Approx.)
ACTUATIONS:	100,000

NOTE: Refer to Tables for Switching Function, Lens / Filter Options and Switch Actuations.

SERIES 65



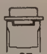
SERIES 73



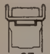
SERIES 600

SERIES 61

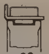
MOUNTING ADAPTERS Specify Desired Mounting Option



**-65
NO
BARRIER**



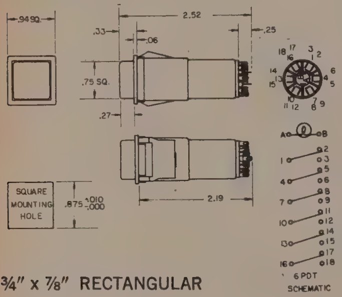
**-67
DOUBLE
BARRIER**



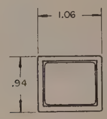
**-68
SINGLE
BARRIER**

Select the mounting adapter to meet your specific requirements. Part number prefix replaces standard first two digits of part numbers listed on chosen model table. (Example: 67-128-xxx same as basic series 65-128-xxx except double barrier.)

MECHANICAL SPECIFICATIONS
3/4″ SQUARE
SERIES 65, 67, 68



3/4″ x 7/8″ RECTANGULAR
SERIES 85, 87, 88

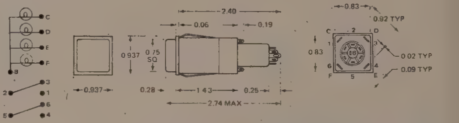


Same Size as Series 65
Except Button and
Flange Size Shown.

SWITCHING/MOUNTING OPTIONS
(SERIES 65, 67, 68, 85, 87, 88)

Snap Feel Momentary	Momentary	Push-on Push-off	Push-on Remain In Push-off	Circuitry
—	65-128	65-228	65HM-2328	1PST - 1 N.O.
—	65-129	65-229	65HM-2329	1PST - 1 N.C.
—	65-130	65-230	65HM-2330	2PST - 2 N.O.
—	65-131	65-231	65HM-2331	2PST - 2 N.C.
—	65-132	65-232	65HM-2332	2PST - 1 N.O. & 1 N.C.
—	65-149	65-249	65HM-2	1PDT
65-550	65-150	65-250	65-350	2PDT
65-551	65-651	65-751	65-851	3PDT
65-552	65-652	65-752	65-852	4PDT
65-554	65-654	65-754	65-854	6PDT

DUAL-QUAD DISPLAY
3/4″ SQUARE
3/4″ x 7/8″
SERIES 600
SERIES 800



NOTE: For 3/4″ x 7/8″ Size Button Style of this Model, Specify 853 in Lieu of 653 (See Tables Below for Switching Options and Lens Options).

SWITCHING/MOUNTING OPTIONS *(SERIES 600, 800)*

Select Series 600 or 800 from above description
Specify Mounting Option (second digit, -5 no barrier, -7 double barrier, -8 single barrier. (i.e. 65X-XXXX-)
Indicate Lighting Option, (third digit; -3 for 2 bulbs, -4 for 4 bulbs)
Select Switching Functions per table at right

EXAMPLE:
653-2250 — **L815 - W/W, W,G,G**

Specify Lens/Filter Option in table below
Top Lens Filter (Color when Illuminated): Standard White, Contact Factory for others
Specify Color of Lens for each Segment of Switch (2 Segments for 653 Series / 4 Segments for 654 Series)

Snap Feel Momentary	Momentary	Push-on Push-off	Push-on Remain In Push-off	Circuitry
—	-2128	-2228	-2328	1PST - N.O.
—	-2129	-2229	-2329	1 PST - N.C.
—	-2130	-2330	-2330	2PST - N.O.
—	-2131	-2231	-2331	2PST - N.C.
—	-2132	-2232	-2332	2PST - 1 N.O. & 1 N.C.
—	-2149	-2249	-2349	1PDT
—	-2150	-2250	-2350	2PDT
-2551	-2651	-2751	-2851	3PDT
-2552	-2652	-2752	-2852	4PDT
-2554	-2654	-2754	-2854	6PDT

NOTE: For Matching Indicator Light Specify (Part No.) — 3210

LENS/FILTER OPTIONS *(SERIES 600, 800)*

	Lens Option Description	Lens Option No.		For 3/4 x 7/8 Lens (Series 800)
		Key Upper Left Corner	Key Upper Right Corner	
☐	Dual Light with No Barrier in Lens	L 811	L 851	L 831
⊟	Dual Light with Horizontal Barrier in Lens	L 812	L 852	L 832
◫	Dual Light with Vertical Barrier in Lens	L 813	L 853	L 833
☐	Quad Light with No Barrier in Lens	L 814	L 854	L 834
⊟	Quad Light with Horizontal Barrier in Lens	L 815	L 855	L 835
⊞	Quad Light with Horizontal Barrier plus Vertical Barrier in Top Half of Lens	L 816	L 856	L 836
⊞	Quad Light with Horizontal Barrier plus Vertical Barrier in Bottom Half of Lens	L 817	L 857	L 837
⊞	Quad Light with Horizontal and Vertical Barriers	L 818	L 858	L 838
◫	Quad Light with Vertical Barrier in Lens	L 819	L 859	L 839
⊞	Quad Light with Vertical Barrier plus Horizontal Barrier in Left Half of Lens	L 820	L 860	L 840
⊞	Quad Light with Vertical Barrier plus Horizontal Barrier in Right Half of Lens	L 821	L 861	L 841

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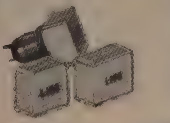
electro-mech
COMPONENTS, INC.

INTERCHANGEABLE LENS/FILTERS
PRINTED CIRCUIT MOUNTINGS
SPECIAL DESIGNS/ASSEMBLIES

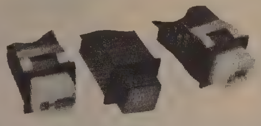
LIGHTED PUSH-BUTTON SWITCHES / INDICATORS

NEW DESIGNS TO ADD TO YOUR PACKAGING HORIZONS

INTERCHANGEABLE PUSH-BUTTON LENS/FILTERS AND BUTTON SHAPES



Displays may be changed or buttons replaced with these non-wearing, clear acrylic interchangeable lens and filter buttons. Legends may be easily changed. Series L150 replaceable lenses may be ordered to provide matching color or numbers with other manufacturers switches.



Choice of push-button shapes and lighting designs enables virtually any tailoring of standard switch or indicator light to meet specific requirements. Standard button or button with opaque sides to prevent light spill-over, or popular keyboard/contoured configuration provides to right appearance and function design. Choice of standard colors and over 30 different sizes, from ½" to 1½", in all popular configurations may be specified.

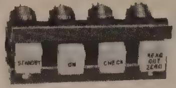
CHROME BARRIER

SERIES 500 WITH INTERLOCK

Added beauty and long-lasting appearance with handsome chrome barriers between each switch or indicator. Independent or interlocking action. Ten types of tracking action and switching sequences. Up to 12 switches in single or dual row, ⅞" or 1" centers.

SUB-PANEL SWITCH ASSEMBLIES

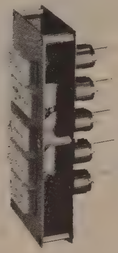
SERIES 400 WITH INTERLOCK



Multi-station switch assemblies designed for sub-panel mounting by means of a flanged "U" channel. All standard ELECTRO-MECH switches can be incorporated with several types of mechanical interlocking/lockout actions between stations. Up to 12 stations in one or two row configurations.

electro-mech quality designs *IN A COMPLETE FAMILY OF* STANDARDS AND SPECIALS

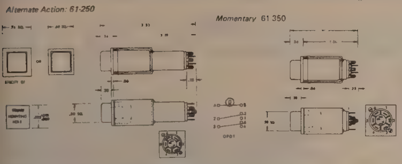
ELECTRO-MECH places emphasis on a tradition of special switch designs to answer unique applications. SUDS — **SPECIAL UTILITY DESIGNS** plan — invites special requirements. Multiple functions, interlocking, matrix systems, flush switch button panels.



SUDS
Special Utility Designs

½" KEYBOARD/PANEL PUSH-BUTTON SWITCH

SERIES 61

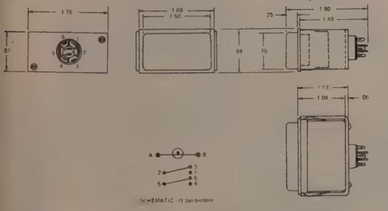


SWITCHING OPTIONS

Description	Momentary Short Switch (9 oz. pressure)	Momentary Regular	Push-on, Push-off Alternate Action
SPST 1 N.O.	61-328	61-128	61-228
SPST 1 N.C.	61-329	61-129	61-229
2PST 2 N.O.	61-330	61-130	61-230
2PST 2 N.C.	61-331	61-131	61-231
2PST 1 N.O. & 1 N.C.	61-332	61-132	61-232
1PDT	61-349	61-149	61-249
2PDT	61-350	61-150	61-250

¾" x 1½" RECTANGULAR MOMENTARY

SERIES 73



SWITCHING OPTIONS

Momentary	1PST N.O.	1PST N.C.	2PST 2 N.O.	2PST 2 N.C.	1 N.O. 1 N.C.	1PDT	2PDT
Illuminated	73-328	73-329	73-330	73-331	73-332	73-349	73-350
Non-Illuminated	73-428	73-429	73-430	73-431	73-432	73-449	73-450

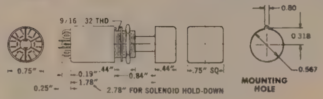
ELECTRO-MECH *SWITCHLINE* AND *SLIMLINE* SWITCHES

SERIES 2650 TO 6PDT

- **Ratings:** 30 Volts DC or 115 Volts AC 2 amps resistive; 1 amp inductive
- **Weight:** 0.8 oz. (approx.)
- **Operating Pressure:** 2 lbs. ±1 lb.
- **Plunger Travel:** 3⁄16" (approx.)
- **Actuations:** 100,000
- Accommodates all **"switchline"** standard lenses Uses one T1¾, AN3140-327, 328, 330 bulb or neon lamp. 3 actuation modes standard also in 2, 3, 4 and 5-pole configuration.

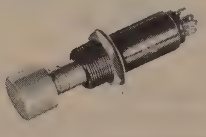
ILLUMINATED

	Mom.	Push-on Push-off	Push-on Remain In Push-off	Snap Feel Mom.
2PDT	2650	2750	2850	2550
3PDT	2651	2751	2851	2551
4PDT	2652	2752	2852	2552
5PDT	2653	2753	2853	2553
6PDT	2654	2754	2854	2554



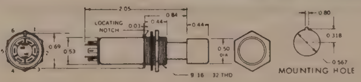
Lenses: Available in ½", ¾", 1" dia., ½", ⅝", ¾" square. Translucent Lexan in white, red, green, blue and yellow.

SERIES 2150 TO 2PDT



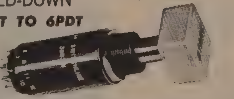
A new 2100 Series Slimline version of our standard Illuminated Pushbutton Switch featuring silver slide bar action. Add BR after part number for mounting on ⅝" centers. Utilizes AN3140-T 1-¾ or ALC-100 bulb. All other specifications same as standard.

	1PST N.O.	1PST N.C.	2PST 2 N.O.	2PST 2 N.C.	1 N.O. 1 N.C.	1PDT	2PDT
Momentary	2128	2129	2130	2131	2132	2149	2150
Push-on/ Push-off	2228	2229	2230	2231	2232	2249	2250



SOLENOID HOLD-DOWN

SPDT TO 6PDT



Switchline Illuminated Pushbutton switches with an integral hold-down coil which is activated with switch. Holds the push-button in the depressed position until coil is de-energized returning it to relaxed position. Available in all circuit configurations up to 6PDT. Same specifications as standard model.

MINIATURE FRONT PANEL MOUNT MOMENTARY SWITCHES

SERIES 5000

An exceptionally short momentary switch available in circuit configurations up to 2PDT. Clear anodized case. All specifications same as standard model except plunger travel which is 3⁄32".

	1PST N.O.	1PST N.C.	2PST 2N.O.	2PST 2N.C.	1 N.O. 1 N.C.	1PDT	2PDT
Momentary	5128	5129	5130	5131	5132	5149	5150

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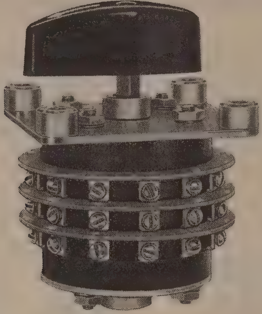
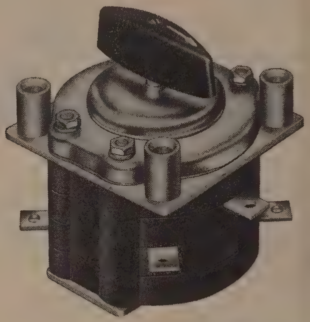
ROTARY POWER SWITCHES

OUR STANDARD PRODUCTS...



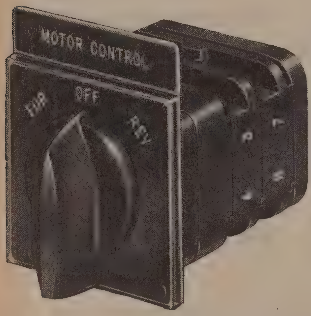
◀ DETENT SWITCHES

10 to 30 amps...up to 600V...up to 75 poles... 2 to 16 positions...wide range of options...military equivalents.



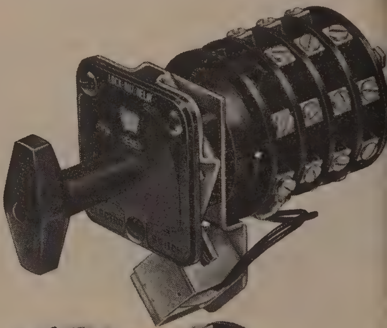
SNAP-ACTION SWITCHES ▶

20 to 200 amps...up to 600V...up to 12 poles...2 to 4 positions...recommended for D.C. applications... military equivalents.



CAM-ACTUATED SWITCHES ◀

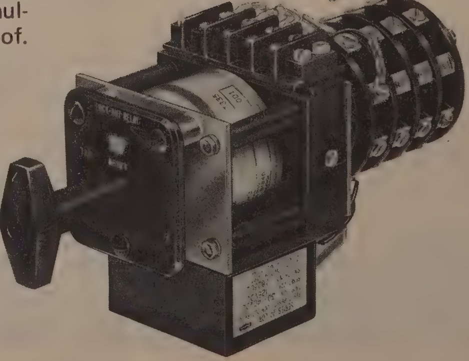
12 to 160 amps...up to 600V...up to 24 poles ...2 to 12 positions...excellent for motor control applications.



LOCK-OUT RELAYS ▶

Manual & Electric Remote Reset

Used primarily as auxiliary relays in applications requiring large numbers of contacts actuated simultaneously. Up to 40 contacts...seismic shock-proof.



Send for Bulletin C-1...our "Catalog of Available Catalogs" or give specific needs for detailed information.

ELECTROSWITCH

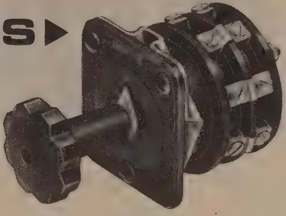
ELECTRO SWITCH CORP. • Weymouth, Massachusetts 02188 • Telephone: 617/335/5200 • TWX: 710/388/037

ROTARY POWER SWITCHES

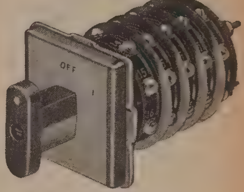
OUR BRIGHT NEW STARS...

DETENT SWITCHES ▶

10 to 30 amp...Standard and Miniaturized versions...up to 600V...up to 20 poles...2 to 8 positions. UL & CSA approved...military equivalents.



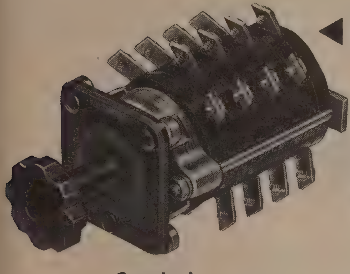
Standard



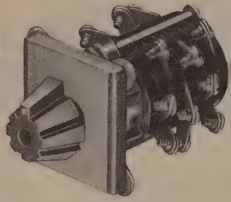
Miniaturized

◀ SNAP-ACTION SWITCHES

20 to 45 amp...Standard and Miniaturized versions...up to 600V...up to 12 poles...2 to 4 positions. UL & CSA approved...military equivalents.



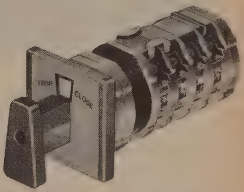
Standard



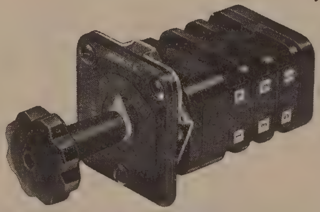
Miniaturized

CAM-ACTUATED SWITCHES ▶

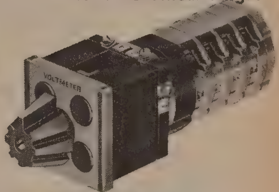
12 to 20 amp units in Standard and Miniaturized versions...up to 600V...up to 24 poles...2 to 12 positions. Unusually large range of options including mechanical targets, lighted plates, handle styles, slip contacts, pull-to-lock, spring-return, removeable handles, etc.



With Mechanical Target



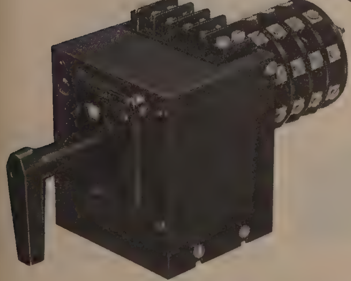
Standard Size



With Lighted Plate

◀ CONTROL SWITCH/RELAY

Remotely operates all instrument and control switch applications. *Retrofits* on existing control panels. Can also operate manually. Wide range of sophisticated functions easily added to basic standard switch/relay. Operates circuit breakers, synchroscopes, etc. Continuous rating: 30A-600V. Up to 20 poles...2 to 8 positions.



Send for Bulletin C-1...our "Catalog of Available Catalogs" or give specific needs for detailed information.

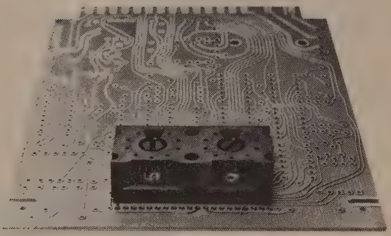
ELECTROSWITCH

ELECTRO SWITCH CORP. • Weymouth, Massachusetts 02188 • Telephone: 617/335/5200 • TWX: 710/388/0377

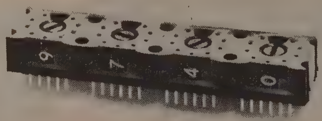
EECO FOR SWITCHES

NEW STRIPSWITCH™

...for direct mounting on printed circuit cards



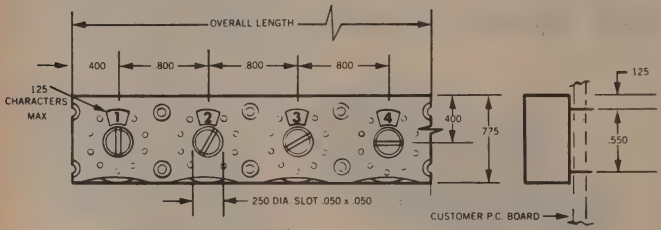
A "Strip" of coded switching stations that mount directly on a PC board or card. Wave soldering both secures the stripswitch to a board mechanically and connects it electrically to the board wiring.

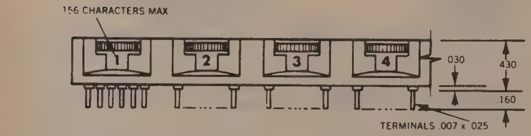


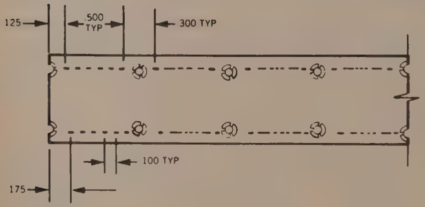
- BCD, decimal and many other codes
- Custom dial marking
- Horizontal or vertical mounting

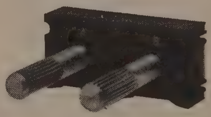
- Eliminates wiring costs
- One to six stations
- Color coding available

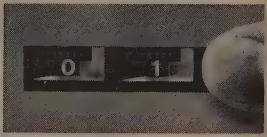
- 8, 10, 12 and 16 position available
- $1.95 per station (Less than $1.50 in production quantities)


OVERALL LENGTH
400
.800
.800
800
125 CHARACTERS MAX
1
2
3
4
400
775
125
.550
250 DIA. SLOT .050 x .050
CUSTOMER P.C. BOARD


156 CHARACTERS MAX
1
2
3
4
030
430
.160
TERMINALS .007 x 025


125
.500 TYP
300 TYP
100 TYP
175





ACTUATES THREE WAYS

EECO FOR SWITCHES

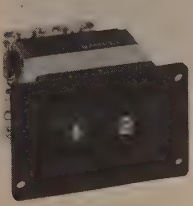
ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA
1441 East Chestnut Avenue · Santa Ana, California 92701
Phone: (714) 835-6000 · TWX 910-595-1550 · Telex 67-8420

EECO FOR SWITCHES

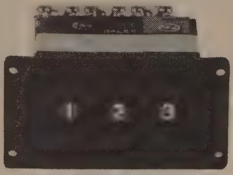
THUMBPOT

NEW

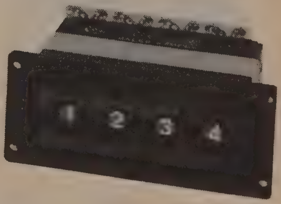
. . . Incremental Voltage Divider to replace ten-turn pots



RESOLUTION 1.0%
(2 decades)



RESOLUTION 0.1%
(3 decades)



RESOLUTION 0.01%
(4 decades)

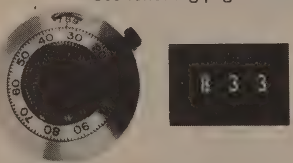
HOW IS ALL THIS ACCOMPLISHED?

The new switching code developed by EECO engineers is similar to the well-known Wolff-Poggendorf voltage divider code (see EECO SWITCH catalog Application notes on Voltage Dividers). The Thumbpot electrically moves the resistors from one line to the other, unlike the Wolff-Poggendorf which alternately switches and shorts matched pairs of resistors. This reduction (by 50 percent) of resistors in each matched set is a prime reason for the attractive price of the thumbpot.

An outstanding feature of the EECO thumbpot is based on the principle that precision is not dependent upon the absolute accuracy of each resistor, but upon their matched ratios. Additionally, this code enables the thumbpot to maintain a constant input resistance, regardless of dial setting.

Like the 10-turn potentiometer, accuracy of the Thumbpot divider is dependent upon the loading resistance. For one percent overall accuracy, load resistance must be at least 100 times the total resistance of the Thumbpot. Similarly, a .1 percent IVD requires a load resistance of 1000 times the Thumbpot resistance. Depending on application requirements, resolution may be increased by increasing the number of switching stations in the IVD. Contact resistance of the switching elements is very stable and temperature coefficients may be specified, consistent with standard resistor characteristics.

- Matte finish, custom dial markings
- Options available: lighting, decimal points, stops, RFI shielding
- Input resistance — 100, 500, 1,000, 5,000, 10,000, 50,000 and 100,000 Ohms (± 1%)
- Accuracy (%) full scale voltage — 1%, .5%, .25%, .1%, .05%
- Two available sizes — 1776 and 1976
- Lighted decimal points
- See following page for dimensional information



- **Perfect Resetability.** When you return to a previously recorded setting, you are assured it is exactly what you read before. In some cases, this feature eliminates the need for additional panel meters.
- **In-Line Digital Display** provides fast, easy reading with no errors . . . even from across the room.
- **Rapid Data Entry.** On a 3-digit incremental voltage divider, large voltage jumps may be made with one quick flick of the finger . . . without having to turn . . . and turn . . . and . . .

THUMBPOT is a revolutionary development by EECO! With the discovery of this new coded approach, THUMBPOT Thumbwheel Switch Assemblies perform all precision voltage dividing and resistance selection functions available with 10-turn pots. THUMBPOT spares you the inherent disadvantages of 10-turn pots and their add-on dials . . . such as hard-to-read dials, slow and awkward dial rotation, lack of exact resetability, resolution limited to 1 part per 10,000 or less.

With the advent of THUMBPOT's newly developed code, EECO can now offer the ultimate in digital voltage dividing at prices that are directly competitive with 10-turn pots — **a first in the industry!** Applications of these voltage dividers range from programmed power supplies to blood cell count analyzers . . . anywhere that precise voltage steps are part of critical programming.

EECO FOR SWITCHES

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EECO FOR SWITCHES

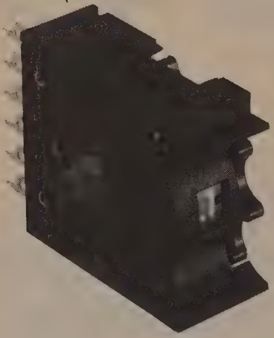
1776 SERIES

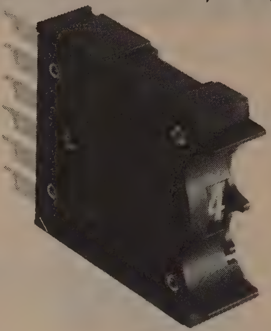
REVOLUTIONARY SLIM

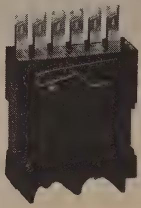
1976 SERIES

. . . prices start at $3.60

- Plastic window readout protection — 1776
- Sealed against dust
- Optional lighting provisions
- Solder tab or notched termination
- Lowest costs
- 8, 10, 12 and 16 positions
- Over 45 standard models
- Choice of Rod or Band type assembly hardware
- Double width switches (triple legend area) — 1776
- Two year warranty

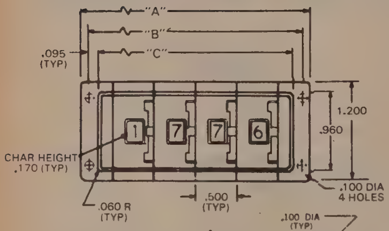


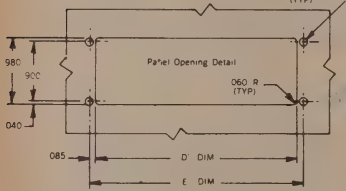


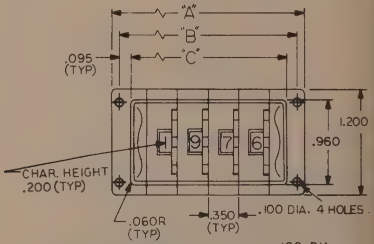


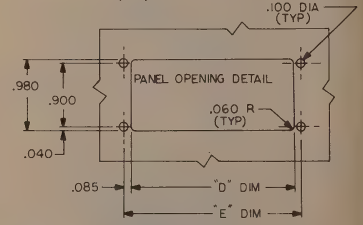
NOTCHED TERMINALS

The solder tab terminals are notched so that the switch can be plugged into a "mother board" and wave soldered.


"A"
"B"
"C"
.095 (TYP)
1.200
.960
CHAR HEIGHT .170 (TYP)
.100 DIA 4 HOLES
.060 R (TYP)
.500 (TYP)
.100 DIA (TYP)


Panel Opening Detail
980
900
040
060 R (TYP)
085
D DIM
E DIM


"A"
"B"
"C"
.095 (TYP)
1.200
.960
CHAR. HEIGHT .200 (TYP)
.060R (TYP)
.350 (TYP)
.100 DIA. 4 HOLES


.100 DIA (TYP)
PANEL OPENING DETAIL
.980
.900
.060 R (TYP)
.040
.085
"D" DIM
"E" DIM

MOUNTING DIMENSIONS

No. of Stations	Part Number	A	B	C	D	E
1	76SG1	1.26	1.09	0.90	0.920	1.090
2	76SG2	1.76	1.59	1.40	1.420	1.590
3	76SG3	2.26	2.09	1.90	1.920	2.090
4	76SG4	2.76	2.59	2.40	2.420	2.590
5	76SG5	3.26	3.09	2.90	2.920	3.090
6	76SG6	3.76	3.59	3.40	3.420	3.590
7	76SG7	4.26	4.09	3.90	3.920	4.090
8	76SG8	4.76	4.59	4.40	4.420	4.590
9	76SG9	5.26	5.09	4.90	4.920	5.090
10	76SG10	5.76	5.59	5.40	5.420	5.590

MOTHER BOARDS

Various "mother boards" are available to facilitate bussing of switch output terminals and provide for mounting of diodes, resistors, or other circuit components. Switches must have notched terminals per Option "N".

MOUNTING DIMENSIONS

No. of Stations	Part Number	A	B	C	D	E
1	97SG1	1.11	.94	.75	.770	.940
2	97SG2	1.46	1.29	1.10	1.120	1.290
3	97SG3	1.81	1.64	1.45	1.470	1.640
4	97SG4	2.16	1.99	1.80	1.820	1.990
5	97SG5	2.51	2.34	2.15	2.170	2.340
6	97SG6	2.86	2.69	2.50	2.520	2.690
7	97SG7	3.21	3.04	2.85	2.870	3.040
8	97SG8	3.56	3.39	3.20	3.220	3.390
9	97SG9	3.91	3.74	3.55	3.570	3.740
10	97SG10	4.26	4.09	3.90	3.920	4.090

EECO FOR SWITCHES

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EECO FOR SWITCHES

2000 SERIES

COMMERCIAL SWITCHES

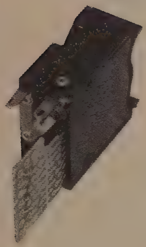
2000 SERIES SUPER SWITCH

- Economical
- Universal Dimensions
- Field adjustable stops
- Optional lighting provisions
- Over 50 standard models
- Sealed or unsealed
- Band or rod assembly hardware
- Detachable indicator ring for quick change of characters
- Prices start at $5.00
- Two year warranty

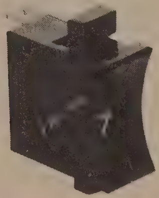
All EECO Switch Products have a two year warranty (except for series 8000 switches)

MILITARY SWITCHES

5000-6000 SERIES — MINIATURE — 700-800 SERIES



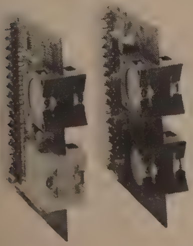
- Meets MIL S-22710
- Cable, printed circuit board or wire loop terminations
- Plastic window readout protection
- Unsealed or fully "O" ring sealed
- Unlighted or lighted with replaceable lamps
- Wide variety of codes and options



- Meets MIL-S-22710
- Circuit board termination
- Lighted or unlighted
- Unsealed or fully "O" ring sealed
- Switches individually replaceable in mounted assemblies
- Extremely rugged mounting hardware

SPECIAL SWITCHES

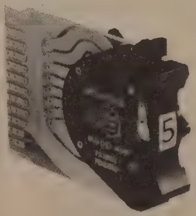
8000 SERIES — LOW COST SWITCH KITS



Mount directly on circuit boards to reduce wiring costs. Code stator pattern is part of the board's etched circuit.

- Low in total cost
- Lighted or unlighted
- Color coded
- Unsealed or fully "O" ring sealed

300-400 SERIES — LARGE AND RUGGED



This large, unusually attractive switch is designed for reliability even in hostile atmospheres and easy operation with gloved fingers.

- Meets MIL-S-22710
- Unsealed or fully "O" ring sealed
- Unlighted or brightly lighted with replaceable lamp
- PCB termination for direct wire and/or connector compatibility

Have you the latest EECO SWITCH CATALOG?

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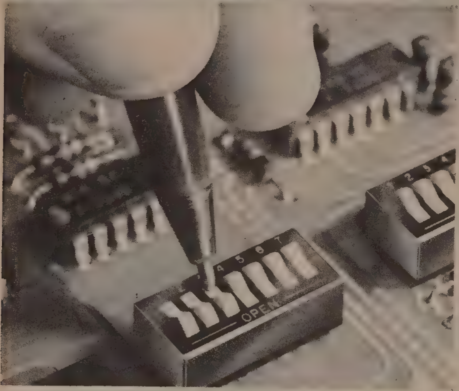
Grayhill

ROCKER DIP SWITCHES— SERIES 76

9 SIZES / 2 THROUGH 10 POSITIONS SPST / INDEPENDENT SWITCHING



ALL THESE DUAL IN-LINE PACKAGE BENEFITS

EASY MOUNTING
to PC board by direct flow-soldering or insertion into a standard socket.

MOLDED-IN TERMINALS
minimize contact system contamination.

COMPACT,
high density design; low profile; minimum above board height .305″.

COST SAVINGS
industry accepted package dimensions; multi-function, programmable PC boards; elimination of mounting hardware or hard-wiring interconnections.

OUTSTANDING PERFORMANCES AT NO PRICE PREMIUM
50 mA at 30 VDC/35,000 operations
125 mA at 30 VDC/25,000 operations
Mechanical life: 50,000 operations

SPRING LOADED
sliding ball contact system provides positive contact, tease-proof reliability, wiping contact, immunity to normal shock and vibration, and exceptionally long life . . . all essentials in back panel logic applications.

PROTECTIVE COVER
reduces contamination during the cleaning and soldering operation — and can remain on the switch in the equipment to deter unauthorized actuation.

OPTIONS
with or without standoffs, protective cover; plus (not available through distributors) black housing (red is standard), variable terminal length. (.125″ max. terminal length is standard).

SPECIFICATIONS

MECHANICAL LIFE: 50,000 operations per rocker.

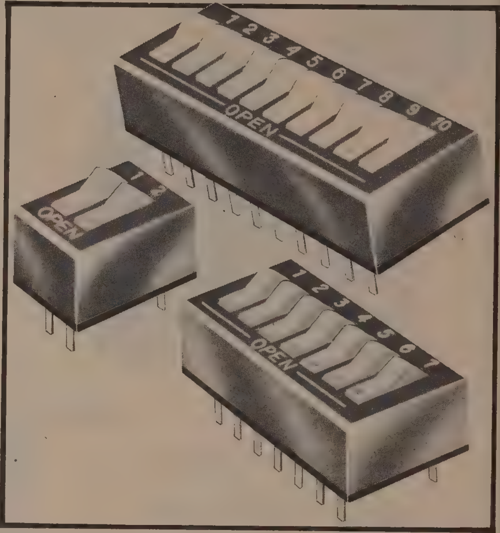
MAKE AND BREAK CURRENT RATING:
35,000 operations at 50 mA 30 VDC.
25,000 operations at 125 mA 30 VDC.

CONTACT RESISTANCE: 50 milliohms maximum after life (10 milliohms initially) measured at 100 milliamps and 2 VDC.

INSULATION RESISTANCE (at 100 VDC): Between adjacent closed contacts: 50,000 megohms after life, (100,000 megohms initially).
Between adjacent open contacts: 50,000 megohms after life, (100,000 megohms initially).

DIELECTRIC STRENGTH: Between adjacent closed contacts: 500 VAC after life (750 VAC initially).
Between adjacent open contacts: 500 VAC after life (750 VAC initially).

CURRENT CARRY RATING: 5 amps with a maximum contact temperature rise of 20°C.

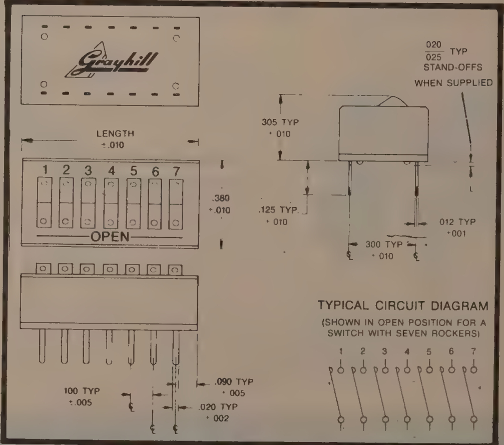


SERIES 76 ROCKER DIP SWITCH (NO COVER)

No. of Rockers	Length	Part Number	
		Switch W/O Stand-Offs	Switch With Stand-Offs
2	0.280	76A02	76B02
3	0.380	76A03	76B03
4	0.480	76A04	76B04
5	0.580	76A05	76B05
6	0.680	76A06	76B06
7	0.780	76A07	76B07
8	0.880	76A08	76B08
9	0.980	76A09	76B09
10	1.080	76A10	76B10

Contact Grayhill for protective cover information.

PRICE: Approx. $1.85 to $3.00 ea. in 100 pc lots dependent on the number of rockers.



✱ Available locally through your Grayhill distributor

0.3″ DIAMETER ROTARY SWITCHES 10 POSITIONS, 1 OR 2 POLES—SERIES 75

Grayhill

SCREWDRIVER ACTUATED
SHAFT ACTUATED
INTEGRAL KNOB ACTUATED

DESIGNED AS THE WORLD'S SMALLEST ROTARY SWITCH

RATED TO MAKE AND BREAK LOGIC LOADS FOR A MINIMUM OF 15,000 CYCLES OF OPERATION

NON-SHORTING WIPING CONTACTS

STYLE CHOICES AND DESIGNATIONS

.300 DIA. CIRCLE OF TERMINALS
SCREWDRIVER ACTUATED, PC MOUNT = AF
SHAFT OPERATED, PC MOUNT = BF
INTEGRAL KNOB ACTUATED, PC MOUNT = CF

RATING:

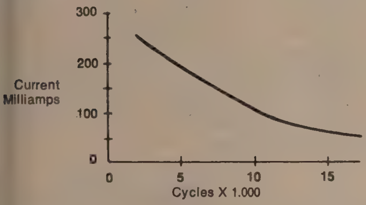


CHART SHOWN FOR NON-SHORTING CONTACTS (BREAK BEFORE MAKE).

VOLTAGE: 115 VAC or 30 VDC, resistive load.

One cycle is 360° rotation and a return through all switch positions to the starting position. The data for the above curve was measured at sea level, 25°C. and 68% relative humidity with the following life limiting criteria.

CONTACT RESISTANCE: 50 milliohms maximum (15 millioms initially).

INSULATION RESISTANCE: 10,000 megohms minimum between mutually insulated parts (50,000 megohms initially).

VOLTAGE BREAKDOWN: 500 VAC minimum between mutually insulated parts.

LIFE EXPECTANCY: As determined from the above curve for the current that must be switched.

Contact GRAYHILL for information if the life limiting criteria are more critical than those listed, if the required cycles of operation are greater than those listed, if a larger make and break current is required than the one listed for the desired number of cycles, or if elevated temperatures or reduced pressures are part of the operating environment.

PRICE: Approx. $3.50 to $5.50 ea. in 100 lots, dependent on style and number of poles.

ADDITIONAL STANDARD FEATURES OR OPTIONS

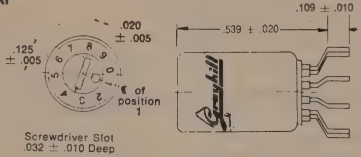
- —Coded Versions
- —0.187 Dia. Circle of Terminal Centers
- —Integral Bar Type Knob†

Complete description in GRAYHILL Engineering Catalog

† Indicates not available through distributors

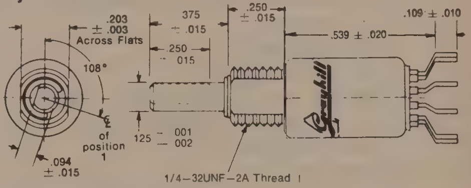
SCREWDRIVER ACTUATED

Style AF


.020 ± .005
.125 ± .005
7
8
9
6
5
0
4
3
2
℄ of position 1
Screwdriver Slot .032 ± .010 Deep
.109 ± .010
.539 ± .020
Grayhill

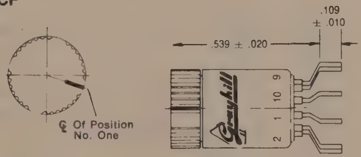
SHAFT OPERATED

Style BF

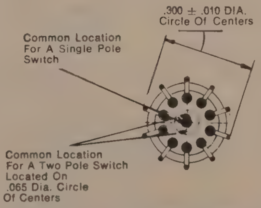

.203 ± .003 Across Flats
375 ± .015
.250 ± .015
.250 ± 015
.109 ± .010
.539 ± .020
108°
℄ of position 1
.094 ± .015
125 + 001 − 002
1/4—32UNF—2A Thread
Grayhill

INTEGRAL KNOB ACTUATED

Style CF

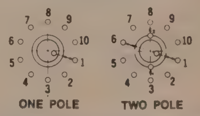

.109 ± .010
.539 ± .020
℄ Of Position No. One
Grayhill
9
10
1
2

REAR VIEW


.300 ± .010 DIA. Circle Of Centers
Common Location For A Single Pole Switch
Common Location For A Two Pole Switch Located On .065 Dia. Circle Of Centers

SERIES 75
PATENT NO.
3,803,370

CIRCUIT DIAGRAM
(Switch is viewed from shaft end and shown in position 1.)


7
8
9
6
10
5
1
4
3
2
ONE POLE
7
8
9
6
10
5
1
4
3
2
TWO POLE

Series	Style	Angle of Throw	Stops	Terminals	Poles Per Deck	Number of Decks		Number of Positions/Pole	Series
						Shorting	Non-Shorting		
75	AF BF CF	36°	FIXED	PRINTED CIRCUIT	1 2	NOT AVAILABLE	1 1	2 thru 10 2 thru 5	75

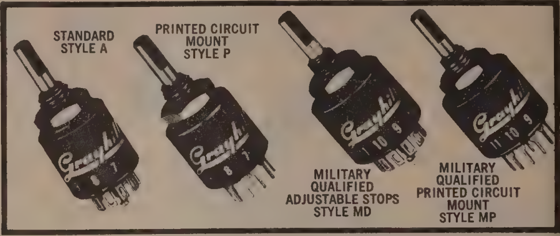
✱ Available locally through your Grayhill distributor

Grayhill

1/2" DIAMETER, SINGLE DECK ROTARY SWITCHES—SERIES 50, 51

OUTSTANDING CIRCUIT VERSATILITY AND A WIDE RANGE OF OPTIONS

AVAILABLE IN STANDARD OR MILITARY STYLES
ADJUSTABLE STOPS PROVIDE IMMEDIATE PROTOTYPES
30,°, 36°, 45°, 60° OR 90° ANGLES OF THROW


STANDARD
STYLE A
PRINTED CIRCUIT
MOUNT
STYLE P
MILITARY
QUALIFIED
ADJUSTABLE STOPS
STYLE MD
MILITARY
QUALIFIED
PRINTED CIRCUIT
MOUNT
STYLE MP

OTHER OPTIONS INCLUDE:

- 1 THRU 4 POLES
- SEALED OR UNSEALED
- SOLDER LUG OR PC TERMINALS
- FIXED OR ADJUSTABLE STOPS

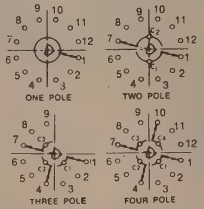
STYLE CHOICES AND DESIGNATIONS

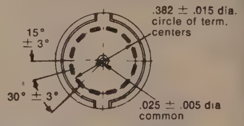
STANDARD = A
STYLE A WITH SHAFT AND PANEL SEAL = S
STYLE A, PC MOUNTABLE = P
STYLE A WITH SHAFT AND PANEL SEAL, PC MOUNTABLE = SP
MILITARY STYLE, UNSEALED = C
STYLE C, PC MOUNTABLE = CP
STYLE C, ADJUSTABLE STOPS = CD
STYLE C, ADJUSTABLE STOPS, PC MOUNTABLE = CDP
MILITARY STYLE WITH SHAFT AND PANEL SEAL = M
STYLE M, PC MOUNTABLE = MP
STYLE M, ADJUSTABLE STOPS = MD
STYLE M, ADJUSTABLE STOPS, PC MOUNTABLE = MDP

CIRCUIT DIAGRAMS

Switches are viewed from shaft end and shown in position 1

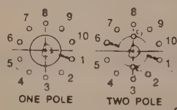
SERIES 51 — 30° ANGLE OF THROW

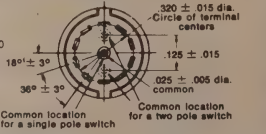

9
10
8
11
7
12
6
1
5
2
4
3
ONE POLE
C2
C1
TWO POLE
C3
C2
C1
THREE POLE
C4
FOUR POLE


.382 ± .015 dia. circle of term. centers
15° ± 3°
30° ± 3°
.025 ± .005 dia common

Common location for a single pole switch. Two pole commons are located as shown in circuit diagram on a .156 ± .015 dia. Circle of centers; four pole commons are located as shown in circuit diagram on a .175 ± .015 dia. circle of centers.

SERIES 50 — 36° ANGLE OF THROW


8
7
9
6
10
5
1
4
2
3
ONE POLE
C1
TWO POLE


.320 ± .015 dia. Circle of terminal centers
.125 ± .015
18° ± 3°
36° ± 3°
.025 ± .005 dia. common
Common location for a single pole switch
Common location for a two pole switch

Series	Style	Angle of Throw	Stops	Terminals	Number of Poles		Number of Positions/Pole	Series
					Shorting	Non-Shorting		
50	A, S, C, M	36°	Fixed	Solder Lug	1 2	1 2	2 thru 10 2 thru 5	50
	P, SP, CP, MP	36°	Fixed	Printed Circuit	1 2	1 2	2 thru 10 2 thru 5	
	CD, MD	36°	Adjustable	Solder Lug	1 —	1 2	2 thru 10 (Adjustable) 2 thru 5 (Adjustable)	
	CDP, MDP	36°	Adjustable	Printed Circuit	1 —	1 2	2 thru 10 (Adjustable) 2 thru 5 (Adjustable)	
51	A, S, C, M	30°	Fixed	Solder Lug	1 2 3 4	1 2 3 4	2 thru 12 2 thru 6 2 or 3 2 or 3	51
	P, SP, CP, MP	30°	Fixed	Printed Circuit	1 2 3 4	1 2 3 4	2 thru 12 2 thru 6 2 or 3 2 or 3	
	CD, MD	30°	Adjustable	Solder Lug	1 — — —	1 2 3 4	2 thru 12 (Adjustable) 2 thru 6 (Adjustable) 2 or 3 (Adjustable) 2 or 3 (Adjustable)	
	CDP, MDP	30°	Adjustable	Printed Circuit	1 — — —	1 2 3 4	2 thru 12 (Adjustable) 2 thru 6 (Adjustable) 2 or 3 (Adjustable) 2 or 3 (Adjustable)	

NOTE! SERIES 50, STYLES C AND M ARE QUALIFIED TO MIL-S-3786/20 AND LISTED ON QPL
SERIES 51, STYLES M, MP, MD AND MDP ARE QUALIFIED TO MIL-S-3786/35 AND LISTED ON QPL

✻ Available locally through your Grayhill distributor

1/2" DIAMETER, SINGLE DECK ROTARY SWITCHES—SERIES 50, 51

Grayhill

STYLE COMBINATIONS

Style	A	S	P	SP	C	CP
FRONT (Shaft End) REAR (Terminal End) Dimension C	Fig. 1 Fig. 5 .617	Fig. 2 Fig. 5 .617	Fig. 1 Fig. 6 .667	Fig. 2 Fig. 6 .667	Fig. 1 Fig. 5 .617	Fig. 1 Fig. 6 .667
Style	**CD**	**CDP**	**M**	**MP**	**MD**	**MDP**
FRONT (Shaft End) REAR (Terminal End) Dimension C	Fig. 3 Fig. 5 .617	Fig. 3 Fig. 6 .667	Fig. 2 Fig. 5 .617	Fig. 2 Fig. 6 .667	Fig. 4 Fig. 5 .617	Fig. 4 Fig. 6 .667
Series	**51**	**50**				
Angle of Throw Angle A Dimension B	30° 105° .562	36° 108° .500				

UNSEALED — FIXED STOPS

FIG. 1

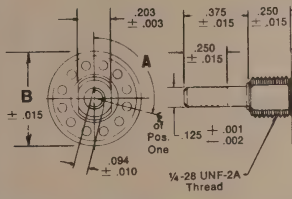
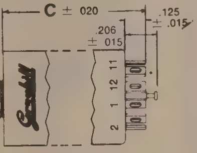
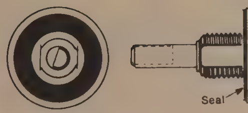


FIG. 5



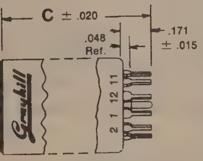
SEALED — FIXED STOPS

FIG. 2



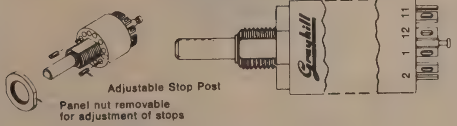
Seal does not alter dimensions when mounted

FIG. 6



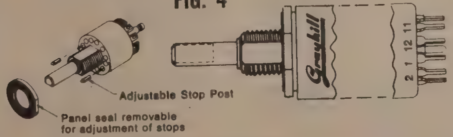
UNSEALED — ADJUSTABLE STOPS

FIG. 3



SEALED — ADJUSTABLE STOPS

FIG. 4



Seal does not alter dimensions when mounted

STANDARD ROTARY SWITCHES

GENERAL RATING:

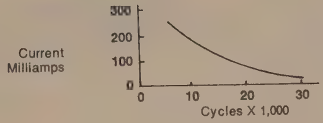


Chart shown for non-shorting contacts (break before make) Voltage: 115 VAC or 30 VDC, resistive load.

One cycle is 360° rotation and a return through all switch positions to the starting position. The data for the above curve was measured at sea level, 25°C. and 68% relative humidity with the following life limiting criteria.

CONTACT RESISTANCE: 50 milliohms maximum. (10 milliohms initially.)

INSULATION RESISTANCE: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

VOLTAGE BREAKDOWN: 600 VAC minimum between mutually insulated parts.

LIFE EXPECTANCY: As determined from the above curve for the current that must be switched.

Contact GRAYHILL for information if the life limiting criteria are more critical than those listed, if the required cycles of operation are greater than those listed, if a larger make and break current is required than the one listed for the desired number of cycles, or if elevated temperatures or reduced pressures are a part of the operating environment.

CONTACT CARRY RATING: Switch will carry 6 amperes continuously with a maximum contact temperature rise of 20°C.

MILITARY STYLE ROTARY SWITCHES

The Series 50 and 51 switches are available in two basic styles, with and without a shaft and panel seal. Adjustable stops and terminals for printed circuit mounting can be added to basic styles. All Series 50 switches except styles including a D or a P are qualified to MIL-S-3786/20. All Series 51 switches except styles including a C are qualified to MIL-S-3786/35. To comply with MIL-S-3786, qualified switches must be ordered with the appropriate markings.

Military Style switches meet the following life limiting criteria.

CONTACT RESISTANCE: 20 milliohms maximum. (8 milliohms initially.)

INSULATION RESISTANCE: 10,000 megohms minimum between mutually-insulated parts. (50,000 megohms initially.)

VOLTAGE BREAKDOWN: 600 VAC minimum between mutually insulated parts.

LIFE EXPECTANCY: As determined from the general rating curve for the current that must be switched.

PRICE: Approx. $3.75 to $10.50 ea. in 100 lots dependent on style and number of poles.

ADDITIONAL STANDARD FEATURES OR OPTIONS

- 45°, 60° or 90° Angles of Throw
- Screwdriver Slotted Shafts
- Coded Versions
- Spring Return (Momentary Positions)
- Push-To-Turn or Pull-To-Turn†
- Keylock (See Description This Section)†
- RFI Grounding†
- Electrostatic or Electromagnetic Shielding†
- Intermix of Shorting and Non-Shorting Contacts†

Complete description in GRAYHILL Engineering Catalog

† Indicates not available through distributors

Grayhill

1 INCH, 1 AMP, SINGLE DECK ROTARY SWITCHES—SERIES 24

SURPRISINGLY LOW PRICES FOR A SWITCH OF THIS QUALITY—36° ANGLE OF THROW, 1 POLE

RATING:

RATED: To make and break the following loads: 1 amp at 115 VAC, resistive; ¼ amp, 115 VAC inductive; 1⁄50 amp, 115 VDC inductive; 1⁄10 amp, 6 to 28 VDC inductive; 1⁄10 amp, 115 VDC resistive; 1 amp, 6 to 28 VDC resistive; to carry 10 amps continuous.

CONTACT RESISTANCE: 10 milliohms initial. After 25,000 cycles of operation 20 milliohms maximum.

INSULATION RESISTANCE: 50,000 megohms.

VOLTAGE BREAKDOWN: 1,000 VAC, (500 VAC, or better after most environmental tests).

LIFE EXPECTANCY: 100,000 mechanical cycles of operation normally.

PRICE: Approx. $1.60 to $2.00 ea. in 100 lots dependent on number of positions, solder lug type. Approx. $2.50 ea. in 100 lots, PC mount type.

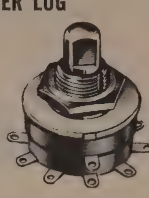
ADDITIONAL STANDARD FEATURES OR OPTIONS

—Stainless Steel Shaft

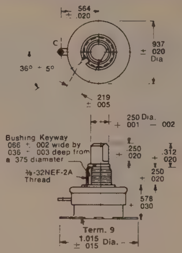
—Special Terminals (Hi Density, Taper Tab, Notched, Shorting Links)

Complete description in GRAYHILL Engineering Catalog.

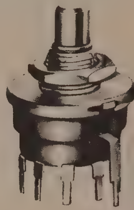
SOLDER LUG



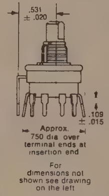
24001 — STEEL SHAFT
24B36 — PLASTIC SHAFT


.564 ± .020
C
36° ± 5°
.937 ± .020 Dia
.219 ± .005
.250 Dia. + .001 — .002
Bushing Keyway .066 ± .002 wide by .036 ± .003 deep from a .375 diameter
⅜-32NEF-2A Thread
.250 ± .020
.312 ± .020
.250 ± .020
.578 ± .030
Term. 9
1.015 ± .015 Dia.

PC MOUNTABLE



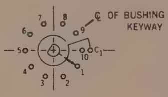
24-878 — STEEL SHAFT
24P36 — PLASTIC SHAFT
(Also Available With Solder Lug Common)


.531 ± .020
.109 ± .015
Approx. .750 dia over terminal ends at insertion end
For dimensions not shown see drawing on the left

CIRCUIT DIAGRAM

(Switch is viewed from shaft end.)

NOTE: All Common Terminals are located above Base Terminals as shown.


℄ OF BUSHING KEYWAY
7
8
9
6
5
10
C1
4
3
2
1

ONE POLE

Grayhill

15 AMP, UL LISTED ROTARY SWITCHES—SERIES 19

30° ANGLE OF THROW
1 POLE, 2 TO 11 POSITIONS
SOLDER LUG OR 'FASTON' TERMINALS

RATING:

Series 19 switches are UL listed at:
15 amps, 120 VAC, non-inductive load.
1 amp, 120 VDC, non-inductive load.
This rating is based on the following criteria:

Overload—50 operations at 125% rated AC load and 150% rated DC load.

Endurance—6000 operations at rated load with 900 VAC dielectric strength before and after test.

Temperature Rise—Not to exceed 30°C when carrying rated AC loatd after endurance test.

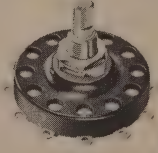
Contacts will carry 20 amps at 115 volts AC with 30°C maximum temperature rise.

CONTACT RESISTANCE: (Measured at 2 VDC and approximately 100 MA) for new switch approximately 10 milliohms.

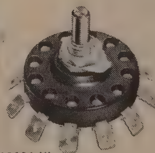
INSULATION RESISTANCE: Approximately 100,000 megohms. Between mutually insulated parts.

VOLTAGE BREAKDOWN: Approximately 2500 VAC. Between mutually insulated parts.

PRICE: Approx: $2.75 to $4.00 ea. in 100 lots, dependent on number of positions.

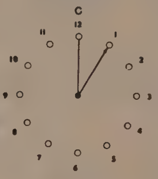


19001-UL

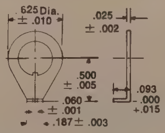


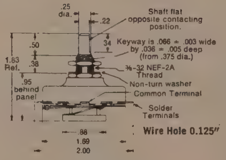
19101-UL

CIRCUIT DIAGRAM

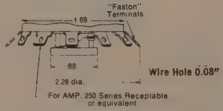

C
12
11
1
10
2
9
3
8
4
7
6
5

NON-TURN WASHER DETAIL


.625 Dia. ± .010
.025 ± .002
.500 ± .005
.060 ± .001
.187 ± .003
.093 -.000 +.015


.25 dia.
.22
Shaft flat opposite contacting position.
.34
Keyway is .066 ± .003 wide by .036 ± .005 deep (from .375 dia.)
.50
1.83 Ref.
.38
⅜-32 NEF-2A Thread
.95 behind panel
Non-turn washer
Common Terminal
Solder Terminals
.88
1.69
2.00
Wire Hole 0.125″

SCREW TERMINAL ADAPTER FOR .250 "FASTON" TERMINALS


"Faston" Terminals
1.69
.88
2.28 dia.
Wire Hole 0.08″
For AMP. 250 Series Receptable or equivalent

Available locally through your Grayhill distributor

1/2" DIAMETER, 1/4 AMP, MULTI-DECK ROTARY SWITCHES—SERIES 71

Grayhill

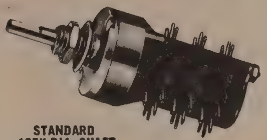
VALUE ENGINEERED TO COMPETE IN PRICE AND OUT PERFORM OPEN-WAFERS ADJUSTABLE STOPS PROVIDE IMMEDIATE PROTOTYPES

VERSATILITY — CHOICE OF

- 30° OR 36° ANGLE OF THROW
- 1 TO 6 POLES, PER DECK
- 1 THRU 12 DECKS
- .125" OR .250" DIA. SHAFT
- PC MOUNTABLE TERMINALS
- SINGLE OR CONCENTRIC SHAFTS

STYLE CHOICES AND DESIGNATIONS

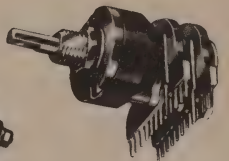
STANDARD WITH .125" DIA. SHAFT = A
STYLE A WITH SHAFT AND PANEL SEALS = AS
STYLE A, PC MOUNTABLE = AF
STYLE A WITH SHAFT AND PANEL SEALS, PC MOUNTABLE = ASF
STYLE A, ADJUSTABLE STOPS = AD
STYLE A, PC MOUNTABLE, ADJUSTABLE STOPS = ADF
STANDARD WITH .250" DIA. SHAFT = B
STYLE B WITH SHAFT AND PANEL SEALS = BS
STYLE B, PC MOUNTABLE = BF
STYLE B WITH SHAFT AND PANEL SEALS, PC MOUNTABLE = BSF
STYLE B, ADJUSTABLE STOPS = BD
STYLE B, PC MOUNTABLE, ADJUSTABLE STOPS = BDF
STANDARD WITH CONCENTRIC SHAFTS = C



STANDARD
.125" DIA. SHAFT
STYLE A

ADJUSTABLE STOPS
STYLE AD

STANDARD
.250" DIA. SHAFT
STYLE B



PC MOUNT
TERMINALS ONE SIDE
STYLE AF

CONCENTRIC SHAFTS
STYLE C

Series	Style	Angle of Throw	Stops	Terminals	Poles Per Deck	Number of Decks Shorting or Non-Shorting	Number of Positions/Pole	Series
71	SINGLE SHAFT SWITCHES							71
	A, AS, B, BS	30°	Fixed	Solder Lug	1 2 3 4 5 6	1 thru 12 1 thru 8 1 thru 5 1 thru 4 1 thru 3 1 or 2	2 thru 12 2 thru 6 2 thru 4 2 thru 3 2 2	
	A, AS, B, BS	36°	Fixed	Solder Lug	1 2	1 thru 12 1 thru 8	2 thru 10 2 thru 5	
	AD, BD	30°	Adjustable	Solder Lug	Same as A and B, 30° Throw above except available 1 thru 4 Poles only			
	AD, BD	36°	Adjustable	Solder Lug	Same as A and B, 36° Throw above			
	AF, BF	30°	Fixed	Printed Circuit Terminals All One Side	1 2	1 thru 12 1 thru 8	2 thru 12 2 thru 6	
	AF, BF	36°	Fixed		1 2	1 thru 12 1 thru 8	2 thru 10 2 thru 5	
	ASF, BSF	30°	Fixed	Same as AF and BF, 30° Throw above				
	ASF, BSF	36°	Fixed	Same as AF and BF, 36° Throw above				
	ADF, BDF	30°	Adjustable	Same as AF and BF, 30° Throw above				
	ADF, BDF	36°	Adjustable	Same as AF and BF, 36° Throw above				
	CONCENTRIC SHAFT SWITCHES				Sections A & B			
	C	30°	Fixed	Solder Lug	1 2 3 4 5 6	1 thru 3 1 thru 3 1 or 2 1 1 1	2 thru 12 2 thru 6 2 thru 4 2 or 3 2 2	
	C	36°	Fixed	Solder Lug	1 2	1 thru 3 1 thru 3	2 thru 10 2 thru 5	

✱ Available locally through your Grayhill distributor

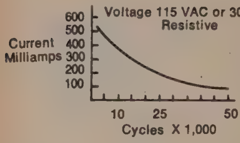
GRAYHILL, INC. • 569 Hillgrove Avenue • LaGrange, Illinois 60525 • (312) 354-1040 • TWX 910-683-1850

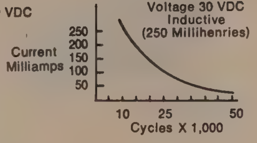
See YELLOW SECTION for Local Sales Offices and Key Personnel

Grayhill

1/2″ DIAMETER, 1/4 AMP, MULTI-DECK ROTARY SWITCHES—SERIES 71

RATING:





Switch rating for break before make contacts.

Curve data based on test data conducted at sea level, 25°C. and 68% relative humidity.

Cycle equals 360° rotation and return.

Cycling rate is 10 cycles per minute.

The curves shown are typical load life curves for a Series 71 Rotary Switch. They show a number of cycles of rotational life that can be expected for the voltages, currents and types of loads shown. Thus, with a 300 milliampere, 115 VAC resistive load, 15,000 cycles of life can be expected. Similarly, if the load were reduced to 200 milliamperes, the life is increased to 25,000 cycles.

Life limiting or failure criteria for these curves are:

CONTACT RESISTANCE: 50 milliohms maximum. (10 milliohms initially.)

INSULATION RESISTANCE: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

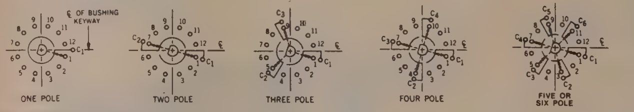
VOLTAGE BREAKDOWN: 500 VAC minimum between mutually insulated parts.

These switches will carry 4 amperes with a maximum contact temperature rise of 20°C. If the life limiting characteristics are less critical than those shown above, if elevated temperatures or reduced pressures are involved, GRAYHILL can predict the switch life for the application.

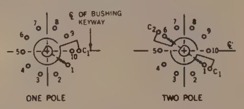
CIRCUIT DIAGRAMS, SOLDER LUG TERMINALS

Switches are viewed from shaft end and shown in position 1.

30° ANGLE OF THROW

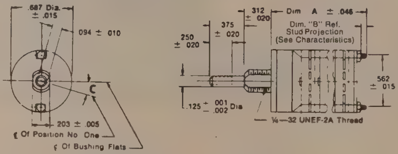

℄ OF BUSHING KEYWAY
ONE POLE
TWO POLE
THREE POLE
FOUR POLE
FIVE OR SIX POLE

36° ANGLE OF THROW


℄ OF BUSHING KEYWAY
ONE POLE
TWO POLE

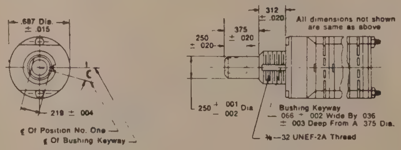
STANDARD WITH .125″ DIA. SHAFT

STYLE A


.687 Dia. ± .015
094 ± 010
C
203 ± .005
℄ Of Position No One
℄ Of Bushing Flats
312 ± 020
Dim A ± .046
375 ± 020
250 ± 020
Dim. "B" Ref. Stud Projection (See Characteristics)
562 ± 015
.125 + 001 − .002 Dia
¼—32 UNEF-2A Thread

STANDARD WITH .250″ DIA. SHAFT

STYLE B


.687 Dia. ± .015
C
219 ± 004
℄ Of Position No. One
℄ Of Bushing Keyway
312 ± .020
All dimensions not shown are same as above
375 ± 020
250 ± 020
250 + 001 − 002 Dia
Bushing Keyway 066 ± 002 Wide By 036 ± 003 Deep From A 375 Dia.
⅜—32 UNEF-2A Thread

STANDARD WITH CONCENTRIC SHAFTS

STYLE C

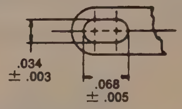
No. of Decks				Approx. Weight Grams
Sec. "A"	Sec. "B"	Dim. "A"	Dim. "B"	
1	1	1.415	.032	24
2	1	1.633	.032	26
3	1	2.131	.312	28
1	2	1.633	.032	26
2	2	2.131	.312	28
3	2	2.349	.312	30
1	3	2.131	.312	28
2	3	2.349	.312	30
3	3	2.567	.312	32

ANGLE C IS 15° IN 12 POSITION SWITCHES AND 36° IN 10 POSITION SWITCHES

Style	Angle of Throw	Angle C
A	30°	15°
A	36°	36°
B	30°	15°
B	36°	36°

No. of Decks	Dim. "A"	Dim. "B"	Approx. Weight Grams
1	.761	.031	14
2	.979	.031	16
3	1.197	.031	18
4	1.415	.031	20
5	1.633	.031	22
6	2.131	.281	24
7	2.349	.281	26
8	2.567	.281	28
9	2.785	.281	30
10	3.003	.281	32
11	3.221	.281	34
12	3.439	.281	36

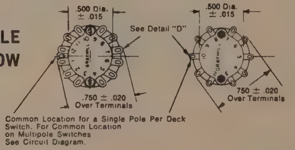
DETAIL "D"

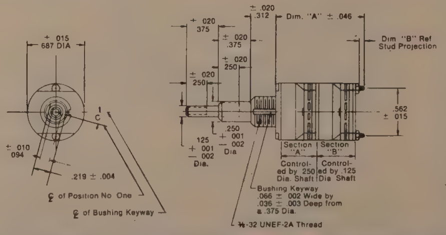

.034 ± .003
.068 ± .005

REAR VIEW

30° ANGLE OF THROW

36° ANGLE OF THROW


.500 Dia. ± .015
See Detail "D"
.500 Dia. ± .015
.750 ± .020 Over Terminals
750 ± .020 Over Terminals
GRAYHILL
Common Location for a Single Pole Per Deck Switch. For Common Location on Multipole Switches See Circuit Diagram.

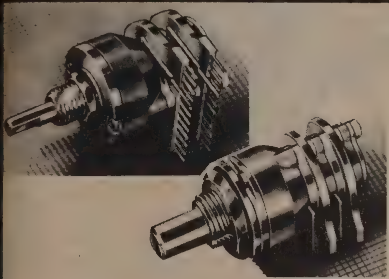

+ 015 687 DIA
C
± 010 094
.219 ± .004
℄ of Position No One
℄ of Bushing Keyway
± .020 .312
Dim. "A" ± .046
+ 020 375
± 020 .375
± 020 250
± 020 250
Dim "B" Ref Stud Projection
.562 ± 015
125 + 001 − 002 Dia.
.250 + 001 − 002 Dia
Section "A"
Section "B"
Controlled by 250 Dia. Shaft
Controlled by .125 Dia Shaft
Bushing Keyway .066 ± 002 Wide by .036 ± .003 Deep from a .375 Dia.
⅜-32 UNEF-2A Thread

Available locally through your Grayhill distributor

1/2" DIAMETER, 1/4 AMP, MULTI-DECK ROTARY SWITCHES—SERIES 71

Grayhill

PC MOUNTABLE, TERMINALS ON ONE SIDE



No. of Decks	Dim. "A"	Dim. "B"	Approx. Weight Grams
1	.761	.031	12
2	.979	.031	14
3	1.197	.031	16
4	1.415	.031	18
5	1.633	.031	20
6	2.131	.281	22
7	2.349	.281	24
8	2.567	.281	26
9	2.785	.281	28
10	3.003	.281	30
11	3.221	.281	32
12	3.439	.281	34

SHAFT AND PANEL SEAL

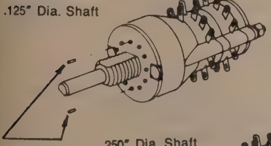
STYLES AS, BS, ASF, BSF

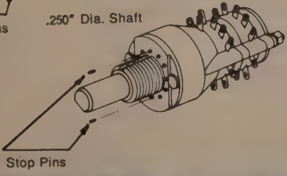
Shaft is sealed by "O" ring inside bushing. Panel is sealed by "O" ring at base of bushing. Seals do not alter dimensions as shown in the drawings when switch is mounted. Panel seal is silicone rubber. Shaft seal is an "O" ring per MIL-P-5516B.

ADJUSTABLE STOPS

STYLES AD, BD, ADF, BDF

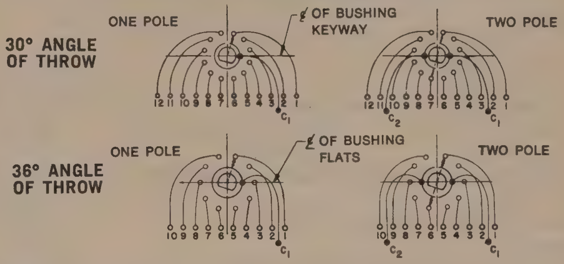
Number of positions per pole can be changed by removing and relocating stop pins in holes in the switch front plate. Available in the single shaft versions with either .125" or .250" diameter; 30° or 36° angle of throw; and solder lug terminals or PC mount on one side styles.


.125" Dia. Shaft
Stop Pins


.250" Dia. Shaft
Stop Pins

CIRCUIT DIAGRAMS

Switches are viewed from shaft end and shown in position 1.


30° ANGLE OF THROW
ONE POLE
℄ OF BUSHING KEYWAY
TWO POLE
12 11 10 9 8 7 6 5 4 3 2 1
C1
C2
36° ANGLE OF THROW
ONE POLE
℄ OF BUSHING FLATS
TWO POLE
10 9 8 7 6 5 4 3 2 1
C1
C2

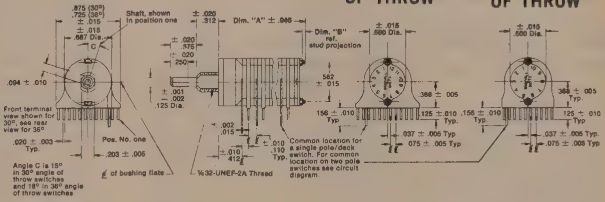
PC MOUNT .125" DIA. SHAFT

REAR VIEWS

STYLE AF

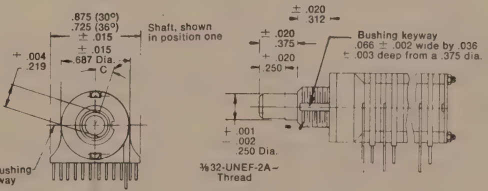
30° ANGLE OF THROW

36° ANGLE OF THROW


.875 (30°) .725 (36°) ± .015
± .015 .687 Dia.
C
Shaft, shown in position one
± .020 .312
Dim. "A" ± .046
± .020 .375
± .020 .250
.094 ± .010
± .001 − .002 .125 Dia.
Dim. "B" ref. stud projection
.562 ± .015
Front terminal view shown for 30°, see rear view for 36°
.020 ± .003 Typ.
Pos. No. one
.203 ± .006
Angle C is 15° in 30° angle of throw switches and 18° in 36° angle of throw switches
℄ of bushing flats
+ .002 .015
± .010 .412
± .010 .110 Typ.
¼-32-UNEF-2A Thread
Common location for a single pole/deck switch. For common location on two pole switches see circuit diagram.
± .015 .500 Dia.
.368 ± .005
.156 ± .010 Typ
.125 ± .010 Typ.
.037 ± .005 Typ
.075 ± .005 Typ
± .015 .500 Dia.
.368 ± .005 Typ.
.156 ± .010 Typ.
.125 ± .010 Typ
.037 ± .005 Typ.
.075 ± .005 Typ

PC MOUNT .250" DIA. SHAFT

STYLE BF


.875 (30°) .725 (36°) ± .015
± .015 .687 Dia.
+ .004 .219
C
Shaft, shown in position one
± .020 .312
± .020 .375
± .020 .250
Bushing keyway .066 ± .002 wide by .036 ± .003 deep from a .375 dia.
+ .001 − .002 .250 Dia.
℄ of bushing keyway
⅜-32-UNEF-2A Thread

(All Dim. And Views Not Shown, Same As Above)

PRICE: Approximately $2.75 ea. in 100 lots, for a 1 deck, 1 pole/deck switch with solder lug termination. In 100 lots, these approximate price adders apply: $1.25 for each additional deck; $0.15 each deck for 2 pole/deck switch; $0.25 each switch for adjustable stops; $0.50 each deck for PC terminals; and $0.50 each switch for shaft and panel seal.

ADDITIONAL STANDARD FEATURES OR OPTIONS

- BCD Coded, Single Deck
- Add-A-Pot or Add-A-Switch Concentric†

Complete description in GRAYHILL Engineering Catalog.

† Indicates not available through distributors

Grayhill

1 INCH, 1 AMP, ROTARY SWITCHES — SERIES 42, 44

OUR MOST POPULAR ROTARY SWITCH FAMILY AVAILABLE IN STANDARD AND MILITARY STYLES SINGLE OR CONCENTRIC SHAFTS AND A WIDE RANGE OF VARIATIONS AND OPTIONS

INCLUDING

- 30°, 36°, 45°, OR 90° ANGLES OF THROW
- 1 THRU 6 POLES/DECK
- 1 THRU 12 DECKS
- NON-SHORTING OR SHORTING CONTACTS
- ADJUSTABLE STOPS
- SHAFT AND PANEL SEALS
- PC MOUNTING
- ADD-A-POTS
- ADJUSTABLE STOPS PROVIDE IMMEDIATE PROTOTYPES

STYLE CHOICES AND DESIGNATIONS

STANDARD = A
STYLE A WITH SHAFT AND PANEL SEAL = S
STYLE A, ADJUSTABLE STOPS = D
MILITARY QUALIFIED (85°C.) = M
MILITARY QUALIFIED (125°C.) = H
MILITARY QUALIFIED (125°C.)
WITH SHAFT AND PANEL SEAL = HS

ELECTRICAL RATING, STYLES A, D AND S

RATED: To make and break the following loads:

	Angle of Throw		
	30° or 36°	45° or 60°	90°
115 VAC resistive	1 amp	5 amps	5 amps
6-28 VDC resistive	1 amp	1 amp	2 amps
115 VAC inductive	0.25 amp	2 amps	2 amps
115 VDC inductive	0.02 amp	—	—
6-28 VDC inductive	0.10 amp	—	—
115 VDC resistive	0.10 amp	—	—

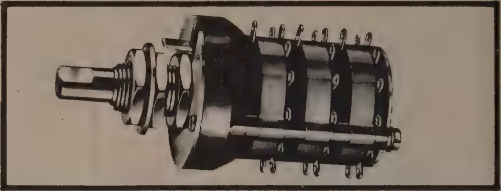
To carry 10 amps continuously.

CONTACT RESISTANCE: After 25,000 cycles of operation 20 milliohms maximum.

INSULATION RESISTANCE: 50,000 megohms minimum (initially).

VOLTAGE BREAKDOWN: 1,000 VAC initially (500 VAC or better after most environmental tests).

LIFE EXPECTANCY: 100,000 mechanical cycles of operation. NOTE: Actual life is determined by a number of facts, including electrical loading, rate of rotation, and environment, as well as maximum contact resistance, minimum insulation resistance, and minimum voltage breakdown required at the end of life.



ELECTRICAL RATING, STYLES M, H AND HS

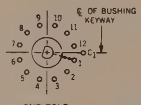
Rated to make and break the loads stated above, as well as meeting all the electrical and environmental requirements of MIL-S-3786/4. Series 42 and 44 Rotary Switches with these style designations are listed on the Qualified Products List.

CIRCUIT DIAGRAMS

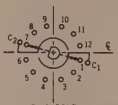
(Switch is viewed from Shaft End and shown in Position No. 1)
NOTE: All Common Terminals are Located Above Base Terminals as Shown.

SERIES 44 & 54 30° ANGLE OF THROW

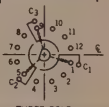
STYLES A, D & S



ONE POLE

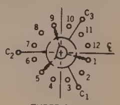


TWO POLE

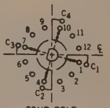


THREE POLE

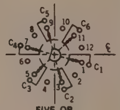
STYLES M, H, HS



THREE POLE

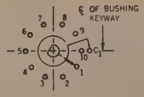


FOUR POLE

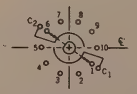


FIVE OR SIX POLE

SERIES 42 & 43 36° ANGLE OF THROW



ONE POLE



TWO POLE

Series	Style	Angle of Throw	Stops	Terminals	Poles Per Deck	Number of Decks		Number of Positions/Pole	Series
						Shorting	Non-Shorting		
	SINGLE SHAFT SWITCHES								
42	A, S, M, H, HS	36°	Fixed	Solder Lug	1 2	1 thru 12 1 thru 12	1 thru 12 1 thru 12	2 thru 10 2 thru 5	42
	D	36°	Adjustable	Solder Lug	1 2	1 thru 12 1 thru 12	1 thru 12 1 thru 12	2 thru 10 (Adjustable) 2 thru 5 (Adjustable)	
44	A, S, M, H, HS	30°	Fixed	Solder Lug	1 2 3 4 5 6	1 thru 12 1 thru 12 1 thru 8 1 thru 6 1 thru 4 1 thru 4	1 thru 12 1 thru 12 1 thru 8 1 thru 6 1 thru 4 1 thru 4	2 thru12 2 thru 6 2 thru 4 2 or 3 2 2	44
	D	30°	Adjustable	Solder Lug	1 2 3 4	1 thru 12 1 thru 12 1 thru 8 1 thru 6	1 thru 12 1 thru 12 1 thru 8 1 thru 6	2 thru 12 (Adjustable) 2 thru 6 (Adjustable) 2 thru 4 (Adjustable) 2 or 3 (Adjustable)	

✱ Available locally through your Grayhill distributor

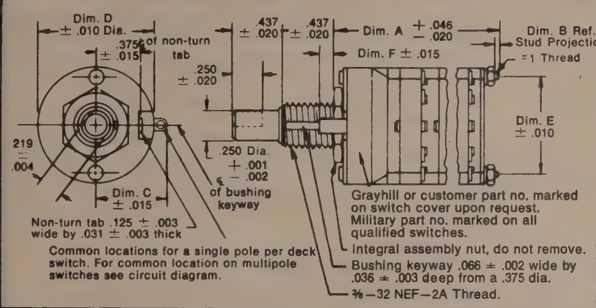
1 INCH, 1 AMP, ROTARY SWITCHES— SERIES 42, 44

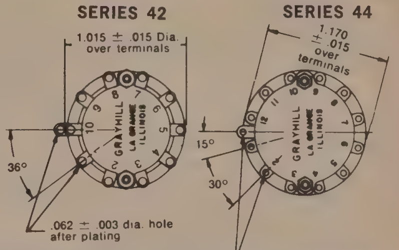
Grayhill

SINGLE SHAFT STYLES A, M AND H

Military styles (style M [85°C.], style H and HS [125°C]), are qualified to MIL-S-3786/4-1. Patent No. 3,297,836.

No. of Decks	Dim. A	B Dim.	42	44	No. of Decks	Dim. A	Dim. B	42	44
			Approx. Weight Grams					Approx. Weight Grams	
1	1.025	.062	40.0	48	7	3.351	.312	73.0	90
2	1.371	.062	45.5	55	8	3.697	.312	78.5	97
3	1.717	.062	51.0	62	9	4.043	.312	84.0	104
4	2.063	.062	56.5	69	10	4.389	.312	89.5	111
5	2.409	.062	62.0	76	11	4.735	.312	95.0	118
6	3.005	.312	67.5	83	12	5.081	.312	100.5	125

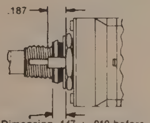

Dim. D ± .010 Dia.
.375 ± .015 ℄ of non-turn tab
.437 ± .020
.437 ± .020
Dim. A + .046 − .020
Dim. B Ref. Stud Projection
=1 Thread
Dim. F ± .015
.250 ± .020
219 ± .004
.250 Dia. + .001 − .002
℄ of bushing keyway
Dim. E ± .010
Dim. C ± .015
Non-turn tab .125 ± .003 wide by .031 ± .003 thick
Common locations for a single pole per deck switch. For common location on multipole switches see circuit diagram.
Grayhill or customer part no. marked on switch cover upon request. Military part no. marked on all qualified switches.
Integral assembly nut, do not remove.
Bushing keyway .066 ± .002 wide by .036 ± .003 deep from a .375 dia.
⅜—32 NEF—2A Thread.


SERIES 42
1.015 ± .015 Dia. over terminals
GRAYHILL LA GRANGE ILLINOIS
36°
.062 ± .003 dia. hole after plating
SERIES 44
1.170 ± .015 over terminals
15°
30°
.062 ± .003 dia. hole after plating

Dimension	C	D	E	F
SERIES 42	.562	1.000	.830	.093
SERIES 44	.642	1.162	1.000	.121

SHAFT AND PANEL SEAL — STYLE S

A shaft and panel seal is available to provide watertight mounting of the Series 42 and 44 rotary switches. Sealing is accomplished by "O" ring shaft seal and GRAYHILL's unique panel seal method. Panel seal dimensional differences are shown in the accompanying drawing.



Dimension .147 ± .010 before compression of seal and .093 minimum compressed.

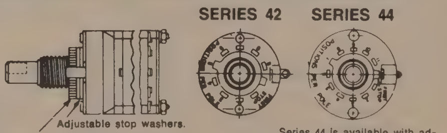
SHAFT AND PANEL SEAL — STYLE HS

Panel is sealed by "O" ring at base of bushing. Shaft is sealed by "O" ring inside bushing. Seals do not alter dimensions shown when switch is mounted. Sealed military qualified switches do not have a non-turn tab. A flat cover plate is supplied with the switch.

A separate non-turn washer is supplied with mounting hardware. Tab projection of this washer is .187" located on a .375" radius from of centerline switch. Non-turn washer must be mounted from front of panel to preserve seal. Panel seal is silicone rubber. Shaft seal is "O" ring per MIL-P-5516B.

ADJUSTABLE STOPS — STYLE D

Adjustable stop switches permit the user to externally set the switch stops which limit its rotation. Adjustment is accomplished by removing the stop washers and relocating them. The knurled nut or the panel can be used to hold-in the stop washers. All other dimensions are the same as the standard style.


SERIES 42
SERIES 44
Adjustable stop washers.

Use of knurled nut is optional.

Series 44 is available with adjustable stops in 30° angle of throw only.

PRICE: Approx. $5.00 ea. in 100 lots, for a 1 deck, 1 pole/deck, 10 position standard switch with fixed or adjustable stops. In 100 lots, these approximate price adders apply $1.30 for each additional deck; $0.50 per pole/deck for multipole switches; and $1.50 each switch for shaft and panel seal.

ADDITIONAL STANDARD FEATURES OR OPTIONS

—45°, 60° or 90° Angles of Throw (Standard or Military Style)
—Concentric Shaft Switches (Standard or Military Style)
—Add-A-Pot Switches (Standard or Military Styles)
—PC Mountable
—Deck Sections and Detent Assemblies
—Keylock (See Description This Section)†
—Push-To-Turn or Pull-To-Turn†
—Spring Return (Momentary Positions)
—Coded Versions
—RFI Grounding†
—Electrostatic or Electromagnetic Shielding†
—Intermix of Shorting and Non-Shorting Contacts†
—Homing Rotor or Progressively Shorting Decks†
—Unidirectional Rotation†
—Special Terminals (Hi Density, Taper Tab, Notched, Shorting Links)†

† Indicates not available through distributors

Complete Description in GRAYHILL Engineering Catalog

✻ Available locally through your Grayhill distributor

GRAYHILL, INC. • 569 Hillgrove Avenue • LaGrange, Illinois 60525 • (312) 354-1040 • TWX 910-683-1850

Grayhill

16, 20 AND 24 POSITION ROTARY SWITCHES — SERIES 53, 57, 59

MAKE AND BREAK MORE CIRCUITS IN LESS SPACE THAN OTHER SWITCHES

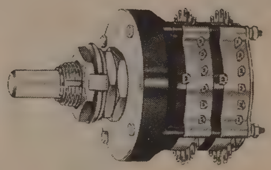
LOGIC LEVEL TO ½ AMP SWITCHING CAPABILITY

STYLE CHOICES AND DESIGNATIONS

MILITARY STYLE = M

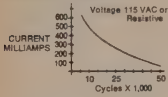
MILITARY QUALIFIED (125°C.)
WITH SHAFT AND PANEL SEALS = HS

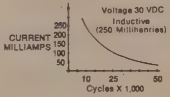
24 POSITION
SERIES 53
STYLE M



Patent No.
3,668,338

GENERAL RATING:





ELECTRICAL RATING, STYLE M

Switch rating for break before make contacts.

Curve data based on test data conducted at sea level, 25°C. and 68% relative humidity.

Cycle equals 360° rotation and return.

Cycling rate is 10 cycles per minute.

The curves shown are typical load life curves for a Series 53M, 57M and 59M Rotary Switch. They show the number of cycles of rotational life that can be expected for the voltages, currents and types of loads shown. Thus, with a 500 milliampere, 115 VAC resistive load, 10,000 cycles of life can be expected. Similarly, if the load were reduced to 200 milliamperes, the life is increased to 30,000 cycles.

Life limiting or failure criteria for these curves are:

CONTACT RESISTANCE: 50 milliohms maximum (15 milliohms initially).

INSULATION RESISTANCE: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

VOLTAGE BREAKDOWN: 500 VAC minimum between mutually insulated parts.

These switches will carry 4 amperes with a maximum contact temperature rise of 20°C. If the life limiting characteristics are less critical than those shown above, or if elevated temperatures or reduced pressures are involved, GRAYHILL can predict the switch life for the application.

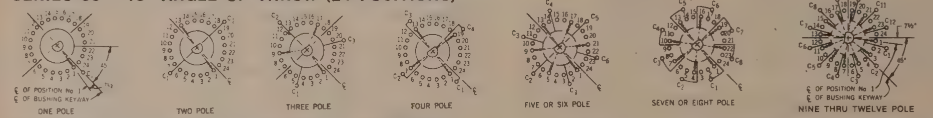
ELECTRICAL RATING, STYLE HS

Rated to make and break the loads stated above, as well as meeting all the electrical and environmental requirements of MIL-S-3786/36. Series 53, 57 or 59, Style HS Rotary Switches are listed on the Qualified Products List with limitations in the number of decks and poles per deck.

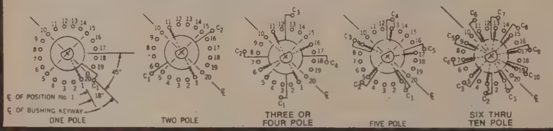
CIRCUIT DIAGRAMS

(Switch is viewed from shaft end and shown in position number one)
All Common Terminals Are Located Above Base Terminals As Shown.

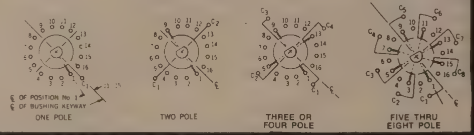
SERIES 53 — 15° ANGLE OF THROW (24 POSITIONS)


℄ OF POSITION No 1
℄ OF BUSHING KEYWAY
7½°
45°
ONE POLE
TWO POLE
THREE POLE
FOUR POLE
FIVE OR SIX POLE
SEVEN OR EIGHT POLE
NINE THRU TWELVE POLE

SERIES 59 — 18° ANGLE OF THROW (20 POSITIONS)


℄ OF POSITION No. 1
℄ OF BUSHING KEYWAY
18°
45°
ONE POLE
TWO POLE
THREE OR FOUR POLE
FIVE POLE
SIX THRU TEN POLE

SERIES 57 — 22½° ANGLE OF THROW (16 POSITIONS)


℄ OF POSITION No 1
℄ OF BUSHING KEYWAY
ONE POLE
TWO POLE
THREE OR FOUR POLE
FIVE THRU EIGHT POLE

Series	Style	Angle of Throw	Stops	Terminals	Poles Per Deck	Number of Decks		Number of Positions/Pole	Series
						Shorting	Non-Shorting		
53	M, HS	15°	Fixed	Solder Lug	1	1 thru 12	1 thru 12	2 thru 24	53
					2	1 thru 12	1 thru 12	2 thru 12	
					3	1 thru 8	1 thru 8	2 thru 8	
					4	1 thru 6	1 thru 6	2 thru 6	
					5 or 6	1 thru 4	1 thru 4	2 thru 4	
					7 or 8	1 thru 3	1 thru 3	2 or 3	
					9, 10, 11 or 12	1 or 2	1 or 2	2	
57	M, HS	22½°	Fixed	Solder Lug	1	1 thru 12	1 thru 12	2 thru 16	57
					2	1 thru 12	1 thru 12	2 thru 8	
					3 or 4	1 thru 6	1 thru 6	2 thru 4	
					5, 6, 7 or 8	1 thru 3	1 thru 3	2	
59	M, HS	18°	Fixed	Solder Lug	1	1 thru 12	1 thru 12	2 thru 20	59
					2	1 thru 12	1 thru 12	2 thru 10	
					3 or 4	1 thru 6	1 thru 6	2 thru 5	
					5	1 thru 4	1 thru 4	2 thru 4	
					6, 7, 8, 9 or 10	1 or 2	1 or 2	2	

* Available locally through your Grayhill distributor

16, 20 AND 24 POSITION ROTARY SWITCHES— SERIES 53, 57, 59

Grayhill

SHAFT AND PANEL SEAL—STYLE HS

In the Style HS switches the panel is sealed by "O" ring at the base of the bushing. Shaft is sealed by "O" ring inside bushing. Seals do not alter dimensions as shown in the line drawings when switch is mounted. A separate non-turn washer is supplied with mounting hardware. See Detail D for Style HS on the drawing page. Non-turn washer must be mounted from front of panel to preserve seal. Panel seal is silicone rubber. Shaft seal is "O" ring per MIL-M-5516B.

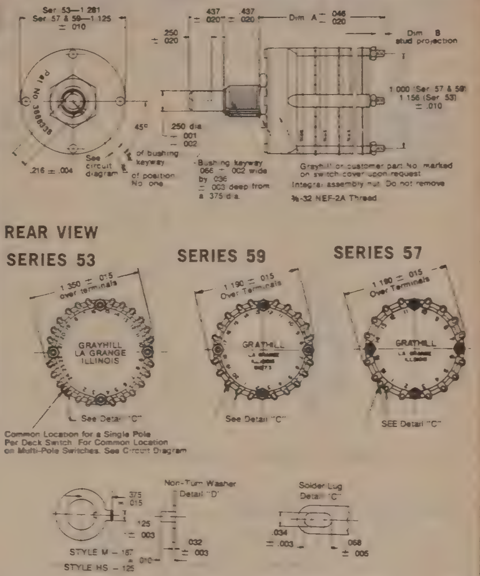
PRICE: Approx. $9.00 ea. in 100 lots, for a 1 deck, 1 pole/deck, 24 position switch. In 100 lots the following price adders apply: $3.75 for each additional deck; $0.60 per pole/deck for multiple switches; and $0.50 each switch for shaft and panel seal.

ADDITIONAL STANDARD FEATURES OR OPTIONS

- —Intermix of Shorting and Non-Shorting Contacts†
- —RFI Grounding†

Complete Description in GRAYHILL Engineering Catalog.

† Indicates not available through distributors



Ser 53—1 281
Ser 57 & 59—1 125
± 010
437 ± 020
.437 ± 020
Dim A + 046 − 020
250 ± 020
Dim B stud projection
1 000 (Ser 57 & 59)
1 156 (Ser 53)
± .010
Pat No 3668338
45°
250 dia − 001 − 002
See circuit diagram
of bushing keyway
of position No one
.216 ± .004
Bushing keyway 066 ± 002 wide by 036 ± 003 deep from a 375 dia
Grayhill or customer part No marked on switch cover upon request
Integral assembly nut Do not remove
⅜-32 NEF-2A Thread
REAR VIEW
SERIES 53
SERIES 59
SERIES 57
1 350 ± 015 over terminals
1 190 ± 015 Over Terminals
1 190 ± 015 Over Terminals
GRAYHILL LA GRANGE ILLINOIS
See Detail "C"
See Detail "C"
SEE Detail "C"
Common Location for a Single Pole Per Deck Switch. For Common Location on Multi-Pole Switches. See Circuit Diagram
Non-Turn Washer Detail "D"
375 ± 015
125 ± 003
032 ± 003
STYLE M – 187 ± 010
STYLE HS – 125
Solder Lug Detail "C"
.034 ± .003
068 ± 005

No. of Decks	Dim. A	Dim. B	Approx. Weight Grams	No. of Decks	Dim. A	Dim. B	Approx. Weight Grams
1	.916	.032	50	7	3.164	.281	110
2	1.249	.032	60	8	3.497	.281	120
3	1.582	.032	70	9	3.820	.281	130
4	1.925	.032	80	10	4.163	.281	140
5	2.248	.032	90	11	4.496	.281	150
6	2.831	.281	100	12	4.829	.281	160

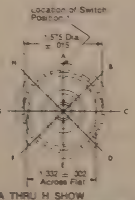
KEYLOCK OPERATED

Grayhill

KEYLOCK SECURITY FOR MULTI-CIRCUIT APPLICATIONS, 1 TO 12 DECKS, 1 TO 4 POLES PER DECK, CHOICE OF 1 AMP RATED OR 300 MA RATED CONTACT SYSTEMS CHOICE OF 30°, 36°, 45°, 60° OR 90° ANGLES OF THROW, PC MOUNT TERMINALS AVAILABLE IN SINGLE DECK STYLE, SEVERAL KEY REMOVAL LOCATIONS AVAILABLE, LOCKS CAN BE KEYED ALIKE OR INDIVIDUALLY

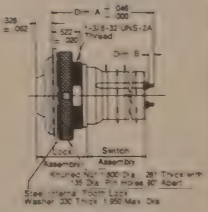
MULTI-DECK SOLDER LUG

No. of Decks	Dim. A	Dim. B	Approx. Weight Grams
1	1.556	.062	123
2	1.802	.062	130
3	2.148	.062	137
4	2.494	.062	144
5	2.840	.062	151
6	3.436	.312	158

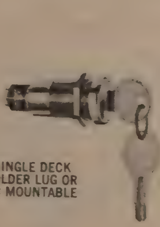


Location of Switch Position 1
1 575 Dia ± 015
A
B
C
D
E
F
G
H
1 332 ± 002 Across Flat

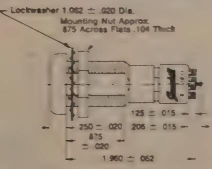
A THRU H SHOW KEY REMOVAL POSITIONS



Dim A + 046 − 000
328 ± 062
522 ± 020
1-3/8-32 UNS-2A Thread
Dim B
Lock Assembly
Switch Assembly
Knurled Nut 1 800 Dia .281 Thick with .135 Dia. Pin Holes 90° Apart
Steel Internal Tooth Lock Washer 030 Thick 1 950 Max Dia

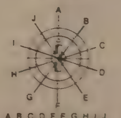


SINGLE DECK SOLDER LUG OR PC MOUNTABLE



Lockwasher 1.062 ± .020 Dia.
Mounting Nut Approx. 875 Across Flats .104 Thick
125 ± 015
250 ± 020
206 ± 015
875 ± 020
1 960 ± 062

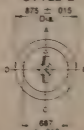
STYLE LL



A
B
C
D
E
F
G
H
I
J

A, B, C, D, E, F, G, H, I, J show key removal positions

STYLE L



875 ± 015 Dia.
A
B
C
D
687 ± 010 Across Flats

SEE SERIES 44 AND SERIES 50 FOR ELECTRICAL INFORMATION—SPRING RETURN VERSIONS AVAILABLE.

CONTACT GRAYHILL FOR ORDERING INFORMATION & PRICE.

✱ Available locally through your Grayhill distributor

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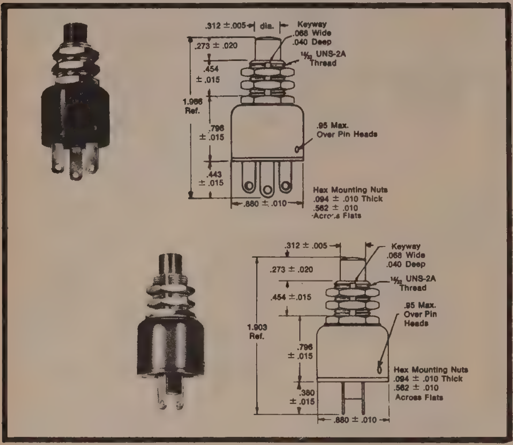
SNAP ACTION AND WIPING CONTACT PUSHBUTTON SWITCHES

Grayhill®

10 AMP SNAP ACTION — SERIES 2000


.312 ±.005 dia.
Keyway .068 Wide .040 Deep
15/32 UNS-2A Thread
.273 ± .020
.454 ± .015
1.966 Ref.
.796 ± .015
.95 Max. Over Pin Heads
.443 ± .015
.880 ± .010
Hex Mounting Nuts .094 ± .010 Thick .562 ± .010 Across Flats
.312 ± .005
Keyway .068 Wide .040 Deep
15/32 UNS-2A Thread
.273 ± .020
.454 ±.015
.95 Max. Over Pin Heads
1.903 Ref.
.796 ± .015
Hex Mounting Nuts .094 ± .010 Thick .562 ± .010 Across Flats
.380 ± .015
.880 ± .010

MOMENTARY CONTACT
EXTREMELY FAST MAKE AND BREAK AUDIBLE CLICK

LIFE EXPECTANCY: 25,000 operations.
RATING CRITERIA: Make and break 10 amps, 115 VAC, Resistive load.
CONTACT RESISTANCE: 25 milliohms maximum on a new switch.
VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.
INSULATION RESISTANCE: 1,000 megohms minimum.

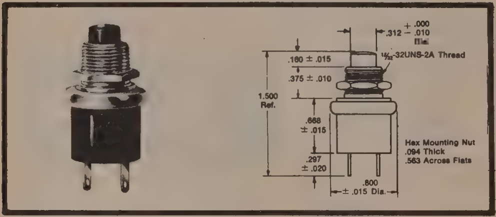
OPERATING FEATURES:

CIRCUITRY: SPST and SPDT, momentary contact
TOTAL BUTTON TRAVEL: .065″ approximately.
OVERTRAVEL: .008 approximately.
ACTUATING FORCE: 36 ounces approximately.
MOUNTING HOLE: 31/64″.
TERMINAL TYPE: Solder also available with faston terminals.

Part No.	Circuitry	Button Color	Part No.	Circuitry	Button Color
2201	SPST-N.O.	Red	7-8	SPST-N.C.	Red
7-7	SPST-N.O.	Black	7-26R	SPDT	Red
2202	SPST-N.C.	Black	7-26B	SPDT	Black

PRICE: Approx. $2.40 to $3.35 ea. in 100 lots, dependent on circuitry.

1 AMP WIPING CONTACT — UL LISTED AT 3 AMPS — SERIES 4000


.312 + .000 − .010 Dia.
15/32-32UNS-2A Thread
.160 ± .015
.375 ± .010
1.500 Ref.
.668 ± .015
.297 ± .020
Hex Mounting Nut .094 Thick .563 Across Flats
.800 ± .015 Dia.

OPERATING FEATURES:

TOTAL BUTTON TRAVEL: .140″ ±.032 (4001, 10-9).
.110″ +.020 −.010 (4002, 10-10).
OVERTRAVEL: .020″ minimum (4001, 10-9).
PRETRAVEL: .010″ minimum (4002, 10-10).
ACTUATING FORCE: 22 ounces ±8 (4001, 4002, 10-9, 10-10).
MOUNTING HOLE: 31/64″.
TERMINAL TYPE: Solder.
RATING CRITERIA: 1 amp, 115 VAC, resistive.
CONTACT RESISTANCE: Less than 25 milliohms on new switch.
VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.
INSULATION RESISTANCE: 1,000 megohms minimum.

Action	Part No.	Button Color	Circuitry	Rating At 115 VAC Resistive	Operations At Rated Load
Momentary	4001 10-9	Red Black	SPST-N.O.	1 Amp	100,000
Momentary	4002 10-10	Black Red	SPST-N.C.	1 Amp	100,000
UNDERWRITERS LABORATORY LISTED					
Momentary	4001 10-9 UL	Red Black	SPST-N.O.	3 Amp	6,000
Momentary	4002 UL 10-10 UL	Black Red	SPST-N.C.	3 Amp	6,000

PRICE: Approx. $0.90 ea. in 100 pc. lots.
Positive feel versions also available.

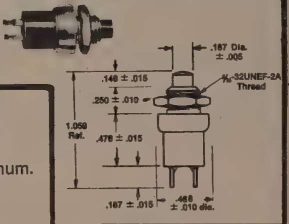
¼ AMP WIPING CONTACT — SERIES 23
½ AMP WIPING CONTACT — SERIES 35

MOMENTARY CONTACT

LIFE EXPECTANCY: 100,000 operations
RATING CRITERIA: Make and break listed current, 115 VAC, resistive load.
CONTACT RESISTANCE: 25 milliohms maximum on a new switch.
VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.
INSULATION RESISTANCE: 1,000 megohms minimum.

SPST — N.O., ¼ AMP

PART NO. 23-1, RED BUTTON
PART NO. 23-4, BLACK BUTTON

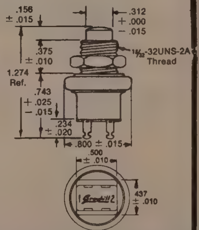

.167 Dia. ± .005
5/16-32UNEF-2A Thread
.146 ± .015
.250 ± .010
1.059 Ref.
.476 ± .015
.167 ± .015
.468 ± .010 dia.

OPERATING FEATURES:

TOTAL BUTTON TRAVEL: .095″ ±.010.
OVERTRAVEL: .005 minimum.
ACTUATING FORCE: 16 ounces ±4.
MOUNTING HOLE: 21/64″.
TERMINAL TYPE: Solder.
PRICE: Approx. $1.00 ea. in 100 pc. lots.

DPST — N.O., ½ AMP

PART NO. 35-1,
RED BUTTON
PART NO. 35-3,
BLACK BUTTON


.156 ± .015
.312 + .000 − .015
15/32-32UNS-2A Thread
.375 ± .010
1.274 Ref.
.743 + .025 − .015
.234 ± .020
.800 ± .015
.500 ± .010
437 ± .010
1 Grayhill 2

OPERATING FEATURES:

TOTAL BUTTON TRAVEL: .062 ±.015.
OVERTRAVEL: .005 minimum.
ACTUATING FORCE: 20 ounces ±8.
MOUNTING HOLE: 31/64″.
TERMINAL TYPE: Solder.
PRICE: Approx. $1.25 ea. in 100 pc. lots.

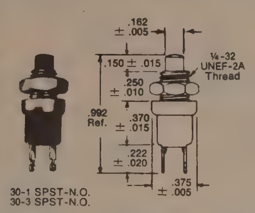
✻ Available locally through your Grayhill distributor

Grayhill

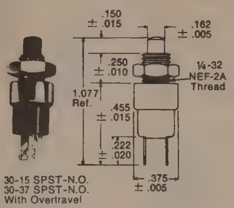
MINIATURE BUTT CONTACT PUSHBUTTON SWITCHES

1 AMP BUTT CONTACT — UL LISTED AT 5 AMPS — SERIES 30

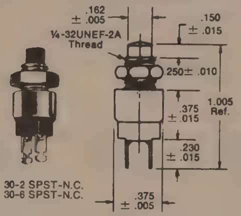
1 MILLION OPERATIONS — WIDE RANGE OF CIRCUITRY AND OPTIONS


.162
± .005
.150 ± .015
¼-32
UNEF-2A
Thread
.250
± .010
.992
Ref.
.370
± .015
.222
± .020
.375
± .005

30-1 SPST-N.O.
30-3 SPST-N.O.


.150
± .015
.162
± .005
.250
± .010
¼-32
NEF-2A
Thread
1.077
Ref.
.455
± .015
.222
± .020
.375
± .005

30-15 SPST-N.O.
30-37 SPST-N.O.
With Overtravel


.162
± .005
.150
± .015
¼-32UNEF-2A
Thread
.250± .010
.375
± .015
1.005
Ref.
.230
± .015
.375
± .005

30-2 SPST-N.C.
30-6 SPST-N.C.

Action	Circuitry	Part No.	Button Color	Rating 115 VAC Resistive	Operations At Rated Load	Total Travel	Actuating Force (oz.)	Mtg. Hole
Momentary	SPST-N.O.	30-1 30-3	Red Black	1 Amp	1,000,000	.062″ ±.010″	10 ±4	17/64
Momentary	SPST-N.C.	30-2 30-6	Black Red	1 Amp	1,000,000	+.010″ .065″ −.015″	8 ±4	17/64
Momentary .020″ Overtravel	SPST-N.O.	30-15 30-37	Red Black	1 Amp	500,000	+.020″ .125″ −.010″	8 ±4	17/64
UNDERWRITERS LABORATORY LISTED								
Momentary	SPST-N.O.	30-1 UL 30-3 UL	Red Black	5 Amp	6,000	.062″ ±.010″	10 ±4	17/64
Momentary	SPST-N.C.	30-2 UL 30-6 UL	Black Red	5 Amp	6,000	+.010″ .065″ −.015″	8 ±4	17/64

Positive Feel, Push-Pull, Watertight Seal Versions Also Available

PRICE: Approx. $0.75 to $0.90 ea. in 100 pc. lots dependent on type required

RATING CRITERIA: 1 amp, 115 VAC, resistive load.

CONTACT RESISTANCE: 25 milliohms maximum on a new switch.

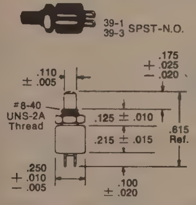
VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

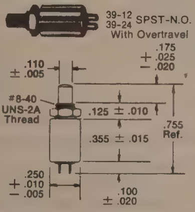
INSULATION RESISTANCE: 1,000 megohms minimum.

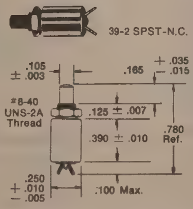
MINIATURE BUTT CONTACT — SERIES 39

ABSOLUTE MINIMUM OF SPACE REQUIRED — CHOICE OF CIRCUITRY AND STYLES MOLDED-IN TERMINALS IN SPST-N.O.

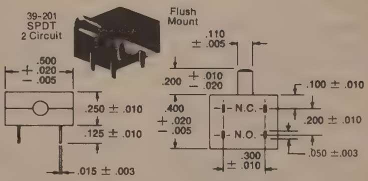
STANDARD FRONT PANEL MOUNTING


39-1
39-3 SPST-N.O.
.110
± .005
.175
+ .025
− .020
#8-40
UNS-2A
Thread
.125 ± .010
.215 ± .015
.615
Ref.
.250
+ .010
− .005
.100
± .020


39-12
39-24 SPST-N.O.
With Overtravel
.110
± .005
.175
+ .025
− .020
#8-40
UNS-2A
Thread
.125 ± .010
.355 ± .015
.755
Ref.
.250
+ .010
− .005
.100
± .020


39-2 SPST-N.C.
.105
± .003
.165
+ .035
− .015
#8-40
UNS-2A
Thread
.125 ± .007
.390 ± .010
.780
Ref.
.250
+ .010
− .005
.100 Max.

PC MOUNTING


39-201
SPDT
2 Circuit
Flush
Mount
.110
± .005
.500
+ .020
− .005
.200
+ .010
− .020
.100 ± .010
.250 ± .010
.125 ± .010
.400
+ .020
− .005
N.C.
N.O.
.200 ± .010
.300
± .010
.050 ± .003
.015 ± .003

Style	Part No.	Button Color	Circuitry	Rating At 115 VAC Resistive	Operations At Rated Load	Total Travel	Actuating Force
Standard Front Panel Mounting	39-1, 39-3	Red Black	SPST-N.O.	½ Amp	1,000,000	.035″ ±.015″	+4 4 oz. −2
	39-2	Black	SPST-N.C.	¼ Amp	250,000	.042″ ±.010″	4 oz. ±2
	39-12, 39-24	Red Black	SPST-N.O. .015″ Overtravel	½ Amp	100,000	.130″ ±.025″	5 oz. ±3
PC Mount	39-201Red 39-201Blk	Red Black	SPDT 2 Circuit	¼ Amp	250,000	+.010″ .050″ −.015″	7 oz. ±3

Limit Switch Version, PC Mount With Standoffs Also Available

PRICE: Approx. $0.95 to $1.70 ea. in 100 pc. lots dependent on type required

RATING CRITERIA —

CONTACT RESISTANCE: 25 milliohms maximum on a new switch.

VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

Available locally through your Grayhill distributor

GRAYHILL, INC. • 569 Hillgrove Avenue • LaGrange, Illinois 60525 • (312) 354-1040 • TWX 910-683-1850

MULTI-CIRCUIT WIPING CONTACT PUSHBUTTON SWITCHES—SERIES 46

Grayhill

¼ AMP WIPING ACTION

LONG WIPE ASSURES HIGH RELIABILITY
SPDT OR DPDT, MOMENTARY OR ALTERNATE ACTION

RATING CRITERIA: Make and break ¼ Amps, 115 VAC, resistive load.;

CONTACT RESISTANCE: 25 milliohms maximum on a new switch.

VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

LIFE EXPECTANCY: 250,000 operations

Action	Part No.‡	Circuitry*	Total Travel	Actuating Force
Momentary	46-101	SPDT(BBM)	.180 min.	17 ±5
	46-110	SPDT(MBB)	.180 min.	17 ±5
	46-102	SPDT(BBM)	.180 min.	17 ±5
	46-111	SPDT(MBB)	.180 min.	17 ±5
	46-200	DPDT(BBM)	.180 min.	35 ±9
	46-201	DPDT(MBB)	.180 min.	35 ±9
Alternate Action	46-502	SPDT(BBM)	.210 ±.015	24 ±8
	46-402	DPDT(BBM)	.210 ±.015	30 ±8

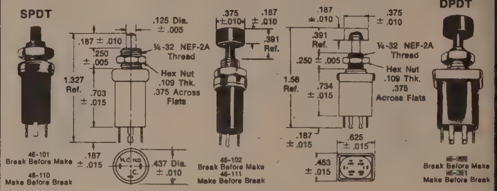
* BBM indicates Break Before Make (Non-Shorting)
MBB indicates Make Before Break (Shorting)

‡ Add Red or Blk for button or cap color.

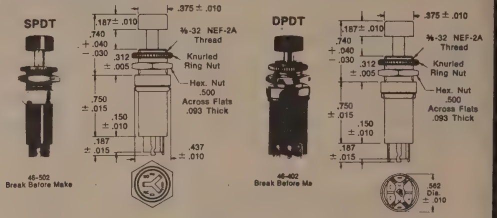
Watertight seal or environmental seal also available.

PRICE: Approx. $2.10 to $3.45 ea. in 100 pc. lots dependent on type required.

MOMENTARY


SPDT
.125 Dia.
± .005
.187 ± .010
.250
± .005
¼-32 NEF-2A
Thread
Hex Nut
.109 Thk.
.375 Across
Flats
1.327
Ref.
.703
± .015
.187
± .015
N.C. N.O.
C.
.437 Dia.
± .010
46-101
Break Before Make
46-110
Make Before Break
.375
±.010
.187
± .010
.391
Ref.
46-102
Break Before Make
46-111
Make Before Break
DPDT
.187
±.010
.375
± .010
.391
Ref.
¼-32 NEF-2A
Thread
.250 ± .005
Hex Nut
.109 Thk.
.375
Across Flats
1.56
Ref.
.734
± .015
.187
± .015
.625
± .015
.453
± .015
Break Before Make
Make Before Break

ALTERNATE ACTION (PUSH ON — PUSH OFF)


SPDT
.375 ± .010
.187± .010
.740
+ .040
− .030
⅜-32 NEF-2A
Thread
.312
± .005
Knurled
Ring Nut
Hex. Nut
.500
Across Flats
.093 Thick
.750
± .015
.150
± .010
.187
± .015
.437
± .010
46-502
Break Before Make
DPDT
.375 ± .010
.187± .010
.740
+ .040
− .030
⅜-32 NEF-2A
Thread
.312
± .005
Knurled
Ring Nut
Hex. Nut
.500
Across Flats
.093 Thick
.750
± .015
.150
± .010
.187
± .015
46-402
Break Before Ma
.562
Dia.
± .010

MINIATURE LIGHTED PUSHBUTTON SWITCHES—SERIES 40

Grayhill

ILLUMINATED 1 AMP BUTT CONTACT

NEON, INCANDESCENT AND LED LIGHTING
NO LAMP MOVEMENT DURING ACTUATION

RATING:

RATING AT 115 VAC RESISTIVE: 1 Amp.

CONTACT RESISTANCE: 25 milliohms or less on a new switch.

VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

LIFE EXPECTANCY: 500,000 operations.

OPERATING FEATURES:

CIRCUITRY: SPST (N.O.) or N.C.), momentary contact.

BUTTON TRAVEL: .062″ ±.010″ for N.O. Switches.
.050″ ±.015″ for N.C. Switches.

ACTUATING FORCE: 16 ounces +8, −4 for N.O. Switches.
7 ounces ±3 for N.C. Switches.

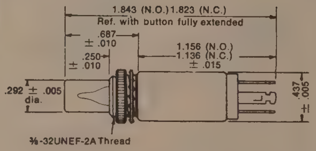
MOUNTING HOLE: 25/64″.

SWITCH TERMINALS: Solder.

LAMP: Neon, General Electric A9A or equivalent.
Incandescent, General Electric 1764 (20 VDC Max.) or equivalent.

INDEPENDENT LAMP AND SWITCH CIRCUITS.

EXTENDED LAMPLIFE: Lamp does not move during actuation of the switch. Incandescent operation at the voltage stated above provides lamp life commensurate with the switch life.


1.843 (N.O.) 1.823 (N.C.)
Ref. with button fully extended
.687
± .010
.250
± .010
1.156 (N.O.)
1.136 (N.C.)
± .015
.292 ± .005
dia.
.437
± .005
⅜-32UNEF-2A Thread

LAMP TERMINALS: Neon and Incandescent — Lead Tin Fused.

LED: EXTERNAL LIMIT RESISTOR REQUIRED.
Anode — Steel, Tin Plated. Cathode — Steel, Gold Plated.

Part No.	Circuitry	Lamp Type
40-1 (Specify Color*)	SPST-N.O.	Neon
40-2 (Specify Color*)	SPST-N.C.	Neon
40-100 (Specify Color†)	SPST-N.O.	Incandescent
40-102 (Specify Color†)	SPST-N.C.	Incandescent
40-200 Red	SPST-N.O.	LED
40-202 Red	SPST-N.C.	LED

* Clear, Transparent Amber, Transparent Red, and Frosted White.

† Clear, Transparent Amber, Transparent Red, Frosted White, Frosted Red, Frosted Green, and Frosted Yellow.

PRICE: Approx. $2.15 to $2.55 ea. in 100 pc. lots dependent on type required.

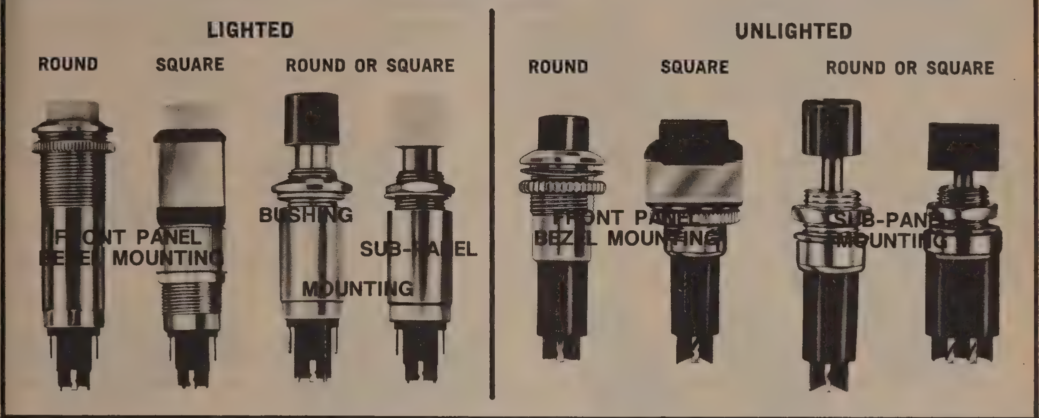
Companion indicator lights are available for the Series 40.

✱ Available locally through your Grayhill distributor

Grayhill

THE DECORATOR LINE OF PUSHBUTTON SWITCHES—SERIES 30, 46, 80

A COORDINATED LINE OF LIGHTED AND UNLIGHTED PUSHBUTTON SWITCHES WIDE CHOICE OF CIRCUITRY AND MOUNTING, WIPING AND BUTT CONTACTS


LIGHTED
ROUND
SQUARE
ROUND OR SQUARE
FRONT PANEL BEZEL MOUNTING
BUSHING
SUB-PANEL
MOUNTING
UNLIGHTED
ROUND
SQUARE
ROUND OR SQUARE
FRONT PANEL BEZEL MOUNTING
SUB-PANEL MOUNTING

LIGHTED DECORATOR LINE PUSHBUTTON SWITCHES ARE DESIGNATED AS THE GRAYHILL SERIES 80 SPST, SPDT, DPDT CIRCUITRY

CONTACTS: Wiping type.

CURRENT RATING AT 115 VAC RESISTIVE: ¼ amp.

CONTACT RESISTANCE: Less than 25 milliohms on a new switch.

VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

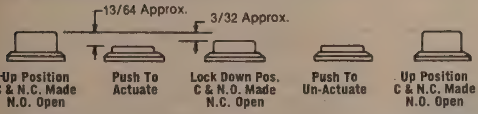
LIFE EXPECTANCY: 250,000 operations.

BUTTON CAPS: White, Amber, Red, Green and Yellow colors are available as solid color or two color (top and bottom). Caps can be ordered with switches as complete assembly or separately.

LAMPS: All button caps accept standard T-1¾ midget flange base lamps. Lamps are not supplied with button caps or assemblies of caps and switches.
It is recommended that the lamp used in these switches be rated at 0.34 CP to provide sufficient illumination.

PRICE: Approx. $2.65 to $4.65 ea. in 100 pc lots dependent on type required. Price includes button cap.

ALTERNATE ACTION OPERATING SEQUENCE FOR ALL APPLICABLE TYPES


13/64 Approx.
3/32 Approx.
Up Position C & N.C. Made N.O. Open
Push To Actuate
Lock Down Pos. C & N.O. Made N.C. Open
Push To Un-Actuate
Up Position C & N.C. Made N.O. Open

LEGENDS: All ½″ square button caps can be legended to order. Applicable to the Series 80 lighted switches and the Series 30 and 46 unlighted switches.
All ½″ round button caps can be legended to order. Applicable to the Series 80 lighted switches. Note: The ⅜″ round button caps used on the Series 30 and 46 unlighted switches are concave to provide for finger fit and cannot be legended.
Contact factory for legend styles and limitations.

UNLIGHTED DECORATOR LINE PUSHBUTTON SWITCHES ARE DESIGNATED AS THE GRAYHILL SERIES 30 OR SERIES 46—SERIES 30, SPST CIRCUITRY

CONTACTS: Butt type.

RATING AT 115 VAC RESISTIVE: 1 amp.

CONTACT RESISTANCE: 25 milliohms or less on a new switch.

VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

LIFE EXPECTANCY:

Circuitry	Operations
SPST (N.O.)	1,000,000
SPST (N.C.)	
SPST (N.O., with Overtravel)	500,000
SPST (N.O., Positive Feel)	200,000

SERIES 46—SPDT OR DPDT CIRCUITRY

CONTACTS: Wiping type.

CURRENT RATING AT 115 VAC RESISTIVE: ¼ Amp.

CONTACT RESISTANCE: Less than 25 milliohms on a new switch.

VOLTAGE BREAKDOWN: 1,000 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

LIFE EXPECTANCY: 250,000 operations.

BUTTON CAPS: White, Red, Green, Blue, Yellow and Black are standard. Some combinations (top and bottom) are also available.

PRICE: Approx. $1.00 to $3.60 ea. in 100 lots dependent on type required.

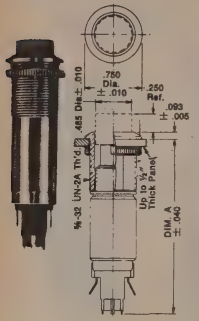
(continued on page 1•2050)

THE DECORATOR LINE OF PUSHBUTTON SWITCHES—SERIES 30, 46, 80

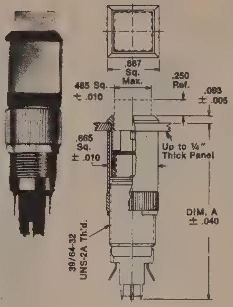
LIGHTED DECORATOR LINE — ¼ AMP RATINGS

FRONT PANEL BEZEL MOUNTING

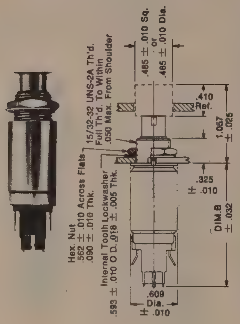
ROUND


.750
Dia.
± .010
.250
Ref.
.093
± .005
.485 Dia.± .010
⅝-32 UN-2A Th'd.
Up to ½" Thick Panel
DIM. A
± .040

SQUARE


.687
Sq.
Max.
.250
Ref.
485 Sq.
± .010
.093
± .005
.665
Sq.
± .010
Up to ¼" Thick Panel
DIM. A
± .040
39/64-32
UNS-2A Th'd.

SUB-PANEL OR BUSHING MOUNTING ROUND OR SQUARE

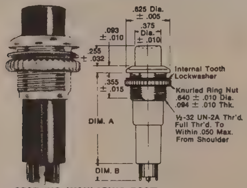

.485 ± .010 Sq.
or
.485 ± .010 Dia.
15/32-32 UNS-2A Th'd.
Full Th'd. To Within
.050 Max. From Shoulder
.410
Ref.
1.057
± .025
Hex. Nut
.562 ± .010 Across Flats
.090 ± .010 Thk.
Internal Tooth Lockwasher
.593 ± .010 O D. .018 ± .005 Thk.
.325
± .010
DIM.B
± .032
.609
Dia.
± .010

Circuitry	Part Number Frt. Panel Round	Part Number Frt. Panel Square	Dim. A	Dim. B
SPST —				
(N.O.) Momentary	80-02-01	80-01-01	1.883	1.159
(N.C.) Momentary	80-02-02	80-01-02	1.883	1.159
SPDT —				
Momentary	80-02-05	80-01-05	1.883	1.159
Alternate Action	80-02-07	80-01-07	2.240	1.516
DPDT —				
Momentary	80-02-08	80-01-08	1.883	1.159
Alternate Action	80-02-09	80-01-09	2.240	1.516

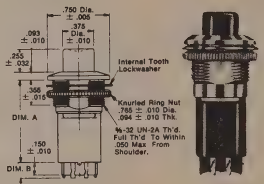
Circuitry	Part Number Sub Panel	Part Number Bushing	Dim. A	Dim. B
SPST —				
(N.O.) Momentary	80-03-01	80-04-01	1.883	1.159
(N.C.) Momentary	80-03-02	80-04-02	1.883	1.159
SPDT —				
Momentary	80-03-05	80-04-05	1.883	1.159
Alternate Action	80-03-07	80-04-07	2.240	1.516
DPDT —				
Momentary	80-03-08	80-04-08	1.883	1.159
Alternate Action	80-03-09	80-04-09	2.240	1.516

UNLIGHTED DECORATOR LINE — ¼ AND 1 AMP RATINGS

FRONT PANEL BEZEL MOUNTING — ROUND BUTTONS


.625 Dia.
± .005
.375
Dia.
± .010
.093
± .010
.255
± .032
Internal Tooth
Lockwasher
.355
± .015
Knurled Ring Nut
.640 ± .010 Dia.
.094 ± .010 Thk.
½-32 UN-2A Thr'd.
Full Thr'd. To
Within .050 Max.
From Shoulder
DIM. A
DIM. B

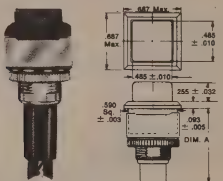
SPST (NO INSULATING POST)
SPDT


.750 Dia.
± .005
.375
Dia.
± .010
.093
± .010
.255
± .032
Internal Tooth
Lockwasher
.355
± .015
Knurled Ring Nut
.765 ± .010 Dia.
.094 ± .010 Thk.
⅝-32 UN-2A Th'd.
Full Th'd To Within
.050 Max From
Shoulder.
DIM. A
.150
± .010
DIM. B

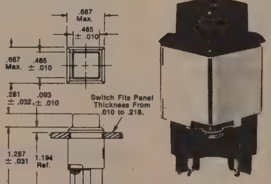
DPDT

Circuitry	Part No.	Dim. A	Dim. B
SPST —			
(N.O.) Momentary	30-05-01	.710 ±.015	.222 ±.020
(N.C.) Momentary	30-05-02	.690 ±.015	.230 ±.015
(N.O. Overtravel) Momentary	30-05-03	.780 ±.015	.222 ±.020
(N.O. Positive Feel) Momentary	30-05-04	.910 ±.020	.222 ±.020
SPDT —			
Momentary	46-05-05	.992 ±.015	.187 ±.015
Alternate Action	46-05-07	1.278 ±.015	.187 ±.015
DPDT —			
Momentary	46-05-08	1.001 ±.015	.187 ±.015
Alternate Action	46-05-09	1.130 ±.015	.187 ±.015

FRONT PANEL BEZEL MOUNTING — SQUARE BUTTONS


.687 Max.
.687
Max.
.485
± .010
.485 ±.010
255 ± .032
.590
Sq.
± .003
.093
± .005
DIM. A
DIM. B

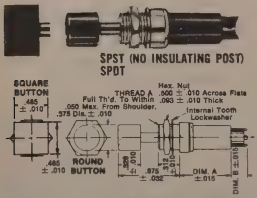
SPST (NO INSULATING POST)
SPDT

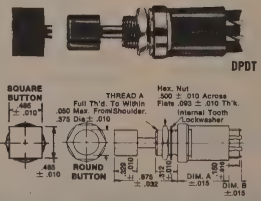

.687
Max.
.485
± .010
.687
Max.
.485
± .010
.281
± .032
.093
± .010
Switch Fits Panel
Thickness From
.010 to .218.
1.287
± .031
1.194
Ref.

DPDT

Circuitry	Part No.	Dim. A	Dim. B
SPST —			
(N.O.) Momentary	30-01-01	.880 ±.020	.222 ±.020
(N.C.) Momentary	30-01-02	.830 ±.020	.230 ±.015
(N.O. Overtravel) Momentary	30-01-03	.920 ±.020	.222 ±.020
(N.O. Positive Feel) Momentary	30-01-04	1.037 ±.020	.222 ±.020
SPDT —			
Momentary	46-01-05	1.174 ±.015	.187 ±.015
Alternate Action	46-01-07	1.264 ±.015	.187 ±.015
DPDT —			
Momentary	46-01-08	As Shown	
Alternate Action	46-01-09		

SUB-PANEL MOUNT — ROUND OR SQUARE BUTTONS


SPST (NO INSULATING POST)
SPDT
SQUARE
BUTTON
.485
± .010
THREAD A
Full Th'd. To Within
.050 Max. From Shoulder.
.375 Dia. ± .010
Hex. Nut
.500 ± .010 Across Flats
.093 ± .010 Thick
Internal Tooth
Lockwasher
.485
± .010
ROUND
BUTTON
.329
± .010
.875
± .032
.312
± .010
DIM. A
±.015
DIM. B ±.015


DPDT
SQUARE
BUTTON
.485
± .010
THREAD A
Full Th'd. To Within
.050 Max. From Shoulder.
.375 Dia ± .010
Hex. Nut
.500 ± .010 Across
Flats .093 ± .010 Th'k.
Internal Tooth
Lockwasher
.485
± .010
ROUND
BUTTON
.329
± .010
.875
± .032
.312
± .010
DIM. A
±.015
.150
± .010
DIM. B
±.015

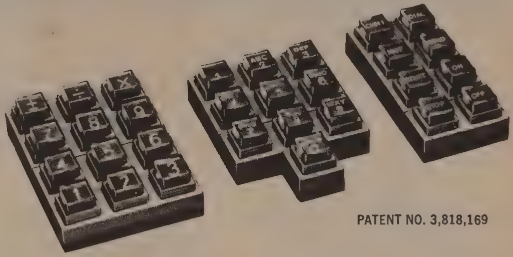
Circuitry	Part No.	Thread A	Dim. A	Dim. B
SPST —				
(N.O.) Momentary	30-03-01	⅜-32	.359	.222
(N.C.) Momentary	30-03-02	⅜-32	.308	.230
(N.O. Overtravel) Momentary	30-03-03	⅜-32	.387	.222
(N.O. Positive Feel) Momentary	30-03-04	15/32-32	.377	.222
SPDT —				
Momentary	46-03-05	⅜-32	.703	.187
Alternate Action	46-03-07	⅜-32	.750	.187
DPDT —				
Momentary	46-03-08	⅜-32	.701	.187
Alternate Action	46-03-09	⅜-32	.750	.187

* Available locally through your Grayhill distributor

Grayhill

PUSHBUTTON SWITCH MODULES PC MOUNTABLE—SERIES 82

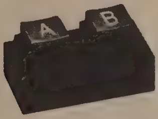
SELF-GENERATED LOGIC, 1 TO 4 POLES PER BUTTON, WIDE CHOICE OF CIRCUITRY
STACK IN ANY ARRAY
CHOICE OF COLORS, CHOICE OF LEGENDS



PATENT NO. 3,818,169

HORIZONTAL MOUNT

1 BUTTON MODULE



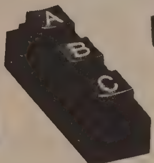
2 BUTTON MODULE

3 BUTTON MODULE

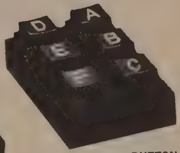
6 BUTTON MODULE

VERTICAL MOUNT

2 BUTTON MODULE



3 BUTTON MODULE



6 BUTTON MODULE

RATING:

RATING AT 5 VDC: 100 milliamps.

CONTACT RESISTANCE: 25 milliohms or less on a new switch.

VOLTAGE BREAKDOWN: 250 VAC between mutually insulated parts.

INSULATION RESISTANCE: 1,000 megohms minimum.

LIFE EXPECTANCY: 1,500,000 operations.

CONTACT BOUNCE: 10 milliseconds or less for the life of the switch.

7-WIRE CODE CAPABILITY UNDER EACH BUTTON

The GRAYHILL Series 82 Pushbutton Modules represent the most versatile switches now available to generate coded outputs for control systems of all kinds.

They are available in modular form in the following sizes:

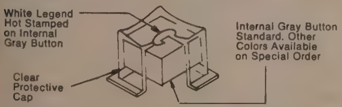
6-button module	2-button module
3-button module	1-button module

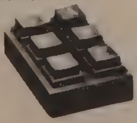
By combining these different modules, pushbutton arrays of any shape or size can easily be assembled on a printed circuit board with uniform spacing. The switching capabilities are practically endless since any code up to 7-wire can be accomplished right in the switches. No extra logic is necessary. Refer to circuit diagrams.

LEGENDING OF BUTTON CAPS

GRAYHILL offers a choice of legending as follows:

STANDARD: Legends hot-stamped on internal button as in this drawing. (See ordering information.)


White Legend Hot Stamped on Internal Gray Button
Clear Protective Cap
Internal Gray Button Standard. Other Colors Available on Special Order



Contact GRAYHILL for Standard Legend Styles & Limitations.

OPERATING FEATURES:

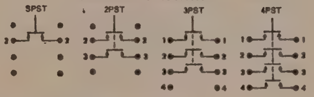
BUTTON TRAVEL: 0.150″ total travel.

OVERTRAVEL: 0.100″ nominal.

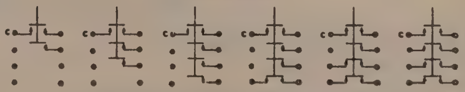
OPERATING FORCE: 4-7 ounces (dependent upon number of poles).

CIRCUIT DIAGRAMS

STANDARD CIRCUITRY

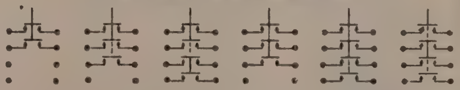


CODED CIRCUITRY



Note: Coded Switches Are Constructed So That Common (C) Is Made After All Other Contacts

OTHER POSSIBLE CIRCUIT CONFIGURATIONS

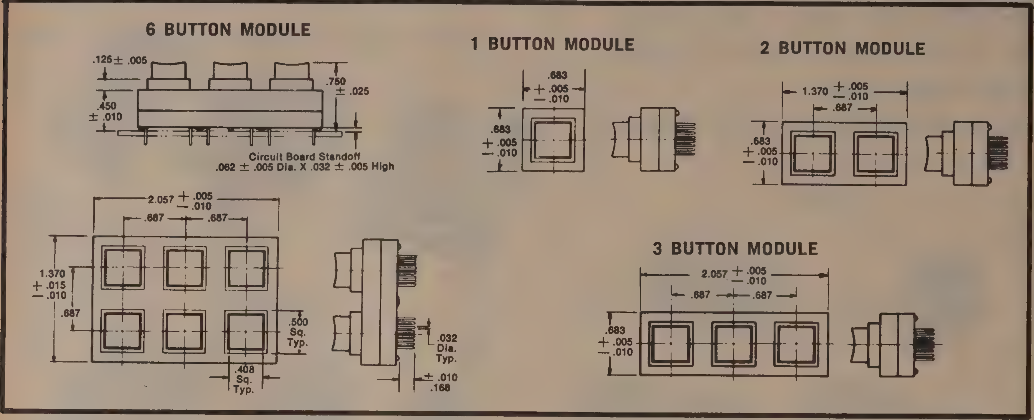


DOUBLE-SHOT MOLDED BUTTON: Takes the place of the internal button and the clear protective cap. Legend permanently molded into button. Available in numerals from 0 to 9 and standard telephone legends. Standard color, gray with white legends; other colors or legends available in large quantities. Also available without legend to provide proper size button to eliminate clear cap.

(continued on page 1•2052)

PUSHBUTTON SWITCH MODULES PC MOUNTABLE—SERIES 82

Grayhill®


6 BUTTON MODULE

1 BUTTON MODULE

2 BUTTON MODULE

3 BUTTON MODULE

MOUNTING:

Modules are designed to plug into any printed circuit board from 1/16″ to 1/8″ thick.

Modules can be stacked horizontally or vertically for any combination of button array and still maintain 11/16″ button centers.

SOLDERING INSTRUCTIONS

Series 82 Pushbutton Switch Modules have been tested, and successfully passed, heat resistance to wave soldering per MIL STD. 202, Method 210A, for the following parameters.

Maximum solder temperature of 260°C (500°F)

Maximum immersion duration of 5 seconds

For best results, your wave soldering procedure should be within these limits. If your application requires you to exceed these limits, contact GRAYHILL for recommendations.

ORDERING INFORMATION:

To order a Series 82 Pushbutton Module, there are five areas in which information is required:

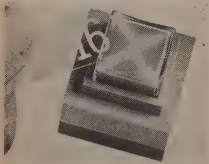
1. **Type of module:** 1-, 2-, 3-, or 6-button.
2. **Type of mounting:** either horizontal or vertical.
3. Circuitry required for each button (A = SPST; B = 2PST; C = 3PST, etc.) or coded or other available circuitry. See opposite page for button letter designations.
4. **Type of button desired:** Standard, or double-shot molded.
   —Color of standard internal button. GRAY is standard; other available colors are WHITE, RED, GREEN, and BLACK.
   Colors can be intermixed. For example, Buttons A through E are GRAY and F is WHITE.
   —Color of button and legend of double-shot molded button (GRAY button with WHITE legend is standard).
5. Legend required on each button (Button A legend #1, Button B legend #2, etc.).

Upon receipt of your order, a part number will be assigned to facilitate future identification of this part. These numbers are sequentially assigned as the need arises and are non-descriptive. Also see below for Series 82 Pushbutton Modules, available from your local distributor.

PRICE: Contact GRAYHILL.

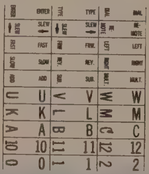
INSERTABLE LEGENDS—STANDARD CIRCUITRY

SERIES 82 PUSH BUTTON MODULES WITH INSERTABLE LEGENDS



For prototype and small quantity usage. Switches are available with clear protective cap slotted on one side to allow the insertion of a clear plastic tab imprinted with the legend. A legend sheet is available with all normally required legends for both vertical and horizontal mounting.

Legend sheet is sold separately, GRAYHILL Part No. 82-AC-2017. Contains white legends 0-19, A-Z, and all other normally used symbols and word groups. Simply cut out and insert in slotted button.


ENTER
TYPE
DIAL
SLEW
SLEW
RE-MOTE
FAST
FRW.
LEFT
SLOW
REV.
RIGHT
ADD
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12
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1
2

ORDERING INFORMATION:

The following chart lists the part numbers of insertable legend Series 82 Pushbutton Switch Modules with SPST circuitry under each button or 4PST circuitry under each button. For prototypes 4PST circuitry can be ordered and pins can be clipped to provide desired circuitry. Coded circuitry cannot be achieved in this manner. These modules are gray in color and are quickly available through your local GRAYHILL distributor.

INSERTABLE LEGEND MODULES

Part No.	No. of Buttons	Circuitry	Part No.	No. of Buttons	Circuitry
82-101-71	1	SPST	82-301-61	3	SPST
82-101-74	1	4PST	82-301-64	3	4PST
82-201-41	2	SPST	82-601-81	6	SPST
82-201-44	2	4PST	82-601-84	6	4PST

ACCESSORY

82AC2017—Legend sheet for above modules.

PRICE: Approx. $1.05 to $5.80 ea. in 100 pc. lots dependent on type and circuitry required.

✱ Available locally through your Grayhill distributor

GORDOS CORPORATION

mercury switches

Switch Part No. Without Lead Wire	Nominal Load Current Amps At 115 V AC Resistive	Differential Angle (Degrees) Max.	Differential Angle (Degrees) Min.	Sketch Number	Nominal Dimensions (Inches) D	L	H	Type of Contract: MM — Mercury to Mercury MWM — Merc. to Wet Metal MDM — Merc. to Dry Metal	Suitable for Low Voltage Application	NOTES
SPST										
HG 216	—	10	—	4	.070	.400	—	MDM	—	Micro-miniature
HG 414 LO	0.1	5	—	8	.350	1 3/16	—	MWM	√	PtTE
HG 220 LO	0.1	10	—	4	.155	½	—	MDM	—	Under 6 volts HG 520LO is Recommended.
HG 520 LO	0.1	10	—	4	.155	½	—	MDM	√	—
HG 221 LO	0.1	15	—	4	.155	⅞	—	MWM	√	PtTE
HG 242 LO	0.1	25	15	11	.275	⅞	—	MDM	—	N.C. Conical Tipover Series. Angles are Measured from Horizontal (A° on Sketch No. 11) Contact is Open at Min. Degree Angle and Closed at Max. Degree Angle Shown in Table.
HG 245 LO	0.3	50	10	11	.275	¾	—	MDM	—	
HG 243 LO	0.5	See Note	See Note	37	.350	1	—	MDM	√	N.O. Conical Tipover Series. Angles are Measured from Vertical (A° on Sketch No. 37) Min. Angle: 20° ±5°, Max. Angle: 65° ±5°.
HG 244 LO	0.5	See Note	See Note	37	.495	1½	—	MDM	√	
HG 253 LO	0.3	3	—	8	.325	1 5/16	—	MWM	√	PtTE
HG 260 LO	0.3	180	—	1	.325	2¾	—	MWM	√	PtE. Nonmagnetic
HG 261 LO	0.3	15	—	1	.325	1¼	—	MWM	√	PtE. Nonmagnetic
HG 402 LO	0.3	.25	—	2	.400	1¼	—	MDM	—	Slow Tilting Action
HG 251 LO	1	2	—	1	.325	1	—	MDM	—	—
HG 252 LO	2	14	—	1	.325	1	—	MWM	√	General Purpose Switch
HG 407 LO	2	5	—	1	.325	1½	—	MDM	—	—
HG 217 LO	3	10	—	8	.325	1⅜	—	MDM	√	—
HG 708 LO	2	15	5	35	.400	1⅜	—	MDM	√	Splash Resistant
HG 566 LO	4	10	—	16	.495	2	—	MDM	—	N.C. 2 Ckts. to Common Lead End Down
HG 567 LO	4	10	—	17	.495	2	—	MDM	—	N.C. 2 Ckts. to Common Lead End Up
HG 431 LO	5	4	—	7	.495	2	—	MDM	√	—
HG 447 LO	7	1.5	—	10	.600	2⅝	—	MDM	√	Slow Tilting Action
HG 457 LO	10	See Note	—	32	.435	See Note	—	MDM	—	High Diff. Angle Switch
HG 259 LO	2		—	32	.325		—	MDM		Make to Customer Specifications
HG 445 LO	10	8	—	10	.600	2	—	MDM	√	—
HG 455 LO	10	5	—	1	.435	1 11/16	—	MDM	√	General Purpose Switch
HG 454 LO	10	5	—	10	.600	2¼	—	MDM	√	—
HG 412 LO	15	8	—	23	.520	2¼	—	MM	√	—
HG 421 LO	15	10	—	27	.450	1⅜	1½	MM	√	High Load Reliability
HG 721 LO	25	8	—	27	.520	2⅛	1 11/16	MM	√	—
HG 482 LO	45	5	—	28	.675	2⅛	2	MM	√	—
HG 803 LO	0.2	1.4	—	5	.325	1⅜	—	MWM	√	PtTE. Thermostat Control Switch
SPDT										
HG 804 LO	0.2	2	—	14	.350	1 5/16	—	MWM	√	PtTE. Thermostat Control Switch
HG 569 LO	4	10	—	18	.495	2	—	MDM	—	—
HG 621 LO	8	7	—	13	.435	2¼	—	MDM	√	—
HG 427 LO	10	14	—	25	.520	2¼	—	MM	√	MBBr
HG 420 LO	15	10	—	24	.520	2	⅝	MM MDM	√	MBBr, MDM Contact Rating 5 Amp at 115 VAC
HG 461 LO	15	14	9	29	.450	1⅜	1½	MM	√	Momentary MBBr
HG 719 LO	25	15	—	29	.520	2⅜	1 11/16	MM	√	MBBr
TWO CKT.										
HG 209 LO	1	6	—	19	.230	1	—	MDM	—	—
HG 628 LO	5	6	—	20	.530	2⅝	—	MDM	√	MBBr
HG 323 LO	18	14	7	21	.495	2¼	11/16	MDM	√	Positive Neutral
HG 638 LO	10	10	—	22	.600	2¼	—	MDM	—	Pilot Ckt. 2 Amp 115V Overlap Angle 3° to 6°
PULSE										
HG 381 LO	1	—	8	33	.225	1	—	MDM	—	Duty Cycle 20 to 50 Milliseconds
HG 702 LO	3	20	15	31	.495	1½	⅝	MDM	—	Duty Cycle 30 to 70 Milliseconds

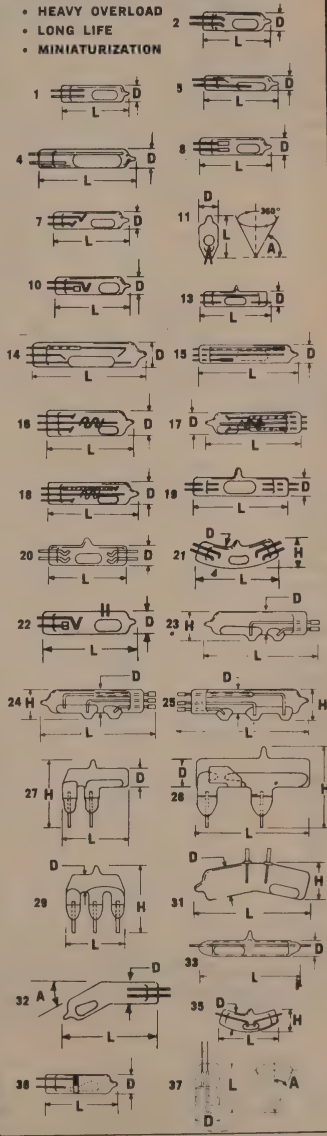
Abbreviations:

MBB — Make Before Break Action

PtE — Platinum Electrodes

PtTE — Platinum Tipped Electrodes

- SEALED CONTACTS
- RELIABLE OPERATION
- ANY OPERATING ANGLE
- POSITION SENSING
- LOW CONTACT RESISTANCE
- HEAVY OVERLOAD
- LONG LIFE
- MINIATURIZATION



Encapsulated and Multi-Switch Packages Available — Consult Factory

GORDOS CORPORATION

Headquarters & Eastern Regional: 250 Glenwood Ave., Bloomfield, N.J. 07003 • Telephone: (201) 743-6800
Mid-West Regional: 3831 Industrial Dr., Rolling Meadows, Ill. 60008 • Telephone: (312) 392-5900
West Regional: 347 Commercial St., San Jose, Calif. 95112 • Telephone: (408) 293-1533

GORDOS
CORPORATION

sub-miniature and miniature reed switches

• GENERAL SPECIFICATIONS

MOUNTING POSITION: Any Plane (WR-126 mercury wetted contacts limited to ±30° from vertical)

INTERNAL ATMOSPHERE: Inert gas (WR-126, MR-138 pressurized)

INSULATION RESISTANCE: (Higher values attained by special treatment)
SPST Form A — 1 x 10^{12} ohms Typical
SPDT Form C — 1 x 10^{9} ohms Typical
Mercury Wetted Form A — 1 x 10^{10} ohms Typical

CAPACITANCE: SPST Form A — 0.2 picofarad Typical
SPDT Form C — 1.2 picofarad Typical

SHOCK: 50 g's @ 11ms

VIBRATION: 35 g's from 50 to 2000 Hz

STANDARD TEST COIL: R — 5105. Exceptions: MR-5203 R-532, MR-5204 R-5109

AVAILABLE SENSITIVITY: 15/70 ampere turns: 40/80 ampere turns (WR-126)
10/50 ampere turns: (MR-1456, 1458, 0770, 0780, 4570, 4590)
15/45 ampere turns: (MR-5203, 5204)
28/42 ampere turns: (MR-5830)
36/50 ampere turns: (MR-5972)

MR-456
MR-0780
MR-107
MR-1148
MR-5203
MR-1157
MR-406
MR-138
WR-126
MR-5204

Part #	A — Maximum Glass Diameter (Inches)	B — Maximum Glass Length (Inches)	C — Nominal Uncut Switch Length (Inches)	D — Minimum Trim Length (Inches)[1]	E — Nominal Uncut Armature Length (Inches)	F — Lead Configuration (Inches)	Maximum Switching Current (Amps)	Maximum Switching Voltage (VDC)	Maximum Switching Capability (Voltage x Current)	Minimum Breakdown Voltage (VRMS)	Maximum Initial Contact Resistance (Ohms)	Typical Operate Time Including Bounce (Milliseconds)	Contact Material[2]
SUB-MINIATURE SPST — FORM A OFFSET GAP									CONSULT FACTORY FOR LOAD/LIFE DATA				
MR-1456	.074	.350	1.85	.480	.990	Pole .026 Dia.	.125	28		100	.200	0.6	D
MR-1458	.074	.350	1.85	.480	.990	Arm. .019 Dia.	.125	28		100	.200	0.6	R
MR-456	.090	.560	1.90	.690	1.045	.023 Dia.	.250	100		250	.150	0.6	D
MR-458	.090	.560	1.90	.690	1.045	.023 Dia.	.250	100		250	.150	0.6	R
CENTER GAP													
MR-0780	.074	.470	1.98	.600	.990	.019 Dia.	.250	28		200	.200	0.25	R
MR-1157	.100	.673	1.98	.800	.990	.023 Dia.	.125	28		100	.150	0.75	D
MR-1158	.100	.673	1.98	.800	.990	.023 Dia.	.125	28		100	.150	0.75	R
MINIATURE SPST — FORM A OFFSET GAP													
MR-406	.105	.885	2.75	1.13	1.238	Pole .028 Dia.	.500	200		250	.100	0.75	D
MR-408	.105	.885	2.75	1.13	1.238	Arm. .015 x .030	.500	200		250	.100	0.75	R
CENTER GAP													
MR-087	.090	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.100	0.75	D
MR-088	.090	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.100	0.75	R
MR-0881	.090	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.200	0.75	HR
MR-107	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.100	0.75	D
MR-108	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.100	0.75	R
MR-1081	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.200	0.75	HR
MR-1148	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200		250	.100	0.50	R
MR-138	.105	.815	2.10	1.25	1.043	.023 Dia.[3]	.500[4]	1000		1200	.100	0.75	R
MR-5830	.105	.845	2.10	1.09	1.043	.023 Dia.	.500	200		250	.090	0.75	R
MR-5972	.105	.845	1.20	1.09	.600	.023 Dia.	.500	200		250	.090	0.75	R
MERCURY WETTED												No Bounce	
WR-126-1	.125	.690	1.62	1.08	.740	Pole .023 Dia.	1.0[4]	1000		1500	.050	1.75	HG
WR-126-20	.125	.690	2.10	1.08	1.240	Arm.[3]	1.0[4]	1000		1500	.050	1.75	HG
SPDT — FORM C												N.O./N.C.	
MR-5203	.125	.600	2.125	.850	1.150	.023 Dia.	.300	28		200	.150	1.0/0.9	R
MR-5204	.125	.600	2.125	.850	1.150	.023 Dia.	.300	28		200	.150	1.0/0.9	R

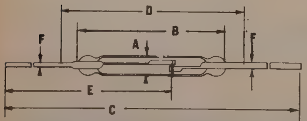
[1] Consult factory before exceeding minimum.

[2] D-Dimet — dropout low; R-Rhodium — dropout normal; Hg-Mercury — dropout normal; HR-Heavy Rhodium—dropout high.

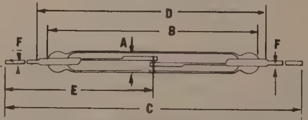
[3] WR-126 Hollow Tube: .040″ Dia.; WR-126-20 Solid Lead: .023″ Dia.; MR-138 Hollow Tube: .040″ Dia.

[4] Derate to .002 amp. @ 1000 VDC.

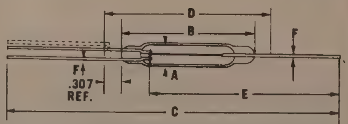
[5] N.C. contact designated by longer lead on MR-5203 and bent lead on MR-5204.



SPST — Form A Offset Gap
SPST — Form A Mercury Wetted



SPST — Form A
Center Gap



SPDT — Form C

GORDOS CORPORATION

compact/standard/large reed switches

• GENERAL SPECIFICATIONS

MOUNTING POSITION: Any Plane

INTERNAL ATMOSPHERE: Inert Gas: (MR-893, 988, 2208 Pressurized)
(MR-830, Vacuum)

INSULATION RESISTANCE: (Higher values attained by special treatment)
SPST Form A — 1 x 10^{12} ohms Typical
SPDT Form C — 1 x 10^{10} ohms Typical

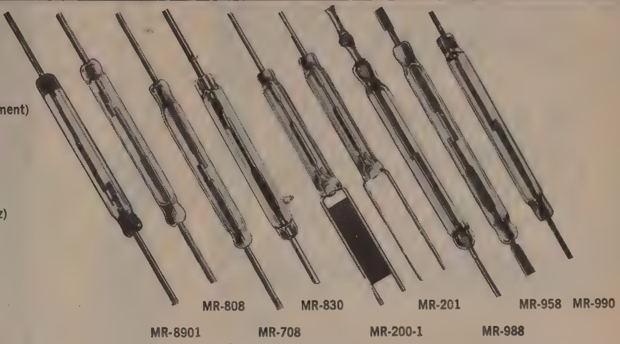
CAPACITANCE: SPST Form A — 0.8 picofarad Typical
SPDT Form C — 4.0 picofarad Typical

SHOCK: 50 g's @ 11ms (MR-990: 30 g's @ 11ms)

VIBRATION: 35 g's 50 to 2000 Hz (MR-990: 20 g's 50 to 2000 Hz)

STANDARD TEST COIL: COMPACT — R-580
STANDARD — R-580
LARGE — R-584

AVAILABLE SENSITIVITY:	
COMPACT	30/80
STANDARD	30/80
(Except MR-8901, 893, 830)	60/100
MR-200-1, 200-2)	20/50
LARGE	40/100



Part #	A — Maximum Glass Diameter (Inches)	B — Maximum Glass Length (Inches)	C — Nominal Uncut Switch Length (Inches)	D — Minimum Trim Length (Inches)(1)	E — Nominal Uncut Armature Length (Inches)	F — Lead Configuration (Inches)	Maximum Switching Current (Amps)	Maximum Switching Voltage (VDC)	Maximum Switching Capability (Voltage x Current)	Minimum Breakdown Voltage (VDC)	Maximum Initial Contact Resistance (Ohms)	Typical Operate Time Including Bounce (Milliseconds)	Contact Material(2)
COMPACT **SPST — FORM A** **OFFSET GAP**													
MR-608	.190	1.45	3.20	1.70	1.79	Pole .055 Dia	1.0	250	CONSULT FACTORY FOR LOAD/LIFE DATA	300	.050	2.0	R
MR-6081	.190	1.45	3.20	1.70	1.79	Arm. .035 x .061	1.0	250		300	.100	2.0	HR
CENTER GAP													
MR-508	.190	1.40	3.12	1.65	1.56	.022 x .061	1.0	250		300	.050	2.0	R
MR-5081	.190	1.40	3.12	1.65	1.56	.022 x .061	1.0	250		300	.100	2.0	HR
STANDARD **SPST — FORM A** **OFFSET GAP**													
MR-808	.190	1.70	3.20	1.95	1.79	Pole	1.0	250		500	.050	2.0	R
MR-8081	.190	1.70	3.20	1.95	1.79	.055 Dia.	1.0	250		500	.100	2.0	HR
MR-8901	.190	1.70	3.20	1.95	1.79	Arm.	3.0	250		400	.500	2.5	W
MR-830	.215(6)	1.70	3.20	1.95	1.79	.035 x .061	3.0(3)	3500		5000	.500	2.5	W
MR-831	.215(6)	1.70	3.20	1.95	1.79	.035 x .061	3.0(3)	3500		10000	.500	2.5	W
MR-893	.190	1.70	3.20	2.50	1.79	Arm.(4)	3.0(3)	1500		2000	.500	2.5	W
CENTER GAP													
MR-708	.190	1.65	3.40	1.90	1.70	.035 x .061	1.0	250		300	.050	2.0	R
MR-7081	.190	1.65	3.40	1.90	1.70	.035 x .061	1.0	250		300	.100	2.0	HR
SPST — FORM C(5)												**N.O./N.C.**	**N.O./ARM./N.C.**
MR-201	.190	1.20	3.15	1.45	1.923	Pole	.250	100		250	.200	2.5/3.5	G/D/P
MR-200-1	.190	1.20	3.15	1.45	1.923	.030 x .055	.250	100		250	.200	3.5/2.5	G/D/G.
MR-200-2 (Latcher)	.190	1.20	3.15	1.45	1.923	Arm. .045 Dia.	.250	100		250	.200	3.5/3.5	G/D/G
LARGE **SPST — FORM A** **CENTER GAP**													
MR-958	.195	2.07	3.20	2.32	1.60	.021 x .100	1.0	250		500	.050	2.5	R
MR-9581	.195	2.07	3.20	2.32	1.60	.021 x .100	1.0	250		500	.100	2.5	HR
MR-988	.195	2.07	3.20	2.50	1.60	.021 x .100(4)	1.0(3)	1200		1400	.050	2.5	R
MR-903	.207	2.07	3.20	2.32	1.60	.021 x .100	2.0	250		500	.150	2.5	W
MR-990	.207	2.07	3.20	2.32	1.60	.021 x .100	3.0	250		300	.050	3.0	W-D

(1) Consult factory before exceeding minimum.

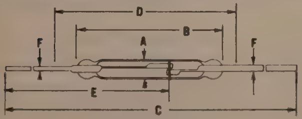
(2) D-Dimet — dropout low; R-Rhodium — dropout normal; HR-Heavy Rhodium — dropout high; W-Tungsten — dropout high; P-Precious metal; G-Gold — dropout low.

(3) Derate to .002 amp. @ 1000 VDC.

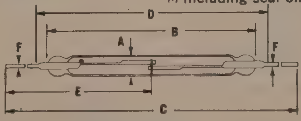
(4) Hollow Tube: .075″ Dia.

(5) N.C. contact designated by color dot. MR-200-1, 200-2 are magnet biased and polarity sensitive.

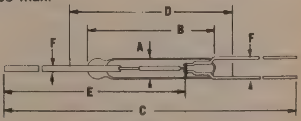
(6) Including seal off tip: .405 max.



SPST — Form A
Offset Gap



SPST — Form A
Center Gap



SPST — Form C

GORDOS CORPORATION

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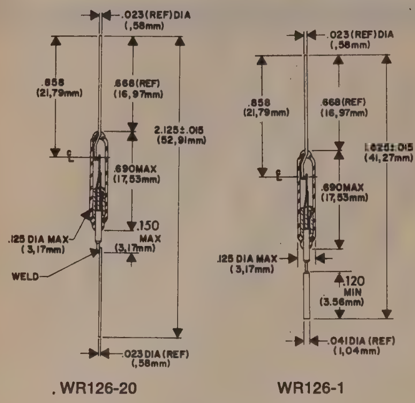
West Regional: 347 Commercial St., San Jose, Calif. 95112 • Telephone: (408) 293-1533

GORDOS
MAGNETIC MERCURY
SWITCH DIVISION

Miniature Mercury-Wetted SPST

WR-126 SERIES



. WR126-20 WR126-1

Approximate Scale 5:4 — Do Not Scale

A miniature pressurized reed switch containing a mercury pool that replenishes the contact surface by capillary action, thus providing a true mercury-to-mercury contact. This switch exhibits the following outstanding features:

1. No bounce
2. 1000-VDC switching
3. 2-amp switching
4. Contact resistance less than 50 milliohms over life
5. Life expectancy in billions of operations

MECHANICAL SPECIFICATIONS

- Contact arrangement — offset gap, normally open
- Mounting position — within 30° of vertical
- External lead finish — electroplated gold suitable for soldering or welding
- Contact material — mercury wet to mercury wet

ELECTRICAL SPECIFICATIONS

- Initial contact resistance — 50 milliohms maximum
- Breakdown voltage(2) — 1500 VRMS minimum
- Capacitance — 0.3 picofarads typical
- Insulation resistance(1) — 1 x 10^9 ohms minimum

CONTACT RATINGS

- Switching voltage — 1000 VDC maximum
- DC resistive load — (reference — 50 watts max.) Consult factory for actual load/life data.
- Current — 2(3) ampere maximum switching, 2 amperes maximum carrying
- Inductive— contact protection required
- Lamp or capacitive — derate by ⅔ or add resistor in series
- Life expectancy —
  28 VDC, 2 amp resistive — 50 million
  50 VDC, 1 amp resistive — 100 million
  50 MVDC, 1 microamp resistive — 5 billion

OPERATE CHARACTERISTICS

- Operate time @ 150% of just operate — 1.8 milliseconds nominal
- Release time — 0.8 milliseconds nominal
- Nominal coil power — 150 milliwatts
- Pull-in sensitivity available — 40 to 80 ampere turns
- Drop-out sensitivity available — 10 ampere turns minimum

MEASUREMENT DETAILS

- Measurements taken in Gordos R-5105 coil with gap centered .140″ above center of coil windings
- R-5105 coil — 10,000 turns No. 48 AWG, 3500 ohms, copper length .750″ (19.05 mm), copper ID .170″ (4.32 mm)

ENVIRONMENTAL SPECIFICATIONS

- Internal atmosphere — hydrogen under pressure

SPECIAL NOTES

- Care must be taken in cutting or bending reed switch leads. End nippers should be used for cutting to reduce the shock wave to the seal. Firm support between the bend and seal is necessary to preserve seal integrity.

(1) Measured @ 100 VDC, higher insulation resistance values are available.
(2) Specific curves on request.
(3) Derate to .002 amps @ 1000 VDC.

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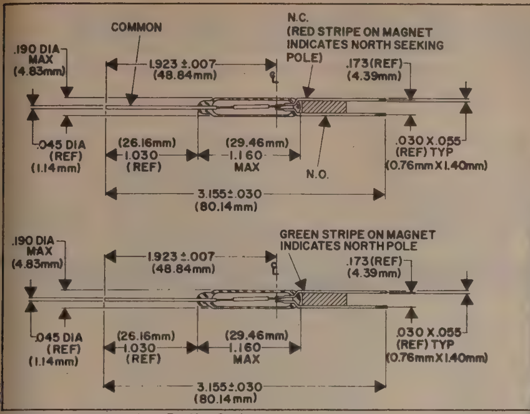
† *Some parameters are subject to change in other pull-in values.*


COMMON
N.C.
(RED STRIPE ON MAGNET INDICATES NORTH SEEKING POLE)
.190 DIA MAX (4.83mm)
1.923 ±.007 (48.84mm)
.173(REF) (4.39mm)
.045 DIA (REF) (1.14mm)
(26.16mm) 1.030 (REF)
(29.46mm) 1.160 MAX
N.O.
.030 X .055 (REF) TYP (0.76mm X 1.40mm)
3.155±.030 (80.14mm)
.190 DIA MAX (4.83mm)
GREEN STRIPE ON MAGNET INDICATES NORTH POLE
1.923 ±.007 (48.84mm)
.173(REF) (4.39mm)
.045 DIA (REF) (1.14mm)
(26.16mm) 1.030 (REF)
(29.46mm) 1.160 MAX
.030 X .055 (REF) TYP (0.76mm X 1.40mm)
3.155±.030 (80.14mm)

Approximate Scale 5:4 — Do Not Scale

GORDOS

REED SWITCH DIVISION

Magnet Biased Compact SPDT

MR-200-1 MR-200-2

Magnet biased
Form "C"
.204″ diameter, max. (5.18 mm)

Switch with a memory

The MR-200-1 is a magnetically biased form "C" switch that will transfer only when the proper polarity magnetic field is applied. Suitable for either permanent magnet or coil actuation.

The MR-200-2 is a magnetically biased latching switch which is bi-stable. Application of a momentary magnetic field of the proper polarity will cause transfer and latch. Reverse polarity will transfer and latch to the opposite pole piece.(3)

MECHANICAL SPECIFICATIONS

- Contact arrangement — offset gap, form "C" (SPDT)
- Mounting position — any plane
- External lead finish — gold over nickel, suitable for soldering or welding
- Contact material
  - N.O. contact — diffused gold
  - N.C. contact — diffused gold
  - Armature — di-met
- Resonance — 1125 Hz typical

ELECTRICAL SPECIFICATIONS

- Initial contact resistance—200 milliohms maximum
- Breakdown voltage(2) — 300 VRMS minimum
- Capacitance — 5 picofarads typical
- Insulation resistance(1) — 1 x 10^{10} ohms typical

CONTACT RATINGS

- Switching voltage — 100 VDC maximum
- DC resistive load — (reference —10 watts max.) Consult factory for actual load/life data.
- Current — .250 ampere maximum switching, 1 ampere maximum carrying
- Inductive — contact protection required
- Lamp or capacitive — derate by ⅔ or add resistor in series

OPERATE CHARACTERISTICS

- MR-200-1
  - Operate time — 1.8 milliseconds typical
  - Bounce time (operate) — 1 millisecond typical
  - Release time — 150 microseconds maximum
  - Bounce time (release) — 2 milliseconds typical
- MR-200-2
  - Transfer time — 1.8 milliseconds typical
  - Bounce time — 1 millisecond typical
- Nominal coil power — 100 milliwatts
- Pull-in sensitivity available
  - MR-200-1 — 20 to 50 ampere turns
    - drop-out — 10 ampere turns minimum
  - MR-200-2 — 20 to 50 ampere turns

MEASUREMENT DETAILS

- Measurements taken in Gordos-580 coil with gap centered, leads full length
- R-580 coil — 10,000 turns #41 AWG, 1400 ohms, copper length 1″ (25.4 mm), copper ID, 0.218″ (5.54 mm)

ENVIRONMENTAL SPECIFICATIONS

- Shock — 50 G's @ 11 milliseconds
- Vibration — 35 G's 50-2000 hertz
- Operating temperature range — −20°C to +40°C
- Internal atmosphere — inert gas

SPECIAL NOTES

- Care must be taken in cutting or bending reed switch leads. End nippers should be used for cutting to reduce the shock wave to the seal. Firm support between the bend and seal is necessary to preserve seal integrity.
- MR-200-1 has red stripe denoting north-seeking pole
  MR-200-2 has green stripe denoting north-seeking pole

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† *Some parameters are subject to change in other pull-in values.*

(1) Measured @ 90 VDC.

(2) Specific curves on request.

(3) Bifilar coils require diode suppression to avoid the collapsing field from the actuate winding inducing a field in the second winding, resulting in unwanted transfer.

GORDOS CORPORATION

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HAMLIN INC

628 LAKE STREET • LAKE MILLS, WISCONSIN 53551
PHONE: SALES 414/648-2361 • TWX 910-260-3740

REED SWITCHES/INDUSTRIAL SENSORS/LIQUID CRYSTAL DISPLAYS

HAMLIN DRY REED FORM C MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MDRR-DT	C	3W	.240	28	20-50	±7.5	2.076	.562	.105	H-33	3W Low Profile Form C	$4.50	$3.58
MRH-DT	C	3W	.250	28	20-60	±7.5	2.124	.610	.130	H-33	Instrument Grade Form C	4.75	3.76
MRG-DT	C	3W	.250	28	20-60	±7.5	2.125	.610	.130	H-33	Moderate Current and Voltage	4.25	3.39
MLC-DT	C	3W	.110	28	27.5, 32.5 & 37.5	±10	2.125	.610	.130	H-33	Economy Form C—Sub-Miniature	3.25	2.64
DLC-DT	C	10W	.500	200	50-115	±15	3.375	1.562	.218	H-32	Economy Form C—Standard	1.75	1.15
DRR-DTH	C	10W	.500	250	50-115	±7.5	3.375	1.562	.218	H-34	High Breakdown Form C	2.75	2.20
DRT-DTH	C	20W	1.5	500	60-115	±7.5	3.375	1.562	.218	H-34	Inductive Loads	5.00	4.25

HAMLIN DRY REED FORM A MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MITI-1	A	.1W	.010	10	30±15	±15	.740	.260	.055	H 31	Micro-Miniature	3.30	2.50
MMRR-2	A	.3W	.010	28	17.5-52.5	±7.5	2.000	.375	.090	H-31	"Grain of Wheat" Size	2.00	1.50
MINI-2	A	3W	.110	28	7.5-32.5	±7.5	2.000	.500	.070	H-31	The Mini-Reed	1.75	1.31
MDRR-4	A	10W	.500	100	12.5-52.5	±7.5	1.235	.600	.105	H-33	Low Profile Form A	1.25	.94
MSRR-2	A	10W	.500	200	17.5-52.5	±7.5	2.250	.800	.090	H-33	Moderate Current and Voltage	1.25	.94
MARR-3	A	10W	.500	200	17.5-57.5	±7.5	1.775	.750	.105	H33	Dip Size	1.10	.83
MRR-2	A	10W	.500	200	17.5-52.5	±7.5	2.230	.800	.130	H-33	Moderate Current and Voltage	1.25	.94
MRR-5	A	10W	.500	500	27.5-62.5	±7.5	2.230	.800	.130	H-33	Breakdown Voltage to 1,000 VDC	2.75	2.06
SRR-2	A	15W	1.0	400	35-115	±7.5	3.375	1.425	.195	H-32	Moderate Current and Voltage	1.50	1.12
MARR-5	A	10W	.500	500	17.5-52.5	±7.5	1.775	.750	.105	H33	Breakdown Voltage to 1,000 VDC	2.75	2.06
DRR-1	A	15W	1.0	400	42.5-132.5	±7.5	3.250	2.100	.207	H-34	Moderate Current and Voltage	1.50	1.12
DRS-2	A	25W	1.0	250	57.5-132.5	±7.5	3.250	2.100	.207	H-34	High Inrush Type Contacts	1.60	1.28
DRR-5	A	25W	1.0	1,000	52.5-132.5	±7.5	3.250	2.100	.207	H-34	Breakdown Voltage to 1,500 VDC	3.00	2.50
DRT-5	A	50W	3.0	1,000	57.5-132.5	±7.5	3.250	2.100	.207	H-34	Inductive Load Type Contacts		

HAMLIN MERCURY-WETTED MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MDC-1	A	50W	2.0	100	40-80	±10	2.250	.610	.130	H33	Tiny Size, Mercury Wetted	4.25	3.19
MDC-DT	C	14W	.500	28	70	±15	1.600	.600	.132	H32	Form C, Mercury Wetted	5.50	4.40

HAMLIN INSTRUMENT GRADE MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MSRH-2	A	10W	.500	200	17.5-52.5	±7.5	2.230	.800	.105	H-33	Instrument Grade—Premium Performance	1.30	1.12
MRH-DT	C	3W	.250	28	20-60	±7.5	2.125	.610	.130	H-33	Instrument Grade—Premium Performance	4.75	3.76

HAMLIN "SPECIAL" MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MDLS-4	A	3W	.100	28	—	—	1.235	.600	.105	—	Latching Reed Switch	2.50	1.87
MAAC-2	A	1W	.100	110VAC	17.5-52.5	±7.5	1.775	.800	.105	H-33	Lamp or Other High Inrush Loads	1.00	.75

HAMLIN HIGH VOLTAGE MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
DRVT-5	A	50W	.004	3,500	.90-150	±10	3.250	1.950	.218	H34	Breakdown Voltage to 5,000 VDC	3.50	2.80
DRVT-10	A	50W	3.0	7,500	100-150	±10	3.250	1.950	.218	H-34	Breakdown Voltage to 10,000 VDC	4.50	4.15
DRVT-15	A	50W	.004	3,500	250 Max.	—	3.195	1.950	.207	H34	Breakdown Voltage to 15,000 VDC	8.50	6.80

HAMLIN HIGH CURRENT MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
SRT-2	A	110VA	1.0	28VDC 110VAC	57.5-132.5	±7.5	3.375	1.610	.195	H-32	High Power Inductive Loads	2.50	2.00
DRR-129	A	100W	3.0	250	42.5-132.5	±7.5	3.250	1.950	.207	H34	Ideal for High Current Loads	2.00	1.60

HAMLIN KEYBOARD (LOW LEVEL) MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MARK-3	A	3W	.100	28	17.5-52.5	±7.5	1.775	.750	.105	H-33	Designed for Keyboard Applications	1.10	.83
MARK-4	A	3W	.100	28	17.5-52.5	±7.5	1.235	.600	.105	H-33	Low Profile Reed Switch for Keyboards	1.00	.75

HAMLIN RADIO FREQUENCY MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MSRF-2	A	.3W	.010	28	27.5-52.5	±10	2.230	.830	.102	H-33	Low R.F. Losses	1.75	1.31
MRMF-2	A	.3W	.010	28	27.5-52.5	±10	2.230	.830	.130	H-33	Low Thermal EMF 5μv/°C	3.50	2.62

HAMLIN ECONOMY MAGNETIC REED SWITCHES

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL IN.	GLASS LENGTH MAXIMUM IN.	GLASS DIAMETER MAXIMUM IN.	ACTUATING MAGNET	SPECIAL FEATURES	QUANTITY PRICING 1-24	QUANTITY PRICING 25-99
MLC-2	A	10W	.500	100	30, 35 & 40	±10	2.230	.800	.105	H-33	Economy Form A	1.10	.83
MLC-DT	C	3W	.110	28	27.5, 32.5 & 37.5	±10	2.125	.610	.130	H-33	Economy Form C—Sub-Miniature	3.25	2.64
DLC-DT	C	10W	.500	200	50-115	±15	3.375	1.562	.218	H-32	Economy Form C—Standard	1.75	1.15

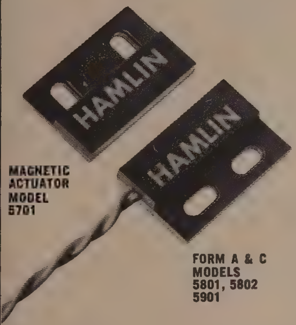
HAMLIN INC

628 LAKE STREET • LAKE MILLS, WISCONSIN 53551
PHONE: SALES 414/648-2361 • TWX 910-260-3740

REED SWITCHES / INDUSTRIAL SENSORS • LIQUID CRYSTAL DISPLAYS

Hamlin now offers the extreme reliability and long life associated with magnetic reed switches in our family of temperature sensing reed switches and reed proximity switches. All models listed are available from stock for immediate delivery. Please consult your local HAMLIN representative or distributor for more information.

REED PROXIMITY AND FERROUS SENSING SWITCHES —



MAGNETIC ACTUATOR MODEL 5701

FORM A & C MODELS 5801, 5802 5901

These reed proximity switches offer all the advantages of magnetic reed switches and come packaged ready for mounting. Epoxy packaging and Teflon coated wires resist solvents, acids and salts. These sensors are completely safe for use in hazardous environments and the shock and vibration characteristics are comparable with that of the basic reed switch.

FORM A & C MODELS — For AC or DC Operation

Part No.	Contact Arrangement	Contact Rating Max.	Switching Voltage Min.	Current Rating Max.	Breakdown Voltage Max.	EACH 1-24	25-49	50-99	100-249
5801	SPST-Form A	10 watts	500 VDC	.500 amp	250 V	$3.75	$3.40	$3.00	$2.60
5802	SPDT-Form C	3 watts	28 VDC	.250 amp	200 V	7.75	7.00	6.20	5.35

FORM A — 1½ Amp Reed/Triac Combination — AC Only

Part No.	Contact Arrangement	Current Rating Max.	Voltage Rating	Blocking Voltage	EACH 1-24	25-49	50-99	100-249
5901	SPST-Form A	1.5 amps*	120-240 VAC 50-60 Hz	400 V peak	$7.75	$7.00	$6.20	$5.35

*At 25°C peak single cycle surge (non-repetitive) 15 amps.

MAGNETIC ACTUATOR — For Form A & C Models

Part No.	Operating Distance	Differential	Release Distance	EACH 1-24	25-49	50-99	100-249
5701	to ⅝″*	⅛″ to ¼″*	9⁄16″ to 13⁄16″*	$2.00	$1.80	$1.60	$1.40

*Head-On Mode.

FERROUS OPERATED FORM A & B — 1½ Amp Reed/Triac Combination — AC Only

FORM A & B MODELS 5401/5403 5404/5406

Part No.	Contact Arrangement	Current Rating Max.*	Voltage Rating	Blocking Voltage	EACH 1-24	25-49	50-99	100-249
5401	SPST-Form A	1.5 amps	120 VAC 50-60 Hz	200 V peak	$9.75	$9.50	$9.25	$8.50
5403	SPST-Form B	1.5 amps		200 V peak	9.75	9.50	9.25	8.50

*At 25°C peak single cycle surge (non-repetitive) 15 amps.

FERROUS OPERATED FORM A & B — AC or DC

Part No.	Contact Arrangement	Contact Rating Max.	Switching Voltage Max.	Current Rating Max.	Breakdown Voltage Min.	EACH 1-24	25-49	50-99	100-249
5404	SPST-Form A	3 watts	100 VDC	.250 amp	200 VDC	$7.75	$7.00	$6.20	$5.35
5406	SPST-Form B	3 watts	120 AC	.250 amp	200 VDC	7.75	7.00	6.20	5.35

TEMPERATURE SENSING REED SWITCHES —

SPST
FORM A&B
L. 1.235″ x .250″
Wt. 1.4 grams
HAMLIN
HAMLIN

SPDT FORM C
L. 1.235″ x .250″
Wt. 1.6 grams

Hamlin temperature sensing reed switches feature automatic resetting, high repeatability, compact size and very long life. Hermetically sealed, safe for use in hazardous environments. Reed switch dependability permits millions of cycles. Standard units from −20°C to +120°C. High temp. units available only in 130, 180, 205 and 250°C temperature ranges, Form B only. Applications include temperature sensing in air, liquids semi-solids, or solids or anywhere that temperature control is needed.

AVAILABLE IN SPST FORM A & B OR SPDT FORM C

Part No.	Contact Arrangement	Contact Rating		Voltage AC	DC	Current (Amps) Carry	Break	Make	Tolerance	Reset Differential	EACH 1-24	25-49	50-99	100-249
TS-A	SPST-Form A (NO)	33W	33VA	120 max.	100 max.	1 max.	1 max.	.250 max.	±5°C	10°C max.	$2.45	$2.20	$2.00	$1.70
TS-B	SPST-Form B (NC)	10W	12VA	120 max.	100 max.	1 max.	1 max.	.500 max.	±5°C	10°C max.	2.10	1.90	1.70	1.43
TS-C	SPDT-Form C	3W	3VA	120 max.	100 max.	1 max.	1 max.	.250 max.	±5°C	10°C max.	5.65	5.10	4.55	3.90
TS High Temp.	SPST-Form B	10W	12VA	120 max.	100 max.	1 max.	1 max.	.500 max.	±10°C	10°C max.	5.65	5.10	4.55	3.90

CALL OR WRITE for the name and number of your nearest HAMLIN sales representative or distributor.

HAMLIN INC

REED SWITCHES/INDUSTRIAL SENSORS/LIQUID CRYSTAL DISPLAYS

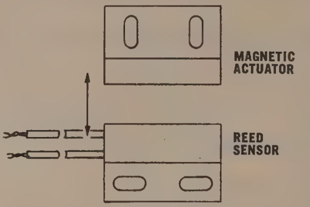
628 LAKE STREET • LAKE MILLS, WISCONSIN 53551
PHONE: SALES 414/648-2361 • TWX 910-260-3740

MODES OF OPERATION

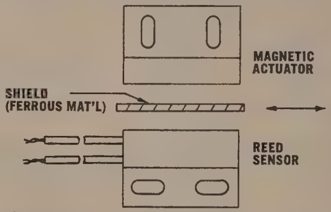
MAGNETICALLY ACTUATED PROXIMITY SWITCHES

MODES OF OPERATION

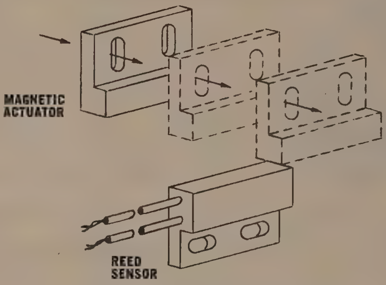
Magnetically Actuated Sensors


MAGNETIC ACTUATOR
REED SENSOR

In this mode of operation the center lines of the magnetic actuator and sensor remain constant while the distance between the two units varies.


MAGNETIC ACTUATOR
SHIELD (FERROUS MAT'L)
REED SENSOR

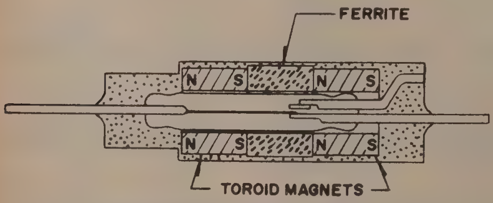
In this type of actuation sensor and actuator are permanently fixed. A piece of ferromagnetic material is passed between the magnet and switch to cause deactuation or release.


MAGNETIC ACTUATOR
REED SENSOR

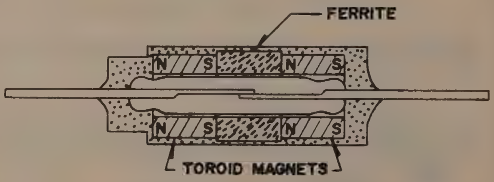
The reed sensor and magnetic actuator pass by each other while remaining parallel and at a constant distance.

WHAT ARE TEMPERATURE SENSING REED SWITCHES?

A basic temperature sensing reed switch consists of a magnetic reed switch, two toroidal magnets and a ferrite whose magnetic reluctance varies with temperature within a narrow range around its curie point. These four components are then potted with an epoxy compound holding the magnets in the proper position about the reed switch contacts. The epoxy also provides a protective coating for the glass to metal seals allowing the forming of the leads without fear of breaking the glass seals.


FERRITE
N
S
N
S
TOROID MAGNETS

TEMPERATURE SENSOR — FORM A


FERRITE
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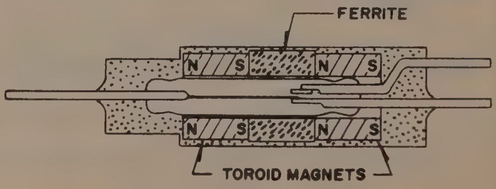
TOROID MAGNETS

TEMPERATURE SENSOR — FORM B

The three basic configurations of the temperature switch are the Normally Open Form A, the Normally Closed Form B and the Single Pole Double Throw Form C. On temperature rise the Form B will open, the Form A will close and the Form C will transfer contacts.


FERRITE
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TOROID MAGNETS

TEMPERATURE SENSOR — FORM C

HEINEMANN

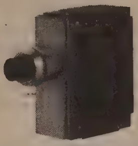
HYDRAULIC-MAGNETIC CIRCUIT BREAKERS

E-FRAME

SERIES AM1

SERIES JA

SERIES JC



SERIES JD

Heinemann breakers offer almost unlimited options: integral or fractional ratings from 10 milliamp to 100 amp, and in steps to 225 amp; single and multipole models; breakers for 60 or 400 Hz AC, or DC service; breakers that meet Mil Specs; and models with special internal circuits like relay-trip and calibrating-tap for control functions. Hydraulic-magnetic actuation assures that ratings and trip points are unaffected by ambient temperature changes. A wide selection of time-delay characteristics permits close match of breaker to equipment requirements. Request the Heinemann Engineering Guide (Bulletin 202), or the Condensed Guide (303), or contact your Heinemann representative. Individual product bulletins listed below.

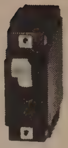
E-FRAME: Smaller than other E-Frame breakers, competitively priced. Approx. 5¾h x 2w x 2⅝d (2-pole). Available in 1 to 6 poles.

SERIES AM1: 1 to 4 poles. UL-component-recognized. Special circuits available. Approx. 2.5h x 2.5d, .75w per pole.

SERIES JA: Compact OEM breaker. Only 2.5 oz/pole. 1 to 4 poles. Approx. 2h x 1.875d, .75w per pole.

JA VARIANTS. Snap-In JB (1 to 4 poles) installs in rectangular panel cutout without screws. JC (1 to 4 poles—single-pole shown) has white or gray rocker handle. JD has round button for push-push operation. JE has moisture-sealed bat-type toggle for marine applications.

CROWBAR IN A CIRCUIT-BREAKER PACKAGE



SERIES JA/Q

The newest **Heinemann JA/Q Electronics Protector** is nearly all-encompassing in its ability to prevent damage to solid-state components. In one standard Series JA package it provides:

- transient/overvoltage crowbar protection, response time 500 nanoseconds;
- electromechanical equipment disconnect (protection for the crowbar) in 10 milliseconds;
- normal overcurrent protection

A thick-film hybrid SCR crowbar microcircuit is packaged into the rear of a Series JA hydraulic-magnetic circuit breaker. A transient or overvoltage on the AC or DC supply line will cause the SCR to fire, placing a dead short across the load to common. The short opens the breaker, removing the equipment from the line. Current ratings 0.020 to 10 A (DC), firing voltages 4.5 to 50 V (DC). Dimensions 2h x .75w x 1.8d. Bulletin 3371.

CONDENSED GUIDE TO HEINEMANN CIRCUIT BREAKERS

Type	Series	Bulletin	Poles	Maximum* Voltages	Interrupting Cap. (amp)	Current (amp)
PANEL MOUNTING	E-Frame	CF-3104	1,2,3,4,5,6	240 AC 480 AC 240 AC (400~) 125 DC	5,000 5,000 5,000 5,000	0.01 to 100 0.01 to 100 0.15 to 100 0.05 to 50
	EH-Frame	3441	2,3	480 AC	15,000	0.5 to 100
	CJ	3111	2	120/240 AC	10,000	125 to 200
			3	240 AC	10.000	100 to 225
GENERAL PURPOSE	1163	3412	1,2,3	250 AC 125 DC	5,000 5,000	0.01 to 100 0.016 to 100
AUXILIARY	0111	3201	1	250 AC	1,500	0.01 to 50
AM SERIES	AM1,	AM-3306	1,2,3,4	250 AC 250 AC (400~) 65 DC	1,000 1,000 1,000	0.02 to 60 0.02 to 60 0.02 to 60
	AM1000	3305	1,2,3	250 AC 250 AC (400~) 125 DC	1,500 1,500 2,000	0.01 to 70 0.15 to 65 0.015 to 100
MINIATURE	JA, JB, JC, JD, JE,	J-3333	1,2,3,4	250 AC 250 AC (400~) 65 DC	1,000 1,000 1,000	0.020 to 30 0.100 to 30 0.020 to 20
SUBMINIATURE	HE	HE-3504	1,2,3	250 AC 250 AC (400~) 50 DC	300 300 500	0.05 to 30 0.05 to 30 0.05 to 30

*AC voltages are 60 Hz unless marked with (400~).

SOLID-STATE DC CIRCUIT BREAKERS

Programable current rating from 0.3 to 1.5A

Last word in speed, reliability, and long life for protection of delicate electronic circuits, the Heinemann Model EA1-B3 reacts within microseconds to overcurrent conditions that might damage components protected even with the fastest electromechanical breaker.

Completely encapsulated; no moving parts; can mount in any position; practically infinite life. Two models—0.3 to 1.0 Adc, and 0.5 to 1.5 Adc, with rating within each range selectable by external programing resistance. Bulletin E-3600.

BROWNOUT PROTECTORS

Solid-state undervoltage sensor installs on third terminal of a Heinemann E-Frame, JA, or AM breaker. When 120V AC line voltage drops and stays between 90 and 100V for two seconds, undervoltage module trips the breaker, protecting motors and other loads from sustained voltage insufficiency. Bulletin 3372.

HEINEMANN ELECTRIC COMPANY 2636 Brunswick Pike, Trenton, N.J. 08602

6236

ILLUMINATED PRODUCTS INC. (formerly MARCO-OAK)

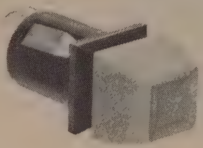
A Subsidiary of OAK Industries Inc.

For over 25 years, Illuminated Products Inc. (Marco-Oak) has been a leading innovator, designer and producer of illuminated pushbutton switches and indicators. IPI's advancements in switch design, esthetics, and dependability will enhance any equipment in which they are used.

IPI illuminated pushbutton switches are offered in a variety of styles: friction caps, low profile, snap-in, Marcoflex, watertight, splashproof, and EMI suppressed. The Presslite switch offers the convenience of a toggle switch combined with an indicator light. Switch bases, mounting hardware, and cap sizes, shapes and colors are designed in modular units ...more than 25,000 variations are possible. In addition, IPI can provide modified or custom switches to fit your panel environment.

SWITCHES — SNAP-IN PRESSLITE AND MARCOFLEX SWITCHES

½ amp momentary action switch and matching indicator



Suitable for use with Light Emitting Diode (L.E.D.)

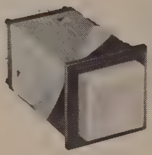
Write for IPI catalog SL-72A

The double break bifurcated wiping action contacts of the Snap-In Presslite Series provide extremely reliable switching for data entry and control applications. In addition to low initial cost, a further major saving results from the very simple mounting procedure of pressing the switch into a round panel hole. The round mounting hole provides a further advantage for matrix mount applications. Instead of the complicated egg crate assemblies which were used in the past, a simple plate with 11⁄16 inch diameter holes punched on ¾ inch centers is all that is needed to mount any size matrix.

All standard pushbutton styles and colors may be ordered for this switch in the type 590 (solder terminals) and 591 (printed circuit terminals) versions. In addition, pushbuttons are available which enhance legibility for use with L.E.D.s and neon lamps.

1. **Switch Characteristics**
   - Contact rating: ½ amp resistive at 30 VDC. 1/10 amp resistive at 115 VAC.
   - Nominal pushbutton travel: .1 in.
   - Nominal operating force: 4 oz.
   - Form X.
2. **Materials and Finishes:**
   - Pushbuttons: high impact plastic per L-P-349a.
   - Housing: black thermoplastic.
   - Mounting clip: stainless steel.
   - Lamp terminals: beryllium copper, tin plated.
   - Switch terminals and contacts: brass, gold plated.
3. **Lamp:** T-1¾ incandescent, T-2 neon, or L.E.D. with midget flange base. Lamp remains stationary when pushbutton is depressed.
4. **Mounting:** Assemblies press fit into .687 ±.005 dia. holes from front of panel .Mounting clips accommodate panels from 1⁄16 in. to 3⁄16 in.
5. **Weight:** Approx. .25 oz.
6. **Solder Terminals:** Terminals accept AMP FASTON receptacle #60415 -1 or equiv.

series 650 marcoflex switch



Write for Marcoflex literature.

The 650 series lighted pushbutton switches are the smallest units currently available that incorporate both double throw and alternate action configurations.

These are the first switches to use IPI's patented Marcoflex switch mechanism, which makes their compact size possible.

Essentially, Marcoflex construction means that switching is performed by a single flexed spring. This simple mechanism reduces the number of parts for increased reliability and low cost. It also provides Series 650 switches with all the desirable mechanical characteristics, generally associated only with larger units: wiping action, multiple point (bifurcated) contact, snap action, tactile feel and high contact force.

The high contact force, together with wipe and bifurcated construction, make the 650 Series switches particularly suitable for low level use. Typical applications are office machines, data systems, computer peripherals, process control apparatus, lab test equipment, broadcast studio controls, telephone systems, point of sale equipment, reservation systems, etc.

Switches are offered in a choice of seven pushbutton colors, which can be custom-engraved to user specifications. Eight lamps are available, ranging from 5 to 125 volts, and the switch can accept any economical unbased T-1¾ or AIC neon lamp. Two mounting choices are available; one has snap mounting clips with solder terminals for mounting on 1⁄16" - 3⁄16" panels, while the second features PC terminals for mounting directly on the PC board.

1. **Switch Characteristics:**
   - Contact rating: 1 amp resistive at 30 VDC, .25 amp resistive at 115 VAC.
   - Single pole, double throw (form C) alternate or momentary action with independent lamp circuit.
   - Wiping snap action; bifurcated contacts.
   - Operating force: 11 oz. nominal.
   - Pushbutton travel: .08 total.
2. **Materials and finishes:**
   - Pushbutton: polycarbonate.
   - Base: molded thermoplastic, black.
   - Terminals (lamp): phosphor bronze, tin plated.
   - Terminals (switch): phosphor bronze, gold plated.
   - Mounting clip: stainless steel.
3. **Lamp:** unit accepts any unbased T—1¾ incandescent or AIC neon lamp. Lamp may be replaced from front of panel by removing pushbutton. No tools required.
4. **Mounting:** two choices available: snap-in mounting clips for 1⁄16"-3⁄16" panels, (5⁄8 in. square holes or slot) or PC terminals for mounting directly on PC board.
5. **Solder terminals** accept AMP FASTON receptacle #60415-1 or equivalent.

ILLUMINATED PRODUCTS INC. (formerly MARCO-OAK)

A Subsidiary of OAK Industries Inc.

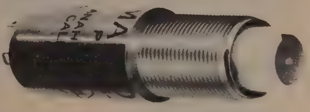
SWITCHES — FRICTION CAP PRESSLITES

Friction Cap Presslites provide the broadest possible flexibility in terms of electrical characteristics, appearance and mounting procedure, allowing the user to "engineer" a switch assembly to meet his specific requirements.

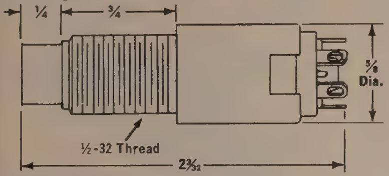
Many pushbutton sizes and configurations are offered, with sufficient space for engraved legends or symbols. Matching indicators are also available.

A wide range of mounting hardware is available to meet virtually every panel appearance or mounting requirement. All use T-1¾ midget flange based lamps.

Bases

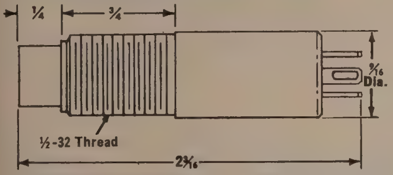


3 amp switch bases (typical)



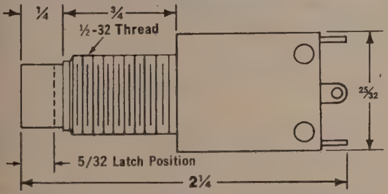
- Momentary Action
- 2 Sizes
- 4 Configurations
- Solder or PC Terminals
- Form Z
- U.L. Recognized
- Low Level Versions

5 amp switch bases (typical)



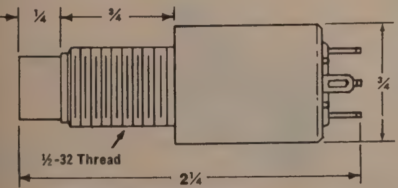
- Momentary or Alternate Action
- 2 Sizes
- Form C and 2 Form C
- With Internal Resistor
- U.L. Recognized

10.5 amp switch bases (typical)



- Momentary or Alternate Action
- U.L. Recognized
- 2 Sizes
- 4 Configurations
- Form X, Z, 2X, 2Z

15 amp switch base



- Momentary or alternate action
- Internal resistor available
- Form C

Pushbuttons

Styles:

Eleven different pushbutton styles are offered for Friction Cap Presslites, including "wrap-around" one-piece continuous construction, black opaque sides with colored top, reverse legend, "invisible" legend except when lit, and covered protected caps. There is a style to fit any panel requirement.

Pushbutton Colors:

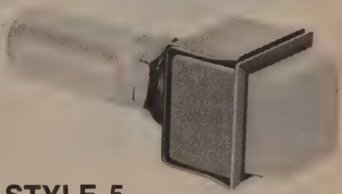
Colors include white, lunar, two reds, two greens, blue, yellow, and orange. Standard colors were selected to provide the best compromise between pleasing appearance in the "off" condition and high light transmission in the "on" state.

Shapes:

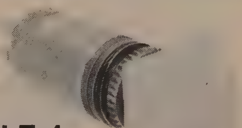
All shapes are available in keyed or unkeyed (rotatable) designs.

PUSHBUTTON SHAPE	PUSHBUTTON SIZE
ROUND	½ in. ⅝ in. ¾ in.
SQUARE	½ in. ⅝ in. ¾ in. ¾ in. keyboard
RECTANGULAR	½ x ¾ in. ½ x ⅞ in. ¾ x 1 in.

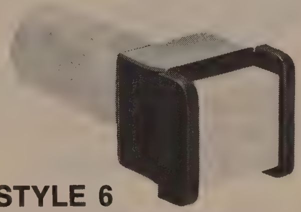
Mounting Hardware



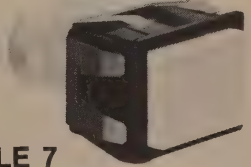
STYLE 5
recess adaptor
(also available in round configuration)



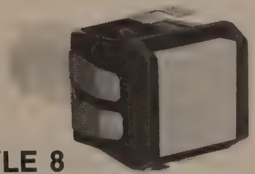
STYLE 1
knurled nut



STYLE 6
recess barrier mount



STYLE 7
flush snap-in mount



STYLE 8
barrier snap-in mount

Write for IPI catalog SL-72A

ILLUMINATED PRODUCTS INC. (formerly MARCO-OAK)

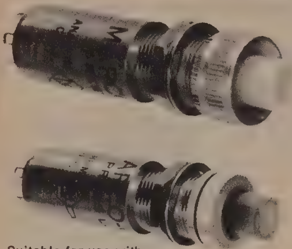
A Subsidiary of OAK Industries Inc.

SWITCHES — LOW PROFILE PRESSLITES, SNIPE

5 amp snap action

ALTERNATE ACTION TYPE 416, TYPE 616 MOMENTARY ACTION TYPE 418, TYPE 618

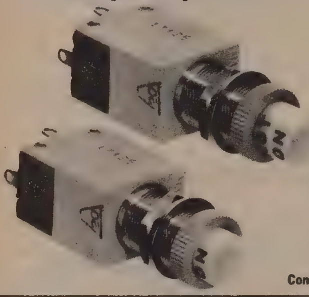
U.L. RECOGNIZED



Suitable for use with Light Emitting Diode (L.E.D.)

1. **Switch Characteristics:**
   - Contact rating: 5 amps resistive at 115 VAC or 28 VDC.
   - Nominal pushbutton travel:
     Type 416,616 7/32 in.
     Type 418,618 ⅛ in.
   - Nominal operating force:
     Type 416,616 1½ lbs.
     Type 418,618 2 lbs.
2. **Materials and Finishes:**
   - Pushbutton: high impact resistant plastic per L-P-349.
   - Pushbutton retention and knurled Mtg. nut: aluminum, bright anodized.
   - Keywasher and Mtg. nut; brass, nickel plated.
   - Housing: aluminum, anodized.
   - Terminals and contacts; coin silver.
   - Terminal board; diallyl phthalate, type SDG.
3. **Lamp:** T-1¾ incandescent, T-2 neon, or D2 L.E.D. with midget flange base. Lamp may be replaced from front of panel by removing pushbutton retention nut. Switches will not operate with lamp removed. Types 416 and 418 contain a built-in resistor for neon lamp use.
4. **Weight:** Approx. .5 oz.
5. **Styles:** Where maximum indication of pushbutton illumination is of primary importance, the reflector style retention nut is recommended.

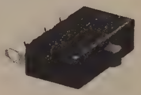
10.5 amp snap action



1. **Switch Characteristics:**
   - Contact rating; 10.5 amps resistive, 125/250 VAC. 10.5 amps resistive, 28 VDC, ¼ H.P. 125/250 VAC. Form C.
   - Alternate action switches: pushing button closes N.O. contacts and latches pushbutton. Pushing button again releases contacts and returns pushbutton to "out" position. Pushbutton latch point is 5/32 in. from "out" position. Switch and latch interlocked to prevent teasing.
   - Nominal pushbutton travel:
     Alternate action switches: 7/32 in.
     Momentary action switches: 3/32 in.
   - Nominal operating force:
     Single pole switches: 12 oz.
     Double pole switches: 20 oz.
   - Form X, 2 form X, form Z, and 2 form Z.
2. **Materials and Finishes:**
   - Pushbuttons; high impact resistant plastic per L-P-349.
   - Knurled nut; aluminum, bright anodized.
   - Keywasher and mtg. nut; brass, nickel plated.
   - Lockwasher; stainless steel.
   - Housing; molded thermoplastic.
   - Contacts: coin silver.
3. **Lamp:** T-1¾ incandescent with midget flange base or AlH neon. Lamp may be replaced from front of panel by removing pushbutton.
4. **Weight:** Approx. .6 oz.
5. **Solder Terminals:** Terminals accept AMP FASTON No. 60729-1 receptacles or equiv.

Contact Module U.L. Listed

10.5 amp, momentary action SNIPE switch



U.L. listed, CSA approved.

The IPI SNIPE (SNap/wIPE) 10.5 amp switch provides reliable switching at both low level and high power levels. The moving member is of rigid construction to assure immunity to high surge currents. One piece, pivotless moving contact construction assures uniformly low contact resistance.

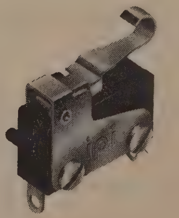
The patented wiping action provides self-cleaning of the contacts on every actuation, for superior low level performance. Optional gold plated contacts are available for use in mildly corrosive environments, or for low level use where the switch is actuated infrequently.

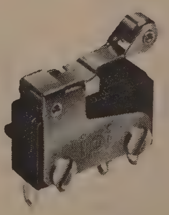
The SNIPE Switch is also available in two convenient, special actuator versions for specific applications.

The loop actuator version is recommended for use with non-sliding surfaces such as equipment doors and safety interlocks. The actuator mechanism is stainless steel.

The roller actuator version is recommended for use with sliding surfaces such as cams and is also of stainless steel construction.

1. **Contact Rating:** 10.5 amps resistive, 125/250 VAC, 10.5 amps resistive, 28 VDC. ¼ h.p., 125/250 VAC.
2. **Switch Characteristics:**
   - Pretravel; .050 in. max.
   - Overtravel; .012 in. min.
   - Operating force; 8 oz. max.
   - Release force; 2 oz. nominal
   - Movement diff.; .020 ± .005 in.
   - Form X or form Z.
3. **Materials and Finishes:**
   - Actuator; molded thermoplastic.
   - Housing; molded phenolic.
   - Terminals; brass, silver plated
   - Contacts; coin silver. Gold plating optional.
4. **Solder Terminals:** Terminals accept AMP FASTON No. 60729-1 receptacles.





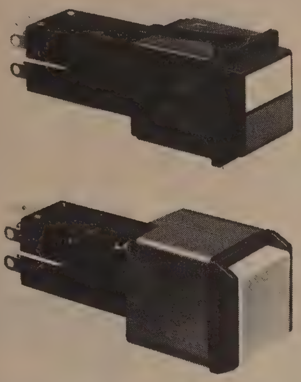
Write for IPI catalog SL-72A

ILLUMINATED PRODUCTS INC. (formerly MARCO-OAK)

A Subsidiary of OAK Industries Inc.

SWITCHES — PRESSLITES

700/800 SERIES



- Contact Rating: 10.5 amps resistive, ¼ H.P., 125/250 VAC. 10.5 amps resistive 28 VDC. Contact modules U.L. listed.
- Latching action: alternate action switches have latching pushbutton feature. Pushbutton latch point is 5/32″ from "out" position.
- Materials and finishes:
  Housing: black thermoplastic
  Contacts: silver alloy
  Lamp terminals: brass, tin plated
  Common terminal is gold finished.
- Lamp: T-1¾ bulb with midget flange base.
- Weight: 1.5 oz. (max.) including pushbutton and mounting hardware.

Illuminated Products 700 and 800 Series Presslites offer a new standard of versatility and convenience to the user. Pushbuttons are available for either split legend (2 lamp) or single legend (1 or 2 lamp) operation. Two optional mounting styles are offered, snap-in for minimum assembly time, and hard mount for application involving shock and vibration. Optional pushbutton barriers or bezels are available, on black or light grey housings. Barriers prevent accidental pushbutton depression.

Both alternate and momentary action is available. Alternate action switches are supplied with a latching pushbutton, which remains depressed while the switch is on, to provide visual recognition of the on-off condition. The latch mechanism (patent pending) is unique in that the switching and latching action are interlocked and occur simultaneously, making it impossible to "tease" the switch. Other latching pushbutton switches require full depression to latch; incomplete depression will temporarily close the switch, but release it as soon as operating pressure is removed.

Contact rating is 10.5 Amps at 125/250 VAC, or 28 VDC. The contact module is U.L. listed and CSA certified. Both single and double pole operation is available, in double break single throw (form X) or double break 2 circuit (form Z). The contacts provide both snap and wiping action, for operation over a broad load range.

All of the above configurations are also available without switch contacts for use as 1 or 2 lamp indicators.

COLORS

Pushbutton colors were selected to provide pleasing appearance in the "off" condition and high light transmission when the lamp is "on". Two red and two green colors are offered to permit effective illumination under both normal and high ambient light environments.

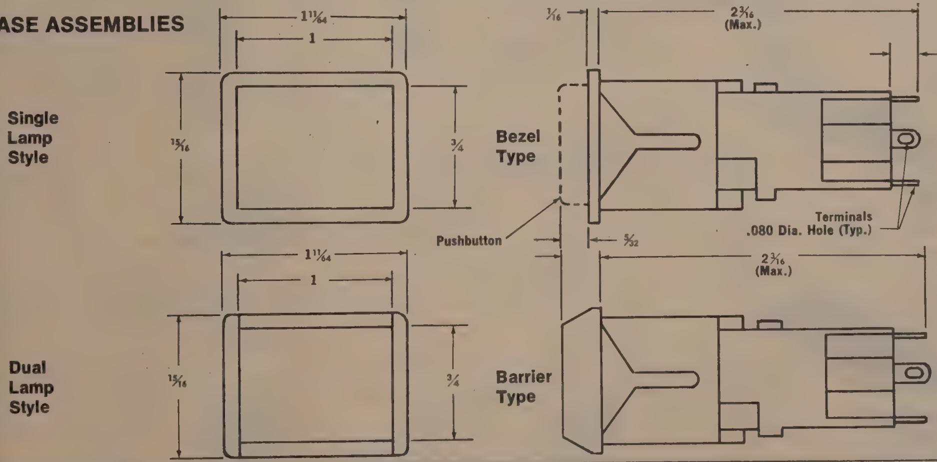
STYLES

Five different bushbutton styles offered meet most requirements. Other styles, such as hidden legends, are also available on special order. Where two different styles are required on a split legend pushbutton, a drawing or sketch should be provided.

ENGRAVING

Illuminated Products Inc. distributors provide custom engraving of all pushbutton styles. Where severe service is anticipated, Style 8 is particularly recommended to protect the engraved legend.

BASE ASSEMBLIES



Write for brochure IPI-2

ILLUMINATED PRODUCTS INC. (formerly MARCO-OAK)
A Subsidiary of OAK Industries Inc.
207 S. Helena St., P.O. Box 4011, Anaheim, CA 92803
Tel: (714) 535-6037 TWX 910-591-1185

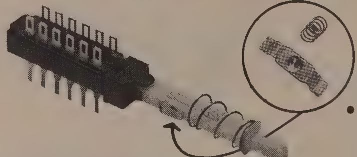
MODULAR PUSH BUTTON SWITCHES

SCHADOW™

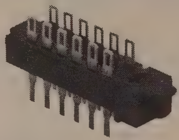
"Creative Switchmakers" for Home Entertainment Products and Test Equipment

If it's a better switch you need . . . better switch to Schadow!

better switch...here's why...

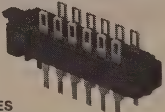


HAND WIRING AND FLO-SOLDERING CONNECTIONS ARE STANDARD
- Solder lugs on top for hand wiring
- PC spikes at bottom for flo-soldering



SUPERIOR MODULAR CONSTRUCTION
- Ease of maintenance . . . switch plunger with sliding contacts is removable from the front without disturbing electrical connections

INDIVIDUAL COIL SPRING LOADED MOVING CONTACTS
- The coil spring-loaded contoured moving contacts have been designed to provide balanced contact pressure for optimum surface to surface interface with the fixed contacts . . . assuring reliable performance in low voltage (dry circuit) applications
- Long term low contact resistance
- Constant coil spring tension at the contact points provides positive self-cleaning action



MODULE ADVANTAGES
- Enclosed housing protects inner contact area from dust and foreign intrusions
- Fixed terminals are "staked" in position, providing an extra seal to help prevent wicking of solder or flux
- Molded PC Board Standoffs, front and back, on bottom side, assure parallel mounting

TECHNICAL DATA

Contact Resistance ....4-6 mOhms
after 25,000 cycles ....6-20 mOhms
Lifetime Expectation Interlocked (50,000)
Momentary, Push Push (100,000) cycles
Material of Construction
Fixed contact. Brass/Silver Plated ....0002"
Moving contact ....Bimetal Brass/Silver .0004"
Plunger Material....Polycarbonate V-0 rated or Delrin
Contacts ....Non-shorting
Housing Material.........Polycarbonate V-0 rated or Glass Reinforced Nylon

Terminal Board Material ....High Grade Paper Phenolic or V-0 rated material......Series F
Key pressure with 2PDT ....28 oz.
Key pressure with 4PDT ....32 oz.
Key pressure with 6PDT ....35 oz.
Key pressure with 8PDT ....42 oz.
Key pressure with 10PDT ....46 oz.
Key pressure with Power Switch ....42 oz.

NOTE: Lighter key pressures available, contact factory for details.

NOTE: For switching applications requiring flame retardant materials, contact factory.

CHASSIS DIMENSIONS FOR SERIES F & SERIES G SWITCHES

NOTE: Maximum stations to be grouped in one interlocking action. 10mm-10 / 12.5mm-23 / 15mm-23 / 17.5mm-23 / 20mm-19

	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
C Dim. 10mm (.394)	A MTG.	1.181	1.575	1.969	2.362	2.756	3.150	3.543	3.937	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480	7.874	8.268	8.661	9.005	9.449	9.843	10.236	10.630	11.024	11.417	11.811	12.205	12.598	12.992	13.386	13.780	14.173	14.567	14.961	15.354	15.748	16.142	16.535	16.929	17.323
	B O-ALL	1.417	1.811	2.205	2.598	2.992	3.386	3.780	4.173	4.567	4.961	5.354	5.748	6.142	6.535	6.929	7.323	7.717	8.110	8.504	8.898	9.291	9.685	10.079	10.472	10.866	11.260	11.654	12.047	12.441	12.835	13.228	13.622	14.016	14.409	14.803	15.197	15.591	15.984	16.378	16.772	17.165	17.559

	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
C Dim. 12.5mm (.492)	A MTG.	1.201	1.693	2.185	2.677	3.169	3.661	4.154	4.646	5.138	5.630	6.122	6.614	7.106	7.598	8.091	8.583	9.075	9.567	10.059	10.551	11.043	11.535	12.028	12.520	13.012	13.504	13.996	14.488	14.980	15.472	15.965	16.457	16.949
	B O-ALL	1.437	1.929	2.421	2.913	3.406	3.898	4.390	4.882	5.374	5.866	6.358	6.850	7.343	7.835	8.327	8.819	9.311	9.803	10.295	10.787	11.280	11.772	12.264	12.756	13.248	13.740	14.232	14.724	15.217	15.709	16.201	16.693	17.185

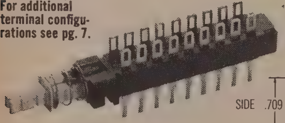
	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
C Dim. 15mm (.590)	A MTG.	1.378	1.969	2.560	3.150	3.740	4.331	4.921	5.512	6.102	6.693	7.283	7.874	8.465	9.055	9.646	10.236	10.827	11.417	12.008	12.598	13.189	13.780	14.370	14.961	15.551	16.142	16.732	17.323
	B O-ALL	1.614	2.205	2.795	3.386	3.976	4.567	5.157	5.748	6.338	6.929	7.520	8.110	8.701	9.291	9.882	10.472	11.063	11.654	12.244	12.835	13.425	14.016	14.606	15.197	15.787	16.378	16.968	17.559

	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C Dim. 17.5mm (.689)	A MTG.	1.476	2.165	2.854	3.543	4.232	4.921	5.610	6.299	6.988	7.677	8.366	9.055	9.744	10.433	11.122	11.811	12.500	13.189	13.878	14.567	15.256	15.945	16.634	17.323
	B O-ALL	1.713	2.402	3.091	3.780	4.468	5.157	5.846	6.535	7.224	7.913	8.602	9.291	9.980	10.669	11.358	12.047	12.736	13.425	14.114	14.803	15.492	16.181	16.870	17.559

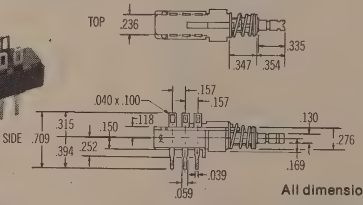
	No. of Stations	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
C Dim. 20mm (.787)	A MTG.	1.575	2.362	3.150	3.937	4.724	5.512	6.299	7.807	7.874	8.661	9.449	10.236	11.024	11.811	12.598	13.386	14.173	14.961	15.748	16.535	17.323
	B O-ALL	1.811	2.598	3.386	4.173	4.961	5.748	6.535	7.323	8.110	8.898	9.685	10.472	11.260	12.047	12.835	13.622	14.409	15.197	15.984	16.772	17.559

F SERIES

For additional terminal configurations see pg. 7.

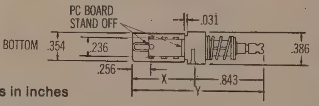


F-6U
6P DT



MODULE DIMENSIONS

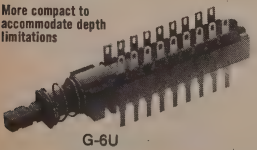
	X	Y
2PDT	.827	1.670
4PDT	1.300	2.143
6PDT	1.772	2.615
8PDT	2 244	3.087
10PDT	2.716	3 559



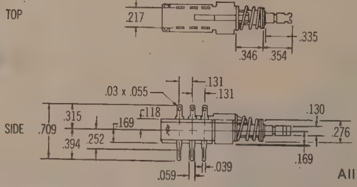
All dimensions in inches

G SERIES

More compact to accommodate depth limitations

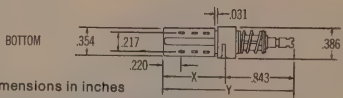


G-6U
6P DT



MODULE DIMENSIONS

	X	Y
2PDT	.705	1.548
4PDT	1.098	1.941
6PDT	1.492	2.335
8PDT	1.886	2.729



All dimensions in inches

IEE/SCHADOW inc

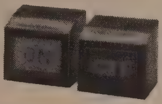
8081 Wallace Road, Eden Prairie, Minn. 55343
612/944-1820 • TWX 910-576-2469 • TELEX: 29-0556

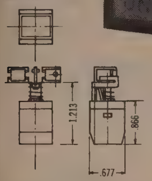
Manufacturing facilities in Minneapolis, Minnesota, Einbeck, W. Germany and W. Berlin
In Canada: Audio Electronics, 167 Denison St., Markham, Ontario L3R 1B5 • 416/495-0720

MECHANICAL REFLECTING INDICATOR BUTTONS FOR F & G SERIES

- Uses no energy. Needs no lamp, lamp/holder, power supply, switch contact or wiring.
- Works on the principle of reflecting ambient light through a clear plastic lens.
- Generates no heat and eliminates costly lamp replacement.

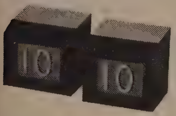
FA 110
DUAL LEGEND INDICATOR BUTTON





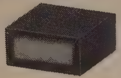
Legend and color change when button is depressed. (Legend is on indicator surface.)

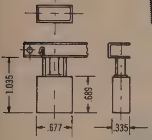
Button Shell Colors: Black, white, grey
Indicators: Black, green, orange, white, grey, yellow



Legend remains the same, but indicator color changes when the button is depressed. (Legend is on rear side of clear lens cap.)

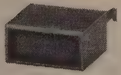
FA 100

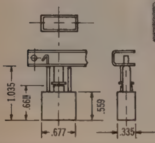




Button Shell Colors: Chrome, black, white, grey
Indicators: Blue, orange, yellow, green, amber, white

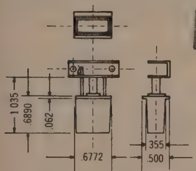
FA 105

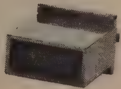




Button Shell Color: Chrome
Indicators: Blue, orange, yellow, green, amber, white

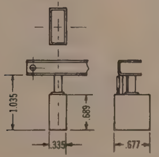
FA 106





Button Shell Colors: Chrome, black
Indicators: Blue, orange, yellow, green, amber, white

FA 101



Button Shell Colors: Chrome, black, white, grey
Indicators: Orange, yellow, green

right on the button . . .

standard buttons for Series F and G Switches

Rectangular buttons also can be snapped on vertically to provide more selection of larger buttons on smaller chassis spacing.

Standard colors shown . . . other colors to match or contrast with your equipment available on special order.

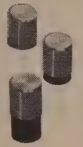
FM
Diameter: .197" to. 284"
Length: .492"
Standard Minimum Spacing: 10mm
Colors: Black, White, Grey

FG
Diameter: .346"
Length: .413"
Standard Minimum Spacing: 10mm
Colors: Black, White, Grey, Red, Green, Chrome

F-200
Diameter: .394"
Length: .433"
Standard Minimum Spacing: 12.5mm
Colors: Chrome/Black, Black/Black

FZ
Diameter: .394"
Length: .642"
Standard Minimum Spacing: 12.5mm
Colors: Black/Black, White/Black, White/Red, Red/Black, Red/Grey

F1.12 - H-3
F1.15 - H-3
F1.21 - H-3
Diameters: .433", .433", .433"
Lengths: .472", .591", .827"
Cap Depth: .472"
Standard Minimum Spacing: 12.5mm
Colors: Black/Metal Cap

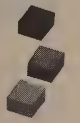


F1.12 - H-4
F1.15 - H-4
F1.21 - H-4
Diameters: .394", .394", .394"
Lengths: .472", .591", .827"
Cap Depth: .079"
Standard Minimum Spacing: 12.5mm
Colors: Black/Metal Cap

F1.12 - H-5
F1.15 - H-5
F1.21 - H-5
Diameters: .480", .480", .480"
Lengths: .571", .689", .925"
Cap Depth: .571"
Standard Minimum Spacing: 12.5mm
Colors: Black/Chrome

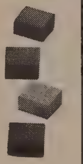
FGK
Diameter: .473"
Length: .492"
Standard Minimum Spacing: 12.5mm
Colors: Red, White, Black

FSC
Width: .386"
Height: .217"
Length: .441"
Standard Minimum Spacing: 10mm
Colors: White, Black, Grey

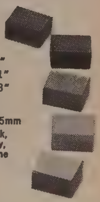


FSO
Width: .484"
Height: .276"
Length: .413"
Standard Minimum Spacing: 12.5mm
Colors: Black, White

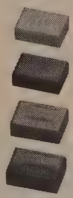
FU12
Width: .470"
Height: .216"
Length: .440"
Standard Minimum Spacing: 12.5mm
Colors: Black, White, Grey, Red



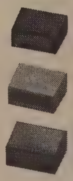
FSM
Width: .579"
Height: .291"
Length: .433"
Standard Minimum Spacing: 15mm
Colors: Black, White, Grey, Red, Chrome



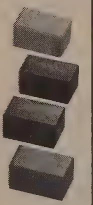
FE
Width: .681"
Height: .236"
Length: .472"
Standard Minimum Spacing: 17.5mm
Colors: Black, White, Grey, Red



FSA
Width: .677"
Height: .315"
Length: .512"
Standard Minimum Spacing: 17.5mm
Colors: Black, White, Grey
Inserts: Silver or Gold

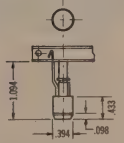


FA
Width: .772"
Height: .394"
Length: .453"
Standard Minimum Spacing: 20mm
Colors: Black, White, Grey, Red



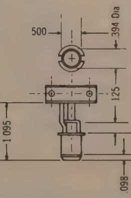
04-7060-00
Width: .487"
Height: .487"
Length: .590"
Cap Depth: .480"
Standard Minimum Spacing: 12.5mm
Colors: Spun-Finish Chrome

FA 201



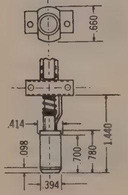
Button Shell Colors: Chrome, black, white, grey
Indicators: Blue, orange, yellow, green

FA 206



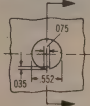
Button Shell Colors: Chrome, black
Indicators: Blue, orange, yellow, green

FA 207



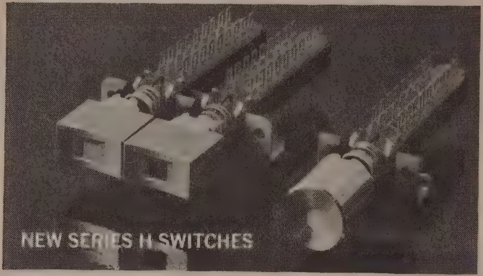
Button Shell Colors: Chrome, black
Indicators: Blue, orange, yellow, green

ZF THREADED BUSHING MOUNT WITH FA 200 BUTTON



Button Shell Colors: Chrome, black, white, grey
Indicators: Blue, orange, yellow, green
Choice of black or chrome front mounting nut.

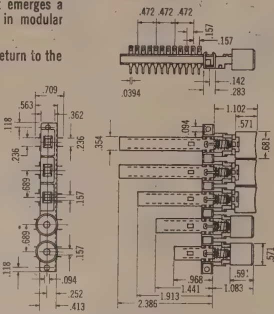
the right touch to turn your equipment on


NEW SERIES H SWITCHES

Out of Schadow and into the limelight emerges a significant and exclusive breakthrough in modular push button switches.

Schadow Series H push buttons always return to the out position to provide continuity of attractive appearance . . . indicate function by a remarkable reflecting principle . . . and are quieter both in push-push and interlocking actions. Add these pluses: constant low contact resistance, coil spring loaded contoured bridging contacts, solder lugs on top, PC spikes bottom, with molded circuit board stand-offs . . . pin centers .157" . . . all the proven characteristics of Schadow successful Series F.

If it's a better switch you need . . . better switch to Schadow.

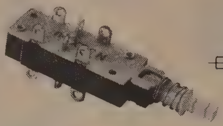

.472
.472
.472
.157
.157
.0394
.142
.283
.709
.563
.362
.118
.236
.236
.689
.157
.689
.157
.118
.094
.252
.413
.354
.094
1.102
.571
.681
.571
.968
1.441
1.913
2.386
.59
1.083

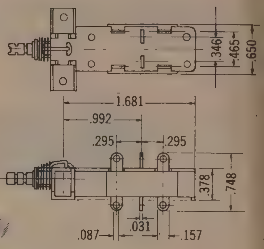
NOTE: Available 2PDT through 8PDT. Also available TV-5 Rated Power Switch.

IEE/SCHADOW inc

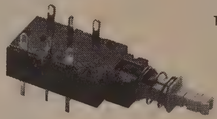
N30 TV-5 rated power switches

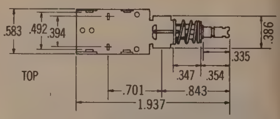
(Also available with 2PDT low voltage auxiliary contacts) UL, CSA, VDE Approved.



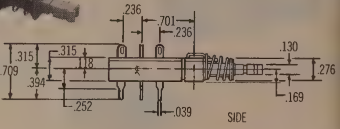

.346
.465
.650
1.681
.992
.295
.295
.378
.748
.087
.031
.157

Series NE 15/F line switches




.583
.492
.394
.386
.335
.347
.354
TOP
.701
.843
1.937

(Also available with 2PDT low voltage auxiliary contacts) UL, CSA, VDE Approved, 6 AMP 250 VAC.


.236
.701
.236
.130
.315
.315
.118
.709
.394
.276
.169
.252
.039
SIDE

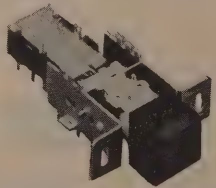
NEED GRAPHICS?

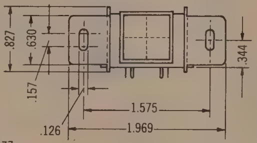
Several examples are shown below. Your specific requirements quoted on request. (Graphics pictured on FA 100 push buttons)

OFF
TAPE
STEREO
MATRIX
PHONO

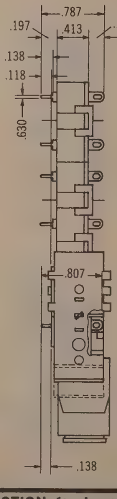
NC-17 line switch

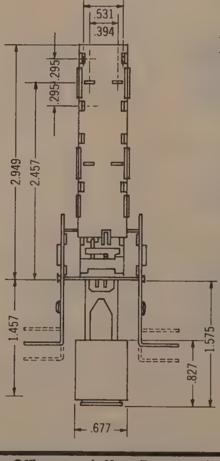
2PDT (pictured); 4PDT.

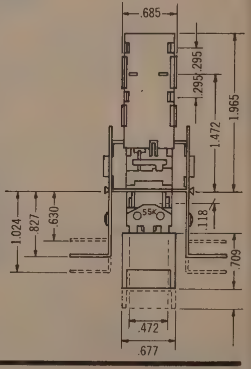



.827
.630
.344
.157
1.575
.126
1.969

POWER SWITCH NC17 (UL, CSA and VDE Approved)
Max Voltage — 250 ac.
Max. Current — 6A (Cos$\phi = 0.75$)
Max. Current — 3A (Inductive load)
Max. Voltage — 250 dc.
Max. Current — 4A dc.
Test voltage between terminals & chassis: 3000V ac.
Test voltage between terminals & contacts: 2000V ac.
Contact Resistance: 50 milli Ω (With rated load).


.787
.197
.413
.177
.138
.118
.630
.807
.138


.531
.394
.295
.295
2.949
2.457
1.457
1.575
.827
.677


.685
.295
.295
1.965
1.472
.118
1.024
.827
.630
.709
.472
.677

CA-110 SERIES

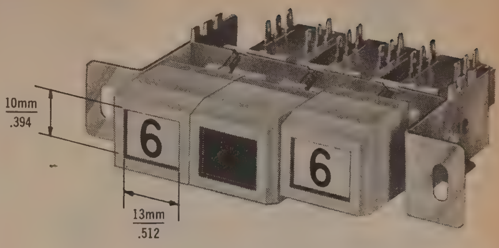
Schadow, the creative switchmaker, has developed a "lampless" push button switch, with bright color indicators — with or without graphics — to mechanically indicate changing functions.

This innovative push-button switch, Series CA 110, is for use in high quality commercial applications. The sophistication of the series in terms of electrical construction (bifurcated contacts — coil spring loaded) and mechanical actions available, will satisfy the most demanding switching requirements.

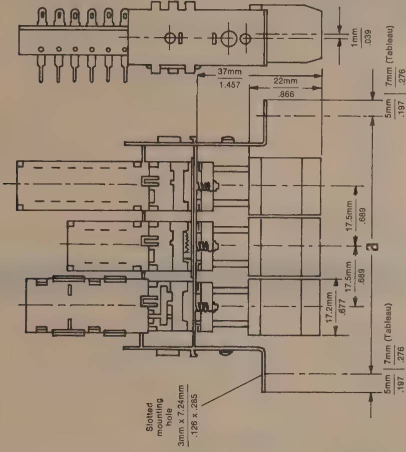
Tableau or stacked switches are available in Series CA 110, 15 switches wide x 10 high per chassis.

Because a lamp and socket assembly is omitted, economies in manufacture permit a lower pricing schedule, and the elimination of another drain on electrical power sources.

If it's a better switch you need . . . better switch to Schadow.


10mm
.394
13mm
.512
6
6

CA 110


1mm
.039
37mm
1.457
22mm
.866
7mm (Tableau)
.276
5mm
.197
17.5mm
.689
a
17.5mm
.689
17.2mm
.677
7mm (Tableau)
.276
5mm
.197
Slotted mounting hole
3mm x 7.24mm
.126 x .285

Legend and color change when button is depressed. (Legend is on indicator surface.)

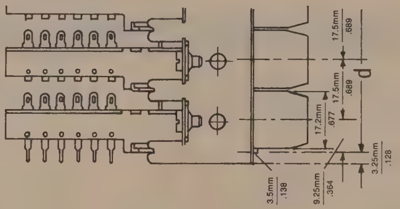
or

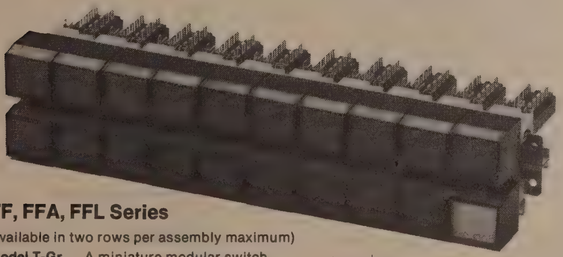
Legend remains the same, but indicator color changes when the button is depressed. (Legend is on rear side of clear lens cap.)

STANDARD COLORS		
BUTTON SHELL	INDICATOR OFF	INDICATOR ON
White	White	White
Gray	Gray	Gray
Black	Black	Black
	Yellow	Yellow
	Green	Green
	Orange	Orange
	Metallic	Metallic

For custom legend applications contact factory.

CA 110 TABLEAU


17.5mm
.689
d
17.5mm
.689
17.2mm
.677
3.25mm
.128
3.5mm
.138
9.25mm
.364



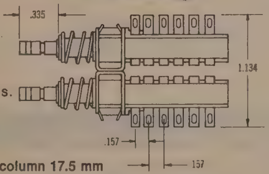
FF, FFA, FFL Series

(available in two rows per assembly maximum)

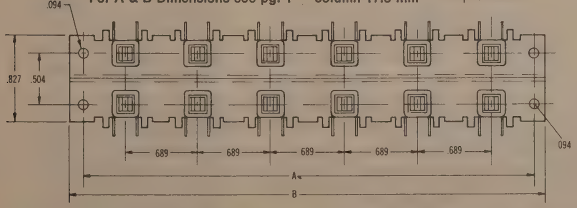
Model T-Gr — A miniature modular switch assembly featuring row-to-row interlocking at low cost.

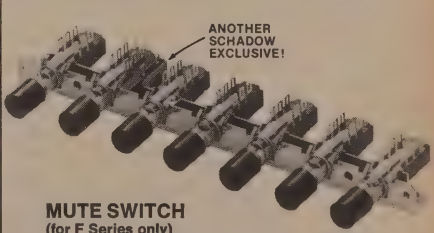
Electrical and mechanical specifications are the same as Series F.

FF Series features Standard F Series push buttons. FFA Series features Schadow mechanical reflecting indicator buttons. FFL Series features illuminated push buttons.


.335
1.134
.157
.157

For A & B Dimensions see pg. 1 — column 17.5 mm


.094
.827
.504
689
689
689
689
.689
.094
A
B

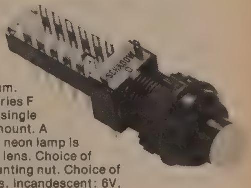

ANOTHER SCHADOW EXCLUSIVE!

MUTE SWITCH
(for F Series only)

To mute noise in critical audio or video circuits. By attaching one Schadow Mute Switch to any module in an interlocking group, momentary closure is made automatically when any button is pushed.

Mute Switch has solder lugs on top, PC pins at bottom in the same plane as F Series switches for ease of installation.

ZFL Series illuminated

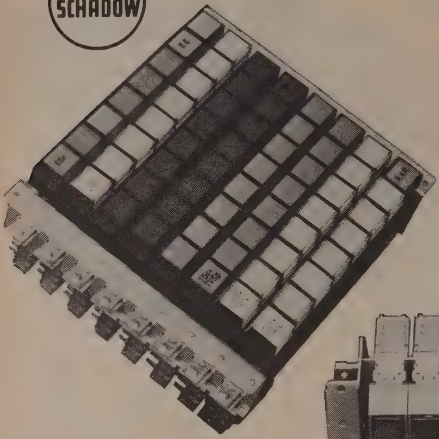


Compact, for illumination where space is at a premium. ZFL can be fitted to any series F module for an illuminated single position central bushing mount. A miniature incandescent or neon lamp is mounted behind a colored lens. Choice of black or chrome front mounting nut. Choice of red, green or yellow lenses. Incandescent: 6V, 12V or 28V Neon: 110-220 AC

Special Terminal Configurations and selective removal of PC pins or Solder lugs as required.

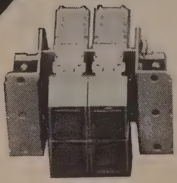
SCHADOW

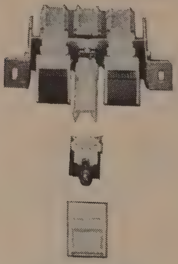
High quality Series CL illuminated and Series C non-illuminated push button switches



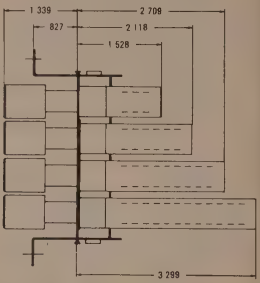
This push-button switch is for use in high quality commercial applications. The sophistication of the Series "CL" & "C" in terms of electrical construction (bifurcated contacts — coil spring loaded) and mechanical actions available will satisfy the most demanding switching requirements.

Tableau or stacked switches available either "CL" or "C" Series, 15 switches wide x 10 high per chassis. With the designation Series "CL" this switch is available with slip-on lamp holder. Use Type 5522 lamp. Button spacing is 17.5mm (.689").





Remover plunger, including button and the sliding bifurcated contacts, by loosening the locking bar.



SPECIFICATIONS: SERIES CL and C PUSH BUTTON SWITCHES

MECHANICAL DATA

Key travel = .315" Contact travel = .197"
Life 300,000 cycles depending upon load.
Key pressure — 2 & 4PDT = 35 oz.; 6 & 8PDT = 49 oz.

MECHANICAL ACTIONS AVAILABLE

Gr	= Interlocking.
Gr_1, Gr_2	= Two independent interlocking groups.
o.A.	= Momentary.
A.o.R.	= Momentary release button for interlocking.
EE	= Push-push.
Z	= Central release for individual latching.
Sp	= Blocking action only one key down. Switching is delayed to increase margin of safety.
Gr + Sp	= Interlocking with blocking. Maximum 15 button (stations) in one row.
Gr_1, + Sp Gr_2 + Sp	= Two groups of interlocking with blocking. (Group 1 can be blocked independent of Group 2.)
o.A. + VSp	= Momentary action with blocking.
EE + VSp	= Push to engage, push again to release — with blocking. The depressed button must first be released before another button can be depressed.
Gr + VSp + A.o.R.	= Interlocking with blocking and locking of button with one central momentary release button. The depressed button must first be released by central release button or solenoid remote release, before another one button can be depressed.
Gr + RSp + A.o.R.	= Locked — Interlocking with blocking. A central release button must first be depressed before any of one interlocked buttons can be depressed; this button remains latched after release button is allowed to return. The main circuit can be interrupted, if necessary, through the release button contacts. In this way, a 4 amp. circuit can be switched, without current, through standard C-Module switch contacts.

CHASSIS AND STATION DATA

Model Number	17.5
Center to center spacing	0.689"
Number of stations	1-15
Standard Buttons-Series "C" (Non-illuminated)	CSX
Standard Buttons-Series "CL" (Illuminated)	CRS, CRR

CONTACT TYPES

Standard: Non-shorting — Solder Terminals Top, PC Terminals Bottom.

Shorting: ks	Short PC top, Standard PC bottom: SI Short PC terminals both sides: SC Special cut off terminals either side .036" long.

INSULATION MATERIAL

Contact Plate: Phenolic 20.62.8 Kl.IV
Module: Polycarbonate (Makrolon)
Contact Plunger 2u, 4u: Polycarbonate (Makrolon)
Contact Plunger 6u, 8u: Polyamid
Outer Plunger: Azetalharz

ELECTRICAL DATA

Voltage Max.: 1000 volts.
Current Max.: 2 amps $\cos_{\phi} = 1$.
Load Max.: 100 watts ac.
Load Max.: 25 watts dc.
Test Voltages: Contact to ground 300 volts ac.
Terminal to terminal: 2000 volts ac.
Auxiliary terminals to outer-terminals: 100 volts ac.
Lamp holder contacts to ground: 1500 volts ac.
Insulation Resistance: $10^{12}\ \Omega$ after 96 hours storage in 95-100% humidity.
Contact Resistance: 5 milli Ω.
Contact Resistance: After 25,000 switching cycles — about 15 milli Ω (depends on load).
Dielectric loss, $tg\delta\ 4x10^3$ (300 kHz).

POWER SWITCH NC17 (UL, CSA and VDE Approved)

Max Voltage — 250 ac.
Max. Current — 6A ($Cos\phi = 0.75$)
Max. Current — 3A (Inductive load)
Max. Voltage — 250 dc.
Max. Current — 4A dc.
Test voltage between terminals & chassis: 3000V ac.
Test voltage between terminals & contacts: 2000V ac.
Contact Resistance: 50 milli Ω (With rated load).

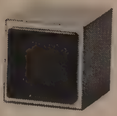
SPECIFICATIONS: SERIES CL TABLEAU SWITCHES

TABLEAU MECHANICAL FEATURES

EGr	= Interlocking independent of each row.
EGr + ESp	= Interlocking with Blocking independent of each row.
TGr	= Interlocking of several (maximum 10) rows up to 150 buttons without blocking.
TGr + ESp	= Interlocking of all buttons, but blocking of buttons in each individual row of switch banks only.
TGr + TSp	= Interlocking and blocking of all buttons (only one button can be depressed at a time).
TGr + TVSp + A.o.R.	= Central release button, or solenoid release, interlocking with blocking. Only one button can be depressed in entire Tableau until central release button is depressed to release previously depressed button.
TEE + TVSp	= Push to engage. Push to release with blocking of tableau section referred to. The only one depressed button must be depressed again to release before any other one button can be depressed.
TGr + TRSp + A.o.R.	= Locked — interlocking with blocking. A central release button must first be depressed and held in its position before any one of the interlocked buttons can be depressed. This button remains latched after release button is allowed to return. The main circuit can be interrupted, if necessary, through the release button contacts. In this way 4 amp can be switched, without current, through the Standard C-Module switch contacts.
EGr + TRSp + A.o.R.	= Central release button in each row (righthand side) with pre-locking of entire keyboard. Only one button can be depressed in the Tableau, and only in that row, the central release button previously has been depressed. The central release buttons are connected as one lock. Each row of interlocked switch banks is independent of each other.

SERIES CL (illuminated style) and SERIES C (non-illuminated style) Buttons

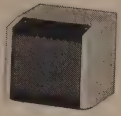
SCHADOW IEE/SCHADOW inc



CSR Push Button

Body:
Black, White, Chrome

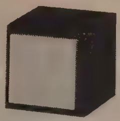
Lens:
Clear, Red, Yellow, Blue, Green, Orange, Grey



CRR Push Button

Body:
Black, White

Lens:
Clear, Blue, Green, Red, Yellow, Orange



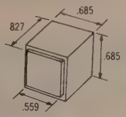
CSX Push Button

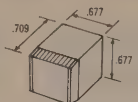
Body:
Black, White, Chrome

Lens:
Black, White, Red, Green

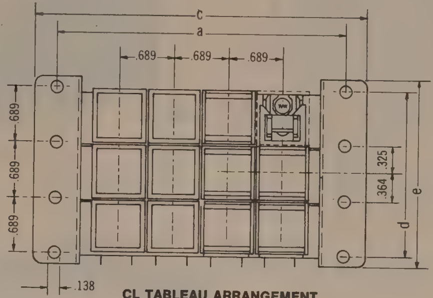
Graphics also available on rear side of lens series CSR and CRR.

CSR and CSX Button Dimensions

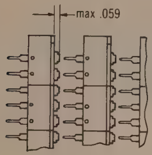

.685
827
.685
.559



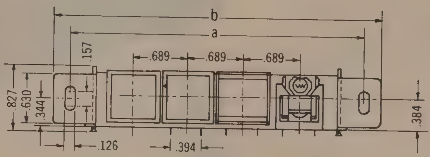
CRR Button Dimensions


c
a
.689
.689
.689
.689
.689
.689
.325
.364
e
d
.138

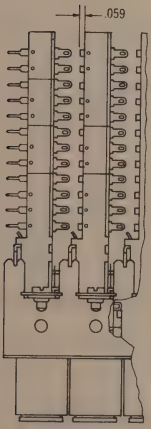
CL TABLEAU ARRANGEMENT



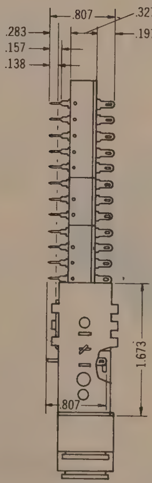
CL TABLEAU OPTIONAL TERMINAL CONFIGURATION


b
a
.157
.689
.689
.689
.827
.630
.344
.384
.126
.394

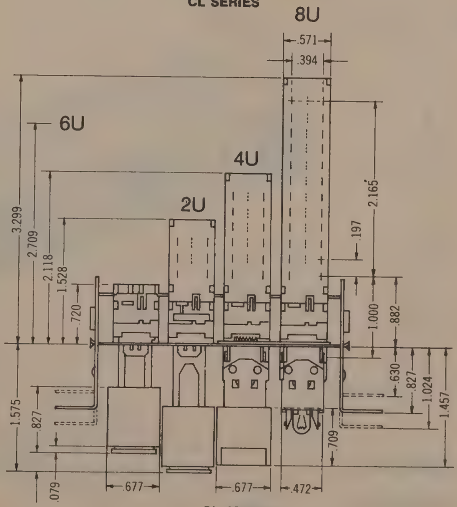
CL SERIES



CL TABLEAU


.807
.327
.283
.197
.157
.138
1.673
.807

CL SERIES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6U
4U
2U
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2.709
2.118
1.528
.720
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.197
1.000
.882
.630
.827
1.024
1.457
1.575
.827
.709
.079
.677
.677
.472

CL SERIES

MOUNTING AND DIMENSIONAL INFORMATION

No. of Stations	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	1.575	2.264	2.953	3.642	4.331	5.020	5.709	6.398	7.087	7.776	8.465	9.154	9.843	10.531	11.220
b	1.969	2.657	3.346	4.035	4.724	5.413	6.102	6.791	7.480	8.169	8.858	9.547	10.236	10.925	11.614
c		2.815	3.504	4.193	4.882	5.571	6.260	6.949	7.638	8.327	9.016	9.705	10.394	11.083	11.772
d		2.067	2.756	3.445	4.134	4.823	5.512	6.201	6.890						
e		2.323	3.012	3.701	4.390	5.079	5.768	6.457	7.146						

IEE/SCHADOW inc

FL Series illuminated push-button switches

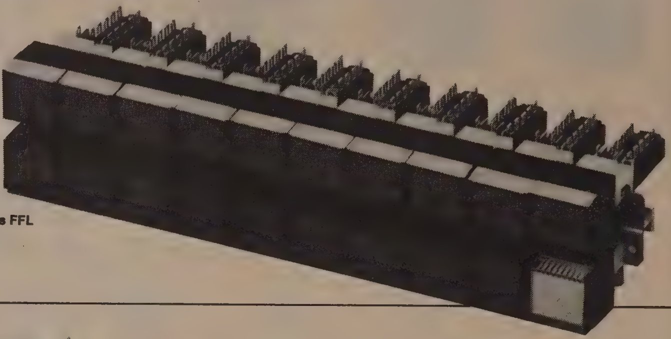
Series F switches can be illuminated simply by installing a snap-fit lampholder, a lamp, and an illuminated-type button. Only the basic front dimensions change. The only additional cost is the lampholder, bulb and the illuminated button.

Illuminated buttons are available with clear or colored front mounted lenses with a white translucent markable insert behind the lens. The lens is easily removable to legend the insert or for lamp replacement. Centerline is 17.5mm for Series FL Switches.

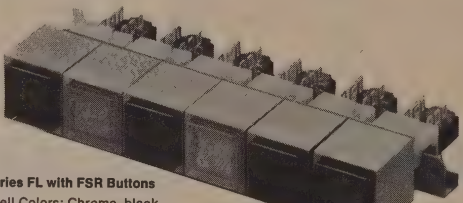
STANDARD LAMPS AVAILABLE:

6522- 6V.30mA
12522-12V.30mA
13522-24V.30mA

Unless otherwise specified, lamps are installed at the factory.



Series FFL

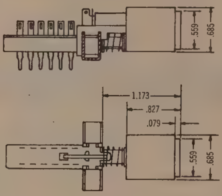


Series FL with FSR Buttons

Shell Colors: Chrome, black, white, grey

Lens Colors: Blue, clear, green, grey, orange, red, yellow

Series FL with FSR Button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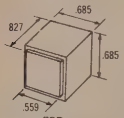
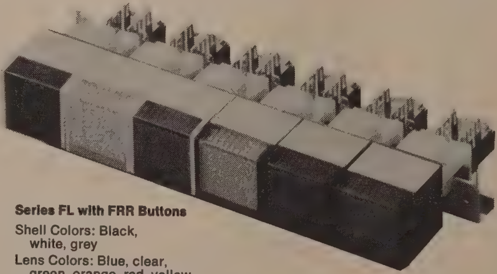

.685
827
.685
.559

FSR
BUTTON DIMENSIONS

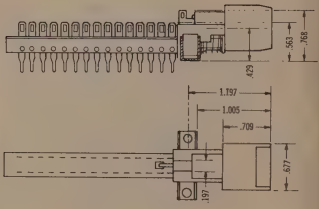


Series FL with FRR Buttons

Shell Colors: Black, white, grey

Lens Colors: Blue, clear, green, orange, red, yellow

Series FL with FRR Button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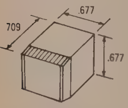
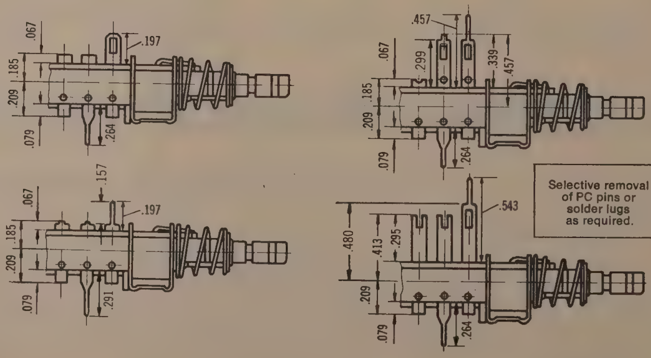
1.197
1.005
.709
.677
.197



FRR
BUTTON DIMENSIONS

Special terminal configurations available


.067
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.067
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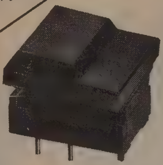
.209
.079
.264
.157
.067
.197
.185
.209
.079
.291
.543
.480
.413
.295
.209
.079
.264

Selective removal of PC pins or solder lugs as required.

digitast™

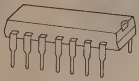
modular electronic switch input component



digitast

SR 12.3mm wide x 17.1mm

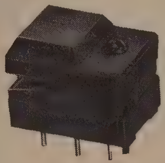
ST 17.3mm wide x 17.1mm (pictured)



digitast

SRL (LED factory or customer installed) 12.3mm wide x 17.1mm (pictured)

STL (LED factory or customer installed) 17.3mm wide x 17.1mm



Digitast is a remarkable new modular electronic switch input component for use with dual in-line packages (DIP). The inner construction, in connection with standard TTL-IC's, eliminates more costly and troublesome conductor plate sandwiched switches.

The single pole, double throw momentary contact element is made of gold-plated over nickel-plated brass. Included in the contact arrangement is a unique bussing contact precluding the need for double-sided printed circuit boards in most applications. The design of the Digitast housing around the outer contacts prevents wicking of flux or solder.

The contact arrangement of the DIP also lends itself to economical PC board designs and assembly techniques of sophisticated electronic equipment. The modular design allows simple plug-in capability, including 2 PC board locator pins and 4 PC board stand offs for flush, parallel mounting. A crisp, consistent tactile feel is achieved through the use of a spring-loaded, vibration-free inner contact arrangement. Two standard button sizes are available: the 12.3mm and 17.3mm widths, with or without light emitting diodes (LED).

The unique two level button design permits the use of the lower level for LED INSTALLATION or for economical HOT STAMPED GRAPHICS.

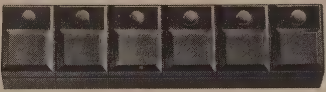
Digitast's uncomplicated construction allows you to economically design varied button configurations to your individual requirements.

Pushing the button applies pressure to the cross bar switching mechanism, in connection with the single pole bussing feature, achieving very low contact bounce and insuring constant electrical output.

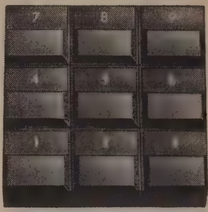
Digitast is innovatively designed for incorporation into the sophisticated electronic equipment of today and tomorrow.

CONSISTENT TACTILE FEEL

Individual button designs for volume orders



Above: Row arrangement—digitast—SRL minimum 12.7mm (.5 in) center distance within a row 17.8mm (.7 in) center distance between more than one row.



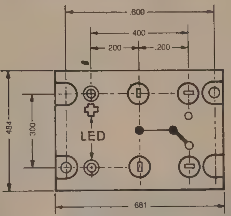
Right: Tableau arrangement — digitast — ST minimum 17.8mm key. centers (.7 in)

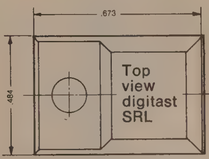
TECHNICAL DATA

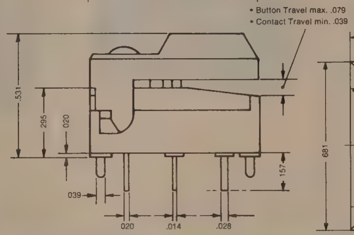
Housing: Polyamid
Total Button Travel: Max. 2mm
Contact Travel: Min. 1mm
Key Pressure: 2N (120p)
Life Expectancy (Mechanical): 5x10⁶
Mounting Method: by soldering to PC board
Ambient Temperature Range: −25°C +85°C
Contact: Brass, gold plated over nickel plated
Current Rating: 24V 10mA
Bounce (Contact time): less than 1MS

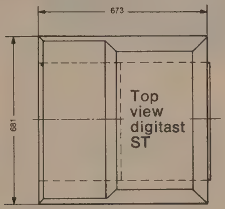
LED SPECIFICATIONS — Type SRL and STL

Type: HP 5082-4484 or equivalent
Color: Red, Green Yellow
Light Band: 660nm
Luminous intensity at 20mA: 8 mcd (1.2 mcd)
DC Forward Current: 50mA (40mA)
DC Power Dissipation: 100mW
Forward Voltage at 20mA: 1.6V
Digitast can be supplied with button disassembled for customer procurement/installation of LED.







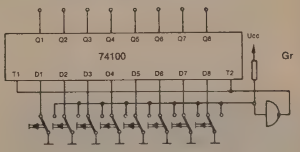


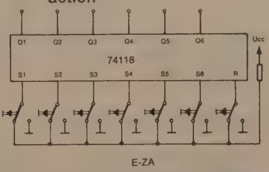
APPLICATION SCHEMATICS — Bounce Free Switching With Standard-TTL-Ics

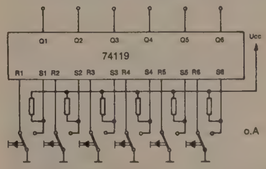
Right: Button arrangement with interlock function

Below: Push to maintain — Button arrangement with central release

Below Right: Button arrangement—Momentary action







Due to continuing research and product technology, specifications are subject to change without notice.

IEE/SCHADOW inc

8081 Wallace Road, Eden Prairie, Minn. 55343
612/944-1820 • TWX 910-576-2469 • TELEX: 29-0556

Manufacturing facilities in Minneapolis, Minnesota, Einbeck, W. Germany and W. Berlin
In Canada: Audio Electronics, 167 Denison St., Markham, Ontario L3R 1B5 • 416/495-0720

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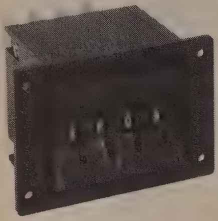
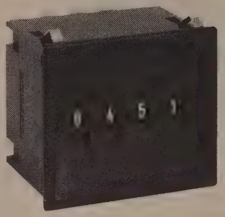
(415) 347-8217 • TWX 910-374-2353 • TELEX 34-9373



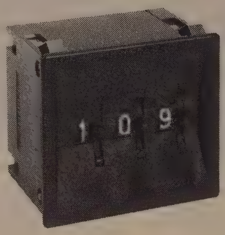
TYPE A

Rear mounted
Housing color: black (std.); grey (special order)
Connections: direct solder or edge connector
Positions available: 10, 11, 12, 16
Overall dimensions for single switch module: 11 mm wide x 53 mm high x 54 mm deep



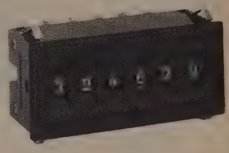
TYPE B

Front mounted
Housing color: black (std.); tan (special order)
Connections: direct solder or edge connector
Positions available: 10, 11, 12, 16
Overall dimensions for single switch module: 12.5 mm wide x 58 mm high x 57 mm deep



TYPE G (the world's largest thumbwheel switch)

Front mounted
Housing color: black (std.); tan (special order)
Connections: direct solder or edge connector
Position available: 10 only
Overall dimensions for single switch module: 10 mm wide x 76 mm high x 79 mm deep



TYPE H (standard) - **TYPE S** (sealed)

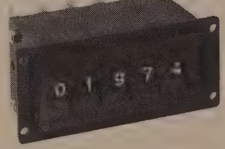
Front mounted
Housing colors: black or tan
Connections: solder, edge connector, PC pins (wire wrap)
Positions available: 10, 11, 16
Overall dimensions for single switch module: 10 mm wide x 33 mm high x 38 mm deep

TYPES L AND N (the world's smallest thumbwheel switches)

Rear mounted
Housing colors: black or tan
Connections: solder, edge connector, PC pins
Position available: 10 only
Overall dimensions for single switch module
Type L - 8 mm wide x 24 mm high x 22 mm deep
Type N - 7 mm wide x 24 mm high x 22 mm deep

TYPE M

Front Mounted
Housing Colors: black or tan
Connections: solder, edge connector, PC pins
Positions available: 10 and 11
Overall dimensions for single switch module: 8 mm wide x 33 mm high x 38 mm deep

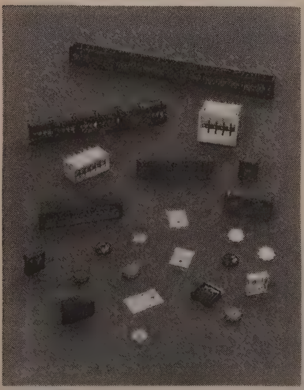


TYPE P

Rear mounted
Housing colors: black or tan
Connections: solder, edge connector, PC pins
Positions available: 10, 11, 16
Overall dimensions for single switch module: 10 mm wide x 30.5 mm high x 28.5 mm deep

TYPE R

Front mounted
Housing color: black
Connections: solder, edge connector, PC pins
Position available: 10 only
Overall dimensions for single switch module: 20 mm wide x 33 mm high x 38 mm deep



PART NUMBER SYSTEM

Switch Modules

☐ ☐ ☐☐☐/☐☐

Type:	Color:	3 or 4 Digit Output Code	Options: (From table below)
A, B, G, H, L, M, N, P, R, S, or Z	B=Black T=Tan		

Accessories for Making Assemblies

☐ ☐ ☐ /☐☐

Type:	Color		Options:
(as above)	(as above)		(From table below)

W	End Plates (pair)
V	Division Plates (pair)
Y	Spacer (same width as switch for any given type)
Y2.7	Narrow Spacer, 2.7 mm wide (P type only)

The following options are available on all types:

A (*) (**)	Stops - to limit number of positions.
B	Slave - to couple wheel to adjacent switch.
B Y	Blind slave - switch built into spacer and coupled to adjacent switch.
D	Hot stamped decimal point on switch housing or spacer.
L	Long board - for mounting components.
LT	Long board - as above but output traces broken except for common (s).
M	Custom marking - on thumbwheel, spacer or housing
1,2,3,4,5	Colored wheel - green, yellow red, blue or white (standard wheel is black).

SEND FOR YOUR COMPLETE INTERSWITCH THUMBWHEEL SWITCH CATALOG

MATRIX BOARDS

INTERSWITCH

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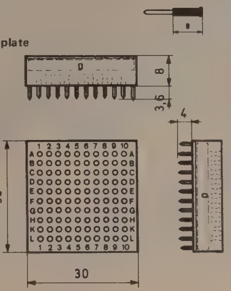
COMPACTMATRIX

FEATURES

- Pin spacing is on .1 inch centers
- Bus bars and pins are gold plated
- Bus bars for rows immediately beneath front plate
- Bus bars for columns are on the bottom
- Thermal rated current 2 amps
- Rated voltage 50 volts



Part Number	Description
679-110-001-XX*	Compactmatrix

XX* Refers to color option (00 Black, 02 Red, 06 Blue, 08 Grey, 09 White)

PINS

Part Number	Description
679-210-601-XX*	Diode pin, cathode-to-tip (columns)
679-210-701-XX*	Diode pin, anode-to-tip (columns)
679-310-200-XX*	Shorting Pin

XX* Refers to color option (00 Black, 02 Red, 04 Yellow 05 Green, 06 Blue, 09 White)

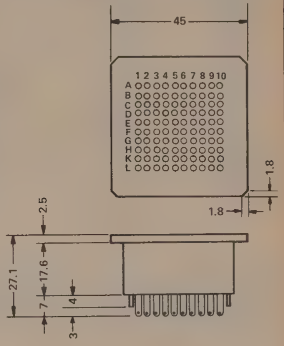
MONOMATRIX

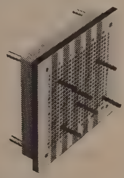
FEATURES

- Economical
- Quality Construction
- Small Space Requirement
- 10 x 10 Matrix

Part Number	Description
673-11-050-00	3-mm grating, 10 row x 10 columns, with mtg. flange and inscription

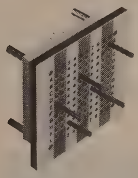
A wide variety of shorting pins and diode pins are available.





3-mm MATRIX BOARDS

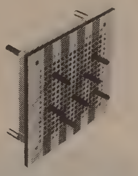
Part Number	Rows/Columns /Grating	Mounting Flange	Front Plate Size (mm)
UNIMATRIX			
673-11-007-01	10/10/3	Yes	57 x 57
02*	10/10/3	Yes	57 x 57
673-11-008-02	20/20/3	Yes	87 x 87
NARROW EXECUTION			
673-11-021-01	20/20/3	No	75 x 75
02	20/20/3	No	75 x 75
673-11-022-01	20/20/3	Yes	99 x 99
02	20/20/3	Yes	99 x 99
NORMAL EXECUTION			
673-11-023-01	22/22/3	No	87 x 87
02	22/22/3	No	87 x 87
673-11-024-02	22/22/3	Yes	111 x 111
02	22/22/3	Yes	111 x 111



4.5-mm MATRIX BOARDS

Part Number	Rows/Columns /Grating	Mounting Flange	Front Plate Size (mm)
UNIMATRIX			
676-11-080-00	10/10/4.5	Yes	70 x 70
676-11-148-00	10/10/4.5	No	58 x 58
STANDARD			
676-11-112-00	20/20/4.5	Yes	142.5 x 142.5

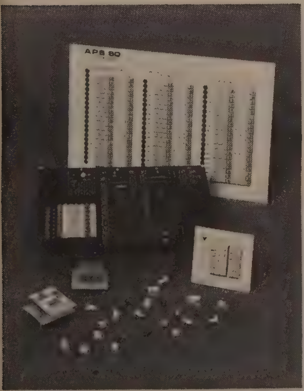
Shorting pins and diode pins are available for the 3-mm, 4.5-mm and 6-mm matrix boards.



6-mm MATRIX BOARDS

Part Number	Rows/Columns /Grating	Front Plate Size (mm)
UNIMATRIX		
674-11-800-00	15/15/6	132 x 132
02	15/15/6	156 x 156
674-11-280-00	16/16/6	150 x 150
STANDARD		
674-11-031-01	10/10/6	126 x 126
02	10/10/6	126 x 126
674-11-033-01	15/15/6	156 x 156
02	15/15/6	156 x 156
674-11-035-01	15/31/6	258 x 156
02	15/31/6	258 x 156
675-11-037-01	31/15/6	156 x 258
02	31/15/6	156 x 258
675-11-039-01	31/31/6	258 x 258
02	31/31/6	258 x 258
674-11-609-01	20/20/6	186 x 186

DATA MODULES



FEATURES

- Unique Programming Device
- Full 4-Bit Binary Output
- Compact Size
- Large Visual Display
- Quick Program Change

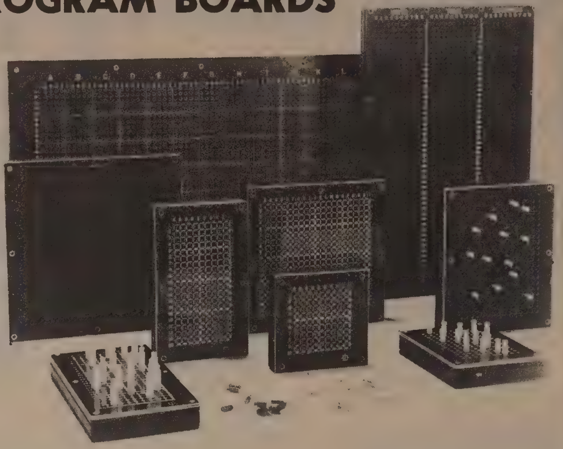
The Data Module is a 5-terminal miniature coding device with a 1 - 2 - 4 - 8 output. The output code selection is obtained by inserting one of 16 different plastic programming keys. The keys selectively close none or more of the contacts housed within the Data Module. These units are available with or without diodes in series with the outputs.

Part Number	Description
All with complement output (4 changeover contacts)	
675-022-200	Direct connection
211	With 4 each 1N4148 anode to common
212	With 4 each 1N645 anode to common
311	With 4 each 1N4148 cathode to common
312	With 4 each 1N645 cathode to common
All with standard contacts	
675-022-300	Direct connection
331	With 4 each 1N4148 anode to common
332	With 4 each 1N645 anode to common
341	With 4 each 1N4148 cathode to common
342	With 4 each 1N645 cathode to common
All with 90° terminations	
675-022-400	Direct connection
431	With 4 each 1N4148 anode to common
432	With 4 each 1N645 anode to common
441	With 4 each 1N4148 cathode to common
442	With 4 each 1N645 cathode to common
All	Programming Keys

MATRIX PROGRAM BOARDS

GENERAL:

As the result of over ten years experience, INFO-LITE has developed a most convenient, compact and economical system for reliable programming and switching • The Matrix Program Board allows a wide variety of switching/programming functions to be performed by simply inserting programming pins (shorting or diode type) into a 2 to10 deck contact matrix • No accessories such as "read" "write" equipment are required • Matrix Board features have lead them to be favored over such devices as patchboards, card readers, toggle and thumbwheel switches, mag/punched tape and electronic memories • The two basic uses for Matrix Program Boards are: (1) Cordless patching (input-output switching), using shorting pins; (2) Programmable diode matrices (logic memories), using diode pins • A two deck (X-Y) contact matrix is comprised of a set of contact busses (inputs) running at 90° to a second set of busses (outputs) • These two contact levels are isolated except at those crosspoints where programming pins are inserted • Terminals (solder/solderless) are provided on the rear surface for each contact buss • INFO-LITE offers two crosspoint grids: the 2000 Series with .250" grid and the 1000 Series with .130" grid • Panels with 5 x 5 to 100 x 100 crosspoints and up to 10 contact decks can be supplied to economically meet your requirements, whether for prototype or production quantities.



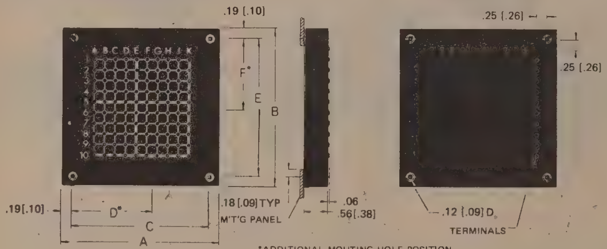
FEATURES

- Reliable closed entry contacts
- Rugged programming pins that will not bend
- Rapid & convenient method of programming/switching
- Permits insertion of components into network without soldering
- Replaces costly complex switching hardware
- Attractive and compact package
- Low capacitance for high frequency applications
- Ease of visual program checking

TYPICAL APPLICATIONS

Numeric Controlled Equipment
Logic Memories
Power Distributors
Circuit/Component Test Programmers
Lighting Systems
Code Generators
Programmable Diode Matrices
Communications Distributors
Status Indicators
Data Logging
Vending Machine Control
Thermo-Couple Selectors
Batching Programmers
Function Generators
Sequence Programmers
Pulse Code Programmers

STANDARD SPECIFICATIONS & STOCK MATRICES FOR 1000 & 2000 SERIES



*ADDITIONAL MOUTING HOLE POSITION

MATRIX SIZE	DASH NO.	2000 SERIES – .250" GRID						1000 SERIES – .130" GRID					
		A	B	C	D	E	F	A	B	C	D	E	F
10 X 10	-1	3.63	3.63	3.25	-	3.25	-	2.02	2.02	1.82	-	1.82	-
10 X 20	-3	3.63	6.12	3.25	-	5.75	2.75	2.02	3 32	1 82	-	3.12	-
10 X 25	-4	3.63	7.38	3.25	-	7.00	3.50	2.02	3.97	1.82	-	3 77	1.82
10 X 50	-5	3.63	13.62	3.25	-	13.25	4.50 8.75	2.02	7 22	1.82	-	7 02	3.51
20 X 20	-8	6.12	6.12	5.75	2.75	5.75	2.75	3.32	3 32	3 12	-	3.12	-
25 X 25	-9	7.38	7.38	7.00	3.50	7.00	3.50	3.97	3.97	3.77	1.82	3.77	1.82

To obtain A or B sizes of special matrix, use: For 1000 Series - L = .13 x (6+N);
For 2000 Series - L = .25 x (5+N); N = Number of crosspoints.

STANDARD SPECIFICATIONS

1 – Contact Type: Closed Entry
2 – Contact Material: Be-Cu, Alloy 25
3 – Contact Finish:
  a - .0002" Ag over Cu Flash
  b - .00002" Min. Au over Ni Flash
4 – Contact Support Material: Silicone Rubber
5 – Contact Resistance: .040 Ohm, typ.
6 – Contact Capacitance: 1 uuf [2 uuf] / in. at 1. MHz, typ.
7 – Bussing: 1st (top) Deck Vert.; 2nd Deck Horiz.
8 – Breakdown Voltage: 1000 VRMS
9 – Current Rating: 5 [2] Amps std; 10 [4] Amps available
10 – Terminals: Combination Taper Pin Socket/Solder Cup [Solder Cup]
11 – Panel Material: Black XXX Grade Phenolic
12 – Panel Marking: Alpha-Numeric/Grid, White Epoxy Ink Screened

NOTE: Values in brackets [ ] are for 1000 Series if two values are given.

SPECIFYING PART NUMBERS

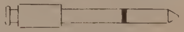
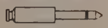
X000-X-XX

.130" GRID 1
.250" GRID 2
MATRIX SIZE (SEE TABLE)
S SILVER CONTACT FINISH
G GOLD CONTACT FINISH
A SCREENED FRONT PANEL
B BLANK FRONT PANEL

EXAMPLE: A 20 X 20, .250" grid matrix with silver contacts & blank front panel would have Pt. No. 2000-8-BS.

U.S. Patent No. 3,631,374

STANDARD PROGRAMMING PINS

1000 SERIES 2-D SHORTING PIN No. 1010X	2000 SERIES 2 D SHORTING PIN No 2010X	2000 SERIES 4 D SHORTING PIN  No 2025X	2000 SERIES 6 D SHORTING PIN No 2045X
1000 SERIES 2-D DIODE PIN  No. 1020X-CSXXXX	2000 SERIES 2 D DIODE PIN No 2020X CSXXXX	2000 SERIES 3 D DIODE PIN No 2042X CSXXXX	2000 SERIES 8 D SHORTING PIN No 2030X

SEE OUR LIGHTED DISPLAY AND READOUT PRODUCTS IN VOLUME 2, SECTION 2450.

"LINKS BETWEEN MAN AND MACHINE"
INFO-LITE CORPORATION
46-10 104th STREET • CORONA, N. Y. 11368

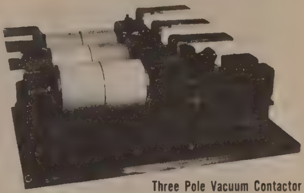
For more information or engineering assistance, contact your local representative or call us direct at
(212) 476-1287

vacuum contactors

INTRODUCTION: Vacuum contactors offer the most reliable means available to control large amounts of power at high voltage. Units designed for dc, power frequency, and rf currents are available in voltage ratings to 50 kv and current ratings to 900 amperes continuous.

ADVANTAGES: The advantages of this type of unit include a high voltage capability, small physical size, high speed quiet operation, long life with minimum maintenance, non-exposed high voltage arcs, and low stable internal losses.

APPLICATIONS: Contactor applications include primary control of power supplies, industrial control of motors, switching in induction heating and mining equipment, tap changing in rf systems, and fault protection of transmitters.


Three Pole Vacuum Contactor

RF Contactor

AC or DC Contactor

Alternating and Direct Current Contactors — For industrial control applications.

MODEL NUMBER	Test Voltage (Pk KV)	Operate Voltage (Pk KV)	Continuous Current (Amps)	Max. Interrupt AC Current (Amps RMS)	Max. Interrupt DC Power (KW)	Capacitor Discharge Decaying to 0 in 200 μs	Contact Arrange-ment	Actuator Voltage (Volts)	Time to Close (Ms)	Break Time (Ms)	Weight (Lbs.)
RP101F4903D21B20 RP101F4904D21B20	50	30	100 DC	N/A	500 (10 A Max.)	N/A	N/O N/C	115 60 Hz	60	50	8¾
RP101F4304D26B20	50	30	100 DC	N/A	500 (10 A Max.)	N/A	N/C	100 DC	55	42	8¾
RP103F4903D21B20 RP103F4904D21B20	50	30	100 RMS	2000	N/A	50 K Amps	N/O N/C	115 60 Hz	60	50	8¾
RP103F4304D26B20	50	30	100 RMS	2000	N/A	50 K Amps	N/C	100 DC	55	42	8¾
RP901K4903D21B30 RP901K4904D21B30	70	50	100 DC	N/A	500 (10 A Max.)	N/A	N/O N/C	115 60 Hz	60	50	15
RP901K4601D26B30 RP901K4602D26B30	70	50	100 DC	N/A	500 (10 A Max.)	N/A	N/O N/C	100 DC	34 27	11 17	15
RP900K4903D21B30 RP900K4904D21B30	70	50	200 RMS	4000 at 13 KV RMS	N/A	100 K Amps	N/O N/C	115 60 Hz	60	50	15
RP900K4601D26B30 RP900K4602D26B30	70	50	200 RMS	4000 at 13 KV RMS	N/A	100 K Amps	N/O N/C	100 DC	34 27	11 17	15

High Voltage RF Contactors — For high power rf load control.

UNIT	Peak Operate Voltage 32 MHz	Continuous Current 32 MHz RMS	Contact Resistance Ohms Max.	Contact Capacitance Pf	Contact Inductance Nh	Contact Arrangement	Open Time	Close Time	Pull-in Current RMS	Hold Current RMS	Hold Power Watts	Actuating Voltage	Motor Current 60 Hz	Weight	Life	Auxiliary Contacts Ratings Volt RMS Current RMS
RP233X4513006M00	25	35	.0005	2	25	N/O	17 Ms.	75 Ms.	.7	.09	10	100 VDC	N/A	3 lbs.	1 x 10^5	Form C 230/7
RF20B4319D31G00	25	200	.0004	10	2.5	latching	7 Sec.	7 Sec.	N/A	N/A	N/A	115 VAC	.11A	5 lbs. 6 oz.	1 x 10^5	Form C 230/7

Three Pole Vacuum Contactors — For three-phase and multi-pole power control applications.

MODEL NUMBER	Operate Voltage 50/60/400 Hz	Operate Current 60 Hz	Interrupt Current Amps RMS	Load Life (Min.)	Actuator Voltage	Approx. Pull-in Current Amps RMS	Approx. Hold Current Amps RMS	Interrupt Time	Auxiliary Contacts	Weight
RP151B4541X44R20	600	200	2000	250,000	26.5 VDC	2.8	.4	Less than 1 Cycle	2 SPDT 230 VAC/10 A	16 lbs.
RP154B4549X41TX0 (60 Hz) RP154B4549X4KTX0 (50 Hz)	1500	300	3000	250,000	115 VAC	22.0	1.9	Less than 2 Cycles	4 SPDT 230 VAC/5 A	25 lbs.

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DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

vacuum interrupters

ITT JENNINGS
CAUTION

RP151B

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CAUTION

RP155B

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CAUTION

RP951B

SPECIFICATIONS	RP151B*	RP155B*	RP951B*
ELECTRICAL			
Line-to-Line Voltage, Rated Maximum	5 KVRMS	5 KVRMS	5 KVRMS
Frequency, Rated	50 - 60 Hz	50 - 60 Hz	50 - 60 Hz
Low Frequency Withstand Voltage	21 KVRMS	21 KVRMS	21 KVRMS
Basic Impulse Level	60 KV, Crest	60 KV, Crest	60 KV, Crest
Continuous Current	200 Amps RMS	300 Amp RMS	600 Amp RMS
Generated Heat Loss	3 Watts @ 200 Amps	7 Watts @ 300 Amps	25 Watts @ 600 Amps
Interrupting Ability, Max @ Rated Voltage	2,000 Amps RMS	2,000 Amp RMS	4,000 Amp RMS
Capacitive Switching Current	- - - - -	- - - - -	- - - - -
Momentary Current	20,000 Amp RMS	20,000 Amp RMS	30,000 Amp RMS
MECHANICAL			
Contact Stroke	5/32 inch	3/16 inch	¼ inch
Contact Opening and Closing Velocity	1 ft/sec	1 ft/sec	2 ft/sec
Contact Opening Force Maximum	20 lbs	15 lbs	32 lbs
Added Force Required for:			
Rated Load Current	30 lbs	30 bs	30 lbs
Momentary Current	100 lbs	100 lbs	200 lbs
Interruptor Weight	2 lbs	2 lbs	7 lbs
Moving Contact Weight	¼ lb	½ lb	1½ lbs
RELIABILITY			
Mechanical Life	250,000 Operations	500,000 Operations	50,000 Operations
Contact Erosion Limit	1/16 inch	1/16 inch	⅛ inch
Typical Operating Life			
Operations at Maximum Interrupting Current	100	50	100
Operations at Rated Current	250,000	500,000	500,000

* No Center Shield

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vacuum interrupters

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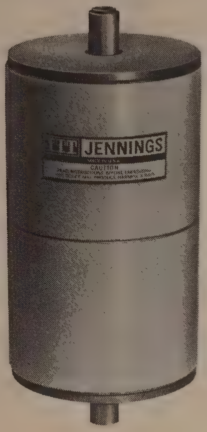
CAUTION

RP103C



RP910B

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RP903C

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RP904B/RP905B

RP103C	RP910B	RP903C	RP904B/RP905B
15.5 KVRMS	15.5 KVRMS	15.5 KVRMS	5 KVRMS
50 - 60 Hz	50 - 60 Hz	50 - 60 Hz	50 - 60 Hz
36 KVRMS	50 KVRMS	50 KVRMS	21 KVRMS
95 KV, Crest	110 KV, Crest	110 KV, Crest	60 KV, Crest
200 Amp RMS	400 Amp RMS	600 Amp RMS	600 Amp RMS
3 Watts @ 200 Amps	11 Watts @ 400 Amps	25 Watts @ 600 Amps	20 Watts @ 600 Amps
2,000 Amp RMS	4,000 Amp RMS	4,000 Amp RMS	8,000 Amp RMS
200 Amp RMS	400 Amp RMS	600 Amp RMS	------
20,000 Amp RMS	20,000 Amp RMS	30,000 Amp RMS	30,000 Amp RMS
5/32 inch	3/16 inch	1/4 inch	1/4 inch
1 ft/sec	1 ft/sec	2 ft/sec	2 ft/sec
8 lbs	15 lbs	32 lbs	32 lb
30 lbs	30 lbs	30 lbs	30 lbs
100 lbs	100 lbs	200 lbs	200 lbs
2¼ lbs	8 lbs	8 lbs	8 lbs
¼ lb	½ lb	1¼ lbs	1¼ lbs
250,000 Operations	500,000 Operations	500,000 Operations	250,000 Operations
1/16 inch	5/32 inch	⅛ inch	⅛ inch
100	50	100	50
250,000	500,000	500,000	250,000

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DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

J-B-T general purpose and industrial toggle switches

WHY IT PAYS TO SPECIFY J-B-T TOGGLE SWITCHES

J-B-T concentrates on trouble-free switches. Among the four groups of **toggle** switches, more than 500 models are Underwriters' Laboratories Inc. listed (most of these are also listed by Canadian Standards Association), and more than 170 models are made to MIL-S-83731 (formerly MIL-S-3950D) and other Government Specifications. Recent market studies indicate that while these switches are a **must** in military applications, more than three times as many are produced for general purpose and industrial uses where the principal requirement is dependability.

J-B-T TOGGLE SWITCHES ARE SPECIFIED FOR FOUR MAIN REASONS

1) **MATERIALS ARE GOOD.** For instance, in the heavy duty switches, J-B-T uses generous proportions of specially selected silver alloys in integral construction for contact surfaces, to provide extra overload protection, to dissipate heat and to keep contact resistance under .005 ohms.

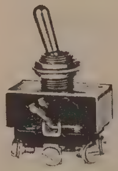
2) **THE DESIGN IS GOOD.** In heavy duty types (AC only), the large contact areas are held firmly in place by the spring action of the lever mechanism. In medium duty types (AC-DC,) self-wiping, heavily silver plated, double-grip contacts are designed for fast make, fast break and wide gap to minimize arcing for greater endurance.

3) **THE VALUE IS GOOD.** The many features required to meet Government standards are also incorporated in the general purpose and industrial series, and together with J-B-T's rigid in-plant testing, pay off in long useful life. And because J-B-T makes **only** quality switches — general purpose, industrial and MIL, the economies of long production runs are reflected in the surprisingly small price differential over run-of-the-mill brands.

4) **DELIVERIES ARE GOOD.** Every effort is made to keep the most popular models on hand in distributor stocks and to produce substantial OEM orders to meet customer's timetables. For complete information on these switches, ask for Catalog TS-7.

ORDERING INFORMATION

There are 3 groups of General Purpose, Industrial, and MIL toggle switches. (A fourth family or group is made up of subminiature models).



Cutaway view showing heavy-duty construction of Group I and Group III switches

Cutaway view showing self-wiping double-grip contacts of Group II switches

GROUP I— Single-pole and double-pole, heavy duty, for AC sevice, rated at 20 A at 125 VAC, 10 A at 250 VAC; ½ HP at 125 VAC, and ¾ HP at 250 VAC. As shown in the cutaway view, the large contacts of silver alloy especially suited for this service are held firmly in place by spring action of the lever linkage. Continuity is made to terminals **opposite** the throw of the lever. Available with screw type, solder type, or push on (spade) terminals.

GROUP II– Single-pole and double-pole, medium duty for AC and DC service, rated at 6 A at 125 VAC-DC, 3 A at 250 VAC-DC. Fast-make, fast-break design with heavily silver plated self-wiping double-grip contacts for exceptional durability. All in this series have solder type terminals. As shown with cutaway view, continuity is made to terminals on the **same** side as the throw of the lever.

GROUP III—3-pole and 4-pole heavy duty for AC service, (also referred to as three-circuit and four-circuit switches which can be used with opposite polarity on adjacent poles). Construction, rating and terminal options the same as Group I.

NUMBERING SYSTEM

For General Purpose and Industrial Switches, part numbers consist of 4 digits and 1 letter. The first two digits designate the Series and Group. 3rd and 4th digits designate the circuit, and the letter designates the type of terminals.

S = Screw Terminals L = Solder Lug P = .250 wide push-on (spade)

Series*	Group & Type	Rating	Terminals Available Standard Type
42	I SP	A	S, L, or P
52	I DP	A	S, L, or P
12 and 16	II SP	B	L only
22, 23, and 26	II DP	B	L only
63	III 3-pole	A	S, L, or P
64	III 4-pole	A	S, L, or P

*All series are also available with lever seal

A - 20 amps at 125 VAC; 10 amps 250 VAC
B - 6 amps at 125 VAC-DC; 3 amps 250 VAC-DC

Example 1: 52 22 P
1 2 3

1) Series and Group:
52 is a Group I Double Pole switch with bat type lever $\frac{11}{16}$" long, and no lever seal.

2) Circuit:
22 is a single throw On-None-Off switch.

3) Type of Terminals:
P is a .250" wide push on terminal.

SPECIALS

Variations from standard switches (such as lever length, finish, etc.) are designated by the standard part number and letter followed by 2 arbitrary numbers, or 2 arbitrary letters or combinations of both.

Example of Special: 52 22 L 00
1 2 3 4

4) 00 designates a specific variation from the standard, such as a bright chrome plated lever.

Prices Net, F.O.B. Factory, domestic packing, were in effect Feb. 1, 1974, and should be regarded as relative only. Quantity prices on request.

J-B-T

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

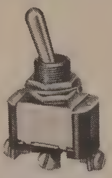
Group I — SP & DP — HEAVY DUTY (AC) 20A @ 125 VAC; 10A @ 250 VAC

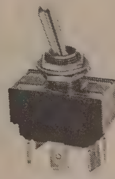
Lever Position			Screw Terminals					Solder Terminals					Push On (Spade) Terminals				
Up	Center	Keyway Down	Model No.	2-24¶	25-49	50-99	100-249	Model No.	2-24¶	25-49	50-99	100-249	Model No.	2-24¶	25-49	50-99	100-249
SPST — 2 TERMINALS																	
On	None	Off	4222S	$1.45	$1.31	$1.14	$ .95	4222L	$1.30	$1.14	$1.00	$ .83	4222P	$1.30	$1.14	$1.00	$ .83
On	None	Off	4224S	1.45	1.31	1.14	.95	4224L	1.30	1.14	1.00	.83	4224P	1.30	1.14	1.00	.83
On	Off*	None	4225S	1.80	1.58	1.37	1.14	4225L	1.50	1.28	1.12	.93	4225P	1.50	1.28	1.12	.93
On	Off	On*	4228S	1.80	1.58	1.37	1.14	4228L	1.50	1.28	1.12	.93	4228P	1.50	1.28	1.12	.93
On	None	Off*	4229S	1.80	1.55	1.33	1.09	4229L	1.50	1.31	1.13	.94	4229P	1.50	1.31	1.13	.94
Off	None	On*	4230S	1.80	1.55	1.33	1.09	4230L	1.50	1.31	1.13	.94	4230P	1.50	1.31	1.13	.94
SPDT — 3 TERMINALS																	
On	Off	On	4221S	1.80	1.58	1.37	1.14	4221L	1.50	1.28	1.12	.93	4221P	1.50	1.28	1.12	.93
On	None	On	4223S	1.80	1.58	1.37	1.14	4223L	1.50	1.28	1.12	.93	4223P	1.50	1.28	1.12	.93
On	None	On*	4226S	2.10	1.82	1.55	1.28	4226L	1.65	1.44	1.25	1.05	4226P	1.65	1.44	1.25	1.05
On*	Off	On*	4227S	2.10	1.82	1.55	1.28	4227L	1.65	1.44	1.25	1.05	4227P	1.65	1.44	1.25	1.05
On	Off	On*	4231S	2.10	1.82	1.55	1.28	4231L	1.65	1.44	1.25	1.05	4231P	1.65	1.44	1.25	1.05
DPST — 4 TERMINALS																	
On	None	Off	5222S	2.25	1.67	1.42	1.12	5222L	2.00	1.51	1.26	1.00	5222P	2.00	1.51	1.26	1.00
On	Off	None	5224S	2.25	1.67	1.42	1.12	5224L	2.00	1.51	1.26	1.00	5224P	2.00	1.51	1.26	1.00
On	Off*	None	5225S	3.20	2.36	1.98	1.57	5225L	2.70	2.05	1.72	1.36	5225P	2.70	2.05	1.72	1.36
None	Off	On*	5228S	2.65	1.97	1.64	1.29	5228L	2.25	1.70	1.41	1.11	5228P	2.25	1.97	1.64	1.29
On	None	Off*	5229S	2.75	2.05	1.70	1.35	5229L	2.35	1.77	1.48	1.16	5229P	2.35	1.77	1.48	1.16
Off	None	On*	5230S	2.75	2.05	1.70	1.35	5230L	2.35	1.77	1.48	1.16	5230P	2.35	1.77	1.48	1.16
DPDT — 6 TERMINALS																	
On	Off	On	5221S	2.65	1.97	1.64	1.29	5221L	2.25	1.70	1.41	1.22	5221P	2.25	1.70	1.41	1.22
On	None	On	5223S	2.65	1.97	1.64	1.29	5223L	2.25	1.70	1.41	1.22	5223P	2.25	1.70	1.41	1.22
On	None	On*	5226S	3.00	2.25	1.88	1.48	5226L	2.60	1.95	1.63	1.29	5226P	2.60	1.95	1.63	1.29
On*	Off	On*	5227S	3.10	2.36	1.98	1.57	5227L	2.70	2.05	1.72	1.36	5227P	2.70	2.05	1.72	1.36
On	Off	On*	5231S	3.00	2.25	1.88	1.48	5231L	2.60	1.95	1.63	1.29	5231P	2.60	1.95	1.63	1.29
On	On	On	5232S	3.10	2.36	1.98	1.57	5232L	2.75	1.96	1.63	1.36	5232P	2.75	1.96	1.63	1.36
On	On	On*	5233S	3.35	2.50	2.11	1.79	5233L	3.00	2.17	1.82	1.46	5233P	3.00	2.17	1.82	1.36
On*	On	On*	5235S	3.40	2.54	2.15	1.81	5235L	3.05	2.20	1.84	1.48	5235P	3.05	2.20	1.84	1.48

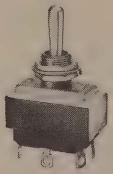
Group II — SP & DP — MEDIUM DUTY (AC-DC) 6A @ 125 VAC; 3A @ 250 VAC

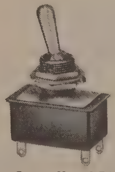
Lever Position			Solder Terminals				
Up	Center	Keyway Down	Model No.	2-24¶	25-49	50-99	100-249
SPST — 2 TERMINALS							
On	None	Off	1222L	$1.40	$1.04	$ .94	$ .89
On	None	Off*	1229L	1.70	1.25	1.22	1.08
Off	None	On*	1230L	1.85	1.35	1.20	1.14
On	None	Off	1622L	1.80	1.33	1.20	1.13
On	None	Off*	1629L	1.90	1.38	1.25	1.18
Off	None	On*	1630L	1.90	1.38	1.25	1.18
SPDT — 3 TERMINALS							
On	None	On	1223L	1.65	1.20	1.10	1.02
On	None	On	1623L	1.70	1.24	1.13	1.07
DPST — 4 TERMINALS							
On	None	Off	2222L	1.95	1.43	1.30	1.21
On	None	Off*	2229L	2.25	1.64	1.49	1.41
Off	None	On*	2230L	2.25	1.64	1.49	1.41
On	None	Off	2322L	2.00	1.46	1.34	1.25
On	None	Off	2622L	2.10	1.55	1.42	1.33
On	None	Off*	2629L	2.30	1.67	1.54	1.44
Off	None	On*	2630L	2.40	1.75	1.61	1.51
DPDT — 6 TERMINALS							
On	None	On	2223L	2.10	1.56	1.42	1.33
On	None	On	2323L	2.15	1.58	1.45	1.36
On	None	On	2623L	2.10	1.56	1.42	1.36

*Momentary ¶On orders for single switches add 50¢. #¼" bushing.
†Side connected terminals. ‡Side and rear connected terminals.
•Most popular models — normally stocked.


Group I — SPDT with Screw Terminals


Group I — DPDT with Push on (.250) Terminals


Group I — DPDT with Solder Type Terminals


Group II — DPST with Solder Type Terminals

UL AND CSA IDENTIFICATION AND RATINGS: CONVERSION TO PREVIOUS NUMBERS

Underwriters' Laboratories, Inc. lists under "Switches, Special Use" all J-B-T general purpose toggle switches, with minor exceptions as noted. Most are also either presently listed by Canadian Standards Association or are in process of being listed. Listing also is given to previous J-B-T UL/CSA numbers as shown in the second column below. Where the new number (1st column) does not appear in the catalog price schedules, it is a model not regularly stocked but manufactured only for substantial production runs. The reference to ST numbers (for JAN-S-23) is to indicate only equivalent circuitry as there are minor construction differences between ST and UL or CSA models.

New Model No.	Previous UL/CSA♦	ST Circuit Equiv.	Rating	New Model No.	Previous UL/CSA♦	ST Circuit Equiv.	Rating	New Model No.	Previous UL/CSA♦	ST Circuit Equiv.	Rating	New Model No.	Previous UL/CSA♦	ST Circuit Equiv.	Rating	Ratings
1222L	121	ST12A	B	2323L	234	ST23N	B	4021L	425	ST42E	A	5227S	507	ST50S	A	**Rating A**
1229L	122	ST12B	B	2622L	261	ST26K	B	4026L	426	ST42F	A	5231S	508	ST50T	A	10 amps, 250 VAC
1230L	123	ST12C	B	2629L	262	ST26L	B	4027L	427	ST42G	A	5222L	521	ST52K	A	20 amps, 125 VAC
1223L	124	ST12D	C	2630L	263	ST26M	B	4031L	428	ST42H	A	5229L	522	ST52L	A	¾ H.P., 250 VAC
1226L	126	ST12F	C	2623L	264	ST26N	B	4024S	—	—	A	5230L	523	ST52M	A	½ H.P., 125 VAC
1322L	131	ST13A	B	2626L	266	ST26R	B	4025S	—	—	A	5223L	524	ST52N	A	
1323L	134	ST13D	C	2722L	271	ST27K	B	4028S	—	—	A	5221L	525	ST52P	A	**Rating B**
1622L	161	ST16A	B	2723L	274	ST27N	B	4024L	—	—	A	5226L	526	ST52R	A	3 amps, 250 VAC-DC
1629L	162	ST16B	B	4022S	401	ST40A	A	4025L	—	—	A	5227L	527	ST52S	A	6 amps, 125 VAC-DC
1630L	163	ST16C	B	4029S	402	ST40B	A	4028L	—	—	A	5231L	528	ST52T	A	
1623L	164	ST16D	C	4030S	403	ST40C	A	5222S	501	ST50K	A	5224S	—	—	A	**Rating C**
1626L	166	ST16F	C	4023S	404	ST40D	A	5229S	502	ST50L	A	5225S	—	—	A	1 amp, 250 VAC-DC
1722L	171	ST17A	B	4021S	405	ST40E	A	5230S	503	ST50M	A	5228S	—	—	A	3 amps, 125 VAC-DC
1723L	174	ST17D	C	4026S	406	ST40F	A	5223S	504	ST50N	A	5224L	—	—	A	
2222L	221	ST22K	B	4027S	407	ST40G	A	5221S	505	ST50P	A	5225L	—	—	A	
2229L	222	ST22L	B	4031S	408	ST40H	A	5226S	506	ST50R	A	5228L	—	—	A	
2230L	223	ST22M	B	4022L	421	ST42A	A									
2223L	224	ST22N	B	4029L	422	ST42B	A									
2226L	226	ST22R	B	4030L	423	ST42C	A									
2322L	231	ST23K	B	4023L	424	ST42C	A									

♦Note: Series 42 models are now supplied with riveted construction as equivalent of old UL/CSA 401 thru 428 with bent staked terminals. Electrical characteristics are identical, but depth behind panel for staked terminals is 3/32" greater for screw type terminals, and 1/16" greater for solder type than for Series 42.

Prices Net, F.O.B. Factory, domestic packing, were in effect March 1, 1975, and should be regarded as relative only. Quantity prices on request.

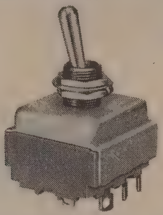
J-B-T

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

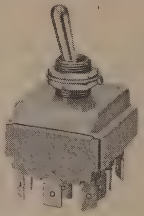
Group III — 3-POLE & 4-POLE — HEAVY DUTY (AC) 20A @ 125 VAC; 10A @ 250 VAC

Lever Position			Screw Terminals					Solder Terminals					Push On (Spade) Terminals				
Up	Center	Keyway Down	Model No.	2-24¶	25-49	50-99	100-249	Model No.	2-24¶	25-49	50-99	100-249	Model No.	2-24¶	25-49	50-99	100-249
3PST 6 TERMINALS																	
On	None	Off	6322S	$5.55	$4.55	$4.09	$3.34	6322L	$5.10	$4.28	$3.81	$3.10	6322P	$5.10	$4.28	$3.81	$3.10
On	None	Off*	6329S	5.90	4.84	4.21	3.37	6329L	5.50	4.55	3.94	3.15	6329P	5.50	4.55	3.94	3.15
Off	None	On*	6330S	5.90	4.85	4.21	3.37	6330L	5.50	4.55	3.94	3.15	6330P	5.50	4.55	3.94	3.15
3PDT 9 TERMINALS																	
On	Off	On	6321S	5.25	4.38	3.79	3.03	6321L	4.80	4.03	3.49	2.79	6321P	4.80	4.03	3.49	2.79
On	None	On	6323S	5.25	4.38	3.79	3.03	6323L	4.80	4.03	3.49	2.79	6323P	4.80	4.03	3.49	2.79
On	None	On*	6326S	6.65	4.99	4.32	3.46	6326L	5.85	4.81	4.18	3.34	6326P	5.85	4.81	4.18	3.34
On*	Off	On*	6327S	6.55	4.99	4.32	3.46	6327L	5.85	4.81	4.18	3.34	6327P	5.85	4.81	4.18	3.34
On	Off	On*	6331S	6.55	4.99	4.32	3.46	6331L	5.85	4.81	4.18	3.34	6331P	5.85	4.81	4.18	3.34
4PST 8 TERMINALS																	
On	None	Off	6422S	6.25	5.38	4.57	3.83	6422L	6.10	5.25	4.45	3.72	6422P	6.10	5.25	4.45	3.72
On	None	Off*	6429S	6.55	5.62	4.77	3.99	6429L	6.40	5.48	4.65	3.88	6429P	6.40	5.48	4.65	3.88
Off	None	On*	6430S	6.55	5.62	4.77	3.99	6430L	6.40	5.48	4.65	3.88	6430P	6.40	5.48	4.65	3.88
4PDT 12 TERMINALS																	
On	Off	On	6421S	5.95	5.15	4.38	3.66	6421L	5.85	5.08	4.30	3.59	6421P	5.85	5.08	4.30	3.59
On	None	On	6423S	6.10	5.25	4.45	3.72	6423L	5.90	5.11	4.34	3.63	6423P	5.90	5.11	4.34	3.63
On	None	On*	6426S	6.75	5.81	4.92	4.11	6426L	6.55	5.62	4.77	3.99	6426P	6.55	5.62	4.77	3.99
On*	Off	On*	6427S	6.75	5.81	4.92	4.11	6427L	6.55	5.62	4.77	3.99	6427P	6.55	5.62	4.77	3.99
On	Off	On*	6431S	6.75	5.81	4.92	4.11	6431L	6.55	5.62	4.77	3.99	6431P	6.55	5.62	4.77	3.99
On	On	On	6432S	7.00	5.99	5.09	4.24	6432L	6.85	5.85	4.96	4.16	6432P	6.85	5.85	4.96	4.16
On	On	On*	6433S	7.20	6.13	5.19	4.34	6433L	7.00	5.99	5.09	4.24	6433P	7.00	5.99	5.09	4.24
On*	On	On*	6435S	7.30	6.21	5.27	4.41	6435L	7.10	6.07	5.15	4.31	6435P	7.10	6.07	5.15	4.31

*Momentary ¶On orders for single switches, add $1.00 •Most popular models — normally stocked. § These four-circuit, triple-throw models not presently UL listed.



Group III — 3PDT with Solder Type Terminals



Group III — 4PDT with Push on (spade) Terminals

DETAILS ON J-B-T MS & ST TOGGLE SWITCHES

J-B-T MIL Series Toggle Switches MS35058 (SP), MS35059 (DP,) and MS25068 (4-Pole); ST40, ST42, ST50, ST52 (SP & DP) JAN Series. All J-B-T MS families contain a silicone rubber bushing seal to meet or exceed sand and dust toggle seal and other specification requirements. The 4-pole MS25068 switch bodies use a distinctive brown molded material chosen after extensive tests for high arc resistance and low shrinkage. All these MS & ST families have single hole mounting for bushing 15⁄32″-32 NS-2A by 15⁄32″ high, and toggle lever 11⁄16″ long. **Bodies** including terminals: **SP:** 1⅛″ x ⅝″ x 11⁄16″ deep: **DP:** 121⁄64″ x ¾″ x 11⁄32″ or 113⁄64″ deep: **4-pole:** 111⁄32″ x 19⁄16″ x 19⁄32″ deep. **Terminals:** MS, ST40, & ST50 types have solderable 6-32 electro-tinned screw terminals. ST42's and ST52's made to former JAN-S-23 and MIL-S-21195A (Ships) use solder lugs but have no seal. **Nominal Ratings:** 20 Amp. at 125 VAC, 10 Amp., at 250 VAC.

MS25098 (SP) and MS25100 (DP) Military Series; ST12 - 27 JAN Series. All MS25098 & MS25100 switches have case to terminal seals and silicone rubber bushing seal to meet and exceed Military standards. All these families have single hole mounting with bushing 15⁄32″-32 NS-2A by 15⁄32″ high (or ¼″ high in odd numbered ST models) and toggle lever 11⁄16″. **Bodies:** including solder terminals are: 1¼″ long, 11⁄16″ wide, 29⁄32″ deep for all MS models and most ST models. **Nominal Ratings at 65,000′ alt.:** SPST, SPDT, DPST circuits are rated at 3 Amp. at 125 VAC-DC. DPDT are rated at 1 Amp at 125 VAC-DC. At sea level, nominal ratings are substantially higher as in Group II general purpose switches. Significant internal improvements over earlier designs of MS25098 and MS25100 give faster break, wider gap, and increased insulation values, resulting in a longer life.

CROSS REFERENCE: AN, MS, AND ST MODEL NUMBERS WITH SIMILAR CIRCUITRY

Screw Terminal				Solder Lug		Screw Terminal				Solder Lug	
MIL-S-83731 See Notes A & B	JAN-S-23 & MIL-S-21195A	MIL-S-6745 See Note A	MIL-S-3950 See Notes A & B	JAN-S-23 & MIL-S-21195A (Ships)	MIL-S-3950 See Note A	MIL-S-83731 See Notes A & B	JAN-S-23 & MIL-S-21195A	MIL-S-6745 See Note A	MIL-S-3950 See Notes A & B	JAN-S-23 & MIL-S-21195A (Ships)	MIL-S-3950 See Note A
SPST				SPST		DPST					
MS35058-22	ST40A	AN3021-2	‡	ST42A	MS35058-9	MS35059-22	ST50K	AN3027-2	‡	ST52K	MS35059-9
MS35058-29	ST40B	AN3021-9	‡	ST42B	MS35058-10	MS35059-29§	ST50L	AN3027-4§	‡	ST52L	MS35059-10§
MS35058-30	ST40C	AN3021-8	‡	ST42C	MS35058-11	MS35059-30§	ST50M	AN3027-5§	‡	ST52M	MS35059-11§
MS35058-24	‡	AN3021-10	MS35058-1	‡	MS35058-12	MS35059-24	‡	AN3027-9	MS35059-1	‡	MS35059-12
MS35058-28	‡	AN3021-11	MS35058-2	‡	MS35058-13	MS35059-28	‡	AN3027-11	MS35059-2	‡	MS35059-13
MS35058-25	‡	AN3021-12	MS35058-3	‡	MS35058-14	MS35059-25§	‡	AN3027-10§	MS35059-3§	‡	MS35059-14§
SPDT				SPDT		DPDT				DPDT	
MS35058-23	ST40D	AN3021-3	MS35058-4	ST42D	MS35058-15	MS35059-23	ST50N	AN3027-3	MS35059-4	ST52N	MS35059-15
MS35058-21	ST40E	AN3021-1	MS35058-5	ST42E	MS35058-16	MS35059-21	ST50P	AN3027-1	MS35059-5	ST52P	MS35059-16
MS35058-26	ST40F	‡	MS35058-6	ST42F	MS35058-17	MS35059-26§	ST50R	AN3027-6§	MS35059-6§	ST52R	MS35059-17§
MS35058-27	ST40G	AN3021-7	MS35058-7	ST42G	MS35058-18	MS35059-27	ST50S§	AN3027-7§	MS35059-7§	ST52S§	MS35059-18§
MS35058-31	ST40H	AN3021-5	MS35058-8	ST42H	MS35058-19	MS35059-31§	ST50T§	AN3027-8§	MS35059-8§	ST52T§	MS35059-19§
‡	‡	AN3021-6†	‡	‡	‡						

‡Not included in this specification. †AN3021-6 same as AN3021-5 with jumper. §Same dimensions as MS35059-27.

Note A: MS and AN types use internal sand and dust toggle seal and other high performance features involving extra cost over ST types. MS types to MIL-S-83731 (formerly MIL-S-3950D) have a silicone rubber bushing seal to meet sand and dust, and toggle seal tests. MIL-S-3950 models are superseded by MIL-S-83731 models.

Note B: For heavy duty switches in the MS25068, MS35058, and MS35059 Series, MIL-S-83731 calls for SCREW TERMINALS ONLY. These terminals have SOLDERABLE FINISH and may be soldered after removal of screws.

Prices Net, F.O.B. Factory, domestic packing, were in effect Feb. 1, 1974, and should be regarded as relative only. Quantity prices on request.

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

military toggle switches—MIL, and JAN types

Series MS35058, MS35059, MS25100, MS25098 and MS25068 to MIL-S-83731 (formerly MIL-S-3950D); Series ST40A-H, ST42A-H, ST50K-T, ST52K-T to JAN-S-23, MIL-S-21195A (Ships), or DDAX Drawings.

NEW! MIL-S-83731 — supersedes MIL-S-3950D for series MS35058, MS35059, MS25100, MS25098 and MS25068: MIL-S-83731 retains the same MS part numbers as well as the temperature, endurance, sand and dust toggle seal, and altitude requirements of former MIL-S-3950D variations. MIL-S-3950E and higher suffixes now are restricted to special purpose environmental switches.

GROUP I — SP & DP — HEAVY DUTY WITH TOGGLE SEAL

Circuitry† Keyway

MIL-S-83731	Model No.	2-24■	25-49	50-99	100-249
SPST — 2 TERMINAL					
On-X-Off	MS35058-22	$2.40	$2.04	$1.61	$1.25
On-Off-X	MS35058-24	2.40	2.04	1.61	1.25
On-Off*-X	MS35058-25	3.30	2.81	2.21	1.72
X-Off-On*	MS35058-28	2.40	2.30	1.81	1.40
On-X-Off*	MS35058-29	2.60	2.21	1.74	1.35
Off-X-On*	MS35058-30	2.60	2.21	1.74	1.35
SPDT — 3 TERMINAL					
On-Off-On	MS35058-21	2.75	2.34	1.84	1.43
On-X-On	MS35058-23	2.75	2.34	1.84	1.43
On-X-On*	MS35058-26	3.20	2.72	2.14	1.66
On*-Off-On	MS35058-27	3.20	2.72	2.14	1.66
DPST — 4 TERMINAL					
On-X-Off	MS35059-22	3.10	2.85	2.17	1.74
On-Off-X	MS35059-24	3.15	2.90	2.21	1.76
On-Off*-X	MS35059-25	4.20	3.86	2.94	2.35
X-Off-On*	MS35059-28	3.70	3.40	2.59	2.07
On-X-Off*	MS35059-29	4.00	3.68	2.80	2.24
Off-X-On*	MS35059-30	3.70	3.40	2.59	2.07
DPDT — 6 TERMINAL					
On-Off-On	MS35059-21	3.50	3.22	2.45	1.96
On-X-On	MS35059-23	3.50	3.22	2.45	1.96
On-X-On*	MS35059-26	4.30	3.96	3.01	2.41
On*-Off-On	MS35059-27	4.20	3.86	2.94	2.35
On-Off-On*	MS35059-31	4.20	3.86	2.94	2.35

GROUP I — SP & DP — HEAVY DUTY — NO SEAL§

TYPE TERMINALS	JAN-S-23	Model No.	2-24■	25-49	50-99	100-249
SCREW TYPE	**SPST — 2 TERMINAL**					
	On-X-Off	ST40A	$1.55	$1.39	$1.20	$1.02
	On-X-Off*	ST40B	1.90	1.63	1.40	1.17
	Off-X-On*	ST40C	1.90	1.63	1.40	1.17
	SPDT — 3 TERMINAL					
	On-X-On	ST40D	1.90	1.65	1.43	1.21
	On-Off-On	ST40E	1.90	1.65	1.43	1.21
	On-X-On*	ST40F	2.20	1.91	1.63	1.37
	On*-Off-On*	ST40G	2.15	1.81	1.56	1.33
	On-Off-On*	ST40H	2.20	1.91	1.63	1.37
SOLDER TYPE	**SPST — 2 TERMINAL**					
	On-X-Off	ST42A	1.40	1.20	1.04	.89
	On-X-Off*	ST42B	1.60	1.39	1.19	1.00
	Off-X-On*	ST42C	1.45	1.28	1.12	.94
	SPDT — 3 TERMINAL					
	On-X-On	ST42D	1.55	1.36	1.18	1.00
	On-Off-On	ST42E	1.55	1.36	1.18	1.00
	On-X-On*	ST42F	1.75	1.52	1.30	1.12
	On*-Off-On	ST42G	1.75	1.52	1.30	1.12
	On-Off-On*	ST42H	1.75	1.52	1.30	1.12
SCREW TYPE	**DPST — 4 TERMINAL**					
	On-X-Off	ST50K	2.40	1.76	1.49	1.20
	On-X-Off*	ST50L	2.90	2.15	1.78	1.42
	Off-X-On*	ST50M	2.90	2.15	1.78	1.42
	DPDT — 6 TERMINAL					
	On-X-On	ST50N	2.75	2.07	1.72	1.38
	On-Off-On	ST50P	2.76	2.07	1.72	1.38
	On-X-On*	ST50R	3.13	2.35	1.97	1.57
	On*-Off-On	ST50S	3.24	2.48	2.08	1.66
	On-Off-On*	ST50T	3.13	2.35	1.97	1.57
SOLDER TYPE	**DPST — 4 TERMINAL**					
	On-X-Off	ST52K	2.16	1.60	1.35	1.07
	On-X-Off	ST52L	2.51	1.90	1.58	1.25
	Off-X-On*	ST53M	2.51	1.90	1.58	1.25
	DPDT — 6 TERMINAL					
	On-X-On	ST52N	2.40	1.80	1.51	1.20
	On-Off-On	ST52P	2.40	1.80	1.51	1.20
	On-X-On*	ST52R	2.79	2.08	1.75	1.40
	On*-Off-On	ST52S	2.92	2.18	1.82	1.47
	On-Off-On*	ST52T	2.79	2.08	1.75	1.40

* Momentary Action

¶ For UL identification and ratings on Models ST12A through ST27N, see Table on second preceding page.

GROUP III — 4-POLE HEAVY DUTY WITH TOGGLE SEAL

Circuitry† Keyway

MIL-S-83731	Model No.	2-24▲	25-49	50-99	100-249
4PST — 8 TERMINAL					
On-Off-X	MS25068-24	$6.25	$5.63	$4.75	$3.75
On-Off*-X	MS25068-25	8.25	7.43	6.27	4.95
X-Off-On*	MS25068-28	6.25	5.63	4.75	3.75
4PDT — 12 TERMINAL					
On-Off-On	MS25068-21	7.00	6.30	5.32	4.20
On-X-On	MS25068-23	7.00	6.30	5.32	4.20
On-X-On*	MS25068-26	8.75	7.88	6.65	5.25
On*-Off-On	MS25068-27	8.75	7.88	6.65	5.25
On-Off-On*	MS25068-31	8.75	7.88	6.65	5.25

▲ On orders for single switches, add $1.00

X No position *Momentary position

Other MS25068 Numbers: Models with suffix -1 through -13 as set forth in MIL-S-3950 are superseded by MIL-S-3950 Revision D Types. The latter are interchangeable electrically and mechanically but meet additional performance standards above the former types. Specifically, **MS25068-1** has become MS25068-21; **-3** now -23; **-5** now -31; **-7** now -27; **-10** now -26; **-11** now -24; **-12** now -28; **-13** now -25.

GROUP II — SP & DP & MEDIUM DUTY WITH TOGGLE SEAL

MIL-S-83731	Model No.	2-24■	25-49	50-99	100-249
SPST — 2 TERMINAL					
On-X-Off	MS25098-22	$2.00	$1.60	$1.49	$1.38
On-X-Off*	MS25098-29	2.60	2.09	1.94	1.75
Off-X-On*	MS25098-30	2.60	2.09	1.94	1.75
SPDT — 3 TERMINAL					
On-X-On	MS25098-23	2.30	1.83	1.71	1.55
DPST — 4 TERMINAL					
On-X-Off	MS25100-22	2.90	2.30	2.15	1.95
On-X-Off*	MS25100-29	3.35	2.67	2.51	2.29
Off-X-On*	MS25100-30	3.35	2.67	2.51	2.29
DPDT — 6 TERMINAL					
On-X-On	MS25100-23	3.10	2.49	2.33	2.13

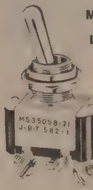
GROUP II — SP & DP MEDIUM DUTY — NO SEALS

JAN-S-23	Model No.	2-24■	25-49	50-99	100-249
SPST — 2 TERMINAL					
On-X-Off	ST12A	$1.42	$1.04	$ .94	$ .89
On-X-Off*	ST12B	1.71	1.25	1.14	1.08
Off-X-On*	ST12C	1.83	1.35	1.23	1.14
On-X-Off	ST13A †	1.46	1.08	.98	.92
On-X-Off	ST16A ‡	1.81	1.33	1.20	1.13
On-X-Off*	ST16B ‡	1.88	1.38	1.25	1.18
Off-X-On*	ST16C ‡	1.88	1.38	1.25	1.18
On-X-Off	ST17A †‡	1.51	1.11	1.01	.94
SPDT — 3 TERMINAL					
On-X-On	ST12D	1.64	1.20	1.10	1.02
On-X-On	ST13D †	1.69	1.24	1.13	1.07
On-X-On	ST16D ‡	1.69	1.24	1.13	1.07
On-X-On	ST17D †‡	1.86	1.36	1.24	1.16
DPST — 4 TERMINAL					
On-X-Off	ST22K	1.94	1.43	1.30	1.21
On-X-Off*	ST22L	2.25	1.64	1.49	1.41
Off-X-On*	ST22M	2.25	1.64	1.49	1.41
On-X-Off	ST23K †	1.99	1.46	1.34	1.25
On-X-Off	ST26K ‡	2.11	1.55	1.42	1.33
On-X-Off	ST26L ‡	2.29	1.67	1.54	1.44
Off-X-On*	ST26M ‡	2.41	1.75	1.61	1.51
On-X-Off	ST27K †‡	2.16	1.58	1.44	1.36
DPDT — 6 TERMINAL					
On-X-On	ST22N	2.12	1.56	1.42	1.34
On-X-On	ST23N	2.17	1.58	1.45	1.36
On-X-On	ST26N ‡	2.12	1.56	1.42	1.34
On-X-On	ST27N †‡	2.29	1.67	1.54	1.44

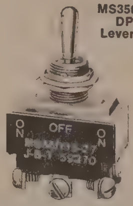
■ On orders for single switches, add 50¢. X No position.

* Momentary position. † Bushing ¼″ high.

‡ Side connected terminals only, except ST16D, -17D, -26N and ST27N have both side and rear connected terminals.

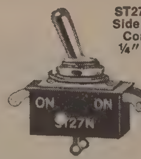


MS35058-21
SPDT
Lever Seal



MS35059-27
DPDT
Lever Seal

MS25100-23 DPDT
Rear Connected;
Lever Seal



ST27N, DPDT
Side and Rear
Connected
¼″ Bushing

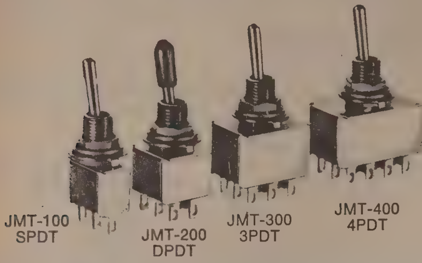
MS25068-27
4 pole DT
Lever Seal

Prices Net, F.O.B. Factory, domestic packing, were in effect Feb. 1, 1974, and should be regarded as relative only. Quantity prices on request.

J-B-T

J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

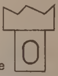
J-B-T SUB-MINIATURE TOGGLE SWITCHES


JMT-100
SPDT
JMT-200
DPDT
JMT-300
3PDT
JMT-400
4PDT

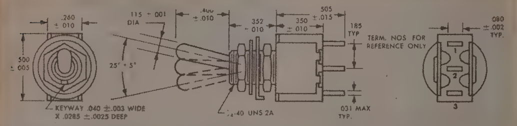
Manufactured by J-B-T in Connecticut, these sub-miniature toggle switches combine drastic reduction in size and weight with the trouble-free performance of J-B-T standard-size General Purpose and Government quality toggle switches.

Widely used in manually controlled, low current, solid state devices, computers, instruments; space, geophysical, and test apparatus, these tiny switches also have application in aircraft, communications, remote control and reservation systems, and peripherals — in short, in the many places where miniaturization makes it necessary to utilize all available space, both in front and rear of panel.

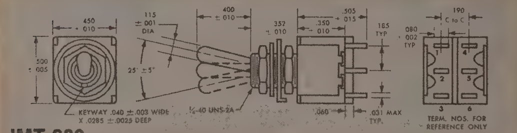
The drawings below cover the basic JMT Series. Standard terminal shown at the right accommodates 3 #22 wires.



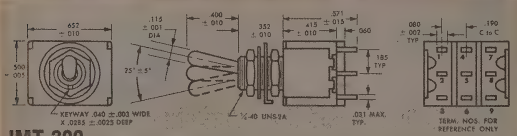
Elongated hole .075 long x .047 wide


.260
± 010
115 ± 001
DIA
.400
±.010
352
± 010
350
± 010
505
±.015
185
TYP
TERM. NOS FOR
REFERENCE ONLY
080
±.002
TYP.
500
± 005
25° ± 5°
1
2
3
KEYWAY .040 ±.003 WIDE
X .0285 ±.0025 DEEP
¼-40 UNS 2A
031 MAX
TYP.

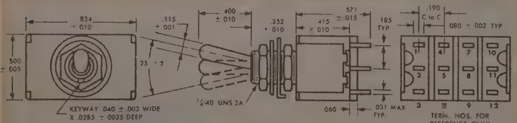
JMT-100


450
± 010
115
± 001
DIA
400
± 010
352
± 010
.350
± 010
.505
± 015
185
TYP
080
± 002
TYP
190
C to C
500
± 005
25° ± 5°
1
2
3
4
5
6
KEYWAY .040 ±.003 WIDE
X .0285 ±.0025 DEEP
¼-40 UNS-2A
.060
.031 MAX
TYP.
TERM. NOS. FOR
REFERENCE ONLY

JMT-200


652
± 010
.115
± 001
DIA
400
± 010
352
± 010
415
± 010
571
± 015
060
080
± 002
TYP
.190
C to C
500
± 005
25° ± 5°
185
TYP
1
2
3
4
5
6
7
8
9
KEYWAY .040 ±.003 WIDE
X .0285 ±.0025 DEEP
¼-40 UNS-2A
.031 MAX.
TYP.
TERM. NOS. FOR
REFERENCE ONLY

JMT-300


834
± 010
.115
± 001
400
± 010
.352
± 010
415
± 010
571
± 015
185
TYP
.190
C to C
080 ± 002 TYP
500
± 005
25 ± 5
1
2
3
4
5
7
8
9
10
11
12
KEYWAY .040 ±.003 WIDE
X .0285 ± .0025 DEEP
¼-40 UNS 2A
060
031 MAX
TYP.
TERM. NOS. FOR
REFERENCE ONLY

JMT-400

● J-B-T Sub-miniature Toggle Switches with distinctive green bodies, ¼″ x ½″ for single-pole, and correspondingly small for 2-, 3-, and 4-pole, are available in 30 double-throw circuit configurations. The JMT Series, shown actual size at the left, with standard bat handle, terminals, and hardware, is considered basic. All Series have high-torque bushings which will not turn or work loose in the J-B-T surface plate; bodies are molded of a superior compound developed for its mechanical and dielectric strength; terminals are firmly staked, and the solder type will withstand repeated solderings.

SPECIFICATIONS

Nominal Rating: 5 amp. resistive load @ 125 VAC and 24 VDC; 3 amp. resistive load, 250 VAC; T01, T02, T06, and T08 Series — .5 Watt, 28 VAC or VDC Max. *UL Ratings:* 5 amp. inductive load (.75PF) @ 125 VAC.

Initial Contact Resistance: 5 milliohms max. 3 VDC, 100 ma.
Insulation Resistance: 20,000 megohms, min. for diallyl phthalate bodies; 10,000 megohms, min. for phenolic bodies.
Dielectric Strength: 1,000 volts rms at sea level.
Life Under Load: 100,000 make-and-break cycles for suffix — 23 models; 60,000 for others.
Bushing Strength: Hi-torque type; 12 pound-inches without physical damage to switch.
Weight (including hardware) = SP, 0.19 oz.; DP. 0.23 oz.; 3 pole, 0.28 oz.; 4-pole, 0.32 oz.

MATERIALS

Switching Contacts and Rockers: Coin silver. *Center Terminals* (non-switching parts): silver plated brass.
Switch Bodies: 1- and 2-pole types molded of green, glass-filled flame retardant diallyl phthalate (DAP) for high strength and arc resistance; at time of publication, 3- and 4-pole types high strength phenolic, but DAP type under development.
Bushings: Brass, nickel-plated. *Clamp:* Stainless Steel.
NOTE: *Gold plated* current carrying parts are available where required for dry circuit (very low energy) applications.
All terminals on MPC, T01, T02, T06, and T08 Series are normally supplied hard gold plated over 200 millionths of nickel, minimum.
Epoxy Sealed terminals are also available.

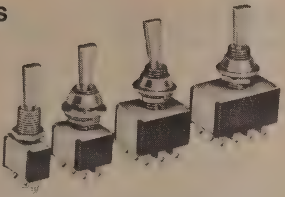
HANDLE & FINISH

JMT SERIES, standard bat handle; bright chrome-plated brass.
LFH SERIES, for panels up to ¼″, flat handle; satin chrome.
FH SERIES, for panels up to 3/16″, flat handle, satin chrome.
LL SERIES, locking lever with anodized natural aluminum cap; also anodized in red, blue, gold, black, and green for circuit coding and identification.
15 SERIES bat handle, and *15F Series* flat handle, are natural aluminum (also available in bright nickel).
MPC SERIES, TO-1 SERIES, standard bat handle, bright chrome-plated brass.
TO-2 SERIES, PC1,2 SERIES, short bat handle, bright chrome.
PB SERIES, push button, .375″ diam. threaded molded knob, normally black, also red or white. Interchangeable threaded .375″ diam. metal knob anodized in natural alum., red, blue, gold, black or green. Refer to page 5.
(*NOTE:* For other available finishes contact the factory or the J-B-T Sales Representative).
Mounting hardware, Hex nuts and locking ring are brass nickel-plated; lockwasher, steel, cadmium-plated with chromate treatment. Normally supplied: one locking ring *W-RI-12*; two hex nuts, *W-NU-11*; one internal tooth lockwasher, *W-WA-16*. Knurled nut, *W-NU-12* and several varieties of dress nut are also available. For details and part numbers, see page 10.
Color Caps: Tight — grip insulator caps for color coding as on JMT-200 DPDT shown above are available for easy attachment before or after switches are mounted, see page 10.

J-B-T
J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

additional sub-miniature toggle switches

LFH AND FH SERIES with Flat Handles

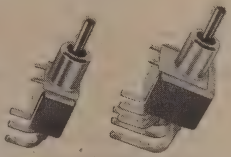


SERIES LFH and FH — provide a human engineering factor, with flat handles that are easy to grasp, give good sensing of the direction of throw, and orderly panel appearance. Flatted on two sides, each lever is permanently aligned in its operating plane perpendicular to the flat. Standard finish is satin chrome, with bright nickel and other finishes available on special order.

LFH and **FH** are identical in appearance, front of panel; the principal differences are .437″ length of bushing and 22° throw on LFH, and .352″ length of bushing with 25° throw on FH, both supplied with W-NU-17B, standard dress nut mounting.

The **FH** Series is designed for mounting on 3/16 in. panels; the **LFH** Series, which is more widely used, is designed for ¼ in. panels, or will provide extra space behind the panel. All models in either series can also be made with MPC or TO2 terminals; most are available with UL listing.

TO2 SERIES for right angle mounting in printed circuit boards



SERIES TO2 — These SPDT and DPDT switches are designed for dry circuit (very low energy) applications. Contacts and terminals are brass, plated with 100 millionths (.0001 minimum) of hard gold over 200 millionths (.0002 minimum) of nickel. Rating 0.5 watts @ 28 volts max. (AC or DC). Other thicknesses of plating on special order. Different from JMT sizes, TO2 bushing is .280″ long unthreaded and lever .272″ long. Terminals are .031″ x .050″.

Other Models and Features — 15/32″ bushing; solderless wrapped terminals; sealed lever; sealed bushing; perpendicular terminals; pinned levers; push-on terminals; epoxy seal

In addition to the best sellers shown in this catalog, J-B-T also produces and will gladly quote on:

Series 15 and 15F — JMT body for space-saving behind panel but substantial 15/32″ bushing and ½″ mounting hole, same as standard size J-B-T toggle switches, for front of panel. Series 15F have flat handles.

Series TO1 — SPDT, DPDT, solderless wrap (wire-wrap terminals for dry circuit applications. Refer to SK-196, -197.

Series TO3 — Sealed lever added to standard J-B-T switches.

Series TO4 — Sealed lever and sealed bushing added to standard J-B-T switch.

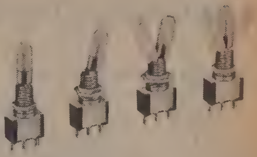
Series TO8 — Right angle bent gold-plated brass terminals for vertical (perpendicular) operation. (90° different from TO2.)

Series T12 — JMT with bat style toggle lever; internally pinned (riveted) where extra ruggedness required.

Series T13 — Standard JMT construction with silver push-on terminals .031″ x .062″ x .200″ for AMP 60900-1 or equal connector.

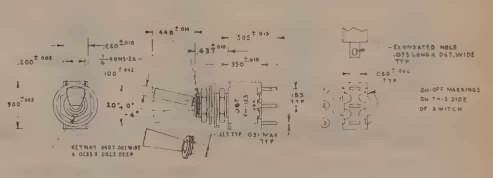
Epoxy Seal — Seals terminals to case. May be specified on any model.

LL SERIES with Locking Levers

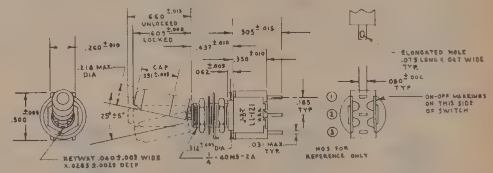


SERIES LL — Made with spring-loaded locking mechanism to prevent accidental shifting of lever — a definite advantage on planes, ships, trains, or other vehicles where sudden motion might cause switching errors. Also, for test equipment, other instrumentation or computer circuits where accumulated data might be lost through unintentional switching. As a human engineering factor, the operator must think about the switching operation before he can complete it.

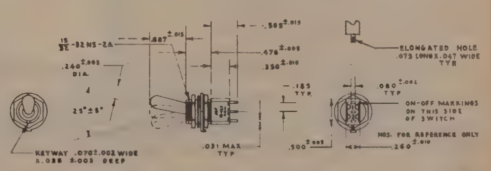
LL Series are normally stocked with natural aluminum caps, but for circuit identification caps can be supplied with anodized colors: red (danger), black, blue, gold or green.


.448 ±.010
.505 ±.015
.260 ±.010
.437 ±.010
.200 ±.005
¼-40NS-2A
.350 ±.010
.100 ±.002
.500 ±.005
20° ± 0° -4°
.185 TYP
.060 ±.002 TYP
ELONGATED HOLE .075 LONG X .047 WIDE TYP
ON-OFF MARKINGS ON THIS SIDE OF SWITCH
KEYWAY .060 ±.003 WIDE X .0285 ± .0015 DEEP
.125 TYP.
.031 MAX TYP
J-B-T

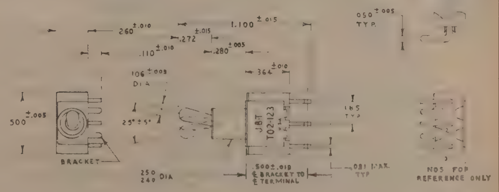
(For double pole, see SK-193; 3-pole, SK-194; 4-pole, SK-195) **LFH-100**


.660 ±.015 UNLOCKED
.605 ±.005 LOCKED
.505 ±.015
.260 ±.010
.437 ±.010
.218 MAX. DIA
CAP .331 ±.005
.350 ±.010
.062 ±.005
.500 ±.005
25° ± 5°
.185 TYP
.080 ±.002 TYP
ELONGATED HOLE .075 LONG X .047 WIDE TYP
ON-OFF MARKINGS ON THIS SIDE OF SWITCH
KEYWAY .060 ±.003 WIDE X .0285 ±.0015 DEEP
.312 ±.005 DIA
¼-40NS-2A
.031 MAX TYP
NOS FOR REFERENCE ONLY
J-B-T LL-121

(For double pole, see SK-181; 3-pole, SK-184; 4-pole, SK-185) **LL-100**


15/32-32NS-2A
.687 ±.015
.505 ±.015
.478 ±.005
.240 ±.005 DIA
.350 ±.010
.185 TYP
25° ± 5°
.080 ±.002 TYP
ELONGATED HOLE .075 LONG X .047 WIDE TYP
ON-OFF MARKINGS ON THIS SIDE OF SWITCH
NOS. FOR REFERENCE ONLY
KEYWAY .070 ±.002 WIDE X .035 ±.005 DEEP
.031 MAX TYP
.500 ±.005
.260 ±.010

(For double pole, see SK-187; 3-pole, SK-188; 4-pole, SK-189) **15-100**


.260 ±.010
1.100 ±.015
.272 ±.015
.050 ±.005 TYP
.110 ±.010
.280 ±.005
.106 ±.003 DIA
.364 ±.010
.500 ±.005
25° ± 5°
.185 TYP
BRACKET
.250 .240 DIA
.500 ±.015 ℄ BRACKET TO ℄ TERMINAL
.031 MAX TYP
NOS FOR REFERENCE ONLY
J-B-T TO2-123

TO2-100

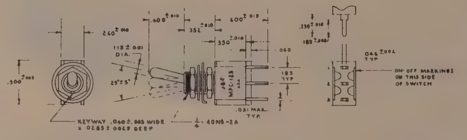
J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

sub-miniature toggle switches

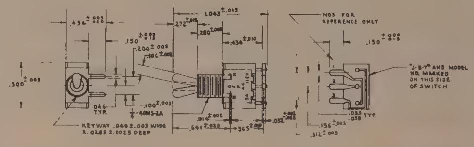
PC1

SERIES MPC, PC1 AND PC2

Sub-miniature toggle switches are made with terminals for insertion in printed circuit boards; MPC for direct insertion, and PC1 and PC2 with small, attached printed circuit, for right angle insertion. Terminals are plated with 100 millionths (.0002 minimum) nickel for ease of solderability. MPC Series includes the same front-of-panel construction as the standard JMT Series as well as such modifications as FH (Flat Handle), LL (Lever Lock), 15 Series (Large Bushing) and other variations. (Illustrations approximately actual size.)


.400 ± .010
.352 ± .010
.600 ± .015
.260 ± .010
.250 ± .010
.183 ± .005
.115 ± .001 DIA.
.350 ± .010
.060
.046 ± .006 TYP
.300 ± .005
25° ± 5°
J-B-T MPC-123
.185 TYP
ON-OFF MARKINGS ON THIS SIDE OF SWITCH
.031 MAX. TYP.
KEYWAY .040 ± .003 WIDE X .0285 ± .0025 DEEP
1/4-40NS-2A

(For double pole, see SK-167; 3-pole, SK-168; 4-pole, SK-169) **MPC-100**


.434 ± .003 −.020
1.043 ± .015
.272 ± .015
.280 ± .010
.150 +.000 −.015
.434 ± .010
.200 ± .005
.106 ± .008
NOS FOR REFERENCE ONLY
.150 +.000 −.015
"J-B-T" AND MODEL NO. MARKED ON THIS SIDE OF SWITCH
.500 ± .005
.046 TYP.
.100 ± .003
1/4-40NS-2A
.014 ± .002
.032 +.001 −.005
.033 .038 TYP.
KEYWAY .040 ± .003 WIDE X .0285 ± .0025 DEEP
.641 ± .020
.365 ± .010
.156 ± .003
.312 ± .003

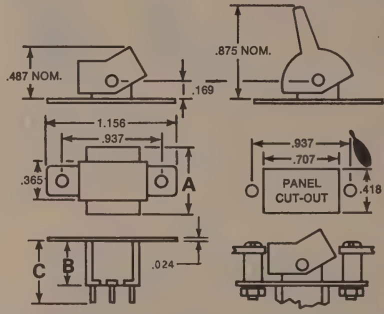
PC1

NEW! SUB-MINIATURE ROCKER AND PADDLE LEVER SWITCHES

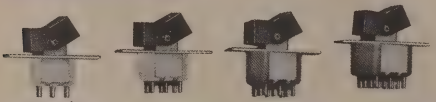
PADDLE LEVER SERIES MP1

Series MP1 † 1-, 2-, 3-, and 4-pole, shown approximately three-quarter size. Paddle levers are molded nylon; black supplied as standard; red and white also available. Other colors on special order.

Electrical characteristics and dimensions below the mounting bracket are the same as in JMT's. Switches also may be made with printed circuit terminals (MPC type for direct insertion), push-on terminals (T13 Series), and solderless wrap terminals (T01 Series). In addition to their attractive modern appearance, the MP1 Paddle Lever Series and the MR1 Rocker Series feature extra built-in strength where it is needed most. A sturdy support column with a rivet-pivot actuator fastening attaches the rocker or paddle **through** the support so that it moves freely in its plane but always is aligned and will not wobble or work loose.


.487 NOM.
.169
.875 NOM.
1.156
.937
.365
A
.937
.707
PANEL CUT-OUT
.418
C
B
.024

ROCKER SERIES MR1



Series MR1 † 1-, 2-, 3-, and 4-pole, shown approximately three-quarter size. Rockers are molded nylon; black supplied as standard; red and white also available. Other colors on special order.

*Momentary
† SERIES MR2 and MP2 are bezel mounted.

	SP	DP	3P	4P	Panel	Standoff	P/N
A	.260	.450	.652	.843	1/16″	.295	W-SPA-11A
B	.350	.410	.475	.475	3/32″	.264	W-SPA-11B
C	.505	.505	.571	.571	1/8″	.233	W-SPA-11C

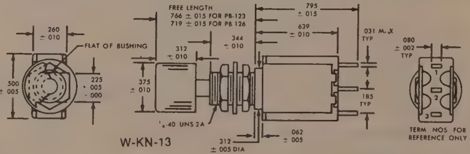
PB AND NEW PB1 PUSH-BUTTON SERIES —(SPDT)

Push button switches combine *5 AMP RATINGS OF JMT* switches with *LIFE UNDER LOAD OF 100,000 CYCLES, MAKE-AND-BREAK*. Configurations are Maintained Action or Momentary Action; now made as single-pole, double-pole are under test.

Construction and dimensions differ from JMT switches but electrical specifications are substantially the same. Force to operate is less than 2 lbs. Rapid break generates audible click. SP weight with hardware is 0.4 ozs., over-all depth behind panel .795″. Flatted (D-shaped) bushings standard.

PB models formerly made with .375″ diam. metal knobs (W-KN-10) now have .375″ diam. threaded molded knob (W-KN-13). Colors as listed. PB1 models, new in this catalog, use .200″ diam. push-on molded knob (W-KN-12), black nylon standard, also red and white. *PB* and *PB1* catalog models have standard JMT solder terminals but can be made with other terminations.

NOTE: *PB1* models, such as PB1-123, are interchangeable with PB models, such as PB-123, except for smaller diameter shaft and knob, and slightly less height in front of panel and are priced the same. For details, ask for SK-273.


260 ± 010
FLAT OF BUSHING
500 ± 005
225 + 005 − 000
FREE LENGTH
766 ± 015 FOR PB-123
719 ± 015 FOR PB 126
312 ± 010
344 ± 010
375 ± 010
795 ± 015
639 ± 010
031 MAX TYP
080 ± 002 TYP
185 TYP
1/4-40 UNS 2A
312 ± 005 DIA
062 ± 005
1
2
3
TERM NOS FOR REFERENCE ONLY

W-KN-13

SPDT – SERIES PB, PB1	Model Number	Quantity net prices 2-9‡	10-29	30-99
Maintained Action Switch				
Push To Make Contact, And Push Again To Reverse Action	PB-123 PB1-123	$2.05 2.05	$1.54 1.54	$1.37 1.37
Momentary Action Switch				
Normally Open Or Normally Closed. (For N C circuit use terminals 2 & 1; for N O, 2 & 3; for N C and N O, 1, 2, & 3.	PB-126 PB1-126	$2.05 2.05	$1.54 1.54	$1.37 1.37

‡ On orders for single switches, add 50 cents

Prices Net, F.O.B. Factory, domestic packing, were in effect April 1, 1974, and should be regarded as relative only. Quantity prices on request.

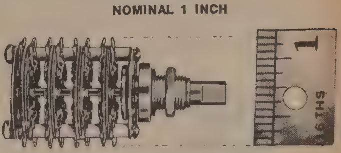
J-B-T INSTRUMENTS, INC.
NEW HAVEN, CONNECTICUT 06508

sub-miniature rotary and lever switches

SUB-MINIATURE SWITCHES MADE TO MANY PERFORMANCE LEVELS OF MIL-S-3786C, TYPE SR05; ALSO NON-MILITARY X AND V VERSIONS.

SERIES 7000, FULL 12 LIVE SWITCHING CONTACTS PER DECK:
SERIES 5000, UP TO 8 POLES PER DUAL-DUTY DECK.

- **Precision built for Low-Current Usage where Size, Weight, Reliability are Important**
- **Unusual Versatility — More Contacts per Deck**
- **Accelerated Snap-Action Detent**
- **MIL Materials Throughout for Military & Non-Military Applications**
- **Uses — For test equipment, airborne and transistorized equipment, geophysical apparatus, and other miniaturized electrical and electronic devices.**



4 DECKS Series 5000
Model Number V-52114N-SR05S30C3MGC. Terminals have hole to accept two 0.032″ dia. wires, and supersede solid "T" terminals formerly supplied.

CAUTION — MIL-S-3786C, a sophisticated specification, spells out more than one performance level in each of several categories such as Temperature-Life, Vibration, Shock, and Altitude, J-B-T SR05 models meet many levels.

TWO BASIC SERIES — Full 12 live switching contacts per deck are available in **Series 7000** using a patented wafer design feature where rotor contacts are on the front, and switching contacts are on the rear of the same deck. 1 to 4 poles per deck 1 to 6 decks, standard.

Up to 8 poles per dual-duty deck are available in **Series 5000** which has up to 12 contacts including common on the front, and up to 12 contacts including common on the rear of the same deck. 1 to 4 poles on each side of dual-duty decks; 1 to 4 decks, standard.

THREE ROTARY TYPES — Both Basic Series are made in 3 types: **MILITARY STYLE SR05,** numbered for specific performance levels of MIL-3786C; **V TYPE,** of similar construction to SR05, but not ordinarily subjected to full military test procedures; and **X TYPE,** using the same materials as V type switches, but intended as replacements for previous models or as original components for non-military devices where requirements are similarly exacting.

LEVER SERIES (L and SR31 Types) — Outstanding design known as VL-7000 or VL-5000 Series, 1 to 4 decks. Illustrated on a following page.

KNOBS — Supplied with individually boxed switches on V and X types; not supplied on SR05 because separate military specification applies.

DIFFERENCES BETWEEN SR05 MILITARY, V & X

Switches other than X types use extra rugged index mechanisms and rotor construction.

FOR ADDITIONAL MODELS AND FULL SPECIFICATIONS, ASK FOR BULLETINS SM-33 AND LAYOUT SHEETS WITH CONTACT ARRANGEMENTS

	NON-MILITARY		MIL-S-3786C
Item	X-7000 X-5000	V-7000 V-5000	V-7000-SR05 V-5000-SR05
Terminals	Hole-type not bent	Hole-type not bent	Hole-type; normally not bent
Shaft	⅛″ dia.	¼″ dia.	¼″ dia. only
Bushing	¼″-32UNEF 2A, ¼″ long	⅜″-32UNEF 2A, ⅜″ long	⅜″-32UNEF 2A, ⅜″ long
Rear Bridge	Black Identification	Red Identification	Stainless Steel, full number
Non-turn Device	Normally supplied	Normally supplied	Supplied, Spec. requires

SEALED

SR05 SHAFT AND BUSHING SEAL NOW AVAILABLE ON 1″ OPEN CONSTRUCTION ROTARY SWITCHES TO MIL-S-3786C

The versatility of J-B-T 1″ open construction sub-miniature rotary switches described in Catalog SM-33 is increased by the addition of shaft and bushing seals to meet the requirements of SR05S Type to MIL-S-3786C.

	MILITARY	
Principal differences:	SR05N	SR05S
Sealed Shaft-to-bushing	No	Yes
Sealed Panel Bushing	No	Yes
Bushing Size	Round ⅜-32	Flatted (D-Shape)
Depth behind panel	See Table Following Page	.100″ longer
Non-Turn Device	Yes (unless otherwise ordered)	Provided by flatted bushing
Other Details	Print SK-135 (E)	Print SK-179

MOST FREQUENTLY ORDERED ROTARY SWITCHES

Decks	Circular Poles per Deck	Positions per Pole	Shorting Non-Shorting	V-Type or X-Type Model	1-24
1	1	12	N-S	V-71121N	$5.54
	1	12	S	V-71121S	5.45
	1	12	N-S	X-71121N	5.31
	1	12	S	X-71121S	5.31
	2	6	N-S	V-72061N	5.82
	4	3	N-S	V-74031N	5.88
1 Dual Duty	2	11	N-S	V-52111N	5.93
	2	11	S	V-52111S	5.93
	4	5	N-S	V-54051N	6.05
	4	5	S	V-54051S	6.05
	8	2	N-S	V-58021N	6.27
2	1	12	N-S	V-71122N	7.63
	1	12	S	V-71122S	7.63
	1	12	N-S	X-71122N	7.29
	2	6	N-S	V-72062N	8.08
	4	3	N-S	V-74032N	8.36
2 Dual Duty	2	11	N-S	V-52112N	9.15
	2	11	N-S	X-52112N	8.70
	4	5	N-S	V-54052N	9.30
3	1	12	N-S	V-71123N	10.00
	2	6	N-S	V-72063N	10.34
	4	3	N-S	V-74033N	11.13
4	1	12	N-S	V-71124N	13.50
	1	12	N-S	X-71124N	12.88
6	1	12	N-S	V-71126N	18.14
1 Lever	4	3	N-S	VL-74031N	5.82
	2	3	N-S	VL-72031N	5.71
	8	2	N-S	VL-58021N	6.16
1	1	12	N-S	Bushing Seal and Lever Seal	
2 Dual Duty	2	11	N-S		
2 Dual Duty	4	5	N-S		
3	1	12	N-S		

* Complete model number for a typical MIL-S-3786C rotary switch is: V-71121N-SR05N30C3MGC, which designates specific performance levels. Likewise, for a typical lever-actuated switch: M3786/31-040. Unless otherwise ordered, switches will be furnished to this suffix (N30C3MGC). On certain models, sealed shaft and bushing are available at $2.00 extra cost, when so ordered.

LEVER ACTION SWITCHES — 2 and 3 Position, 1 to 4 Decks, 2 to 8 Poles Per Deck

SUB-MINIATURE LEVER SWITCHES

Derived from the high-performance subminiature switches described on another page. The VL-7000 and the VL-5000 positive indexing series and the VSRL-7000 and VSRL-5000 spring return types provide excellence in lever switches. MIL materials throughout; crisp 30° indexing. Max. depth behind panel 1.250″; panel slot .962″ x .062″; other details to SK-139, Rev. A and Catalog SM-33.

Typical switches are:

VL-71031N, single-pole, 3-position, one-deck, non-shorting **$5.42**

VSRL-71031N, same as above, with spring return to center position from either side **6.55**

VL-71032N, single-pole, 3-position, two-deck, non-shorting **7.97**

TYPE SR31 LEVER-ACTUATED SWITCHES TO MIL-S-3786C, MEDIUM AND HIGH SHOCK

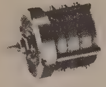
Sub-miniature open construction, lever-actuated switches, similar to the one illustrated above, recently have been added to MIL-S-3786C as SR31 types. This category covers shorting and non-shorting; 1 to 4 poles per section; 1 to 4 sections per switch; meets both Medium and High Shock requirements as in Models M3786/31-040. Typical models are printed on preceding page.

janco CORPORATION

Manufactured under the strictest quality controls for over 28 years!

Series "A" Miniature Rotary Selector Switches

Series A-15



15°

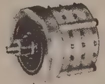
Max. Positions: 24
Body Diameter: 2″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
6-1900 Series 1 pole/deck
6-1912 Series 2 pole/deck
6-1980 Series 3 pole/deck
6-1914 Series 4 pole/deck
6-1913 Series 6 pole/deck

Series A-45

45°

Max. Positions: 8
Body Diameter: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
5 amps 28 v dc Res.
2.5 amps 28 v dc Ind.
1906 Series 1 pole/deck
1-1910 Series 2 pole/deck

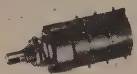
Series A-20



20°

Max. Positions: 18
Body Diameter: 2″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
Available only in single pole per deck construction.

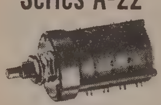
Series A-60



60°

Max. Positions: 6
Body Diameter: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
Available only in single pole per deck construction.

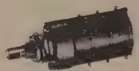
Series A-22



22½°

Max. Positions: 16
Body Diameter: 1.5″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
3-1900 Series 1 pole/deck
3-1912 Series 2 pole/deck
3-1914 Series 4 pole/deck

Series A-90



90°

Max. Positions: 4
Body Diameter: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
5 amps 28 v dc Res.
2.5 amps 28 v dc Ind.
Available only in single pole per deck construction.

Series A-30

30°

Max. Positions: 12
Body Diameter: 1.036″
Electrical Rating:
2 amps 115 v ac Res.
1 amp 28 v dc Res.
0.5 amp 28 v dc Ind.
1905 Series 1 pole/deck
1-1909 Series 2 pole/deck
4-1900 Series 3 pole/deck
67-1940 Series 4 pole/deck
67-1900 Series 6 pole/deck

Series A-36

36°

Max. Positions: 10
Body Diameter: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
1900 Series 1 pole/deck
1960 Series 2 pole/deck

ON MOST OF THE SWITCHES LISTED, THE FOLLOWING FEATURES ARE AVAILABLE:

1. Deck Identification
2. Extended Thru Bolt for Rear Mounting
3. O-ring Shaft and Panel Seal
4. Combination of Decks
   a) Nonshorting and shorting
   b) Shorting, shorting and bridging
   c) Nonshorting and shorting and bridging
5. Bridging contacts
6. Momentary positions
7. Isolated positions
8. Adjustable stops
9. Solenoid driven
10. Keylock
11. Gang switches
12. Concentric shaft switches

For switches that incorporate these features, a unique Janco part number must be assigned at the plant.

JANCO CORPORATION
Box 3038 • Burbank, CA 91504 • 3111 Winona Avenue • (213) 849 2107 • (213) 845 7473 • TWX 910 498 2701

Janco engineers will design a switch to meet your specific requirements!

Janco CORPORATION

Series "B" Micro-Miniature Rotary Selector Switches

- **TOTALLY ENCLOSED**
- **EXPLOSION PROOF**
- **UNITIZED CONSTRUCTION**

All switches offer maximum protection against radio frequency interference.

Body Diameter: .623"

Electrical rating continuous: 8 amps at 28 v dc.

Switching rate:
0 to 0.25 amp resistive 0 to 28 v dc.
0 to 0.25 amp resistive 0 to 115 v ac.
0 to 0.12 amp inductive 0 to 28 v dc.

TORQUE: 5 to 9" ounces.
CONTACT RESISTANCE: .005 ohms average.
INSULATION RESISTANCE:
100,000 megohms minimum at 100 volt.
10,000 megohms minimum at 500 volts.
DESIGNED AND BUILT to meet the environmental and functional requirements of MIL-S-3786.

Series B-30

30°

Max. Positions: 12

2500 Series	1 pole/deck
2530 Series	2 pole/deck
2531 Series	3 pole/deck
"M" SERIES	
2500M Series	1 pole/deck
2530M Series	2 pole/deck
2531M Series	3 pole/deck

Series B-36

36°

Max. Positions: 10

1-2500 Series	1 pole/deck
1-2530 Series	2 pole/deck
"M" SERIES	
1-2500M Series	1 pole/deck
1-2530M Series	2 pole/deck

Series B-45

45°

Max. Positions: 8

2-2500 Series	1 pole/deck
2-2530 Series	2 pole/deck
"M" SERIES	
2-2500M Series	1 pole/deck
2-2530M Series	2 pole/deck

JANCO ROTARY SWITCHES GENERAL SPECIFICATIONS

All switches offer maximum protection against radio frequency interference.

ELECTRIC RATING:
Carry 10 amps continuous.
Make and Break — see individual switch data.

VOLTAGE DROP:
0.1 volt or less at rated amperage.
Initial Contact Resistance .003 OHM.

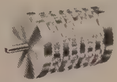
LIFE:
10,000 double cycles make and break rated amperage.

TORQUE:
1 to 3 inch lbs.

SWITCHES DESIGNED AND BUILT IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:
MIL-S-6807 (rotary switches enclosed)
MIL-S-3786 (rotary switches)
MIL-E-5272 (environmental testing)

Series "C" Rotary Selector Switches

Series C-22



22½°

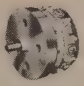
Max. Positions: 16
Body Diameter: 3"
Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
6 amps 28 v dc Ind.
Available only in single pole per deck construction.
Screw terminals only.

Series C-30

30°

Max. Positions: 11 plus off
Body Diameter: 2.180"
Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.
Available in 1 and 3 poles per deck construction.
Screw terminals only.

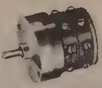
Series C-36



36°

Max. Positions: 9 plus off
Body Diameter: 2.375"
Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.
Available only in single pole per deck construction.
Screw terminals only.

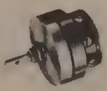
Series C-45



45°

Max. Positions: 7 plus off
Body Diameter: 1.93"
Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.
Available in 1 and 2 poles per deck construction.
Screw terminals only.

Series C-90



90°

Max. Positions: 4
Body Diameter: 2.12"
Electrical Rating:
1 pole construction
15 amps Res. 115 v ac
15 amps Res. 28 v dc
10 amps Ind. 28 v dc
2 pole construction
7.5 amps Res. 115 v ac
7.5 amps Res. 28 v dc
5 amps Ind. 28 v dc
Screw terminals only.

JANCO CORPORATION

Box 3038 • Burbank, CA 91504 • 3111 Winona Avenue • (213) 849 2107 • (213) 845 7473 • TWX 910 498 2701

janco
CORPORATION

WRITE FOR NEW COMPLETE CATALOG

Series "D" Pushbutton Rotary Switches

BI-DIRECTIONAL

INDEX	SERIES	NO. OF POSITIONS
45°	D45B	8
36°	D36B	10
30°	D30B	12
22½°	D22B	16

SERIES 2800 QPL to MIL-S-22710/18

UNI-DIRECTIONAL

INDEX	SERIES	NO. OF POSITIONS
45°	D45U	8
36°	D36U	10
30°	D30U	12
22½°	D22U	16

SERIES 2900M QPL to MIL-S-22710/23

FEATURES:

Totally enclosed, explosion proof.

Printed-circuit construction.

Black or white numbers on black or white background indicate switch positions (black numbers on white background for lighted switches).

All standard codes available. Available in 8, 10, 12 or 16 positions.

Plastic covered buttons, available in black, red, green, yellow, white or blue.

PERFORMANCE DATA:

ELECTRICAL RATING CONTINUOUS:
3 amps

MAKE AND BREAK
.125 amp res. at 28 v dc and 115 v ac
.05 amp ind. at 28 v dc

PUSH FORCE:
55 oz. max.

CONTACT RESISTANCE:
Initial .100 ohms
After life .160 ohms

LIFE:
50,000 cycles
Cycle consists of 720° rotation.

INSULATION RESISTANCE:
5,000 megohms

ALTITUDE:
70,000 ft.

TEMPERATURE RANGE:
−65°C to +85°C.

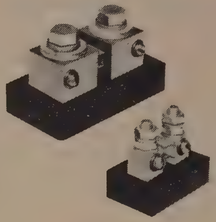
PLUNGER TRAVEL:
.180 approx.

DIELECTRIC STRENGTH:
750 volts RMS

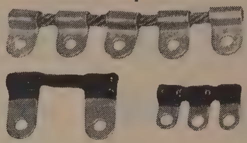
WEIGHT:
½ oz. approx.

Designed to meet the requirements of MIL-S-22710

Special Products



EXTERNAL AMMETER SHUNTS • MIL-S-61-B



FLEXIBLE BUS ASSEMBLIES

BONDING JUMPERS

BUS BARS

JANCO CORPORATION
Box 3038 • Burbank, CA 91504 • 3111 Winona Avenue • (213) 849 2107 • (213) 845 7473 • TWX 910-498-2701

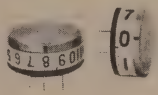
"ADAPTABILITY THROUGH VERSATILITY"

janco CORPORATION

Typical Unique Applications of Janco Rotary Switches

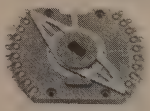
FOR "DRY" CIRCUIT SWITCHING

Intended to interface with low level and "dry" logic circuits. Ideal for use with TTL, ECL, and CMOS type devices, and is available in a variety of detent angles and output codes. The basic switch length is under one inch and additional decks add approximately 5⁄16" each.



MINI CODE SWITCH

Intended to be used with card racks on ½" centers, the unit measures ⅜" high. Provides decimal, octal hexadecimal, and most other common codes. Can also be lighted and supplied with or without seals.



TRANSMISSION SELECTOR SWITCH

Positive heavy detent mechanism produces 6" lbs. of force. Contacts make and break 15 amps @ 115 VAC switch through 10 selectable positions. The heavy duty diallyl provides high insulation resistance. Unique circuit provides isolated 10 position dual output.

FEATURES INTERLOCKING SELECTION MECHANISM

Prevents user from inadvertent selection of an unwanted or undesirable position or digit by automatic, predetermined, limited selection of positions in any switch bank. In its simplest form, a two-bank module could have the left or right switch limited to any number of positions with relationship to the other. Available with any number of banks, positions or selective characteristics.

JANCO
JANCO
JMP 36

MINIATURE PIN-TYPE ROTARY SWITCHES

Designed for printed circuit boards and front panel mounting. Available in various numbers of positions and poles.

FEATURES UNIQUE ON-OFF OPERATION

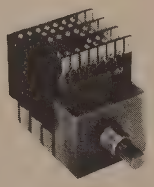
Actuated by pulling knob out of "off" position and rotating to "on" positions. While in "on" positions, circuitry cannot be shut off until knob is returned to "off" position and depressed. Number of positions optional.

MASTER COMMUNICATIONS SELECTOR SWITCH

In addition to providing the standard and modified coded outputs, it offers unique switching functions effected by longitudinal shaft movement. Momentary spring return or detented maintained contact positions actuated by pulling on the shaft. Only .675" in diameter.

MINIATURE POWER SWITCH CUTS COSTS BY 50%

Janco's line of miniature rotary switches is available with an auxiliary snap action switch affixed to the back. Coupled with an isolated positions feature, it enables the user to switch 10 amps with no danger to the switch. Cost reduction is approximately 50% over conventional power switches.



MORE SWITCHING IN LESS SPACE

Circuit board construction is featured in this switch. Offers the same switching capabilities normally associated with switches having 2 to 3 times more decks. Also features isolated positions and custom codes.

JET ENGINE START SWITCH

Switch knob is depressed and the contacts are held in a closed position by the solenoid. After the jet engine reaches the desired RPM, the starter system removes power to the switch, thereby disengaging the solenoid. A lighted knob is coupled with the start system indicating function.

MANUALLY HOMING ROTARY SWITCH

Features instant release button, which automatically returns to predetermined designated home position. Has four positions with visual indicator. Variations available.

JANCO CORPORATION

Box 3038 • Burbank, CA 91504 • 3111 Winona Avenue • (213) 849-2107 • (213) 845-7473 • TWX 910-498-2701

SERIES 1400/Illuminated Push Button Controls

STANDARD FEATURES AND OPTIONS

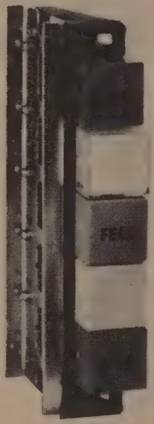
Capacity:	single push button or 2 to 20 on a frame
Contacts:	DPDT, 4 amperes, 125 VAC or 2 amperes, 250 VAC
Contact Material:	silver plated standard, gold plated .0002″ optional
Terminals:	solder or printed circuit (gold plating included when specified on contacts)
Illumination:	6, 12, or 24 volt lamps; sockets and terminals included at all stations. Lamps installed at factory or supplied separately
Legends:	hot stamping or engraving on outer or inner caps; printed transparent film inserts between outer and inner caps
Cap Size:	⅜″ x ¾″ rectangular or ¾″ square
Mounting:	two holes for #6 screws or #4-48 tapped plates; mating #4-48 screws available
Colors:	transparent: (light diffusing grid pattern also available with rectangular cap) red, yellow, green, blue, and clear Opaque: red, yellow, green, blue, white, black, dark gray, and light gray.

SWITCHING COMBINATIONS AND DEFINITIONS

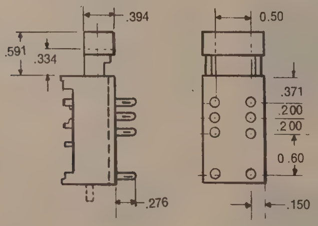
Normal Position:	released condition.
Interlock:	sometimes called lockout, only one of two or more buttons can be pressed at one time. Interlock can be incorporated between any number of buttons.
Momentary:	spring returned to the normal position.
Maintained:	switch remains in depressed position until any of the release actions described below occur.
Push/Push:	push to lock in depressed position. Push again to release.
Reciprocal Release:	the switch remains in the depressed position until another reciprocal release button is pressed.
Master Release:	press to release any of the buttons in the depressed position. (The master release includes DPDT contacts, so it can double as a momentary switch.)
Reciprocal & Master Release:	combines the release actions of both the reciprocal and master release buttons.

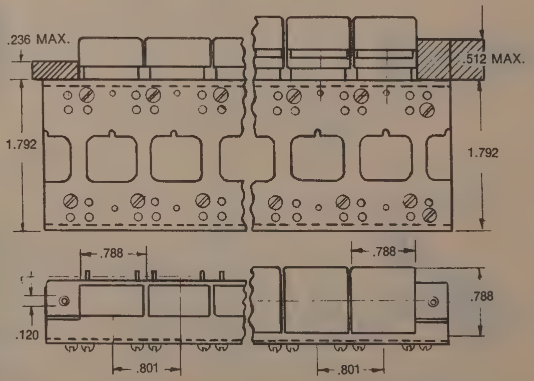
SINGLE PUSH BUTTONS AND INDICATOR LIGHTS

For single button DPDT switching, you can order matching series 1400 controls with momentary or push/push action. Then, put an extra attractive touch to the appearance of your equipment with matching series 1400 indicator lights. The single push buttons and indicator lights are identical to the other series 1400 controls in form and fit and they are supplied with the same standard features and options. Mounting plates are optional.



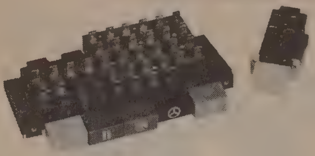
LEGEND SIDE GUIDE





LEDEX INC.
126 WEBSTER STREET. DAYTON, OHIO 45401 /
PHONE: (513) 224-9891

SERIES 1500/Illuminated Push Button Controls
16A-250 VAC POWER SWITCH



The Series 1500 single and ganged switch assemblies give you many benefits not found in other switches.

Up to five circuits per switch station, in combinations of N.O. or N.C. contacts, enables you to perform more complex switching in less space. Switch single phase, two phase/three wire, or three phase power with one module.

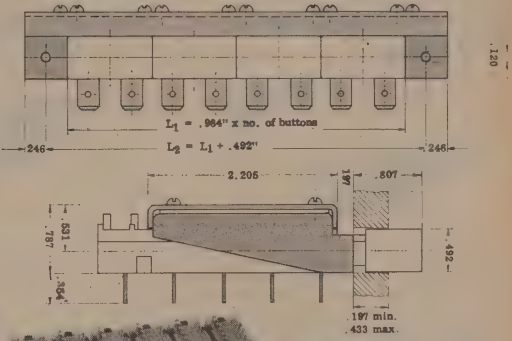
Combine the wide variety of circuits with the interrelated switching logic, such as interlock, reciprocal or master release, or any combination of these for the exact solution to your switching requirements.

All of this, plus the Series 1500 **saves you money**... when buying them — when installing them — when using them! Priced as low as $.85 per station at the 1000 quantity makes them one of the most economical power switches available. When installing them, simply attach spade terminals to the color coded contacts — eliminate soldering and relay hook-up. You get the biggest savings when you use them. Series 1500's are high-quality switches built to take it. The rugged construction and non-removable caps make these switches ideal for use in vending machines, major appliances, and other equipment subject to heavy use.

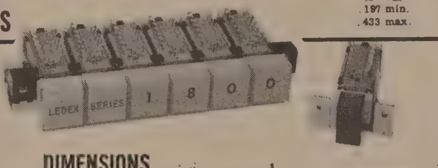
STANDARD FEATURES AND OPTIONS

CAPACITY... single push button to fifteen button assemblies.
CONTACTS... double breaking, silver plated brass.
MAX. CIRCUITRY PER... std. length — 1 NO+3 NC or 2 NO+2 NC or 3 NO+1 NC.
SWITCH MODULE... extended — 1 NO+4 NC or 2 NO+3 NC or 3 NO +2 NC or 4 NO+1 NC.
CURRENT CAPACITY ... 16A/250 VAC resistive.
LIFE, ELECTRICAL @ 10A/250 VAC... 5 x 10^4 with resistive load.
TERMINAL COLOR CODE... red dot — normally closed, no marking — normally open.
TERMINALS... spade lug .248" x .032"; mate with Amp "Faston" #42844-1 or equivalent.
MOUNTING... two holes for #6 screws or #4-48 tapped plates.
CAPS (NON-REMOVABLE)... size — .49" x .96". (Color (opaque) — black, white, red, yellow, green, blue, dark grey, light grey.
LEGENDS... hot stamping or engraving.

DIMENSIONS



SERIES 1800/Illuminated Push Button Controls



Tailor the Series 1800 illuminated push button controls to meet your specific switching requirements. You can integrate up to twenty high and low level switch modules on a mounting rail. The modules can be programmed to provide the interrelated release actions and interlock you desire.

The low level modules, with self-cleaning contacts, should be used to switch loads less than 20 watts. They are available with either 2P2T or 4P2T wiping contacts. For controlling circuits up to 6A/250 VAC, use the modules with bridging contacts. They are available with 2 NC, 2 NO, or 1 NC+1 NO contacts.

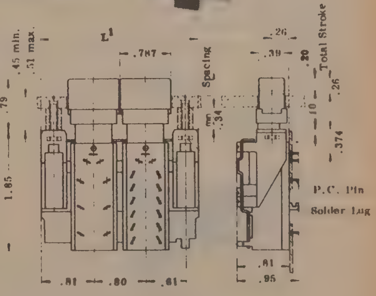
Options include single or dual bulb illumination. Legends can be hot stamped or engraved on opaque and transparent caps. Mylar film legends can be inserted behind the outer button lens on transparent caps.

For ease of installation, assemblies are available with P.C. or solder lug terminals. The solder lug terminals also accept Amp "Faston" #110 connectors or equivalent.

STANDARD FEATURES AND OPTIONS

CAPACITY... one to twenty switch modules on a frame.
SWITCHING ACTION... momentary. Push/push, reciprocal, master, reciprocal plus master release, interlock.
CONTACTS:
WIPING... 2P2T or 4P2T contacts @ 1A/60V. 20W maximum; 10 mA/5V minimum.
LIFE... 1,000,000 actuations @ minimum or 50,000 @ maximum load.
BRIDGING... 1 NO+1 NC, 2 NO or 2 NC contacts @ 6A/250 VAC maximum; 10 mA/20V minimum.
LIFE... 250,000 actuations @ minimum or 50,000 @ maximum load.
MATERIAL... silver plated brass.
TERMINALS... solder lug accepts Amp "Faston" #110 or printed circuit board pins.
LEGENDS... hot stamp, engrave or film insert (see legend chart for standard type).

DIMENSIONS



L¹ = .80" x No. buttons +.82"

ILLUMINATION... single or dual sockets for T4.6 mm lamps at all stations. Rectangle cap style ⁷⁄₁₆ x ¾ available in single socket only.
CAPS:
⅜ x ¾ inch.
Opaque... black, white, red, green, yellow, blue, light gray.
Transparent with light diffusing grid or plain... clear, red, green, yellow, blue.
⁷⁄₁₆ x ¾ and ¾ x ¾ inch.
Opaque... black, light gray.
Transparent for inner cap legend... clear, red, green, yellow, blue.
MOUNTING... front panel mounting with #4-48 screws.

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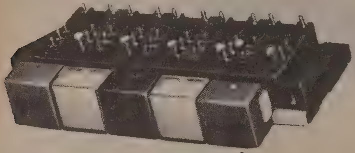
PUSH BUTTON SWITCHES

SWITCHES & SIGNAL LIGHTS

A versatile concept that gives you interrelated switching combinations . . . plus prototypes in 72 hours. Momentary . . . push/push . . . reciprocal release . . . master release . . . inter-lock . . . one assembly does the job of several.



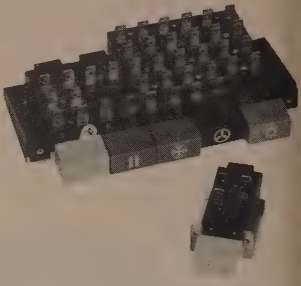
SERIES 1400 — ILLUMINATED PUSH BUTTON CONTROLS

DPDT contacts, 2 amps, 250 VAC. Two to 20 stations on a frame. Mount vertically or horizontally. Single button and indicator lights to match.

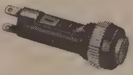
U.L. LISTED

SERIES 1500 — PUSH BUTTON CONTROLS

More switching in less space. Up to five circuits per switch station. Color coded contacts for use with solderless spade terminals. Non-removable caps, rugged construction. Use to switch single phase, two phase/three wire, or three phase power with one module 16A @ 250 VAC resistive.



LIGHTED & UNLIGHTED MINIATURE PUSH BUTTONS



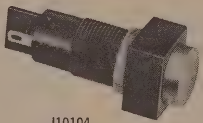
J10107

J15106

Part No. 15106 has double break contacts, with one set NO and one NC. Electrical life is 100,000 operations at contact rating of .1A/24VDC. Built-in lamp life is 10,000 hours.

Part No. J10107 has single throw NO contacts. Push button measures approx. ¼" dia. and has minimum electrical life of 50,000 operations at .1A/24VAC, resistive load.

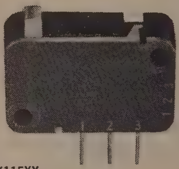
MOMENTARY PUSH BUTTONS



J10104

Round or square bezel 1P1T silver plated contacts, 2A/250VAC. Transparent or opaque caps available for legend display. Other momentary and maintained switches stocked, with a choice of size and colors, ratings up to 10A/250VAC.

CONTACTLESS SWITCHES



K115XX

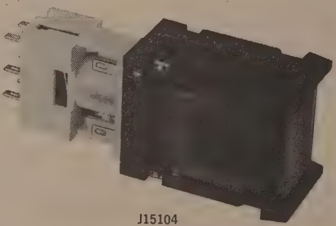
Contactless, miniature, push button and keyboard switches for highly reliable solid state operation, with transistor or Schmitt Trigger output, positive or negative logic. Solid state thumbwheel switches also available.

SERIES 1700 — ILLUMINATED PUSH BUTTONS

J15107

Lighted momentary and maintained with matching indicating lights, 2A/250VAC, 2 to 4 poles. Square, round or rectangular lens. Bulb, lens, and legend insert easily from front end of panel. Bulb life span 50,000 hours minimum.

DUAL BULB PUSH BUTTONS



J15104

Lighted dual bulb push buttons with either momentary or maintained action. Available with 1P2T or 2P2T contacts, 6A/115VAC or 2A/250VAC.

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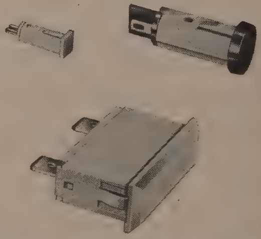
SIGNAL LIGHTS



Wide variety of attractively styled lights, from miniature pilot to large signal. Options include opaque or transparent lens, grid patterns, built-in or replaceable bulbs, solder, spade or PC terminals, and ratings from 6 to 220 volts.

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LEDEX

MANUAL ROTARY SWITCHES

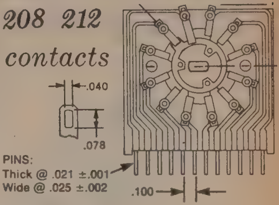
ROTARY SWITCHES

STANDARD SPECIFICATIONS

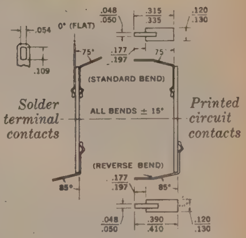
	206, 208, 212	306, 312	406, 412	506, 512	524
CONSTRUCTION	Throughbolts				
SHAFT — Military*	¼" steel, cadmium plated, chromated per QQ-P-416, class 2, type II (50 hour salt spray).				
Commercial	¼" steel, cadmium plated.				
MOUNTING	Steel bushing, ⅜-32 thread, optional ¼ or ⅜ inch, standard length.				
SPACERS	Glass filled thermoplastic polyester	Glass filled nylon, grade G 1/30.			
LOCATING LUG	Standard fixed at .375" radius; or can be deleted.	Standard fixed at 17/32" radius; or can be deleted.	Variable at 15° increments except 75°, 90°, 105°, 255°, 270°, 285°.	Standard fixed at 17/32" radius; or can be deleted.	Variable at any angle ±2° at 17/32" radius, or can be deleted.
METAL PARTS	All metal parts cold rolled steel with cadmium plating for commercial applications. Chromate dip for 50 to 100 hour salt spray per MIL-S-3786 for military applications. Special materials such as passivated stainless steel or nickel plated brass parts are also available.				
INDEX MECHANISM	Dual ball Starmate detent or single ball (hill and valley).	Dual ball Starmate, spring or single ball detent (Hill and Valley)			Single or dual ball detent.
STOPS	Fixed or adjustable.				Fixed at positions specified
INSULATION MATERIALS	Diallyl phthalate stator and rotor; epoxy glass or silicone glass with KEL-F rotors.	Stator and rotor: Phenolic, Kel-F, Epoxy Glass, Ceramic, Mycalex†	Stator and rotor: Phenolic, Epoxy glass.	Stator and rotor: Phenolic, Kel-F	Stator and rotor: Phenolic, Epoxy Glass.
CONTACT RATINGS Make/Break	**Brass—Silver plated** .5 ampere at 28 VDC, resistive; .25 ampere at 110 VAC, resistive.	**Brass—Silver plated** 1 ampere at 28 vdc, resistive; .5 ampere at 110 vac.	**Brass—Silver plated** 1 ampere at 28 vdc, resistive; .5 ampere at 110 vac.	**Brass—Silver plated** 1 ampere at 28 vdc, resistive; .5 ampere at 110 vac.	**Brass—Silver plated** 1 ampere at 28 vdc, resistive; .5 ampere at 110 vac.
	Solid Silver 1 ampere at 28 VDC, resistive; .5 ampere. at 110 VAC, resistive.	**Solid Silver** 2 amperes at 28 vdc, resistive; 1 ampere at 110 vac.	**Solid Silver** 2 amperes at 28 vdc, resistive; 1 ampere at 110 vac.	**Solid Silver** 2 amperes at 28 vdc, resistive; 1 ampere at 110 vac.	**Solid Silver** 2 amperes at 28 vdc, resistive; 1 ampere at 110 vac.
	Carry—5 amperes.	Carry—5 amperes.	Carry—5 amperes.	Carry—10 amperes.	Carry—5 amperes.
	Dielectric—750 volts, contact to contact.	Dielectric—1,000 volts, contact to contact; 500 volts when contacts are insulated back to back.			
	Contact resistance, in accordance with MIL-S-3786, will not exceed .010 ohms initially nor .020 ohms after rotational life tests.				

†Mycalex sections supplied with Kel-F rotors.

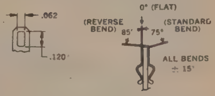
series 206 208 212
contacts


.040
.078
PINS:
Thick @ .021 ±.001
Wide @ .025 ±.002
.100

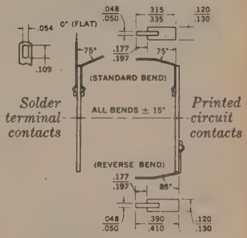
series 306 312 524


.054
.109
0° (FLAT)
.048/.050
.315/.335
.120/.130
75°
.177/.197
75°
(STANDARD BEND)
Solder terminal contacts
ALL BENDS ± 15°
Printed circuit contacts
(REVERSE BEND)
.177/.197
85°
85°
.048/.050
.390/.410
.120/.130

series 506 512


.062
.120
0° (FLAT)
(REVERSE BEND)
85°
75°
(STANDARD BEND)
ALL BENDS ± 15°

series 406 412


.054
.109
0° (FLAT)
.048/.050
.315/.335
.120/.130
75°
.177/.197
75°
(STANDARD BEND)
Solder terminal contacts
ALL BENDS ± 15°
Printed circuit contacts
(REVERSE BEND)
.177/.197
85°
.048/.050
.390/.410
.120/.130

STATOR INSULATION GUIDE

STATOR INSULATION	MIL SPEC.	USABLE TEMPERATURE LIMIT (C)	MINIMUM INSULATION RESISTANCE (MEGOHMS)	
diallyl phathalate	*MIL-M-14F type SDG*	*125*	*10,000*	*Most recent material, combines best combinations of desirable dielectric, low moisture, and structural characteristics at prices competitive to phenolic.*
Phenolic	*MIL-P-3115, type PBE-P*	*100*	*1,000*	*Most economical, most commonly used. Though non-nutrient to fungi, varnish impregnation per MIL-V-173 is available. Meets most military and commercial application requirements.*
Epoxy-Glass	*MIL-P-18177, type GEB*	*125*	*10,000*	*Economical, excellent structural and dielectric strength. Lower moisture absorption rate than phenolic.*
Silicone Glass	*MIL-P-997C, type GSG*	*125*	*10,000*	*Good RF characteristics. Lower structural strength than epoxy glass, and slightly higher in cost.*

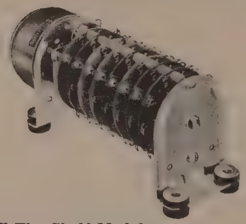
LEDEX

LEDEX INC.
126 WEBSTER STREET, DAYTON, OHIO 45401
PHONE: (513) 224-9891

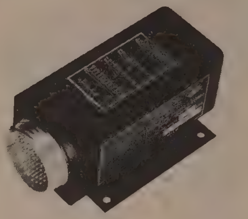
LEDEX REMOTE SWITCHING

STEPPING SWITCHES/CIRCUIT SELECTORS

Versatility, Economy, and Reliability are the main benefits offered by Ledex manual rotary switches. Sizes range from ½″ diameter multi-deck designs to 24-position switches measuring 2¼″ in diameter. For your more complex requirements, switches are available with concentric shafts or as complete switching packages. To simplify wiring and reduce your assembly costs, you can specify designs to include pre-wired components, wiring harnesses, or PC terminals.



30 Off-The-Shelf Models
Ledex Stepping Switches are used for transfer switching, remote control of predetermined circuit patterns, remote sequencing of complex switching arrangements, or in programming checkout and sequential operations. They are known best for their ability to perform multiple switching functions reliably, in limited space, and under severe operating and environmental conditions. Available in open construction, pre-wired modules or as packaged control solutions.

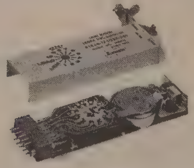


Ledex Hermetically Sealed Switches are engineered to withstand severe shock and vibration, such as encountered in aircraft, missile and military applications, and to provide added switching reliability in adverse environments. Used extensively in aero/space and underwater guidance controls, as mode selectors, in rocket firing devices, and in a variety of military control functions that demand a high degree of reliability. There are 19 models available from the shelf.

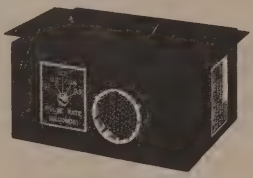
PACKAGED CONTROL SOLUTIONS

Here are examples of Ledex Stepping Switches designed into compact, reliable control packages that combine the best characteristics of solid state and electromechanical technologies.

Whether your problem involves armament controls or commercial control functions, there's a good chance Ledex has already solved a similar problem. Our Packaged Switches Catalog, B-3252, shows several more detailed examples and also includes specifications for 19 hermetically sealed switches available from the shelf.



Miniaturized Armament Control Intervalometer
Flat, compact, 12-position stepping switch measures only ½″ x 1¼″ x 4¼″, fires 19 rockets, sequentially in pairs. It includes a Ledex pulser to control time intervals over mil-spec. temperature and voltage ranges.



40-position Intervalometer with single or optional 5-speed ripple fire control
40-position intervalometer has 5 adjustable control speeds for rocket firing at intervals of 100, 200, 300, 400 or 500 milliseconds. Hybrid design combines best characteristics of solid state and electromechanical products for optimum performance, minimum weight, maximum reliability and lowest cost. Firing time intervals are maintained at ±5% through a voltage range of 22 to 31 vdc.

Universal Stores Dispenser
Intervals Variable on Digital Basis

All solid state and among the most flexible of Ledex intervalometer designs, this one permits the pilot to vary release intervals to any rate ranging from 30 ms to 9.99 seconds in increments of 10 ms. It includes a stepping switch to distribute sequential fire commands. Timing tolerance is ±10% over a voltage range of 22 to 32 volts and temperature to −55°C to +85°C. The package includes built-in suppression to protect solid state circuitry when switching inductive loads.

For engineering assistance and technical literature, write or phone.

LEDEX INC.
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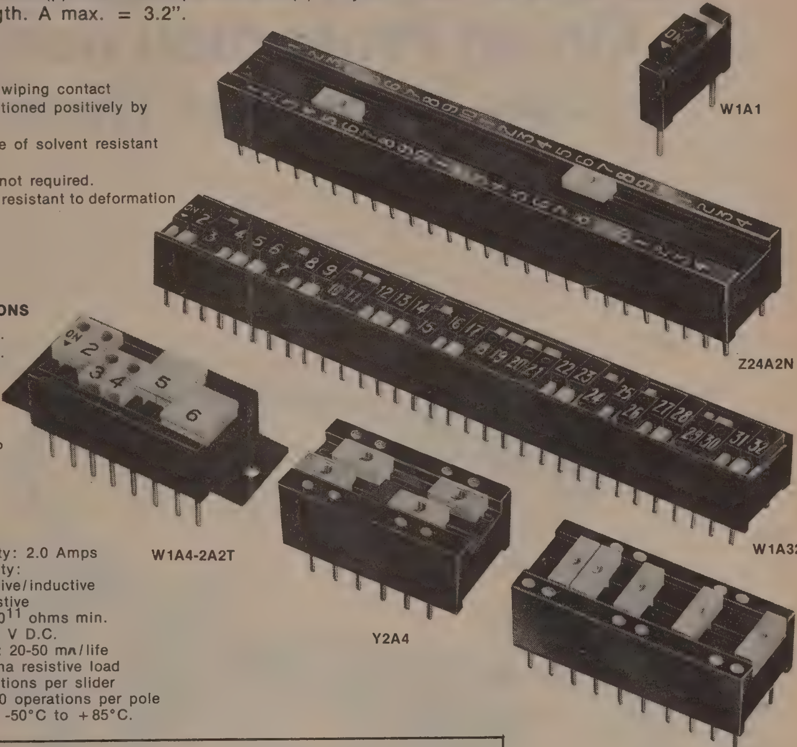
PHONE: (513) 224-9891

DIP SWITCH SUPERMART

Hundreds of Models • Reliable Performance • Custom Designs • Low Cost

A unique manufacturing process® makes it possible to furnish Lineac Switches in any desired configuration of switch patterns (W; X; Y; Z Series); slider positions or throws (t); poles per slider (p) and sliders per module (s) subject to data of Table #1 and maximum switch length. A max. = 3.2".



IMPORTANT FEATURES

- High reliability, patented wiping contact
- Detent-action sliders positioned positively by fingers or pen-point.
- Housing and sliders made of solvent resistant materials.
- Protective plastic covers not required.
- Pins of rigid alloy material resistant to deformation in handling.

SECONDARY DESIGN OPTIONS

#J -Common connected pins.
#M-Open frame construction.
#N-Numeric scale starting with "O".
#Q-Stops for multiple sliders/track.
#T -Mounting tabs for #2-56 screws.

SPECIFICATIONS

1. Current carrying capacity: 2.0 Amps
2. Current breaking capacity:
   .5A — 28 V D.C. resistive/inductive
   .5A — 115 V A.C. resistive
3. Insulation resistance: 10^{11} ohms min.
4. Dielectric strength: 500 V D.C.
5. Typ. internal resistance: 20-50 mΩ/life
6. Life expectancy at 50 ma resistive load
   W Series: 25,000 operations per slider
   X: Y: Z Series: 100,000 operations per pole
7. Operating temperature: -50°C to +85°C.

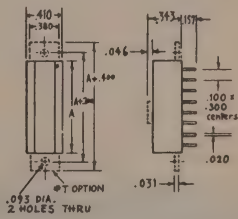
TABLE #1 SWITCH PARAMETERS

Series	Switch Action	Slider Connects A Selected Pin To	Throws (t)	Poles (p)	Sliders (s)	A ≤ 3.2"
W	Transverse Non-shorting	an opposite pin	1(on-off) 2(on-on)	1-8 1-4	1-32 1-16	(.1)pst
X	Longitudinal Shorting	an opposite pin	2-32	1-8	1-16	(.1)pst
Y*	Longitudinal Non-shorting	an opposite pin	2 on-off-on	1-8	1-20	.15ps
Z	Longitudinal Shorting	a "common" end pin	2-30 2-15	1-2 1-4	2 or 1 4 to 1	.200(1+t/2) .200(1+t)

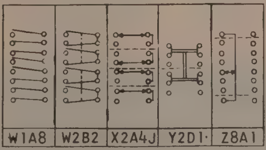
* ps must be an even number. Center-off position available to order

SWITCH OUTLINE

For "A" Dimension - See Table #1



TYPICAL SWITCH CONFIGURATIONS



Descriptive Bulletin and Price Guide available on request.

PART NUMBER

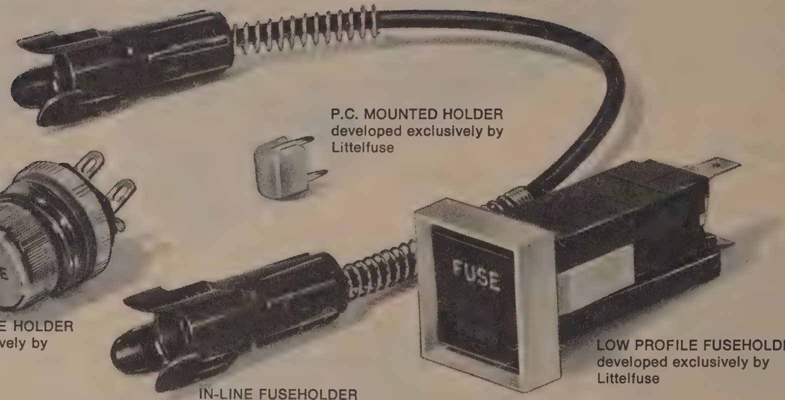
Series (W;X;Y;Z)
Poles per slider 1-A | 4-D | 7-G ; 2-B | 5-E | 8-H ; 3-C | 6-F
Switches/module (1-32)
Secondary options:
W Series: (J;M;T)
X;Y;Z Series: (J;N;Q;T)

Examples:

#W2A4JMT - W Series; SPDT; 4 switches/module; J; M; T options.
#X2B6J - X Series; DPDT; 6 switches/module; J option.

LINEAC CORPORATION
222 LAKE AVENUE, YONKERS, N.Y. 10701 [914] YO 3-5900

At Littelfuse we don't just meet your Circuit Protection needs —we anticipate them.



P.C. MOUNTED HOLDER
developed exclusively by
Littelfuse

TWIN MICROFUSE HOLDER
developed exclusively by
Littelfuse

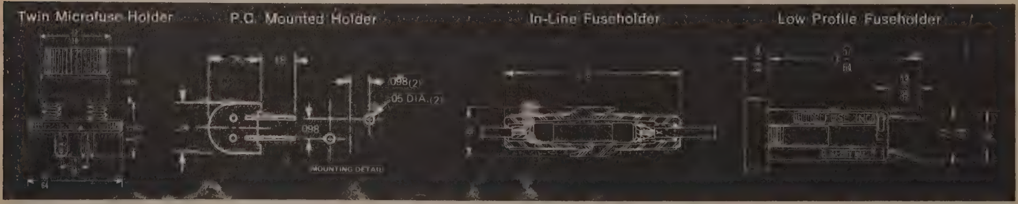
LOW PROFILE FUSEHOLDER
developed exclusively by
Littelfuse

IN-LINE FUSEHOLDER
developed exclusively by
Littelfuse

But that should come as no surprise. Since 1927, Littelfuse has provided the electronic industry with a complete line of fuses, fuseholders, circuit breakers, switches, and relays. Whatever a customer's need, we have a quality product to satisfy it.

But Littelfuse has to do more than keep up with the industry—we have to stay ahead of it. Our research and development engineers are constantly designing and testing to create tomorrow's products—more advanced, more streamlined, more versatile. Low-Profile Snap Mount fuseholders, P.C. Board fuseholders, Twin Microfuse holders, "Twist-Lock" In-Line fuseholders—these are just a few of the products developed exclusively by Littelfuse.

For detailed information on the complete line of Littelfuse products, write for Catalog #17. Or contact our representative or authorized Littelfuse distributor in your area. He will be glad to help you determine your immediate needs—and to help you plan for tomorrow's.



Littelfuse– *first in design and innovation*

P.C. Mounted Holder — 281007
A low-profile, plug-in fuseholder accommodating Littelfuse picofuses and microfuses. Edge-mounted, the holder permits easy and rapid fuse removal and replacement. Rated at 5 amps to 125 volts.

Twin Microfuse Holder — 280021
A versatile twin or single circuit holder for space-tight applications. Accepts two microfuses or a combination of micro and picofuse. Rated at 5 amps to 125 volts.

In-Line Fuseholder — 155100
A low-cost holder with "twist lock" allowing easy fuse extraction and replacement. Accepts all ¼″ x 1¼″ fuses and SFE fuses to 20 amps. Available in black, transparent or six other standard colors.

Low Profile Fuseholder
Square cap fuseholder snaps into chassis, eliminating need for mounting hardware. The cap snaps open for quick and easy fuse insertion and removal. Aesthetically styled to complement modern instrument panels, the holder is available in several color combinations.

HOW TO ORDER LOW PROFILE FUSEHOLDERS

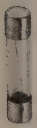
Six digit number is a coded description of fuseholder

348	6	4	5
A	B	C	D

- A Series Number **348** for 3AG Standard fuses, **347** for Pin Indicating.
- B Terminal Style: **6,** 3/16″ w. quick-connect and solder type; **8,** ¼″ w. quick-connect and solder type.
- C Bezel Color: Specify **1,** red; **2,** green; **3,** yellow; **4,** blue; **5,** white; **7,** black; **9,** gray.
- D Cap Color: Specify **1,** red; **2,** green; **3,** yellow; **4,** blue; **5,** white; **7,** black; **9,** gray.

NOTE: To order a cap assembly **only** for 3AG standard fuses, use **348** series number and insert a **0** in the terminal style and bezel color locations (**348 001**). To order a cap assembly for 3AG Pin Indicating fuses, use **347** series number and insert a **0** in the terminal style and bezel color locations (**347 001**). To order a body assembly **only,** use **348** (for 3AG fuses) and insert a **0** in the cap color location (**348 850**). The body assembly only for 3AG Pin Indicating fuses is identical to 348 series.

Littelfuse offers more than 6,000 kinds of fuses, fuseholders, circuit breakers, switches, and relays, including the following:



¼″ dia. x 1¼″ long 3AG fuses for electronic circuit protection applications.

311 Series
Glass tube. Medium-acting for automobiles, radios, amplifiers, etc. 4-30 amps.

312 Series
Glass tube. Fast-acting for general fuse protection. 1/100-10 amps.

313 Series
Glass tube. Slo-Blo. Designed to withstand momentary high-current surges but to open quickly on sustained overloads. 1/100-30 amps.

314 Series
Ceramic tube. High interrupting capacity up to 10,000 amps at 250 volts. 1/8-30 amps.

All fuses shown above can be supplied with pigtail leads for "Soldered In" applications. Similar electrical performance also available in 9/32″ x 1-1/4″ and 13/32″ x 1-1/2″ Fuses.

342 (000) Series
3AG Miniature, Space-saving Panel Fuseholder. Rated at 20 amperes to 250 volts.

341 (000) Series
3AG Panel Fuseholder with screw driver slot knob. Rated at 15 amperes to 250 volts.

342006
3AG Watertight Panel Fuseholder. Rated at 20 amperes to 250 volts.

344 (000) Series
3AG Indicating Fuseholder for visual display of blown fuse. Two lens styles available. Rated at 20 amperes to 250 volts.

340255
3AG Shielded Fuseholder. Eliminates radio frequency interference. Rated at 30 amperes to 250 volts.

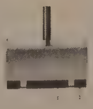
Subminiature Picofuse
9/32″ long x 3/32″ dia. Axial leads— 275 (000) Series. Radial leads— 276 (000) Series. 1/16-15 amps to 125 volts.

Subminiature Microfuse
Plug-in or pigtail types with transparent or metal caps. 10,000 amp short circuit capacity. 1/500-5 amps to 125 volts.

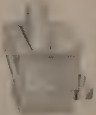
Subminiature Fuseholder
For picofuse and microfuse. Available in standard, indicating, or R.F. shielded types.

Fuse Clips
Available with solder lugs, with and without fuse stops and for printed circuit board mounting.

Fuse Blocks
Open fuse mountings with solder, screw or quick connect terminals. 1-12 poles.



Circuit Breakers
Manual reset breakers. Rated currents 4/10-4.1 amps to 250 volts.



Switches
Momentary action SPST switches. Rated at 5 amps-125 volts or 2.5 amps-250 volts.

Relays
Low voltage power relays for automotive, marine and recreational vehicle applications.

LF

Littelfuse Inc. *Subsidiary of Tracor, Inc.*

800 EAST NORTHWEST HIGHWAY • DES PLAINES, ILLINOIS 60016 • PHONE: (312) 824-1188

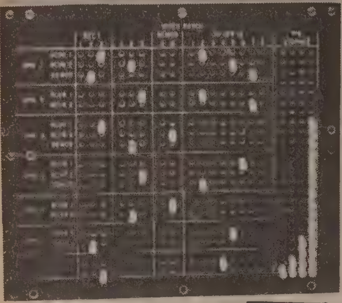
LVC INDUSTRIES INC.

CO-ORD SWITCH · BLOC-LITE DIVISIONS

135-25 37th AVENUE • FLUSHING, NEW YORK 11354

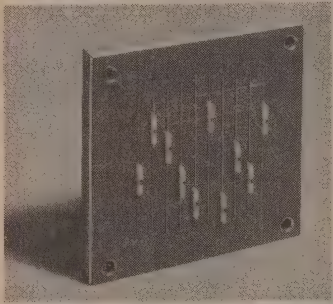
MATRIX BOARDS
SLIDE SWITCHES
LIGHT INDICATORS

MATRIX PROGRAM BOARDS



CO-ORD Matrix Program Boards are composed of 2 to 8 decks of contacts that are bussed on .250 centers. The contact rows of one deck are usually oriented perpendicular to the rows of adjacent deck(s) so as to obtain switching crosspoints. Electrical connections of the bussed contact rows are effected by inserting shorting pins at the desired crosspoints; "CO-AX", phone plug type pins are available for networks which require component insertion (Diodes, resistors, etc.). Single board matrices of up to 11,000 crosspoints are available in standard or special arrangements. Bussed and isolated contacts can be had alone or in combination. Panels may be screened, engraved, or fitted with pre-punched templates for rapid program changing. **Write for Bulletin 1466** U. S. Patent No. 3,349,361

MATRIX SLIDE SWITCHES

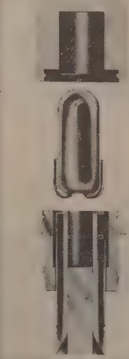


CO-ORD Matrix Slide Switches are designed to provide reliable, low cost matrix switching for applications requiring manual data entry operations. These simplified, versatile switches are available in various ranges of standard sizes, with capacities including up to 25 outputs per switching line. Each output is controlled by a separate contact slider which in turn can provide as many as 25 positions (variations). Special designed Matrix Slide Switches can be supplied with as many as 5000 switching positions.

The combined features of the CO-ORD Matrix Slide Switch makes it ideally suited for applications where data is to be entered at remote terminals such as test equipment programming, machine tool controls, programming of process controls, as well as numerious other applications. **Patent Pending** **Write for Bulletin 1474**

MINI-BRITE "simplicity" in subminiature indicator lights

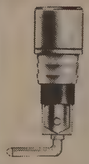
HOUSING GUIDES LAMP LEADS TO CONTACTS



Housing is keyed so that wire leads of lamp will only be accepted by the electrical contacts.

MINI-BRITE
75001
Panel Mount

MINI-BRITE
75002
Panel/Printed Circuit Mount



MINI-BRITE
75003
Printed Corcuit Mount

MINI-BRITE subminiature indicators have been engineered and are manufactured with the idea of achieving the ultimate in simplicity, standardization, reliability and cost reduction . . . this has been accomplished by the design of a unique housing and contact arrangement centered on the use of standard, wire terminal lamps . . . which provides light intensity comparable to units five times their size.
Conforms to MS90308. U. S. Patent #3,559,153

- **FRONT RELAMPABLE** just remove the snap on cap
- **STANDARD LAMPS** any T-1 lamp, wire lead type
- **EASY INSTALLATION** press housing into hole
- **WIRING OPTIONS** combination solder/female terminal
- **MOUNTING OPTIONS** panel mounted, panel/printed circuit
- **HIGH DENSITY PACKAGING** mount on .250 centers.
- **CODED CAPS** available in a variety of colors

Write for Bulletin 1470

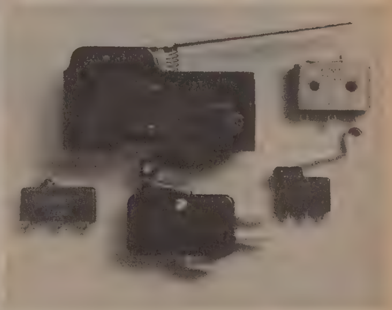
MICRO SWITCH
CATALOG **200**

Position Sensing and Manual Control Switches

FOR COMMERCIAL, COMPUTER, AND AEROSPACE EQUIPMENT

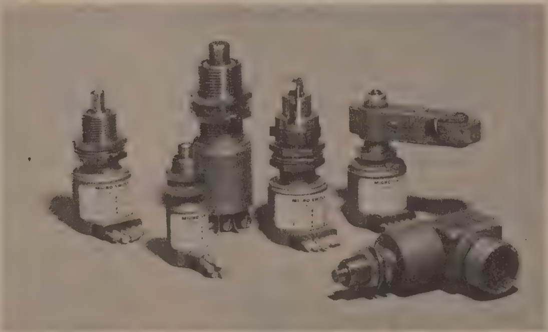
PROXIMITY SWITCHES

PUSHBUTTON SWITCHES



BASIC SWITCHES

TOGGLE SWITCHES



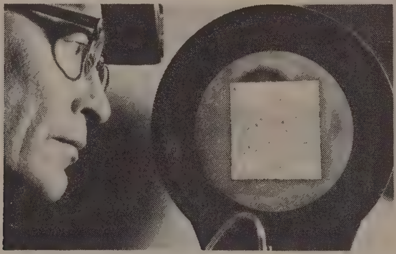
MINIATURE LIMIT SWITCHES

MICRO SWITCH MAKES YOUR IDEAS WORK

Catalog 200 is your guide to position sensing and manual control switches for a wide spectrum of application on aerospace, commercial, and computer equipment. This catalog is a companion to Catalog 50, which primarily covers MICRO SWITCH products for industrial use.

Though thousands of catalog listings can be specified using the pages of Catalog 200, they represent only a fraction of the line available from the world's largest switch manufacturer. If the switch you need to meet your special application requirements isn't cataloged here, contact your nearest MICRO SWITCH Branch Office. It's likely that "special" switch you need has already been built.

QUALITY ASSURANCE

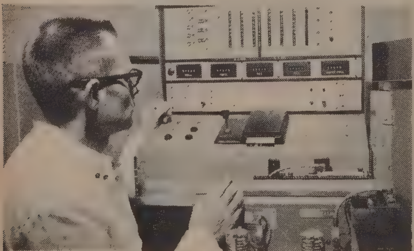


Quality Assurance for the customer is not a department, it is the business of everyone at MICRO SWITCH . . . the result of a total concern for the details that make up customer satisfaction. This program starts with the customer and penetrates the entire organization—from raw material and design on through production and shipping.

The emphasis at MICRO SWITCH is on prevention of defects, rather than simply their detection.

Our QA program is designed to assure reliability *before* manufacturing begins. It includes a strict vendor rating system, and innovative operator self-checking procedures. A management function, QA is organized to assist, train, influence and guide a total effort in producing quality products for our customers.

MICRO SWITCH procedures meet the requirements and intent of MIL-I-4520EA and are under surveillance of the Defense Supply Agency (DSA). Also, since MICRO SWITCH has single standard quality control designation, customers do not pay a premium for special handling of non-qualified products. Where applicable, we meet the requirements of Underwriters' Laboratories, Inc., and the Canadian Standards Association. Control of quality in conformance to our established procedures is applicable to all products, whether for military or commercial use.



SALES AND SERVICE/ WORLDWIDE

MICRO SWITCH maintains the largest field engineering force in the switching industry—close to you and your customer—in Branch Offices in major U.S. cities and Worldwide Sales Offices of Honeywell International.

In addition to MICRO SWITCH facilities in this country, there is manufacturing in Germany, the United Kingdom, the Netherlands, Canada, Australia, Mexico, and Japan.

APPLICATION ASSISTANCE

Our field engineers are especially trained to work on any aspect of your application requirements; from product selection, including reliability and quality/cost factors, to proper installation and operation for maximum service. When a fieldman tackles your problem he's not working on it alone. He is backed up by a whole team of experts at the factory—experienced problem solvers with many specialized talents in engineering products to meet highly sophisticated specifications.

FAST DELIVERY

A nationwide network of MICRO SWITCH Authorized Distributors stock MICRO SWITCH products for immediate off-the-shelf delivery. This means you seldom have to accept a substitute. You get exactly what you need, when you need it. For the location of the MICRO SWITCH Authorized Distributor which serves you, contact your nearest MICRO SWITCH Branch Office.

MOUNTING DIMENSIONS

Mounting dimensions are shown in English and metric equivalents. These dimensions are for reference only. For exacting layout work, request an engineering drawing from your nearest MICRO SWITCH Branch Office.

WARRANTY

Seller warrants its products to be free from defects in material and workmanship under normal use and service and Seller will repair or replace without charge any such product it finds to be so defective on its return to Seller within 18 months after date of shipment by Seller. *The foregoing is in lieu of all other expressed or implied warranties (except of title), including those of merchantability and fitness for particular purpose, guarantees, obligations, or liabilities on the part of the Seller.*

In this catalog . . .

Group I MANUAL CONTROL SWITCHES

Whether you're prototyping a new design or planning to face-lift an existing panel, you'll benefit by considering the wide selection of ***pushbuttons, indicators, toggles, rocker, paddle, rotary selector*** and ***interlock switches.*** Developed with adherance to good human factors principles, these products aid the designer by offering almost limitless options in visual display techniques, operators, and arrangement of components. Many are qualified to military specifications.

The behind-panel options are also extensive, including a choice of circuitry, electrical ratings (from power loads to solid state requirements), and termination means. (For information on MICRO SWITCH oiltight manual controls for industrial application, refer to Catalog 50.)

And, if you have a ***keyboard*** application, MICRO SWITCH has the most complete array of solid state keyboards for unmatched flexibility, including many stock listings available off-the-shelf. Our application engineers will also custom tailor a keyboard to your exact specifications, while providing the most for your switching dollar.

The broad MICRO SWITCH line of manual control switches offers the world's biggest selection from a single source. With such a wide spectrum from which to choose, you're likely to find the right combination of design freedom, product reliability, and cost. These products are backed up by a reputation for built-in quality, which is continually being assured by a program that is the model of the industry.

As control problems become more complex and sophisticated, MICRO SWITCH is continually developing new products and exploring new technologies to help make your ideas work. If you can't find what you need to solve your advanced manual control switching requirements in this catalog, chances are that MICRO SWITCH has the design currently in process.

SECTION A—LIGHTED AND UNLIGHTED PUSHBUTTONS

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Series 4 .... A1
Series 3 .... A13
Series SN & SD A21
Series 1 .... A31
Series 2 .... A37
Series 2M A45
Series 2N A47
Series 2W A53
Series DS A55
Series DM A60
Series 302PB A63

SECTION B—UNLIGHTED PUSHBUTTONS

Series PB & 12MA B1
Series 6 .... B4
Series 8 .... B5

SECTION C—TOGGLES, ROCKERS, AND PADDLES

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Series TL C14
Series TP C18
Series TS C21
Series AT C22
Series ET C27
Toggle Switch Accessories C29

SECTION D—ROTARY SELECTORS AND INTERLOCKS

Series RM & AS D1
Series AC D3

SECTION E—KEYBOARDS AND MOTORS

Series PX E1
Series SW & SD E2
DC Control Motors E2

Group II POSITION SENSING SWITCHES

Snap-action ***basic switches*** are manufactured with watch-like precision to hold exacting tolerances, insuring accurate repeatability and long life. They can be furnished in a wide choice of actuators, circuitry, electrical capacity, operating characteristics, and sealing—from thumb size elements to miniature space and weight savers. Solid state designs are also available.

Mercury switches offer position sensitive quiet operation over a long trouble-free life. Tilting moves the mercury pool which makes or breaks contact between the electrodes in a hermetically sealed glass tube.

Miniature Sealed ***Limit switches*** covered in this catalog are refinements of a design pioneered by MICRO SWITCH for aerospace use 30 years ago. Today, they are an industry standard for high performance switching under demanding environmental conditions, when space and weight specifications are critical. Wide choice of actuators, circuitry, and termination. (For information on oiltight limit switches for industrial applications, refer to Catalog 50.)

No-touch controls described in this catalog are solid state proximity switches, designed primarily for aerospace and ordance equipment. Switch actuation takes place without physical contact. Available in all-metal sensing and magnetically-operated designs, these devices are environment sealed in a compact self-contained assembly. Long life, high reliability switching is provided under severe operating conditions. (For information on other MICRO SWITCH proximity switches and photoelectric controls for industrial application, refer to Catalog 50 or Catalog NTC.)

SECTION F—SMALL BASIC SWITCHES

Page
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Series SM F5
Series V3 .... F9
Series TB F13

SECTION G—STANDARD BASIC SWITCHES

Series A & Z G1

SECTION H—SEALED AND HIGH TEMPERATURE BASIC SWITCHES

Series SE & XE H1
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Series HS H6
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Series AS & MP I1

SECTION J—LIMIT SWITCHES

Series EN J1
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SECTION K—NO-TOUCH CONTROLS

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Standards & Definitions L1
Index L2

All data published in this catalog is effective as of the date of publication and subject to correction.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

MANUALLY OPERATED SWITCHES TABLE OF CONTENTS

Pushbuttons

Selection Guide facing page.

Lighted pushbuttons and indicators. Low installed cost, easy wiring, single section. Ratings from 10 amps to gold contacts to solid state versions.

Series 4

Pg. A1

Lighted pushbuttons and indicators. Matrix, individual or strip mount. 1 or 2 section. 5 amp rating or reed switches.

Series 3

Pg. A13

Hall effect, solid state switching. Lighted and unlighted pushbuttons and indicators. Wide selection of buttons and legends. Snap-in or P.C. board mount.

Series SN

Pg. A21

Lighted pushbuttons and indicators. Bushing mount, panel seal, single section. Wide variety of switching units (15 amp to solid state).

Series 1

Pg. A31

Lighted pushbuttons and indicators. Individual or strip, snap-in mount. 1 to 4 section, wide choice of switch modules and displays.

Series 2

Pg. A37

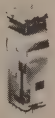
2W
Military version
Pg. A53

2M
Round version
Pg. A45

2N-2L
Lower cost version
Pg. A47

Miniature lighted pushbutton. Matrix, strip or individual mount. 1 to 4 sections, military versions.

Series DS



Pg. A55

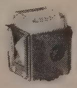
Low cost, snap-in mount, snap-on buttons or integral plungers. Lighted versions, momentary, two-level alternate action or pull-to-cheat operation. 10 amp rating.

Series DM

Pg. A60

Miniature size lighted pushbuttons and indicators. 1 or 2 section, 7 amp rating, snap-in mount.

Series 302PB



Pg. A63

Bushing mounted. Wide choice of circuitry or ratings.

Unlighted Pushbuttons

12MA
Auxiliary manual actuator
Pg. B3

Series 6
Operators for 2D modules
Pg. B4

Series 8
Miniature design
Pg. B5

Series PB
Compact design
Pg. B1

Toggle Switches

Selection Guide opposite page C1.

Complete miniature manual line. 6 amp rating, 1 to 4 poles. Variety of actuators, contacts and termination. Sealed versions.

Series 8

Pg. C1

Miniature toggle line. Meets military specifications. 5 amp rating. Wide variety of actuators. 1 or 2 poles.

Series TW

Pg. C11

Sealed toggle and rocker toggle series. Standard size. 1, 2 and 4 poles. Various actuators, termination, and circuitry.

Series TL-TP

Pg. C14

Standard size toggles, 1 or 2 pole. Various actions, circuitry and termination.

Series TS

Pg. C21

Toggle switch assemblies using basic switches. Wide variety of ratings, contacts, actuators, terminals, and sealing.

Series AT

SM Basics
5 amps or gold contacts
Pg. C22

SM Basics
Panel and lever seal
Pg. C25

HM Basics
Hermetically sealed
Pg. C25

V3 Basics
1-10 poles
15 amps
Pg. C26

Magnetically held toggle switch. Environment proof sealing. Various actuators and terminals.

Series ET

Pg. C27

Special Purpose

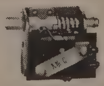
Rotary selector switch assemblies. Variety of precision snap-acting switches and circuitry in your choice of sequence action.

Series RM/AS

Pg. D1

Door interlock switches for use on hazardous electronic equipment. Variety of precision snap-acting switches.

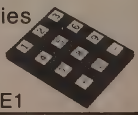
Series AC



Pg. D3

Numeric keyboard for use in adverse environments. 12 or 16 key, gold contacts, low profile construction.

Series PX

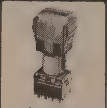


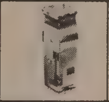
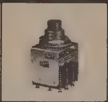
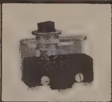
Pg. E1

MICRO SWITCH also has the world's largest selection of oiltight *Industrial Manual Controls*. For complete information ask for MICRO SWITCH Catalog 50.

PUSHBUTTON SWITCHES

1. Use the matrix below to quickly determine your initial application considerations, i.e., price range; mounting type, button size, if lighted—the number of lamps and button sections, and available circuitry.
2. Turn to the listed pages for ordering information.

INITIAL APPLICATION CONSIDERATIONS	SERIES 4 Page A1-A12	SERIES SN-SD Page A21-A30	 SERIES 2* Page A37-A44	SERIES 2N Page A47-A48	SERIES 2M Page A45-A46	SERIES 302PB Page A63-A64	SERIES 1* Page A31-A36
PRICE							
Low Range	●	●					
Medium Range			●	●	●		●
High Range			●*			●	
MOUNTING							
Snap-in Mount							
Individual	●	●	●	●	●	●	
Strip	●	●	●	●		●	
Bushing Mount							●
P.C. Board		●					
BUTTON SIZE							
¾"	●	●		●	●	●	●
1" and over			●				
LIGHTED UNITS –DISPLAY AND CIRCUITRY							
1 Lamp, 1 Section Display							
1 or 2 form C	●		●	●	●		
1 — 4 form C			●	●	●	●	●
Solid state, Hall Effect	●	●	●	●	●		●
2 Lamps, 1 or 2 Sections							
1 or 2 form C			●	●			
2 form C			●	●	●	●	
1 form Z			●	●	●		
4 Lamps, 1 — 4 Sections							
1 or 2 form C			●	●	●		
1 — 4 form C			●	●	●		

INITIAL APPLICATION CONSIDERATIONS	SERIES 3 Page A13-A20	 SERIES DS* Page A55-A59	SERIES 8 Page C1-C10	SERIES 6 Page B4	 SERIES PB* Page B1-B3	 SERIES 12MA Page B3	SERIES DM Page A60-A62
PRICE							
Low Range			●				●
Medium Range	●			●	●	●	
High Range		●					
MOUNTING							
Snap-in Mount							
Individual	●	●					●
Strip	●	●					●
Modular Mounting System							
Strip	●	●					
Matrix	●	●					
Bushing Mount			●	●	●	●	
P.C. Board	●		●				
BUTTON SIZE							
½"			●	●	●	●	●
¾"	●	●		●			
1" and over		●				●	●
LIGHTED UNITS —DISPLAY AND CIRCUITRY							
1 Lamp, 1 Section Display							
1 or 2 form C	●						●
2 Lamps, 1 or 2 Sections							
1 or 2 form C	●	●					
1 or 2 form A, X, Y, or Z	●						
4 Lamps, 1 — 4 Sections							
1 or 2 form C		●					
UNLIGHTED UNITS — CIRCUITRY							
1 or 2 form C		●				●	●
1 — 4 form C			●	●	●		
1 form Z				●			

*Military qualified designs available.

For information on MICRO SWITCH oiltight Industrial Manual Controls (Series PM, PT, PW, and CMC), please refer to Catalog 50, available upon request from your nearest MICRO SWITCH Branch Office.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES 4 LIGHTED PUSHBUTTON SWITCHES/INDICATORS

- Choice of Solid State or Precision Snap-Action Switching
- Low Installed Cost
- Front of Panel Mounting and Relamping—Without Tools
- Distinctive Lighted Display Colors
- Attractive Housings with Barriers or Full Bezels

Series 4 provides an attractive panel display and switching versatility at a low installed cost to help you stretch your panel budget. Units can be furnished assembled, with lamp, ready to snap-in the panel. There is a choice of solder/quick-connect terminals or printed circuit board terminals.

HALL EFFECT SOLID STATE SWITCHING

The Hall effect solid state concept sets the standard for switch reliability. An integrated circuit actuated by a magnet produces an analog control voltage which is converted into a digital output with a trigger circuit. Solid state models with current sinking output interface directly with DTL, RTL, and TTL discrete transistor circuits. Current sourcing output is also available. Stable operation is provided from a 6 to 16 VDC power supply. Units for use with a 5 VDC power supply can be furnished. Since these are solid state devices, there is no contact bounce or contamination and a long operating life is assured. No buffer circuitry is required.

PRECISION SNAP-ACTION SWITCHING

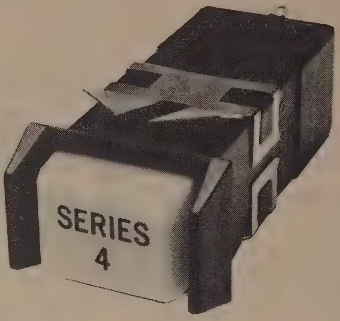
Dependable performance at power (5 and 10 amp, 250 VAC) or low energy loads is provided by MICRO SWITCH time-proven SM type basic switches. Circuitry can be 1-pole (SPDT) or 2-pole (DPDT), momentary or alternate action.

MATCHING INDICATORS

The indicators are identical externally to the Series 4 lighted switches for a harmonious panel appearance.

LOCKED BUTTON OPTION

Series 4 can be furnished with a locked button option for use in areas accessible to the public, where tampering and vandalism are problems. The housing has a special mounting clip with built-in button retainer. This mounting clip must be removed from behind panel to allow button removal. Button movement during switch operation is unaffected by the locked button feature. (These units cannot be relamped from front of panel.)



BUTTONS

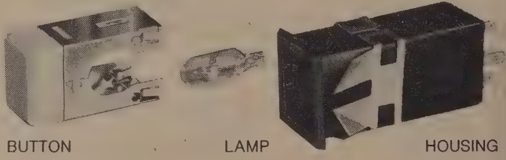
Vivid color buttons provide attractive, clearly visible lighted display with: (1) transmitted color—display color can be distinguished whether the lamp is ON or OFF; (2) projected color—button is white with the lamp OFF and colored when illuminated; and (3) hidden legend/hidden color—button appears black with the lamp off, and legend and color appear when illuminated.

LAMPS

The Series 4 lamp remains stationary during button operation, minimizing filament breakage due to a moving lamp. There is a choice of T-3 ¼ wedge-base lamps (6, 12 and 28 V) or T-2 telephone slide-base lamps (120 V).

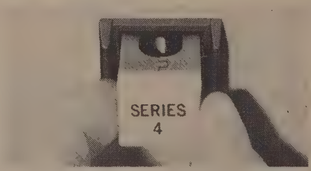
HOUSINGS

Housings for switches and indicators are identical in appearance, but the indicator housings have no provision for switching. They may be snap-in mounted on panels up to .20" (10,2mm) thick. Housings are available in full bezel or barrier styles, momentary or alternate action switching, and contain the lamp socket and termination means.

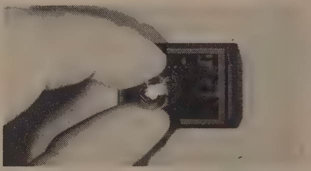


CONVENIENT PANEL FRONT MOUNTING AND RELAMPING

1. Snap-in mounting. Switch or indicator is easily inserted into the cutout. Mounting clips grip the panel. No tools are needed.



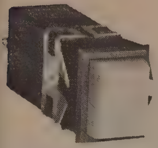
2. Lamps and legends can be changed from panel front. When button is removed, lamp is extracted from its socket and retained in button.



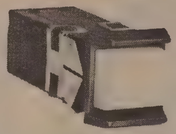
3. Ease of lamp replacement. After the inoperative lamp is automatically removed with the button, the new lamp is inserted without the use of tools.

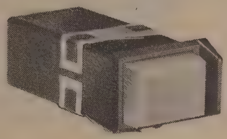
SERIES 4 LIGHTED PUSHBUTTON SWITCHES/INDICATORS A

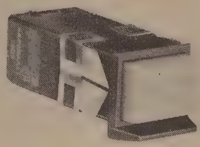
VERSATILITY IN PANEL ARRANGEMENT


BEZEL ON ALL SIDES

BARRIERS ON SHORT SIDES


BARRIERS ON LONG SIDES

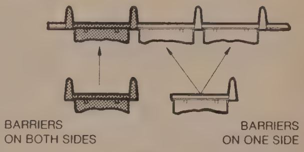

BARRIER ON ONE SHORT SIDE


BARRIER ON ONE LONG SIDE

BEZEL TYPE housings can be top-of-panel or subpanel mounted, individually or in strips. A bezel surrounds four sides.

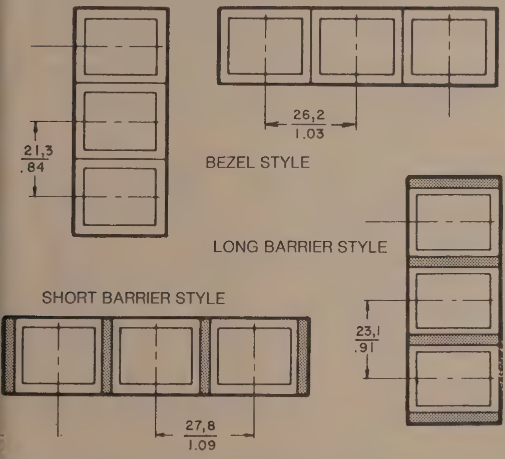
BARRIER TYPE HOUSINGS are normally mounted top-of-panel in strips, but can also be individually mounted. Barriers are on either the short or long sides.

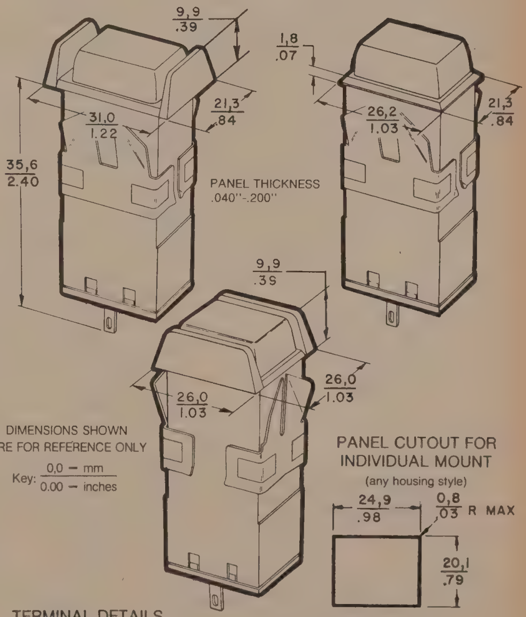
The drawing below shows how housings with a barrier on one side are used in a strip of two or more units. The first has a barrier on two sides, and all other units have a barrier on one side and butt against each other.


BARRIERS
ON BOTH SIDES
BARRIERS
ON ONE SIDE

DIMENSIONS

MOUNTING CENTERS FOR STRIP MOUNT


21,3
.84
26,2
1.03
BEZEL STYLE
LONG BARRIER STYLE
SHORT BARRIER STYLE
23,1
.91
27,8
1.09


9,9
.39
1,8
.07
21,3
.84
31,0
1.22
26,2
1.03
21,3
.84
35,6
2.40
PANEL THICKNESS
.040"-.200"
9,9
.39
26,0
1.03
26,0
1.03
24,9
.98
0,8
.03
R MAX
20,1
.79

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm
0.00 — inches

PANEL CUTOUT FOR INDIVIDUAL MOUNT
(any housing style)

PANEL CUTOUT FOR STRIP MOUNT

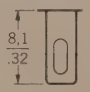
	HOUSING STYLE	DIMENSIONS	
		WIDTH	LENGTH
Short Sides Abutting	Full Bezel	79" (20,1 mm)	[No. of units x 1.03" (26,2 mm)] -.05" (1,4 mm)
	Short Barrier	.79" (20,1 mm)	[No. of units x 1.09" (27,8 mm)] - .12" (3,0 mm)
Long Sides Abutting	Full Bezel	.98" (24,8 mm)	[No. of units x .84" (21,3 mm)] - .05" (1,4 mm)
	Long Barrier	.98" (24,8 mm)	[No. of units x .91" (23,1 mm)] - .12" (3.0 mm)

TERMINALS

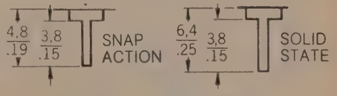
All terminals are plated to permit soldering.
Quick-connect terminals are .110" (2,8 mm) wide by .020" (0,5 mm) thick. The slot is .130" (3,3 mm) long by .048" (1,2 mm).
Printed circuit terminals are: Lamp—.025 (0,6 mm) by .020" (0,5 mm); Switch—.025" (0,6 mm) square.

TERMINAL DETAILS

.110 Q.C.

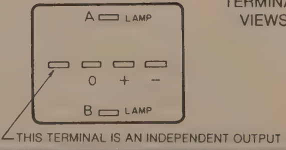


PRINTED CIRCUIT

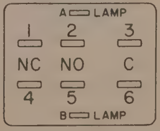

4,8
.19
3,8
.15
SNAP ACTION
6,4
.25
3,8
.15
SOLID STATE

TERMINAL VIEWS

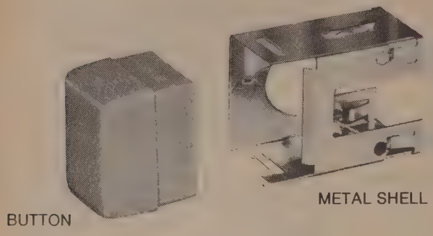
SOLID STATE


A LAMP
0
+
−
B LAMP
THIS TERMINAL IS AN INDEPENDENT OUTPUT

SNAP-ACTION


A LAMP
1
2
3
NC
NO
C
4
5
6
B LAMP

FLEXIBILITY IN ILLUMINATED COLOR TECHNIQUES


BUTTON
METAL SHELL

Series 4 has vivid color lighted buttons, featuring a choice of seven button types which can be used to meet your individual display requirements.

Button Construction

The button assembly consists of a plastic button which snaps into a metal shell. The shell acts as a lamp removal tool and provides a heat sink for the lamp. Construction details of the various button types are shown in the chart below. The A through G button type designations correspond to the code letters in the ordering guide.

Transmitted Color

The display color can be distinguished whether the lamp is ON or OFF. Button types A, E, F, and G can be used. Type A is a one-piece colored button. Type E and F are water-clear colorless transparent buttons, with smooth face and matte finish sides, and have color inserts. Type A, E and G have all five sides lighted, while the type F button has only its face lighted.

Type G buttons are a high-profile design (see chart below) which makes it ideal for sub panel mounting.

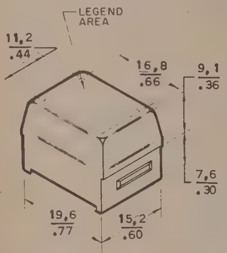
Projected Color

White type B buttons with color inserts, appear white when the lamp is OFF and colored when illuminated. All five sides are lighted.

Hidden Legend/Hidden Color

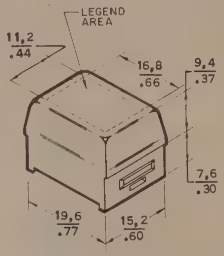
This display appears black when lamp is OFF. Legend and color appear when illuminated. This effect is achieved with a transparent black (smoky gray) button and color insert. Either type C (five sides lighted) or type D (only face lighted) buttons can be used.

TYPE A BUTTON
(5 sides lighted)


LEGEND AREA
11,2 / .44
16,8 / .66
9,1 / .36
7,6 / .30
19,6 / .77
15,2 / .60

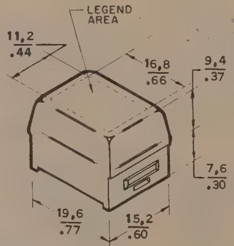
TRANSLUCENT
COLORED BUTTON

TYPE B BUTTON
(5 sides lighted)


LEGEND AREA
11,2 / .44
16,8 / .66
9,4 / .37
7,6 / .30
19,6 / .77
15,2 / .60

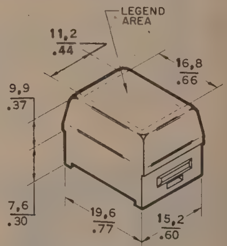
TRANSLUCENT
WHITE BUTTON

TYPE C & E BUTTONS
(5 sides lighted)


LEGEND AREA
11,2 / .44
16,8 / .66
9,4 / .37
7,6 / .30
19,6 / .77
15,2 / .60

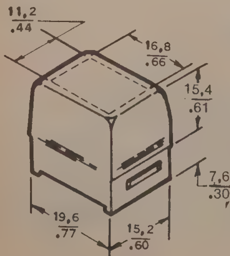
TRANSPARENT BUTTON
TYPE C—BLACK
TYPE E—COLORLESS

TYPE D & F BUTTONS
(only face lighted)


LEGEND AREA
11,2 / .44
16,8 / .66
9,9 / .37
7,6 / .30
19,6 / .77
15,2 / .60

TRANSPARENT BUTTON
TYPE D—BLACK
TYPE F—COLORLESS

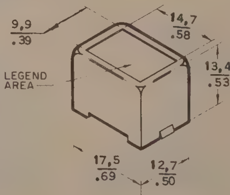
TYPE G BUTTON
(5 sides lighted)


11,2 / .44
16,8 / .66
15,4 / .61
7,6 / .30
19,6 / .77
15,2 / .60

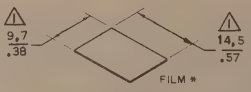
TRANSLUCENT
COLORED BUTTON

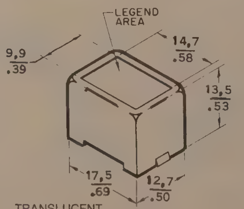
DIMENSIONS SHOWN
ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

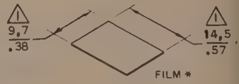

9,9 / .39
14,7 / .58
LEGEND AREA
13,4 / .53
17,5 / .69
12,7 / .50

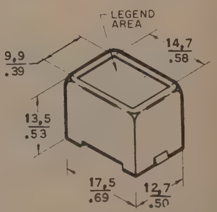
TRANSPARENT
COLORED INSERT


9,7 / .38
14,5 / .57
FILM *


LEGEND AREA
9,9 / .39
14,7 / .58
13,5 / .53
17,5 / .69
12,7 / .50

TRANSLUCENT
COLORED
INSERT


9,7 / .38
14,5 / .57
FILM *

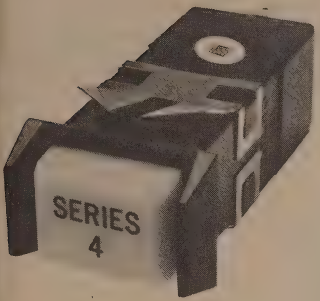

LEGEND AREA
9,9 / .39
14,7 / .58
13,5 / .53
17,5 / .69
12,7 / .50

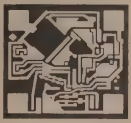
OPAQUE BLACK INSERT WITH
TRANSLUCENT COLORED FACE

±.005
* THICKNESS-.004" to .007"
(FILM FURNISHED BY CUSTOMER)

SERIES 4 LIGHTED PUSHBUTTON SWITCHES/INDICATORS

HALL EFFECT SOLID STATE SWITCHES





.040-inch square integrated circuit chip is located in switch base.

ELECTRICAL INFORMATION

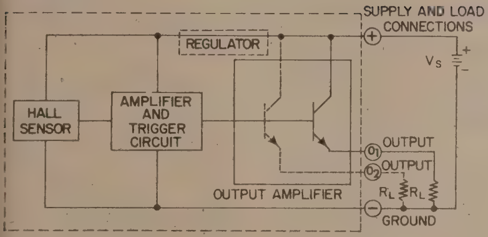
Series 4 lighted pushbuttons with switching element code letters **SA, SC, SB, SD and SS** in their catalog listing use the reliable Hall effect solid state switch. The magnetic field from a magnet on the switch plunger produces a digital output from an integrated circuit which interfaces directly with most electronic circuits: discrete transistor circuits, integrated logic circuits, SCR's etc.

Solid state models are available in a choice of current sourcing or current sinking outputs, .110 quick-connect or printed circuit terminals, and operation by a 6 to 16 VDC or 5 VDC power supply.

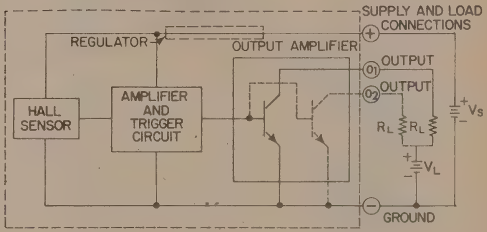
FOR MORE INFORMATION

Contact your nearest MICRO SWITCH Branch Office for additional information which may be required by your application. Competent field engineers, experienced in applying solid state switches can assist in selecting the proper device to meet your needs.

CURRENT SOURCING CIRCUIT


SUPPLY AND LOAD CONNECTIONS
REGULATOR
+
Vs
HALL SENSOR
AMPLIFIER AND TRIGGER CIRCUIT
O1 OUTPUT
O2 OUTPUT
OUTPUT AMPLIFIER
RL
RL
−
GROUND

CURRENT SINKING CIRCUIT*


SUPPLY AND LOAD CONNECTIONS
REGULATOR
OUTPUT AMPLIFIER
+
O1 OUTPUT
O2 OUTPUT
HALL SENSOR
AMPLIFIER AND TRIGGER CIRCUIT
RL
RL
Vs
VL
−
GROUND

*5 VDC circuit does not include voltage regulator

ELECTRICAL DATA

SUPPLY VOLTAGE DC	OUTPUT			TYPICAL SUPPLY CURRENT	LEAKAGE CURRENT AMPS	SERIES 4 SWITCHING ELEMENT CODE LETTERS	TERMINAL TYPE
	OUTPUT TYPE	CURRENT PER OUTPUT	OUTPUT VOLTAGE				
6-16 V	Current Sinking	10mA (max)	0.4 V (max)	3 mA ($V_s=6$ V)	10 μA	SA	.110 Q.C.
				5m A ($V_s=16$ V)		SC	P.C.
	Current Sourcing	10 mA (max)	V_s-2 V (min)	3m A ($V_s=6$ V)	10 μA	SB	.110 Q.C.
				5m A ($V_s=16$ V)		SD	P.C.
5 V (4.75-6.0)	Current Sinking	+4 mA (max)	+0.4 V (max)	2.5 mA	5μA	SS	.110 Q.C.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

PUSHBUTTON SWITCH ORDERING GUIDE

Catalog listings for Series 4 pushbutton switches may be derived from the ordering guide to specify either: (1) an assembled unit or (2) a switch housing only (less button), as shown in the following examples:

4A21BBA21 designates a switch housing only. It includes the first four options, but *not* the three which refer to button specifications—Display Type, Display Color, and Legend.

4A21BBA21AYN is a catalog listing for an assembled pushbutton switch. It includes all seven options in the ordering guide—Housing Style, Housing Color, Switching Element, Illumination, Display Type, Display Color, and Legend Codes.

Example: 4A21 B BA 21

SWITCH HOUSING STYLE

Code	Description
4A11	Bezel on all sides, mounting clips on long sides
4A12	Bezel on all sides, mounting clips on short sides
4A13	Bezel on all sides, mounting clips on long sides, housing provisions for locked button
4A21	Barriers on short sides, mounting clips on long sides
4A22	Barriers and mounting clips on short sides
4A23	Barrier on one short side, mounting clips on long sides
4A24	Barrier on one short side, mounting clips on short sides
4A25	Barriers on short sides, mounting clips on long sides, housing provisions for locked button
4A26	Barrier on one short side, mounting clips on long sides, housing provisions for locked button
4A31	Barriers and mounting clips on long sides
4A32	Barriers on long sides mounting clips on short sides
4A33	Barrier on one long side, mounting clips on long sides
4A34	Barrier on one long side, mounting clips on short sides
4A35	Barriers and mounting clips on long sides, housing provisions for locked button
4A36	Barrier on one long side, mounting clips on long sides, housing provisions for locked button

HOUSING COLOR

Code	Color
B	Black
G	Gray

Contact your nearest MICRO SWITCH branch office for availability of other colors

SNAP-ACTION SWITCHING ELEMENT

Electrical Data	Action	Terminals 110 QC	Terminals PC
1-Pole (SPDT) 5 a. silver contacts	Momentary	AA	AD
	Alt. Action	BA	BD
2-Pole (DPDT) 5 a. silver contacts	Momentary	EA	ED
	Alt. Action	FA	FD
1-Pole (SPDT), gold contacts	Momentary	CA	CD
	Alt. Action	DA	DD
2-Pole (DPDT), gold contacts	Momentary	GA	GD
	Alt. Action	HA	HD
2-Pole combination gold (SPDT) and 5 a. silver (SPDT) contacts	Momentary	JA	JD
	Alt. Action	KA	KD
1-Pole (SPDT), 10 a. silver contacts	Momentary	LA	
	Alt. Action	MA	
2-Pole (DPDT) 10 a. silver contacts	Momentary	NA	
	Alt. Action	PA	
1-Pole (SPDT) gold alloy contacts	Momentary	QA	
	Alt. Action	RA	
2-Pole (DPDT), gold alloy contacts	Momentary	TA	
	Alt. Action	VA	

SOLID STATE SWITCHING ELEMENT

Electrical Data	Action	Terminals 110 QC	Terminals PC
Current Sinking, Regulated 6-16 Volts	Momentary only	SA	SC
Current Sourcing, Regulated 6-16 Volts	Momentary only	SB	SD
Current Sinking, 5 volts	Momentary only	SS	

ILLUMINATION

Code	Description
11	No lamp, has lamp socket for T-3¼ wedge base lamps.
12	6 volt lamp, ASA #259 (T-3¼)
13	6 volt lamp, ASA #159, (T-3¼)
21	12 volt lamp, ASA #161, (T-3¼).
31	28 volt lamp, ASA #656 or #152, (T-3¼)
41*	No lamp, Has lamp socket for T-2 telephone slide-base No. 5 lamps.
42**	120 volt lamp, (T-2 telephone slide-base No. 5.
91	Unlighted, no lamp socket

**Note:* This illumination code (41) can be used with all housing styles. UL listing is 28 volts max, lamp.

***Note:* This illumination code (42) must be used only where the locked button option is specified in the Housing Style code.

If the locked button option is specified in the Housing Style code, the unit will have a UL Listing of 120 volts max., lamp.

Mounting clips on the long sides of the housing are specified when individually mounted or when the long sides of strip mounted housings parallel the long sides of the panel cutout slot. The most secure mounting is achieved when the mounting clips are on the long sides

Mounting clips on the short sides of the housing are specified when short sides of strip mounted housings parallel the long sides of the panel cutout slot.

SWITCH HOUSING ONLY

At this point, you have a catalog listing for ordering the switch housing only. If you wish to specify a button also, add a code letter from each of the three charts on the facing page.

SERIES 4 LIGHTED PUSHBUTTON SWITCHES/INDICATORS

ELECTRICAL RATINGS

Snap-Action Switching Elements:

5-Amp Silver Contacts - 5 amp res., 3 amps ind. 30 vdc. UL Listed: 5 amps, 250 vac.

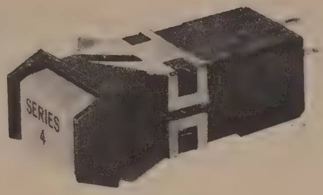
10-Amp Silver Contacts - UL Listed; 10 amps ¼ hp, 125 or 250 vac.

Gold Contacts - 1 amp res., 0.5 amp. ind., 30 vdc. UL Listed: 1 amp, 125 vac.

Gold Alloy Contacts - UL Listed: 0.1 amp, res., 30 vdc; 1 amp, 125 vac.

Solid State Switching Elements:

For electrical data on solid state switching elements, refer to page A4.



4A21BBA21AYL is an assembled pushbutton switch with black housing, barriers on short sides and mounting clips on long sides, 1-pole 5-amp silver contacts (alternate action), 12 volt lamp, and yellow (transmitted color) unlegended button. Note: If button is not desired, omit the last three code letters (AYL).

A

DISPLAY TYPE (Button w/metal shell)

A
Transmitted color.
5 sides lighted.
1-piece translucent button.

B
Projected color. 5 sides lighted.
Translucent white button
w/color insert.

C
Hidden color/hidden legend. 5 sides lighted.
Transparent black button
w/translucent color insert.

D
Hidden color/hidden legend.
Only face lighted.
Transparent black button
w/translucent color insert.

E
Transmitted color 5 sides lighted.
Transparent colorless button
w/translucent color insert.

F
Transmitted color. Only face lighted.
Transparent colorless button
w/translucent color insert.

G
Same as type "A" except 250" higher.

Y

DISPLAY COLOR

B
Std. Blue

G
Std. Green

R
Std. Red

S
Transparent Black (Unlighted applications only)

Y
Std. Yellow

W
Std. White (Do not use with Type B button)

A
Std. Amber (For use with Type A or G button only)

L

LEGEND (Legend Order Sheet must accompany all orders for legended buttons)

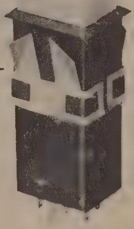
J
Legends on both *button and insert*, button assembled. Use with C & D button types.

K
Legend on insert only, button assembled. (For C, D, E and F button types.)

L
Legend on button only, button assembled. (For customer who prefers to have MICRO SWITCH provide legending.) Use with any button.

N
No legend, button assembled. (For applications not requiring legends.) Use with any button.

U
No legend, button unassembled. (For customer who does his own legending.) Use with any button.



SWITCH HOUSING WITH BUTTON, READY TO INSTALL IN YOUR PANEL

INDICATOR ORDERING GUIDE

Series 4 lighted indicators feature the same housing styles as the pushbutton switches — full bezel or barrier types. They are also identical in size and appearance and may be mounted individually or in vertical or horizontal strips. Buttons are interchangeable with the lighted switches. Indicators have no provision for switching. There is a choice of .110 quick-connect or printed circuit terminals.

Housing styles can be used to provide functional "shape coding" in a mixed panel of indicators and switches. For example, bezel types may be specified for indicators and barrier types for switches.

Indicator catalog listings may be derived from the ordering guide to specify either (1) an assembled unit or (2) an indicator housing only (less button), as shown in these examples:

4C11G21ABN is a catalog listing for an assembled lighted indicator. It includes all six options in the ordering guide—Housing Style, Housing Color, Illumination, Display Type, Display Color and Legend Codes.

4C11G21ABN designates an indicator housing only. It includes the first three options, but not the last three which refer to button specifications—Display Type, Display Color, and Legend.

Example: 4C11 G 21

INDICATOR HOUSING STYLE

Description	Terminals	
	110 QC	PC
Bezel on all sides, mounting clips on long sides	**4C11**	**4D11**
Bezel on all sides, mounting clips on short sides	**4C12**	**4D12**
Bezel on all sides, mounting clips on long sides, housing provisions for locked button.	**4C13**	**4D13**
Barriers on short sides, mounting clips on long sides	**4C21**	**4D21**
Barriers and mounting clips on short sides	**4C22**	**4D22**
Barrier on one short side, mounting clips on long sides	**4C23**	**4D23**
Barrier on one short side, mounting clips on short sides	**4C24**	**4D24**
Barriers on short sides, mounting clips on long sides, housing provisions for locked button.	**4C25**	**4D25**
Barrier on one short side, mounting clips on long sides, housing provisions for locked button	**4C26**	**4D26**
Barriers and mounting clips on long sides	**4C31**	**4D31**
Barriers on long sides mounting clips on short sides	**4C32**	**4D32**
Barrier on one long side, mounting clips on long sides	**4C33**	**4D33**
Barrier on one long side, mounting clips on short sides	**4C34**	**4D34**
Barriers and mounting clips on long sides, housing provisions for locked button.	**4C35**	**4D35**
Barrier on one long side, mounting clips on long sides, housing provisions for locked button.	**4C36**	**4D36**

HOUSING COLOR

B	Black
G	Gray
	Contact your nearest MICRO SWITCH branch office for availability of other colors.

ILLUMINATION

11	No lamp, has lamp socket for T-3¼ wedge base lamps
12	6 volt lamp, ASA #259, (T-3¼)
13	6 volt lamp, ASA #159, (T-3¼).
21	12 volt lamp, ASA #161, (T-3¼).
31	28 volt lamp, ASA #656 or 152, (T-3¼).
41*	No lamp, Has lamp socket for T-2 telephone slide-base No. 5 lamps.
42*	120 volt lamp, (T-2 telephone slide-base No. 5.)
91	Unlighted. no lamp socket

**Note:* This illumination code (41) can be used with all housing styles. UL listing is 28 volts max, lamp.

***Note:* This illumination code (42) must be used only where the locked button option is specified in the Housing Style code.

If the locked button option is specified in the Housing Style code, the unit will have a UL Listing of 120 volts max., lamp.

INDICATOR HOUSING ONLY

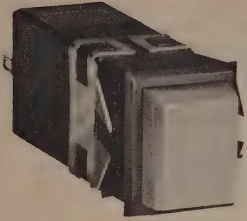
At this point, you have a catalog listing for ordering the housing only. If you wish to specify a button also, add a code letter from each of the three charts on the facing page.

Mounting clips on the long sides of the housing are specified when individually mounted or when the long sides of strip mounted housings parallel the long sides of the panel cutout slot.

The most secure mounting is achieved when the mounting clips are on the long sides.

Mounting clips on the short sides of the housing are specified when short sides of strip mounted housings parallel the long sides of the panel cutout slot.

SERIES 4 LIGHTED PUSHBUTTON SWITCHES/INDICATORS A



4C11G21ABN is an assembled lighted indicator with bezel on all sides of the gray housing and mounting clips on short sides, .110 QC terminals, 12 volt lamp, and blue (transmitted color) unlegended button. Note: if button is not desired, omit the last three code letters **(ABN)**.

A

DISPLAY TYPE (Button w/metal shell)

A
Transmitted color.
5 sides lighted.
1-piece translucent button.

B
Projected color. 5 sides lighted.
Translucent white button
w/color insert.

C
Hidden color/hidden legend.
5 sides lighted.
Transparent black button
w/translucent color insert.

D
Hidden color/hidden legend.
Only face lighted.
Transparent black button
w/translucent color insert.

E
Transmitted color.
5 sides lighted.
Transparent colorless button
w/translucent color insert.

F
Transmitted color.
Only face lighted.
Transparent colorless button
w/translucent color insert.

G
Same as type "A" except 250" higher.

B

DISPLAY COLOR

B
Std. Blue

G
Std. Green

R
Std. Red

S
Transparent Black (Unlighted applications only)

Y
Std. Yellow

W
Std. White (Do not use with Type B button)

A
Std. Amber (For use with Type A or G button only)

N

LEGEND (Legend Order Sheet must accompany all orders for legended buttons)

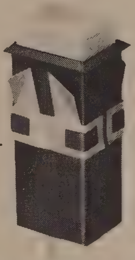
J
Legends on both button and insert, button assembled. Use with C & D button types.

K
Legend on insert only, button assembled. (For C, D, E and F button types.)

L
Legend on button only, button assembled. (For customer who prefers to have MICRO SWITCH provide legending.) Use with any button.

N
No legend, button assembled. (For applications not requiring legends.) Use with any button.

U
No legend, button unassembled. (For customer who does his own legending.) Use with any button.



INDICATOR HOUSING WITH BUTTON, READY TO INSTALL IN YOUR PANEL

LAMP DATA

LISTING CODE	INDUSTRY LAMP NO.	DESIGN VOLTS	Socket Volts	6.3	6.0	5.5	5.0
13	159	6.3	Amps	.15	.14	.135	.12
			MSCP	.34	.27	.24	.17
			Rated Life— Hours Avg.	9,000	16,500	28,000	28,000
12	259	6.3	Socket Volts	6.3	6.0	5.5	5
			Amps	.25	.24	.225	.21
			MSCP	.65	.52	.39	.29
			Rated Life— Hours Avg.	9,000	16,000	44,500	50,000
42	NONE	120	Amps— .025 Rated Life 5,000 Hrs.				

LISTING CODE	INDUSTRY LAMP NO.	DESIGN VOLTS	Socket Volts	14	12	11	10
21	161	14	Amps	.19	.17	.16	.15
			MSCP	1.0	.60	.4	.3
			Rated Life— Hours Avg.	4,000	25,000	26,500	28,000
31	656 or 152	28	Socket Volts	28	27	26	24
			Amps	.06	.057	.054	.05
			MSCP	.65	.52	.49	.39
			Rated Life— Hours Avg.	5,000	7,500	10,000	10,000
NONE	557	14	AMPS—.420 MSCP 2.5—Rated Life 500 Hrs.				

BUTTON ORDERING GUIDE

Buttons may be furnished with or without the metal shell, assembled or unassembled. When type B, C, D, E, or F buttons are ordered unassembled, the insert is also unassembled.

For a detailed description of the various button types and the display effects they provide, refer to page A3.

Catalog listings for Series 4 buttons are derived from the ordering guide, or shown in the example, below.

4B1AGN is a catalog listing for a green (transmitted color) unlegended button. (If the button shell is also desired, substitute 4B2 for 4B1 in the listing.)

Example:

4BI A G N

4BI

BUTTON WITHOUT METAL SHELL

4B1
Button only
(without metal shell)

BUTTON WITH METAL SHELL

4B2
Both button and metal shell provided.

BUTTON WITH METAL SHELL, WITH PROVISION FOR LOCKED BUTTON

4B3
Both button and metal shell provided

A

BUTTON TYPE

A
Transmitted color.
5 sides lighted.
1-piece translucent button.

B
Projected color. 5 sides lighted.
Translucent white button & color insert.

C
Hidden color/hidden legend. 5 sides lighted.
Transparent black button & translucent color insert.

D
Hidden color/hidden legend. Only face lighted. Transparent black button & translucent color insert.

E
Transmitted color.
5 sides lighted.
Transparent colorless button & translucent color insert.

F
Transmitted color. Only face lighted. Transparent colorless button & color insert.

G
Same as type "A" except .250" higher

G

DISPLAY COLOR

B
Std. Blue

G
Std. Green

R
Std. Red

S
Transparent Black (Unlighted applications only)

Y
Std. Yellow

W
Std. White (Do not use with Type B button)

A
Std. Amber (For use with Type A or G button only)

N

LEGEND (Legend Order Sheet must accompany all orders for legended buttons)

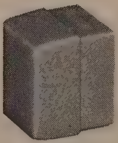
U
No legend, button unassembled (For customer who does his own legending.) Use with any button except 4B1A—

N
No legend, button assembled. (For applications not requiring legends.) Use with any button.

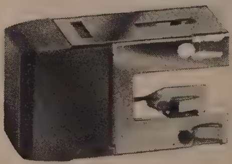
L
Legend on button only, button assembled. (For customer who prefers to have MICRO SWITCH provide legending.)
Use with any button.

K
Legend on insert only, button assembled. (For C, D, E and F button types.)

J
Legends on both *button and insert*, button assembled. Use with C & D button types



Button



Button and Metal Shell

LEGENDING

HOT STAMP LEGENDS

Use the Legend Order Sheet FO-63039 to specify hot stamp legending from MICRO SWITCH. Reproduce it on your office copier or request a pad of forms from our branch office nearest you. Legends are oversprayed for maximum durability.

The drawing at right provides information to build a simple holding fixture (horn) if you prefer to do your own legending of buttons or inserts, by hot stamp or engraving.

FILM LEGENDS

Film legends are not supplied by MICRO SWITCH. However, this service is readily available from commercial photographic or contact printing sources. Films offer the flexibility of using either a positive or negative approach, and enable special characters to be easily produced. The film should be polyester type to withstand lamp heat and must be precision cut, per the dimensions shown on page A3, to insure proper alignment.

The film fits into a shallow undercut on the face of the button insert. The film is held securely when the outer button and insert are snapped together. (Note: It is difficult to disassemble for legend changes without damaging the parts.)

Button and insert should be snapped together prior to being assembled to the button shell.

BUTTON ORIENTATION

The legended button should be assembled to the button in the orientation shown at right, with the button notch keyed to the lamp removal slot in the metal shell. This will reduce the possibility of lamp droppage when the button is removed from the housing. All buttons are legended by MICRO SWITCH in this manner.

REPLACEMENT PARTS

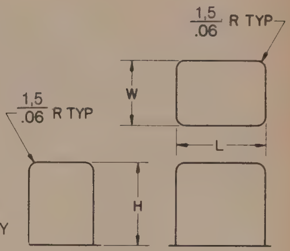
MOUNTING CLIPS

CATALOG LISTING	DESCRIPTION
4Z31	Mounting clips for long sides (2 required per housing)
4Z32	Mounting clips for short sides. (2 required per housing)

METAL SHELL

CATALOG LISTING	DESCRIPTION
4Z41	Metal shell for use with type 4B1 buttons.

FIXTURE FOR HOLDING BUTTONS AND INSERTS WHILE HOT STAMPING OR ENGRAVING LEGENDS

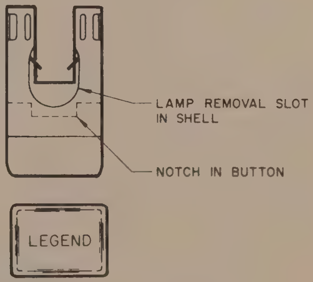


DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0}{0.00}$ — mm / — inches

ITEM	H	L	W
Insert	.55" (14,0 mm)	.64" (16.6 mm)	.43" (10.9 mm)
Button Type A	.62" (15,7 mm)	.67" (17,0 mm)	.48" (12,2 mm)
Button Type B, C & D	.62" (15,7 mm)	.69" (17,5 mm)	.50" (12,7 mm)
Button Type G	.87" (22,0 mm)	.68" (17,3 mm)	.48" (12,2 mm)

$\pm\frac{0,13}{.005}$



LAMPS

CATALOG LISTING	DESCRIPTION
4Z212	No. 259 6-volt lamp (T-3¼)
4Z213	No. 159 6-volt lamp (T-3¼)
4Z221	No. 161 12-volt lamp (T-3¼)
4Z222*	No. 557 12-volt lamp (T-3¼)
4Z231	No. 656 or 152 28-volt lamp (T-3¼)
4Z242	Telephone base 120-volt lamp (T-2)

*This is a flasher lamp. It may be purchased as a separate item only.

FO-63039

ACCOUNT NO. 126 - 035

CATALOG LISTING 4		
CUST. P.O. NO.	CUST. DWG. NO.	
MICRO SALES ORDER	LINE NO.	SCHED. NO.

CUSTOMER: ______

ADDRESS: ______

______ (CITY) ______ (STATE)

SERIES 4

LEGEND ORDER SHEET

INSTRUCTIONS:

1. Determine if legend is to be applied to outer button shell, or to button insert.
2. Select appropriate Fig. No. from CHART "A" or "B", and enter on legend order chart.
3. Place ✓ in appropriate "TYPE SIZE" column *(refer to CHART "C" for examples)*.
4. Place ✓ in BLACK or WHITE legend color column.
5. Indicate quantity desired.
6. Fill in legend description *(DO NOT EXCEED MAXIMUM NUMBER OF LINES OR CHARACTERS AS INDICATED BY CHART "A" or "B")*.

A BUTTON: LEGEND ON TOP SURFACE

LEGEND AREA	TYPE SIZE	Fig. 1				Fig. 2			
		WITHOUT AN "M" OR "W"		WITH ONE "M" OR "W"		WITHOUT AN "M" OR "W"		WITH ONE "M" OR "W"	
		MAX. CHAR. per LINE	MAX. LINES per AREA	MAX. CHAR. per LINE	MAX. LINES per AREA	MAX. CHAR. per LINE	MAX. LINES per AREA	MAX. CHAR. per LINE	MAX. LINES per AREA
Fig 1	7/64	7	3	6	3	5	4	4	4
	9/64	6	2	5	2	4	3	4	3
Fig. 2	13/64	4	1	3	1	3	2	2	2

B BUTTON INSERT: LEGEND ON TOP SURFACE

LEGEND AREA	TYPE SIZE	Fig. 3				Fig. 4			
		WITHOUT AN "M" OR "W"		WITH ONE "M" OR "W"		WITHOUT AN "M" OR "W"		WITH ONE "M" OR "W"	
		MAX. CHAR. per LINE	MAX. LINES per AREA	MAX. CHAR. per LINE	MAX. LINES per AREA	MAX. CHAR. per LINE	MAX. LINES per AREA	MAX. CHAR. per LINE	MAX. LINES per AREA
Fig. 3	7/64	5	2	5	2	3	3	3	3
	9/64	4	1	4	1	3	2	2	2
Fig. 4	13/64	3	1	2	1	2	2	1	2

C

Modified Gothic lettering (A thru Z), numerals (0 thru 9) and Symbols below available in 7/64, 9/64 and 13/64 type size.

A 3
MODIFIED GOTHIC

STANDARD SYMBOLS AVAILABLE

.	,	:	;	!	?	'	_	"	/	(	)	*	&	@
$	¢	#	%	°	+	−	±	÷	X	=	≠	>	<	∞
→	↑	↓	←	CR	¼	½	¾	⅓	⅔					

LEGEND ORDER CHART

CUSTOMER PART NO.	FIG. NO.	TYPE SIZE CHART A OR B			LEGEND COLOR		BUTTON QUAN.	LEGEND DESCRIPTION DO NOT EXCEED MAXIMUM NUMBER OF LINES OR CHARACTERS SEQUENCE: LEFT TO RIGHT OR TOP TO BOTTOM			
		7/64	9/64	13/64	BLACK	WHITE		1 st. LINE	2 nd. LINE	3 rd. LINE	4 th. LINE

SHEET PREPARED BY:

______ (Signature) ______ (Date)

SPECIAL LEGENDS

NOTE: Use this area to show special legend Locations or Configurations NOT Shown above.
NON-STANDARD legends will involve additional charges and increased delivery time.

FIG. "A"	FIG. "B"
FIG. "C"	FIG. "D"

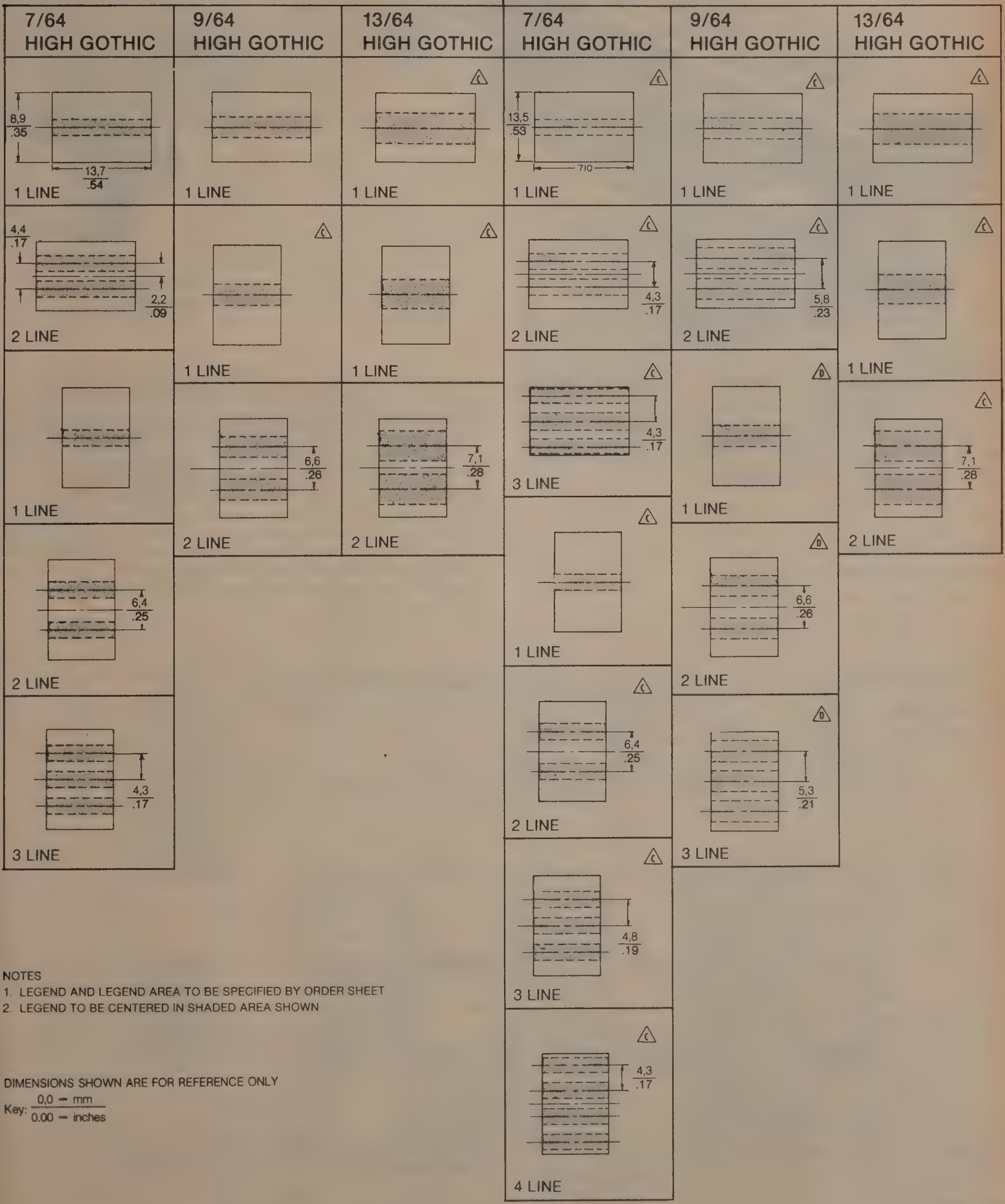
MICRO SWITCH

SERIES 4 LIGHTED PUSHBUTTON SWITCHES/INDICATORS

LEGEND AREAS

BUTTON INSERTS

BUTTONS


7/64 HIGH GOTHIC
8,9 .35
13,7 .54
1 LINE
4,4 .17
2,2 .09
2 LINE
1 LINE
6,4 .25
2 LINE
4,3 .17
3 LINE
9/64 HIGH GOTHIC
1 LINE
C
1 LINE
6,6 .26
2 LINE
13/64 HIGH GOTHIC
C
1 LINE
C
1 LINE
7,1 .28
2 LINE
7/64 HIGH GOTHIC
C
13,5 .53
710
1 LINE
C
4,3 .17
2 LINE
C
4,3 .17
3 LINE
C
1 LINE
C
6,4 .25
2 LINE
C
4,8 .19
3 LINE
C
4,3 .17
4 LINE
9/64 HIGH GOTHIC
C
1 LINE
C
5,8 .23
2 LINE
D
1 LINE
D
6,6 .26
2 LINE
D
5,3 .21
3 LINE
13/64 HIGH GOTHIC
C
1 LINE
C
1 LINE
C
7,1 .28
2 LINE

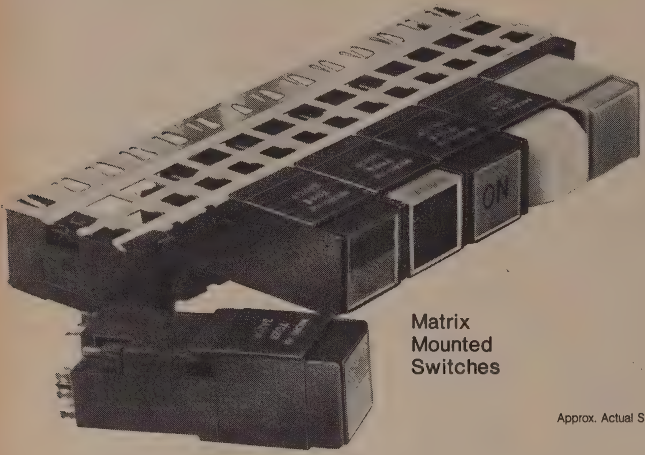
NOTES

1. LEGEND AND LEGEND AREA TO BE SPECIFIED BY ORDER SHEET
2. LEGEND TO BE CENTERED IN SHADED AREA SHOWN

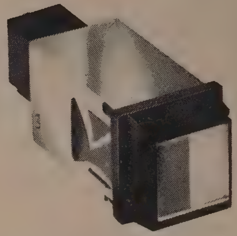
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

SERIES 3 LIGHTED PUSHBUTTON SWITCHES



Matrix
Mounted
Switches



Approx. Actual Size

Individual
Mount Switch

- Front of Panel Replacement of Switches and Lamps
- Relegendable Buttons
- Six Standard Lighted Display Colors Available
- Momentary or 2-Level Alternate Action
- Power Switches or Electronic Duty Form A Reed Switches

Series 3 has multiple options in the same size package. By standardizing on Series 3 as building blocks for your control panels, you can specify either matrix, individual, or strip mounting, momentary and two-level alternate-action, power or reed switches (with audible "click click" feedback), and matching lighted indicators.

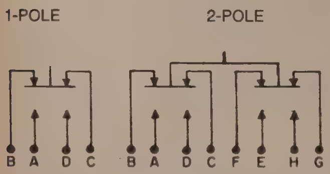
Matrix mounted switches are provided with termination suitable for direct wiring, printed circuit board mounting or plug-in termination to customer pre-wired connector blocks. They can be replaced from the panel front by simply using a screw driver to disengage the switch mounting lugs from the mounting rails.

Individual mount switches have spring clips on two sides for front of panel snap-in mounting.

POWER SWITCHES

Contact Arrangement:

Schematic shows Form Z circuitry (Form X and Y versions available.)



Electrical Rating:

5 amp ind. or res., 115 VDC
3 amp ind., 5 amp res., 28 VDC
100,000 operations at rated load, 95% survival.

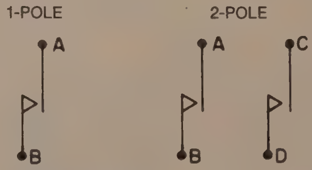
Characteristics:

Operating force 8.0 oz. (227 g.) approx.
Total travel** .25 in. approx. (6,3 mm) approx.

**When alternate-action switches are operated, the button remains depressed approximately .180 in. and the circuit is maintained until the button is pushed again.

REED SWITCHES

Contact Arrangement:



Electrical Rating:

Alternating Current
12VA Max - Inrush or Resistive
Max. Voltage: 240VAC @ 12VA
Max. Current: 250 milliamps @ 12VA

Direct Current
8 Watts Maximum Resistive only
Max. Voltage: 240VDC @ 8 Watts
Max. Current: 250 milliamps @ 8 Watts

VAC 60 Cy.	Maximum Current in Milliamps	Volts DC	Maximum Current in Milliamps
0-48	250	0-32	250
120	100	120	66
240	50	240	33

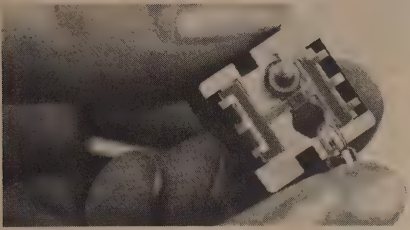
1,000,000 operations at rated load, 95% survival.

Characteristics:

Operating force 3.0 oz. (85 g.) approx.
Total travel** .25 in. (6,3 mm) approx.

SERIES 3 LIGHTED PUSHBUTTON SWITCHES A

BUTTONS



Lamps and legends can be changed from the panel front. The button is removed by pulling it forward out of the switch housing. Lamps are retained in the button for ease of replacement.

Relegendable buttons have a transparent colorless insert which fits over a colored diffuser plate and snaps into the button's shell. Legending may be applied to the diffuser plate. The diffuser plate can be easily removed and replaced if a change of legend information is desired. To ensure proper orientation during assembly, the button is keyed to the switch housing. Lighted display is provided by one or two 5, 12, 14 or 28 volt T-1 lamps.

UL LISTING AND CSA CERTIFICATION

UL listed, CSA certified Series 3 devices are available.

CAUTION: Combining UL-CSA listed *switches* with unlisted buttons, and unlisted switches with UL-CSA *buttons* is not recommended; this may result in excessive wear causing shorter life. Style 3D buttons should only be used with 3A, 3G, 3B and 3H switches. UL-CSA 3N buttons should only be used with UL-CSA switches — styles 3E, 3F, 3K and 3L.

LEGENDING

MICRO SWITCH will furnish hot stamp legending in standard modified Gothic. Contact our local branch office for Series 3 legend order sheets that provide data on type size and possible number of characters per line.

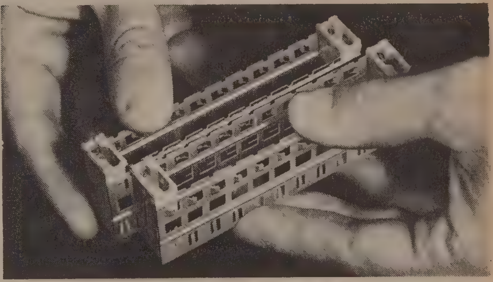
INDICATORS

Lighted indicators are identical in size and appearance to the switches, but without provision for switching.

MOUNTING

Mounting options for Series 3 switches and indicators are:

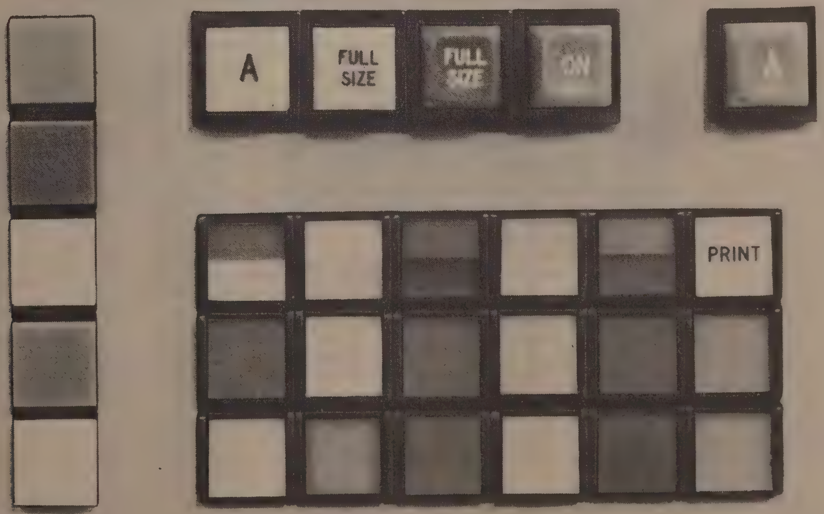
1. Individual mount units have integral clips on two sides of the housing for front of panel snap-in mounting. They can be mounted in separate cutouts or strip mounted in a single cutout.
2. Units that require Type 3M mounting hardware are mounted in a single cutout. Two or more rows can be attached together to form a matrix or a single row can be strip mounted.



TERMINATION-SWITCHES AND INDICATORS

Direct wiring to switch, plug-in to connector blocks, or printed circuit board termination. Available on either switch or connector.

NOTE: Caution should be exercised when soldering to direct wire terminations to prevent overheating and flux contamination of the switch contacts.



POWER SWITCH ORDERING GUIDE

Ordering Example
3A10-A is a power switch for matrix or strip mounting, has direct wire termination, 1-pole Form Z circuitry, momentary action, two lamp circuits, and black housing.

THRU-PLUNGER SWITCHES
Switches with Electrical Codes **16, 17, 66,** and **67,** have thru-plungers which attach to mechanical interlock devices to provide bailing and lookout functions.

Example:

3A 10 A

Add—1 to listing if connector block is required (3A and 3E modules only).
(Connector blocks have direct wire terminations only.)

POWER SWITCH MOUNTING TYPE
3A For matrix or strip mounting. Requires use of 3M type mounting hardware.
3E U.L. listed 3A type device.†
3F U.L. listed 3G type device.†
3G For individual or strip mounting. No additional mounting hardware required.

†Use 3N buttons only.

ELECTRICAL CODE			DESCRIPTION			
Thru Plunger for Inter-lock‡	Direct Wire	P.C. Term.	Poles	Switch Circuitry	Action	Lamp Ckt(s)
16	10	70	1	Form Z	Mom	2
	11		1	Form X	Mom	2
	12		1	Form Y	Mom	2
17	13	71	1	Form Z	Mom	1
	14		1	Form X	Mom	1
	15		1	Form Y	Mom	1
66	20	72	2	Form Z	Mom	2
	21		2	Form X	Mom	2
	22		2	Form Y	Mom	2
	23		2	1 (Z), 1 (Y)	Mom	2
	24		2	1 (X), 1 (Z)	Mom	2
67	25	73	2	Form Z	Mom	1
	26		2	Form X	Mom	1
	27		2	Form Y	Mom	1
	28		2	1 (Z), 1 (Y)	Mom	1
	29		2	1 (X), 1 (Z)	Mom	1
	30	74	1	Form Z	Alt	2
	31		1	Form X	Alt	2
	32		1	Form Y	Alt	2
	33	75	1	Form Z	Alt	1
	34		1	Form X	Alt	1
	35		1	Form Y	Alt	1
	40	76	2	Form Z	Alt	2
	41		2	Form X	Alt	2
	42		2	Form Y	Alt	2
	43		2	1 (Z), 1 (Y)	Alt	2
	44		2	1 (X), 1 (Z)	Alt	2
	45	77	2	Form Z	Alt	1
	46		2	Form X	Alt	1
	47		2	Form Y	Alt	1
	48		2	1 (Z), 1 (Y)	Alt	1
	49		2	1 (X), 1 (Z)	Alt	1
	50		1	Form Z	Mom	None
	51		1	Form X	Mom	None
	52		1	Form Y	Mom	None
	53		2	Form Z	Mom	None
	54		2	Form X	Mom	None
	55		2	Form Y	Mom	None
	56		2	1 (Z), 1 (Y)	Mom	None
	57		2	1 (X), 1 (Z)	Mom	None
	58		1	Form Z	Alt	None
	59		1	Form X	Alt	None
	60		1	Form Y	Alt	None
	61		2	Form Z	Alt	None
	62		2	Form X	Alt	None
	63		2	Form Y	Alt	None
	64		2	1 (Z), 1 (Y)	Alt	None
	65		2	1 (X), 1 (Z)	Alt	None

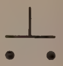
‡Use 3A or 3E only

Color Code	DESCRIPTION	
	Housing (bezel**)	Barrier
A	Black	None
F	Black	Black
L	Gray	None
M	Gray	Gray

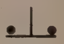
**Bezel provided with 3G and 3F only.

Circuitry:

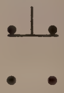
X=SPST—N.O. Double Make



Y=SPST—N.C. Double Break



Z=SPDT—Double-make Double-Break Break-before-Make



CAUTION: Combining UL-CSA listed *switches,* with unlisted buttons, and unlisted switches with UL-CSA *buttons* is not recommended: this may result in excessive wear causing shorter life. Style 3D buttons should only be used with 3A, 3G, 3B, and 3H switches. UL-CSA 3N buttons should only be used with UL-CSA switches—styles 3E, 3F, 3K and 3L.

REED SWITCH ORDERING GUIDE

3H50A is a reed switch for individual or strip mounting, has printed circuit terminals, 1-pole Form A circuitry, two lamp circuits, and black bezel and housing.

Example: 3H 50 A

THRU-PLUNGER SWITCHES

Switches with Electrical Codes **15, 16, 25,** and **26** have thru-plungers which attach to mechanical interlock devices to provide bailing and lockout functions.

Add—1 if connector block is required (3B and 3K modules only). (Connector blocks have direct wire termination only.)

REED SWITCH MOUNTING TYPE
3B For matrix or strip mounting. Requires use of 3M type mounting hardware.
3H For individual or strip mounting. No additional hardware required.
3K U.L. listed 3B type device.†
3L U.L. listed 3H type device.†

ELECTRICAL CODE			DESCRIPTION			
Thru Plunger for Inter-lock‡	Direct Wire	Printed Circuit Term.	Pole(s)	Switch Circuitry	Action	Lamps Ckt(s)
15	10	50	1	Form A (N.O.)	Mom	2
16	11	51	1	Form A (N.O.)	Mom	1
	12	52	1	Form A (N.O.)	Mom	None
	13††	53††	1	Form A (N.O.)	Mom	2
	14††	54††	1	Form A (N.O.)	Mom	1
25	20	60	2	Form A (N.O.)	Mom	2
26	21	61	2	Form A (N.O.)	Mom	1
	22	62	2	Form A (N.O.)	Mom	None
	23††	63††	2	Form A (N.O.)	Mom	2
	24††	64††	2	Form A (N.O.)	Mom	1
	30	70	1	Form A (N.O.)	Alt	2
	31	71	1	Form A (N.O.)	Alt	1
	32	72	1	Form A (N.O.)	Alt	None
	40	80	2	Form A (N.O.)	Alt	2
	41	81	2	Form A (N.O.)	Alt	1
	42	82	2	Form A (N.O.)	Alt	None

†Use 3N buttons only. ††No audible feedback ‡Use 3B or 3K only.

COLOR CODE	DESCRIPTION	
	HOUSING (bezel**)	BARRIER
A	Black	None
F	Black	None
L	Gray	None
M	Gray	Gray

**Bezel provided with 3H and 3L only.

CAUTION: Combining UL-CSA listed *switches* with unlisted buttons, and unlisted switches with UL-CSA *buttons* is not recommended; this may result in excessive wear causing shorter life. Style **3D** buttons should only be used with **3A, 3G, 3B** and **3H** switches. UL-CSA **3N** buttons should only be used with UL-CSA switches — styles **3E, 3F, 3K** and **3L**.

INDICATOR ORDERING GUIDE

Example: 3J 10 M

Add—1 if connector block is required (3C modules only).

3J1OM is an indicator for individual or strip mounting; has two lamp circuits; and gray bezel, housing and barriers.

INDICATOR MOUNTING TYPE
3C For matrix or strip mounting. Requires use of 3M type mounting hardware
3J For individual or strip mounting. No additional mounting hardware required.

ELECTRICAL CODE	DESCRIPTION Lamp Circuits(s)
10	2
11	1.

Printed circuit terminals and UL listed indicators are available on request. Contact your nearest MICRO SWITCH Branch Office.

COLOR CODE	DESCRIPTION	
	Housing (bezel**)	Barrier
A	Black	None
F	Black	Black
L	Gray	None
M	Gray	Gray

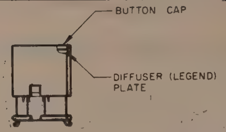
**Bezel provided with 3J only.

Use only "indicator style" buttons with these indicators. They are indicated by the **M** or **P** Legend Code letters in the ordering guide for buttons.

SERIES 3 LIGHTED PUSHBUTTON SWITCHES
BUTTON ORDERING GUIDES
THREE-PIECE RELEGENDABLE BUTTONS

(Cap, Diffuser/Legend Plate, and Lampholder), Flat Style Single-Section or Two Section Display.

Note: If lamps are not desired, omit the Lamp Code number from the catalog listing.



3D11WW1L-1 is a relegendable flat button, has a single section display, black button shell, white display color, transparent colorless cap, legend, and one 5-volt lamp. For use with switches only.

Example:

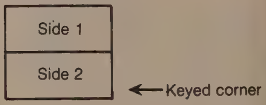
3D	1	1	WW	1	L	1
BUTTON	CONSTRUCTION	SHELL COLOR	DISPLAY COLOR*	CAP COLOR	LEGEND	LAMPS
3D For use with power and reed switches and indicators 3N U.L. listed for use only with UL listed power and reed switches.	1 Single-section display 2 Two-section display	1 Black 2 Gray	W white R red G green B blue Y yellow D orange K black	1 transparent colorless 2 Transparent black, hidden color 3 Projected color, translucent white	**Switch Buttons:** L with legend N w/o legend, **Indicator Buttons:**** M with legend P w/o legend	1 one 5 volt 2 two 5 volt 3 one 28 volt 4 two 28 volt 5 one 12 volt 6 two 12 volt 7 one 14 volt 8 two 14 volt (Omit character if no lamp desired.)

*For single-section buttons, enter a double letter at this position in the Catalog Listing. Example: Red — RR

**Note: Only "indicator style" buttons should be used in indicators, as indicated by the M or P Legend Code letters.

When ordering two-section buttons, add the letter for Side 1 first. Example: If you desire Side 1 to be Red and Side 2 Blue, enter RB.

View from top of two-section button



ONE-PIECE NON-RELEGENDABLE BUTTONS

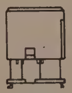
Flat Style or Truncated Style Single-Section Display

Note: If lamps are not desired, omit the lamp Code number from the catalog listing.

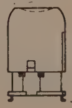
3D4RM2 is a non-relegendable truncated button, has single section display, red button color, legend, and two 5-volt lamps. For use with indicators only.

3D	4	R	M	2
BUTTON	CONSTRUCTION	DISPLAY COLOR	LEGEND	LAMPS
3D For use with power and reed switches and indicators	3 Flat style, single-section 4 Truncated style, single-section	W white R red G green B blue Y yellow	**Switch Buttons:** L with legend N w/o legend **Indicator Buttons:**** M with legend P w/o legend	1 one 5 volt 2 two 5 volt 3 one 28 volt 4 two 28 volt 5 one 12 volt 6 two 12 volt 7 one 14 volt 8 two 14 volt (Omit character if no lamp desired.)

Flat Style



Truncated Style



All 3D4 type buttons will be engraved legending. Hidden color and hidden legending available on request. Contact your nearest MICRO SWITCH Branch Office.

**Note: Only "indicator style" buttons should be used in indicators as indicated by the M or P Legend Code.

MOUNTING HARDWARE ORDERING GUIDE

Example:

3M1 — 09

MOUNTING HARDWARE BASE LISTING
3M1 Standard Type for use with connector blocks for plug-in wiring
3M2 Narrow width type, allows direct wiring

ROW LENGTH*	
01 1-Unit	**17** 9-Unit
02 1½-Unit	**18** 9½-Unit
03 2-Unit	**19** 10-Unit
04 2½-Unit	**20** 10½-Unit
05 3-Unit	**21** 11-Unit
06 3½-Unit	**22** 11½-Unit
07 4-Unit	**23** 12-Unit
08 4½-Unit	**24** 12½-Unit
09 5-Unit	**25**13-Unit
10 5½-Unit	**26** 13½-Unit
11 6-Unit	**27** 14-Unit
12 6½-Unit	**28** 14½-Unit
13 7-Unit	**29** 15-Unit
14 7½-Unit	**30** 15½-Unit
15 8-Unit	**31** 16-Unit
16 8½-Unit	

Mounting hardware for 3A, 3E, 3B, 3K, and 3C units is provided by a box girder structure (see 3M Type drawings below). Interlocking tabs enable them to be assembled into a multi-row matrix.

To specify the row length in the catalog listing, add the number of switches and/or indicators, then convert the total to the proper suffix number, i.e. "09" for a 5-unit row.

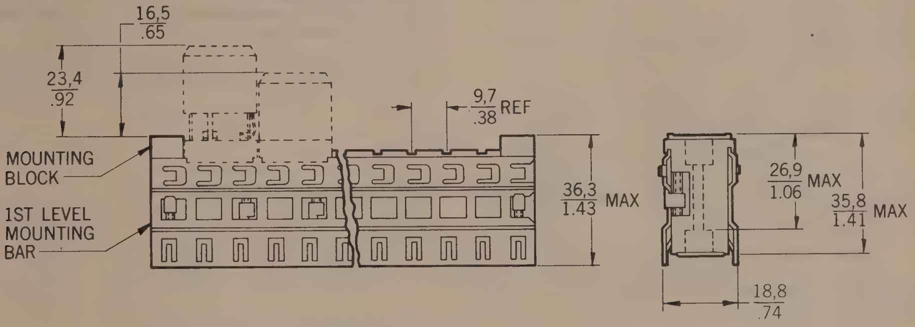
Each 3M Type listing consists of two mounting bars and two mounting blocks in packet form.

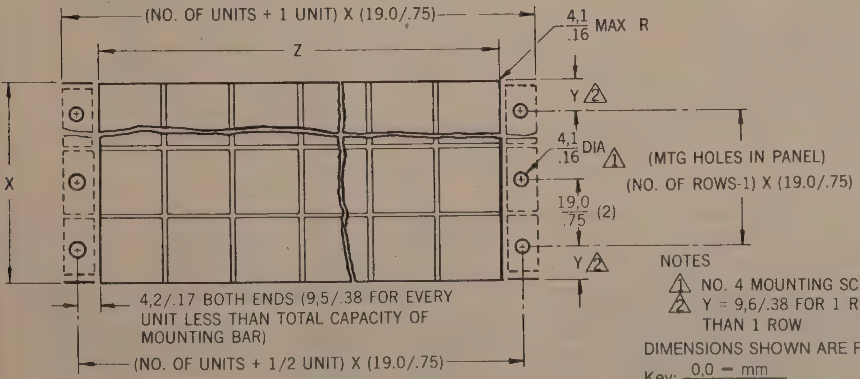
COMPLETELY ASSEMBLED STRIPS OR MATRICES USING TYPE 3M MOUNTING HARDWARE

MICRO SWITCH will provide completely assembled strips or matrices at an additional charge per station of first level devices (switches) with no set-up charge. Contact your MICRO SWITCH Branch Office for pricing of assembled strips or matrices.

MOUNTING AND CUTOUT INFORMATION

For 3A, 3E, 3B, 3K, and 3C units using 3M Type Mounting Hardware.


16,5 / .65
23,4 / .92
9,7 / .38 REF
MOUNTING BLOCK
1ST LEVEL MOUNTING BAR
36,3 / 1.43 MAX
26,9 / 1.06 MAX
35,8 / 1.41 MAX
18,8 / .74


(NO. OF UNITS + 1 UNIT) X (19.0/.75)
Z
4,1 / .16 MAX R
Y ⚠2
X
4,1 / .16 DIA ⚠1 (MTG HOLES IN PANEL)
(NO. OF ROWS-1) X (19.0/.75)
19,0 / .75 (2)
Y ⚠2
4,2/.17 BOTH ENDS (9,5/.38 FOR EVERY UNIT LESS THAN TOTAL CAPACITY OF MOUNTING BAR)
(NO. OF UNITS + 1/2 UNIT) X (19.0/.75)

NOTES

⚠1 NO. 4 MOUNTING SCREW RECOMMENDED

⚠2 Y = 9,6/.38 FOR 1 ROW 10,0/.40 FOR MORE THAN 1 ROW

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

No. of Rows		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DIM. X & Z	mm ±0,25	19,3	39,1	58,2	77,2	96,3	115,3	134,4	153	172,1	191,5	210,6	229,6	248,7	267,7	286,8	305,8
	inches ±.010	0.76	1.54	2.29	3.04	3.79	4.54	5.29	6.04	6.79	7.54	8.29	9.04	9.79	10.54	11.29	12.04

SERIES 3 LIGHTED PUSHBUTTON SWITCHES

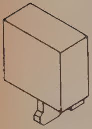
ACCESSORIES

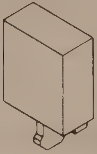
SPACER BLOCKS

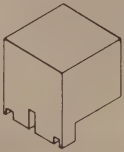
Spacers are used to fill openings in rows of functional modules, provide expansion space or act as barriers against accidental operation.

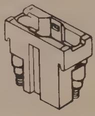
The 3T1K-1 spacer block contains a low level ½ unit spacer plus a mounting block.

A ½ unit spacer is ¾'' x ⅜''.


3T1


3T2


3T3


MOUNTING BLOCK

Example:

3T1 K -1

STYLE	UNIT-LEVEL
3T1	½ UNIT LOW LEVEL
3T2	½ UNIT HIGH LEVEL
3T3	1 UNIT LOW LEVEL

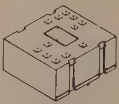
COLOR
A—Gray
B—Blue
G—Green
K—Black
R—Red
W—White
Y—Yellow

MOUNTING BLOCK
ADD: —1
Omit if mounting block is not desired.

To order mounting blocks for spacers as a separate item, specify 3M4-02. They are also used for attachment to mounting bars in first level 3M hardware packets.

CONNECTOR BLOCKS FOR MATRIX-MOUNTED SWITCHES*

Plug-in at the base of switches and indicators providing means of attaching leadwires. Terminal locations are marked for identification. Connector block consits of a terminal housing with terminals inserted.


3R1 - 3R6

CATALOG LISTING	DESCRIPTION
3R1	Terminal Housing for power switch or indicator module (3A, 3C, 3E types only)
3R2	Terminal Housing with 12 quick connect terminals installed for power switch or indicator module (3A, 3C, 3E types only)
3R3	Terminal Housing with 12 Printed Circuit Board terminals installed for power switch or indicator module (43A, 3C, 3E types only)
3R4	Terminal Housing for reed switch (3B, 3L types only)
3R5	Terminal Housing with 8 quick connect terminals installed for reed switch (3B, 3L types only)
3R6	Terminal Housing with 8 printed circuit board terminals installed for reed switch (3B, 3L types only)
3R7	Quick Connect Terminals (Sold only in multiples of 50)
3R8	Printed Circuit Board terminals (Sold only in multiples of 50)

*To be used only on the matrix mounted switches and indicators using 3M1 hardware

MECHANICAL INTERLOCK

Switches with tru-plungers can be interlocked in single rows, up to 10 units (length), to provide the following functions:

Bail and Lockout. Buttons are operated in one-by-one sequence, with one button in row always held down by a mechanical detent.

Momentary Lockout. Circuit transfer is maintained only while the button is manually held depressed. Only one button is row can be operated at a time. There is no bailing function.

Row Lockout Station. Optional addition to Momentary Lockout row. When this station is operated, other buttons are locked in free position until it is depressed again.

Clearing Station. Optional addition to Bail and Lockout row. Clearing station returns previously operated buttons to free position.

MICRO SWITCH can provide: (a) complete assembly, consisting of 1st level thru-plunger switches and buttons assembled in mounting hardware, and 2nd level interlock assembly; or the 2nd level interlock assembly as a separate item for attachment to the 1st level row by the user.

To order a 2nd level bail and lockout assembly, specify catalog listing **3W7**, plus suffix code which denotes the number of units, etc. up to 10 units. Example **3W7-06** is a six-unit bail and lockout device. Order thru-plunger switches and mounting hardware from the Series 3 ordering guides.

For information to order other mechanical interlock devices and complete assemblies, contact ytour nearest MICRO SWITCH Branch Office.

REPLACEMENT PARTS

Example:

3P2 RG N

DIFFUSER LEGEND PLATE
3PI Single-Section
3P2 Two-Section

DISPLAY COLOR*
W White
R Red
G Green
B Blue
Y Yellow
D Orange
K Black

LEGEND
L Legend
N No legend

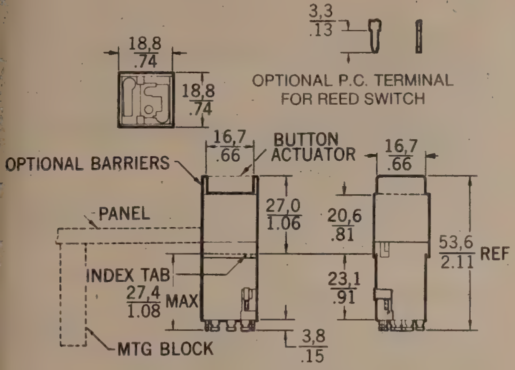
*Enter double letter, per procedure in button ordering guides.

CATALOG LISTING	DESCRIPTION
3P5CC	Clear button cap
3P5SA	Smoky gray cap (hidden color)
3P11CL	Locking device for converting a switch button for use in an indicator.
3P5LP	5 volt T-1 lamp
3P12LP	12 volt T-1 lamp
3P14LP	14 volt T-1 lamp
3P28LP	28 volt T-1 lamp
3P11QC	Individual push-on connectors for attachment to switch terminals. (Sold only in multiples of 100)

SERIES 3 LIGHTED PUSHBUTTON SWITCHES

SWITCHES AND INDICATORS

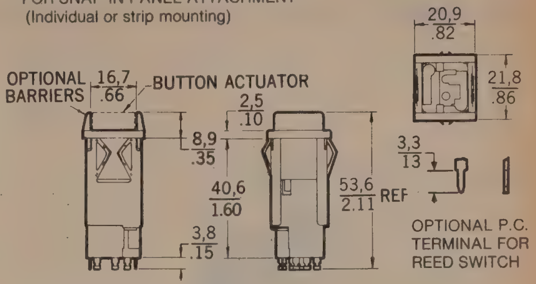
FOR USE WITH 3M MOUNTING HARDWARE
(Matrix or strip mounting)


18,8
.74
18,8
.74
3,3
.13
OPTIONAL P.C. TERMINAL FOR REED SWITCH
OPTIONAL BARRIERS
16,7
.66
BUTTON ACTUATOR
16,7
.66
PANEL
27,0
1.06
20,6
.81
53,6
2.11
REF
INDEX TAB
27,4
1.08
MAX
23,1
.91
MTG BLOCK
3,8
.15

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 = mm / 0.00 = inches

FOR SNAP-IN PANEL ATTACHMENT
(Individual or strip mounting)


20,9
.82
21,8
.86
OPTIONAL BARRIERS
16,7
.66
BUTTON ACTUATOR
2,5
.10
8,9
.35
40,6
1.60
3,8
.15
53,6
2.11
REF
3,3
.13
OPTIONAL P.C. TERMINAL FOR REED SWITCH

PANEL CUTOUT DIMENSIONS

1. Individual Mounting:

   $20{,}4 \pm^{0,5}_{0,0}$ x $19{,}6 \pm^{0,5}_{0,0}$ / $.805 \pm^{.020}_{.000}$ x $.722 \pm^{.020}_{.000}$

2. Strip Mounting:

   $20{,}4 \pm^{0,5}_{0,0}$ Width x [(20,8 x No. of units)—0,8] ±0,25 length /

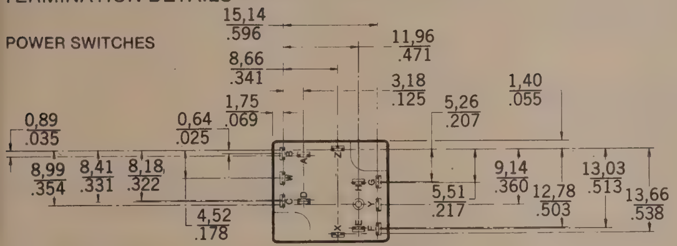
   $.805 \pm^{.020}_{.000}$ Width x [(.822 x No. of units)—.035] ±.010 length

3. Recommended panel thickness:

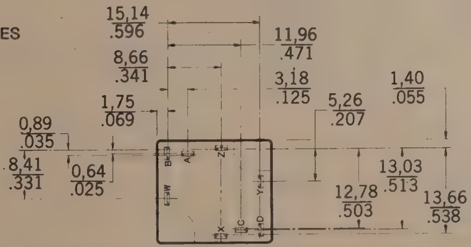
   1,5 to 3,8/.06 to .15

TERMINATION DETAILS

POWER SWITCHES

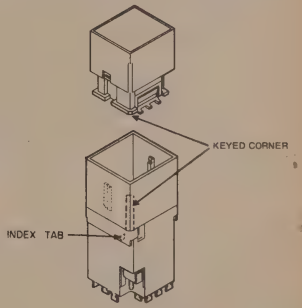

15,14
.596
11,96
.471
8,66
.341
3,18
.125
1,40
.055
1,75
.069
5,26
.207
0,89
.035
0,64
.025
8,99
.354
8,41
.331
8,18
.322
9,14
.360
13,03
.513
5,51
.217
12,78
.503
13,66
.538
4,52
.178

REED SWITCHES

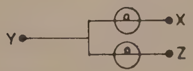

15,14
.596
11,96
.471
8,66
.341
3,18
.125
1,40
.055
1,75
.069
5,26
.207
0,89
.035
8,41
.331
0,64
.025
13,03
.513
12,78
.503
13,66
.538

NOTE-
TOLERANCES ARE ± 0,25/.010

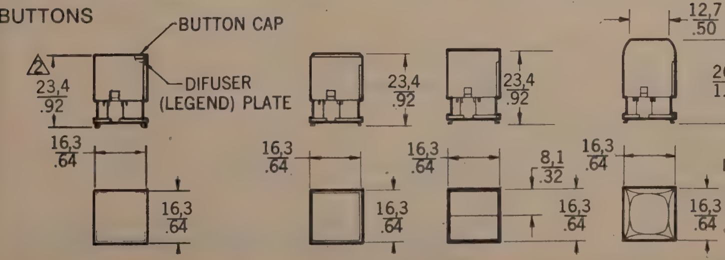
BUTTON KEYED TO HOUSING

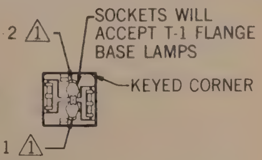

KEYED CORNER
INDEX TAB

LAMP CIRCUITRY



BUTTONS


BUTTON CAP
2
23,4
.92
DIFUSER (LEGEND) PLATE
23,4
.92
23,4
.92
12,7
.50
26,6
1.05
16,3
.64
16,3
.64
16,3
.64
16,3
.64
16,3
.64
8,1
.32
16,3
.64
16,3
.64
16,3
.64
16,3
.64


2
SOCKETS WILL ACCEPT T-1 FLANGE BASE LAMPS
KEYED CORNER
1

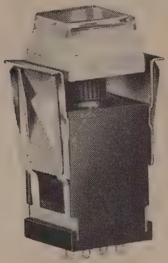
NOTE—

1 LAMP POSITION '1' IS LIGHTED BY TERMINAL 'X' (CIRCUIT 'X') WHILE '2' IS LIGHTED BY TERMINAL 'Z' (CIRCUIT 'Z')

2 EXTENDED POSITION)

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SN SERIES SOLID STATE PUSHBUTTON SWITCHES



The SN Series pushbuttons use the revolutionary Hall effect solid state switch pioneered and developed by MICRO SWITCH. Solid state pushbutton switches eliminate the problem of contact bounce.

This Series is the answer for direct control of solid state circuitry. No matter whether your application calls for one pushbutton, a control panel, or a complete keyboard, we have switch modules to meet your requirements.

The 11SN Series switches are made for direct panel mounting with snap-in hardware and the 101SN Series, 201SN Series and 301SN Series mount direct to printed circuit boards without additional mounting or support hardware. Lighted modules are available in both the 11SN Series and the 201SN Series.

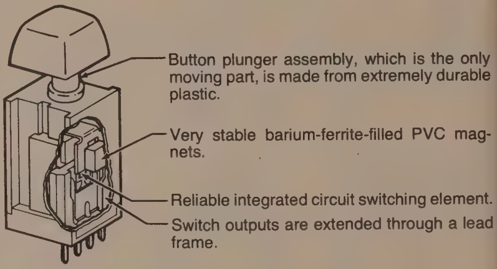
The SN Series is ideal for building custom arrays. There are thousands of legends tooled and we have the in-house capability to tool any special legend you may require. Multiple-unit buttons and space bars with complete mounting hardware are available. In fact, MICRO SWITCH has the largest selection of button shapes, sizes, and colors in the industry.

- Proven Hall Effect Solid State Switching
- Solid State Switching
- Bounce-Free Output
- Lighted & Non-Lighted Switches and Indicators
- Momentary-Action Modules
- Alternate-Action Modules
- Wide Selection of Buttons
- PC-Board Mounting or Panel Mounting
- Long Life and High Reliability

SWITCHING CONCEPT

The Hall effect solid state concept is one of the most reliable switching elements ever designed. An integrated circuit, actuated by magnets, produces an analog control voltage. This voltage is converted into a digital output with a trigger circuit. Two isolated outputs are available from each switch module which may be used individually or wired in parallel. Level and pulsed outputs are available.

CONSTRUCTION DETAILS


Button plunger assembly, which is the only moving part, is made from extremely durable plastic.
Very stable barium-ferrite-filled PVC magnets.
Reliable integrated circuit switching element.
Switch outputs are extended through a lead frame.

OPERATING CHARACTERISTICS

	MOMENTARY	ALTERNATE ACTION
Total Travel	4,75 mm Nominal .187 in.	6,35 mm Nominal .250 in.
Force at operating point	85 g Nominal 3 oz.	127 g Nominal 4.5 oz.
Pretravel	2,54 mm Nominal .100 in.	2,54 mm Nominal .100 in.
Release point @ 5VDC and 75°F (24°C) with respect to free position)	1,02 mm 0.040 in. Min.	1,02 mm 0.040 in. Min.

The operating characteristics of the SN Series have been selected for high operator throughput and are suited for both keyboard and individual pushbutton applications.

SN SERIES SOLID STATE PUSHBUTTON SWITCHES

RELIABILITY

Momentary Module: Indicated MCBF (mean cycles between failures) 5.4 x 10^9
Contact MICRO SWITCH Branch Offices for test data.

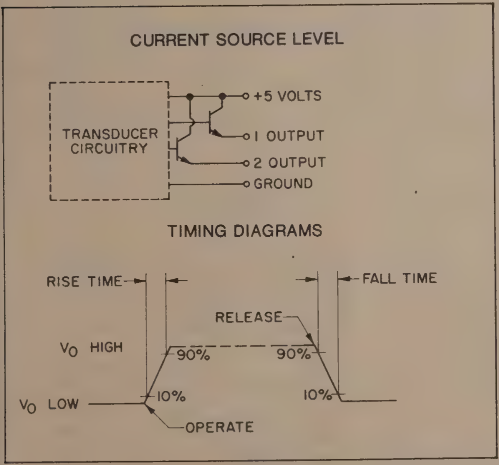
PERFORMANCE

OPERATING VOLTAGE RANGE	5VDC ± 10%
OPERATING TEMPERATURE	*Unlighted:* +32°F to +125°F (0 to 52°C) *Lighted:* +32°F to +125°F (0 to 52°C) (+32°F to +110°F (0 to 43°C) when four or more lighted modules used in an array.)
STORAGE TEMPERATURE	−40°F to +140°F (−40 to +60°C)

ELECTRICAL INFORMATION

CURRENT SOURCING	
POWER REQUIREMENTS	5VDC regulated ± 10% 5mA standby current.
OUTPUT CAPACITY	*Unoperated:* 10µ A max. leakage from Vcc. *Operated:* 2.8VDC min. at 1 to 10mA current sourcing (20mA with outputs paralleled).
RISE TIME	1.0µ second max. at 10mA per output.
FALL TIME	2.0µ second max. at 10mA per output.
LAMP	5VDC, 0.115 Amps.*

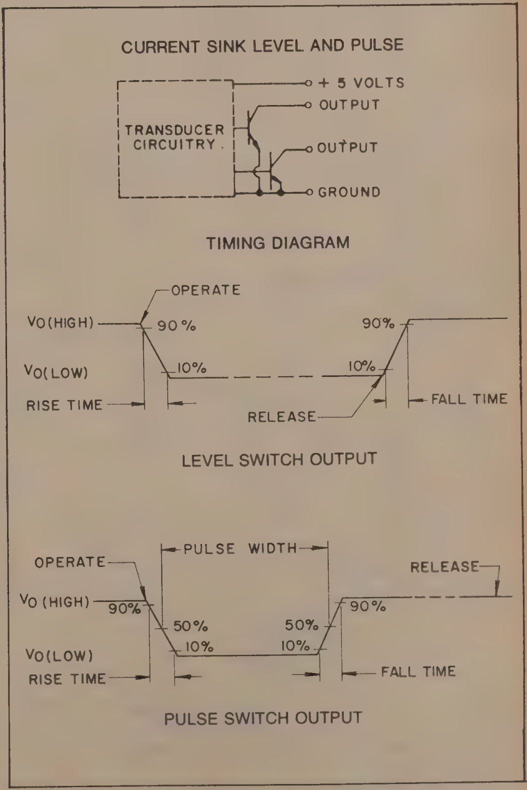
*For extended life, 4.25 to 4.75VDC is recommended.


CURRENT SOURCE LEVEL
TRANSDUCER CIRCUITRY
+5 VOLTS
1 OUTPUT
2 OUTPUT
GROUND
TIMING DIAGRAMS
RISE TIME
FALL TIME
RELEASE
V_O HIGH
90%
90%
V_O LOW
10%
10%
OPERATE

Current sourcing devices are not generally recommended. Contact a MICRO SWITCH Branch Office for application information.

CURRENT SINKING	
POWER REQUIREMENTS	5VDC regulated ± 10 %. 5mA max. standby current.
OUTPUT CAPACITY (LEVEL)	*Unoperated:* 10µA max. collector leakage to ground. *Operated:* 0.4VDC max. (referenced to minus supply) sinking 4mA per output (8mA without outputs paralleled).
OUTPUT CAPACITY (PULSE)	*Unoperated:* (and with button depressed after pulse) 10µA max. collector leakage to ground. *Operated:* (during pulse) 0.4VDC max. (referenced to minus supply) sinking 4mA per output (8mA with outputs paralleled). Pulse width: 10 to 100µ seconds.
RISE TIME	1.0µ second max. at 4mA per output.
FALL TIME	1.0µ second max. at 4mA per output.
LAMP	5VDC, 0.115 Amps.*

*For extended life, 4.25 to 4.75VDC is recommended.

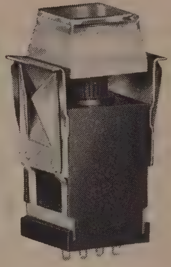

CURRENT SINK LEVEL AND PULSE
TRANSDUCER CIRCUITRY
+ 5 VOLTS
OUTPUT
OUTPUT
GROUND
TIMING DIAGRAM
OPERATE
VO (HIGH)
90 %
90%
VO(LOW)
10%
10%
RISE TIME
RELEASE
FALL TIME
LEVEL SWITCH OUTPUT
PULSE WIDTH
OPERATE
RELEASE
VO (HIGH)
90%
90%
50 %
50%
10%
10%
VO(LOW)
RISE TIME
FALL TIME
PULSE SWITCH OUTPUT

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

11SN SERIES PANEL MOUNTED MODULES

The 11SN Series is designed for panel mounting and comes complete with snap-in mounting hardware. Switches may be mounted individually or in rows. The switch can be specified with either current sourcing or current sinking outputs. Momentary and alternate action modules, lighted or non-lighted, and indicator modules (no switching element) are available. To simplify wiring, the switch is terminated with gold-plated solder lugs. One-unit truncated buttons or relegendable buttons are available for the non-lighted listings. The lighted listings use the same buttons as the 201SN Series.

MODULE
WITH NON-LIGHTED
TRUNCATED BUTTON

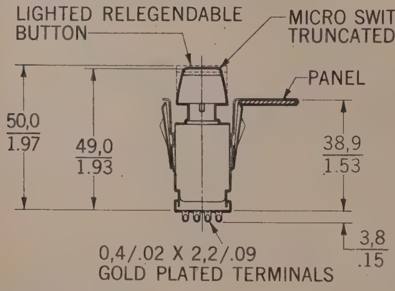

MODULE
WITH NON-LIGHTED
RELEGENDABLE BUTTON

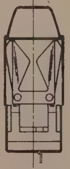
MODULE
WITH TRUNCATED
LIGHTED BUTTON

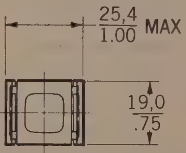
ORDER GUIDE
11SN SERIES LISTINGS

HIGH OPERATING FORCE	LIGHTED		NON-LIGHTED	OUTPUT			INDICATOR MODULE (NO SWITCH)	ALTERNATE ACTION	MOMENTARY ACTION	ORDER THIS CATALOG LISTING
	W/LAMP	W/O LAMP		SOURCE LEVEL	SINK LEVEL	SINK PULSE				
			x	x					x	**11SN1**
			x	x					x	**11SN11**
			x			x			x	**11SN17**
			x		x				x	**11SN21**
x			x		x				x	**11SN31**
			x	x				x		**11SN3**
			x		x			x		**11SN23**
		x			x				x	**11SN1A1**
	x				x				x	**11SN1A2**
		x				x			x	**11SN1B1**
	x					x			x	**11SN1B2**
		x		x					x	**11SN1C1**
	x			x					x	**11SN1C2**
		x			x			x		**11SN2A1**
	x				x			x		**11SN2A2**
		x		x				x		**11SN2C1**
	x			x				x		**11SN2C2**
		x					x			**11SN3D1**
	x						x			**11SN3D2**

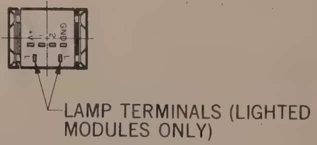
11SN SERIES DIMENSIONS







TERMINATION



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

RECOMMENDED PANEL CUTOUT

No. of Units	Length +.010−.000
1	19,3 mm **.760 in**
2	38,5 mm **1.517 in**

Add .755 (19,2 mm) for each unit over 2 to the 1.517 (38,5 mm)

1. Recommended panel cutout width is .900 ± .010 (22,9 ±0,25 mm) wide .005 (±0,13 mm) x (see chart) for length.
2. With .910 (23,1 mm) panel width
3. Recommended mounting panel thickness is .060 to .250 (1.52 to 6,35 mm)

101SN SERIES MODULES
non-lighted

The 101SN Series modules are designed for direct printed circuit board mounting. They may be used individually or mounted in groups. Standard ¾ inch spacing between switch modules can be maintained for both block and offset arrays. Space bars with mounting hardware are also available. To simplify installation, each module has strips of two-sided tape which hold the module in place during the solder operation.

ORDER GUIDE
101SN SERIES ACTIVE SWITCH MODULE LISTINGS

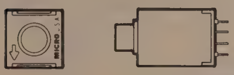
FOR USE WITH* SUPPORT MODULES	CIRCUIT		PLUNGER		OPERATING FORCE NOM. grams	OUTPUT		ACTION		ORDER THIS CATALOG LISTING
	SOURCE	SINK	STEPPED	SLOPED	ounces	LEVEL	PULSE	MOMENTARY	ALTERNATE	
	x			x	85 **3**	x		x		**101SN1**
	x		x		85 **3**	x		x		**101SN2**
	x			x	127 **4.5**	x			x	**101SN3**
	x		x		127 **4.5**	x			x	**101SN4**
		x		x	85 **3**		x	x		**101SN17**
		x	x		85 **3**		x	x		**101SN18**
		x		x	85 **3**	x		x		**101SN11**
		x	x		85 **3**	x		x		**101SN12**
		x		x	127 **4.5**	x			x	**101SN13**
		x	x		127 **4.5**	x			x	**101SN14**
x		x		x	43 **1.5**	x		x		**101SN25**
x		x	x		43 **1.5**	x		x		**101SN26**
x		x		x	43 **1.5**		x	x		**101SN27**
x		x	x		43 **1.5**		x	x		**101SN28**

*Listings checked in this column have a reduced spring force so that when they are used with two-unit buttons, the combined spring force of the active module and the inactive support module is the same as a conventional module used under a one-unit button.
Three-unit buttons require two support modules, thus the combined force will be 1.5 oz. (43g) higher than the standard module with a one-unit button.

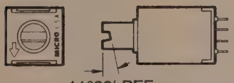
101SN SERIES SUPPORT MODULE LISTINGS FOR USE WITH MULTIPLE-UNIT BUTTONS

FOR USE WITH 2-UNIT BUTTON (1 REQUIRED)	FOR USE WITH 3-UNIT BUTTON (2 REQUIRED)	PLUNGER		BUTTON AND LEGEND PERPENDICULAR TO ROW	BUTTON AND LEGEND PARALLEL TO ROW	ORDER THIS CATALOG LISTING
		STEPPED	SLOPED			
x			x		x	**101SN51**
x		x			x	**101SN52**
x			x	x		**101SN53**
	x		x	x	x	**101SN55**

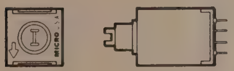
NOTE: These listings do not have a switching element.



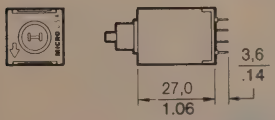
101SN55


MICRO
11°30′ REF

101SN52

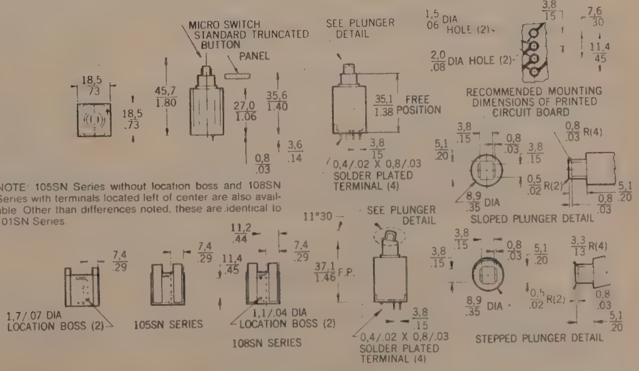


101SN51


MICRO
3,6
.14
27,0
1.06

101SN53

101SN SERIES DIMENSIONS


MICRO SWITCH STANDARD TRUNCATED BUTTON
PANEL
SEE PLUNGER DETAIL
18,5
.73
45,7
1.80
18,5
.73
27,0
1.06
35,6
1.40
3,6
.14
0,8
.03
35,1
1.38
FREE POSITION
3,8
.15
0,4/.02 X 0,8/.03 SOLDER PLATED TERMINAL (4)
1,5
.06
DIA HOLE (2)
2,0
.08
DIA HOLE (2)
3,8
.15
7,6
.30
11,4
.45
RECOMMENDED MOUNTING DIMENSIONS OF PRINTED CIRCUIT BOARD
3,8
.15
0,8
.03
0,8
.03
R(4)
5,1
.20
3,8
.15
0,5
.02
R(2)
8,9
.35
DIA
5,1
.20
0,8
.03
SLOPED PLUNGER DETAIL
11°30
SEE PLUNGER DETAIL
11,2
.44
7,4
.29
7,4
.29
7,4
.29
11,4
.45
37,1
1.46
F.P.
1,7/.07 DIA LOCATION BOSS (2)
105SN SERIES
1,1/.04 DIA LOCATION BOSS (2)
108SN SERIES
3,8
.15
0,4/.02 X 0,8/.03 SOLDER PLATED TERMINAL (4)
3,8
.15
3,8
.15
0,8
.03
5,1
.20
3,3
.13
R(4)
8,9
.35
DIA
0,5
.02
R(2)
0,8
.03
5,1
.20
STEPPED PLUNGER DETAIL

NOTE: 105SN Series without location boss and 108SN Series with terminals located left of center are also available. Other than differences noted, these are identical to 101SN Series.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm
0.00 — inches

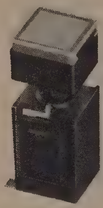
201SN SERIES LIGHTED MODULES

The 201SN Series are lighted modules which are available either with or without a switching element. The switching modules may be used as individual lighted pushbuttons or for custom arrays. The modules without switching elements are designed for use as lighted indicators.

All 201SN Series modules use a T-1 miniature lamp which projects light through the translucent top surface of the button. The lighted surface of the button is easily distinguishable in the ambient light of office environments. Through the use of a lamp driver circuit the light may be controlled by the switching circuit or it may be controlled by the system depending on the purpose for which the light indicator is used.

The lamp may be changed simply by removing the button. This is especially convenient where only the button is accessible from the front of the panel. The electrical characteristics of the switch are the same as those given for all SN Series switches. See page A28 for buttons.

MODULE WITH TRUNCATED LIGHTED BUTTON



MODULE WITH RELEGENDABLE LIGHTED BUTTON

TOP VIEW OF MODULE

MODULE LISTINGS

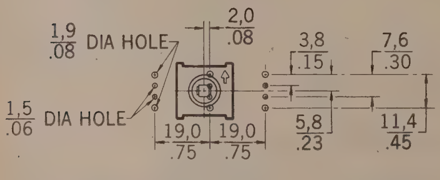
Example: **201SN1A1**
201SN (-) (-) (-)

ACTION	OUTPUT	LAMPS
1 Momentary	**A** Sink Level	**1** Without lamp
2 Alternate	**B** Sink Pulse (not available in alternate action)	**2** With lamp
3 Indicator	**C** Source Level	
4 Momentary-Low Force (For use with two-unit button)	**D** Indicator only (no switch output.)	
5 Support Indicator (For use with two-unit button)		

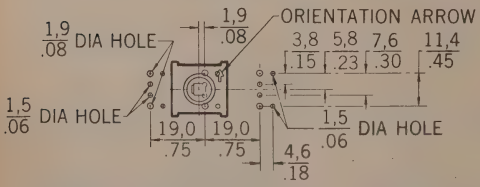
Lamp: T-1 Bi-pin, 5VDC, 0.115 amps, MICRO SWITCH part no. SW-10569. Lamps may also be purchased direct from the manufacturer such as: Chicago Miniature, 4433 N. Ravenswood Avenue, Chicago, Illinois (part no. CM-7-7715); or CIMCO International, Inc., 201 N. Wells Street, Room 1920, Chicago, Illinois (Part no. OL 718BP).

The modules are designed for direct printed circuit board mounting. To simplify installation each module has strips of two-sided tape which hold the module in place during the solder operation. No additional hardware is required to mount the switch.

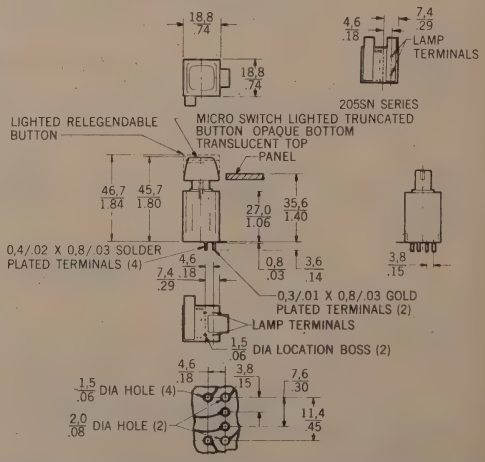
NOTE: 205SN Series without locating boss also available.


1,9 / .08 DIA HOLE
2,0 / .08
3,8 / .15
7,6 / .30
1,5 / .06 DIA HOLE
19,0 / .75
19,0 / .75
5,8 / .23
11,4 / .45

CIRCUIT BOARD DIMENSIONS FOR 101SN SERIES


1,9 / .08 DIA HOLE
1,9 / .08
ORIENTATION ARROW
3,8 / .15
5,8 / .23
7,6 / .30
11,4 / .45
1,5 / .06 DIA HOLE
19,0 / .75
19,0 / .75
1,5 / .06 DIA HOLE
4,6 / .18

CIRCUIT BOARD DIMENSIONS FOR 201SN SERIES


18,8 / .74
18,8 / .74
4,6 / .18
7,4 / .29
LAMP TERMINALS
205SN SERIES
LIGHTED RELEGENDABLE BUTTON
MICRO SWITCH LIGHTED TRUNCATED BUTTON OPAQUE BOTTOM TRANSLUCENT TOP
PANEL
46,7 / 1.84
45,7 / 1.80
27,0 / 1.06
35,6 / 1.40
0,4/.02 X 0,8/.03 SOLDER PLATED TERMINALS (4)
4,6 / .18
7,4 / .29
0,8 / .03
3,6 / .14
3,8 / .15
0,3/.01 X 0,8/.03 GOLD PLATED TERMINALS (2)
LAMP TERMINALS
1,5 / .06 DIA LOCATION BOSS (2)
4,6 / .18
3,8 / .15
7,6 / .30
1,5 / .06 DIA HOLE (4)
11,4 / .45
2,0 / .08 DIA HOLE (2)

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

301SN SERIES TWO-LEVEL MODULES

The 301SN Series switch modules have two levels of output. The first level is pulsed with a pulse duration of 55 microseconds nominal and the second output is level (switch output is on as long as plunger is held depressed to second level). An increase in operating force from 2.8 oz (79g) to 16 oz. (454g) between the two levels prevents accidental actuation of the second level.

The modules are designed for direct printed circuit board mounting and may be used individually or mounted in groups. Standard ¾ inch spacing between modules can be maintained for both block and offset arrays. To simplify installation, each module has strips of two-sided tape which hold the module in place during the solder operation.

The 301SN Series modules may be used for repeat keys when building keyboards from SN Series modules. The operating characteristics are within the parameters established by the office typewriter industry. The first level would be used to generate a normal single coded output; the second level would be used to generate a repeat strobe signal for repeat operation.

301SN SERIES OPERATING CHARACTERISTICS

Total Travel	6,35 mm **0.250 inch nom.**
Force at operating point	Level one: 2.5 oz. (71g) nom. **Level two: 22 oz. (624g) nom.**
Force at start of level two.	16 oz. (454g) nom.
Release point at 5VDC and 75°F (24°C).	Level one: 0.040 in. (1,02 mm) nom. **Level two: 0.100 in. (2,54 mm) nom.**

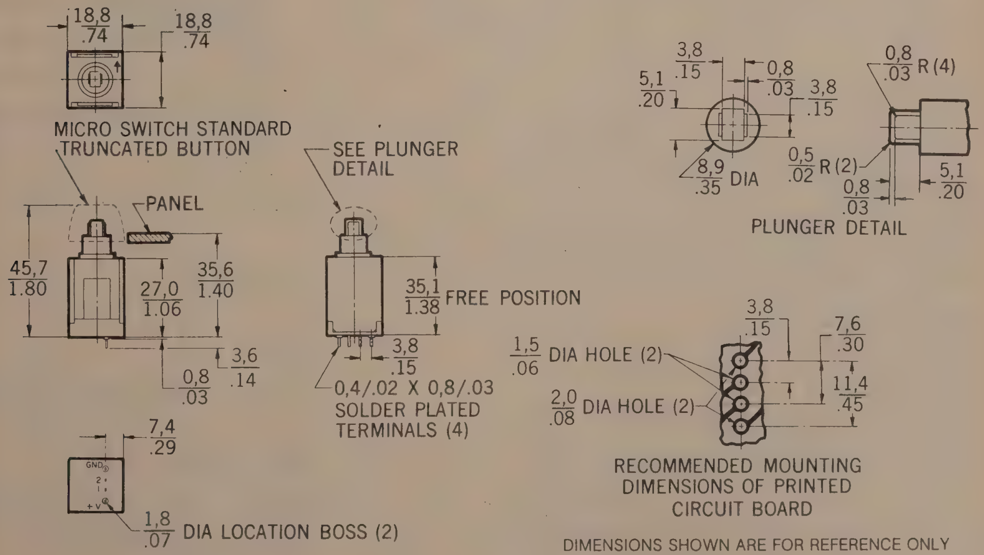
301SN SERIES CATALOG LISTING

301SN1	Sloped button orientation
301SN2	Stepped button orientation

301SN SERIES ELECTRICAL CHARACTERISTICS

POWER REQUIREMENTS	5VDC regulated ± 10%. 17mA standby current.
OUTPUT CAPACITY (LEVEL ONE AND LEVEL TWO)	*Unoperated:* (and operated after pulse duration for level one) 10μA max. collector leakage to ground. *Operated:* 0.4VDC max. (reference to minus supply) sinking 4mA per output (8mA without outputs paralleled). Pulse width: (level one only) 10 to 100μ seconds.
RISE TIME	1.0μ second max. at 4mA per output.
FALL TIME	1.0μ second max. at 4mA per output.

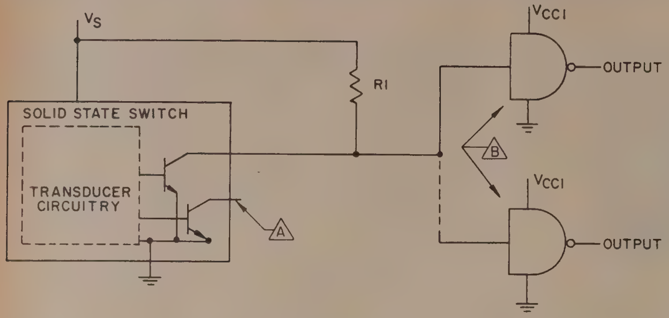
301SN SERIES DIMENSIONS


18,8 / .74
18,8 / .74
MICRO SWITCH STANDARD TRUNCATED BUTTON
PANEL
45,7 / 1.80
27,0 / 1.06
35,6 / 1.40
3,6 / .14
0,8 / .03
7,4 / .29
GND
+V
1,8 / .07 DIA LOCATION BOSS (2)
SEE PLUNGER DETAIL
35,1 / 1.38 FREE POSITION
3,8 / .15
0,4/.02 X 0,8/.03 SOLDER PLATED TERMINALS (4)
3,8 / .15
5,1 / .20
0,8 / .03
3,8 / .15
8,9 / .35 DIA
0,5 / .02 R (2)
0,8 / .03
0,8 / .03 R (4)
5,1 / .20
PLUNGER DETAIL
1,5 / .06 DIA HOLE (2)
2,0 / .08 DIA HOLE (2)
3,8 / .15
7,6 / .30
11,4 / .45
RECOMMENDED MOUNTING DIMENSIONS OF PRINTED CIRCUIT BOARD

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

INTERFACING FOR CURRENT SINKING OUTPUTS



μA: Microamps
mA: Milliamps

△A Same fanout applies to second output. If the outputs are paralleled to double the fanout, one resistor of 5K (R1) can be used.

△B Fanout denotes maximum units switch will directly interface per each isolated switch output.

△C The value of R1 is calculated to meet manufacturers' specifications.

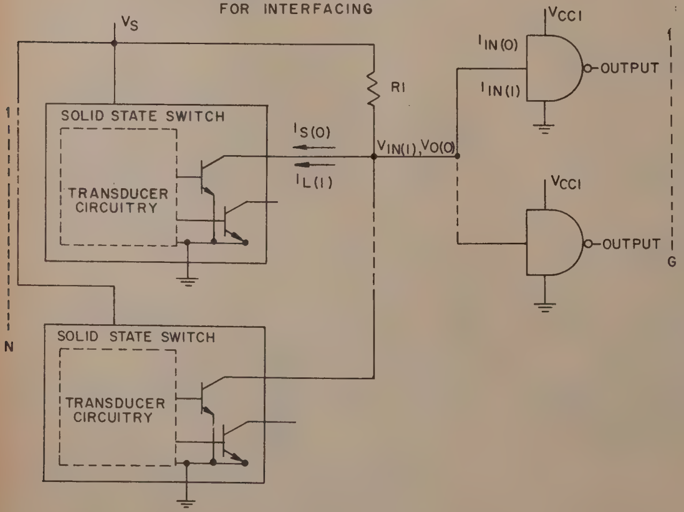
△D Manufacturers' specifications used to calculate R1. See definitions below.

R1 ± 10%
VS — +5.0 ± 0.5 volts
Vcc1 — Logic device supply voltage. Manufacturers' specifications apply.

LOGIC TYPE	VARIATION	SERIES	R1 △C	MAX FANOUT PER OUTPUT	LOGIC "1" △D		LOGIC "O" △D	
					Vin(1)	Iin(1)	Vo(0)	Iin(0)
DTL	Standard	800	10K	2	2.4V.	10μA	0.4V.	1.4 mA
TTL	Low Power	54L/74L	10K	10	2.4V.	10μA	0.4V.	0.18 mA
	Type I	54/74	10K	2	2.4V.	40μA	0.4V.	1.6 mA
	Type II	54H/74H	10K	1	2.4V.	50μA	0.4V.	2.0 mA
	Type III	MC 3000	10K	1	2.4V.	50μA	0.4V.	2.0 mA

GENERAL CALCULATIONS FOR INTERFACING

GENERAL CALACULATIONS FOR INTERFACING



"Logic 1" voltage > "Logic O" voltage (definition).

All of the following parameters should be positive when used in the equations.

N — Number of switch outputs connected. (Can be from same switch and/or different switches)
G — Number of units to be driven.
$V_{in(1)}$ — Minimum input voltage to insure "Logic 1."†*
$V_{O(0)}$ — Maximum output voltage of switch for "Logic O." (.4 volts)†
$I_{in(0)}$ — Maximum input current per unit load at Vo(0).*
$I_{in(1)}$ — Maximum input current per unit load at Vin(1).*
$I_{L(1)}$ — Maximum leakage current per switch output at "Logic 1." (10μ A)
$I_{S(0)}$ — Maximum sink current per switch output at Vo(0). (4.0mA)
VS(m) — Maximum supply voltage to switch.
VS(n) — Minimum supply voltage to switch.

For Logic "1" Conditions:

$$R1 < \frac{V_{s(n)} - V_{in(1)}}{-(N)I_{L(1)} + (G)I_{in(1)}}$$

For Logic "O" Conditions:

$$R1 > \frac{V_{S(m)} - V_{o(0)}}{-(N)I_{S(0)} - (G)I_{in(0)}}$$

Both conditions have to be met. Both limits calculated have to be positive.

†Max and min voltages should have adequate noise margins from switching thresholds.
*Listed in manufacturers' specifications.

SN SERIES BUTTONS non-lighted

MICRO SWITCH offers a wide variety of button sizes, shapes, and colors. We have thousands of legends tooled and the capability of tooling special legends. Check with your nearest MICRO SWITCH Branch Office for the complete button and legend information.

UNIT SIZE	ORDER THIS CATALOG LISTING	ACTIVE MODULE	SUPPORT MODULE
One-Unit	2SW1 Legend 2SW3 Blank	101SN Series 11SN Series (Non-Lighted)	None Required
Two-Unit single level	2SW23—Concave, Left (legend)* 2SW25—Concave, Right (legend)* 2SW27—Concave—Blank 2SW31—Concave—Top (legend) 2SW33—Concave—Bottom (legend)	101SN Series	101SN51 101SN52 101SN53
Three-Unit convex	2SW15—sloped, convex (legend) 2SW17—sloped, blank 2SW59—(vertical legend) **	101SN Series	101SN55 (2) required
Three-Unit concave	2SW19—sloped, horizontal (legend) 2SW21—sloped, blank 2SW35—sloped, (vertical legend) **	101SN Series	101SN55 (2) required
One-Unit square re-legendable Non-lighted	2SW603 ***	101SN Series 11SN Series (Non-Lighted)	None required
Two-Unit relegendable	2SW602 ***	101SN Series	101SN51 101SN52 101SN53

*Left means the active module goes under left side of button. Right means the active module goes under right side of button.

**Active module goes under center of button.

***Legend inserts are not provided unless specified.

COLORS FOR TRUNCATED BUTTONS (non-lighted)

SHELL COLOR	MICRO SWITCH COLOR NUMBER
GRAY (LIGHT)	1
RED	2
GREEN	4
BLUE	5
WHITE	6
BLACK	7
MEDIUM GRAY (MICRO SWITCH STANDARD)	9
LIGHT BROWN	10
OFF-WHITE	11
DK. GRAY	15
BLUE W/GRAY CAST	16
OFF-WHITE (LIGHTER THAN 11)	17
YELLOW	18
MUSTARD-YELLOW	29
BEIGE	23
FROST GRAY (LIGHTER THAN 1)	30
IVORY BEIGE	31
CHARCOAL GRAY	33
CREAM BEIGE	38
DK. OLIVE BROWN	43

We have the largest selection of buttons in the industry. Thousands of legends have been tooled, and we have the in-house capability to tool any special legends you may require. Letters, numbers, symbols, and words are available in English, Greek, Hebrew, Arabic, Russian (Cyrillic), or Japanese (Kana). Contact a MICRO SWITCH Branch Office for information and assistance.

LEGEND	MICRO SWITCH COLOR NUMBER
WHITE (MICRO SWITCH STANDARD)	2
RED	4
GRAY	6
BLACK (MICRO SWITCH STANDARD)	9
BEIGE GRAY	17
OFF-WHITE	18
BROWN	19
BLUE-GRAY	21

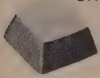
MICRO SWITCH

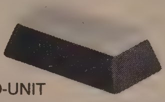
A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES SN TRUNCATED LIGHTED BUTTONS

BUTTON LISTINGS FOR USE WITH 201SN SERIES AND 11SN SERIES LIGHTED MODULES

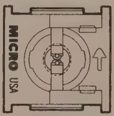
ONE-UNIT





TWO-UNIT

Example: 2SW 701-02-A-T
SW(—) (-)—(-)(-)

STYLE OF BUTTON	COLOR OF OPAQUE BOTTOM	COLOR OF TRANSLUCENT TOP	LEGEND CODE
701 Sloped Button (Legend Perpendicular to Orientation Arrow) 702 Stepped Button (Legend Perpendicular to Orientation Arrow) 703 Sloped Button (Legend Parallel to Orientation Arrow) 705* Two-unit Sloped Button (Legend Perpendicular to Orientation Arrow) 706 Two-unit Stepped Button (Legend Perpendicular to Orientation Arrow) 707 One and one-half unit Sloped Button Legend Perpendicular to Orientation Arrow) 708 One and one-half unit Stepped Button (Legend Perpendicular to Orientation Arrow) 709 Two unit Sloped Vertical Button—Switch Position Bottom (Legend Parallel to Orientation Arrow) 	02 Red 04 Green 05 Blue 06 White 07 Black 09 Gray 10 Lt. Brown 11 Off-White 15 Gray 17 Lt. Off-White 18 Yellow 31 Ivory Beige 33 Charcoal	A White B Yellow C Red D Green E Blue** F Lt. Gray	N None T Top legended***

*Use only with 201 momentary listings, also support module 201SN5D1 or 201SN5D2.
**Not recommended for high ambient light conditions.
***Top Legended — specify legend and legend color: Black White

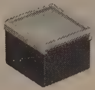
RELEGENDABLE LIGHTED BUTTONS

FOR USE WITH 201SN SERIES AND LIGHTED 11SN SERIES MODULES

Example: 2SW603-2
2SW (—)(-)(-)

BASE COLOR	LENS COLOR	LEGEND CODE
611 Black	A White	L Legended
613 Blue	B Yellow	N Not Legended
	C Red	
	D Green	
	E Blue	

Note: Available in one-unit size only.



RELEGENDABLE LIGHTED BUTTON

NOTE: Available in one unit size only.
Legend Colors: Black or White.
Legend Size: per guidelines for 2-shot molded buttons. found in Section 1 of the Keyboard Button Legends Manual.
Legending: The legend film strip is supplied with the button and slipped between the button cap and lens. Relegending is accomplished by removing the old film strip and replacing it with the new one.

RELEGENDABLE NON-LIGHTED BUTTONS

FOR USE WITH 101SN SERIES, 301SN SERIES, AND 11SN SERIES MODULES

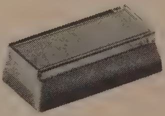
Example: 2SW603-2
2SW (—)-(-)

TYPE	BASE COLOR	
603 1-UNIT	GRAY	— 1
	RED	— 2
	BLUE	— 5
	WHITE	— 6
	BLACK	— 7
	STD. GRAY	— 9
	Lt. BROWN	—10
	OFF-WHITE	—11
	DK. GRAY	—15
	BEIGE	—23

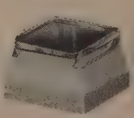
NOTE Legend inserts are not provided unless specified. Legend insert colors are black or white.

Example: 2SW602-2
2SW(—)-(-)

TYPE	BASE COLOR	
602 2-UNIT	GRAY	— 1
	RED	— 2
	BLUE	— 5
	WHITE	— 6
	BLACK	— 7
	STD. GRAY	— 9
	OFF-WHITE	—11
	DK. GRAY	—15



TWO-UNIT



ONE-UNIT

Legend sizes: per guidelines for 2-shot molded buttons found in Section 1 of the Keyboard Button Legends Manual. Contact a MICRO SWITCH Branch Office for more information.

SERIES SD SOLID STATE MODULES A

Build Your Own Low Profile Keyboard

The MICRO SWITCH Series SD module is a low profile solid state keyboard module. The heart of the SD module is the proven MICRO SWITCH Hall Effect integrated circuit. We are using a lower cost, higher reliability integrated circuit packaging technique. The SD module uses a flip-chip, solder bump bonded integrated circuit and ceramic substrate. (A proven IC packaging process). The batch processing aspects of this packaging technique greatly improve the process controllability and cost.

The primary advantages of the SD module are: lower price and profile, with no sacrifice to high quality, reliability and throughput. The SD module has simple construction (see drawing). A height comparison is shown between the original solid state module and the low profile SD module.

The SD module is directly compatible with all common logic families with no special buffering or electronic circuitry needed.

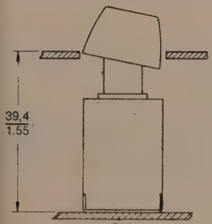
Buttons are available in a wide variety of sizes, shapes, and colors.

SD modules are available with:

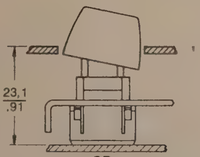
- Level or pulsed outputs
- Sourcing or sinking outputs
- Momentary or alternate action
- Scanning interface
- Led Lighting
- Stepped or sloped buttons

Series SD is panel mounted. The simple metal plate grid mounting will allow you to design your own keyboard array. SD modules snap into the panel cutout shown for fast and easy assembly.

STEPPED BUTTONS SHOWN



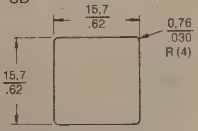
SN



SD

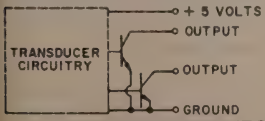
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

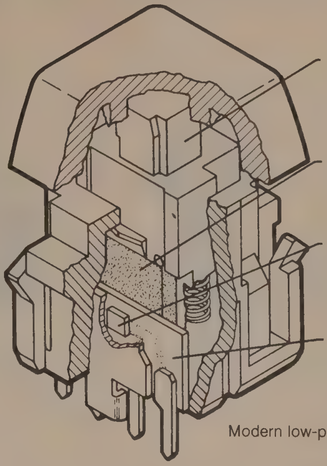
Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$



MOUNTING PLATE CUTOUT

CURRENT SINK LEVEL AND PULSE





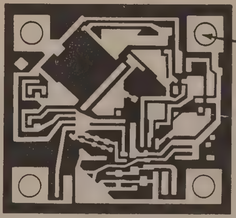
Button plunger, the only moving part is made of extremely durable plastic.

A very stable barium ferrite filled magnet operates the chip

The proven Hall effect chip is the heart of every switch module

A ceramic substrate holds the chip and provides a path for the chip's output

Modern low-profile design.



Tiny solder "bumps" in each corner of the chip, identify MICRO SWITCH's advanced "flip-chip" technology.

Electrical Information

CURRENT SINK LEVEL

POWER REQUIREMENTS	5 volts DC regulated ± 10% 5 milliamps max standby current
OUTPUT CAPACITY	Unoperated: 10 microamps max. collector leakage to ground Operated: 0.4 volts DC max. (referenced to minus supply) sinking 4 milliamps per output (8 milliamps with outputs parallel.
RISE TIME	1.0 microsecond max. @ 4 milliamps per output
FALL TIME	1.0 microsecond max. @ 4 milliamps per output

CURRENT SINK PULSE

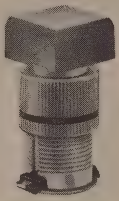
Same as current sink level except:

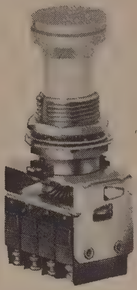
OUTPUT CAPACITY	Unoperated: (and with button depressed after pulse) 10 microamps max. collector leakage to ground Operated: (during pulse) 0.4 volts DC max. referenced to minus supply) sinking 4 milliamps per output (8 milliamps with outputs paralleled) Pulse width:-10 to 100 microseconds

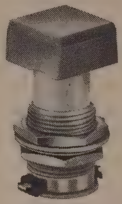
FOR FURTHER INFORMATION CONTACT YOUR LOCAL MICRO SWITCH BRANCH OFFICE.

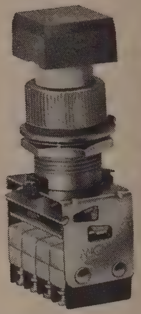
SERIES 1 LIGHTED PUSHBUTTON SWITCHES

TYPE 1B
SWITCH
(sealed)


TYPE 1D
INDICATOR
(sealed)


TYPE 1C
SWITCH
(unsealed)


TYPE 1E
INDICATOR
(unsealed)


TYPE IJ
MIL-S-22885/81
(sealed)

- Bushing Mounting Simplifies Installation
- Panel Seal Option
- Front of Panel Relamping
- Stationary Lamp Socket
- 1-4 SPDT Switch Units
- Round or Square Buttons
- Matching Indicators
- Momentary or Alternate Action
- Precision Switching Reliability
- Solid State Switching Option

Series 1 can be provided with a panel seal between the actuator button and bushing, and bushing and panel to provide a completely panel sealed unit. These seals are not removed during relamping, thus are not subject to damage or loss. Sealing is in accordance with the drip-proof requirements of MIL-S-22885.

RELIABLE, LONG-LIFE OPERATION

Long life mechanical and electrical performance is assured by the rugged Series 1 construction and use of time-proven type SM basic switches. There is a choice of silver or gold contacts, momentary or alternate action, solder or quick connect termination, and up to four-pole double-throw circuitry. Solid state switching can also be furnished.

Military type 1J versions are qualified under MIL-S-22885/81.

These one-lamp pushbuttons have a stationary lamp socket which is part of the bushing assembly. Since the lamp does not move when the button is operated, filament breakage due to a moving lamp is minimized, resulting in an extremely reliable lighted switch.

Relamping can be accomplished quickly and easily by releasing the lamp from its socket detent with a side push on the bulb.

ATTRACTIVE DISPLAY COLORS

Illumination is provided in a well balanced display of five transmitted colors: white, green, yellow, blue and red. They provide an attractive panel display whether lighted or unlighted. Series 1 offers a choice of round or square button design, which can be furnished with hot stamp legending.

Panel installation is quick and easy, since the switch is bushing mounted. Several versions are provided with a keying washer which prevents the unit from being rotated while mounted in the panel.

PERFORMANCE

Series 1 meets or exceeds the following requirements of MIL-S-22885:

Mechanical Life: 150,000 operations

Temperature: −67° to +185°F (−55° to +85°C)

Seal: Meets drip proof, sand, and dust requirements.

PANEL THICKNESS

Series 1 switch/indicators can be mounted in panels up to 6.4 mm/.250 in. thick. Round display devices with bezels fit panels up to 12.7 mm/.50 in. thick.

ORDERING INFORMATION

Use the ordering guides to build up catalog listings for buttons, switch/indicators, indicators, and bezels:

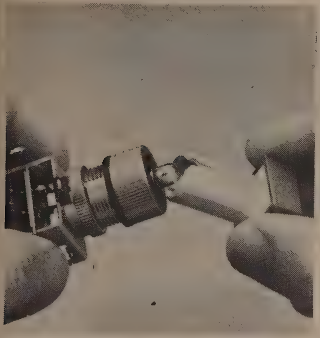
Switch/Indiactors	page A33
Indicators only	page A34
Buttons	page A34
Bezels	page A34

The MIL-S-22885 qualified Series 1 is an exception to the above procedure (page A36). It is ordered as an assembly, i.e., switch/indicator and button.

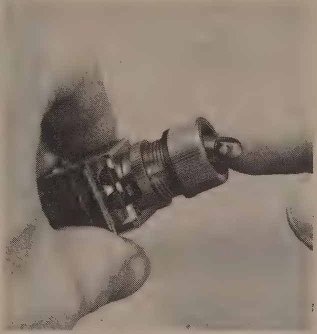
SERIES 1 LIGHTED PUSHBUTTON SWITCHES

FRONT-OF-PANEL RELAMPING

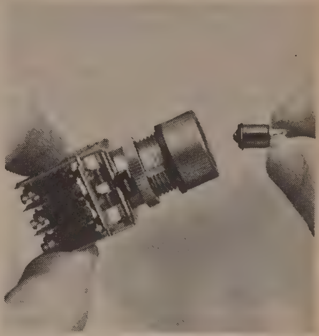
Should a lamp burn out, relamping can be accomplished quickly from the panel front, without tools, as shown below.



1. Remove button from switch with an outward pull.



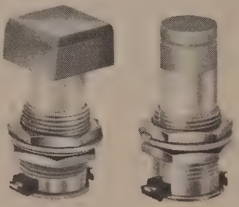
2. Dislodge lamp by pushing it in the direction of the keyway, to disengage it from the socket detent. Remove the lamp.



3. Insert new lamp by pressing it into the socket until it snaps into the socket. Replace the button.

BEZEL ACCESSORY

Aluminum bezels can be provided for use with 5/8-inch diameter round buttons. Button height can be adjusted during installation to be above flush or flush with the bezel. Bezels are available with or without a panel seal; in bright, dull or black finishes.



MATCHING INDICATORS

Indicators are identical to lighted switches in appearance from the panel front, providing a uniform display appearance. Buttons are interchangeable. Indicators have no provision for switching.

BUTTONS

In addition to ¾-inch square buttons, Series 1 offers interchangeable ½, 5/8 and ¾-inch diameter round buttons. Round or square buttons can be used in the same panel display for shape coding of switch functions, or to differentiate between switches and indicators.

From left, above, are two bezel-equipped Series 1 units and the hardware used for mounting, a round display device without a bezel, and a round button.

LEGEND SERVICE

MICRO SWITCH provides hot stamp legending for Series 1 buttons. Legending is applied directly to the front of the button. All buttons are provided with a clear wear-resistant finish for maximum legend durability and to reduce surface glare.

Legend order sheet FO-63157 should be used to specify hot stamp legending from MICRO SWITCH. Buttons may also be hot stamped or engraved by the user.

LAMPS

Series 1 devices can be furnished with flange base T-1¾ incandescent lamps.

LAMP NUMBER	VOLTAGE	CURRENT
327	28 VDC	.040 Amp
328	6 VDC	.200 Amp

MOUNTING DIMENSIONS

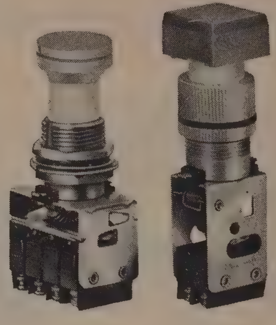
Refer to pages A35 and A36 for Series 1 mounting dimensions and panel cutout information.

SWITCH/INDICATOR ORDERING GUIDES

Select one feature character from each section of the ordering guide to specify the catalog listing that meets your specific needs.

Example: 1B100-2 designates a sealed, 1-pole momentary-action switch with silver contacts and a 28 volt lamp.

Each Series 1 switch/indicator consists of the switching units, bushing and lamp (if requested).



Without Seal With Seal

SNAP-ACTION SWITCHES

Electrical Data

SILVER CONTACTS

5 amps resistive, 3 amps inductive (sea level); 5 amps resistive, 2.5 amps inductive (50,000 feet), 28 VDC., 2.4 amps, lamp load UL listed: 5 amps, 250 VAC.

GOLD CONTACTS

1 amp resistive, 0.5 amp inductive, 30 VDC. UL listed: 1 amp, 125 VAC.

Example:

1B 100 - 2

TYPE
1B Sealed
1C Unsealed
1M For use with 1P Bezels (order bezel separately)

SNAP-ACTION (SM) SWITCHING ELEMENT	
100 Momentary	1-pole silver contacts
118 Alt. Action	
113 Momentary	1-pole gold contacts
174 Alt. Action	
002 Momentary	2-pole silver contacts
026 Alt. Action	
001 Momentary	2-pole gold contacts
025 Alt. Action	
005 Momentary	3-pole silver contacts
101 Alt. Action	
004 Momentary	3-pole gold contacts
028 Alt. Action	
009 Momentary	4-pole silver contacts
033 Alt. Action	
008 Momentary	4-pole gold contacts
032 Alt. Action	

Note: All poles have double-throw circuitry.

LAMPS
-1 6V
-2 28V
(Omit character if no lamp desired)

Note: Mounting hardware for Type 1M is included in the bezel packet.

ORDER BUTTONS FROM CHART ON FACING PAGE.

SOLID STATE SWITCHES

Example:

1F 011 - 2

TYPE
IF Sealed
IG Unsealed

Order buttons from chart on facing page.

SOLID STATE SWITCHING ELEMENT	
011 Momentary	Current Sourcing
012 Momentary	Current Sinking
013 Momentary	Current Sinking ⚠
014 Momentary	Current Sinking Pulse Output

LAMPS
–1 6V
–2 28V
(Omit character if no lamp desired)

⚠ Voltage applied externally to outputs = –0.5 VDC to +15 VDC

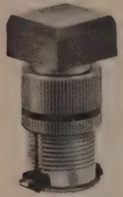
Contact your nearest MICRO SWITCH branch office for further information

OTHER SWITCHING OPTIONS

Possible Series 1 switching variations include power switches which will handle up to 20 amps; and quick-connect, Termi-point, and screw terminals. Refer to the section on Series 2 switch modules which begins on page A49 for examples of switch options that can be provided.

SERIES 1 LIGHTED PUSHBUTTON SWITCHES A

INDICATOR ORDERING GUIDE


With Seal

Without Seal

Matching Series 1 indicators use the same buttons as the lighted switches and provide a uniform panel appearance in a display of mixed indicators and switches. Buttons are ordered as separate items.

Catalog Listing 1D1 has the same knurled seal nut, panel seal, and knurled back-up nut as the type 1B lighted switch.

Catalog Listing 1E1 is not panel sealed and has a pair of hexnuts in place of the knurled nuts. It matches the type 1C lighted switch.

Indicators do not have a provision for switching. Select the desired indicator catalog listing from the chart below:

Example: 1D1-1 is a sealed indicator with a 6 volt lamp.

ORDER BUTTONS SEPARATELY FROM CHART AT RIGHT.

Example:

1D1 -1

INDICATOR TYPE	LAMPS
1D1 Sealed **1E1** Unsealed	**-1** 6V **-2** 28V (Omit character if no lamp desired)

BUTTON ORDERING GUIDE

Select one feature character from each section in the chart below to specify a complete button catalog listing. Example: 1A11G-L is a ¾-inch square green button, with legend. Note button type for use with panel seal and unsealed panel version.

Example:

1A11 G -L

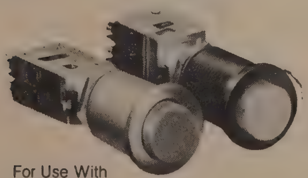
SQUARE BUTTON TYPE	COLOR (Transmitted)	LEGEND*
For use with panel seal devices: **1A11** (¾″ square) For use with unsealed devices: **1A12** (¾″ square)	**R** Red **G** Green **B** Blue **Y** Yellow **W** White	**L** With Legend (Omit if no legend is desired)

ROUND BUTTON TYPE
For use with panel sealed devices: **1A13** (½″ dia.) **1A15** (⅝″ dia.) **1A17** (¾″ dia.) For use with unsealed devices: **1A14** (½″dia.) **1A16** (⅝″ dia.) **1A18** (¾″ dia.)

*Legend Order Sheet, FO-63157 must accompany all orders for legended buttons.

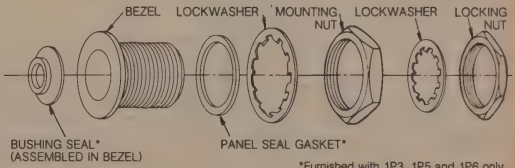
Copies are available from your nearest MICRO SWITCH Branch Office.

BEZEL ORDERING GUIDE


For Use With 5/8" Dia. Buttons

Bezels are furnished in packets which include mounting hardware. They may be specified with or without a panel seal, in a choice of three finishes. Bezels have an external thread for mounting and an internal thread which accepts Type 1M switch/indicators (see mounting dimension drawing on the following page).

BEZEL ASSEMBLY



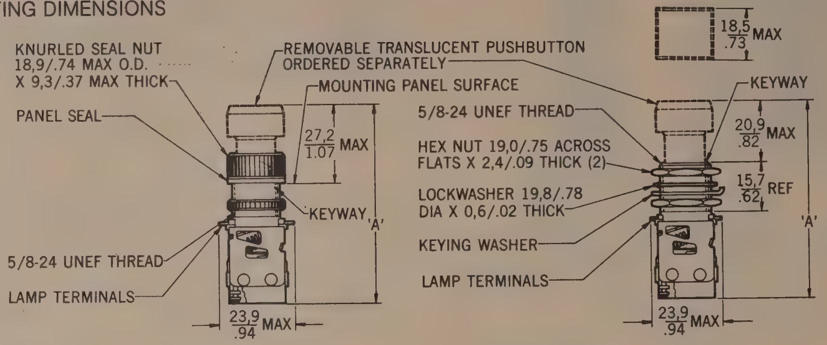
*Furnished with 1P3, 1P5 and 1P6 only.

Button height can be adjusted during installation to be above flush or flush with the bezel.

BEZEL FINISH	CATALOG LISTING	
	SEALED TYPE	UNSEALED TYPE
Bright	1P3	1P10
Dull	1P5	1P9
Black	1P6	1P8

SERIES 1 LIGHTED PUSHBUTTON SWITCHES

MOUNTING DIMENSIONS


KNURLED SEAL NUT 18,9/.74 MAX O.D. X 9,3/.37 MAX THICK
PANEL SEAL
REMOVABLE TRANSLUCENT PUSHBUTTON ORDERED SEPARATELY
MOUNTING PANEL SURFACE
27,2/1.07 MAX
KEYWAY
'A'
5/8-24 UNEF THREAD
LAMP TERMINALS
23,9/.94 MAX
18,5/.73 MAX
KEYWAY
5/8-24 UNEF THREAD
HEX NUT 19,0/.75 ACROSS FLATS X 2,4/.09 THICK (2)
20,9/.82 MAX
15,7/.62 REF
LOCKWASHER 19,8/.78 DIA X 0,6/.02 THICK
KEYING WASHER
LAMP TERMINALS
'A'
23,9/.94 MAX

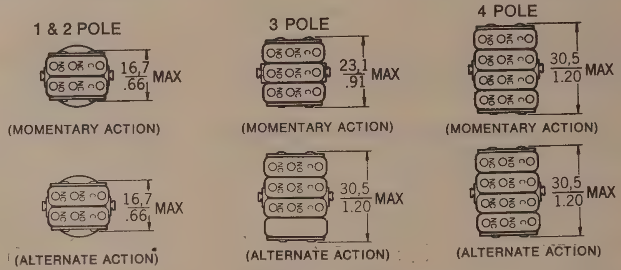
1B SERIES PANEL SEALED ASSEMBLY WITH 1A11 TYPE BUTTON

1C SERIES UNSEALED ASSEMBLY WITH 1A12 TYPE BUTTON

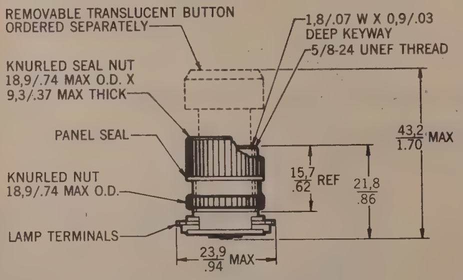
ACTION	DIM. "A" MAX.	
	mm	inches
MOM.	66,3	2,61
ALT.	73,5	2.90

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

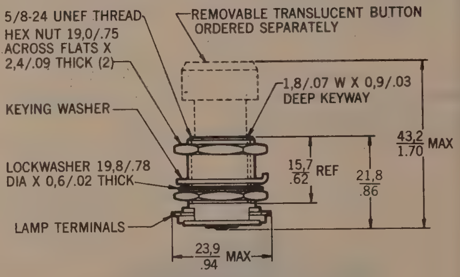
Key: 0,0 – mm / 0.00 – inches


1 & 2 POLE
16,7/.66 MAX
(MOMENTARY ACTION)
16,7/.66 MAX
(ALTERNATE ACTION)
3 POLE
23,1/.91 MAX
(MOMENTARY ACTION)
30,5/1.20 MAX
(ALTERNATE ACTION)
4 POLE
30,5/1.20 MAX
(MOMENTARY ACTION)
30,5/1.20 MAX
(ALTERNATE ACTION)

BOTTOM VIEWS

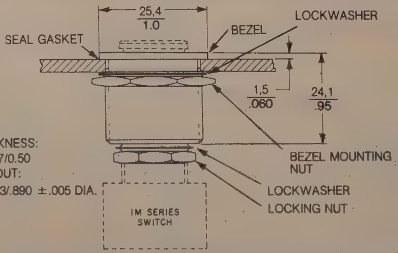

REMOVABLE TRANSLUCENT BUTTON ORDERED SEPARATELY
1,8/.07 W X 0,9/.03 DEEP KEYWAY
5/8-24 UNEF THREAD
KNURLED SEAL NUT 18,9/.74 MAX O.D. X 9,3/.37 MAX THICK
PANEL SEAL
KNURLED NUT 18,9/.74 MAX O.D.
LAMP TERMINALS
43,2/1.70 MAX
15,7/.62 REF
21,8/.86
23,9/.94 MAX

1D1 PANEL SEALED INDICATOR WITH 1A11 TYPE BUTTON


5/8-24 UNEF THREAD
HEX NUT 19,0/.75 ACROSS FLATS X 2,4/.09 THICK (2)
REMOVABLE TRANSLUCENT BUTTON ORDERED SEPARATELY
1,8/.07 W X 0,9/.03 DEEP KEYWAY
KEYING WASHER
LOCKWASHER 19,8/.78 DIA X 0,6/.02 THICK
LAMP TERMINALS
43,2/1.70 MAX
15,7/.62 REF
21,8/.86
23,9/.94 MAX

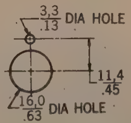
1E1 UNSEALED INDICATOR WITH 1A12 TYPE BUTTON

BEZEL

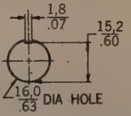

25,4/1.0
SEAL GASKET
BEZEL
LOCKWASHER
1,5/.060
24,1/.95
BEZEL MOUNTING NUT
LOCKWASHER
LOCKING NUT
IM SERIES SWITCH

PANEL THICKNESS:
UP TO 12,7/0.50
PANEL CUTOUT:
22,6 ±0,13/.890 ±.005 DIA.

PANEL CUTOUT


3,3/.13 DIA HOLE
11,4/.45
16,0/.63 DIA HOLE

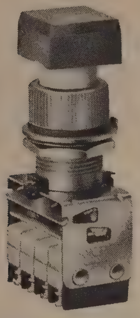
WITH KEYING WASHER


1,8/.07
15,2/.60
16,0/.63 DIA HOLE

WITHOUT KEYING WASHER

MIL-S-22885/81 QUALIFIED PANEL SEALED SWITCH ASSEMBLIES

MIL PART NO.	MICRO SWITCH CATALOG LISTING	BUTTON COLOR	NO. OF POLES	CONTACT ACTION
MIL-S-22885/81-01R	1J001-R	RED	2	Momentary
-01G	1J001-G	GREEN		
-01Y	1J001-Y	YELLOW		
-01B	1J001-B	BLUE		
-01W	1J001-W	WHITE		
-02R	1J002-R	RED	2	Alternate Action (Single level)
-02G	1J002-G	GREEN		
-02Y	1J002-Y	YELLOW		
-02B	1J002-B	BLUE		
-02W	1J002-W	WHITE		
-03R	1J003-R	RED	4	Momentary
-03G	1J003-G	GREEN		
-03Y	1J003-Y	YELLOW		
-03B	1J003-B	BLUE		
-03W	1J003-W	WHITE		
-04R	1J004-R	RED	4	Alternate Action (Single level)
-04G	1J004-G	GREEN		
-04Y	1J004-Y	YELLOW		
-04B	1J004-B	BLUE		
-04W	1J004-W	WHITE		



TYPE 1J
4-POLE ASSEMBLY
• (Also available with 2 poles)

MIL-S-22885 switch assemblies consist of the switch unit, bushing, mounting hardware, and button. They may be ordered from the chart above. Lamps are ordered as separate items.

Type 1J devices are furnished with the ¾-inch square button assembled to the bushing.

ELECTRICAL DATA

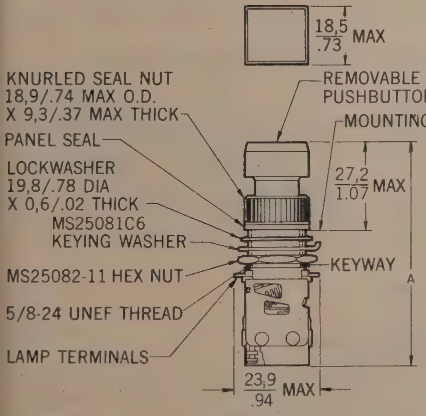
5 amps resistive, 3 amps inductive (sea level); 5 amps resistive, 2.5 amps inductive (50,000 feet), 28 VDC., 2.4 amps, lamp load.
UL listed: 5 amps, 250 VAC.

LAMP DATA

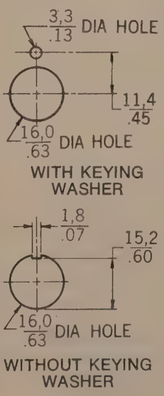
Lamps are not furnished with MIL-S-22885/81 switches. However, T-1-¾ incandescent lamps with a flange base may be ordered as separate items from MICRO SWITCH, as shown in the chart below.

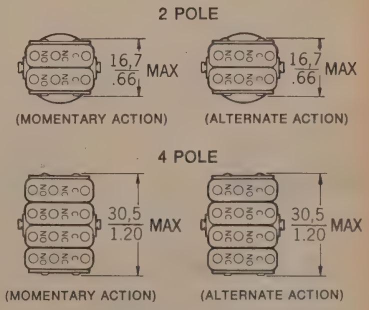
Users having lamp contracts may prefer to purchase larger quantities by that means.

MICRO SWITCH Catalog Listing	LAMP NO.	VOLTS	AMPS
2E5	328	6	.200
2E3	330	14	.080
2E1	327	28	.040


18,5
.73
MAX
KNURLED SEAL NUT
18,9/.74 MAX O.D.
X 9,3/.37 MAX THICK
REMOVABLE TRANSLUCENT
PUSHBUTTON ORDERED SEPARATELY
MOUNTING PANEL SURFACE
PANEL SEAL
LOCKWASHER
19,8/.78 DIA
X 0,6/.02 THICK
MS25081C6
KEYING WASHER
27,2
1.07
MAX
KEYWAY
MS25082-11 HEX NUT
A
5/8-24 UNEF THREAD
LAMP TERMINALS
23,9
.94
MAX

ACTION	DIM. "A" MAX.	
	MM	INCHES
MOM.	66,3	2.61
ATL.	73,5	2.90


3,3
.13
DIA HOLE
11,4
.45
16,0
.63
DIA HOLE
WITH KEYING WASHER
1,8
.07
15,2
.60
16,0
.63
DIA HOLE
WITHOUT KEYING WASHER


2 POLE
16,7
.66
MAX
(MOMENTARY ACTION)
16,7
.66
MAX
(ALTERNATE ACTION)
4 POLE
30,5
1.20
MAX
(MOMENTARY ACTION)
30,5
1.20
MAX
(ALTERNATE ACTION)

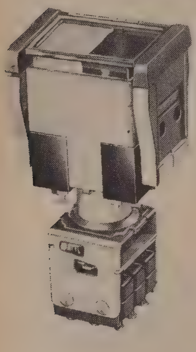
BOTTOM VIEWS

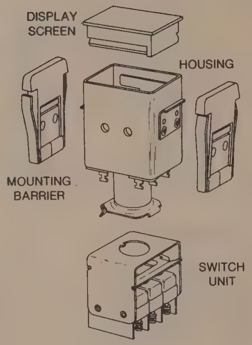
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

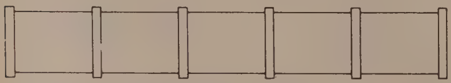
SERIES 2 RECTANGULAR DISPLAY MODULAR LIGHTED

- Up to Four-Lamp Indication
- Choice of 1, 2, 3 or 4-Section Display Screens
- Barrier Mount
- Modules Assemble Easily, Without Special Tools
- Thousands of Color Display and Circuit Control Combinations
- Flange Mount

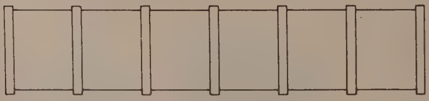




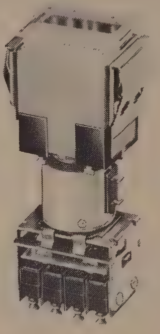
Barriers serve as mounting devices and separate the display screens to prevent accidental operation. The desired number of units are combined in a strip and snapped into the panel slot.

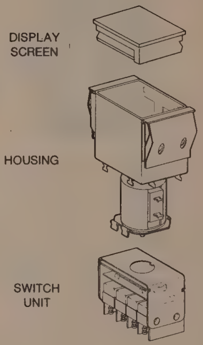


BARRIERS ON SHORT SIDES

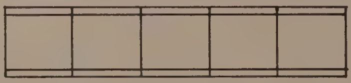


BARRIERS ON LONG SIDES

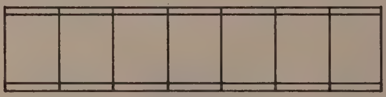




Flange mounted units are supplied with the mounting devices ready-attached. They can be individually installed or replaced, and permit an overlay panel. Optional spacing barriers can be used to separate groupings.



FLANGES ON LONG SIDES



FLANGES ON SHORT SIDES

HOW TO ORDER

Each Series 2 module has its own catalog listing and is ordered as a separate item.

Barrier Mount Modules:

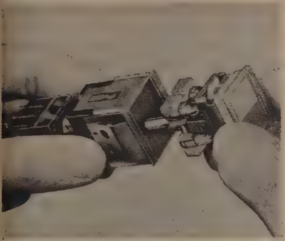
HOUSINGS	Page
Operator-Indicators, Type 2C & 2C200	A39
Indicators Only, Type 2F & 2F200	A40
DISPLAY SCREENS, Type 2A	A43,44
LAMPS, Type 2E	A48
LAMP TOOL, 15PA32 (required for 2C and 2F housings only)	A37
SWITCH UNITS, Type 2D	A49-52
MOUNTING BARRIERS, Type 2B	A40
SWITCH GUARD, 2H20 (optional)	A38

Flange Mount Modules:

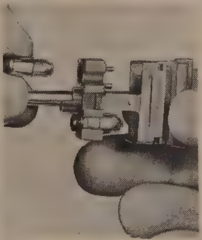
HOUSINGS	Page
Operator-Indicators, Type 2C & 2C200	A41
Indicators only, Type 2F & 2F200	A42
DISPLAY SCREENS, Type 2A	A43,44
LAMPS, Type 2E	A48
LAMP TOOL, 15PA32 (required for 2C & 2F housings only)	A37
SWITCH UNITS, Type 2D	A49-52
RFI SHIELD	A44
SWITCH GUARD, 2H20 (optional)	A44
PANEL SEAL, 2H11 (optional)	A38
SPACING BARRIERS (optional)	A42
MIL-S-22885 ASSEMBLIES, Type 2W	A53,54

SERIES 2 PUSHBUTTON SWITCHES AND INDICATORS A

FRONT OF PANEL RELAMPING



1.



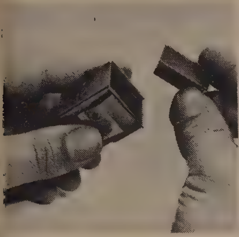
2.

TYPE 2C200 AND 2F200 HOUSINGS ARE RELAMPED WITHOUT TOOLS

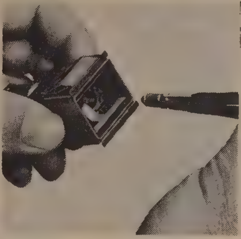
Type 2C200 (operator-indicator) and 2F200 (indicator only) housings have a separate lampholder assembly that can be removed to enable replacement of lamps or filters, without tools. The unit is keyed to maintain proper orientation.

1. Remove display screen/lampholder assembly.
2. Relamp and replace assembly.

LAMPS: T-1-3/4 flange base lamps only.



1.



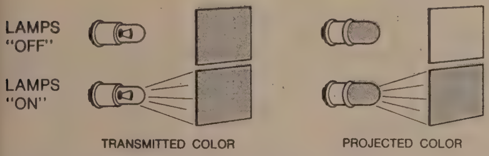
2.

USE LAMP TOOL WITH TYPE 2C AND 2F HOUSINGS

To easily remove and replace lamps or color filters from Type 2C (operator-indicator) or 2F (indicator only) housings, a Catalog Listing 15PA32 lamp tool is inserted into the socket until it bottoms against the lamp base flange. The glass bulb portion of the lamp is gripped, when installing.

1. Remove display screen.
2. Relamp with 15PA32 tool and replace screen.

LAMPS: T-1-3/4 grooved base lamps are recommended.



DISPLAY COLOR OPTIONS

Transmitted color refers to the use of clear lamps and colored buttons in applications which require the color to be distinguished when the display is unlighted.

Projected color is a technique that uses white buttons and colored filters over the clear lamps. When the lamps are lighted, the white translucent button takes on the color projected by the filters.

MODULES ASSEMBLE EASILY, WITHOUT SPECIAL TOOLS

All modules are ordered as separate items which snap together for easy assembly. Switch modules are shown here being attached to spring clips on the bottom of operator-indicator housing.

COIL EQUIPPED UNITS FOR REMOTE OPERATION

Housings with integral hold-in coils enable maintained and remote released contacts. Pull-in coils (available as flange mount only), in addition, provide remote actuation.

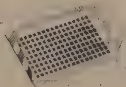
COLOR FILTERS

Filters used with Type 2C and 2F housings are fitted over the lamp bulb, while those used with Type 2C200 and 2F200 housings are slipped over the lamp sockets.

	Catalog Listings					
Filter Style	Red	Yellow	Green	Blue	Amber	White*
For Type 2C and 2F Housings	2G5	2G6	2G7	2G8	2G10	2G11
For Type 2C200 and 2F200 Housings	2G12	2G13	2G14	2G15	2G16	2G17

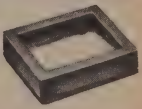
*Has blue tint to compensate for high yellow content of incandescent lamps at low voltages.

RFI SHIELD



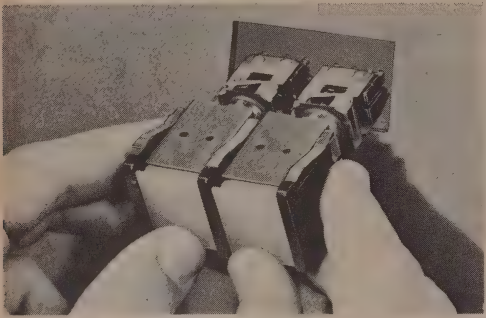
An accessory Radio Frequency Interference shield is available for use with flange mount Type 2C200 and 2F200 housings only. It consists of a metal grid which is installed under the display screen and grounded to the housing. Catalog Listing 2H18 fits one-section screens, while the 2H19 is for 2, 3 and 4-section screens.

PANEL SEAL



Catalog Listing 2H11 (for flange mount only protects the pushbutton and behind panel components from contamination by moisture and dirt entering through the panel cutout. It consists of a gray snap-on cover with transparent elastomer seal and a gray base with an adhesive seal for bonding to the panel.

SERIES 2 BARRIER MOUNT MODULES



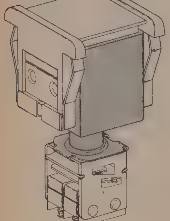
Barrier Mount

Type 2C, 2F, 2C200 and 2F200 barrier mount assemblies are identical in panel appearance. However, the Type 2C200 and Type 2F200 housings have different internal construction to enable relamping without tools. Housings are available for long or short barrier mounting, with two or four lamp sockets, and in indicator and operator-indicator designs (with or without integral d-c hold-in coils). Socket terminal locations are identified, as shown in the dimension drawings.

Lampholder Assemblies

Lampholder assemblies are furnished with 2C200 and 2F200 housings. Lampholders may also be ordered separately for replacement by specifying the following catalog listings: for operator-indicators—15PA203 (4-lamp type) and 15PA204 (2-lamp type); for coil-equipped operator-indicators—15PA207 (2-lamp type) and 15PA2001 (4-lamp type); for indicators only—15PA205 (4-lamp type) and 15PA206 (2-lamp type).

Operator-Indicator Housing Modules



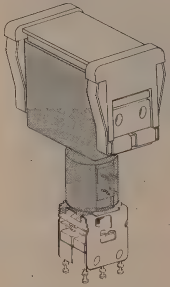
HOUSINGS THAT USE LONG BARRIERS

These housings are assembled to panels with mounting barriers attached to the longer sides.

Switch modules shown on pages A49-A52.

Catalog Listings

Long Barrier Operator-Indicator Housing Type	No. of Sockets	Type 2C	Type 2C200
No Coil	2 (A & C)	2C7	2C207
	4 (A, B, C, & D)	2C9	2C209
6 vdc Hold-in Coil	2 (A & C)	2C19	2C219
	4 (A, B, C, & D)	2C21	2C221
28 vdc Hold-in Coil	2 (A & C)	2C31	2C231
	4 (A, B, C, & D)	2C33	2C233
48 vdc Hold-in Coil	2 (A & C)	2C43	2C243
	4 (A, B, C, & D)	2C45	2C245



HOUSINGS THAT USE SHORT BARRIERS

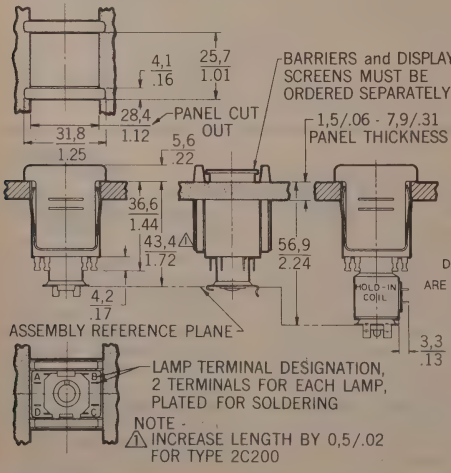
These housings are assembled to panels with mounting barriers attached to the shorter sides.

Switch modules shown on pages A49-A52.

Catalog Listings

Short Barrier Operator-Indicator Housing Type	No. of Sockets	Type 2C	Type 2C200
No Coil	2 (A & C)	2C1	2C201
	4 (A, B, C, & D)	2C3	2C203
6 vdc Hold-in Coil	2 (A & C)	2C13	2C213
	4 (A, B, C, & D)	2C19	2C215
28 vdc Hold-in Coil	2 (A & C)	2C25	2C225
	4 (A, B, C, & D)	2C27	2C227
48 vdc Hold-in Coil	2 (A & C)	2C37	2C237
	4 (A, B, C, & D)	2C39	2C239

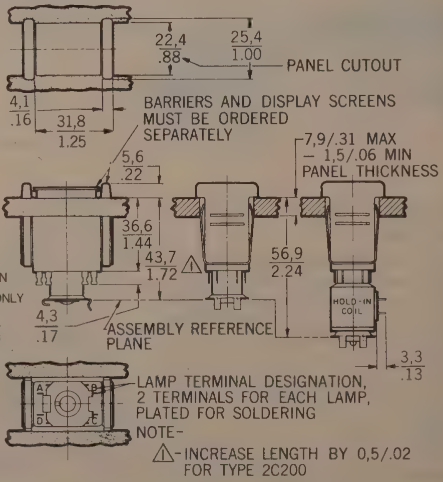
LONG BARRIER
OPERATOR-INDICATORS


4,1
.16
25,7
1.01
BARRIERS and DISPLAY SCREENS MUST BE ORDERED SEPARATELY
28,4
1.12
PANEL CUT OUT
31,8
1.25
5,6
.22
1,5/.06 - 7,9/.31
PANEL THICKNESS
36,6
1.44
43,4
1.72
56,9
2.24
4,2
.17
HOLD-IN COIL
ASSEMBLY REFERENCE PLANE
3,3
.13
A
B
C
D
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP, PLATED FOR SOLDERING

NOTE -
⚠ INCREASE LENGTH BY 0,5/.02 FOR TYPE 2C200

DIMENSIONS SHOWN
ARE FOR REFERENCE ONLY
Key: 0,0 — mm / 0.00 — inches

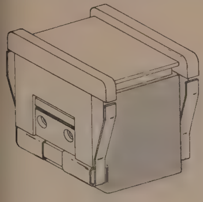
SHORT BARRIER
OPERATOR-INDICATORS


22,4
.88
25,4
1.00
PANEL CUTOUT
4,1
.16
31,8
1.25
BARRIERS AND DISPLAY SCREENS MUST BE ORDERED SEPARATELY
7,9/.31 MAX
— 1,5/.06 MIN
PANEL THICKNESS
5,6
.22
36,6
1.44
43,7
1.72
56,9
2.24
HOLD-IN COIL
4,3
.17
ASSEMBLY REFERENCE PLANE
3,3
.13
A
B
C
D
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP, PLATED FOR SOLDERING

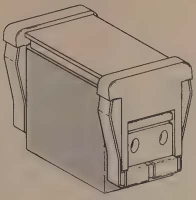
NOTE-
⚠- INCREASE LENGTH BY 0,5/.02 FOR TYPE 2C200

SERIES 2 PUSHBUTTON SWITCHES AND INDICATORS

INDICATOR HOUSING MODULES



Long Barrier



Short Barrier

Indicators match their respective operator-indicator counterparts in panel appearance, but have no provision for attaching switch units. They utilize the same barriers for panel mounting.

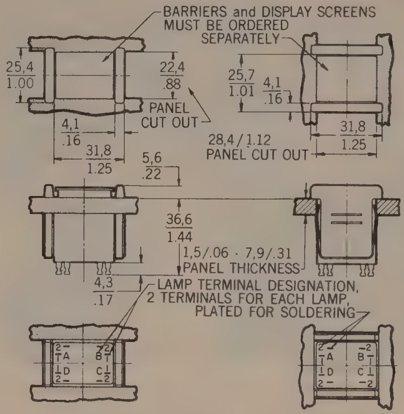
Catalog Listings

Barrier Mount Indicator Housing Type	No. of Sockets	Type 2F	Type 2F200
Long	2 (A & C)	2F7	2F207
	4 (A, B, C & D)	2F9	2F209
Short	2 (A & C)	2F1	2F201
	4 (A, B, C & D)	2F3	2F203

INDICATORS

SHORT BARRIER

LONG BARRIER


BARRIERS and DISPLAY SCREENS MUST BE ORDERED SEPARATELY
25,4
1.00
22,4
.88
PANEL CUT OUT
25,7
1.01
4,1
.16
4,1
.16
31,8
1.25
5,6
.22
28,4/1.12
PANEL CUT OUT
31,8
1.25
36,6
1.44
1,5/.06 - 7,9/.31
PANEL THICKNESS
4,3
.17
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP, PLATED FOR SOLDERING
A
B
C
D
2
1

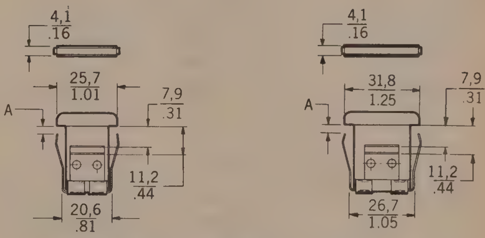
MOUNTING BARRIERS

Molded color barriers are available in two panel thickness ranges (.19" panels require the .06" to .19" type). For strip-mounted units, specify one more barrier than the number of units in the group.

Catalog Listings

Mounting Barriers	For Panel Thickness	Gray	Black	White	Red
Attach to Long Sides	.06" to .19"	2B2	2B4	2B14	2B15
	.19" to .31"	2B6	2B8	2B16	2B18
Attach to Short Sides	.06" to .19"	2B1	2B3	2B10	2B11
	.19" to .31"	2B5	2B7	2B12	2B13

A	PANEL THICKNESS
1,5/.06 4,6/.18	1,5-4,8/.06-.19 4,8-7,9/.19-.31


4,1
.16
25,7
1.01
7,9
.31
A
11,2
.44
20,6
.81
4,1
.16
31,8
1.25
7,9
.31
A
11,2
.44
26,7
1.05

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 = \text{mm}}{0.00 = \text{inches}}$

LENGTH OF PANEL CUTOUT*

Type of Indicator or Operator-Indicator	Number of Units													
	1		2		3		4		5		6		7	
	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
Short Barrier	36,09	1.421	68,00	2.677	99,87	3.992	131,72	5.186	163,60	6.441	195,48	7.696	227,36	8.951
Long Barrier	30,00	1.181	55,78	2.196	81,58	3.212	106,34	4.226	133,12	5.241	159,90	6.256	184,68	7 271

*Nominal dimensions, tolerance ± 0,25 mm/.010 in. (In 5% of the cases, the cutout will be undersized for the build-up of assembled units and will require enlargement).

HOLD-IN COIL ELECTRICAL DATA

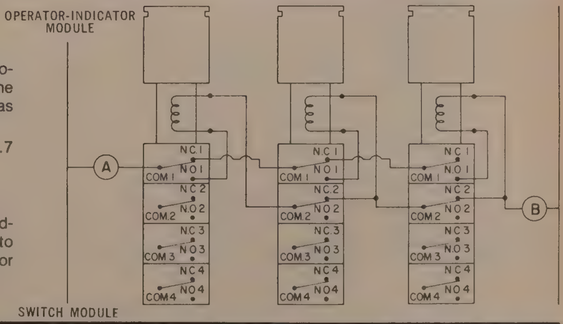
(also available in Flange mount.)

Hold-in coil equipped operator-indicator housings enable electromagnetic maintained and released contact. When energized, the coil holds the device in the operated condition, after the screen has been manually depressed.

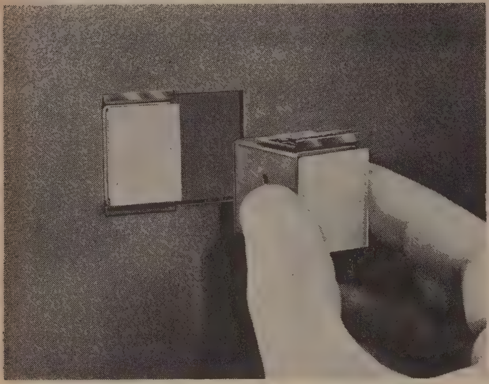
Approximate coil power ratings are 1.3 watts, 6 vdc coil and 1.7 watts, 28 or 48 vdc coil.

ELECTRICAL BAIL

The circuit at right shows a means of operating any number of hold-in coil units, one-by-one, in situations that require only one switch to be operated at a time. A cancel switch can be installed at either or both points "A" and "B" to perform clearing of all switches.


OPERATOR-INDICATOR MODULE
A
B
NC 1
NO 1
COM 1
NC 2
NO 2
COM 2
NC 3
NO 3
COM 3
NC 4
NO 4
COM 4
SWITCH MODULE

SERIES 2 FLANGE MOUNT MODULES



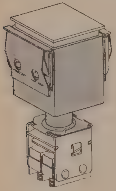
Flange Mount

Type 2C, 2F, 2C200 and 2F200 flange mount assemblies are identical in panel appearance. However, the Type 2C200 and 2F200 housings have provision for manual relamping, without tools. Housings are supplied with long or short mounting flanges, two or four lamp sockets, and in indicator and operator-indicator designs (with or without integral d-c hold-in or pull-in coils). A panel seal accessory is available.

Lampholder Assemblies

Lampholder assemblies are furnished with 2C200 and 2F200 housings. Lampholders may also be ordered separately for replacement by specifying the following catalog listings: for operator-indicators—15PA203 (4-lamp type) and 15PA204 (2-lamp type); for coil-equipped operator-indicators—15PA207 (2-lamp type) and 15PA2001 (4-lamp type); for indicators only—15PA205 (4-lamp type) and 15PA206 (2-lamp type).

Operator-Indicator Housing Modules



HOUSINGS WITH FLANGES ON LONG SIDES

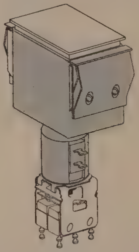
These housings have spring clip mounting devices ready-attached on the longer sides.

Switch modules shown on pages A49-A52.

Catalog Listings

Long Flange Operator-Indicator Housing Type	No. of Sockets	Type 2C	Type 2C200
No Coil	2 (A & C)	2C4	2C204
	4 (A, B, C, & D)	2C6	2C206
6 vdc Coil (Hold-in)	2 (A & C)	2C16	2C216
	4 (A, B, C & D)	2C18	2C218
28 vdc Coil (Hold-in)	2 (A & C)	2C28	2C228
	4 (A, B, C, & D)	2C30	2C230
48 vdc Coil (Hold-in)	2 (A & C)	2C40	2C240
	4 (A, B, C, & D)	2C42	2C242
28 vdc Coil* (Pull-in)	4 (A, B, C & D)	2C68	2C268

*Also available with flanges on all four sides—2C77 (Type 2C) and 2C277 (Type 2C200)



HOUSINGS WITH FLANGES ON SHORT SIDES

These housings have spring mounting clips ready-attached to the shorter sides.

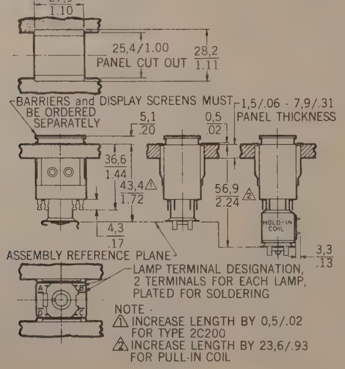
Switch modules shown on pages A49-A52.

Catalog Listings

Short Flange Operator-Indicator Housing Type	No. of Sockets	Type 2C	Type 2C200
No Coil	2 (A & C)	2C10	2C210
	4 (A, B, C, & D)	2C12	2C212
6 vdc Coil (Hold-in)	2 (A & C)	2C22	2C222
	4 B, C, & D)	2C24	2C224
28 vdc Coil (Hold-in)	2 (A & C)	2C34	2C234
	4 (A, B, C, & D)	2C36	2C236
48 vdc Coil (Hold-in)	2 (A & C)	2C46	2C246
	4 (A, B, C, & D)	2C48	2C248
28 vdc Coil* (Pull-in)	4 (A, B, C, & D)	2C69	2C269

*Also available with flanges on all four sides—2C77 (Type 2C) and 2C277 (Type 2C200)

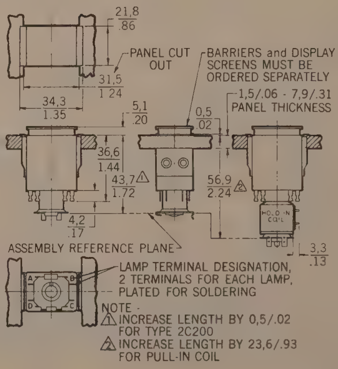
LONG FLANGE
OPERATOR-INDICATOR


27,9
1.10
25,4/1.00
PANEL CUT OUT
28,2
1.11
BARRIERS and DISPLAY SCREENS MUST BE ORDERED SEPARATELY
1,5/.06 - 7,9/.31
PANEL THICKNESS
5,1
.20
0,5
.02
36,6
1.44
43,4
1.72
56,9
2.24
HOLD-IN COIL
4,3
.17
3,3
.13
ASSEMBLY REFERENCE PLANE
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP, PLATED FOR SOLDERING
A
B
C
D
NOTE -
1 INCREASE LENGTH BY 0,5/.02 FOR TYPE 2C200
2 INCREASE LENGTH BY 23,6/.93 FOR PULL-IN COIL

DIMENSIONS SHOWN
ARE FOR REFERENCE ONLY

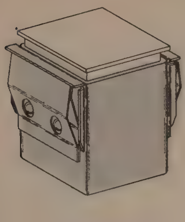
Key: 0,0 — mm / 0.00 — inches

SHORT FLANGE
OPERATOR-INDICATORS

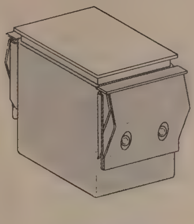

21,8
.86
PANEL CUT OUT
BARRIERS and DISPLAY SCREENS MUST BE ORDERED SEPARATELY
31,5
1.24
34,3
1.35
5,1
.20
0,5
.02
1,5/.06 - 7,9/.31
PANEL THICKNESS
36,6
1.44
43,7
1.72
56,9
2.24
HOLD-IN COIL
4,2
.17
3,3
.13
ASSEMBLY REFERENCE PLANE
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP, PLATED FOR SOLDERING
A
B
C
D
NOTE -
1 INCREASE LENGTH BY 0,5/.02 FOR TYPE 2C200
2 INCREASE LENGTH BY 23,6/.93 FOR PULL-IN COIL

SERIES 2 PUSHBUTTON SWITCHES AND INDICATORS A

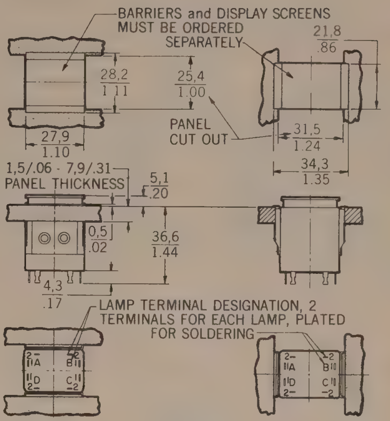
INDICATOR HOUSINGS



Long Flange



Short Flange


BARRIERS and DISPLAY SCREENS MUST BE ORDERED SEPARATELY
21,8 / .86
28,2 / 1.11
25,4 / 1.00
PANEL CUT OUT
31,5 / 1.24
34,3 / 1.35
27,9 / 1.10
1,5/.06 - 7,9/.31 PANEL THICKNESS
5,1 / .20
0,5 / .02
36,6 / 1.44
4,3 / .17
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP, PLATED FOR SOLDERING
2– IIA
B II –2
IID 2–
C II –2

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

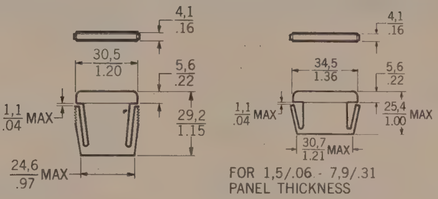
Key: 0,0 — mm / 0.00 — inches

Catalog Listings

Flange Mount Indicator Housing Type	No. of Sockets	Type 2C	Type 2C200
Long Flange	2 (A & C)	2F4	2F204
	4 (A, B, C, & D)	2F6	2F206
Short Flange	2 (A & C)	2F10	2F210
	4 (A, B, C, & D)	2F12	2F212

SPACING BARRIERS

Spacing barriers, not necessary for mounting, can be used to color code groupings and prevent accidental actuation of two screens with one push.


4,1 / .16
30,5 / 1.20
5,6 / .22
1,1 / .04 MAX
29,2 / 1.15
24,6 / .97 MAX
4,1 / .16
34,5 / 1.36
5,6 / .22
1,1 / .04 MAX
25,4 / 1.00 MAX
30,7 / 1.21 MAX
FOR 1,5/.06 - 7,9/.31 PANEL THICKNESS

Catalog Listings

Spacing Barriers	Gray	Black	White	Red
For Long Flange Housing	2B9	2B18	2B19	—
For Short Flange Housing	2F23	2B24	2B25	2B26

LENGTH OF PANEL CUTOUT*

Type of Indicator or Operator-Indicator	Number of Units													
	1		2		3		4		5		6		7	
	mm	in	mm	in	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
Short Flange**	21,87	.860	43,56	1.715	62,73	2.570	86,97	3.424	108,69	4.279	130,40	5.134	152,10	5.988
Long Flange**	27,94	1.1	55,75	2.195	83,57	3.290	111,36	4.384	139,17	5.479	166,98	6.574	194,77	7.668

*Nominal dimensions, tolerance ± 0,25mm/.010 in. (In 5% of the cases, the cutout will be undersized for the build-up of assembled units and will require enlargement.)

**Add 4,19mm/.165 in. to length for each optional spacing barrier used with flange mount units.

PULL-IN COIL ELECTRICAL DATA

(available in Flange mount only)

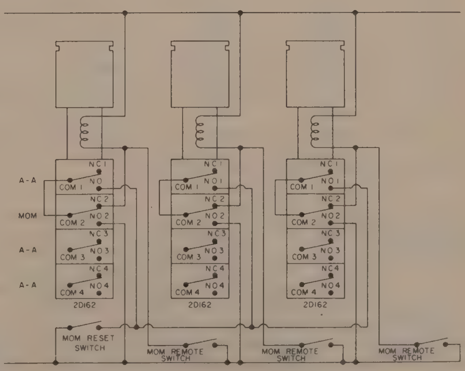
Pull-in coil equipped operator-indicators enable electromagnetic actuated, maintained and released contacts. Energizing the coil pulls in the operating plunger, causing circuit transfer in the switching unit. A 28 vdc, 2.2 amps. (approx) is required during actuation (for about 20 ms or less) and only .11 amp. (approx) during hold-in. (Recommended for operation at 85 to 100% of rated voltage.)

Switch units that can be used are "TB", "PL" and all "SM" types except low force and 4-pole alternate-action designs. Maximum ambient temperature limits are 120°F (48.9°C) (1 or 2 pole momentary-action), 110°F (48.9°C) (3-pole momentary-action), 100°F (37.8°C) (4-pole momentary-action) and 90°F (32.2°C) (all alternate-action or momentary/alternate-action) switch units.

Note: A 4-pole momentary switch such as a 2D9 requries 28 volts for proper actuation.

ELECTRICAL BAIL

The circuit at right shows how any number of Catalog Listing 2D162 can be operated in one-by-one sequence. Each actuation releases previously actuated switch. Power is required only during the reset pulse. (Reset can also be accomplished by depressing previously actuated screen.)

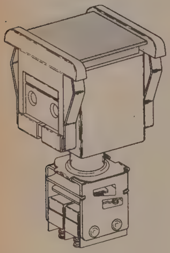

A-A
MOM
A-A
A-A
NC 1
NO 1
COM 1
NC 2
NO 2
COM 2
NC 3
NO 3
COM 3
NC 4
NO 4
COM 4
2D162
2D162
2D162
MOM RESET SWITCH
MOM REMOTE SWITCH
MOM REMOTE SWITCH
MOM REMOTE SWITCH

Note: Specify 2C200 type only, if 2H20 switch guard is used.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES 2 DISPLAY SCREENS

ONE-PIECE DISPLAY SCREENS



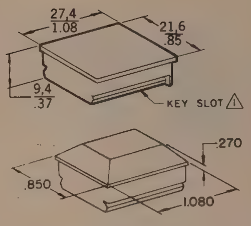
Single Section

One-piece single-section display screens are available in two styles—standard (translucent) and truncated pyramid (translucent or transparent).

Catalog Listings

Color	Standard	Truncated Pyramid	
		Transparent	Translucent
Red	2A1	2A97	2A92
Yellow	2A2	2A98	2A93
Green	2A3	2A99	2A94
Blue	2A4	2A100	2A95
White	2A5	2A96*	2A91
Amber	Not Available	2A113	2A112

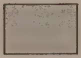
*Colorless transparent


27,4
1.08
21,6
.85
9,4
.37
KEY SLOT ⚠
.270
.850
1.080

⚠KEY SLOT FACES SIDE OF HOUSING SHOWING CATALOG LISTING (ABOVE LAMP TERMINALS "A" AND "B")

THREE-PIECE DISPLAY SCREENS

Single Section



These screens have transparent colored or colorless caps, transparent colorless legend inserts and translucent colored bases.

Catalog Listings

Color	Colored Caps	Colorless Caps
Red	2A66	2A81
Yellow	2A67	2A82
Green	2A68	2A85
Blue	2A69	2A86
White	—	2A70
Amber	—	2A114

Two Section

LATERAL SPLIT

LONGITUDINAL SPLIT

Silicone rubber light baffles prevent spillage from one section to another. Bases are translucent colored with transparent colorless caps and inserts.

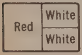
Catalog Listings

Colors	Lateral Split	Longitudinal Split
Yellow-Yellow	2A44	2A59
Green-Blue	2A45	2A60
Green-White	2A46	2A61
Green-Green	2A47	2A62
Blue-White	2A48	2A63
Blue-Blue	2A49	2A64
White-White	2A50	2A65

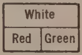
Catalog Listings

Colors	Lateral Split	Longitudinal Split
Red-Red	2A36	2A51
Red-Yellow	2A37	2A52
Red-Green	2A38	2A53
Red-Blue	2A39	2A54
Red-White	2A40	2A55
Yellow-Green	2A41	2A56
Yellow-Blue	2A42	2A57
Yellow-White	2A43	2A58

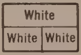
THREE AND FOUR SECTION


Red
White
White

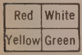
2A218


White
Red
Green

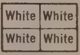
2A170


White
White
White

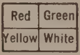
2A171


Red
White
Yellow
Green

2A172

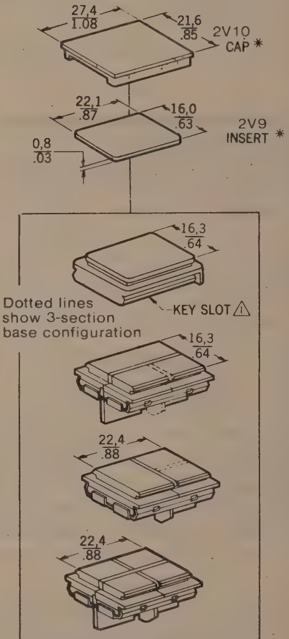

White
White
White
White

2A173


Red
Green
Yellow
White

2A174

These screens are available in any combination of red, yellow, green, blue, amber and white. Half-segments are illuminated by two lamps and quarter-segments by one lamp each. Items shown are stock items. If you desire other color arrangements, contact your nearest MICRO SWITCH Branch Office.


27,4
1.08
21,6
.85
2V10
CAP *
22,1
.87
16,0
.63
0,8
.03
2V9
INSERT *
16,3
.64
KEY SLOT ⚠
Dotted lines show 3-section base configuration
16,3
.64
22,4
.88
22,4
.88

⚠KEY SLOT FACES SIDE OF HOUSING SHOWING CATALOG LISTING (ABOVE LAMP TERMINALS "A" AND "B")

*Order for replacement only.

SCREENS WITH COLORED RIM CAPS

FIG. 1

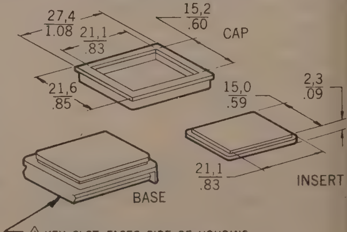
FIG. 2

Catalog Listings

COLOR OF RIM CAP		
Red	Green	Blue
2A106	2A108	2A107

With these screens, a change in control status can be indicated by both color and shape. They have colored transparent rim caps, colorless transparent inserts and white translucent bases. Filters of the same color as the caps are put on two of the four lamps. When the filtered lamps are lighted, a solid color appears (Fig. 1), while the unfiltered lamps, when lighted, result in a white display with a colored frame. (Fig. 2).

Since the insert is exposed, legending should be done on the base or reverse side of the insert.


27,4
1.08
21,1
.83
15,2
.60
CAP
21,6
.85
15,0
.59
2,3
.09
21,1
.83
INSERT
BASE

⚠KEY SLOT FACES SIDE OF HOUSING SHOWING CATALOG LISTING (ABOVE LAMP TERMINALS "A" AND "B")

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

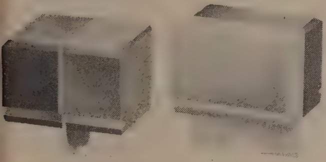
Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

SERIES 2 PUSHBUTTON SWITCHES AND INDICATORS

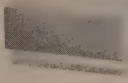
"GUMDROP" TYPE DISPLAY SCREENS

These bright colored screens are available in two heights, for sub-panel or flush-panel mounting.

Style 1 projects ½" (approx.) and Style 2 projects ⅜" (approx.) above the housing, as compared with the 3/16 (approx.) projection of the standard 2A1 type button. MICRO SWITCH provides hot stamp legending, which is oversprayed for maximum durability. Single section and two section longitudinal and lateral splits are available in both heights.



TWO SECTION (style 1 shown)



SINGLE SECTION (style 2 shown)

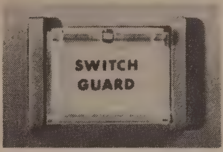
Catalog Listings

Style	Single Section Display Screens				
	Red	Yellow	Green	Blue	White
1	2A2011	2A2012	2A2013	2A2014	2A2015
2	2A2001	2A2002	2A2003	2A2004	2A2005

There are many color combinations available in the two section "gumdrops". Please contact your nearest MICRO SWITCH Branch Office for further information.

SWITCH GUARD

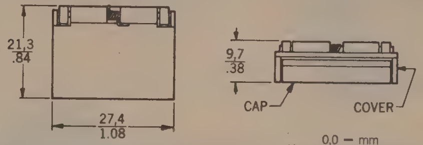
Catalog listing 2H20 has a hinged cover which prevents accidental depression of the display screen. It takes the place of the transparent slide-on cap furnished with three-piece display screens.



Barrier mount assembly with guard installed (can also be used with all flange mount units).

Guard requires a "lift-to-push" response to operate switch.

Note: When the 2H20 is to be used with pull-in coil devices, specify 2C200 type.



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 – mm / 0.00 – inches

LEGEND INFORMATION

MICRO SWITCH provides legend service on the inserts supplied with three-piece screens for Series 2 and Series 2N. Ordering forms are available, upon request.

Note: MICRO SWITCH does not provide legending service on 2A1 type one-piece screens.

Legend pricing is shown in the list price and discount schedule. Special symbols trademarks, etc., are offered on the basis of tooling.

On any one screen, only one size of type is provided in either black or white. After legending, the insert is assembled to the display screen. The type face used is "Modified Gothic".

RECOMMENDED SCREEN AND LEGEND COLOR COMBINATIONS FOR OPTIMUM LEGIBILITY

Screen Color	Legend Lettering Black	White
Red		X
Green		X
Blue		X
Yellow	X	
Amber	X	X
White	X	

TEMPERATURE CONSIDERATIONS

DISPLAY SCREENS—Series 2 display screens covered in this catalog are acrylic. They will withstand temperatures up to +120°F (49°C) total ambient. For applications requiring tolerance of ambients up to +150°F (66°C), polycarbonate display screens are available. Consult your nearest MICRO SWITCH Branch Office for further information.

OPERATOR/INDICATOR HOUSINGS—The 2C, 2C200, 2F, and 2F200 housings will withstand ambient temperatures to +275°F (135°C).

& . , : ; ! ? ' $ ¢ # / ( ) * @ _ " % °

$+ - = \div \times \pm \neq {}^{C}{}_{R} > \infty \rightarrow \cdot$

0123456789 1/4 1/2 3/4 1/3 2/3

ABCDEFGHIJKLMNOPQRSTUVWXYZ

START MANUAL

WORK SIZE STOP

13/64 (18 pt.)

& . , : ; ! ? ' $ ¢ # / ( ) * @ _ " % ° $+ - = \div \times \pm$

$\neq {}^{C}{}_{R} > \infty \rightarrow \cdot$ 0123456789

ABCDEFGHIJKLMNOPQRSTUVWXYZ

START MANUAL WORK SIZE

S
T
O
P

9/64 (12 pt.)

& . , : ; ! ? ' $ ¢ # / ( ) * @ _ " % ° $+ - = \div \times \pm \neq$

${}^{C}{}_{R} > \infty \rightarrow \cdot$ ABCDEFGHIJKLMNOPQRSTUVWXYZ

0123456789 START

MANUAL WORK SIZE

7/64 (10 pt.)

S
T
O
P

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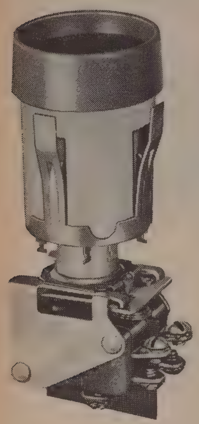
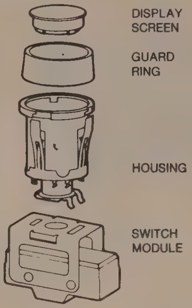
SERIES 2M ROUND DISPLAY MODULAR LIGHTED



Round display modules are compatible with rectangular Series 2 in color, size and light output.

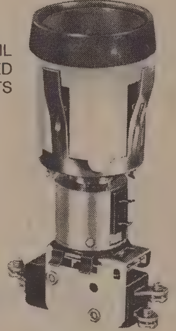


- Guard Rings Help Prevent Accidental Operation
- All Modules Keyed to Panel
- Up to Four-Lamp Indication
- Wide Array of Switch Modules
- Wide Selection of Modules for Custom Panels

Guard rings encircle the display screens from front of panel and help prevent accidental operation. By choice of color, the user can employ them to aid color coding in a closely grouped arrangement. The different guard ring colors can also be used to code control functions to enable faster, easier station location by the operator.

All modules-housing, screens, guard rings and switch modules, assemble quickly, without special tools. All modules are keyed to insure proper legend orientation.

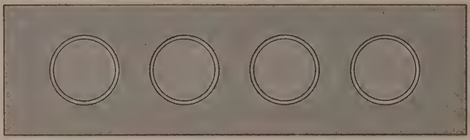
MATCHING INDICATORS



COIL EQUIPPED UNITS

Matching indicators for round display operator-indicators provide a uniform panel appearance.

Housings with integral hold-in coils enable maintained and remote released contacts.

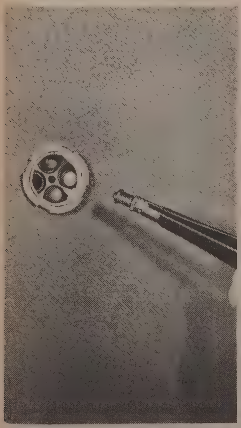


CHOICE OF TRANSMITTED OR PROJECTED COLOR

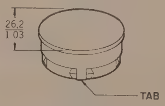
Colored screens can be used for transmitted color or white screens with color filters over the lamps can provide projected color schemes. Use the same filters, as shown for "Type 2C and 2F."

LAMP-FILTER TOOL

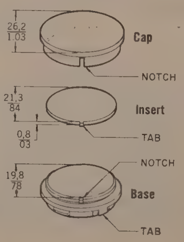
This tool, Catalog Listing **15PA32**, permits changing of lamps and color filters from the panel front.



1-PIECE SCREEN



3-PIECE SCREEN



DISPLAY SCREENS

One-piece translucent screens and three-piece (cap, insert and base) screens are available in five colors.

The three-piece screens can be furnished with either transparent colorless caps or transparent caps colored to match the translucent base. Inserts are colorless transparent.

NOTE keying tab relationships.

Catalog Listings

Color	1-Piece Screens	3-Piece Screens: Colored Cap and Base	3-Piece Screens: Colorless Cap and Colored Base
Red	2J1	2J6	2J10
Yellow	2J2	2J7	2J11
Green	2J3	2J8	2J12
Blue	2J4	2J9	2J13
White	2J5	—	2J14

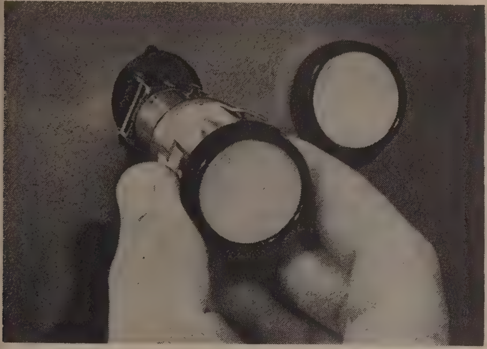
Replacement Cap and Insert

2V23—Colorless transparent legend insert.
2V24—Colorless transparent cap.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

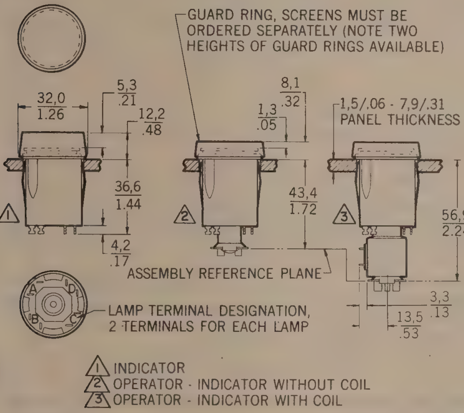
Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

SERIES 2M PUSHBUTTON SWITCHES AND INDICATORS A



Round display indicators and operator-indicators are assembled to the panel by pressing them into the round hole provided. Panel thickness can range from 1/16'' to 5/16'' thick.

Switch units are attached to spring clips on the bottom of each operator-indicator to provide combined control and indication.


GUARD RING, SCREENS MUST BE ORDERED SEPARATELY (NOTE TWO HEIGHTS OF GUARD RINGS AVAILABLE)
32,0 / 1.26
5,3 / .21
12,2 / .48
36,6 / 1.44
4,2 / .17
8,1 / .32
1,3 / .05
43,4 / 1.72
1,5/.06 - 7,9/.31 PANEL THICKNESS
56,9 / 2.24
ASSEMBLY REFERENCE PLANE
3,3 / .13
13,5 / .53
A
B
C
D
LAMP TERMINAL DESIGNATION, 2 TERMINALS FOR EACH LAMP
1
2
3
1 INDICATOR
2 OPERATOR - INDICATOR WITHOUT COIL
3 OPERATOR - INDICATOR WITH COIL

HOUSINGS FOR INDICATORS AND OPERATOR-INDICATORS

Four flexing spring leaves on the housing hold it secure in the panel. Housings are available with two or four lamp sockets.

Operator-indicators can be furnished with or without integral holding coils.

Catalog Listings

	Operator-Indicator Housing			Indicator Housing
		With Hold-in Coil		
No. of Sockets	Without Coil	6vdc	28vdc	
2 (A & C)	2M1	2M3	2M5	2R1
4 (A, B, C & D)	2M2	2M4	2M6	2R2

Note: Since guard rings overlap slightly, 57,4 mm/1.26 in. is required between mounting hole centers for side-by-side mounting.

GUARD RINGS

Colored guard rings have two height options: a .315'' type which extends slightly above an unoperated screen and a .475'' type which gives extra protection against accidental operation. They are attached to the housing from the panel front by a turn-to-lock action, making them easily removable when relamping.

Catalog Listings

Guard Ring Color	Red	White	Gray	Black	Blue
.315'' Height	2K1	2K2	2K3	2K4	2K5
.475'' Height	2K6	2K7	2K8	2K9	2K10

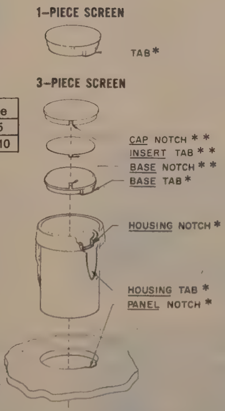
HOW TO ORDER

Each Series 2M module has its own catalog listing and is ordered as a separate item.

	Page
HOUSINGS	
Operator-Indicators, Type 2M	A46
Indicators Only, Type 2R	A46
DISPLAY SCREENS, Type 2J	A45
GUARD RINGS, Type 2K	A46
LAMPS, Type 2E	A48
LAMP TOOL, 15PA32	A45
SWITCH UNITS, Type 2D	A49-52

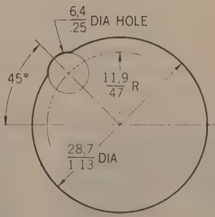
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches


1–PIECE SCREEN
TAB *
3–PIECE SCREEN
CAP NOTCH * *
INSERT TAB * *
BASE NOTCH * *
BASE TAB *
HOUSING NOTCH *
HOUSING TAB *
PANEL NOTCH *

* ALIGNS WITH NOTCH INSIDE HOUSING, TAB ON OUTSIDE OF HOUSING, AND NOTCH IN PANEL HOLE

* * LOCATED 45° FROM BASE TAB


6,4 / .25 DIA HOLE
45°
11,9 / 47 R
28.7 / 1 13 DIA

PANEL CUTOUT

Mounting is accomplished by the two-hole method.

A .250'' diameter is used as a key to prevent rotation of the housing. This hole overlaps a 1.125'' diameter hole. Both holes are standard punch sizes.

A tab at the base of the screen aligns with the panel key.

Care should be taken when legending to insure proper orientation.

MICRO SWITCH

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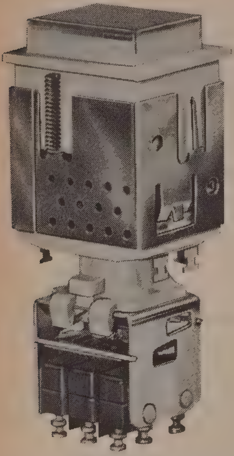
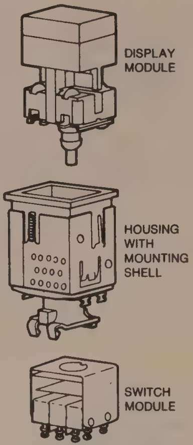
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES 2N MODULAR LIGHTED PUSHBUTTONS AND INDICATORS





- **Molded-In Color Housings**
- **Spring-Lock Mounting**
- **Up To Four-Lamp Indication**

Series 2N has a spring-lock mounting which holds units secure in the panel, yet provides resiliency to protect against the effects of shock. Molded color housings, in gray, white or black, can be supplied with terminals for two or four lamps.

Catalog Listings

No. of Lamp Terminals	Housing Code*		
	Gray	Black	White
2 (A & C)	2N1	2N3	2N6
4 (A, B, C & D)	2N2	2N4	2N6

*Other colors available in production quantities. Contact Branch Office for details.

HOLD-IN COIL MODULE

Coil modules are attached between the housing and switch module for electromagnetic maintained and released contact.

A downward push on the terminal boss (see photo) permits it to be turned and locked in two positions, 90° apart, for wiring convenience.

Catalog Listings

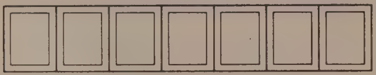
Coil Module	2P1	2P2	2P3
Voltage	6 vdc	28 vdc	48 vdc
Rating	.47 amp	.10 amp	.066 amp

A 12 vdc coil is also available. Contact your nearest MICRO SWITCH Branch Office for ordering information.

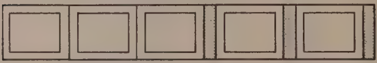
HOW TO ORDER

Each Series 2N module has its own catalog listing and is ordered as a separate item.

	Page
HOUSINGS, Type 2N (includes mounting shell, plus an adapter plate which can be attached in place of a switch module to convert the device for use as an indicator only)	A47
DISPLAY MODULES, Type 2L & 2L2000	A48
LAMPS, Type 2E	A48
SWITCH UNITS, Type 2D	A49-52
HOLD-IN COIL MODULE, Type 2P (optional)	A47
SPACING BARRIERS, Type 2B (optional)	A47



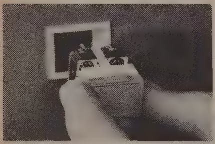
MOUNTED WITH LONG SIDES ABUTTING



MOUNTED WITH SHORT SIDES ABUTTING

SPACING BARRIERS

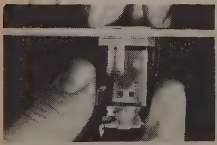
Spacing barriers can be used in rows that are mounted with the short sides abutting. Two colors are available: black - Catalog Listing 2B44 and gray - Catalog Listing 2B43.

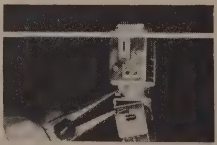


MANUAL RELAMPING

Both lamps and filters can be replaced from the panel front manually, without tools.

1. Grasp screen and pull out display module.
2. Remove inoperative lamp and make replacements.





EASY INSTALLATION

Spring loaded detents in the mounting shell provide a firm pressure to lock the housing securely in the panel, yet provide resiliency to protect lamp filaments from the effects of shock and vibration.

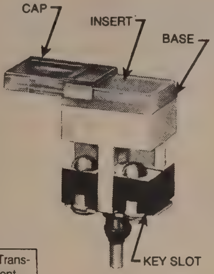
1. Insert housing in panel and slide on mounting shell.
2. Attach switch module to mounting clips on housing.

SERIES 2N MODULAR LIGHTED PUSHBUTTONS AND INDICATOR

THREE-PIECE TYPE 2L DISPLAY MODULES

Colored display modules provide transmitted color, while white screens with color filters over the lamps can be used for projected color effects.

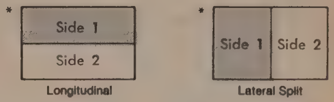
SINGLE SECTION (three-piece type)


CAP
INSERT
BASE
KEY SLOT

Catalog Listings

BASE COLOR	With Trans-lucent Caps in Same Color as Base	With Trans-parent Caps in Same Color as Base	With Trans-parent Colorless Caps
Red	2L1	2L66	2L81
Yellow	2L2	2L67	2L82
Green	2L3	2L68	2L85
Blue	2L4	2L69	2L86
White	2L5	—	2L70

TWO SECTION (three piece type)


*
Side 1
Side 2
Longitudinal
*
Side 1
Side 2
Lateral Split

*Keyed Corner

BASE COLORS		Longitudinal Split Base	Lateral Split Base
Side 1	Side 2		
Red	White	2L6	2L16
Red	Green	2L7	2L17
Red	Blue	2L8	2L24
Red	Yellow	2L9	2L37
White	Green	2L10	2L46
White	Blue	2L11	2L48
White	Yellow	2L12	2L43
Green	Blue	2L13	2L19
Green	Yellow	2L14	2L41
Yellow	Blue	2L15	2L22
Red	Red	2L51	2L36
Yellow	Red	2L52	2L23
Green	Red	2L53	2L38
Blue	Red	2L54	2L39
White	Red	2L55	2L40
Yellow	Green	2L56	2L21
Blue	Yellow	2L57	2L42
Yellow	White	2L58	2L20
Yellow	Yellow	2L59	2L44
Blue	Green	2L60	2L45
Green	White	2L61	2L18
Green	Green	2L62	2L47
Blue	White	2L63	2L25
Blue	Blue	2L64	2L49
White	White	2L65	2L50

THREE AND FOUR SECTION (three-piece type)

These modules have colored bases, transparent colorless caps and inserts. Contact your nearest MICRO SWITCH Branch Office for color combinations.

REPLACEMENT CAP AND INSERT

2V17—Colorless transparent legend insert.
2V18—Colorless transparent cap.

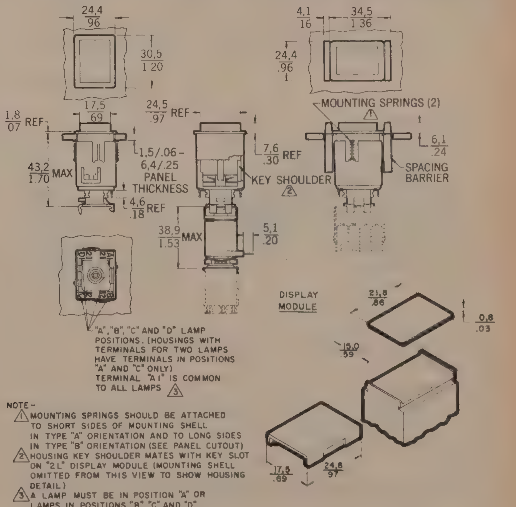
SOLID "GUMDROP" TYPE 2L2000 DISPLAY MODULES

Type 2L2000 bright colored gumdrop display modules are available in two heights, for sub-panel or flush-panel mounting. Style 1 projects 5/16" (approx.) and Style 2 projects 7/16" (approx.) above the housings, as compared with the 1/4" (approx.) projection of the Type 2L three-piece modules. MICRO SWITCH provides hot stamp legending, which is oversprayed for maximum durability.

Catalog Listings

Style	Single Section Display Screens*				
	Red	Yellow	Green	Blue	White
2	2L2011	2L2012	2L2013	2L2014	2L2015
1	2L2001	2L2002	2L2003	2L2004	2L2005

*There are many color combinations available in the two section "gumdrops". Please contact your nearest MICRO SWITCH Branch Office for further information.


24,4 / .96
30,5 / 1.20
4,1 / .16
34,5 / 1.36
24,4 / .96
MOUNTING SPRINGS (2) 1
1,8 / .07 REF
17,5 / .69
24,5 / .97 REF
43,2 / 1.70 MAX
1,5/.06 - 6,4/.25 PANEL THICKNESS
4,6 / .18 REF
7,6 / .30 REF
KEY SHOULDER 2
6,1 / .24
SPACING BARRIER
38,9 / 1.53 MAX
5,1 / .20
DISPLAY MODULE
21,8 / .86
0,8 / .03
15,0 / .59
17,5 / .69
24,6 / .97

"A", "B", "C" AND "D" LAMP POSITIONS. (HOUSINGS WITH TERMINALS FOR TWO LAMPS HAVE TERMINALS IN POSITIONS "A" AND "C" ONLY) TERMINAL "A1" IS COMMON TO ALL LAMPS 3

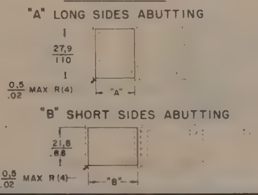
NOTE -
1. MOUNTING SPRINGS SHOULD BE ATTACHED TO SHORT SIDES OF MOUNTING SHELL IN TYPE "A" ORIENTATION AND TO LONG SIDES IN TYPE "B" ORIENTATION (SEE PANEL CUTOUT)
2. HOUSING KEY SHOULDER MATES WITH KEY SLOT ON "2L" DISPLAY MODULE (MOUNTING SHELL OMITTED FROM THIS VIEW TO SHOW HOUSING DETAIL)
3. A LAMP MUST BE IN POSITION "A" OR LAMPS IN POSITIONS "B", "C" AND "D" WILL NOT LIGHT
TOTAL LAMP WATTAGE SHOULD NOT EXCEED 2.4 WATTS

LENGTH OF PANEL CUTOUT*

Mounting Orientation (see drawing)	Number of Units									
	1		2		3		4		5	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
"A"	21,72	855	46,18	1.818	70,64	2.781	95,05	3.742	119,48	4.704
"B"	27,81	1.095	58,37	2.298	88,93	3.501	119,48	4.702	149,96	5.904
"B" w/barriers	39,01	1.536	73,63	2.899	108,23	4.261	142,82	5.623	177,42	6.985

*Nominal dimensions, tolerance ± 0,25 mm/.010 in.
(In some cases, a larger panel cutout may be desired. Cutouts as large as 0,20 mm/.008 in. more per unit will result in an acceptable mounting condition.)

PANEL CUTOUT


"A" LONG SIDES ABUTTING
27,9 / 1.10
0,5 / .02 MAX R(4)
"A"
"B" SHORT SIDES ABUTTING
21,8 / .86
0,5 / .02 MAX R(4)
"B"

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

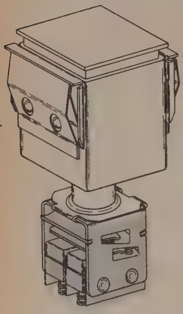
Key: 0,0 — mm
0.00 — inches

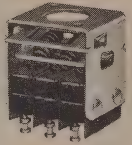
MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

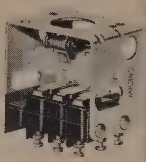
SERIES 2 SWITCH MODULES

"SM" Subminiature (Multi-SPDT) Switch Modules

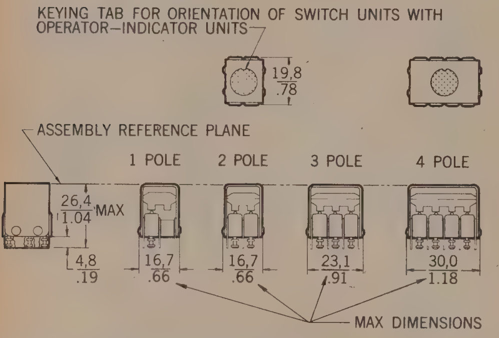




"SM" switch modules are available with momentary-action in a choice of two styles, one having a pronounced touch-feedback, while the other has a low force for rapid operation; alternate-action; and a combination momentary/alternate-action. Extra length turret type terminals are solder plated.



MOMENTARY ACTION

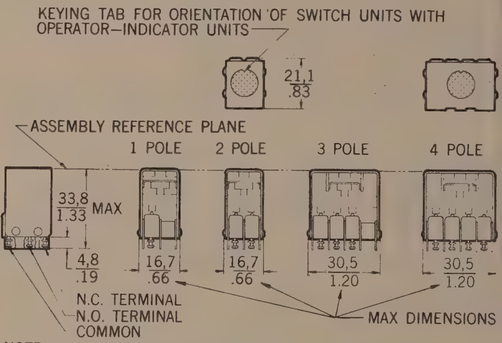

KEYING TAB FOR ORIENTATION OF SWITCH UNITS WITH OPERATOR—INDICATOR UNITS
19,8
.78
ASSEMBLY REFERENCE PLANE
1 POLE
2 POLE
3 POLE
4 POLE
26,4
1.04
MAX
4,8
.19
16,7
.66
16,7
.66
23,1
.91
30,0
1.18
MAX DIMENSIONS

NOTE -
1—'T2' TERMINALS ARE PLATED FOR SOLDERING
2—SWITCHES DO NOT NECESSARILY OPERATE SIMULTANEOUSLY

Catalog Listings

No. of SPDT Circuits	Momentary-Action			
	Touch-Feedback Type		Low Force Type	
	Gold Contacts	Silver Contacts	Gold Contacts	Silver Contacts
1	2D113	2D100	2D320	2D402
2	2D1	2D2	2D140	2D139
3	2D4	2D5	2D320	2D328
3	2D8	2D9	2D152	2D151

ALTERNATE ACTION


KEYING TAB FOR ORIENTATION OF SWITCH UNITS WITH OPERATOR—INDICATOR UNITS
21,1
.83
ASSEMBLY REFERENCE PLANE
1 POLE
2 POLE
3 POLE
4 POLE
33,8
1.33
MAX
4,8
.19
16,7
.66
16,7
.66
30,5
1.20
30,5
1.20
N.C. TERMINAL
N.O. TERMINAL
COMMON
MAX DIMENSIONS

NOTE -
1—'T2' TERMINALS ARE PLATED FOR SOLDERING
2—SWITCHES DO NOT NECESSARILY OPERATE SIMULTANEOUSLY

Catalog Listings

No. of SPDT Circuits	Alternate-Action		Mom./Alt.-Action
	Gold Contacts	Silver Contacts	Silver Contacts
1	2D174	2D118	—
2	2D25	2D28	2D161*
3	2D28	2D101	—
4	2D32	2D33	2D162**

***Has one momentary and one alternate-action switch.**
****Has one momentary and three alternate-action switches.**

ELECTRICAL RATING

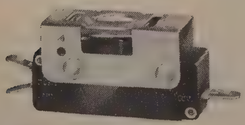
Silver Contacts
30 vdc - 5 amps res. sea level or 50,000 ft., 3 amps ind. sea level, 2.5 amps ind. 50,000 ft., Max. inrush, 24 amps.

UL and CSA listing for basic switch:
125 or 250 vac . . . . 5 amps

Gold Contacts
30 vdc - 0.5 amp ind., 1 amp res. sea level and 50,000 ft., 2 amps max. inrush.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY ·Key: 0,0 — mm / 0.00 — inches

"PL" Quick Connect (SPDT) Switch Module



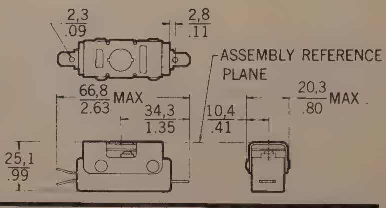
MOMENTARY-ACTION

Contact Arrangement	Catalog Listing
SPDT	2D120

Catalog listing 2D120 has a "PL" type silver contact unit with quck-connect terminals for use in fast assembly operations. Easy "snap-on" wiring cuts installation time to a minimum.

ELECTRICAL RATING

125 vac .... 15 amps, 0.5 hp
250 vac .... 1 hp


2,3
.09
2,8
.11
ASSEMBLY REFERENCE PLANE
66,8
2.63
MAX
34,3
1.35
10,4
.41
20,3
.80
MAX
25,1
.99

"V3" Compact (SPDT-DPDT) Switch Modules

Catalog Listing 2D70 is single-pole double-throw. Catalog Listing 2D72 has double-pole double-throw circuitry.

Screw terminals with lockwashers are provided. On double-pole units, a flexible insulating barrier is installed between the basic switches. Series 2 assemblies built up from short flange operator units and "V3" switch units should have spacing barriers between them to prevent mechanical interference.

These switch units are also available with quick-connect terminals for fast, easy wiring. Contact your nearest MICRO SWITCH Branch Office for details.

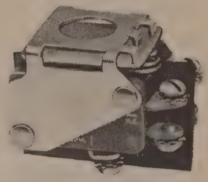
ELECTRICAL RATING

30 vdc - 10 amps ind. *sea level, 6 amps, ind.* 50,000 ft., motor load 6 amps.** UL and CSA listing for basic switch:

125 or 250 vac	10 amps ⅓ hp
125 vdc	½ amp
250 vdc	¼ amp

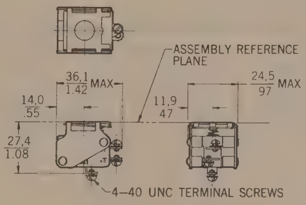
*Inductive currents in accordance with AN 3179.

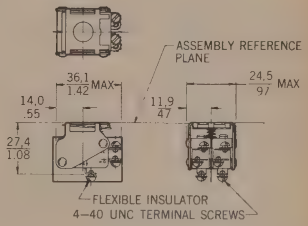
**Motor load rating based on starting current.



MOMENTARY-ACTION

No. Spdt Circuits	Catalog Listing
1	2D70
2	2D72


ASSEMBLY REFERENCE PLANE
36,1/1.42 MAX
24,5/.97 MAX
14,0/.55
11,9/.47
27,4/1.08
4—40 UNC TERMINAL SCREWS

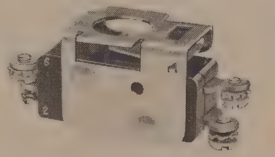

ASSEMBLY REFERENCE PLANE
36,1/1.42 MAX
24,5/.97 MAX
14,0/.55
11,9/.47
27,4/1.08
FLEXIBLE INSULATOR
4—40 UNC TERMINAL SCREWS

"TB" Compact (2-Circuit) Switch Modules

Catalog listing 2D64 (screw terminals) and 2D86 (solder terminals) have a two-circuit "TB" switch which gives very close to simultaneous operation of all contacts. Twin-break silver contacts provide the versatility required when two isolated circuits must be controlled. There are four terminals, with one normally closed circuit and one normally open. A single-pole double-throw circuitry is easily arranged by connecting the two terminals on one side of the switch together and using the combination as the common terminal.

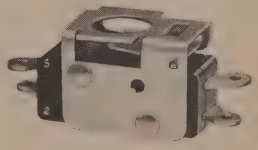
ELECTRICAL RATING

30 vdc	10 amps
UL and CSA Listing for basic switch:	
125-250 vac	10 amps
125 vac	0.5 hp



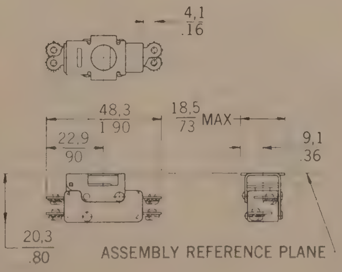
MOMENTARY-ACTION

Contact Arrangement	Catalog Listing
2-Circuit Dbl.-Break	2D64

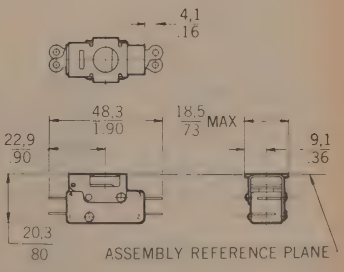


MOMENTARY-ACTION

Contact Arrangement	Catalog Listing
2-Circuit Dbl.-Break	2D86


4,1/.16
48,3/1.90
18,5/.73 MAX
22,9/.90
9,1/.36
20,3/.80
ASSEMBLY REFERENCE PLANE

NOTE-
1-TERMINALS ARE PLATED FOR SOLDERING.


4,1/.16
48,3/1.90
18,5/.73 MAX
22,9/.90
9,1/.36
20,3/.80
ASSEMBLY REFERENCE PLANE

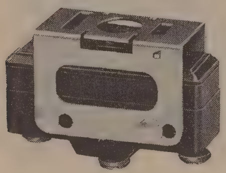
NOTE-
1-TERMINALS ARE PLATED FOR SOLDERING.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

SERIES 2 SWITCH MODULES

"A" 20-Amp and "Z" 15-Amp (SPDT) Switch Modules



Catalog Listing 2D66 has a high a-c capacity type "A" switch unit. Up to 2 horsepower a-c motors can be directly controlled. It has screw terminals.

Catalog Listing 2D68 has a type "Z" switch unit which offers slightly lower operating force than the type "A". It is also equipped with screw terminals.

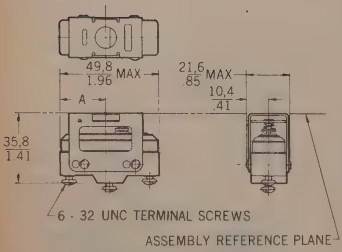
ELECTRICAL RATING

UL and CSA listing for basic switch:

	2D68	2D66
125, 250, 480 vac	15 amps	20 amps
125 vdc	½ amp	1 hp
250 vdc	¼ amp	2 hp

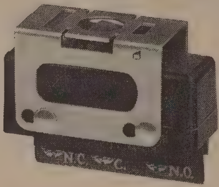
MOMENTARY-ACTION

Contact Arrangement	Catalog Listing
SPDT	2D66 & 2D68


49,8
1.96
MAX
A
21,6
.85
MAX
10,4
.41
35,8
1.41
6 - 32 UNC TERMINAL SCREWS
ASSEMBLY REFERENCE PLANE

	2D66	2D68
Dim. "A"	.885	1.055

"DT" (DPDT in Single Housing) Switch Module



Catalog listing 2D89 contains a "DT" type double-pole double-throw basic switch with screw terminals. It makes and breaks two independent circuits simultaneously. This module is approximately interchangeable with the "A" and "Z" types shown at left.

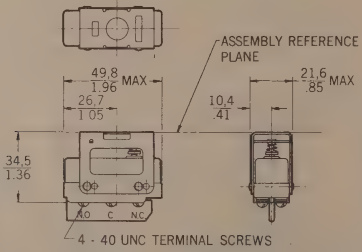
ELECTRICAL RATING

UL and CSA listing for basic switch:

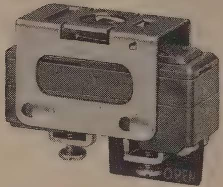
125 vdc	0.3 amp resistive
250 vdc	0.15 amp resistive
125 or 250 vac	10 amps

MOMENTARY-ACTION

Contact Arrangement	Catalog Listing
DPDT	2D89


ASSEMBLY REFERENCE PLANE
49,8
1.96
MAX
26,7
1.05
21,6
.85
MAX
10,4
.41
34,5
1.36
NO
C
NC
4 - 40 UNC TERMINAL SCREWS

"MT" High d-c Capacity (SPDT) Switch Unit Modules



Catalog listing 2D88 has a "MT" magnetic blowout basic switch with high direct-current capacity. It provides means of switching d-c loads up to 10 amps, 125 volts, when wired either polarized or non-polarized. A small permanent magnet is incorporated in its design. This magnet protects the contacts when the circuit is broken by blowing the d-c arc away from them. Terminals are screw type.

ELECTRICAL RATING

Non-Polarized:

125 vdc	10 amps res., ¼ hp
250 vdc	1.5 to 3 amps res.

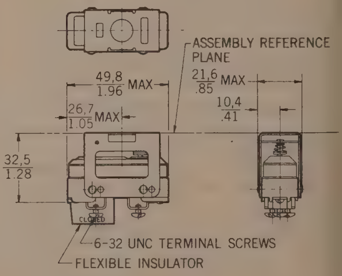
Polarized*:

125 vdc	10 amps res., ½ hp
250 vdc	1.5 amps res.

*To polarize, connect negative side of line to common terminal or mount switch with brass screws, using a non-conducting barrier between switch and mounting surface.

MOMENTARY-ACTION

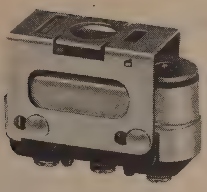
Contact Arrangement	Catalog Listing
SPDT	2D88


ASSEMBLY REFERENCE PLANE
49,8
1.96
MAX
26,7
1.05
MAX
21,6
.85
MAX
10,4
.41
32,5
1.28
CLOSED
6-32 UNC TERMINAL SCREWS
FLEXIBLE INSULATOR

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

"HS" Hermetically Sealed (SPDT) Switch Module



Catalog listing 2D62 is equipped with the "HS" true hermetically sealed basic switch. Terminals are screw type.

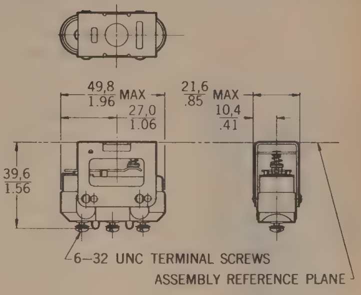
ELECTRICAL RATING

28 vdc ....25 amps res., 10 amps ind, 5 amps motor load, 3 amps lamp load. UL listing for basic switch:

125 vac .... 1 amp ind. or res.

MOMENTARY-ACTION

Contact Arrangement	Catalog Listing
SPDT	2D62



LAMP INFORMATION

T-1 ¾ incandescent lamps are available from MICRO SWITCH in 6, 14, and 28 volt versions. Order flange base lamps for products which have the no-tool relamping feature.

Use of neon lamps is not recommended. Light output is approximately 30% of an incandescent lamp. Also, a neon lamp will not illuminate blue or green filters or display screens due to the absence of these colors from the neon light spectrum.

CATALOG LISTING	BASE STYLE	TYPE NO.	RATING			LIFE/VOLTAGE†	
			VOLTS	AMPS	LIFE IN HOURS	VOLTAGE	EXPECTED LIFE (HRS.)
2E5	Flange	328*				5.16	4,000
			6	.200	500	5.60	1,200
2E6	Grooved	337**				6.40	200
2E3	Flange	330*				12.0	4,900
			14	.080	750	13.0	2,100
2E4	Grooved	336**				16.0	150
2E1	Flange	327*				24.0	7,500
	Grooved		28	.040	1000	26.0	2,800
2E2		334**				30.0	400

*Flange Base (for Series 2 Type 2C200 and 2F200, and Series 2N)

**Grooved Base (for 2C and 2F)

***6 volt lamps are best suited for applications where shock or vibration is a factor.

†These are experimental continuous life test results supplied by a lamp manufacturer for reference only. Intermittent operation may reduce these figures as much as 50%. Ratings are based on median values of current and life.

Lamp Policy—No warranty is offered or implied hereby, the service being one of convenience only for customers not having a convenient source of miniature lamp purchase contract. MICRO SWITCH cannot guarantee to provide lamps from specific manufacturers. Any technical or quality questions regarding such lamps should be directed to the lamp manufacturer.

TEMPERATURE CONSIDERATIONS

DISPLAY SCREENS—Series 2 display screens covered in this catalog are acrylic. They will withstand temperatures up to +120°F (49°C) total ambient. For applications requiring tolerance of ambients up to +170°F (77°C), polycarbonate display screens are available. Consult your nearest MICRO SWITCH Branch Office for further information.

OPERATOR/INDICATOR HOUSINGS—The 2C, 2C200, 2F, and 25200 housings will withstand ambient temperatures to +275°F (135°C).

REPLACEMENT PARTS

DISPLAY SCREENS

CATALOG LISTING	DESCRIPTION
2V9	Legend insert (colorless transparent) for Type 2A display screens.
2V10	Cap (colorless transparent) for Type 2A display screens.

LAMPHOLDER ASSEMBLIES

CATALOG LISTING	DESCRIPTION
15PA203	For 4-lamp Type 2C200 housings.
15PA204	For 2-lamp Type 2C200 housings.
15PA205	For 4-lamp Type 2F200 housings.
15PA206	For 2-lamp Type 2F200 housings.
15PA207	For 2-lamp coil-equipped Type 2C200 housings.
15PA2001	For 4-lamp coil-equiped Type 2C200 housings.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

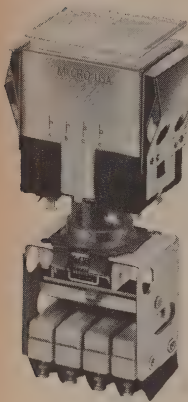
Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

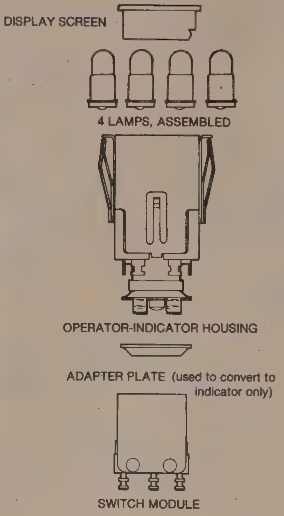
MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032 / PHONE 815-232-1122

SERIES 2W

ASSEMBLED MIL-S-22885/15 LIGHTED PUSHBUTTON SWITCHES




DISPLAY SCREEN
4 LAMPS, ASSEMBLED
OPERATOR-INDICATOR HOUSING
ADAPTER PLATE (used to convert to indicator only)
SWITCH MODULE

- Meet MIL-S-22885 Requirements
- Projected Color
- Short and Long Flange Mounting
- Front Panel Relamping

2W Series Lighted Pushbutton Switches and Indicators are ordered as assembled devices from a single part number. Relamping can be accomplished from the panel front, without tools (refer to 2C200 relamping procedure on page A38).

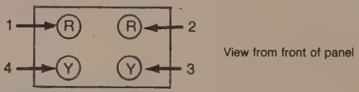
MIL-S-22885/15 covers the assembled lighted pushbutton switch listings. They consist of a display screen, an operator-indicator housing, 4 lamps and a switch module.

FILTERS (Optional)

Filters for projected colors conform to MIL-S-22885/12. They can be ordered assembled or as separate items. To order filters *in the assembly*, they are to be indicated by suffix letters in place of the "XXXX" portion of the MIL or MICRO SWITCH listing. Color suffixes are B = blue, G = green, R = red, W = white, Y = yellow and A = amber. The suffix letters should be listed in the order of their desired lamp socket location.

EXAMPLE: **M22885/15-49RRYY** or **2W106RRYY**.
1234 1234

An X must be used to denote the absence of a filter.



To order filters separately, refer to chart below.

Color Filter	Blue	Green	Red	White*	Yellow	Amber
Catalog Listing	2G101	2G102	2G103	2G104	2G105	2G106

*Has blue tint to compensate for high yellow content of incandescent lamps at low voltages.

LAMPS

Four 28V T-1¾ flange base lamps will be in each assembly which is ordered by the MIL listing unless otherwise specified on the order. If the MICRO SWITCH listing is used for ordering, the lamp option must be specified as a suffix. (See chart below).
EXAMPLE: **2W106XXXX-*2A*.**

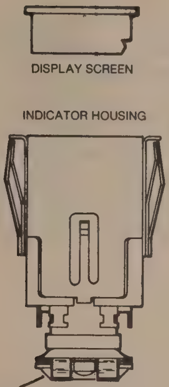
Flange Base Lamp Type	28V,#327	6V,#328	14V,#330
Lamp Quantity	4	4	4
Listing Suffix	-1A	-2A	-3A

MIL Part No.	MICRO SWITCH Catalog Listing	EACH LIGHTED PUSHBUTTON SWITCH CONSISTS OF THE FOLLOWING ASSEMBLED ITEMS:			
		Operator-Indicator Housing	Display Screen*	Lamps	Switch Module
M22885/15-49 (xxxx)	2W106xxxx-1A	Long Flange	Single Section	4	2D280 (mom. 2-pole)
M22885/15-50 (xxxx)	2W107xxxx-1A	Long Flange	Single Section	4	2D281 (mom. 4-pole)
M22885/15-51 (xxxx)	2W108xxxx-1A	Long Flange	Single Section	4	2D282 (alt. act. 2-pole)
M22885/15-52 (xxxx)	2W109xxxx-1A	Long Flange	Single Section	4	2D283 (alt. act. 4-pole)
M22885/15-53 (xxxx)	2W110xxxx-1A	Long Flange	2-Section Lateral Split	4	2D280 (mom. 2-pole)
M22885/15-54 (xxxx)	2W111xxxx-1A	Long Flange	2-Section Lateral Split	4	2D281 (mom. 4-pole)
M22885/15-55 (xxxx)	2W112xxxx-1A	Long Flange	2-Section Lateral Split	4	2D282 (alt. act. 2-pole)
M22885/15-56 (xxxx)	2W113xxxx-1A	Long Flange	2-Section Lateral Split	4	2D283 (alt. act. 4-pole)
M22885/15-57 (xxxx)	2W114xxxx-1A	Long Flange	2-Section Longitudinal Split	4	2D280 (mom. 2-pole)
M22885/15-58 (xxxx)	2W115xxxx-1A	Long Flange	2-Section Longitudinal Split	4	2D281 (mom. 4-pole)
M22885/15-59 (xxxx)	2W116xxxx-1A	Long Flange	2-Section Longitudinal Split	4	2D282 (alt. act. 2-pole)
M22885/15-60 (xxxx)	2W117xxxx-1A	Long Flange	2-Section Longitudinal Split	4	2D283 (alt. act. 4-pole)
M22885/15-61 (xxxx)	2W118xxxx-1A	Short Flange	Single Section	4	2D280 (mom. 2-pole)
M22885/15-62 (xxxx)	2W119xxxx-1A	Short Flange	Single Section	4	2D281 (mom. 4-pole)
M22885/15-63 (xxxx)	2W120xxxx-1A	Short Flange	Single Section	4	2D282 (alt. act. 2-pole)
M22885/15-64 (xxxx)	2W121xxxx-1A	Short Flange	Single Section	4	2D283 (alt. act. 4-pole)
M22885/15-65 (xxxx)	2W122xxxx-1A	Short Flange	2-Section Lateral Split	4	2D280 (mom. 2-pole)
M22885/15-66 (xxxx)	2W123xxxx-1A	Short Flange	2-Section Lateral Split	4	2D281 (mom. 4-pole)
M22885/15-67 (xxxx)	2W124xxxx-1A	Short Flange	2-Section Lateral Split	4	2D282 (alt. act. 2-pole)
M22885/15-68 (xxxx)	2W125xxxx-1A	Short Flange	2-Section Lateral Split	4	2D283 (alt. act. 4-pole)
M22885/15-69 (xxxx)	2W126xxxx-1A	Short Flange	2-Section Longitudinal Split	4	2D280 (mom. 2-pole)
M22885/15-70 (xxxx)	2W127xxxx-1A	Short Flange	2-Section Longitudinal Split	4	2D281 (mom. 4-pole)
M22885/15-71 (xxxx)	2W128xxxx-1A	Short Flange	2-Section Longitudinal Split	4	2D282 (alt. act. 2-pole)
M22885/15-72 (xxxx)	2W129xxxx-1A	Short Flange	2-Section Longitudinal Split	4	2D283 (alt. act. 4-pole)

White translucent base, clear legend insert and cap

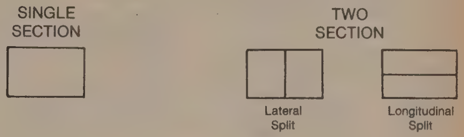
SERIES 2W INDICATORS (MIL-S-22885) A

MIL-S-22885/16 LIGHTED INDICATOR ASSEMBLY



MIL-S-22885/16 consists of a display screen assembled to an indicator housing. The housing has an adapter plate that can be removed (for the attachment of a switch module) to convert the assembly for use as a pushbutton switch.

DISPLAY SCREENS



MOUNTING

Panel cutout dimensions for both MIL-S-22885/16 indicators and MIL-S-22885/15 lighted pushbutton switches are same as shown in the chart, middle of page A42. For further information, contact your nearest MICRO SWITCH branch office.

FILTERS (Optional)

To order filters, follow the procedure shown for Series 2.

MIL Part No.	MICRO SWITCH Catalog Listing	EACH LIGHTED INDICATOR CONSISTS OF THE FOLLOWING ASSEMBLED ITEMS: Indicator Housing	Display Screen*
M22885/16-15 (xxxx)	2W100xxxx	Long Flange	Single Section
M22885/16-16 (xxxx)	2W101xxxx	Short Flange	Single Section
M22885/16-17 (xxxx)	2W102xxxx	Long Flange	2-Section Lateral Split
M22885/16-18 (xxxx)	2W103xxxx	Short Flange	2-Section Lateral Split
M22885/16-19 (xxxx)	2W104xxxx	Long Flange	2-Section Longitudinal Split
22885/16-20 (xxxx)	2W105xxxx	Short Flange	2-Section Longitudinal Split

*White translucent base, clear legend insert and cap

LAMPS (Optional)

Lamps are not included in MIL-S-22885/16 assemblies when ordered by the MIL listing, unless otherwise specified on the order. If the MICRO SWITCH listing is used for ordering, and lamps are desired, the lamp option must be specified as a suffix to the listing (see chart below)

EXAMPLE: 2W100XXXX-*1A*.

Flange Base Lamp Type	28V, #327		6V, #328		14V, #330	
Lamp Quantity	2	4	2	4	2	4
Listing Suffix	-1B.	-1A	-2B	-2A	-3B	-3A

MIL-S-22885/11 SWITCH MODULES

ASSEMBLE EASILY

Switch modules snap onto spring clips on the bottom of the housings. A needle-nose pliers should be used to assemble the switch module to the operator-indicator.

ELECTRICAL RATING

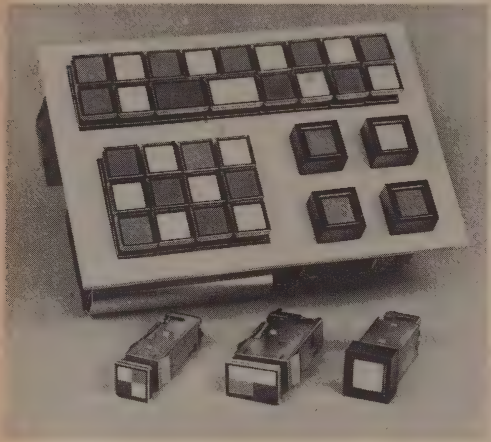
28 vdc: (sea level or 50,000 ft) 4 amps res., 2.5 amps ind., 2 amps lamp. 115 vac: (sea level) 5 amps res. and ind., 1.5 amps lamp.

MIL-S-22885/11 switch modules consist of two or four subminiature SPDT basic snap-action switches. They have silver contacts. There is a choice of momentary (push-on release-off) or alternate (push-on push-off) action. Terminals are "T2" double turret type, plated for soldering.

Mil Part No.	MICRO SWITCH Catalog Listing	SWITCH MODULE DESCRIPTION
M22885/11-01	2D280	Momentary, 2-pole
M22885/11-02	2D281	Momentary, 4-pole
M22885/11-03	2D282	Alternate Action, 2-pole
M22885/11-04	2D283	Alternate Action, 4-pole

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES DS MINIATURE DISPLAY SWITCHES



- MIL-S-22885 Qualified Versions
- Reliable SX—7 amp Basic Switch
- Long Life Lamps—Replaceable From Panel Front
- Rugged Mounting System—Enables One-Hole Matrix or Strip Mounting
- Individual Mount Option
- RFI Attenuation
- Projected and Transmitted Color

Designed to meet the requirements of MIL-S-22885, the "DS" Series of miniature lighted display switches have exceptional RFI attenuation and rugged metal construction. Available in momentary and alternate action types, they provide outstanding control flexibility and display versatility; are highly adaptable to many military and commercial applications.

There are two design options: (1) custom matrix configurations featuring plug-in switches which can be replaced from the panel front without special tools and are easily fitted into a pre-assembled box girder mounting system; (2) individual mount switches, used primarily for remote stations or indicating functions. Terminals are turret solder type. A snap-on bezel acts as a guard to reduce the possibility of accidental actuation of the pushbutton.

CONFIGURATION

Switch and indicators—1-unit (3/4" x 3/4") and 1-1/2-unit (3/4" x 1-1/8"). Switch stroke is .250". Indicators are the same configuration as switches, except the button has high free position force.

Matrix—any size and shape, depending on types and number of switches used. A single row will hold up to sixteen 1-unit switches or up to ten 1-1/2-unit switches.

Individual Mount—1-unit size.

PERFORMANCE CAPABILITIES

The DS device has been designed using MIL-S-22885 as a performance standard. The following areas which have been tested are minimum levels of performance applicable to all DS listings. In many cases these levels have been exceeded by MICRO SWITCH evaluation testing.

Electrical Endurance—Assemblies subjected to a minimum of 25,000 make and break cycles under applicable loading conditions.

Dielectric Withstanding Voltage—1,000 volts RMS.

Salt Fog Resistance—Device exposed to 5 percent solution for 96 hours

Sand and Dust—Switch front exposed to sand dust per MIL-STD-810A at +25°C and +71°C for two hours each.

Thermal Shock—Device exposed to −55°C and −85°C for ½ hour each, alternately for 5 hours.

Moisture Resistance—In accordance with Method 106 MIL-STD-202 for 10 days.

RFI—DSH and DSJ switches were individually tested in accordance with the general procedure of MIL-STD-285 as specified by MIL-S-22885/71. Contact your nearest MICRO SWITCH Branch Office for further information.

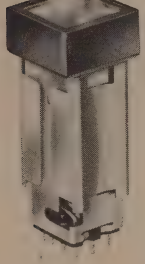
Electrical Endurance—DSJ type is qualified to MIL-S-22885 meets 25,000 operations minimum life at rated loads. DSA, DSH, and DSK types meet 25,000 operations minimum life on basis of similiarity to DSJ.

Vibration—Individual mount and up to and including 2 x 8 matrix—10 G's, 10-500 Hz; up to and including 4x5 matrix—3 G's, 10-500 Hz.

Shock—Per MIL-STD-202, Method 213—50 G half sine wave test.

SWITCH/INDICATOR ORDERING GUIDE

(Shown with DSB buttons installed)



1 Unit
Individual Mount

1 Unit

1½ Unit

Plug-In Strip and Matrix Mount

Individual mount units have a snap-on bezel. Termination is direct to the switch terminals on the **DSH** and to a captive connector block which is attached by a screw to the base of the **DSK**. They can also be mounted in strips.

Matrix mount DSA units require **DSM** mounting hardware which is ordered separately. They plug into connector blocks which enable replacement from the panel front without disturbing the wiring.

Catalog listings for switch/indicators (less buttons) are derived from the ordering guide, as shown in the example below.

DSH-204BH is an individual mount, direct wire, 1-unit switch, has 1-pole alternate action silver contacts, black bezel and circuitry for two lamps in positions 1 and 4.

Example:

DSH — 204 B H

HOUSING TYPE

DSH
Individual mount, direct wire.

DSK
Individual mount, with captive connector block.

DSA
For strip or matrix mounting. Includes connector block.
(Requires DSM mounting hardward.)

Order buttons separately, from page A57.

SWITCH/INDICATOR TYPE

ELECTRICAL DATA	1-UNIT	1 1/2-UNIT (DSA only.)
Indicator only. (No provision for switching.)	501	601*
1-Pole SPDT Silver Contacts	104 Momentary	304* Momentary
	204 Alt. Action	404* Alt. Action
2-Pole DPDT Silver Contacts	105 Momentary	305* Momentary
	205 Alt. Action	405* Alt. Action
1-Pole SPDT Gold Contacts	102 Momentary	302* Momentary
	202 Alt. Action	402* Alt. Action
2-Pole DPDT Gold Contacts	103 Momentary	303* Momentary
	203 Alt. Action	403* Alt. Action

*1½-unit housings available with DSA only.

With or Without BEZEL

A No Bezel	DSA only
B Black Bezel	DSH and DSK only
G Gray Bezel	

LAMP CIRCUITS

Keying Corner ① ② ③ ④

A	1			
B		2		
C			3	
D				4
E	1,	2		
F		2,	3	
G			3,	4
H	1,			4
J	1,		3	
K		2,		4
L	1,	2,	3	
M		2,	3,	4
N	1,	2,		4
P	1,		3,	4
R	1,	2,	3,	4

Lamp contacts are provided for the appropriate circuits.

MOUNTING

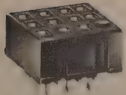
DSA: See page A58
DSH and DSK:
See page A59

CIRCUITRY

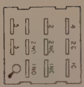
One or two SPDT basic switches with momentary and 2-level alternate action.

ELECTRICAL RATING (amps)

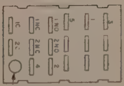
	BASIC SWITCHES Silver Contacts		BASIC SWITCHES Gold Contacts	
	SEA LEVEL	50,000 FT	SEA LEVEL	50,000 FT
28 VAC:				
Inductive	4	2.5	0.5	0.5
Resistive	7	4	1	1
115 vac. 60 hz:				
Inductive	7	—	1	—
Resistive	7	—	1.5	—



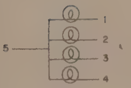
CONNECTOR BLOCK



KEYING HOLE
1 UNIT

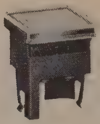


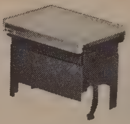
KEYING HOLE
1½ UNIT



LAMP CIRCUITRY

BUTTON ORDERING GUIDE


1 Unit


1½ Unit

The 1-unit (3/4"x3/4") and 1½-unit (3/4"x1-1/8") DSB buttons are ordered separately for assembly to **DSA, DSH,** and **DSK** switch/indicators. Button catalog listings are derived from the ordering guide, as shown in the example below.

DSB22-RRGG-NRI is a 1½-unit 2-section (vertical split) button which is red in quadrants 1 and 2 and green in quadrants 3 and 4 (transmitted color), no legend, 5-volt lamps in all four positions.

DISPLAY COLOR OPTIONS

Transmitted color refers to the use of clear lamps and colored buttons in applications which require the color to be distinguished when the display is unlighted.

Projected color is a technique that uses white buttons and colored filters over the clear lamps. When the lamps are lighted, the white translucent button takes on the color projected by the filters.

Note: If lamps are not desired, omit the last two characters in the catalog listing

DSB22 — RRGG — N R 1

BUTTON CONSTRUCTION

DISPLAY	SIZE
Single-Section	DSB 11 1-Unit DSB 21 1 1/2-Unit
2-Section Vertical Split	DSB 12 1-Unit DSB 22 1 1/2-Unit
2-Section Horizontal Split	DSB 13 1-Unit DSB 23 1 1/2-Unit
3-Section (1/2 at top)	DSB 14 1-Unit DSB 24 1 1/2-Unit
3-Section (1/2 at bottom)	DSB 15 1-Unit DSB 25 1 1/2-Unit
3-Section (1/2 at left)	DSB 16 1-Unit DSB 26 1 1/2-Unit
3-Section (1/2 at right)	DSB 17 1-Unit DSB 27 1 1/2-Unit
4-Section	DSB 18 1-Unit DSB 28 1 1/2-Unit

COLOR

KEYING CORNER → 1 2 / 3 4

Include color codes for each quadrant.

TRANSMITTED COLORS:	PROJECTED COLORS:
R Red	A Red
B Blue	C Blue
Y Yellow	D Yellow
G Green	E Green
W White	H White

LEGEND

L	Legended*
N	No Legend (Blank plate provided)

*Legend Order Sheet, FO-62799, must accompany all orders for legended buttons.

LAMP POSITIONS & NO. OF LAMPS

KEYING CORNER → ① ② / ③ ④

Lamps in positions:

A	1			
B		2		
C			3	
D				4
E	1,	2		
F		2,	3	
G			3,	4
H	1,			4
J	1,		3	
K		2,		4
L	1,	2,	3	
M		2,	3,	4
N	1,	2,		4
P	1,		3,	4
R	1,	2,	3,	4

LAMP TYPE

1	5 Volt
2	28 Volt

LAMP DATA

Each device, either 1 or 1½-unit size, can use up to four MS24515 long-life lamps within the button housing. They retain the same brightness at any button level. Lamps are easily installed or removed from the panel front without special tools. The 5-volt, .115 amp lamps (Type 718) have a 40,000 hour life expectancy, while 28-volt .024 amp lamps (Type 6839) have 16,000 hours. They have a common ground to simplify wiring.

LEGENDING

The legend plate is located between the button cap and diffuser plate. Re-legending of buttons is accomplished by removing the old film strip and replacing with the new one. MICRO SWITCH will provide hot stamp legend service in 7/64", 9/64", and 13/64" character height on the legend film strip.

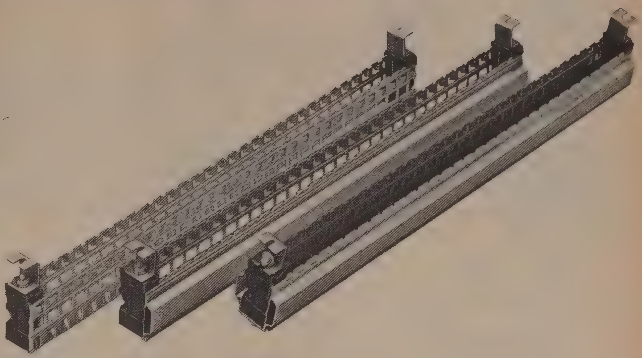
Ask your MICRO SWITCH Branch Office for DS Legend Order Sheet (FO-62799).

MATRIX MOUNTING HARDWARE ORDERING GUIDE

Mounting hardware shown on this page can be used with either 1 unit or 1½ unit DSA switches. It consists of mounting bars assembled with mounting blocks on the ends of the rows to form a rigid box girder frame.

Rows are interlocked to build the mounting matrix. Each mounting block has a U-shaped bracket attached at the top to facilitate panel installation.

There is a provision for attaching other rows on both sides of **DSM-1** mounting bars and on one side of **DSM-2** mounting bars.



DSM-1 DSM-2 DSM-3

Catalog listings for mounting hardware are derived from the ordering guide as shown in the example below.

DSM-309 can be used to mount five units of switches and/or indicators in a single strip mount, such as two 1 1½ unit switches and two 1-unit switches.

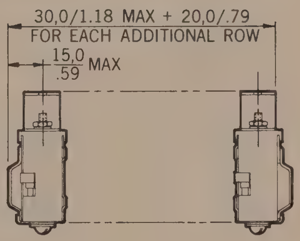
Example:

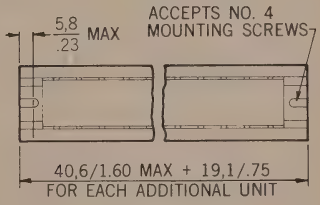
DSM-2 15

MOUNTING HARDWARE TYPE
DSM-1 For inside rows of matrix.
DSM-2 For outside rows of matrix. (reinforced on one side)
DSM-3 For single strip mount. (reinforced on both sides)

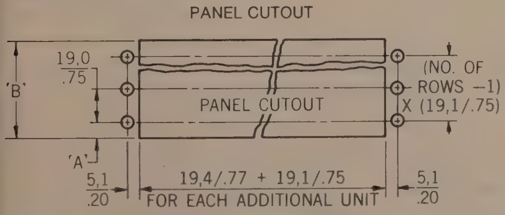
ROW LENGTH SUFFIX IN 1/2-UNIT INCREMENTS (Based on total number of units occupied by switches and/or indicators in the row.)

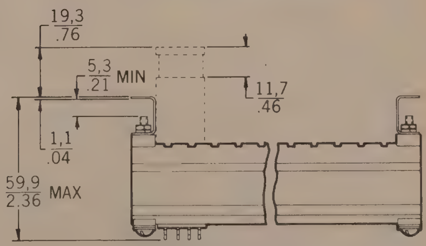
01	1-Unit	**17**	9-Unit
02	1 1/2-Unit	**18**	9 1/2-Unit
03	2-Unit	**19**	10-Unit
04	2 1/2-Unit	**20**	10 1/2-Unit
05	3-Unit	**21**	11-Unit
06	3 1/2-Unit	**22**	11 1/2-Unit
07	4-Unit	**23**	12-Unit
08	4 1/2-Unit	**24**	12 1/2-Unit
09	5-Unit	**25**	13-Unit
10	5 1/2-Unit	**26**	13 1/2-Unit
11	6-Unit	**27**	14-Unit
12	6 1/2-Unit	**28**	14 1/2-Unit
13	7-Unit	**29**	15-Unit
14	7 1/2-Unit	**30**	15 1/2-Unit
15	8-Unit	**31**	16-Unit
16	8 1/2-Unit		


30,0/1.18 MAX + 20,0/.79
FOR EACH ADDITIONAL ROW
15,0/.59 MAX


5,8/.23 MAX
ACCEPTS NO. 4 MOUNTING SCREWS
40,6/1.60 MAX + 19,1/.75
FOR EACH ADDITIONAL UNIT

MATRIX MOUNTING


PANEL CUTOUT
19,0/.75
'B'
PANEL CUTOUT
(NO. OF ROWS −1) X (19,1/.75)
'A'
5,1/.20
19,4/.77 + 19,1/.75
FOR EACH ADDITIONAL UNIT
5,1/.20


19,3/.76
5,3/.21 MIN
11,7/.46
1,1/.04
59,9/2.36 MAX

A — 8,94 ± 0,13/.352 ± .005 IF EFFECTIVE PANEL THICKNESS IS 5,94/.234 OR LESS.

A — 9,70 ± 0,13/.382 ± .005 IF EFFECTIVE PANEL THICKNESS EXCEEDS 5,94/.234.

B — (17,88 + 19,05/.704 + .750 FOR EACH ADDITIONAL ROW) ± 0,25/.010 IF EFFECTIVE PANEL THICKNESS IS 5,94/.234 OR LESS.

B — (19,43 + 19,05/.765 + .750 FOR EACH ADDITIONAL ROW) ± 0,25/.010 IF EFFECTIVE PANEL THICKNESS EXCEEDS 5,94/.234.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

MICRO SWITCH

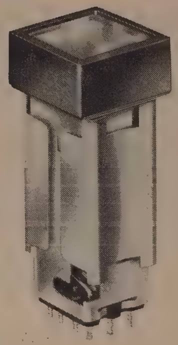
A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES DS MINIATURE DISPLAY SWITCHES

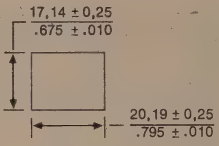
COMPLETELY ASSEMBLED
MIL-S-22885 INDIVIDUAL MOUNT
DSJ LIGHTED SWITCH/INDICATORS

DSJ switches meet the requirements of MIL-S-22885 and are available in single-hole mount 1-unit size. Mounting can be on .062" to .242" thick panels. They are complete assemblies, consisting of: (1) two SPDT silver contact SX type subminiature basic switches rated at 7 amps, 250 vac; and (2) three-piece white buttons (cap, diffuser plate and housing.) Display can utilize up to four T-1 Type lamps. If projected or transmitted color, lamps or less circuitry either in switch or lamp are needed, see DSH and DSK switches.

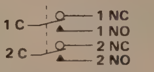
DSJ catalog listings charted below consist of a completely assembled lighted pushbutton switch or indicator. Lamps are not furnished. Select desired display and switching action or indicator only.



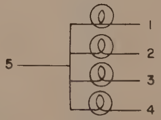
BUTTON		CATALOG LISTINGS		
		Momentary Action Switches	Alternate Action Switches	Indicators
□	Single Section Display	DSJ-0001 (M22885/71-01)	DSJ-0009 (M22885/71-09)	DSJ-0017 (M22885/71-17)
⊟	2-Section Horizontal Display	DSJ-0002 (M22885/71-02)	DSJ-0010 (M22885/71-10)	DSJ-0018 (M22885/71-18)
◫	2-Section Vertical Display	DSJ-0003 (M22885/71-03)	DSJ-0011 (M22885/71-11)	DSJ-0019 (M22885/71-19)
⊞	4-Section Split Display	DSJ-0004 (M22885/71-04)	DSJ-0012 (M22885/71-12)	DSJ-0020 (M22885/71-20)
⊞	3-Section Display (½ Section at Right)	DSJ-0005 (M22885/71-05)	DSJ-0013 (M22885/71-13)	DSJ-0021 (M22885/71-21)
⊞	3-Section Display (½Section at Left)	DSJ-0006 (M22885/41-06)	DSJ-0014 (M22885/71-14)	DSJ-0022 (M22885/71-22)
⊞	3-Section Display (½ Section at Top)	DSJ-0007 (M22885/71-07)	DSJ-0015 (M22885/71-15)	DSJ-0023 (M22885/71-23)
⊞	3-Section Display (½ Section at Bottom)	DSJ-0008 (M22885/71-08)	DSJ-0016 (M22885/71-16)	DSJ-0024 (M22885/71-24)


17,14 ± 0,25
.675 ± .010
20,19 ± 0,25
.795 ± .010

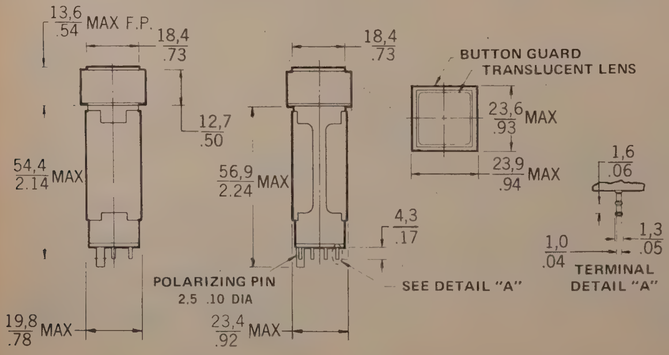
Panel Cutout

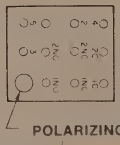

1 C
1 NC
1 NO
2 C
2 NC
2 NO

Switch Circuitry



Lamp Circuitry


13,6
.54
MAX F.P.
18,4
.73
12,7
.50
54,4
2.14
MAX
19,8
.78
MAX
18,4
.73
56,9
2.24
MAX
4,3
.17
POLARIZING PIN
2.5 .10 DIA
23,4
.92
MAX
BUTTON GUARD
TRANSLUCENT LENS
23,6
.93
MAX
23,9
.94
MAX
SEE DETAIL "A"
1,6
.06
1,3
.05
1,0
.04
TERMINAL
DETAIL "A"


POLARIZING PIN

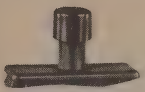
Switch Termination Identification

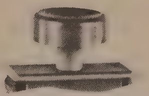
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

SERIES DM PUSHBUTTON SWITCHES A

- Attractive, Ruggeg Snap-In Panel Mount Design
- Easy Installation
- Snap-On and Integral Design Pushbuttons
- Quick Connect Terminals
  .188 inch (4,78 mm) or .250 in. (6,35 mm)
- Various Actions
- Lighted Versions
- Legend Capability
- Expected Mechanical Life—95%
  1 Million Operations
- Temperature Range
  −35° to +180°F (−37° to 82°C)
- UL-CSA Listed


WITH BUTTON "A"


WITH BUTTON "B"

WITH BUTTON "C"

SPDT
3DM1 MOMENTARY
2003DM1 Alt. Action

2-SPDT
4DM1 MOMENTARY
2004DM1 Alt. Action

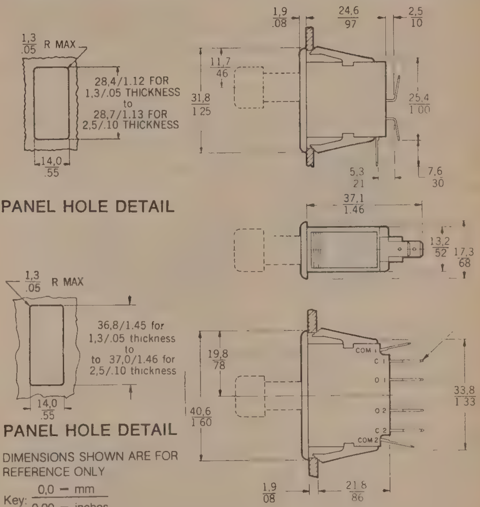
Series DM switches offer a choice of several button styles and one or two single pole double throw circuits. Switch actions include momentary, push-pull, alternate action, and a momentary with pull to cheat option. Silver contacts are standard, gold alloy contacts are available, also combinations of gold or silver. Other options include single throw circuits, angled terminals, plus plungers and faceplates in white, black, gray or red. Request further information from your local Branch Office.

TERMINATION

Quick-connect 4,8 mm x 0,5 mm/.188" x .020" terminals are standard. (Series DM can also be furnished with 6,4 mm x 0,8 mm/.250" x .032" terminals.)

SWITCHES WITH SNAP-ON BUTTONS

Switches on this page can be purchased with the buttons ready-installed or switches and buttons can be ordered separately. Switches have gray faceplates.


1,3 .05 R MAX
28,4/1.12 FOR 1,3/.05 THICKNESS to 28,7/1.13 FOR 2,5/.10 THICKNESS
14,0 .55
1,9 .08
24,6 .97
2,5 .10
11,7 .46
31,8 1.25
25,4 1.00
5,3 .21
7,6 .30
37,1 1.46
13,2 .52
17,3 .68
1,3 .05 R MAX
36,8/1.45 for 1,3/.05 thickness to 37,0/1.46 for 2,5/.10 thickness
14,0 .55
19,8 .78
40,6 1.60
COM 1
C 1
O 1
O 2
C 2
COM 2
33,8 1.33
1,9 .08
21,8 .86

PANEL HOLE DETAIL

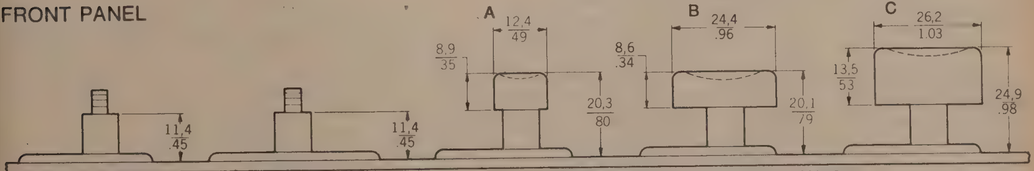
PANEL HOLE DETAIL

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

BUTTON STYLES

FRONT PANEL


A
12,4 .49
8,9 .35
20,3 .80
B
24,4 .96
8,6 .34
20,1 .79
C
26,2 1.03
13,5 .53
24,9 .98
11,4 .45
11,4 .45

(SPDT) (DPDT) EITHER 3DMI OR 4DMI SWITCHES

CATALOG LISTINGS

SPDT			Momentary	Alternate Action
Button Style	Button Color	Button Only	3DM1 and Button	2003DM1 and Button
A	Black	31PA1	13DM1-A1	2013DM1-A1
	Red	31PA2	13DM1-A2	2013DM1-A2
B	Black	31PA3	13DM1-B1	2013DM1-B1
	Red	31PA4	13DM1-B2	2013DM1-B2
	Green	31PA7	13DM1-B3	2013DM1-B3
C	Black	31PA5	13DM1-C1	2013DM1-C1
	Red	31PA6	13DM1-C2	2013DM1-C2

DPDT			Momentary	Alternate Action
Button Style	Button Color	Button Only	4DM1 and Button	2004DM1 and Button
A	Black	31PA1	14DM1-A1	2014DM1-A1
	Red	31PA2	14DM1-A2	2014DM1-A2
B	Black	31PA3	14DM1-B1	2014DM1-B1
	Red	31PA4	14DM1-B2	2014DM1-B2
	Green	31PA7	—	—
C	Black	31PA5	14DM1-C1	2014DM1-C1
	Red	31PA6	14DM1-C2	2014DM1-C2

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES DM SWITCHES

WITH INTEGRAL BUTTONS/PLUNGERS

Manual and Interlock Applications

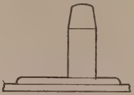
Series DM switches that are described on this page have integral design pushbuttons. They have the same features and options of DM Pushbuttons. Concave surface plungers are available in red or black with gray faceplates. Many other features/modifications are available including alternate action, housing and color variations, terminal variations and single-throw circuitry.

ELECTRICAL RATING

UL and CSA Listing: 125,250 or 277 VAC, 10 amps. 1/3 H.P.
For listings designed to meet CEE24 or low current gold contacts contact your local Branch Office.

ALTERNATE-ACTION

Alternate-action devices have a push on-push off operation. The maintained "on" position of the plunger is at a lower level than the normal "off" position. (Two-level alternate-action.)

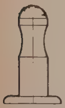


Bullet Nose Description*	Catalog Listing	Circuitry
White Plastic	2001DM1	SPDT
Black Plastic	2002DM4	DPDT

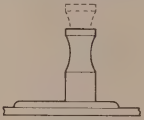
*Other plungers available contact a MICRO SWITCH Branch Office.

PULL TO CHEAT

A "pull to cheat" feature allows normal momentary option. However, by pulling the plunger out beyond normal free position a maintained "on" position is achieved.



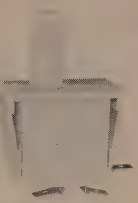
2DM409



2DM401

Description	Circuitry	Catalog Listing
Finger Grip White Plastic	SPDT	1DM401
Bullet Nose Black Plastic	DPDT	2DM408
Finger Grip Black Plastic	DPDT	2DM409

MOMENTARY ACTION

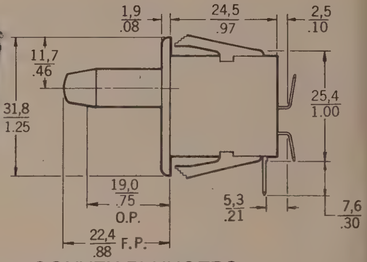


1DM1 (SPDT)

BULLET NOSE PLUNGERS

Description	Circuitry	Catalog Listing
0.875 in. plunger White plastic	SPDT	1DM1
.0875 in. plunger Black plastic	DPDT	2DM4

2DM1 (DPDT)



CONVEX PLUNGERS

Description	Circuitry	Catalog Listing
White plastic	SPDT	1DM21

CONCAVE PLUNGERS

Description All Gray Faceplates	Circuitry	Catalog Listing
Black Plunger	SPDT	1DM18
Red Plunger	SPDT	1DM19
Black Plunger	DPDT	2DM5
Red Plunger	DPDT	2DM6

Characteristics: O.F.—Operating Force; R.F.—Release Force; O.T.—Overtravel; D.T.—Differential Travel; F.P.—Free Position;

ORDER GUIDE

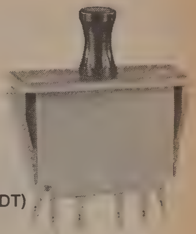
Plunger Type	Order This Listing	F.P. mm IN. ± .025	O.P. mm IN.	Max. Full mm O.T. Pos. IN.	O.F. OP Max. g OZ.	R.F. g OZ.	Max. Diff. Travel mm IN.	Latch Position mm IN. ± .030	Extend Position Max. mm IN.
BULLET NOSE Momentary	1DM1	22,4 .880	19,1 ± 1,5 .750 ± .060	9,53 .375	425 15	85 3	1,14 .045	—	—
Momentary	2DM1	22,4 .880	19,6 ± 1,0 .770 ± .040	10,2 .400	650 24	170 6	1,14 .045/Circuit	—	—
Alternate-Action	2001DM1	22,4 .880	—	15,4 .605	567 20	—	1,14 .045	16,9 .665	—
Alternate-Action	2002DM4	22,4 .880	—	15,4 .605	749 28	—	1,14 .045/Circuit	16,9 .665	—
Pull to Cheat	2DM408	18,4 .725 Max.	15,7 ± 1,3 .620 ± .050	11,8 .465	680 24	170 6	1,14 .045/Circuit	—	22,0 .865
CONCAVE Momentary	1DM18	11,4 .450	—	3,05 .120	425 15	85 3	1,14 .045	—	—
Momentary	1DM19	11,4 .450	—	3,05 .120	425 24	85 3	1,14 .045	—	—
Momentary	2DM5	11,4 .450	—	3,05 .120	680 24	170 6	1,14 .045/Circuit	—	—
Momentary	2DM6	11,4 .450	—	3,05 .120	680 24	170 6	1,14 .045/Circuit	—	—
CONVEX Momentary	1DM21	11,4 .450	9,02 ± 1,5 .355 ± .060	3,05 .120	425 15	85 3	1,14 .045	—	—
Pull to Cheat	1DM401	17,8 .700	18,9 ± 1,3	13,2 .520	425 15	85 3	1,14 .045	—	23,6 .930
Pull to Cheat	2DM409	21,6 .850	.745 ± .050	15,0 .590	680 24	170 6	1,14 .045/Circuit	—	25,1 .990

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

SERIES DM SWITCHES

1DM301 (SPDT)



2DM301 (DPDT)

PUSH-PULL TWO-POSITION ACTION

When the black button is pushed, it remains down and maintains circuit transfer until it is pulled up again.

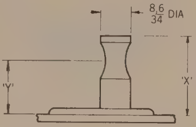
CATALOG LISTINGS

No. of SPDT Circuits	Black Button-Gray Faceplate
1	1DM301
2	2DM301

ELECTRICAL RATING

UL and CSA Listing: 125,250 or 277 VAC, 10 amps. 1/3 H.P.

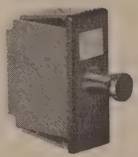
For listings designed to meet CEE24 or low current gold contacts contact your local Branch Office.



Free Position	"X" DIM.	.950/24,1
Max. Over Travel	"Y" DIM.	.625/15,9

SERIES DM

LIGHTED PUSHBUTTON SWITCHES



Push-pull-Type

Series DM lighted pushbutton switches are available with all the features of non-lighted switches plus 6 or 28 volt incandescent or 115 volt neon lamps with a choice of lens colors. They are available in single pole only.

ORDERING INFORMATION

To order, combine the basic (function) listing from Table 1 with the desired color suffix (for the lens) to complete the catalog listing. (For example, catalog listing 106DM301-R is a push-pull two-position switch with a 6 volt lamp and a red lens.)

TABLE 1—BASIC LISTING ORDER GUIDE

SWITCH TYPE	LAMP	BASE LISTING (Add Color Suffix)
Momentary Action	6 volt	106DM1—
	28 volt	128DM1—
	115 volt	1115DM1—
Push-Pull	6 volt	106DM301—
	28 volt	128DM301—
	115 volt	1115DM301—
Alt. Action	6 volt	2106DM1—
	28 volt	2128DM1—
	115 volt	2115DM1—

NOTE: All above listings have black buttons and faceplates. White or gray faceplates can be supplied in production quantities.

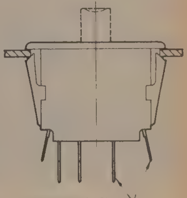
TABLE 2—COLOR SUFFIX

LAMP TYPE	LENS COLOR (Add suffix letter to base listing)					
6 or 28 volt (Translucent Lens)	Red -R	Yellow -Y	Green -G	Blue -B	White -W	Colorless
115 Volt Neon Transparent Lens)	-R	-Y				-C

The average life of the permanently assembled (non replaceable) lamp is 25,000 hours, as rated by the lamp manufacturer. The neon lamp version is supplied with an integral series-wired resistor.

LAMP RATINGS:

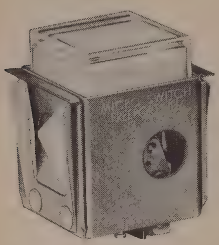
6V	.20 amp
28V	.94 amp
115V	1.9 milliamp

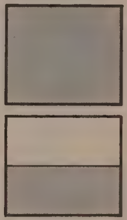


DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

SERIES 302PB LIGHTED PUSHBUTTON SWITCHES





SHOWN ACTUAL SIZE

Series 302PB is available in a choice of momentary or alternate-action operation of two single-pole double-throw switches. When the alternate-action switch is pushed, the display screen remains slightly depressed and circuit transfer is maintained until the next operation.

MATCHING INDICATORS

Series 302LT indicators are identical to 302PB switches in size and appearance, but have no switching function.

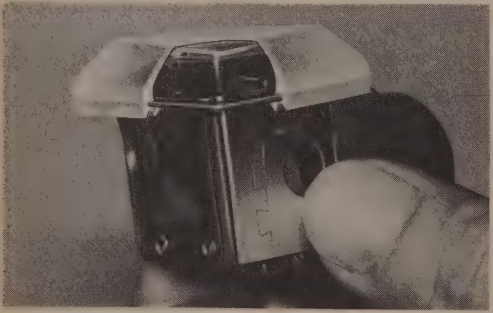
TWO LAMPS

Two long-life 5 volt T-1 lamps are provided with each unit, one under each half of the display screen. 12 and 28 volt lamps are also available. Lamp terminals are separate from switch terminals.

MOUNTING

Units snap into panels, held secure by spring clips on the mounting flanges. Recommended panel thickness is .060" to .250" (1,5 mm to 6,3 mm). Thicker panels lessen retention. Row mounting requires a .903" (+.020 −.000) wide slot or single in a .903" (+.020 −.000) by .826" hole. (22,9 mm by 21 mm).

PANEL SEAL

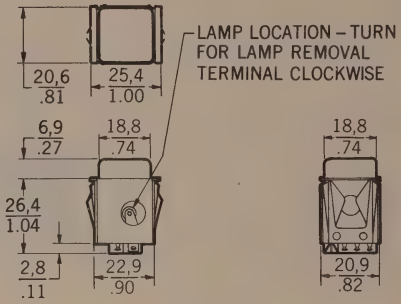


A seal accessory, Catalog Listing 302PA2, is available for protecting switches, indicators and other behind panel components from moisture or dirt.

Clear elastomer cover fits over screen and edge of mounting plate (see cutaway) during installation.

This seal is used with individual units, but is not suited to row mounted units or applications which require spacing barriers.

- Miniature Size-Occupies Less Than One Cubic Inch
- One or Two-Section Display, Two-Lamp Indication



ELECTRICAL RATING

28 vdc . . . 7 amps res., 4 amps ind. sea level, 2.5 amps ind. at 50,000 ft., 4 amps motor load, 2.5 amps lamp load and 25 amps max. inrush. UL and CSA listing for basic switch: 115/230 vac . . . 7 amps res. and ind., 15 amps inrush.

SPACING BARRIERS

Spacing barriers may be used to separate groupings of switches or indicators and guard against accidental operation of two screens with one push.

The barriers mount separately on the panel and are not attached to the switches or indicators. They seat flush against the flat sides of the units. Barriers are .115" thick.

CATALOG LISTINGS

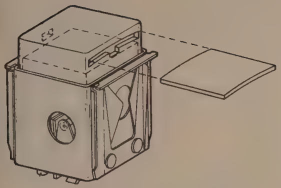
GRAY	BLACK	RED	WHITE
302PA1-GY	302PA1-BK	302PA1-R	302PA1-W

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

SERIES 302PB LIGHTED PUSHBUTTON SWITCHES

ONE SECTION DISPLAY UNIT ORDERING GUIDE



These switches and indicators have a translucent colored base, a .665" square (.030" thick) translucent colored legend insert and a transparent colorless cap.

The entire screen is illuminated by both lamps.

TABLE a—BASIC LISTING

MOMENTARY SWITCH	ALT. ACTION SWITCH	INDICATOR
302PB3-T-	302PB5-T-	302LT2-

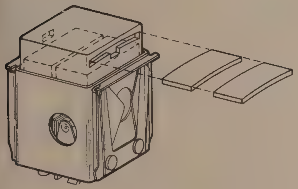
HOW TO ORDER

To order, combine the basic (function) listing from Table 1a with the desired color suffix in Table 1b to complete the catalog listing. For example, **302PB5-T-B** is an alternate-action switch with a blue screen and insert.

TABLE 1b—COLOR SUFFIX

Screen Color	Suffix	Screen Color	Suffix
Blue	-B	White	-W
Green	-G	Yellow	-Y
Red	-R		

TWO-SECTION DISPLAY UNIT ORDERING GUIDE



CATALOG LISTINGS
TABLE 2a—BASIC LISTING

MOMENTARY SWITCH	ALT. ACTION SWITCH	INDICATOR
302PB4-T-	302PB6-T-	302LT3-

Two-section screens are also available in a one-piece retractive style which has a lens pattern on the inside contour. When lighted, it provides a sparkling jewel-like appearance. There is no provision for a legend insert. For more information, contact your nearest MICRO SWITCH Branch Office.

Each screen on these switches and indicators has a transparent colorless cap, divided translucent colored two-section base and two .325" x .655" (.030" thick) translucent colored legend inserts which match the base color. They can be furnished in single color or two color combinations. A baffle in the base prevents light spillage from one section to the other when only one lamp is lighted.

TABLE 2b—COLOR SUFFIX

SCREEN COLOR	SUFFIX
BLUE-BLUE	-BB
BLUE-GREEN	-BG
BLUE-RED	-BR
BLUE-WHITE	-BW
BLUE-YELLOW	-BY
GREEN-GREEN	-GG
GREEN-RED	-GR
GREEN-YELLOW	-GY
RED-RED	-RR
RED-YELLOW	-RY
WHITE-GREEN	-WG
WHITE-RED	-WR
WHITE-WHITE	-WW
WHITE-YELLOW	-WY
YELLOW-YELLOW	-YY

HOW TO ORDER

To order momentary or alternate-action switches and indicators with two-section display, combine the basic (function) listing in Table 2a with the desired color suffix in Table 2b to complete the catalog listing. For example, 302LT3-GY is an indicator with a green-yellow screen.

HOW TO ASSEMBLE INSERTS

Inserts are package with each switch or indicator, unassembled. Bend insert slightly between the thumb and two fingers and push completely through slot. It will then flatten out and be retained. It cannot fall out.

MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

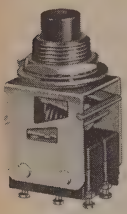
SERIES PB PUSHBUTTON SWITCHES

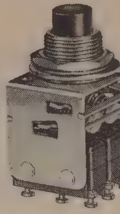
TOUCH-FEEDBACK TYPE

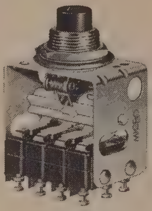
- Compact Designs
- Multi-Pole Switching

ELECTRICAL RATING FOR ALL SERIES PB EXCEPT 15PB and 700 PB

30 VDC-5 amps res. sea level or 50,000 ft., 3 amps ind. sea level, 2.5 amps ind. 50,000 ft., 24 amps. max. inrush. UL and CSA listing for basic switch:
125 or 250 VAC. . . . . 5 amps

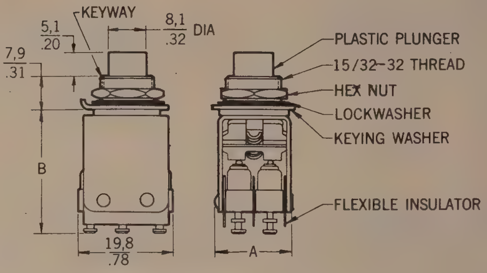

2-POLE MOMENTARY-ACTION


3-POLE MOMENTARY-ACTION


4-POLE ALTERNATE-ACTION

CATALOG LISTINGS

BUTTON COLOR	No. of SPDT Circuits				
	2	2	3	4	4
	Mom. Action	Alt. Action	Mom. Action	Mom. Action	Alt. Action
Black	2PB11-T2	82PB19-T2	3PB11-T2	4PB11-T2	84PB19-T2
	2PB732-T2 (M8805/ 23-001)	—	—	4PB714-T2 (M8005/ 23-003)	—
Red	2PB12-T2	82PB21-T2	3PB12-T2	4PB12-T2	84PB21-T2
	2PB717-T2 (M8005/ 23-002)	—	—	4PB717-T2 (M8005/ 23-004)	—
Green	2PB273-T2	82PB22-T2	3PB273-T2	4PB273-T2	84PB22-T2

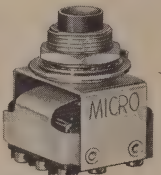

KEYWAY
5,1
.20
8,1
.32
DIA
7,9
.31
B
19,8
.78
A
PLASTIC PLUNGER
15/32-32 THREAD
HEX NUT
LOCKWASHER
KEYING WASHER
FLEXIBLE INSULATOR

	2-Pole	3-Pole	4-Pole
Dim. "A" (max.)	Mom. Act. 16,8/.66 Alt. Act. 17,3/.68	23,1/.91 —	30,0/1.18 30,5/1.20
Dim. "B"	Mom. Act. 26,7/1.05 Alt. Act. 33,0/1.34	26,7/1.05 —	26,7/1.05 33,0/1.34

SHORT TRAVEL SWITCH

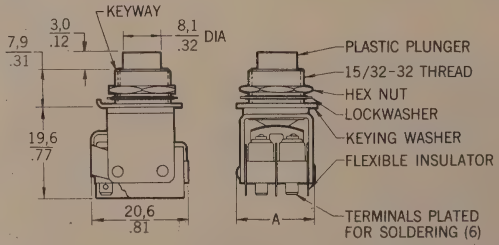
These switches are similar in appearance to the touch-feedback design, but have a leaf actuator for lower operating forces and shorter travel.

2-POLE MOMENTARY-ACTION


3-POLE MOMENTARY-ACTION

CATALOG LISTINGS

BUTTON COLOR	NO. OF SPDT CIRCUITS	
	2	3
Black	2PB7	3PB7
Red	2PB8	3PB8


KEYWAY
3,0
.12
8,1
.32
DIA
7,9
.31
19,6
.77
20,6
.81
A
PLASTIC PLUNGER
15/32-32 THREAD
HEX NUT
LOCKWASHER
KEYING WASHER
FLEXIBLE INSULATOR
TERMINALS PLATED FOR SOLDERING (6)

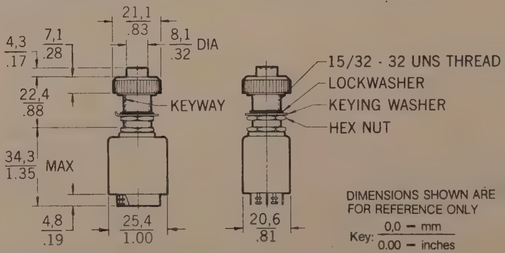
	2-Pole	3-Pole
Dim. "A" (max.)	17,0/.67	23,8/.94

SEALED AT BUSHING, BUTTON, PANEL AND SWITCH UNITS

MOMENTARY ACTION

Catalog Listing **2PB901-T2** meets the submergence requirements of MIL-STD-108D (up to 10 p.s.i. water pressure for one hour). It is sealed facenut-to-panel, button-to-facenut, and bushing-to-facenut (prevents entry of water from back of panel, up and over bushing wall). The two SPDT switch units are potted in a corrosion-resistant metal enclosure.

The knurled facenut is chrome finished to provide an attractive panel appearance with the black button.


21,1
.83
4,3
.17
7,1
.28
8,1
.32
DIA
22,4
.88
KEYWAY
34,3
1.35
MAX
4,8
.19
25,4
1.00
20,6
.81
15/32 - 32 UNS THREAD
LOCKWASHER
KEYING WASHER
HEX NUT

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
Key: 0,0 — mm / 0.00 — inches

WITH BUTTON AND PANEL SEALS

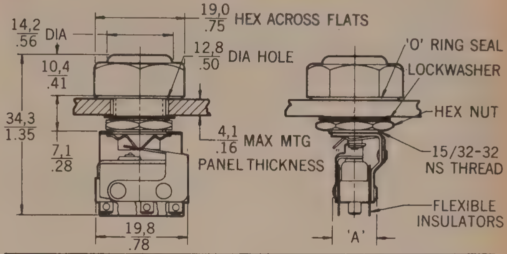
MOMENTARY-ACTION

1PB4

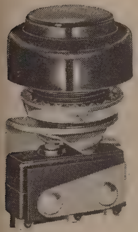
2PB4

BOTH HAVE BLACK BUTTONS.
OPERATING FORCE 1,36 Kg/3 LBS. APPROX.

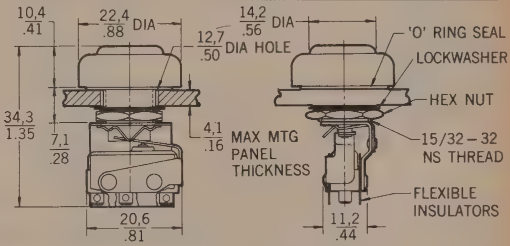
This two-piece design assembly enables the pushbutton to be separated from the switch unit and mounted in the panel. The switch unit is then easily wired and snapped into place from behind the panel. There is an elastomer seal bonded between the plunger and button collar and an "O" ring seals the button assembly to the panel front.


14,2 / .56 DIA
19,0 / .75 HEX ACROSS FLATS
12,8 / .50 DIA HOLE
10,4 / .41
34,3 / 1.35
7,1 / .28
4,1 / .16 MAX MTG PANEL THICKNESS
19,8 / .78
'O' RING SEAL
LOCKWASHER
HEX NUT
15/32-32 NS THREAD
FLEXIBLE INSULATORS
'A'

	1-Pole	2-Pole
Dim "A" (max)	11,7/.46	17,0/.67



1PB42 (black button)
1PB43 (red button)
OPERATING FORCE 1.36 Kg/3 LBS. APPROX.

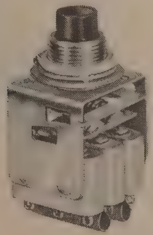

10,4 / .41
22,4 / .88 DIA
14,2 / .56 DIA
12,7 / .50 DIA HOLE
34,3 / 1.35
7,1 / .28
4,1 / .16 MAX MTG PANEL THICKNESS
20,6 / .81
11,2 / .44
'O' RING SEAL
LOCKWASHER
HEX NUT
15/32 – 32 NS THREAD
FLEXIBLE INSULATORS

ELECTRICAL RATING: Refer to top of page B1.

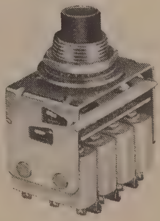
HERMETICALLY SEALED SWITCH UNITS

MOMENTARY-ACTION

2-POLE



3-POLE



4-POLE

Hermetic Seal

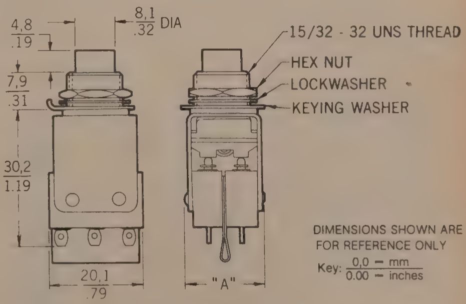
Sealing consists of metal-to-metal fusion around the cover, actuator, base and mounting holes of each switching unit. The terminals are joined to the housing by glass-to-metal seals. The vapor-proof container permits use in damp locations without danger of condensation on the contacts, as well as providing protection from external contaminants. All external parts are corrosion resistant and meet MIL-S-6743 specifications. This design also meets explosion-proof requirements of MIL-E-5272.

Electrical Rating: 3 amps. ind., 5 amps. res., 28 VDC and 115 VAC 400 cps.

CATALOG LISTINGS

BUTTON COLOR	NO. OF SPDT CIRCUITS		
	2	3	4
Black	702PB1	703PB1	704PB1
Red	702PB2	703PB2	704PB2
Green	702PB3	703PB3	

These pushbuttons are equipped with MICRO SWITCH "HM" hermetically sealed switch units which provide electrical stability under abrupt changes in atmospheric and environmental conditions. Good feel of the switching action is provided by a touch-feedback which is transmitted through the button when it is operated.


4,8 / .19
8,1 / .32 DIA
7,9 / .31
30,2 / 1.19
20,1 / .79
"A"
15/32 - 32 UNS THREAD
HEX NUT
LOCKWASHER
KEYING WASHER

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
Key: 0,0 — mm / 0.00 — inches

	2-Pole	3-Pole	4-Pole
Dim. "A" (max.)	16,8/.66	23,1/.91	30,0/1.18

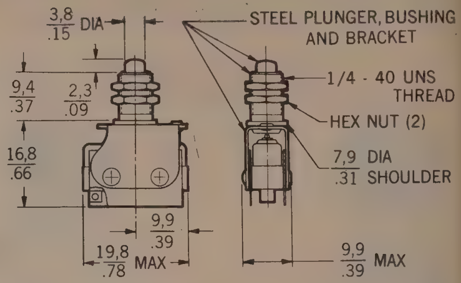
SERIES PB PUSHBUTTON SWITCHES

MINIATURE SIZE SWITCHES

MOMENTARY-ACTION

Catalog Listing **1PB5** is a single-pole double-throw miniature pushbutton switch, weighing only 8,5 g/0.3 oz. It has a steel button to enable use under hinged plates or paddle levers, in addition to manual operation.

ELECTRICAL RATING: Refer to top of page B1.

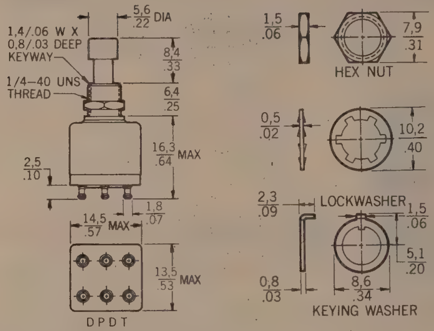

3,8/.15 DIA
STEEL PLUNGER, BUSHING AND BRACKET
9,4/.37
2,3/.09
1/4 - 40 UNS THREAD
HEX NUT (2)
16,8/.66
7,9 DIA/.31 SHOULDER
9,9/.39
19,8/.78 MAX
9,9/.39 MAX

MOMENTARY- ACTION

Catalog listing **15PB2** is a miniature unlighted pushbutton switch.

Contact arrangement is double-pole double-throw.

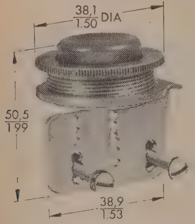
ELECTRICAL RATING: 1.5 amps., 5 amps res., 1 amp lampload, 30 VDC and 115 VAC.


5,6/.22 DIA
1,4/.06 W X 0,8/.03 DEEP KEYWAY
8,4/.33
1/4–40 UNS THREAD
6,4/.25
16,3/.64 MAX
2,5/.10
14,5/.57 MAX
1,8/.07
13,5/.53 MAX
DPDT
1,5/.06
7,9/.31
HEX NUT
0,5/.02
10,2/.40
2,3/.09
LOCKWASHER
1,5/.06
5,1/.20
0,8/.03
8,6/.34
KEYING WASHER

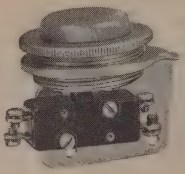
SERIES 12MA PUSHBUTTON ACTUATORS

AUXILIARY PUSHBUTTON ACTUATORS

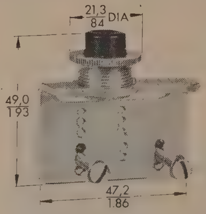
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
Key: 0,0 — mm / 0.00 — inches


38,1/1.50 DIA
50,5/1.99
38,9/1.53

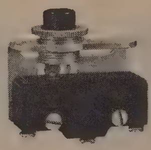
ACTUATOR WITH 1" BUTTON



12MA7 WITH BASIC SWITCH

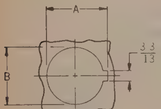

21,3/.84 DIA
49,0/1.93
47,2/1.86

ACTUATOR WITH ½" BUTTON



12MA1 WITH BASIC SWITCH

PANEL CUTOUT



Dimension	Button dia. ½"	Button dia. 1"
"A"	18,0/.71	34,0/1.34
"B"	16,8/.66	32,5/1.28

CATALOG LISTINGS

½" dia.	Black	12MA1
	Red	12MA2
	Green	12MA3
1" dia.	Black	12MA5
	Red	12MA6
	Green	12MA7

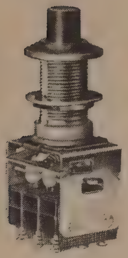
Easy To Assemble to Wide Variety of Basic Switches

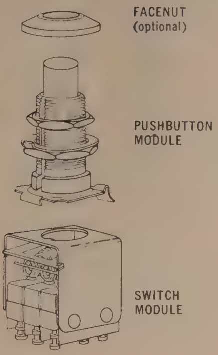
Series 12MA actuators can be combined with A and Z pin plunger basic switches in Section G and TB basic switches in Section F to provide custom pushbutton assemblies for most electrical capacity or circuitry requirements.

They accommodate panels 1,5 to 7,9 mm/.060 to .312-inch thick. A neat, attractive panel appearance is presented by the smooth plastic ½" and 1" diameter buttons and clear anodized aluminum bushings. A keying stud prevents bushing rotation. (Order actuators and switches as separate items.) Two sets of switch mounting screws and lockwashers are supplied with each actuator.

SWITCHES SHOWN ARE NOT INCLUDED WITH THE ACTUATOR

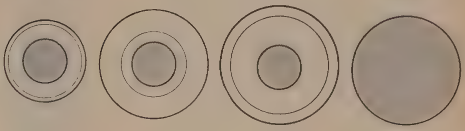
SERIES 6 MODULAR PUSHBUTTON SWITCHES **B**





- East-to-Assemble Modules
- Wide Array of Switch Modules
- Choice of Three Facenut Types, Including One With Panel Seal

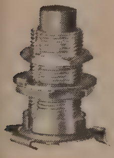
custom pushbutton switch assemblies can be built up from interchangeable modules, enabling lower inventories.



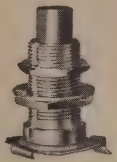
Panel views, left to right: hexnut, with 6C3, 6C2 and 6C1 facenuts, and ¾" diameter button.

PUSHBUTTON MODULES

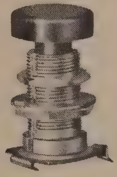
Pushbutton modules consist of an operating button, mounting bushing, two hexnuts and a keying washer. Mounting, clips are provided at the base of the bushing for attachment of switch modules (or optional hold-in coil modules). They can be mounted in panels up to .312" thick.



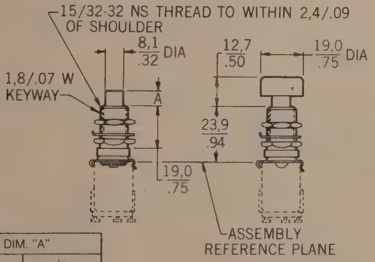
6A46, 6A47
and 6A48



6A49
and 6A50



6A43, 6A44
and 6A45



	DIM. "A"	
	mm	in.
6a43 6A44 6A45	5,1	.20
6A46 6A47 6A48	8,6	.34

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

BUTTON COLOR	5/16" DIA. CONCAVE BOTTOM		3/4" DIA. FLAT BUTTON
	3/16" HEIGHT	3/8" HEIGHT	1/2" HEIGHT
Black	6A43	6A46	6A49**
Red	6A44	6A47	6A50**
Green	6A45	6A48	—

*Measured from top of bushing to top of button.

**Button supplied unassembled.

COIL MODULE

Hold-in coils can be added to a Series 6 assembly between the pushbutton and switch modules to provide electromagnetic maintained and released contact. Refer to Page A47 for catalog listings.

SWITCH MODULES

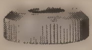
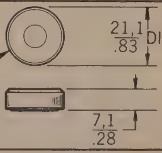
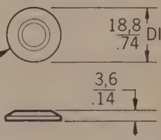
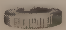
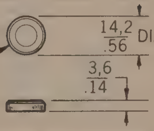
All switch modules shown on Pages A49-A52 can be snapped onto Series 6 pushbutton modules.

FACENUTS

A more attractive panel appearance can be achieved by substituting a facenut for one of the hexnuts supplied with the pushbutton modules.

Catalog Listing 6C1 has panel-to-bushing and bushing-to-button seals. It is for use with 6A46, 6A47 and 6A48 pushbutton modules only. The edge is knurled for assembling ease.

Catalog Listing 6C2 has a beveled edge and 6C3 has a knurled edge.

 6C1	KNURLED FACENUT WITH PANEL AND PLUNGER SEALS  21,1/.83 DIA 7,1/.28
6C2	BEVELED FACENUT  18,8/.74 DIA 3,6/.14
 6C3	KNURLED FACENUT  14,2/.56 DIA 3,6/.14

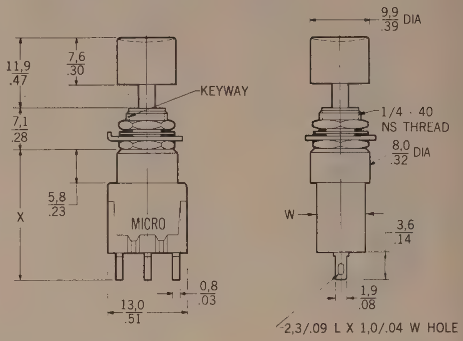
SERIES 8 PUSHBUTTON SWITCHES — TYPE 8N AND 8P

Series 8 pushbutton switches are part of a complete line of miniature manual switches, which also includes toggle, rocker, and paddle switches. Refer to pages C1-C10 for information on these other Series 8 products.

Type 8N and 8P switches meet requirements for a miniaturized 1/4" diameter bushing mounted pushbutton. Concave surface buttons are available in two sizes and eight colors. Type 8P switches have bushing and panel seals, and a "D" bushing instead of a keyway slot.

Switch catalog listings are derived from the ordering guide, as shown in the example below. Buttons are ordered separately.

TYPE 8N
(Shown with small button)



Note: Mounting dimensions for 8P switches are similiar to the 8N, however they have a "D" bushing instead of a keyway slot. Refer to page C10 for the "D" bushing panel cutout.

W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 21,0/.83 1 & 2 poles
23,6/.93 3 & 4 poles

Example:

8N	2	02	1	A
PUSHBUTTON SWITCH	NO. OF POLES	ACTION	TERMINAL STYLE	CONTACT MATERIAL
8N 1/4" Bushing **8P** 1/4" Bushing (Panel and Bushing Seal.) Order button separately.	1 1 pole 2 2 pole 3 3 pole 4 4 pole	01 Alternate Action 02 Momentary Action	1 Solder 2 P.C. 3 Wirewrap	A Silver contacts. Copper end terminals. Brass center terminals, silver plating. B Brass contacts and terminals, with .0001" min. gold over .0002" min. nickel. C Fine silver contacts and brass terminals, with .0001" min. gold over .0002" min. nickel.

8N switches are furnished with momentary (push-on, release-off) or alternate action (push-on, push-off). A double-headed arrow (↔) on the switch case identifies momentary switches, while a single-headed arrow identifies alternate-action types.

Buttons, available in two sizes and eight colors, are ordered separately. They press-fit to the switch plunger after the switch is mounted.

CONTACT ACTION

When the button is depressed, alternate-action 8N devices transfer the circuit between the center (common) terminal(s) and the terminal(s) on one side of the switch. When the button is released, the circuit is maintained. The next operation transfers the circuit to the terminal(s) on the other side of the switch.

Momentary action switches have the normally closed terminal(s) located on the keyway side of the switch. When the button is depressed, the circuit transfers the circuit to the terminal(s) opposite the keyway. Releasing the button transfers the circuit to the terminal(s) on the keyway side.

BUTTONS

	DIMENSIONS	CATALOG LISTING	COLOR
LARGE BUTTON 	.59" DIA. BY .39" HEIGHT	8Z0061	WHITE
		8Z0062	RED
		8Z0063	BLACK
		8Z0064	GRAY
		8Z0065	GREEN
		8Z0066	BLUE
		8Z0067	AMBER
		8Z0068	YELLOW
SMALL BUTTON 	.39" DIA. BY .30" HEIGHT	8Z0081	WHITE
		8Z0082	RED
		8Z0083	BLACK
		8Z0084	GRAY
		8Z0085	GREEN
		8Z0086	BLUE
		8Z0087	AMBER
		8Z0088	YELLOW

TOGGLE/ROCKER & PADDLE SWITCH SELECTION GUIDE

1. Use the "Initial Application Considerations" column to help you find the most suitable toggle types.
2. Turn to the listed pages for more details and ordering information.

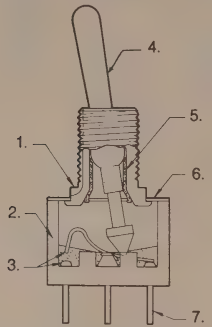
INITIAL APPLICATIONS CONSIDERATIONS	 SERIES TL TOGGLE SWITCHES Pg. C14 to C17	 SERIES AT TOGGLE SWITCH ASSEMBLIES Pg. C23 to C27	 SERIES TW MINIATURE TOGGLE SWITCHES Pg. C11 to C13	 SERIES 8 MINIATURE TOGGLE SWITCHES Pg. C1 to C10	 SERIES 8 MINIATURE PADDLE & ROCKER SWITCHES Pg. C1 to C1o	 SERIES TP ROCKER SWITCHES Pg. C18 to C20	 SERIES ET MAGNETICALLY HELD TOGGLE SWITCHES Pg. C28 to C32	 SERIES TS TOGGLE SWITCHES Pg. C21 to C22
ELECTRICAL RATING								
1 Amp or Less		●		●	●		●	
6 Amps or Less	●	●	●	●	●	●	●	●
Over 6 Amps	●	●				●		●
POSITION								
2 Position	●	●	●	●	●	●	●	●
3 Position	●	●	●	●	●	●	●	●
ACTION								
Momentary	●	●	●	●	●	●	●	●
Maintained	●	●	●	●	●	●	●	●
NO. OF POLES								
1 Pole	●	●	●	●	●	●	●	●
2 Pole	●	●	●	●	●	●	●	●
3 Pole		●		●				
4 Pole	●	●		●		●		
Up to 10 Poles		●						
TERMINATION								
Solder	●	●	●				●	●
Quick-Connect	●	●	●			●		●
Comb. Solder/Q.C.				●	●			
Screw	●	●				●	●	●
Printed Circuit				●	●			
Wire Wrap				●	●			
IWTS	●		●					
Leadwire							●	
SEALS								
Bushing Seal	●		●	●		●	●	●
Environment Proof	●						●	
Panel (seal accessory) for 15/32″ dia. bushings	●	●	●	●			●	●
Hermetically Sealed (basic switches)		●						
OPERATOR TYPES								
Small dia. Lever		●	●	●				
Large dia. Lever	●	●	●	●			●	●
Long Lever	●			●				●
Flatted Lever				●				
Tab Lever	●	●	●				●	●
Pull-To-Unlock Lever	●	●	●	●			●	
Paddle					●			
Rocker (unlighted)					●	●		
Rocker (lighted)					●			
MOUNTING								
1/4″ dia. Bushing		●	●	●				
15/32″ dia. Bushing	●	●	●	●			●	●
Snap-In					●			
3-Hole		●		●		●		●
AGENCY LISTING								
Military	●	●	●				●	
UL	●	●	●	●	●	●		●
CSA	●	●	●			●		
PRICE								
Low Range				●	●			●
Moderate Range	●	●	●			●		●
High Range	●	●				●	●	

MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES 8 MINIATURE MANUAL SWITCHES

Series 8 offers an outstanding variety of electrical and structural features throughout this line of commercial miniature manual switches.

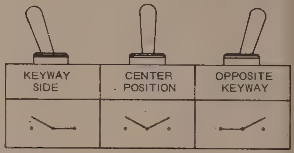


The MICRO SWITCH Series 8 line of miniature manual switches is ideally suited for commercial applications which have limited space requirements and demand high quality and performance standards. There is a wide choice of operator options: toggles - with small, large, flatted, color tipped, short, long, and pull-to-unlock levers; rockers - in lighted and unlighted versions; paddles; and pushbutton switches - with a choice of two button sizes. Accessories, such as colored plastic lever sleeves for toggle switches and colored bezels for rocker and paddle switches, can be used to enhance panel appearance and to identify control functions.

QUALITY CONSTRUCTION

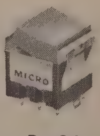
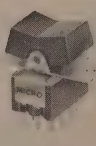
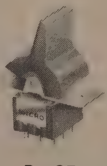
1. HIGH TORQUE BUSHING. Prevents toggle switch bushing from rotating or separating from case during assembly.
2. ARC-RESISTANT CASE. Constructed of high strength plastic and compartmented to assure isolation of circuits in multi-pole devices.
3. CONTACTS. Choice of fine silver, gold/nickel plated brass, or gold/nickel plated fine silver contacts for handling a variety of electrical loads.
4. OPERATORS. Choice of levers, i.e., small, large, flatted, color tipped, short, and long levers; and rocker, paddle, and pushbutton operators, to provide maximum flexibility.
5. LEVER STOP. Toggle switch bushings have a built-in lever stop to prevent contact transfer or switch damage should a downward force be applied to the lever.
6. RECESSED COVER ATTACHMENT. All Series 8 switches have the steel cover attached to the case away from close proximity to the switch terminals. This isolation aids in preventing shorting between the terminals and case during assembly or use.
7. EPOXY SEALED TERMINALS. All switches have epoxy sealed terminals, except the 8A1011.

LEVER/ CIRCUIT RELATIONSHIP



The operating sequence above is repeated in multipole devices. Each pole has double-throw circuitry and consists of three terminals which exit at the bottom of the switch case. The keyway is a helpful reference when you are applying a switch with the momentary (ON) circuit at one of the extreme lever positions.

SERIES 8 PUSHBUTTON SWITCHES ARE SHOWN ON PAGE B5.

TYPE 8A & 8F SMALL LEVER (8F-Sealed Version)	TYPE 8B LARGE LEVER	TYPE 8C FLATTED LEVER	TYPE 8D LONG LEVER	TYPE 8E LEVER LOCK	TYPE 8G SHORT LEVER	TYPE 8S COLOR TIP
Pg. C3	Pg. C3	Pg. C3	Pg. C3	Pg. C3	Pg. C3, C9	Pg. C3
TYPE 8H ROCKER	TYPE 8H PADDLE	TYPE 8K ROCKER (Lighted)	TYPE 8M ROCKER	TYPE 8M PADDLE	TYPE 8Q ROCKER	TYPE 8Q PADDLE
						
Pg. C5	Pg. C5	Pg. C5	Pg. C7	Pg. C7	Pg. C7	Pg. C7

SERIES 8 MINIATURE MANUAL SWITCHES

SPECIFICATIONS

ELECTRICAL DATA

Fine Silver Contacts: 6 amps, res; 2 amps., ind., 125 VAC (60Hz) and 28 VDC. UL Listed (most models): 6 amps, 125 VAC. Gold/Nickel Plated Brass or Fine Silver Contacts: 0.5 VA max. at 20 volts max.

PERFORMANCE DATA

Initial Switch Resistance 10 milliohms max. at 2-6 VDC, 1 amp, resistive.

Initial Dielectric Strength: 100 microamps max. current leakage between mutually insulated terminals and ground, at sea level at 1000 VAC

Initial Insulation Resistance 1000 megohms min. resistance between mutually insulated terminals and ground, at 500 VDC

Mechanical Endurance: 100,000 switching operations - 95% survival for type 8A1

Strength of Actuator: Will withstand 3.6 Kg. (8 lbs.) push test in any direction.

Strength of Terminals: Will withstand 2.3 Kg (5 lbs.) pull in any direction.

Strength of Mounting Means: For normal installation, mounting nut will withstand torque of 1.7 Nm (15 in. lbs.) without damage to threads or switch body.

Vibration: 100-500 Hz at 10G—10 microseconds max.

Shock: 50 G, 1/2 Sinwave

Seal (8F and 8P): Will withstand 1 meter (3.3 ft.) head of water for 30 minutes.

TOGGLE SWITCHES

Bushing: Nickel plated brass. Toggle Lever: Chrome-plated brass, except type 8C which has a nickel plated brass lever. Lever Sleeves for 8A and 8B: Vinyl. Colored Lever Tips for 8S: Nylon.

PADDLE AND ROCKER SWITCHES

Operators and Bezels: Polycarbonate. 8H and 8K Mounting Clips: Stainless Steel. 8K Lamp Terminals: Silver plated phosphor bronze terminals which accept two No. 22 AWG wires. 8Q and 8M Mounting Plates: Cold rolled cadmium plated steel. 8Q and 8M Standoffs: Nickel plated brass.

PUSHBUTTON SWITCHES

Buttons: Nylon

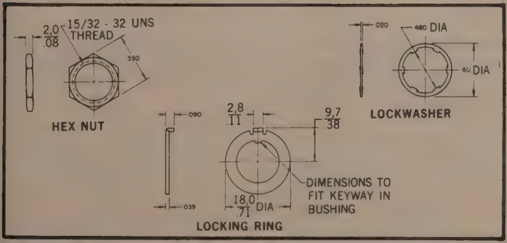
GENERAL

Case: Epoxy resin, with epoxy terminal seals standard on all switches, except 8A1011. Metal Housing: Cold rolled steel, zinc plated.

MOUNTING HARDWARE

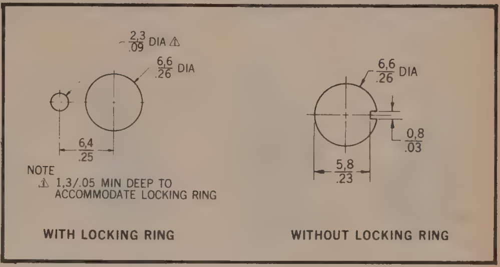
(Refer to page C10 for other options.)

Type 8B:


2,0
.08
15/32 · 32 UNS THREAD
.550
HEX NUT
.020
.480 DIA
.60 DIA
LOCKWASHER
.090
2,8
.11
9,7
.38
.039
18,0
.71
DIA
DIMENSIONS TO FIT KEYWAY IN BUSHING
LOCKING RING

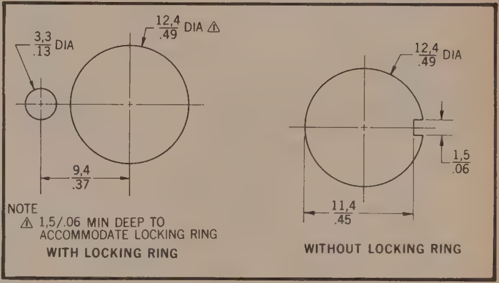
MOUNTING DETAIL

Types 8A, 8C, 8D, 8E, 8N, and 8S:

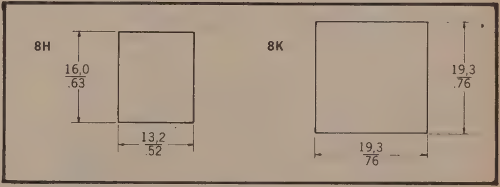

2,3
.09
DIA ⚠
6,6
.26
DIA
6,4
.25
NOTE
⚠ 1,3/.05 MIN DEEP TO ACCOMMODATE LOCKING RING
WITH LOCKING RING
6,6
.26
DIA
0,8
.03
5,8
.23
WITHOUT LOCKING RING

Types 8F and 8P: Refer to page C10.

Type 8B:


3,3
.13
DIA
12,4
.49
DIA ⚠
9,4
.37
NOTE
⚠ 1,5/.06 MIN DEEP TO ACCOMMODATE LOCKING RING
WITH LOCKING RING
12,4
.49
DIA
1,5
.06
11,4
.45
WITHOUT LOCKING RING

Types 8H and 8K:


8H
16,0
.63
13,2
.52
8K
19,3
.76
19,3
76

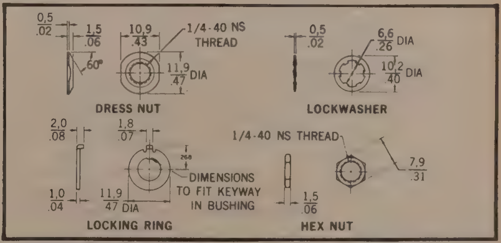
Types 8M and 8Q: Refer to page C7

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

Types 8A, 8D, 8E, 8N and 8S:
2 hexnuts, 1 lockwasher, and 1 locking ring

Type 8C:
1 dressnut, 1 hexnut, and 1 locking ring


0,5
.02
1,5
.06
60°
10,9
.43
1/4-40 NS THREAD
11,9
.47
DIA
DRESS NUT
0,5
.02
6,6
.26
DIA
10,2
.40
DIA
LOCKWASHER
2,0
.08
1,8
.07
.268
1,0
.04
11,9
47
DIA
DIMENSIONS TO FIT KEYWAY IN BUSHING
LOCKING RING
1/4-40 NS THREAD
7,9
.31
1,5
.06
HEX NUT

SERIES 8 TOGGLE SWITCHES

TYPE 8A & 8F*
SMALL LEVER

TYPE 8B
LARGE LEVER

TYPE 8C
FLATTED LEVER

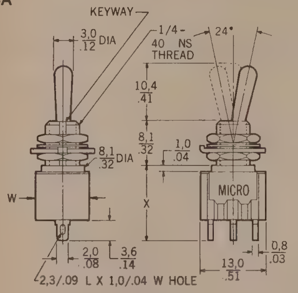
TYPE 8D
LONG LEVER

TYPE 8E
LEVER LOCK

TYPE 8G**
SHORT LEVER

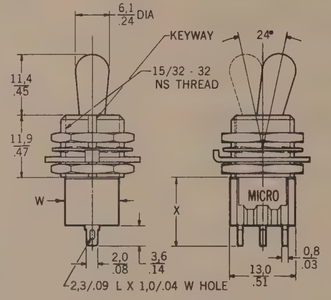
TYPE 8S

8A


KEYWAY
3,0 .12 DIA
1/4 - 40 NS THREAD
24°
10,4 .41
8,1 .32
8,1 .32 DIA
1,0 .04
MICRO
W
X
2,0 .08
3,6 .14
0,8 .03
13,0 .51
2,3/.09 L X 1,0/.04 W HOLE

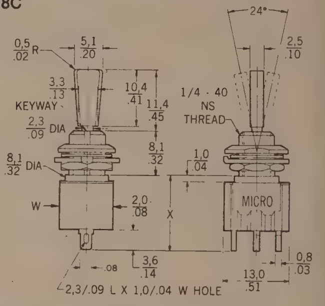
W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 13,7/.54 1 & 2 poles
16,0/.63 3 & 4 poles

8B


6,1 .24 DIA
KEYWAY
24°
15/32 - 32 NS THREAD
11,4 .45
11,9 .47
MICRO
W
X
2,0 .08
3,6 .14
0,8 .03
13,0 .51
2,3/.09 L X 1,0/.04 W HOLE

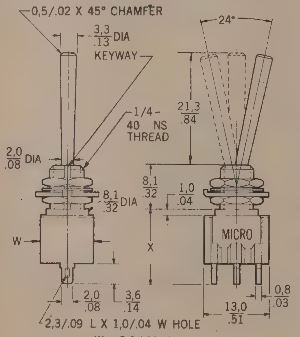
W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 13,7/.54 1, 2, 3 & 4 poles

8C


24°
0,5 .02 R
5,1 .20
2,5 .10
3,3 .13
10,4 .41
11,4 .45
1/4 - 40 NS THREAD
KEYWAY
2,3 .09 DIA
8,1 .32
8,1 .32 DIA
1,0 .04
MICRO
W
2,0 .08
X
.08
3,6 .14
0,8 .03
13,0 .51
2,3/.09 L X 1,0/.04 W HOLE

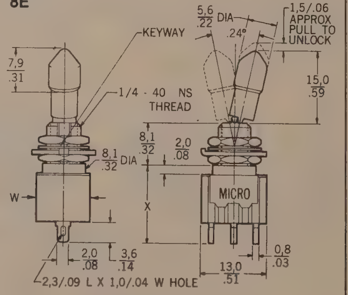
W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 13,7/.54 1 & 2 poles
16,0/.63 3 & 4 poles

8D


0,5/.02 X 45° CHAMFER
24°
3,3 .13 DIA
KEYWAY
1/4 - 40 NS THREAD
21,3 .84
2,0 .08 DIA
8,1 .32
8,1 .32 DIA
1,0 .04
MICRO
W
X
2,0 .08
3,6 .14
0,8 .03
13,0 .51
2,3/.09 L X 1,0/.04 W HOLE

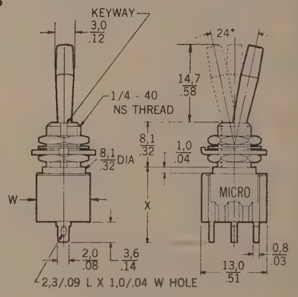
W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 13,7/.54 1 & 2 poles
16,0/.63 3 & 4 poles

8E


5,6 .22 DIA
1,5/.06 APPROX PULL TO UNLOCK
24°
KEYWAY
7,9 .31
15,0 .59
1/4 - 40 NS THREAD
8,1 .32
8,1 .32 DIA
2,0 .08
MICRO
W
X
2,0 .08
3,6 .14
0,8 .03
13,0 .51
2,3/.09 L X 1,0/.04 W HOLE

W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 14,7/.58 1 & 2 poles
17,3/.68 3 & 4 poles

8S


KEYWAY
3,0 .12
24°
14,7 .58
1/4 - 40 NS THREAD
8,1 .32
8,1 .32 DIA
1,0 .04
MICRO
W
X
2,0 .08
3,6 .14
0,8 .03
13,0 .51
2,3/.09 L X 1,0/.04 W HOLE

W = 8,0/.31 1 pole
13,0/.51 2 pole
18,0/.70 3 pole
23,0/.89 4 pole
X = 13,7/.54 1 & 2 poles
16,0/.63 3 & 4 poles

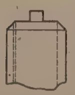
LEVER LOCK FEATURE

Pull-to-Unlock levers are a guard against accidental lever movement. To change lever positions, a spring-loaded locking mechanism must be released by pulling outward on the knobbed lever.

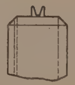
Two-position switches have a type D locking configuration which locks the lever in either of the two extreme positions. Three-position switches have a type A configuration which locks the lever in any of the three positions.

*Dimensions for panel and bushing sealed type 8F switches are similar to type 8A. Type 8F switches have a "D" bushing instead of a keyway slot. Refer to page C10 for the "D" bushing panel cutout.

**Refer to page C9 for mounting dimensions.



TYPE "D"
LOCKED IN TWO EXTREME POSITIONS (NO CENTER POSITION)



TYPE "A"
LOCKED IN THREE POSITIONS

TOGGLE SWITCH ORDERING GUIDE

Toggle switch catalog listings are derived from the ordering guide as shown in the example below. Refer to page C10 to order colored lever sleeves for type 8A nd 8B switches.

Example:

8A 2 01 I A

TOGGLE & BUSHING

8A
¼" bushing, .12" dia. x .41" length lever.

8B
15/32" bushing, .24" dia. x .45" length lever.

8C
1/4" bushing, .20" dia. x .41" length flatted lever.

8D
1/4" bushing, .13 dia. x .84" length lever.*

8E
1/4" bushing, .22" dia. x .59" length pull-to-unlock lever.

8F
Panel and bushing seal, ¼" bushing, .12" dia. x .20" length lever.

8G
Non-threaded 1/4" bushing, .11" dia. x .27" length lever.

NO. OF POLES

1
1-pole

2
2-pole

3
3 pole

4
4 pole

CIRCUITRY

	Opposite Keyway	Center	Keyway
01	ON	NONE	ON
02	ON	OFF	ON
03	NONE	ON	(ON)
04	(ON)	OFF	(ON)
05	ON	OFF	(ON)
06	ON	NONE	(ON)
10	ON	ON	ON
11	ON	ON	(ON)
12	(ON)	ON	(ON)

( ) Parenthesis denotes momentary position

TERMINAL STYLE

1
Solder

2
Printed Circuit

3
Wirewrap

4
Side formed P.C.*

6
End formed P.C.*

*Recommended for 8G type.

CONTACT MATERIAL

A
Silver contacts. Copper end terminals, center brass terminals, silver plating.

B
Brass contacts and terminals, with .0001" min. gold over .0002" min. nickel.

C
Fine silver contacts and brass terminals, with .0001" min. Gold over .0002" min, nickel.

Note: Type 8E lever lock switches are currently available with 01 circuitry (two-position ON-NONE-ON) or 02 circuitry (three-position ON-OFF-ON) only. If other variations are desired, contact your nearest MICRO SWITCH Branch Office.

TOGGLE & BUSHING

8S
1/4" bushing, .12" dia. x .58" length lever with color coded plastic tip.

COLOR TIP

1 White
2 Red
3 Black
4 Gray
5 Green
6 Blue
7 Amber
8 Yellow

To be used for designating 8S color tip only

8S 3 02 1 A – 2

TOGGLE SWITCH OPTIONS

Add suffix code numbers to Series 8 toggle switch catalog listings to designate the desired option.

Example: **8A2011A-001** has a "D" bushing instead of a keyway slot.

For information on additional Series 8 options, contact your nearest MICRO SWITCH Branch Office.

CODE NUMBER	TOGGLE SWITCH OPTION
-001	¼" dia. "D" bushing. (See page C10 for panel cutout)
-002	Black bushing and hardware.
-003	Black toggle lever, bushing, and mounting nut.
-004	8Z0178 dressnut in place of 8Z0171 dressnut.*
-005	8Z0182 locking ring in place of 8Z0174 locking ring*
-007	Metric thread for 1/4" dia. bushing

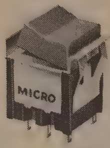
*See page C10

SERIES 8 PADDLE AND ROCKER SWITCHES

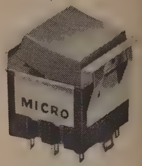
Paddle and rocker operators used with type 8H switches are interchangeable. Type 8K lighted switches are used with rocker operators only.

The wide choice of operator colors enable color coding of switch functions. They also provide a coordinated, attractive panel appearance when used in a mixed panel of Series 8 miniature toggle switches and pushbutton switches. (For information on three-hole mount switches with non-removable paddle rockers, refer to pages C7 and C8.)

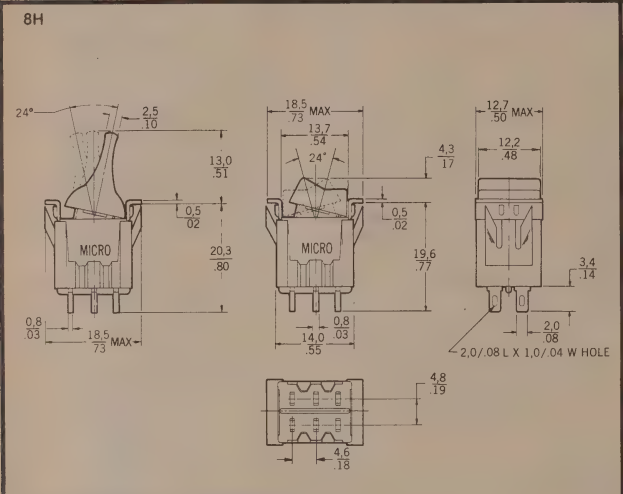
TYPE 8H
WITH PADDLE
OPERATOR



TYPE 8H
WITH ROCKER
OPERATOR

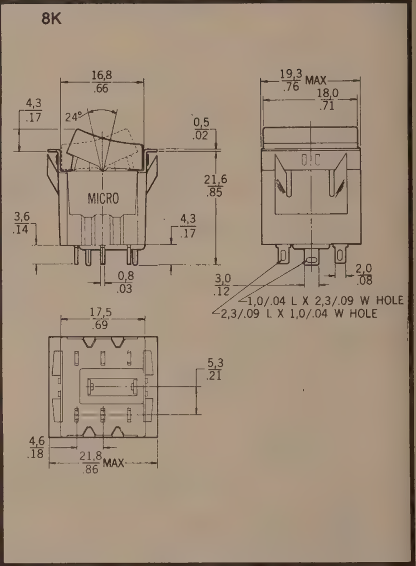


TYPE 8K
WITH LIGHTED
ROCKER OPERATOR


8H
24°
2,5
.10
13,0
.51
0,5
.02
20,3
.80
MICRO
0,8
.03
18,5
.73 MAX
18,5
.73 MAX
13,7
.54
24°
4,3
.17
0,5
.02
19,6
.77
MICRO
0,8
.03
14,0
.55
12,7
.50 MAX
12,2
.48
3,4
.14
2,0
.08
2,0/.08 L X 1,0/.04 W HOLE
4,8
.19
4,6
.18

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

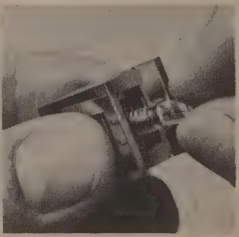

8K
16,8
.66
4,3
.17
24°
0,5
.02
21,6
.85
MICRO
3,6
.14
4,3
.17
0,8
.03
19,3
.76 MAX
18,0
.71
3,0
.12
2,0
.08
1,0/.04 L X 2,3/.09 W HOLE
2,3/.09 L X 1,0/.04 W HOLE
17,5
.69
5,3
.21
4,6
.18
21,8
.86 MAX

EAST TO RELAMP

Relamping of 8K switches is accomplished by (1) grasping the rocker and removing it with an outward pull and (2) extracting lamp by unscrewing or by pulling it out with a lamp tool. The lamp is installed by inserting it in the lamp socket.

MICRO SWITCH lamp tool, catalog listing **15PA7,** or a short length of plastic tubing (.220-inch I.D.) can also be used for lamp removal.

REMOVE ROCKER



REPLACE LAMP

LAMP INFORMATION

There are a number of type T-1¾ subminiature screw-base lamps which will fit the socket of 8K switches.

Lamps that are rated for 28 volts or less are recommended.

Lamps which are below .8 watt or above 1.5 watts should not be used in these devices. The former will be too dim for adequate illumination of the rockers and the latter will be too warm for the plastic or the finger's touch, especially if used with over-voltage.

Lamps are not furnished with 8K switches. However, MICRO SWITCH will stock and sell limited quantities of the following types (Order by catalog listing):

CATALOG LISTING	RATED VOLTAGE	NOMINAL CURRENT (AMPS)
8Z0101	6.3	.20
8Z0102	14.0	.08
8Z0103	28.0	.04

PADDLE AND ROCKER SWITCH ORDERING GUIDE

To simplify user parts inventories and provide versatility in operator options, switches, paddles, and rockers are sold separately. Switches snap into panels and are held secure by spring clips on the mounting flanges. They can be mounted individually or in strips.

8H TYPE

8H switches with paddle operators enable quick identification of the toggle position. Rocker operators have the advantages of toggle switch circuitry and versatile pushbutton control and styling.

8K TYPE

8K switches feature one-lamp illumination and relamping from the front of panel. They combine the features of rocker operation with an independent light source for illuminated color display, using a T-1¾ commercial grade screw base lamp.

Catalog listings for type 8H and 8K switches are derived from the ordering guide, as shown in the example, below.

Example: 8H 1 01 1 A

PADDLE AND ROCKER SWITCHES

8H
Non-lighted., Snap-in mounting.

8K
Lighted. Snap-in mounting (Rocker operator only)

Order operators separately

NO. OF POLES

1
1 pole

2
2 pole

CIRCUITRY

	One Extreme	Center	Other Extreme
01	ON	NONE	ON
02	ON	OFF	ON
04	(ON)	OFF	(ON)
05	ON	OFF	(ON)
06	ON	NONE	(ON)

( ) Parenthesis denotes momentary positions.

TERMINAL STYLE

1
Solder

2
P.C.

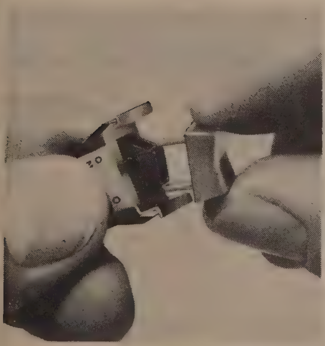
3
Wire Wrap

CONTACT MATERIAL

A
Silver contacts. Copper end terminals. Brass center terminals, silver plating.

B
Brass contacts and terminals with .0001" min. gold over .0002" min. nickel.

C
Fine silver contacts and brass terminals, with .0001" min. gold over .0002" min. nickel.



Operators are easily assembled to the switches by simply pressing them into place in the recesses of the switch operator socket. They are not intended to be easily removed.

BEZEL ACCESSORY

An optional colored bezel accessory is available for use with individual mount units (see photo) to enhance panel appearance and identify control functions. The bezel is assembled by snapping it into the flanges on two sides of the switch. They can be removed and replaced if color changes are necessary.

8H OPERATORS AND BEZELS

COLOR	ROCKER	PADDLE	BEZEL
White	8Z0021	8Z0001	8Z0191
Red	8Z0022	8Z0002	8Z0192
Black	8Z0023	8Z0003	8Z0193
Gray	8Z0024	8Z0004	8Z0194
Green	8Z0025	8Z0005	8Z0195
Blue	8Z0026	8Z0006	8Z0196
Amber	8Z0027	8Z0007	8Z0197
Yellow	8Z0028	8Z0008	8Z0198

WITH BEZEL

8K ROCKERS AND BEZELS

COLOR	ROCKER	BEZEL
White	8Z0041	8Z0211
Red	8Z0042	8Z0212
Black	8Z0043	8Z0213
Gray		8Z0214
Green	8Z0045	8Z0215
Blue	8Z0046	8Z0216
Amber	8Z0047	8Z0217
Yellow	8Z0048	8Z0218

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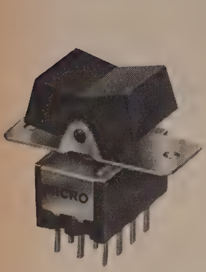
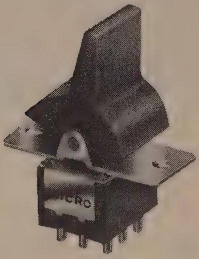
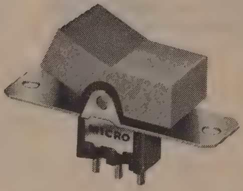
SERIES 8 PADDLE AND ROCKER SWITCHES



TYPE 8M
ROCKER SWITCH

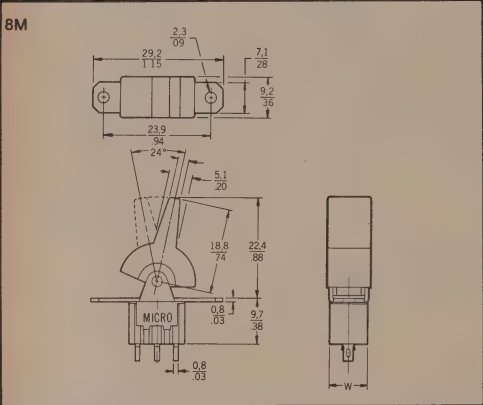


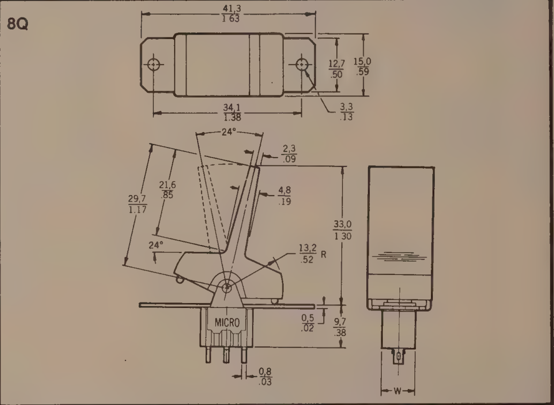
TYPE 8M
PADDLE SWITCH

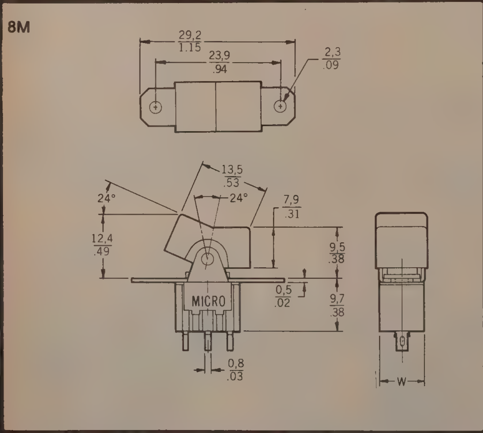


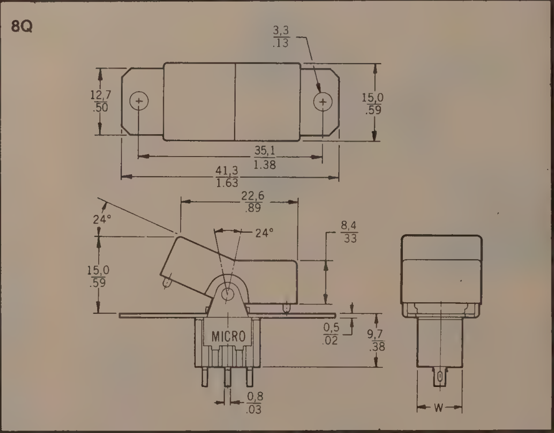
TYPE 8Q
ROCKER SWITCH

TYPE 8Q
PADDLE SWITCH


8M
2,3 / .09
29,2 / 1.15
7,1 / .28
9,2 / .36
23,9 / .94
24°
5,1 / .20
18,8 / .74
22,4 / .88
0,8 / .03
9,7 / .38
MICRO
0,8 / .03
W


8Q
41,3 / 1.63
12,7 / .50
15,0 / .59
34,1 / 1.38
3,3 / .13
24°
2,3 / .09
21,6 / .85
29,7 / 1.17
4,8 / .19
33,0 / 1.30
24°
13,2 / .52 R
0,5 / .02
9,7 / .38
MICRO
0,8 / .03
W


8M
29,2 / 1.15
23,9 / .94
2,3 / .09
13,5 / .53
24°
24°
7,9 / .31
12,4 / .49
9,5 / .38
0,5 / .02
9,7 / .38
MICRO
0,8 / .03
W


8Q
3,3 / .13
12,7 / .50
15,0 / .59
35,1 / 1.38
41,3 / 1.63
22,6 / .89
24°
24°
8,4 / .33
15,0 / .59
0,5 / .02
9,7 / .38
MICRO
0,8 / .03
W

W — 8,0/.31 1 pole; 13,0/.51 2 pole; 17,8/.70 3 pole; 22,6/.89 4 pole.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 \text{ — mm}}{0.00 \text{ — inches}}$

ROCKER AND PADDLE SWITCH ORDERING GUIDE

Example: 8M 2 01 2 A E 6

PADDLE AND ROCKER SWITCHES

8M*
Three hole mount .937 between mounting holes

8Q*
Three hole mount 1.375 between mounting holes

*Stand-off mounting hardware for 1/8" panel thickness furnished with each switch.

NO. OF POLES

1	1 pole
2	2 pole
3	3 pole
4	4 pole

CIRCUITRY

One Extreme	Center	Other Extreme
	01	
ON	None	ON
	02	
ON	OFF	ON
	04	
(ON)	OFF	(ON)
	05	
ON	OFF	(ON)
	06	
ON	None	(ON)
	10	
ON	ON	ON
	11	
ON	ON	(ON)
	12	
(ON)	ON	(ON)

( ) Parenthesis denotes momentary position.

TERMINAL STYLE

1	Solder
2	P.C.
3	Wire Wrap

CONTACT MATERIAL

A
Silver contacts. Copper end terminals, brass center terminals, silver plating.

B
Brass contacts and terminals with .0001'' min. gold over .0002'' nickel.

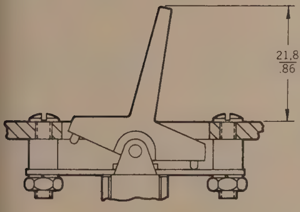
C
Fine silver contacts. Brass terminals with .0001'' min. Gold over .0002 min. nickel.

STYLE OF OPERATOR

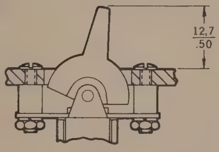
E	Rocker (8M only)
F	Paddle (8M only)
G	Rocker (8Q only)
H	Paddle (8Q only)

COLOR OF OPERATOR

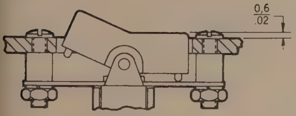
1	White
2	Red
3	Black
4	Gray
5	Green
6	Blue
7	Amber
8	Yellow



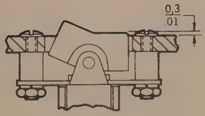
8Q



8M



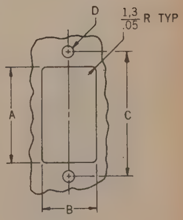
8Q



8M

DIMENSIONS SHOWN
ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$



PANEL CUTOUT
See chart below for dimensions.

STAND-OFF HARDWARE

Panel Thickness	Switch Type	Operator Style	Catalog Listing
1/16"	M	E & F	8Z0231
	Q	G	8Z0232
	Q	H	8Z0233
3/32"	M	E & F	8Z0236
	Q	G	8Z0237
	Q	H	8Z0238
1/8"	M	E & F	8Z0241
	Q	G	8Z0242
	Q	H	8Z0243

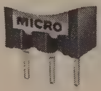
PANEL CUTOUT		TYPE 8M		TYPE 8Q	
		MIN.	MAX.	MIN.	MAX.
A	mm	17,90	18,03	27,76	27,89
	in.	.705	.710	1.093	1.098
B	mm	10,67	10,69	16,41	16,54
	in.	.416	.421	.646	.651
C	mm	23,57	23,93	34,80	35,05
	in.	.932	.942	1.370	1.380
D	mm	2,36	2,44	3,05	3,12
	in.	.093	.096	.120	.123

MICRO SWITCH
A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

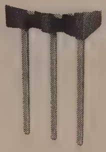
SERIES 8 TERMINATION DATA

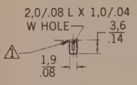
Series 8 has five terminal options: Style 1-solder (may also be used for quick-connect), Style 2-printed circuit. (may also be used for solder or quick-connect), Style 3-wire wrap (may also be used for P.C.), Style 4-side formed P.C., and Style 6-end formed P.C. termination.

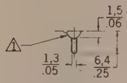
STYLE 1

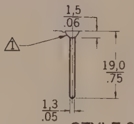


STYLE 2

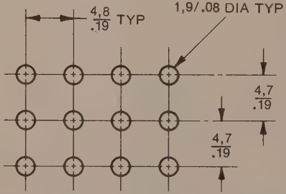

STYLE 3


2,0/.08 L X 1,0/.04
W HOLE
3,6
.14
1,9
.08
STYLE 1

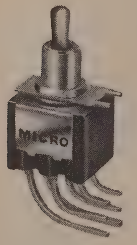

1,5
.06
1,3
.05
6,4
.25
STYLE 2


1,5
.06
19,0
.75
1,3
.05
STYLE 3

PRINTED CIRCUIT PANEL LAYOUT


4,8
.19 TYP
1,9/.08 DIA TYP
4,7
.19
4,7
.19

△ EPOXY TERMINAL SEAL, .060 MAX HIGH



STYLE 6
TERMINALS
(END FORMED)

TYPE 8G
SWITCH

STYLE 4
TERMINALS
(SIDE FORMED)

SOLDERING PROCEDURES

1. 60-40 solder should be used
2. 700°F solder iron tip temperature

Hold solder tip to terminal 1½ to 3 seconds. **3 SECONDS MAX.**

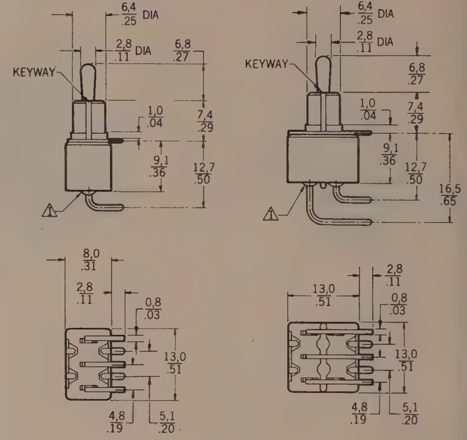
This allows the terminal to heat quickly on the exterior of the switch only and reduces greatly the chance of flux migrating inside the switch.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

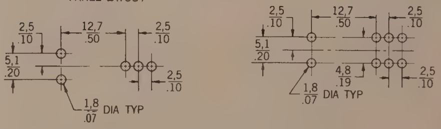
Key: 0,0 — mm
0.00 — inches

TYPE 8G

WITH STYLE 4 TERMINALS

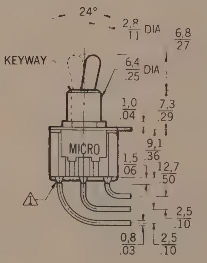

6,4
.25 DIA
2,8
.11 DIA
6,8
.27
KEYWAY
1,0
.04
7,4
.29
9,1
.36
12,7
.50
6,4
.25 DIA
2,8
.11 DIA
KEYWAY
6,8
.27
1,0
.04
7,4
.29
9,1
.36
12,7
.50
16,5
.65
8,0
.31
2,8
.11
0,8
.03
13,0
.51
4,8
.19
5,1
.20
13,0
.51
2,8
.11
0,8
.03
13,0
.51
4,8
.19
5,1
.20

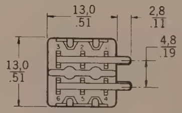
PRINTED CIRCUIT PANEL LAYOUT

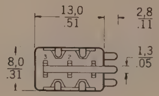

2,5
.10
12,7
.50
2,5
.10
5,1
.20
2,5
.10
1,8
.07 DIA TYP
2,5
.10
12,7
.50
2,5
.10
5,1
.20
4,8
.19
2,5
.10
1,8
.07 DIA TYP

TYPE 8G

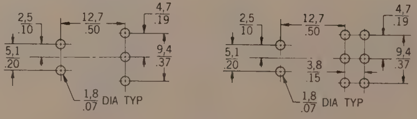
WITH STYLE 6 TERMINALS


24°
2,8
.11 DIA
6,8
.27
KEYWAY
6,4
.25 DIA
1,0
.04
7,3
.29
MICRO
9,1
.36
1,5
.06
12,7
.50
2,5
.10
0,8
.03
2,5
.10


13,0
.51
2,8
.11
4,8
.19
13,0
.51
2—POLE


13,0
.51
2,8
.11
1,3
.05
8,0
.31
1—POLE

PRINTED CIRCUIT PANEL LAYOUT

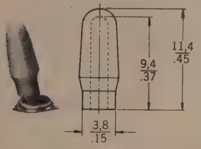

2,5
.10
12,7
.50
4,7
.19
5,1
.20
9,4
.37
1,8
.07 DIA TYP
2,5
.10
12,7
.50
4,7
.19
5,1
.20
9,4
.37
3,8
.15
1,8
.07 DIA TYP

COLORED LEVER SLEEVES

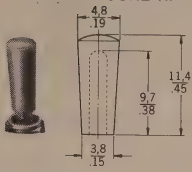
These sleeves assist in identifying control functions and will be acceptable to most industrial design needs.

FOR 8A TOGGLES

ROUND TIP


11,4
.45
9,4
.37
3,8
.15

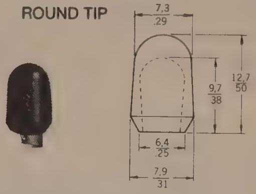
CONE TIP


4,8
.19
11,4
.45
9,7
.38
3,8
.15

COLOR	ROUND TIP	CONE TIP
White	8Z0111	8Z0151
Red	8Z0112	8Z0152
Black	8Z0113	8Z0153
Gray	8Z0114	8Z0154
Green	8Z0115	8Z0155
Blue	8Z0116	8Z0156
Amber	8Z0117	8Z0157
Yellow	8Z0118	8Z0158

FOR 8B TOGGLES

ROUND TIP


7,3
.29
12,7
.50
9,7
.38
6,4
.25
7,9
.31

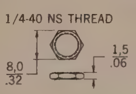
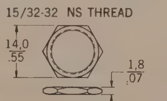
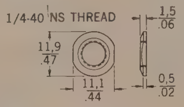
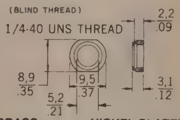
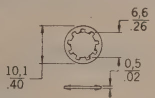
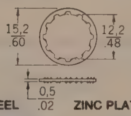
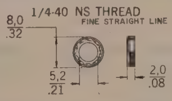
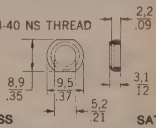
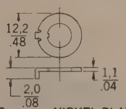
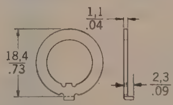
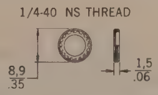
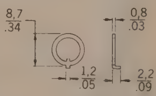
COLOR	CATALOG LISTING
White	8Z0131
Red	8Z0132
Black	8Z0133
Gray	8Z0134
Green	8Z0135
Blue	8Z0136
Amber	8Z0137
Yellow	8Z0138

MOUNTING HARDWARE

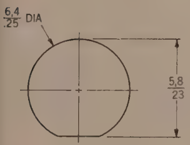
Mounting hardware can be ordered separately by specifying the 8Z catalog listings shown in the chart at right.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

STANDARD		OPTIONAL	
HEX NUT 8Z0172  1/4-40 NS THREAD 8,0 .32 1,5 .06 BRASS NICKEL PLATED	**HEX NUT** 8Z0175  15/32-32 NS THREAD 14,0 .55 1,8 .07 BRASS NICKEL PLATED	**DRESS NUT** 8Z0171  1/4-40 NS THREAD 1,5 .06 11,9 .47 11,1 .44 0,5 .02 BRASS NICKEL PLATED	**PANEL DRESS NUT** 8Z0178  (BLIND THREAD) 1/4-40 UNS THREAD 2,2 .09 8,9 .35 9,5 .37 5,2 .21 3,1 .12 BRASS NICKEL PLATED
LOCKWASHER 8Z0173  6,6 .26 10,1 .40 0,5 .02 STEEL ZINC PLATED	**LOCKWASHER** 8Z0176  15,2 .60 12,2 .48 0,5 .02 STEEL ZINC PLATED	**KNURLED NUT** 8Z0180  8,0 .32 1/4-40 NS THREAD FINE STRAIGHT LINE 5,2 .21 2,0 .08 BRASS CHROME PLATED	**PANEL DRESS NUT** 8Z0181  1/4-40 NS THREAD 2,2 .09 8,9 .35 9,5 .37 5,2 .21 3,1 12 BRASS SAT
LOCKING RING 8Z0174  12,2 .48 1,1 .04 2,0 .08 BRASS NICKEL PLATED	**LOCKING RING** 8Z0177  1,1 .04 18,4 .73 2,3 .09 BRASS NICKEL PLATED	**KNURLED FACE NUT** 8Z0179  1/4-40 NS THREAD 8,9 .35 1,5 .06 BRASS CHROME PLATED	**LOCKING RING** 8Z0182  8,7 .34 0,8 .03 1,2 .05 2,2 .09 BRASS NICKEL PLATED

PANEL CUTOUT FOR "D" BUSHING


6,4
.25
DIA
5,8
.23

QUICK-CONNECTOR RECEPTACLES

The chart below lists a number of quick-connector receptacles that can be used with Series 8 type 2 and type 3 terminals. There are hand crimp tools available to install the connectors that are sold "loose piece" in 500-piece quantities: AMP #46412, for use with AMP #61976-1; and AMP #90204,. for use with AMP #61454-1.

For further information on these items, contact American Pamcor Incorporated, Valley Forge, Penn.; or AMP Incorporated, Harrisburg, Penn.

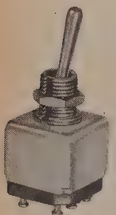
Terminal Type	Connector Part No.	Description
Style 1 Solder	AMP #60658-1 AMP #61976-1	Unplated brass, sold in "reels" of 10,000 pieces. Unplated brass, sold "loose piece" in 500-piece quantities.
Style 2 (P.C.)	AMP #60900-1 AMP #60900-2 AMP #60900-3 AMP #61454-1	Tin plated brass, sold in "reels" of 12,000 pieces. Gold plated brass, sold in "reels" of 12,000 pieces. Unplated brass, sold in "reels" of 12,000 pieces. Tin plated brass, sold "loose piece" in 500-piece quantities.

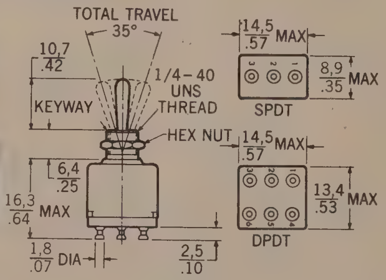
SERIES TW TOGGLE SWITCHES

- Qualified to MIL-S-83731
- Space & Weight Saver
- SPDT or DPDT
- Molded-in Terminals
- Choice of 1/4" Or 15/32" Bushing
- Pull-To-Unlock Option on 15/32" Bushing

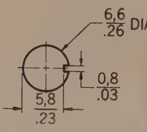
Series TW offers toggle switching versatility equal to larger toggle switches with the additional advantages of small size and light weight. It meets the requirements of MIL-S-83731. Housing is nickel-plated brass on a high dielectric thermoset plastic switching base. Molded-in terminals are plated for soldering. There is positive return on momentary versions and reasonable operating forces. All switches are furnished with a lockwasher, a keying washer, and two hexnuts. Special ("on-on-on") circuitries, similar to those shown for series TL are available for TW also

STANDARD TOGGLE LEVER

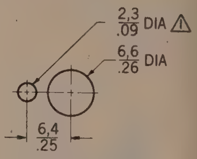



TOTAL TRAVEL
35°
10,7/.42
KEYWAY
1/4–40 UNS THREAD
HEX NUT
6,4/.25
16,3/.64 MAX
1,8/.07 DIA
2,5/.10
14,5/.57 MAX
8,9/.35 MAX
SPDT
14,5/.57 MAX
13,4/.53 MAX
DPDT

MOUNTING DETAIL FOR ¼" BUSHING SWITCHES


6,6/.26 DIA
0,8/.03
5,8/.23

WITHOUT LOCKING RING

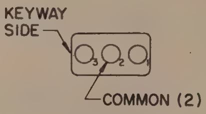

2,3/.09 DIA △
6,6/.26 DIA
6,4/.25

WITH LOCKING RING

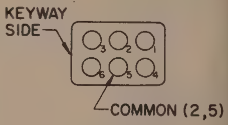
NOTE –
△1,1/.05 MIN DEEP TO ACCOMMODATE LOCKING RING

TERMINAL CIRCUIT IDENTIFICATIONS

Terminal identifications are referred to in the Ordering Charts to indicate which circuits are made in each toggle position (i.e., "1-2" reference indicates circuit closure through terminals 1 and 2).


KEYWAY SIDE
3
2
1
COMMON (2)

ONE POLE

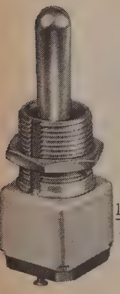

KEYWAY SIDE
3
2
1
6
5
4
COMMON (2,5)

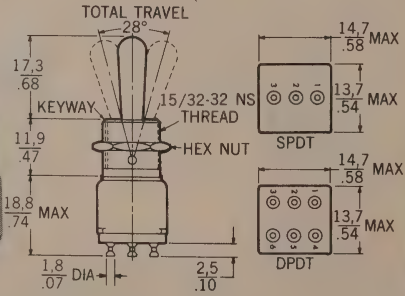
TWO POLE

ELECTRICAL RATING

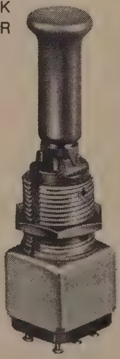
Volts	Amperes Resistive	Amperes Inductive	Amperes Lamp
30 VDC	5	2	1
115 VAC	5	2	1

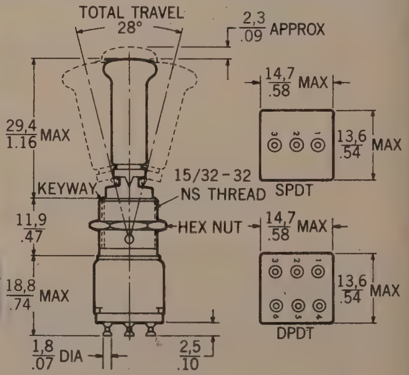
STANDARD TOGGLE LEVER



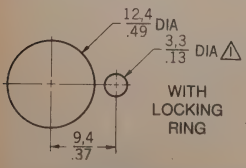

TOTAL TRAVEL
28°
17,3/.68
KEYWAY
15/32-32 NS THREAD
HEX NUT
11,9/.47
18,8/.74 MAX
1,8/.07 DIA
2,5/.10
14,7/.58 MAX
13,7/.54 MAX
SPDT
14,7/.58 MAX
13,7/.54 MAX
DPDT

PULL-TO-UNLOCK TOGGLE LEVER

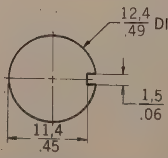



TOTAL TRAVEL
28°
2,3/.09 APPROX
29,4/1.16 MAX
KEYWAY
15/32–32 NS THREAD
HEX NUT
11,9/.47
18,8/.74 MAX
1,8/.07 DIA
2,5/.10
14,7/.58 MAX
13,6/.54 MAX
SPDT
14,7/.58 MAX
13,6/.54 MAX
DPDT

MOUNTING DETAIL FOR 15/32" BUSHING SWITCHES


12,4/.49 DIA
3,3/.13 DIA △
9,4/.37

WITH LOCKING RING


12,4/.49 DIA
1,5/.06
11,4/.45

WITHOUT LOCKING RING

NOTE –
△1,4/.06 MIN DEEP TO ACCOMMODATE LOCKING RING

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 – mm / 0.00 – inches

SERIES TW TOGGLE SWITCHES

ORDER GUIDE 2-POSITION

Circuitry	Circuits Made With Toggle At:		STANDARD TOGGLE ¼" Bushing		STANDARD TOGGLE 15/32" Bushing		Pull-to-Unlock Toggle (available on 15/32" Bushing TW only.)	
	Keyway Position	Opposite Keyway	Catalog Listing	Military No.	Catalog Listing	Military No.	Add Suffix to Standard Toggle Listing	Military No.**
ONE POLE	2-1 ON	2-3 ON	1TW1-3	MS27716-23	11TW1-3	MS27718-23	D,F,G	MS27720-23
	2-1 ON*	2-3 ON	1TW1-8	MS27716-26	11TW1-8	MS27718-26	F	MS27720-26
TWO POLE	2-1 & 5-4 ON	2-3 & 5-6 ON	2TW1-3	MS27717-23	12TW1-3	MS27719-23	D,F,G	MS27721-23
	2-1 & 5-4 ON*	2-3 & 5-6 ON	2TW1-8	MS27717-26	12TW1-8	MS27719-26	F	MS27721-26

ORDER GUIDE 3-POSITION

Circuitry	Circuits Made With Toggle At:			STANDARD TOGGLE 1/4" Bushing		STANDARD TOGGLE 15/32" Bushing		Pull-to-Unlock Toggle (available on 15/32" Bushing TW only.)	
	Keyway Position	Center Position	Opposite Keyway	Catalog Listing	Military No.	Catalog Listing	Military No.	Add Suffix to Standard Toggle Listing	Military No.**
ONE POLE	2-1 ON	OFF	2-3 ON	1TW1-1	MS27716-21	11TW1-1	MS27718-21	ALL	MS27720-21
	2-1 ON*	OFF	2-3 ON	1TW1-5	MS27716-31	11TW1-5	MS27718-31	E,F,K,L,M,N	MS27720-31
	2-1 ON*	OFF	2-3 ON*	1TW1-7	MS27716-27	11TW1-7	MS27718-27	E,L,N	MS27720-27
TWO POLE	2-1 & 5-4 ON	OFF	2-3 & 5-6 ON	2TW1-1	MS27717-21	12TW1-1	MS27719-21	ALL	MS27721-21
	2-1 & 5-4 ON*	OFF	2-3 & 5-6 ON	2TW1-5	MS27717-31	12TW1-5	MS27719-31	E,F,K,L,M,N	MS27721-31
	2-1 & 5-4 ON*	OFF	2-3 & 5-6 ON*	2TW1-7	MS27717-27	12TW1-7	MS27719-27	E,L,N	MS27721-27

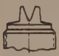
*These positions only are momentary. All others are maintained.

**Also add appropriate suffix letter to the Military Approval Number.

LOCKING CONFIGURATIONS

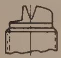
When ordering pull-to-unlock toggle listings add the suffix letter shown in this chart to the standard toggle catalog listing and the Military Approval Number.

"A"



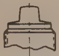
Locked In Three Positions

"B"



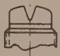
Locked In Center and Extreme Position (Kerf Side)

"D"



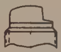
Locked Out Of Center Position

"E"



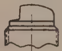
Locked In Center Position

"F"



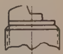
Locked In Extreme Position (Opposite Kerf)

"G"



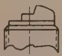
Locked In Extreme Position (Kerf Side)

"H"



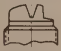
Locked Out Of Center And Extreme Position (Kerf Side)

"J"



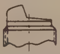
Locked Out Of Center And Extreme Position (Opposite Kerf)

"K"



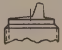
Locked In Center And Extreme Position (Opposite Kerf)

"L"



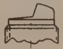
Locked Out Of Extreme Position (Kerf Side)

"M"



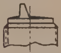
Locked Out Of And Into Extreme Position (Opposite Kerf)

"N"



Locked Out Of Extreme Position (Opposite Kerf)

"P"

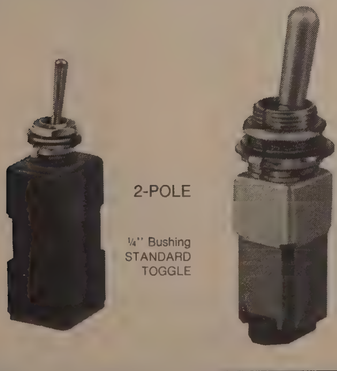


Locked Out Of And Into Extreme Position (Kerf Side)

MILITARY QUALIFIED SPECIAL CIRCUITRY

For MS qualified special circuitry versions of the 12TW series, refer to Data Sheet 204.

SERIES TW TOGGLE SWITCHES WITH IWTS TERMINATION



2-POLE

¼" Bushing
STANDARD
TOGGLE

1-POLE

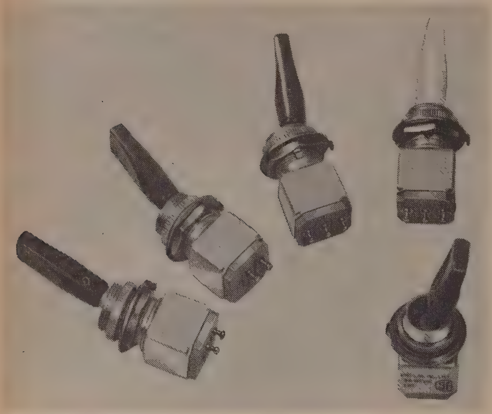
15/32" Bushing
STANDARD
TOGGLE

Miniature-size Series TW toggle switches are available with IWTS (Integrated Wire Termination System) to provide you with a reliable, completely serviceable unit which meets Military Specification requirements. There is a choice of 1/4" or 15/32" diameter bushings, in one or two pole circuitry.

Versions will accept no. 20 wire utilizing MIL-C-39029 contact pins. Connections are resistant to shock, vibration and high pulling forces. A 15/32" bushing pull-to-unlock toggle is also available.

Contact your nearest MICRO SWITCH Branch Office for further information.

SERIES TW TOGGLE SWITCHES WITH COLORED TAB LEVERS

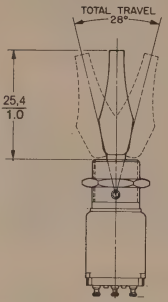


Decorator colored tab levers in eight standard colors are available in white, black, blue, red, green, orange, light gray and medium gray for the TW Series of miniature toggle switches.

The lever shape and color offers designers an attractive front-of-panel apperance for graphic display and functional identity. Levers are made of sturdy nylon and can withstand temperatures up to 85°C (185°F).

All TW19 switches are furnished with a decorative knurled nut to further enhance front-of-panel appearance, a lockwasher, keying washer and hex nut.

TAB SHAPE PROVIDES EASY FUNCTION IDENTIFICATION



HOW TO ORDER

To order, combine the basic (function) listing from Table I with the desired lever color suffix from Table II to complete the catalog listing.

For Example: Catalog Listing 11TW19-2-A003 is a 2-position, 1-pole maintained toggle with blue tab lever.

TABLE I—TOGGLE POSITION AND CONTACT ARRANGEMENT

		Circuits Made with Toggles At:			
	Circuitry	Keyway Position	Cemter Position	Opposite Keyway	Basic Listing
2-POSITION	One Pole	OFF 2—1 ON 2—1 ON*	NONE NONE NONE	2—3 2—3 ON 2—3 ON	11TW19-2- — — — — 11TW19-3- — — — — 11TW19-8- — — — —
	Two Pole**	OFF 2—1 & 5—4 2—1 & 5—4*	NONE NONE NONE	2, 3, 5, 6 2—3 & 5—6 ON 2—3 & 5—6 ON	12TW19-2- — — — — 12TW19-3- — — — — 12TW19-8- — — — —
3-POSITION	One Pole	2—1 ON 2—1 ON* 2—1 ON*	OFF OFF OFF	2—3 ON 2—3 ON 2—3 ON*	11TW19-1- — — — — 11TW19-5- — — — — 11TW19-7- — — — —
	Two Pole**	2—1 & 5—4 ON 2—1 & 5—4 ON* 2—1 & 5—4 ON*	OFF OFF OFF	2—3 & 5—6 ON 2—3 & 5—6 ON 2—3 & 5—6 ON*	12TW19-1- — — — — 12TW19-5- — — — — 12TW19-7- — — — —

*These positions only are momentary. All others are maintained.
**Special circuitries available on request.

TABLE II—TAB LEVER COLORS

TAB LEVER COLOR	WHITE	BLACK	BLUE	RED	GREEN	ORANGE	LIGHT GRAY	MEDIUM GRAY
Color Suffix	A001	A002	A003	A004	A005	A006	A007	A008

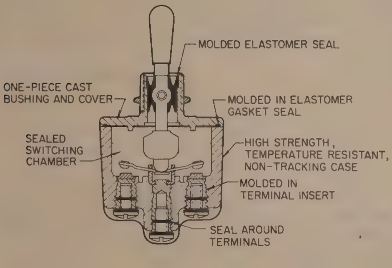
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
Key: 0,0 — mm / 0.00 — inches

SERIES TL TOGGLE SWITCHES

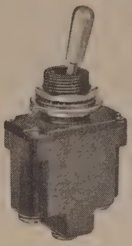
- Qualified to MIL-S-3950
- Environment-Proof Sealing
- 1-, 2-, and 4-Pole Circuitry
- Standard and Pull-To-Unlock Toggle Levers
- 2- and 3-Position, Maintained and Momentary Toggle Action

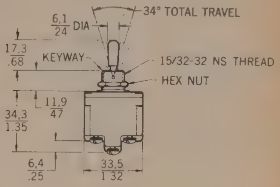
Type "TL" toggle switches are the most versatile line of toggle switches offered by MICRO SWITCH to the military/aerospace and commercial aircraft industries. Varsatility is accomplished by combining a choice of toggle levers with two- and three-position maintained and mementary toggle action, and 1-, 2- and 4-pole circuitry. The high strength, temperature resistant, non-tracking case material, silver cadmium oxide constact and the step-design screw and solder turret terminal construction assure electrical stability and non-shorting wiring connections. Operating temperature range is from −65° to + 71.1°C (−85° to 160°F). TL toggle switches meet military Specification Number MIL-S-3950 (Immersion).

CONSTRUCTION

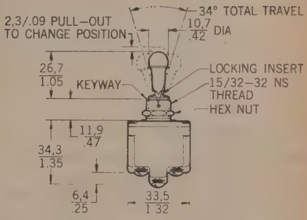

MOLDED ELASTOMER SEAL
ONE-PIECE CAST BUSHING AND COVER
MOLDED IN ELASTOMER GASKET SEAL
SEALED SWITCHING CHAMBER
HIGH STRENGTH, TEMPERATURE RESISTANT, NON-TRACKING CASE
MOLDED IN TERMINAL INSERT
SEAL AROUND TERMINALS

STANDARD LEVER




6,1/.24 DIA
34° TOTAL TRAVEL
17,3/.68
KEYWAY
15/32-32 NS THREAD
HEX NUT
11,9/.47
34,3/1.35
6,4/.25
33,5/1.32

PULL TO UNLOCK LEVER


34° TOTAL TRAVEL
2,3/.09 PULL-OUT TO CHANGE POSITION
10,7/.42 DIA
LOCKING INSERT
26,7/1.05
KEYWAY
15/32-32 NS THREAD
HEX NUT
11,9/.47
34,3/1.35
6,4/.25
33,5/1.32

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

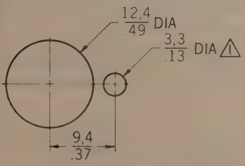
Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

TOGGLE OPTIONS

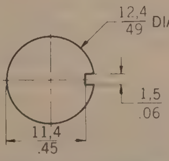
Standard toggle lever operates on a direct action spring loaded toggle mechanism to provide excellent tactile feed-back in both the momentary and maintained toggle positions. The toggle lever is approximately ⅝ inch long and has a non-glare matte nickel plated finish.

Pull-to-unlock toggle levers prevent accidental toggle movement. The knobbed toggle lever must be pulled out approximately .090 inch to change positions. Thirteen different locking configurations are available. This lever style also has a non-glare matte nickel finish.

MOUNTING DETAIL


12,4/.49 DIA
3,3/.13 DIA △
9,4/.37

WITH LOCKING RING


12,4/.49 DIA
1,5/.06
11,4/.45

WITHOUT LOCKING RING

NOTE– △ 1,4/.06 MIN DEEP TO ACCOMMODATE LOCKING RING

ELECTRICAL RATINGS

Rating Code*	28 Volts D.,C.			115 VDC	250 VDC		115 Volts A.C. 60 & 400 CPS		230 VAC
	Ind.	Res.	Lamp	Res.	Res.	Ind.	Res.	Lamp	Res.
1	15	20	5	0.75	0.5	10	15	3	6
2	10	15	4	0.75	0.5	7	15	2	6
3	15	20	7	0.75	0.5	15	15	4	6
4	10	18	5	0.75	0.5	8	11	2	6
5	12	20	5	0.75	0.5	15	15	4	6
6	10	18	4	0.75	0.5	8	11	2	6

*Referred to in Ordering Charts.

SERIES TL TOGGLE SWITCHES

ORDER GUIDE 2-POSITION SWITCHES

Circuitry	Circuit(s) Made With Toggle At: Keyway Position	Circuit(s) Made With Toggle At: Opposite Keyway	Elec. Rating Code	Standard Toggle: Catalog Listing	Standard Toggle: Military Number	Pull-to-Unlock Toggle: Add Suffix To Standard Toggle Listing	Pull-to-Unlock Toggle: Military Number†
ONE POLE	OFF	2-3	1	1TL1-2	MS24523-22	D, F, G	MS24658-22
	OFF*	2-3	2	1TL1-4	MS24523-29	F	MS24658-29
	1-2*	OFF	2	1TL1-6	MS24523-30	F	MS24658-30
	1-2	2-3	1	1TL1-3	MS24523-23	D, F, G	MS24658-23
	1-2*	2-3	2	1TL1-8	MS24523-26	F	MS24658-26
TWO POLE	OFF	2-3, 5-6	3	2TL1-2	MS24524-22	D, F, G	MS24659-22
	OFF*	2-3, 5-6	4	2TL1-4	MS24524-29	F	MS24659-29
	1-2, 4-5*	OFF	4	2TL1-6	MS24524-30	F	MS24659-30
	1-2, 4-5	2-3, 5-6	3	2TL1-3	MS24524-23	D, F, G	MS24659-23
	1-2, 4-5*	2-3, 5-6	4	2TL1-8	MS24524-26	F	MS24659-26
FOUR POLE	OFF	2-3, 5-6 8-9, 11-12	5	4TL1-2	MS24525-22	D, F, G	MS24660-22
	OFF*	2-3, 5-6 8-9, 11-12	6	4TL1-4	MS24525-29	F	MS24660-29
	1-2, 4-5, 7-8, 10-11*	OFF	6	4TL1-6	MS24525-30	F	MS24660-30
	1-2, 4-5, 7-8, 10-11	2-3, 5-6, 8-9, 11-12	5	4TL1-3	MS24525-23	D, F, G	MS24660-23
	1-2, 4-5, 7-8, 10-11*	2-3, 5-6, 8-9, 11-12	6	4TL1-8	MS24525-26	F	MS24660-26

*These positions only are momentary. All others are maintained.

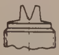
†Also add the appropriate suffix letter to the Military Approval number.

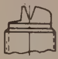
ORDER GUIDE 3-POSITION SWITCHES (Continued, next page)

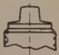
Circuitry	Circuit(s) Made With Toggle At: Keyway Position	Circuit(s) Made With Toggle At: Center Position	Circuit(s) Made With Toggle At: Opposite Keyway	Elec. Rating Code	Standard Toggle: Catalog Listing	Standard Toggle: Military Number †	Pull-to-Unlock Toggle: Add Suffix to Standard Listing	Pull-to-Unlock Toggle: Military Number †
ONE POLE	1-2	OFF	2-3	1	1TL1-1	MS24523-21	ALL TYPES	MS24658-21
	1-2*	OFF	2-3	2	1TL1-5	MS24523-31	E, F, K, L, M, N	MS24658-31
	1-2*	OFF	2-3*	2	1TL1-7	MS24523-27	E, L, N	MS24658-27
	None**	OFF	2-3	1	1TL1-21	MS24523-24	E, F, K, M	MS24658-24
	None**	OFF*	2-3	2	1TL1-41	MS24523-25	F	MS24658-25
	None**	1-2	2-3	1	1TL1-31	MS24523-33	E, F, K, M	MS24658-33
	None**	1-2	2-3*	2	1TL1-51	MS24523-32	E	MS24658-32
	1-2*	OFF	NONE**	2	1TL1-61	MS24523-28	E	MS24658-28

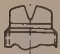
LOCKING CONFIGURATIONS

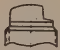
When ordering pull-to-unlock toggle listings, add the suffix letter shown in this chart to the standard toggle listing and the MS-number. For example, to order a 1TL1-1 pull-to-unlock toggle switch with the lever locked in the center position, add the letter "E"; i.e., 1TL1-1E, MS-24658-21E.

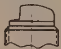
"A"

Locked In
Three Positions

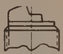
"B"

Locked In
Center and
Extreme Position
(Kerf Side)

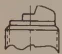
"D"

Locked Out
Of Center
Position

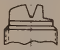
"E"

Locked In
Center Position

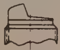
"F"

Locked In
Extreme Position
(Opposite Kerf)

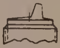
"G"

Locked In
Extreme Position
(Kerf Side)

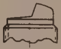
"H"

Locked Out Of
Center And
Extreme Position
(Kerf Side)

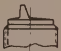
"J"

Locked Out Of
Center And
Extreme Position
(Opposite Kerf)

"K"

Locked In
Center And
Extreme Position
(Opposite Kerf)

"L"

Locked Out Of
Extreme Position
(Kerf Side)

"M"

Locked Out Of
And Into
Extreme Position
(Opposite Kerf)

"N"

Locked Out Of
Extreme Position
(Opposite Kerf)

"P"

Locked Out Of
And Into
Extreme Position
(Kerf Side)

ORDER GUIDE 3-POSITION (Cont.)

Circuitry	Circuit(s) Made With Toggle At: Keyway Position	Circuit(s) Made With Toggle At: Center Position	Circuit(s) Made With Toggle At: Opposite Keyway	Elec. Rating Code	Standard Toggle: Catalog Listing	Standard Toggle: Military Number†	Pull-to-Unlock Toggle: Add Suffix to Standard Listing	Pull-to-Unlock Toggle: Military Number†
TWO POLE	1-2,4-5	OFF	2-3,5-6	3	2TL1-1	MS24524-21	ALL TYPES	MS24659-21
	1-2,4-5*	OFF	2-3,5-6	4	2TL1-5	MS24524-31	E,F,K,L,M,N,	MS24659-31
	1-2, 4-5*	OFF	2-3, 5-6*	4	2TL1-7	MS24524-27	E,L,N	MS24659-27
	None**	OFF	2-3, 5-6	3	2TL1-21	MS24524-24	E,F,K,M	MS24659-24
	None**	OFF*	2-3, 5-6	4	2TL1-41	MS24524-25	F	MS24659-25
	None**	1-2, 4-5	2-3, 5-6	3	2TL1-31	MS24524-33	E,F,K,M	MS24659-33
	None**	1-2, 4-5	2-3, 5-6*	4	2TL1-51	MS24524-32	E	MS24659-32
	1-2, 4-5*	OFF	None**	4	2TL1-61	MS24524-28	E	MS24659-28
	1-2, 4-5	1-2, 5-6	2-3, 5-6	3	2TL1-10	MS27407-4	ALL TYPES	MS27408-4
	1-2, 4-5*	1-2, 5-6	2-3,5-6	4	2TL1-50	MS27407-5	E,F,K,L,M,N	MS27408-5
	1-2, 4-5*	1-2,5-6	2-3,5-6*	4	2TL1-70	MS27047-6	E,L,N	MS27408-6
FOUR POLE	1-2,4-5 7-8, 10-11	OFF	2-3, 5-6, 8-9, 11-12	5	4TL1-1	MS24525-21	ALL TYPES	MS24660-21
	1-2, 4-5, 7-8, 10-11*	OFF	2-3, 5-6, 8-9, 11-12	6	4TL1-5	MS24525-31	E,F,K,L,M,N	MS24660-31
	1-2, 4-5 7-8, 10-11*	OFF	2-3, 5-6, 8-9, 11-12*	6	4TL1-7	MS24525-27	E,L,N	MS24660-27
	None**	OFF	2-3, 5-6, 8-9, 11-12	5	4TL1-21	MS24525-24	E,F,K,M	MS24660-24
	None**	1-2, 4-5, 7-8, 10-11	2-3, 5-6 8-9, 11-12	5	4TL1-31	MS24525-33	E,F,K,M	MS24660-33
	None**	1-2, 4-5 7-8, 10-11	2-3, 5-6, 8-9, 11-12*	6	4TL1-51	MS24525-32	E	MS24660-32
	1-2, 4-5, 7-8, 10-11*	OFF	None**	6	4TL1-61	MS24525-28	E	MS24660-28
	1-2, 4-5, 7-8, 10-11	2-3, 4-5	2-3, 5-6, 8-9, 11-12	5	4TL1-10	—	ALL TYPES	—
	1-2, 4-5 7-8, 10-11*	2-3, 4-5, 7-8, 11-12	2-3, 5-6, 8-9, 11-12	6	4TL1-50	MS27409-2	E,F,K,L,M,N	MS27406-2
	1-2, 4-5, 7-8, 10-11*	2-3, 4-5	2-3, 5-6, 8-9, 11-12*	6	4TL1-70	—	E,L,N	—
	1-2, 4-5, 7-8, 10-11	2-3, 4-5, 7-8, 11-12	2-3, 5-6 8-9, 11-12	5	4TL1-12	MS27406-1	ALL TYPES	MS27409-1
	1-2, 4-5, 7-8, 10-11*	2-3. 4-5, 7-8, 11-12	2-3, 5-6, 8-9, 11-12*	6	4TL1-72	MS27406-3	E,L,N	MS27409-3

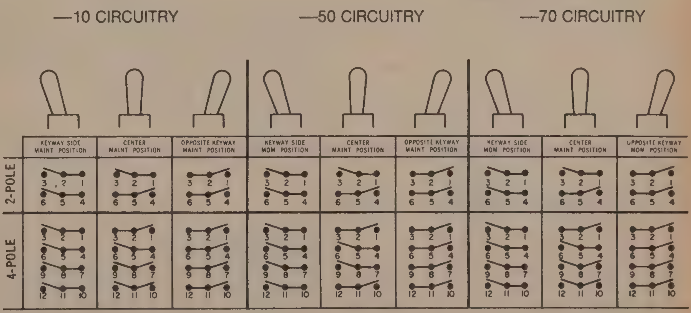
*These positions only are momentary. All others are maintained.

**Toggle lever is blocked from these positions. Toggle becomes two position, with center being one extreme position.

†Also add appropriate suffix letter to the Military Approval number

SPECIAL CIRCUITRIES

Catalog Listings with —**10**, —**50**, and —**70** suffix numbers shown in the TL, TP, and TS Ordering Charts have special "on-on-on" circuits, as illustrated. TL's with —12 suffix are same as —50, except keyway position is maintained; while —72 is same as —50, except that opposite keyway position is momentary.

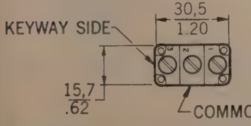

—10 CIRCUITRY
—50 CIRCUITRY
—70 CIRCUITRY
KEYWAY SIDE MAINT POSITION
CENTER MAINT POSITION
OPPOSITE KEYWAY MAINT POSITION
KEYWAY SIDE MOM POSITION
CENTER MAINT POSITION
OPPOSITE KEYWAY MAINT POSITION
KEYWAY SIDE MOM POSITION
CENTER MAINT POSITION
OPPOSITE KEYWAY MOM POSITION
2-POLE
4-POLE
3 2 1
6 5 4
9 8 7
12 11 10

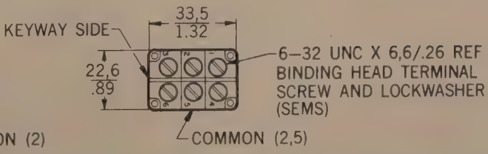
TERMINAL CIRCUIT IDENTIFICATION

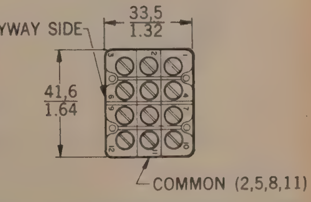
Terminal identifications are referred to in the Ordering Charts to indicate which circuits are made in each toggle position (i.e., 1-2 reference indicates circuit closure through terminals 1 and 2).

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

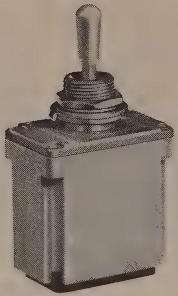
Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$


KEYWAY SIDE
30,5
1.20
15,7
.62
COMMON (2)


KEYWAY SIDE
33,5
1.32
22,6
.89
6—32 UNC X 6,6/.26 REF
BINDING HEAD TERMINAL
SCREW AND LOCKWASHER
(SEMS)
COMMON (2,5)


KEYWAY SIDE
33,5
1.32
41,6
1.64
COMMON (2,5,8,11)

SERIES TL TOGGLE SWITCHES

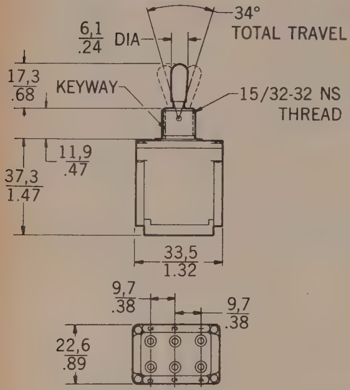


IWTS VERSION

IWTS (Integrated Wire Termination System) provides a reliable, completely serviceable unit which meets MIL-S-3950 requirements.

IWTS improves maintainability since wiring bundles need not be disturbed. Leads are quickly and easily assembled or removed with an insert-extract tool.

A unique three-rib (grommet style) elastomer seal protects the lead connections without potting. There are no exposed metal terminals. Versions are available that will accept No. 16 or 20 wire, utilizing MIL-C-39029 contact pins. Connections are resistant to shock, vibration and high pulling forces.



HOW TO ORDER

101TL, 102TL and 104TL type switches with IWTS termination are qualified to MIL-S-3950 and have the same circuitry and electrical rating as their 1TL, 2TL, and 4TL counterparts which are described on pages C15 and C16. Listed below are the MS drawing numbers for the IWTS versions. The complete numbers are shown in data sheet 204.

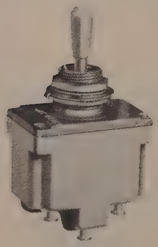
	Circuitry	Type	Std. Lever	Lever Lock
For No. 16 Wire	One Pole	101TL1	MS27722	MS27781
	Two Pole	102TL1	MS27723	MS27782
	Four Pole	104TL1	MS27724	MS27783
For No. 20 Wire	One Pole	101TL2	MS27784	MS27787
	Twp Pole	102TL2	MS27785	MS27788
	Four Pole	104TL2	MS27786	MS27789

Terminal accessory packets are necessary for wiring. They contain an insert-extract tool, contact pins, and plugs for unused terminal holes.

	PACKET LISTINGS		CONTENTS		
	For No. 16 Wire*	For No. 20 Wire**	Tool	Contact Pins	Seal Plugs
ONE POLE	15PA111-1	15PA112-1	1	3	1
TWO POLE	15PA111-2	15PA112-2	1	6	2
FOUR POLE	15PA111-4	15PA112-4	1	12	4

*Accepts contact pin M39029/01-14-16
**Accepts contact pin M39029/01-16-20

SOLDER TURRET TERMINAL VERSION



HOW TO ORDER

11TL, 12TL, and 14TL type switches with solder turret terminals are qualified to MIL-S-3950. They have the same circuitry and electrical ratings as their 1TL, 2TL, and 4TL counterparts which are described on pages C15 and C16. For example, 11TL1-2 is the same as 1TL1-2, except it has solder turret terminals instead of screw terminals. The complete MS drawing numbers are shown in data sheet 204.

Circuitry	Type	Std. Lever	Lever Lock
One Pole	11TL	MS27734	MS27737
Two Pole	12TL	MS27735	MS27738
Four Pole	14TL	MS27736	MS27739

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

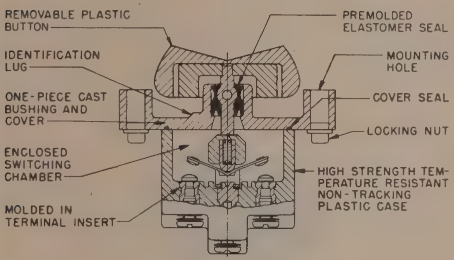
Key: 0,0 — mm / 0.00 — inches

SERIES TP ROCKER BUTTON SWITCHES

- **2- and 3-Position Pushbutton Action**
- **2 Button Styles**
- **1-, 2-, and 4-Pole Circuitry**
- **Flush Panel or Above Panel Mounting**

"TP" rocker button actuated switches combine the advantages of toggle switch circuitry and current carrying capacity with versatile pushbutton manual control and styling. Their internal operating mechanism and case design are identical to the "TL" lever actuated toggle switches. They also offer similar versatiltiy with two button styles, two- and three-position, maintained and momentary operation, and 1-, 2- and 4-pole circuitry. "TP" rocker button switches have a temperature range of from −65° to +160°F (-54° to 71°C).

CONSTRUCTION


REMOVABLE PLASTIC BUTTON
IDENTIFICATION LUG
ONE-PIECE CAST BUSHING AND COVER
ENCLOSED SWITCHING CHAMBER
MOLDED IN TERMINAL INSERT
PREMOLDED ELASTOMER SEAL
MOUNTING HOLE
COVER SEAL
LOCKING NUT
HIGH STRENGTH TEMPERATURE RESISTANT NON-TRACKING PLASTIC CASE

UL AND CSA LISTED
ELECTRICAL RATINGS

Rating Code*	Electrical Rating
L31	10 amps-125 or 250 VAC ¼ HP-125 VAC; ½ HP-250 VAC
L32	15 amps-125 or 250 VAC ½ HP-125 VAC; 1 HP-250 VAC
L80	15 amps-125 or 250 VAC ½ HP-125 VAC; 1 HP-250 VAC 5 amps-120 VAC "L"

*Referred to in Ordering Charts

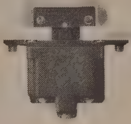
MOUNTING OPTIONS

Above panel mounting presents a distinct button appearance.

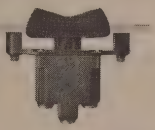
Flush panel mounting presents a low button profile and permits edge lighting of depressed buttons.

"TP" switches are 3-hole mounted. The button panel cutout dimension is 23,9 mm x 38,4 mm/.94" x 1.151" centered on the switch mounting holes.

If a smaller panel cutout is desirable, the following dimensions are suggested: 23,1 mm x 36,1 mm/.91" x 1.50". CAUTION: This panel cutout requires close tolerances in centering the cutout with the mounting holes.

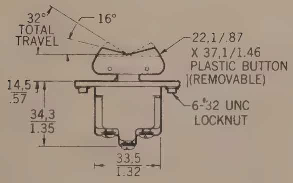


ABOVE PANEL

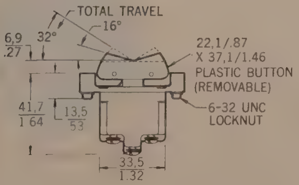


FLUSH PANEL

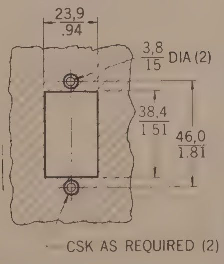
Above Panel

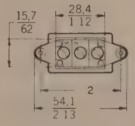

32° TOTAL TRAVEL
16°
22,1/.87 X 37,1/1.46 PLASTIC BUTTON (REMOVABLE)
14,5
.57
34,3
1.35
6-32 UNC LOCKNUT
33,5
1.32

Flush Panel


TOTAL TRAVEL
16°
32°
6,9
.27
22,1/.87 X 37,1/1.46 PLASTIC BUTTON (REMOVABLE)
41,7
1.64
13,5
.53
6-32 UNC LOCKNUT
33,5
1.32

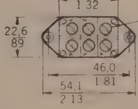
Panel Cutout

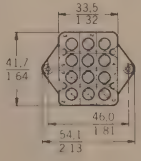

23,9
.94
3,8
.15
DIA (2)
38,4
1.51
46,0
1.81
CSK AS REQUIRED (2)


15,7
.62
28,4
1.12
2
54,1
2.13

One Pole

Two Pole


33,5
1.32
22,6
.89
6-32 UNC X 6,6/.26 REF BINDING HEAD TERMINAL SCREW AND LOCKWASHER (SEMS)
46,0
1.81
54,1
2.13


33,5
1.32
41,7
1.64
46,0
1.81
54,1
2.13

Four Pole

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\dfrac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

SERIES TP ROCKER BUTTON SWITCHES

BUTTON OPTIONS

Buttons are removable and interchangeable, and measure .870" x 1.46".

Transparent buttons accept under-the-surface legend inserts for station and function identification. NOTE: Legend inserts are not furnished. Legended inserts or engraving on buttons should be obtained from your local supplier.

Translucent (white plastic) buttons offer clean unlighted appearance, and are most acceptable for edge lighting (as described under Mounting Options). They may be engraved and filled, if legending is desired.

Colored plastic buttons enable color coding of switch functions.

TP7 and TP8 switches without buttons may be ordered for use with colored buttons. To convert catalog listings shown in the charts to TP7 and TP8 designs, substitute TP7 for TP1 and TP12, for above panel mounted switches; and substitute TP8 for TP4 and TP16 for flush panel mounted switches. Example: catalog listing **1TP8-2** is the same as **1TP4-2**, but it is supplied without a button.

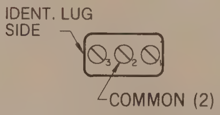
	Color	Listing
Catalog listings for buttons only.	Translucent	12PA3
	Transparent	12PA4
	White*	12PA5-W
	Yellow*	12PA5-Y
	Black*	12PA5-BK
	Green*	12PA5-G
	Red*	12PA5-R
	Blue*	12PA5-Bl

*Will accept engraved legends.

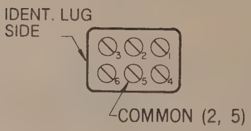
TERMINAL CIRCUIT IDENTIFICATION

Terminal identifications are referred to in the Ordering Charts to indicate which circuits are made in each toggle position (i.e., 1-2 reference indicates circuit closure through terminals 1 and 2).

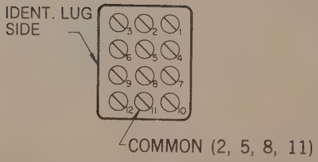
One Pole



Two Pole



Four Pole



TYPICAL ONE-POLE
FLUSH PANEL
TRANSLUCENT
BUTTON SWITCH

TYPICAL TWO-POLE
FLUSH PANEL
TRANSLUCENT
BUTTON SWITCH

TYPICAL FOUR-POLE
ABOVE PANEL
TRANSPARENT
BUTTON SWITCH

SERIES TP ROCKER BUTTON TOGGLE SWITCHES

ORDER GUIDE—2-POSITION

Circuitry	Circuit(s) Made With Button At:		Elec. Rating Code	CATALOG LISTING			
				Flush Panel		Above Panel	
	Ident Lug Position	Opposite Ident. Lug		Translucent Button	Transparent Button	Translucent Button	Transparent Button
ONE POLE	OFF	2-3	L80	1TP1-2	1TP12-2	1TP16-2	1TP4-2
	OFF*	2-3	L31	1TP1-4	1TP12-4	1TP16-4	1TP4-4
	1-2*	OFF	L31	1TP1-6	1TP12-6	1TP16-6	1TP4-6
	1-2	2-3	L80	1TP1-3	1TP12-3	1TP16-3	1TP4-3
	1-2*	2-3	L31	1TP1-8	1TP12-8	1TP16-8	1TP4-8
TWO POLE	OFF	2-3, 5-6	L32	2TP1-2	2TP12-2	2TP16-2	2TP4-2
	OFF*	2-3, 5-6	L31	2TP1-4	2TP12-4	2TP16-4	2TP4-4
	1-2, 4-5*	OFF	L31	2TP1-6	2TP12-6	2TP16-6	2TP4-6
	1-2, 4-5	2-3, 5-6	L32	2TP1-3	2TP12-3	2TP16-3	2TP4-3
	1-2, 4-5*	2-3, 5-6	L31	2TP1-8	2TP12-8	2TP16-8	2TP4-8
FOUR POLE	OFF	2-3, 5-6, 8-9, 11-12	L32	4TP1-2	4TP12-2	—	4TP4-2
	OFF*	2-3, 5-6, 8-9, 11-12	L31	4TP1-4	4TP12-4	4TP16-4	4TP4-4
	1-2, 4-5, 7-8, 10-11*	OFF	L31	4TP1-6	4TP12-6	—	—
	1-2, 4-5, 7-8, 10-11	2-3, 5-6, 8-9, 11-12	L32	4TP1-3	4TP12-3	4TP16-3	4TP4-3
	1-2, 4-5, 7-8, 10-11*	2-3, 5-6, 8-9, 11-12	L31	4TP1-8	4TP12-8	4TP16-8	—

*These positions only are momentary. All others are maintained.

ORDER GUIDE—3-POSITION

Circuitry	Circuit(s) Made With Button At:			Elec. Rating Code	CATALOG LISTING			
					Flush Panel		Above Panel	
	Ident Lug Position	Center Position	Opposite Ident Lug		Translucent Button	Transparent Button	Translucent Button	Transparent Button
ONE POLE	1-2	OFF	2-3	L80	1TP1-1	1TP12-1	1TP16-1	1TP4-1
	1-2*	OFF	2-3	L31	1TP1-5	1TP12-5	1TP16-5	1TP4-5
	1-2*	OFF	2-3*	L31	1TP1-7	1TP12-7	1TP16-7	1TP4-7
	None**	OFF	2-3	L80	1TP1-21	1TP12-21	—	1TP4-21
	None**	OFF*	2-3	L31	—	1TP12-41	—	1TP4-41
	None**	1-2	2-3	L80	1TP1-31	1TP12-31	—	1TP4-31
	None**	1-2	2-3*	L31	1TP1-51	1TP12-51	1TP16-51	1TP4-51
	1-2*	OFF	None**	L31	1TP1-61	1TP12-61	1TP16-61	1TP4-61
TWO POLE	1-2, 4-5	OFF	2-3, 5-6	L32	2TP1-1	2TP12-1	2TP16-1	2TP4-1
	1-2, 4-5*	OFF	2-3, 5-6	L31	2TP1-5	2TP12-5	2TP16-5	2TP4-5
	1-2, 4-5*	OFF	2-3, 5-6*	L31	2TP1-7	2TP12-7	2TP16-7	2TP4-7
	None**	OFF	2-3, 5-6	L32	2TP1-21	2TP12-21	2TP16-21	2TP4-21
	None**	OFF*	2-3, 5-6	L31	2TP1-41	2TP12-41	2TP16-41	—
	None**	1-2, 4-5,	2-3, 5-6	L32	2TP1-31	2TP12-31	2TP16-31	2TP4-31
	None**	1-2, 4-5	2-3, 5-6*	L31	2TP1-512	TP12-51	2TP16-51	2TP4-51
	1-2, 4-5*	OFF	None**	L31	2TP1-61	2TP12-61	2TP16-61	2TP4-61
	1-2, 4-5	1-2, 5-6	2-3, 5-6	L32	2TP1-10	2TP12-10	2TP16-10	2TP4-10
	1-2, 4-5*	1-2, 5-6	2-3, 5-6	4***	2TP1-50	2TP12-50	2TP16-50	2TP4-50
	1-2, 4-5*	1-2, 5-6	2-3, 5-6*	4***	2TP1-70	2TP12-70	2TP16-70	2TP4-70
FOUR POLE	1-2, 4-5, 7-8, 10-11	OFF	2-3, 5-6, 8-9, 11-12	L32	4TP1-1	4TP12-1	4TP16-1	4TP4-1
	1-2, 4-5, 7-8, 10-11*	OFF	2-3, 5-6, 8-9, 11-12	L31	4TP1-5	4TP12-5	—	4TP4-5
	1-2, 4-5, 7-8, 10-11*	OFF	2-3, 5-6, 8-9, 11-12*	L31	4TP1-7	4TP12-7	4TP16-7	4TP4-7
	None**	OFF	2-3, 5-6, 8-9, 11-12	L32	4TP1-21	4TP12-21	4TP16-21	4TP4-21
	None**	OFF*	2-3, 5-6 8-9, 11-12	L31	4TP1-41	4TP12-41	4TP16-41	4TP4-41
	None**	1-2, 4-5 7-8, 10-11	2-3, 5-6 8-9, 11-12	L32	4TP1-31	—	4TP16-31	4TP4-31
	None**	1-2, 4-5 7-8, 10-11	2-3, 5-6, 8-9, 11-12*	L31	4TP1-51	—	4TP16-51	4TP4-51
	1-2, 4-5, 7-8, 10-11*	OFF	None**	L31	4TP1-61	4TP12-61	4TP16-61	4TP4-61
	1-2, 4-5, 7-8, 10-11	2-3, 4-5	2-3, 5-6, 8-9, 11-12	L32	4TP1-10	4TP12-10	—	4TP4-10
	1-2, 4-5, 7-8, 10-11*	2-3, 4-5, 7-8, 11-12	2-3, 5-6, 8-9, 11-12	6***	4TP1-50	4TP12-50	4TP16-50	4TP4-50
	1-2, 4-5, 7-8, 10-11*	2-3, 4-5	2-3, 5-6, 8-9, 11-12*	6***	4TP1-70	4TP12-70	4TP16-70	4TP4-70

*These positions only are momentary. All others are maintained.

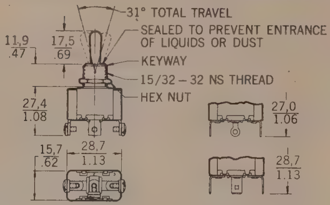
**Toggle lever is blocked from these positions. Toggle becomes two position, with center being one extreme position.

***Refer to TL Electrical Rating Chart

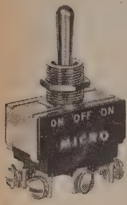
MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

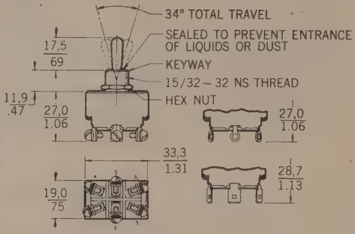
SERIES 11TS AND 12TS TOGGLE SWITCHES

1 POLE


31° TOTAL TRAVEL
SEALED TO PREVENT ENTRANCE OF LIQUIDS OR DUST
KEYWAY
15/32 – 32 NS THREAD
HEX NUT
11,9 .47
17,5 .69
27,4 1.08
15,7 .62
28,7 1.13
27,0 1.06
28,7 1.13

2 POLE


ON OFF ON
MICRO

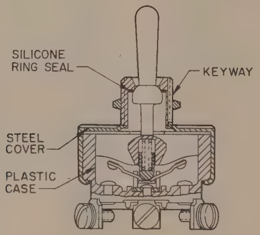

34° TOTAL TRAVEL
SEALED TO PREVENT ENTRANCE OF LIQUIDS OR DUST
KEYWAY
15/32 – 32 NS THREAD
HEX NUT
17,5 69
11,9 .47
27,0 1.06
27,0 1.06
33,3 1.31
19,0 75
28,7 1.13

- Rugged Construction
- Solder, Screw, or Quick Connect Terminals
- UL and CSA Listed Electrical Ratings

Series 11TS and 12TS toggle switches are ruggedly constructed for contact protection from dust and moisture. Available with either solder, screw or .250" width quick connect terminals, this series offers a choice of single-pole double-throw or double-pole double-throw circuitries. The series also has UL and CSA listed electrical ratings.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 = \text{mm}}{0.00 = \text{inches}}$


SILICONE RING SEAL
KEYWAY
STEEL COVER
PLASTIC CASE

ELECTRICAL RATINGS*

UL Code L-80	UL Code L-31
15 Amps., 125-250 VAC	10 Amps., 125-250 VAC
½ HP, 125 VAC	¼ HP, 125 VAC
1 HP, 250 VAC	½ HP, 250 VAC
5 Amps., 125 VAC (L)	

UL Code L-32	UL Code L-37
15 Amps., 125-250 VAC	15 Amps., 125-250 VAC
½ HP, 125 VAC	⅓ HP, 125 VAC
1 HP, 250 VAC	¾ HP, 250 VAC

*Referred to in Ordering Charts

2-POSITION

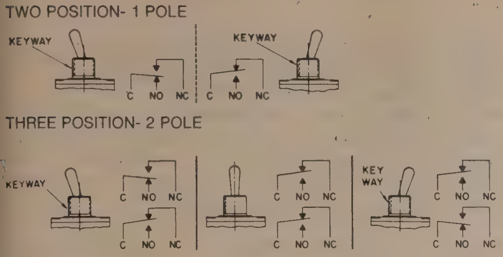
Circuitry	Circuit(s) Made With Toggle At: Keyway Position	Opposite Keyway	Elec. Rating Code	CATALOG LISTING Screw Terminals	Solder Terminals	Quick Connect Terminals
ONE POLE	OFF	2-3 ON	L-80	11TS15-2	11TS115-2	11TS85-2
	2-1 ON	2-3 ON	L-80	11TS15-3	11TS115-3	11TS95-3
	OFF*	2-3 ON	L-31	—	11TS115-4	11TS95-4
	2-1 ON*	OFF	L-31	11TS15-6	11TS115-6	11TS95-6
	2-1 ON*	2-3 ON	L-31	11TS15-8	11TS115-8	11TS95-8
TWO POLE	OFF	2-3 & 5-6 ON	L-32	12TS15-2	12TS115-2	12TS95-2
	2-1 & 5-4 ON	2-3 & 5-6 ON	L-32	12TS15-3	12TS115-3	12TS95-3
	OFF*	2-3 & 5-6 ON	L-37	—	12TS115-4	12TS95-4
	2-1 & 5-4 ON*	OFF	L-37	12TS15-6	12TS115-6	12TS95-6
	2-1 & 5-4 ON*	2-3 & 5-6 ON	L-37	12TS15-8	12TS115-8	12TS95-8

*Marked toggle positions are momentary. All other positions are maintained.

3-POSITION

Circuitry	(Circuits) Made With Toggle At: Keyway Position	Center Position	Opposite Keyway	Elec. Rating Code	CATALOG LISTING Screw Terminals	Solder Terminals	Quick Connect Terminals
ONE POLE	2-1 ON	OFF	2-3 ON	L-80	11TS15-1	11TS115-1	11TS95-1
	NONE	OFF	2-3 ON	L-80	—	—	11TS95-21
	2-1 ON*	OFF	2-3 ON	L-31	11TS15-5	—	11TS95-5
	2-1 ON*	OFF	NONE	L-31	11TS15-61	—	11TS95-61
	2-1 ON*	OFF	2-3 ON*	L-31	11TS15-7	11TS115-7	11TS95-7
TWO POLE	2-1 & 5-4 ON	OFF	2-3 & 5-6 ON	L-32	12TS15-1	12TS115-1	12TS95-1
	NONE	OFF	2-3 & 5-6 ON	L-32	12TS15-21	12TS115-21	12TS95-21
	2-1 & 5-4 ON*	OFF	2-3 & 5-6 ON	L-37	12TS15-5	12TS115-5	12TS95-5
	2-1 & 5-4 ON*	OFF	NONE	L-37	12TS15-61	12TS115-61	12TS95-61
	2-1 & 5-4 ON*	OFF	2-3 & 5-6 ON*	L-37	12TS15-7	12TS115-7	12TS95-7
	2-1 & 5-4 ON	2-1 & 5-6 ON	2-3 & 5-6 ON	L-32	—	12TS115-10	12TS95-10

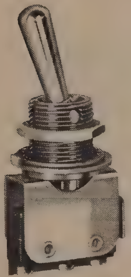
*Marked toggle positions are momentary. All other positions are maintained.

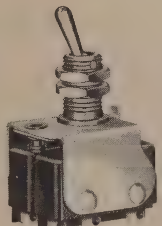

TWO POSITION- 1 POLE
KEYWAY
C NO NC
KEYWAY
C NO NC
THREE POSITION- 2 POLE
KEYWAY
C NO NC
C NO NC
C NO NC
C NO NC
KEY WAY
C NO NC
C NO NC

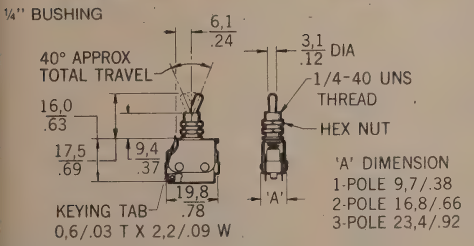
MICRO SWITCH Toggle Switch Assemblies couple a toggle switch operator with one or more precision SM, SX or V3 type basic switches. In two position devices, i.e., Series 6AT and 23AT, the normally open contacts of all basic switches are actuated when the toggle lever is located in the keyway position. In three position devices, i.e., 7, 8, 10, 11, 13, 15, and 22AT devices, one set of normally open contacts are actuated in each extreme position, while all switches in the center position are released, closing the normally closed contacts. Schematic at left shows actuation by positions.

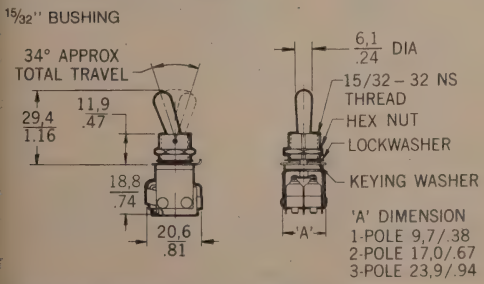
SERIES 6AT 2-POSITION TOGGLE SWITCH ASSEMBLIES

- Two Bushing Sizes—¼" and 15⁄32"
- Silver or Gold Contacts Offered
- Basic Switches UL and CSA Listed
- Short Depth Behind Panel
- Momentary and Maintained Positions






¼" BUSHING
6,1
.24
40° APPROX
TOTAL TRAVEL
16,0
.63
17,5
.69
9,4
.37
19,8
.78
KEYING TAB
0,6/.03 T X 2,2/.09 W
3,1
.12
DIA
1/4-40 UNS
THREAD
HEX NUT
'A'
'A' DIMENSION
1-POLE 9,7/.38
2-POLE 16,8/.66
3-POLE 23,4/.92


15⁄32" BUSHING
34° APPROX
TOTAL TRAVEL
11,9
.47
29,4
1.16
18,8
.74
20,6
.81
6,1
.24
DIA
15/32 – 32 NS
THREAD
HEX NUT
LOCKWASHER
KEYING WASHER
'A'
'A' DIMENSION
1-POLE 9,7/.38
2-POLE 17,0/.67
3-POLE 23,9/.94

DIMENSIONS SHOWN ARE
FOR REFERENCE ONLY

Key: $\frac{0,0\ -\ \text{mm}}{0.00\ -\ \text{inches}}$

Series 6AT Toggle Switch Assemblies control 1, 2, or 3 pole, double-throw precision SM basic switches. SM basic switches used in these assemblies are offered with gold or silver contacts in a choice of pierced solder terminals, "T" turret terminals, or "T2" double-turret terminals. Bushing sizes are offered in ¼" or 15⁄32" as charted below. Silver contacts are offered for general use, while gold contacts are offered for low energy circuits.

ELECTRICAL RATINGS (BASIC SWITCHES)

UL & CSA LISTING	RATING AT 30 VDC		
SILVER CONTACTS		Amperes at	
	Type Load	Sea Level	50,000 feet
5 Amps., 125-250 VAC	Inductive	3	2.5
	Resistive	5	5
	Max. Inrush	24	24
GOLD CONTACTS			
	Inductive	0.5	0.5
1 Amp., 125 VAC	Resistive	1	1
	Max. Inrush	2	2

Mounting Style	Number of Poles	Type Contacts	Catalog Listings		
			Solder Terminals	"T" Terminals	"T2" Terminals
¼" Bushing with Key Tab	1	Silver	6AT2	6AT2-T 6AT68-T*	6AT2-T2 6AT68-T2*
		Gold	6AT23	—	6AT23-T2
	2	Silver	6AT3	6AT3-T	6AT3-T2
		Gold	6AT13	—	6AT13-T2
	3	Silver	6AT501	6AT501-T	6AT501-T2
		Gold	—	—	—
¼" Bushing without Key Tab	1	Silver	6AT1	6AT1-T 6AT75-T* 6AT201-T**	6AT1-T2 6AT201-T2**
		Gold	—	—	6AT56-T2
	2	Silver	6AT4	6AT4-T 6AT231-T**	6AT4-T2 6AT231-T2**
		Gold	—	—	—
	3	Silver	—	—	—
		Gold	—	—	—
15⁄32" Bushing with Key Washer	1	Silver	6AT6	6AT6-T	6AT6-T2
		Gold	6AT17	—	6AT17-T2
	2	Silver	6AT7	6AT7-T	6AT7-T2
		Gold	6AT42	—	6AT42-T2
	3	Silver	6AT10	6AT10-T	6AT10-T2
		Gold	6AT18	—	6AT18-T2

*Extra Long Toggle Lever—17,0mm/.67"

**Momentary position opposite keyway. Key washer in place of key tab.

Refer to page F2 for other SM switches that can be provided in AT assemblies, including military qualified versionsl.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES 13AT AND 23AT TOGGLE SWITCH ASSEMBLIES

2&3 POSITIONS

- Standard Toggle, Tab, or Pull-To-Unlock Levers
- Momentary and Maintained Lever Positions
- 2, 3, and 4 Pole Versions
- Silver or Gold Contacts
- UL & CSA Listed Basic Switches

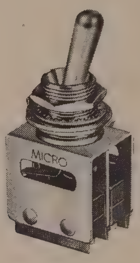
Series 13AT and 23AT contain two, three, or four SPDT subminiature type SM basic switches.

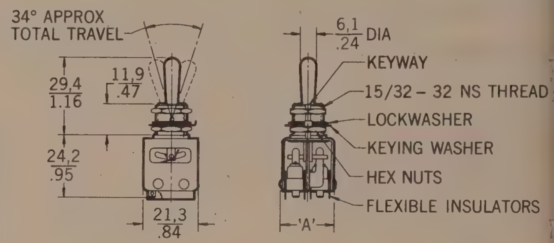
PULL-TO-UNLOCK LEVER OPTIONS

As a guard against accidental operation, pull-to-unlock toggle levers must be pulled .090 inch (approx.) to change positions. A chart showing the 13 locking configurations and their catalog listing suffix code letters is shown on page C15.

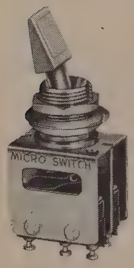
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

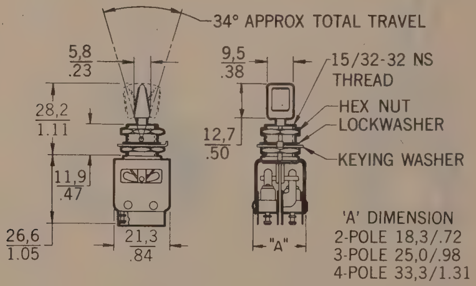
STANDARD LEVER



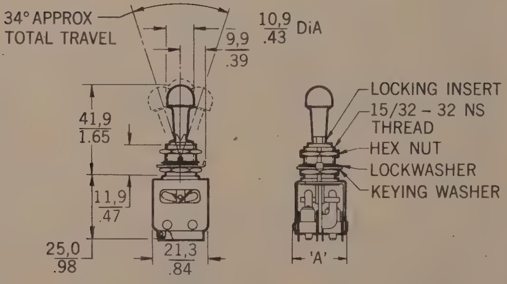

34° APPROX TOTAL TRAVEL
29,4 / 1.16
11,9 / .47
24,2 / .95
21,3 / .84
6,1 / .24 DIA
KEYWAY
15/32 – 32 NS THREAD
LOCKWASHER
KEYING WASHER
HEX NUTS
FLEXIBLE INSULATORS
'A'

TAB LEVER




34° APPROX TOTAL TRAVEL
5,8 / .23
28,2 / 1.11
11,9 / .47
26,6 / 1.05
21,3 / .84
9,5 / .38
12,7 / .50
15/32-32 NS THREAD
HEX NUT
LOCKWASHER
KEYING WASHER
"A"
'A' DIMENSION
2-POLE 18,3/.72
3-POLE 25,0/.98
4-POLE 33,3/1.31

PULL-TO-UNLOCK LEVER


34° APPROX TOTAL TRAVEL
9,9 / .39
10,9 / .43 DIA
41,9 / 1.65
11,9 / .47
25,0 / .98
21,3 / .84
LOCKING INSERT
15/32 – 32 NS THREAD
HEX NUT
LOCKWASHER
KEYING WASHER
'A'

ELECTRICAL RATINGS (BASIC SWITCHES)

UL & CSA Listing	Type	Rating at 30 VDC	
		Amperes at	
SILVER CONTACTS	Load	Sea Level	50,000 feet
5 Amps., 125-250 VAC	Inductive	3	2.5
	Resistive	5	5
	Max. Inrush	24	24

UL & CSA Listing	Type	Rating at 30 VDC	
		Amperes at	
GOLD CONTACTS	Load	Sea Level	50,000 feet
I Amp., 125 VAC	Inductive	0.5	0.5
	Resistive	1	1
	Max. Inrush	2	2

SERIES 13AT AND 23AT TOGGLE SWITCH ASSEMBLIES

2 & 3 POSITIONS

TWO POSITION TOGGLE SWITCHES

Toggle Lever Position		No. of Poles	Type Contacts	Standard Lever Catalog Listings			Pull-to-Unlock with Solder Terminals Specify Locking Letter*		Tab Lever with "T2" Terminals
Keyway	Opposite Keyway			Solder Terminals	"T" Terminals	"T2" Terminals			
Maint.	Maint.	2	Silver	23AT1	23AT1-T	23AT1-T2	23AT1-	Specify D, F or G from locking chart and add code letter to catalog listing at left. (Refer to Page C15 for locking chart.)	23AT402-T2
			Gold	23AT11	—	23AT11-T2	23AT11-		—
		3	Silver	23AT2	23AT2-T	23AT2-T2	23AT2-		23AT408-T2
			Gold	23AT12	—	23AT12-T2	23AT12-		—
		4	Silver	23AT3	23AT3-T	23AT3-T2	23AT3-		—
			Gold	23AT8	—	—	—		—
Mom.	Maint.	2	Silver	23AT4	23AT4-T	23AT4-T2			23AT403-T2
			Gold	23AT19	—		—		—
		3	Silver	23AT5	—	23AT5-T2	—		—
			Gold	23AT18	—	—	—		—
		4	Silver	23AT6	—	23AT6-T2			—
			Gold	23AT34	—	—	—		—

M8805/26 TOGGLE SWITCHES

Toggle Lever Position		No. of Poles	Type Contacts	Standard Lever With "T2" Terminals		Tab Lever With "T2" Terminals	
Keyway	Opposite Keyway			Catalog Listing	Military Approval No.	Catalog Listing	Military Approval No.
Maint.	Maint.	2	Silver	23AT73-T2	M8805/26-001	23AT473-T2	M8805/26-003
		4	Silver	23AT74-T2	M8805/26-002	23AT474-T2	M8805/26-004

THREE POSITION TOGGLE SWITCHES

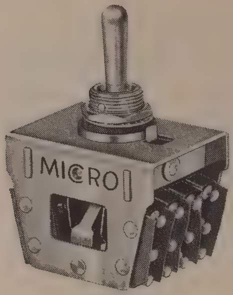
Toggle Lever Position			No. of Poles	Type Contacts	Standard Lever Catalog Listings			Pull-to-Unlock with Solder Terminals Specify Locking Letter*		Tab Lever with "T2" Terminals
Keyway	Center	Opposite Keyway			Solder Terminals	"T" Terminals	"T2" Terminals			
Maint.	Maint.	Maint.	2	Silver	13AT2	13AT2-T	13AT2-T2	13AT2-	Specify any locking chart letter and add to catalog listing at left. (Refer to Page C15 for locking chart.)	13AT402-T2
				Gold	13AT18	13AT18-T	—	—		—
			3	Silver	13AT5	13AT5-T	—	13AT5-		—
				Gold	—	—	—	—		—
			4	Silver	13AT9	13AT9-T	13AT9-T2	13AT9-		13AT409-T2
				Gold	13AT29	—	—	—		—
Mom.	Maint.	Mom.	2	Silver	13AT1	13AT1-T	13AT1-T2	13AT1	Specify E, L or N from locking chart and add code letter to catalog listing at left. (Refer to Page C15 for locking chart.)	13AT401-T2
				Gold	13AT26	—	—	—		13AT423-T2
			3	Silver	13AT4	—	—	—		13AT413-T2
				Gold	—	—	—	—		—
			4	Silver	13AT8	—	13AT8-T2	13AT8-		13AT408-T2
				Gold	13AT64	—	—	—		—
Maint.	Maint.	Mom.	2	Silver	13AT3	13AT3-T	13AT3-T2	13AT3-	Specify E,G,B,L,P or N from locking chart and add code letter to catalog listing at left. (Refer to Page C15 for locking chart.)	13AT403-T2
				Gold	13AT27	13AT27-T	—	—		—
			3	Silver	—	—	—	—		—
				Gold	—	—	—	—		—
			4	Silver	13AT10	—	—	13AT10-		13AT410-T2
				Gold	—	—	—	—		—

*Not all variations are available on a from stock basis. For complete information, contact your nearest MICRO SWITCH Branch Office.

M8805/26 TOGGLE SWITCHES

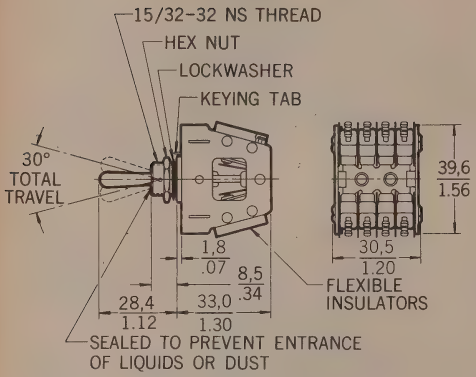
Toggle Lever Position			No. of Poles	Type Contacts	Standard Lever With "T2" Terminals		Tab Lever With "T2" Terminals	
Keyway	Center	Opposite Keyway			Catalog Listing	Military Approval No.	Catalog Listing	Military Approval No.
Mom.	Maint.	Mom.	2	Silver	13AT271-T2	M8805/26-005	13AT471-T2	M8805-26-006
			3	Silver	13AT274-T2	M8805/26-011	13AT474-T2	M8805/26-012
Maint.	Maint.	Maint.	2	Silver	13AT272-T2	M8805/26-007	13AT472-T2	M8805/26-008
			3	Silver	13AT275-T2	M8805/26-013	13AT475-T2	M8805/26-014
Maint.	Maint.	Mom.	2	Silver	13AT273-T2	M8805/26-009	13AT473-T2	M8805/26-010

SERIES 22AT TOGGLE SWITCH ASSEMBLIES



- Contains 8 SPDT "SM" Type Switches
- Basic Switches UL and CSA Listed
- Panel and Lever Seals
- Momentary and Maintained Positions

Series 22AT Toggle Switch Assemblies contain 8 SPDT silver contact SM basic switches. Basic switches are mounted in two banks controlled by a single lever. Movement of lever from the center position actuates one bank of 4 switches in each extreme position providing a variety of wiring combinations. Splash type bushing and lever seals prevent the entrance of moisture and dust behind the panel, or into the contact area.


15/32-32 NS THREAD
HEX NUT
LOCKWASHER
KEYING TAB
30° TOTAL TRAVEL
1,8 / .07
8,5 / .34
28,4 / 1.12
33,0 / 1.30
39,6 / 1.56
30,5 / 1.20
FLEXIBLE INSULATORS
SEALED TO PREVENT ENTRANCE OF LIQUIDS OR DUST

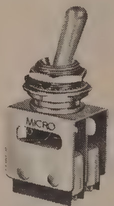
ELECTRICAL RATINGS (BASIC SWITCHES)

UL & CSA Listing	Rating at 30 VDC		
	Type Load	Ampere Capacity at	
		Sea Level	50,000 feet
5 Amps., 125-250 VAC	Inductive	3	2.5
	Resistive	5	5
	Max. Inrush	24	24

Toggle Lever Position			
Key Tab Position	Center Position	Position Opposite Key Tab	Catalog Listing with "T" Terminals
Momentary	Maintained	Momentary	22AT1-T
Maintained	Maintained	Maintained	22AT2-T
Maintained	Maintained	Momentary	22AT3-T

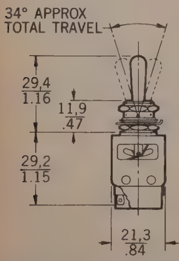
SERIES 213AT TOGGLE SWITCH ASSEMBLIES

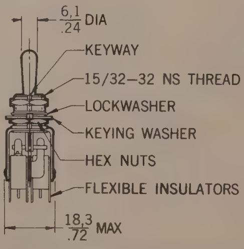
- Hermetically Sealed Basic Switches
- Three Position



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

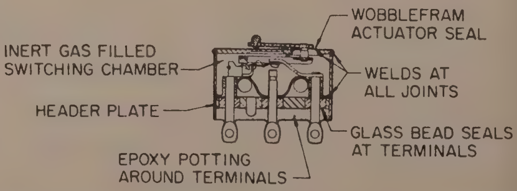
Key: $\frac{0,0}{0.00}$ = mm / = inches


34° APPROX TOTAL TRAVEL
29,4 / 1.16
11,9 / .47
29,2 / 1.15
21,3 / .84

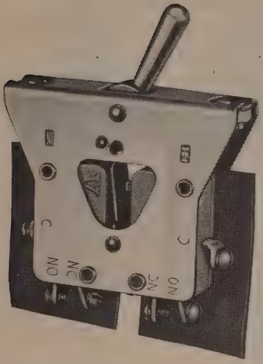

6,1 / .24 DIA
KEYWAY
15/32–32 NS THREAD
LOCKWASHER
KEYING WASHER
HEX NUTS
FLEXIBLE INSULATORS
18,3 / .72 MAX

The 213AT Series uses the hermetically sealed HM switch as its basic switching unit. The true hermetic sealing of the HM is achieved with a metal-to-metal, glass-to-metal construction that assures maximum seal effectiveness for exceptionally long periods of time despite continuous changes in atmospheric pressures and temperatures. See the internal construction drawing below for details of the HM basic.

Catalog Listing **213AT11** has two independently operating single-pole double-throw circuits. The toggle action is three position with a maintained center and a momentary in both extremes. Alternate switches are operated in each extreme position.

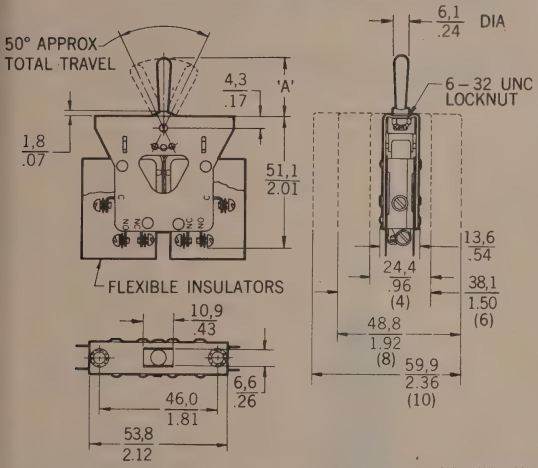

WOBBLEFRAM ACTUATOR SEAL
INERT GAS FILLED SWITCHING CHAMBER
WELDS AT ALL JOINTS
HEADER PLATE
GLASS BEAD SEALS AT TERMINALS
EPOXY POTTING AROUND TERMINALS

TOGGLE SWITCH HIGH CAPACITY ASSEMBLIES—3 POSITIONS



- 2-4-6-8-10 Switch Control
- Basic Switches UL and CSA Listed
- High Electrical Capacity
- Maintained and Momentary Positions
- 3 Hole Mounting—Rugged Construction

"AT" Toggle Switch Assemblies shown in the chart below contain high capacity V3 basic switches with terminal screws. Mounting is three-hole with (2) fastening screws (not furnished) from face of panel. Two toggle lever lengths are offered, with longer lever assembled to 6-8-10 switch units for reduced operating force. "AT" assemblies charted below contain two banks of V3 switches, with one bank operated in each extreme position.



ELECTRICAL RATINGS (BASIC SWITCHES)

UL & CSA Listing	Rating at 30 VDC		
15 Amps., 125-250 VAC ⅓ HP, 125-250 VAC ½ Amp., 125 VDC ¼ Amp., 250 VDC 5 Amps., 125 VAC (L)	Type Load	Ampere Capacity at Sea Level	50,000 feet
	Inductive	10	6
	Resistive	10	10
	Motor	6	6

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

TOGGLE LEVER POSITIONS			NUMBER OF BASIC SWITCHES	LEVER LENGTH "A"		CATALOG LISTING
ONE EXTREME	CENTER	OTHER EXTREME		MM	IN.	
Maintained	Maintained	Maintained	2	22,4	.88	11AT30
			4	22,4	.88	15AT1
			6	22,4	.88	7AT4
			8	22,4	.88	8AT4
			10	31,8	1.25	10AT4
Momentary	Maintaned	Momentary	2	22,4	.88	11AT20
			4	22,4	.88	15AT2
			6	31,8	1.25	7AT51
			8	31,8	1.25	8AT1
			10	31,8	1.25	10AT1
Momentary	Maintained	Maintained	2	22,4	.88	11AT50
			4	22,4	.88	15AT3
			6	22,4	.88	7AT6
			8	22,4	.88	8AT6

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES ET TOGGLE SWITCHES MAGNETICALLY HELD

Type "ET" toggle switches include a holding coil within their sealed housing to offer unique application possibilities to toggle switch users. Basically, the coil replaces mechanical holding mechanisms to maintain the toggle in an operated position. The toggle can be released by breaking the coil circuit. This type of operation is useful in missile launching complexes where a sequence of operations and checks must be performed and are subject to remote, immediate and simultaneous cancellation, and in other remote release applications.

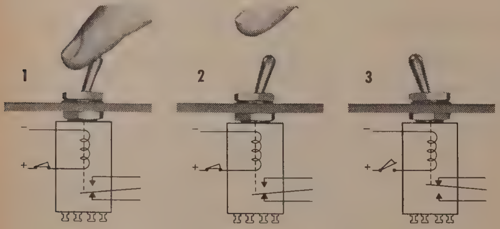
Seal Definition: Environment-Proof
Toggle Action: Two and Three-Position, magnetically maintained
Military Specifications: MIL-S-5594
Temperature Range: −54°C to 70°C (−65°F to +158°F)

Principle of Operation

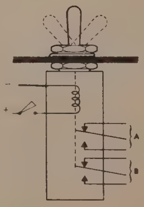
When hold-in coil circuit is open, the "ET" functions as a momentary contact switch. When the coil is energized (through remote contacts), the toggle lever is held (maintained) in the operated position. De-energizing the coil causes the lever to snap back to the unoperated position. The lever can also be released manually.

NOTE: The solenoid has a holding capacity only. It will not pull the toggle lever into an operating position from an unoperated position.

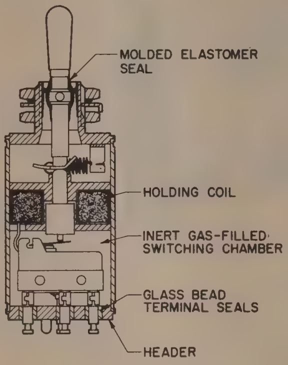
Two-position — The illustration below show the operating sequence for a "25ET" type switch with one SPDT circuit: (1) circuit closed manually, (2) energized solenoid holds switch circuit closed, and (3) remote control breaks solenoid circuit, releases toggle, opening switch circuit. (In the case of "26ET" type switches, which have two SPDT circuits, both circuits transfer when the lever is operated.)



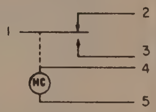
Three-position — "27ET" type switches have two SPDT circuits. There is magnetic hold-in capability in both directions from center. When the lever is in the center position, the circuitry is as shown in the illustration at right. When the lever is moved to one extreme position, switch (A) circuit is transferred and switch (B) circuit is maintained. In the other extreme position, switch (B) circuit is transferred, while switch (A) circuit is maintained.



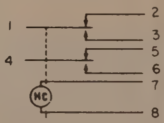
- Qualified to MIL-S-5594
- Environment-Proof Sealing
- Two and Three Position Magnetically Maintained Toggle Action
- Standard, Tab, and Pull-To-Unlock Levers
- Turret, Leadwire, and Screw terminals



Circuitry



Single-pole Double-throw



Double-pole Double-throw

Electrical Rating

Rating Code	VOLTAGE	AMPERAGE							
		Sea Level (Sealed)				65,000 ft (Unsealed)**			
		Inrush	Res.	Ind.	Motor	Inrush	Res.	Ind.	Motor
A	28 DC	24	4	2.5	4	24	4	2	4
B	28 DC	24	4	3	4	24	4	2.5	4
C	28 DC	24	7	2	—	—	5	1.5	—

**This rating established unsealed to provide data for military purposes.

Circuit Operation

Circuitry	TWO-POSITION TOGGLE Circuit Made With Toggle At:		THREE-POSITION TOGGLE Circuit Made With Toggle At:		
	Keyway* Position	Opposite Keyway	Keyway* Position	Center Position	Opposite Keyway*
SPDT:	1-3	1-2	—	—	—
DPDT:	1-3, 4-6	1-2, 4-5	1-3, 4-5	1-2, 4-5	1-2, 4-6

*These positions are magnetically held when coil is energized; and momentary when coil is not energized.

SERIES ET TOGGLE SWITCHES MAGNETICALLY HELD

TOGGLES

STANDARD

PULL-TO-UNLOCK

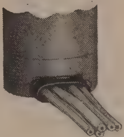
PUSH-TO-UNLOCK

TAB

Standard — Tapered matte finish stainless steel.
Pull-to-unlock — Prevents accidental actuation; must be pulled out to change positions.
Push-to-unlock — As a guard against accidental operation, the toggle must be depressed. 100 inch (approx.) before it can be moved to either extreme position. Energizing the coil causes the extreme positions to be electrically maintained until the coil circuit is broken.
Tab—Paddle shaped clear anodized aluminum tab.

TERMINALS

TURRET


LEADWIRE

SCREW

Turret — Plated for easy solder connection of up to #14 wire.
Leadwire — No. 20 wire per MIL-W-5086, marked per MIL-W-5088. Standard length of 6 feet. Leadwire ends are stripped and solder dipped. Other material and lengths can be furnished. Contact your nearest MICRO SWITCH Branch Office for further information.
Screw — 4-40NC x .125 round head screws with lockwashers. Separated by molded phenolic barriers.

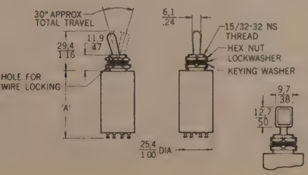
Circuitry	No. of Toggle Positions	Lever Type	Terminals	Elect. Rating Code	Weight		Dimension "A"		Catalog Listing
					grams	ounces	mm	inches	
SPDT	2	Standard	Leadwire (90° from Keyway)	B	241	8.5	51,6	2.03	25ET61-6 (M5594/1-1)
	2	Standard	Solder Turret	B	113	4.0	47,5	1.87	25ET61-T (M5594/1-2)
	2	Standard	Screw	B	113	4.0	61,2	2.41	25ET61-S (M5594/1-3)
	2	Tab	Leadwire (in-line w/Keyway)	B	241	8.5	51,6	2.03	25ET62-6 (M5594/1-4)
	2	Standard	Leadwire (180° from Keyway)	B	241	8.5	51,6	2.03	25ET63-6 (M5594/1-5)
	2	Standard	Leadwire (90° from Keyway)	B	241	8.5	51,6	2.03	25ET64-6 (M5594/1-6
DPDT	2	Standard	Solder Turret	A	113	4.0	47,5	1.87	26ET61-T (M5594/2-1)
	2	Standard	Solder Turret	A	113	4.0	47,5	1.87	26ET65-T* (M5594/2-2)
	3	Standard	Solder Turret	C	113	4.0	58,7	2.28	27ET61-T (M5594/3-1)
	3	Pull-To-Unlock	Leadwire (90° from Keyway)	C	340	12.0	66,0	2.60	27ET2-6-E**
	3	Push-To-Unlock	Solder Turret	C	113	4.0	58,7	2.28	27ET51-T

*460 ohm instead of standard 220 ohm coil.
**Locking configuration (designation by letter suffix on listing) is shown in the locking chart on page C15.

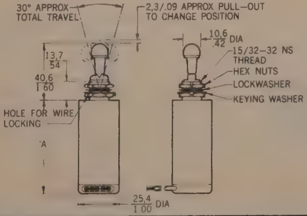
DIMENSIONS

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

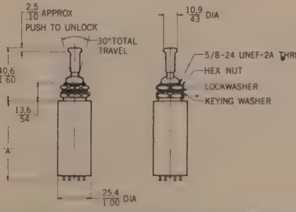
STANDARD AND TAB TOGGLE LEVER


30° APPROX TOTAL TRAVEL
29,4 / 1 16
11,9 / 47
HOLE FOR WIRE LOCKING
'A'
6,1 / .24
15/32-32 NS THREAD
HEX NUT
LOCKWASHER
KEYING WASHER
25,4 / 1 00 DIA
9,7 / 38
12,7 / 50

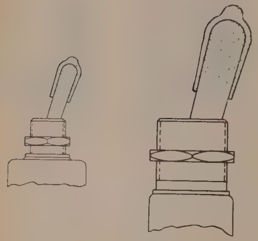
PULL-TO-UNLOCK TOGGLE LEVER


30° APPROX TOTAL TRAVEL
2,3/.09 APPROX PULL—OUT TO CHANGE POSITION
13,7 / 54
40,6 / 1 60
HOLE FOR WIRE LOCKING
'A
10,6 / .42 DIA
15/32—32 NS THREAD
HEX NUTS
LOCKWASHER
KEYING WASHER
25,4 / 1 00 DIA

PUSH-TO-UNLOCK TOGGLE LEVER


2,5 / .10 APPROX PUSH TO UNLOCK
30°TOTAL TRAVEL
40,6 / 1 60
13,6 / 54
'A'
25,4 / 1 00 DIA
10,9 / 43 DIA
5/8-24 UNEF-2A THREAD
HEX NUT
LOCKWASHER
KEYING WASHER

TOGGLE SWITCH ACCESSORIES



COLORED PLASTIC LEVER CAPS

Colored plastic lever caps fit ¼" and 15/32" diameter bushing toggle switches listed in the chart below.

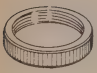
To order lever caps, add the appropriate letter(s) to the basic catalog listing. Example: 15PA90-2G is a green sleeve that fits the toggle lever of a TW toggle switch with a ¼-inch bushing.

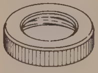
Toggle Switch Catalog Listing	Lever Cap Catalog Listing	Colors Available					
		Blue	Black	White	Green	Yellow	Red
For all 6AT2 types	15PA90-1	BL	BK	W	G	Y	R
For ¼" bushing TW toggle	15PA90-2	BL	BK	W	G	Y	R
For 6AT68 type	15PA90-3		BK	W			R
For all Standard Lever toggles (TW, TL TS, etc.)	15PA90-4		BK	W			R

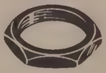
To order, add color designation to basic listing.

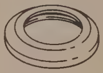
DECORATIVE MOUNTING HARDWARE

MICRO SWITCH offers several styles of dress hardware for both ¼" and 15/32" bushing sizes. All are designed to be decorative additions to any panel design. The four available styles are illustrated below.


A

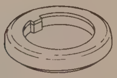

B


C


D

Style	Description	Bushing Size	Catalog Listing
A	Knurled Nut	¼"	19PA5-1
	(Chrome Finish)	15/32"	19PA6-1
	(Black Finish)	15/32"	19PA6-4
B	Knurled Capnut	¼"	19PA5-2
	(Chrome Finish)	15/32"	19PA6-2
C	Hex Nut	¼"	19PA5-3
	(Black Finish)	15/32"	19PA6-3
D	Tapered Nut (Chrome Finish)	15/32"	19PA6-5

PANEL SEAL



Offered for 15/32" bushing toggle switches, this panel seal is a round, corrosion resistant steel cupwasher with a silicon elastomer lining and keying tab for sealing keying slot on toggle bushing. Order Catalog Listing 15PA87 (MS25196).

SERIES RM AND AS ROTARY SELECTOR SWITCHES

- Completely Enclosed Contacts
- Camshaft Insures Accurate Sequencing
- Virtually Infinite Variety Of Switching Sequence Combinations
- Load Handling Versatility
- Excellent Feel of Detent Action

MICRO SWITCH Series 1RM and AS Rotary Selection Switches feature direct action switching through a camshaft operating mechanism. In addition to insuring accurate sequencing over a long operating life, the camshaft principle eliminates the need for complicated "jumper" wiring to provide the desired switching sequence. All cams are long-wearing, fungus-resistant, laminated thermosetting plastic.

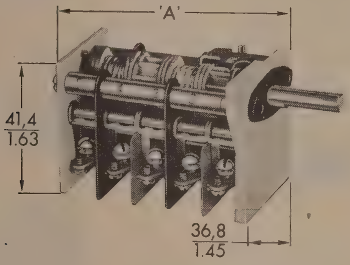
The precision snap-action switches used in the assembly have single-pole double-throw circuitry, which enables "on-off", "on-on", and "off-on" switching. Both movable and stationary contacts are enclosed to help prevent dust and dirt from entering the switching chamber. Some types are completely sealed.

SUMMARY OF ROTARY SELECTOR SWITCH OPTIONS

ROTARY SWITCH SERIES	TYPE OF BASIC SWITCH	NO. OF BASICS	NO. OF OPERATING POSITIONS	DETENT ANGLES (DEGREES)	SHAFT EXTENSION* MM INCHES	BUS BAR	SHAFT SEAL	PANEL SEAL
1RM	V3	2-8	2-8	45,90	25,4 19,1 12,7 1.0, .75, .50	Optional	Yes	Yes
20AS	V3	4-20	2-12	30, 60	19,1 25,4 .75*, 1.00*	Optional	Optional	Optional
17AS	SM or HM	2-8	2-12	30, 36, 45, 90	18,5 22,4 .73*, .88*	No	Optional	Optional
25AS	SE	2-8	2-8	45, 90	22,4 .88*	No	Optional	Optional
27AS** and 28AS	SM	2-8	2, 3	90	17,8 .70	No	Yes	No

*Deduct 0,76 mm (.03") approx. if panel seal is not used.
**27AS has potted lead wire termination.

SERIES 1RM



No. of Dasics		2	3	4	5	6	7	8
Dim. "A"	mm	33,0	43,2	53,3	66,0	76,2	88,9	99,1
	in.	1.3	1.7	2.1	2.6	3.0	3.5	3.9

The IRM Series of rotary selector switches have a single-bank arrangement of up to eight type V3 high capacity basic switches. Twin torsion springs on the camshaft provide positive detent positions.

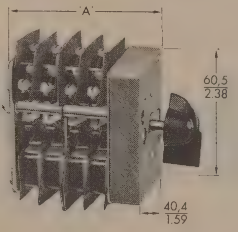
IRM rotaries are mounted at the front of the panel. Three holes are required, one for the ¼-inch diameter shaft and two for the 6/32NC mounting screws.

A flexible gasket on the front plate compresses flush to the mounting surface during installation, sealing the assembly to the panel. A ring seal further limits the entry of dust, dirt and moisture into the shaft bearing surface from the mounting holes.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

SERIES 20AS



KNOB NOT FURNISHED

No. of Basics		4	6	8	10	12	14	16	18	20
Dim. "A"	mm	45,7	55,9	66,0	78,7	88,9	102	112	122	132
	in.	1.8	2.2	2.6	3.1	3.5	4.0	4.4	4.8	5.2

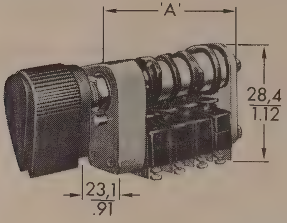
This double-bank design features up to 20 type V3 basic switches in one compact assembly. Series 20AS is normally front mounted by means of three holes, one for the ¼-inch diameter shaft and two for the 6-32 NC mounting screws. Rear mounting means can be furnished. Panel and shaft seals are optional.

Basic Switch Type	Electrical Data	Terminals
V3	SPDT, SPNO or SPNC. Up to 15 amps. ⅓ hp. 120 or 250 VAC. (Gold contacts available.)	Solder, Screw or Quick-Connect

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

SERIES RM AND AS ROTARY SELECTOR SWITCHES

SERIES 17AS



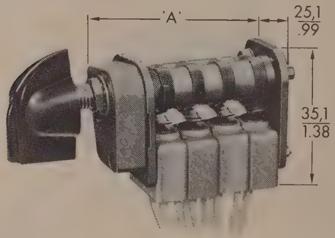
KNOB NOT FURNISHED

No. of Basics		2	3	4	5	6	7	8
Dim. "A"	mm	30,5	38,1	43,2	50,8	58,4	66,0	71,1
	in.	1.2	1.5	1.7	2.0	2.3	2.6	2.8

The 17AS Series is a single-bank arrangement of up to 8 type SM (shown) or hermetically-sealed HM basic switches. Front mounting on the ¼-inch diameter bushing is standard but rear mounting can be provided. Panel and shaft seals are optional.

As is the case with all MICRO SWITCH rotaries, the basic switches are factory assembled to be operated in the sequence required by your application. For example, Decimal-to-Binary versions have been set up, primarily for use on computer consoles, to introduce information by converting decimal constants to a positional number code.

SERIES 25AS



KNOB NOT FURNISHED

No. of Basics		2	3	4	5	6	7	8
Dim. "A"	mm	38,1	45,7	55,9	63,5	71,1	83,8	91,4
	in.	1.5	1.8	2.2	2.5	2.8	3.3	3.6

Single-bank 25AS rotaries have up to 8 environment-proof type SE basic switches. Mounting is from the front on the ¼-inch diameter bushing.

ORDERING INFORMATION

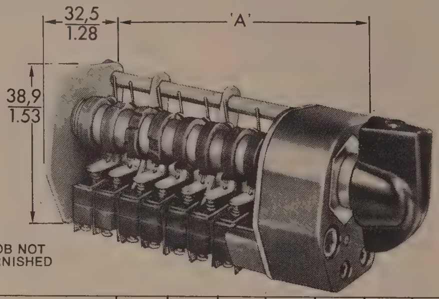
Each rotary selector switch is factory assembled and adjusted to the desired sequence on a custom basis.

Because of the almost infinite number of design combinations, it is not feasible to include all the available catalog listings.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm
0.00 — inches

COCK-AND-FIRE SERIES 27AS AND 28AS

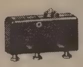
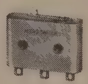
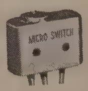


KNOB NOT FURNISHED

No. of Basics		2	3	4	5	6	7	8
Dim. "A"	mm	45,7	53,3	58,4	66,0	73,7	78,7	86,4
	in.	1.8	2.1	2.3	2.6	2.9	3.1	3.4

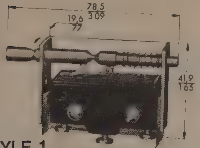
Cock-and-Fire rotary selector switches move positively from one position to another, without encountering circuit tease or actuator hang-up between the detents. They are furnished with up to eight type SM basic switches. Mounting is from the device's front by means of three holes, one for the ¼-inch diameter shaft and two for the 6-32 NC mounting screws. The 27AS is identical to the 28AS (shown), except for being provided with No. 20 leadwires, which are embedded in epoxy at the terminal entrance.

SWITCHING UNITS

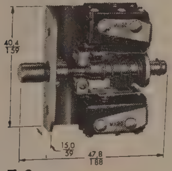
Basic Switch Type	Electrical Data	Terminals
SM 	SPDT. Up to 10 amps, ¼ hp, 125 or 250 VAC. (Gold contacts available.)	Solder "T" and "T2", solder post, or quick-connect terminals.
HM Hermetically Sealed 	SPDT. Up to 5 amps res., 28 VDC or 115 VAC 400 Hz. (Gold contacts available.)	Solder post terminals or leadwire.
SE Environment Proof 	SPDT, SPNO, or SPNC. 5 amps res., 28 VDC, 125 or 250 VAC 60 Hz	Solder "T" terminals or leadwire

Contact your nearest MICRO SWITCH Branch Office or Authorized Distributor for assistance in choosing the exact combination of features to meet your needs.

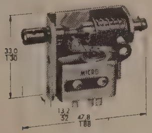
ORDER GUIDE DOOR INTERLOCK SWITCHES



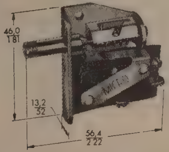
STYLE 1



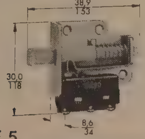
STYLE 2



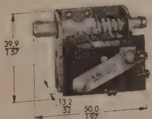
STYLE 3



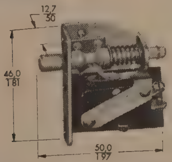
STYLE 4



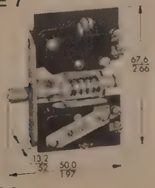
STYLE 5



STYLE 6



STYLE 7



STYLE 8

For use on hazardous electronic equipment. They automatically cut power when service door or drawer is opened helping to protect personnel and equipment.

To test circuits with the power "on" the actuating rod can be manually set (pulled) to a maintained—on position. When the door or drawer is closed following test or service, the actuating rod automatically returns to the normal or reset position so that next time the door is opened, power is cut off.

Series DM switches are also widely used as door interlock switches. See page A61 for additional interlock switch possibilities.

CIRCUITRY		ELECTRICAL DATA
Single-Pole Double-Throw	A	15 amps, 125, 250 or 480 VAC; ½ amp, 125 VDC; ¼ amp, 250 VDC.
Single-Pole Double-Throw	B	5 amps, 125 or 250 VAC; 30 VDC ind., 3 amps (sea level) and 2.5 amps (50,000 ft.); res, 5 amps (sea level and 50,000 ft.); maximum inrush 25 amps.
Single-Pole Double-Throw	C	15 amps, 125 or 250 VAC; ½ amp, 125 VDC; ¼ amp, 250 VDC; ⅓ hp, 125 or 250 VAC.

NOTE: Metric values shown in light face (11,1).
English values shown in bold face (**.438**).

CHARACTERISTICS:
F.P. — Free Position;
O.P. — Operating Position;
D.P. — Depressed Position.

Actuators	Description	Style No.	Electrical Data Ref.	Catalog Listing	Basic Switch Type	F.P. max. mm (in.)	O.P. min. mm (in.)	D.P. max. mm (in.)
Steel	High Capacity	1	A	1AC2	BZ	11,1 **.438**	6,35 **.250**	3,18 **.125**
	Up to 4 separate SPDT circuits	2	B	8AC1	SM(4)	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Three 1 foot leads Sealed basic switches	3	B	9AC4	SE	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Two 3 foot leads SPST—N.O. Sealed basic switches	3	B	9AC12-3	SE	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Can be reset without momentary circuit break	4	C	13AC1	V3	15,9 **.625**	12,3 **.485**	6,68 **.263**
	Subminiature size	5	B	17AC1-T	SM	9,53 **.375**	5,59 **.220**	4,45 **.175**
*High strength thermoplastic		6	C	22AC1	V3	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Tapped hole in end of actuator rod	6	C	22AC2	V3	9,53 **.375**	5,16 **.203**	3,18 **.125**
		7	C	23AC1	V3	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Tapped hole in end of actuator rod	7	C	23AC2	V3	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Two separate SPDT circuits	8	C	24AC1	V3(2)	9,53 **.375**	4,75 **.187**	3,18 **.125**
	Tapped hole in end of actuator rod	8	C	24AC2	V3(2)	9,53 **.375**	4,75 **.187**	3,18 **.125**
	Tapped hole in end of steel actuator rod	6	C	2AC59 (MS16101-1)	V3	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Two separate SPDT circuits	8	C	4AC54 (MS16106-2)	V3(2)	9,53 **.375**	4,75 **.187**	3,18 **.125**
	Two separate SPDT circuits	8	C	4AC55 (MS16106-5)	V3(2)	9,53 **.375**	4,75 **.187**	3,18 **.125**
	Up to four separate SPDT circuits	2	B	8AC9 (MS16106-3)	SM(4)	9,53 **.375**	5,16 **.203**	3,18 **.125**
	Subminiature size	5	B	17AC18-T (MS16106-4)	SM	9,53 **.375**	5,59 **.220**	4,45 **.175**

*Not for use in temperatures over +185°F (85°C)
For higher temperatures order steel actuator Catalog Listing 2AC or 3AC in place of Catalog Listing 22AC or 23AC respectively. Order Catalog Listing 4AC8 in place of Catalog Listing 24AC2 for higher temperature use.

PX NUMERIC KEYBOARD

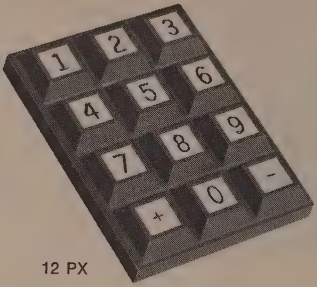
- Oiltight and Watertight
- Jam-Proof Buttons
- Durable Legends
- Reliable, Direct Drive Gold Contacts
- Low Cost Installation
- Low Profile Construction
- Silicone or Neoprene Covers
- Positive Tactile Feedback
- Suitable for Outdoor Environments

PX Numeric Keyboards are designed for use in adverse environments. The one-piece elastomer cover (neoprene or silicon) seals out oils, grease water, dust, sand and chips. Even sticky substances won't affect the operation of the keyboard. PX Keyboards can be washed down from front of panel without affecting operations.

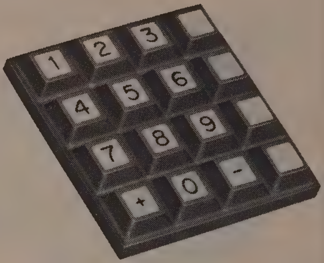
The keys provide tactile feedback and the internal construction makes them jam-proof. Permanent legends remain readable in the grimiest environments.

The standard legends (as illustrated) are double-shot molded for durability. Special legends can be hot-stamped. The inserts are interchangeable for varying formats. Operating the keys exerts force directly on the gold contacts for reliable switching of low energy circuits and dependable operation over a wide range of electronic voltages.

The low profile, compact keyboards require minimum panel space. They install quickly and easily with mounting studs. Solder pin terminals are grouped in the center of the board for convenient wiring and simple panel preparation.


1
2
3
4
5
6
7
8
9
+
0
-

12 PX


1
2
3
4
5
6
7
8
9
+
0
-

16 PX

SPECIFICATIONS

OPERATING CHARACTERISTICS

Operating Force: 10 oz (284g) nominal
Key Travel: 0.10 inch (2,54mm) approx.

ACTION

Slow make and slow break

MOUNTING

Four 6-32 UNC threaded studs (12 key)
Six 6-32 UNC threaded studs (16 key)

KEY SPACING

¾ inch center to center

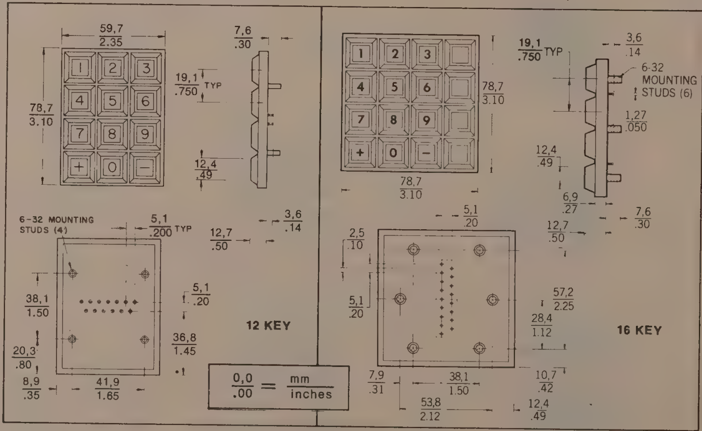
ELECTRICAL DATA

Contact Rating: 20 mA max.
@ 4—12 VDC
Circuitry: SPNO (common bus)

ORDERING INFORMATION

CATALOG LISTING	# OF KEYS	COVER MATERIAL	TEMPERATURE RANGE		PRINCIPAL ADVANTAGE
			OPERATING	NON-OPERATING	
12PX1-1	12	Neoprene	−18°C to +71°C (0°F to 160°F)	−51°C to 121°C (−60°F to 250°F)	Oil resistant
16PX1-1	16	Neoprene			
112PX1-1	12	Silicone	−34°C to 71°C (−30°F to 160°F)	−51°C to 121°C (−60°F to 250°F)	Low operating temperature
116PX2-3	16	Silicone			

MOUNTING DIMENSIONS


59,7
2.35
7,6
.30
78,7
3.10
19,1
.750
TYP
12,4
.49
6-32 MOUNTING STUDS (4)
5,1
.200 TYP
12,7
.50
3,6
.14
38,1
1.50
5,1
.20
36,8
1.45
20,3
.80
8,9
.35
41,9
1.65
12 KEY
0,0 = mm
.00 = inches
19,1
.750 TYP
3,6
.14
6-32 MOUNTING STUDS (6)
78,7
3.10
1,27
.050
12,4
.49
6,9
.27
78,7
3.10
5,1
.20
2,5
.10
12,7
.50
7,6
.30
5,1
.20
57,2
2.25
28,4
1.12
16 KEY
7,9
.31
38,1
1.50
10,7
.42
53,8
2.12
12,4
.49

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

SERIES SW and SD

KEYBOARDS TO FIT EVERY NEED

At MICRO SWITCH, we have the world's most complete line of solid state keyboards . . . which means unmatched design flexibility for you. Our application engineers will custom tailor a keyboard to your exact specifications, whether from our time-proven SW series of our new low-profile SD series.

Choose from keys offering over 10,000 legends, 30 colors, and 60 shapes, including standard, sculptured or re-legendable keys — or create new keys to fit your needs. Even lighted and two-level keys are available.

MICRO SWITCH keyboards are available with features like MOS, TTL and DTL encoding, and with two-key or N-key rollover. Your choice of alpha and numeric arrays.

FAST DELIVERY

Working with MICRO SWITCH, you draw on our extensive solid state experience. We've been designing reliable keyboards for hundreds of applications since 1968 and are presently producing thousands of units a week. Each offering a 1% AQL and two-year warranty. This means we can supply you quickly at lower unit prices.

So whatever your needs, and whatever your budget, we'd like to supply a keyboard to fit. Contact a MICRO SWITCH Branch Office for complete information.

MODULES

If you prefer to build your own keyboards, our complete line of Series SD and SW modules are available to you.

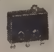
DC CONTROL MOTORS

If you'd like to give your products a faster start, ask us about our complete line of low inertia motors with fast acceleration and deceleration. Sizes from 1 to 6 inches diameter, with integral tachometer options. For more information, contact your nearest MICRO SWITCH Branch Office.

POSITION SENSING SWITCHES
TABLE OF CONTENTS

BASIC SWITCHES

Type SX



Smallest snap action switch. Rated to 7 amps. Choice of actuators and terminals.

Page F1-F4

Type SM

Subminiature size. Rated to 11 amps. Choice of actuators and terminals.

Page F5-F8

Type V3

Miniature size. Rated to 15 amps. Wide selection of actuators and terminals.

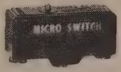
Page F9-F12

Type TB

Two and four circuit, double break. Rated to 10 amps. Choice of auxiliary actuators and terminals.

Page F13

Type Z & A



Standard size switches. Ratings to 20 amps. High precision — long life. Wide choice of actuators and terminals.

Page G1-G10

Type SE/XE

Sealed, environment proof switches. Rated to 7 amps. Choice of auxiliary actuators and termination.

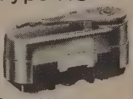
Page H1-H3

Type HM

Hermetically sealed. Subminiature size. Rated to 5 amps at 28 VDC or 115 VAC, 400 Hz. Choice of auxiliary actuators and termination.

Page H4-H5

Type HS



Hermetically sealed, standard size. Rated to 25 amps, 28 VDC. Choice of levers and termination.

Page H6

Type HT

High temperature, to 1000°F. Standard size. Rated to 3 amps.

Page H7

Mercury Switch

Glass enclosed, hermetically sealed. Rated to 45 amps. Tilt to operate.

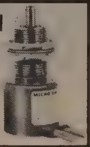
Page I1-I4

LIMIT SWITCHES

Limit Switches Selection Guide and other limit switches. Industry's widest selection of enclosed limit switches.

Front of Section J

Type EN



Environment proof. Many variations of actuators, circuitry, termination and electrical ratings for military/aerospace and commercial applications.

Page J1-J6

Type HE

Hermetically sealed EN type switch.

Page J7

Type HR

High temperature hermetically sealed switches, to 600°F.

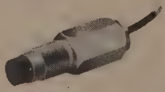
Page J8

NO TOUCH CONTROLS

Solid State Proximity, Photoelectric, Hall effect, solid state line. Complete Industrial Proximity line. Complete line of Photoelectric controls.

Page K1

Type FW

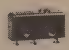


Environment sealed. Choice of Hall effect or eddy current operation.

Page K2-K3

BASIC SWITCH PRODUCT SELECTION GUIDE

STANDARD BASICS & MINIATURE BASICS

							
		1SX	SM	V3	TB	BZ	BA
FEATURE		Page F1	Page F5	Page F9	Page F13	Page G1	
MAX. CURRENT AMPS (AC)		7	11	15	10	15	20
CIRCUITRY		SPDT	SPDT	SPDT	2 or 4 CKT. DB	SPDT specials	SPDT
LOW ENERGY GOLD CONTACTS		x	x	x		x	
MIN. OPERATING FORCE		20 g	6 g	15 g	7 OZ.	1 OZ.	14 OZ.
MIN. DIFFERENTIAL TRAVEL (IN.)		.001	.001	.002	.015	.0004	.002
SIZE—LENGTH (IN.)		.50	.78	1.1	1.25	1.94	1.94
ACTUATION	plunger	x	x	x	x	x	x
	lever	x	x	x		x	x
UPPER TEMPERATURE LIMITS °F	nominal	250	250	180	180	180	180
	high	400	400	600		400	250
AUXILIARY ACTUATORS		x	x	x	x	x	x
WIRING TERMINALS	screw		x	x	x	x	x
	solder	x	x	x	x	x	x
	quick-connect	x	x	x		x	
	leadwire						
MOUNTING	side	x	x	x	x	x	x
	bushing					x	x
AGENCY LISTED	UL	x	x	x	x	x	x
	CSA	x	x	x	x	x	x
MILITARY APPROVED		x	x	x	x	x	x
SEALING	elastomer		x			x	

SPECIAL BASICS

		Environmental use						Solid State*	
		SE	XE	HM	HS	HT	AS	SS	XL
FEATURE		Page H1		Page H4	Page H6	Page H7	Page I1		
MAX. CURRENT AMPS (AC)		5	7	5 400 Hz.	25(DC)	10(DC)	45	(DC) 20mA	(DC) 20mA
CIRCUITRY		SPST SPDT	SPST SPDT	SPDT	SPDT	SPDT	SPST SPDT 2CKTDB		
LOW ENERGY GOLD CONTACTS				x			mercury	Hall Effect Solid State	
MIN. OPERATING FORCE		4 OZ.	5 OZ.	1.5 OZ.	4 OZ.	10 OZ.	—	—	10 g
MIN. DIFFERENTIAL TRAVEL (IN.)		.004	.005	.030	.020	—	0.15° Max.	—	.030
SIZE—LENGTH (IN.)		.88	.62	.79	1.9	1.9	.5 to 3.0	.20 to 1.0	1.1
ACTUATION	plunger	x	x	x		x	position tilt	magnet	x
	lever				x				x
SEALING	environment	x	x					x	
	hermetic			x	x		x		
WIRING TERMINALS	screw				x	x			
	solder	x	x	x			x	x	x
	leadwire	x	x	x	x		x	x	
MOUNTING	side	x	x	x	x	x			x
	bracket						x	x	
	bushing					x		x	
AGENCY LISTED	UL	x	x		x	x			
	CSA	x	x		x	x			
MILITARY APPROVED		x	x	x	x				
AUXILIARY ACTUATORS		x	x	x	x	x			x
UPPER TEMPERATURE °F		230 or 300		500	300	1000	392	300	212

*For information on solid state products ask your nearest MICRO SWITCH Branch Office for literature.

NOTE: MICRO SWITCH has many complete lines of Industrial Controls, i.e., Limit and Enclosed Switches, Compact Relays, Oiltight Manual Controls, No Touch Controls. Request literature from your nearest MICRO SWITCH Branch Office.

TYPE SX SUBMINIATURE BASIC SWITCHES

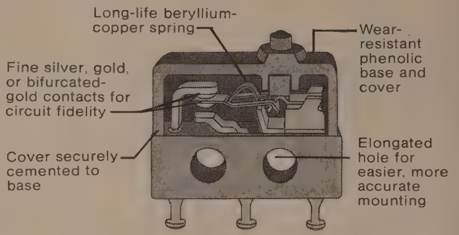
The SX series basic switches are the smallest snap-action switches from MICRO SWITCH. These switches are ideal where savings in space and weight are important. Unless otherwise noted, all listings have silver contacts.

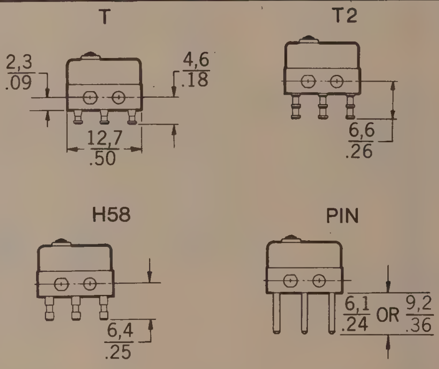
Some of the important features available with design variations include:

- Low operating force to 3 ox. (85 grams) maximum
- Sensitive differential travel of .001 inch maximum
- Power load switching capability of 7 amperes
- Long mechanical life of 10,000,000 cycles—95% survival for 11SX series
- Temperature tolerance −65° to +250°F (−54 to 121°C) on standard construction
- High temperature designs for up to +400°F (204°C)
- Gold contacts for low energy applications
- Bifurcated gold contacts for maximum reliability
- Variety of integral and auxiliary actuators
- Choice of several terminal styles
- Military Standard construction with 4 listings on the MIL-S-8805 qualified products list
- UL and CSA listed

The 1SX switches are available with several types of terminations. The T and T2 terminals provide easy lead wire attachment. The H58 terminal offers the simplicity of quick-connect. The H58 terminals mate with AMP .058-inch receptacles.

AVAILABLE TERMINALS


Long-life beryllium-copper spring
Wear-resistant phenolic base and cover
Fine silver, gold, or bifurcated-gold contacts for circuit fidelity
Cover securely cemented to base
Elongated hole for easier, more accurate mounting


T
2,3
.09
4,6
.18
12,7
.50
T2
6,6
.26
H58
6,4
.25
PIN
6,1
.24
OR
9,2
.36

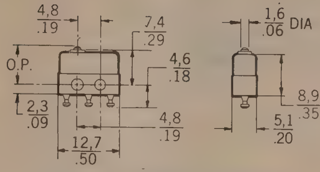
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 = mm / 0.00 = inches

CIRCUITRY	ELECTRICAL DATA	CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	A 5 amps res., 3 amps ind., (sea level), 4 amps res., 2 amps ind., (50,000 feet), 28 vdc 5 amps res. or ind., 115 vac, 60 Hz. UL and CSA Listed: 5 amps, 250 vac.	Single-Pole Double-Throw	E 3 amps res., 2 amps ind., (sea level), 28 vdc. UL listed: 3 amps, 250 vac.
Single-Pole Double-Throw	B 7 amps res., 4 amps ind., (sea level), 7 amps res., 2.5 amps ind., (50,000 feet), 28 vdc. UL and CSA listed: 7 amps, 250 vac.	Single-Pole Double-Throw	F 7 amps res., 4 amps ind., 2.5 amps lamp load, (sea level), 4 amps res., 2.5 amps ind., 2.5 amps lamp load, (50,000 feet), 28 vdc. 7 amps res., 7 amps ind., 2 amps lamp load, 115 vac, 60 Hz (sea level).
Single-Pole Double-Throw	C 3.5 amps res., 2 amps ind., (sea level), 3.5 amps res., 1.5 amps ind., (50,000 feet), 28 vdc. UL listed: 7 amps, 250 vac.	Single-Pole Double-Throw	H .010 amp res. and ind., (sea level). 28 vdc. UL and CSA listed: 1 amp, 125 vac.
Single-Pole Double-Throw	D 1 amp res., 0.5 amp ind., (sea level and 50,000 feet), 28 vdc. UL and CSA listed: 1 amp, 125 vac.	Single-Pole Double-Throw	I 7 amps res., 4 amps ind., (sea level), 28 vdc.

TYPE SX PIN PLUNGER

FIG. 1



MOUNTING HOLES ACCEPT PINS OR
SCREWS OF 2,3/.09 DIA

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 = \text{mm}}{0.00 = \text{inches}}$

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

STRAIGHT PLUNGER ORDER GUIDE

Recommended For	Fig. No.	Electrical Data Ref. Page F1	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P.* m.m. inches
Most applications	1	A	11SX21-T	142 5	28 1	0,51 .020	0,1 .004	0,051 .002	8,13 .320
Applications requiring gold contacts. 11SX type.	1	D	13SX21-T	142 5	28 1	0,51 .020	0,1 .004	0,076 .003	8,13 .320
Best stability under varying humidity. 11SX type.	1	A	17SX21-T	142 5	28 1	0,51 .020	0,1 .004	0,076 .003	8,13 .320
For use in sealed enclosures. 11SX type.	1	A	11SX22-T	142 5	28 1	0,51 .020	0,1 .004	0,076 .003	8,13 .320
Up to 7 amps load handling	1	B	1SX1-T	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
Lower Force	1	B	2SX1-T	85 3	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
Differential travel reduction	1	C	1SX12-T	142 5	28 1	0,51 .020	0,1 .004	0,051 .002	8,13 .320
Lowest differential travel	1	E	11SXV-1T	142 5	21,2 0.75	0,51 .020	0,1 .004	0,025 .001	8,13 .320
Lowest differential travel with bifuracted gold contacts	1	H	12SX3-T	142 5	28 1	0,51 .020	0,1 .004	0,025 .001	8,13 .320
Added overtravel	1	B	1SX48-T	142 5	28 1	0,51 .020	0,25 .010	0,13 .005	8,13 .320
Best stability under varying humidity	1	B	21SX1-T	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
Applications requiring gold contacts	1	D	3SX1-T	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
MIL-S-8805 application requirements +180°F (82°C) maximum use	1	F	21SX39-T (MS24547-1)	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
MIL-S-8805 application requirements +180°F (82°C) maximum use	1	F	21SX39-T2 (MS24547-4)	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
MIL-S-8805 application requirements for gold contacts +180°F (82°C) maximum use	1	D	23SX39-T (MS24547-2)	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
MIL-S-8805 application requirements for gold contacts +180°F (82°C) maximum use	1	D	23SX39-T2 (MS24547-5)	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
Operating in temperature to +400°F (204°C) (See Page F4 for actuators)	1	I	4SX1-T	142 5	28 1	0,51 .020	0,1 .004	0,13 .005	8,13 .320
Best reliability (Bifurcated gold contacts)	1	H	12SX2-T	142 5	28 1	0,51 .020	0,1 .004	0,076 .003	8,13 .320
Best reliability with higher current rating (Bifurcated gold contacts)	1	D	12SX1-T	142 5	28 1	0,51 .020	0,1 .004	0,076 .003	8,13 .320

*± 0,38 mm
± .015 in

Note:

For best results especially in the application of the bifurcated contact 12SX series, high temperature 4SX1-T, low differential travel 11SX1-T, and the high overtravel 1SX48-T, contact a MICRO SWITCH Branch Office.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPE SX INTEGRAL LEVERS

CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	A 4 amps res., 2 amps ind., (50,000 feet), 28 vdc, 5 amps res. or ind., 115 vac, 60 Hz. 28 vdc; 5 amps res. or ind., 115 vac, 60 Hz. UL and CSA listed: 5 amps, 250 vac

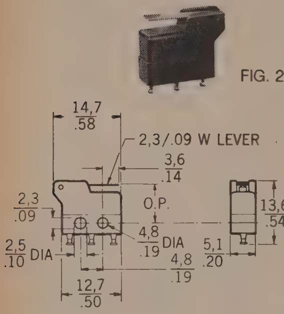


FIG. 2
14,7
.58
2,3/.09 W LEVER
3,6
.14
2,3
.09
O.P.
13,6
.54
4,8
.19
DIA
2,5
.10
DIA
5,1
.20
4,8
.19
12,7
.50

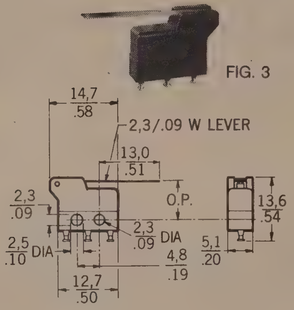


FIG. 3
14,7
.58
2,3/.09 W LEVER
13,0
.51
2,3
.09
O.P.
13,6
.54
2,5
.10
DIA
2,3
.09
DIA
5,1
.20
4,8
.19
12,7
.50

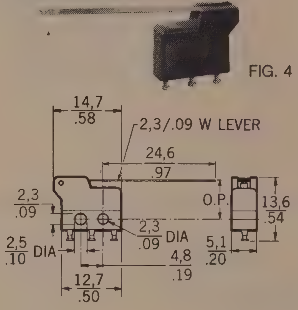


FIG. 4
14,7
.58
2,3/.09 W LEVER
24,6
.97
2,3
.09
O.P.
13,6
.54
2,5
.10
DIA
2,3
.09
DIA
5,1
.20
4,8
.19
12,7
.50

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0}{0.00}$ = mm / inches

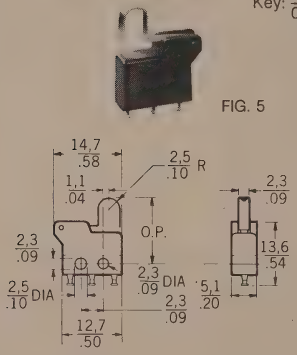


FIG. 5
14,7
.58
2,5
.10
R
1,1
.04
2,3
.09
O.P.
2,3
.09
13,6
.54
2,5
.10
DIA
2,3
.09
DIA
5,1
.20
2,3
.09
12,7
.50

MOUNTING HOLES ACCEPT PINS OR
SCREWS OF .087 DIAMETER (2,21 mm)

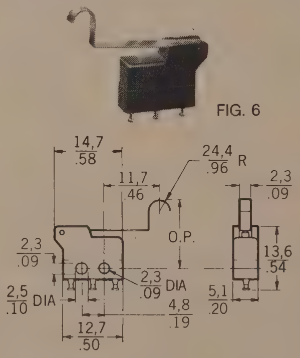


FIG. 6
14,7
.58
24,4
.96
R
11,7
.46
2,3
.09
O.P.
2,3
.09
13,6
.54
2,5
.10
DIA
2,3
.09
DIA
5,1
.20
4,8
.19
12,7
.50

INTERCHANGEABLE WITH
1SX1-T SWITCH WITH JX-25 ACTUATOR

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position

INTEGRAL LEVER ORDER GUIDE

Description	Fig. No.	Electrical Data Ref.	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P. m.m. inches
.135 inch (3,43 mm) long straight lever	2	A	311SX1-T	50 1.76	9 .32	1,65 .065	0,36 .014	0,51 .020	8,43 ± 1,14 .332 ± .045
.505 inch (12.8 mm) long straight lever	3	A	311SX2-T	30 1.1	5 .18	2,92 .115	0,64 .025	0,89 .035	8,26 ± 1,91 .325 ± .075
.965 inch (24,5 mm) long straight lever	4	A	311SX3-T	20 .71	3 .11	4,70 .185	1,17 .046	1,52 .060	7,75 ± 2,92 .305 ± .115
.042 inch (1,1 mm) long simulated roller lever	5	A	311SX4-T	60 2.1	11 .39	1,27 .050	0,25 .010	.0,38 .015	14,15 ± 0,91 .557 ± .036
.459 inch (11,7 mm) long simulated roller lever	6	A	311SX5-T	30 1.1	5 .18	2,67 .105	0,56 .022	0,89 .035	14,86 ± 1,65 .585 ± .065

TYPE SX AUXILIARY ACTUATORS

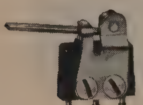
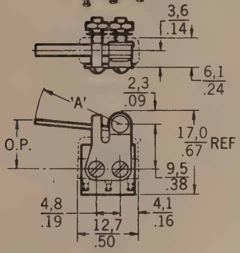


FIG. 7



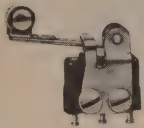
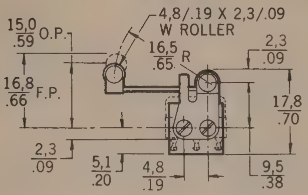


FIG. 8



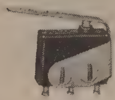
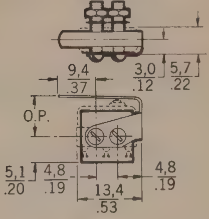


FIG. 9



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

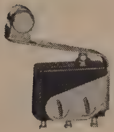


FIG. 10

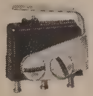


FIG. 11

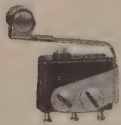


FIG. 12

SWITCHES ARE NOT INCLUDED WITH ACTUATORS.

AUXILIARY ACTUATOR ORDER GUIDE

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position. F.P. — Free Position

							Characteristics*			
Description	Fig. No.	Actuator Length A m.m. inches	Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. m.m. inches	O.T. m.m. inches	D.T. max. m.m. inches	O.P.†† m.m. inches	F.P. m.m. inches
Straight lever	7	18,3 .72	JX-20	28 1 approx.	4 .14	—	0,76 .030 approx.	0,76 .030 approx.	10,8 .425 approx.	12,3 .485 approx.
Roller lever	8	16,5 .65	JX-25	43 1.5	4 .14	—	0,51 .020	0,76 .030	14,9 ± 1,14 .585 ± .045	16.8 .660 max.
Straight leaf	9	9,4 .37†	JX-40	198 7	57 2	.225 approx.	0,38 .015	0,64 .025	7,5 .295	12,3 .485 ref.
Roller leaf	10	6,1 .24†	JX-45	198 7	28 1	.225 approx.	0,38 .015	0,64 .025	12,2 .480	16.5 .650 ref.
Reverse leaf	11	9,4 .37†	JX-41**	170 6	28 1	110 approx.	0,38 .015	0,64 .025	7,5 .295	9,4 .370 ref.
Reverse roller leaf	12	7,6 .30†	JX-51**	170 6	57 2	.110 approx.	0,38 .015	0,64 .025	12,8 .505	14,7 .580 ref.
Straight leaf (For higher temp.)	9	9,4 .37†	JX-95	198 7	57 2	.225 approx.	0,38 .015	0,64 .025	7,5 .295	12,3 .485 ref.
Rolller leaf (For higher temp.)	10	6,1 .24†	JX-96	198 7	28 1	.225 approx.	0,38 .015	0,64 .025	12,2 .480	16,5 .650 ref.
Straight lever (For higher temp.)	7	18,3 .72	JX-219	28 1	4 .14	—	0,76 .030 approx.	0,76 .030 approx.	10,8 .425 approx.	12,3 .485 approx.
Roller lever (For higher temp.)	8	16,5 .65	JX-220	43 1.5	4 .14	—	0,51 .020	0,76 .030	14,9 ± 1,14 .585 ± .045	16,8 .660 max.

Except where stated†† ± 0,76 mm
± .030 in

*All characteristics are taken with actuator assembled on Catalog Listing 1SX1-T as shown

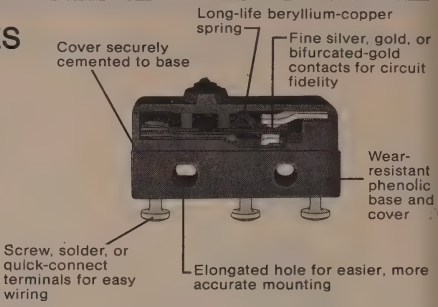
**Switch is mounted with plunger end reversed from JX-40

†"A" measurement is from center of mounting hole nearest tip of lever to the point indicated on drawing.

NOTE: Above actuators should be used at temperatures below +300° F (149°C); except listings JX-95, JX-96, JX-219 and JX-220 are for use with the 4SX1-T to 400°F. (204°C)

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPE SM SUBMINIATURE BASIC SWITCHES


Long-life beryllium-copper spring
Cover securely cemented to base
Fine silver, gold, or bifurcated-gold contacts for circuit fidelity
Wear-resistant phenolic base and cover
Screw, solder, or quick-connect terminals for easy wiring
Elongated hole for easier, more accurate mounting

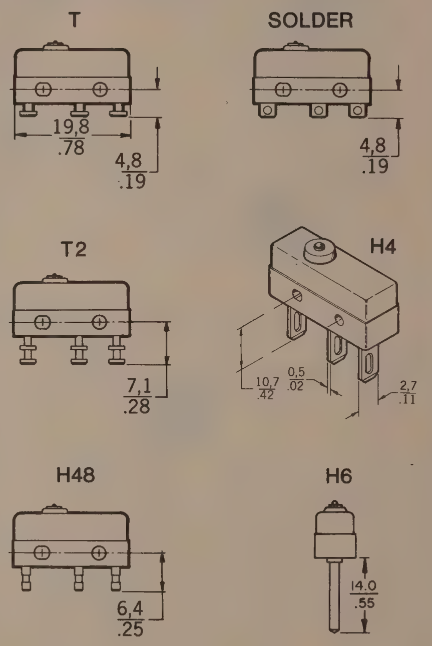
The SM series switches are slightly larger than the SX switches. These switches combine small size and light weight with ample electrical capacity, precision operation and long life. Unless otherwise noted, all listings have silver contacts.

Some of the important features available with design variations include:

- Los operating force to 56 grams maximum
- Sensitive differential travel of .001 inch (0,025 mm) maximum
- Power load switching capability to 11 amps (VAC)
- Motor load handling capacity to ¼ hp (VAC)
- Long mechanical life of 10,000,000 cycles—95% survival for 11SM series
- Standard temperature range −65° to +180°F (−54 to 85°C)
- High temperature construction available for use to +400°F (204°C)
- Gold contacts for low energy applications
- Bifurcated godl contacts for maximum reliability
- Variety of integral and auxiliary actuators
- Choice of several terminal styles
- Military Standard construction with two listings on the MIL-S-8805 qualified products list
- UL and CSA listed
- BSI and TV-2 construction available

Various terminals are available for most listings. These include the T and T2 for wrap around soldering of leadwires. Solder terminals for solder connections. H58 terminals and the H4 series terminals provide easy quick-connect installation. H6 type are rectangular wire wrap terminals. Other quick-connect terminals of the Series H types are available as well as screw terminal designs. Contact a MICRO SWITCH Branch Office for ordering information.

AVAILABLE TERMINALS


T
19,8
.78
4,8
.19
SOLDER
4,8
.19
T2
7,1
.28
H4
10,7
.42
0,5
.02
2,7
.11
H48
6,4
.25
H6
14.0
.55

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

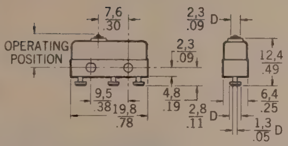
CIRCUITRY	ELECTRICAL DATA	CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	J 5 amps res., 3 amps ind., (sea level) 5 amps res., 2.5 amps ind., (50,000 feet), 28 vdc. UL listed: 5 amps, 250 vac.	Single-Pole Double-Throw	P .1 amps res., 30 vdc. UL listed: .1 amp, 125 vac.
Single-Pole Double-Throw	K UL Listed 5 amps, 125 or 250 vac.	Single-Pole Double-Throw	R 5 amps res., 3 amps ind., 2.4 amps lamp load (sea level), 5 amps res., 2.5 amps Ind., 2.4 amps lamp load, (50,000 feet), 28 vdc. 5 amps res., 5 amps ind.; 1.5 amps lamp load, 115 vac, 60 Hz (sea level)
Single-Pole Double-Throw	M UL listed: 11 amps and ¼ hp, 125 or 250 vac.		
Single-Pole Double-Throw	N 1 amp res., 0.5 amp ind., 30 vdc. UL listed: 1 amp, 125 vac.	Single-Pole Double-Throw	S UL listed 4 amps, 250 vac.

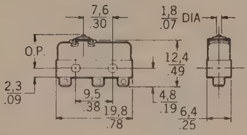
TYPE SM PIN PLUNGERS

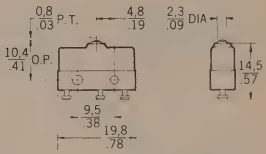
FIG. 13

FIG. 14

FIG. 15







MOUNTING HOLES ACCEPT PINS OR SCREWS OF .087 INCH (2,21mm) MAX. DIAMETER.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{\text{0,0 — mm}}{\text{0.00 — inches}}$

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

PIN PLUNGER ORDER GUIDE

Recommended For	Fig. No.	Electrical Data Ref. Page F5	Typical Catalog Listing	O.F. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P.* m.m. inches
Most applications	13	J	11SM1-T	85-142 3-5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Operating in temperatures to +250°F (121°C)	13	J	11SM3-T	85-142 3-5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Operating in temperatures to +400°F (204°C)	13*	*	11SM244-T	85-142 3-5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Best stability under varying humidity	13	J	22SM1-T	85-142 3-5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Less differential travel	13	K	11SM401-T	99 3.5 max.	28 1	0,51 .020	0,13 .005	0,025 .001	8,38 .330
Lower force	13	S	11SM701-T	56 2	14 .5	0,51 .020	0,13 .005	0,051 .002	8,38 .330
Up to 11 ampere ¼ hp (AC) load handling	13	M	41SM1-T	85-142 3-5	28 1	0,76 .030	0,13 .005	0,1 .004	8,38 .330
Application requiring gold contacts	13	N	11SM23-T	85-142 3-5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Gold alloy contacts	13	P	11SM1077-T	85-142 3-5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Best reliability Bifurcated gold contacts	13	N	12SM4-T	85-142 3-5	28 1	0,51 .020	0,076 .003	0,1 .004	8,38 .330
Bifurcated gold contacts Reduced Rating	13	P	12SM604-T	85-142 3-5	28 1	0,51 .020	0,076 .003	0,1 .004	8,38 .330
Sealed plunger Construction	14	K	411SM1	85-212 3-7.5	28 1	0,51 .020	0,13 .005	0,1 .004	8,38 .330
Center plunger position	15	J	51SM1-T	57-142 2-5	28 1	0,76 .030	0,25 .010	0,15 .006	10,3 ± 0,51 .406±.020
MIL-S-8805 application requirements solder terminals	13	R	21SM284 (MS25085-1)	85-142 3-5	28 1	0,76 .030	0,13 .005	0,1 .004	8,38 .330
MIL-S-8805 application requirements	13	R	21SM284-T2 (MS25085-2)	85-142 3-5	28 1	0,76 .030	0,13 .005	0,1 .004	8,38 .330

*(See Page H5 for actuators) For electrical data contact MICRO SWITCH Branch Office.

Except where stated *±0,38m.m. ±.015 in

Note:
For best results, especially in the application of the low differential travel 11SM401, high temperature 11SM244, 10 ampere capacity 41SM, and the bifurcated contact 12SM, contact a MICRO SWITCH Branch Office.

SM basic switches are available with (UL) TV-2 rated versions. Circuitry is SPDT. All lever styles and terminal variations shown can be furnished.

TYPE SM INTEGRAL LEVERS

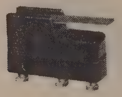


FIG. 16

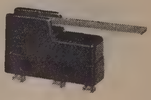


FIG. 17

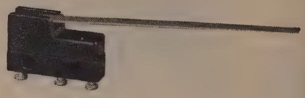
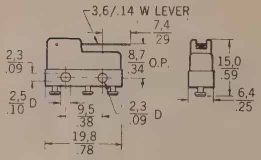
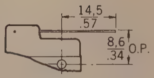
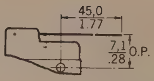


FIG. 18







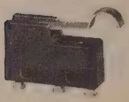


FIG. 19

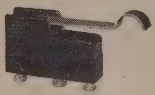


FIG. 20

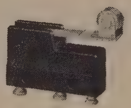


FIG. 21

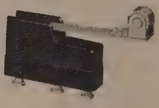
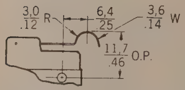
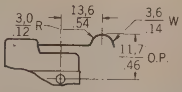
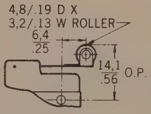
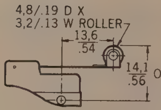


FIG. 22









MOUNTING HOLES ACCEPT PINS AND SCREWS OF .087 INCH (2,21mm) MAX. DIAMETER.
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

INTEGRAL LEVER ORDER GUIDE

Characetristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

Description	Fig. No.	Electrical Data Ref. Page F5	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T.max. m.m. inches	Characteristics O.T. min. m.m. inches	D.T. max. m.m. inches	O.P. m.m. inches
.285 inch (7,24mm) long straight lever	16	J	311SM1-T	40 1.4	7 .25	2,16 .085	0,51 .020	0,48 .019	8,64±1,5 .340±.060
.285 inch (7,24mm) long straight lever. Lower force	16	S	311SM701-T	16 .57	3 .11	2,16 .085	0,51 .020	0,36 .014	8,64±1,5 .340±.060
.565 inch (14,35mm) long straight lever	17	J	311SM2-T	30 1.1	5 .18	3,05 .120	0,66 .026	0,69 .027	8,51±2 .335±080
.565 inch (14,35mm) long straight lever. Lower force	17	S	311SM702-T	12 .4	2 .07	3,05 .120	0,66 .026	0,38 .015	8,51±2 .335±.080
1.765 inch (44,8mm) long straight lever	18	J	311SM3-T	15 .53	2 .07	7,89 .310	1,45 .057	2,8 .110	7,11±4,3 .280±.170
1.765 inch (44,8mm) long straight lever. Lower Force	18	S	311SM703-T	6 .2	1 .04	7,87 .310	1,45 .057	1,78 .070	7,11±4.3 .280±.170
.251 inch (6,38mm) long simulated roller lever	19	J	311SM4-T	40 1.4	7 .25	2,16 .085	0,46 .018	0,48 .019	11,7±1,5 .460±.060
.251 inch (6,38mm) long simulated roller lever. Lower force	19	S	311SM704-T	16 .57	3 .11	2,16 .085	0,46 .018	0,33 .013	11,7±1,5 .460±.060
.535 inch (13,6mm) long simulated roller lever	20	J	311SM5-T	30 1.1	5 .18	3,05 .120	0,66 .026	0,69 .027	11,56±2 .455±.080
.535 inch (13,6mm) long simulated roller lever. Lower force	20	S	311SM705-T	12 .4	2 .07	3,05 .120	0,66 .026	0,38 .015	11,56±2 .455±.080
.251 inch (6,38mm) long roller lever	21	J	311SM6-T	40 1.4	7 .25	2,16 .085	0,46 .018	0,48 .019	14,2±1,5 .560±.060
.251 inch (6,38mm) long roller lever. Lower force	21	S	311SM706-T	16 .57	3 .11	2,16 .085	0,46 .018	0,33 .013	14,2±1,5 .560±.060
.535 inch (13,6mm) long roller lever	22	J	311SM7-T	30 1.1	5 .18	3,05 .120	0,66 .026	0,69 .027	14,1±2 .555±.080

TYPE SM INTEGRAL LEAFS—AUXILIARY ACTUATORS

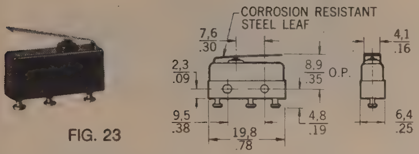


FIG. 23

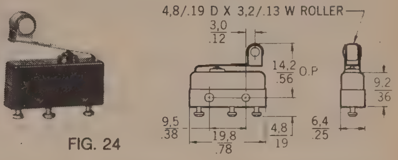


FIG. 24

MOUNTING HOLES ACCEPT PINS OR SCREWS OF .087 INCH (2,21mm) MAX. DIAMETER.

INTEGRAL LEAF ORDER GUIDE

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

						Characteristics			
Recommended For	**Fig. No.**	**Electrical Data Ref. Page F5**	**Typical Catalog Listing**	**O.F. max grams ounces**	**R.F. min. grams ounces**	**P.T. max. m.m. inches**	**O.T. min. m.m. inches**	**D.T. max. m.m. inches**	**O.P. m.m. inches**
Force and stability of	23	J	111SM1-T	198	57	5,54	0,76	0,76	8,89±0,76
flexible leaf actuator				7	2	.218	.030	.030	.350±.030
Flexible leaf with roller	24	J	111SM2-T	198	57	5,56	0,76	0,64	14,3±0,76
				7	2	.219	.030	.025	.562.030

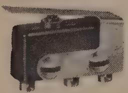


FIG. 25

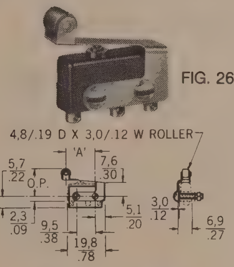


FIG. 26

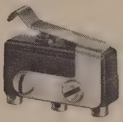


FIG. 27

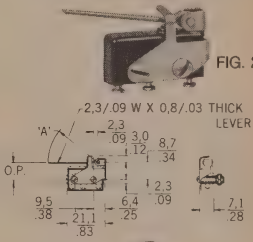


FIG. 28

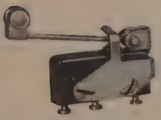


FIG. 29

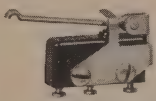


FIG. 30

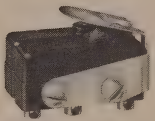


FIG. 31

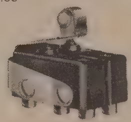


FIG. 32

Key: 0,0 — mm / 0.00 — inches

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY.
SWITCHES ARE NOT INCLUDED WITH THE ACTUATORS.

AUXILIARY ACTUATOR ORDER GUIDE

Characteristics: O.F. — OPERATING FORCE; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position

							Characteristics*			
Description	**Fig. No.**	**Actuator Length A m.m. inches**	**Catalog Listing**	**O.F. max. grams ounces**	**R.F. min. grams ounces**	**P.T. max. m.m. inches**	**O.T. min. m.m. inches**	**D.T. max. m.m. inches**	**O.P. m.m. inches**	**F.P. max. m.m. inches**
Straight leaf	25	16,8	JS-2	284	57	1,98	0,38	0,38	8,89±0,76	11,3
		.66		10	2	.078	.015	.015	.350±.015	.445
Roller leaf	26	15	JS-5	284	85	1,98	0,38	0,38	14,2±0,76	16,9
(bronze roller)		.59		10	3	.078	.015	.015	.560±.015	.665
Formed leaf	27	14,7	JS-7	284	57	2,39	0,79	0,38	9,65±0,76	12,1
Simulated roller		.58		10	2	.094	.031	.015	.380±.015	.475
Straight lever	28	26.2†	JS-220	28	4	3,18	0,76	0,76	10,3	—
		1.03		1	.14	.125 approx.	.030	.030	.406 approx.	
Roller lever	29	25,4†	JS-246	28	4	3,18	0,76	0,76	14,3	—
(steel roller)		1.00		1	.14	.125 approx.	.030	.030	.562 approx.	
Formed leaf	30	25,4†	JS-221	28	4	3,18	0,76	0,76	11,6	—
Simulated roller		1.00		1	.14	.125 approx.	.030	.030	.455 approx.	
Tandem leaf	31	5,3	JS-33**	510	284	2,36	0,15	0,38	8,89±0,76	10,5
		.21		18	10	.093	.006	.015	.350±.015	.415
Tanden roller leaf	32	4,3	JS-31**	1134	454	2,36	0,13	0,38	14,5±0,76	16,1
(bronze roller)		.17		40	16	.093	.005	.015	.570±.015	.635

* All characteristics are taken with actuator assembled to Catalog Listing 11SM3-T as shown

** Travel characteristics on tandem actuators vary with actual basic switch characteristics.

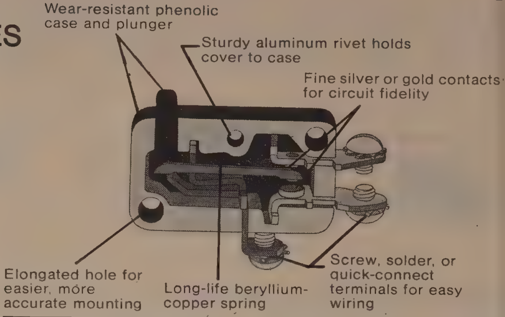
NOTE: Above actuators should be used below +300°F. See page H5 for other actuators that may be used with SM switches at higher temperatures.

†"A" measurement is from the pivot point of lever to the point indicated on drawing.

MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPE V3 MINIATURE BASIC SWITCHES


Wear-resistant phenolic case and plunger
Sturdy aluminum rivet holds cover to case
Fine silver or gold contacts for circuit fidelity
Elongated hole for easier, more accurate mounting
Long-life beryllium-copper spring
Screw, solder, or quick-connect terminals for easy wiring

The V3 series switches are small switches which feature high electrical capacity and long life. Their size and shape meet design requirements in all types of applications.

Some of the important features with design variations include:

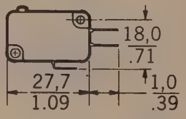
- Low operating force to 15 grams maximum
- Sensitive differential travel of .008 inch maximum
- Power load switching capability up to 15 amperes
- Motor handling capacity of ½ horsepower
- Long mechanical life of 10,000,000 cycles — 95% survival for V3-100 Series.
- Temperature tolerance up to +180°F (82°C) on standard construction
- High temperature construction for use up to +600°F (316°C)
- Gold alloy contacts for special applications
- UL and CSA listed
- 3,1 mm mounting holes available

TV RATED SWITCHES

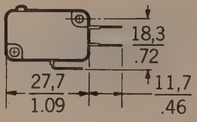
V3 basic switches are available with TV-3, TV-4, and TV-5 ratings. There is a choice of SPDT, SPNC, and SPNO circuitry. All lever styles and terminal variations can be furnished.

AVAILABLE TERMINALS

QUICK CONNECT

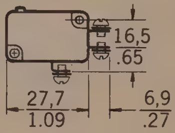

18,0
.71
27,7
1.09
1,0
.39

.188" wide by .020" thick terminals

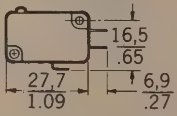

18,3
.72
27,7
1.09
11,7
.46

.250" wide by .032" thick terminals

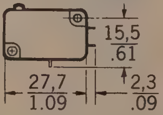
SCREW


16,5
.65
27,7
1.09
6,9
.27

SOLDER


16,5
.65
27,7
1.09
6,9
.27

SHORT SOLDER


15,5
.61
27,7
1.09
2,3
.09

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	UL and CSA Listed: T 11 amps and ⅓ hp, 125, 250, or 277 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc; 4 amps. 125 vac "L" (lamp load).
	UL and CSA Listed: TT 10 amps and ⅓ hp, 125 or 250 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc 4 amps, 125 vac "L" (lamp load).
Single-Pole Double-Throw unless otherwise noted in order guide	UU 10 amps res., 10 amps ind., (sea level), 6 amps ind. (50,000 feet), 6 amps motor load, 30 vdc.
	UL and CSA Listed: U 15 amps and ½ hp, 125 or 250 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc; 5 amps, 120 vac "L" (lamp load).
Single-Pole Double-Throw	VV UL and CSA Listed: 3 amps-125,250,277 vac; 1/10 hp-250 vac
Single-Pole Double-Throw	V UL and CSA Listed: 10 amps and ¼ hp, 125 or 250 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc; 3 amps, 125 vac "L" (lamp load).
Single Pole Double-Throw	W 10 amps, 250 vac or 28 vdc; ½ amp, 125 vdc; ¼ amp, 250 vdc.
Single-Pole Double-Throw	X UL Listed 1 amp, 125 vac.
Single-Pole Double-Throw	Y 10 amps and ⅓ hp, 125 or 250 vac; 4 amps, 125 vac "L" (lamp load).
Single-Pole Double-Throw	YY UL and CSA Listed: 5 amps-125,250,277 vac 1/10 hp-250 vac

TYPE V3 PIN PLUNGER—INTEGRAL LEVER

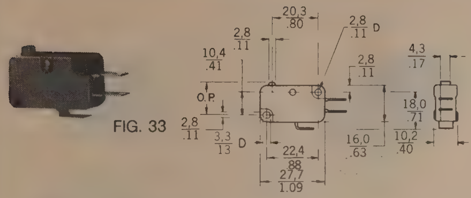


FIG. 33

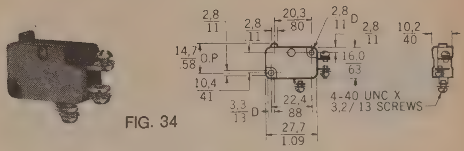


FIG. 34

Characteristics:
O.F. — Operating Force
R.F. — Release Force; P.T. — Pretravel;
O.T. — Overtravel; D.T. — Differential Travel;
O.P. — Operating Position

PLUNGER ORDER GUIDE

Recommended For	Fig. No.	Electrical Data Ref. Page F9	Typical Catalog Listing	O.F. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. m.m. inches	O.P.** m.m. inches
Most applications	33	T	V3-101-D8	227 8 max.	57 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14.7 .578
General use. Screw Terminals	34	T	V3-101	227 8 max.	57 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
Added overtravel	33	TT	V3-1101-D8	75 max. 2.6	10 .35	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
Lower force Added overtravel	33	V	V3-2101-D8	50 max. 1.8	5 .18	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
Lower force	33	YY	V3-2401-D8	25 .9	—	1,2 .047	1,27 .050	0,051-0,25 .002-010	14,7 .578
Lowest force	33	VV	V3-2451-D8	15 .53	—	1.2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
Up to 15 amps load handling	33	U	V3-3001-D8	135 max. 4.8	15 .53	1,2 .047	1,27 .050	0,051-0,25 .002-.010	14,7 .578
Less differential travel	33	Y	V3-154-D8	170 6 max.	28 1	1,2 .047	1,02 .040	0,2 .008 max.	14,7 .578
Applications requiring gold alloy contacts	33	X	V3-343-D8	227 8 max.	57 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
MIL-S-8805 application requirements SPDT	34	UU	V3-1001 (MS25253-1)	170-397 6-14	113 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
MIL-S-8805 application requirements SPNC	—	UU	V3-1002 (MS25253-3)	170-397 6-14	113 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
MIL-S-8805 application requirements SPNO	—	UU	V3-1003 (M25253-2)	170-397 6-14	113 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
Operating in temperature to +302°F (150°C)	34	T	V3-129	227 8 max.	57 2	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
Operating in temperature to +400°F (204°C)	34	W	V3-245*	284-709 10-25	170 6	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578
Operating in temperature to +600°F (316°C)	34	W	V3-1301*	170-397 6-14	113 4	1,2 .047	1,02 .040	0,15-0,41 .006-.016	14,7 .578

*For actuators, contact MICRO SWITCH Branch Office.

** ±0,38
±0,15

Note: For best results especially in the application of the high temperature V3-129, V3-245, V3-1301 and gold alloy contact V3-343, consult a MICRO SWITCH Branch Office.

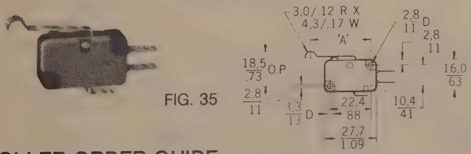


FIG. 35

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm
0.00 — inches

Characteristics: O.F. — Operating Force;
R.F. — Release Force; P.T. — Pretravel;
O.T. — Overtravel; D.T. — Differential Travel;
O.P. — Operating Position; F.P. — Free Position

SIMULATED ROLLER ORDER GUIDE

Recommended For	Fig. No.	Length of Lever "A" m.m. inches	Electrical Data Ref. Page F9	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P.* m.m. inches
Most applications	35	32,6 1.285	T	V3L-121-D8	113 4	14,2 .5	3,18 .125	2,03 .080	1,27 .050	18.5 .730
Added overtravel	35	32.6 1.285	TT	V3L-1123-D8	40 1.4	5 .18	2,54 .100	2.03 .080	0,76 .030	18,5 .730
Lower force Added overtravel	35	32,6 1.285	V	V3L-2105-D8	33 1.2	2 .07	2,54 .100	2,03 .080	0.76 .030	18,5 .730
Up to 15 amps load handling. Best for performance under shock and vibration	35	32,6 1.285	U	V3L-3014-D8	75 2.6	7 .21	2,54 .100	2,03 .080	0,76 .030	18,5 .730

* ±1.5 mm
+ .060 in

TYPE V3 INTEGRAL LEVERS

FIG. 36

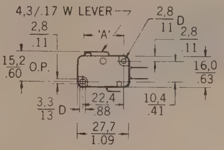


FIG. 37

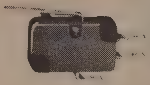
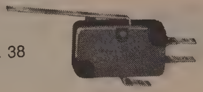


FIG. 38



Characteristics: O.F. — Operating Force;
R.F. — Release Force; P.T. — Pretravel;
O.T. — Overtravel; D.T. — Differential Travel;
O.P. — Operating Position.

STRAIGHT LEVER ORDER GUIDE

Recommended For	Fig. No.	Length of Lever "A" m.m. inches	Electrical Data Ref. Page F9	Typical Catalog Listing	O.F. max. grams ounces	R.F. min grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P. m.m. inches
Most applications	36	21,3 .840	T	V3L-101-D8	255 9	57 2	1,5 .060	1,02 .040	0,41 .016	15,2±0,51 .600±.020
	37	35.6 1.40	T	V3L-104-D8	113 4	14,2 .5	3,18 .125	2,29 .090	1,27 .050	15,2±1.5 .600±.060
	38	59.4 2.34	T	V3L-131-D8	60 2.1	12 .42	6,6 .260	3,81 .150	2,29 .090	14,7±2 .580±.080
Added overtravel	36	21,3 .840	TT	V3L-1105-D8	75 2.6	10 .35	1,5 .060	1,14 .045	0,33 .013	15,2±0,51 .600±.020
	37	35.6 1.40	TT	V3L-1108-D8	35 1.2	4 .14	2,79 .110	2,29 .090	0,76 .030	15,2±1,5 .600±.060
	38	59,4 2.34	TT	V3L-1122-D8	20 .71	2 .07	5,08 .200	4,06 .160	1,4 .055	15,2±1,8 .600±.070
Lower force Added overtravel	36	21,3 .840	V	V3L-2101-D8	50 1.8	5 .18	1,5 .060	1,14 .045	.33 .013	15,2±0,51 .600±.020
	37	35,6 1.40	V	V3L-2102-D8	30 1.1	2 .07	2,79 .110	2,29 .090	0,76 .030	15,2 ± 1,5 .600 ± .060
	38	59,4 2.34	V	V3L-2106-D8	16 .57	1 .04	5,08 .200	4,06 .160	1,4 .055	15,2±1,8 .600±.070
Lowest Force	37	35,6 1.40	YY	V3L-2424-D8	12 .42	—	2,79 .110	2,29 .090	0,76 .030	15,2±1,5 .600±.060
	38	59,4 2.34	YY	V3L-2425-D8	7 .25	—	5,08 .200	4,06 .160	1,4 .055	15,2±2 .600±.080
Up to 15 amps load handling. Best performance under shock and vibration	36	21,3 .840	U	V3L-3001-D8	135 4.8	15 .53	1,5 .060	1,02 .040	0,33 .013	15,2±0,51 .600±.020
	37	35,6 1.40	U	V3L-3005-D8	75 2.6	6 .21	3,05 .120	2,29 .090	0,81 .032	15,2±1,5 .600±.060
	38	59,4 2.34	U	V3L-3013-D8	40 1.4	3 .11	5,33 .210	4,06 .160	1,52 .060	15,2±1,9 .600±.075

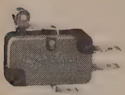


FIG. 39

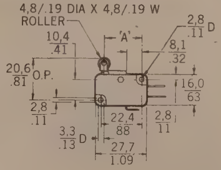
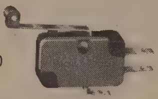


FIG. 40



DIMENSIONS SHOWN ARE
FOR REFERENCE ONLY

Key: 0,0 = mm / 0.00 = inches

Characteristics: O.F. — Operating Force;
R.F. — Release Force; P.T. — Pretravel;
O.T. — Overtravel; D.T. — Differential Travel;
O.P. — Operating Position

ROLLER LEVER ORDER GUIDE

Recommended For	Fig. No.	Length of Lever "A" m.m. inches	Electrical Data Ref. Page F9	Typical Catalog Listing	O.F. max grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P. m.m. inches
Most applications	39	20,6 .81	T	V3L-139-D8	227 8	57 2	1,5 .060	1,02 .040	0,41 .016	20,6±0,76 .810±.030
	40	34 1.34	T	V3L-111-D8	113 4	14,2 .5	3,18 .125	2,16 .085	1,27 .050	20,6±1,5 .810±.060
Added overtravel	39	20.6 .81	TT	V3L-1117-D8	75 2.6	10 .35	1,2 .047	1,14 .045	0,33 .013	20,6±0,76 .810±.030
	40	34 1.34	TT	V3L-1101-D8	35 1.2	4 .14	3,18 .125	2,16 .085	0,76 .030	20,6±1,5 .810±.060
Lower force Added overtravel	39	20,6 .81	V	V3L-2103-D8	50 1.8	5 .18	1,2 .047	1,14 .045	0,33 .013	20,6±0,76 .810±.030
	40	34 1.34	V	V3L-2104-D8	31 1.1	2 .07	3,18 .125	2,16 .085	0,76 .030	20,6±1,5 .810±.060
Up to 15 amps load handling. Best for performance under shock and vibration	39	20,6 .81	U	V3L-3003-D8	135 4.8	15 .53	1,2 .047	1,02 .040	0,33 .013	20,6±0,76 .810±.030
	40	34 1.34	U	V3L-3004-D8	70 2.5	14 .49	3,18 .125	2,16 .085	0,76 .030	20,6 ± 1,5 .810 ± .060

TYPE V3 AUXILIARY ACTUATORS

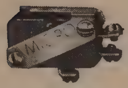


FIG. 41

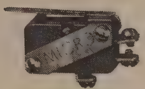


FIG. 42

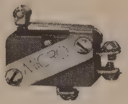
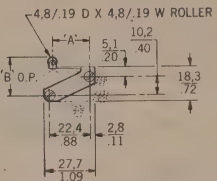
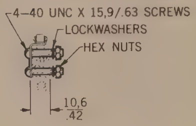


FIG. 43


4,8/.19 D X 4,8/.19 W ROLLER
'A'
5,1
.20
10,2
.40
'B' O.P.
18,3
.72
22,4
.88
2,8
.11
27,7
1.09


4–40 UNC X 15,9/.63 SCREWS
LOCKWASHERS
HEX NUTS
10,6
.42

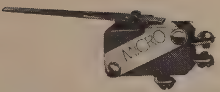


FIG. 44

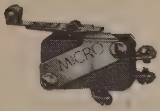


FIG. 45

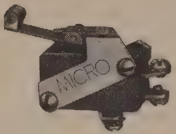
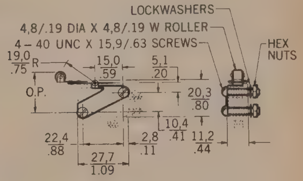


FIG. 46


LOCKWASHERS
4,8/.19 DIA X 4,8/.19 W ROLLER
4 – 40 UNC X 15,9/.63 SCREWS
HEX NUTS
19,0
.75
R
15,0
.59
5,1
.20
O.P.
20,3
.80
10,4
.41
11,2
.44
22,4
.88
2,8
.11
27,7
1.09

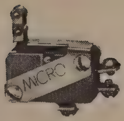


FIG. 47

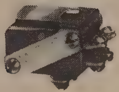


FIG. 48

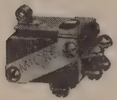
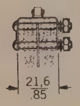


FIG. 49



SWITCHES ARE NOT INCLUDED WITH ACTUATORS

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

AUXILIARY ACTUATOR ORDER GUIDE

Description	Fig. No.	Actuator Length "A" m.m. inches	Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	Characteristics* O.T. min. m.m. inches	D.T. max. m.m. inches	O.P. m.m. inches	F.P. max. m.m. inches
Leaf type	41	21,3 .84	JV-1	340 12	113 4	1,19 .047	0,79 .031	0,41 .016	15±0,38 .590±.015	16,4 .645
Long leaf	42	32,3 1.27	JV-7	255 9	113 4	1,57 .062	1,27 .050	0,64 .025	14,5±0,76 .570±.030	17,4 .685
Roller leaf	43	20,6 .81	JV-5	340 12	113 4	1,52 .060	0,79 .031	0,41 .016	20,3±0,64 .800±.025	22,1 .870
Long lever	44	44,5† 1.75	JV-26	40 1.4	6 .21	8,33 .328	3,58 .141	4,75 .187	12,7±3,18 .500±.125	—
Roller lever	45	19,1† .750	JV-20	85 3	14,2 .5	4,78 .188	1,57 .062	1,98 .078	19,5±1,4 .766±.055	23,8 .936
Roller lever	46	17,7† .695	JV-220	85 3	14,2 .5	4,78 .188	1,57 .062	1,98 .078	19,5±1,1 .766±.045	23,8 .936
One-way roller lever	47	20,6 .81	JV-30	340 12	113 4	2,03 .080	0,51 .020	0,38 .015	25,7±0,76 1.010±.030	27,7 1.09
Tandem leaf	48	20,6 .81	JV-91**	510 18	170 6	1,57 .062	0,89 .035	—	14,9±0,76 .588±.030	16,5 .650
Tandem roller leaf	49	20,6 .81	JV-82**	510 18	170 6	1,57 .062	0,89 .035	—	20,5±0,76 .806±.030	21,8 .860

NOTE: Contact a MICRO SWITCH Branch Office for application assistance when actuators will be used at temperatures above 300° F. (149°C)

*Characteristics taken with actuator assembled on Catalog Listing V3-100 switch as shown.

**Travel characteristics on tandem actuators vary with actual basic switch characteristics. These shown are typical for the assembly.

†"A" measurement is from the pivot point of lever to the point indicated on drawing.

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPE TB DOUBLE-BREAK BASIC SWITCHES

Type TB switches are small double-break units which offer a means of controlling isolated circuits. These switches find many uses in modern control systems because of their circuitry.

Features within the TB series include:

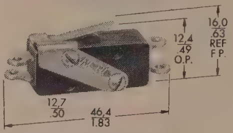
- Power Load Switching Capability Up To 10 Amperes
- Motor Handling Capacity of ½ Horsepower, 125 VAC
- Two- and Four-Circuit Double-Break
- Several Auxiliary Actuators
- Choice of Terminal Styles
- UL and CSA Listed

APPLICATION REQUIREMENTS

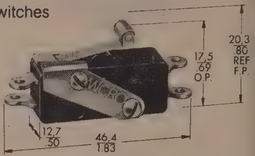
The terminals of two- and four-ciurcuit double-break switches must be wired to equal voltage sources and the same polarity. The loads should be on the same sides of the lines.

AUXILIARY ACTUATORS

For use with 1TB1-1 and 1TB1-2 switches

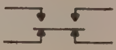
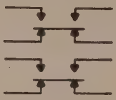

16,0
.63
REF
F.P.
12,4
.49
O.P.
12,7
.50
46,4
1.83

Leaf Actuator JT-1*


20,3
.80
REF
F.P.
17,5
.69
O.P.
12,7
.50
46,4
1.83

Roller Leaf JT-5

Switches are not included with the actuators

CIRCUITRY	CIRCUITRY	ELECTRICAL DATA
Two-Circuit Double-Break 	Four-Circuit Double-Break 	Z 10 amps, 125 or 250 vac, or 30 vdc. UL and CSA listed; 10 amps, 125 or 250 vac; ½ hp, 125 vac.

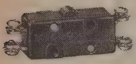
Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position

ORDER GUIDE

Description	Style No.	Electrical Data Ref.	Catalog Listing	O.F. grams ounces	R.F. min grams ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
Two-circuit, double-break End screw terminals	50	Z	1TB-1	198-368 7-13	113 4	1,52 .060	0,25 .010	0,38-0,64 .015-.025	11,7 .460
Two-circuit, double-break End solder terminals	51	Z	1TB1-2	198-368 7013	113 4	1,52 .060	0,25 .010	0,38-0,64 .015-.025	11,7 .460
Two-circuit, double-break Front solder terminals	52	Z	1TB1-3	198-368 7-13	113 4	1,52 .060	0,25 .010	0,38-0,64 .015-.025	11,7 .460
Four-circuit, double break Front solder terminals	53	Z	41TB5-3	567-1020 20-36	227 8	1,78 .070	0,25 .010	0,64-1,14 .025-.045	4,70 .185

*±0,38 mm
±.015 in

FIG. 50



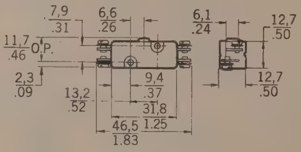

7,9
.31
6,6
.26
6,1
.24
12,7
.50
11,7
.46
O.P.
2,3
.09
13,2
.52
9,4
.37
31,8
1.25
46,5
1.83
12,7
.50

FIG. 51

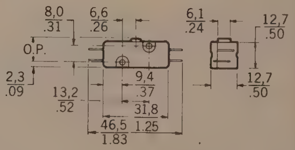

8,0
.31
6,6
.26
6,1
.24
12,7
.50
O.P.
2,3
.09
13,2
.52
9,4
.37
31,8
1.25
46,5
1.83
12,7
.50

FIG. 52

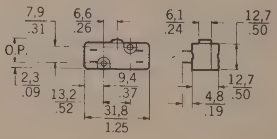
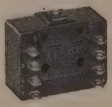
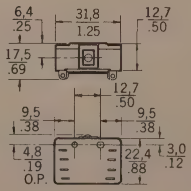

7,9
.31
6,6
.26
6,1
.24
12,7
.50
O.P.
2,3
.09
13,2
.52
9,4
.37
31,8
1.25
12,7
.50
4,8
.19

FIG. 53




6,4
.25
31,8
1.25
12,7
.50
17,5
.69
12,7
.50
9,5
.38
9,5
.38
4,8
.19
O.P.
22,4
.88
3,0
.12

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

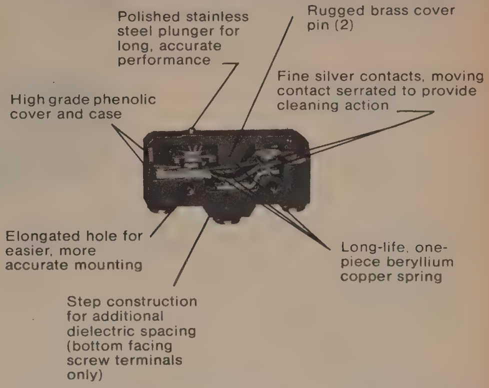
TYPES Z AND A

The type Z switch design meets most applications needs. Modifications of the standard silver contact design and material, spring configuration, and plunger locations give the type A switches greater electrical load handling capacity. Other changes in materials and switch design provide operating characteristics, temperature tolerances, and sealing to cover a wide range of special requirements.

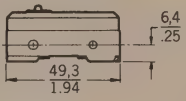
Some of the important features available with design variations include:

- Operating Force as low as 4 oz. (113 grams) maximum
- Sensitive Differential Travel of .0002 to .0003 inches (0,0005 to 0,008 mm)
- Power Load Switching cabability to 20 Amperes
- Motor Handling Capacity of 2 Horsepower at 250 VAC
- Long Mechanical Life
- Temperature Tolerance From −65°F to +180°F (−54 to 82°C) on Standard Construction
- High Temperature Construction For Up To +400°F (204°C)
- Sealed Plunger and Cover
- Momentary or Maintained Contact Action
- Alloy Contacts for Special Application Needs
- Variety of Integral Actuators
- Variety of Auxiliary Actuators
- Variety of Terminal Designs
- Versatility of Mounting
- Military Standard Construction With Over 50 Listings On the MIL-S-8805 Qualified Products List
- UL and CSA Listed

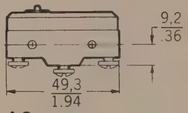
Most of the catalog listings in the following order guides have A2 type terminals. Several other terminal styles are available and specific information should be requested from a MICRO SWITCH Branch Office or Authorized Distributor.


Polished stainless steel plunger for long, accurate performance
Rugged brass cover pin (2)
Fine silver contacts, moving contact serrated to provide cleaning action
High grade phenolic cover and case
Elongated hole for easier, more accurate mounting
Long-life, one-piece beryllium copper spring
Step construction for additional dielectric spacing (bottom facing screw terminals only)

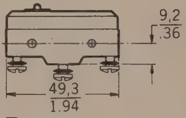
AVAILABLE TERMINALS


6,4
.25
49,3
1.94

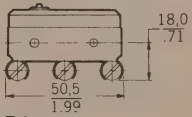
Solder
Use up to #14 wire


9,2
.36
49,3
1.94

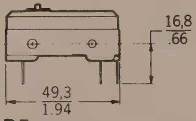
A2
Bottom facing
6-32 NC x .218"
screw with cup washers
A4 (Same as A2
except #8 screws)


9,2
.36
49,3
1.94

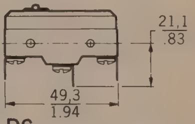
T
Bottom facing
6-32NC x .218"
screw with Sems
lockwashers


18,0
.71
50,5
1.99

P4
Side facing
8-32 NC x .218"
screw with cup washers


16,8
.66
49,3
1.94

D5
6,35 mm 0,81 mm
.250" wide x .032" thick
quick-connect


21,1
.83
49,3
1.94

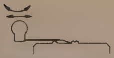
D6
6,35 mm 0,81 mm
.250" wide x .032"
thick quick-connect

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

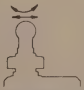
Key: 0,0 — mm / 0.00 — inches

ACTUATORS

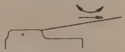
Basic switches in this section use the actuators described below.



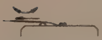
Roller Leaf —
low-force, large movement actuation.



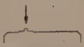
Panel-mount Roller Plunger —
actuation by cams.



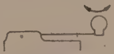
Lever —
very low force,
slow cams and slides.



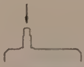
Leaf —
low-force, slow moving cams or slides.



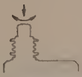
Pin Plunger —
in-line motion.



Roller Lever —
very low force,
fast moving cams.



Overtravel Plunger —
in-line applications requiring additional overtravel.



Panel-mount Plunger —
heavy-duty in-line applications or slow cams.
Cam rise should not exceed 30°.

MICRO SWITCH
A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPES Z AND A PIN PLUNGERS

ORDER GUIDE
PIN PLUNGER

MICRO SWITCH

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position.

Recommended For	Mtg. Fig.	Electrical Data (Page G8)	Order this Catalog Listing	O.F. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. m.m. inches	O.P.* m.m. inches
Most applications	1	A	BZ-2R-A2	255-368 9-13	113 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
Lower force	1	C	BZ-R21-A2	113 4	71 2.5	0,30 .012	0,13 .005	0,005-0,013 .0002-.0005	15,88 .625
Less differential travel	1	D	BZ-R-A2	198-255 7-9	113 4	0,30 .012	0,13 .005	0,005-0,008 .0002-.0003	15,88 .625
Best repeatability	1	D	BZ-R19-A2	198-340 7-12	113 4	0,30 .012	0,13-0,20 .005-.008	0,005-0,02 .0002-.0008	16,26 .640
Operating in Temperature to +250° F (121° C)	1	A	BZ-2R24-A2	255-368 9-13	113 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
Operating in temperature to +250° F (121° C)	3	G	BA-2R24-A2	397-624 14-22	284 10	1,27 .050	0,25 .010	0,05-0,19 .0020-.0075	16,26 .640
Operating in temperature to +400° F (204° C)	1	B	BZ-2R244-A2	255-368 9-13	113 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
Dustproof and splash resistant seal	2	A	BZ-2R5551-A2	255-425 9-15	113 4	— —	0,13 .005	0,01-0,06 .0004-.0025	15,88 .625
Applications requiring gold alloy contacts plus dustproof and splash resistant seal	2	P	BZ-2R725551-A2	227-425 8-15	113 4	— —	0,13 .005	0,01-0,06 .0004-.0025	15,88 .625
Best service for sealed construction	2	A	BZ-2R55-A2	255-425 9-15	113 4	— —	0,13 .005	0,01-0,06 .0004-.0025	15,88 .625
MIL-S-8805 application requirements	1	A	BZ-2RT04 (8805/1-004)	255-368 9-13	170 6	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
Best stability under varying humidity	1	A	BZ-2R05-A2	255-368 9-13	113 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
Up to 20 ampere load handling	3	G	BA-2R-A2	397-624 14-22	284 10	1,27 .050	0,25 .010	0,05-0,19 .0020-.0075	16,26 .640
Applications requiring gold alloy contacts	1	P	BZ-2R72-A2	255-368 9-13	113 4	0,38 .015	0,13 .005	0,01-0,05 .0004-.0020	15,88 .625
Manual reset (maintained contact) applications, solder terminals	4	E	BZ-RX	198-255 7-9 57-284 2-10	— — — —	0,30 .012 — —	0,13 .005 0,38 .015	— — — —	15,88 .625 — —

NOTE: For best results, especially with the application of the manual reset, flexible leaf, and overtravel plunger switches contact a MICRO SWITCH Branch Office.

* ±0,38 mm
±.015 in.

All catalog listings shown are not necessarily stock items. Stocking depends on sales experience.

FIG. 1

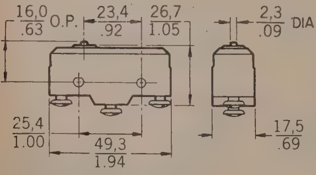


FIG. 2

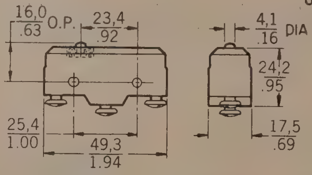


FIG. 3

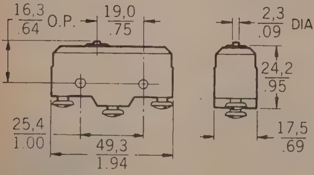
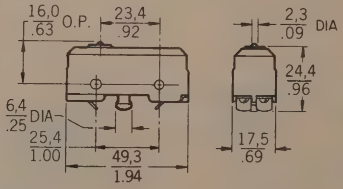


FIG. 4



MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3,53 mm) DIAMETER
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

TYPES Z AND A OVERTRAVEL PLUNGERS

ORDER GUIDE OVERTRAVEL PLUNGER

MICRO SWITCH

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position.

Recommended for	Mtg. Fig.	Electrical Data (Page G8)	Order this Catalog Listing	O.F. grams **ounces**	R.F. min. grams **ounces**	P.T. max. mm **inches**	O.T. min. mm **inches**	D.T. mm **inches**	O.P.* mm **inches**
Added overtravel. For manual operation and slow 20° (max.) cam rise	**11**	**A**	**BZ-2RD-A2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	21,21 **.835**
Dustproof and splash resistant seal	**12**	**A**	**BZ-2RDS5551-A2**	368-538 **13-19**	113 **4**	—	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
Applications requiring gold alloy contacts	**11**	**P**	**BZ-2RD72-A2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	21,21 **.835**
Applications requiring gold alloy contacts plus dustproof and splash resistant seal	**12**	**P**	**BZ-2RDS725551-A2**	368-538 **13-19**	113 **4**	—	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
Operating in temperature to +250° F (121° C)	**11**	**A**	**BZ-2RD24-A2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	21,21 **.835**
Up to 20 ampere load handling	**13**	**G**	**BA-2RB-A2**	397-624 **14-22**	284 **10**	1,27 **.050**	2,39 **.094**	0,05-0,19 **.0020-.0075**	26,20 **1.03**
Added overtravel. For in-line operation and with JR auxiliary actuators	**14**	**A**	**BZ-2RS-A2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
Dustproof and splash resistant seal	**15**	**A**	**BZ-2RS5551-A2**	255-425 **9-15**	113 **4**	—	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
Applications requiring gold alloy contacts	**14**	**P**	**BZ-2RS72-A2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	28,20 **1.110**
Applications requiring gold alloy contacts plus dustproof and splash resistant seal	**15**	**P**	**BZ-2RS725551-A2**	255-425 **9-15**	113 **4**	—	1,52 **.060**	0,01-0,063 **.0004-.0025**	28,20 **1.110**
Operating in temperature to +250° F (121° C)	**14**	**A**	**BZ-2RS24-A2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	28,20 **1.110**
MIL-S-8805 application requirements	**14**	**A**	**BZ-2RST04** **(m 8805/1-012)**	255-368 **9-13**	170 **6**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	28,20 **1.110**
Same as BZ-2RD-A2 except for self lifting pressure plate terminals		**A**	**BZ-2RD-PC2**	255-368 **9-13**	113 **4**	0,38 **.015**	1,52 **.060**	0,01-0,05 **.0004-.0020**	21,21 **.835**

* ±0,51 mm ±.020 in.

FIG. 11

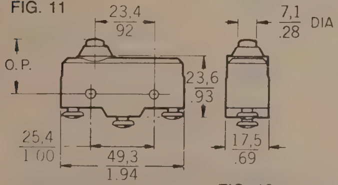
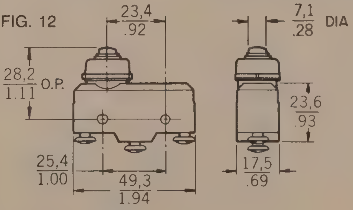

23,4
92
7,1
.28
DIA
O.P.
23,6
.93
25,4
1.00
49,3
1.94
17,5
.69

FIG. 12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.28
DIA
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O.P.
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1.00
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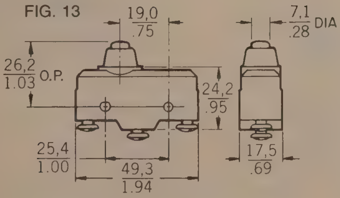
1.94
17,5
.69

FIG. 13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O.P.
24,2
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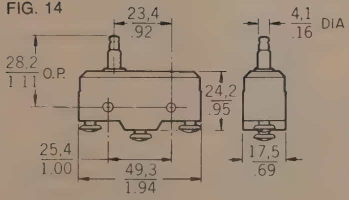
1.00
49,3
1.94
17,5
.69

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

FIG. 14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.16
DIA
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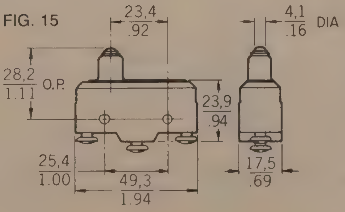
1.11
O.P.
24,2
.95
25,4
1.00
49,3
1.94
17,5
.69

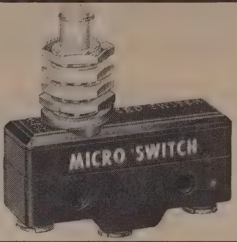
FIG. 15


23,4
.92
4,1
.16
DIA
28,2
1.11
O.P.
23,9
.94
25,4
1.00
49,3
1.94
17,5
.69

MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3.53 MM) DIAMETER

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPES Z AND A
OVERTRAVEL PLUNGERS


MICRO SWITCH

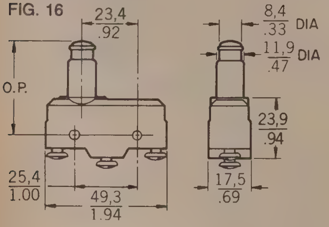
Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; Q.P. — Operating Position; F.P. — Free Position.

ORDER GUIDE
OVERTRAVEL PLUNGER

Recommended for	Mtg. Fig.	Electrical Data (Page G8)	Order This Catalog Listing	O.F. grams ounces	R.F. mm. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. m.m. inches	O.P. * m.m. inches
Added overtravel. For manual in-line operation and for slow 30° (max) rise cams	16	A	BZ-2RQ-A2	255-368 9-13	113 4	0,38 .015	5,56 .219	0,01-0,05 .0004-.0020	38,10 ±0,51 1.500 ±.020
Operating in temperature to +250°F (121° C)	16	A	BZ-2RQ24-A2	255-368 9-13	113 4	0,38 .015	5,56 .219	0,01-0,05 .0004-.0020	38,10 ±0,51 1.500 ±.020
BZ-2RQ-A2 type applications with bushing mount	17	A	BZ-2RQ1-A2	255-368 9-13	113 4	0,38 .015	5,56 .219	0,01-0,05 .0004-.0020	21,82 .859
MIL-S-8805 application requirements	17	A	BZ-2RQ1T04 (m 8805/1-020)	255-368 9-13	170 6	0,38 .015	5,56 .219	0,01-0,05 .0004-.0020	21,82 .859
Applications requiring gold alloy contacts	17	P	BZ-2RQ172-A2	255-368 9-13	113 4	0,38 .015	5,56 .219	0,01-0,05 .0004-.0020	21,82 .859
Operating in temperature to +250° F (121° C)	17	A	BZ-2RQ124-A2	255-368 9-13	113 4	0,38 .015	5,56 .219	0,01-0,05 .0004-.0020	21,82 .859
Up to 20 ampere load handling	18	G	BZ-2RQ1-A2	397-624 14-22	284 10	1,27 .050	5,56 .219	0,05-0,191 .0020-.0075	21,82 .859
Added overtravel. Roller plunger for rapid cam (30° max) rise and slide operation	19	A	BZ-2RQ18-A2	255-368 9-13	113 4	0,38 .015	3,56 .140	0,01-0,05 .0004-.0020	33,32 ±1,14 1.312 ±.045
Applications requiring gold alloy contacts	19	P	BZ-2RQ1872-A2	255-368 9-13	113 4	0,38 .015	3,56 .140	0,01-0,05 .0004-.0020	33,32 ±1,14 1.312 ±.045
Operating in temperature to +250° F (121° C)	19	A	BZ-2RQ1824-A2	255-368 9-13	113 4	0,38 .015	3,56 .140	0,01-0,05 .0004-.0020	33,32 ±1,14 1.312 ±.045
Applications requiring roller plunger 90° to major axis of switch	20	A	BZ-2RQ181-A2	255-368 9-13	113 4	0,38 .015	3,56 .140	0,01-0,05 .0004-.0020	33,32 ±1,14 1.312 ±.045

Except where stated * ±0.76 mm.
±.030 in.

FIG. 16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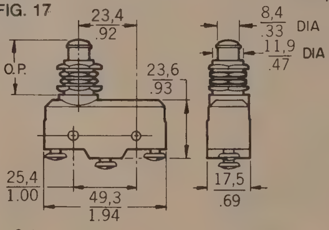
.92
8,4
.33 DIA
11,9
.47 DIA
O.P.
23,9
.94
25,4
1.00
49,3
1.94
17,5
.69

FIG. 17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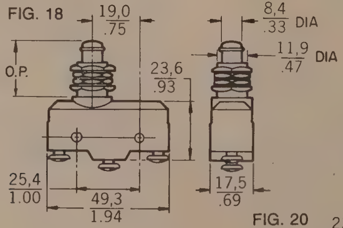
8,4
.33 DIA
11,9
.47 DIA
O.P.
23,6
.93
25,4
1.00
49,3
1.94
17,5
.69

FIG. 18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11,9
.47 DIA
O.P.
23,6
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25,4
1.00
49,3
1.94
17,5
.69

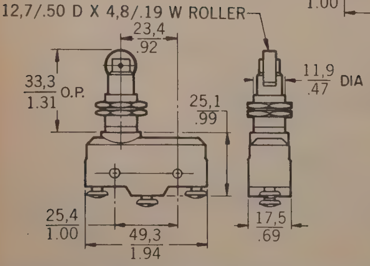
MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3,53 MM) DIAMETER

THREADED BUSHINGS (NOT FIG. 16) ARE 15/32-32NS

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 = \text{mm}}{0.00 = \text{inches}}$

FIG. 19


12,7/.50 D X 4,8/.19 W ROLLER
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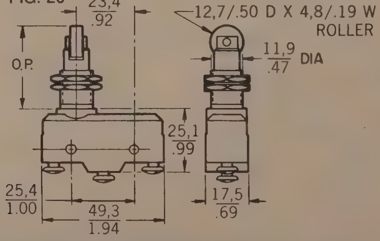
11,9
.47 DIA
25,4
1.00
49,3
1.94
17,5
.69

FIG. 20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12,7/.50 D X 4,8/.19 W
ROLLER
11,9
.47 DIA
O.P.
25,1
.99
25,4
1.00
49,3
1.94
17,5
.69

TYPES Z AND A INTEGRAL LEVERS

MICRO SWITCH

ORDER GUIDE
STRAIGHT LEVER

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating position; F.P. — Free Position.

Recommended for	Mtg. Fig.	Electrical Data (Page G8)	Order This Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
2.5 inch lever requirements	21	A	BZ-2RW80-A2	71 2.5	14 0.50	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750
Lower force (without external return spring)	21	A	BZ-2RW84-A2	28 1	3,54 0.125	8,33 .328	5,56 .219	0,18-1,27 .007-.050	19,1 .750
Best repeatability	21	A	BZ-2RW-A2	28-71 1-2.5	14 0.50	—	4,78 .188	0,41-1,98 .016-.078	18,26 .719
Adjustable operating point (17 mm to 22 mm) (.670" to .880")	22	A	BZ-2RW899-A2	71 2.5	14 0.50	—	3,54† .125	0,18-1,27 .007-.050	17,02-22,35 .670-.880
Lowest operating force	21	I	BZ-RW8435-A2	7.1 .25	—	6,76 .266	5,56 .219	0,08-0,38 .003-.015	19,1 .750
6 inch lever requirements	21	A	BZ-2RW863-A2	28 1	—	—	14,68 .578	0,46-3,68 .018-.145	19,1 ±1,52 .750 ±.060
Dustproof and splash resistant seal	21	A	BZ-2RW805551-A2	71 2.5	14 0.50	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750
Applications requiring gold alloy contacts	21	P	8Z-2RW8072-A2	71 2.5	14 0.50	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750
Applications requiring gold alloy contacts plus dustproof and splash resistant seal.	21	P	BZ-2RW8725551-A2	71 2.5	14 0.50	—	5,56 .219	0,18-1,27 .007-.050	19.1 .750
MIL-S-8805 application requirements	21	A	BZ-2RWT04 (m 8805/1-044)	28-92 1-3,25	21 0.75	7,52 .296	4,37 .172	2,36 .093	19,1 .750
Operating in temperature to +250° F (121° C)	21	A	BZ-2RW824-A2	71 2.5	14 0.50	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750
Operating in temperature to +400° F (204° C)	21	B	BZ-2RW8244-A2	71 2.5	14 0.50	—	5,56 .219	0,18-1,27 .007-.050	19,1 .750
Up to 20 ampere load handling	23	G	BA-2RV-A2	71 2.5	14 0.50	15,88 .625	1,98 .078	2,77 .109	19,1 .750
Reverse acting actuator (switch plunger depressed in free position)	24	A	BZ-2RM-A2	170 6	28 1	5,56 .219	5,56 .219	0,10-0,89 .004-.035	19.1 .750

†From $\frac{17}{.670}$ O.P.

Except where stated * ±0.76 mm ±.030 in.

FIG. 21

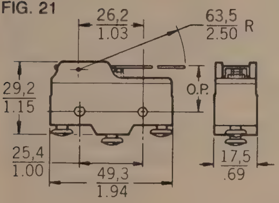


FIG. 22

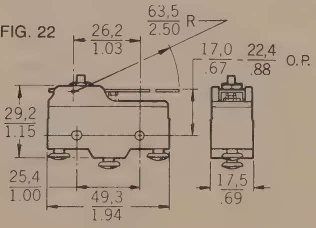


FIG. 23

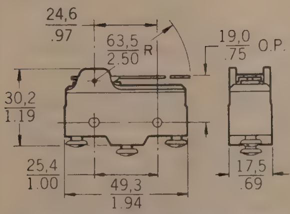
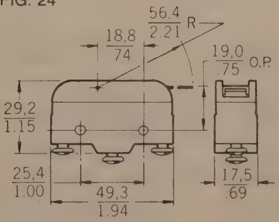


FIG. 24

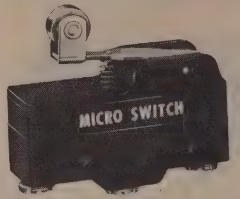


MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3,53 MM) DIAMETER

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

TYPES Z AND A INTEGRAL ROLLER LEVERS



ORDER GUIDE ROLLER LEVER

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position.

Recommended for	Mtg. Fig.	Electrical Data (Page G8)	Order this Catalog Listing	O.F. max. grams Oz	R.F. min. grams Oz	P.T. max. mm inches	O.T. min. mm inches	D.T. mm inches	O.P.* mm inches
1.05 inch (26.7 mm) long (steel roller) lever applications	25	A	BZ-2RW822-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
Dustproof and splash resistant seal	25	A	BZ-2RW8225551-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
Applications requiring gold alloy contacts	25	P	BZ-2RW82272-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
Applications requiring gold alloy contacts plus dustproof and splash resistant seal	25	P	BZ-2RW822725551-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
Operating in temperature to +250° F (121° C)	25	A	BZ-2RW82224-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
Adjustable operating point 29,8 mm to 30.6 (1.172" to 1.203")	26	A	BZ-2RW82299-A2	170 6	43 1.5	—	1,02-29,8† .040-1.172	0,08-0,51 .003-.020	29,77-30,56 1,172-1,203
1.05 inch (26,7 mm) long (simulated roller) lever applications	27	A	BZ-2RW80147-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	30,17 1.188
Up to 20 ampere load handling	28	G	BA-2RV22-A2	170 6	43 1.5	6,35 .250	0,76 .030	1,14 .045	29,77 1.172
1.90 inch (48,3 mm) long (steel roller) lever applications	29	A	BZ-2RW82-A2	99 3.5	21,2 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1,188 ±.030
Dustproof and splash resistant seal	29	A	RZ-2RW825551-A2	99 3.5	21,2 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1.188 ±.030
Application's requiring gold alloy contacts	29	P	BZ-2RW82721-A2	99 3.5	21,2 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1.188 ±.030
Applications requiring gold alloy contacts, plus dustproof, and splash resistant seal	29	P	BZ-2RW82725551-A2	99 3.5	21,2 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1.188 ±.030
Operating in temperature to +250° F (121° C)	29	A	BZ-2RW8224-A2	99 3.5	21,2 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1.188 ±.030
Adjustable operating point (29,2 mm to 31,5 mm) (1.150" to 1.240")	26	A	BZ-2RW8299-A2	99 3.5	21,2 0.75	—	2,16-29,2†† .085-1.15	0,10-1,0 .004-.040	29,2 1.150
1.90 inch 48,3 mm) long (simulated roller lever applications)	27	A	BZ-2RW80196-A2	99 3.5	21,2 0.75	—	3,96 .156	0,10-1,0 .004-.040	30,17 ±0,76 1.188 ±.030
Up to 20 ampere load handling	30	G	BA-2RV2-A2	99 3.5	14,1 0.50	11,89 .468	1,52 .060	2,16 .085	30,17 ±0,76 1.188 ±.030
Best repeatability and O.P. stability	31	I	BZ-RW922-A2	340 12	113 4	0,38 .015	2,54 .100	0,013-0,025 .0005-.0010	31,37 1.235
One-way roller (9,4 mm x 3,8 mm) .37" dia. x 15" wide roller	32	A	BZ-2RW826-A2	170 6	43 1.5	—	2,39 .094	0,08-0,51 .003-.020	41,34 1.625
One-way roller (4,83 mm x 4,83 mm) .19" dia. x .19" wide roller	32	A	BZ-2RW825-A2	227 8	43 1.5	—	1,52 .060	0,38 .015	28,96 1.14

†From 1.172 O.P.
††From 1.150 O.P.

Except where stated * ±0,38 mm ±.015 in.

FIG. 25

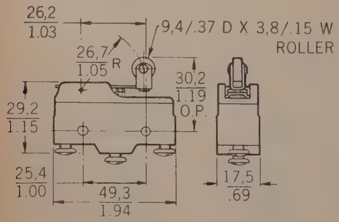
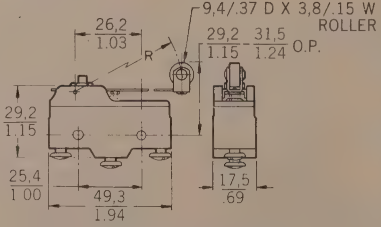
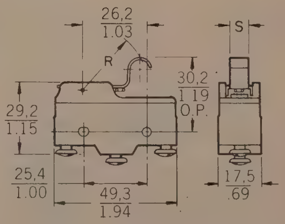


FIG. 26



R = 26,7/1.05 FOR BZ-2RW82299-A2
48,3/1.90 FOR BZ-2RW8299-A2

FIG. 27



R = 26,7/1.05 FOR BZ-2RW80147-A2
48,3/1.90 FOR BZ-2RW80196-A2

S = 7,9/.31 FOR BZ-2RW80147-A2
4,8/.19 FOR BZ-2RW80196-A2

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3,53 MM) DIAMETER

TYPES Z AND A ROLLER LEVERS CONT'D.—LEAF ACTUATORS

FIG. 28

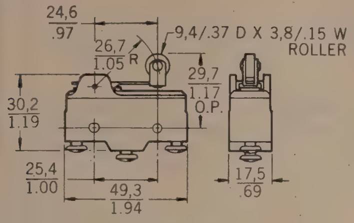

24,6
.97
26,7
1.05
R
9,4/.37 D X 3,8/.15 W
ROLLER
29,7
1.17
O.P.
30,2
1.19
25,4
1.00
49,3
1.94
17,5
.69

FIG. 29

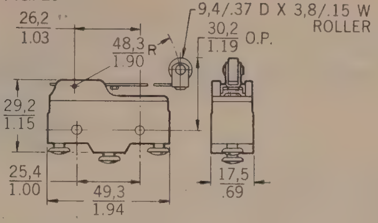

26,2
1.03
9,4/.37 D X 3,8/.15 W
ROLLER
30,2
1.19
O.P.
48,3
1.90
R
29,2
1.15
25,4
1.00
49,3
1.94
17,5
.69

FIG. 30

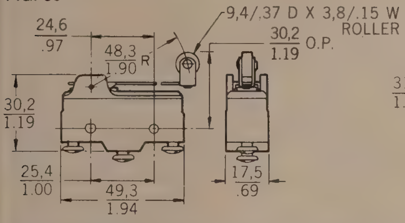

24,6
.97
48,3
1.90
R
9,4/.37 D X 3,8/.15 W
ROLLER
30,2
1.19
O.P.
30,2
1.19
25,4
1.00
49,3
1.94
17,5
.69

FIG. 31

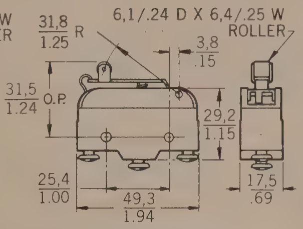
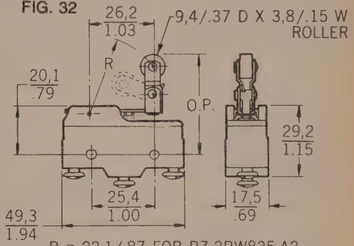

31,8
1.25
R
6,1/.24 D X 6,4/.25 W
ROLLER
3,8
.15
31,5
1.24
O.P.
29,2
1.15
25,4
1.00
49,3
1.94
17,5
.69

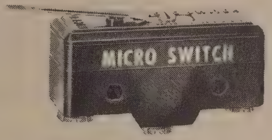
FIG. 32


26,2
1.03
9,4/.37 D X 3,8/.15 W
ROLLER
R
20,1
.79
O.P.
29,2
1.15
25,4
1.00
17,5
.69
49,3
1.94

R = 22,1/.87 FOR BZ-2RW825-A2
32,0/1.26 FOR BZ-2RW826-A2

MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3,53 MM) DIAMETER

ORDER GUIDE
FLEXIBLE LEAF


MICRO SWITCH

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position.

Recommended for	Mtg. Fig.	Electrical Data (Page G8)	Order This Catalog Listing	O.F. max. grams oz	R.F. min. grams oz	P.T. max. mm inches	O.T. max. mm inches	D.T. max. mm inches	O.P.* mm inches
Applications requiring the force and stability of the flexible leaf actuator	33	A	BZ-2RL-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
Dustproof and splash resistant seal	33	A	BZ-2RL5551-A2	198 7	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
Applications requiring gold alloy contacts	33	P	BZ-2RL72-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
Applications requiring gold alloy contacts plus dust proof and splash resistant seals	33	P	BZ-2RL725551-A2	198 7	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
MIL-S-8805 application requirements	33	A	BZ-2RLT04 (m 8805/1-001)	142 5	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
Operating in temperature to +250° F (121° C)	33	A	BZ-2RL24-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
Operating in temperature to +400° F (204° C)	33	B	BZ-2RL244-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	17,48 .688
Up to 20 ampere load handling	34	G	BA-2RL-A2	255 9	28 1	—	1,57 .062	1,57 .062	17,48 .688

* ±0,76 mm
±.030 in

FIG. 33

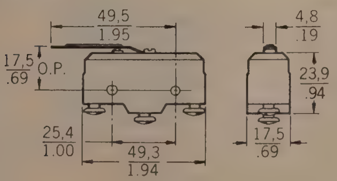
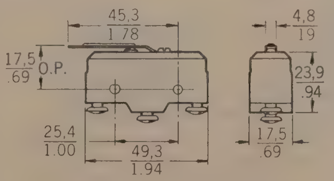

49,5
1.95
4,8
.19
17,5
.69
O.P.
23,9
.94
25,4
1.00
49,3
1.94
17,5
.69

FIG. 34


45,3
1.78
4,8
.19
17,5
.69
O.P.
23,9
.94
25,4
1.00
49,3
1.94
17,5
.69

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key 0,0 — mm
0.00 — inches

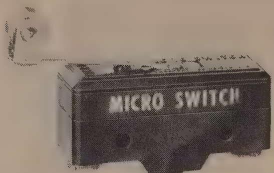
MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139" (3.53 MM) DIAMETER

MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

TYPES Z AND A ROLLER LEAF ACTUATORS

ORDER GUIDE
FLEXIBLE LEAF WITH ROLLERS



Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position.

Recommended for	Mtg. Fig.	Electrical Data Page G8	Order This Catalog Listing	O.F. max. grams oz	R.F. min. grams oz	P.T. max. mm inches	O.T. max. mm inches	D.T. max. mm inches	O.P.* mm inches
Applications requiring the force and stability of the flexible leaf with roller	35	A	BZ2RL2-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	28,6 1.125
Dustproof and splash resistant seal	35	A	BZ-2RL25551-A2	198 7	14 0.50	—	1,52 .060	1,27 .050	28,6 1.125
Applications requiring gold alloy contacts	35	P	BZ-2RL2721-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	28,6 1.125
Applications requiring gold alloy contacts plus dustproof and splash resistant seal	35	P	BZ-2RL2725551-A2	198 7	14 0.50	—	1,52 .060	1,27 .050	28,6 1.125
MIL-S-8805 application requirements	35	A	BZ-2RL2T04 (m 8805/1-036)	106-142 3.75-5	14 0.50	—	1,52 .060	1,27 .050	28,6 1.125
Operating in temperature to +250° F (121° C)	35	A	BZ-2RL224-A2	142 5	14 0.50	—	1,52 .060	1,27 .050	28,6 1.125
Operating in temperature to +400° F (204° C)	35	B	BZ-2RL2244-A2	142 5	14 0.50		1,52 .060	1,27 .050	28,6 1.125
Up to 20 ampere load handling	36	G	BA-2RL2-A2	255 9	28 1	—	1,52 .060	1,65 .065	28,6 1.125

* ±0.76 mm
±.030 in.

FIG. 35

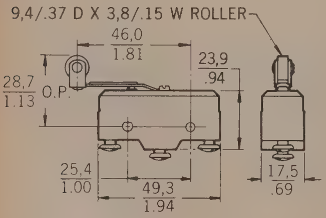
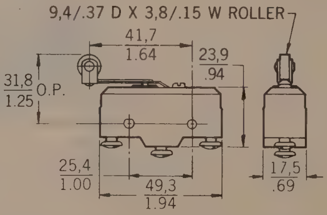


FIG. 36



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 = \text{mm}}{0.00 = \text{inches}}$

MOUNTING HOLES ACCEPT PINS OR SCREWS OF .139′′ (3,53 MM) DIAMETER

ELECTRICAL DATA

Most of these switches are listed by UL and CSA and the current and voltage values shown are based on test conditions specified by these agencies. Electrical life of the switch is influenced by each application condition as well as by voltage and current. For application assistance contact a MICRO SWITCH Branch Office with respect to your requirements.

Single-Pole Double-Throw unless otherwise noted in Order Guide	**A** 15 amps, 125, 250 or 480 vac; ⅛ hp, 125 vac; ¼ hp, 250 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc.	Single-Pole Double-Throw unless otherwise noted in Order Guide	**E** 15 amps, 125, 250 or 480 vac; ¼ hp, 125 vac, ½ hp, 250 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc.
Single-Pole Double-Throw unless otherwise noted in Order Guide	**B** 5 amps, 125, 250 or 480 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc.	Single-Pole Double-Throw unless otherwise noted in Order Guide	**G** 20 amps, 125, 250 or 480 vac; 10 amps, 125 vac "L" (tungsten lamp load); 1 hp, 125 vac; 2 hp, 250 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc.
Single-Pole Double-Throw unless otherwise noted in Order Guide	**C** 10 amps, 125, 250 or 480 vac;	Single-Pole Double-Throw unless otherwise noted in Order Guide	**I** 10 amps, 125, 250 or 480 vac; ⅛ hp, 125 vac; ¼ hp, 250 vac;
Single-Pole Double-Throw unless otherwise noted in Order Guide	**D** 15 amps, 125, 250 or 480 vac; ⅛ hp, 125 vac; ¼ hp, 250 vac.	Single-Pole Double-Throw	**P** 1 amp res., ½ amp ind., 28 vdc. (Not UL Listed)

TYPES Z AND A AUXILIARY ACTUATORS

These auxiliary actuators adapt the plunger type basic switches in this section to many application needs. Auxiliary actuators minimize the need for a large inventory of switch types. Actuators and switches are sold as separate items and must be ordered separtely. Mounting hardware is furnished with the actuator.

- Additional Overtravel
- Quick, Easy Installation
- Corrosion Resistance
- MIL-S-8805 Listed Units

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F.P. — Free Position.

ORDER GUIDE AUXILIARY ACTUATORS

Description	Mtg. Fig.	For Type Z Switches	O.T. min. mm inches	O.P.* mm inches	F.P. max. mm inches	For Type A Switches	O.T. min. mm inches	O.P.* mm inches	F.P. max. mm inches
Roller lever for "S" plunger type Z switches only. Permits cam operation.	55	JR	11,1 .437	44,45 ±3,18 1.75 ±.125					
Adjustable roller lever. Tang on top of actuator can be bent to adjust O.P. and F.P.	56	AD5721R (8805/59) AN3169-1	11,1 .437 approx.	31,75-41,15 1.25-1.62	39,6-43,7 1.56-1.72	ADA3721R	9,53 .375 approx.	40,48 1.594 approx.	46,03 1.812
Straight plunger. Panel mount. Adjustable O.P.	57	MC2711 (8805/58) AN3168-2	4,78 .188	27,79 1.094	29,4 1.156	MCA2711	3,96 .156	28,17 1.109	30,18 1.188
Sealed straight plunger. Panel mount. Elastomer seal boot keeps out liquid splash and dirt.	58	MC2711H	4,78 .188	28,98 1.141	29,4 1.156	MCA2711H	4,37 .172	27,38 ±0,76 1.078 ±.030	29,56 1.156
Roller plunger. Panel mount. Roller parallel to long axis of the switch	59	MD3211Q	3,18 .125 approx.	35,7 1.406	37,69 1.484	MDA3711Q	3,18 .125	36,12 1.422	37,69 1.484
Cross roller plunger. Panel mount. Roller perpendicular to long axis of the switch	60	MD3211Q1	3,18 .125 approx.	35,7 1.406	37,69 1.484	MDA3711Q1	3,18 .125	36,12 1.422	37,69 1.484
High overtravel plunger. panel mount. Adjustable operating point.	61	MC7711 (8805/58) AN3167-1	20,62 .812	69,1 2.719	70,64 2.781	MCA7711	19,84 .781	69,44 2.734	71,42 2.812

Except where stated * ±1,14 mm ±.045 in.

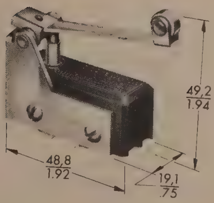


FIG. 55

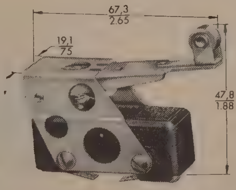


FIG. 56

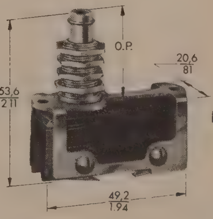


FIG. 57

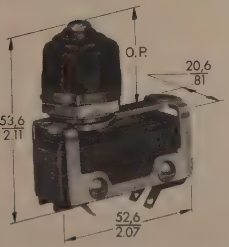


FIG. 58

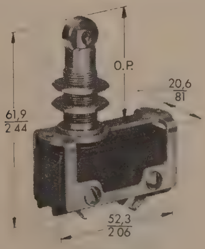


FIG. 59

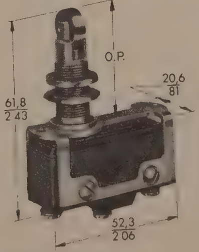


FIG. 60

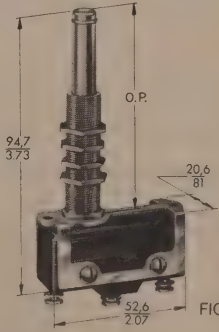


FIG. 61

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 - \text{mm}}{0.00 - \text{inches}}$

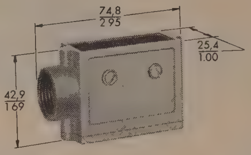
SWITCHES SHOWN ARE NOT INCLUDED WITH THE ACTUATOR.

ACCESSORIES STANDARD BASIC SWITCHES

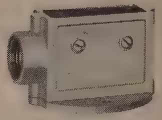
TYPE "3PA" DIE CAST ALUMINUM ENCLOSURES

- Protect Switch From Physical Abuse
- Protect Personnel From Contact With Exposed Terminals
- For Solder or Screw Terminals
- Provide Rugged Mounting Means
- ½-14NPSM Internal Thread Conduit Hub

3PA1 SIDE MOUNT ENCLOSURE—Can be mounted from either side through .140" (3,55 mm) dia. holes on 1" (25,4 mm) centers.
3PA2 FLANGE MOUNT ENCLOSURE—Switch is first secured in enclosure; two 0.172" (4,37 mm) dia, holes in the flange accept #8 machine screws for mounting.
3PA6 ENCLOSURE—For use with actuator Fig. 56.



3PA1



3PA2

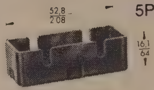
WIDTH OF BASE IS 2.125 INCHES (54mm) AND MOUNTING HOLE CENTERS ARE 1.625 INCHES (41,3mm) APART.

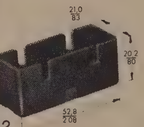
TYPE "5PA" PLASTIC TERMINAL ENCLOSURES

- Easy to Use
- Screw and Solder Terminal Versions
- Protect Personnel From Contact with Exposed Terminals

5PA1—For solder terminal switches
5PA2—For screw terminal switches
5PA3—For solder or screw terminal switches with auxiliary actuators assembled.

5PA1





5PA2

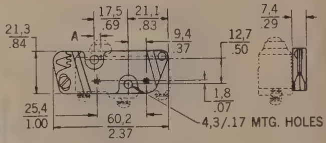
5PA1 w/SWITCH ASSEMBLY

TYPE "8MA" ADJUSTABLE MOUNTING BRACKET

- Sturdy Cadmium-Plated Steel Construction
- Fast, Easy Screwdriver Adjustment
- Can Be Used With All Basic Switches in This Section

The operation point of the basic switch can be regulated up to .080" (2 mm) by loosening the locking screw, inserting a screwdriver in the adjusting slot, and twisting.
Listing 8MA1—Has adjustment slot on the left.
Listing 8MA2—Has adjustment slot on the right.

8MA1 w/SWITCH ASSEMBLED



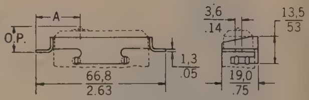
'A' Dimension for
Z Type 3,6/.14
A Type 7,8/.31

17MA1-B CONVERSION MOUNTING BRACKET

- Converts Basic Switches From Side To Top Mount
- Corrosion Resistant
- Snaps Into Switch Mounting Holes—Without Tools

17MA1-B

17MA1-B w/SWITCH ASSEMBLED



'A' Dimension for	O.P.
Z Type 22,9/.90	11,6/.46
A Type 27,0/1.06	11,9/.47

SWITCHES ARE NOT INCLUDED WITH BRACKET

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

TYPE SE AND XE ENVIRONMENT-PROOF

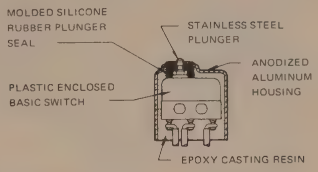
Type SE and XE switches are the smallest environment-proof switches offered by MICRO SWITCH. Both types enclose basic switches within a corrosion resistant aluminum housing to seal the precision switch contacts against contamination. The construction drawing shows the method of sealing. Type SE switches enclose a type SM basic switch and XE switches enclose the smaller 1SX basic switch.

Some of the important features available with design variations include:

- Watertight seal per enclosure design symbol 3, MIL-S-8805
- Power load switching capability up to 7 amperes
- Temperature tolerance up to +230°F (110°C)
- High temperature construction for use to +300°F (149°C)
- Several auxiliary actuators
- Choice of termination
- Military standard construction with two listings on the MIL-S-8805 qualified products list.
- All 4SE Series are UL and CSA approved.
- UL approval on all 4XE series.

Switches held depressed for extended periods of time at temperature extremes may experience retarded plunger return upon deactuation. Where such a condition exists in the application, contact a MICRO SWITCH Branch Office for special designs that are available.

TYPICAL CONSTRUCTION DETAIL


MOLDED SILICONE RUBBER PLUNGER SEAL
STAINLESS STEEL PLUNGER
ANODIZED ALUMINUM HOUSING
PLASTIC ENCLOSED BASIC SWITCH
EPOXY CASTING RESIN

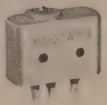
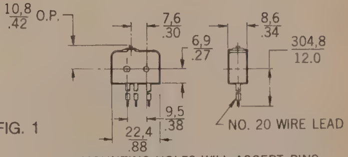
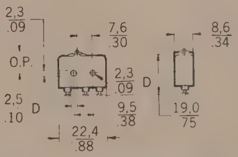


FIG. 1



MOUNTING HOLES WILL ACCEPT PINS OR SCREWS OF 22,1/.087 DIA

FIG. 2



DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0}{0.00}$ — mm / — inches

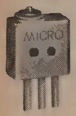
Characteristics: Operating Force; R.F. — Release Force; P. T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position

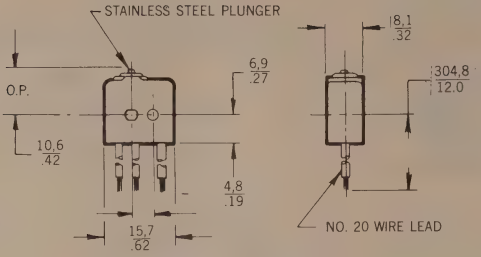
ORDER GUIDE
TYPE SE ENVIRONMENT PROOF SWITCHES

Recommended For	Fig. No.	Electrical Data Ref. Page H2	Typical Catalog Listing	O.F. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P. m.m. inches
Most applications	1	A	1SE1*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
For customer leading	2	A	1SE1-T	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
SPST — Normally-closed	1	A	1SE2*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
SPST — Normally-open	1	A	1SE3*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
Use to +230° F (110°C). Leadwires tolerates +392°F (200°C)	1	A	2SE1*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
UL and CSA listing and UL and CSA listed lead wire	1	B	4SE1*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
Oil resistant. Fluosilicone seal	1	A	5SE1*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
Oil resistant. Leadwire tolerates +392°F (200°C)	1	A	6SE1*	142-482 5-17	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425
Lower force	1	A	7SE1*	113-227 4-8	57 2	1,27 .050	0,08 .003	0,1 .004	10,8 .425
High return force	2	A	12SE4-T	142-538 5-19	113 4	1,27 .050	0,08 .003	0,1 .004	10,8 .425

*These listings have one foot leads. For longer leads contact your nearest MICRO SWITCH Branch Office.

TYPE SE AND XE CONT'D





MOUNTING HOLES WILL ACCEPT PINS OR
OR SCREWS OF 22,1/ .087 DIA

FIG. 3

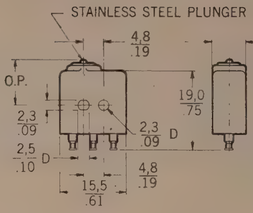


FIG. 4

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 = mm / 0.00 = inches

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

ORDER GUIDE
TYPE XE ENVIRONMENT-PROOF SWITCHES

Recommended For	Fig. No.	Electrical Data Ref.	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.† mm inches
Most applications. MIL-S-8805 requirements	3	C	1XE1* (MS27994-1)	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
For customer leading	4	C	1XE1-T (MS27994-3)	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
SPST — Normally-open	3	C	1XE3*	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
Use to +230°F (110°C). Leadwires tolerate +392°F (200°C)	3	C	2XE1*	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
UL listing and UL and CSA listed leadwire	3	D	4XE1*	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
Oil resistant Fluosilicone seal	3	C	5XE1*	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
Oil resistant. Leadwire tolerates +392°F (200°C)	3	C	6XE1*	142-482 5-17	113 4	1,27 .050	0,1 .004	0,13 .005	10,8 .425
Less operating force Use to +300°F (149°C)	3	E	14XE1*	255 9 max.	57 2	0,76 .030	0,1 .004	0,13 .005	10,9 .430
For customer leading Use to +300°F (149°C)	4	E	14XE1-T	255 9 max.	57 2	0,76 .030	0,1 .004	0,13 .005	10,9 .430

Except where stated† ± 0,51 mm
± .020 in

*These listings have one foot leads. For longer leads contact your nearest MICRO SWITCH Branch Office.

CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	A 5 amps res., 3 amps ind., (sea level), 5 amps res., 2.5 amps ind., (50,000 feet) 28 vdc. 5 amps res., 5 amps ind., 125 or 250 vac, 60 Hz.
Single-Pole Double-Throw	B UL and CSA Rating 5 amps, 250 vac, 60 Hz
Single-Pole Double-Throw	C 7 amps res., 4 amps ind., (sea level), 7 amps res.; 2.5 amps ind., (50,000 feet), 28 vdc. 7 amps res., 4 amps ind.; (sea level), 115 vac. 400 Hz
Single-Pole Double-Throw	D UL Rating 7 amps, 250 vac 60 Hz
Single-Pole Double-throw	E 7 amps res., 4 amps ind., (sea level), 7 amps res., 2.5 amps ind., (50,000 feet), 28 vdc.

TYPES SE AND XE AUXILIARY ACTUATORS

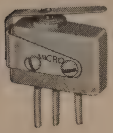


FIG. 5

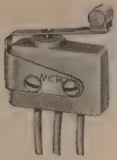


FIG. 7

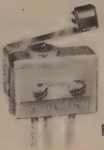


FIG. 6

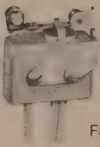
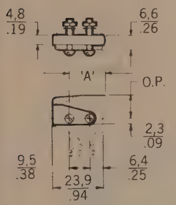
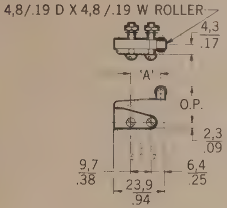


FIG. 9





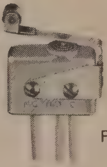


FIG. 8

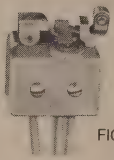


FIG. 10

Key: 0,0 — mm / 0.00 — inches

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
SWITCHES ARE NOT INCLUDED WITH THE ACTUATORS

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F. P. — Free Position.

ORDER GUIDE
AUXILIARY ACTUATORS FOR TYPE SE SWITCHES

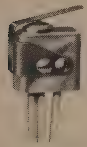
Description	Fig. No.	Actuator Length A m.m. inches	Catalog Listing*	O.F. max. grams ounces	R.F. min. grams ounces	P.T. approx. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P.* mm inches	F.P.† mm inches
Straight leaf	5	16,8 .66	JE-1**	340 12	57 2	3,81 .150	0,38 .015	0,64 .025	11,2 .440	15 .590
Roller leaf. Roller turned 90° to switch axis	6	16,8 .66	JE-4**	340 12	57 2	3,81 .150	0,38 .015	0,64 .025	16,3 .640	20,1 .790 approx.
Roller leaf	7	14,2 .560	JE-5	340 12	57 2	3,81 .150	0,38 .015	0,64 .025	16,3 .640	20,1 .790
Roller leaf. Reversed position	8	14,2 .560	JE-17**	340 12	57 2	3,81 .150	0,38 .015	0,64 .025	16,3 .640	20,1 .790
Roller lever	9	13,7 .540	JE-21	170 6	28 1	2,54 .100	0,25 .010	0,41 .016	16,3 .640	18,8 .740
Roller lever. Reversed position	10	17,8 .700	JE-22	482 17	113 4	2,54 .100	0,15 .006	0,3 .012	16,8 ± 1,3 .660 ± .050	19,3 ± 1,3 .760 ± .050

*All characteristics taken with actuator assembled on 1SE1 switch as shown

**Mounting hardware furnished

Except where stated† ± 0,76 mm
± .030 in

Contact your nearest MICRO SWITCH Branch Office for other variables with and without hardware.



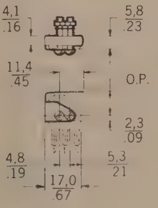


FIG. 11

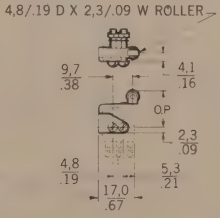


FIG. 12

Key: 0,0 — mm / 0.00 — inches

SWITCHES ARE NOT INCLUDED WITH THE ACTUATORS
DIMENSIONS FOR REFERENCE ONLY

ORDER GUIDE
AUXILIARY ACTUATORS FOR TYPE XE SWITCHES

Description	Style No.	Catalog Listing*	O.F. max. grams ounces	R.F. min. grams ounces	P.T. approx. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P. mm inches	F.P. mm inches
Straight lever	11	JM-1	595 21	85 3	3,18 .125	0,23 .009	0,3 .012	10,8 ± 0,76 .425 ± .030	14 ± 0.76 .550 ± .030
Roller lever	12	JM-5	595 21	85 3	3,18 .125	0,23 .009	0,3 .012	15,9 ± 0,89 .625 ± .035	19,1 ± 0,89 .750 ± 0.35

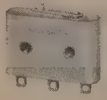
*All characteristics taken with actuator assembled on 1XE1 switch as shown.

TYPE HM MINIATURE HERMETICALLY SEALED

Type HM miniature basic switches are the answer to the need for an extremely small light weight switch with true hermetic sealing and ample electrical capacity. They are the smallest hermetically sealed snap-action switches offered by MICRO SWITCH and are interchangeable (in mounting hole location and operating characteristics) with the MS25085-1 (listing 21SM284) basic switch.

Some of the important features available with design variations include:

- Hermetically sealed per enclosure design symbol 5, MIL-S-8805
- Power load switching capability up to 5 amperes 28 vdc and 125 vac, 400 cycles
- Temperature tolerance from −85°F to +250°F (−65 to 121°C)
- High temperature construction for use from −85°F to +500°F. (−65 to 260°C)
- Variety of auxiliary actuators
- Choice of terminal styles
- Gold contacts for special applications
- Military standard construction with three listings on the MIL-S-8805 qualified products list.



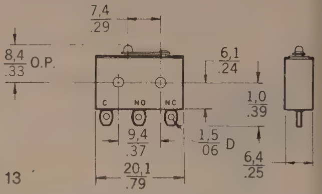
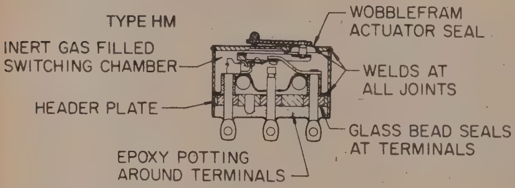

7,4
.29
8,4
.33
O.P.
6,1
.24
C
NO
NC
1,0
.39
9,4
.37
1,5
.06
D
6,4
.25
20,1
.79

FIG. 13

MOUNTING HOLES WILL ACCEPT PINS OR SCREWS OF 1,9/.08 DIA


TYPE HM
INERT GAS FILLED SWITCHING CHAMBER
HEADER PLATE
EPOXY POTTING AROUND TERMINALS
WOBBLEFRAM ACTUATOR SEAL
WELDS AT ALL JOINTS
GLASS BEAD SEALS AT TERMINALS

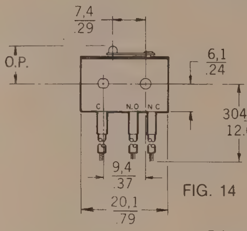

7,4
.29
O.P.
6,1
.24
C
N.O
NC
304,8
12.0
9,4
.37
20,1
.79

FIG. 14

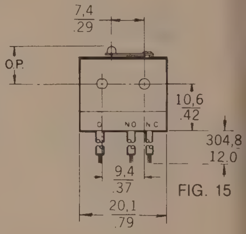

7,4
.29
O.P.
10,6
.42
C
NO
NC
304,8
12.0
9,4
.37
20,1
.79

FIG. 15

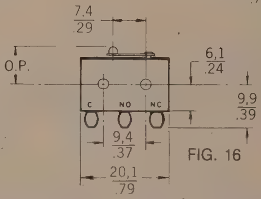

7,4
.29
O.P.
6,1
.24
C
NO
NC
9,9
.39
9,4
.37
20,1
.79

FIG. 16

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0{,}0 = \text{mm}}{0.00 = \text{inches}}$

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position.

ORDER GUIDE
TYPE HM HERMETICALLY SEALED SWITCHES

Recommended For	Fig. No.	Electrical Data Ref. Page H5	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max mm inches	O.P.* mm inches
Most applications	13	F	1HM1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
1 foot long leads MIL-W-16878 Type E wire	14	F	2HM1-1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
Added overtravel	13	F	1HM61	198 7	28 1	0,76 .030	0,15 .006	0,15 .006	8,38 .330
Applications requiring gold contacts	13	H	3HM1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
Operating in temperature to 300°F (149°C)	13	G	5HM1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
Operating in temperature to +500°F (260°C) with weld tab termination	16	G	5HM6	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
1 foot long leads MIL-W-16878 Type E wire. Use to +500°F (260°C)	15	G	6HM1-1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
MIL-S-8805 application requirements	13	I	1HM19 (MS27216-1)	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
MIL-S-8805 application requirements. 1 ft. (305mm) leads.	14	I	2HM19-1 (MS27216-2)	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
5 foot (1524mm) long leads	14	I	2HM19-5 (MS27216-4)	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
Bifurcated gold contacts	13	J	9HM1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330
Exceeds MIL-S-8805 requirements for shock and vibration	13	K	11HM1	198 7	28 1	0,76 .030	0,08 .003	0,15 .006	8,38 .330

CONTINUED NEXT PAGE

* ± 0,38mm
± .015 in

TYPE HM AUXILIARY ACTUATORS

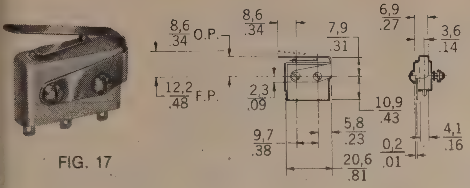

8,6/.34 O.P.
8,6/.34
7,9/.31
6,9/.27
3,6/.14
12,2/.48 F.P.
2,3/.09
10,9/.43
5,8/.23
9,7/.38
4,1/.16
0,2/.01
20,6/.81

FIG. 17

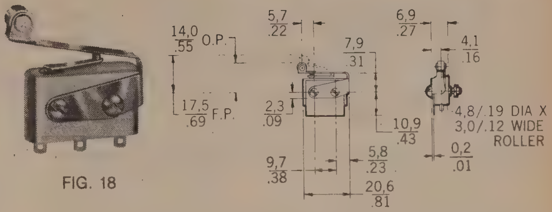

14,0/.55 O.P.
5,7/.22
7,9/.31
6,9/.27
4,1/.16
17,5/.69 F.P.
2,3/.09
10,9/.43
4,8/.19 DIA X 3,0/.12 WIDE ROLLER
0,2/.01
5,8/.23
9,7/.38
20,6/.81

FIG. 18

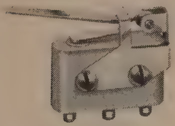


FIG. 19

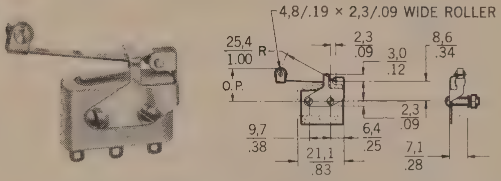

4,8/.19 × 2,3/.09 WIDE ROLLER
25,4/1.00 R
2,3/.09
3,0/.12
8,6/.34
O.P.
2,3/.09
9,7/.38
6,4/.25
21,1/.83
7,1/.28

FIG. 20

SWITCHES ARE NOT INCLUDED
WITH THE ACTUATORS

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

ORDER GUIDE
AUXILIARY ACTUATORS FOR TYPE HM SWITCHES

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel; O.P. — Operating Position; F. P. — Free Position

Description	Fig. No.	Temp. (Max.)	Catalog Listing	O.F.max. grams ounces	R.F. min. grams ounces	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	O.P. mm inches	F.P. mm inches
Leaf	17	500°F (260°C)	JS-152	255 9	57 2	—	0,76 .030	0,76 .030	8,64 .340 approx.	12,2 .480 approx.
Roller leaf	18	500°F (260°C)	JS-151	255 9	57 2	—	0,76 .030	0,76 .030	14 .550 approx.	17,5 .690 approx.
Straight lever	19	500°F (260°C)	JS-307	43 1.5	4 .11	3,18 .125 approx.	0,64 .025	1,42 .056	10,3 .406 approx.	
Roller lever	20	500°F (260°C)	JS-308	43 1.5	4 .11	3,18 .125 approx.	0,64 .025	1,42 .056	14,3 .562 approx.	

Characteristics taken with actuator on catalog listing 5HM6

NOTE: Type HM switches are not generally recommended for 115 vac, 60 Hz. If you have a 60 Hz application in the milliamp range, contact your nearest MICRO SWITCH Branch Office for assistance.

For applications that require the switch to function electrically during exposure to sub-freezing temperatures contact a MICRO SWITCH Branch Office for special design variations that are available.

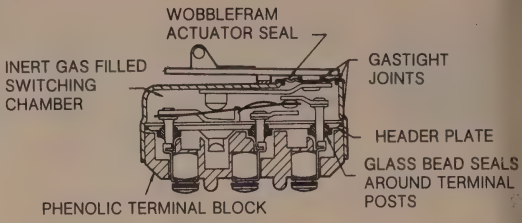
CIRCUITRY	ELECTRICAL DATA	CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	F 5 amps res.; 3 amps ind., 28 vdc or 115 vac, 400 Hz.	Single-Pole Double-Throw	I 4 amps res., 2 amps ind., 0.5 amps lamp load, 115 vac, 400 Hz. 4 amps res., 2 amps ind., 1 amp lamp load 28 vdc.
Single-Pole Double-Throw	G 4 amps res., 2 amps ind., 28 vdc. 2.5 amps res. or ind., 115 vac, 400 Hz.	Single-Pole Double-Throw	J ½ amp res. ¼ amp ind. (sea level or 70,000 ft.) 28 vdc
Single-Pole Double-Throw	H 1 amp res., 0.25 amp ind., 28 vdc.	Single-Pole Double-Throw	K 3 amps res., 1 amp ind. (Sea level or 70,000 ft.) 28 vdc lamp res. or ind. (sea level) 115 vac. 400 Hz.

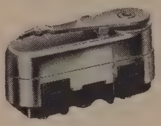
TYPE HS HERMETICALLY SEALED

Type HS switches are designed for applications where maximum electrical rating and maximum sealing are essential, and where size and weight requirements are less critical. These switches are side mounted through mounting holes which are outside the sealing switching chamber.

Some of the important features available with design variations include:

- Hermetically sealed per enclosure design symbol 5, MIL-S-8805.
- Power load switching capability up to 25 amperes, 28 vdc
- Temperature tolerance from −67°F to +180°F (−55 to 82°C)
- High temperature construction for use to +300°F (149°C)
- Several styles of integral lever actuators
- Two styles of terminals
- Military standard construction with two listings on the MIL-S-8805 qualified products list.
- UL and CSA listings available


WOBBLEFRAM ACTUATOR SEAL
INERT GAS FILLED SWITCHING CHAMBER
GASTIGHT JOINTS
HEADER PLATE
GLASS BEAD SEALS AROUND TERMINAL POSTS
PHENOLIC TERMINAL BLOCK



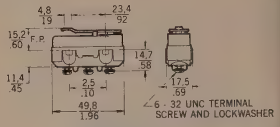

4,8/.19
23,4/.92
15,2/.60
F.P.
14,7/.58
11,4/.45
2,5/.10
49,8/1.96
17,5/.69
6 - 32 UNC TERMINAL SCREW AND LOCKWASHER

FIG. 21

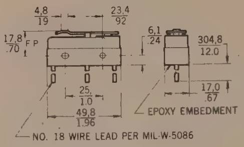

4,8/.19
23,4/.92
17,8/.70
F P
6,1/.24
304,8/12.0
25,/1.0
49,8/1.96
17,0/.67
EPOXY EMBEDMENT
NO. 18 WIRE LEAD PER MIL-W-5086

FIG. 22

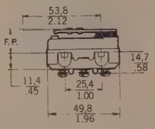

53,8/2.12
F.P.
14,7/.58
11,4/.45
25,4/1.00
49,8/1.96

FIG. 23

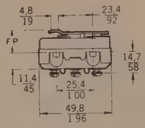

4,8/.19
23,4/.92
F P
14,7/.58
11,4/.45
25,4/1.00
49,8/1.96

FIG. 24

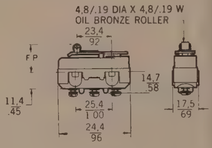

4,8/.19 DIA X 4,8/.19 W OIL BRONZE ROLLER
23,4/.92
F P
14,7/.58
11,4/.45
25,4/1.00
24,4/.96
17,5/.69

FIG. 25

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

MOUNTING HOLES WILL ACCEPT PINS OR SCREWS OF .139 DIA

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T.—Overtravel; D.T.—Differential Travel; O.P. — Operating Position

ORDER GUIDE
TYPE HS HERMETICALLY SEALED SWITCHES

Recommended For	Fig. No.	Electrical Data Ref.	Typical Catalog Listing	O.F. max. grams ounces	R.F. min. grams ounces	P.T. max. m.m. inches	O.T. min. m.m. inches	D.T. max. m.m. inches	O.P.* m.m. inches
Most applications. MIL-S-8805 (M8805/47)	21	L	1HS1 (MS25011-1)	284-624 10-22	113 4	1,65 .065	0,25 .010	0,51 .020	13,5 .530
Lead wire termination	22	M	4HS4-118	284-624 10-22	113 4	1,65 .065	0,25 .010	0,51 .020	15,6 .615 ± .020
Applications requiring added overtravel	23	L	1HS41	113-567 4-20	57 2	—	1,57 .062 max.	2,54 .100	13,54 .533 approx.
MIL-S-8805 requirements. More operating force	24	L	1HS6 (MS25011-2)	624-794 22-28	113 4	2,16 .085	0,25 .010	0,51 .020	13,5 .530
Roller lever	25	L	1HS3	284-624 10-22	113 4	1,65 .065	0,25 .010	0,51 .020	18,3 .720
Operating in temperature to +250°F (121°C)	21	N	101HS1	284-624 10-22	113 4	1,65 .065	0,25 .010	0,51 .020	13,5 .530
Operating in temperature to +300°F (149°C)	21	O	102HS1	284-850 10-30	113 4	1,65 .065	0,25 .010	0,51 .020	13,5 .530

Contact a Branch Office for auxilliary actuators for use with HS switches

Except where stated *± 0,38g
± .015 in

CIRCUITRY	ELECTRICAL DATA	CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	L 25 amps res., 10 amps ind., 5 amps motor, 3 amps lamp load, 28 vdc; 1 amp res., 1 amp ind., 125 vac, 60 Hz UL-CSA Rating: 1 amp., 125 vac, 60 Hz.	Single-Pole Double-Throw	N 20 amps res., 10 amps ind., 28 vdc; 1 amp res., 1 amp ind., 125 vac, 60 Hz UL-CSA Rating: 1 amp., 125 vac, 60 Hz.
Single-Pole Double-Throw	M 15 amps res., 10 amps ind., 28 vdc; 1 amp res., 1 amp ind., 125 vac, 60 Hz	Single-Pole Double-Throw	O 10 amps res., 5 amps ind., 28 vdc; 1 amp res., 1 amp ind., 125 vac, 60 Hz UL-CSA Rating: 1 amp., 125 vac, 60 Hz.

TYPE HT HIGH TEMPERATURE

These switches will withstand temperatures up to +1000°F. In them, the switching element is mounted on a ceramic base within a stainless steel enclosure. HT switches are not classified as sealed switches. Features within the HT series include:

- Temperature Tolerance (Up to +1000°F) (538°C)
- Designed to Meet Military Requirements
- Side and Panel Mount
- UL Listed

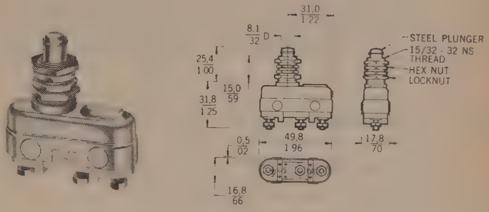

31,0
1.22
8,1
.32
D
25,4
1.00
15,0
.59
31,8
1.25
0,5
.02
49,8
1.96
16,8
.66
STEEL PLUNGER
15/32 - 32 NS THREAD
HEX NUT LOCKNUT
17,8
.70

FIG. 26

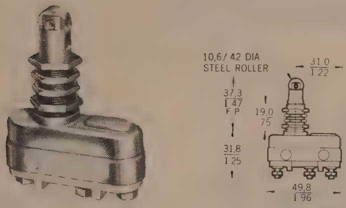

10,6/.42 DIA STEEL ROLLER
31,0
1.22
37,3
1.47
F P
19,0
.75
31,8
1.25
49,8
1.96

FIG. 27

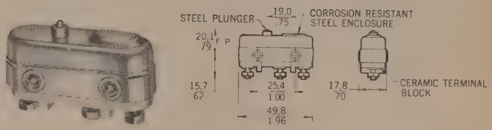

STEEL PLUNGER
19,0
.75
CORROSION RESISTANT STEEL ENCLOSURE
20,1
.79
F P
15,7
.62
25,4
1.00
49,8
1.96
17,8
.70
CERAMIC TERMINAL BLOCK

FIG. 28

MOUNTING HOLES WILL ACCEPT PINS OR SCREWS OF .139 DIA ON 1.000 CENTERS

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

ORDER GUIDE
TYPE HT HIGH TEMPERATURE SWITCHES

Characteristics: O.F. — Operating Force; R.F. — Release Force; P.T. — Pretravel; O.T. — Overtravel; D.T. — Differential Travel

Description	Fig. No.	Electrical Data Ref.	Catalog Listing	O.F. grams ounces	R.F. min. grams ounces	P.T. max. mm inches	O.T. min. mm inches	O.P. mm inches
Straight plunger panel mount	26	P	1HT1	284-567 10-20	170 6	1,65 .065	4,78 .188	23,7 .935 approx.
Roller plunger panel mount	27	P	3HT1	850 30 max.	170 6	1,65 .065	4,78 .188	16,8 .66 approx.
Pin plunger side mount	28	P	2HT1	284-567 10-20	170 6	1,27 .050	0,25 .010	35,9 1.413 approx.

CIRCUITRY	ELECTRICAL DATA
Single-Pole Double-Throw	P 10 amps res., 5 amps ind., 4 amps motor load, 2.4 amps lamp load, 28 vdc. UL switches 3 amps, 1/10 HP, 125 vac. 3 amp, 1/6 HP, 250 vac.

MERCURY SWITCHES

MICRO SWITCH mercury switches are glass tubes into which stationary electrodes and a pool of mercury are hermetically sealed. Tilting the tubes moves the mercury pool which makes or breaks contact between the electrodes.

When you need a trouble-free switch for use in a contaminated atmosphere or where operating force is extremely low, consider the advantages of MICRO SWITCH glass tube mercury switches. There is a wide range of sizes, electrical capacities, and operating characteristics. Contacts are hermetically sealed to resist effects of dust, dirt, oil and corrosive fumes. Maintenance costs are minimized since there are no moving parts to wear out.

- High electrical capacity (up to 45 amps)
- Environment free construction
- Low contact resistance
- Excellent repeatability
- Low force operation
- Temperature ranges from −65°F to 500°F (−54 to 260°C)
- long shelf life
- Low cost
- Easy installation and operation
- Silent operation
- Wide range of differential angles (15° max. to 20° min.)
- Extremely long life

UL AND CSA CONSIDERATIONS

MICRO SWITCH mercury switches will pass UL tests when properly applied and have leadwires and insulation suitable for the application. A number of UL listed PVC insulated leadwires are available.

UL and CSA have not established basic test parameters for their investigative purpose that would apply to all mercury switch applications. Since the application conditions vary widely, mercury switches by themeelves are not a UL or CSA listing; the switch is evaluated by UL or CSA in the application.

MICRO SWITCH has assisted many designers in the proper choice and application of a mercury switch in a control system requireing a UL or CSA listing. Contact your nearest MICRO SWITCH Branch Office if assistance is desired in these applications.

POSSIBLE MOUNTING AND ACTUATION METHODS

(1) "Over center" mounting. If the support mechanism has a small free motion, an extra "over center" snap-action can occur as the mercury will over-balance the device, picking up this free motion.

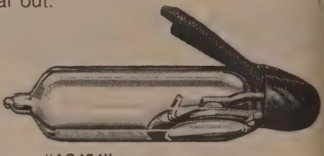
(2) Where minimum operating space is a requirement, "on center" mounting results in a minimum displacement of each end of the tube.

(3) If only minimum operating force is available, "below center" mounting could be used. Lowest operating force can be secured by counter-balancing the switch and its support. The actuating mechanism and switch tube move while the mercury almost remains stationary.

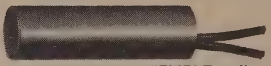
(4) For temperature control, the switch may be mounted on bimetal strip, the angle varying with the temperature.

(5) A mercury switch can be actuated by a cam-driven lever.

(6) A pivoted actuator can be used with a mercury switch to detect a break in thread or wire tension. When the strand parts or slacks, the actuator arm drops and tilts the switch interrupting current to the reel motor.



"AS454" Series for a-c or d-c in direct control of fractional horsepower motors, heaters, lamps and solenoids. SPST.



"7MPI Type"
Metal or plastic enclosures protect against damage

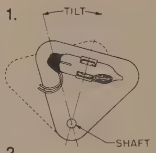
"AS408" Series offers both quality and economy. For use on animated displays, appliances, etc. SPST.

"AS419" Series subminiature size unit for use when a minimum of operating energy is available. SPST.

FOR FURTHER INFORMATION

Request a copy of the Mercury Switch Instruction Manual AS-1 for application data and details on other variations available.

1.



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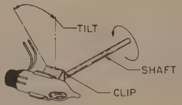
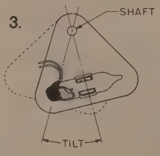


3.



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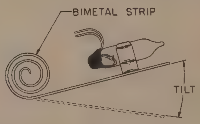

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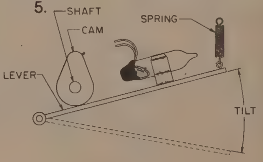
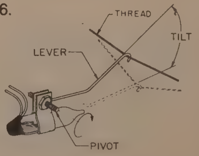


6.



SMALL DIAMETER, LIGHT AND MEDIUM DUTY SWITCHES

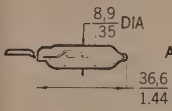
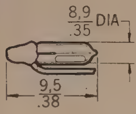
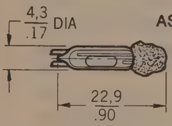
ORDERING INFORMATION

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

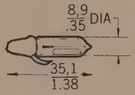
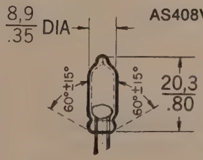
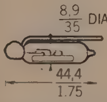
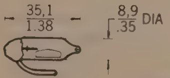
Key: 0,0 – mm / 0.00 – inches

*This catalog listing has 7 inch (178mm) PVC leadwires. Other types and lengths are available. See the Mercury Switch Instruction Manual AS-1.

- SINGLE POLE—SINGLE THROW—LIGHT DUTY

Catalog Listing	Differential Angle	Electrical Data	Comments
 AS400D29 *	0.2° to 0.8°	**Resistive:** 30 vac—1.5 amps 30 vdc— .75 amp **Inductive:** at 30 vac 0.4 amp steady state; 1.0 amp inrush	Maximum resistance is .090 ohms without leads. Wetted nickel electrodes provide a low and stable contact resistance for low energy "dry circuit" applications. (Mercury to wetted electrode contact) Mtg. clip 1MR14-A
 AS408A25 *	5° max.	**Resistive:** 30 vac—1.5 amps 115 vac— .5 amp 30 vdc—2.0 amps 115 vdc— .7 amp **Inductive:** Inrush current should not exceed above values.	General Purpose—Low cost standard. If operated upside down (leads coming from the top) characteristics will change. (Mercury to dry electrode contact) Mtg clip 1MR14-A
 AS419A1 *	10° max.	**Resistive:** 30 vac—1.5 amps 115 vac— .5 amp 30 vdc—2.0 amps 115 vdc— .7 amp **Inductive:** Inrush current should not exceed above values.	General Purpose Miniature—Long electrode indicates recommended "up" position. Small mercury fill and small size allow lower operating force than larger switch such as AS417B, AS454A, etc. (Mercury to dry electrode contacts). Mtg. clip 1MR11-F

- SINGLE POLE—SINGLE THROW—MEDIUM DUTY

Catalog Listing	Differential Angle	Electrical Data	Comments
 AS408C6 *	10° max.	**Resistive:** AC:2 amps @ 30v 1 amp @ 115v .5 amp @ 230v DC:1.2 amps @ 30v .6 amp @ 115v .3 amp @ 230v **Inductive:** Inrush current should not exceed above values. 50,000 operations at full load	Platinum wetted electrodes provide low and stable contact resistance from low energy loads to maximum rated loads. If operated upside down (leads coming from the top) characteristics will change. (Mercury to wetted electrode contacts Mtg. clip 1MR14-A
 AS408V0	60° ± 15° Break from vertical (one plane only)		"Tipover" Series. Use as safety switch on portable or mobile equipment. Circuit opens if equipment accidentally tips over. When switch is in vertical position circuit will break within 60° ±15° from vertical in one plane only as shown. Platinum wetted electrodes provide low and stable contact resistance from low energy loads to maximum rated loads. (Mercury to wetted electrode contacts). No lead wires attached Mtg. clip 1MR14-A
 AS412A1 *	.3° to 1.2°	**Resistive:** 1 amp @ 115 vac 0.6 amp @ 115 vdc **Inductive:** @30 vac 1.5 amps steady state 3.5 amps inrush	Low Cost Precision Switch (Mercury to dry electrode contacts) Mtg. clip 1MR14-A
 AS417B2 *	12° max.	**Resistive:** AC:8 amps @ 30v 4.5 amps @ 115v 2.25 amps @ 230v DC:8 amps @ 30v 3 amps @ 115v 1.5 amps @ 230v **Motor Loads:** AC:1/20 hp @ 115v 1/20 hp @ 230v DC:1/40 hp @ 115v 1/40 hp @ 230v	Low Cost Standard—Same as AS408 except molybdenum electrodes added for higher electrical capacity. (Mercury to dry electrode contacts) Mtg. clip 1MR14-A

MERCURY SWITCH

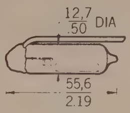
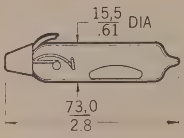
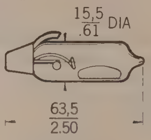
LARGE DIAMETER, HEAVY AND MEDIUM DUTY SWITCHES

ORDERING INFORMATION (Cont.)

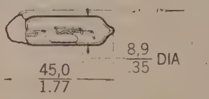
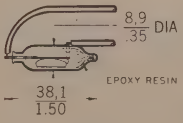
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY. Key: 0,0 – mm / 0.00 – inches

*This catalog listing has 7 inch (178mm) PVC lead wires. Other types and lengths are available. See the Mercury Switch Instruction Manual AS-1.

- SINGLE POLE—SINGLE THROW—HEAVY DUTY

Catalog Listing	Differential Angle	Electrical Data	Comments
 AS431A34 *	1° to 3°	Resistive: AC: 15 amps @ 30v 8 amps @ 115v 4 amps @ 230v DC: 15 amps @ 30v 5 amps @ 115v 2.5 amps @ 230v Motor Loads: AC: 1/8 hp @ 115v & 230v DC: 1/16 hp @ 115v & 230v AC lamp load: 400 watts	Compact size with relatively high electrical capacity. (Mercury to dry electrode contacts) Mtg. clip 2MR4-B
 AS452A41 *	1° to 3°	Resistive: AC: 30 amps @ 30v 20 amps @ 115v 10 amps @ 230v DC: 30 amps @ 30v 12 amps @ 115v 6 amps @ 230v Motor Loads: AC: .5 hp @ 115v .5 hp @ 230v DC: .25 hp @ 115v .25 hp @ 230v AC lamp load: 1000 watts	All switches in these families have the same tube diameter and electrode configuration. Length of tube and mercury fill determine the differential angle. NOTE: AS454A is a high capacity switch at minimum cost. (Mercury to wetted electrode contacts). Mtg. clips 1MR2-B or 1MR7-B
 AS454A89 *	2° to 5°		

- SINGLE POLE—DOUBLE THROW—MEDIUM DUTY

Catalog Listing	Differential Angle	Electrical Data	Comments
 AS604K40 *	.25° to 1.35°	Resistive: 1 amp @ 115 vac 0.6 amp @ 115 vdc Inductive: @ 30 vac Tip—1.5 amp steady state 7.5 amp inrush (75,000 operations) Pinch—1.5 amp steady state 3.5 amp inrush	Low cost single-pole double-throw precision switch. Mercury to dry electrode contacts. Mtg. clips 1MR14-A
 AS613A2	12° max.	Resistive: AC: 2 amps @ 30v 1 amp @ 115v .5 amp @ 230v DC: 1.2 amps @ 30v .6 amp @ 115v .3 amp @ 230v Inductive: inrush current should not exceed above values. 100,000 operations at full load.	Nickel wetted electrodes provide low and stable contact resistance from low energy loads to maximum rated loads. (Mercury to wetted electrode contacts) Listing has 5 inch (127 mm) PVC leads. Mtg. clip 1MR14-A

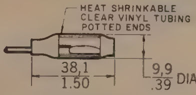
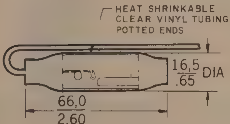
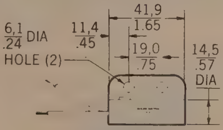
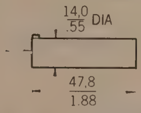
ENCLOSED MERCURY SWITCHES AND MOUNTING CLIPS.

ORDERING INFORMATION (Cont.)

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

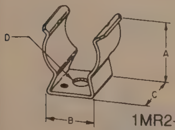
Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

• ENCLOSED SWITCHES

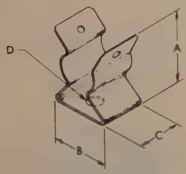
Catalog Listing	Differential Angle	Electrical Data	Comments
 HEAT SHRINKABLE CLEAR VINYL TUBING POTTED ENDS 38,1 / 1.50 9,9 / .39 DIA **AS408D65**	12° max.	**Resistive:** AC: 1.5 amps @ 30v .5 amp @ 115v DC: 2 amps @ 30v .7 amp @ 115v **Inductive:** Inrush current should not exceed above values.	Heat shrinkable clear vinyl tubing over switch. Ends are potted. (Mercury to dry electrode contacts) Listing has 7.75 inch (197mm) PVC leads Mtg. clip 1MR14-A
 HEAT SHRINKABLE CLEAR VINYL TUBING POTTED ENDS 16,5 / .65 DIA 66,0 / 2.60 **AS454A83**	2° to 5°	**Resistive:** AC: 30 amps @ 30v 20 amps @ 115v 10 amps @ 230v DC: 30 amps @ 30v 12 amps @ 115v 6 amps @ 230v **Motor Loads:** AC: .5 hp @ 115v & 230v DC: .25 hp @ 115v & 230v **AC Lamp Load:** 1000 watts	Heat shrinkable clear vinyl tubing over switch. Ends are potted. (Mercury to wetted electrode contacts) Listing has 8 inch (203mm) PVC leads. Mtg clips 1MR2-B or 1MR7-B
 41,9 / 1.65 6,1 / .24 DIA HOLE (2) 11,4 / .45 19,0 / .75 14,5 / .57 DIA **5MP24-6**	12° max.	**Resistive:** AC: 8 amps @ 30v 4.5 amps @ 115v 2.25 amps @ 230v DC: 8 amps @ 30v 3 amps @ 115v 1.5 amps @ 230v **Motor Loads:** AC: 1/20 hp @ 115v & 230v DC: 1/40 hp @ 115v & 230v **AC Lamp Load:** 225 watts	Nylon can with a wrap-around spring steel bracket. Basic switch is AS417B. (Mercury to dry electrode contacts) Close on counterclockwise rotation Listing has 7 inch (178mm) PVC leads
 **7MP1-2**	12° max.		Polypropylene can. The basic switch is AS417B. (Mercury to dry electrode contacts) Listing has 6 inch (152mm) PVC leads. Mtg. clip 2MR4-B

• MOUNTING CLIPS

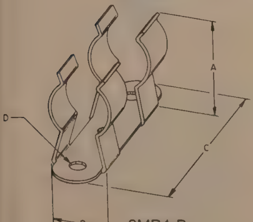
Mounting clips hold the switch securely by spring tension. They are to be ordered separately. When application conditions require, tube movement incident to slipping and tampering can be avoided by running a wire through the holes in the mounting clip, then twisting the wires to lock them. Ambroid or glyptal cement can also be applied to secure the wire and clip to the tube. The recommended mounting clip for each switch is listed in the specifications charts.



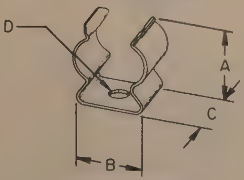
1MR2-B



1MR14-A



2MR4-B



1MR7-B & 1MR11-F

Dimensions for reference only

Catalog Listing	Material	Thickness mm (inches)	Dimensions mm (inches)			
			A	B	C	D
1MR14-A	Phosphor bronze	0,46 .018	14 .550	10,2 .400	7,87 .310	3,23 .127 dia
1MR2-B	Cold rolled steel*	0,71 .028	19,1 .750	10,3 .406	12,7 .500	5,69 .224 dia
1MR7-B	Tempered steel	0,46 .018	18,3 .720	17,5 .688	11,2 .440	3,66 .144 dia.
1MR11-F	Stainless steel	0,25 .010	6,99 .275	5,54 .218	6,35 .250	1,52 .060 dia.
2MR4-B	Cold Rolled steel #	0,64 .025	17,3 .681	11,9 .47	32,7 1.286	4,22 (3) .166 dia.

*Cadmium plated #Zinc plated

MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

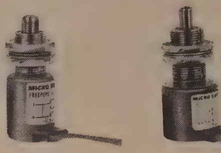
IN THIS SECTION

LIMIT SWITCHES

Type EN

"EN" limit switches offer environment proof versatility. Many combinations of actuators, circuitries, terminals and electrical ratings are offered for military aerospace and commercial aircraft applications. They feature:

- Environment proof sealing
- Meet MIL-S-8805 requirements
- Largest variety of termination
- Wide choice of circuitry
- Up to 4-SPDT circuits
- Up to 15 amp electrical rating@28VDC
- Widest choice of actuators
- Variety of reliable snap action basic switches
- 5/8'' or 15/32'' bushing mounted for easy installation
- Choice of sizes

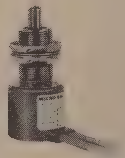


Page J1-J6

Type HE

The "HE" is a hermetically sealed version of the EN switch. Applications will be similar except the HE meets maximum sealing requirements. Features include:

- Hermetically sealed
- Meet MIL-S-8805 requirements
- Withstands up to 250°F temperatures
- Interchangeable with 1EN1 type switch
- 2-SPDT circuits

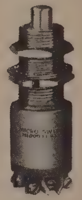


Page J7

Type HR

"HR" switches combine hermetic sealing with high temperature capabilities. Features include:

- Stainless steel construction for corrosion resistance.
- Meet MIL-S-8805 requirements
- Hermetically sealed
- Withstand up to 615°F temperatures
- 5/8'' bushing mounted for easy installation
- Variety of termination
- Choice of actuators



Page J8

OTHER LIMIT SWITCHES

FOR ORDERING INFORMATION REFER TO MICRO SWITCH CATALOG 50

HEAVY DUTY LS

The Heavy Duty LS is the versatile performer for your most demanding applications. They feature:

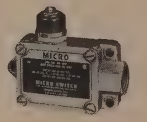
- NEMA 1, 4 and 13 sealing
- UL-CSA listed
- Standard and plug-in versions
- Wide selection of operating levers
- All standard operating head types
- Mounting and tracking interchangeability
- Rugged zinc alloy die cast housing
- Exceeds automotive manufacturers requirements
- Solid state to heavy duty 10 amp. electrical ratings

Type E6/V6

The "E6/V6" type is the most widely used enclosed switch. They feature:

- Momentary or maintained contact
- Sealed or unsealed actuators
- UL-CSA listing
- 10 or 15 amp electrical rating
- Wide selection of actuators
- Side or base mounting
- Readily available replacement parts
- Cast aluminum housing

Type F



Type "F" enclosed switches offer a higher electrical rating in a compact sealed enclosure. Additional features include:

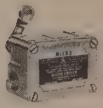
- Momentary or maintained contact
- UL-CSA listing
- 15 or 20 amp electrical rating
- Easy wiring and basic switch replacement
- NEMA 1, 3, 3R, 4 and 13
- Wide selection of actuators
- Cast aluminum housing

Type OP

The "OP" enclosed switches are precision snap-action switches sealed in rugged cast aluminum housings.

- Mounting from 4 sides
- UL-CSA listing
- NEMA 1, 3, 3R, 4 and 13
- Up to 20 amp electrical rating
- Easy wiring and basic switch replacement
- Interchangeable with "EX"

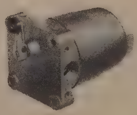
Type EX



The "EX" is a compact explosion proof switch. They are ruggedly constructed to handle high capacity jobs in hazardous locations.

- UL-CSA listing
- Complete interchangeability with "OP"
- Up to 20 amp electrical rating
- Smallest UL listed explosion proof housing
- Many actuator variations
- NEMA 1, 7 and 9

Type CX



"CX" switches are built especially for outdoor use in hazardous locations.

- Mount from four sides and front
- UL-CSA listed
- 15 or 20 amp electrical rating
- Easy wiring and basic switch replacement
- NEMA 1, 3, 3R, 3S, 4, 7, 9 and 13 sealing
- Rugged cast aluminum housing

Type 914CE

The "914CE" are miniature enclosed switches. They are environmentally sealed and have a pre-wired cable.

- 5 amp electrical rating
- Factory pre-wired cable
- Precision operation
- Sealed construction
- Rugged metal housing
- Simple 2 screw mounting

Note: MICRO SWITCH has many complete lines of Industrial Controls, i.e., Limit and Enclosed Switches, Compact Relays, Oiltight Manual Controls, No Touch Controls. Request literature from your nearest MICRO SWITCH Branch Office.

TYPE "EN" ENVIRONMENT PROOF LIMIT SWITCHES J

Type "EN" limit switches are the most versatile line of environment-proof switches available. Many combinations of actuators, circuitry, terminals and electrical ratings are offered to meet the demands of military/aerospace and commercial aircraft applications.

Listings in this section are "standard" size. Miniature and Special Application Requirement designs of the "EN" type construction are described later.

Seal Definition: Environment Proof
Resilient per MIL-S-8805, Class 4

Military Specifications:
MIL-S-8805 (See chart on page J3 for applicable performance requirements.)

Standard Temperature Range: −65° to +185°F (−54 to 85°C). Special listings are available with −65° to −250°F (−54 to 121°C). Even higher temperatures can be withstood for short durations. Contact a MICRO SWITCH Branch Office for specific information.

Electrical Life: 25,000 cycles minimum at rated load. Life will increase with reduced loads.

Mechanical Life: 100,000 operations minimum except for the 400 and 600 series switches which have 50,000 cycles minimum.

Termination
Termination is specified in the ORDER GUIDES. Leadwires are generally provided in 6-foot lengths. Leadwires are of the guage and Military Specifications noted in the ORDER GUIDE. All leadwire ends are solder dipped.

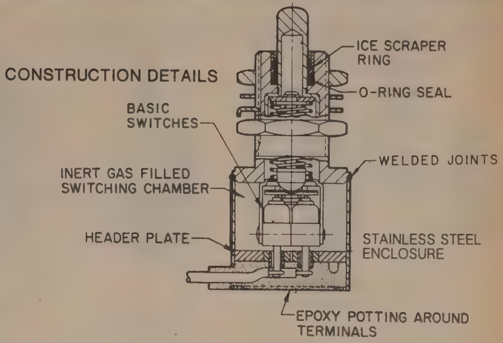
Screw terminal listing 1EN1-S has 4-48 NF x .175 inch roudn head screws with lock washers. Terminals are well isolated by phenolic barriers and epoxy casting resin.

Receptacle termination listings 1EN42-R and 1EN43-R utilize pin receptacles (mating connectors should be ordered separately).

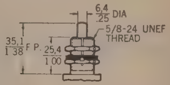
Mounting
Plunger actuator switches mount through ⅝-inch or ¹⁵⁄₃₂-inch diameter holes. Lock washer, keyed washer and wire lock hexagon mounting nuts lock the switches in their mounting. Rotary actuator switches mount through ¹⁵⁄₃₂-inch diameter holes. A lock washer, wire lock hexagon nut and locating pins on the top of th housing prevent switch rotation.

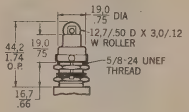
Electrical Ratings (for general application)
Refer to appropriate MIL-specification for ratings applicable to specific switches.

Gold contacts can be provided with ¼ a. ind. and ½ a. res. at 28 VDC electrical rating.


CONSTRUCTION DETAILS
ICE SCRAPER RING
O-RING SEAL
BASIC SWITCHES
WELDED JOINTS
INERT GAS FILLED SWITCHING CHAMBER
HEADER PLATE
STAINLESS STEEL ENCLOSURE
EPOXY POTTING AROUND TERMINALS

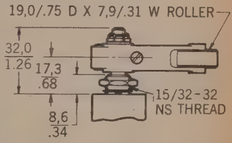
Actuators
PLUNGER—For in-line actuation. An ice scraper ring cleans the actuator with each operation.


6,4 / .25 DIA
5/8-24 UNEF THREAD
35,1 / 1.38 F.P.
25,4 / 1.00

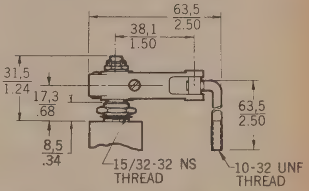

19,0 / .75 DIA
12,7/.50 D X 3,0/.12 W ROLLER
44,2 / 1.74 O.P.
19,0 / .75
5/8-24 UNEF THREAD
16,7 / .66

ROLLER PLUNGER—For cam and slide actuation not to exceed 20° rise. Roller adjusts laterally in 45° increments. An ice scraper ring cleans the actuator with each operation.

ROTARY ROLLER LEVER—For cam and slide actuation with more than a 30° rise. A spring returned mechanism, this actuator is available in clockwise and counterclockwise operation designs. The actuator adjusts laterally to any position through 360°. The roller is laminated phenolic.

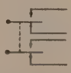

19,0/.75 D X 7,9/.31 W ROLLER
32,0 / 1.26
17,3 / .68
15/32-32 NS THREAD
8,6 / .34

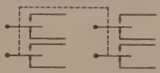
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY
Key: 0,0 − mm / 0.00 − inches

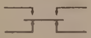

63,5 / 2.50
38,1 / 1.50
31,5 / 1.24
17,3 / .68
8,5 / .34
63,5 / 2.50
15/32-32 NS THREAD
10-32 UNF THREAD

ROTARY LINKAGE LEVER—A threaded rod attaches to the rotary lever for positive actuation. The rotary lever operates in either direction and adjusts laterally to any position through 360°. The threaded rod pivots on two planes. The actuator has no spring return, but is controlled directly by the movement of the actuating device.

Circuitry:


TWO SINGLE-POLE DOUBLE-THROW CIRCUITS


FOUR SINGLE-POLE DOUBLE-THROW CIRCUITS


TWO CIRCUIT DOUBLE BREAK

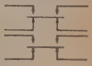

FOUR CIRCUIT DOUBLE BREAK

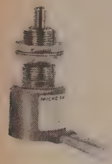
CHART 1

Rating Code	Voltage	Amperage							
		Sea Level				50,000 Feet			
		Inrush	Motor	Res.	Ind.	Inrush	Motor	Res.	Ind.
SM	28DC	24	4	5	3	24	4	4*	2
V3	28DC	36	6	10	6	36	6	10	6
TB	28DC	30	5	15	10	30	5	15	10
	115DC	10	1	1	.5	10	1	1	.5

*5 amps on rotary switches.

Note: For other electrical data, contact your nearest MICRO SWITCH Branch Office.

"EN" SWITCHES STANDARD SIZE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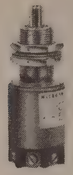
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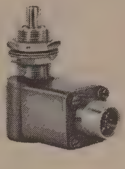
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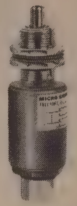
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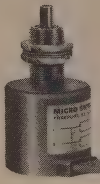
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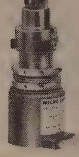
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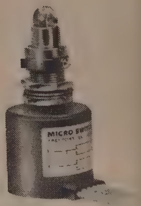
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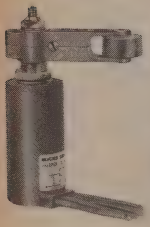
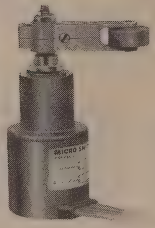

31EN1-6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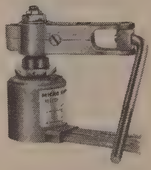
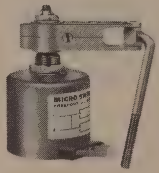

41EN1-6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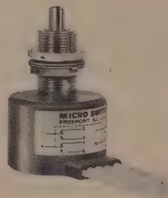
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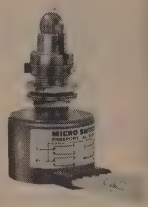

25EN9-6

ORDER GUIDE

Characteristics: O.F.—Operating Force; R.F.—Release Force; P.T.—Pretravel; O.T.—Overtravel; D.T.—Differential Travel;

Circuitry	Actuator	Termination	Elec. Rating Code page J1	Order This Listing	Characteristics					Housing Dimensions*		
					O.F. Kg lbs.	R.F. min. Kg lbs.	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	Height mm inches	Diameter mm inches	Wgt. max. G oz.
Two Single-Pole Double Throw Circuits	Plunger	No. 20 Leadwire (MIL-W-8777)	SM	1EN1-6 (MS24331-1) (8805/40)	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,51 .020	24,9 .980	25,4 1.0	207 7.3
	Plunger	Screw	SM	1EN1-S	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,51 .020	38,2 1.505	25,4 1.0	99 3.5
	Plunger	Side Receptacle	SM	1EN42-R	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,51 .020	26,9 1.06	58,4† 2.3	221 7.8
	Plunger	Bottom Receptacle	SM	1EN43-R	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,51 .020	53,3 2.1	25,4 1.0	204 7.2
	Plunger	No. 18 Leadwire (MIL-W-8777)	V3	2EN1-6 (MS24331-2) (8805/40)	2,7-5,5 6-12	2,3 5	1,27 .050	6,35 .250	0,89 .035	38,1 1.5	38,1 1.5	156 5.5
	Roller Plunger	No. 20 Leadwire (MIL-W-5086)	SM	21EN9-6	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,51 .020	24,9 .980	25,4 1.0	252 8.9
	Roller Plunger	No. 18 Leadwire (MIL-W-5086)	V3	22EN9-6	2,7-5,5 6-12	2,3 5	1,02 .040	6,35 .250	0,76 .030	38,1 1.5	38,1 1.5	383 13.5
	Rotary Roller Lever	No. 20 Leadwire (MIL-W-8777)	SM	31EN11-6. (CW) (MS21320-1) (8805/48) 31EN1-6 (CCW) (MS21320-2)	1,4-2,8 Nm max. 12-25 in. lb.	1,0Nm 9 in. lb.	13°	32°	4° max.	53,6 2.11	25,4 1.0	269 9.5
	Rotary Roller Lever	No. 18 Leadwire (MIL-W-8777)	V3	32EN11-6 (CW) (MS21320-3) (8805/48) 32EN1-6 (CCW) (MS21320-4) (8805/48)	1,4-2,8 Nm max 12-25 in. lb.	1,0Nm 9 in. lb.	20°	25°	6° max.	68,6 2.7	38,1 1.5	368 13
	Rotary Linkage Lever	No. 20 Leadwire (MIL-W-8777)	SM	41EN1-6 (MS24420-1)	,34 Nm max. 3 in. lb.	—	—	—	12° max.	25,4 1	25,4 1.0	213 7.5
	Rotary Linkage Lever	No. 18 Leadwire (MIL-W-8777)	V3	42EN1-6 (MS24420-2) (8805/49)	,57 Nm max. 5 in. lb.	—	—	—	12° max.	42,2 1.66	38,1 1.5	220 7.75
Four Single-Pole Double-Throw Circuits	Plunger	No. 20 Leadwire (MIL-W-5086)	SM	5EN1-6	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,76 .030	30,5 1.2	38,1 1.5	346 12.2
	Roller Plunger	No. 20 Leadwire (MIL-W-5086)	SM	25EN9-6	2,7-5,5 6-12	1,8 4	1,02 .040	6,35 .250	0,76 .030	30,5 1.2	38,1 1.5	360 12.7

*Combine housing diameter and height with actuator dimension for overall size of switch

†This dimension is maximum length rather than housing diameter.

Nm—Newton meters

For information on MIL-S-8805, see "Military Qualifications" in reference section.

"EN" SWITCHES CONT'D STANDARD SIZE

3EN1-6

23EN9-6

33EN1-6

43EN1-6

4EN1-6

24EN9-6

34EN1-6

44EN1-6

ORDER GUIDE

Characteristics: O.F.—Operating Force; R.F.—Release Force; P.T.—Pretravel; O.T.—Overtravel; D.T.—Differential Travel;

Circuitry	Actuator	Termination	Elec. Rating Code page J1	Order This Listing	Characteristics					Housing Dimensions*		
					O.F. Kg lbs.	R.F. min. Kg lbs.	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	Height mm inches	Diameter mm inches	Weight max. g oz.
Two Circuit Double Break	Plunger	No. 18 Leadwire (MIL-W-8777)	TB	3EN1-6 (MS24331-3) (8805/40)	2,7-5,5 6-12	2,3 5	1,52 .060	6,35 .250	0,89 .035	33,3 1,31	38,1 1.5	241 8.5
	Roller Plunger	No. 18 Leadwire (MIL-W-5086)	TB	23EN9-6	2,7-5,5 6-12	2,3 5	1,52 .060	6,35 .250	0,89 .035	33,3 1.31	38,1 1.5	255 9
	Rotary Roller Lever	No. 18 Leadwire (MIL-W-8777)	TB	33EN11-6 (CW) (MS21320-5) (8805/48) 33EN1-6 (CCW) (MS21320-6) (8805/48)	1,4-2,8Nm 12-25 in lb.	.9Nm 8 in lb.	15°	30°	5°	62 2.44	38,1 1.5	269 9.5
	Rotary Linkage Lever	No. 18 Leadwire (MIL-W-8777)	TB	43EN1-6 (MS24420-3) (8805/49)	.1-.37Nm 1-3.25 in. lb.	—	—	—	20°	35,8 1.41	38,1 1.5	252 8.9
Four Circuit Double Break	Plunger	No. 18 Leadwire (MIL-W-8777)	TB	4EN1-6 (MS24331-4) (8805/40)	2,7-5,5 6-12	2,3 5	1,78 .070	6,35 .250	1,14 .045	43,2 1.7	38,1 1.5	368 13
	Roller Plunger	No. 18 Leadwire (MIL-W-5086)	TB	24EN9-6	2,7-5,5 6-12	2,3 5	1,78 .070	6,35 .250	1,14 .045	43,2 1.7	38,1 1.5	368 13
	Rotary Roller Lever	No. 18 Leadwire (MIL-W-8777)	TB	34EN11-6 (CW) (MS21320-7) (8805/48) 34EN1-6 (CCW) (MS21320-8) (8805/48)	1.4-2.8 Nm 12-25 in lb.	.9Nm 8 in. lb.	15°	30°	10°	71,6 2.82	38,1 1.5	439 15.5
	Rotary Linkage Lever	No. 18 Leadwire (MIL-W-8777)	TB	44EN1-6 (MS24420-4) (8805/49)	1.1 Nm max. 10 in lb.	—	—	—	20°	45,7 1.8	38,1 1.5	451 15.9

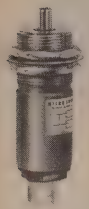
*Combine housing diameter and height with actuator dimensions for overall size of switch.
Nm = Newton meters

CHART II
MIL-S-8805 PERFORMANCE APPROVED SWITCHES

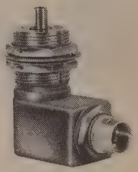
Catalog Listing	Procurement Part No.	Terminal Strength Kg. (Lbs.)	Strength of Actuating Means Kg. (Lbs.)	Strength of Mounting Bushing Nm (In. Lbs.)	Vibration	Shock	Moisture Resistance	Salt Spray	Explosion	Accelera-tion	Seal Resilient (Design 4)
1EN1-6 2EN1-6 3EN1-6 4EN1-6	MS24331-1 MS24331-2 MS24331-3 MS24331-4	6,8 15	13,6 30	1,7 15	10-58 Hz at .060 in. (1,52 mm) D.A. 58-500 Hz at 10g	100g .006 sec. pulse sawtooth	x	x	x	N/A	x
31EN11-6 31EN1-6 32EN11-6 32EN1-6 33EN11-6 33EN1-6 34EN11-6 34EN1-6	MS21320-1 MS21320-2 MS21320-3 MS21320-4 MS21320-5 MS21320-6 MS21320-7 MS21320-8	6,8 15	4,5 10	1,7 15	10-58 Hz at .060 in. (1,52mm) D.A. 58-500 Hz at 10g	100g .006 sec. pulse sawtooth	x	x	x	N/A	x
41EN1-6 42EN1-6 43EN1-6 44EN1-6	MS24420-1 MS24420-2 MS24420-3 MS24420-4	6,8 15	N/A N/A	1,7 15	10-58 HZ at .060 in. (1,52mm) D.A. 58-500 Hz at 10g	100g .006 sec. pulse sawtooth	x	x	x	N/A	x
1EN75-R3M8805/65-001		N/A	4,5 10	1,7 15	10-72 Hz at .060 in. (1,52mm) D.A. 72-2000 Hz at 15g	High impact type "H"	x	x	x	20g	x

D.A. = double amplitude or displacement N/A = not applicable X = applicable test

"EN" SWITCHES SPECIAL REQUIREMENTS



1EN75-R



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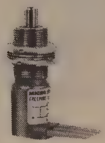


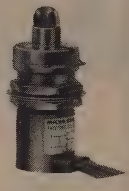
1EN51-6
1EN231-6

1EN61-6

(1EN194-S is similar in appearance but has screw terminals)

1EN75-R3

21EN75-R1



21EN75-2

ORDER GUIDE

Characteristics: O.F.—Operating Force; R.F.—Release Force; P.T.—Pretravel; O.T.—Overtravel; D.T.—Differential Travel;

						Characteristics					
Special Requirement	Actuator	Termination	Circuitry	Elec. Rating Code* Page J1	Order This Listing	O.F. Kg lbs.	R.F. min. Kg lbs.	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	Weight g oz.
HIGH IMPACT ACTUATION	Plunger	No. 20 Leadwire (MIL-W-7139)	(2)SPDT	SM	1EN231-6	2.7-5.5 6-12	1.8 4	1,02 .040	5,84 .230	0,51 .020	207 7.3
LOW FORCE OPERATION	Plunger	No. 20 Leadwire (MIL-W-5086)	(2)SPDT	SM	1EN51-6	1.4-2.7 3-6	.9 2	1,02 .040	6,35 .250	0,51 .020	213 7.5
INCREASED OVERTRAVEL	Plunger	No. 20 Leadwire (MIL-W-5086)	(2)SPDT	SM	1EN61-6	2.7-5.5 6-12	1.8 4	1,02 .040	12,7 .500	0,51 .020	227 8
INCREASED OVERTRAVEL	Plunger	Screw	(2)SPDT	SM	1EN194-S	2.7-5.5 6-12	1.8 4	0,38-1,02 .015-.040	22,9 .900	0,51 .020	113 4
HIGH SHOCK	Plunger	Bottom Receptacle	(2)SPDT	SM	1EN75-R	2.7-5.5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	198 7
HIGH SHOCK	Plunger	Side Receptacle	(2)SPDT	SM	1EN76-R	2.7-5.5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	227 8
HIGH SHOCK	Plunger	Bottom Receptacle	(2)SPDT	SM	1EN75-R3 (M8805/65-001)	2.7-5.5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	198 7
HIGH SHOCK	Roller Plunger	Bottom Receptacle	(2)SPDT	SM	21EN75-R1	2.7-5.5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	204 7.2
HIGH SHOCK	Roller Plunger	No. 20 Leadwire (MIL-W-8777)	(2)SPDT	SM	21EN75-2	2.7-5.5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	207 7.3

The above switches are just a few of the designs which have been developed to meet special application requirements. If you have similar or different special requirements, contact MICRO SWITCH for the right switch to meet them.

HIGH IMPACT SHOCK

Catalog listing 1EN75-R3 (M8805/65-001) has been qualified to MIL-S-8805, including High Impact Shock class H. Other switches rated for High Impact Shock applications incorporate the same plunger mechanism and internal switch design as used in the 1EN75-R3 and are expected to conform to the same requirements.

The terminations of these listings are as follows:

1EN75-R	Deutch Receptacle	DM-9601-7P-1D
1EN75-R3	Cannon Receptacle	GS02-165-1P-003
1EN76-R	Deutch Receptacle	DM-9705-7S-1
21EN75-R1	Cannon Receptacle	GS02-16S-1P-003
21EN75-2	Two Foot Lead Wire	MIL-W-8777,20 gauge

Other EN switches are capable of withstanding the effects of High Impact Shock, depending on the individual requirements of a given application. For further information, contact your nearest MICRO SWITCH Branch Office.

HIGH VELOCITY ACTUATION—This switch is designed to withstand near "hammer-blow" actuation as is found in over-center locking mechanisms. It is dimensionally interchangeable with standard size listing 1EN1-6.

LOW FORCE OPERATION — Special spring construction within this switch reduces the normal 6-12 pound (2.7-5.5Kg) "EN" operating force to 3-6 pounds. (1.4-2.7Kg) This switch is also dimensionally interchangeable with the standard size listing 1EN1-6.

Low force 600 Series EN's have 2 to 4 pounds (.9 to 1.8Kg) of operating force

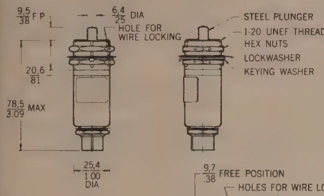
INCREASED OVERTRAVEL — A longer plunger and bushing on this switch extends the "EN" overtravel capabilities from the normal .250 inch to .900 inch (6,35 to 22,9mm). The longer bushing also permits additional adjustment of the plunger position.

“EN” SWITCHES SPECIAL REQUIREMENTS J

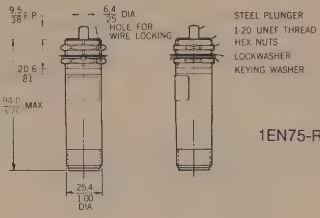
DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: $\frac{0,0 - \text{mm}}{0.00 - \text{inches}}$

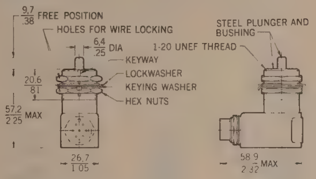
DIMENSIONS


9,5
.38 F P
6,4
.25 DIA
HOLE FOR
WIRE LOCKING
STEEL PLUNGER
1-20 UNEF THREAD
HEX NUTS
LOCKWASHER
KEYING WASHER
20,6
.81
78,5
3.09 MAX
25,4
1.00
DIA

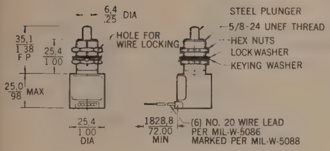
1EN75-R


9,5
.38 F P
6,4
.25 DIA
HOLE FOR
WIRE LOCKING
STEEL PLUNGER
1-20 UNEF THREAD
HEX NUTS
LOCKWASHER
KEYING WASHER
20,6
.81
94,0
3.70 MAX
25,4
1.00
DIA

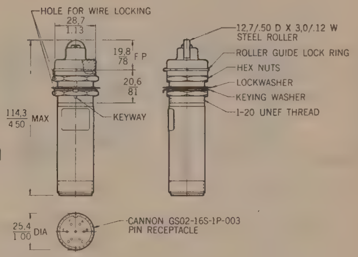
1EN75-R3


9,7
.38 FREE POSITION
HOLES FOR WIRE LOCKING
6,4
.25 DIA
1-20 UNEF THREAD
STEEL PLUNGER AND
BUSHING
KEYWAY
LOCKWASHER
KEYING WASHER
HEX NUTS
20,6
.81
57,2
2.25 MAX
26,7
1.05
58,9
2.32 MAX

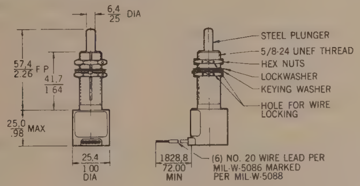
1EN76-R


6,4
.25 DIA
35,1
1.38
F P
25,4
1.00
HOLE FOR
WIRE LOCKING
STEEL PLUNGER
5/8-24 UNEF THREAD
HEX NUTS
LOCKWASHER
KEYING WASHER
25,0
.98 MAX
25,4
1.00
DIA
1828,8
72.00
MIN
(6) NO. 20 WIRE LEAD
PER MIL-W-5086
MARKED PER MIL-W-5088

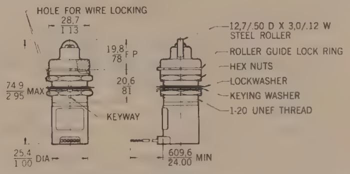
1EN51-6
1EN231-6


HOLE FOR WIRE LOCKING
28,7
1.13
19,8
.78 F P
20,6
.81
114,3
4.50 MAX
KEYWAY
12,7/.50 D X 3,0/.12 W
STEEL ROLLER
ROLLER GUIDE LOCK RING
HEX NUTS
LOCKWASHER
KEYING WASHER
1-20 UNEF THREAD
25,4
1.00 DIA
CANNON GS02-16S-1P-003
PIN RECEPTACLE

21EN75-R1


6,4
.25 DIA
57,4
2.26 F P
41,7
1.64
25,0
.98 MAX
25,4
1.00
DIA
STEEL PLUNGER
5/8-24 UNEF THREAD
HEX NUTS
LOCKWASHER
KEYING WASHER
HOLE FOR WIRE
LOCKING
1828,8
72.00
MIN
(6) NO. 20 WIRE LEAD PER
MIL-W-5086 MARKED
PER MIL-W-5088

1EN61-6


HOLE FOR WIRE LOCKING
28,7
1.13
19,8
.78 F P
20,6
.81
74,9
2.95 MAX
KEYWAY
12,7/.50 D X 3,0/.12 W
STEEL ROLLER
ROLLER GUIDE LOCK RING
HEX NUTS
LOCKWASHER
KEYING WASHER
1-20 UNEF THREAD
25,4
1.00 DIA
609,6
24.00 MIN

21EN75-2
1EN194-S

“EN” SWITCHES
MINIATURE TYPE

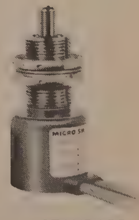
Miniature Type “EN” switches meet the increasing demands for smaller size and lighter weight without sacrificing switch performance or electrical capacity. These types are of the same construction, seal and materials as the standard size “EN” switches described on page J1.

TYPE “400EN” — These switches are directly interchangeable with their standard size “EN” counterpart, yet are smaller in diameter and lighter weight. For example, miniature listing 402EN1-6 has the same circuitry, mechanical characteristics (including actuator free position), leadwire type and length, and bushing diameter as standard listing 1EN1-6 (see ORDER GUIDE, Page J2). The miniature listing housing is .312-inch (7,92mm) smaller in diameter and the switch weighs 1/2-ounce (14,2 g) less.

TYPE “600EN” — These switches offer even greater reductions in size and weight, as indicated by the “600EN” equivalent to the standard listing 1EN1-6. Listing 602EN1-6 is nearly 1/2 inch (12,7mm) shorter, has a .156 (3,96mm) inch smaller diameter bushing, a .312-inch (7,92 mm) smaller diameter housing, and weighs 1.1 ounce (31,2g) less.

The 602EN600 series has a .469 inch (11.9mm) bushing a small .125 inch diameter plunger, 2 to 4 pounds (.9-1.8Kg) operating force and .250 in. (6,35mm) overtravel.

MINIATURE



STANDARD

Seal Definition: Environment-Proof
Resilient per MIL-S-8805, Class 4

Military Specifications:
MIL-S-8805 (See chart on page J6 for applicable performance requirements.)

Temperature Range: —65°F to +185°F (—54 to 85°C)

Electrical Ratings:
(MIL-S-8805 ratings apply when this specification is invoked.)

VOLTAGE	AMPERAGE							
	Sea Level				50,000 ft.			
	In-rush	Motor	Res.	Ind.	In-rush	Motor	Res.	Ind.
28 DC	24	4	7	4	24	4	7	2.5

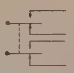
NOTE: Contact your nearest MICRO SWITCH Branch Office for assistance regarding 400Hz and 60Hz applications.

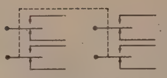
MICRO SWITCH

A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

"EN" SWITCHES MINIATURE TYPE

Circuitry:

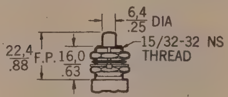

TWO-SINGLE-POLE DOUBLE-THROW CIRCUITS


FOUR SINGLE-POLE DOUBLE-THROW CIRCUITS

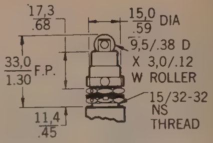
Termination

All miniature "EN" limit switches shown in this section have 6-foot (1,3m) lengths of No. 20 lead wire per MIL-W-8777, marked per MIL-W-5088. For variations, contact MICRO SWITCH.

"600EN" ACTUATOR DIMENSIONS



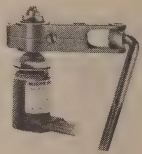
PLUNGER



ROLLER PLUNGER

"400EN" Plunger and Rotary Linkage Lever actuator dimensions are the same as those shown for standard size "EN" switches.

402EN1-6


442EN1-6

444EN1-6

404EN1-6

602EN1-6

622EN1-6

604EN1-6

602EN602-6

ORDER GUIDE

Characteristics: O.F.—Operating Force; R.F.—Release Force; P.T.—Pretravel; O.T.—Overtravel; D.T.—Differential Travel;

			Characteristics					Housing Diomensions*		
Circuitry	Actuator	Order This Listing	O.F. Kg lbs.	R.F. min. Kg lbs.	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	Height mm inches	Diameter mm inches	Weight g oz.
"400EN" Two Single-Pole Double-Throw Circuits	Plunger	402EN1-6 (MS21321-1) (8805/39)	2,7-5,5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	24,9 .980	17,5 .688	204 7.2
	Rotary Linkage Lever	442EN1-6	.34 Nm max. 3 in. lbs.	—	—	—	12°	25,4 1.0	17,5 .688	207 7.3
Four Single-Pole Double-Throw Circuits	Plunger	404EN1-6 (MS21321-2) (8805/39)	2,7-5,5 6-12	1.8 4	1,02 .040	6,35 .250	0,51 .020	30,5 1.2	25,4 1.0	354 12.5
	Rotary Linkage Lever	444EN1-6	.34 Nm max. 3 in. lbs.	—	—	—	12°	30,2 1.19	25,4 1.0	340 12
"600EN" Two SPDT Circuits	Plunger Roller Plunger	602EN1-6 (MS27240-1) (8805/43) 622EN1-6 (MS27240-3) (8805/43)	2,7-5,5 6-12	1.8 4	1,02 .040	3,18 .125	0,51 .020	25,4 1.0	17,5 .688	176 6.2 204 7.2
Four SPDT Circuits	Plunger	604EN1-6 (MS27240-2) (8805/43) 624EN11-6 (MS27240-4) (8805/43)	2,7-5,5 6-12	1.8 4	1,02 .040	3,18 .125	0,51 :020	30,5 1.2	25,4 1.0	354 12.5
"602EN600" Two SPDT Circuits	.125 Dia. Plunger	602EN602-6	.9-1.8 2-4	.45 1	0,38 .015	6,35 .250	0,51 .020	25,4 1.0	17,5 .688	170 6.0

*Combine housing diameter and height with actuator dimensions for overall size of switch.
Nm—Newton meters

CHART III
MIL-S-8805 PERFORMANCE APPROVED SWITCHES

Catalog Listing	Procurement Part No.	Terminal Strength Kg (Lbs.)	Strength of Actuating Means (Lbs.)	Strength of Mounting Bushing Nm (In. Lbs.)	Vibration	Shock	Moisture Resistance	Salt Spray	Explosion	Accelera-tion	Seal Resilient (Design 4)
402EN1-6 404EN1-6	MS21321-1 MS21321-2	6.8 15	13.6 30	1.7 15	10-72 Hz at .060 in. (1,52mn) D.A. 72-2000 Hz at 15g	100g .006 sec. pulse sawtooth	x	x	x	N/A	x
602EN1-6 604EN1-6 622EN1-6 624EN1-6	MS27240-1 MS27240-2 MS27240-3 MS27240-4	6.8 15	4.5 10	1.7 15	10-72 Hz at .060 in (1,52mm) D.A. 72-2000 Hz at 15g	100g .006 sec. pulse sawtooth	x	x	x	N/A	x

D.A. = double amplitude or displacement   N/A = not applicable   X = applicable test

TYPE "HE" HERMETICALLY SEALED LIMIT SWITCH

True hermetic sealing with metal-to-metal, glass-to-metal construction assures maximum seal effectiveness for exceptionally long periods of time despite continuous changes in atmospheric pressures and temperatures.

Listing 1HE1-6 is directly interchangeable with the 1EN1-6 (MS24331-1) environment-proof switches and has the same operating characteristics, physical dimensions and electrical capacity. This switch features corrosion resistance, small size, one-hole wire-lock mounting, and MIL-W-8777 leadwire.

Modifications: Other leadwire types and lengths are available. Receptacle termination is also possible.

Most EN type actuators can be provided on HE switches. Contact your local MICRO SWITCH Branch Office for details.

Sealing Definitions: Hermetic sealing per MIL-S-8805, Hermetic Design 5.

Military Specification: MIL-S-8805/80
Catalog Listing 1HE1-6 (M8805/80-01)

Vibration: 10 to 72Hz at .060 in. (1.52mm) D.A.
72 to 2000 Hz at 20 g

Shock: 200 g, .007 sec., half sine pulse.

Strength of Actuating Means: 250 lbs. (113.4 kg)

Strength of Mounting Means: 400 in/lbs. (45.2 Nm)

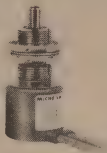
Also meets sand and dust, explosion, icing. minimum current and moisture resistance requirements.

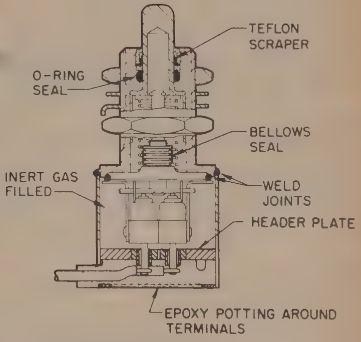
Temperature Range: -65° F to +250° F. (-54 to 121°C)

Weight: 7.3 oz. (207g) max. (including 6 ft. (1,83m) leadwires)

Mechanical Life: 100,000 operations minimum

CONSTRUCTION DETAILS



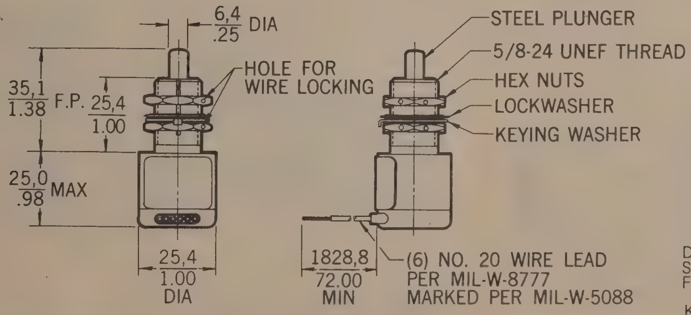

TEFLON SCRAPER
O-RING SEAL
BELLOWS SEAL
INERT GAS FILLED
WELD JOINTS
HEADER PLATE
EPOXY POTTING AROUND TERMINALS

Electrical Rating: 28 vdc, 5 amp. res., 3 amp. ind., 4 amp motor load; sea level to 100,000 ft. (M8805/80-01 ratings apply when MIL-S-8805 is invoked.)

Circuitry: Two single-pole double-throw

Electrical Life: 25,000 operations at rated load.

MOUNTING DIMENSIONS


6,4 / .25 DIA
HOLE FOR WIRE LOCKING
35,1 / 1.38
F.P. 25,4 / 1.00
25,0 / .98 MAX
25,4 / 1.00 DIA
STEEL PLUNGER
5/8-24 UNEF THREAD
HEX NUTS
LOCKWASHER
KEYING WASHER
1828,8 / 72.00 MIN
(6) NO. 20 WIRE LEAD PER MIL-W-8777 MARKED PER MIL-W-5088

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

ORDER GUIDE

Characteristics: O.F.—Operating Force; R.F.—Release Force; P.T.—Pretravel; O.T.—Overtravel; D.T.—Differential Travel:

Actuator	Order This Listing	O.F. min. Kg. lbs.	R.F. min. Kg. lbs.	P.T. max. m.m. in.	O.T. min. m.m. in.	D.T. max. m.m. in.
Plunger	IHE1-6	2.7-5.5	1.8	1.02	6.35	0.51
	(M8805/80-01)	6-12	4	.040	.250	.020

TYPE "HR" HIGH TEMPERATURE HERMETICALLY SEALED SWITCHES

"HR" switches combine maximum sealing, high (615°F, 324°C) temperature capabilities and rugged, heavy duty, corrosion-resistant construction to provide reliable switching in the most demanding applications.

Seal Definition: Hermetic per MIL-S-8805, Class 5

Military Specifications: MIL-S-8805/41
Catalog Listing 12HRI-S (MS24594-1)

Terminal Strength: 15 lbs. (6,8 Kg)

Strength of Actuating Means: 35 lbs. (15,9 Kg)

Strength of Mounting Bushing: 15 in./lbs. (1,7 Nm)

Vibration: 10-58 Hz at .060 in (1,52 mm) D.A.
58-500 Hz at 10 g's.

Shock: 100 g, .006 sec. sawtooth pulse.
Also meets moisture resistance, explosion and salt spray requirements.

Temperature Range: —65°F to +615°F (—54 to 324°C)

Modifications: Receptacle termination is available. Temperature rating may be lowered because of receptacle limitations.

Electrical Rating:
MS24594-1 ratings apply when MIL-S-8805/41 is invoked.

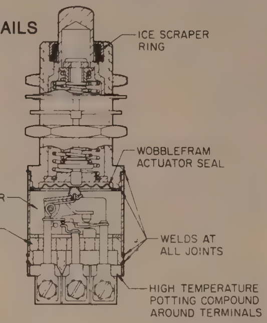
VOLTAGE	AMPERAGE Ind.	AMPERAGE Res.
28 DC	2	5
115 AC (60 cps)	1	1

Mounting

Plunger actuator switches bushing mount through ¾ inch (19,1 mm) diameter holes. Lock washer, keying washer and wire lock hexagon mounting nuts lock the switches in their mounting.

Rotary actuator switches mount through 15/32 inch (11,9 mm) diameter holes. A lock washer, wire lock hexagon nut and locating pins on the top of the housing prevent switch rotation.

CONSTRUCTION DETAILS


ICE SCRAPER RING
WOBBLEFRAM ACTUATOR SEAL
INERT GAS FILLED SWITCHING CHAMBER
HEADER PLATE
WELDS AT ALL JOINTS
HIGH TEMPERATURE POTTING COMPOUND AROUND TERMINALS

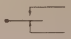
Actuators

PLUNGER — For in-line actuation. An ice scraper ring cleans the actuator with each operation. Material: stainless steel.

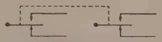
ROLLER PLUNGER — For cam and slide actuation not to exceed 20° rise. Roller adjusts laterally in 45° increments. An ice scraper ring cleans the actuator with each operation. Material: stainless steel

ROTARY LINKAGE LEVER — Threaded rod attaches to the actuating device for positive actuation. It operates in either direction and adjusts laterally to any position through 360°. Rod pivots on two planes. The actuator has no spring return, but is controlled directly by the movement of the actuating device.

Circuitry:



ONE SINGLE-POLE DOUBLE-THROW CIRCUIT



TWO SINGLE-POLE DOUBLE-THROW CIRCUITS

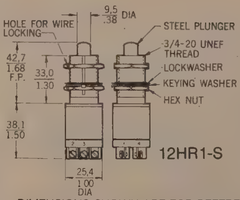
12HR1-S

22HR1-S

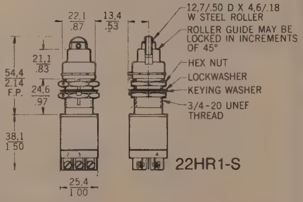
41HR1-S

12HR8-6

Dimensions


HOLE FOR WIRE LOCKING
9,5 / .38 DIA
STEEL PLUNGER
3/4-20 UNEF THREAD
LOCKWASHER
KEYING WASHER
HEX NUT
42,7 / 1.68 F.P.
33,0 / 1.30
38,1 / 1.50
25,4 / 1.00 DIA

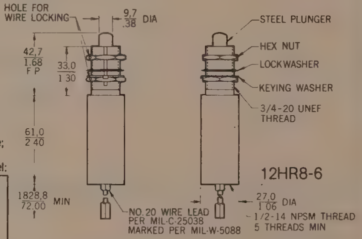
12HR1-S


22,1 / .87
13,4 / .53
12,7/.50 D X 4,6/.18 W STEEL ROLLER
ROLLER GUIDE MAY BE LOCKED IN INCREMENTS OF 45°
HEX NUT
LOCKWASHER
KEYING WASHER
3/4-20 UNEF THREAD
54,4 / 2.14 F.P.
21,1 / .83
24,6 / .97
38,1 / 1.50
25,4 / 1.00

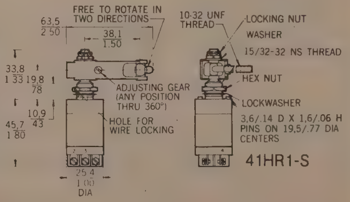
22HR1-S

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches


HOLE FOR WIRE LOCKING
9,7 / .38 DIA
STEEL PLUNGER
HEX NUT
LOCKWASHER
KEYING WASHER
3/4-20 UNEF THREAD
42,7 / 1.68 F P
33,0 / 1.30
61,0 / 2.40
1828,8 / 72.00 MIN
NO. 20 WIRE LEAD PER MIL-C-25038 MARKED PER MIL-W-5088
27,0 / 1.06 DIA
1/2-14 NPSM THREAD 5 THREADS MIN

12HR8-6


FREE TO ROTATE IN TWO DIRECTIONS
63,5 / 2.50
38,1 / 1.50
10-32 UNF THREAD
LOCKING NUT
WASHER
15/32-32 NS THREAD
HEX NUT
LOCKWASHER
3,6/.14 D X 1,6/.06 H PINS ON 19,5/.77 DIA CENTERS
33,8 / 1.33
19,8 / .78
10,9 / .43
45,7 / 1.80
ADJUSTING GEAR (ANY POSITION THRU 360°)
HOLE FOR WIRE LOCKING
25,4 / 1.00 DIA

41HR1-S

ORDER GUIDE

Characteristics: O.F.—Operating Force; R.F.—Release Force; P.T.—Pretravel; O.T.—Overtravel; D.T.—Differential Travel:

Actuator	Circuitry	Terminals*	Order This Listing	O.F. Kg. lbs.	Characteristics R.F. min. Kg. lbs.	P.T. max. mm inches	O.T. min. mm inches	D.T. max. mm inches	Weight g Oz.
Plunger	(2)SPDT	Screw	12HR1-S (MS24594-1)	2,7-5,5	2,3	1,27	6,35	0,38	127 4.5
	SPDT	Leadwire	12HR8-6						284 10
Roller Plunger	(2)SPDT	Screw	22HR1-S	6-12	5	.050	.250	.015	142 5
Rotary Linkage Lever	(2)SPDT	Screw	41HR1-S	3,39 Nm max. 30 in oz.	—	—	—	10°	142 5

*Screw terminals are 4-48 NF x .188" screw with sems washers. Leadwire terminals are 6 ft. (1,83m) No. 20 wire lead per MIL-C-25038. Leadwire listing also has ½-14 NPSM internally threaded conduit hub at base.

NO-TOUCH DEVICES K

These controls are actuated without physical contact and can often satisfy switching needs where electromechanical switches are difficult to apply.

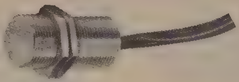
No-touch controls perform as limit switches, positioning devices, speed controls, counters, inspection tools, and in many other functions. The static design of these controls prevents them from wearing out mechanically—either from constant use, or from detecting rough or abrasive parts or materials. No-touch controls can detect small, lightweight parts without detaining them; delicate, painted, or polished surfaces without marring them. They can detect irregularly shaped objects, and respond to objects regardless of their direction of entry into the sensing field.

SOLID STATE NO TOUCH CONTROLS

FW

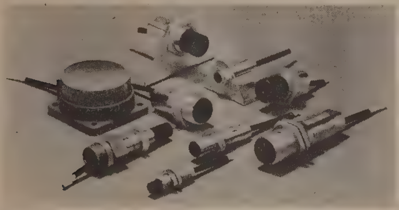
FW Series solid state proximity switches have the sensing element and switching electronics sealed in a single compact unit for highly reliable, long life, no touch switching. See pages K2 and K3 for complete details.

SR



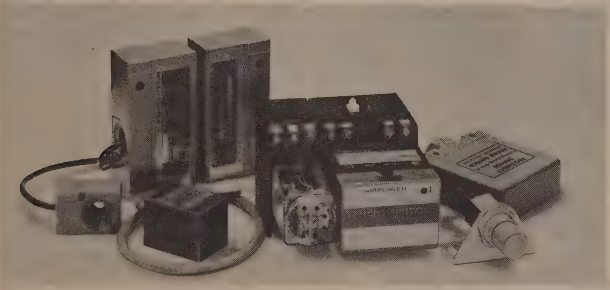
103SR Series Hall effect switches feature a threaded aluminum bushing for ease of mounting. The output can be digital or analog (linear). They are available for use with either a 5VDC or a 6 to 16 VDC power supply. For complete information ask for Product Sheet SR.

FY



Types FY and 50FY self contained proximity switches provide solid state reliability and speed in a rugged, versatile industrial pacakge. They incorporate all the benefits of no-touch switching in a simple, economical control for industry. For complete information ask for Product Brochure FY.

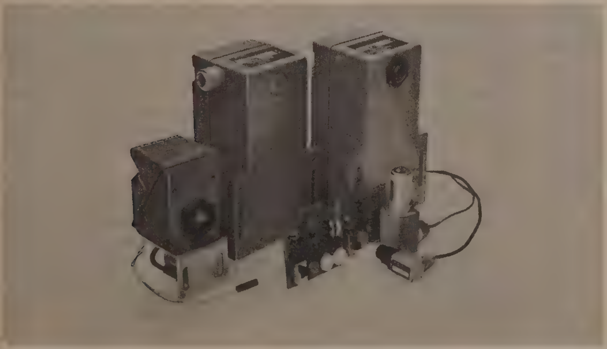
OTHER NO TOUCH CONTROLS



PROXIMITY CONTROLS

Proximity controls respond to the nearness of metal only, and detect through non-metallic materials. MICRO SWITCH offers the most complete line of proximity controls in the industyr.

For further information ask for Catalog NTC.



PHOTOELECTRIC CONTROLS

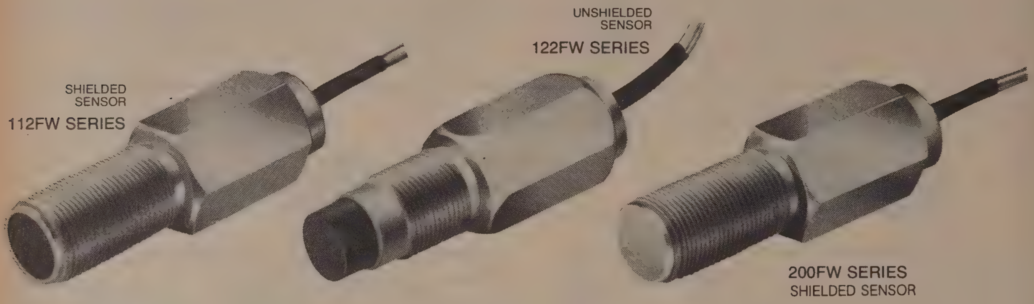
Photoelectric controls respond to opaque or translucent materials including metal, at distances to 250 feet.

The versatility and depth of our photoelectric controls provide you with the broadest selection available. These are contemporary to complement the progressive solid state control trend; or traditional to satisfy established design patterns.

Ask for Catalog NTC for complete information.

MICRO SWITCH A DIVISION OF HONEYWELL
FREEPORT, ILLINOIS 61032/ PHONE 815-232-1122

FW SERIES MINIATURE SELF CONTAINED PROXIMITY CONTROLS



- Compact, Lightweight Design
- Solid State Reliability
- Protection Against Effects of Transients—MIL-STD-704
- Load Short Protection
- No Contact Bounce-Enables Direct Interface with Logic Devices
- Environment Sealed
- Bushing Mounting (5/8" Dia.)
- Leadwire or Connector Termination
- 18 to 32 VDC Supply Voltages
- Variety of Output Circuitries

FW Series solid state proximity switches have the sensing elements and associated electronics incorporated into an integral assembly. They provide high reliability and long life in severe operating environments. Switch actuation takes place without physical contact between the sensor and the metal actuator. The switching function is performed without moving parts. In addition to solid state reliability, this design offers: (1) Sensor and switch enclosed within a metal housing to ensure excellent sealing and physical protection; (2) housing has thick walls which provide effective shielding and help protect the device from changes in operating point when mounted on aluminum, steel, and other aircraft materials. High reliability switching is provided over a long operating life, under severe operating conditions.

Series FW interfaces directly with most electronic circuits: discrete transistor circuits, integrated logic circuits, SCR's, etc. The output level eliminates the need for amplifiers in most applications, resulting in lower installation costs.

100FW SERIES

Series 100FW proximity switches utilize the eddy current principle. They are actuated by metal objects without physical contact.

Unshielded Sensor. Switches with an unshielded sensor have a longer operating point than the shielded design. 100FW series switches detect all metals and are especially sensitive to ferrous types. Shielded sensors should be considered when there is adjacent metallic material.

Shielded Sensor. Switches with a shielded sensor have the housing extended flush to the sensing face, thus shielding the sensor from the effect of metallic material that might be located near the sides of the switch. The shielded sensor has a shorter operating point.

200FW SERIES

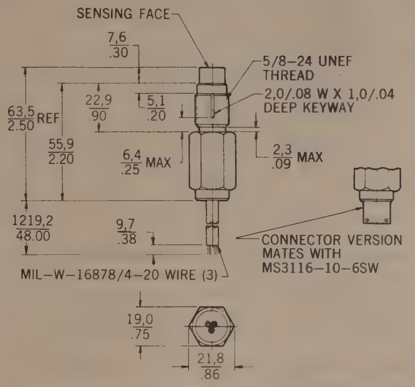
Series 200FW proximity switches are operated by the magnetic field of a permanent magnet or electromagnet. The switching element is a Hall sensor with a digital output.

Sensor design. The sensor is completely shielded with an all-metal face which provides physical and environmental protection to the switch. Since the 200FW is not affected by surrounding non-ferrous metals, the sensor can be used in applications that require detection of movement through a non-ferrous wall.

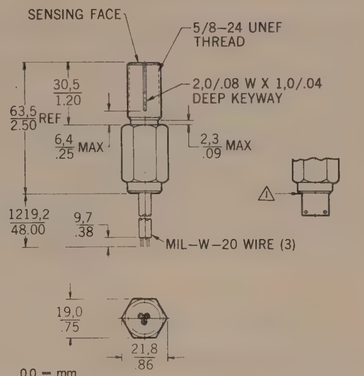
MICRO SWITCH offers a wide array of other options in the most complete line of proximity switches available from a single source—backed up by over 40 years of switch design experience. Contact the nearest MICRO SWITCH Branch Office for further information on ferromagnetic-metals sensing and all-metals sensing proximity switches.

SERIES FW MINIATURE SELF CONTAINED PROXIMITY CONTROLS

122 FW SERIES
UNSHIELDED SENSOR


SENSING FACE
7,6 / .30
5/8–24 UNEF THREAD
2,0/.08 W X 1,0/.04 DEEP KEYWAY
63,5 / 2.50 REF
22,9 / .90
5,1 / .20
55,9 / 2.20
6,4 / .25 MAX
2,3 / .09 MAX
1219,2 / 48.00
9,7 / .38
CONNECTOR VERSION MATES WITH MS3116–10–6SW
MIL–W–16878/4–20 WIRE (3)
19,0 / .75
21,8 / .86

112FW and 200FW SERIES
SHIELDED SENSOR


SENSING FACE
5/8–24 UNEF THREAD
2,0/.08 W X 1,0/.04 DEEP KEYWAY
30,5 / 1.20
63,5 / 2.50 REF
6,4 / .25 MAX
2,3 / .09 MAX
△
1219,2 / 48.00
9,7 / .38
MIL–W–20 WIRE (3)
19,0 / .75
21,8 / .86

DIMENSIONS SHOWN ARE FOR REFERENCE ONLY

Key: 0,0 — mm / 0.00 — inches

△ 112FW CONNECTOR VERSION MATES WITH MS3116-10-6SW
200FW CONNECTOR VERSION MATES WITH MS3116-8-4S

FW SELECTION GUIDE

Input		Output			Sensing Range		Catalog Listing	Termination	Circuitry	Temperature Range
Voltage	Current	Type	Current	Voltage	Shielded	Unshielded				
18 to 32 VDC	20 mA max.	Sinking	120 mA max. Res. or Ind.	1.0 VDC max. Actuated	2.41 min.* .095 in.		112WF12-R1	Conn.	SPNO	−65°F −54°C to +185°F +85°C
							112FW12-4	Wire		
			50 mA max. Lamp	32 VDC max. Deactuated		5,84 mm* .230 in.	122FW12-R1	Conn.		
							122FW12-4	Wire		
			100 mA max. Res. or Ind.	32 VDC max. Actuated 0.4 VDC max. Deactuated	350 gauss max. required to operate 30 gauss min. required to release (see below)		211FW10-R	Conn.	SPNC	−65°F −54°C to +212°F +100C
							211FW10-4	Wire		
			50 mA max. Lamp	0.4 VDC max. Actuated 32 VDC max. Deactuated			212FW10-R	Conn.	SPNO	
							212FW10-4	Wire		

*With standard actuator 15,875 dia. x 1,585 thick (.625 dia. x .062 thick) SAE 1020 steel.

MTBF (mean time between failure) of 100 FW and 200 FW Series products is 100,000+ hours.

CIRCUIT PROTECTION 100 AND 200 FW SERIES
- False Pulse
- Reverse Voltage
- 400 Hz Interference
- Transient Voltage (MIL-STD-704)
- Load Short (100 FW series only)

Additional FW listings are available, i.e., sourcing output, SPNC circuitry, leadwire. The nearest MICRO SWITCH Branch Office will be happy to assist you. Competent field engineers, experienced in applying solid state switches, can assist in selecting the proper device for your application.

200FW SENSING RANGE

Since the operate and release points can be varied by using different magnets as actuators, the Series 200FW offers a large measure of application flexibility. For example, using a 101M67 magnet (available from MICRO SWITCH), the Series 200FW characteristics are:

	101MG7	
	mm	in.
Min. Operate	2,41	.095
Max. Release	11,43	.450

DEFINITIONS

Alternate Action — Push "ON" — Push "OFF", maintained contact operation. In some cases a two level operator is provided.

Basic Switch — A self-contained switching unit. It can be used alone, gang-mounted, built into assemblies or enclosed in metal housings.

Double Break Contacts — (Twin break). This breaks the circuit in two places. Referred to as from Z circuitry also.

Double-Pole Double-Throw (DPDT) — Switches which make and break two separate circuits. This circuit provides a normally open and normally closed contact for each pole.

Dust-Tight — This seal guards against dust and dirt, but does not seal against moisture and vapors. Premolded elastomer boots and non-hardening cement are often used to accomplish this seal.

Environment-Proof Switch — A switch which is completely sealed to ensure constant operating characteristics. Sealing normally includes an "O" ring on actuator shaft and fused glass-to-metal terminal seals or complete potting and an elastomer plunger-case seal.

Explosion-Proof Switch — A UL listed switch capable of withstanding an internal explosion of a specified gas without igniting surrounding gases.

Military explosion proof requirements specify that the switch will not cause an explosion. This can be done by sealing the switch contacts from the atmosphere.

Hermetically Sealed Switch — A switch completely sealed to provide constant operating characteristics. All junctures made with metal-to-metal or glass-to-metal fusion.

Momentary Switch — A switch with contacts that return from operated condition to normal condition when actuating force is removed. Unless otherwise stated, all switches in this catalog are momentary.

Normally Closed Contacts (N.C.) — Provide a normally closed circuit when actuator is in free position.

Normally Open Contacts (N.O.) — Provide a normally open circuit when actuator is in free position.

Precision Snap-Acting Switch — An electromechanical switch having predetermined and accurately controlled characteristics, and having a spring loaded quick make and break contact action.

Single-Pole Double-Throw (SPDT) — Switch which may either make or break a circuit, depending on how it is wired.

OPERATING CHARACTERISTICS

Definitions below explain the meaning of operating characteristics. Characteristics shown in tables throughout catalog were chosen as most significant.

Linear dimensions for in-line actuation are from top of plunger to a reference line, usually the center of the mounting holes, or the top of the switch housing.

Differential Travel (D.T.) — Plunger or actuator travel from point where contacts "snap-over" to point where they "snap-back."

Free Position (F.P.) — Position of switch plunger or actuator when no external force is applied (other than gravity).

Full Overtravel Force — Force required to attain full overtravel of actuator.

Operating Position (O.P.) — Position of switch plunger or actuator at which point contacts snap from normal to operated position. Note that in the case of flexible or adjustable actuators, the operating position is measured from the end of the lever or its maximum length. Location of operating position measurement shown on mounting dimension drawings.

Operating Force (O.F.) — Amount of force applied to switch plunger or actuator to cause contact "snap-over." Note in the case of adjustable actuators, the force is measured from the maximum length position of the lever.

Overtravel (O.T.) — Plunger or actuator travel safely available beyond operating position.

Pretravel (P.T.) — Distance or angle traveled in moving plunger or actuator from free position to operating position.

Release Force (R.F.) — Amount of force still applied to switch plunger or actuator at moment contacts snap from operated position to unoperated position.

Total Travel (T.T.) — Distance from actuator free position to overtravel limit position.

REFERENCE STANDARDS

The UL and CSA references in this catalog do not imply specific approval of our products but rather that our products are designed to meet the safety and performance standards recommended by such agencies. Evaluation of our products by these agencies is limited to procedures established to examine switch performance within areas of their interest. Actual application requirements may exceed performance levels investigated by these agencies. We recommend that switches be tested to your exact application requirements.

UL (Underwriter's Laboratories, Inc.) is chartered as a non-profit organization without capital stock under the laws of the state of Delaware, to establish, maintain, and operate laboratories for the examination and testing of devices, systems and materials. Founded in 1894, the enterprise is operated for service, not for profit.

CSA (Canadian Standards Association) is a non-profit, non-governmental association established as a national standardization body for Canada. Included in its scope of activities is the responsibility of investigating and approving products and materials in the interest of safety.

MILITARY QUALIFICATIONS

To increase your effectiveness in using MIL-S-numbers, minimize your cost, and reduce your delivery time for switches procured to this specification, MICRO SWITCH publishes Data Sheet 204. It provides current information on the specification, and is revised and reissued as changes and additions occur. Please contact MICRO SWITCH for the most up-to-date issue.

Mounting Dimensions — All dimensions on the mounting dimension drawings in this catalog are subject to change without notice and are for reference only. Request current drawings from the nearest MICRO SWITCH Branch Office or write to Freeport.

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MICRO SWITCH
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A DIVISION OF HONEYWELL

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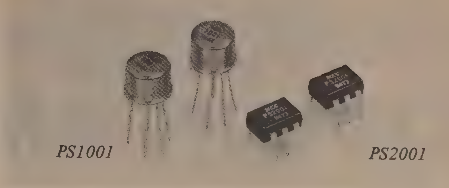
MICRO SWITCH makes your ideas work.

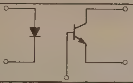
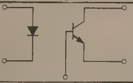
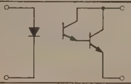
OPTICAL ISOLATORS

Isolators employing optically coupled circuitry for interface applications.



Features:

- High speed operation
- High voltage isolation
- High current transfer ratio

Type No.	Package	Equivalent Circuit	Absolute Maximum Ratings (Ta = 25°C)						Electrical Characteristics (Ta = 25°C)					
			I_F (mA)	P_D (mW)	V_{CEO} (V)	I_C (mA)	P_C (mW)	BV (V)	V_F (V)	I_{CEO} (nA)	CRT (%)	V_{CE} (sat) (V)	$R_{1\text{-}2}$ (Ω)	t_r t_f (μs)
PS1001	TO-5		60	100	30	50	150	1000	Max. 1.4	Max. 200	Min. 20	Max. 0.3	Min. 10^{11}	Typ. 5.0 Typ. 5.0
PS2001	MINI DIP		60	100	30	50	150	2500	Max. 1.4	Max. 200	Min. 30	Max. 0.3	Min. 10^{11}	Typ. 5.0 Typ. 5.0
PS2002*	MINI DIP		50	100	40	50	100	2500	Max. 1.9	Max. 200	Min. 100	Max. 1.2	Min. 10^{11}	Typ. 100 Typ. 100

* *Available soon.*

SWITCHES AND RELAYS

●Reed Switches and Reed Relays

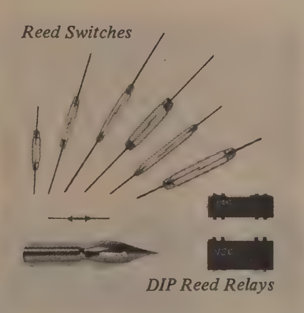
Ruthenium contacts used in NEC's reed switches provide highly reliable switching and long life operation.

●Mercury-Wetted Contact Switches and Relays

NEC's mercury-wetted contact switches and relays provide bounce-free switching performance under a billion operations.

●Miniature Relays

The MR10 and MR11 relays are designed to meet the long life, high reliability and small size requirements for P.W.board mounting in communications and industrial applications. (The new MR11-series latching relays are also available.)


Reed Switches

DIP Reed Relays

MC Relays

MC Switches

MR Relays

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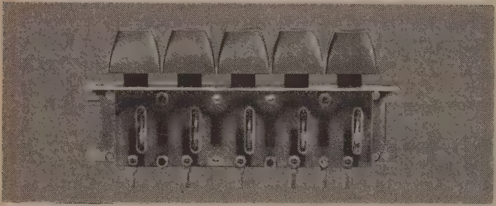
NEC
Nippon Electric Co., Ltd.

Maxi-SWITCH
KEYSTRIPS AND KEYBOARDS

The Maxi-Switch Company is a leading producer of pushbutton switch components and switch assemblies for the computer, photo-copy, business machine, automation and peripheral equipment industries.

The Maxi-Switch Keystrip construction technique facilitates the design and production of custom keyboards. Individual push-button stations may be purchased singly, in Keystrips, numeric blocks, or as completed Keyboards, with or without encoding circuitry. The wide range of features, options and accessories complement Keyboard adaptability.

1600 & 1800 KEYSTRIPS

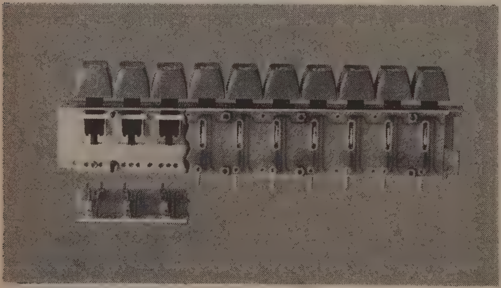


1800 KEYSTRIP

Maxi-Switch Keystrips present an unique approach to switch construction. These modular units offer long mechanical life and high quality in readily available, off-the-shelf assemblies. Combinations of different contact types, contact forms and plunger actions may be used within a single Keystrip. Up to 20 or more stations may be accommodated per Keystrip with standard spacing of ⅝ or ¾ inch between stations. Other spacings are optionally available.

Standard Series 1600 and Series 1800 switches are equipped with glass reed contacts, and differ only in frame height and available options (1600 — 1.5″ high, 1800 — 1.1″ high). Contact options (1600 only) include cross-bar palladium leaf contacts and 15 ampere snap-action power contacts. Reset and lockout solenoids may also be used with Series 1600 Keystrips.

Individual reeds may be tied to a common bus on one side, or brought out to seperate terminals, depending on the requirements of the application. The common bus feature saves component and mother-board space, and requires fewer solder connections.



1600 KEYSTRIP

SPECIFICATIONS

BUTTONS:

A variety of lighted and unlighted buttons available in several colors. Ask for Maxi-Switch Bulletin MS 2500 for information on buttons and Keystrip/Keyboard illumination.

TERMINALS:

Printed circuit, pierced solder lug, plug-in male/female contacts, wire-wrap, .110 quick connect.

CONTACTS:

Glass Reed, form A or B, single or dual station. 28 VDC @ 250 Ma.

Cross-Bar Palladium leaf contacts, form A, B or C (1600 only). 3 Ampere @ 28 VDC, 3 Ampere @ 115 VAC.

Snap Action Power Contacts (1600 only). 10 Ampere @ 250 VAC, ½ Ampere @ 125 VDC; or 15 Ampere @ 250 VAC, ½ Ampere @ 125 VDC.

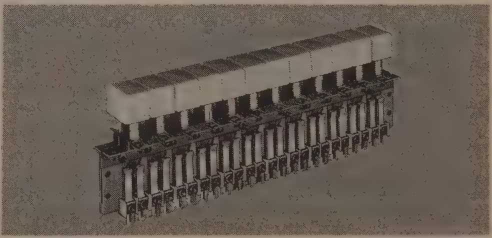
PLUNGER ACTIONS:

Momentary Contact (standard)
Interlatch and Lockout
Alternate Action (push-push)
Lockout Only
Key Motion Sensing
Cross-Bank Interlatch and Lockout (between Keystrips).

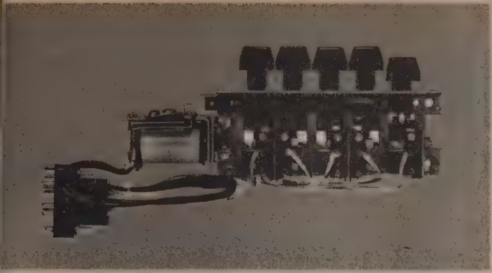
1200/1400 KEYSTRIPS

Series 1200 and 1400 Keystrips feature two-piece steel frames as the basic structure, with push-button components mounted between two frame halves. Precision tooling and the highest quality materials are used in Maxi-Switch construction for long life and trouble-free operation. Careful attention to tolerances gives smooth action with low operating force. These Keystrips may be supplied as completed individual keystrips, assemblies of several keystrips, or in custom panel assemblies, wired and tested.

Series 1200 and 1400 Keystrips may be lighted with one or two lamps per switch station (form A lamp contact not available on 1400 switches with more than 3 bits). Both midget groove and midget flange T-1¾ bulbs are available. Lamp sockets may be furnished with solder lugs, AMP 78 Series taper tabs, 3-inch pigtail lead wires, or with common bussing.

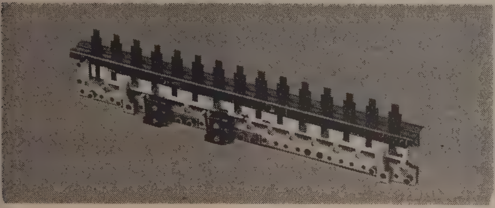


1200 KEYSTRIP



1200 KEYSTRIP

1400 BINARY KEYSTRIPS

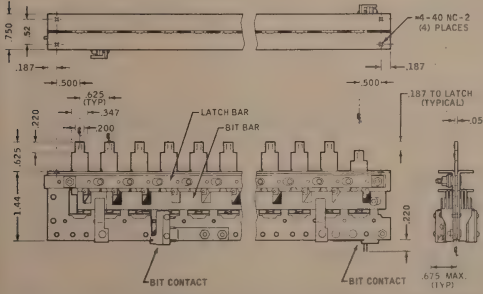


1400 KEYSTRIP

Maxi-Switch offers the newest concept in binary coded decimal switching. Series 1400 switches represent a significant advancement in the development of simplified mechanical encoding techniques, eliminating the maze of contacts, diodes, and interconnections normally associated with switch encoding. Wiring, bussing and solder connections are reduced to a minimum, with appearance and reliability enhanced by simplified construction. Up to 20 buttons can be accommodated on a single 1400 Keystrip.

BCD encoding is accomplished by means of movable bit bars fitted with snap-in acetyl resin coding cams. These cams cause the bit bars to close the proper contacts for a discrete code when a button is depressed. Coding may be modified in the field or by the customer simply by repositioning the bit cams.

The Maxi Binary Switch will provide 3, 4, 5 or 6-bit binary output through snap-action contacts rated at 3 amperes, 300 watts, form "A" (SPST/NO) or form "C" (SPDT).

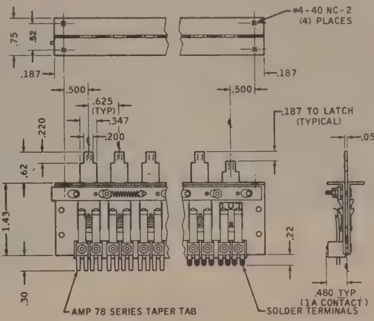


FOR BUTTON DIMENSIONS SEE TECHNICAL BULLETIN MS2500

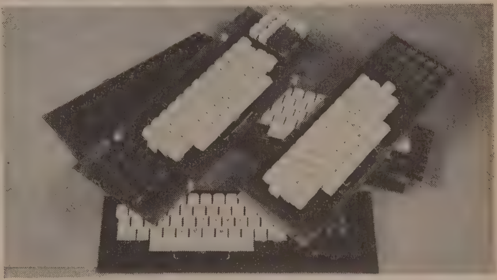
1200 KEYSTRIPS

Series 1200 Keystrips provide circuit switching of up to 20 positions per keystrip. Many action options are available, and variations of standard design may be quickly accomplished using basic shelf stock for fast prototype and production service. Maxi Keystrip construction is strong and durable. The heavy duty frame members eliminate problems of cocked or twisted buttons and imperfect spacing. Our Keystrips add a touch of lasting quality to the appearance of any equipment.

The range of available contact forms (A, AA, B, C or F), plunger actions, terminals and buttons allow the designer to specify switches which are exactly suited to the application. With Maxi-Switch there need be no compromise with quality or capability.



KEYBOARDS



Maxi-Switch offers several types of keyboards, including both mechanical and reed switches, with individual stations, or in modular strips.

Maxi 3200 Series individual mechanical switches feature simplicity and long life in a low-cost switch that incorporates contact wiping action. Our 3400 Series modular mechanical switches have single or double contacts, and may be optionally illuminated.

Series 2700 individual reed switch keyboards feature pretested reeds which are machine adjusted for consistent operation. Series 2900 modular reed switches are designed to allow reed replacement from the back of the circuit board when necessary.

Encoding formats may be standard USASCI or EBCDIC, or special codes as required. Standard data level outputs are provided.

Keytops are available in a variety of sizes, styles and colors. Maxi can supply special custom legends as required.

Contact your Maxi-Switch representative for information on standard or custom encoded keyboards. See specifications on Maxi-Switch standard ASR-33 and ANSI keyboards on the following page.

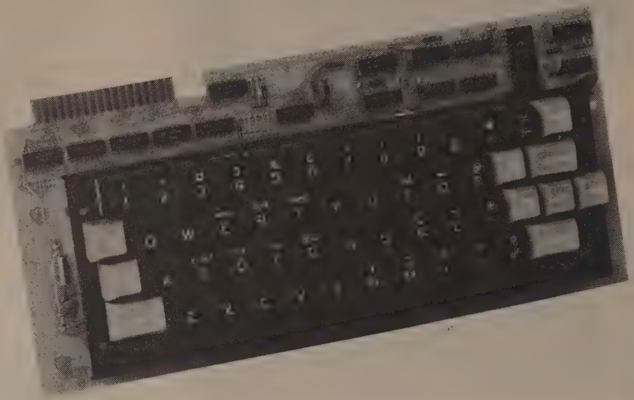
THE Maxi-SWITCH CO.

9697 EAST RIVER RD. • MINNEAPOLIS, MINNESOTA 55433
(612) 755-7660

Maxi-SWITCH

ASR-33 KEYBOARD 2132-032

- STANDARD 53-KEY TTY-33 LAYOUT
- STANDARD ASCII CODE
- ODD OR EVEN PARITY SELECT
- QUAD MODE
- 2-KEY ROLLOVER
- GOLD DOUBLE BIFURCATED CONTACTS (4 contacting paths)
- LONG LIFE, LOW COST



The Maxi-Switch ASR-33 type mechanical switch encoded keyboard combines the best in economy and performance. This rugged and attractive keyboard utilizes the double bifurcated Maxi mechanical keyboard switch with gold contacts and carefully designed wiping action for consistent performance. Life tests have shown switch life to be in excess of 20 million operations.

Encoding for the ASR-33 keyboard is accomplished with TTL circuitry and a reliable scanning technique. A unique noise discriminating circuit eliminates problems of switching noise. Output is standard 7 bit ASCII code. Odd or even parity can be selected by internal jumper.

A number of button colors are available as an option to match the decor of the application.

SPECIFICATIONS

CIRCUIT BOARD:

.062-inch G10 glass epoxy board with gold plated edge connector.

SWITCHES:

Pre-Travel	.100-inch minimum
Over-Travel	.020-inch minimum
Total Travel	.187-inch ±.010-inch

OPERATING FORCE:

3 ozs.

KEYTOPS:

Double-shot cycolac plastic. Special colors and legends optionally available.

INPUT POWER:

+5 VDC, ±10% at 500 Ma max.

OUTPUT:

ASCII code set, standard TTL levels, terminated in Cinch 251-18-30-160 or equivalent connector. Logic output, buffered positive. "I" = 2.5 V min. I olad = 400 microamps. "0" = 0.4 V max. I sink = 16 milliamps.

WEIGHT:

1.5 lb.

TEMPERATURE:

0°C to 50°C operating.

INTERLOCK:

Standard 2-key rollover.

STROBE:

Positive or negative. 20 microsecond pulse on initial key closure.

PARITY:

Odd or even, selected by jumper on output connector.

REPEAT:

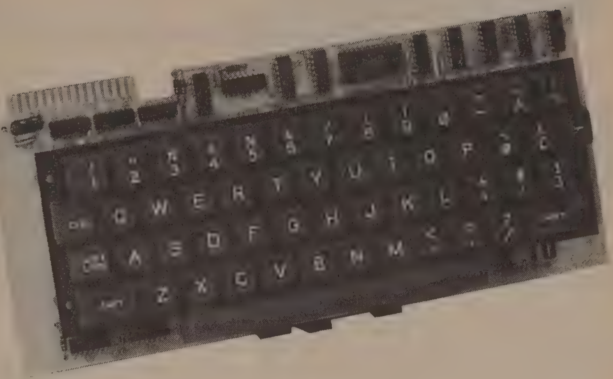
Repeat key can be used as function key or wired to provide internal repeat at 10 characters-per-second.

This keyboard may be modified, or special keyboards designed to meet customer requirements. For further information on custom units, contact the local Maxi-Switch representative or the factory.

Maxi-SWITCH

ANSI KEYBOARD 2132-033

- STANDARD 53-KEY TTY-33 LAYOUT
- STANDARD ASCII CODE (Including lower and upper alpha)
- QUAD MODE
- 2-KEY ROLLOVER
- GOLD DOUBLE BIFURCATED CONTACTS (4 contacting paths)
- LONG LIFE, LOW COST



The Maxi-Switch ANSI standard mechanical switch encoded keyboard combines the best in economy and performance. This rugged and attractive keyboard utilizes the double bifurcated Maxi mechanical keyboard switch with gold contacts and carefully designed wiping action for consistent performance. Life tests have shown switch life to be in excess of 20 million operations.

Encoding for the ANSI keyboard is accomplished with TTL circuitry and a reliable scanning technique. A unique noise discriminating circuit eliminates problems of switching noise. Output is standard 7 bit ASCII code.

A number of button colors are available as an option to match the decor of the application.

SPECIFICATIONS

CIRCUIT BOARD:

.062-inch G10 glass epoxy board with gold plated edge connector.

SWITCHES:

Pre-Travel	.100-inch minimum
Over-Travel	.020-inch minimum
Total Travel	.187-inch ±.010-inch

OPERATING FORCE:

3 ozs.

KEYTOPS:

Double-shot cycolac plastic. Special colors and legends optionally available.

OUTPUT:

ASCII code set, standard TTL levels, terminated in Cinch 251-18-30-160 or equivalent connector. Logic output, buffered negative. "0" = 2.5 V min. I load = 400 microamps. "I" = 0.4 V max. I sink = 16 milliamps.

INPUT POWER:

+5 VDC, ±10% at 500 Ma max.

WEIGHT:

1.5 lb.

TEMPERATURE:

0°C to 50°C operating.

INTERLOCK:

Standard 2-key rollover.

STROBE:

Positive or negative. 20 microsecond pulse on initial key closure.

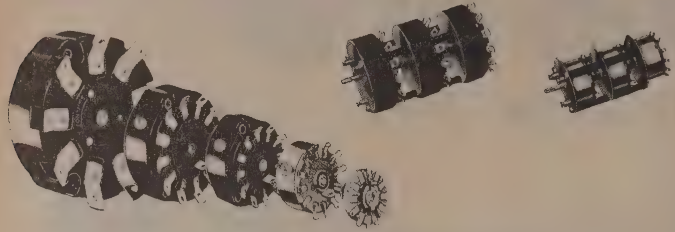
SHIFTED CASE OPTION:

An additional jumper may be added to give upper case alpha only.

This keyboard may be modified, or special keyboards designed to meet customer requirements. For further information on custom units, contact the local Maxi-Switch representative or the factory.

THE Maxi-SWITCH CO.
9697 EAST RIVER RD. • MINNEAPOLIS, MINNESOTA 55433
(612) 755-7660

OHMITE® power tap switches, high current, non-shorting type



INTRODUCING

MODEL 711

Smallest Switch for Its Rating
7 Amps, 125 Volts

All Ohmite switches feature the slow-break, quick-make action deemed so desirable for switching of AC current.

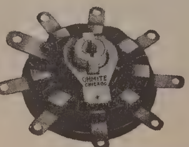
All models except 711 feature all ceramic, arc-proof bodies and solid silver alloy, fixed and movable contacts. The large, thick, silver-alloy fixed contact disks are permanently welded to copper studs. These, in turn, are riveted and soldered to sturdy terminal lugs, assuring a permanent mechanical and electrical joint. The rotor (moving) contact, also of solid silver-alloy, is riveted and soldered to the contact arm. Face of the rotor contact is slightly rounded assuring a perfect seating of the contacts with a slight rubbing, self-cleaning motion on every operation. Models 111, 212, 312 and 412 are UL listed.

The new Model 711 tap switch was designed to achieve high current capability with small size. It is actually smaller than many low current instrument switches. It interrupts 7 amperes at 125 VAC and can carry 15 amperes AC or DC. The Model 711 features a melamine phenolic body with solid silver-alloy fixed and movable contacts.

Model	Alternate Current Rating		Diameter	Shaft Diameter	Max. Panel Thickness	Weight	No. of Taps
	Amps.	Volts					
711	7	125	1⅛″	¼″	⅛″	.047 lb.	3-11
111	15	125	1¾″	¼″	¼″	.16 lb.	3-11
212	20	150	2¼″	¼″	¼″	.4 lb.	3-12
312	30	300	3⁵⁄₁₆″	¼″	¼″	.75 lb.	3-12
412	50	300	4³⁄₁₆″	¼″	¼″	1.4 lb.	3-12
608	100	300	6″	⅜″	1″	5 lb.	3-8

ALL CERAMIC OPEN TYPE TAP SWITCHES

Shorting Type


Non-Shorting Type

Designed to transfer currents of several amperes in circuits requiring high voltage insulation. Ceramic body construction. Monel metal taps; silver-graphite brush.

Switches up to 8 taps are approximately 3¼″ diameter including lugs; 9 to 12 tap switches are approximately 4¼″ diameter. Switches can be ordered assembled 2 to 3 in tandem. Single hole mounting by means of ⅜″ diameter bushing and hexagon nut accommodates panels up to ¼″ thick (maximum).

Maximum current capacity is 7 amperes but only 3 amperes at 120 V.A.C. should be interrupted. Current ratings are less for all direct current circuits above 20 volts, for inductive circuits and high voltages.

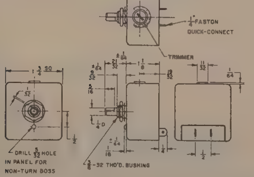
OHMITE® OHMITROL solid state power and motor speed controls

FEATURES:

- Conserves space & power
- Smallest 1 & 2 KW control
- AC & DC output types
- Built-in on-off switch
- Adjustable control range
- Choice of component & portable styles
- Long life

Catalog No.		Input Volts	Freq.	Output Range (Nominal)	Load Capacity Rating (Maximum)
Component Style	Portable Style				
PCA-1000-08	PCA-1001-08	120 VAC	60 Hz	0-120 VAC	1 KW, 8.3 Amps AC
PCA-1000-15	—				15 Amps AC
PCA-1100-08	PCA-1101-08		50 Hz		1 KW, 8.3 Amps AC
PCA-1020-08	PCA-1021-08	240 VAC	60 Hz	0-240 VAC	2 KW, 8.3 Amps AC
PCA-1120-08	PCA-1121-08		50 Hz		
PCD-1000-06	PCD-1001-06	120 VAC	60 Hz	0-120 VDC and Full 120 VDC	6.0 Amp DC Resistive 3.5 Amp DC Motor Load
PCD-1100-06	PCD-1101-06		50 Hz		
PCD-1020-06	PCD-1021-06	240 VAC	60 Hz	0-240 VDC and Full 240 VDC	
PCD-1120-06	PCD-1121-06		50 Hz		

Model PCA-Component Style

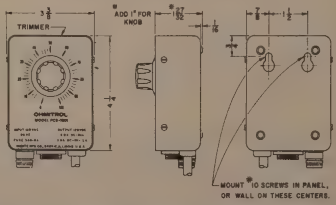


RECEPTACLE FOR TYPE PCA 1001

RECEPTACLE FOR TYPE PCA 1021

RECEPTACLE FOR TYPE PCD 1001 (AMPHENOL 91-PN3F)

Models PCA and PCD-Portable



FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX

OTTO
CONTROLS

OTTO
CONTROLS

OTTO snap-action switches MAKE & BREAK everytime

because the OTTO design features inherent rocking-action that breaks welds and wipes contacts clean.

PUSHBUTTONS* miniature & moistureproof

TYPE P1 (MIL-S-8805/3)

P1-1

P1-2

P1-3

P1-5

P1-6

P1-7

P1-8

FEATURES

- 250,000 mech. cycles.
- High contact pressure: 120 gr.
- Low contact resist: <10 milliohms.
- Repeatable trip point within .001".
- Rolling sleeve principle seals button.
- Sealed case and terminals.

Pushbutton is sealed by silicone rubber boot operating on a "rolling sleeve" principle to give long life and smooth operation. Case & terminals sealed against environment and solder flux. Load ratings: 10 A. res., 5 A. ind., 3A. lamp. Contact forms: N.O., N.C., 2-circuit. Red or black button.

TYPE P3 Commercial Grade

P3-3

P3-6

P3-7

P3-8

Momentary or push-pull double-break action. Same specs as P1 military series. Choice of solder or screw terminals. Designed for use in panel boards, computers, business machines, instruments. Can be used as limit switch.

twostep™ for applications requiring 3 modes of operation

FEATURES

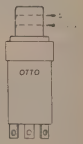
- Unique 2-position design.
- Sequential contact action.
- 12 contact arrangements.
- Make- before-break contact option.
- Moistureproof construction.
- 100,000 mechanical cycles.

P2-1

P2-3

P2-6

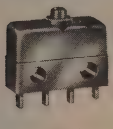
Ideal for "off-high-low", "off-slow-fast", "Stop-fine-course" applications. Each level operates an independent set of SPDT circuits rated to 5 A. Twelve contact arrangements are offered to satisfy just about any circuit requirement. Also available as DPDT single detent.

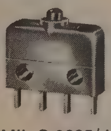


BASICS* unique patented design assures extraordinary long life less than 10 milliohms contact resistance

SUB-SUBMINIATURE

TYPE B3 for low level circuits


MIL-S-8805/76


MIL-S-8805/101

CHARACTERISTICS

- Contact Resistance: .010Ω max.
- 10 million mech. cycles.
- 100,000 cycles at full load.
- Operating Force: 5^{+3}_{-2} oz.
- Release Force: 1.5 oz. min.
- Pretravel: .035" max.
- Overtravel: .006" min.
- Move. Diff.: .015±.005 in.
- Temp. Range: −65° to +125°C.
- Size: .200" or .156" wide x .350" h. x .510" lg.

MIL-S-8805/76 THIN B3-4140

For your run-of-the- "MIL" projects, OTTO's B3-4140 series is only .200" thick. Contact resistance less than 10 milliohms, contact pressure higher than normal, minimal contact bounce. Gold flashed contacts, solder terminals in diallyl case. Rated 4A Res. SPDT; 8A. Res., SPDT-DB.

MIL-S-8805/101 THINNER B3-1140

Brand new, OTTO inspired military spec. Only .156" thin, yet all the rating, life, and reliability of the /76 version. You can get five B3-1140 series in the space of four B3-4140 with room to spare. Your choice of double-break form X, Y, Z and single break form C. B3-1140 turret terminals, B3-2140 solder terminals. Also commercial versions.

TOGGLE/PUSHBUTTON ACTUATORS

T1-0001. Four position, 6-pole toggle featuring MIL-S-8805/4 basic switches. Positions #1 & #3 are 2PDT maintained action each, position #4 is 2PDT momentary, position #2 is center "off". Rated 7A. res. each pole. **T1-0004.** Same except 3-position, 4-pole toggle. Position #1 is 2PDT momentary, position #2 is center "off", position #3 is 2PDT maintained action. **T1-0005.** Same as T1-0001 except all four positions are maintained action.

T2-0001. Combo toggle & pushbutton. It's a 2-position toggle and a pushbutton switch all in one. 30° toggle throw, .135" total pushbutton travel with 4.5 lbs. operating force. Rated 10A res. & ind.

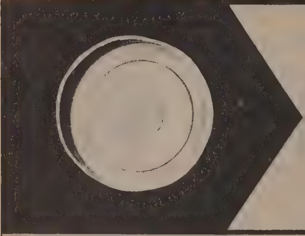
T4-0001. Four-way toggle with 4-pole N.O. double-break momentary action. Rated 5A. res. Dims.: 1.156 dia. X 1.160 behind panel.

OTTO CONTROLS Division, OTTO engineering, Inc.
36 Main St., Carpentersville, Illinois 60110 Phone: 312/428-7171

*U.S. Pat. No. 3,612,793.

touch switches

The remarkable "Touch-Activated" switches incorporate the unique, patented, Wild Rover "Electrical grating" contact design. This exclusive development enables transient energy to be distributed evenly over a multiplicity of contact points — a first in switch technology: compact, low profile, contemporary design and sealed packaging.



TC-1 CAPSULE

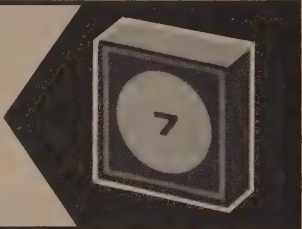
The TC-1 CAPSULE is the basic switch element in a disc-shaped capsule, offering designers a low-cost, easy-to-install touch switch without cosmetic frills. It offers a broad range of applications and is particularly suited for PC Board installation.

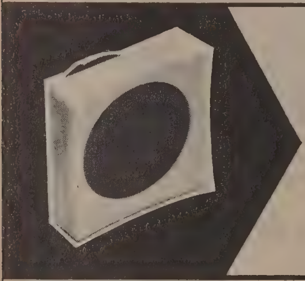
SPECIFICATIONS — Switch rating: 12 to 120 VAC, 50 ma. to 1.6 amps.; 12 to 24 VDC, 200 ma. to 1 amp. Contact resistance: 30 milliohms nominal. Life: 1,000,000 cycles minimum.

M SERIES MINI-LITHIC® SWITCHES

The M series switches are economical, mini-sized switches especially useful where space is at a premium. Available in round and square bezels, with standard colors of blue, beige, white and black. Numbered legends from 0-9. Custom legends at nominal cost available on special order, designed for PC board mounting in applications from intercoms to mini-computers, from appliances to data entry systems.

Rating: 12 to 120V (same at TC-1).





SE SERIES: SEALED, SCREW TERMINATION

The SE SERIES switches are available in four attractive styles in a wide color choice with tough plastic frames. They are suited to control functions, e.g., office machines, elevators, appliances, vending machines, "panic buttons", etc. They are dust-proof, oil and water proof. LED or incandescent indicators are optional on the SE1 and SE2 styles. Legendizing is available.

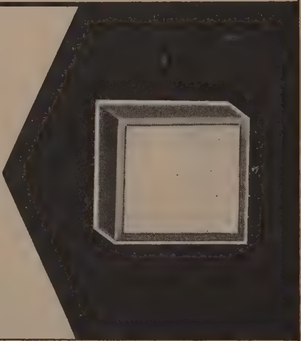
SPECIFICATIONS — Switch rating: 12 to 220 VAC, 50 ma. to 1.6 amp.; 12 to 24 VDC, 200 ma. to 1 amp.
Contact resistance: 30 milliohms nominal.
Life: 1,000,000 cycles min.

PCK SERIES: KEYBOARD SWITCHES

The PCK series of switches are ideally suited for "mini-sized" numerical data entry devices. PCK switches move in a smooth, linear motion in a full 1/16" travel without binding. These unique keyboard switches have been "touch-engineered" for smooth and gentle yet positive switch action.

APPLICATION — The PCK-1 keyboard switch is designed for 1/32" thick printed circuit boards and the PCK-2 for application to 1/16" thick boards. These switches can be mounted virtually adjacent to each other on .520" centers. Legendizing is available.

SPECIFICATIONS — Switch Rating: 200 ma., 24V AC/DC non-inductive. Make your own keyboard or let us quote on your requirements. Contact Resistance: 50 milliohms typical under essentially dry circuit conditions. Operating Force: 3 ounces typical.



SEND FOR COMPLETE INFORMATION

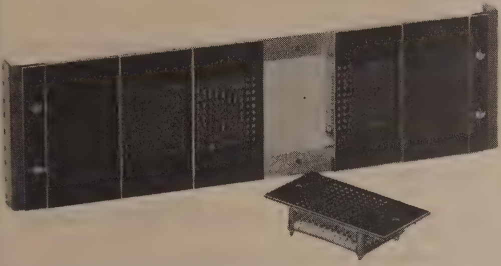
REFAC Electronics Corp.
1275 BLOOMFIELD AVENUE - FAIRFIELD, NEW JERSEY 07006
TELEPHONE 201/575-8820 — TWX 710-734-4348
MAILING ADDRESS: P.O. BOX 453, CALDWELL, NEW JERSEY 07006

A REFAC Company
Manufacturer's of Wild Rover Switches & Keyboards

SEALECTRO

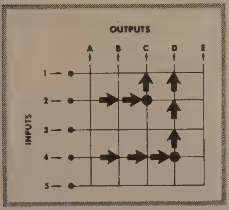
SEALECTROBOARD®

CORDLESS PROGRAMMING BOARDS



"Sealectroboard" programming and switching provides complete ease and simplicity of operation with drastic reductions in hardware and space. A single pin is used to complete the program circuit or insertion of a component . . . move the pin to a new location and you have a new program function. "Sealectroboards" are made in 2 to 5 deck versions and with a variety of pin styles such as shorting pins, diode holders and skip pins as well as with engraved or silk-screened panel marking and color coded program areas.

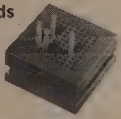
Modular "Sealectroboard" are designed to facilitate program board expansion in prototype and design applications and are offered off-the-shelf from Sealectro Distributors. Each modular board is a 10 x 10 matrix with two contact decks in bussed upper and lower or bussed upper, individual lower contact configurations. Companion mounting and panel pieces are designed for 19″ relay rack mounting and allow expansion from a single board up to 6 boards in just 5½″ of rack space. Write for our complete catalog and technical specifications. . . .



Bussed Upper and Lower Contacts

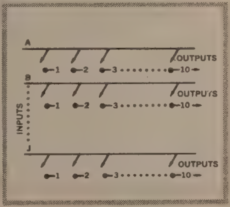
The Modular Sealectroboard is available with bussed upper and lower contacts and provides an ideal means for input / output switching. The standard 10 x 10 hole Modular Sealectroboard may be considered 10 Single Pole, Single Throw, Normally Open switches with 10 inputs each.

New Miniboards



Pack a 10 x 10 hole format (100 crosspoints) into a 1 inch square. These new microminiature boards have all of the standard features of the larger size Sealectroboard, including modular, expandable construction, shorting and diode pins, and Sealectro's built-in reliability.

U.S. Pat. No. 3,027,534



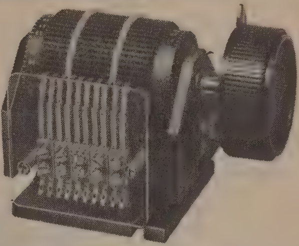
Bussed Upper and Individual Lower Contacts

The Modular Sealectroboard is also available with bussed upper and individual lower contacts which provide individual electrical access to each program hole and a path between many terminals and a lesser number of bussed terminals. The standard 10 x 10 hole Modular Sealectroboard with this contact configuration may be considered a 10 Pole, Single Throw, Normally Open switch with 10 positions per pole.

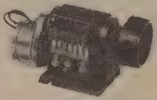
PROGRAM SWITCHING

SEALECTROSWITCH®

PROGRAMMING SWITCHES



Programs may be changed in seconds without special tools and with 100% reproducibility. The Sealectroswitch programming switch provides a degree of versatility that can't be met by comparable devices . . . and in half the space and half the cost. Extremely high "built-in accuracies" are provided through precision machined drums while flexibility is obtained through unique, field-adjustable, sliding contact actuators. Check these features • Field Adjustable Cams with Multiple ON/OFF Functions or Point-to-Point Switches • Manual or Remote Operation with Timing Motor or Solenoid Drive • Transfer Speeds to 50 Milliseconds without Appreciable Contact Bounce • Removable Drums • Form A, B, and C Contacts in a Single Unit • Up to 57 Circuit Controls in a Single Unit • Contacts Rated for Dry Circuit to 2 Amps, 24 VDC or 115 VAC • Optional 10 Amp or 20 Amp, 115 VAC U.L. Approved Contacts.



Enclosed, snap-action contacts and timing motor drive.

60 program positions, 60 contacts and stepping motor drive.

U.S. Pat. No. 3,330,917 Also protected by foreign patents

LCT SEALECTRO TIMER

- Field adjustable
- Multiple function
- Economical, precise programming
- Sets up in seconds with 100% repeatability
- Up to 60 On/Off functions per revolution
- 15 Amp contact rating
- U.L. approved

60 drum positions, precisely fabricated at factory, permit up to 60 On/Off functions in a single 360° operation on a single contact. The drum is indexed, eliminating guesswork in set-ups, and also guaranteeing 100% repeatability when re-setting to a former program.

Actuators are merely slid by hand, to or out of operational position. In seconds, set up a complex timing program with varying time dwells for On/Off functions. In seconds, set up a pulse generator capable for supplying precisely timed pulses in various groups.

SEALECTRO SLIDE➡'N SWITCH

- Exclusive random access to any circuit from any circuit.
- Up to 10 times as fast as thumbwheel switches.
- Modular expandable design.
- Compact, 2⅝″ high. Each switch module 11⁄32″ wide.
- Reduced contact wear.
- Economical, costs far less than average thumbwheel switch.
- Guaranteed for 250,000 operations per contact minimum.
- Terminates in standard PC card connector, or hard wire.

Write today for our complete catalog . . .

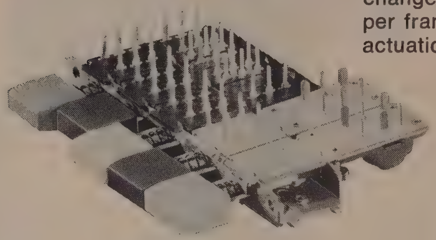
SEALECTRO

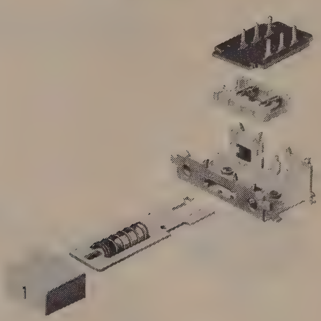
®
PROGRAMMING DEVICES DIVISION
SEALECTRO
CORPORATION
MAMARONECK, N. Y. 10543
PHONE: (914) 698-5600 TWX: 710-566-1110
· Sealectro Ltd., Portsmouth, Hants, England
Sealectro S.A., P.O. Box 24.
Zone Industrielle de la Garde, la Garde 83, France

SEACOR SWITCHES

TYPE MX/MXL: MODULAR PUSHBUTTON SWITCH SYSTEM

Illuminated or non-illuminated modular design offers interchangeability of elements to meet any need. To 25 stations per frame. Signal and power switching. SPDT to 16PDT per actuation. The "Engineer's Switch."





SPECIFICATIONS—

Contact Arrangements: SPDT to 8PDT; shorting or non-shorting; double-wiping contacts

Current and Voltage Ratings—
- **Current:** 2A, max.
- **Voltage:** 250V, eff. max.
- **Power:** 15 WDC, 25 WAC

Initial Contact Resistance: 5 milliohms (between 2 contacts short circuited)

Insulation Resistance: 5×10^{10} ohms between 2 contacts

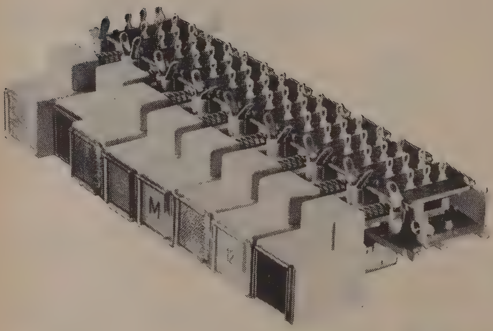
Breakdown Voltage—
- **Contact to Contact:** 1500 VRMS
- **Contact to Frame:** 2000 VRMS

Lamp Data (MXL): Type LTL T5.5 bulb; min. tel. type, slide base; 6V, 12V, 24V lamps avail.

Materials—
- **Frame:** Steel, zinc plated and passivated
- **Slider Bar (Plunger):** Steel, zinc plated and passivated
- **Moving Contacts:** Spring brass with rolled silver coating
- **Fixed Contacts:** Spring brass with hard silver plating
- **Contact Types:** Solder lug or 3 size PC terminals
- **Buttons:** Molded Polystyrene; Lenses & filters (MXL) high temp. acrylic

Life Test: Greater than 100,000 cps before 1 mohm increase in contact resistance

Actuation Modes—(All modes may be combined with **lock-out** feature)
- **Momentary:** Spring loaded non-latching
- **Self Releasing:** Push-Push, alternate action; push to latch, push to release
- **Mutual Release:** Interlatch, mutual latching; push to latch, push diff. button to release. Solenoid release also available
- **Momentary-Mutual Release:** Manual release, clearing; operates as mutual release but doesn't latch
- **Self Release Clearing:** Releases all prev. depressed self releasing stations
- **Accumulative Latch:** Combines self releasing and self release clearing modes
- **Power Switch:** DPDT spring loaded snap type. U.L. 3A @ 125V, TV-3



Request complete MX brochure and worksheets.

SEACOR—IF IT'S A SWITCH, WE PROBABLY HAVE IT.

Seacor has nearly any switch: pushbutton, rotary, thumbwheel, toggle, slide, lever, etc., etc. If you need a switch we almost certainly have the one you need. Along with **proven** quality and reliability. Top-flight engineering help if you need it. Best possible prices and delivery. If you need switches, you need Seacor. Write for catalogs, prices and delivery.

SEACOR DELIVERS

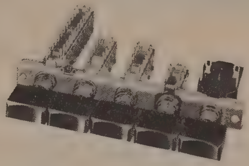
Seacor Inc.

598 Broadway • Norwood, New Jersey 07648 • (201) 768-6070 • TELEX 135354.

SEACOR SWITCHES

TYPE P MODULAR PC PUSHBUTTON SWITCHES

Designed for printed circuit soldering • Interchangeable elements • SPDT to 8PDT per actuation • To 12 stations, std. • Signal and power switching • Greater than 500,000 cycles, life rating • Guided plunger.



SPECIFICATIONS

Contact Arrangements: SPDT to 8PDT; non-shorting.

NOW! Shorting or non-shorting

Current & Voltage Ratings—
- **Current:** 2A, max.
- **Voltage:** 250V eff. max.
- **Power:** 15 WDC, 25 WAC

Initial Contact Resistance: 4 milliohms (between two contacts short circuited)

Insulation Resistance: 2 x 10^{13} ohms between two contacts

Breakdown Voltage—
- **Contact to Contact:** 2000 VRMS
- **Contact to Frame:** 3000 VRMS

Materials—
- **Frame:** Cold rolled steel, zinc plated and passivated
- **Slider Bar (plunger):** Makrolon; glass filled
- **Moving Contacts:** Spring brass with 12μ rolled silver coating; spring loaded

Materials—
- **Fixed Contacts:** Spring brass with 3μ hard silver plating
- **Contact Support:** Makrolon; glass filled
- **Contact Types:** Solder lug & 3 sizes PC terminals
- **Buttons:** Molded polystyrene

Life Test: 500,000 cycles exc. mut. rel. = 45,000 cycles

Key Travel: 5.4 mm incl. overtravel

Actuation Force: Approx. 500 gms (4PDT switch)

Actuation Modes—
- **Momentary:** Spring loaded non-latching
- **Self Releasing:** Push-push; alt. action
- **Mutual Release:** Interlatch, mutual latching; push to latch, push diff. button to release
- **Momentary-Mutual Release:** Manual release, clearing; operates as mutual release but does not itself latch

Power Switch: DPDT U.L. 6A @ 125V (17.5 mm only)

SERIES 5000 SUBMINIATURE SNAP-ACTION TOGGLE SWITCHES

FEATURES—

Excellent mechanical and electrical performance • Minimum size; less panel space; less behind-panel space • Pinned handles for prevention of damage and rotation • Human engineered; positive switching "feel" • Exceptionally rugged highest quality materials • Hundreds of styles; wide range of options • All standard functions.

SPECIFICATIONS—

Basic Types: SPDT, DPDT, 3PDT, 4PDT

Functions: All standard functions

Current/Voltage Ratings—
- 5A @ 125 VAC, resistive load
- 1.5A @ 250 VAC, tungsten load
- 4A @ 30 VDC
- 3A @ 250 VAC, resistive load
- 1A @ 250 VAC, inductive load
- 8A @ 6 VDC

Contact Resistance, Initial: less than 5 mohms @ 2 VDC, 1A

Insulation Resistance: greater than 1000 Mohms between terminals and case ground @ 500 VDC

Dielectric Strength: 2000 VRMS between lugs or contacts and frame

Life Ratings: 100,000 operations (mech); 50,000 operations (elec) full resistive load

Op. Temp. Range: −60°C to +125°C

Materials: Switching contacts and outside terms are solid silver, gold plated optional; center term, brass, hard silver plated; switch body blue diallyphthalate; handles, bright chrome-plated brass.

Handle Shapes: Bat; flatted, fluted; short, medium, long

OTHER TOGGLE SWITCHES

Seacor offers a complete line of toggle switches meeting virtually any requirement. All are excellent price/performance values. Seacor toggle switches are widely used in commercial applications, for example: electrical/electronic test equipment; computers; peripherals; business machines; home entertainment products, etc., etc. Send for complete data.

SEACOR DELIVERS

598 Broadway • Norwood, New Jersey 07648 • (201) 768-6070 • TELEX 135354

Seacor Inc.

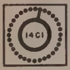
Shallco

14, 18, 22 SERIES ROTARY SWITCHES

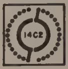
AVAILABLE CIRCUITS

SERIES 14

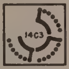
11¼° INDEXING SHORTING



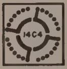
1 POLE
2 to 31 Pos. with Stops
32 Pos. Continuous Rot



2 POLE
2 to 15 Positions

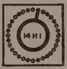


3 POLE
2 to 7 Positions

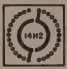


4 POLE
2 to 7 Positions

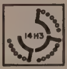
22½° INDEXING NON-SHORTING



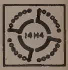
1 POLE
2 to 15 Pos with Stops
16 Pos. Continuous Rot



2 POLE
2 to 8 Positions



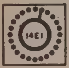
3 POLE
2 to 4 Positions



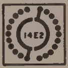
4 POLE
2 to 4 Positions

VIEWS SHOWN
ARE EXTREME
CCW POSITION
AS VIEWED
FROM SHAFT
END

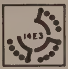
15° INDEXING SHORTING



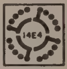
1 POLE
2 to 23 Pos with Stops
24 Pos Continuous Rot



2 POLE
2 to 11 Positions

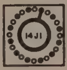


3 POLE
2 to 5 Positions

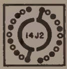


4 POLE
2 to 5 Positions

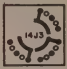
30° INDEXING NON-SHORTING



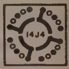
1 POLE
2 to 11 Pos. with Stops
12 Pos. Continuous Rot.



2 POLE
2 to 6 Positions



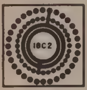
3 POLE
2 to 3 Positions



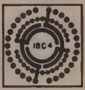
4 POLE
2 to 3 Positions

SERIES 18

11¼° INDEXING SHORTING

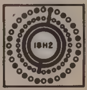


2 POLE
2 to 31 Pos with Stops
32 Pos Continuous Rot

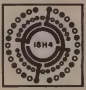


4 POLE
2 to 15 Positions

22½° INDEXING NON-SHORTING

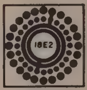


2 POLE
2 to 15 Pos with Stops
16 Pos Continuous Rot.

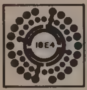


4 POLE
2 to 8 Positions

15° INDEXING SHORTING

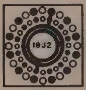


2 POLE
2 to 23 Pos. with Stops
24 Pos Continuous Rot

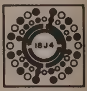


4 POLE
2 to 11 Positions

30° INDEXING NON-SHORTING



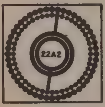
2 POLE
2 to 11 Pos. with Stops
12 Pos. Continuous Rot



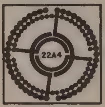
4 POLE
2 to 6 Positions

SERIES 22

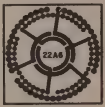
7½° INDEXING SHORTING



2 POLE
2 to 46 Pos with Stops
48 Pos Continuous Rot

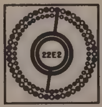


4 POLE
2 to 23 Positions

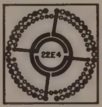


6 POLE
2 to 15 Positions

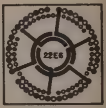
15° INDEXING NON-SHORTING



2 POLE
2 to 23 Pos with Stops
24 Pos Continuous Rot



4 POLE
2 to 12 Positions



6 POLE
2 - 8 Positions

SPECIFICATIONS

ELECTRICAL

Current Ratings: Carry — 10 amps, continuous
Make and Break, 2 amps up to 120 VAC or up to 30 VDC at 10,000 and 20,000 cycles respectively.
Higher loads may be switched with shorter life.

Contact Resistance: .003 ohms max., initial
.010 ohms max., end of life

Insulation Resistance: > 10^{14} ohms

Voltage Breakdown: Between Poles — 2,000 V. RMS
Between Contacts — 1500 V. RMS
Between Decks — 6,000 V. RMS
Circuit to Frame — 3,000 V. RMS

MECHANICAL

Terminal Strength: Withstands 5 lbs. pull.
Detent: Star wheel type
Stop Strength: Withstands 50 in-lbs.
Mounting: 2 hole type, see outline drawings.
Construction: Open frame type

MATERIAL

Current Carrying Parts: Solid Silver-Alloy
Terminals: Turret type capable of attaching two 20 AWG wires. Terminals are integral with contacts.
Decks: Glass Epoxy per Mil-P-18177
Detent and Shaft Assembly: Stainless Steel

ENVIRONMENTAL

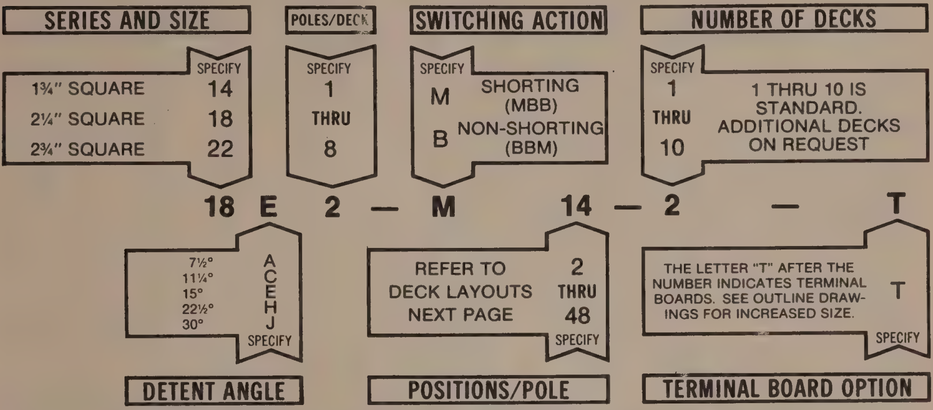
Temperature Range: Commercial, —40°C. to +85° C. Military, —65°C. to +125°C.
Other: Designed to meet the general requirements of Mil-S-3786.

Shallco

14, 18, 22 SERIES ROTARY SWITCHES

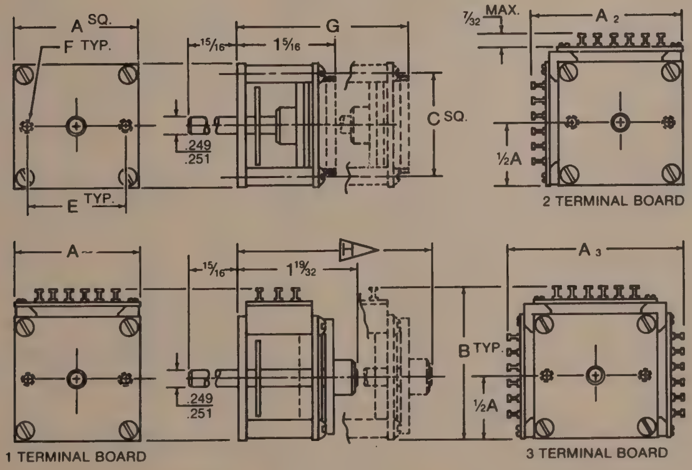
DEVELOPING THE TYPE NUMBER

The system below will assist you in specifying the correct part number of the switch required for your application. Submit any special shaft modifications or other desired modifications as separate data. Our Engineering Department can assist you with major variations.


SERIES AND SIZE
SPECIFY
1¾" SQUARE 14
2¼" SQUARE 18
2¾" SQUARE 22
POLES/DECK
SPECIFY
1
THRU
8
SWITCHING ACTION
SPECIFY
M SHORTING (MBB)
B NON-SHORTING (BBM)
NUMBER OF DECKS
SPECIFY
1
THRU
10
1 THRU 10 IS STANDARD. ADDITIONAL DECKS ON REQUEST
18 E 2 — M 14 — 2 — T
7½° A
11¼° C
15° E
22½° H
30° J
SPECIFY
DETENT ANGLE
REFER TO DECK LAYOUTS NEXT PAGE
2
THRU
48
SPECIFY
POSITIONS/POLE
THE LETTER "T" AFTER THE NUMBER INDICATES TERMINAL BOARDS. SEE OUTLINE DRAWINGS FOR INCREASED SIZE.
T
SPECIFY
TERMINAL BOARD OPTION

Example: 18E2-M14-2-T is a series 18, 2¼" square, 15° indexing, 2 poles per deck, shorting (make before break), 14 position, 2 deck switch with terminal boards.

OUTLINE DRAWINGS


A SQ.
F TYP.
E TYP.
15/16
1 5/16
G
.249
.251
C SQ.
7/32 MAX.
A 2
½A
2 TERMINAL BOARD
A
15/16
1 19/32
H
A 3
B TYP.
½A
.249
.251
1 TERMINAL BOARD
3 TERMINAL BOARD

Back-Panel Depth				
No. of Decks	G		H ▷	
	Series 14	Series 18 & 22	Series 14	Series 18 & 22
2	2¼	2 9/32	2½	2 9/16
3	3 3/16	3¼	3 7/16	3 17/32
4	4⅛	4 7/32	4⅜	4½
5	5 1/16	5 3/16	5 5/16	5 15/32
6	6	6 5/32	6¼	6 7/16
7	6 15/16	7⅛	7 3/16	7 13/32
8	7⅞	8 3/32	8⅛	8⅜
9	8 13/16	9 1/16	9 1/16	9 11/32
10	9¾	10 1/32	10	10 5/16

NOTES:

H ▷ The H Dimension for a two and three terminal board switch is the same, for the corresponding number of decks, as the H dimension for the single terminal board switch.

Tolerances:
Decimals ± .010
Fractions ± 1/32

Terminals Per Deck (Max.)			
Series	No. Terminal Boards		
	1	2	3
14	18	36	54
18	24	48	72
22	30	60	90

Standard Dimensions							
Series	A	A_2	A_3	B	C	E	F
14	1¾	2 3/16	2⅝	2 3/16	1.438	1.375	6-32
18	2¼	2⅝	3	2⅝	1.875	1.500	8-32
22	2¾	3 1/16	3⅜	3 1/16	2.250	1.500	8-32

P. O. BOX 1089
TEL. 919/934-3135

SMITHFIELD, N. C. 27577
TWX 510-939-1455

Shallco

CUSTOM INSTRUMENT SWITCHES

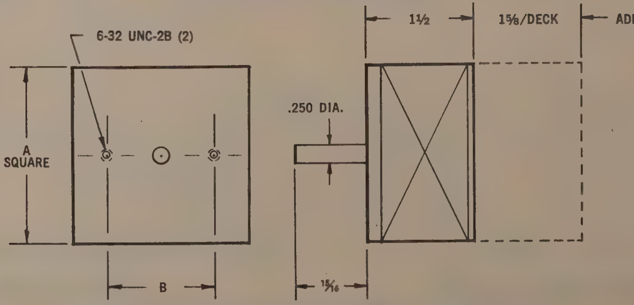
THE CES SERIES ROTARY SWITCHES ARE AVAILABLE IN MANY STYLES. ALL SWITCHES ARE PRECISION MADE FROM STANDARD TOOLS IN PREMIUM MATERIALS AT REASONABLE PRICES IN ALL QUANTITIES.

	Maximum Positions	Dim. A	Dim. B	Contact Spacing	Max. Postions with Stops	Deck Type
SINGLE POLE PER DECK — **SHORTING** — **1-8 DECKS**	20	1¾	1¼	18°	20	A9
	22	1¾	1¼	16.36°	22	A21
	26	2⅛	1½	13.84°	25	B29
	30	2⅛	1½	12°	29	B21
	36	2⅛	1½	10°	35	B1
	40	3	1½	9°	39	N3
	45	3	1½	8°	44	N9
	50	3⅝	2½	7.2°	49	D19
	60	3⅝	2½	6°	58	D5
	72	5	2½	5°	70	E1
	80	5	2½	4.5°	77	F7
	100	7	2½	3.6°	98	H3
	120	7	2½	3°	116	H1
	144	8	2½	2.5°	139	K1

	Maximum Positions	Dim. A	Dim. B	Contact Spacing	Max. Postions with Stops	Deck Type
TWO POLES PER DECK — **SHORTING** — **1-8 DECKS**	9	1¾	1¼	18°	9	A11
	10	1¾	1¼	16.36°	10	A27
	14	2⅛	1½	12°	14	B35
	17	2⅛	1½	10°	17	B5
	40	3	1½	9°	39	N13
	45	3	1½	8°	44	N17
	60	4	2½	6°	58	E15
	72	5	2½	5°	70	F11
	80	6	2½	4.5°	77	G5

	Maximum Positions	Dim. A	Dim. B	Contact Spacing	Max. Postions with Stops	Deck Type
3 TO 4 POLES PER DECK — **SHORTING** — **1-8 DECKS**	16	2½	1½	10°	16	C5
	19	3	1½	9°	19	N23
	21	3	1½	8°	21	N29
	28	4	2½	6°	28	E7
	34	5	2½	5°	34	F3
	36	6	2½	4.5°	36	G7

OUTLINE DIMENSIONS



Shallco

CUSTOM INSTRUMENT SWITCHES

	Maximum Positions	Dim. A	Dim. B	Contact Spacing	Max. Postions with Stops	Deck Type
SINGLE POLE PER DECK — NON-SHORTING — 1-8 DECKS	11	1¾	1¼	32.72°	11	A10
	13	2⅛	1¼	27.69°	13	B10
	15	2⅛	1¼	24°	15	B12
	16	2⅛	1¼	22.5°	16	B16
	18	2½	1¼	20°	18	C2
	20	2½	1¼	18°	20	C12
	24	3	1¼	15°	24	N10
	25	3⅝	1¼	14.4°	24	D14
	30	3⅝	2½	12°	29	D6
	36	5	2½	10°	35	F2
	40	5	2½	9°	39	F8
	50	6	2½	7°	50	G2
	60	7	2½	6°	58	H2
	72	8	2½	5°	70	K2
TWO POLES PER DECK — NON-SHORTING — 1-8 DECKS	Maximum Positions	Dim. A	Dim. B	Contact Spacing	Max. Postions with Stops	Deck Type
	7	2⅛	1¼	24°	7	B22
	9	2⅛	1¼	20°	9	B6
	18	2½	1¼	20°	18	C28
	11	3	1¼	16°	11	N16
	20	3	1¼	18°	20	N30
	30	4	2½	12°	29	E12
	36	5	2½	10°	35	F10
	40	6	2½	9°	38	G8
3 TO 4 POLES PER DECK — NON-SHORTING — 1-6 DECKS	Maximum Positions	Dim. A	Dim. B	Contact Spacing	Max. Postions with Stops	Deck Type
	9	2½	1¼	20°	9	C6
	10	3	1¼	18°	10	N36
	11	3	1¼	16°	11	N38
	14	4	2½	12°	14	E20
	17	5	2½	10°	17	F4
	19	6	2½	9°	19	G6

SPECIFICATIONS

ELECTRICAL

1. SILVER ALLOY SWITCHING
2. CURRENT CAPACITY: SWITCH — 2 AMPS.
   CARRY — 10 AMPS.
3. CONTACT RESISTANCE: 3-5 MILLIOHMS

MECHANICAL

1. ALUMINUM MTG. PLATE
2. GLASS EPOXY DECKS
3. BALL TYPE DETENT
4. LIFE: >20,000 CYCLES

ORDERING CODE

CES — I B21 — I — 28

STYLE
DECK TYPE
NO. POSITIONS
NO. DECKS
POLES/DECK

SHALLCO INCORPORATED
P.O. 1089 HWY. 301 SOUTH
SMITHFIELD, N.C. 27577
TEL. (919) 934-3135
TWX 510-939-1955

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switches

Nature seldom makes mistakes. Likewise Shigoto. You get fewer out-of-tolerance switches from us. And, because we control manufacture from design to delivery, you get them when you want them. Any way, shape or form you want them. Shigoto *has* to save OEM's production dollars. Naturally! We make a living helping you make money.

Some of the standard items in the Shigoto switch lineup:

- slide type
- toggle
- rocker type
- snap action
- lever type
- illuminated
- keyboard
- rotaries
- thumb wheel
- P.C. board type
- knife type
- limit type
- ganged
- reed type
- key lock
- foot pedal

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350 Fifth Avenue, New York, N.Y. 10001/ (212) 695-0200/ Telex 224219

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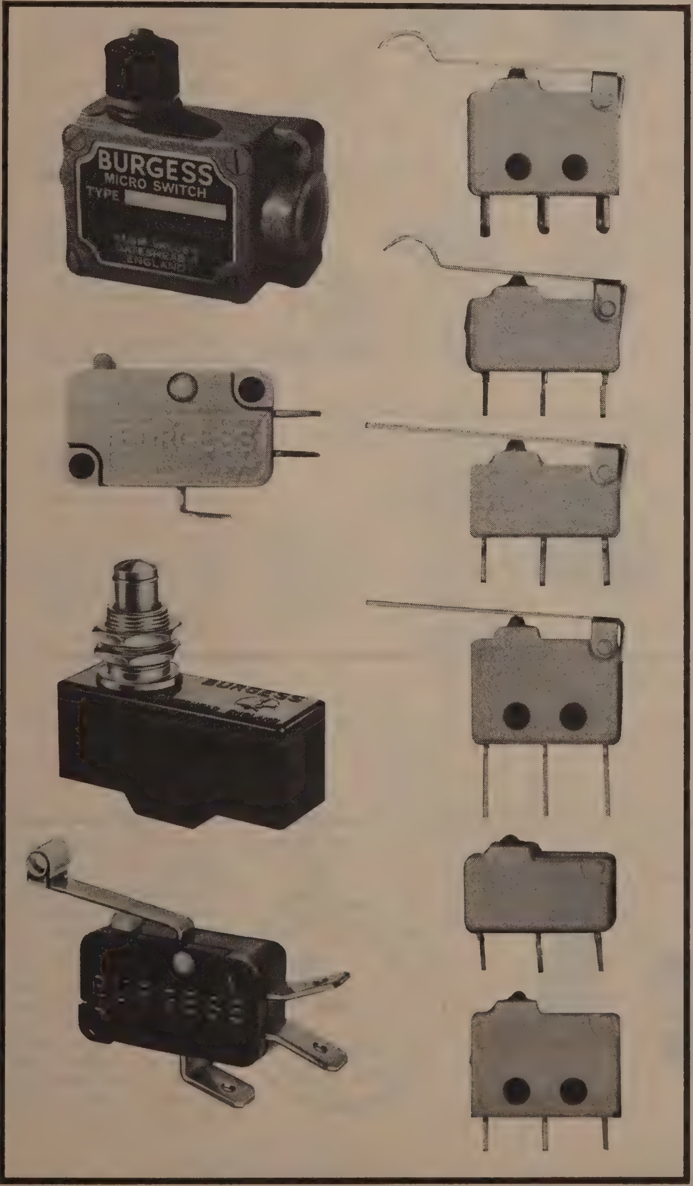
...your source for brand name switches through local electronics distributors



switches from SPEMCO®

- miniature
- sub-miniature
- proximity
- lever
- snap-action
- limit
- pushbutton
- locking

Burgess micro switches are available from SPEMCO®

- moulded and metal case
- limit
- double break
- manual
- miniature, sub-miniature and micro-miniature

Brandname, speciality switches, at competitive prices, are available to you from Spemco at your local electronics distributor. Spemco switches can fill your needs, whether they be for prototypes, lab designs, production quantities, or for maintenance-repair-operations.

NEW CATALOG AVAILABLE

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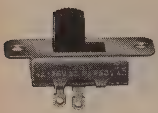
Doug Gmeiner, president
23425 Harper Ave.
St. Clair Shores, MI. 48080
Telephone (313) 771-2700.

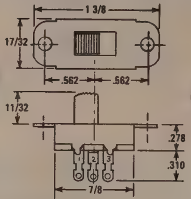
STACKPOLE®

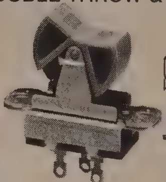
SLIDE AND ROCKER SWITCHES

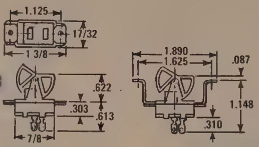
Stackpole is the world's largest producer of slide and rocker switches for the appliance, power tool and electronic industries. For a complete specification guide to all types of Stackpole slide and rocker switches, request Bulletin 78/79-102.

SINGLE POLE—SINGLE THROW, DOUBLE THROW & THREE POSITION



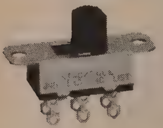

1 3/8
17/32
.562
.562
11/32
1 2 3
.278
.310
7/8

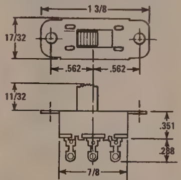


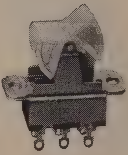

1.125
17/32
1 3/8
.622
.303
.613
7/8
1.890
1.625
.087
1.148
.310

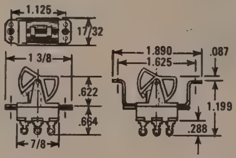
UL & CSA ratings from 3 amp 125 VAC to 11 amp 125 VAC. Variable knob styles in a wide spectrum of colors. Detent, smooth, and momentary actions. Types available with fire resistant material and TV ratings. Rocker switches available with flat or offset brackets.

DOUBLE POLE—DOUBLE THROW



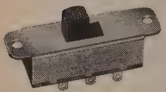

1 3/8
17/32
.562
.562
11/32
.351
.288
7/8

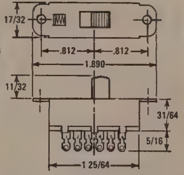


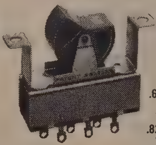

1.125
17/32
1 3/8
.622
.664
7/8
1.890
1.625
.087
1.199
.288

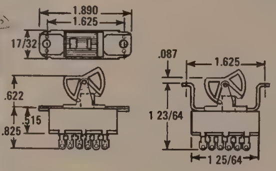
UL & CSA ratings from 1 amp 125 VAC to 4 amp 125 VAC. Double wipe contacts and gold plating available on request for low current applications. Detent and smooth action. Rocker switches come with flat or offset brackets.

DOUBLE POLE—DOUBLE THROW, THREE POSITION & FOUR POSITION



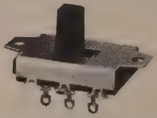

17/32
.812
.812
1.890
11/32
31/64
5/16
1 25/64

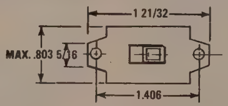


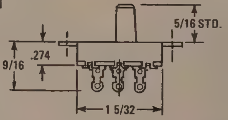

1.890
1.625
17/32
.622
.515
.825
.087
1.625
1 23/64
1 25/64

UL & CSA ratings at 6 amp 125 VAC, 3 amp 250 VAC. Variable knob heights and colors. Solder lug and PC terminals. Rugged performance and long life. Detent, smooth, and momentary actions. Rocker knob lettering available on request. Flat or offset rocker brackets.

TRIPLE POLE—TWO POSITION & THREE POSITION



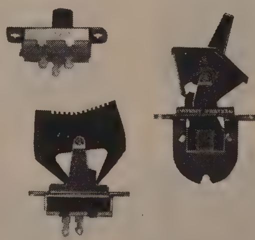

1 21/32
MAX. .803
5/16
1.406


5/16 STD.
.274
9/16
1 5/32

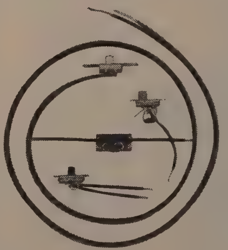
Double wipe contact series. Ideal for low-current applications.

TV RATED SWITCHES

For TV Rated Switch requirements, Stackpole is the sole producer of both slide and rocker switches and snap-over-center rotary action switches. The basic slide switch with TV-1 Rating in SP-ST or SP-DT can be modified with glamor caps, toggles and mounting brackets. The basic TV-3 Rated, snap-over-center rotary action switch is SP-ST or SP-DT.



WIRE LEADS AND OTHER FEATURES



Standard Stackpole slide and rocker switches can be provided with additional features which lower assembly cost and tailor units for specific applications. Switches are available with wire leads, diodes and rectifiers preassembled at the factory. The diode switch becomes a multiple speed control device, eliminating multiple tap windings and complex circuitry.

STACKPOLE COMPONENTS CO. • FARMVILLE, VA. 23901 • PHONE: 804-392-4111

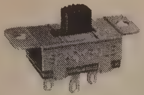
STACKPOLE

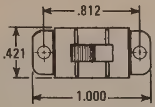
MINIATURE SLIDE SWITCHES

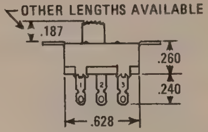
Stackpole miniature slide switches are engineered to the same high standards as the full-size line, provide long life and excellent reliability where space is critical. For complete information, request Bulletin 78-903.

SINGLE POLE—SINGLE THROW & DOUBLE THROW DOUBLE POLE—SINGLE THROW & DOUBLE THROW

Available with UL & CSA* inductive load ratings of 1 amp or 3 amp @ 125 VAC (.5 amp @ 125 VDC). Spring return SP-ST and SP-DT also available.



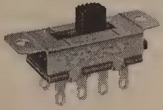

.812
.421
1.000

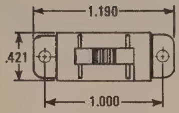

OTHER LENGTHS AVAILABLE
.187
.260
.240
1
2
3
.628

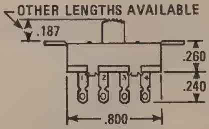
*CSA listing requires use of solder guard.

SINGLE POLE—THREE POSITION DOUBLE POLE—THREE POSITION

Available with UL & CSA* inductive load ratings of 1 amp or 3 amp @ 125 VAC (.5 amp @ 125 VDC). Spring return to center from each direction available on single pole, not UL listed.



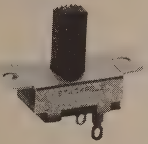

1.190
.421
1.000

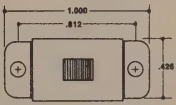

OTHER LENGTHS AVAILABLE
.187
.260
.240
1
2
3
4
.800

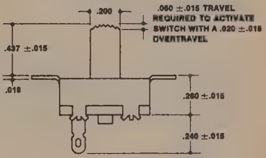
*CSA listing requires use of solder guard.

PUSHBUTTON, MOMENTARY NORMALLY OPEN, SP-ST

(NOT RATED)

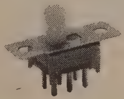


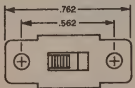

1.000
.812
.426

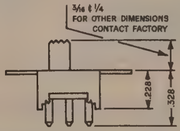

.200
.060 ±.015 TRAVEL REQUIRED TO ACTIVATE SWITCH WITH A .020 ±.015 OVERTRAVEL
.437 ±.015
.016
.260 ±.015
.240 ±.015

SUB-MINIATURE SLIDE SWITCHES

Available in single pole, double throw with inductive load ratings of 1 amp @ 125 VAC and double pole, double throw, not rated.






3/16 & 1/4
FOR OTHER DIMENSIONS CONTACT FACTORY
.228
.328

ADVANTAGES

Simplicity of design, automated assembly, and thorough production testing make these miniature slide switches a quality buy at an economy price. Large-area, silver-clad contacts ensure long life. Special fiber-surfaced FSXP bases reduce arc-tracking. XXXP & other grades also available.

All AC ratings are for inductive loads at .75-.80 power factor.

Contact arrangements are break-before-make (nonshorting).

Silver-plated solder lug terminals are standard, permit fast, positive soldering. PC or space-saver terminals may be specified as options. PC terminals are available with case mounting ears removed. Solder guards can be supplied separately or assembled to switches.

Optional models for low-current switching have special gold-plated contacts and terminals.

Black nylon triggers 3⁄16" high are standard for all slide switches. Options include an entire spectrum of colors and heights of ⅛", .200", ¼", ⅜", or ½".

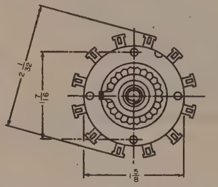
STACKPOLE COMPONENTS CO. • FARMVILLE, VA. 23901 • PHONE: 804-392-4111

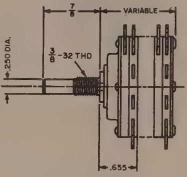
STACKPOLE

ROTARY SWITCHES

Stackpole rotary switches combine the high reliability of fully enclosed, modular construction with economy and a wide range of off-the-shelf options. Three separate series provide sizes and configurations to meet any application need. For complete specifications of standard rotary switches, request Bulletin 73-103.

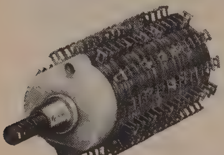
SERIES 600—1⅝" DIA. ENVIRONMENT-PROOF ROTARY SWITCH

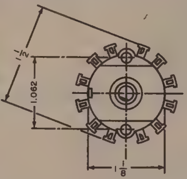


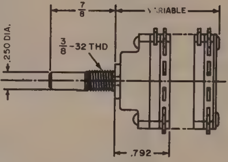


Index Angles	15°, 30°, 60°, 90°
No. of Decks	15°—3 max. 30°, 60° & 90°—15 max.
Poles per Deck	15°—12 max. 30°— 6 max. 60°— 4 max. 90°— 3 max.

SERIES 100—1⅛" DIA. ENVIRONMENT-PROOF ROTARY SWITCH

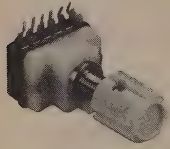


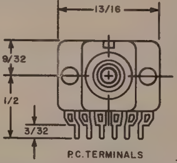


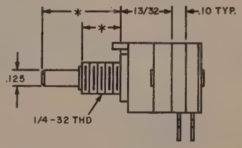


Index Angles	22½°, 30°, 36°, 45°, 60°, 90°
No. of Decks	20 max. for any Index Angle
Poles per Deck	30°, up to 6, max. 36°, up to 5, max. 60°, 4 max. 90°, 3 max. *22½° & 45°—Consult Stackpole

SERIES 80—SUBMINIATURE ENVIRONMENT-PROOF RECTANGULAR ROTARY SWITCH







PC or Solder Lug Terminals

Index Angles	30°, 60°, 90°
No. of Decks	30°, 10 max. 60°, 10 max. 90°, 10 max.
Poles per Deck	30°, up to 6, max. 60°, up to 4, max. 90°, up to 3, max.

ELECTRICAL SPECIFICATIONS

	Series 80	Series 100	Series 600
Breakdown Voltage (Sea Level)			
Terminal to terminal	600 VAC	1000 VAC	1000 VAC
Terminal to ground	1000 VAC	2000 VAC	2000 VAC
Electrical Rating (Resistive Load)			
Silver-plated brass contacts			
At 125 VAC	.050 Amp	.3 Amp	.5 Amp
At 28 VDC	.1 Amp	.5 Amp	1 Amp
Silver-alloy contacts			
At 125 VAC	.075 Amp	.5 Amp	1 Amp
At 28 VDC	.125 Amp	1 Amp	2 Amp
Current-carrying capacity (Max temp rise, 30° C)	6 Amp	15 Amp	25 Amp
Contact Resistance (Silver-Plated Brass)			
Average initial, less than	.005 Ohm	.003 Ohm	.003 Ohm
Maximum initial	.010 Ohm	.010 Ohm	.010 Ohm

ADVANTAGES

All series feature totally enclosed designs, seal out dirt, moisture and corrosion, seal in lubrication. Rugged, torsionally rigid assemblies withstand rough usage. Series 100 conforms to MIL-S-3786 for shock, vibration and explosion-proofing.

Series 80 has 13/16" x 9/16" body with in-line pins, ideal for either PC board insertion or hand solder applications.

DELIVERY

Fastest in the industry. Within one week for standard configurations, within two weeks on specials (samples in 2-3 days). Request Bulletin 73-102 for information and method of specifying custom-design switches.

STACKPOLE COMPONENTS CO. • P. O. BOX 14466 • RALEIGH, N. C. 27610 • PHONE: 919-828-6201

STACKPOLE

Lo-Pro™ KEYSWITCHES & KEYBOARDS

Reliable and economical, Stackpole's data entry keyswitches provide optimum human-factors design, with low profile, .160" key travel (.100" & .125" optional), 3-ounce operating force and sealed case. Available in momentary and latching types, and in standard keyboard arrays for calculators, computer terminals, touch-tone communications equipment, electronic tuning, credit-card verifiers, point-of-sale devices, industrial controls, instruments, etc.

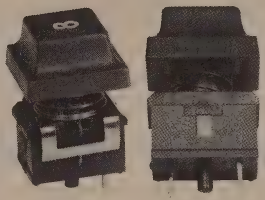
Lo-Pro KEYSWITCHES

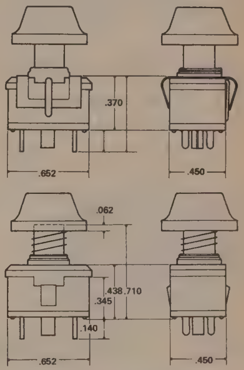
Lo-Pro 5—5,000,000 operations
Lo-Pro 20—20,000,000 operations

Exclusive Stackpole design using only six basic components makes these high-reliability keyswitches the best choice for all types of data entry applications. With a body profile of less than 7/16", wave-solderable terminals, and self-aligning, snap-in mounting design for both PC boards and metal panels, these switches facilitate fast, economical assembly. Keyswitch plunger cruciform can be varied to accept a variety of key cap styles.

Exclusive coil-spring, crosspoint-type contacts with controlled wipe are self-cleaning, provide high force per unit of contact area. The Form A contacts are rated at 5 milliamps, up to 15 volts. Initial contact bounce is typically less than 1.0 millisecond, initial contact resistance for Lo-Pro 5 less than .2 ohm and for Lo-Pro 20 less than 200 ohms.

For complete specifications, request Bulletin 77-103.



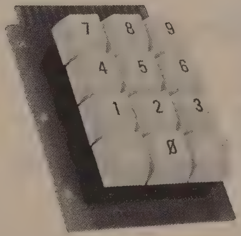


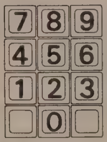
Lo-Pro CALCULATOR & COMMUNICATIONS KEYBOARDS

These keyboard arrays use Stackpole's Lo-Pro 5 (standard) or Lo-Pro 20 (optional) momentary keyswitches mounted either on PC boards that accept standard edgeboard connectors with .156" centers, or in metal panels, prealigned and ready to plug into your PC board. Either style simplifies keyboard installation and substantially reduces assembly costs.

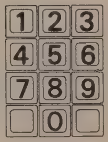
Keyboards can also be ordered with Lo-Pro latching switches.

Keyboards in either the calculator or communications format can be supplied with single or double keycaps in truncated or low-profile revolute shapes to complement equipment styling. Special colors and a variety of special keycap legends can be provided to suit any application. For further information, request Bulletin 77-105.





Calculator



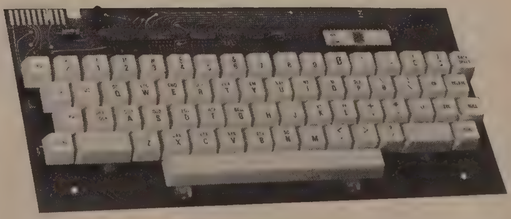
Touch Tone

Lo-Pro TERMINAL KEYBOARD
ASCII

This standard, off-the-shelf keyboard for computer terminal applications uses Lo-Pro 20 keyswitches which are rated at 20,000,000 operations to provide maximum life and reliability in a versatile yet economical unit.

The keyboard is completely self-contained, with all necessary control, logic and driver circuits on the PC board in which the keyswitches are mounted. Full 64-key, 3-mode, two-key rollover & ASCII encoding. Output drivers provide TTL/DTL/CMOS compatibility, 7-bit positive or negative data output plus odd or even parity, positive and negative strobe pulse.

An optional version is available with Lo-Pro 5 keyswitches. For further information, request Bulletin 77-106.



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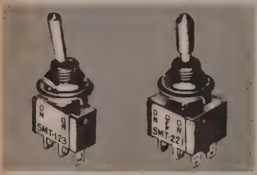
SPRAGUE SWITCHES

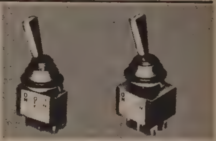


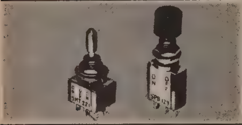
SERIES SMT SUBMINIATURE TOGGLE SWITCHES, BAT HANDLE

- SPDT and DPDT types listed by Underwiters' Labs.
- Combine drastic reduction in size and weight with trouble-free performance.
- Widely used in "today's" low-current, solid state equipment.
- Available in popular double-throw circuit configurations.
- Constructed of high-quality materials, featuring coin silver switching contacts, rockers.
- Toggle caps for color coding available. Cat. No. SWH-100 is assortment of 8 – 2 each black, blue, red, white. SWH-101, white; SWH-102, blue; SWH-103, black; SWH-104, yellow; SWH-105, green; SWH-106, grey; SWH-107, red. All except SWH-100, 50 per pkg.

SERIES SMF SUBMINIATURE TOGGLE SWITCHES, FLAT HANDLE

- Llisted by Underwriters' Laboratories.
- Same quality construction as Series SMT.
- Specially-designed handles provide ease of grasp, good sense of direction of throw, enhance panel appearance.
- Satin-finish chrome flat handle (paddle lever).
- Ideal for quick visual alignment of 2 or 25 switches in a row.
- Unique pinned toggle design prevents rotation of handle.



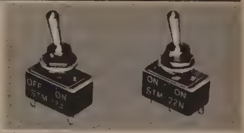


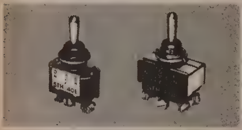
SERIES SPB SUBMINIATURE PUSH-BUTTON SWITCHES

- SPB-123 is a maintained action switch (push to make and break contact).
- SPB-126 is a momentary action switch (normally open, or normally closed).
- Caps for color coding (10 per pkg.) include Cat. No. SWH-201, white; SWH-203, black; SWH-207, red.

SERIES STM MEDIUM-DUTY TOGGLE SWITCHES

- Listed by Underwriters' Laboratories.
- For use where ruggedness, durability are more important than size.
- Self-wiping, heavily silver-plated double-grip contacts ensure dependability, long life.
- Includes standard mounting hardware.





SERIES STH HEAVY-DUTY TOGGLE SWITCHES

- Listed by Underwriters' Laboratories.
- Well constructed with specially selected materials.
- Silver alloys on contact surface areas insure extra overload protection, heat dissipation, and low contact resistance for greater reliability.
- Solderable No. 6-32 electro-tinned screw terminals.

SERIES SAS APPLIANCE TOGGLE SWITCHES

- Listed by Underwriters' Laboratories.
- Excellent replacements for ON-OFF switches widely used on many types of home and commercial appliances.
- SAS-300, screw terminals; SAS-500, 6" leads.
- Silver-on-brass contacts, nickel-on-brass bushings.

SAS-300
SAS-500

Description	Cat. No.	Circuit Type	Toggle Lever or Button Action	No. of Terminals	Nom. Rating (amperes) 125 VAC	Nom. Rating (amperes) 250 VAC	Bushing Size L. x D.	Body Size L. x T. x H.	Lever Lgth.	Photo No.
Subminiature Toggle, Bat Handle	SMT-121	SPDT	ON-OFF-ON	3	5	3	.352 x .250	.500 x .260 x .350	.400	1
	SMT-123	SPDT	ON-NONE-ON	3	5	3	.352 x .250	.500 x .260 x .350	.400	1
	SMT-126	SPDT	ON-NONE-ON*	3	5	3	.352 x .250	.500 x .260 x .350	.400	1
	SMT-221	DPDT	ON-OFF-ON	6	5	3	.352 x .250	.500 x .450 x .350	.400	1
	SMT-223	DPDT	ON-NONE-ON	6	5	3	.352 x .250	.500 x .450 x .350	.400	1
	SMT-321	3PDT	ON-OFF-ON	9	5	3	.352 x .250	.500 x .652 x .415	.400	1
	SMT-323	3PDT	ON-NONE-ON	9	5	3	.352 x .250	.500 x .652 x .415	.400	1
	SMT-421	4PDT	ON-OFF-ON	12	5	3	.352 x .250	.500 x .834 x .415	.400	1
	SMT-423	4PDT	ON-NONE-ON	12	5	3	.352 x .250	.500 x .834 x .415	.400	1
Subminiature Toggle, Flat Handle	SMF-121	SPDT	ON-OFF-ON	3	5	3	.352 x .250	.500 x 260 x 350	.448	2
	SMF-123	SPDT	ON-NONE-ON	3	5	3	.352 x .250	.500 x .260 x .350	.448	2
	SMF-221	DPDT	ON-OFF-ON	6	5	3	.352 x .250	.500 x .450 x .350	.448	2
	SMF-223	DPDT	ON-NONE-ON	6	5	3	.352 x .250	.500 x .450 x .350	.448	2
Subminiature Push-button	SPB-123	SPDT	push ON, push OFF	3	5	3	.344 x .250†	.500 x .260 x .639	.766	3
	SPB-126	SPDT	momentary ON or OFF	3	5	3	.344 x .250†	.500 x .260 x .639	.719	3
Medium Duty Toggle	STM-12A	SPST	ON-NONE-OFF	2	6	3	.468 x .468	1.250 x .687 x .687	.687	4
	STM-12D	SPDT	ON-NONE-ON	3	3	1	.468 x .468	1.250 x .687 x .687	.687	4
	STM-22K	DPST	ON-NONE-OFF	4	6	3	.468 x .468	1.250 x .687 x .687	.687	4
	STM-22N	DPDT	ON-NONE-ON	6	6	3	.468 x .468	1.250 x .687 x .687	.687	4
Heavy Duty Toggle	STH-40A	SPST	ON-NONE-OFF	2	20	10	.468 x .468	1.125 x .625 x .750	.687	5
	STH-40D	SPDT	ON-NONE-ON	3	20	10	.468 x .468	1.125 x .625 x .750	.687	5
	STH-40E	SPDT	ON-OFF-ON	3	20	10	.468 x .468	1.125 x .625 x .750	.687	5
	STH-50K	DPST	ON-NONE-OFF	4	20	10	.468 x .468	1.327 x .750 x .750	.687	5
	STH-50N	DPDT	ON-NONE-ON	6	20	10	.468 x .468	1.327 x .750 x .750	.687	5
	STH-50P	DPDT	ON-OFF-ON	6	20	10	.468 x .468	1.327 x .750 x .750	.687	5
	STH-50S	DPDT	ON*-OFF-ON*	6	20	10	.468 x .468	1.327 x .750 x .750	.687	5
Appliance Toggle	SAS-300	SPST	ON-OFF	2	6	3	.343 x .468	1.109 x .531 x .546	.687	6
	SAS-500	SPST	ON-OFF	2	6	3	.343 x .468	1.109 x .531 x .546	.687	6

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*momentary

IND-EEM-34-PPAO

†flatted

Sizes subject to change without notice.

RAYTHEON PUSH BUTTON SWITCHES/MP and P SERIES

"P" style
DPDT

"MP" style

A line of momentary contact, miniature push button switches in both snap action and butt contact constructions.

Contacts on the snap action style are gold on brass and are especially recommended for low energy circuits. Terminals are epoxy sealed and the switch can be wired for either normally open or normally closed operation. Snap on nylon caps are available in an assortment of colors.

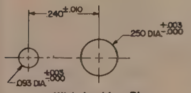
The low cost butt contact switches are available in both normally open and normally closed styles. Contacts are coin silver. Recommended for use where a minimum of behind the panel space is available.

SWITCH DESCRIPTIONS

Model	Contacts	Description
MP1F1*	SPST	N.O. Butt Contact
MP1E1†	SPST	N.C. Butt Contact
P1F1	SPDT	Snap Action
P2F1	DPDT	Snap Action

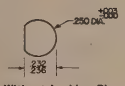
*Red Plunger †Black Plunger

INSTALLATION "P" STYLE



.240 ±.010
.250 DIA. +.003 −.000
.093 DIA. +.003 −.000

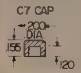
With Locking Ring



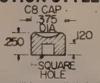
.250 DIA. +.003 −.000
.232
.236

Without Locking Ring

CAPS FOR "P" SNAP ACTION STYLE



C7 CAP
.200 DIA.
.155
.120



C8 CAP
.375 DIA.
.250
.120
SQUARE HOLE

Unless otherwise specified a C7 white cap will be supplied. Available colors are: white, black, red, orange, yellow, green, blue, brown, gray.

SPECIFICATIONS

"MP" BUTT CONTACT STYLE

Contacts: Coin Silver
Contact Rating: 1 ampere resistive load at 120 VAC or 28 VDC or 0.5 amperes at 250 VAC
Terminals: Coin Silver
Insulation Resistance: 10,000 megohms minimum
Dielectric Strength: 1000 volts rms at sea level
Initial Contact Resistance: 10 millohms, maximum
Electric Life: 1,000,000 make and break cycles
Total Plunger Travel: MP1F1 = .110 includes .020 minimum over travel. MP1E1 = .055 includes .020 minimum pre travel.
Actuation Force: 8 ounces ±4
Case: Diallyl Phthalate (DAP)
Bushing: Brass, cadmium plated with clear chromate finish
Hardware: 1 Hex mounting nut; 1 internal tooth lockwasher
Mounting Hole: ¼" diameter

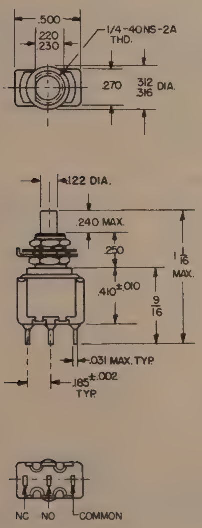
"P" SNAP ACTION STYLE

Contacts: Gold over Brass
Contact Rating: 1 ampere resistive load at 120 VAC or 28 VDC
Terminals: Gold over Brass terminals, epoxy sealed
Insulation Resistance: 1000 megohms minimum
Dielectric Strength: 1000 volts rms at sea level
Electric Life: 60,000 cycles minimum at full load
Mechanical Life: 100,000 make and break cycles, minimum
Maximum Allowable Force on Plunger: 10 pounds
Case: General Purpose Phenolic
Housing: Stainless Steel
Bushing: Cadmium w/clear chromate over brass. High torque to withstand 12 in. lbs.
Hardware: 2 hex mounting nuts, 1 internal tooth lockwasher, 1 locking ring.

DIMENSIONS

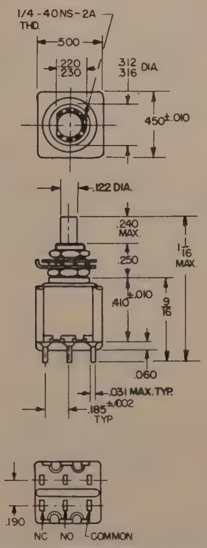
"P" SNAP ACTION STYLE

SPDT



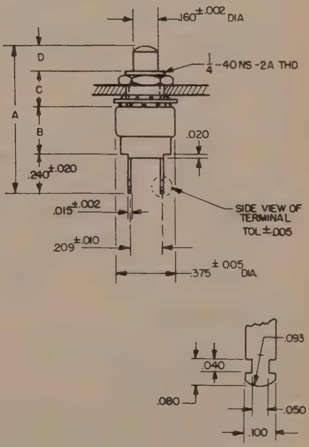
.500
.220
.230
1/4-40NS-2A THD.
.270
.312
.316 DIA.
.122 DIA.
.240 MAX.
.250
1 1/16 MAX.
.410 ±.010
9/16
.031 MAX. TYP.
.185 ±.002 TYP.
NC
NO
COMMON

DPDT



1/4-40NS-2A THD.
.500
.220
.230
.312
.316 DIA.
.450 ±.010
.122 DIA.
.240 MAX.
.250
1 1/16 MAX.
.410 ±.010
9/16
.060
.031 MAX. TYP.
.185 ±.002 TYP.
.190
NC
NO
COMMON

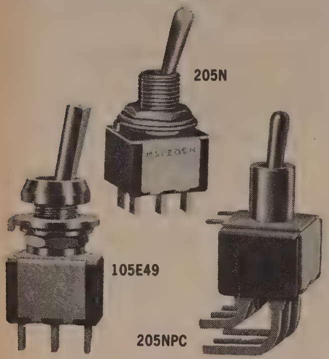
"MP" BUTT CONTACT STYLE



.160 ±.002 DIA
D
1/4-40NS-2A THD
C
A
B
.020
.240 ±.020
.015 ±.002
SIDE VIEW OF TERMINAL TOL ±.005
.209 ±.010
.375 ±.005 DIA
.093
.040
.080
.050
.100

	A (REF)	B ±0.015	C ±0.010	D ±0.015
MP1F1	1.047	0.407	0.227	0.173
MP1E1	1.047	0.407	0.250	0.150

RAYTHEON MINIATURE TOGGLE SWITCHES


205N
105E49
205NPC

A quality ultra-small toggle switch combining high current capacity and long life in a miniature package. The small case size makes it ideally suited for miniaturized equipment with front and rear of panel space limitations.

SPECIFICATIONS

Current Rating: Coin Silver Contacts 5 amperes resistive load at 120 VAC or 28 VDC, or 2 amps at 250 VAC. Brass contacts with gold over nickel plate 0.4 volt-amperes at 20 V max. (AC or DC)

Initial Contact Resistance for Silver: 10 Milliohms at 2-4 VDC, 1 amp

Insulating Resistance: Over 1000 Megohms between terminals and case ground at 500VDC

Voltage Breakdown: 1000VAC between terminals and case ground for a duration of one minute

Operating Force: Below 1.5 Kg.

Life Cycle: 100,000 (40,000 on momentary types) on-off, switching actions at rated current

Moisture Resistance: Over 8 Megohms after 48 hours at 40°C and humidity of 95%

Heat Resistance: One hour at 140°C

Case Material: Black phenolic resin

Contacts and Terminals: Right Angle and PC terminal types brass with 50 millionths gold plate. Other types solid silver (center terminal copper with silver plate)

SWITCH DESCRIPTIONS

Model	Contacts	Description (on) indicates momentary position
Standard Toggle and Terminals		
105D	SPDT	ON-NONE-ON
105E	SPDT	ON-OFF-ON
105F	SPDT	(ON)-ON-NONE
105G	SPDT	(ON)-OFF-(ON)
105H	SPDT	(ON)-OFF-ON
205N	DPDT	ON-NONE-ON
205P	DPDT	ON-OFF-ON
205R	DPDT	(ON)-ON-NONE
205S	DPDT	(ON)-OFF-(ON)
205T	DPDT	(ON)-OFF-ON
205PA	DP3T	ON-ON-ON
305D	3PDT	ON-NONE-ON
305E	3PDT	ON-OFF-ON
405N	4PDT	ON-NONE-ON
405P	4PDT	ON-OFF-ON

Model	Contacts	Description (on) indicates momentary position
Flatted Toggle, Standard Terminals		
105D49	SPDT	ON-NONE-ON
105E49	SPDT	ON-OFF-ON
205N49	DPDT	ON-NONE-ON
205P49	DPDT	ON-OFF-ON
Standard Toggle, PC Terminals		
105D2	SPDT	ON-NONE-ON
105E2	SPDT	ON-OFF-ON
205N2	DPDT	ON-NONE-ON
205P2	DPDT	ON-OFF-ON
305D2	3PDT	ON-NONE-ON
405N2	4PDT	ON-NONE-ON
Short Toggle, Right Angle PC Terminals		
105DPC	SPDT	ON-NONE-ON
105E3	SPDT	ON-OFF-ON
105F3	SPDT	(ON)-ON-NONE
205NPC	DPDT	ON-NONE-ON
205P3	DPDT	ON-OFF-ON

SWITCH ACCESSORIES

Color Caps

Attractive plastic caps that slip over the standard toggle. Packaged in multiples of 25 units. Colors available Red, White, Black, Blue, Gray, Green or Yellow.

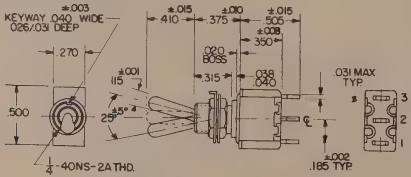
Mounting Nuts

The N-2 hex nut is standard. Three other styles, packaged in multiples of 25 units are available as a separate item.

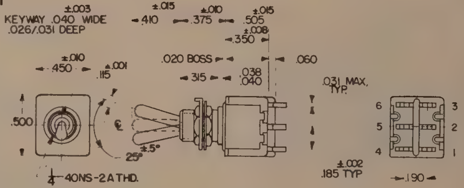
N-1	¼-40 Knurl Nut
N-1A	¼-40 Knurl Panel Dress Nut, with lip for automatic stop
N-2	¼-40 Standard Hex Nut
N-3	¼-40 Panel Dress Nut, Blind thread

STANDARD TOGGLE DIMENSIONS

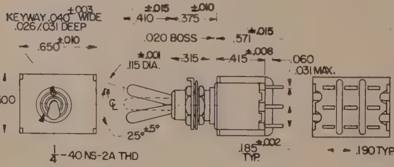
SPDT


KEYWAY .040 WIDE ±.003
.026/.031 DEEP
.410 ±.015
.375 ±.010
.505 ±.015
.350 ±.008
.270
.020 BOSS
.115 ±.001
.315
.038
.040
.031 MAX TYP.
.500
25° ±5°
℄
3
2
1
.185 TYP. ±.002
¼-40NS-2A THD.

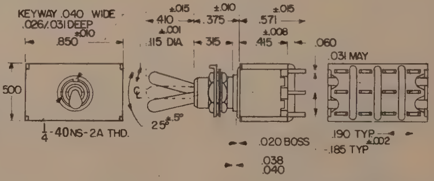
DPDT


KEYWAY .040 WIDE ±.003
.026/.031 DEEP
.410 ±.015
.375 ±.010
.505 ±.015
.350 ±.008
.450 ±.010
.115 ±.001
.020 BOSS
.060
.315
.038
.040
.031 MAX. TYP.
.500
℄
25° ±5°
6
5
4
3
2
1
.185 TYP ±.002
.190
¼-40NS-2A THD.

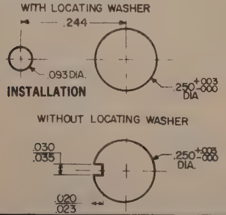
3PDT


KEYWAY .040 WIDE ±.003
.026/.031 DEEP
.410 ±.015
.375 ±.010
.020 BOSS
.571 ±.015
.650 ±.010
.115 DIA. ±.001
.315
.415 ±.008
.060
.031 MAX.
.500
℄
25° ±5°
.185 TYP. ±.002
.190 TYP
¼-40 NS-2A THD

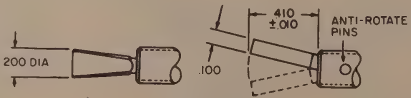
4PDT


KEYWAY .040 WIDE
.026/.031 DEEP
.410 ±.015
.375 ±.010
.571 ±.015
.850 ±.010
.115 DIA ±.001
.315
.415 ±.008
.060
.031 MAY
.500
℄
25° ±5°
¼-40NS-2A THD.
.020 BOSS
.038
.040
.190 TYP
.185 TYP ±.002

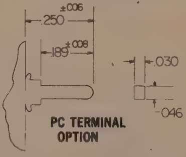
Standard Toggle Installation


WITH LOCATING WASHER
.244
.093 DIA.
INSTALLATION
.250 +.003 -.000 DIA.
WITHOUT LOCATING WASHER
.030
.035
.250 +.003 -.000 DIA.
.020
.023

Flatted Toggle Option


200 DIA
.100
.410 ±.010
ANTI-ROTATE PINS

PC Terminal Option


.250 ±.006
.189 ±.008
.030
.046
PC TERMINAL OPTION

brass w/50 millionths gold plate

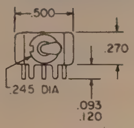
RAYTHEON COMPANY • DISTRIBUTOR PRODUCTS OPERATION
Fourth Avenue, Burlington, Massachusetts 01803 Tel.: (617) 272-6400 TWX: 710-332-7641

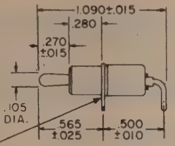
RAYTHEON TOGGLE, ROCKER AND LEVER SWITCHES

MINIATURE TOGGLE SWITCHES (continued)

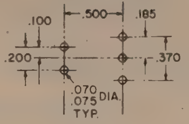
RIGHT ANGLE PC TERMINAL DIMENSIONS

SPDT

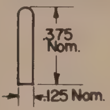

.500
.270
.245 DIA
.093
.120


1.090±.015
.280
.270
±.015
.105
DIA.
.565
±.025
.500
±.010

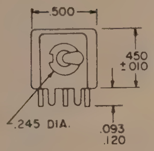
Terminal support is ½ hd brass Electrotin plated

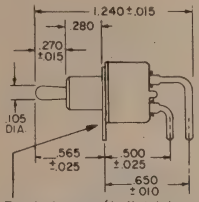

.100
.500
.185
.200
.370
.070
.075
DIA.
TYP.

Color Cap Dimensions
C-9

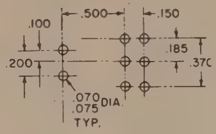

.375
Nom.
.125 Nom.

DPDT


.500
.450
±.010
.245 DIA.
.093
.120


1.240±.015
.280
.270
±.015
.105
DIA.
.565
±.025
.500
±.025
.650
±.010

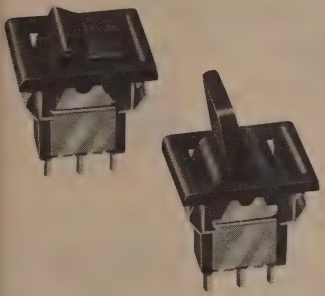
Terminal support is ½ hd. brass Electrotin plated.


.100
.500
.150
.185
.200
.370
.070
.075
DIA.
TYP.

ROCKER AND LEVER SWITCHES

A series of high quality rocker and lever switches with actuators styled to complement modern panel design.

Simple, snap-in, front of panel mounting with spring clips to lock unit firmly on panels with thickness of .062 up to .125. An attractive snap-on nylon bezel is available in colors to match or contrast with the actuator. U/L listed.



SPECIFICATIONS

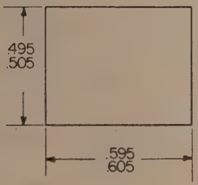
Current Rating: 5 amperes at 120VAC or 28VDC
Initial Contact Resistance: 10 Milliohms max at 2-4VDC, 1 Ampere
Insulation Resistance: 1000 Megohm minimum
Voltage Breakdown: 1000VAC between terminals and case ground for a duration of one minute
Life: 100,000 make-and-break cycles
Case: Black Phenolin Resin
Contacts: Coin Silver
Terminals: Coin Silver
Mounting Bracket: Stainless Steel

SWITCH DESCRIPTIONS

Model	Contacts	Description
R1A1	SPDT	ROCKER
R2A1	DPDT	ROCKER
LE1A1	SPDT	LEVER
LE2A1	DPDT	LEVER

Bezel and Actuator available in white, black, or red. Unless specified will be supplied in black.

INSTALLATION

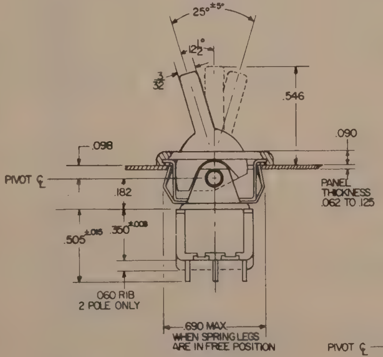

.495
.505
.595
.605

Panel Cut-Out Both Styles

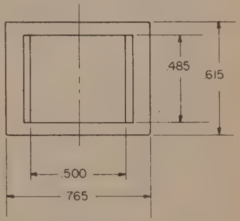
Bezel should be attached before installing switch in panel. Slide the lip on one side of mounting bracket into slot on underside of bezel. Squeeze opposite side of mounting bracket until the other lip on bracket snaps into bezel.

DIMENSIONS

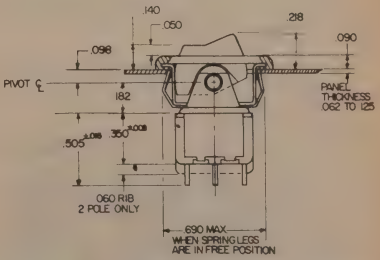
LEVER


25°±5°
12½°
3/32
.546
.090
.098
PIVOT ℄
.182
PANEL THICKNESS .062 TO .125
.505±.015
.350±.008
.060 RIB
2 POLE ONLY
.690 MAX
WHEN SPRING LEGS ARE IN FREE POSITION

Bezel


.485
.615
.500
.765

ROCKER


.140
.050
.218
.090
.098
PIVOT ℄
.182
PANEL THICKNESS .062 TO .125
.505±.015
.350±.008
.060 RIB
2 POLE ONLY
.690 MAX
WHEN SPRING LEGS ARE IN FREE POSITION

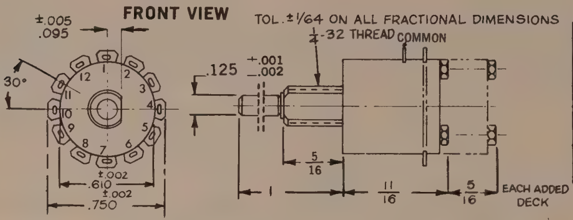
AMF
RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

series "c" miniature rotary switches

- Up to 12 active positions per deck shorting **or** non-shorting, with 30° spacing.
- Shorting **AND** non-shorting poles may be grouped on one deck in any combination.
- As many as 6 poles per deck.
- All individual deck parts are self-contained, and are permanently molded into place.
- Available with adjustable stops.

U.S. Pat. #3352979



POLE (Common) LOCATION	
POLES	AT TERM. #
1	1
2	1, 7
3	1, 5, 9
4	1, 4, 7, 10
5	1, 3, 5, 7, 9
6	1, 3, 5, 7, 9, 11

"OFF-THE-SHELF DELIVERY"

SERIES "CC" (COMMERCIAL VERSION OF SERIES "C")

All specifications and features remain essentially the same as in the Series "C" switch. Electrical specifications are derated by approximately 40%.

Materials and tooling are modified to reduce cost.

Priced at the same level as open frame or wafer switches. Off-the-shelf delivery.

For ordering information see below, but indicate CC. (For example: 11-CCM-2).

ELECTRICAL FEATURES

1. Initial contact resistance — .010Ω max.
2. Current carrying capacity — 5.5 amps.
3. Current breaking capacities
   ¼ amp — 115 V.A.C. resistive
   ¼ amp — 28 V.D.C. resistive
   ⅛ amp — 28 V.D.C. inductive.
4. Dielectric strength (voltage breakdown) —
   a. between any two adjacent positions — 800 v RMs (60 cycles).
   b. between any active position to ground 1500 V (60 cycles).
5. Insulation resistance (measured at 25°C, 50% RH at sea level) — 10^5 megohms.
6. Thermal EMF — 1 microvolt/°C maximum.
7. Capacitance — between adjacent active contacts .5 PFD Max.
8. Capacitance — between contact and common terminal .9 PFD Max.

MECHANICAL FEATURES

1. Life expectancy — in excess of 50,000 mechanical operations.
2. Detent — stainless steel roller-type detent snaps from position to position. Detent housing made of special high-strength plastic, providing positive action and minimal wear.
3. Stop strength — Designed to withstand 10 pounds-inches of torque.
4. "Molded in" terminals give exceptional terminal strength, completely eliminating movement.
5. Terminal locations clearly marked on rear cover plate.
6. On any one deck of a multi-pole switch, a variety of combinations of shorting (MBB) and non-shorting (BBM) actions may be obtained.
7. Materials and finishes:
   Rotor — Lexan
   Rotor blade — Beryllium copper (silver plated)
   Contacts & solder terminals — solid silver alloy
   Housing — Diallyl Phthalate
   Stator — Diallyl Phthalate
   Shaft — stainless steel
   All brass parts nickel plated
8. One piece contact terminal construction has holes large enough to accept two #22 AWG wires.
9. Shaft and panel seal at additional cost may be specified by using prefix "S" before switch type numbers. Bushing and shaft stick-out from mounting surface is reduced by 1/16". Overall length of switch from mounting surface is increased by 1/16".
10. Explosion proof per paragraph 4, p. 12 of MIL-S-3786.

ENGINEERING NOTE
Series "A" available with above specifications but with "wrap-around" turret-type solder lugs. "Across-terminal" dimension is .820 (±.002).

SINGLE DECK

Spacing: 30° between positions

SHORTING

SINGLE POLE

Positions	Type
2	11-CM-2
3	11-CM-3
4	11-CM-4
5	11-CM-5
6	11-CM-6
7	11-CM-7
8	11-CM-8
9	11-CM-9
10	11-CM-10
11	11-CM-11
12	11-CM-12 (with stops)
12	11-CM-12-CR (continuous rotation)

2 POLES PER DECK

Positions	Type
2	12-CM-2
3	12-CM-3
4	12-CM-4
5	12-CM-5
6	12-CM-6

3 POLES

Positions	Type
2	13-CM-2
3	13-CM-3
4	13-CM-4

4 POLES

Positions	Type
2	14-CM-2
3	14-CM-3

5 POLES

Positions	Type
2	15-CM-2

6 POLES

Positions	Type
2	16-CM-2

NON-SHORTING

SINGLE POLE

Positions	Type
2	11-CB-2
3	11-CB-3
4	11-CB-4
5	11-CB-5
6	11-CB-6
7	11-CB-7
8	11-CB-8
9	11-CB-9
10	11-CB-10
11	11-CB-11
12	11-CB-12 (with stops)
12	11-CB-12-CR (continuous rotation)

2 POLES PER DECK

Positions	Type
2	12-CB-2
3	12-CB-3
4	12-CB-4
5	12-CB-5
6	12-CB-6

3 POLES PER DECK

Positions	Type
2	13-CB-2
3	13-CB-3
4	13-CB-4

4 POLES PER DECK

Positions	Type
2	14-CB-2
3	14-CB-3

5 POLES PER DECK

Positions	Type
2	15-CB-2

6 POLES PER DECK

Positions	Type
2	16-CB-2

MULTI-DECK SWITCHES UP TO 12 DECKS AVAILABLE

For multi-deck version of these switches, indicate number of decks as follows. Merely change first number of coding as shown:

Number of decks	
One deck	1 1-CB-4
Two decks	2 1-CB-4
Three decks	3 1-CB-4

"M" = Shorting action (MBB)
"B" = Non-shorting action (BBM)
Supplied unless otherwise specified.

Code: 2 6—CM—2

Positions per pole
shorting
Series
poles per deck
number of decks

e.g. this is 2 decks, 6 poles per deck, Series "C" shorting action, 2 positions per pole.

AMF

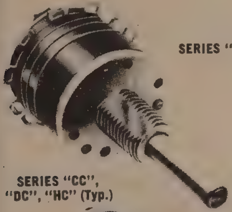
General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

RCL Electronics

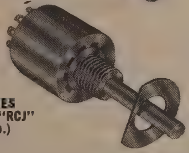
miniature rotary switches
(LOW COST COMMERCIAL VERSIONS)

Completely automated facilities and mass production tooling, now makes RCL highly competitive in commercial applications with "obsolete" wafer-type and open frame switches.

Material and tooling are modified to reduce cost, but comparable performance is maintained with our "standard" series of switches, to correspond with "instrument type" switches.


SERIES "CC", "DC", "HC" (Typ.)

SERIES "EC", "TC" (Typ.)


SERIES "FCJ", "RCJ" (Typ.)

SERIES "FC", "GC", "RC" (Typ.)

RCL STANDARD TYPE	RCL COMMERCIAL TYPE	MAX. POSITIONS PER DECK (Shorting or non-shorting)	MAX. POLES PER DECK	MAX. DECKS AVAIL.
C	CC	12	6	12
D	DC	10	2	12
E	EC	24	12	20
F	FC/FCAC	10	3	1
H	HC	6	3	12
R	RC/RCAC	12	6	1
T	TC	12	6	20
FJ	FCJ	10	3	1
RJ	FRJ	12	4	1

RCL SERIES	BODY DIAM.	MAX. POS. PER DECK	MAX. POLES PER DECK	MAX. NO. OF DECKS
CC	.610	12	6	12
DC	.610	10	2	12
HC	.610	6	3	12
TC	1.380	12	6	20
EC	1.380	24	12	20
FC FCPC	.524	10	3	1
RC RCPC	.586	12	4	1
FCJ	.524	10	3	1
RCJ	.586	12	4	1

MODIFICATIONS OF ELECTRICAL FEATURES

COMMERCIAL TYPE "CC", "DC", "HC", "AC", "FC", "RC"

- Initial contact resistance — .015Ω max.
- Current breaking capacities
  - 1/8 amp — 115 V.A.C. resistive
  - 1/8 amp — 28 V.D.C. resistive
  - 1/8 amp — 28 V.D.C. inductive
- Dielectric strength (voltage breakdown) —
  - a. between any two adjacent positions — 500V (60 cycles)
  - b. between any active position to ground 1000V (60 cycles)

COMMERCIAL TYPES "EC", "TC"

- Current carrying capacity; 6 amps
- Current breaking capacity (Rated Load at 125°C)
  - 1 amp — 115 V.A.C. resistive
  - 3/4 amp — 28 V.D.C. resistive
  - 1/4 amp — 28 V.D.C. inductive

SPECIAL MODIFICATIONS AVAILABLE:

All commercial version RCL switches are available with the following features at additional cost:

- Spring return feature (Series CC and DC only)
- "Push-to-turn" and "pull-to-turn" spring loaded action where an isolated position is required.
- Shaft and panel seals (specify by using prefix "S" when ordering).
- Non-standard shaft and bushing lengths.
- Specially coded outputs, including decimal to binary for digital applications.
- 1/4" diameter shaft and 3/8"-32 threaded bushing (Series CC, DC, HC, AC only)

CONTACT FACTORY FOR COMPLETE SPECIFICATIONS

INDUSTRY'S BEST DELIVERY

AMF
RCL Electronics

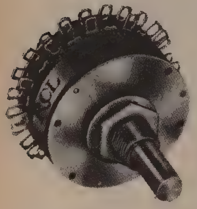
General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

miniature rotary switches

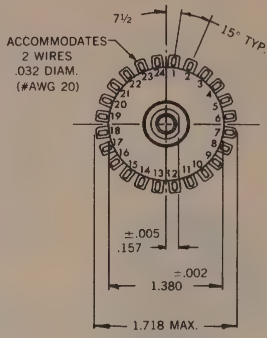
SERIES "E" 1⅜" BODY DIAMETER

AVAILABLE WITH CONCENTRIC SHAFT

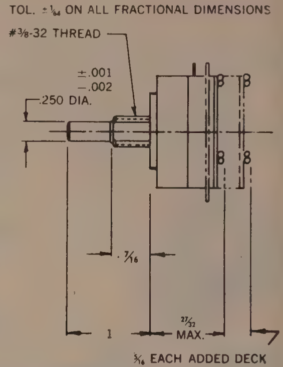
- Up to 24 active positions per deck, **shorting or non-shorting**, and up to 12 poles per deck
- Meets all applicable requirements of Mil S-3786
- Available with concentric shaft
- Available with adjustable stops



Poles	Pole (Common) Location At Term. #
1	1
2	1, 13
3	1, 9, 17
4	1, 7, 13, 19
5	1, 5, 9, 13, 17
6	1, 5, 9, 13, 17, 21
7	1, 3, 5, 7, 9, 11, 13
8	1, 3, 5, 7, 9, 11, 13, 15
9	1, 3, 5, 7, 9, 11, 13, 15, 17
10	1, 3, 5, 7, 9, 11, 13, 15, 17, 19
11	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21
12	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23



FRONT VIEW



SERIES "EC" (LOW COST COMMERCIAL VERSION OF SERIES "E")

OFF-THE-SHELF DELIVERY

All specifications and features remain essentially the same as in the Series "E" switch. Materials and tooling are modified to reduce cost. Electrical specifications are derated by approximately 40%.

Priced at $1.96 each in quantities of 1,000. Priced at the same level as open frame or wafer switches. For ordering information see below but indicate EC. (For example: 11-ECM-2)

ELECTRICAL FEATURES

- Contact resistance: .010 ohms max. initial
- Current carrying capacity: 10 amps
- Current breaking capacity
  - 2 amps — 115 VAC Resistive
  - 1 amp — 28 VDC Resistive
  - .5 amps — 28 VDC Inductive

MECHANICAL FEATURES

- Life expectancy: in excess of 50,000 mechanical operations.
- Rotational Torque: 20 to 80 ounce-inches depending on number of poles per deck and number of decks.
- Stop Strength: 15 pound-inches.
- Solder terminals will accept two .032 diam. (AWG #20) wires.
- "Molded-in" terminals result in exceptionally high contact stability, completely eliminating movement.
- Shaft and Panel Seals at additional cost may be specified by using Prefix "S" before Switch Type Numbers. This reduces bushing and shaft stick-out from mounting surace by 1/16". Overall lengths of switch from mounting surface is increased by 1/16".
- Explosion Proof per paragraph 4.8.12 of Mil-S-3786.
- Weight: 1 Deck Switch 1.75 oz. For each additional deck add .500 oz.

ALSO AVAILABLE IN 12 POSITION VERSION AS SERIES "T"

SINGLE DECK SPACING 15° BETWEEN POSITIONS

SINGLE POLE

Positions	Shorting Type	Non-Shorting Type
2	11-EM-2	11-EB-2
3	11-EM-3	11-EB-3
4	11-EM-4	11-EB-4
5	11-EM-5	11-EB-5
6	11-EM-6	11-EB-6
7	11-EM-7	11-EB-7
8	11-EM-8	11-EB-8
9	11-EM-9	11-EB-9
10	11-EM-10	11-EB-10
11	11-EM-11	11-EB-11
12	11-EM-12	11-EB-12
13	11-EM-13	11-EB-13
14	11-EM-14	11-EB-14
15	11-EM-15	11-EB-15
16	11-EM-16	11-EB-16
17	11-EM-17	11-EB-17
18	11-EM-18	11-EB-18
19	11-EM-19	11-EB-19
20	11-EM-20	11-EB-20
21	11-EM-21	11-EB-21
22	11-EM-22	11-EB-22
23	11-EM-23	11-EB-23
24	11-EM-24	11-EB-24
*24	11-EM-24CR Continuous Rotation	11-EB-24CR Continuous Rotation

2 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	12-EM-2	12-EB-2
3	12-EM-3	12-EB-3
4	12-EM-4	12-EB-4
5	12-EM-5	12-EB-5
6	12-EM-6	12-EB-6
7	12-EM-7	12-EB-7
8	12-EM-8	12-EB-8
9	12-EM-9	12-EB-9
10	12-EM-10	12-EB-10
11	12-EM-11	12-EB-11
12	12-EM-12	12-EB-12

3 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	13-EM-2	13-EB-2
3	13-EM-3	13-EB-3
4	13-EM-4	13-EB-4
5	13-EM-5	13-EB-5
6	13-EM-6	13-EB-6
7	13-EM-7	13-EB-7
8	13-EM-8	13-EB-8

4 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	14-EM-2	14-EB-2
3	14-EM-3	14-EB-3
4	14-EM-4	14-EB-4
5	14-EM-5	14-EB-5
6	14-EM-6	14-EB-6

5 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	15-EM-2	15-EB-2
3	15-EM-3	15-EB-3
4	15-EM-4	15-EB-4

6 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	16-EM-2	16-EB-2
3	16-EM-3	16-EB-3
4	16-EM-4	16-EB-4

7 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	17-EM-2	17-EB-2

8 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	18-EM-2	18-EB-2

9 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	19-EM-2	19-EB-2

10 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	1-10-EM-2	1-10-EB-2

11 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	1-11-EM-2	1-11-EB-2

12 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	1-12-EM-2	1-12-EB-2

ALTHOUGH ONLY 1 DECK IS SHOWN FOR ILLUSTRATIVE PURPOSES, UP TO 20 DECKS ARE AVAILABLE.

AMF

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

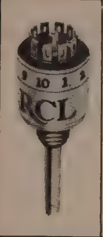
RCL Electronics

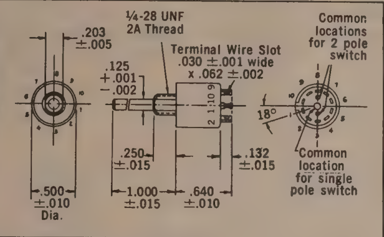
miniature rotary switches

OFF-THE-SHELF DELIVERY

MILITARY QUALIFIED TO MIL-S-3786/20 AND LISTED ON QPL

RCL SERIES "F" 10-POSITION SWITCHES




¼-28 UNF
2A Thread
.203
±.005
.125
+.001
−.002
Terminal Wire Slot
.030 ±.001 wide
x .062 ±.002
Common
locations
for 2 pole
switch
18°
.250
±.015
.132
±.015
Common
location
for single
pole switch
.500
±.010
Dia.
1.000
±.015
.640
±.010

Available with shortened behind panel depth of .563 max.
(Instead of .640 ± .010, specify Series "FF".)

NEW PRODUCT NOTE

NOW AVAILABLE

SERIES "G" 6-POSITION SWITCHES

Specifications are the same as RCL's "F" series, but with 60° throw and non-shorting only. Up to 1 pole-6 position, or 2 pole-3 position.

Available with standard solder lugs or printed circuit terminals.

½" DIAMETER

This new subminiature rotary switch has been designed to offer the features of larger switches in a fraction of the space formerly required.

SPECIFICATIONS FOR BOTH "F" AND "R" SERIES

Contact Resistance: 10 milliohms maximum initial.

Insulation Resistance: 50,000 megohms initial; 10,000 megohms min. between mutually insulated parts.

Voltage Breakdown: 600 VAC min. between mutually insulated parts.

Electrical Rating: Will make and break 50 milliamperes: 115 VAC for 25,000 cycles or 200 milliamperes 115 VAC for 10,000 cycles.

Contacts: Shorting or non-shorting contacts.

Deck and Terminal Arrangement: Available only in one deck with terminals projecting from rear of switch.

Shaft Length, Flat and Orientation: Available in accordance with individual requirements.

Materials and Finishes: In accordance with applicable MIL specs.

Contact Terminals: Solid silver alloy gold plated. Will accept Two #22 AWG wires.

Common: Terminal brass gold plated.

Wipers: Solid silver alloy.

Environmental requirements: Meets or exceeds MIL-S-3786. Explosion proof per paragraph 4.8.12 of MIL-S-3786.

SERIES "F" SINGLE DECK — 36° BETWEEN POSITIONS

SHORTING

SINGLE POLE

Positions	Type
2	11-FM-2
3	11-FM-3
4	11-FM-4
5	11-FM-5
6	11-FM-6
7	11-FM-7
8	11-FM-8
9	11-FM-9
10	11-FM-10
*10	11-FM-10-CR

2 POLES

Positions	Type
2	12-FM-2
3	12-FM-3
4	12-FM-4
5	12-FM-5

3 POLES

Positions	Type
2	13-FM-2
3	13-FM-3

(*continuous rotation)

NON-SHORTING

SINGLE POLE

Positions	Type
2	11-FB-2
3	11-FB-3
4	11-FB-4
5	11-FB-5
6	11-FB-6
7	11-FB-7
8	11-FB-8
9	11-FB-9
10	11-FB-10
*10	11-FB-10-CR

2 POLES

Positions	Type
2	12-FB-2
3	12-FB-3
4	12-FB-4
5	12-FB-5

3 POLES

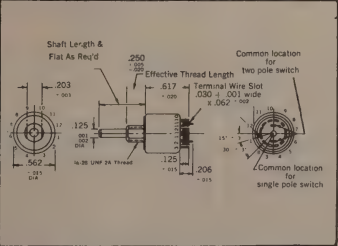
Positions	Type
2	13-FB-2
3	13-FB-3

(*continuous rotation)

ORDERING INFORMATION:
△ Shortened bushing and shaft stick-out available with screwdriver slot for P.C. applications. Specify PCA
△ Shaft and panel seals may be specified by using Prefix "S".
△ Standard terminal with shortened bushing and shaft stick-out available. Contact factory.

SERIES "R" 12-POSITION SWITCHES

MILITARY QUALIFIED TO MIL-S-3786/35 AND LISTED ON QPL


Shaft Length &
Flat As Req'd
.250
+.005
−.020
Effective Thread Length
Common location
for
two pole switch
.203
±.003
.617
±.020
Terminal Wire Slot
.030 ± .001 wide
x .062 ±.002
.125
.001
.002
DIA
¼-28 UNF 2A Thread
.562
±.015
DIA
.125
±.015
.206
±.015
15°
30
Common location
for
single pole switch

**SPECIAL ENGINEERING NOTE
BOTH SERIES ("F" and "R")
AVAILABLE WITH PRINTED CIRCUIT
TERMINALS! (To order specify prefix "PC")**

⁹⁄₁₆" DIAMETER

SHORTING

SINGLE POLE

Positions	Type
2	11-RM-2
3	11-RM-3
4	11-RM-4
5	11-RM-5
6	11-RM-6
7	11-RM-7
8	11-RM-8
9	11-RM-9
10	11-RM-10
11	11-RM-11
12	11-RM-12
*12	11-RM-12-CR

(*continuous rotation)

2 POLES

Positions	Type
2	12-RM-2
3	12-RM-3
4	12-RM-4
5	12-RM-5
6	12-RM-6

3 POLES

Positions	Type
2	13-RM-2
3	13-RM-3
4	13-RM-4

4 POLES

Positions	Type
2	14-RM-2
3	14-RM-3

6 POLES

Positions	Type
2	16-RM-2

NON-SHORTING

SINGLE POLE

Positions	Type
2	11-RB-2
3	11-RB-3
4	11-RB-4
5	11-RB-5
6	11-RB-6
7	11-RB-7
8	11-RB-8
9	11-RB-9
10	11-RB-10
11	11-RB-11
12	11-RB-12
*12	11-RB-12-CR

(*continuous rotation)

† 6 POLE SERIES AVAILABLE WITH STANDARD TERMINALS ONLY

2 POLES

Positions	Type
2	12-RB-2
3	12-RB-3
4	12-RB-4
5	12-RB-5
6	12-RB-6

3 POLES

Positions	Type
2	13-RB-2
3	13-RB-3
4	13-RB-4

4 POLES

Positions	Type
2	14-RB-2
3	14-RB-3

6 POLES†

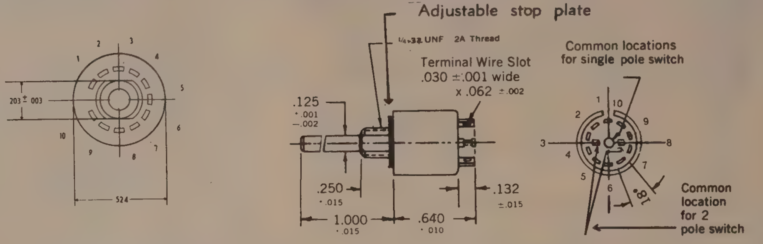
Positions	Type
2	16-RB-2

AMF
RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

miniature rotary switches

RCL SERIES "FCJ" COMPLETELY ENCLOSED SWITCHES WITH ADJUSTABLE STOPS


1
2
3
4
5
6
7
8
9
10
203 ± 003
524
Adjustable stop plate
1/4-32 UNF 2A Thread
Terminal Wire Slot
.030 ±.001 wide
x .062 ±.002
.125 +.001 −.002
.250 +.015
1.000 +.015
.640 +.010
.132 ±.015
Common locations for single pole switch
18°
Common location for 2 pole switch

A subminiature multi-deck rotary switch with adjustable stops . . . permits the user to vary the number of positions!

FEATURES

- From 2 to 10 positions available merely by moving external plate!
- Shorting or non-shorting action available.
- As many as 3 poles possible on one deck!
- Instant switching to any desired number of positions.
- Available with P.C. terminals. To order use Suffix P.C.
- Permits stocking of a minimum number of switch types.
- Ideal for breadboard setups and prototype work — where rapid circuit modification may be desired.

This switch is furnished with one internal fixed stop and one external adjustable stop plate. This permits adjustment of the number of positions.

Adjustments are made merely by rotating the external adjustable plate until its integral stop tab passes through the proper hole in the switch front plate.

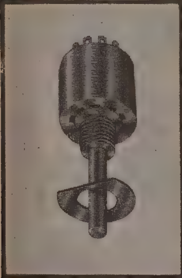
30° SHORTING

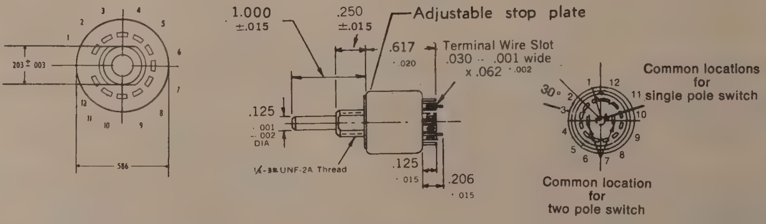
Type No.	Single Deck Number of Poles Per Deck	Maximum Number of Positions Per Pole
11-FCM-10-J	1 pole per deck	2 through 10
12-FCM-5-J	2 poles per deck	2 through 5
13-FCM-3-J	3 poles per deck	2 or 3

30° NON-SHORTING

Type No.	Single Deck Number of Poles Per Deck	Maximum Number of Positions Per Pole
11-FCB-10-J	1 pole per deck	2 through 10
12-FCB-5-J	2 poles per deck	2 through 5
13-FCB-3-J	3 poles per deck	2 or 3

RCL SERIES "RCJ" COMPLETELY ENCLOSED SWITCHES WITH ADJUSTABLE STOPS




1
2
3
4
5
6
7
8
9
10
11
12
203 ± 003
586
1.000 ±.015
.250 ±.015
Adjustable stop plate
.617 +.020
Terminal Wire Slot
.030 ± .001 wide
x .062 ±.002
.125 +.001 −.002 DIA
1/4-32 UNF-2A Thread
.125 +.015
.206 +.015
30°
Common locations for single pole switch
Common location for two pole switch

A subminiature multi-deck rotary switch with adjustable stops . . . permits the user to vary the number of positions!

FEATURES

- From 2 to 10 positions available merely by moving external plate!
- Shorting or non-shorting action available.
- As many as 4 poles possible on one deck!
- Instant switching to any desired number of positions.
- Available with P.C. terminals. To order use Suffix P.C.
- Permits stocking of a minimum number of switch types.
- Ideal for breadboard setups and prototype work — where rapid circuit modification may be desired.

This switch is furnished with one internal fixed stop and one external adjustable stop plate. This permits adjustment of the number of positions.

Adjustments are made merely by rotating the external adjustable plate until its integral stop tab passes through the proper hole in the switch front plate.

30° SHORTING

Type No.	Single Deck Number of Poles Per Deck	Maximum Number of Positions Per Pole
11-RCM-12-J	1 pole per deck	2 through 12
12-RCM-6-J	2 poles per deck	2 through 6
13-RCM-4-J	3 poles per deck	2 through 4
14-RCM-3-J	4 poles per deck	2 or 3

30° NON-SHORTING

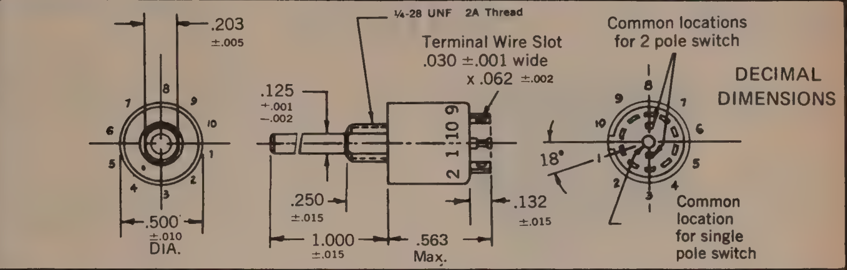
Type No.	Single Deck Number of Poles Per Deck	Maximum Number of Positions Per Pole
11-RCB-12-J	1 pole per deck	2 through 12
12-RCB-6-J	2 poles per deck	2 through 6
13-RCB-4-J	3 poles per deck	2 through 4
14-RCB-3-J	4 poles per deck	2 or 3

INDUSTRY'S BEST DELIVERY

AMF
RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

RCL SERIES "FF" 10-POSITION SWITCHES



For critical applications where "behind panel depth" is at a premium. The overall length of .640 (Type F) has been reduced to .563 on Type FF.

½" diameter

This new subminiature rotary switch has been designed to offer the features of larger switches in a fraction of the space that was formerly required.

SPECIFICATIONS:

Contact Resistance: 10 milliohms maximum initial.

Insulation Resistance: 50,000 megohms initial. 10,000 megohms min. between mutually insulated parts.

Voltage Breakdown: 600 VAC min. between mutually insulated parts.

Electrical Rating: Will make and break 50 milliamperes 115 VAC for 25,000 cycles or 200 milliamperes 115 VAC for 10,000 cycles.

Shaft Length, Flat and Orientation: Available in accordance with individual requirements.

Poles: Any combination of shorting and non-shorting poles is available.

Deck and Terminal Arrangement: Available only in one deck with terminals projecting from rear of switch.

Materials and Finishes: In accordance with applicable MIL specs.

Contact Terminals: Solid silver alloy gold plated. Will accept two #22 AWG wires.

Environmental requirements: Meets or exceeds MIL-S-3786.
Explosion proof per paragraph 4.8.12 of MIL-S-3786.

Common Terminal: Brass, silver and gold plated.

Wipers: Solid silver alloy.

SERIES "F" SINGLE DECK

SHORTING

Single Pole

Positions	Type
2	11-FFM-2
3	11-FFM-3
4	11-FFM-4
5	11-FFM-5
6	11-FFM-6
7	11-FFM-7
8	11-FFM-8
9	11-FFM-9
10	11-FFM-10
*10	11-FFM-10-CR

*Continuous Rotation

2 Poles

Positions	Type
2	12-FFM-2
3	12-FFM-3
4	12-FFM-4
5	12-FFM-5

36° BETWEEN POSITIONS

NON-SHORTING

Single Pole

Positions	Type
2	11-FFB-2
3	11-FFB-3
4	11-FFB-4
5	11-FFB-5
6	11-FFB-6
7	11-FFB-7
8	11-FFB-8
9	11-FFB-9
10	11-FFB-10
*10	11-FFB-10-CR

*Continuous Rotation

2 Poles

Positions	Type
2	12-FFB-2
3	12-FFB-3
4	12-FFB-4
5	12-FFB-5

RCL ADDITIONAL OPTIONAL FEATURES (ALL SERIES)

- Special "Spring Return" (Series A, C, D, H)
- "Push-To-Turn" or "Pull-To-Turn" where an isolated position is required
- Key operated switches
- ⅛" or ¼" diameter shafts (Series A, C, D, H)
- Progressive Shorting (Series E, T)
- RFI Grounding
- 4 mm Shaft (Except series E, T)
  6 mm Shaft (Series A, C, D, H, T, E)
- Shaft and panel water seals
- Non-standard shafts and bushing lengths
- Flatted shafts
- Special Coded Outputs (Except F, FBC, R, RPC)
- Unidirectional Rotation (Series E, T)

RCL
SWITCH
ENGINEERING
HANDBOOK

AN EASY-TO-READ
NEWLY EXPANDED
TECHNICAL CATALOG OF
RCL

INDUSTRY'S MOST
COMPLETE SELECTION
OF
MINIATURE
ROTARY
SWITCHES
INCLUDING MILLIMETER
CONVERSION DRAWINGS OF
EVERY RCL SWITCH!

General Sales Office
RCL ELECTRONICS DIVISION
AMF INCORPORATED
700 South 21st Street
Irvington, New Jersey 07111

AMF
RCL Electronics

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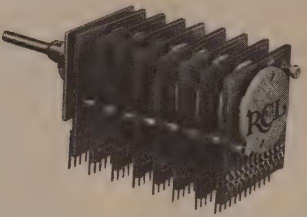
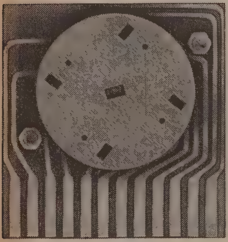
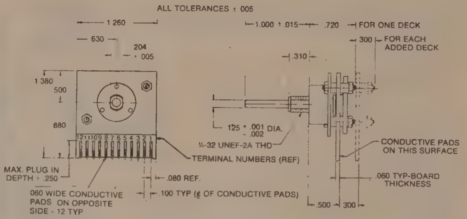
series "K" switches



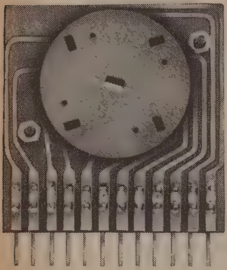
Now, Single or Multi-Deck Switches with a choice of (A) Solderless terminals which fit all standard Edgeboard Connectors, or (B) Solderable "PC" board types available in a maximum of 6, 10 or 12 positions (including 1 Off) per deck. Up to 6 decks. Specifically designed to minimize assembly labor and costly hand soldering. The ultimate in labor saving rotary switches for either "PC" or Edgeboard Connector mounting.

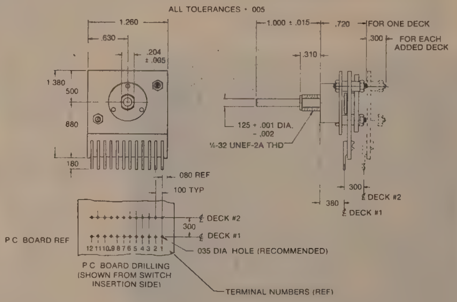
VERSION A




ALL TOLERANCES ± 005
1 260
630
204
± 005
1 380
500
880
12 11 10 9 8 7 6 5 4 3 2 1
MAX. PLUG IN DEPTH = .250
060 WIDE CONDUCTIVE PADS ON OPPOSITE SIDE - 12 TYP
TERMINAL NUMBERS (REF)
.080 REF.
.100 TYP (℄ OF CONDUCTIVE PADS)
1.000 ± .015
.720
FOR ONE DECK
300
FOR EACH ADDED DECK
.310
125 + .001 - .002 DIA.
¼-32 UNEF-2A THD
CONDUCTIVE PADS ON THIS SURFACE
.060 TYP-BOARD THICKNESS
.500
300

VERSION B




ALL TOLERANCES ± 005
1.260
.630
.204
± .005
1 380
500
880
180
080 REF
100 TYP
P C BOARD REF
℄ DECK #2
300
℄ DECK #1
12 11 10 9 8 7 6 5 4 3 2 1
035 DIA HOLE (RECOMMENDED)
P C BOARD DRILLING (SHOWN FROM SWITCH INSERTION SIDE)
TERMINAL NUMBERS (REF)
1.000 ± .015
.720
FOR ONE DECK
.300
FOR EACH ADDED DECK
.310
125 + .001 - .002 DIA.
¼-32 UNEF-2A THD
300
℄ DECK #2
380
℄ DECK #1

AVAILABLE AT FAR LESS COST THAN REGULAR MINIATURE ROTARY SWITCHES AT SAME HIGH RCL QUALITY STANDARDS

FEATURES

TWO DISTINCT VERSIONS

RCL
12 11 10 9 8 7 6 5 4 3 2 1

(A) Solderless terminals which fit all standard Edgeboard Connector Types.

(B) Solderable "PC" Board Types with terminals specifically designed for wave soldering.

- Wiring Errors Eliminated.
- Customer wiring labor and cost greatly reduced in final assembly. A true customer labor-saving device.
- Exceeds the requirements of MIL-S-3786.

AMF

RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

MECHANICAL FEATURES

1. Life expectancy - 100,000 mechanical operations.
2. Detent: Stainless steel ball-type snaps positively from position to position. The detent housing is made of special high-strength material, providing positive action and minimal wear.
3. Stop strength — Designed to withstand 7 pound-inches of torque.

ROTOR — Lexan
ROTOR BLADE — Beryllium Copper (Silver plated)
CONTACTS — Copper alloy, Nickel Plated
SOLDER TERMINAL — Tinned Brass
DETENT HOUSING — High strength material
STATOR — High strength Plastic

OPERATING SHAFT — Stainless Steel

Unless otherwise specified, all metal hardware is plated to meet 50 hour salt spray per military specifications (MIL-S-3786).

ADDITIONAL AVAILABLE FEATURES

- Available with non-standard shaft lengths.
- Available with flatted shaft.
- Available with specially coded outputs, including decimal to binary for digital work.
- Shorting action available upon request.
- Available with adjustable stops (To order use suffix "J")
- ¼" diameter shaft and ⅜-32 bushing available.

MAXIMUM SWITCHING PER DECK

Type "KC" (30° Between Positions)

NO. OF POLES	MAX. POSITION/POLE	POLES AT TERMINAL #
1	2 to 12 INCL. 1 OFF	1
2	2 to 6 INCL. 1 OFF	1, 7

Type "KD" (36° Between Positions)

NO. OF POLES	MAX. POSITION/POLE	POLES AT TERMINAL #
1	2 to 10 INCL. 1 OFF	1
2	2 to 5 INCL. 1 OFF	1, 6

Type "KH" (60° Between Positions)

NO. OF POLES	MAX. POSITION/POLE	POLES AT TERMINAL #
1	2 to 6 INCL. 1 OFF	1
2	3 INCL. 1 OFF	1, 4

SERIES "KC"
SINGLE DECK
30° Between Positions
NON-SHORTING

SINGLE POLE

Positions	Type
2	11-KCB-2
3	11-KCB-3
4	11-KCB-4
5	11-KCB-5
6	11-KCB-6
7	11-KCB-7
8	11-KCB-8
9	11-KCB-9
10	11-KCB-10
11	11-KCB-11
12	11-KCB-12

2 POLES PER DECK

Positions	Type
2	12-KCB-2
3	12-KCB-3
4	12-KCB-4
5	12-KCB-5
6	12-KCB-6

SERIES "KD"
SINGLE DECK
36° Between Positions
NON-SHORTING

SINGLE POLE

Positions	Type
2	11-KDB-2
3	11-KDB-3
4	11-KDB-4
5	11-KDB-5
6	11-KDB-6
7	11-KDB-7
8	11-KDB-8
9	11-KDB-9
10	11-KDB-10

2 POLES PER DECK

Positions	Type
2	12-KDB-2
3	12-KDB-3
4	12-KDB-4
5	12-KDB-5

SERIES "KH"
SINGLE DECK
60° Between Positions
NON-SHORTING

SINGLE POLE

Positions	Type
2	11-KHB-2
3	11-KHB-3
4	11-KHB-4
5	11-KHB-5
6	11-KHB-6

2 POLES PER DECK

Positions	Type
2	12-KHB-2
3	12-KHB-3

ORDERING INFORMATION
FOR MULTI-DECK SWITCHES

For multi-deck version of any switches listed, indicate number of decks as follows: (Merely change first number of coding as shown). Code shown indicates 6 decks, 1 pole per deck, Series "KC", Non-Shorting Action, 2 positions per pole, version "A" (solderless terminals). Versions "A" or "B" are specified by adding the corresponding letters as a suffix.-

NUMBER OF DECKS

ONE DECK	11-KCB-4 (A or B)
TWO DECKS	21-KCB-4 (A or B)
THREE DECKS	31-KCB-4 (A or B)
FOUR DECKS	41-KCB-4 (A or B)
FIVE DECKS	51-KCB-4 (A or B)
SIX DECKS	61-KCB-4 (A or B)
SEVEN DECKS	71-KCB-4 (A or B)
EIGHT DECKS	81-KCB-4 (A or B)

Both Versions Available with up to 8 Decks!

CODE: 6 - 1 - KC - B - 2 - A

NUMBER OF DECKS
POLES PER DECK
SWITCH SERIES
NON-SHORTING ("M" Indicates Shorting)
ACTIVE POSITIONS PER POLE
VERSION "A"*

* VERSION "A": Edgeboard Connector Mounting
VERSION "B": Printed Circuit Board Mounting

AMF

RCL Electronics

General Sales Office:
700 So. 21st Street
Irvington, N. J. 07111

keylock switches

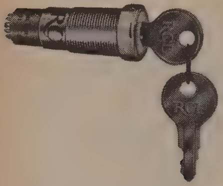
SERIES CC, DC, HC, FC, RC

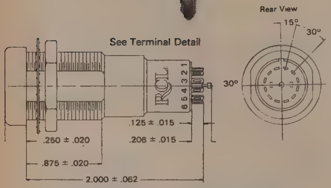
Provides maximum security by permitting operation only by authorized personnel.

Adaptable to most RCL commercial style miniature rotary switches (6 to 12 positions).

Specifications: 8 tumblers . . . 7/8" diameter . . . Double bitted lock. Operation by double sided flat key . . . 2 provided. Secured by nut at rear of panel to prevent unauthorized loosening or dismounting.

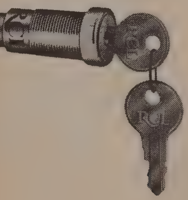
TYPE RC

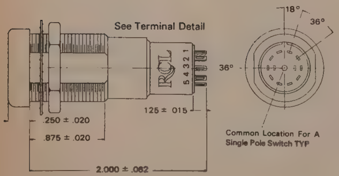



Rear View
15°
30°
See Terminal Detail
RCL
6 5 4 3 2 1
30°
.125 ± .015
.250 ± .020
.206 ± .015
.875 ± .020
2.000 ± .062

Common Location For a Single Pole Switch. For Approx. Location of Commons on a Multi-Pole Switch See Circuit Diagrams Type "R"

TYPE FC

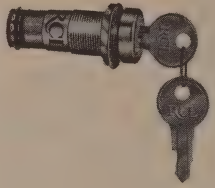



18°
36°
See Terminal Detail
RCL
5 4 3 2 1
36°
125 ± 015
.250 ± .020
.875 ± .020
2.000 ± .062

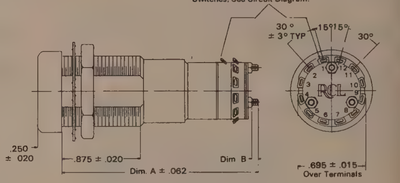
Common Location For A Single Pole Switch TYP

		TERMINAL NUMBERS					
RCL SERIES	TOTAL # OF POSITIONS AVAILABLE	A	KEY INSERTION AND WITHDRAWAL POSITIONS B	C	D	ANGLE OF THROW	CONFIGURATIONS
CC	12	1	4	7	10	30°	2
CC	12	1		7		30°	1
DC	10	1		6		36°	3
HC	6	1		4		60°	4
FC	10	1		6		36°	3
RC	12	1	4	7	10	30°	2
RC	12	1		7		30°	1

TYPE CC, DC, HC

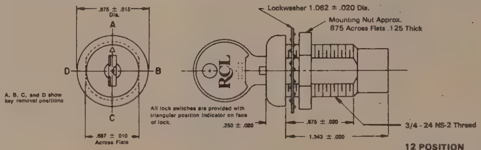


Common Location For A Single Pole Switch. For Approx. Location of Commons On Multiple Switches. See Circuit Diagram.


30°
± 3° TYP
15° 15°
30°
RCL
.250
± 020
.875 ± .020
Dim B
Dim. A ± .062
.695 ± .015
Over Terminals

NO. OF DECKS	DIM A	DIM B
1	2.070	.062
2	2.365	.062
3	2.660	.062
4	2.995	.062
5	3.250	.062
6	3.795	.312
7	4.090	.312
8	4.385	.312
9	4.680	.312
10	4.975	.312
11	5.270	.312
12	5.565	.312

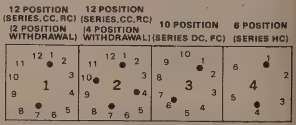
LOCK ASSEMBLY


.875 ± .015
Dia.
A
B
C
D
A, B, C, and D show key removal positions
.687 ± .010
Across Flats
Lockwasher 1.062 ± .020 Dia.
Mounting Nut Approx.
875 Across Flats .125 Thick
RCL
All lock switches are provided with triangular position indicator on face of lock.
.250 ± .020
.875 ± .020
1.343 ± .020
3/4 - 24 NS-2 Thread

STANDARD KEY WITHDRAWAL POSITIONS

Available With Key Removal Only at Position Indicated.

Engineering Note: All Configurations Available For Key Withdrawal In Every Position. Contact Factory. Special 2, 3 or 4 key lock Switches available to provide limited access on different levels of authority. Consult factory.


12 POSITION
(SERIES, CC, RC)
(2 POSITION WITHDRAWAL)
12 POSITION
(SERIES, CC, RC)
(4 POSITION WITHDRAWAL)
10 POSITION
(SERIES DC, FC)
6 POSITION
(SERIES HC)
1
2
3
4

CONFIGURATIONS

ORDERING INFORMATION

To order Keylock Modification, use prefix -001

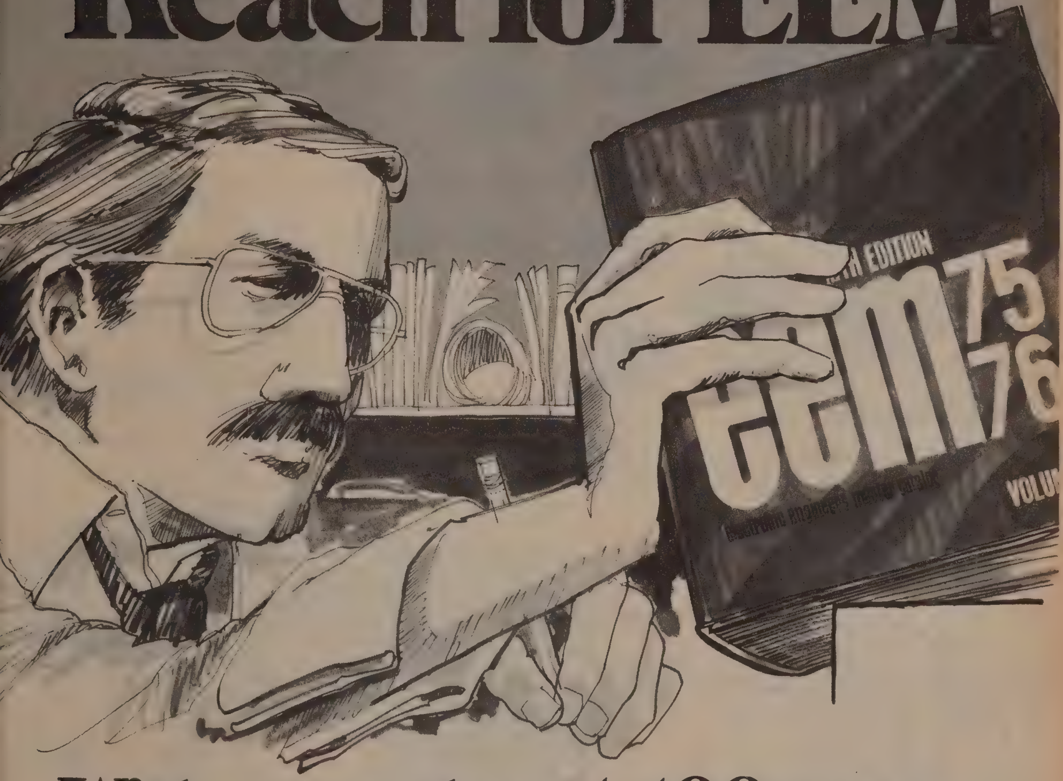
EXAMPLE:

To order CC Type Switch (Commercial Version) 2001-11-CCM-2
(2 position, single pole, single deck with keylock)
(4001 would indicate 4 position Key Withdrawal — available only in 12 position switch)

Refer to RCL miniature Rotary Switch Catalog for complete ordering information on all series of switches.

There is more catalog data available to you at your fingertips than ever before...when you

Reach for EEM


TH EDITION
eem 75 76
electronic engineers master catalog
VOLU

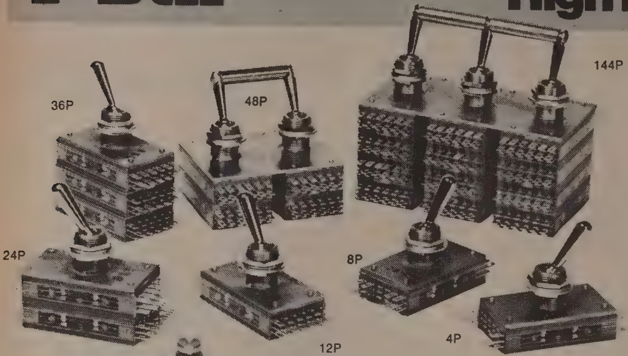
With more than 4,400 pages of product data from 700 manufacturers of electronic products in EEM.

eem

electronic engineers master

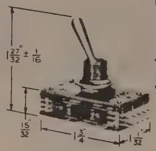
UNITED TECHNICAL PUBLICATIONS, INC. DIV. OF COX BROADCASTING CORP.
645 STEWART AVE., GARDEN CITY, N.Y. 11530 (516) 248-9700

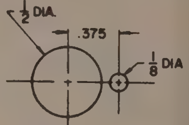
T*bar® SWITCHES for Multipole High Density Switching



T-Bar Toggle Switches

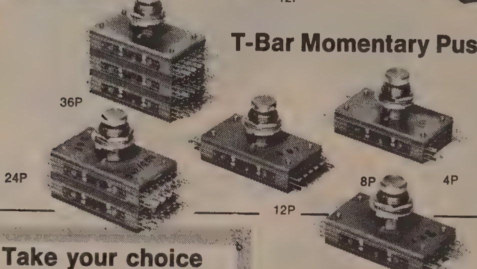
Switch from 4 to 144 circuits with one T-Bar Toggle Switch. Available in configurations of 4, 8, 12, 24, 36, 48, 72, 108 and 144 poles. For low level applications specify the 902 Series.



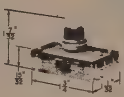


PANEL CUTOUT FOR TOGGLE AND PUSH-BUTTON SWITCHES

T-Bar Momentary Push-Button Switches

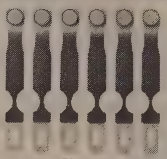


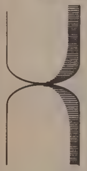
Switch from 4 to 36 circuits with one T-Bar Momentary Push-Button Switch. Available in configurations of 4, 8, 12, 24 and 36 poles.



Take your choice of 2 contacts!

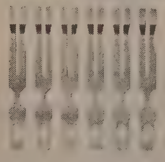
800 SERIES
for reliable General Purpose Switching





The 800 Series contact is a highly reliable gold-plated button contact. With its high contact pressure and positive wiping action, it is used in control type applications and in general purpose switching, such as relays, valves, lamps, etc. Contact Rating: up to 5 AMPS max.

900 SERIES
for reliable Low Level Switching

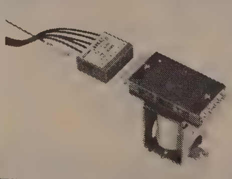


The 900 Series DATA-RITE™ contact has the reliability of a bifurcated contact with the added feature of two degrees of wiping action. The unique EDGE-TO-DOME contact guarantees a clean surface, which is critical for low level signals. The 900 Series is typically used in computer I/O signals; voice and data-grade communications; thermocouple and strain gauge outputs; all low level switching, whenever reliability is a premium, or whenever slight variations in contact resistance cannot be tolerated. Contact Rating: Microvolts up to 1 AMP max.

SWITCH SPECIFICATIONS

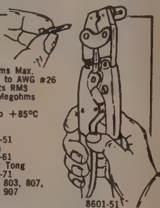
Contacts:	Series 800—general purpose gold plated Series 900—low-level bifurcated gold plated
Contact Rating:	Series 800—5 amps max. resistive to 150 watts Series 900—1 amp maximum resistive to 50 watts
Life Expectancy: at 20 CPM	Series 800—50,000 cycles Series 900—50,000 cycles
Contact Resistance:	20 milliohms typical
Ambient Temperatures:	—55° to plus 85°C
Terminals:	Mate with T-Bar Connectors
Dielectric Strength:	1000 VRMS @ 60 cycles/sec. (higher available)
Insulation:	5000 megohms min. (higher available)

T-BAR CONNECTORS



The T-Bar Series 88601 Connector has been specifically designed for use with T-Bar switches and relays. The connector contacts are crimp type which are snapped into a plastic insulator block. After installation, connectors are held in place against shock and vibration by use of a retaining clip.

Current Carrying Capacity	5 Amps
Contact Resistance	5 Milliohms Max.
Wire Accommodated	AWG #18 to AWG #26
Dielectric Strength	1000 Volts RMS
Insulation Resistance	100,000 Megohms Min.
Ambient Temperature	−55°C to +85°C
Weight	0.3 Oz.
Recommended Tools	Crimper P/N 8601-51 Extraction P/N 8601-61 Connector Tong P/N 8601-71
Use 88601 With	801, 802, 803, 807, 901, 902, 907



8601-51 Crimping Tool

HOW TO ORDER

1. Specify Series
2. Specify Number of Poles and Contact Form

Don't forget to order the mating T-Bar Series 88601 Connector! One for each 6 poles.

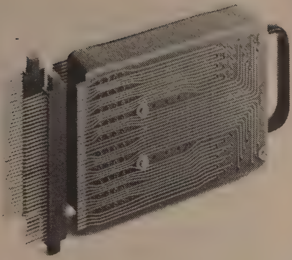
902 —— 12 C

SERIES	Application	No. of Poles	Contact Forms*
T-Bar® TOGGLE SWITCHES			
802	Gen. Purpose	4 to 144	"A" or "C"
902	Low Level		
T-Bar® PUSHBUTTON SWITCHES			
803	Gen. Purpose	4 to 36	"A" or "C"

'A" — normally open contacts. Form "C" — double throw, break-before-make.

Manufactured under 1 or more of the following patents: 3206990, 3226508, 3689858.
®"T-Bar"—Reg. T.M.

T·bar INCORPORATED
SWITCHING COMPONENTS DIV.
144 Danbury Road, Wilton, Conn. 06897 • (203) 762-8351



6900 Series T-bar® Pluggable Switching Modules

SERIES 6900 T-BAR Pluggable Switching Modules are designed to switch many parallel circuits simultaneously. They provide the systems integration engineer with a highly reliable and remarkably convenient transfer or matrix switch for data acquisition systems, multi-station testing, computer/peripheral reconfiguring or teleprocessing.

This brochure describes two types of SERIES 6900:

Type I: Switches one set of circuits simultaneously and is available with switching capacity of 36 to 72 lines.

Type II: Switches two independent sets of circuits of 24 or 36 lines each.

The actual switching function is performed by T-BAR multi-pole relays with years of reliable and proven performance behind them. Combining T-BAR relays with a modular package offers meaningful advantages:

1. **Ease of Wiring:** A complete range of card edge connectors is available: Solderless wrap, termi-point and solder.
2. **Ease of Packaging:** Module cages mount in standard 19" or 24" electronic cabinets. No special housings or sheet metal is required. Design effort is reduced to wire lists.
3. **Ease of Assembly and Maintenance:** The 6900 simply plugs into your system. For trouble shooting, adjacent modules can be swapped. A problem module is quickly replaceable, and the module itself is repairable.
4. **Low Cost:** A complete switching system can be designed, assembled and wired for as little as $5 or less per cross point depending on control logic. Compare that cost with any other method of similar quality equipment.

Following are typical operating characteristics:

Mechanical Life:
20,000,000 cycles for solenoid operated relays
1,000,000 cycles for magnetic latching relays

Contact Life:
20,000,000 cycles (@ 10ma, 30mv)

Contact Rating:
6900 Series, low level to 1 ampere
6800 Series, 100 ma to 5 amperes

NOTE:
These modules were originally designed for computer-level signals. Tests show that a 6801-52C module with all circuits maintained at a 1 ampere load will stabilize at a temperature below 30°C in still air. With all circuits at 3 amperes, however, the temperature will exceed 85°C — a marginal operating condition. At least 75% of all circuits should be maintained under 1 ampere unless forced air cooling is provided. Consult our applications engineers if greater load conditions are being considered.

Coil Power:
Solenoid operated relay modules:
24 poles, form A or C = 3.5 watts
36 poles, form A or C, 48A = 5.25 watts
48C, 52A or C, 60A, 72A = 6.6 watts
Standard latching relays = 6 watts
Bifilar latching relays = 10 watts

Operate Time:
45 Milliseconds maximum

Through Path Resistance:
200 Milliohms maximum

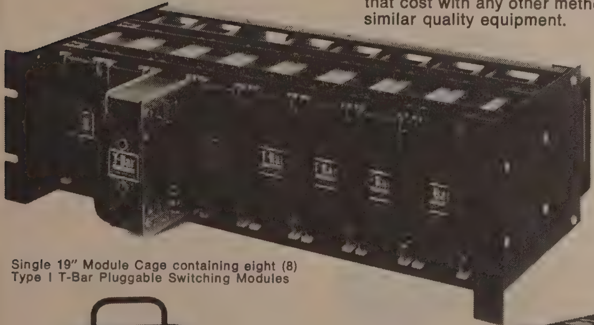
Dielectric Withstanding Voltage:
350 v. RMS

Isolation:
Wideband data transmission rates to 50 KB are handled routinely. Computer I/O switching requires attention to assure equal lengths of parallel signal lines and to prevent skewing the data front. T-BAR's application engineers can assist in this area.

Weight:
20 - 22 ounces

All items are manufactured under one or more of the following patents: 3206990, 3226508, 3689856

® T-BAR-Reg. T.M.



Single 19" Module Cage containing eight (8) Type I T-Bar Pluggable Switching Modules

SWITCHING UNIBUS?

Ask for information on
6900-M525 . . .
the 72 pole module
that plugs directly into
DEC connector block H803.

Two (2) 19" Module Cages assembled together using side splice plates

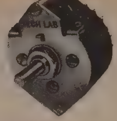
T·bar INCORPORATED
SWITCHING COMPONENTS DIV.
144 Danbury Road/Wilton, Connecticut 06897/(203) 762-8351

design versatility and prototype manufacture

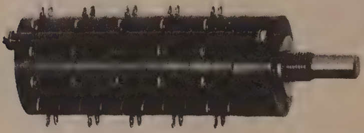
plus switches & attenuators in production quantities.

Tech Labs
SINCE 1935

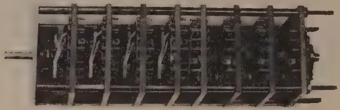
TECH LABORATORIES, INC.
BERGEN AND EDSALL BOULEVARDS
PALISADES PARK, N.J. 07650
TEL: 201 — 944-2221



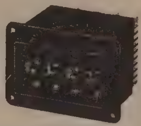
TYPE 2 ROTARY SWITCH
- Four insulation materials available
- 1 to 4 poles / Deck
- Up to 24 positions/pole
- 2-1/4" x 1-3/4" x 24 decks (max)
- Adjustable stops
- 5 amps 120 VAC max.
- Precious metal contacts



TYPE 3 ROTARY SWITCHES
- Enclosed molding in diallyl phthalate
- Molded in terminals
- 1 or 2 poles
- Up to 12 positions/pole
- 1-1/4" OD up to 8 decks (max)
- Adjustable stops
- 12 amps 28 VDC
- Precious metal contacts

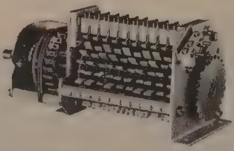


SQUARE ROTARY SWITCHES
- 13 models available
- 1-5/16" sq to 8" sq. X 15 decks (max)
- 1 to 12 poles
- up to 150 positions/pole
- fixed stops or continous rotation
- 3 amps at 120 VAC
  to 15 amps at 120 VAC
- precious metal contacts

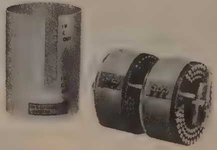


THUMBWHEEL SWITCHES
- Modular construction
- Compact
- Wide range of logic codes
- Positive detent
- Simple installation
- Two models available
  Panelmite & Thumbmite

REMOTELY CONTROLLED ROTARY SWITCHES
- All Tech Lab Switches can be supplied as stepping switches or continous motor driven
- Solenoid drives
- Motor & Geneva drives
- Enercon AC incremental motor drive
- Available with interrupters or homing decks
- Completely pre-wired ready to install
- Hermetical sealing available



PROGRAMMING SWITCHES
- Adjustable Programming for sequencing, timing, scanning multiplexing, code generation
- Single pole/(drum)
- 1 to 24 positions/poles/(drum)
- Up to 10 drum modules
- Manual, motor, or solenoid operation
- Contact rating up to 20 amps.



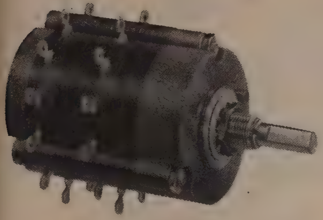
ROTARY, VARIABLE ATTENUATORS
- Five basic models
  1-7/16" to 3" dia.
- All circuit configurations
- Wide range of impedance
- Available with detents, tapers and cueing
- Aluminum anodized can
- Precious metal contacts
- Up to 45 steps
- Audio, video and RF

VERTICAL, VARIABLE ATTENUATORS
- Two basic models
  1" and 1-1/2" wide
- Many circuit configurations available
- Wide range of impedance
- Available with detents, tapers, and cueing
- Black anodized escutcheon plate
- Precious metal contacts
- Up to 30 steps

FIXED ATTENUATORS
- Two Basic Models
- Standard circuits "T" and Bridged "H" — others available
- Octal plug-in base available
- Up to 80 db loss
- Many impedance available

SPECIALS Tech Labs can customize your Switch and Attenuator requirements, completely pre-wire your switches ready for installation. We can also undertake prototype design and manufacturing. Contact our factory for quotations.

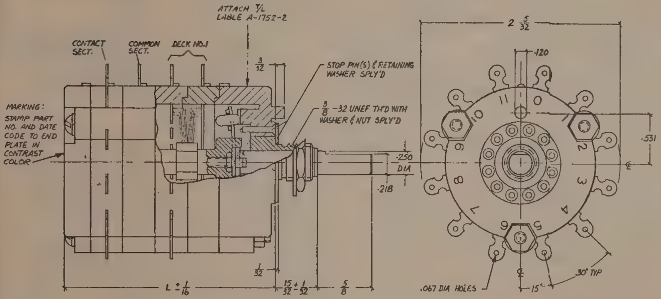
rotary instrument switch series 2000



- EXTREMELY LOW CONTACT RESISTANCE — LESS THAN ONE MILLIOHM
- Extremely High Insulation Resistance — More Than One Million Megohms
- Totally Enclosed — Dust Tight
- Long Life — In Excess of One Million Cycles
- 12 Position, 1-6 Pole
- Solid Silver Contacts
- External Adjustable Stops

Tech Labs
SINCE 1935
TECH LABORATORIES, INC.
BERGEN AND EDSALL BOULEVARDS
PALISADES PARK, N.J. 07650
TEL: 201 — 944-2221

Series 2000 Rotary Instrument Switches are shorting types (make-before-break) which feature solid silver contacts, hardened beryllium copper detent spring, and nylon detents for smooth action. This exceptionally stable, long-lived rotary switch is available from one to six poles for a wide range of applications including precision bridges and decades, thermocouple switching, and laboratory test equipment.


ATTACH T/L LABLE A-1752-2
CONTACT SECT.
COMMON SECT.
DECK NO.1
3/32
STOP PIN(S) & RETAINING WASHER SPLY'D
3/8 -32 UNEF TH'D WITH WASHER & NUT SPLY'D
MARKING: STAMP PART NO. AND DATE CODE TO END PLATE IN CONTRAST COLOR
.250 DIA
.218
1/32
L ± 1/16
15/32 ± 1/32
5/8
2 5/32
.120
.531
.067 DIA HOLES
15°
30° TYP
0
1
2
3
4
5
6
7
8
9
10
11

SPECIAL DESIGN VARIATIONS

SIX AND ELEVEN POSITION DETENTS

The six position detent is 60° throw, skipping every other contact. The eleven position detent is 30° throw with the eleventh position omitted so that the detent goes 60° from position ten to position zero.

GUARD RINGS

Switches are available with built-in guard rings between segments. Guard rings can make or not make contact with the assembly screws, as specified.

SHAFT LENGTHS

Special shaft lengths are available on special order.

OFFSET WIPERS

30° and 180° offset wipers are available for use in special circuits.

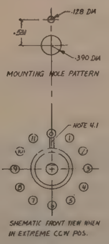
SPECIAL CONSTRUCTIONS

Switches can be supplied in many special configurations, including two twelve segment sections (no common), twelve segment wafer with common on each side (commons can be hooked in parallel to reduce contact resistance), twelve ear common, etc.

SINGLE AND DOUBLE ROW COIL MOUNTING PLATES

Single and double row coil mounting plates can be supplied pre-assembled into the switches. Molded of black polycarbonate.

No. of Decks	Switch Length "L"	Torque In Lb.-In.
1	1.54	1.3±.3
2	2.23	1.5±.3
3	2.92	1.7±.3
4	3.61	1.9±.3
5	4.29	2.1±.3
6	4.98	2.3±.3


.128 DIA
.531
.390 DIA
MOUNTING HOLE PATTERN
NOTE 4.1
1
2
3
4
5
6
7
8
9
10
11
SHEMATIC FRONT VIEW WHEN IN EXTREME CCW POS.

SPECIFICATIONS

ELECTRICAL

Type: 12 position, 1 to 6 pole shorting. 30° throw.

Contact Resistance: Less than 1 milliohm. (Varies less than ½ milliohm after one million cycles.)

Insulation Resistance: Better than 1,000,000 megohms between contacts or to metal shaft after 60 days exposure to 100% relative humidity.

Capacitance: Less than 1 micromicrofarad between contacts or to ground.

Current Capacity: 5 Amps. max. continuous duty.

Thermal EMF: Extremely low. Silver contacts to silver alloy brushes.

Voltage Breakdown: Withstands 1500V RMS between contacts and to ground.

Losses: Low electrical losses at frequencies up to several megacycles.

Model No.	No. Poles	Depth Below Panel
2010	1	$1\frac{19}{32}$″
2020	2	$2\frac{9}{32}$″
2030	3	$2\frac{31}{32}$″

MECHANICAL

Type: Totally enclosed, wafer type, dust tight.

Detent: Long life nylon, hardened beryllium copper detent spring.

Body: Diallyl Phthalate (DAP).

Contacts: Quadruple-Leaf silver alloy free-positioning contact brushes. Solid silver contacts.

Shaft: Polycarbonate inner, stainless steel outer.

Stops: Completely adjustable from outside of switch without disassembly.

Mounting: $\frac{25}{64}$″ central hole, .128 (#30) keying hole on $\frac{17}{32}$″ radius.

Outside Diameter: $2\frac{5}{32}$″ overall including solder lugs.

Model No.	No. Poles	Depth Below Panel
2040	4	$3\frac{21}{32}$″
2050	5	$4\frac{11}{32}$″
2060	6	$5\frac{1}{32}$″

TAPESWITCH®

OPERATED BY
HAND.........FOOT........VEHICLE

PRESS-AT-ANY-POINT RIBBON type & MAT type SENSING SWITCHES

BUY THE RIBBON SWITCH IN THE SIZE YOU NEED!

SUCCESSFULLY PROVEN IN ALL INDUSTRIES. PATENTED CONSTRUCTION WITHSTANDS MANY TONS OF FORCE YET CLOSES ON LIGHT FINGER PRESSURE. TAPESWITCHES ARE UNEXCELLED FOR—SAFETY . . . AUTOMATION . . . ANTIBURGLAR SYSTEMS . . . COUNTING . . . TIMING . . . DOOR CONTROL . . . LIGHT SWITCHING . . . MACHINE CONTROL . . . MATERIAL HANDLING INSTRUMENTATION . . . COMPUTER AND CONSOLE SWITCHING . . . AND MANY OTHER APPLICATIONS.

These versatile sensing switches may be used directly with **electro-mechanical devices** and **solid state devices.**

Pressure at any point from hand, foot, or vehicle will cause contact. These are ideal for instrumentation and control tasks because of their **flat configuration, "Press-at-any-Point" operation,** and **sealed** qualities.

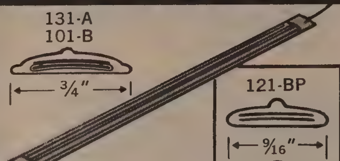
TAPESWITCHES are designed in accordance with the best principles of switch and cable design, with jacketing and insulation meeting the requirements of MIL-C-9154 and MIL-I-631C respectively. Results are exceptional stand-by reliability (required in alarms) as well as excellent contact performance.

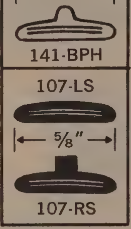
Typical life tests with repeated impacts at ONE POINT on a Tapeswitch have given over three million operations without failure. (24 Volt AC relay coil 0.3 Amperes)

RATINGS: All Tapeswitch products are rated 117 VAC, at 1 Ampere. However for floor switching, 30 VAC or less is recommended.

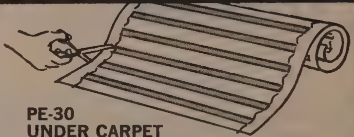
NOTE: U.L. classification for Ribbon Switches does not presently exist.

A FEW TAPESWITCH CONTROL SWITCHES

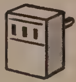




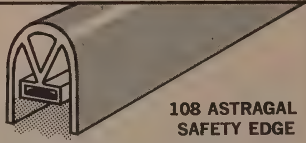
RIBBON SWITCHES
Factory sealed units with 18 inch connecting wire at one end. Styles shown in box have 8 oz. nominal finger sensitivity. 131-A — 40 oz.; 101-8 — 12 oz. sensitivity. Standard lengths: 1, 2, 5, 8, 10, 12, 15, 18, 20 ft.



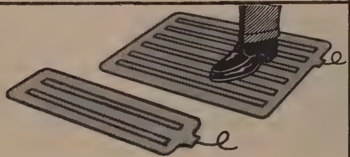
**PE-30
UNDER CARPET
SWITCHING RUNNER**
30 inches wide x 3⁄32 inches thick and can be cut to any length from 25 ft. or 5 ft. roll. For indoor use under carpeting. Tapeswitches in parallel between Polyethylene sheets. Tinned wires for easy twisting or soldering connections.



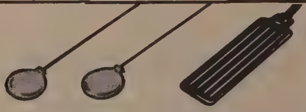
TAPESWITCH RELAY R-1
FOR NORMALLY CLOSED OR NORMALLY OPEN OPERATION OF ANY TAPESWITCH. Plug-in unit gives NC or NO control of 117 Volts AC, 5 Amperes. Built-in low voltage transformer.



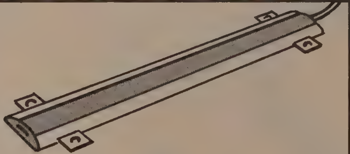
**108 ASTRAGAL
SAFETY EDGE**
Unique patented design universal safety cushion switch for leading edge of doors, machinery, etc. Responds to side thrust and head-on thrust. Std. lengths: 6, 8, 10, 12, 15, 20, 25, 30 ft. OTHER STYLES ALSO AVAILABLE. Mounts on edges 1″ to 2½″ wide. Cushion depth 1⅞″.



CVP SWITCHING MATS
CVP style mats are durable yet flexible and only ⅛ inch thick (approx.). Available in sizes 23 x 35 inches, 17 x 23 inches and 6 x 23 inches. Very popular items.

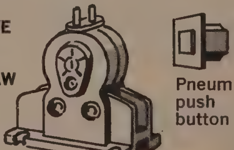


NC-3 NO-1 FOOTSWITCH 111
NC-3 is a unique normally closed wafer style switch 1⅛″ diameter, by 3⁄16″ thick. Designed to sound alarm when object is lifted off switch. NO-1 similar form but normally open. 20 oz. nominal sensitivity. Footswitch 111 normally open flat rugged, sealed switch, 2″ x 5″ x ¼″ thick.



RBMA ROAD SWITCH
Successful, rugged roadway switch for counting, timing, controlling by vehicles. Replaceable sealed switch element. 2″ wide, 7⁄16″ thick. Std. lengths: 2, 3, 5, 8, 10 ft. Cast iron end protectors available.

**SENSITIVE
AIRWAVE
SWITCH
MODEL AW**

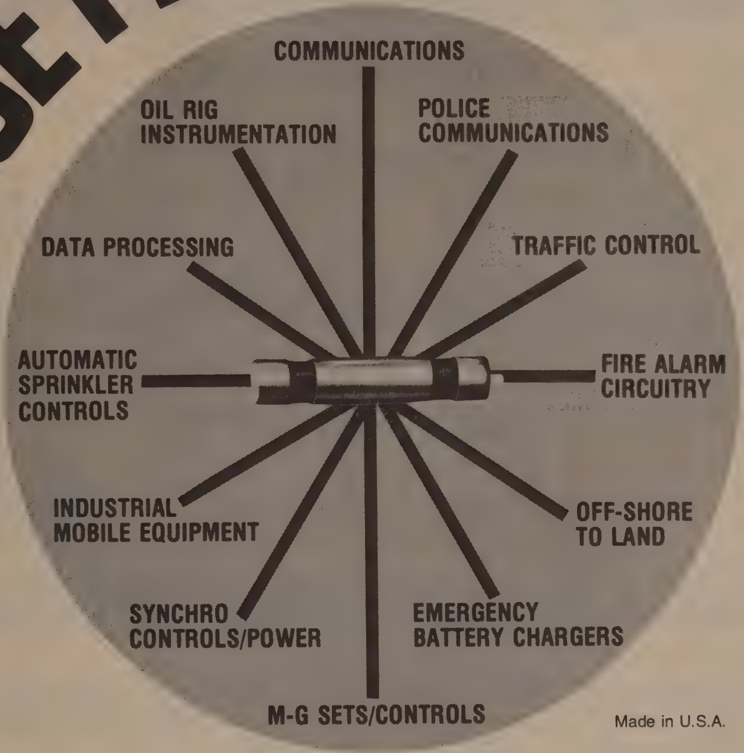


High quality diaphragm switch with adjustable sensitivity. For operation by **tubing squeeze**/impact, air motion, vacuum. Remote push-buttons for explosive environments, etc. Silver contacts operate normally open or normally closed.

TAPESWITCH CORPORATION OF AMERICA

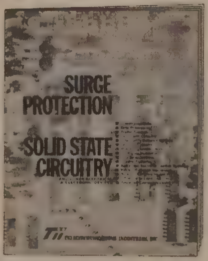
320 BROAD HOLLOW RD., FARMINGDALE, N.Y. 11735 • (516) 694-6312—(212) 895-8713

FULL CIRCLE SURGE PROTECTION


COMMUNICATIONS
POLICE COMMUNICATIONS
TRAFFIC CONTROL
FIRE ALARM CIRCUITRY
OFF-SHORE TO LAND
EMERGENCY BATTERY CHARGERS
M-G SETS/CONTROLS
SYNCHRO CONTROLS/POWER
INDUSTRIAL MOBILE EQUIPMENT
AUTOMATIC SPRINKLER CONTROLS
DATA PROCESSING
OIL RIG INSTRUMENTATION

Made in U.S.A.

Protect your solid state equipment from junction damage caused by high-current surges due to power switching and lightning transient induction. Ordinary protective devices ground only one wire, allowing currents to reach your equipment through the "other" wire. TII 3-Electrode Gas Tube Surge Arresters simultaneously ground both wires of a signal or power pair. TII protection can end unnecessary service calls and customer complaints. To learn more about surge and how to protect against it, write for your free copy of "Surge Protection for Solid State Circuitry"


SURGE PROTECTION
SOLID STATE CIRCUITRY

UL-Listed and
REA-Accepted
Models Available

Worldwide Patents:
1,121,300; 1,120,361; 1,455,343; 3,281,625; 763,560; 3,333,153; 3,340,431; 788,066; 792,356; 3,535,779; 3,522,570; 3,791,711.

TII®

TELECOMMUNICATIONS INDUSTRIES, INC.

1375 Akron Street, Copiague, New York 11726 ■ (516) 842-5000

More than 12 years and over 2,000,000 tubes in service. • Licensed by M-O-Valve Co., Ltd. and by Western Electric Co.

TRANSTECTOR® *OFF THE SHELF . . .*

Transient • Surge • Overvoltage • Undervoltage Protection

AC (BI-POLAR) COMPONENTS

TRANSIENT VOLTAGE SUPPRESSORS

These suppressors are designed to keep your equipment operating continuously during transient conditions.

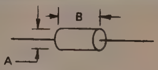
In operation the suppressors will clamp the line to a specified voltage, while absorbing the energy of the transient. Properly used, these suppressors have been proven effective in suppressing severe voltage transients and surges generated by load switching, coupling and electrostatic discharge.

The Model ACP suppressors are provided in separate models for line to line only, and line to line, line to ground protection.

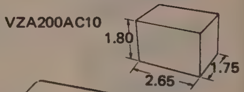
The line to ground feature is included to suppress electrostatic discharge (such as induced lightning noise) that frequently appears on both sides of the power line.

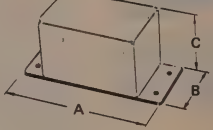
PART NUMBER	CLAMP VOLTAGE	POWER (WATTS)	BULLETIN
LOW LEVEL SIGNAL LINE PROTECTION 5 NANO-SECOND RESPONSE			
VZB1.3AC1	1.3	1500	1008
VZB2.2AC1	2.2		
VZB3.3AC1	3.3		
VZB5.4AC1	5.4		
AC POWER SUPPLY PROTECTION 5 NANO-SECOND RESPONSE			
VZA33AC1	33	1500	1039
VZA60AC1	60		
VZA100AC1	100		
VZA200AC10	200	10,000	1042
120 VOLT AC PRIMARY LINE PROTECTION 50 NANO-SECOND RESPONSE			
ACP120-001	200	4600	1041
ACP120-002*	200		
ACP120-003	200	8000	
ACP120-004*	200		
240 VOLT AC PRIMARY LINE PROTECTION 50 NANO-SECOND RESPONSE			
ACP240-001	400	4600	1040
ACP240-002*	400		
ACP240-003	400	8000	
ACP240-004*	400		

MECHANICAL



MODEL	A	B
VZB	.25	.75
VZA	.20	.37





MODEL	A	B	C
ACP---001,-002	3.0	2.0	0.75
ACP---003,-004	6.5	2.875	3.0

All dimensions in inches

*INCLUDES ADDITIONAL LINE TO GROUND SUPPRESSION

OVERVOLTAGE PROTECTOR

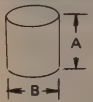
Commonly used in:

- Motor Generator Power Supplies
- Medical Electronics
- Radar and Communications
- Test Equipment
- Process Control and Computers

There are high energy, solid state protectors. When activated, the protector will bring an overvoltage to a safe level within 500 nanoseconds and continue to protect until the system's fuse or circuit breaker has opened.

PART NUMBER	SUPPLY CURRENT	SURGE CURRENT	BULLETIN
120 VOLT AC PRIMARY LINE PROTECTION 50 NANO-SECOND RESPONSE			
V200AC5	5	100	110
V200AC10	10	200	
V200AC20	20	240	
V200AC35	35	325	
V200AC50	50	1200	
V200AC100	100	1600	
240 VOLT AC PRIMARY LINE PROTECTION 50 NANO-SECOND RESPONSE			
V400AC5	5	100	110
V400AC10	10	200	
V400AC20	20	240	
V400AC35	35	325	
V400AC50	50	1200	
V400AC100	100	1600	

MECHANICAL



SUPPLY CURRENT	A	B
5 10 20 35	1.5	1.5
50 100	2.5	2.5

All dimensions in inches

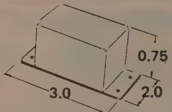
UNDERVOLTAGE SENSOR

Designed to add undervoltage control to relays, circuit breakers and alarms. Our solid state sense circuits provide reliable, low cost protection with built in line return hysteresis to prevent recycling.

PART NUMBER	CIRCUIT VOLTAGE	TRIP POINT	BULLETIN
BROWN-OUT PROTECTION			
LV10B-100	120	104	105
LV10B-200	240	195	

Ask about combination over/under sensors.

MECHANICAL



FOR MORE INFORMATION CALL FREE LINE (213) 283-9278 collect

LOCAL REPRESENTATIVES IN ALL MAJOR U.S. CITIES,
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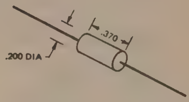
HOLLAND - ISRAEL - JAPAN - SOUTH AFRICA

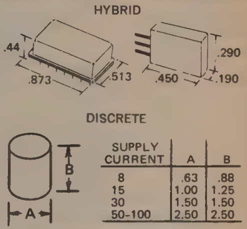
TRANSTECTOR SYSTEMS
Division of Konic International Corporation
532 Monterey Pass Rd., Monterey Park, Cal. 91754

TRANSTECTOR® *OFF THE SHELF . . .*

Transient • Surge • Overvoltage • Undervoltage Protection

DC COMPONENTS

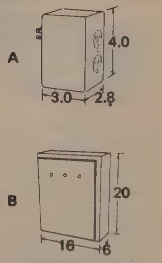
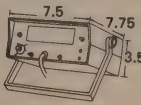
APPLICATION	PART NUMBER	CLAMP VOLTAGE	POWER (WATTS)	BULLETIN	MECHANICAL
TRANSIENT VOLTAGE SUPPRESSORS For protecting TTL, CMOS, MOS, DTL, Linear IC's and other Solid State Circuits from high speed, high voltage transients and surges. The Model VZ Suppressor is a silicon device which has high surge current capability and nanosecond response. It is designed to keep your equipment operating continuously, during transient voltage conditions. It has been proven effective in suppressing severe voltage surges, spikes, static discharge and lightning induced transients.	**DC POWER LINE PROTECTION** **5 NANO-SECOND RESPONSE**				
	VZ6DC1	6	1500	107	
	VZ16DC1	16			
	VZ24DC1	24	1500	1043	
	VZ30DC1	30			
	VZ33DC1	33			
	VZ40DC1	40			
	VZ50DC1	50			
	VZ60DC1	60			
	VZ100DC1	100			

APPLICATION	FEATURES	BULLETIN	MECHANICAL
OVERVOLTAGE PROTECTORS For protecting electronic circuits from transient and continuous overvoltages. These are no nonsense, no nuisance tripping protectors. Unlike delayed (10 microsecond) devices, these feature a built in circuit that suppresses all nuisance transients (50 nanosecond response) without tripping the crowbar. Only when the suppressor reaches its power saturation point, will the crowbar circuit clamp the line to ground. This protector will eliminate nuisance transients and false shutdowns while providing overvoltage protection from regulator runaway, crossed power lines, and power supply failure.	STANDARD: • TRIP VOLTAGE . . . 5 thru 200 • TRIP TOLERANCE ±5%, ±10% • CURRENT RANGE . 5 thru 100 amp • RESPONSE TIME . . . <50 nano-sec Optional: • REMOTE SENSE • VARI-ADJUST • LOGIC SIGNAL OUTPUT	1036	 HYBRID .44 .873 .513 .290 .450 .190 DISCRETE B A

SUPPLY CURRENT	A	B
8	.63	.88
15	1.00	1.25
30	1.50	1.50
50-100	2.50	2.50

All dimensions in inches

AC COMMERCIAL PROTECTORS AND INSTRUMENT PRODUCTS

APPLICATION	PART NUMBER	SERVICE	PACKAGE	BULLETIN	MECHANICAL
TRANSIENT/SURGE SUPPRESSOR Protection for systems, branch service and facilities from lightning surges, transients and "power bumps". These protectors are designed to provide the high speed protection that standard line regulators cannot. Full facility protectors are available on special order.	**PRIMARY POWER PROTECTION**				 All dimensions in inches
	ACP-100	120, 1ϕ	A (Plug In)	100	
	ACP-1000-120	120/208, 3ϕ			
	ACP-1000-240	240, 3ϕ	B (NEMA)	101	
	ACP-1000-480	480, 3ϕ			
	These units are suitable for 50/60 hz and 400 hz. They are available in ratings for services from 100 VA to 240 KVA.				
UNDERVOLTAGE PROTECTORS Solid state sense circuits provide reliable, low cost protection for motors, air conditioners and electronics. These protectors include a built in hysteresis to prevent hazardous re-cycling.	**BROWN-OUT PROTECTION**				
	LV102-100P	120, 1ϕ	A (Plug In)	1007	
	LV102-100W	120, 1ϕ	A (Wire In)		
	3 phase protection is available				
TRANSIENT VOLTAGE COUNTER	**SERVICE AND LAB MONITORING**				
Records high speed transients and undervoltage occurrences on AC power lines. Features simplied controls, fast response and lightweight portability.	TCD640	120 vac 1 Phase 60 hertz	Inst.	1047	

FOR MORE INFORMATION CALL FREE LINE (213) 283-9278 collect

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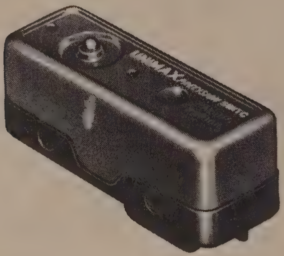
TRANSTECTOR SYSTEMS
Division of Konic International Corporation
532 Monterey Pass Rd., Monterey Park, Cal. 91754

Unimax ® Switch

The complete line of snap-acting Standard, Miniature, Subminiature and Miniature Subminiature switches for commercial and military applications.

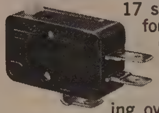
Basic precision switches

Type 2 HB



The basic switch for close control of electrical circuits requiring combinations of small motions, high repeatability and long life. Switches can be sealed or unsealed and all types of actuators are available. Ratings start at 20 amps to 480 VAC. UL and CSA listed. **Detailed specifications in our Catalog 60.**

Low-Force miniature switches Type TM

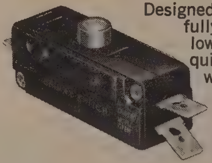


17 standard models feature low operating force with negative force gradient, and a complete line of lever and roller lever actuators. Four terminal styles include ¼″ quick-connect. Molded-in overtravel stop limits button movement, preventing overstress and shock loading of blade. Mounting holes are independent of cover for improved electrical insulation and high case strength. Two lever pivot locations provide either low actuating motion or forces as low as 8 grams. Ratings from dry circuit to 15 amps. **Detailed specifications in our Catalog 60.**

Basic subminiature switches Type LM

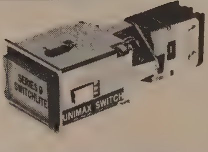
Long life subminiature switches provide reliable switching in limited space. Variations available include integral or auxiliary actuators, ratings to 10 amperes, silver or gold cross bar contacts and choice of four terminal styles. **Detailed specifications in our Catalog 60.**

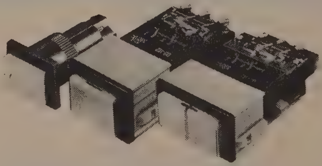
General purpose switches Type A



Designed for applications that require fully enclosed, high performance, low-cost, snap-acting switches with quick-connect terminals. Stall free, with high repeatability. Single or double pole, sealed or unsealed with a full range of actuators. Rated 15 or 25 amps at 125/250 VAC. **Detailed specifications in our Catalog 60.**

LPB Lighted Pushbutton Controls





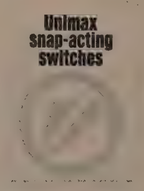
LPB Series 9 Lighted Pushbutton Switches

Unimax LPB Series 9 are four lamp lighted pushbutton panel controls designed to meet the requirements of MIL-S-22885/9-12 (for QPL approved controls designate series 9M). They are offered in a wide range of display styles. Color coding and customized messages can be easily changed or modified in the field. **For more technical information request our Catalog 50.**

LPB EAO Series Lighted Pushbutton Controls

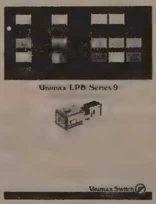
The EAO Series 01, 02, 03 LPB's offer you an exceptionally large selection of high quality illuminated pushbutton switches with a wide range of styles, capabilities and prices. All models are available in momentary or alternate actions or as indicators only. All EAO Series LPB's are quickly and easily installed, and relampable from the front of the panel. Ratings, and electrical and mechanical performance are uniformly high. The EAO switches provide a complete choice of lens cap colors in all models. **For more technical information request our Bulletin 515.**

Free Catalogs!
At your request



Unimax snap-acting switches

44 page catalog #60 on snap-acting switches.



Unimax LPB Series 9

12 page catalog #50 on LPB Series 9.

EAO Series 01, 02, 03 Lighted Pushbutton Controls

6 page bulletin #515 on EAO Series.

Unimax ® Switch
CORPORATION
A Riker-Maxson Subsidiary, Ives Road, Wallingford, Connecticut 06492
Phone (203) 269-8701, TWX (710) 476-1397

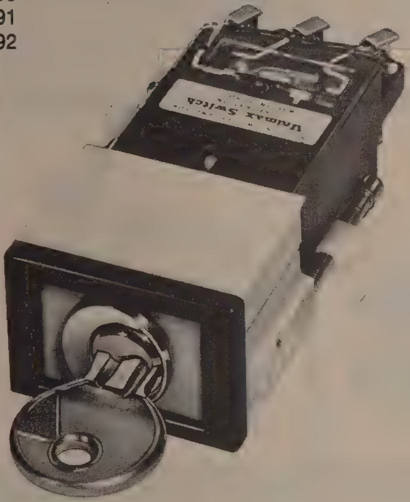
Unimax key-lock switches

EAO Series 02

☐ Eliminates unauthorized use of equipment.
☐ Locks out equipment during down time.
☐ Prevents turn-off except by authorized personnel.
☐ Emergency cut-off or start up of equipment.

Standard key lock switch

02-190
02-191
02-192



Switch Functions

02-190—2 pole double throw—lockable in "actuated" position only

02-191—2 pole double throw—lockable in "free" position only

02-192—2 pole double throw—lockable in either "actuated" or "free position."

Note: These switches permit removal of the key only when switch is locked.

The Panic switch

02-199

Emergency
cut-off
or start

Switch Functions

02-199—2 pole double throw switch with mushroom cap. When switch is actuated, it automatically locks itself in and can only be reset by unlocking with key. When unlocked, switch automatically returns to free position. With key in switch and switch unlocked it can be operated as a momentary action switch.

Technical data:

Switches—Snap action, DPDT.
Contacts—Fine silver, rated 10 amps @ 380 V.
Terminals—Silver plated screw type.

Mounting—From front of panel—rear mounting sleeve.
Panel Thickness—Up to 3/8" maximum.
Depth Behind Panel—Less than 3".

Panel Cut-out—1.17 x .860 in.
Bezel—Black
Push button—Standard—Grey
Push button—02-199—Red

Two keys supplied with each switch— 50 different lock numbers available.

Unimax Switch CORPORATION

A Riker-Maxson Subsidiary/Wallingford, Conn. 06492/Tel: (203) 269-8701

Wanna start something?

We're already starting computers, home appliances, musical instruments, toys, power tools and on n' on.

If you want to start something, use our switches. UID manufactures the largest selection of illuminated and standard push-button, rocker and slide switches for your applications. And, we feature a complete line of power transistor sockets. Start by calling UID.

AMF UID Electronics Division
4105 Pembroke Road, Hollywood, Florida, (305) 981-1211, TWX 510-954-9810

VEETRONIX, INC.

KEYBOARD SWITCHES

ALTERNATE ACTION
AND BI-LEVEL TYPES
ARE AVAILABLE

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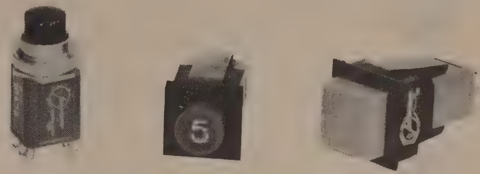
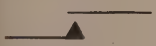
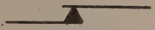
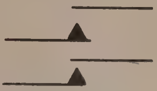




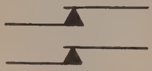
FORM A



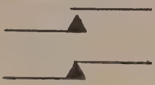
FORM B



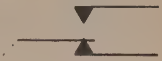
FORM AA



FORM BB



FORM AB



FORM C

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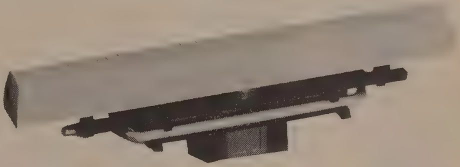

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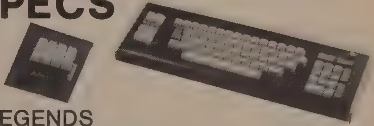

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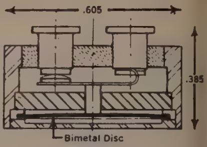
The information herewith supplied is correct to the best of our knowledge, but we disclaim any liability from error and reserve the right to effect modification in specifications and prices without notice.

ELMWOOD SENSORS SUB-MINIATURE SNAP-ACTION THERMOSTATS

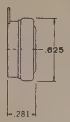
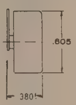
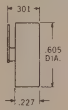
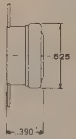
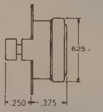
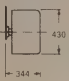
Elmwood thermostats are engineered for quick thermal response. Their heart is the bimetallic snap-acting disc which has proven highly reliable and serviceable over hundreds of thousands of cycles. Elmwood precision thermostats are manufactured and tested to conform to military specifications MIL-E-5272. Nickel plating is standard; other plating available. A variety of brackets and studs, as shown, are standard.

- **Many mounting arrangements**
- **Exposure from —65°F to +550°F**
- **Proven Military and Civilian Performance Record**
- **Narrow or Wide Differential**
- **Rated to 15 Amps.**
- **Immediate Delivery from Stock**
- **Custom Packaging**

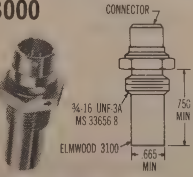
When contacts are closed, current passes from terminal to terminal through the stationary contact to the movable contact, which is actuated by the snap movement of bimetal disc. This disc, which is fully insulated from the switch chamber by the pin and disc retainer, is affected by surface or ambient temperature changes only. Upon reaching the opening temperature, the disc snaps from a concave to a convex shape, releasing the pin which opens the contacts. The open circuit allows the temperature to drop and causes the disc to snap to its original position, closing the contacts. A thermostat which closes on a rise in temperature operates in a similar manner, but in reverse action.



ELMWOOD #3100

DESCRIPTION	ELECTRICAL RESISTIVE		THERMAL		
	VOLTS	AMPS	RANGE	DIFFERENTIAL	TOLERANCE
3001  Precise, reliable unit for electronic communications, missile and aircraft controls, heater blanket controls and crystal ovens. This inexpensive unit is factory-calibrated, has the highest quality operating parts, a phenolic base and metal closure. These assure maximum dust protection and high thermal and electrical dependability. It is available with a variety of mountings and terminals. **Terminal T-123**	30 AC/DC	6	+0°F to +350°F	Wide 12°F or more STD	Wide ±5°F STD
	125 AC	6			
	250 AC	3		Narrow 6°F Max. Avail. 80 to 200°F	Narrow ±3°F Min.
3100  This thermostat is hermetically sealed with high compression glass and heliarc welded steel case. It is so constructed as to withstand the severest environmental conditions such as altitude, shock, vibration and corrosive atmosphere. It has been extensively tested by government agencies, and has been used for many government and civilian purposes, such as aircraft warning controls, de-icing equipment, etc. Ideal for packaging in special enclosures. **Terminal T-116**	30 AC/DC	6	—10°F to +500°F	Wide 12°F or more STD	Wide ±5°F STD
	125 AC	6			
	250 AC	3		Narrow 6°F Max. Avail. 80 to 200°F	Narrow ±3°F Min.
3150  Low silhouette SPST switch, hermetically sealed, available narrow or wide differential as standard. Temperature calibrations pre-set at factory, 100% inspected. Open or close on temperature rise. Heliarc welded in steel housing, glass-to-metal seal at terminal junction. Maximum resistance to shock and vibration. Ideal for use in heater blankets, computers, crystal ovens, electronic and radar equipment, gyros, airborne de-icers, etc. **Terminal T-109**	30 AC/DC	4	—10°F to +350°F	Narrow 6°F Max. Avail. 50 to 225°F	Narrow ±3°F STD
	125 AC	4		Wide 12°F or more STD	Wide ±5°F STD
3450  This inexpensive control unit is designed with either phenolic (up to 300°F) or ceramic base, and has a tight-fitting dustproof metal closure. It is recommended for applications where its heavy electric construction makes it ideal to control high amperage uses. Also available for European applications that require 4mm or 8mm spacing. **Terminal T-101**	30 AC/DC	15	+0°F to +350°F	15°F or more	±8°F STD
	125 AC	15			
	250 AC	8			±5°F Min.
3400M  Manual reset snap-acting non-adjustable thermostat designed for computers, electrical equipment and military applications. Opens on rise only. Once opened, it will not recycle automatically at room temperature until the reset button is pushed, snapping the disc and closing the circuit. Dustproof, with a high-temp phenolic base protected by metal closure. 100% temperature inspected. Also available for European applications requiring 4mm spacing. **Terminal T-101**	30 AC/DC	12.5	+100°F to +350°F	Manual Reset	±15°F STD
	125 AC	12.5			
	250 AC	6.25			±6°F Min. at 150°F or less
3305  Sub-miniature SPST, snap-action switch measuring only .430" in diameter, with narrow (±3°F) tolerance and narrow (6°F) differential. Hermetically sealed steel housing, glass-to-metal seal, all welded construction. Fast, reliable, excellent for crystal ovens, gyro platforms, heater blankets, computers, test equipment, etc. Three terminals and two brackets available. Temperature calibrations are factory preset. 100% thermally and mechanically inspected. **Terminal T-133**	30 AC/DC	2	+100°F to +250°F	Wide 20°F Max.	Wide ±8°F
	125 AC	2		Narrow 6°F Max.	Narrow ±3°F

3000



Custom designed package houses a non-adjustable, snap action Elmwood Sensors 3100 single-pole single-throw thermostat. Performance characteristics are outlined on the preceding pages. Housing material is stainless steel, all-welded construction. Customized connectors, size, and threads may be designed to suit requirements. Qualified by many military and aircraft applications; complete proposals are available upon request.

NOTE: Electrical ratings, life cycles and performance characteristics have been established after testing and review of standard operating conditions. The specifications outlined in this bulletin suggest the performance characteristics when the units are subject to these standard conditions. To ensure that our laboratory test conditions duplicate the performance requirements for the application, all thermostats should be tested for each application. For special narrower tolerances, differentials, brackets, terminals and set points which are not specified or standard, please consult the factory. Warranty is limited as provided in Elmwood Sensors Inc. standard terms of sale.

AVAILABLE MOUNTING BRACKETS

FIG. B208

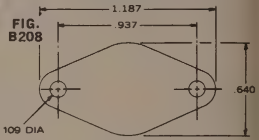


FIG. B209

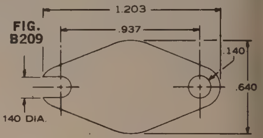


FIG. B210

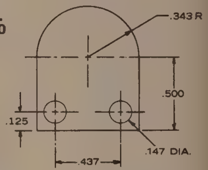


FIG. B211

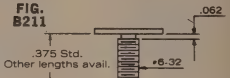


FIG. B212

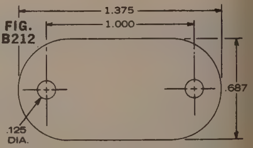
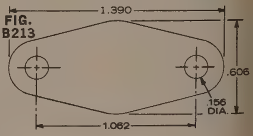
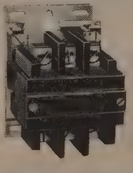


FIG. B213



Samples and Ordering — please furnish complete information on application, exposure, electrical requirements, and temperature set points to facilitate the furnishing of proper samples.



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CARBORUNDUM THERMISTORS

Carborundum thermistors are temperature dependent resistors, offered in a wide variety of resistance-temperature characteristics. They are available with a wide range of negative temperature coefficients at 25°C ranging from −0.3%/°C to −5.4%/°C. These parts are made from ceramic materials, bonded in a high-temperature firing process into rod, disc, and chip configurations. They are available in a large range of sizes, thermal characteristics, resistance values, and temperature coefficients to suit the needs of many types of electrical and electronic circuits.

Carborundum offers long experience in the design of special resistance devices. This, together with expertise in the field of ceramic technology, assures a stable and uniform product to meet your thermistor requirements. All materials used in the manufacture of Carborundum thermistors are of the highest quality. Strict quality control is maintained over all stages of manufacture, and a minimum of two calibrations at the specified reference temperature is standard.

DEFINITIONS

Zero Power Resistance... is the resistance of a thermistor at the calibrating temperature, measured in such a manner that the measuring current does not appreciably heat the thermistor. Resistance, as used here, means zero power resistance unless otherwise stated.

Beta (β)... is the number that satisfies the equation:

$$R_1/R_2 = {}_{\epsilon}\beta\ (1/T_1\text{-}1/T_2)$$

Carborundum determines beta from measurements at 25°C and 73.2°C. Beta is proportional to the slope of the resistance-temperature characteristic, and it is also known as the material constant. It is not truly a constant, but it gives a good approximation of resistance over a substantial working range. In the equation, ϵ is 2.718..., the base of natural logarithms, and β, T_1, and T_2 are in Kelvin (K).

Alpha (α)... or temperature coefficient of resistance (TCR) is proportional both to beta and to the square root of the temperature at which it is specified. Very nearly,

$$\alpha = -100\ \beta/T^2$$

In this equation, temperature is in Kelvin (K), and α is in percent per degree C (%/°C). It is evident that alpha becomes much higher as temperatures decrease.

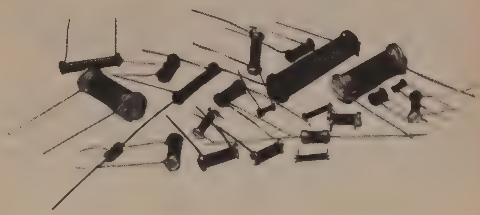
Dissipation Constant (δ)... is the ratio of power dissipated by the thermistor divided by the temperature rise above ambient due to self-heating. Here, it is 20 times the power required, in watts, to bring the thermistor to 75°C in an ambient of 25°C, and it is expressed in milliwatts.

Time Constant (τ)... is the time required for a thermistor which has attained equilibrium after being self-heated to 75°C to cool to 43.4°C in an ambient of 25°C. It is expressed in seconds.

Both δ and τ are necessarily approximate quantities, and they represent complicated concepts. They cannot be fully defined or used unless the conditions under which they are measured are fully defined.

In particular, note that the dissipation of a thermistor is the sum of dissipation due to conduction, convection, and radiation, which are related to temperature by linear, square-law, and fourth-power equations respectively. Only over narrow temperature ranges can dissipation constant be considered constant.

Also note that time constant is defined by a zero-power cooling curve. If the thermistor is attached to a heat sink the effective time constant is changed substantially. The time required for a thermistor to reach equilibrium due to heating from a current passing through it may be dramatically different from the time constant as defined above.



THERMISTOR SPECIFICATION

Thermistors are most often specified by a zero power resistance, suitably toleranced, at some specified temperature (most often 25°C or 37.8°C), and by a temperature coefficient, also suitably toleranced. This is all that is required as an electrical specification. Additional specifications may result in double dimensioning and be unduly restrictive (and therefore costly) or ambiguous.

The zero power resistance of a thermistor should be read in a temperature controlled, agitated oil bath. Not only does the oil bath provide a more controllable constant temperature, but it also speeds the settling of the reading.

TEMPERATURE COEFFICIENTS

Of a variety of ways in which temperature coefficients may be expressed, beta is chosen as being the most nearly universal. If β is known, then it is possible to calculate the approximate resistance of the thermistor at any given temperature.

Alpha changes with temperature. Due to the problems associated with the accurate measurement of an incremental difference in temperature, direct measurement of α is both impractical and imprecise.

The ratio of resistances between two temperatures may be specified. In order to obtain the approximate resistance at any other temperature, beta must be calculated or a resistance-temperature characteristic curve used.

Resistance may be specified at each of two (or more) temperatures. Where this is done, one resistance usually carries a tight tolerance, the other resistance(s) a much looser tolerance. Two tight tolerances on resistance at two different temperatures may result in an unrealistically tight tolerance on temperature coefficient.

OTHER CONSIDERATIONS

In creating a specification for a thermistor, the following should be taken into account:

- ...size of the thermistor body and size overall.
- ...coating material, if any.
- ...marking, if any.
- ...lead detail, including material, length, diameter, and trim.

Note that δ and τ are fully defined by the physical parameters of a thermistor. If they are shown on a drawing, they should be shown as nominal or marked for reference only.

When possible, specify a thermistor by part number. Second best, show a part number with exceptions (for example, 0325F5-434 except ±5% tolerance on resistance). When neither of these is practical, it is best to fully define the thermistor by a detail drawing.

The Carborundum Company, Graphite Products Division, Post Office Box 339,
Niagara Falls, N.Y. 14302 Tel: (716) 278-2521 Telex: 91-555 (CARBO GLO NGF)

CARBORUNDUM

CARBORUNDUM THERMISTORS

RODS AND CHIPS

ROD THERMISTORS

Rod thermistors are manufactured by extruding and firing a suitable ceramic mixture. For a given type of thermistor, low-, medium-, or high-sensitivity, a number of mixtures are available: in general, a mixture yielding a higher resistivity product also yields a higher beta or temperature sensitivity.

Standard rod thermistors are shown in the table below. They have a resistance tolerance of ±10% at 25°C, and they are neither coated nor marked. Special rod thermistors may be ordered with intermediate resistance values, other resistance tolerances, other calibration temperatures, coating, marking, special lead preparation, etc. Parts without wire leads are also available.

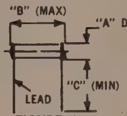


FIGURE 1

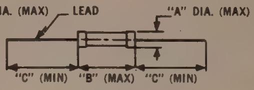


FIGURE 2

Style	Figure	Dimensions (inches) A	B	C	AWG	Dissipation Constant (mw/°C)	Time Constant (seconds)
0325F5- 0325H5-	1	0.12	0.30	1.00	24	6.0	10
0540F4-	2	0.20	0.50	1.25	20	9.5	22
0550H4-	2	0.20	0.63	1.25	20	11.0	25
0550F5- 0550H5-	1	0.22	0.63	1.38	20	11.0	25
1099F5-	1	0.38	1.13	1.38	20	24.0	90

		MEDIUM TEMPERATURE COEFFICIENT Type "F" Rods Beta ±10%			HIGH TEMPERATURE COEFFICIENT Type "H" Rods Beta ±5%	
Resistance Ohms ±10% @ 25°C	Dash Number	Style 0325F5	Styles 0540F4- 0550F5-	Style 1099F5-	Style 0325H5-	Styles 0550H4- 0550H5-
2.2	-402	——	——	1300	——	——
3.3	-403	——	——	1350	——	——
4.7*	-404	——	1300	1400	——	——
6.8	-406	——	1350	1450	——	——
10.0*	-410	1300	1400	1500	——	——
15.0	-411	1350	1450	1550	——	——
22.0*	-412	1400	1500	1600	——	——
33.0	-413	1450	1550	1600	——	——
47.0*	-414	1500	1600	1650	——	——
68.0	-416	1550	1600	1650	——	——
100*	-420	1600	1650	1700	——	——
150	-421	1600	1650	1700	——	——
220*	-422	1650	1700	1750	——	——
330	-423	1650	1700	1750	——	——
470*	-424	1700	1750	1800	——	——
680	-426	1700	1750	1800	——	——
1,000*	-430	1750	1800	1850	——	3000
1,500	-431	1750	1800	1850	——	3100
2,200*	-432	1800	1850	1900	3000	3150
3,300	-433	1800	1850	1900	3100	3200
4,700*	-434	1850	1900	1950	3150	3300
6,800	-436	1850	1900	1950	3200	3400
10,000*	-440	1900	1950	2000	3300	3500
15,000	-441	1900	1950	2000	3400	3600
22,000*	-442	1950	2000	2050	3500	3700
33,000	-443	1950	2000	2050	3600	3800
47,000*	-444	2000	2050	2100	3700	3900
68,000	-446	2000	2050	2100	3800	4000
100,000*	-450	2050	2100	2150	3900	4100
150,000	-451	2050	2100	2150	4000	4150
220,000*	-452	2100	2150	2200	4100	4200
330,000	-453	2100	2150	2200	4150	4250
470,000*	-454	2150	2200	2200	4200	4300
680,000	-456	2150	2200	——	4250	4350
1,000,000*	-460	2200	2200	——	4300	4400
1,500,000	-461	2200	——	——	4350	——
2,200,000	-462	2200	——	——	4400	——

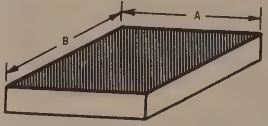
Order by the style number followed by the dash number. For example, part number 0540F4-404 is a thermistor of style 0540F4-, of 4.7 ±10% ohms resistance, and with a beta of 1300 ±10% K.

STOCK ITEMS, carried by Carborundum distributors, are styles 0540F4- and 0550H4- of those resistance values marked with an asterisk (*).

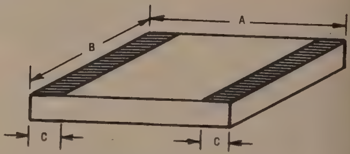
CHIP THERMISTORS

Chip thermistors, manufactured by a proprietary process, are available to meet today's needs for miniaturization. Standard parts, shown in the table below, are furnished without leads, and are suitable for use in hybrid microcircuits. Parts with wire leads are also available.

The basic material system is substantially the same as that for disc thermistors, and the data for temperature characteristics of disc thermistors apply. Chip thermistors have a nominal thickness of 0.015 inch. Metallization is Dupont 8032 silver.



STYLE 1



STYLE 2

Carborundum Part Number	Resistance at 25°C in Ohms	Nominal Dimensions A	B	C	Style	Dissipation Constant mw/°C	Time Constant Seconds
A1515C-1	300 ±10%	0.15	0.15		1	4.5	8.5
A1010C-1	680 ±10%	0.10	0.10		1	3.0	6.0
A0505C-1	2,800 ±10%	0.05	0.05		2	1.5	4.0
A1005D-1	53,000 ±10%	0.10	0.05	0.015	2	2.5	5.0
A2010D-1	53,000 ±10%	0.20	0.10	0.030	2	6.0	18.0
B1515C-1	26 ±10%	0.15	0.15		1	4.5	8.5
B1010C-1	60 ±10%	0.10	0.10		1	3.0	6.0
B0505C-1	240 ±10%	0.05	0.05		1	1.5	4.0
B1005D-1	3,000 ±10%	0.10	0.05	0.015	2	2.5	5.0
B2010D-1	3,000 ±10%	0.20	0.10	0.030	2	6.0	18.0
C1515C-1	55 ±10%	0.15	0.15		1	4.5	8.5
C1010C-1	130 ±10%	0.10	0.10		1	3.0	6.0
C0505C-1	520 ±10%	0.05	0.05		1	1.5	4.0
C1005D-1	9,200 ±10%	0.10	0.05	0.015	2	2.5	5.0
C2010D-1	9,200 ±10%	0.20	0.10	0.030	2	6.0	18.0
D1515C-1	500 ±10%	0.15	0.15		1	4.5	8.5
D1010C-1	1,100 ±10%	0.10	0.10		1	3.0	6.0
D0505C-1	4,400 ±10%	0.05	0.05		1	1.5	4.0
D1005D-1	88,000 ±10%	0.10	0.05	0.015	2	2.5	5.0
D2010D-1	88,000 ±10%	0.20	0.10	0.030	2	6.0	18.0

CARBORUNDUM

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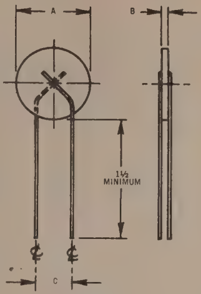
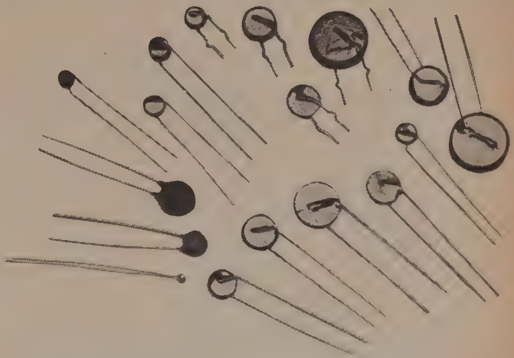
CARBORUNDUM THERMISTORS
HIGH SENSITIVITY NTC DISCS

DISC THERMISTORS

Disc thermistors are manufactured by pressing and firing a suitable ceramic mixture. Carborundum offers six standard mixtures of various resistivity and beta.

Standard disc thermistors are shown in the table on this page. They have a resistance tolerance of ±10% at 25°C, and they are neither coated nor marked. Special disc thermistors may be ordered with intermediate resistance values, other resistance tolerances, other calibration temperatures, coating, marking, special lead preparation, etc. Parts without wire leads are also available.





Notes:

1. Dielectric coating and marking are extra-cost options.
2. Kinked leads for printed circuit use available upon request.

TYPICAL PARTS

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	Dimensions B	Dimensions C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "A" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
*A3306J-16	50 ±20%	0.82	0.06	⅜	18	29.0	100
A2606J-16	75 ±20%	0.65	0.06	⅜	20	20.0	80
A2004J-16	100 ±10%	0.50	0.04	¼	20	15.0	60
A3311J-16	100 ±20%	0.82	0.11	⅜	18	29.0	150
*A2207J-16	120 ±20%	0.55	0.07	¼	20	17.0	75
*A3312J-16	120 ±20%	0.82	0.12	⅜	18	29.0	150
A1604J-16	150 ±10%	0.40	0.04	¼	20	9.0	38
*A1203J-16	200 ±10%	0.30	0.03	¼	24	8.0	30
A2612J-16	200 ±20%	0.65	0.12	⅜	20	22.0	100
*A1204J-16	300 ±10%	0.30	0.04	¼	24	8.0	30
*A0803J-16	500 ±10%	0.20	0.03	⅛	24	7.0	20
A1612J-16	500 ±10%	0.40	0.12	¼	20	11.0	60
*A0805J-16	750 ±10%	0.20	0.05	⅛	24	7.0	23
*A0807J-16	1,000 ±10%	0.20	0.07	⅛	24	7.2	26
A1212J-16	1,000 ±10%	0.30	0.12	¼	24	9.0	40
A0809J-16	1,500 ±10%	0.20	0.09	⅛	24	7.5	30
A0810J-16	2,000 ±10%	0.20	0.10	⅛	24	7.5	30
TYPE "B" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
*B3306J-16	2.0 ±20%	0.82	0.06	⅜	18	29.0	100
B2605J-16	3.0 ±20%	0.65	0.05	⅜	20	20.0	80
*B1804J-16	3.8 ±20%	0.45	0.04	⅜	22	12.0	48
*B2004J-16	5.0 ±10%	0.50	0.04	¼	20	15.0	60
B3312J-16	5.0 ±20%	0.82	0.12	⅜	18	29.0	150
*B1604J-16	7.5 ±10%	0.40	0.04	¼	20	9.0	38
*B1203J-16	10.0 ±10%	0.30	0.03	¼	24	8.0	30
B2612J-16	10.0 ±20%	0.65	0.12	⅜	20	22.0	100
*B1205J-16	15.0 ±10%	0.30	0.05	¼	24	8.5	35
*B1206J-16	20.0 ±10%	0.30	0.06	¼	24	8.5	35
B2012J-16	20.0 ±10%	0.50	0.12	¼	20	16.0	80
*B0804J-16	30.0 ±10%	0.20	0.04	⅛	24	7.0	20
B0807J-16	50.0 ±10%	0.20	0.07	⅛	24	7.2	26
B1212J-16	50.0 ±10%	0.30	0.12	¼	24	9.0	40
B0809J-16	75.0 ±10%	0.20	0.09	⅛	24	7.5	30
B0810J-16	100.0 ±10%	0.20	0.10	⅛	24	7.5	30
TYPE "L" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
L1205J-16	3,000 ±10%	0.30	0.05	¼	24	8.5	35
*L1209J-16	5,000 ±10%	0.30	0.09	¼	24	9.0	40
*L0805J-16	7,500 ±10%	0.20	0.05	⅛	24	7.0	23
*L0807J-16	10,000 ±10%	0.20	0.07	⅛	24	7.2	26
*L0810J-16	15,000 ±10%	0.20	0.10	⅛	24	7.5	30

Specifications	Type A	Type B	Type C	Types D & L	Type M
R @ 25°C / R @ 125°C	28.5	14.2	18.7	35.3	62.0
β (K) ±5% (25.0°C - 73.2°C)	3980	3070	3415	4200	4900
Temp. Coef. (α) %/°C @ 25°C	−4.4	−3.4	−3.8	−4.7	−5.4

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	Dimensions B	Dimensions C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "C" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
*C2604J-16	10.0 ±10%	0.65	0.04	⅜	20	20.0	80
C2004J-16	15.0 ±10%	0.50	0.04	¼	20	15.0	60
C1603J-16	20.0 ±10%	0.40	0.03	¼	20	9.0	38
C3312J-16	20.0 ±20%	0.82	0.12	⅜	18	29.0	150
C1605J-16	30.0 ±10%	0.40	0.05	¼	20	9.0	38
*C1205J-16	50.0 ±10%	0.30	0.05	¼	24	8.5	35
C2012J-16	50.0 ±10%	0.50	0.12	¼	20	16.0	80
*C0803J-16	75.0 ±10%	0.20	0.03	⅛	24	7.0	20
*C0804J-16	100.0 ±10%	0.20	0.04	⅛	24	7.0	20
C1612J-16	100.0 ±10%	0.40	0.12	¼	20	11.0	60
*C0807J-16	150.0 ±10%	0.20	0.07	⅛	24	7.2	26
C0808J-16	200.0 ±10%	0.20	0.08	⅛	24	7.2	26
C1212J-16	200.0 ±10%	0.30	0.12	¼	24	9.0	40
C0810J-16	300.0 ±10%	0.20	0.10	⅛	24	7.5	30
TYPE "D" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
D2604J-16	100 ±20%	0.65	0.04	⅜	20	20.0	80
D2003J-16	150 ±10%	0.50	0.03	¼	20	15.0	60
D1804J-16	200 ±10%	0.45	0.04	¼	20	12.0	48
D3312J-16	200 ±20%	0.82	0.12	⅜	18	29.0	150
D1604J-16	300 ±10%	0.40	0.04	¼	20	9.0	38
*D1204J-16	500 ±10%	0.30	0.04	¼	24	8.0	30
D2612J-16	500 ±20%	0.65	0.12	⅜	20	22.0	100
D1206J-16	750 ±10%	0.30	0.06	¼	24	8.5	35
*D1207J-16	1,000 ±10%	0.30	0.07	¼	24	8.5	35
D1612J-16	1,000 ±10%	0.40	0.12	¼	20	11.0	60
*D0806J-16	1,500 ±10%	0.20	0.06	⅛	24	7.0	23
*D0807J-16	2,000 ±10%	0.20	0.07	⅛	24	7.2	26
D1212J-16	2,000 ±10%	0.30	0.12	¼	24	9.0	40
*D0810J-16	3,000 ±10%	0.20	0.10	⅛	24	7.5	30
TYPE "M" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
M1203J-16	7,500 ±10%	0.30	0.03	¼	24	8.0	30
M1204J-16	10,000 ±10%	0.30	0.04	¼	24	8.5	35
M2012J-16	10,000 ±10%	0.50	0.12	¼	20	16.0	80
M1207J-16	15,000 ±10%	0.30	0.07	¼	24	8.5	35
*M0803J-16	20,000 ±10%	0.20	0.03	⅛	24	7.0	20
M1209J-16	20,000 ±10%	0.30	0.09	¼	24	9.0	40
*M0805J-16	30,000 ±10%	0.20	0.05	⅛	24	7.0	23
*M0809J-16	50,000 ±10%	0.20	0.09	⅛	24	7.5	30
*M0810J-16	75,000 ±10%	0.20	0.10	⅛	24	7.5	30

* Disc thermistors carried by Carborundum distributors are indicated by asterisk.

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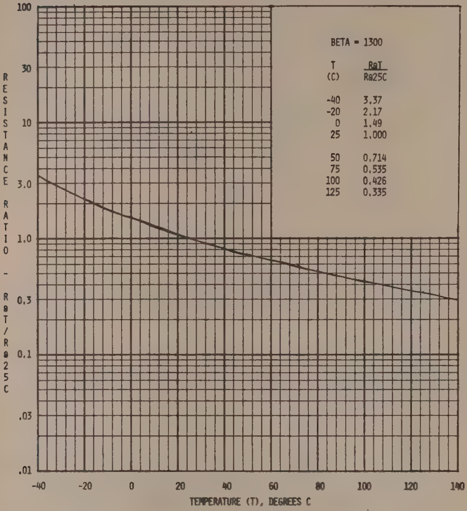
CARBORUNDUM THERMISTORS

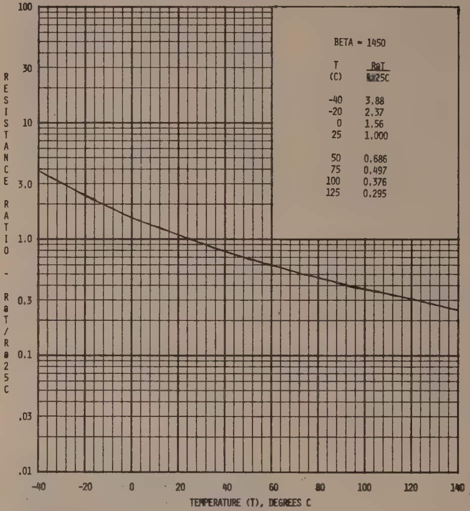
RESISTANCE-TEMPERATURE CHARACTERISTICS

. . . FOR TYPE F RODS
BETA = 1300



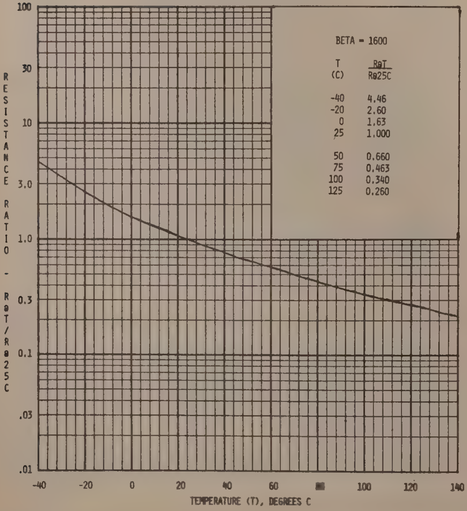
T (C)	R@T / R@25C
-40	3.37
-20	2.17
0	1.49
25	1.000
50	0.714
75	0.535
100	0.426
125	0.335

. . . FOR TYPE F RODS
BETA = 1450



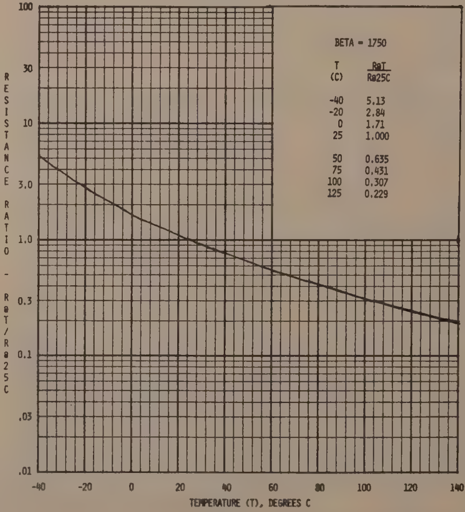
T (C)	R@T / R@25C
-40	3.88
-20	2.37
0	1.56
25	1.000
50	0.686
75	0.497
100	0.376
125	0.295

. . . FOR TYPE F RODS
BETA = 1600



T (C)	R@T / R@25C
-40	4.46
-20	2.60
0	1.63
25	1.000
50	0.660
75	0.463
100	0.340
125	0.260

. . . FOR TYPE F RODS
BETA = 1750



T (C)	R@T / R@25C
-40	5.13
-20	2.84
0	1.71
25	1.000
50	0.635
75	0.431
100	0.307
125	0.229

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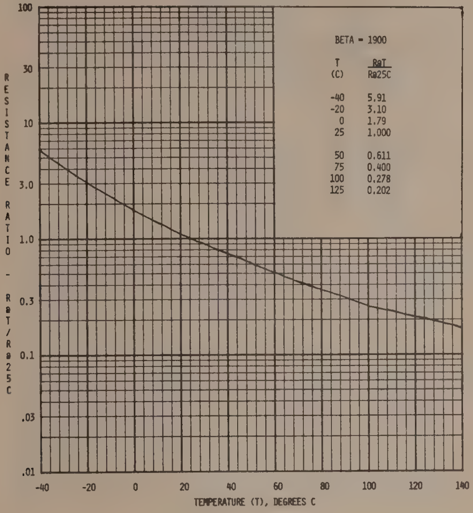
CARBORUNDUM THERMISTORS

RESISTANCE-TEMPERATURE CHARACTERISTICS

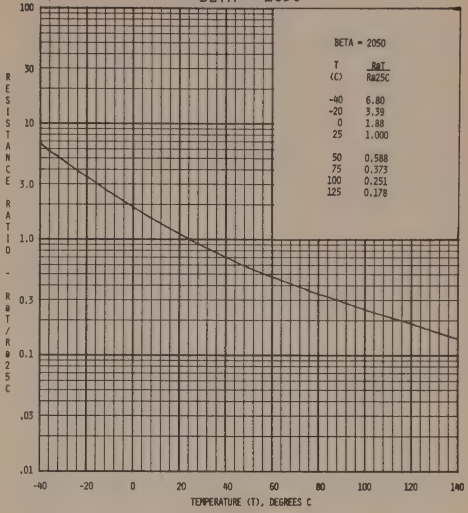
. . . FOR TYPE F RODS
BETA = 1900



BETA = 1900

T (C)	R@T / R@25C
-40	5.91
-20	3.10
0	1.79
25	1.000
50	0.611
75	0.400
100	0.278
125	0.202

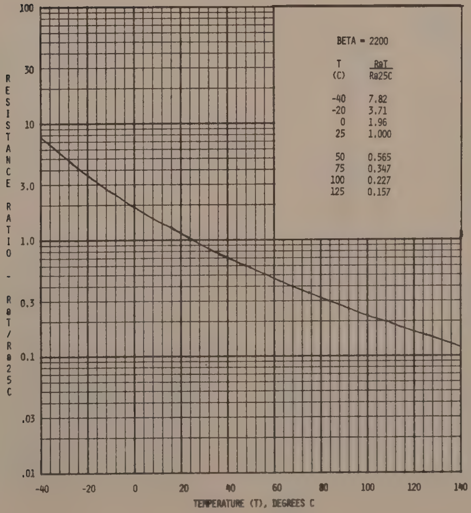
. . . FOR TYPE F RODS
BETA = 2050



BETA = 2050

T (C)	R@T / R@25C
-40	6.80
-20	3.39
0	1.88
25	1.000
50	0.588
75	0.373
100	0.251
125	0.178

. . . FOR TYPE F RODS
BETA = 2200



BETA = 2200

T (C)	R@T / R@25C
-40	7.82
-20	3.71
0	1.96
25	1.000
50	0.565
75	0.347
100	0.227
125	0.157

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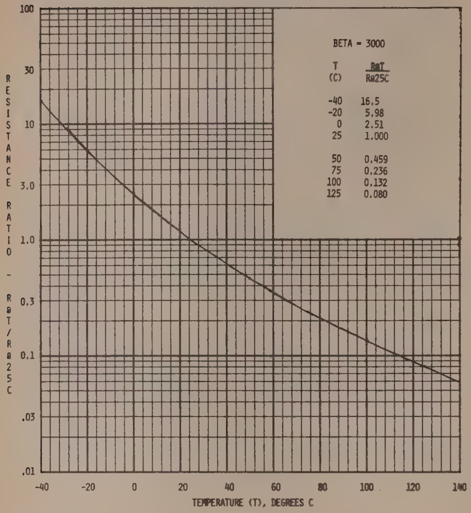
CARBORUNDUM THERMISTORS

RESISTANCE-TEMPERATURE CHARACTERISTICS

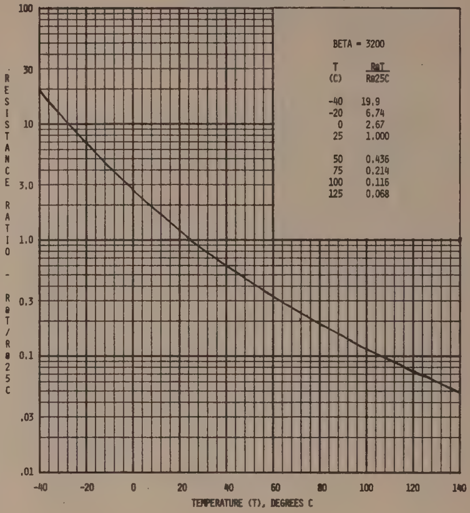
. . . FOR TYPE H RODS AND TYPE C DISCS BETA = 3000



BETA = 3000

T (C)	R@T / R@25C
-40	16.5
-20	5.98
0	2.51
25	1.000
50	0.459
75	0.236
100	0.132
125	0.080

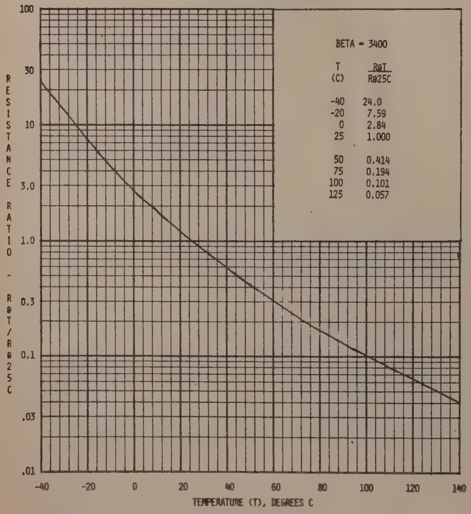
. . . FOR TYPE H RODS BETA = 3200



BETA = 3200

T (C)	R@T / R@25C
-40	19.9
-20	6.74
0	2.67
25	1.000
50	0.436
75	0.214
100	0.116
125	0.068

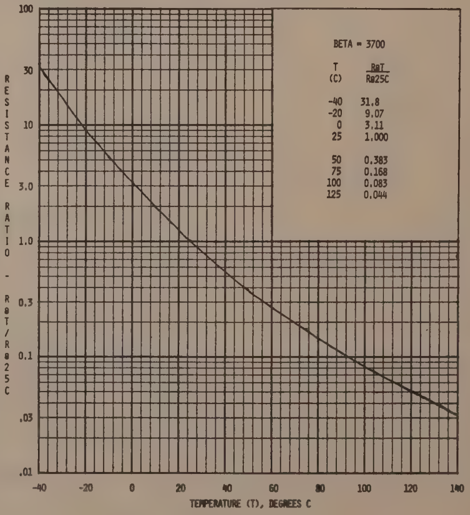
. . . FOR TYPE H RODS AND TYPE B DISCS BETA = 3400



BETA = 3400

T (C)	R@T / R@25C
-40	24.0
-20	7.59
0	2.84
25	1.000
50	0.414
75	0.194
100	0.101
125	0.057

. . . FOR TYPE H RODS BETA = 3700



BETA = 3700

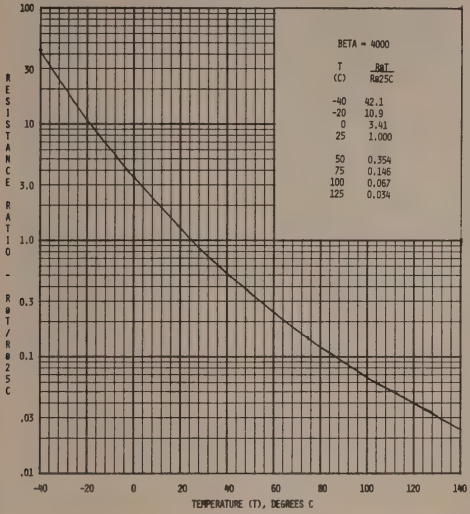
T (C)	R@T / R@25C
-40	31.8
-20	9.07
0	3.11
25	1.000
50	0.383
75	0.168
100	0.083
125	0.044

CARBORUNDUM THERMISTORS

RESISTANCE-TEMPERATURE CHARACTERISTICS

. . . FOR TYPE H RODS AND TYPE A DISCS

BETA = 4000

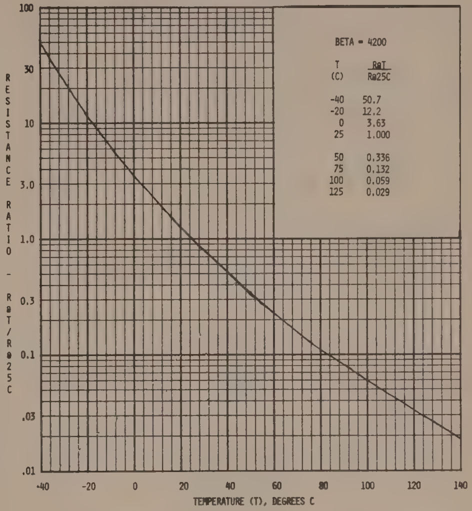


BETA = 4000

T (C)	R@T / R@25C
-40	42.1
-20	10.9
0	3.41
25	1.000
50	0.354
75	0.146
100	0.067
125	0.034

. . . FOR TYPE H RODS AND TYPE D AND L DISCS

BETA = 4200

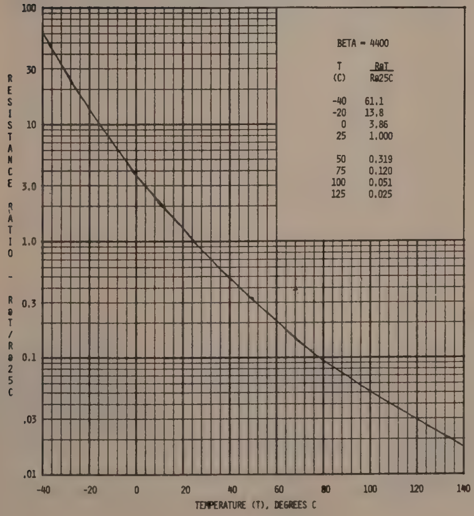


BETA = 4200

T (C)	R@T / R@25C
-40	50.7
-20	12.2
0	3.63
25	1.000
50	0.336
75	0.132
100	0.059
125	0.029

. . . FOR TYPE H RODS

BETA = 4400

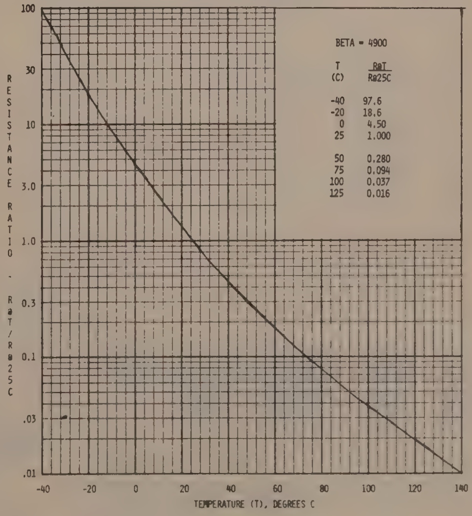


BETA = 4400

T (C)	R@T / R@25C
-40	61.1
-20	13.8
0	3.86
25	1.000
50	0.319
75	0.120
100	0.051
125	0.025

. . . FOR TYPE M DISCS

BETA = 4900



BETA = 4900

T (C)	R@T / R@25C
-40	97.6
-20	18.6
0	4.50
25	1.000
50	0.280
75	0.094
100	0.037
125	0.016

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THERMISTORS from FENWAL ELECTRONICS

1. **Glass Coated Beads** — used where small size, fast response, high precision, stability, and temperatures to 600°F are required.

2. **Glass Probes** — medium-small in size. Many of the advantages of beads but rugged, more easily mounted, useful in liquid media.

3. **Iso-Curve*Interchangeable Thermistors** — these units available in bead or glass probe configurations, follow standard curves over wide temperature range, and are completely interchangeable. Units match standard curves as close as ±¼% of resistance or as required.

*R.T.M.

4. **Discs** — used where medium power dissipation is a requirement and space not a problem. Useful to 300°F.

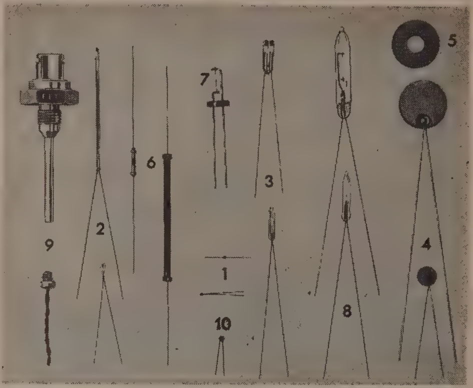
5. **Washers** — used where high power dissipation is a prime requirement.

6. **Rods** — these units have power dissipation intermediate between discs and washers and are also used where their physical shape is an asset.

7. **Mounted Beads** — provide ease in using glass beads in such applications as gas chromatography, flow and vacuum measurement, etc.

8. **Vacuum and Gas Filled Assemblies** — high power sensitivity for specialized circuit applications.

9. **Probe Assemblies** — standard catalog types or built to specific military or commercial requirements. We are experienced in design of probe assemblies for all fields of application including industrial control and indication, aerospace — specializing in telemetry applications, and oceanographic — featuring fast response, very high pressure, and interchangeability using our Iso-Curve Thermistors.



10. **NEW "LOW COST"**
Uni-Curve* Interchangeable Thermistors — completely interchangeable units having an accuracy of ±0.2°C over a temperature range of 0°C to 70°C and available on special order to other tolerances and ranges.

*TM

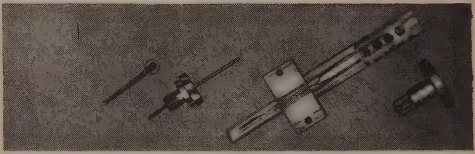
ISO-CURVE® Interchangeable Thermistors

F.E. Iso-curve* thermistors are special bead and glass probe thermistors that have been precision matched at the factory to standardized resistance-temperature curves. They have the unique and valuable characteristic of complete electrical interchangeability. In addition they offer all of the functional advantages associated with standard thermistors, including large resistance change per degree of temperature change which provides high accuracy and resolution.

Thermistors are normally rated by the value of their resistance at 77°F Standard units having the same rated resistance, however, will not exhibit identical resistance-versus-temperature characteristics over their full temperature range. Iso-curve thermistors, on the other hand, will match a specified R-T curve over full temperature range required. Iso-curve thermistors are available at the present time in six standardized R-T curve values: 500, 1K, 2K, 4K, 15K, and 100K ohms. These standard curves represent permanent specifications and an F.E. Iso-curve thermistor purchased five years from now will be perfectly interchangeable with one of the same value purchased today.

*MADE UNDER PAT. 3109227 AND OTHERS. ISO-CURVE IS A TRADEMARK OF F.E.I.

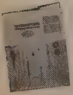
Thermistor Probe Assemblies



Standardized thermistor assemblies, provided in complete, ready-to-mount housings, enable you to take advantage of the precision and interchangeability of Fenwal Electronics thermistors. A complete line of thermistor probes is available for a variety of missile, aircraft, and industrial applications, including liquid level indication and control, temperature measurement and control of fluids and gases and many other applications. Precise calibration can be supplied with individual probes at all desired temperatures. Completely interchangeable probes with identical resistance-temperature curves are available to any desired tolerance down to 0.1°C over the full temperature range. Most of these housings can be made to meet military specifications if required.

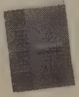
Fenwal Electronics

Here's help in applying F.E. Thermistors . . .



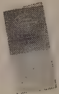
"Thermistors: Their Characteristics and Uses." Detailed bulletin gives basic information and many applications. Bulletin L-1A.

Thermistor Housing Manual (L-5). Detailed information on how Fenwal Electronics can build thermistor sensor assemblies to fit your requirements.

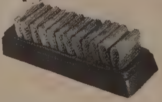


Iso-Curve Thermistors(L-2A) Complete data on patented interchangeable units with identical resistance/temperature curves.

Thermistor Manual (EMC-6) Most complete up-to-date listing of thermistors available. Theory, engineering data, complete specifications.

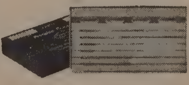


New 24-page Capsule Thermistor Course Book. A complete primer on thermistors, their characteristics and uses.



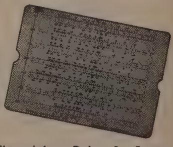
G-200. Kit contains 12 different thermistors with complete specs. PRICE $19.95.

THERMISTOR EXPERIMENTAL KITS



G-700. (Above) Kit contains 4 thermistors. PRICE $4.95.

Now available . . . UNI-CURVE G-500 KIT containing 6 completely interchangeable thermistors ranging from 3K to 100K ohms. PRICE $19.95.



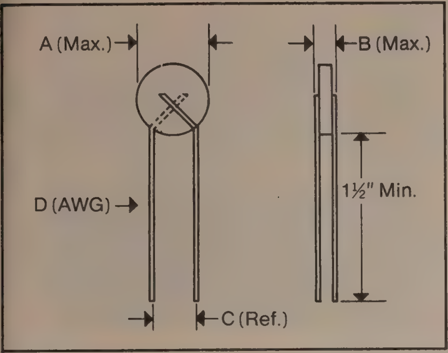
Thermistor Data & Curve Computer—(G300B) Provides resistance temperature characteristics for all F.E. Thermistors. Simplifies selection of the right thermistor for every application. PRICE $1.50.

FENWAL ELECTRONICS

63 FOUNTAIN STREET, FRAMINGHAM, MASS. 01701 • (617) 872-8841

Keystone
CARBON COMPANY

DISC TYPE THERMISTORS WITH CROSSED LEADS

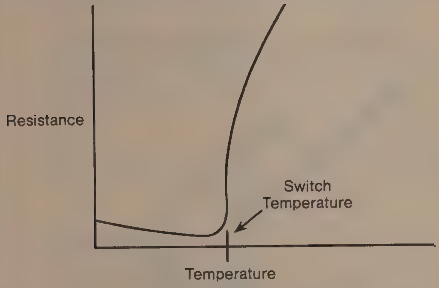


Maximum operating temperature—125°C

Keystone also offers a line of Disc-Type Thermistors ranging in sizes from .100 inch to 1.00 inch in diameter. Thirty-four different slopes are available (temperature coefficients from −3.75% per °C at 25°C to −5.22% per °C at 25°C). Resistance values range from 11.16 ohms to 518,400 ohms at 25°C. Write for short form catalog T-504 or complete catalog BW2.

KCC TYPE	R @ 25°C	Tol. ±%	A Max.	B Max.	C Ref.	D AWG.	Dissipation Constant (MW °/C)	Time Constant (Sec)	Temp. Coef. at 25°C % per °C
RL1004-65.6-59-D1	100	20	.110"	.120"	.100	26	2.5	9	−3.38
RL1003-312-73-D1	500	10	.110"	.110"	.100	26	2.5	9	−3.83
RL1007-624-73-D1	1000	10	.110"	.160"	.100	26	2.8	10	−3.83
RL1003-1746-97-D1	3000	10	.110"	.110"	.100	26	2.5	9	−4.39
RL1004-2910-97-D1	5000	10	.110"	.120"	.100	26	2.5	9	−4.39
RL1009-5820-97-D1	10,000	10	.110"	.180"	100	26	3.0	10	−4.39
RL1007-13770-120-D1	25,000	10	.110"	.160"	.100	26	2.8	10	−4.84
RL1003-26670-140D1	50,000	10	.110"	.110"	.100	26	2.5	9	−5.08
RL1006-53330-140-D1	100,000	10	.110"	145"	.100	26	2.8	10	−5.08
RL1004-104550-155-D1	200,000	10	.110"	.120"	.100	26	2.5	9	−5.22
RL2004-16.4-59-D1	25	20	.220"	.125"	.156	24	6.5	20	−3.38
RL2007-32.8-59-D1	50	20	.220"	165"	156	24	6.5	30	−3.38
RL2003-62.4-73-D1	100	10	220"	.115"	.156	24	6.5	20	−3.83
RL2005-124.8-73-D1	200	10	.220"	.140"	.156	24	6.5	20	−3.83
RL2008-187.1-73-D1	300	10	.220"	.175"	.156	24	6.5	30	−3.83
RL2013-312-73-D1	500	10	.220"	.230"	.156	24	7.2	50	−3.83
RL2004-582-97-D1	1000	10	.220"	.125"	.156	24	6.5	20	−4.39
RL2006-657-69-D1	1000	20	.220"	.150"	.156	24	6.5	20	−3.58
RL2007-1164-97-D1	2000	10	.220"	.165"	.156	24	6.5	30	−4.39
RL2009-1446-97-D1	2500	10	.220"	185"	156	24	6.5	30	−4.39
RL2010-1746-97-D1	3000	10	.220"	.195"	.156	24	7.0	35	−4.39
RL2006-2753-120-D1	5000	10	.220"	.150"	156	24	6.5	20	−4.84
RL2012-5506-120-D1	10,000	10	.220"	.220"	.156	24	7.2	50	−4.84
RL2006-13330-140-D1	25,000	10	.220"	.150"	.156	24	6.5	20	−5.08
RL2012-26660-140-D1	50,000	10	.220"	.220"	.156	24	7.2	50	−5.08
RL2008-52270-155-D1	100,000	10	.220"	.175"	.250	24	6.5	30	−5.22
RL3004-6.56-59-D1	10	20	.320"	125"	.156	24	7.0	35	−3.38
RL3504-31.2-73-D1	50	10	.370"	.125"	.250	24	7.5	45	−3.83
RL4004-174.6-97-D1	300	10	.420"	.125"	.250	24	3.0	50	−4.39
RL4504-3.28-59-D1	5	20	.475"	.130"	.328	22	10.0	60	−3.38
RL4504-15.6-73-D1	25	10	.475"	.130"	.328	22	10.0	60	−3.83
RL4504-116.4-97-D1	200	10	.475"	.130"	.328	22	10.0	60	−4.39
RL7605-6.24-73-D1	10	20	.795"	.150"	.328	20	16.0	70	−3.83
RL7605-58.2-97-D1	100	10	.795"	.150"	.328	20	16.0	70	−4.39

PTC—POSITIVE TEMPERATURE COEFFICIENT THERMISTORS



Positive Temperature Coefficient (PTC) thermistors are characterized by an extremely large resistance change in a small temperature span. The figure above depicts a generalized resistance temperature plot for a PTC. The temperature at which the resistance begins to increase rapidly is referred to as the switching temperature. This point can be changed from below 0°C to above 120°C.

LISTING OF TYPICAL TYPES

KCC Type No.	R @ 25°C, Ohms	Nominal Diameter	Nominal Thickness	Switching Temperature
RL6606-5-65-50-PTO	5	.66"	.06"	65°C
RL4006-12-65-50-PTO	12	.40"	.06"	65°C
RL3006-20-65-50-PTO	20	.30"	.06"	65°C
RL4513-25-65-120-PTO	25	.45"	.13"	65°C
RL2006-35-65-50-PTO	35	.20"	.06"	65°C
RL5450-3.0-120-20-PTO	3.0	.54"	.50"	120°C
RL6305-10-120-20-PTO	10.0	.63"	.05"	120°C
RL3006-15.0-120-25-PTO	15.0	.30"	.05"	120°C
RL3312-100-120-50-PTO	100	.33"	.12"	120°C

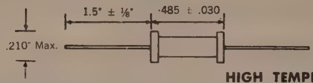
TYPICAL PTC APPLICATIONS

• Automatic Color TV Degaussing • Air Flow Measurement • Non-Destructive Fuse • Single Phase Motor Starting • Liquid Level Sensing • Combination Heater-Thermostat • Arc Suppression • Time Delay Fusing

Keystone CARBON COMPANY
Thermistor Division • St. Marys, Pa. 15857
814-781-1591 • Telex No. 91-4517

Keystone
CARBON COMPANY

ROD TYPE THERMISTORS



LOW/MEDIUM TEMPERATURE COEFFICIENT

TYPE	RESISTANCE AT °C 0	25	37.8	50	75	104.4	125	BETA ±10% (37.8-104.4°C)	R @ 25°C / R @ 125°C	Neg. Temp. Coef. @ 25°C
15-20-35-S1	30.6	20	16.4	13.8	9.90	7.01	5.65	1500	3.5	1.59
15-50-42-S1	80.6	50	40.1	32.9	22.6	15.3	11.9	1700	4.2	1.78
15-100-42-S1	161	100	80.2	65.8	45.3	30.6	23.8	1700	4.2	1.78
15-200-42-S1	322	200	160	132	90.6	61.2	47.7	1700	4.2	1.78
15-500-50-S1	847	500	391	314	206	133	100	1900	5.0	1.98
15-1K-50-S1	1690	1K	782	628	413	266	201	1900	5.0	1.98
15-2K-52-S1	3430	2K	1560	1240	808	515	387	1950	5.2	2.03
15-5K-54-S1	8680	5K	3860	3060	1980	1240	924	2000	5.4	2.07
15-10K-54-S1	17.4K	10K	7730	6130	3950	2480	1850	2000	5.4	2.07
15-20K-59-S1	35.6K	20K	15.3K	12K	7560	4640	3400	2100	5.9	2.17
15-50K-62-S1	90K	50K	37.9K	29.5K	18.5K	11.2K	8120	2150	6.2	2.22

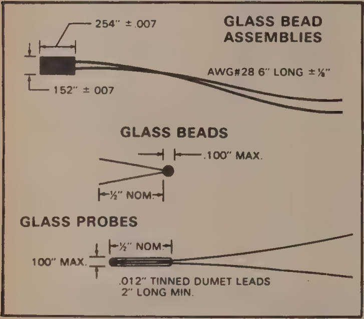
HIGH TEMPERATURE COEFFICIENT

TYPE	RESISTANCE AT °C 0	25	37.8	50	75	104.4	125	BETA ±10% (37.8-104.4°C)	R @ 25°C / R @ 125°C	Neg. Temp. Coef. @ 25°C
15-1K-139-S1*	2500	1K	656	451	227	111	71.9	3150	13.9	3.38
15-2K-139-S1*	4990	2K	1310	902	454	222	144	3150	13.9	3.38
15-5K-181-S1	13.7K	5K	3150	2100	979	450	276	3425	18.1	3.74
15-10K-192-S1	28.2K	10K	6240	4100	1890	855	520	3500	19.2	3.83
15-20K-292-S1	67.2K	20K	11.6K	7140	2920	1190	685	4000	29.2	4.46
15-50K-292-S1	168K	50K	28.9K	17.8K	7320	2980	1710	4000	29.2	4.46
15-100K-404-S1	372K	100K	55K	32.4K	12.2K	4540	2080	4400	40.4	4.86
15-200K-424-S1	753K	200K	109K	63.9K	23.9K	8740	4720	4450	42.4	4.91
15-500K-482-S1	1.95meg	500K	268K	154K	55.6K	19.7K	10.4K	4600	48.2	5.03
15-1meg-583-S1	4.06meg	1meg	523K	294K	100K	33.7K	17.1K	4830	58.3	5.22

*Supplied with ±20% tolerance at 25°C only.

GLASS BEADS • GLASS PROBES • GLASS BEAD ASSEMBLIES

Glass bead thermistors are exceptionally stable because the glass seal protects the thermistor from hostile environments.



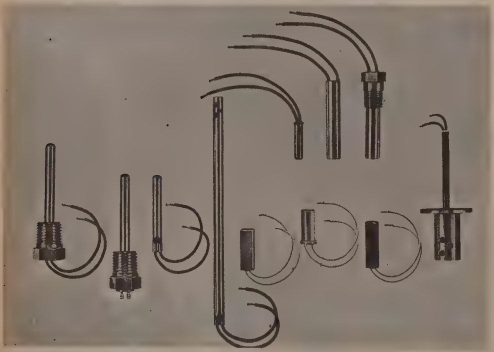
RESISTANCE/TEMPERATURE CHARACTERISTICS

TYPE	−21.5°C	0°C	25°C	37.8°C	50°C	104.4°C	150°C	232°C	TEMP. COEFF. AT 25°C
RL0504-614.8-71-G___*	7687	2775	1K	614.8	398.8	86.59	32.85	8.865	−3.88%
RL0504-8783-95-G___*	154.5K	48.48K	15K	8783	5484	924.5	290.3	59.55	−4.36%
RL0504-16.92K-112-G___	370.3K	105.3K	30K	16.92K	10.18K	1511	426.9	83.08	−4.67%
RL0504-27.76K-120-G___	643.1K	182.2K	50K	27.76K	16.50K	2313	642.0	109.7	−4.80%
RL0504-55.53K-120-G___	1.286 meg	364.5K	100K	55.53K	32.99K	4628	1284	219.5	−4.80%
RL0504-111.3K-125-G___	2.699 meg	743.5K	200K	111.3K	65.78K	8904	2415	407.4	−4.85%
RL0504-272.6K-142-G___	7.391 meg	1.976 meg	500K	272.6K	158.6K	19.20K	4706	682.0	−5.04%
RL0504-530.5K-148-G___	15.04 meg	3.939 meg	1 meg	530.5K	301.7K	35.84K	8780	1252	−5.14%

*Not presently available in Glass Probes.
Tolerance on resistance values ±20% @25°C. Closer tolerances available.

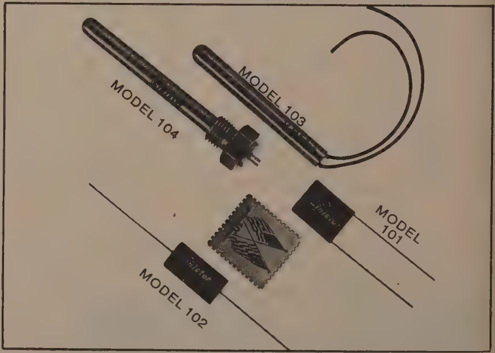
-**G1** for Glass Beads with platinum leads
-**G15** for Glass Probes
-**G20** for Glass Bead Assemblies

THERMISTOR PROBES



The probes illustrated above include stainless steel, aluminum, and chrome-plated materials in a variety of configurations. In addition, a variety of other designs are available. These probes are used in conjunction with solid state circuitry for liquid level measurement, and for use as sensors to measure the temperature of liquids or surface temperatures. Write for probe catalog TP-739.

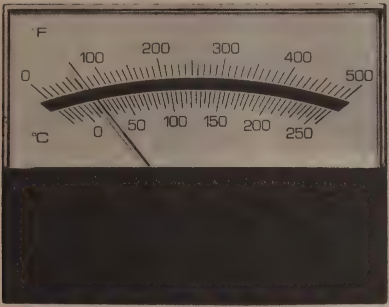
LINISTOR® ASSEMBLIES



Keystone developed Linistor assemblies to give an accurate resistance response over a temperature span of 0° to 100° C. Because Linistor assemblies have flattened out the thermistor resistance curve to a constant and predictable straight-line plot, they are valuable in a wide range of applications. Four standard encasements are available. Write for Linistor Bulletin L-601.

Keystone CARBON COMPANY
Thermistor Division • St. Marys, Pa. 15857
814-781-1591 • Telex No. 91-4517

MODUTEC



taut-band PYROMETERS

Request Modutec Catalog PYR-1104
for detailed information

Modutec Pyrometers offer a desirable combination of the reliable and precise Modutec taut-band meter movement, years-ahead functional design, and a full selection of sizes, styles, and temperature ranges.

Styles Modutec Pyrometers are offered in the following styles: surface mount (S and C Series); bezel mount (BA Series), and Windo-Mount (flush with panel — W Series). For a description of these styles please see Modutec Panel Meter pages in Section 2400.

Features & Specifications

- **Taut-band movement suspension for frictionless operation, assuring utmost sensitivity with excellent resistance to shock and vibration.**
- **Self-shielding magnetic circuit eliminates the effects of steel panel mounting or external fields.**
- **Styling is handsome and contemporary without compromising function.**
- **Flat, 100° arc scales for easy, accurate reading. Mirror scales are standard.**
- **Accuracy of ±2% full scale is standard (based on standard mV value listed in N.B.S. Circular #561.)**
- **Thermistor copper error compensation.**
- **Supplied with adjustable resistor for matching with thermocouple.**
- **Manual cold junction compensation.**

Ranges, Types, Sizes, Prices

Temperature Range °F	Temperature Range °C	Thermocouple Type*	1½"	2½"	3½"	4½"	5½"
−100/+600	−70/+310	E	$39.00	$37.80	$39.00	$40.20	$41.40
−100/+1100	−70/+600	E	39.00	37.80	39.00	40.20	41.40
0/+300	−20/+150	E or J	40.20	39.00	40.20	41.40	42.60
0/+500	−20/+260	E or J	39.00	37.80	39.00	40.20	41.40
0/+800	−20/+430	E or J	39.00	37.80	39.00	40.20	41.40
0/+1000	−20/+540	E, J, or K	39.00	37.80	39.00	40.20	41.40
0/+1500	−20/+820	E or K	39.00	37.80	39.00	40.20	41.40
0/+2000	−20/+1100	K	39.00	37.80	39.00	40.20	41.40
0/+3000	−20/+1650	R	40.80	39.60	40.80	42.00	43.20

*E = chromel/constantan; J = iron/constantan; K = chromel/alumel; T = copper/constantan; R = platinum/platinum—10% rhodium.

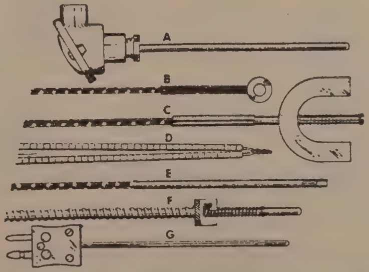
Options & Modifications

Many desirable options can be incorporated quickly at the Modutec factory modification centers, thus providing, in effect, custom pyrometers for very little delay and added cost. These options include: improved accuracy; colored cases including custom colors; high temperature cases and covers; illumination; sealed cases; rear zero adjustment. Many modifications such as custom dials and/or scales, hot-stamp case marking, etc., are possible; please consult factory for your requirements.

THERMOCOUPLES

Modutec Thermocouples are available quickly, from stock, in a useful variety of types and configuration. A few are shown here, with prices. These are available in all the thermocouple types listed in the pyrometer price schedule above.

For detailed information on thermocouples, wire, and related hardware, request Modutec Catalog PYR-1104.



A—T/C head with probe	$41.40
B—Washer type	$10.60
C—Magnet clamp type	$18.00
D—Ceramic insulated type	$11.10
E—Spade tip type	$21.25
F—Bayonet type	$18.00
G—Male plug with probe	$19.20

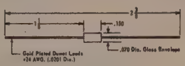
DISCOUNT SCHEDULE: 1-9 units NET; 10-24 10%; 25-49 20%; 50-99 30%, applicable to combined total.

MODUTEC, INC.
18 Marshall St., Norwalk, CT 06854 (203) 853-3636 TWX: 710-468-2039

NL INDUSTRIES

NTC THERMISTORS

H-SERIES THERMISTORS

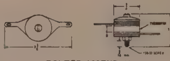


"H" Series Thermistors for high temperature or rugged environments use up to 400°C.

Catalog Number	1H-104	1H-503	1H-203	2H-103	2H-502	2H-202
Zero Power Resistance @25°C; OHMS ± 10%	100,000	50,000	20,000	10,000	5,000	2,000
Resistance Ratio; $\frac{R_{25°C}}{R_{125°C}}$	29.85	29.85	29.85	19.80	19.80	19.80
*Dissipation Constant (δ); $\frac{\text{milliwatts}}{°C}$	2	2	2	2	2	2
**Thermal Time Constant (τ); (sec.)	8	8	8	8	8	8
Maximum Operating Temperature; (°C)	400	400	400	400	400	400

0.75" DIA. WASHER ASSEMBLIES

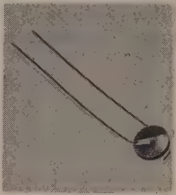
Washer Assemblies for "Soft-Starts" in inductive or illuminating applications up to 240 V.A.C. Limits inrush current to lower value eliminating current surges and in lighting circuits prolonging bulb life, reducing costs. Sizes to 2" Dia. also available for high power applications.

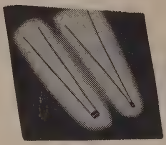


BOLTED ASSEMBLY

CATALOG NUMBER BOLTED ASSEMBLY	ZERO POWER RESISTANCE @ 25°C OHMS ±10%	GRADE	BETA β (25°C-75°C) °K	RESISTANCE RATIO R_{25}/R_{75}	RESISTANCE RATIO R_{25}/R_{125}	ZERO POWER NOMINAL RESISTANCE @ 150°C OHMS
9RT1A10	4150	4	4500 ±100	8.75	48.78	41.9
9RT1A11	3150	4	4500 ±100	8.75	48.78	31.8
9RT1A12	1000	4	4500 ±100	8.75	48.78	10.1
9RT1A1	415	1	3965 ±55	6.76	29.85	7.47
9RT1A3	315	1	3965 ±55	6.76	29.85	5.67
9RT1A5	100	1	3965 ±55	6.76	29.85	1.80
9RT1A2	41.5	2	3530 ±80	5.49	19.80	1.25
9RT1A4	31.5	2	3530 ±80	5.49	19.80	.945
9RT1A6	10	2	3530 ±80	5.49	19.80	0.3
9RT1A7	4.15	3	3000 ±150	4.26	12.95	0.200
9RT1A8	3.15	3	3000 ±150	4.26	12.95	0.152
9RT1A9	1	3	3000 ±150	4.26	12.95	0.0482

DISC THERMISTORS



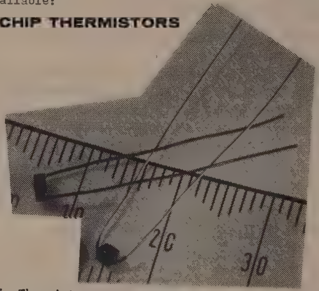


Larger size thermistors with close electrical tolerances. For temperature detection, control, and compensation circuits. Larger size reduces self-heating effect. These units are especially suited for current inrush suppression and time delay application.

Type	Ohms @ 25°C	Res. Ratio 25°C/125°C	Diss. Const. MW/°C	Time Const.	Dia. In.
4D101	100K	48.78	4	12	.1
4D103	50K	48.78	4	8	.1
1D051	20K	29.85	2	4.5	.05
1D101	10K	29.85	4	12	.1
1D103	5K	29.85	4	8	.1
1D201	3K	29.85	8	34	.2
1D301	3K	29.85	11.5	85	.3
2D052	2K	19.80	2	4	.05
1D203	1K	29.85	7.5	19	.2
1D501	1K	29.85	19	140	.5
2D054	1K	19.80	2	3	.05
2D102	1K	19.80	4	10	.1
2D104	500	19.80	4	6	.1
2D202	300	19.80	8	24	.2
2D302	300	19.80	10.5	75	.3
2D204	100	19.80	7.5	16	.2
3D102	100	12.95	4	10	.1
2D402	100	19.80	15.5	70	.4
2D504	50	19.80	15.5	70	.5
3D104	50	12.95	4	6	.1
3D202	30	12.95	8	28	.2
3D204	10	12.95	7.5	16	.2
3D402	10	12.95	15.5	70	.4
2D404	25	19.80	14	25	.4
3D504	5	12.95	15.5	70	.5
4D051	200K	48.78	2	4.5	.05

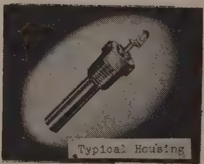
Also available:

NTC CHIP THERMISTORS



Chip Thermistors are available with or without leads or protective coatings in resistances from 100 to 100K ohms in temperature coefficients from -3.9%/°C to -4.9%/°C.

THERMISTOR PROBES



NL offers a wide range of speciality thermistor housings in many configurations. These housings can be designed to accept either NTC or PTC type thermistors to meet requirements for special applications.

NL INDUSTRIES, INC.

Electronics Department

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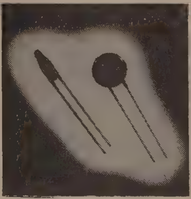
NL INDUSTRIES

VARISTORS

DISCS

Varistors protect circuits and components from inductive voltage surges by limiting peak discharge voltage, when AC or DC magnetic or inductive current is suddenly interrupted. Black dielectric coated after moisture protection with silicone impregnation. Continuous temp. 110°C.



.5" Dia.

CATALOG NUMBER	MAXIMUM VALUES						SPECIFICATIONS	
	CONTINUOUS OPERATING VOLTAGE VOLTS		CONTINUOUS POWER RATING	DISCHARGE CAPACITY	PEAK DISCHARGE VOLTAGE FOR GIVEN DC DISCHARGE CURRENT		DC TEST VOLTAGE & CURRENT	
	DC	AC	WATTS	WATT-SECONDS	AMPS	VOLTS	VOLTS	AMPERES
70D-5010	150	135	.25	30	.10	400	175 ±20%	.001
68D-5010	60	54	.25	30	.10	200	75 ±20%	.0025
67D-5010	30	27	.25	30	.25	100	35 ±20%	.005
65D-5010	15	13.5	.25	20	.25	60	15 ±20%	.010

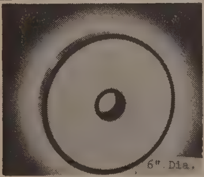
.75" Dia.

ORDER NUMBER	MAXIMUM VALUES						SPECIFICATIONS	
	CONTINUOUS OPERATING VOLTAGE (VOLTS)		CONTINUOUS POWER RATING	DISCHARGE CAPACITY	PEAK DISCHARGE VOLTAGE FOR GIVEN DC DISCHARGE CURRENT		DC TEST VOLTAGE & CURRENT	
	DC	AC	(WATTS)	(WATT-SECONDS)	(AMPS)	(VOLTS)	VOLTS	AMPERES
71D-7000	150	135	.75	50	.125	400	175 ±20%	.005
68D-7000	60	54	.75	50	.25	185	70 ±20%	.0125
66D-7000	30	27	.75	50	.50	100	35 ±20%	.025
63D-7000	15	13.5	.75	50	1.00	52	17.5 ±20%	.050

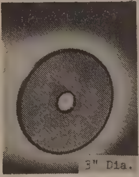
1.0" Dia.

ORDER NUMBER	MAXIMUM VALUES						SPECIFICATIONS	
	CONTINUOUS OPERATING VOLTAGE (VOLTS)		CONTINUOUS POWER RATING	DISCHARGE CAPACITY	PEAK DISCHARGE VOLTAGE FOR GIVEN DC DISCHARGE CURRENT		DC TEST VOLTAGE & CURRENT	
	DC	AC	(WATTS)	(WATT-SECONDS)	(AMPS)	(VOLTS)	VOLTS	AMPERES
71D10000	300	270	1.5	275	.25	1000	350 ±20%	.005
68D10000	150	135	1.5	275	.50	575	175 ±20%	.010
66D10000	60	54	1.5	275	1.0	305	70 ±20%	.025
63D10000	30	27	1.5	275	1.5	175	35 ±20%	.050

WASHERS



6" Dia.



3" Dia.

3" Dia.

ORDER NUMBER	MAXIMUM VALUES						SPECIFICATIONS	
	CONTINUOUS OPERATING VOLTAGE VOLTS		CONTINUOUS POWER RATING	DISCHARGE CAPACITY	PEAK DISCHARGE VOLTAGE FOR GIVEN DC DISCHARGE CURRENT		DC TEST VOLTAGE & CURRENT	
	DC	AC	WATTS	WATT-SECONDS	AMPERES	VOLTS	VOLTS	AMPERES
71W30100	1,500	1,350	3.5	9,250	10	7,500	1,800 ±20%	0.0025
69W30100	300	270	3.0	5,100	1.5	1,350	520 ±20%	0.050
68W30100	150	135	3.0	5,100	2.5	800	230 ±20%	0.050
67W30100	60	54	3.0	1,700	5.0	250	85 ±20%	0.100
66W30100	30	27	3.0	1,700	5.0	150	36 ±20%	0.100
63W30100	15	13.5	3.0	1,350	10	100	25 ±20%	0.500
62W30100	7	6.3	3.0	1,100	10	40	9 ±20%	0.500

6" Dia.

ORDER NUMBER	MAXIMUM VALUES						SPECIFICATIONS	
	CONTINUOUS OPERATING VOLTAGE VOLTS		CONTINUOUS POWER RATING	DISCHARGE CAPACITY	PEAK DISCHARGE VOLTAGE FOR GIVEN DC DISCHARGE CURRENT		DC TEST VOLTAGE & CURRENT	
	DC	AC	WATTS	WATT-SECONDS	AMPS	VOLTS	VOLTS	AMPERES
69W60100	275	250	10	22,500	10	1,200	550 ±20%	0.500
68W60200	200	180	10	22,500	12.5	990	400 ±20%	0.500
68W60100	150	135	10	22,500	15	780	300 ±20%	0.500

ASSEMBLIES

Protect circuits and components from inductive voltage surges. Assemblies have one or more WASHERS. Bracket mounted with spring lock washer for contact pressure. Washer insulated from central bolt and mounting brackets. Connections made to terminals shown. Bracket mounted assemblies available for stud mounting. Substitute "C" for "A" in type number. Varistors are moisture protected with silicone impregnation. AC voltage rating 90% of DC voltage rating. Continuous temp. rating 110°C.

Type "3A"

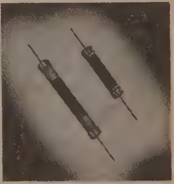
CATALOG NUMBER	MAXIMUM VALUES				
	Continuous DC Operating* Voltage Rating (Volts)	Continuous Power Loss in Operation (Watts)	Discharge Capacity** (Watt-Seconds)	Peak Discharge Voltage For Given DC Discharge Current	
				(Amps)	(Volts)
9RV3A1	6	3	1,100	10	40
9RV3A2	6	6	2,200	20	40
9RV3A3	6	12	4,400	40	40
9RV3A4	12	3	1,350	10	80
9RV3A5	12	6	2,700	20	80
9RV3A6	12	12	5,400	40	80
9RV3A7	25	6	2,700	10	160
9RV3A8	50	3	1,700	5	200
9RV3A9	50	6	3,400	10	200
9RV3A10	50	12	6,800	20	200
9RV3A11	100	6	3,400	5	400
9RV3A12	150	3	5,100	2.5	775
9RV3A14	300	3	5,100	1.5	1,350
9RV3A15	600	6	10,200	0.5	2,300

Type "6A"

Type	CATALOG NUMBER	MAXIMUM VALUES				
		Continuous DC Operating* Voltage Rating (Volts)	Continuous Power Loss in Operation (Watts)	Discharge Capacity** (Watt-Seconds)	Peak Discharge Voltage For Given DC Discharge Current	
					(Amps)	(Volts)
BRACKET	9RV6A1	150	10	22,500	15	780
	9RV6A2	150	20	45,000	30	780
	9RV6A3	150	30	67,500	45	780
	9RV6A4	150	40	90,000	60	780
	9RV6A5	300	20	45,000	10	1,440
	9RV6A6	275	10	22,500	10	1,200
	9RV6A7	275	20	45,000	20	1,200
	9RV6A8	275	30	67,500	30	1,200
	9RV6A9	275	40	90,000	40	1,200
	9RV6A10	550	20	45,000	5	2,160
BOX	9RV6A50	150	200	450,000	300	780
	9RV6A51	200	200	450,000	250	990
	9RV6A52	275	200	450,000	200	1,200
	9RV6A53	300	240	540,000	170	1,550
	9RV6A54	400	240	540,000	140	1,900
	9RV6A55	550	240	540,000	60	2,160
	9RV6A60	150	100	225,000	150	780
	9RV6A61	200	100	225,000	125	990
	9RV6A62	275	100	225,000	100	1,200
	9RV6A63	300	120	270,000	135	1,550
	9RV6A64	400	120	270,000	70	1,900
	9RV6A65	550	120	270,000	30	2,160

VARISTOR RODS

Varistor rods protect circuits and components from inductive voltage surges by limiting peak discharge voltage to a safe value when AC or DC magnetic or inductive circuit current is suddenly interrupted. Other applications include rectification of asymmetrical waveforms in TV circuits to aid in High Voltage Regulation.



ORDER NUMBER	MAXIMUM VALUES					SPECIFICATIONS	
	CONTINUOUS OPERATING VOLTAGE VOLTS		CONTINUOUS POWER RATING	PEAK DISCHARGE VOLTAGE FOR GIVEN DC DISCHARGE CURRENT		DC TEST VOLTAGE & CURRENT	
	DC	AC	WATTS	AMPERES	VOLTS	VOLTS	AMPERES
72R-2200	3300	2950	0.4	.010	10,500	3,800 ±20%	.0001
72R-2100	1700	1525	0.25	.001	3,700	2,000 ±20%	.0001
71R-2100	1100	1000	0.25	.005	3,300	1,125 ±20%	.0001
69R-2100	600	540	0.25	.010	1,900	920 ±20%	.0010
68R-2100	300	275	0.25	.025	1,000	400 ±20%	.0010
66R-2100	150	135	0.25	.050	600	165 ±20%	.0010

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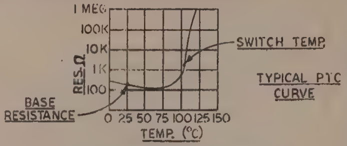
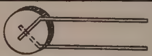
PTC SWITCHING THERMISTORS

The Positive Way to SENSE MEASURE CONTROL REGULATE PROTECT



Positive Temperature Coefficient Thermistors (PTC) as manufactured by NL Industries Electronics Department are doped Barium Titanate solid state semiconductor devices. They are available in various configurations all with or without leads and with or without protective coating

"D" SERIES DISC

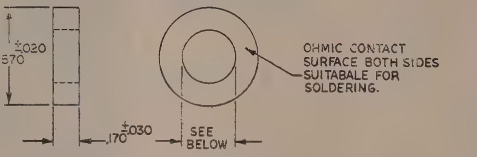


PART NO.	BREAK POINT*	RESISTANCES**	NOMINAL SIZES
100 D10211	0°C ±5°C	1000 OHMS ±30% @ 25°C	.6" DIA. X.250" THK.
130 D18011	30°C ±5°C	18 OHMS ±50% @ 25°C	.8" DIA. X.100" THK.
175 D40113	75°C ±5°C	400 OHMS ±40% @ 25°C	.2" DIA. X.080" THK.
200 D65011	100°C ±5°C	65 OHMS ±38% @ 25°C	.3" DIA. X.170" THK.
225 D25011	125°C ±5°C	25 OHMS ±40% @ 25°C	.8" DIA. X.225" THK.

*OTHER BREAKPOINTS AND RESISTANCES AVAILABLE.

**RESISTANCE AT BREAKPOINT EQUALS FIVE TIMES THE BASE RESISTANCE.

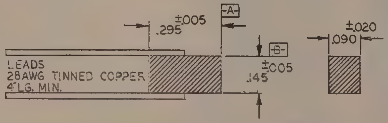
TOROID SHAPE



PART NO.	BREAK POINT*	BASE RESISTANCE (25°C)	SLOPE	INSIDE DIA.
180W30100	+80°C ±5%	300 OHMS. ±50%	20% BETWEEN 1.5K & 10K OHMS	.350 ±.050
222W75100	+122°C ±5%	750 OHMS ±33%	200% BETWEEN 2K & 10K OHMS	.365 ±.010

*RESISTANCE AT BREAKPOINT EQUALS FIVE TIMES BASE RESISTANCE.
OTHER BREAKPOINTS AND RESISTANCE VALUES AVAILABLE.

"Q" SERIES (ROD TYPE)



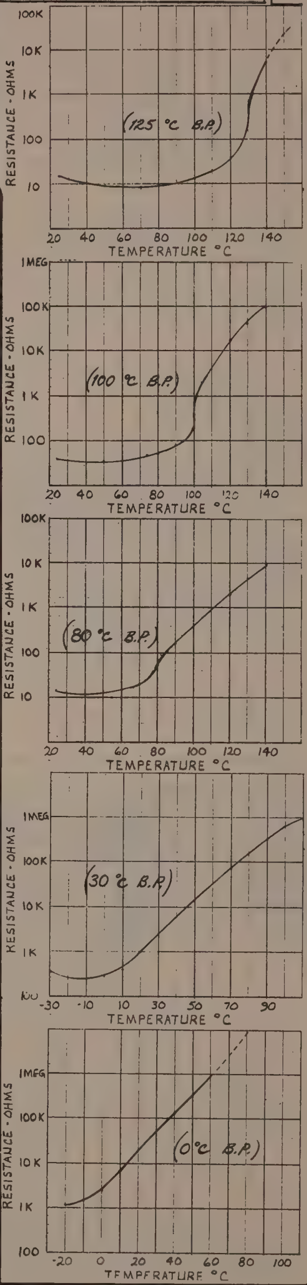
PART NO.	BREAK POINT*	BASE RESISTANCE (25° C)**	LEADS ON SURFACE
155Q20111	+55°C ±5°C	200 OHMS ±15%	B-B
165Q20111	+65°C ±5°C	200 OHMS ±15%	B-B
165Q80111	+65°C ±5°C	750 OHMS ±33%	A-A
175Q20111	+75°C ±5°C	200 OHMS ±25%	B-B
175Q80111	+75°C ±5°C	750 OHMS ±33%	A-A
185Q20111	+85°C ±5°C	200 OHMS ±25%	B-B
185Q80111	+85°C ±5°C	750 OHMS ±33%	A-A
195Q80111	+95°C ±5°C	750 OHMS ±33%	A-A
220Q32211	+120°C ±5°C	3200 OHMS ±25%	A-A

* OTHER RESISTANCE VALUES AND BREAKPOINTS FROM 0°C ALSO AVAILABLE.

** RESISTANCE AT BREAKPOINT EQUALS FIVE TIMES BASE RESISTANCE.

TYPICAL PTC RESISTANCE VS. TEMPERATURE CURVES

Resistance measured under zero-power in a carefully controlled temperature bath.



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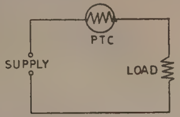
PTC SWITCHING THERMISTORS

PTC SWITCHING THERMISTOR APPLICATIONS

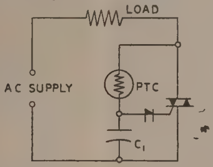
Thermal Overload

The PTC Switching Thermistor can be used for thermal overload protection by placing it in close thermal contact to, and electrically in series with the device to be protected.



High Power Thermal Overload

For high power overload protection, the PTC switching thermistor can be used as a sensor in the gate circuit of a Triac.

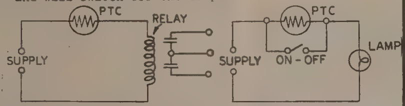


Temperature Control

The above circuit may also be used as a temperature controller. Control temperature will be determined by switch temperature of the thermistor.

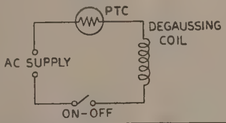
Time Delay

The PTC Thermistor can be used as the time delay element in a time delay circuit. By placing the thermistor in series with a relay, the relay will pull in immediately and then after a certain time will drop out due to the self-heating and switching action of the thermistor. Another time delay application of the PTC Switching Thermistor is slow turn-off of lighting circuits. When the switch is on, the thermistor remains cold and thus in its low-resistance mode. Once the switch is opened, the thermistor begins to heat and will switch off the lamp.



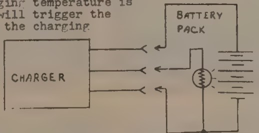
Surge Generation

Because PTC thermistors are available with a very low base resistance, they can deliver very high currents for a short period of time before switching to their high-resistance mode. A typical application of this sort is automatic degaussing of a color TV CRT.

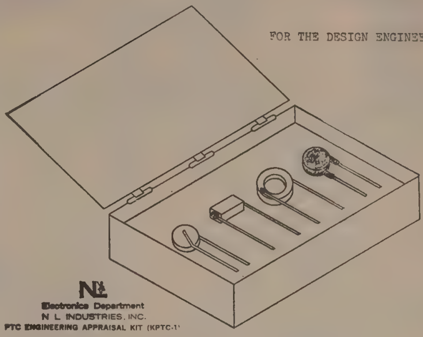


OVER-CHARGE PROTECTOR

The PTC Thermistor will easily interface with electronic charging circuitry. By inbedding PTC directly in the battery pack, it will sense the temperature of the pack. When the critical charging temperature is reached, the PTC will trigger the charger to reduce the charging current.



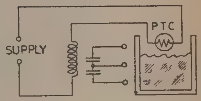
FOR THE DESIGN ENGINEER...



KIT INCLUDES FOUR PTC DEVICES RANGING FROM BREAKPOINTS OF 0°C TO 125°C IN TYPICAL LEAD CONFIGURATIONS MOST WIDELY SPECIFIED BY THE DESIGN ENGINEER. TECHNICAL DATA FOR EACH DEVICE IS ALSO INCLUDED.

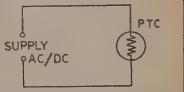
Liquid Level Sensing

A PTC Thermistor can be used to sense liquid level by placing it in series with a relay or in conjunction with other solid state devices. In operation, the PTC is selected to self-heat to its high-resistance mode in free air. When the liquid comes in contact with the thermistor, this heat is dissipated into the liquid, thus cooling the thermistor to its low-resistance mode to energize a solenoid or relay.



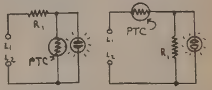
Heater

In this application, the PTC Thermistor is connected directly across the supply. When the circuit is energized, the thermistor quickly heats to its control temperature because of its low base resistance. Once the control temperature is reached, it very accurately maintains that temperature.



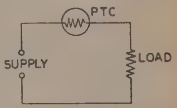
SIMPLE TEMPERATURE INDICATOR

Using only a PTC, Indicator Light, and Supply Voltage; a simple indicator can be devised by placing the PTC either in series or parallel with light to give desired on-off indications with temperature.



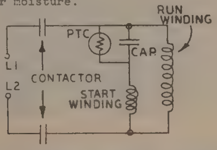
Current Limiting

The PTC Thermistor is placed in series with the load. The thermistor is operated normally in its low-resistance mode until there is an over-current situation. At that time the thermistor quickly self-heats to its high-resistance mode thus limiting current to the load.



Motor Starter

A PTC Thermistor can be selected to parallel the start capacitor in a capacitor start motor. The PTC Thermistor having a very low base resistance delivers a large current surge to the start winding of the motor and then heats to its high-resistance mode, thus cutting out the start winding. The motor starter PTC Thermistor eliminates the old start relay or centrifugal switch and is not affected by dust or moisture.



TYPICAL MOTOR STARTER

NL INDUSTRIES, INC.
Electronics Department
P.O. Box 787, 1981 Port City Boulevard, Muskegon, Michigan 49443 • (616) 777-2602
SALES DEPARTMENT • (616) 777-2806 • TWX: 510-394-4130

THERMO-ELECTRIC COMPONENTS

OMEGA®

ONE COMPLETE SOURCE FOR ALL

OMEGA ENGINEERING, INC.
P.O. Box 4047, Stamford, Connecticut 06907

WRITE OR PHONE...

NEW! FREE!

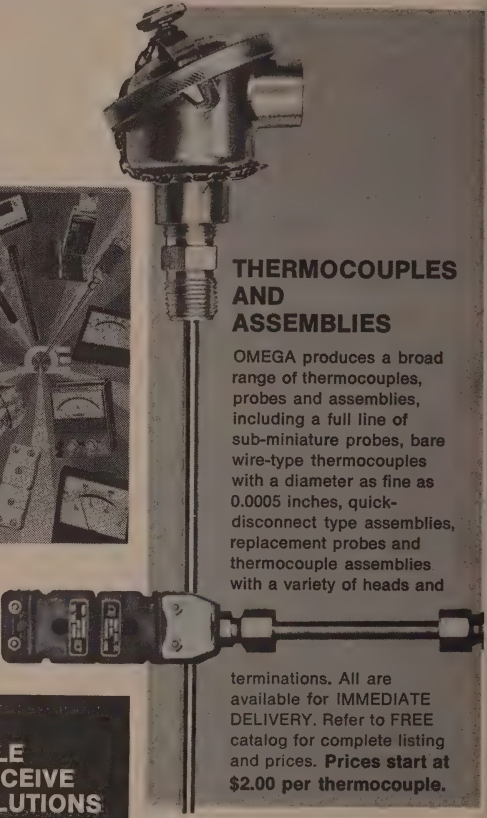
THERMOCOUPLE HANDBOOKS

THERMOCOUPLE CALIBRATION TABLES AND ALLOY DATA
NEW REFERENCE TABLES SUPERSEDES N.B.S. CIRCULAR #561
IRON-CONSTANTAN
CHROMEL-ALUMEL
CHROMEL-CONSTANTAN
COPPER-CONSTANTAN
PLATINUM VS. PLATINUM 10% RHODIUM
PLATINUM VS. PLATINUM 13% RHODIUM
PLATINUM 6% RHODIUM VS. PLATINUM 30% RHODIUM
TUNGSTEN VS. TUNGSTEN 26% RHENIUM
TUNGSTEN 5% RHENIUM VS. TUNGSTEN 26% RHENIUM
TUNGSTEN 3% RHENIUM VS. TUNGSTEN 25% RHENIUM

omega engineering inc.
THE OMEGA TEMPERATURE MEASUREMENT HANDBOOK

OMEGA'S CT-3 ...
only source for latest NBS thermocouple calibration tables.

OMEGA'S HANDBOOK and CATALOG ...
Most complete listing of over 5,000 temperature measurement products. All prices included.



THERMOCOUPLES AND ASSEMBLIES

OMEGA produces a broad range of thermocouples, probes and assemblies, including a full line of sub-miniature probes, bare wire-type thermocouples with a diameter as fine as 0.0005 inches, quick-disconnect type assemblies, replacement probes and thermocouple assemblies with a variety of heads and terminations. All are available for IMMEDIATE DELIVERY. Refer to FREE catalog for complete listing and prices. **Prices start at $2.00 per thermocouple.**

SURFACE PROBES AND PYROMETERS

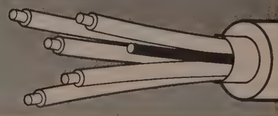
OMEGA offers a number of unique, patented thermocouple probes designed for measuring the precise temperature of moving and stationary surfaces. Also available are companion readout meters, portable pyrometers and companion probes for heavy duty service. New miniature thermometer and its companion probes are in stock also. ALL OFF-THE-SHELF. **Prices start at $6.00 per probe.**

YOUR THERMOCOUPLE PROBLEMS RECEIVE REALISTIC SOLUTIONS AT OMEGA

Most thermocouple problems can be solved using Omega's "off-the-shelf" thermocouple products. But, if you have that SPECIAL problem requiring exotic thermocouples, multi-point/profile thermocouples, motorized switches, or anything unusual in thermometry, just send us a print. Omega will quote you realistically. Our years of experience and technology assure you QUICK DELIVERY and the right temperature sensor for the job. AND, WE KEEP OUR PROMISES.

THERMOCOUPLE WIRE

OMEGA's broad range of thermocouple wire encompasses just about every conceivable type available, including bare wire, teflon coated wire, metal-sheathed wire, all types of asbestos, glass, plastic covered and enameled wire in sizes from 0.0005" diameter on up. Even tungsten-rhenium, platinum and base metal alloys, plus various extension wire types ... all ON HAND for IMMEDIATE DELIVERY. Buy as little or as much as you need!



FOR IMMEDIATE OFF-THE-SHELF DELIVERY

Ask about "Speed Service": orders shipped within 24 hours when requested. Minimum Order: $10.00.

THERMOCOUPLES

YOUR OFF-THE-SHELF THERMOCOUPLE REQUIREMENTS . . .

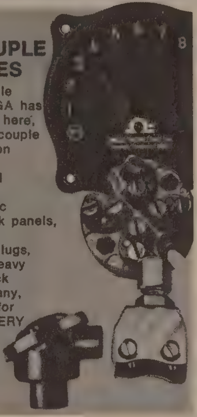
"OMNI-AMP" THERMOCOUPLE AMPLIFIERS

Just plug a thermocouple into Omega's unique new miniature, portable amplifier. A choice of ranges will enable you to boost any millivolt signal from unity to 100 times. Low cost and inexpensive operation from two small mercury batteries eliminates need for thermocouple and meter impedance matching. Drives any readout device with 1000 ohms or greater input impedance. Lab models too! NOW . . . OFF-THE-SHELF! Nothing like it is available from any other source.

Prices start at only $85.

THERMOCOUPLE ACCESSORIES

If it's a thermocouple accessory . . . OMEGA has it! Too many to list here, they include thermocouple insulators, protection tubes, compression fittings, color-coded connectors, high temperature ceramic connectors and jack panels, selector switches, thermocouple alloy lugs, connector heads, heavy duty miniature quick disconnects and many, many more . . . all for IMMEDIATE DELIVERY off-the-shelf.

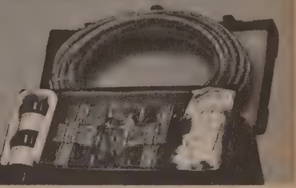


THERMOCOUPLE ASSEMBLY KITS

CEMENTS AND LACQUERS

OMEGA offers an expanded variety of kits to cement fine gage thermocouples in place and to build a variety of thermocouple probes and assemblies in only minutes. Available OFF-THE-SHELF.

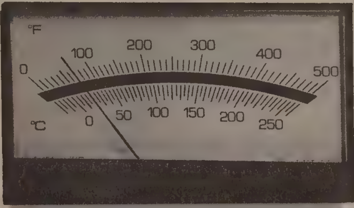
Prices start at $2.00.



COMPENSATORS AND ICE POINT REFERENCES

OMEGA's thermocouple references and cold junction compensators include electrical bridge networks, thermoelectric refrigeration and heated oven reference types available in a complete range of calibrations. All are rugged, versatile and low priced. All for IMMEDIATE DELIVERY.

Prices start at $85.00.



METERS, AMPLIFIERS AND READOUTS

OMEGA's expanded line of readout meters, digital readouts for thermocouples, thermistors and RTD's, plus thermocouple amplifiers are available now for IMMEDIATE DELIVERY.

Meter prices start at $36.00.

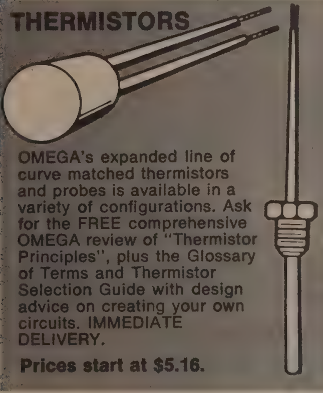
TEMPILAQ
2500°F
1371°C
TEMPIL CORP.

TEMPERATURE SENSITIVE PAINTS, LACQUERS, CRAYONS, SPRAYS AND PELLETS

If you require any markers to be used as high quality surface temperature indicators, OMEGA has a vast variety of convenient forms, including paints, lacquers, crayons, sprays and pellets OFF-THE-SHELF.

Prices start at $1.00.

THERMISTORS



OMEGA's expanded line of curve matched thermistors and probes is available in a variety of configurations. Ask for the FREE comprehensive OMEGA review of "Thermistor Principles", plus the Glossary of Terms and Thermistor Selection Guide with design advice on creating your own circuits. IMMEDIATE DELIVERY.

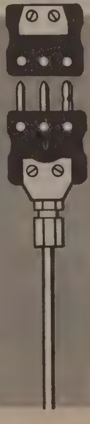
Prices start at $5.16.

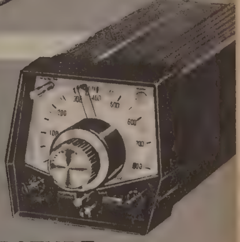
RTD's

PLATINUM RESISTANCE THERMOMETERS

Offering a variety of lead configurations and sizes, with compression fittings, and a choice of compression heads and quick disconnects, the OMEGA line of platinum resistance thermometers is available for IMMEDIATE DELIVERY.

Prices start at $39.00 for single units.





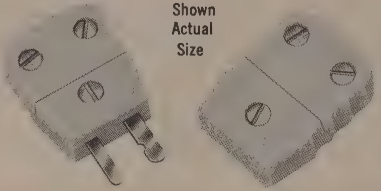
TEMPERATURE CONTROLLERS

OMEGA's solid state plug-in electronic indicating temperature controllers feature full plug-in construction; plug-in relays; full-time, full-scale indication; thermocouple break protection; heating and cooling lights and easy screw terminal wiring. 3 lbs. Available for IMMEDIATE DELIVERY. **Price: $135.00.**

CALL OMEGA . . . (203)359-1660

OMEGA ENGINEERING, INC.
P.O. Box 4047, Stamford, Connecticut 06907

OMEGA®
(COLOR CODED THERMOCOUPLE CONNECTORS)


Shown Actual Size

MINIATURE CONNECTORS

HIGH TEMPERATURE STANDARD CONNECTORS

Shown Actual Size

3
4
5
6
K CHROMEL + ALUMEL –
3
4
5
6
T COPPER + CONSTANTAN –
Shown Actual Size

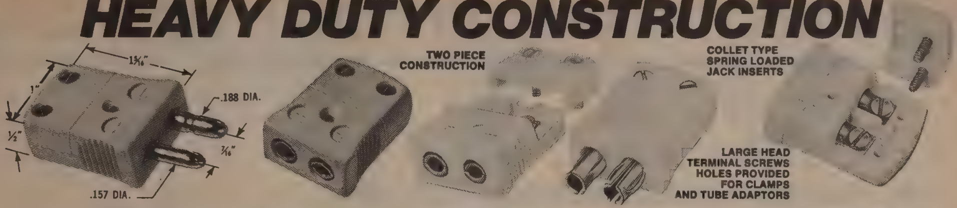
STRIP PANEL JACKS

Shown Actual Size

VERY HIGH TEMPERATURE CERAMIC CONNECTORS

CALL OMEGA... (203) 359-1660

HEAVY DUTY CONSTRUCTION


1³⁄₁₆"
1"
½"
.188 DIA.
³⁄₁₆"
.157 DIA.
TWO PIECE CONSTRUCTION
COLLET TYPE SPRING LOADED JACK INSERTS
LARGE HEAD TERMINAL SCREWS HOLES PROVIDED FOR CLAMPS AND TUBE ADAPTORS

TYPE OST COLOR-CODED THERMOCOUPLE CONNECTORS

Body Color	Thermocouple Used with Connector	Actual Alloy in Connector		Alloy Code	Catalog Designation of Pair†	Price of Pair	Price Female Only	Price Male Only
		+	−					
Yellow	Chromel-Alumel	Chromel	Alumel	K*	OST-CHAL-MF	5.60	3.60	2.00
Blue	Copper-Constantan	Copper	Constantan	T*	OST-COCO-MF	5.00	3.00	2.00
Black	Iron-Constantan	Iron	Constantan	J*	OST-IRCO- MF	5.00	3.00	2.00
Violet	Chromel-Constantan	Chromel	Constantan	E*	OST-CHCO-MF	5.50	3.50	2.00
Green	Platinum-13% Rhodium	Copper	Alloy #11	R*	OST-PTRH-MF	5.50	3.50	2.00
Green	Platinum-10% Rhodium	Copper	Alloy #11	S*	OST-PTRH-MF	5.50	3.50	2.00
White	Uncompensated	Copper	Copper	CU	OST-UNCO-MF	5.00	3.00	2.00

†When ordering extra male or female connectors use the suffix M or F only.

*ANSI Designations are K, T, J, E, R and S.

** TRADE NAME GENERAL ELECTRIC CO.

The type OST color-coded, quick disconnect plugs and jacks provide reliable connections between the thermocouples and extension wires. The connector prongs **Match ANSI thermocouple grade calibration** to assure high accuracy. The color-coded bodies are molded of **high performance glass reinforced Valox**. Tubular plug prongs and collect type jack inserts have low mass and reduce temperature gradients.** Negative prongs and inserts are larger than positives to insure proper polarity upon connection. This is a standard feature on all OMEGA's connectors. **Recommended for most applications.** Will withstand ambient **temperatures up to 425°F.** Fully interchangeable with other thermocouple connectors. **High impact Construction.**

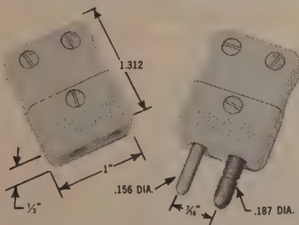
NEW EXTRA HEAVY DUTY

TYPE OGP COLOR-CODED THERMOCOUPLE CONNECTORS

Body Color	Thermocouple Used with Connector	Actual Alloy in Connector		Alloy Code	Catalog Designation of Pair†	Price of Pair	Price Female Only	Price Male Only
		+	−					
Yellow	Chromel-Alumel	Chromel ***	Alumel ***	K*	OGP-CHAL- MF	8.50	4.75	3.75
Blue	Copper-Constantan	Copper	Constantan	T*	OGP-COCO- MF	7.00	4.00	3.00
Black	Iron-Constantan	Iron	Constantan	J*	OGP-IRCO- MF	7.00	4.00	3.00
Violet	Chromel-Constantan	Chromel	Constantan	E*	OGP-CHCO- MF	8.50	4.75	3.75
Green	Platinum-13% Rhodium	Copper	Alloy #11	R*	OGP-PTRH- MF	8.50	4.75	3.75
Green	Platinum-10% Rhodium	Copper	Alloy #11	S*	OGP-PTRH- MF	8.50	4.75	3.75
Red/Green	W vs W/26% Re	Alloy #200	Alloy #226	WR	OGP-WOOR-MF	8.50	4.75	3.75
Red	W/5% Re vs W/26% Re	Alloy #405	Alloy #426	W5	OGP-WO5R- MF	8.50	4.75	3.75
Red/White	W/3% Re vs W/25% Re	Alloy #203	Alloy #225	W3	OGP-WO3R- MF	8.50	4.75	3.75
White	Uncompensated	Copper	Copper	CU	OGP-UNCO- MF	7.00	4.00	3.00

†When ordering extra male or female connectors use the suffix M or F only.

*ANSI Designations are K, T, J, E, R and S.



TYPE OGP CONNECTORS EXTRA HEAVY DUTY CONSTRUCTION

** TRADE NAME GENERAL ELECTRIC CO.
*** TRADE NAME HOSKINS MFG. CO.

Omega's new, color-coded, EXTRA heavy duty connectors provide rapid dependable connections between thermocouples and extension wires. The connector prongs and inserts are **machined from solid bar stock of matched alloys and meet ANSI grade calibrations** to maintain accuracy. The connector body consists of three pieces **molded of a high performance, glass filled Valox**** capable of service **temperatures up to 425°F.** They are recommended for **severe service applications.** Will mate with OST connectors. They are available in calibrations compatible with the new **tungsten-rhenium** thermocouples.

HIGH TEMPERATURE CERAMIC

TYPE OX

CERAMIC COLOR-CODED THERMOCOUPLE CONNECTORS

Body Color	Thermocouple Used with Connector	Actual Alloy in Connector		Alloy Code	Catalog Designation of Pair*	Price of Pair	Price Female Only	Price Male Only
		+	−					
Yellow	Chromel-Alumel	Chromel	Alumel	K*	OX-CHAL- MF	8.50	4.75	3.75
Blue	Copper-Constantan	Copper	Constantan	T*	OX-COCO- MF	7.00	4.00	3.00
Black	Iron-Constantan	Iron	Constantan	J*	OX-IRCO- MF	7.00	4.00	3.00
Violet	Chromel-Constantan	Chromel	Constantan	E*	OX-CHCO- MF	8.50	4.75	3.75
Green	Platinum-13% Rhodium	Copper	Alloy #11	R*	OX-PTRH- MF	8.50	4.75	3.75
Green	Platinum-10% Rhodium	Copper	Alloy #11	S*	OX-PTRH- MF	8.50	4.75	3.75
Red/Green	W vs W/26% Re	Alloy #200	Alloy #226	WR	OX-WOOR-MF	8.50	4.75	3.75
Red	W/5% Re vs W/26% Re	Alloy #405	Alloy #426	W5	OX-WO5R- MF	8.50	4.75	3.75
Red/White	W/3% Re vs W/25% Re	Alloy #203	Alloy #225	W3	OX-WO3R- MF	8.50	4.75	3.75
White	Uncompensated	Copper	Copper	CU	OX-UNCO- MF	7.00	4.00	3.00

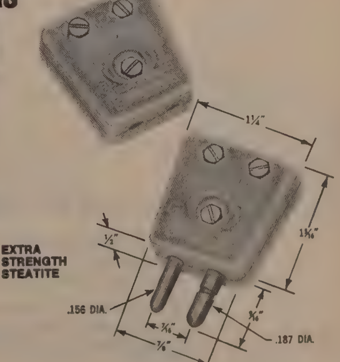
†When ordering extra male or female connectors use the suffix M or F only.

*ANSI Designations are K, T, J, E, R and S.

- For high vacuum applications specify unglazed ceramic bodies suffix-UOX.
- Ceramic connectors of Chromel-Alumel, Iron-Constantan and Chromel-Constantan good to 1200°F. All others limited to 500°F by compensating alloys. Ceramic connectors are basically fragile.

OMEGA's color-coded, ceramic thermocouple connectors are intended for both high and low temperatures in the range −400 to 1200°F. The connectors are made from matched thermocouple alloys and have standard, polarized contacts.

Compatible connectors are available for the New TUNGSTEN-RHENIUM THERMOCOUPLE ALLOYS as well as the PLATINUM-RHODIUM THERMOCOUPLE ALLOYS. Omega will make color coded connectors for other special alloys on request.

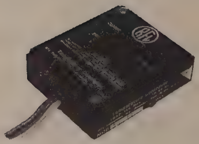


THERMOCONTROL DIVISION RFL Since 1922

4 WAYS TO BUY
RFL ELECTRONIC TEMPERATURE CONTROLLERS TO SATISFY ANY APPLICATION (Solid-State . . . No Moving Parts To Wear Out)

1 THE BASIC UNITS (Models 70, 71, 72, 75 & 7040)

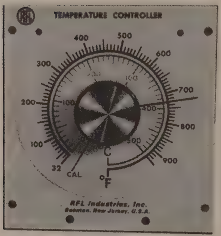
Compact, nonindicating units, ideal for OEM applications. Full power rating when mounted on metal surface or with RFL mountings. Can be used with most resistance type sensors. Available RFL sensors are listed below.



Model 70

Model	Overall Range	Accuracy to	Current Load	Size	Sensor Resistance	Sensor Type
70	−70 to 325°C −94 to 617°F	±0.05°C	1 to 15 Amps	3″ x 3½″ x 1″	8000 to 100 ohms	27687
71	0 to 500°C 32 to 932°F	±0.05°C	1 to 15 Amps	3″ x 3½″ x 1″	RTD Type (100 ohm Sensor)	24928
72	−90 to 325°C −130 to 617°F	±0.1°C	1 to 15 Amps	3″ x 3½″ x 1″	30,000 to 300 ohms	27687
75	−65 to 325°C −85 to 617°F	±0.2°C	1 to 15 Amps	3″ x 3½″ x 1″	6000 to 100 ohms	27687
7040	−70 to 325°C −94 to 617°F	±0.05°C	1 to 40 Amps	3″ x 6″ x 6″	8000 to 100 ohms	27687

Models 70, 71, 7040 are phase firing. Models 72 and 75 are zero voltage firing for minimal RFI.

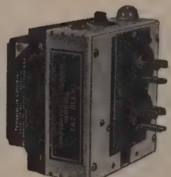


#42065

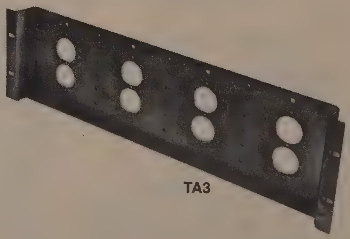
SENSORS & RANGES				
SENSOR No.	MODEL 70 & 7040	MODEL 71	MODEL 72	MODEL 75
24928	—	0 to 500°C 32 to 932°F	—	—
27687-3	−5 to 120°C 25 to 248°F	—	−30 to 80°C −22 to 176°F	0 to 120°C 32 to 248°F
27687-5	30 to 160°C 86 to 320°F	— —	10 to 130°C 50 to 266°F	40 to 160°C 104 to 320°F
27687-7	80 to 250°C 176 to 482°F	—	40 to 200°C 104 to 392°F	85 to 250°C 185 to 482°F
27687-13	220 to 325°C 428 to 617°F	—	165 to 325°C 329 to 617°F	230 to 325°C 446 to 617°F
27687-15	−70 to 10°C −94 to 50°F	—	−90 to −10°C −130 to 14°F	−65 to 10°C −85 to 50°F

NOTE: For liquid immersion of 27687 series sensors use RFL 34739 Stainless Steel Well. Models 70, 72, 75, and 7040 sensors $^{3}/_{16}$″ diameter by 1¼″ long with 10″ leads. Model 71 sensor $^{3}/_{16}$″ diameter by 4″ long with 2′ leads.
#42065 Set Point Assembly provides for direct temperature setting (both °C and °F) for Model 71 Controller.
#42060 Set Point Assembly for Models 70, 75, and 7040 Controllers. 0-100 Scale.
#42070 Set Point Assembly for Model 72 Controller. 0-100 Scale.

TA1



TA2



TA3

2 PLUG-ABLE MOUNTINGS FOR BASIC UNITS (Except for Model 7040)

These mountings make it easy for anyone to install an RFL controller. They plug into standard duplex outlets (NEMA type 5-15R and type 6-15R).

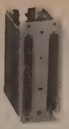
TA1 Mounting (Controller shown for reference) Plug-in line and load. Controller may be ordered installed and wired to Mounting. Specify for 115 or 230 volts when ordering.

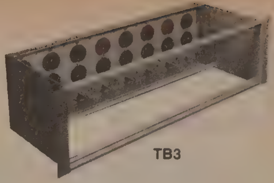
TA2 Mounting (Controller shown for reference) Plug-in line, load and sensor. Control box contains ON/OFF switch, power level indicator, sensor receptacle and plug.
Specify for 115 or 230 volts when ordering.

TA3 Multi-mount for up to four TA1 or TA2 Mountings, Aluminum alloy, 19″ wide x 5¼″ high x 1½″ deep, fits standard EIA rack. Provided with holes for mounting NEMA receptacles, fuse blocks, and remote set point plugs.

TB1

TB2




TB3

3

PLUG-IN SYSTEM MODULES FOR SINGLE OR MULTIPOINT OPERATION

Now you can create a complete rack mounted temperature control and/or measurement system at minimum cost. The TB1 Control Module accepts all basic controller units except Model 7040. The Control Modules plug into the TB3 8-module chassis for quick assembly and easy service.

TB1 Control Module with ON/OFF power switch, power level indicator, set point control and sensor jack (on rear). Specify for 115 or 230 volts when ordering.

TB2 Measurement Module for sequential readout of up to seven Control Modules with push-button selector. Requires one RFL type 24928 platinum sensor for each Control Module to be monitored. The control and measurement sensors can be placed together or in separate locations depending on system requirements.

TB3 Chassis for mounting up to eight Control Modules is 19″ W x 5¼″ H x 9½″ D of aluminum alloy. Specify number and location of desired Modules on Chassis when ordering (Control Modules require NEMA receptacles, all of which are supplied). Specify for 115 or 230 volts when ordering.

TB4 Chassis for mounting up to seven Control Modules and one Measurement Module. Specify for 115 or 230 volts when ordering.

4

PORTABLE 800 SERIES TEMPERATURE CONTROLLERS

Available with RFL Models 70, 71, 72, and 75 Temperature Controllers. An ideal unit to evaluate the effectiveness of closer temperature control of your existing equipment.

These convenient, ready-to-use units consist of the solid-state controller attached to a control box, containing an ON/OFF switch, power level indicator, load-output socket (115V or 230V), sensor jack, set point knob and scale, line fuse and an 8 ft. line cord. Select sensor from table below:

TEMPERATURE CONTROLLER

Series 800

SENSORS AND RANGES

SENSOR	MODEL 870	MODEL 871	MODEL 872	MODEL 875
42301	—	0 to 500°C 32 to 932°F	—	—
42300-3	−5 to 120°C 25 to 248°F	—	−30 to 80°C −22 to 176°F	0 to 120°C 32 to 248°F
42300-5	30 to 160°C 86 to 320°F	—	10 to 130°C 50 to 266°F	40 to 160°C 104 to 320°F
42300-7	80 to 250°C 176 to 482°F	—	40 to 200°C 104 to 392°F	85 to 250°C 185 to 482°F
42300-13	220 to 325°C 428 to 617°F	—	165 to 325°C 329 to 617°F	230 to 325°C 446 to 617°F
42300-15	−70 to 10°C −94 to 50°F	—	−90 to −10°C −130 to 14°F	−65 to 10°C −85 to 50°F

Models 870, 872 and 875 sensors, 3/16″ diameter by 1¼″ long with 6′ cable and grounded plug. Cables are specially ground circuit shielded and are connected through the safety ground.

Model 871 sensor, 3/16″ diameter by 4″ long with 6′ cable and grounded plug.

NOTE: 34739 Stainless Steel Well must be used for liquid immersion of all sensors except 42301.

DIRECT READING ELECTRONIC THERMOMETERS

MODEL 290A Electronic indicating thermometer provides measurement span of −60°C (−76°F) to +130°C (+266°F) in 3 ranges selected by pushbuttons using single thermistor probe. Multiple scale taut-band meter has °C and °F scales. Built-in calibration check and adjustment assure long-term accuracy. Storage well for probe in back of unit. Probes available for gas, liquid, and surface contact.

SPECIFICATIONS

Accuracy: ±1.5°C (±2.5°F) with ambient temperatures at 25°C ±10°C

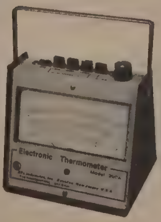
Range: −60°C to +130°C in three overlapping scales: −60°C to +10°C, 0°C to +70°C, and +60°C to +130°C.

Indication: 4½″ taut-band meter.

Power Source: 9-volt "transistor" battery.

Size: 5¾″ wide x 5½″ high x 4½″ deep.

Detailed descriptive literature available.



MODEL 212A An accurate, laboratory type electronic thermometer for precise temperature measurement of liquids, gases, and atmosphere between −100°C and +500°C, using one platinum probe. Completely self-contained with probe storage well in back of unit. Battery operated and it has all solid state circuitry. Ranges are selected by unique pushbutton switches mounted on printed circuit board.

SPECIFICATIONS

Range: −100°C to +500°C in seven scales:

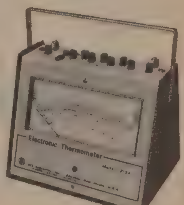
−100°C to +500°C
−100°C to 0°C
0°C to +100°C
+100°C to +200°C
+200°C to +300°C
+300°C to +400°C
+400°C to +500°C.

Accuracy: ±0.75°C

Power Source: Three 9-volt "transistor" batteries.

Size: 7¼″ wide x 6½″ high x 5½″ deep.

Detailed descriptive literature available.



RFL Industries, Inc.

Thermocontrol Division • Boonton, New Jersey 07005
Tel. (201) 334-3100 / TWX: 710-987-8352 / CABLE: RADAIRCO, N. J.

AAC

American Aerospace Controls Inc.

131 VERDI STREET, FARMINGDALE, NEW YORK 11735 ☐ (516) 694-5100

CURRENT, VOLTAGE AND POWER INSTRUMENTATION

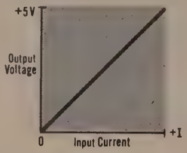
CURRENT SENSORS D.C.

American Aerospace Controls' D.C. current sensors are used for measurement and control applications requiring an accurate high level D.C. output signal proportional to the input current. Most models feature "pass thru hole" construction for the power cable providing complete electrical isolation of the output. Models are available in grades suitable for industrial and military applications.

913A

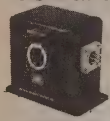
HIGH ACCURACY SMALL SIZE

Current Ranges Amps DC
100
50
20
10



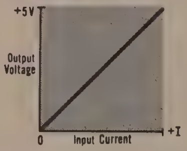
Output Volts	0 to 5 VDC
Response	1 ms
Accuracy	±1% F.S.
Excitation	24-32 VDC
Temp. Coef.	.08% F.S./°C
Size	1⅝ x 1⅝ x 2⅜

902 and 916



HIGH CURRENT RANGES

Current Ranges Amps DC 902	916
300	1000
200	750
100	500
50	

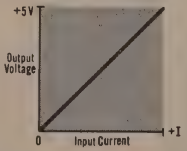


Output Volts	0 to 5 VDC
Response	5 ms
Accuracy	±1% F.S.
Temp. Coef.	.05% F.S./°C
Excitation	24-32 VDC
Size	2 3/16 x 3¾ x 3 1/16

903 and 923

MEDIUM CURRENT RANGES

Current Ranges Amps DC 903		923
2.0	0.1	50
1.0	0.05	20
0.5	0.02	10
0.2	0.01	5



Output Volts	0 to 5 VDC
Response	50 ms
Accuracy	±1%
Temp. Coef.	.04%/°C
Excitation	24-32 VDC
Size	2 x 2 9/16 x 2⅞

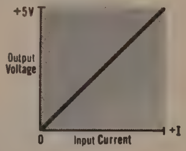
CURRENT SENSORS MOVEABLE JAW TYPE

A complete line of moveable jaw type current sensors are available for D.C., A.C. and combination D.C. and A.C. current measurements. Models cover both military and industrial applications. These transducers are well suited for diagnostic testing of automotive electric circuits. Uses include measurement of starter current, battery drain, and generator-alternator current. Fast response units permit accurate analysis of current wave forms. Output voltage can be indicated on a meter, scope or recorder.

929

HI-ACCURACY MIL-SPECS

Current Ranges Amps. D.C.
0-1000
0-500
0-200
0-100
0-50

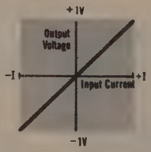


Output	0 to 5 VDC
Accuracy	±1% F.S.
Excitation	28 VDC ±4 VDC
Response	200 µsec
Temp. Range	−55°C to +85°C
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

930

DUAL RANGE FAST RESPONSE BIDIRECTIONAL

Current Ranges Amps. DC	
±1000	±150
± 500	±100
± 400	± 50
± 300	± 30

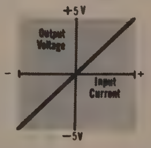


Output Volts	0 to ±1 VDC
Accuracy	±2% F.S.
Response	100 µsec
Excitation	±15 VDC @ 50 MA
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

932

SINGLE RANGE FAST RESPONSE BIDIRECTIONAL

Current Ranges Amps. DC	
±50	±500
±40	±400
±30	±300
±20	±200
±10	±100



Output	0 to ±5 VDC
Accuracy	1% F.S.
Excitation	±15 VDC ±1 VDC
Response	100µ sec
Temp. Range	−20°C to +70°C
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

AAC

American Aerospace Controls Inc.

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CURRENT SENSORS BIDIRECTIONAL

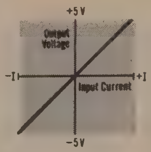
Bidirectional current sensors are used to sense either D.C. currents whose polarity or direction of flow may reverse or A.C. currents within the response capabilities of the device. The electrically isolated output signal duplicates the current wave form. Because of their fast response characteristics, these sensors may be used for pulse measurements and controls.

905

HIGH ACCURACY
HIGH OUTPUT

Current Ranges
Amps D.C.

±5
±2
±1
±0.5
±0.2
±0.1
±0.05



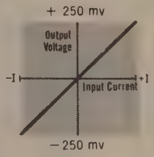
Output	0 to ±5 VDC
Response	50 ms
Accuracy	±1% F.S.
Excitation	±15 VDC
Temp. Coef.	.04% F.S. /°C
Size	2 x 2$\frac{3}{16}$ x 2$\frac{7}{8}$

910

FAST RESPONSE
ECONOMY

Current Ranges
Amps DC or AC Peak

±300
±200
±150
±100
±50
±25



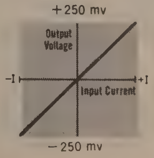
Output Volts	0 to ±250 mv
Response	5 μs
Accuracy	±2% F.S.
Excitation	15 VDC
Temp. Coef.	0.15% F.S. / °C
Size	1 x 1$\frac{3}{4}$ x 2$\frac{1}{16}$

909

HIGH CURRENT
REMOVABLE YOKE

Current Ranges
Amps DC or AC Peak

±2500
±1500
±1000
±750
±500
±250
±150



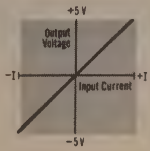
Output Volts	0 to 250 mv
Response	200 μs
Accuracy	±2% F.S.
Temp. Coef.	0.15% F.S. / °C
Excitation	24-32 VDC
Size	1$\frac{5}{16}$ x 3$\frac{1}{4}$ x 4$\frac{5}{8}$

925

HIGH ACCURACY
HIGH OUTPUT

Current Ranges
Amps D.C.

±100
±50
±20
±10



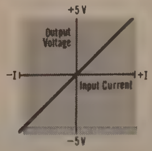
Output	0 to ±5 VDC
Response	50 ms
Accuracy	±1% F.S.
Excitation	±15 VDC
Temp. Coef.	.04% F.S. /°C
Size	2 x 2$\frac{3}{16}$ x 2$\frac{7}{8}$

907

FAST RESPONSE
HIGH OUTPUT

Current Ranges
Amps DC or AC Peak

±150
±100
±50
±25



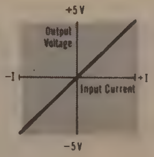
Output Volts	0 to 5 VDC
Response	100 μsec
Accuracy	±2% F.S.
Excitation	±15 VDC
Temp. Coef.	0.15% F.S. / °C
Size	1 x 1$\frac{3}{4}$ x 2$\frac{1}{16}$

927

MEDIUM CURRENT RANGES
HIGH OUTPUT

Current Ranges
Amps DC or AC Peak

±1000
±750
±500
±300
±250
±200
±150
±100
±50



Output Volts	0 to ±5 VDC
Response	100 micro sec
Accuracy	±2% F.S.
Excitation	±15 VDC
Temp. Coef.	0.15% F.S. / °C
Size	2 x 2$\frac{3}{16}$ x 2$\frac{7}{8}$

AAC

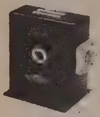
American Aerospace Controls Inc.

131 VERDI STREET, FARMINGDALE, NEW YORK 11735 ☐ (516) 694-5100

CURRENT SENSORS A.C.

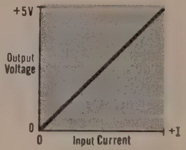
A broad line of "pass thru hole type" A.C. current sensors are available for measurement or control of current at standard line frequencies or over a broad frequency spectrum. The sensors produce a high level D.C. signal output that is electrically isolated from the current line. Power dissipation is negligible and economy models of these sensors may be used as replacements for shunts.

1004



60 TO 400 Hz

Current Ranges Amps AC rms	
100	5
50	2
20	1
10	

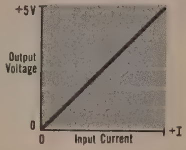


Output Volts	0 to 5 VDC
Response	150 ms
Repeatability	½% F.S.
Accuracy	±2% F.S. Max.
Excitation	Self Excited
Frequency	50 to 400 Hz
Temp. Stability	0.1% F.S. /°C
Size	2 x 2 9/16 x 2⅞

1003AM1 and 1003AM2

60 Hz
ECONOMY

Current Ranges Amps AC rms	
AM1	AM2
100	250
50	200
20	150
10	
5	

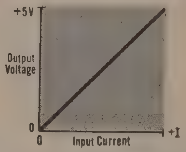


Output Volts	0 to 5 VDC
Response	150 ms
Repeatability	½%
Accuracy	± 2% F.S.
Excitation	Self Excited
Temp. Stability	0.1% F.S./°C
Size (AM1)	1 x 2 1/16 x 2
Size (AM2)	1 3/16 x 2⅞ x 2½

1001

HIGH CURRENT
REMOVABLE YOKE

Current Ranges Amps AC rms
2500
1500
1000
750
500
250
150



Output Voltage	0 to 5 VDC
Frequency Range	50 Hz to 2000 Hz
Accuracy	±2.5% FS
Temp. Stability	.15% F.S. /°C
Excitation	24-32 VDC
Response	50 ms
Size	1 9/16 x 3¼ x 4⅝

A.C. CURRENT CONTROLLERS

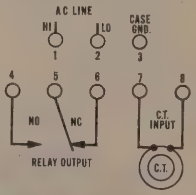
A.C. Current Controllers are adjustable devices that detect a set current level and produce a relay closure or opening when the set current level is exceeded. These ruggedly built industrial control devices utilize a current to voltage "thru hole" toroidal transformer to sense the line current. The (CT) current transformer's output is fed to a control box which contains the signal conditioning circuitry and relay. Uses include overload and underload detection, ground fault monitoring, power failure, etc.

850

60 Hz
INDUSTRIAL

Settable Input Current Ranges Amps 60 Hz	
0 to 2	0 to 20
0 to 5	0 to 50
0 to 10	0 to 100

Options
Time Delay — .5 sec. to 5 sec. 400 Hz operation. Solid state output.



Output	Relay 10 Amp SPDT
Line Voltage	115 VAC or 220 VAC
Line Frequency	50 to 60 Hz
Burden	3 Watts
Set Point	Adjustable 10% to Full Scale
Repeatability	2% F.S.
Reset	Automatic
Response	500 ms

WATT TRANSDUCERS A.C.

A.C. Watt transducers are used for measurement or control of A.C. power. These low insertion devices provide a high level linear D.C. output. Models are available covering real watts (VA times Power Factor) and Volt Amps (VA).

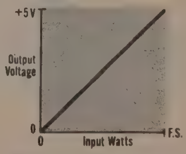
411 and 413

60 Hz
115 and 230 VAC

Kilowatt Ranges
0-1 to 0-100

Current Ranges Amps
0-10 to 0-500

Voltage Ranges VAC
80 to 150 and 160 to 300



Output 411	0 to 100 mV DC
Output 413	0 to 5V DC
Excitation	Self Excited
Accuracy	2% F.S.
Power Factor	0 to ±1
Response	400 ms
Temp. Coef.	.15% /°C
Size	3 7/16 x 4⅛ x 2 5/16

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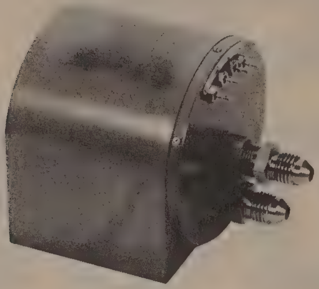
POTENTIOMETRIC TYPE PRESSURE TRANSDUCER

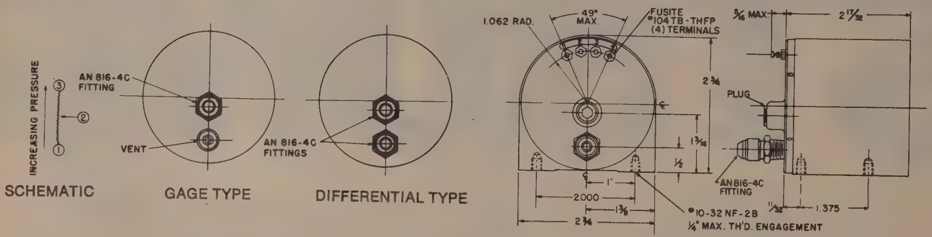
BUNKER RAMO AMPHENOL



MODEL TP-300

- No amplification required lowering system cost.
- Precision jewel and ball bearings improve reliability and lower maintenance costs.
- Linear and non-linear functions available for increased design flexibility.

DIMENSIONS



SCHEMATIC GAGE TYPE DIFFERENTIAL TYPE

ABSOLUTE TYPE UNIT ILLUSTRATED

AMPHENOL reserves the right to change specifications without notice as part of our continuous program of product improvement.

SPECIFICATION PERFORMANCE DATA — Model TP-300

GENERAL

Pressure Ranges: 0-1, 0-2, 0-3, 0-5, 0-10, 0-15, 0-30, 0-50, 0-100, psia, psig and psid.

Over Range Factor: 0-1 to 0-10 psi: 250% of full scale pressure. Minimum over 10 psi: 150% of full scale pressure.

ELECTRICAL

Excitation Voltage Range: 100 volts maximum, ac or dc.

Output Voltage Range: 100 volts maximum, ac or dc.

Power Rating: 1.0 watts at 104°F (40°C).

Maximum Noise Level: 400 mv.

Potentiometer Ranges: 500-15,000 ohms.

PERFORMANCE

Time Constant: Less than 0.02 seconds.

Life Expectancy: 100,000 full-scale cycles.

Static Error Band: (Including effects of linearity, hysteresis, friction and repeatability): ±3.5%* — 0-1 psi Pressure Range. ±3.0% — 0-2 psi Pressure Range. ±2.5% — 0-3 psi Pressure Range: ±2.0% — 0-5 psi Pressure Range: ±1.5% — 0-10 psi Pressure Range. ±1.5% — 0-15 psi Pressure Range. ±1.0% — 0-30 psi Pressure Range and over.

Vibration Error Band: ±2%, depending on Pressure Range.

Temperature Error Band: ±2% maximum.

Acceleration Sensitivity (for 5g's and over): ±0.05%/g depending on Pressure Range.

ENVIRONMENTAL

Temperature Range: −67°F to 212°F (−55°C to 100°C).

Humidity Range: 0-100% relative humidity (units are mechanically sealed).

Vibration Range: 10g at 55-2,000 Hz.

Acceleration Range: 50g.

Shock: 50g for 11 milliseconds.

PHYSICAL

Weight: Less than 0.5 lbs.

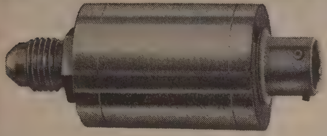
Dimensions: Refer to outline drawing.

* Absolute type unit

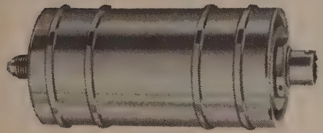
NOTE: Standard characteristics and ratings are described, special characteristics can also be supplied upon request.

CONDUCTIVE PLASTIC POTENTIOMETRIC PRESSURE TRANSDUCER

BUNKER RAMO AMPHENOL



Models TP-101, TP-1000

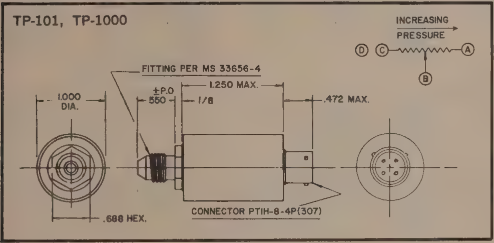


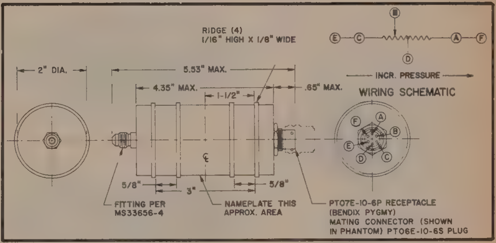
Model TP-2000

MODELS TP-101, TP-1000, TP-2000

- No amplification required for lower system cost
- Infinite resolution eliminates hunting in closed-loop servo systems
- High degree of safety with all-welded stainless-steel case

DIMENSIONS


TP-101, TP-1000
INCREASING PRESSURE
D
C
A
B
FITTING PER MS 33656-4
1.250 MAX.
±P.0 550
1/8
.472 MAX.
1.000 DIA.
.688 HEX.
CONNECTOR PTIH-8-4P(307)


RIDGE (4)
1/16" HIGH X 1/8" WIDE
E
C
B
A
F
D
INCR. PRESSURE
WIRING SCHEMATIC
2" DIA.
5.53" MAX.
4.35" MAX.
1-1/2"
.65" MAX.
℄
5/8"
3"
5/8"
FITTING PER MS33656-4
NAMEPLATE THIS APPROX. AREA
PT07E-10-6P RECEPTACLE (BENDIX PYGMY) MATING CONNECTOR (SHOWN IN PHANTOM) PT06E-10-6S PLUG

PERFORMANCE DATA

DESIGN CHARACTERISTICS

Measurand: Static Pressure, Absolute or Gauge, Liquids or Gases

Measurand Range: TP-101 — 0-15 to 0-350 psia or psig, 0-500 psia on special order
TP-1000 and TP-2000 — 0-500 to 0-10,000 psia or psig

Measurand Properties: Compatible with Ni-Span, 17-4PH corrosion-resistant steel and AISI 300 Series stainless steel

Operating Principle: TP-101 — Capsule Force Summer, Potentiometric Transduction
TP-1000 and TP-2000 — Helical Bourdon Tube Force Summer, Potentiometric Transduction, Silicone-Oil Damping Fluid

Theoretical Transfer Function: Linear with Pressure (Non-linear with Pressure available)

MECHANICAL DESIGN

Weight: TP-101 — Less than 2 oz.
TP-1000 — Approximately 3 oz.
TP-2000 — Less than 1 lb., 12 oz.

Pressure Connection: Fitting per MS33656-4 for ¼" Flared Tubing

Proof Pressure: TP-101 — 400% F.S. (1000 psi max.)
TP-1000 and TP-2000 — 150% F.S.

Burst Pressure Rating: TP-101 — 200% F.S. without rupture (1000 psi max.)
TP-1000 and TP-2000 — 200% F.S.

ELECTRICAL DESIGN

Excitation: AC or DC Voltage

Insulation Resistance: 50 Megohms at 500 V dc

Output Characteristics: DC Voltage Ratio, 0 to 100% VR
Power Rating
TP-101 and TP-1000 — 0.25 W at 40°C derated linearly to zero at 125°C
TP-2000 — 0.5 W at 40°C derated linearly to 0.1 W at 100°C
Resistance Range, 50 to 5000Ω ±10%, higher values on special order

Internal Calibration: Potentiometer may be tapped to give a relative check as % VR

Electrical Connection:
TP-101 — PT1H-8-4P (307)
TP-1000 — PT1H-8-4P (307)
TP-2000 — PT07H-10-6P

PERFORMANCE CHARACTERISTICS

Static Error Band: ±1.0% (models TP-101 and TP-1000), ±0.5% (model TP-2000) VR as referred to terminal line (includes terminal linearity, hysteresis, friction and repeatability)

Resolution: Infinite (Stepless Conductive-Plastic Element)

Cycling Life: 100,000 Full-Scale Cycles

Time Constant: 20 msec from zero to 63% of range

ENVIRONMENTAL EFFECTS

Condition	Operating Range	Error
Temperature	−65°F to +250°F	.01% VR per °F
Acceleration	TP-101 and TP-1000 — to 100g	Less than 1.0% of full range*
	TP-2000 — 10g	Less than 1.0% of full range*
Vibration	TP-101 and TP-1000 — 35g to 2000 Hz	1.0% VR max.*
	TP-2000 — 0.06" DA 10-60 cps, 10g, 60-2,000 cps	1.0% VR max.*
Shock	TP-101 and TP-1000 — 100g at 8 msec	
	TP-2000 — 50g per 11 ±1 milliseconds without damage	

* As measured along most sensitive axis

Humidity, Sand, Dust, Salt Spray, Fungus per MIL-E-5272C

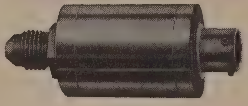
PRESSURE TRANSDUCERS & SENSORS

BUNKER RAMO AMPHENOL

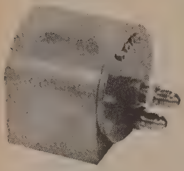
CONTROL PERFORMERS--DESIGNED TO MEET

FEATURES

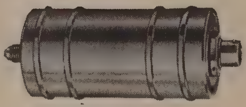
- No amplification required for lower total system cost.
- Infinite resolution (standard or available on all models) prevents hunting in closed-loop servo systems.
- Linear outputs standard — non-linear outputs available on special order.
- Meet MIL SPEC standards.



TP-101



TP-300



TP-2000

POTENTIOMETRIC PRESSURE-TRANSDUCER

Model No.	Measurand	Dimensions	Weight	Proof Pressure	Pressure Range, psi	Static Error Band*
TP-101	Static Pressure, Absolute or Gauge	1.00″ dia. 1.25″ max. long plus fitting and connector (2.40″ max. overall)	Less than 2 oz.	400% of full scale press. (1000 psi max.)	0-15 to 0-350 (0-500 special)	±1.0%
TP-200	Static Pressure, Absolute, Gauge & Differential	2.00″ dia. 2.5″ long ($3\frac{11}{16}$″ long over ports)	Approx. 5 oz.	100% of full scale press. (not to exceed 100 psi in case)	0-5 to 0-10, 0-15 to 0-100	±2.5% ±1.5%
TP-300	Static Pressure, Absolute, Gauge & Differential	2¾″ dia. $2\frac{17}{32}$″ long	Less than 0.5 lb.	0-10 range 250% of full scale press. Over 10 range, 150% of full scale press.	0-1 0-2 0-3 0-5 0-10 0-15 0-30 to 0-100	±3.5% ±3.0% ±2.5% ±2.0% ±1.5% ±1.0%
TP-1000	Static Pressure, Absolute or Gauge	1.00″ dia. 1.25″ max. long plus fitting and connector (2.40″ max. overall)	Approx. 3 oz.	150% of full scale press.	0-500 0-10,000	±1.0% V.R.
TP-2000	Static Pressure, Absolute or Gauge	2.00″ dia. 5.53″ max. length	Approx. 1.9 lbs.	150% of full scale press.	0-500 to 0-6000	±0.5% V.R.

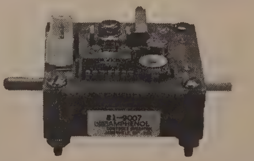
NOTE: THE MODELS SHOWN ABOVE REPRESENT TYPICAL SPECIFICATIONS.
* Static Error Band (including terminal linearity, hysteresis friction & repeatability).

CONVERSION FACTORS FOR PRESSURE UNITS

Pressure Unit Value	millibars	mm mercury 0°C	in. mercury 0°C
1 atmosphere	1013.250	760.000	29.9213
1 millibar (mb)	1	0.75006	0.029530
1 mm mercury (mm Hg)	1.3332	1	0.03937
1 in. mercury (in. Hg)	33.864	25.400	1
1 gram/cm² (g/cm²)	0.98067	0.73556	0.028959
1 lb/in² (psi)	68.9476	51.715	2.0360
1 lb/ft²	0.47880	0.35913	0.014139
1 cm water 20°C	0.97891	0.73424	0.028907
1 in. water 20°C	2.4864	1.8650	0.73424

FEATURES

- Low Cost — for wide flexibility in use.
- Solid-State Electronics for reliability.
- Rugged Construction — to withstand shock and vibration.
- Small Size —— fits confined space.
- TC-Matched Components.
- DC output for analog systems; frequency output for digital systems.



CAPACITIVE PRESSURE-SENSOR PERFORMANCE

Model No.	Measurand	Dimensions	Weight (approx.)	Proof Pressure	Pressure Range	Static Error Band*
81-9004	Static Pressure Absolute	2.25″ x 2.25″ x .825″	3 oz.	150% of full-scale press.	150 to 1060 mb	±2% F.S. over the temp. range −30°C to +50°C
81-9005	Static Pressure Absolute	2.25″ x 2.25″ x .825″	3 oz.	150% of full-scale press.	100 to 1100 mb	±3% F.S. over the temp. range −20°C to +50°C
81-9006	Static Pressure Gage	2.25″ x 2.25″ x .825″	3 oz.	150% of full-scale press.	0″ Hg to 16″ Hg vacuum	±3% F.S. over the temp. range −40°C to +125°C
81-9007	Static Pressure Gage	2.25″ x 2.25″ x .825″	3 oz.	150% of full-scale press.	0 to 10 psig	±3% F.S. over the temp. range 0°C to +70°C
81-9008	Static Pressure Absolute	2.25″ x 2.25″ x .825″	3 oz.	150% of full-scale press.	4-14 psig	±3% F.S. over the temp. range −20°C to +71°C

NOTE: THE MODELS SHOWN ABOVE REPRESENT TYPICAL SPECIFICATIONS.
* Static Error Band (including terminal linearity, hysteresis friction & repeatability).

PRESSURE TRANSDUCERS & SENSORS BUNKER RAMO AMPHENOL

YOUR PRESSURE-MEASUREMENT NEEDS

PERFORMANCE

Vibration Error	Temperature Error	Acceleration Error	Response Time	Life	Excitation	Power Rating	Resolution	Noise Max.	Output Form	Temperature Range	Vibration	Acceleration	Shock	Features	Model No.
1.0% V.R. max.	.01% V.R. per °F	Less than 1.0% of full scale	20 msec from zero press. to 63% of range	100,000 full-scale cycles	AC or DC voltage	.25 watt at 40°C derated linearly to zero at 125°C	Infinite (Conductive Plastic Element)	400 MV	50 to 5000Ω ±10% (Potentiometric)	−65°F to +250°F	35g to 2000 Hz	to 100g	100g at 8 msec	1. Ni-Span-C Capsule 2. Wirewound Element available 3. Linear and non-linear outputs available 4. All-welded stainless-steel case	TP-101
±2.0% max. ±1.0% max.	±1.5% max. ±1.0% max.	±.05% per g max. ±.03% per g max.	50 millisec max. 20 millisec max.	250,000 full-scale cycles min.	AC or DC voltage	1.0 watt at 40°C derated linearly to .1 watt at 100°C	.15% max. depending on ORV	400 MV	500 to 50,000Ω ±5% (Potentiometric)	−55°C to +100°C	10g at 5-2000 Hz	50g	75g without damage	1. Ni-Span-C Capsule 2. Infinite Resolution (C.P. Element) available 3. Single or Dual outputs 4. Linear and non-linear outputs available	TP-200
±2% depending on press. range	±2.0% max.	±.05% per g depending on press. range (5g & over)	Less than 0.02 sec.	100,000 full-scale cycles	AC or DC voltage	1.0 watt at 40°C	Dependent on resistance value	400 MV	500 to 15,000Ω ±10% (Potentiometric)	−55°C to +100°C	100g at 55-2000 Hz	50g	50g for 11 msec	1. Ni-Span-C Capsule 2. Infinite Resolution (C.P. Element) available 3. Single or Dual outputs 4. Linear and non-linear outputs available	TP-300
1.0% V.R. max.	.01% V.R. per °F max.	1.0% of full range max.	20 msec from zero press. to 63% of range	100,000 full-scale cycles	AC or DC voltage	.25 watt at 40°C derated linearly to zero at 125°C	Infinite (Conductive Plastic Element)	400 MV	50 to 5000Ω ±10% (Potentiometric)	−65°F to +250°F	35g to 2000 Hz	to 100g	100g at 8 msec	1. Ni-Span-C Bourdon Tube 2. Linear or non-linear outputs available 3. Oil-filled to minimize shock & vibration effects 4. All-welded stainless-steel case	TP-1000
1.0% V.R. max.	.01% V.R. per °F max.	1.0% of full range max.	20 msec from zero press. to 63% of range	100,000 full-scale cycles	AC or DC voltage	.5 watt at 40°C derated linearly to .1 watt at 100°C	Infinite (Conductive Plastic Element)	400 MV	100 to 5000Ω ±10% (Potentiometric)	−50°C to +100°C	10g 60-2000 Hz	10g	50g for 11 msec	1. Ni-Span-C Bourdon Tube 2. Linear or non-linear outputs available 3. Oil-filled to minimize shock & vibration effects 4. All-welded stainless-steel case	TP-2000

OTHERS ARE AVAILABLE TO MEET YOUR SPECIFIC NEEDS. AMPHENOL'S EXPERIENCED ENGINEERING STAFF WELCOMES YOUR INQUIRIES.

gram/cm²	lb/in²	lb/ft²	cm water 20°C	in. water 20°C
1033.227	14.69595	2116.22	1035.08	407.513
1.0197	0.014504	2.0885	1.0215	0.40218
1.3595	0.019337	2.7845	1.3619	0.53620
34.531	0.49115	70.726	34.573	13.619
1	0.014223	2.0482	1.0018	0.39441
70.307	1	144	70.433	27.730
0.48824	0.0069444	1	0.48912	0.19257
0.99821	0.014198	2.0444	1	0.3937
2.5354	0.036063	5.1930	2.5400	1

Vibration Error	Temperature Error	Response Time	Life	Excitation	Resolution	Output Form	Temperature Range	Vibration	Shock	Model No.
No electrical discontinuity or mechanical damage. Changes in output within total error band.	Within total error band.	Less than 100 ms for 350 mb pressure change	Greater than 1 x 10^6 F.S. cycles	12 V. DC	Infinite	D.C. Voltage (4.7 VDC at 1060 mb to 7.2 VDC at 150 mb)	−30°C to +50°C	MIL-STD-202 Method 204D Test Cond. A 10g, 10 to 500 Hz	MIL-STD-202 Method 204D Test Cond. G 50g, 11 ms Saw Tooth	81-9004
No electrical discontinuity or mechanical damage. Changes in output within total error band.	Within total error band.	Less than 100 ms for 200 mb pressure change	Greater than 1 x 10^6 F.S. cycles	18 V. DC	Infinite	Frequency (nominal 1.8 KHz decreasing 100 Hz per 100 mb increase in pressure)	−20°C to +50°C	MIL-STD-202 Method 204D Test Cond. A 10g, 10 to 500 Hz	MIL-STD-202 Method 204D Test Cond. G 50g, 11 ms Saw Tooth	81-9005
No electrical discontinuity or mechanical damage. Changes in output within total error band.	Within total error band.	Less than 0.1 sec for 8″ Hg pressure change	Greater than 1 x 10^6 F.S. cycles	9 to 15 V. DC	Infinite	Frequency (nominal 300 KHz decreasing 4 KHz per inch of HG increasing vacuum)	−40°C to +125°C	MIL-STD-202 Method 204D Test Cond. A 10g, 10 to 500 Hz	MIL-STD-202 Method 204D Test Cond. G 50g, 11 ms Saw Tooth	81-9006
No electrical discontinuity or mechanical damage. Changes in output within total error band.	Within total error band.	Less than 100 ms for a 5 psig change	Greater than 1 x 10^6 F.S. cycles	12 V. DC	Infinite	D.C. Voltage (3.5 V. at 0 psig to 8.5 V. at 10 psig)	0°C to +70°C	MIL-STD-202 Method 204D Test Cond. A 10g, 10 to 500 Hz	MIL-STD-202 Method 204D Test Cond. G 50g, 11 ms Saw Tooth	81-9007
No electrical discontinuity or mechanical damage. Changes in output within total error band.	Within total error band.	Less than 100 ms for a 5 psia change	Greater than 1 x 10^6 F.S. cycles	6 to 15 V. DC	Infinite	D.C. Voltage (3.5 V. at 5 psia to 6.4 V. at 13 psia)	−20°C to +71°C	MIL-STD-202 Method 204D Test Cond. A 10g, 10 to 500 Hz	MIL-STD-202 Method 204D Test Cond. G 50g, 11 ms Saw Tooth	81-9008

OTHERS ARE AVAILABLE TO MEET YOUR SPECIFIC NEEDS. AMPHENOL'S EXPERIENCED ENGINEERING STAFF WELCOMES YOUR INQUIRIES.

FW BELL INC.

The Gaussmeter People

MAGNETIZERS

Model 860

Model 870

FEATURES:

Solid-state
Low-voltage operation (safety)
sampling Stabilizer
Manual or Automatic operation

DESCRIPTION

Bell magnetizers are capacitive discharge power units designed to supply a current pulse to a magnetizing fixture coil. The energy level of the pulse is variable and accurately repeatable. Internal logic makes it impossible to fire the magnetizer until the capacitor-stored energy reaches the present level. The use of high-reliability SCR's and other solid-state components insures that Bell magnetizers will operate continuously within specifications.

model number	energy maximum	storage voltage	storage capacity	peak magnetizing current	cabinet size
860	600 watt-sec	35 V to 350 V	10,000 µF	6 kA	19.75'' W 14.75'' H 18.06'' D
861				12 kA	
860 A	1200 watt-sec		20,000 µF	6 kA	
861 A				12 kA	
870	1800 watt-sec		30,000 µF	6 kA	19.75'' W 21.75'' H 18.06'' D
871				12 kA	
870 A	3000 watt-sec		50,000 µF	6 kA	
871 A				12 kA	

COMMON SPECIFICATIONS

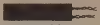
Inputs:
control connector on rear, for remote firing
Outputs:
magnetize complete, (logic output) system ready lamp, (indicates when capacitors are at the preset voltage) current shunt, 0.1 mV/A proportional (to measure the charging current)
Operation:
manual or automatic with magnetizer control module
Weight:
approximately 130 lbs
Shipping weight:
approximately 180 lbs
Power:
117 Vac, 15 A, 60 Hz or 234 Vac, 7.5 A, 50 Hz

ORDERING INFORMATION

Contact F. W. Bell, Inc. for application assistance. Product assistance and technical literature are available. If standard models are not available, F. W. Bell, Inc. can design for your special electrical and physical requirements.

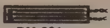
For other Bell products turn to pages 1•614, 1•615

HALL GENERATORS



BH-200

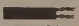
BH-202



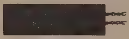
BH-201

BH-203

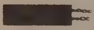
BH-204



BH-205



BH-206



BH-207

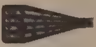
BH-208

BH-700

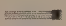
BH-701

BH-702

BH-203



FH-301



FH-302

BH-200	General Purpose Transverse
BH-201	Ultra-Thin Transverse
BH-202	Small Axial
BH-203	General Purpose Axial
BH-204	Midget Axial
BH-205	Midget Transverse
BH-206	High Sensitivity Transverse
BH-207	High Resolution Tangetil
BH-208	Ultra-Midget Axial
BH-700	Low-Cost Transverse
BH-701	High Linearity Transverse
BH-702	Ferrite Imbedded
BH-703	3-Axis
FH-301	Thin Film
FH-302	Thin Film
BH-850	Earth Field Sensing
BHT-921	Cryogenic

DESCRIPTION

Bell Hall Effect generators are unique solid-state components which provide a voltage output proportional to ambient magnetic flux density. Bell manufactures a wide variety of standard Hall generators. This wide selection plus the engineering capability to provide you with standard models allows the Bell generators to meet the needs of virtually any magnetic field measurement application.

SPECIFICATIONS

	bulk	thin film
control current, I_c	100 to 200 mA	15 to 30 mA
input resistance, R_{in}	1 to 4 ohms	20 to 80 ohms
output resistance, R_{out}	1 to 4 ohms	50 to 200 ohms
magnetic sensitivity, γ	from 6 to 16 mV/kF, standard 55 mV/kG, high sensitivity	

TYPES, APPLICATIONS

Types:

high linearity, high output, high sensitivity, cryogenic, ferrite imbedded, multi-axis

Applications:

current sensors, guidance systems, brushless dc motors, magnetic field measurements, proximity sensors, power transducers

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FW BELL INC.
A Subsidiary of
The Arnold Engineering Company

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Columbus, Ohio 43229
Phone: (614) 888-7501
TWX: 810-337-2851

REAL POWER TRANSDUCERS PX 2000 SERIES PX 4000 SERIES

F.W. BELL INC.

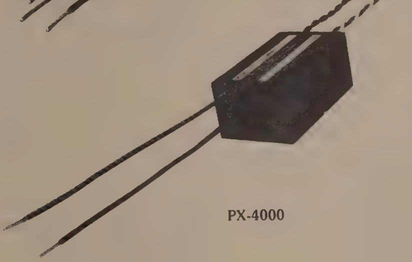
The Gaussmeter People

POWER SYSTEM TRANSDUCERS R-2000 SERIES

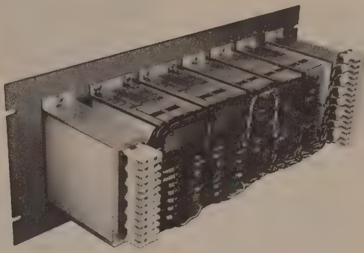
FEATURES

- Economical
- Light-weight
- Small
- Reliable

PX-2000



PX-4000



- A complete line of utility tested and approved transducers for measurement of active power, reactive power, current and voltage at standard frequencies in single phase and 3-phase power systems.
- Accurate and reliable long-life operation, enhanced by high-grade components, thorough inspection, high overload capability, 2000 V rms dielectric test and 3000 V crest transient test.
- Standard output range 0 to 1 mA dc into any load from 0 to 10 kohm. Linearity better than 0.2%. Operating accuracy 0.5% of rated output, when used with any combination of wide range operating conditions.
- Sturdy aluminum cases of uniform height and length for all models, allowing easy-to-trace wiring in one plane. Dimensions compatible with standard racks and panels.
- Space-saving two-section current & voltage transducers, permitting as many as eight measuring circuits on one 19″ panel: active power, reactive power, 3 current and 3 voltages.

DESCRIPTION

PX 2000 and PX 4000 series transducers are compact, accurate, and dependable solid-state modules for the measurement and control of single-phase and three-phase power. Each series has models for various frequency bands in the range from 50Hz to 10 kHz. The module output is a power proportional dc voltage.

Each module consists of a potential transformer, a Hall Effect multiplier, and corrective circuitry that reduces the influence of low-power factor and of ambient temperature fluctuations. The output circuits are completely isolated from the input circuit and can easily be interfaced with panel meters, recorders, amplifiers, and power control circuitry.

The light-weight transducers are epoxied in small nylon cases with through mounting holes and wire leads. This configuration facilitates assembly with associated devices. Simplicity, versatility, high performance, and low cost make these modules ideal for incorporation into power and process monitors, limiters, controllers, and in many other industrial applications.

	Specifications	PX 2000 series	PX 4000 series
INPUT	Rated power levels	50-2000 W	1000 W
	Rated current levels	0.5-20 A	5 A
	Rated voltage	120 V	220 V
	Frequency, nominal	60-180-360 Hz	1-3 kHz
	Frequency, min to max	40 to 2000 Hz	0.5 to 10 kHz
OUTPUT	Rated dc output across 50	±55 mV	>±30 mV
	Ripple, peak to peak	110 mV	>60 mV
	Response time to 99%	<50 µs	<5 µs
	Rated accuracy	0.5%	0.5%
	Linearity vs. power	±0.2%	±0.2%

ORDERING INFORMATION

Contact F. W. Bell, Inc. for application assistance. Product assistance and technical literature are available. If standard models are not available, F. W. Bell, Inc. can design for your special electrical and physical requirements.

For other Bell products turn to pages 1•614, 1•615

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4949 Freeway Drive E
Columbus, Ohio 43229
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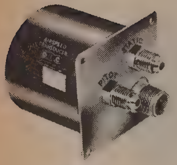
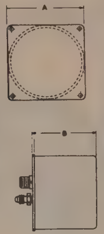
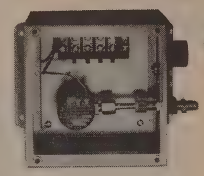
CIC PRECISION PRESSURE TRANSDUCERS/TRANSMITTERS

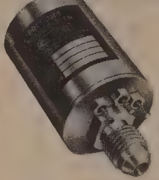
LINEAR WITH PRESSURE / ALTITUDE / AIRSPEED / FLOW / SQUARE ROOT



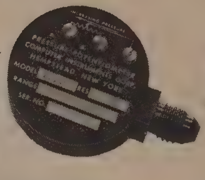
#7100
Air Speed Transducer

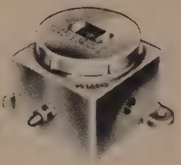






WEATHER-PROOF
(Available in All Models)





EXPLOSION-PROOF
(Available in All Models)

Model No.	Pressure Range	Gage, Absolute, Differential	Pressure Media	Linearity	Repeat-ability	Temp.	Dia. A	Lgth. B	Case Press.	Weight	Temp. Range
1000 & 1100	0-10 to 0-500 PSI Gage, Absolute, Differential	Gage, Absolute, Differential	Absolute, Differential Air or Oil — Non-corrosive Gage: Any media compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.156	1.55	200 PSIA	2 oz.	−55°C to +85°C
1200	0-300 to 0-10,000 PSI	Gage, Absolute	Any media compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.00	2.00	200 PSIA	4 oz.	−55°C to +85°C
1300	0-15 to 0-500 PSI	Gage	Any compatible with Inconel X-750	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.156	2.60	500 PSIA	6 oz.	−55°C to +85°C
2000	0-10 to 0-500 PSI	Gage, Absolute, Differential	Absolute, Differential: Air or Oil, Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.01%/C°	1.25 Hex.	1.75	500 PSIA	3 oz.	−55°C to +85°C
3000	0-100 to 0-10,000 PSI	Gage, Absolute	Any compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.62	.71	—	3 oz.	−55°C to +85°C
3200	0-100 to 0-10,000 PSI	Gage, Absolute	Any compatible with Ni-Span-C	To ±.3% F.S.	±.1% F.S.	±.02%/C°	2.38	.72	—	3 oz.	−55°C to +85°C
4000	0-3 to 0-200 PSI	Gage, Absolute, Differential	Absolute, Differential: Air or Oil, Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.3% F.S.	±.05% F.S.	±.02%/C°	2.06	2.16	200 PSIA	12 oz.	−55°C to +85°C
4105 & 4120	0-2 to 0-10,000 PSI Current Output	Gage, Absolute, Differential 1-5 or 4-20 M.A.D.C.	Absolute, Differential: Air or Oil, Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	5.00 Explosion or Weather-proof	4.625	200 PSIA	6 lb.	−40°F to +150°F
4500	0-2 to 0-200 PSI	Differential	High side: Any compatible with Ni-Span-C. Low side: Any compatible with isolating diaphragm	To ±.3% F.S.	±.1% F.S.	±.02%/C°	2.00	3.20	1000 PSIA	14 oz.	−20°C to +85°C
4500F	0-3 to 0-200 PSID Flow transmitter	Linearity of Voltage Output (Proportional to $\sqrt{\Delta P}$)	High side: Any compatible with Ni-Span-C. Low side: Any compatible with isolating diaphragm	To ±.5% F.S.	±.1% F.S.	±.02%/F°	2.00	3.20	1000 PSIA	14 oz.	0°F to +185°F
4600	0-200 to 0-10,000 PSI	Differential	High side: Any compatible with Ni-Span-C. Low side: any compatible with isolating diaphragm	To ±.3% F.S.	±.1% F.S.	±.02%/C°	2.63	2.18	1000 PSIA	14 oz.	−20°C to +85°C
6000	0-.1 to 0-2 PSI	Gage, Differential; 0-0.5 to 0-5 PSI Absolute	Absolute, Differential: Air or oil — Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.3% F.S.	±.05% F.S.	±.02%/C°	3.20	2.84	100 PSIA	12 oz.	−55°C to +85°C
6100	0-2 to 0-200 PSI	Gage, Differential; 0-5 to 0-200 PSI Absolute	Absolute, Differential: Air or oil — Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.3% F.S.	±.05% F.S.	±.02%/C°	2.63	2.84	150 PSIA	10 oz.	−55°C to +85°C
6200	0-50 to 0-10,000 PSI	Gage, Absolute, Differential	Gage, Absolute: Any compatible with Ni-Span-C. Differential: Air, oil — Non-corrosive	To ±.3%	±.05%	±.02%/C°	2.63	1.09	500 PSIA	6 oz.	−55°C to +85°C
7000	0 to 80,000 feet	Altitude	Absolute: Air	To ±.3%	5 feet	±.02%/C°	2.63	2.84	—	10 oz.	−55°C to +85°C
7100	0 to 1,000 knots	Airspeed	Differential: Air	To ±.3%	±.15 knots	±.02%/C°	2.63	2.84	—	10 oz.	−55°C to +85°C

CIC

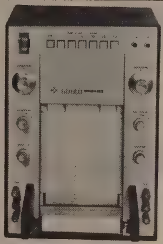
COMPUTER INSTRUMENTS CORPORATION/92 MADISON AVE., HEMPSTEAD, N.Y. 11550/516-483-8200

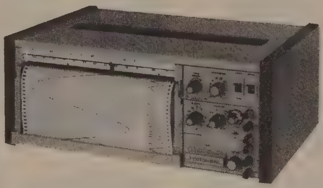
The Complete Line of Gould/Brush Analog and Digital Recording Systems.

Brush direct writing recorders produce written records of highest accuracy, trace clarity, crispness and uniformity.

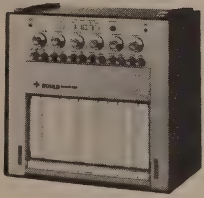
Gould offers a complete selection of general purpose, high performance direct writing and strip chart recorders with many exclusive features.

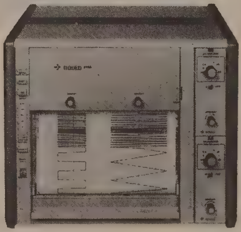
Most models are available in both portable and rack mounted versions. These quality recorders are ideally suited for industrial and scientific applications that require the highest precision, sensitivity and accuracy. Write for bulletin 1250 for specifications on all models.

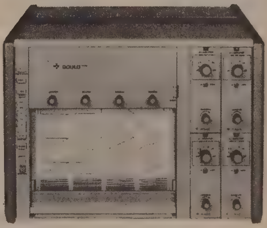

BRUSH 222 • 2-CHANNEL. Portable battery operated version of popular Brush 220 recorder. Internal recharger. 30Hz frequency response. Sensitivity 1mV/div. to 500V f.s.

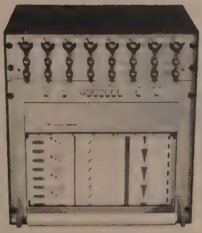

BRUSH 110 STRIP CHART. Most versatile 10-inch recorder. One or two channels; integrator optional. Lifetime thermal pen guarantee. 0.25 second full scale response.

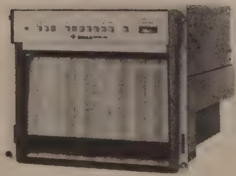
BRUSH 816 • 8-CHANNEL HI-SPEED MULTIPOINT. Data is recorded at a rate 2 sec. / per point to 16 points / sec.


BRUSH 260 • 6-CHANNEL. High precision and maximum operator convenience. Built-in preamps. 1mV/div. to 500V f.s. sensitivity.


BRUSH 2400 • 2-CHANNEL. Channels are a true 100mm wide. Plug-in preamps. 30Hz frequency response.


BRUSH 2400 • 4-CHANNEL. 50mm channels, 50Hz frequency response, 99.65% linearity.


BRUSH 481 • 8-CHANNEL. 1mV/div. to 500 V f.s. sensitivity. Model 480 available without preamps.


BRUSH 200 • 8-CHANNEL. The world's standard for high performance recorders. Tailored to your specific requirements. Recorder module is featured above.

GOULD 6000 DATA ACQUISITION SYSTEM. 128 floating and integrating inputs, real time monitoring, 200 points/sec., 3M computer grade tape cartridge.

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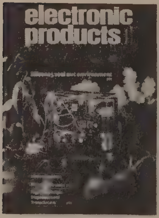

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moxon

VARIABLE RELUCTANCE TRANSDUCERS

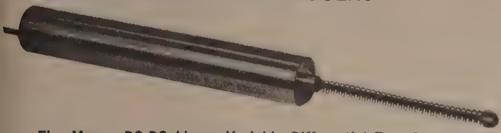
Since pioneering variable reluctance transducer measurement in 1938, Moxon Inc. (Crescent Technology) has continually paced the industry by developing new transducer types and systems. The expanded line presently includes a complete range of precision sensors in the following types: ROTARY POSITION, LINEAR POSITION, VELOCITY and TORQUE.

Moxon transducers are currently used in the following programs: ATLAS, CENTAUR, SPARTAN, MINUTEMAN, C-5A, F-14, F-15, B-1, MBT-70 and SPACE SHUTTLE.

In addition to the transducer line, Moxon produces a complete line of complementary electronic components. While the standard systems fit most applications, Moxon engineers have the know-how to develop custom systems for special requirements.

To find the right transducer system for your application, simply contact the factory giving specs. and qtys. Drawings and price quotations will be supplied in return.

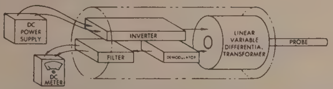
PRECISION LINEAR TRANSDUCERS



The Moxon DC-DC Linear Variable Differential Transformer type (LVDT) Transducer, Models 1104 and 1110 have the advantage of DC voltage operation with the accuracy of devices that are more expensive and which require more support circuits and equipment.

A regulated DC Power Supply is all that this instrument needs to operate, along with a method of reading, recording, or otherwise using its output. Output power is sufficient to operate meters, analog to digital converters, recorders and many other instruments or control circuits.

These instruments have become increasingly popular as direct replacements of potentiometers. The advantages are great, such as, infinite resolution, sealed electronics, high speed response and no friction (by use of an isolated core) or electrical wearing parts (brushes or slip rings) which means the transducer life will far exceed the associated mechanical hardware.



SYSTEM BLOCK DIAGRAM SHOWING INTERNAL ELECTRONICS

SPECIFICATIONS

ELECTRICAL	MODEL 1104 MODEL 1105*	MODEL 1110 MODEL 1111*
Excitation	24 VDC Regulated	6 VDC Regulated
Sensitivity, at Full Stroke into a 500 K ohm load	±5.000 VDC ±1.0%	±.400 VDC ±1.0%
Linearity	0.25% of Full Range (.1% Optional*)	
Ripple	50 mv RMS	4 mv RMS
Output Impedance	Less than 4 K ohms	Less than 1 K ohms
Insulation Resistance	50 Megohms @ 50 VDC	100 Megohms @ 50 VDC
Dielectric Strength	100 VAC, RMS, 60 Hz for 60 Seconds	
Shielding	Electromagnetic and Electrostatic	
Temperature Coefficient	.02% per °F	.01% per °F
Repeatability	0.01%	

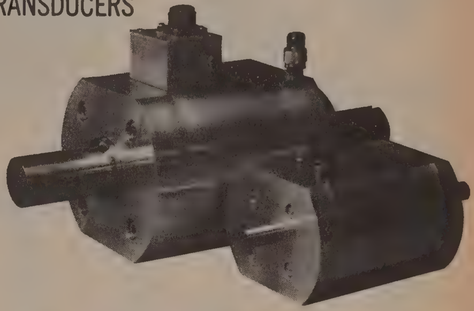
* The 1105 and 1111 have .1% linearity. All other specs remain as shown.

MECHANICAL	
Construction	Corrosion Resistant Steel — .75 Inch Diameter
Lead Wires	26 AWG, Teflon, 12 Inches Long
Probe Extension	3/32 Inch Diameter with a 2-56 Threaded End

ENVIRONMENTAL	
Operating Temperature	−20°F to +250°F
Storage Temperature	−65°F to +250°F

Stroke (Inches)	Housing Length (Inches)	Input Current ma.	
		1104	1110
—1 ±0.050	3.00	45	40
—2 ±0.100	3.00	35	40
—3 ±0.250	3.50	30	35
—4 ±0.500	4.25	25	35
—5 ±1.000	5.00	25	30
—7 ±3.000	14.00	25	25

TORQUE TRANSDUCERS



Moxon Torque Transducers are precision electronic torque measuring instruments for making static and dynamic measurements. They employ a linear variable reluctance principle to provide an AC or DC output signal proportional to the amount of torque applied.

The DC versions contain an integral electronic package. A nominal 24 volt DC excitation voltage generates an output of 0±5 VDC proportional to the torque applied in either a clockwise or counterclockwise direction.

FEATURES

NO SLIP RINGS NOISE OR WEAR • INFINITE LIFE • INFINITE RESOLUTION • COMPACT • EASY TO USE

TYPICAL APPLICATIONS

Automotive, process control, earth moving, oil drilling, nuclear reactors, farm equipment and manufacturing, aircraft, shipboard, chemical, baking etc. industries.

PHYSICAL CHARACTERISTICS

TORQUE RANGE: 5 to 200,000 inch pounds
OVERLOAD RANGE: 200% of full scale.
TEMPERATURE RANGE: −65° F to 200°F.
SPEED: 0 to 6000 RPM STD; optional to 25,000 RPM.

ELECTRICAL	DC	AC
Excitation	22-34 VDC unregulated	5 Vrms 400 to 1,000 Hz
Sensitivity	5 VDC ±10 mV full range	15 to 20 mV/V full range
Ripple	Less than 20 mV RMS	N/A
Linearity	0.25% half-range, 0.75% full range	
Hysteresis	Less than 0.25%	
Repeatability	Better than 0.15%	
Resolution	Infinite	
Output Impedance	Less than 100 ohms	
Thermal Sensitivity Shift	Less than 0.02% per °F	
Shielding	Electromagnetic	

DIGITAL READOUT/POWER SUPPLY

To have a complete displacement or torque sensing system, a companion unit that contains a digital readout in either 3½ or 4½ digits and the excitation power supply can be furnished. The readout can be calibrated in any conventional engineering units. Models with high/low limit comparators are also available.

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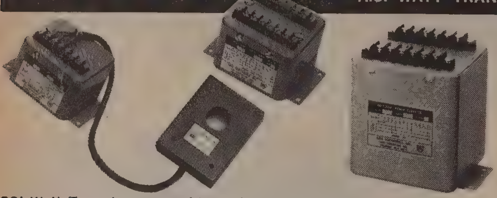
OSI

TRANSDUCERS — WATT, CURRENT, VOLTAGE, VAR

A.C. WATT TRANSDUCERS (102 STANDARD 60 Hz MODELS AVAILABLE)



OSI Watt Transducers provide an isolated D.C. output proportional to the true power (EI x Cos θ) consumed in single or three phase circuits. Their fast response makes them very useful on non-sinusoidal as well as sinusoidal waveforms. Outputs of millivolts, milliamperes or volts are available, offering flexibility to the designer in interfacing to control or metering systems.

SINGLE PHASE 60 Hz MODELS

MODEL NUMBER PC5-	FULL SCALE INPUTS			OUTPUT CALIB. 50MV =
	VOLTS	AMPS	WATTS	
1	120	5	600	500W
2	240	5	1.2K	1KW
3	480	5	2.4K	2KW
10	120	10	1.2K	1KW
11	240	10	2.4K	2KW
12	480	10	4.8K	4KW
19	120	15	1.8K	1.5KW
20	240	15	3.6K	3KW
21	480	15	7.2K	6KW
28	120	50	6K	5KW
29	240	50	12K	10KW
30	480	50	24K	20KW
31	120	100	12K	10KW
32	240	100	24K	20KW
33	480	100	48K	40KW
34	120	200	24K	20KW
35	240	200	48K	40KW
36	480	200	96K	80KW
37	120	400	48K	40KW
38	240	400	96K	80KW
39	480	400	192K	160KW
40	120	600	72K	60KW
41	240	600	144K	120KW
42	480	600	288K	240KW
43	120	1000	120K	100KW
44	240	1000	240K	200KW
45	480	1000	480K	400KW
46	120	2000	240K	200KW
47	240	2000	480K	400KW
48	480	2000	960K	800KW
49	120	50	6K	5KW
50	240	50	12K	10KW
51	480	50	24K	20KW
58	120	100	12K	10KW
59	240	100	24K	20KW
60	480	100	48K	40KW
67	120	200	24K	20KW
68	240	200	48K	40KW
69	480	200	96K	80KW
76	120	400	48K	40KW
77	240	400	96K	80KW
78	480	400	192K	160KW
85	120	600	72K	60KW
86	240	600	144K	120KW
87	480	600	288K	240KW
94	120	1000	120K	100KW
95	240	1000	240K	200KW
96	480	1000	480K	400KW

3 PHASE 3 WIRE 60 Hz MODELS

MODEL NUMBER PC5-	FULL SCALE INPUTS			OUTPUT CALIB. 100MV =
	VOLTS	AMPS	WATTS	
4	120	5	1.04K	1KW
5	240	5	2.08K	2KW
6	480	5	4.16K	4KW
13	120	10	2.08K	2KW
14	240	10	4.16K	4KW
15	480	10	8.31K	8KW
22	120	15	3.12K	3KW
23	240	15	6.24K	6KW
24	480	15	12.5K	12KW
52	120	50	10.4K	10KW
53	240	50	20.8K	20KW
54	480	50	41.6K	40KW
61	120	100	20.8K	20KW
62	240	100	41.6K	40KW
63	480	100	83.1K	80KW
70	120	200	41.6K	40KW
71	240	200	83.1K	80KW
72	480	200	166K	160KW
79	120	400	83.1K	80KW
80	240	400	166K	160KW
81	480	400	332K	320KW
88	120	600	125K	120KW
89	240	600	249K	240KW
90	480	600	499K	480KW
97	120	1000	208K	200KW
98	240	1000	416K	400KW
99	480	1000	831K	800KW

3 PHASE 4 WIRE 60 Hz MODELS

MODEL NUMBER PC5-	FULL SCALE INPUTS			OUTPUT CALIB. 150MV =
	VOLTS	AMPS	WATTS	
7	120	5	1.80K	1.5KW
8	240	5	3.60K	3KW
9	480	5	7.2K	6KW
16	120	10	3.6K	3KW
17	240	10	7.2K	6KW
18	480	10	14.4K	12KW
25	120	15	5.4K	4.5KW
26	240	15	10.8K	9KW
27	480	15	21.6K	18KW
55	120	50	18K	15KW
56	240	50	36K	30KW
57	480	50	72K	60KW
64	120	100	36K	30KW
65	240	100	72K	60KW
66	480	100	144K	120KW
73	120	200	72K	60KW
74	240	200	144K	120KW
75	480	200	288K	240KW
82	120	400	144K	120KW
83	240	400	288K	240KW
84	480	400	576K	480KW
91	120	600	216K	180KW
92	240	600	432K	360KW
93	480	600	864K	720KW
100	120	1000	360K	300KW
101	240	1000	720K	600KW
102	480	1000	1.44M	1.2MW

OSI

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PIONEER IN SOLID STATE TECHNOLOGY FOR ENERGY CONVERSION AND POWER MONITORING

OSI TRANSDUCERS — WATT, CURRENT, VOLTAGE, VAR

A.C. WATT TRANSDUCERS

SPECIFICATIONS

INPUT

Overload (Continuous):
  Voltage, 1.25 X Rating
  Current, 2 X Rating (5, 10 and 15 A Models)
    10 X Rating (50 A thru 2000 A Models)

Burden (At Max. Rated Input):
  Voltage, 1.25 VA
  Current, 1.25 VA
  Amplifier, 2 VA

Power Factor Range: 0.5 Lead to 0.5 Lag

Frequency Range: 50 to 70 Hz

Dielectric Test (Input/Output/Case):
  1500 V RMS

Models PC5-28 through PC5-48 are complete with OSI Current Transducers.

Models PC5-49 through PC5-102 are supplied with current transformers.

OUTPUT

Output Load: 10K ohms

Adjustment Range: ±10%

Response Time (Base Unit): 5 Milliseconds
  (With Options): 400 MS

Temperature Effect (−10°C to +60°C):
  ±1% F.S. from the Calibrated Value.

ACCURACY AT 25°C

Including Power Factor Error, Linearity, Repeatability, and Initial Calibration Set Point Error:
  PC5- 1 thru PC5- 48 ±0.5% F.S.
  PC5-49 thru PC5- 57 ±2.0% F.S.
  PC5-58 thru PC5-102 ±1% F.S.

Standard units have millivolt outputs as indicated. Units having 0 to 1 milliampere or 0 to 10 volt are available as options and are ordered by adding the option letter as a suffix to the standard model number, For example PC5-1A has an output of 0 - 1 milliampere for 500 watts input.

AMPLIFIED OUTPUT OPTIONS

A. 0 to 1 milliampere output. No external amplifier power required. Load 0 to 10K ohms.

B: 0 to 1 milliampere output. External amplifier power required. 85-135 VAC at 2 watts. Load 0 to 10K ohms.

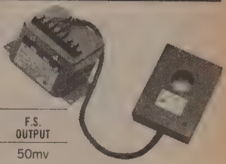
C: 0 to 10 volt output. No external amplifier power required. Load greater than 2K ohms.

D: 0 to 10 volt output. External amplifier power required. 85 - 135 VAC at 2 watt. Load greater than 2K ohms.

VAR AND POWER FACTOR TRANSDUCERS

OSI manufactures a line of 60 Hertz 1ϕ and 3ϕ VAR transducers and a line of 60 Hertz 1ϕ and 3ϕ power factor transducers. These units are essential in attaining efficient utilization of electrical power. VAR units provide an output proportional to reactive or reflected power. Power factor units are available to provide a d.c. output proportional to power factor, or an output proportional to load phase angle. Write for information on standard models and custom-engineered models to meet your requirements.

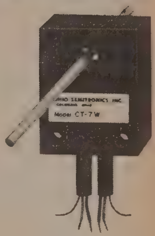
DC WATT TRANSDUCERS



OSI d.c. watt transducers provide a d.c. output proportional to power delivered to a load by d.c., low frequency a.c., chopped waveform a.c., or nonsymmetrical a.c. inputs.

MODEL	NOMINAL VOLTAGE	NOMINAL CURRENT	F.S. POWER	F.S. OUTPUT
PC7-31	120V	100A	10KW	50mv

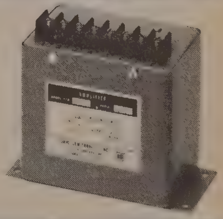
CURRENT TRANSDUCERS D.C. TO MEGAHERTZ



CT Series Current Transducers introduce negligible circuit interaction and require no physical or electrical connection to circuit being measured. An output voltage is provided which is directly proportional to the instantaneous current flow through the window. The flat d.c. to Megahertz frequency response together with the less - than - 1 - microsecond - risetime makes the units ideally suited for monitoring, control, or analysis of d.c., steady-state or transient currents.

MODEL	PEAK CURRENT AMPERES	BIAS CURRENT MILLIAMPERES	FULL SCALE OUTPUT MILLIVOLTS
CT-7W	30	100	60
CT-100W	100	100	60
CT-200W	200	100	100
CT-600W	600	100	60
CT-1000W	1000	100	60

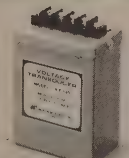
SIGNAL CONDITIONER



The Model **CTA-101** Signal Conditioner is designed to provide excitation for the d.c. to Kilohertz transducers and amplify the output up to a 10 volt peak level. Calibration adjustments are provided to allow setting transducer sensitivity to match system requirements.

VOLTAGE AND CURRENT TRANSDUCERS

CT5-1



VT150

OSI Voltage and Current Transducers provide an isolated d.c. output proportional to 50 to 500 Hz inputs. Models with filtered outputs to meet many control and metering requirements are available.

MODEL	F.S. INPUT	F.S. OUTPUT	ACCURACY
VT150	150V.	1 ma	0.5% F.S.
VT150/10	150V.	10 V	0.5% F.S.
CT5-1	5A.	1 ma	0.5% F.S.

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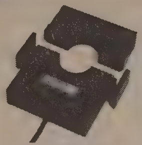
PIONEER IN SOLID STATE TECHNOLOGY FOR ENERGY CONVERSION AND POWER MONITORING

OSI TRANSDUCERS — WATT, CURRENT, VOLTAGE, VAR

CURRENT TRANSDUCERS DC TO KILOHERTZ

MODEL CT200L

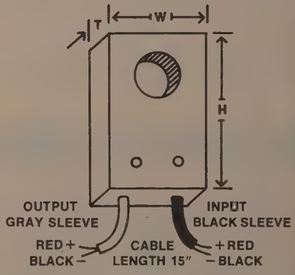

MODEL CT2000LTS

These current transducers provide flat d.c. to Kilohertz response which allows accurate waveform monitoring and measurements of d.c., sinusoidal or distorted waveform currents with high accuracy. Since no physical or electrical connection is necessary to the circuit being monitored, they are especially useful where high voltages are present by providing an output which is electrically isolated from the current source.

Models with better than 1% linearity and temperature effects less than 1% are stock items in current ranges to 8000 Amps. Special units for higher currents or split-core configurations can be supplied for specific requirements. Auxiliary amplifier-power supply units are available to provide 10 Volt output when desired instead of 50 millivolt output of transducer alone.

MODEL	ENCLOSED CURRENT AMPS RMS	CONTROL CURRENT MA (NOM)	OUTPUT MV. (TYP.)	LINEARITY % F.S.	TEMPERATURE EFFECT ON OUTPUT	TEMPERATURE RANGE °C	RESISTANCE TYP. IN Ω	RESISTANCE TYP. OUT Ω
CT50L	50	100	30	0.5	−0.15%/°C	−40 +65	4	3
CT50LTT	50	100	20	0.5	±1%	0 +40	4	25
CT50LT	50	100	20	0.5	±1%	−40 +65	4	25
CT100L	100	100	50	0.5	−0.15%/°C	−40 +65	4	3
CT100LTT	100	100	50	0.5	±1%	0 +40	4	25
CT100LT	100	100	50	0.5	±1%	−40 +65	4	25
CT200L	200	100	75	0.5	−0.15%/°C	−40 +65	4	3
CT200LTT	200	100	50	0.5	±1%	0 +40	4	25
CT200LT	200	100	50	0.5	±1%	−40 +65	4	25
CT400L	400	100	50	0.5	−0.15%/°C	−40 +65	4	3
CT400LTT	400	100	50	0.5	±1%	0 +40	4	25
CT400LT	400	100	50	0.5	±1%	−40 +65	4	25
CT600L	600	75	100	0.5	−0.15%/°C	−40 +65	4	3
CT600LTT	600	50	100	0.5	±1%	0 +40	4	25
CT600LT	600	50	100	0.5	±1%	−40 +65	4	25
CT1000L	1000	100	75	1	−0.15%/°C	−40 +65	4	3
CT1000LTT	1000	100	50	1	±1%	0 +40	4	25
CT1000LT	1000	100	50	1	±1%	−40 +65	4	25
CT1KL	1000	200	75	0.5	−0.15%/°C	−40 +65	25	6
CT1KLTT	1000	200	50	0.5	±1%	0 +40	25	25
CT1KLT	1000	200	50	0.5	±1%	−40 +65	25	25
CT2000L	2000	100	100	1	−0.15%/°C	−40 +65	4	3
CT2000LTT	2000	100	75	1	±1%	0 +40	4	25
CT2000LT	2000	100	75	1	±1%	−40 +65	4	25
CT2KL	2000	200	150	0.5	−0.15%/°C	−40 +65	25	6
CT2KLTT	2000	200	100	0.5	±1%	0 +40	25	25
CT2KLT	2000	200	100	0.5	±1%	−40 +65	25	25
CT8KL	8000	200	500	1	−0.15%/°C	−40 +65	25	6
CT8KLTT	8000	200	350	1	±1%	0 +40	25	25
CT8KLT	8000	200	350	1	±1%	−40 +65	25	25

PHYSICAL DIMENSIONS	INCHES				WEIGHT
MODEL	H	W	T	WINDOW DIAM.	LBS.
CT50L, LT, LTT	1½	1	½	⅜	1/16
CT100L, LT, LTT	2	2	¾	¾	¾
CT200L, LT, LTT	4	3⅛	⅞	1⅛	1
CT400L, LT, LTT	4	3⅛	⅞	1⅛	1
CT600L, LT, LTT	5	4	1	1⅛	1½
CT1000L, LT, LTT	6	5	1⅜	2	3½
CT1KL, LT, LTT	6	5	1⅜	2	3½
CT2000L, LT, LTT	6	5	1⅜	2	3½
CT2KL, LT, LTT	6	5	1⅜	2	3½
CT8KL, LT, LTT	13¾	10	1⅞	8¼ x 5½	13



NOTES: The split core option is available on all Models except the 50 Ampere size. To order, add the letter "S" to the Model Number. All units exhibit DC to 5 kHz response. The rise time for a step input is 100 microseconds. The time to reach 99% of the steady state value is 500 microseconds.

The electrical isolation (line to output) is at least 5000 volts for all Models, except the 50 Ampere size which is rated at 600 volts.

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The depth of our electric power measuring knowledge has produced a complete line of superior Power Transducers and related Measuring Devices for Industry, Electric Utilities, and Systems Manufacturers.

Because of our size and in-depth knowledge, we can furnish regular models, models with standard modifications, or we can build to your own custom specifications and deliver faster than any other supplier in the industry.

Also, our Research and Development Division is always on the alert to produce the needed new equipment so necessary in our ever-changing technology. We invite your inquires on any need.

Your attention is called to this complete list of our product line, with abbreviated descriptions and options and modifications. Your inquiries will receive our prompt attention.

DIGILOGIC

WATT TRANSDUCER DL-A2 Series

VAR TRANSDUCERS DLV-A2 Series

These Digilogic Watt and Var Transducers represent a new high-accuracy method of measuring true power to ±0.10%, and true VARS to ±0.15%. It is the most accurate in the United States.

There are five models in each Watt and Var, with 1, 1½, 2, 2½, and 3 Element, and Single Phase, 3 Phase-3 Wire, and 3 Phase-4 Wire Connections.

WATT/WATTHOUR TRANSDUCER

DL-A2-6070 Series (Uni-Directional)

DL-A2-6096 Series (Bi-Directional)

This Scientific Columbus Watt/Watthour Transducer is another major break-through in power instrumentation. By combining the ±0.10% Digilogic Watt Transducer with a high-accuracy integrating Analog to Frequency Converter, both Watts and Watthours are measured simultaneously within a single package, to an accuracy that surpasses conventional watt transducers and watthour measuring devices.

There are five models, with 1, 1½, 2, 2½, and 3 Element. and Single Phase, 3 Phase-3 Wire, and 3 Phase-4 Wire Connections.

These Watt/Watthour Transducers are the ultimate in accuracy, and can be used for billing and as a lab standard.

EXCELTRONIC

WATT TRANSDUCER XL-A2 Series

VAR TRANSDUCER XLV-A2 Series

The EXCELTRONIC line of Transducers is the perfect combination of other Scientific Columbus products. The accuracy, reliability, and stability of the ±0.10% Digilogic line was combined with the smaller-sized, rugged, less-expensive ±0.5% Hall line. The result is an accurate, inexpensive ±0.25% Transducer mechanically and electrically interchangeable with what has been available for many years.

HALLTIPLIER™

WATT TRANSDUCERS WT-A2 Series

VAR TRANSDUCERS VT-A2 Series

Scientific Columbus has the most complete selection of Hall Effect Watt and Var Transducers available. In addition to high reliability, Halltiplier™ Transducers feature such advantages as calibration adjustment, choice of filtered or unfiltered outputs, and minimal space requirements.

There are five models each of Watt and Var Transducers to fit every possible wiring connection.

HALLTIPLIER™

CURRENT AND VOLTAGE TRANSDUCERS CT-510 and VT-110 Series

Halltiplier™ Current and Voltage Transducers are manufactured to the same high standards of the Watt and Var Series. In addition to their high accuracy (±0.25%), they have features such as minimal space requirements and adjustable or nonadjustable outputs.

TEMPERATURE TRANSDUCERS

Series 9015N, 9016P, 9017T, 9018T, 9019C

The Scientific Columbus Temperature Transducer offers an accurate but inexpensive method of measuring temperature through the use of different sensors. They are manufactured to the same high standards as all other products in the line of "The Power Instrumentation People."

PORTABLE TRANSDUCER CALIBRATOR

Model 1369 C — Watts, Vars, Amps, Volts

Scientific Columbus' Portable Transducer Calibrator is designed to permit easy field checking and calibration of watt, var, volt, and current transducers. The Calibrator is a digitally programmable multi-function power transducer calibrator and/or tester for receiving inspection, field testing, and calibration of power-monitoring transducers and supervisory systems.

DEMAND CONTROL THE COMPLETE SOLUTION

Want to conserve energy? Of course you do. And Scientific Columbus has the devices, both automatic and manual, that will help you use your power more efficiently. Ask for details to determine which best fits your needs.

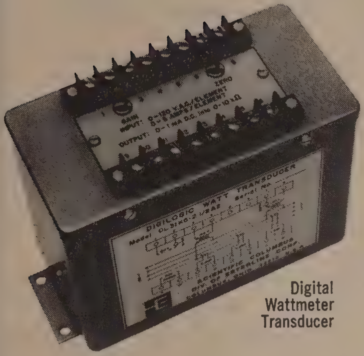
SHUNT/ISOLATION/AMPLIFIER

The Model 6271A Shunt Amplifier is a linear amplifier designed to amplify DC shunt millivolt signals, or DC voltages from 50 m.v. to 1000 VDC, and provides **complete isolation** of the input signal.

PROCESS CONTROL POWER TRANSDUCERS

Scientific Columbus has more than 60 High Output Constant Current Transducers. These Power Transducers convert Watts, Vars, Voltage, Current Frequency, Power Factor, and Temperature to the popular outputs compatible with process control equipment.

ADDITIONAL DEVICES IN THE SCIENTIFIC COLUMBUS LINE



Digital
Wattmeter
Transducer

Calibrator

Digital Wattmeter

AC EXPANDED SCALE VOLTAGE TRANSDUCER

Converts AC voltage to a proportional DC milliampere signal.

POWER FACTOR TRANSDUCERS

In a wide selection that produce a DC output which is linearly proportional to the phase angle difference between the voltage and current of an AC Power System.

FREQUENCY TRANSDUCERS

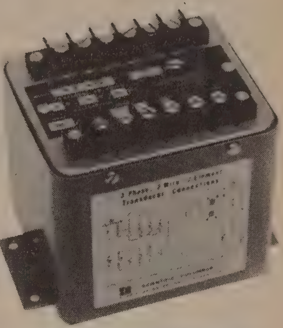
That develop a DC output signal which is proportional to input frequency.

DIGITAL WATTMETERS FOR PRECISION LABORATORY MEASUREMENTS

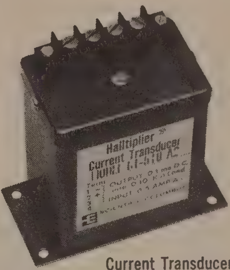
Are highly accurate for measurement of power. May be used as a standard watt meter in conjunction with digital printers, x-y recorders, or limit-alarm devices.

ANALOG TO FREQUENCY CONVERTER

When the signal is received from a watt transducer, all of the instantaneous analog watt information is still available, with no degradation of performance.



Our new **EXCELTRONIC** electronic
line of Transducers



Current Transducer

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Amperex Instrument Cathode Ray Tubes

MONO-ACCELERATOR TYPES

Flat-faced, mono-accelerator CRT's intended primarily for use in inexpensive oscilloscopes, read-outs, and monitors for industrial and medical instrumentation.

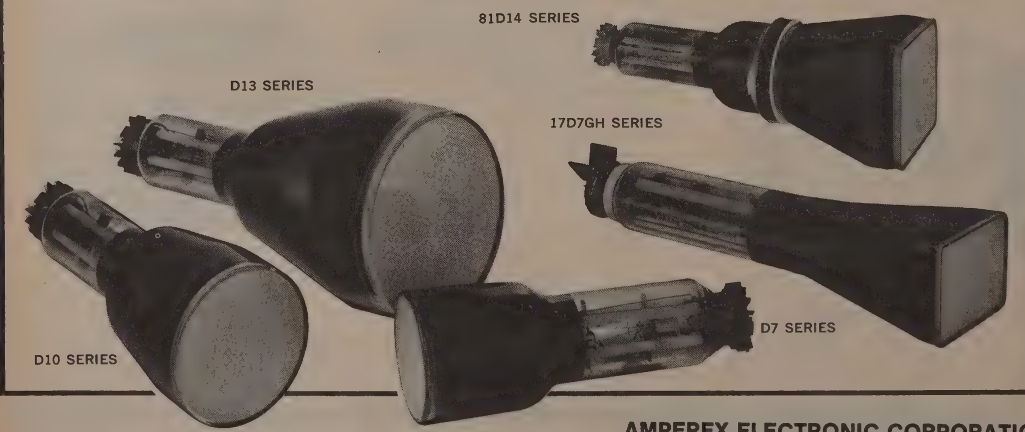
Amperex CRT's are ruggedly constructed and are designed to be mounted in any position; thus they are suitable for use in portable and mobile instruments as well as in fixed equipment. Special low-wattage heaters are available in most types to reduce power consumption of portable equipment.

These are electrostatic deflection tubes, electrostatically focussed and with symmetrical X and Y deflection plates. Orthogonality between X and Y plates is 90° ±1°. Deflection linearity from 25% to 75% of full deflection is better than 1%.

No external astigmatism control is needed for equipment in which these CRT's are used; initial adjustment at the time of manufacture is all that is required if mean X and Y plate potentials are correctly set.

Each tube is supplied with an Amperex 55566 14-pin socket.

TYPE	DIAMETER (in.)	DISPLAY AREA (cm)	PHOSPHOR	DEFLECTION COEFFICIENT (V/cm)		ACCELERATOR VOLTAGE	HEATER CURRENT (mA at 6.3V)	LENGTH (in.)	WEIGHT (oz.)
				HOR.	VERT.				
D7-190GH	2.52	5 x 6	P31	29	11.5	1000	300	8	9
D7-190GM	2.52	5 x 6	P7	29	11.5	1000	300	8	9
D7-191GH	2.52	5 x 6	P31	29	11.5	1000	95	8	9
D7-191GM	2.52	5 x 6	P7	29	11.5	1000	95	8	9
D10-160GH	3.35	6 x 8	P31	32	13.7	1500	300	9¼	14
D10-160GM	3.35	6 x 8	P7	32	13.7	1500	300	9¼	14
D10-161GH	3.35	6 x 8	P31	32	13.7	1500	95	9¼	14
D10-161GM	3.35	6 x 8	P7	32	13.7	1500	95	9¼	14
D13-480GH	4.48	8 x 10	P31	31.3	14.4	2000	300	11¼	23
D13-480GM	4.48	8 x 10	P7	31.3	14.4	2000	300	11¼	23
D13-481GH	4.48	8 x 10	P31	31.3	14.4	2000	95	11¼	23
D13-481GM	4.48	8 x 10	P7	31.3	14.4	2000	95	11¼	23
NEW RECTANGULAR TYPES INTRODUCED IN 1974									
17D7GH-L	3.0 (Diag.)	3.6 x 6	P31	13	22	1000	95	8	9
81D14GH-L	5.95 (Diag.)	8 x 10	P31	23	13.5	2000	95	13.11	23 (appr.)



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Electro-Optical Devices Division
Slatersville, Rhode Island 02876
Telephone: 401-762-3800 TWX: 710-382-6332

Amperex Instrument Cathode Ray Tubes

POST-DEFLECTION ACCELERATOR TYPES

A complete range of flat faced rectangular and round post-deflection accelerator tubes for use in laboratory and portable instrumentations at bandwidths of 25 MHz and higher.

Main Features:

- High deflection sensitivity
- Excellent center to edge resolution
- Short overall length
- State-of-the-art glass techniques
- Availability of low power heaters
- Availability of trace rotation coils
- All tubes are supplied with sockets

Type E14-100GH offers a split-beam display with horizontal axes perfectly parallel and with 100% overlap between both vertical and horizontal systems. Traces strike the screen at nearly 90° to minimize image distortion. A special Amperex circuit is available to completely eliminate the shift that normally occurs when the intensity or focus of a dual trace CRT is adjusted. The circuit also provides automatic focussing of the tube.

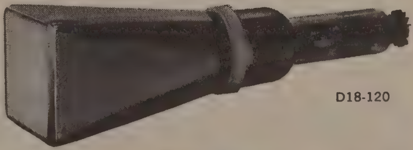
TYPE	DIAGONAL (In.)	DISPLAY AREA (cm)	PHOSPHOR	DEFLECTION COEFFICIENT (V/cm)		LINE WIDTH (mm)	ACCELERATOR VOLTAGE	POST-DEFLECTION VOLTAGE	LENGTH (In.)
				HOR.	VERT.				
D14-120GH	5.5	8 x 10	P31	4.2	15.5	0.4	1500	10,000	15.2
D14-120GM	5.5	8 x 10	P7	4.2	15.5	0.4	1500	10,000	15.2
1) D14-121GH	5.5	8 x 10	P31	4.2	15.5	0.4	1500	10,000	15.2
1) D14-121GM	5.5	8 x 10	P7	4.2	15.5	0.4	1500	10,000	15.2
2) D14-160GH/09	5.5	8 x 10	P31	4.1	15.2	0.3	1500	10,000	16.4
2) D14-160GM/09	5.5	8 x 10	P7	4.1	15.2	0.3	1500	10,000	16.4
3) D10-170GH	4 (DIAM)	6 x 8	P31	3.5	13	0.42	1000	6,000	13.2
D18-120GH	7	10 x 12	P31	4.5	15.5	0.35	2000	10,000	17.8
D18-120GM	7	10 x 12	P7	4.5	15.5	0.35	2000	10,000	17.8
4) E14-100GH	5.5	8 x 10	P31	9	13.5	0.35	1500	10,000	16.7
82D14GH-L	5.94	8 x 10	P31	19	9.5	0.35	4000	2,000	13.03

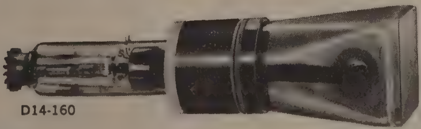
Notes: 1) Side connections to deflection plates reduce plate capacitance, allow operation up to 50 MHz.
2) Complete with coils for image rotation/orthogonality correction. Suitable for applications to 80 MHz. Edge-lit graticule.
3) Circular envelope and face.
4) Split beam; 100% overlap of the two systems.

82D14

D10-170

D14-120


D18-120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E14-100GH

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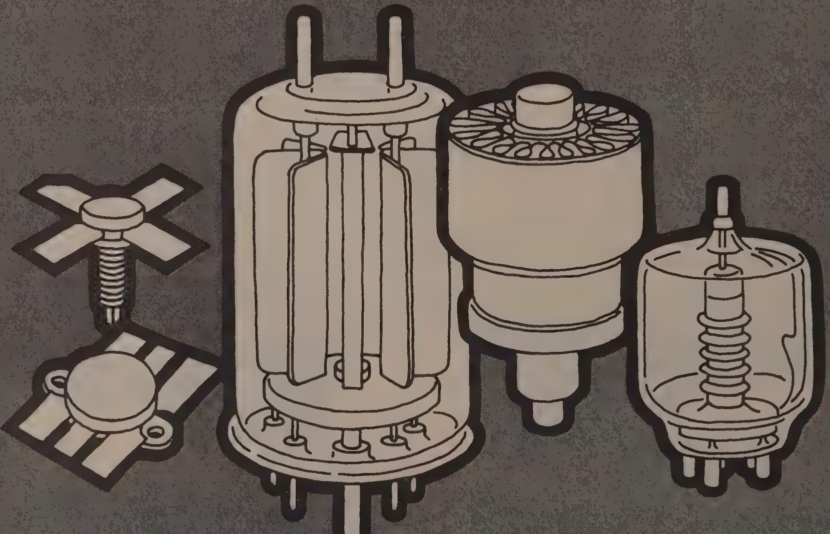

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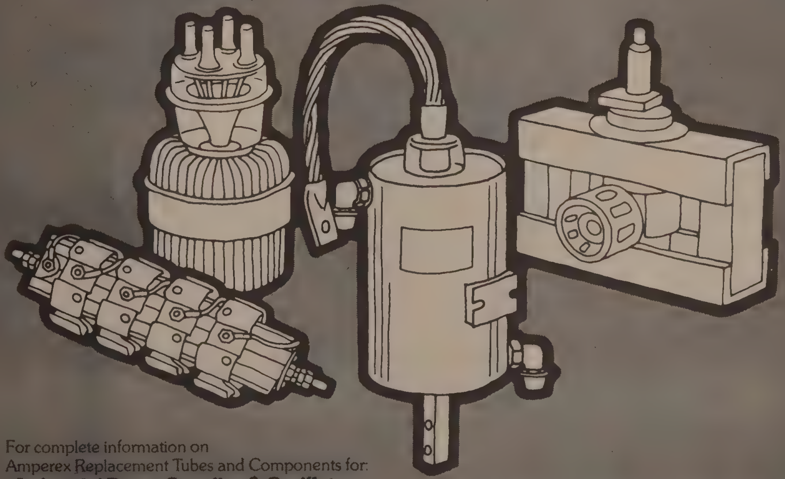

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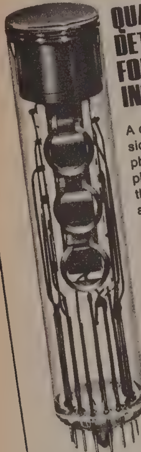
GaAs(Cs), RNOX Sb•Cs, BIALKALI



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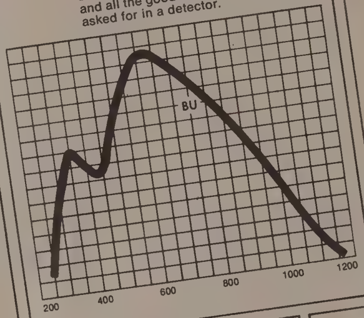
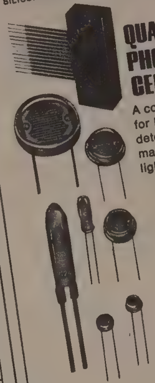
MACROSCOPIC COST

Low noise, wide range, stable, fast and all the good things that you have asked for in a detector.



LED, LAMP PHOTOCELLS
MULTICHANNEL CdS,
SILICON PHOTOCELLS CdS, PbS, LED



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A complete line for light meters, flame detectors, automated machinery and lighting systems.

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8573, 25PE12, 8480, N513,
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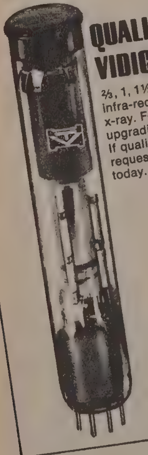
N400, N177, N371,



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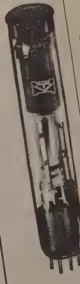
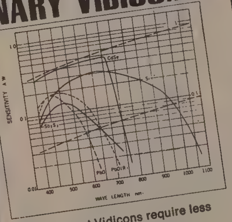
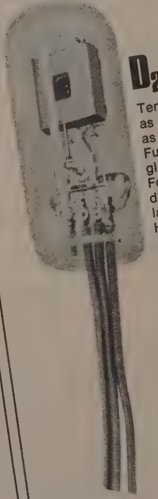




Silicon target Vidicons require less than .01 footcandle of light for effective performance—one-tenth the requirement of conventional antimony trisulfide vidicons. Unsurpassed resolution is another reason for switching to the N747T or N736T Vidicon for surveillance, industrial and educational TV cameras. When you compare the performance, you'll be amazed at the price.



D_2 LAMPS

Ten standard types and as many custom types as you can dream up. Fused silica or UV glass envelopes. For quality detectors and lamps call HAMAMATSU

HAMAMATSU

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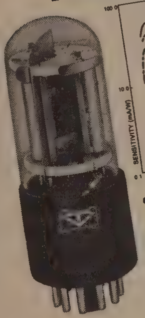
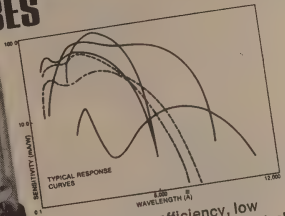
UNIQUE CAPABILITY

MORE SIDE-ON PHOTOMULTIPLIER TUBES





- High quantum efficiency, low noise, low drift and wide spectral range
- Window materials—UV-glass, fused-quartz or borosilicate
- Cathode materials include bialkali, multialkali and GaAs as well as solar blind and S-1
- Choose from the most complete line of exceptional quality Side-On photomultiplier Tubes.

IS A DETECTOR WITH SUB NANOSECOND RISE-TIME OF VALUE TO YOU?

IF YES-

Can you live with an S-1, S-5, S-13, S-20, or S-25 cathode?

IF YES-

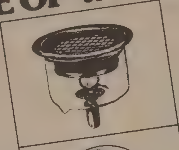
Will you pay $190 for it? Or $520 in a housing?

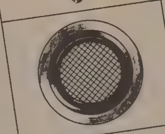
IF YES-

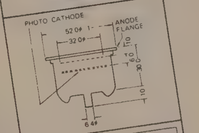
Write, or call me personally (Ralph Eno) and let's talk about it.

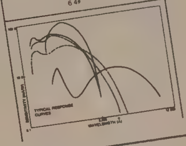
IF NO-

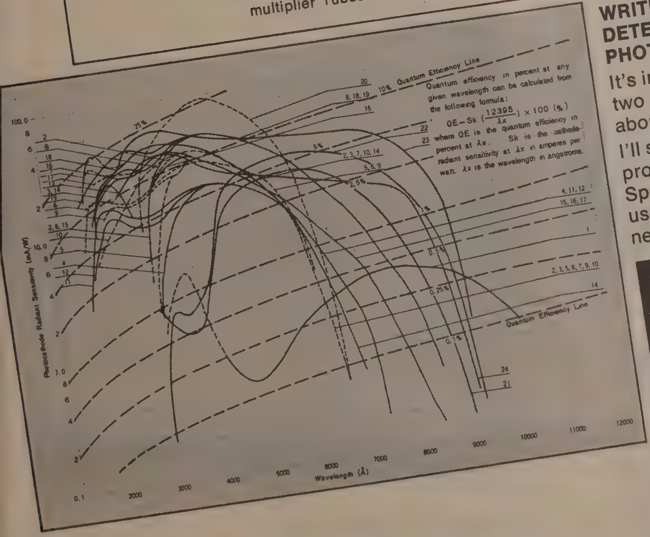
But you do need quality detectors such as Photomultipliers, Vidicons, Silicon Detectors, InAs, InSb, and others ranging in price from $1 to $6,000, send for our full catalog.











Quantum efficiency in percent at any given wavelength can be calculated from the following formula:

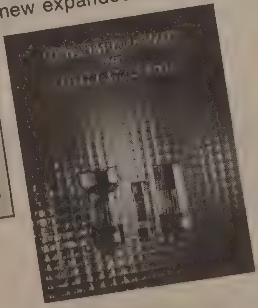
$$QE = Sk\left(\frac{12398}{\lambda x}\right) \times 100\ (\%)$$

where QE is the quantum efficiency in percent at λx. Sk is the cathode radiant sensitivity at λx in amperes per watt. λx is the wavelength in angstroms.

WRITE FOR DATA SHEETS DETECTORS VIDICONS — PHOTOSENSITIVE DEVICES

It's impossible to catalog over 800 detectors on two pages so call me, Ralph Eno, and let's talk about your requirements.

I'll send you specific data sheets for the products you ask about. I'll also send you our Spectral Response Chart which is widely used and in its third printing, plus our new expanded catalog.



HAMAMATSU

120 Wood Avenue • Middlesex, New Jersey 08846 • 201/469-6640

The INTER-TECHNICAL Group, Inc.

U.S. AGENCY FOR THORN RADIO VALVES & TUBES LTD.

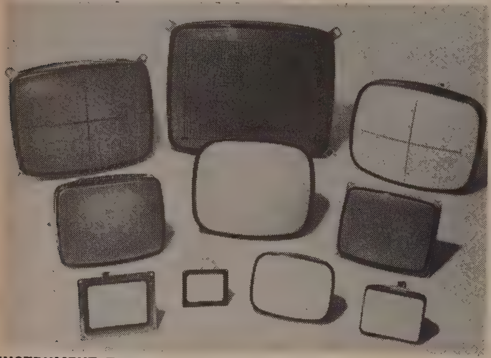
BRIMAR

high quality MONITOR TUBES/RADAR TUBES/ INSTRUMENT TUBES

NINETEEN DIFFERENT PHOSPHORS / INTERNAL & EXTERNAL GRATICULES / FLASHOVER PROTECTION / IMPLOSION PROTECTION (5 Different Constructions)

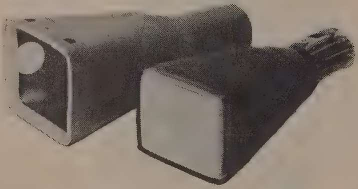
Accessories offered for Brimar cathode ray tubes include sockets, connectors, yokes, focusing coils and twist coils. Substantial savings can be offered when Magnetic Shields and Tubes are purchased as assemblies.

MONITOR TUBES



INSTRUMENT TUBES

D14-172 SHORT RECTANGULAR TUBE



D14-172/D18-130 SHORT RECTANGULAR TUBES

Short overall lengths (12 and 12.2 inches) / Rectangular 3.9 x 3.15- and 4.7 x 3.9-inch displays (10 x 8- and 12 x 10-cm) / Spiral p.d.a. for bright trace/Internal graticules available / For general purpose applications. Substantial savings can be effected when TELCON SHIELDS and TUBES are purchased as assemblies. See shields described in EEM Page 2•1230.

Thorn Radio Valves and Tubes Limited is one of Britain's largest manufacturers of industrial cathode ray tubes. Examine a BRIMAR catalog and you will find about the widest range of tubes, one of which is likely to be a perfect fit for your requirement. But if you have something unusual in mind it is probable that BRIMAR can make it.

PARTIAL LISTING OF AVAILABLE TYPES

Selected Types	Application and Description	Face Shape & Dia. (Min.)	Useful Min. Screen Area (Inch)
FLYING-SPOT SCANNER TUBES			
Q8-100AA	Magnetic focus. Educational EVR video reproducers	3 ●	2.1x1.5
Q13-200GS	Electrostatic focus. Document readers or telecine EHT connection by CT8 socket	5 ●	3.5x2.7
SMALL ELECTROSTATIC DISPLAY TUBES			
D3-130	General purpose indicating device	1 ●	1.1
D7-200	Indicators. Oscilloscopes. CCTV. Alpha-numerical readout	3 ■	2x1.6
D7-201	Low power, 8 to 10 mil spot. Inexpensive. For portable scopes.	3 ■	2x1.6
RADAR TUBES			**Defl. Angle**
F15-101	Low cost small boat radar, lightweight (0.3 lbs.). Short (9.5″). High brightness	6 ●	53
F21-10	General marine use. Aluminized	8½ ●	41
F28-130	Rimguard III 'push-through' protection. Private yacht radar	11 ■	90
F31-10	General marine use	12 ●	40
F31-14	Rimband protected. Private yacht transportable radar	12 ■	110
F41-120	Major radars for ships, port, and aircraft control	16 ●	50
DISPLAY AND PICTURE MONITOR TUBES			
M17-10	Medical waveform display. Television camera viewfinder	7 ■	70
M21-13	Medical waveform data display. Industrial monitors	8½ ■	90
M24-120	Rimguard reinforced envelope, integral mounting lugs. Data display	9.45 ■	90
M31-100	Alpha numerical or graphical, computer read-out Bonded face-plate	12 ■	70
M31-184	Industrial monitor, rimband, integral mounting lugs	12 ■	90
M36-141	Television studio monitor (Sim 14 BAP)	14 ■	70
M36-142	Television studio monitor. Protected version of M36-141. Bonded face-plate (Sim 14 BDP)	14 ■	70
M38-100	Industrial monitors. Data displays. Rimguard III	15 ■	90
M38-120	Monitor tube	15 ■	110
M38-140	High voltage focus, high resolution data display, fine line width (8 mil-shrinking raster). Short (12.6″)	15 ■	110
M44-120	Data displays. Ind. picture monitors. Squared-off screen. Rimguard III	17 ■	110
M61-120	Industrial monitors. Data displays. Squared up screen. Rimguard III.	24 ■	110

BRIMAR GRATICULES

For users who require internal graticules, Brimar instrument tubes can be provided with internally-applied graticules in a number of different scale designs, many with a choice of either black or gray lines. Since the graticules are inside the tube face in the same plane as the phosphor, there is no parallax error or dust collection problem. Special designs can be supplied when justified by the quantity ordered.

BRIMAR DEFLECTION YOKES

Because of customer demand for deflection yokes, coils are available for certain popular Brimar tube types. These provide good center to edge spot performance and good picture shape at a reasonable price.

P. O. BOX 23
IRVINGTON N.Y. 10533
TEL: (914) 591-8822
TWX: 710-564-0802

BRIMAR

ELECTROSTATIC INSTRUMENT TUBES
Comparison Chart

BANDWIDTH MHz	Va kV	USEFUL SCREEN							
		Less than 13 cm		6 cm x 10 cm	8 cm x 10 cm		10 cm x 10 cm		10 cm x 12 cm
		Round	Rect.	Rect.	Round	Rect.	Round	Rect.	Rect.
LOW <10	1.0	■ D3-130 103 324 240							
	1.5	■ D10-230 260 208 102							
	1.8		■ D7-200 180 260 252 ■ D7-201 190 290 116						
	2				■ D13-630 340 230 120				
	2.5						▨ D13-30 440 170 165	▨ D16-100 387 170 170	
	3				▨ D13-600 315 270 102 ▨ D13-601 315 270 102 ▨ SE5F 330 350 120	▨ D14-170 308 280 114 ▨ D14-171 308 280 114 ▨ D14-172 308 280 114 ▨ D14-173 308 280 114			▨ D18-130 310 348 165
MEDIUM 10/25	2		▨ D10-240 260 185 51						
	3				▨ D13-610 371 158 70				
	3.5				▨ D13-611 371 169 71				
	4	▨ SE3A 330 180 38 ▨ SE4D 362 200 38		▨ D13-33 386 105 81 ▨ D13-46 386 105 81 ▨ D13-47 371 175 50 ▨ D13-471 371 175 50		▨ D14-180 384 170 70			
	6		☐ D10-210 230 97 50						
HIGH 25/100	10			☐ D13-51 335 150 36					
	12					☐ D14-150 386 145 48 ☐ D14-200 405 142 43 ☐ D14-210 420 140 34			

■ Monoaccelerator

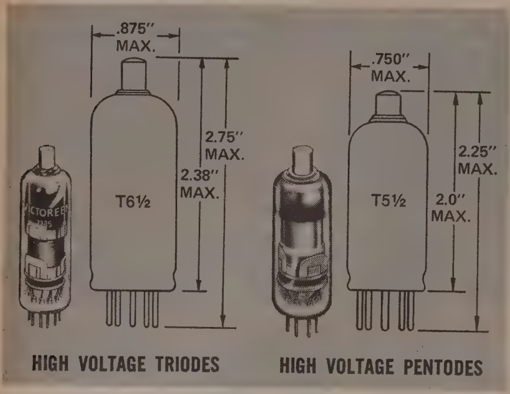
▨ Spiral pda

☐ Mesh pda

KEY

TYPE NUMBER		
Max. Overall Length (mm)	Full x Scan Volts	Full y Scan Volts

VICTOREEN VACUUM TUBES-MINIATURE HIGH VOLTAGE



HIGH VOLTAGE TRIODES **HIGH VOLTAGE PENTODES**

Victoreen offers a complete line of high voltage vacuum tubes with plate voltages as high as 10 Kv and plate dissipations as high as 15 watts. The high voltage current saving capacity of these vacuum tubes suggests their use as shunt or pass tube regulators. The characteristics of these vacuum tubes suggest their use in high voltage switching applications or as high voltage amplifiers. Manufactured to meet the requirements of MIL-E-1, Victoreen can supply life test and MTBF data on many types.

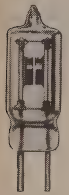
TYPES OF TUBES

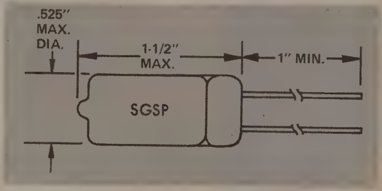
Type	Plate Voltage E_b Max.	Plate Current I_b Max.	Plate Dissipation P_p Max.	Grid Voltage E_{c1} Max.
7235 High Voltage Triode	10kV	5mA avg. 100mA peak	12 watts	−200 volts
6842 High Voltage Pentode	4kV	10mA avg. 100mA peak	8 watts	−100 volts
7234 High Voltage Pentode	10kV	8mA	6 watts	−100 volts
7683 High Voltage Pentode	1kV	20mA	15 watts	−100 volts

VICTOREEN SPARK GAPS-SURGE PROTECTION & ACTIVATION

SGSP FOR PROTECTIVE APPLICATIONS

The SGSP series of spark gaps is a rugged glass encapsulated series of protective devices capable of handling as much as 10 times the energy of the familiar "button" gaps. Their construction lends them to either circuit board mounting or insertion in a suitable socket. This type spark gap is available in any firing voltage from 150 to 5000 volts. Parameters on some of the more common types are listed below.



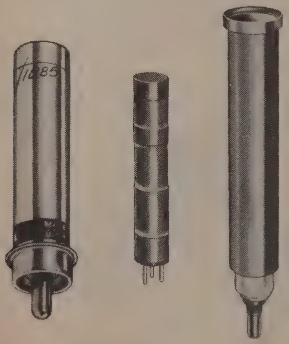


Type	Nominal DC Firing Volt. ±10%	Firing Voltage @ 100 v/ μsec. Rise	Firing Voltage @ 10 kv/ μsec. Rise	Extinguishing Voltage	Energy Dissipation Capability*
SGSP-150	150	360	550	15	100 Joules
SGL	215	470	730	15	100 Joules
SGSP-350	350	680	1050	15	100 Joules
SGSP-470	470	920	1400	15	100 Joules
SGSP-600	600	1150	1750	20	100 Joules
SGSP-800	800	1530	2350	40	100 Joules

*Maximum energy capable of being dissipated in a single pulse.

VICTOREEN "GM" COUNTER TUBES

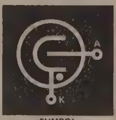
TYPES 1B85, 6306, VG40, VG41



VICTOREEN Geiger tubes have been rigorously designed to meet the demanding requirements of almost every type of industrial or laboratory application. The 1B85 and 6306 feature high sensitivity, aluminum walls and organic quench while the VG 40 and VG 41 offer long life, halogen quench, plus special stainless steel walls. A 1.4 mg/cm² mica end window on the VG 40 permits detection of low and high energy emitters and even alpha particles. Both type of tubes offer shock and vibration resistance substantially superior to glass-walled tubes.

Detection of alpha, beta, gamma and X-ray radiation with a wide choice of sensitivities is further evidence of the flexibility and performance capabilities of VICTOREEN's line of Geiger tubes.

Simple mounting and replacement of tubes is achieved through the use of standard type bases. VICTOREEN Geiger tubes are the first choice for use in portable survey instruments, area monitoring systems and precision laboratory measuring equipment.



SYMBOL

For applications requiring characteristics beyond those listed or for engineering data, contact VICTOREEN's Application Engineering Department.

VICTOREEN

VICTOREEN INSTRUMENT DIV.
10101 WOODLAND AVENUE • CLEVELAND, OHIO 44104

SG
SHELLER-GLOBE CORPORATION

VICTOREEN COROTRONS

HIGH VOLTAGE REGULATING AND REFERENCE DIODES

The COROTRON* may best be described as the high voltage, gaseous equivalent of the Zener diode. At high voltage, it can perform all the functions performed by the Zener at low voltages. It may be used as a simple shunt voltage regulator, precise high voltage reference, DC coupling element or portion of a divider string.

COROTRONS operate in the Corona mode of gaseous discharge and should not be confused with the older "Glow Discharge Tubes." Unlike glow tubes but like the Zener, there is no spread between "firing" voltage and "operating" voltage. They're available at any desired nominal voltage from 350 to 30,000 volts and are not restricted to certain "natural" voltages. They exhibit a positive slope to their regulation cure rather than a negative slope and, therefore, are not subject to relaxation oscillation when used with shunt capacitance to reduce dynamic impedance; nor are they subject to "jumps" and "jitter" or noises due to "glow area shift." COROTRONS are unaffected by ambient light conditions and can operate in total darkness at exactly the same voltage as in daylight.

NOMINAL OPERATING VOLTAGE

Since the tube has a positive slope to its regulation characteristics, the nominal voltage must be measured at some predetermined test point. This test point is selected as an appropriate quiescent condition for typical circuits in which this particular tube type has been employed.

TOLERANCE

This is the value by which the voltage for the specific tube type may vary from its nominal value at the test point.

*Registered Trademark of VICTOREEN INSTRUMENT DIV.

MINIMUM CURRENT

This is that value of current below which noise may be encountered unless the COROTRON is by-passed by a small value of capacitance and above which quiet operation may be expected.

MAXIMUM CURRENT

This is the highest value of current at which the tube may safely be operated in a steady state condition without effecting the life of the tube.

PEAK CURRENT

Peak current is that value of current to which transients or other low duty cycle phenomena may cause current excursions without introducing malfunctions.

REGULATION

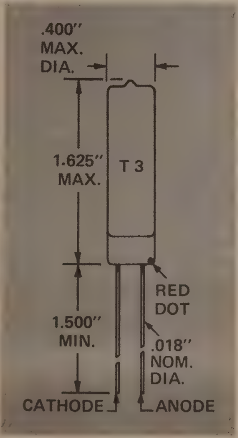
Regulation is assumed to be the change in operating voltage as the current through the tube is increased from its minimum value to its maximum value. Since this total excursion is rarely, if ever, encountered in a well designed circuit, the output voltage of the supply will always be held to a lower value than that listed in the column headed "REGULATION." Since the regulation curve is linear, one may readily compute the change in voltage to be anticipated for any fractional value of the previously mentioned current excursion.

WIDE SELECTION OF COROTRONS

Type	Nominal Voltage Range	Voltage Tolerance Range	Current Range In μa			Regulation (Max.)
			Min.	Max.	Peak	
GV1A	350-2000 @ 35μa	±(10-30)V	5-25	100	200-350	4-18V
GV3A, B	400-2500 @ 50μa	±(10-37)V	5-25	300-700	400-1400	20-85V
GV3S	400-3000 @ 50μa	±(10-45)V	10-25	250-650	300-1200	14-65V
GV4S	400-3500 @ 100μa	±(10-58)V	10-35	200-1000	300-1900	8-100V
GV5A, B, C	400-5000 @ 100μa	±(10-150)V	10-35	400-1000	600-1800	18-105V
GV6C	4000-6000 @ 100μa	±(100-150)V	50	500-600	900	55V
GV6A	400-3000 @ 500μa	±(10-75)V	50	750-2000	900-2900	25-120V
GV9A	450-3000 @ 1000μa	±(11-75)V	100	1500-3000	2000-6000	25-80V

TYPICAL COROTRONS

TYPES GV3A, GV3B



Current capabilities to 700μa.

Regulation of the order of 10 volts per 100 micro-amps.

Designed to regulate high voltage power supplies for portable radiation detection instruments and photo-multiplier tubes, as DC coupling elements and for other high voltage — low current applications.

Shock: 100g-11ms per MIL-STD-202C method 202B.

Vibration: 10-55cps-10g.

COMMONLY USED TYPES

Type	Nominal Voltage @ 50μa Test Point	Tolerance	Current In Microamperes			Regulation* (Max.)	Altitude
			Min.	Max.	Peak		
GV3B-400	400V	±10V	5	300	400	20V	72,000
GV3B-500	500V	±10V	5	300	400	30V	71,000
GV3B-600	600V	±12V	5	300	400	32V	70,000
GV3B-700	700V	±14V	5	300	400	35V	69,000
GV3B-800	800V	±16V	5	400	500	35V	68,000
GV3A-900	900V	±13V	10	500	700	35V	66,000
GV3A-1000	1000V	±15V	10	500	750	40V	65,000
GV3A-1200	1200V	±18V	15	600	800	60V	63,000
GV3A-1400	1400V	±21V	15	700	850	85V	60,000
GV3A-1800	1800V	±27V	20	550	1000	85V	57,000
GV3A-2000	2000V	±30V	20	500	1100	85V	55,000
GV3A-2200	2200V	±33V	25	450	1200	85V	53,000
GV3A-2500	2500V	±37V	25	400	1400	85V	50,000

*This regulation is the change in voltage over useful range of current from Min. to Max.

FOR ADDITIONAL INFORMATION REQUEST BULLETIN 5630-2-74

SHELLER-GLOBE CORPORATION
VICTOREEN INSTRUMENT DIV.
10101 WOODLAND AVENUE • CLEVELAND, OHIO 44104
VICTOREEN

VARO

IMAGE INTENSIFIER AND CONVERTER TUBES

18mm, 25mm and 40mm IMAGE INTENSIFIER ASSEMBLIES

Single-Stage and 3-Stage

Passive viewing devices, Varo's Image Intensifier's permit direct viewing in low light levels in the visible spectrum with no artificial light source required. Starlight or even the upper air glow can provide sufficient illumination for a usable image which is then intensified. When light rays are focused on the photocathode (S-20 with extended red response and a sensitivity of 175 μa/lumen), an image of emitted electrons is formed, electrostatically accelerated, and focused on the phosphor (aluminized P-20) screen, resulting in a light-amplified image which may be observed through conventional optics.

MODEL NO.	DESCRIPTION	STAGES	POWER SOURCE	NOMINAL OPERATING VOLTAGE	MIN. RESOLUTION (CENTER)
8857	18mm	Single	2.65 VDC	12,500V	63 lp/mm
8858	18mm	Three	2.65 VDC	38,000V	32 lp/mm
8585	25mm	Single	6.75 VDC	15,000V	63 lp/mm
8586	25mm	Three	6.75 VDC	45,000V	28 lp/mm
8605	40mm	Single	6.75 VDC	15,000V	63 lp/mm
8606	40mm	Three	6.75 VDC	45,000V	28 lp/mm

Monovoltage, Low-power, High-Resolution INFRARED IMAGE CONVERTER TUBES

Military and Commercial Applications

For converting near-infrared radiation into a visible image, these tubes are the heart of active night-vision devices. Resolution is high: 50 lp/mm on Model 6929 and 6914; 35 lp/mm on Model 6914A. When infrared radiation is focused onto the IR-sensitive photocathode of the tube, an emitted electron image is formed, which is then accelerated and focused onto the fluorescent screen of the tube. This image may then be viewed through conventional optics.

MODEL JAN 6929 (12,000V) is in accordance with MIL-E-1/1583

MODEL JAN 6914 and 6914-A (16,000V) with MIL-E-1/1049E.

MODELS EIA 6929 (12,000V) and EIA 6914 (16,000V) are available to meet EIA registration requirements.

IMAGE INTENSIFIER ASSEMBLY
VARO INC

MODEL 3600 25mm MICROCHANNEL INVERTER INTENSIFIER

Advanced microchannel plate technology permits this image intensifier to achieve a high intensification factor in a minimum of space. It features automatic as well as manual brightness control, is protected against bright sources, and is packaged with an internal high-voltage multiplier and oscillator. Minimum resolution (both center and off-center) is 28 lp/mm. Cathode sensitivity is 225 mA/lumen. Power source required: 2.65 VDC.

Additional specification information on these and selected units is available from the factory.

SPECIAL PURPOSE INTENSIFIERS

A number of image intensifiers have been designed and developed by Varo to meet special military requirements. Among these are:

ZOOM INTENSIFIERS: Including 40mm/18mm; 80mm/40mm; and 40mm/25mm.

GATED INTENSIFIERS: Including 18mm, 25mm, 40mm and 80mm.

For more information on these special purpose intensifiers, or other special requirements, contact the factory.

ELECTRON DEVICES DIVISION 2203 WALNUT ST., P. O. BOX 1437, GARLAND, TEXAS 75040 (214) 272-3561 OR 272-4642 TWX 910-860-5194 TELEX 73-0353

18TH EDITION

eem 75 76

MANUFACTURERS AND SALES OFFICES DIRECTORY

This index provides an alphabetical listing of manufacturers supplying electronic equipment, instrumentation, components, materials and fabrication services. Included for each company are addresses, phone numbers, TWX numbers where applicable, selected distributors, and who to contact for information on pricing, applications and customer service. A condensed list of products made by the company appears below each name, as well as Federal Supply Code (FSC) numbers, Qualified Parts List (QPL) numbers and minimum order data. When available, free literature is also listed.

Boldfaced listings indicate those manufacturers who have provided catalog data in the white pages of EEM. Volume numbers appear first, before the bullet, the page number is listed after it. Many companies have placed their representative symbol before their names as an aid to identification.

All SYSTEMS, 344 New Albany Rd., Moorestown, N.J., 08057, Tel: 609-234-4420, TWX: 710-897-1190; Empl.: 65

Products manufactured: Amplifiers, Antennas, Cable Assemblies & Harnesses, CATV Systems & Equipment, Coders, Comm. Systems, Comparators, Converters, Counters, Data Acquisition & Reduction Systems, Demodulators, Diplexers, Antenna, Encoders, Generators, Gyros (All Types), Kits, Test Equipment, Modulator/Demodulators, Modulators, All Kinds, Monitors, Mounts, Multipliers, Radar Systems, Receivers, Services, Assembly, Production & Test, Servo Systems, Shifters, Synthesizers, Testers, Timers, Underwater Communication, Detection, Navigation, etc. Equipment

AARON-DAVIS CO., 1720 22nd St., Santa Monica, Cal., 90404, Tel: 213-829-1834; Empl.: 12

Products manufactured: Inverters, Power Supplies

Local Sales Offices & Reps.

Ariz	Phoenix, Cleveland Entprs.	602-264-1969
Cal	San Diego, Rochette & Assocs.	714-282-4616
Cal	San Gabriel, Rochette & Assocs.	213-285-1251
Colo	Littleton, Cleveland Entprs.	303-771-6242
Md	Silver Spring, Rep-Tron	301-593-4844
NM	Albuquerque, Cleveland Entprs.	505-298-7671

ABA INDUSTRIES, INC., Box 517, Pinellas Pk., Fla., 33565, Tel: 813-546-3571; FSC No: 26795; Empl.: 200

For info on price: D. J. Morrison; Application info: B. W. Harting; Customer service: D. J. Morrison; Delivery info: D. J. Morrison

Products manufactured: Antenna Rotators, Antennas, Controls/Control Eqpt., Drives & Drive Mechanisms (Dial), Mounts, Multiplexers, Pedestals, Radar, Services, Assembly, Production & Test, Servo Systems, Tracking Systems

Local Sales Offices & Reps.

Md	Timonium, De Shawn Assocs.	301-252-4878
Tex	Ft. Worth, J. T. Honston Assocs.	817-265-2931

ABACUS CONTROLS INC., 65 Fourth St., Somerville, N.J., 08876, Tel: 201-526-6010; Empl.: 20
p. 1•1026; p. 2•1731

Products manufactured: Amplifiers, Chargers, Battery, Coils Including Assemblies & Forms, Controls/Control Eqpt., Converters, Generators, Inverters, Oscillators, Power Supplies, Protectors, Reactors, Regulators, Shifters, Synthesizers, Testers, Transformers, Voltage Sources

ABACUS ELCTRNS. CORP., 10 Hudson Terr., Dobbs Ferry, N.Y., 10522, Tel: 914-693-1450; Empl.: 25

Products manufactured: Bezels, Shielded & Unshielded, Boards, Printed Circuit, Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Connectors, Dials, Fasteners, Handles For Cabinets, Circuit Boards, Racks, etc., Locks, Dial & Shaft, Services, Assembly, Production & Test, Sockets, Spacers, Terminal Blocks, Boards & Strips, Terminals

ABBOTT SCREW & MFG. CO., 6525 N. Clark St., Chicago, Ill., 60626, Tel: 312-761-8400; Empl.: 161; Minimum order: $50

For info on price: J. O'Connor; Application info: F. Vosecky; Customer service: F. Harkabus; Delivery info: M. Gerber

Free literature available: Steloc Engineering Guide & Price List, Steloc Engineering Guide & Price List (Distributor), Capability Booklet (Intro. to our facilities)

Products manufactured: Fasteners, Pins

ABBOTT TRANSISTOR LABS., Industrial Div., 5176 W. Jefferson Blvd., Los Angeles, Cal., 90016, Tel: 213-930-1040; Empl.: 12 .... p. 1•1047-1056

Customer service: C. Montour

Products manufactured: Power Supplies

Local Sales Offices & Reps.

NJ	Fort Lee, Abbott Transistors	201-224-6900

abbott transistor

ABBOTT TRANSISTOR LABS, Power Supply Div., 5200 W. Jefferson Blvd., Los Angeles, Cal., 90016, Tel: 213-936-8185, Telex: 69-1398; FSC No: 15755; Empl.: 125; Minimum order: $10 .... p. 1•1038-1046

Customer service: A. Hilbert

Free literature available: 60 page Power Supply Catalog listing complete specifications and prices of over 3500 standard power modules.

Products manufactured: Converters, Inverters, Power Supplies

Local Sales Offices & Reps.

NJ	Fort Lee, Abbott Transistor Lab., Inc.	201-224-6900

ABBOTT TRANSISTOR LABS., Transformer Div., 5176 W. Jefferson Blvd., Los Angeles, Cal., 90016, Tel: 213-930-1040; Empl.: 12 .... p. 2•1720-1725

Customer service: W. Lovett

Free literature available: 12 page transformer catalog of miniature 60 Hz and 400 Hz power transformers.

Products manufactured: Transformers

Local Sales Offices & Reps.

NJ	Fort Lee, Abbott Transistors	201-224-6900

ABESTO CORP., Ackerman St., Bloomfield, N.J., 07003, Tel: 201-338-6814; Minimum order: $25

For info on price: R. Kay; Application info: R. Kay; Customer service: R. Steinman; Delivery info: B. Scarpelli

Products manufactured: Bumpers, Coatings, Grommets, Rubber, Services, Assembly, Production & Test, Tubing

ABLE CABLE DIV., 115 S. Northwest Hwy., Barrington, Ill., 60010, Tel: 312-381-2460; Empl.: 25; Minimum order: $15

Customer service: R. A. Knaack

Products manufactured: Cable Assemblies & Harnesses

Local Sales Offices & Reps.

Ill	Barrington, W. Biery	312-381-7333
Ill	Downers Grove, E. Joyner & Co.	312-968-8383
Tex	Dallas, G. Weinreich & Assoc.	214-321-2800

ABLESTIK LABORATORIES, 833 W. 182nd St., Gardena, Cal., 90248, Tel: 321-6252, TWX: 910-346-7606; FSC No: 21109; Minimum order: $25

For info on price: H. E. Harris; Application info: N. Nygard; Customer service: H. E. Harris; Delivery info: Order Desk

Products manufactured: Adhesives (All Types)

Local Sales Offices & Reps.

Cal	Los Altos, Neal Olson-Ablestik	415-326-8358
Mass	Sudbury, L. J. Maroni Assocs.	617-443-2170
NY	Camillus, H. C. Murray	315-487-0634
NY	Hartsdale, Powell-Pendergraph	914-761-7792
Pa	Colmar, E. Lasky Assocs.	215-822-2510
Tex	Dallas, Waddle Sls. Co.	214-638-2860
Wisc	Milwaukee, Process Technology	414-464-6620

ABRAMS INSTR., 606 E. Shiawassee, Lansing, Mich., 48901, Tel: 517-484-9441, TWX: 810-251-0785; Empl.: 35

Customer service: M. Gates

Products manufactured: Counters, Indicators, Motors, Services, Assembly, Production & Test, Timers

Local Sales Offices & Reps.

Ariz	Scottsdale, J.A. Swanson Assocs.	602-946-6950
Cal	N. Hollywood, Jewett Co.	213-789-8103
Kans	Leawood, Thunderbird Tech. Sls. & Svcs., Inc.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls. & Svcs., Inc.	314-567-6488
Md	Ellicott City, McCourt Co.	301-465-4515
Mo	St. Louis, Thunderbird Tech. Sls. & Svcs., Inc.	314-567-6488
Ohio	Cincinnati, Loesch Assocs.	606-331-4332
Ohio	Cleveland, Loesch Assocs.	216-241-4581

ACCEL INDL HEAT SINK, 5338 Alhambra, Los Angeles, Cal., 90032, Tel: 213-221-9188

Customer service: Order Desk

Free literature available: Pictorial description of 60 heat sinks available from stock. Economy mounting hole patterns for most often used transistor/semiconductor devices and ordering information to insure customers desired hole pattern lay out and otther features such as length of part & finish.

Products manufactured: Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ala	Huntsville, Repcom	205-852-3305
Cal	San Diego, J.S. Heaton Co.	714-452-1456
Cal	San Francisco, P. O'Neal & Assocs.	415-924-1691
Fla	Ft. Lauderdale, Repcom	305-564-1929
Fla	Melbourne, Repcom	305-254-1877
Fla	Miami Springs, Repcom	305-887-8723
Fla	Orlando, Repcom	305-894-7217
Ga	Warner Robins, Repcom	912-923-1393
Ill	Mt. Prospect, Anatronic Assoc.	312-296-2468
Minn	Minneapolis, C.R. Leeds Co., Div. Jewlemont Corp.	612-333-5393
Ohio	Canton, CSA Equipt. Sls. Co.	216-456-1359

ACCESSORIES FOR ELECTRONICS, 23-25 Bell Blvd., Box 56, Bayside, N.Y., 11360, Tel: 212-939-5474; Empl.: 15

Customer service: P. Johnson

Free literature available: Catalog #723-Transistor Pads, P.C. Jacks & Terminals, Clips, Clamps, Circuit Card Ejectors, Grounding Terminals, Wire Ties, I.C. & Relay Pads, Transistor Covers, Busing-Captive Hardware Flysheet showing P.C. Card Guides, Bobbins, Diode Sleeves, Capacitor Pads & Cone Nuts.

Products manufactured: Bobbins, Winding, Coil & Transformer, Bushings, Glass, Plastic, Metal, Rubber, Etc., Capacitor, Hardware, Clamps & Clips, Connectors, Fasteners, Guides, Circuit Board, Holder & Carriers, Holders, Circuit Board (Production Type), Insulators & Insulation, Jacks (All Types), Packages, Integrated Circuit, Pads, Transistor Mounting, Pins, Plug & Jack Sets, Pullers, Resistor, Hardware, Services, Assembly, Production & Test, Sookets, Spacers, Terminals

Local Sales Offices & Reps.

Cal	Garden Grove, H. Miller	714-893-4670
Cal	Los Angeles, Corcoran Assocs.	213-823-2425
Fla	Hallandale, L.M. Bairstow Assoc.	305-927-2421
Md	Baltimore, Stitzer Assocs.	301-823-2600
Mass	Melrose, Accessories for Elctrns.	617-665-0666
Minn	Brainerd, M. (Red) Johnson	218-963-7875
NY	Buffalo, R.A. Murray Co.	716-632-6913
NY	DeRuyter, S.A. Caputo	315-682-2920
Ohio	Dayton, Buckeye Components	513-278-4279
Pa	Paoli, Stitzer Assocs.	215-644-5500
Wash	Seattle, W. Spaulding Co.	206-282-9173
FOR:	Can., Toronto, Electrorep Ltd.	416-787-1257

ACESSO-WIRE, Box 76, Garnvl. Trm., Garnersville, N.Y., 10923, Tel: 914-947-1220; Empl.: 18; Minimum order: $50

Customer service: S. L. Roth

Products manufactured: Cable Assemblies & Harnesses, Cable, Connectors, Fasteners, Heat Guns, Production, Lubricants, Services, Assembly, Production & Test, Splices, wire (Including, Butt & Cap Types), Terminal Blocks, Boards & Strips, Testers, Wire, Wire & Cable Ties, Wire Markers, Wire Nuts, Wire Strippers

ACCUMET ENGINEERING CORP., 25 Broad St., Hudson, Mass., 01749, Tel: 617-568-8311; Minimum order: $50

Customer service: J. B. Snook

Products manufactured: Crystals, Resistors, Semiconductor Wafer Fabrication, Substrates

ACCURATE ELECTRONICS CO., 2635 So. Wabash Ave., Chicago, Ill., 60616, Tel: 312-225-7500; Empl.: 25; Minimum order: $15

For info on price: D. B. Lytle; Application info: F. DiLegge; Customer service: F. DiLegge; Delivery info: T. Valenziano

Free literature available: Literature describes our products including features, specifications and industries where used. they are broken down into Power Conversion Units, Battery Chargers, Battery Back Up Systems, and Magnet Controllers.

Products manufactured: Chargers, Battery, Power Supplies, Transformers

Local Sales Offices & Reps.

Ill	Chicago, Ropek & Cahill	312-287-7292
NY	New York City, NEPA	212-867-0340
NC	Charlotte, Engineering Sls. Co.	803-253-4004
Ohio	Cleveland, Hird & Son	216-331-7272
Tex	Houston, R & K Engrg. & Sls. Corp.	713-465-8367
Utah	Salt Lake City, D. W. Richardson Co.	801-467-9714
Wisc	Milwaukee, G. T. Stephenson & Assoc.	414-273-7275

ACCURIDE, Div. of Standard Precision, 12311 S. Shoemaker, Santa Fe Springs, Cal., 90670, Tel: 213-944-6236, TWX: 910-338-0256; Minimum order: $35

Products manufactured: Cable Retractors, Simulators

Local Sales Offices & Reps.

Cal	San Jose, Accuride	408-249-4707
Colo	Golden, B. Callister & Assocs.	303-761-0992
Fla	Ft. Lauderdale, Orbe	305-564-8571
Ga	Atlanta, Davidson Co.	404-993-4570
Ill	Arlington Heights, Accuride	312-259-7282
Mass	Holliston, Accuride	617-492-2474
Mich	Grand Rapids, J.E. Mackay Co.	616-451-4990
Minn	Minneapolis, E.C. Elctrn. Sls.	612-831-0229
NY	Kirkville, RMJ Inds.	315-656-7285
Ohio	Troy, R.J. Pugh & Assoc.	513-335-7846
Okla	Tulsa, Blair Engrg.	918-663-9850
Pa	Philadelphia, Accuride	215-233-3000
Tex	Dallas, Blair Engrg.	214-352-8411

ACCUTRONICS-A HAMMOND CORP., 628 North St., Geneva, Ill., 60134, Tel: 312-232-2600, TWX: 910-237-1680; FSC No: 16484; Empl.: 80
p. 1•280-282; p. 2•346,347

For info on price: G. Dewar; Application info: G. Dewar; Customer service: J. Vill Wock; Delivery info: G. Dewar

Free literature available: Catalog covers various types of oscillators from 1Hz to 250 MHz, (3) conversion charts.

Products manufactured: Boards, Printed Circuit, Boards, Printed Wiring, Universal, Delay Lines, Generators, Oscillators

ACDC ELECTRONICS, 401 Jones Rd., Oceanside, Cal., 92054, Tel: 714-757-1880, TWX: 910-322-1470; Empl.: 400; Minimum order: $50 .... p. 1•1027-1036

For info on price: J. Hall; Application info: R. Abbott; Customer service: J. Hall; Delivery info: J. Hall

Products manufactured: Power Supplies, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrn. Assocs.	205-881-5031
Ariz	Scottsdale, OEM Specialties	602-948-3360
Cal	Lawndale, Group Three Elctrns Ward Davis Assocs.	213-542-5581
Cal	San Diego, Harvey King, Inc.	714-276-7541
Cal	Sunnyvale, Group Three Elctrns Ward Davis Assocs.	408-245-4392
Colo	Denver, PLS Assocs.	303-771-0140
Conn	Hamden, J & J Assocs.	203-624-7800
Fla	Ft. Lauderdale, Beacon Elctrn. Assocs.	305-776-6074
Fla	Maitland, Beacon Elctrn. Assocs.	305-647-3498
Ga	Atlanta, Beacon Elctrn. Assocs.	404-351-3654
Ill	Des Plaines, Cozzens & Cudahy, Inc.	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy, Inc.	317-244-2456
Md	Kensington, Elctrn. Mktg. Assocs.	301-881-5300
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Cozzens & Cudahy, Inc.	612-884-4336
Mo	Kansas City, Cozzens & Cudahy, Inc.	816-454-5836
Mo	St. Louis, Cozzens & Cudahy, Inc.	314-423-1234
NJ	Fort Lee, Tech. Mktg. Assocs.	201-224-6911
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	East Syracuse, Ossmann Instrs., Inc.	315-437-6666
NY	Rochester, Ossmann Instrs., Inc.	716-328-2230
NY	Vestal, Ossmann Instrs., Inc.	607-785-9947
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	King of Prussia, Elctrn. Mktg. Assocs.	215-248-5050
Pa	Pittsburgh, WKM Assocs.	412-892-2953
SC	Spartanburg, Beacon Elctrn. Assocs.	803-583-7615
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937

ACE PLASTIC CO., INC., 91-54 Van Wyck Expwy., Jamacia, N.Y., 11435, Tel: 212-523-5500; Empl.: 100; Minimum order: $25

Customer service: I. Steinberg

Products manufactured: Services, Assembly, Production & Test, Tubing

ACHESON COLLOIDS CO., Div. Acheson Inds., 1635 Washington Ave., Port Huron, Mich., 48060, Tel: 313-984-5581, TWX: 810-231-5265; Empl.: 150; Minimum order: $25

For info on price: J. Anderson; Application info: J. J. Coniglio; Customer service: F. Clary; Delivery info: R. R. Powers

Products manufactured: Chemicals, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Fabrics, Conductive, Films, Heaters & Heating Elements, Inks For Thick Film Microcircuits, Insulators & Insulation, Kits, Breadboarding (For Engineers), Kits, Shielding, Lubricants, Materials, Graphite; Materials, Self-Lubricating, Metal Compounds, Foils; Powders, Sheet, Stock, Metal Oxides, Metals, Paints, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber, Services, Assembly, Production & Test, Shields

Local Sales Offices & Reps.

Cal	LaMirada	714-523-8812
Ga	Atlanta	404-451-7452
Ill	Chicago	312-664-2032
Ind	South Bend	219-272-8511
Mass	Boston	617-662-6787
Mich	Detroit	313-352-6639
NJ	Elizabeth	201-353-0414
NY	Rochester	716-381-7610
Ohio	Cincinnati	513-631-6750
Ohio	Cleveland	216-521-1900
Pa	Melvern	215-644-4886
Tex	Dallas	817-292-4264

ACME BATTERY CORP., 700 Canal St., Stamford, Conn., 06904, Tel: 203-324-4125; Empl.: 40

For info on price: L. M. Dorflinger; Application info: L. Schub; Customer service: L. M. Dorflinger; Delivery info: L. M. Dorflinger

Products manufactured: Batteries

ACME ELECTRIC, 748 Water St., Cuba, N.Y., 14727, Tel: 716-968-2400, TWX: 510-245-2700; Empl.: 1200

For info on price: R. Milne; Application info: D. Chesner; Customer service: R. Milne; Delivery info: R. Milne

Free literature available: Basic Transformer Catalog; Communications Power Products Catalog; PS2L Solid State Load Bank Brochure; Switching Power Supplies, Linear 20KHZ Brochure.

Products manufactured: Chargers, Battery, Chokes, Coils Including Assemblies & Forms, Converters, Eliminators, Battery, Inverters, Loads, Electronic Variable, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Ala	Birmingham, Hopper & McCoy	205-822-2536
Ariz	Phoenix, Abbott Sls. Co.	602-252-6171
Cal	Los Angeles, J. Blesso & Assocs.	213-921-6387
Cal	Oakland, Baxter Co.	415-654-3177
Colo	Denver, Western Reps.	303-986-6025
Conn	Wolcott, G.P. Dannecker	203-879-4005
Fla	Jacksonville, Glenn Assocs.	904-744-1247
Fla	Miami, Glenn Assocs.	305-592-7335
Fla	Orlando, Glenn Assocs.	305-293-7482
Fla	Tampa, Glenn Assocs.	813-879-5890
Ga	Atlanta, Hopper & McCoy	404-872-5802
Haw	Kailua, R.A. Kemp Co.	808-839-5593
Ill	Chicago, Weinstein & White	312-787-0166
Ind	Indianapolis, A.L. Pickens Co.	317-632-9379
Iowa	Cedar Rapids, Arnie Sell & Assocs.	319-393-4225
Iowa	Davenport, Arnie Sell & Assocs.	319-359-1295
Kans	Prairie Village, R.E. Gooley Co.	913-813-0200
Ky	Louisville, A.L. Pickens Co.	502-491-4215
La	New Orleans, Associated Mfrs. Agents	504-522-6267
Md	Pikesville, Wilson Assocs.	301-252-2231
Mich	Detroit, Buschagen Geldersma & Gratch	313-535-6550
Mich	Grand Rapids, Buschagen Geldersma & Gratch	616-361-5335
Minn	St. Paul, H.A. Cullen & Assoc.	612-646-7371
Miss	Jackson, Associated Mfrs. Agents	601-969-0561
Mo	St. Louis, Burgoyne Electrical Sls.	314-521-3162
Neb	Omaha, A. Sell & Assocs.	402-391-4068
NH	Nashua, R.P. Reese	603-883-2407
NJ	Carstadt, R.W. Noel & Co.	201-935-7171
NY	Manlius, E.D. Sweeney	315-682-6915
NY	Rochester, G.N. Mergel	716-334-6909
NY	Vestal, W.J. Frey	607-748-8053
NC	Greensboro, Barber-Ayers & Assoc.	919-273-3629
Ohio	Chagrin Falls, Lusty - Thomson, Inc.	216-543-8181
Ohio	Westerville, P.R. Collier	800-362-2279
Okla	Oklahoma City, J. Pitts	405-232-0011
Pa	Oreland, Cusick Electrical Sls.	215-886-2100
Pa	Pittsburgh, M.F. Smith Assocs.	412-276-5363
Tenn	Memphis, Hicks Sls. Agency	901-396-5725
Tenn	Nashville, Hopper & McCoy	615-883-7557
Tex	Houston, Burrus & Matthews	713-227-5205
Tex	Irving, Burrus & Matthews	214-251-3031
Tex	Longview, Burrus & Matthews	214-758-9841
Va	Richmond, Barber-Ayers & Assoc.	703-288-7772
Wash	Seattle, H.M. Denny Co.	206-282-7200
FOR:	Can., Scarboro, Ont.o, J.H. McKechnie	416-485-5409

ACME ELEC. HEATING CORP., 4685 E. 11th, Hialeah, Fla., 33013

Customer service: J. B. Sampson 305-685-8326

Products manufactured: Cable, Furnaces, Heaters & Heating Elements, Ovens, Solder Pots & Baths, Thermocouples, Elements & Accessories

ACME MODEL ENGRG. CO., 654 Bergen Blvd., Ridgefield, N.J., 07657, Tel: 201-943-7650; Empl.: 16

For info on price: A. Asfar; Application info: F. Risdell; Customer service: F. Parks; Delivery info: A. Arenas

Products manufactured: Boards, Printed Circuit, Bushings, Glass, Plastic, Metal, Rubber, Etc., Chassis, Metal, Clamps & Clips, Eyelets, Fasteners, Holder & Carriers, Labels, Pressure-Sensitive, Adhesive, Printers, Retainers, Services, Assembly, Production & Test, Springs (All Types), Terminal Blocks, Boards & Strips, Terminals, Tubing

ACME PLASTIC PRODUCTS CO., INC., 9629 N. 22nd Ave., Phoenix, Ariz., 85021, Tel: 602-997-9944; Empl.: 6

Products manufactured: Services, Assembly, Production & Test

ACOPIAN CORP., Box 585, Easton, Pa., 18042, Tel: 215-258-5441, TWX: 510-651-4949; FSC No: 14749; Minimum order: $10 .... p. 1•1057

For info on price: J. Joseph; Application info: T. Skopal; Customer service: T. Skopal; Delivery info: J. Joseph

Free literature available: Power supplies offering a choice of performance levels and mechanical configurations. PC-mounting, narrow profile, plug-in, unregulated, premium performance, rack mounting, multiple output.

Products manufactured: Power Supplies, Suppressors

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assoc.	205-534-9771
Ariz	Scottsdale, Williams Assoc.	602-947-4297
Cal	Los Angeles, Basic Sys. Co.	213-938-2833
Cal	Palo Altos, Held & Mollard, Inc.	415-965-9321
Cal	San Diego, Basic Sys. Co.	714-279-9641
Colo	Denver, Williams Assoc.	303-373-4730
Conn	Enfield, Meas. Equip. Co.	203-745-9050
Fla	Orlando, Gentry Assoc.	305-894-4401
Ill	Wheeling, Potter-Mac Co.	312-541-4600
Kans	Shawnee Mission, Maury & Bettis Co.	913-362-0772
Kans	Wichita, Maury E. Bettis Co.	316-685-7441
Md	Ellicott City, Doss Elctrns.	301-465-1336
Mass	Wakefield, Meas. Equip. Co.	617-245-4870
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Mich	Grand Rapids, J.C. Hofstetter Co.	616-942-0650
Minn	Minneapolis, Kirkeby & Assoc.	612-377-3239
Mo	St. Louis, Maury E. Bettis Co.	314-429-2099
NM	Albuquerque, Williams Assoc.	505-255-1638
NY	Elbridge, L-Tron Corp.	315-689-3787
NY	Latham, L-Tron Corp.	518-785-5032
NY	Tonawanda, L-Tron Corp.	716-691-8887
NY	Woodbury, J.N. Sweeney & Co.	516-692-4222
NC	Charlotte, Jake Rudisill Assoc., Inc.	704-377-6901
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-725-4477
Okla	Tulsa, Norvell Assoc.	918-663-1247
Pa	Ardmore, Martin Elec. Co.	215-649-6332
Pa	Reading, Beil & Whitaker	215-779-2610
Tex	Dallas, Norvell Assocs.	214-350-6771
Tex	Houston, Norvell Assocs.	713-774-2568

ACOUSTIC POWER SYSTEMS, 2051F E. Cerritos, Anaheim, Cal., 92806, Tel: 714-535-5490; Empl.: 5

Customer service: Frank M. Tillou

Free literature available: Reprints of ASME paper entitled "A New Shaker for Modal Testing of Large Structures in the Seismic Frequency Range".

Products manufactured: Testers

Local Sales Offices & Reps.

Cal	Walnut Creek, Dale-Dahl Assocs.	415-933-9595
Colo	Littleton, Eissler Sls. & Svcs.	303-794-1779
Conn	New Haven, Vibration Sls. & Svc.	203-389-1527
Fla	Orlando, Triflex	305-896-3152
NJ	Teaneck, I. Rudnick	201-836-7392
Tex	Dallas, Merit Co.	214-620-0021

ACRODYNE CONTROLS, Box 1044, Janesville, Wisc., 53545, Tel: 608-752-9081; Empl.: 12; Minimum order: $25

Customer service: R. Mowris

Products manufactured: Motors, Relays, Switches

ACROMARK CO., 60 Locust/Dept. 397, Berkeley Hts., N.J., 07922, Tel: 201-464-6474; Empl.: 50

Customer service: W. H. Schmidt

Free literature available: Catalog Pages 410, 610, 630 & 9AH; Also Catalog Page 14 L, 14 M and 20 C.

Products manufactured: Machines/Machinery, Production, Nameplates

Local Sales Offices & Reps.

Cal	Long Beach, J. Dan Culp Sls.	213-531-2591
Cal	Walnut Creek, Advanced Test Sys.	415-937-4225
Colo	Denver, Plateau Machinery Co.	303-758-0135
Ill	Downers Grove, Midwest Tech. Ser.	312-968-4343
Mass	Southwick, Electron Sls. Co.	413-569-3109
Mich	Adrian, E. Loncki	313-263-6539
NY	Skaneateles, Tech-Sonic Assocs.	315-685-6144
NC	High Point, H. Bull	919-882-8997
Ohio	Cincinnati, Lohrer Ind. Equip.	513-574-2700
Tenn	Memphis, E.H. Carlson	901-682-3207
Tex	Houston, Mercer Engrs.	713-529-6121
Wash	Hoodsport, G.M. Earsley Co.	206-877-9707

ACROMAG, INC., 30765 Wixom Rd., Wixom, Mich., 48096, Tel: 313-624-1541; Empl.: 45; Minimum order: $10

Customer service: Sls DePt.

Products manufactured: Amplifiers, Controls/Control Eqpt., Converters, Indicators, Isolators, Monitors, Relays

Local Sales Offices & Reps.

Cal	Palo Alto, Priz Co.	415-326-9333
Cal	Santa Fe Springs, D.A. Matthews/Assoc.	213-693-5432
Colo	Denver, Control Equip. Corp.	303-399-6931
Fla	Jacksonville, L.E. Rogers Co.	904-743-5877
Fla	Ruskin, L.E. Rogers Co.	813-645-1453
Ga	Atlanta, R. Freeman Assocs.	404-261-9065
Ill	Schaumburg, Carvel Engrg. Co.	312-885-8800
La	Baton Rouge, Petro-Chem. Equip. Co.	504-927-4360
La	Metairie, Petro-Chem. Equip. Co.	504-586-8337
Mass	Norwell, Bordewieck Engrg. & Sls.	617-659-4915
Mich	Ann Arbor, H.C. Heym Assocs.	313-971-6552
Mich	Marquette, NWR Elctrns. Corp.	906-226-7578
Mich	Saginaw, H.C. Heym Assocs.	517-799-0673
Minn	Edina, NWR Elctrns. Corp.	612-831-6240
Minn	Virginia, NWR Elctrns. Corp.	218-741-5060
Mo	St. Louis, Scherrer Instr. Co.	314-644-5362
Neb	Omaha, Control Sls., Inc.	402-342-1717
NJ	Montclair, E.C. Smith & Assocs.	201-783-6668
NY	Albany, O.R. Lawrence Co.	518-456-4444
NY	Buffalo, O.R. Lawrence Co.	716-839-4422
NY	New York, E.C. Smith & Assocs.	212-682-6890
NY	Syracuse, O.R. Lawrence Co.	315-455-5587
NC	Matthews, W.K. Hile Co.	704-847-9125
Ohio	Chagrin Falls, J. Kilroy Corp.	216-247-8997
Ohio	Cincinnati, G.H. Drysdale & Assoc.	513-752-2069
Okla	Tulsa, D. Allert Co.	918-743-7706
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Bridgeville, Instr. Svcs., Inc.	412-221-3601
Pa	Devon, B & A Assocs.	215-688-5173
Tenn	Knoxville, W.K. Hile, Co.	615-588-1061
Tenn	Memphis, M. Watson Co.	901-272-7496
Tex	Houston, Gay Engrg. & Sls.	713-869-3306
Tex	Midland, Gebhart & Boyd Assoc.	915-697-1171
Utah	Salt Lake City, Specialty Sls. Co.	801-262-2979
Va	Chester, W.K. Hile, Co.	804-271-0014
Wash	Bellevue, McLaren, Inc.	206-454-3400
WVa	St. Albans, Instr. Svcs., Inc.	304-722-2953
Wisc	Oconomowoc, Booker Co.	414-873-4000
EXP:	Boston, Extech Int'l.	617-227-7090

ACRON CORP., 1095 Towbin Ave., Lakewood, N.J., 08701, Tel: 201-364-7200; Empl.: 40; Minimum order: $25

For info on price: L. D. Fykse; Application info: S. Heritage; Customer service: S. Heritage; Delivery info: S. Heritage

Free literature available: Acro-lar Dialer; Sound Discriminator - Audio Detector; LG-600 - Burglar-Fire Alarm Panel; Acro-Dial - Reperstory Dialer; Acro-Probe - Logic Probe.

Products manufactured: Alarms, Detectors, Power Supplies, Probes

Local Sales Offices & Reps.

Ariz	Phoenix, Mountain West Alarm	602-263-8831
Cal	Glendale, Detectronics	213-240-4036
Cal	Hayward, Consolidated Communications Corp.	415-886-5115
Conn	New Britain, Newbrite Industries, Ltd.	203-229-1840
Fla	Miami, Gulfstream Assoc.	305-885-2907
Ga	Atlanta, Detectronics	404-875-8601
Ind	Michigan City, S & B Distrs.	219-872-0569
Mass	Watertown, Detectronics	617-929-1245
Mich	Detroit, Alarm Supp. Co.	313-255-2303
Pa	Pittsburgh, Triangle Elctrns. Co.	412-441-9659
Tex	Dallas, Detectronics	214-363-7377

ACTION LABS INC., 3238 Washington Ave. N., Minneapolis, Minn., 55412, Tel: 612-522-4391; Empl.: 45

For info on price: D. R. Kubes; Customer service: D. R. Kubes; Delivery info: D. R. Kubes

Products manufactured: Cable Assemblies & Harnesses, Services, Assembly, Production & Test

ACTIVE CONTROL INSTRUMENTATION, Box 194, E. Northport, N.Y., 11731, Tel: 516-864-2111; Empl.: 6 p. 1•228,229

For info on price: M. Prober; Customer service: Cust. Svc.

Free literature available: Detail sheets (specification control drawings) giving specifications, size, description of operation, applications and ordering information for each of the models shown on catalog page (display ad). Request specific model.

Directory of Local Distributors Starts on page 401

Products manufactured: Alarms, Amplifiers, Controls/Control Eqpt., Converters, Current Sensors, Indicators, Isolators, Monitors, Probes, Protectors, Services, Assembly, Production & Test, Signal Averagers, Transducers

ACTIVE & PASSIVE COMPONENTS, 6 Aerial Way, Syosset, N.Y., 11791, Tel: 516-433-5311, TWX: 510-221-1807; Empl.: 50

For info on price: S. Bernstein; Application info: J. Milton; Customer service: Sls Dept; Delivery info: Sls Dept

Free literature available: Metallized film capacitor catalog R. F. Interference Filter catalog

Products manufactured: Capacitors, Fixed, Filters

Local Sales Offices & Reps.

Ala	Huntsville, Repcom Inc.	205-534-9959
Ariz	Phoenix, R.L. Davis Co.	602-955-2266
Cal	Encino, El Tec Systems	213-981-9881
Cal	Oakland, MHR Sls. Agency	415-569-1564
Fla	Ft. Lauderdale, R. Adams	305-564-1929
Fla	Melbourne, Repcom Inc.	305-254-1877
Fla	Miami Springs, L. Hatfield	305-887-8723
Fla	Orlando, J. Gilbert	305-894-7217
Fla	Seminole, G. Tillett	813-393-0584
Ga	Warner Robins, O. Bowman	912-923-1393
Ill	Glenview, Crimson Engrg. Co.	312-724-1780
Ind	Fort Wayne, W.W. Bieberich, Inc.	219-432-2537
Md	Baltimore, Bernard White & Co.	301-484-5400
Mass	Brookline, Harman Assocs.	617-232-6687
Mich	Detroit, Nicon Assocs.	313-341-7668
Minn	Minneapolis, G. E. Arneson & Co.	612-920-2086
NJ	Cherry Hill, Jay Assocs.	609-662-0399
NJ	Kenilworth, Ventronics, Inc.	201-272-9262
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Pittsford, Graydon-Sherman	716-381-8838
Tex	Addison, Southland Comps.	214-233-0603
Tex	Houston, Southland Comps.	713-782-4575
Wash	Kirkland, T. Brian Ind.	206-827-5811
FOR:	Can., Montreal, Solid State Engrg. Co.	514-481-3313

A C TRANSFORMER CORP., 89 Madison St., Newark, N.J., 07105, Tel: 201-589-8574; Empl.: 13; Minimum order: $25

Customer service: G. Giangrande

Products manufactured: Transformers

ACUREX, 485 Clyde, Mountain View, Cal., 94042, Tel: 415-964-3200, TWX: 910-379-6593; Empl.: 385

Customer service: E. L. Rossiter

Free literature available: 1) WDC Brochure - List Standard Products; 2) Torque - Outlines Standard Torque Systems.

Products manufactured: Comm. Systems, Data Acquisition & Reduction Systems, Indicators, Monitors, Transmission Systems, Data

ACUSHNET CAPACITOR CO., 720 Belleville, New Bedford, Mass., 02745, Tel: 617-999-3291, TWX: 710-344-6451; Empl.: 300; Minimum order: $100

For info on price: J. Pedro; Application info: W. O'Mara; Customer service: A. Ovellette; Delivery info: A. Ovellette

Products manufactured: Capacitors, Fixed, Networks

Local Sales Offices & Reps.

Ala	Huntsville, TMA	205-883-7893
Ariz	Tempe, Gassner & Clark	602-968-9037
Cal	Hawthorne, WCV Co.	213-772-4479
Cal	San Carlos, F. Kottmeier	415-592-8333
Colo	Denver, Electrodyne	303-757-7679
Fla	Pompano Beach, TMA	305-942-0774
Ill	Chicago, Gassner & Clark	312-345-4245
Ind	Indianapolis, F. Campisano	513-662-1616
Iowa	Cedar Rapids, Gassner & Clark	319-393-5763
Kans	Leawood, Thunderbird Sls.	913-642-7220
Md	Baltimore, Burgin-Kreh	301-788-5200
Mass	Lexington, J.E. Boeing Co.	617-862-2500
Mich	Detroit, Carrier & Gable	313-444-8980
Minn	Minneapolis, J. Barnes Sls.	612-474-2907
Mo	St. Louis, Thunderbird Sls.	314-567-6488
NJ	Cherry Hill, J. Barrett Assoc.	609-429-1551
NJ	Orange, Comtronic Sls.	516-741-8966
NY	Garden City, Comtronic Sls.	516-741-8966
NY	Ithaca, B. Dean	607-272-2187
NC	Winston-Salem, Burgin-Kreh	919-768-4174
Ohio	Cincinnati, F. Campisano	513-662-1616
Okla	Oklahoma City, Ammon-Rizos	405-373-2748
Pa	Pittsburgh, G. Root Co.	412-561-4125
Tex	Dallas, Ammon-Rizos	214-233-5591
Va	Lynchburg, Burgin-Kreh	703-845-5600
Wash	Seattle, B. Blum Assoc.	206-282-2590

AD AUTOMATION, 830 Linden Ave., Rochester, N.Y., 14625, Tel: 716-381-2370; Empl.: 80; Minimum order: $40

For info on price: M. Boone; Application info: N. Webb; Customer service: N. Webb; Delivery info: M. Boone

Free literature available: ADA 71/7 - Adapt 10K - programmable leakage and continuity tester - testing any complex wiring system up to 10,000 inputs and outputs.

Products manufactured: Testers

Local Sales Offices & Reps.

Cal	So San Francisco, Howard & Co.	415-589-3050
Cal	Van Nuys, Elliott Assoc.	213-781-8454
Md	Riverdale, Riggs Assocs.	301-927-3380
Mass	Chelmsford, S&S Elctrns.	617-273-0115

A. D. DATA SYS., INC., 830 Linden Ave., Rochester, N.Y., 14625, Tel: 716-381-2370; Empl.: 75; Minimum order: $40 .... p. 1•127

For info on price: M. Boone; Application info: N. Webb; Customer service: N. Webb; Delivery info: M. Boone

Free literature available: Brochure: 73-1 Scan-A-Meter - Low Priced Data logger with multiple Analog Input.

Products manufactured: Analyzers, Antenna Switching Matrices, Clocks (All Types), Comm. Systems, Converters, Data Acquisition & Reduction Systems, Data Loggers, Matrices, Computer, Monitors, Multiplexers, Relays, Scanners, Switches, Testers

Local Sales Offices & Reps.

Cal	San Francisco, Howard & Co.	415-589-3050
Cal	Van Nuys, Gordon Elliot	213-873-6862
Md	Riverdale, Riggs Assocs.	301-927-3380
Mass	Chelmsford, S&S Elctrns.	617-256-8731

AD-VANCE MAGNETICS, 226 E. 7th St., Rochester, Ind., 46975, Tel: 219-223-3158, TWX: 810-290-0294; Empl.: 17; Minimum order: $25 .... p. 2•1210,1211

For info on price: J. Loebig; Application info: R. D. Vance; Customer service: K. Nixon; Delivery info: J. Loebig

Free literature available: Magnetic Shielding Alloys, CRT Shields, P-M Shields, Shielding Chambers, Tape Data Protectors, Shielding Foil, Special Fabricated Magnetic Shields, TWT Shields, Storage Tube Shields, Scan Converter Shields, Transformer Shields, Indicator Shields

Products manufactured: Alloys, Chamber, Environmental Test, Containers, Foil, Metal Compounds, Foils, Powders, Sheet, Stock, Pickups, Telephone (For Recording), Shields, Wire Strippers

Local Sales Offices & Reps.

Cal	Los Altos, Frauman Assoc.	415-941-0660
Cal	Pasadena, A-F Sls.	213-681-5631
Conn	Meriden, A. Allison	203-237-9232
Ill	Westchester, Brouillette	312-345-6500
Md	Baltimore, D.K. Jones Assoc.	301-752-0577
NJ	Fairlawn, Harris Assoc.	201-796-5200
Ohio	Dayton, Gemini Inc.	513-890-5394
Pa	Westchester, Curley Assoc.	215-692-6886
Tex	Dallas, Techno Assoc.	214-357-9213

ADALET MFG. CO., Div. Scott & Fetzer Co., 4801 W. 150th St., Cleveland, Ohio, 44135, Tel: 216-267-9000; FSC No: 73389; Empl.: 134; Minimum order: $25

For info on price: J. Larsen; Application info: A. J. Hermanson; Customer service: N. Rutti; Delivery info: N. Rutti

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cases, Equipment, Instrument, Meter, Switches

Local Sales Offices & Reps.

Ala	Birmingham, C.W. Ashby Co.	205-879-1651
Cal	Emeryville, G.E. Honn Co.	415-653-0737
Cal	Los Angeles, H.R. "Tex" Benike Assocs.	213-263-7451
Colo	Denver, Electrical Agencies Co.	303-623-8245
Fla	W. Palm Beach, Dineen Assocs.	305-968-6332
Ga	Atlanta, All South Agency	404-874-6301
Ill	Rosemont, L. Butter & Assocs., Inc.	312-671-5040
Ind	Indianapolis, Bennett Elec. Sls. Co.	317-257-1426
Kans	Shawnee Mission, Stover & Assocs.	913-649-6600
La	Metairie, General Power & Control Corp.	504-834-1345
Md	Pikesville, Wilson Assocs., Inc.	301-252-2231
Mass	Boston, C.C. Pierce Co., Inc.	617-268-8816
Mich	Detroit, Engel-Klaes Co.	313-342-9220
Minn	Minneapolis, Pinkney & Assocs., Inc.	716-839-3373
Mo	St. Louis, A. Haumesser Co.	314-781-1225
Neb	Omaha, Electrical Prods. Co.	402-393-7350
NM	Albuquerque, R.B. Black Co.	505-265-0144
NY	Bronx, W.D. Schofield Assocs.	212-933-2900
NY	Rochester, Canavan-Scanlon Assocs., Inc.	716-442-0720
NY	Syracuse, Canavan-Scanlon Assocs., Inc.	315-437-1271
NC	Charlotte, Adams-Gamble-Whiting Inc.	704-377-3489
Ohio	Cincinnati, C.J. Leesman Sls. Co.	513-681-2081
Ohio	Columbus, C.J. Leesman Sls. Co.	614-457-4700
Okla	Tulsa, C. Mullen & Assocs.	918-749-4991
Pa	Jenkintown, P. Jacobson Assocs.	215-884-5524
Pa	Pittsburgh, R.E. Grinder	412-242-3533
Tex	Dallas, W.J. Heummer Agency	214-339-3600
Tex	Houston, Ampsco	713-523-7486
Utah	Salt Lake City, B. Cable & Equip. Co.	801-364-3452
Va	Portsmouth, H.K. Spencer	703-488-3041
Wash	Seattle, Strohecker, Inc.	206-623-0357
WVa	Charleston, Skaff Engrg. Co.	304-342-0131
Wisc	Milwaukee, A.W. Schwind Co.	414-276-9988

ADAMS-RUSSELL CO., INC., 280 Bear Hill Rd., Waltham, Mass., 02154, Tel: 617-890-2540, TWX: 710-324-1614; Empl.: 350

For info on price: C.M. Jones; Application info: R.E. Snyder; Customer service: C.M. Jones; Delivery info: C.M. Jones

Free literature available: Application notes "Receiving System Design Using Active Antennas" "Some Considerations in the Specification of a Radio Frequency Distribution System" "RF Matrix Switching System" Catalog of Standard Products

Products manufactured: Amplifiers, Antenna Feed Systems, Antenna Switching Matrices, Antennas, Cable Assemblies & Harnesses, Couplers, Direction Finders, Dividers, Shifters, Switches, Waveguides & Adapters

ADAMS-SMITH INC., Box 363, Needham, Mass., 02192, Tel: 617-263-1400; Empl.: 12

Customer service: R. J. LaBonte

Products manufactured: Computers, Editing Equipment, Tape

ADAMS & WESTLAKE CO., 1025 W. Michigan St., Elkhart, Ind., 46514, Tel: 219-264-1141; Empl.: 642

For info on price: C. H. Goshorn; Application info: J. Borreli; Customer service: C. Goshorn; Delivery info: C. Goshorn

Free literature available: Adlakes extensive line of Mercury Wetted, Mercury Displacement, and Dry Reed Relays and Solid State Devices are illustrated with dimensional diagrams and photos accompanying product descriptions.

Products manufactured: Relays, Switches

Local Sales Offices & Reps.

Ala	Birmingham, M-G Elctrns. & Equip. Co.	205-328-4525
Cal	Santa Fee Springs, Sierra-Pacific Engrg.	213-921-9634
Cal	Walnut Creek, P.W. Jasin Co.	415-935-6339
Conn	Berlin, White Sls. Co.	203-224-0423
Fla	Hollywood, W.B. Wimberly Co.	305-961-0227
Fla	Orlando, W.B. Wimberly Co.	305-425-3083
Ill	Chicago, Adams & Westlake Co.	312-346-6232
Mass	Needham, White Sls. Co.	617-444-3676
Mich	Royal Oak, R.H. Jackson Co.	313-542-5059
Mo	Independence, B. Gribble	816-SY6-4333
Mo	St. Louis, Wells-White Co.	314-726-2511
NJ	Newark, Adams & Westlake Co.	201-623-6532
NY	East Northport, Adams & Westlake Co.	516-368-4096
NY	Fayetteville, M.P. Andrews, Inc.	315-637-5291
Ohio	Cincinnati, Beedle Equip. Co.	513-793-0140
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
Pa	Radnor, W. Henry Cordray Sls. Co.	215-687-1366
Tex	Addison, Southland Engrg. & Sls., Inc.	214-233-0603
Tex	Houston, Southland Engrg. & Sls., Inc.	713-782-4575
Wash	Seattle, Eicher-Richards Co.	206-LA3-7888
FOR:	Can., Toronto 15, Ont., Lisle-Metrix Ltd.	416-249-9151

Local Distributors

Ala	Birmingham, MG Elctrns. & Equip. Co., 3112 6th Ave. S.	205-328-4525

Directory of Local Distributors Starts on page 401

NJ Fair Lawn, Relay Specialties, 1300 Plaza Rd. 201-797-3313
Okla Tulsa, Radio, 1000 Main St. S. 918-587-9123
Pa McKeesport, Barno Radio Co., 5403 W. Smithfield 412-664-9394

ADAR ASSOCS., INC., 118 North Ave., Burlington, Mass., 01803, Tel: 617-273-1850, TWX: 710-332-6878; Empl.: 55

For info on price: R. Hollenberg; Application info: R. Hollenberg; Customer service: T. Schulte; Delivery info: R. Hollenberg

Free literature available: DR12/20 brochure, DR32 brochure, DR64 brochure, Series 300 - Manual Memory Programmer, Model 550 - Programmer/Verifier, Model 520 - Automated Universal Memory Duplicator, Model 510 - Tape Reader

Products manufactured: Generators, Pulsers, Logic Test, Test Systems, Testers

Local Sales Offices & Reps.
Ala Huntsville, Beacon Elctrns. Assoc. 205-881-5031
Ariz Phoenix, Mesa Engrg. 602-943-9213
Cal Anaheim, F.L. Wolfe, Inc. 714-956-8220
Cal Culver City, F.L. Wolfe, Inc. 213-559-7200
Cal Palo Alto, Coherent Mktg. Assocs. 415-327-2217
Cal San Diego, Mesa Engrg. 714-278-8021
Cal Sunnyvale, Adar West Coast 408-734-3937
Colo Boulder, Mile High Elctrns. 303-444-5615
Fla Fort Lauderdale, Beacon Elctrns. Assoc. 305-776-6074
Fla Maitland, Beacon Elctrns. Assoc. 305-647-3498
Ga Atlanta, Beacon Elctrns. Assoc. 404-351-3654
Md Randallstown, Beacon Elctrns. Assoc. 301-922-1248
Mass Waltham, W.M. Hague Co. 617-899-5600
NJ Wayne, K&J Assocs. 201-694-3334
NY E. Setauket, K&J Assocs. 516-751-8686
NY Rochester, K&J Assocs. 716-232-6640
SC Spartanburg, Beacon Elctrns. Assoc. 803-582-4613
Va Falls Church, Beacon Elctrns. Assoc. 703-534-1673

ADAPTER/CHARGER PRDTS., 7807 N. Poineer Lane, Peoria, Ill., 61614, Tel: 309-691-0810; Empl.: 50

For info on price: P. Smith; Application info: J. Planck

Free literature available: Wall plug-in power supplies and chargers.

Products manufactured: Alarms, Chargers, Battery, Power Supplies

Local Sales Offices & Reps.
Cal Santa Ana, Spectrum Assoc. 714-835-4114
Fla Orlando, Data Rep. Inc. 305-843-5224
Minn Minneapolis, Jos. Co. Sls. Engrg. 612-835-5858

ADC PRODS., 4900 W. 78th St., Minneapolis, Minn., 55435, Tel: 612-835-6800, TWX: 910-576-2832; Empl.: 723; Minimum order: $50 .... p. 2•444-449

Customer service: Communication Comp. Sls.

Free literature available: ADC Products Catalog-Description and price list for ADC's standard communication components.

Products manufactured: Cords, Jacks (All Types), Panels, Plug & Jack Sets, Plugs, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.
Cal Menlo pk., ADC Western Sls. Office 415-323-1386
Colo Denver, Parker-Webster Co. 303-770-1972
Conn Bloomfield, Zaslow Sls. Co. 203-242-7781
Ill Oakbrook, Whitmore Assocs. 312-325-4727
Minn Minneapolis, ADC Midwestern Sls. Off. 612-835-6500
NJ Cherry Hill, Danco Corp. 609-424-5590
NM Albuquerque, A.Q. Elctrns. 505-255-8701
NY Syracuse, ADC Northeast Sls. Office 315-458-3747
Ohio Cincinnati, J.W. Murray & Assoc. 513-662-1616
Ohio Cleveland, C.A. Robinson Co. 216-381-9049
Tex Dallas, ADC Dallas Sls. Office 214-241-6783

Local Distributors
Fla Jacksonville, Southeast Elctrns., Inc., 1125 Rosselle St., Box 2517
Ga Atlanta, Ack Radio Supply Co., 554 Deering Rd. N.W.
Ga Atlanta, Power & Tele. Sup., Box 43223 404-691-6813
Ga Decatur, Southern Telephone Supply Co., Box 833 404-457-5512
Ill Chicago, Newark Elctrns., 500 N. Pulaski Rd. 312-638-4411
Ind Indianapolis, RA-Dis-Co., 814 N. Senate Ave. 317-637-5571
Kans Lenexa, North Elect. Sup., 10951 Lakeview Ave. 913-888-9800
Mo Kansas City, Alexander Elctrns., 1820 Wyandotte St.
NJ Rahway, Terminal Elctrs., Pinewood St. 201-381-5700
NY New York, Gray Bar Elec. Co., 420 Lexington Ave.
NY New York, Harvey Elctrns., 2 W. 45th St. 212-582-1500
NY Woodbury, Harvey Radio Co., 60 Crossways Park W. 516-921-8700
NC Lexington, Power & Telephone Supply, Box 1063 704-249-0256
Ohio Columbus, Buckeye Tele. Co., 125 Kinnear Rd. 614-488-0655
Ohio Dayton, ESCO, Inc., 221 Crane St. ... 513-224-9192
Pa Philadelphia, Philadelphia Elec., 112 N. 12th St. 215-568-7400
Tenn Kingsport, Radio Elctrns. Supply, Box 827
Tenn Memphis, Power & Tele. Sup., 2690 Yale Ave. 901-324-8811
Tenn Nashville, Electra Distr. Co., 1914 East End Ave.
Tex Dallas, Southern Telephone Supply, 8808 Sovereign Row 214-631-5340
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
For: Can., Brockville, Ont., Automatic Elec. Supply, 100 Strowger Blvd. 613-342-6621
For: Can., Montreal, Que., Payette Radio Ltd., 730 St. Jacques St. 514-866-6681
For: Can., Toronto, Ont., Electro Sonic Supply, 543 Yonge St. 416-924-9301

ADCOR ELECTRONIC PACKAGING CORP., 50 E. 41st St., New York, N.Y., 10017, Tel: 212-532-6862; Empl.: 10

For info on price: A. Chertoff; Application info: A. Chertoff; Customer service: S. Russell; Delivery info: S. Russell

Free literature available: Universal PC Cards: applications data packaging densities, artwork design parameters, manufacturing specifications. Intermediate & high density connector configurations. Compatable wire-wrapping guards.

Products manufactured: Backpanel Interconnect Systems, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Connectors, Integrated Circuit Packaging Systems, Services, Assembly, Production & Test

ADCOTECH CORP., 575 Maude Ave., Sunnyvale, Cal., 94086, Tel: 408-733-2820

Customer service: Sls. Dept.

Free literature available: Literature includes a lead straightener ad, sheet covering adcotech product lines, and data sheets on Adcotech's model 4300-S lead straightener, trim & form tools, and Adcotech's line of bench-type air presses.

Products manufactured: Kits, Marking (Dial, Instrument, Equipment, etc.), Machines/Machinery, Production, Services, Assembly, Production & Test, Tools

ADDINGTON LABORATORIES, INC., Corp. Hdqts., 2975 Scott Blvd., Santa Clara, Cal., 95050, Tel: 408-249-8050; Empl.: 180

ADDINGTON LABS, INC., Cable & Connector Div., 1043 DiGiulio Ave., Santa Clara, Cal., 95050, Tel: 408-248-5515, TWX: 910-338-0138

Customer service: J. Campbell

Products manufactured: Cable, Connectors, Feedthrus & Seals, Environmental

Local Sales Offices & Reps.
Cal Fullerton, Engineer System Products 714-879-5500
Md Baltimore, Wright & Assoc. 301-398-3748
NY Huntington Station, Gray & Reed Assoc. 516-433-3333

ADDINGTON LABS., INC., Microwave Comps. Div., 1043 DiGiulio Ave., Santa Clara, Calif., 95050, Tel: 408-248-5511, TWX: 910-338-0138; Empl.: 70

Customer service: L. Becker

Products manufactured: Circulators, Ferrite, Direction Finders, Filters, Isolators, Multiplexers, Shifters, Switches

Local Sales Offices & Reps.
Ariz Phoenix, Elctrn. Enterprises 602-946-9860
Cal Los Altos, Stout-Loeswick 415-948-3265
Colo Boulder, J. Smith & Assocs. 303-442-7100
DC Washington, Applied Eng. Consultants 202-783-7319
Kans Wichita, Eugene Carbiener Assoc. 316-682-5782
Md Ellicott City, Applied Engrg. Consultants 301-465-1272
Mass Lexington, Eugene F. Delfino Co. 617-449-4141
NJ Westfield, Gray & Reed Assoc. 201-233-6116
NM Las Cruces, Elctrn. Enterprises 505-524-0126
NY Huntington Sta., Gray & Reed Assoc. 516-433-3333
NY Syracuse, Lightstone Corp. 315-454-3209
Ohio Dayton, Berberick Assocs. 513-433-0342
Pa Newtown Square, SWR Assoc. 215-356-8550
Tex Dallas, Texas Avionics 214-368-3566
FOR: Can., Georgetown, Ont., RDB Sheppard Agencies Ltd. 416-877-9846

ADDINGTON LABS, INC., Semiconductor Div., 680 W. Maude Ave., Sunnyvale, Cal., 94086, Tel: 408-733-3883, TWX: 910-339-9230

Products manufactured: Diodes

ADDINGTON LABS., INC., Solid State Prods. Div., 680 W. Maude Ave., Sunnyvale, Cal., 94086, Tel: 408-245-6810, TWX: 910-339-9230; Empl.: 120

Customer service: B. White

Products manufactured: Discriminators, Generators, Multipliers, Oscillators

Local Sales Offices & Reps.
Cal Los Altos, Stout-Loeswick 415-948-3265
Cal Los Angeles, Basic Systems Corp. 213-938-2833
Fla Clearwater, Southeastern Component Sales 813-531-8324
Kans Wichita, Eugene Carbiener Assoc. 316-682-5782
Md Silver Springs, Eastern Instrumentation 301-681-6500
Mass Lowell, Russell Engrg. Services 617-458-7146
NM Las Cruces, Electronic Enterprises 505-524-0126
NY Bridgeport, Lightstone Corp. 315-699-5747
NY Huntington Station, Gray & Reed Assoc. 516-433-3333
Ohio Dayton, Ashby Associates 513-252-5627
Pa Newton Square, SWR Assoc. 215-356-8550
Tex Dallas, Texas Avionics 214-363-6324
FOR: Can., Georgetown, Ont., RDB Sheppard Agencies Ltd. 416-877-9846

ADDISON DIV. MUIRHEAD, INC., 1101 Bristol Rd., Mountainside, N.J., 07092, Tel: 201-233-0610, Telex: 13-8275; Empl.: 10; Minimum order: $10

Customer service: R. M. Seelagy

Free literature available: Maze Master - low cost cable tester, Auto Scan - high speed portable fault finder, Auto Trak - self-programming fault finder system, BITS - Backplane Integrated Test System and Short Form Catalog - brief description of each product. Above brochures provided w/specifications and Price List.

Products manufactured: Cable Fault Locators, Test Systems, Testers

Local Sales Offices & Reps.
Ariz Phoenix, Zeus, Inc. 602-253-6104
Cal Corona Del Mar, D. E. Ward 714-675-3839
Cal San Jose, H. Sharpe Assocs. 408-257-3635
Colo Denver, Zeus, Inc. 303-770-4400
Conn Hamden, Instr. Consits. Inc. 203-288-5246
Ill Wheaton, Engrg. Prods. Assoc. 312-653-6826
Iowa Cedar Rapids, Tech. Reps. Inc. 319-363-2489
Md Silver Spring, ARA Elctrns. 301-565-2584
Mass Waban, Instr. Consits., Inc. 617-969-9881
Mich Detroit, Electro Entprs. 313-521-1500
Minn Minneapolis, Engrg. Prods. Assoc. 612-925-1883
Mo Hazelwood, Tech. Reps. Inc. 314-731-5200
Mo Peculiar, Tech. Reps., Inc. 816-737-1414
NM Albuquerque, Zeus, Inc. 505-268-3941
NY DePew, Labtronics 716-685-4111
NY Schenectady, Labtronics 518-372-6649
NY Syracuse, Labtronics 315-454-9314
NY Ulster Park, Labtronics 914-471-2806
Ohio Cleveland, Electro Entprs. 216-261-7670
Ohio Dayton, Electro Entprs. 513-426-6071
Pa Glenside, ARA Elctrns. 215-887-5250
Pa Pittsburgh, Electro Entprs. 412-371-8497
Utah Salt Lake City, Zeus Inc. 810-466-4924
Wash Seattle, J.B. Jolly Co. 206-938-4166

ADDMASTER CORP., 416 Junipero Serra Dr., San Gabriel, Cal., 91776, Tel: 213-285-1121; Empl.: 400

Customer service: D. Moore

Free literature available: "Paper Tape Equipment" - describes Line of Readers and Accessories. "Model 56 Printer" - Description of and Interface Instructions for OEM Printer.

Products manufactured: Printers, Readers

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices	205-536-1969
Cal	Los Altos, Sys. Mktg. Conslts.	415-968-4180
Colo	Denver, Grifco	303-722-4674
Conn	New Canaan, R.H. Sturdy Co.	203-966-2580
Fla	Fort Lauderdale, Scientific Devices	305-721-4260
Fla	Orlando, Scientific Devices	305-841-8180
Fla	St. Petersburg, Scientific Devices	813-521-1720
Ill	Chicago, Scientific Sls.	312-775-7594
Ind	Indianapolis, Scientific Sls.	317-253-4606
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Wellesley Hills, R.H. Sturdy Co.	617-235-2330
Minn	Bloomington, Scientific Sls.	612-881-3300
NJ	Ridgewood, Instrumentation Sls.	201-445-5210
NM	Albuquerque, Fry-Gates Co.	505-298-1875
NY	Schenectady, N.W. Alexander & Assoc.	518-377-0581
NC	Burlington, Scientific Devices	919-228-6279
Ohio	Akron, Shamrock Elctrn. Sls.	216-666-3796
Ohio	Dayton, Shamrock Elctrn. Sls.	513-298-3052
Pa	Cambridge Springs, Shamrock Elctrn. Sls.	814-398-8348
Pa	King of Prussia, S & S Assoc.	215-265-3450
Wash	Seattle, Delcom Sls. Co.	206-248-0090

ADEC INC., 12 Kulick Rd., Fairfield, N.J., 07006, Tel: 201-575-1570; Empl.: 30

Customer service: D. L. Wiesen

Products manufactured: Antennas, Handsets, Chestsets, Headphones, Headsets, Etc., Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Speaker Systems, Speakers

ADRE CO., Box 6415, Milwaukee, Wisc., 53209, Tel: 414-352-3531; Empl.: 50; Minimum order: $15

Customer service: G.B. Herrider

Free literature available: Adre catalog #F3-271: Benefits, features & prices of contact burnishing tools and kits for maintaining or restoring full power capacity to precious metal electrical contacts.

Products manufactured: Burnishers, Contact, Chemicals, Metal Compounds, Foils, Powders, Sheet, Stock, Tools

ADRET CORPORATION, 1887 Lititz Pike, Lancaster, Pa., 17601, Tel: 717-569-7059, TWX: 510-657-4434

For info on price: P. D. Beckwith; Application info: P. D. Beckwith; Customer service: E. C. Odell; Delivery info: P. D. Beckwith

Free literature available: CATALOG - Covers complete line of Synthesizers (12 models) covering 0.001 Hz to 110 MHz with high spectral purity. All programmable. SERIES 6000 BROCHURE - Programmable Frequency Synthesizers to 600 MHz with 0.01 Hz resolution; and Spectrum Analyzers with 120 db dynamic range, 10 Hz bandwidth and 5 Hz accuracy.

Products manufactured: Analyzers, Generators, Oscillators, Synthesizers

Local Sales Offices & Reps.

Ala	Huntsville, J. L. Highsmith	205-881-3294
Cal	Los Altos, Systems Mark. Cons.	415-941-7122
Cal	S. Pasadena, QPL	213-687-3705
Colo	Englewood, Zeus, Inc.	303-770-4400
Fla	Orlando, J. L. Highsmith & Co.	305-293-5202
Md	Rockville, TE Corp.	301-340-0303
Mass	Stoneham, Ken Corp.	617-438-5464
Mich	Detroit, Electro Sls	313-526-8800
NM	Albuquerque, Trembly Assocs.	505-293-4444
NC	Charlotte, J. L. Highsmith & Co.	704-333-7743
Ohio	Cleveland, Electro Sls	216-261-5440
Pa	Pittsburgh, Electro Sls	412-371-9449
Tex	Richardson, Scientific Sls Co.	214-231-6541
Va	Richmond, J. L. Highsmith & Co.	805-272-5888
Wash	Bellevue, Topp Engin. Sls Corp.	206-747-5400

ADRET CORPORATION cont'd

Advertisment

Programmable Frequency Synthesizers to 600 MHZ with 0.01 HZ resolution, AM, FM, PM, Sweep and Search. Special inquiries invited.

Spectrum Analyzers to 110 MHZ with 120 db dynamic range, 5 HZ accuracy, 10 HZ bandwidth.

ADTOOL CORP., 10 Ronald Dr., Montreal W P Q, Can., Tel: 514-482-2548; Empl.: 18

For info on price: D. Derry; Delivery info: J. St Louis

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Cutters, Wire, Hand Operated, Drawers, Sliding, Drivers, Nut, Flux, Brazing & Soldering Materials, Heat Guns, Production, Heat Sinks, Soldering, Lamps, Machines/Machinery, Production, Pliers, Scissors, Screwdrivers, Solder (All Types), Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Tools, Tweezers, Hand & Vacuum, Wire Strippers, Wire Twisters, Wrenches

Local Sales Offices & Reps.

FOR: Can., Montreal West, Que., Adtool Corp.
FOR: Can., Toronto, Ont., Adtool Corp.

ADVANCE CONVERSION DEVICES CO., 109 Eighth St., Passaic, N. J., 07055, Tel: 201-778-0707; Empl.: 24
p. 1•1084,1085

Products manufactured: Chargers, Battery, Controls/Control Eqpt., Converters, Inverters, Monitors, Power Supplies

Local Sales Offices & Reps.

Md	Annapolis, Hayden Assocs.	202-296-6059
Tex	Dallas, Data Aids Assocs.	214-620-1551
Tex	Houston, Data Aids Assocs.	713-862-6685
Wash	Seattle, Datacom Assocs.	206-285-2525

ADVANCE ROSS ELCTRNS. CORP., 135 S. La Salle St., Chicago, Ill., 60603, Tel: 312-KI3-660; Empl.: 110

Customer service: C. Connors

Products manufactured: Cores, Magnetic, Substrates

Local Sales Offices & Reps.

Ill	Chicago, M. Gottlieb Assocs.	312-775-1151
Ind	Fort Wayne, G. Bieberich	219-432-2537
Mass	Carlisle, Carlisle Tech. Sls.	
NJ	Ringwood, Harvey Assocs.	201-962-7871

ADVANCE WEIGHT SYSTEMS, INC., Box 663, 19 S. 10th St., Battle Creek, Mich., 49016, Tel: 616-962-6657; Empl.: 7

Customer service: A. R. Oxley

Free literature available: Brochures and Data Sheets covering our complete line of weigh cells, weight meters and automatic controls for weighing systems.

Products manufactured: Amplifiers, Cells, Load, Indicators, Signal Conditioners & Equipment, Transducers

ADVANCED CIRCUITRY, Litton Systems Inc., 4811 W. Kearney St., Springfield, Mo., 65803, Tel: 417-862-0751, TWX: 910-775-4705; Empl.: 635

Products manufactured: Boards, Printed Circuit, Boards, Printed Wiring, Universal, Circuits, Printed, Multilayer, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Canoga Park, A.C.D. of Litton	213-884-7230
Cal	Garden Grove, A.C.D. of Litton	714-539-1515
Cal	San Diego, S & R Elctrns.	714-565-8411
Cal	San Jose, A.C.D. of Litton	408-227-3800
Colo	Littleton, A.C.D. of Litton	303-794-6395
Fla	Tampa, A.C.D. of Litton	813-988-4224
Ill	Chicago, Carlson Elctrn. Sls.	312-774-4812
Mass	Woburn, Bel-Mac Corp.	617-935-6810
Mich	Flint, Tech-Neering Ind. Inc.	313-232-7332
Minn	Minneapolis, Giefer Sls. Co.	612-884-2395
NJ	Flanders, A.C.D. of Litton	201-584-0772
NJ	Lakewood, A.C.D. of Litton	201-367-1130
NY	Guilderland, Solder Pot	518-355-1829
Ohio	Englewood, A.C.D. of Litton	513-836-7488
Pa	Ft. Washington, Kirk-Sandell Inc.	215-643-2100
Tex	Plano, A.C.D. of Litton	214-423-4880
Va	Richmond, A.C.D. of Litton	804-794-6268
Wisc	Milwaukee, Carlson Elctrn. Sls.	414-476-2790

ADVANCED DEVICES LAB, 316 Mathew St., Santa Clara, Cal., 95050; Empl.: 93

For info on price: C. H. Handley 408-241-6551; Application info: C. H. Handley; Customer service: C. H. Handley; Delivery info: M. Carter 408-241-9282

Free literature available: Specification sheets

Products manufactured: Controls/Control Eqpt., Detectors, Transducers

Local Sales Offices & Reps.

Cal	Santa Clara	408-241-9282
Ill	Elk Grove Village	312-437-3269
NJ	Long Branch	201-229-7424

ADVANCED DIGITAL RESEARCH, 1901 Old Middfld Way, Mountain View, Cal., 94043, Tel: 415-965-1303; Empl.: 7; Minimum order: $25

Customer service: R. A. Hein

Free literature available: Several data sheets and users manuals.

Products manufactured: Testers

ADVANCED DYNAMIC INSTRS. DIV., Electodyne, Inc., Box 358, Alexandria, Va., 22313, Tel: 703-836-4641; Empl.: 5; Minimum order: $25

Customer service: C. C. Vincentz

Free literature available: Vibration Test Systems brochure covering equipment manufactured, technical specifications and prices.

Products manufactured: Accelerometers, Amplifiers, Analyzers, Calibrators, Equalizers, Meters, Power Supplies, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Ridge Instrs. Co.	205-837-3211
Cal	Montebello, TUCUL Engrg. Co.	213-728-7397
Cal	Mt. View, Morse Assocs.	415-968-7722
Fla	Orlando, Newco & Assocs.	305-293-7700
Ga	Tucker, Ridge Instr. Co.	404-939-1554
Ill	Des Plaines, Maher Engrg. Co.	312-824-2124
Md	Silver Spring, ARA Elctrns. of MD.	301-565-2585
Mass	Acton, E.E. Specialists	617-259-9200
NM	Taos, Dyma Electronics	505-758-2686
Ohio	Dayton, LI/Corp.	513-434-6367
Pa	Glenside, ARA Electronics, Inc.	215-887-5250
Tex	Dallas, Merit Co.	214-352-8040
FOR:	Can., Montreal, Que., J. G. Weiss Co. Ltd.	515-489-6887

ADVANCED HIGH VOLTAGE INC., 14532 Arminta St., Van Nuys, Cal., 91402, Tel: 213-997-7222; Empl.: 13
p. 1•1090-1092

Customer service: M. J. Alexander

Free literature available: 32 Page Catalog of High Voltage Sources (and low voltage sources insulated for High Voltage use) to 75 Kilovolts and 400 watts. Inputs are either line (AC) or DC.

Products manufactured: Converters, Loads, Electronic Variable, Power Supplies

Local Sales Offices & Reps.

NY	Great Neck, EAC Assocs.	516-466-9798
Tex	Dallas, Bouco Sls. Assocs.	214-247-6708
Va	Annandale, J. Hopkins & Assoc.	703-323-1641

ADVANCED KINETICS, 1231 Victoria St., Costa Mesa, Calif., 92627, Tel: 714-646-7165; Empl.: 32

For info on price: R. L. Gradishar; Application info: R. W. Waniek; Customer service: R. L. Gradishar; Delivery info: R. L. Gradishar

Products manufactured: Amplifiers, Bolometers, Calibrators, Cameras, Chamber, Environmental Test, Choppers, Coils Including Assemblies & Forms, Controls/Control Eqpt., Current Sources, Demagnetizers, Detectors, Discharge Systems, Energy, Electroplating Equipment & Supplies, Indicators, Integrators, Electronic, Interferometer Systems, Lamps, Lasers & Laser Systems, Magnetizers, Magnetometers, Magnets, Meters, Modulators, All Kinds, Monitors, Power Supplies, Spectrometers, Switches, Testers, Transducers, Tubes

ADVANCED MATERIALS SYSTEMS, 72 Elm St. N., Atteboro, Mass., 02703, Tel: 617-695-1401; Empl.: 100

For info on price: L. Toth; Customer service: C. Landis

Products manufactured: Metals, Services, Assembly, Production & Test, Wire

Local Sales Offices & Reps.

Conn West Hartford, R.S. Pettigrew & Co.
203-233-8533

Directory of Local Distributors Starts on page 401

Ill	Chicago, Electro-Comp. Sls.	312-763-3636
Mass	West Newton, R.S. Pettigrew & Co.	617-969-5770
NJ	Asbury Park, Lancaster Industrial Sls.	201-988-5401
Pa	Lancaster, Lancaster Industrial Sls.	717-397-2942

ADVANCED MEMORY SYS., INC., 1275 Hammerwood Ave., Sunnyvale, Cal., 94086, Tel: 408-734-4330, TWX: 910-339-9369; Empl.: 650

For info on price: D. Green; Application info: B. Flansburg Ext. 381; Customer service: P. Brown Ext. 300; Delivery info: P. Brown Ext. 300

Free literature available: 6002, 6003, 7001 Data Sheets: Specifications that each product is capable of performing. Application Notes: More technical, Engrg. information on particular product. Bitscoops: Literature dealing with a product or application.

Products manufactured: Integrated Circuit Devices, Memory Systems

Local Sales Offices & Reps.

Ariz	Phoenix, Hecht-Henschen Co.	602-275-4411
Cal	Los Altos, Cain-White Co.	415-948-6533
Cal	Norwalk, Bertrand & Zoolalian	213-921-9791
Cal	Sunnyvale, Advanced Memory Sys.	408-734-1842
Colo	Boulder, R.G. Entprs.	303-447-9211
Ind	Indianapolis, Technical Reps.	317-849-6454
Md	Baltimore, Stemler Assocs.	301-944-8262
Mass	Cambridge, Data Memory Assocs.	617-858-4728
Mass	Randolph, Advanced Memory Sys.	617-828-2181
Mich	Southfield, Luebbe Sls.	313-357-0355
Minn	St. Paul, Cahill Assocs.	612-646-7217
NJ	Barrington, Stemler Assocs.	215-644-3477
NJ	Ridgewood, Instrumentation Sls. Co.	201-445-5210
NY	Plainview, Central Assocs.	516-433-0808
Ohio	Cincinnati, Luebbe Sls.	513-871-4211
Ohio	Cleveland, Luebbe Sls.	216-333-0425
Ohio	Dayton, Luebbe Sls.	513-294-0426
Okla	Tulsa, Norvell Assocs.	918-663-1247
Pa	Delmont, Luebbe Sls.	412-468-4019
Tex	Dallas, Norvell Assocs.	214-350-6771
Tex	Houston, Norvell Assocs.	713-774-2568
Va	Alexandria, Stemler Assocs.	703-548-7818
FOR:	Can., Montreal, Que.l, J.G. Weiss Co.	610-421-3512
FOR:	Can., North Vancouver, B.C., J.G. Weiss Co.	604-987-3833
FOR:	Can., Steinbach, Manitoba, J.G. Weiss Co.	204-326-6405
FOR:	Can., Toronto, Ont., J.G. Weiss Co.	416-766-0843

ADVANCED MICRO DEVICES, 901 Thompson Pl., Sunnyvale, Cal., 94086, Tel: 408-732-2400, TWX: 910-339-9280; Empl.: 750

For info on price: O. Bailey Ext. 341; Application info: S. Simonsen Ext. 266; Customer service: J. Verhelst Ext. 576; Delivery info: J. Verhelst Ext. 570

Products manufactured: Indicators, Integrated Circuit Devices

AP ADVANCED POWER, INCORPORATED
Economy thru Advanced Technology.

ADVANCED POWER INC., 1621 S. Sinclair St., Anaheim, Cal., 92806, Tel: 714-997-0034, TWX: 910-593-1332; Empl.: 45; Minimum order: $25

For info on price: K. Nelson; Application info: G. Mousel; Customer service: K. Nelson; Delivery info: K. Nelson

Free literature available: Controfluxer product catalog #A1173 APS D.C. power supply series bulletin #APS974

Products manufactured: Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Ind	Fort Wayne, Advanced Comp Sls	219-432-2546
Ind	Indianapolis, Advanced Comp. Sls.	317-545-6441
Md	Silver Spring, Rep-Tron	301-593-4844
Minn	St. Paul, Northport Engrg	612-698-3841
Ohio	Milford, Knight Tech. Sls.	513-831-1513
Ore	Eugene, J. A. Tudor & Assoc.	503-686-1252
Ore	Portland, J. A. Tudor & Assoc.	503-288-5154
Pa	Norristown, Data Engrg Co.	215-279-8146
Wash	Seattle, J. A. Tudor & Assoc.	206-682-7444
Wash	Spokane, J. A. Tudor & Assoc.	509-327-3328

ADVANCED POWER INC. cont'd

Advertisment

CONTROFLUXER - regulator/filters, AC line;
CONTROFLUXER - DC power supplies;
APS series economy OEM DC power supplies;
High frequency SCR switching Controfluxer DC power supplies;
Custom designed AC & DC power conditioners.

A E G TELEFUNKEN, 570 Sylvan Ave., Englewood Clfs., N.J., 07632, Tel: 201-568-8570, Telex: 135497; Minimum order: $100

Customer service: J. Szafranski

Products manufactured: Amplifiers, Cells, Photoconductive, Photoemissive, Photovoltaic, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Crystals, Delay Lines, Detectors, Diodes, Display Devices/Displays, Films, Integrated Circuit Devices, Isolators, Lamps, Monitors, Potentiometers, Power Supplies, Rectifiers, Regulators, Thyristors (Includes Silicon Controlled Rectifiers), Transistors, Tubes, Valves, Vacuum

AEL, INC., Richardson Rd., Colmar, Pa., 18915, Tel: 215-822-2929, TWX: 510-661-4976; Empl.: 1500

Customer service: T. J. Keffer X241

Free literature available: In addition to company capability and facility literature, brochures covering each product line.

Products manufactured: Amplifiers, Analyzers, Antenna Feed Systems, Antenna Switching Matrices, Antenna Towers & Supports, Antennas, Attenuators, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Cable, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Printed, Multilayer, Comm. Systems, Connectors, Converters, Counters, Couplers, Detectors, Diodes, Direction Finders, Display Devices/Displays, Dividers, Drivers, Switch, Duplexers, Microwave, Filters, Generators, Horns, Microwave, Isolators, Limiters, Microwave Integrated Circuits (MIC's), Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Mounts, Multipliers, Networks, Oscillators, Power Supplies, Preselector-Mixers, Preselectors, Radar Systems, Receivers, Rectifiers, Services, Assembly, Production & Test, Shifters, Simulators, Switches, Terminals, Testers, Transceivers, Transistors, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs., Inc.	205-536-1941
Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Anaheim, Blair Assocs.	714-635-1350
Cal	Inglewood, L & M Engrg.	213-674-6850
Cal	San Jose, L & M Engrg.	408-292-3220
Colo	Denver, Shefler-Kahn Co.	303-232-0873
Fla	Clearwater, Reynolds & Assocs., Inc.	813-726-2373
Fla	Ft. Lauderdale, Reynolds & Assocs., Inc.	305-581-6611
Fla	Hollywood, Reynolds & Assocs., Inc.	305-987-6720
Fla	Palm Beach, Reynolds & Assocs.	305-622-6850
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Fla	St. Petersburg, Reynolds & Assocs.	813-360-1484
Ga	Atlanta, Reynolds & Assocs., Inc.	404-252-5360
Haw	Honolulu, Har-Kom Hawaii, Inc.	808-587-178
Ill	Northfield, Wright Travis Associates	312-441-6055
Md	Timonium, Deshawn Assocs.	301-252-4878
Mass	Needham, Addelco Corp.	617-444-4754
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
NY	E. Syracuse, Ossmann Instr.	315-437-6666
NY	Melville, ASTROREP Inc.	516-423-2266
NC	Greensboro, Reynolds & Assocs., Inc.	919-275-3725
Ohio	Dayton, Ashby Assocs.	513-252-5627
Pa	Plymouth Meeting, Scientific Devices	215-825-9515
Tex	Irving, Kemco, Inc.	214-255-0537
Wash	Seattle, Rush Drake Assocs.	206-763-2755

AEL COMMUNICATIONS CORP., SUB. OF AMER. ELCTRN. LABS. INC., Box 507, Lansdale, Pa., 19446, Tel: 215-822-2929, TWX: 510-661-4976; Empl.: 100

Free literature available: Covers AELCC facilities and activities in a handsome and resilient 3-ring binder.

Products manufactured: Amplifiers, Attenuators, Cable, CATV Systems & Equipment, Connectors, Converters, Filters, Services, Assembly, Production & Test, Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Mo	Ballwin, R. Hood	314-227-3212
Pa	Lansdale, J. Sacco	215-822-2929

AEMCO DIV., Midtex, Inc., 1650 Tower Blvd., Mankato, Minn., 56001, Tel: 507-387-6521, TWX: 910-565-2244; Empl.: 600 ....p. 1•1548-1572

Products manufactured: Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Panels, Relays, Sockets, Suppressors, Switches, Timers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Twentieth Century Mktg.	205-772-9237
Cal	Inglewood, J. Berman Co.	213-776-1281
Cal	Oakland, Moulthrop Sls.	415-261-7676
Colo	Denver, Barnhill Five	303-426-0222
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Ill	Downers Grove, Richmar Elctrns. Corp.	312-968-0118
Kans	Overland Park, Beams Co.	913-341-7744
Mich	Detroit, Nicon Assocs.	313-341-7688
NH	Nashua, Bell Controls	603-882-6985
NJ	Ridgewood, Ballou Inc.	201-444-6990
NY	Buffalo, R.F. Lamb Co.	716-832-5517
Ohio	Dayton, K.W. Elctrn. Sls.	513-890-2150
Pa	Philadelphia, Professional Sls. Assoc.	215-676-2918
Tex	Richardson, Oeler & Menelaides	214-234-6334
Wash	Seattle, C.B. Parson & Co.	206-762-7373
EXP:	Montreal 355, Que., Can., Coba Elctrns. Ltd.	514-381-2523

Local Distributors

Ariz	Phoenix, Moltronics, 2746 W. Palm La.	602-272-7951
Cal	Mt. View, Powell Elctrns., 411 Fairchild Dr.	415-964-0820
Cal	San Diego, Moltronics, 7969 Engineer Rd.	714-278-5020
Cal	Santa Clara, Fisher Brownell, 338 L Edward Ave.	408-294-6183
Cal	Santa Clara, Moltronics, 337 Mathew St.	408-244-7600
Cal	Southgate, Moltronics, 5160 E. Imperial Hwy.	213-773-6521
Fla	Oakland Park, Peerless Radio Corp., 1040 N.E. 43rd Ct.	305-566-5966
Ill	Addison, Lectron Control, 524 S. Westgate St., Unit C	312-543-8460
Ill	Arlington Heights, S & R Corp., 2420 East Oakton	312-593-2545
Iowa	Cedar Rapids, J. Vrbik Co., Three 50th Street N.E.	319-377-8244
Mass	Cambridge, Apollo Elctrns., 200 Second St.	617-868-3120
Mass	Lowell, F. McCartin Co., 181 Market St.	617-454-9101
Mo	Kirkwood, Winslow Design & Sls., 206 N. Clay Ave.	
Mo	St. Louis, Electric Controls, 2735 Mercantile Dr.	314-645-2400
NY	Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave.	716-858-1287
NY	Hempstead, Kahgan Comps., 556 Peninsula Blvd.	516-538-2300
NY	Rochester, Masline Elctrns., 511 Clinton Avenue So.	716-546-5373
NY	Woodside, Switches Unlimited, 49-1143 Ave.	212-651-0945
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-434-2171
Ohio	Toledo, Fee & McCarthy, Inc.	
Pa	Erie, Erie Corp. Contractors, 1968 Buffalo Rd.	
Tex	Dallas, Component Specialities, 2560 Elctrns. La.	214-357-4576
Tex	Houston, Comp. Specialities, 7313 Ashcroft, Suite 202	713-771-7237
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500
For:	Can., Scarborough, Ont., Carsten Elctrns., 52 Howden Rd.	416-751-2371

AERO-MOTIVE MFG CO., 1-94 At Miller Rd., Kalamazoo, Mich., 49001; Minimum order: $20

Customer service: B. Rowe 616-381-1202

Products manufactured: Reels, Cord & Cable

AEROCOM, 3090 S.W. 37th Ave., Miami, Fla., 33133, Tel: 305-448-6503; Empl.: 100

Customer service: F. I. Stacy

Products manufactured: Amplifiers, Comm. Systems, Controls/Control Eqpt., Receivers, Transmitters, Transponders

Local Sales Offices & Reps.

Cal	Los Angeles, Aeronautical Elctrn. Sls. Corp.	213-670-5166

AEROFLEX LABS., INC., South Service Rd., Plainview, N.Y., 11803, Tel: 516-694-6700, TWX: 510-224-6417; Empl.: 150; Minimum order: $100

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For info on price: N. L. Russell; Application info: M. Ruderman; Customer service: A. Garrett; Delivery info: A. Garrett

Free literature available: TQ Series Torquers (MIL-SPEC), Valueline Series Torquers, Brushless DC Motors, Part Nos. Tech Data, and Dimensions for above.

Products manufactured: Antenna Rotators, Antennas, Controls/Control Eqpt., Counters, Motors, Mounts, Pedestals, Radar, Servo Systems, Simulators, Tachometers, Testers, Tracking Systems

Local Sales Offices & Reps.

Cal	Aptos, Allen & Sweeney Assoc.	408-688-7114
Cal	Torrance, Allen & Sweeney Assocs.	213-373-3318
Conn	Thomaston, Tygren Co.	203-264-6880
Ill	Lombard, Quadtron Assocs.	312-627-6800
Kans	Wichita, D & O Engrg. Co.	316-264-7358
Md	Lutherville, P. Knox & Co.	301-252-1288
Mass	Stoneham, K & D Assoc.	617-438-3121
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	St. Paul, Vikeland Sls.	612-645-4647
Ohio	Fairborne, Tech. Assocs.	513-878-2484
Pa	Jenkintown, Stein Instrumentation	215-885-2370
Tex	Houston, Aid Elctrns.	713-777-3882
Tex	Irving, Aid Elctrns.	214-259-4761
Wash	Seattle, G.M. Gillet & Assoc.	206-284-3344
EXP:	New York City, N.Y., Frathom Co.	212-687-9390

AEROLITE ELEXS CORP., 2207 Summit Ave., Union City, N.J., 07087, Tel: 201-863-2955; Empl.: 60; Minimum order: $50

For info on price: A. Veres; Customer service: A. Veres; Delivery info: D. Palmer

Products manufactured: Alarms, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, CATV Systems & Equipment, Couplers, Lamps, Services, Assembly, Production & Test, Sockets

AEROSPACE AVIONICS, INC., Airport International Plaza, 110 Wilbur Pl., Bohemia, N.Y., 11716, Tel: 516-589-9200, TWX: 510-228-7889; Empl.: 200

Products manufactured: Amplifiers, Annunciators, Controls/Control Eqpt., Converters, Inverters, Power Supplies

AEROTRONIC ASSOCS., INC., Riverside Dr., Contoocook, N.H., 03229, Tel: 603-746-3141; Empl.: 70

For info on price: M. Longley; Customer service: P. White; Delivery info: P. White

Free literature available: Aerotronic's new model 707-241 (Mem 1024) 80 position dynamic burn-m system for MOS memories is a complete system including plug-in cards (devices), power supplies, clock and line drivers and indicators.

Products manufactured: Chamber, Environmental Test, Clamps & Clips, Heat Exchangers & Systems, Meters, Testers

Local Sales Offices & Reps.

Cal	Mt. View, Aerotronic Assoc. West	415-961-7440
Fla	Longwood, Saber Assocs.	305-422-3686
Ill	Des Plaines, Cozzens & Cudahy	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy	317-244-2456
Minn	Minneapolis, Cozzens & Cudahy	612-884-4336
Mo	St. Louis, Cozzens & Cudahy	314-423-1234
NM	Albuquerque, Electronic Entprs.	505-256-3561

AEROVOX INDS., INC., 740 Belleville Ave., New Bedford, Mass., 02741, Tel: 617-994-9661, TWX: 710-344-6985; Minimum order: $200

Customer service: T. P. Richards

Free literature available: Oil capacitor catalog; Product bulletin on non-PCB "environol" capacitors.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Del	Greenville, H. Anderson	302-655-2917
Fla	Oviedo, Conley & Assocs.	305-365-3283
Ill	Chicago, T. B. Hunter Assocs.	312-777-2500
Ill	Wheaton, J-C OEM Sls.	312-668-7621
Ind	Indianapolis, F. J. Campisano Co.	317-247-8623
Mass	Lexington, J. E. Boeing Co.	617-862-2500
Mich	Southfield, Carrier & Gable	313-444-8980
Minn	Minneapolis, Comstrand	612-560-5300
Mo	Grandview, Beneke & McCaul	816-765-2998
NJ	Cherry Hill, J. N. Barrett Assocs.	609-429-1551
NY	Garden City, Comtronic Assocs.	516-741-8966
NY	Ithaca, B. Dean	607-272-2187
Ohio	Cincinnati, F. J. Campisano Co.	513-662-1616
Pa	Pittsburgh, G. S. Root & Co.	412-561-4125
Tex	Dallas, Hale & Assocs.	214-250-8791
Tex	Houston, Ammon & Rizos Co.	713-781-6240
Wash	Bellevue, Western Tech. Sls.	206-641-3900

AERTECH INDUSTRIES, 825 Stewart Dr., Sunnyvale, Cal., 94086, Tel: 408-732-0880, TWX: 910-339-9207; Empl.: 326

For info on price: F. Brewer X-467; Customer service: R. Williams X-514; Delivery info: B. Wright X-462

Products manufactured: Amplifiers, Capacitors, Fixed, Circulators, Ferrite, Converters, Couplers, Detectors, Diodes, Diplexers, Antenna, Dividers, Filters, Integrated Circuit Devices, Isolators, Limiters, Microwave Integrated Circuits (MIC's), Mixer-Preamplifiers, Microwave, Mixers, Monitors, Mounts, Multipliers, Oscillators, Preselector-Mixers, Preselectors, Receivers, Tuners

Local Sales Offices & Reps.

Cal	Los Altos, J. Stone & Assocs.	415-948-4563
Cal	Los Angeles, Fetty-Schodenuve, Inc.	213-651-4050
Colo	Boulder, H. Bass & Assocs.	303-499-7509
Fla	Fort Lauderdale, Snow Co.	305-563-2448
Ga	Chamblee, E.G. Holmes & Assocs.	404-451-6161
Ill	Northfield, Feller Assocs.	312-446-8065
Kans	Shawnee Mission, Tech. Sls. Assocs.	913-888-3330
Md	Ellicott City, Doss Elctrns., Inc.	301-465-1336
Mass	Natick, Wayland Engrg Sls	617-655-6080
Mo	St. Louis, Tech. Sls. Assocs.	314-725-5361
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Jericho, Dal-tech Devices Inc.	516-433-7448
NY	Syracuse, Syracuse Tech Reps	315-488-0222
Pa	Elkins Park, Snow Assocs.	215-379-4700
Tex	Richardson, Lear Assocs.	214-231-5388
Wash	Seattle, Delcom Sls. Co.	206-248-0090

AETNA ENGRG., 3249 Overland Ave., Los Angeles, Cal., 90034, Tel: 213-836-4016; Empl.: 10

Customer service: T. A. Zimmerman

Products manufactured: Services, Assembly, Production & Test

AFI INDUSTRIES INC., 400 Warburton Pl., Long Branch, N.J., 07740, Tel: 201-229-8300

Products manufactured: Circuits, Hybrid, Thick Film, Multipliers, Rectifiers

AGASTAT DIV., See Control Prods. Div. Amerace Esna

AGFA-GEVAERT, INC., 275 North St., Teterboro, N.J., 07608, Tel: 201-288-4100, TWX: 710-990-6137; Empl.: 750; Minimum order: $100

Customer service: E. Haggerty Ext. 211

Products manufactured: Films, Lenses, Optical & Camera, Paper, Graphic Recording, Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Cal	Brisbane, AGFA-GEVAERT, Inc.	415-467-2330
Cal	Glendale, AGFA-GEVAERT, Inc.	213-246-8141
Ga	Atlanta, AGFA-GEVARET, Inc.	404-355-7450
Ill	Chicago, AGFA-GEVAERT, Inc.	312-267-9100
Mass	Waltham, AGFA-GAVAERT, Inc.	617-890-5430
NY	New York, AGFA-GEVAERT, Inc.	212-685-6641
Tex	Dallas, AGFA-GEVAERT, Inc.	214-631-7290

AGNEW-HIGGINS, INC., Box 15423, Santa Ana, Cal., 92705, Tel: 714-893-1301; Empl.: 45

For info on price: A. Urabe; Application info: H. Wildermuth; Customer service: A. Urabe; Delivery info: T. Cobb

Free literature available: Catalog WS 773: comprehensive 12-page summary of clean work stations & clean fume hoods offered with selection guide which explains the effectiveness of the laminar flow principle.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Blowers & Fans & Accessories

Local Sales Offices & Reps.

Cal	Los Angeles, Weightman Assocs.	213-645-6060
Cal	San Francisco, Howard & Co.	415-589-3050
Colo	Denver, Vinson Assocs., Inc.	303-757-5151
Fla	Winter Haven, W.K. Ousley, Inc.	813-294-6441
Ga	Atlanta, Spillane & Assocs.	404-252-5145
Md	Silver Spring, Normco Assocs.	301-567-6569
Mass	Norwood, S. Pierce, Inc.	617-762-3164
NM	Albuquerque, Vinson Assocs., Inc.	505-265-5991
NY	Rochester, T. Ferguson Sls. Inc.	
Ohio	Dayton, H. Noyes & Assocs.	513-274-2871
Tex	San Antonio, Alchem Assocs.	512-434-7596

Advertisment

CLEAN AIR TO WORK IN - From the manufacturers of the world's first laminar flow clean rooms. Laminar/Flow Clean Work Stations - Modular sizes: tabletop models, floor models, downflow fume hoods, with a full range of accessories: stainless steel counter tops, filter service gauges, etc. Blower-Filter Modules for converting existing rooms into CLEAN rooms. Blower-Filter stand units for converting existing work stations into CLEAN work stations. Free factory consultation on your clean room needs. All equipment guaranteed in writing to meet Fed. Std. 209.

AIKEN INDUSTRIES, 200 Park Ave., New York, N.Y., 10017, Tel: 301-475-8961; Empl.: 50; Minimum order: $50

For info on price: P. R. Hanback; Application info: W. P. Riendeau; Customer service: P. R. Hanback; Delivery info: F. Clark

Products manufactured: Circuit Breakers, Protectors

Local Sales Offices & Reps.

Cal	Oakland, Richard B. Peters Co.	415-835-5135
Cal	Panorama City, C. E. Yost	213-781-8966
Cal	Pasadena, T. W. Yeakle	213-684-2275
Ill	Barrington, Perhats Assocs.	312-381-6360
Mich	Southfield, Eynon-Weyand Assocs.	313-354-3430
Ohio	Cleveland, Rockford Controls Ohio	216-731-5250
Ohio	Dayton, Rockford Controls Ohio	513-278-7362
Pa	Jenkintown, Arnold Assocs.	215-742-0600
Pa	Monroeville, Rockford Controls Ohio	412-373-3531
Wash	Bellevue, Pacific Consultants	206-454-2504
FOR:	Can., Montreal, Que., Major Sls. Dists.	514-844-1720

AIKEN INDUSTRIES, INC., Communications & Electronics Div., 9125 Gaither Rd., Gaithersburg, Md., 20760, Tel: 301-948-5210, TWX: 710-828-9706; Empl.: 220; Minimum order: $100

Customer service: Mktg. Dept.

Free literature available: Trade magazines

Products manufactured: Amplifiers, Antenna Switching Matrices, Comm. Systems, Counters, Dividers, Meters, Receivers, Switches, Tuners

Local Sales Offices & Reps.

Cal	Santa Clara	408-244-8852

AIL, Comac Road, Deer Park, N.Y., 11729, Tel: 516-595-3094, TWX: 510-227-6073; Empl.: 3100

Customer service: R. H. Frechen

Products manufactured: Amplifiers, Analyzers, Detectors, Diplexers, Antenna, Equalizers, Filters, Radar Systems, Radiometers, Receivers, Simulators

Local Sales Offices & Reps.

Cal	Los Angeles, D.O. Ness	213-641-1322
Ohio	Dayton, A.P. Vogel	513-254-3511
Va	Arlington, S. Collin	703-521-3300

AILTECH, 815 Broad Hollow Rd., Farmingdale, N. Y., 11735, Tel: 516-595-6471, TWX: 510-224-6558; Empl.: 200

Products manufactured: Amplifiers, Analyzers, Attenuators, Calibrators, Cavities, Microwave, Converters, Diodes, Gages, Generators, Insertion Loss Measurement Systems, Meters, Mixer-Preamplifiers, Microwave, Mixers, Oscillators, Preselectors, Receivers, Standards, Testers, Transducers, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Electronics	205-881-5031
Ariz	Scottsdale, Inter-Mountain Engrg. Co.	602-947-7379
Cal	La Jolla, Ward/Davis Assoc.	714-459-3351
Cal	Lawndale, Ward/Davis Assoc.	213-542-7740
Cal	Los Angeles, Ailtech, West Coast Oper.	213-965-4911
Cal	Sunnyvale, Ward/Davis Assoc.	408-245-4392
Colo	Boulder, Herb Bass Assoc.	303-499-7509
Fla	Maitland, Beacon Elctrns.	305-647-3498
Fla	Palm Beach Gardens, Beacon Elctrns.	305-622-2770
Ga	Atlanta, Ailtech	404-939-2016
Ill	Chicago, K. Meyers Co.	312-774-6440
Ind	Indianapolis, K. Meyers Co.	317-243-6681
Kans	Shawnee Mission, EIR Co.	913-362-0919
Mass	Burlington, R.J. Sickles Assocs.	617-272-7285
Mich	Detroit, Micro Sls. Corp.	313-482-1229
Minn	Minneapolis, K. Meyers Co.	612-920-7080
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Palasades Park, Scientific Dev. East	201-945-3962
NM	Albuquerque, Inter-Mountain Engrg. Co.	505-344-2212
NY	East Syracuse, Ossmann Instrs.	315-437-6666
NY	Rochester, Ossmann Instrs.	716-328-2230
Ohio	Dayton, Micro Sls. Corp.	513-885-4171
Ohio	Medina, Micro Sls. Corp.	216-725-4568
Ore	Lake Oswego, Hudson Assoc.	503-227-4916
Pa	Ambler, W & M Assocs.	215-643-4119
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Houston, Scientific Dev.	713-623-4250
Tex	Richardson, Scientific Dev.	214-231-8106
Tex	San Antonio, Scientific Dev.	512-694-6251
Va	Alexandria, Dyna Rep Co.	703-354-1222
Wash	Bellevue, Hudson Assoc.	206-455-0773
Wash	Seattle, Drake Assoc.	206-763-2755
FOR:	Can., Brampton Ont., Baytronix, Ltd.	416-453-1252
FOR:	Can., Montreal, Quebec, Baytronix Ltd.	514-342-4281
FOR:	Can., Ottawa, Ontario, Baytronix Ltd.	613-728-0113
FOR:	Can., Vancouver, B.C., National Electrolab Ltd.	604-879-9161

AILTECH, 19535 E. Walnut Dr., City of Industry, Cal., 91748, Tel: 213-965-4911; Minimum order: $25

For info on price: B. Philp Ext. 256; Application info: T. D. Eccles Ext. 226; Customer service: B. Philp Ext. 256; Delivery info: B. Philp Ext. 256

Products manufactured: Amplifiers, Analyzers, Gages, Generators, Meters, Oscillators, Preselector-Mixers, Preselectors, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Beacon	205-881-5031
Ariz	Scottsdale, I.M.E.C.	602-947-7379
Cal	City of Industry	213-965-4911
Cal	San Fran., Ailtech	415-321-2533
Colo	Boulder, Herb Bass Assoc.	303-499-7509
Conn	Hamden, Scientific Devices	203-248-9361
Ga	Atlantic, Beacon	404-351-3654
Ill	Chicago, K. W. Meyers	312-774-6440
Kans	Shawnee Mission, E.I.R. Co.	913-362-0919
Mass	Burlington, R. J. Sickles Assoc.	617-272-7285
NM	Albuquerque, I.M.E.C.	505-883-9010
NY	E. Syracuse, Ossmann Instrs.	315-437-6666
NY	Farmingdale, L.I.	516-595-7541
Ohio	Centerville, Micro Sales Corp.	513-885-4171
Pa	Ambler, W & M Assoc.	215-643-4119
Tex	Richardson, Scientific Dev.	214-231-8106
Wash	Seattle, R. S. Drake Assoc.	206-763-2755

AIMSCO INC., 2110 W. Ruffnes St., Seattle, Wash., 98199, Tel: 206-284-5563, TWX: 910-444-1333; Empl.: 25; Minimum order: $10

Customer service: C. Ernst

Free literature available: 832 page fastener guidebook catalog.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Eyelets, Fasteners, Grommets, Handles For Cabinets, Circuit Boards, Racks, etc., Locks, Dial & Shaft

Local Sales Offices & Reps.

Cal	Oakland	415-836-2405
Colo	Denver	303-892-6650
Ore	Portland	503-223-4377
Utah	Salt Lake City	801-364-0120
Wash	Seattle	206-284-5563

AIPHONE USA, 2116 N. Pacific Ave., Seattle, Wash., 98103, Tel: 206-634-3040, Telex: 32-0288; Empl.: 6

Products manufactured: Comm. Systems

Local Sales Offices & Reps.

Cal	N. Hollywood, Basset & Moore, Inc.	213-877-7129
Cal	Oakland, H. Gabriel Sls.	415-465-5361
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Fla	Maitland, Hutto-Hawkins-Pergoy, Inc.	305-831-2474
Ga	Atlanta, H. W. Phillips Co.	404-237-7564
Ill	Chicago, G. Duvall Co.	312-774-5115
Ind	Mulberry, Maish Sls.	317-296-2322
Mass	Needham, Piper Assocs.	617-449-1144
Mich	Detroit, Burcaw Co. & Assoc.	313-533-7700
Minn	Minneapolis, J. E. M. Anderson Co.	612-823-6459
Mo	Kansas City, K.S.W. Assocs.	816-358-5240
NY	Flushing, Bettan Sls.	212-591-7600
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
Ohio	Columbus, Mandabach & Assocs.	614-235-0265
Pa	Levittown, Sher Sls. Co.	215-946-6200
Tex	Dallas, Miller & Assocs.	214-661-5002
Wash	Seattle, R. Merritt Co.	206-682-7337

AIR-O-TRONICS PRODS., Box K, Morrisville, N.Y., 13408, Tel: 315-684-3705; Empl.: 10; Minimum order: $10

Customer service: S. F. Trush

Free literature available: Solid State Timer Catalog & Flexcon Single Contact Flexible Test Connector Flyer

Products manufactured: Connector Adapters, Connectors, Controls/Control Eqpt., Leads, Test & Adaptors, Plug Adapters, Probes, Relays, Socket Adapters, Soldering Accessories, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, W. S. Harmon Co.	
Ill	Chicago, Electro-Kinetics	

AIR PRODS. & CHEMS., INC., Box 538, Allentown, Pa., 18105, Tel: 215-395-4911, TWX: 510-651-3686; Empl.: 13000

Products manufactured: Chemicals, Coatings, Controls/Control Eqpt., Etchants, Printed Circuit, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Services, Assembly, Production & Test, Torches, Soldering, Welding & Access.

Local Sales Offices & Reps.

Ala	Birmingham	205-870-5603
Ala	Dothan	205-794-5422
Ala	Mobile	205-433-6513
Ala	Muscle Shoals	205-381-0542
Ark	Little Rock	501-375-1256
Cal	Long Beach	213-830-5200
Cal	Mountain View	415-961-4560
Conn	Glastonbury	203-633-6485
Fla	Dania	305-920-2085
Fla	Jacksonville	904-786-2652
Fla	Panama City	904-763-1672
Fla	Pensacola	904-432-1406
Fla	Tallahassee	904-222-3015
Fla	Tampa	813-621-2477
Ga	Albany	912-432-0538
Ga	Chamblee	404-451-2712
Ga	Columbus	404-323-1349
Ill	Granite City	618-452-8100
Ill	Hillside	312-449-5850
Ind	Shelbyville	317-392-1731
Ind	South Bend	219-288-4941
Iowa	Cedar Rapids	319-366-7371
Iowa	Des Moines	515-243-8131
Iowa	Fort Dodge	515-576-7159
Iowa	Sioux City	712-252-4466
Ky	Louisville	502-451-6340
Ky	Paducah	502-443-4589
La	New Orleans	504-254-1590
Md	Baltimore	301-477-2882
Md	Hyattsville	301-864-2345
Md	Salisbury	301-742-3800
Mass	Framingham	617-879-4810
Mich	Detroit	313-893-7420
Minn	Shakopee	612-445-4610
Miss	Clarksdale	601-624-2547
Miss	Greenwood	601-453-5421
Miss	Jackson	601-366-1433
Miss	Tupelo	601-842-5138
Mo	Kansas City	816-421-5495
Mo	St. Louis	
Neb	Grand Island	308-382-1695
Neb	Lincoln	402-464-3191
Neb	Omaha	402-341-5500
NJ	Camden	609-365-4500
NJ	Iselin	201-548-4600
NJ	Menlo Park	201-548-4600
NY	Rochester	716-436-7780
NC	Asheville	704-254-0958
NC	Charlotte	704-523-9421
NC	Greensboro	919-299-1361
NC	Raleigh	919-828-4462
Ohio	Cleveland	216-781-2800
Ohio	Middletown	513-424-1281
Okla	Oklahoma City	405-232-3456
Okla	Tulsa	918-627-2266
Pa	Creighton	412-226-1511
Pa	Hometown	717-467-2981
Pa	York	717-848-1407
SD	Rapid City	605-342-4490
Tenn	Chattanooga	615-265-1019
Tenn	Kingsport	615-247-7193
Tenn	Knoxville	615-522-5153
Tenn	Memphis	901-947-1141
Tex	Arlington	817-265-5185
Tex	Houston	713-869-7507
Va	Hampton	804-826-5430
Va	Richmond	804-358-4913
Va	Roanoke	703-343-3683
WVa	Parkersburg	304-485-1691
Wisc	Milwaukee	414-494-8785

AIR QUIP-ROBLEYCO, Box 1118, Richardson, Tex., 75080, Tel: 214-234-3285; FSC No: 53507; Empl.: 7

For info on price: D. Roberts; Application info: F. Roberts; Customer service: B. Wessley; Delivery info: D. Roberts

Free literature available: Technical data sheet showing styles, sizes, colors, tolerances and dimensional outline drawings. Sample kit available on request.

Products manufactured: Pullers

Local Sales Offices & Reps.

Ariz	Phoenix, Arrowhead Sales Co.	602-277-7148
Cal	Hawthorne, Emperor Sales	213-679-4080
Cal	Woodland Hills, Cal-Ward Sales	213-883-2202
Colo	Arvada, Arrowhead Sales	303-423-5556
Fla	Tampa, S. K. Wallace Assoc.	813-961-1037
Ga	Jonesboro, S. K. Wallace Assoc.	404-471-6297
Ill	Elk Grove Village, Midwest Meridan Corp.	312-437-6531
Iowa	Cedar Rapids, Midwest Meridan Corp.	319-365-6561
Mass	Wellesley, R. P. Mahan Co.	617-237-1040
Mich	Grand Rapids, Midwest Meridan Corp.	616-949-7798
Mo	St. Louis, Midwest Meridan Corp.	314-878-4441
NJ	Redbank, H.J. Sundermeyer	201-842-0726
NC	Greensboro, S. K. Wallace Assoc.	909-292-0487
Ohio	Dayton, Midwest-Meridan Corp.	513-276-4137
Tenn	Memphis, S. K. Wallace Assoc.	901-682-2281
Tex	Richardson, Robleyco	214-234-3285
FOR:	Can., Toronto, Ont., J-Tronics	416-429-6324

AIR-VAC ENGRG. CO., 100 Gulf St., Milford, Conn., 06460, Tel: 203-874-2541; Empl.: 30; Minimum order: $10

For info on price: M. Sullivan; Application info: L. Vacca; Customer service: C. Lasto; Delivery info: M. Sullivan

Free literature available: Vacuum Handling of small parts; vacuum removal and reflow removal of multi-lead components from P.C.B.; Air operated vacuum pumps capable of 29.7" Hg.

Products manufactured: Pumps, Vacuum, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Tools, Tweezers, Hand & Vacuum

Local Sales Offices & Reps.

Cal	Alameda, WILNAT Co.	415-483-9629
Cal	Northridge, P. Dooley Co.	213-360-2231
Conn	Guilford, The Ober Co.	203-453-4361
Fla	Miami, Ludlum Assocs.	305-885-2514
Ga	Roswell, Electro Rep Assocs.	404-993-1332
Ill	Downers Grove, The Tipler Corp.	312-969-4343
Mich	Detroit, E & E Engrg., Inc.	
Minn	Minneapolis, Air Engrg. & Supply	
Mo	Kansas City, Burke Sls. Co.	816-842-5511
NH	Spofford, Bahr Sls. Co.	603-352-5444
NJ	Hohokus, D.J. Fisher Co. Inc.	201-652-0090
NM	Albuquerque, TOLTEC Corp.	505-268-4366
NY	Syracuse, Mr. J. V. Costello	315-472-0322
NC	Charlotte, Electro Rep Assocs.	704-527-2530
Ohio	Medina, McShane	216-725-4568
Tex	Dallas, PESO	214-369-3181

Wash	Seattle, Vandy	206-789-3300
Wisc	Brookfield, D. R. Manecke Co.	414-782-2525
EXP:	Hallandale, Florida, EMEC, Inc.	305-925-6366
FOR:	Can., Toronto, Ontario, Willer Engrg. Ltd.	416-783-3373

AIRBORN, INC., 4321 Airborn Dr., Addison, Tex., 75001, Tel: 214-233-2000; FSC No: 10400; QPL No: Multiple; Empl.: 150; Minimum order: $15 ....p. 2•452-455

For info on price: Order Desk; Application info: Appl. Desk; Customer service: Order Desk; Delivery info: Order Desk

Products manufactured: Connectors, Contacts, Electrical

Local Sales Offices & Reps.

Cal	Los Angeles, Air Born	213-670-7983
Cal	Sunnyvale, Cutlass Elctrns. N.	408-733-5885
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
NJ	Denville, Grimm, Siegel Assocs., Inc.	201-625-1900
NY	E. Northport, Airborn	516-757-6534
NC	Charlotte, Reynolds & Assocs.	704-527-2536
Wash	Bellevue, B. Waddell	206-822-0211

AIR BORNE CONTROLS, 9939 Glenoaks Blvd., Sun Valley, Cal, 91352

AIRCO INDUSTRIAL GASES, 575 Mountain Ave., Murray Hill, N.J., 07974, Tel: 201-464-8100, TWX: 710-984-7992

Products manufactured: Analyzers, Controls/Control Eqpt., Gages

Local Sales Offices & Reps.

Ariz	Phoenix	602-273-1255
Cal	City of Industry	213-338-5566
Cal	San Leandro	415-483-8560
Conn	New Haven	203-777-4436
Ga	Atlanta	404-351-2850
Ill	Broadview	312-681-8950
Ill	East Alton	618-462-6857
Kans	Lawrence	913-843-1404
La	Metairie	504-887-8596
Mass	South Acton	617-263-7767
Mich	Southfield	313-355-9494
Mich	Southfield	313-355-9494
Minn	St. Paul	612-645-6431
NY	Albany	518-489-3719
NY	Buffalo	716-852-4702
Ohio	Cleveland	216-842-9330
Pa	King of Prussia	215-265-3900
Pa	Pittsburgh	412-562-3700
Wash	Seattle	206-762-7251
Wash	Vancouver	206-695-1255

AIRCO ELCTRNS., Resistor Plant, Bolivar Rd., Box 547, Bradford, Pa., 16701, Tel: 814-362-5536, TWX: 510-695-5921; Empl.: 1000 .... p. 2•368,369,1408,1409

Customer service: R. Butler

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, CSC	205-883-7794
Ariz	Scottsdale, Mercury Eng. Sales	602-945-1927
Cal	El Segundo, Varigon	213-644-3611
Cal	Santa Ana, Dave Tevis Elctrns.	714-558-0268
Cal	Sunnyvale, Quad Rep	408-733-7300
Colo	Boulder, R. G. Enterprises	303-447-9211
Conn	Newton, Gerber Sls.	203-426-3440
Fla	Terra Ceia, CSC	813-360-7460
Ill	Chicago, C. L. Greenslade Sls.	312-561-0156
Ind	Ft. Wayne, J. Kilfoil Co.	219-749-0113
Kans	Shawnee Mission, Mid-America Electronics Mkt.	913-236-4800
Mass	Waltham, Gerber Sales	617-890-8040
Mich	Troy, C. B. Jensen & Assoc.	313-643-0506
Minn	Hopkins, Grayden & Flemmer	612-941-1120
NM	Albuquerque, A. Q. Electronics	505-255-8701
NY	Fayetteville, R. W. Jackson Co.	315-637-3851
NY	Floral Park, MOS Assocs.	516-694-5923
NC	Sanford, CSC	919-832-1897
Ohio	Cincinnati, J. Kilfoil Co.	513-791-6150
Ohio	Cleveland, Perry Lohse & Co.	216-381-4424
Okla	Tulsa, Vista Assoc.	918-627-7557
Pa	Fairview Village, R. Hilderbrand	215-247-6225
Tex	Richardson, Vista Assoc.	214-235-4547
Wash	Seattle, H. S. Thorpe Co.	206-784-3333

AIRCO ELCTRNS., Div. Airco, Inc., Grand Plaza, 945 Grand Ave., Nogales, Ariz., 85621, Tel: 602-287-5851, TWX: 910-973-9794; Empl.: 1000 p. 2•368,369,1408,1409

Products manufactured: Chokes, Coils Including Assemblies & Forms

Refer to Airco Elctrns., Bradford, Pa. for Sales Office information.

AIRCO ELCTRNS., Special Comps. Oper., Packard Rd. at 47th, Niagara Falls, N.Y., 14302, Tel: 716-285-6971, TWX: 710-524-1653; Empl.: 1000 p. 2•368,369,1408,1409

Customer service: E. Westgren

Products manufactured: Networks, Resistors

Refer to Airco Elctrns., Bradford, Pa. for Sales Office Information.

AIRCOM, INC., Rte. 16B, Union, N.H., 03887, Tel: 603-473-2323; Empl.: 10

Free literature available: Catalog E Shows our complete line of catalog passive waveguide components covering the frequency range from 1-90 GHz.

Products manufactured: Adapters, Waveguide, Antennas, Attenuators, Bends & Twists, Microwave, Cavities, Microwave, Couplers, Delay Lines, Detectors, Dividers, Dummy Loads, Filters, Generators, Horns, Microwave, Impedance Converters, Microwave, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Mismatches, Microwave, Precision, Mixers, Mounts, Oscillators, Probes, Shifters, Sliding Loads, Microwave, Slotted Lines, Microwave, Switches, Tees, Terminals, Transmitters, Tuners, Waveguides & Adapters

AIRCRAFT & ELEX SPCLTYS, Box 126, Plainfield, Ind, 46168, Tel: 317-839-2551; FSC No: 00529; Empl.: 150; Minimum order: $15

For info on price: C. W. Martin; Application info: C. Selby; Customer service: C. R. Johnson; Delivery info: C. R. Johnson

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Lead Assemblies & Receptacles, Wire, Wire Shielding

AIRCRAFT APPLIANCES EQPT, 152 E Dr., Brmalea, Ont, Can., Tel: 416-459-0920, TWX: 610-492-4396; Empl.: 250

Customer service: A. R. Doe Ext 234

Products manufactured: Alternators, Generators, Motors, Tachometers

AIRFLYTE ELCTRNS. CO., Box 207, Bayonne, N.J., 07002, Tel: 201-436-2230, TWX: 710-729-4489; Empl.: 60; Minimum order: $25 .... p. 1•932,933

For info on price: J. Piret; Application info: J. Piret; Customer service: D. O'Brien; Delivery info: D. O'Brien

Products manufactured: Brushes & Brush Assemblies, Commutators, Contact Strips, Finger, Contacts, Electrical, Counters, Encoders, Generators, Indicators, Services, Assembly, Production & Test, Slip-Rings & Assemblies, Switches, Terminal Blocks, Boards & Strips, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, N. G. Ganem Co.	602-945-0839
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	Sunnyvale, RDX Corp.	408-734-4500
Conn	No. Haven, Kitchen & Kutchin	203-239-0212
Fla	Miami Bch., Geartner Assocs.	305-861-3661
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Ft. Wayne, R. F. Specialists	219-485-8982
Kans	Prairie Village, R. G. Sls.	913-381-8812
Md	Baltimore, R.P. Luce & Co.	301-752-8200
Mass	Lexington, Kitchen & Kutchin	617-862-8230
NJ	Clifton, Avionics Equip., Inc.	201-772-1956
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Pa	Philadelphia, R.P. Luce & Co.	215-884-8365
Tex	Dallas, Jacobson Co.	214-363-7584
FOR:	Can., Rexdale, Ont., F. Eakin Ltd.	416-638-0451

AIRMATIC/BECKETT-HARCUM, 185 Park Dr., Wilmington, Ohio, 45177, Tel: 513-382-1691; Empl.: 89; Minimum order: $20

Customer service: N. E. Holder

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Controls/Control Eqpt., Couplings, Drills & Accessories, Hand & Power, Gages, Switches, Tubing, Valves, Solenoid

AIRPAX ELCTRNS., INC., Cambridge Div., Woods Rd., Cambridge, Md., 21613, Tel: 301-228-4600, TWX: 710-865-9655; Empl.: 550

For info on price: Sales Off; Application info: Sales Off; Customer service: L. Slaughter

Products manufactured: Choppers, Circuit Breakers, Limiters, Protectors, Seals, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Gramer & Company	602-279-1231
Cal	Mt. View, Airpax Elctrns., Inc.	415-965-0355
Cal	Pico Rivero, Westrep	213-949-2551
Fla	Fern Park, M.G. Assoc.	305-841-8793
Ind	Indianapolis, A.D. Moore Co.	317-291-6550
Iowa	Cedar Rapids, Reid Assocs., Inc.	319-362-6302
La	Bossier City, Deeco Controls	318-746-2141
Md	Silver Spring, Rep-Tron Inc.	301-593-4844
Mass	Wellesley Hills, Airpax Elctrns., Inc.	617-237-2600
Mich	Southfield, Automatic Controls	313-354-1190
Minn	Hopkins, Fred Peterson Co.	612-941-5400
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NY	Great Neck, J. Di Blasi Assocs., Inc.	516-482-4040
NY	Syracuse, C.W. Floring	315-478-2149
NC	Winston-Salem, L.G. White	919-725-3612
Ohio	Cleveland, Baehr, Greenleaf & Assoc.	216-221-9030
Ohio	Dayton, C.P. Haskell	513-298-3331
Okla	Tulsa, T.J. Ray Co.	918-627-1515
Pa	Pittsburgh, Friday Engrg. Sls.	412-341-1444
Tex	Dallas, Stevens Sls.	214-350-2476
Tex	Houston, Haltom Co.	713-782-5625
Tex	Odessa, Barnco Co.	915-332-0293
Wash	Seattle, Don Smith Sls.	206-633-3160
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529
FOR:	Can., Port Credit, Ont., Leonard Elec., Ltd.	416-274-3454

AIRPAX ELCTRNS., Controls Div., 6801 W. Sunrise Blvd., Ft. Lauderdale, Fla., 33313, Tel: 305-587-1100, TWX: 510-955-9866; Empl.: 200; Minimum order: $25

For info on price: R. Knabe; Application info: R. Knabe; Customer service: M. Morgan; Delivery info: M. Morgan

Free literature available: General Catalog 0200, Meter Catalog 0200G

Products manufactured: Amplifiers, Converters, Counters, Indicators, Meters, Probes, Relays, Switches, Tachometers, Transducers

Local Sales Offices & Reps.

Cal	Mountain View, Airpax Elctrns.	415-965-0355
Cal	Santa Fe Springs, Sls. Engrs. Ltd.	714-521-8673
Colo	Littleton, Aztec Entprs.	303-795-0250
Fla	Fern Park, M.G. Assocs.	305-841-8793
Ill	Chicago, K-W Assoc.	312-792-2618
Ill	Downers Grove, Richmar Elctrns.	312-968-0118
Ind	Indianapolis, Electro Engrg. & Sls.	317-547-5273
Iowa	Cedar Rapids, Reid Assoc.	319-362-6302
La	Baton Rouge, Process Specialty Co.	504-937-0644
La	Bossier City, Deeco Co.	318-742-0856
Md	Phoenix, Rebco Sls	301-592-8907
Mass	Wellesley Hills, Airpax Elctrns.	617-237-2600
Mich	Southfield, Automatic Controls Co.	313-354-1190
Minn	Minneapolis, E.J. Doyle Co.	612-827-5847
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Wallington, Comp-Tech Sales	201-935-5454
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Buffalo, R.M. Newell Co.	716-632-0662
NY	Great Neck, J. DiBlasi Assocs.	516-482-4040
NY	New Hyde Park, Comp-Tech Sls.	516-593-2628
NY	Syracuse, C.W. Floring & Assoc.	315-478-2149
NC	Charlotte, MacGuire & Crawford Instr. Co.	704-366-3454
Ohio	Cincinnati, J.W. Murray & Assoc.	513-662-1616
Ohio	Medina, T-M-T Ind'l. Controls	216-725-7989
Okla	Tulsa, Lucas Controls	918-749-6491
Pa	Harleysville, T. Jackson & Assocs.	215-643-5560
Pa	Pittsburgh, Friday Engrg. Sls.	412-341-1444
Tenn	Hixson, G. Grant Co.	615-875-4633
Tenn	Memphis, Engineered Instrs.	901-743-3402
Tex	Dallas, Stevens Sls.	214-350-2476
Tex	Houston, Haltom Co.	713-782-5625
Tex	Odessa, Barnco, Inc.	915-332-0293
Va	Roanoke, Process Specialties	703-345-5683
Va	Rockville, Virginia Meter & Controls Co.	804-285-4228
Wash	Bellevue, Southwell Controls Ltd.	206-454-1140
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529

AIRPOT CORP., 27 Lois St., Norwalk, Conn., 06851, Tel: 203-846-2021; Minimum order: $10

For info on price: M.E. Barrelle; Application info: L. Wilcox; Customer service: M. Gaberman; Delivery info: M.E. Barrelle

Free literature available: Bulletins showing applications and performance characteristics as well as selection guide for ordering.

Products manufactured: Dampers, Servo, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Mounts, Shafts & Adapters

AIRTROL CORP., 203 W. Hawick St., Rockton, Ill., 61072, Tel: 815-624-8051; Empl.: 30

For info on price: N. K. Anderson; Application info: N. K. Anderson; Customer service: N. K. Anderson; Delivery info: G. Bauer

Free literature available: General Product Brochure spec sheets on individual product lines subfractional shaded pole motors-booster duct fans blazer and zephyr fans.

Products manufactured: Blowers & Fans & Accessories, Motors

Local Sales Offices & Reps.

Ariz	Phoenix, RDX Corp.	602-267-8162
Cal	Los Angeles, R. Meussdorffer & Assocs.	213-788-0771
Cal	San Diego, J. C. Henberger Co.	714-223-7114
Cal	San Francisco, RDX Corp.	408-734-4500
Conn	, SIR Assocs.	203-268-2560
Fla	Orlando, J. K. Kessler & Assocs.	305-323-9282
Fla	Tampa, J. K. Kessler & Assocs.	813-248-5078
Ill	Chicago, Momak Sls.	312-654-4524
Md	Baltimore, Naudain Assocs.	301-442-2270
Mass	Boston, SIR Assocs.	617-861-9646
Mich	Detroit, C. W. Anderson Assocs.	313-642-1250
Minn	Minneapolis, G. E. Arneson & Co.	612-835-2177
NJ	Camden, Naudain Assocs.	609-235-1801
NJ	Newark, P. H. Werner	201-376-9440
NY	Buffalo, E. E. Harries & Co.	716-671-6365
NY	New York, P. H. Werner	201-376-9440
NY	Syracuse, E. E. Harries & Co.	315-637-9871
Ohio	Dayton, Dynel Co.	513-434-6467
Pa	Philadelphia, Naudain Assocs.	609-235-1801
Tex	Dallas, J. B. Guenther	214-691-8500
Tex	Houston, J. B. Guenther	713-468-0232
Wash	Seattle, D. C. Grover & Assocs.	206-588-1310
Wisc	Milwaukee, B. Colman Co.	414-464-5900

AIRTRON, Div. Litton Inds., 200 E. Hanover Ave., Morris Plains, N.J., 07950, Tel: 201-539-5500, TWX: 710-986-7473; FSC No: 80006; Empl.: 350; Minimum order: $35

For info on price: M. Grosso; Application info: E. Strong; Customer service: N. T. Trojanowski

Products manufactured: Amplifiers, Antenna Feed Systems, Antennas, Attenuators, Chokes, Circulators, Ferrite, Couplers, Crystals, Detectors, Dividers, Dummy Loads, Filters, Flanges, Waveguide, Gaskets, Shielding, R-F-Also See Shields, R-F, Isolators, Junctions, Hybrid, Microwave, Limiters, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Oscillators, Shifters, Shutters, Microwave, Strip-Line Components, Microwave, Switches, Tees, Terminals, Tubing, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ariz	Scottsdale, Carter Assocs.	602-947-4355
Cal	Canoga Park, Microwave Tech. Sls.	13-340-0542
Cal	Redwood City, Parks & Pruitt Assoc.	415-364-1640
DC	Wash D.C., T. Britt Assoc.	202-628-0707
Fla	Pompano Beach, Precision Mktg.	305-971-8270
Kans	Olathe, Bob Rush Assocs.	913-782-1177
Md	Baltimore, Frank Dickison-Airtron	301-823-0923
Mass	Lexington, Zieco, Inc.	617-861-8300
NJ	Cherry Hill, H.J. White Co.	609-428-4544
NJ	Fort Lee, Tech. Mktg.	
NY	Liverpool, R & D Assocs.	315-622-2350
Ohio	Dayton, A. Grimm	513-299-8461
Tex	Richardson, Texport Elctrns.	214-690-4004
Wash	Seattle, D. Smith Sls. Co.	206-633-3160

AITKEN COMMUNICATIONS INC., 701 S 10th St., Taft, Cal, 93268, Tel: 805-765-5403; Empl.: 4

Customer service: K. Aitken

Free literature available: Descriptions of and pictures of the two main products - Broadcast Automation and an Oilfield Control Unit.

Products manufactured: Controls/Control Eqpt.

AJAX MAGNETHERMIC CORP., 1745 Overland Ave., N.E., Warren, Ohio, 44482, Tel: 216-372-2529; Empl.: 450

For info on price: J. K. McLaughlin; Application info: R. Hoeek; Customer service: L. Jones; Delivery info: L. Hielman

Products manufactured: Converters, Furnaces, Generators, Heaters & Heating Elements, Motor Electric Generator Sets, Multipliers

AKG DIV., North American Philips Corp., 100 E. 42nd St., New York, N.Y., 10017; Empl.: 20

For info on price: S. R. Ravich 212-697-3600 Ext. 349; Application info: G. Langoon 212-697-3600 Ext. 595; Customer service: W. Kroesen 212-392-0100; Delivery info: L. Kinigson 212-697-3600 Ext. 410

Products manufactured: Handsets, Chestsets, Headphones, Headsets, Etc., Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Transducers

Local Sales Offices & Reps.

Cal	Culver City, Marshank Sls. Co.	213-559-2591
Cal	Walnut Creek, MacPherson Sls. Co.	415-937-1482
Colo	Denver, B & B Elctrn. Prods.	303-934-2123
Conn	Stamford, J. B. Anthony Co.	203-585-2027
Fla	Miami, World Wide Prods.	305-754-5475
Ga	Atlanta, Fidelicom Inc.	404-458-3616
Ill	Chicago, T. Pappas & Assocs.	312-685-2338
Iowa	Des Moines, B.E.A.M.S. Inc.	515-282-0292
Md	Silver Spring, Taub Sls. Inc.	301-622-0300
Mass	Natick, VF Sales Inc.	617-237-6544
Mich	Ferndale, Shalco Inc.	313-547-4771
Minn	Minneapolis, T. B. Allen & Assocs.	612-926-7656
NY	Syracuse, Paston-Hunter Co.	315-437-2992
Ohio	Cleveland, J. B. Parent Co.	216-333-9955
Tex	Houston, Wyborny Sls. Co.	713-772-0961
Wash	Seattle, Earl & Brown Co.	206-284-1121

AKRO-MILS, INC., Box 989, Akron, Ohio, 44309, Tel: 216-253-5593; Minimum order: $25

Customer service: D. Martin

Free literature available: Catalog 7-1 Akro-Mils modular storage cabinets. Describes 10 different drawer sizes available in modular cabinets ranging from 1-1/4"x2-3/4"x5-7/8" up to 16-3/4"x3"x11".

Products manufactured: Bins, Part Storage, Cabinets & Accessories, Containers

AKRON PORCELAIN CO., 2719 Cory Ave., Akron, Ohio, 44314, Tel: 216-745-2159; Empl.: 130

Customer service: R.G. McCann

Free literature available: 1. "Electrical Porcelain" 2. Plastic "Sheet" showing custom molded parts.

Products manufactured: Services, Assembly, Production & Test

ALADDIN ELCTRNS., 701 Murfreesboro Rd., Nashville, Tenn., 37210, Tel: 615-748-3335; Empl.: 250; Minimum order: $110 .... p. 2•1727-1730

For info on price: M. Elliott; Application info: J. Marshall; Customer service: M. Elliott; Delivery info: M. Elliott

Products manufactured: Chokes, Coils Including Assemblies & Forms, Delay Lines, Filters, Transformers

Local Sales Offices & Reps.

Cal	Los Altos, Ewing-Foley	415-941-4525
Cal	So. Pasadena, Aladdin Elctrns.	213-799-7714
Colo	Denver, E. W. Johnson Co.	303-985-4810
Fla	Winter Park, Young & Lawrence Assoc.	305-647-6525
Ill	Chicago, Electro-Comp. Sales	312-763-3636
Ind	Indianapolis, Schroeder & Loomis	317-251-4571
Iowa	Cedar Rapids, Seltec Sales Corp.	319-362-8155
Md	Timonium, Barnhill & Assoc.	301-252-6360
Mass	Needham, Deveer Sls. Engrg.	617-444-4200
Mich	Southfield, Luebbe Sls. Co.	513-357-0355
Minn	Minneapolis, F. B. Hill	612-941-5270
Mo	Kansas City, Automatic General Sls.	816-333-0206
NY	Rochester, R.P. Kennedy Co.	716-271-6322
NC	Raleigh, Barnhill & Assoc.	919-876-7825
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Tex	Dallas, G. Weinreich & Assoc.	214-321-2800
Va	Lynchburg, Barnhill & Assoc.	703-246-4624

ALAN INDUSTRIES INC., PO Box 1203, Columbus, Ind., 47201, Tel: 812-372-8869; FSC No: 52750; Empl.: 15; Minimum order: $10

For info on price: W. Kennedy; Application info: F. Walker; Customer service: F. Walker; Delivery info: W. Kennedy

Products manufactured: Attenuators, Detectors, Dividers, Dummy Loads, Switches, Terminals

Local Sales Offices & Reps.

Ariz	Tempe, Gassner & Clark	602-968-9037
Cal	Los Altos, Stout-Loeswick, Inc.	415-948-3265
Cal	Santa Ana, California Electronic Mktg.	714-835-2702
Cal	Woodland Hills, California Electronic Mktg.	213-884-7867
Fla	Clearwater, Saber Assocs.	813-441-1301
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-241-3351
Ga	Woodstock, Saber Assocs.	404-432-9625
Ill	Chicago, K. W. Meyers Co.	312-774-6440
Ind	Indianapolis, K. W. Meyers Co.	317-243-6681
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Waltham, Scientific Devices-New England	617-894-5637
Minn	Minneapolis, K. W. Meyers co.	612-920-7080
NY	Tuckahoe, Asco Elctrns.	914-779-8110
Pa	King of Prussia, S & S Assocs.	215-265-3450
FOR:	Can., Don Mills, Ont., Tech Assocs.	416-445-7490

ALAUN ENGRG., 515 South Palm, Alhambra, Cal, 91803, Tel: 213-289-2172; Minimum order: $25

Customer service: A. Braun

Products manufactured: CATV Systems & Equipment, Comm. Systems, Connector Adapters, Switches

ALBEROX CORP., New Bedford Ind'l. Pk., New Bedford, Mass., 02745, Tel: 617-995-1725; Empl.: 80; Minimum order: $50 .... p. 2•456

For info on price: H. Mathieu; Application info: A. J. Coutu; Customer service: H. Mathieu; Delivery info: H. Mathieu

Free literature available: Alberox High Voltage Terminal Bushings and Custom Ceramic-to-Metal Seals. Catalog 472.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Connectors, Feedthrus & Seals, Environmental, Headers, Insulators & Insulation, Seals, Services, Assembly, Production & Test, Terminals

Local Sales Offices & Reps.

Cal	Santa Cruz, K. Lloyd	408-426-3424
Fla	Orlando, Buchanan & Abrams Assoc.	305-896-7444
Ill	Chicago, Weldin Sls. Co.	312-267-4944
Ind	Indianapolis, J. C. Butler	317-253-5143
Mass	Weston, J. Goode Assocs.	617-235-3900
NJ	Haddonfield, Keefe Elctrn. Sls. Co.	609-429-4650
NY	Pompey, S. F. Foster Co.	315-677-3333
NY	Valley Stream, Levison Sls. Co.	516-561-9696

ALCO ELECTRONIC PRODS., INC., 1551 Osgood St., North Andover, Mass., 01845, Tel: 617-685-4371, TWX: 710-342-0552; Empl.: 60

p. 1•1926,1927; p. 2•1076-1078

For info on price: L. Fontaine 686-0126; Application info: T. J. Clark 685-4371; Customer service: G. Sweeney 685-4371; Delivery info: G. Sweeney 685-4371

Free literature available: Alco will supply upon request catalogs or data sheets of any products shown in EEM. All literature is self-descriptive.

Products manufactured: Caps, Lenses, Indicator Light, Controls/Control Eqpt., Counters, Display Devices/Displays, Drivers & Decoders For Readouts, Indicators, Keyboards, Alphanumeric & Decimal, Knobs, Lamps, Lights, Meters, Monitors, Power Supplies, Probes, Relays, Sockets, Switch Mounting Plates, Switches, Terminal Blocks, Boards & Strips, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, W. Bert Knight Co.	602-242-3057
Ark	Little Rock, J.Y. Schoonmaker Co.	501-376-2158
Cal	Daly City, R. Del. Bucchia & Assocs.	415-756-1664
Cal	Newport Beach, W. Bert Knight, Inc.	714-833-8250
Colo	Denver, Camel Elctrns. Inc.	303-757-6191
Conn	Newton, Gerber Sls. Corp.	203-426-3440
Fla	No. Miami Beach, Irby & Connolly, Inc.	305-949-5197
Fla	Orlando, Irby & Connolly, Inc.	305-894-8471
Ill	Glen Ellyn, Rockford Controls Co.	312-469-6016
Ind	Greenwood, Valontino-Schillinger E. Assoc.	317-888-2260
Ind	South Bend, Valontino-Schillinger E. Assoc.	219-219-6258
Iowa	Marion, Thomas & Modrcin Assoc.	319-377-6261

Kans	Shawnee Mission, Thomas & Modrcin Assoc.	913-432-2131
Md	Towson, Habco Elctrns.	301-825-9637
Mass	E. Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Southfield, Champagne Sls. Co.	313-354-0270
Minn	St. Paul, Countryman Assocs.	612-645-9151
Mo	Hazelwood, Thomas & Modrcin Assoc.	314-895-4700
NJ	Keasbey, Addem II	516-567-5900
NY	Dewitt, Tri-Tech Elctrns.	315-446-2881
NY	E. Rochester, Tri-Tech Elctrns.	716-381-2722
NY	Huntington Station, Addem I	516-567-5900
NY	Larchmont, Tri-Tech Elctrns.	914-834-4423
Ohio	Cincinnati, Luebbe Sales Co.	513-671-4211
Ohio	Cleveland, Luebbe Sales Co.	216-333-0425
Ohio	Dayton, Luebbe Sales Co.	513-294-0426
Okla	Tulsa, J.Y. Schoonmaker Co.	918-936-1423
Pa	Feasterville, PSA Inc.	215-355-6244
Pa	Pittsburgh, Trymax Co.	412-823-8400
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Tex	Houston, J.Y. Schoonmaker Co.	713-926-9510
Utah	Salt Lake City, Camel Elctrns. Inc.	801-355-6181
Va	Lynchburg, Habco Elctrns.	804-384-5236
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
FOR:	Can., Montreal, Que., Canadian Gen. Elec.	514-733-9911
FOR:	Can., Toronto, Ont., Canadian Gen. Elec.	416-537-4481

Local Distributors

Ala	Huntsville, Mock Elctrns., 2310 Memorial Pky. S.	205-539-2401
Cal	Burbank, Woods Co., 2012 Burbank Blvd.	213-849-3211
Cal	Hayward, Dunlap Elctrns., Box 3607	415-783-9260
Cal	Inglewood, Cal. Switch & Signal, 1009 Arbor Vitae	213-776-3550
Cal	Los Angeles, Cal. Elctrns. Supp., 1911 Armacost W.	213-477-8561
Cal	Los Angeles, Elec. Switch, 2478 Fletcher Dr.	213-664-1141
Cal	Mountain View, Abacus Elctrns. Co., 1065 Terra Bella Ave.	415-961-1500
Cal	Oakland, Brill Elctrns., 610 E. 10th St.	415-834-5888
Cal	Palo Alto, Zack Elctrns., 654 High St.	415-326-5432
Cal	Riverside, Elctrn. Supp., 2846 Third	714-787-9220
Cal	Sunnyvale, Acacia Sls., 384 San Aleso	408-735-0100
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Fla	Miami, Elctrn. Equip., 2701 N.W. 42nd Ave.	305-871-3500
Fla	Tampa, Lykes Elctrn., 5426 W. Crenshaw	813-229-1885
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Rosemont, Advent Elctrns., 7110 N. Lyndon Ave.	312-298-4210
Kans	Wichita, Interstate Elctrns., 1330 E. First St.	316-264-6317
Md	Gaithersburg, Pioneer Washington, 9100 Gaither Rd.	301-948-0710
Mass	Bellingham, Dowiak Assocs., 356 Hartford Ave.	617-966-0404
Mass	Burlington, Wilshire Elctrns. N/E, One Wilshire Rd.	617-272-8200
Mass	Framingham, Future Elctrns., 225 Worcester Rd.	617-879-0860
Mass	Lynn, Land Elctrns., 9 Rear Franklin St.	617-592-2220
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Ann Arbor, Advent, 254 S. Wagner Rd.	313-769-8650
Mich	Farmington, Harvey/Michigan, 23461 Ind'l. Pk. Dr.	313-477-1650
Minn	St. Paul, Ragon, 1136 W. Larpenteur St.	612-488-0201
Mo	St. Louis, Olive Elctrn. Supp., 6662 Olive Blvd.	314-863-7800
NJ	Haddonfield, Mid Atlantic Elctrns., 140 Haddon Ave.	609-428-8288
NY	Binghamton, Harvey/Federal Elctrns., Vestal Pky.	607-748-8211
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Hempstead, Elctrn. Equip., 741 Peninsula Blvd.	516-538-5510
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Stotts-Friedman Co., 108 N. Jefferson St.	513-224-1111
Pa	Cornwells Heights, Reliance Merchandizing, 195 Ind'l. Pk.	215-638-8200
Pa	Philadelphia, Almo Elctrns., 9815 Roosevelt Blvd.	215-676-6000
Pa	Pittsburgh, Cameradio, 2801 Liberty	412-391-7400
Tenn	Knoxville, Ind'l. Elctrns., Governor Sevier Hywy.	615-573-7135
Tex	Dallas, All State, 510 S. Good Latimer Expwy.	214-651-0242
Tex	Houston, Lenert Co., 1420 Hutchins St.	713-225-1465
Utah	Salt Lake City, W.H. Bintz Co., 433 W. 3rd South	801-363-5821
Va	Arlington, Arlington Elctrns., 3636 Lee Highway	703-524-2412
Wisc	Milwaukee, Marsh Elctrns., 6047 Beloit Rd.	414-545-6500
For:	Can., Vancouver, B.C., L.A. Varah, 2077 Albert St.	604-873-3211

ALCONOX INC., 217 Park Ave. S., New York, N.Y., 10003, Tel: 212-473-1300; Empl.: 10; Minimum order: $50

For info on price: E. P. Fenlon; Application info: E. P. Fenlon; Customer service: R. Salazar; Delivery info: R. Salazar

Free literature available: Cleaning Guide - outlines proper procedure to obtain clean surfaces, Brochure - describes qualities of our detergents.

Products manufactured: Cleaners & Solvents

ALDEN SYS. CO., INC., Box A, Dept. 262, Westboro, Mass., 01581, Tel: 617-366-8556; Empl.: 5

Customer service: G. Morrison

Free literature available: "More Dollars From Less Space" brochure 22 pages, describes cost cutting techniques in lab and factory production lines. "NPR#28 display utility turntable." "NPR#29 packaging work center."

Products manufactured: Benches, Consoles, Stools, Tables, Recorders

ALDSHIR MFG., 111 Lake, Tuckahoe, N.Y., 10707; Empl.: 8; Minimum order: $25

Customer service: G. Shirley 914-779-1297

Free literature available: Omnidaptor Fact Sheet (Describes world's only universal 45 RPM adaptor). AP-1 Catalog Sheet (Lists all models of replacement 45 RPM adaptors manufactured by Aldshir plus makes and models from original sources and cross-referencing).

Products manufactured: Phonographs, Parts & Accessories

ALERT TECHNOLOGY, INC., 2910 MacArthur Blvd., Northbrook, Ill., 60062, Tel: 312-498-0940; Empl.: 6; Minimum order: $40

Customer service: A. M. Cutshaw

Free literature available: Literature on Digital Probe Checks Integrated Circuit Logic & Ordering Information.

Products manufactured: Probes, Pulsers, Logic Test, Testers

Local Sales Offices & Reps.

Ill	Des Plaines, Coombs Assocs.	312-298-4830
Ind	Ft. Wayne, Coombs Assocs.	219-747-0402
Mo	St. Louis, Coombs Assocs.	314-567-3657
Wisc	Greendale, Coombs Assocs.	414-421-2300

ALESSI INDUSTRIES, 3195 Bldg. C, Airport Loop Dr., Costa Mesa, Cal., 92626, Tel: 714-979-8912; FSC No: 50093; Empl.: 7; Minimum order: $25

Customer service: V. Alessi

Free literature available: Alessi Dice Matrix Test Station; Microprobe Test Station; Micropositioner Test Station; Micropositioner; Test Probe Fixture; Four-Point Probes; Map/Test Station.

Products manufactured: Controls/Control Eqpt., Semiconductor Wafer Fabrication, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Electronic Entprs.	602-946-9860
Cal	Palo Alto, Coherent Mktg. Assoc.	415-327-2217
Cal	Santa Ana, Schlines-Richardson	714-832-1949
Ill	Chicago, Electro-Tech Mktg. Assoc.	312-588-4535
Mass	Malden, Controlyne	617-321-1733
NJ	Upper Montclair, Controlyne	201-746-8900
Tex	Richardson, R. S. Marston Co.	214-235-3577
Wash	Seattle, Demarest & Assoc.	206-523-0600

ALFORD MFG. CO., 120 Cross St., Winchester, Mass., 01890, Tel: 617-729-8050, TWX: 710-348-1063; Empl.: 48; Minimum order: $20

Customer service: G. Cohen

Free literature available: Instruments and Components Catalogs

Products manufactured: Adapters, Waveguide, Attenuators, Bridges, Calibrators, Detectors, Diplexers, Antenna, Dividers, Dummy Loads, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Probes, Shifters, Sliding Loads, Microwave, Slotted Lines, Microwave, Switches, Tees, Terminals, Waveguides & Adapters

ALISSA MFG. CO., 2800 La Cienega Ave., Los Angeles, Cal., 90034, Tel: 213-559-7480 .... p. 2•24-27

Products manufactured: Capacitors, Variable, Testers

ALL AMERICAN TOOL & MFG. CO., 8027 Lawndale, Skokie, Ill., 60076, Tel: 312-673-7084; Empl.: 12; Minimum order: $5

For info on price: J.E. McMenamin; Application info: J. E. McMenamin; Customer service: H. Shrude, Engrg.; Delivery info: J.E. McMenamin

Free literature available: Vibration Test Equipment Selector - Agree Type Test Equipment

Products manufactured: Test Equipment, Testers, Vibrators

Local Sales Offices & Reps.

Ariz	Phoenix, Pacific Scientific Co.	602-273-7464
Cal	City of Commerce, Pacific Scientific Co.	213-927-5333
Colo	Boulder, Pacific Scientific Co.	303-237-5210
Kan	Lenexa, S. Sterling Co.	913-888-2995
Mich	Detroit, S. Sterling Co.	313-255-1970
Mo	St. Louis, S. Sterling Co.	314-567-3636
NM	Albuquerque, Pacific Scientific Co.	505-265-6638
NY	Amityville, Testing Machines, Inc.	516-842-5400
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Okla	Tulsa, Pacific Scientific Co.	918-749-1244
Ore	Portland, Pacific Scientific Co.	503-256-1770
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Tex	Dallas, Pacific Scientific Co.	214-661-3730
EXP:	Evanston, Ill., Inter-Ocean Export Assocs.	312-273-5314
EXP:	Evanston, Ill., Inter-Ocean Export Assocs.	312-273-5314

ALL CHANNEL PRODUCTS CORP., 47-75 48th St., Woodside, N.Y., 11377, Tel: 212-361-8120

Customer service: S.L. Dorosin

Products manufactured: Antennas

Local Sales Offices & Reps.

Cal	Los Angeles, Erlanger Sls. Co.	213-731-2238
Fla	Margate, Florida Elctrns.	305-972-0800
Ga	Atlanta, Kennon-Frazier & Co.	404-351-3145
Ill	Lake Bluff, Gettleman, Litteken, Sabbit & Co.	312-295-1050
Ind	Indianapolis, Haycox	317-251-2777
Minn	St. Paul, G. Johnson Assoc.	612-451-3039
Mo	Raytown, M. Taraski Sls. Co.	816-358-1442
Ohio	Euclid, Hauler-Wade & Assoc.	216-662-5842
Pa	Elkins Park, H. H. Seletsky	215-887-1424
Tex	Houston, S. Katzoff & Assoc.	713-666-1636
Wash	Seattle, Western Reps.	206-284-1671

ALL SHIELD ENCLOSURES, See All-Tronics, Inc.

ALL-TRONICS INC., 45 Bond St., Westbury, N.Y., 11590, Tel: 516-333-3090, TWX: 510-222-3655; Empl.: 45; Minimum order: $50 .... p. 1•538-543

For info on price: M. Herbach; Application info: S. Klein; Customer service: M. Herbach; Delivery info: J. Lametta

Products manufactured: Cabinets & Accessories, Capacitors, Fixed, Coils Including Assemblies & Forms, Containers, Filters, Insertion Loss Measurement Systems, Networks, Services, Assembly, Production & Test, Suppressors

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	
Cal	Los Angeles, C. E. Holmes Co.	213-256-2255
Cal	Palos Verdes Estate, Schulman & Assocs.	213-373-6564
Cal	San Diego, Daniels & Doty	714-560-6266
Cal	San Francisco, Schonin Co., Inc.	415-467-8700
Colo	Denver, Camel Electronics, Inc.	303-757-6191
Fla	Seminole, Massey Assocs.	813-531-4030
Ill	Chicago, Communications Engrs.	312-761-0548
Md	Bethesda, Warner Assocs.	301-469-8904
Mass	Waltham, Betronic Assocs.	617-894-8400

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NY	Plainview, R. Smith Assocs.	516-681-3155
NY	Syracuse, Lenard Co.	315-GR 9-9191
NC	Charlotte, B. Henry Assocs.	704-375-8958
Ohio	Dayton, C. V. Clark Co.	513-294-7337
Pa	Easton, Frank Liberman	215-253-3100
Pa	Philadelphia, Mid-Eastern Assocs.	215-842-2810
Tex	Arlington, Kentron Eng. Sls.	817-265-8292
Tex	Dallas, Kentron Eng. Sls.	214-352-7535
Va	McLean, D. Carwithen	703-821-3131
Wash	Bellevue, TMS Enterprises	
FOR:	Can., Mississauga, Ont., D. R. Beattie	416-822-4414
FOR:	Can., Mississauga, Rayshield, c/o David R. Beattie Ltd.	416-822-4414

ALLACO PRODS DIV., Bacon Inds., Inc., 192 Pleasant St., Watertown, Mass., 02172, Tel: 617-926-2550; Empl.: 18; Minimum order: $25

For info on price: Sales Dept.; Application info: T. Willett; Customer service: T. Willett; Delivery info: Sales Dept.

Free literature available: Allaco Products, supplies free Data Sheets on the epoxy & urethane potting compounds & adhesives that we manufacture.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber

ALLARD INSTR., Div. of Applied Fluidics, 770 Main St., Westbury, N.Y., 11590, Tel: 516-334-8742, TWX: 510-222-8695; Empl.: 17 .... p. 1•601; p. 2•1121

Customer service: P. Sorrentino

Free literature available: Fluidic leak detector LD100; Century series Electronic leak detector ELD100, ELD200; AFI fluidic controller FC100A; Electromagnetic Indicators (Composite), Type 102, Type 101, Type 104, Type 109, Type 110, Type 108, Type 120, Type 219, Type 129, Type 124.

Products manufactured: Actuators, Annunciators, Display Devices/Displays, Indicators

Local Sales Offices & Reps.

Cal	Pico Rivera, Westrep	213-949-2551

ALLEGHENY LUDLAM STEEL CO., 2000 Oliver Bldg., Pittsburgh, Pa., 15222, Tel: 412-261-5300, TWX: 412-642-3045; Empl.: 20,000

Products manufactured: Foil, Laminations, Seals, Shields

Local Sales Offices & Reps.

Cal	Los Angeles	213-685-9550
Cal	S. San Francisco	415-583-9855
Conn	Windsor	203-688-5241
Ga	Atlanta	404-394-9613
Ill	Chicago	312-774-8600
Mass	Boston	617-879-8342
Mich	Detroit	313-564-6900
Mo	St. Louis	314-991-2900
NY	Buffalo	716-633-8800
NY	New York	914-694-1880
Ohio	Cincinnati	513-351-8000
Okla	Cleveland	216-333-9300
Pa	Philadelphia	215-839-7370
Tenn	Memphis	901-767-6962
Tex	Houston	713-529-2647
Wash	Seattle	206-GL4-6950
Wisc	Milwaukee	414-258-5900

ALLEN AVIONICS, INC., Div. A.K. Allen Co., 255 E. 2nd St., Mineola, N.Y., 11501, Tel: 516-248-8080; Minimum order: $35 .... p. 1•422-427,532-537

Products manufactured: Attenuators, Coils Including Assemblies & Forms, Delay Lines, Equalizers, Filter Synthesizers, Filters, Networks, Synthesizers

Local Sales Offices & Reps.

Ala	Gadsden, Nickerson Co.	205-547-7718
Cal	Culver City, E.V. Roberts & Assocs.	213-870-9561
Cal	Palo Alto, Adtek Assocs.	415-323-5414
Cal	San Diego, E.V. Roberts & Assocs.	714-565-4535
Colo	Golden, J.F. Hurlbut Co.	303-279-7796
Fla	Oldsmar, Nickerson Co.	813-855-4209
Fla	Tampa, Nickerson Co.	813-885-1416
Ga	Decatur, Nickerson Co.	404-321-4678
Ill	Chicago, Electro-Tech Mktg. Assocs.	312-588-4535
Kans	Prairie Village, Engrg. Svcs.	913-649-4000
Md	Baltimore, D.K. Jones & Assocs.	301-752-0577
Mass	Natick, Wayland Engrg. Sls.	617-655-6080
Minn	Anoka, K. Haugen & Assocs.	612-421-3395
Mo	St. Louis, Engrg. Svcs.	314-997-1515
NJ	Cherry Hill, H.J. White Co.	609-428-4544
NY	Woodbury, J.N. Sweeney & Co.	516-692-4222
NC	Kannapolis, Nickerson Co.	704-932-6772
Ohio	Dayton, Ashby Assocs.	513-252-5627
Tex	Dallas, Texas Avionics	214-368-3566
Wash	Seattle, Underwood & Underwood Inc.	206-243-2133
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

Advertisment

Allen Avionics manufactures passive delay lines, filters, attenuators and passive networks. 3 day delivery on LC filters to customers specifications. We are unique in our field in that we build lumped delay lines having time delay to rise time rations of up to 300/1. We are the sole supplier of the Spiradel delay line.

ALLEN-BRADLEY CO., 1201 S. Second St., Milwaukee, Wisc., 53204, Tel: 414-671-2000, TWX: 910-262-3451; Empl.: 6500 .... p. 2•1410-1417,1584-1591

Customer service: D. Newmann

Free literature available: Publication RO - Complete bound catalog. Publication 6024 - Brief catalog of line.

Products manufactured: Attenuators, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Controllers, Programmable, Controls/Control Eqpt., Cores, Magnetic, Isolators, Lights, Magnets, Motors, Networks, Potentiometers, Pullers, Relays, Resistors, Solenoids, Switches, Timers

Local Sales Offices & Reps.

Ala	Birmingham	205-879-4641
Alas	Anchorage, J.A. Tudor & Assoc.	907-274-6350
Ariz	Phoenix, E. P. Weller Co.	602-959-6000
Ark	Little Rock, C.H. Stout Inc.	501-372-2555
Cal	City of Commerce	213-724-5713
Cal	Newport Beach, W.B. Knight Co.	714-833-8250
Cal	South San Francisco	415-871-0200
Colo	Denver	303-936-7303
Conn	Stratford	203-378-7364
Fla	Fort Lauderdale	305-771-0400
Fla	Jacksonville, Van & Smith Co.	904-384-2376
Fla	Miami, C.R. Lee & Assoc.	305-444-7414
Fla	Orlando, Van & Smith Co.	305-425-7026
Fla	Tampa, Van & Smith Co.	813-877-8393
Ga	Atlanta, R.E. Wilson Co.	404-876-8833
Haw	Honolulu, R.J. Austin & Assoc.	808-395-4011
Ill	Chicago	312-922-9302
Ill	Rockford	815-965-8795
Ind	Fort Wayne	219-745-7068
Ind	Indianapolis	317-293-5223
Ind	Merrillville	219-769-7770
Iowa	Bettendorf	319-355-5316
Ky	Louisville, Rietze Co.	502-893-2571
La	Metairie	504-888-2281
La	Shreveport, C.H. Stout of Shreveport Inc.	318-221-5555
Me	Portland	207-772-3555
Md	Baltimore	301-265-5600
Mass	Agawam	413-785-1984
Mass	Framingham	617-879-5900
Mich	Flint	313-232-9341
Mich	Grand Rapids, E.B. Dewey Co.	616-454-1825
Mich	Kalamazoo, E.B. Dewey Co.	616-344-6163
Mich	Lansing	517-393-8600
Mich	Madison Heights	313-583-9400
Minn	St. Paul	612-636-5050
Mo	Kansas City	816-421-4595
Mo	Maryland Heights	314-567-6326
Neb	Omaha, Midwest Equipment Co.	402-734-1020
NJ	Bloomfield	201-338-4600
NM	Albuquerque	505-265-7723
NY	Albany	518-869-5373
NY	Buffalo	716-634-2711
NY	Rochester	716-461-3660
NY	Syracuse	315-463-4501
NC	Charlotte	704-372-3287
NC	Greensboro	919-272-5870
Ohio	Akron	216-253-2106
Ohio	Cincinnati	513-793-7580
Ohio	Cleveland	216-391-2855
Ohio.	Columbus	614-263-6881
Ohio	Dayton	513-294-4468
Ohio	Toledo	419-841-7726
Okla	Tulsa, J.W. Elder Co.	918-583-9149
Ore	Eugene, J.A. Tudor & Assoc.	503-686-1252
Ore	Portland, J.A. Tudor & Assoc.	503-288-5154
Pa	Allentown	215-437-2401
Pa	Erie	814-868-8214
Pa	King of Prussia	215-337-1990
Pa	Pittsburgh	412-923-1844
Pa	York	717-848-2239
SC	Greenville	803-235-1280
Tenn	Knoxville	615-588-0591
Tenn	Memphis, C.H. Stout of Tennessee Inc.	901-362-1616
Tenn	Nashville	615-834-1860
Tex	Dallas	214-748-6356
Tex	Houston	713-225-0747
Tex	San Antonio	512-732-4362
Utah	Salt Lake City, Stevens Sls. Co.	801-487-8971
Va	Richmond	804-282-4285
Wash	Seattle, J.A. Tudor & Assoc.	206-682-7444
Wash	Spokane, J.A. Tudor & Assoc.	509-327-3328
WVa	Charleston, S.C. Payne	304-343-1393
Wisc	Appleton	414-731-3202
Wisc	Milwaukee	414-671-2000

Local Distributors

Ariz	Phoenix, Kierulff Elctrns., 2633 East Buckeye Rd.	602-273-7331
Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Los Angeles, Kierulff Elctrns., Inc., 2585 Commerce Way	213-685-5511
Cal	Mountain View, Elmar Elctrns., Inc., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Kierulff Elctrns., 8797 Balboa Ave.	714-278-2112
Colo	Denver, Cramer/Denver Elctrns., 5465 E. Evans Pl. at Hudson	303-758-2100
Conn	North Haven, Cramer/Conn, 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/Hollywood, 4035 N. 29th Ave.	305-923-8181
Fla	Orlando, Cramer/Orlando, 345 N. Graham Ave. Box 20214	305-894-1511
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Indl. Ct.	404-448-9050
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, Sub. of Graham Elctrns. Supply, 3606 E. Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns. Supply, 133 S. Pa. St.	317-634-8202
Md	Gaithersburg, Cramer/Washington, 16021 Indl. Dr.	301-948-0110
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Minn	Minneapolis, Newark-Minneapolis Elctrn., 336 Hoover St., N.E.	612-331-6350
NJ	Somerset, Schweber Elctrns., 43 Belmont Dr.	201-469-6008
NY	Westbury, Schweber Elctrns., Jericho Tpke.	516-334-7474
Ohio	Cincinnati, Newark Elctrns. Corp., 9799-G Princeton Rd.	513-874-5115
Ohio	Cleveland, Schweber Elctrns. Corp., 23880 Commerce Pk. Dr.	216-464-2970
Pa	Philadelphia, Almo Elctrns., Roosevelt Blvd. at Blue Grass Rd.	215-676-6000
Tex	Dallas, Solid State Elctrns. of Tex, 2643 Manana Dr. Box 20299	214-352-2601
Tex	Houston, Harrison Equip., 1616 McGowen Ave.	713-224-9131
Utah	Salt Lake City, Cramer/Utah, 391 West 2500 So.	801-487-4131
Wash	Seattle, Kierulff Elctrns., 5940 Sixth Ave., So.	206-763-1550
For:	Can., Downsview, Ont., Cesco Elctrns., 24 Martin Ross Ave.	416-661-0220
For:	Can., Montreal, Que., Cesco Elctrns. Ltd., 4050 Jean Talon St. W.	514-735-5511
For:	Can., Ottawa, Ont., Cesco Elctrns., 1300 Carling Ave.	613-729-5118
For:	Can.,Que., Cesco Elctrns. Ltd., 98 Rue St. Vallier, Ouest	418-524-4641

ALLEN BRADLEY, Sys. Div., 747 Alpha Dr., Highland Heights, Ohio, 44143, Tel: 216-449-6700, TWX: 810-427-2975; Empl.: 250

For info on price: J. Caputo; Application info: P. Zilko; Customer service: R. Martin; Delivery info: J. Caputo

Free literature available: Allen-Bradley NC Series 4000 and CNC 7300 systems provide full capability for all turning, milling and maching center applications. The numerous features and available options are descibed in two NC brochures. Programmable Controller is expandable, easily programmed by ladder diagrams, and self-checking. Bulleting 1774 discusses solid-state control features and modular construction for memory (up to 8K) and inputs/outputs (1,024) available. Bulletin 1750 and 1755 describe the two versions of PMC. Read-only and Read-write memory are available.

Products manufactured: Controllers, Programmable, Controls/Control Eqpt.

Local Sales Offices & Reps.

Ala	Birmingham, Allen-Bradley Co.	205-879-4641
Alas	Anchorage, Allen-Bradley Co.	907-274-6350
Ariz	Phoenix, Ind'l. Control	602-959-8620
Ark	Little Rock, C.H. Stout, Inc.	501-374-8201
Cal	Los Angeles, Allen-Bradley Co.	213-724-5713
Cal	S. San Francisco, Allen-Bradley Co.	415-761-3225
Colo	Denver, Allen-Bradley	303-936-7303
Conn	Bridgeport, Allen-Bradley	203-378-7364
Fla	Jacksonville, Van & Smith Co.	904-384-2376
Fla	Miami, C.R. Lee & Assoc.	305-444-7414
Fla	Orlando, Van & Smith Co.	305-425-7026
Fla	Tampa, Van & Smith Co.	813-877-8393
Ga	Atlanta, R.E. Wilson Co.	404-876-8833
Haw	Honolulu, R.J. Austin & Assocs.	808-395-4011
Ill	Chicago, Allen-Bradley Co.	312-922-9302
Ill	Rockford, Allen-Bradley Co.	815-965-8795
Ind	Fort Wayne, Allen-Bradley Co.	219-745-7068
Ind	Gary, Allen-Bradley Co.	219-769-7770
Ind	Indianapolis, Allen-Bradley Co.	317-293-5223
Iowa	Davenport, Allen-Bradley Co.	319-355-2831
Ky	Louisville, Rietze Co.	502-893-2571
La	New Orleans, Allen-Bradley Co.	504-888-2281
La	Shreveport, C.H. Stout of Shreveport, Inc.	318-425-5485
Me	Portland, Allen-Bradley Co.	207-772-3555
Md	Baltimore, Allen-Bradley Co.	301-265-5600
Mass	Boston, Allen-Bradley Co.	617-879-5900
Mass	Springfield, Allen-Bradley Co.	413-732-3430
Mich	Detroit, Allen-Bradley Co.	313-583-9400
Mich	Flint, Allen-Bradley Co.	313-232-9341
Mich	Grand Rapids, E.B. Dewey Co.	616-454-1825
Mich	Kalamazoo, E.B. Dewey Co.	616-344-6163
Mich	Lansing, Allen-Bradley Co.	517-393-8600
Minn	St. Paul, Allen-Bradley Co.	612-636-5050
Mo	Kansas City, Allen-Bradley Co.	816-421-4595
Mo	Saint Louis, Allen-Bradley Co.	314-567-6326
Neb	Omaha, Midwest Equip. Co.	402-341-7600
NJ	Bloomfield, Allen-Bradley Co.	201-338-4600
NM	Albuquerque, W. Dolde Sls. Co.	505-256-0307
NY	Albany, Allen-Bradley Co.	518-869-5373
NY	Buffalo, Allen-Bradley Co.	716-873-7617
NY	Rochester, Allen-Bradley Co.	716-461-3660
NY	Syracuse, Allen-Bradley Co.	315-463-4501
NC	Charlotte, Allen-Bradley Co.	704-372-3287
NC	Greensboro, Allen-Bradley Co.	919-272-5870
Ohio	Akron, Allen-Bradley Co.	216-253-2106
Ohio	Cincinnati, Allen-Bradley Co.	513-793-7580
Ohio	Cleveland, Allen-Bradley Co.	216-391-2855
Ohio	Columbus, Allen-Bradley Co.	614-263-6881
Ohio	Dayton, Allen-Bradley Co.	513-294-4466
Ohio	Toledo, Allen-Bradley Co.	419-841-7726
Okla	Tulsa, J.W. Elder Co.	918-583-9149
Ore	Eugene, J.A. Tudor & Assocs.	503-686-1252
Ore	Portland, J.A. Tudor & Assocs.	503-288-5154
Pa	Allentown, Allen-Bradley Co.	215-437-2401
Pa	Erie, Allen-Bradley Co.	814-868-8214
Pa	Philadelphia, Allen-Bradley Co.	215-337-1990
Pa	Pittsburgh, Allen-Bradley Co.	412-923-1844
Pa	York, Allen-Bradley Co.	717-848-2239
SC	Greenville, Allen-Bradley Co.	803-268-1391
Tenn	Knoxville, Allen-Bradley Co.	615-588-0591
Tenn	Memphis, C.H. Stout of Tenn., Inc.	901-362-1616
Tenn	Nashville, Allen-Bradley Co.	615-834-1860
Tex	Dallas, Allen-Bradley Co.	214-748-6356
Tex	Houston, Allen-Bradley Co.	713-225-0747
Tex	San Antonio, Allen-Bradley Co.	512-732-4362
Utah	Salt Lake City, Stevens Sls. Co.	801-467-5489
Va	Norfolk, Allen-Bradley Co.	804-499-0218
Va	Richmond, Allen-Bradley Co.	804-282-4285
Wash	Seattle, J.A. Tudor & Assocs.	206-682-7444
Wash	Spokane, J.A. Tudor & Assocs.	509-327-3328
WVa	Charleston, S.C. Payne-Mgr.	304-343-1393
Wisc	Appleton, Allen-Bradley Co.	414-731-3202
Wisc	Milwaukee, Allen-Bradley Co.	414-671-2000

ALLEN ELCTRNS. DIV., Allen Organ Co., Macungie, Pa., 18062, Tel: 215-965-9801; Empl.: 500; Minimum order: $30

Customer service: M.F. Nelson

Products manufactured: Coils Including Assemblies & Forms, Oscillators

ALLEN MFG. CO., Drawer 570, Hartford, Conn., 06101, Tel: 203-242-8511, TWX: 710-425-0099; Empl.: 420; Minimum order: $50

For info on price: G. Merrick; Application info: M. Kubick; Customer service: G. Merrick; Delivery info: G. Merrick

Products manufactured: Adhesives (All Types), Fasteners, Pins, Screwdrivers, Tools, Wrenches

ALLIANCE MFG. CO., North American Phillips Co., Alliance, Ohio, 44601, Tel: 216-821-5360

Products manufactured: Antenna Rotators, Motors

ALLIED CHEMICAL CORP., Specialty Chemicals Div., Box 1087R, Morristown, N.J., 07960, Tel: 201-455-2000; Empl.: 30000

Products manufactured: Chemicals, Cleaners & Solvents, Etchants, Printed Circuit, Machines/Machinery, Production

Local Sales Offices & Reps.

Cal	Los Angeles
Ill	Palatine
Mass	Burlington
NJ	Saddle Brook
Tex	Houston

ALLIED CONTROL CO., See Gould Inc., Allied Control Div.

ALLIED SYSTEMS CORP., Box 11005, Greensboro, N.C., 27409, Tel: 919-299-2294; Empl.: 25 ....p. 2•458,459

For info on price: E. V. Saude; Customer service: V. Buie; Delivery info: E. V. Saude

Free literature available: Catalogs 567 and 677 offer two complete lines of Patchboard Programming Systems with more than twenty-one models and sizes from 200 positions to 5120 positions with associated Patchcords and Hardware. Special Systems on Request.

Products manufactured: Boards, Programming, Cable Assemblies & Harnesses, Connectors, Contacts, Electrical, Controllers, Programmable, Cords, Covers, Protective (Including Dust), Jack Covers, Kits, Programming Board, Lead Assemblies & Receptacles, Leads, Test & Adaptors, Panels, Pins, Plugs, Probes, Services, Assembly, Production & Test, Splices, wire (Including, Butt & Cap Types), Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Ala	Huntsville, Tech-Rep Assocs., Inc.	205-881-5925
Cal	Long Beach, Cairns Engrg. Sls. Corp.	213-432-7444
Cal	San Carlos, Electro Pacific	415-593-1334
Fla	Ft. Lauderdale, Tech-Rep Assocs., Inc.	305-792-0962
Fla	Indian Rocks Beach, Tech-Rep Assocs., Inc.	813-595-2834
Mass	Waltham, ICM Co.	617-891-8059
Minn	Minneapolis, Paul Ericson & Assocs.	612-884-1969
NY	New Hook, R. P. Kennedy Co.	914-876-2700
NY	Rochester, R. P. Kennedy Co.	716-271-6322
Va	Arlington, H. J. Heffernan Co.	703-522-6666

ALLIS-CHALMERS, Box 512, Milwaukee, Wisc., 53201, Tel: 414-475-2000, TWX: 910-262-3444; Empl.: 26000

Products manufactured: Controls/Control Eqpt., Motor & Generator Armatures, Rotors, Stators, Motor Electric Generator Sets, Regulators, Relays, Switches, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles	213-726-0931
Cal	Walnut Creek	415-937-3111
Colo	Lakewood	303-238-7920
Fla	Tampa	813-877-9541
Ga	Atlanta	404-261-3970
Ill	Oak Park	312-383-6600
Ind	Indianapolis	317-783-3265
Mass	Boston	617-482-3700
Mich	Kalamazoo	616-343-1621
Mich	Southfield	313-352-6870
Minn	Bloomington	612-944-1500
Mo	St. Louis	314-991-5270
NJ	Union	201-687-3700
NY	Rochester	716-436-2883
NC	Charlotte	704-364-0412
Ohio	Akron	216-836-7996
Ohio	Cleveland	216-333-9090
Ohio	Norwood	513-351-6700
Ohio	Norwood	513-351-9000
Okla	Tulsa	918-587-9163
Pa	Haverford	215-527-0900
Pa	York	717-755-0942
Tex	Dallas	214-369-7300
Tex	Houston	713-522-1081
Va	Richmond	703-282-7678
Wash	Bellevue	206-454-3481
Wisc	Milwaukee	414-475-4799
Wisc	Milwaukee	414-475-3441

ALMA, Div. Develco Inc., 530 Logue Ave., Mountain View, Cal., 94043, Tel: 415-968-3903, TWX: 910-379-6588; Empl.: 80; Minimum order: $50

For info on price: G. Patterson; Customer service: R. Rondoe

Free literature available: Product Brochures and Application Notes.

Products manufactured: Testers

Local Sales Offices & Reps.

Ala	Huntsville, Saber Assocs.	205-534-3387
Cal	San Diego, QPL, Inc.	714-453-4150
Cal	South Pasadena, QPL, Inc.	213-682-3705
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Fla	St. Petersburg, Saber Assocs.	813-441-1301
Ill	Chicago, Sea, Inc.	312-282-6694
Ind	Carmel, Sea, Inc.	317-846-2593
Md	Gaithersburg, Data Time, Inc.	301-948-7666
Md	Randallstown, Beacon North, Inc.	301-922-1248
Mass	Waltham, W.M. Hague Co.	617-899-5600
Minn	Minneapolis, Sea, Inc.	612-425-4455
NJ	Fairfield, KLS Assocs.	201-227-2900
NC	Raleigh, Saber Assocs.	919-787-9675
Pa	Abington, Bach-Stewart Assocs.	215-885-1550
Tex	Austin, Crockett Southwest Co.	512-451-8269
Tex	Irving, Crockett Southwest Co.	214-251-1776
Va	Falls Church, Beacon North, Inc.	703-534-1673
Wash	Seattle, R.S. Drake Assocs.	206-763-2755
Wisc	Waukesha, Sea, Inc.	414-547-6637

Advertisment

Alma manufactures a broad line of integrated circuit (IC) testers which include the models 380C and 480B bench-top digital IC testers, the Alma 550 linear IC tester, the model 720 watch IC/module tester, and the Alma 760 RAM IC tester. Phone your nearest Alma representative (listed above) for a demonstration.

ALMOND INSTRS. CO., 1223 East Edna Pl., Covina, Cal., 91724, Tel: 213-967-4151; Empl.: 45

Products manufactured: Converters, Discriminators, Memory Systems, Modulator/Demodulators, Modulators, All Kinds, Oscillators, Power Supplies, Recorders

ALNOR INSTRUMENT CO., 7301 N. Caldwell Ave., Niles, Ill., 60648, Tel: 312-647-7866; Empl.: 160; Minimum order: $15

For info on price: J. J. Kuska; Application info: M. D. Carlson; Customer service: M. D. Carlson; Delivery info: M. Fink

Free literature available: Temperature measuring & control instruments, air-velocity meters, dew point apparatus & thermocouples

Products manufactured: Controllers, Programmable, Controls/Control Eqpt., Meters, Thermocouples, Elements & Accessories, Wire

Local Sales Offices & Reps.

Ala	Birmingham, Ind'l. Htg. & Finishing Co.	205-822-4456
Alas	Anchorage, Hoteco Div.-Amstan, Inc.	907-274-4485
Ariz	Phoenix, Portis & Assocs.	602-947-4379
Ark	Little Rock, McCallister Equip. Co.	501-375-4474
Cal	Costa Mesa, Tech. Prods. & Controls	714-646-8585
Cal	San Francisco, Elctrn. Engrg. Ltd.	415-593-2189
Colo	Denver, D. E. Bond Assocs.	303-756-1234
Fla	Miami, Florida Precision Inst. Co.	305-324-1731
Ga	Atlanta, Measure-Trol Co.	404-255-7249
Haw	Honolulu, Controls, Inc.	808-841-7333
Ind	Indianapolis, Electro Engrg. Sls.	317-547-5273
Iowa	Cedar Rapids, Mueller Sls. Corp.	319-365-1196
Iowa	Davenport, Mueller Sls. Corp.	319-324-4962
La	New Orleans, M. Erichson Co.	504-834-9360
Md	Baltimore, Jobe & Co.	301-235-3502
Mass	Boston, Osgood Engrg. Co.	617-933-4744
Mich	Detroit, B. Turpin Co.	313-272-0746
Minn	Minneapolis, Mueller Sls. Corp.	612-544-8888
Mo	St. Louis, Ind'l. Svc. Labs.	314-535-5760
NJ	Union City, M. Stock, Inc.	201-864-2140
NY	Buffalo, Thermal Systems, Inc.	716-662-5560
NY	New York City, M. Stock, Inc.	212-227-4380
NY	Rochester, Thermal Systems, Inc.	716-377-1970
NY	Syracuse, Thermal Systems, Inc.	315-458-5202
NC	Charlotte, A.D. Penn Co.	704-847-4426
Ohio	Cincinnati, Beedle Equip. Co.	513-793-0140

Ohio	Cleveland, Alnor Instr. Co.	216-464-2225
Okla	Tulsa, J. Schoeffler Co.	918-742-5331
Ore	Portland, Fairman B. Lee Co.	503-236-9515
Pa	Philadelphia, Wistex	215-337-1240
Pa	Pittsburgh, L.H. Boleky Co.	412-761-8994
Tex	Dallas, Gay Sls. Co.	214-368-2325
Tex	Houston, Patterson Equip. Co.	713-666-1451
Utah	Salt Lake City, Control Equip. Co. of S/L	801-487-7741
Va	Richmond, Virginia Tech. Assoc.	703-266-9654
Wash	Seattle, Fairman B. Lee Co.	206-244-7262
Wisc	Milwaukee, Mueller Sls. Corp.	414-781-5310
EXP:	Chicago, Ill, A. Torres Export	312-539-3663

ALPHA COMPONENTS CORP., 115 Eucalyptus Dr., El Segundo, Cal., 90245, Tel: 213-322-7780; Empl.: 12; Minimum order: $25

For info on price: J. T. Cataldo; Application info: J. T. Cataldo; Customer service: D. J. Hardy; Delivery info: D. J. Hardy

Products manufactured: Blowers & Fans & Accessories, Chargers, Battery, Comm. Systems, Counters, Diodes, Power Supplies, Rectifiers, Relays, Resistors, Transformers, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ariz	Phoenix, B.G. Sls.	602-266-7252
Cal	Los Angeles, D. Forth Assoc.	213-338-4816
Cal	San Francisco, Weseloh & Assoc.	415-961-0565
Fla	Oldsmar, L. A. Assoc.	813-855-4209
Md	Joppa, J.C. Merican	301-679-6989
Minn	Minneapolis, Smith Sales Co.	612-377-3187
Miss	Greenwood, L.R. Massey	601-453-3038
NY	Brooklyn, I. Brown Co.	212-493-1379
NY	Camillus, Trademark Elex Assoc.	315-488-5518
NY	Northport, Production Sls. Assoc.	516-757-0336
Ore	Portland, Dale Weber Co.	503-234-7671
Tex	Dallas, Techno Assocs.	214-357-9213
EXP:	Calif. Beverly Hills, Itonra International	213-272-0011

ALPHA DATA INCORPORATED, 20750 Marilla Street, Chatsworth, Cal, 91311, Tel: 213-882-6500, TWX: 910-494-4914; Empl.: 35

Customer service: L. T. Lincoln

Free literature available: Magnetic Disc Memories: ALPHA DATA 10-inch and 16-inch Disc Memories are optimized to meet the requirements of your system in terms of storage, capacity, transfer rate and access times. Plug compatible computer/controllers. Integrated Circuit Tester Model 1416:
A new fully automatic digital IC tester designed to evaluate virtually all types of digital TTL and DTL circuits.

Products manufactured: Memory Systems, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Mountain View, Sciéntific Devices	415-964-4230
Cal	San Diego, Mesa Elctrns.	714-278-8021
Colo	Littleton, Data Sys. Mktg.	303-795-1960
Conn	Avon, Instrument Dynamics	203-678-1088
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Ga	Woodstock, Saber Assocs.	404-432-9625
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Addison, Midwest Mktg. M. R.	312-279-2442
Kans	Mission, Midwest Mktg. M. R.	913-384-3737
Md	Silver Spring, L. G. White & Assocs.	301-585-3141
Mass	Wakefield, Instrument Dynamics	617-245-5100
Mich	Southfield, DATA-TRON	313-354-6421
Mo	Florissant, Midwest Mktg. M. R.	314-831-0342
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Albuquerque, Scientific Devices-Albuquerque	505-268-6729
NY	Schenectady, N. W. Alexander & Assocs.	518-377-0581
NC	Raleigh, Saber Assocs.	919-834-3961
Ohio	Dayton, DATA-TRON	513-223-8421
Ohio	Wickliffe, DATA-TRON	216-585-8421
Pa	Audubon, Holmes Assocs.	215-666-0636
Tex	Houston, Data Appls. Corp.	713-661-4501
Tex	Richardson, Data Appls. Corp.	214-231-4846
Utah	Bountiful, Data Sys. Mktg.	801-295-3457

ALPHA ELECTRONIC SERVICES, 8431 Monroe Ave., Stanton, Cal., 90680, Tel: 714-821-4400; Empl.: 47; Minimum order: $10

For info on price: D. Valdez; Application info: D. E. Lippincott; Customer service: C. Moore; Delivery info: R. Paumier

Free literature available: Catalog containing specifications and applications information on miniature thick film hybrid tone encoders/decoders, tone generators and selective signalling tone devices. Prices are included.

Products manufactured: Circuits, Hybrid, Thick Film, Comm. Systems, Controls/Control Eqpt., Decoders, Encoders, Filters, Generators, Receivers, Transmitters

Local Sales Offices & Reps.

Cal	Hayward, Solid State Comms.	415-785-4610

ALPHA INSTR. INC., 20 Sylvan Rd., Woburn, Mass., 01801, Tel: 617-935-5150, TWX: 710-393-1236; FSC No: 17540; Empl.: 300; Minimum order: $50

For info on price: W. Minks; Application info: J. Richmond; Customer service: H. Miller; Delivery info: H. Miller

Free literature available: Alpha microwave diodes catalog and alpha solid state control devices catalog.

Products manufactured: Attenuators, Detectors, Diodes, Limiters, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Altos, Stout-Loeswick	415-948-3265
Cal	Los Angeles, Cain Technology	213-476-2251
Colo	Arvada, Cleveland Enter.	303-423-3707
Fla	Clearwater, Southeastern Sls.	813-531-8324
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Ft. Wayne, RF Specialists	219-485-8982
Md	Glen Burnie, Micro-Comp	301-761-4600
Mass	Lexington, Lancer Assoc.	617-861-1720
Mich	Warren, DEM Elctrns. Sls.	313-755-6660
Mo	St. Louis, Boweng Reps.	314-429-7327
NM	Albuquerque, Cleveland Enter.	505-345-2481
NY	E. Syracuse, Ossmann Instrs.	315-437-6666
NY	Great Neck, Trionic Assocs.	516-466-2300
Ohio	Dayton, Rixan Assocs.	513-278-4216
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Tex	Dallas, Cain and Co.	214-233-6809

ALPHA METALS, INC., 56 Water St., Jersey City, N.J., 07304, Tel: 201-434-6778, Telex: 125-798; Empl.: 400

Customer service: H. Greenberg

Free literature available: Aplha Product Package - mini catalog, Preforms handbook - primer on use of solder preforms, Ionograph - device measures ionic contamination, Pot-Rite - solder analysis.

Products manufactured: Alloys, Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Flux, Brazing & Soldering Materials, Forms, Wire, Laminates, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Preforms, Precious Metal, Services, Assembly, Production & Test, Solder (All Types), Soldering Accessories, Standards

Local Sales Offices & Reps.

Cal	Santa Ana	714-547-7315
Cal	Sunnyvale	408-727-0630
Ill	Des Plaines	312-297-0730

ALPHA WIRE CORP., 711 Lidgerwood Ave., Elizabeth, N.J., 07207, Tel: 201-925-8000, TWX: 710-996-5895; Empl.: 250 .... p. 1•44,45; p. 2•1835-1880

For info on price: B. Finn; Application info: T. Reme; Customer service: P. Dietlin; Delivery info: P. Dietlin

Free literature available: T-2 Tubing Catalog, W-8 Wire & Cable Catalog, Teflon Cable Brochure, Zipper Tubing Brochure

Products manufactured: Blowers & Fans & Accessories, Braid, Cable, Cabinets & Accessories, Cable, Caps, Forms & Tapes, Heat Shrinkable, Chassis, Circuit Board Mounting, Chassis, Metal, Clamps & Clips, Cords, Tubing, Wire, Wire Markers, Wire Shielding

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co., Inc.	602-258-7893
Cal	Inglewood, J. Berman Co.	213-776-1281
Cal	Oakland, Moulthrop Sls., Inc.	415-261-7676
Fla	Maitland, Hutto-Hawkins-Peregory, Inc.	305-831-2474
Ga	Atlanta, Millar Elctrns., Inc.	404-261-6160
Ill	Chicago, GNB Assoc.	312-673-4050
Ind	Indianapolis, Mktg. Engrs., Inc.	317-546-1523
Mich	St. Clair Shores, J.M. Thorpe Co.	313-779-6363
Minn	Minnepolis, Clark R. Gibb Co.	612-377-1200
Mo	Kansas City, L.F. Florence Co.	816-561-7222
NJ	Elizabeth, Alpha Wire Corp.	201-925-8000
NY	Rochester, Marsey Sls., Inc.	716-442-9700
Ohio	Cleveland, Marlow Assocs., Inc.	216-932-0900
Tex	Dallas, J.Y. Schoonmaker Co., Inc.	214-357-8481
Wash	Seattle, Earl & Brown Co., Inc.	206-284-1,121

FOR:	Can., Downsview, Ont., F. Eakin, Limited	416-245-3600

A L S ELECTRONICS CORP., 733 E. Edna Pl., Covina, Cal., 91723, Tel: 213-966-7431, TWX: 910-584-1812; Empl.: 40 .... p. 1•1087

For info on price: S. Kurzet; Customer service: Pres.

Products manufactured: Converters, Inverters, Power Supplies

ALTEC DIV., Altec Corp, 1515 S. Manchester Ave., Anaheim, Calif., 92803, Tel: 714-774-2900, TWX: 910-591-1142; Empl.: 1100

Customer service: R. J. Foulies

Products manufactured: Amplifiers, Attenuators, Bridges, Chokes, Coils Including Assemblies & Forms, Comm. Systems, Equalizers, Filters, Generators, Meters, Microphones, All Kinds, Mixers, Networks, Panels, Pickups, Telephone (For Recording), Speaker Systems, Speakers, Transformers

ALTHOR PRODS., 202 Bay 46th St., Brooklyn, N.Y., 11214, Tel: 212-373-7444; FSC No: 14998; Empl.: 7; Minimum order: $2

Customer service: G. Strum

Free literature available: Leaflet UB-72 (with current Price Change List) on Clear Polystyrene Plastic Boxes for storage or display & See-Thru Plastic Drawer Cabinets. Circular BL-74- Blank Labels - Self-Adhesive.

Products manufactured: Cabinets & Accessories, Containers, Labels, Pressure-Sensitive, Adhesive

AMRAD CORPORATION, Box 876, Paris, Tex., 75460, Tel: 214-785-4544, TWX: 910-860-5941

Products manufactured: Capacitor, Hardware, Caps, Forms & Tapes, Heat Shrinkable, Clamps & Clips, Cords, Fasteners, Retainers, Strain Reliefs, Cable & Wire, Tubing, Wire & Cable Ties

Local Sales Offices & Reps.

Ill	Chicago, Ropek-Cahill, Inc.	312-287-7292
Mich	Benton Harbor, Ken-Mor Assocs.	616-927-3134
NY	Flushing, Miller Co.	212-263-4446
Ohio	Cleveland, Loesch Assocs.	216-241-4581

AMATOM ELECTRONIC HARDWARE, Div. MITE Corp., 446 Blake St., New Haven, Conn., 06515, Tel: 203-397-3311; FSC No: 06540; Empl.: 55; Minimum order: $10 .... p. 2•457,1258

For info on price: Sls. Dept.; Application info: W. Bailey; Customer service: F. De Fonzo; Delivery info: M. Cousins

Products manufactured: Bumpers, Bushings, Glass, Plastic, Metal, Rubber, Etc., Caps, Lenses, Indicator Light, Clamps & Clips, Connector Adapters, Connectors, Contacts, Electrical, Couplings, Fasteners, Grommets, Handles For Cabinets, Circuit Boards, Racks, etc., Insulators & Insulation, Knobs, Lamps, Lights, Locks, Dial & Shaft, Pads, Transistor Mounting, Posts, Sockets, Spacers, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Cal	Pasadena, T.W. Yeakle	213-684-2275
Cal	Santa Clara, Novatronix	408-243-9530
Colo	Denver, Novatronix	408-243-9530
Conn	Bethany, Reps. Corp.	203-393-0024
Fla	Miami, S.K. Wallace Assocs.	305-691-1654
Fla	Tampa, S.K. Wallace Assocs.	813-932-3568
Ga	Jonesboro, S.K. Wallace Assocs.	404-471-6297
Ill	Downers Grove, S.W. Anderson Co.	312-964-2600
Ill	Glen Ellyn, S.W. Anderson Co.	312-469-7182
Ind	Crown Point, S.W. Anderson Co.	219-663-1707
Ind	Indianapolis, S.W. Anderson Co.	317-255-1971
Mass	Topsfield, Reps. Corp.	617-426-0541
Minn	Minneapolis, C.E. Bohlig Co.	612-922-7011
NY	New Rochelle, A & M Assocs.	914-235-4672
NY	Syracuse, Lenard Co.	315-479-9191
NC	Greensboro, S.K. Wallace Assocs.	919-292-0487
NC	Kernersville, S.K. Wallace Assocs.	919-993-3993
Ohio	Cincinnati, J.O. Olsen Co.	513-922-2176
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Pa	Birchrunville, Jadelectronics Assocs.	215-647-5151
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Tenn	Memphis, S.K. Wallace Assocs.	901-682-2281
Tex	Garland, G.V. Peck Co.	214-341-8311
Tex	Houston, G.V. Peck Co.	713-664-1435
Wash	Seattle, Blum & Assocs.	206-284-4082
Wisc	Milwaukee, S.W. Anderson Co.	414-476-5100

Local Distributors
Cal Mountian View, Ratel Elctrns., 815 Maude Ave. 415-965-2010
Cal North Hollywood, J. S. Bennett, 12011 Sherman Rd. 213-875-2631
Cal Southgate, Reliable Inds. Inc., 10724 Garwick Pl. 213-773-5611
Cal Sunnyvale, J. S. Bennett, 1060 W. Evelyn Ave. 408-732-2810
Mass Woburn, J. S. Bennett, 15 Cummings Park 617-935-8020
Minn Minneapolis, Aero Space Computer Supply, 9270 Bryant Ave. So. 612-884-4725
NY Briarcliff Manor, Lawrence Tufts Co., Woodside Ave. 212-562-7880

AMBI-TECH INDS. INC., 861 Washington Ave., Westwood, N.J., 07675, Tel: 201-666-0504; Empl.: 12

Customer service: M. C. Baum

Free literature available: Literature describes short°stop and brake°switch electronic motor brakes for osha safety and productivity applications. With no mechanical attachment to motors, units feature smooth, automatic operation and torque adjustment.

Products manufactured: Brakes, Controls/Control Eqpt.

AMBROID CO., 612 Montello St., Brockton, Mass., 02401, Tel: 617-583-6163; Empl.: 10; Minimum order: $15

For info on price: C. McNutt; Application info: L.L. Blyler; Customer service: L. Lawrence; Delivery info: L. Lawrence

Free literature available: Electrical data on adhesives.

Products manufactured: Adhesives (All Types), Cleaners & Solvents

AMCO ENGINEERING CO., 7333 W. Ainslie St., Chicago, Ill., 60656, Tel: 312-867-8500, TWX: 910-221-5192; Empl.: 188; Minimum order: $25
p. 1•49-52

For info on price: J. Witecha; Application info: D. Begitschke; Customer service: F. A. Johnson; Delivery info: J. Knight

Free literature available: Cabinets, Consoles and Racks - Modular - for Electronic or Electrical Systems - OEM, Computer, Military, Test, Educational, Medical, TV & Broadcast. Unlimited color & styling variations are standard

Products manufactured: Benches, Consoles, Stools, Tables, Blowers & Fans & Accessories, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Frames, Cabinet & Rack, Panels, Racks

Local Sales Offices & Reps.
Ala Huntsville, Ridge Instr. Co. 205-837-3211
Alas Anchorage, Arva, Inc. 907-272-5231
Ariz Phoenix, Gramer & Co. 602-279-1231
Cal Encino, V & L Assocs. 213-986-9703
Cal Millbrae, Polach & Bensinger, Inc. 415-697-2525
Colo Denver, Williams Assocs. 303-373-4730
Conn Avon, Instr. Dynamics, Inc. 203-678-1088
Fla Altamonte Springs, WMM Assocs. 305-831-4645
Fla Clearwater, WMM Assocs. 813-447-2533
Fla Pompano Beach, WMM Assocs. 305-943-3091
Ga Tucker, Ridge Instr. Co. 404-939-1554
Haw Honolulu, Adtech, Inc.
Ill Chicago, R.L. Lang & Assocs. 312-867-4241
Ind Ft. Wayne, McDonald Sls. Co. 219-747-3650
Md Rockville, L.G. White & Co. 301-770-6556
Mass Wakefield, Instr. Dynamics, Inc. 617-245-5100
Mich Detroit, WKM Assocs. 313-892-2500
Minn St. Paul, Bonament Heyda Co. 612-484-8531
Mo Kansas City, Forristal-Young Sls. Co. 816-358-6771
Mo St. Louis, Forristal-Young Sls. Co. 314-645-2360
Neb Omaha, Forristal-Young Sls. Co. 402-333-0800
NJ Woodcliff Lake, F&F Assocs. 201-778-6767
NM Albuquerque, Williams Assocs. 505-255-1638
NY Coram, F&F Assocs. 516-334-1160
NY North Syracuse, NACO Elctrns. 315-699-2651
NC Winston Salem, L.G. White & Co. 919-725-3612
Ohio Cleveland, WKM Assocs. 216-267-0445
Ohio Dayton, WKM Assocs. 513-434-7500
Okla Tulsa, D. Shuhart Co. 918-747-4136
Ore Portland, Arva, Inc. 503-292-8762
Pa King of Prussia, White-Keystone 215-265-1817
Pa Pittsburgh, WKM Assocs. 412-892-2953
Tenn Oak Ridge, Ridge Instr. Co. 615-483-1311
Tex Bellaire, Brice Co. 713-666-1788
Tex Dallas, D. Shuhart Co. 214-239-0185
Wash Seattle, Arva, Inc. 206-622-0177
EXP: Mahwah, N.J., Transconco, Inc. 201-825-0473

Local Distributors
Ariz Phoenix, Gramer Distributing, 100 W. Camelback Rd., Suite 101B 602-279-1231
Cal Los Angeles, Mil-Comm Dists., 1616 Cotner Ave. 213-478-0525
Cal San Francisco, Zack Elctrns., 1444 Market St. 415-626-1444
Ind Indianapolis, Ra-Dis-Co., 814 N. Senate Ave. 317-637-5571
Ind South Bend, Radio Distributing, 1212 High St. 219-287-2911
Md Baltimore, Radio Elec. Svc. Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Cambridge, Apollo Elctrns., 101 Binney St. 617-868-3120
NC Raleigh, Southeastern Radio Supply Co., 414 Hillsborough St. 919-828-2311
Okla Tulsa, S & S Radio Supply Co., 537 S. Kenosha 918-582-8242
Tex Houston, Lenert Co., Box 2184 713-225-1465
Wash Seattle, Ron Merritt Co., 1320 Prospect St. 206-622-0177
Wisc Madison, Satterfield Elctrns., Box 1438 608-257-4801

AMERICAN AEROSPACE CONTROLS, INC., 131 Verdi St., Farmingdale, N.Y., 11735, Tel: 516-694-5100; Empl.: 30; Minimum order: $25
p. 1•230-232,2330-2332

For info on price: Order Desk; Application info; G. D. D'Abramo; Customer service: G. D. D'Abramo; Delivery info: Mrs. Roberts

Free literature available: General Catalog, Short Form Catalog, Data Sheets on Each Product.

Products manufactured: Current Sensors, Generators, Magnetoresistors, Hall, Monitors, Multipliers, Relays, Transducers

Local Sales Offices & Reps.
Cal Los Angeles, Dyna Sls. Co. 213-268-1175
Mass Newton Center, Daner Hayes, Inc. 617-969-4650
Ohio Cleveland, Instrumentation Sys. 216-486-0782
Ohio Dayton, Instrumentation Sys. 513-294-2838
Pa Pittsburgh, Instrumentation Sys. 412-243-1111

AMERICAN AIRLINE FREIGHT SYSTEM, 633 3rd Ave., New York, N.Y., 10017

Customer service: Freight Cust. Sve.

Free literature available: Brochures on all of our product lines from handling a one pound shipment to chartering a 747 freighter.

Products manufactured: Containers

Local Sales Offices & Reps.
Ariz Phoenix, R. C. Gass 602-273-1221
Cal Los Angeles, J. C. Boyd 213-776-2520
Cal San Diego, T. J. Stokes 714-235-5400
Cal San Francisco, R. C. James 415-761-1300
DC Washington, H. W. Jones 202-393-6460
Ill Chicago, R. L. Kragel 312-641-3131
Md Baltimore, G. J. Martin 301-761-1300
Mass Boston, M. F. Brueckner 617-567-7700
Mich Detroit, W. G. Patrick 313-291-7550
Mo St. Louis, J. P. Bowlin 314-426-5522
NY Albany, L. H. Larche 518-869-5321
NY Buffalo, R. H. Butler 716-632-6007
NY New York, H. W. Coron 212-656-3325
Ohio Cincinnati, R. R. Trenkamp 606-283-3271
Ohio Cleveland, M. E. Bradley 216-265-6660
Ohio Dayton, C. A. Tucker 513-898-5511
Okla Oklahoma City, R. T. Fitzhugh 405-685-5591
Pa Philadelphia, T. C. Johnson 215-365-5060
Tex Dallas, K. M. Miller 214-574-3520
Tex El Paso, H. P. Hallock 915-778-9484
Tex Houston, D. J. Charleston 713-228-5237
Tex San Antonio, G. L. Allison 512-824-1401
Utah Salt Lake City, J. J. Woerner 801-328-2531
FOR: Can., Toronto, G. J. Britz 416-676-2511

AMERICAN ALUMINUM CO., 230 Sheffield St., Dept. EEM, Mountainside, N.J., 07092, Tel: 201-AD 3-3500; Empl.: 125

For info on price: T. Moser; Application info: D. Stanley; Customer service: R. R. King; Delivery info: D. Stanley

Free literature available: Literature contains illustrations and brief explanations of engineered products AMALCO has manufactured to our customers specifications.

Products manufactured: Cases, Equipment, Instrument, Meter, Cases, Transit, Chassis, Metal, Containers

Local Sales Offices & Reps.
Ariz Scottsdale, F. Schoeffler Assocs. 602-948-3470
Cal Downey, E. Shyffer & Assoc. 213-928-1824
Cal Palo Alto, Abbott Engrg. Co. 415-327-0830
Colo Denver, W. Purdy Co. 303-777-1411
Fla Orlando, Hi-Co Assocs. 305-273-0571
Ga Decatur, H. M. Walton Co. 404-482-2794
Ill Northfield, H. S. Tollaksen Co. 312-441-6644
Ind Indianapolis, Russell Sales Co. 317-547-0188
Md North East, Progressive Assocs. 301-287-6422
Mich Birmingham, W. A. Baumstark Co. 313-644-1120
Minn Wayzata, Schlenker & Assocs. 610-473-5417
Mo St. Louis, R. Pratt & Assocs. 314-426-0420
NJ Boonton, Winter Assocs. 201-334-3434
NJ Collingswood, K. Randall Co. 609-854-3323
NY Plainview, Flower Hill Prods. 516-420-8555
NY Rochester, Upstate Component Sls. 716-288-1080
NY Troy, New-Co Assocs. 518-BE 5-0539
NC Greensboro, Mfr. Sls. Co. 919-274-2474
Ohio Bay Village, T. R. Heekin 216-871-6939
Pa Villanova, C.I.V. Co. 215-525-7054
RI Peace Dale, G. Forman Co., Inc. 401-789-3021
Tex Dallas, J. M. Spell Co. 214-620-0040
Tex Houston, Traton, Inc. 713-782-8234
WVa Wheeling, D & L Sls. Co. 304-232-0490

AMERICAN ASTRIONICS, Div. of Technicolor, 291 Kalmus Dr., Costa Mesa, Cal., 92626, Tel: 714-540-4330; Empl.: 30

Products manufactured: Amplifiers, Converters, Data Acquisition & Reduction Systems, Memories, Buffer, Memory Systems

Local Sales Offices & Reps.
Cal Costa Mesa, American Astronics 714-540-4330
Fla Orlando, Scientific Devices 305-424-7932
Va Springfield, Scientific Devices 703-451-6500

AMERICAN CHEMICAL ETCHING, INC., 13730 Desmond St., Pacoima, Cal., 91331, Tel: 213-896-1188; Empl.: 16

Customer service: T. Boyer

Products manufactured: Antennas, Encoders, Laminations, Services, Assembly, Production & Test, Shields, Springs (All Types), Strip-Line Components, Microwave

AMERICAN DESIGN COMPONENTS, 39 Lispenard St., New York, NY, 10013, Tel: 212-WO 6-5650

AMERICAN ELECTRIC CABLE CO., 181 Appleton St., Holyoke, Mass., 01040, Tel: 413-539-9893; Empl.: 100

For info on price: H. Peterson; Application info: W.M. Mayo; Customer service: W.M. Mayo; Delivery info: W.M. Mayo

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Services, Assembly, Production & Test, Solder (All Types), Strips, Wire, Wire Shielding, Wire Strippers, Wire Twisters

Local Sales Offices & Reps.
Cal Los Altos, Shannon Elctrns. 415-941-2217
Md Baltimore, Coulbourn DeGreif Inc. 301-247-4646
Mass Holyoke, American Electric Cable Co. 413-539-9893
Minn Minneapolis, International Sales Co. 612-831-8423
Mo Kirkwood, Limmit Manufacturers' Repr. 314-822-3015
NJ Hohokus, D.J. Fisher Co., Inc. 201-652-0090
NY E. Syracuse, Mac-Tron Sales & Engrg., Co. 315-422-2425
Ohio Cleveland, Milber Co. 216-752-7528
Pa Ardmore, W.K. Metz 215-649-3966
FOR: Can., Montreal, Que., McIntyre Agencies Ltd. 514-731-9618

AMERICAN ELEC. HEATER, 6110 Cass Ave., Detroit, Mich., 48202, Tel: 313-875-2505; Empl.: 75; Minimum order: $25

For info on price: D. Wilson; Application info: R. S. Edwards; Customer service: D. Wilson; Delivery info: D. Wilson

Products manufactured: Cleaners, Ultrasonic, Heat Guns, Production, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Wire Strippers

Local Sales Offices & Reps.
Ariz Phoenix, Maddox Sls. Co. 602-274-3807
Cal Pico Rivera, Maddox Sls. Co. 213-949-5433
Cal San Diego, Maddox Sls. Co. 714-444-6959
Cal San Francisco, Maddox Sls. Co. 415-431-2953
Colo Boulder, Mile High Elctr. 303-444-5615
Fla Clearwater, H.R. Gross Co. 813-446-6649
Ga Atlanta, Millar Elctr. Inc. 404-261-6160
Ill Mt. Prospect, American Electrical Heater Co. 312-253-6813
Ind Indianapolis, Sukup & Cox Inc. 317-253-5501

Directory of Local Distributors Starts on page 401

Iowa	Des Moines, K. Kelly & Co.	515-255-5501
Kans	Shawnee Mission, K. Kelly & Co.	913-722-0000
La	Metairie, F. McKinney Sls. Co.	504-887-1723
Md	New Carrolton, W. A. Brown Co.	301-577-4527
Mass	Wayland, Ellingwood Inc.	617-358-2883
Mo	St. Louis, K. Kelly & Co.	314-968-3800
NM	Albuquerque, Maddox Sls. Co.	505-298-2422
NY	Cicero, Advanced Comps Corp.	315-699-2671
NY	Clinton, Advanced Comp Corp.	315-853-6438
NY	Elmhurst, Wilson Assoc.	212-899-0929
NY	Endicott, Advanced Comp Corp.	607-785-3191
NY	Scottsville, Advanced Comp Corp.	716-889-1429
NC	Raleigh, Millar Elctr. Inc.	919-787-9585
Ohio	Wickliffe, Associate Sls. Co.	216-585-5445
Okla	Tulsa, J.F. McKinney Sls. Co.	918-742-6791
Ore	Portland, J.W. EcKersley Co.	503-246-3183
Pa	Norristown, American Electrical Heater Co.	215-272-4818
Tex	Dallas, J.F. McKinney Sls. Co.	214-631-9450
Tex	Houston, J.F. McKinney Sls. Co.	713-774-3232
Va	Alexandria, W. A. Brown Co.	703-836-1800
FOR:	Can., Downsview, Ontario, Len Finkler Ltd.	416-630-9103
FOR:	Can., Montreal, Quebec, Len Finkler Ltd.	514-342-9800
FOR:	Can., N. Vancouver, B.C., Len Finkler Ltd.	604-988-2713
FOR:	Can., Sherwood Park, Alberta, Len Finkler Ltd.	403-699-2979

AMERICAN ELECTRONIC CONTROLS, 25 Clark Dr., Barrington, N.J., 08007, Tel: 609-546-5792; Empl.: 23

Customer service: R. Patterson

Products manufactured: Controls/Control Eqpt., Deposition Equipment, Vacuum & Accessories, Heaters & Heating Elements, Test Equipment, Testers, Timers

AMERICAN ELECTRONICS, INC., 1600 E Valencia Dr., Fullerton, Cal., 92631, Tel: 714-871-3020, TWX: 910-592-1256; FSC No: 89321; Empl.: 150; Minimum order: $100

Customer service: B. G. Guy 714-871-3020

Free literature available: Hi-Cycle Inductor-Alternators, 400 cycle Motor-Generator Sets, Permanent Magnet DC Motors, Compensated Computing Resolvers & Amplisolvers, DC Motors, Resolvers, Stepper Motors

Products manufactured: Alternators, Converters, Generators, Motor & Generator Armatures, Rotors, Stators, Motor Electric Generator Sets, Motors, Resolvers, Synchro, Servo Systems, Tachometers

Local Sales Offices & Reps.

Cal	Los Angeles, Products Supply Co.	213-659-1858
Cal	Los Angeles, Sumitomo Shoji Amer.	213-627-4783
Ill	Chicago, Engineered Sls Co.	312-867-8434
Ohio	Lakewood, Power Engrg. Sales	216-221-9090
Wash	Seattle, Instrument Lab.	206-283-5850

AMERICAN GAS & CHEMICALS CO., LTD., 511 E. 72nd St., New York, N.Y., 10021, Tel: 212-535-7336; Empl.: 25

Products manufactured: Detectors

AMERICAN INSTR. CO., Div. Travenol Labs. Inc., 8030 Georgia Ave. - Dept. D16-2, Silver Spring, Md., 20910, Tel: 301-JU 9-1727, TWX: 710-825-9621; Empl.: 572

For info on price: R. Dennis; Application info: F. Quinn; Customer service: R. Dennis; Delivery info: R. Dennis

Products manufactured: Alarms, Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Indicators

Local Sales Offices & Reps.

Cal	Santa Ana, American Instr. Co.	714-557-2120
Cal	Sausalito, American Instr. Co.	415-332-4726
Colo	Denver, American Instr. Co.	303-422-6313
Fla	Gainesville, American Instr. Co.	904-378-4612
Haw	Kailua, American Instr. Co.	808-254-2491
Ill	Barrington, American Instr. Co.	312-381-5120
Mass	Bedford, American Instr. Co.	617-275-0014
NJ	Collingswood, American Instr. Co.	609-854-6633
NY	Babylon, American Instr. Co.	212-353-3663
NY	Pittsford, American Instr. Co.	716-334-0110
NC	Black Mountain, American Instr. Co.	704-669-6100
Ohio	Cleveland, American Instr. Co.	216-248-5920
Tex	DeSoto, American Instr. Co.	214-224-1222
Tex	Humble, American Instr. Co.	713-446-7551
FOR:	Can., Don Mills, Ont., American Instr. Co.	416-247-0485

AMERICAN LAVA CORP., Sub 3M Co., Cherokee Blvd. & Mfg. Rd., Chattanooga, Tenn., 37405, Tel: 615-265-3411, TWX: 810-573-5216; Empl.: 2000

Products manufactured: Capacitors, Fixed, Circuits, Printed, Multilayer, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Cores, Ceramic, Feedthrus & Seals, Environmental, Heat Sinks, Soldering, Holder & Carriers, Insulators & Insulation, Packages, Integrated Circuit, Seals, Services, Assembly, Production & Test, Substrates, Terminals, Thermocouples, Elements & Accessories, Tubes, Tubing

Local Sales Offices & Reps.

Ariz	Scottsdale, American Lava	602-948-6750
Cal	Los Angeles, 3M Co.	213-726-1511
Cal	San Francisco, 3M Co.	415-761-1155
Conn	Orange, American Lava	203-795-3254
Ill	Bedford Park, 3M Co.	312-585-7800
Ind	Indianapolis, American Lava	317-888-2196
Mass	Boston, 3M Co.	617-449-0300
Minn	St. Paul, 3M Co.	612-733-8407
NJ	West Caldwell, 3M Co.	201-227-9100
NY	Phoenix, American Lava	315-695-3335
Ohio	Cleveland, 3M Co.	216-267-1800
Pa	Philadelphia, 3M Co.	215-742-0200
Tenn	Chattanooga, American Lava	615-877-1677
Tex	Dallas, 3M Co.	214-327-7311
Va	Roanoke, American Lava	703-989-3572

AMERICAN MAGNETICS CORP., P.O. Box 8, Carterville, Ill., 62918, Tel: 618-985-4838; Empl.: 120; Minimum order: $25

For info on price: V. R. Stoner; Application info: R. E. Hume; Customer service: V. R. Stoner; Delivery info: R. L. Watson

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Transformers

Local Sales Offices & Reps.

Fla	Miami, L. P. Hench Co.	305-652-4991
Ind	Fort Wayne, Component/Insulation Corp.	219-485-7114
Iowa	Cedar Rapids, D. Taylor	319-364-2282
Mass	Newton Upper Falls, Brookdale Elctrns. Engrg.	617-244-6969
Mich	Birmingham, Forand Sls. Co.	313-644-0087
NY	Glen Oaks, S. Oser	212-343-4506
NY	Rochester, L. G. Marchese Assoc.	716-342-7664
Ohio	Cleveland, Component/Insulation corp.	216-521-3570
Okla	Tulsa, Component's Inc.	918-583-9149
Pa	Narberth, S. A. Jeffries	215-664-8500
Tex	Dallas, United Comps.	214-324-1448

AMERICAN MAGNETICS, Box R, Oak Ridge, Tenn., 37830, Tel: 615-482-1056; Empl.: 8

For info on price: D. L. Coffey; Application info: K. R. Efferson; Customer service: E. T. Henson; Delivery info: E. T. Henson

Products manufactured: Coils Including Assemblies & Forms, Magnets

AMERICAN MICROSYSTEMS, INC., 3800 Homestead Rd., Santa Clara, Cal., 95051, Tel: 408-246-0330, TWX: 910-338-0018; Empl.: 3000; Minimum order: $50

For info on price: R. Konrad; Application info: R. Konrad; Customer service: M. Jones; Delivery info: M. Jones

Products manufactured: Display Devices/Displays, Integrated Circuit Devices, Semiconductor Wafer Fabrication

Local Sales Offices & Reps.

Instar

Ariz	Phoenix, Hecht, Henschen & Assocs.	602-275-4411
Cal	Manhattan Beach, American Micro-systems	213-379-2452
Cal	Mountain View, American Micro-systems	415-969-0610
Fla	Altamonte Springs, American Micro-systems	305-830-8889
Ill	Elk Grove Village, American Micro-systems	312-437-6496
Mass	Norwood, American Micro-systems	617-762-0726
Mich	Brighton, Lowrey & Assocs.	313-227-7067
Mich	Livonia, American Micro-systems	313-478-9339
Minn	Minneapolis, American Micro-systems	612-546-3354
NY	Monsey, American Micro-systems	914-352-5333
NY	Syracuse, Precision Sls. Co.	315-458-2223
Okla	Oklahoma City, Parvin Sls. Co.	
Ore	Beaverton, E. S. Chase Co.	503-649-6177
Pa	Ambler, American Micro-systems	215-643-0217
Pa	Pittsburgh, Compu Graphs	412-366-5056
Tex	Addison, Parvin Sls. Co.	214-239-9148
Tex	Houston, Parvin Sls. Co.	713-784-9900
Tex	Richardson, American Micro-systems	214-231-5721
Wash	Edmonds, E. S. Chase Co.	206-774-3586

AMERICAN MONARCH CORP., 2801-37th Ave., N.E., Minneapolis, Minn., 55421, Tel: 612-788-9161; Empl.: 175

For info on price: R. Sutherland; Application info: L. Anderson; Customer service: R. Sutherland; Delivery info: R. Sutherland

Products manufactured: Chassis, Metal, Chokes, Converters, Eliminators, Battery, Inverters, Power Supplies, Testers, Transformers

Local Sales Offices & Reps.

Cal	Santa Clara, Cummings & Assocs.	408-241-3444
Cal	Woodland Hills, Cummings & Assocs.	213-340-6036
Fla	St. Petersburg, Lanagan Sls. Co.	813-822-1192
Ill	Oak Park, Wasson-Gallagher Inc.	312-261-7517
Md	Baltimore, J.A. Maguire & Co.	301-377-0223
Mass	Lexington, Circuit Sls. Co.	617-861-0567
Mich	Birmingham, Forand Sls. Co.	313-644-0087
NJ	Pennsauken, J.A. Maguire & Co.	609-665-5136
NJ	Plainfield, J.A. Maguire & Co.	201-754-6400
NY	Camillus, Ontec	315-488-2203
NY	Fayetteville, Ontec	
NY	Grand Island, Ontec	716-773-9319
NY	Plainview, Preisick Assoc.	516-681-8444
NY	Rochester, Ontec	716-464-8636
NC	Winston Salem, J.A. Maguire & Co.	919-723-5980
Okla	Oklahoma City, Ammon & Rizos Co.	405-373-2748
Okla	Tulsa, Ammon & Rizos Co.	918-633-8518
Tex	Dallas, Ammon & Rizos Co.	214-233-5591
Tex	Houston, Ammon & Rizos Co.	713-729-1233

AMERICAN OPTICAL CORP., Sci. Instr. Div., Eggert & Sugar Rds., Buffalo, N.Y., 14215, Tel: 716-895-4000; Empl.: 1500

Products manufactured: Microscopes

Local Sales Offices & Reps.

Cal	Los Angeles	213-245-6454
Cal	San Francisco	415-826-8300
Colo	Denver	303-321-1010
Ga	Atlanta	404-881-1426
Ill	Chicago	312-671-3506
Md	Silver Spring	301-585-3681
Mass	Boston	617-782-2538
Mich	Detroit	313-962-0919
Minn	Minneapolis	612-823-8261
Mo	St. Louis	314-531-1155
NY	Buffalo	716-895-4000
NY	New York City	212-986-2300
Ohio	Cincinnati	513-421-4414
Ohio	Cleveland	216-241-0737
Pa	Philadelphia	215-568-1448
Pa	Pittsburgh	412-281-9513
Tenn	Memphis	901-525-4401
Tex	Dallas	214-747-8361
Tex	Houston	713-526-1731

AMERICAN POWER DEVICES, 7 Andover St., Andover, Mass., 01810

AMERICAN POWER SYSTEMS CORP., 51 Jackson St., Worcester, Mass., 01608, Tel: 617-753-8103; Empl.: 51

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Cal	Pasadena, P. Nurches Co.	213-681-8957
Conn	Madison, United Comps. Inc.	203-562-4002
Conn	New Haven, United Comps. Inc.	203-502-4002
Mass	Attleboro, United Comps. Inc.	617-225-0556
Mass	Worcester, Ampsco Mktg. Corp.	617-753-8103
NY	Roslyn Heights, Trauco Assoc. Inc.	516-621-3223
RI	Saunderstown, United Comps. Inc	401-295-8342

AMERICAN RADIO RELAY LEAGUE, 225 Main St., Newington, Conn., 06111, Tel: 203-666-1541; Empl.: 80

Free literature available: Catalogue sheets showing our various publications.

Products manufactured: Technical Books

AMERICAN RESCH. CORP., Rte. 6 & New Britain Ave., Farmington, Conn., 06032, Tel: 203-677-2693; Empl.: 15

For info on price: J. Shamroth; Customer service: T. Augustyn

Products manufactured: Chamber, Environmental Test

AMERICAN SAFETY RAZOR, P.O. Box 500, Staunton, Va., 24401

AMERICAN SMELTING & REFINING CO., 120 Broadway, New York, N.Y., 10005

AMERICAN SWITCH CORP., Sadler St., Gloucester, Mass., 01930, Tel: 617-281-2224; Empl.: 8

Customer service: R. T. Armitage

Free literature available: Comprehensive catalog listing all electrical & mechanical specs plus features, new product insert sheets cross reference sheet price schedule, and listing reps. & distributors.

Products manufactured: Switches

Local Sales Offices & Reps.
Ariz Scottsdale, Chewer Electronic Sls. 602-994-3288
Cal Encino, V & L Assocs. 213-986-9703
Cal San Carlos, D.H. Ross Co. 415-591-4411
Colo Arvada, Cleveland Entprs. Inc. 303-423-3707
Conn Wallingford, Com-Sale Assocs. 203-269-7964
Fla Hollywood, W. Ben Wimberly Co. 305-961-6962
Fla Orlando, W. Ben Wimberly Co. 305-423-2514
Ga Smyrna, Fausett of Georgia 404-436-5169
Ill Streamwood, Al Holte & Assocs. 312-837-4066
Ind Fort Wayne, Needler Sls. Co. Inc. 219-447-2123
Iowa Cedar Rapids, J. Vrbik Co. 319-377-8244
Md Baltimore, Bernard White & Co. 301-484-5400
Mass Gloucester, American Switch Corp. 617-281-2224
Mass Waltham, Com-Sale Assocs. 617-890-0011
Minn Minneapolis, Hasse & Assocs. 612-535-2671
Mo Saint Louis, Gordon Fixman Eng'g. Co. 314-725-5219
NJ Teaneck, Stan Axelrod Assocs. 201-836-2661
NM Albuquerque, Cleveland Entprs. Inc. 505-298-7671
NY Port Washington, P.D. Aaron Assoc. 516-883-0600
NY Syracuse, Nycom Inc. 315-437-8343
Ohio Vandalia, W.J. Braver & Assoc., Inc. 513-898-1224
Ohio Wickliffe, W.J. Braver & Assoc., Inc. 216-943-0601
Pa Pittsburgh, W.J. Braver & Assoc., Inc. 412-921-3213
Tex Dallas, McCoy Assocs. 214-350-9931
Tex Houston, McCoy Assocs. 713-649-5756
Va Vinton, Fausett of Georgia 703-890-1128
Wash Seattle, R.K. Squibb, Inc. 206-632-2450

Local Distributors
Ariz Scottsdale, Vanguard Supply Co., 10333 N. Scottsdale Rd. 602-948-2240
Cal Anaheim, Henry Radio Co., 931 N. Euclid St. 714-772-9200
Cal Buena Pk., S.J. Radio Elctrns., 6001 Beach Blvd. 714-521-1906
Cal Burlingame, Rose Electr. Dist. Co., 846 Stanton Rd. 415-697-0224
Cal Canoga Pk., Sandy's Electr. Supply, 21305 Saticoy St. 213-346-8353
Cal Costa Mesa, Mar-Vac Elctrns., 1829 Newport Blvd. 714-540-3280
Cal Long Beach, Scott Radio Supply, 266 Alamitos Ave. 213-437-8629
Cal Los Angeles, Control Parts Distributors, 1252 W. Temple St. 213-625-1488
Cal Los Angeles, Elec. Switches, 2478 Fletcher Dr. 213-664-1141
Cal San Jose, Peninsula Elctrn. Supply, 980 S. First St. 408-294-8781
Cal San Rafael, Elctrns. Plus, 823 Fourth St. 415-457-0466
Cal Santa Monica, Master Distributors, 1553 17th St. 213-395-2637
Cal Van Nuys, Patane Avionics, 5937 Kester Ave. 213-968-4455
Fla Miami, Farreys Hdw. Co., 7225 NW Seventh Ave. 305-754-5451
Ill Streamwood, GTI Supply, 517 Hillside Dr. 312-837-4066
Iowa Cedar Rapids, Jerry Vrbik Co., Three 50th St. N.E. 319-377-8244
Md Beltsville, Treeko Sls., 10739 Tucker St. 301-937-8260
Md Bethesda, Empire Electr. Supply, 4907 Rugby Ave. 301-656-3300
Mass Cambridge, Apollo Electr., 101 Binney St. 617-868-3120
Mass Waltham, QPL Elctrn. Distributors, 47 Calvary St. 617-924-4100
Mich Grand Haven, GTI Supply, Beechtree Marion 616-842-5430
Minn Minneapolis, Industrial Components, 5280 W. 74th St. 612-831-2666
NH Londonderry, Yankee Electr. Supply, Grenier Ind. Village 603-625-9746
NJ Colonia, Pamco Elctrns., 1333 St. George St. 201-574-9366
NJ Fairfield, Industrial Elctrns., 1275 Bloomfield Ave. 201-575-8420
NJ Hackensack, Tide Electr., 97 S. State St. 201-488-3900
NJ Rockaway, Electrospec, 11 Bank St. 201-625-2300
NY Melville, Prime Electronics, 275 Broadhollow Rd. 516-420-1600
NY Mt. Vernon, QAR Industrial Elctrn. Sls., 621 S. Columbus Ave. 914-699-2224
NY Port Washington, Connector Concepts Corp., 735 P. Washington Blvd. 516-883-0600
Ore Portland, EOFF Electric Co., 509 NW 10th Ave. 503-222-9411
Pa Philadelphia, Simco Electronics, 3907 N. Broad St
Tex Dallas, All State Elctrns., 510 S. Good Latimer St. 214-748-6533
Tex Dallas, Dallas Instruments, 10205 Plano Rd. 214-341-2990
Tex Dallas, KA Elctrn. Sls., 1220 Majesty 214-634-7870
Tex Fort Worth, Industry Elctrns. Supply, 1818 E. Dagget Ave. 817-531-2961
Tex Irving, EDCO Elctrns., 614 Plymouth Pk. Ctr. 214-259-7544
Tex San Antonio, Sherman Elctrns. Supply, 720 San Pedro Ave. 512-226-0247
Tex Stafford, Southwest Elctrns., 12725 Royal Dr. 713-782-3060
Wash Seattle, Radar Electric Co., 168 Western Ave. W. 206-282-2511

AMERICAN TECHNICAL CERAMICS, 1 Norden La., Huntington Sta., N.Y., 11746, Tel: 516-271-9600, TWX: 510-226-6993; FSC No: 29990; Empl.: 150 ...... p. 2•28-31

For info on price: Cust. Sls. & Svc.; Application info: W. F. Hamilton; Customer service: Cust. Sls. & Svc.; Delivery info: Cust. Sls. & Svc.

Free literature available: Send for the following ATC literature: "UHF/Microwave Capacitors" product catalog, THE RF CAPACITOR HANDBOOK, "ATC UHF/Microwave Capacitor Kits", RF Capacitor Technical Chart.

Products manufactured: Capacitors, Fixed, Capacitors, Variable

Local Sales Offices & Reps.
Ala Huntsville, FM Assocs. 205-536-9990
Ariz Phoenix, Thorson Co. 602-956-5300
Cal Burbank, Wright Engrg. Co. 213-843-7240
Cal San Jose, Allgood North 408-288-6731
Fla Orlando, FM Assocs. 305-851-5710
Fla Tequesta, FM Assocs. 305-746-3126
Ill Chicago, Tech. Sls. 312-237-7210
Md Randallstown, C. Malinow & Co. 301-922-2092
Mass Natick, Wayland Engrg. Sls. 617-655-6080
Mo Kansas City, Harris-Hanson Co. 816-444-9494
Mo St. Louis, Harris-Hanson Co. 314-432-3611
NM Albuquerque, Technology Marketing Assocs. 303-841-3435
NY Liverpool, R & D Assocs. 315-622-2350
NY Syracuse, Nycom, Inc. 315-437-8343
NC Greensboro, FM Assocs. 919-294-2754
Ohio Dayton, Berberich Assocs. 513-433-0342
Tex Addison, Parvin Sls. 214-239-9148
Tex Houston, Parvin Sls. 713-721-1054
Wash Bellevue, Thorson Co. 206-455-9180

AMERICAN TIME PRODUCTS, BULOVA WATCH, 61-20 Woodside Ave., Woodside, N.Y., 11377, Tel: 212-335-6000; Minimum order: $100 p. 1•4,295,1006,1007,1124

Customer service: R. Ansell

Products manufactured: Amplifiers, Analyzers, Bridges, Calibrators, Choppers, Coders, Coils Including Assemblies & Forms, Comparators, Controls/Control Eqpt., Crystals, Decoders, Demodulators, Detectors, Drivers, Chopper, Filters, Generators, Indicators, Inverters, Keyers, Tone, Light Choppers, Meters, Modulator/Demodulators, Modulators, All Kinds, Monitors, Oscillators, Power Supplies, Records, Frequency Test, Regulators, Scanners, Servo Systems, Standards, Switches, Timers, Transducers, Tuning Forks

Local Sales Offices & Reps.
Ariz Scottsdale, Carter Assocs. 602-947-4355
Cal Palo Alto, A. Barrauck 415-327-7711
Ill Chicago, Tech. Rep. Inc. 312-761-0548
Minn Minneapolis, Torkelson Assocs. 612-835-2414
NY Buffalo, H.C. Johnson Agencies 716-632-7880
NY Mamaroneck, Cane Tech. Sls. 914-698-4411
Pa Glenshaw, H.C. Johnson Agencies 716-482-3000
Tex Richardson, Carl Tinch Sls. Co. 214-231-1322
EXP: New York, N.Y., C. Tennant 212-679-1300

AMERICAN TRANS-COIL CORP., 124-06 101st Ave, Richmond Hill, N.Y., 11419, Tel: 212-441-5207; Empl.: 50

Customer service: W. T. Clancy

Free literature available: Bulletins listing items we (ATC) supply for specific military equipment ie: AN/GRC-106-Bulletin #125. Items listed are cross referenced to U.S. Govt. Drawings, Fed. Stock No., and O.E.M. Part No.

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Discriminators, Filters, Networks, Oscillators, Reactors, Transformers

Advertisment

American Trans-Coil Specializes in Military type Coils Transformers and Filters Tolerances within one quarter of one percent. For prototype and production quantities of linear permeable tuned R.F. and I.F. transformers, B.F.O.'s discriminator transformers, R.F. oscillators, toroids, networks and filters-active and passive, send your specifications or drawings for responsive quotations.

AMERICAN ULTRAVIOLET, 320 Commerce St., Chatham, N.J., 07928, Tel: 201-635-8355, Telex: 139266; Empl.: 14; Minimum order: $15

For info on price: G. W. Fitzgerald 201-635-8355; Application info: G. W. Fitzgerald 201-635-8355; Customer service: J. S. Raymond 201-635-8356; Delivery info: D. M. Loges 201-635-8357

Products manufactured: Lamps, Lights, Radiometers, Sockets, Ultraviolet Inspection Lighting

AMERICAN USED COMPUTER CORP., Box 68, Kenmore Sta., Boston, Mass., 02215, Tel: 617-261-1100, TWX: 710-321-6388

Products manufactured: Computers, Converters, Memory Systems, Printers, Punched Card Equipment

AMERICAN VECTOR/TDC, 201 Culver Rd., Dayton, N.J., 08810, Tel: 201-329-4683, TWX: 710-983-4448; Empl.: 175 .... p. 1•1083

Products manufactured: Amplifiers, Controls/Control Eqpt., Converters, Generators, Inverters, Oceanographic Equip. (Electronic), Oscillators, Power Supplies, Regulators, Services, Assembly, Production & Test, Shifters, Signal Conditioners & Equipment, Standards, Testers, Transformers, Transmitters, Underwater Communication, Detection, Navigation, etc. Equipment, Voltage Sources

Local Sales Offices & Reps.
Cal Inglewood, L & M Engrg. Inc. 213-674-6850
Cal San Diego, Qualtronics 714-224-6555
Cal Santa Clara, L & M Engrg. Inc. 408-243-2891
Ill Chicago, K. W. Meyers Co. 312-774-6440
Ind Indianapolis, K. W. Meyers Co. 317-243-6681
Md Silver Spring, Gawler-Knoop Co. 301-589-4406
Mass Attleboro, Electronic Sls. of New England 617-222-4078
Minn Minneapolis, K. W. Meyers Co. 612-920-7080

NJ	Englewood, Central Assocs.	201-568-0808
NM	Albuquerque, Rustco Entprs.	505-296-6474
NY	Plainview, Central Assocs.	516-433-0808
NY	Rochester, Scientific Devices	716-334-2445
Ohio	Cleveland, Automated Equip. & Eng.	216-462-2855
Pa	Philadelphia, W. F. Assocs.	215-224-4120
Pa	Pittsburgh, Automated Equip. & Eng.	412-931-7616
Tex	Houston, Scientific Sls. Co.	713-781-2711
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Wash	Seattle, Hayes Tech.	206-763-2210
FOR:	Can., Scarborough, Ontario, J. De Groot Assoc.	416-264-2991

AMERICAN VIDEONETICS CORP., 795 Kifer Rd., Sunnyvale, Cal., 94086, Tel: 408-732-2000, TWX: 910-339-9362; Empl.: 70; Minimum order: $25

For info on price: R. Meyering; Application info: L. Lehman; Customer service: L. Leahman; Delivery info: R. Meyering

Free literature available: 1. Datacord tape memory systems. Product specifications & application notes on all digital recording devices offered by AVC. 2. Magnetic Head Products. All magnetic head products.

Products manufactured: Heads, Recording Playback, Erase, Memory Systems, Recorders

AMERICAN ZETTLER, INC., 16881 Hale Ave., Irvine, Cal., 92705, Tel: 714-540-4190; Empl.: 70

p. 1•1574-1577,1932

Products manufactured: Covers, Protective (Including Dust), Relays, Retainers, Sockets, Solenoids, Switches

Local Sales Offices & Reps.

Ala	S.E. Huntsville, Elmar Assocs.	215-881-0274
Ariz	Tempe, J.F. Hurlbut Co.	602-968-5962
Cal	Mountain View, G.C. Woempner Co.	415-964-5454
Cal	Santa Monica, Rep Assocs.	213-829-5401
Colo	Golden, J.F. Hurlbut Co.	303-279-7996
Conn	North Haven, Forsberg Sls.	203-239-5111
Fla	Maitland, Barrett Assocs.	305-678-0172
Fla	Miami, Barrett Assocs.	305-681-4957
Ga	Atlanta, Elmar Assocs.	404-938-2821
Ill	Elk Grove Village, Knoblock & Assocs.	312-593-5940
Ind	Indianapolis, Quad-El Inc.	317-356-5449
Kans	Shawnee Mission, Florence & Meyer Inc.	913-722-5210
Kans	Wichita, Florence & Meyer Inc,	316-838-7226
Mass	Brockton, Forsberg Sls.	617-522-6300
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
Mo	St. Charles, Florence & Meyer	314-724-6690
NJ	Cherry Hill, Danco Elctrn. Sls. Corp.	609-424-5590
NY	Alexander, B.H. Tollefson Assocs.	716-591-1219
NY	Auburn, B.H. Tollefson Assocs.	315-253-4109
NY	Lynbrook, MWM Assocs.	516-593-6190
NY	Rochester, B.H. Tollefson Assocs.	716-271-4141
NC	Raleigh, Elmar Assocs.	919-787-2841
Ohio	Cincinnati, R. Makin Assocs.	513-232-5588
Tex	Dallas, R. Martin Assocs.	214-361-8584
Tex	Houston, R. Martin Assocs.	713-462-4077
Wash	Seattle, Thornson Co.	206-455-9180
Wisc	Milwaukee, Devos/Prinz	414-272-0356
For:	Can., Ottawa, Ont., Lake Engrg.	613-729-6090
For:	Can., Richmond, B.C., Lake Engrg.	604-277-0414
For:	Can., Scarborough, Ont., Lake Engrg.	416-751-5980
For:	Can., St. Laurent, Que., Lake Engrg.	514-747-2441
For:	Can., Winnipeg, Man., Lake Engrg.	604-889-7966

AMERICAN ZETTLER, INC. cont'd

Advertisment

Alois Zettler, a Swiss company, is one of the largest relay and switch manufacturers in Europe. American Zettler, a wholly owned subsidiary, follows the traditional Swiss observance of quality and precision. Assembly and checkout facilities in the United States are staffed by highly skilled and experienced circuit analysts who are on call to assist you in specifying any relay or switch application. A complete stock of products assures you of immediate, off-the-shelf delivery. Our engineers will be glad to provide you with free samples of American Zettler relays and switches and discuss your problems at no cost or obligation. Simply call or write one of the Sales-Engineering Representatives listed, or contact our headquarters in Irvine, California.

AMERSIL, INC., 685 Ramsey Ave., Hillside, N.J., 07205, Tel: 201-688-4500; Empl.: 100; Minimum order: $25

Customer service: Sls. Dept.

Free literature available: Amersil Price list EM-9503-3 Covers a complete line of fused quartz and fused silica products designed to meet the exacting specifications required by the electronic industry.

Products manufactured: Machines/Machinery, Production, Quartz, Fused, Silica, Fused, Substrates, Tubing

Local Sales Offices & Reps.

Cal	Pasadena, Amersil, Inc.
Mass	Plymouth, Amersil, Inc.
Ohio	Cleveland, Amersil, Inc.
Tex	Dallas, Roy Tindel & Assocs.
FOR:	Can., Toronto, Ont., Engelhard Inds. Div.

AMETEK, Applies Materials Div., Station Square Two, Paoli, Pa., 19301, Tel: 215-647-2121

Customer service: R. Menard

Free literature available: Electro Deposition of Aluminum-Four-Page Bulletin AM-102 Describes Ametek, Applied Materials Process For Ambient Temperature Electro Deposition of Aluminum.

Products manufactured: Services, Assembly, Production & Test

Advertisment

Selective gold plating of electronic components such as semiconductors and electrical contacts in production quantities. Also, ambient temperature electrodeposition of aluminum on microelectronic parts to provide excellent corrosion resistance and conductivity. Request free descriptive literature from AMETEK, Applied Materials.

AMETEK CONTROLS DIVISION, 860 Pennsylvania Blvd., Feasterville, Pa., 19047, Tel: 215-355-6900; Empl.: 100

Products manufactured: Coils Including Assemblies & Forms, Controls/Control Eqpt., Demodulators, Indicators, Meters, Power Supplies, Transducers, Transformers, Wire

AMETEK, HUNTER SPRING DIVISION, One Spring Ave., Hatfield, Pa., 19440, Tel: 215-822-2971, TWX: 510-661-4888; FSC No: 6635; QPL No: 43560; Empl.: 375; Minimum order: $25

For info on price: A. Haag; Application info: A. Haag; Customer service: R. Hager; Delivery info: A. Haag

Products manufactured: Forms, Wire, Gages, Mounts, Reels, Cord & Cable, Springs (All Types)

AMETEK/LAMB ELECTRIC, 627 Lake St., Kent, Ohio, 44240, Tel: 216-673-3451; Empl.: 1000

For info. on price: R. Page; Application info: E. J. Moore; Customer service: K. Wagner; Delivery info: R. Page

Free literature available: LC 101 - Capabilities Brochure; LC 102 - Product Selection Guide.

Products manufactured: Blowers & Fans & Accessories, Motors, Pumps, Vacuum

Local Sales Offices & Reps.

Cal	Thousand Oaks, J. H. Leadam	805-497-2817
Colo	Denver, N. Novosel	303-623-4583
Ill	Elk Grove, L. L. Chamberlain	312-255-3097
Minn	Minneapolis, L. D. Dykstra	612-888-9044
NJ	Morristown, W. W. Washnock	201-267-3772
NY	Rochester, P. J. Treveiler	716-436-5700
Ohio	Ravenna, S. W. Mackey	216-296-8867

AMF ELECTICAL PRODS., Development Div., 1025 N. Royal St., Alexandria, Va., 22314, Tel: 703-548-7221, TWX: 703-931-4209; Empl.: 243

Customer service: Mrsp. Jensen

Products manufactured: Alarms, Amplifiers, Annunciators, Cable Assemblies & Harnesses, Circuits, Hybrid, Thick Film, Computers, Oceanographic Equip. (Electronic), Transponders, Underwater Communication, Detection, Navigation, etc. Equipment

AMGLO CORP., 5301 Wesley Terr., Rosemont, Ill., 60018, Tel: 312-671-4321; Empl.: 21

Customer service: D. Novy

Products manufactured: Capacitors, Fixed, Flashers, Lamps, Power Supplies, Tubes

AMI/COAST MAGNETICS, INC., 1207 N. LaBrea Ave., Inglewood, Cal., 90301, Tel: 213-673-3245; FSC No: 22558; Empl.: 50

For info on price: A. Jones; Customer service: J. Zarate; Delivery info: A. Jones

AMP CAPITRON DIV./AMP INC., 1595 S. Mt. Joy St., Elizabethtown, Pa., 17022, Tel: 717-367-1105, TWX: 510-657-4561

p. 1•128,129,526,527,1088,1089; p. 2•450,451

Products manufactured: Cable, Connectors, Converters, Filters, Lead Assemblies & Receptacles, Modulators, All Kinds, Networks, Power Drivers, Hybrid (High Current, High Voltage), Power Supplies, Programmers, Punched Card Equipment, Punches, Chassis, Readers, Transformers

Local Sales Offices & Reps.

Cal	Compton	213-537-4490
Cal	Cupertino	408-255-3830
DC	Wash	202-293-6936
DC	Washington	202-293-6939
Fla	Orlando	305-841-7771
Ill	Hoffman-Estates	312-885-0720
Mass	Needham	617-444-4839
NY	Canadaiga	315-394-0930
NY	Manhasset	516-627-5418
Tex	Richardson	214-231-2118

AMP INC., Ind'l. Div., Box 3608, Harrisburg, Pa., 17105, Tel: 717-564-0100, TWX: 510-657-4110; Empl.: 12,000

Products manufactured: Boards, Programming, Cable, Capacitors, Fixed, Clamps & Clips, Connector Adapters, Connectors, Contacts, Electrical, Converters, Cords, Data Acquisition & Reduction Systems, Fasteners, Filters, Jacks (All Types), Kits, Terminal, Lamps, Lead Assemblies & Receptacles, Lights, Machines/Machinery, Production, Modulators, All Kinds, Networks, Panels, Plugs, Power Supplies, Punched Card Equipment, Readers, Relays, Sockets, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Switches, Terminals, Tools, Transformers, Tubing

Local Sales Offices & Reps.

Cal	Compton	213-537-4490
Cal	Cupertino	408-255-3830
DC	Washington	204-484-9596
Ga	Atlanta	404-934-6363
Ill	Elk Grove Village	312-439-5800
Mass	Weston	617-891-7500
Mich	Southfield	313-645-5590
Minn	Minneapolis	12-831-8242
NJ	Cranford	201-276-4382
NY	Pittsford	716-385-2860
Ohio	Columbus	614-486-0276
Pa	Berwyn	215-647-6060
Tex	Dallas	14-357-9151

AMP SPECIAL INDUSTRIES, Valley Forge, Pa., 19482, Tel: 215-647-1000, Telex: 84-6405; Empl.: 600

For info on price: A. Salvucci; Application info: F. Harned; Customer service: A. Salvucci; Delivery info: A. Salvucci

Free literature available: Product information bulletins (data sheets); catalog-most widely used products; brochures-for specific industries, or product mix.

Products manufactured: Boards, Programming, Caps, Forms & Tapes, Heat Shrinkable, Clamps & Clips, Compounds, Encapsulating, Insulating, Molding, Potting, Connectors, Cords, Cutters, Wire, Hand Operated, Ducts, Wiring, Integrated Circuit Packaging Systems, Kits, Connector, Kits, Terminal, Lamps, Machines/Machinery, Production, Punched Card Equipment, Readers, Relays, Sockets, Splices, wire (Including, Butt & Cap Types), Switches, Terminal Blocks, Boards & Strips, Terminals, Tools, Tubing, Wire & Cable Ties, Wire Strippers

Local Sales Offices & Reps.

Alas	Anchorage, Yukon Radio Supp.	
Cal	Compton, AMP Special Industries	213-639-1691
Cal	San Mateo, AMP Special Industries	415-573-7722
Colo	Denver, AMP Special Industries	303-756-9453
Ga	Atlanta, AMP Special Industries	404-939-7604
Haw	Honolulu, AMP Special Industries	538-3774
Ill	Elk Grove Village, AMP Special Industries	312-439-7800
Mass	Weston, AMP Special Industries	617-899-6700
Mich	Southfield, AMP Special Industries	313-557-1210
Minn	Minneapolis, AMP Special Industries	612-927-5444
Mo	Kansas City, AMP Special Industries	816-753-6245
NJ	Cranford, AMP Special Industries	201-276-8300
Ohio	Cincinnati, AMP Special Industries	513-821-6650
Pa	Paoli, AMP Special Industries	215-647-3250
Pa	Philadelphia, AMP Special Industries	215-647-3250
Pa	Pittsburgh, AMP Special Industries	412-344-7900
Tex	Dallas, AMP Special Industries	214-631-0850

AMERICAN MICROWAVE INDS., INC., 140 Fourth Ave., Waltham, Mass., 02154, Tel: 617-890-4750, TWX: 710-324-6377; Empl.: 234

For info on price: E. J. DeVita; Application info: B. W. Cooper; Customer service: C. Lewis; Delivery info: Sls. Dept.

Products manufactured: Adapters, Waveguide, Attenuators, Bends & Twists, Microwave, Cable Assemblies & Harnesses, Caps, Connector, Connector Adapters, Connectors, Couplers, Detectors, Dividers, Dummy Loads, Junctions, Hybrid, Microwave, Microwave Integrated Circuits (MIC's), Mixers, Modulators, All Kinds, Strip-Line Components, Microwave, Switches, Terminals, Tools, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Anaheim, American Microwave Ind. S/W	714-956-1800
Cal	Santa Clara, American Microwave Ind. N/W	408-249-5172
Colo	Boulder, J. Smith & Assoc.	303-442-7100
Fla	Palm Bay, Spartech Assoc.	305-727-8045
Ga	Smyrna, Spartech Assoc.	404-432-3644
Kans	Shawnee Mission, Tech. Sls. Assoc.	913-888-3330
Md	Lanham, Brimberg Assoc., Inc.	301-552-2200
Mass	Burlington, Burlington Sls.	617-272-7655
NM	Albuquerque, J. Smith & Assocs.	505-265-3406
NY	Syracuse, C.W. Floring & Assoc.	315-478-2149
NY	Tuckohoe, Asco Electronics	914-779-8110
Ohio	Dayton, Genelco	513-299-1819
Ore	Beaverton, Arneson Assoc.	503-646-6064
Pa	Plymouth Meeting, R. Mar Co.	215-825-2841
Tex	Ft. Worth, W. Pat Fralia Co., Inc.	817-738-2394
Wash	Redmond, Desco, Northwest	206-455-9325

AMPEREX ELCTRONIC CORP., Electro-Optical Devices Div., Box 278, Slatersville, R.I., 02876, Tel: 401-762-3800, TWX: 710-382-6332; Empl.: 250
p. 1•2350,2351

Products manufactured: Capacitors, Fixed, Cavities, Microwave, Cells, Photoconductive, Photoemissive, Photovoltaic, Coils Including Assemblies & Forms, Connectors, Couplers, Detectors, Diodes, Intensifiers, Image, Oscillators, Rectifiers, Scanners, Switches, Thyristors (Includes Silicon Controlled Rectifiers), Transistors, Tubes, Yokes

Local Sales Offices & Reps.

Ala	Huntsville, NAPECC	205-543-7351
Ariz	Phoenix, NAPECC	602-279-9588
Cal	N. Hollywood, NAPECC	213-762-2118
Cal	San Diego, NAPECC	714-453-5440
Cal	Santa Clara, NAPECC	408-249-1134
Colo	Denver, NAPECC	303-922-8434
Fla	Ft. Lauderdale, NAPECC	305-772-2840
Ill	Elk Grove Vil., NAPECC	312-593-8220
Ind	Indianapolis, NAPECC	317-257-6547
Mass	Waltham, NAPECC	617-899-7100
Mich	Southfield, NAPECC	313-357-4288
NJ	Rochelle Park, NAPECC	201-843-4810
NY	Hicksville, NAPECC	516-931-6200
Ohio	Dayton, NAPECC	513-278-7351
Pa	King of Prussia, NAPECC	215-265-4240
Tex	Dallas, NAPECC	214-691-2141
Va	Richmond, NAPECC	804-282-6515
Wash	Bellevue, NAPECC	206-746-3600

AMPEREX ELECTRONIC CORP., Hicksville Div., Box 418 - 230 Duffy Ave., Hicksville, N.Y., 11802, Tel: /516-931-6200, TWX: 501-221-1839; Empl.: 400
p. 1•2352,2353

Products manufactured: Amplifiers, Batteries, Cable, Capacitors, Variable, Cavities, Microwave, Cells, Photoconductive, Photoemissive, Photovoltaic, Circulators, Ferrite, Detectors, Diodes, Oscillators, Photomultiplier Tube Housings, Printers, Rectifiers, Spark Gaps, Speaker Systems, Speakers, Switches, Thermocouples, Elements & Accessories, Thyristors (Includes Silicon Controlled Rectifiers), Transducers, Transistors, Tubes, Wire

Local Sales Offices & Reps.

Ala	Huntsville, NAPECC	
Ariz	Phoenix, NAPECC	
Cal	N. Hollywood, NAPECC	
Cal	San Diego, NAPECC	714-453-2925
Cal	Santa Clara, NAPECC	
Col	Denver, NAPECC	
Conn	Shelton, Comark Assocs.	203-929-4884
Fla	Ft. Lauderdale, NAPECC	
Fla	Winter Park, NAPECC	
Ind	Indianapolis, NAPECC	
Ill	Elk Grove Village, NAPECC	312-593-8220
Kans	Olathe, B.C. Elctrn. Sls.	
Mass	Waltham, NAPECC	617-899-7100
Mich	Hazelwood, B.C. Elctrn. Sls.	
Mich	Southfield, NAPECC	
Minn	Minneapolis, Siedare Assocs.	612-533-2294
NJ	Rochelle Park, NAPECC	
NY	Endicott, Tech-Mark, Inc.	607-748-7473
NY	Fairport, Tech-Mark	
NY	Hicksville, NAPECC	
NY	Liverpool, Tech-Mark	
NY	Pleasant Valley, Tech-Mark	
NY	Port Chester, Radiation Elctrns.	
NC	Raleigh, Candor Co.	
Ohio	Dayton, NAPECC	
Ore	Portland, Western Tech. Sls.	
Pa	King of Prussia, NAPECC	
SC	Myrtle Beach, Candor Co.	803-448-5213
Tenn	Chattanooga, Candor Co.	
Tex	Dallas, NAPECC	
Va	Richmond, NAPECC	
Wash	Bellevue, NAPECC	
Wash	Bellevue, Western Technical Sls.	
FOR:	Can. Vancouver, B.C., Philips	
FOR:	Can., Montreal, Que., Philips Elctrns. Inds., Ltd.	
FOR:	Can., Toronto 17, Ont., Philips Elctrns. Inds., Ltd.	

AMPEREX ELECTRONIC CORP., Providence Pike, Slatersville, R.I., 02876, Tel: 401-762-9000, TWX: 710-387-1591; FSC No: 73445; Empl.: 388; Minimum order: $100

For info on price: Cust Svc; Application info: Mktg Svcs; Delivery info: Cust Svc

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Delay Lines, Diodes, Integrated Circuit Devices, Rectifiers, Regulators, Transformers, Transistor, Diode, Thyristor Heat Dissipators, Transistors, Tubes, Yokes

Local Sales Offices & Reps.

Ala	Huntsville	205-534-7351
Ariz	Phoenix	602-279-9588
Cal	North Hollywood	213-762-2118
Cal	San Diego	714-453-9250
Cal	Santa Clara	408-249-1134
Colo	Denver	303-922-8434
Fla	Fort Lauderdale	305-772-2840
Fla	Winter Park	305-678-2522
Ill	Elk Grove Village	312-593-8220
Ind	Indianapolis	317-257-6547
Mass	Waltham	617-899-7100
Mich	Southfield	313-357-4288
NJ	Rochelle Park	201-843-4810
NY	Hicksville	516-931-6200
Ohio	Dayton	513-278-7351
Pa	King of Prussia	215-265-4240
Tex	Dallas	214-691-2141
Va	Richmond	703-282-6515

AMPERITE CO., INC., 600 Palisade Ave., Union City, N.J., 07087, Tel: 201-UN 4-9504; Empl.: 76

Products manufactured: Relays

AMPEX CORP., 401 Broadway, Redwood City, Cal., 94063, Tel: 415-367-2011, TWX: 415-364-9034; Empl.: 14000

Products manufactured: CATV Systems & Equipment, Cores, Magnetic, Demagnetizers, Duplicators, Editing Equipment, Tape, Erasers, Magnetic Tape (Bulk), Heads, Recording Playback, Erase, Memory Systems, Mixers, Recorders, Services, Assembly, Production & Test, Splicing Equipment, Magnetic Tape, Tape Recording Accessories, Tape Search Equipment, Tapes, Recording, Magnetic (All Types), Television Systems & Equipment Closed-Circuit

AMPHENOL CADRE DIV., Bunker Ramo Corp., 20 Valley St., Endicott, N.Y., 13760, Tel: 607-754-4444; Empl.: 750 p. 2•460,461

Customer service: E. Exley

Free literature available: TC-1 Telephone Products Catalog- Standard products such as running cable, delta splices, & custom capabilities. FC-1 describes Cadre's capabilities in custom interconnection, backplane wiring, cable & harness assemblies. ACCESS&T describes our selective decapsulation process.

Products manufactured: Backpanel Interconnect Systems, Boards, Printed Wiring, Universal, Braid, Cable, Cable Assemblies & Harnesses, Cable, Clamps & Clips, Compounds, Encapsulating, Insulating, Molding, Potting, Machines/Machinery, Production, Services, Assembly, Production & Test, Strain Reliefs, Cable & Wire, Strip-Line Components, Microwave

(Refer to Amphenol Sales Div for sales office information)

AMPHENOL CANADA LTD., 44 Metropolitan Rd., Scarborough, (Ont.), Can., Tel: 416-291-4401, TWX: 06-217-676; Empl.: 125 p. 2•460,461

For info on price: R. M. Newbord 416-291-4401; Application info: R. M. Newbord 416-291-4401; Customer service: E. Farquharson 416-291-1621; Delivery info: E. Farqharson 416-291-1621

Free literature available: Catalog FC-3. Containing application data and mechanical, electrical and dimensional specifications on 481 and 482 series filter connector systems. Performance data is also included.

Products manufactured: Connectors, Filters

Refer to Amphenol Sales Div. for sales off. information

AMPHENOL COMPS. GRP. MKTG., Bunker Ramo Corp., 900 Commerce Dr., Oak Brook, Ill., 60521, Tel: 312-654-3100, TWX: 910-651-0191

Products manufactured: Services, Assembly, Production & Test

Refer to Amphenol Sales Div. for sales office information

AMPHENOL COMPONENT MKTG. SVC., 2875 S. 25th Ave., Broadview, Ill., 60153, Tel: 312-345-4260, TWX: 910-226-1961; Minimum order: $50
p. 2•460,461

Customer service: L. F. Edwards

Free literature available: 760 series cooling fan catalog - long life ball bearing & extra thin fans 390 series cooling fans-catalog-lowest cost fans 279 catalog-miniature epoxy encapsulated power supplies

Products manufactured: Blowers & Fans & Accessories, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Young & Lawrence Assoc., Inc.	205-539-6575
Ariz	Phoenix, MR Engineering Sales Co.	602-959-5150
Cal	Los Angeles, M. A. Stolaroff Co.	213-295-7781
Cal	San Diego, M. A. Stolaroff Co.	714-234-6905
Cal	Santa Clara, Nova-Tronix	408-243-9530
Colo	Boulder, Comp. Prods. Sls. Co.	303-444-2730
Fla	Ft. Lauderdale, Young & Lawrence Assoc.	305-563-6717
Fla	St. Petersburg, Young & Lawrence Assoc., Inc.	813-894-0026
Fla	Winter Park, Young & Lawrence Assoc., Inc.	305-647-6929

Ill DesPlaines, Lincoln, Hodges & Assocs. 312-297-3810
Ind Indianapolis, Marketing Engineers Inc. 317-546-1523
Kans Wichita, Dy-Tronic, Inc. 316-943-6221
Md Baltimore, J.R. Daniels & Co. 301-825-3330
Mass Lexington, J.E. Boeing Co., Inc. 617-862-2500
Mich Benton Harbor, Ken-Mor Assocs., Inc. 616-927-3134
Mich Rochester, Ken-Mor Assocs., Inc. 313-651-1890
Minn Minneapolis, Milt Westland Assocs. 612-866-5002
Mo Hazelwood, DY-Tronix Inc. 314-731-5799
Mo Kansas, Dy-Tronix, Inc. 816-761-6543
NY Jamaica, S-J Sls. Assocs., Inc. 212-291-3232
NY Syracuse, C. W. Floring & Assoc. 315-478-2149
NC Raleigh, Candor Co. 919-876-4999
Ohio Dayton, The Whelan Corp. 513-434-7551
Pa King of Prussia, Montero Assocs. 215-265-0634
Pa Media, W. Reeves Assocs., Inc. 215-566-6709
SC Myrtle Beach, Candor Co. 803-448-8361
Tenn Chattanooga, Candor Co. 615-894-7454
Tex Austin, K&H Sls. Co. 512-836-2842
Tex Plano, K & H Sls. Co. 214-423-6520
Va Lynchburg, Candor Co. 804-846-6579
Wash Bellevue, Ruggles Technical Sls. 206-455-2778
Wisc Waukesha, Lincoln, Hodges & Assocs. 414-542-3087

Local Distributors
Ariz Phoenix, Moltronics of Ariz., 2746 West Palm La. 602-272-7951
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal San Carlos, Sterling Elctrns., 1061 Industrial Way 415-592-2353
Cal San Diego, Moltronics, 7969 Engineer Rd.
Cal South Gate, Moltronics, 5610 East Imperial Hwy. 213-773-6521
Cal Sunnyvale, Acacia Sls., 384 San Aleso Ave. 408-735-0100
Colo Lakewood, Acacia Sls., 11111 W. 8th Ave. 303-232-2882
Ill Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd. 312-697-8200
Ind Fort Wayne, Fort Wayne Elctrns. Supply, 3606 Maumee Ave. 219-423-3422
Ind Indianapolis, Graham Elctrns., 133 S. Pennsylvania 317-634-8202
Ind Indianapolis, Meunier Elctrn. Supply, 3409 E. Washington 317-635-3511
Ind Indianapolis, Ra-Dis-Co., 814 N. Senate Ave. 317-637-5571
Ind South Bend, Radio Distributing Co., 1212 High St. 219-287-2911
Ky Louisville, P.I. Burks Co., 842 S. 7th St. 502-589-3960
Md Baltimore, Technico, 1404 Bare Hills Ave. 301-828-6416
Md Savage, Pyttronics Inds., 8220 Wellmorr Ct. 301-792-7000
Mass Braintree, Allied Elctrns., One Century Circle, Campanelli Industrial Pk. 617-848-4150
Mass Watertown, DRW Elctrns. Corp., 600 Pleasant St. 617-923-1900
Minn Minneapolis, Industrial Comps., 5280 W. 74th St. 612-831-2666
NY Binghamton, Federal Elctrns., Box 1208 607-748-8211
NY Farmingdale, DRW Elctrns. Corp., 100 Milbar Blvd. 516-249-2660
NC Greensboro, Technico, 6223 Tri Port Ct. 919-294-1065
Ohio Cincinnati, Schuster Elec. Co., 11320 Grooms Rd. 513-984-1600
Ohio Medina, DRW Elctrns. Corp., 7409 Spencer Lake Rd. 216-725-6422
Pa Montgomeryville, Pyttronics Inds., Stump Rd., Box 433 215-643-2850
Tex Dallas, Solid State Elctrns. Co., 2643 Manana Dr. 214-352-2601
Tex Fort Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Houston, Solid State Elctrns, Co., Box 36849
Utah Salt Lake City, W.H. Bintz Co., 433 W. Third St., Box 1350 801-363-5821
Va Norfolk, Priest Elctrns., 6431 Tidewater Dr. 703-855-0141
Wash Seattle, Zepher Elctrns. Sls. Co., 647 Industrial Dr. 206-242-2517

AMPHENOL CONNECTOR DIV., Bunker Ramo Corp., 2801 S. 25th Ave., Broadview, Ill., 60153, Tel: 312-261-2000, TWX: 910-226-1974; Empl.: 1000 p. 2•460,461

Products manufactured: Caps, Connectór, Clamps & Clips, Connector Adapters, Connectors, Contacts, Electrical, Lead Assemblies & Receptacles, Plug Adapters, Plugs, Strain Reliefs, Cable & Wire, Thermocouples, Elements & Accessories, Tools

Refer to Amphenol Sales Div. for sales office information.

AMPHENOL CONNECTOR DIV., CONTROLS OPERS., Bunker Ramo Corp., 2801 S. 25th Ave., Broadview, Ill., 60153, Tel: 312-261-2000, TWX: 910-226-1974; Empl.: 250 p. 2•460,461

Products manufactured: Counters, Dials, Gages, Potentiometers, Resistors, Switches, Transducers

Refer to Amphenol Sales Div. for sales office information.

AMPHENOL CONNECTOR DIV., SAMS OPERS., Bunker Ramo Corp., 9201 Independence Ave., Chatsworth, Cal., 91311, Tel: 213-341-0710, TWX: 910-494-1211; Empl.: 500 p. 2•460,461

Products manufactured: Braid, Cable, Cable, Connectors, Feedthrus & Seals, Environmental, Plugs, Services, Assembly, Production & Test, Terminals, Wire

Refer to Amphenol Sales Div. for sales office information.

AMPHENOL IND'L. DIV., Bunker Ramo Corp., 1830 S. 54th Ave., Chicago, Ill., 60650, Tel: 312-242-1000, TWX: 910-229-1541; Empl.: 2000 p. 2•460,461

Products manufactured: Boards, Programming, Caps, Connector, Clamps & Clips, Connector Adapters, Connectors, Contacts, Electrical, Cords, Holder & Carriers, Jacks (All Types), Kits, Connector, Pins, Plugs, Shields, Sockets, Strain Reliefs, Cable & Wire, Terminals, Tools

Refer to Amphenol Sales Div. for sales office information.

AMPHENOL RF DIV., Bunker Ramo Corp., 33 E. Franklin St., Danbury, Conn., 06810, Tel: 203-743-9272, TWX: 710-456-0281; Empl.: 700 p. 2•460,461

For info on price: A. Kasiewicz; Application info: Adv. Mgr.; Customer service: Prod. Mgr.

Products manufactured: Adapters, Waveguide, Antenna Switching Matrices, Arresters, Electrical Surge, Lightning, Cable Assemblies & Harnesses, Cable, Connector Adapters, Connector Blocks, Mother Board, Connectors, Contacts, Electrical, Delay Lines, Feedthrus & Seals, Environmental, Horns, Microwave, Integrated Circuit Packaging Systems, Jack Adapters (All Types), Kits, Connector, Lead Assemblies & Receptacles, Line Strechers, Microwave, Packages, Integrated Circuit, Plug Adapters, Relays, Seals, Shifters, Shutters, Microwave, Slide Rules (Circuitry Computing), Strip-Line Components, Microwave, Switches, Tees, Terminals, Tools, Waveguides & Adapters

Refer to Amphenol Sales Div. for sales office information

AMPHENOL SALES DIV., Bunker Ramo Corp., 2875 S. 25th Ave., Broadview, Ill., 60153, Tel: 312-345-4260, TWX: 910-226-1961 p. 2•460,461

Products manufactured: Cable Assemblies & Harnesses, Caps, Connector, Clamps & Clips, Connector Adapters, Connectors, Contacts, Electrical, Dials, Pins, Plugs, Potentiometers, Power Supplies, Services, Assembly, Production & Test, Shields, Sockets, Strain Reliefs, Cable & Wire, Switches, Tools, Transducers

Local Sales Offices & Reps.
Cal Los Angeles, Amphenol Sls. Div. 213-649-5015
Cal San Francisco, Amphenol Sls. Div. 408-732-8990
Colo Denver, Amphenol Sls. Div. 303-758-8033
DC Washington, Amphenol Sls. Div. 703-525-2818
Fla Orlando, Amphenol Sls. Div. 305-647-5504
Ill Chicago, Amphenol Sls. Div. 312-345-9000
Ind Indianapolis, L.M. DeVoe Co. 317-257-1227
Kans Kansas City, Amphenol Sls. Div. 913-888-7223
Mass Boston, R. Purinton 617-475-7055
Minn Minneapolis, Amphenol Sls. Div. 612-835-4595
Mo St. Louis, Amphenol Sls. Div. 314-895-1400
NY New York, Amphenol Sls. Div. 516-364-2270
NY Syracuse, Amphenol Sls. Div. 315-455-5786
NC Greensboro, Amphenol Sls. Div. 919-275-8644
Ohio Dayton, Amphenol Sls. Div. 513-294-0461
Pa Philadelphia, Amphenol Sls. Div. 609-234-3434
Tex Dallas, Amphenol Sls. Div. 214-235-8318
Wash Seattle, Amphenol Sls. Div. 206-455-2525
EXP: Broadview, Ill., Amphenol Sls. Div. 312-345-4260

Local Distributors

See Page 2•463 for Amphenol local distributor listings.

AMPLICA INC., 780 Lakefield/Bldg. F, Westlake Village, Cal., 91361, Tel: 213-889-8700, TWX: 910-336-1546; FSC No: 51025; Empl.: 19

Customer service: J.A. Cole

Products manufactured: Amplifiers, Converters, Isolators

Local Sales Offices & Reps.
Cal Mt. View, D. Lay Assocs. 415-968-7500
Cal Westlake Village, MCA Repco 213-889-5553
Fla Clearwater, Southeastern Comp. Sls. Inc. 813-531-8324
Ill Park Ridge, RF Specialists 312-698-2044
Mass Reading, Geder-Rotondi Assoc. 617-944-3105
NY Bayside, R. Diamond 212-423-7330
Pa Ambler, WM Assocs. 215-643-4119
Tex Arlington, N&W Sls. 817-461-4443
Va Alexandria, Vanguard Eng. Sls. 703-768-1660
Wash Seattle, R. Drake Assoc. 206-763-2755
EXP: Los Angeles, Cal., Trans-World Trade 213-472-0444
FOR: Can., Montreal260, Que., Soquelec, Ltd. 514-482-6427

AMPLIFIER RESEARCH CORP., 160 School House Rd., Souderton, Pa, 18964, Tel: 215-723-8181; Empl.: 10 p. 1•2,3

For info on price: D. W. Roth; Application info: D. R. Shepherd; Customer service: D. W. Roth; Delivery info: D. W. Roth

Free literature available: Data Folder: Contains individual data sheets for broad band, high power RF amplifiers giving complete specifications and performance data. Price schedule showing price & delivery for small quantities also included.

Products manufactured: Amplifiers, Transformers

Local Sales Offices & Reps.
Cal Los Angeles, RF Assocs. 213-478-1586
Cal Palo Alto, RF Assocs. 415-494-3331
Conn Hamden, Scientific Devices 203-298-9361
Fla Orlando, Truex Assocs. 305-859-2160
Ill Chicago, Elctrn. Instr. Assocs. 312-271-3774
Ind Indianapolis, Elctrn. Instr. Assocs. 317-257-7231
Md Woodbine, Morar Assocs. 301-924-2169
Mass Waltham, Scientific Devices-New England 617-894-5637
NJ Westfield, Gray & Reed Assocs. 201-233-6116
NY New York, Gray & Reed Assocs. 516-433-3333
Pa Melrose Park, R. Meyers Assoc. 215-224-1663
Tex Dallas, Airep Elctrns. Inc. 214-827-2120
EXP: Indianapolis, Ind., Texscan Tech. Prods. 317-357-8781
FOR: Can., Winnipeg R2V-OX1, Electrodesign Ltd. 204-338-5050
FOR: Can., La Salle 650, Quebec, Electrodesign Ltd. 514-363-5120
FOR: Can., Ottawa 7, Ont., Electrodesign Ltd. 613-745-0541
FOR: Can., Toronto 19, Ont., Electrodesign Ltd. 416-787-0991

AMPOWER SEMICONDUCTOR CORP., 375 Kings Highway, Smithtown, N.Y., 11787, Tel: 516-582-6767; FSC No: 52333; Empl.: 45

Customer service: J. Krasny

Free literature available: Short Form Catalog; list of JAN, JAN-TX, JAN-TXV power transistors.

Products manufactured: Transistors

Local Sales Offices & Reps.
Ariz Scottsdale, Fred Board Assoc. 602-994-9388
Cal Lafayette, Phillips Assoc. 415-284-2579
Cal Marina Del Rey, Westaironics 213-821-7958
Fla Orlando, Geartner Assoc. 305-299-1000
Ill Bellwood, FIAT Eng'g 312-547-6200
Ind Ft. Wayne, Delesa Sls. 219-483-9537
Md Towson, L.H. Kolman Asso. 301-752-8756
NJ Holbrook, R.O.M.E. 516-488-7777
Ohio Dayton, Oliver Penrod Assoc. 513-258-2143
Pa Colmar, E.L. Asso. 215-822-2510
Pa Erie, ECCO Sls. 814-452-3762
Tex Richardson, Thornton-Leeper Assoc. 214-231-6891

AMPRO CORP., 2220 Maplewood Ave., Willow Grove, Pa., 19090, Tel: 215-657-3100; Minimum order: $25

For info on price: A. Meyer; Application info: E. M. Mullin; Customer service: H. N. Larkin; Delivery info: R. F. Grochowski

Free literature available: CARTRIDGE TAPE EQUIPMENT - Radio broadcasting and recording studio playback and record, endless loop type equipment. CONSOLES: - Audio mixers, 4 channel thru 12 channel, available in monaural, dual monaural, stereo and dual stereo, rotary and slide faders up to 48 inputs.

Products manufactured: Amplifiers, Cases, Equipment, Instrument, Meter, Recorders, Tape Recording Accessories, Tape Search Equipment, Transports, Tape (all kinds)

AMPROBE INSTR., Div. SOS Consolidated Inc., 630 Merrick Rd., Lynbrook, N.Y., 11563, Tel: 516-LY 3-5600

Products manufactured: Meters, Monitors, Probes, Pyrometers, Recorders, Testers, Transducers

AMTRON DIV., Sippican Corp., 14820 S. Kedzie Ave., Midlothian, Ill., 60445, Tel: 312-389-3955, TWX: 910-689-4494; FSC No: 5808; Empl.: 400; Minimum order: $15

Customer service: L. Burdick

Free literature available: Application Notes: Controls for Automation Switchboard Brochures: Military and Commercial Relays Brochures: Solid State and Time Delay

Products manufactured: Comm. Systems, Controls/Control Eqpt., Counters, Relays, Switchboards, Timers

AMUNEAL MFG. CORP., 4737 Darrah St., Philadelphia, Pa., 19124, Tel: 215-535-3000; FSC No: 23740; Empl.: 35; Minimum order: $25

For info on price: S.M. Kamens; Application info: E. Kunz

Free literature available: Our catalogue describes a complete line of standard and custom shields for magnetic sensitive tubes and components. Sample of Wrap Around Shielding Foil is supplied in our catalogue available for engineering evaluation.

Products manufactured: Foil, Shields

Local Sales Offices & Reps.

Cal	Redwood City, Parks & Pruitt Assocs.	415-364-1640
Cal	Santa Ana, C.E.M., Inc.	714-835-2702
Colo	Denver, Walter Engrg. Assocs.	303-777-5585
Fla	Hallandale, L.M. Bairstow Assocs.	305-927-2421
Ill	Wilmette, Crest Assocs.	312-256-5202
Ind	Indianapolis, Crest Assocs.	317-844-2800
Md	Pikesville, A. Wetterhahn Co.	301-484-6376
Mass	Framingham, L. Roffer Co.	617-877-4900
Mich	Jackson, Norwood Scroggs Co.	517-750-1170
Minn	Minneapolis, R-J, Inc.	612-922-1425
NJ	Oaklyn, A. Wetterhahn Co.	609-858-3003
NY	Queens Village, Buscaglia Assocs.	212-468-3666
Ohio	Cincinnati, R. Makin Assocs.	513-232-5588

Advertisment

Amuneal offers a complete line of standard and custom shields for magnetic-sensitive tubes and components, including weld-fabricated or spun CRT shields, printed circuit shields, drawn can shields, and foil Wrap-Around Shielding, supplied in rolls. Amuneal "U-Tile-Mu" Shielding Tiles, 6"x6" or 12"x12", with pressure-sensitive adhesive backing, provide a simple, versatile means for do-it-yourself magnetic shielding of rooms, test chambers, cabinets, etc. Ask for literature. Free sample of wrap-around shielding included.

A. M. W. CORP., 78 Bow, Arlington, Mass., 02174, Tel: 617-643-9600; Empl.: 25

For info on price: W. C. Mears 617-643-9600; Application info: F. F. Maxant 617-641-0080; Customer service: E. Murphy 617-643-9600; Delivery info: L. Kelly 617-641-0080

Free literature available: Brochures (flyers) on oversewing machine, versamatic, hydropress & linamatic giving characteristics & specifications. Facilities listing of machine shop & assembly equipment & capabilities

Products manufactured: Cams, Machines/Machinery, Production, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Los Angeles, Gane Brothers & Lane, Inc.	213-RI9-8388
Cal	San Francisco, Gane Brothers & Lane, Inc.	415-396-3290
Ga	Atlanta, Gane Bros. & Lane Inc.	404-758-1411
Ill	Chicago, Gane Bros. & Lane, Inc.	312-666-5840
Mo	St. Souis, Gane Bros. & Lane, Inc.	314-OL2-2700
NY	New York City, Gane Bros. & Lane, Inc.	212-WA5-0400
NY	Port Washington, Robbins & Bendror Assoc.	516-865-7220
Tex	Dallas, Gane Bros. & Lane, Inc.	214-ME7-0700
Wash	Seattle, Gane Bros. & Lane, Inc.	206-622-5454

THE ANACONDA COMPANY BRASS DIVISION, 414 Meadow St., Waterbury, Conn., 06720, Tel: 203-757-2021, TWX: 710-477-0925; Empl.: 5000

Free literature available: Anaconda Publication #C-25 offers electrical properties and uses of copper conductors including physical and electrical uses in engineering design with dimensions, weights, etc.

Products manufactured: Alloys, Bus Bars & Systems, Conduit, Electrical, Tubing

Local Sales Offices & Reps.

Cal	Oakland	415-562-2131
Cal	Paramount	213-636-0321
Colo	Denver	303-534-8764
Conn	Waterbury	203-757-2021
Fla	Tampa	813-839-5363
Ga	Atlanta	404-261-4681
Ill	Hinsdale	312-242-1414
Ind	Indianapolis	317-546-1151
Iowa	Cedar Rapids	319-364-2465
Mass	Braintree	617-848-6680
Mich	Detroit	313-554-3500
Minn	Minneapolis, 612-920-6393	
Miss	Jackson	601-354-4391
Mo	Kansas City	816-753-3341
Mo	St. Louis	314-966-0606
NY	Amherst	716-835-3915
NY	New York City	212-697-1166
NY	Syracuse	315-422-1205
NC	Charlotte	704-568-2422
Ohio	Cincinnati	513-421-9050
Ohio	Cleveland	216-251-1105
Ohio	Worthington	614-888-1985
Pa	Frazer	215-647-0600
Pa	Pittsburgh	412-341-5185
Tex	Dallas	214-368-6311
Tex	Houston	713-529-4741
Wisc	Milwaukee	414-258-7600

THE ANACONDA CO., Wire and Cable Div., Greenwich Office Park 3, Greenwich, Conn., 06830, Tel: 203-661-0090, TWX: 710-579-2970

Products manufactured: Cable, Cams, Wire, Wire Shielding

ANADEX INSTRS., INC., 7833 Haskell Ave., Van Nuys, Cal., 91406, Tel: 213-782-9527, TWX: 910-495-1762; Empl.: 75; Minimum order: $25

For info on price: K. A. Mathews; Application info: A. B. Lappas; Customer service: L. Stanberry; Delivery info: C. Porter

Free literature available: 26-page Catalog describing all Anadex standard products.

Products manufactured: Comparators, Converters, Counters, Detectors, Generators, Meters, Printers, Signal Conditioners & Equipment, Synthesizers, Timers

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier, Inc.	205-536-5650
Ariz	Scottsdale, PLS Assocs., Inc.	602-957-9110
Cal	Los Altos, J. Stone & Assocs.	415-948-4563
Cal	Los Angeles, Basic Sys.	213-938-2833
Cal	San Diego, Basic Sys.	714-279-9641
Colo	Denver, PLS Assocs.	303-771-0140
Conn	W. Hartford, Instrument Assocs.	203-525-9367
Fla	Orlando, Currie, Peak & Frazier, Inc.	305-855-0843
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Kans	Mission, Pivan Engrg. Co.	913-722-1030
Md	Wheaton, SONCO	301-942-9420
Mass	Bedford, Instrument Assocs.	617-275-0700
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501
Mo	St. Louis, Pivan Engrg. Co.	314-567-3636
NJ	Fort Lee, Tech. Mktg. Assocs.	201-224-6911
NM	Albuquerque, PLS Assocs., Inc.	505-255-2330
NY	E. Syracuse, Ossmann Instrs., Inc.	315-437-6666
NY	Rochester, Ossmann Instrs., Inc.	716-328-2230
NY	Vestal, Ossmann Instrs., Inc.	607-785-9947
NC	Greensboro, Currie, Peak & Frazier, Inc.	919-273-3040
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-276-5873
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	Blue Bell, SONCO	215-CH2-8460
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
Tex	Dallas, Data Mktg. Assocs.	14-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Wash	Seattle, R.S. Drake Assocs., Inc.	206-763-2755
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940

ANADYNE, 12741 Los Nietos Rd., Santa Fe Springs, Cal., 90607, Tel: 213-698-7991, TWX: 910-586-1881; Empl.: 100 .... p. 1•1108,1109

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Smith & Assocs.	602-943-4131
Cal	Oakland, Moulthrop Sls. Inc.	415-261-7676
Conn	Durham, Marr Assocs.	203-349-9691
Fla	Ft. Lauderdale, UniRep, Inc.	305-527-1556
Md	Baltimore, Stitzer Assocs.	301-823-2600
Minn	Minneapolis, Bitronics Sls. Co.	612-866-3035
NJ	Wallington, Comp-Tech Sls.	201-935-5454
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	New Hyde Park, Comp-Tech Sls.	516-593-2628
Okla	Tulsa, T. Burton Sls.	918-936-2562
Tex	Addison, Campion Sls. Co.	214-239-9196

ANALOG DEVICES, Box 280, Rte. I, Ind'l. Pk., Norwood, Mass., 02062, Tel: 617-329-4700, TWX: 710-394-6577; Empl.: 1000 .... p. 1•606

For info on price: K. Rutherford Ext. 302; Application info: K. Rutherford Ext. 302; Customer service: P. Bosworth Ext. 380

Free literature available: 1975 PRODUCT GUIDE-272 pages - Contains product descriptions and selection guides to all Analog Devices' product lines. Written for designers of instruments used in electronic measurement and designers of computer based control systems.

Products manufactured: Amplifiers, Capacitors, Fixed, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Coatings, Comm. Systems, Comparators, Computers, Converters, Data Acquisition & Reduction Systems, Demodulators, Detectors, Display Devices/Displays, Dividers, Expanders, Data, Films, Hybrid Voltage Regulators, Indicators, Integrated Circuit Devices, Integrators, Electronic, Isolators, Meters, Modulator/Demodulators, Multiplexers, Multipliers, Networks, Potentiometers, Power Supplies, Process Control Systems, References, D-C Voltage, Regulators, Resistors, Resolvers, Synchro, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test, Servo Systems, Substrates, Switches, Synchro Transmitters, Solid-State, Technical Books, Transistors, Transmission Systems, Data

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier	205-536-5650
Cal	Long Beach, Analog Devices Inc.	213-595-1783
Cal	Los Altos, Analog Devices, Inc.	415-941-4874
Colo	Boulder, Moore/Eiler Assoc.	303-665-3351
Fla	Orlando, Currie, Peak & Frazier	305-855-0843
Ill	Chicago, Analog Devices, Inc.	312-894-3300
Ill	Northfield, Torkelson Assoc.	312-446-9085
Ind	Indianapolis, Torkelson Assoc.	317-244-7867
Kans	Shawnee Mission, Tech. Sales, Assoc.	913-888-3330
Md	Silver Spring, Rep-Tron, Inc.	301-593-4844
Mich	Detroit, Electro Sales Assoc.	313-526-8800
Minn	Minneapolis, Torkelson Assoc.	612-835-2414
Mo	Ferguson, Tech-Sales Assoc.	314-725-5361
NM	Albuquerque, Moore/Eiler Assoc.	505-292-3322
NY	Binghamton, Labtronics, Inc.	607-748-0509
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Ulster Park, Labtronics, Inc.	518-372-6649
NY	Woodbury, Harwood-Sandler Assoc.	516-692-6100
NC	Greensboro, Currie, Peak & Frazier	919-273-3040
Ohio	Cleveland, Electro Sales Assoc.	216-261-5440

Ohio	Dayton, Electro Sales Assoc.	513-426-5551
Pa	Ambler, Wyncote Instru. Co.	215-643-2440
Pa	Middletown, Wyncote Instrumentation Co.	717-944-0950
Pa	Pittsburgh, Electro Sales Assoc.	412-371-9449
Tex	Houston, Data Applications Corp.	713-661-4501
Tex	Richardson, Analog Devices, Inc.	214-231-5094
Tex	San Antonio, Data Applications Corp.	512-732-7176
Wash	Seattle, Avionics Liaison, Inc.	206-767-3870
FOR:	Can., Downsview, Ont., Tracon Elctrns. Corp.	416-638-0052
FOR:	Can., Montreal, Que., Tracan Elctrns. Corp.	514-341-4163
FOR:	Can., Ottawa, Ont., Tracon Elctrns. Corp.	613-820-0269
FOR:	Can., West Vancouver, B.C., Tracan Elctrns. Western Ltd.	604-926-3411

ANALOG DEVICES, RESISTOR PDT., 1665 Buffalo Rd., Rochester, NY, 14624, Tel: 717-247-6773

Free literature available: Custom spec. guide - resistor networks; Custom spec. guide - precircuits; Standard thin film precision resistor networks -

Products manufactured: Attenuators, Circuits, Hybrid, Thin-Film, Cores, Magnetic, Films, Networks, Resistors, Standards

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier	205-536-5650
Cal	Long Beach, Analog Devices	213-595-1783
Cal	Los Altos, Analog Devices	415-941-4874
Colo	Denver, Moore/Eiler Assocs.	303-449-4262
Fla	Orlando, Currie, Peak & Frazier	305-855-0843
Ill	Northfield, Torkelson Assoc.	312-446-9085
Ill	Rosemount, Analog Devices	312-297-8710
Ind	Indianapolis, Torkelson Assoc.	317-244-7867
Kans	Shawnee Mission, Technical Sls.	913-888-3330
Md	Silver Spring, Reptron, Inc.	301-593-4844
Mich	Detroit, Electro Sls. Assoc.	313-526-8800
Minn	Minneapolis, Torkelson Assoc.	612-835-2414
Mo	Ferguson, Technical Sls.	314-725-5361
NJ	Irvington, Harwood Sandler Assocs.	201-399-3748
NM	Albuquerque, Moore/Eiler Assoc.	505-292-3322
NY	Binghamton, Labtronics, Inc.	607-748-0509
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Woodbury, Harwood-Sandler Assoc.	516-692-6100
NC	Greensboro, Currie, Peak & Frazier	919-273-3040
Ohio	Cleveland, Electro Sls. Assoc.	216-261-5440
Ohio	Dayton, Electro Sls. Assoc.	513-426-5551
Okla	Tulsa, Data Appls. Corp.	214-231-4846
Pa	Ambler, Wycote Instrumentation	215-643-2440
Pa	Pittsburgh, Electro Sls. Assoc.	412-371-9449
Tex	Houston, Data Appls. Corp.	713-661-4501
Tex	Richardson, Data Appls. Corp.	214-231-4846
Tex	San Antonio, Data Appls. Corp.	512-732-7176
Wash	Seattle, Avionics Liason	206-767-3870
FOR:	Can., Downsview, Ont., Tracan	416-638-0052
FOR:	Can., Montreal, Que., Tracan	514-341-4163
FOR:	Can., Ottawa, Ont., Tracon	613-820-0269
FOR:	Can., West Vancouver, B.C., Whittaker Elctrns., Ltd.	604-926-3411

ANALOG DEVICES, Semiconductor Div., 829 Woburn St., Wilmington, Mass, 01887

ANALOGIC CORP., Audubon Rd., Wakefield, Mass., 01880, Tel: 617-246-0300, TWX: 710-348-0425; Empl.: 245; Minimum order: $25 .... p. 1•130-133,602,603

For info on price: Tech. Support Grp.; Application info: W. Appell, Ext. 179; Customer service: R. R. Roediger; Delivery info: G. Fisher, Ext. 126

Free literature available: Data Sheets

Products manufactured: Amplifiers, Calibrators, Converters, Data Acquisition & Reduction Systems, Indicators, Integrated Circuit Devices, Meters, Multiplexers, Power Supplies, Signal Conditioners & Equipment, Standards, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs.	205-536-1941
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Costa Mesa, Meas. Assocs.	714-540-7160
Cal	San Francisco, Wm. C. Benison	415-398-2211
Colo	Denver, BFA Corp.	303-744-3301
Conn	Guilford, R.H. Sturdy Co.	203-453-5424
Fla	Clearwater, Reynolds & Assoc.	813-726-2373
Fla	Ft. Lauderdale, Reynolds & Assoc.	305-581-6611
Fla	Hollywood, Reynolds & Assoc.	305-987-6720
Fla	Palm Beach Gardens, Reynolds & Assoc.	305-622-4336
Fla	Satellite Beach, ReynoLds & Assoc.	305-773-4700
Fla	St. Petersburg, Reynolds & Assoc.	813-360-1484
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Ill	Chicago, Berndt Assoc. Inc.	312-283-0713
Ind	Carmel, Berndt Assoc. Inc.	317-844-0114
Md	Baltimore, Jay Co.	301-252-8494
Mass	Wellesley Hills, R.H. Sturdy Co.	617-235-2330
Mich	Detroit, WKM Assocs.	313-892-2500
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Crues, BFA Corp.	505-523-0601
NY	Dewitt, DB Assocs.	315-446-0220
NY	New York City, Hansen Assocs.	212-947-0379
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Ore	Beaverton, Arneson Assoc.	503-643-5754
Pa	Norristown, Data Engrg. Co.	215-279-8146
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Dallas, Data Aids Assocs.	214-620-1551
Tex	Houston, Data Aids Assocs.	13-862-6685
Utah	Salt Lake City, BFA Corp.	801-466-6522
Va	McLean, Jay Co.	703-790-5666
Wash	Seattle, Arneson Assoc.	206-762-7664
Wisc	Brookfield, Berndt Assoc.	414-786-6950

ANALYTICAL MEASUREMENTS, 31 Willow St., Chatham, N.J., 07928, Tel: 201-273-7500; Empl.: 35

For info on price: T.P. Scarinzi; Application info: F.G. Paully; Customer service: F.D. Moore; Delivery info: F.G. Paully

Products manufactured: Controls/Control Eqpt., Indicators, Kits, Test Equipment, Recorders

ANAREN MICROWAVE, INC., 185 Ainsley Drive, Syracuse, N.Y., 13205, Tel: 315-476-7901, TWX: 710-541-1507; FSC No: 31597; Empl.: 165

For info on price: D. Gustin; Application info: J. Krastel; Customer service: D. Gustin; Delivery info: D. Gustin

Free literature available: General Product Catalog, Pin Attenuator Bulletins, Balanced Mixer Bulletins, Ultra-Miniature Hybrids Bulletin, Phase/Amplitude Tracking Receiver Front End Catalog, Various Hybrid & Power Divider Bulletins.

Products manufactured: Antenna Feed Systems, Attenuators, Comparators, Converters, Couplers, Demodulators, Detectors, Diodes, Discriminators, Dividers, Junctions, Hybrid, Microwave, Mixers, Modulator/Demodulators, Modulators, All Kinds, Multiplexers, Networks, Shifters, Strip-Line Components, Microwave

Local Sales Offices & Reps.

Ariz	Phoenix, The Thorson Co.	602-956-5300
Cal	Los Angeles, Cain Technology	213-476-2251
Cal	Palo Alto, Waldman Assocs.	415-961-4100
Colo	Denver, The Thorson Co.	303-355-3521
Fla	Palm Bay, Spar Tech Assocs.	305-727-8045
Ga	Smyrna, Spar Tech Assocs.	404-432-3644
Ill	Park Ridge, R.F. Specialists	312-698-2044
Ind	Fort Wayne, R.F. Specialists	219-485-8982
Md	Davidsonville, R.L. Engrg.	301-760-5533
Mass	Reading, Geder-Rotondi Assocs.	617-944-3105
NM	Albuquerque, The Thorson Co.	505-265-5655
NY	Greenvale, Bertram D. Aaron & Co.	516-621-0630
NY	Skaneateles, Robtron	315-685-5731
Pa	Philadelphia, Eastern Instrumentation of Phila., Inc.	215-927-7777
Tex	Houston, Kemco, Inc.	713-467-1061
Tex	Irving, Kemco, Inc.	214-255-0537
Wash	Seattle, Rush S. Drake Assocs., Inc.	206-763-2755

ANCHOR BOLT & SCREW, 2950 W. Grand, Chicago, Ill., 60622, Tel: 312-252-2200; Empl.: 100; Minimum order: $50

Free literature available: "Product Line Sheet" "Fastener Engineering Handbook" - engineering specifications for fasteners "Thread Dimension Card"

Products manufactured: Fasteners

Local Sales Offices & Reps.

Colo	Denver, Central Western Sls.	303-534-4733
Ind	Columbus, Ritter, Inc.	812-372-1534
Iowa	W. Des Moines, Product Comps.	515-277-1783
Mich	Lansing, Marketing Professionals	517-484-0828
Mich	Southfield, Coskey-Gates Assoc.	313-354-5522
Minn	Minneapolis, G.L. Engstrom & Assoc.	612-546-0001
Mo	Maryland Hts., D.F. Adams & Assoc.	314-567-1785
SC	Columbia, G.E. Younginer & Assoc.	803-772-6671
Tex.	Houston, Manco Metals	713-664-8084
Wisc	Milwaukee, Anchor Bolt & Screw Co.	414-342-4800

ANCHOR PLASTICS, 36-36 36th, Long Island City, N.Y., 11106, Tel: 212-729-1494, Telex: 12-362; Empl.: 200

For info on price: H. Katz; Application info: H. Katz; Customer service: H. Katz; Delivery info: R. Kuhn

Free literature available: Design Guide- custom extrusions of thermoplastic shapes - tubes, rods, mouldings - fully illustrated. Applications, special surface finishes and fastening data are included.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Coils Including Assemblies & Forms, Couplings, Dials, Gaskets, Shielding, R-F-Also See Shields, R-F, Phonographs, Parts & Accessories, Retainers, Scales, Dial, Services, Assembly, Production & Test, Shafts & Adapters, Slide Rules (Circuitry Computing), Strips, Tubing

ANCHOR SPECIALTY MFG. INC., 300 Hollister Rd., Teterboro, N.J., 07608, Tel: 201-288-1939; Empl.: 10

Customer service: W. Zablocky

Products manufactured: Cabinets & Accessories, Cable, Clamps & Clips, Jigs And Fixtures, Chassis & Circuit Board, Leads, Test & Adaptors, Panels, Racks, Services, Assembly, Production & Test, Switchboards, Testers

ANDERSEN & ASSOC., WALTHER M.A., 4 Main St. Ext., Tariffville, Conn., 06081, Tel: 203-658-7666; FSC No: 52045; Empl.: 18

For info on price: V. W. Andersen; Application info: R. L. Sawin; Customer service: S. E. Rittenburg; Delivery info: V. W. Andersen

Free literature available: Catalog sheets.

Products manufactured: Controls/Control Eqpt., Decade Boxes, Delay Lines, Memory Systems, Modulator/Demodulators, Standards, Transducers

ANDERSEN LABS., INC., 1280 Blue Hills Ave., Bloomfield, Conn., 06002, Tel: 203-242-0761, TWX: 710-425-2390; Empl.: 300 .... p. 1•428,429,

Customer service: R. T. Ruder

Products manufactured: Delay Lines, Filters, Lasers & Laser Systems, Memory Systems, Modulator/Demodulators, Recorders

ANDERSON JACOBSON, 1065 Morse Ave., Sunnyvale, Cal., 94086, Tel: 408-734-4030; Empl.: 450

Customer service: T. B. Zmach

Products manufactured: Modulator/Demodulators, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	Inglewood, Anderson Jacobson	213-674-4051
Cal	San Diego, Anderson Jacobson	714-484-0149
Ga	Atlanta, Anderson Jacobson	404-451-2744
Ill	Northbrook, Anderson Jacobson	312-498-4220
Md	Rockville, Anderson Jacobson	301-424-1767
Mass	Burlington, Anderson Jacobson	617-273-1420
Minn	St. Paul, C. Papeleux	612-333-7228
NJ	Hackensack, Anderson Jacobson	201-488-2525
NY	New York, Anderson Jacobson	212-594-9630
NY	Rochester, Anderson Jacobson	716-436-2420
Ohio	Cincinnati, Anderson Jacobson	513-793-5556
Pa	King of Prussia, Anderson Jacobson	215-265-3446
Pa	Pittsburgh, Chiodo	412-881-8989

ANDREW ANTENNA CO. LTD., 606 Beech St., Whitby, Ont., Can., Tel: 668-3348, TWX: 610-384-2754; Empl.: 120

For info on price: R. Zedic 52; Application info: R. Zedic 52; Customer service: B. Correll 32; Delivery info: B. Correll 32

Free literature available: New product bulletins.

Products manufactured: Antenna Feed Systems, Antennas, Bends & Twists, Microwave, Cable, Connectors, Dehydrators, Waveguides & Adapters

ANDREW CORP., 10500 W. 153rd St., Orland Park, Ill., 60462, Tel: 312-349-3300, TWX: 910-651-3340; Empl.: 600

Customer service: H. Woodbury

Products manufactured: Antennas, Cable, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Claremont	714-626-3505
Cal	Palo Alto	415-323-3139
Colo	Denver	303-222-1579

Md	Rockville	301-762-1900
NJ	Hawthorne	201-852-1310
Tex	Richardson	214-235-1279

ANGSTROHM PRECISION, INC., Box 1827, Hagerstown, Md., 21740, Tel: 301-739-8722, TWX: 710-853-6834; FSC No: 17745; QPL No: Multiple; Empl.: 250; Minimum order: $50

For info on price: T. M. Hart; Application info: T. M. Hart; Customer service: T. Brown; Delivery info: T. Brown

Free literature available: Literature describing Angstrohm hi-reliability metal film resistors approved to MIL-R-55182 and MIL-R-10509, ladder networks, plus-R large positive temperature coefficient silicon resistors, and vitreous enameled wire-wound ring rheostats approved to MIL-R-22.

Products manufactured: Networks, Potentiometers, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, Twentieth Century Mktg., Inc.	205-772-9237
Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Los Altos, Recht Assocs.	415-941-0338
Cal	Van Nuys, JFD Sls. Office	213-785-0487
Colo	Denver, Camel Elctrns.	303-757-6191
Fla	Clearwater, Perrott Assocs., Inc.	813-531-5513
Fla	Orlando, Perrott Assocs., Inc.	305-275-1132
Ill	Hinsdale, MoMak Sls.	312-654-4524
Ind	Greenwood, Valentine-Schillinger & Assoc.	317-888-2260
Ind	South Bend, Valentine-Schillinger & Assoc.	219-291-6258
Md	Ellicott City, Doss Elctrns., Inc.	301-465-1336
Mass	Framingham, JFD Sls. Office	617-872-4843
Minn	St. Louis Park, Beta Engrg.	612-925-4422
Mo	Blue Springs, CHESCO	816-229-1404
Mo	St. Charles, CHESCO	314-946-6677
NJ	East Hanover, HLM Assoc.	201-386-0794
NY	New Hartford, JFD Sls. Office	315-732-3507
NY	Northport, H L M Assocs.	516-423-1818
Ohio	Chagrin Falls, Pine Sls. Co.	216-247-6198
Ore	Portland, C.K. Shanks & Assoc.	503-292-5656
Pa	Philadelphia, S. K. Macdonald, Inc.	215-545-1205
Pa	Pittsburgh, S. K. Macdonald Inc.	412-366-2643
Tex	Dallas, United Comps.	214-324-1448
Wash	Seattle, C.K. Shanks & Assoc.	206-632-4290
Wisc	Milwaukee, Star Engrg. Sls.	414-645-3680

ANIXTER-MARK, Anixted Comms. Sys., 5439 W. Fargo, Skokie, Ill., 60076, Tel: 312-675-1500; Empl.: 49; Minimum order: $10

Customer service: E.N. Lamarre

Free literature available: Grid Antennas; CB Antennas.

Products manufactured: Antenna Feed Systems, Antennas, Cable Assemblies & Harnesses, Wire

Local Sales Offices & Reps.

Cal	Los Angeles, RF Assocs.	213-478-1586
Cal	Palo Alto, RF Assocs. Co.	415-494-3331
Mass	Waltham, Meas. Consultant Corp.	617-890-4400
NJ	Merchantville, L. Adezro Sls. Co.	609-662-3540

ANN ARBOR TERMINALS, INC., 6107 Jackson Rd., Ann Arbor, Mich., 48103, Tel: 313-769-0926, TWX: 810-223-6033; Empl.: 45 .... p. 1•134-140

For info on price: K. Straith; Application info: K. Straith; Customer service: S. Clark; Delivery info: D. Evans

Free literature available: SHORT FORM CATALOG. 8-page descriptive brochure on entire product line. Provides basic specifications and applications information on all CRT display electronics.

Products manufactured: CATV Systems & Equipment, Display Devices/Displays, Generators, Keyboards, Alphanumeric & Decimal, Memory Systems, Monitors, Television Systems & Equipment Closed-Circuit, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Tubes

Local Sales Offices & Reps.

Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Santa Clara, Ann Arbor Terminals	408-249-6046
Colo	Denver, BFA Corp.	303-744-3301
Fla	Orlando, Technical Assocs.	305-894-7531
Ill	Chicago, SEA, Inc.	312-282-6694
Ind	Carmel, SEA, Inc.	317-846-2593
Minn	Minneapolis, SEA, Inc.	612-425-4455
NM	Albuquerque, BFA Corp.	505-296-8303
NM	Las Cruces, BFA Corp.	505-523-0601
Pa	Jenkintown, Stein Instrumentation	215-885-2370
SC	Spartanburg, Technical Assocs.	803-579-2904
Tex	Dallas, Remtek, Inc.	214-387-2855
Utah	Salt Lake City, BFA Corp.	801-486-6522
Wash	Seattle, Rush Drake Assocs.	206-763-2755
Wisc	Milwaukee, SEA, Inc.	414-547-6637

ANNIS R B CO., 1101 N. Delaware, Indianapolis, Ind., 46202, Tel: 317-637-9282; Empl.: 10; Minimum order: $5

Customer service: R. B. Annis

Free literature available: Pocket Magnetometers; Enclosed Demagnetizers; Open Style Demagnetizers; Audiophile Han-D-Kits; Notes on Demagnetizing; Split Core C.Ts; Hi-Flux Magnetic Equip.; Products; Dymograph Balancers; Special Magnetic Equip.

Products manufactured: Coils Including Assemblies & Forms, Demagnetizers, Erasers, Magnetic Tape (Bulk), Indicators, Magnetizers, Magnetometers, Meters, Power Supplies, Recorders, Tape Recording Accessories, Transformers

Advertisment

DEMAGNETIZERS Annis Demagnetizers available from small hand held units to heavy industrial types. Over 1000 varieties to choose from.
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METERS, GAUSS Measure magnetic residuals in tape recording equipment, tools & steel parts.
TRANSFORMERS, INSTRUMENT Annis Split Core Current Transformers. Ranges from 150 to 6000/5 amperes. Six sizes. Will operate direct writing recorders.

ANODYNE INC., 1270 N.W. 165th St., N. Miami Beach, Fla., 33169, Tel: 305-621-3641, TWX: 810-848-7200; Empl.: 150; Minimum order: $45

For info on price: E. T. Turney, Jr.; Application info: E. T. Turney, Jr.; Customer service: E. T. Turney, Jr.; Delivery info: D. Pare

Free literature available: Facilities Brochure, Catalog.

Products manufactured: Labels, Pressure-Sensitive, Adhesive, Nameplates

Local Sales Offices & Reps.

Conn	Vernon, G-M Assocs.	203-646-4443
Ind	Fort Wayne, Given Co.	219-432-5585
Mass	Framingham, G-M Assocs.	617-872-4871
Mich	Birmingham, D.L. Touhy Assocs.	313-645-5700
NJ	Marlton, N. Krouse Assocs.	609-424-3543
NJ	Mountain Lakes, Components for Elctrns.	201-334-2921

ANRO ELEX INDS. LTD., 300 Wildcat Rd., Downsview, Ont, Can., Tel: 416-661-2600; Empl.: 85

Customer service: E.H. Jones

Free literature available: Coils and low pressure switches literature.

Products manufactured: Coils Including Assemblies & Forms, Switches

ANSLEY ELCTRNS. CORP., Sub. Thomas & Betts Corp., 3208 Humboldt St., Los Angeles, Cal., 90031, Tel: 213-223-2331, TWX: 910-321-3938; Empl.: 200

Customer service: V. Saccone

Products manufactured: Boards, Printed Circuit, Cable Assemblies & Harnesses, Cable, Circuits, Flexible, Connectors, Jumpers, Strain Reliefs, Cable & Wire, Tools

Local Sales Offices & Reps.

Ala	Huntsville, Technology Mktg.	205-883-7893
Cal	(NO) San Jose, Ansley Elctrns.	408-267-2434
Cal	(SO) San Diego, L.L. Stoakes	714-274-6281
Colo	Littleton, Simpson Assocs.	303-794-8381
Conn	Madison, JEMCO Sls.	203-245-1505
Fla	S.E. Pampano Beach, TMA	305-942-0774
Ill	Des Plaines, Ansley Elctrns. Inc.	312-298-5545
Ind	Fort Wayne, J & B Engrg. Sls. Co.	219-483-2813
Kans	Kansas City, Harris-Hanson Co.	816-444-9494
Md	Baltimore, Burgin Kreh Assoc., Inc.	301-788-5200
Mass	Amherst, JEMCO Sales	617-326-3436
Mich	Grand Rapids, R.P. Urban	616-245-0511
Mo	(East) St. Louis, Harris-Hanson Co.	314-432-3611
NH	Amherst, JEMCO Sls.	617-326-3436
NY	(Upstate) Shortsville, Ansley Elctrns. Corp.	315-289-3400
NC	Winston-Salem, Burgin-Kreh Assoc.	919-768-4174
Okla	Tulsa, R.D. Spooner Co.	918-936-2562
Pa	Doyestown, Ansley Elctrns. Corp.	215-345-1800
Tex	Dallas, R.D. Spooner	214-357-8636
Tex	Houston, R.D. Spooner Co.	713-783-3640
Va	Lynchburg, Burgin-Kreh Assoc., Inc.	804-845-5600

ANTENNA CORP. OF AMERICA, P.O. Box 865, Burlington, Iowa, 52601, Tel: 319-753-1625; Minimum order: $10

Customer service: W. Picker 319-753-2095

Products manufactured: Amplifiers, Antenna Rotators, Antenna Towers & Supports, Antennas, Arresters, Electrical Surge, Lightning, Cable, CATV Systems & Equipment, Connectors, Couplers, Mounts, Television Systems & Equipment Closed-Circuit, Terminals, Transformers, Wire

Local Sales Offices & Reps.

Ariz	El Dorado, D. Bellew Sls.	501-863-8325
Cal	San Carlos, P & J Ents.	415-591-4689
Cal	Van Nuys, A. Szerlip Sls. Co.	213-782-1765
Colo	Greeley, G. Moss Elctrns.	303-353-1452
Fla	Ft. Lauderdale, Sproch Sls.	305-587-3792
Ga	Douglasville, I. Jones	404-942-1596
Ill	Centralia, Bob Dunn Sls. Co.	618-533-1775
Iowa	Wever, W.L. Brookhiser	319-372-2513
Mass	Braintree, Rudolph-MacInnis Assoc.	617-843-0908
Mich	Kentwood, Cecil Geer Co.	616-534-9449
Minn	Minneapolis, HMR	612-920-8200
Mo	Liberty, Lectro Reps	816-781-2522
NJ	Moorestown, DiVincent & Legato Assoc.	609-235-8290
NY	Camillus, Callahan-Ferguson Co.	315-487-3870
NY	Elizabethtown, J. Grandrath	518-962-4500
NY	Yonkers, J. Brown Elec. Sls.	914-779-7330
Tex	Dallas, Townsend Sls. Co.	214-241-7791
Tex	Lewisville, J.M. Greiten	214-434-2870
Wash	Seattle, Fleehart & Sullivan	206-522-1533

ANTENNA DESIGNS, INC., 802 Washington St., Burlington, Iowa, 52601

ANTENNA RESEARCH ASSOCIATES, INC., 11317 Frederick (Box 196), Beltsville, Md., 20705, Tel: 301-937-8888; Empl.: 15; Minimum order: $25

For info on price: H. W. Rapalus; Application info: R. W. Masters; Customer service: H. W. Rapalus; Delivery info: H. W. Rapalus

Free literature available: Technical specification sheets which include a descriptive commentary on the specific systems involved.

Products manufactured: Antenna Feed Systems, Antenna Rotators, Antennas, Couplers, Radar Systems

Local Sales Offices & Reps.

Tex	Corpus Christi	512-882-6591

ANTENNA SPECIALISTS CO., 12435 Euclid Ave., Cleveland, Ohio, 44106

ANTENNACRAFT, Box 1005, Burlington, Iowa, 52601

M M NEWMAN CORP., Antex Div., Marblehead, Mass., 01945, Tel: 617-631-7100; Empl.: 8; Minimum order: $10

For info on price: F. McCarron; Application info: A. Foresta; Customer service: P. Cohen; Delivery info: F. McCarron

Products manufactured: Caps, Forms & Tapes, Heat Shrinkable, Heat Guns, Production, Kits, Cable-End Sealing, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Tubing, Wire Markers

ANZAC ELECTRONICS, 39 Green St., Waltham, Mass., 02154

A. P. CIRCUIT CORP., 865 West End Ave., New York, N.Y., 10025, Tel: 212-222-0876 .... p. 1•528,529

Customer service: F. Ellern

Free literature available: Filter Catalog - describes both variable frequency modules and fixed frequency modules. Frequency Covered 0.01 Hz-20 MHz. Examples of applications are included.

Products manufactured: Analyzers, Filters

Directory of Local Distributors Starts on page 401

Local Sales Offices & Reps.

Ohio	Cleveland, S. Sterling	216-442-8080
Va	Fairfax, Shibley Assocs.	703-591-3008

A.P. PRODUCTS, 72 Corwin Dr., Painesville, Ohio, 44077, Tel: 216-357-5597

APAHOUSER CORP. OF N.E., 101 Walnut St., Watertown, Mass., 02172, Tel: 617-924-1500; FSC No: 53721; Empl.: 80

For info on price: F. Gately; Application info: F. Gately; Customer service: F. Gately; Delivery info: I. Goldfine

Products manufactured: Bus Bars & Systems, Cabinets & Accessories, Chassis, Metal, Dials, Panels, Scales, Dial, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips

APM-HEXSEAL, 44 Honeck St., Englewood, N.J., 07631, Tel: 201-569-5700; Empl.: 80; Minimum order: $50

For info on price: C. J. Czapinski; Application info: C. J. Czapinski; Customer service: S. Hoffman; Delivery info: F. Miller

Free literature available: Environmental seals for switches, sealskrews & nuts, miniature o-rings, armored power connectors, lamp diffusers, custom engineered splash covers.

Products manufactured: Connectors, Fasteners, Feedthrus & Seals, Environmental, Rubber

Local Sales Offices & Reps.

Ariz	Phoenix, Zeus	602-258-7519
Cal	Costa Mesa, Porter Co.	
Cal	Encino, Porter Co.	213-788-2350
Colo	Englewood, Zeus, Inc.	303-770-4400
Conn	Newton, Gerber Sls. Corp.	203-426-3440
Fla	Orlando, Buchanan & Abrams Assoc.	305-898-7444
Ill	Hinsdale, Hill-Gray Assoc.	312-325-4810
Ind	Fort Wayne, Val-Skol Sls., Inc.	219-742-9122
Ind	Indianapolis, Val-Skol Sls., Inc.	317-926-5063
Iowa	Cedar Rapids, Penzner-Mankus Assoc.	319-362-9177
Kans	Overland Park, Penzner-Mankus Assoc.	913-381-0004
Kans	Wichita, Penzner-Mankus Assoc.	316-254-2662
Mass	E. Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Troy, C.B. Jensen & Assoc.	313-643-0506
Minn.	St. Paul, Northport Engrg.	612-698-3841
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Great Neck, L. Tylinski Co.	516-466-9070
NY	Syracuse, Rep-Tech, Inc.	315-437-2845
Ohio	Cincinnati, Val-Skol Sls., Inc.	513-563-6790
Ohio	Cleveland Hgts., Val-Skol Sls., Inc.	216-462-2822
Ohio	Columbus, Val-Skol Sls., Inc.	614-291-4123
Pa	Paoli, T. Griffin Co.	215-647-1550
Tex	Dallas, R.P. Votteler	214-823-2320
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Seattle, Blum & Assocs.	206-285-2590

API INSTRUMENTS, See LFE Corp., Process Control Div.

APOLLO CORP., 465, Suwa, Takatsuku, Kawasaki, Japan, Tel: 044-811-2161; Empl.: 30

For info on price: M. Kohmoto; Application info: M. Kishita; Customer service: M. Kohmoto; Delivery info: M. Kohmoto

Products manufactured: Lamps, Relays, Tubes

APOLLO LASERS INC., 6357 Arizona Cir., Los Angeles, Cal., 90045, Tel: 213-776-3343, Telex: 69-8204; Empl.: 60; Minimum order: $50

For info on price: R. T. Pitlak; Application info: W. T. Wegner; Customer service: W. T. Wegner

Products manufactured: Lasers & Laser Systems, Scribers, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

APPLETON ELECTRONIC DIV., Appleton Electric Co., 2950 N. Paulina, Chicago, Ill., 60657

APPLIED CIRCUITS, INC., 31-24 14th St., Long Island City, N.Y., 11106, Tel: 212-274-6001; Empl.: 20 p. 2•345

Customer service: Customer Service Dept.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal

APPLIED CONTROL CO., 1275 Bloomfield Ave., Fairfield, N.J., 07006, Tel: 201-227-5454; Empl.: 23; Minimum order: $100

For info on price: S. Richer; Application info: W. Merel; Customer service: W. Merel; Delivery info: S. Richer

Free literature available: Model 71000 SCR Motor Controls; Model 3000 Series Modular Controllers containing, contractors, signal conditioners, limit alarms, time integral totalizers; Model 7000 Series ARL Lamp Power Supplies

Products manufactured: Alarms, Amplifiers, Annunciators, Chargers, Battery, Comparators, Controls/Control Eqpt., Detectors, Gages, Indicators, Monitors, Power Supplies, Regulators, Relays, Services, Assembly, Production & Test, Servo Systems, Signal Conditioners & Equipment, Testers, Totalizers, Digital

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APPLIED DATA COMMUN., 1509 E. McFadden Ave., Santa Ana, Cal., 92705, Tel: 714-547-6954; Empl.: 12

Customer service: Roger Saville

Free literature available: Series 41 Data Sheets, Tech Notes, Price List-Program Loading Unit Series 42 -3M Tape Cartridge System Series 61 IBM Compatible Floppy Disk System

Products manufactured: Enclosures, Module, Plug-In, Recorders

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Altos, C. White	415-948-6533
Cal	Santa Ana, Applied Data Comms.	714-547-6954
Colo	Golden, J. F. Hurlbut Co.	303-279-7796
Fla	Ft. Lauderdale, Reynolds & Assoc.	305-581-6611
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Ind	Munster, Bexdata	312-221-1411
Md	Wheaton, Sonco	301-942-9420
Mass	Lynnfield, Newmar	617-245-7960
Minn	Edina, Bexdata	612-835-5220
NY	Rochester, K. & J. Assoc.	716-232-6640
Tex	Richardson, Lear Assoc.	214-231-5388
Wash	Bellevue, Brennen Assoc.	206-454-9332

APPLIED DESIGN CO., 2465 Sheridan Dr., Tonawanda, N.Y., 14150, Tel: 716-837-4400; Empl.: 150

For info on price: T. Y. Smith; Application info: E. A. Berger; Customer service: H. E. Kellar; Delivery info: H. E. Kellar

Free literature available: General Descriptive Literature

Products manufactured: Cases, Equipment, Instrument, Meter, Cases, Transit, Containers, Services, Assembly, Production & Test

APPLIED DIGITAL DATA SYS., INC., 100 Marcus Blvd., Hauppauge, N.Y., 11787, Tel: 516-231-5400, TWX: 510-227-9886; Empl.: 127

For info on price: R. Kaufman; Application info: J. Friedman; Customer service: R. Petrilak; Delivery info: W. Posner

Free literature available: 980, 880, 580, 680, 380, 780, "A" Series, 815 printer, Data Sheets Included

Products manufactured: Computers, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	Los Angeles	714-539-7731
Cal	San Jose	408-292-5822
DC	Washington	301-933-5999
Fla	Miami	305-279-9179
Ga	Marietta	404-992-2190
Ill	Chicago	312-530-1100
Mass	Boston	617-468-7231
NY	Hauppauge	516-231-5400
Pa	Pittsburgh	412-931-5050
Tex	Houston	713-376-3801

APPLIED ELECTRO TECHNOLOGY, INC., 2220 S. Anne St., Santa Ana, Cal., 92704, Tel: 714-556-6570, TWX: 910-595-1797; FSC No: 52797; Empl.: 20; Minimum order: $25 p. 1•1578,1579

For info on price: L. Daniel; Application info: H. Whitmore; Customer service: L. Daniel; Delivery info: L. Daniel

Free literature available: Phase Sequence Relay Catalog 1A-1; Phase Sequence Indicator Catalog 2A-1; Time Delay Relay Catalog 3B-1; Time Delay Relay Catalog 3A-1; Flasher Catalog 4A-1.

Products manufactured: Circuits, Hybrid, Thin-Film, Clocks (All Types), Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Current Sensors, Generators, Indicators, Lamp Drivers, Monitors, Power Supplies, Relays, Testers, Timers

APPLIED FLUIDICS INC., 770 Main St., Westbury, N.Y., 11590, Tel: 516-334-8742; Empl.: 20

Customer service: Pat Sorrentino

Free literature available: Brochure on Century Series Electronic Leak Detectors.

Products manufactured: Detectors

Local Sales Offices & Reps.

Cal	Pico Rivera, Westrep	213-949-2551

APPLIED GRAPHICS, 58 Shore, Glenwood Landing, N.Y., 11547, Tel: 516-676-1211; Empl.: 29; Minimum order: $50

Customer service: K. DiMaggio

Free literature available: Applied Graphics PSM 75 pressure sensitive graphic tape catalog containing a comprehensive listing of tapes, screen and color sheets, transfer lettering and related supplies.

Products manufactured: Tapes, Films & Foils, Pressure Sensitive

APPLIED MAGNETICS CORP., Magnetic Head Div., 75 Robin Hill Rd., Goleta, Calif., 93017, Tel: 805-964-4881, TWX: 910-334-1195; Empl.: 3600

For info on price: W.P. Graham; Application info: W.P. Graham; Customer service: J. Patin; Delivery info: J. Patin

Products manufactured: Heads, Recording Playback, Erase

Local Sales Offices & Reps.

Ariz	Scottsdale, Barnhill Five	602-947-5745
Cal	Santa Clara, King Assoc.	408-249-1022
Colo	Denver, Barnhill Five	303-426-0222
Mass	Wakefield, Data Engrg. Svc.	617-245-6666
NJ	Livingston, Graydon-Sherman, Inc.	201-994-9055
NM	Albuquerque, Barnhill Five	505-293-5955
NY	Fayetteville, Graydon-Sherman, Inc.	315-637-9861
Ohio	Dayton, Ashby Assocs., Inc.	513-252-5627
Tex	Richardson, Oeler & Menelaides	214-234-6334
Utah	Salt Lake City, Barnhill Three	801-487-1327

APPLIED MATERIALS INC., 3050 Bowers Ave., Santa Clara, Cal., 95051, Tel: 408-249-5555, Telex: 34-6332; Empl.: 450

Products manufactured: Controllers, Programmable, Controls/Control Eqpt., Generators, Machines/Machinery, Production, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test

APPLIED MICROWAVE, Div. Epsco Inc., 411 Providence Hwy., Westwood, Mass., 02090, Tel: 617-329-1500, TWX: 710-348-0484; FSC No: 15894; Empl.: 150; Minimum order: $25 p. 1•901-904

Customer service: H. Clark

Free literature available: Data sheets/brochures with detailed specifications of high power microwave signal sources and cavity oscillators; ECM, radar, TACAN, altimeter, IFF simulators; and data conversion systems.

Products manufactured: Amplifiers, Cavities, Microwave, Converters, Generators, Modulators, All Kinds, Oscillators, Simulators, Synthesizers, Test Systems, Transmitters

Local Sales Offices & Reps.

Ariz	Scottsdale, PLS Assoc.	602-957-9110
Cal	Anaheim, Blair Assoc.	714-635-1350
Cal	San Jose, Mich Assocs.	408-246-7330
Colo	Denver, PLS Assoc.	303-771-0140
Fla	Fort Lauderdale, Snow Co.	305-563-2448
Ill	Northfield, Feller Assoc.	312-446-8065
Mass	Waban, Bawer Assoc.	617-244-6572
NJ	Haworth, Central Assoc.	201-568-0808
NM	Albuquerque, PLS Assoc.	505-255-2330

NY	Plainview, Central Assoc.	516-433-0808
NY	Syracuse, Syracuse Tech. Reps.	315-488-0222
Tex	Fort Worth, Carey Wolf & Assoc.	817-738-1996
Tex	Houston, Carey Wolf & Assoc.	714-721-2442
Va	Annandale, J. Hopkins Assoc.	703-323-1641
Wash	Seattle, Datacom Assoc.	206-285-2525
EXP:	Hallandale, Fla., Emec, Inc.	305-925-6386

APPLIED MOTORS INC., Box 106, 4808 Boeing Dr., Rockford, Ill., 61105, Tel: 815-397-2006; Empl.: 120; Minimum order: $10

For info on price: R. A. Baird; Application info: R. A. Baird; Customer service: J. E. Malinowski; Delivery info: V. M. Gaines

Free literature available: Model BA bulletin - motors for low voltage battery powered systems; Model SR bulletin - motors for SCR speed control systems; Model VC bulletin - motors with integral bridge rectifiers; REDI LINE motor-generator bulletin.

Products manufactured: Motor Electric Generator Sets, Motors

Local Sales Offices & Reps.

Ala	Birmingham, East South Sls. Co.	205-323-2223
Cal	Hawthorne, W. H. Del Mar	213-756-1431
Cal	Mountain View, Claypool Controls Co.	415-968-7488
Conn	Ridgefield, E. S. Williams Co.	203-438-7474
Ill	Chicago, Clarkson Engrg. Co.	312-286-2314
Mass	Marblelead, Canner Assocs.	617-599-4740
Minn	Burnsville, R. E. Norene & Assoc.	612-890-1333
Mo	St. Louis, Terry & Hodges	314-965-0746
NY	Rochester, A. F. Zissler	716-586-6232
Ohio	Dayton, Rockford Controls Ohio	513-278-7362
Okla	Tulsa, Dynamic Component Sls.	918-749-1689
Pa	Broomall, J. C. Whiddett Co.	215-353-6343
Pa	Monroeville, Rockford Controls Ohio	412-373-2531
Tex	Bellaire, Dynamic Component Sls.	713-668-7729
Tex	Dallas, Dynamic Component Sls.	214-363-6191
Wisc	Cedarburg, R. E. Norene & Assoc.	414-377-5440

APPLIED RESEARCH INC., 76 S. Bayles Ave., Port Washington, N.Y., 11050, Tel: 516-883-5700, TWX: 510-223-0822; Empl.: 50 .... p. 2•1276,1277

For info on price: C. G. Costas; Application info: A. M. Scandurra; Customer service: C. G. Costas; Delivery info: C. G. Costas

Products manufactured: Amplifiers, Attenuators, Converters, Couplers, Filters, Multipliers, Switches, Terminals

Local Sales Offices & Reps.

Cal	Anaheim, Blair Assocs.	714-635-1350
Cal	Portola Valley, Kipp Assocs.	415-851-0123
Mass	Waban, Bawer Assocs.	617-244-6572
NY	Bridgeport, Lightstone Corp.	315-699-3209
NY	Port Washington, ARI	516-883-5700
Pa	Newtown Square, SWR Assocs.	215-356-8550
Tex	Dallas, Texas Avionics	214-368-3566
Va	Fairfax, Schibley Assocs.	703-591-3008

APPLIED SYSTEMS CORP., 26401 Harper Ave., St. Clair Shores, Mich., 48081, Tel: 313-779-8700; Empl.: 6

Products manufactured: Alarms, Analyzers, Comm. Systems, Computers, Controllers, Programmable, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Data Loggers, Integrated Circuit Devices, Monitors, Process Control Systems, Recorders, Test Systems, Testers, Timers, Totalizers, Digital, Transmission Systems, Data

A. P. W. CO., INC., 72 W. Main, Rockaway, N. J., 07866, Tel: 201-627-0643; Empl.: 18

For info on price: L. Rowe; Application info: A. Pfeil; Customer service: A. K. Pfeil; Delivery info: A. K. Pfeil

Free literature available: Free Listings

Products manufactured: Coils Including Assemblies & Forms, Solenoids

Local Sales Offices & Reps.

NY	Seaford, H. Abbott	516-781-5256

AQUALARM INC., 544 W. 182nd, Gardena, Cal., 90248, Tel: 213-321-5873; Empl.: 10; Minimum order: $25

Customer service: J. Herscovitz

Free literature available: Brochure - describes alarm system & emphasizes features. Catalogue sheet - lists and shows products and accessories. Installation instructions - for-do-it-yourself installation, covers all applications of the different types of switches.

Products manufactured: Alarms, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Switches

ARCO ELCTRNS., See PFC Mfg. Div.

ARCO ELECTRONICS INC., Community Drive, Great Neck, N.Y., 11021, Tel: 516-487-0500, TWX: 510-223-0888; Empl.: 490 .... p. 1•1547; p. 2•32-39,619

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Boards, Programming, Capacitors, Fixed, Capacitors, Variable, Connector Adapters, Connectors, Networks, Pins, Relays, Socket Adapters, Sockets

Local Sales Offices & Reps.

Cal	Anaheim, Lo-Dan Inc.	714-956-1560
Cal	Chatsworth, Arco Pacific	213-882-8707
Cal	San Carlos, Lo-Dan Inc.	415-592-4600
Cal	San Diego, Lo-Dan Inc.	714-279-6383
Cal	Van Nuys, Obie Mktg. Co.	213-997-1124
Fla	No. Miami, L. Haas Co. Inc.	305-949-9143
Ill	Chicago, Lassers & Co.	312-673-4050
Ind	Indianapolis, Advanced Comp. Sls.	317-545-6441
Mass	Lynn, Keene Sls.	617-595-2300
Mich	Southfield, Reps. Elctrn. Prods.	313-354-9066
Minn	St. Paul, Northport Engrs. Inc.	612-698-3841
NJ	Teaneck, Stan Axelrod Assoc.	201-836-6661
NY	Rochester, L-Mar Assoc.	716-328-5240
Ohio	Cleveland, Marlow Assoc. Inc.	216-932-0900
Ohio	Dayton, Marlow Assoc. Inc.	513-426-6270
Tex	Dallas, Berthold Sls. Co.	214-526-8329
Tex	Dallas, EBR, Inc.	214-942-2716
Wash	Seattle, DMS/Vantage	206-784-6800
Wash	Seattle, Vantage Corp.	206-455-3460
EXP:	Great Neck, Arco N.Y.	516-487-0500

ARCO WIRE & CABLE, 5168 Vineland Ave., N. Hollywood, Cal., 91601, Tel: 213-877-3376; Empl.: 10; Minimum order: $25

For info on price: E.L. Paul; Application info: B.B. Poole; Customer service: B. LeGault; Delivery info: B. LeGault

Free literature available: Line Card

Products manufactured: Cable Assemblies & Harnesses, Cable, Cords, Wire

Advertisment

Thermocouple Wire
High Temperature Wire
Teflon Hookup Wire
Teflon Coaxial Cable
U/L Wire and Cable
Aircraft Wire and Cable

ARCOLECTRIC SWITCH CORP., Box 348, 11120 Chandler Blvd., No. Hollywood, Cal., 91603, Tel: 213-985-3130; Minimum order: $35 p. 1•1959; p. 2•1125

For info on price: L. Lewis; Application info: L. Lewis; Customer service: J. Thomson; Delivery info: L. Lewis

Free literature available: Complete catalog covering switches: Toggle, Push-Button, Rocker etc., and indication lights neon, and lamp holders.

Products manufactured: Caps, Lenses, Indicator Light, Lamp Adapters, Lamps, Lights, Sockets, Switch Handle Boots, Switches

AREMCO PRODS., INC., Box 429, Ossining, N.Y., 10562, Tel: 914-762-0685; Empl.: 12; Minimum order: $25

For info on price: Order Dept.; Application info: R. M. Soberman; Customer service: Order Dept.; Delivery info: Order Dept.

Products manufactured: Adhesives (All Types), Alloys, Cleaners & Solvents, Coatings, Crystals, Drills & Accessories, Hand & Power, Gages, Graphite Parts, Materials, Graphite, Metals, Ovens, Services, Assembly, Production & Test, Substrates, Tools, Tubing

Local Sales Offices & Reps.

Cal	Torrance, Cal. Tech. Svcs.	213-320-1310
Fla	Winterhaven, S&S Sales Reps.	813-293-7304

ARENBERG ULTRASONIC LAB INC., 94 Green, Jamaica Plain, Mass., 02130, Tel: 617-522-8640; Empl.: 17; Minimum order: $20

Customer service: Robert J. Toronto 617-522-4038

Free literature available: Brochures describing our line of ARULAB test equipment including high voltage pulsed RF oscillator, amplifiers, pre-amplifier, attenuators and auxillary equipment.

Products manufactured: Amplifiers, Attenuators, Cable Assemblies & Harnesses, Coils Including Assemblies & Forms, Detectors, Generators, Power Supplies

A.R.F. PRODUCTS, Box 3226, Boulder, Colo., 80303, Tel: 303-443-4844, TWX: 910-940-3446; FSC No: 15196; Empl.: 24

For info on price: J. D. Ellington; Application info: A. B. Przedpelski; Customer service: J. D. Ellington; Delivery info: J. D. Ellington

Products manufactured: Alarms, Amplifiers, Cavities, Microwave, Comm. Systems, Controls/Control Eqpt., Couplers, Data Acquisition & Reduction Systems, Filters, Generators, Meters, Networks, Oscillators, Ovens, Receivers, Synthesizers, Transmitters, Transponders

Local Sales Offices & Reps.

Ariz	Tempe, PLS Assocs.	602-957-9110
Colo	Denver, PLS Assocs.	303-771-0140
NM	Albuquerque, PLS Assocs.	505-255-2330

ARGA CONTROLS, 35 E. Glenarm, Pasedena, Cal., 91105, Tel: 213-682-3314; FSC No: 50290; Empl.: 12; Minimum order: $25

For info on price: D. Umland; Application info: H. Galman; Customer service: H. Galman; Delivery info: A. Raines

Products manufactured: Controllers, Programmable, Controls/Control Eqpt., Converters, Indicators, Meters, Monitors, Relays, Signal Conditioners & Equipment, Transducers

Local Sales Offices & Reps.

Cal	Long Beach, Emerson Kirk Engrg. Co.	213-439-9559
Cal	Oakland, W. Nott & Co.	
Ill	Wilmette, Crest Assocs. Inc.	312-256-5202
Ind	Indianapolis, Crest Assocs.	317-844-2800
Kans	Prairie Village, Engineering Svcs. Co.	913-649-4000
Mo	St. Louis, Engineering Svcs. Co.	314-997-1515
Ore	Beaverton, Arneson Assocs.	503-646-3416
Va	Falls Church, Beacon Elctrn. Assocs.	703-534-1673
Wash	Seattle, Arneson Assocs.	206-762-7664

ARGOS PRODUCTS CO., INC., 600 S. Sycamore St., Genoa, Ill., 60135, Tel: 815-784-5118; Empl.: 85; Minimum order: $25

For info on price: R.M. Johnson; Application info: A.T. Hoyne; Customer service: A. Andree; Delivery info: A. Andree

Free literature available: 1. Eight page sound system components catalog; 2. Twelve page sound column selection and installation guide; 3. Audiophile Sound Systems flyer; 4. Sound column flyer; 5. Engineering Assistance Program brochure.

Products manufactured: Baffles, Speaker, Public Address Systems, Speaker Systems

Local Sales Offices & Reps.

Ark	El Dorado, D. Bellew Sls.	501-863-8325
Cal	Culver City, W. Alderson Co.	213-870-1030
Cal	San Francisco, Meyer, Ross & Fleming, Inc.	415-285-8880
Colo	Denver, K-C Marketers, Inc.	303-733-5561
Fla	North Miami, Winfield Elctrns. Sls.	305-945-6544
Ga	Atlanta, Murphy & Cota	404-875-2525
Haw	Honolulu, G. Piety Factors, Inc.	808-839-9059
Ill	Chicago, G. Mcl. Cole Co.	312-774-3535
Ind	Indianapolis, C. Scheffler Co.	317-253-6337
La	Kenner, D. Bellew Sls.	504-729-4550
Mass	North Scituate, W.A. Hendrickson Co.	617-545-0652
Mich	Plymouth, J. Malcolm Flora, Inc.	313-453-4296
Minn	St. Paul, W. Engelbretson	612-222-2338
Mo	Kansas City, Nevco, Inc.	816-421-1751
NJ	Fort Lee, TMC Sls. Corp.	201-944-5665
NY	Camillus, Callahan-Ferguson	315-487-3870
NC	Burlington, Murphy & Cota	404-875-2525
Ohio	Richfield, Bear Mktg.	216-659-3131
Ore	Salem, B.J. Walling	503-363-6445
Pa	Enon Valley, Nebco Assocs.	216-457-2333
Tenn	Memphis, D. Bellew Sls.	901-365-9437
Tex	Richardson, Campion Sls. Co.	214-238-8145
Va	, Stinson Assocs.	215-896-7378
Wash	Seattle, Pacnor Mktg.	206-284-8020
Wisc	Milwaukee, J. Kiehm	414-545-6083
EXP:	New York, Roburn Agencies, Inc.	212-989-5939

ARI INDS., INC., 9000 King St., Franklin Pk., Ill., 60131, Tel: 312-671-0511, TWX: 910-227-0052; Empl.: 100; Minimum order: $50

For info on price: D. Boyce; Application info: D. Mackenzie; Customer service: E. Kapustka; Delivery info: A. Yavitz

Free literature available: Thermocouples; Heaters; Hi Temp. Cable; Self powered Newtron Detectors; Temp. Controllers.

Products manufactured: Cable, Connectors, Controls/Control Eqpt., Thermocouples, Elements & Accessories, Transducers, Wire

Local Sales Offices & Reps.

Ariz	Scottsdale, Inter-Mountain Engrg.	602-947-7379
Cal	Laguna Beach, Marchi-Barus Assocs.	714-497-1815
Cal	Redwood City, Marchi Assocs.	415-364-3411
Colo	Denver, Davis Assocs.	303-744-6644
Conn	North Haven, Forsberg Sls.	203-239-5111
Ill	Northfield, Istronics	312-446-3231
Ind	Indianapolis, Process Heat & Control	317-542-8331
Md	Baltimore, Wilt Cooke & Comp.	301-685-1511
Mass	Brockton, Forsberg Sls.	617-522-6300
Mich	Clawson, Instr. Specialties	313-435-3311
Minn	Minneapolis, Industra	612-929-6224
Mo	St. Louis, Maise Equip. Co.	314-241-4351
NM	Albuquerque, Rustco Entprs.	505-296-6474
NY	Flushing, Tri-State	212-358-1010
NY	Rochester, Nickles Engrg.	
Ohio	Chagrin Fall, The Jerry Kilroy Corp.	216-247-8997
Ohio	Cincinnati, Schlemmer Assocs.	513-522-8340
Pa	Blue Bell, W. Gregory & Co.	215-643-4702
Tex	Houston, Instrs.	713-225-6626
Va	Richmond, Advance Control Equip. Co.	804-264-2588

ARIES ELECTRONICS, Box 231, Frenchtown, N.J., 08825, Tel: 201-996-4096, TWX: 510-235-3391; FSC No: 51167; Minimum order: $25

Customer service: W. Sinclair

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Programming, Connectors, Headers, Jumpers, Packages, Integrated Circuit, Sockets

Local Sales Offices & Reps.

Ariz	Scottsdale, Sales Engrg.	602-945-5781
Cal	Palo, Alto, Engineering Assoc.	415-326-7842
Cal	Pasadena, P. Nurches Co.	213-681-8957
Colo	Wheatridge, Waugaman Assoc.	303-423-1020
Fla	Lighthouse Point, Saber Assoc.	305-943-3076
Ill	Des Plaines, Coombs Assoc.	312-298-4830
Md	Baltimore, J. A. Maguire & Co.	301-377-0223
Mass	Waltham, Betronic Assoc.	617-894-8400
Mich	Lathrup Village, R. C. Nordstrom & Co.	313-559-7373
Mo	Kansas City, L. F. Florence Co.	816-561-7222
NJ	Ho-Ho-Kus, D. J. Fisher Co.	201-652-0092
NJ	Pennsauken, J. A. Maguire & Co.	609-665-5136
NY	Elbridge, L-Tron Corp.	315-689-3787
NC	Winston-Salem, J. A. Maguire & Co.	919-884-7665
Ohio	Dayton, Midwest Mktg. Assoc.	513-433-2511
Tex	Arlington, Ion Assoc.	817-461-9661
Wash	Kirkland, Todd-Brian Inds.	206-827-5811

Local Distributors

Cal	Mt. View, Ratel Elctrns., 815 Maude Ave.	415-965-2010
Fla	Margate, Controlled Dist., 2922 N. State Rd. 7	305-971-4950
Ill	Mundelein, J & R Entprs., 668 Tower Rd.	312-566-2030
Tex	Richardson, Air Quip Sls., 909 Business Pky.	214-234-3285
Utah	Salt Lake, Alta-Land Elec., 2280 Main St.	801-486-7227

ARISTO GRID LAMP PRDTS., 65 Harbor, Port Washington, N.Y., 11050, Tel: 516-767-6575; Empl.: 15; Minimum order: $15

Customer service: P. Hellman

Products manufactured: Lamps, Lights, Ultraviolet Inspection Lighting, X-Ray Inspection Equipment

ARMCO STEEL CORP., 703 Curtis St., Middletown, Ohio, 45043

Products manufactured: Metal Compounds, Foils, Powders, Sheet, Stock

Local Sales Offices & Reps.

Ala	Mountain Brook	205-879-0166
Ariz	Phoenix	602-274-0528
Cal	Los Angeles	213-776-5191
Colo	Englewood	303-761-2414
Ga	Atlanta	404-325-9740
Ill	Chicago	312-782-4082
Ind	Indianapolis	317-257-5491
Iowa	Bettendorf	319-355-7722
Iowa	Des Moines	515-278-2801
Kans	Wichita	316-685-4248
Ky	Louisville	502-426-3120
La	Metairie	504-887-6910
La	Shreveport	318-861-2427
Md	Baltimore	301-825-5300
Mass	Wellesley Hills	617-235-8350
Mich	Detroit	313-444-1144
Mich	Grand Rapids	616-363-7731
Minn	Minneapolis	612-521-7661
Miss	Jackson	601-362-0248
Mo	Clayton	314-727-9385
Mo	Joplin	417-624-0697
Mo	Kansas City	816-483-7666
Mo	Springfield	417-883-5025
Neb	Omaha	402-346-3911
NJ	Englewood Cliffs	201-947-4454
NM	Albuquerque	505-265-5993
NY	Buffalo	716-839-3180
NC	Greensboro	919-273-6927
Ohio	Cleveland	216-464-7474
Ohio	Columbus	614-846-7110
Ohio	Dayton	513-298-4301
Ohio	Fairfax	513-272-0904
Okla	Oklahoma City	405-848-8771
Okla	Tulsa	918-663-2550
Pa	Bala-Cynwyd	215-839-6750
Pa	Pittsburgh	412-391-2900
SD	Sioux Falls	605-336-0063
Tenn	Memphis	901-683-8201
Tenn	Nashville	615-298-5443
Tex	Dallas	214-526-7821
Tex	Houston	713-621-7700
Tex	Lubbock	806-763-2868
Tex	San Antonio	512-736-3166
Wash	Bellevue	206-454-5450
Wisc	Milwaukee	414-271-5628

ARMEL ELECTRONICS, 1601 75th, N. Bergen, N.J., 07047, Tel: 201-869-4300, TWX: 201-868-0069; FSC No: 91663; Empl.: 55; Minimum order: $20

Customer service: V. A. Pasqualino

Products manufactured: Connectors, Sockets, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Cal	Culver City, Deangelo, Rothman & Co.	213-398-6239
Md	Baltimore, R. A. Wafer Assocs.	301-744-1133
Mass	Newtown Upper Falls, Brookdale Elctrns.	617-244-6969

ARMSTRONG CORK CO., W. Liberty St., Lancaster, Pa., 17604, Tel: 717-397-0611, TWX: 717-560-4405; Empl.: 24,000

Customer service: S. W. Eby

Free literature available: Armstrong Insulation Products: Sixteen page brochure with complete descriptions and specifications for Armaflex and Armalok insulation materials.

Products manufactured: Adhesives (All Types), Compounds, Encapsulating, Insulating, Molding, Potting, Heaters & Heating Elements, Insulators & Insulation, Seals

Local Sales Offices & Reps.

Cal	Burlingame, Armstrong Cork Co., Ind. Prods. Div,	415-697-3025
Ill	Park Ridge, Armstrong Cork Co., Ind. Products Div.	312-696-3130
Mich	Oak Park, Armstrong Cork Co., Ind. Products Div.	313-968-7700
Mo	St. Louis, Armstrong Cork Co., Ind. Products Div.	314-863-7979
NY	Saddle Brook, Armstrong Cork Co., Ind. Products Div.	201-843-0300
NC	Charlotte, Armstrong Cork Co., Ind. Products Div.	704-372-2720
Ohio	Cincinnati, Armstrong Cork Co., Ind. Prods. Div.	513-563-4160
SC	Greenville, Armstrong Cork Co., Ind. Prods. Div.	803-288-0881

ARNOLD ENGINEERING CO., Box "G", Marengo, Ill., 60152, Tel: 815-568-2000, TWX: 910-642-2790; Empl.: 1500 .... p. 2•1212,1213

Products manufactured: Cores, Ceramic, Cores, Magnetic, Foil, Laminations, Magnetizers, Magnets, Shielding Beads, Ferrite

Local Sales Offices & Reps.

Ariz	Scottsdale, C.T. Fink & Assocs.	602-992-9884
Cal	Fullerton, Arnold Engrg. Co.	714-871-1560
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	Palo Alto, Arnold Engrg. Co.	415-326-9302
Cal	San Bernardino, Shankman Assoc.	714-997-0660
Mass	Lexington, Arnold Engrg. Co.	617-862-2804
Mich	Jackson, Arnold Engrg. Co.	517-784-5663
Minn	Minneapolis, F.W. Ladky Assocs.	612-545-1494
Mo	Hazelwood, Centech Inc.	314-731-4220
Mo	Raytown, Centech Inc.	816-358-8100
Neb	Ogallala, Ogallala Elctrns.	308-284-4093
NJ	Leonia, Arnold Engrg. Co.	201-461-8150
NJ	Leonia, Ontec	201-461-8150
NY	Rochester, Ontec	716-464-8636
NC	Raleigh, Arnold Engrg. Co.	919-828-3270
Ohio	Shaker Heights, Arnold Engrg. Co.	216-283-7580
Pa	King of Prussia, H. Hackett Assocs.	215-265-7864
Tex	Dallas, Arnold Engrg. Co.	214-821-4654
Wisc	Madison, F.W. Ladky Assocs.	608-222-0900
Wisc	Milwaukee, F.W. Ladky Assocs.	414-964-8060

ARNOLD MAGNETICS CORP., 11520 Jefferson Blvd., Culver City, Cal., 90230, Tel: 213-870-7014, TWX: 910-343-6468; Empl.: 50; Minimum order: $15 p. 1•1093-1105

For info on price: J. McGann; Application info: R. Pizer; Customer service: J. McGann; Delivery info: J. McGann

Free literature available: Short form catalog Design as you order Toroidal winding machine Dummy Power Supply Sample

Products manufactured: Converters, Counters, Decade Boxes, Filters, Inverters, Machines/Machinery, Production, Power Supplies, Transformers

Local Sales Offices & Reps.

Cal	Mountain View, Nor-Cal Assocs.	415-961-8121
Cal	San Diego, Daniels & Doty Sls. Co.	714-560-6266
Colo	Boulder, Scientific Devices, Intermountain	303-449-9466
Mass	Stoneham, Ken Corp.	617-438-5464
Mo	Kansas, Pem Sls.	314-427-7200
NJ	Wallington, Com-Tech Sls.	201-935-5454
Ohio	Cleveland, Bock Assoc.	216-331-5212
Pa	Media, W. Reeves Assocs.	215-566-6709
Tex	Richardson, Texport Co.	214-690-4004

ARNOUX CORP., 35 Anacapa St., Santa Barbara, Cal., 93101, Tel: 805-963-3476; Empl.: 20 .... p. 1•604,605

Products manufactured: Analyzers, Comm. Systems, Converters, Data Acquisition & Reduction Systems, Data Loggers, Decommutators, Telemetering, Indicators, Meters, Multiplexers, Power Supplies

ARRA INC., Antenna & Radome Resch. Assocs., 15 Harold Ct., Bay Shore, N.Y., 11706, Tel: 516-231-8400, TWX: 510-227-6231; Empl.: 45 .... p. 2•1278,1279

Products manufactured: Adapters, Waveguide, Attenuators, Bends & Twists, Microwave, Calibrators, Couplers, Dividers, Drivers, Switch, Dummy Loads, Duplexers, Microwave, Filters, Junctions, Hybrid, Microwave, Kits, Training Aid, Limiters, Line Strechers, Microwave, Mismatches, Microwave, Precision, Modulators, All Kinds, Oscillators, Shifters, Strip-Line Components, Microwave, Switches, Tees, Terminals, Transmitters, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Saber Assoc.	205-534-3387
Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Los Angeles, R F Assocs. Inc.	213-478-1586
Cal	Palo Alto, R F Assocs. Inc.	415-327-3331
Colo	Boulder, R.A. Mayes Co.	303-444-0782
Fla	Lighthouse Point, Saber Assoc.	305-943-3076
Fla	Longwood, Saber Assoc.	305-422-3686
Fla	St. Petersburg, Saber Assoc.	813-441-1301
Ill	Northfield, Feller	312-446-8065
Iowa	Cedar Rapids, Tech Reps.	319-363-2489
Kans	Olathe, Tech Reps.	913-782-1177
Md	Ellicott City, Doss Elctrns.	301-465-1336
Mass	Cochituate, Micronic Assocs.	617-872-6561
Mo	Hazelwood, Tech. Reps.	314-731-5200
NJ	Hackettstown, EAC Assoc.	201-852-5987
NJ	Newtown Sq., SWR Assoc.	215-356-8550
NM	Albuquerque, R. A. Mayes	505-292-2330
NY	Great Neck, EAC	516-466-9798
NY	Syracuse, Tesco Mktg. Assocs.	315-463-4566
NC	Raleigh, Saber Assoc.	919-834-3961
Pa	Newton Sq., SWR Assocs. Corp.	215-356-8550
Tex	Houston, R.A. Mayes	713-466-8325
Tex	Richardson, R.A. Mayes	214-235-3043
Utah	Centerville, R.A. Mayes Co.	801-292-6781
EXP:	Fla., Hallandale, Emec Inc.	305-925-6366

ARROW-HART, INC., 103 Hawthorn St., Hartford, Conn., 06106, Tel: 203-249-8471, Telex: 99328
p. 1•233-236,1580-1585,1933; p. 2•621

Products manufactured: Caps, Connector, Circuit Breakers, Connector Boxes & Strips, Power Outlet, Connectors, Controls/Control Eqpt., Dials, Lights, Motors, Relays, Switches, Timers

Local Sales Offices & Reps.

Ariz	Phoenix	602-957-2860
Ark	Little Rock, Carlton Bates	501-562-9100
Ark	Marion	901-525-6585
Cal	Cerritos	213-773-1736
Cal	Sacramento	916-444-5769
Cal	San Diego	714-287-1300
Cal	San Rafael	415-472-5071
Cal	Santa Clara	408-249-0515
Conn	Hartford	203-249-8471
Ga	Decatur	404-981-4940
Ill	Bensenville	312-595-7750
La	Metairie	504-733-6287
Md	Baltimore	301-467-6896
Mass	Norwood	617-762-3660
Mich	Southfield	313-352-6810
Minn	Minnetonka	612-935-0173
Mo	St. Louis	314-351-0770
NJ	Cinnaminson	609-829-4777
NJ	Teterboro	201-288-3600
NY	Endicott	607-785-0785
NY	Hamburg	716-649-5322
NY	Herkimer	315-866-0443
NY	Honeoye Falls	716-227-2630
NY	Mt. Vernon, QAR Ind.	914-699-2224
NY	Stuyvesant	518-684-6703
NY	Syracuse	315-479-5595
Ohio	Cincinnati	513-793-8300
Ohio	Cleveland	216-651-7733
Ore	Portland	503-234-4563
Tex	Garland	214-270-5441
Va	Richmond	804-262-9556
Wash	Bellevue	206-747-3730
Wisc	Milwaukee	414-351-0840

ARROW-M, 250 Sheffield Ave., Mountainside, N.J., 07092, Tel: 201-232-4260, Telex: 138-213; Minimum order: $50 p. 1•1586-1595

For info on price: T. E. Gottlick; Application info: F. Buccino; Customer service: F. Buccino; Delivery info: F. Buccino

Free literature available: Catalogs, Test Reports, Technical Info.

Products manufactured: Counters, Meters, Relays, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Powertronics	205-852-6347
Ariz	Phoenix, Arrowhead Sls Corp.	602-277-7148
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Cal	Santa Clara, Westrep	408-984-0350
Conn	Madison, United Components Inc.	203-562-4002
Fla	Casselberry, E I R Inc.	305-830-9600
Fla	Palm Beach, EIR Inc.	305-585-7957
Fla	Plantation, EIR Inc.	305-791-6390
Ill	Chicago, Brock & Cushman	312-622-4110
Ind	Carmel, Giesting Assoc.	316-844-8171
Mich	Detroit, Nicon Assoc.	313-341-7688
Minn	St. Paul, Skor	612-645-6461
NH	Pelham, United Components Inc.	617-454-2751
NJ	Haddonfield, Thomas Assoc. Inc.	609-854-3011
NJ	Plainfield, Meg Electronic Sls.	201-757-4332
NC	Thomasville, Powertronics	919-476-6727
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242
RI	Saunderstown, United Components Inc.	617-226-0556
Tex	Addison, Dunbar Assoc.	214-239-7151

Local Distributors

Fla	W. Palm Beach, Nurmi Elctrn. Supply Inc., 1727 Donna Rd.	305-686-8553
NJ	Fair Lawn, Relay Specialties, 1300 Plaza Rd.	201-797-3313
NY	Ontario Center, Pace Elctrn. Prods., Box 161	315-524-2491

ART WIRE & STAMPING CO., 9 Wing Dr., Cedar Knolls, N.J., 07927, Tel: 201-267-2000, Telex: 13-6455; Empl.: 100

Free literature available: Art of Wire Forming; Knurled Terminals; Keyboard Contacts; Wire Forms and Stampings; We Have A Way With Wire.

Products manufactured: Connectors, Forms, Wire, Pins, Services, Assembly, Production & Test, Terminals, Wire

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Hagestad	602-945-8415
Cal	Downey, Corbett-Smith	213-927-2788
Cal	San Francisco, D.R. Cox	415-441-8566
Ind	Indpls, Hoster & Sieloff	317-844-9921
Kans	Kansas City, L. Bruns	913-AT 9-5242
Mich	Detroit, W. Crawford Assoc.	313-836-8121
Minn	St. Paul, R. Bittrick	612-226-6178
Tex	Dallas, P. Scanlon	214-AD 1-4661

ARTECH CORP., 2816 Fallfax Dr., Falls Church, Va., 22042, Tel: 703-560-3292

Free literature available: Brochure contains information on R.F. attenuators, vacuum-ultraviolet lamps and detectors, and testing and coating services.

Products manufactured: Boards, Printed Circuit, Cells, Photoconductive, Photoemissive, Photovoltaic, Crayons, Coatings, Pellets, etc., Temperature Indicating, Detectors

Local Sales Offices & Reps.

Kans	Kansas City, Nevco	816-421-1751

ARTISAN ELCTRNS. CORP., 5 Eastmans Rd., Parsippany, N.J., 07054, Tel: 201-887-7100; Empl.: 150; Minimum order: $15

For info on price: A. Seman; Application info: A. Bastian; Customer service: M. Minter; Delivery info: M. Minter

Free literature available: Specification Data on General Purpose Relays; Specification Data on Industrial Solenoids; Specification Data on Solid State Timers; Specification Data on Solid State Programmers; Cross Reference Literature on General Purpose Relays.

Products manufactured: Annunciators, Coils Including Assemblies & Forms, Controls/Control Eqpt., Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Drivers, Solenoid, Flashers, Indicators, Panels, Recorders, Relays, Solenoids, Switches, Testers, Timers

Local Sales Offices & Reps.

Cal	Los Altos, Herb Waldek Assoc.	415-964-4699
Cal	San Gabriel, P.F. Wiley Co.	213-663-8028
Conn	Bloomfield, Zaslow Sls.	203-242-7781
Conn	Milford, Zaslow Sls.	203-878-1094
Fla	Orlando, Geartner Associates	305-299-1000
Ill	Northfield, Such & Assocs. Inc.	312-446-8934
Md	Hyattsville, Eastern Components	301-577-2925
Mass	Lowell, Zaslow Sls.	617-458-8452
Mass	Northboro, Zaslow Sls.	617-393-8150
Mich	Farmington, Oliver Stirling	313-851-7373
Minn	Minneapolis, Delta Assoc.	612-560-6240
NJ	N. Caldwell, Masin-Esco	201-226-2550
NY	Chappaqua, Masin-Esco	914-CE 8-8337
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Syosset, Masin-Esco	516-364-0310
Ohio	Cincinnati, G & H Sls. Co.	513-771-8231
Ohio	Grove City, G & H Sls. Co.	614-878-1128
Pa	Philadelphia, Eastern Comps.	215-836-1616
Tex	Irving, Aid Elctrns.	214-159-4761
FOR:	Can., Downsview, Ontario, Zaslow Sls.	416-727-1211

ARTOS ENGRG. CO., 15600 W. Lincoln Ave., New Berlin, Wisc., 53151, Tel: 414-782-3300, Telex: 26-9549; Empl.: 300

For info on price: H. T. Randar; Application info: M. Randar; Customer service: R. O. Dusel; Delivery info: P. Woboril

Products manufactured: Machines/Machinery, Production, Wire Strippers

Local Sales Offices & Reps.

Cal	Fullerton, C. Martin
Conn	Stamford, Artos Engrg. Co.
Ga	Atlanta, Artos Engrg.
Ill	Morton Grove, Artos Engrg. Co.

ARTRONIC INSTR. CO., 11232 Triangle La., Silver Spring, Md., 20902, Tel: 301-949-1131; FSC No: 09446
p. 1•430,431

Customer service: M. E. Pugh

Free literature available: General catalog.

Products manufactured: Delay Lines, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Filters, Networks, Reactors, Transformers

ARVIN FREQUENCY DEVICES, Elctrn. Sys. Div., Arvin Inds., 15th St. Plant, Columbus, Ind., 47201, Tel: 812-379-3842, TWX: 810-352-1272; Empl.: 30

Products manufactured: Oscillators

Local Sales Offices & Reps.

Cal	Los Angeles, E. Landa	213-879-0770
Cal	San Diego, Tauber Assocs.	714-274-7242
Iowa	Cedar Rapids, HR Brown Sls. Co.	319-366-0635
Mass	Needham, Addèlco	617-444-4754
NY	Great Neck, EAC Assocs., Inc.	516-466-9798
EXP:	Chicago, Ill., E.D. Magnus Assocs.	312-334-1502

ASARCO INTERMETALLICS CORP., 120 Broadway, New York, N.Y., 10005

ASHMAN INDUSTRIES (1966) LTD., 66 Brock Rd., Greensville Dundas, Ont., Can., Tel: 416-628-6371; Empl.: 48

For info on price: H. Rushton; Customer service: S. Harathyan; Delivery info: M. Booker

Free literature available: Catalogue

Products manufactured: Benches, Consoles, Stools, Tables, Boards, Plug-In, Boards, Printed Circuit, Cabinets & Accessories, Cable Assemblies & Harnesses, Cases, Equipment, Instrument, Meter, Chassis, Metal, Decade Boxes, Panels, Power Supplies, Racks, Services, Assembly, Production & Test

ASHLAND ELEC. PRODS., 32-02 Queens Blvd., L.I.C., N.Y., 11101, Tel: 212-EX 2-4010; Empl.: 150
p. 1•486,487,934-937

For info on price: R. Lukasik; Application info: R. Lukasik; Customer service: J. Parks; Delivery info: J. Parks

Free literature available: We offer a catalog which describes Ashland's product line, this consists of fractional horsepower electric motors, axial fans and centrifugal blowers. Electrical and mechanical specifications are included.

Products manufactured: Blowers & Fans & Accessories, Motor & Generator Armatures, Rotors, Stators, Motors

Local Sales Offices & Reps.

Cal	Burlingame, W.J. Purdy	415-347-7701
Cal	Los Angeles, C. Repp	213-GR 7-4475
Cal	Sacramento, Wm. J. Purdy Co.	916-481-0971
Colo	Denver, Wm. J. Purdy Co.	303-777-1411
Fla	Fern Park, M. G. Assocs.	305-841-8793
Ill	Chicago, Berndt Assoc.	312-283-0713
Md	Riversdale, Riggs Assocs.	301-927-3380
Mass	Brookline, Harman	617-232-6687
Minn	Minneapolis, Electronic Innovators	612-884-7471
Miss	Corinth, Remco	601-287-5369
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	Brooklyn, Eastern Elctrn. Sls.	212-763-5180
NY	Fairport, TAC Assocs.	716-377-1742
NY	Utica, Elcom Sls.	315-732-6445
Ohio	Akron, Augnat Assocs.	216-725-6087
Pa	Doylestown, T.O.E. Sales	201-568-5747
Tenn	Bristol, Remco	615-968-4195
Tex	Dallas, RMC & Assoc.	214-363-0166
Wash	Kirkland, Todd-Brian	206-827-5811
FOR:	Can., Montreal West, Que., Hooker Elec. Canada	514-487-5151

ASSEMBLED PRODUCTS CO., Box 750, St. Albans, Vt., 05478; Empl.: 22

Customer service: A. Sherry 802-893-4513

Products manufactured: Cable, Relays, Wire

ASSOCIATE GENERAL LABS., INC., 8934 W. Ogden Ave., Brookfield, Ill., 60513, Tel: 312-485-1135; Empl.: 11

Customer service: A. Schroeder

Products manufactured: Machines/Machinery, Production, Services, Assembly, Production & Test

ASSOCIATED ENGRG. & MFG. CORP., 546 Valley Rd., Upper Montclair, N.J., 07043, Tel: 201-783-7800; Empl.: 69; Minimum order: $100

For info on price: D.M. Fox; Application info: D.M. Fox; Customer service: J. Reid; Delivery info: J. Francis

Products manufactured: Caps, Connector, Connectors, Metals, Relays, Sockets, Switches, Terminals, Wire

ASSOCIATED ENVIRONMENTAL SYSTEMS, 360 Merrimack St., Lawrence, Mass., 01842, Tel: 617-683-9501, TWX: 710-342-0765; Empl.: 300; Minimum order: $15

Customer service: D. L. Thomas

Free literature available: Complete catalog of products

Products manufactured: Chamber, Environmental Test, Ovens, Refrigerators, Environmental Test

Local Sales Offices & Reps.

Ala	Birmingham, Dilcher Engrg. Co. Inc.	205-252-3300

Directory of Local Distributors Starts on page 401

Ariz	Scottsdale, Sls. Engrg., Inc.	602-945-5781
Cal	Mountain View, IFM, Inc.	415-961-2828
Cal	Van Nuys, Gordon-Elliot, Inc.	213-873-6862
Conn	East Hartford, E. E. Specialists, Inc.	203-568-1500
Fla	St. Petersburg, Dilcher Engrg. Co. Inc.	813-343-1041
Ga	Atlanta, Dilcher Engrg. Co.	404-261-1678
Ill	Chicago, Midwest Elctrn. Sls.	312-626-0030
Ind	Indianapolis, Midwest Elctrn. Sls.	317-926-3736
Iowa	Cedar Rapids, Midwest Elctrn. Sls.	319-362-4410
Kans	Wichita, Aero-Hill Sls.	316-943-6371
Md	Silver Spring, ARA Elctrns., Inc.	301-565-2584
Mass	Acton, Edcom	617-969-9710
Mich	Detroit, Electro Entprs., Inc.	313-521-1500
Minn	Minneapolis, E. J. Doyle Co.	612-827-5847
NY	Albany, J. A. Reagan Co., Inc.	518-489-4777
NY	Binghamton, J. A. Reagan Co., Inc.	607-723-9661
NY	Great Neck, Trionic Assocs., Inc.	516-466-2300
NY	New Hartford, J. A. Reagan Co., Inc.	315-732-3775
NC	Winston Salem, Radco Co.	919-722-9671
Ohio	Cleveland, Electro Entprs., Inc.	216-261-7670
Ohio	Dayton, Electro Entprs., Inc.	513-426-6071
Pa	Glenside, ARA Elctrns., Inc.	215-887-5250
Tex	Dallas, True Technology Co.	214-691-7870
Wisc	Waukesia, Midwest Elctrn. Sls.	414-542-5129

ASSOCIATED RESEARCH, INC., 6125 W. Howard St., Niles, Ill., 60648, Tel: 312-647-7850; Minimum order: $10 .... p. 1•607

For info on price: R. S. Barnard; Application info: M. Kaltenbach; Customer service: R. S. Barnard; Delivery info: M. Kaltenbach

Products manufactured: Cable Fault Locators, Meters, Power Supplies, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Sls. Engrg.	602-945-5781
Ark	Little Rock, Electra-Tech Midsouth	501-562-4090
Cal	Paramount, Brenner-Fiedler Assoc.	213-531-7222
Cal	San Francisco, California Instr. Co.	415-863-0350
Fla	Miami, Ludlum Assocs. Co.	305-592-6523
Fla	Orlando, Ludlum Assocs. Co.	305-894-7761
Ga	Atlanta, Holman-Lobsinger Co.	404-256-9120
Ill	Chicago, Factory Office	312-647-7850
Ind	Indianapolis, C.M. Buck & Assocs.	317-251-1281
Md	Bethesda, Bartlett Assocs.	301-656-3061
Mass	Needham, Northeast Reps.	617-449-3034
Mich	Birmingham, Electro-Mation Assocs.	313-564-6517
Minn	Edina, Ainslie Co.	612-920-2996
Mo	Kansas City, Cleaves-Bessmer-Marietti	816-353-6011
Mo	St. Louis, Fitzgerald Sls. Co.	314-241-4066
Neb	Omaha, F.C. Clatterbaugh Co.	402-331-3950
NY	Brooklyn, Associated Research	212-451-0708
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Ohio	Brecksville, D & B Engrg. Sls.	216-526-6320
Pa	Pittsburgh, Bollinger & Bradford	412-561-2340
Pa	Wayne, Bartlett Assocs.	215-688-7325
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Wash	Seattle, D.A. Olson	206-522-6594

ASSOCIATED SPECIALTIES CO., 1751 Main St., Orefield, Pa., 18069, Tel: 215-395-9172

Customer service: V. Laudenslager

Products manufactured: Power Supplies

ASSOCIATED SPRING CORP., 18 Main St., Bristol, Conn., 06010, Tel: 203-582-9581, TWX: 710-454-0592; Empl.: 6,105

For info on price: R. O.. Corley; Application info: S. M. Rimmer; Customer service: R. O. Corley; Delivery info: R. O. Corley

Products manufactured: Fasteners, Forms, Wire, Services, Assembly, Production & Test, Springs (All Types)

Local Sales Offices & Reps.

Cal	Gardena	213-323-4833
Colo	Denver	303-399-2643
Conn	Bristol	203-582-9581
Ga	Atlanta	404-256-2510
Ill	Lombard	312-495-4760
Ill	Mattoon	217-235-5601
Mich	Ann Arbor	313-665-8686
Mich	Plymouth	313-453-6100
NY	Syracuse	315-457-9200
NC	Arden	704-684-7836
Ohio	Dayton	513-253-4131
Pa	Corry	814-665-8241
Tenn	Memphis	901-332-4832
Tex	Dallas	214-631-3441
Wisc	Milwaukee	414-482-1600

ASSOCIATED TESTING LABS., Northwest Ind'l. Pk., Burlington, Mass., 01803, Tel: 617-272-9050; Empl.: 100

Products manufactured: Chamber, Environmental Test, Services, Assembly, Production & Test, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Engrg. Sls. Assocs.	602-945-5781
Cal	Mt. View, IFM-North	415-961-2828
Cal	Van Nuys, Gordon-Elliot, Inc.	213-873-6862
NY	Albany, Compar Albany	518-489-7408
NC	Winston-Salem, Radco Co.	919-722-9671
Tex	Dallas, True Technology	713-649-7874
Tex	Houston, True Technology	214-239-7741

ASSOCIATED TESTING LABORATORIES, 9 Brighton Rd., Clifton, N.J., 07012, Tel: 201-473-6455; Empl.: 45

Customer service: D.W. Hanright

Free literature available: Facilities & capabilities brochures describe testing services offered.

Products manufactured: Services, Assembly, Production & Test

ASTATIC CORP., Box 120, Conneaut, Ohio, 44030; Empl.: 500

Products manufactured: Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds

Local Sales Offices & Reps.

Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Sacramento, W.J. Purdy Co.	916-422-0128
Cal	Van Nuys, M. Roth Sls.	213-989-3738
Colo	Denver, Connors, Inc.	303-934-5829
Conn	Waterbury, Anderson Sls. Assocs.	203-753-2487
Fla	Orlando, Hollingsworth & Still, Inc.	305-671-4515
Ga	Atlanta, Hollingswoth & Still, Inc.	404-394-3270
Ill	Chicago, Markal Sls. Corp.	312-282-5800
Ind	Indianapolis, Sukup & Cox, Inc.	317-253-1215
Iowa	Des Moines, Kathrinus-Kelly & Co.	515-255-4584
Kans	Shawnee Mission, Kathrinus-Kelly & Co.	913-722-0000
La	Chalmette, Cartwright & Bean Inc.	901-276-4442
Md	Silver Spring, Lowery Assocs. Co.	301-439-3542
Mass	Boston, Anderson Sls. Assocs.	617-227-2980
Mich	Southfield, R. Milsk Co.	313-354-3310
Miss	Jackson, Cartwright & Bean Inc.	601-354-1368
Mo	St. Louis, Kathrinus-Kelly & Co.	314-968-3800
NJ	Teaneck, S. Axelrod Assoc.	201-836-6661
NY	Lake Ronkonkoma, S. Axelrod Assoc.	
NY	Syracuse, Paston-Hunter Co., Inc.	315-437-2992
NC	Charlotte, Hollingsworth & Still Inc.	704-536-7047
Ohio	Beachwood, Elctrn. Salesmasters Inc.	216-831-9555
Ohio	Dayton, Elctrn. Salesmasters Inc.	513-837-2379
Ore	Portland, D.G. Weber Co.	503-234-0686
Pa	Broomall, Lowery Assocs. Co.	215-356-5300
Pa	Harrisburg, Lowery Assocs. Co.	215-233-0917
Tenn	Memphis, Cartwright & Bean Inc.	901-276-4442
Tex	Dallas, Maynard & Gunn Sls. Co.	214-742-2384
Tex	Houston, Maynard & Gunn Sls. Co.	713-497-0544
Utah	Bountiful, Connors, Inc.	801-292-4664
Va	Charlottesville, Lowery Assocs. Co.	703-973-6672
Wash	Seattle, D.G. Weber Co.	509-623-5990
Wash	Spokane, D.G. Weber Co.	509-624-3908
EXP:	Plainview, NY, Morhan Exporting Corp.	516-293-5582

ASTRO ELCTRNS., INC., 2478 Fender Ave., Unit "D", Fullerton, Calif., 92631, Tel: 714-526-5581; Empl.: 14; Minimum order: $100

For info on price: C. Jasper; Application info: G. A. Harter; Customer service: G. A. Harter; Delivery info: C. Jasper

Products manufactured: Potentiometers, Resistors

Local Sales Offices & Reps.

Cal	Los Angeles, Component Mktg. Assocs.	213-541-2515
Ohio	Cincinnati, B. Stephens Manufacturers' Rep.	513-921-0350

ASTRO-GEO-MARINE INC., Box 5526, Oxnard, Cal., 93030, Tel: 805-485-3128; FSC No: 51473; Empl.: 10

Customer service: J. E. Fenole

Products manufactured: Converters, Inverters, Power Supplies, Services, Assembly, Production & Test

ASTRO-MED, Div Atlan-Tol Inds. Inc., 639 E. Greenwich Ave., West Warwick, R.I., 02893, Tel: 401-828-4000; Empl.: 35

For info on price: D. Colinan; Application info: E. V. Pizzoti; Customer service: M. Cote; Delivery info: B. Berthiume

Free literature available: (1) "Barebones" Recorders - One, two, three, and four channel low cost recorders; (2) "OEM" Recorders - One, two, three, and four channel recorders; (3) Portable Battery Powered Recorder; (4) Eight channel recorder.

Products manufactured: Paper, Graphic Recording, Recorders

ASTRO CIRCUIT CORP., 540 Main St., Tewksbury, Mass., 01876, Tel: 851-7229, Telex: 947851; Empl.: 140; Minimum order: $100

Customer service: W. J. Galvin

Free literature available: Literature provides a photographic description of facilities as well as a description of capabilities, in design, engineering and manufacturing.

Products manufactured: Circuits, Printed, Multilayer

Local Sales Offices & Reps.

Mass	Randolph, Naton Assocs.	617-986-6417
NY	Roslyn Heights, Productronics Ltd.	516-484-2619

ASTRO DYNAMICS, Northwest Indl. Park, Burlington, Mass., 01803, Tel: 617-272-3900; Empl.: 50; Minimum order: $25

Free literature available: Our literature describes our cooling devices which can help solve any cooling problems one might have, and our flowmeters and flow generators which can measure accurately.

Products manufactured: Blowers & Fans & Accessories, Chamber, Environmental Test, Containers, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Motors, Services, Assembly, Production & Test, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ariz	Scottsdale, Fryco	602-945-3281
Cal	Orange, Current Prod. Sls.	714-633-7414
Cal	Pasadena, Components Corp.	213-681-7448
Colo	Boulder, Components Prods. Sls. Co.	303-444-2730
Fla	Jupiter, Cherry Assocs.	305-746-4591
Ill	Hillside, TX Sales	312-499-0600
Ind	Ft. Wayne, TX Sales	219-489-4447
Md	Ellicott City, V.P.I., Inc.	301-465-4060
Mass	Reading, Champagne Assocs.	617-944-3011
Mich	Dearborn Heights, Ankofski Assocs.	315-565-6330
Mich	Ferndale, Tiby Co.	313-547-3550
Minn	Minneapolis, Components Group	612-824-4222
NJ	Mt. Ephraim, Burdette Co.	609-931-1300
NY	Northport, Production Sls. Assocs.	516-757-0336
Ohio	Cleveland, Tiby Co.	216-371-5335
Pa	North Wales, V.P.I.	215-368-4233
Tex	Grand Prairie, Howell Sls. Co.	214-262-5153
Va	Merrifield, V.P.I.	703-573-7837

ASTRODATA INC., 240 E. Palais Rd., Anaheim, Cal., 92805, Tel: 714-772-1000, TWX: 910-591-1175; Empl.: 238; Minimum order: $75

For info on price: J. McLendon; Application info: J. McLendon; Customer service: W. J. Konvalinka; Delivery info: W. J. Konvalinka

Products manufactured: Boards, Printed Circuit, Comm. Systems, Counters, Decommutators, Telemetering

ASTRODYNE, INC., Sub. Roanwell Corp., 353 Middlesex Ave., Wilmington, Mass., 01887, Tel: 617-272-3850, TWX: 710-347-0704; Empl.: 60; Minimum order: $25

For info on price: R. G. Vossler; Application info: E. Kuklinski; Customer service: R. Levesque; Delivery info: R. Levesque

Free literature available: Catalog NC-740 Natural Convection Heat Sinks-Outlines and performance graphs Catalog FC-730 Forced Convection Cooling Assemblies - description & performance data Catalog HP-7000 Heat Pipes-description Catalog HE-5740 Heat Exchangers-description-sizers & performance-low pressure.

Products manufactured: Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Heat Exchangers & Systems, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ariz	Scottsdale, Inter-Mountain Engrg. Co.	602-947-7379
Cal	Anaheim, Lodan, Inc.	714-956-1560
Cal	Redwood City, Parks & Pruitt Assoc.	415-364-1640
Cal	San Diego, Earle Assoc.	714-278-5441
Colo	Boulder, Mile High Elctrns.	303-444-5615
Fla	Eau Gallie, J.J. Smith & Assoc.	305-254-4206
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Md	Baltimore, Kaufholz Assoc.	301-488-6561
Mass	Brookline, Harman Assoc.	617-232-6687
Mich	Birmingham, Forand Sls. Co.	313-644-0087
Minn	St. Louis Park, Beta Engrg. Co.	612-925-4422
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Harrington Park, Metro Tech. Sls.	201-768-8495
NY	East Syracuse, Jones-Sudders Inc.	315-437-9118
NY	Jericho, Metro Tech. Sls.	516-935-3330
NC	Burlington, P.J. Nahser Co.	919-226-8053
Ohio	Cleveland, Component/Insulation Corp.	216-521-3570
Pa	Newtown Square, Kaufholz Assoc.	215-356-5000
Pa	Pittsburgh, J.W. Kight Co.	412-781-8303
Tex	Irving, Lee Sls. Corp.	214-363-3831
Wash	West Seattle, G.M. Gillett Assoc.	206-284-3344
EXP:	Stamford, Conn., J.P. Int'l. Corp.	203-348-2691

ASTROLAB, INC., 1600 Essex St., Rahway, N.J., 07065, Tel: 201-382-8204, TWX: 710-996-5870; Empl.: 36

Products manufactured: Attenuators, Cable, Connector Adapters, Connectors, Dummy Loads, Jack Adapters (All Types), Tees, Terminals, Waveguides & Adapters, Wire Shielding

Local Sales Offices & Reps.

Cal	Los Angeles, Fetty/Schoenduve	213-651-4050
Cal	Palo Alto, E. Rinker	415-321-7041
Fla	Clearwater, Brennan Assocs.	813-446-5006
Wash	Renton, W. Milt Baxley	206-226-0650

ASTRO PRODUCTS CO., 1971 Spear St., S. Burlington, Vt., 05401, Tel: 802-864-7625; Empl.: 41; Minimum order: $25

For info on price: H. Hassen; Customer service: A. Hunyadi

Products manufactured: Cable Assemblies & Harnesses, Cable, Wire

ASTROSYSTEMS, INC., 6 Nevada Dr., Lake Success, N.Y., 11040, Tel: 516-328-1600, TWX: 510-223-0411; Empl.: 150 .... p. 1•142,143

Application info: J. O'Brien; Customer service: D. Bates; Delivery info: D. Lavaglio

Products manufactured: Amplifiers, Bridges, Calibrators, Controllers, Programmable, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Decade Boxes, Dividers, Encoders, Indicators, Modules, Logic, Encapsulated, Potentiometers, Power Supplies, Repeaters, Servo, Signal Conditioners & Equipment, Standards, Switches, Synchro Transmitters, Solid-State, Testers, Transducers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Engrg.	205-837-4304
Ariz	Scottsdale, Electronic Entprs.	602-946-9860
Cal	Huntington Beach, Wheatcroft Engrg. Co.	714-842-5569
Cal	San Francisco, Wm Benison	415-398-2211
Colo	Denver, Bond Assoc.	303-756-1234
DC	Wash., Astrosystems	202-296-4380
Fla	Orlando, Datarep, Inc.	305-843-5224
Ill	Mt. Prospect, Automation Equip.	312-398-7550
Mass	Lexington, Dimensional Systems	617-862-2700
Mass	Sturbridge, Brandford Controls	617-347-7367
Minn	Minneapolis, Engrg. Prods.	612-925-1883
NJ	West Trenton, Kriegner Sales	609-882-6330
NM	Albuquerque, BFA Corp.	505-296-8303
NM	Las Cruces, Electronic Enterprises	505-524-0125
NY	Cazenovia, P. DeCew, Inc.	315-655-8602
NC	Charlotte, Beck Sls. & Engrg.	704-366-5366
Ohio	Dayton, LI/Corp.	513-434-6367
Okla	Tulsa, Kemp Eng. Co.	918-299-2636
Ore	Portland, Hayes Tech.	503-238-0001
Tex	Addison, Kemp Engrg.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Wash	Seattle, Hayes Technical	206-763-2210
Wisc	Wauwatosa, Larson Assoc.	414-258-0529

FOR:	Can., La Salle, Quebec, Electrodesign, Ltd.	514-363-5120
FOR:	Can., Ontario, Electrodesign, Ltd.	613-745-0541
FOR:	Can., Toronto, Electrodesign, Ltd.	416-787-0991

ATEC, INC., Box 19426, Houston, Tex., 77024, Tel: 713-468-7971; Empl.: 48

Products manufactured: Comparators, Controls/Control Eqpt., Counters, - Data Acquisition & Reduction Systems, Data Loggers, Indicators, Scanners, Test Systems, Testers, Timers, Totalizers, Digital

ATKOMATIC VALVE CO., INC., Box 11258, 141 Sherman Dr., Indianapolis, Ind., 46201, Tel: 317-357-8421; FSC No: 70642; Empl.: 38; Minimum order: $5

For info on price: R. L. Thompson; Application info: R. B Spear; Customer service: A. E. Richardson; Delivery info: R. L. Thompson

Free literature available: General Bulletin - Brief description of solenoid valve line (enclosed). Catalog No. 68 - Quick value Selection chart, 16-page engineering section, complete description of valve line. 50 pages ring binder. Contains current prices. Free on request.

Products manufactured: Valves, Solenoid

Local Sales Offices & Reps.

Ala	Birmingham, Control Specialists	205-871-9679
Ala	Spanish Fort, Control Specialists	205-433-1453
Ariz	Phoenix, Bews & Wallace Co.	602-275-4496
Ariz	Tucson, Bews & Wallace Co.	602-297-4001
Ark	Little Rock, Murrel Haase & Co.	501-376-7227
Cal	Paramount, Brenner-Fiedler & Assoc.	213-531-7222
Cal	Richmond, Wagner-Denco Sls.	415-237-9054
Colo	Denver, Berry Co.	303-935-4587
Conn	Hamden, Pond Tech. Sls.	203-288-6278
Fla	Orlando, Control Center	305-896-6831
Ga	Atlanta, Rittelmeyer & Co.	404-688-8331
Ill	Chicago, Miller Engrg. Specialties	312-725-0221
Iowa	Cedar Rapids, Skarda Equip. Co.	319-393-3003
Kans	Prairie Village, Parker & Foster	913-381-9330
KY	Louisville, Richard Equip. Co.	502-895-8060
La	Baton Rouge, Del Rio	504-927-9167
Mass	Somerville, Peeco	617-666-4444
Mich	Warren, L.W. Jeffries Co.	313-755-6162
Minn	St. Paul, A-tu-Zee	612-646-6383
Mo	St. Louis, Tepco Ind. Sls.	314-741-1800
Neb	Omaha, Skarda Equip. Co.	402-731-7690
NJ	Rochelle Park, Gale Equip. Co.	201-843-1144
NY	Buffalo, J.W. Simpson Co.	716-634-3995
NY	Syracuse, J.R. Manier	315-446-9533
NC	Charlotte, Mec-Tric Control Co.	704-376-8551
Ohio	Cincinnati, Richard Equip. Co.	513-271-8666
Ohio	Cleveland, Commercial Elec. Prods. Corp.	216-241-2886
Ohio	Toledo, Fred H Hall Co.	419-531-4878
36/		
Okla	Tulsa, Delcon	918-622-6380
Pa	Broomall, John C. Whiddett Co.	215-353-6343
Pa	Pittsburgh, Controlamatic Co.	412-563-4611
Tenn	Memphis, Murrel Hasse & Co.	901-743-4304
Tex	Dallas, Southwestern Controls	214-742-6266
Tex	Houston, Southwestern Controls	713-666-2801
Va	Richmond, Virginia Carolina Controls Co.	804-644-0361
Wash	Seattle, Greaves Co.	206-284-0660
Wisc	New Berlin, D.E. Riley Corp.	414-786-1230
FOR:	Can., Calgary, Alb., Cantech Controls Ltd.	403-252-8151
FOR:	Can., Lachine, Montreal, Que., Cowper Co. Ltd.	
FOR:	Can., Mississauga, Ont., Dycon Ltd.	416-625-4350
FOR:	Can., No. Vancouver, BC, Greaves Ind. Sls. Ltd.	604-988-6755

ATLANTIC LAMINATES, 174 N. Main St., Franklin, N.H., 03235, Tel: 603-934-5736, TWX: 510-298-1170; Minimum order: $80

For info on price: E. Groehl; Application info: L. P. Blanchet; Customer service: J. Dyer; Delivery info: E. Groehl

Free literature available: Polyimide - G 10 - FR 4 - FR 5 - Teflon - Rexolite - Polyester - Plus Special Products and Mass Molding.

Products manufactured: Laminates

Local Sales Offices & Reps.

Cal	San Fernando, MacDonald & Assoc.	213-365-3616
Cal	Santa Clara, Butler Chemical	408-244-4177
Colo	Boulder, R-G Enterprises	303-447-9211
Conn	Southport, JCL Assocs.	203-255-2456
Fla	Winter Park, Young & Lawrence	305-647-6929
Ill	Chicago, Brock & Cushman, Inc.	312-622-4110
Ind	Noblesville, D-M Assocs.	317-773-3600
Minn	Minneapolis, Hamlet & Smith	612-546-3666
Mo	Baldwin, McQuillan Assocs.	314-391-0078
NJ	Rocky Hills, Krone & Rubin Assocs.	609-924-0200
Ohio	Cleveland, Insulation & Components	216-331-4434
Tex	Dallas, Bunker Industries	214-630-1600
Wash	Seattle, H-J Sales	206-522-6980
Wisc	Milwaukee, Hamlet & Smith	414-272-2787

ATLANTIC OPTICAL MOULDING CO., Ellis St., Dudley, Mass., 01570, Tel: 617-943-1746; Empl.: 6

Customer service: J. F. Krysiak

Free literature available: Glass molding of all type of optical and techinical glasses. Lens pressings and "Precision Glass Parts" for Optical, Industrial and Electronic applications.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Caps, Lenses, Indicator Light, Insulators & Insulation, Lenses, Readout & Display, Services, Assembly, Production & Test, Substrates

ATLANTIC RESEARCH COROPRATION, 5390 Cherokee Avenue, Alexandria, Va, 22314; Empl.: 831

Products manufactured: Alarms, CATV Systems & Equipment, Comm. Systems, Decoders, Detectors, Display Devices/Displays, Graphite Parts, Lasers & Laser Systems, Materials, Graphite, Meters, Power Supplies, Probes, Regulators, Rings, Retaining, Scramblers, Data, Seals, Services, Assembly, Production & Test, Television Systems & Equipment Closed-Circuit, Testers, Tracking Systems, Underwater Communication, Detection, Navigation, etc. Equipment, X-Ray Inspection Equipment

ATLAS ELECTRIC DEVICES, 4114 N. Ravenswood Ave., Chicago, Ill., 60613, Tel: 312-327-4520; Empl.: 95

Products manufactured: Chamber, Environmental Test, Lamps, Lights

ATLAS ENGRG. CORP., 26 Custer St., W. Hartford, Conn., 06110, Tel: 203-246-5651; FSC No: 07001; Empl.: 10; Minimum order: $10

For info on price: C. Schectman; Application info: F. Sweeney; Customer service: C. Schectman; Delivery info: C. Schectman

Products manufactured: Chamber, Environmental Test, Refrigerators, Environmental Test, Services, Assembly, Production & Test

ATLAS EYELETS, Pinkham St., Fairhaven, Mass., 02719, Tel: 617-997-9491

Customer service: A. Pinkham

Products manufactured: Eyelets

Local Sales Offices & Reps.

Ill	Chicago, E.C. Rowell & Co.	312-238-3401

ATLAS FIBRE CO., 6970 N. Central Park Ave., Chicago, Ill., 60645, Tel: 312-465-1234; Empl.: 3; Minimum order: $50

For info on price: L. A. Grusin; Application info: M. L. Grusin; Customer service: R. Welch

Free literature available: Catalog includes samples of material, Prices, & Listing of Grade & Size Range.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Coils Including Assemblies & Forms, Insulators & Insulation, Services, Assembly, Production & Test

ATLAS SOUND DIV., American Trading & Production Corp., 10 Pomeroy Rd., Parsippany, N.J., 07054, Tel: 201-887-7800; Empl.: 350; Minimum order: $35

For info on price: J. A. Palmieri; Application info: J. A. Palmieri; Customer service: J. Just; Delivery info: J. Just

Free literature available: Catalogue and Technical Data Describing: A) Microphone Stands, Accessories and Fittings, B) Environment-Protected Loudspeakers, Alarm and Signaling, Transducers, Custom Sound Drivers, Intercom and Siren Speakers, Mounting and Transformer Accessories

Products manufactured: Speakers

ATLEE CORP., 8 Gill St., Woburn, Mass., 01801, Tel: 617-933-3510, TWX: 710-393-0176; Empl.: 40

Products manufactured: Bus Bars & Systems, Clamps & Clips, Guides, Circuit Board, Holders, Circuit Board (Production Type), Holders, Crystal, Mounts

Local Sales Offices & Reps.
Cal Burlingame, J. Logan & Assocs. 415-697-6100
Mass Woburn, Atlee Corp. 617-933-3510
Mich Walled Lake, T. Mulligan & Assocs. 313-624-0174
NJ Madison, Livera-Polk Assocs. 201-377-3220
NY Roslyn Heights, Livera-Polk Assocs. 516-484-1276
NY Syracuse, Rep Tech, Inc. 315-437-2845
Ohio Columbus, T. Mulligan & Assocs. 614-457-2242
FOR: Can., Richmond, B.C., Lake Engrg. Co. 604-277-0414
FOR: Can., Scarborough, Ont., Lake Engrg. Co. 416-751-5980
FOR: Can., St. Laurent, P.Q., Lake Engrg. Co. 514-747-2441

ATMOSPHERE CONTROLS PRDTS., 295 Polaris, Mt. View, Cal., 94043, Tel: 415-969-2690; Empl.: 16

For info on price: J. P. Conroy; Delivery info: W. E. Ellis

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Cabinets & Accessories, Dehumidifiers (For Equipment), Services, Assembly, Production & Test

ATOMERGIC CHEMETALS CO., 584 Mineola Ave., Carle Place, N.Y., 11514, Tel: 516-333-5600, TWX: 510-222-5059; Empl.: 30; Minimum order: $25

For info on price: M. Altman; Application info: M. Blum; Customer service: H. J. Gary; Delivery info: E. Krings

Free literature available: 144 page General Product Brochure which lists all the different chemicals, metals, intermetallics, and semiconductor compounds we either produce or supply.

Products manufactured: Alloys, Chemicals, Crystal Blanks, Crystals, Display Devices/Displays, Ferrite Material & Parts, Graphite Parts, Lubricants, Materials, Graphite, Materials, Self-Lubricating, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Quartz, Fused, Semiconductor Wafer Fabrication, Silica, Fused, Substrates, Wire

Local Sales Offices & Reps.
Cal Los Angeles, Ron Geller 213-836-2777

ATR ELECTRONICS, INC., 300 E. 4th St., St. Paul, Minn., 55101, Tel: 612-222-3791; Minimum order: $25 p. 1•1110,1111

Customer service: A. Goffstein

Free literature available: ATR literature covers ATR DC-AC Inverters, Battery Eliminators, Vibrators, and Standby Power Systems.

Products manufactured: Chargers, Battery, Converters, Eliminators, Battery, Inverters, Power Supplies, Relays, Transformers, Vibrators

AUBURN MFG., Pease Ave. & Stack St., Middletown, Conn., 06457, Tel: 203-346-6631; Minimum order: $25

For info on price: D. Holmes; Application info: M. Weiner; Customer service: D. Holmes; Delivery info: D. Holmes

Free literature available: Gaskets, Shielding; Insulation Materials and Parts; Tapes, Pressure Sensitive; Spacers and Shock & Vibration Mounts as well as additional specific information regarding sealing components and/or materials.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Fasteners, Gaskets, Shielding, R-F-Also See Shields, R-F, Insulators & Insulation, Mounts, Seals, Shields, Sound Absorbing Materials, Spacers, Tapes, Films & Foils, Pressure Sensitive

Advertisment

Manufacturers of custom-made insulated parts (all materials), shielding RMI/EFI Gaskets, Shock and Vibration Mounts as well as virtually all types of sealing components. Distributor for CHR Products and Dow Corning Sealants RTVs. (CHR products include Silicone Rubber, Sponge and Coated Fabrics, Viton Rubber and Temp-R-Tape and Glas).

AUDIO-TECHNICA U.S., INC., 33 Shiawassee Ave., Fairlawn, Ohio, 44313, Tel: 216-836-0246

Products manufactured: Cleaners & Solvents, Handsets, Chestsets, Headphones, Headsets, Etc., Phonographs, Parts & Accessories

Local Sales Offices & Reps.
Cal Los Angeles ....Pacific Audio Sls.
Cal Oakland, Paul Seaman Co. 415-562-9241
Colo Arvada, C B Elctrn. Mktg. 303-422-0561
Ga East Point, P. Hayden Assocs. 404-766-0261
Ill Skokie, SER, Inc. 312-673-2250
Ind Indianapolis, Kingston-Sharkey Assocs. 317-353-9406
Md Baltimore, David Bros., Co. 301-764-7189
Mass Wellesley Hills, B. Gedzelman Sls. 617-235-8775
Mich Buchanan, Riley & Petchell Sls. 616-695-6356
Mich Detroit, Riley & Petchell Sls. 313-535-7000
Minn Minneapolis, SER, Inc. 612-894-1388
Mo Raytown, Mid-West Mktg. 816-358-6638
NJ Ridgefield, Bi-State Mkts. 201-943-5888
NY Kenmore, Al Toupkin Sls. 716-873-8839
NY Spring Valley, B. Gedzelman Sls. ... 914-EL6-3477
Ohio Columbus, C.L. Pugh Co. 614-486-9678
Ohio Newtown, G. Conneen Sls. 215-353-2241
Tex Houston, L.J. Paul Assocs. 800-231-3501
Wash Seattle, W.K. Wood Co. 206-246-5111

AUDIO-VIDIO ENGRG. CO., 65 Nancy Blvd., Merrick, N.Y., 11566, Tel: 516-546-4239

Customer service: R. Drucker

Free literature available: Spec. sheet on video hum stop coil model HSC-1 engineering bulletin 1.1 on video hum stop coils.

Products manufactured: Filters

Local Sales Offices & Reps.
Cal Anaheim, BCD, Inc. 714-528-9505

AUDIO EQUIP. CO., INC., Div. W. Kidde & Co., Inc., 706 Forrest St., Charlottesville, Va., 22901, Tel: 804-977-8050, TWX: 510-587-5461; Empl.: 50

For info on price: L. D. Armentrout; Application info: T. Reed; Customer service: E. Williams; Delivery info: E. Williams

Free literature available: 8-page illustrated catalog on electronic hand-held power megaphones and portable P.A. systems.

Products manufactured: Amplifiers, Speakers

AUDIOSEARS CORP., South St., Stamford, N.Y., 12167, Tel: 607-652-7305; FSC No: 3661; Empl.: 100; Minimum order: $20

For info on price: G. Vicary Mahler; Application info: R. Rusa; Customer service: G. Vicary Mahler; Delivery info: G. Vicary Mahler

Free literature available: Telephone; Handsets, Telepone Operators; Headsets, Miscellaneous; Headsets, Microphones, Earphones; and component parts there of.

Products manufactured: Handsets, Chestsets, Headphones, Headsets, Etc., Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds

Local Sales Offices & Reps.
Cal Huntington Beach, H. Brunning 714-968-7724
NJ Medford, Mech. Elec. Sls. 609-654-8209
NY. Geneva, J. Sumers Assocs. 315-789-2238

AUDIOTRONICS, 7428 Bellaire Ave., N. Hollywood, Cal., 91605, Tel: 213-765-2645, Telex: 69-1241; Empl.: 277; Minimum order: $10

For info on price: T. Severdia; Application info: T. Severdia; Customer service: D. Christenson; Delivery info: C. Morey

Products manufactured: Demodulators, Handsets, Chestsets, Headphones, Headsets, Etc., Microphones, All Kinds, Monitors, Phonographs, Parts & Accessories, Public Address Systems, Recorders, Speaker Systems, Terminals, Data Display (including Alphanumeric & Graphic)

AUGAT INC., 33 Perry Ave., Attleboro, Mass, 02703; Empl.: 450; Minimum order: $25 ....p. 2•632-639

For info on price: D. O'Brien; Application info: G. Howland; Customer service: C. Kiefer; Delivery info: S. Mitchell

Products manufactured: Backpanel Interconnect Systems, Boards, Plug-In, Cabinets & Accessories, Cable Assemblies & Harnesses, Cable, Clamps & Clips, Connector Adapters, Connectors, Drawers, Sliding, Frames, Cabinet & Rack, Heat Sinks, Soldering, Integrated Circuit Packaging Systems, Jacks (All Types), Jumpers, Kits, Breadboarding (For Engineers), Kits, Terminal, Pins, Plug Adapters, Plugs, Racks, Services, Assembly, Production & Test, Socket Adapters, Sockets, Terminals, Tools

Local Sales Offices & Reps.
Ariz Phoenix, Howe & Howe Sls., Inc. 602-264-7971
Cal Los Angeles, P. F. Wiley Co. 213-663-8028
Cal San Carlos, D. H. Ross Co. 415-591-4411
Colo Littleton, Simpson Assocs., Inc. 303-794-8381
Conn New Canaan, Stan Pierce, Inc. 203-966-4630
Fla Clearwater, H.R. Gross & Co. 813-446-6649
Ga Atlanta, Cartwright & Bean, Inc. 404-255-5262
Ill Rolling Meadows, Sumer 312-394-4900
Kans Shawnee Mission, Lowell-Kangas & Assocs. 913-631-3515
La Chalmette, Cartwright & Bean, Inc. 504-279-4598
Mich Ferndale, Hilltronics, Inc. 313-398-5556
Minn Edina, M. Foster Co. 612-835-2252
Miss Jackson, Cartwright & Bean, Inc. 601-981-1368
Mo St. Louis, Lowell-Kangas & Assocs. 314-821-4050
NJ Cherry Hill, Trinkle Sls., Inc. 609-795-4200
NM Albuquerque, Piper-Goyne, Inc. 505-265-6794
NY Mt. Vernon, D. Sonkin Assocs. 914-668-9809
NY N. Syracuse, D. Allen, Inc. 315-458-7470
NC Charlotte, Cartwright & Bean, Inc. 704-333-6457
NC Raleigh, Cartwright & Bean, Inc. 919-832-7128
Ohio Brecksville, A. Nace Co. 216-526-4323
Ohio Englewood, A. Nace Co. 513-836-7548
Ore Portland, C.K. Shanks & Assocs. 503-292-5656
Pa Pittsburgh, A. Nace Co. 412-922-7225
Tenn Knoxville, Cartwright & Bean 615-693-7450
Tenn Memphis, Cartwright & Bean, Inc. 910-276-4442
Tex Dallas, J.B. Guenther, Inc. 214-691-8500
Tex Houston, J.B. Guenther, Inc. 713-468-0232
Utah Salt Lake City, Simpson Assocs., Inc. 801-486-3731
Wash Seattle, C. K. Shanks & Assoc. 206-632-4290
FOR: Can., Montreal, Que., A. C. Simmonds & Sons Ltd. 514-352-5250
FOR: Can., Willowdale, Ont., A. C. Simmonds & Sons Ltd. 416-491-1010

Local Distributors
Ala Birmingham, ACK Radio Supply Co., 3101 Fourth Ave. So. 205-322-0588
Ala Huntsville, Cramer/Huntsville, 2310 Bob Wallace Ave. S.W. 205-539-5722
Ariz Phoenix, Cramer/Ariz., 2643 East University Dr. 602-267-7321
Ariz Phoenix, Kierulff Elctrns, Inc., 2633 East Buckeye Rd. Box 20007 602-273-7331
Ariz Phoenix, Sterling Elctrns, Drawer 20867/2001 East University Dr. 602-258-4531
Cal Agoura, Augat West Sales Office, Box 178 213-889-4567
Cal Encino, Rush Assoc., 17025 Ventura Boulevard 213-986-8533
Cal Irvine, Cramer/Los Angeles, 17201 Daimler St. 213-771-8300
Cal Los Angeles, Kierulff Elctrns, 2585 Commerce Way 213-685-5511
Cal Mountain View, Elmar Elctrns, 2288 Charleston Rd. 415-961-3611
Cal San Carlos, Sterling Elctrns, 1061 Industrial Rd. 415-592-2353
Cal San Deigo, Kierulff Elctrns, 8797 Balboa Ave. 714-278-2112
Cal San Diego, Cramer/San Diego, 8913 Complex Dr. 714-565-1881
Cal Sun Valley, Richey Elctrns, Inc., 10871 La Tuna Canyon Rd. 213-875-2862
Cal Sunnyvale, Cramer/San Francisco, 720 Palomar Ave. 408-739-3011
Colo Commerce City, Elmar Elctrns, Inc., 6777 East 50th Ave. 303-287-9611
Colo Denver, Cramer/Denver, 5465 East Evans Place at Hudson 303-758-2100
Colo Denver, Kierulff Elctrns, Inc., 10890 East 47th Ave. 303-343-7090
Conn Hamden, Arrow Elctrns, 295 Treadwell St. 203-284-3807
Conn North Haven, Cramer/Conn., 35 Dodge Ave. 203-239-5641
Fla Hollywood, Cramer/Hollywood, 4035 N. 29th Ave. 305-923-8181
Fla Orlando, Cramer/Orlando, 345 North Graham Ave. Box 20214 305-894-1511

Ga Atlanta, Cramer/Atlanta, 3923 Oakcliff Ind'l Center ... 404-448-9050
Ill Chicago, Semiconductor Specialists, Inc., Box 66125/O'Hare Int. Airport ... 312-279-1000
Ill Mt. Prospect, Cramer/Chicago, 1911 South Busse Rd. ... 312-593-8230
Ill Rosemont, Kierulff Elctrns, Inc., 9340 William St. 312-670-8560
Ind Fort Wayne, Fort Wayne Elctrn. Supply, 3606 E. Maumee Ave. ... 219-423-3422
Ind Indianapolis, Graham Elctrns Supply, Inc., 133 S. Penn St. ... 317-634-8202
Ind Indianapolis, Ra-Dis Company, Inc., 814 North Senate Ave./Box 1064 ... 317-637-5571
Iowa Cedar Rapids, Deeco, Inc., 2500 16th Ave. S.W. 319-365-7551
Kans Wichita, Radio Supply Co., 115 Laura Street 316-267-5214
Md Baltimore, Hamilton/Avnet Elctrns., Box 8647/Friendship Int'l Airport ... 301-796-5000
Md Bethesda, Empire Elctrn Supply, 4907 Rugby Ave. ... 301-656-3300
Md Gaithersburg, Cramer/Wash., 16021 Industrial Dr. ... 301-948-0110
Md Gaithersburg, Kierulff Elctrns, Inc., 16021 Industrial Dr. ... 301-948-0250
Md Hanover, Cramer/Baltimore, 7255 Standard Dr. 301-796-5790
Md Hyattsville, Milgray/Wash., 5405 Lafayette Pl. 301-864-1111
Mass Boston, DeMambro Elctrns, 1095 Commonwealth Ave. ... 617-787-1200
Mass Needham Heights, Kierulff Elctrns, 14 Charles St. ... 617-449-3600
Mass Newton, Cramer Elctrns, 85 Wells Ave. 617-969-7700
Mass Watertown, Sterling Elctrns, 51 Spring St. 617-926-9720
Mich Ann Arbor, Wedemeyer Elctrns Supply Co., 2280 S. Ind'l Highway ... 313-665-8611
Mich Livonia, Cramer/Detroit, 13193 Wayne Rd. 313-425-7000
Mich Troy, Augat Mid West Sales Office, 2848 Sunridge Drive ... 313-644-0404
Minn Edina, Cramer/Minnesota, 7275 Bush Lake Rd. 612-835-7811
Minn St. Paul, Gopher Elctrns, 2520 West Larpenteur Ave. ... 612-645-0889
Mo Kansas City, Walters Radio Supply, Inc., 3635 Main St. ... 816-531-7015
Mo St. Charles, Lectronix, Inc., 306 McDonough St. /Box 188 ... 314-723-1120
NJ Cherry Hill, Cramer/Pa., 12 Springdale Rd. 609-424-5993
NJ Moonachie, Cramer/NJ, 1 Barrett Ave. 201-935-5600
NJ Mt. Laurel, Hamilton/Avnet Elctrns, 113 Gaither Dr./East Gate Ind'l Park ... 609-234-2133
NJ Mt. Laurel, Kierulff Elctrns, 109 Gaither Dr./East Gate Ind'l Park ... 609-234-2353
NJ Pennsauken, Resco Elctrns Div., Airport & Central Highways/Airport Ind'l Park 609-662-4000
NM Albuquerque, Cramer/NM, 137 Vermont N.E. 505-265-6767
NY Binghamton, Stack Ind'l Elctrns, 45-49 Wash. 607-723-6326
NY Bohemia, Car-Lac Elctrn Ind'l Sls, 75 Orville Dr. 516-567-4200
NY Buffalo, Summit Distrs., 916 Main St. 716-884-3450
NY East Syracuse, Cramer/Syracuse, 6716 Joy Rd. 315-437-6671
NY Endwell, Cramer/Binghamton, 3220 Watson Blvd. ... 607-754-6661
NY Freeport, Milgray Elctrns, 191 Hanse Ave. 516-546-6000
NY Hauppauge, Cramer/L.I., 11787/29 Oser Ave. 516-231-5600
NY Rochester, Cramer/Rochester, 3000 South Winton Rd. ... 716-275-0300
NY Rochester, Summit Distrs., 292 Commerce Dr. 716-334-8110
NC Winston-Salem, Cramer/E. W. Winston-Salem, 938 Burke St. ... 919-725-8711
NC Winston-Salem, Kirkman Elctrns, Inc., 901 W. Second St./Drawer K-Salem Station 919-724-0541
Ohio Cincinnati, Cramer/Tri States, 666 Redna Terrace ... 513-771-6441
Ohio Cleveland, Cramer/Cleveland, 5835 Harper Rd. 216-248-8400
Ohio Cleveland, Milgray/Cleveland, 1821 E. Fortieth St. ... 216-881-8800
Ohio Cleveland, Pattison Supply Co., Box 6178/4550 Willow Pkwy ... 216-441-3000
Ohio Columbus, Thompson Elctrns Supplies, Inc., 182 East Long St. ... 614-228-6191
Pa Monroeville, Cramer/Pittsburgh, 616 Beatty Dr. 412-252-7410
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-288-2600
Tex Dallas, Cramer/Tex., 13740 Midway Rd. 214-661-9300
Tex Dallas, Sterling Elctrns, 2875 Morrell Rd. 214-357-9131
Tex Houston, Sterling Elctrns, 4201 Southwest Freeway/Box 1229 ... 713-623-6600
Utah Salt Lake City, Cramer/Utah, 391 West 2500 So. 801-487-4131
Utah Salt Lake City, Standard Supply Co., Box 1047/255 E. 6th South ... 801-355-2971
Wash Seattle, Cramer/Seattle, 5602 6th Ave. So. 206-762-5755
Wash Seattle, Kierulff Elctrns, Inc., 5940 6th Ave. So. 206-763-1550
Wisc Oak Creek, Cramer/Wisc., 430 West Rawson Ave. ... 414-764-1700
For: Can., Downsview, Ont., Cramer/Canada, Alness St., Unit #9 ... 416-661-9222
For: Can., Edmonton, Alberta, Cardinal Ind'l Elctrns, Ltd., 14804 119th Ave. ... 403-455-4122
For: Can., Mississauga (Toronto), Ont., Hamilton-Avnet Int'l (Can.) Ltd., Dorman Rd. 416-677-7432
For: Can., Montreal, Que., Hamilton-Avnet Int'l (Canada) Ltd., 2670 Paulhus St. ... 514-331-6443
For: Can., Ottawa, Ont., Hamilton-Avnet Int'l (Can.) Ltd., 880 Lady Ellen Pl. ... 913-725-3071
For: Can., St. Laurent, Que., Cramer/Montreal, 1451 Begin St. ... 514-331-9101
For: Can., Vancouver, B.C., R-A-E Ind'l Elctrns Ltd., 1629 Main St. ... 604-687-2621

AUL INSTRS., INC., 139-30 34th Rd., Flushng, N.Y., 11354, Tel: 212-886-0600; Empl.: 40; Minimum order: $25

For info on price: E. Saul; Application info: S. Kirdahl; Customer service: B. Grenet; Delivery info: B. Grenet

Products manufactured: Analyzers, Attenuators, Bridges, Chargers, Battery, Current Sources, Dividers, Dummy Loads, Generators, Meters, Oscilloscopes, Power Supplies, Receivers, Regulators, Standards

AURIC CORP., 470 Frelinghuysen Ave., Newark, N.J., 07114, Tel: 201-242-4100

For info on price: M. Bick; Application info: J. Lochet; Customer service: S. Siegel; Delivery info: S. Siegel

Products manufactured: Chemicals, Machines/Machinery, Production, Metals, Services, Assembly, Production & Test

AURICH F W & CO, 3601 Gilman Ave. W., Seattle, Wash., 98199, Tel: 206-284-5561, TWX: 910-444-1333; Empl.: 25; Minimum order: $50

For info on price: C. Ernst 206-284-5561; Application info: F. Aurich 206-284-5562; Customer service: M. Weber 206-284-5565; Delivery info: R. Norton 206-284-5566

Free literature available: Fastener Handbook - 128 pages of technical data.

Products manufactured: Fasteners

Local Sales Offices & Reps.
Cal Oakland ... 415-836-2405
Wash Seattle ... 206-284-5561

AUSTRON, INC., 1915 Kramer, Austin, Tex., 78758, Tel: 512-836-3523, TWX: 910-874-1356; Empl.: 75 .... p. 1•279

Products manufactured: Calibrators, Comm. Systems, Data Acquisition & Reduction Systems, Data Loggers, Indicators, Meters, Monitors, Oscillators, Receivers, Scanners, Standards, Synthesizers

Local Sales Offices & Reps.
Cal Calabasas, M. Shovlowsky ... 213-348-3402
Colo Littleton, Aztec Entprs. ... 303-795-0250
Del Newark, Brisco ... 302-731-5000
Fla Orlando, R.J. Cheney & Assoc's. ... 305-894-7371
Ill Chicago, Megatek, Inc. ... 312-889-1277
Md Rockville, T.E. Corp. ... 301-340-0303
NJ Haddonfield, Brisco ... 215-923-1075
NM Albuquerque, Aztec Entprs. ... 505-255-2440
NC Matthews, W.K. Hile Co. ... 704-847-9125
Tex Houston, Dixon Engrg., Inc. ... 713-844-3021
Va Chester, W.K. Hile Co. ... 804-271-0014

AUTO TROL CORP., 5650 N. Pecos St., Denver, Colo., 80221, Tel: 303-458-5900; Empl.: 100

Customer service: D. M. McNeill

Products manufactured: Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Drafting Machines, Recorders

Local Sales Offices & Reps.
Cal Orange, T. Loigu ... 714-532-1954
Colo Denver, J. M. Mann ... 303-458-5900
Md Lanham, D. L. Wilson ... 301-459-4448
Mich Livonia, S. J. Hanson ... 313-478-9775
NH Nashua, R. M. Jennings ... 603-883-9291
NJ Fair Lawn, P. W. M. Zeman ... 201-797-8000
Tex Dallas, G. W. Sickler ... 214-661-8027

AUTOCON INDS., INC., Sub. Control Data, 2300 Berkshire La. N., Minneapolis, Minn., 55441, Tel: 612-545-2851; Empl.: 400

For info on price: P. T. Durgin; Application info: P. T. Durgin; Customer service: B. Christensen

Free literature available: Computer directed control systems, pressure controllers, tone communications and variable motor speed controllers.

Products manufactured: Alarms, Annunciators, Comm. Systems, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Display Devices/Displays, Indicators, Modulators, All Kinds, Receivers, Scanners, Terminal Equipment, Digital, Transducers, Transmission Systems, Data, Transmitters

Local Sales Offices & Reps.
Ark Little Rock, McCallister Equip. Co. 501-375-4474
Cal Man. Beach, James O. Gierlich Co. 213-772-4434
Cal San Mateo, Ambrosini & Chalmers 415-341-7415
Colo Denver, Slaybaugh-Thompson ... 303-238-4379
Fla Orlando, V. K. Assocs. ... 305-843-5294
Ga Atlanta, R. Healey & Asso. ... 404-351-1861
Ill Tinley Pk., Ecology Control Sys. ... 312-429-2338
Ind Carmel, Wetterlin Eng. Sls. ... 317-844-3371
Iowa Ames, Automatic Sys. Co. ... 515-232-4770
Kan Shawnee Mis., Ron Heyse & Asso. 913-262-0300
La Metairie, Parson & Sanderson Co. 504-834-1330
Md Baltimore, Durling Elec. Co. ... 301-467-5560
Mass Sharon, Adcour ... 617-784-3996
Mich Detroit, H. V. Burton Co. ... 313-864-9490
Minn St. P:aul, Prest Co. ... 612-690-1537
Miss Jackson, Hartco Services ... 601-982-1716
Mo. St. Louis, Williams Equip. Co. ... 314-997-1030
NJ Upper Montclair, R. F. Goodwin Asso. 201-744-8121
NM Albuquerque, Applied Products ... 505-298-8611
NY Orchard Pk., R. H. Perry Co. ... 716-675-0796
NY Syracuse, R. H. Perry Co. ... 315-468-3507
NC Charlotte, Interstate Utility Sls. ... 704-377-2636
Ohio Cincinnati, H. P. Thompson ... 513-891-4414
Ohio Cleveland, J. P. Bergren Co. ... 216-932-9445
Okla Okla. City, Pumpco ... 405-235-4341
Ore Beaverton, David Fry Co. ... 503-643-5448
Pa King of Prussia, Reinbrecht Assocs. 215-265-6180
Pa Pittsburgh, Electrical Engineered Products 412-561-7667
Tenn Knoxville, Dickey Engrg Co. ... 615-524-8641
Tenn Memphis, Van Brocklin & Asso. ... 901-683-3595
Tex Dallas, J. F. Rasco Co. ... 214-747-0108
Tex Houston, T-Con ... 713-783-0229
Tex San Antonio, Powell & Roberts ... 512-735-9123
Utah Salt Lake City, Con-Tro-Flow Co. ... 801-486-3555
Wash Seattle, Clair Stebbins Co. ... 206-246-1170
WVa Charleston, Elec. Eng. Products ... 304-344-2171
Wisc Milwaukee, Allan Engrg Co. ... 414-353-5070

AUTOMATIC DIE CUTTING MCH, 149 Church, New York, N.Y., 10007, Tel: 212-962-7658; Empl.: 31

Customer service: E. E. Cosgrove

Products manufactured: Machines/Machinery, Production, Services, Assembly, Production & Test, Tapes, Electrical Insulation, Tubing

AUTOMATIC ELECTRIC, Industrial Sales Div., Northlake, Ill., 60164

AUTOMATIC COIL, Div. Designatronics Inc., 55 S. Denton Ave., New Hyde Pk., N.Y., 11040, Tel: 516-328-3300, TWX: 510-223-0842

Customer service: M. Scheck

Products manufactured: Chokes, Coils Including Assemblies & Forms, Filters, Transformers

Local Sales Offices & Reps.
Cal San Mateo, Melvin Sls. Co. ... 415-349-7444

AUTOMATIC CONNECTOR INC., 400 Moreland Rd., Commack, N.Y., 11735, Tel: 516-543-5000, TWX: 510-226-3744

Directory of Local Distributors Starts on page 401

AUTOMATIC PRODUCTION SYSTEMS INC., 1602 Hylton Rd., Pennsauken, N.J., 08011, Tel: 609-663-7812; Empl.: 25; Minimum order: $25

For info on price: E. A. Summers; Application info: E. Cioli; Customer service: A. Spor

Free literature available: Data sheets describing specifications and features of all products - Data Sheets For DiGiprobe - AP502 Cable Tester, AP 503 Cable Tester, AP600 Cable Tester, OmmiTester 1000, OmniTester 900, OmniTester 2000, OmniTester 3000.

Products manufactured: Analyzers, Test Systems, Testers

Local Sales Offices & Reps.

Cal	N. Hollywood, Crown Elct.	213-877-3550
Conn	Hartford, Victor Assoc.	203-246-5643
Ill	Chicago, Solid State Elec.	312-889-8033
Mass	Framingham, Victor Assoc.	617-879-5710
Minn	Bloomington, E.C. Elctrn. Sls.	612-831-0229
NJ	Cherry Hill, Gordon Co.	609-667-6644
NJ	Wayne, K & J Assoc.	201-694-3334
Ohio	Columbus, Measurement Instrs.	614-488-9753
Tex	Dallas, Data Marketing Assoc.	214-358-4643
FOR:	Can., Toronto, Ont., Neeco, Ind.	416-678-2890

AUTOMATIC TIMING & CONTROLS CO., King of Prussia, Pa., 19406, Tel: 215-265-0200; Empl.: 300

For info on price: J. N. Senior; Application info: W. F. Popjoy; Customer service: W. C. Hannes; Delivery info: M. Burke

Free literature available: Selection Guide; Digital Selection Guide; Photoelectric Design Guide; Complete Catalogs.

Products manufactured: Alarms, Cells, Load, Controls/Control Eqpt., Counters, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Demodulators, Gages, Indicators, Printers, Programmers, Recorders, Relays, Switches, Timers, Transducers, Transformers

Local Sales Offices & Reps.

Ala	Birmingham, Control Equip. Co.	205-TR9-8211
Ariz	Phoenix, Portis & Assocs.	602-947-4379
Cal	San Francisco, Automated Process Controls Co.	415-467-6162
Cal	Van Nuys, Time Trol	213-873-5151
Colo	Denver, D.E. Bond Assoc.	303-756-1234
Conn	Middletown, Mancib Co.	203-347-5629
Fla	Lakeland, A.A. Elec. Div.	813-682-6181
Ga	Atlanta, Control Equip. Co.	404-237-1688
Ill	Glen Ellyn, Rockford Controls Co.	312-469-6016
Ind	Indianapolis, Rockwell Engrg. Co.	317-CL 1-9453
Ky	Louisville, Air-Hydro Power Co.	502-451-1000
La	New Orleans, Mid South Sls. Co.	504-822-3030
Md	Baltimore, Jobe & Co.	301-235-3502
Mass	Burlington, Mancib Co.	617-272-9450
Mich	Brighton, H. H. Barnum Co.	313-229-2961
Mich	Lowell, H. H. Barnum Co.	616-451-0980
Minn	Minneapolis, Automated Controls, Inc.	612-377-7727
Mo	Kansas City, Duncan Sales & Engrg., Inc.	816-523-2908
Mo	University City, E. Mooney Co.	314-725-8875
NJ	Newark, Norman Bragar Co.	201-344-1100
NY	Buffalo, Niagara Electric Sls. Co.	716-886-4000
NY	Rochester, Niagara Electric Sls. Co.	716-271-1223
NY	Syracuse, Niagara Elec. Sls. Co.	315-422-9177
NY	Yonkers, Ross Co.	212-TA4-5424
NC	Charlotte, Brown & Morrison	704-333-0774
Ohio	Cincinnati, Anderson-Bolds, Inc.	513-272-3351
Ohio	Cleveland, Anderson-Bolds, Inc.	216-229-4700
Ohio	Worthington, Anderson-Bolds, Inc.	614-885-3933
Okla	Tulsa, Driscoll Automatic Control Co.	918-747-6625
Ore	Eugene, J. A. Tudor & Assoc.	503-344-9212
Ore	Portland, J. A. Tudor & Assoc., Inc.	503-288-5154
Pa	King of Prussia, Applied Controls, Inc.	215-265-3832
Pa	Pittsburgh, Gilson Engrg. Sls. Inc.	412-931-6114
Tenn	Memphis, Engineered Instrs.	901-743-3402
Tex	Houston, Gettys-Eads-Adair	713-781-3005
Utah	Salt Lake City, Control Equip. Co. of Salt Lake	801-487-7741
Va	Richmond, Jobe & Co.	804-282-6508
Wash	Seattle, J. A. Tudor & Assoc.	206-MU 2-7444
Wash	Spokane, J. A. Tudor & Assoc.	509-FA 7-3328
Wisc	Cedarburg, Automation Engrg. Co.	414-377-7500

AUTOMATION DEVICES, INC., Box A.D., Automation Pk., Fairview, Pa., 16415, Tel: 814-474-5561; Empl.: 60

For info on price: D. Buseck; Application info: L. Kallsen

Products manufactured: Controls/Control Eqpt., Indicators, Machines/Machinery, Production, Sound Absorbing Materials

Local Sales Offices & Reps.

Ariz	Mesa, L.C. Brandt	602-832-0710
Cal	Santa Fe Springs, Automation Devices Western	213-693-3745
Colo	Denver, R.M. Moore	303-222-4858
Conn	Fairfield, W. Whitehead	203-255-4543
Fla	Clearwater, Tangen Drives Inc.	813-446-9871
Ill	Chicago, C. Schanstra	312-344-6580
Md	Riderwood, E. Miles, Jr.	301-823-1434
Mass	Concord, R. Malloy	617-369-8889
Mich	Detroit, J. Bishop	313-538-0595
Minn	Minneapolis, H. West	612-721-6661
Miss	Jackson, P. Patrick	601-982-1621
Mo	St. Louis, E. Benninger	314-381-1300
NJ	Chatham, G. Crawford	201-635-6868
NY	Syracuse, K. Reed	315-478-2232
NY	Yonkers, E. Ross	212-824-5424
NC	Charlotte, J. Dixon	704-366-9661
Ohio	Cleveland, J. Schiefferle	814-838-6163
Ohio	Hicksville, C. Kallsen	419-542-8117
Ohio	Perrysburg, K. Lytle	419-475-4305
Pa	Erie, W. Baker	814-459-5135
Tenn	Memphis, J. Barbour, H. Lewis, C. Walker	901-362-2253
Tex	Dallas, S. Lomax	214-361-1134
Wisc	Milwaukee, J. O'Meara	414-353-7040
EXP:	Can., Niagara Falls, Ont., S. Fisk	416-354-3881

AUTOMATION DISPLAYS INC., Box 1122, Eau Claire, Wisc., 54701, Tel: 715-834-9595; Empl.: 10; Minimum order: $25

Customer service: J.E. Carpentier

Free literature available: The brochure contains pictures of our work to illustrate our capabilities in the information display field.

Products manufactured: Annunciators, Display Devices/Displays, Lamp Drivers, Multiplexers, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Spectrum Co.	602-997-6324
Cal	Santa Ana, Spectrum Assocs. Inc.	714-835-4114
Ill	Chicago, Bex Data Ltd.	312-221-1411
Mass	Lexington, B & B Assocs.	617-862-5054
Mich	Walled Lake, Berberich Assocs. Inc.	313-624-2211
Minn	Minneapolis, Bex Data Ltd.	612-835-5220
Mo	St. Louis, Bex Data Ltd.	314-872-3357
NJ	Cherry Hill, L.H. Walke Co.	609-424-3766
NJ	Delran, T. McLaughlin Co.	609-461-5243
NM	Albuquerque, Western Consultants	
Ohio	Dayton, Berberich Assocs. Inc.	513-433-0342
Tex	Dallas, T-Square Assocs.	214-369-3173
Wash	Bellevue, Hudson Co.	206-455-0773

AUTOMATION DYNAMICS, Div. ABC Digital, Inc., 25 Charles St., Westwood, N.J., 07675, Tel: 201-666-2458; FSC No: 53089; Empl.: 15

For info on price: B. K. Cheng 201-666-2458; Application info: C. H. Wu 201-666-2554; Customer service: D. Marchak 201-666-2554; Delivery info: R. A. Wood 201-666-2458

Products manufactured: Comparators, Data Acquisition & Reduction Systems, Testers

AUTOMATION INDS., Sperry Div, Shelter Rock Rd., Danbury, Conn., 06810, Tel: 203-748-3581, TWX: 710-456-0392; Empl.: 350; Minimum order: $25

For info on price: B. Hodge; Application info: L. Johnson; Customer service: W. R. Kitchin; Delivery info: F. J. Lynch

Free literature available: Bulletin 105 - Nondestructive Test Equipment and Systems.

Products manufactured: Detectors, Indicators, Magnetometers, Testers, Transducers, X-Ray Inspection Equipment

Local Sales Offices & Reps.

Cal	Chatsworth, Automation Industries, Inc., Sperry Div.	213-882-2600
Cal	Downey, Automation Industries, Inc., Sperry Div.	213-773-6133
Cal	San Jose, Automation Industries, Inc., Sperry Div.	408-244-4520
Ga	Tucker, Automation Industries, Inc., Sperry Div.	404-939-8762
Ill	Rosemont, Automation Industries, Inc., Sperry Div.	312-671-1670
Mich	Warren, Automation Industries, Inc., Sperry Div.	313-756-5940
Ohio	Dayton, Automation Industries, Inc., Sperry Div.	513-274-0892
Ohio	Rocky River, Automation Industries, Inc., Sperry Div.	216-333-5575
Pa	Phoenixville, Automation Industries, Inc., Sperry Div.	215-933-8961
Pa	Pittsburgh, Automation Industries, Inc., Sperry Div.	412-371-3335
Pa	Spring City, Automation Industries, Inc., Sperry Div.	215-948-8220
Tenn	Nashville, Automation Industries, Inc., Sperry Div.	615-256-6607
Tex	Dallas, Automation Industries, Inc., Sperry Div.	214-351-5381
Tex	Houston, Automation Industries, Inc., Sperry Div.	713-774-9650
Va	Falls Church, Automation Industries, Inc., Sperry Div.	703-536-8600
Wash	Renton, Automation Industries, Inc., Sperry Div.	206-228-3170
FOR:	Can., Mississauga, Ont., Automation Ind. (Can.) Ltd., Sperry Div.	416-678-9215

AUTOMATION PRDTS., 3030 Max Roy, Houston, Tex., 77008, Tel: 713-869-0361

For info on price: S. S. Turner; Application info: W. Bouldin Jr.; Customer service: B. J. Williams; Delivery info: J. Robertson

Products manufactured: Controls/Control Eqpt., Densitometers, Electronic, Indicators, Switches

AUTO-SWAGE PRODUCTS INC., 726 River Rd.; Shelton, Conn., 06484, Tel: 203-929-1401, Telex: 963542; Empl.: 170; Minimum order: $50

For info on price: R. L. Mikulsky; Application info: R. L. Mikulsky; Customer service: R. L. Mikulsky; Delivery info: R. MacCormack

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Contacts, Electrical, Eyelets, Fasteners, Forms, Wire, Pins, Posts, Rivets, Services, Assembly, Production & Test, Sockets, Spacers, Springs (All Types), Terminals

Local Sales Offices & Reps.

Ariz	Scottsdale, E.E. Black	602-947-2007
Cal	Glendale, Haldeman & Frazier	213-247-3330
Colo	Denver, Industrial Hardware Co.	303-426-1440
Ind	Greensburg, H.K. Feaster	812-663-5689
Minn	Minneapolis, W.R. Maleckar Co.	612-926-7601
NY	Rochester, Gislason Sls.	716-454-4741
Ohio	Beachwood, Davis & Hawley Sls. Co.	216-464-9655
Pa	Broomal, AM Tech. Sls. Co.	215-356-0574
Tex	Richardson, C.D. Price Co.	214-231-4321
EXP:	New York, N.Y., Lang & Zysk	212-227-1743

AUTOSPLICE/DV GEN STAPLE, 220 E. 23rd St., New York City, N.Y., 10010, Tel: 212-674-4369; Empl.: 40; Minimum order: $25

For info on price: B. Glasser; Application info: J. Zahnstecher; Customer service: C. Iadanza; Delivery info: B. Glasser

Free literature available: Autosplice a new splicing system that operates from a continuous spool of spliceband material. In one simultaneous action the machine feeds a length of this spliceband, cuts it and forms it and crimps it around the items to be assembled. Insulsplice - the only machine in the world that operates from a plastic laminated metal strip, and both makes and attaches insulated splices at the same time.
Autopin - this machine operates from a continuous coil of either round or square wire and inserts pins into printed circuit boards, bobbins, etc. Autotab - production machine that inserts pre-stamped terminal directly into printed circuit boards, components, etc.

Products manufactured: Backpanel Interconnect Systems, Clamps & Clips, Connectors, Contacts, Electrical, Fasteners, Forms, Wire, Jumpers, Laminates, Machines/Machinery, Production, Pins, Services, Assembly, Production & Test, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Terminal Blocks, Boards & Strips, Terminals, Tools, Wire, Wire & Cable Ties, Wire Nuts

AUTOTRON, INC., 3269 N. Vermilion St.; Box 595, Danville, Ill., 61832, Tel: 217-446-0650

Free literature available: Catalog 76 - contains latest released information on photoelectric controls developments, application survey, 56 complete application sketches and dimensional diagrams for innumerable practical uses.

Products manufactured: Alarms, Controls/Control Eqpt., Counters, Light Sources, Photoelectric

Local Sales Offices & Reps.

Ariz	Mesa, L.C. Brandt Co.	602-832-0710
Ark	Ft. Smith, Electro-Related Prods.	501-646-7756
Cal	Los Angeles, Electro Comps. Distrs.	213-264-7100
Cal	San Francisco, J.M. Krotozyner	415-777-4636
Fla	Ft. Lauderdale, R.D. Jacobs	305-524-1932
Ill	Addison, Lectron Controls Co.	312-543-8460
Mass	Needham, White Sls. Co.	617-444-3676
Mich	Detroit, Basic Service Corp.	313-837-8820
Minn	Minneapolis, Bican Co.	612-827-4734
Mo	Kansas City, Automation Specialties, Inc.	816-421-6646
Mo	St. Louis, Kathrinus, Kelly & Co.	314-968-3800
NY	Elmont, Crane & Egert Corp.	516-488-2100
NY	Rochester, T. Ferguson Sls.	716-482-7757
NC	Charlotte, Electro-Rep Assocs.	704-527-2530
Ohio	Cincinnati, J.W. Murray & Assoc.	513-662-1616
Ohio	Cleveland, C.A. Robinson Co.	216-381-9049
Pa	Paoli, Tyler Griffin Co.	215-644-7710
Tex	Houston, RMA/Southland	713-462-4077
Utah	Salt Lake City, Control Agency	801-466-8601
Wash	Seattle, C.B. Parsons & Co.	206-762-7373
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529
FOR:	Can., Burlington, Ont., Higginson Equip. Sls. Ltd.	416-634-1888

AUTOTRONICS, INC., 2700 Davis Blvd., Joplin, Mo, 64801

AUTRONICS CORP., 180 N. Vinedo Ave., Pasadena, Cal, 91107, Tel: 213-681-3545, TWX: 910-588-1977; FSC No: 03972; Empl.: 40; Minimum order: $25

p: 1•237,1113

For info on price: D. A. McNamara; Application info: C. B. Barnes

Free literature available: Brochure showing custom design capabilities and experience, with typical product catágories. Available direct or through sales representatives.

Products manufactured: Alarms, Controls/Control Eqpt., Converters, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Flashers, Generators, Inverters, Monitors, Power Supplies, Relays, Switches, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Goleta, Thorson Co.	805-964-8751
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	Mountain View, Thorson Co.	415-964-9300
Cal	San Diego, Thorson Co.	714-298-8385
Cal	Tustin, Thorson Co.	714-544-5121
Colo	Denver, Thorson Co.	303-355-3521
Kans	Olathe, B.C. Elctrn. Sls.	913-782-6696
Kans	Wichita, B.C. Elctrn. Sls.	316-686-3394
Md	Baltimore, R. P. Luce & Co.	301-752-8200
Mo	Hazelwood, B.C. Elctrn. Sls.	314-731-1255
NJ	Berkeley Hgts., R.P. Luce & Co.	201-464-6440
NM	Albuquerque, Thorson Co.	505-265-5655
NY	New Hyde Pk., R. P. Luce & Co	516-437-4550
Pa	Phila., R. P. Luce & Co.	215-884-8365
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Wash	Bellevue, Thorson Co.	206-455-9180
Wash	Seattle, Thorson Co.	206-632-0710

AVA ELCTRNS., 242 Pembroke Ave., Landsdowne, Pa, 19050, Tel: 215-284-2500; Empl.: 45; Minimum order: $25

For info on price: Order Dept.; Application info: Mr. Pal; Customer service: Marianne; Delivery info: Marianne

Free literature available: Catalogues of Products.

Products manufactured: Amplifiers, Arresters, Electrical Surge, Lightning, Attenuators, Connector Adapters, Couplers, Panels, Tees, Television Systems & Equipment Closed-Circuit, Terminals, Transformers

Local Sales Offices & Reps.

Cal	Carlsbad, L. J. Erickson	714-726-5270
Fla	Tampa, S. K. Wallace Assoc.	305-691-1654
Ga	Atlanta, S. K. Wallace Assoc.	
Ill	Chicago, M. Gottlieb Assoc.	312-775-1151
Md	Kensington, Forti-Austin Assoc.	301-949-4149
Mass	Wellsley Hill, M. Scott Co.	617-235-0102
Mich	Southfield, Champagne Sls. Co.	313-354-0270
NJ	Fort Lee, TMC Sls. Corp.	201-944-8340
NJ	Willingboro, Forti-Austin Co.	609-871-3720
NY	Syracuse, W. Tauber Co.	315-446-7094
Ohio	Cleveland, J. O. Olsen Co.	216-752-5444
Pa	Pittsburgh, R. Tanner Co.	412-561-4687
Wash	Seattle, W. Lanphear Dist.	206-633-4900

AVANTEK, INC., 3175 Bowers Ave., Santa Clara, Cal., 95051, Tel: 408-249-0700, TWX: 910-339-9274; Empl.: 300

For info on price: B. Goff; Application info: J. Graves; Customer service: J. Dechristofaro; Delivery info: J. Dechristofaro

Free literature available: Component catalog lists the many microwave products manufactured by Avantek. Specs, applications and case outline data are some features

Products manufactured: Amplifiers, CATV Systems & Equipment, Circuits, Hybrid, Thin-Film, Integrated Circuit Devices, Microwave Integrated Circuits (MIC's), Oscillators, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Altos, Cain-White & Co.	415-948-6533
Cal	Los Angeles, Cain Technology	213-476-2251
Colo	Denver, Thorson Co.	303-759-0809
DC	Washington, Applied Engrg. Consits.	301-953-2808
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Des Plaines, Cozzens/Cudahy	312-298-3600
Ind	Indianapolis, Cozzens/Cudahy	317-244-2456
Kans	Shawnee Mission, E.I.R.	913-362-0919
Md	Ellicott City, Applied Engrg. Consits.	301-465-1272
Mass	Burlington, Tritek, Inc.	617-272-4550
Mich	Detroit, Micro Sls. Corp.	313-482-1229
Minn	Minneapolis, Cozzens/Cudahy	612-884-4336
Mo	Hazelwood, E.I.R.	314-895-4100
Mo	St. Louis, Cozzens/Cudahy	314-423-1234
NJ	Fort Lee, Tech. Mktg. Assocs.	201-224-6911
NM	Albuquerque, Thorson Co.	505-265-5655
NY	Skaneateles, Robtron	315-685-5731
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Dayton, Micro Sls. Corp.	513-885-4171
Pa	Philadelphia, Eastern Instrumentation	215-927-7777
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Wash	Seattle, Thorson Co.	206-455-9180

AVIATECH INTL. INC., 4250 Veterans Hwy., Holbrook, N.Y., 11741, Tel: 516-981-9300, Telex: 967892; Empl.: 10

Customer service: G. H. Inhafer

Free literature available: Data sheets on closed circuit low light level TV systems, microphones, headsets and airborne antennas

Products manufactured: Antennas, Handsets, Chestsets, Headphones, Headsets, Etc., Microphones, All Kinds, Television Systems & Equipment Closed-Circuit

AVIATION ELEC., LTD., Sub. Bendix Corp., Box 2140, Station O, Montreal, H4L 4x8 Que., Can., Tel: 514-744-2811, Telex: 05-826688; Empl.: 925

Customer service: C. Watts

Products manufactured: Computers, Potentiometers, Transducers

AVIBANK MFG. INC., 210 S. Victory Blvd., Burbank, Calif., 91503, Tel: 213-843-4330, TWX: 910-498-2215; Empl.: 200; Minimum order: $35

Customer service: L. Slocum

Free literature available: A 100 page catalog of our product in a one-inch hard cover binder.

Products manufactured: Connectors, Fasteners, Pins

Local Sales Offices & Reps.

NY	Smithtown, Avibank Mfg. Inc.	516-979-8045

AVID ELECTRONICS CORP., Box 426, Baldwin, Pl., N.Y., 10505, Tel: 914-628-6952; FSC No: 08842; Empl.: 10; Minimum order: $25

For info on price: D. McVey; Application info: J. Del; Customer service: M. McVey; Delivery info: M. McVey

Free literature available: Components catalog covers sizes, detail dimension and part numbers. Listings include spacers, terminals, plus handles screws and custom fabricated parts-metal and plastic.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Connectors, Contacts, Electrical, Fasteners, Handles For Cabinets, Circuit Boards, Racks, etc., Insulators & Insulation, Pins, Services, Assembly, Production & Test, Shafts & Adapters, Spacers, Terminal Blocks, Boards & Strips, Terminals

AVIONIC INSTRS. INC., 943 E. Hazelwood Ave., Rahway, N.J., 07065, Tel: 201-382-7100, Telex: 844413; Empl.: 32

Free literature available: Product Manual containing a brochure, price list, specification sheets, and block diagrams upon request.

Products manufactured: Chargers, Battery, Inverters, Regulators

AVIONICS LTD., Box 200, Niagara-On-Lane, Ont., Can., Tel: 416-468-3632; Empl.: 25

Customer service: J. G. Mitchell

Products manufactured: Boards, Plug-In, Boards, Printed Circuit

AVTRON MFG., INC., 10409 Meech Ave., Cleveland, Ohio, 44105, Tel: 216-641-8310, TWX: 810-421-8435; FSC No: 01014; Empl.: 125; Minimum order: $25

For info on price: R. D. Thomas; Application info: R. D. Thomas; Customer service: R. J. Strober; Delivery info: D. C. Garris

Free literature available: Technical Bulletins covering Avtron's complete product line of Drive Stands, Load Banks, Digital Control/Monitor, and Winding Test Equipment upon request.

Products manufactured: Controls/Control Eqpt., Converters, Counters, Dummy Loads, Generators, Heat Sinks, Soldering, Indicators, Loads, Electronic Variable, Meters, Tachometers, Test Systems, Testers

Local Sales Offices & Reps.

Wash	Bellevue, J. Findlay Co.	206-454-5200
Wisc	Appleton, J.K. Luke	414-739-3238

AVX CERAMICS, Box 867, Myrtle Beach, S.C., 29577, Tel: 803-448-3191, TWX: 810-661-2252; FSC No: 9K916; Empl.: 2387 .... p. 1•530,531; p. 2•2-23

For info on price: F. Fry; Customer service: J. Bodine

Free literature available: GC 74 General Catalogue, FC 74 Filter Catalogue

Products manufactured: Capacitors, Fixed, Filters

Local Sales Offices & Reps.

Ala	Huntsville, Powertronics, Inc.	205-852-6347
Ariz	Tempe, Interstate Mktg. Assoc.	602-968-7201
Cal	Mt. View, Quadrep Inc.	415-964-3532
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Colo	Denver, Zeus	303-771-6200
Fla	Oviedo, Conley & Assocs., Inc.	305-365-3283
Ill	Chicago, T.B. Hunter Assocs.	312-777-2500
Ind	Indianapolis, F.J. Campisano Co.	317-247-8623
Iowa	Cedar Rapids, J.R. Sls. Engrg. Inc.	319-377-8211
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Lexington, J.E. Boeing Co.	617-862-2500
Mich	Southfield, J.L. Montgomery	313-358-2616
Minn	Minneapolis, Comstrand Inc.	612-560-5300
Mo	Grandview, Beneke & McCaul, Inc.	816-765-2998
NJ	Cherry Hill, J.N. Barrett Assocs.	609-429-1551
NM	Albuquerque, Zeus	505-256-9831
NY	Garden City, Comtronic Assocs.	516-741-8966
NY	Ithaca, B. Dean, Inc.	607-272-2187
NC	Thomasville, Powertronics, Inc.	919-476-6727
NC	Winston-Salem, Burgin-Kreh	919-768-4174
Ohio	Cincinnati, F.J. Campisano Co.	513-662-1616
Ohio	Dayton, Schmidt & Assoc.	513-293-6657
Ohio	South Euclid, F.J. Campisano Co.	216-381-4949
Okla	Oklahoma City, Ammon & Rizos	405-721-2365
Ore	Portland, Western Tech. Sls.	503-297-1711
Pa	Pittsburgh, G.S. Root & Co.	412-561-4125
Tex	Dallas, Ammon & Rizos Co.	214-233-5591
Tex	Houston, Ammon & Rizos Co.	713-729-1233
Utah	Salt Lake City, Zeus	801-486-2317
Va	Lynchburg, Burgin-Kreh Assoc.	804-845-5600
Wash	Bellevue, Western Tech. Sls.	206-641-3900
FOR:	Can., Montreal, Kaytronics Ltd.	514-487-3434

Local Distributors

Ala	Huntsville, Cramer Elctrns., 2310 Bob Wallace Ave.	205-539-5722
Ariz	Phoenix, Cramer Elctrns., 2643 E. University Ave.	602-267-7321
Ariz	Phoenix, R.V. Weatherford, 1917 N. 25th Dr.	602-272-7144
Cal	Anaheim, R.V. Weatherford, 1550 Babbitt Ave.	714-547-0891
Cal	Glendale, R.V. Weatherford, 6921 San Fernando Rd.	213-849-3451
Cal	Inglewood, Newark Elctrns., 4747 W. Centry Blvd.	213-678-0441
Cal	Irvine, Cramer, 17201 Daimler St.	714-979-3000
Cal	Los Angeles, Texas Instruments Supply, 5200 W. 104th St.	213-776-4490
Cal	Palo Alto, R.V. Weatherford, 3240 Hillview Ave.	415-493-5373
Cal	Pomona, R.V. Weatherford, 1095 E. Third St.	714-623-1621

Cal	San Diego, Cramer, 8975 Complex Dr.	714-565-1881
Cal	San Diego, R.V. Weatherford, 7872 Raytheon Rd.	714-278-7400
Cal	Sunnyvale, Cramer, 720 Palomar Ave.	408-739-3011
Cal	Woodland Hills, Jaco Elctrns., 21201 Oxnard St.	213-887-6400
Colo	Denver, Cramer Elctrns., E. Evans Place	303-758-2100
Colo	Denver, Newark Elctrns., 2170 S. Grape St.	303-757-3351
Conn	N. Haven, Cramer Elctrns., 35 Dodge Ave.	203-239-5641
Conn	Westport, Newark Elctrns., 25 Sylvan Rd. S.	203-226-6921
Fla	Ft. Lauderdale, Newark Elctrns., 1360 N.W. 65th Ave.	305-587-2372
Fla	Hollywood, Cramer Elec., N. 29th Ave.	305-923-8181
Fla	Orlando, Cramer, 345 N. Graham Ave.	305-894-1511
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Mt. Prospect, Cramer Elec., 1911 S. Busse Rd.	312-593-8230
Iowa	Cedar Rapids, Newark Elctrns., 1019 First Ave. S.W.	319-362-1171
Md	Beltsville, Newark Elctrns., 10440 Baltimore Ave.	301-937-5085
Md	Gaithersburg, Cramer Elec., Ind'l. Dr.	301-948-0110
Md	Hanover, Cramer Elec., 7255 Standard	301-796-5790
Mass	Newton, Cramer Elec., 85 Wells Ave.	617-969-7700
Mass	Woburn, Newark Elctr., 13A Wheeling Ave.	617-935-8350
Mich	Detroit, Newark Elctrns., 20700 Hubbell Ave.	313-548-0250
Mich	Livonia, Cramer, 13193 Wayne Rd.	313-425-7000
Mich	Wyoming, Newark Elctrns., 3645 Linden Ave.	616-241-6681
Minn	Edina, Cramer, 7275 Bush Lake Rd.	612-835-7811
Minn	Minneapolis, Newark Elctrns., 336 Hoover St.	612-331-6350
NJ	Clark, Texas Instrument Supply, 301 Central Ave.	201-382-6400
NJ	Kenilworth, Newark Elctrns., 303 Monroe Ave.	201-272-8410
NJ	Moonachie, Cramer Elec., 1 Barrett Ave.	201-935-5600
NM	Albuquerque, Cramer Elec., Vermont N,E.	505-265-5767
NM	Albuquerque, R.V. Weatherford, 6106 Marble Ave., N.E.	505-842-9868
NY	Endwell, Cramer, 3220 Watson Blvd.	607-754-6661
NY	Hauppauge, Cramer, 29 Oser Ave.	516-231-5600
NY	Hauppauge, Jaco Elctrns., Engineers Rd.	516-273-5500
NY	Plainview, Newark Elctrns., 80 Express St.	516-822-5000
NY	Rochester, Cramer Elec., 3000 S. Winton Rd.	716-275-0300
NY	Rochester, Newark Elctrns., 3000 S. Winton Rd.	716-473-6600
NY	Syracuse, Cramer, 6716 Joy Rd.	315-437-6671
NC	Winston-Salem, Cramer, 938 Burke St.	919-725-8711
Ohio	Cincinnati, Cramer, 666 Redna Terr.	513-771-6441
Ohio	Cincinnati, Newark Elctrns., 9799 G. Princeton Rd.	513-874-5115
Ohio	Cleveland, Cramer, 5835 Harper Rd.	216-248-8400
Ohio	Cleveland, Newark Elctrns., 2028 E. 46th St.	216-361-4700
Pa	Cherryhill, Cramer, Springdale Rd.	609-424-5993
Pa	Monroeville, Cramer, 616 Beatty Dr.	412-252-7410
Tex	Dallas, Cramer, 13740 Midway Rd.	214-661-9300
Tex	Dallas, Newark Elctrns., Box 38299	214-271-2511
Tex	Dallas, R.V. Weatherford, 10836 Grissom La.	214-243-1571
Tex	Dallas, Texas Instrument Supply, 6000 Denton Dr.	214-238-6952
Tex	Houston, R.V. Weatherford, 3500 W.T.C. Jester Blvd.	713-688-7406
Tex	Houston, Texas Instrument Supply, 3939 Ann Arbor Dr.	713-785-4800
Utah	Salt Lake City, Cramer, 391 W. 2500 South	801-487-4131
Utah	Salt Lake City, Newark Elctrns., 2540 S. 300 West	801-486-1048
Wash	Seattle, Cramer, 5602 6th Ave. S.	206-762-5755
Wash	Seattle, R.V. Weatherford, 541 Industry Dr.	206-243-6340
Wisc	Brookfield, Newark Elctrns., 3695 N. 126th St.	414-781-2450
Wisc	Oak Creek, Cramer, W. Rawson Ave.	414-764-1700

AXEL ELCTRNS., Unit of General Signal, 134-20 Jamaica Ave., Jamaica, N.Y., 11418, Tel: 212-291-3900, TWX: 710-582-2618; FSC No: 13058; Empl.: 180

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Customer service: J. Alaimo

Products manufactured: Capacitors, Fixed, Filters, Networks, Power Supplies, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Board Assocs.	602-994-9388
Cal	Fremont, Spence Assocs.	415-656-9506
Fla	Miami, Reptronics	303-251-5478
Ind	Auburn, Tech Line	219-925-1757
Iowa	Hiawatha, Gassner & Clark Co.	319-393-5763
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Medway, J. Gallagher	617-533-7292
Minn	Chanhassen, Barnes Sls. Assocs.	612-474-2907
Mo	St. Louis, Repco	314-343-9313
Ohio	Cleveland, E.E. Bock & Assocs.	216-331-5212
Ohio	Dayton, L.D. Bruno Co.	513-434-1847
Pa	Fort Washington, G.C.M.	215-646-7535
Pa	Pittsburgh, Automated Equip. & Engrg.	412-931-7616
FOR:	Can., Mississauga, Ont., Rayshield	416-822-4414

AYDIN CONTROLS, 414 Commerce Dr., Ft. Washington, Pa., 19034, Tel: 215-542-7800, TWX: 510-661-1520; Empl.: 120; Minimum order: $50

Customer service: J. E. Bauer

Free literature available: "Get the Picture" applications brochure for color graphics and high resolution graphics; Raster Scan Graphic Display Systems; High Resolution Graphics.

Products manufactured: Converters, Display Devices/Displays, Encoders, Generators, Keyboards, Alphanumeric & Decimal, Monitors

Local Sales Offices & Reps.

Cal	Palo Alto, P. Papathakis	415-493-3939
Cal	Westlake Village, C. T. Morton	213-889-1513
Fla	Fort Walton Beach, G. W. Cleveland	904-242-3414
Mass	Bedford, R. Claflin	617-275-0296
Tex	Dallas, Data Mktg. Assoc.	214-661-0300

AYDIN ENERGY SYSTEMS, 3180 Hanover St., Palo Alto, Cal., 94303, Tel: 415-493-3900, TWX: 910-373-1238; Empl.: 300

For info on price: C. V. Weden; Application info: C. V. Weden; Customer service: K. Hanabusa; Delivery info: K. Hanabusa

Products manufactured: Amplifiers, Comm. Systems, Generators, Modulators, All Kinds, Power Supplies, Reactors, Testers, Transformers, Transmitters

B & B MOTOR & CONTROL, 96 Spring St., New York, N.Y., 10012, Tel: 212-966-5777, Telex: 14-1484; Empl.: 30; Minimum order: $15

For info on price: I. Herman; Application info: D. Shaw; Customer service: M. Penn; Delivery info: K. Palmer

Free literature available: MOTOR SPEED CONTROL CATALOG Motors and controls from 0.02 to 10,000 RPM, 1/2000 to 3/4 HP. MOTOR CATALOG AC and DC systems from 1/2000 to 1-1/8 HP. IMPULSE COUNTER GUIDE Sodeco line of electromechanical impulse counters.

Products manufactured: Controls/Control Eqpt., Counters, Motors

Local Sales Offices & Reps.

Conn	Wallingford	203-869-8494
Ind	Indianapolis	317-248-0396
NJ	Edison	201-420-1466
NY	Rochester	716-473-6640

B & F INSTRS., INC., Box 238, Corwells Hgts, Pa., 19020, Tel: 215-639-7100, TWX: 510-667-1516; Empl.: 100; Minimum order: $50

Customer service: E. H. New, Jr.

Free literature available: Bulletins 450A, AN109 Thru AN113 Describe Our Digital Data Acquisition Systems, Bulletins MS10A, EB30, AN106 and 107 Describe Our Digital Data Loggers.

Products manufactured: Amplifiers, Bridges, Cases, Equipment, Instrument, Meter, Converters, Data Acquisition & Reduction Systems, Data Loggers, Indicators, Oscillographs, Direct Writing, Power Supplies, Process Control Systems, Scanners, Signal Conditioners & Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs., Inc.	205-837-4304
Ariz	Phoenix, Cleveland Ent.	602-996-6130
Cal	Anaheim, FLW	714-956-8220
Cal	Culver City, FLW	213-559-7200
Cal	North Hollywood, F.L. Wolfe Inc.	213-877-5518
Cal	San Diego, F.L. Wolfe, Inc.	714-277-0993
Cal	Walnut Creek, D. Dahl Assocs.	415-933-9595
Colo	Arvada, Cleveland Entprs., Inc.	303-423-3707
Fla	Orlando, RJC Assocs.	305-894-7371
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Iowa	Cedar Rapids, Palatine Engrg. Sls.	319-365-0071
Kans	Andover, Palatine Engrg. Sls.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Mass	Natick, Andruss-Peskin Corp.	617-653-3919
Mich	Royal Oaks, Measurement Instrs.	313-352-2144
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, Palatine Engrg. Sls.	314-426-7055
NJ	Stirling, NBS Assocs.	201-464-8500
NM	Albuquerque, Cleveland Entprs., Inc.	505-345-2481
NC	Winston-Salem, Radco Co.	919-722-9671
Ohio	Cincinnati, Measurement Instrs.	513-531-2729
Ohio	Columbus, Measurement Instrs.	614-488-9753
Okla	Tulsa, Palatine Sls.	918-622-0321
Ore	Portland, Applied Arts and Science	503-233-4683
Pa	Jenkintown, PDC Corp.	215-887-9610
Tex	Austin, Palatine Sls.	512-451-7463
Tex	Houston, Palatine Engrg. Sls.	713-783-1492
Tex	Richardson, Palatine Engrg. Sls.	214-231-9489

B & K DYNASCAN, See Dynascan

B & K INSTRUMENTS, INC., 5111 W. 164th St., Cleveland, Ohio, 44142, Tel: 216-267-4800, TWX: 810-421-8266; FSC No: 27591; Empl.: 65; Minimum order: $25

For info on price: L. Stier; Application info: L. Stier; Customer service: T. Romo; Delivery info: L. Stier

Free literature available: New 1974 Short Form Catalog describes briefly the full line of precision transducers and instrumentation for sensing, measuring, and analyzing all aspects of sound and vibration.

Products manufactured: Accelerometers, Amplifiers, Analyzers, Bridges, Calibrators, Comm. Systems, Computers, Filters, Gages, Generators, Kits, Test Equipment, Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Oscillators, Recorders, Services, Assembly, Production & Test, Signal Conditioners & Equipment, Technical Books, Test Equipment, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Phoenix, Barnhill Three, Inc.	602-947-7841
Cal	Anaheim, B & K Instrs., Inc.	714-778-2450
Cal	San Mateo, B & K Instrs., Inc.	415-574-8100
Colo	Denver, Barnhill Three, Inc.	303-934-5505
Conn	Hamden, Equip. Sls. Co.	203-248-5581
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Kans	Overland Park, Carter Elctrns., Inc.	913-649-6996
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	Chelmsford, Equip. Sls. Co.	617-256-8547
Mich	Detroit, B & K Instrs.	313-557-1930
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	St. Louis, Carter Elctrns., Inc.	314-731-2237
NM	Albuquerque, Barnhill Three, Inc.	505-299-7658
NY	DeWitt, DB Assocs.	315-446-0220
NY	Great Neck, Meas. Technology, Inc.	212-895-7177
NC	Raleigh, Lee Assocs., Inc.	919-787-5818
Ohio	Cincinnati, B & K Instrs.	513-874-5379
Pa	Philadelphia, Letronix, Inc.	215-242-6223
Pa	Pittsburgh, B & K Instrs.	412-276-6393
Tex	Dallas, Barnhill Two, Inc.	214-231-2573
Tex	Houston, Barnhill Two, Inc.	713-688-9971
Wash	Seattle, H. Levinson Co.	206-323-5100

Wisc	Milwaukee, Carter Elctrns., Inc.	414-464-5555

BABCOCK ELECTRONICS, Sub Esterline Corp., Box 1499, Costa Mesa, Cal., 92626, Tel: 714-540-1234, TWX: 910-595-1517; Empl.: 500

For info on price: G. W. Henn; Application info: J. M. Brown; Customer service: J. N. Larson; Delivery info: J. N. Larson

Free literature available: Catalogs for military and commercial relays. Full, half and 1/6 size crystal can relays latching and non latching. Time delay relays, voltage sensors, reed relays, general purpose, and solid state relays.

Products manufactured: Relays

Local Sales Offices & Reps.

Ala	Huntsville, Elctrn. Mktg. Assoc.	205-837-6061
Ariz	Phoenix, Chaparral Mfgr. Reps.	602-996-9648
Cal	Los Angeles, E. Landa Co.	213-879-0770
Cal	Redwood City, Warren & Hickey Sls. Co.	415-368-3849
Colo	Englewood, Checkmate Sls.	303-771-4920
Conn	North Haven, Kitchen & Kutchin	203-239-0212
Fla	Clearwater, G.F. Bohman Assoc.	813-422-5606
Fla	Ft. Lauderdale, G.F. Bohman Assocs.	305-564-3081
Fla	Orlando, G.F. Bohman Assocs.	305-855-0274
Ill	Chicago, Carlson Elctrn. Sls.	312-774-4812
Ind	Greenwood, V. Schillinger & Assocs.	317-888-2260
Ind	South Bend, V. Schillinger & Assocs.	219-291-6258
Kans	Olathe, BC Elctrn. Sls.	913-782-6696
Md	Silver Springs, Rep-Tron	301-593-4844
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Minn	Minneapolis, J.J. Exon Co.	612-566-5340
Mo	Hazelwood, BC Elctrn Sls.	314-731-1255
NJ	Haddonfield, Gray Assocs.	609-429-5300
NJ	Teaneck, R.T. Reid Assocs.	201-692-0200
NM	Albuquerque, Data Handling Co.	505-268-4364
NY	North Syracuse, Advanced Comps. Corp.	315-699-2671
NY	Scottsville, Advanced Comps. Corp.	716-889-1429
NC	Winston Salem, Elctrn. Mktg. Assocs.	919-722-5151
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Ohio	Dayton, Giesting Assocs.	513-293-4044
Ore	Beaverton, Arneson Assocs.	503-643-5754
SC	Greenville, Elctrn. Mktg. Assocs.	803-268-1125
Tex	Richardson, Barry Sls. Co.	214-234-0255
Utah	Salt Lake City, Checkmate Sls.	
Wash	Seattle, Arneson Assocs.	206-762-7664
Wisc	Milwaukee, Carlson Elctrnc. Sls.	414-476-2790
FOR:	an., Montreal, Que., Space Elctrns. Sls. Corp.	514-735-1108
FOR:	Can., Toronto, Ont., Space Elctrn. Sls. Corp.	416-677-4205

BACHARACH INSTRUMENT CO., 625 Alpha Dr., Pittsburgh, Pa., 15238, Tel: 412-782-3500, TWX: 710-664-2085; Empl.: 500

Products manufactured: Alarms, Analyzers, Detectors, Indicators

Local Sales Offices & Reps.

Cal	Canoga Park	213-348-4142
Cal	Mountain View	415-967-7221
Ill	Wheeling	312-541-3293
Mich	Berkley	313-399-7883
NJ	Little Ferry	201-440-4662
Pa	Philadelphia	215-338-5173
Tex	Houston	713-688-7150

BACON INDS., 192 Pleasant St., Watertown, Mass., 02172, Tel: 617-926-2550; Empl.: 18; Minimum order: $25

For info on price: Sales Dept.; Application info: T. Willett; Customer service: T. Willett

Free literature available: Data Sheets on our epoxy, and urathane potting compounds; Data Sheets on our molded rubber line & other services.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber, Seals, Services, Assembly, Production & Test

BAFCO, INC., 717 Mearns Rd., Warminster, Pa., 18974, Tel: 215-674-1700, TWX: 510-665-6860; Empl.: 21

For info on price: R. France; Application info: A. M. Fuchs; Customer service: R. France; Delivery info: R. France

Free literature available: Catalog 7172 and Tech. Publ. 7172-1 describes the complete line of Frequency Response Analyzers and provide theoretical basis of operation for measurement of dt ratio and phase shift from 0.005 HZ thru 50,000 HZ in poor S/N conditions.

Products manufactured: Actuators, Analyzers, Controls/Control Eqpt., Filters, Meters, Servo Systems, Test Equipment, Testers

Local Sales Offices & Reps.

Cal	Carson, ABCO Co.	213-537-5152
Cal	Santa Clara, Mauldin	415-326-5291
Conn	Newton, Daner-Hayes Inc.	203-426-9094
Fla	Orlando, Truex	305-859-2160
Mass	Newton Centre, Daner-Hayes Inc.	617-969-4650
NY	Rochester, Daner-Hayes Inc.	716-467-5100
Ohio	Dayton, P. Glavinos	513-433-1010
Pa	Melrose Park, R. Meyers Assoc.	215-224-1663

BAGANOFF ASSOCS., INC., 6809 W. Florissant, St. Louis, Mo., 63136, Tel: 831-0956; Empl.: 12

Customer service: E. Brown

Products manufactured: Amplifiers, Analyzers, Comm. Systems, Computers, Converters, Data Acquisition & Reduction Systems, Delay Lines, Generators, Services, Assembly, Production & Test, Testers

BAKER CO., INC., Drawer E - Sanford Airport, Sanford, Me., 04073, Tel: 207-324-8773; Empl.: 80

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Ovens

Local Sales Offices & Reps.

Ariz	Gilbert, R. Pressnell	602-833-5387
Cal	Dana Point, Dana Scientific Co.	714-495-0492
Cal	Richmond, Tegal Corp.	415-232-1757
Fla	Clearwater, Datco	813-531-4255
Ga	Decatur, B. H. Yates Co.	404-633-6900
Ill	Villa Park, Motordor	312-833-2700
Ind	Indianapolis, Little & Assocs.	317-545-4083
Mass	Cambridge, Rush Assocs.	617-661-1200
Mich	Dearborn, W. Mullins & Assoc.	313-563-3340
Minn	St. Paul, S. Clasen	612-439-6347
Mo	Clayton, Gateway Scientific	314-725-3464
NJ	Newark, Thornton Assocs.	201-622-0905
NC	Cary, R. Petty	919-467-9663
Okla	Okla. City, Oklahoma Air Filter Sls. & Svc.	405-521-9918
Tenn	Memphis, Dickson Instr. Co.	901-452-2612
Tex	Houston, Contamination Control	713-943-1883
Wash	Lake Stevens, Northwest Scientific Instrs.	206-259-0123
FOR:	Can., Oakville, Ont., Cartec	416-844-4561

BAKER, J.T. CHEMICAL CO., Phillipsburg, N.J., 08865, Tel: 201-859-2151, TWX: 510-235-2924; Empl.: 750; Minimum order: $150

For info on price: G. L. Collins; Application info: T. P. Merrick; Customer service: W. D. Alpaugh; Delivery info: W. D. Alpaugh

Free literature available: Product Information Bulletin 174 lists ULTREX(R) products for research, and reagents for the lab with application data, starting materials, purification mmethods, packaging and characterization. "Defined Purity Dopants" describes product features, packaging/price info and examples of actual Certificates of Analysis.

Products manufactured: Chemicals, Cleaners & Solvents, Metal Oxides

Local Sales Offices & Reps.

Cal	Hayward	415-471-6225
Ill	Glen Ellyn	312-469-4224
Ohio	Hudson	216-653-6635
FOR:	Can., Weston, Ont., c/o Richardson-Merrell Canada Ltd.	416-749-8620

BAKNOR INDUSTRIES LTD., 58 Oakwood Ave., N., Port Credit, Ont., L5g3L8, Tel: 416-274-1591, Telex: 06-961252; FSC No: WJ0905; Empl.: 6; Minimum order: $25

For info on price: M.E. Sawicki 416-274-1592; Application info: A.R. von den Baumen 416-274-1721; Customer service: S. DeAmeral 416-274-1591; Delivery info: L. Ruddy 416-274-1591

Free literature available: Spec sheets

Products manufactured: Capacitors, Fixed, Resistors

Local Sales Offices & Reps.

FOR:	Can., Oakville, Ont., Haltronics Ltd.	416-844-2121

BALCO CAPACITORS, Div. Balco Elctrns., Inc., 307 Washington St., Orange, N.J., 07050, Tel: 201-677-1200, TWX: 710-994-5812; FSC No: 5910; Empl.: 50; Minimum order: $50

For info on price: R. W. Hagerty; Application info: R. W. Hagerty; Customer service: L. James; Delivery info: R. W. Hagerty

Free literature available: Precision Film Capacitors, Wrap & Fill Film Capacitors

Products manufactured: Capacitors, Fixed, Networks, Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Schoeffler Assocs.	
Cal	Culver City Sodaro Co.	213-478-7733
Cal	Van Nuys, Penwarden Entprs.	213-785-0773
Conn	Meriden, Abbitt-Allison	203-237-9232
Ill	Northbrook, R.T. Howlett & Assocs.	312-498-5444
Kans	Overland Park, Bob Rush Assocs.	913-831-4259
NJ	Harrington Pk., Metro Tech. Sls.	201-768-8495
NY	Jericho, Metro Tech. Sls.	516-935-3330
Wash	Seattle, J.B. Jolly	206-938-4166
Wisc	Milwaukee, Gentron Corp.	414-543-8110
EXP:	New York, Multiparts Corp.	212-944-4372
EXP:	Westbury, N.Y., Minthorne Int'l. Inc.	516-334-3303
FOR:	Can., Montreal, Que., Electro Design	514-389-5914
FOR:	Can., Ottowa, Ont., Electro Design	613-745-0541
FOR:	Can., Toronto, Ont., Electrodesign Ltd.	416-787-0991
FOR:	Can., Ville Lasalle, Que., Electrodesign Ltd.	514-363-5120

Local Distributors

Ohio	Dayton, McGuire Prod., 206 Troy St.	513-222-1651
Tex	Houston, Lenert Co., 1420 Hutchins	713-225-1465

BALDWIN ELCTRNS., 1101 McAlmont St., Little Rock, Ark., 72203, Tel: 501-375-7351, TWX: 910-722-7384; Empl.: 435; Minimum order: $20 ....p. 1•144-146

Customer service: S. Berg

Free literature available: Application papers concerning operating characteristics of optical encoders.

Products manufactured: Alarms, Circuits, Hybrid, Thick Film, Controls/Control Eqpt., Converters, Counters, Encoders, Indicators, Motors, Tachometers

Local Sales Offices & Reps.

Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Los Angeles, Baldwin Elctrns., Inc.	213-368-1716
Colo	Denver, R.A. Mayes, Co.	303-444-0782
Conn	North Haven, Northeast Reps., Inc.	203-239-2507
Fla	Boca Raton, Conley Assocs.	305-395-6108
Fla	Oviedo, Conley Associates	305-365-3283
Fla	Tampa, Conley Assocs.	813-933-3183
Ill	Chicago, Carlson Elctrns. Sls. Co.	312-774-9022
Kans	Kansas City, Carlson Elctrns. Sls. Co.	913-432-2144
Md	Arnold, Baldwin Elctrns., Inc.	301-757-5904
Mass	Needham Heights, Northeast Reps.	617-449-3034
Minn	Minneapolis, J. J. Exon Co.	612-566-5340
Mo	St. Louis, Carlson Elctrn. Sls. Co.	314-991-0262
NJ	Ridgewood, Instrumentation Sls. Co.	201-445-5210
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	Buffalo, H. C. Johnson Agencies	716-632-7880
NY	Rochester, H.C. Johnson Agencies	716-482-3000
NY	Syracuse, H.C. Johnson Agencies	315-637-9383
Ohio	Cincinnati, Baldwin Elctrns., Inc.	513-231-1786
Ore	Portland, Brett Associates, Inc.	503-232-4184
Pa	Pittsburgh, H.C. Johnson Agencies	412-961-0414
Tex	Fort Worth/Dallas, Carey, Wolf & Associates	817-738-1996
Tex	Houston, Carey, Wolf & Assoc.	713-643-2114
Utah	Salt Lake City, R.A. Mayes Co.	801-292-6781
Wash	Seattle, Brett Associates, Inc.	206-935-8054
Wisc	Wauwatosa, Carlson Elctrns. Sls. Co.	414-476-2790

Ballantine

BALLANTINE LABORATORIES, INC., 90 Fanny Rd., Box 97, Boonton, N.J., 07005, Tel: 201-335-0900, TWX: 710-987-8380; FSC No: 50423; Empl.: 65; Minimum order: $25

For info on price: I. Bromberg; Application info: M. J. Lichtenstein; Customer service: T. Gilbert; Delivery info: N. Lauchaire

Products manufactured: Amplifiers, Calibrators, Counters, Generators, Meters, Oscilloscopes, Probes, Recorders, Services, Assembly, Production & Test, Shunts, Meter, Standards, Thermocouples, Elements & Accessories, Totalizers, Digital, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assoc. Inc.	205-534-9771
Ariz	Scottsdale, Williams Assoc.	602-947-4297
Cal	Irvine, Moxon Elctrns.	714-556-6500
Cal	San Diego, Moxon Elctrns.	714-292-4820
Cal	Santa Clara, Moxon Elctrns.	408-249-2491
Colo	Denver, Williams Assocs.	303-343-2911
Conn	New Haven, Mc Bar Assoc.	203-865-4376
Fla	Melbourne, Gentry Assocs.	305-773-0812
Fla	Orlando, Gentry Assocs.	305-894-4401
Fla	St. Petersburg, Gentry Assocs.	813-867-7820
Ill	Chicago, Scientific Sls.	312-775-7594
Ind	Indianapolis, Scientific Sls.	317-253-4606
Kans	Shawnee Mission, Eir Co.	913-362-0919
Md	Baltimore, Dyna Rep Co.	301-256-3709
Mass	Waltham, McBar Assocs.	617-890-0233
Mich	Royal Oak, Group Ten	313-549-3910
Minn	Bloomington, Scientific Sls.	612-881-3300
Mo	Hazelwood, Eir Co.	314-895-4100
NJ	Haddonfield, Dyna Rep Co.	609-795-1700
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Mt. Vernon, Q.E.D. Elctrns.	914-664-0080
NY	North Syracuse, NACO Elctrns.	315-699-2651
NY	Schenectady, NACO Elctrns.	518-244-4720
NY	Utica, NACO Elctrns.	315-732-1801
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-293-7061
Okla	Norman, Data Mktg. Assoc. Inc.	405-364-8320
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc. Inc.	512-828-0937
Va	Alexandria, Dyna Rep Co.	703-354-1222
Va	Newport News, Dyna Rep Co.	804-874-7729
Wash	Seattle, Rush S. Drake Assoc.	206-763-2755

BALSTON, INC., Box C, 703 Massachusetts Ave., Lexington, Mass, 02173, Tel: 617-861-7240, Telex: 92-3481

For info on price: D. Weldon; Application info: J. Alpert; Customer service: J. Alpert; Delivery info: C. Mahler

Free literature available: Technical information on the selection and use of high efficiency filters for removal of oil from compressed air. Technical information filtration of deionized water. Summary of applications for high efficiency liquid and gas filters. Quick Reference Chart on Balston High Efficiency Filters.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded)

Local Distributors

Ala	Mobile, Alabama Controls Co., Box 7154	205-479-2345
Cal	Palo Alto, Priz-Co., 2675 Park Blvd.	415-326-9333
Cal	Paramount, Brenner-Fiedler & Assoc., 16210 Gundry Ave.	213-636-3206
Colo	Denver, Mundix Ind'l Controls, 5495 Marion St.	303-893-2390
Fla	Orlando, Control Center, 1013 E. Montana St.	305-896-6831
Ill	Chicago, A. Stanley & Co., 6059 N. Albany Ave.	312-973-7376
Md	Baltimore, Jobe & Co., 2857 Greenmount Ave.	301-235-3502
Mich	Detroit, Michigan Value & Fitting Co., 17236 E. Warren Ave.	313-884-9415
Minn	Eden Prairie, G. Speaker Co., 14760 Martin Dr.	612-941-5730
Mo	Hazelwood, E. M. Thompson Co., 400 Brooks Dr.	314-731-2688
Mo	Kansas City, E. M. Thompson Co., 208 W. 10th St.	816-471-8248
Neb	Omaha, E. M. Thompson Co., 119 S. 19th St.	402-341-4635
NJ	Moorestown, Salem Scientific, Box 354	609-235-4565
NJ	Springfield, RJM Sls., Box 82	201-467-1210
NY	Buffalo, R.L. Stone Co., 1807 Elmwood Ave.	716-873-1873
NY	Rochester, R.L. Stone Co., Box 9148	716-381-1155
NY	Syracuse, R.L. Stone Co., 2023 Milton Ave.	315-468-2700
NC	Charlotte, Salem Sls. Assocs., Box 9323	704-375-3328
Ohio	Cincinnati, J.R. Douglass Co., Box 31075	513-931-4986
Ohio	Cleveland, F. W. Kirk Co., 15017 Detroit Ave.	216-226-1970
Pa	Pittsburgh, J.F. Kraus & Co., 360 Broadmoor Ave.	412-531-1200
Tenn	Memphis, Centro, Inc., Box 7311	901-526-0518
Tex	Dallas, H & D Distributors, 6211 Denton Dr.	214-351-6478
Tex	Pasadena, Tech-Quip, Inc., Box 6191	713-473-2891
Utah	Provo, Priz-Co., 17 E. 200 North	801-377-5858
Va	Richmond, Jobe & Co., 2508 Grenoblerd	804-282-6508
WVa	So. Charleston, Appalachian Controls Co., Box 8246	304-744-5324
Wisc	Appleton, Guy Speaker Co., 1425 N. Douglas St.	414-739-6066
Wisc	Milwaukee, Guy Speaker Co., 5706 W. Vliet St.	414-258-2325
For:	Can., Mississauga, Ont., Can-Am Instrs. Ltd., 1938 Mattawa Ave.	416-277-4541
For:	Can., Montreal, Que., Can-Am Instrs. Ltd., Box 397, Snowden Po.	514-931-2588

BARBER-COLMAN CO., Motor Div., Dept. S, 12116 Rock St., Rockford, Ill., 61101, Tel: 815-877-0241, TWX: 815-398-0341; Empl.: 5000

Products manufactured: Blowers & Fans & Accessories, Motors, Relays

Local Sales Offices & Reps.

Ala	Huntsville, Candor Co.	205-539-6575
Cal	Menlo Park, Long & Assocs., Inc.	415-327-1300
Cal	Sherman Oaks, R. Meussdorffer & Assoc.	213-788-0771
Colo	Denver, Todd & Assocs., Inc.	303-744-2313
Conn	Berlin, White Sls. Co.	203-224-0423
Ill	Chicago, D. Dolin Sls. Inc.	312-286-6200
Ind	Ft. Wayne, Menze Sls.	219-747-5616
Kans	Overland Park, Penzner-Mankus Assocs.	913-381-0004
Md	Baltimore, Machinery & Equip. Sls. Inc.	301-889-2070
Mass	Needham, White Sls. Co.	617-444-3676
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	Hazelwood, Penzner-Mankus Assocs.	314-731-4334
NJ	Mt. Laurel, Naudain Assocs.	609-235-1801
NJ	Springfield, P. H. Werner, Inc.	201-376-9440
NY	East Aurora, Harries & Hershaw	716-652-1221
NC	Winston-Salem, Candor Co.	919-924-1480
SC	Myrtle Beach, Candor Co.	803-448-5213
Va	Lynchburg, Candor Co.	703-239-5265
Wisc	Milwaukee, Barber-Colman Co.	414-464-5900
EXP:	Milwaukee, Wis., Dummann World Trade Co.	414-464-0100

BARBER-COLMAN CO., Industrial Instrs. Div., 2711 Rock St., Rockford, Ill., 61101, Tel: 815-877-0241, TWX: 815-398-0341; Empl.: 5000

Customer service: M. Bengston

Free literature available: Ten page brochure describes Barber-Colman's solid state, reprogrammable sequence logic control systems, designed to increase productive machine time by improving cycle time and machine sequence repeatability.

Products manufactured: Actuators, Alarms, Amplifiers, Controllers, Programmable, Controls/Control Eqpt., Converters, Indicators, Meters, Monitors, Process Control Systems, Pyrometers, Recorders, Relays, Signal Conditioners & Equipment, Testers, Thermocouples, Elements & Accessories, Transducers, Wire

Local Sales Offices & Reps.

Ala	Birmingham, Control Equip. Co.	205-879-8211
Ala	Huntsville, Control Equip. Co.	205-883-1330
Cal	Alhambra, Barber-Colman Co., Industrial Instrs. Div.	213-282-9166
Cal	Redwood City, CB Controls	415-364-2313
Cal	San Diego, R. Brainard Co.	714-274-1333
Colo	Denver, Technical Engrg. Sls.-Svc. (TESSCO)	303-744-1119
Conn	Stamford, Barber-Colman Co., Industrial Instrs. Div.	203-325-1367
Fla	Miami, G. Brophy Assoc.	305-444-6253
Fla	Winter Park, Control Equip. Co.	305-647-4496
Ga	Atlanta, Barber-Colman Co., Industrial Instrs. Div.	404-633-2566
Ill	Lincolnwood, Barber-Colman Co., Industrial Instrs. Div.	312-673-4550
Ill	Loves Park, Barber-Colman Co., Industrial Instrs. Div.	815-633-9585
Ill	Rock Island, Barber-Colman Co., Industrial Instrs. Div.	309-786-3351
Ind	Indianapolis, Barber-Colman Co., Industrial Instrs. Div.	317-293-4700
Ind	Lanesville, Barber-Colman Co., Industrial Instrs. Div.	812-952-2653
Kans	Prairie Village, Parker & Foster, Inc.	913-381-9330
La	Baton Rouge, Allen Assocs.	504-293-0644
La	Shreveport, JDJ Sls. Co.	318-865-2393
Md	Laurel, Barber-Colman Co., Industrial Instrs. Div.	301-792-7377
Mass	Canton, Barber-Colman Co., Industrial Instr. Div.	617-828-9498
Mich	Grand Rapids, Barber-Colman Co., Industrial Instrs. Div.	616-245-9217
Mich	Southfield, Barber-Colman Co., Industrial Instrs. Div.	313-358-4210
Minn	Minneapolis, Pyro-Matic Industrials, Inc.	612-786-2222
Mo	St. Louis, Barber-Colman Co., Industrial Instrs. Div.	314-781-9009
NJ	Rochelle Park, Barber-Colman Co., Industrial Instrs. Div.	201-845-8607
NY	Buffalo, Barber-Colman Co., Industrial Instr. Div.	716-875-4413
NC	Charlotte, Barber-Colman Co., Industrial Instrs. Div.	704-372-5492
Ohio	Cincinnati, Barber-Colman Co., Industrial Instrs. Div.	513-791-0900
Ohio	Columbus, Industrial Data Control Co.	614-228-1352
Ohio	Highland Hgts., Barber-Colman Co., Industrial Instrs. Div.	216-461-2480
Ohio	Toledo, Barber-Colman Co., Industrial Instrs. Div.	419-476-6661
Okla	Tulsa, Electrical & Inst. Sls. Co.	918-664-0980
Pa	Frazer, Barber-Colman Co., Industrial Instrs. Div.	215-647-4650
Pa	Pittsburgh, Barber-Colman Co., Industrial Instrs. Div.	412-885-2200
Tenn	Memphis, Combustion & Controls Co.	901-525-7402
Tex	El Paso, Delta Instr. Co.	915-533-4207
Tex	Fort Worth, Barber-Colman Co., Industrial Instrs. Div.	817-732-2818
Tex	Pasadena, ASKCO Instr. Co.	713-472-3688
Utah	Salt Lake City, Control Sys., Inc.	801-364-6425
Va	Richmond, Indamation Co.	804-272-7270
Wash	Bellevue, KAKar Corp.	206-454-1318
WVa	Charleston, Chemac Co.	304-346-0884
Wisc	Appleton, Pyro-Matic Industrials, Inc.	414-739-4247
Wisc	Brookfield, Pyro-Matic Industrials, Inc.	414-781-2222
FOR:	Can., Dorval, Quebec, Barber-Colman of Canada, Ltd., Industrial Instrs. Div.	514-631-9064
FOR:	Can., Vancouver 10, British Columbia, Instrument Service Labs	604-876-3361
FOR:	Can., Weston, Ontario, Barber-Colman of Canada, Ltd., Industrial Instrs. Div.	416-742-6210
FOR:	Can, Edmonton, Alb., Instr. Srvc. Labs.	403-465-3677

BARBER CORP., Box 271, Waynesville, Ohio, 45068, Tel: 513-897-2926; Empl.: 25

For info on price: C. M. Barber; Application info: C. M. Barber; Customer service: M. S. Barber

Products manufactured: Power Supplies, Relays, Solenoids, Switches, Testers

BARDEN CORP., 200 Park Ave., Danbury, Conn., 06810, Tel: 203-744-2211, TWX: 203-744-0097; Empl.: 1100

For info on price: E. V. Silver; Application info: W. W. Warner; Customer service: E. V. Silver; Delivery info: E. V. Silver

Free literature available: Selection & usage guide to precision bearings The Barden linear bearing.

Products manufactured: Bearings

BARKER ELEC. SLS., Box 405, Ship Bottom, NJ, 08008, Tel: 609-494-8209; Empl.: 17

Free literature available: Catalog & Technical Data. Terminal converters vacuum types "U.H.F." & "Standard" patterns. Leaflet - Descriptive Data. New "Wilkins" multicouple with high output (up to 1.6 volts) and extreme accuracy of reversal differences & temperature coefficients.

Products manufactured: Cores, Magnetic, Magnets, Thermocouples, Elements & Accessories

Advertisment

Vacuum Thermocouples, Mfr. L.R. Graham Co. UHF and STANDARD Low Frequency styles from 1mA up. Accurate RMS and true SQUARE LAW outputs with Low Reversal Errors and Compensated Temperature Coefficients. Wide current tracking ratios, long to fast time responses. Single units and matched parameters. Complete technical catalog available.

BARKER PRODS. CO., 344 Central St., Saugus, Mass., 01906, Tel: 617-233-9070, TWX: 617-233-6676; Empl.: 60

Customer service: W. A. Brackett

Free literature available: Catalog

Products manufactured: Connector Adapters, Connectors, Cords, Jack Adapters (All Types), Jacks (All Types), Plug Adapters, Plug & Jack Sets

Local Sales Offices & Reps.

Ariz	Phoenix, R. Fissell Co.	602-264-4031
Cal	Burbank, Koessler Sls. Co.	213-849-5716
Cal	Lafayette, Wilkins-Mason Assocs.	415-284-9200
Colo	Denver, Vines & Co.	303-832-6967
Fla	Ormond Beach, J.F. Thompson Co.	904-677-2298
Ga	Atlanta, Maitland K. Smith	404-939-5838
Ill	Chicago, T. Pappas & Assocs. Inc.	312-685-2338
Mass	Auburndale, Mktg. Elctrn., Inc.	617-527-7753
Mich	Detroit, Riley & Petchell Sls., Inc.	313-535-7000
Minn	Minneapolis, J. E. M. Anderson Co.	612-823-6459
NJ	Montclair, Component Marketers Inc.	201-746-6717
Ohio	Twinsburg, F. Ohman Inc.	216-425-7455
Pa	Wynnewood, Stinson Assocs.	215-896-7378
Tex	Dallas, C. Lucas Sls. Co.	214-330-8181
Wash	Seattle, D. Champlin Co.	206-362-0401
FOR:	Can., Mississauga, Ontario, W. Farrow Assocs., Ltd.	416-625-8151

BARKER & WILLIAMSON, INC., Canal St., Bristol, Pa., 19007, Tel: 215-788-5581; Empl.: 50

Products manufactured: Amplifiers, Analyzers, Antennas, Capacitors, Variable, Chokes, Coils Including Assemblies & Forms, Counters, Couplers, Dummy Loads, Filters, Generators, Meters, Switches, Terminals, Transformers

BARNES ENGRG. CO., 30 Commerce Rd., Stamford, Conn., 06902, Tel: 203-348-5381, TWX: 710-474-3367; Empl.: 400; Minimum order: $25

For info on price: R. Bouton; Application info: R. F. Leftwich; Customer service: R. Bouton; Delivery info: B. Manning

Free literature available: Literature for Infrared Thermometers that make non-contact temperature measurements and Infrared Microscopes and Micro Scanners for non-contact temperature measurements of micro-targets.

Products manufactured: Analyzers, Bolometers, Cameras, Controls/Control Eqpt., Detectors, Microscopes, Pyrometers, Radiometers, Scanners, Standards

Local Sales Offices & Reps.

Cal	Los Altos, J. Stone Assocs.	415-948-4563
Cal	Los Angeles, Basic Systems Co.	213-938-2833
Colo	Evergreen, Mountaintek	303-674-5255
Fla	Casselberry, GPI Instrs.	305-831-6215
Fla	Orlando, E. G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E. G. Holmes & Assocs.	404-451-6161
Haw	Honolulu, Elctrn. Measurement Corp.	808-847-1138
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
La	Baton Rouge, SESCO	504-272-3730
Md	Silver Spring, Spectro Systems	301-949-8261
Mass	Marblehead, Northeast Assocs.	617-631-9500
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, E. J. Doyle Co.	612-827-5847
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NJ	East Orange, Friedman Assocs.	201-673-2500
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Fayetteville, M. P. Andrews	315-637-3144
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Pa	Elkins Park, Snow Assocs.	215-379-4700
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Houston, SESCO	713-668-7840
Tex	Richardson, SESCO	214-231-9364
Utah	Salt Lake City, Montaintek	810-272-4611
Va	Virginia Beach, E. G. Holmes & Assocs.	804-481-6556
Wash	Seattle, Showalter-Judd	206-624-9020
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

BARNES & REINECKE, INC., 351 E. Ohio St., Chicago, Ill., 60611, Tel: 312-321-0350; Empl.: 250

For info on price: J. E. Smart; Application info: J. E. Smart; Customer service: J. E. Smart; Delivery info: J. G. Ferkan

Products manufactured: Chargers, Battery, Meters

BARON-BLAKESLEE, INC., 1620 S. Laramie Ave., Chicago, Ill., 60650, Tel: 312-656-7300

For info on price: P. Johnson; Application info: P. Johnson; Customer service: J. C. Avery; Delivery info: J. C. Avery

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic

Local Sales Offices & Reps.

Cal	Gardena	213-532-0730
Cal	Newark	415-794-6511
Cal	San Diego	714-295-0041
Cal	Santa Fe Springs	213-723-0971
NJ	South Kearny	201-589-5933
NY	Garden City	516-747-8460
Ore	Portland	503-252-3468
Wisc	Oak Creek	414-762-6850

BARTLETT-EMERY INSTRUMENT CORP., 14th & Ave. "M", Ft. Madison, Iowa, 52627, Tel: 319-372-8366; Empl.: 25; Minimum order: $10

Customer service: P. R. Bartlett

Products manufactured: Meters, Shunts, Meter, Testers, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Cal	Los Altos, Schwerin Assocs.	415-941-3737
Cal	Malibu, Corman Co.	213-457-7524
Mo	Kansas City, Nevco, Inc.	816-421-1751
Mo	St. Louis, Nevco, Inc.	314-843-7406
Pa	Glenside, W.E. Girard Co.	215-887-4411

BASE TEN SYSTEMS, INC., 3828 Quakerbridge Rd., Trenton, N.J., 08619, Tel: 609-586-7010, TWX: 510-685-5692; Empl.: 100; Minimum order: $300

For info on price: R. E. Van Doren; Application info: J. W. Pflueger, Jr.; Customer service: J. W. Pflueger, Jr.; Delivery info: R. E. Van Doren

Free literature available: 1. Bulletin 1271 - PCM Systems (Airborne Telemetry). 2. Bulletin 2000/4000 - PAM and PCM Telemetry Components. 3. Model 500-480 PCM Decommutator 4. LGK-100 Voice Scan Spectrograph 5. Voiceprint Identification.

Products manufactured: Amplifiers, Comm. Systems, Commutators, Converters, Data Acquisition & Reduction Systems, Decommutators, Telemetering, Generators, Modulators, All Kinds, Monitors, Signal Conditioners & Equipment, Switches, Testers

Local Sales Offices & Reps.

Cal	Saratoga, M. Bergman Co.	408-257-5900
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Tex	Dallas, Synthenetics	214-631-1740
EXP:	New York, N.Y., Technitron	212-758-2790

BASF SYSTEMS, Crosby Dr., Bedford, Mass, 01730

BASLER ELECTRIC CO., Box 269, Rte. 143, Highland, Ill., 62249, Tel: 618-654-2341, TWX: 910-996-2522; Empl.: 740

Products manufactured: Amplifiers, Chargers, Battery, Controls/Control Eqpt., Converters, Monitors, Potentiometers, Power Supplies, Reactors, Regulators, Relays, Switchboards, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	LaHabra, Nolan Assocs.	213-694-2146
Cal	LaMirada, Marrs & Assocs.	213-947-2095
Cal	Palo Alto, Abbott Engrg. Co.	415-327-0830
Colo	Littleton, Piper-Goyne	303-798-8955
Conn	Thomaston, Nelson, Bennett, Skilton Assoc.	203-283-5959
Fla	Jacksonville, Belcher & Assocs.	904-724-7811
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ga	Atlanta, Electro Mech Sls. Engrg. Co.	404-393-0444
Ill	Chicago, H. Sam Tollaksen	312-441-6644
La	Chalmette, L. Elliott Co.	504-737-1895
Md	Glen Burnie, Faion Lott Co.	301-744-4611
Mass	Braintree, R.F. Duffy Assocs.	617-335-7724
Mich	Farmington, Miltimore Sls. Inc.	313-476-2446
Minn	Minneapolis, White Sls. Co.	612-929-4661
Mo	North Kansas City, H.J. Weisler & Assocs.	816-421-1679
Mo	St. Louis, H.J. Weisler & Assocs.	314-428-3934
NJ	Cherry Hill, L.H. Walke Co.	609-424-3766
NM	Albuquerque, Piper-Goyne	505-265-6794
NY	Memphis, Aero Sls. Co.	315-458-4774
NY	Roslyn, Seidel Assocs.	516-621-1117
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
NC	Raleigh, Electro Mech Sales Engrg. Co.	919-782-6452
Ohio	Cleveland, A.H. Baier Co., & Assocs.	216-461-6161
Okla	Tulsa, L. Elliott Co.	918-743-7794
Ore	Portland, McLaren Inc.	503-297-2248
Pa	Pittsburgh, Gormley Elec. Co.	412-371-4111
Tex	Dallas, Wm. Reese Assocs.	214-638-6575
Wash	Bellevue, McLaren, Inc.	206-454-3400
EXP:	St. Louis, Mo., Brauner Export Co.	314-426-2600

BAUMKER MFG. CO., 5144 Enterprise, Toledo, Ohio, 43612; Empl.: 8

Products manufactured: Comm. Systems

BAUSCH & LOMB, S.O.P.D, Division, 1400 N. Goodman St., Rochester, N.Y., 14602, Tel: 716-232-6000, TWX: 716-97-8231; Empl.: 5500

Products manufactured: Analyzers, Counters, Lasers & Laser Systems, Lenses, Optical & Camera, Magnifying Glasses, Inspection, Microscopes, Recorders, Scanners

Local Sales Offices & Reps.

Cal	Compton	213-636-9381
Cal	San Francisco	415-863-1580
Ga	Atlanta	404-873-2023
Ill	Deerfield	312-948-9290
Md	Sparks	301-666-2109
NJ	Parsippany	201-263-3300
FOR:	Can., Scarborough 706, Ont.	416-291-7911

BAY LABORATORIES, INC., 20160 Center Ridge Rd., Cleveland, Ohio, 44116, Tel: 216-333-3898; Empl.: 20; Minimum order: $10

Customer service: G. J. Prusha

Products manufactured: Amplifiers, Converters, Data Acquisition & Reduction Systems, Data Loggers, Filters, Indicators, Memory Systems, Monitors, Multiplexers, Signal Conditioners & Equipment

Local Sales Offices & Reps.

Cal	Long Beach, Saber Entprs.	213-595-5646

BAY PRODS., Div. American Metal Works, 8701 Torresdale Ave., Phila., Pa., 19136, Tel: 215-DE8-7300; Empl.: 125

For info on price: A. Gold; Customer service: T. Ford; Delivery info: S. Segal

Free literature available: Bay catalog - #69D Contains product and eng. info.

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Containers, Racks

Local Sales Offices & Reps.

Ala	Birmingham, Southern Ind. Sls.	
Ariz	Tucson, Industrial Tool & Supp.	602-624-6656
Cal	Los Angeles, McKinley Eq. Co.	213-263-6931
Cal	San Carlos, James Old & Son	415-591-8231
Del	Wilmington, Bruce Ind. Supp.	302-OL 5-9617
Fla	Tampa, Florida Bin & Shelving Co.	813-626-4101
Ga	Atlanta, Atlanta Bin & Shelving	404-636-4393
Ill	Chicago, A. H. Waprin Assoc.	312-644-7938
Ind	South Bend, Balient Handling Equip.	219-291-6115
Iowa	Cedar Rapids, Allen Supp. Co.	
Md	Bladensburg, Thompson & Cooke Co.	301-864-6380
Md	Cockeysville, Fabricators Inc.	301-666-2720
Mass	Waltham, Alexander Steel Co.	617-891-5780
Mich	Union Lake, Solve Needs Co.	

Minn	Minneapolis, Haldeman-Homme Co.	612-331-4880
NJ	Linden, Reliance Eq. Co.	201-381-0770
NY	Long Island City, A. Liss & Co.	212-392-8484
Pa	Bala-Cynwyd, Material Handling Co.	215-839-3440
RI	Central Falls, Rand Mat'l. Handling Co.	401-751-7657
Tex	Houston, Texas Mat'l Hangling Co.	713-666-5851
Va	Richmond, Bates Co.	804-233-3002
Wash	Seattle, F. T. Crowe & Co.	206-284-8484
Wisc	Milwaukee, Badger-Beau Equip. Co.	414-453-5581

BAYSHORE SYSTEMS CORP., 5404-B Port Royal Rd., Springfield, Va., 22151, Tel: 703-321-9625; Empl.: 25

Products manufactured: Antennas, Decoders, Diplexers, Antenna, Hydrophones & Accessories, Receivers, Recorders, Timers, Transmitters

Local Sales Offices & Reps.

Cal	Millbrae, Ashby Assocs.	415-692-4442
Fla	Orlando, UNIREP	305-295-4817
Minn	New Brighton, Dalska Assocs.	612-631-2941
Ohio	Dayton, Ashby Assocs.	513-252-5627
Pa	Huntingdon Valley, Rabal Assocs.	215-947-4825
RI	Cumberland, Perry Assocs.	

BEAD ELCTRNS., Div. Bead Chain Mfg. Co., 110 Mountain Grove St., Bridgeport, Conn., 06605, Tel: 203-334-4124; Empl.: 150; Minimum order: $40

For info on price: B. M. Krafcik; Application info: A. B. Mudgett; Customer service: B. M. Krafcik; Delivery info: B. M. Krafcik

Free literature available: Bead Electronics catalog listing male and female contacts, leads, connectors, terminals, square wire wrap pins, wire leads, etc.

Products manufactured: Connectors, Contacts, Electrical, Eyelets, Fasteners, Forms, Wire, Jacks (All Types), Pins, Terminals

Local Sales Offices & Reps.

Cal	Los Angeles, Yarbrough Sls. Co.	213-254-5101
Ill	Chicago, Gene F. Sls. Co.	312-545-5562
Ind	Indianapolis, Hoster & Sieloff Assocs., Inc.	317-844-9921
Mass	Needham, A. G. Anderson	617-449-1418
Mich	Orchard Lake, Fox Industries, Inc.	313-363-3105
Minn	Minneapolis, Nygaard Sls. Co.	612-881-3727
NJ	Beach Haven, Dyneers, Inc.	609-492-2869
NY	Lake Grove, Krone & Rubin Assocs.	609-924-0200
NY	Webster, Krone & Rubin Assocs., Inc.	716-671-6709
Va	Williamsburg, Dyneers, Inc.	804-229-3612
Wash	Seattle, F.W. Aurich & Co.	206-284-5561
EXP:	Union City, N.J., Alton Co.	201-865-4080
FOR:	Can., Thornhill, Ont., EMI Sls.	416-889-1204

BEARING INSPECTION, 10041 Shoemaker Ave., Santa Fe Springs, Cal., 90670, Tel: 213-944-6251; Empl.: 32

Customer service: D. L. Hutton

Products manufactured: Analyzers, Bearings, Tools

BECKMAN INSTRS., (AISSD), 2500 Harbor Blvd., Fullerton, Cal., 92634, Tel: 714-871-4848, TWX: 910-592-1260; Empl.: 3500

Products manufactured: Alarms, Amplifiers, Analyzers, Baths, Controlled Temperature (Air & Liquid), Computers, Data Acquisition & Reduction Systems, Densitometers, Electronic, Indicators, Interferometer Systems, Meters, Networks, Oceanographic Equip. (Electronic), Oscillographs, Direct Writing, Oscilloscopes, Paper, Graphic Recording, Probes, Radiometers, Recorders, Scales, Dial, Standards, Technical Books, Testers, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Cal	Mountain View	415-326-1970
Colo	Denver	303-371-0950
Ga	Atlanta	404-934-3830
Haw	Honolulu	808-395-9744
Ill	Lincolnwood	312-583-1020
La	Baton Rouge	504-926-5085
Md	Silver Springs	301-622-2500
Mass	Wakefield	617-245-6800
Mich	Southfield	313-424-8800
Minn	Minneapolis	612-835-2202
Mo	Creve Coeur	314-432-5610
NJ	Mountainside	201-232-7600
NC	Durham	919-383-5593
Ohio	Cleveland	216-886-3020
Ohio	Reading	513-761-9560
Pa	Broomall	215-544-2695
Pa	Pittsburgh	412-921-1530
Tex	Dallas, 214-637-1640	
Tex	Houston	713-781-0810
Utah	Salt Lake City	801-467-5471
Wash	Bellevue	206-454-9528
FOR:	Can., Edmonton, Alberta	403-482-3447
FOR:	Can., Montreal 251, Que.	514-735-1376
FOR:	Can., North Vancouver, B.C. 1	604-980-3471
FOR:	Can., Toronto, Ont.	416-251-5251

BECKMAN INSTRS., Cedar Grove Opers., 89 Commerce Rd., Cedar Grove, N.J., 07009, Tel: 201-239-6200, TWX: 710-994-5781; Empl.: 3500

For info on price: J. Short; Application info: P. Wilson; Customer service: J. Short; Delivery info: D. Casale

Free literature available: Beckman Instruments offers Bulletin 505 which provides a capsule look at a wide array of electrical test equipment.

Products manufactured: Bridges, Controls/Control Eqpt., Decade Boxes, Dividers, Indicators, Meters, Oceanographic Equip. (Electronic), Power Supplies, Recorders, Services, Assembly, Production & Test, Testers

Local Sales Offices & Reps.

Cal	Fullerton	714-521-3700
Ga	Atlanta	404-934-3830
Ill	Lincolnwood	312-583-1020
NJ	Cedar Grove	201-239-6200
Pa	Pittsburgh	412-921-1530
Tex	Houston	713-781-0810
Va	Richmond	804-282-0555

BECKMAN INSTRS., Ectrn. Instrs. Div. Ectrn. Instrumentation, 3900 N. River Rd., Schiller Park, Ill., 60176, Tel: 312-671-3300, TWX: 910-253-1820; Empl.: 3500

Products manufactured: Counters, Data Acquisition & Reduction Systems, Generators, Meters, Printers, Signal Conditioners & Equipment, Testers, Transducers

BECKMAN INSTRS., Helipot Div., 2500 Harbor Blvd., Fullerton, Cal., 92634, Tel: 714-871-4848, TWX: 910-592-1260; Empl.: 3500

p. 1•880-883; p. 2•1126,1127,1418,1419,1610-1621

Customer service: C. H. Vessey

Free literature available: Hybrid Microcircuit Technical Bulletin. Cermet Trimming Potentiometer Technical Bulletin. Precision Potentiometer Technical Bulletin. Resistor Network Technical Bulletin.

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Converters, Dials, Diodes, Display Devices/Displays, Dividers, Drivers & Decoders For Readouts, Filters, Hybrid Voltage Regulators, Integrated Circuit Devices, IC's, Active Filters, Lamp Drivers, Networks, Potentiometers, Protectors, Regulators, Resistors, Servo Systems, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Murcota Corp.	205-539-8476
Cal	Fullerton, Beckman	714-871-4848
Cal	Mountain View, Beckman Instrs.	415-961-6817
Cal	San Diego, Beckman	714-565-6244
Colo	Denver, Barnhill Five	303-934-5505
Fla	Clearwater, Lynch-Gentry Assocs.	813-443-2697
Fla	Ft. Lauderdale, Lynch-Gentry Assocs.	
Ill	Chicago, Carlson Elctrn. Sls. Co.	312-774-9022
Iowa	Cedar Rapids, Comstrand	319-363-4905
Kans	Overland Park, Sheridan Assocs.	913-383-1636
Md	Silver Spring, Beckman	301-622-2500
Mass	Needham Hgts., Beckman	617-444-9010
Mich	Farmington, Sheridan Assocs.	313-477-3800
Minn	Minneapolis, Comstrand	612-560-5300
Mo	Florissant, Sheridan Assocs.	314-837-5200
NJ	Clifton, Beckman	201-778-8888
NJ	Mt. Laurel, Beckman	609-235-3314
NM	Albuquerque, Barnhill Five	505-299-7658
NY	Buffalo, Ossmann Comp. Sls.	716-832-4271
NY	Kingston, Ossmann Comp. Sls.	914-338-5505
NY	Rochester, Ossmann Comp. Sls. Corp.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls.	315-454-4477
NY	Vestal, Ossmann Comp. Sls.	607-785-9949
NC	Winston-Salem, Murcota Corp.	919-723-1001
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Cleveland, Sheridan Assocs.	216-524-8120
Ohio	Dayton, Sheridan Assocs.	513-277-8911
Okla	Tulsa, Norvell Assocs.	918-663-1247
Ore	Portland, Almac/Stroum	503-292-3534
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640
Tex	Dallas, Norvell Elctrns., Inc.	214-350-6771
Tex	Houston, Norvell Assocs.	713-774-2568
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300
FOR:	Can., Toronto, Ont., Beckman	416-251-5251

Local Distributors

Ala	Huntsville, M & C Sls.	205-539-8476
Ala	Huntsville, Powell Elctrns.	205-539-2731
Ariz	Phoenix, Liberty Elctrns.	602-257-1272
Ariz	Tempe, Marshall Inds.	602-968-6181
Cal	El Monte, Marshall Inds.	213-686-0141
Cal	El Segundo, Liberty Elctrns.	213-322-8100
Cal	Irvine, Marshall Inds.	714-556-6400
Cal	Mountain View, Elmar Elctrns.	415-961-3611
Cal	San Diego, Liberty Elctrns.	714-565-9171
Cal	San Diego, Marshall Inds.	714-278-6350
Cal	Sunnyvale, Marshall Inds.	408-732-1100
Colo	Arvada, Marshall Inds.	303-423-9670
Colo	Commerce City, Elmar Elctrns.	303-287-9611
Conn	Hamden, Arrow Elctrns.	203-248-3801
Conn	North Branford, Marshall Inds.	203-484-0488
Fla	Clearwater, Lynch-Gentry Assocs.	813-443-2697
Fla	Miami Springs, Powell Elctrns.	305-885-8761
Fla	Orlando, Powell Elctrns.	305-859-1450
Fla	Winter Park, Lynch-Gentry Assocs.	305-671-7649
Ill	Mount Prospect, Magnuson Elctrns.	312-956-0700
Ill	Rosemont, Advent Elctrns.	312-298-4210
Md	Baltimore, Arrow Elctrns.	301-247-5200
Md	Beltsville, Powell Elctrns.	301-937-4030
Mass	Burlington, Arrow Elctrns.	617-273-0100
Mass	Lexington, Harvey/R & D Elctrns.	617-861-9200
Mass	Newton Highlands, Marshall Inds.	617-965-5115
Mich	Farmington, Sheridan Sls. Co.	313-477-3800
Minn	Bloomington, Arrow Elctrns.	612-888-5522
Minn	St. Paul, Magnuson Elctrns.	612-227-8495
Mo	Florissant, Sheridan Sls. Co.	314-837-5200
NJ	Moorestown, Arrow/Angus	609-235-1900
NJ	Rutherford, Kierulff Elctrns.	201-935-2120
NJ	Saddle Brook, Arrow Elctrns.	201-797-5800
NM	Albuquerque, Elmar Elctrns.	505-292-1111
NY	Buffalo, Ossmann Component Sls. Corp.	716-832-4271
NY	Farmingdale, Arrow Elctrns.	516-694-6800
NY	Farmingdale, Marshall Inds.	516-293-4141
NY	Hicksville, Kierulff Elctrns.	516-433-5530
NY	Kingston, Ossmann Component Sls. Corp.	914-338-5505
NY	Rochester, Ossmann Component Sls. Corp.	716-442-3290
NY	Syracuse, Ossmann Component Sls. Corp.	315-454-4477
NY	Vestal, Ossmann Component Sls. Corp.	607-785-9949
NC	Winston-Salem, M & C Sls.	919-723-1001
Ohio	Cincinnati, Sheridan Sls. Co.	513-761-5432
Ohio	Cleveland, Sheridan Sls. Co.	216-831-0130
Ohio	Dayton, Sheridan Sls. Co.	513-277-8911
Okla	Tulsa, Norvell Elctrns.	918-663-1247
Ore	Portland, Almac/Stroum Elctrns.	503-292-3534
Pa	Philadelphia, Powell Elctrns.	215-365-1900
Pa	Pittsburgh, Sheridan Sls. Co.	412-244-1640
Tex	Dallas, Norvell Elctrns.	214-350-6771
Tex	Houston, Norvell Elctrns.	713-774-2568
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300
Wash	Seattle, Liberty Elctrns.	206-763-8200
For:	Can., Toronto, Ont., Semad Elctrns.	416-635-9880
For:	Can., Vancouver, BC, Semad Elctrns.	604-434-2622

BECKMAN INSTRS., Information Displays Oper., Box 3579, Scottsdale, Ariz., 85257, Tel: 602-947-8371, TWX: 910-950-1293; Empl.: 150; Minimum order: $100

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For info on price: P. Cornell; Application info: J. Dorrough; Customer service: E. Wilcox; Delivery info: E. Wilcox

Free literature available: 1. Short Form Catalog - Showing photograph, specifications, and brief description of all products. 2. Technical Bulletin - VC-525 Voltage Converter. 3. Catalog Sheet - SM-800 Display Modules. 4. SP-350/330 Character Front-showing actual size & color of Beckman IDO displays. 5. OEM Price List.

Products manufactured: Converters, Display Devices/Displays, Drivers & Decoders For Readouts, Integrated Circuit Devices

Local Sales Offices & Reps.

Ala	Huntsville, Murcota Corp.	205-539-8476
Cal	Fullerton, Beckman Instrs.	714-871-4848
Cal	Mountain View, Beckman Instrs.	415-961-6817
Cal	San Diego, Beckman Instrs.	714-565-6244
Colo	Denver, Barnhill Five	303-934-5505
Fla	Clearwater, Lynch-Gentry Assocs.	813-443-2697
Fla	Ft. Lauderdale, Lynch-Gentry Assocs.	
Fla	Winter Park, Lynch-Gentry Assocs.	305-671-7649

Ill	Chicago, Carlson Elctrn. Sls. Co.	312-774-9022
Iowa	Cedar Rapids, Comstrand	319-363-4905
Kans	Overland Park, Sheridan Assocs.	913-383-1636
Md	Silver Spring, Beckman Instrs.	301-622-2500
Mass	Needham Heights, Beckman Instrs.	617-444-9010
Mich	Farmington, Sheridan Assocs.	313-477-3800
Minn	Minneapolis, Comstrand	612-460-5300
Mo	Florissant, Sheridan Assocs.	314-837-5200
NJ	Clifton, Beckman Instrs.	201-778-8888
NJ	Mt. Laurel, Beckman Instrs.	609-235-3314
NY	Buffalo, Ossmann Comp. Sls.	716-832-4271
NY	Kingston, Ossmann Comp. Sls.	914-338-5505
NY	Rochester, Ossmann Comp. Sls.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls.	315-454-4477
NY	Vestal, Ossmann Comp. Sls.	607-785-9949
NC	Winston-Salem, Murcota Corp.	919-723-1001
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Cleveland, Sheridan Assocs.	216-524-8120
Ohio	Dayton, Sheridan Assocs.	513-277-8911
Okla	Tulsa, Norvell Assocs.	918-663-1247
Ore	Portland, Almac/Stroum	503-292-3534
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640
Tex	Dallas, Norvell Assocs.	214-350-6771
Tex	Houston, Norvell Assocs.	713-744-2568
Wash	Seattle, Almac/Stroum	206-763-2300
FOR:	Can., Toronto Ont., Beckman Instrs.	416-251-5251

Local Distributors

Ala	Huntsville, M&C Sls.	
Ala	Huntsville, Powell Elctrns./Huntsville, 803 Oster Dr., Box 1095	205-539-2731
Ariz	Phoeniz, Liberty Elctrns./Ariz.	602-257-1272
Ariz	Tempe, Marshall Inds.	602-968-6181
Cal	El Mont, Marshall Inds.	213-686-0141
Cal	El Segundo, Liberty Elctrns.	213-322-8100
Cal	Fullteron, Beckman Instrs.	714-871-4848
Cal	Irvine, Marshall Inds.	714-556-6400
Cal	Mountain View, Elmar Elctrns.	415-961-3611
Cal	San Diego, Liberty Elctrns.	714-565-9171
Cal	San Diego, Marshall Inds.	714-278-6350
Cal	Sunnyvale, Marshall Inds.	408-732-1100
Colo	Denver, Elmar Elctrns./Denver	303-287-9611
Colo	Denver, Marshall Inds.	303-423-9670
Conn	Hamden, Arrow Elctrns.	203-245-3801
Conn	Hamden, Marshall Inds.	203-288-9241
Fla	Clearwater, Lynch-Gentry Assocs.	813-443-2697
Fla	Miami Springs, Powell Elctrns./Fla., 1740 N. W. 69th Ave., Box 514	305-885-8761
Fla	Orlando, Powell Elctrns./Florida, Oakridge Commerce Ctr., 2032 Palmridge Way	305-859-1450
Fla	Winter Park, Lynch-Gentry Assocs.	305-671-7649
Ill	Mt. Prospect, Magnuson Elctrns.	312-956-0700
Ill	Rosemont, Advent Elctrns., 7110 Lyndon St.	312-298-4210
Md	Baltimore, Arrow Elctrns.	301-247-5200
Md	Beltsville, Powell Elctrns./Wash, 10728 Hanna St.	301-937-4030
Mass	Burlington, Arrow Elctrns.	617-273-0100
Mass	Lexington, Harvey/R & D Elctrns.	617-861-9200
Mass	Newton Highlands, Marshall Inds.	617-965-5115
Mich	Farmington, Sheridan Sls. Co.	313-477-3800
Minn	St. Paul, Magnuson Elctrns.	612-227-8495
Mo	Florissant, Sheridan Sls. Co.	314-837-5200
NJ	Mt. Laurel, Arrow/Angus	609-235-1900
NJ	Rutherford, Kierulff Elctrns.	201-935-2120
NJ	Saddlebrook, Arrow Elctrns.	201-797-5800
NY	Buffalo, Ossmann Comp. Sls.	716-832-4271
NY	Farmingdale, Arrow Elctrns.	516-694-6800
NY	Farmingdale, Marshall Inds.	516-293-4141
NY	Hicksville, Kierulff Elctrns.	516-433-5530
NY	Kingston, Ossmann Comp. Sls.	914-338-5505
NY	Rochester, Ossmann Comp Sls.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls.	315-454-4477
NY	Vestal, Ossmann Comp. Sls.	607-785-9949
NC	Winston-Salem, M & C Sls.	919-723-1001
Ohio	Cincinnati, Sheridan Sls. Co.	513-761-5432
Ohio	Cleveland, Sheridan Sls. Co.	216-524-8120
Ohio	Dayton, Sheridan Sls. Co.	513-277-8911
Okla	Tulsa, Norvell Elctrns.	918-663-1247
Ore	Portland, Almac/Stroum	503-292-3534
Pa	Philadelphia, Powell Elctrns./Philadelphia, South Island Rd., Box 8765	215-365-1900
Pa	Pittsburgh, Sheridan Sls. Co.	412-244-1640
Tex	Dallas, Norvell Elctrns.	214-350-6771
Tex	Houston, Norvell Elctrns.	713-774-2568
Wash	Seattle, Almac/Stroum	206-763-2300
Wash	Seattle, Liberty Elctrns./Northwest	206-763-8200
For:	Can., Montreal, Que., Specialty Elctrns.	514-336-4500
For:	Can., Toronto, Ont., Weber Semad Elctrns.	416-635-9880
For:	Can., Vancouver, B.C., Weber Semad Elctrns.	604-434-2622

BECO, INC., 740 Kesler Mill Rd., Salem, Va., 24153, Tel: 703-389-3053; FSC No: 06673; Empl.: 21; Minimum order: $10

For info on price: L. S. Ball; Application info: C. R. Ball, Jr.; Customer service: M. O. Weddle; Delivery info: L. S. Ball

Free literature available: Power Supply Catalog - Lists current models, outlines features, contains glossary of terms & connection modes. Kit Catalog - Describes various kits, parts & plans available.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Counters, Kits, Power Supply, Power Supplies, Services, Assembly, Production & Test

BECTON, DICKINSON & CO., Edmont-Wilson Div., 3157 Walnut St., Coshocton, Ohio, 43812, Tel: 614-622-4311; Minimum order: $25

For info on price: D. Cores; Application info: M. Sweet; Customer service: D. Cores

Products manufactured: Calibrators, Meters

BEECHWOOD MFG. CORP., 360 S. Downey Ave., Indianapolis, Ind., 46219, Tel: 317-356-2493; Empl.: 12; Minimum order: $20

Customer service: R. E. Cox

Products manufactured: Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Metal

Local Sales Offices & Reps.

Ala	Huntsville, F.M. Assoc.	205-536-9990
Cal	Mt. View, Connolly & Co.	415-967-6988
Fla	Orlando, F.M. Assoc.	305-851-5710
Fla	West Palm Beach, F.M. Assoc.	305-746-3126
NC	Greensboro, F.M. Associates	919-294-2754
Va	Baileys Crossroads, Q.T. Electronic Sls.	703-671-4357

BEEDE ELECTRICAL INSTR. CO., INC., S. Main St., Penacook, N.H., 00331, Tel: 603-753-6362, TWX: 710-364-6977; Empl.: 500; Minimum order: $25

p. 1•238,239,612,613

Customer service: Sales Dept.

Free literature available: Bltn. Mr-2 Meter Relays; Bltn. T-1 Pyrometer Meter relays; Bltn. T-2 Pyrometers; Bltn. PM-10 Panel Meters

Products manufactured: Meters, Monitors, Motors, Relays, Tachometers

Local Sales Offices & Reps.

Ala	Huntsville, Comp. Sls. Corp.	205-883-7794
Ariz	Phoenix, MR Engineering	602-959-5150
Cal	Los Angeles, Universal Comp. Co.	213-641-4255
Cal	San Carlos, Elctrn. Engrg. Assoc.	415-593-2189
Colo	Denver, Elctrn. Sls, Inc.	303-771-6300
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
Fla	Fort Lauderdale, Comp. Sls. Corp.	305-523-5906
Fla	Indian Harbor Beach, Comp. Sls. Corp.	305-773-0919
Fla	St. Petersburg, Comp. Sls. Corp.	813-894-4366
Fla	Terra Ceia, Comp. Sls. Corp.	813-722-6376
Ill	Skokie, Saffro & Assocs.	312-588-0905
Kans	Leawood, Thunderbird Tech. Sls. & Svc.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls. & Svc.	316-684-3941
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Ann Arbor, O-M Sls. Co.	313-994-6073
Minn	Minneapolis, Wenco Sls.	612-866-3639
Mo	St. Louis, Thunderbird Tech. Sls. & Svc.	314-567-6488
NH	Dover, R. Perron & Co.	603-742-2321
NJ	Ridgewood, Ballou, Inc.	201-444-6990
NY	Buffalo, Ossman Comp. Sls. Corp.	716-832-4271
NY	Kingston, Ossman Comp. Sls. Corp.	914-338-5505
NY	Rochester, Ossman Comp. Sls. Corp.	716-442-3290
NY	Syracuse, Ossman Comp. Sls. Corp.	315-454-4477
NY	Vestal, Ossman Comp. Sls. Corp.	607-785-9949
NC	Raleigh, Comp. Sls. Corp.	919-832-1897
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Ohio	Dayton, D. Steffen & Assocs.	513-293-3146
Pa	Devon, B & A Assocs.	215-687-5173
Tex	Dallas, Southwest Elctrn. Ind.	214-233-9816
Tex	Houston, Southwest Elctrn. Ind.	713-729-1670
Wash	Mercer Island, J. H. Andersen Assocs.	206-232-0484
Wash	Vancouver, J. Anderson & Assoc.	206-256-1475
FOR:	Brampton, Ontario, Can., Mod-Tronic Instr. Ltd.	416-457-6322

Local Distributors

Cal	Los Angeles, Metermaster, 5647 Jillson St.	213-685-4340
Cal	Santa Clara, Dynametron, 3343 Edwards Ave.	408-246-6535
Colo	Denver, Metermaster Inst. Corp., 1165 S. Cherokee St.	303-722-5766
Conn	Middletown, Mancib Co., Randolph & Coe Rds.	203-346-6646
Fla	Pompano Beach, A&M Instr., 6560 SW 7th Ct.	305-972-1610
Ill	Chicago, EIL Instrs., 221 W. 79th St.	312-874-8070
Ill	Oak Park, Pacific Indicator, 6603 W. North Ave.	312-261-1330
Ind	Indianapolis, EIL Instrs., 7061 Twin Oaks Dr., Ste. M	317-545-1373
Kans	Overland Pk., Brooks Elctrn. Svc Co., 3761 W. 95th St.	913-648-3131
Md	Timonium, EIL Instrs., 1830 York Rd.	301-252-1260
Mass	Burlington, Mancib Co., A St. at Middlessex Tpk.	617-272-9450
Mich	Clawson, Instr. Specialties, 1024 W. 14 Mile Rd.	313-435-3311
Minn	Minneapolis, Environ Labs, 9725 Gerard Ave.	612-888-7795
Mo	St. Louis, Scherrer Instrs., 7170 Manchester Ave.	314-644-5362
NY	Rockville Centre, A&M Instr., 5 Nassau St.	516-678-6960
Ohio	Cleveland, Weschler Elec. Corp., 4250 W. 130th St.	216-251-4609
Pa	Pittsburgh, EIL Instrs., 1844 Ardmore Blvd.	412-731-5230
Tex	Houston, Electrical Inst. & Meter Co., 1424 Westheimer St.	713-526-6871
Va	Alexandria, EIL Instrs., Shirley Hwy. at Edsall Rd.	703-354-4330
Wash	Seattle, Eicher-Richards Co., 2727 NE Blakeley St.	206-523-7888

BEHLMAN DIV., CALIFORNIA INSTRS., Div. Aiken Ind., 5150 Convoy St., San Diego, Cal, 92111, Tel: 714-279-8620; FSC No: 16067; Empl.: 80; Minimum order: $25

For info on price: W. W. Hanford; Application info: W. W. Hanford; Customer service: D. Chilcoat; Delivery info: W. W. Hanford

Free literature available: Cimron® digital multimeter selection guide Invertron® AC power source short form catalog.

Products manufactured: Amplifiers, Converters, Generators, Power Supplies, Protectors, Regulators, Transformers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Ariz	Scottsdale, Williams Assocs. Inc.	602-947-4297
Cal	Cupertino, T. L. Snitzer Co.	408-257-8333
Cal	Los Angeles, T. L. Snitzer Co.	213-836-6170
Colo	Denver, Williams Assocs. Inc.	303-343-2911
Fla	Orlando, FM Assocs.	305-851-5710
Fla	Tequesta, FM Assoc.	305-746-3128
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Sea	312-282-6694
Ind	Carmel, Sea	317-846-2593
Iowa	Cedar Rapids, Palatine Engrg. Sls. Co.	319-365-8071
Kans	Andover, Palatine Engrg. Sls. Co.	316-683-7512
Kans	Overland Pk., Palatine Engrg. Sls. Co.	913-262-5643
La	Baton Rouge, SESCO	504-927-7574
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Waytek	612-933-2133
Mo	St. Louis, Palatine Engrg. Sls.	314-426-7055
NM	Albuquerque, Williams Assocs. Inc.	505-255-1638
NY	Great Neck, Eastern Instr. of N.Y.	516-466-9505
NY	North Syracuse, NACO Electronics Inc.	315-699-2651
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Philadelphia, Eastern Instr. of Phil.	219-927-7777
Tex	Houston, Sesco	713-668-7840
Tex	Richardson, Sesco	214-231-9364
Va	Annandale, Nine Assocs.	703-256-9105
Wash	Seattle, Datacom Assocs.	206-329-2989

BEHLMAN ENGINEERING CORP., Box 4518, 427 N. Nopal St., Santa Barbara, Cal., 93103, Tel: 805-963-9019 .... p. 1•1114-1119

For info on price: J. Behlman; Application info: H. L. Behlman; Customer service: H. L. Behlman; Delivery info: J. Behlman

Free literature available: Describes Line of A.C. power supplies. Includes price list.

Products manufactured: Converters, Generators, Inverters, Power Supplies, Regulators

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs.	205-536-1941
Ariz	Phoenix, R.L. Davis Co.	602-955-2266
Cal	Burbank, Instr. Specialists, Inc.	213-849-7181
Cal	San Diego, Instr. Specialists, Inc.	714-565-2555
Cal	Santa Clara, Instr. Specialists, Inc.	408-244-1505
Conn	Glastonbury, Instr. Reps., Inc.	203-633-0777
Fla	Satellite, Reynolds & Assocs.	305-773-4700
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Md	Rockville, Farrell Assocs., Inc.	301-424-9460
Mass	Lexington, Instr. Reps., Inc.	617-861-8620
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NM	Albuquerque, Scientific Devices	505-293-3494
Pa	King of Prussia, Letronix	215-265-1020
FOR:	Can., West Hill, Electromechanical Prods.	416-282-3870

BEL FUSE, 203 Van Vorst, Jersey City, N.J., 07302, Tel: 201-432-0463, TWX: 710-730-5301; Empl.: 125 p. 1•432-442,1966

Products manufactured: Circuit Breakers, Coils Including Assemblies & Forms, Converters, Delay Lines, Fuses, Transformers

Local Sales Offices & Reps.

Cal	Burlingame, Leddy Assoc.	415-347-5247
Cal	Escondido, Andrew Elctrn. Sls.	714-743-3015
Cal	Garden Grove, Impact Elctrns.	213-431-3581
Conn	Rowayton, Eastern Tech. Sls.	203-853-8350
Fla	Clearwater, Southeastern Comp. Sls.	813-531-8324
Ill	Chicago, Memac Sls.	312-545-1033
Ind	Indianapolis, Lat-Tronics	317-846-5788
Mass	Waban, QRC Corp.	617-332-9600
Minn	St. Louis Park, Beta Engrg.	612-925-4422
NY	Hempstead, Kahgan Sls.	516-538-2300
NY	Pompey, S.F. Foster Co.	315-677-3333
Pa	Bala Cynwyd, M. Friedman & Assoc.	215-839-3450
Tex	Addison, Parvin Sls.	214-239-9148

BELDEN

BELDEN CORP., Electronic Div., Box 1100, Richmond, Ind., 47374, Tel: 317-966-6661; Empl.: 3783 p. 2•1882-1909

Products manufactured: Braid, Cable, Bus Bars & Systems, Cable Assemblies & Harnesses, Cable, Cords, Cutters, Wire, Hand Operated, Probes, Testers, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices), Wire

Local Sales Offices & Reps.

Cal	Anaheim	714-991-0645
Cal	Claremont	714-624-7910
Cal	Granada Hills	213-361-7256
Cal	Pleasanton	415-846-8003
Cal	San Mateo	415-348-2060
Cal	West Covina	213-331-2592
Colo	Aurora	303-751-2870
Fla	Boca Raton	305-395-4392
Ga	Lilburn	404-921-3504
Haw	Hololulu	808-531-7548
Ill	Arlington Hts.	312-392-3849
Ill	Batavia	312-879-1625
Ill	Hinsdale	312-654-4462
Ind	Indianapolis	317-849-1945
Iowa	Des Moines	515-278-4343
La	Kenner	504-722-7223
Mass	Framingham Center	617-877-2120
Mich	Novi	313-477-9177
Minn	Burnsville	612-894-3697
Mo	Black Jack	314-355-1495
NH	Exeter	603-772-9007
NJ	Ft. Lee	212-762-8433
NY	Brockport	716-637-2869
NY	Pomona	914-354-0032
NC	Charlotte	704-535-4553
Ohio	Englewood	513-836-3805
Ohio	Medina	216-725-4285
Okla	Tulsa	918-663-5245
Pa	Pittsburgh	412-922-9056
Pa	St. Davids	215-293-0867
Tenn	Bartlett	901-388-9181
Tex	Dallas	214-823-1423
Tex	Houston	713-444-0844
Va	Fairfax	703-273-5771
Wash	Bellevue	206-885-5808
Wisc	Waukesha	414-968-2631

BELL CO., INC., 106 Morrow Ave., Box 92E, Trussville, Ala., 35173, Tel: 205-655-2135; Empl.: 19

For info on price: N. H. Bell; Application info: N. H. Bell; Customer service: N. H. Bell; Delivery info: H. M. Bell

Free literature available: Information on Graphic Sign Systems, Nameplates, and Special Marking applications for all types of business.

Products manufactured: Boards, Printed Circuit, Nameplates, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips

BELL, INC., F.W., 4949 Freeway Dr. E., Columbus, Ohio, 43229, Tel: 614-888-7501, TWX: 810-337-2851; Empl.: 50; Minimum order: $25 p. 1•614,615,2338,2339

Customer service: D. L. Calvelage

Free literature available: Catalogs which describe in detail all the capabilities and specifications for each of our product lines.

Products manufactured: Analyzers, Generators, Magnetizers, Magnetometers, Meters, Multipliers, Probes, Transducers

Local Sales Offices & Reps.

Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	Pasadena, P. Nurches Co.	213-796-5844
Colo	Denver, G. Moss Elctrns.	303-985-8815
Colo	Greeley, Gordon Moss Elctrns., Inc.	303-353-1452
Conn	Glastonbury, Instr. Reps.	203-633-0777
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Mass	Lexington, Instrument Reps.	617-861-8620
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NM	Albuquerque, G. Moss Elctrns.	505-821-6101
NY	Mamaroneck, Cane Tech. Sls.	914-698-4411
NY	Syracuse, Labtronics, Inc.	315-454-9314
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Ore	Portland, Brett Assocs.	503-232-4184
Pa	Paoli, T. Griffin Co.	215-644-7710
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Dallas, Carey-Wolf & Assocs.	214-823-5383
Tex	Ft. Worth, Carey-Wolf & Assocs.	817-738-1996
Tex	Houston, Cary-Wolf & Assocs.	713-721-2442
Wash	Seattle, Brett Assocs.	206-935-8054
EXP:	New York, N.Y., J. Plasencia, Inc.	212-867-8084
FOR:	Can., Burnaby B.C., Megatronix Ltd.	604-526-3312
FOR:	Can., Montreal, Megatronix Ltd.	514-488-0404
FOR:	Can., Ottawa, Ont., Megatroix Ltd.	613-729-4004
FOR:	Can., Weston Ont., Megatronix	416-742-8015

BELL & HOWELL, 706 Bostwick Ave., Bridgeport, Conn., 06605, Tel: 203-367-6751, TWX: 710-453-2997; Empl.: 125; Minimum order: $25

For info on price: I. Isdale; Application info: I. Isdale; Customer service: E. Board; Delivery info: E. Board

Free literature available: Hybrid operational amplifier catalog. Electro optical detector bulletin.

Products manufactured: Amplifiers, Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Meters

Local Sales Offices & Reps.

Ala	Huntsville, Beacon	205-881-5031
Ariz	Phoenix, Toward Engrg.	602-955-3193
Cal	Chatsworth, Boyle Assocs.	213-773-5982
Cal	Millbrae, Ashby Assocs.	415-692-4442
Fla	Ft. Lauderdale, Beacon Elctrns.	305-776-6074
Fla	Maitland, Beacon	305-647-3498
Ga	Atlanta, Beacon	404-351-3654
Ill	Elmhurst, Schuten Assocs.	312-833-0980
La	Baton Rouge, Response Instr. Serv. & Eng.	504-766-4645
Mass	Brookline, Technology Prods. Group	617-731-0858
Mich	Birmingham, J.C.H. Co.	313-643-7203
Mich	Grand Rapids, J.C.H. Co.	616-942-0650
Minn	Minneapolis, C.E. Bohlig & Co.	612-922-7011
NY	Bay Shore, Brunetta Sls.	516-586-1800
NY	Rochester, Scientific Devices	716-334-2445
Ohio	Dayton, J.C.H. Co.	513-296-1010
Ohio	Medina, J.C.H. Co.	216-241-4880
SC	Spartanburg, Beacon	803-582-4613
Tex	Dallas, Allied Comps.	214-238-0408
Tex	Houston, Allied Comps.	713-782-5408
Va	Falls Church, Beacon North, Inc.	703-534-1673
Wash	Bellevue, Scientific Devices	206-454-0900

BELL & HOWELL CO., Elctrns. & Instrs. Grp., 360 Sierra Madre Villa, Pasadena, Cal., 91109, Tel: 213-443-3211, TWX: 910-587-3440

Products manufactured: Data Acquisition & Reduction Systems, Recorders, Tape Recording Accessories

BELL INDUSTRIES, ELECTRONIC COMPONENTS DIV., 150 W. Cypress Ave., Burbank, Cal., 91502, Tel: 213-846-9302, TWX: 910-498-2207

Products manufactured: Capacitors, Fixed, Filters, Networks

BELL INDUSTRIES, J.W. Miller Div., 19070 Reyes Ave., Compton, Cal., 90221, Tel: 213-537-5200, TWX: 910-346-6740; Empl.: 85; Minimum order: $25 p. 2•370-379

For info on price: A. Bufford; Application info: F. T. Scott; Customer service: A. Bufford; Delivery info: T. Shiffer

Products manufactured: Capacitors, Fixed, Chokes, Coders, Coils Including Assemblies & Forms, Detectors, Discriminators, Filters, Relays, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, H.A. Moore Sls. Co.	602-274-4558
Ark	El Dorado, D. Bellew Sls., Inc.	501-863-8325
Cal	Gardena, Bidwell Sls. Assocs.	213-770-0300
Cal	Redwood City, Logan Sls. Co.	415-369-6726
Colo	Denver, R.G. Bowen Co., Inc.	303-722-4641
Fla	Maitland, Hutto-Hawkins-Peregoy, Inc.	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy, Inc.	305-943-3583
Ga	Atlanta, Millar Electronics, Inc.	404-261-6160
Ill	Chicago, Markal Sls. Corp.	312-282-5800
Ind	Indianapolis, Elctrn. Reps., Inc.	317-897-9328
La	Kenner, D. Bellew Sls., Inc.	504-729-4560
Md	Baltimore, Par-Nell Sls. Co.	301-655-2944
Mass	North Scituate, W.A. Hendrickson Co.	617-545-0652
Mich	Southfield, Markal Sls. Corp.	313-355-5700
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
Mo	Raytown, Marty Taraski Sls Co.	816-358-1442
NJ	Englewood, J.J. Bressler, Inc.	201-569-7600
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Binghamton, Bucci Assocs.	607-798-7141
NY	Lancaster, Lawrence Ind'l Sls.	716-685-1993
NY	Rochester, Marsey Sls., Inc.	716-442-9700
NC	Raleigh, Millar Elctrns., Inc.	919-787-9564
Ohio	St. Marys, T. Shelby & Co.	419-394-3377
Ore	Portland, Earl & Brown, Co.	503-245-2283
Pa	Holland, Par-Nell Sls. Co.	215-355-9330
Tenn	Memphis, D. Bellew Sls., Inc.	901-365-9437
Tex	Richardson, Campion Sls. Co.	214-238-8145
Wash	Seattle, Earl & Brown Co.	206-284-1121
EXP:	New York City, N.Y., Roburn Agencies, Inc.	212-989-5939

BEMAN MFG., INC., New Cumberland, Pa., 17070, Tel: 717-938-1451, TWX: 510-650-3539; Empl.: 250

Products manufactured: Cable Assemblies & Harnesses, Cable, Caps, Connector, Circuits, Flexible, Clamps & Clips, Connector Adapters, Connectors, Contact Strips, Finger, Contacts, Electrical, Cords, Eyelets, Grommets, Jacks (All Types), Jumpers, Lead Assemblies & Receptacles, Pins, Plug & Jack Sets, Plugs, Resistors, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Fla	Fern Park, M & G Assoc.	305-841-8793
Ill	Park Ridge, Metcom Assoc.	312-696-1490
Ind	Kokomo, R. Leib	317-453-1398
Mass	Waltham, Mekkom	617-891-7520
Mich	Bloomfield Hills, Ellinger Sales	313-642-0203
Pa	Philadelphia, Newson Assoc.	215-248-3377

BEMCO, INC., 9908 San Fernando Rd., Pacoima, Cal., 91331, Tel: 213-899-5296, TWX: 910-496-1520; Empl.: 53

For info on price: F. Garacci; Application info: F. Garacci; Customer service: L. Hernandel; Delivery info: F. Garacci

Products manufactured: Chamber, Environmental Test, Heat Exchangers & Systems, Ovens, Services, Assembly, Production & Test, Valves, Vacuum

THE BENDIX CORP., Flight Systems Div., Teterboro, N.J., 07608, Tel: 201-288-2000, TWX: 710-990-6136; Empl.: 2900

Products manufactured: Amplifiers, Annunciators, Controls/Control Eqpt., Gages, Indicators, Motors, Pedestals, Radar, Repeaters, Servo, Resolvers, Synchro, Services, Assembly, Production & Test, Servo Systems, Synchros, Transducers

BENDIX-GUIDANCE SYSTEMS, Teterboro, N.J., 07608, Tel: 201-288-2000, TWX: 201-990-6136; Empl.: 2500

Products manufactured: Accelerometers, Computers, Gyros (All Types), Transducers

Local Sales Offices & Reps.

Cal	Lakewood, Bendix	213-595-4311
DC	Washington, Bendix	202-331-8200
Ohio	Dayton, Bendix	513-276-2154
Wash	Tukwila, Bendix	206-246-8100
EXP:	New York, N.Y., Bendix Int'l	212-262-8000
FOR:	Can., Montreal, Que., Aviation Elec.	314-744-2811

THE BENDIX CORP., Test Systems Div., Teterboro, N.J., 07608, Tel: 201-288-2000, TWX: 710-990-6136; Empl.: 900

Products manufactured: Test Equipment, Test Systems, Testers .

BENDIX CORP., Aerospace Sys. Div., 3300 Plymouth Rd., Ann Arbor, Mich., 48107, Tel: 313-665-7766, TWX: 810-223-6041; FSC No: 07038; Empl.: 700

For info on price: B. Maddalena; Application info: B. Maddalena; Customer service: J. O'Doherty; Delivery info: B. Maddalena

Products manufactured: Scanners, X-Ray Inspection Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Bendix Corp.	205-533-0180
Ohio	Dayton, Bendix Corp.	513-276-2154
Va	Arlington, Bendix Corp.	703-841-1200

BENDIX CORP., Avionics Div, Box 9414, Ft. Lauderdale, Fla., 33310, Tel: 305-776-4100, TWX: 510-955-9884; Empl.: 950

For info on price: A. White 316-684-0177; Customer service: E. Casey 305-776-4100; Delivery info: D. Bossle 305-776-4100

Products manufactured: Antennas, Direction Finders, Indicators, Radar Systems, Receivers, Transmitters

Local Sales Offices & Reps.

Cal	Burbank	213-843-4600
Kans	Wichita	316-684-0177
Md	Cockeysville	301-252-7740
Ohio	Dayton	513-224-9214
Tex	Euless	817-267-3641

BENDIX CORP, Communications Div, East Joppa Rd., Towson, Md., 21204, Tel: 301-823-2200, TWX: 710-232-1823; Empl.: 1,000

Products manufactured: Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Coders, Comm. Systems, Microwave Integrated Circuits (MIC's), Modules, Logic, Encapsulated, Multiplexers, Radar Systems, Receivers, Transceivers, Transmitters, Transponders

BENDIX, Electric & Fluid Power Div., Hwy. 35, Eatontown, N.J., 07724, Tel: 201-542-2000, TWX: 710-722-6686; FSC No: 83298; QPL No: Multiple; Empl.: 500

For info on price: G. P. Clericuzio; Application info: J. Breickner; Customer service: G. P. Clericuzio; Delivery info: K. Smith

Free literature available: Developers and manufacturers of electric power systems including rotary AC-DC generators, power conversion systems and electric power supervisory/control equipment.

Products manufactured: Inverters, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Bendix Corp.	205-539-3673
Cal	Los Angeles, Bendix Corp.	213-377-0170
DC	Washington, Bendix Corp.	202-841-1200
Ohio	Dayton, Bendix Corp.	513-276-2154
Wash	Tukwila, Bendix Corp.	206-246-8107

BENDIX CORP., THE, Electrical Comp. Div., Sidney, N.Y., 13838, Tel: 607-563-9511, TWX: 510-261-7550; Empl.: 3500 .... p. 2•640-642

Customer service: Sls. Dept.

Free literature available: Form SL-100-4, "Electrical Connectors" illustrates and briefly describes the connector product line.

Products manufactured: Adapters, Waveguide, Cable Assemblies & Harnesses, Caps, Connector, Connector Adapters, Connectors, Packages, Integrated Circuit, Switches, Tachometers, Testers

Local Sales Offices & Reps.

Cal	Lakewood	213-920-1711
Cal	Palo Alto	415-494-1224
Fla	Orlando	305-894-6931
Ill	Des Plaines	312-296-7791
Mass	Lexington	617-861-8900
NJ	Teterboro	201-288-1710
NY	New York, Bendic International	
Ohio	Dayton	513-276-2154
Tex	Dallas	214-243-4394
Wash	Tukwila	206-246-8100
FOR:	Can., Montreal, Aviation Elec. Ltd.	

BENDIX CORP., Electrodynamics Div., 11600 Sherman Way, N. Hollywood, Calif., 91605, Tel: 213-765-1010, TWX: 910-499-2151; Empl.: 1200

Products manufactured: Actuators, Comm. Systems, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Hydrophones & Accessories, Radar Systems, Receivers, Servo Systems, Underwater Communication, Detection, Navigation, etc. Equipment, Valves, Solenoid

Local Sales Offices & Reps.

DC	Washington, Bendix Corp., Electrodynamics Div.	202-333-8200

BENDIX CORP. ENVIRONMTL. SCI., 1400 Taylor Ave., Dept. 81, Baltimore, Md., 21204, Tel: 301-825-5200, TWX: 710-232-1805; Empl.: 350

Products manufactured: Alarms, Analyzers, Comm. Systems, Data Acquisition & Reduction Systems, Monitors, Oceanographic Equip. (Electronic), Scanners, Services, Assembly, Production & Test, Signal Conditioners & Equipment, Switches, Synchro Transmitters, Solid-State, Transducers, Transmission Systems, Data

Local Sales Offices & Reps.

EXP:	New York, NY, Bendix Corp., Bendix Int'l.	
FOR:	Can., Montreal, Que., Aviation Elec. Ltd.	514-744-2811

BENDIX CORP., Instr. & Life Support Div., 2734 Hickory Grove Rd., Davenport, Iowa, 52808, Tel: 319-324-9101, TWX: 910-525-1197; Empl.: 750; Minimum order: $30

Customer service: M. J. Gallagher

Free literature available: "Guidelines for Sonic Energy Cleaning", Complete System or Flexible Options Sonic Energy Cleaning", O"How to Evaluate Sonic Energy Cleaning EquipmentO", "Immersible Sonic Cleaning Systems".

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic, Generators, Transducers

Local Sales Offices & Reps.

Cal	Los Angeles, Barnard & Assocs.	213-973-5050
Cal	San Francisco, Avionics Liaison Inc.	415-783-1131
Ill	Northfield, Marsland Distributing Co.	312-295-1616
Mass	Concord, H. M. Nazor Assocs.	617-259-8784
Wash	Seattle, Avionics Liaison, Inc.	206-767-3870

BENDIX, Microwave Devices Plant, Hurricane Rd., Franklin, Ind., 46131, Tel: 317-736-6136, TWX: 810-260-2600 .... p. 2•643,1214,1280

Products manufactured: Circulators, Ferrite, Connector Adapters, Connectors, Couplers, Dividers, Dummy Loads, Headers, Isolators, Jack Adapters (All Types), Jacks (All Types), Loads, Electronic Variable, Meters, Monitors, Seals, Services, Assembly, Production & Test, Shifters, Strip-Line Components, Microwave, Terminals, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Phoenix, Shefler Kahn Co.	602-258-7893
Cal	No. Hollywood, Jewett	213-789-8103
Colo	Denver, Gossard	303-985-0602
Conn	Wethersfield, Underwood Sls.	203-563-3046
Fla	Ft. Lauderdale, CBC, Inc.	305-782-0804
Ill	Chicago, Techrep	312-761-0548
La	Metairie, McKinney Sls.	504-887-1723
Md	Baltimore, Components Sls.	301-484-3647
Mass	Chelmsford, Underwood Sls.	617-256-8191
Minn	Minneapolis, F.B. Hill Co.	612-941-5270
Mo	St. Charles, Buse Sls. Co.	314-946-6430
NJ	Paramus, Astrorep, Inc.	
NY	E. Aurora, E.E. Harries & Co.	716-652-1221
NY	Fayetteville, E.E. Harries & Co.	315-637-9871
NY	Melville, Astrorep Inc.	516-432-2266
NY	Webster, E.E. Harries & Co.	716-671-6365
Ohio	Cleveland, Components Inc.	216-842-2737
Okla	Tulsa, McKinney Sls. Co.	918-742-6791
Ore	Portland, C.K. Shanks	503-292-5656
Pa	Feasterville, PSA, Inc.	215-355-6244
Tex	Bellaire, McKinney Sls. Co.	713-774-3232
Tex	Dallas, J. McKinney Sls.	214-631-9450
EXP:	N.Y., N.Y., Bendix Int'l.	212-262-8000
FOR:	Can., Montreal, Aviation Electric Ltd.	514-744-2811

BENDIX CORP., Motor Comps. Div., Elmira, N.Y., 14903, Tel: 607-737-8303, TWX: 510-252-1594; Empl.: 1000; Minimum order: $50

For info on price: F. Loomis 607-737-8254; Application info: F. Loomis 607-737-8254; Customer service: T. Fice 607-737-8254; Delivery info: T. Fice 607-737-8254

Free literature available: New 27 page catalog and application guide describing a complete line of Tooth, multiple Disc and single surface Electric Clutches and brakes with application considerations.

Products manufactured: Brakes, Brushes & Brush Assemblies, Clutches, Power Supplies

Local Sales Offices & Reps.

Ala	Birmingham, Wilcox & Allen	205-592-0356
Cal	Bell Gardens, N. A. D'Arcy Co.	213-773-5511
Cal	San Diego, N. A. D'Arcy Co.	714-274-8700
Conn	Old Lyme, Aid Engrg. Sls. Co.	203-529-7946
Conn	Rocky Hill, Aid Engrg. Sls. Co.	203-673-3692
Ill	Chicago, Halliday-Lenhart	312-446-9320
Mass	Westboro, Aid Engrg. Sls. Co.	617-890-8181
Mich	Birmingham, J. C. Hofstetter Co.	313-643-7203
Mo	Kansas City, Terry & Hodges	913-722-1024
Mo	St. Louis, Terry & Hodges	314-965-0746
NJ	Livington, Varrelman-Gorman Co.	201-992-2505
NY	Centerport, Varrelman-Gorman Co.	212-463-5000
NY	Elmira, Motor Components Div.	607-737-8303
NC	Charlotte, M. R. Snyder Co.	704-377-6571
Ohio	Cincinnati, Fremont & Lewis	513-891-3560
Ore	Portland, N. Rupp Co.	503-228-4311
Pa	Bridgeville, Foster-McClinton Inc.	412-941-4800
Pa	Paoli, Joos Equip. Co.	215-644-5875
Tex	Richardson, D. E. Horman Co.	214-234-2021
Wash	Bellevue, N. Rupp Co.	206-455-2130
Wisc	Wauwatosa, Gille Engrg. Sls.	414-258-4100

BENTHOS, INC., Edgerton Dr., N. Falmouth, Mass., 02556, Tel: 617-563-5917; Empl.: 33; Minimum order: $25

Customer service: B. Eaton

Free literature available: Oceanographic Catalog – summary of equipment deep sea cameras – Edgerton camera system deep sea floats – glass floatation spheres Taptone – vacuum/pressure inspection of cans & containers

Products manufactured: Cameras, Chamber, Environmental Test, Lights, Oceanographic Equip. (Electronic)

BERG ELECTRONICS, Div. I.E. du Pont de Nemours & Co. (Inc.), York Expwy., New Cumberland, Pa., 17070, Tel: 717-938-6711, TWX: 510-650-3538; Empl.: 1200 p. 2•645-652

Products manufactured: Connectors, Contacts, Electrical, Integrated Circuit Packaging Systems, Machines/Machinery, Production, Pins, Sockets, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Cal	Woodland Hills	213-347-8830
Ill	Lincolnwood	312-982-4280
Mass	East Longmeadow	413-525-4228
Minn	Minneapolis	612-835-4820
PA	New Cumberland	717-232-8656

BERKELEY NUCLEONICS, 1198 Tenth St., Berkeley, Cal., 94710, Tel: 415-527-1121; Empl.: 15; Minimum order: $20

Customer service: D. Ellis

Products manufactured: Amplifiers, Calibrators, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Generators, Power Supplies, Simulators

Local Sales Offices & Reps.

DC	Washington, Scientific Sys.	202-726-4161
Ill	Chicago, Corleet & Assoc.	312-626-6726
NY	Syosset, Scientific Sys.	516-921-3737
Tenn	Knoxville, Pulcir, Inc.	615-693-3641

BERKELEY INSTRUMENTS, INC., 1701 Reynolds Ave., Santa Ana, Cal., 92705, Tel: 714-556-0623, TWX: 800-854-3253; Empl.: 25 .... p. 1•616,617

Products manufactured: Alarms, Calibrators, Counters, Generators, Meters, Printers, Testers

Local Sales Offices & Reps.

EXP:	Can., Montreal, Que., Electrodesign, Ltd.	514-363-5120

BERTAN ASSOCS., INC., 180 Miller Pl., Hicksville, N.Y., 11801, Tel: 516-433-3110; FSC No: 6130; Empl.: 48; Minimum order: $50 .... p. 1•1120,1121

Customer service: L. L. Bertan

Free literature available: Short Form Catalog - describes high voltage products and capabilities including high voltage instrumentation, nuclear power supplies, CRT power supplies and other electron beam high voltage power supplies.

Products manufactured: Converters, Meters, Power Supplies, Probes, Testers, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, PLS Assoc.	602-957-9110
Cal	Encino, King-Way Assoc.	213-788-4124
Cal	Milbrae, Ashby Assoc.	415-692-4442
Colo	Denver, PLS Assocs.	303-771-0140
Ill	Aurora, D. Smith & Assoc.	312-896-0828
Md	Silver Springs, Spectroscopy Sys.	301-949-8261
Mass	Framingham, Victor Assocs.	617-879-5710
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
NM	Albuquerque, PLS Assocs.	505-255-2330
Ohio	Cleveland, Carter, McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Pa	Monroeville, Carter, McCormic & Peirce	412-372-4415
Pa	Windmoor, Spectroscopy Sys.	215-836-1545
Tex	Dallas, Dwayne Clement & Assocs.	214-239-6105

VACUUM THERMOCOUPLES

BEST ELECS. DIV., Harry Levinson Co., 1211 E. Denny Way, Seattle, Wash., 98122, Tel: 206-323-5100, TWX: 910-444-2154; Empl.: 4; Minimum order: $15

Customer service: H. Levinson

Products manufactured: Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Cal	Menlo Park, Straube Assocs., Inc.	415-323-2476
Colo	Denver, Straube Assocs., Inc.	303-426-0890

Advertisment

Vacuum thermocouples for the measurement of true rms, or power. Matched pairs for Linear rms conversion. Multijunction consisting of 100 prs. in series. True differential type.

BETA TECHNOLOGY, INC., 94 Verdi St., Farmingdale, N.Y., 11735, Tel: 516-293-4313; Empl.: 6

For info on price: E.J. Youskites; Application info: W.S. Douglas; Customer service: W.S. Douglas; Delivery info: W.S. Douglas

Free literature available: Data sheets of standard video products.

Products manufactured: Amplifiers, Comm. Systems, Data Compressors, Digital, Delay Lines, Display Devices/Displays, Dividers, Editing Equipment, Tape, Generators, Meters, Modulator/Demodulators, Modulators, All Kinds, Monitors, Multiplexers, Receivers, Switches, Television Systems & Equipment Closed-Circuit, Test Equipment, Translators, Data, Transmission Systems, Data, Transmitters

BETAMITE ELECTRONIC DEV., 6321 W. Slauson Ave., Culver City, Cal., 90230, Tel: 213-390-3401; Empl.: 12

Products manufactured: Flashers, Relays

Local Sales Offices & Reps.

Ariz	Scottsdale, J.A. Swanson Assoc.	602-947-4379
Cal	San Diego, Andrew Elctrn. Sls.	714-747-3015
Mass	Framingham, victor Assocs.	617-879-5710
Wash	Seattle, Carlyle Tech.	206-ME2-4290

BETATRONIX, INC., 100 Ricefield La., Hauppauge, N.Y., 11787, Tel: 516-543-8780, TWX: 510-226-3748; Empl.: 35

Customer service: H. W. Cashman

Free literature available: Catalog describes, Quality Control System, various Models of Precision Conductive Plastic and Wire-Wound Potentiometers, Special Designs (including switches), and Packaging Capabilities.

Products manufactured: Potentiometers, Rheostats, Switches

BEUKERS LABS., INC., 30 Orville Drive, Bohemia, N.Y., 11716, Tel: 516-567-5100, TWX: 510-288-7888; Empl.: 60; Minimum order: $10

For info on price: F. Fetkowitz; Application info: F. Fetkowitz; Customer service: C. B. Williams; Delivery info: F. Fetkowitz

Products manufactured: Amplifiers, Couplers, Filters, Oscillators, Receivers, Tracking Systems, Transmitters

BF ELCTRNS., 415 S. Nardo, Solana Beach, Calif., 92075, Tel: 714-755-1881; Empl.: 7

Customer service: W. Blair

Free literature available: Detailed specification sheets on our line of telemetry and communication receivers, transmitters, amplifiers, filters, etc.

Products manufactured: Amplifiers, Comm. Systems, Converters, Filters, Generators, Kits, Power Supply, Multipliers, Receivers, Transmitters

BG ELECTRONICS, INC., 9 Elm Ave., Mount Vernon, N.Y., 10550, Tel: 914-664-5591; FSC No: 33791; Empl.: 32

For info on price: W. Bein; Application info: W. Bein; Customer service: W. Bein; Delivery info: A. J. Slasser

Free literature available: Catalog of typical products; Flyer-telegraph tone channel filters; Flyer-speech plus filters.

Products manufactured: Delay Lines, Equalizers, Filters, Networks, Transformers

Local Sales Offices & Reps.

Cal	San Carlos, Westronics Assocs.	415-592-1417
Ill	Arlington Heights, Hagan Sls. Co.	312-394-0617
Md	Annapolis, Hayden Assocs.	202-296-6059
NY	Huntington, Andrews & Andrews Inc.	516-692-8586
Tex	Dallas, J. A. Green Co.	214-631-7450
Tex	Houston, J. A. Green Co.	713-526-2959
EXP:	Lemoyne, PA, Elctrns. Int'l.	717-737-8858

BH ELECTRONICS, 245 E. 6th St., St. Paul, Minn., 55101

B. H. INDUSTRIES, 5784 Venice Blvd., Los Angeles, Cal, 90019, Tel: 213-937-4763; Empl.: 6; Minimum order: $38

Customer service: R. Quiring

Products manufactured: Chargers, Battery, Chokes, Converters, Decade Boxes, Inverters, Power Supplies, Transformers

Local Sales Offices & Reps.

Mass	Lexington, MRI	617-861-6270

BICRON ELCTRNS. CO., Box 807, Barlow St., Canaan, Conn., 06018, Tel: 203-824-5125; Empl.: 70

For info on price: S. Kopcha; Application info: J. Wootton; Customer service: J. Casey; Delivery info: P. Kent

Free literature available: Brochures showing Electro-Mechanical, Electro-Magnetic Assemblies. Solenoid design data sheets. X-Ray, non-contact and Bicron/Vollmer contact gaging and control systems data and specification sheets.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Converters, Generators, Inverters, Reactors, Solenoids, Testers, Transducers, Transformers

Local Sales Offices & Reps.

Va	Vinton, C. Schmitt	703-890-3859

BIDDLE, JAMES G., Township Line & Jolly Rds., Plymouth Meeting, Pa., 19462, Tel: 215-646-9200; Empl.: 197

Products manufactured: Bridges, Cable Fault Locators, Controls/Control Eqpt., Counters, Decade Boxes, Detectors, Indicators, Locators, Open-Short, Meters, Oscillators, Potentiometers, Relays, Services, Assembly, Production & Test, Standards, Testers, Transmitters, X-Ray Inspection Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins-Co., Inc.	205-539-1771
Cal	Mountainview, Tech-Ser., Inc.	415-969-9020
Cal	San Diego, Tech-Ser., Inc.	714-222-1121
Cal	Torrance, Tech-Ser, Inc.	213-538-2267
Colo	Denver, Tessco, Inc.	303-744-1119
Conn	Middletown, The Mancib Co.	203-346-6646
Fla	Orlando, Col-Ins-Co., Inc.	305-423-7615
Fla	St. Petersburg, Col-Ins-Co.	813-343-0978
Ga	Atlanta, Williams & Assocs.	404-261-3434
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
La	New Orleans, Butler & Land, Inc.	504-722-6363
Md	Silver Spring, Sel-Tronics, Inc.	301-589-3391
Mass	Burlington, The Mancib Co.	617-272-9450
Mich	Royal Oak, Satullo Co.	313-549-3910
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
Mo	Kansas City, C.B. Fall Co.	816-942-3912
Mo	St. Louis, C.B. Fall Co.	314-968-3850
NJ	Saddlebrook, L & M Assoc.	201-843-8700
NM	Albuquerque, Tech. Marketing Asso.	505-298-4321
NY	Brentwood, L & M Assoc.	516-231-8363
NY	Fayetteville, Savage Sales Co.	315-682-2131
NY	New York, L & M Asso.	212-675-7486
Ohio	Cincinnati, Peter Lax Co.	513-771-4411
Ohio	Cleveland, Peter Lax Co.	216-226-8815
Okla	Tulsa, Butler & Land	918-664-8633
Ore	Portland, Instr. Lab., Inc.	503-234-6683
Pa	Andalusia, L & M Assoc.	215-639-3100
Pa	Pittsburgh, Peter Lax Co.	412-833-5477
Tex	Dallas, Butler & Land, Inc.	214-363-8900
Tex	Houston, Butler & Land, Inc.	713-464-4662
Va	Richmond, Virginia Tech. Assoc.	804-266-9654
Wash	Seattle, Instr. Lab., Inc.	206-283-5850

BIKOR CORPORATION, 1228 253rd St., Harbor City, Cal., 90710, Tel: 213-325-2820 .... p. 1•1122,1123

For info on price: R. Pizer; Application info: J. Zagorin

Free literature available: Summary catalog, proposal drawings per customer's specific needs.

Products manufactured: Converters, Power Supplies, Regulators, Transformers

BIOCOLOGY SYS. INC., 19 Daniel Rd., Fairfield, N.J., 07006, Tel: 201-227-6188; Empl.: 26; Minimum order: $100

For info on price: T. Greco; Application info: T. J. Ramney; Customer service: J. Corteze

Free literature available: Brochures on: White & clean rooms computer rooms laminar flow work stations clean room equipment.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Air Conditioners (For Equipment)

BIOCOM, INC., 9522 W. Jefferson Blvd., Culver City, Cal., 90230, Tel: 213-836-7263; Empl.: 24; Minimum order: $25

Customer service: B. Dickey

Products manufactured: Amplifiers, Bridges, Comm. Systems, Data Acquisition & Reduction Systems, Demodulators, Oscillators, Oscilloscopes, Transducers, Transmitters

BIOMATION, INC., 10411 Bubb Rd., Cupertino, Cal., 95014, Tel: 408-255-3500, TWX: 910-338-0226

For info on price: D. Blecki; Application info: R. Tottingham; Customer service: S. Austin; Delivery info: K. Scott

Free literature available: Short form catalog describes complete line of Waveform Recorders, Logic Analyzers and Logic Recorders.

Products manufactured: Analyzers, Converters, Recorders

Local Sales Offices & Reps.

Ariz	Phoenix, C.W. Fowler Co.	602-274-5537
Cal	La Jolla, Ward/Davis Assoc.	714-459-3351
Cal	Lawndale, Ward/Davis Assoc.	213-542-7740
Cal	Sunnyvale, Ward/Davis Assoc.	408-245-3700
Colo	Denver, C.W. Fowler Co.	303-744-9595
Conn	Hamden, P. Jenks Assoc.	203-281-0810
Fla	Orlando, E.G. Holmes & Assoc.	305-894-8901
Ga	Chamblee, E.G. Holmes & Assoc.	404-451-6161
Ill	Chicago, Pivan Engrg.	312-539-4838
Ind	Indianapolis, Pivan Engrg.	317-253-1681
Kans	Mission, Pivan Engrg.	913-722-1030
Md	Wheaton, Sales Technology	301-340-0015
Mass	Wakefield, P. Jenks Assoc.	617-246-1590
Mich	Detroit, WKM Assoc.	313-434-7500
Minn	Minneapolis, Pivan Engrg.	612-537-4501
Mo	St. Louis, Pivan Engrg.	314-567-3636
NM	Albuquerque, C.W. Fowler Co.	505-299-7676
NY	Dewitt, D.B. Assoc.	315-446-0220
NY	Port Chester, Radiation Elctrns.	914-937-2300

Ohio	Cleveland, WKM Assoc.	216-267-0445
Ohio	Dayton, WKM Assoc.	513-434-7500
Okla	Norman, Data Mktg. Assoc.	405-364-8320
Pa	Norristown, Data Engrg.	215-272-1444
Pa	Pittsburgh, WKM Assoc.	412-892-2953
Tex	Dallas, Data Mktg. Assoc.	214-358-4643
Tex	Houston, Data Mktg. Assoc.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Va	Virginia Beach, E.G. Holmes Assoc.	804-481-6558
Wash	Seattle, Showalter Instrs.	206-455-4922
Wisc	Brookfield, Pivan Engrg.	414-786-1940

BIOMETRICS INSTRUMENT CORP., Sub. Varo, Inc., 2201 Walnut, Garland, Tex., 75040, Tel: 214-276-6141, TWX: 910-860-5093; Empl.: 1500 ....p. 1•1528-1531

Products manufactured: Amplifiers, Chargers, Battery, Chokes, Coils Including Assemblies & Forms, Converters, Filters, Generators, Inverters, Power Supplies, Reactors, Rectifiers, Regulators, Testers, Transformers

Local Sales Offices & Reps.

NJ	Eatontown, L. Donnelly	201-229-1400
Ohio	Dayton, B. Zunke	513-253-8935
Va	Arlington, A. Fiedler	703-920-4500

BIRD ELECTRONIC CORP., 30303 Aurora Rd., Solon, Ohio, 44139, Tel: 216-248-1200, TWX: 810-427-2687; FSC No: 70998; Empl.: 185; Minimum order: $5 p. 1•618,619

For info on price: P. Cornell; Customer service: L. Kuklinski; Delivery info: T. Bonsky

Products manufactured: Alarms, Attenuators, Bridges, Calorimeters, Microwave, Connector Adapters, Connectors, Couplers, Detectors, Dummy Loads, Filters, Heat Exchangers & Systems, Meters, Monitors, Probes, Resistors, RFI Measuring Equipment, Switches, Terminals, Testers

Local Distributors

Cal	Los Angeles, Henry Radio, 11240 W. Olympic	213-477-6701
NY	New York, Barry Elctrns., 512 Broadway	212-925-7000
Pa	Trevose, Hamtronics Trevose TV & Elec., 4033 Brownsville	215-357-1400

BIRD, RICHARD H. & CO., INC., 1 Spruce St., Waltham, Mass., 02154, Tel: 617-894-0160; FSC No: 17706; Empl.: 70; Minimum order: $50

Customer service: R. Cameron

Products manufactured: Bearings, Insulators & Insulation, Pins

BIRNBACH CO., INC., 177 Hanse Ave., Freeport, N.Y., 11520, Tel: 516-223-8400; Empl.: 20

Products manufactured: Braid, Cable, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cable, Circuit Breakers, Clamps & Clips, Connectors, Cords, Couplings, Fasteners, Insulators & Insulation, Jack Adapters (All Types), Jacks (All Types), Leads, Test & Adaptors, Pads, Transistor Mounting, Panels, Plug Adapters, Plug & Jack Sets, Plugs, Pointers, Dial, Posts, Probes, Retainers, Socket Adapters, Spacers, Splices, wire (Including, Butt & Cap Types), Switches, Terminal Blocks, Boards & Strips, Terminals, Transistor, Diode, Thyristor Heat Dissipators, Tubing, Wire

Local Sales Offices & Reps.

Fla	No. Miami, L. Haas Co.	305-949-9143

BISHOP GRAPHICS, 20450 Plummer St., Chatsworth, Cal., 91311, Tel: 213-993-1000, Telex: 66-2400; Empl.: 70; Minimum order: $15

Customer service: D. Belanger

Free literature available: Bishop Technical Manual and General Catalog – over 84 pages packed with hundreds of time and money-saving tips, plus full details on over 15,000 printed circuit symbols and tapes, light tables, drafting film and vellum.

Products manufactured: Benches, Consoles, Stools, Tables, Boards, Printed Circuit, Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Kits, Printed Circuit, Labels, Pressure-Sensitive, Adhesive, Lenses, Optical & Camera, Tapes, Films & Foils, Pressure Sensitive

Local Sales Offices & Reps.

Cal	Irvine, Bishop Graphics Drafting Supply Center	714-979-8952, 213-628-6161
Cal	Sunnyvale, Bishop Graphics Drafting Supply Center	408-732-9010

BIVAR, INC., 1617 E. Edinger Ave., Santa Ana, Cal., 92705, Tel: 714-547-5832; Empl.: 7 .... p. 2•1259,1266

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Capacitor, Hardware, Fasteners, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Holder & Carriers, Holders, Circuit Board (Production Type), Integrated Circuit Packaging Systems, Pads, Transistor Mounting, Pullers, Racks, Resistor, Hardware, Socket Adapters, Sockets, Spacers, Tubing

Local Sales Offices & Reps.

Ariz	Scottsdale, Jack Osborn	602-838-9358
Cal	San Diego, Qualtronics Co.	714-560-8955
Cal	Santa Clara, L.A. Woods	408-984-7444
Colo	Denver, W.J. Purdy Co.	303-777-1411
Fla	Winter Park, Young & Lawrence	305-647-6929
Ill	Chicago, Kennedy Engrg.	312-631-8283
Iowa	Marion, Thomas & Modrcin	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin	913-432-2131
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Detroit, Heick & Ralph Assocs.	313-538-3350
Minn	Minneapolis, Thurston Assocs.	612-929-7801
Mo	Hazelwood, Thomas & Modrcin	314-895-4700
NY	Conklin, Comerota Assocs.	607-775-4442
NY	Jericho, HRC Comp-Tech	516-832-5550
Ohio	Cincinnati, Tri-State Mktg.	513-761-7993
Pa	Elkins Park, K.B. Erdman Co.	215-224-1833
Tex	Dallas, Elcom Co.	214-352-5006
Wash	Seattle, Blum & Assocs.	206-285-2590
EXP:	Resea, Cal., Dynatronics International	213-881-8700

BLACK & WEBSTER, INC., 281 Winter St., Waltham, Mass., 02154, Tel: 617-890-9100, TWX: 710-324-1959; Empl.: 60

Customer service: J. Barber

Free literature available: Literature describes electric press type machines for small parts assembly-staking, marking, riveting, swaging, terminal setting, etc. Safety devices for punch presses also presented.

Products manufactured: Machines/Machinery, Production, Tools

BLACKHAWK NETWORKS CORP., 14 N. Parker Dr., Janesville, Wisc., 53545, Tel: 608-752-8701; FSC No: 12724; Empl.: 10

Products manufactured: Filters

Local Sales Offices & Reps.

Ill	Chicago, E. Schmeichel Co.	312-524-0307

BLH ELCTRNS., INC., 42 Fourth Ave., Waltham, Mass., 02154, Tel: 617-890-6700, TWX: 710-324-0683; FSC No: 03089; Empl.: 400; Minimum order: $25

For info on price: J. Enman, Ext. 207; Application info: G. Welch, Ext. 388; Customer service: E. Studlien, Ext. 375; Delivery info: Order Services, Ext. 207

Free literature available: General Catalog – 001 – Description and specifications of all BLH Products; including strain gauges and accessories; Load, Pressure, Torque Transducers; Instruments and Systems for stress analysis, process control, Scientific and Test, and Calibration.

Products manufactured: Amplifiers, Bridges, Cells, Load, Gages, Indicators, Recorders, Services, Assembly, Production & Test, Signal Conditioners & Equipment, Testers, Thermocouples, Elements & Accessories, Thermometers, Resistance, Transducers

BLILEY ELECTRIC CO., 2545 W. Grandview Blvd., Erie, Pa., 16512, Tel: 814-838-3571, TWX: 510-696-6886; FSC No: 71034; QPL No: 3098; Empl.: 230; Minimum order: $50 .... p. 1•282,283

For info on price: H. A. Yocum; Application info: F. C. Swartz; Customer service: R. L. Samick; Delivery info: H. A. Yocum

Free literature available: Literature describes our complete product line which includes Quartz Crystals and Related Frequency Control Devices for use in electric equipment as required by various segments (Military and Commercial) of the Electronic Industry.

Products manufactured: Crystal Blanks, Crystals, Delay Lines, Filters, Holders, Crystal, Memory Systems, Mounts, Oscillators, Ovens

Local Sales Offices & Reps.

Cal	Los Angeles, Elsner-Rambo Co.	213-664-2928
Conn	Meriden, P.R. Sturgeon Co., Inc.	203-237-1112
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Elmont, F. Edwin Schmitt Co.	516-437-8150
NC	Raleigh, R.W. Mitscher Co.	919-828-0575
Ore	Portland, C.K. Shanks & Assocs.	503-292-5656
Tenn	Shelbyville, R.W. Mitscher Co.	615-684-4544
Tex	Grand Prairie, Howell Sls., Inc.	214-262-5153
Va	Troutville, R.W. Mitscher Co.	804-484-4932
Va	Virginia Beach, R.W. Mitscher Co.	804-481-7200
Wash	Seattle, C.K. Shanks & Assocs.	206-632-4290
EXP:	Plainview, Telesco Int'l. Corp.	516-433-6210
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

BLONDER-TONGUE LABS., INC., One Jake Brown Rd., Old Bridge, N.J., 08857, Tel: 201-679-4010; Empl.: 450

For info on price: S. Stone; Application info: R. St. Louis; Customer service: S. Stone; Delivery info: S. Stone

Free literature available: Distributor products catalog MATU professional products catalog

Products manufactured: Amplifiers, Antenna Rotators, Antennas, Attenuators, Boxes, Junction, Outlets & Wall Plates, Bridges, Cabinets & Accessories, Cable, CATV Systems & Equipment, Connector Adapters, Connectors, Converters, Couplers, Detectors, Filters, Generators, Insertion Loss Measurement Systems, Jack Adapters (All Types), Meters, Modulators, All Kinds, Plugs, Power Supplies, Splicers, Coaxial Cable, Switches, Television Systems & Equipment Closed-Circuit, Terminals, Test Equipment, Tools, Transformers

Local Sales Offices & Reps.

Alas	Anchorage, H. J. Lang & Assocs	907-279-5741
Ariz	Phoenix, Toward Engrg Assoc.	602-955-3193
Cal	Los Angeles, Southern: E. N. Strassner Co.	213-666-1511
Cal	Redwood City, Northern: Sinai-Johnson	415-365-6263
Colo	Denver, R. Bolwen Assocs.	303-744-2501
Fla	Port Charlotte, W. F. Hemminger Co.	813-625-6050
Haw	Honolulu, G. Piety Factors	808-841-0195
Ill	Oak Park, G. Petitt Co.	312-261-0342
Ind	Fort Wayne, N. Hoemig Sls Co.	219-747-0826
La	New Orleans, Texport Co.	504-486-6073
Mass	North Scituate, W. A. Handrickson Co.	617-545-0652
Mich	Brighten, Lectro Sls Co.	313-632-7941
Minn	Edina, M. Folster Co.	612-835-2252
Mo	Kansas City, Forristal-Young Sls Co.	816-358-6771
Mo	St. Louis, Forristal-Young Sls Co.	314-645-2380
NM	Albuquerque, C. T. Carlberg & Assocs	505-265-1579
NY	Phelps, LSM Assocs Orchard Park	315-548-4891
NY	Tuckahoe, L-C-A Sls	914-961-4700
NC	Greensboro, Adams & Assocs.	919-272-6838
Ohio	Columbus, Weller Elctrn Sls	614-885-7819
Tenn	Memphis, Texport Co.	901-683-0880
Tex	Dallas, Texport Co.	214-358-3435
Tex	Houston, Spivey-LeBoeuf Assocs.	713-649-1221
Tex	Richardson, Spivey-LeBoeuf Assocs.	214-231-3190
Utah	Salt Lake City, R. Bowen Assocs.	801-299-3920
Wash	Seattle, Pacnor Mktg	206-284-8020
EXP:	Plainview, N.Y., Morhan Exporting Corp.	516-293-5582
FOR:	Can., London, Ont., Telequipment, Ltd.	519-439-8871

BLUE M ELECTRIC CO., 138th & Chatham St., Blue Island, Ill., 60406, Tel: 312-385-9000, TWX: 910-689-3398; Empl.: 250 .... p. 1•468,469

For info on price: H. Mathews; Application info: W. Tranbarger; Customer service: A. Anleitner; Delivery info: H. Mathews

Free literature available: Catalog E-176-192 picturing and describing company's lines of environmental chambers, ovens furnaces and baths, includes complete specifications and performance data.

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Controls/Control Eqpt., Furnaces, Heaters & Heating Elements, Ovens, Programmers, Refrigerators, Environmental Test, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Blue M Engrg.	602-947-7026
Cal	El Monte, Blue M Engrg.	213-442-6672
Cal	Sunnyvale, Blue M Engrg.	408-734-8734
Ga	Atlanta, Blue M Engrg.	404-237-7644
Mass	Framingham, Blue M Engrg.	617-235-8320

Mich	Allen Park, Blue M Engrg.	313-381-2123
NY	Elmsford, Blue M Equip. Co.	914-592-3883
Ohio	Cincinnati, Blue M Engrg.	513-821-6278
Pa	Ardmore, Blue M Engrg.	215-649-1448
Tex	Garland, Blue M Engrg.	214-272-2509

BLUM, JULIUS & CO., INC., Box 292, Carlstadt, N.J., 07072, Tel: 201-438-4600, TWX: 710-989-0112; Minimum order: $25

Products manufactured: Tubing

BODINE ELECTRIC CO., 2500 W. Bradley Pl., Chicago, Ill., 60618, Tel: 312-IR8-3515, Telex: 25-3646; Empl.: 800; Minimum order: $400 .... p. 1•938

Customer service: M. L. Lindsten

Free literature available: Catalogs: Overy 340 stocked motors, gearmotors, and SCR speed/torgue controls. 1/2000 thru 1/4 HP. torques .3 Oz-in. thru 342 L6-in. Catalog CDC: Adjustable speed/torque drive systems. Chassis and encased controls for bodine shunt wound and permanent magnet D-C motors and gearmotors

Products manufactured: Controls/Control Eqpt., Motors

Local Sales Offices & Reps.

Cal	Los Angeles, C.E. Mello	213-626-9159
Cal	Saratoga, E.W. Duemmlein	408-257-0900
Mass	Andover, L.R. Cascino	617-470-0050
Mich	Grosse Ile, P.S. Miller	313-386-0900
Minn	Minneapolis, E.R. Kaye	612-588-2821
Mo	Kansas City, Automation Specialties	816-421-6646
NY	Buffalo, H. Cardoza	716-834-3377
NY	East Syracuse, R.H. Nichols	315-437-2813
NY	Massapequa, D.V. Mayorga	516-541-1611
NY	Rochester, J.F. Serr	716-586-6226
Ohio	Chagrin Falls, D.E. DeWolf	216-543-1591
Ore	Portland, D.E. Johnson	503-246-3131
Tex	Dallas, General Power Equip.	214-368-4655
Tex	Houston, General Power Equip.	713-524-1895
EXP:	Ill., Export Dept., Bodine Elec.	312-478-3515

Local Distributors

Ala	Mobile, Brownell Electro, Inc., 3450 Armour Dr.	205-479-5405
Cal	Antioch, King Bearing, Inc., 109 "I" St.	415-757-4680
Cal	Fremont, King Bearing, Inc., 37237 Maple St.	415-797-8552
Cal	Fresno, King Bearing, Inc., 2452 S. East Ave.	209-485-7660
Cal	Los Angeles, Andrews Hardware, 1610 W. 7th St. at Union	213-HU3-8110
Cal	Los Angeles, Minarik Electric Co., 224 East Third St.	213-MA4-3161
Cal	Merced, King Bearing, Inc., 847 W. 17th St.	209-722-6218
Cal	Modesto, King Bearing, Inc., 2053 Yosemite Blvd.	209-529-2880
Cal	Mountain View, King Bearing, Inc., 2133 (A) Leghorn St.	415-968-8316
Cal	Oakland, King Bearing, Inc., 541 Julie Ann Way	415-568-6690
Cal	Sacramento, King Bearing, Inc., 2779 Del Monte St.	916-372-0790
Cal	San Jose, King Bearing, Inc., 1008 S. 2nd St.	408-294-3363
Cal	San Leandro, Republic Supply Co., 2025 Pike Ave.	415-EL7-2211
Cal	Stockton, King Bearing, Inc., 1350 E. Scotts Ave.	209-464-7661
Cal	Tulare, King Bearing, Inc., 360 S. M St.	209-686-4738
Colo	Denver, Wazee Electric Co., 2020 W. Barberry Pl.	303-892-7003
Fla	Orlando, Brownell Electro, Inc., 307 27th St.	305-843-6770
Ga	Hapeville, Brownell Electro, Inc., 3020 Commerce Way	404-762-5181
Ill	Chicago, Excel Electric Service Co., 2113 S. Western Ave.	312-VI7-7220
Ill	Chicago, Samuel Harris & Co., 114 N. Clinton St.	312-FR2-7272
Ill	Rockford, Samuel Harris & Co., 2526 20th St.	815-398-0606
Ill	St. Charles, Samuel Harris & Co., 315 Industrial Dr.	312-584-5000
Ill	Waukegan, Samuel Harris & Co., 1720 Grand Ave.	312-ON2-0372
La	Baton Rouge, Louisiana Bearings, Inc., 2864 Weller Ave.	504-357-0622
La	Lake Charles, Behring's Bearing Svc., 1233 3rd St.	318-HE9-9001
Mass	Medford, Empire Electrical Co., 54 Mystic Ave.	617-395-5000
Mass	Somerville, Electro Sls Co., 100 Fellsway West	617-666-0500
Mich	Detroit, Howard Electric Co., 4801 Bellevue Ave.	313-WA3-0430
Minn	Minneapolis, Boustead Electric & Mfg., 7135 Madison Ave. W.	612-544-9131
Mo	Kansas City, Kronfield-Thorp Elec., 2700 McGee Trafficway	816-BA1-4000
Mo	St. Louis, Zeller Electric, Inc., 4250 Hoffmeister Ave.	314-638-9641
NJ	Cherry Hill, Motor & Control Sys. Div. of Jos. T. Fewkes & Co., 6 Springdale Road	609-424-5810
NJ	Edison, B & B Motor & Control, 146 U.S. Highway #1	201-420-1466
NY	Bingamton, Diehl Binghamton, Inc., 5 Lewis St.	607-772-1760
NY	East Syracuse, Diehl Syracuse, Inc., 4413 James St.	315-437-2826
NY	N. Y., B & B Motor & Control, 96 Spring St.	212-WO6-5777
NY	Rochester, B & B Motor & Control Corp. of Rochester, 3259 Winton Rd. So.	716-473-6640
NC	Charlotte, Mize Company, Inc., 513 W. 24th St.	704-ED3-0356
Ohio	Cleveland, Reserve Electric Co., 2090 E. 19th St.	216-PR1-5764
Ohio	Dayton, Thal Mor Assocs. Inc., 3232 Encrete La.	513-298-9939
Okla	Oklahoma City, Dagwell Dixie Co., 816 W. Main St.	405-232-7671
Okla	Tulsa, Dagwell Dixie Co., 39 N. Lewis St.	918-932-4231
Ore	Portland, Star Machinery Co., 3461 N.W. Yeon Ave.	503-226-3011
Pa	Pittsburgh, Braunlich-Roessle Co., 3117-3127 Penn Ave.	412-471-6995
Tenn	Memphis, Brownell Electro Inc., 3053 Tranquillity Dr.	901-332-9254
Tenn	Nashville, Tennessee Machinery Co., 1133 Polk Ave.	615-242-1742
Tex	Baytown, Behring's Bearing Svc., 3307 Market St.	713-583-1911
Tex	Beaumont, Behring's Incorporated, 2980 Milam St.	713-TE3-8675
Tex	Dallas, Bearing Chain & Supply, 1630 Prudential Dr.	214-ME1-8310
Tex	Fort Worth, Bearing Chain & Supply, 217 N. Beach St.	817-TE8-6701
Tex	Houston, Behring's Bearing Svc., 1417 Clay At LaBranch	713-CA4-1743
Tex	La Marque, Behring's Bearing Svc., 916 Highway 1765	713-WE8-8156
Tex	Port Arthur, Behring's Incorporated, 1749 7th St.	713-YU5-9333
Tex	Tyler, Bearing Chain & Supply, 2500 W. N.W. Loop 323	214-LY2-0873
Va	Richmond, Industrial Supply Corp., 1905 Westwood Ave.	804-EL5-8041
Wash	Seattle, Industrial Electric, 1938 Fairview Ave., E.	206-EA9-3900
Wisc	Milwaukee, Trester Service Elec., 3225 N. Pierce St.	414-264-8170
Wisc	New Berlin, Electric Sls. & Engrg., 16150 W. Rogers Dr.	414-782-2400
For:	Can., Brantford, ON, Renold Canada Ltd., Park Road No.	519-756-6118
For:	Can., Edmonton, AB, Renold Canada Ltd., 12253-75th St.	403-474-2431
For:	Can., Hampton, NB, Renold Canada Ltd., P.O. Box 180	506-832-5324
For:	Can., London, ON, Renold Canada Ltd., 28 Firestone Blvd.	519-453-3420
For:	Can., Montreal, PQ, Renold Canada Ltd., 2333 Masson St.	514-527-8701
For:	Can., Quebec City, PQ, Renold Canada Ltd., 210 Rue Lee	418-522-2011
For:	Can., Rexdale, ON, Renold Canada Ltd., 110 Skyway Ave.	416-741-5732
For:	Can., Vancouver, BC, Renold Canada Ltd., 1290 Odlum Dr.	604-255-8455
For:	Can., Winnipeg, MB, Renold Canada Ltd., 1302 Notre Dame Ave.	204-772-9541

BODINE CO., 236 Mt. Pleasant Rd., Collierville, Tenn., 38017, Tel: 901-853-7211; Empl.: 30

For info on price: D. Crippen; Application info: R. H. Bodine, Jr.; Customer service: D. Crippen; Delivery info: D. Crippen

Products manufactured: Lighting Equipment, Emergency

Local Sales Offices & Reps.

Cal	Los Angeles, E. S. Condon Co.	213-728-7926
Cal	San Francisco, Drath-Jacobs	415-467-5642
Colo	Denver, Repco-Electro Sls.	303-232-3070
Fla	Orlando, Hartman & Assocs.	305-894-4151
Ga	Atlanta, J. J. Perry, Jr.	404-237-8239
Haw	Honolulu, Pacific Electrical Sls. Agency	808-536-5145
Ill	Chicago, Electri-Agency	312-439-5030
Ind	Indianapolis, C. M. Buck & Assocs.	317-251-1281
Ky	Louisville, Winn-Beck Agency	502-426-1126
La	New Orleans, General Manufacturers Agents	504-861-3855
Md	Baltimore, A. Daniels	301-752-0982
Mich	Detroit, KVA Assocs.	313-892-6000
Minn	Minneapolis, Frven & Vedders Sls.	612-822-1642
Miss	Jackson, A. Spencer	601-373-5552
Mo	Kansas City, B. Andrews Co.	816-931-7195
Mo	St. Louis, Consolidated Agencies, Inc.	314-721-1213
NJ	Somerville, D. Caughlan & Assocs.	201-725-5623
NY	Baldwinsville, R. A. Blann	315-635-6231
NY	New York, Mark Sls. Agency	516-221-2995
NC	Charlotte, C. Alley Assocs.	704-523-1532
Ohio	Cleveland, Verne LaSalle	216-241-3788
Okla	Tulsa, Tri-States Sls. Co.	918-836-5342
Pa	Pittsburgh, W. G. Cashdollar Assoc.	412-731-7915
Tenn	Nashville, Factory Sls. Agency	615-327-9051
Tex	Dallas, Lammers-Galvin	214-369-1271
Tex	Houston, Lighting & Electrical Sls.	713-923-7781
Tex	San Antonio, Hyltin-Ayres	512-828-0624
Wisc	Milwaukee, Electric Materials of Wisc.	414-383-0350

BOGEN DIV., Lear Siegler, Inc., Box 500, Paramus, N.J., 07652, Tel: 201-343-5700, TWX: 710-990-5047; Empl.: 332

Free literature available: Six brochures describe Bogen's lines of public address intercoms, telephone-intercoms, school sound consoles, selective radio pocket paging, and pocket paging with voice.

Products manufactured: Amplifiers, Baffles, Speaker, Cases, Equipment, Instrument, Meter, Comm. Systems, Encoders, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Public Address Systems, Receivers, Speaker Systems, Speakers, Transformers, Transmitters, Tuners

Local Sales Offices & Reps.

Ala	Mobile, Hollingsworth & Still	205-478-8108
Ariz	Scottsdale, Marshank Sls. Co.	602-949-9443
Cal	Culver City, Marshank Sls. Co.	213-559-2591
Cal	Redwood City, Sinai-Johnson	415-365-6263
Cal	Sacramento, Sinai-Johnson	916-428-4666
Colo	Denver, Ron Bowen & Assocs.	303-744-2501
Fla	Umatilla, Hollingsworth & Still	904-669-4738
Ga	Atlanta, Hollingsworth & Still Inc.	404-394-3270
Haw	Honolulu, Nylen Brothers	808-538-1171
Ill	Chicago, R. R. Hutmacher Assocs.	312-631-3248
Ind	Indianapolis, Kingston-Sharkey & Assocs.	317-353-9408
La	New Orleans, The Texport Co.	504-486-6073
Md	Baltimore, D. H. Brothers Co.	301-764-7189
Mass	Wellesley Hills, M. Scott Co.	617-235-0102
Mich	Buchanan, Riley & Petchell, Inc.	616-695-6356
Mich	Detroit, Riley & Petchell, Inc.	313-535-7000
Minn	St. Paul, Skor	612-645-6461
Mo	Kansas City, Forristal-Young Sls. Co.	816-358-6771
Mo	St. Louis, Forristal-Young Sls. Co.	314-645-2360
Neb	Omaha, Forristal-Young Sls. Co.	402-333-0800
NJ	Ridgefield, Bi-State Marketers Inc.	201-943-5888
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Buffalo, Waxman-Currant Sls. Co.	716-873-0442
NC	Charlotte, Hollingsworth & Still Inc.	704-536-7047
Ohio	Cincinnati, McFadden Sls. Co.	513-825-1224
Ohio	Columbus, McFadden Sls. Co.	614-221-3363
Ohio	N. Olmstead, Avcom, Inc.	216-777-2060
Okla	Tulsa, The Texport Co.	918-939-1727
Ore	Salem, Pacnor Mktg.	503-363-6445
Pa	Laverock, M. Weinberg Assocs.	215-885-1918
Pa	Pittsburgh, F. P. Yarussi Co.	412-221-4676
Tenn	Memphis, The Texport Co.	901-683-0880
Tex	Austin, Texport Co.	512-928-0096
Tex	Houston, The Texport Co.	713-464-2828
Tex	Richardson, Texport Co.	214-238-7117
Utah	Salt Lake City, R. Bowen & Assocs.	801-363-6801
Wash	Seattle, Pacnor Mktg.	206-284-8020
EXP:	New York, N.Y., Genex Corp.	212-524-2557

BOKER'S, INC., 3106 Snelling Ave. S, Minneapolis, Minn., 55048

BOONTON ELECTRONICS CORP., Route #287, Parsippany, N.J., 07054, Tel: 201-887-5110, TWX: 710-986-8241; FSC No: 6625; Empl.: 150; Minimum order: $15 .... p. 1•620-625

For info on price: P. Farnsworth Ext. 178; Application info: L. Pokorny Ext. 174; Customer service: P. Farnsworth Ext. 178; Delivery info: P. Farnsworth Ext. 178

Products manufactured: Bridges, Generators, Meters, Semiconductor Wafer Fabrication, Test Systems

Local Sales Offices & Reps.

Ala	Huntsville, J.L. Highsmith, Inc.	205-881-3294
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	North Hollywood, O'Halloran Assoc.	213-877-0173
Cal	Palo Alto, O'Halloran Assoc.	415-326-1493
Cal	San Diego, O'Halloran Assoc.	714-224-2824
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Hamden, Scientific Devices, Conn.	203-248-9361
Fla	Orlando, J.L. Highsmith, Inc.	305-293-5202
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
Kans	Olathe, B. Rush Assoc.	913-782-1177
Md	Silver Spring, Sel-Tronics, Inc.	301-589-3391
Mass	Burlington, R.G. Sickles Assoc.	617-272-7285
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
NJ	Palisades Park, Scientific Devices East	201-945-3962
NM	Albuquerque, Zeus Inc.	505-268-3941
NY	Rochester, Scientific Devices	716-334-2445
NC	Charlotte, J.L. Highsmith	704-333-7743
Ohio	Centerville, Micro Sales Corporation	513-433-8171
Pa	Melrose Park, R. Meyers Assoc.	215-224-1663
Tex	Dallas, Airep Elctrns. Inc.	214-827-2120
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Wash	Bellevue, Scientific Devices Northwest	206-454-0900

BORG-WARNER INGERSOLL PRODS., See Ingersoll Prods Div. Borg-Warner

BORG-WARNER THERMOELECTRICS, Dept. Borg-Warner, Wolf & Algonquin Rds., Des Plaines, Ill., 60018, Tel: 312-827-3131; Empl.: 240 .... p. 1•488-491

Products manufactured: Cooling/Heating Modules, Thermoelectric, Heat Exchangers & Systems

Local Sales Offices & Reps.

EXP:	Franklin Park, Ill., Borg-Warner Aerospace Prods. International	312-455-3120

BOSTITCH, Div. of Textron, Inc., Briggs Dr., E. Greenwich, R.I., 02818, Tel: 401-TU 4-2500; Empl.: 2500

Free literature available: Staplers, nailers and fastening systems for industrial and commercial users are described in a 16-page, illustrated BOSTITCH brochure. Specific applications for each tool and system, including Auto-Nailer fastening systems and the BOSS line of forced entry fastening tools are outlined.

Products manufactured: Fasteners, Machines/Machinery, Production

Local Sales Offices & Reps.

Cal	Los Angeles	213-724-0440
Cal	San Francisco	415-648-7200
Ga	Atlanta	404-458-2324
Ill	Northbrook	312-498-6550
Ind	Indianapolis	317-353-2171
Mass	Winchester	617-729-6400
Mich	Farmington	313-477-1200
Mo	Md. Hts.	314-567-6120
NJ	Carlstadt	201-933-8660
NC	Charlotte	704-376-4402
Ohio	Middleburg Heights	216-826-0500
Pa	Montgomeryville	215-643-6200
Tenn	Memphis	901-365-7200
Tex	Dallas	214-631-7580
Wash	Seattle	206-283-6300

BOSTON INSULATED WIRE & CABLE CO., 65 Bay St., Dorchester, Mass., 02125, Tel: 617-265-2102, Telex: 94-0604; FSC No: 71102; Empl.: 200

For info on price: R. Janeway; Customer service: A. Sutkis; Delivery info: R. Janeway

Products manufactured: Cable Assemblies & Harnesses, Cable, Connector Adapters, Connectors, Cords, Wire

Local Sales Offices & Reps.

Cal	Bell, Engr. Ind'l. Prod.	213-588-9161
Cal	Los Angeles, Bos. Ins. W & C Elec. Access. Div.	213-532-9064
Cal	Mill Valley, H.B. Burley III	415-388-2104
Colo	Denver, P. A. Douden Co.	303-744-1497
Conn	Southbury, A. Coscina	617-265-2102
Ga	Atlanta, Hardcastle & Rhyne	404-261-4540
Ga	Tallapoosa, W. Bridges	404-574-2060
Ill	Chicago, Brisky Assocs.	312-597-7890
Ill	Hinsdale, T. Russell	312-641-1045
Kans	Shawnee Mission, Lowell-Kangas & Assocs., Inc.	913-631-3515
La	New Orleans, Case Sls. Co.	504-835-7713
La	New Orleans, Mid-South Sls. Co.	502-822-3030
Md	Columbia, W. Hill	301-752-3558
Mass	North Attleboro, W. Conroy	617-265-2102
Mich	Royal Oak, M. McAuliffe Sls.	313-545-7177
Minn	Minneapolis, C. E. Bohlig Co.	612-922-7011
Mo	St. Louis, Lowell-Kangas & Assocs., Inc.	314-821-4050
NJ	Cherry Hill, J. Schindell Assocs.	609-424-1441
NM	Albuquerque, Sealect Technology, Inc.	505-299-1137
NY	Pittsford, NoCo, Inc.	716-461-4750
NC	Charlotte, Power Engrg. Co.	705-537-8099
Ohio	Chagrin Falls, F. Gunther	216-247-5823
Pa	Ambridge, R. R. Meinert Co.	412-931-6627
Tenn	Knoxville, Engr. Prod. Co.	615-588-3312
Tenn	Memphis, Engr. Prods. Co.	901-327-6622
Tex	Houston, C. A. Richards & Assocs.	713-522-7987
Wash	Seattle, Datacom Assocs.	206-285-2525
FOR:	Can., Hamilton, Ont., Boston Insulated Wire & Cable Co., Ltd.	416-529-7151
FOR:	Can., Montreal 2, Quebec, Boston Insulated Wire & Cable Co., Ltd.	514-866-7151

BOURNS, INC., Instr. Div., 6135 Magnolia, Riverside, Calif., 92506, Tel: 714-684-1700, TWX: 910-332-6103; Empl.: 250

Customer service: J. Pancake

Products manufactured: Accelerometers, Gages, Potentiometers, Resistors, Switches, Transducers, Transformers

Local Sales Offices & Reps.

Aerospace

Ala	Huntsville, Kemp Instrs., Inc.	205-837-4304
Cal	Hayward, Avionics Liaison, Inc.	415-783-1131
Cal	San Diego, L.L. Stoakes Inc.	714-274-6281
Colo	Arvada, Cleveland Entprs.	303-423-3707
Fla	Orlando, Truex Assocs., Inc.	305-859-2160
Iowa	Cedar Rapids, Tech. Reps., Inc.	319-363-2489
Md	Gaithersburg, Wright Co.	301-948-5151
Mass	Natick, Andruss-Peskin Corp.	617-653-3919
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Peirce Inc.	616-349-9666
Minn	Minneapolis, Furber Sls. Co.	612-861-1518
Mo	Hazelwood, Tech. Reps., Inc.	314-731-5200
Mo	Independence, Technical Representatives	816-737-1414
NM	Albuquerque, Cleveland Entprs.	505-345-2481
NY	Fayetteville, H. C. Johnson Agency, Inc.	315-637-9383
NY	Guilderland, H.C. Johnson Agency, Inc.	518-456-9681
NY	Melville, Astrorep, Inc.	516-423-2266
NY	Rochester, H. C. Johnson Agency, Inc.	716-482-3000
NY	Williamsville, H. C. Johnson Agency, Inc.	716-632-7880
Ohio	Cleveland, Carter McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter McCormic & Peirce	513-278-5873
Ohio	Worthington, Carter McCormic & Peirce	614-888-4466
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Pa	Glenshaw, H. C. Johnson Agency, Inc.	412-961-0414
Pa	Jenkintown, PDC Corp.	215-887-9610
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431

Industrial

Ala	Huntsville, Kemp Instrs., Inc.	205-837-4304
Cal	Foster City, Featherstone Assocs.	415-341-1617
Cal	San Diego, L.L. Stoakes Inc.	714-274-6281
Colo	Arvada, Cleveland Entprs.	303-423-3707
Fla	Orlando, Milne Assocs.	305-855-1533
Ill	Schaumburg, Carvel Engrg.	312-882-6088
La	Harvey, Bourns, Inc.	504-362-2043
Md	Gaithersburg, Wright Co.	301-948-5151
Mass	Natick, Andruss-Peskin Corp.	617-653-3919
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Peirce Inc.	616-349-9666
Mo	Hazelwood, Tech. Reps., Inc.	314-731-5200
Mo	Independence, Technical Representatives	816-737-1414
NJ	Stirling, NBS Assocs.	201-464-8500
NM	Albuquerque, Cleveland Entprs.	505-298-7671
NY	Fayetteville, H. C. Johnson Agency, Inc.	315-637-9383
NY	Guilderland, H.C. Johnson Agency, Inc.	518-456-9681
NY	Rochester, H. C. Johnson Agency, Inc.	716-482-3000
NY	Williamsville, H. C. Johnson Agency, Inc.	716-632-7880
Ohio	Cleveland, Carter McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter McCormic & Peirce	513-278-5873
Ohio	Worthington, Carter McCormic & Peirce	614-888-4466
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Ore	Portland, Brett Assocs., Inc.	503-232-4184
Pa	Glenshaw, H. C. Johnson Agency, Inc.	412-961-0414
Pa	Glenside, Elcom, Inc.	215-885-1325
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Wash	Seattle, Brett Assocs., Inc.	206-935-8054

BOURNS, INC., Trimpot Prods. Div., 1200 Columbia Ave., Riverside, Cal., 92507, Tel: 714-684-1700, TWX: 910-332-1252; Empl.: 4000 .... p. 2•1420,1623-1626

Customer service: Appl. Eng.

Free literature available: Short-Form Catalog - All Products, Panel Potentiomenter Brochure, Resistor Networks Brochure, Custom Precision Potentiometer Brochure, Trimpot Digest (Application Periodical)

Products manufactured: Dials, Networks, Potentiometers, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns.	205-881-5031
Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Long Beach, Bourns, Inc.	213-774-8000
Cal	Palo Alto, Quad Rep.	415-964-3532
Cal	San Leandro, Quad Rep.	415-352-5942
Colo	Denver, Parker Webster	303-770-1972
Fla	Clearwater, Dyne-A-Mark	813-441-4702
Fla	Ft. Lauderdale, Dyne-A-Mark	305-771-6501
Fla	Orlando, Dyne-A-Mark	305-299-6303
Ga	Atlanta, Beacon Elctrns. Assoc.	404-351-3654
Ill	Chicago, D. Dolin Sls.	312-286-6200
Ill	Southern, Centech	816-358-8100
Ind	Ft. Wayne, G&D Electrn. Sls.	219-432-5585
Md	Glen Burnie, Micro-Comp., Inc.	301-761-4600
Mass	Hingham, Bourns, Inc.	617-749-5800
Mich	Detroit, Rathsburg Assoc.	313-882-1717
Minn	Edina, Mel Foster Co., Inc.	612-835-2252
Mo	Hazelwood, Centech	314-731-4220
Mo	Raytown, Centech	816-358-8100
NJ	Haddonfield, Thomas Assoc.	609-854-3011
NM	Albuquerque, A.Q. Elctrns.	505-255-8701
NY	Ithaca, B. Dean, Inc.	607-272-2187
NY	Melville, Bourns, Inc.	516-271-3500
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg	216-659-3131
Ore	Portland, J.J. Backer Co.	503-297-3776
Ore	Salem, J.J. Backer Co.	503-362-0717
Pa	Enon Valley, Nebco Assocs.	216-457-2333
Pa	Philadelphia, Thomas Assoc.	215-627-6615
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Dallas, Allied Comps., Inc.	214-238-0408
Tex	El Paso, A.Q. Elctrns.	915-545-2363
Tex	Houston, Allied Components	713-691-3961
Wash	Seattle, J. J. Backer Co.	206-285-1300
FOR:	Can., Downsview, Ont., Kaytronics, Ltd.	416-638-5511
FOR:	Can., Montreal, Que., Kaytronics, Ltd.	514-487-3434
FOR:	Can., Vancouver, B.C., L.A. Varah, Ltd.	604-873-3211

Local Distributors

Ala	Huntsville, Cramer/E.W., 2310 Bob Wallace Ave., S.W.	205-539-5722
Ala	Huntsville, Hamilton/Avnet Elctrns., 805 Oster Dr., N.W.	205-533-1170
Ariz	Phoenix, Hamilton/Avnet, 2615 So. 21st St.	602-275-7851
Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	602-273-7331
Cal	Chatsworth, Westates Elctrns. Corp., 20151 Bahama St.	213-341-4411
Cal	Culver City, Hamilton Electro Sls., 10912 W. Washington Blvd.	213-558-2121
Cal	Irvine, Cramer/Los Angeles, 17201 Daimler St.	213-771-8300
Cal	Mountain View, Hamilton/Avnet, 575 E. Middlefield Rd.	415-961-7000
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	Riverside, Elctrn. Supp. Corp., 2486 Third St.	714-683-7300

Cal	San Diego, Cramer/San Diego, 8975 Complex Dr.	714-565-1881
Cal	San Diego, Hamilton/Avnet, 8917 Complex Dr.	714-279-2421
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar	408-739-3011
Colo	Denver, Cramer/Denver, 5465 E. Evans Pl.	303-758-2100
Colo	Denver, Hamilton/Avnet, 5921 N. Broadway	303-534-1212
Colo	Denver, Kierulff Elctrns., 10890 E. 47th Ave.	303-371-6500
Conn	Georgetown, Hamilton/Avnet, 643 Danbury Rd.	203-762-0361
Conn	Hamden, Wilshire Elctrns., 2554 State St.	203-281-1166
Conn	North Haven, Cramer Elctrns., 35 Dodge Ave.	203-239-5641
Conn	Norwalk, Harvey Elctrns., 112 Main St.	203-853-1515
Fla	Hollywood, Cramer/E.W., 4035 N. 29th Ave.	305-923-8181
Fla	Hollywood, Hamilton/Avnet, 4020 N. 29th Ave.	305-925-5401
Fla	Orlando, Cramer/E.W., 345 N. Graham Ave.	305-894-1511
Fla	Orlando, Hammond Elctrns., 911 W. Central Blvd.	305-849-6060
Ga	Atlanta, Cramer/E.W., 3923 Oakcliff Ind'l. Ct.	404-448-9050
Ga	Norcross, Hamilton/Avnet, 6700 1-85, Suite 2B	404-448-0800
Ill	Chicago, Newark Elctrns. Corp., 500 N. Pulaski Rd.	312-638-4411
Ill	Mt. Prospect, Cramer Elctrns., 1911 S. Busse Rd.	312-593-8230
Ill	Schiller Park, Hamilton/Avnet, 3901 N. 25th Ave.	312-678-6310
Ind	Fort Wayne, Fort Wayne Elctrns. Supply, 3606 Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns. Supp., 133 S. Pennsylvania St.	317-634-8486
Ind	Indianapolis, Pioneer/Indiana, 6408 Castleplace Dr.	317-849-7300
Kans	Lenexa, Hamilton/Avnet, 37 Lexena Ind'l. Ctr.	913-888-8900
La	Lafayette, Ralph's of Lafayette, 3004 Cameron	318-234-4507
Md	Gaithersburg, Cramer/E.W., 16021 Ind'l. Dr.	301-948-0110
Md	Gaithersburg, Pioneer/Washington Elctrns., 9100 Gaither Rd.	301-948-0710
Md	Hanover, Cramer/Baltimore, 7255 Standard Dr.	301-796-5790
Md	Hanover, Hamilton/Avnet, 7255 Standard Dr.	301-796-5000
Mass	Burlington, Hamilton/Avnet Elctrns., 185 Cambridge St.	617-273-2120
Mass	Burlington, Wilshire Elctrns./New England, One Wilshire Rd.	617-272-8200
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Livonia, Hamilton/Avnet, 12870 Farmington Rd.	313-522-4700
Mich	Livonia, Pioneer/Michigan, 13485 Stamford	313-525-1800
Minn	Edina, Cramer/Bonn Co., 7275 Bush Lake Rd.	612-835-7811
Minn	Edina, Hamilton/Avnet, 7683 Washington Ave. S.	612-941-3801
Minn	Minneapolis, Newark Elctrns., 336 Hoover St., N.E.	612-331-6350
Mo	Hazelwood, Hamilton/Avnet, 364 Brookes La.	314-731-1144
NJ	Cedar Grove, Hamilton/Avnet, 218 Little Falls Rd.	201-239-0800
NJ	Cinnaminson, Wilshire Elctrns., 855 Ind'l. Hwy., Unit 5	215-627-1920
NJ	Clifton, Wilshire Elctrns., 312 Clifton Ave.	201-365-2600
NJ	Moonachie, Cramer Elctrns., 1 Barrett Ave.	201-935-5600
NJ	Mount Laurel, Hamilton/Avnet, 113 Gaither Dr., E. Gate Ind'l. Pk.	609-234-2133
NJ	Somerset, Schweber Elctrns., 43 Belmont Dr.	201-469-6008
NM	Albuquerque, Cramer/New Mexico, 137 Vermont, N.E.	505-265-5767
NM	Albuquerque, Elctrn. Parts Co., 2620 Rhode Island, N.E.	505-293-6161
NM	Albuquerque, Hamilton/Avnet Elctrns., 2450 Baylor Dr., S.E.	505-765-1500
NY	Binghamton, Harvey Elctrns., Box 1208	607-748-8211
NY	Buffalo, Standard Elctrns., 3519 Union Rd.	716-685-4220
NY	E. Syracuse, Cramer/Eastern, 6716 Joy Rd.	315-437-6671
NY	E. Syracuse, Hamilton/Avnet, 6500 Joy Rd.	315-437-2641
NY	Endwell, Cramer/Binghamton, 3220 Watson Blvd.	607-754-6661
NY	Hauppauge, Cramer/Esco, 29 Oser Ave.	516-231-5600
NY	Rochester, Cramer, E.W., 3000 S. Winton Rd.	716-275-0300
NY	Rochester, Hamilton/Avnet Elctrns., 167 Clay Rd.	716-442-7820
NY	Westbury, Hamilton/Avnet, 70 State St.	516-333-5800
NY	Westbury, Schweber Elctrns., Jericho Tpke.	516-334-7474
NY	Woodbury, Harvey Elctrns., 60 Crossways Pk. W.	516-921-8700
NC	Winston-Salem, Cramer/E.W., 938 Burke St.	919-725-8711
Ohio	Cincinnati, Hughes-Peters, 4865 Duck Creek Rd.	513-351-2000
Ohio	Cleveland, Hamilton/Avnet Elctrns., 761 Beta Dr.	216-461-1400
Ohio	Cleveland, Pioneer Standard Elctrns., 4800 E. 131 St.	216-587-3600
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Hamilton/Avnet Elctrns., 118 Westpark Rd.	513-433-0610
Ohio	Dayton, Pioneer-Dayton, 1900 Troy St.	513-236-9900
Pa	Montgomery, Pyttronic Inds., Stump Rd.	215-643-2850
Pa	Pittsburgh, Cameradio Elctrns., 2801 Liberty Ave.	412-288-2600
Pa	Pittsburgh, Pioneer/Pittsburgh, 560 Alpha Dr.	412-782-2300
RI	Providence, Wm. Dandreta & Co., 28 Wolcott St.	401-861-2800
Tex	Dallas, Cramer Elctrns., 13740 Midway Rd.	214-350-1355
Tex	Dallas, Hamilton/Avnet, 4445 Sigma Rd.	214-661-8661
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Hamilton/Avnet, 1216 W. Clay St.	713-526-4661
Tex	Houston, Harrison Equip. Co., Box 3268, 1616 McGowen St.	713-224-9131
Utah	Salt Lake City, Cramer/Utah, 391 W. 2500 S.	801-487-4131
Utah	Salt Lake City, Hamilton/Avnet, 647 W. Billinis Rd.	801-262-8451
Wash	Bellevue, Hamilton/Avnet, 13407 Northrup Way	206-746-8750
Wash	Seattle, Cramer/Seattle, 5602 Sixth Ave. S.	206-762-5755
Wisc	Mequon, Taylor Elec. Co., 1000 W. Donges Bay Rd.	414-241-4321
Wisc	Oak Creek, Cramer/Wisconsin, 430 W. Rawson Ave.	414-764-1700
For:	Can., Downsview, Ont., Cramer Elctrns. Can., Ltd., 920 Alness St., Unit 9	416-661-9222
For:	Can., Mississauga, Ont., Hamilton/Avnet, 6291-19 Dorman Rd.	416-677-7432
For:	Can., Ottawa, Ont., Hamilton/Avnet, 880 Lady Ellen Pl.	613-725-3071
For:	Can., St. Laurent, Que., Hamilton/Avnet, 2670 Paulus	514-331-6443
For:	Can., Toronto 19, Ont., Zentronics Ltd., 185 Bridgeland Ave.	416-789-5111
For:	Can., Vancouver 10, B.C., L.A. Varah Ltd., 2077 Alberta St.	604-873-3211

BOURNS PACIFIC MAGNETIC CORP., Div. Bourns, Inc., Box 1398, Romoland, Cal., 92380, Tel: 714-657-5195, Telex: 67-6446; Empl.: 120; Minimum order: $35 .... p. 1•443; p. 2•381,1732,1733

For info on price: R.F. Miller; Application info: R.F. Miller; Customer service: L. Hall; Delivery info: L. Hall

Products manufactured: Chokes, Coils Including Assemblies & Forms, Delay Lines, Transducers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Twentieth Century Mktg., Inc.	205-772-9237
Ariz	Scottsdale, De Angelo, Rothman & Cheever, Inc.	602-948-2240
Cal	Encino, H. Stein	213-986-2016
Cal	Mountain View, Tri-Rep	415-965-1822
Fla	Oviedo, Conley Assocs., Inc.	305-365-3283
Ind	Southbend, Valentine-Schillinger & Assocs.	219-291-6258
Mass	Concord, Bourns Pacific Magnetic Corp.	617-369-6249
Mass	Reading, Kanan Assocs.	617-944-8484
Minn	Edina, M. Foster Co.	612-941-7600
NJ	Long Branch, Bourns Pacific Magnetics Corp.	201-229-5317
NM	Albuquerque, Tri-Tronix	505-265-0172
NY	Huntington Station, Addem 1	516-567-5900
NY	Syracuse, Electra Sls. Corp.	315-455-5783
Ohio	Richfield, N. Bear Mktg.	216-659-3131
Ore	Beaverton, Arneson Assocs.	503-643-5754
SC	Myrtle Beach, Candor Co., Inc.	803-448-5213
Tex	Dallas, Bourns Pacific Magnetics Corp.	214-272-1443
Wash	Seattle, Arneson Assocs.	206-762-7664

BOW SOLDER PRODUCTS, 25 Amsterdam St., Newark, N.J., 07105, Tel: 201-589-2266; Empl.: 25; Minimum order: $100

For info on price: J. Buccine; Customer service: S. Turkus; Delivery info: W. Walzer

Free literature available: Six page catalog showing various types of solders and fluxes available. Technical data and specifications are included.

Products manufactured: Flux, Brazing & Soldering Materials, Solder (All Types)

BOWMAN ELECTRICAL PRODS. CORP., 108 N. Jefferson St., Chicago, Ill., 60606, Tel: 312-372-8556; Empl.: 55

For info on price: J. Swimmer; Application info: S. Rubin; Customer service: M. Mindel; Delivery info: S. Sylan

Free literature available: Descriptive Literature of three models of permanent magnet synchroneous timing motors showing specifications including standard speeds from 1 RPM to 60 RPM.

Products manufactured: Motors

BOWMAR/ALI, INC., Sub. Bowmar Instr. Corp., 531 Main St., Acton, Mass., 01720, Tel: 617-263-8365, TWX: 710-347-1400; Empl.: 600

Customer service: Sls. Dept.

Products manufactured: Analyzers, Calculators, Electrical & Electronic, Clutches, Couplings, Drives & Drive Mechanisms (Dial), Equalizers, Filters, Generators, Limit Stops, Mechanical, Locks, Dial & Shaft, Meters, Telephone Channel Test & Simulator Equipment, Testers

BOWMAR INSTR. CORP., 8000 Bluffton Rd., Ft. Wayne, Ind., 46809, Tel: 219-747-3121, TWX: 810-332-1510; Empl.: 500; Minimum order: $100

For info on price: E. H. Koors X 326; Application info: Prod Mgr; Customer service: Cust Svc Mgr; Delivery info: Prod Mgr

Products manufactured: Actuators, Calculators, Electrical & Electronic, Computers, Controls/Control Eqpt., Counters, Display Devices/Displays, Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Keyboards, Alphanumeric & Decimal, Motors, Printers, Repeaters, Servo, Switches

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Phoenix, Sheffler-Kahn	602-258-7893
Cal	Chatsworth, Nippon Miniature Bearing Corp.	213-882-4478
Cal	Costa Mesa, Bowmar Instr. Corp.	714-979-7707
Cal	Dublin, Airsupply Co.	415-829-0870
Cal	Santa Monica, Airsupply Co.	213-871-0520
Colo	Denver, Sheffler-Kahn	303-623-1567
Conn	Suffield, T.P. Dunn Assocs.	203-668-0446
Fla	Clearwater, Saber Assoc.	813-441-1301
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Ga	Smyrna, Spartech, Inc.	404-432-3644
Ill	Park Ridge, Probe Elect.	312-696-2828
Ind	Fort Wayne, J & B Engrg. Sls. Co.	219-483-2813
Mass	Medway, Gallager Sls. Co.	617-533-7292
Mass	Waltham, Impact Sls. Co.	617-893-2850
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Mo	St. Charles, Bowmar Instr. Corp.	314-724-7335
NJ	Livingston, Graydon-Sherman, Inc.	201-994-9055
NJ	Matawan, Bowmar Instr. Corp.	201-526-0400
NY	Clinton, Airsupply Co.	315-735-8341
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Great Neck, ERA, Inc.	516-822-9890
NY	Pittsford, Graydon-Saerman	315-637-9861
Ohio	Dayton, Whelan Corp.	513-434-7551
Okla	Oklahoma City, Ammon & Rizos	405-373-2748
Tex	Dallas, Ammon & Rizos	214-233-5591
Tex	Houston, Ammon & Rizos	713-729-1233
Wash	Bellevue, Airsupply Co.	206-454-7922

BOWMAR/TIC, INC., 850 Lawrence Dr., Newbury Park, Calif., 91320, Tel: 805-498-2161, TWX: 910-336-1265; Empl.: 200

Customer service: D.W. Gustafson

Free literature available: General precision potentiometer catalog entitled "Upgrade Your System With Our Pots".

Products manufactured: Brakes, Clutches, Potentiometers, Switches, Timers, Transducers, Tubes

Local Sales Offices & Reps.

Cal	Van Nuys, Cardinal Assoc.	213-787-5511
Conn	Suffield, Terrance Dunn & Assoc.	203-668-0446
Ga	Smyrna, Spartech Assoc.	404-432-3644
Ill	Park Ridge, Probe Elctrns.	312-696-2828
Ind	Ft. Wayne, J & B Engrg. Sls.	219-483-2813
Mass	Medway, J. Gallagher Sls.	617-533-7292
Minn	Minnetonka, T.H. Ayre Assoc.	612-474-4125
NY	Buffalo, R.A. Murray Co.	716-632-6913
NY	Plainview, ERA	516-822-9890
Tex	Dallas, Brice Co.	214-233-9808

BRADY CO., W. H., 2221 W. Camden Rd., Milwaukee, Wis., 53201, Tel: 414-332-8100; Minimum order: $30

For info on price: J. Kaiser; Application info: K. Von Sleet; Customer service: J. Young

Products manufactured: Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Heat Guns, Production, Kits, Marking (Dial, Instrument, Equipment, etc.), Labels, Pressure-Sensitive, Adhesive, Machines/Machinery, Production, Nameplates, Switches, Tapes, Films & Foils, Pressure Sensitive, Testers, Tubing, Wire Markers

Local Sales Offices & Reps.

Cal	Redondo Beach	213-373-6869
Cal	San Francisco	415-574-5822
Cal	San Mateo	415-574-5822
Colo	Denver	303-455-6232
Conn	Hartford	203-247-1283
Fla	Tampa	404-636-5581
Ga	Atlanta	404-636-5581
Ill	Chicago	312-827-6108
Ind	Indianapolis	317-545-5500
Kans	Kansas City	816-363-4133
Mass	Waltham	617-893-8390
Mich	Birmingham	313-642-6643
Minn	Minneapolis	612-926-4666
Mo	St. Louis	314-535-3406
NJ	Maplewood	201-763-7274
NY	Huntington	516-433-6088
NY	Rochester	716-442-8857
NC	Charlotte	704-333-0928
Ohio	Chagrin Falls	216-382-5090
Pa	King of Prussia	215-337-1275
Pa	Pittsburgh	412-766-0555
Tenn	Memphis	901-452-2640
Tex	Dallas	214-363-3710
Wash	Medina	206-455-1177
Wisc	Milwaukee	414-332-8100

BRAILSFORD & CO., 670 Milton Rd., Rye, N.Y., 10580, Tel: 914-967-1820; Empl.: 20; Minimum order: $10

For info on price: R.E. Drummond; Application info: R.E. Drummond; Customer service: R.E. Drummond; Delivery info: D.G. Kelly

Free literature available: Brushless D.C. Miniature Axial Fans: Brushless D.C. Miniature Centrifugal Blowers; Brushless D.C. Miniature Diaphragm Pumps, Vacuum or Pressure; Sequence Timers, Low Current D.C., Governed & Nongoverned.

Products manufactured: Blowers & Fans & Accessories, Motors, Pumps, Vacuum, Timers

BRAM METALLURGICAL-CHEM. CO., 245 W. Chelten Ave., Phila., Pa., 19144, Tel: 215-GE 8-4900; Empl.: 2; Minimum order: $50

For info on price: H. H. Bram; Application info: T. G. Bram; Customer service: H. H. Bram; Delivery info: T. G. Bram

Free literature available: "High Purity Metals" card.

Products manufactured: Alloys, Bi-Metals, Thermostatic, Crystals, Foil, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Quartz, Fused, Services, Assembly, Production & Test, Silica, Fused, Tubing, Wire

BRAMCO CONTROLS DIV., Ledex, Inc., College & South Sts., Piqua, Ohio, 45356, Tel: 513-773-8271; Empl.: 75; Minimum order: $49

For info on price: J. Market; Application info: J. Market; Customer service: A. Burnett; Delivery info: A. Burnett

Free literature available: Catalog 240, Auto-Connect, Radio-Telephone Interconnect, *Catalog 260, Control Head, Mobile Radiotelephone Control Head, Catalog 505, Selective Call, Catalog 512, Identifier System, (ANI) Automatic Number I.D., Catalog 606, 4020, AM Tone Telemetry Sys., Catalog 650, Series 5500 Digital Telemetry Sys. Catalog 750 FSK System

Products manufactured: Alarms, Annunciators, Comm. Systems, Controls/Control Eqpt., Decoders, Detectors, Encoders, Filters, Generators, Monitors, Multiplexers, Oscillators, Receivers, Relays, Standards, Transmission Systems, Data, Transmitters, Transponders

Local Sales Offices & Reps.

Cal	Burbank, RTS Comms.	213-843-3111
Cal	Santa Clara, RTS Comms.	408-247-2310
Conn	Trumbull, SIR Assocs.	203-268-2560
Fla	Orlando, Data Rep. Inc.	305-843-5224
Ill	Arlington Hts., Reshal Assocs.	312-398-7660
Ill	La Grange Park, Bierhaus Sls., Inc.	312-354-5100
Kans	Shawnee Mission, Technical Sls. Assoc.	913-888-3330
Mass	Lexington, SIR Assocs.	617-862-1812
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-559-7373
Minn	Minnetonka, T.H. Ayre Assocs.	612-474-4125
NY	Liverpool, Lewis & Dunnigan Co.	315-622-2133
NY	Oceanside, Bittan Assocs.	516-678-6222
NC	Raleigh, A.B. Andrews & Co.	919-833-5565
Ohio	Dayton, Dynel Co.	513-434-6467
Pa	Philadelphia, V. S. Malta	215-836-5122
Pa	Pittsburg, R.F. Clark Co.	412-242-9500
Tex	Dallas, Elcom	214-352-5006
Wisc	Milwaukee, Bierhaus Sls., Inc.	414-332-0900
EXP:	Dayton, Ohio, Int'l. Sls. Div., Ledex, Inc.	513-224-9891
FOR:	Can., Richmond, B.C., Lake Engrg. Co. Ltd.	604-277-0414
FOR:	Can., Scarborough, Ont., Lake Engrg. Co. Ltd.	416-751-5980
FOR:	Can., St. Laurent 381, Que., Lake Engrg. Co. Ltd.	514-747-2441

BRAND DIELECTRICS, INC., Route 203, N. Windham, Conn., 06256, Tel: 203-423-6321; Empl.: 5

Products manufactured: Compounds, Encapsulating, Insulating, Molding, Potting, Insulators & Insulation, Tapes, Electrical Insulation, Tubing

BRAND-REX CO., Box 498, Willimantic, Conn., 06226, Tel: 203-423-7771; FSC No: 71124; Empl.: 1000; Minimum order: $100

Products manufactured: Cable, Insulators & Insulation, Tubing, Wire

Local Sales Offices & Reps.

Alas	Anchorage, Rostel Co.	907-344-9247
Cal	Santa Ana, Brand-Rex Co.	714-540-7806
Cal	Sunnyvale, Brand-Rex Co.	408-245-3564
Colo	Denver, Brand-Rex Co.	303-759-2751
Fla	Tampa, Brand-Rex Co.	813-876-4632
Ga	Atlanta, Brand-Rex Co.	404-394-9416
Ga	Roswell, E. Rushin Co.	404-993-6498
Ill	Glenview, Brand-Rex Co.	312-729-5600
Ind	Indianapolis, Brand-Rex Co.	317-844-2860
Iowa	Des Moines, KSW Assocs.	515-279-9235
La	Metairie, Aneson Assocs.	504-835-6445
Md	Baltimore, J.A. Maguire & Co.	301-377-0223
Mass	Clinton, Brand-Rex Co.	617-368-8234
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Kansas City, KSW Assocs.	816-358-5240
Mo	St. Louis, KSW Assocs.	314-781-6111
NJ	Pennsauken, J.A. Maguire & Co.	609-665-5136
NJ	Plainfield, J.A. Maguire & Co.	201-754-6400
NY	Rhinebeck, Brand-Rex Co.	914-297-6296
Ohio	Aurora, Clark Sls. Co.	216-543-5656
Ore	Portland, Brand-Rex Co.	503-292-9189
Pa	Pittsburgh, Brand-Rex Co.	412-371-3290
SC	Greenwood, H. Reynolds	803-229-6801
Tex	Addison, Parvin Sls. Co.	214-239-9148
Tex	Houston, Parvin Sls. Co.	713-721-1054
Wisc	Brookfield, Brand-Rex Co.	414-392-2141

BRANSON CORP., Vanderhoff Ave., Denville, N.J., 07834, Tel: 201-625-0600, TWX: 710-987-8466; FSC No: 99928; Empl.: 40; Minimum order: $25

Customer service: J. Witzler

Free literature available: Complete catalog with applications data & QPL listings

Products manufactured: Relays, Sockets, Switches

Local Sales Offices & Reps.

Fla	Orlando, Perrott Assoc. Inc.	305-275-1132
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Mo	St. Louis, Engrg. Svcs. Co.	314-726-2233
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242

BRANSON CLEANING EQUIP. CO., Parrott Dr., Shelton, Conn., 06484, Tel: 203-929-7301, TWX: 710-474-0893; Empl.: 300; Minimum order: $25

For info on price: R. Harvey; Application info: F. Terry; Customer service: R. Harvey; Delivery info: T. Martinez

Free literature available: Bransonics - self-contained ultrasonic cleaners; E - Module - industrial aqueous ultrasonic cleaning equipment; FD-UD Series - industrial solvent ultrasonic cleaning equipment.

Products manufactured: Cleaners, Ultrasonic, Detectors, Generators, Machines/Machinery, Production, Oscillators, Transducers

Local Sales Offices & Reps.

Ariz	Phoenix, H. C. Torrey Assocs.	602-944-0352
Cal	Fullerton, Branson Cleaning Equip.	714-870-6360
Cal	Santa Clara, Branson Cleaning Equip.	408-249-2616
Colo	Denver, Crump Co.	303-426-1443
Fla	Clearwater, MacGregor Assocs.	813-446-7310
Fla	Coral Springs, MacGregor Assocs.	305-752-1924
Ga	Lilburn, MacGregor Assocs.	404-921-1300
Haw	Honolulu, Thom Equip. Co.	808-847-2027
Ill	Des Plaines, Branson Cleaning Equip.	312-824-7175
Kans	Kansas City, Pacific Scientific Co.	913-381-2600
Mass	Woburn, Branson Cleaning Equip.	617-935-8060
Mich	Detroit, Gottsman Machinery Assocs.	313-838-5020
Mo	Saint Louis, Pacific Scientific Co.	314-731-2440
NJ	Stratford, Branson Cleaning Equip.	609-627-2888
NY	Rochester, Branson Cleaning Equip.	716-288-0100
NC	Charlotte, Branson Cleaning Equip.	704-394-7309
Tex	Richardson, Branson Cleaning Equip.	214-234-2477

BRAUN-BUSH CO., 8833 78th St., Woodhaven, N.Y., 11421, Tel: 212-296-3332; Empl.: 26; Minimum order: $10

For info on price: G. Dinnis; Application info: M. Cheney; Customer service: G. Aitken; Delivery info: M. Thompson

Products manufactured: Brushes & Brush Assemblies

BRAUN CO., INC., 4200 31st St. N., St. Petersburg, Fla., 33714, Tel: 813-526-9104; Empl.: 60; Minimum order: $25

For info on price: H. Bonser; Application info: H. Bonser; Customer service: A. de Alcala; Delivery info: E. Clarke

Free literature available: 20 page catalog on standard items- finger stock - contact rings - component clips; single page flyer on welded contacts single page flyer on assemblies.

Products manufactured: Clamps & Clips, Contact Strips, Finger, Contacts, Electrical, Springs (All Types)

Local Sales Offices & Reps.

Cal	Los Angeles, El-Com Inc.	213-223-1353
Conn	Glastonbury, Barton & Caron Inc.	203-633-9417
Ill	Chicago, Brock & Cushman	312-622-4110
Mass	Auburndale, Barton & Caron Inc.	617-332-2021
Mich	Chagrin Falls, Bray Assoc. Inc.	216-247-4474
NC	Charlotte, J.C. Jackson Co.	704-536-2713
Pa	Pittsburgh, Buchanan Sls. Co.	412-782-3324

BRAXTON MFG. CO., Echo Lake Rd. N., Watertown, Conn., 06795, Tel: 203-274-6781; Empl.: 35

For info on price: A. F. Anderson; Application info: J. Triano; Customer service: C. Swanson; Delivery info: B. Lyons

Products manufactured: Eyelets, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Costa Mesa, Braxton Mfg. Cal.	714-645-7363
Tex	Richardson, Burns Tech. Sls.	214-423-3379

BRELONIX, INC., 106 North 36th St., Seattle, Wash, 98103, Tel: 206-ME 3-1964; Empl.: 10

Customer service: T. A. Rommel

Free literature available: Brochure describing Model SAM-100 Aircraft SSB Transceiver and Accessories.

Products manufactured: Comm. Systems, Couplers, Receivers, Transmitters

BRINKMANN INSTRS., INC., Cantiague Rd., Westbury, N.Y., 11590, Tel: 516-334-7500, TWX: 510-222-8254; Empl.: 150; Minimum order: $15

Customer service: K. Peters

Free literature available: Lauda Circulators, baths and accessories, Metrohm Recording Polarographic Analyzer, Wenking Electronic Potentiostats and Galvanostats

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Potentiometers, Recorders

Local Sales Offices & Reps.

Cal	Burlingame
Cal	Los Angeles
Ill	Des Plaines
Md	Silver Spring
Mo	St. Louis
NY	Syracuse
Ohio	Cincinnati
Ohio	Cleveland
Pa	Philadelphia
Tex	Houston

BRISTOL SAYBROOK CO., 97 Coulter St., Old Saybrook, Conn., 06475, Tel: 203-388-3414; Empl.: 125

Customer service: G. S. Willis

Free literature available: Free application data and ordering information is available on a complete line of synchronous motors and timing devices. Special modifications are available on OEM quantities.

Products manufactured: Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Indicators, Motors, Relays, Switches, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, C.E. Mello Co.	213-626-9159
Cal	Palo Alto, O'Donnell Assoc.	415-327-9260
Conn	Old Saybrook, M.L. Assoc.	203-388-9718
Ill	Chicago, J.C. Angel Co.	312-878-0653
Mass	Marlboro, M.L. Assoc.	617-485-6190
Mich	Novi, Miltimore Sls.	313-476-2446
Mo	Independence, Gribble Sls. Engr. Co.	816-796-4333
NJ	Nutley, Challenge Assoc.	201-667-3558
NJ	Pitman, Colrud Co.	609-589-5866
NY	Camillus	315-672-3988
NY	Old Saybrook, Challenge Assoc.	203-388-5562
NY	Pittsford	716-381-6714
NC	Charlotte, R.W. Chapman Co.	704-525-2421
NC	Raleigh, R.W. Chapman Co.	919-782-2624
Ore	Beaverton, David Fry Co.	503-643-5448
SC	Greenville, R.W. Chapman Co.	803-232-5391
Tex	Arlington, Ion Assoc.	817-461-9661

BRITISH AIRCRAFT CORP. (USA INC.), Intratec Div., 399 Jefferson Davis Hwy., Arlington, Va., 22202, Tel: 703-979-1400; Empl.: 100; Minimum order: $50

Customer service: G.J. McCallum

Products manufactured: Analyzers, Interferometer Systems, Kits, Breadboarding (For Engineers)

BROADVIEW CHEMICAL, 2910 S. 18th St., Broadview, Ill., 60153

BROMBERG ENGINEERING, 12 Simpson Rd., Wayland, Mass., 01778, Tel: 617-653-4285; Empl.: 6

For info on price: J. Swartz; Application info: N. S. Bromberg; Customer service: N. S. Bromberg; Delivery info: J. Swartz

Free literature available: Brochure describing OEM or custom dedicated instrumentation for clinical or pollution analysis employing fluoresence, scattering, polarization, optical density and electrochemistry. Using DAMS and D&S2AMS&I1.

Products manufactured: Amplifiers, Interferometer Systems, Lasers & Laser Systems, Meters, Services, Assembly, Production & Test, Spectrometers

BROOKHAVEN INSTRS. CORP., Box 3136, Austin, Tex., 78764, Tel: 512-442-1216; Empl.: 8

For info on price: E. J. Rogers; Delivery info: R. L. Davis

Free literature available: Brochures giving technical specs and descriptive info. on electronic integrators & sweep generators. Price lists.

Products manufactured: Generators, Integrators, Electronic, Services, Assembly, Production & Test

Local Sales Offices & Reps.

NY	Port Chester, Radiation Elctrns. Inc.	914-937-2300
Tenn	Knoxville, Pulcir Inc.	615-693-3461

BROOKS INSTR. DIV., Emerson Elec. Co., Hatfield, Pa., 19440, Tel: 215-368-2000; Empl.: 450

Customer service: N. Wilcox

Products manufactured: Alarms, Controls/Control Eqpt.

Local Sales Offices & Reps.

Ariz	Scottsdale, Brooks Instr. Div. Emerson Elec. Co.	602-947-8073
Cal	Stanton, Brooks Instr. Div. Emerson Elec. Co.	213-860-4460
Del	Wilmington, Brooks Instr. Div. Emerson Elec. Co.	215-724-7373
Ill	Westchester, Brooks Instr. Div. Emerson Elec. Co.	312-345-2740
NJ	Teaneck, Brooks Instr. Div. Emerson Elec. Co.	212-753-4628
Ohio	Cleveland, Brooks Instr. Div. Emerson Elec. Co.	216-884-7036
Pa	Hatfield, Brooks Instr. Div. Emerson Elec. Co.	215-247-2366
Tex	Houston, Brooks Instr. Div. Emerson Elec. Co.	713-784-4930

BROOKS CO. INC., WINFIELD, Conn. at Fowle St., Woburn, Mass., 01801, Tel: 617-933-5300

For info on price: Miss Salines; Application info: H. A. Perry, Jr.; Customer service: H. A. Perry, Jr.; Delivery info: Miss Salines

Free literature available: Form #52A-description of Tapfree and Alumtap Cutting Fluids.

Products manufactured: Lubricants

BSR (USA) LTD, Route 303, Blauvelt, NY, 10913

BUCHANAN CRIMP TOOL PRODS., Amerace Corp. Control Prods. Div., 1065 Floral Ave., Union, N.J., 07083, Tel: 201-289-2225; FSC No: 5120; QPL No: 22520; Empl.: 65; Minimum order: $50 .... p. 2•653

Customer service: J. Nosti

Free literature available: Catalog (T105) 32 page catalog describing full line of manual, pneumatically-operated and automatic feed crimping tools listing Mip-specs and contact types accommodated.

Products manufactured: Tools

Local Sales Offices & Reps.

Cal	Van Nuys	213-997-7243

BUCKBEE MEARS CO., 245 E. 6th St., St. Paul, Minn., 55101, Tel: 612-228-6371; Empl.: 1600

Products manufactured: Boards, Printed Circuit, Circuits, Flexible, Circuits, Printed, Multilayer, Laminations, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Los Angeles	213-889-9962
Cal	San Jose	408-248-2750
Colo	Denver	303-237-3870
Ill	Elk Grove Village	312-439-6433
Minn	St. Paul	612-228-6371
NH	Nashua	603-883-0316
NJ	E. Windsor	609-443-3340
NY	Manlius	315-469-7394
Ohio	Sylvania	419-882-6918
Pa	Allentown	215-398-1511
Tex	Plano	214-423-3110

BUCKEYE STAMPING CO., 555 Marion Rd., Columbus, Ohio, 43207, Tel: 614-445-8433; Empl.: 75 p. 1•46-48; p. 2•1075

Customer service: J. Willcox

Free literature available: Instrument Knobs; Instrument Cases & Cabinets; Printed Circuit Board Guides & Racks.

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Guides, Circuit Board, Knobs, Racks, Stands, Instruments

Local Sales Offices & Reps.

Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Cal	Pasadena, P. Nurches Co.	213-MU1-8957
Colo	Greeley, G. Moss Elctrns., Inc.	303-353-1452
Fla	St. Petersburg, S. Partak Inc.	813-393-5402
Ill	Chicago, W.J. Doyle Co.	312-BR4-6685
Mass	Belmont, Elctrn. Comps. & Svc.	617-484-8680
Mich	Lathrup Village, R.C. Nordstrom Co.	313-559-7373
Minn	Minneapolis, A.J. Warner Co.	612-729-7371
Mo	Raytown, Production Automation	816-737-0066
NY	Lynbrook, P. Saftler Assoc.	516-593-7880
Ohio	Columbus, Elctrns. Mktg.	614-299-4161
Pa	Paoli, T. Griffin Co.	215-647-1550
Tex	Houston, Southland Engrg. & Sls.	713-462-4077
Wash	Seattle, Underwood & Underwood	206-243-2133

BUD RADIO, INC., 4605 E. 355th St., Willoughby, Ohio, 44094, Tel: 216-946-3200, TWX: 810-427-2604; Empl.: 200 .... p. 1•54,55

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Benches, Consoles, Stools, Tables, Blowers & Fans & Accessories, Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Connector Boxes & Strips, Power Outlet, Drawers, Sliding, Frames, Cabinet & Rack, Handles For Cabinets, Circuit Boards, Racks, etc., Panels, Racks, Services, Assembly, Production & Test, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Berman Co.	602-994-8081
Cal	Inglewood, J. Berman Co.	213-649-6111
Cal	San Carlos, D.H. Ross Co.	415-591-4411
Colo	Denver, Lindberg Co.	303-758-9033
Fla	Orlando, Cartwright & Bean Co.	305-422-4531
Fla	Plantation, Cartwright & Beam Co.	305-791-3[illegible]
Ga	Atlanta, Cartwright & Bean Co.	404-255-5262
Ill	Chicago, GNB Assocs.	312-673-4050
Ind	Indianapolis, Southern Sls. Corp.	317-257-7575
Iowa	Cedar Rapids, Palatine Engrg. Sls.	319-365-8071
Kans	Andover, Palatine Engrg. Sls.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
La	Chalmette, Cartwright & Bean Co.	504-279-4598
Mass	Needham, Mullin Tech. Sls.	617-444-4780
Mich	St. Clair Shores, J.M. Thorpe	313-779-6363
Minn	Minneapolis, C. Gibb Co.	612-377-1200
Miss	Jackson, Cartwright & Beam Co.	601-981-1368
Mo	St. Louis, Palatine Engrg. Sls.	314-426-7055
NJ	Cherry Hill, Trinkle Sls.	609-795-4200
NY	Rochester, Marsey Sls.	716-442-9700
NY	Rockville Centre, Willgold	516-764-4022
NC	Charlotte, Cartwright & Bean Co.	704-333-6457
NC	Raleigh, Cartwright & Bean Co.	919-832-7128
NM	Albuquerque, Lindberg Co.	505-345-2489
Ohio	Cleveland, Marlow Assocs.	216-932-0900
Ohio	Xenia, Marlow Assocs.	513-426-6270
Ore	Portland, Earl & Brown Co.	503-245-2283
Tenn	Knoxville, Cartwright & Bean Co.	615-693-7450
Tenn	Memphis, Cartwright & Bean Co.	901-276-4442
Tex	Dallas, Lund & Co.	214-358-4335
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Seattle, Earl & Brown Co.	206-284-1121

BUDWIG MFG. CO., P.O. Box 97, Ramona, Calif., 92065, Tel: 714-789-0900; FSC No: 31827; Empl.: 50

Customer service: E. Creighton

Free literature available: Form 663-D Data-Straps, Grommets; Form 712-A Data Cabinet Feet; Form 906 Data Antenna Connectors.

Products manufactured: Bumpers, Clamps & Clips, Grommets

BULOVA WATCH CO., FREQ. CONTROLS DIV., Elctrns. Div., 61-20 Woodside Ave., Woodside, N.Y., 11377, Tel: 212-335-6000; Minimum order: $100 p. 1•4,284-295,1124

For info on price: W. Carnes; Application info: M. Isola; Customer service: M. F. Casino; Delivery info: M. Isola

Products manufactured: Amplifiers, Analyzers, Bridges, Calibrators, Chargers, Battery, Chokes, Choppers, Chronometers, Cleaners, Ultrasonic, Clocks (All Types), Coders, Coils Including Assemblies & Forms, Comparators, Controls/Control Eqpt., Converters, Counters, Crystals, Decoders, Demodulators, Detectors, Dividers, Drivers, Chopper, Filter Synthesizers, Filters, Generators, Inverters, Keyers, Tone, Light Choppers, Meters, Modulators, All Kinds, Monitors, Networks, Oscillators, Power Supplies, Receivers, Records, Frequency Test, Regulators, Scanners, Servo Systems, Standards, Switches, Timers, Transducers, Tuning Forks

Local Sales Offices & Reps.

Ariz	Scottsdale, Carter Assocs.	602-947-4355
Cal	Menlo Park, Straube Assocs.	415-323-2476
Colo	Boulder, Straube Assocs.	303-443-8600
Conn	Suffield, Terrance P. Dunn Co.	203-668-0446
Fla	Clearwater, Purrett Assocs.	813-531-5513

Fla	Orlando, Perrott Assocs.	305-275-1132
Ill	Chicago, Techrep, Inc.	312-761-0548
Iowa	Cedar Rapids, J.R. Sls. Engrg. Inc.	319-377-8211
Kans	Prairie Village, Engrg. Svcs. Inc.	913-649-4000
Md	Baltimore, Callas Elctrns. Inc.	301-744-7711
Mass	Chelmsford, Underwood Sls.	617-256-8191
Minn	Minneapolis, Tornolson Assocs.	612-835-2414
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Englewood Cliffs, E. Glass Assocs.	201-592-0200
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Fayetteville, H.C. Johnson Agencies	315-637-9383
NY	Guiderland, H.C. Johnson Agencies	518-456-9681
NY	Rochester, H.C. Johnson Agencies	716-482-3000
Ohio	Akron, Avoy Natalino Assocs.	216-725-6087
Ohio	Dayton, Avoy Natalino Assocs.	513-223-5002
Ore	Portland, J. J. Backer	503-297-3776
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Pa	Philadelphia, Eastern Comps.	215-927-6262
Tex	Dallas, United Comps.	214-324-1448
Wash	Seattle, J.J. Backer	206-285-1300
EXP:	New York, N.Y., C. Tunnant & Sons	212-679-1300
EXP:	New York, N.Y., Landseas Corp.	212-265-8323

BULOVA WATCH CO., SERVO PRODS. ELCTRNS. DIV., 61-20 Woodside Ave., Woodside, N.Y., 11377, Tel: 212-335-6000, TWX: 710-582-2637; Minimum order: $100 .... p. 1•1910-1913

Customer service: Ed Cohen

Products manufactured: Amplifiers, Controls/Control Eqpt., Servo Systems

BULOVA WATCH CO., Sys. & Instrs. Div., Green Acres Rd., W., Valley Stream, N.Y., 11582, Tel: 516-561-2600, TWX: 510-225-8409; Empl.: 750

Products manufactured: Switches, Testers, Timers

BULOVA WATCH CO., Timer Lab., Bulova Pk., Flushing, N.Y., 11370, Tel: 212-DE 5-6000, TWX: 212-672-0344; Minimum order: $25

Customer service: A. Craig

Free literature available: Descriptions of applications of precision D.C. clocks and timers in a variety of scientific projects.

Products manufactured: Clocks (All Types), Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Indicators, Timers

BUNKER-RAMO CORP., Elctrn. Sys. Div., 31717 La Tienda Dr., Westlake Village, Cal, 91361, Tel: 213-889-2211, TWX: 910-494-1234

Products manufactured: Comm. Systems, Computers, Hydrophones & Accessories, Oceanographic Equip. (Electronic), Underwater Communication, Detection, Navigation, etc. Equipment

BUNTING, BRASS & BRONZE CO., Div. N.L. Inds., Inc., 715 Spencer St., Toledo, Ohio, 43609, Tel: 419-382-3451, Telex: 28-6413; Empl.: 450; Minimum order: $25

For info on price: J. J. Doherty ext 276; Application info: R. A. Peterson ext 224; Customer service: C. Sevrence ext 214; Delivery info: C. Sevrence ext 214

Free literature available: #72 catalog - Stock listing of cast bronze and powder metal oil-filled bearings. #5 catalog - Engineering data on powder metal.

Products manufactured: Bearings, Bushings, Glass, Plastic, Metal, Rubber, Etc.

Local Sales Offices & Reps.

Cal	Los Angeles	213-747-5566
Ga	Atlanta	404-876-6316
Ill	Elk Grove Village	312-593-2750
NJ	Robbinsville	609-587-5705

BURDETTE BUSS BARS, INC., 383 Kings Hwy., Cherry Hill, N.J., 08034, Tel: 609-931-1300; Empl.: 7; Minimum order: $50

For info on price: R. Kemper 609-931-1300; Application info: D. Kemper 609-931-1302

Products manufactured: Bus Bars & Systems, Connectors

Local Sales Offices & Reps.

Fla	Casselberry, Publicover Assocs.	305-834-5775
Md	Timonium, Technical Mktg. Co.	301-252-4780
Mass	Westboro, Technical Mktg. Co.	617-366-8460
NJ	Mt. Ephraim, Burdette Co.	609-931-1309

BUREAU ENGRAVING, INC., Ind'l. Div., 219 N. Second St., Minneapolis, Minn., 55401, Tel: 612-339-8001, TWX: 910-576-2733; Empl.: 550; Minimum order: $500

For info on price: J. Patterson; Application info: J. Patterson; Customer service: J. Patterson; Delivery info: B. Currie

Products manufactured: Boards, Printed Circuit, Circuits, Flexible, Circuits, Printed, Multilayer

BURGESS BATTERY, See Gould Inc., Portable Battery Div.

BURGESS SWITCH CO., 777 Warden Ave., Scarborough, Ont., Ont., Can., MIL 4C3, Tel: 416-751-8280; FSC No: 36497; Empl.: 1000; Minimum order: $25

For info on price: Sls. Order Off.; Application info: Tech. Sls. Off.; Customer service: Cust. Svc. Dept.; Delivery info: Exped. Dept.

Free literature available: Ultraminiature micro switches.

Products manufactured: Switches

Local Sales Offices & Reps.

Fla	Clearwater, Lynch Gentry Assoc.	813-443-2697
Ga	Atlanta, Murphy & Cota	404-875-2525
Ill	Des Plaines, Lincoln Hodges	312-297-3810
Mass	Waltham, R.J.C. Assocs.	617-899-5858
Mich	Bloomfield Hills, R. C. Dakin Co.	313-647-2262
Minn	St. Paul, Kenco Co.	612-645-7717
NJ	Clifton, Faber Assocs.	201-773-8900
NY	Buffalo, Niagara Elec.	716-886-4000
NY	Rochester, Niagara Elec.	716-271-1223
NY	Syracuse, Niagra Elec.	315-437-1656
Ohio	Cleveland, Anderson-Bolds	216-229-4700
Tex	Dallas, Wm. Reese Corp.	214-638-6575
Wisc	Waukesha, Lincoln Hodges Assocs.	414-542-3087

BURLING INSTR. CO., 16 River Rd., Box 298, Chatham, N.J., 07928, Tel: 201-635-9481; Empl.: 27; Minimum order: $10

For info on price: J. Price; Application info: T. Mick; Customer service: J. Price; Delivery info: I. Altman

Products manufactured: Controls/Control Eqpt., Monitors, Switches, Thermostats

Local Sales Offices & Reps.

Cal	Los Angeles, C. Meriam Co.	213-269-8271
Cal	Mountain View, Claypool Controls Co.	415-969-7458
Colo	Denver, Toncray Equip. Co.	303-CH4-1102
Conn	Bridgeport, M.A. Selmon Co.	203-366-3651
Fla	Cantonment, C.B. Metcalf Co.	904-476-7710
Fla	Jacksonville, Olen Sls. Corp.	904-744-3988
Fla	Miami, Henning Co.	305-NA4-5832
Ga	Atlanta, J.R. Stilwell Co.	404-237-9844
Haw	Honolulu, Berkley Engrg. & Equip. Co.	
Ill	Chicago, Kelburn Engrg. Co.	312-775-8383
La	New Orleans, Gilbert & Assocs.	504-UN6-7444
Md	Baltimore, G. Goodman Ind.	301-837-3210
Mich	Roseville, H.C. Engelman Co.	313-777-0750
Minn	Minneapolis, Industra Co.	612-929-6224
Mo	Florissant, H and R Sls. & Engrg. Co.	314-837-3966
Neb	Omaha, H.G. Klug Co.	402-553-1377
NJ	Springfield, RJM Sls.	201-467-1210
NJ	Westfield, Mechanical Specialties Co.	201-233-9188
NY	Rochester, H.C. Johnson Agencies	716-482-3000
NC	Charlotte, Brown & Morrison	704-ED3-0774
Ohio	Bay Village, C. H. Joy Co.	216-TR1-5900
Ohio	Cincinnati, BC Engrg. Co.	513-891-6122
Okla	Tulsa, Quigg Process Equip. Co.	918-587-0166
Pa	Broomall, J.C. Whiddett Co.	215-353-6343
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Tex	Arlington, Pan-Tech Engrg. Co.	817-261-4111
Tex	Houston, Pan-Tech Engrg. Co.	713-623-0640
Tex	Odessa, Barngo, Inc.	915-332-0293
Wash	Kirkland, Unit Process Co.	206-822-0241
EXP:	New Haven, Conn., Masten-Wright Corp.	203-288-1638
FOR:	Can., Thornhill, Ont., Baker Instrs. Ltd.	416-889-8642
FOR:	Can., Vancouver, B.C., J. Sherman Co.	604-254-3113

BURLINGTON OPERS. DIV., Electronized Chems. Corp., S. Bedford St., Burlington, Mass., 01803, Tel: 617-272-2850, TWX: 710-332-0502; FSC No: 24011; Empl.: 125; Minimum order: $25

Customer service: W.P. Broderick

Free literature available: Short Form Catalog contains synopsis of heat shrinkable tubings, tapes, and parts available from E.C.C. Gives data relating to electrical, mechanical and chemical properties of various heat shrinkable materials.

Products manufactured: Caps, Forms & Tapes, Heat Shrinkable, Heat Guns, Production, Laminates, Services, Assembly, Production & Test, Tapes, Electrical Insulation, Tubing

BURNDY CORPORATION, Richards Ave., Norwalk, Conn., 06852, Tel: 203-838-4444, TWX: 710-468-2546; Empl.: 3500

For info on price: S. Miller; Application info: J. F. Bradley; Customer service: S. Miller; Delivery info: S. Miller

Free literature available: HYLOK&T Connectors-Multi-pin, rectangular connectors, HYPOINT&T-Leadless IC receptacles, TRIMTRIO&T-Rectangular, OIKMATE&T & Round Connectors, Power & Coax Contacts, Large HYRING&T Assemblies-for termination of multi-conductor shielded cable, Smooth BANTAM&T Connectors, Solder BANTAM Connectors, Rack and Connector, Terminals & Spices, LG107-1, Printed Circuit Connectors Rack and Panel Connectors, Terminals & Splices, LG107-1, Printed Circuit Connectors

Products manufactured: Cable, Connectors, Contacts, Electrical, Holder & Carriers, Integrated Circuit Packaging Systems, Limiters, Machines/Machinery, Production, Sockets, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Terminal Blocks, Boards & Strips, Terminals, Tools, Wire & Cable Ties, Wire Strippers

Local Sales Offices & Reps.

Ariz	Phoenix, Burndy Corp.	602-947-5715
Ark	Little Rock, C.H. Stout, Inc.	501-374-8201
Cal	El Segundo, Burndy Corp.	213-772-5401
Cal	San Diego, Burndy Corp.	714-278-7131
Cal	Santa Clara, Burndy Corp.	408-249-5353
Colo	Denver, Burndy Corp.	303-377-8859
Conn	Norwalk, Burndy Corp.	203-838-4444
Fla	Ft. Lauderdale, Burndy Corp.	305-685-6446
Fla	Winter Park, Burndy Corp.	305-851-7430
Ga	Atlanta, Burndy Corp.	404-292-1633
Ill	Schiller Park, Burndy Corp.	312-678-5211
La	New Orleans, C.H. Stout of LA, Inc.	504-486-3707
La	Shreveport, C.H. Stout of Shreveport, Inc.	318-425-5485
Md	Silver Spring, Bradley Electro Sls. Corp.	301-587-1886
Mass	Dedham, Burndy Corp.	617-326-6386
Mich	Troy, Burndy Corp.	313-557-2668
Minn	Bloomington, Burndy Corp.	612-835-2500
Miss	Jackson, C.H. Stout, of Miss. Inc.	601-354-4326
Md	St. Louis, Burndy Corp.	314-878-4294
Mo	Kansas City, Burndy Corp.	816-353-3131
NY	Pelham, Burndy Corp.	914-738-3200
NY	Rochester, Burndy Corp.	716-381-3792
NY	Syracuse, Burndy Corp.	315-422-3990
NC	Greensboro, Burndy Corp.	919-274-8441
Ohio	Cleveland, Burndy Corp.	216-749-2665
Ohio	Dayton, Burndy Corp.	513-222-7997
Ore	Portland, Burndy Corp.	503-244-8559
Pa	Philadelphia, Burndy Corp.	215-265-1615
Pa	Pittsburgh, Muller, Harper & Assoc.	412-931-6460
Tenn	Memphis, C.H. Stout of Tenn., Inc.	901-362-1616
Tex	Dallas, Burndy Corp.	214-231-1456
Tex	Houston, Burndy Corp.	214-231-1456
Va	Richmond, Bradley Electro Sls. Corp.	804-649-8787
Wash	Seattle, Burndy Corp.	206-624-5442
WVa	Charleston, Skaff Engrg. Co.	304-342-0131
EXP:	Norwalk, Conn., Burndy Corp.	203-838-4444

BURNS ENGRG., INC., 10201 Bren Rd. East, Minnetonka, Minn., 55343, Tel: 612-935-4400, Telex: 29-0184

Products manufactured: Probes, Thermocouples, Elements & Accessories, Thermometers, Resistance, Transducers

BURNS ENGRG., INC. cont'd

Advertisment

Platinum, Nickel & special RTD's. Interchangeability 0.1° F or 0.1% of temperature (Precision Series) or 3/4° for 1/2% of temperature (Relia Bulb Series). Also 1/4° F Interchangeability over any span of 75° F or less. Thermocouples and specialized electronics. STOCK DELIVERY ON SEVERAL MODELS

BURR-BROWN, 6730 S. Tucson Blvd., Tucson, Ariz., 85734, Tel: 602-294-1431, TWX: 910-952-1111; Empl.: 405

Products manufactured: Amplifiers, Capacitors, Fixed, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Comparators, Converters, Dividers, Filters, Generators, Integrated Circuit Devices, IC's, Active Filters, Multiplexers, Multipliers, Networks, Power Supplies, Voltage Sources

Local Sales Offices & Reps.

Ga	Atlanta, BCS Assocs.	404-874-9925
Ala	Huntsville, BCS Assocs.	205-881-6220
Ala	Mobile, BCS Assocs.	205-342-9670
Ariz	Tucson, Burr-Brown Research Corp.	602-294-1431
Cal	San Diego, Elctrn. Mrktg. Specialists	714-566-1000
Cal	San Jose, Burr-Brown Research Corp.	408-984-7700
Cal	Santa Ana, Burr-Brown Research Corp.	714-835-0712
Cal	Sherman Oaks, Elctrn. Mktg. Specialists	213-990-4244
Cal	Sunnyvale, Elctrn. Mrktg. Specialists	408-245-9291
Fla	Ft. Lauderdale, BCS Assocs.	305-735-7641
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Addison, Burr-Brown Research Corp.	312-832-6520
Md	Silver Spring, QED Elctrns.	301-588-8134
Mass	Wakefield, Meas. Equip. Co.	617-245-4870
Mich	Farmington, Sheridan Assocs.	313-477-3800
Minn	Minneapolis, ECR, Inc.	612-831-4547
Mo	Florissant, Sheridan Assocs.	314-837-5200
NJ	Camden, QED Elctrns., Inc.	215-925-8711
NY	Clinton, Advanced Comps. Corp.	315-853-6438
NY	Endicott, Advanced Comps. Corp.	607-785-3191
NY	Mt. Vernon, QED Elctrns., Inc.	914-664-0080
NY	Syracuse, Advanced Comps. Corp.	315-699-2671
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Cleveland, Sheridan Assocs.	216-524-8120
Okla	Tulsa, Norvell Assocs.	918-663-1247
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640
Tex	Dallas, Norvell Assocs.	214-350-6771
Tex	Houston, Norvell Assocs.	713-774-2568
Wash	Seattle, Hayes Tech.	206-763-2210
FOR:	Calgary, Alb.	403-261-0780
FOR:	Can., Longueuil, Que.	514-670-1212
FOR:	Can., Malton, Ont.	416-678-1500
FOR:	Can., Ottawa, Ont.	613-829-9651
FOR:	Can., Vancouver, B.C.	604-253-7136

BURROUGHS CORP., Electronic Components Div., Box 1226 - Mt. Bethel Rd., Plainfield, N.J., 07061, Tel: 201-757-3400, TWX: 710-997-9539; Empl.: 1100

For info on price: R. Pignatello 201-757-5000; Application info: G. Weber; Customer service: R. Pignatello; Delivery info: R. Pignatello

Products manufactured: Display Devices/Displays, Tubes

Local Sales Offices & Reps.

Cal	Palo Alto	415-321-5363
Cal	Santa Ana	714-835-7335
Ga	Atlanta	404-633-0606
Mass	Brockton	617-364-3220
Mich	Royal Oaks	313-545-3250
NY	Henrietta	716-544-8582
Ohio	Kettering	513-299-5174
Tex	Dallas	214-748-9863
Va	McLean	703-893-2950

BURROUGHS CORP., OEM Sales, 460 Sierra Madre Villa, Pasadena, Cal., 91109, Tel: 213-351-6551, TWX: 910-585-1835; Empl.: 50,000

Products manufactured: Comm. Systems, Computers, Encoders, Memory Systems, Modulator/Demodulators, Perforators, Printers, Punched Card Equipment, Readers, Recorders, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ala	Huntsville	205-539-4433
Ariz	Phoenix	602-264-1281
Ark	Little Rock	501-FR 2-4121
Cal	Los Angeles	213-483-4520
Cal	San Diego	714-560-7222
Cal	San Francisco	415-UN 3-4062
Colo	Denver	303-861-8222
Conn	Hartford	203-AD 3-9871
Del	Wilmington	302-478-4200
DC	Washington	202-833-3280
Fla	Jacksonville	904-EX8-1551
Fla	Orlando	305-628-0999
Ga	Atlanta	404-881-8888
Haw	Honolulu	808-949-4171
Idaho	Boise	208-343-4911
Ill	Chicago	312-WA2-7600
Ill	Springfield	217-528-3455
Ind	Indianapolis	317-925-9051
Iowa	Cedar Rapids	319-393-1812
Iowa	Sioux City	712-258-7552
Kans	Wichita	316-MU2-6536
Ky	Lexington	606-253-2626
La	Baton Rouge	504-926-0012
Me	Portland	207-SP 3-8119
Md	Baltimore	301-667-9700
Mass	Lexington	617-862-9810
Mich	Detroit	313-972-7300
Mich	Lansing	517-IV 5-9401
Minn	Minneapolis	612-870-1891
Miss	Jackson	601-956-5004
Mo	Kansas City	816-421-0202
Mo	St. Louis	314-534-7510
Neb	Omaha	402-344-4105
NH	Manchester	603-NA 7-7686
NJ	Paterson	201-967-0800
NJ	Trenton	609-883-5670
NM	Albuquerque	505-247-1594
NY	Buffalo	716-877-4774
NY	New York	212-972-3000
NY	Syracuse	315-463-8651
NY	W. Hempstead	516-483-6625
NC	Raleigh	919-876-6822
ND	Fargo	701-AD 2-7135
Ohio	Cincinatti	513-242-3790
Ohio	Cleveland	216-398-6700
Ohio	Columbus	614-224-7248
Okla	Oklahoma City	405-843-9437
Okla	Tulsa	918-LU 7-5138
Ore	Portland	503-639-9660
Pa	Philadelphia	215-LO 8-1400
Pa	Pittsburgh	412-343-3622
RI	E. Providence	401-GE 4-1811
SC	Columbia	803-772-8274
Tenn	Knoxville	615-588-7451
Tenn	Nashville	615-385-0082
Tex	Dallas	214-RI8-9861
Tex	Houston	713-688-6911
Utah	Salt Lake City	801-DA 8-8947
Vt	Burlington	802-864-6861
Va	Roanoke	703-DI 3-1537
Wash	Seattle	206-MA 3-1780
WVa	Wheeling	304-CE 2-0690
Wisc	Milwaukee	414-UP 3-8600

BURWEN LAB. INC., 209 Middlesex Tpke., Burlington, Mass., 01803, Tel: 617-273-1488; Empl.: 84

Customer service: R. Bollman

Free literature available: Specification sheets that cover bandwidths & applications on all Burwen dynamic noise filters, specs on modules, users list, application sheets.

Products manufactured: Amplifiers, Detectors, Filters, Networks

BUSSCO ENGRG., 119 Standard St., El Segundo, Cal., 90245, Tel: 213-322-6580, TWX: 910-348-6295; Empl.: 95; Minimum order: $50

For info on price: Sls Dept; Application info: Engrg Dept; Customer service: P. Wainscott; Delivery info: P. Wainscott

Free literature available: General Catalog

Products manufactured: Backpanel Interconnect Systems, Bus Bars & Systems, Terminals

Local Sales Offices & Reps.

Cal	San Carlos, Lodan, Inc.	415-592-4600
Cal	San Diego, AAA Sls.	714-565-0122
Colo	Denver, Todd Assoc., Inc.	303-761-7801
Conn	North Haven, Forsberg Sls.	203-239-5111
Fla	Eau Gallie, J. J. Smith Manufacturers Rep.	305-727-3163
Ill	Oak Park, M. Reith	312-383-5728
Mass	Brockton, Forsberg Sls.	617-522-6300
Mich	Grand Rapids, R. P. Urban & Assoc.	616-245-0511
Minn	St. Paul, Countryman & Assoc.	612-645-9151
NJ	So. Bound Brook, Jolt Elctrn. Sls.	201-469-2030
NY	Rochester, R. P. Kennedy Co.	716-271-6322
Pa	LaFayette Hill, M.C.D. Assoc.	215-828-0560
Tex	Dallas, E. B. Robertson, Inc.	214-942-2716
Tex	Houston, E. B. Robertson, Inc.	713-785-6800
Va	McLean, Carwithen Assoc.	301-589-9112
Wash	Bellevue, H. Paulman Sls.	206-455-3311

BUSSMANN MANUFACTURING, Div. McGraw-Edison Co., University at Jefferson, St. Louis, Mo., 63107, Tel: 314-421-1740; FSC No: 5920; QPL No: Multiple; Minimum order: $15 .... p. 1•1960-1965

For info on price: N. Schmitz; Application info: W. Curtis; Customer service: N. Schmitz; Delivery info: N. Schmitz

Free literature available: BUSS Form SFB - 28 page catalog featuring the complete line of Fuses, Fuseholders, Fuse Blocks and Accessories

Products manufactured: Clamps & Clips, Fuses, Indicators

Local Sales Offices & Reps.

Ala	Montgomery, A. Ashurst	205-328-9623
Cal	Los Angeles, L. Waggoner	213-263-7105
Cal	San Francisco, R. Madden	415-282-8220
Colo	Denver, L. Hall	303-322-2189
Conn	Cheshire, J. Miller	203-624-2440
Fla	Clearwater, W. Penhallegon	813-531-5112
Ga	Chamblee, L. Acker	404-457-1356
Ill	Northlake, J. Waters	312-562-3370
Ill	Peoria Heights, V. Saporita	309-685-9897
Ind	Carmel, J. Adams	317-637-9606
Iowa	Davenport, T. Bates	319-355-5400
Kans	Overland Park, B. Favaloro	816-EM3-3700
Ky	Louisville, M. Dickson	502-451-7652
La	New Orleans, A. Richard	504-488-5333
Md	Baltimore, J. Rambo	301-243-1717
Mass	Winchester, C. Dane	617-HA6-2122
Mich	Grand Rapids, R. Berry	616-949-4660
Mich	Southfield, T. Ewald	313-961-9405
Minn	Minnetonka, R. Norris	612-935-6280
Mo	St. Louis, P. Friemel	314-421-1740
Neb	Bellevue, B. Shriver	402-341-9224
NJ	Newark, A. Cox	201-484-3500
NY	Brewerton, P. Palys	315-422-1929
NY	Fairport, G. Goyette	716-377-7591
NY	New York, T. Lawless	212-267-1466
NC	Greensboro, K. Williams	919-299-3348
Ohio	Cincinnati, J. Wulfmeyer	513-241-1740
Ohio	Orient, J. Wise	614-237-9810
Ohio	Strongsville, G. Ockuly	216-561-4875
Ohio	Toledo, J. Atkins	419-241-1141
Okla	Oklahoma City, H. Gossage	405-751-4996
Okla	Tulsa, L. Welborn	918-742-5914
Ore	Lake Oswego, S. Dyrnes	503-234-0281
Pa	Newtown Square, A. Branning	215-KI6-0644
Pa	Pittsburgh, H. Slack	412-364-5230
Tenn	Memphis, R. Terry	901-397-2306
Tex	Dallas, J. Tubbesing	214-357-8357
Tex	Houston, E.H. McGowan	713-526-3101
Utah	Salt Lake City, O. Christiansen	801-363-4596
Va	Hayes, W. Kirkland	804-642-5550
Wash	Seattle, R. Shipek	206-RO3-1350
Wisc	Milwaukee, W. Burbach	414-964-3185

C & A PRODUCTS, INC., 37-12 58th St., Woodside, N.Y., 11377, Tel: 212-779-4303; Empl.: 37 ... p. 1•148-151

Customer service: R. M. Bogin

Free literature available: Synchro-to-Digital Converters, Angle Position Indicators, Synchro-to-Linear DC Converters, Multiplexed Synchro-to-Digital Converters, Digital-to-Sine-Cosine DC Converters, Digital-to-Synchro Converters, Synchro-to-Sine-Cosine DC Converters, Absolute Shaft Angle Encoders.

Products manufactured: Amplifiers, Controls/Control Eqpt., Converters, Demodulators, Detectors, Encoders, Indicators, Meters, Programmers, Repeaters, Servo, Resolvers, Synchro, Servo Systems, Standards, Switches, Synchro Transmitters, Solid-State, Testers, Transducers.

C-COR ELCTRNS., D., 60 Decibel Rd., State College, Pa., 16801, Tel: 814-238-2461, TWX: 510-691-1933; FSC No: 12775; Empl.: 150; Minimum order: $25

Customer service: G. H. Rachau

Free literature available: 1974-75 Industrial Short Form Catalog, Industrial Amplifier Catalog Data Sheets, Cable Television Systems and Products Catalog 1974-75, Cable Television Systems and Products Price List July 15, 1974

Products manufactured: Amplifiers, CATV Systems & Equipment, Converters, Mixers

Local Sales Offices & Reps.

Cal	Canoga Park, C-COR Elctrns., Western	213-887-0754
Cal	Los Altos, Astroel, Inc.	415-948-3636
DC	Wash., Eastern Instr.	301-839-3800
Va	Richmond, Eastern Instr., Inc.	703-644-6622
EXP:	NY, N.Y., S. Ginsbury	212-689-5212

C-F ELECTRONICS, INC., 14709 Keswick St., Van Nuys, Cal., 91405, Tel: 213-781-3849; FSC No: 5905; Empl.: 50; Minimum order: $15

For info on price: K. Landers; Application info: R.G. Jordan; Customer service: K. Landers; Delivery info: K. Landers

Free literature available: Catalog Free samples when ordered on company purchase order

Products manufactured: Networks, Resistors, Shunts, Meter

Local Sales Offices & Reps.

Ariz	Phoenix, Moltronics of Ariz.	602-272-7951
Ariz	Phoenix, MIRCO Electronics	602-944-2281
Ariz	Phoenix, Parts Electronics	602-258-6476
Cal	San Diego, Ohm Spun Electronics	714-277-6230
Cal	Santa Clara, Mauldin Co.	408-249-7660

C & K COMPONENTS, INC., 103 Morse St., Watertown, Mass., 02172, Tel: 617-926-0800, TWX: 710-327-0460; FSC No: 09353; Empl.: 190; Minimum order: $1 .... p. 1•1968,1969

For info on price: S. Trocki; Application info: J. Martinec; Customer service: N. Seldon; Delivery info: M. Kincaid

Products manufactured: Switch Hardware, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Mfg.	205-881-5031
Ariz	Scottsdale, Engrg. Sls. Assoc.	602-945-5781
Cal	Los Altos, Ewing-Foley Inc.	415-941-4525
Cal	Los Angeles, Universal Comp. Co.	213-641-4255
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Ga	Atlanta, Beacon Mfg.	404-351-3654
Ill	Des Plaines, Control Sls.	312-296-5595
Minn	St. Louis Park S., Beta Engrg. Co.	612-925-4422
NJ	Cherry Hill, Quality Comps.	609-428-6266
NY	Elbridge, L-Tron Corp.	315-689-3787
NY	Mt. Vernon, D. Sonkin Assoc.	914-668-9809
Ohio	Cincinnati, F.E. Kahsar Sls.	513-471-9011
Ohio	Hudson, F.E. Kahsar Sls.	216-653-6808
Tex	Richardson, R.F. Kimball Co.	214-231-3447
Utah	Salt Lake City, Arrowhead Sls. Corp.	801-487-0036

Local Distributors

Ala	Huntsville, Cramer
Alas	Anchorage, Yukon Radio Supply
Ariz	Phoenix, Kierulff Elctrns.
Cal	Gardena, Santa Monica Bell
Cal	Glendale, RCA, Cramer
Cal	Los Angeles, Fisher Switches
Cal	Los Angeles, Kierluff Elctrns.
Cal	Menlo Park, Bell Inds.
Cal	Palo Alto, Kierluff Elctrns.
Cal	Redwood City, Cramer Elctrns.
Cal	San Diego, Kierluff Elctrns.
Cal	San Diego, R&C/Cramer
Cal	Santa Clara, Fisher Switches
Colo	Denver, Kierluff Elctrns.
Conn	Hamden, Wilshire Elctrns.
Fla	Miami, Electronics Equip.
Fla	Orlando, Hallmark Elctrns. Corp.
Fla	Orlando, Hammond Elctrns.
Fla	Palm Beach Gardens, Controlled Distr.
Ga	Atlanta, Cramer/Atlanta
Ill	Palatine, Cramer/Chicago
Ill	Rosemont, Advent Elctrns.
Ill	Westchester, L-Comp, Inc.
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply
Iowa	Cedar Rapids, Deeco, Inc.
Kans	Wichita, Radio Supply Elctrns.
Ky	Owensburg, Ohio Valley Sound
Md	Baltimore, Arrow Elctrns.
Mass	Burlington, Arrow Elctrns.
Mass	Dedham, Gerber Elctrns.
Mass	Needham, Schley/Kierluff
Mass	Newton, Cramer Elect.
Mass	Watertown, D.R.W. Elec. Corp.
Mich	Ann Arbor, Advent
Minn	St. Louis, Park Elctrns.
Mo	St. Louis, L-Comp, Inc.
Neb	Lincoln, Scott Elect. Supply Corp.
NJ	Moorestown, Arrow-Angus
NJ	Springfield, Route Elect.
NM	Albuquerque, Kierluff Elctrns.
NY	Albany, E. E. Taylor
NY	Bohemia, Car Lac Elctrns.
NY	Buffalo, Summit Distr.
NY	Hempstead, Elctrn. Equip.
NC	Raleigh, Pyttronics
Ohio	Dayton, Esco, Inc.
Okla	Oklahoma City, Hallmark Elctrns. Corp.
Pa	Huntington Valley, Hallmark Elctrns.
Pa	Montgomeryville, Pyttronics Inds.
Pa	Paoli, F.J.R./Kierluff-Phil.
Tex	Dallas, Hallmark Elctrns. Corp.
Tex	Houston, Altair Co.
Utah	Salt Lake City, Kimball Elctrns.
Va	Richmond, Meridian Elctrns.
Wash	Bellevue, Bell Inds.
Wash	Seattle, Kierluff Elctrns.
Wisc	Mequon, Taylor Elect. Co.
Wyo	Cheyenne, Houge Radio & Supply Co.

CABLE SYSTEMS & ASSEMBLY CO., INC., 210 Broadway, Everett, Mass., 02149, Tel: 617-387-7550; FSC No: 33426; Empl.: 65; Minimum order: $48

For info on price: T. Armelin; Application info: E. Vecchia; Customer service: T. Armelin; Delivery info: C. Ferrando

Products manufactured: Cable Assemblies & Harnesses, Cable, Cords, Services, Assembly, Production & Test

CABLEMASTER DIV., Accurate Elctrns. Corp., 7350 Atoll St., No. Hollywood, Cal., 91605, Tel: 213-875-0500

Products manufactured: Locators, Open-Short, Testers

Local Sales Offices & Reps.

Cal	San Jose, White & Co.	408-292-8229
Fla	Orlando, R. Attaway Co.	305-424-9983
Md	Lutherville-Timonium, Naudain Assocs.	301-252-5378
Mich	Detroit, Electro Enterprises, Inc.	313-886-2280
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NC	Winston-Salem, Radco Co.	919-722-9671
Ohio	Cleveland, Electro Enterprises, Inc.	216-261-7670
Ohio	Dayton, Electro Enterprises, Inc.	513-426-6071
Pa	Phildelphia, Naudain Assocs.	215-564-3194
Pa	Pittsburgh, Electro Enterprises, Inc.	412-371-8497
Tex	Houston, Brice Co.	713-526-3197
Va	Lynchburg, Naudain Assocs.	703-846-8044
Wash	Seattle, Paratech	206-783-3900

CABLEWAVE SYSTEMS INC., 60 Dodge Ave., North Haven, Conn., 06473, Tel: 203-239-3311, TWX: 710-465-0244; Empl.: 135; Minimum order: $50

Customer service: S. Raucci, Jr.

Products manufactured: Antenna Feed Systems, Cable, Connector Adapters, Connectors, Dehydrators, Delay Lines, Kits, Cable-End Sealing, Plug Adapters, Socket Adapters, Splicers, Coaxial Cable, Tees, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Technology Mktg. Assocs.	205-883-7893
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Alhambra, M. W. Riedel & Co.	213-283-7694
Cal	Redwood City, Woodworth Co.	415-365-0252
Fla	Ormond Beach, Technology Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Ft. Wayne, McDonald Sls. Co.	219-747-3650
Md	New Carrollton, W. A. Brown Equip-Comp, Inc.	301-577-4527
Mass	Haverhill, L-K Assocs.	617-373-1313
Mo	Kansas City, Forristal-Young Sls. Co.	816-358-6771
Mo	St. Louis, Forristal-Young Sls. Co.	314-645-2360
Neb	Omaha, Forristal-Young Sls. Co.	402-333-0800
NJ	Keasbey, Addem 2	516-567-5900
NY	Huntington Station, Addem 1	516-567-5900
NY	Syracuse, T2 Elctrns.	315-463-8592
NC	Winston-Salem, Burgin-Kreh Assocs., Inc.	919-768-4174
Pa	Fort Washington, Kirk-Sandell, Inc.	215-643-2100
Tex	Dallas, Hillman Entprs.	214-827-4790
Va	Alexandria, W. A. Brown Equip-Comp, Inc.	703-836-1800
Va	Lynchburg, Burgin-Kreh Assocs., Inc.	804-845-5600
Wash	Bellevue, Thorson Co.	206-455-9180
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

CABTRON SYS., INC., 200 Anets Dr., Northbrook, Ill., 60062, Tel: 312-498-6090; Empl.: 30 .... p. 1•56,57

Free literature available: Short form catalog 801 metal cabinets for electronic equipment featuring the exclusive filtered base construction and all modular design.

Products manufactured: Benches, Consoles, Stools, Tables, Blowers & Fans & Accessories, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Panels, Racks

Local Sales Offices & Reps.

Ariz	Scottsdale, Elctrn. Entpr., Inc.	602-946-9860
Cal	Santa Clara, Nova-Tronix	408-243-9530
Cal	Tustin, Spaulding Sls. Co.	714-832-1384
Colo	Golden, F. R. Campbell Assocs.	303-238-4174
Fla	Cocoa, Orbe, Inc.	305-452-9568
Fla	Fort Lauderdale, Orbe, Inc.	305-564-8571
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ill	Northbrook, Cabtron Sys.	312-498-6090
Ind	Fort Wayne, S & S Elctrns.	219-743-4611
Md	Silver Spring, Ansell Engrg.	301-949-1655
Mass	Wakefield, Meas. Equip. Co.	617-245-4870
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	St. Paul, Countryman Assocs.	612-645-9151
Mo	Raytown, Prod. Automation	816-737-0066
NM	Albuquerque, Elctrn. Entprs.	505-256-3561
NY	Port Washington, Paul D. Aaron	516-883-0600
NY	Syracuse, Tesco Assocs.	315-463-4566
NC	Kernersville, S. K. Wallace Assoc.	919-993-3993
Ohio	Cleveland, Geotronix Mktg. Assoc.	216-526-2535
Ohio	Columbus, Geotronix Mktg. Assoc.	614-457-8472
Pa	Feasterville, Professional Svc.	215-355-6244
Tex	Addison, Dunbar Assocs.	214-239-7151
Wash	Renton, S. Wilson Co.	206-226-0650

CADDEL-BURNS MFG. CO., INC., 40 E. 2nd St., Mineola, N. Y., 11501, Tel: 516-746-2310; Empl.: 30 p. 2•382-386

Products manufactured: Chokes, Coils Including Assemblies & Forms, Cores, Magnetic, Delay Lines, Filters, Shields, Transformers, Wire

Local Sales Offices & Reps.

Ohio	Dayton, C. V. Clark	513-294-7337

CADDELL COIL CORP., 35 Main St., Poultney, Vt., 05764, Tel: 802-287-4055; Empl.: 6; Minimum order: $10

For info on price: J. Caddell; Application info: J. Caddell; Customer service: R. Caddell; Delivery info: R. Caddell

Free literature available: Catalog, catalog supplement & price list. Lists stock coil products-toroids, chokes, variable coils, pot core transformers and coil parts. Gives specifications-inductance, Q, etc.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Fla	Sebastian, R.B. Caddell	809-492-2971
Mass	West Falmouth, D.P. MacDonald	617-548-7039

Advertisment

COIL WINDING JOB SHOP–RF coils, chokes, transformers. Coils to Print or Specification–toroids, printed circuit, pot core inductors, high current chokes, coils with ferrite or powdered iron, slug tuned, pi wound, single layer, random wound, encapsulation.
RF coils for communication, experimentation, avionics, radar, CATV, RF power, tests & measurement.
Send for catalog of stock coils.

CADDOCK ELECTRONICS, INC., 3127 Chicago Ave., Riverside, Cal., 92507, Tel: 714-683-5361, TWX: 910-332-6108; FSC No: 19647; Empl.: 80; Minimum order: $25 .... p. 1•884-887; p. 2•1428-1443

For info on price: F. Grimes; Application info: R. Caddock; Customer service: L. Johnson; Delivery info: F. Grimes

Free literature available: 1. Long-term stability data (40,000 hours) on Micronox high-performance resistors. 2. Test summary compiled from two years of Reliability Testing on Caddock Micronox film resistors.

Products manufactured: Dividers, Films, Networks, Packages, Integrated Circuit, Resistors

Local Sales Offices & Reps.

Ore	Portland, Almac/Stroum Elctrns.	503-292-3534
Tex	Houston, Unidyne, Inc.	713-782-0218
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300

Local Distributors

Tex	Houston, Lenert Co., 1420 Hutchins	713-225-1465

CADILLAC PLASTIC & CHEMICAL, Dayco Co., Box 810, Detroit, Mich., 48232, Tel: 313-869-9500; Empl.: 1000

For info on price: L. Lumberg; Application info: D. Meyer; Customer service: D. Meyer; Delivery info: D. Meyer

Free literature available: Cadillac Plastic Buyers Guide - the complete what, where and how of plastics for industry and home. Cadillac Plastic OSHA-Spec Safety Products Buyers Guide - complete Osha-Spec Safety Products line featuring brand name products in compliance with OSHA standards.

Products manufactured: Bearings, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Bushings, Glass, Plastic, Metal, Rubber, Etc., Conductive Plastic Materials, Containers, Covers, Protective (Including Dust), Laminates, Materials, Self-Lubricating, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber, Seals, Services, Assembly, Production & Test, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive, Tubing

Local Sales Offices & Reps.

Ala	Birmingham	205-251-8951
Ala	Mobile	205-456-8481
Alas	Anchorage	907-337-2863
Ariz	Phoenix	602-264-0861
Cal	Anaheim	714-538-0021
Cal	North Hollywood	213-980-0840
Cal	So. San Francisco	415-761-0740
Colo	Denver	303-287-2506
Conn	Hartford	203-278-6900
Del	Wilmington	302-655-1027
DC	Washington	202-638-4552
Fla	Jacksonville	904-724-7274
Ga	Atlanta	404-351-9800
Ill	Chicago	312-243-2500
Ill	Rockford	815-874-9444
Ind	Indianapolis	317-639-5343
Ind	South Bend	219-272-1200
Iowa	Davenport	319-391-2224
Kans	Kansas City	913-888-5950
Ky	Louisville	502-448-6444
La	New Orleans	504-834-6222
Md	Baltimore	301-485-4200
Mass	Boston	617-666-8840
Mich	Detroit	313-869-9500
Mich	Flint	313-238-0411
Mich	Grand Rapids	616-452-6926
Mich	Kalamazoo	616-343-1341
Minn	Minneapolis	612-339-7941
Mo	St. Louis	314-991-1790
NH	Manchester	603-627-3583
NJ	Linden	201-862-8900
NJ	Pennsauken	609-662-4100
NM	Albuquerque	505-345-2516
NY	Albany	518-459-3377
NY	Buffalo	716-684-9200
NY	Long Island City	212-721-8484
NY	Rochester	716-235-2260
NC	Charlotte	704-523-7880
Ohio	Akron	216-644-7183
Ohio	Cincinnati	513-271-2780
Ohio	Cleveland	216-441-2200
Ohio	Columbus	614-228-6991
Ohio	Toledo	419-244-6757
Okla	Tulsa	918-836-6556
Pa	Philadelphia	215-925-3473
Pa	Pittsburgh	412-372-2202
RI	Warwick	401-738-6969
Tenn	Memphis	901-365-6600
Tex	Dallas	214-631-4460
Tex	Ft. Worth	817-332-4421
Tex	Houston	713-928-2581
Va	Richmond	804-276-2791
Wash	Seattle	206-682-7252
Wisc	Green Bay	414-435-8811
Wisc	Milwaukee	414-444-7650

CAHNMAN, HVGO N. ASSOCS., See Casso-Solar Inc.

CAI, DIV. BOURNS INC., 550 W. Northwest Hwy., Barrington, Ill., 60010, Tel: 312-381-2400, TWX: 910-651-1904; Empl.: 600; Minimum order: $100

For info on price: F. Consdorf x 406; Application info: K. Paap x 415; Customer service: G. Lohuis x 401; Delivery info: F. Consdorf x 406

Products manufactured: Cameras, Lenses, Optical & Camera

Local Sales Offices & Reps.

Cal	Los Angeles	213-670-4909
Va	Arlington	703-525-2590

CAIG LABS., INC., 455A Union Ave. Box 788), Westbury, N.Y., 11590, Tel: 516-334-1940; Empl.: 12; Minimum order: $10

Customer service: J. Howard

Free literature available: Bulletin C-200-Technical Facts about Cremoline Contact cleaner as applied to electronic and electrical metal contacts.

Products manufactured: Chamber, Environmental Test, Cleaners & Solvents, Coatings, Controls/Control Eqpt., Flux, Brazing & Soldering Materials, Heat Guns, Production, Lamps, Lubricants, Meters, Solder (All Types), Solder Pots & Baths, Soldering Accessories, Soldering Equipment

Local Sales Offices & Reps.

Cal	Northridge, P Dooley	213-360-2231
Fla	Winterhaven, S & S Sls. Reps.	813-293-7304
Ill	Palatine, J Clark	312-358-5095
Ohio	Canton, G. Melbourne	216-492-3333

Local Distributors

Ark	Little Rock, Carlton-Bates Co., 6821 Scott Hamilton Dr.	501-562-9100
Cal	Los Angeles, California Elec. Sply., 1911 Armacost W.	213-826-8333
Del	Wilmington, Wholesale Elctrn., 1402 Walnut St.	302-656-5988
Ill	Champaign, Klaus Radio Inc., 905 S. Neil St.	217-356-1896
Ill	Chicago, Complete Reading Elect., 100 So. Jefferson St.	
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
La	Baton Rouge, R.P.S. Elctrns., Inc., 1732 Plank Rd.	504-344-3761
Md	Bethesda, Empire Elctrns., 4907 Rugby Ave.	301-OL6-3300
Md	Rockville, Capital Radio Wholesalers, 12270 Wilkins Ave.	301-881-2270
Mich	Grand Rapids, Stotts-Friedman, 2035 Eastern Ave., S.E.	616-241-6731
Mo	Kansas City, Walters Radio Supply Inc., 3635 Main St.	816-531-7015
NC	Fayetteville, Southeastern Radio, 325 Rowan St.	
Ohio	Cleveland, Complete Reading Elect., 13311 Enterprise Ave.	
Tex	El Paso, Midland Spec. Co., 2235 Wyoming Ave.	915-533-9555
Tex	Odessa, Midland Specialty Co., 2101 Andrew's Highway	915-337-7365
Va	Norfolk, Priest Elctrns., 6431 Tidewater Dr.	703-855-2021
Va	Norfolk, Radio Parts Dist. Co., 5652 E. Virginia Bch. Blvd.	703-855-8095

CAL-METEX CORP., 509 Hindry Ave., Inglewood, Cal., 90301, Tel: 213-641-8000, TWX: 910-328-6100; Empl.: 37

Products manufactured: Adhesives (All Types), Air Cleaners & Filters (Shielded & Unshielded), Bezels, Shielded & Unshielded, Braid, Cable, Conductive Plastic Materials, Contacts, Electrical, Containers, Gaskets, Shielding, R-F-Also See Shields, R-F, Honeycomb Sheets, Panels, etc., Rubber, Shields, Tubing, Wire, Wire Shielding

Local Sales Offices & Reps.

Ariz	Phoenix, Intermountain Engrg.	602-947-7379
Cal	Los Altos, Frauman Assoc.	415-941-0660
Cal	Los Angeles, Universal Comps.	213-474-1537
Colo	Denver, Walter Assoc.	303-777-5585
Wash	Seattle, Jon B. Jolly, Assoc.	206-938-4166
FOR:	Can., Vancouver, B.C., J.B. Jolly	206-938-4166

CAL-POWER CORP., 140 Kansas St., El Segundo, Calif., 90245, Tel: 213-772-2171, TWX: 910-348-6678; Empl.: 30

For info on price: L. Berggren; Application info: K. Richter

Products manufactured: Chargers, Battery, Controls/Control Eqpt., Converters, Eliminators, Battery, Inverters, Monitors, Power Supplies, Regulators

CAL-R, INC., P.O. Box 1397, Santa Monica, Cal., 90406, Tel: 213-451-9761, TWX: 910-343-6966; Empl.: 130

Products manufactured: Capacitors, Fixed, Resistors, Thermistors

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg. Assoc.	602-277-1453
Cal	Mountain View, Caltron/Pyle, Inc.	415-964-3244
Cal	San Diego, LoDan Inc.	714-279-6383
Colo	Boulder, Mile High Elctrns.	303-444-5615
Conn	Woodbridge, Electronic Mktg. Co.	203-397-1461
Fla	Tampa, F. C. Nickerson Co.	813-885-1416
Ill	Northbrook, Raines-Brin Assocs.	312-498-0890
Ind	Greenwood, Valentine Schillinger	317-888-2260
Ind	South Bend, Valentine Schillinger	219-291-6258
Md	Baltimore, Wafer Assocs.	301-744-1133
Minn	St. Louis Park, Beta Engrg. Co.	612-925-4422
Mo	Blue Springs, Cairns & Hayes Elec. Sls.	816-229-1404
Mo	St. Charles, Cairns & Hayes Elec. Sls.	314-946-6677
NY	Bay Shore, Brunetta Sls. Co.	516-586-1800
NY	Dewitt, Tri-Tech Elctrns.	315-446-2881
Ohio	Cleveland, Del Steffen & Assocs.	216-461-8333
Ohio	Dayton, Del Steffen & Assocs.	513-293-3145
Pa	Narberth, Electro-Comp Sls. Co.	215-664-3576
Tex	Dallas, Hillman Entprs.	214-827-4790
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778
EXP:	Cal., Santa Monica, Trans-World Trade	213-472-0444
FOR:	Can., Mississauga, Ont., Anbak Sls. Can., Ltd.	416-625-1061

CALEX MGF. CO., INC., 3305 Vincent Rd., Pleasant Hill, Calif., 94523, Tel: 415-932-3911; FSC No: 29988; Empl.: 30; Minimum order: $15 .... p. 1•240,1153

For info on price: A. Dallons; Application info: R. A. Belford; Customer service: T. Cate; Delivery info: A. Dallons

Free literature available: Product Catalog, Individual Data Sheets, Power Supply Brochure - 12 page brochure containing modular power supplies and mounting kits.

Products manufactured: Alarms, Amplifiers, Comparators, Current Sources, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Filters, Magnetometers, Monitors, Multipliers, Power Supplies, Regulators, Relays, Timers, Voltage Sources

Local Sales Offices & Reps.

Cal	Mountain View, Gado Instr. Sls.	415-961-2222
Minn	Wayzata, Wm. A. Sternad	612-473-4700
Wash	Bellevue, Topp Engr. Sls. Co.	206-747-5401

Local Distributors

Cal	Santa Monica, Distr. Specialist, 1710 Santa Monica Blvd.	213-829-5401

CALICO DIV., California Instrus. Co., Div. Aiken Inds., Inc., 5150 Convoy St., San Diego, Cal., 92111, Tel: 714-279-8620; FSC No: 16067; Empl.: 80; Minimum order: $25

For info on price: W.W. Hanford; Application info: W.W. Hanford; Customer service: D. Chilcoat; Delivery info: W.W. Hanford

Free literature available: Cimron® Digital Multimeter Selection Guide Invertron® AC Power Source, Short Form Catalog

Products manufactured: Amplifiers, Converters, Counters, Meters, Oscilloscopes, Tape Recording Accessories

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Ariz	Scottsdale, Williams-Assocs., Inc.	602-947-4297
Cal	Los Altos, Jay Stone & Assoc.	415-948-4563
Cal	Los Angeles, QPL Inc.	213-682-3705
Cal	Los Angeles, T. Louis Sniter Co.	213-836-6170
Cal	San Diego, QPL Inc.	714-274-3722
Colo	Denver, Williams-Assocs., Inc.	303-373-4730
Fla	Orlando, FM Assocs.	305-851-5710
Fla	Tequesta, FM Assoc.	305-746-3128
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, SEA Inc.	312-282-6694
Ind	Carmel, SEA Inc.	317-846-2593
Kans	Overland Park, Palatine Engrg.	913-262-5643
Kans	Shawnee Mission, EIR Co.	913-362-0919
La	Baton Rouge, Systems Engrg. Sls. Co., Inc.	504-927-7574
Md	Silver Springs, Eastern Instr.	301-681-8500
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Waytek	612-933-2133
Mo	Hazelwood, EIR Co.	314-895-4100
Mo	St. Louis, Palatine Engrg.	314-426-7055

NM	Albuquerque, Williams-Assocs., Inc.	505-255-1638
NY	Great Neck, Eastern Instr. of N.Y.	516-466-9505
NY	North Syracuse, NACO Electronics	315-699-2651
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Philadelphia, Eastern Instr. of Phil.	215-927-7777
Tex	Houston, Systems Engrg. Sls. Co., Inc.	713-668-7840
Tex	Richardson, Systems Engrg. Sls. Co., Inc.	214-231-9364
Wash	Seattle, Datacom Assocs.	206-285-2525

CALIFORNIA AVIONICS LABS., INC., Box 701, Palo Alto, Calif., 94302, Tel: 415-328-7999; Empl.: 5; Minimum order: $10

Customer service: K. A. Hirschberg

Free literature available: Cable Catalog

Products manufactured: Cable Assemblies & Harnesses, Calibrators, Cords, Data Acquisition & Reduction Systems, Generators, Leads, Test & Adaptors

CALIFORNIA COMPUTER PRODS., 2411 W. La Palma Ave., Anaheim, Cal, 92801, Tel: 714-821-2011, TWX: 910-591-1154; Empl.: 4000

For info on price: Sls. Off.; Application info: J. L. Pyle; Delivery info: Sls. Off.

Free literature available: Literature on the following products: digital plotting equipment, disk and tape memory systems, COM systems, intelligent terminals, and our automated tape library.

Products manufactured: Computers, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Disc Packs, Magnetic, Drums Computer Memory, Memory Systems, Paper, Graphic Recording, Printers, Recorders

Local Sales Offices & Reps.

Ala	Huntsville	205-837-8540
Cal	El Segundo	714-523-7081
Cal	Newport Beach	714-833-0141
Cal	Sunnyvale	408-732-8421
Colo	Denver	303-433-7136
Conn	Meridian	203-634-3181
Fla	Maitland	305-645-1011
Fla	Orlando	305-851-1580
Ga	Atlanta	404-449-4610
Ill	Rosemont	312-693-6030
Kans	Shawnee Mission	913-362-0707
Md	Rockville	301-770-5274
Mass	Waltham	617-890-0484
Mich	Southfield	313-358-3130
Minn	Bloomington	612-888-0297
Minn	Minneapolis	612-888-0297
Mo	St. Louis	314-567-5215
NJ	Union	201-686-7100
NY	Fairport	716-223-2110
NY	Hicksville	516-938-7255
Ohio	Cleveland	216-243-7180
Ohio	Dayton	513-276-3915
Okla	Tulsa	918-742-8039
Ore	Beaverton	503-646-3942
Pa	Bala Cynwyd	215-667-1740
Pa	Pittsburgh	412-922-3430
Pa	Wayne	215-687-2910
Tex	Dallas	214-661-2326
Tex	Houston	713-781-6133
Utah	Salt Lake City	801-355-3459
Wash	Bellevue	206-747-9321
EXP:	Anaheim, Cal.	714-821-2011

CALIFORNIA INSTRS. CO., Div. Aiken Inds. Inc., 5150-Convoy St., San Diego, Cal., 92111, Tel: 714-279-8620, Telex: 695047; FSC No: 16067; Empl.: 80; Minimum order: $25 .... p. 1•626-629,1164,1165

For info on price: W. W. Hanford; Application info: W. W. Hanford; Customer service: D. Chilcoat; Delivery info: W. W. Hanford

Free literature available: Cimron® Digital Multimeter Selection Guide Invertron® AC Power Source Short Form Catalog

Products manufactured: Amplifiers, Converters, Counters, Generators, Isolators, Meters, Oscillators, Oscilloscopes, Power Supplies, Probes, Protectors, Regulators, Shifters, Suppressors, Tape Recording Accessories, Transformers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, FM Assoc.	205-536-9990
Ariz	Scottsdale, Williams Assoc.	602-947-4297
Cal	Los Altos, Jay Stone & Assoc.	415-948-4563
Cal	Los Angeles, Basic Systems	800-252-9075
Colo	Denver, Williams Assoc.	303-373-4730
Fla	Orlando, FM Assoc.	305-851-5710
Fla	Tequesta, FM Assoc.	305-746-3128
Haw	Honolulu, Aloha Assoc.	808-941-1574
Ill	Chicago, Sea Inc.	312-282-6694
Ind	Carmel, Sea	317-846-2593
Kans	Shawnee Mission, EIR Co.	913-362-0919
Md	Silver Springs, Eastern Instrumentation	301-681-6500
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Waytek Inc.	612-933-2133
Mo	Hazelwood, EIR Co.	314-895-4100
NM	Albuquerque, Williams Assoc.	505-255-1638
NY	Great Neck, Eastern Instr. of N.Y.	516-466-9505
NY	North Syracuse, NACO Elctrns.	315-699-2651
NC	Greensboro, FM Assoc.	919-294-2754
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Philadelphia, Eastern Instr. of Phil.	215-927-7777
Tex	Houston, Systems Engrg. Sls. Co.	713-668-7840
Tex	Richardson, Systems Engrg. Sls. Co.	214-231-9364
Wash	Seattle, Datacom Assoc.	206-285-2525

CALIFORNIA MICROWAVE, INC., 455 W. Maude Ave., Sunnyvale, Cal., 94086, Tel: 408-732-4000, TWX: 910-339-9231; Empl.: 315

For info on price: Mktg. Dept.; Application info: Mktg. Dept.; Customer service: R. Parry; Delivery info: Contracts Dept.

Products manufactured: Circulators, Ferrite, Converters, Isolators, Multipliers, Oscillators, Testers

Local Sales Offices & Reps.

Cal	Los Angeles, Cain Technology	213-476-2251
Cal	Mountain View, D. Lay Assocs.	415-968-7500
Colo	Englewood, Cal. Microwave	303-770-8228
Ill	Park Ridge, R. F. Specialists	312-698-2044
Ind	Ft. Wayne, R. F. Specialists	219-485-8982
Md	Glen Burnie, Micro-Comp	301-761-4600
Mass	Lexington, Lancer Assocs.	617-861-1720
NY	Great Neck, Trionic Assocs.	516-466-2300
NY	Skaneateles, Robtron	315-685-5731
Pa	Ambler, W. M. Assocs.	215-643-4119
Tex	Arlington, N and W Sls.	817-461-4443
Va	Arlington, Cal. Microwave	703-841-1774

CALLINS CAPACITORS, Box C, Greenfield, Tenn., 38230, Tel: 901-235-2234, TWX: 810-590-3779; Empl.: 435; Minimum order: $100

For info on price: M. O'Hara; Application info: J. Stewart; Customer service: M. R. Maness; Delivery info: J. Hamilton

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ala	Huntsville, Comps. Sls. Corp.	205-883-7794
Ariz	Phoenix, Southwest e/m Engrg.	602-993-0250
Ariz	Phoenix, W. Bert Knight Co.	602-242-3057
Cal	Newport Beach, W.B. Knight Co.	714-833-8250
Cal	Redwood City, Parks & Pruitt Assocs.	415-364-1640
Conn	Meriden, Electro Prods. Sls.	203-235-4040
Conn	Waterbury, Selmark Assocs.	203-754-3060
Fla	Indialantic, Comps. Sls. Corp.	305-727-2681
Fla	N. Palm Beach, Callins Ind.	305-848-3466
Fla	Terra Ceia, Comps. Sls. Corp.	813-722-6376
Ind	Columbus, A. Bolenbaugh	812-372-8666
Md	Baltimore, Stitzer Assocs.	301-823-2600
Mass	Millis, Selmark Assocs.	617-376-2914
Mass	Waltham, Electro Prods. Sls.	617-899-1570
Mich	Jackson, Norwood Scroggs Co.	517-750-1170
Minn	Minneapolis, Comstrand	612-560-5300
Minn	Minneapolis, White Sls. Co.	612-929-4661
Mo	Hazelwood, Dy-Tronix	314-731-5799
Mo	Kansas City, Dy-Tronix	816-761-6543
NY	Camillus, C.L. Avery Assocs.	315-672-3988
NY	New York City, C.L. Avery Assocs.	212-823-5224
NY	Rye, C.L. Avery Assocs.	914-967-7610
NC	Raleigh, Comps. Sls. Corp.	919-832-1897
Okla	Broken Arrow, P. J. Scanlon Co.	918-251-1427
Okla	Tulsa, P.J. Scanlon Co.	918-663-1427
Pa	Paoli, Stitzer Assocs.	215-644-5500
Tex	Houston, P.J. Scanlon Co.	713-497-2302
Tex	Richardson, P.J. Scanlon Co.	214-231-4661
Wisc	Milwaukee, Gentron Corp.	414-351-1660

CALMARK CORP., 408 S. Gladys Ave., San Gabriel, Cal., 91776, Tel: 213-287-0451; FSC No: 52094; Empl.: 6; Minimum order: $10

For info on price: W. J. Jacobs; Application info: A. Weisman; Customer service: M. Kerby; Delivery info: M. Kerby

Free literature available: Technical Data and Pricing for PC Card Cages, Card Guides, Card Insertion and Extraction Devices.

Products manufactured: Chassis, Circuit Board Mounting, Chassis, Metal, Guides, Circuit Board, Pullers, Racks

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs.	205-536-1941
Ariz	Tempe, Delta Elctrn. Sls. Corp.	602-966-9903
Cal	Fremont, H. K. Foraker Co.	415-657-2213
Cal	San Gabriel, Calmark Corp.	213-287-0451
Colo	Denver, West/Mark Assocs.	303-433-7181
Fla	Satellite Beach, Reynolds & Assocs. Inc.	305-773-4700
Ga	Atlanta, Reynolds & Assocs. Inc.	404-252-5360
Ill	Arlington Hgts., Martec Assocs.	312-956-8090
Md	Towson, Kraft Electronic Sls.	301-828-5838
Mass	Westboro, Technical Mktg. Svcs. Co.	617-366-8462
Minn	Minneapolis, Components Group	612-824-4222
NJ	Medford, Component Consultants	609-654-2800
NY	Cooperstown, Fitzelle Assocs.	607-547-9333
NY	Northport, Production Sls. Assocs.	516-757-0336
Ohio	Cleveland, Components, Inc.	216-842-2737
Ohio	Hamilton, Components, Inc.	513-721-2997
Okla	Broken Arrow, P. J. Scanlon Co.	
Tex	Richardson, P. J. Scanlon Co.	214-231-4661

CALTRON INDUSTRIES, 2015 Second St., Berkeley, Cal., 94710, Tel: 415-548-1966; Empl.: 18

For info on price: S. Foster; Application info: J. Chourre; Customer service: S. Foster; Delivery info: S. Foster

Free literature available: Lab products catalog-wire, cable, tubing, & cable assemblies for laboratories. Manufacturing services data sheets-wire & cable harnessing, cable assemblies.

Products manufactured: Cable Assemblies & Harnesses, Cable

CALVERT ELCTRNS., INC., 220 E. 23rd St., New York, N.Y., 10010, Tel: 212-679-1340, TWX: 710-581-4068; Empl.: 50; Minimum order: $50

For info on price: J. McBride; Application info: I. Gips; Customer service: R. Borden; Delivery info: P. Karl

Products manufactured: Diodes, Integrated Circuit Devices, Transistor, Diode, Thyristor Heat Dissipators, Transistors, Tubes

Local Sales Offices & Reps.

Cal	San Jose, Calvert Elctrns.	408-265-0521
Fla	Clearwater, Brennan Assocs.	813-446-5006
Fla	Orlando, Brennan Assocs.	305-425-4382
Ill	Chicago, R. Olson Assts.	312-545-3237
Minn	Minneapolis, J.E.M. Anderson Co.	612-823-6459
Pa	Willow Grove, R. Lewis Sales	215-659-0704

CAMBRIDGE MEMORIES, INC., 12 Crosby Dr., Bedford, Mass., 01730, Tel: 617-271-6500, Telex: 92-3336; Empl.: 500

For info on price: W. R. Nimee 271-6502; Application info: W. R. Nimee 271-6502; Customer service: D. C. Turner 271-6505; Delivery info: D. C. Turner 271-6505

Products manufactured: Memory Systems

Local Sales Offices & Reps.

Ariz	Phoenix, Mountaintek	602-242-5551
Cal	Los Altos, Casey Assocs.	415-941-6892
Cal	Torrance, Mitronics Inds.	213-323-7934
Colo	Boulder, Mountaintek	303-444-1738
Colo	Littleton, Mountaintek	303-794-1779
Fla	Orlando, Technical Assocs.	305-894-7531
Ind	Columbus, Miltronics	812-376-6321
Kans	Shawnee Mission, Inland Assocs.	913-362-2366
Mass	Framingham, Victor Assocs.	617-237-4070
Mass	Waltham, Computer Mktg. Assoc.	617-890-1776
Mo	Glencoe, Inland Assocs.	314-938-4992
NM	Albuquerque, Mountaintek	505-268-0003
NY	Great Neck, Measurement Tech.	516-482-3500
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
SC	Spartanburg, Technical Assocs.	803-579-2904
Tex	Dallas, Remtek	214-369-8146
Tex	Houston, Remtek	713-664-2113
Utah	Salt Lake City, Mountaintek	801-278-6056
Va	Annandale, Roy Lankenau Assocs.	703-256-0800
Wash	Bellevue, L. B. Robbins Co.	206-455-1246

CAMBRIDGE THERMIONIC CORP., 455 Concord Ave., Cambridge, Mass., 02138, Tel: 617-491-5400, TWX: 710-320-6399; FSC No: 71279; Empl.: 614; Minimum order: $25

For info on price: R. M. Soule; Application info: W. Walkup; Customer service: R. M. Soule; Delivery info: Cust. Svc. Dept.

Products manufactured: Bars, Shorting, Boards, Plug-In, Boards, Printed Circuit, Boards, Programming, Capacitors, Fixed, Capacitors, Variable, Cards, Linear Function, Cards, Logic, Chokes, Clamps & Clips, Coils Including Assemblies & Forms, Connectors, Controls/Control Eqpt., Converters, Cooling/Heating Modules, Thermoelectric, Crystals, Delay Lines, Enclosures, Module, Plug-In, Eyelets, Filters, Integrated Circuit Devices, Jack Covers, Kits, Breadboarding (For Engineers), Kits, Terminal, Knobs, Machines/Machinery, Production, Modules, Logic, Encapsulated, Motors, Panels, Plug Adapters, Plug & Jack Sets, Posts, Power Supplies, Probes, Pullers, Racks, Shift Registers, Socket Adapters, Sockets, Spacers, Terminal Blocks, Boards & Strips, Terminals, Testers, Transformers

Local Sales Offices & Reps.

Cal	Belmont, Cambridge Thermionic	415-592-4524
Cal	Los Angeles, Cambridge Thermionic	213-776-0472
Colo	Denver, Zeus, Inc.	303-770-4400
Fla	Casselberry, Publicover Assocs.	305-834-5775
Ill	Chicago, Berndt Assocs., Inc.	312-283-0713
Ind	Ft. Wayne, Berndt Assocs., Inc.	317-844-0114
Kans	Overland Park, Ensco-Rep	913-381-7557
Mass	Cambridge, Cambridge Thermionic	617-491-5400
Mich	Dearborn, Pitcher-Poulin, Inc.	313-582-5450
Minn	St. Paul, Cahill Assocs.	612-646-7217
Mo	St. Louis, Ensco-Rep	314-567-3935
NM	Albuquerque, Zeus	505-256-9831
NC	Charlotte, Robert W. Chapman & Co.	704-525-2421
NC	Raleigh, Robert W. Chapman & Co.	919-782-2624
Ohio	Cleveland, K.W. Elctrn. Sls.	216-831-8292
Ohio	Dayton, K.W. Elctrn. Sls.	513-890-2150
Ore	Portland, J.J. Backer Co.	503-297-3776
Ore	Salem, J.J. Backer Co.	503-362-0717
Pa	Allison Park, K W Electronic Sls.	412-487-4300
Pa	Philadelphia, K.B. Erdman Co.	215-224-1833
SC	Greensboro, Robert W. Chapman & Co.	803-232-5391
Tex	Houston, R.F. Kimball	800-492-2805
Tex	Richardson, R.F. Kimball	214-231-3447
Utah	Salt Lake City, Zeus	801-486-2317
Wash	Seattle, J.J. Backer Co.	206-285-1300
Wisc	Brookfield, Berndt Assocs.	414-786-6950
FOR:	Can., Calgary, Alba., Smith-Paterson & Assoc.	
FOR:	Can., Dorval, Que., Cambridge Thermionic (Can.) Ltd.	514-636-9815
FOR:	Can., Vancouver, B.C., Smith-Paterson & Assoc.	604-681-0743
FOR:	Can., Winnipeg, Manitoba, Smith-Paterson & Assoc.	204-774-1855

Local Distributors

Ala	Huntsville, Cramer/E.W. Huntsville, 2310 B. Wallace A	205-539-5722
Ariz	Phoenix, Cramer/Arizona, 2816 N 16th St.	602-263-1112
Cal	Gardena, Bell Inds., 306 E. Alondra Blvd.	213-321-5802
Cal	Menlo Pk., Bell Inds., 1070 O'Brien Dr.	415-323-9431
Colo	Denver, Cramer/Denver, 5465 Evan Pl.	303-758-2100
Conn	Hamden, Wilshire Elctrns., 2554 State St.	203-281-1166
Fla	Hollywood, Cramer/E.W. Hollywood, 4035 N. 29th A.	305-923-8181
Ga	Atlanta, Cramer/E.W. Atlanta, 3923 Oakcliff Ind. C.	404-448-9050
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Mt. Prospect, Cramer/Chicago, 1911 S. Busse R.	312-593-0230
Ind	Ft. Wayne, Fort Wayne Elec. Sup., 3606 Maumee Ave.	219-423-3422
Kans	Lenexa, Hall-Mark Elctrns., 9006 Rose Hill Rd.	913-888-4747
La	New Orleans, Southern Radio Sup., 1909 Tulane Ave.	504-524-2345
Md	Rockville, Cramer/E.W. Wash., Drawer 1648	301-948-0110
Mass	Boston, DeMambro, 1095 Commonwealth	617-787-1200
Mich	Wyoming, Newark Ind. Elect., 3645 Linden Ave. SE	616-241-6681
Minn	Edina, Cramer/Bonn, 7275 Bush Lake Rd.	612-941-4860
MO	Univ. City, Olive Ind. Elect., 6662 Olive Blvd.	314-863-7800
Neb	Lincoln, Scott Elctrn. Sup., 4040 Adams St.	402-434-8308
NJ	Camden, General Radio Supply, 600 Pen St.	609-964-8560
NJ	Rahway, Terminal Elctrns., 1463 Pinewood St.	201-381-5700
NM	Albuquerque, Cramer/New Mexico, 137 Vermont N.E.	505-265-5767
NY	Binghamton, Stack Indust. Elect., 45 Washington St.	607-723-6326
NY	Rochester, Cramer/Rochester, 3259 Winton Rd. S.	716-275-0300
NC	Winston-Salem, Cramer/E.W. W/Salem, 938 Burke St.	919-725-8711
Ohio	Dayton, Pioneer Standard Ele., 1900 Troy St.	513-236-9900
Okla	Tulsa, Hall-Mark Elctrns., 4846 S. 83rd E.	918-835-8458
Pa	Philadelphia, Philadelphia Elect., 1225 Vine St.	215-568-8288
Tex	Dallas, Cramer/Texas, 2970 Blystone La.	214-350-1355
Wash	Bellevue, Bell Inds., 1900 132nd N.E.	206-747-1515
Wisc	Milwaukee, Cramer/Wisconsin, 5626 N. 91st St.	414-462-8300

CAMCAR SCREW & MFG., 600 18th Ave., Rockford, Ill., 61101, Tel: 815-226-3600

Customer service: H. Kirrish 815-226-2400

Products manufactured: Fasteners

CAMUSAT GUEGUEN TELECOM. INT'L., 2 Windward Ave., White Plains, N.Y., 10605, Tel: 914-949-3719, TWX: 710-568-1305; Empl.: 230

Customer service: G. N. Snider

Products manufactured: Antenna Towers & Supports, Antennas, Comm. Systems

Advertisment

- –Towers, Microwave, Radio, TV: Guyed and Self-Supporting
- –Troposcatter Antennas 20' to 120' Lightweight, Patented Design
- –Earth Station Antennas for Synchronous Satellities
- –Passive Reflectors
- –Portable Temporary Towers
- –Civil Engineering, Erection, Installation Overseas
- –Factories in Europe

CAMWIL INC., 835 Keeaumoku, Honolulu, Haw., 96814, Tel: 808-955-0766; Empl.: 12

Products manufactured: Labels, Temperature Indicating

CANNON, C.F. CO., Springwater, N.Y., 14560, Tel: 716-669-2550; Empl.: 25

Products manufactured: Handsets, Chestsets, Headphones, Headsets, Etc.

CANON U.S.A., INC., 10 Nevada Dr., Lake Success, N.Y., 11040, Tel: 516-488-6700, Telex: 96-1333; Empl.: 400 .... p. 1•942

Products manufactured: Amplifiers, Brushes & Brush Assemblies, Commutators, Controls/Control Eqpt., Heads, Recording Playback, Erase, Motors, Recorders, Scanners, Tachometers, Transports, card

CAPACITOR DIV. GENERAL INSTR. CORP., see General Instr. Corp., Semiconductor Prods. Grp. Capacitor Prods.

CAPLUGS DIV., Protective Enclosures Co., 2150 Elmwood Ave., Buffalo, N.Y., 14207, Tel: 716-876-9855, TWX: 716-858-1022; Empl.: 125

Products manufactured: Plug Buttons, Services, Assembly, Production & Test

CAPITOL MACHINE & SWITCH CO., Box 651, Danbury, Conn., 06810, Tel: 203-744-3300, TWX: 710-456-0365; Empl.: 125 .... p. 1•1970,1971

Products manufactured: Lights, Switches

Local Sales Offices & Reps.

Cal	Downey, Trimarco Inc.	213-861-8244
Cal	Los Altos, Frauman Assocs.	415-941-0660
Cal	San Diego, Tauber & Assocs. Inc.	714-274-7242
Colo	Denver, Franklin Sls. Co.	303-922-3623
Conn	N. Haven, Comp. Rep.	203-239-9762
Fla	Orlando, F. Fausett	305-894-6071
Ga	Smyrna, B-C Elctrns.	404-436-5169
Ill	Oak Pk., G. Petitt	312-261-0342
Kans	Shawnee, Lowell, Kangas & Assocs. Inc.	913-631-3515
Mass	Needham, Comp. Rep.	617-444-2484
Mich	Detroit, Heick & Ralph Assocs.	313-538-3350
Minn	So. Minneapolis, Bitronics Sls. Co.	612-835-7744
Mo	St. Louis, Lowell, Kangas & Assocs., Inc.	314-821-4050
NJ	Livingston, Varrelman-Gorman Co.	201-992-2505
Ohio	Chagrin Falls, E. Frost	216-247-7181
Pa	Philadelphia, J. Biernbaum	215-635-1030
Tex	Dallas, Blackburn Assoc.	214-692-8885
Va	Vinton, F. Fausett & Co.	703-890-1128
Wash	Seattle, John McClamrock Co.	206-244-9391
FOR:	Can., Montreal, Que., H.W. Brieger Sls. Co.	514-482-0722
FOR:	Can., Scarborough, Ont., J.R. Tilton, Ltd.	416-757-4171

CAPTOR CORP., 5040 S. County Rd. (25A), Tipp City, Ohio, 45371, Tel: 513-667-8484; Empl.: 48; Minimum order: $25

For info on price: O. Bruns; Application info: B. Jenks; Customer service: O. Bruns; Delivery info: B. Jenks

Products manufactured: Capacitors, Fixed, Filters

Local Sales Offices & Reps.

Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Ill	Chicago, Croydon Elctrns., Inc.	312-237-4343
Ind	Fort Wayne, Croydon-Sarge	219-422-2311
Kans	Wichita, Avionics Engrg. Sls.	316-264-6201
Md	Wheaton, Magyar & Assocs.	301-871-8833
Mass	Framingham, L. Roffer Co.	617-877-4900
Pa	Philadelphia, Magyar & Assocs.	215-763-5044
Tex	Dallas, Blackburn & Assocs.	214-351-9991
EXP:	Smithtown, N.Y., C.P.S.	516-420-9559

CABTRON SYSTEMS, INC., 200 Anets Dr., Northbrook, Ill., 60062; Empl.: 35

Free literature available: Short form Catalog #801 metal cabinets for electronic equipment featuring the exclusive filtered base construction and all modular design.

Products manufactured: Cabinets & Accessories

Local Sales Offices & Reps.

Ariz	Scottsdale, Elctrn. Enterprise	
Cal	Santa Clara, Nova Tronix	408-243-9530
Cal	Tustin, Spaulding Sls. Co.	714-832-1384
Colo	Golden, F.R. Campbell	303-238-4174
Conn	Enfield, Measurement Equip.	203-745-9050
Ind	Fort Wayne, S & S Elctrns.	219-743-4611
Md	Silver Springs, Ansell Engrg.	301-949-1655
Mass	Wakefield, Measurement Equip.	617-245-4870
Mich	Farmington, H. Lowell Co.	
Minn	St. Paul, Countryman Assocs.	612-645-9151
Mo	Hazelwood, Production Automation Corp.	314-731-2331
Mo	Raytown, Production Automation Corp.	816-737-0066
NM	Albuquerque, Elctrn. Enterprise	505-256-3561
NY	Pt. Washington, P.D. Aaron Assocs.	516-883-0600
NY	Syracuse, Tesco Mktg. Resch.	315-463-4566
Ohio	Cleveland, Geotronix Mktg. Assoc.	216-526-2535
Pa	Feasterville, Professional Service Assoc.	215-355-6244
Tenn	Memphis, S.K. Wallace	901-682-2281
Tex	Addison, Dunbar Assoc.	214-239-7151
Wash	Renton, S. Wilson Co.	206-226-0650

CARBONE LORRAINE INDUSTRIES CORP., 400 Myrtle Ave., Boonton, N.J., 07005, Tel: 201-DE 4-0700; Empl.: 350

Products manufactured: Batteries, Brushes & Brush Assemblies, Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Contacts, Electrical, Fabrics, Conductive, Flashers, Fuses, Graphite Parts, Jigs And Fixtures, Chassis & Circuit Board, Limiters, Materials, Self-Lubricating, Resistors, Thermistors

Local Sales Offices & Reps.

Battery Prods.

La	Westwego, Automatic Power	504-347-2384
Pa	Philadelphia, ESB Inc.	215-342-8000
Tex	Houston, Automatic Power	713-228-9081
Tex	Houston, Tideland Signal Corp.	713-681-6101

Brush Prods.

Cal	San Francisco, Advance Carbon Prod.	415-431-4034
Colo	Arvada, R F S	303-423-1264
Conn	Newington, Interep Co.	203-666-4233
Fla	Boca Raton, J. Krupinski	305-395-5970

Fla	Delray Beach, J.W. Beaver	305-276-0111
Ill	Homewood, Carbone	312-798-7400
Ind	Highland, H A Smolen Co.	219-838-2700
Mich	Detroit, Winton Crawford Assocs.	
Mich	Owosso, Cortem Int. Div., Toledo Commutator Co.	517-725-8192
Minn	Minneapolis, W.B. Odegard	
Miss	Jackson, Lawrence & Co.	601-982-9513
NJ	E. Orange, David A. Rugg Co.	201-675-4822
NJ	Toms River, Beaver Co.	201-244-6467
NY	Syracuse, B. Fleckenstein	315-488-7883
Ohio	Copley, Norco	216-666-3774
Pa	Pittsburgh, Bowman & Co.	412-781-5949
Wisc	Milwaukee, F C du Bois & Assocs.	

Carbolube

Cal	San Francisco, Advance Carbon Prods.	415-431-4034
Conn	Newington, Interep Co.	203-666-4233
Fla	Boca Raton, J. Krupinski	305-395-5970
Fla	Delray Beach, J.W. Beaver	305-276-0111
Ill	Homewood, Carbone	312-SY8-7400
Ind	Highland, H.A. Smolen Co.	219-838-2700
Mich	Franklin, Schlee Sls. & Engrg. Co.	313-499-3430
Minn	Minneapolis, William Be Odegard	612-929-2226
Miss	Jackson, Lawrence Co.	601-982-9513
NJ	East Paterson, Bergen Ind. Supp.	201-796-2600
NJ	Toms River, Beaver Co.	201-244-6467
NY	Carle Place, Atomergic Chemetals Co.	212-786-0900
NY	Syracuse, B. Fleckenstein	315-488-7883
Ohio	Copley, Norco	216-666-3774
Pa	Pittsburgh, Bowman Co.	412-781-5949
Wisc	Oconomowoc, McNellis Representatives	414-567-9731
FOR:	Can., Valleyfield, P.Q., Cipel & Le Carbone	514-373-7337

Chemical Equip.

Cal	Glendale, Horrell Co.	213-245-6452
Cal	Pinole, Cutino Co.	415-223-5555
Fla	Hastings, Paul Sleeper Assoc.	904-328-5177
Ga	Atlanta, G.H. Crossley & Assocs.	404-261-4278
Ill	Homewood, J.J. Carey	312-798-7400
La	Gonzales, Wallace Co.	504-644-2861
Md	Millersville, PSI	301-987-1343
Mass	Cambridge, Mooney New England	617-864-5630
Mich	Galesburg, Hagadone Co.	616-665-4982
Mo	St. Louis, Technical Serv. Corp.	314-647-4252
NJ	Boonton, Carbone	201-334-0700
NJ	Little Falls, Mooney Bros. Co.	201-256-6200
NY	Batavia, F.J. Guppenberger	716-343-0115
NC	Charlotte, Carotek	704-847-4406
Ohio	Cincinnati, R.A. Mueller & Assocs.	513-242-2535
Okla	Tulsa, Laster/Castor Corp.	918-663-7365
Pa	McMurray, Kenneth R. Sears	412-941-8574
Pa	Philadelphia, M & S Seitz Co.	215-563-6136
Tenn	Chattanooga, David F. Moore & Assocs.	615-622-2123
Tex	Houston, Mercer Engineers	713-529-6121
Wisc	Milwaukee, A.E. Rasmussen Co.	414-342-2065
For:	Can., Valleyfield, P.Q., Cipel & Le Carbone Ltd.	514-373-7337

CARBORUNDUM CO., Graphite Prods. Div., Box 339, Niagara Falls, N.Y., 14302, Tel: 716-278-2731, Telex: 91 555; Empl.: 250 .... p. 1•2309-2315; p. 2•1445-1447

For info on price: D. L. Pietras 716-278-2521; Application info: H. R. Emes 716-278-2143; Customer service: N. L. Nadeau 716-278-2521; Delivery info: N. L. Nadeau 716-278-2521

Products manufactured: Abrasive Belts, Compounds, Cords, Powders, etc., Coatings, Dummy Loads, Heaters & Heating Elements, Insulators & Insulation, Materials, Self-Lubricating, Resistors, Suppressors, Terminals, Thermistors

Local Sales Offices & Reps.

Ala	Huntsville, Twentieth Century Mktg.	205-772-9237
Cal	El Segundo, Varigon Assocs.	213-679-0621
Cal	Palo Alto, O'Donnell Assocs. North	415-327-9260
Cal	San Diego, Varigon Assocs.	714-299-5413
Fla	Clearwater, WMM Assocs.	813-477-2533
Ill	Chicago, T.B. Hunter Assoc.	312-777-2500
Ind	Indianapolis, Electro-Rep	317-255-4147
Md	Westminster, FBD Sls.	301-876-2396
Mass	West Springfield, Carborundum	413-739-7361
Mich	Southfield, Rep Assocs.	313-354-9066
NY	Elmont, Crane & Egert Corp.	516-488-2100
NY	Niagara Falls, Carborundum	716-278-2521
NC	Cary, F.B.D. Sls.	919-467-7595
Ohio	Dayton, Sidnell Co.	513-433-7761
Pa	Ambler, Kirk-Sandell	215-643-2100
Tex	Houston, Vista Assocs.	713-661-0119
Tex	Richardson, Vista Assocs.	214-235-4547
Va	Portsmouth, F.B.D. Sls.	804-484-3162

CARCO ELCTRNS., 1180 O'Brien Dr., Menlo Park, Calif., 94025, Tel: 415-321-8174, Telex: 348482; Empl.: 41

For info on price: J.M. Carter; Application info: W.M. Spont; Customer service: J.M. Carter; Delivery info: W.M. Spont

Products manufactured: Actuators, Analyzers, Bearings, Bridges, Modulators, All Kinds, Simulators, Testers

CARDINAL CONTROL CO., 110 Kensington Rd., Kensington, Conn., 06037, Tel: 203-828-6379; Minimum order: $10

Customer service: E. P. Beatman

Free literature available: Relay Catalog - Standards and specials, coils, switches assemblies, Timer, Catalog - Solid State standards and specials. Automac Literature-Press overload control. Accessories Literature-Sockets, brackets, clips.

Products manufactured: Coils Including Assemblies & Forms, Controls/Control Eqpt., Relays, Services, Assembly, Production & Test, Sockets, Switches, Timers

CARDION ELCTRNS., Unit General Signal Corp., Long Island Expwy., Woodbury, N.Y., 11797, Tel: 516-921-7300, TWX: 510-221-2179; FSC No: 12909; Empl.: 300

Customer service: J.F. Riley Ext. 211

Products manufactured: Comm. Systems, Control Systems, Air Traffic, Converters, Data Acquisition & Reduction Systems, Decoders, Display Devices/Displays, Monitors, Radar Systems, Receivers, Transmission Systems, Data

CARLINGSWITCH INC., 505 New Park Ave., W. Hartford, Conn., 06110, Tel: 203-233-5551, TWX: 710-425-0034; Empl.: 650; Minimum order: $25 p. 1•1972,1973

For info on price: B. Boucher; Application info: R. Smith; Customer service: M. Miller; Delivery info: M. Miller

Free literature available: Full Line - Cat G Short Form Distributing - Cat GS

Products manufactured: Switch Handle Boots, Switches

Local Sales Offices & Reps.

Cal	Van Nuys, Pacific Switch	213-873-4802
Conn	W. Hartford, Atlantic Switch	203-523-5259
Fla	Hialeah, Switch Controls	305-822-0892
Ill	Wheaton, Conectrix	312-653-1130
Tex	Dallas, Texaswitch	214-357-1768

CAROLINA MEDICAL ELCTRNS., INC., U.S. 52 Expwy., Box 307, King, N.C., 27021, Tel: 919-983-5132; Empl.: 26; Minimum order: $5

Customer service: C. R. Jones

Products manufactured: Meters, Recorders, Transducers

CARSON MFG. CO., 5451 N. Rural St., Indianapolis, Ind., 46220, Tel: 317-257-3191; Empl.: 125-150

Products manufactured: Controls/Control Eqpt., Switches, Transformers

CARTER MFG. CORP., Sugar Rd., Bolton, Ma., 01740, Tel: 617-779-5501; FSC No: 03929; Empl.: 25; Minimum order: $50 .... p. 2•1640,1641

Customer service: L. W. Tedstone

Free literature available: Data sheets illustrating a representative cross section of our product line. All or most of our products can be modified to meet customers specific requirements.

Products manufactured: Potentiometers, Switches

Local Sales Offices & Reps.

Cal	Millbrae, Polach & Bensinger Inc.	415-697-2525
Conn	Glastonbury, C.K. Barton Assocs.	203-633-9417
Ill	Chicago, Comms. Engrs.	312-761-0548
Mass	Auburndale, Charles K. Barton Assocs.	617-332-2021
NJ	Kinnelon, Ind'l. Science Supply Corp.	201-838-8746
NY	Great Neck, Ind'l. Science Supply Corp.	516-487-1174
Ohio	Dayton, Bek Assocs.	513-278-1343
Tex	Dallas, Southern Engrg. & Sls. Co.	214-748-5760

CARTER MOTOR CO., 2707 W. George St., Chicago, Ill., 60618, Tel: 312-588-7700; Minimum order: $5

Customer service: E. J. Mitchell

Products manufactured: Converters, Inverters, Motors, Tachometers

Local Sales Offices & Reps.

Cal	San Jose, J.T. McFarland Assocs.	408-268-2600
Cal	Sherman Oaks, R. Meussdorffer & Assocs.	213-788-0771
Colo	Englewood, H. Kaub & Co.	303-761-5881
Conn	Old Lyme, S. Armstrong	203-673-3692
Conn	Rocky Hill, Aid Engrg. Sls.	203-673-3692
Fla	Orlando, C. Ammerman	305-894-6071
Ga	Smyrna, B-C Elctrn. Sls.	404-436-5169
Ill	Oak Brook, A.G. Erickson & Assocs.	312-323-1367
Kans	Shawnee Mission, Double V Power Sls.	913-262-1345
La	New Orleans, J.B. Clements	504-282-2897
Md	Baltimore, B. Young	301-235-3726
Mass	Westborough, T. Sanden	617-890-8181
Mich	Ann Arbor, V. Miklas	313-769-5181
Mich	Marshall, R. Reed Inc.	616-781-7287
Minn	Minneapolis, A.J. Warner Co.	612-729-7371
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Floral Park, Cushing Electro Sls.	516-775-7170
NC	Raleigh, J. Nagle	919-828-0575
Okla	Tulsa, R.D. Jay	918-939-5956
Pa	Philadelphia, Clisby & Assocs.	215-425-7724
Tex	Dallas, E.W. Haley	214-742-2515
Tex	Houston, M.F. Klicpera Co.	713-747-3868
Va	Troutville, R. Lawson	703-345-3283
Va	Virginia Beach, C. Bludau	804-481-7200
Wash	Seattle, R. Johnston Co.	206-524-5170
EXP:	Wheaton, Ill., CHS Int'l.	312-665-3402

CARTER SEMICONDUCTOR, 6901 Jericho Tpk., Syossett, N.Y., 11701, Tel: 516-598-0660, TWX: 510-224-6691

Products manufactured: Diodes, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ariz	Tempe, Saguaro Tech. Svc.	602-275-0431
Cal	Cupertino, Carter Semiconductor tor	408-245-7884
Cal	San Diego, Frugaletti Assoc.	714-272-6769
Ill	Northbrook, Jassen Assoc.	312-498-4260
Ind	Indianapolis, J. L. Weber Agcy.	317-255-4117
Iowa	Cedar Rapids, Engrg. Svc.	319-366-1591
Kans	Praire Village, Engrg. Svc.	913-649-4000
Md	Towson, C. H. Newson	
Mass	Lexington, Contact Sls.	
Mich	Detroit, S. Greiner	313-882-7570
Minn	St. Louis Pk., J. O'Brien	612-920-3643
Mo	St. Louis, Engrg. Svc.	314-726-2233
NJ	Stratford, A. E. Luba	609-784-5000
NY	Amityville, Carter Semiconductor	516-598-0660
NY	Northport, Halcon Assoc.	516-423-1818
Ohio	Dayton, E. M. A.	413-433-2800
Tex	Richardson, Thornton-Leepee Elctrn. Sls.	214-231-6891

CASTLE TV TUNER SERVICE, INC., 5710 N. Western Ave., Chicago, Ill., 60645, Tel: 312-561-6354; Empl.: 17

For info on price: A. Western 312-561-6354; Application info: C. Western 312-561-6355; Customer service: C. Western 312-561-6355; Delivery info: I. Stein 312-561-6354

Free literature available: TV receiver signal circuit analyzing instruments furnishing substitute signals for all signal stages of color or B & W TV receivers. TV field strength meters.

Products manufactured: CATV Systems & Equipment, Meters, Test Equipment, Testers

Local Sales Offices & Reps.

Cal	Los Angeles, Erlanger Sls. Co.	213-731-2238
Del	Newark, Di Vincent & Legato Assoc.	
Fla	Ft. Lauderdale, Unirep, Inc.	305-527-1556
Ill	Arlington Hts., P. Dombrow Co.	312-253-3326
Iowa	Des Moines, T. L. Dowell & Assoc.	515-225-1620
Kans	Overland Pk., T. L. Dowell & Assoc.	913-236-8200
Mass	Braintree, Rudolph Mac Inn's Assoc.	617-843-0908
Minn	Minneapolis, HMR Inc.	612-920-8200
Mo	St. Louis, T. L. Dowell & Assoc.	314-968-4234
NJ	Moorestown, Di Vincent & Legato	609-235-8299
NY	N. Bellmore, W. Keller & Assoc.	516-785-2826
Ohio	St. Mary's, Repp Co.	419-394-4724
Pa	Pittsburgh, Tanner Co.	412-561-4687
Tenn	Memphis, Ranger Elctrns. Co.	901-388-5410
Tex	Hurst, Ranger Elctrns. Co.	817-281-2736

CATON CONNECTOR CORP., 425 Northern Blvd., Great Neck, N.Y., 11021, Tel: 516-466-9288; FSC No: 52196; Empl.: 14; Minimum order: $50

For info on price: F. Tylinski 516-466-9288; Application info: L. Galambos 716-746-6817; Customer service: L. Tylinski 516-466-9288; Delivery info: L. Tylinski 516-466-9288

Free literature available: Brochure describes high voltage (over 1000 volts), corona free, connectors and cable assemblies, and cable assemblies, also pressurized and watertight. Typical applications are in radar systems, x-ray equipment, laser systems CRT displays, etc.

Products manufactured: Connectors

Local Sales Offices & Reps.

Cal	Garden Grove, Impact Elctrns.	213-431-3581
Cal	Los Altos, Parsons & Meister	415-941-4745
Ill	Hinsdale, H. Gray Assoc.	312-325-4810
NJ	Mt. Laurel, Naudain Assoc.	609-235-1801
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Ithaca, B. Dean	607-272-2187
NC	Raleigh, B. Dean	919-782-9226
Ore	Forest Grove, B. Doran Sls.	503-357-3333

Advertisment

Designer and manufacturer of High Voltage Connectors and Cable Assemblies.
Our specialty is Corona Free and also Watertight Connectors.
These products find applications in copying machine, CRT terminals, ion implantation equipment, Laser equipment, Power supplies, radar X-ray equipment, Xenon flashers, nuclear equipment.
Connectors are single and/or multipin; Coaxial, Triaxial; Molded on types;
Quick disconnects or Field assembled. We invite your inquiries.
Write for literature

CBS LABORATORIES, High Ridge Rd., Stamford, Conn., 06905, Tel: 203-327-2000, TWX: 710-474-0694

Products manufactured: Amplifiers, Equalizers, Generators, Records, Frequency Test

Local Sales Offices & Reps.

Cal	LaCanada, CBS Laboratories	213-790-4393

CCS HATFIELD WIRE & CABLE GROUP, Continental Copper & Steel Industries, Inc., 12 Commerce Dr., Cranford, N.J., 07016, Tel: 201-272-3850; Empl.: 1036; Minimum order: $100

For info on price: G. Joyce; Application info: L. Kelly; Customer service: P. Sefranka; Delivery info: D. Christie

Products manufactured: Cable, Wire

Local Sales Offices & Reps.

Ariz	Phoenix, J. Smith Baker Agency	602-254-5189
Cal	Los Angeles, Agencies Co.	213-263-9561
Colo	Denver, Empire Elec. Sls.	303-744-1776
Ga	Atlanta, Hoppert & McCoy	404-875-5802
Ill	Chicago, J. Schonthal & Assoc.	312-828-0774
Ill	Melrose, CCS Hatfield Wire & Cable Grp.	312-379-4750
Iowa	Des Moines, Dick Bray Elec. Sls. Co.	515-225-2961
La	New Orleans, Redmann Sls. Co.	504-525-4103
Md	Baltimore, Bloom Assocs.	301-233-2222
Mass	Braintree, B.N. Yanow & Co.	617-848-7300
Mich	Detroit, Hoffman Bros.	313-873-7550
Minn	Mound, Jerry Finn & Assocs.	612-472-3562
Mo	St. Louis, CCS Hatfield Wire & Cable Grp.	314-434-1311
NJ	Cranford, CCS Hatfield Wire & Cable Grp.	201-272-3850
NJ	Linden, E.H. MacLeod & Assoc.	201-862-2233
NJ	Pennsauken, J.B. Currell Assoc.	609-663-0888
NM	Albuquerque, Hallek Sls. Co.	505-298-3114
NY	LeRoy, S & S Assocs.	716-967-6248
NC	Greensboro, Barber-Ayers & Assoc.	919-273-3628
Ohio	Cincinnati, A.L. Ehlers Co.	513-242-4200
Ohio	Cleveland, Pressler-Weissinger Co.	216-351-5841
Pa	Pittsburgh, L & R Elec. Corp.	412-781-4811
Tex	Dallas, Source, Inc.	214-747-3521
Tex	Houston, Brenner Elec. Sls.	713-225-0766
Utah	Price, Schroeder Bros. Co.	801-637-0522
Utah	Salt Lake City, Lyle W. Williams Co.	801-487-7621
Wash	Seattle, Shaffer & Nelson	206-523-0664
WVa	Wheeling, R.M. Wilson Co.	304-232-5860
Wisc	Butler, J.F. Nolan & Assoc.	414-781-1140

CEA, Div. Berkleonics, Inc., 1 Aerovista Pk., San Luis Obispo, Cal., 93401, Tel: 800-235-4150, 800-592-5910; Empl.: 30 .... p. 1•1125

Products manufactured: Chargers, Battery, Converters, Cords, Current Sources, Heat Exchangers & Systems, Inverters, Isolators, Power Supplies, References, D-C Voltage, Standards, Transformers, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Cal	San Luis Obispo, Johnson Assocs.	805-544-7770
Cal	Van Nuys, Tri-Tek	213-997-8340
Md	Betheseda, S & S Assocs.	301-654-1434
NM	Albuquerque, F. Hawken	505-292-2196
Pa	King of Prussia, S & S Assocs.	215-265-3450
Pa	Pittsburgh, R. F. Clark Co.	412-242-9500
Tex	Houston, Lear & Assocs.	713-649-7727
Tex	Richardson, Lear & Assoc.	214-231-5388
EXP:	Cal., L.A., Trans-World Tr.	213-472-0444

CELANESE CHEMICAL CO., 245 Park Ave., New York, N. Y., 10017

Products manufactured: Chemicals, Cleaners & Solvents

CELANESE PLASTICS, 550 Broad St., Newark, N.J., 07102

CELCO, Constantine Engrg. Labs., Co., 70 Constantine Dr., Mahwah, N.J., 07430, Tel: 201-327-1123, TWX: 710-988-1018; Empl.: 45 .... p. 1•630,631

For info on price: E. Ryder, 201-327-1123; Application info: M. J. Constantine, 714-986-9868

Free literature available: Product literature on: Deflection Yokes, Coils, Micropositioners, Large-Format and Micro- Scanners & Printers, CRT Displays, CRT Spot Analyzers, X-Y Deflection Amplifiers, Display Circuitry, Dual-Ramp Generators, 70mm Photo Recorders.

Products manufactured: Amplifiers, Analyzers, Cameras, Cards, Linear Function, Character Recognition Systems, Coils Including Assemblies & Forms, Comm. Systems, Data Acquisition & Reduction Systems, Display Devices/Displays, Generators, Integrated Circuit Devices, Intensifiers, Image, Microscopes, Mounts, Power Supplies, Printers, Radar Systems, Recorders, Regulators, Scanners, Services, Assembly, Production & Test, Shields, Yokes

Local Sales Offices & Reps.

Cal	Upland, Celco, Pacific	714-986-9868
Minn	Minneapolis, Loonam Assoc.	612-927-4055
Tex	Richardson, P.J. Scanlon	214-231-4661

CENTRAL PLASTICS DISTS., 2701 N. Pulaski Road, Chicago, Ill., 60639, Tel: 312-235-3300; Empl.: 32

For info on price: L. Longwell; Application info: H. Greenwald; Customer service: L. Longwell; Delivery info: T. Harris

Free literature available: Central Plastics General Catalog

Products manufactured: Insulators & Insulation, Nameplates, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Tubing

Local Sales Offices & Reps.

Ill	Rockford, Rockford Central Plastics	815-397-4465

CENTRALAB DISTRIBUTOR PRODS., N. 93 W 16112 Megal Dr., Menomonee Falls, Wisc., 53051, Tel: 414-228-2911, TWX: 910-260-3620

For info on price: C. Zickuhr; Application info: K. Youngbeck; Customer service: S. Wilkin; Delivery info: S. Wilkin

Refer to Centralab Elctrns. Div. for Sales Office Information.

CENTRALAB, Electrs. Div. - Globe Union, 5757 N. Green Bay Ave., Milwaukee, Wisc., 53201, Tel: 414-228-1200, TWX: 414-228-2315; Empl.: 5500

Products manufactured: Attenuators, Capacitors, Fixed, Capacitors, Variable, Circuits, Hybrid, Thick Film, Circuits, Printed, Multilayer, Cores, Ceramic, Dividers, Filters, Insulators & Insulation, Integrators, Electronic, Networks, Potentiometers, Resistors, Seals, Substrates, Switches, Tubing

Local Sales Offices & Reps.

Ariz	Phoenix, Clemick-Neenan & Assoc.	602-279-7649
Cal	Los Angeles, Clemick-Neenan & Assoc.	213-476-1272
Cal	Palo Alto, Brooks Technical Group	415-328-3232
Colo	Denver, Electro-Rep Inc.	303-744-2821
Fla	Orlando, Cartwright & Bean, Inc.	305-422-4531
Fla	Plantation, Cartwright & Bean, Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean, Inc.	404-255-5262
Haw	Honolulu, Dougherty Enterprises	
Ill	Des Plaines, Centralab	312-694-4870
Ind	Indianapolis, L.M. De Voe Co.	317-257-1227
Iowa	Cedar Rapids, J. Vrbik Co.	319-377-8244
Kans	Shawnee Mission, Lowell-Kangas & Assoc.	913-631-3515
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Md	Pikesville, J. Bresson Assoc.	215-839-6770
Mass	Needham, Centralab	617-444-4847
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
Mich	St. Joseph, R.C. Merchant & Co.	616-983-7378
Minn	Minneapolis, Centralab	612-831-5212
Miss	Jackson, Cartwright & Bean, Inc.	601-981-1368
Mo	St. Louis, Lowell-Kangas & Assoc.	314-821-4050
NJ	Clifton, Centralab	201-778-5900
NY	Albany, Reagan/Compar Albany	518-489-7408
NY	Endwell, Reagan/Compar Albany	607-723-8743
NY	Fairport, Reagan/Compar Albany	716-271-2230
NY	New Hartford, Reagan/Compar Albany	315-732-3775
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
NC	Raleigh, Cartwright & Bean, Inc.	919-832-7128
Ohio	Cleveland, Imtech Inc.	216-826-3400
Ohio	Dayton, Imtech Inc.	513-885-4181
Ohio	Fairborn, R.G. Siff & Assoc.	513-252-7785
Ore	Portland, J.J. Backer Co.	503-297-3776
Ore	S. E. Salem, J. J. Backer Co.	503-362-0717
Pa	Narberth, J. Bresson Assoc.	215-839-6770
Pa	Pittsburgh, Imtech	412-247-1050
Tenn	Knoxville, Cartwright & Bean, Inc.	615-693-7450
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	El Paso, Centralab	915-779-3966
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Va	Lynchburg, J. Bresson Assoc.	215-839-6770
Wash	Seattle, J.J. Backer Co.	206-285-1300
Wisc	Milwaukee, Centralab	414-228-2122

CENTRALAB SEMICONDUCTOR, Globe-Union, 4501 Arden Dr., El Monte, Cal., 91734, Tel: 213-579-0700, TWX: 910-587-3429; Empl.: 300

Products manufactured: Amplifiers, Caps, Lenses, Indicator Light, Cells, Photoconductive, Photoemissive, Photovoltaic, Diodes, Lubricants, Punched Card Equipment, Racks

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engg.	602-955-3193
Cal	Los Altos, Recht	415-941-0336
Cal	Los Angeles, Clemick-Neenan	213-476-1272
Cal	Orange, Clemick-Neenan	714-998-2525
Colo	Denver, McLoud & Raymond	303-756-1589
Fla	Orlando, Cartwright & Bean	305-425-8284
Ga	Atlanta, Cartwright & Bean	404-237-2273
Ill	Des Plaines, Centralab	312-827-4487
Ind	Indpls., L.M. DeVoe	317-257-1227
Md	Baltimore, Component Sls.	301-484-3647
Mass	Burlington, Contact Sls.	617-273-1520
Mich	Southfield, REP Assocs.	313-354-9066
Minn	Minneapolis, Furber Sls.	612-861-1518
Mo	St. Louis, Coombs	314-542-3636
NJ	Clifton, Centralab	201-778-5900
NY	Rochester, W.H. Zimmerman	716-586-4450
NY	Syracuse, W.H. Zimmerman	315-474-4889
Ohio	Cleveland, Imtech	216-382-9090
Pa	Glenside, Elcom Inc.	215-885-1325
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, R.E. Nesbitt	214-357-4601
Tex	Houston, R. Nesbitt Co.	713-224-3633
Wash	Seattle, J. Backer Co.	206-285-1300
FOR:	Toronto 18, Ont Can., Wilson Entprs.	416-231-7536

CENTRE ENGRG., 307 Benner Pike, State College, Pa., 16801

CENTRON ENGRG., 24015 Garnier St., Torrance, Cal., 90510, Tel: 213-530-4410, Telex: 69-8223; Empl.: 20; Minimum order: $25

For info on price: G. McCray; Application info: G. McCray; Customer service: N. Levesque; Delivery info: Order Desk

Free literature available: Drafting Aids - complete line of printed circuit-artwork symbols, tapes, and donut pads. For making printed circuit master artworks. Available off the shelf. Available on request.

Products manufactured: Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Kits, Breadboarding (For Engineers), Kits, Printed Circuit, Tapes, Films & Foils, Pressure Sensitive

Local Sales Offices & Reps.

Ariz	Phoenix, W. Bert Knight Co.	602-242-6787
Ariz	Scottsdale, F. Board Assocs.	602-949-9561
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Cal	Newport Beach, W.B. Knight Co.	714-833-8350
Colo	Denver, W.J. Purdy Co.	303-777-1411
Fla	Orlando, Cartwright & Bean	305-422-4531
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Hinsdale, Hill-Gray Assoc.	312-325-4810
Ind	Mulberry, Maish Sls.	317-296-2322
Kans	Overland Pk., T.L. Dowell	913-236-8200
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Minn	Minneapolis, Dick Borrett Co.	612-929-0028
NJ	Teaneck, Fisher Elect. Assocs.	201-837-1200
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Syracuse, Mar-Com Assocs.	315-437-2992
Ohio	St. Marys, T. Shelby & Co., Inc.	419-394-3377
Ore	Portland, Earl & Brown, Co.	206-284-1121
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, J.Y.Schoonmaker Co.	314-357-8481

CENTRONICS, Hudson, N.H., 03051, Tel: 603-883-0111, TWX: 710-228-6505; Empl.: 700; Minimum order: $50

Free literature available: On impact printers for EDP and communications applications. Specification data sheets.

Products manufactured: Printers, Teleprinters, Terminal Equipment, Digital

Local Sales Offices & Reps.

Cal	Santa Ana	714-979-6650
Ill	Rolling Meadows	312-398-4500
Mass	Burlington	617-272-8545
NH	Hudson	603-883-0111
NJ	Mt. Holly	609-234-6111
Ohio	Kettering	513-294-0070
Tex	Arlington	817-461-5711

CERAMASEAL, INC., Sub. Interpace Corp., Box 25, New Lebanon Center, N.Y., 12126, Tel: 518-794-7800, Telex: 14-5442; FSC No: 07601; Empl.: 60; Minimum order: $25

For info on price: G. D. Sawin; Application info: H. Jennings; Customer service: P. A. Beresford; Delivery info: P. A. Beresford

Free literature available: Literature On: High Alumina Ceramic & High Temp. Porcelain-Metal Sealed Bushings. High Vacuum: Flanges and Hardware, Coaxial Connectors and Cables, & Sapphire, Quartz and Glass Windows.

Mini-Vacuum, - Mini Thermocouple Vacuum, - Rotary Motion, & High Vacuum Feedthrus.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Connectors, Deposition Equipment, Vacuum & Accessories, Feedthrus & Seals, Environmental, Headers, Lead Assemblies & Receptacles, Seals, Services, Assembly, Production & Test, Terminals

Local Sales Offices & Reps.

Ariz	Wickenburg, H. A. Omley	602-684-7201
Ark	Little Rock, C.H. Stout, Inc.	501-374-8201
Cal	Atherton, Wadsworth-Pacific Mfg. Assoc.	415-321-3619
Cal	Pacific Palisades, Wadsworth-Pacific Mfg. Assoc.	213-454-4313
Colo	Denver, Continental Divide Prods.	303-420-0130
Ill	Mt. Prosepect, Automation Equip. Co.	312-398-7550
La	New Orleans, C.H. Stout of La., Inc.	504-482-3183
La	Shreveport, C.H. Stout of La., Inc.	318-425-5485
Md	Baltimore, R. A. Wafer Assoc.	301-744-1133
Mass	Boston, P-J Engrg. Sls. Co.	617-783-0510
Miss	Jackson, C.H. Stout of Miss., Inc.	601-354-4326
NY	Binghamton, Canavan-Scanlon Assoc.	607-724-7220
NY	Buffalo, Canavan-Scanlon Assoc.	716-839-3373
NY	Rochester, Canavan-Scanlon Assoc.	716-442-0720
NY	Syracuse, Canavan-Scanlon Assoc.	315-437-1271
NC	Charlotte, J. Rudisill Assoc.	704-377-6901
Ohio	Chagrin Falls, Bray Assocs.	216-247-4474
Pa	Pittsburgh, Muller-Harper & Assoc.	412-931-6460
Tenn	Knoxville, C.E. Fox	615-522-4404
Tenn	Memphis, C. H. Stout, Inc.	901-526-7601
Tex	Dallas, E.B. Robertson, Inc.	214-942-8486
Tex	Houston, E.B. Robertson, Inc.	713-785-6800
Tex	Lubbock, E.B. Robertson, Inc.	806-746-6527
Wash	Seattle, J. B. Jolly, Inc.	206-938-4166
FOR:	Can., Islington, Toronto, D.T. Shaw Co. Ltd.	416-231-2706
FOR:	Can., Montreal 379, D.T. Shaw Co. Ltd.	514-332-1163
FOR:	Can., Delta, British Columbia, Ocean Comps. Ltd.	604-521-3419

CERAMIC MAGNETICS, INC., 87 Fairfield Rd., Fairfield, N.J., 07006, Tel: 201-227-4222; Empl.: 25; Minimum order: $85

For info on price: A. G. Lang, Jr.; Application info: A. G. Lang, Jr.; Customer service: G. Schaller; Delivery info: G. Schaller

Free literature available: A catalog which presents all the technical data on the ferrites manufactured at this facility.

Products manufactured: Cores, Ceramic, Cores, Magnetic, Ferrite Material & Parts, Heads, Recording Playback, Erase, Magnets

Local Sales Offices & Reps.

Cal	Irvine, A. C. Allen	714-552-9428
Conn	North Haven, Northeast Reprs.	203-239-2507
Ill	Park Ridge, R. McIntosh	312-825-8070
Mass	Needham Heights, Northeast Reprs.	617-449-3034
Minn	St. Paul, Knox Assocs.	612-488-5402
NY	Buffalo, H. C. Johnson Agencies	716-632-7880
NY	Fayetteville, H. C. Johnson Agencies	315-637-9383
NY	Rochester, H. C. Johnson Agencies	716-482-3000
Pa	Glenshaw, H. C. Johnson Agencies	412-961-0414
Wash	Richland, H. Svobada	509-783-6523
Wash	Seattle, J. B. Jolly	206-938-4166
FOR:	Can., B.C., H. Bourgeois	604-521-3419

CERRO COMMUNICATION PRODUCTS, Box 2026, Anniston, Ala, 36201

CERRO WIRE & CABLE CO., Div. Cerro Corp., 285 Nicoll St., New Haven, Conn., 06504, Tel: 203-772-2250, TWX: 710-465-2149; Empl.: 500

Customer service: R.L. Belard Ext. 216

Products manufactured: Cable, Wire

Local Sales Offices & Reps.

Cal	Fremont	415-651-0460
Cal	Sherman Oaks	213-872-1610
Conn	Branford	203-488-1604
Ga	Norcross	404-449-1868
Ill	Bellwood	312-379-2265
Mo	Clayton	314-721-2498
Mo	Independence	816-358-9191
NJ	Avenel	201-381-2170
NJ	Cherry Hill	609-779-7667
Ohio	Rocky River	216-333-8640
Pa	Pittsburgh	412-343-5022
Tex	Dallas	214-233-2294
Tex	Houston	713-523-6843

CHADWICK-HELMUTH CO., INC., 111 E. Railroad Ave., Monrovia, Calif., 91016, Tel: 213-358-4567; Empl.: 20

Customer service: B. Minteer

Products manufactured: Controls/Control Eqpt., Lights, Testers

CHALCO ENGRG. CORP., 15126 S. Broadway, Gardena, Cal., 90248, Tel: 213-FA 1-0121, TWX: 910-346-7026; Empl.: 95; Minimum order: $25

Customer service: J. Cox

Products manufactured: Converters, Duplicators, Paper-Tape Preparation Systems, Perforators, Readers, Recorders

CHANNEL INDS., 839 Ward Dr., Santa Barbara, Cal., 93105, Tel: 805-967-0171; Empl.: 75

For info on price: R. F. Carlson; Application info: R. M. Callahan; Customer service: L. Barrett; Delivery info: R. M. Callahan

Products manufactured: Crystals, Hydrophones & Accessories, Oceanographic Equip. (Electronic), Transducers

Local Sales Offices & Reps.

Ohio	Newbury, Channel Prods., Inc.	216-564-2245

CHANNEL MASTER DIV. AVNET, Rte. 209, Ellenville, N.Y., 12428, Tel: 914-647-5000; Empl.: 1000

Products manufactured: Alarms, Amplifiers, Antenna Rotators, Antenna Towers & Supports, Antennas, Arresters, Electrical Surge, Lightning, Attenuators, Cable, CATV Systems & Equipment, Comm. Systems, Connectors, Converters, Couplers, Filters, Meters, Mixers, Mounts, Phonographs, Parts & Accessories, Receivers, Rivets, Rods, Ground, Tape Recording Accessories, Transformers, Tubes, Wire

CHANNELLOCK, INC., S. Main St., Meadville, Pa., 16335, Tel: 814-336-1175; Empl.: 500 .... p. 2•1693

Customer service: W. S. DeArment

Free literature available: Complete catalog illustrating the channellock line of mechanic's hand tools: pliers, hammers, screwdrivers, adjustable wrenches, aviation and metal cutting snips.

Products manufactured: Cutters, Wire, Hand Operated, Drivers, Nut, Heat Sinks, Soldering, Knives & Knife Sets, Pliers, Screwdrivers, Tools, Wire Strippers, Wrenches

Local Sales Offices & Reps.

Cal	Alhambra, J.J. Brown Co.	213-283-1322
Cal	S. San Francisco, J.J. Brown Co.	415-589-5775
Colo	Denver, Western Ind'l. Sls. & Svcs. Co.	303-758-3972
Fla	Ft. Lauderdale, G.A. Palmer	305-764-3487
Ga	Decatur, J.C. Lyle & Assocs.	404-378-5691
Ill	Chicago, Muzzy & Peters	312-287-1360
Ind	Jeffersonville, Wixson-Clinard Co.	812-283-0955
La	Mansfield, Lynn & Hemphill, Inc.	318-872-1108
Mass	Wellesley, T. Sawyer Sls. Co.	617-235-2667
Mich	Detroit, Wixson-Nehls Co.	313-871-8815
Minn	Minneapolis, R.L. Perrin & Assocs.	612-831-1211
Mo	Kansas City, D. Schmelzinger Co.	816-444-5330
Neb	Omaha, J. Pedersen	402-571-8604
NJ	Brickstown, A.P. Henricks Co., Inc.	201-892-2894
NJ	Summit, A.P. Henricks Co., Inc.	201-273-0555
NY	Brooklyn, A.P. Henricks Co., Inc.	212-680-0045
NY	Marcellus, A.P. Henricks Co., Inc.	315-673-1340
NY	Merrick, A.P. Henricks Co., Inc.	516-379-8507
NY	New York, A.P. Henricks Co., Inc.	212-732-9630
Ohio	Cleveland, H.W. Murray Co., Inc.	216-333-2977
Okla	Oklahoma City, Lynn & Hemphill, Inc.	405-524-9807
Pa	Glenolden, A.P. Henricks Co., Inc.	215-583-3921
Pa	Pittsburgh, E.D. McGinley	412-561-7979
Tex	Dallas, Lynn & Hemphill, Inc.	214-747-4745
Va	Richmond, D. Miller & Assocs.	703-353-5324
Wash	Port Orchard, R.G. Sullivan Co.	206-871-0872
EXP:	South Bend, Ind., United Export Corp.	219-232-8286

CHASSIS-TRAK, DIV., General Devices Co., Inc., 525 S. Webster Ave., Indianapolis, Ind., 46219, Tel: 317-359-5407, Telex: 27-2169; Empl.: 125; Minimum order: $50 .... p. 1•63-66

For info on price: S. Gray; Application info: R. D. Lambert; Customer service: R. L. Watson; Delivery info: S. Gray

Free literature available: Catalogs covering: Chassis-Trak solid bearing slides, Chassis-Trak bottom mount slides, Chassis-Trak linear ball-bearing slides, Chassis-Trak circulating ball bearing slides Chassis-Trak handles

Products manufactured: Handles For Cabinets, Circuit Boards, Racks, etc., Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ariz	Scottsdale, Schoeffler Assoc.	602-948-3470
Cal	Los Angeles, M. A. Stolaroff Co.	213-295-7781
Cal	Mtn. View, G. Woempner Co.	415-964-5454
Cal	San Diego, M. A. Stolaroff Co.	714-234-6905
Cal	Van Nuys, J. Thomas	213-782-3820
Colo	Sedalia, Jensen Reps.	303-688-4154
Conn	Cheshire, Coakley, Boyd & Abbett, Inc.	203-272-2261
Fla	North Miami, Winfield Elctrn. Sls.	305-945-6544
Fla	Tampa, Winfield Elctrn. Sls.	813-884-6500
Ill	Rolling Meadows, Lightner Assoc.	312-398-3000
Ind	Indianapolis, Mktg. Engineers, Inc.	317-546-1523
Ind	South Bend, Valentine & Schillinger	219-291-6258
Kans	Shawnee Mission, Lowell, Kangas & Assoc.	913-631-3515
Md	Bethesda, G. Rosen Assocs., Inc.	301-530-8448
Mass	Needham, Coakley, Boyd & Abbett, Inc.	617-444-5470

Directory of Local Distributors Starts on page 401

Mich	Brighton, Valentine & Schillinger	313-227-7863
Minn	St. Paul, Northport Engineering	612-698-3841
Mo	St. Louis, Lowell, Kangas & Assocs.	314-821-4050
NY	Fayetteville, H.G. Richter Inc.	315-637-6713
NY	Manhassett, Kalber & Mack	516-627-6620
NC	Paw Creek, Ward Tech. Sls. Co.	704-399-3481
Ohio	Cincinnati, Components, Inc.	513-721-2997
Ohio	Cleveland, Components, Inc.	216-842-2737
Tex	Dallas, R. Martin Assoc.	214-361-8584
Tex	Houston, R. Martin Assoc.	713-462-4077
Wash	Olympia, Bergford Assoc.	206-866-2001
EXP:	Indianapolis, General Devices Co.	317-359-5407

CHATHAM CONTROLS CORP., 33 River Rd., Chatham, N.J., 07928, Tel: 201-635-8892; FSC No: 04814; Empl.: 11; Minimum order: $10

For info on price: D. C. Perst; Application info: J. S. Ecklof; Delivery info: J. N. Ash

Free literature available: Miniature and sub-miniature hermetically sealed thermostats.

Products manufactured: Controls/Control Eqpt., Monitors, Switches, Thermostats

Local Sales Offices & Reps.

Cal	Pasadena, Components Corp.	213-681-7448
NJ	Fairlawn, PAR Assocs., Inc.	201-447-3722

CHATILLON JOHN & SONS, 83-30 Kew Gardens Rd., Kew Gardens, N.Y., 11415, Tel: 212-847-5000; Empl.: 135; Minimum order: $50

Customer service: R. H. Eklund

Products manufactured: Gages, Scales, Dial, Springs (All Types), Testers

CHATSWORTH DATA CORP., 9732 Cozycroft Ave., Chatsworth, Cal., 91311, Tel: 213-341-9200; Empl.: 45

For info on price: H. G. Boehm; Application info: R. Miller; Customer service: J. O'Neil

Free literature available: Cablemaster-A compact, versatile unit for rapid and efficient testing of electrical cable assemblies, harnesses, connectors, and bulk cable.

Products manufactured: Punched Card Equipment, Testers

CHEM AERO, INC., 231 E. Lomita Blvd., Wilmington, Cal., 90744, Tel: 213-775-2581, TWX: 910-345-6267; Empl.: 100; Minimum order: $1000

For info on price: D. Thomas; Application info: D. Thomas; Customer service: C. Hansen; Delivery info: D. Martin

Free literature available: Brochures detail bus bars, heatsinks, memory frames, multi-layer boards and assemblies, the rigid-to-flex technique, and bus bar design engineering.

Products manufactured: Boards, Printed Circuit, Bus Bars & Systems, Circuits, Flexible, Circuits, Printed, Multilayer, Heat Exchangers & Systems, Panels, Pins, Strips

Local Sales Offices & Reps.

Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Anaheim, LoDan	213-924-1691
Cal	Mountain View, Melchior/Wesley	415-964-2321
Cal	San Diego, LoDan	714-279-6383
Fla	Clearwater, Reynolds & Assoc.	305-773-4700
Ga	Atlanta, Reynolds & Assoc.	
Mass	Waltham, United Engr. Sls.	617-890-6680
Mich	St. Clair Shores, J. M. Thorpe Co.	313-779-6363
Minn	Minneapolis, Technical Assoc.	612-929-6721
Mo	Florissant, H & R Sls. & Engrg.	314-921-6242
NJ	Livingston, Varrelman-Gorman	201-992-2505
Tex	Dallas, Precision Sls.	214-351-6964
Wash	Seattle, Todd-Brian Ind.	206-827-5811

CHEMCUT CORP., 500 Science Pk., State College, Pa., 16801, Tel: 814-238-0514, Telex: 842-555; Empl.; 186

For info on price: R. Lorah; Application info: J. Infield; Customer service: I. Hoy; Delivery info: R. Lorah

Free literature available: P.C. board and chemical machining process equipment...from printing and etching to regeneration and cleaning.

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.

Cal	Anaheim, Chemcut Corp., Western Dist. Office	714-630-1700

Local Distributors

Cal	Anaheim, Chemcut Corp. Western Dist. Off., Box 6376, 1509-A Kraemer Blvd.	714-630-1700
Fla	Maitland, Photo Chem. Sys., Box 1475	305-647-1593
Ga	Roswell, Photo Chem. Sys., 900 Sun Valley Rd.	404-993-1738
Ill	Chicago, John Plosflich & Assoc., 4106 N. Nashville Ave.	312-286-7676
Ill	Elk Grove Village, Chemcut-Central Dist. Off., 1210 Jarvis Ave.	312-956-6513
Ind	W. Lafayette, Bruce Johnson Co., 132 Tamiami Ct.	317-463-4616
Mass	Waltham, Etchomatic, Inc., Box 444, 151 Newton St.	617-893-2020
Minn	Minneapolis, T.K. Gray, Inc., St. Anthony Off. Pk.,2812 Anthony La., N.E.	612-781-4874
NY	East Meadow, Granirer Assoc., 1359 Oak La.	516-292-1627
NY	Skaneateles, Spar-Kleen Prod., Box 2, Fennell St.	315-685-5711
Ohio	Cleveland, L.W. Hodson Machinery Co., 9400 Midwest Ave.	216-587-4500
Okla	Tulsa, Lew Wenzel & Co., 520 S. Peoria Ave.	918-587-3371
Ore	Portland, Vandy Corp., Box 4383	503-297-1900
Tex	Dallas, Lew Wenzel & Co., 2850 Satsuma	214-243-1546
TEx	Houston, Lew Wenzel & Co., 1909 Scott St.	713-225-2147
Va	Alexandria, Chem. Etching Equip. & Supp. Co., 7629 Crawford Ct.	703-971-2646
Wash	Seattle, Vandy corp., Box 70651	206-789-3300

CHEMETRON CORP., Welding Prods., 111 E. Wacker St., Chicago, Ill., 60601, Tel: 312-565-5000

Free literature available: Instruction manual & catalog of our maintenance & repair alloys & fluxes.

Products manufactured: Alloys, Flux, Brazing & Soldering Materials, Solder (All Types), Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Torches, Soldering, Welding & Access., Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

CHEMICAL ELECTRONIC ENG., Amboy Rd. Box 203, Matawan, N.J., 07747

CHEMICAL ETCHING EQUIP. & SUPPLY, 7629 Crawford Ct., Alexandria, Va., 22310, Tel: 703-971-2646; Empl.: 5; Minimum order: $25

Customer service: R. E. Hunt

Free literature available: Printed Circuit Processing Equipment

Products manufactured: Blowers & Fans & Accessories, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Cameras, Comparators, Densitometers, Electronic, Drafting Machines, Drills & Accessories, Hand & Power, Electroplating Equipment & Supplies, Furnaces, Heaters & Heating Elements, Holders, Circuit Board (Production Type), Knives & Knife Sets, Lamps, Lenses, Optical & Camera, Lights, Machines/Machinery, Production, Microcircuit Production Equip., Power Supplies, Racks, Rectifiers, Solder (All Types), Solder Pots & Baths, Soldering Equipment, Testers

CHEMPLAST, INC., 31-150 Dey Rd., Wayne, N.J., 07470, Tel: 201-696-4700, TWX: 710-988-5834; Empl.: 200; Minimum order: $15

For info on price: H. Hill; Application info: L. Atkins; Customer service: L. Atkins; Delivery info: E. Walty

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Caps, Forms & Tapes, Heat Shrinkable, Chemicals, Coatings, Cords, Heat Guns, Production, Insulators & Insulation, Lubricants, Materials, Self-Lubricating, Services, Assembly, Production & Test, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive, Tubing, Wire

Local Sales Offices & Reps.

Ariz	Phoenix, A. W. Anderson	602-277-5911
Ark	Poyen, Component Parts	501-337-9580
Cal	Dana Point, J. Edwards	714-493-5046
Cal	Van Nuys, Chemplast-West	213-786-8866
Colo	Englewood, R-C Sls. Co.	303-789-0565
Conn	Branford, W.C. Thompson	203-488-8838
Fla	Vero Beach, J.D. Rule	305-589-5357
Ill	Rosemont, W. Cogger	312-671-0099
Kans	Wichita, Regal Plastic & Sup.	316-263-1211
Md	Pasadena, P.J. Simard	301-437-0855
Mass	Revere, J.G. Ferraro	617-289-6225
Minn	Minneapolis, Service Tool & Engr. Co.	612-941-7151
Mo	Kansas City, Regal Plastic & Sup. Co.	816-471-6390
Mo	St. Louis, J.A. Crowe	314-842-1353
Neb	Omaha, Regal Plastic & Sup. Co.	402-344-4446
NJ	Lincoln Park, E.R. Fischer	201-694-4763
NJ	Mount Holly, J.T. Anderson	609-267-6902
NY	New Hyde Park, J.J. Hagmaier	516-742-0524
Ohio	Kettering, D. McMullian	503-299-8063
Ohio	Olmsted Falls, B. Williams	216-886-1050
SC	Columbia, G.E. Younginer	803-772-6671
Tex	Dallas, Kolster	214-233-4158
Tex	Houston, J.V. Glaves	713-626-4131
Utah	Salt Lake City, Ward & Assoc.	801-487-0756
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
EXP:	Wayne, N.J., H. Hamilton	201-696-4700

CHEMTRONICS, INC., 45 Hoffman Ave., Hauppauge, N.Y., 11787, Tel: 516-582-3322; Empl.: 23; Minimum order: $50

Customer service: R. G. Russell

Free literature available: Dealer Catalog available upon request. Provides complete information on each product that is currently being manufactured.

Products manufactured: Adhesives (All Types), Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Demagnetizers, Lubricants, Solder (All Types)

Local Sales Offices & Reps.

Cal	Burlingame, Wm. J. Purdy Co.	415-347-7701
Cal	West Covina, Dow Forth Assoc.	213-967-2893
Colo	Englewood, Electronix Spec. Co.	303-781-4409
Fla	Ft. Lauderdale, Jack Sproch Sls. Corp.	305-886-0927
Ga	Norcross, B. Cooper Co.	404-448-5460
Ill	Chicago, Markal Sls. Corp.	312-282-5800
Ind	Indianapolis, New/Era Sls.	317-257-7333
Mass	N. Scituate, W.A. Hendrickson	617-545-0652
Minn	St. Paul, Carl-M Co.	612-699-8004
Mo	Raytown, Taraski Sls. Corp.	816-358-4590
NY	Grand Island, L.J. McTaggart Assoc.	716-773-9222
Ohio	St. Mary's, Repp Co.	419-394-4724
Pa	Pittsburgh, R. Tanner Co.	412-561-4687
Tex	Richardson, Willoughby-Fouler Co.	214-235-3664
Wash	Seattle, Fleehart & Sullivan	206-LA 2-1533
FOR:	Can., St. Laurent, Montreal, Paco Elctrns. Ltd.	514-748-6787

CHERRY ELECTRICAL PRODS. CORP., 3600 Sunset Ave., Waukegan, Ill., 60085, Tel: 312-689-7700, TWX: 910-235-1572; Empl.: 1050 .... p. 1•1974-1985

Free literature available: Catalog of Switches and Keyboards - 72 pages, Gas Discharge Displays - 6 pages, Keyboard Key Cap Work Book - 32 pages, Facilities Booklet (pocket) - 16 pages.

Products manufactured: Calculators, Electrical & Electronic, Delcalcomania, Display Devices/Displays, Keyboards, Alphanumeric & Decimal, Matrices, Computer, Programmers, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Powertronics	205-852-6347
Cal	Palo Alto, Abbott Engrg.	415-327-0830
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Arvada, Arrowhead Sls.	303-423-5556
Conn	Meriden, Electro-Prods. Sls.	203-235-4040
Fla	Ft. Lauderdale, CBC Elctrns.	305-484-7330
Ill	Waukegan, Cherry Electrical Prods.	312-689-7600
Ind	Fort Wayne, Menze Sls.	219-747-5616
Kans	Prairie Village, Thro Indl. Sls.	913-362-2533
Mass	Waltham, Electro-Prods. Sls.	617-899-1570
Mich	Novi, Miltimore Sls.	313-476-2446
Mich	Troy, McPahil Corp.	313-689-6444
Minn	St. Paul, Cahill Assoc.	612-646-7217
Mo	Florissant, Miller Assoc.	314-355-1642
NJ	Fort Lee, S. Justin Assoc.	201-947-4371
NJ	Pitman, Colrud Co.	609-589-5866
NM	Albuquerque, IMEC	505-883-9010
NY	Rochester, Andres Comp. Sls.	716-244-2445
NC	Thomasville, Oren Entprs., Inc.	919-476-6727
Ore	Portland, J.J. Backer Co.	503-297-3776
Tex	Dallas, Ion Assocs.	
Utah	Salt Lake City, Arrowhead Sls.	801-487-4716
Wash	Seattle, J.J. Backer Co.	206-285-1300
Wisc	Pewaukee, D. Herrick	414-691-2770
FOR;	Can., Oakville, Ont., H. Diamond Sls. Ltd.	416-844-6787

Local Distributors

Cal	Chattsworth, Westates Elec. Corp., 20151 Bahama St.	213-341-4411
Cal	Orange, Westates Elec. Corp., 948 Elm St.	714-532-6891
Cal	Sunnyvale, Westates Elec. Co., 255 N. Mathilda Ave.	408-733-8383
Tex	Richardson, Southwest Elec., 1100 Executive Dr.	214-234-3050

Tex	Stafford, Southwest Elec., 12725 Royal Dr.	713-494-6021

CHERRY RIVET & BOOTS NUT DIVS., Townsend Co., P.O. Box 2157, Santa Ana, Calif., 92707, Tel: 714-545-5511, TWX: 910-595-1500; Empl.: 817

Customer service: R. E. Herndon

Free literature available: Catalogs on Cherry MS Rivets, Cherrylock Rivets, Boots "Banc-Lok" Inserts, Boots Nuts.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Fasteners, Rivets

Local Sales Offices & Reps.

Ga	Atlanta, J.O. King	404-355-7660
Kans	Wichita, Std. Parts & Equip. Corp.	316-522-1516
Tex	Ft. Worth, Std. Parts & Equip. Corp.	817-336-2521

CHESTERFIELD PRODS. INC., 511A Victor St., Saddle Brook, N.J., 07662, Tel: 201-845-6886; Empl.: 27; Minimum order: $25 .... p. 1•548

For info on price: M. Silver; Application info: A. J. Spencer; Customer service: M. Silver; Delivery info: M. Silver

Products manufactured: Analyzers, Attenuators, Coils Including Assemblies & Forms, Delay Lines, Equalizers, Filters, Generators, Meters, Monitors

Local Sales Offices & Reps.

Ill	Chicago, K. W. Meyers Co.	312-774-6440
Ind	Indianapolis, K. W. Meyers Co.	317-243-6681
Md	Edgewater, Commart, Inc.	301-798-0607
Mass	Acton, E.E. Specialists, Inc.	617-259-9200
Minn	Minneapolis, K. W. Meyers Co.	612-920-7080
NJ	Saddle Brook, L&M Assocs.	201-843-8700
NY	Brentwood, L & M Assocs.	516-231-8363
NY	New York City, L & M Assocs.	212-675-7486
Pa	Andalusia, L & M Assocs.	215-639-3100
Tex	Dallas, Bradenco	214-358-3278
Tex	Houston, Bradenco	713-529-9881
Wisc	Milwaukee, K. W. Meyers Co.	414-482-1313

CHICAGO CONDENSER CORP, 3255 W. Armitage, Chicago, Ill., 60647, Tel: 312-227-7070; Empl.: 15; Minimum order: $25

For info on price: P. Phillips; Application info: K. Peter; Customer service: P. Phillips; Delivery info: P. Phillips

Products manufactured: Capacitors, Fixed, Power Supplies

Local Sales Offices & Reps.

Cal	Redwood City, Warren-Hickey Sls. Co.	415-368-3849

CHICAGO DYNAMIC INDUSTRIES, Precision Prods. Div., 1725 Diversey Blvd., Chicago, Ill., 60614, Tel: 312-935-4600; Empl.: 478

For info on price: J. M. Early; Application info: S. Heide; Customer service: J. M. Early; Delivery info: F. E. Kucera

Free literature available: Complete catalog or individual spec. sheets on thumbwheel, rotary, slide, and pushbutton switches; custom components; mechanical or pulse counters.

Products manufactured: Counters, Relays, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assocs.	205-837-0221
Cal	Inglewood, Weightman & Assocs.	213-645-6060
Cal	Menlo Park, West Engrg. Sls.	415-325-2885
Colo	Denver, TESSCO	303-744-1119
Fla	Maitland, Craft Assocs.	305-645-2242
Ga	Atlanta, Craft Assocs.	404-252-5001
Ill	Rolling Meadows, Sumer, Inc.	312-394-4900
Ind	Fort Wayne, Temple Engrg.	219-744-4331
Md	Glen Arm, Hodgins Assocs.	301-592-7047
Mass	Norwood, JMG	617-762-5333
Mich	Detroit, L. H. Dickelman Co.	313-255-3300
Minn	Edina, M. Foster Co.	612-835-2252
Mo	Kansas City, Harris-Hanson Co.	816-HI4-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Carlin, S.A.M. Assocs.	201-727-5335
NY	Jamaica, S.A.M. Assocs.	212-OL8-8881
NC	Greensboro, L & D, Inc.	919-292-3201
Ohio	Cleveland, L.H. Dickelman Co.	216-831-1039
Tex	Dallas, Glidden Electro Equip.	214-EM3-6539
Tex	Houston, Glidden Electro Equip.	713-681-1415
EXP:	Westbury, N.Y., Minthorne Int'l. Co.	516-334-3303

CHICAGO LOCK CO., 4275 W. Belmont Ave., Chicago, Ill., 60641, Tel: 312-282-7177, Telex: 25-4055; Empl.: 408 p. 1•1986,1987

Products manufactured: Switches

Local Sales Offices & Reps.

NY	New Rochelle	914-636-1311

CHICAGO MINIATURE LAMP/DRAKE, 4433 N Ravenswood Ave., Chicago, Ill., 60640, Tel: 312-784-1020, TWX: 910-221-5445; FSC No: 71744; Minimum order: $75

For info on price: C. Feeney 312-784-1020; Application info: M. Kaczmarek 312-867-7227; Customer service: C. Feeney; Delivery info: C. Feeney

Products manufactured: Caps, Lenses, Indicator Light, Diodes, Display Devices/Displays, Indicators, Lamps, Lights, Sockets

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe Sls., Inc.	602-264-7971
Cal	Mt. View, CMLW	415-967-2346
Cal	N. Hollywood, Chicago Miniature Lamp Co.	213-877-0158
Colo	Denver, Lindberg Co.	303-758-9033
Conn	Newtown, Gerber Sls. Corp.	203-426-3440
Fla	Hollywood, Component Engrg. Sls. Co.	305-922-5230
Ga	Atlanta, Winfield Southeast Co.	404-636-3023
Ill	Chicago, CMLW	312-784-1020
Ind	Indianapolis, Tech. Reprs.	317-849-6454
Iowa	Cedar Rapids, PMA Corp.	319-362-9177
Kans	Overland Park, PMA Corp.	913-381-0004
Kans	Wichita, PMA Corp.	316-264-2662
Mass	East Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Detroit, Rathsburg Assoc.	313-882-1717
Minn	Minneapolis, Nortec Sls.	612-835-7414
Mo	Hazelwood, PMA Corp.	314-731-4334
NJ	Cherry Hill, Trinkle Sls., Inc.	609-795-4200
NJ	Parsippany, TMA	201-227-4073
NM	Albuquerque, Lindberg Co.	505-345-2489
NY	N. Syracuse, L.D. Allen, Inc.	315-458-7470
NY	Port Washington, T.M.A.	516-883-2432
NY	Snyder, L.D. Allen, Inc.	716-839-3300
NC	Charlotte, Winfield Southeast Co.	404-636-3023
Ohio	St. Marys, T. Shelby & Co.	419-394-3377
Ore	Portland, J.J. Backer Co.	503-297-3776
Ore	Salem, J.J. Backer Co.	503-362-0717
Tenn	Hermitage, Winfield Southeast Co.	404-636-3023
Tex	Dallas, Techno Assocs.	214-357-9213
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Seattle, J.J. Backer Co.	206-285-1300
EXP:	Chicago, Ill.; Chicago Miniature	312-784-1020
FOR:	Can., Montreal, P.Q., General Instr. Can.	514-636-9454
FOR:	Can., Toronto, Ont., General Instr. Can.	416-763-4133

CHICAGO SWITCH, INC., 2035 W. Wabansia, Chicago, Ill., 60647, Tel: 312-489-5500; Empl.: 150; Minimum order: $25 .... p. 1•1988

For info on price: E. H. Petersen; Application info: E. H. Petersen; Customer service: M. Moore; Delivery info: M. Moore

Free literature available: GENERAL CATALOG - An attractive two color, 24 page catalog containing over 250 switches, many of which are in stock for immediate delivery. Included in this catalog are photos, dimensional line drawings, specifications, prices, and ordering information on our complete line of switches-including slide, snap action, rotary, pushbutton, rocker, paddle and leaf.

Products manufactured: Lights, Sockets, Switch Hardware, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Cleveland Entr.	602-996-6130
Cal	Burlingame, J. Logan & Assoc.	415-697-6100
Cal	San Gabriel, V. Gott & Assoc.	213-285-2148
Colo	Denver, Omega Ltd.	303-758-1508
Conn	Bethany, Reps. Corp.	203-393-0024
Fla	Casselberry, E.I.R.	305-830-9600
Ga	Atlanta, Winfield-Southeast Co.	404-636-3023
Ind	Indianapolis, Tech. Reps.	317-849-6454
Mass	Topsfield, Reps. Corp.	617-887-5050
Mich	Southfield, Kingsley Assoc.	313-424-8181
Minn	Minneapolis, Stack-Johnson, Inc.	612-925-2111
NJ	Mountain Lakes, Comps. Elctrns.	201-334-2921
NM	Albuquerque, Cleveland Entr.	505-345-2481
NY	Syracuse, Nycom, Inc.	315-437-8343
NC	Charlotte, Winfield-Southeast Co.	404-636-3023
Ohio	Beachwood, Elctrn. Salesmasters, Inc.	216-831-9555
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Glenside, Elcom, Inc.	215-885-1325
Tenn	Hermitage, Winfield-Southeast Co.	404-636-3023
Tex	Dallas, Erickson-Vilter Sls.	214-243-6611
Utah	Salt Lake City, Omega Ltd.	801-266-9617
Wash	Bellevue, N.R. Schultz Co.	206-454-5224

Local Distributors

Cal	Burlingame, Rose Elctrns., 846 N. Stanton Rd.	415-697-0224

CHOMERICS

CHOMERICS, INC., 77 Dragon Court, Woburn, Mass., 01801, Tel: 617-935-4850, TWX: 710-393-0173; Empl.: 90; Minimum order: $50

For info on price: P. A. Connolly; Application info: R. Stahl; Customer service: P. A. Connolly; Delivery info: D. Smith

Free literature available: Technical Bulletin 41-Describes CHO-THERM, a thermally conductive, electrically insulating silicone rubber for insulating power semiconductors. Bulletin 967-Describes standard QUICKEY keyboards, featuring low profile, tactile feel.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Gaskets, Shielding, R-F-Also See Shields, R-F, Keyboards, Alphanumeric & Decimal, Pads, Transistor Mounting, Rubber, Shields, Switches, Transistor, Diode, Thyristor Heat Dissipators, Tubing

Local Sales Offices & Reps.

Component

Cal	Los Angeles, El-Com, Inc.	213-223-1351
Pa	Glenside, C.A. Briggs Co.	215-885-2244
Tex	Dallas, J. Clay Co.	214-350-1281

RFI Shielding

Cal	Irvine, Chomerics/Job-Ready	714-556-4170
Cal	Los Angeles, El-Com, Inc.	213-223-1351
Cal	San Carlos, Lo-Dan, Inc.	415-592-4600
Fla	Orlando, Data-Rep, Inc.	305-843-5224
Fla	Pompano Beach, Data-Rep, Inc.	305-781-9279
Ill	Skokie, Mar-Con Assoc.	312-675-6450
Md	Rockville, Mechtronics Sls., Inc.	301-340-2130
Minn	Minneapolis, Milt Westlund Assoc.	612-866-5002
Mo	St. Louis, Chomerics/Mid-America	314-434-3880
NY	Jamaica, S-J Assocs.	212-291-3232
NY	Manhasset, Win-Cor Elctrn. Sls.	516-627-9474
Okla	Tulsa, Blair Engrg.	918-633-9850
Ore	Portland, Houston Co.	503-235-4174
Pa	Philadelphia, Professional Svc. Assoc.	215-355-6244
Tex	Dallas, Blair Engrg.	214-352-8411
Tex	Dallas, K. A. Elctrn. Sls.	214-634-7870
Tex	Houston, Blair Engrg.	713-772-0677
Wash	Seattle, Houston	206-622-0750

Local Distributors

Cal	Los Angeles, El-Com, 5134 Valley Blvd.	213-223-1351

CHRISTIANSEN RADIO INC., 1950 San Remo, Laguna Beach, Cal., 92651, Tel: 714-497-1506; Empl.: 9

For info on price: J. Conroy; Application info: A. D. Christiansen; Customer service: J. Conroy; Delivery info: J. Conroy

Free literature available: Brochures: Mini-Mount Solid State Electronics Kits, Mini-Mounts DC/UHF Breadboarding, Electronics in Education, Instructor's Manual A Series.

Products manufactured: Benches, Consoles, Stools, Tables, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Chassis, Circuit Board Mounting, Integrated Circuit Packaging Systems, Integrated Circuit Devices, Kits, Breadboarding (For Engineers), Kits, Power Supply, Kits, Printed Circuit, Kits, Test Equipment, Kits, Training Aid, Pads, Transistor Mounting, Soldering Accessories, Soldering Equipment, Strips, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Los Altos, Andot Tech. Sls. Co.	415-941-8858

CHRISTIE ELEC., 3404A W. 67th St., Los Angeles, Cal., 90043, Tel: 213-750-1151, TWX: 910-321-3867; FSC No: 02294; Empl.: 120; Minimum order: $1,095 p. 1•1180,1186

Customer service: H. Rudman

Free literature available: Bulletin AC-73 High-current DC power supplies; regulated and non-regulated; up to 1500 amps and 126 DC output volts.

Products manufactured: Chargers, Battery, Current Sources, Eliminators, Battery, Lamps, Lights, Power Supplies, Rectifiers, Sockets, Testers

Local Sales Offices & Reps.

Cal	Santa Clara, Thomas-Hartman Assoc.	408-247-1252
Fla	Orlando, Newco & Assocs.	305-293-7700
Md	Silver Spg., L. White	301-585-3141
NC	Winston-Salem, L. White & Co.	919-725-3612
Tex	Richardson, C. Tinch	214-231-1322
EXP:	Cal., L.A., Trans-World Trade	213-472-0444

CHRONETICS, INC., 500 Nuber Ave., Mt. Vernon, N.Y., 10550, Tel: 914-699-4400, TWX: 710-560-0014; Empl.: 55 p. 1•634; p. 2•1286

For info on price: Sls. Dept.; Application info: S. Gordon; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Complete and detailed literature on the following items: PG-10, PG-11A, PG-12, PG-13, PG-14B, PG-16, PG-32A, 1012.

Products manufactured: Amplifiers, Analyzers, Delay Lines, Generators

Local Sales Offices & Reps.

Ariz	Tempe, Trembly Assoc.	602-966-4428
Cal	Sherman Oaks, Windsor Dynamics	213-989-3631
Cal	Woodside, Windsor Dynamics	415-854-4870
Colo	Parker, Technology Mktg. Assoc.	303-841-3435
Conn	Hamden, Equip. Sls. Co., Inc.	203-248-5581
Fla	Clearwater, Brennan Assocs., Inc.	813-446-5006
Fla	Orlando, Brennan Assocs., Inc.	305-425-2161
Ill	Elk Grove Village, L.F. Green & Assocs.	312-593-0282
Ill	Mt. Prospect, Contemporary Science	312-255-3793
Ind	Indianapolis, L.F. Green & Assocs.	317-253-2087
Kans	Olathe, R. Rush Assocs.	913-782-1177
Md	Bethesda, Powell-Pendergraph, Inc.	301-656-4535
Mass	Chelmsford, Equip. Sls. Co., Inc.	617-256-8547
Minn	Minneapolis, L.F. Green & Assocs.	612-781-1611
Mo	St. Louis, R. Rush Assocs.	314-426-3656
NM	Albuquerque, Technology Mktg. Assoc.	505-298-4321
NY	Mt. Vernon, Q.E.D. Elctrns., Inc.	914-664-0080
Ohio	Dayton, Rixan Assocs.	513-278-4216
Ohio	Westerville, Contemporary Science, Inc.	216-292-7533
Pa	Abington, Powell-Pendergraph, Inc.	215-657-0300
Tex	Dallas, R. Martin Assocs, Inc.	214-358-3704
Tex	Houston, R. Martin Assocs., Inc.	713-462-4077
Va	Richmond, Powell-Pendergraph, Inc.	703-264-2341
Wash	Seattle, H. Levinson Co.	206-EA 3-5100

CHRONO-LOG CORP., 2 W. Park Rd., Havertown, Pa., 19083, Tel: 215-853-1130; Empl.: 15; Minimum order: $20 .... p. 1•152,153

For info on price: D. Biberman; Application info: D. Biberman; Customer service: A. Roy

Free literature available: Condensed Catalog - Digital Clocks, Calendars, Time Code Readers, Generators, Tape Search Systems. Series 70,000 Bulletin - versatile Digital Clocks. Series 9,000 Bulletin - low cost Time Code & Generator Readers.

Application Notes - individual bulletins of Chrono-log Digital Clocks and Time Code Equipment.

Products manufactured: Chronometers, Clocks (All Types), Controllers, Programmable, Converters, Counters, Generators, Receivers, Standards, Tape Search Equipment, Timers

Local Sales Offices & Reps.

Mass	Needham, J.J. Wild, Inc.	617-HI4-2366
Va	Arlington, H.J. Heffernan Co.	703-JA2-6666
FOR:	Can., Don Mills, Ont.; York Instrs.	416-445-1255

CHRONOMITE LABS, 21011 S. Ligueroa St., Carson, Cal., 90745

CIMCO WIRE & CABLE, INC., 250 W. Crescent Ave., Allendale, N.J., 07401, Tel: 201-327-2522, Telex: 13-3443; Empl.: 58; Minimum order: $50 p. 2•1910,2023

Customer service: H. Singer

Products manufactured: Cable, Tubing, Wire

Local Sales Offices & Reps.

Cal	Chatsworth, Cal-Ward Sls. Co.	213-885-1771
Fla	Orlando, Royce Elctrn. Sls., Inc.	305-843-6030
Ill	Chicago, Kennedy Engrg.	312-631-8283
Ind	Ft. Wayne, Component/Insulation Corp.	219-485-7114
Kans	Shawnee Mission, K & M Sls.	913-262-1444
Mass	Weston, F.C. Talbot Co.	617-893-6877
Mich	Birmingham, Forand Sls. Co.	313-644-0087
Minn	Minneapolis, Paul Ericson & Assocs.	612-884-1969
NY	East Syracuse, Mac-Tron Sls. & Engrg. Co.	315-422-2425
Ohio	Cleveland, Component/Insulation Corp.	216-521-3570
Pa	Pittsburgh, J.W. Kight Co.	412-781-8303
Pa	Radnor, Cordray Sales Co.	215-687-1366
Tenn	Memphis, Wm. L. Porter Co.	901-386-7714
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Wash	Kirkland, Lehr Assocs.	206-827-4581
FOR:	Can., Montreal, Que., Allied Elctrn. Sls.	514-488-5547

CINCH, See TRW Cinch

CINCINNATI ELCTRNS. CORP., 2630 Glendale Milford Rd., Cincinnati, Ohio, 45241, Tel: 513-563-6000, TWX: 810 464-8151; FSC No: 80045; Empl.: 900

Free literature available: Radio Sets, Receivers, Transceivers, Decoders, Demodulators, Antennas, Displays, Amplifiers, IR Receiving Sets and Detectors, Radar Sets.

Products manufactured: Amplifiers, Antennas, Boards, Printed Circuit, Circuits, Hybrid, Thick Film, Coders, Comm. Systems, Couplers, Decoders, Decommutators, Telemetering, Demodulators, Detectors, Mixer-Preamplifiers, Microwave, Modulator/Demodulators, Modulators, All Kinds, Multiplexers, Packages, Integrated Circuit, Radar Systems, Receivers, Scanners, Services, Assembly, Production & Test, Transceivers, Transmitters

CINCINNATI MILACRON, Molded Plastics Division, P.O. Box 246, Blanchester, Ohio, 45107, Tel: 513-783-2464, Telex: 214472; Empl.: 10000

Products manufactured: Laminates

Local Sales Offices & Reps.

Ala	Huntsville, Component Sls.	205-883-7794
Cal	Fremont, H.K. Foraker	415-657-2213
Cal	Sepulveda, R.L. Assocs.	213-782-7826
Colo	Boulder, Straube Assocs.	303-443-8600
DC	Bellevue, Ray Over Sls.	206-454-9187
Fla	Terra Ceia, Component Sls.	813-360-7460
Ill	Chicago, Electro-Comp. Sls., Inc.	312-763-3636
Ind	Ft. Wayne, P. Kilfoil	219-749-0113
Kans	Mission, Inland Assocs.	913-362-2366
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
Minn	Minneapolis, M. Franklin	612-835-6422
Mo	Glencoe, Inland Assocs.	314-938-4992
NH	Spofford, Bahr Sls.	603-352-5444
NJ	Springfield, F. F. Sylvester Assoc.	201-376-3324
NM	Albuquerque, Straube Assocs.	505-294-1880
NY	Rochester, Landfear & Brophy	716-442-0430
NC	Raleigh, Component Sls. Corp.	919-832-1897
Ohio	Cincinnati, J.F. Kilfoil Co.	513-791-6150
Ohio	Grafton, A. Risser	216-458-5091
Pa	Fairview Village, R.H. Hilderbrand Co.	215-247-6225
Tex	Garland, G.V. Peck Co.	214-341-8311
Utah	Salt Lake City, Straube Assocs.	801-328-4513
FOR:	Can., Brock Elctrns. Ltd.	613-342-0152

CINCINNATI SUB-ZERO PRODUCTS, 2612 Gilbert Ave., Cincinnati, Ohio, 45206, Tel: 513-751-8810; Empl.: 40

For info on price: T. J. Frederick; Application info: T. J. Frederick; Customer service: R. E. Schroeder; Delivery info: T. E. Spicer

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Testers

CIPHER DATA PRODUCTS, 7655 Convoy Ct., San Diego, Cal., 92111, Tel: 714-279-6550, TWX: 910-335-1257; Empl.: 132

Customer service: E. L. Phillips

Products manufactured: Computers, Converters, Data Acquisition & Reduction Systems, Recorders

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	Mountain View, Thorson Co.	415-964-9300
Cal	San Diego, Mesa Elctrns.	714-278-8021
Colo	Boulder, Measurement Consultants	303-449-5294
Fla	Orlando, FM Assocs.	305-851-5710
Ill	Chicago, Data Elctrns.	312-283-0300
Ind	Columbus, Miltronics	812-376-6321
Mass	Wakefield, Instr. Dynamics	617-245-5100
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Minneapolis, Data Elctrns.	612-786-9666
NJ	Ramsey, Cipher East Regional Off.	201-825-0335
NM	Las Cruces, Measurement Consultants	505-526-2491
NY	East Setauket, K & J Assocs.	516-751-8686
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Dayton, E. V. Swede Swenson	513-425-2773
Pa	Pennsauken, Megargel/Himmelstein	609-662-3081
Tex	Houston, Comspec	713-461-4487
Tex	Richardson, Comspec	214-234-4137
Utah	Murray, Measurement Conslt.	801-268-3181

CIR-Q-TEL, INC., 10504 Wheatley St., Kensington, Md., 20795, Tel: 301-946-1800; Empl.: 20

Customer service: D. E. Claycomb

Free literature available: Mini Catalog - filters and other products.

Products manufactured: Attenuators, Circulators, Ferrite, Detectors, Filters, Isolators

CIRCON CORP., 749 Ward Drive, Santa Barbara, Cal., 93111, Tel: 805-967-0404; Empl.: 30; Minimum order: $15

Customer service: Sls. Order Desk

Free literature available: MicroVideo Systems; MicroTools; MicroHardware; MicroIndicators & Lamps, MicroLuminators and MicroMagnifiers.

Products manufactured: Cameras, Caps, Lenses, Indicator Light, Eyelets, Fasteners, Kits, Breadboarding (For Engineers), Kits, Terminal, Knives & Knife Sets, Lamps, Leads, Test & Adaptors, Lenses, Optical & Camera, Lights, Microcircuit Production Equip., Microscopes, Monitors, Probes, Recorders, Rivets, Sockets, Solder (All Types), Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Television Systems & Equipment Closed-Circuit, Terminals, Testers, Tools, Tweezers, Hand & Vacuum

Local Sales Offices & Reps.

Ariz	Phoenix, Jensen Tools & Alloys	602-959-2210
Fla	Longwood, Lenz Engrg. Co.	305-831-9797
Fla	Miami, Elctrn. Equip.	305-871-3500
Ill	Chicago, Brooks Engrg. Co.	312-944-1227
Md	Rockville, Winston Sls. Co.	301-881-5780
Mass	Framingham, DLG Assocs.	
Mass	Sudbury, DLG Assocs.	617-877-7880
Mich	Detroit, Group Ten Tech. Sls. Corp.	313-549-3910
NJ	East Brunswick, Sigma Comms. Assocs.	201-238-3910
NM	Albuquerque	505-265-6775
NY	Binghamton, Stack Ind'l. Elctrns.	607-723-6326
NY	Hempstead, Davis Elctrns.	516-483-9200
NY	Merrick, Sigma Comms. Assocs.	516-623-7227
Ohio	Cleveland, Group Ten Tech. Sls. Corp.	216-486-2800
Ohio	Dayton, Group Ten Tech. Sls. Corp.	513-277-6531
Pa	Feasterville, H. Mann	215-355-7200
Pa	Plymouth Meeting, Techni-Tool	215-825-4990
Tex	Dallas, Southwestern Engrg. & Equip. Co.	214-826-6661
Tex	Spring, Southwestern Engrg. & Equip. Co.	713-353-4333
Wash	Seattle, Demarest Assocs.	206-523-0600

CIRCUIT ASSEMBLY CORP., 3169 Red Hill Ave., Costa Mesa, Ca., 92626, Tel: 714-540-5490, TWX: 910-595-1971; Empl.: 275

For info on price: T. Piatt; Application info: T. Piatt; Customer service: B. Payne; Delivery info: B. Payne

Products manufactured: Cable Assemblies & Harnesses, Cable, Connectors, Contacts, Electrical, Enclosures, Module, Plug-In, Jumpers, Pins, Plug Caps & Shells, Sockets, Wire

Local Sales Offices & Reps.

Ariz	Scottsdale, Barnhill Five	602-947-5745
Cal	Los Angeles, Product Supply Co.	213-659-1858
Cal	Santa Clara, Kelley Sales	408-249-0786
Colo	Denver, Barnhill Five	303-426-0222
Conn	Wallingford, Con Sales	203-269-7964
Fla	Fort Lauderdale, Tech-Rep Assocs.	305-792-0962
Fla	Indian Rocks Beach, Tech-Rep Assocs.	813-595-2834
Ill	Wilmette, Crest-Assocs.	312-256-5202
Mass	Waltham, Con Sales	617-890-0011
NJ	Westwood, R. C. Assocs.	201-664-1241
NM	Albuquerque, Barnhill Five	505-293-5956

Tex	Arlington, N. & W. Sales	817-461-4443
Wash	Bellevue, Hays Industrial	206-883-8888

CIRCUIT-STIK, INC., 24015 Garnier St., Torrance, Cal., 90510, Tel: 213-530-5530, Telex: 69-8223; FSC No: 06656; Empl.: 43; Minimum order: $25

For info on price: D. Harper; Application info: G. McCray; Customer service: D. Harper; Delivery info: Order Desk

Products manufactured: Boards, Printed Circuit, Connectors, Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Kits, Breadboarding (For Engineers), Kits, Printed Circuit, Racks, Socket Adapters, Sockets, Tapes, Films & Foils, Pressure Sensitive

Local Sales Offices & Reps.

Ariz	Phoenix, W. B. Knight Co.	602-242-6787
Ariz	Scottsdale, F. Board Assocs.	602-949-9561
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Newport Beach, W. B. Knight, Inc.	714-833-8250
Colo	Denver, W.J. Purdy Co.	303-777-1411
Fla	Orlando, Cartwright & Bean, Inc.	305-422-4531
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Hinsdale, Hill-Gray Assoc.	312-325-4810
Ind	Mulberry, Maish Sls.	317-296-2322
Kans	Overland Pk., T.L. Dowell	913-236-8200
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Minn	Minneapolis, D. Borrett Co.	612-929-0028
NJ	Teaneck, Fisher Elect. Assoc.	201-837-1200
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Syracuse, Mar-Com Assocs.	315-437-2843
Ohio	St. Marys, Thomas Shelby & Co.	419-394-3377
Ore	Portland, Earl & Brown Co.	206-284-1121
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481

CIRCUIT STRUCTURES LAB., Div. Lincoln Instr. Co., Inc., 3200 N. San Fernando Blvd., Burbank, Calif., 91504, Tel: 213-849-6341; Empl.: 4

For info on price: G. Vogel; Application info: E.L. Deatrick; Customer service: G. Vogel; Delivery info: G. Vogel

Products manufactured: Chassis, Circuit Board Mounting, Chassis, Metal, Guides, Circuit Board, Kits, Breadboarding (For Engineers), Pads, Transistor Mounting

CIRCUIT TECHNOLOGY, 160 Smith St., Farmingdale, N.Y., 11735, Tel: 516-293-8686, TWX: 510-224-6555; Empl.: 280; Minimum order: $1000

For info on price: M. Spitz; Application info: B. Sabatini; Customer service: J. DiPietro; Delivery info: J. DiPietro

Free literature available: Facilities & Capabilities Brochure.

Products manufactured: Circuits, Hybrid, Thick Film, Converters, Drivers, Switch, Filters, Hybrid Voltage Regulators, Integrated Circuit Devices, IC's, Active Filters, Integrators, Electronic, Lamp Drivers, Networks

Local Sales Offices & Reps.

Cal	Manhattan Beach	213-374-7446

CIRTECH CORP., 3802 W. 95th St., Leawood, Kans., 66206, Tel: 913-649-2800, TWX: 910-749-6806

Products manufactured: Filters

Local Sales Offices & Reps.

Ariz	Phoenix, Runyon Co.	602-959-6060
Cal	Los Angeles, Westaironics, Inc.	213-466-6201
Fla	Clearwater, WMM Assoc., Inc.	813-446-0075
Mass	Braintree, Bordewieck Eng. Sales	617-843-0845
NY	Buffalo, Telesco Assoc., Inc.	716-834-1026
NY	New York, F & F Assoc.	516-ED 4-1160
Ohio	Dayton, Berberich & Assoc.	513-252-9981
Tex	Dallas, Tinch Sls. Co.	214-231-1322

CLAIREX ELCTRNS. INC., 560 S. 3rd Ave., Mt. Vernon, N.Y., 10550, Tel: 914-664-6602; Empl.: 120; Minimum order: $25 .... p. 1•1008,1009

For info on price: A. Rabidoux; Application info: S. Aconsky; Customer service: A. Rabidoux; Delivery info: A. Rabidoux

Free literature available: Photocell Design Manual, Photomud Catalog, Spec Sheets

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Isolators, Transistors

Local Sales Offices & Reps.

Cal	Culver City, E.V. Roberts & Assoc.	213-870-9561
Cal	Palo Alto, E.V. Roberts & Assoc.	415-494-1671
Cal	San Diego, E.V. Roberts & Assoc.	714-565-4535
Colo	Eastlake, Jenson Reps.	303-688-4151
Fla	North Miami Beach, Irby & Connolly Inc.	305-949-5197
Fla	Orlando, Irby & Connolly Inc.	305-894-8471
Ga	Decatur, Electro Rep. Assoc. Inc.	
Ill	Chicago, L-Tec Inc.	312-286-1500
Md	Lutherville, Cunningham & Assoc.	301-296-4306
Mass	Norwell, Bordewieck Eng. Sls. Co.	617-659-4915
Mich.	Ferndale, Hilltronics Inc.	313-398-5556
Minn	Minneapolis, H.M.R. Inc.	612-920-8200
NJ	Fort Lee, Tecnimat	201-461-8686
NY	Cato, Clairex Elctrns.	315-626-6426
NY	Mt. Vernon, Clairex Elctrns.	914-664-6602
NY	Roslyn Heights, Livera Polk Assoc.	516-484-1276
NC	Charlotte, Electro Rep. Assoc.	704-527-2530
Ohio	Chardon, Clairex Elctrns.	216-285-3415
Pa	Media, W. Reeves Assoc.	215-566-6709
Tex	Dallas, J.B. Guenther Inc.	214-691-8500
Tex	Houston, J.B. Guenther Inc.	713-468-0232
Wash	Seattle, H. Levinson Co.	206-323-5100

Local Distributors

Ala	Birmingham, M-G Elctrns & Equip., Inc., 3112 6th Ave. S.	205-328-4525
Cal	Culver City, E.V. Roberts & Assocs., Inc., 9601 W. Jefferson Blvd.	213-870-9561
Cal	Garden Grove, Allied Elctrns. Corp., 12311 Ind'l. St.	714-894-7585
Cal	Palo Alto, E.V. Roberts & Assocs., Inc., 800 San Antonio Rd.	415-494-1671
Cal	San Diego, E.V. Roberts & Assocs., Inc., 8861 Balboa Ave., Suite E	714-565-4535
Fla	Orlando, Hammond Elctrns., Inc., 911 W. Central Blvd.	305-241-6601
Fla	Tampa, Lykes Elctrns. Corp., 5426 W. Crenshaw	813-886-6621
Ill	Elgin, Allied Elctrns. Corp., 1355 Sleepy Hollow Rd.	312-697-8200
Ind	Indianapolis, Graham Elctrns. Supp., Inc., 133 S. Pennsylvania St.	317-634-8486
Kans	Topeka, Acme Radio Supply, Box 437, 135 Kansas	913-235-1363
Ky	Louisville, P.I. Burks Co., 842 S. 7th St.	502-589-3960
La	New Orleans, Southern Radio Supply Co., 1901 Tulane Ave.	504-524-2343
Mass	Newton, Cramer Elctrns., Inc., 85 Wells Ave.	617-969-7700
Mass	Norwell, Bordewieck Sls. Co., 427 Washington St.	617-659-4915
Mich	Detroit, Michigan Lectrols Corp., 18315 W. 7 Mile Rd.	313-255-4250
Mich	Detroit, R.S. Elctrns., 12775 Lyndon Ave.	313-491-1000
Minn	Minneapolis, Stark Elctrns., 112 3rd. Ave. N.	612-294-1325
Mo	St. Louis, Van Sickle Radio Elctrns., 1915017 Washington Ave.	314-621-5000
NJ	Cherry Hill, D.F. Assocs., 135 Dumas Rd.	609-428-3455
NY	Buffalo, Summit Dists., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	New York, Blan Elctrns. Corp., 56 Warren St.	212-233-6288
NY	Rochester, Summit Elctrns. Rochester, 292 Commerce Dr.	716-334-8110
NC	Greensboro, Hammond Elctrns., Inc., 2923 Pacific Ave.	919-275-6391
NC	Raleigh, Southeastern Radio Supply Co., 414 Hillsborough St.	919-828-2311
NC	Winston-Salem, Kirkman Elctrns., Inc., 901 W. 2nd St.	919-724-0541
Ohio	Cincinnati, Hughes-Peters, Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Columbus, Hughes-Peters, Inc., 418 E. 11th. Ave.	614-294-5351
Pa	Pittsburgh, R.P.C. Elctrns., 620 Alpha Dr.	412-782-3770
SC	Columbia, Dixie Radio Supply Co., 1900 Barnwell St.	803-253-5333
SC	Greenville, Hammond Elctrns., Inc., Box 2308	803-233-4121
Tenn	Memphis, Bluff City Dist. Co., 234 E. St.	901-276-4501
Tenn	Nashville, Electra Distr. Co., 1914 W. End Ave.	615-329-3971
Tex	Dallas, Wholesale Elctrn. Supply, Ross at Central	214-824-3001
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Ft. Worth, Wholesale Elctrn. Supply Co., 550 South Freeway	817-336-0461
Tex	Richardson, Altair Co., 405 N. Plano Rd.	214-231-5166
Wash	Seattle, Radar Elec. Co., 168 Western Ave. W.	206-282-2551
Wisc	Mequon, Taylor Elec. Co., 1000 W. Donges Bay Rd.	414-241-4321
Wisc	Milwaukee, Parts Mart Corp., 1314 N. 7th St.	414-276-4160
For:	Can., Willowdale, Ont., Electro-Sonic Ind'l. Sls. Ltd., 1100 Gordon Baker Rd.	416-494-1666

CLARE & CO., C.P., 3101 Pratt Blvd., Chicago, Ill., 60645, Tel: 312-262-7700, Telex: 25-3775; Empl.: 1500 p. 1•1596-1615

For info on price: R. E. Axthelm; Application info: T. Sipp; Customer service: T. Miller; Delivery info: T. Miller

Products manufactured: Relays, Sockets, Switches

Local Sales Offices & Reps.

Ala	Huntsville, C.P. Clare & Co.	205-534-5438
Ariz	Phoenix, Spectrum Assocs.	602-997-6324
Ark	Fort Smith, Electro-Related Prods.	501-783-7323
Cal	Mountain View, C.P. Clare & Co.	415-968-2831
Cal	Santa Ana, Spectrum Assocs.	714-835-4114
Colo	Denver, Electrodyne, Inc.	303-757-7679
Fla	Ft. Lauderdale, R.I. Smith Assocs.	305-772-5100
Ga	Atlanta, A. Brown Assocs.	404-457-6381
Ill	Chicago, C.P. Clare & Co.	312-262-7700
Ind	Fort Wayne, Baehr, Greenleaf & Assoc.	219-447-1608
Kans	Shawnee Mission, Lowell-Kangas & Assoc.	913-631-3515
La	Harvey, Electro-Related Prods.	504-368-7487
Md	Ellicott City, Doss Elctrns., Inc.	301-465-1336
Mass	Needham, C.P. Clare & Co.	617-449-4780
Mich	Southfield, C.P. Clare & Co.	313-356-3988
Minn	St. Paul, Repor, Inc.	612-645-8618
Mo	St. Louis, Lowell-Kangas & Assoc.	314-821-4050
NY	Great Neck, C.P. Clare & Co.	516-466-2100
NY	Syracuse, C.P. Clare & Co.	315-637-3939
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Cincinnati, Baehr, Greenleaf & Assoc.	513-891-3828
Ohio	Cleveland, Baehr, Greenleaf & Assoc.	216-221-9030
Ohio	Columbus, Baehr, Greenleaf & Assoc.	614-486-4046
Pa	Erie, Foster-McClinton Inc.	814-455-9111
Pa	Ft. Washington, C.P. Clare & Co.	215-643-5321
Pa	Pittsburgh, Foster-McClinton Inc.	412-941-4800
SC	Greenville, R.W. Chapman & Co.	803-232-5391
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, Gettys-Eads-Adair Inc.	713-781-3006
Utah	Salt Lake City, Electrodyne, Inc.	
Va	Richmond, Advance Control Equip.	804-270-7182
Wash	Bellevue, C.P. Clare & Co.	206-747-5600
WVa	Huntington, Foster-McClinton, Inc.	304-736-5161
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529

Local Distributors

Ala	Birmingham, M. G. Elctrns. & Equip., 3112-6th Ave., S.	205-328-4525
Ala	Huntsville, Cramer/EW Inc., 2310 Bob Wallace Ave. S.W.	205-539-5722
Ala	Huntsville, Powell Elctrns., 803 Oster Dr.	205-539-2731
Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	602-273-7331
Ark	Fort Smith, Wise Wholesale Elctrns., 1001 Towson Ave.	501-783-8925
Ark	Little Rock, Carlton-Bates Co., Scott Hamilton Dr. at 69th	501-562-9100
Cal	Los Angeles, Kierulff Elctrns. Corp., 2585 Commerce Way	213-685-5511
Cal	Los Angeles, Texas Instrs. Supply Co., 5200 W. 104th St.	213-776-4490
Cal	Menlo Park, Bell Inds, Elctrn. Dist. Div., 1070 O'Brien Dr.	415-323-9431
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	San Diego, Kierulff Elctrns., 8797 Balboa Ave.	714-278-2112
Cal	Sun Valley, Richey Elctrns., 10871 La Tuna Canyon	213-983-0222
Cal	Sunnyvale, Texas Instrs. Supply 776 Palomar	408-732-5555
Colo	Denver, Kierulff Elctrns. Corp., 10890 E. 47th Ave.	303-343-7090
Colo	Denver, Texas Instrs. Supply Co., 2149 S. Holly St.	303-757-7671
Conn	North Haven, Cramer/Connecticut, 35 Dodge Ave.	203-239-5648

Fla Hollywood, Cramer/EW Inc., 4035 N. 29th Ave. 305-923-8181
Fla Miami Springs, Powell Elctrns., 1740 N.W. 69th Ave. 305-885-8761
Fla Orlando, Cramer/EW Inc., 345 N. Graham Ave. 305-894-1511
Ga Atlanta, Cramer/EW Atlanta, 3923 Oakcliff Industrial Ct. 404-448-9050
Ga Atlanta, Specialty Distributing, 763 Juniper St., N.E. 404-873-2521
Ill Arlington Heights, Texas Instrs. Supply Co., 2420 E. Oakton 312-593-7660
Ill Mount Prospect, Cramer/Chicago, 1911 South Busse Rd. 312-593-8230
Ill Palatine, Ohm/Elctrns., 649 Vermont Ave. 312-359-5500
Ill Peoria, Klaus Radio & Elctrns., 8400 N. Pioneer Pkwy. 309-691-4840
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-423-3422
Ind Indianapolis, Graham Elctrns. Supply, 133 S. Pennsylvania St. 317-634-8486
Kans Wichita, Radio Supply Co., Inc., 115 Laura 316-267-5214
La LaFayette, Ralph's of LaFayette, Box "R" 318-234-4507
Md Beltsville, Treeko Sales, 10739 Tucker St. 301-937-8260
Md Gaithersburg, Cramer/EW Washington, 16021 Industrial Dr. 301-948-0110
Md Hanover, Cramer/EW Baltimore, 7235 Standard Dr. 301-796-5790
Md Rockville, Pioneer/Washington Elctrns., 1037 Taft St. 301-424-3300
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mass Newton Centre, Cramer Elctrns., 85 Wells Ave. 617-969-7700
Mich Detroit, RS Elctrns., 12775 Lyndon Ave. 313-491-1000
Mich Livonia, Cramer/Detroit, 13193 Wayne Rd. 313-425-7000
Minn Edina, Cramer/Bonn, 7275 Bush Lake Rd. 612-835-7811
Minn Edina, Texas Instrs. Supply Co., 7615 Metro Blvd., Suite 202 612-941-5020
Minn Minneapolis, Control Design, 3433 E. 25th St. 612-721-1628
Mo Kansas City, Walters Radio Supply, 3627-35 Main St. 816-531-7015
Mo St. Louis, Olive Industrial Elctrns., 6662 Olive Blvd. 314-863-7800
Neb Lincoln, Scott Electrn. Supply Corp., 4040 Adams St., Box 4467 402-434-8308
NJ Cherry Hill, Cramer/Pennsylvania, No. 12 Springdale Rd. 215-923-5950
NJ Clifton, Wilshire Elctrns./N.J., 312 Clifton Ave. 201-365-2600
NJ Moonachie, Cramer/N.J., 1 Barrett Ave. 201-935-5600
NJ Moorestown, Arrow/Angus, 126 Pleasant Valley Ave. 609-235-1900
NM Albuquerque, Kierulff Elctrns. Corp., 2524 Baylor Dr. S.E. 505-247-1055
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661
NY East Syracuse, Cramer/Syracuse, 6716 Joy Rd. 215-437-6671
NY Endwell, Cramer/Binghamton, 3220 Watson Blvd. 607-754-6661
NY Farmingdale, Wilshire Elctrns./L.I., 1855 New Hwy 516-293-5775
NY Hauppauge, Cramer/L.I., 29 Oser Dr. 516-231-5600
NY Johnson City, Wilshire Elctrns., 617 Main St. 607-797-1236
NY Rochester, Cramer/Rochester, 3259 Winton Road So. 716-275-0300
NY Rochester, Simcona Elctrns., 275 Mt. Read Blvd. 716-328-3230
NC Raleigh, Cramer/EW Raleigh, 3901 Winton Rd. 919-876-2371
NC Winston-Salem, Cramer/EW Inc., 938 Burke St. 919-725-8711
Ohio Cincinnati, Cramer/Tri-States, 666 Redna Terr. 513-771-6441
Ohio Cleveland, Cramer/Cleveland, 5835 Harper Rd. 216-248-8400
Ohio Cleveland, Pioneer/Cleveland Elctrns., 4800 E. 131st St. 216-587-3600
Ohio Dayton, Pioneer/Dayton Elctrns., 1900 Troy St. 513-236-9900
Okla Tulsa, Texas Instrs. Supply, 12151 E. Skelly Dr. 918-437-4555
Pa Allentown, Federated Elctrns., A Div. Federated Purchaser, 936 Union Blvd. 215-437-4431
Pa Philadelphia, Powell Elctrns., S. Island Rd. 215-365-1900
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-288-2600
SC Columbia, Dixie Radio Supply, 1900 Barnwell St. 803-253-5333
Tenn Nashville, Electra Distributing Co., 1914 West End Ave. 615-329-3971
Tex Austin, Texas Instrs. Supply Co., 2601 N. Lamar 512-258-1636
Tex Dallas, Cramer/Tex., 2970 Blystone La. 214-350-1355
Tex Dallas, Texas Instrs. Supply Co., 6000 Denton Dr. 214-238-6853
Tex Houston, Tex. Instrs. Supply, 3939 Ann Arbor Dr. 713-785-4800
Utah Salt Lake City, Alta-Land Elctrns., 2280 S. Main St. 801-486-7227
Va Richmond, Meridian Elctrns., 1001 W. Broad St. 804-355-0669
Wash Seattle, Almac-Stroum Elctrns., 5811 Sixth Ave. S. 206-763-2300
Wash Seattle, Kierulff Electronics, 5940 Sixth Ave. S. 206-763-1550
Wisc Milwaukee, Marsh Elctrns., Inc., 6047 West Beloit Rd. 414-545-6500
Wisc Oak Creek, Cramer/Wisc., 430 W. Rawson Ave. 414-764-1700

CLARE-PENDAR, Box 785, Post Falls, Idaho, 83854, Tel: 208-773-4541; Empl.: 500; Minimum order: $50

For info on price: T. Drahman; Application info: D. Dillard; Customer service: T. Drahman; Delivery info: T. Drahman

Free literature available: Switchlight Systems, S410 Monoform, S190 General Switchlight.

Products manufactured: Annunciators, Caps, Lenses, Indicator Light, Display Devices/Displays, Indicators, Keyboards, Alphanumeric & Decimal, Lenses, Readout & Display, Lenses, R-F, Lights, Sockets, Switchboards, Switches

Local Sales Offices & Reps.
Ala Huntsville, C.P. Clare & Co. 205-534-5438
Ariz Phoenix, Spectrum Assoc. 602-997-6324
Ark Ft. Smith, J.R. Masterson 501-783-7323
Cal Mt. View, C.P. Clare & Co. 415-968-2831
Cal Santa Ana, Spectrum Assoc. 714-835-4114
Colo Denver, Electrodyne 303-757-7679
Fla Ft. Lauderdale, R.I. Smith Assoc. 305-772-5100
Fla Largo, R.I. Smith Assoc. 813-585-2980
Ga Atlanta, A. Brown & Assoc. 404-457-6381
Ill Chicago, C.P. Clare & Co. 312-262-7700
Ind Ft. Wayne, Baehr Greenleaf & Assoc. 219-447-1608
Kans Shawnee Mission, Lowell-Kangas & Assoc. 913-631-3515
Md Ellicott City, Doss Elctrns., Inc. 301-465-1336
Mass Needham, C.P. Clare & Co. 617-449-4780
Mich Southfield, C.P. Clare & Co. 313-356-3988
Minn St. Paul, Repor, Inc. 612-645-8618
Mo St. Louis, Lowell-Kangas & Assoc. 314-821-4050
NY Fayetteville, C.P. Clare & Co. 315-637-3939
NY Great Neck, C.P. Clare & Co. 516-466-2100
NY Huntington, Caravan Sls. Corp. 516-692-2839
NC Charlotte, R.W. Chapman & Co. 704-525-2421
NC Raleigh, R.W. Chapman & Co. 919-782-2624
Ohio Cincinnati, Baehr Greenleaf & Assoc. 513-891-3826
Ohio Cleveland, Baehr Greenleaf & Assoc. 216-221-9030
Ohio Columbus, Baehr Greenleaf & Assoc. 614-486-4046
Pa Bridgeville, Foster-McClinton, Inc. 412-941-4800
Pa Erie, Foster-McClinton, Inc. 814-455-9111
Pa Ft. Washington, C.P. Clare & Co. 215-643-5321
SC Greenville, R.W. Chapman & Co. 803-232-5391
Tex Dallas, R.E. Nesbitt Co. 214-357-4601
Tex Houston, Gettys-Eads-Adair, Inc. 713-781-3005
Va Portsmouth, Advance Control Equip. 804-393-6642
Va Richmond, Advance Control Equip. 804-264-2588
Wash Bellevue, C.P. Clare & Co. 206-747-5600
WVa Huntington, Foster-McClinton, Inc. 304-736-5161
Wisc Wauwatosa, Larsen Assoc. 414-258-0529

CLARKE-HESS COMM., Resch. Corp., 43 W. 16th St., New York, N.Y., 10011, Tel: 212-255-2940; FSC No: 34423 ...... p. 1•636,637

Customer service: M. Jacobs

Free literature available: Equivalent Series Resistance in Capacitors. Function Generator Synchronization Notes. Experiments with Function Generators and Multipliers

Products manufactured: Amplifiers, Generators, Memory Systems, Meters, Modulators, All Kinds, Multipliers, Oscillators, Test Equipment, Test Systems, Testers

Local Sales Offices & Reps.
Ill Chicago, P. Lind Elctrns. Co. 312-774-1246
Ind Indianapolis, P. Lind Elctrns. Co. 317-547-9178
Kans Leawood, Leemark Engrs., Inc. 913-NI8-0124
Mass Waltham, W. M. Hague Co. 617-899-5600
Minn Circle Pines, P. Lind Elctrns. Co. 612-786-5770
Tex Richardson, Spectra Sls. 214-234-3600
Va Crossroads, Q.T. Elctrns. Sls. Co. 703-671-4357

CLAROSTAT MFG. CO., INC., Washington St., Dover, N.H., 03820, Tel: 603-742-1120, TWX: 510-297-4455; Empl.: 600 ...... p. 2•1627

For info on price: D. Flanagan; Application info: J. McDevitt

Free literature available: 388/389 1/2" Square Modular Potentiometer, 731A - 10 turn pot, 381 - Quiet-one 1 watt 5/8" Dia. Conducture plastic variable pot, 1975 - Distributor full line catalog, Engineering catalog.

Products manufactured: Attenuators, Decade Boxes, Dials, Potentiometers, Resistors, Rheostats, Switches

Local Sales Offices & Reps.
Ariz Phoenix, J. Berman Co., Inc.
Ark Little Rock, J.Y. Schoonmaker Co. 501-375-2168
Cal Inglewood, J. Berman Co. 213-776-1281
Cal Menlo Park, Straube Assoc. 415-323-2476
Colo Denver, Straube Assoc./Mtn. States 303-426-0890
Fla Bradenton, Hutto-Hawkins-Peregoy Inc. 813-755-4015
Fla Maitland, Hutto-Hawkins-Peregoy Inc. 305-831-2474
Fla Pompano Beach, Hutto-Hawkins-Peregoy Inc. 305-943-9593
Ga Atlanta, Millar Elctrs. Inc. 404-261-6160
Ill Chicago, Clarostat Mfg. Co. Inc. 312-792-3898
Ind Fort Wayne, Needler Sls. Co. 219-447-2123
Ind Indianapolis, New/Era Sls. Inc. 317-257-7333
Iowa Cedar Rapids, Palatine Eng. Sls. Inc. 319-365-8071
Kans Andover, Palatine Eng. Sls. Inc. 316-683-7512
Kans Overland Park, Palatine Eng. Sls. Inc. 913-262-5643
Md Lutherville, L.D. Lowery Inc. 301-VA3-2172
Md Silver Spring, Lowery Assoc. 301-HE9-3542
Mass Concord, Clarostat Mfg. Co. Inc. 617-369-7933
Minn Minneapolis, A.J. Warner Co. 612-729-7371
Mo St. Louis, Palatine Eng. Sls. Inc. 314-426-7055
NM Albuquerque, Straube Assoc./Mt. States 505-292-0295
NY Manhasset, Win-Cor Elctr. Sls. Corp. 516-627-9474
NY N. Syracuse, L.D. Allen Inc. 315-458-7470
NY Snyder, L.D. Allen Inc. 716-839-3300
NC Raleigh, Millar Elctrs. Inc. 919-787-9564
Ohio Cleveland, K.W. Elctrs. Sls. Inc. 216-831-8292
Ohio Dayton, K.W. Elctrs. Sls. Inc. 513-890-2150
Okla Tulsa, J.Y. Schoonmaker Co. 918-936-1423
Ore Portland, Almac/Stroum Elctrs. 503-292-3534
Pa Allison Park, K.W. Elctrs. Sls. Inc. 412-487-4300
Pa Broomall, L.D. Lowery Inc. 215-356-5300
Pa Camp Hill, Beil & Whitaker Inc.
Pa Harrisburg, Beil & Whitaker Inc. 717-652-0184
Pa Reading, Beil & Whitaker Inc. 215-779-2610
Tex Dallas, J.Y. Schoonmaker Co. Inc. 214-357-8481
Tex Houston, J.Y. Schoonmaker Co. Inc. 713-926-9510
Va Charlottesville, L.D. Lowery Inc. 703-973-6672
Wash Seattle, Almac/Stroum Co. 206-763-2300
EXP: New York, N.Y., M. Simons & Sons Co. Inc. 212-227-5513
FOR: Montreal, Quebec, Can., Superior Int'l. 514-683-6331

Local Distributors
Ariz Phoenix, Sterling Elctrns., 201 E. University Dr. 602-258-4531
Cal Irvine, Cramer/Los Angeles, 17201 Daimler 714-979-3000
Cal Oakland, Brill Elctrns., 610 E. 10th St. 415-834-5888
Cal Riverside, Elctrn. Supp., 2486 Third St. 714-787-9220
Cal San Carlos, Sterling Elctrns., 1061 Ind. Rd. 415-592-2353
Cal Sun Valley, Richey Elctrns., 10871 La Tuna Canyon Rd. 213-875-2862
Colo Denver, Acacia Sls., 11111 W. 8th Ave., Unit B 303-232-2882

Colo	Denver, Elctrn. Parts Co., 1212 S. Broadway	303-266-3755
Conn	Fairfield, U-Tronics, 273 Linwood Ave.	203-255-4521
Conn	North Haven, Cramer Elctrns., 35 Dodge Ave.	203-239-5641
Fla	Miami, Elctrn. Equip., 2701 N.W. 42nd St.	305-635-0421
Fla	Oakland Park, Peerless Radio of Fla., 1040 N.E. 43rd Ct.	305-566-5966
Ga	Atlanta, Lykes Elctrns., 1135 Chattahoochee	404-355-2223
Ill	Chicago, Newark Elctrns. Corp., 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Radio Corp., 1355 Sleepy Hollow Rd.	312-697-8200
Ill	Palatine, Ohm Elctrns., 649 Vermont Ave.	312-359-5500
Ind	Indianapolis, Radisco, 814 N. Senate Ave.	317-637-5571
Iowa	Cedar Rapids, Deeco, 2500 16th Ave., S.W.	319-365-7551
Kans	Wichita, Radio Supp., 131 Laura	316-267-5216
Ky	Louisville, P.I. Burks, 659 S. 9th St.	502-583-2871
La	Lafayette, Ralph's of Lafayette, 3004 Cameron	318-369-9818
Md	Baltimore, Radio Elec. Serv. Co., 1026 Cromwell Bridge Rd.	301-823-0070
Md	Savage, Pyttronics, 8200 Wellmoor Ct.	301-792-7000
Mass	Dedham, Gerber Radio, 852 Providence Hwy., Rte. #1	617-329-2400
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mass	Newton, Greene-Shaw Co., Inc., 70 Bridge St.	617-969-8900
Mass	Watertown, Sterling Elctrns., 51 Spring St.	617-926-9720
Mich	Ann Arbor, Wedemeyer Elctrn. Supp., 2280 S. Ind. Hwy.	315-665-8611
Mich	Augusta, Great Lakes Elctrns., Div. Knappen Milling Co.	616-731-4156
Minn	Minneapolis, Harry Stark Elctrns. Supp., 112 3rd Ave., N.	612-332-1325
NH	Concord, Evans Radio, Box 893	603-224-9961
NJ	Hanover, State Elctrns., 36 Route 10	201-887-2550
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	Rochester, Simcona Elctrns., 275 Mt. Read Blvd.	716-328-3230
NC	Greensboro, Hammond Elctrns. of Carolina, 4923 Pacific Ave.	919-275-6391
NC	Winston-Salem, Kirkman Elctrns., 901 W. 22nd St.	919-724-0541
Ohio	Akron, Akron Elctrns., 107 S. Arlington St.	216-762-8818
Ohio	Cleveland, Pioneer-Cleveland, 4800 E. 131st St.	216-587-3600
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Stotts Friedman Co., 108-112 N. Jefferson St.	513-224-1111
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9123
Ore	Portland, Almac/Stroum Elctrns., 8888 S.W. Canyon Rd.	503-292-3534
Pa	Philadelphia, Almo Ind. Elctrns., Roosevelt Blvd., at Blue Grass Rd., N.E. Ind. Pk.	215-676-6000
Pa	Philadelphia, Philadelphia Elctrns., 112 N. 12th St.	215-568-7400
Pa	Pittsburgh, Cameradio, 2801 Liberty	412-288-2600
SC	Columbia, Dixie Radio Supp., 1900 Barnwell St.	803-253-5333
Tenn	Memphis, Bluff City Dist., 234 East St.	901-725-9500
Tenn	Nashville, Electra Dist., 1914 West End Ave.	615-329-3971
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-8366
Tex	Ft. Worth, Sweico, 1512-18 E. Lancaster	817-335-6521
Tex	Houston, Sterling Elctrns., 4201 S.W. Frwy.	713-623-6600
Va	Charlottesville, Virginia Radio Supp., 717 Henry Ave.	804-296-4184
Wash	Seattle, Almac/Stroum Elctrns., 5811 Sixth Ave., S.	206-763-2300
Wisc	Milwaukee, Elctrnc. Expeditors, 6045 N. Greenbay Ave.	414-374-6666

CLARY CORP., Precision Instrs. Div., 320 W. Clary Ave., San Gabriel, Calif., 91776, Tel: 213-287-6111; Empl.: 50

Products manufactured: Gyros (All Types), Printers, Recorders, Terminal Equipment, Digital

CLAUSS CUTLERY CO., Box 667, Fremont, Ohio, 43420, Tel: 419-332-7344; Empl.: 175; Minimum order: $75

For info on price: L. Beal; Application info: J. Hart; Customer service: L. Beal; Delivery info: L. Beal

Free literature available: Pocket size catalog and price list

Products manufactured: Scissors, Tweezers, Hand & Vacuum, Wire Strippers

CLEAN ROOM PRODS., 56 W. Penataquit Ave., Bay Shore, N.Y., 11706, Tel: 516-968-8282; Empl.: 27; Minimum order: $15

For info on price: W. Duncan; Application info: W. Duncan; Customer service: C. Coppola; Delivery info: C. Coppola

Free literature available: General Catalog - Clean Room Ancillaries & Materials "Clean Rooms"

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Benches, Consoles, Stools, Tables, Carts & Dollies, Instrument & Equipment, Cleaners & Solvents, Cleaners, Ultrasonic, Counters, Indicators, Lights, Machines/Machinery, Production, Ultraviolet Inspection Lighting

CLEMENS MFG. CO., 630 So. Berry Rd., St. Louis, Mo., 63122, Tel: 314-961-7228; Empl.: 3

Products manufactured: Generators

CLEVELAND CRYSTALS, INC., Box 17157, Euclid, Ohio, 44117, Tel: 216-486-6100; FSC No: 8K400; Empl.: 12; Minimum order: $50

Customer service: A. Carlson

Free literature available: Basic Data Sheets: Electro-optic crystals, piezoelectric II-DI crystals Lithium iodate, piezoelectric KBS (potassium peutaborate) infrared polarizer

Products manufactured: Crystal Blanks, Crystals, Modulators, All Kinds

CLEVELAND ELECTRONICS, INC., 14500 Darley Ave., Cleveland, Ohio, 44110, Tel: 216-249-3700, TWX: 810-421-8656; Empl.: 500

Customer service: J. Riffe

Products manufactured: Speakers, Yokes

CLEVELAND INSTITUTE OF ELCTRNS., 1776 E. 17th St., Cleveland, Ohio, 44164, Tel: 216-781-9400

Customer service: Registrar

Free literature available: CIE School Catalog: electronics homestudy courses-basic & advanced training information-benefits of CIE methods. FCC Booklet: answers popular questions about the various FCC licenses & permits- How to prepare for the government FCC exam.

Products manufactured: Technical Books

CLEVELAND MICA CO., 1360 Hird Ave., Lakewood, Ohio, 44107, Tel: 216-226-1360; Empl.: 50; Minimum order: $25

For info on price: W. D. Burton; Application info: W. D. Burton; Customer service: D. Brady; Delivery info: D. Brady

Free literature available: General information sheet on Mica.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Insulators & Insulation

Local Sales Offices & Reps.

Ill	Northfield, Special Electric Co.	800-558-0640
NY	New York, United Mineral & Chemical Corp.	212-966-4330
Ohio	Cleveland, C.J. Voneman Co.	216-333-5500
Tex	Frankston, Cline & Son, Inc.	214-876-2223

CLIFTON PRECISION, Litton Systems, Inc., Marple at Brdway., Clifton Hgts., Pa., 19018, Tel: 215-622-1000, TWX: 510-669-9782; FSC No: 86197; Empl.: 1000

Customer service: E. Demarco

Free literature available: Our general catalog is major source of information. Various products do appear in bulletin form as well; however, the data is always updated in the catalog, while bulletins become obsolete.

Products manufactured: Amplifiers, Controls/Control Eqpt., Converters, Encoders, Indicators, Motors, Repeaters, Servo, Resolvers, Synchro, Servo Systems, Synchros, Testers, Transducers

Local Sales Offices & Reps.

Ariz	Phoenix, Clifton Precision	602-242-0910
Cal	Norwalk, Comar Co.	213-921-8695
Cal	Sunnyvale, Comar	408-245-3193
Fla	Altamonte Springs, Clifton Precision	305-831-1441
Ill	Elk Grove Village, Midwest Meridian	312-437-6531
Iowa	Cedar Rapids, Midwest Meridian	319-365-6561
Mass	W. Newton, Darbury Corp.	617-244-2053
Mich	E. Grand Rapids, Midwest Meridian	616-949-7798
Mo	Maryland Hgts., Midwest Meridian	314-878-4441
NY	Greenlawn, Reflex Elctrn.	516-549-1888
Ohio	Dayton, Midwest Meridian	513-276-4137
Tex	Dallas, Midwest Meridian	214-251-3933

CLIMATRONICS CORP., 1324 Motor Pkwy., Hauppauge, N.Y., 11787, Tel: 516-234-2772; Empl.: 15

Customer service: T. Schreiber

Products manufactured: Bridges, Cable Assemblies & Harnesses, Choppers, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Detectors, Indicators, Modulator/Demodulators, Modulators, All Kinds, Monitors, Probes

Local Sales Offices & Reps.

Mass	Bedford, Ambientmetrics	617-274-6450

CLINTON ELCTRNS. CORP., 6701 Clinton Rd., Rockford, Ill., 61111, Tel: 815-633-1444, Telex: 257-484

For info on price: C. G. Phillipps; Application info: P. Knulty; Customer service: K. Pohl; Delivery info: K. Pohl

Free literature available: Free brochure describing products and capabilities.

Products manufactured: Tubes

CML-MACARR, INC., 167 National Rd., Edison, N.J., 08817, Tel: 201-287-2810, TWX: 710-998-0560; Empl.: 100 .... p. 1•1154-1161

Products manufactured: Amplifiers, Chargers, Battery, Controls/Control Eqpt., Converters, Discharge Systems, Energy, Generators, Inverters, Motor Electric Generator Sets, Motors, Oscillators, Power Supplies, Testers, Transformers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Cal	Costa Mesa, Meas. Assoc.	714-540-7160
Cal	Sunnyvale, RDP Instrs.	408-735-9040
Fla	Orlando, Datarep	305-843-5224
Fla	Pompano Bch., Datarep	305-781-9279
Fla	St. Petersburg, Datarep	813-345-8503
Ill	Des Plaines, Marsland Assoc.	312-298-2620
Ill	Elk Grove Village, L.F. Green & Assoc.	312-593-0282
Ind	Indianapolis, L.F. Green	317-293-9827
Md	Fulton, Gans-Fryling	301-837-6311
Mass	Burlington, Tekdata	617-273-0198
Mich	Detroit, H. Teplitz	313-537-9058
Minn	Minneapolis, Marsland Assoc.	314-278-6949
Minn	Mpls., L.F. Green	612-781-1611
Mo	Florissant, Marsland Assocs.	816-765-0641
NJ	Fort Lee, Tech. Mktg. Assocs.	201-224-6911
NY	Fayetteville, M. P. Andrews	315-637-3144
Ohio	Cleveland, H. Teplitz & Co.	216-371-2044
Ohio	Dayton, H. Teplitz & Co.	315-277-6531
Pa	Exton, Scientific Mktg.	215-363-7377
Tex	Dallas, True Technology	214-691-7870
Va	Arlington, Gans-Fryling	703-527-3262

CO-OPERATIVE INDS., INC., 100 Oakdale Rd., Chester, N.J., 07930, Tel: 201-879-5151, TWX: 510-235-1277; FSC No: 81482; Empl.: 250; Minimum order: $25

Customer service: C. Baletti

Free literature available: Waveguide Catalog; Plastic Conduit Catalog; Flex Metal Conduit/Hose Catalog; Gen'l Capability Brochure

Products manufactured: Bends & Twists, Microwave, Braid, Cable, Cable, Chokes, Conduit, Electrical, Connectors, Couplers, Ducts, Wiring, Flanges, Waveguide, Lead Assemblies & Receptacles, Shields, Tubes, Tubing, Waveguides & Adapters, Wire

COASTCOM, 2346 Stanwell Dr., Concord, Cal., 94520, Tel: 415-825-7500; Empl.: 25

Customer service: G.H. Vought

Free literature available: Data sheets describing the operation and listing specifications of our program audio transmission equipment and other specialized multiplex equipment.

Products manufactured: Comm. Systems, Filters, Multiplexers

Local Sales Offices & Reps.

Cal	Concord, Coastcom	415-825-7500
Cal	Santa Fe Springs, Kennedy Engrg. Co.	213-868-9965
Fla	Melbourne, Repcom, Inc.	305-254-1877
Md	Edgewater, Commart	301-261-4344
NJ	Totowa, H.M. Holzberg Assocs.	201-256-0455
Tex	El Paso, H. Markowitz Co.	915-584-1795

COAX DEVICES INC., Box 234-EEM, Chelsea, Mass., 02150, Tel: 617-884-6983; Empl.: 20

Products manufactured: Adapters, Waveguide, Attenuators, Cavities, Microwave, Detectors, Dividers, Dummy Loads, Duplexers, Microwave, Horns, Microwave, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Mismatches, Microwave, Precision, Mixers, Mounts, Probes, Terminals, Waveguides & Adapters

COAXIAL DYNAMICS, INC., 13110 Enterprise, Cleveland, Ohio, 44135, Tel: 216-267-2233; Empl.: 28

Customer service: R. J. Scott

Free literature available: Catalog binder and specific flysheets on individual items: e.g. filters, watt meters, power sensors.

Products manufactured: Attenuators, Couplers, Detectors, Dummy Loads, Filters, Meters, Monitors, Probes, Strip-Line Components, Microwave, Switches, Terminals

Local Sales Offices & Reps.

Del	Newark, Tom Wright & Assoc.	301-398-3748
Ind	Ft. Wayne, Tx Sales Inc.	219-485-0805
Iowa	Cedar Rapids, S & O Sales	319-393-1845

COBEHN, INC., 226 Passaic Ave., Fairfield, N.J., 07006, Tel: 201-227-6675; Empl.: 5

For info on price: D. F. Cook; Application info: G. L. Henzel; Customer service: W. E. Bellars; Delivery info: D. F. Cook

Free literature available: High velocity spray equipment and fractionally distilled solvent for the critical cleaning of precision electronic, electro-mechanical and mechanical components.

Products manufactured: Cleaners & Solvents, Machines/Machinery, Production

Local Sales Offices & Reps.

Cal	Fullerton, John Broadbent, Jr.	714-879-4974
Cal	San Diego, J. C. Henberger Co.	714-223-7114
Ill	Des Plaines, Marsland Assocs., Inc.	312-298-2620
Ind	Indianapolis, Marsland Assocs., Inc.	317-924-3568
Md	Kensington, Aeron Assocs.	301-946-0070
Mass	Boston, R. E. Bailey	617-426-0846
Mich	Cedar, C & D Assocs.	616-334-3722
Minn	Minneapolis, Marsland Assocs., Inc.	612-545-4481
Mo	St. Peters, Marsland Assocs., Inc.	314-278-6949
NJ	Montclair, Ameresco, Inc.	201-746-5300
NY	Rochester, Rochester Ind'l. Supply Co.	716-325-2386
Pa	Reading, Chemtronics Div., Ind'l. Abrasives	215-779-3910
Tex	El Paso, Test Equip. Co.	915-755-9182
Utah	Bountiful, Bert Randall Assocs.	801-292-4965

COBER ELCTRNS., INC., 7 Gleason Ave., Stamford, Conn., 06902, Tel: 203-327-0003, TWX: 710-474-3371; FSC No: 28909; Empl.: 60; Minimum order: $50

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For info on price: B. Zarkower; Application info: B. Zarkower; Customer service: A. Fairman; Delivery info: A. Fairman

Products manufactured: Amplifiers, Dielectric Heating Equipment, Generators, Machines/Machinery, Production, Modulators, All Kinds, Networks, Power Supplies, Protectors, Radar Systems, Regulators, Relays, Testers, Transformers, Transmitters

Local Sales Offices & Reps.

Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Los Altos, J. Stone	415-948-4563
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Colo	Denver, Zeus, Inc.	303-770-4400
DC	Wash, Eastern Instr.	301-681-6500
Fla	Palm Bay, SparTech Assocs.	305-727-8045
Ga	Smyrna, SparTech Assocs.	404-432-3644
Mass	Waban, Instrument Conslts.	617-969-9881
Mass	Waltham, Meas. Conslts.	617-890-4400
Mich	Detroit, Micro Sls.	313-482-1229
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	E. Syracuse, Ossmann Instr.	315-437-6666
NY	Great Neck, Eastern Instr.	516-466-9505
Ohio	Dayton, Micro Sls.	513-298-3033
Pa	Phila., Eastern Instr.	215-927-7777
Tex	Fort Worth, Carey, Wolf & Assoc.	817-738-1996
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
FOR:	Calgary 21, Alberta, Can., Canadian Dynamics, Ltd.	403-269-2202
FOR:	Don Mills, Ont., Can., Componetics Limited	416-445-3230
FOR:	Donauworth, Germany, Telemeter Electronic Gmoh	
FOR:	Montreal, P.Q., Can., Componetics Limited	514-342-4117

CODEX CORP., 15 Riverdale Ave., Newton, Mass., 02195, Tel: 617-969-0600, Telex: 92-2443; Empl.: 459

For info on price: R. Lowry; Application info: R. Lowry; Customer service: B. Richner; Delivery info: J. Madison

Free literature available: High speed data processing equipment. Modems and multiplexers.

Products manufactured: Comm. Systems, Modulator/Demodulators, Terminal Equipment, Digital, Transmission Systems, Data

Local Sales Offices & Reps.

Cal	Los Angeles, P. Lindberg	213-552-2558
Cal	San Francisco, C. Rose	415-329-1700
Conn	New Haven, J. Blenner	203-488-8918
DC	Washington, G. Dickey	202-223-2990
Ga	Atlanta, L. Wallace	404-944-8233
Ill	Chicago, C. Cutsforth	312-992-1136
Mass	Boston, D. Kendrick	617-336-7495
Mass	Boston, S. Puchkoff	617-444-4060
NY	New York, D. Kirshy	201-779-6500
Ohio	Cleveland, J. Reid	216-886-3330
Tex	Dallas, G. Anderson	214-661-5235
FOR:	Can., Toronto, T.E. Field Assoc. Ltd.	416-292-1475

CODI CORPORATION, Pollitt Dr., Fair Lawn, N.J., 07410, Tel: 201-797-3900, TWX: 710-988-2241; FSC No: 16352; QPL No: 19500; Empl.: 73; Minimum order: $25

For info on price: J.S. LaBruna; Application info: W.C. Henderson; Customer service: P. Lydon; Delivery info: L. Dobson

Free literature available: Data sheets on the following products: Voltage Variable Capacitors; Zeners & Reference Diodes; High Voltage Rectifiers; Multijunction Diodes; Log Diodes; Chips; and White Noise Generator & Short Form catalog

Products manufactured: Bridges, Calibrators, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Crystals, Diodes, Generators, Power Supplies, Rectifiers, References, D-C Voltage, Regulators, Standards, Suppressors

Local Sales Offices & Reps.

Ala	Huntsville, BJR Ind's.	205-881-3569
Ariz	Tempe, Gassner & Clark Co.	602-968-9037
Cal	Burlingame, Leddy	415-347-5247
Cal	Santa Ana, California Elctrn. Mktg.	714-835-2702
Colo	Littleton, B.B. Farquhar	303-795-1973
Fla	Ft. Lauderdale, CBC Elctrns., Inc.	305-484-7330
Ill	Franklin Pk., Dekotech, Inc.	312-455-5100
Ind	Fort Wayne, Delesa Sls. Co.	219-483-9537
Iowa	Cedar Rapids, S & O Sls. Co.	319-393-1845
Kans	Shawnee, J.F. Guernsey	913-631-2414
Md	Hyattsville, Eastern Components	301-577-2925
Mass	Norwood, J.M.G.	617-762-5333
Mich	Ferndale, SHALCO	313-547-4771
Mo	Shawnee, J.F. Guernsey	913-631-2414
NY	Williamsville, R.A. Murray Co.	716-632-6913
Ohio	Dayton, The Whelan Corp.	513-434-7551
Ore	Portland, C.K. Shanks & Assoc.	503-292-5656
Pa	Flourtown, Eastern Comps.	215-836-1616
Tex	Dallas, J. Clay Co.	214-350-1281
Wash	Seattle, C.K. Shanks & Assoc.	206-632-4290
EXP:	N.Y., N. Y., Singer Prods.	212-432-1400

COHU ELECTRONICS, INC., San Diego Div., Box 623, San Diego, Cal., 92112, Tel: 714-277-6700, TWX: 910-335-1244; Empl.: 210

For info on price: E. V. Dempsey; Application info: D. Frost; Customer service: C. Murray; Delivery info: Area Sls. Office

Free literature available: Closed-circuit television short form catalog; Broadcast television short form catalog

Products manufactured: Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Scottsdale, Perspective Measurements	602-947-3860
Cal	Cerritos, Cohu	213-926-7002
Cal	San Carlos, Cohu	415-592-7851
Cal	San Diego, Cohu	714-277-6700
Cal	San Diego, Perspective Measurements	714-278-8931
Colo	Denver, Cohu	303-573-8835
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Des Plaines, Cohu	312-824-4422
Md	Bethesda, Bartlett Assocs.	301-656-3061
Mass	Bedford, Cohu	617-275-0370
Neb	Lincoln, Cohu	402-467-2900
NJ	Florham Park, Cohu	201-377-6636
NC	Greensboro, BCS Assocs.	919-273-1918
Pa	Wayne, Bartlett Assocs.	215-638-7325
Tex	Arlington, Cohu	817-461-1707

COIL-CRAFT INC., 340 Bronxville Rd., Bronxville, N.Y., 10708, Tel: 914-337-4775; Empl.: 7; Minimum order: $15

For info on price: H. Julie; Application info: J. Julie; Customer service: J. Julie

Free literature available: Four page catalog listing technical information on tuneable, Hi Q inductors.

Products manufactured: Coils Including Assemblies & Forms, Couplers, Dividers, Filters, Transformers

Advertisment

Our line of turnable RF coils affords highest Q and stability in filter applications from audio thru VHF. Values of .027 to 100,000 uH spaced in a 10% series have overlapping tuning ranges. We also make wideband matching transformers, power splitter-combiners, Directional couplers, audio transformers, fixed and tunable filters. We will also design and fabricate any of the above items to your specific requirements.

COILCRAFT, 1102 Siler Lake Rd., Cary, Ill., 60013, Tel: 312-639-2361, TWX: 910-651-2251; Minimum order: $100

For info on price: R. G. Adams; Application info: J. Renskers; Customer service: R. G. Adams; Delivery info: D. Brodie

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Filters, Heads, Recording Playback, Erase, Networks, Reactors, Transformers

COIL SPECIALTY CO., Box 120, Route 322, Boalsburg, Pa., 16827, Tel: 814-466-6244; Empl.: 25

Customer service: H. Hoffman

Free literature available: RF & IF coils and chokes manufactured to customers specifications.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Filters, Resistors, Transformers

Advertisment

Coil Specialty Co. has facilities to manufacture small or large quantity requirements of IF and RF coils, chokes, transformers, hash filters, solenoid, special bobbin, reed switch or any other specialty windings to customer's specifications.
Quotations and sample requirements given immediate attention.

COIL WINDING EQUIP. CO., Railroad Plaza, Oyster Bay, N.Y., 11771, Tel: 516-922-5660; Empl.: 35; Minimum order: $10

For info on price: B. A. George; Application info: H. R. Snider; Customer service: G. Meier; Delivery info: B. A. George

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.

Ariz	Scottsdale, Elctrn. Entprs.	602-946-9860
NM	Albuquerque, Elctrn. Entprs.	505-256-3561
NM	Las Cruces, Elctrn. Entprs.	505-524-0126
NY	Oyster Bay, Coil Winding Equip. Co.	516-922-5660

COLE-FLEX CORP., 91 Cabot St., W. Babylon, N.Y., 11704, Tel: 516-249-6150

Products manufactured: Cable, Caps, Forms & Tapes, Heat Shrinkable, Cleaners & Solvents, Cords, Heat Guns, Production, Insulators & Insulation, Kits, Cable-End Sealing, Lubricants, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive, Tubing

Local Sales Offices & Reps.

Cal	Glendale, Armstrong Sls. Co.	213-245-5344
Cal	Redwood City, Warren & Hickey Sls. Co.	415-368-3849
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Miami, World Wide Prods. Inc.	305-949-3457
Ga	Atlanta, Henry Phillips Co.	404-252-0720
Ill	Chicago, GNB Assoc.	312-673-4050
Ind	Indianapolis, Sukup & Cox	317-253-1215
Kans	Overland Park, Penzner-Mankus Assoc.	913-381-0004
La	Chalmette, Cartwright & Bean	504-279-4598
Mass	Lynn, Keene Sls. Co. Inc.	617-595-2300
Mich	Ferndale, Shalco Inc.	313-547-4771
Minn	Minneapolis, J.E.M. Anderson	612-823-6459
Miss	Jackson, Cartwright & Bean	601-354-1368
Mo	Hazelwood, Penzner-Mankus Assoc.	314-731-4334
NY	N. Syracuse, L.D. Allen Inc.	315-458-7470
NY	N.Y., I. Brown & Assoc.	212-493-1379
Ohio	Columbus, Weller Electronic Sls.	614-885-7819
Pa	Wynnewood, J. Stinson & Assoc.	215-896-7378
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, J. Collins Co.	214-341-7866
Wash	Seattle, W.K. Widdekind Co.	206-284-8020

COLE INSTRUMENT CORP., Div. F.H. Cole Enterprises, 2034 Placentia Ave., Costa Mesa, Cal., 92627, Tel: 714-642-8080; Empl.: 35

Customer service: P. Hunson

Products manufactured: Accelerometers, Controls/Control Eqpt., Drivers, Switch, Index Assemblies, Switch, Kits, Switch Assembling, Programmers, Shields, Switches, Testers

COLEMAN INSTR. DIV., 2000 York Road, Oak Brook, Ill., 60521, Tel: 312-887-0770; Empl.: 250; Minimum order: $25

For info on price: R. Glos; Application info: D. Smeaton; Delivery info: R. Glos

Products manufactured: Meters, Pumps, Vacuum, Recorders, Spectrometers

COLEMAN MICROWAVE CO., Box 59, Rte. 22, Lebanon, N.J., 08833, Tel: 201-534-2480; Empl.: 8

Customer service: K.R. Coleman

Free literature available: Microwave Filter Brochure which lists various types and frequencies of tunable bandpass filters. This brochure is representative of our product line but does not include other types of filters and wavemeters which Coleman Microwave Co. also manufactures.

Products manufactured: Cavities, Microwave, Diplexers, Antenna, Discriminators, Dummy Loads, Filters, Meters, Multiplexers, Preselector-Mixers, Preselectors, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Beacon	205-881-5031
Ariz	Tempe, Jarko Assocs.	602-966-3020
Fla	Maitland, Beacon	305-647-3498
Ga	Atlanta, Beacon	404-351-3654
Miss	Hernando, Beacon	601-368-9008
Okla	Norman, Data Marketing Assocs.	405-364-8320
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
SC	Spartanburg, Beacon	803-582-4613
Tex	Houston, Data Marketing Assocs. Inc.	713-686-9627
Tex	San Antonio, Data Marketing Assocs.	512-828-0937
Va	Woodbridge, M. Lader Co.	703-494-3321

COLLINS RADIO CO., 160-180, Cedar Rapids, Iowa, 52406

COLLINS RADIO, Dallas, Tex., 75207, Tel: 214-690-5000, TWX: 910-867-4709; Empl.: 16000

Customer service: L. Marx 214-690-6020

Products manufactured: Amplifiers, Analyzers, Antennas, Cable Assemblies & Harnesses, Calibrators, CATV Systems & Equipment, Cavities, Microwave, Circuits, Cordwood, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Circuits, Printed, Multilayer, Coils Including Assemblies & Forms, Comm. Systems, Comparators, Computers, Converters, Demodulators, Detectors, Dividers, Dummy Loads, Equalizers, Filters, Generators, Indicators, Integrators, Electronic, Leads, Test & Adaptors, Limiters, Memory Systems, Meters, Mixers, Modulators, All Kinds, Monitors, Mounts, Multipliers, Networks, Oscillators, Ovens, Preselectors, Punched Card Equipment, Racks, Radar Systems, Receivers, Regulators, Relays, RFI Measuring Equipment, Services, Assembly, Production & Test, Servo Systems, Shields, Shifters, Standards, Switches, Synthesizers, Tape Search Equipment, Television Systems & Equipment Closed-Circuit, Terminal Equipment, Digital, Terminals, Testers, Totalizers, Digital, Transformers, Transmission Systems, Data, Transmitters, Tuners, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Alas	Anchorage	904-337-2870
Ariz	Nogales	602-287-2101
Ariz	Sierra Vista	602-458-4491
Ark	Limestone	501-428-5257
Cal	La Habra	213-691-2304
Cal	Long Beach	213-593-8722
Cal	Los Angeles	213-647-5611
Cal	Palo Alto	415-493-9033
Cal	San Carlos	415-343-3224
Cal	San Mateo	415-342-2131
Cal	Saratoga	408-255-9399
Colo	Littleton	303-795-8784
Fla	Lighthouse Point	305-943-8371
Fla	Madeira Beach	813-391-8065
Fla	Miami Springs	305-888-0611
Fla	Tallahassee	904-877-2580
Ga	Atlanta	404-761-0607
Ga	Warner Robins	912-922-6616
Ill	Buffalo Grove	312-537-3760
Kans	Wichita	316-942-4201
La	Pineville	318-640-3412
Md	Bethesda	301-223-4222
Mass	Burlington	617-272-4050
Minn	Maple Plain	612-479-2633
Minn	Minneapolis	612-922-2876
Mo	Grandview	816-763-3928
Mo	Kansas City	816-942-4449
NJ	Red Bank	201-741-5379
NY	Guilderland Center	518-371-6610
NY	Lake Success	212-343-1600
NY	New York City	212-661-6530
Ohio	Cincinnati	513-825-3802
Ohio	Dayton	513-276-3931
Ohio	Galion	419-468-3964
Okla	Oklahoma City	405-632-6801
Okla	Tulsa	918-836-3751
Pa	Natboro	215-672-7797
SC	Rock Hill	803-366-7322
Tenn	Rockford	615-573-9717
Va	Arlington	703-524-9503
Wash	Seattle	206-725-1000

COLLINS RADIO GROUP, Comps. Mktg., 4311 Jamboree Blvd., Newport Beach, Calif., 92663, Tel: 714-833-4661, TWX: 910-595-1705; Empl.: 800

Products manufactured: Filters, Integrated Circuit Devices

Local Sales Offices & Reps.

Cal	Burlingame, J. Logan Assocs.	415-697-6377
Cal	Garden Grove, Impact Elctrns.	714-893-8551
Cal	San Jose, Collins Radio Grp.	415-961-1306
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Buffalo Grove, Collins Radio Grp.	312-537-3760
Ind	Ft. Wayne, Bieberich, Inc.	219-432-2537
Ky	Lexington, Circuit Sls.	617-861-0567
Md	Bethesda, Collins Radio Grp.	202-223-4222
Mich	Warren, Dem Elctrns. Sls.	313-755-6660
Minn	Minneapolis, Merrill Franklin Co.	612-835-6422
Mo	St. Louis, Engineering Svcs. Co.	314-977-1515
NY	Plainview, E.R.A.	516-822-9890
NY	Syracuse, T&S2 Elctrns. Co.	315-463-8592
Ohio	Dayton, D. Steffen & Assocs.	513-293-3145
Tex	Dallas, Texas Microwave Elctrns.	
Wash	Seattle, R. Johnston Co.	206-524-5170

COLORADO CRYSTAL CORP., 2303 W. 8th St., Loveland, Colo., 80537, Tel: 303-667-9248

Customer service: E. Altick

Products manufactured: Crystals

COLORADO VIDEO, INC., Box 928, Boulder, Colo., 80302, Tel: 303-444-3972, TWX: 910-940-3248; Empl.: 19 p. 1•111-118

For info on price: G. Southworth; Application info: J. Sparks; Customer service: C. Elliott; Delivery info: C. Elliott

Products manufactured: Television Systems & Equipment Closed-Circuit, Test Equipment

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Cal	San Diego, Perspective Meass.	714-278-8931
Cal	Westlake Village, LD Bevan Co.	213-889-3653
Colo	Littleton, Cropley, Inc.	303-794-4231
Fla	Orlando, BCS Assocs.	305-896-4881
NC	Greensboro, BCS Assocs.	919-273-1918
Pa	Exton, Scientific Mktg., Inc.	215-363-7377
Tex	Dallas, CVI Southwest Regional	214-233-5497
Va	Williamsburg, BCS Assocs.	703-877-4053

COLUMBIA COMPONENTS, Div. Computer Instrs., 50 Madison Ave., Hempstead, N.Y., 11550, Tel: 516-483-8200, TWX: 510-222-4189

Products manufactured: Circuits, Hybrid, Thick Film, Delay Lines, Modules, Logic, Encapsulated, Networks, Potentiometers

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scien. Instr.	205-837-1601
Cal	Los Angeles, E. Landa	213-897-0770
Cal	Menlo Park, Frauman	415-322-8461
Cal	San Diego, B. Tauber & Assoc. Inc.	714-274-7242
Fla	Orlando, F. Baetzman	305-295-4817
Ill	Chicago, Lightner Assoc.	312-SP 4-1500
Md	Pimonium, Barn Hill & Assoc.	301-252-5610
Mo	Kansas City, Automatic General Elec.	816-333-8206
NJ	Cherry Hill, Jay Assocs.	609-662-0399
NJ	Morristown, D. Snyder	201-569-8800
NY	Huntington, Andrews & Andrews	516-692-8686
NY	Rochester, Semple	716-342-1413
Ohio	Fairborn, J. C. Hofstetter Co.	216-241-4880
Utah	Salt Lake City, Cannon Eng. & Sls.	206-454-2514
Va	Lynchburg, Glen White	703-846-4624

COLUMBIA ELECTRIC MFG. CO., 4519 Hamilton Ave. N.W., Cleveland, Ohio, 44114, Tel: 216-361-8060; Empl.: 60

Products manufactured: Alternators, Generators, Meters

COLUMBIA ELCTRN. CABLES, 11 Cove St., New Bedford, Mass., 02744, Tel: 617-999-4455; Empl.: 2,500; Minimum order: $50 p. 2•1911

For info on price: L. Cohen; Application info: A. Souza; Customer service: N. Aronberg; Delivery info: A. Souza

Free literature available: Brochures on: Basket Merchandisers; Color Foam; Cross Reference Guide; Distributor Price Sheet; Dura-Color; Durafoam for Color TV; Shielded Permafoam TV Transmission; Super Duracolor; TV Cheater & Power Asst. Kit; and Various Ext. Cords.

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Cords, Wire, Wire Shielding

Local Sales Offices & Reps.

Ala	Huntsville, Winfield Southeast Co.	205-533-3509
Ariz	Phoenix, J.R. Morgan Agency	602-252-3089
Cal	Gardena, Bidwell Sls. Assocs.	213-770-0300
Cal	San Francisco, Technical Sls. Assocs.	415-467-1434
Colo	Englewood, ESP Co.	303-781-4409
Fla	Miami, Winfield Electronic Sls.	305-945-6544
Ga	Atlanta, Winfield Southeast	404-636-3023
Haw	Honolulu, Gene Piety Factors	808-839-9059
Ill	Chicago, Bransky Sls.	312-433-2375
Ind	Indianapolis, Elctrn. Reps.	317-897-9326
Kans	Shawnee Mission, Lowell-Kangas & Assoc.	913-631-3515
La	New Orleans, Texport Co.	504-486-6073
Md	Silver Springs, Mid-Atlantic Sls. Co.	301-593-7749
Mass	Norwood, Rudolph & MacInnis Assoc.	617-769-5450
Mich	St. Clair Shores, J.M. Thorpe Co.	313-779-6363
Mich	St. Joseph, R. C. Merchant & Co.	616-983-7378
Minn	Minneapolis, H. M. R. Inc.	612-920-8200

Directory of Local Distributors Starts on page 401

Mo	St. Louis, Lowell-Kangas & Assoc.	314-821-4050
NY	N. Bellmore, L.W. Keller & Assoc.	516-785-2826
NY	Port Washington, T.M.A., Inc.	516-883-2432
NY	Rochester, J. Brown Elctrn. Sls.	716-266-2728
NY	Yonkers, J. Brown Elctrn. Sls.	914-779-7330
NC	Charlotte, Winfield /SE Co.	704-536-2757
Ohio	Columbiana, Nebco Assocs.	216-457-2333
Ohio	Richfield, Bear Mktg.	216-659-3131
Okla	Tulsa, The Texport Co.	918-939-1727
Ore	Salem, Pacnor Mktg.	503-363-6445
Pa	Philadelphia, S.K. MacDonald, Inc.	215-545-1205
Pa	Reading, Beil-Whitaker	215-779-2610
Tenn	Hermitage, Winfield Southeast Co.	615-889-5207
Tenn	Memphis, Texport Co.	901-683-0880
Tex	Houston, Texport Co.	713-464-2828
Tex	Richardson, Texport Co.	214-238-7117
Wash	Seattle, Pacnor Mktg. Co.	206-284-8020

COLUMBIA RESCH. LABS., Macdade Blvd. & Bullens La., Woodlyn, Pa., 19094, Tel: 215-532-9464, TWX: 510-669-3625; Empl.: 96

For info on price: J. Sarty; Application info: T. Carey; Customer service: R. R. Reymos; Delivery info: R. R. Reymos

Products manufactured: Accelerometers, Alarms, Amplifiers, Analyzers, Controls/Control Eqpt., Meters, Microphones, All Kinds, Recorders, Services, Assembly, Production & Test, Signal Conditioners & Equipment, Testers, Transducers, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, R. A. Mayes Co.	602-279-5243
Colo	Broomfield, R. A. Mayes Co.	303-466-6311
Ill	Des Plaines, Marsland Assocs., Inc.	312-298-2620
Ind	Indianapolis, Marsland Assocs., Inc.	317-924-3568
Mich	Detroit, Electro Sls. Assocs., Inc.	313-526-8800
Minn	Minneapolis, Marsland Assocs., Inc.	612-545-4481
Mo	Florrisant, Marsland Assocs., Inc.	314-278-6949
NM	Albuquerque, R. A. Mayes Co.	505-265-7989
NY	Mamaroneck, Cane Tech Sls., Inc.	914-698-4411
Ohio	Cleveland, Electro Sls. Assocs., Inc.	216-261-5440
Ohio	Dayton, Electro Sls. Assocs., Inc.	513-426-5551
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tex	Richardson, R. A. Mayes Co.	214-235-3043
Wash	Bellevue, Topp Engrg. Sls., Inc.	206-747-5401

COLUMBIA TECH, See Humiseal Div. and Industrial Mica Div.

COLUMBUS ELECTRIC MFG. CO., Box 289A Rt #2, Piney Flats, Tenn., 37686, Tel: 615-538-8191; Empl.: 160; Minimum order: $15

Customer service: L. Belt

Free literature available: Switch Catalogue, Control Catalogue

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Controls/Control Eqpt., Switches

Local Sales Offices & Reps.

Cal	Los Angeles, F. Alleman	213-222-8128
Cal	Oakland, W. Nott	415-654-3747
Conn	Glaston Bury, Barton-Caron Assoc.	203-633-9417
Ill	Chicago, J. Angel Co.	312-878-0653
Mass	Auburndale, B. Caron	
NY	Henlett, E. Mann	516-569-5769
Ohio	Columbus, D. Davies	614-239-1158
Tex	Dallas, Blackburn Assoc.	214-351-9991

COM/TECH SYSTEMS INC., 15 William St., New York, N.Y., 10005, Tel: 212-425-0733; Empl.: 8; Minimum order: $100

For info on price: C. M. Mengani; Application info: S. Sherin; Customer service: C. M. Mengani; Delivery info: C. M. Mengani

Free literature available: Data sheet - Secre/Data scrambler AN-101 Scramblers for cash dispensers AN-102 Scramblers for multi-drop systems Secre/Data operating procedures

Products manufactured: Comm. Systems, Scramblers, Data

COMCO PLASTICS, INC., 98-36 C. Jamaica Ave., Richmond Hill, N.Y., 11418, Tel: 212-849-9000; Empl.: 125; Minimum order: $35

For info on price: J. Steele; Application info: J. Steele; Customer service: J. Steele; Delivery info: J. Schram

Products manufactured: Insulators & Insulation, Laminates, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Conn	Orange, Commercial Plastics & Supply Corp.	203-799-2351
Fla	Miami, Commercial Plastics & Supply Corp.	305-576-3333
Ga	Atlanta, Commercial Plastics & Supply Corp.	404-579-2600
Ill	Chicago, Commercial Plastics & Supply Corp.	312-277-4500
Md	Hyattsville, Commercial Plastics & Supply Corp.	301-864-6228
Mass	Somerville, Commercial Plastics & Supply Corp.	617-623-2100
Mich	Warren, Commercial Plastics & Supply Corp.	313-755-1700
NJ	Newark, Commercial Plastics & Supply Corp.	201-824-5400
NJ	Trenton, Commercial Plastics & Supply Corp.	609-883-5100
NY	New York, Commercial Plastics & Supply Corp.	212-477-5000
NC	Raleigh, Commercial Plastics & Supply Corp.	919-834-2511
Pa	Philadelphia, Commercial Plastics & Supply Corp.	215-331-8600
Tex	Dallas, Commercial Plastics & Supply Corp.	214-631-8170

COMMUNICATION ASSOCS., INC., 200 McKay Rd., Huntington Station, N.Y., 11746, Tel: 516-271-0800, TWX: 510-226-6998; Empl.: 150; Minimum order: $10

For info on price: G. W. Zachmann; Application info: G. W. Zachmann; Customer service: B. Hannon; Delivery info: B. Hannon

Free literature available: The "Mk II" brochure describes CAI's complete line of Marine SSB communications equipment and systems. The "Company Heard Around the World" brochure describes CAI facilities and outlines their HF/SSB communications products.

Products manufactured: Antennas, Receivers, Transceivers, Transmitters

COMMUNICATIONS EQUIPMENT CO., INC., 5134 East 65th Street, Indianapolis, Ind., 46220, Tel: 317-849-9240; Empl.: 23

For info on price: T. A. Garmhausen 616-334-3081; Application info: H. I. Morris 616-334-3081

Free literature available: Individual data sheets for each item. 3 ring binder covering all products.

Products manufactured: Amplifiers, Annunciators, Comm. Systems, Racks

COMMUNICATIONS TECHNOLOGY CORP., 2237 Colby Ave., Los Angeles, Cal., 90064, Tel: 213-478-5061, TWX: 910-342-6983; Empl.: 250; Minimum order: $15

For info on price: H. Reeves; Application info: D. deVilleneuve; Customer service: H. Reeves; Delivery info: H. Reeves

Free literature available: 1975 price book - reviews product application, kit contents, & gives resale prices.

Products manufactured: Caps, Connector, CATV Systems & Equipment, Clamps & Clips, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Cords, Covers, Protective (Including Dust), Fasteners, Insulators & Insulation, Kits, Cable-End Sealing, Kits, Terminal, Knives & Knife Sets, Locators, Open-Short, Services, Assembly, Production & Test, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Testers, Tools, Tubing, Wrenches

COMMUNICATIONS TRANSISTOR CORP., 301 Industrial Way, San Carlos, Cal., 94070, Tel: 415-592-9390, TWX: 910-376-4893; FSC No: 50155; Empl.: 170; Minimum order: $50

For info on price: B. J. McDaniel; Application info: B. J. McDaniel; Customer service: S. Huebner; Delivery info: S. Huebner

Free literature available: Short Form Catalog.

Products manufactured: Transistors

Local Sales Offices & Reps.

Ariz	Scottsdale, DeAngelo, Rothman & Cheever	602-948-2240
Ariz	Scottsdale, Varian Assocs.	602-947-5461
Cal	Culver City, DeAngelo, Rothman & Co.	213-398-6239
Cal	Los Altos, Varian Assocs.	415-968-7630
Cal	San Diego, Trans Dynamics, Inc.	714-298-8215
Fla	Clearwater, Dyne-A-Mark Corp.	813-441-4702
Fla	Fort Lauderdale, Dyne-A-Mark Corp.	305-771-6501
Fla	Orlando, Dyne-A-Mark Corp.	305-299-6303
Ga	Atlanta, Varian Assocs.	404-252-0045
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Ft. Wayne, RF Specialists	219-485-8982
Iowa	Des Moines, Beams	515-282-0292
Kans	Shawnee Mission, Beams	913-341-7744
Md	Cheverly, Varian Assocs.	301-773-7010
Mass	Waltham, Com-Sale	617-890-0011
Minn	Minneapolis, Tech. Assocs.	612-929-6721
Mo	Creve Coeur, Beams	314-569-1060
NJ	Mt. Laurel, Varian Assocs.	609-235-6800
NJ	Springfield, Varian Assocs.	201-376-6600
NY	Dix Hill, K & J Engrg.	516-242-0888
NY	Huntington, CDB Entprs., Inc.	516-692-5200
NY	Syracuse, Varian Assocs.	315-437-2568
Ohio	Chagrin Falls, Crest Comp. Sls.	216-543-9808
Tex	Richardson, Varian Assocs.	214-235-2385
Wash	Tukwila, General Elctrns., Inc.	206-243-5141

COMPONENT RESCH., 1717 19th St., Santa Monica, Cal., 90404, Tel: 213-829-3615, TWX: 910-343-6864; FSC No: 12517; QPL No: Multiple; Empl.: 150; Minimum order: $20 .... p. 2•42

For info on price: S. Kellerman; Application info: D. Kellerman; Customer service: C. Davis; Delivery info: C. Davis

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

EXP:	Cal., Beverly Hills, M. Stewart & Co.	213-272-0103

COMPONENT SPECIALTIES, 9143 E. La Rosa Dr., Temple City, Cal., 91780, Tel: 213-283-0015; FSC No: 28984; Empl.: 45; Minimum order: $75

For info on price: Office; Application info: R. C. Johnston; Customer service: N. Laughlin; Delivery info: N. Laughlin

Free literature available: Our brochure shows the variety of magnetic components produced. All products are custom designed to fit customer specific requirements.

Products manufactured: Clutches, Coils Including Assemblies & Forms, Relays, Solenoids, Transformers

COMPONENTS CORP., 106 Main St., Denville, N.J., 07834, Tel: 201-627-0290; Empl.: 11

Customer service: W. Gordon

Free literature available: Digi-Klips® - Board to Board Interconnect System, describes Digi-Klip system and gives specifications; contact facts - application potential of Digi-Klips and associated items.

Products manufactured: Connectors, Converters, Power Supplies, Records, Frequency Test

Local Sales Offices & Reps.

Cal	Los Angeles, E. E. Strassner Co.	213-666-1511
Cal	San Carlos, LoDan	415-592-4600
Ga	Atlanta, Electro-Components	404-451-5489
Ill	Des Plaines, Coombs Assocs.	312-298-4830
Mass	Northboro, Henik Assoc.	617-891-5660
NJ	W. Trenton, W. Hartig	609-882-2433
Tex	Garland, G. V. Peck Co.	214-341-8311
FOR:	Can., Westmount, Montreal Que., W. F. Griffith	

COMPONENTS SPECIALTIES, INC., 393 So. FRanklin St., Hempstead, N.Y., 11550, Tel: 516-292-9500

For info on price: J. Berliant; Application info: S. Hulkower; Customer service: B. Zachman; Delivery info: B. Zachman

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Comm. Systems, Eliminators, Battery, Grilles, Jacks (All Types), Meters, Networks, Plug & Jack Sets, Potentiometers, Power Supplies, Probes, Speaker Systems, Speakers, Switch Handle Boots, Switches, Testers, Transformers

COMPONENTS SPECIALTIES, IN cont'd

Advertisment

SPECO - Complete line of automotive speakers. Auto grilles replacement speakers 1" - 15". The most complete line of miniature speakers in stock in the U.S. Miniature speakers made to your specifications. 25 to 70 volt line transformers. Miniature and sub-miniature jacks and plugs, volume controls, ear pieces and pillow speakers. A full line of electrolytic capacitors. Trumpets and intercoms.

COMPU-LITE CORP., 17795 Sky Park Cir. #C, Irvine, Cal., 92707, Tel: 714-546-9045; FSC No: 51420; Empl.: 50; Minimum order: $25

Customer service: S. Rasmussen

Free literature available: Product Summaries & Data Sheets with Engineering Specifications, Photos, Etc.

Products manufactured: Clamps & Clips, Indicators, Sockets, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Repcom, Inc.	205-534-9959
Ariz	Phoenix, Gramer & Co.	602-279-1231
Cal	Los Angeles, Universal Components Co.	213-641-4255
Cal	San Carlos, Electronic Engineering Assoc. Ltd.	415-593-2189
Conn	Woodbridge, Electronic Marketing Co.	203-397-1461
Fla	Melbourne, Repcom Inc.	305-254-1877
Ga	Warner Robins, Repcom Inc.	912-923-1393
Ill	Oakbrook, Whitmore Associates Inc.	312-325-4727
Mich	Dearborn, Villani-Pitcher Inc.	313-271-4600
Minn	Bloomington, OEM Sales Co.	612-884-5930
NJ	Englewood Cliffs, Sprung/Nussbaum Inc.	201-947-6767
Pa	Jenkintown, Arnold Associates	215-887-7870
Wash	Bellevue, Pacific Consultants	206-454-2503
Exp:	Irvine, Cal., D. Rippin Ind'l. Exp. Mgr.	714-493-2589

COMPUMOD, INC., 306 River St., Haverhill, Mass., 01830, Tel: 617-373-9104, TWX: 710-347-0269

Products manufactured: Converters

Local Sales Offices & Reps.

Cal	Pasadena, A-F Sls. Engrg. Inc.	213-681-5631
Conn	West Hartford, Instrument Assocs	203-525-9367
Fla	Orlando, Brosey Enterprises	305-622-6045
Fla	Palm Beach Gardens, Brosey Enterprises	305-622-6045
Ill	Elk Grove, L.F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L.F. Green & Assocs.	317-293-9827
Mass	Bedford, Instrument Assocs.	617-275-0700
Mich	Southfield, Data-Tron	313-354-6421
Minn	Fridley, L.F. Green & Assocs.	612-781-1611
NJ	Bogota, Neville & Vespo, Inc.	201-487-1507
NY	New Hartford, KLM Assocs.	315-735-8525
NY	North Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-442-0820
Ohio	Dayton, Data-Tron	513-223-8421
Ohio	Wickliffe, Data-Tron	216-585-8421
Okla	Tulsa, R. Matthews Elctrns.	918-936-2562
Pa	Media, W. Reeves Assocs.	215-566-6709
Tex	Dallas, R. Matthews Elctrns.	214-233-0363
Tex	Houston, R. Matthews Elctrns.	713-664-7131
Va	Fairfax, Nine Assocs.	703-273-1830
Wash	Seattle, J.B. Jolly Inc.	206-938-4166

COMPUTER AUTOMATION, INC., Ind. Prods. Div., 18651 Von Karman, Irvine, Cal., 92664, Tel: 714-833-8830, TWX: 910-595-1767; Empl.: 360

Customer service: A. Armoni

Products manufactured: Test Systems, Testers

Local Sales Offices & Reps.

Cal	Costa Mesa, Measurement Assocs.	714-540-7160
Colo	Denver, Computer Automation	303-466-1749
Ill	Chicago, Computer Automation	312-956-6400
Mass	Burlington, W.M. Hague Co.	617-899-5600
NJ	Ramsey, Computer Automation, Inc.	201-825-0990
Ohio	Cleveland, Computer Automation, Inc.	716-777-8700
Tex	Houston, Computer Automation	713-626-9430
Wash	Seattle, Computer Automation	206-455-9650

COMPUTER COMPS., 88-06 Van Wyck Expwy., Jamaica, N.Y., 11418, Tel: 212-AX 1-3500; Empl.: 45 p. 1•1616,1617

Products manufactured: Coils Including Assemblies & Forms, Relays, Sockets, Transformers

Local Sales Offices & Reps.

Cal	Santa Monica, Rep Assocs.	213-829-5401
Ill	Bellwood, Fiat Eng. Assocs.	312-547-6200
Mass	Billerica, Matrix Sls.	617-667-9268
NJ	Springfield, Svc. & Tech. Inc.	201-232-2666
NY	Commack, Svc. & Tech. Inc.	516-543-1061
NY	Rochester, L-Mar Assocs.	716-328-5240
Ohio	Chagrin Falls, Crest Component Sls.	216-543-9808
Pa	King of Prussia, White-Keystone Inc.	215-265-1817
Wash	Renton, Control Instr. Co.	206-226-7170
EXP:	N.Y., Baldwin, Milano Brothers	516-223-9000

COMPUTER CONVERSIONS CORP., 6 Dunton Ct., East Northport, N.Y., 11731, Tel: 516-261-3300; FSC No: 51086; Empl.: 100 p. 1•154,155

Customer service: S. J. Renard ,

Free literature available: Complete technical and applications on data on synchro/digital or DC, digital or DC/synchro, absolute encoders, angle indicators, rectangular to polar, modulators, demodulators, and multiplexed converters.

Products manufactured: Amplifiers, Calibrators, Comm. Systems, Controls/Control Eqpt., Converters, Counters, Demodulators, Encoders, Indicators, Meters, Modulator/Demodulators, Modulators, All Kinds, Resolvers, Synchro, Scalers, Binary, Decade, Standards, Synchro Transmitters, Solid-State, Synchros, Testers, Transducers

Local Sales Offices & Reps.

Cal	Burlingame, Leddy Assocs.	415-347-5247
Fla	Clearwater, Brennan Assocs.	813-446-5006
Ind	Carmel, Rich Elctrn. Mktg.	317-844-8462
Mass	Brookline, Technology Prods. Grp.	617-731-0858
NM	Albuquerque, F.Y. Gates Co.	505-298-1875
NY	Liverpool, R & D Assocs.	315-622-2350
Tex	Dallas, Jacobson Co.	214-363-7584
Va	Fairfax, Nine Assocs.	703-273-1803
Wash	Redmond, Desco, Northwest	206-455-9325

Advertisment

CCC manufactures a complete line of low cost, solid state, shaft and synchro to digital or DC ($295), and digital or DC to synchro converters for the military and commercial market. Other related products are rectangular to polar co-ordinate converters, digital phase meters ($295), digital angle indicators ($595), digital data converters, computer modulators and demodulators. Evaluation units supplied on request. Write for further information and free data conversion chart.

COMPUTER DEVICES CORP., 63 Austin Blvd., Commack, N.Y., 11725, Tel: 516-543-4220; Empl.: 50

Products manufactured: Coders, Decade Boxes, Delay Lines, Equalizers, Generators, Memories, Buffer, Memory Systems, Networks, Oscillators, Standards, Synthesizers

Local Sales Offices & Reps.

Cal	Arcadia, Mar-Land Entprs.	213-681-9440
Ill	Chicago, Kemp Sls. Co.	312-622-1121
Md	Baltimore, R.A. Wafer Assocs.	301-744-1133
NH	Windham, J.A. Justice Co.	603-434-4290
NJ	Cherry Hill, J.N. Barrett Assocs.	609-429-1551
NY	Tarrytown, Garrettson Co.	914-631-2650
NY	Utica, B.D. Hummel Co.	315-736-7821
Tex	Dallas, Bouco Sls. Assocs.	214-247-1749
EXP:	New Rochelle, N.Y., Montclair Elctrns.	914-576-1400

COMPUTER DEVICES OF CALIF., 11901 Burke St., Santa Fe Springs, Cal., 90670, Tel: 213-698-2595, Telex: 65-7478; FSC No: 32423; Empl.: 150 p. 1•940,941

For info on price: J. Rock; Application info: W. Diston; Customer service: J. Bazinet; Delivery info: J. Bazinet

Free literature available: Bulletin 6-72 - Large Angle Step Motors, 23 - Small Angle Stepping & Synchronous Motors 34H - 1.8° & 5° Stepping & Synchronous Motors; C&D - 1.8° 40 Steppers, 23F - 50 Steppers,

20 - PS & PE Value Line Steppers & Synchronous Motors, ESM - Electronics for Stepper Motors, PC-1 Rapid-Syn Drivers 484 - Rapid Syn Drivers

SFC - Short Form Catalog - Stepping Motor & Drivers.

Products manufactured: Controls/Control Eqpt., Motors

Local Sales Offices & Reps.

Cal	Redwood City, Archie Cardwell	415-364-7553
Cal	Santa Fe Springs, Computer Devices of Cal.	213-723-6593
Colo	Denver, Camel Elctrns.	303-757-6191
Conn	Old Saybrook, M.L. Assocs.	203-388-9718
Fla	Orlando, MacKay, Smith & Assocs.	305-277-1513
Ill	Barrington, G. A. Cridland Co.	312-381-7044
Mass	Marlboro, M.L. Assocs.	617-485-6190
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Minn	St. Paul, W.E. Taubert	612-636-6414
NH	East Derry, M.L. Assocs.	603-432-5838
NJ	Cherry Hill, R.E. Winter Assocs.	609-429-0696
NJ	Tenafly, ABC Elctrn. Sls. Co.	201-568-2354
NY	Cazenovia, A.E. Decew Agency	315-655-8602
NY	Sodus, A.E. Decew Agency	315-483-6561
NY	Williston Park, ABC Elctrn. Sls. Co.	516-747-6610
NC	Charlotte, MacKay, Smith, & Assocs.	704-527-0240
Ohio	Dayton, Electrical Sys. Co.	513-434-9822
Tex	Houston, Oeler & Menelaides	713-772-0730
Tex	Richardson, Oeler & Menelaides	214-234-6334
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778

COMPUTER INSTRS., 92 Madison Ave., Hempstead, N.Y., 11550, Tel: 516-483-8200, TWX: 510-222-4189; Empl.: 260 p. 1•2340; p. 2•1642,1643

Products manufactured: Circuits, Hybrid, Thick Film, Commutators, Controls/Control Eqpt., Delay Lines, Dividers, Films, Gages, Indicators, Meters, Modules, Logic, Encapsulated, Networks, Paper, Graphic Recording, Potentiometers, Recorders, Resistors, Switches, Testers, Transducers, Transmitters

Local Sales Offices & Reps.

Instrument & Controls

Ala	Huntsville, Int'l. Sci. Instr.	205-837-1601
Cal	Glendale, Meko Instr.	213-240-4664
Cal	Los Altos, Servo Data	415-964-1325
Colo	Denver, Technical Engrg. Sls.-Serv.	303-744-1119
Fla	Clearwater, Technical Comps. & Instr.	813-584-1122
Ill	Lansing, North Central Engrg.	312-474-3580
Kans	Andover, Palatine Engrg.	316-683-7512
Kans	Overland Pk., Palatine Engrg.	913-262-5643
Md	Greenbelt, J.E. Cuesta	301 552-1200
Mass	Norwell, Bordewieck Engrg. Sls. Co.	617-659-4915
Mich	Trenton, North Central Eng.	313-675-3157
Minn	Minneapolis, R.J. Sls.	612-922-1425
Mo	St. Louis, Palatine Engrg.	314-426-7055
NY	Westbury, Tech-Rep Engrg. Sls.	516-997-7946
Ohio	Dayton, J. Hofstetter	513-296-1010
Ohio	Medina, J. Hofstetter	216-241-4880
Okla	Tulsa, Pan Tech Engrg.	918-747-2494
Pa	Valley Forge, J.E. Cuesta & Co.	215-265-5800
Tex	Arlington, Pan Tech Engrg.	817-261-4111
Tex	Houston, Pan Tech Engrg.	713-623-0640
Wash	Seattle, Barrett Equip. Co.	206-522-8325

Potentiometer & Components

Ala	Huntsville, Int'l. Sci. Instrs.	205-837-1601
Ariz	Scottsdale, Carter Assoc.	602-947-4355
Cal	Los Altos, Servo-Data	415-964-1325
Cal	Los Angeles, E. Landa Co.	213-879-0770
Cal	San Diego, B. Tauber & Assoc.	714-274-7242
Colo	Denver, Camel Elctrns.	303-757-6191
Ill	Chicago, Berndt Assoc.	312-283-0713
Ind	Ft. Wayne, Temple Engrg.	219-744-4331
Iowa	Cedar Rapids, Palatine Engrg.	319-365-8071
Kans	Overland Pk., Palatine Engrg.	913-262-5643
Md	Baltimore, Callas Elctrns.	301-744-7711
Mass	Millis, Selmark Assocs.	617-376-2914
Mich	Birmingham, J. Hofstetter	313-642-0590
Minn	Mpls., R.J. Sls.	612-922-1425
Mo	St. Louis, Palatine Engrg.	314-426-7055
NH	Plaistow, Selmark Assocs.	617-375-0305
NJ	E. Orange, Masin-Esco	201-674-6505
NY	Jericho, Electro-Rep, Inc.	516-938-0540
NY	Massapequa Pk., Metro Tech.	516-798-1066
NY	Penfield, A & D Devices	716-586-8033
Ohio	Dayton, J. Hofstetter	513-298-0662
Ohio	Medina, J. Hofstetter	216-241-4880

Okla	Tulsa, Carter Assocs.	918-936-5100
Pa	Valley Forge, J. E. Cuesta	215-265-5800
Tex	Garland, Carter Assocs.	214-276-7151
Wash	Seattle, Gillett & Assocs.	206-284-3344

COMPUTER LABS, 1109 S. Chapman St., Greensboro, N.C., 27403, Tel: 919-292-6427, TWX: 510-922-7954; FSC No: 34031; Empl.: 40; Minimum order: $100

For info on price: D. W. Brockman; Application info: D. W. Brockman; Customer service: G. W. Perryman; Delivery info: D. W. Brockman

Free literature available: Individual data sheets, or catalog of data sheets. Also booklets containing reprints of articles and/or talks by engineers from company, useful as reference material.

Products manufactured: Amplifiers, Converters

Local Sales Offices & Reps.

Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	No. Hollywood, Cardinal Assocs.	213-877-6641
Colo	Denver, R.A. Mayes Co.	303-444-0782
Conn	Hamden, J & J Assocs.	203-624-7800
Md	Laytonsville, G-T Assocs.	301-949-8060
Mass	Burlington, J & J Assocs.	617-272-2606
NJ	Fairfield, KLS Assocs.	201-227-2900
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	Penfield, A & D Devices	716-586-8033
Tex	Dallas, R.A. Mayes Co.	214-235-3043

COMPUTER OPERATIONS, 10774 Tucker St., Beltsville, Md., 20705, Tel: 301-937-5377; Empl.: 19

Products manufactured: Memory Systems

Local Sales Offices & Reps.

Colo	Boulder, Par Assocs.	303-499-4736
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ind	Munster, Bexdata Ltd.	312-221-1411
Md	Rockville, MESA	301-881-8430
Mass	Wellesley, Northeast Data	617-237-1509
Minn	Edina, Bexdata Ltd.	612-941-2999
Mo	St. Louis, Bexdata Ltd.	314-872-3357
NJ	Cinnaminson, MESA	609-786-0284
Okla	Norman, Data Mktg.	405-364-8320
Tex	Houston, Data Mktg.	713-686-9627
Wash	Bellevue, Brennan Assoc.	206-454-9332

COMPUTER POWER, INC., 42 E. Park Avenue, Madison, NJ, 07940; Tel: 201-377-4003; Empl.: 50; Minimum order: $500

For info on price: R. Love; Application info: R. Love; Customer service: P. Ahlers; Delivery info: J. Moore

Free literature available: Interruptable and non-interruptable (UPS) power systems; General facilities brochure; modular power supply.

Products manufactured: Chokes, Computers, Converters, Inverters, Power Supplies, Reactors, Transformers

Advertisment

Small special purpose computers, all types of custom multiple output computer power supplies. Low cost, high efficiency, sine wave, regulated, interruptable, and non-interruptable (U.P.S.) AC power systems which include batteries, charger and inverter up to 15 KVA for many hours. Custom magnetics up to 100 KVA for all types of applications such as inverters converters, ferro regulators etc. We will assist in the design of the magnetic interface circuitry at no extra charge.

COMPUTER PRODUCTS, Box 23849, Ft. Lauderdale, Fla., 33307, Tel: 305-974-5500, TWX: 510-956-9895; Empl.: 150; Minimum order: $/50

For info on price: W. Ford; Application info: W. Ford; Customer service: R. Cheek; Delivery info: R. D'Allessandro

Free literature available: Power Supply Catalog - lists 61 models of encapsulated modular power supplies - from 3.6 to 26 volts, from 65MA to 2000 MA. RTP Device Specifications - describes CPI line of computer directed measurement & control equipment. RTP Pricing & Configuration Guide - provides model no.'s and pricing info on RTP line.

Products manufactured: Multiplexers, Power Supplies, Scanners

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps., Inc.	205-539-4411
Cal	North Hollywood, B.J. Wolfe Entps.	213-877-5518
Cal	Sunnyvale, RDP Instrs., Inc.	408-735-9040
Fla	Fort Lauderdale, W.A. Brown Comps., Inc.	305-776-4800
Fla	Orlando, W.A. Brown Comps., Inc.	305-425-5505
Ill	Chicago, Data Elctrns.	312-283-0300
Ind	Indianapolis, J. Holsapple & Assocs.	317-899-2890
Md	Ellicott, A/D Inc.	301-531-6700
Mass	Lynnfield, Andrews Airtronics., Inc.	617-245-5220
Minn	Minneapolis, Data Elctrns.	312-786-9666
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Fayetteville, M.P. Andrews	315-637-9734
NY	Roslyn Heights, Travco Assocs.	516-621-3223
NC	Raleigh, W.A. Brown Comps.	919-876-9601
NC	Winston-Salem, W.A. Brown Comps., Inc.	919-725-5384
Ohio	Cincinnati, J.O. Olsen & Co.	513-922-2176
Ohio	Cleveland, J.O. Olsen & Co.	216-752-5444
Pa	Pittsburgh, J.O. Olsen & Co.	412-279-2550
Tex	Garland, G.V. Peck Co.	214-341-8311
Tex	Houston, G.V. Peck, Co.	713-664-1435
Wash	Bellevue, Brennan Assocs.	206-454-9332

COMPUTER TALK INC., Box 145, Idledale, Colo., 80453, Tel: 303-697-4315; Empl.: 20

Customer service: W. M. Barnes

Free literature available: Powerful - Fast - Automatic Computer; Billion Byte Disk Memories; Free - Floating Cursor Digitizers.

Products manufactured: Computers, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Memory Systems

COMPUTER TERMINAL SYS., 52 Newtown Plaza, Plainview, N.Y., 11803, Tel: 516-293-6611; FSC No: 33948; Empl.: 30; Minimum order: $25

For info on price: J. Gross; Application info: J. Gross; Customer service: E. Mermelstein; Delivery info: J. Gross

Free literature available: Line of versatile alphanumeric printers. Printing on impact paper, pressure sensitive labels, tickets, IBM cords, tags, sales slips, bank checks and plastic stock.

Products manufactured: Controls/Control Eqpt., Data Loggers, Printers, Teleprinters

Local Sales Offices & Reps.

Cal	Palo Alto, Gil Eakins	415-326-5317
Fla	Fort Lauderdale, Snow Co.	305-563-2448

COMSTRON SEG., 120-30 Jamaica Ave., Richmond Hill, N.Y., 11418, Tel: 212-441-3200, Telex: 146337; Empl.: 35 .... p. 1•544,545,638,639

Customer service: R. W. Tramposch

Free literature available: Brochure describing our Frequency Synthesizer

Products manufactured: Filters, Generators, Meters, Recorders, Synthesizers, Telephone Channel Test & Simulator Equipment, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Measurement Consits.	602-994-9519
Cal	Inglewood, L & M Engrg.	213-674-6850
Cal	San Jose, L & M Engrg.	408-292-3220
Colo	Boulder, Measurement Consits.	303-449-5294
Conn	Hamden, J & J Assocs.	203-624-7800
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Fla	St. Petersburg, Saber Assocs.	813-441-1301
Ga	Woodstock, Saber Assocs.	404-432-9625
Ill	Chicago, Electronic Instr. Assoc.	312-271-3774
Ind	Indianapolis, Electronic Instrs. Assoc.	317-257-7231
Kans	Wichita, Winco	316-684-8224
Md	Lanham, Brimberg Assocs.	301-552-2200
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
NJ	Hazlet, Mer Mon Elctrn. Instrum.	201-264-1851
NM	Las Cruces, Measurement Consits.	505-526-2491
NY	Plainview, Eastern Metro Assocs.	516-WE1-1414
NC	Raleigh, Saber Assocs.	919-834-3961
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Detroit, Comtel-Sterling Co.	513-298-7573
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Tex	Hurst, Anderson-Wylie Assocs.	817-268-2327
Utah	Murray, Measurement Consits.	801-268-3181

COMSTRON-SEG MULTIMETRICS, 120-30 Jamaica Ave., Richmond Hill, N.Y., 11418, Tel: 212-441-4240, Telex: 146337; Empl.: 35 .... p. 1•544,545,638,639

Customer service: R. W. Tramposch

Free literature available: Brochures describing our Models - Series AF-100, AF-200, AF-400.

Products manufactured: Analyzers, Filters, Generators, Meters, Recorders, Signal Conditioners & Equipment, Synthesizers, Telephone Channel Test & Simulator Equipment, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices, SE, Inc.	205-536-1969
Ariz	Scottsdale, Measurement Consits.	602-994-9519
Cal	Mountain View, Gado Instr. Sls.	415-961-2222
Cal	Signal Hill, Saber Entprs.	213-595-5646
Colo	Boulder, Measurement Consits.	303-449-5294
Conn	Hamden, J & J Assocs.	203-624-7800
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Fla	St. Petersburg, Saber Assocs.	813-441-1301
Ga	Woodstock, Saber Assocs.	404-432-9625
Ill	Chicago, Electronic Instrument Assocs., Inc.	312-271-3774
Ind	Indianapolis, Electronic Instrument Assocs., Inc.	317-257-7231
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
NJ	Hazlet, Mer-Mon Electronic Instrumentation	201-264-1851
NM	Las Cruces, Measurement Consits.	505-526-2491
NY	Plainview, Eastern Metro Assocs., Inc.	516-WE 1-1414
NC	Raleigh, Saber Assocs.	919-834-3961
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling Co.	513-298-7573
Pa	Mt. Penn, Mer-Mon Electronic Instrumentation	215-779-1640
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Utah	Murray, Measurement Consits.	801-268-3181
Va	Annandale, J. Hopkins Assocs.	703-323-1641
FOR:	Can., Don Mills, Ont., Componetics, Ltd.	416-445-3230
FOR:	Can., Montreal, Que., Componetics, Ltd.	514-342-4117

CONAP, INC., 184 E. Union St., Allegany, N.Y., 14706, Tel: 716-372-9650, TWX: 510-245-2769; Empl.: 115

Products manufactured: Adhesives (All Types), Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Insulators & Insulation, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Anaheim, Advance Electrical Sls.	714-870-0304
Cal	Belmont, Advance Electrical Sls.	415-592-4550
Ga	Macon, Stoneco Assocs.	912-745-4652
Ill	Wood Dale, Lucole Entprs.	312-595-7846
Ind	Indianapolis, Sheer Engrg.	317-852-8766
Mass	Marshfield, Conap, Inc.	617-837-1459
Minn	Burnsville, W.J. Koness	612-890-9159
Mo	St. Louis, Ensco-Rep Inc.	314-542-3935
NJ	Riverton, Given Assocs.	609-829-7249
NY	Allegany, Conap, Inc.	716-372-9650
NY	Bayside, Davis & Co.	212-229-7987
Pa	Meadville, Conap, Inc.	814-336-1996
SC	Myrtle Beach, J.D. Morrison Assocs.	803-448-2819
Tex	Garland, Cogburn & Assocs.	214-271-1147
Wash	Seattle, Advance Electrical Sls.	206-762-2262
Wisc	Brookfield, Techno-Ind'l. Sls. Co.	414-783-4385

CONCORD ELCTRNS., 37 Great Jones St., Dept. JE, New York, N.Y., 10012, Tel: 212-777-6571, TWX: 710-581-4930; Empl.: 150 .... p. 2•654,655

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Connectors, Contacts, Electrical, Handles For Cabinets, Circuit Boards, Racks, etc., Insulators & Insulation, Jacks (All Types), Pins, Spacers, Terminals, Tools

Local Sales Offices & Reps.

Cal	Fremont, H. Foraker	415-657-2213
Mass	Woourn, Jalco Assocs.	617-227-1515
FOR:	Can., Downsview, Ont., Kaytronics Engrg.	416-638-5511
FOR:	Can., Montreal, Que., Kaytronics Engrg.	514-489-9335

CONDENSER PRODUCTS CORP., Box 997, Brooksville, Fla., 33512, Tel: 904-796-3562

Products manufactured: Capacitors, Fixed, Power Supplies

CONDOR PACIFIC INDS. CALIF., 8740 Remmet Ave., Canoga Park, Cal., 91304, Tel: 213-882-0550; Empl.: 20

Customer service: E. J. Smith

Products manufactured: Gyros (All Types)

CONFORMING MATRIX CORP., Box 5126, Pt. Pl. Sta., Toledo, Ohio, 43611, Tel: 419-729-3777; Empl.: 35; Minimum order: $15

Customer service: R. Sebetto

Products manufactured: Films

CONIC CORP., Terra Com Div., 9020 Balboa Ave., San Diego, Cal., 92123, Tel: 714-278-4100, TWX: 910-335-1183

Customer service: B. M. Jennings

Free literature available: Specification Sheet - Lists the product specification and discusses the Theory of Operation.

Products manufactured: Power Supplies, Receivers, Transmitters

CONNECTICUT HARD RUBBER CO., 407 East St., New Haven, Conn., 06509, Tel: 203-777-3631, TWX: 710-465-0264; Empl.: 80

Products manufactured: Gaskets, Shielding, R-F-Also See Shields, R-F, Rubber, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive

CONNECTOR CORP., 6025 N. Keystone Ave., Chicago, Ill., 60646, Tel: 312-539-3108 .... p. 2•657-660

Products manufactured: Antennas, Backpanel Interconnect Systems, Cable Assemblies & Harnesses, Clamps & Clips, Connector Adapters, Connector Blocks, Mother Board, Connectors, Contacts, Electrical, Holders, Crystal, Jacks (All Types), Pins, Plug Adapters, Plug & Jack Sets, Plugs, Relays, Retainers, Services, Assembly, Production & Test, Socket Adapters, Sockets, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Cal	Altadena, D. Wagner	213-681-4060
Ill	Chicago, Bauman Sls.	312-539-3108
Kans	Leawood, Vasen Sls. Co.	913-649-0679
Mass	Needham, Coakley Boyd & Abbett	617-444-5470
Mich	Jackson, E.H. Jordan	517-782-0694
Minn	Minneapolis, E. Mellus & Assoc. Inc.	612-854-4270
NY	Dewitt, A. Bowser	315-446-5920
NY	Synder, H.J. Sapecky	716-839-4170
NC	Raleigh, J. Nagle	919-782-0213
Tenn	Shelbyville, C. McLanahan	615-684-4544
Va	Virginia Beach, C. Bludau	703-464-0500

CONNECTICUT MICROWAVE CORP., Route 44, New Hartford, Conn., 06057, Tel: 203-693-4247; FSC No: 50974; Empl.: 16; Minimum order: $25

For info on price: S. T. Urbank; Application info: M. DePalo; Customer service: R. Poppe; Delivery info: S. T. Urbank

Free literature available: Brochure which includes outline dwgs & specifications of approx 50 models of directional couplers selected from approx 400 different units produced by this firm.

Products manufactured: Couplers, Dummy Loads

Local Sales Offices & Reps.

Pa	King of Prussia, J.T. Birkhead	215-688-4021
Va	Fairfax, Schibley Assocs.	703-591-3008

Advertisment

DIRECTIONAL COUPLERS, COAXIAL AND WAVEGUIDE, designed to produce DC or RF outputs sensitive to forward and reflected main line RF power. Your most exacting "SPECIAL" RF power measuring requirements can, in most cases, be satisfied by but a slight modification of one of our hundreds of standard models. Meet MIL Specs.

CONNECTOR INDS. OF AMERICA, 639 N. Wayne, Cincinnati, Ohio, 45215, Tel: 513-733-3680; FSC No: 32076; Empl.: 30

For info on price: K. C. Neal; Application info: F. S. Knolik; Customer service: K. C. Neal; Delivery info: K. C. Neal

Products manufactured: Connectors, Seals, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest e/m Engrg., Inc.	602-944-1521
Conn	Branford, W. McCoy Co.	203-488-2012
Fla	Zephyrhills, Tool-Tronics	813-782-7177
Ill	Chicago, D. Dolin Sls. Co.	312-286-6200
Md	Baltimore, J.R. Daniel & Co.	301-825-3330
Mich	Birmingham, Forand Sls. Co.	313-644-0087
Mo	St. Louis, Boweng	314-429-7327
NJ	Newfoundland, T.A. Adamo Prod., Inc.	201-697-2450
NY	Syracuse, Canavan-Scanlon Assocs.	315-463-9161
Ohio	Cleveland, Component/Insulation Corp.	216-521-3570

CONNOR-WINFIELD CORP., 109 Turner Ct., W. Chicago, Ill., 60185, Tel: 312-231-5270; Empl.: 17 p. 1•296-299

Products manufactured: Alarms, Generators, Integrated Circuit Devices, Meters, Oscillators, Relays, Standards, Timers, Transformers

Local Sales Offices & Reps.

Cal	Encino, C.D.H. Assocs.	213-345-3111
Cal	Los Altos, Frauman Assocs.	415-941-0660

CONRAC CORP, See Cramer Div.

CONRAC CORP., Instrs/Controls Div., 1700 S. Mountain Ave., Duarte, Cal., 91010, Tel: 213-359-9141

Products manufactured: Accelerometers, Controls/Control Eqpt., Gyros (All Types), Indicators, Potentiometers, Switches, Transducers

CONRAC CORP., Machine Tool Div., 9200 Bolsa Ave., Westminister, Cal., 92683, Tel: 714-894-4711

Products manufactured: Controls/Control Eqpt., Cords, Machines/Machinery, Production

CONRAC CORP., New Jersey Div., Sherwood La., Fairfield, N.J., 07006, Tel: 201-226-7777

Products manufactured: Comm. Systems, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Indicators

CONRAC DIV., Conrac Corp., 600 N. Rimsdale Ave., Covina, Calif., 91722, Tel: 213-966-3511

Products manufactured: CATV Systems & Equipment, Converters, Display Devices/Displays, Monitors, Mounts, Receivers

CONRAC CORP., Turner Div., 909 17th St. N.E., Cedar Rapids, Iowa, 52402

Products manufactured: Amplifiers, Machines/Machinery, Production, Microphones, All Kinds

CONSOLIDATED CONTROLS CORP., 12 Durant Ave., Bethel, Conn., 06801, Tel: 203-743-6721, TWX: 710-456-0446; FSC No: 02750; Empl.: 300; Minimum order: $25

Customer service: G. L. Garavel

Products manufactured: Actuators, Comparators, Controls/Control Eqpt., Converters, Couplings, Data Acquisition & Reduction Systems, Data Loggers, Gages, Indicators, Meters, Monitors, Multiplexers, Printers, Probes, Scanners, Switches, Transducers, Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.

Ariz	Scottsdale, OEM Specialties	602-948-3360
Cal	Redwood City, Marchi Assocs.	415-364-3411
Colo	Denver, D. E. Bond Assocs.	303-756-1234
Conn	Meriden, Abbott-Allison Inc.	203-237-9232
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Haw	Honolulu, Atecs Corp.	
Ill	La Grange, Olson Engrg. & Sls. Co.	312-482-3300
Mass	Boston, Abbott-Allison Inc.	617-245-0250
Mich	Southfield, Automatic Controls Co.	313-354-1190
Minn	Minneapolis, JD Co.	612-454-5552
Mo	St. Louis, Boweng Representatives	314-429-7327
NM	Albuquerque, Industrial Prods. Corp.	505-256-3561
NY	Massapequa, Clime Equip. Co.	516-798-5634
Ohio	Cleveland, Jay Industrial Sls. Co.	216-831-9393
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
Pa	Pittsburgh, Ener-Jet Inc.	412-682-0777
SC	Greenville, Egan Assocs.	803-288-4450
Tex	Houston, C. M. Asfahl Agency	713-523-3764
Utah	Salt Lake City, Specialty Sls. Co.	801-262-2979
Va	Annandale, R.W. Lankenau & Assocs.	703-256-0800
Wash	Bellevue, M. Poggi Co.	206-454-2026
EXP:	New York, N. Y., Technitron Inc.	212-758-2790

CONSOLIDATED REFINING CO, see CRM Div Consolidated Refining Co

CONSOLIDATED RESISTANCE CO. OF AMERICA, INC., 222 Lake Ave., Yonkers, N.Y., 10701, Tel: 914-YO3-5900 .... p. 2•1427

For info on price: J. J. Wilentchik; Application info: J. J. Wilentchik; Customer service: A. Powers; Delivery info: A. Powers

Products manufactured: Resistors

CONSOLIDATED WIRE & ASSOC. CORPS., 1635 S. Clinton St., Chicago, Ill., 60616, Tel: 312-421-4441; Empl.: 57; Minimum order: $100 p. 2•1929,1930,1933-1968

Customer service: T. A. Mann

Products manufactured: Braid, Cable, Cable, Cords, Leads, Test & Adaptors, Wire, Wire Shielding

Local Sales Offices & Reps.

Cal	Glendale, Armstrong Sls. Co.	213-245-5344
Colo	Arvada, Arrowhead Sls. Co.	303-423-5556
Conn	West Haven, Johnson Assocs.	203-932-0162
Fla	Hollywood, S.K. Wallace Assoc.	305-961-6640
Fla	Tampa, S.K. Wallace Assoc.	813-961-1037
Ga	Jonesboro, S.K. Wallace Assoc.	404-471-6297
Ill	Chicago, R.R. Hutmacher Assoc.	312-631-3248
Ind	Indianapolis, New/ERA Sls.	317-257-7333
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Md	Kensington, Forti-Austin Assoc.	301-949-1706
Mass	Wellesley Hills, Johnson Assoc.	617-235-3977
Mich	Detroit, Burcaw Co. & Assoc.	313-533-7700
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
Mo	St. Louis, Palatine Engrg. Sals.	314-426-7055
NJ	Willingboro, Forti-Austin Assoc.	609-871-9290
NY	Buffalo, Maury Farber & Assoc.	716-856-3543
NY	Flushing, Bettan Sls., Inc.	212-591-7600
NC	Kernersville, S.K. Wallace Assoc.	919-993-3993
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Tenn	Memphis, S.K. Wallace Assoc.	901-682-2281
Tex	Dallas, E.L. Wilks & Co.	214-242-5321
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Wash	Seattle, Interface Ectrns.	206-285-3500
EXP:	Plainview, N.Y., Morhan Exporting	516-293-5582

CONSTANTA CO. OF CAN., 280 Regina Ave., Montreal, Can., Tel: 514-766-8569; Empl.: 33

Products manufactured: Capacitors, Fixed, Resistors

Local Sales Offices & Reps.

Cal	Bellflower, Royer Assocs.	213-867-3638
Cal	Walnut Creek, Murray Assocs.	415-937-7577
Md	Towson, W.M. Jones Co.	301-823-5721
Mass	Newton Upper Falls, Brookdale Elctrns. Engrg. Ltd.	617-244-6969
NY	Buffalo, J.M. Glass	716-856-9272
Ohio	Dayton, LI/Corp	513-434-6367

CONTINENTAL CONNECTOR CORP., 34-63 56th St., Woodside, N.Y., 11377, Tel: 212-899-4422, TWX: 710-582-2565; FSC No: 95238; Empl.: 550 ...p. 2•662-665

For info on price: H. Schade; Application info: O. Chernoff; Customer service: G. Palmquist

Free literature available: CONDENSED CATALOG - 8 different series listed and highlighted with pertinent specs for each group: PRINTED CIRCUIT CATALOG - 84-page manual with specifications, illustrations, descriptions and ordering information on receptacle type pc board connectors: MICROMINIATURE CONNECTOR CATALOG.

Products manufactured: Connectors, Sockets, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Encino, Continental Connector Corp.	213-886-6025
Cal	Los Altos, Continental Connector Corp.	415-948-0211
Cal	San Diego, Southwest Tech. Sls.	714-565-2295
Ill	Chicago, Continental Connector Corp.	312-282-1455
Mass	Chestnut Hill, M.M. Ross	617-469-0674
NY	Woodside, Continental Connector Corp.	212-899-4422
Pa	Warminster, Continental Connector Corp.	215-441-0195
Tex	Dallas, Continental Connector Corp.	214-620-1840

FOR:	Can., Scarborough, Al Attree	416-267-6567

Local Distributors

Cal	Chatsworth, Westates Elctrns., 20151 Bahama St.	213-341-4411
NY	W. Hempstead, March Elctrns., 600 Hempstead Tpke.	516-486-6511

CONTINENTAL RENTALS DIV., Continental Leasing, 175 Middlesex Tpke., Bedford, Mass., 01730, Tel: 617-275-0850

Products manufactured: Amplifiers, Analyzers, Bridges, Cameras, Counters, Filters, Generators, Meters, Monitors, Oscillators, Oscillographs, Direct Writing, Oscilloscope Plug-Ins, Oscilloscopes, Power Supplies, Recorders, RFI Measuring Equipment, Services, Assembly, Production & Test, Synthesizers, Test Equipment

Local Sales Offices & Reps.

Ariz	Mesa, Scientific Devices Albuq.	602-834-1682
Cal	Los Angeles, Continental Rentals	213-477-7521
Cal	Sunnyvale, Contінetal Rentals	408-735-8300
Colo	Denver, Scientific Devices	303-573-9466
Conn	Hartford, Instrument Assocs.	203-525-9367
Ill	Des Plaines, Scientific Devices	312-297-5240
Ill	Elk Grove Village, Continental Rental Div	312-439-4700
Iowa	Cedar Rapids, Techn. Rep. Inc.	319-363-2489
Md	Ellicott City, Continental Rental Div.	301-465-7880
Mass	Bedford, Continental Rental Div.	617-275-0850
Mich	Detroit, Scientific Devices	313-851-5945
Minn	Minneapolis, Scientific-Devices	612-544-1616
Mo	Hazelwood, Technical Rep. Inc.	314-731-5200
Mo	Independence, Technical Rep. Inc.	816-356-3010
NJ	Metuchen, Continental Rental Div.	505-268-6729
NJ	Albuquerque, Scientific Devices-Albuq.	505-268-6729
Ohio	Cleveland, Scientific Devices	216-261-2000
Ohio	Dayton, Scientific Devices	513-298-9904
Tex	Dallas, Continental Rental Div.	214-357-1779
Tex	Houston, Scientific Devices	713-623-4250

CONTINENTAL SPECIALTIES, 44 Kendall Street, Box 1942, New Haven, Conn., 06509, Tel: 203-624-3103; Empl.: 15; Minimum order: $5 ....p. 2•348-351

For info on price: B. Bovee 203-624-3103; Application info: J. Pascoe 415-383-4207; Customer service: B. Bovee 203-624-3103; Delivery info: P. Contento 203-624-3103

Free literature available: Seasonal catalog describing breadboarding & circuit testing devices manufactured by Continental Specialties. Data sheets giving detailed description of Continental Specialties' Proto Board line and QT Socket line.

Products manufactured: Analyzers, Clamps & Clips, Connectors, Integrated Circuit Devices, Kits, Breadboarding (For Engineers), Kits, Training Aid, Sockets, Terminal Blocks, Boards & Strips, Testers

Local Sales Offices & Reps.

Cal	San Francisco, Continental Specialties	415-383-4207

CONTROL DATA CORP., 2815 El Segundo Blvd., Hawthorne, Cal., 90250

CONTROL DATA CORP., Printed Circuit Operation, 3965 Meadowbrook Rd., St. Louis Park, Minn, 55426

CONTROL DATA CORP., Connector Div., 31829 W. Tienda Dr., Westlake Village, Cal., 91361, Tel: 213-889-3535, TWX: 910-494-1224; Empl.: 180; Minimum order: $100

Customer service: T. Mueller

Products manufactured: Connector Blocks, Mother Board, Connectors, Contacts, Electrical

Local Sales Offices & Reps.

Cal	Glendale, Orion Sls.	213-240-3151
Cal	San Diego, Orion Sls.	714-566-0360
Cal	Santa Clara, Cindel Sls.	408-249-4424
Cal	Tustin, Orion Sls.	714-832-9687
Colo	Denver, Rope & Williamson	303-758-8507
Conn	Hartford, Cable Assocs.	203-525-5016
Fla	Ft. Lauderdale, Orbe Inc.	305-771-8915
Fla	St. Petersburg, Orbe Inc.	813-894-0687
Ill	Chicago, Such-Bohmer, Inc.	312-446-8934
Md	Stevenson, Tyler Griffin Co.	301-484-0251
Mass	Boston, Cable Assocs.	617-267-7322
Mich	Farmington, CMP	313-477-7700
Mo	St. Louis, Ensco-Rep	314-567-3935
NY	Mamaroneck, Cane Tech. Sls.	914-698-4411
NY	Rochester, T. Ferguson Sls.	716-482-7757
Ohio	Cleveland, CMP	216-333-5650
Pa	Pittsburgh, CMP	412-824-3760
Tex	Richardson, R.F. Kimball Co.	214-231-3447

CONTROL DATA CORP., Magnetic Components Div., 7801 Computer Ave., Minneapolis, Minn., 55435, Tel: 612-830-5800, TWX: 910-576-2978; Empl.: 500

Products manufactured: Motors, Power Supplies, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps.	205-539-4411
Cal	Yorba Linda, E. Grabowski	714-528-5555
Colo	Denver, Williams-Assocs.	303-373-4730
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-776-4800
Fla	Orlando, W.A. Brown Comps.	305-425-5505
La	Metairie, McKinney Sls. Co.	504-887-1723
Mass	Framingham, F.C. Hatch	617-879-3854
NM	Albuquerque, Williams-Assocs.	505-255-1638
NY	New York, J.D. Grey	914-255-0393
NC	Winston-Salem, W.A. Brown Comps.	919-725-5384
Ohio	Cleveland, Research Development Prod. Assocs.	216-526-5260
Ohio	Dayton, Research Development Prod. Assocs.	513-253-6175
Tex	Bellaire, McKinney Sls. Co.	713-774-3232
Tex	Dallas, McKinney Sls. Co.	214-631-9450
Va	Alexandria, W.A. Brown Equip-Comp	703-836-1800
Wash	Seattle, Avionics Liaison, Inc.	206-767-3870
Wisc	Racine, E. Wojcik	414-554-7167
EXP:	New York, N.Y., Lothar-Sanford Co.	212-757-3881

CONTROL DEVICES INC., 204 New Boston St., Woburn, Mass., 01801, Tel: 617-935-1105; Empl.: 54; Minimum order: $25

For info on price: J. F. Colligan; Application info: D. Gove; Customer service: A. Dean; Delivery info: G. Marino

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Cal	Torrance, Mitronics Inds.	213-323-7934
Conn	Huntington, Comtronic Assoc. Inc.	203-929-4953
Fla	Clearwater, WMM Assoc.	813-726-8871
Ill	Chicago, Pivan Engng.	312-539-4838
NY	Garden City, Comtronic Assoc. Inc.	516-741-8966
NY	Ithaca, B. Dean Inc.	607-272-2187
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Pa	Broomall, L.D. Lowery Inc.	215-356-5300
Tex	Dallas, EBR	214-942-2716

CONTROL ELCTRNS. CO., INC., 153 Florida St., Farmingdale, N.Y., 11735, Tel: 516-694-0125; Empl.: 50 p. 1•110,444

Customer service: H. Goldstein

Free literature available: Supplier of all types of delay line components, including variable magneto strictive, ultrasonic dispersive, lumped constant, etc. Full military and commercial lines.

Products manufactured: Amplifiers, Delay Lines, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Filters, Memory Systems, Meters, Synthesizers

Local Sales Offices & Reps.

Cal	Sherman Oaks, R.T. Assocs.	213-788-7588
Ill	Chicago, LGS Elctrn.	312-622-8183
Md	Ellicott City, VPI	301-465-4060
Mass	W. Medway, J. Gallagher	617-533-7292
Pa	Montgomery, VPI	215-474-3200
EXP:	Fla., Hallandale, Emec	305-925-6366

CONTROL EQUIP. CORP., 220 Tanner St., Lowell, Mass., 01851, Tel: 617-459-0573; Empl.: 10; Minimum order: $25

For info on price: G. Stephens; Application info: G. Stephens; Customer service: L. J. Pouliot; Delivery info: O. W. Ryden

Products manufactured: Cards, Logic, Comparators, Converters, Counters, Data Acquisition & Reduction Systems, Data Loggers, Generators, Integrators, Electronic, Multiplexers, Paper-Tape Preparation Systems, Punched Card Equipment, Recorders, Scanners, Switches, Testers, Totalizers, Digital, Translators, Data

CONTROL PRODUCTS CORP., 4431 W. Division St., Chicago, Ill., 60651, Tel: 312-235-1131; Empl.: 60

Free literature available: CPC manufactures thermocouples, sheated conductor, heaters, control panels and systems using electrical, electronic, pneumatic components custom built. We supply adjustable speed and frequency systems, using regadyne all AC control from 5 thru 1500 HP.

Products manufactured: Alarms, Cable Assemblies & Harnesses, Controls/Control Eqpt., Converters, Meters, Panels, Thermocouples, Elements & Accessories, Wire

Local Sales Offices & Reps.

Ariz	Mesa, D.C. Donath Co.	602-964-2782
Cal	Irvine, C. Oestreicher	714-673-1235
Mich	Detroit, K.V.A. Assocs.	313-892-6000
Mich	Grand Rapids, H.E. Frakie	616-949-4366
Minn	St. Paul, E. C. Stiedemann Co.	612-739-3775
Ohio	Cincinnati, A.H. Parker	513-563-1843
Pa	Bethayres, Control Instr. Sls. Co.	215-676-1808
Pa	Pittsburgh, Weiss Instr.	412-371-3020
Tex	El Paso, Progress Sls. Co.	915-566-2731
Tex	Houston, Houston Tech. Sls.	713-664-9891
Wash	Bellevue, Topp Engrg. Sls. Corp.	206-747-5401
Wisc	Milwaukee, E.C. Stiedemann Co.	414-332-1250

CONTROL PRODS., INC., E. Hanover, N.J., 07936, Tel: 201-887-9400; Empl.: 35; Minimum order: $10

For info on price: M. P. Deachuck; Application info: M. P. Deachuck; Customer service: C. Artho; Delivery info: C. Artho

Free literature available: Thermal Folder and 10 Data Sheets

Products manufactured: Switches

CONTROL SCIENCES, INC., 10315 Woodley Ave., Granada Hills, Cal., 91344, Tel: 213-342-3067; FSC No: 53317; Empl.: 8

For info on price: H. C. Ericsson; Application info: M. Bushell; Customer service: M. Bushell; Delivery info: H. C. Ericsson

Products manufactured: Converters, Demodulators, Indicators, Transformers

Local Sales Offices & Reps.

Ala	N. W. Huntsville, W. A. Brown Assoc.	205-539-4411
Cal	Van Nuys, Cardinal Assoc.	213-787-5511
Fla	Fort Lauderdale, W.A. Brown Assoc.	305-776-4800
Fla	Orlando, W.A. Brown Assoc.	305-425-5505
Ga	Tucker, W.A. Brown Assoc.	404-939-1674
La	Gretna, W.A. Brown Assoc.	504-366-5766
NY	Syracuse, Syracuse Tech. Reps.	315-488-0222
NC	Winston-Salem, W.A. Brown Assoc.	919-768-3600
Ohio	Cincinnati, G & H Sls. Co.	513-771-8231
Pa	Hatboro, DeShawn Assoc.	215-675-9111

CONTROL SWITCH, A Cutler Hammer Co., 1420 Delmar Dr., Folcroft, Pa., 19032, Tel: 215-586-7500, Telex: 83-4216; FSC No: 81640; Empl.: 250; Minimum order: $50

For info on price: F. Giasone; Application info: G. Maier; Customer service: J. Boyle; Delivery info: F. Giasone

Free literature available: Bulletins on: High reliability toggle, pushbutton, limit, lighted and special switches for direct PCB mounting for commercial, aircraft, industrial and military control applications

Products manufactured: Indicators, Lamps, Lights, Sockets, Switches

Local Sales Offices & Reps.

Cal	Menlo Park, Control Switch Inc.	415-854-1005
Cal	Sepulveda, R. L. Assocs.	213-782-7826
Fla	Lighthouse Point, Saber Assocs., Inc.	305-943-3076
Ga	Woodstock, Saber Assocs., Inc.	404-432-9625
Ill	Chicago, Carlson Elctrn. Sls. Co.	312-774-9022
Ind	Indianapolis, R. O. Whitesell & Assoc., Inc.	317-359-5283
Ky	Louisville, R. O. Whitesell & Assoc., Inc.	502-893-7303
Md	Lanham, Eastern Comps. Inc.	301-577-2925
Mass	Newton, Control Switch Inc.	617-244-7514
Mich	Grand Rapids, R. O. Whitesell & Assoc., Inc.	616-451-8901
Mich	Southfield, R. O. Whitesell & Assoc., Inc.	313-358-2020
Mich	St. Joseph, R. O. Whitesell & Assoc., Inc.	616-983-7337
Minn	Minneapolis, Control Switch Inc.	612-831-3560
Miss	Corinth, Rakes Engrg & Mktg. Corp.	601-287-5369
Mo	St. Louis, Carlson Elctrn. Sls. Co.	314-991-0262
NY	Oceanside, Bittan Assocs., Inc.	516-678-6222
NC	Smithfield, Byrd & Barbour Sls.	919-934-8136
Ohio	Cincinnati, R. O. Whitesell & Assoc., Inc.	513-521-2290
Ohio	Columbus, R. O. Whitesell & Assoc., Inc.	614-888-9396
Ohio	Dayton, R. O. Whitesell & Assoc., Inc.	513-298-9546

Ohio	Lakewood, R. O. Whitesell & Assoc., Inc.	216-228-7525
Okla	Tulsa, Control Switch Inc.	918-627-3312
Pa	Paoli, Control Switch Inc.	215-878-0820
Pa	Philadelphia, Eastern Comps., Inc.	215-836-1616
Pa	Pittsburgh, R. O. Whitesell & Assoc., Inc.	412-344-7277
Tenn	Bristol, Rakes Engrg. & Mktg. Corp.	615-968-4195
Tex	Richardson, Thunderbird Tech. Sls. & Svcs., Inc.	214-690-0763
Wash	Bellevue, Control Switch Inc.	206-747-5560
Wisc	Wauwatosa, Carlson Elctrn. Sls. Co.	414-476-2790

Local Distributors

Cal	Culver City, Western Electromotive Inc., 8467 Steller Dr.	213-870-7621
Fla	Ft. Lauderdale, Peerless Radio Corp. of Fla. Inc., Box 23143	305-566-5966
Fla	Miami, Electronic Equip. Co., 2701 NW 42nd Ave.	305-871-3500
Md	Kensington, Marine Air Supply, 10233 Kensington Pkwy.	301-949-1353
Mass	Boston, Sager Elec. Supply Co., 172 High St.	617-542-2281
NY	Lynbrook, Peerless Radio Corp., 19 Wilbur St.	516-593-2121
Ohio	Dayton, Related Components Inc., 1721 E. Third St.	513-253-6116
Tex	Dallas, Texas Instr. Supply Co., 6000 Denton Dr.	214-238-6821

CONTROL SYSTEMS RESEARCH, INC., CSR Bldg., 632 Fort Duquesne Blvd., Pittsburgh, Pa., 15222, Tel: 412-566-1200, TWX: 710-664-4203; Empl.: 150

Free literature available: Systrol Catalog-Latest developments in digitally controlled drive systems with full wave 4 quadrant regenerative servo controllers. Acc-U-Lok Catalog-New electromechanical synchronizing mechanical isolated shafts.

Products manufactured: Amplifiers, Boards, Printed Circuit, Controls/Control Eqpt., Motors, Repeaters, Servo, Servo Systems

Local Sales Offices & Reps.

Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700
Conn	Middletown, CSR	203-346-6240
Ill	Libertyville, CSR	312-367-0003
Mich	W. Bloomfield, CSR	313-682-2717
NY	E. Aurora, CSR	412-566-1200
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Ohio	Chagrin Falls, CSR	216-247-6021
Pa	Malvern, Miller & Dietz Co.	215-647-7373
Pa	Pittsburgh, CSR	412-566-1200
Pa	Pittsburgh, R.F. Clark	412-242-9500
Tex	Dallas, Dwayne Clement Assocs.	214-239-6105

CONTROL TECHNOLOGY CO., 41-16 29th St., L.I.C., N.Y., 11101, Tel: 212-EM 1-2133; Empl.: 35

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Products manufactured: Actuators, Amplifiers, Analyzers, Bridges, Comparators, Computers, Controls/Control Eqpt., Converters, Dampers, Servo, Data Acquisition & Reduction Systems, Demodulators, Detectors, Indicators, Integrated Circuit Devices, Integrators, Electronic, Modulator/Demodulators, Modulators, All Kinds, Monitors, Multipliers, Repeaters, Servo, Servo Systems, Simulators, Synchro Transmitters, Solid-State, Testers, Tracking Systems, Translators, Data

CONTROLCRAFT CORP., 213 Main St., West Chicago, Ill., 60185, Tel: 312-231-7511; Empl.: 35

Products manufactured: Controls/Control Eqpt., Counters, Drivers, Solenoid, Encoders, Generators, Indicators, Light Sources, Photoelectric, Modulators, All Kinds, Scalers, Binary, Decade, Scanners, Shift Registers, Switches, Tachometers, Timers, Totalizers, Digital, Transducers

Local Sales Offices & Reps.

Ark	Little Rock, Electra-Tech Midsouth, Inc.	501-562-4090
Colo	Denver, Tessco Co.	303-744-1119
Ind	Indianapolis, National Engrg. Co.	317-251-1132
Mass	Braintree, Bordewieck Engrg. Sls. Co.	617-843-0845
Minn	Minneapolis, Bican Co.	612-827-4734
NY	Syracuse, B. Fleckenstein	315-488-7883
Ohio	Cleveland, Harvey Teplitz & Co.	216-371-2044
Ohio	Dayton, Harvey Teplitz & Co.	513-277-6531
Ore	Beaverton, D. Fry Co.	503-643-5448

CONTROL PRODUCTS DIV., Amerace Corp., 2330 Vauxhall Rd., Union, N.J., 07083, Tel: 201-964-4400, TWX: 710-985-4687; FSC No: 3L154; QPL No: 2270; Empl.: 275; Minimum order: $25

Customer service: G. Elwood

Free literature available: SR-3: Electropneumatic timers for industrial controls. SS-7: Solid-State timing relays. G-109: Terminal Blocks for design engineering freedom. CR-1: General Purpose and Magnetic Latch relays.

Products manufactured: Connectors, Controllers, Programmable, Controls/Control Eqpt., Motors, Programmers, Relays, Switches, Terminal Blocks, Boards & Strips, Timers

Local Sales Offices & Reps.

Agastet Control Prods.

Ala	Birmingham, Control Prods. Div.	205-979-0511
Cal	Foster City, Control Prods. Div.	415-349-3817
Cal	San Diego, J. C. Henberger Co.	714-223-7114
Cal	Santa Fe Springs, Control Prods. Div.	213-863-5753
Colo	Denver, C. Beabout Co.	303-244-3151
Conn	Prospect, P. Yoder	203-758-4221
Del	Wilmington, Control Prods. Div.	302-475-2636
Ga	Atlanta, Control Prods. Div.	404-261-1224
Haw	Honolulu, H. C. Burgess	808-623-3118
Ill	Elk Grove Village, Control Prods. Div.	312-437-8354
Kans	Kansas City, G. H. Pearson	913-341-6210
Mass	Boston, Control Prods. Div.	617-326-8686
Mich	Southfield, Linder Assoc., Inc.	313-353-4334
Minn	Minneapolis, Control Prods. Div.	612-560-5640
Mo	Kirkwood, Control Prods. Div.	314-821-1909
Neb	Omaha, B. Gurney & Assoc.	402-342-8445
NJ	Union, Control Prods. Div.	201-355-7770
NY	Buffalo, R. F. Lamb Co.	716-874-4900
NY	Long Isl., Control Prods. Div.	516-627-8809
NY	Rochester, T. Ferguson Sls.	716-482-7757
Ohio	Cincinnati, Control Prods. Div.	513-729-2904
Ohio	Solon, Control Prods Div.	219-692-2452
Pa	Bridgeville, Foster-McClinton, Inc.	412-941-4800
Pa	Erie, Foster-McClinton, Inc.	814-455-9111
SC	Inman, J. Hile	803-578-6080
Tex	Houston, Control Prods. Div.	713-666-8421
Tex	Plano, Control Prods. Div.	214-423-4431
WVa	Huntington, Foster-McClinton, Inc.	304-736-5161

Buchanan Terminal Blocks

Cal	Los Angeles, Control Prods. Div.	213-863-5753
Cal	Palo Alto, Control Prods. Div.	415-325-4486
Colo	Denver, P. Douden Co.	303-744-1497
Conn	Waterbury, Control Prods. Div.	203-758-4221
Fla	Coral Springs, O. C. Puckett Co.	305-752-0648
Fla	Jacksonville, O. C. Puckett Co., Inc.	904-724-3453
Fla	Orlando, O. C. Puckett Co., Inc.	305-422-7197
Fla	Temple Terr., O. C. Puckett Co., Inc.	813-988-7077
Haw	Honolulu, D. Schwab	808-537-1658
Ill	Chicago, Control Prods. Div.	312-583-8131
Iowa	Cedar Rapids, Bertsch Elec. Sls. Co.	319-366-7719
Mich	Grand Rapids, Linder Assoc., Inc.	616-364-0748
Mich	Lansing, Linder Assoc., Inc.	517-489-0292
Minn	Minneapolis, Lee-Noonan Co.	612-920-7851
Mo	Raytown, Arehart-Barnds Sls. Co.	816-356-3488
Neb	Lincoln, E. Taber & Sons	402-423-4420
NJ	New Brunswick, Control Prods. Div.	201-297-1511
NM	Albuquerque, T. Deskin & Assoc.	505-242-3581
NY	Buffalo, A. Schultz Co.	716-839-1010
Ohio	Cleveland, V. O'Neill	216-331-4273
Ore	Portland, M. Gerrard	503-224-0864
Pa	Oreland, Cusick Elec. Sls. Co.	215-886-2100
Pa	Pittsburgh, M. Smith & Assoc.	412-276-5363
Tex	Dallas, Control Prods. Div.	214-423-4431
Wash	Seattle, Tal Agencies, Inc.	206-624-3355

CONTROLS RESEARCH CORP., 2100 S. Fairview, Santa Ana, Cal., 92704, Tel: 714-549-2990, TWX: 910-595-1106

For info on price: D. P. Schulze; Application info: D. P. Schulze; Customer service: E. Whelin; Delivery info: E. Whelin

Free literature available: Data sheets on both reed and mechanical switch modules, also on stock keyboards using reeds, mechanical switches, and solid state switches (CRC C-SCAN).

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Cal	Encino, King-Way Assoc.	213-788-4124
Cal	Los Altos, Ewing-Foley	415-941-4525
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Downers Grove, Richmar Elctrns. Corp.	312-968-0118
Md	Randallstown, J. M. Chavis Assoc.	301-484-6399
Mich	Farmington Hills, W. R. Hummon & Assoc.	313-474-0661
Minn	Minneapolis, Engineering Products Assoc.	612-925-1883
NH	Nashua, Bell Controls	603-882-6984
NJ	Ridgewood, Hansen Assoc.	212-947-0379
Ohio	Medina, J. C. Hofstetter Co.	216-725-4477
Pa	Horsham, CMS Mktg.	215-672-8300
Tex	Garland, Carter Assocs.	214-276-7151
Wash	Mercer Island, J. H. Andersen Assoc.	206-232-0484
FOR:	Can., Downsview, Ont., Kaytronics Ltd.	416-638-5511
FOR:	Can., Montreal, Que., Kaytronics Ltd.	514-487-3434

CONTROLTEK INC., 2235 N.W. Savier, Portland, Ore., 97210, Tel: 503-222-9381; Empl.: 4

Customer service: G. Fagg

Products manufactured: Chargers, Battery, Controls/Control Eqpt., Converters, Counters, Inverters, Power Supplies

Local Sales Offices & Reps.

EXP:	Portland, Ore., Extech Ltd.	

CONVERSION CHEM. CORP., 210 E. Main St., Rockville, Conn., 06066, Tel: 203-872-0541, TWX: 710-435-2336; Empl.: 43

Products manufactured: Chemicals, Cleaners & Solvents, Coatings, Etchants, Printed Circuit

Local Sales Offices & Reps.

Cal	Montebello, Conversion Chemical	213-726-0825
Ill	Chicago, Conversion Chemical Corp.	312-247-7117
Ill	Lansing, G. A. Hobbs	312-474-5264
Mass	Dudley, J. A. Cristina	617-943-3096
Mich	Albion, L. Calicotte	517-629-3502
NY	East Syracuse, K. R. MacDonald	315-463-0685
NC	Charlotte, Conversion Chemical Corp.	704-394-1378
NC	Statesville, B. G. Deal	704-872-3256
Ohio	Sylvania, E. P. Agnew	419-882-1282
Ohio	Toledo, Conversion Chemical Corp.	419-531-3703
EXP:	Rockville, Conn., Kenvert International	203-875-8081

COOK ELEC. CO., 6201 Oakton St., Morton Grove, Ill., 60053, Tel: 312-967-6600, TWX: 910-223-3654; Empl.: 800; Minimum order: $50

For info on price: H. Thielsen; Application info: H. Wickstrom; Customer service: R. Tasson; Delivery info: R. Tasson

Free literature available: Catalog 701B Lists general line of field adjustable and factory calibrated pressure switches. Specials upon request.

Products manufactured: Controls/Control Eqpt., Relays, Switches

Local Sales Offices & Reps.

Cal	El Segundo, Skytronics	213-772-3231
Cal	Encino, V & L Assocs.	213-986-9703
Cal	Los Altos, Frauman	415-941-0660
Ind	Mishawaka, DeWald Fluid Power	219-255-4776
Iowa	Cedar Rapids, Palatine Engrg.	319-365-8071
Kans	Andover, Palatine Engrg.	316-683-7512
Kans	Overland Pk., Palatine Engrg.	913-262-5643
Md	Baltimore, Milan Assocs.	301-825-1120
Mich	Fenton, Kundinger Fluid Power	313-629-2248
Mo	St. Louis, Palatine Engrg.	314-426-7055
NY	Binghamton, Canavan-Scanlon	607-724-7220
NY	Rochester, Canavan-Scanlon	716-442-0720
NY	Syracuse, Canavan-Scanlon	315-437-1271
Ohio	Cleveland, D. Steffen	216-461-8333
Ohio	Dayton, D. Steffen	513-293-3145
Pa	Philadelphia, S.K. MacDonald	215-545-1205
Tex	Dallas, Economy Gauge & Instr. Supply	214-243-8370
Wisc	Appleton, Kundinger Fluid Power	414-739-7463
EXP:	Ill., Chicago, E. Magnus	312-334-1503

COOPER GROUP, Weller Elctrns. Div., Box 728, Apex, N.C., 27502, Tel: 919-362-7511, Telex: 579497; Empl.: 350; Minimum order: $25

Customer service: G. Huegerich

Products manufactured: Soldering Equipment, Soldering Guns, Irons & Desoldering Tools

COORS PORCELAIN CO., 600 Ninth St., Golden, Colo., 80401, Tel: 303-279-6565; Empl.: 1600; Minimum order: $250

For info on price: D. Chandler; Application info: T. Glass; Customer service: T. Glass; Delivery info: T. Glass

Free literature available: 952 - alumina cermaic specification and application literature.

Products manufactured: Coatings, Packages, Integrated Circuit, Seals, Substrates, Tubing

Local Sales Offices & Reps.

Ariz	Phoenix, Hecht, Henschen & Assoc.	602-275-4411
Cal	Goleta, J.N. Paxson	805-968-3632
Cal	Newport Beach, S. Whisner	714-772-9500
Fla	Melbourne, Reynolds & Assoc.	305-727-3205
Ill	Chicago, A.S. Deter, Jr.	312-541-8010
Ind	Indianapolis, D.R. Reimer	317-783-2856
Kans	Kansas City, Mid-America Elctrns., Inc.	913-236-4800
Mich	Southfield, Eynon-Weyand Assoc.	313-354-3430
Minn	Minneapolis, D.G. Perry & Co.	612-920-3212
NJ	Hopatcong, R.P. Collins	201-526-9050
NY	Ithaca, B. Dean, Inc.	607-272-2187
NC	Winston-Salem, Dula Assoc.	919-768-7166
Pa	West Chester, R.L. White	215-692-2674
Tex	Hurst, H.L. Moschel	817-336-4721
Tex	Richardson, P.J. Scanlon Co.	214-231-4661

COPPERWELD BIMETALLICS, Div. Copperweld Corp., Glassport, PA, 15045, Tel: 412-664-7131, TWX: 710-794-4806

Customer service: W. G. Ross

Free literature available: Literature covers properties and characteristics of copperweld® (copper-clad steel) and Alumoweld® (aluminum-clad steel) wire and strand for use in electrical and mechanical applications.

Products manufactured: Antenna Towers & Supports, Cable, CATV Systems & Equipment, Clamps & Clips, Forms, Wire, Metals, Rods, Ground, Wire, Wire & Cable Ties

CORCOM, 2635 No. Kildare Ave., Chicago, Ill., 60639, Tel: 312-384-7400, TWX: 910-221-5308; FSC No: 05245; Empl.: 275 .... p. 1•546,547

Customer service: Reg. Sls. Mgr.

Products manufactured: Coils Including Assemblies & Forms, Comparators, Connector Boxes & Strips, Power Outlet, Connectors, Filters

Local Sales Offices & Reps.

Ariz	Scottsdale, Q.T. Wiles & Assoc.	602-948-5590
Cal	Los Angeles, Q.T. Wiles & Assoc.	213-649-1232
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, Q.T. Wiles & Assoc.	714-565-6893
Cal	Tustin, Q.T. Wiles & Assoc.	714-832-4952
Colo	Boulder, Straube Assocs.	303-426-0890
Conn	Milford, Conti-Younger	203-929-3294
Fla	Altamonte, W.M.M. Assocs.	305-831-4645
Fla	Clearwater, W.M.M. Assocs.	813-447-2533
Fla	Pompano, W.M.M. Associates	305-943-3091
Ga	Atlanta, G.S. O'Hara	404-237-0600
Ill	Downers Grove, Richmar Elctrns. Corp.	312-968-0118
Ind	Fort Wayne, Robert O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, Robert O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, Robert O. Whitesell & Assocs.	317-452-6065
Iowa	Cedar Rapids, Palatine Eng. Sls.	319-365-8071
Kans	Andover, Palatine Eng. Sls.	316-683-7512
Kans	Overland Park, Palatine Eng. Sls.	913-262-6820
Ky	Louisville, Robert O. Whitesell & Assocs.	502-893-7303
Md	Baltimore, D.K. Jones & Assocs.	301-752-0577
Mass	Waltham, Conti-Younger Assocs.	617-890-4582
Mich	Grand Rapids, Robert O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, Robert O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, Robert O. Whitesell & Assocs.	616-983-7337
Minn	Edina, M. Foster Co.	612-835-2252
Mo	St. Louis, Palatine Eng. Sls.	314-426-7055
NM	Albuquerque, Straube Assocs.	505-292-0295
NY	Clinton, Advanced Comp. Corp.	315-853-6438
NY	Endicott, Advanced Comp. Corp.	607-785-3191
NY	Manhasset, Win-Cor Elctrn. Sls.	516-627-9474
NY	No. Syracuse, Advanced Comp. Corp.	315-699-2671
NY	Scottsville, Advanced Comp. Corp.	716-889-1429
Ohio	Cincinnati, Robert O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, Robert O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, Robert O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, Robert O. whitesell & Assocs.	513-298-9546
Ore	Portland, Earl & Brown Co.	503-245-2283
Pa	Feasterville, Professional Service Assoc.	215-355-6244
Pa	Pittsburgh, Robert O. Whitesell & Assocs.	412-344-7277
Tex	Austin, K & H Sls.	512-836-2842
Tex	Plana, K & H Sls.	214-423-6520
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Wash	Seattle, Earl & Brown Co.	206-284-1121
Wisc	Oak Creek, Richmar Elctrns. Corp.	414-475-0141
FOR:	Toronto, Ont., Can., Atlas Elctrns., Ltd.	416-781-6174

Local Distributors

Cal	Mt. View, Terminal Elctrns., 880 Maude Ave.	415-969-9240
Cal	South Gate, CEC/Moltronics, 5610 E. Imperial Hwy.	213-773-6521
Cal	Sunnyvale, Diplomat/Westland, 1118 Elko Dr.	408-734-1900
Colo	Denver, Elctrn. Parts, 1212 S. Bdwy.	303-744-1992
Fla	Orlando, Hammond Elctrns., 911 W. Central	305-849-6060
Ga	Atlanta, Lykes Elctrns., 1135 Chattahoochee Ave. N.W.	404-355-2223
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow	312-697-8200
Ill	Palatine, Ohm Elctrns., 649 Palatine	312-359-5500
Md	Savage, Pyttronics Ind., 8220 Wellmore Ct.	301-792-7000
Mass	Dedham, Gerber Elctrns., 852 Providence	617-329-2400
Mo	Raytown, Advanced Elctrns., 9052 B50 Hwy	816-737-1443
NJ	Haddonfield, Mid Atlantic, 140 Haddon Ave.	609-428-8288
NY	Mt. Vernon, QAR Ind. Elctrn., 621 S. Columbus	914-699-2224
Tex	Richardson, Prime Distr., 777 S. Central Expwy.	214-231-0170
Utah	Salt Lake City, Diplomat/Alta Land, 2280 S. Main	801-486-7227
Wash	Seattle, Interface Elctrns., 300 2nd Ave. W.	206-285-3500

CORDOVER & CO., CARL, 3914 North 29th Ave., Hollywood, Fla., 33020, Tel: 305-921-6300; Empl.: 25; Minimum order: $25

For info on price: C. Cordover; Application info: J. Cordover; Customer service: D. Abbey; Delivery info: D. Abbey

Products manufactured: Alarms, Diodes, Kits, Printed Circuit, Modules, Logic, Encapsulated, Rectifiers, Transistor, Diode, Thyristor Heat Dissipators, Transistors

CORNELL-DUBILIER ELCTRNS., 2070 Maple, Des Plaines, Ill, 60018

CORNELL-DUBILIER ELECTRONICS, 150 Avenue "L", Newark, N.J., 07105, Tel: 201-589-7500; QPL No: Multiple; Empl.: 3000; Minimum order: $25

Customer service: H. Cerretti

Free literature available: Cornell - Dubilier Component Selector provides convenient identification of standardized products, applied by CDE Distributors, and guidance to selection of customized parts developed through engineering services.

Products manufactured: Antenna Rotators, Capacitors, Fixed, Filters, Relays, Vibrators

Local Sales Offices & Reps.

Ariz	Scottsdale	602-946-4437
Cal	Los Altos	415-941-3399
Cal	San Diego	714-565-9444
Cal	Venice	213-821-5001
Colo	Littleton	303-798-8955
Fla	Maitland	305-831-1242
Ga	Atlanta	404-261-6160
Ill	Des Plaines	312-299-7761
Ind	Indianapolis	317-545-6247
Iowa	Des Moines	515-276-6387
Mass	Norwood	617-762-5333
Mich	Detroit	313-882-1717
Minn	Minneapolis	612-546-5361
Mo	Liberty	816-781-2522
Mo	St. Louis	314-534-4611
NM	Albuquerque	505-265-6794
NY	Rochester	716-544-9580
NC	Raleigh	919-787-9564
Ohio	Cleveland	216-271-5429
Ohio	Dayton	513-298-7224
Ore	Portland	503-297-3777
Pa	Norristown	215-272-0118
Pa	Pittsburgh	412-563-0303
Tex	Dallas	214-357-4024
Wash	Seattle	206-285-1300
EXP:	Des Plaines, Ill.	312-299-8171
FOR:	Can., Lower Sackville, Halifax County, N.S.	902-865-8960
FOR:	Can., Montreal 379, Que.	514-331-2722
FOR:	Can., Scarborough 733, Ont.	416-755-9346
FOR:	Can., Vancouver 9, B.C.	604-980-4346

CORNING GLASS WORKS, Electronic Prod. Div., Houghton Pk., Bldg. A-2, Corning, N.Y., 14830, Tel: 607-974-8652, TWX: 510-252-1385; Minimum order: $45 p. 2•105,1449

Customer service: F. Quan 607-974-8679

Free literature available: Corning Electronics - Electronic Components Catalog #ECC-1

Products manufactured: Capacitors, Fixed, Delay Lines, Heaters & Heating Elements, Memory Systems, Resistors, Transducers

Local Sales Offices & Reps.

Cal	Orange, Corning Glass Works	714-541-5275
Cal	Sunnyvale, Corning Glass Works	408-732-5050
Colo	Denver, Corning Glass Works	303-756-9457
Ill	Chicago, Corning Glass Works	312-693-6830
Kans	Leawood, H.C. Heyde Co.	913-649-8628
Me	Kennebunk, Components, Inc.	207-282-5111
Mass	Littleton, Corning Glass Works	617-486-3125
NC	Raleigh, Corning Glass Works	919-876-1100
NC	Wilmington, Corning Glass Works	919-791-5040
Pa	Bradford, Corning Glass Works	814-362-5571
Pa	Broomall, L.D. Lowery Assocs.	215-356-5300
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
FOR:	Can., Toronto, Ont., Corning Glass Works of Canada	416-421-1500

Local Distributors

Ala	Huntsville, Cramer/EW Inc., 2310 Bob Wallace Ave., S.W.	205-539-5722
Ariz	Phoenix, Liberty Elctrns., 3130 N. 27th Ave.	602-257-1272
Cal	El Segundo, Liberty Elctrns. Inc., 124 Maryland St.	213-322-8100
Cal	Gardena, Bell Industries, 306 E. Alondra Blvd.	213-321-5802
Cal	Mountain View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Liberty Elctrns., 8248 Mercury Ct.	714-565-9171
Colo	Commerce City, Elmar Elctrns., 6777 E. 50th Ave.	303-287-9611
Colo	Denver, Cramer Elctrns., 5465 E. Evans Pl.	303-758-2100
Conn	North Haven, Cramer Elctrns. Inc., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/EW Inc., 4035 N. 29th Ave.	305-923-8181
Fla	Hollywood, Hamilton/Avnet Elctrns., 4020 N. 29th Ave.	305-925-5401
Fla	Orlando, Cramer/EW Inc., 345 N. Graham Ave.	305-894-1511
Ill	Chicago, Bell Ind., 7701 N. Auston Ave.	312-282-5400
Ill	Elk Grove Village, Schweber Elctrns., 1380 Jarvis Ave.	312-593-2740
Ind	Indianapolis, Graham Elctrns. Supp., 133 S. Pennsylvania St.	317-634-8202
Kans	Lenexa, Hamilton Avnet Elctrns., 37 Lenexa Ind'l Center	913-888-8900
Md	Baltimore, Radio Elctrn. Svc. Co., 1026 Cromwell Bridge Rd.	301-823-0700
Md	Hyattsville, Milgray/Washington, Inc., 5405 Lafayette Pl.	301-864-1111
Md	Rockville, Cramer/EW, Inc., Box 1648	301-948-0110
Mass	Newton Centre, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mass	Watertown, Sterling Elctrns., 70 Summer St.	617-926-9720
Minn	St. Paul, Ragon Elctrns., 1136 W. Larpenteur Ave.	612-488-0201
NJ	Cherry Hill, Cramer/Penn, 12 Springdale Rd	609-424-5993
NJ	Somerset, Schweber Elctrns., 43 Belmont Dr.	201-469-6008
NM	Albuquerque, Cramer Elctrns., 137 Vermont N.E.	505-265-5767
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000

NY	Hauppauge, Cramer/Long Island, 29 Oser Ave.	516-231-5600
NY	Rochester, Cramer/Rochester, Inc., 3000 S. Winton Rd.	716-275-0300
NY	Syracuse, Cramer/Eastern, Inc., 6716 Joy Rd.	315-437-6671
NY	Westbury, Schweber Elctrns., Jericho Tnpk.	516-334-7474
NY	Woodbury, Harvey Elctrns., 60 Crossways Pk. W.	516-921-8700
NC	Raleigh, Resco, 701 Georgetown Rd.	919-832-2077
NC	Winston-Salem, Cramer/EW, Inc., 938 Burke St.	919-725-8711
Ohio	Cincinnati, Sheridan Assocs., Box 37826	513-761-5432
Ohio	Cleveland, Schweber Elctrns., 23880 Commerce Pk. Rd.	216-464-2970
Ohio	Columbus, Hughes-Peters, Inc., 481 E. 11th Ave.	614-294-5351
Pa	Philadelphia, Almo Elctrns., Roosevelt Blvd. at Blue Grass Rd.	215-676-6000
Tex	Dallas, Solid State Elctrns., 2643 Manana St., Box 20299	214-352-2601
Tex	Houston, Hamilton/Avnet Elctrns., 1216 W. Clay St.	713-526-4661
Utah	Salt Lake City, Cramer Elctrns., 391 West 2500 South	801-487-4131
Wash	Seattle, Liberty Elctrns./NW, 5305 Second Ave., S.	206-763-8200
For:	Can., Downsview, Ont., Cesco Elctrns., 24 Martin Ross Ave.	416-661-0220
For:	Can., Montreal, Cesco Elctrns., 4050 Jean-Talon St., W.	514-735-5511

CORNING GLASS WORKS, FLUIDIC PRODUCTS, Corning, N.Y., 14830, Tel: 607-974-8311, TWX: 510-252-1595; Empl.: 8000; Minimum order: $30

For info on price: S. Gunn 607-974-8467; Application info: L. Roueche 607-974-8674; Customer service: S. Gunn 607-974-8467; Delivery info: S. Gunn 607-974-8467

Free literature available: Complete technical information on fluidic elements, peripheral equipment, systems and circuits plus a wide variety of applications information.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Controls/Control Eqpt., Converters, Counters; Detectors, Kits, Breadboarding (For Engineers), Kits, Training Aid, Modules, Logic, Encapsulated, Shift Registers, Switches, Timers, Transducers

CORNING GLASS WORKS, Memory Prods Dept., 3900 Electronic Dr., Raleigh, N.C., 27602, Tel: 919-876-1100, TWX: 510-928-1840; Empl.: 25

For info on price: H. S. Craumer; Application info: H. S. Craumer; Customer service: W. L. Brown; Delivery info: W. L. Brown

Free literature available: MCA 5.02 - Glass Delay Lines for Video Processing, MCA 5.03 - Low Cost 1H Video Delay Line, MCA 5.04 - High Performance Video Delay Line; MAN 4 - Sharpening TV Pictures With Video Delay Lines; 1H & 2H - Video Delay Line Questionnaire For Custom Designed Video Delay Lines.

Products manufactured: Delay Lines

CORNING GLASS WORKS, Corning Scientific Instruments, Medfield, Mass., 02052, Tel: 617-359-2341; Empl.: 8000

Products manufactured: Meters, Recorders

CORNING GLASS WORKS, Tech. Prods. Div., Corning, N.Y., 14830, Tel: 607-974-9000, TWX: 510-252-1384; Empl.: 34,000

For info on price: J. R. Dalle Pezze 607-974-7237; Application info: N. S. Kenny 607-974-7562

Free literature available: Brochures: (1) VYCOR BRAND GLASSES (2) DATA SHEILD PRECISION TAPE REEL (3) MACHINABLE GLASS-CERAMIC (4) CERCOR GLASS-CERAMIC HEAT EXCHANGER CORES (5) FUSED SILICA (6) MODEL CH-40 RADIANT PANEL HEATERS (7) HEAT EXCHANGERS (8) PROPERTIES OF GLASSES AND GLASS-CERAMICS

Products manufactured: Antennas, Bushings, Glass, Plastic, Metal, Rubber, Etc., Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Heat Exchangers & Systems, Heaters & Heating Elements, Honeycomb Sheets, Panels, etc., Lenses, Optical & Camera, Quartz, Fused, Seals, Silica, Fused, Substrates, Tape Recording Accessories, Thermocouples, Elements & Accessories, Tubing

Local Sales Offices & Reps.

Cal	Orange, Corning Glass Works	714-541-5275
Cal	Palo Alto, Corning Glass Works	415-328-7400
Ill	Chicago, Corning Glass Works	312-337-6600
NY	New York City, Corning Glass Works	212-752-1100

CORNING GLASS WORKS, TELEVISION PRODS. DIV., Corning, N.Y., 14830, Tel: 607-974-8600, TWX: 510-252-1595; Empl.: 8000

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Compounds, Encapsulating, Insulating, Molding, Potting, Fiber Optic Bundles, Indicators, Insulators & Insulation, Mounts, Quartz, Fused, Seals, Silica, Fused, Spacers, Substrates, Tubing, Waveguides & Adapters

CORTEC, INC., 890 Production Pl., Newport Beach, Cal., 92660, Tel: 714-642-1877; Empl.: 27; Minimum order: $15

Customer service: A. Herbert

Free literature available: Cortec manufactures powdered iron cores for R.F. applications.

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Cores, Magnetic

Local Sales Offices & Reps.

Cal	Orange, Sls & Mktg. Assoc.	714-997-5720
Cal	Santa Clara, Rodgers	408-984-8110
Minn	St. Paul, Knox Assoc.	612-488-5402
NJ	Old Bridge, S.E.A. Co.	201-679-8800
NY	Buffalo, J.R. Henderson	716-634-8650
NC	Charlotte, McLean Sls.	704-366-2675

COSAR CORP., 3121 Benton St., Garland, Tex., 75042, Tel: 214-276-9487, Telex: 730-764; Empl.: 50

For info on price: J. D. Peterson; Application info: J. D. Peterson; Customer service: B. Milner; Delivery info: B. Milner

Free literature available: Twenty-page ZESTRON Reed Relay Catalog has sections on dynamic characteristics, load considerations, contact protection and reliability as well as detailed product data.

Products manufactured: Densitometers, Electronic, Relays, Testers

Local Sales Offices & Reps.

Cal	Fullerton	714-992-4690
Conn	Greenwich	203-661-2325
Ill	Chicago	312-539-6181
Tex	Dallas	214-276-9487

COSMO ELEC. LTD., 2145 Marion Pl., Baldwin, N.Y., 11510

COSMO PLASTICS CO., 3239 W. 14th St., Cleveland, Ohio, 44109, Tel: 216-861-5594, TWX: 810-421-8444; Empl.: 500

For info on price: D. Haft; Application info: R. G. Bumm; Customer service: D. Haft; Delivery info: D. Haft

Free literature available: Catalog/design manual covers bobbin-terminal assemblies, material specifications, terminal designs. Lists specifications of over 1000 transformer, pot core, reed relay, IF, rectangular, round bobbins.

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms

Local Sales Offices & Reps.

Ariz	Phoenix, Electrical Specialty Co.	602-275-5736
Cal	Los Angeles, Electrical Specialty Co.	213-724-9600
Cal	San Diego, Electrical Specialty Co.	714-239-1345
Cal	So. San Francisco, Electrical Specialty Co.	415-589-9611
Colo	Denver, Electrical Specialty Co.	303-321-0226
Conn	Guilford, R.H. Whitehead Jr. & Assocs.	203-453-3762
Ill	Chicago, A.J. Ellis Co.	312-262-2708
Ind	Fort Wayne, Blind & Assocs.	219-748-7705
Ind	Indianapolis, Blind & Assocs.	317-251-1249
Md	Timonium, Heller Sls. Co.	301-252-4780
Mass	Boston, Whitehead Assocs.	617-542-7676
Minn	Minneapolis, Ladky Assocs. of Minn.	612-884-2125
Mo	Webster Grove, Hippler Sls. Co.	314-961-8499
NJ	Morristown, Andrews & Andrews, Inc.	201-569-8800
NY	Huntington, Andrews & Andrews, Inc.	516-692-8686
NY	Rochester, P.J. Andres	716-271-2201
Ohio	North Olmsted, Plus Sls., Inc.	216-734-8989
Ore	Portland, Electrical Specialty Co.	503-227-3601
Pa	Ardmore, R.D. Freedman Assocs.	215-649-3679
Tenn	Knoxville, T.S. Stone Co.	615-546-9282
Utah	Salt Lake City, Electrical Specialty Co.	801-487-9805
Va	Roanoke, A.B. Kreger, Jr.	703-989-4738
Wash	Seattle, Electrical Specialty Co.	206-682-3434

COTO-COIL CO., 65 Pavilion Ave., Providence, R.I., 02905, Tel: 401-467-4777; Empl.: 110 .... p. 1•1618-1623

Products manufactured: Coils Including Assemblies & Forms, Relays, Switches

Local Sales Offices & Reps.

Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Cal	Pasadena, P. Nurches Co.	213-681-8957
Conn	Plantsville, Parnetics Co.	203-628-9343
Ill	Lombard, Quadtron Assocs.	312-627-6800
NY	Brooklyn, Eastern Elctrn. Sls.	212-763-5180
Ohio	Cleveland, J. Olsen Co.	216-752-5444
Wash	Seattle, H. Levinson Co.	206-323-5100

COUCH S.H. DIV., ESB Inc., 36 River St., Boston, Mass., 02126, Tel: 617-298-4147; Empl.: 203

Products manufactured: Relays

Local Sales Offices & Reps.

Ariz	Scottsdale, Mercury Engrg. Sls.	602-945-1927
Cal	Burbank, TransDynamics, Inc.	213-849-6261
Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Cal	San Diego, TransDynamics, Inc.	714-298-8215
Colo	Denver, I.W. Strong & Assocs.	303-292-6900
Conn	Madison, A&M Elctrn. Reps.	203-245-1031
Fla	Orlando, Buchanan & Abrams Assocs.	305-898-7444
Ill	Wheaton, H.J. Batha Co.	312-668-4740
Iowa	Cedar Rapids, Snider Sls. Co.	319-326-4410
Mass	Needham, A&M Elctrn. Reprs.	617-444-8170
Mich	Grand Rapids, Elko Sls. Corp.	616-959-1451
Mich	Grosse Pointe Woods, Elko Sls. Corp.	313-884-7893
Minn	Minneapolis, International Sls. Co.	612-831-8423
Mo	St. Louis, Pem Sls. Co.	314-427-7200
NY	Rochester, J.G. Welch	716-244-1100
NY	Syracuse, H.R. Murray, Inc.	315-446-5555
NC	Winston-Salem, Radco Co.	999-722-9671
Ohio	Cincinnati, Phister Equip. Co.	513-421-3850
Ohio	Cleveland, Greenleaf & Assocs.	216-333-5480
Ore	Portland, J.W. Eckersley Co.	503-246-3183
Pa	Philadelphia, Technicraft Co.	215-483-4700
Tex	Dallas, Hillman Entprs.	214-827-4790

COUNTERSCAN SYSTEMS, Box 536, Sutton, Neb., 68979, Tel: 402-773-3875; Empl.: 100

Customer service: Mktg. Mgr.

Free literature available: Literature describes multiplexing and interconnect systems including interface adjustments, matching, considerations. Describes sophiaticated data switching systems - State of the Art Equip.

Products manufactured: Controllers, Programmable, Counters, Data Acquisition & Reduction Systems, Multiplexers, Scanners, Switches

Advertisment

Manufacturer of sophisticated backplane and wiring harness test equipment. Uses a self contained microprocessor with an internal electrically reprogrammable LSI-MOS memory and all CMOS integrated circuit construction. Complete with printer, mating connectors - Capacities to 768 K points. Modest Cost. Call Collect for info.

COUNTIS INDS., Box 1444, San Luis Obispo, Cal., 93406, Tel: 805-544-1770; Empl.: 9

Products manufactured: Ferrite Material & Parts

COX & CO., INC., 215 Park Ave., S., New York, N.Y., 10003, Tel: 212-OR 4-4727, TWX: 710-581-2839; Empl.: 85

Products manufactured: Adhesives (All Types), Baths, Controlled Temperature (Air & Liquid), Bridges, Cable, Chamber, Environmental Test, Controls/Control Eqpt., Heaters & Heating Elements, Indicators, Laminates, Monitors, Ovens, Probes, Relays, Resistors, Standards, Switches, Thermistors, Thermostats, Transducers, Wire

Local Sales Offices & Reps.

Cal	Palos Verdes Penninsula, J. E. Scott	213-377-9761

Directory of Local Distributors Starts on page 401

NY	Syracuse, Lenard Co.	315-GR 9-9191
Vt	Vergennes, M. Benton	802-877-2656
Wash	Mukilteo, J. Ransom	206-775-5431

CPS INC., DISPLAY GRP., 722 E. Evelyn Ave., Sunnyvale, Cal., 94086, Tel: 408-738-0530, Telex: 357-450; FSC No: 31640; Empl.: 62; Minimum order: $25 .... p. 1•1162,1163

Customer service: J. Gwinner

Free literature available: Beam penetration CRT, Color Monitor Catalog.

Products manufactured: Monitors, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	Los Angeles, Basic Systems	213-938-2833
Cal	Sunnyvale, AMASCO	408-733-8690
Fla	Melbourne, REPCOM	305-254-1877
Md	Baltimore, Scientific Devices	301-788-6611
Mass	Burlington, Tekdata	617-273-0198
Minn	Minneapolis, Jaynus	612-884-1700
NJ	Palisades Park, Scientific Devices-East	201-871-3916
Pa	Audubon, Holmes	215-666-0636
Tex	Dallas, Data Aids	214-620-1551
Va	Springfield, Scientific Devices-DC	703-451-6500
Wash	Seattle, Underwood/Jensen	206-575-0123

CPS INC. - POWER SUPPLY GRP., 722 E. Evelyn Ave., Sunnyvale, Cal., 94086, Tel: 408-738-0530, Telex: 357-450; FSC No: 31640; Empl.: 62; Minimum order: $25 .... p. 1•1162,1163

Customer service: J. Gwinner

Free literature available: High Voltage Power Supply Catalog to 50 kv DC.

Products manufactured: Connectors, Converters, Power Supplies, Probes

Local Sales Offices & Reps.

Cal	Los Angeles, Basic Systems	213-938-2833
Cal	Sunnyvale, AMASCO	408-733-8690
Fla	Melbourne, Repcom	305-254-1877
Ill	Northfield, Torkelson Associates	312-446-9085
Ind	Indianapolis, Torkelson Associates	317-244-7867
Md	Baltimore, Scientific Devices-DC	301-788-6611
Mass	Burlington, Tekdata Inc.	617-273-0198
Mich	Center Line, Dietrich	313-754-6450
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
NJ	Palisades Park, Scientific Devices-East	201-871-3916
NY	N. Syracuse, NACO	315-699-2651
Ohio	Cleveland, Dietrich & Assocs.	216-781-1855
Pa	Audubon, Holmes Assocs.	215-666-0636
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
Tex	Irving, Space Elctrns.	214-251-2266
Va	Springfield, Scientific Devices-DC	703-451-6500
Wash	Seattle, Underwood/Jensen	206-575-0123

CRAIG SYS. CORP., 360 Merrimack St., Lawrence, Mass., 01842, Tel: 617-688-6961, TWX: 710-342-0765; Empl.: 200

Customer service: R. Noebel

Free literature available: Our literature describes general purpose mobile shelters, transporters and some shelter accessories used to house communication, radar, teletype and other systems requiring mobility.

Products manufactured: Antenna Towers & Supports, Benches, Consoles, Stools, Tables, Cases, Equipment, Instrument, Meter, Cases, Transit, Containers, Frames, Cabinet & Rack, Kits, Shielding, Mounts, Racks, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Fullerton, Craig Sys. Corp.	714-879-3180
Md	Rockville, W. F. Frank Assoc.	301-340-7717
Minn	St. Paul, Debeck Assoc.	612-690-1557
Pa	York, N. R. Osborne Assoc.	717-755-2114

CRAMER COIL, Box 32, Grafton, Wisc., 53024; Empl.: 35; Minimum order: $25

Customer service: R. Rubinstein 414-377-7040

Free literature available: R.F. Coils, power transformers, balun coils.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Component Mktg.	
Colo	Aurora, Robbins & Assoc.	
Ill	Park Ridge, Metcom Assoc.	
Ind	Greenwood, Valentine & Schillinger	
Ind	South Bend, Valentine & Schillinger	
Mass	Brookline, Technology Prods. Group	
Minn	Minneapolis, OEM Sls. Co.	
Neb	Lincoln, Mktg. Assoc.	
NJ	Teaneck, Abbott Gordon	
Pa	Erie, Tuznik Assoc.	
Wash	Seattle, F. Jackson C.	
FOR:	Can., Oakville, Ont., Danowski Sls. Ltd.	

CRAMER DIVISION, Conrac Corporation, Old Saybrook, Conn., 06475, Tel: 203-388-3574, Telex: 966-453; Empl.: 350 .... p. 1•143,943

Customer service: C. R. Gasparini

Products manufactured: Alarms, Monitors, Motors, Tape Recording Accessories, Tape Search Equipment, Tapes, Recording, Magnetic (All Types), Timers

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins-Co.	205-539-1771
Ariz	Phoenix, Spectrum Assocs.	602-997-6324
Cal	Palo Alto, Held & Mollard	415-965-9321
Cal	Santa Ana, Spectrum Assocs.	714-835-4114
Cal	Santa Fe Springs, Conrac Security Detection	213-945-2673
Colo	Denver, I.W. Strong & Assoc.	303-292-6900
Conn	Rocky Hill, Aid Engrg. Sls. Co.	203-673-3692
Fla	Orlando, Col-Ins-Co.	305-423-7615
Ga	Clarkston, Col-Ins-Co.	404-934-7280
Ill	Arlington Heights, Martec Assocs.	312-956-8090
Ind	Indianapolis, Sukup & Cox	317-253-1215
Md	Rockville, L.G. White & Co.	301-770-6556
Mass	Westboro, Aid Engrg. Sls. Co.	617-890-8181
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Minn	Minneapolis, Jos-Co. Sls. Engrg.	612-835-5858
Mo	St. Louis, H.J. Weisler & Assoc.	314-428-3934
NY	Elmsford, Cramer Div./Conrac Corp.	914-592-5500
NY	Rochester, Upstate Comp. Sls.	716-288-1080
NC	Raleigh, Col-Ins-Co.	919-834-6591
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Pa	Broomall, J.C. Whiddett Co.	215-353-6343
Tex	Dallas, Glidden Electro Equip. Co.	214-363-6539
Wash	Mercer Island, J.H. Andersen Assocs.	206-232-0484

CRATEX RUBBERIZED ABRASIVES, 1600 Rollins Rd., Burlingame, Cal., 94010, Tel: 415-697-1600; Empl.: 19

Free literature available: Catalog/price list describing Cratex rubberized abrasive wheels, points, blocks, sticks, and cones for light deburring, smoothing, cleaning, and polishing.

Products manufactured: Abrasive Belts, Compounds, Cords, Powders, etc.

CREST INDUSTRIES, INC., Box 35, Northbrook, Ill., 60062, Tel: 312-272-2440; Empl.: 10; Minimum order: $35

Customer service: P. Taylor

Free literature available: Short form catalog available describing crest prewired power strips and A.C. distribution Panels. Full catalog & distributor or industrial price list available on request.

Products manufactured: Boxes, Junction, Outlets & Wall Plates

Local Sales Offices & Reps.

Ariz	Tempe, J.F. Hurlbut Co.	602-968-5962
Cal	Carson, Bidwell Sls. Assocs.	213-770-0300
Cal	Redwood City, Warren & Hickey Sls. Co.	415-368-3849
Colo	Golden, J.F. Hurlbut Co.	303-279-7138
Fla	St. Petersburg, C.M. Furman Co.	813-898-8864
La	New Orleans, IBL Engrg. Co.	504-895-4793
Md	Baltimore, B. White & Co., Inc.	301-484-5400
Minn	Minneapolis, A.S. Miller & Son	612-866-6677
NY	Buffalo, M. Farber Assocs., Inc.	716-856-3543
NY	Oceanside, Bittan Assocs., Inc.	516-678-6222
NC	Charlotte, C.M. Furman Co.	704-375-2332
Okla	Tulsa, IBL Engrg. Co.	918-936-6305
Tex	Dallas, IBL Engrg. & Sls., Inc.	214-363-2921
Tex	Houston, IBL Engrg. & Sls., Inc.	713-467-5115
Wisc	Milwaukee, W.M. Braun & Assts.	414-332-1040

Advertisment

Crest "Prewired" Power Strips and A. C. Distribution Panels are designed for quality installations featuring all UL approved components. Reduce Internal Wiring in your Rack Cabinet by installing a Crest Prewired Power Strip or Power Panel. Send for your free catalog.

CRESTRONICS INC., 23539 Crest Forest Dr., Box "S", Crestline, Cal., 92325, Tel: 714-338-1722; Empl.: 11

Products manufactured: Converters, Power Supplies

CRM DIV., See Consolidated Refining Co.

CROSS ELECTRONICS INC., 100 Commonwealth Dr., Warrendale, Pa., 15086, Tel: 412-776-1591; Empl.: 35

For info on price: F. C. Stebbins; Application info: T. S. Roman; Customer service: D. Heddaeus; Delivery info: R. Heddaeus

Free literature available: 1 SCR proportional power controllers 2 Temperature controllers 3 Static relays 4 signal conditioners 5 static contactors 6 magnetic amplifiers & reactors 7 systems
8 electronic assemblies 9 electrical assemblies 10 mechanical assemblies 11 wiring harnesses 12 parts & subassemblies

Products manufactured: Amplifiers, Cable Assemblies & Harnesses, Coils Including Assemblies & Forms, Controllers, Programmable, Controls/Control Eqpt., Current Sensors, Isolators, Power Supplies, Reactors, Regulators, Relays, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Newcomb Assocs.	205-852-0304
Fla	Winterpark, GPI Instrs.	305-831-6215
Md	Bethesda, S & S Assocs.	301-654-1434
Mo	St. Louis, Wm. Adler Assoc.	314-423-7200
NY	N. Syracuse, KLM Assocs.	315-458-6214
NY	New Hartford, KLM Assocs.	315-735-8525
NY	Rochester, KLM Assocs.	716-442-0820
NY	Roslyn Heights, TRAVCO Assoc.	516-621-3223
NC	Research Triangle Park, Newcomb Assocs.	919-467-6248
Pa	King of Prussia, S & S Assocs.	215-265-3450
Tex	Richardson, Concept Sls. Inc.	214-387-1434

CROVEN, LTD., 500 Beech St., Whitby, Ont., Can., Tel: 416-668-3324, TWX: 610-384-2750; QPL No: Multiple; Empl.: 250 .... p. 1•300,301

For info on price: R. A. McCormick; Application info: R. A. McCormick; Customer service: J. Bates; Delivery info: G. Rankine

Free literature available: Quartz, Crystal Catalogue

Products manufactured: Circuit Breakers, Crystal Blanks, Crystals, Filters, Oscillators

Local Sales Offices & Reps.

Cal	San Mateo, Melvin Sls. Co.	415-349-7444
Cal	Sepulveda, R.L. Assocs.	213-892-5386
Cal	Van Nuys, R.L. Assocs.	213-782-7826
Mass	Sherborn, Naton Assoc.	617-986-6417
FOR:	Can., Que., Montreal, Ben Manis Assocs.	514-336-4500

CROWN INTERNATIONAL, Box 1000, Elkhart, Ind., 46514, Tel: 219-294-5571, TWX: 810-294-2160; Empl.: 175 .... p. 1•14,15

Products manufactured: Amplifiers, Analyzers, Controls/Control Eqpt., Dials, Duplicators, Recorders

Local Sales Offices & Reps.

Conn	Woodbridge, Elctrn. Mktg.	203-397-1461
Ga	Atlanta, Fidelicom	404-458-3616
Ill	Chicago, P. Berndt Assocs.	312-283-0713
Md	Gaithersburg, Wright Co.	301-948-5151
Mich	Ferndale, Shalco	313-547-4771
Minn	St. Paul, Skor	612-645-6461
NJ	Parlin, JMR Sls., Inc.	201-727-5335
NY	E. Rochester, RJC Assoc.	716-385-2521
NY	Rochester, Ossmann	315-437-6666
Ohio	Dayton, Ashby Assocs.	513-252-5627

CRYDOM CONTROLS, Int'l. Rectifier, 1521 Grand Ave., El Segundo, Cal., 90245, Tel: 213-322-4987

For info on price: L. Bringle; Application info: J. Weiss; Customer service: L. Bringle; Delivery info: L. Bringle

Free literature available: Crydom photo-isolated solid-state power relays-contains technical info and application data for solid/state relays from 2.5A to 40A and voltages of 120, 240 and 480 V. AC.

Products manufactured: Relays

Local Sales Offices & Reps.

Ala	Birmingham, Com-Trol Corp.	205-823-0897
Ariz	Scottsdale, Williams-Assocs	602-947-4297
Cal	San Diego, Southwest Tech. Sls.	714-565-2295
Cal	Santa Clara, T. Hartman Assoc.	408-247-1252
Cal	Tustin, Morgan Johnson Co.	714-832-7282
Colo	Denver, Williams-Assocs.	303-373-4730
Conn	Ridgefield, W. Johnson Co.	203-438-3351
Fla	Ft. Lauderdale, N. Bredesen	305-566-3289
Kans	Overland Park, Dy-Tronix	816-761-6543

Kans	Wichita, Dy-Tronix	316-943-6221
Md	Rockville, Marktron Inc.	301-762-6210
Md	Timonium, Marktron Inc.	301-252-7111
Mass	Norwood, JMG, Inc.	617-762-5333
Mich	Bloomfield Hills, Roth Ind'l Sls.	313-626-3171
Minn	St. Paul, Repor	612-645-8618
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Ridgewood, Ballou Inc.	201-444-6990
NM	Albuquerque, Williams-Assocs.	505-255-1638
NY	Buffalo, R. W. Mitscher Co.	716-633-7970
NY	New York City, Ballou Inc.	212-964-4640
NC	Raleigh, R. W. Mitscher Co.	919-828-0575
Ohio	Aurora, EMA Inc	216-562-6104
Ohio	Centerville, EMA Inc.	513-433-2800
Okla	Tulsa, W. Pat Fralia Co.	918-663-8707
Ore	Beaverton, Vantage Corp.	503-644-6111
Pa	Bala Cynwyd, J. V. Calhoun Co.	215-839-3000
Pa	Erie, F. McClinton	814-455-9111
Pa	Pittsburgh, F. McClinton	412-561-4803
Pa	Scranton, J. V. Calhoun Co.	717-587-1164
Pa	York, J. V. Calhoun Co.	717-244-4597
Tenn	Shelbyville, R. W. Mitscher Co.	615-684-4544
Tex	Ft. Worth, W. Pat Fralia Co.	817-738-2394
Tex	Houston, W. Pat Fralia Co.	713-772-1572
Va	Charlottesville, Marktron Inc.	804-973-5874
Wash	Bellevue, Vantage Corp.	206-455-3460
WVa	Huntington, F. McClinton	304-736-5161
Wisc	Racine, KMG Sls Co.	414-639-9005

CRYSTAL NETWORK PRODS. CORP., 818 Parade St., Erie, Pa., 16503, Tel: 814-459-2351; Minimum order: $100

For info on price: R. H. Tuznik; Application info: J. T. Tuznik; Customer service: R. K. Tuznik; Delivery info: R. K. Tuznik

Products manufactured: Crystals, Discriminators, Filters, Oscillators

CRYSTAL TECHNOLOGY, 2510 Old Middlefield Way, Mountain View, Cal, 94043, Tel: 415-961-9311; Empl.: 30; Minimum order: $100

Customer service: R. L. Carlson

Free literature available: Growth and fabrication of single crystal oxides, including lithium niobate, lithium tantalate, tellurium dioxide, BSO, BGO, and GGG. Fabrication of transducers and surface acoustic wave delay lines.

Products manufactured: Crystals, Delay Lines, Modulators, All Kinds, Transducers

Local Sales Offices & Reps.

Ill	Chicago, Brooks Engrg. Co.	312-944-1227
Md	Silver Spring, Spectro Sys.	301-949-8261
Mass	Billerica, Drew Associates	617-667-6643
NJ	E Windsor, Cook & Weil, Inc.	609-448-7409
NY	New York, Cook & Weil	212-741-1053

CRYSTEK CRYSTALS
CORPORATION
A Whitehall Company

CRYSTEK CRYSTALS CORP., 1000 Crystal Dr., Ft. Myers, Fla., 33901, Tel: 813-936-2109; Empl.: 2500

For info on price: L. Stacey; Application info: J. Case; Customer service: A. Whidden; Delivery info: L. Stacey

Free literature available: New Quartz Crystal Catalog includes application notes, definitions, specification charts, graphs and ordering information.

Products manufactured: Crystal Blanks, Crystals

Local Sales Offices & Reps.

Ala	Birmingham, H. W. Phillips Co., Inc.	205-655-8415
Ark	Little Rock, Schoonmaker	501-375-2168
Cal	Los Angeles, Crystek Crystals Sls. Office	714-936-8055
Cal	San Francisco, J.E. Stricker Co.	415-342-1425
Colo	Denver, KC Marketeers	303-733-5561
DC	Washington, Sonny Simberkoff Assocs., Inc.	703-525-5898
Fla	Ft. Lauderdale, Sprock Sls., Inc.	305-587-3792
Fla	Sarasota, Sprock Sls.	
Ga	Atlanta, H. W. Phillips Co., Inc.	404-252-0720
Ill	Chicago, Cummings & Foley Sls., Co.	312-725-8110
Ind	Indianapolis, Shamrock Elctrn. Sls.	317-251-5527
Iowa	Des Moines, Kathrinus-Kelly & Co.	515-255-4584
Kans	Kansas City, Kathrinus-Kelly & Co.	913-722-0000
Mass	Boston, Data Memory Assocs.	617-868-3120
Mich	Detroit, RC Merchant & Co.	313-535-6000
Mich	St. Joseph, RC Merchant & Co.	616-983-7378
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, Kathrinus-Kelly & Co.	314-968-3800
NJ	South Orange, Sonny Simberkoff Assocs., Inc.	201-763-7900
NY	Buffalo, Sonny Simberkoff Assocs., Inc.	716-834-8119
NY	New York City, Sonny Simberkoff Assocs., Inc.	212-943-7023
NC	Burlington, Sonny Simberkoff Assocs., Inc.	919-584-6450
Ohio	Akron, Shamrock Elctrn. Sls.	216-666-1400
Ohio	Dayton, Shamrock Elctrn. Sls.	513-298-3052
Okla	Tulsa, Schoonmaker Co.	918-936-1423
Ore	Portland, EBCO	503-245-2283
Pa	Philadelphia, Sonny Simberkoff Assocs., Inc.	215-455-9579
Pa	Pittsburgh, Shamrock Elctrns. Sls.	
Tex	Dallas, Schoonmaker Co.	214-357-8481
Tex	Houston, Schoonmaker Co.	713-926-9510
Va	Arlington, Sonny Simberkoff Assocs., Inc.	703-525-5898
Wash	Seattle, EBCO	206-284-1121
FOR:	Can., Toronto Ont., Fanon Elctrns.	416-363-5011

CTS CORP., 905 N. West Blvd., Elkart, Ind., 46514, Tel: 219-293-7511, TWX: 810-294-2167; Empl.: 6100

Free literature available: New 12-page Short Form Catalog for Expanding CTS Industrial Distributor Product Line. The handsome two-color, 12-page catalog pictures and describes capabilities of: 53 types of CTS cermet, carbon, and wirewound trimmers and potentiometers.
36 choices of CTS 1-1/16" diameter Rotary Selector Switches and an additional 20 miniature 13/16" diameter Selector Switches. 101 values of six or 8 lead single-in-line resistor networks. 126 values of CTS 14 or 16 lead DIP resistor networks.
7 new DIP programmable switches. Distributor quantity prices are included for each product line. Write: J.C. Wells, Distributor Sales Manager, CTS Corporation, 905 North West Boulevard, Elkhart, Indiana 46514. Phone: (219) 293-7511.

Products manufactured: Circuits, Hybrid, Thick Film, Controllers, Programmable, Controls/Control Eqpt., Controls, Fader, Converters, Crystal Blanks, Crystals, Discriminators, Filters, Hybrid Voltage Regulators, Networks, Oscillators, Ovens, Potentiometers, Power Drivers, Hybrid (High Current, High Voltage), Resistors, Rheostats, Speaker Systems, Speakers, Standards, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Interep Assocs.	205-881-3677
Ariz	Phoenix, Hecht, Henschen & Assocs.	602-275-4411
Cal	Burlingame, Logan & Assocs.	415-697-6100
Cal	South Pasadena, CTS Corp.	213-682-1137
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	North Haven, Comp Rep Assocs.	203-239-9762
Fla	Cocoa, Orbe, Inc.	305-452-9568
Fla	Ft. Lauderdale, Orbe, Inc.	305-564-8571
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ga	Atlanta, Interep Assocs.	404-394-7756
Ind	Elkhart, CTS Corp.	219-293-7511
Iowa	Marion, Thomas & Modrcin Assocs.	319-377-6261
Kans	Shawnee Mission Thomas & Modrcin Assocs.	913-432-2131
Md	Baltimore, Coulbourn DeGreif, Inc.	301-247-4646
Mass	Needham, Comp Rep Assocs.	617-444-2484
Mich	Grand Rapids, J.L. Montgomery, Inc.	616-774-9308
Mich	Southfield, J.L. Montgomery, Inc.	313-358-2616
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
Mo	Hazelwood, Thomas & Modrcin Assocs.	314-838-6446
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Jamaica, S-J Sales Assocs.	212-291-3232
NY	Syracuse, Nycom, Inc.	315-437-8343
NC	Raleigh, Component Sls.	919-782-8433
Ohio	Cincinnati, Baehr, Greenleaf & Assocs.	513-891-3827
Ohio	Cleveland, Baehr, Greenleaf & Assocs.	216-221-9030
Ohio	Upper Arlington, Baehr, Greenleaf & Assocs.	614-486-4046
Okla	Oklahoma City, Parvin Sls. Co.	405-942-4581
Pa	Fort Washington, G.C.M. Inc.	215-646-7535
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Tex	Addison, Parvin Sls. Co.	214-239-9148
Tex	Houston, Parvin Sls. Co.	713-721-1054
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Bellevue, SD-R2 Prods. & Sls.	206-747-9424
EXP:	Elkhart, Ind., CTS Corp.	219-293-7511
FOR:	Can., Streetsville, Ont., CTS of Canada, Ltd.	416-826-1141

CTS OF BERNE, 406 Parr Rd., Berne, Ind., 46711, Tel: 219-589-3111, TWX: 810-589-1580 ....p. 2•1421-1426

Customer service: J. Long

Products manufactured: Resistors

Refer to CTS Corp. for sales office information

CTS KNIGHTS, INC., 400 Reimann Ave., Sandwich, Ill., 60548, Tel: 815-786-8411 ....p. 1•303-311

Customer service: C. Mooibroek

Products manufactured: Crystal Blanks, Crystals, Discriminators, Filters, Oscillators, Ovens

Refer to CTS Corp. for sales office information

CTS MICROELECTRONICS, INC., 1201 Cumberland Ave., W. Lafayette, Ind., 47906, Tel: 317-563-2565, TWX: 810-342-1882 ....p. 1•888; p. 2•1622

Customer service: F. Leingang

Products manufactured: Circuits, Hybrid, Thick Film, Potentiometers, Power Drivers, Hybrid (High Current, High Voltage)

Refer to CTS Corp. for sales office information

CTS OF PADUCAH, INC., 1565 N. 8th St., Paducah, Ky., 42001, Tel: 502-442-1641, TWX: 510-546-1152; Empl.: 1000; Minimum order: $100

Customer service: G. Draffen

Free literature available: Catalog 50M-3-73 complete listing of all loudspeakers and do-it-yourself systems (complete with crossover networks) available for immediate shipment from CTS stock.

Products manufactured: Speaker Systems, Speakers

Local Sales Offices & Reps.

Ark	El Dorado, D. Ballew Sls.	501-863-8325
Cal	San Francisco, Meyer, Ross & Fleming	415-285-8880
Cal	Van Nuys, Markman Co.	213-787-6151
Colo	Denver, B & B Elctrn. Prods.	303-934-2123
Fla	Maitland, Hutto, Hawkins, Peregoy	305-831-2474
Ga	East Point, P. Hayden & Assocs.	404-766-0261
Ill	Oak Park, G. Petitt Co.	312-265-0342
Ky	Paducah, CTS of Paducah	502-442-1641
Md	Silver Springs, Mid Atlantic Sls.	301-593-7749
Mass	Boston, Anderson Sls. Assocs.	617-227-2980
Mich	Plymouth, J. Malcolm Flora	313-453-4296
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, Lowell-Kangas & Assocs.	314-821-4050
NJ	Caldwell, A. Cerf & Co.	201-226-2263
NY	Syracuse, W. Tauber Co.	315-446-7094
Ohio	Medina, T. Grant Assocs.	216-725-6528
Pa	Enon Valley, Nebco Assocs.	216-457-2333
Tex	Dallas, Collins Co.	214-341-7866
Wash	Bellevue, SDR&S2 Prods. & Sls.	206-747-9424
EXP:	Summit, N.J., N. Christensen Int'l. Mktg.	201-273-3833

CUBIC CORP., 9233 Balboa Ave., San Diego, Cal., 92123, Tel: 714-277-6780, TWX: 714-279-0267; Empl.: 2100

Customer service: T. Grady

Products manufactured: Antenna Feed Systems, Antennas, Boards, Programming, Comm. Systems, Data Acquisition & Reduction Systems, Interferometer Systems, Meters, Receivers, Simulators, Tracking Systems, Translators, Data, Transmission Systems, Data, Transmitters

CUNNINGHAM, Sub. Gleason Works, 10 Carriage St., Honeoye Falls, N.Y., 14472, Tel: 716-624-2000, TWX: 510-254-4202; Empl.: 108 ....p. 1•640,641,2012,2013

Customer service: G. Appleton

Free literature available: 8 page reprint for switching products line. Product wall chart for CCTV products line.

Products manufactured: Matrices, Computer, Monitors, Multiplexers, Scanners, Switches, Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Cal	Pasadena, Luscombe Engrg. Pasadena	213-684-2000
Cal	San Mateo, Luscombe Engrg. San Francisco	415-342-7057
Colo	Parker, Technology Mktg. Assocs.	303-841-3435
Conn	Hamden, Instr. Conslts.	203-288-5246
Ill	Des Plaines, Cozzens & Cudahy	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy	317-244-2456
Md	Bethesda, Bartlett	301-656-3061
Mass	Waban, Instrument Conslts., Inc.	617-969-9881
Minn	Minneapolis, Cozzens & Cudahy	612-884-4336

Mo	St. Louis, Cozzens & Cudahy	314-423-1234
NM	Albuquerque, Tech. Mktg. Assocs.	505-298-4321
NY	White Plains, Bartlett	914-949-6476
Pa	Wayne, Bartlett	215-688-7325
Tex	Houston, Scien. Sls.	713-666-5318
Tex	Richardson, Scien. Sls.	214-231-6541
Wash	Seattle, Delcom Sls. Co.	206-248-0090

CURTIS INDUSTRIES INC., 8000 West Tower Ave., Milwaukee, Wisc., 53223, Tel: 414-354-1500; Empl.: 160; Minimum order: $50 .... p. 2•666,667

For info on price: M. Schuman; Application info: R. Van der Elsen; Customer service: M. Schuman; Delivery info: M. Schuman

Free literature available: Terminal Block Catalog - Broad Range of Terminal Blocks for High Current, Control, and Electronic Applications. Relay Socket Catalog - Complete Line Covering Octul and Rectangular Base Relays.
Liquid Level Control Catalog - Complete Line Covering Sensitivity Ranges and Cost Ranges.

Products manufactured: Controls/Control Eqpt., Indicators, Sockets, Terminal Blocks, Boards & Strips, Timers

Local Sales Offices & Reps.

Ariz	Scottsdale, DeAngelo, Rothman, Cheever	602-948-2240
Cal	Los Altos, Ewing-Foley	415-941-4525
Cal	Santa Fe Springs, Sls. Engineers Ltd.	213-921-4337
Colo	Boulder, Comp. Prods. Sls.	303-444-2730
Fla	Lakeland, AA Electric Div. of AEC	813-682-6181
Ga	Atlanta, Holman-Lobsinger Co.	404-256-9120
Haw	Honolulu, Dougherty Entprs.	
Ill	Downers Grove, Richmar Elctrns. Corp.	312-968-0118
Ind	Indianapolis, Val-Skol Sls.	317-926-5063
La	New Orleans, W. Case & Assocs.	504-835-7713
Md	Woodbine, Naudain Assocs.	301-252-5378
Mass	Sturbridge, Electrical Apparatus Co.	617-347-7447
Mich	Farmington Hills, Electro-Matic	313-478-1182
Minn	St. Paul, Kenco Co.	612-645-7717
Mo	Hazelwood, Dy-Tronix	314-731-5799
Mo	Kansas City, Dy-Tronix	816-761-6543
NJ	Mount Laurel, Naudain Assocs.	609-235-1801
NY	Buffalo, Ossmann Comp. Sls.	716-832-4271
NY	Kingston, Ossmann Comp. Sls.	914-338-5505
NY	Rochester, Ossmann Comp. Sls.	716-442-3290
NY	Valley Cottage, LRC Assocs.	914-634-7973
NC	Winston-Salem, L.G. White & Co.	919-725-3612
Ohio	Cincinnati, Val-Skol Sls.	513-563-6790
Ohio	Cleveland, Val-Skol Sls.	216-526-2156
Ohio	Columbus, Val-Skol Sls.	614-291-4123
Okla	Tulsa, T.J. Ray Co.	918-627-1515
Pa	Philadelphia, Naudain Assocs.	215-564-3194
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
Tenn	Memphis, R.D. Thomas Co.	901-683-0341
Tex	Richardson, R.F. Kimball Co.	214-231-3447
Wash	Seattle, C.B. Parsons & Co.	206-762-7373
Wisc	Oak Creek, Richmar Elctrns.	414-475-0141
FOR:	Willowdale, Ont., Can., A.C. Simmonds & Sons, Ltd.	416-491-1010

Local Distributors

NY	Scarsdale, Logicomp Elctrns., Inc., 52 Lafayette Rd.	914-723-3334

CURTIS INSTRS., INC., 200 Kisco Ave., Mt. Kisco, N.Y., 10549, Tel: 914-666-2971, TWX: 710-571-2163; Empl.: 50; Minimum order: $40 .... p. 1•642,643

For info on price: R. MacDonald, 914-666-2971; Application info: E. Sands, 914-666-2971; Customer service: R. MacDonald, 914-666-2971

Free literature available: 2 booklets describing range of analog timers and counter and comparing them with digital types. 2 booklets describing Curtis line of integrating instruments featuring the unique infinite memory integrator.

Products manufactured: Counters, Indicators, Integrators, Electronic, Meters, Testers, Timers

Local Sales Offices & Reps.

Cal	Milbrae, Polach & Bensinger, Inc.	415-697-2525
Cal	Seal Beach, Texel Engrg.	213-596-9411
Colo	Boulder, R.G. Entprs.	303-447-9211
Ill	Elmhurst, Schuten Assocs.	312-833-0980
Ind	Ft. Wayne, McDonald Sls. Co.	219-743-4611
Mass	Brookline, Harman Assocs.	617-232-6687
Mo	St. Louis, Fixman Engrg.	314-725-5219
NM	Albuquerque, Goyne, Assocs. Inc.	505-765-8794
NY	Syracuse, Rep. Tech., Inc.	315-437-2845
NC	Winston-Salem, Radco Engrg.	919-722-9671
Pa	Media, W. Reeves Assocs., Inc.	215-LO 6-6709
Va	Arlington, Gans Fryling, Inc.	703-527-3262
Wash	Seattle, Blum & Assocs.	206-782-1600
Wisc	Milwaukee, Star Engrg. Co.	414-645-3680

CUSH CRAFT CORP., 621 Hayward St., Manchester, N.H., 03103, Tel: 627-7877; Empl.: 30; Minimum order: $50

For info on price: R. Cushman; Application info: R. Cushman; Customer service: J. C. Arsenault; Delivery info: J. C. Arsenault

Products manufactured: Antenna Feed Systems, Antennas, Arresters, Electrical Surge, Lightning

Local Sales Offices & Reps.

Alas	Anchorage, H. J. Lang & Assoc.	907-279-5741
Cal	Los Angeles, Wallace & Wallace	213-744-0401
Cal	San Francisco, Feathenstone Sls. Co.	415-467-3133
Colo	Aurora, AES Sls. Co.	303-366-0208
Fla	Hollywood, E. Healy	305-961-6640
Ga	Jonesboro, E. Clanton	404-471-6297
Kans	Shawnee Mission, Lowell Kangas & Assoc.	913-631-3515
Mo	St. Louis, Lowell Kangas-Assoc.	314-821-4050
NY	Farmingdale, Chester Drexler Co.	516-249-8206
NC	Kernersville, M. F. Motsinger Jr.	919-993-3993
Ohio	N. Jackson, Ohio Assocs.	216-538-3215
Ore	Portland, Jud LeBrun Co.	503-244-6805
Pa	Philadelphia, Herman Lewis Co.	215-567-5020
Tenn	Memphis, A. F. Howard	901-682-2281
Tex	Dallas, Collins Co.	214-341-7866
EXP:	Chicago, E. D. Magnus Assoc.	312-334-1503

CUSTOM CABLE CO., 3325 Royal Ave., Oceanside, N.Y., 11572, Tel: 516-536-0300; Empl.: 3

Customer service: J. Michelman

Products manufactured: Braid, Cable, Cable, Wire

CUSTOM COIL & TRANSFORMER CO., Box 2624, Zanesville, Ohio, 43701, Tel: 614-452-6973; Empl.: 75

For info on price: D. Young; Application info: D. Young; Customer service: D. Young; Delivery info: R. Tilton

Products manufactured: Chokes, Coils Including Assemblies & Forms, Transformers

CUSTOM CONNECTOR CORP., 1738 E. 30th St., Cleveland, Ohio, 44114, Tel: 216-241-1679; Empl.: 36; Minimum order: $25

For info on price: D. G. Harper; Application info: J. R. Crosby; Customer service: D. Jones; Delivery info: D. Jones

Free literature available: Relay Socket Catalog

Products manufactured: Sockets

Local Sales Offices & Reps.

Cal	Downey, Sierra-Pacific Engrg, Inc.	213-928-1815
Colo	Aurora, Comp. Specialties	303-341-0160
Ill	Chicago, Control Sls.	312-296-5595
Mass	Norwell, Bordewieck Engrg. Sls. Co.	617-659-4915
Mo	St. Louis, Control Design	314-426-3150
NJ	Edison, Burgoyne Elec. Sls.	201-225-0450
NJ	Mt. Laurel, J. G. Speck Assoc.	609-234-4957
NY	Baldwinsville, Scibetta Reps.	315-622-3993
NC	Charlotte, J. Rudisill Assoc.	704-377-6901
Pa	New Kennsington, J. G. Speck Assoc.	609-234-4957
Tex	Dallas, Carey & Assoc.	214-363-7813
Tex	Houston, Carey & Assoc.	713-460-1111
Wisc	Milwaukee, Control Sls.	414-354-6266

CUSTOM ELCTRNS., Browne St., Oneonta, N.Y., 13820, Tel: 607-432-3880, TWX: 510-241-8292; Empl.: 60 p. 2•102,103

For info on price: D. Hathaway; Application info: J. Ahearn; Customer service: S. Vance; Delivery info: T. Puzo

Free literature available: Company Brochure, Technitip Data Sheets-CMR, CER, CEM Type units & mica data

Products manufactured: Capacitors, Fixed, Networks

Local Sales Offices & Reps.

Cal	Los Angeles, M.A. Stolaroff Co.	213-295-7781
Cal	Santa Clara, Richards Ass.	408-246-5860
Ill	Chicago, Rozner Sales	312-283-0022
Mass	Stow, Musello Assocs.	617-369-5900
Minn	Minneapolis, Revere Assocs.	617-781-7700
Mo	Kansas City, K & M Sls. & Assocs.	
NY	New York, Martech Assocs.	516-627-1151
Tex	Dallas, Hillman Entprs.	214-827-4790
Wash	Seattle, Underwood Inc.	206-243-2133

CUSTOM POWER, INC., 740 W. Collins Ave., Orange, Cal., 92667, Tel: 714-639-2390; Empl.: 45; Minimum order: $25

For info on price: R. Williams; Application info: T. Mehl; Customer service: A. M. Parker; Delivery info: A. M. Parker

Free literature available: Custom Power Supplies; General Information, Pictures Units previously manufactured. Custom OEM/Standards; shows outline drawings, general specifications, pricing. Transformers; states we build custom transformers. Standard Off the shelf supplies; data sheet with pricing.

Products manufactured: Power Supplies, Transformers

CUSTOM SCIENTIFIC INSTRS., 13 Wing Dr., Box A, Whippany, N.J., 07981, Tel: 201-538-8500; Empl.: 25; Minimum order: $25

Customer service: H. J. Bultman Jr.

Free literature available: Catalog or individual brochures of instruments.

Products manufactured: Chamber, Environmental Test, Testers

CUTLER-HAMMER, INC., 4201 N. 27th St., Milwaukee, Wisc., 53216, Tel: 414-442-7800, TWX: 910-262-3089

Free literature available: Order Log: A complete catalog of Commercial and Military Switches and Relays. Industrial Control Catalog: A complete catalog of motor starters, relays, timers and accessory devices.

Products manufactured: Arresters, Electrical Surge, Lightning, Brakes, Bus Bars & Systems, Circuit Breakers, Clutches, Controls/Control Eqpt., Drivers, Solenoid, Lights, Panels, Relays, Switchboards, Switches, Timers

Local Sales Offices & Reps.

Ala	Birmingham	205-871-1166
Ala	Mobile	205-471-5852
Ariz	Phoenix	602-957-1430
Ark	Little Rock	501-375-8355
Cal	Anaheim	714-776-1910
Cal	Concord	415-682-8800
Cal	Menlo Park	415-854-1005
Cal	San Diego	714-298-5432
Colo	Colorado Springs	303-576-1453
Colo	Denver	303-934-5408
Conn	Hartford	203-563-0104
Fla	Jacksonville	904-725-2845
Fla	Tampa	813-839-5493
Ga	Atlanta	404-939-3023
Haw	Honolulu	808-531-0596
Ill	Broadview	312-379-7565
Ill	Peoria	309-685-4031
Ill	Rockford	815-398-6585
Ind	Indianapolis	317-546-4096
Ind	South Bend	219-256-1591
Iowa	Ankeny	515-964-0258
Iowa	Davenport	319-323-8057
Kans	Mission	913-236-6313
Kans	Wichita	316-263-5216
Ky	Louisville	502-458-2639
La	New Orleans	504-366-1616
La	Shreveport	318-869-3194
Md	Rockville	301-881-8450
Md	Towson	301-825-6041
Mass	Newton	617-244-7511
Mass	Worcester	616-853-5824
Mich	Bridgeport	517-777-0880
Mich	Grand Rapids	616-243-0152
Mich	Lansing	517-482-2553
Mich	Southfield	313-444-8700
Minn	Minneapolis	612-831-3560
Mo	Joplin	417-623-6007
Mo	St. Louis	314-429-7711
Neb	Omaha	402-391-5040
NH	Dover	603-742-1687
NJ	Trenton	215-878-0820
NJ	Union	201-687-4433
NM	Albuquerque	505-266-7955
NY	Melville	516-595-4424
NY	New York	212-687-0707
NY	Rochester	716-271-5460
NY	Syracuse	315-437-7201
NC	Charlotte	704-523-3056
NC	Greensboro	919-272-4567
Ohio	Cincinnati	513-825-5252
Ohio	Dayton	513-293-2117
Okla	Oklahoma City	405-848-4807
Okla	Tulsa	918-627-3312
Ore	Eugene	502-342-8251
Pa	Pittsburgh	412-922-2707
Pa	Wayne	215-878-0820
RI	E. Providence	401-434-8555
SC	Columbia	803-772-6531
SC	Greenville	803-232-4639
Tenn	Memphis	901-458-2631
Tenn	Nashville	615-292-5539

Tex	Dallas	214-631-3731
Tex	Houston	713-526-1205
Utah	Salt Lake City	801-487-1338
Va	Norfolk	703-499-0555
Va	Richmond	804-353-4413
Wash	Seattle	206-747-5560
Wash	Spokane	509-326-1610
WVa	Charleston	304-343-4141
Wisc	Milwaukee	414-354-6050

CUTLER-HAMMER SHALLCROSS, Preston St., Selma, N.C., 27576, Tel: 919-965-2341, TWX: 510-920-0740; FSC No: 54294; QPL No: 39007; Empl.: 477; Minimum order: $50

For info on price: J. E. Russell; Application info: C. M. Huber; Customer service: C. A. Johnson; Delivery info: C. A. Johnson

Free literature available: Stockistor Stock List - Power wirewound resistors per Mil-R-39007 (RWR 80s, 81s, & 89S) stocked (1,000 ohmic values) in packages of 10 for fast delivery through Authorized Distributors.

Products manufactured: Bridges, Decade Boxes, Meters, Networks, Probes, Resistors, Switches, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, G. R. McKnight Co.	415-325-2844
Cal	Hawthorne, WCV Co.	213-772-4479
Cal	San Carlos, Winco Sls.	415-365-6082
Colo	Denver, Camel Elctrns.	303-757-6192
Fla	Oviedo, Conley Assocs.	305-365-3284
Ill	Chicago, Berndt Assocs.	312-283-0713
Kans	Olathe, T.R.I.	913-782-1177
Md	Bethesda, Warren Mount Co.	301-657-9312
Mass	Allston, Vector Sls., Inc.	617-787-2790
Mich	Farmington Hills, H. Lowell Co.	313-581-7474
NY	Plainview, ERA, Inc.	516-822-9890
NY	Rochester, Ontec	716-464-8636
NC	Smithfield, Byrd & Barbour Sls.	919-934-8136
Ohio	Cincinnati, A.C. Wahl & Assocs.	513-821-3270
Tenn	Bristol, Remco Corp.	615-968-4195
Tex	Richardson, Zonk Engrg. Co.	214-238-7651
Wash	Seattle, Underwood & Underwood	206-243-2133

Local Distributors

Cal	Carson, Hi-Rel, 20507 S. Belshaw Ave.	213-537-6500
Cal	Hawthorne, Westec, 14125 Inglewood Ave.	213-772-4479
Cal	Sunnyvale, Diplomat/Westland, 1118 Elko Dr.	408-734-1900
Fla	Clearwater, Diplomat/Southland, 1771 N. Hercules Ave.	813-443-4514
Md	Bethesda, Wire Supply, 4924 St. Elmo Ave.	301-657-9333
Minn	Minneapolis, Diplomat/Electro Com, 3816 Chandler Dr.	612-788-8601
Mo	St. Louis, Diplomat/St. Louis, 2725 Mercantile Dr.	314-645-8550
NJ	Haddonfield, Mid-Atlantic, 140 Haddon Ave.	609-428-8288
NY	Farmingdale, Command Elctrns., 114 Allen Blvd.	516-293-1212
NY	Plainview, ACI, 28 South Mall	516-293-6630
NY	Vestal, Harvey Federal, E. Vestal Pkwy.	607-748-8211
Ohio	Dayton, Diplomat/Northland, 2452 Stanley Ave.	513-228-1080

CVC PRODUCTS, INC., 525 Lee Rd., Box 1886, Rochester, N.Y., 14603, Tel: 716-458-2550, Telex: 97-8269; Empl.: 160; Minimum order: $30

For info on price: E. Chamberlain; Application info: R. Weeks; Customer service: G. Sadler; Delivery info: E. Chamberlain

Free literature available: Gauge Control Catalog, Diffusion Pump Catalog, High Vacuum Distillation Catalog, Pump Fluid Catalog.

Products manufactured: Analyzers, Chamber, Environmental Test, Controllers, Programmable, Controls/Control Eqpt., Deposition Equipment, Vacuum & Accessories, Evaporation Equipment, Electron Beam, Furnaces, Gages, Lubricants, Microcircuit Production Equip., Power Supplies, Pumps, Vacuum, Services, Assembly, Production & Test, Testers, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Hayward	415-785-4440
Cal	Van Nuys	213-787-6001
Ga	Atlanta	404-233-1171
Ill	Mt. Prospect	312-394-0840
Mass	Wellesley	617-235-8273
Mich	Southfield	313-352-6367
NJ	Union	201-376-4900
Ohio	Cincinnati	513-871-6558
Tex	Richardson	214-235-2378
FOR:	Can., St. Laurent, Montreal, Canadian Vacuum Equip. Co. Ltd.	514-332-1025

CW INDUSTRIES, 550 Davisville Rd., Warminster, Pa., 18974, Tel: 215-355-7080, TWX: 510-667-1875; Empl.: 500 .... p. 1•1967; p. 2•656

Customer service: H. Cohen

Products manufactured: Connectors, Potentiometers, Resistors, Switches

Local Sales Offices & Reps.

Cal	Redwood City, W. Hickey Sls.	415-368-3849
Cal	Van Nuys, Shephard Comps.	213-787-4610
Colo	Denver, L.G. Moss	303-985-9815
Colo	Greeley, G. Moss Elctrns.	303-353-1452
Ill	Chicago, G. Mcl Cole	312-774-3535
Ind	Indpls., Southern Sls.	317-257-7575
Md	Pikesville, J. Nichols	301-484-6376
Mass	Needham, A & M Elctrn. Reps.	617-444-8170
Mich	Detroit, Nicon Assocs.	313-341-7688
Minn	Minneapolis, E. Melius	612-854-4270
Miss	Meridian, Herron Assoc.	601-483-9306
Mo	St. Louis, E. Hill	314-621-1818
NJ	Oaklyn, A. Wetterhahn	609-858-3003
NM	Albuquerque, Staley Co.	505-294-2660
NY	Elmont, F.E. Schmitt	516-437-8150
NY	Hempstead, Kahgan Sls. Corp.	516-538-2300
NY	Syracuse, W.A. Franklin Sls. Corp.	315-474-2954
NY	Whitesboro, H. Lessman	315-736-5460
Ohio	Cincinnati, H. Behrends	513-351-4441
Ohio	Rocky River, G. Herrick	216-333-0333
Tex	Dallas, Vista Assocs.	214-235-4547
Va	Chesapeake, F.B.D. Sls.	703-484-3162
Wash	Seattle, Carlyle Tech.	206-622-4288
EXP:	N.Y., N.Y., Roburn Agencies	513-294-1648
FOR:	Can., Etobicoke, Ont., C. Pipe	416-622-3403

CYBEREX, INC., 7171 Industrial Park Blvd., Mentor, Ohio, 44060, Tel: 216-946-1783, Telex: 980644; Empl.: 60

Products manufactured: Chargers, Battery, Controls/Control Eqpt., Converters, Inverters, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Ala	Birmingham, Crim Sls. & Engrg. Co.	205-871-4084
Alas	Anchorage, J.P. Bagoy & Assocs.	907-274-8531
Cal	Fullerton, Western Automation/Power Sys.	714-879-0440
Cal	San Francisco, Artwel Elec., Inc.	415-467-1880
Colo	Denver, Electrical Agencies Co.	303-623-8246
Conn	Bolton, Metronics, Inc.	203-643-5358
Conn	Wilton, J.H. Burnett	203-762-8862
Fla	Brandon, J. Meeks & Assocs.	813-689-6137
Fla	Miami, A.C. Chaney & Assocs.	305-754-8857
Ga	Lilburn, R.W. Dollar	404-469-6861
Haw	Honolulu, Atlas Elec. Co.	808-571-906
Ill	Chicago, Gannon Elec.	312-774-2884
Ill	Chicago, W. Lamont Assocs.	312-777-8575
Ind	Indianapolis, R.M. Price	317-255-0665
Kans	Lenexa, Matney & Co.	913-888-6900
La	Metairie, General Power & Control	504-834-1345
Md	Pikesville, A.D. Wilson Assocs.	301-252-2231
Mass	Framingham, Total Power Corp.	617-237-2024
Mich	Southfield, Engel-Klaes Co.	313-355-1610
Minn	Minneapolis, A.M. Johnson Co.	612-927-8741
Mo	St. Louis, Karraker Co.	314-231-3666
Neb	Omaha, Electric Equip. Sls. Co.	402-556-4198
NM	Albuquerque, Bowden Engrg. & Sls.	505-268-7676
NY	Buffalo, Robinson Assocs.	716-886-7350
NY	Latham, Robinson Assocs.	518-785-5844
NY	New York City, NEPA, Inc.	212-867-0340
NY	Rochester, Robinson Assocs.	716-342-3130
NY	Syracuse, Robinson Assocs.	315-478-0241
NY	White Plaines, Shea Assocs.	914-949-2366
NC	Charlotte, Motion Technology, Inc.	704-525-9855
NC	Greensboro, R.W. Chapman & Co.	919-273-1809
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Chagrin Falls, Drivex Corp.	216-247-6701
Ohio	Cincinnati, Alexander Equip. Co.	513-221-7520
Ohio	Cleveland, Collart Co.	216-333-5550
Ohio	Wadsworth, Ohio Industrial	216-334-2518
Okla	Tulsa, H. Furtney Co.	918-747-6490
Ore	Gresham, Artwel Electric/Structural Substations	503-665-5141
Pa	Concordville, Harris & Kenworthey, Inc.	215-459-5532
Pa	Philadelphia, Technicraft Co.	215-483-4700
Pa	Pittsburgh, Waggoner-Ver Hill Assocs.	412-241-5202
SC	Greenville, R.W. Chapman & Co.	803-232-5391
SC	W. Columbia, R.W. Chapman & Co.	803-796-9796
Tenn	Concord, R.W. Chapman & Co.	615-966-6120
Tex	Dallas, Carey & Assocs.	214-363-7813
Tex	Houston, Carey & Assocs.	713-460-1111
Va	Falls Church, Negley Assocs.	703-560-7920
WVa	Charleston, McJunkin Corp.	304-348-5211
Wisc	Cedarburg, W. Osbon Assocs.	414-377-2400

CYCLE-DYNE, INC., Sub. Axel Elctrns., Inc., 134-20 Jamaica Ave., Jamaica, N.Y., 11418, Tel: 212-AX 1-3907, TWX: 710-582-2618; Empl.: 50; Minimum order: $15

For info on price: A. H. Fisher; Application info: N. Gagliardi; Customer service: D. Drechsel; Delivery info: W. McCook

Free literature available: Induction and Dielectric Heating Equipment, accessories, heat exchangers, work coils, fixtures, spare parts and service in the field.

Products manufactured: Converters, Dielectric Heating Equipment, Generators, Heaters & Heating Elements, Machines/Machinery, Production, Soldering Equipment

CYCLO-TRONICS, INC., 3858 N. Cicero Ave., Chicago, Ill., 60641, Tel: 312-282-6141; Empl.: 10

Customer service: Dave Goldware

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.

EXP:	Burlington, Ont., Can., Arbell Equip. Ltd.	416-632-9494

CYCON CORP., 1080 E. Duane Ave., Sunnyvale, Cal., 94086, Tel: 408-732-8311, TWX: 910-339-9216; Empl.: 40

For info on price: D. Armanino; Application info: C. Cump; Customer service: D. Armanino; Delivery info: D. Armanino

Free literature available: Our literature contains specifications, pin outs, operational characteristics, and applications data for proprietary & second source A/D and D/A Converters.

Products manufactured: Amplifiers, Converters, Multiplexers, Multipliers

Local Sales Offices & Reps.

Ala	Huntsville, South Central Mkt.	205-852-4600
Ariz	Tempe, J. F. Hurlbut & Co.	602-968-5962
Cal	Los Angeles, Basic Sys. Co.	213-938-2833
Cal	San Carlos, Electronic Engrg. Assocs.	415-593-2189
Colo	Golden, J. F. Hurlbut & Co.	303-279-7138
Conn	Hamden, Instrument Consultants, Inc.	203-288-5246
Fla	Orlando, Truex Assocs.	305-859-2160
Ill	Des Plaines, Coombs Assocs.	312-298-4830
Mass	Waban, Instrument Consultants, Inc.	617-969-9881
Minn	Minneapolis, Arjay Sls.	612-925-1833
Mo	St. Louis, Beneke & McCaul	314-567-3657
NY	Syracuse, T Elctrns.	315-463-8592
Pa	Abington, Bach Stewart Assocs.	215-885-1550
Tex	Dallas, McCoy Assocs.	214-350-9931
Tex	Houston, Carter Assocs.	713-644-1307
Wash	Seattle, R. Drake & Assocs.	206-763-2755
Wisc	Greendale, Coombs Assocs.	414-421-2300

D-CEMCO, INC., 3200 N. San Fernando Blvd., Burbank, Calif., 91504, Tel: 213-849-6341; Empl.: 16; Minimum order: $20

For info on price: G. Vogel; Application info: E. L. Deatrick; Customer service: G. Vogel; Delivery info: D. Vogel

Products manufactured: Contacts, Electrical, Frames, Cabinet & Rack, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Kits, Breadboarding (For Engineers), Pads, Transistor Mounting, Spacers, Terminal Blocks, Boards & Strips, Terminals

D & L SALES CO. INC., 296 Preakness Ave., Paterson, N.J., 07502, Tel: 201-684-8223, 684-8224; Empl.: 10; Minimum order: $25

For info on price: I. Delgado; Application info: N. Bafundo; Customer service: I. Delgado; Delivery info: I. Delgado

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms

DABURN ELECTRONICS & CABLE CORP., 2360 Hoffman, Bronx, N.Y., 10458, Tel: 212-295-0050, TWX: 710-593-4145; FSC No: 25706; Minimum order: $25 p. 2•1973-1992

For info on price: F. Martin; Application info: B. Danziger; Customer service: S. Goltz; Delivery info: M. Wieczorek

Free literature available: Full catalog of electronic wire, cable, tubing and sleeving, lacing cord and tape, fastening devices and hardware; includes teflon constructions, audio and communication cables, retractible cords; shrinkable PVC, polyolefin, teflon, kynar, neoprene, dual wall teflon tubing and shrinkable tape.

Products manufactured: Braid, Cable, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cable, Caps, Forms & Tapes, Heat Shrinkable, Clamps & Clips, Connectors, Cords, Fasteners, Heat Guns, Production, Heat Sinks, Soldering, Insulators & Insulation, Jacks (All Types), Plugs, Posts, Switch Hardware, Switches, Terminal Blocks, Boards & Strips, Terminals, Tubing, Wire, Wire & Cable Ties, Wire Shielding

Local Sales Offices & Reps.

Ala	Gadsden, F.C. Nickerson Co.	205-547-7718
Cal	San Mateo, Carelli-EMA	415-341-6666
Conn	Waterbury, Anderson Sls. Co.	203-753-2487
Fla	Oldsmer, F.C. Nickerson Co.	813-855-4209
Fla	Seminola, F.C. Nickerson Co.	813-397-4843
Fla	Tampa, F.C. Nickerson Co.	813-885-1416
Haw	Honolulu, Hawaii Elctrn. Ser.	808-845-8207
Kans	Colwich, Dy-Tronix, Inc.	316-263-6590
Md	Baltimore, Dyna Rep Co.	301-256-8300
Mass	Boston, Anderson Sls. Co.	617-227-2980
Mo	Hazelwood, Dy-Tronix, Inc.	314-731-5799
Mo	Kansas City, Dy-Tronix, Inc.	816-761-6543
NJ	Haddonfield, Dyna Rep.	609-795-1700
NY	E. Syracuse, Honsinger Assoc.	315-463-5718
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
NY	Plainview, R. Smith Assoc.	516-681-3155
NY	Spring Valley, R. Smith Assoc.	914-354-6067
NC	Franklin, F.C. Nickerson Co.	704-524-6363
Ohio	Cleveland, Ind'l. Sls. Assoc.	216-721-7500
Tex	Garland, G.V. Peck Co.	214-341-8311
Va	Alexandria, Dyna Rep.	703-354-1222
Va	Newport News, Dyna Rep.	804-874-7729

DACO INSTR. CO., 30 Stran Rd., Milford, Conn., 06460, Tel: 203-874-2515, TWX: 710-462-1049; Empl.: 40

Products manufactured: Dehumidifiers (For Equipment), Dehydrators, Display Devices/Displays, Indicators, Solenoids

DAICO INDUSTRIES INC., Box 5225, Compton, Cal., 90220, Tel: 213-631-1143, TWX: 910-346-6741; Empl.: 35; Minimum order: $50 .... p. 2•1281-1284

Customer service: P. Nooteboom

Free literature available: Cat & Chart, Low frequency (IF and RF) switches, programmable (multi-bit) attenuators and phase shifters. Combining elements include both solid state switches and RF relays.

Products manufactured: Antenna Switching Matrices, Attenuators, Couplers, Relays, Shifters, Switches

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Smith & Assocs.	602-947-2495
Cal	Los Altos, Cain-White & Co.	415-948-6533
Colo	Boulder, J. Smith & Assocs.	303-442-7100
Colo	Littleton, J. Smith & Assocs.	303-794-8891
Fla	Palm Bay, Spartech Assocs.	305-727-8045
Ga	Smyrna, Spartech Assocs.	404-432-3644
Iowa	Cedar Rapids, Penzner-Mankus Assocs.	319-362-9177
Kans	Overland Park, Penzner-Mankus Assocs.	923-381-0004
Kans	Wichita, Penzner-Mankus Assocs.	316-264-2862
Mass	Cochituate, Micronic Assocs.	617-872-6561
Mo	Hazelwood, Penzner-Mankus Assocs.	314-731-4334
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	Huntington Station, Gray & Reed Assocs.	516-GE 3-3333
Pa	Newtown Square, SWR Assocs.	215-EL6-8550
Wash	Seattle, Datacom Assocs.	206-285-2525

DALE ELECTRONICS INC., Sub. Lionel Corp., Box 609, Columbus, Neb., 68601, Tel: 402-564-3131, TWX: 910-668-3605; Empl.: 2000; Minimum order: $35 p. 2•1452

Customer service: N. Newman

Free literature available: Dale Full Line Catalog 232 pages of detailed catalog information on all Dale propus lines. Wirewound-film resistors, resistor networks, trimmer pots, connectors, inductors, transformers and surge arresters.

Products manufactured: Arresters, Electrical Surge, Lightning, Attenuators, Chokes, Coils Including Assemblies & Forms, Connectors, Converters, Networks, Potentiometers, Relays, Resistors, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Los Alamitos, J.S. Heaton Co. South	213-598-6676
Cal	Redwood City, J.S. Heaton Co. North	415-369-4671
Cal	San Diego, J.S. Heaton Co. South	714-454-1456
Colo	Denver, Williams Assocs.	303-373-4730
Fla	Palm Beach Gardens, Graham Assocs.	305-622-4049
Ill	Chicago, D.J.M. Elctrn. Sls., Inc.	312-774-6525
Ind	Fort Wayne, Scott Elctrns., Inc.	219-743-1586
Ind	Indianapolis, Scott Elctrns., Inc.	317-897-9976
Ky	Louisville, Scott Elctrns., Inc.	502-583-3220
Md	Towson, R.L. Wilkinson, Inc.	301-377-7800
Mass	Wakefield, Kaelber & Mack, Inc.	617-245-9359
Mich	Detroit, Burcaw Co. & Assocs.	313-533-7700
Mich	Kentwood, Burcaw Co. & Assocs.	616-531-1000
Minn	Minneapolis, Merrill Franklin Co.	612-835-6422
NJ	Fairlawn, Kaelber & Mack, Inc.	201-797-7782
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Buffalo, M. Farber Assocs.	716-856-3543
NY	Manhasset, Kaelber & Mack, Inc.	516-627-6620
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Ohio	Cleveland, Scott Elctrns., Inc.	216-291-2600
Ohio	Columbus, Scott Elctrns., Inc.	614-236-8619
Ohio	Dayton, Scott Elctrns., Inc.	513-294-0539
Okla	Tulsa, E.F. Aymond Co.	918-936-2562
Ore	Beaverton, ES/Chase Co.	503-649-6177
Pa	Glenside, R. Wilkinson, Inc.	215-424-8400
Pa	Pittsburgh, Scott Elctrns., Inc.	412-781-3112
Tex	Dallas, E.F. Aymond Co.	214-826-7620
Tex	Houston, E. F. Aymond Co.	713-442-5791
Wash	Edmonds, ES/Chase Co.	206-774-3586
Wisc	Cambridge, D. J. M. Elctrns. Sls.	608-423-4190
FOR:	Canada, Scarborough, Ont., Dale Electronics, Canada, Ltd.	416-759-5631

Local Distributors

Ariz	Phoenix, Dalis Elctrn. Supply, 917 N. 7th St.	602-258-8151
Ariz	Phoenix, Hamilton/Avnet Corp., 2615 S. 21st St.	602-275-7851
Cal	Culver City, Avnet Corp., 10916 Washington Blvd.	213-559-4111
Cal	Mountain View, Hamilton/Avnet Corp., 575 E. Middlefield Rd.	415-961-7000
Cal	Mountain View, Shelley-Rodabaugh, 2444 Old Middlefield Way	415-969-1820
Cal	San Diego, Hamilton/Avnet Corp., 8917 Complex Dr.	714-279-1550
Cal	San Diego, Shanks & Wright, 2045 Kettner Blvd.	714-239-0176
Cal	San Diego, Shelley-Neumann, Inc., 3347 Industrial Ct.	714-459-3701
Cal	Santa Monica, F. Shelley Elctrns., 1040 Pico Blvd.	213-392-3913
Colo	Denver, Newark-Denver Elctrns., 2170 S. Grape St.	303-757-3351
Colo	Denver, Waco Elctrns., 4616 Ironton St.	303-371-4370
Conn	Stratford, Electro/Comp, 2415 Main St.	203-375-5811
Fla	Fort Lauderdale, Newark Elctrns., 1360 N.W. 65th Ave.	305-587-2372
Fla	Palm Beach Gardens, G.S. Marshall Co., 10385 Riverside Dr.	305-622-8490
Ga	Atlanta, Jackson Elctrns., 1135 Chattahoochee Ave., N.W.	404-355-2223
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd.	312-697-8200
Ill	Palatine, Ohm Elctrns., 649 Vermont Ave.	312-359-5500
Ill	Schiller Park, Hamilton/Avnet Elctrns., 3901 Pace Ct.	312-678-6310
Ill	Skokie, Bell Inds., 7701 N. Austin Ave.	312-282-5400
Ind	Evansville, Ohio Valley Sound, 20 E. Sycamore St.	812-425-6173
Ind	Ft. Wayne, Ft. Wayne Elctrns., 3606 Maumee Ave.	219-742-4346
Ind	Indianapolis, Graham Elec. Supply, 133 S. Pennsylvania St.	317-634-8202
Ind	South Bend, Radio Distributing Co., 1212 High St.	219-287-2911
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave., S.W.	319-365-7551
Kans	Wichita, Radio Supply Co., 115 Laura	316-267-5216
Ky	Lexington, Radio Elctrn. Equip Co., 480 Skain Ave.	606-255-6661
La	New Orleans, Southern Radio Supply Co., 1909 Tulane Ave.	504-524-2343
Md	Baltimore, Radio Elec. Svc. Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Watertown, Sterling Elctrns., 51 Spring St.	617-926-9720
Mass	West Newton, A.W. Mayer Co., 38 Border St.	617-965-1111
Mich	Ann Arbor, Wedemeyer Elctrn. Supply, 2280 S. Industrial Hwy.	313-665-8611
Mich	Detroit, R S Elctrns., 12775 Lyndon St.	313-491-1000
Mich	Grand Rapids, Stotts-Friedman, 2035 Eastern, S.E.	616-241-6731
Mich	Oak Park, Newark-Detroit Elctrns., 20700 Hubbell Ave.	313-548-0250
Mich	Wyoming, Newark Industrial Elec. Corp., 3645 Linden Ave., S.E.	616-241-6681
Minn	Minneapolis, Stark Elctrns., 112 3rd Ave., N.	612-332-1325
Minn	St. Paul, Gopher Elctrns. Co., 2520 W. Larpenteur	612-645-0241
Mo	Kansas City, Burnstein-Applebee Co., 3199 Mercier St.	816-561-5460
Mo	Kansas City, Radiolab, Inc., 3814 Main	816-561-9935
Mo	St. Charles, Lectronix, Inc., 306 McDonough St.	314-946-6424
NJ	Clifton, Wilshire Elctrns., 312 Clifton Ave.	201-365-2800
NJ	Kenilworth, Newark Elctrns. Ctr., 303 Monroe Ave.	201-272-8410
NJ	Rahway, Terminal Elctrns., Rahway Ind'l. Ctr., 1463 Pinewood St.	201-381-5700
NJ	Roselle, Garden State Ind'l. Elctrns., 407 Hope Ave.	201-241-9000
NJ	Springfield, Federated Purchaser, 155 U.S. Rte 22	201-376-8900
NJ	Springfield, Route Elctrns., Echo Plaza, U.S. Rte. 22	201-379-7710
NJ	Trenton, Allen & Hurley, 23 S. Warren St.	609-393-3300
NM	Albuquerque, Kierulff Elctrns. Co., 2524 Baylor Dr., S.E.	505-247-1058
NM	Albuquerque, Sterling Elctrns., 3530 Pan American Fwy., N.E.	505-345-6601
NY	Binghamton, Stack Ind'l. Elctrns., 45 Washington Ave.	607-723-6326
NY	Buffalo, Radio Equip. Corp., 196 Vulcan St.	716-874-2690
NY	Buffalo, Summit Dist., 916 Main	716-884-3450
NY	E. Farmingdale, Harrison Radio Corp., 20 Smith St.	516-293-7990
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Farmingdale, Hallmark Elctrns., 167 Marine St.	516-293-7500
NY	Johnson City, Wilshire Elctrns., 617 Main St.	607-797-1236
NY	Plainview, Fairmont Elctrns., 35 S. Service Rd.	516-694-8200
NY	Poughkeepsie, Higgins & Sheer, 123 Dutchess Turnpike	914-471-3510
NY	Rochester, Simcona Elctrns. Corp., 275 Mt. Read Blvd.	716-328-3230
NY	Rockville Centre, Midway Ind'l. Elctrns., 24 Maple Ave.	516-764-2400
NY	Rome, Rome Elctrns., 216 Erie Blvd. E.	315-337-5400
NY	Yorkville, Valley Ind'l. Elctrns., Commercial Dr.	315-736-3393
NC	Charlotte, Brownell-Electro, 5141 Belhaven Blvd.	704-394-4341
NC	Winston-Salem, Kirkman Elctrns., 901 W. Second St.	919-724-0541
Ohio	Cincinnati, Hughes-Peters, Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Cleveland, Pioneer Standard Elctrns., 4800 E 131st St.	216-587-3600
Ohio	Cleveland, W.M. Pattison Supply Co., 4550 Willow Pkwy.	216-441-3000
Ohio	Cleveland, Winteradio Elctrns. Supply Corp., 1468 W. 25th St.	216-621-9383
Ohio	Columbus, Hughes-Peters, Inc., 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Nasco, Inc., 3201 Plainfield Rd.	
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Ohio	Kettering, Plaintronics Co., Box 2265, 3100 Plainfield Rd.	513-253-9176
Ohio	Lima, Lima Radio, 150 W. Grand Ave.	419-228-1220
Okla	Tulsa, Oil Capitol Electrs., 708 S. Sheridan	918-836-2541
Okla	Tulsa, Radio, Inc., 1000 S. Main	918-587-9123

Directory of Local Distributors Starts on page 401

Ore	Portland, Almac/Stroum Electrs., Box 25444	503-292-3534
Pa	Philadelphia, Herbach & Rademan, 401 E. Erie Ave.	215-426-1700
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-288-2600
Pa	Pittsburgh, RPC Electrs., 620 Alpha Dr.	412-782-3770
RI	Providence, W. Dandreta & Co., 28 Wolcott St.	401-861-2800
Tenn	Nashville, Electra Distributing Co., 1914 W. End Ave.	615-329-3971
Tex	Dallas, Sterling Elctrns., 2875 Merrell Rd. Box 20129	214-357-9131
Tex	El Paso, McNichols, Inc., 3012 E. Yandell Dr.	915-566-2936
Tex	Fort Worth, Textronics, Inc., 1108 E. Lancaster	817-335-8111
Tex	Houston, Lenert Co., Box 2184, 1420 Hutchins	713-225-1465
Tex	Houston, Sterling Electrns., Box 1229	713-623-6600
Va	Richmond, I.T.R., 1425 Blue Jay La.	804-288-7198
Wash	Bellevue, Hamilton/Avnet Corp., 13407 Northrup Way	206-624-5930
Wash	Seattle, Almac-Stroum Elctrns., 5811 Sixth Ave. S.	206-763-2300
Wash	Seattle, Radar Elec. Co., 168 Western Ave., W.	206-282-2511
WVa	Charleston, McJunkin Corp., Box 513	304-348-5211

DALE ELECTRONICS, INC., Box 74, Norfolk, Nebr., 68701, Tel: 402-371-0080, TWX: 910-623-0163; Minimum order: $35 .... p. 2•1452

Customer service: B. Means

Free literature available: Refer to Dale Electronics, Columbus Neb. for catalog information.

Products manufactured: Attenuators, Circuits, Hybrid, Thick Film, Filters, Networks, Resistors

Refer to Dale Electronics Columbus, Neb. for sales office and distributor information.

DALE ELCTRNS., INC., Yankton Div., E. Hwy. 50, Box 180, Yankton, S.D., 57078, Tel: 605-665-9301, TWX: 910-668-3605; Empl.: 250; Minimum order: $35 p. 2•1452

Customer service: John Elliot

Free literature available: Refer to Dale Electronics, Columbus Neb. for catalog information.

Products manufactured: Arresters, Electrical Surge, Lightning, Bobbins, Winding, Coil & Transformer, Chokes, Coils Including Assemblies & Forms, Connectors, Controls/Control Eqpt., Drives & Drive Mechanisms (Dial), Filters, Kits, Potentiometer, Rheostat, Motors, Potentiometers, Protectors, Relays, Spark Gaps, Suppressors, Transformers

Refer to Dale Elctrns., Columbus, Neb. for sales office and distributor information.

DALE ELCTRNS. CANADA, LTD., 18 Howden Rd., Scarborough, Ont., Can., Tel: 416-759-5631, TWX: 610-492-1381; Minimum order: $35 .... p. 2•1452

Customer service: K. Beeby

Free literature available: Refer to Dale Elctrns, Columbus, Neb. for catalog information.

Products manufactured: Resistors

Local Sales Offices & Reps.

FOR:	Can., Burnaby, B.C., ES/Chase Ltd.	604-298-4515
FOR:	Can., Dorval, Que., Avotroics Ltd.	514-631-9168
FOR:	Can., London, Ont., Welwyn Can. Ltd.	519-451-9490
FOR:	Can., Montreal, Que., Bach-Simpson Ltd.	514-731-9617
FOR:	Can., Willowdale, Ont., Avotroics Ltd.	416-493-9711

DAMON CORP., Elctrns. Div., 80 Wilson Way, Westwood, Mass., 02090, Tel: 617-449-0800, TWX: 710-348-6722; Empl.: 75; Minimum order: $50 p. 1•312,313

Customer service: Ed Doherty

Products manufactured: Delay Lines, Discriminators, Filters, Oscillators

Local Sales Offices & Reps.

Cal	No. Hollywood, Jewett Assocs.	213-789-8103
Cal	Palo Alto, Waldman Assocs.	415-961-4100
Del	Springfield, Scientific Devices	703-451-6500
Fla	Melbourne, Repcom, Inc.	305-254-1877
Ill	Northfield, Feller Assoc.	312-446-8065
Mass	Cambridge, Vector Sls.	617-491-5700
NJ	Cherry Hill, Stemler Assocs.	609-966-4070
NM	Albuquerque, ALS Elctrns.	505-298-2575
NY	Tuckahoe, Spectrum Sls.	914-793-1660
Tex	Addison, Southland Comp.	214-233-0603

DAN-L INC., 229 Laurel Rd., E. Northport, N.Y., 11731, Tel: 516-757-8000; FSC No: 28327; Empl.: 22; Minimum order: $25

For info on price: E. P. Huber; Application info: D. Eltermann; Customer service: J. Closky; Delivery info: E. P. Huber

Products manufactured: Sockets

DANA EXACT ELECTRONICS, INC., Box 160, 455 SE 2nd Ave., Hillsboro, Ore., 97123, Tel: 503-648-6661, TWX: 910-460-8811; Empl.: 60; Minimum order: $5 p. 1•644,645

Customer service: J. Foster

Free literature available: Dana exact Electronics, Inc. short form catalog listing function generators, waveform synthesizers and frequency synthesizers.

Products manufactured: Amplifiers, Generators, Synthesizers

Local Sales Offices & Reps.

Ala	Hunstville, BCS Assocs.	205-881-6220
Ariz	Scottsdale, PLS Assocs.	602-957-9110
Cal	Los Angeles, Basic Sys. Corp.	213-938-2833
Cal	Palo Alto, Coherent Mktg. Assocs.	415-327-2217
Colo	Denver, PLS Assocs.	303-771-0140
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Chicago, Pivan Engrg. Inc.	312-539-4838
Ind	Indianapolis, Pivan Engrg Inc.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg. Inc.	913-722-1030
Md	Kensington, Electronic Mktg. Assocs.	301-744-7700
Mass	Waltham, Measurement Conslts. Corp.	617-890-4400
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Minn	Minneapolis, Pivan Engrg. Inc.	612-537-4501
Mo	St. Louis, Pivan Engrg. Inc.	314-567-3636
NM	Albuquerque, PLS Assocs. Inc.	505-255-2330
NY	Great Neck, Measurement Tech. Inc.	516-482-3500
NY	Rochester, KLM Assocs. Inc.	315-735-8525
NC	Greensboro, BCS Assocs. Inc.	919-273-1918
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-278-5873
Okla	Tulsa, Palatine Sls. Inc.	918-622-0321
Ore	Portland, Hayes Technical	503-238-0001
Pa	King of Prussia, Electronic Mktg. Ass.-Carter, McCormic/P	412-472-4415
RI	Cumberland, Measurement Consultants Corp.	410-333-6000
Tex	Richardson, Palatine Sls. Inc.	214-231-9489
Wash	Seattle, Hayes Technical	206-763-2210
Wisc	Brookfield, Pivan Engrg. Inc.	414-786-1940
FOR:	Can., Downsville, Ont., Electronetic Sys. Ltd.	416-661-3673

DANA LABS., INC., 2401 Campus Dr., Irvine, Calif., 92664, Tel: 714-833-1234, TWX: 910-595-1136; FSC No: 21793; Empl.: 300

For info on price: C. Steinke; Application info: C. Steinke; Customer service: B. Bishop; Delivery info: C. Steinke

Free literature available: The package contains information on our digital voltmeters, electronic counters and frequency synthesizers, including our new model 2000 Danameter which is a hand-held digital voltmeter that runs on a 9 volt transistor battery. Each catalog includes general information on the product as well as specifications.

Products manufactured: Counters, Meters, Synthesizers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs., Inc.	205-534-9771
Ariz	Phoenix, PLS	602-957-9110
Cal	Irvine, Dana Labs., Inc.	714-833-1234
Cal	La Jolla, Ward-Davis Assocs.	714-459-3351
Cal	Lawndale, Ward-Davis Assocs.	213-542-7740
Cal	Sunnyvale, Ward-Davis Assocs.	408-245-3700
Colo	Denver, PLS	303-771-0140
Conn	Hamden, P. Jenks Assocs.	203-281-0810
DC	Wheaton, Sonco, Inc.	301-942-9420
Fla	Orlando, Gentry Assocs., Inc.	305-894-4401
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg. Co.	913-722-1030
Md	Wheaton, Sonco, Inc.	301-942-9420
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Peirce, Inc.	616-349-9666
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501
Mo	St. Louis, Pivan Engrg. Co.	314-567-3636
NJ	Ft. Lee, Tech. Mktg. Assocs.	201-224-6911
NM	Albuquerque, PLS	505-255-2330
NY	Rochester, Ossmann Instruments, Inc.	716-328-2230
NY	Syracuse, Ossmann Instruments, Inc.	315-437-6666
NY	Vestal, Ossmann Instruments, Inc.	607-785-9947
NC	Burlington, Gentry Assocs. Inc.	919-227-3639
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-278-5873
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	Blue Bell, Sonco, Inc.	215-542-1490
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Wash	Seattle, R. Drake Assocs., Inc.	206-763-2755
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940

DANIELS MFG. CORP., 2266 Franklin Rd., Bloomfield Hills, Mich., 48013, Tel: 313-338-9611; FSC No: 5120; QPL No: 22520; Empl.: 50; Minimum order: $25

For info on price: W. Daniels; Application info: H. Kemmer; Customer service: H. Kemmer; Delivery info: H. Kemmer

Free literature available: Catalogs describing crimping tools, contact insertion & removal tools and tool kits. Catalog also includes cross reference of tools and contact part numbers they will crimp.

Products manufactured: Tools

Local Sales Offices & Reps.

Ala	Madison, Southeastern Assocs.	205-772-9616
Cal	Bellflower, Daniels Mfg. Corp.	714-774-6872
Fla	Orlando, Balmar Ents.	305-851-4041
Md	Bethesda, Sparks & Co.	301-654-1094

DANTRONICS, INC., 3175 Hafner Ct., St. Paul, Minn, 55112, Tel: 612-484-2108; Empl.: 22

Free literature available: Dantec 100 Automatic Transistor tester, Dantec 200 medium power diode and SCR tester.

Products manufactured: Analyzers, Controls/Control Eqpt., Meters, Testers

Advertisment

TESTERS FOR TRANSISTORS, DIODES, SLR'S, FETS, TRIACS, POTS, ETC.
EITHER ON WAFER OR FINAL DEVICE
FOR HIGH SPEED HANDLERS OR MANUAL INSERTION.

D.A.T.A. INC., A Cordura Co., 32 Lincoln Ave., Orange, N.J., 07050, Tel: 201-673-8030, TWX: 710-994-5839; Empl.: 36; Minimum order: $9.75

For info on price: P. McGill; Application info: E. H. Marriott; Customer service: B. Ehrlich; Delivery info: P. McGill

Free literature available: Brochures and Price lists.

Products manufactured: Technical Books

DATA, INC., 130 S. Mason, Box 2074, Ft. Collins, Colo., 80521, Tel: 303-493-1222; Empl.: 3

Products manufactured: Amplifiers, Recorders

DATA-CONTROL SYSTEMS, Commerce Dr., Box 584, Danbury, Conn., 06810, Tel: 203-743-9241, TWX: 710-456-0376; FSC No: 08539; Empl.: 199; Minimum order: $50

Customer service: J. S. Lombardo

Free literature available: Application and Specification Information On Analog and Digital (PCM) Telemetry Systems.

Products manufactured: Amplifiers, Calibrators, Comm. Systems, Data Acquisition & Reduction Systems, Decommutators, Telemetering, Demodulators, Detectors, Discriminators, Filters, Generators, Modulator/Demodulators, Modulators, All Kinds, Oscillators, Signal Conditioners & Equipment, Testers, Transmission Systems, Data

Local Sales Offices & Reps.

Ala	Huntsville, Data-Control Sys.	205-536-0784
Ariz	Phoenix, BFA Corp.	602-946-4215
Cal	Westminister, Data-Control Sys.	714-894-4471
Colo	Denver, BFA Corp.	303-744-3301
Conn	Danbury, Data-Control Sys.	203-743-9241
Conn	Hamden, Pat Jenks Assoc.	203-281-0810
Fla	Orlando, Uni-Rep	305-295-4817
Md	Laytonville, G T Assocs.	301-949-8060
Mass	Natick, Rabal Assoc.	617-655-5909
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Melville, Astrorep	516-423-2266
Ore	Norman, Data-Mktg. Assoc.	405-364-8320
Pa	Huntingdon Valley, Rabal Assoc.	215-947-4825
Tex	Dallas, Data Mktg. Assoc.	214-358-4643
Tex	Houston, Data-Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Utah	Salt Lake City, BFA Corp.	801-466-6522

DATA DELAY DEVICES, 253 Crooks Ave., Clifton, N.J., 07011, Tel: 201-772-1106; Empl.: 10 ...... p. 1•445-451,552

Products manufactured: Coils Including Assemblies & Forms, Decade Boxes, Delay Lines, Equalizers, Filters, Networks, Oscillators, Synthesizers

Local Sales Offices & Reps.

Cal	Mountain View, Weseloh & Assocs.	415-961-0565
Cal	Santa Monica, Rep Assocs.	213-829-5401
Fla	Winter Haven, S & S Sls. Reps.	813-293-7304
Mass	Framingham, Victor Assocs.	617-879-5710
NY	Huntington, C. R. Mayer Co.	516-921-7876
Va	Alexandria, W. A. Brown Equip. Comp.	703-836-1800
Tex	Dallas, IBL Engrg. & Sls. Inc.	214-363-2921

Advertisment

We manufacture, Design, Develop:

- Electromagnetic Delay lines fixed; variable, lumped, distributed, electrically variable.
- Filters Passive & Active of all response types
- Inductors, Fixed, variable, toroids, electrically variable
- Oscillators, Low-Freq. modular
- Magnetostrictive Delay Lines

DATA DISC INC., 686 W. Maude Ave., Sunnyvale, Cal., 94086, Tel: 408-732-7330, TWX: 910-339-9244; Empl.: 281; Minimum order: $25

For info on price: Sls. Dept.; Application info: Mktg. Dept.; Customer service: W. Sattler; Delivery info: Mktg. Dept.

Products manufactured: Display Devices/Displays, Memory Systems, Recorders, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	Topanga, Data Disc	213-883-8413
Colo	Denver, Grifco	303-722-4674
Fla	Melbourne, Data Disc	305-724-2108
Ill	Glenview, Data Disc	312-729-8030
Kans	Shawnee Mission, Inland Assocs.	913-362-2366
Md	Bethesda, Bartlett Assocs.	301-656-3061
Mass	Framingham, Bartlett Assocs.	617-879-7530
Mich	Center Line, Dietrich & Assocs.	313-754-6450
Minn	Hopkins, F. Peterson Co.	612-941-5400
Mo	Glencoe, Inland Assocs.	314-938-4992
NY	Elmsford, Data Disc	914-592-8658
NY.	White Plains, Bartlett Assocs.	914-949-6476
NC	Charlotte, Electro-Rep Assocs.	704-527-2530
Ohio	Cleveland, Dietrich & Assocs.	216-781-1855
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
Pa	Wayne, Bartlett Assocs.	215-688-7325
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504

DATA DISPLAY PRODUCTS, 5428 W. 104tb St., Los Angeles, Cal., 90045, Tel: 213-641-1232; FSC No: 15513; Empl.: 14; Minimum order: $15

For info on price: P. Lodhie; Application info: Q. Lodhie; Customer service: P. Lodhie; Delivery info: P. Lodhie

Products manufactured: Diodes, Lamp Drivers, Lamps, Lights, Sockets

Local Sales Offices & Reps.

Ariz	Scottsdale, G. R. McKnight Co.	602-949-0809
Cal	Menlo Park, G. R. McKnight Co.	415-325-2844
Cal	Sun Valley, Weightman & Assocs.	213-768-5750
Ill	Glendale Heights, Trend-Tronics	312-963-2210
Mass	Sturbridge, Branford Controls	617-347-7367
Minn	Minneapolis, R. W. Marshall Co.	612-929-0457
NJ	Fair Lawn, Geo. D. Harris Assoc.	201-796-5200
NM	Albuquerque, McKnight Co.	505-266-6423
Pa	Jenkintown, Arnold Assocs.	215-742-0600

DATA GENERAL CORP., Route 9, Southboro, Mass., 01772, Tel: 617-485-9100, TWX: 710-390-0309; Empl.: 3000

Products manufactured: Computers, Converters, Memory Systems, Printers, Readers, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ariz	Scotsdale	602-994-0351
Cal	El Segundo	213-973-0401
Cal	Palo Alto	415-965-1010
Cal	Sacremento	916-441-0167
Cal	San Diego	714-276-8450
Cal	Santa Ana	714-558-9421
Cal	Santa Barbara	
Colo	Denver	303-758-5080
Conn	North Haven	203-239-4438
Fla	Ft. Lauderdale	305-771-0784
Fla	Orlando	305-851-8230
Fla	St. Petersburg	813-576-4157
Ga	Atlanta	404-325-3181
Ill	Schaumburg	312-885-0505
Ind	Indianapolis	317-248-8306
Ky	Louisville	502-456-1490
Mass	Waltham	617-891-7000
Mich	Southfield	313-357-0006
Minn	Minneapolis	612-854-7727
Mo	Clayton	314-726-0811
Mo	Kansas City	816-531-1326
NJ	Saddlebrook	201-843-0676
NM	Albuquerque	505-266-5951
NY	Buffalo	716-674-6200
NY	Commack	516-864-2700
NY	New York City	212-867-1010
NY	Rochester	716-385-2000
NY	Schenectady	518-377-1300
NY	Syracuse	315-455-1525
NC	Greensboro	919-275-8586
Ohio	Dayton	513-435-1932
Ohio	Euclid	216-289-2660
Okla	Tulsa	918-749-5763
Ore	Portland	503-297-1756
Pa	Blue Bell	215-643-5515
Pa	Pittsburgh	412-922-7584
Tex	Austin	512-451-7487
Tex	Dallas	214-233-4496
Tex	Houston	713-688-8641
Utah	Salt Lake City	801-484-5271
Va	Falls Church	703-893-0910
Wash	Renton	206-228-5890
Wisc	Milwaukee	

DATAGRAPHICS CORP., 8402 Speedway, San Antonio, Tex., 78230, Tel: 512-342-9486; Empl.: 26; Minimum order: $25

For info on price: S. Smith; Application info: S. Smith; Customer service: J. Kosek; Delivery info: S. Smith

Products manufactured: Converters, Data Acquisition & Reduction Systems, Data Loggers, Timers

Local Sales Offices & Reps.

Cal	Newport Beach, FLW, Inc.	714-540-4412
Cal	North Hollywood, FLW, Inc.	213-877-5518
Cal	San Diego, FLW, Inc.	714-277-0993
Conn	Hamden, Equipment Sls. Co.	203-248-5581
DC	Washington, Scientific Sys. Sls. Corp.	202-726-4161
Mass	Chelmsford, Equipment Sls. Co.	617-256-8547
Minn	Minneapolis, Kirkeby & Assoc.	612-377-3239
NM	Albuquerque, Moore-Eiler	505-344-8020
NY	Syosset, Scientific Sys. Sls.	516-921-3737
NC	Matthews, W.K. Hile Co.	704-847-9125
Ohio	Dayton, G.L. Ashby Assoc.	513-252-5627
Okla	Norman, Data Mktg. Assoc.	405-364-8320
Tex	Dallas, Data Mktg. Assoc.	214-358-4643
Tex	Houston, Data Mktg. Assoc.	713-686-9627
EXP:	San Antonio, Tex., Data Graphics Corp.	512-342-9486

DATA NUMERICS, 141-A Central Ave., Farmingdale, N.Y., 11735, Tel: 516-293-6600; Empl.: 40

Customer service: A. H. Battaglia

Free literature available: Act I – Automatic continuity tester Act II – Automatic continuity tester, high voltage version Data check 200S – Cable & continuity tester, solid state version Data check 200H – Cable & continuity tester, Hi-Pot model

Products manufactured: Cards, Linear Function, Cards, Logic, Computers, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips, Test Systems, Testers

Local Sales Offices & Reps.

Cal	Encino, World Enterprises	213-342-5473
Cal	San Diego, Tauber & Assoc	714-274-7242
Kan	Wichita, Winco, Inc.	316-684-8224
Md	Cockeysville, Advanced Tech. Sls	301-666-9026
Mass	Newton Centre, Daner Hayes	617-969-4650
Mich	Grand Rapids, R. P. Urban & Assoc.	616-245-0511
NY	Farmingdale, Haines Prod	516-420-1177
Pa	Erie, Tuznik Assoc.	814-459-1894
Wash	Seattle, Drake Assoc	206-763-2755

DATA PRECISION CORPORATION, Audubon Rd., Wakefield, Mass, 01880, Tel: 617-246-1600; Empl.: 100 p. 1•646,647

For info on price: R. Scheinfein; Application info: R. Scheinfein; Customer service: J. Muise; Delivery info: L. Beston

Free literature available: Catalogs of our 3 1/2, 4 1/2 & 5 1/2/digit digital multimeters, Catalog of our new 7 digit, 100 MHz frequency counter, Evaluating digital multimeters-guide to selecting the right meter for your appliation.

Products manufactured: Counters, Meters, Probes

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Scottsdale, Measurement Conslts.	602-944-9519
Cal	Costa Mesa, Meas. Assocs.	714-540-7160
Cal	Sunnyvale, Amasco	408-733-8690
Colo	Boulder, Meas. Conslts.	303-449-5294
Conn	E. Hartford, Tekdata, Inc.	203-525-7647
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9796
Fla	Winterhaven, Lee Assocs.	813-294-5815
Ga	Atlanta, Lee Assocs.	404-457-7117
Haw	Kailua, Lanikai Elctrns.	808-262-6286
Ill	Elk Grove Village, L. F. Green Assoc.	312-593-0282
Ind	Indianapolis, L. F. Green Assoc.	317-293-9827
Md	Lanham, Brimberg Assoc.	301-552-2200
Mass	Burlington, Tekdata, Inc.	617-273-0198
Mich	Detroit, Micro Sls. Corp.	313-482-1229
Minn	Minneapolis, L. F. Green Assoc.	612-781-1611
Mo	Hazelwood, Production Automation Corp.	314-731-2331
Mo	Raytown, Production Automation Corp.	816-737-0066
NJ	Camden, QED Elctrns. Inc. of PA	215-925-8711
NJ	Union City, Meas. Tech. Inc.	201-863-5660
NM	Albuquerque, Meas. Conslts.	505-265-6471
NM	Las Cruces, Meas. Conslts.	505-526-2491
NY	DeWitt, DB Assocs.	315-446-0220
NY	Great Neck, Measurement Tech. Inc.	516-482-3500
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Cleveland, Micro Sls. Corp.	216-725-4560
Ohio	Dayton, Micro Sls. Corp.	513-433-8171
Ore	Portland, Hayes Tech.	503-238-0001
Tex	Dallas, Comspec. Inc.	214-234-4137
Tex	Houston, Comspec. Inc.	713-461-4487
Utah	Murray, Meas. Conslts.	801-268-3181
Wash	Seattle, Hayes Tech.	206-763-2210

DATAPRODUCTS CORP., 6219 DeSoto Ave., Woodland Hills, Cal., 91365, Tel: 213-887-8490; Empl.: 3500

Free literature available: OEM product catalog, Individual data sheets on all products.

Products manufactured: Comm. Systems, Computers

Local Sales Offices & Reps.

Cal	Newport Beach	714-752-7411
Cal	Sunnyvale	408-733-9890
Fla	Pompano Beach	305-942-2257
Md	Bethesda	301-652-8120
Mass	Framingham	617-620-1950
Mich	Southfield	313-355-0822
Minn	Minneapolis	612-835-2066
NJ	Cherry Hill	609-667-7555
Tex	Dallas	214-231-4771

DATA SPECIALTIES, 3455 Commercial Ave., North Brook, Ill., 60062, Tel: 312-564-1800; Empl.: 30; Minimum order: $25

Customer service: E. Kaplan

Products manufactured: Comm. Systems, Data Acquisition & Reduction Systems, Data Loggers, Paper-Tape Preparation Systems, Perforators, Readers, Receivers, Recorders, Tape Winders

Local Sales Offices & Reps.

Ariz	Phoenix, Mountaintek	602-242-5551
Cal	San Diego, Moxon	714-292-4820
Cal	Santa Clara, Moxon	408-249-2491
Colo	Boulder, Mountaintek	303-444-1783
Colo	Evergreen, Mountaintek	303-674-5255
Ind	Columbus, Miltronics	812-376-6321
Mass	Waltham, Digital Sls. Assoc.	617-899-4300
NM	Albuquerque, Mountaintek	505-268-0003
NY	Guilderland, Electro Modular Sys.	518-456-2665
NY	Roslyn Heights, Travco Assocs.	516-621-3223
Pa	Norristown, Denco	215-279-8146
RI	N. Scituate, Digital Sls. Assoc.	401-647-5075
Utah	Salt Lake City, Mountaintek	801-272-4611

DATA TECHNOLOGY, 2700 S. Fairview, Santa Ana, Cal., 92704, Tel: 714-546-7160, TWX: 910-595-1570; Empl.: 150; Minimum order: $25 .... p. 1•649-651,863

For info on price: S. Blakemore; Application info: W. Kennedy; Customer service: L. Lombard; Delivery info: S. Blakemore

Free literature available: Data sheets for: panel meters; multi meters; strip chart recorders.

Products manufactured: Backpanel Interconnect Systems, Converters, Meters, Recorders

Local Sales Offices & Reps.

Ariz	Phoenix, Trembly Assocs.	602-253-6104
Cal	Los Angeles, Basic Sys.	213-938-2833
Cal	Mountain View, Prod. Data of No. Calif.	415-941-4410
Cal	San Diego, Basic Sys.	714-279-9641
Colo	Broomfield, Figaro-Klebba Assocs.	303-466-8228
Fla	Orlando, E.G. Holmes	305-894-8901
Ga	Chamblee, E.G. Holmes	404-451-6161
Ill	Chicago, Sea Inc.	312-282-6694
Ind	Carmel, Sea Inc.	317-846-2593
Kans	Prairie Village, Engrg. Svcs.	913-649-4000
Md	Bel Air, Dyna Rep. Co.	703-354-1222
Mass	Braintree, Data Technology Corp.	617-843-0954
Mass	Waltham, McBar Assoc.	617-890-0233
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	Minneapolis, Sea Inc.	612-425-4455
Mo	St. Louis, Engrg. Svcs.	314-997-1515
NJ	Bogota, Neville & Vespo	
NJ	Haddonfield, Dyna Rep.	609-795-1700
NY	New Hartford, KLM Assocs.	315-735-8525
NY	No. Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-442-0820
NY	Tuckahoe, Neville & Vespo	212-539-1515
Ohio	Cleveland, Data Equip. Sls. Co.	216-252-3151
Tex	Richardson, Lear Assocs.	214-231-5388
Utah	Salt Lake City, Figaro, Klebba Assoc.	303-466-8228
Va	Alexandria, Dyna Rep Co.	703-354-1222
Va	Virginia Beach, E.G. Holmes	804-481-6556
Wash	Seattle, H. Levinson Co.	206-323-5100
Wisc	Waukesha, Sea Inc.	414-547-6637
FOR:	Can., Downsview, Ont., Electronetic Sys.	416-636-3673
FOR:	Can., Montreal, Que., Electronetic Sys. Ltd.	514-343-4112
FOR:	Can., Ottawa, Ont., Electronetic Sys. Ltd.	613-733-3781
FOR:	Can., Vancourver, BC, Electronetic Sys. Ltd.	604-687-5696

DATA TECHNOLOGY INC., 65 Grove St., Watertown, Mass., 02172, Tel: 617-924-1773; Empl.: 42

Products manufactured: Computers, Controls/Control Eqpt., Converters, Counters, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Encoders, Indicators, Recorders

Local Sales Offices & Reps.

Cal	San Marino, Dale-Dahl Assoc.	213-682-3417
Cal	Walnut Creek, Dale-Dahl Assoc.	415-933-9595
Ill	Deerfield, Traco Eng. Co.	312-945-3520
Md	Gaithersburg, Wright Co.	202-296-0979
Mass	Framingham, Victor Assocs.	617-879-5710
Mich	Southfield, Sterling-Lowell Co.	313-352-8881
Mo	St. Louis, Coombs Assocs.	314-542-3399
NM	Albuquerque, W. Dolde Sls Co.	505-256-0307
NY	Albany, J.A. Reagan Co.	518-489-4777
NY	Mamoroneck, Neville & Vespo	212-539-1515
NY	New Hartford, J.A. Reagan Co.	315-732-3775
NY	Rochester, J.A. Reagan Co.	716-473-2115
Ohio	Cleveland, Geotronix Mktg. Assoc.	216-238-8520
Okla	Tulsa, J.W. Elder Co.	918-583-9149
Ore	Eugene, J. Tudor & Assocs.	503-344-9212
Ore	Portland, J. Tudor & Assocs.	503-288-5154
Pa	Exton, Scientific Mktg., Inc.	215-363-7377
Wash	Seattle, J. Tudor & Assocs.	206-682-7444
Wash	Spokane, J. Tudor & Assocs	509-327-3328

DATA TEST CORP., 2450 Whitman Rd., Concord, Cal., 94518, Tel: 415-689-3583, TWX: 910-481-9973; Minimum order: $25

Customer service: D. Greenwood

Free literature available: Family product guide.

Products manufactured: Analyzers, Test Systems, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, B F A Corp.	602-946-4215
Cal	Los Angeles, Burtis Instr. Sls.	213-887-1360
Cal	Oakland, Advanced Technology	415-452-1401
Colo	Denver, B F A Corp.	303-744-3301
Conn	Hamden, Equipment Sls. Co.	203-248-5581
Ill	Wheaton, Engrg. Prods. Assocs.	312-653-6826
Mass	Chelmsford, Equipment Sls. Co.	617-256-8547
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Minn	Minneapolis, Engrg. Prods. Assocs.	612-925-1883
NJ	Pennsauken, Megargel/Himmelstein Assoc.	609-662-3081
NM	Albuquerque, B F A Corp.	505-292-2323
NM	Las Cruces, B F A Corp.	505-523-0601
NY	Tuckahoe, Asco Elctrns.	914-779-8110
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Ohio	Dayton, Electro Sls. Assocs.	513-426-5551
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Utah	San Antonia, Data Mktg. Assocs.	512-828-0937

DATA TRANSLATION, 109 Concord St., Framingham, Mass., 01701, Tel: 617-879-3595, Telex: 948316; Empl.: 15; Minimum order: $38

Customer service: F. Molinari

Free literature available: DATAX Data Acquisition Module brochure; DATAX User Instruction Guide; Data Acquisition System articles; Point Plotting data sheets and application data; DC-DC Converter data sheets; Microcomputer and minicomputer interface guides.

Products manufactured: Amplifiers, Converters, Data Acquisition & Reduction Systems, Meters, Modules, Logic, Encapsulated

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Instrs., Inc.	205-539-4411
Ariz	Scottsdale, Barnhill Three	602-947-7841
Cal	Los Angeles, Basic Sys. Co.	213-938-2833
Cal	Mt. View, Product Data	415-941-4410
Colo	Denver, Barnhill Three	303-934-5505
Fla	Ft. Lauderdale, W.A. Brown Instrs.	305-776-4800
Fla	Ft. Walton Beach, W.A. Brown Instrs.	904-243-6424
Fla	Indialantic, W.A. Brown Instrs.	305-723-0766
Fla	Orlando, W.A. Brown Instrs.	305-425-5505
Ga	Atlanta, W.A. Brown Instrs.	404-939-1674
Kans	Prairie Village, Engineering Svcs. Co.	913-649-4000
La	Gretna, W.A. Brown Instrs.	504-366-5766
Md	Fulton, Gans-Fryling	301-953-3724
Mo	St. Louis, Engineering Svcs. Co.	314-997-1515
NM	Albuquerque, Barnhill Three	505-299-7658
NY	Rochester, Scientific Devices-New York	716-334-2445
NY	Tenafly, Budd-Tronics	201-569-2230
NC	Durham, W.A. Brown Instrs.	919-489-1546
Ohio	Wickliffe, Data-Tron	216-585-8421
Pa	Abington, Bach-Steward Assocs.	
Tenn	Knoxville, W.A. Brown Instrs.	615-584-2614
Tex	Houston, Barnhill Two	713-688-9971
Tex	Richardson, Barnhill Two	214-231-2573
Va	Arlington, Gans-Fryling	703-527-3262
Wash	Bellevue, Scientific Devices-Northwest	206-454-0900

DATACOM, INC., Box 278, Ft. Walton Beach, Fla., 32548, Tel: 904-244-6121, TWX: 510-730-7693; Empl.: 40; Minimum order: $25

For info on price: T. D. Jaye; Application info: T. D. Jaye; Customer service: A. J. Williams; Delivery info: L. L. Croxton

Products manufactured: Alarms, Data Acquisition & Reduction Systems, Memory Systems, Recorders

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak, & Frazier, Inc.	205-536-5650
Fla	Orlando, Currie, Peak & Frazier, Inc.	305-855-0843
Md	Greenbelt, J.E. Cuesta & Co.	301-552-1200
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Mo	Hazelwood, Technical Reps.	314-731-5200
NC	Greensboro, Currie, Peak, & Frazier, Inc.	919-273-3040
Ohio	Dayton, Electro Sls. Assocs.	513-426-5551
Pa	Valley Forge, J.E. Cuesta & Co., Inc.	215-265-5800

DATADYNE CORP., Box 247, King of Prussia, Pa., 19406, Tel: 215-265-1793; FSC No: 53032; Empl.: 23; Minimum order: $25

For info on price: J. Riggs; Application info: J. P. Roding; Customer service: R. D. Currie; Delivery info: L. H. Biscombe

Free literature available: 1. Application Guide for high-speed digital printer mechanisms. 2. Service and Operating instructions for high-speed digital Printer including electronics & mechanics. 3. Low-speed printer specification 4. High-speed printer specification.

Products manufactured: Printers

DATAK CORP., 65 Seventy-First St., Guttenberg, N.J., 07093, Tel: 201-869-2200 .... p. 2•354,1079

For info on price: B. Postorino 201-869-2200; Application info: C. Pflueger 201-869-2203; Customer service: C. Pflueger 201-860-2203; Delivery info: F. Marascio 201-869-2200

Free literature available: Full Line catalog and price sheets; Reprint of article "Printed Circuit Applications of JotDraft Dry Transfers"; Reprint of article "Direct Etch Resist for Printed Circuits"; Printed Circuit Kits brochure.

Products manufactured: Capacitors, Fixed, Delcalcomania, Dials, Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Kits, Marking (Dial, Instrument, Equipment, etc.), Labels, Pressure-Sensitive, Adhesive, Nameplates, Scales, Dial

Local Sales Offices & Reps.

Ariz	Phoenix, H. Premil	602-939-6787
Cal	Millbrae, Polach & Bensinger	415-697-2525
Cal	West Covina, Don Forth Assocs.	213-962-1431
Colo	Denver, W.J. Purdy Co.	303-777-1411
Conn	Wallingfd., Adams-McGregor	203-269-0225
Fla	Ft. Lauderdale, Unirep, Inc.	901-683-7616
Ill	River Forest, Petitt Co.	312-369-9040
Md	Kensington, Forti-Austin	301-949-1707
Mass	Scituate, K. Walsh	617-545-2213
Minn	Minneapolis, Kodo Assoc.	612-881-1255
NJ	Caldwell, BCD Sls. Co.	201-226-2263
NJ	Willingboro, Forti-Austin Assocs.	609-871-9290
NM	Albuquerque, W.J. Purdy Co.	505-266-7959
NY	Middle Village, BCD Sls. Co.	212-894-1331
Ohio	Cleveland, C.H. Dolfuss, Jr. & Co.	PR 1-1270
Ohio	Dayton, C.H. Dolfus, Jr. & Co.	213-275-4831
Ore	Lake Oswego, McMillan Elctrns.	503-636-7954
Pa	Pittsburgh, G.S. Root & Co.	412-561-5707
RI	Lincoln, Adams-McGregor	401-726-1300
SC	Taylors, H.C. Norman	803-244-6254
Tenn	Memphis, H.C. Norman Sls. Co.	901-683-7616
Tex	Dallas, Loss & Stewart	214-691-6039

Local Distributors

Ala	Huntsville, Mock Elect. Inc., 2310 Memorial Pkwy.
Alas	Juneau, Juneau Elctrn., 241 S. Franklin
Ariz	Tempe, Circuit Special, 1110 N. Scottsdale Rd.
Cal	Palo Alto, Zack Elctrns., 654 High St.
Cal	San Francisco, Zack Elctrns., 1444 Market St.
Cal	W. Los Angeles, Cal. Elect. Supply, 1911 Armacost Ave.
Colo	Colorado Springs, Walker Elect., 2838 N. Prospect St.
Conn	Waterbury, Bond Radio Elect., 438 W. Main St.
Del	Wilmington, RESCO, 3601 Market St.
Fla	W. Palm Bch., Nurmi Elect., 1727 Donna Rd.
Ga	Atlanta, Lykes Elect. Sply., 1135 Chattahoochee Ave. N.W.
Haw	Honolulu, Precision Radio Ltd., 1160 S. King
Ill	Peoria, Klaus Radio & Elect., 8400 N. Pioneer Pkwy.
Ind	Indianapolis, Graham Elect., 133 Pennsylvania St.
Ky	Louisville, P.I. Burks Co., 842 So. 7th St.
La	N. Orleans, Radio Parts Inc., 1112 Magazine St.
Md	Baltimore, A S I Elect., 1728-30 Whitehead Rd.
Mass	Boston, Sager Elctrical Sply., 172 High St.
Mass	Dedham, Gerber Elect., 852 Providence Hwy.
Mich	Muskegan, Western Elect. Sply., 1781 Fifth St.
Minn	Minneapolis, Electronic Ctr., 107 Third Ave., N.
Mo	Kansas City, Burstein Applebee, 3199 Mercier
Mo	St. Louis, Gateway Elect., 8123-25 Page Blvd.
Neb	Lincoln, Scott Elect. Sply., 4040 Adams St.
Nev	Reno, Elect. Dist. Co., Box 2918
NH	Concord, Evans Radio Inc., Box 893
NJ	Spfld., Route Elect., Echo Plaza, Rt. 22

NM Albuquerque, Elect. Parts, 222 Truman St. N.E.
NY Buffalo, Summit Distributor, 916 Main St.
NY L.I. City, H.L. Dalis, Inc., 35-35 24th St.
NY Rochester, Rochester Radio Sply., 140 W. Main St.
NY Syosset, Lafayette Radio, 111 Jericho Tpk.
NC Raleigh, Southeastern Radio, 414 Hillsborough St.
Ohio Akron, Akron Elect. Sply., 107 So. Arlington St.
Ohio Columbus, Hughes-Peters, 481 E. 11th Ave.
Okla Tulsa, Radio Inc., 1000 So. Main St.
Ore Portland, Portland Radio Sply., 1234 S.W. Stark St.
Pa Pittsburgh, R.P.C. Electronics, 620 Alpha Dr.
Pa Reading, G. D. Barbey, 333 N. 4th St.
RI Providence, W. Dandreta & Co., 28 Wolcott St.
SC Columbia, Dixie Radio Sply., 1900 Barnwell St.
Tenn Memphis, W & W Distributing, 641 Madison
Tex El Paso, Midland Specialty Co., 2235 Wyoming Ave.
Utah Provo, Central Stan Elect., Box N
Utah Salt Lake City, Kimball Elect., 350 Pierpont Ave.
Va Arlington, Arlington Elect. Who., 3636 Lee Hwy.
Wash Seattle, Radar Elect. Co., 169 Western Ave. W.
Wisc Milwaukee, Parts Mart Corp., 1314 N. Seventh St.

DATALOG DIV., LITTON SYS., 1770 Walt Whitman Rd., Melville, N. Y., 11746, Tel: 516-694-8326, TWX: 510-224-6477; Empl.: 110; Minimum order: $50

For info on price: Mktg. Dept. Ext. 151; Application info: Mktg. Dept. Ext. 151; Customer service: Prod. Svcs.-H. Israel Ext. 442; Delivery info: Mktg. Dept. Ext. 151

Free literature available: Brochures - Messagefax, Videofax, Pressfax, Weatherfax, Policefax, Photo Recorder, Printers - MC1000,MC2000, MC3000, MC3434, MC4600, MC8800, 1100 and MC5000

Products manufactured: Comm. Systems, Printers

Local Sales Offices & Reps.

Cal	Studio City	213-986-7350
NJ	Bayonne	201-823-2310
Okla	Tulsa	918-664-6170

DATAMETRICS INC., 340 Fordham Road, Wilmington, Mass., 01887, Tel: 617-658-5410; Empl.: 104; Minimum order: $50

For info on price: S. Lucke; Application info: H. Gray; Customer service: A. Crampton; Delivery info: K. McMillan

Free literature available: Programmable Controller Handbook; Pressure/Vacuum Measurement Handbook; Time Code Generator Catalog; Flow Measurement Catalog; Absolute Timing Distribution Handbook.

Products manufactured: Amplifiers, Bridges, Calibrators, Controllers, Programmable, Converters, Data Acquisition & Reduction Systems, Detectors, Encoders, Gages, Generators, Indicators, Meters, Monitors, Multiplexers, Standards, Switches, Tape Search Equipment, Thermometers, Resistance, Timers, Totalizers, Digital, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs. Inc.	205-533-5896
Cal	Campbell, Sedillo Co.	408-374-5220
Cal	Canoga Park, Boyle Assocs.	213-773-5982
Cal	Palo Alto, R. W. Thompson Assocs.	213-677-6105
Cal	Studio City, Pi Instruments	213-983-0151
Colo	Littleton, RADCO Elctrns.	303-794-4279
DC	Washington, Scientific Sys. Sls. Corp.	202-726-4161
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ga	Atlanta, W. L. Schoonover	404-255-0761
Kans	Shawnee Mission, Pivan Eng.	913-722-1030
Md	Rockville, TE Corp.	301-340-0303
Mass	Burlington, Scientific Sys. Sls. Corp.	617-273-1660
Mass	Burlington, Tekdata	617-273-0198
Mass	Natick, Andruss-Peskin Corp.	617-653-3919
Mich	Detroit, S. Sterling Co.	313-255-1970
Mo	St. Louis, Pivan Eng.	314-542-3636
NM	Albuquerque, Klein Aerospace	505-344-8020
NY	Depew, Labtronics	716-685-4111
NY	Garden City, PM Elctrns.	
NY	Syosset, Scientific Sys. Sls. Corp.	516-921-3737
NY	Syracuse, Labtronics	315-454-9314
NC	Raleigh, Lee Assocs. Inc.	919-787-5818
NC	Winston-Salem, RADCO Co.	919-722-9671
Ohio	Dayton, E. V. Swenson	513-435-2772
Ohio	Dayton, S. Sterling	513-298-7573
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
Tex	Dallas, True Tech. Co.	214-691-7870
Tex	Houston, Leeco	713-649-7727
Tex	Richardson, Leeco	214-231-7696
Wash	Bellevue, Topp Engrg. Sls. Corp.	206-747-5401
Wash	Seattle, Showalter Judd	206-624-9020

DATAPROBE, INC., 290 Huyler St., So. Hackensack, N.J., 07606, Tel: 201-489-5588; Empl.: 10

Customer service: S. Weiss

Products manufactured: Comm. Systems, Controls/Control Eqpt., Display Devices/Displays, Generators, Multiplexers, Receivers, Testers, Transmitters

DATASCAN DIV., Anadex Instruments Inc., 7833 Haskell Ave., Van Nuys, Ca., 91406, Tel: 213-782-9527, TWX: 910-495-1762; Empl.: 95; Minimum order: $15

Customer service: Will Luff

Free literature available: Digital Panel Meter Catalog, I.C. Logic Card Handbook

Products manufactured: Cards, Logic, Comparators, Controls/Control Eqpt., Converters, Integrators, Electronic, Meters, Racks

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assoc. Inc.	205-533-5896
Ariz	Tempe, PLS Assocs.	602-957-9110
Cal	Los Altos, Jay Stone & Assocs.	415-948-4563
Colo	Denver, PLS Assocs.	303-771-0140
Conn	W. Hartford, Instrument Assocs.	203-525-9367
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Kans	Mission, Pivan Engrg. Co.	913-722-1030
Md	Wheaton, Sonco	301-942-9420
Mass	Bedford, Instrument Assocs.	617-275-0700
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Peirce, Inc.	616-349-9666
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501
Mo	St. Louis, Pivan Engrg. Co.	314-567-3636
NJ	Ft. Lee, Tech. Mktg. Assoc.	201-224-6911
NM	Albuquerque, PLS Assocs.	505-255-2330
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-278-5873
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	Blue Bell, Sonco	215-CH2-8460
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Wash	Seattle, R. S. Drake Assocs.	206-763-2755
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940
FOR:	Can., Montreal, Que., Radionics Ltd.	514-735-4565

DATATRON, INC., Box 11427, Santa Ana, Cal., 92711, Tel: 714-540-9330, TWX: 910-595-1589; Empl.: 300

Products manufactured: Annunciators, Display Devices/Displays, Editing Equipment, Tape, Generators, Lights, Services, Assembly, Production & Test, Tape Search Equipment, Test Systems, Testers, Translators, Data

Local Sales Offices & Reps.

Ala	Huntsville, Currie Aerospace	205-536-5650
Cal	Anaheim, Broadcast Comms. Devices	714-528-9505
Cal	Ben Lomond, Broadcast Comms. Devices	408-336-5437
Cal	Los Angeles, Basic Sys.	213-938-2833
Cal	Mountain View, Prod. Data Co.	415-941-4410
Cal	San Diego, Mesa Elctrns.	714-278-8021
Colo	Englewood, Davis Assocs.	303-761-9228
Colo	Evergreen, Didier/Denver	303-674-6000
Fla	Lighthouse Point, Saber Assocs.	305-422-3686
Ga	Atlanta, Radford Assocs.	404-237-6097
Ill	Chicago, Megatek, Inc.	312-889-1277
Md	Gaithersburg, Data-Time	301-948-7666
Mass	North Billerica, Datatron East	617-667-5353
Mich	Detroit, WKM Assocs.	313-892-2500
Mich	Farmington Hills, M. Dyer	313-892-2500
Minn	Minneapolis, Megatek, Inc.	612-933-2133
Mo	Raytown, Production Automation	816-737-0066
NJ	Fairfield, KLS Assocs.	201-227-2900
NM	Albuquerque, Rustco Entprs.	505-296-6474
NY	Garden City, P.M. Elctrns.	516-248-4858
NY	Kings Park, KLS Assocs.	212-233-4849
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Dallas, Martin, Zienkosky, Browne & Assoc.	214-233-5535
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Wash	Seattle, Avionics Liaison	206-767-3870
FOR:	Can., Don Mills, Ont., Glentronix	416-444-8497
FOR:	Can., Montreal-Nord 462, Que., Auvinic	514-322-4564

DATAWEST CORP., 7333 E. Helm Dr., Scottsdale, Ariz., 85260, Tel: 602-948-3280; Empl.: 14; Minimum order: $150

Customer service: N. T. Holzer

Products manufactured: Controllers, Programmable, Converters

DATEL SYSTEMS INC., 1020 Turnpike St., Canton, Mass., 02021, Tel: 617-828-8000, TWX: 710-348-0135; Empl.: 215; Minimum order: $30

p. 1•156-161,241,648,1166,1167

For info on price: B. Aldsworth; Application info: B. Salow; Customer service: S. Jackson; Delivery info: S. Jackson

Free literature available: 70 Pg Engineering Product Handbook-General catalog of A/D & D/A converters, multiplexers, sample/holds, DPM's; power supplies; 20 pg Data Acquisition Brochure; 16 Pg Power Supply Catalog; 16 Pg Cassette Data Logger Brochure; 60 Individual Product Data Sheets.

Products manufactured: Amplifiers, Computers, Converters, Counters, Data Acquisition & Reduction Systems, Data Loggers, Filters, Integrated Circuit Devices, Meters, Multiplexers, Multipliers, Power Supplies, Printers, Recorders, Tapes, Recording, Magnetic (All Types), Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scientific Instrs.	205-837-1601
Ariz	Phoenix, Cleveland Ent.	602-996-6130
Cal	Los Angeles, Datel Sys.	213-933-7256
Cal	Santa Ana, Datel Sys., Inc.	714-835-2751
Cal	Sunnyvale, Datel Sys.	408-733-2424
Colo	Westminster, Harvey Data Sys., Inc.	303-427-5299
Fla	Lighthouse Point, Saber Assocs., Inc.	305-943-3076
Fla	Longwood, Saber Assocs., Inc.	305-422-3686
Fla	St. Petersburg, Saber Assocs., Inc.	813-441-1301
Haw	Honolulu, Hawaii Data Sys.	808-946-1533
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Iowa	Marion, B. Rush Assocs.	319-377-6313
Kans	Olathe, Technical Reps.	913-782-1177
Mass	Canton, Datel Sys., Inc.	617-828-8000
Mich	Troy, G.R. Peters Assocs.	313-524-2920
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	Hazelwood, Technical Reps.	314-731-5200
NJ	Fort Lee, Tech Mktg. Assoc.	201-224-6911
NM	Albuquerque, Cleveland Ent.	505-345-2481
NY	Liverpool, R & D Assocs.	315-622-2350
Ohio	Cleveland, Instrumentation Sys.	216-486-0782
Ohio	Dayton, Instrumentation Sys.	513-294-2838
Pa	King of Prussia, Rivco	215-265-5211
Pa	Pittsburgh, Instrumentation Sys.	412-243-1111
Tex	Dallas, Evans-McDowell	214-238-7157
Tex	Houston, Evans-McDowell	713-783-2900
Va	Arlington, H.J. Heffernan Co.	703-522-6666
Wash	Seattle, Jon B. Jolly Inc.	206-938-4166
Wisc	Milwaukee, Carter Elctrns.	414-464-5555
EXP:	Montreal 12, Quebec, Can., Prelco Elctrns., Ltd.	514-389-8051
EXP:	Ottawa, Ontario, Can., Prelco Elctrns., Ltd.	613-237-6150
EXP:	Rexdale, Ontario, Can., Prelco Elctrns., Ltd.	416-678-0401

DATEX DIV., Conrac Corp., 1600 S. Mountain Ave., Duarte, Cal., 91010, Tel: 213-395-9141

Products manufactured: Comm. Systems, Controls/Control Eqpt., Converters, Indicators

DATRON SYSTEMS, 20716 Plummer St., Chatsworth, Cal., 91311, Tel: 213-882-9616, TWX: 910-494-2787; Empl.: 165; Minimum order: $100

For info on price: F. M. Amtsberg; Application info: N. Hannon; Customer service: F. M. Amtsberg; Delivery info: F. M. Amtsberg

Products manufactured: Amplifiers, Antenna Feed Systems, Antenna Rotators, Antennas, Computers, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Detectors, Horns, Microwave, Indicators, Integrators, Electronic, Limit Stops, Mechanical, Mounts, Networks, Pedestals, Radar, Radar Systems, Servo Systems, Tracking Systems

Local Sales Offices & Reps.

Ala	Huntsville, P. T. Miller Assocs.	205-534-2652

Cal	Mountain View, Microwave Mktg. Assocs.	415-969-3355
Cal	Santa Barbara, Kannard Engrg., Inc.	805-682-1928
DC	Washington, ECM Assocs.	202-296-1337
Fla	Ft. Lauderdale, Snow Co.	305-563-2449
Mass	Needham Hgts., Reptron, Inc.	617-449-4142
Tex	Fort Worth, C. Wolf & Assocs.	817-738-1996

DATTILO ENTERPRISES, INC.

DATTILO ENTERPRISES, INC., 9405 Doral Ct., Louisville, Ky., 40220, Tel: 502-426-1212; Empl.: 50

Customer service: D. P. Dattilo 502-491-6262

Free literature available: Available literature includes a short form brochure describing capabilities and services offered. Application notes (with photos) are included with specific details on cost reduction re-design.

Products manufactured: Cards, Linear Function, Cards, Logic, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ind	Indianapolis, Needler Sls. Co.	317-255-8056
Ky	Louisville, Custom Comp. Sls.	502-969-4473

Advertisment

Why do so many firms, both large and small, come to Dattilo Enterprises, Inc. for design, layout, and complete printed circuit assemblies. The answer is simple. We do more than anyone else in the industry to help you with your individual circuit needs. We provide weekly status reports to keep you up-to-date with your RFQ or Purchase order. We do not offer excuses, only fast, concise information or solutions. We have established our reputation on superior quality at reasonable prices. For complete printed circuit assemblies from design to finished product; remember our name. We would be pleased to add your company to our constantly growing list of satisfied customers. If the above sound to good to be true.......try us, you will be very pleasantly surprised.

DATUM, INC., 1363 State College Blvd., Anaheim, Calif., 92806, Tel: 714-533-6333, TWX: 910-592-1289; Empl.: 300

Products manufactured: Amplifiers, Analyzers, Clocks (All Types), Computers, Converters, Data Acquisition & Reduction Systems, Generators, Memory Systems, Multiplexers, Printers, Readers, Receivers, Recorders, Tape Recording Accessories, Tape Search Equipment, Terminal Equipment, Digital, Timers

Local Sales Offices & Reps.

Ala	Huntsville, Datum	205-881-7629
Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Scottsdale, BFA of Arizona, Inc.	602-946-4215
Cal	Lawndale, Ward/Davis Assoc.	213-542-7740
Cal	San Diego, Datum, Inc.	714-453-1633
Cal	Sunnyvale, Ward/Davis Assoc.	408-245-3700
Colo	Denver, BFA of Arizona, Inc.	303-744-3301
Conn	Hamden, P. Jenks Assoc.	203-281-0810
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9767
Fla	Longwood, Southern Data Assocs.	305-831-3311
Fla	Winterhaven, Lee Assocs.	813-294-5815
Ill	Hoffman Estates, Datum, Inc.	312-298-1244
Kans	Wichita, Winco, Inc.	316-684-8224
Md	Silver Spring, K-G Elctrns.	301-588-3000
Mass	Wakefield, P. Jenks Assoc.	617-246-1590
Mass	Waltham, Datum, Inc.	617-899-7474
Mich	Detroit, Electro Sls. Assoc.	313-526-8800
NM	Albuquerque, BFA of Arizona, Inc.	505-292-1212
NM	Las Cruces, BFA of Ariz., Inc.	505-523-0601
NY	Great Neck, Krasner Assocs.	516-487-0690
NY	Melville, Astrorep	516-423-2266
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Aurora, EMA, Engrg. Mktg. Assoc.	216-562-6104
Ohio	Centerville, EMA, Inc.	513-433-2800
Ohio	Cleveland, Electro Sls. Assoc.	216-261-5440
Ohio	Dayton, Electro Sls. Assoc.	513-426-5551
Pa	Norristown, Denco, Data Engrg. Co.	215-279-8146
Pa	Pittsburgh, Electro Sls. Assoc.	412-371-9449
Tex	Arlington, J. T. Houston Assoc.	817-265-2931
Tex	Dallas, Data Aids Assoc.	214-620-1551
Tex	Dallas, Datum, Inc.	214-352-7411
Tex	Houston, Data Aids Assoc.	713-862-6685
Utah	Salt Lake City, BFA of Ariz.	801-466-6522
Wash	Seattle, Comptronics, Inc.	206-284-4842

DAVIDSON ELCTRN. DEV. CO., 2211 Peninsula Dr., Erie, Pa., 16506, Tel: 814-833-9818

Customer service: A. R. Davidson

Products manufactured: Bridges, Meters, Test Systems

Local Sales Offices & Reps.

Mich	Detroit, WKM Assocs.	313-892-2500
Ohio	Cleveland, W.K.M. Assocs.	216-267-0445
Ohio	Dayton, W.K.M. Assocs.	513-434-7500
Pa	Pittsburgh, W.K.M. Assocs.	412-892-2953

Advertisment

Davidson designs and builds to your requirements: automatic test equipment, data acquisition systems, automatic adjust equipment, and special devices for the electrical and electronic industry.

DAVIES MOLDING CO., HARRY, 4920 Bloomingdale Ave., W., Chicago, Ill., 60639, Tel: 312-622-8966; FSC No: 5355; Empl.: 170; Minimum order: $25

For info on price: L. A. Sera; Application info: L. A. Sera; Customer service: R. C. Appleby Jr.; Delivery info: R. C. Appleby Jr.

Free literature available: 24 page catalog of plastic knobs, handles, and cases available without tooling costs.

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Dials, Handles For Cabinets, Circuit Boards, Racks, etc., Knobs

Local Sales Offices & Reps.

Cal	Belmont, Littrell Western Sls., Inc.	415-592-3346
Cal	Los Angeles, Littrell Western Sls., Inc.	213-261-0164
Conn	Meriden, P.R. Sturgeon Co.	203-237-1112
Fla	Fort Lauderdale, W. Chester Smith	305-564-1477
Ill	Chicago, R. W. Kruse Co.	312-736-9546
Ind	Clermont, L.T. Clower Co.	317-293-3598
Iowa	Cedar Rapids, Clancey Co.	319-365-7141
Iowa	Des Moines, Clancey Co.	515-278-1331
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Mich	Bloomfield Hills, Gitre Co.	313-645-1777
Mo	Kansas City, Clancey Co.	816-931-3090
Mo	St. Louis, Clancey Co.	314-432-3633
NY	Syosset, Rywel Sls.	516-364-0888
Ohio	Westlake, Foley & Beilstein Co.	216-871-8830
Pa	Erie, M.L. Crowell Co.	814-454-0250
Pa	Paoli, W.G. Walker	215-627-8146
Tenn	Memphis, L.E. Offutt Co.	901-789-1210
Tex	Dallas, Commercial Plastics & Supply Co.	214-631-8170
Wash	Seattle, Northwest Plastics Inds.	206-763-0441
Wisc	Milwaukee, Clague Sls. Corp.	414-272-1951
FOR:	Can., Toronto, Atlas Elctrns., Ltd.	416-781-6174

DAVEN, See McGraw-Edison Co.

DAVIS ELEC. CO., Box 38, Cape Girardeau, Mo., 63701, Tel: 314-335-5547; Empl.: 54; Minimum order: $100

For info on price: B. D. Davis; Application info: T. Le Grand; Customer service: B. D. Davis; Delivery info: B. D. Davis

Products manufactured: Relays

Local Sales Offices & Reps.

Cal	Costa Mesa, George Mousel Co.	714-546-8990
Cal	Los Altos, Schwerin Assocs.	415-941-3737
Cal	Santa Barbara, Schwerin Assocs.	805-967-7317
Fla	Palm Beach Gardens, W. Reasor & Assocs.	305-622-4049
Fla	Tampa, W. Reasor & Assocs.	813-877-2886
Ill	Norridge, Gianaras Sls. Co.	213-SP4-4600
Mass	Scituate, Near, Inc.	617-545-6327
Mo	Kansas City, Automatic Gen. Elctrn. Sls., Co.	816-DE3-8206
Ohio	Cincinatti, Components Inc.	513-721-2997
Ohio	Cleveland, Components Inc.	216-VI2-2737
Pa	Radnor, W. Henry Cordray Sls. Co.	215-TR8-3737
Tex	Dallas, Stevens Sls. Co.	214-350-2476
Wisc	Cedarburg, TFL Assocs.	414-377-7030

DAVIS & CO., J.W., Box 35313, Dallas, Tex., 75235, Tel: 214-352-8405; Empl.: 42

For info on price: W. Hevron; Application info: W. N. Fangio; Customer service: S. DeHay; Delivery info: W. Hevron

Products manufactured: Amplifiers, Attenuators, Cabinets & Accessories, Knobs, Mixers, Speaker Systems, Speakers, Transformers

Local Sales Offices & Reps.

Ill	Chicago, B. Burns & Assocs.	312-775-1233
Kans	Overland Park, T. Dowell & Assocs.	913-236-8200
Tex	Dallas, Crockett Sls. Co.	214-748-8209

DE COURSEY ENGRG. LAB., 11828 W. Jefferson, Culver City, Cal., 90230, Tel: 213-EX7-9668; Empl.: 7

Customer service: L. W. Howard

Free literature available: "Active Filters by DeCoursey" "DeCoursey Model 110 Electronic Dividing Network."

Products manufactured: Chargers, Battery, Coils Including Assemblies & Forms, Filters, Inverters, Networks, Transformers

DEARBORN ELCTRNS. DIV., Sprague Elec. Co., Box 1076, Longwood, Fla., 32750, Tel: 305-838-3011; FSC No: 56289; Minimum order: $50

Customer service: J. D. Kowalsk 413-664-4411 Ext. 2435

Products manufactured: Capacitors, Fixed

Refer to Sprague Electric for Sales office information

DEARBORN WIRE & CABLE CO., 8299 Evenhouse Dr., Rosemont, Ill., 60018, Tel: 312-696-1000; Empl.: 58; Minimum order: $25 .... p. 2•1993

For info on price: K. Brcka; Application info: K. Brcka; Customer service: M. DePinto; Delivery info: J. Lebert

Products manufactured: Braid, Cable, Bus Bars & Systems, Cable Assemblies & Harnesses, Cable, Cable Retractors, Cords, Monitors, Shields, Tubing, Wire, Wire Shielding

Local Distributors

Cal	Burlingame, Rose Elctrns., 846 Stanton	415-697-0224
Cal	Garden, Allied Elctrns., 12821 Knotts Ave.	213-598-8671
Cal	Inglewood, Switch & Signal, 1009 W. Arbor	213-776-3550
Fla	Clearwater, Diplomat Southland, 1771 N. Hercules	813-443-4512
Fla	Miami, Electro-Standards Lab., 3560 N.W. 34th	305-633-6973
Ill	Chicago, Allied Elctrns., 2400 W. Washington	312-421-2400
Ill	Chicago, Merrill Elctrns., 3563 N. Milwaukee	312-386-2525
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Ill	Elk Grove, Diplomat Lakeland Electrn., 2451 Brickvale	312-595-1000
Ind	Evansville, Hutch & Sons, 300 N. Main	812-425-7201
Ind	Fort Wayne, Fort Wayne Elctrns., 3606 Maumee Ave.	219-423-3422
Mich	Grand Rapids, Stotts-Friedman, 2035 Eastern Ave.	616-241-6731
Minn	Minneapolis, Electro-Com, 3816 Chandler Dr.	612-788-8601
Mo	St. Louis, Diplomat St. Louis, 2725 Mercantile	314-645-5550
NY	Rochester, Simcona Elctrncs., 275 Mt. Read Blvd.	716-328-3230
Tenn	Knoxville, Industrial Electric, Gov. J. Sevier	615-753-7135
Tex	Garland, Hisco, 3710 Marquis	214-272-5411
Tex	Houston, Altair Co., 9501 Baythorne	713-462-3029
Tex	Houston, Hisco, 1815 Dallas	713-228-6662
Tex	Richardson, Altair, Box 26	204-231-5166
Utah	Salt Lake, Diplomat Alta Elctrns., 2280 S. Main Str.	801-486-7227
Va	Portsmouth, Distributors Inc., 710-712 Country	703-399-2446
Va	Richmond, Avec Elctrns., 2002 Staples	703-359-6071
Wisc	Milwaukee, Electronic Expeditors, 6045 Green	414-228-8100

DECISION DATA COMPUTER CORP., 100 Witmar Rd., Horsham, Pa, 19044

DECITEK, Div. Jamesbury Corp., 250 Chandler St., Worcester, Mass., 01602, Tel: 617-798-8731; Empl.: 800

Free literature available: Bulletin D2 Decitek Punched Tape Readers

Products manufactured: Readers

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns. Assocs.
Cal	Costa Mesa, Costello Little & Co.
Cal	Los Altos, Casey Assoc.
Conn	Southbury, J.J. Wild
Fla	Ft. Lauderdale, Beacon Elctrns. Assoc.
Fla	Maitland, Beacon Elctrns. Assoc..
Ga	Atlanta, Beacon Elctrns. Assoc.
Ill	Rolling Meadows, Lightner Assoc.
Kans	Shawnee Mission, Inland Assoc.
Mass	Needham, J.J. Wild
Mich	Southfield, Data-Tron
Minn	Minneapolis, Loonam Assoc.
Mo	Glen Cove, Inland Assoc.
NJ	Woodbridge, J.J. Wild
NY	Jericho, J.J. Wild
Ohio	Dayton, Data-tron
Ohio	Wickliffe, Data-tron
Pa	Monroeville, Data-tron
SC	Spartanburg, Beacon Elctrns. Assoc.

DEFIANCE CIRCUIT CORP., Sub. Hi-G, 12 Shepherd St., Lawrence, Mass., 01843, Tel: 617-688-1856, TWX: 710-342-1246; Empl.: 120; Minimum order: $100 p. 2•252,253

Customer service: Bill Imlach 617-688-1856

Products manufactured: Boards, Printed Circuit

Local Sales Offices & Reps.

Cal	Downey, Trimarco	213-861-8244
Conn	Middletown, John E. Boeing	203-632-1892
Ga	Marietta, K & E Assocs.	404-427-0241
Ill	Des Plaines, Coombs Assoc.	312-298-4830
Kans	Wichita, Buse Sls.	316-685-8036
Md	Timonium, Heller Sls.	301-252-4780
Mass	Lexington, John E. Boeing Co.	617-862-2500
Minn	Minneapolis, Nygaard Sls.	612-881-3727
Miss	Corinth, K & E Assoc.	601-287-5369
Mo	St. Charles, Buse Sls. Co.	314-946-6430
NY	Great Neck, Pacent-DiBlasi	516-482-4678
NY	Rochester, Tech-Mark	716-223-1252
Pa	Glenside, Elcom, Inc.	215-885-1325
Tex	Dallas, Blackburn Assoc.	214-351-9991
EXP:	Can.,Mississauga, Ont., Anbak Sales	416-625-1061

DEGUSSA INC., Metals Div., Two Pennsylvania Plaza, New York, N.Y., 10001, Tel: 212-563-7100, TWX: 710-581-6320; Empl.: 30; Minimum order: $25

Customer service: Metals Div.

Free literature available: Catalog 101 - Platinum resistance elements for temperature sensing, Catalog 102 - Resistance temperature detectors, WS-81 - Platinum resistance surface temperature sensor.

Products manufactured: Probes, Thermometers, Resistance, Transducers, Wire

DEL ELECTRONICS CORP., 250 E. Sandford Blvd., Mt. Vernon, N.Y., 10550, Tel: 914-699-2000, TWX: 710-562-0130; FSC No: 01378; Empl.: 100 p. 1•1168-1176; p. 2•120

For info on price: W. Young; Application info: B. Michalak; Customer service: T. Galgano; Delivery info: T. Galgano

Free literature available: Complete Catalogs Available

Products manufactured: Analyzers, Capacitors, Fixed, Capacitors, Variable, Chokes, Coils Including Assemblies & Forms, Connectors, Controls/Control Eqpt., Converters, Counters, Dividers, Indicators, Inverters, Modulators, All Kinds, Monitors, Multipliers, Networks, Oceanographic Equip. (Electronic), Power Supplies, Reactors, Regulators, Relays, Switches, Testers, Transducers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Cal	Downey, Trimarco, Inc.	213-861-8244
Cal	Palo Alto, Brooks Techn. Group	415-328-3232
Cal	Pasadena, D Ellis Co.	213-681-9108
Cal	San Carlos, Winco Sls.	415-365-6082
Colo	Littleton, Radco Elctrns.	303-794-4279
Fla	Winter Haven, Lee Assocs.	813-294-5815
Fla	Winter Park, Young & Lawrence Assoc.	305-647-6929
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Elmhurst, Scott Assocs.	312-279-5681
Md	Ellicott City, Whitco	301-937-1122
Mass	Burlington, TriTek Inc.	617-272-4550
Mich	Dearborn, Pitcher-Poulin	313-582-5450
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-559-7373
Minn	Mpls., Scott Elctrn. Sls.	612-929-2985
Mo	Springfield, Del-Tech Assocs.	417-881-3667
NJ	Nutley, I. Brill	201-667-0653
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Commack, L.K. Haner Assocs.	516-864-2220
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Cincinnati, F.J. Campisano	513-662-1616
Ohio	Fairborn, Tech. Assocs.	513-878-2484
Ore	Portland, J.E. Edstrom	503-775-8527
Pa	Ardmore, Martin Elec. Co.	215-649-6332
Tex	Richardson, Athans Sls. Co.	214-235-7859
FOR:	Can., Toronto, Ont., Datamex	416-787-1208
FOR:	Can., Ville La Salle, Que., Electrodesign	514-363-5120

DELBERT BLINN. CO., Box 2007, Pomona, Calif., 91766, Tel: 714-623-1257

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Fasteners, Insulators & Insulation, Pads, Transistor Mounting, Services, Assembly, Production & Test, Sockets, Spacers, Transistor, Diode, Thyristor Heat Dissipators

DELCO ELECTRONICS DIV., General Motors Corp., 700 Firmin St., Kokomo, Ind., 46901, Tel: 317-457-8461, TWX: 810-269-1921; Empl.: 9500 ....p. 1•1838-1841

Free literature available: Short Form Catalogs, Data Sheets and Application Notes.

Products manufactured: Accelerometers, Alarms, Cards, Logic, Computers, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Diodes, Gyros (All Types), Heat Sinks, Soldering, Inverters, Rectifiers, Suppressors, Transistor, Diode, Thyristor Heat Dissipators, Transistors

Local Sales Offices & Reps.

Cal	Goleta	805-968-1011
Cal	Van Nuys	213-988-7550
Ind	Kokomo	317-459-2175
NJ	Union	201-687-3770
Exp:	NY New York, Gen. Motors Overseas Opers, Power & Ind'l. Prods. Dept.	212-486-3723

Local Distributors

Ala	Birmingham, Forbes Distr. Co., 1416 Fourth Ave., S.	205-251-4104
Ala	Huntsville, Powell Elctrns., 803 Oster Dr.	205-539-2731
Ariz	Phoenix, Sterling Elctrns., 1930 N. 22nd Ave.	602-258-4531
Cal	Goleta, R.P.S. Elctrns., 350-E So. Kellogg Ave.	805-964-6823
Cal	Los Angeles, Kierulff Elctrns., 2585 Commerce Way	213-685-5511
Cal	Los Angeles, R.P.S. Elctrns., 1501 S. Hill St.	213-748-1271
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	San Diego, Kierulff Elctrns., 8797 Balboa Ave.	714-278-2112
Cal	San Diego, R.P.S. Elctrns., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	Sunnyvale, Bell Inds., 1161 N. Fairoaks Ave.	408-734-8570
Colo	Denver, Kierulff Elctrns., 10890 E. 47th Ave.	303-371-6500
Conn	Norwalk, Harvey Elctrns., 112 Main St.	203-853-1515
Fla	Miami Springs, Powell Elctrns./Fla., 1744 N.W. 69th Ave.	305-592-3260
Fla	Orlando, Powell Elctrns./Fla., 2032 Palm Ridge Way	305-859-1450
Ill	Rosemont, Kierulff Elctrns., 9340 William St.	312-678-8560
Ill	Skokie, Bell Inds., 7701 N. Austin Ave.	312-282-5400
Ind	Indianapolis, Graham Elctrns. Supply, 133 So. Pennsylvania St.	317-634-8202
Md	Baltimore, Radio Elec. Serv. Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Billerica, Kierulff Elctrns.	617-935-5134
Mass	Newton, Greene-Shaw Co., Chapel Bridge Pk., 70 Bridge St.	617-969-8900
Mich	Farmington, Harvey-Michigan, 23461 Ind. Pk. Dr.	313-477-1650
Mich	Livonia, Pioneer/Mich.	313-525-1800
Minn	Minneapolis, Stark Elctrns. Supply Co., 112 3rd Ave., N.	612-332-1325
Mo	Kansas City, Walters Radio Supp., 2627-3635 Main St.	816-531-7015
Mo	St. Louis, LCOMP-St. Louis, 2605 S. Hanley Rd.	314-647-5505
NJ	Cinnaminson, Wilshire Elctrns./Philadelphia, 855 Ind. Hwy. - Unit 5	609-786-8990
NJ	Clifton, Wilshire Elctrns./N.J., 312 Clifton Ave.	201-365-2600
NM	Albuquerque, Sterling Elctrns., 3530 Pan American Fwy.	505-345-6601
NY	Binghamton, Harvey Elctrns., Box 1208	607-748-8211
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Farmingdale, Wilshire Elctrns./L.I., 1855 New Highway	516-293-5775
NY	Woodbury, Harvey Elctrns., 60 Crossways Pk. W.	516-921-8700
Ohio	Cincinnati, United Radio, 7713 Reinhold Dr.	513-761-4030
Ohio	Cleveland, Pattison Supp. Co. Ind. Elctrns. Div., 4550 Willow Pkwy.	216-441-30000
Ohio	Dayton, Pioneer.Dayton, 1900 Troy St.	513-236-9900
Pa	Philadelphia, Almo Elctrns., Roosevelt Blvd. at Blue Grass Rd. Northeast Ind. Pk.	215-698-4000
Pa	Pittsburgh, Cameradio Elctrns., 2801 Liberty Ave.	412-288-2600
SC	Columbia, Dixie Radio Supp. Co., 1900 Barnwell St.	803-253-5333
Tex	Dallas, Sterling Elctrns., 2875 Merrell Rd.	214-263-1711
Tex	Fort Worth, Adleta Elctrns. Co., S. Expwy. at E. Vickery	817-336-7446
Tex	Garland, Kierulff Elctrns.	214-271-2471
Tex	Houston, Harrison Equip. Co., 1616 McGowen St.	713-224-9131
Wash	Seattle, Kierulff Elctrns., 5940 6th Ave. S.	206-763-1550
For:	Can., Scarborough, Ont., Lake Engrg. Co., Ltd., 123 Manville Rd.	416-751-5980

DELEVAN DIV., AMERICAN PREC. INDS., Clutch & Brake Prods., 270 Quaker Road, E. Aurora, N.Y., 14052, Tel: 716-652-3600, Telex: 91-293; Empl.: 350 ..... p. 1•945

Customer service: J. Holmes

Free literature available: Hysteresis Clutches & Brakes, Model 20 Electro-Magnetic Clutches & Brakes, Precision Electro-Mechanical Clutches & Brakes

Products manufactured: Brakes, Clutches

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest e/m Engrg., Inc.	602-993-0250
Cal	Los Altos, Servo-Data	415-964-1325
Cal	Los Angeles, L-Tronix Assocs.	213-256-2224
Colo	Denver, Walter Engrg. Assocs.	303-777-5585
Fla	Boca Raton, Conley & Assocs., Inc.	305-395-6108
Fla	Oviedo, Conley & Assocs., Inc.	305-365-3283
Fla	Tampa, Conley & Assocs., Inc.	813-933-3183
Ill	Hinsdale, Momak Sls.	312-654-4524
Kans	Leawood, H.C. Heyde Co.	913-649-8628
Md	Lutherville, J.A. Dougherty Sls. Co.	301-321-7890
Mass	Boston, P.J. Engrg. Sls. Co.	617-924-5950
Minn	Minneapolis, E.C. Elctrn. Sls.	612-831-0229
NJ	Parlin, Martech Assocs.	201-721-2200
NJ	Woodstown, Loman Co.	609-769-0055
NY	Manhassett, Martech Assocs.	516-627-1151
NY	Syracuse, M. C. Antil	315-437-4851
Tex	Dallas, Scott Tech. Sls. Co.	214-352-7698
EXP:	Montreal, Can., J.G. Weiss Co. Ltd.	514-489-6887
EXP:	North Vancouver, Can., J.G. Weiss Co. Ltd.	604-987-3833
EXP:	Rexdale, Ont., Can., J.G. Weiss Co. Ltd.	416-766-0843

DELEVAN DIV., COIL PRODS., American Precision Inds., 270 Quaker Rd., E. Aurora, N.Y., 14052, Tel: 716-652-3600, Telex: 91-293; FSC No: 99800; QPL No: Multiple; Empl.: 350; Minimum order: $40 .... p. 2•388

For info on price: F. E. Riehle; Application info: R. Schuler; Customer service: S. Kerling; Delivery info: S. Kerling

Products manufactured: Chokes, Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg.	602-277-1453
Cal	Los Angeles, L-Tronix Assoc.	213-256-2224
Cal	Menlo Park, Long & Assoc.	415-327-1300
Colo	Denver, Walter-Engrg.	303-777-5585
Fla	Boca Raton, Conley & Assc.	305-395-6108
Fla	Oviedo, Conley & Assoc.	305-365-3283
Fla	Tampa, Conley & Assoc.	813-933-3183
Ill	Hinsdale, MO-MAK Sls.	312-654-4524
Ind	Ft. Wayne, W.W. Bieberich	219-432-2537
Iowa	Cedar Rapids, Lorenz Sls.	319-393-9125
Kans	Leawood, H.C. Heyde Co.	913-649-8628

Md	Lutherville, J. Dougherty Sls.	301-321-7890
Mass	Boston, P.J. Engrg.	617-924-5950
NJ	Haddonfield, Thomas Assocs.	609-854-3011
NJ	Parlin, Martech Assc.	201-721-2200
NY	Endicott, Tech-Mark	607-748-7473
NY	Fairport, Tech-Mark	716-223-1252
NY	Manhasset, Martech Assc.	516-627-1151
Ohio	Cleveland, C. Robinson	216-381-9049
Ohio	Dayton, C. Robinson	513-275-2412
Okla	Broken Arrow, P.J. Scanlon Co.	918-251-1427
Ore	Portland, D.G. Weber Co.	503-234-0686
Tenn	Shelbyville, R. Mitscher	615-684-4544
Tex	Houston, P.J. Scanlon	713-466-6897
Tex	Richardson, P. Scanlon	214-231-4661
Wash	Seattle, D. G. Weber Co.	206-623-5990

Local Distributors

Cal	Glendale, R. V. Weatherford, 6921 San Fernando Rd.	213-849-3451
Cal	Mountain View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Cal	Woodland Hill, Rampart Comps., 21201 Oxnard St.	213-887-7260
Conn	Fairfield, Utronics, 273 Linwood Ave.	203-255-4521
Fla	Clearwater, Diplomat/Southland, 1771 No. Hercules Ave.	813-443-4514
Ind	South Bend, Radio Distributing, 1212 High St.	219-287-2911
Md	Savage, Pyttronics Ind., 8200 Wellmoor Ct.	301-792-7000
Mass	Boston, P. J. Engrg. Supply, 360 N. Beacon St.	617-783-0510
NJ	Pennsauken, Resco Elctrns., Airport Industrial Pk.	215-925-6900
NY	Buffalo, Summit Distributors, 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Freeport, Milgray/New York, 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Rampart Components, Engineers Rd.	516-273-1111
Tex	Dallas, Hall-Mark Elctrns., 9333 Forest La.	214-231-6111

DELAVAN ELECTRONICS, 14441 No. 73rd St., Scottsdale, Ariz., 85260, Tel: 602-948-6350; Empl.: 500; Minimum order: $10

Customer service: J. Frantz

Products manufactured: Controls/Control Eqpt., Indicators, Switches

DELTA-BENCO-CASCADE LTD., 124 Belfield Rd., Rexdale, Ont. Can. M9W 1G1, Tel: 416-241-2651; Empl.: 500

Customer service: J. Galco 716-874-6570

Free literature available: Complete catalog on cable television products.

Products manufactured: Amplifiers, Attenuators, Calibrators, CATV Systems & Equipment, Converters, Couplers, Filters, Meters, Monitors, Transformers, Transmitters

Local Sales Offices & Reps.

NY	Buffalo, Delta-Benco-Cascade	716-874-6570
FOR:	Can., Don Mills, Ont., Welsh Communications	416-445-5650

DELTA DESIGN, INC., 5725 Kearny Villa Road, San Diego, Cal, 92123, Tel: 714-292-5000, TWX: 910-335-1215; Empl.: 55; Minimum order: $50

Customer service: G. Whitlock

Free literature available: Literature on Environmental Temperature Chambers, Ambient and Environmental Semiconductor Handlers, DIP and TO-5 Carrier Loaders/Unloaders and Burn-In Systems.

Products manufactured: Chamber, Environmental Test, Controllers, Programmable, Controls/Control Eqpt., Machines/Machinery, Production, Monitors, Ovens, Testers

DELTA ELCTRN. CONTROL, 1701 Pomona St., Costa Mesa, Cal., 92627, Tel: 714-646-7776; FSC No: 33434; Empl.: 40; Minimum order: $25

For info on price: C. W. Jobbins; Application info: L. O. Hodges; Customer service: H. Bakowski; Delivery info: B. Selle

Free literature available: Catalog: Shows general line of products manufactured. Paper: "Power Amplifiers for Sonar Systems" by L.O. Hodges, C.W. Jobbins and Dr. L.R. Syelzle. This is a 20 page study of designed and applications of class B and class D amplifiers.

Products manufactured: Amplifiers, Controls/Control Eqpt., Converters, Inverters, Power Supplies, Tachometers, Transmitters

DELTA PRODUCTS, Box 1147, Grand Junction, Colo., 81501, Tel: 303-242-9000; Empl.: 140

Products manufactured: Alarms, Controls/Control Eqpt.

Local Sales Offices & Reps.

Ariz	Phoenix, McSherry & Assocs.	602-265-2803
Cal	Santa Rosa, Thomas	707-542-7380
Cal	Van Nuys, A. Szerlip Sls.	213-782-1765
Colo	Denver, McSherry & Assoc.	303-238-8361
Colo	Grand Junction, Delta Prods., Inc.	303-242-9000
Fla	Miami, Sochin Sls.	305-235-6048
Ga	Doraville, R. Alan Dist.	404-458-3195
Haw	Honolulu, A. Mosher	808-732-3636
Ind	Indianapolis, Shamrock Elctrn.	317-251-5527
Md	Severna Park, Hochrein & Assoc.	301-987-4003
Mass	Northboro, W.B. Pray Sls.	617-393-3434
Mich	Brighton, Lectro Sls.	313-532-5725
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	Independence, C.W. Dreese & Assoc.	816-461-7294
NY	Utica, G.E. & C.F. Bates Assoc.	315-735-4389
Ohio	Akron, Shamrock Elctrn.	216-666-1400
Tex	Houston, Ranger Elctrns.	713-526-1044
Wash	Chehalis, B.E. Barkis & Assoc.	204-339-8024
EXP:	South Bend, Ind., Schwanke & Marshall Int., Inc.	219-232-5948

DELTEC CORP., 980 Buenos Ave., San Diego, Cal., 92110, Tel: 714-297-4466; Empl.: 50 .... p. 1•1181-1183

Customer service: R. D. Scott

Free literature available: Super-Isolation Transformers, 250VA to 500VA; A-C Line Conditioners, 1200VA to 5000VA; D-C to A-C Inverters, 300VA to 15KVA; Uninterruptible Power Systems, 700VA to 30KVA.

Products manufactured: Inverters, Isolators, Power Supplies, Protectors, Regulators, Suppressors, Transformers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, F-M Assocs.	205-536-9990
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Pasadena, A-F Sales Engg.	213-681-5631
Colo	Denver, Zeus, Inc.	303-770-4400
Fla	Orlando, F-M Assocs.	305-851-5710
Fla	Tequesta, F-M Assocs.	305-746-2996
Iowa	Cedar Rapids, Technical Reps.	319-363-2489
Kans	Kansas City, Technical Reps	913-782-1177
Md	Silver Springs, Sel-Tronics	301-589-3391
Mass	Waltham, McBar Assocs.	617-890-0233
Minn	Minneapolis, Electro-Service Co.	612-827-2907
Mo	Independence, Technical Reps.	816-737-1414
NJ	Pennsauken, Megargel/Himmelstein Assoc.	609-662-2081
NJ	Ridgwood, Hansen Assoc.	201-652-7055
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Fairport, NACO Elctrns. Corp.	716-223-4490
NY	North Syracuse, NACO Elctrns. Corp.	315-699-2651
NY	Utica, NACO Elctrns. Corp.	315-732-1801
NC	Greensboro, F-M Assocs.	919-294-2754
Tex	Houston, Data Appls. Corp.	713-661-4501
Tex	Richardson, Data Appls. Corp.	214-231-4846
Tex	San Antonio, Data Appls. Corp.	512-732-7176
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Wash	Bellevue, TOPP Engrg. Sls. Corp.	206-747-5401

DELTROL CONTROLS, 2745 S. 19th St., Milwaukee, Wisc., 53215, Tel: 414-671-6800; Empl.: 300

Customer service: D. Uhen

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Relays, Solenoids, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, Cummings & Assoc.	213-340-6035
Cal	Palos Verdes Estates, Deltrol Controls	213-377-4294
Cal	San Francisco, Cummings & Assoc.	408-247-8656
Colo	Denver, Parker-Webster	303-770-1972
Conn	Thomaston, Nelson & Schoonmaker	203-283-5959
Fla	North Miami, Winfield Electronic Sls.	305-945-6544
Ga	Atlanta, Winfield Southeast Co.	404-636-3023
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Deltrol Controls	312-547-0500
Ind	Ft. Wayne, W. Bieberich Co.	219-432-2537
Ind	New Albany, W. W. Bieberich	812-945-3187
Md	Lutherville, Timonium, Naudain Assoc.	301-252-5378
Mich	Rochester, Kent & Assoc.	313-651-1890
Minn	St. Paul, Kenco Co.	612-645-7717
Mo	Hazelwood, Dy-Tronix	314-731-5799
Mo	Kansas City, Dy-Tronix	816-761-6543
NJ	Mount Laurel, Naudain Assocs.	609-235-1801
NY	Plainview, Deltrol Controls	516-931-3815
NY	Rochester, Deltrol Controls	716-473-3340
NC	Charlotte, Winfield Southeast Co.	704-536-2757
Ohio	Dayton, Deltrol Controls	513-223-3502
Ohio	Parma, Deltrol Controls	216-845-6727
Okla	Tulsa, T. J. Ray Co.	918-627-1515
Pa	Philadelphia, Naudain & Assoc.	609-235-1801
Tex	Dallas, E. F. Aymond Co.	214-826-7620
Tex	Houston, E. F. Aymond Co.	713-461-4487
Wash	Seattle, Underwood & Underwood	206-243-2133
Wisc	Wauwatosa, F.C. DuBois & Assoc.	414-774-3100
EXP:	Can., Ontario, Islington, Power Service Products	416-239-2977

Local Distributors

Ala	Birmingham, Forbes Distributing Co.	205-251-4104
Ala	Decatur, Forbes Distributing Co.	205-353-4546
Ala	Dothan, Hand Supply	205-792-3148
Ala	Huntsville, Hall-Mark	205-539-0691
Alas	Anchorage, Alaska Bussell Elec. Co.	907-279-2150
Ariz	Phoenix, Service Supply Co.	602-264-6126
Ark	Fort Smith, Carlton-Bates Co.	501-782-7258
Ark	Little Rock, Carlton-Bates Co.	501-562-9100
Cal	Los Angeles, Electric Switches	213-664-2125
Cal	Los Angeles, Electro Components Distrs.	213-264-7100
Cal	San Jose, Consolidated Parts	408-294-3202
Cal	Westminster, B. A. S. E. Electronics	714-894-1303
Cal	Woodland Hills, C & A Elctrns.	213-340-6022
Colo	Denver, Fistell's Elctrns. Supply Co.	303-244-4691
Colo	Denver, Intermark Elctrns.	303-936-8284
Colo	Grand Junction, Radio & Elctrns. Supply Co.	303-243-3346
Conn	New Haven, Hatry Elctrns.	203-787-5921
Conn	Waterbury, Suburban Supply Co.	203-757-1251
Conn	West Port, Hi-Rel Inds.	203-226-4731
Fla	Miami, Electronic Equip.	305-871-3500
Fla	Tampa, Leader Elctrns. Distrs.	813-835-1891
Fla	Tampa, Lykes Elctrns Corp.	305-633-8535
Ga	Chamblee, Lance Engrg.	404-458-6280
Haw	Honolulu, V. Kim Elctrns.	808-533-7132
Ill	Chicago, G. W. Berkheimer Co.	312-468-5454
Ill	Chicago, Merrill Elctrns. Inc.	312-286-2525
Ill	Chicago, Revere Elctrns. Supply	312-738-3636
Ill	Elgin, Stolz-Wickes, Inc.	312-741-4506
Ill	Elk Grove, Hall-Mark Elctrns.	312-437-8800
Ill	Peoria, Warren Radio Co.	309-674-5998
Ill	Rockford, J & M Elctrns., Inc.	815-963-6445
Ill	Wheeling, G. W. Berkheimer Co.	312-537-9300
Ind	Elkhart, Warren Radio Co.	219-523-2398
Ind	Fort Wayne, Fort Wayne Elctrns. Supply	219-423-3422
Ind	Fort Wayne, G. W. Berkheimer Co.	219-744-4156
Ind	Fort Wayne, Warren Radio Co.	219-743-5344
Ind	Gary, G. W. Berkheimer Co.	219-887-0141
Ind	Indianapolis, G. W. Berkheimer Co.	317-787-2206
Ind	Indianapolis, Graham Elctrns.	317-634-8486
Ind	Indianapolis, Warren Radio Co.	317-634-5566
Ind	South Bend, G. W. Berkheimer Co.	219-288-4741
Ind	South Bend, Radio Distributing Co.	219-287-2911
Iowa	Cedar Rapids, Iowa Radio Supply Co.	319-364-6154
Iowa	Davenport, Warren Radio	319-323-8051
Iowa	Dubuque, Miller Electric	319-588-1469
Iowa	Marshalltown, Egelston Electric	515-752-4678
Iowa	Waterloo, Farnsworth Electronics, Inc.	391-364-6154
Iowa	West Des Moines, Ramco Co.	515-274-2548
Kans	Great Bend, Cen-Kan Supply, Inc.	316-792-4362
Kans	Lenexa, Hall-Mark Electronics	913-888-4747
Ky	Ashland, Ashland Electric Co.	606-324-4107
Ky	Louisville, Peerless Electronic Equipment Co.	502-637-7677
Ky	Paducah, Warren Radio Co.	502-442-4367
La	Amelia, Bayou Bouef Elec.	504-631-2853
Md	Baltimore, Chesapeake Electronics	301-665-7595
Md	Baltimore, Hall-Mark Electronics	301-265-8500
Md	Baltimore, Temsco, Inc.	301-685-4523
Md	Baltimore, United Electronics	301-732-5000
Mass	Cambridge, Interstate Electronics Equip.	617-868-7440

Mass	Fitchburg, Gettens Electric Supply Co.	617-343-3711
Mass	Waltham, QPL Electronic Distributors, Inc.	617-891-0460
Mich	Alpena, P & B Supply Inc.	517-354-5025
Mich	Ann Arbor, Gulf Electronics	313-769-8650
Mich	Battle Creek, Warren Radio Co.	616-965-3338
Mich	Detroit, Michigan Lectrol Corp.	313-255-4250
Mich	Flint, Roth Electric Supply Co.	313-234-8661
Mich	Grand Rapids, Stotts Friedman Electronics Co.	616-241-6731
Mich	Grand Rapids, Warren Radio Co.	616-456-5385
Mich	Kalamazoo, Warren Radio Co.	616-381-4203
Mich	Marquette, Warren Radio Co.	517-723-5239
Mich	Owaso, N.R.W. Electronics Corp.	906-226-7578
Mich	Port Huron, Huron Electric Supply Co.	313-985-8183
Minn	Minneapolis, Control Design, Inc.	612-721-1629
Minn	Minneapolis, Hall-Mark Electronics	612-925-2944
Mo	Kansas City, Kornfeld Thorp Electric	816-221-4000
Mo	St. Louis, Briner Electric Co.	314-321-1185
Mo	St. Louis, Control Design	314-426-3150
Mo	St. Louis, Hall-Mark Electronics	314-521-3800
Mo	St. Louis, Van Sickle Radio Electronics	314-621-5000
NJ	Belleville, Beltronics Corp.	201-751-2250
NJ	Edison, William Electronics Supply	201-985-3700
NJ	Rahway, Terminal Electronics Corp.	201-381-5700
NJ	Union City, Nidisco, Inc.	201-863-2111
NM	Albuquerque, Electronic Parts Co.	505-293-6161
NY	Brooklyn, Brooklyn Electronics, Inc.	212-748-1300
NY	Buffalo, Buffalo Electric Co.	716-854-4420
NY	East Islip, East Islip Electrical Supply	516-581-7600
NY	Farmingdale, Hall-Mark	516-293-7500
NY	Hempstead, Davis Electronics	516-483-9200
NY	Hempstead, Electronic Equipment Co.	516-895-5757
NY	New Hyde Park, Motors & Armatures, Inc.	516-437-9100
NY	Rochester, Simcona Electronics Corp.	716-328-3230
NC	Durham, Vickers Electronics Supply Co.	919-688-6311
ND	Minot, John Iverson	701-838-5466
ND	Williston, John Iverson	701-572-5126
Ohio	Akron, Sun Radio Co.	216-434-2171
Ohio	Akron, Warren Radio Co.	216-434-6668
Ohio	Cincinnati, United Radio Inc.	513-761-4030
Ohio	Cleveland, Warren Radio Co.	216-888-5225
Ohio	Cleveland, Winter-radio Electronic Supply	216-621-9383
Ohio	Columbus, McJunkin Corp.	614-294-3711
Ohio	Toledo, Warren Radio Co.	419-248-3364
Ohio	Wickliffe, Gateway Megatech	216-944-8565
Okla	Oklahoma City, Miller Jackson Co.	405-235-8426
Okla	Oklahoma City, Trice Wholesale Electronics	405-524-4411
Okla	Tulsa, Hall-Mark Electronics	918-835-8458
Ore	Albany, Portland Electric & Plumbing	503-926-7755
Ore	Eugene, Portland Electric & Plumbing	503-342-2101
Ore	Eugene, Tillman & Booth Inc.	503-343-7701
Ore	Medford, Portland Electric & Plumbing	503-779-6311
Ore	Portland, Central Distributors	503-234-0711
Ore	Portland, Portland Electric & Plumbing Co.	503-226-2531
Pa	Erie, Mace Electronics	814-838-3511
Pa	McKeesport, Barno Radio Co.	412-751-5966
Pa	Philadelphia, Simco Electronics Inc.	215-229-1880
Pa	Trevose, Hall-Mark Electronics	215-355-7300
SC	Columbia, Dixie Radio Supply	803-253-5332
SC	West Columbia, Standard Distributors	803-796-0350
Tenn	Chattanooga, Curle Electronics	615-266-4728
Tenn	Dyersburg, Warren Radio Co.	901-285-3850
Tenn	Knoxville, Bondurant Bros.	615-573-9151
Tex	Austin, Hargus-Austin, Inc.	512-478-6618
Tex	Beaumont, Marine & Industrial Electric	713-835-2517
Tex	Corpus Christi, Nunn Electric Supply Co.	512-884-0341
Tex	Dallas, Buffalo Electric Co.	214-421-7671
Tex	Dallas, Hall-Mark Electronics	214-231-5101
Tex	El Paso, McNicol Inc.	915-566-2936
Tex	El Paso, Sunland Supply Co.	915-533-5901
Tex	Houston, Buffalo Electric Co.	713-228-4431
Tex	Houston, Hall-Mark Electronics	713-781-6100
Tex	Houston, Nunn Electric Supply Corp.	713-928-5511
Tex	Lubbock, R & R Electric Co.	806-765-7727
Tex	Odessa, Midland Specialty Co.	915-337-6365
Tex	Richardson, Amtex Electric	214-637-1310
Utah	Salt Lake City, Alta Electronics	801-486-7227
Utah	Salt Lake City, Control Equipment Co.	801-487-7741
Utah	Salt Lake City, W. H. Bintz	801-363-5821
Va	Arlington, Arlington Electronic Wholesalers, Inc.	202-524-6256
Va	Charlottesville, Piedmont Electric Supply Corp.	804-977-2990
Va	Richmond, Meridian Electronics	804-353-6648
Va	Staunton, Piedmont Electric Supply Corp.	703-885-5186
Va	Staunton, Southern Electric Corp.	703-886-6218
Wash	Seattle, Almac Stroum Electronics	206-763-2300
Wash	Seattle, Interface Electronics Corp.	206-285-3500
Wash	Seattle, Pepco	206-325-2435
Wisc	Madison, Satterfield Electronics	608-257-4801
Wisc	Mequon, Taylor Electric Co.	414-241-4321
Wisc	Milwaukee, Hall-Mark Electronics	414-476-1270
Wisc	Wausau, Electronics Inc.	715-845-4671
Wisc	Wausau, Forward Electronics, Inc.	715-845-4355
For:	Can., Ont., Islington, Power Service Prods.	416-239-2977

DELTRON, INC., Wissahickon Ave., N. Wales, Pa., 19454, Tel: 215-699-9261, TWX: 510-661-8061; Empl.: 75;

Minimum order: $15

For info on price: P. M. Gerber; Application info: J. Phillips; Customer service: P. M. Gerber; Delivery info: J. Phillips

Free literature available: Deltron manufactures a complete line of highly regulated power supplies covering OEM applications as well as systems and laboratory requirements.

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Incotech, Inc.	205-837-6061
Ariz	Phoenix, Arrowhead Sales Corp.	602-271-7148
Cal	Inglewood, L & M Engrg.	213-674-6850
Cal	Sunnyvale, AMASCO	408-733-8690
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Conn	Hamden, Pat Jenks Assocs.	203-281-0810
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Chicago, Berndt Assocs.	312-283-0713
Ind	Carmel, Berndt Assocs.	317-844-0114
Md	Wheaton, Sonco	301-942-9420
Mass	Wakefield, Pat Jenks Assoc.	617-246-1590
Mich	Detroit, Micro Sls. Corp.	313-482-1229
Mo	St. Louis, Gordon Fixman	314-725-5219
NJ	Haddonfield, TAI Corp.	609-854-3011
NY	Baldwinsville, Scibetta Reps.	315-622-3993
NY	Tuckahoe, Spectrum Sls.	914-793-1660
Ohio	Centerville, Micro Sales Corp.	513-885-4171
Ohio	Cleveland, Micro Sls. Corp.	216-243-7430
Ore	Portland, McLaren, Inc.	503-297-2248
Tex	Garland, Gordon V. Peck Co.	214-341-8311
Tex	Houston, Gordon V. Peck Co.	713-664-1435
Utah	Salt Lake City, Arrowhead Sls.	801-487-4716
Wash	Bellevue, McLaren, Inc.	206-454-3400
Wisc	Brookfield, Berndt Assocs.	414-786-6950
FOR:	Can., Don Mills, Ont., Componetics Ltd.	416-445-3230
FOR:	Can., Montreal, Que., Componetics Ltd.	514-342-4117

DELTRONIC CRYSTAL INDS., INC., Box 323, Denville, N.J., 07834, Tel: 201-361-2222; Empl.: 5

Customer service: S. Samuelson

Free literature available: Product bulletins YIG-1 & GGG-1, data/spec sheets

Products manufactured: Crystals, Ferrite Material & Parts, Filters, Oscillators

DEMEK, INC., 4824 Rainbox Blvd., Shawnee-Mission, Kans., 66205, Tel: 913-384-0444; Empl.: 10

Products manufactured: Comm. Systems, Converters, Punched Card Equipment, Translators, Data, Transmission Systems, Data

DENISON, R.B., INC., 103 Broadway, Bedford, Ohio, 44146, Tel: 216-232-8200; Empl.: 40; Minimum order: $5

For info on price: J. Basar; Application info: F. Hardcastle; Customer service: J. Basar; Delivery info: J. Basar

Free literature available: Individual Bulletins are available for Type L, Type C, Type M, Type SG and Type P limit switches. Complete catalogs are not available. Reader must specify bulletin of interest.

Products manufactured: Switches

Local Sales Offices & Reps.

Ala	Birmingham, J. Spader Co.	205-879-1366
Ark	Fort Smith, J.R. Masterson	501-646-7756
Cal	Los Angeles, R.B. Clapp Co.	213-225-2395
Cal	San Francisco, Artwel Elec. Inc.	415-467-1880
Colo	Denver, TESSCO	303-744-1119
Conn	Hartford, R. Sawtell Assoc.	413-562-6627
Fla	Indian Rocks Beach, Kirk Sls. Co.	813-595-7353
Ga	Buford, R.L. Matus	404-945-2946
Ill	Chicago, G.H. Anderson	312-728-3827
Ind	Indianapolis, L.W. Loyen Co.	317-359-0311
Mass	Norwood, R.P. Hyland Co.	617-762-0345
Mass	Westfield, R. Sawtell Assoc.	413-562-6627
Mich	Farmington Hills, R. McBride Co.	313-474-2300
Minn	Minneapolis, W.A. Hallock Co.	612-920-6100
Mo	St. Louis, R. Greene Co.	816-333-7585
NY	Buffalo, A.C. Schultz Inc.	315-475-5263
NY	Flushing, Tri State Comps., Inc.	212-358-1010
NC	Charlotte, W.E. Cook & Assoc.	704-525-3384
Ohio	Cincinnati, Nelcor, Inc.	513-871-2816
Ohio	Cleveland, J.L. Finnicum & Assoc.	216-226-7076
Pa	Malvern, Miller & Dietz Co.	215-647-7373
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
Tex	Dallas, Stout Schmidt Co.	214-241-4435
Tex	Houston, Stout-Jennings-Schmidt	713-729-1994
Va	Richmond, Reynolds Cowardin Assoc.	703-266-3457
Wash	Seattle, H. Campbell Co.	206-634-1200

DENNISON MFG. CO., Marke9ting & Attaching Sys. Div., Framingham, Mass., 01701, Tel: 617-879-0511, Telex: 948-478; FSC No: 5975; QPL No: 2310; Empl.: 6000

Customer service: F. T. Wright

Free literature available: Product Bulletin #283 gives specifications and prices on heavy duty Bar-Lok&T cable ties. Bundle diameters 1/16" to 3". Unique manufacturing process lowers cost and reduces weight. Product Bulletin #295 gives specifications and prices on adjustable Secur-A-Tie® fasteners for lowest cost.

Light duty bundling, closing, tieing or harnessing diameters from 1/16" to 1 3/8".

Products manufactured: Clamps & Clips, Fasteners, Labels, Pressure-Sensitive, Adhesive, Machines/Machinery, Production, Nameplates, Wire & Cable Ties

Local Sales Offices & Reps.

Ala	Birmingham	205-251-9558
Ariz	Phoenix	602-264-2699
Cal	Burlingame	415-347-1487
Cal	Rosemead	213-283-0214
Colo	Denver	303-388-8187
Conn	Hamden	203-528-0625
Fla	Ft. Lauderdale	305-947-3531
Fla	Tampa	813-894-0681
Ga	Atlanta	404-355-7665
Ill	Des Plaines	312-298-8870
Ind	Indianapolis	317-243-3209
Iowa	Des Moines	515-278-4276
La	New Orleans	504-947-2197
Md	Riverdale	301-792-4474
Mass	Waltham	617-890-0027
Mich	Grand Rapids	616-455-1620
Mich	Southfield	313-354-6440
Minn	Minneapolis	612-544-7738
Mo	Independence	816-358-4488
Mo	St. Louis	314-352-4161
NY	Buffalo	716-875-3084
NY	Elnora	518-869-8406
NY	New York	212-489-9400
NY	Rochester	716-244-3250
NC	Gastonia	704-867-8315
NC	Greensboro	919-275-9915
NC	Raleigh	919-782-5969
Ohio	Cincinnati	513-621-0865
Ohio	Cleveland	216-888-0515
Ohio	Columbus	614-231-2944
Ore	Portland	503-226-3241
Pa	Pittsburgh	412-923-1620
Pa	Wayne	215-687-9110
SC	Spartanburg	803-585-7175
SC	Taylors	803-232-8033
Tenn	Nashville	615-256-8718
Tex	Dallas	214-826-3150
Tex	Houston	713-771-4940
Tex	San Antonio	512-828-6055
Va	Richmond	804-644-2841
Wash	Seattle	206-243-2740
Wisc	Wauwatosa	414-778-0560

DERINGER MFG. CO., 1250 Town Line Rd., Mundelein, Ill., 60060, Tel: 312-566-4100, TWX: 910-685-4321; Empl.: 220

Products manufactured: Contacts, Electrical

DESIGN AUTOMATION, INC., 809 Massachusetts Ave., Lexington, Mass., 02173, Tel: 617-862-8998; Empl.: 5

Customer service: N. Sokal

Free literature available: Check lists for design review of electronic and electromechanical equipment.

Products manufactured: Amplifiers, Computers, Converters, Data Acquisition & Reduction Systems, Inverters, Services, Assembly, Production & Test, Transformers, Transmitters

DESIGNATRONICS INC., 55 S. Denton Ave., New Hyde Park, NY, 11040

DESPATCH OVEN CO., P.O. Box 1320, Minneapolis, Minn., 55440, Tel: 612-331-1873; Empl.: 250

Products manufactured: Chamber, Environmental Test, Controls/Control Eqpt., Furnaces

DEST DATA CORP., 1285 Forgewood Ave., Sunnyvale, Cal., 94085, Tel: 408-734-1234; Empl.: 33; Minimum order: $50

For info on price: A. E. Kushnick; Application info: I. Mallender; Customer service: A. E. Kushnick; Delivery info: I. Mallender

Free literature available: DSD 120/240 - Document Scanners and Digitizers OCR/Comp - OCR Equipment

Products manufactured: Cameras, Comm. Systems, Compressors, Data, Converters, Data Compressors, Digital, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Expanders, Data, Interferometer Systems, Readers, Recorders, Scanners, Servo Systems, Transmission Systems, Data

DETORONICS CORP., 10660 E. Rush St., S. El Monte, Cal., 91733, Tel: 213-579-7130, TWX: 910-587-3436; FSC No: 29867; Empl.: 45

For info on price: R. Wilson; Application info: D. Duke; Customer service: D. Baroda; Delivery info: R. Wilson

Free literature available: Illustrative brochure depicting various hermetically sealed glass to metal connectors and headers. Technical catalogs sheets available on request.

Products manufactured: Connector Adapters, Connectors, Detectors, Feedthrus & Seals, Environmental, Headers, Holder & Carriers, Packages, Integrated Circuit, Resistors, Seals, Services, Assembly, Production & Test, Terminals

DEUTSCH CO., Elec. Components Div., Municipal Airport, Banning, Cal., 92220

DEUTSCH FASTENER CORP., 7001 W. Imperial Hwy., Los Angeles, Cal., 90045, Tel: 213-649-1400, TWX: 213-673-1000; Empl.: 100; Minimum order: $25

Customer service: E. Baumgarten

Free literature available: Folders describing specialized fastening devices such as captive screws as well as flare inserted nuts, press to open latches stress panel fasteners and related devices.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Fasteners, Handles For Cabinets, Circuit Boards, Racks, etc., Pins, Rivets

DEUTSCH RELAYS, INC., 65 Daly Rd., East Northport, N.Y., 11731, Tel: 516-864-6000, TWX: 510-226-0233; Empl.: 420

For info on price: S. Saccareccia; Application info: R. Robotti; Customer service: R. D'Ambrosio; Delivery info: R. D'Ambrosio

Free literature available: Short Form Relay Catalog - Describes the wide line of Electromechanical relays produced by Deutsch Relays. Time Controllers Catalogs - Describes the Time Dealy Relays available from Deutsch Relays.

Products manufactured: Relays

Local Sales Offices & Reps.

Cal	Burlingame, J. Logan & Assoc.	415-697-6100
Fla	Altamonte Springs, Semtronic Assocs.	305-931-8235
Ga	Atlanta, Grady Duckett	404-451-3529
Ill	Chicago, Berndt Assocs.	312-283-0713
Mass	Waltham, Rantek	617-890-5110
Ohio	Dayton, Electro-Com	513-898-5140
Pa	King of Prussia, Monteiro Assocs.	215-265-0634
Tex	Dallas, Allied Inc.	214-238-0408
Wash	Bellvue, Pacific NW Consult.	206-454-2503
FOR:	Can., Burlington, Ont., Neeco	416-632-1403
FOR:	Can., Toronto, Ont., Neeco	416-364-0443

DEVELCO, 530 Logue Ave., Mountain View, Cal., 94043, Tel: 408-969-1600, TWX: 910-379-6588; Empl.: 75; Minimum order: $25

For info on price: G. Patterson; Customer service: R. Rondoe

Free literature available: Product Brochures and Application Notes.

Products manufactured: Amplifiers, Display Devices/Displays, Isolators, Magnetometers, Standards, Testers

Local Sales Offices & Reps.

Md	Gaithersburg, Data Time, Inc.	301-948-7666

Advertisment

Develco manufactures a broad range of high-technology products which include: (1) Fluxgate magnetometers; (2) Superconducting magnetometers, gradiometers, shields and cryostats; (3) Fiber-Optic isolated data links; (4) Geophysical instrumentation; (5) LF/VLF time and frequency instruments; (6) 3-axis displays for signal analysis; and, (7) the Alma (see separate Alma listing) line of IC testers.

DIACON, 4812 G Kearny Mesa Rd., San Diego, Cal., 92111, Tel: 714-279-6992; Empl.: 225; Minimum order: $100

For info on price: D. Fleming; Application info: P. Scott; Customer service: B. Moran; Delivery info: D. Fleming

Free literature available: Packages - hermetic ceramic dips and flatpaks cerdip technology, low temp seal. Equipment - environment and ambient handlers for test equipment.

Products manufactured: Machines/Machinery, Production, Packages, Integrated Circuit

Local Sales Offices & Reps.

Mass	Fall River, Greenlees Assoc.	617-674-9858
NY	New York, Huth Sls.	212-984-1765
Tex	Richardson, Marston Co.	214-235-3577
Wash	Bellvue, SD-R&S2 Co.	206-747-9424

DI-ACRO, Div. Houdaille Inds., Inc., 316 8th Ave., Lake City, Minn., 55041, Tel: 612-345-4571; Empl.: 400; Minimum order: $20

For info on price: F. W. Coyle; Application info: R. Scroggins; Customer service: T. Kruempel; Delivery info: F. W. Coyle

Products manufactured: Machines/Machinery, Production, Punches, Chassis, Services, Assembly, Production & Test

DI/AN CONTROLS, INC., 944 Dorchester Ave., Boston, Mass., 02125, Tel: 617-288-7700, TWX: 710-333-1732; Empl.: 180; Minimum order: $25

For info on price. H. Smith; Application info: H. Smith; Customer service: E. Healey; Delivery info: H. Smith

Free literature available: Ticket Printers - describes functions and specifications, as well as applications for a variety of ticket, bag and label printers. Model 9030 teleprinter - describes features and characteristics of this wide carriage, 30 CPS impact teleprinter.

Products manufactured: Memory Systems, Printers, Teleprinters, Teletypewriters & Equipment, Terminal Equipment, Digital, Timers

DIALIGHT, 203 Harrison Pl., Brooklyn, N.Y., 11237, Tel: 212-497-7600, TWX: 710-584-5487; Empl.: 400

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For info on price: C. Dombroski; Application info. C. Dombroski; Customer service: H. Goodman; Delivery info: A. Romaine

Products manufactured: Diodes, Display Devices/Displays, Drivers & Decoders For Readouts, Flashers, Lamps, Lights, Sockets, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, R. Stitzer Co.	602-944-6808
Cal	Oakland, Moulthrop Sls.	415-261-7676
Cal	Pico Rivera, Westrep	213-949-2551
Colo	Denver, R.G. Bowen Co.	303-722-4641
Fla	Orlando, Cartwright & Bean, Inc.	305-422-4531
Fla	Plantation, Cartwright & Bean, Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean, Inc.	404-255-5262
Ill	Hinsdale, Hill-Gray Assocs.	312-325-4810
Ind	Indianapolis, Southern Sls. Corp.	317-257-7575
Kans	Shawnee Mission, K & M Sls. Co.	913-262-1444
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Mass	Needham, Mullin Tech. Sls.	617-444-4780
Mich	Ferndale, Hilltronics Inc.	313-398-5556
Minn	St. Paul, R.G. Ragon, Inc.	612-488-0201
Mo	St. Louis, K & M Sls. Co.	314-423-2420
NJ	Wayne, R. Home Assocs.	201-835-7400
NY	No. Syracuse, Precision Sls.	315-458-2223
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
Ohio	Cleveland, K.W. Elctrn. Sls.	216-831-8292
Ohio	Dayton, K.W. Elctrn. Sls.	513-890-2150
Ore	Portland, Almac/Stroum Elctrns.	503-292-3534
Pa	Allison Park, K.W. Elctrn. Sls.	412-487-4300
Pa	Broomall, L.D. Lowery, Inc.	215-528-5170
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Houston, Tesco	713-464-2828
Tex	Richardson, Tesco	214-690-4004
Utah	Salt Lake City, R.G. Bowen Co.	801-363-8801
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300
EXP:	Brooklyn, N.Y., Dialight	212-497-7600

Local Distributors

Ariz	Phoenix, Moltronics of Ariz, 2746 W. Palm La.	602-272-7951
Cal	Chatsworth, Westates Elctrns., 20151 Bahama St.	213-341-4411
Cal	Culver City, Western Electromotive, 8467 Steller Dr.	213-870-7621
Cal	Inglewood, Newark Elctrns., 4747 W. Century Blvd.	213-678-0441
Cal	Sacramento, Sacramento Elctrns., 1219 S. St.	916-441-4821
Cal	Santa Clara, Fisher/Brownell, 3381 Edward Ave.	408-244-6182
Cal	Sun Valley, Richey Elctrns., Inc., 10871 La Tuna Canyon Rd.	213-875-2862
Cal	Sunnyvale, Bell Industries, 1161 No. Fair Oak	408-734-8570
Colo	Denver, Meter Master Instr., 1165 S. Cherokee St.	303-722-5766
Colo	Denver, Newark-Denver Elctrns., 2170 S. Grape St.	303-757-3351
Conn	Waterbury, Surburban Supply, 117 Benedict St.	203-757-1251
Fla	Orlando, Hammond Elctrns., 911 W. Central Blvd.	305-849-6060
Ga	Atlanta, Specialty Dist., 763 Juniper St., N.E.	404-873-2521
Ill	Chicago, Elctrn. Dists., Inc., 4900 No. Elston Ave.	312-283-4800
Ill	Chicago, Newark Elctrns., 500 No. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd.	312-697-8200
Ill	Peoria, Klaus Radio & Elect., 8400 N. Pioneer Pkwy.	309-691-4840
Ind	Ft. Wayne, Fort Wayne Elctrn. Supply, 3606 E. Maumee St.	219-423-3422
Ind	Indianapolis, Graham Elctrn. Supply, 133 S. Pennsylvania St.	317-634-8202
Ind	Indianapolis, Ra-Dis-Co., 814 N. Senate Ave.	317-637-5571
Ind	South Bend, Radio Dist., 1212 High St.	219-287-2911
Ky	Louisville, P.I. Burks Co., 842 S. 7th St.	502-583-2871
La	Lafayette, Ralph's of Lafayette, 3004 Cameron St.	318-234-4507
La	New Orleans, Southern Radio Supply Co., 1909 Tulane Ave.	504-524-2343
Md	Baltimore, Radio Elec. Svc., 1026 Cromwell Bridge Rd.	301-823-0070
Md	Gaithersburg, Cramer/EW Wash., 16021 Industrial Dr.	301-948-0110
Md	Rockville, Capitol Radio Wholesalers, 12270 Wilkins Ave.	301-881-2270
Md	Rockville, Pioneer Washington Elect., 1037 Taft St.	301-424-3300
Mass	Boston, De Mambro Radio Supply Co., 1095 Commonwealth Ave.	617-787-1200
Mass	Boston, Sager Electrical Supply, 172 High St.	617-542-2281
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy.	617-329-2400
Mass	Newton Centre, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mass	Springfield, T.F. Cushing, Inc., 1026 Bay St.	413-788-7341

Mass	Wilbraham, Ind'l. Components, 2551 Boston Rd.	413-596-3854
Mich	Ann Arbor, Wedemeyer Elctrn. Supply, 2280 S. Industrial Hwy.	313-665-8611
Mich	Detroit, Newark-Detroit Elctrn. Supply, 20700 Hubbell Ave.	313-548-0250
Mich	Wyoming, Newark Elctrn., 3645 Linden Ave. S.E.	616-241-6681
Minn	St. Paul, Gopher Elctrns., 2520 W. Larpenteur Ave.	612-645-0241
Mo	Kansas City, Walters Radio Supply, 3635 Main St.	816-531-7015
Mo	No. Kansas City, LCOMP-Kansas City, 1520 Taney	816-221-2400
Mo	St. Louis, LCOMP-St. Louis, 2605 So. Hanley	314-647-5505
Neb	Lincoln, Scott Elctrn. Supply, 4040 Adams St.	402-434-8308
NJ	Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd.	609-424-1300
NJ	Hanover, State Elctrns., 36 Rt. 10	201-887-2550
NJ	Kenilworth, Newark Elctrns., 303 Monroe Ave.	201-272-8410
NJ	Pennsauken, Resco Elctrns., Airport & Central Hwys.	609-662-4000
NJ	Rahway, Terminal Elctrns. Corp., Rahway Industrial Ctr., Pinewood St.	201-381-5700
NJ	Springfield, Federated Elctrns., 155 U.S. Rt. 22	201-376-8900
NY	Binghamton, Stack Industrial Elctrns., 45 Washington St.	607-723-6326
NY	Buffalo, Summit Distributors, 916 Main St.	716-884-3450
NY	E. Farmingdale, Harrison Radio, 20 Smith St.	516-293-7990
NY	Elmsford, Ancar Electronics Supply, 1 Nepperhan Ave.	914-592-7100
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Long Island City, H.L. Dalis, 35-35 24th St.	212-361-1100
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	Rochester, Summit Elctrns. of Rochester, 292 Commerce Dr.	716-334-8110
NY	Rome, Rome Elctrns., 108 Spring St.	315-337-5400
NY	Syosset, Milo Elctrns., 170 Eileen Way	516-364-1111
NY	Woodbury, Harvey Radio, 60 Crossways Park W.	516-921-8700
NC	Greensboro, Hammond Elctrns. of Carolina, 2923 Pacific Ave.	919-275-6391
NC	Raleigh, Southeastern Radio Supply, 414 Hillsborough St.	919-828-2311
NC	Winston-Salem, Cramer/EW, 938 Burke St.	919-725-8711
Ohio	Akron, Akron Elctrn. Supply, 107-117 S. Arlington St.	216-762-8818
Ohio	Akron, Sun Radio, 110 E. Market St.	216-434-2171
Ohio	Cincinnati, Hughes-Peters, 4865 Duck Creek Rd.	513-351-2000
Ohio	Cincinnati, Newark Cincinnati, 9799-G Princeton Rd.	513-874-5115
Ohio	Cincinnati, United Radio, Summit Rd. & Reinhold Dr.	513-761-4030
Ohio	Cleveland, Pioneer-Standard-Cleveland Div., 4800 E. 131 St.	216-587-3600
Ohio	Columbus, Hughes-Peters, 481 E. 11th St.	614-294-5351
Ohio	Dayton, Pioneer/Dayton Div., Pioneer-Standard Electr., 1900 Troy St.	513-236-9900
Ohio	Dayton, Stotts-Friedman, 108 N. Jefferson St.	513-224-1111
Ohio	Highland Hgts, RPC Elctrns., 749 Miner Rd.	216-461-4700
Ohio	Lima, Lima Radio Parts, 150 W. Grand Ave.	419-228-1220
Ohio	Solon, Radio & Elctrn. Parts (Repco), 6835 Cochran Rd.	216-248-8900
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9124
Ore	Portland, Almac/Stroum Elctrns., 4475 Scholls Ferry Rd.	503-292-3534
Pa	Erie, Seaway Elec. Supply, 142 W. 12 St.	814-456-4228
Pa	Montgomeryville, Pyttronic Industries, Montgomeryville Ind'l Pk.	215-242-6700
Pa	Philadelphia, Almo Elctrns., Roosevelt Blvd. at Blue Grass Rd.	215-676-6000
Pa	Philadelphia, Philadelphia Elctrns., 1225 Vine St.	215-568-8288
Pa	Pittsburgh, Cameradio Elctrns., 2801 Liberty Ave.	412-288-2600
Pa	Reading, G. D. Barbey Co., 333 No. 4th St.	215-376-7451
RI	Providence, Wm. Dandreta & Co., 28 Wolcott St.	401-861-2800
SC	Greenville, Hammond Elctrns. of Carolina, 100 Augusta St.	803-293-4121
Tenn	Kingsport, Radio Elec. Supply, 961 E. Sullivan St.	615-247-8111
Tenn	Nashville, Electra Distributing, 1914 West End Ave.	615-255-8444
Tex	Dallas, Texas Instr. Supply, 6000 Denton Dr.	214-238-6811
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Garland, Newark Elctrns., 707 Easy St.	214-271-2511
Tex	Houston, Harrison Equip. Co., 1616 McGowen	713-224-9131
Tex	Houston, Lenert Co., 1420 Hutchins	713-225-1465
Tex	Houston, Newark-Houston Elctrns. Corp., 6902 Harwin Dr.	713-782-4800
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th South	801-355-2971
Va	Norfolk, Priest Elctrns., 6431 Tidewater Dr.	703-855-0141
Va	Richmond, Meridian Elctrns., 1001 W. Broad St.	804-353-6648
Wash	Seattle, Almac/Stroum Elctrns., 5811 Sixth Ave. So.	206-763-2300
Wisc	Milwaukee, Elctrn. Expaditors, 6045 N. Green Bay Ave.	414-228-8100
Wisc	Milwaukee, Parts Mart, 1314 N. 7th St.	414-276-4160
For:	Can., Don Mills, Ont., Saynor Elctrns. Ltd., 99 Scarsdale Rd.	416-445-2347
For:	Can., Downsview, Ont., Cesco Elctrns. Ltd., 24 Martin Ross Ave.	416-661-0220
For:	Can., Montreal, Que., Cesco Elctrns., Ltd., 4050 Jean Talon St. W.	514-735-5511
For:	Can., Montreal, Que., Payette Radio Ltd., 730 St. James St. W.	514-866-6681
For:	Can., Ottawa, Ont., Wackid Radio TV Labs, Ltd., 312 Parkdale Ave.	613-728-1821
For:	Can., Ottawa, Ont., Cesco Elctrns. Ltd., 1300 Carling Ave.	613-729-5118
For:	Can., Toronto, Ont., Electro Sonic Supply Co., Ltd., 543 Yonge St.	416-924-0711
For:	Can., Toronto, Ont., Zentronics, Ltd., 185 Bridgeland Ave.	416-525-1700
For:	Can., Vancouver, B.C., L.A. Varah Ltd., 2077 Alberta St.	604-873-3211
For:	Can., Winnipeg, Man., Cam Gard Supply, Ltd., 1777 Ellice Ave.	204-786-8401

DIAMONITE PRODUCTS DIV., Box 581, Shreve, Ohio, 44676, Tel: 216-567-2145; Empl.: 250

Customer service: P. Dunley

Free literature available: Diamonite Alumina Electronic Ceramics-Brochure

Products manufactured: Cores, Ceramic, Insulators & Insulation, Seals, Substrates, Tubing

Local Sales Offices & Reps.

Ala	Huntsville, Techn. Sls.	205-881-1750
Cal	Atherton, Wadsworth-Pacific Mfg. Assoc.	415-321-3619
Cal	Pacific Palisades, Wadsworth-Pacific Mfg. Assoc.	213-454-4313
Conn	Simsbury, C.M. Billard & Co.	203-658-7200
Fla	Ft. Lauderdale, G.F. Bohman Assocs.	305-564-3081
Fla	Orlando, G.F. Bohman Assocs.	305-855-0274
Ind	Indianapolis, H.G. Lake Co.	317-783-7254
Mich	Farmington, Scanlon-Cotter Co.	313-477-9080
Mo	St. Louis, A.V. Doran Co.	314-725-3377
NJ	Trenton, William S. Mills	609-882-4111
NY	Liverpool, Wadsworth Mfg. Assocs.	315-652-6865
NY	Manlius, Wadsworth Mfg. Assocs.	315-682-5705
NC	Greensboro, Manufacturers Sls. Co.	919-274-2474
Ohio	Dayton, H.G. Lake Co.	513-277-8181
Ohio	Richmond Heights, H.G. Lake Co.	216-486-1477
Pa	Philadelphia, K.B. Erdman Co.	215-224-1833
Tex	Addison, Manufacturers Mktg. Svc.	214-661-5160
Tex	Kemah, Manufacturers Mktg. Svc.	713-334-4717
Wisc	Elm Grove, Gibbons & Hebbe	414-782-6900

DIA-NETICS INC., 18823 Napa St., Northridge, Cal., 91324, Tel: 213-886-2616; Empl.: 35 .... p. 2•422,423

For info on price: M. Easton; Application info: L. Fleury; Customer service: L. Fleury; Delivery info: E. Wilson

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms

DICEON ELECTRONICS, 18522 Von Karman Ave., Irvine, Cal., 92664, Tel: 714-833-0870, TWX: 910-595-1794

Customer service: Area Sls. Coordinator

Products manufactured: Circuits, Flexible, Circuits, Printed, Multilayer, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ala	Huntsville, Electronic Mktg. Assocs.	205-837-6061
Ariz	Phoenix, Markets West	602-279-2378
Cal	Mt. View, West/Mark Assocs.	415-969-1700
Colo	Denver, Rope & Williamson	303-758-8507
Ill	Barrington, L. Bacher & Assocs.	312-381-6780
Mass	Wakefield, Data Engrg. Svcs.	617-234-6666
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Minn	Anoka, K. Haugen & Assocs.	612-421-3395
NJ	Livingston, Graydon-Sherman	201-994-9055
NY	Fayetteville, Graydon-Sherman	315-637-9861
NC	Cary, Electronic Mktg. Assocs.	919-722-5151
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Pa	Yeadon, Graydon-Sherman	215-664-7316
SC	Greenville, Electronic Mktg. Assocs.	803-244-8120
Tex	Richardson, P. J. Scanlon Co.	214-231-4661

DICKSON ELECTRONICS, See Siemens Corp, Comps Div.

DIELECTRIC COMMS, Div. Sola Basic Inds., Raymond, Maine, 04071, Tel: 207-655-4555, TWX: 710-229-6890; FSC No: 08441; Empl.: 165

For info on price: P. Skahan; Application info: R. Tanczos; Customer service: P. Skahan; Delivery info: R. Tanczos

Products manufactured: Dehydrators, Dummy Loads, Meters

DIELECTRIC INSTR. CORP., 761 Franklin Ave., Pittsburgh, Pa., 15221, Tel: 412-731-6566; Empl.: 10

Customer service: W. M. Wyman

Products manufactured: Bridges, Meters, Services, Assembly, Production & Test, Testers, Timers

DIELECTRIC SCIENCES, 5 South Ave., Burlington, Mass, 01803, Tel: 617-272-8960; FSC No: 50509; Empl.: 6

Customer service: J. A. Goldlust

Products manufactured: Cable, Connectors, Lead Assemblies & Receptacles, Wire

Local Sales Offices & Reps.

Cal	San Diego, Encom	714-299-1616
Cal	San Francisco, Encom	415-969-0330

DIETZ DESIGN, INC., 100 Electronics Pkwy., Belton, Mo., 64012; Tel: 816-331-4911; Empl.: 50

For info on price: D. Liter; Application info: V. L. Zugenbuhler; Customer service: C. Gurnett

Free literature available: Catalog sheets on Desco Plug-in Assemblies, Company folder describing capabilities and showing pictures of products manufactured, and catalog sheet designated 2700 EEM File System showing telegraph tone channel band pass filters and there frequency.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Delay Lines, Enclosures, Module, Plug-In, Filters, Networks, Reactors, Standards, Transformers

DIETZ, HENRY G. CO., INC., 14-26 28th Ave., Long Island City, N.Y., 11102, Tel: 212-RA 6-3347; Empl.: 20; Minimum order: $10

Customer service: H. G. Dietz

Free literature available: Catolog - Title: flow meters, low pressure switches and velocity actuated flow switches (contents: general description of products available).

Products manufactured: Controls/Control Eqpt., Switches

DIETZGEN CORP., 2425 N. Sheffield Ave., Chicago, Ill, 60613, Tel: 312-549-3300; Empl.: 200

Products manufactured: Drafting Machines, Readers

Local Sales Offices & Reps.

Cal	Los Angeles	213-678-3761
Cal	San Diego	714-234-8411
Cal	San Francisco	408-984-2460
Colo	Denver	303-399-2180
Conn	North Brunswick	201-297-3500
DC	Washington	202-223-8130
Fla	Orlando	305-241-5671
Ga	Atlanta	404-934-5240
Ill	Chicago	312-549-3300

Ky	Louisville	502-584-2265
La	New Orleans	504-525-7121
Mass	Upper Newton Falls	617-965-4830
Mich	Birmingham	313-644-1900
Mo	Kansas City	816-471-3340
NJ	North Bruswick	201-297-3500
Ohio	Cincinnati	513-761-2724
Ohio	Cleveland	216-631-2660
Ohio	Columbus	614-224-5149
Okla	Oklahoma City	405-232-1147
Pa	Philadelphia	215-688-6400
Pa	Pittsburgh	412-563-6880
Tex	Arlington	214-263-3111
Wash	Seattle	206-623-1158
Wisc	Brookfield	414-671-1518
FOR:	Can., Weston, Ont., 416-749-2077	

DIGIAC CORP., 175 Engineers Rd., Smithtown, N.Y., 11787, Tel: 516-273-8600; Empl.: 50; Minimum order: $10

Customer service: G. Timmes

Free literature available: Apple Cat - Includes educational training products, in computer electronics, technology, electromechanical technology, mechanisms & linkages fluid power technology. Electrolab - Data sheets to include, introductory to electricity training systems, advanced electrical machines studies, electrical technology training systems and power supplies.

Products manufactured: Amplifiers, Benches, Consoles, Stools, Tables, Computers, Controls/Control Eqpt., Converters, Generators, Power Supplies, Recorders, Servo Systems

Local Sales Offices & Reps.

Ala	Birmingham, Technical Training Aids	205-822-1326
Ariz	Scottsdale, Peterson Assocs.	602-945-6605
Cal	Granada Hills, Tech. Education Svcs.	213-360-1061
Fla	Winter Pk., Tech. Training Aids	305-647-5373
Ill	Downers Grove, Aidex Corp.	312-963-4270
Iowa	Marion, Gib Klein Co.	319-393-4048
Md	Columbia, W.B. Cavanaugh Co.	301-730-6777
Mich	Plymouth, J. Close	313-453-7531
Minn	Eden Prairie, Lab Corp.	612-944-1807
NH	Windham, Helmar Assocs.	603-893-4586
NY	East Norwich, Tequipment	516-922-6590
NY	Pittsford, Vowell Assocs.	716-381-9280
NC	Sanford, A.B. Williams Jr. Assoc.	919-775-4164
Ohio	Toledo, Freeman Supply Co.	419-691-4624
Pa	Philadelphia, Delta Equip. Co.	215-236-6350
SD	Watertown, J.L.H. Assocs.	605-886-4667
Tex	Dallas, Tol-Mark Co.	214-341-6917
Tex	Temple, Digiac Corp.	817-778-5681
Wash	Edmonds, Tomahawic Corp.	206-776-4598
Wisc	Milwaukee, Lab Corp.	414-771-2946

DIGI-DATA CORP., 8580 Dorsey Rd., Jessup, Md., 20794, Tel: 301-498-0200, TWX: 710-867-9254; Empl.: 80; Minimum order: $20

For info on price: R. Arnold; Application info: R. Pedersen; Customer service: C. Guenther; Delivery info: R. Arnold

DIGILIN INC., 3521 W. Pacific Ave., Burbank, Cal., 91505, Tel: 213-846-1800, TWX: 910-498-2758; Empl.: 50; Minimum order: $25

For info on price: E. B. Hibbs Jr.; Application info: J. Masatsugu; Customer service: M. Lessard; Delivery info: M. Jones

Free literature available: Literature describes performance specifications for Digilins' Broad Line of Digital Panel Meters, Thermocouple indicators, and process control meters.

Products manufactured: Comparators, Counters, Meters

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scien.	205-837-1601
Cal	Burbank, DeAngelo, Rothman & Co.	213-398-6239
Cal	Mountain View, Tech-Ser, Inc.	415-969-9020
Cal	San Diego, DeAngelo, Rothman & Co.	714-560-5707
Fla	Orlando, Turex Assocs.	305-859-2160
Ill	Chicago, Midwest Elctrn. Sls.	312-626-0030
Md	Rockville, Marktron	301-762-6210
Mich	Clawson, Instr. Specialties	313-435-3311
Mich	Royal Oak, Group Ten	313-549-3910
Minn	Minneapolis, E.C. Elctrns.	612-831-0229
Mo	Kansas City, Harris Hanson Co.	816-444-9494
Mo	St. Louis, Harris Hanson Co.	314-432-3611
NJ	Stirling Heights, N.B.S. Assocs.	201-464-8500
NM	Albuquerque, Intermountain Engrg.	505-883-9010
NY	E. Syracuse, Ossmann Instrs.	315-437-6666
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Ore	Portland, Hayes Tech.	503-232-5343
Pa	Glenside, Elcom, Inc.	215-885-1325
Wash	Seattle, Hayes Tech.	206-763-2210
EXP:	Medway, Mass., Surel Int'l.	617-533-2041

DIGITAL COMPUTER CONTROLS, INC., 12 Industrial Rd., Fairfield, N.J., 07006; Empl.: 25; Minimum order: $50

For info on price: B. R. Erickson; Application info: P. Goodman; Customer service: J. Laidlaw; Delivery info: V. Choffo

Free literature available: Minicomputers and associated equipment including discs, printers, card readers, tape drives, communications. Electronic cash registers.

Products manufactured: Computers

Local Sales Offices & Reps.

Ariz	Phoenix, Mountaintek	602-242-5551
Cal	Cupertino, Digital Computer Controls	408-255-6690
Cal	Irvine, Digital Computer Controls	714-556-2760
Colo	Boulder, Mountaintek	303-444-1738
Colo	Evergreen, Mountaintek	303-674-5255
Conn	Danbury, Digital Computer Controls	203-792-1230
Fla	Altamonte Springs, Digital Computer Controls	305-862-6699
Kans	Shawnee Mission, Inland Assocs.	913-362-2366
Md	Silver Spring, Digital Computer Controls	301-587-5871
Mass	Wakefield, Digital Computer Controls	617-245-6240
Mich	Southfield, Digital Computer Controls	313-559-4633
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Glencoe, Inland Assocs.	314-938-4992
NJ	Fairfield, Digital Computer Controls	201-575-0146
NM	Albuquerque, Mountaintek	505-268-0003
Ohio	Columbus, Meas. Instrs., Inc.	614-488-9753
Tex	Dallas, Remtek	214-369-8146
Tex	Houston, Remtek	713-664-2113
Utah	Salt Lake City, Mountaintek	801-272-4611
Wash	Seattle, Rush S. Drake Assocs.	206-763-2755
EXP:	N.J., Fairfield, Digital Computer Controls Inc.	201-575-9100
FOR:	Can., St. Laurent, Mont., Que., Digital Computer Controls	514-748-9694

DIGITAL DEV. CORP., 5575 Kearny Villa Rd., San Diego, Calif., 92123, Tel: 714-278-9920; Empl.: 375; Minimum order: $50

For info on price: M. Mougel; Application info: M. Mougel; Customer service: T. Rodstrum; Delivery info: D. Kinzel

Products manufactured: Memory Systems

Local Sales Offices & Reps.

Cal	Sunnyvale, Digital Dev. Corp.	408-733-5622
Fla	Orlando, W.A. Brown Instr., Inc.	305-425-5505
Mass	Boston, Digital Dev. Corp.	617-965-6099
Pa	Philadelphia, Digital Dev. Corp.	609-227-4617
Tex	Richardson, Digital Dev. Corp.	214-235-3488
Wash	Seattle, Showalter-Judd, Inc.	206-762-2310

DICEON ELECTRONICS, 18522 Von Karman Ave., Irvine, Cal., 92664, Tel: 714-833-0870, TWX: 910-595-1794; Empl.: 225

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ariz	Phoenix, Markets West	602-279-2378
Cal	Mt. View, West/Mark Assocs.	415-969-1700
Colo	Denver, Rope & Williamson	303-758-8507
Ill	Barrington, L. Bacher & Assocs.	
Mass	Westboro, Tech. Mktg. Svcs.	617-366-8462
Minn	Anoka, K. Haugen & Assocs.	612-421-3395
NJ	Livingston, Graydon-Sherman	201-994-9055
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
SC	Greenvile, Elctrn. Mktg. Assocs.	803-244-8120
Tex	Richardson, P.J. Scanlon Co.	214-231-4661

DIGITAL EQUIPMENT CORP., 146 Main St., Maynard, Mass., 01754, Tel: 617-897-5111; Empl.: 19000

Products manufactured: Comm. Systems, Computers, Controllers, Programmable, Converters, Data Acquisition & Reduction Systems, Data Compressors, Digital, Data Loggers, Disc Packs, Magnetic, Memories, Buffer, Memory Systems, Multiplexers, Paper-Tape Preparation Systems, Printers, Punched Card Equipment, Readers, Recorders, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Test Systems

Local Sales Offices & Reps.

Ala	Huntsville	205-881-7730
Ariz	Phoenix	602-267-1364
Ariz	Tucson	602-795-5840
Cal	Los Angeles	213-479-3791
Cal	Mountainview	415-964-6200
Cal	Oakland	415-635-3000
Cal	San Diego	714-280-7880
Cal	Santa Ana	714-979-2460
Cal	Sunnyvale	408-735-9200
Colo	Englewood	303-770-6150
Conn	Fairfield	203-255-5991
Conn	Meriden	203-237-8441
Fla	Fort Lauderdale	305-739-0530
Fla	Orlando	305-851-4450
Ga	Atlanta	404-451-7411
Haw	Kailua, Oahu	808-261-3182
Ill	Rolling Meadows	312-640-5500
Ind	Indianapolis	317-248-9461
Iowa	Bettendorf	319-359-7581
Ky	Louisville	502-458-9561
La	Metairie	504-837-0257
Md	Lanham	301-459-7900
Mass	Maynard	617-897-5111
Mass	Waltham	617-890-0330
Mass	Westfield	413-568-9511
Mich	Farmington Hills	313-478-3000
Minn	Minneapolis	612-854-6562
Mo	Independence	816-252-2300
Mo	St. Louis	314-872-8540
NH	Manchester	603-668-5507
NJ	Fairfield	201-227-9280
NJ	Metuchen	201-549-4100
NJ	Princeton	609-452-2940
NM	Albuquerque	505-296-5411
NY	Albany	518-869-8461
NY	Huntington Station	516-694-4131
NY	New York	212-582-1300
NY	Rochester	716-461-1700
NY	Syracuse	315-437-1593
NC	Durham	919-489-3347
Ohio	Cleveland	216-289-9000
Ohio	Columbus	614-868-1900
Ohio	Dayton	513-294-3323
Ohio	Sylvania	419-882-0511
Ohio	Worthington	614-888-9572
Okla	Tulsa	918-749-4476
Ore	Portland	503-297-3761
Pa	Blue Bell	215-825-4200
Pa	Monroeville	412-243-9404
Tenn	Knoxville	615-588-6571
Tenn	Nashville	615-244-0130
Tex	Austin	512-454-3660
Tex	Dallas	214-620-2051
Tex	Houston	713-777-3471
Utah	Salt Lake City	801-487-4669
Va	Richmond	804-282-3157
Wash	Bellevue	206-641-0070
Wisc	Milwaukee	414-784-1311

DIGITAL EQUIPMENT CORP., Comps. Grp., One Iron Way, Marlborough, Mass., 01752

DIGITAL GEN'L. CORP., Univ. Cir. Resch. Ctr., 11000 Cedar Ave., Cleveland, Ohio, 44106, Tel: 216-721-0440; Empl.: 15

Customer service: W. Rittman

Free literature available: DC IV Diagnostic Computer Test System - Computer controlled; functional test system for testing digital and hybrid logic cards. ELF - Portable test system for testing digital logic cards.

Products manufactured: Test Systems, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, C.T. Fink & Assocs.	602-947-7981
Cal	North Hollywood, Crown Elctrns.	213-877-3550
Ill	Park Ridge, West-Tronics	312-696-3115
Mass	Framingham, Victor Assocs.	617-879-5710
Mich	Royal Oak, Meas. Instrs.	313-352-2144
Minn	Minneapolis, Bitronics Sls. Co.	
NJ	Livingston, Graydon-Sherman	201-994-9055
NY	Baldwinsville, Scibetta Reps.	315-622-3993
Ohio	Cleveland, Meas. Instrs.	216-333-6611
Ohio	Columbus, Meas. Instrs.	614-488-9753
Ohio	Dayton, Meas. Instrs.	513-252-8132
Pa	Monroeville, Meas. Instrs.	412-366-1906
Tex	Richardson, C. Tinch Sls. Co.	214-231-1322
Tex	Richardson, C. Tinch Sls. Co.	214-231-1322

DIGITAL SCIENTIFIC, 11455 Sorrento Valley Rd, San Diego, Cal., 92121, Tel: 714-453-6050, TWX: 910-322-1136

For info on price: P. H. Rosa; Application info: J. J. Gormley; Customer service: R. W. Sykes; Delivery info: J. J. Gormley

Free literature available: Sales/Technical Brochures - Meta 4® Computer Emulators.

Products manufactured: Computers

Local Sales Offices & Reps.

Cal	Los Angeles	213-640-1360
DC	Washington	703-620-3458
Ill	Chicago	312-449-5155
Mich	Detroit	313-642-7448
NY	New York	212-943-8777
Tex	Dallas	214-239-0170

DIGITECH DATA INDS., INC., 66 Grove St., Ridgefield, Conn., 06877, Tel: 203-438-3731; Empl.: 100

Products manufactured: Amplifiers, Analyzers, Comm. Systems, Generators, Kits, Test Equipment, Meters, Oscillators, Relays, Synthesizers, Test Equipment, Testers

DIGITECH DATA INDS., INC., 66 Grove St., Box 547, Ridgefield, Conn., 06877, Tel: 203-438-3731, Telex: 969-623; Empl.: 60; Minimum order: $25

For info on price: D. Doherty; Application info: W. C. Andrews; Customer service: D. Doherty; Delivery info: D. Doherty

Free literature available: Short form catalog, data sheets defining our telecommunications test equipment.

Products manufactured: Amplifiers, Analyzers, Generators, Meters, Oscillators, Relays, Terminals, Data Display (including Alphanumeric & Graphic), Testers

DIGITRAN CO., 855 So. Arroyo Pkwy., Pasadena, Cal., 91105, Tel: 213-449-3110, TWX: 910-588-3794

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Products manufactured: Decade Boxes, Dividers, Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns. Assoc.	205-881-5031
Ariz	Phoenix, Howe & Howe Sls., Inc.	602-264-7971
Cal	Los Altos, Shannon Assoc.	415-941-2217
Cal	San Diego, Celtec Co. Inc.	714-279-7961
Colo	Englewood, Todd Assoc.	303-761-7801
Fla	Mitland, Beacon Elctrns. Assoc.	305-647-3498
Fla	Palm Beach Gardens, Beacon Elctrns. Assoc.	305-622-2770
Ga	Atlanta, Beacon Elctrns. Assoc.	404-351-3654
Ill	Chicago, Scientific Sls. Corp.	312-775-7594
Ind	Ft. Wayne, R.O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-452-6065
Iowa	Des Moines, Beams	515-282-0292
Kans	Overland Park, Beams	913-341-7744
Ky	Louisville, R.O. Whitesell & Assoc.	502-893-7303
Md	Rockville, Marktron, Inc.	301-762-8210
Md	Silver Springs, Mil, Inc.	301-585-6141
Md	Timonium, Marktron, Inc.	301-252-7111
Mich	Grand Rapids, Robert O. Whitesell & Assoc.	616-451-8901
Mich	South Field, Robert O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, Robert O. Whitesell & Assoc.	616-983-7337
Minn	Bloomington, Scientific Sls. Corp.	612-881-3300
Mo	St. Louis, Beams	314-781-6855
NJ	Cherry Hill, N. Kronstadt Assoc.	609-662-2958
NJ	Dumont, Dom Ciccone	201-273-6140
NJ	Haddonfield, Sunday-O'Brien	609-249-4013
NM	Albuquerque, Data Handling Co.	505-268-4364
NY	Buffalo, Telesco Assoc.	716-834-1026
NY	Canandaigua, Telesco Assoc.	716-872-6417
NY	Coram, B. O'Brien	201-273-6140
NY	Liverpool, Telesco Assoc.	315-451-4925
NY	Rochester, Telesco Assoc.	716-271-3780
Ohio	Cincinnati, R.O. Whitesell & Assoc.	513-521-2290
Ohio	Columbus, R.O. Whitesell & Assoc.	614-888-9396
Ohio	Dayton, Mil, Inc.	513-268-8771
Ohio	Lakewood, R.O. Whitesell & Assoc.	216-228-7525
Ore	Beaverton, Arnescon Assoc.	503-643-5754
Pa	Pittsburgh, Robert O. Whitesell & Assoc.	412-344-7277
SC	Spartanburg, Beacon Elctrns. Assoc.	803-582-4613
Tex	Dallas, Allied Comps., Inc.	214-238-0408
Tex	Houston, Allied Comps., Inc.	713-691-3961
Va	Charlottesville, Marktron, Inc.	703-973-5874
Wash	Seattle, Arneson Assoc.	206-762-7664
FOR:	Can. Malton, Ontario, Deskin Sls., Inc.	416-677-5517
FOR:	Can. Montreal, Que., Deskin Sls., Inc.	514-384-1420
FOR:	Can., Vancouver, B.C., Deskin Sls., Inc.	604-324-6331

Local Distributors

Ala	Huntsville, Powell Electrs./Huntsville, 803 Oster Dr.	205-539-2731
Cal	Los Angeles, El-Com, Inc., 5134 Valley Blvd.	213-223-1351
Cal	Mt. View, Powell Electrns., Inc., 411 Fairchild Dr.	415-964-0820
Conn	Hamden, Impact Sls. Inc., 60 Connolly Pkwy.	203-281-1331
Fla	Coral Springs, Controlled Distrs., Inc., 7857 W. Sample Rd.	305-752-4950
Fla	Miami Springs, Powell Electr./Fla., Box 514	305-592-3260
Fla	Orlando, Powell Elctrns./Fla., 2049 W. Central Blvd.	305-859-1450
Ill	Mt. Prospect, Magnuson Elctrns., 2420 Oakton St.	312-956-0700
Ind	Indianapolis, Pioneer Standard, 6408 Castle Pl.	317-849-7300
Md	Bettsville, Powell Electr./Wash., 10728 Hanna St.	301-937-4030
Mass	Waltham, Impact Sls. Co., 223 Crescent St.	617-893-2850
Mich	Romulus, Pioneer Standard, 6337 N. Beverly Plaza	313-729-8500
Minn	St. Paul, Magnuson Elec., Inc., 1246 W. 7th St.	612-227-8495
NY	Buffalo, Ossmann Comp. Sls. Corp., 395 Cleveland Dr.	716-832-4271
NY	Kingston, Ossmann Comp. Sls. Corp., 411 Washington Ave.	914-338-5505
NY	Lynbrook, Peerless Radio Corp., 19 Wilbur St.	516-593-2121
NY	Rochester, Ossmann Comp. Sls., 280 Metro Park	716-442-3290
NY	Syracuse, Ossmann Comp. Sls. Corp., 132 Pickard Bldg.	315-454-4477
NY	Vestal, Ossmann Comp. Sls. Corp., 1911 Vestal Pkwy. E.	607-785-9949
Ohio	Cleveland, Pioneer Standard, 4800 E. 131st St.	216-587-3600
Ohio	Columbus, Electronics Mktg. Corp., 1150 W. Third Ave.	614-200-4161
Ohio	Dayton, Pioneer Standard, 1900 Troy St.	513-236-9900
Pa	Philadelphia, Powell Electr./Philadelphia, S. Island Rd., Box 8765	215-365-1900
Pa	Pittsburgh, Pioneer Standard, 560 Alpha Dr.	412-782-2300
Tex	Dallas, Powell Elctrns./Dallas, 2860 Walnut Hill Dr.	214-350-4186
Tex	Dallas, Solid State Electrs. Co. of Tex., 2643 Manana	214-352-2601
Tex	Houston, Solid State Elctrns. Co. of Texas, Box 36849	713-785-5436

DIGITRONICS CORP., 1 Albertson Ave., Albertson, N.Y., 11507, Tel: 516-484-1000, TWX: 510-223-0607

Products manufactured: Comm. Systems, Converters, Integrated Circuit Packaging Systems, Perforators, Printers, Readers, Recorders, Transmission Systems, Data

DILECTRON, Div. Bestran Corp., 2669 S. Myrtle Ave., Monrovia, Cal., 91016, Tel: 213-446-6195, TWX: 910-582-3210; Empl.: 400

Customer service: R.J. Ruby

Free literature available: Catalog - Complete line of disc and monolithic ceramic capacitors

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Phoenix, W. Bert Knight Co.	602-242-3057
Cal	Newport Beach, W. Bert Knight Co.	714-833-8250
Cal	Redwood City, Logan Sls.	415-369-6726
Colo	Denver, Piper-Goyne	303-934-6971
Conn	Vernon, G.M. Assocs.	203-646-4443
Fla	Indian Rocks Beach, Tech-Rep Assocs.	813-595-2834
Ga	Marietta, K&E Assocs.	404-427-0241
Ill	Chicago, Schumacher Elec. Co.	312-384-6060
Ind	Indianapolis, Scott Elctrns.	317-897-9976
Ky	Louisville, Scott Elctrns	502-583-3220
Mass	Framingham, G.M. Assocs.	617-872-4871
Mich	Plymouth, Scott Elctrns.	313-357-2088
Mo	Kansas City, R.R. Burton Co.	816-444-8300
NJ	Marlton, Krouse Assocs.	609-424-3543
NM	Albuquerque, Piper-Goyne	505-265-6794
NY	Fulton, C.D. Truax	315-592-7184
NY	Valley Cottage, LRC Assocs.	914-634-7973
Ohio	Cleveland, Scott Elctrns.	216-291-2600
Pa	Ardmore, Wm. K. Metz	215-649-3966
Tex	Richardson, Semiconductor Sls. Assocs.	214-231-6181
Wash	Seattle, Ray Johnston	206-524-5170
FOR:	Can., Markham, Ont., Elctrn. Components Intl.	416-499-5681

DILLON, W.C. & CO., 14620-EP Keswick St., Van Nuys 340, Calif., 91407, Tel: 213-786-8812, Telex: 65-1449; Empl.: 80; Minimum order: $15

For info on price: R. Magio; Application info: R. Magio; Customer service: J. W. Dillon; Delivery info: E. Webber

Products manufactured: Cells, Load, Controls/Control Eqpt., Gages, Indicators, Limit Stops, Mechanical, Power Supplies, Scales, Dial, Services, Assembly, Production & Test, Switches, Testers, Transducers

Local Sales Offices & Reps.

Fla	Ft. Lauderdale, R. Jacobs	305-523-8694
Haw	Mililani, H.C. Burgess & Assocs.	808-623-3118
Ill	Chicago, Service Assoc.	312-568-4545
Md	Baltimore, Jobe & Co.	301-235-3503
Mass	Hathorne, Danvers, Osgood Engrg.	617-933-4744
Mich	Detroit, Basic Serv. Corp.	313-837-8820
NY	Amityville, Long Island, Testing Machines Inc.	516-598-1400
Ohio	Brecksville, M.A. Blankenburg Co.	216-526-1100
Pa	Newtown Square, C.W. Middlestead Co.	215-528-5092
Tex	Dallas, Dillon Equip. Co.	214-824-2511
Wisc	Milwaukee, C. V. Kray Co.	414-352-5194

DIMCO-GRAY COMPANY, 207 E. Sixth St., Dayton, Ohio, 45402, Tel: 513-224-1913; Empl.: 130

For info on price: R. Cramer; Application info: R. Cramer; Customer service: B. Chaney; Delivery info: R. Cramer

Free literature available: DIMCO-GRAY stock molded plastic knobs and handles, snapslide fasteners, and GraLab darkroom, sports, photographic and industrial timers.

Products manufactured: Fasteners, Knobs; Timers

Local Sales Offices & Reps.

Cal	Downey, Corbett-Smith	213-927-2677
Conn	Torrington, Manu-Rep	203-643-4485
Fla	Eustis, R.K. Welter	215-657-0100
Ga	Atlanta, Electro-Mech Sls. Engr. Co.	404-256-4414
Ill	Des Plaines, L. Hodges & Assocs.	312-297-3810
Mich	Birmingham, Barribeau-Simmons Co.	313-646-7800
Minn	Minneapolis, Christian-Richards Co.	612-929-7574
Mo	Kansas City, Automatic General Elctrn. Sls.	816-333-8206
NJ	Forked River, Feralite Metals Corp.	609-693-8575
NY	Rochester, W. Stevenson	716-271-2200
NC	Raleigh, Electro-Mech Sls. Engr. Co.	919-782-6452
Ohio	Lyndhurst, A.C. Wahl & Assocs.	216-461-4930
Pa	Willow Grove, Techparts	215-659-6900
Tex	Hurst, Edmar Tech. Sls. Co.	817-282-5561
Wash	Seattle, National Co.	206-623-7060
Wisc	Waukesha, Lincoln Hodges & Assocs.	414-542-3087
FOR:	Can., Toronto, Ont., Precision Express Supply Ltd.	416-481-5211

DIMENSIONAL SYSTEMS, INC., 31 Hartwell Ave., Lexington, Mass., 02173, Tel: 617-862-2700; Empl.: 25

For info on price: M. N. Barry; Application info: J. Novosielski; Customer service: M. Wiener; Delivery info: M. N. Barry

Free literature available: DMS-15 Datafile 1510 Add-on core memory for PDP-15 computer DMS-9 Datafile 910 Add-on core memory for PDP-9 computer, DMS-10 Brochure Add-on core/semiconductor memory for PDP-10 computer, Datadraft Brochure Automated engineering drafting system.

Products manufactured: Drafting Machines, Memory Systems

DIPLOHMATIC DIV., Harry Levinson Co., 1211 E. Denny Way, Seattle, Wash., 98122, Tel: 206-323-5100, TWX: 910-444-2154; Empl.: 4; Minimum order: $15

Customer service: H. Levinson

Products manufactured: Potentiometers, Resistors

DISC ROTASWITCH®
Shaft Encoder

DISC INSTRUMENTS, INC., 102 E. Baker St., Costa Mesa, Ca., 92626, Tel: 714-979-5300, TWX: 910-595-1987; Empl.: 60; Minimum order: $20

For info on price: E. L. McElroy Ext. 32; Application Info: B. Wiles Ext. 45; Customer service: L. Hulburt Ext. 53; Delivery info: B. Treadway Ext. 52

Free literature available: Packages upon request for all Disc Instruments' standard products, describing both electrical and mechanical specifications of individual units.

Products manufactured: Cards, Logic, Controls/Control Eqpt., Counters, Couplings, Encoders, Generators, Indicators, Integrators, Mechanical & Electro-Mechanical, Power Supplies, Switches, Tachometers, Transducers

Local Sales Offices & Reps.

Cal	Mt. View, TRI REP	415-965-1822
Cal	Studio City, Pi Instr.	213-995-0077
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Mass	Lexington, SIR Assocs.	617-862-1812
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Minn	Minneapolis, Waytek, Inc.	612-933-2133
Mo	Raytown, Production Automation	816-737-0066
NY	Buffalo, Good Components Corp.	716-634-4400
NY	White Plains, Swedelco, Inc.	914-946-1122
Ore	Beaverton, Fry Controls, Inc.	503-643-5448
Pa	Glenside, C. A. Briggs Co.	215-885-2244

DISPLAY DEVICES, Box 667, Encinitas, Cal., 92024, Tel: 714-753-0113; FSC No: 26107; Minimum order: $25 p. 2•1142,1143

For info on price: C. Homer; Application info: C. Ross; Customer service: C. Homer; Delivery info: C. Homer

Free literature available: Component catalog - all components we sell; backlighted panel drawings - typical applications; LED panels.

Products manufactured: Caps, Lenses, Indicator Light, Display Devices/Displays, Labels, Pressure-Sensitive, Adhesive, Lamp Adapters, Lamps, Lenses, Readout & Display, Lights, Sockets

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Santa Clara, Nova-Tronix	408-243-9530
Cal	Torrance, James W. Johnson	213-371-8580
Fla	Miami, Ludlum Assocs. Co.	305-592-6523
Fla	Orlando, Ludlum Assocs. Co.	305-894-7761
Ill	Bellwood, Fiat Engrg. Assocs.	312-547-6200
Ind	Ft. Wayne, Advanced Comp. Sls.	219-432-2546
Ind	Indianapolis, Advanced Comp. Sls.	317-545-6441
Md	Towson, Kraft Elctrn. Sls., Inc.	301-828-5838
Mich	Plymouth, Romarc	313-455-0300
Minn	St. Paul, Northport Engrg.	612-698-3841
NH	Nashua, Bell Controls	603-882-6984
NJ	Wayne, G T Assoc.	201-694-6040
NY	North Salem, Lodol-Bell Controls	203-438-7808
NC	Winston-Salem, Dula Assocs.	919-768-7166
Ohio	Chagrin Falls, Crest Comp. Sls.	216-543-9808
Pa	Newton Square, Holdsworth & Co., Inc.	215-356-8550
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Wash	Renton, Control Inst. Co.	206-226-7170

DIT-MCO INT'L., 5612 Brighton Terr., Kansas City, Mo., 64130, Tel: 816-444-9700; Empl.: 160; Minimum order: $25 .... p. 1•6660

For info on price: B. A. Claxton; Application info: B. A. Claxton; Customer service: J. Herbert; Delivery info: B. A. Claxton

Products manufactured: Test Systems, Testers

Local Sales Offices & Reps.

Cal	Corona, G. Coulter	213-772-4386
Cal	Los Angeles, A. Holtz	213-772-4386
Fla	Cocoa Beach, P. File	305-295-9780
Mass	Beverly, J. Coogan	617-734-5400
Mo	Kansas City, P. Tobin	816-363-6288
NY	N.Y., J. Fitzsimmons	212-682-5844

DIVA, INC., 607 Industrial Way West, Eatontown, N.J., 07724, Tel: 201-544-9000, TWX: 710-722-6645; Empl.: 80; Minimum order: $one

For info on price: R. Maly; Application info: R. Maly; Customer service: S. Trudo; Delivery info: R. Maly

Free literature available: General Disc Drive Description and Controllers. Product Description and General Specs of Computrollers. Floppy Disc Systems. Magnetic Tape Systems. Cartridge Disc Systems. Controllers & Multiwire, Design & Production.

Products manufactured: Circuits, Printed, Multilayer, Memory Systems

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Mass	Bedford, E. H. Gittines	617-275-1436
FOR:	Can., Ottawa, Ont., Gil York	613-225-8789

DIVERSIFIED ELECTRONICS CO., 720 E. Evelyn St., Sunnyvale, Cal., 94086, Tel: 408-738-3911; Empl.: 8

Customer service: Order desk

Products manufactured: Calculators, Electrical & Electronic, Computers

DIVERSIFIED ELECTRONICS INC., Box 6231, Sta. B, Evansville, Ind., 47712, Tel: 812-426-2806; Empl.: 35 p. 1•1624-1627

Customer service: C. L. Smith

Free literature available: Phase Monitor Catalog - contains specifications, applications and operational description. Current Monitor Catalog - contains specifications, applications and operational description. Air Conditioning/Refrigeration Controls Catalog - contains specifications, applications, check-out procedure and installation procedures.

Products manufactured: Controls/Control Eqpt., Monitors, Protectors, Relays, Sockets, Timers

Local Sales Offices & Reps.

Cal	L.A., Cutlass Elctrns.	213-324-7360
Conn	Meriden, Abbott-Allison Co.	203-237-9232
Fla	Ft. Lauderdale, Armor Investment Corp.	305-733-7767
Ill	Chicago, Lincoln Hodges Assoc.	312-297-3810
Ind	Ft. Wayne, McDonald Sls. Co.	219-747-3650
NC	Charlotte, L.P. Spoon Co.	704-372-3290
Tex	Ft. Worth, C. Yarborough Co.	817-451-8000
Wisc	Janesville, National Sls. Off.	608-752-1402
Wisc	Milwaukee, Automation Prods. Co.	414-425-2250
FOR:	Can., Quebec, Electrodesign, Ltd.	514-363-5120

Local Distributors

Cal	Cathedral City, Consolidated Electrical Distr.; 33-660 Cathedral Canyon Dr.	714-328-1131
Cal	San Francisco, E.B. Ward & Co., 337 Roebling Rd.	415-873-1660
Del	Wilmington, Wilmington Supply, 2000 Maryland Ave.	302-656-4421
Fla	Miami, ACR Supply Inc., Box 1	305-576-1120
Ind	Indianapolis, Ra-Dis-Co, 814 Senate Ave.	317-637-5571
Ky	Louisville, E & H Electric Supply, Box 1022	502-587-0991
Md	Rockville, Boland Trane Service Ag., 12320 Parklawn Dr.	301-881-8600
Mich	Detroit, Cochrane Supply & Eng., 19300 Beech Daly Rd.	313-255-4050
Neb	Seward, Lee's Refrigeration Co., 734 Seward	402-643-3344
Nev	Las Vegas, Desert York Co., Box 14606	702-384-3980
NJ	Fairlawn, Relay Specialties, 13-00 Plaza Rd.	201-797-3313
NY	Maspeth, Power Cooling, 59-55 60th St.	212-894-8003
Ohio	Columbus, Columbus Temperature Controls, 100 East Swan St.	614-221-7133
Tex	Ft. Worth, Air-Tec Supply, Box 8446	817-732-3447
Utah	Salt Lake, Distributors Inc., 234 West 13th South	

DIXON AUTOMATION, 23915 Garnier, Torrance, Cal., 90509

Free literature available: Chip Assembly Robot: Automatically Places & Solderdips Chip Capacitors, IC's and Resistors onto Substrates.

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.

Ariz	Phoenix, K. Jahn Co.	602-956-9060
Cal	Inglewood, Weightman Assoc.	213-645-6060
Cal	Menlo Park, West Engineering Sls.	415-325-2885

DIXON CORP., Metacom Ave., Bristol, R.I., 02809, Tel: 401-253-2000; Empl.: 210; Minimum order: $25

For info on price: J. G. Holloway; Application info: W. A. Tucker; Customer service: F. Rounds; Delivery info: G. Beauchaine

Products manufactured: Bearings, Bushings, Glass, Plastic, Metal, Rubber, Etc., Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Films, Grommets, Insulators & Insulation, Laminates, Materials, Self-Lubricating, Tapes, Electrical Insulation, Terminals

Local Sales Offices & Reps.

Ala	Birmingham, Moodie & Assoc.	205-823-0815
Cal	Glendale, Lockwood Assocs.	213-247-3330
Cal	Palo Alto, Lockwood Assoc.	415-328-3999
Conn	Plainville, N. F. Mooers	203-747-3042
Fla	Coral Spgs., D. H. Bond	305-752-0344
Ill	Arlington, A. H. Walkie	312-394-8313
Ind	Indianapolis, Hoster & Sieloff	317-844-9921
Mich	Dearborn, Firth Assoc.	313-565-0615
Minn	Minnapolis, Swenson Ind. Sls.	612-544-7789
Mo	Florissant, H & R Sls. & Engrg.	314-921-6242
NY	Commack, P. Hoade	516-543-9308
NY	Penfield, CHP Sls. Corp.	716-381-2800
NC	Sanford, C.G. Simpson	919-776-8025
Ohio	N. Olmstead, G. E. Blaney	216-777-4322
Pa	Aston, J. F. Walls	215-622-2300
Tex	Dallas, Benson Engrg. Co.	214-352-7541
Utah	Salt Lake City, B. S. Anderson	801-486-6401
Wisc	Milwaukee, Fisher-Barton	414-258-1022

DIXSON, INC., Box 1449, Grand Junction, Colo., 81501, Tel: 303-242-8863, TWX: 910-929-6991; Empl.: 460

Customer service: K. Rogers

Products manufactured: Meters

Local Sales Offices & Reps.

Ariz	Phoenix, Kay Entprs.	602-242-6787
Ark	Ft. Smith, Electro-Related Products	501-783-7323
Cal	Long Beach, Emerson Kirk Engrg.	213-439-9559
Colo	Littleton, Simpson Assocs., Inc.	303-794-8381
Fla	North Miami, Winfield Elctrn. Sls. Co.	305-945-6544
Ill	Des Plaines, E. Flaxman Co.	312-298-8580
Kans	Olathe, BC Elctrn. Sls., Inc.	913-782-6696
Mich	Benton Harbor, Hampton, Askin & Assocs., Inc.	616-925-0341
Mo	Hazelwood, BC Electronic Sls., Inc.	314-731-1255
NJ	Oaklyn, A. Wetterhahn Co.	609-858-3003
NY	Mount Vernon, D. Sonkin Assocs.	914-668-9809
NY	Syracuse, Nycom, Inc.	315-437-8343
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Tex	Dallas, United Comps.	214-324-1448
Utah	Salt Lake City, Simpson Assocs., Inc.	801-486-3731
Wash	Bellevue, SD-R2	206-747-9424

DOERR ELECTRIC CORP., 1201 Doerr Way, Cedarburg, Wisc., 53012, Tel: 414-377-0500

Products manufactured: Motors

DOLAN-JENNER INDS., INC., 10 Ingalls Ct., Melrose, Mass., 02176, Tel: 617-662-8200; Empl.: 60; Minimum order: $15

For info on price: F. Laudin; Application info: F. Pettis; Customer service: J. Prior; Delivery info: F. Laudin

Free literature available: Bulletin 738-Glass Fiber Optics-Custom Designed, 818-Industrial Heavy Duty-Fiber Optics, 728-Plastic Fiber Optics, 737-Glass Fiber Optics, 739-Technical Data-Fiber Optics, 746-Registration Controls

Products manufactured: Controls/Control Eqpt., Counters, Detectors, Fiber Optic Bundles, Indicators, Lights, Scanners, Switches, Transducers

DOLPH, JOHN C. CO., New Rd., Monmouth Junction, N.J., 08852, Tel: 201-DA 9-2333

Products manufactured: Adhesives (All Types), Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Insulators & Insulation, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

DORAN MFG. CO., 1033 Bader St., Cincinnati, Ohio, 45225, Tel: 513-681-5424; Empl.: 25; Minimum order: $100

For info on price: R. Demar; Application info: R. Demar; Customer service: D. A. Griffin; Delivery info: D. A. Griffin

Free literature available: Send for free disigners' guide and catalog from Doran Mfg. Co. , booklet includes material and terminal tab selection guide for your custom terminal board.

Products manufactured: Connectors, Terminal Blocks, Boards & Strips, Terminals

DORIC SCI. CORP., 3883 Ruffin Rd., San Diego, Calif., 92123, Tel: 714-565-4415, Telex: 69-5001; Empl.: 105; Minimum order: $25

For info on price: F. Schulte; Application info: A. Frowiss; Customer service: G. Roberts; Delivery info: S. Shelquist

Free literature available: This new 4-page brochure provides a quick look at the highlight features of digital instruments for physical measurements. A wide range of products, from single point indicators to multipoint data loggers, are listed and described.

Products manufactured: Alarms, Amplifiers, Bridges, Calibrators, Comparators, Converters, Data Acquisition & Reduction Systems, Data Loggers, Indicators, Meters, Monitors, Multiplexers, Potentiometers, Power Supplies, Signal Conditioners & Equipment, Standards

Local Sales Offices & Reps.

Cal	Los Altos, J. Stone & Assocs.	415-948-4563
Cal	Los Angeles, Basic Sys.	213-938-2833
Cal	San Diego, Mesa Elctrns.	714-278-8021
Colo	Littleton, Radco Elctrns.	303-794-4279
Conn	Hamden, Applied Measurements	203-288-5288
DC	Washington, Powell-Pendergraph	301-656-4535
Ill	Chicago, Doric Scientific Corp.	312-397-8545
Ill	Chicago, SEA, Inc.	312-282-6694
Ind	Carmel, SEA, Inc.	317-846-2593
Kans	Prairie Village, Engineering Svcs. Co.	913-649-4000
La	Baton Rouge, Sesco	504-272-3730
Mass	West Acton, Applied Measurements, Inc.	617-263-2766
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Minneapolis, SEA, Inc.	612-425-4455
Mo	St. Louis, Engineering Svcs. Co.	314-997-1515
NJ	Fairfield, KLS Assocs., Inc.	201-227-2900
NM	Albuquerque, Rustco Entprs.	505-296-6474
NY	Fairport, Naco Elctrns. Corp.	716-244-4720
NY	N. Syracuse, Naco Elctrns. Corp.	315-699-2651
NY	Utica, Naco Elctrns. Corp.	315-732-1801
NC	Charlotte, Doric Scientific Corp.	704-536-8096
Ohio	Cleveland, Instrumentation Sys., Inc.	216-486-0782
Ohio	Dayton, Instrumentation Sys., Inc.	513-294-2838
Pa	Abington, Bach-Stewart Assocs.	215-885-1550
Pa	Pittsburgh, Instrumentation Sys., Inc.	412-243-1111
Pa	Warrington, Doric Scientific Corp.	215-343-3215
Tex	Houston, Sesco	713-668-7840
Tex	Richardson, Sesco	214-231-9364
Va	Richmond, Powell-Pendergraph, Inc.	804-264-2341
Wash	Seattle, Seatronics, Inc.	206-767-4330
Wisc	Waukesha, SEA, Inc.	414-547-6637

DORMEYER INDUSTRIES, 3418 N. Milwaukee, Chicago, Ill., 60641, Tel: 312-283-4000; Empl.: 650

Customer service: Sls. Coordinators

Free literature available: Engineering workbook for use in specifying linear solenoids as relates to work force required in application.

Products manufactured: Chargers, Battery, Coils Including Assemblies & Forms, Power Supplies, Solenoids, Transformers

DOUGLAS ELECTRONICS, 718 Marina Blvd., San Leandro, Cal., 94577, Tel: 415-483-8770; Empl.: 20; Minimum order: $10

For info on price: L. Powell; Application info: C. Pennebaker; Customer service: N. Cain; Delivery info: L. Powell

Free literature available: 1. Catalog of Circuit Buaro Components 2. Mini Computer products

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Chassis, Circuit Board Mounting, Connector Blocks, Mother Board, Connectors, Integrated Circuit Devices, Printers, Racks, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

DOUGLAS-WORKMAN ELCTRNS CORP., 4300 Peters Rd., Ft. Lauderdale, Fla., 33317, Tel: 305-791-9390

Customer service: D. Workman; Delivery info: H. Biesemeyer

Free literature available: Form D100-B Description of exact replacement television knobs, available to Electronic Parts Distributors.

Products manufactured: Knobs

DOUGLAS RANDALL DIV., Walter Kidde, 6 Pawcatuck Ave., Pawcatuck, Conn., 02891, Tel: 203-599-1750; Empl.: 125
p. 1•549,1629-1638; p. 2•1734

For info on price: J. Barber; Application info: E. J. Goehring; Customer service: J. Barber; Delivery info: J. Barber

Free literature available: Reed Relay Catalogs-complete description & details of standard products. Solid State Relays-complete details on twenty standard models. Modular Tone Controls-technical data on oscillators and fritch including application notes.

Products manufactured: Coders, Coils Including Assemblies & Forms, Controls/Control Eqpt., Decoders, Detectors, Encoders, Monitors, Oscillators, Regulators, Relays, Switches, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Leigh Sls., Inc.	205-852-3270
Cal	Los Altos, Parsons & Meister	415-941-4745
Cal	Los Angeles, Sodaro Assocs.	213-478-7733
Cal	San Diego, Qualtronix	714-560-8955
Conn	Ridgefield, JMG, Inc.	617-762-5333
Fla	Maitland, Ellis Assoc.	305-645-1101
Ill	Chicago, R. Cahill, Inc.	312-287-7292
Mass	Norwood, JMG, Inc.	617-762-5333
Minn	St. Paul, Cahill	612-646-7217
Mo	Kansas City, R.R. Burton Sls. Co.	816-444-8300
Mo	Maryland Hgts., Delltron Co.	314-434-3804
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Rochester, H.R. Murray, Inc.	716-244-1100
NY	Syracuse, H.R. Murray Inc.	315-446-5555
NC	Knightdale, Leigh Sales	919-266-0105
Ohio	Berea, Geotronix Mktg. Assoc.	216-243-8520
Ohio	Columbus, Geotronix Mktg. Assoc.	614-457-8472
Pa	Glenside, Elcom, Inc.	215-885-1325
Tex	Dallas, BESCO	214-376-1929
Va	Reston, Boyle Assocs.	703-620-9558
Wash	Seattle, Carlyle Tech. Sls.	206-622-4288

Local Distributors

Mass	W. Newton, A. Mayer Co., Inc., 38 Border St.	617-965-1111

DOW CHEMICAL CO., Box 2020, Midland, Mich., 48640, Tel: 517-636-1000, TWX: 810-266-9490; Empl.: 52000

Products manufactured: Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Etchants, Printed Circuit, Insulators & Insulation, Metal Oxides, Metals, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Services, Assembly, Production & Test, Sound Absorbing Materials, Tubing

Local Sales Offices & Reps.

Cal	Pasadena	213-577-1515
Cal	Walnut Creek	415-933-3100
Conn	Stamford	203-359-3300
Ga	Atlanta	404-394-4141
Ill	Des Plaines	312-297-1000
Ind	Indianapolis	317-926-3441
Kans	Shawnee Mission	913-362-2100
La	Baton Rouge	504-937-2222
Mass	Wellesley	617-237-2070
Mich	Grand Rapids	616-949-9000
Mich	Southfield	313-358-1300
Minn	Minneapolis	612-835-4200
Mo	St. Louis	314-726-5000
NJ	Moorestown	609-234-0400
NJ	Saddle Brook	201-845-5000
NY	New York	212-757-8300
NY	Williamsville	716-631-5540
NC	Charlotte	704-525-9030
Ohio	Cincinnati	513-793-6200
Ohio	Cleveland	216-861-5825
Pa	Pittsburgh	412-281-3030
Tenn	Memphis	901-767-5000
Tex	Dallas	214-742-8691
Tex	Houston	713-626-3170
Wash	Bellevue	206-455-2144

DOW CORNING, Savage Rd. Bldg., Midland, Mich., 48640, Tel: 517-636-8000, TWX: 810-266-9006

Products manufactured: Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Crystals, Insulators & Insulation, Lubricants, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber,

Local Sales Offices & Reps.

Cal	Los Angeles	213-289-5186
Cal	Palo Alto	415-964-7744
Ga	Atlanta	404-934-6595
Ill	Chicago	312-671-3100
Mass	Boston	617-965-1010
Mich	Farmington	313-474-4000
NJ	Englewood Cliffs	201-567-4960
NC	Greensboro	919-275-9706
Ohio	Cleveland	216-464-2330
Tex	Dallas	214-661-0702

DRACON INDUSTRIES, 9541 Mason Ave., Chatsworth, Cal., 91311, Tel: 213-882-8595; Empl.: 150; Minimum order: $10

For info on price: J. Mason; Application info: A. Polzer; Customer service: B. Witt; Delivery info: B. Witt

Products manufactured: Amplifiers, Baffles, Speaker, Cable, Generators, Power Supplies, Racks, Speaker Systems, Speakers, Tools

DRAKE MFG. CO., Sub. Gen. Instr. Corp., 4626 N. Olcott Ave., Harwood Heights, Ill., 60656, Tel: 312-867-7227, TWX: 910-221-0236; Empl.: 150

Products manufactured: Bezels, Shielded & Unshielded, Diodes, Holders, Circuit Board (Production Type), Lamps, Lights, Sockets

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe Sls.	602-264-7971
Cal	Mountainview, R.T. Pross	415-967-2346
Cal	N. Hollywood, Chicago Miniature/Drake	213-877-0158
Colo	Denver, Lindberg Co.	303-758-9033
Conn	Newton, Gerber Sls.	203-426-3440
Fla	Hollywood, Component Eng. Sls.	305-922-5230
Ga	Atlanta, Winfield Southeast Co.	404-636-2023
Ill	Chicago, Chicago Miniature Lamp Works	312-784-1020
Ind	Indianapolis, Technical Reps.	317-849-6454
Kans	Overland Park, Penzer-Mankus Assoc.	913-381-0004
Mass	Needham, Chicago Miniature/Drake	617-449-4730
Mass	Waltham, Gerber Sls.	617-890-8040
Mich	Detroit, Rathsburg Assoc.	313-882-1717
Minn	Minneapolis, Nortec Sls.	612-835-7414
NJ	Cherry Hill, Trinkle Sls.	609-795-4200
NY	North Syracuse, L.D. Allen	315-458-7470
NY	Port Washington, TMA	516-883-2432
Ohio	St. Mary's, T. Shelby & Co.	419-394-3377
Tex	Dallas, Techno Assocs.	214-357-9213
Wash	Seattle, J.J. Backer Co.	206-285-1300
EXP:	Chicago, Ill., E.D. Magnus & Assoc.	312-334-1503

DRAKE CO., R.L., 540 Richard St., Miamisburg, Ohio, 45342, Tel: 513-866-2421, Telex: 288-017

For info on price: J. H. Brunzo; Application info: J. H. Brunzo; Customer service: W. F. Frost; Delivery info: J. H. Brunzo

Free literature available: Technical brochures on any R.L. Drake Co. product upon request.

Products manufactured: Amplifiers, Couplers, Filters, Meters, Receivers, Transceivers, Transmitters

DRANETZ

DRANETZ ENGRG. LABS., 2385 S Clinton Ave., So. Plainfield, N.J., 07080, Tel: 201-755-7080, TWX: 710-997-9553; FSC No: 23207; Empl.: 50; Minimum order: $25 .... p. 1•652-657

Customer service: L. Banas

Free literature available: Description, specifications and application information for time/phase/impedance/energy and line disturbances are described instruments to measure, analyze and record AC volts/amps/frequency/ time/phase/impedance/energy and line disturbances are described in individual and general catalogs and application notes.

Products manufactured: Amplifiers, Analyzers, Bridges, Calibrators, Coders, Comm. Systems, Comparators, Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Current Sensors, Data Acquisition & Reduction Systems, Detectors, Equalizers, Filters, Generators, Indicators, Insertion Loss Measurement Systems, Meters, Monitors, Networks, Oceanographic Equip. (Electronic), Shifters, Signal Conditioners & Equipment, Standards, Telephone Channel Test & Simulator Equipment, Test Equipment, Testers, Timers, Totalizers, Digital, Transformers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Cal	Los Angeles, E. Mintz	213-645-2066
Cal	Palo Alto, Coherent Mktg. Assoc.	415-327-2217
Cal	San Diego, E. Mintz	213-645-2066
Colo	Denver, Hamilton Assocs.	303-629-0901
Conn	Hamden, Scientific Devices-Conn.	203-248-9361
Fla	Orlando, Datarep, Inc.	305-843-5224
Fla	Pompano Beach, Datarep, Inc.	305-781-9279
Fla	St. Petersburg, Datarep, Inc.	813-345-8503
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Elk Grove Village, L. F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L. F. Green & Assocs.	317-293-9827
Md	Rockville, Mesa	301-881-8430
Mass	Waltham, Scientific Devices-New England	617-894-5637
Mich	Royal Oak, Group Ten	313-549-3910
Minn	Minneapolis, L. F. Green & Assoc.	612-781-1611
Mo	St. Louis, Delltron Co.	314-869-4779
NJ	Cinnaminson, Mesa	609-786-0284
NJ	Fairfield, KLS Assocs.	201-227-2900
NY	Rochester, Scientific Devices	716-334-2445
NC	Charlotte, Ranson, Wallace & Baesel, Inc.	704-334-4244
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-293-7061
Ore	Portland, Topp Eng. Sls.	503-644-3020
Tex	Austin, Martin, Zienkosky, Browne & Assocs.	512-454-4371
Tex	Dallas, Martin, Zienkosky, Browne & Asso.	214-233-5535
Tex	Houston, Martin, Zienkowsky, Browne & Asso.	713-523-7333
Wash	Bellevue, Topp Engrg. Sls.	206-747-5400
WVa	W. Virginia, Group Ten	513-293-7061
FOR:	Can., Ottawa, Ont., Kenwood Controls	613-722-8233
FOR:	Can., St. Catherines, Ont., Kenwood Controls	416-682-3286
FOR:	E. Can., Montreal, Que., Kenwood Controls	514-738-4969
FOR:	W. Can., Vancouver, B.C., Canadian Dynamics	604-325-3201

DRESSEN-BARNES ELCTRNS., 250 N. Vinedo Ave., Pasadena, Cal., 91107, Tel: 213-681-0643, TWX: 910-588-3780; FSC No: 94412; Empl.: 85; Minimum order: $25

For info on price: M. Foes 213-795-7731; Application info: A. Washnesky 213-795-7731; Customer service: M. Foes 213-795-7731; Delivery info: M. Foes 213-795-7731

Products manufactured: Converters, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Young & Lawrence Assoc.	205-539-6575
Cal	Mountain View, Tech-Ser.	415-969-9020
Cal	Pasadena, Dressen-Barnes	213-795-7731
Fla	Ft. Lauderdale, Young & Lawrence Assoc.	305-563-6717
Fla	St. Petersburg, Young & Lawrence Assoc.	813-894-0026
Fla	Winter Park, Young & Lawrence Assoc.	305-647-6929
Md	Simpsonville, Seirec Assoc.	301-596-5520
Mass	Needham, A. & M. Elec. Reps.	617-444-8170
Mich	Detroit, Hocker Assocs.	313-431-1403
NY	Elmira, A & D Dev.	607-733-0405
NY	Hartsdale, Comp. Sls.	914-725-1050
NY	Rochester, A & D Devices	716-586-8033
NY	Verona, A & D Devices	315-337-7321
Ohio	Dayton, Hocker Assocs.	513-298-8638
Tex	Plano, Zeus Eng.	214-423-2027
Wash	Seattle, Avionics-Liaison	206-767-3870

DUKANE CORP., 2900 Dukane Dr., St. Charles, Ill., 60174

Products manufactured: Amplifiers, Analyzers, Baffles, Speaker, Clocks (All Types), Comm. Systems, Detectors, Generators, Grilles, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Phonographs, Parts & Accessories, Public Address Systems, Speaker Systems, Speakers, Transducers, Tuners, Underwater Communication, Detection, Navigation, etc. Equipment, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

DULLRON CO., INC., 425 N. Findlay St., Dayton, Ohio, 45401, Tel: 513-226-4000; Empl.: 2100

For info on price: J. A. Welch 513-226-4056; Application info: R. J. Hinman 513-226-4249; Customer service: J. R. Adcock 513-226-4117; Delivery info: R. J. Hinman 513-226-4249

Free literature available: Complete and descriptive literature on Durcon laboratory sinks and tops made from corrosion resistant Durcon® epoxy resin.

Products manufactured: Benches, Consoles, Stools, Tables

Local Sales Offices & Reps.

Ala	Birmingham, Clary & Assocs.	205-251-2085
Ariz	Phoenix, Tyson-Feist Assocs.	602-277-4427
Ariz	Tucson, Tyson-Feist Assocs.	602-296-0349
Ark	N. Little Rock, C.A. Riner Co.	501-372-4156
Cal	Los Angeles, Scanlan & Lucas	213-266-2020
Cal	San Francisco, Specification Products	415-981-1154
Colo	Denver, Parker/Shyne Assocs.	303-893-5149
Conn	Windsor, R. Yost Assocs.	203-527-4101
Fla	Jacksonville, Trippe & Black Assocs.	904-737-7022
Fla	Miami, N. Ascher & Assocs.	305-371-3195
Fla	Orlando, Tripp & Black Assocs.	305-841-4995
Fla	Tampa, P. Pullara & Assocs.	813-872-5657
Ga	Atlanta, Clary & Assocs.	404-873-1861
Haw	Honolulu, B. Watanabe	808-845-0939
Ill	Broadview, W.R. Wallin Assocs.	312-379-2626
Ind	Indianapolis, Aspinall & Assocs.	317-926-3421
Iowa	Des Moines, M.B. Townsend Co.	515-279-1641
La	Alexandria, W.H. Grant, Jr.	318-443-4084
La	New Orleans, Grant & Assocs.	504-525-4207
Md	Bethesda, Steck Sls. Co.	301-657-2442
Md	Severna Park, Donnelly & Burns Assocs.	301-647-4100
Mich	Detroit, R.L. Deppman Co.	313-872-6304
Mich	Grand Rapids, J.R. Thomas & Assocs.	616-454-2500
Minn	Minneapolis, H.E. Agness Co.	612-339-4696
Mo	Kansas City, Hebenstreit Co.	816-561-4661
Mo	St. Louis, Brodz Sls & Engineer Co.	314-426-0335
Mont	Great Falls, D.E. Weidner Co.	406-453-2727
Neb	Omaha, Shiner Sls. Co.	402-493-6625
NJ	Waldwick, Salsbury Sls. Co.	201-652-2666
NM	Albuquerque, Mohon Sls. Co.	505-344-3449
NY	Buffalo, E.C. Oldach	716-634-0024
NY	Long Island City, Salsbury Sls. Co.	212-786-8260
NY	Syracuse, J.A. Walsh	315-474-1089
NC	Charlotte, Smith & Stevenson	704-525-3388
Ohio	Cleveland, BWA Co.	216-781-4040
Ohio	Hilliard, BWA Co.	614-876-2477
Ohio	Norwood, BWA Co.	513-631-3330
Ohio	Toledo, BWA Co.	419-472-6531
Okla	Broken Arrow, Brazeal & Dilbeck	918-251-1509
Okla	Oklahoma City, Brazeal & Dilbeck	405-232-2940
Ore	Portland, G.J. Scott Co.	503-228-8643
Pa	Philadelphia, R. Burns Assocs.	215-925-7255
Pa	Pittsburgh, R.J. Fitzgerald Assocs.	412-486-8900
Tenn	Knoxville, Corrigan Co.	615-584-8335
Tenn	Memphis, Corrigan Co.	901-274-5712
Tex	Dallas, Dillard Assocs.	214-748-7708
Tex	Houston, H.F. Wood & Assocs.	713-686-8441
Utah	Salt Lake City, Richards & Hansen	801-487-1355
Va	Richmond, Otto Sls. Co.	804-288-5648
Wash	Bellevue, J. Wm. Jones Sls. Agency	206-747-4447
Wash	Spokane, D.E. Weidner Co.	509-535-4632
Wisc	Wauwatosa, T. Tiernan & Assocs.	414-453-8838
FOR:	Can., Vancouver, B.C., Scott-Peterson Agencies, Ltd.	604-685-7304

DUMONT ELECTRON TUBES & DEVICES CORP., 750 Bloomfield Ave., Clifton, N.J., 07015, Tel: 201-773-2000, TWX: 710-989-7149

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Counters, Detectors, Diodes, Mounts, Photomultiplier Tube Housings, Tubes

DUMONT OSCILLOSCOPE LABS., INC., 40 Fairfield Pl., W. Caldwell, N.J., 07006, Tel: 201-575-8666, TWX: 710-734-4308; Empl.: 125; Minimum order: $25

Products manufactured: Cameras, Oscilloscope Plug-Ins, Oscilloscopes, Probes

DUNCAN ELECTRONICS, INC., 2865 Fairview Rd., Costa Mesa, Cal., 92626, Tel: 714-545-8261, TWX: 910-595-1128; FSC No: 5905; Empl.: 170; Minimum order: $25 .... p. 1•2024,2025; p. 2•1654,1655

For info on price: R. L. Rissler; Application info: R. L. Rissler; Customer service: R. Macke; Delivery info: R. Macke

Products manufactured: Attenuators, Controls, Fader, Dials, Potentiometers, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest e/m Engrg., Inc.	602-993-0250
Cal	Costa Mesa, Duncan Elctrns., Inc.	714-545-8261
Cal	El Monte, Telemart Co.	213-444-7666
Cal	Mountain View, Caltron/Pyle	415-964-3244
Colo	Denver, Zeus, Inc.	303-771-6200
Conn	Newtown, Gerber Sls. Corp.	203-426-3440
Fla	Ft. Lauderdale, Orbe, Inc.	305-564-8571
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ga	Atlanta, G. Duckett Sls. Co.	404-451-3529
Ill	Mt. Prospect, Delta Tech. Sls.	312-437-9412
Ind	Greenwood, Valentine & Schillinger	317-888-2260
Ind	South Bend, Valentine & Schillinger	219-291-6258
Kans	Shawnee Mission, Florence & Meyer	913-722-5210
Kans	Wichita, Florence & Meyer	316-838-7226
Md	Rockville, Marktron, Inc.	301-762-6210
Md	Timonium, Marktron, Inc.	301-252-7111
Mass	East Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Grosse Pointe Park, Greiner Assocs.	313-499-0188
Minn	Minneapolis, J.J. Exon Co.	612-566-5340
Mo	St. Charles, Florence & Meyer	314-723-8566
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Copiague, Sencor, Inc.	516-842-7676
NY	De Ruyter, R.P. Kennedy Co.	315-682-2920
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Ohio	Dayton, Rockford Controls Ohio, Inc.	513-898-5452
Ohio	Euclid, Rockford Controls Ohio, Inc.	216-731-5250
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Ore	Portland, C. K. Shanks & Assoc.	503-292-5656
Pa	Monroeville, Rockford Controls Ohio, Inc.	412-373-2531
Pa	Philadelphia, Sencor, Inc.	215-698-9660
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Va	Charlottesville, Marktron, Inc.	703-973-5874
Wash	Seattle, C. K. Shanks & Assoc.	206-632-4290

Local Distributors

Cal	San Carlos, Sterling Elctrns., 1061 Industrial Rd.	415-592-2353
Cal	Sun Valley, Richey Elctrns., 10871 La Tuna Canyon Rd.	213-875-2862
Colo	Denver, Ind. Elctrns., Box 22457	303-771-2636
Fla	Tampa, Lykes Elctrns., 1800 N.W. 23rd	305-633-8535
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow	312-697-8200
Ill	Westmont, Bodelle Co., 47 Chestnut La.	312-323-9670
Mich	Ann Arbor, Advent Elctrns., 254 S. Wagner Rd.	313-769-8650
Minn	Minneapolis, Stark Elctrns., 112-3rd Ave. N.	612-332-1325
NJ	Clifton, Parts Masters, 411 Main Ave.	201-777-7706
NJ	Perth Amboy, Sterling Elctrns., 774 Pfieffer Blvd.	201-442-8000
NM	Albuquerque, Ind. Elctrns., 310 Val Verde S.E.	505-266-8721
NY	NYC, Martin Audio, 320 W. 46th	212-265-6470
Ohio	Akron, Akron Elctrns., 107 S. Arlington	216-762-8818
Pa	Erie, Mace Elctrns., 2631 W. 8th	814-838-3544
Tex	Stafford, Southwest Elctrns., 12725 Royal Dr.	713-494-6021
Wash	Seattle, Radar Electric, 168 Western Ave. W.	206-282-2511

DUNEGAN/ENDEVCO, Rancho Viejo Rd., San Juan Capistrano, Cal., 92675, Tel: 714-831-9131, TWX: 910-596-1415; Empl.: 30

Customer service: B. Sonnenberg

Products manufactured: Detectors

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assocs.	205-837-0221
Cal	Palo Alto, Dunegan/Endevco	415-969-3212
Cal	Rowland Heights, Dunegan/Endevco	714-493-8181
Cal	San Juan Capistrano, Dunegan/Endevco	714-493-8181
Cal	Santa Clara, Johnson Assocs.	408-984-4626
Fla	Maitland, Craft Assocs.	305-645-2242
Ga	Atlanta, Craft Assocs.	404-393-0400
Ill	Chicago, Rhodes Engineering Co.	312-478-0161
Ill	Crystal Lake, Dunegan/Endevco	815-459-7226

Md	Towson, Dunegan/Endevco	301-752-0688
Mass	Bedford, Dunegan/Endevco	617-969-8063
NJ	Haddonfield, Dunegan/Endevco	609-428-5285
Ohio	Brecksville, RDP Assocs.	216-526-5260
Ohio	Dayton, RDP Assocs.	513-253-6175
FOR:	Can., Scarborough, Ont., J. DeGroot Assocs.	416-264-2991

DUNTON, M.W. CO., 350 Kinsley Ave., Providence, R.I., 02903, Tel: 401-331-3600; Empl.: 14; Minimum order: $8

Products manufactured: Flux, Brazing & Soldering Materials, Solder (All Types)

Local Sales Offices & Reps.

Ariz	Phoenix, Nibco of Phoenix	602-272-6853
Cal	Los Angeles, Nanklyell/Rollins & Assoc.	213-588-9166
Colo	Denver, Nibco of Denver	303-936-2328
DC	Wash, Barnett & Benner	301-864-5640
Fla	Pinellas Park, Distributor Sls. of Fla.	813-527-6651
Ga	Atlanta, Cochran & Co.	404-351-7767
Ill	Addison, Preferred Dist.	312-543-4660
Ind	Indianapolis, C.T. Voyles Co.	317-359-0698
Iowa	Des Moines, Mack McClain Corp.	515-288-0184
Md	Baltimore, R.B. Fulton Co.	301-467-0750
Mass	Reading, F. Banester	617-944-3776
Mich	Birmingham, Marshall Durston Co.	313-646-6144
Minn	Minneapolis, Nibco Midwest	612-544-3377
Mo	St. Louis, Nibco of St. Louis	314-647-2141
NJ	Woodbury, C.W. Cope Assoc.	609-845-0573
NY	Mineola, W.G. Roller	516-746-4486
NY	Rochester, Kolstad Assoc.	716-288-2086
NC	Greensboro, J.M. Pleasants Co.	919-288-1707
Ohio	Worthington, Shreiner Wright	614-846-1700
Tenn	Memphis, Cochran-Prather	901-274-4018
Tex	Dallas, H.F. Wood & Assoc.	214-631-4470
Va	Richmond, Taylor, Lipscomb & Appel	804-648-4431
Wash	Seattle, Baxter-Rutherford	206-623-1954

DUPONT INDUSTRIAL FIBERS, Center Rd. Bldg., Wilmington, Del, 19898

DURA PLASTICS N.Y., INC., 49 Richmondville Ave., Westport, Conn., 06880, Tel: 203-227-9588; Empl.: 90; Minimum order: $100

For info on price: J. F. Layman; Application info: J. Layman; Customer service: C. Halas; Delivery info: C. Halas

Free literature available: Catalog - Custom fabrication and vacuum forming of thermoplastics.

Products manufactured: Bezels, Shielded & Unshielded, Boxes, Junction, Outlets & Wall Plates, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Dials, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ill	Downers Grove, Jon Wright Distr. Co.
NY	N.Y. C., Dura Plastics of N.Y.

DURABLE INTERNATIONAL, INC., 3-01 27th Ave., Long Island City, NY, 11102, Tel: 212-726-1200

DURAKOOL, 1010 N. Main St., Elkhart, Ind., 46514, Tel: 219-264-1116, Telex: 25-8482; Empl.: 120; Minimum order: $25 .... p. 1•1639-1643

For info on price: N. Thorn; Application info: B. Brewers; Customer service: B. Brewers; Delivery info: D. Severs

Products manufactured: Relays, Switches

Local Sales Offices & Reps.

Cal	Los Angeles, Hundley Co.	213-240-3600
Cal	Los Gatos, Ind'l Mktg Assoc.	408-358-1734
Ga	Atlanta, Austin Brown Assocs	404-457-6381
Ill	Chicago, Kelburn Engrg Co.	312-775-8383
Ind	Indianapolis, Kelburn Engrg Co.	317-257-9874
Iowa	Davenport, Volco Co.	319-326-5233
Iowa	Des Moines, Volco Co.	515-283-1650
La	Metairie, Carey & Assocs	504-737-7614
Md	Cockeysville, N. H. Yates & Co.	301-667-6300
Mass	Waltham, DeVeer Sales Engrg Co.	617-899-5900
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Minn	Minneapolis, Volco Co.	612-336-1746
Mo	Kansas City, R. Greene Co.	816-333-7585
Mo	St. Louis, R. Greene Co.	314-644-2666
Neb	Omaha, Volco Co.	402-346-2203
NY	Wantagh, DONY Tech. Sls.	516-826-5550
NC	Matthews, Carolina Tech. Reps.	704-847-4494
Ohio	Akron, Sords Elec	216-644-7074
Ohio	Cincinnati, Sords Elec	513-272-3351
Ohio	Cleveland, Sords Elec	216-229-4700
Ohio	Worthington, Sords Elec	614-885-3933
Ore	Portland, Branom Instr. Co.	503-285-9861
Pa	Pittsburgh, Carter, McCormic & Pierce	412-824-3760
Pa	Willow Grove, Techparts	215-659-6900
Tenn	Nashville, Austin Brown Assocs	615-256-3003
Tex	Dallas, Carey & Assocs	214-363-7813
Tex	Houston, Carey & Assoc	713-460-1111
Utah	Salt Lake City, Thermalink Intermountain	801-466-8601
Va	Richmond, Virginia Tech. Assocs.	804-266-9654
Wash	Seattle, Branom Instr. Co.	206-762-6050
Wisc	Milwaukee, Kelburn Engrg Co.	414-545-2122
FOR:	Can., Ancienne Lorette, Que., Davis Controls	418-524-1823
FOR:	Can., Edmonton So., Alb, Davis Controls	403-439-5644
FOR:	Can., Halifax S.NS, Davis Controls	902-429-3877
FOR:	Can., Hamilton, Que., Davis Controls	416-522-2551
FOR:	Can., Islington, Ont., Davis Controls	416-233-3211
FOR:	Can., London, Ont., Davis Controls	519-432-9341
FOR:	Can., Montreal, Que., Davis Controls	514-481-7765
FOR:	Can., Ottowa, Ont., Davis Controls	613-237-6361
FOR:	Can., Richmond, BC, Davis Controls	604-685-1942
FOR:	Can., Winnipeg, Manitoba, Davis Controls	204-589-6625

Local Distributors

Pa	Narberth, Power Modules, Box 465	215-839-1331

DURANT DIGITAL INSTRUMENTS, Cutler Hammer Co., 901 S. 12th St., Watertown, Wisc., 53094, Tel: 414-261-4070, TWX: 910-260-3713; Minimum order: $25

Customer service: E. J. Parulski

Products manufactured: Controls/Control Eqpt., Counters, Machines/Machinery, Production, Switches

Local Sales Offices & Reps.

Ala	Birmingham, Spader & Assocs.	205-879-1366
Cal	Los Angeles, Durant Digital Instrs.-Cutler Hammer Co.	213-876-4000
Cal	Menlo Park, Durant Digital Instrs.-Cutler-Hammer Co.	415-854-2178
Colo	Denver, Durant Digital Instrs.-Cutler Hammer	303-922-3458
Conn	Stamford, Durant Digital Instrs.-Cutler Hammer Co.	203-327-1750
Fla	Clearwater, H.R. Gross & Co.	813-446-6649
Ill	Chicago, Durant Digital Instrs.-Cutler-Hammer Co.	312-237-1222
Kans	Mission, Durant Digital Instrs.-Cutler-Hammer Co.	913-262-2199
Md	Baltimore, Durant Digital Instrs.-Cutler Hammer Co.	301-825-6626
Mass	Wakefield, Durant Digital Instrs.-Cutler Hammer Co.	617-246-0024
Mich	Detroit, Durant Digital Instrs.-Cutler Hammer Co.	313-535-3630
Minn	Minneapolis, Durant Digital Instrs.-Cutler Hammer	612-835-5534
Mo	St. Louis, Durant Digital Instrs.-Cutler Hammer	314-423-3431
NY	Rochester, Durant Digital Instrs.-Cutler Hammer	716-328-5700
NC	Charlotte, Durant Digital Instrs.-Cutler Hammer	704-525-3149
Ohio	Cincinnati, Durant Digital Instrs.-Cutler Hammer	513-531-5073
Ohio	Cleveland, Durant Digital Instrs.-Cutler Hammer	216-464-8787
Ore	Portland, Durant Digital Instrs.-Cutler Hammer	503-297-4374
Pa	Paoli, Durant Digital Instrs.-Cutler Hammer	215-688-5055
Tex	Houston, Durant Digital Instrs.-Cutler Hammer	713-528-4183
Wash	Bellevue, Durant Digital Instrs.-Cutler Hammer	206-747-2001

DURGIN & BROWN, INC., 80 Allen Rd., Burlington, Vt., 05401, Tel: 802-863-6873; Empl.: 26; Minimum order: $10

For info on price: R. Martineau; Application info: R. Haskins; Customer service: R. Haskins; Delivery info: B. Hutchins

Free literature available: Digital systems products catalog. Complete catalog of counters, timers and controllers for production and process control.

Products manufactured: Counters, Display Devices/Displays, Indicators, Process Control Systems, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, RDX Corp.	602-267-8162
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-734-4500
Conn	Enfield, Measurement Equip. Co.	
Ind	Indianapolis, National Engrg. Co.	317-251-1132
Mass	Wakefield, Measurement Equip. Co.	617-245-4870
NY	Sodus, AED Agency	315-483-6561
Pa	Abington, Industrial Mktg. Specialist	215-659-0444
Tex	Dallas, Glidden Electro Equip. Co.	214-363-6539
Wash	Bellevue, Hickey Engineering Sales	206-454-0460

DUTREX INDS., INC., 150 Fifth Ave., New York, N.Y., 10011, Tel: 212-989-5000, TWX: 710-581-6234; Empl.: 20

For info on price: H. H. Friedman; Application info: H. H. Friedman; Customer service: P. Ortiz; Delivery info: P. Ortiz

Products manufactured: Diodes, Tubes

DYNACO INC., Box 88 Coles Rd., Blackwood, N.J., 08012, Tel: 609-228-3200, Telex: 831-493; Empl.: 100; Minimum order: $500

For info on price: V. Kaplan; Application info: W. Phillips; Customer service: V. Kaplan; Delivery info: V. Kaplan

Products manufactured: Amplifiers, Speaker Systems, Transformers, Tuners

DYNACOR, Div. Vectrol, Inc., 1010 Westmore Ave., Rockville, Md., 20850, Tel: 301-424-6900; Empl.: 48; Minimum order: $25

For info on price: R. Mitchell; Application info: R. Vollmer; Customer service: K. Berger; Delivery info: K. Berger

Free literature available: Miniature tape wound bobbin cores

Products manufactured: Cores, Magnetic

DYNAGE, INC., 1331 Blue Hills Ave., Bloomfield, Conn., 06002, Tel: 203-243-0315, TWX: 710-425-6063; Empl.: 60; Minimum order: $25 .... p. 1•1178,1179

For info on price: J. A. Pfingsten; Application info: J. A. Pfingsten; Customer service: L. Fedora; Delivery info: L. Fedora

Free literature available: Catalog 73-1 - Power Supplies.

Products manufactured: Cards, Logic, Controllers, Programmable, Controls/Control Eqpt., Power Supplies, References, D-C Voltage

Local Sales Offices & Reps.

Cal	Palo Alto, Engrg. Assocs.	415-494-7842
Cal	San Gabriel, Van Gott & Assoc.	213-285-2148
Fla	Casselberry, EIR, Inc.	305-830-9600
Ill	Northfield, H. Sam Tollaksen Co.	312-441-6644
Minn	St. Paul, Countryman Assocs.	612-645-9151
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Jericho, HRC Comp-Tech.	516-822-5550
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Ohio	Dayton, Midwest Mktg. Assoc.	513-433-2511
Pa	Paoli, Stitzer Assocs.	216-644-5500
Tenn	Bristol, Rakes Engrg. & Mktg. Corp.	615-968-4195

Local Distributors

Cal	Santa Monica, Distr. Specialist, 1710 Santa Monica Blvd.	213-829-5401
Pa	Trappe, Empire Intl., 106 W. 7th Ave.	215-489-6061

DYNAIR ELCTRNS. INC., 6360 Federal Blvd., San Diego, Calif., 92114, Tel: 714-582-9211, TWX: 910-335-2040; FSC No: 11650; Empl.: 150; Minimum order: $20

For info on price: M. Hughes Ext. 69; Application info: D. A. Keller Ext. 61; Customer service: E. Jett Ext. 26; Delivery info: M. Hughes Ext. 69

Products manufactured: Amplifiers, CATV Systems & Equipment, Demodulators, Direction Finders, Modulators, All Kinds, Power Supplies, Switches, Television Systems & Equipment Closed-Circuit, Transponders

Local Sales Offices & Reps.

DC	Washington, L. Darrigo	703-471-4078

DYNALAB CORP., 7808 Gloria Ave., Van Nuys, Cal., 91406, Tel: 213-781-3151; Empl.: 8

Products manufactured: Amplifiers, Analyzers, Antenna Feed Systems, Cavities, Microwave, Comm. Systems, Comparators, Converters, Couplers, Demodulators, Diplexers, Antenna, Discriminators, Duplexers, Microwave, Filters, Generators, Inverters, Limiters, Microphones, All Kinds, Mixer-Preamplifiers, Microwave, Modulators, All Kinds, Multipliers, Networks, Oscillators, Power Supplies, Prescalers, Preselectors, Probes, Receivers, Scramblers, Data, Shifters, Strip-Line Components, Microwave, Timers, Transceivers, Transformers, Transmitters, Transponders

DYNALOY, INC., 7 Great Meadow La., Hanover, N.J., 07936, Tel: 201-887-9270; FSC No: 27908; Empl.: 19; Minimum order: $10

For info on price: M. Bell; Application info: A. Ringel; Customer service: N. Gallop; Delivery info: M. Bell

Free literature available: Remove-A-Pads-New fast dissolving CFX1 type-under 15 seconds in chlorinated or fluorinated solvents: AWE Type under 1 minute in water-Decap & Uresolve - For dissolving most epoxies, RTV silicones, urethanes over 14 different selective solvents for failure analysis; Chemical deflashing; salvage, Conductive coatings & epoxy silver solders - air dry, silver & gold filled; unique one component silver epoxy for die attach.

Products manufactured: Adhesives (All Types), Chemicals, Cleaners & Solvents, Coatings, Conductive Plastic Materials, Pads, Transistor Mounting, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Spacers

Local Sales Offices & Reps.
Ariz Scottsdale, E. J. Foley & Assocs. 602-945-2665
Cal Westminster, Contronic Devices 714-897-2266
Ind Noblesville, G. Cardoza 317-773-6985
Minn Minneapolis, International Sales 612-831-8423
Tex Dallas, M. Daggett, Jr. & Assoc. 214-368-0135

DYNAMAGNETIC ENGRG, INC., 620 E. Dyer Rd., Santa Ana, Cal., 92705, Tel: 714-540-2081; FSC No: 52635; Empl.: 7; Minimum order: $10

Customer service: L. J. Zynda

Free literature available: A four page brochure with drawings showing numerous packaging configurations, terminals, mounting means, performance ratings, and sizes. Various applicable mil-specs. are listed.

Products manufactured: Capacitors, Fixed, Filters, Suppressors

DYNAMIC COMMUNICATIONS, INC., 948 Ave.E, P.O. Box 10116, Riviera Beach, Fla., 33404, Tel: 305-844-1323; Empl.: 30

For info on price: R.E. Beja; Application info: J. Penny; Customer service: T. Gault; Delivery info: R.E. Beja

Free literature available: Short form catalog which gives a complete description of each product manufactured. Individual data sheets for technical info on each product.

Products manufactured: Amplifiers, Comm. Systems, Meters, Probes, Transponders

Local Sales Offices & Reps.
Cal Anaheim, Gillingham Assocs. 714-280-6050
Cal Oakland, Sinclair Elctrn. Assoc. 415-451-1835
Fla Terra Ceia, Communications Supp. Corp.
813-360-7460
Ga Altanta, J.E. Joyner Assoc. 404-691-1776
Mass Newton, Techmar 617-444-8130
Minn Minneapolis, C.K. Melby Co. 612-884-7688
Mont Billings, Duane E. Parker & Assoc.
406-245-6349
NY Greenvale, Bertram D. Aaron & Co.
516-621-0630
NY Syracuse, Tesco Mktg. Assoc. 315-463-4566
Tex Richardson, Horizon Engrg. Sls. 214-238-9121
Va Arlington, Magnum Systems & Comm.
703-524-0884
Wash Seattle, Robert R. Slater Co. 206-622-3860
Wisc Brookfield, Steffen Sls. Co. 414-781-7591
EXP: Chicago, Ill, E.D. Magnus & Assoc.
312-334-1503

DYNAMIC CONTROLS CORP., 8 Nutmeg Rd., S. Windsor, Conn., 06074, Tel: 203-289-6807, TWX: 710-425-1994; FSC No: 07148; Empl.: 200; Minimum order: $35

For info on price: R. Kowalski ext. 68; Application info: R. Kowalski ext. 68; Customer service: R. Kowalski ext. 68; Delivery info: J. Dutton ext. 30

Products manufactured: Controls/Control Eqpt., Detectors, Flashers, Monitors, Power Supplies, Switches, Timers

Local Sales Offices & Reps.
Cal Los Angeles, Ledbetter Assocs. 213-454-2421
Tex Arlington Hgts., Aero Sls Co. 817-732-6907

DYNAMIC INSTR. CORP., 933 L.I. Motor Pkwy., Hauppauge, N.Y., 11787, Tel: 516-234-2900, TWX: 510-227-9884; Empl.: 720 .... p. 1•1177; p. 2•1735

Products manufactured: Chargers, Battery, Coils Including Assemblies & Forms, Converters, Eliminators, Battery, Inverters, Isolators, Plug Adapters, Power Drivers, Hybrid (High Current, High Voltage), Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.
Cal Burlingame, J. Logan & Assoc. 415-697-6100
Cal Monrovia, Electro-Mechanical Instr.
213-358-1881
Colo Arvada, Arrowhead Sls. Corp. 303-423-5556
Conn Bloomfield, Zaslow Sls. Co. 203-242-7781
Fla Maitland, Hutto, Hawkins, Peregoy, Inc.
305-831-2474
Ga Atlanta, Millar Elctrns. Inc. 404-261-6160
Ill Oakbrook, Whitmore Assoc. Inc. 312-325-4727
Mass Lowell, Zaslow Sls. Corp. 617-458-8452
Minn St. paul, H.A. Cullen Assoc. 612-646-7371
NY Plainview, Preisick Assoc. 516-681-8444
NY Syracuse, Naylor Elec. Co. 315-GR2-9183
NC Raleigh, Millar Elctrns. Inc. 919-787-9564
Ohio Englewood, Ad-El-Tek Co. 513-836-2741
Pa Devon, Kiley Elec. Co. 215-687-9340
Tex Dallas, E.B. Robertson Inc. 214-942-2716
Utah Salt Lake City, Arrowhead Sls. Corp.
801-487-3444
EXP: Downsview Ont., Can., Zaslow-Can.
416-249-1954

DYNAMIC MEASUREMENTS CORP., 6 Lowell Ave., Winchester, Mass., 01890, Tel: 617-729-7870, TWX: 710-348-6596; Empl.: 60

Customer service: R. Palmer

Free literature available: Complete specifications and applications data covering a broad range of convertor and operational amplifier products.

Products manufactured: Amplifiers, Comparators, Converters, Power Supplies

Local Sales Offices & Reps.
Ala Huntsville, Beacon Sls. 205-881-5031
Ariz Scottsdale, De Angelo, Rothman & Cheever
602-948-2240
Cal Santa Clara, Mauldin Co. 408-249-7660
Cal Santa Monica, Rep Assocs. 213-829-5401
Colo Englewood, Klein Aerospace 303-781-4967
Conn North Haven, Kitchen & Kutchen 203-239-0212
Fla Ft. Lauderdale, Beacon Elec. Assoc.
305-776-6074
Fla Maitland, Beacon Elec. Assoc. 305-647-3498
Ga Atlanta, Beacon Elec. Assoc. 404-351-3654
Md Simpsonville, A/O Elctrns. 301-997-8033
Mass Lexington, Kitchen & Kutchen 617-862-8230
Mich Detroit, Burcaw Assoc. 313-533-7700
Mich Kentwood, Burcaw Assoc. 616-531-1000
Miss Hernando, Beacon Elec. Assoc. 601-368-9008
Mo St. Louis, Ozark Elec. Mktg. 314-423-7200
NJ Wallington, Comp-Tech Sls. 201-935-5454
NY Ithaca, B. Dean Inc. 607-272-2187
Ohio Cleveland, Marlow Assoc. 216-932-0900
Ohio Xenia, Marlow Assoc. 513-426-6270
Pa Horsham, CMS Mktg. 215-672-8300
SC Spartanburg, Beacon Sls. 803-582-4613
Tex Dallas, Bouco Sls. Assocs. 214-247-6708
Tex Houston, Bouco Sls. Assocs. 713-661-9640
Wash Renton, Control Instrument 206-226-7170
EXP: N.C. Greensboro, Beacon Elec. Assoc.
919-674-9432
FOR: Can., Toronto, Ont., Norgay Enterprises
416-233-2930

DYNAMIC SYSTEM ELCTRNS., 35 Anacapa St., Santa Barbara, Cal., 93101, Tel: 805-963-3479
p. 1•604,605

Products manufactured: Converters, Data Acquisition & Reduction Systems, Data Loggers, Multiplexers

DYNAMICS ELCTRN. PRODS., INC., 12117 E. Slauson Ave., Santa Fe Springs, Cal., 90670, Tel: 213-723-6395; FSC No: 51209; Empl.: 35 .... p. 1•5

For info on price: A. L. White; Application info: J. Stephenson; Customer service: D. Cantrell; Delivery info: D. Cantell

Free literature available: Current and Voltage Excitation of Resistance Bridges Grounding and Shielding Practices for Instrumentation Systems.

Products manufactured: Amplifiers, Filters, Meters, Power Supplies, Signal Conditioners & Equipment

Local Sales Offices & Reps.
Ala Huntsville, Currie Peak & Frazier, Inc.
205-536-5650
Ariz Scottsdale, J. Smith & Assocs. 602-947-2495
Cal Palo Alto, Egbert Engrg. Assocs. 415-326-1387
Cal Santa Fe Springs, Dynamics Elctrn. Prods., Inc.
213-945-2493
Colo Littleton, J. Smith & Assocs. 303-794-8891
Conn Hamden, P. Jenks Assocs. 203-281-0810
Fla Orlando, Currie Peak & Frazier, Inc.
305-855-0843
Ill Chicago, Pivan Engrg. Co. 312-539-4838
Ill Skokie, Pivan Engrg. Co. 312-679-7870
Ind Indianapolis, Pivan Engrg. Co. 317-253-1681
Kans Shawnee Mission, Pivan Engrg. Co.
913-722-1030
Md Fulton, Gans-Fryling, Inc. 301-837-6311
Mass Wakefield, P. Jenks Assocs. 617-246-1590
Mich Detroit, S. Sterling Co. 313-255-1970
Minn Minneapolis, Pivan Engrg. Co. 612-537-4501
Mo St. Louis, Pivan Engrg. Co. 314-567-3636
NJ Cherry Hill, Williams Assocs. 609-424-4110
NM Albuquerque, J. Smith & Assocs. ... 505-255-2111
NY Kings Park, KLS Assocs., Inc. 516-724-1325
NY Penfield, A & D Devices, Inc. 716-586-8033
NC Greensboro, Currie Peak & Frazier, Inc.
919-273-3040
Ohio Cleveland, S. Sterling Co. 216-442-8080
Ohio Dayton, S. Sterling Co. 513-298-7573
Pa Pittsburgh, S. Sterling Co. 412-922-5720
Tex Houston, C.M. Asfahl, Inc. 713-523-3764
Va Arlington, Gans-Fryling, Inc. 703-527-3262
Wash Seattle, Comptronics 206-284-4842
Wisc Brookfield, Pivan Engrg. Co. 414-786-1940

DYNAMOD, Power Prods Corp., Box 152, Little Ferry, N.J., 07643, Tel: 201-440-9112; Empl.: 80

Products manufactured: Power Supplies

DYNAPAR CORP., 1675 Delany Rd., Gurnee, Ill., 60031, Tel: 312-662-2666, TWX: 910-235-1865; Empl.: 120; Minimum order: $30

Customer service: R. R. Brooks Ext. 41

Free literature available: Industrial Digital Equipment (Bulletin 100) The publication describes and illustrates digital measurement and control components and provides abbreviated specifications. On systems, application descriptions are provided.

Products manufactured: Computers, Controls/Control Eqpt., Counters, Data Acquisition & Reduction Systems, Encoders, Indicators, Timers, Totalizers, Digital, Transducers

Local Sales Offices & Reps.
NJ Westfield, Dynapar Corp. 201-654-3111
Ohio Willowick, Dynapar Corp. 216-944-9616

DYNASCAN CORP., 1801 W. Belle Plaine Ave., Chicago, Ill., 60613, Tel: 312-327-7270; Empl.: 250
p. 1•608-611

Products manufactured: Comm. Systems, Counters, Generators, Meters, Oscilloscopes, Power Supplies, Probes, Testers, Transceivers

Local Sales Offices & Reps.
Ala Birmingham, Maitland K. Smith, Inc.
205-967-3080
Cal Redwood City, Sinai-Johnson, Inc.
415-365-6263
Cal Van Nuys, Mike Roth Sls. of Cal. 213-989-3738
Colo Denver, K-C Mkts., Inc. 303-733-5561
Fla Ft. Lauderdale, Sproch Sls., Inc. 305-587-3792
Fla Sarasota, Sproch Sls., Inc. 813-924-7768
Ga Marietta, Maitland K. Smith, Inc. 404-971-2831
Ill Centralia, R. Dunn 618-533-1775
Ill Mt. Prospect, Q & B, Inc. 312-392-1200
La New Orleans, Texport Co. 504-486-6073
Mich Detroit, Burcaw Co. & Assoc. 313-533-7700
Minn Minneapolis, Kodo Assoc. 612-881-1255
Mo Crestwood, Nevco, Inc. 314-843-7406
Mo Kansas City, Nevco, Inc. 816-421-1751
NY Ballston Lake, G. Dworkin 518-877-8586
NY Grand Island, McTaggart Assoc. 716-773-9222
NY North Bellmore, L.W. Keller Assoc.
516-785-2826
NC Charlotte, Maitland K. Smith, Inc. ...704-372-1026
Ohio Conneaut, T. Clements, Reg. S. Mgr.
216-593-1646
Ohio Novelty, D. Kocher, District S. Mgr.
216-338-3964
Okla Tulsa, Texport Co. 918-939-1727

Pa	Jenkinton, J. Spangler	215-884-2787
RI	Glouster, A. Previte	401-949-0534
Tenn	Memphis, Texport Co.	901-683-0880
Tex	Houston, Texport Co.	713-464-2828
Wash	Seattle, Fleeheart & Sullivan	206-522-1533
EXP:	Plainview, N.Y., Empire Exporters	516-293-5582
EXP:	Toronto, Canada, Atlas Elctrns., Inc.	416-781-6174

DYNATECH CORP., 1225 E. Wakenham Ave., Santa Ana, Cal., 92702, Tel: 714-558-8755, TWX: 910-595-1951; Empl.: 100; Minimum order: $35

Customer service: E. Krause

Products manufactured: Backpanel Interconnect Systems, Connector Blocks, Mother Board, Connectors, Panels, Sockets

Local Sales Offices & Reps.

Ala	Huntsville, Technology Mktg. Assoc.	205-883-7893
Ariz	Phoenix, Hecht, Henschen & Assoc.	602-275-4411
Cal	Los Altos, Frauman Assoc.	415-941-0660
Cal	Santa Ana, Dynatech Corp.	714-558-8755
Colo	Denver, Rope & Williamson	303-758-8507
Fla	Winter Park, C.B.C. Elctrns.	305-644-2277
Ill	Evanston, Rendell Sls. Co.	312-866-8060
Ind	Indianapolis, J.D. Mktg.	317-849-9832
Mass	Westboro, Technical Mktg. Svc.	617-366-8462
Mich	Warren, DEM Elctrn. Sls.	313-755-6660
Minn	Bloomington, S. Clothier Co.	612-888-4666
Mo	St. Charles, Buckman & Assoc.	314-724-6690
NY	Spring Valley, R. Smith Assoc.	914-354-6067
NY	Syracuse, D. Dwyre	315-472-8282
NC	Winston-Salem, Burgin-Kreh & Assoc.	919-768-4174
Ohio	Canton, CSA Equip. Sls. Co.	216-456-1359
Pa	Ft. Washington, Kirk-Sandell	215-643-2100
Tex	Richardson, Zonk Engrg. Co.	214-238-7651
Va	Charlottesville, K.-Sandell	703-977-2033
Wash	Bellevue, Vantage Corp.	206-455-3460

Local Distributors

Cal	Mountain View, Abacus Elctrns., 1065 Terra Bella Ave.	416-961-1500
Cal	Orange, R.C. Elctrns., 17885 Skypark Cir.	714-549-9822
Cal	Woodland Hills, Elcon, 6325 DeSoto, Bldg. E	213-884-4852
NY	Farmingdale, Broadline Elec. Dist., 119 Marine St.	516-420-8320
NY	New York, Hofor Ind'l Svcs., Inc., 342 Madison Ave.	212-682-3092
Tex	Addison, Computer Comp Corp., 732 Wiley Post Rd.	214-239-0271
Wash	Seattle, Intermark Elctrns., 621 S. Michigan	206-767-3160

DYNATRON CO., Box 48822, Los Angeles, Cal., 90048, Tel: 213-933-4413; Empl.: 3; Minimum order: $25

Customer service: M. S. Robbins

Free literature available: Description of the color bar T.V. subcarrier frequency comparator system using the DyCo Model 175 and a color T.V. set for calibration against network rubidiums.

Products manufactured: Comparators, Connector Adapters, Television Systems & Equipment Closed-Circuit

DYNISCO, 20 S. West Pk., Westwood, Mass., 02090, Tel: 617-326-8210, Telex: 092-4347; Empl.: 78; Minimum order: $50

For info on price: R. J. Van Hooft; Application info: R. J. Van Hooft; Customer service: L. Shovelton; Delivery info: L. Shovelton

Products manufactured: Controls/Control Eqpt., Gages, Power Supplies, Transducers

Local Sales Offices & Reps.

Cal	Long Beach, E. Kirk Engrg. Co.	213-439-9559
Cal	San Francisco, Automated Process Controls	415-467-6162
Conn	Newtown, D. Hayes Inc.	203-426-9094
Fla	Ft. Lauderdale, Beacon Elctrn. Assocs. Inc.	305-776-6074
Ga	Atlanta, Beacon Elctrn. Assocs. Inc.	404-351-3654
Ill	Chicago, Thermo/Cense Inc.	312-792-2760
Mass	Newton Centre, D. Hayes Inc.	617-969-4650
Minn	Minneapolis, Automated Controls Inc.	612-377-7727
Mo	St. Louis, Ozark Elctrn. Mktg.	314-423-7200
NJ	Englewood, Tridon Sls. Co.	201-569-8011
NY	Rochester, D. Hayes Inc.	
Ohio	Cincinnati, Schlemmer Assocs.	513-522-8340
Ohio	Cleveland, Orr Assocs.	216-885-1324
Pa	Jenkintown, PDC Corp.	215-887-9610
SC	Spartanburg, Beacon Elctrn. Assocs. Inc.	803-582-4613
Tex	Arlington, D. Dawson Co.	817-265-6426
Utah	Salt Lake City, Applied Engrg. Prods. Co.	801-582-4942
Va	Falls Church, Beacon North Inc.	703-534-1673

DYTRO CORP., 63 Tec St., Hicksville, N.Y., 11801, Tel: 516-822-2130, TWX: 710-593-4135; Empl.: 15; Minimum order: $100

Products manufactured: Comparators, Converters, Data Acquisition & Reduction Systems, Data Loggers, Demagnetizers, Meters, Printers, Testers

Local Sales Offices & Reps.

Cal	North Hollywood, Crown Elctrns.	213-877-3550
Mass	Waltham, Instrumentation Controls & Measts.	617-891-8059
Tex	Houston, Leeco Inc.	713-487-1402

DYTRONICS CO., INC., 4800 Evanswood Dr., Columbus, Ohio, 43229, Tel: 614-885-3303; Empl.: 25

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Products manufactured: Filters, Generators, Meters, Shifters, Standards, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrn. Assoc.	205-881-5031
Cal	San Mateo, Dayton Assocs.	415-347-9419
Colo	Wheatridge, Technology Mktg. Assoc.	303-423-6106
Fla	Ft. Lauderdale, Beacon Elctrn. Assoc.	
Ill	Des Plaines, Marsland Assocs.	312-775-1309
Mass	Acton, Applied Meas.	617-263-2766
Minn	Minneapolis, Marsland Assoc.	612-545-4481
Tex	Dallas, Airep Elctrns.	214-363-5291
Va	Arlington, Gans-Fryling, Inc.	703-527-3262
Wash	Seattle, J.B. Jolly, Inc.	206-938-4166
EXP:	New York, N.Y., Joseph Plasencia, Inc.	212-867-8084

DYTRONICS DIV., GTI Corp., Box 217, Leesburg, Ind., 46538, Tel: 219-453-3261, Telex: 023-2653; Empl.: 150

For info on price: S. E. Edwards; Application info: R. L. Gerber; Customer service: N. L. Banghart; Delivery info: N. L. Banghart

Products manufactured: Boards, Printed Circuit, Circuits, Flexible

Local Sales Offices & Reps.

Ark	Hot Springs, Meredith Young Assoc.	501-262-1365
Cal	Santa Ana, Calif Elctrn Mktg.	714-835-2702
Fla	Orlando, Geartner Assoc.	305-299-1000
Ill	Chicago, Midwest Elctrn. Sls.	312-626-0030
Ind	Indianapolis, Electro-Reps	317-255-4147
Kans	Mission, Mid-Amer. Elctrn. Mktg.	913-236-4800
Mass	Attleboro, E. J. Hughes Assoc.	617-226-0050
Mich	Rochester, Kent & Assocs.	313-651-1890
Minn	St. Paul, Kenco Co.	612-645-7717
Miss	Jackson, Meredith Young Assoc.	601-366-8185
NJ	Parsippany, Total Mktg. Approach	201-227-4073
NY	East Aurora, E. E. Harries & Co.	716-652-1221
NY	Fayetteville, E. E. Harries & Co.	315-637-9871
Ohio	Chagrin Falls, Alexander Indl. Sls.	216-247-4133
Pa	Ardmore, R. D. Freedman Assoc.	215-649-3679

DZUS FASTENER CO., INC., 425 Union Blvd., West Islip, N.Y., 11795, Tel: 516-669-0494; Empl.: 100

Products manufactured: Fasteners

Local Sales Offices & Reps.

Cal	Anaheim, Dzus Fastener Co.	714-635-0830

E-H RESCH. LABS., INC., Dept. A., 515 11th St., Oakland, Cal., 94604, Tel: 415-834-3030, TWX: 910-366-7258; Empl.: 175

Products manufactured: Amplifiers, Attenuators, Calibrators, Comparators, Converters, Current Sources, Generators, Integrators, Electronic, Meters, Oscilloscopes, Probes, Recorders, Testers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Lawndale, Ward/Davis Assocs.	213-542-7740
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	W. Hartford, Instr. Dynamics	203-233-5503
Fla	Orlando, BCS Assocs.	305-843-1510
Ill	Chicago, Cozzens & Cudahy, Inc.	312-298-3600
Md	Baltimore, E-H Research Labs.	301-532-7400
Mass	Wakefield, Instr. Dynamics	617-245-5100
Minn	Mpls., Cozzens & Cudahy, Inc.	612-884-4336
Mo	St. Louis, Cozzens & Cudahy, Inc.	314-423-1234
NJ	Haddonfield, Dyna Rep. Co.	609-795-1700
NJ	Union, SBM Reps.	201-687-8737
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Pleasantville, SBM Reps.	914-769-1811
NY	Rochester, SBM Reps.	716-381-8330
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Centerville, Micro Sls.	513-885-4171
Ohio	Medina, Micro Sls. Corp.	216-221-5505
Ore	Portland, McLaren, Inc.	503-297-2248
Tex	Dallas, Data Mktg.	214-661-0300
Tex	Houston, Data Mktg.	713-686-9627
Wash	Bellevue, McLaren, Inc.	206-454-3400

E & L INSTRUMENTS, INC., 61 First St., Derby, Conn., 06418, Tel: 203-735-8774, Telex: 963536; Empl.: 25

For info on price: G. LaRatta; Application info: R. Vuillequez; Customer service: D. Tomalis; Delivery info: D. Tomalis

Free literature available: 1) Circuit Design Line-catalogue on range of breadboarding instruments & accessories, 2) Innovator Series Brochure-programmed/teacher's manual, 3) Adam Brochure-Modular-breadboarding instrument, 4) Elite Brochure-range of design requirements from incoming inspection thru research lab.

Products manufactured: Analyzers, Boards, Plug-In, Boards, Printed Wiring, Universal, Boards, Programming, Cards, Linear Function, Cards, Logic, Chassis, Circuit Board Mounting, Clamps & Clips, Generators, Integrated Circuit Devices, Jumpers, Kits, Breadboarding (For Engineers), Kits, Marking (Dial, Instrument, Equipment, etc.), Kits, Power Supply, Kits, Programming Board, Kits, Test Equipment, Kits, Training Aid, Power Supplies, Probes, Sockets, Terminal Blocks, Boards & Strips, Terminals, Testers

Local Sales Offices & Reps.

Cal	Mountain View, IFM Co.	415-961-2828
Cal	Palos Verdes, Edwards Assocs.	213-377-0975
Colo	Denver, R. Bowen Assoc.	303-722-4641
Conn	Woodbridge, Electronic Mktg. Co.	203-397-1461
Fla	Orlando, Nine Assocs.	305-628-1124
Ill	Arlington Heights, Martec Assocs.	312-956-8090
Mo	Kansas City, T. Dowell Co.	913-236-8200
NJ	Springfield, Shortess-Rawson & Assocs.	201-467-8585
NY	N. Syracuse, Naco Elctrns.	315-699-2651
Ohio	Dayton, Rixan Assocs.	513-222-0011
Pa	Valley Forge, J. E. Cuesta & Co.	215-265-5800
Tex	Richardson, Tesco, Inc.	214-690-4004
Va	Fairfax, Nine Assocs.	703-273-1803
Wash	Seattle, J. Jolly, Inc.	206-938-4166
FOR:	Can., Vancouver, BC, RAE Industrial Electronics Ltd.	604-687-2621
FOR:	Can., Edmonton, Alb., Cardinal Ind'l. Elctrns. Ltd.	403-455-4122
FOR:	Can., Winnipeg, Man., J. Fortin Co.	204-774-6286

E & M LABORATORIES, INC., 5388 Sterling Ctr. Dr., Westlake Village, Cal., 91361, Tel: 213-889-1470, TWX: 910-494-1953; FSC No: 14135; Empl.: 75

For info on price: G. M. Underberger; Application info: C. C. Carnegie; Customer service: M. McGinniss; Delivery info: W. Reed

Products manufactured: Amplifiers, Circulators, Ferrite, Drivers, Switch, Isolators, Strip-Line Components, Microwave, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Cupertino, Data Elec. Sls	408-255-2084
Cal	Los Angeles, McDougall/McLaughlin Co.	213-477-8556
Colo	Parker, TMA, Inc.	303-841-3435
Fla	Lighthouse Point, Saber Assocs., Inc.	305-943-3076
Ga	Woodstock, Saber Assocs	404-432-9625
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Ft. Wayne, TX Sls	219-489-4447
Mass	Stoneham, REPCO	617-438-3113
NJ	Haworth, Central Assocs., Inc.	201-568-0808
NJ	Pennsauken, Megargel/Himmelstein Assoc.	609 662-3081
NM	Albuquerque, TMA, Inc.	505-298-4321
NY	No. Syracuse, Naco Elctrns.	315-699-2651
NY	Plainview, Central Assocs., Inc.	516-433-0808
NY	Rochester, NACO Elctrns.	716-244-4720
NY	Utica, Naco Elctrns. Corp.	315-733-1801
NC	Raleigh, Candor Co.	919-876-4999
Ohio	Shaker Hts, Tex. Sls	216-561-1900
SC	Myrtle Beach, Candor Co., Inc.	803-448-5213
Tenn	Chattanooga, Candor Co., Inc.	615-894-7454
Tex	Dallas Airep Elctrns.	214-827-2120
Utah	Salt Lake City, Monarch Dist. & Representing	
Wash	Seattle, Datacom Assoc.	206-285-2525

Directory of Local Distributors Starts on page 401

FOR:	Can., Vancouver, Mitec Elctrns Ltd.	604-988-7317
FOR:	Can., Quebec, Mitec Elctrns Ltd.	514-334-9140

E-SYSTEMS INC., Garland Div., Box 6118, Dallas, Tex., 75222, Tel: 214-272-0515, TWX: 910-860-5187; Empl.: 1700

Products manufactured: Antenna Feed Systems, Antennas, Comm. Systems, Data Acquisition & Reduction Systems, Display Devices/Displays, Receivers

Local Sales Offices & Reps.

Fla	Fort Walton Beach	904-243-0127
Mass	Lexington	617-861-9050
NJ	W. Long Branch	201-222-0565
NY	Rome	315-336-1911
Ohio	Dayton	513-254-8464
Va	Arlington	703-524-2310
Va	Hampton	703-838-2010

E-SYSTEMS, INC., Memcor Div., 1320 Flaxmill Rd., Huntington, Ind., 46750, Tel: 219-356-4300, TWX: 810-333-1530; Empl.: 1100; Minimum order: $50 p. 2•1484-1491,1656-1665

For info on price: B. Broom; Application info: J. Fredricks; Customer service: B. Broom; Delivery info: J. Fredricks

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Dials, Fasteners, Kits, Potentiometer, Rheostat, Knobs, Locks, Dial & Shaft, Resistors, Rheostats

Local Sales Offices & Reps.

Ala.	Huntsville, Murcota Inc.	205-539-8476
Cal	Culver City, De Angelo, Rothman & Co.	213-398-6239
Cal	San Carlos, D.H. Ross Co.	415-591-4411
Colo	Denver, Gossard & Assoc.	303-985-0602
Fla	Boca Raton, R.K. Welter Co.	305-391-9067
Ga	Atlanta, Murcota Corp.	404-875-2525
Ill	Chicago, D. Dolin Sls. Co.	312-286-6200
Ind	Ft. Wayne, M & N Prods. Co.	219-747-2461
Iowa	Marion, Thomas & Modrcin Assocs.	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin Assocs.	913-432-2131
Md	Baltimore, D.H. Brothers Co.	301-764-7189
Mass	Boston, Anderson Sales Assoc.	617-227-2980
Mich	St. Clair Shores, J.M. Thorpe Co.	313-779-6363
Minn	St. Paul, H.A. Cullen, Assoc.	612-646-7371
Mo	Hazelwood, Thomas & Modrcin Assocs.	314-895-4700
NJ	East Orange, Masin Esco Inc.	201-674-6505
NY	E. Syracuse, Honsinger Mktg. Assocs.	315-463-5718
NY	Syosset, Masin Esco Inc.	516-364-0310
NC	Burlington, Murcota Corp.	919-585-1577
NC	Winston Salem, Murcota Corp.	919-723-1001
Ohio	Cleveland, Glover Sls. Co.	216-842-4520
Pa	Newtown Square, G.M. Conneen	215-353-2241
Tex	Dallas, Southwest Electronic Ind.	214-233-9816
Tex	Houston, Southwest Electronic Ind.	713-729-1670
Wash	Seattle, R.K. Squibb Inc.	206-632-2450

E-T-A PRODS. CO. AMERICA, 7400 N. Croname Rd., Chicago, Ill., 60648, Tel: 312-647-8303, Telex: 253780; Empl.: 13; Minimum order: $20

For info on price: D. Schneider 312-647-8303; Application info: W. Gillich 312-647-8306; Delivery info: D. Schneider 312-647-8303

Free literature available: Condensed Catalog; individual catalog sheets; bulletin 402, thermal magnetic circuit breaker.

Products manufactured: Circuit Breakers, Relays

Local Sales Offices & Reps.

Cal	Santa Fe Springs, Sierra-Pacific Eng.	213-921-9634
Cal	Walnut Creek, P.W. Jasin Co.	415-935-6339
Colo	Denver, Vinson Assocs.	303-757-5151
Conn	Meriden, Eagle Assocs.	203-235-9036
Fla	Orlando, Buchanan & Abrams Assoc.	305-898-7444
Ill	Chicago, Midwest Elctrn. Sls.	312-777-9700
Ind	Indianapolis, Garstang Engrg.	317-632-9903
Iowa	Cedar Rapids, Midwest Elctrn. Sls.	319-362-4410
Kans	Wichita, Dy-Tronix Inc.	316-943-6221
La	New Orleans, M.F. Klicpera Co.	504-282-2897
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-559-7373
Minn	Minneapolis, Wenco Sls.	612-866-3639
Mo	Hazelwood, Dy-Tronix Inc.	314-731-5799
Mo	Kansas City, Dy-Tronix	816-761-6543
NJ	Fort Lee, S. Justin Assoc.	201-947-4371
NY	Buffalo, Harries & Kershaw Co.	716-652-1221
NY	Rochester, Harries & Kershaw Co.	716-671-6365
NY	Syracuse, Harries & Kershaw Co.	315-637-9871
Ohio	Cincinnati, J.O. Olsen Co.	513-922-2176
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Okla	Tulsa, M.F. Klicpera Co.	918-939-5956
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Pa	Willow Grove, Techparts	215-659-6900
Tenn	Nashville, Stark & Assocs.	615-352-4276
Tex	Dallas, M.F. Klicpera	214-742-2515
Tex	Houston, M.F. Klicpera	713-747-3868
Wash	Kirkland, W.J. Stulgis Co.	206-822-3867
Wisc	Waukesha, J.C. Morkin Sls. Eng.	414-542-5129

E-TRONICS, 16774 Schoenborn, Sepulveda, Cal., 91343, Tel: 213-892-7279; Empl.: 28

Products manufactured: Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chokes, Coils Including Assemblies & Forms, Converters, Inverters, Power Supplies, Transformers

EV-GAME INC., Box 711, Freeport, N.Y., 11520, Tel: 516-378-0440, Telex: 96-1304; Empl.: 60; Minimum order: $20

Customer service: Sales Dept.

Products manufactured: Cable, Connector Adapters, Connectors, Cords, Crystals, Jack Adapters (All Types), Microphones, All Kinds, Motors, Phonographs, Parts & Accessories, Plug Adapters, Plug & Jack Sets, Tape Recording Accessories

Local Sales Offices & Reps.

Ariz	Phoenix, B & G Sls. Co.	602-266-5624
Ark	El Dorado, D. Bellew Sls. Co.	501-863-8325
Cal	San Francisco, Technical Sls.	415-467-1434
Cal	W. Covina, D. Forth Assocs.	213-967-2893
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Ormand Beach, J. F. Thompson Co.	904-677-2298
Ga	Atlanta, H. W. Phillips Co.	404-237-7564
Ill	Skokie, M. Bermann Sls. Co.	312-675-3740
Ind	Indianapolis, Mid-Central Sls.	317-283-1727
Ky	Ferncreek, Mid-Central Sls.	502-239-5614
La	Kenner, D. Bellew Sls. Co.	504-729-4550
Md	Baltimore, E-K-P Assocs.	301-788-6498
Mich	Detroit, Riley & Petchell Sls.	313-535-7000
Minn	Minneapolis, Kodo Assocs.	612-881-1255
Mo	Raytown, Midwest Mktg.	816-358-6638
NJ	Englewood, J. J. Bressler	201-569-7600
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
NY	New York, J. J. Bressler	212-564-4105
NC	Burlington, E. P. Ester Co.	919-226-5942
Ohio	Cleveland, H. Miller Sls. Co.	216-321-3900
Pa	Easton, E-K-P Assocs.	215-258-6477
Tenn	Memphis, L. Jones	901-683-7616
Tex	Irving, Antle-Smith Sls. Co.	214-259-8707
Wash	Seattle, W. R. Lanphear Sls. Co.	206-633-4900

E-Z-HOOK, Div. of Tektest, Inc., Box 450, Arcadia, Cal., 91006, Tel: 213-446-6175, TWX: 910-582-1614 ... p. 2•671

Products manufactured: Cable Assemblies & Harnesses, Clamps & Clips, Connectors, Cords, Jumpers, Kits, Breadboarding (For Engineers), Kits, Test Equipment, Leads, Test & Adaptors, Probes, Testers

EAGLE MAGNETICS CO., Box 24283, 7421 Crawfordsville Rd., Indianapolis, Ind., 46224, Tel: 317-297-1030; Empl.: 11 .... p. 2•1216,1217

For info on price: R. Jackson; Application info: J. L. Coddington; Customer service: R. Jackson; Delivery info: R. Jackson

Free literature available: Transformer Brochure-Design & Application, Testing, Cathode-Ray-Tube Brochure-Design & Application, Testing, Magnetic Shielding Materials Brochure-Design & Application, Testing

Products manufactured: Foil, Shields

EAGLE-PICHER INDS., Commercial Prods, Dept., Box 130, Seneca, Mo., 64865, Tel: 417-776-2258; Empl.: 100 p. 1•1208

Customer service: H.M. York

Free literature available: Battery Application Manual.

Products manufactured: Batteries

Local Sales Offices & Reps.

Ariz	Phoenix, Spectrum Assocs.	602-997-6324
Cal	Palo Alto, Abbott Engrg. Co.	415-327-0830
Cal	Santa Ana, Spectrum Assocs.	714-835-4114
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Fla	Maitland, Ellis Assocs.	305-645-1101
Ill	Oak Brook, Whitmore Assocs.	312-325-4727
Mass	Northboro, Zaslow Sls. Co.	617-393-8150
Minn	Minneapolis, Jaynus Assocs.	612-884-1700
NY	Plainview, Preisick Assocs.	516-681-8444
NY	Syracuse, Naylor Elec. Co.	315-656-2251
NC	Greensboro, L & D	919-292-3201
Ohio	Dayton, Ad-El-Tek/El Compo	513-836-2741
Tex	Dallas, E. B. Robertson	214-942-2716

EAGLE-PICHER INDUSTRIES, INC., Elctrns. Div., Box 47, Joplin, Mo., 64801, Tel: 417-623-8000, TWX: 910-774-4508; Empl.: 700; Minimum order: $100

Customer service: P. E. Grayson Ext: 448

Free literature available: Special purpose batteries for military and aerospace applications.

Products manufactured: Batteries, Boards, Printed Circuit, Braid, Cable, Cable, Chargers, Battery, Crystals, Metals, Services, Assembly, Production & Test

EAGLE SIGNAL, Mfg. Div. Gulf & Western Inds., Box 3585, Davenport, Iowa, 52808, Tel: 319-326-8111; Empl.: 800

For info on price: D. J. Morse 312-326-8125; Application info: J. C. Schwartz 312-326-8143; Customer service: E. P. Doak 312-326-8127; Delivery info: E. P. Doak 312-326-8127

Free literature available: An industrial control selection guide describing everything from control relays to programmable control systems including time, count and temperature controls; control sensors; prices; sales offices.

Products manufactured: Controllers, Programmable, Controls/Control Eqpt., Counters, Indicators, Light Sources, Photoelectric, Programmers, Relays, Sensors, Light, Switches, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ala	Birmingham, McConnell Sls. & Engrg. Corp.	205-871-3501
Ariz	Phoenix, Bews & Wallace Co., Inc.	602-275-4496
Ariz	Tucson, Bews & Wallace Co., Inc.	602-297-4001
Cal	Burlingame, Campbell & George Co.	415-697-2965
Cal	Los Angeles, Hundley Co.	213-240-3600
Colo	Denver, Empire Electrical Sls. Co.	303-744-1776
Fla	Ft. Lauderdale, Ward Engrg. Co.	305-564-4883
Fla	Jacksonville, Ward Engrg. Co.	904-388-7656
Fla	Orlando, Ward Engrg. Co.	305-851-0725
Ga	Atlanta, B. Fancher & Assocs.	404-448-7078
Idaho	Twin Falls, C.W. Silver Inc.	208-733-0460
Ill	Chicago, Kelburn Engrg. Co.	312-775-8383
Ill	Moline, J. Otis & Assocs.	309-762-9311
Ind	Indianapolis, Kelburn Engrg. Co.	317-257-9874
La	Baton Rouge, Thompson Equip. Co.	504-355-6663
La	New Orleans, Thompson Equip. Co.	504-833-6381
Md	Glen Burnie, E.J. Varholy & Sons Inc.	301-760-3344
Mass	Norwood, Gibson Engrg. Co.	617-769-3600
Mich	Detroit, R.D. Ernest Assocs.	313-861-7311
Mich	Spring Lake, Mackinaw Engrg. Co.	616-842-9170
Minn	Minneapolis, W. Hallock Co.	612-920-6100
Mo	Kansas City, R. Greene Co.	816-333-7585
Mo	St. Louis, R. Greene Co.	314-644-2666
NJ	Hackensack, C.H. Ribble Co.	201-342-2602
NY	Buffalo, Munhall Co.	716-856-1212
NC	Charlotte, B. Fancher & Assocs.	704-376-1753
Ohio	Cleveland, J.L. Finnicum & Assocs.	216-226-7076
Ohio	Dayton, Thal-Mor Assocs.	513-298-9939
Okla	Oklahoma City, L. Elliott Co.	405-842-7885
Okla	Tulsa, L. Elliott Co.	918-743-7794
Ore	Portland, Branom Instr. Co.	503-285-9861
Pa	Havertown, W. F. Keegan & Co.	215-528-6640
Pa	Monroeville, H. A. Deevers & Co.	412-372-4000
Tenn	Knoxville, J. R. Stephenson Agency	615-588-7474
Tex	Addison, L. Elliott Co.	214-239-8533
Tex	Missouri City, L. Elliott Co.	713-499-1571
Utah	Salt Lake City, C. W. Silver Inc.	801-355-5377
Wash	Seattle, Branom Instr. Co.	206-762-6050
WVa	Charleston, Skaff Engrg. Co.	304-342-0131
Wisc	Milwaukee, Kelburn Engrg. Co.	414-545-2122
EXP:	Davenport, Iowa, (Eagle Signal - J. Duda)	319-326-8146

EAI, See Electronic Assocs.

EASTERN AIR DEVICES MOTOR DIV., Electro Audio Dynamics, Inc., 385 Central Ave., Dover, N.H., 03820, Tel: 603-742-3330, TWX: 510-297-4454; Empl.: 325

Directory of Local Distributors Starts on page 401

Products manufactured: Alternators, Blowers & Fans & Accessories, Controls/Control Eqpt., Gearheads & Speed Reducers, Motors, Reducers, Tachometers

Local Sales Offices & Reps.

Ala	Huntsville, International Scientific	205-837-1601
Ariz	Tempe, Gassner & Clark	602-945-7979
Cal	Los Altos, Servo Data	415-964-1325
Cal	Los Angeles, Universal Comps.	213-641-4255
Fla	Orlando, Perrott Assoc.	305-275-1132
Ill	Westchester, Gassner & Clark	312-345-4245
Mich	Detroit, A. Blumenberg Assoc.	313-557-1934
Minn	St. Paul, R. G. Ragon	612-488-0201
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NY	No. Syracuse, L. D. Allen	315-458-7470
NY	Rochester, H. C. Johnson Agencies	716-482-3000
Ohio	Dayton, Midwest Mktg Assoc.	513-433-2511
Pa	Newtown Square, Hagy Assoc.	215-459-0504
Tex	Houston, Carey Assoc.	713-460-1111
FOR:	Can., Montreal, Que., Componetics, Ltd.	514-342-4117

EASTERN DELTA CORP., 29-09 S. Broadway, Fair Lawn, N.J., 07410, Tel: 201-797-4200; Empl.: 31; Minimum order: $25

For info on price: S. Carlson; Application info: I. Green; Customer service: I. Green; Delivery info: F. McKenzie

Products manufactured: Arresters, Electrical Surge, Lightning, Chargers, Battery, Chokes, Demagnetizers, Diodes, Eliminators, Battery, Limiters, Protectors, Rectifiers, Services, Assembly, Production & Test, Suppressors, Transformers, X-Ray Inspection Equipment

Local Sales Offices & Reps.

NJ	Fair Lawn, Eastern Delta Corp.	201-797-4200

EASTMAN CHEM. PRODS., Sub. Eastman Kodak Co., Kingsport, Tenn., 37662, Tel: 800-251-0351, TWX: 810-574-5174; Empl.: 1000

Customer service: Info. Svcs.

Free literature available: Pub. No. PA-14 Describes bonding strength and fast setting properties of Eastman 910® brand of cyanoacrylate adhesives. Pub. No. PO-12 General information on Tenite® Pollyallomer in wire coatings and other applications.

Products manufactured: Adhesives (All Types), Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

Local Sales Offices & Reps.

Conn	Hartford
Del	Newark
Fla	Tampa
Ga	Atlanta
Ga	Dalton
Ill	Chicago
Ky	Louisville
La	New Oreans
Mass	Boston
Mich	Detroit
Minn	Minneapolis
Mo	Kansas City
Mo	St. Louis
NJ	Millburn
NY	Buffalo
NY	New York City
NC	Charlotte
NC	Greensboro
NC	Raleigh
Ohio	Akron
Ohio	Cincinnati
Ohio	Cleveland
Ohio	Columbus
Ohio	Toledo
Okla	Tulsa
Pa	Bethlehem
Pa	Philadelphia
Pa	Pittsburgh
SC	Greenville
Tenn	Memphis
Tex	Dallas
Tex	Houston

EASTMAN KODAK, Bus. Sys. Mkt. Div., 343 State St., Rochester, NY, 14608

EASY-UP INC., Racine, Wisc., 53401, Tel: 414-633-6389; Empl.: 12

For info on price: T. I. Le Clear; Application info: T. I. Le Clear; Customer service: T. I. Le Clear; Delivery info: Main

Free literature available: Brochures-All products described.

Products manufactured: Benches, Consoles, Stools, Tables, Carts & Dollies, Instrument & Equipment, Mounts

Local Sales Offices & Reps.

Ga	Smyrna, B-C Elctrn. Sls.	404-436-5169
Ill	Skokie, M. Bermann Sls. Co.	312-675-3740
Ind	Port Wayne, N. Hoemig Sls. Co.	219-747-0826
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Detroit, R. Milsk Co.	313-342-6660
Minn	Minneapolis, R. Ripley & Assocs.	612-881-8282
Mo	St. Louis, Kathrinus-Helly-Boswell Co.	314-962-5627
NY	Yonkers, J. Mesnick Elctrn. Sls.	914-961-6619

EATON CORP., Ind'l. Drives Div., 9919 Clinton Rd., Cleveland, Ohio, 44111; Empl.: 1640

Products manufactured: Brakes, Controls/Control Eqpt., Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Motors, Reducers

Local Sales Offices & Reps.

Cal	Los Angeles	213-724-4320
Cal	San Francisco	415-588-4307
Colo	Denver	303-623-7011
Conn	Stratford	203-375-5207
Fla	Jacksonville	904-786-3254
Ga	Atlanta	404-448-6600
Ill	Elk Grove Village	312-439-6200
Iowa	Des Moines	515-278-4540
La	Metairie	504-888-9811
Md	Timonium	
Mass	Westboro	617-235-1624
Mich	Grand Rapids	616-245-8748
Mich	Southfield	313-345-5085
Minn	Minneapolis	612-835-5110
Mo	Maplewood	314-645-4732
NJ	Cherry Hill	215-563-1446
NJ	Fairfield	201-227-4111
NY	Buffalo	716-836-0850
NY	Syracuse	315-463-8202
NC	Charlotte	704-375-5659
Ohio	Cincinnati	513-874-4800
Ohio	Cleveland	216-523-5304
Okla	Tulsa	918-587-7917
Pa	Pittsburgh	412-341-6565
Tenn	Memphis	901-272-1374
Tex	Dallas	214-522-6191
Tex	Fort Worth	817-332-5351
Tex	Houston	713-623-0797
Tex	Odessa	915-366-4951
Wash	Seattle	206-624-7292
Wisc	Milwaukee	414-462-3800

EATON CORPORATION, Engineered Fasteners Division, Box 6688, Cleveland, Ohio, 44101, Tel: 216-523-5363, TWX: 810-421-8678; Empl.: 1300; Minimum order: $100

For info on price: W. J. Febel 216-523-5325; Application info: W. J. Febel 216-523-5325; Customer service: W. H. Gibbons 216-523-5705; Delivery info: W. A. Sutton 216-523-5771

Free literature available: Bulletin 383 - high carbon spring steel fasteners, heat treated. Used throughout automotive, appliance, radio-tv industries. Also complete line of plastics fasteners. Exotic & precious metal stampings, precision, miniature & ' sub-miniatures for electro-mechanical components.
Catalog 034-100 - Full Line of Cold Headed Nut-Bolt-Washer Assemblies & Specialties, Railroad Washers.

Products manufactured: Clamps & Clips, Connectors, Contacts, Electrical, Fasteners, Forms, Wire, Grommets, Rings, Retaining, Rivets, Springs (All Types), Strain Reliefs, Cable & Wire, Terminals, Wire

Local Sales Offices & Reps.

Cal	Santa Ana	714-542-7295
Ill	Oak Park	312-589-0300
Mich	Southfield	313-354-2810
Minn	Richfield	612-866-3896
Mo	St. Louis	314-725-1182
NJ	Kenilworth	201-272-8780
NY	Rochester	716-654-9690
Ohio	Cincinnati	513-771-9303
Ohio	Cleveland	216-523-5363
Tenn	Chattanooga	615-892-8452
Va	Roanoke	703-343-3678

EBY CO., HUGH H., 4701 Germantown, Philadelphia, Pa., 19144, Tel: 215-842-3000, TWX: 710-670-0452; FSC No: 72825; Empl.: 150; Minimum order: $200

For info on price: W. Telmosse; Application info: M. Sterling; Customer service: M. Costello; Delivery info: M. Costello

Products manufactured: Clamps & Clips, Connectors, Jacks (All Types), Plugs, Posts, Services, Assembly, Production & Test, Sockets

Local Sales Offices & Reps.

Cal	Norwalk, Zoolialian Inc.	213-921-9791
Ill	Des Plaines, E. Flaxman Co.	312-298-8580
Ill	Streamwood, Al Holte & Assoc.	312-837-4066
Md	Baltimore, Component Sls.	301-484-3647
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Southfield, Baer Ents.	313-357-3330
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Hazelwood, Technical Representatives	314-731-5200
NY	Huntington, Caravan Sls. Corp.	516-421-1391
NY	Jamaica, S-J Sls. Assoc.	212-291-3232
NY	Larchmont, Hingston Walsh Assoc.	914-834-5781
NY	Liverpool, B.C.S. Assocs.	315-458-4774
NY	New York, Eltron Export Corp.	212-944-7635
Ohio	Cleveland, Components, Inc.	216-842-2737
Pa	Glenside, Griffin Co.	215-646-8383
FOR:	Can., Quebec, Electrodesign Ltd.	514-363-5120

Local Distributors

Cal	Los Angeles, Dyna Service Co., 1020 S. Atlantic Blvd.	213-268-8531
Ill	Des Plaines, Edmar Elctrns., 1305 Rand Rd.	312-298-8580
NY	Buffalo, Summit Dists., 916 Main St.	716-884-3450
NY	Jamaica, Eby Sls. Co., 148-05 Archer Ave.	212-291-3232

ECC CORP., Box 669, Euless, Tex., 76039; Empl.: 927

Products manufactured: Controls/Control Eqpt., Regulators, Relays, Switches, Thyristors (Includes Silicon Controlled Rectifiers), Timers

Local Sales Offices & Reps.

Ala	Huntsville, Interep Assocs.	205-881-3677
Ariz	Scottsdale, F. Board Assocs.	602-949-9561
Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Arvada, Arrowhead Sls.	303-423-5556
Fla	Clearwater, Perrott Assocs.	813-531-5513
Fla	Orlando, Perrott Assocs.	305-275-1132
Ill	Elk Grove Village, John G. Twist Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-453-6868
Iowa	Cedar Rapids, John G. Twist Co.	319-393-8703
Ky	Louisville, R.O. Whitesell & Assocs.	502-893-7303
Mass	Lexington, KCA Comps., Inc.	
Mich	Grand Rapids, R.O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Minneapolis, Elec. Comp. Sls.	612-933-2594
Mo	Hazelwood, Centech Sls.	314-731-4220
Mo	Raytown, Centech Sls.	816-358-8100
NM	Albuquerque, A.Q. Elctrns.	505-255-8701
NY	Binghamton, Elcom Sls., Inc.	607-723-9270
NY	Rochester, Elcom Sls., Inc.	716-385-1400
NY	Whitesboro, Elcom Sls., Inc.	315-732-6445
NC	Charlotte, R.W. Chapman	704-525-2421
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Columbus, R.O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assocs.	513-298-9546
Ohio	Lakewood, R.O. Whitesell & Assocs.	216-228-7522
Pa	Bala Cynwyd, M. Friedman Assocs.	215-839-3450
Pa	Pittsburgh, R.O. Whitesell & Assocs.	412-242-0100
SC	Greenville, R.W. Chapman & Co.	803-232-5391
Tenn	Bristol, Remco	615-968-4195
Tex	Dallas, Component Specialties, Inc.	214-357-4576
Tex	Houston, Component Specialties, Inc.	713-771-7237
Tex	Richardson, Oeler & Menelaides	214-234-6334
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444

Directory of Local Distributors Starts on page 401

Wash	Bellevue, Vantage Corp.	206-455-3460
Wisc	Oak Creek, Erdman Sls. Co.	414-761-2120
Wisc	Waukesha, John G. Twist Co.	414-786-6330
FOR:	Downsview, Ont., Can., Cantronics Ltd.	416-661-2494
FOR:	Montreal, Quebec, Can., Cantronics Ltd.	514-733-0749

ECHO SCIENCE CORP., 485 E. Middlefield Rd., Mountain View, Cal., 94040, Tel: 415-961-7145, TWX: 910-379-6499; Empl.: 180

Customer service: R. R. Watson

Free literature available: Video Discassette Recorder, Video Tape Recorder, military and commercial, military-ruggedized. Video Disc Recorder - VDR 300, 310 & 315 & VDR-1R, Video Tape Recorder - WRR-411, WR-200 series Longitudinal Recorder, Transient Free Recorder.

Products manufactured: Memory Systems, Recorders

Local Sales Offices & Reps.

Cal	San Diego, Tauber & Assoc.	714-274-7242
Md	Laytonsville, G-T Assocs.	301-949-8060
NY	Huntington, Data Logic Sls.	516-421-1644
Tex	Dallas, Martin, Zienkasky, Browne & Assoc.	214-233-5535

ECONOMY FUSE DIV., Federal Pacific Elec. Co., 2070 Maple St., Des Plaines, Ill., 60016, Tel: 312-299-2211

Products manufactured: Fuses

ECP CORP., 4726 Superior Ave., Cleveland, Ohio, 44113

ECTRON CORP., 8159 Engineer Rd., San Diego, Cal., 92111, Tel: 714-278-0600, TWX: 910-335-1259; Empl.: 30
p. 1•7,162

Customer service: J. W. JaQuay

Free literature available: Differential DC Amplifiers and Signal Conditioners, Wide Band Differential DC Amplifiers, 500 Series DC Amplifiers, Industrial DC Amplifiers Multipurpose Signal Conditioners, Thermocouple Simulator/Calibrator

Products manufactured: Amplifiers, Calibrators, Data Acquisition & Reduction Systems, Data Loggers, Signal Conditioners & Equipment, Standards, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Ala	Huntsville, Incotech, Inc.	205-837-6061
Cal	Encino, Sci Devices	213-986-9933
Cal	Los Alamitos, Sci. Devices	213-598-7678
Cal	Mtn. View, Sci. Devices	415-964-4230
Cal	San Diego, Scientific Devices	714-279-6642
Colo	Littleton, Aztec Enter.	303-795-0250
Conn	E. Hartford, Tekdata	203-525-7647
Fla	Orlando, Datarep	305-843-5224
Fla	Pompano Beach, Datarep	305-781-9279
Ill	Chicago, S.E.A. Inc.	312-282-6694
Ind	Carmel, S.E.A. Inc.	317-846-2593
Md	Perry Hall, Dyna Rep. Co.	301-256-8300
Mass	Burlington, Tekdata	617-273-0198
Mich	Royal Oak, Satullo	313-549-3910
Minn	Minneapolis, S.E.A. Inc.	612-425-4455
NJ	Haddonfield, Dyna Rep Co.	609-795-1700
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Fayetteville, Doolittle Elctrns. Corp.	315-637-3222
NY	Great Neck, Eastern Instrumentation	516-466-9505
NC	Winston-Salem, Radco Co.	919-722-9671
Ohio	Cleveland, Instrumentation Sys. Inc.	216-486-0782
Ohio	Dayton, Instrumentation Sys. Inc.	513-294-2838
Pa	Pittsburgh, Instrumentation Sys.	412-243-1111
Va	Alexandria, Dyna Rep.	703-354-1222
Wash	Seattle, R.S. Drake Assocs.	206-763-2755
Wisc	Waukesha, S.E.A. Inc.	414-547-6637
FOR:	Can., Scarborough, Ont., J. DeGrott	416-264-2991

EDAL INDS., INC., 4 Short Beach Rd., E. Haven, Conn., 06512, Tel: 203-467-2591; Empl.: 200; Minimum order: $50

For info on price: E. Pagano; Application info: E. Pagano; Customer service: D. Vagnini; Delivery info: D. Vagnini

Products manufactured: Arresters, Electrical Surge, Lightning, Bridges, Diodes, Limiters, Rectifiers, Spacers, Suppressors, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Component Sls.	205-883-7794
Cal	Los Altos, Schwerin Assoc.	415-941-3737
Cal	Los Angeles, Current Product Sls.	714-633-7414
Conn	Madison, A&M	203-245-1031
Fla	Terra Ceia, Component	813-722-6376
Ill	Chicago, Brock & Cushman	312-622-4110
Mass	Needham, A&M Sls.	617-444-8170
Mich	Ferndale, Hilltronics	313-398-5556
Minn	Minneapolis, Furber Sls.	612-861-1518
Mo	Blue Springs, Chesco	816-229-1404
Mo	St. Charles, Chesco	314-946-6677
NJ	Nutley, I. Brill	201-667-0653
NY	Brooklyn, Eastern	212-763-5180
NY	Buffalo, H.C. Johnson	716-632-7880
NY	Rochester, H.C. Johnson	716-482-3000
Ohio	Cleveland, Brauer	216-943-0601
Ohio	Vandalia, Brauer & Assoc.	513-898-1224
Pa	Pittsburg, Brauer	412-821-3213
Pa	Radnor, Cordray Sls.	215-878-3737
RI	Needham, A & M	617-444-8170
Va	Reston, Boyle Assoc.	703-620-9558
Wisc	West Allis, Brock & Cushman	414-933-3374

E.D.I. INC., Box 66, Cairo, Ill., 62914, Tel: 618-734-1694; Empl.: 3

Customer service: E. Badran

Products manufactured: Boards, Printed Circuit

EDISON ELECTRONICS DIV., See McGraw-Edison Co.

EDISON, INSTR. DIV., McGraw Edison Co., 2 Babcock Pl., W. Orange, N.J., 07051, Tel: 201-736-1000, TWX: 710-994-5810; Empl.: 450

Products manufactured: Alarms, Controls/Control Eqpt., Detectors, Gages, Indicators, Meters, Monitors, Probes, Pyrometers, Recorders, Relays, Switches, Transducers

EDMAC ASSOCIATES INC., 333 W. Commercial St., East Rochester, N.Y., 14445, Tel: 716-385-1440; Empl.: 70

Products manufactured: Counters, Data Acquisition & Reduction Systems, Data Loggers, Filters, Recorders, Services, Assembly, Production & Test, Testers, Underwater Communication, Detection, Navigation, etc. Equipment

EDMUND SCIENTIFIC CO., 555 Edscorp Bldg., Barrington, N.J., 08007, Tel: 609-547-3488, Telex: 831-564; Empl.: 175; Minimum order: $5

For info on price: B. McKelevy; Application info: B. McKelevy; Customer service: D. Blackburn; Delivery info: D. Blackburn

Free literature available: Catalog 752 - More than 4,500 unusual bargains for hobbyists, schools & industry. Bulletin 9903 "Tips & Things For Beating the Energy Crisis". Consumer benefits from energy conservation. Includes solar energy devices, alternate energy devices, heat pipes.

Products manufactured: Adhesives (All Types), Alarms, Analyzers, Batteries, Calculators, Electrical & Electronic, Cameras, Cells, Photoconductive, Photoemissive, Photovoltaic, Chargers, Battery, Chemicals, Cleaners, Ultrasonic, Demagnetizers, Fiber Optic Bundles, Lamps, Lasers & Laser Systems, Lenses, Optical & Camera, Lenses, Readout & Display, Lights, Magnets, Magnifying Glasses, Inspection, Meters, Microscopes, Pyrometers, Radiometers

EDO WESTERN CORP., 2645 S. 300 West, Salt Lake City, Utah, 84115, Tel: 801-486-7481; Empl.: 225

Free literature available: Data sheets on each product and brochures on systems in the areas of oceanographic instrumentation, closed circuit TV systems for airborne and underwater applications, transducers and hydrophones, and piezoceramic crystals.

Products manufactured: Amplifiers, Cases, Equipment, Instrument, Meter, Coders, Crystals, Hydrophones & Accessories, Indicators, Monitors, Oceanographic Equip. (Electronic), Receivers, Recorders, Television Systems & Equipment Closed-Circuit, Transducers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instr.	205-837-4304
Ariz	Scottsdale, J. Smith & Assocs.	602-947-2495
Cal	Laguna Beach, J. M. Elgar	714-494-3965
Colo	Boulder, J. Smith & Assocs.	303-442-7100
Conn	West Hartford, Instrument Assocs.	203-525-9367
Md	Rockville, E. J. Winston	301-881-5780
Md	Silver Spring, L. G. White & Co.	301-685-1780
Mass	Bedford, Instrument Assocs.	617-275-0700
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	College Point, Edo Int'l.	212-445-6000
Ohio	Risingsun, Mecom	419-457-3231
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Tex	Stafford, Electrosystems Engrg.	713-721-0126
Wash	Seattle, Coccolith & Co.	206-525-8952
FOR:	Can., Delta, B.C., Band Elctrns.	604-581-9104

EDSYN, INC., 15958 Arminta St., Van Nuys, Cal., 91406, Tel: 213-873-5115, Telex: 65-1469; Empl.: 25
p. 2•1694,1695

Products manufactured: Meters, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools

Local Distributors

Ariz Phoenix, Jensen Tools & Alloys, 4117 N. 44 th St.
Cal El Monte, Marshall Inds., 9674 Telstar Ave.
Cal El Segundo, Alpha Comps., 115 Eucalyptus Dr.
Cal El Segundo, Wassco, 410 Douglas St.
Cal Glendale, MacDonald Co., 213 S. Brand Blvd.
Cal Los Angeles, Garrett Corp., 6015 E. Randolph St.
Cal San Jose, J. Elctrn. Tool Co., 1918 Story Rd.
Cal Santa Clara, Com Kyl, 2368 Walsh Ave.
Cal Torrance, Erem Corp., 3740 Skypark Dr.
Ill Chicago, EMF Co., 6135 W. Belmont
Minn Minneapolis, H. Stark's Inc., 112 3rd Ave. N.
NJ Saddlebrook, Tool-Tronics, 114 Route 46
Pa Huntingdon Valley, H. Mann Inc., 3983 Mann Rd.
Tex Fort Worth, Tandy Corp., 2615 W. 7th St.
Wash Seattle, Seattle Tool Supply, 1161 Eleventh St.

EDWARDS HIGH VACUUM, 3279 Grand Isl. Blvd., Grand Island, N.Y., 14072, Tel: 716-773-7552, Telex: 91-536; Empl.: 40; Minimum order: $10

For info on price: R. Niccola; Application info: H. Stry; Customer service: R. Niccola; Delivery info: R. Niccola

Products manufactured: Chamber, Environmental Test, Couplings, Deposition Equipment, Vacuum & Accessories, Detectors, Evaporation Equipment, Electron Beam, Feedthrus & Seals, Environmental, Gages, Lubricants, Pumps, Vacuum, Switches, Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.

Cal	El Segundo, Edwards High Vacuum, Inc.	213-322-7699
Colo	Denver, Continental Divide Prods., Inc.	303-420-0130
Fla	Orlando, Physimetrics, Inc.	305-894-8081
Ga	Atlanta, Physimetrics, Inc.	404-261-8720
Ill	Oak Lawn, Edwards High Vacuum, Inc.	312-423-0443
Mass	So. Weymouth, Edwards High Vacuum, Inc.	617-337-8931
Mich	Dearborn, Anger Assocs.	313-584-9853
NJ	Sussex, Edwards High Vacuum, Inc.	201-835-3925
NM	Albuquerque, Southwestern Engrg. & Equip. Co.	505-265-6775
NY	Grand Island, Edwards High Vacuum, Inc.	716-773-7552
Tex	Dallas, Southwestern Engrg. & Equip. Co.	214-826-6661
Tex	Houston, Southwestern Engrg. & Equip. Co.	713-353-4333

EECO, 1441 E. Chestnut Ave., Santa Ana, Cal., 92701, Tel: 714-835-6000, TWX: 910-595-1550; Empl.: 642
p. 1•2030-2033

Free literature available: EECO Switch Catalog, EECO Electronic Packaging Products Catalog #1002, EECO Guide to Punched Tape Readers/Perforators #630.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Cards, Logic, Chassis, Circuit Board Mounting, Dividers, Editing Equipment, Tape, Modules, Logic, Encapsulated, Packages, Integrated Circuit, Paper-Tape Preparation Systems, Perforators, Readers, Services, Assembly, Production & Test, Switch Hardware, Switches, Tape Search Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins-Co	205-539-1771
Cal	Los Altos, Recht Assocs.	415-941-0336
Cal	San Diego, Mesa Engr. & Sls. Assoc.	714-278-8021
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
Fla	Orlando, Col-Ins-Co	305-423-7615
Ga	Clarkston, Col-Ins-Co	404-938-7280
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Iowa	Cedar Rapids, Palatine Sls.	319-365-8071
Kans	Andover, Palatine Sls., Inc.	316-683-7512
Kans	Overland Park, Palatine Sls., Inc.	913-262-5643
Md	Kensington, EMA (Elctrn. Mktg. Assts.)	301-881-5300
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Farmington Hills, H. Lowell Co.	313-851-7474

Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, Palatine Sls., Inc.	314-426-7055
NH	Dover, R. Perron Co., Inc.	603-742-2321
NJ	Ft. Lee, Tecnimat	201-461-8686
NY	Fairport, NACO Electronics Corp.	716-244-4720
NY	No. Syracuse, NACO Electronics Corp.	315-699-2651
NY	Utica, NACO Electronics Corp.	315-732-1801
NC	Raleigh, Col-Ins-Co	919-834-6591
Ohio	Aurora, EMA, Inc.	216-562-6104
Ohio	Centerville, EMA, Inc. (Engr. Mktg. Assts.)	513-433-2800
Okla	Tulsa, Palatine Sls., Inc.	918-622-0321
Pa	King of Prussia, EMA (Elctrn. Mktg. Assts.)	215-265-1600
Pa	Philadelphia, EMA, Inc.	215-248-5050
Tex	Austin, Palatine Sls., Inc.	512-451-7463
Tex	Houston, Palatine Sls., Inc.	713-783-1492
Tex	Richardson, Palatine Sls., Inc.	214-231-9489
Wash	Seattle, B. Hirsh Co.	206-783-3423

Local Distributors

Ala	Huntsville, Hall-Mark Elect. Corp., 4739 Commercial Dr.	205-837-8700
Ariz	Tempe, G.S. Marshall Co., 835 W. 22nd St.	602-968-6181
Cal	Costa Mesa, Schweber Elctrns., 3000 Red Hill Ave.	714-556-3880
Cal	El Monte, G.S. Marshall Co., 9674 Telstar Ave.	213-686-0141
Cal	Irvine, G.S. Marshall Co., 17975 Sky Park Blvd.	714-556-6400
Cal	San Diego, G.S. Marshall Co., 8057 Raytheon Rd.	714-278-6350
Cal	Sunnyvale, G.S. Marshall Co., 788 Palomar	408-732-1100
Colo	Arvada, G.S. Marshall Co., 5633 Kendall Ct.	303-423-9670
Conn	Danbury, Schweber Elctrns., Finance Dr. Commerce Indust. Pk.	203-792-5000
Conn	N. Branford, G.S. Marshall Co., 200 Shaw Rd.	203-484-0488
Fla	Hollywood, Schweber Elctrns., 2830 N. 28th Terrace	305-927-0511
Fla	Orlando, Hall-Mark Elctrns., 7233 Lake Ellenor Dr., Box 13950	305-885-4020
Fla	Palm Beach Gardens, G.S. Marshall Co., 10384 Riverside Dr.	305-622-8490
Ga	Atlanta, Schweber Elctrns., 4126 Pleasantdale Rd.	404-449-9170
Ill	Des Plaines, G.S. Marshall, 300 East Touhy Ave.	312-298-3700
Ill	Elk Grove Village, Schweber Electronics, 1380 Jarvis Ave.	312-593-2740
Ill	Elk Grove Village, Hall-Mark Elctrns., 180 Crossen Ave.	312-437-8800
Iowa	Cedar Rapids, Schweber Elctrns., 302 Executive Plaza	319-393-9125
Kans	Lenexa, Hall-Mark Elect. Corp., 9006 Rosehill Rd.	913-888-4747
Md	Baltimore, Hall-Mark Elect. Corp., 6660 Security Blvd.	301-265-8500
Md	Rockville, Schweber Elctrns., 5640 Fisher La., Twinbrook Pkwy.	301-881-2970
Mass	Newton Highland, G.S. Marshall, 88 Needham St.	617-965-5115
Mass	Waltham, Schweber Elctrns., 213 Third Ave.	617-890-8484
Mich	Troy, Schweber Elctrns., 86 Executive Dr.	313-583-9242
Minn	Bloomington, Hall-Mark Elect. Corp., 9201 Penn Ave. So.	612-884-9056
Minn	Edina, Schweber Elctrns., 7015 Washington Av. S.	612-941-5280
Mo	Earth City, Hall-Mark Elect. Corp., 13789 Rider Trails	314-291-5350
NJ	Somerset, Schweber Elctrns., 43 Belmont Dr.	201-469-6008
NY	Farmingdale, G.S. Marshall Co., 230 Sherwood Ave.	516-293-4141
NY	Farmingdale, Hall-Mark Elctrns., 167 Marine St.	516-293-7500
NY	Rochester, Schweber Elctrns., 2 Town Line Circle	716-461-4000
NY	Westbury, Schweber Elctrns., Jericho Turnpike	516-334-7474
NC	Raleigh, Hall-Mark Elctrns., 3000 Industrial Dr.	919-832-4465
NC	Raleigh, Schweber Elctrns., 10 Sunnybrook Rd.	919-832-8881
Ohio	Beachwood, Schweber Elctrns., 23880 Commerce Pk. Rd.	216-464-2970
Ohio	Dayton, G.S. Marshall Co., 6388 No.Dixie Dr.	513-898-1105
Okla	Tulsa, Hall-Mark Elect. Corp., 4846 S. 83rd E. Ave.	918-835-8458
Pa	Trevose, Hall-Mark Elect. Corp., Box 125	215-355-7300
Tex	Austin, Schweber Elctrns., 2628 Longhorn Blvd.	512-837-2890
Tex	Dallas, G.S. Marshall Co., 14205 Proton Rd.	214-233-5200
Tex	Dallas, Hall-Mark Elctrns., 9333 Forest La.	214-231-5101
Tex	Dallas, Schweber Elctrns., 14177 Proton Rd.	214-661-5010
Tex	Houston, Hall-Mark Elctrns., 8000 Westglen	713-781-6100
Tex	Houston, Schweber Elctrns., 7420 Harwin Rd.	713-784-3600
Wash	Bellevue, G.S. Marshall Co., 1801 130th Ave. N.E.	206-883-1084
Wisc	Milwaukee, Hall-Mark Elect. Corp., 11925 W. Ripley Ave.	414-476-1270

EEMCO DIV., Datron Sys., 4585 Electronics Pl., Los Angeles, Cal., 90039, Tel: 213-247-7060, TWX: 910-497-2269; Empl.: 200

Products manufactured: Actuators, Cabinets & Accessories, Controls/Control Eqpt., Gears & Gear Mechanisms (Precision), Motor & Generator Armatures, Rotors, Stators, Motor Electric Generator Sets, Motors, Valves, Solenoid

Local Sales Offices & Reps.

Cal	Encino, El Tec	213-981-9881
Cal	Palo Alto, Mauldin Co.	415-326-5291
Colo	Golden, J. T. Hurlbet Co.	303-279-7138
Conn	Hamden, Northeast Eng.	
Conn	Huntington, G.T.C.Assocs.	203-929-0981
Fla	Hialeah, Shaw Engrg. & Sls.	305-888-0835
Fla	Orlando, Dost Assoc.	305-295-4440
Ga	Atlanta, Brown Assoc.	
Ill	Chicago, J Golten Co.	312-725-7870
Mass	Danvers, Northeast Eng.	617-774-3010
Mass	So. Natick, Wm. Beaver	617-655-1529
Mass	Westford, G. T. C. Assocs.	617-459-6782
Minn	St. Paul, Vikeland Sls.	612-645-4647
NY	Manhasset, Northeast Eng.	
NY	Plainview, L.I., R Smith Assocs.	516-822-6140
NY	Rochester, L. G. Marchese Assoc.	716-342-7664
NY	Spring Valley, R Smith Assocs.	914-352-1067
Ohio	Cleveland, Geotronix	216-238-8520
Ore	Portland, J. J. Backer Co.	503-297-3776
Pa	Devon, B & A Assocs.	215-688-5173
Wash	Kirkland, R. Chase	206-454-2514
Wash	Seattle, J. J. Backer Co.	206-285-1300

EFRATOM CALIFORNIA, INC., 3303 Harbor Blvd., Costa Mesa, Cal., 92626, Tel: 714-556-1620, Telex: 685-635; Empl.: 18

Customer service: H. Badura

Free literature available: Data Sheets and General Brochure describing our products, technical articles on Rubidium Frequency Standards.

Products manufactured: Receivers, Standards

Local Sales Offices & Reps.

Mass	Reading, Geder-Rotondi	617-944-3105

E G & G INC., Georgetown, Mass, 01833

EG & G, INC., 35 Congress St., Salem, Mass., 01970, Tel: 617-745-3200, TWX: 710-347-6741

Products manufactured: Detectors, Diodes, Lamps, Lights, Meters, Monitors, Power Supplies, Probes, Protectors, Radiometers, Spark Gaps, Transformers, Tubes

EG&G, INC., Bedford Div., 35 Congress St., Salem, Mass., 01970, Tel: 617-745-3200, TWX: 710-347-6741; Empl.: 310

Products manufactured: Alarms, Comm. Systems, Data Compressors, Digital, Flashers, Lamps, Lights, Magnifying Glasses, Inspection, Power Supplies, Recorders, Scanners, Transmitters

EG&G, INC., Electro-Optics Div., 35 Congress St., Salem, Mass., 01790, Tel: 617-745-3200, TWX: 710-347-6741; FSC No: 25506; Empl.: 400; Minimum order: $50 .... p. 1•1011-1013

For info on price: J. McClafferty; Application info: G. Riley; Customer service: J. McClafferty; Delivery info: J. McClafferty

Free literature available: Photodiode Catalog; Light Measurement Instrument Catalog; Flashtube, Transformer, High Energy Switch Catalog; Strobe and Sensitometer Catalog

Products manufactured: Amplifiers, Arresters, Electrical Surge, Lightning, Cells, Photoconductive, Photoemissive, Photovoltaic, Densitometers, Electronic, Detectors, Diodes, Generators, Lamps, Lights, Meters, Monitors, Power Supplies, Protectors, Radiometers, Spark Gaps, Switches, Transformers, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles, EG&G, Inc.	213-484-8780
Md	Riverdale, EG&G, Inc.	301-779-4272
Mass	Salem, E G & G Inc., Electro-Optics Div.	617-745-3200
EXP:	Can., Waterloo, Ont. N2J-4C3, Optikon Corp., Ltd.	519-743-8571

E.I. DUPONT DE NEMOURS & CO., 1007 Market St., Wilmington, Del., 19898, Tel: 302-774-2421; Empl.: 110000

Products manufactured: Abrasive Belts, Compounds, Cords, Powders, etc., Adhesives (All Types), Analyzers, Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Detectors, Electroplating Equipment & Supplies, Etchants, Printed Circuit, Fiber Optic Bundles, Films, Flux, Brazing & Soldering Materials, Heat Exchangers & Systems, Indicators, Inks For Thick Film Microcircuits, Insulators & Insulation, Laminates, Lubricants, Materials, Self-Lubricating, Metals, Meters, Paints, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Refrigerants, Spray, Services, Assembly, Production & Test, Solder (All Types), Sound Absorbing Materials, Spectrometers, Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Cal	Los Angeles	213-843-1038
DC	Washington	202-DU7-0416
Del	Wilmington	302-774-2421
Ill	Chicago	312-222-5050
Md	Baltimore	301-PL2-2506
NY	New York	212-971-4771
Pa	Philadelphia	215-WA3-2493
Tex	Houston	713-467-4449

EICO ELECTRONIC INSTR. CO., 283 Malta St., Brooklyn, NY, 11207

EIMAC, Div. Varian Assocs., 301 Industrial Way, San Carlos, Calif., 94070, Tel: 415-592-1221, TWX: 910-376-4893

Products manufactured: Amplifiers, Diodes, Filters, Headers, Heat Exchangers & Systems, Lamps, Lights, Modulators, All Kinds, Power Supplies, Seals, Sockets, Switches, Tubes

Local Sales Offices & Reps.

Ariz	Scottsdale, Varian Assocs., Eimac Div.	602-947-5461
Cal	Los Altos, Varian Assocs., Eimac Div.	415-968-7630
Cal	Santa Monica, Varian Assocs., Eimac Div.	213-828-5588
Fla	Clearwater, Varian Assocs., Eimac Div.	813-446-8513
Fla	Lighthouse Point, Varian Assocs., Eimac Div.	305-943-9495
Ga	Atlanta, Varian Assocs., Eimac Div.	404-252-0045
Ill	Park Ridge, Varian Assocs., Eimac Div.	312-825-6686
Md	Cheverly, Varian Assocs., Eimac Div.	301-773-7010
Mass	Waltham, Varian Assocs., Eimac Div.	617-890-4560
NJ	Cherry Hill, Varian Assocs., Eimac Div.	609-428-6800
NJ	Springfield, Varian Assocs., Eimac Div.	201-376-6600
NM	Albuquerque, Varian Assocs., Eimac Div.	505-345-3827
NY	Syracuse, Varian Assocs., Eimac Div.	315-437-2568
Ohio	Dayton, Varian Assocs., Eimac Div.	513-298-7318
Tex	Richardson, Varian Assocs., Eimac Div.	214-235-2385

EIP, INCORPORATED, 3230 Scott Blvd., Santa Clara, Cal., 95051, Tel: 408-244-7975, TWX: 910-338-0155; Empl.: 70

Customer service: R. Bush

Free literature available: Literature describing automatic microwave frequency counters and their capabilities-20 Hz to 20 Ghz.

Products manufactured: Counters

Local Sales Offices & Reps.

Ariz	Phoenix, Zeus, Inc.	602-253-6140
Cal	La Jolla, Ward/Davis Assocs.	714-459-3351
Cal	Lawndale, Ward/Davis Assocs.	213-542-7740
Cal	Sunnyvale, Ward/Davis Assocs.	408-245-3700
Colo	Denver, Zeus, Inc.	303-770-4400
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Kans	Shawnee Mission, EIR Co.	913-362-0909
Md	Wheaton, Sonco Inc.	301-942-9420
Mass	Waltham, Meas. Consits. Corp.	617-890-4400
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Fort Lee, Tech. Mktg. Assocs.	201-224-6911
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	East Syracuse, Ossmann Instrs., Inc.	315-437-6666
NY	Rochester, Ossmann Instrs., Inc.	716-328-2230
NY	Vestal, Ossmann Instrs., Inc.	607-785-9947
NC	Burlington, Gentry Assocs., Inc.	919-227-3639
Ohio	Cleveland	216-486-2800
Ohio	Dayton	513-277-6531
Okla	Norman, Data Mktg. Assocs., Inc.	405-364-8320
Pa	Blue Bell, Sonco Inc.	215-524-1490
Tex	Dallas, Data Mktg. Assocs., Inc.	214-358-4643
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Wash	Seattle, Arva-Hudson	206-622-0177
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940

EL-RAD MFG. CO., 4300 N. California, Chicago, Ill, 60618, Tel: 312-478-7300, TWX: 910-221-0104; FSC No: 11253; Empl.: 300 .... p. 2•1773,1774

Customer service: J. Clark

Products manufactured: Antennas, Coils Including Assemblies & Forms, Delay Lines, Filters, Networks, Transformers

Local Sales Offices & Reps.

Cal	San Marino, Van Gott Assoc.	213-282-1125
Fla	Melbourne, Hanson Assocs.	305-727-7474
Ill	Palatine, Butor Sls. Co.	312-358-2988
Md	Glen Burnie, Faion Lott & Co.	301-744-4611
Mich	Jackson, E.H. Jordan & Assocs.	517-782-0694
Minn	Minneapolis, Elctrn. Innovators Inc.	612-884-7471
NY	Rochester, Elcom Sls.	716-385-1400

ELASCO, Div. Buchbinder Corp., 5 Northwood Rd., Bloomfield, Conn, 06002, Tel: 203-242-0708; Empl.: 50

For info on price: S. Buchbinder; Application info: R. Wolff; Customer service: J. Lovinger; Delivery info: W. Grenen

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Cal	Santa Clara, Cummings & Assoc.	408-247-8656
Cal	Woodland Hills, Cummings & Assoc.	213-340-6035
Conn	Bloomfield	203-242-0708
Mich	Plymouth, Romarc	313-455-0300
NY	Mamaroneck, Cane Technical	917-698-4411
Pa	King of Prussia, Riuco	215-265-5211

Local Distributors

Mass	Dedham, Gerber Elctrns., 825 Providence Hwy.	617-329-2400

ELCO, Maryland Rd. & Computer Ave., Willow Grove, Pa., 19090, Tel: 215-659-7000, TWX: 510-665-5573; Empl.: 825

Products manufactured: Bus Bars & Systems, Chassis, Circuit Board Mounting, Connectors, Contacts, Electrical, Flashers, Guides, Circuit Board, Machines/Machinery, Production, Plugs, Posts, Racks, Sockets, Terminals, Tools

Local Sales Offices & Reps.

Ala	Huntsville, EMA	205-837-6061
Ariz	Phoenix, Ralph Stitzer Co.	602-944-6808
Cal	El Segundo, Elco Pacific	213-675-3311
Cal	Oakland, Moulthrop Sls.	415-261-7676
Cal	San Diego, Celtec Co.	714-279-7961
Colo	Denver, Parker, Webster Co.	303-770-1972
Conn	Cheshire, Scientific Comps.	203-272-2160
Fla	Ft. Lauderdale, R. I. Smith Assocs.	305-772-5100
Ill	Chicago, Carlson Elctrn. Sls. Co.	312-774-4812
Ind	Ft. Wayne, Baehr, Greenleaf & Assocs.	219-483-6864
Md	Rockville, Marktron Inc.	301-762-6210
Md	Timonium, Marktron Inc.	301-252-7111
Mass	Wilburn, Belmac Corp.	617-935-6810
Mich	Farmington, Sheridan Assocs.	313-476-2446
Minn	St. Paul, Cahill	612-646-7217
Mo	Crestwood, Nevco Inc.	
Mo	Kansas City, Nevco Inc.	816-421-1751
NY	Binghamton, Canavan-Scanlon Assocs.	607-724-7220
NY	Buffalo, Canavan-Scanlon Assocs.	716-839-3373
NY	Jericho, Electro Rep.	516-938-0540
NY	Rochester, Canavan-Scanlon Assocs.	716-442-0720
NY	Syracuse, Canavan-Scanlon Assocs.	315-437-1271
NC	Winston-Salem, EMA	919-722-5151
Ohio	Cincinnati, Baehr-Greenleaf	513-891-3826
Ohio	Columbus, Baehr, Greenleaf & Assocs.	614-486-4046
Ohio	Lakewood, Baehr-Greenleaf	216-221-9030
Okla	Tulsa, H. Daly	918-627-4159
Ore	Portland, Almac/Stroum	503-292-3534
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Pa	Willow Grove, Elco Corp.	215-659-7000
SC	Greenville, EMA	803-268-1125
Tex	Houston, Aid Elctrns.	713-777-3882
Tex	Irving, Aid Elctrns.	214-259-4761
Utah	Salt Lake City, Parker Webster Co.	801-486-3737
Wash	Seattle, Almac/Stroum	206-763-2300
Wisc	Milwaukee, Carlson Elctrn. Sls.	414-476-2790

ELCO PACIFIC, 2200 Park Pl., El Segundo, Cal., 90245, Tel: 213-675-3311, TWX: 910-325-6602

ELCOM INDUSTRIES, INC., 10277 Bach Blvd., St. Louis, Mo., 63132, Tel: 314-429-3100; Empl.: 20

Customer service: T. C. Noel, Jr.

Products manufactured: Comm. Systems, Punched Card Equipment, Readers

ELCOM SYSTEMS, INC., 127F Brook Ave., Deer Pk., N.Y., 11729, Tel: 516-667-5800; Empl.: 6

Customer service: L. Pollachek

Free literature available: Catalog #731 - complete product line

Products manufactured: Attenuators, Converters, Couplers, Mixers, Terminals, Transformers

ELCOR PRODS. NEOTEC ELCTRNS. INC., Box 986, 2431 Linden La., Silver Spring, Md., 20910, Tel: 301-589-6614; Empl.: 100

For info on price: C. Guinnee; Application info: K. V. Bargen; Customer service: C. Guinnee; Delivery info: C. Guinnee

Free literature available: ELCOR Product Catalog Including: Isolated, Transformers 4025W, Power Transformers 40 to 6000VA, Power Supplies 3% to .002% Reg., Signal Conditioners, Integrators, Electronic, Prices and Application Info.

Products manufactured: Integrators, Electronic, Meters, Power Supplies, References, D-C Voltage, Regulators, Signal Conditioners & Equipment, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Elctrn. Ent.	602-946-9860
Cal	Arcadia, William H. H. Co.	213-447-6166
Cal	San Mateo, J.E. Lape Co.	415-345-3021
Ill	Addison, R.E. Stemm, Inc.	312-279-2440
Ill	Rockford, Rockford Reps.	815-964-5806
Md	Silver Springs, ML Council Assoc.	301-587-1755
Mass	Lexington, Zieco, Inc.	617-861-8300
NJ	Hillsdale, B. Cameron Assoc.	201-461-2595
NM	Albuquerque, Elctrn. Enterprises	505-256-3561
NM	Las Cruces, Elctrn. Enterprises	505-524-0126
NY	Guilderland, Electro Modular Sys.	518-456-2665
Okla	Oklahoma City, J. R. Lukeman & Assoc.	405-848-4791
Pa	King of Prussia, Letronix	215-265-1020
EXP:	N.Y., N.Y., Henley & Co.	212-986-5544

ELDEC CORP., Box 100, 16700 13th Ave. W., Lynnwood, Wash., 98036, Tel: 206-743-1313, TWX: 910-449-2855; Empl.: 600; Minimum order: $25 .... p. 1•1193-1196

For info on price: W. W. Arnold; Application info: R. B. Banks; Customer service: R. Keating; Delivery info: B. A. Stone

Products manufactured: Chargers, Battery, Converters, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Astro-Tec.	205-881-1861
Cal	Northridge, Tauber & Assocs.	213-368-4011
Cal	Torrance, ELDEC	213-532-8732
Conn	Madison, A & M Elctrn. Reps.	203-245-1031
Ga	Atlanta, Astro-Tec	404-237-0943
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Kans	Wichita, D & O Engrg. Co.	316-264-7358
La	New Orleans, Astro-Tec	504-581-2099
Mass	Needham, A & M Elctrn. Reps.	617-444-8170
Mass	Stoneham, Robertson Elctrn. Prods. Co.	617-438-3113
Mich	Royal Oak, Group Ten	313-549-3910
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501
Mo	Bridgeton, D & O Engrg. Co.	314-731-3800
NJ	Dover, R.L. Diamond Inc.	
NY	Bayside, R.L. Diamond, Inc.	212-423-7330
NY	Binghamton, Labtronics, Inc.	607-748-0509
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Ulster Park, Labtronics, Inc.	518-372-6649
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Tex	Arlington, D & O Engrg. Co., Inc.	817-261-2300
Tex	Bedford, Astro Tec	817-267-1361
Va	Arlington, Astro Tec	703-979-2498
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940
FOR:	Can., Toronto, Ont., Patlon Aircraft & Ind. Ltd.	416-239-7389

ELDEN MFG. CO., 2712 N. Elston Ave., Chicago, Ill., 60647; Empl.: 12

Products manufactured: Counters, Machines/Machinery, Production, Motors

ELDORADO INSTRUMENT CO., 2151 Arnold Industrial Hwy., Concord, Cal., 94520, Tel: 415-686-4200; Empl.: 20

Products manufactured: Counters, Generators, Meters, Timers, Totelizers, Digital

Local Sales Offices & Reps.

Cal	Cupertino, T. Louis Snitzer Co.	408-257-8333
Cal	Del Mar, Snitzer	714-454-2191
Cal	Los Angeles, Snitzer	213-836-6170
Colo	Littleton, Aztec Entprs.	303-795-0250
Fla	Orlando, E. Holmes	305-894-8901
Ga	Chamblee, E. Holmes	404-451-6161
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indpls., Carter Elctrns.	317-293-0696
Kans	Leawood, Leemark Engrs.	913-648-0124
Md	Lanham, Brimberg Assocs., Inc.	301-552-2200
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Mpls., Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NJ	Fairfield, KLS Assocs.	201-227-2900
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	N. Syracuse, NACO Elctrns.	315-699-2651
NY	NY, KLS Assocs.	212-233-4849
Pa	Ambler, W M Assocs.	215-643-4119
Tex	Austin, Crockett Southwest Co.	512-476-6801
Tex	Dallas, Crockett Southwest Co.	214-637-6120
Va	Virginia Bch., E.G. Holmes	703-340-6556
Wash	Bellevue, Brennan	206-454-9332
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

ELEC-TROL, INC., 26477 N. Golden Valley Rd., Saugus, Cal., 91350, Tel: 805-252-8330, TWX: 910-336-1556; FSC No: 51636; Empl.: 300; Minimum order: $25 p. 1•1644-1647

For info on price: M. Wainess; Application info: M. Wainess; Customer service: N. Koon; Delivery info: N. Koon

Products manufactured: Relays

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrn. Assocs.	205-881-5031
Ariz	Phoenix, Southwest Engrg, Inc.	602-993-0250
Cal	Mt. View, Gene C. Woempner Co.	415-964-5454
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Orange, NPM Assocs.	203-878-4066
Fla	Ft. Lauderdale, Beacon Elctrn. Assocs.	305-776-6074
Fla	Maitland, Beacon Elctrn. Assocs.	305-647-3498
Ga	Atlanta, Beacon Elctrn. Assocs.	404-351-3654
Ill	Des Plaines, Lincoln, Hodges & Assocs.	312-297-3810
Mass	Franklin, NPM Assocs.	617-528-5013
Mich	Detroit, Nicon Assocs.	313-341-7688
Mich	St. Joseph, Nicon Assocs.	616-983-4989
Minn	Minneapolis, R-J, Inc.	612-922-1425
Mo	Blue Springs, Chesco	816-229-1404
Mo	St. Charles, Chesco	314-946-6677
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Jericho, HRC Comp-Tech, Inc.	516-822-5550
NY	New Hartford, KLM Assocs.	315-735-8525
NY	North Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-442-0820

Ohio	Cincinnati, G & H Sls. Co.	513-771-8231
Ohio	Grove City, G & H Sls. Co.	614-878-1128
Pa	Birchrunville, Jadelectronic Associates, Inc.	215-647-5151
SC	Spartanburg, Beacon Elctrn. Assocs.	803-582-4613
Tex	Dallas, Allied Comps., Inc.	214-238-0408
Tex	Houston, Allied Comps., Inc.	713-691-3961
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Bellevue, R. Over Sls.	206-454-4551
Wisc	Waukesha, Lincoln, Hodges & Assocs.	414-542-3087

Local Distributors

Cal	Sunnyvale, Acacia Sls., 384 San Aleso St.	408-735-0100
Cal	Van Nuys, Patane Avionics, 5937 Kester Ave.	213-988-4455
Colo	Lakewood, Acacia Sls., 11111 W. 8th Ave.	303-232-2882
Fla	Margate, C.D.I., 2922 N. State Rd. Suite 105	305-971-4950
Ill	Elk Grove Village, Diplomat/Lakeland, 2451 Brickvale Dr.	312-595-1000
Tex	Dallas, Solid State Elctrns. Co. of Tex, 2643 Manana	214-352-2601
Tex	Houston, Solid State Elctrns. Co. of Tex, 6400 Westpark Dr., Suite 480	713-785-5436

ELECTRA/MIDLAND CORP., Box 760, Mineral Wells, Tex., 76067, Tel: 817-325-7871, TWX: 910-890-5855

Products manufactured: Circuits, Hybrid, Thick Film, Resistors

(Refer to Electra/Midland Corp., Midland Div., for sales office information.)

ELECTRAC, INC., 1614 Orangethrope Way, Anaheim, Calif., 92801, Tel: 714-879-6021; Empl.: 40

Customer service: L. Katz

Products manufactured: Analyzers, Comm. Systems, Converters, Demodulators, Detectors, Filters, Indicators, Multipliers, Receivers, Tracking Systems

ELECTRIC INDICATOR CO., INC., 272 Main Avenue, Norwalk, Conn., 06851, Tel: 203-847-5861, Telex: 96-5945; Empl.: 102

For info on price: W. L. Sly; Application info: W. L. Sly; Customer service: F. J. Drake; Delivery info: F. J. Drake

Free literature available: Catalogs on AC & DC generators; AC & DC commutator motors; AC induction & AC torque motors; AC hysteresis & salient pole synchronous motors; AC self-synchronous motors; AC induction & synchronous gear motors; and stepping motors.

Products manufactured: Alternators, Converters, Generators, Motor Electric Generator Sets, Motors, Resolvers, Synchro, Synchros, Tachometers, Transformers

ELECTRIC MACHINERY MFG. CO., 800 Central Ave., Minneapolis, Minn., 55413, Tel: 612-378-0500, TWX: 612-321-1390; Empl.: 1600

For info on price: C. M. Burns Ext. 548; Application info: C. M. Burns Ext. 548; Customer service: K. B. Green Ext. 613

Products manufactured: Controls/Control Eqpt., Converters, Motor Electric Generator Sets, Motors

Local Sales Offices & Reps.

Ala	Birmingham	205-822-4474
Ariz	Phoenix	602-244-0331
Cal	Los Angeles	213-685-6444
Cal	San Francisco	415-392-8296
Colo	Denver	303-388-6322
Conn	Rocky Hill	203-563-9338
Fla	Tampa	813-872-7859
Ga	Atlanta	404-458-7971
Ill	Barrington	312-381-8091
Ill	Oak Brook	312-325-9620
Ind	Indianapolis	317-546-4053
Kans	Prairie Village	913-362-8540
La	Gretna	504-362-1074
Mass	Waltham	617-890-3792
Mich	Farmington	313-477-3774
Mich	Grand Rapids	616-459-8156
Minn	Minneapolis	612-831-2111
Mo	St. Louis	314-872-7300
Mont	Butte	406-792-5447
NM	Albuquerque	505-344-3288
NY	Buffalo	716-839-0851
NY	New York	212-697-0955
NC	Charlotte	704-332-6191
Ohio	Cincinnati	513-791-0480
Ohio	Cleveland	216-885-1254
Okla	Tulsa	918-743-9851
Ore	Portland	503-223-7349
Pa	Broomall	215-353-5040
Pa	Pittsburgh	412-563-7603
Pa	York	717-854-0217
Tenn	Knoxville	615-522-0165
Tenn	Memphis	901-767-3555
Tex	Dallas	214-748-6691
Tex	Houston	713-526-3283
Utah	Salt Lake City	801-487-5621
Va	Richmond	703-784-5293
Va	Vienna	703-790-5790
Wash	Bellevue	206-455-3655
Wash	Spokane	509-535-2931
Wisc	Milwaukee	414-332-5140
FOR:	Can., Calgary, Alberta	403-265-4854
FOR:	Can., North Vancouver, B.C.	604-985-7451
FOR:	Can., Scarborough, Ont.	416-449-3200
FOR:	Can., Winnipeg, Manitoba	204-338-5404

FIRING CIRCUITS, see Marathon Elec.

ELECTRIC SOLDERING IRON CO., Box 247, Deep River, Conn., 06417

ELECTRIC TACHOMETER CORP., 68th & Upland Sts., Philadelphia, Pa., 19142, Tel: 215-SA6-7723, Telex: 831-475; FSC No: 20049; Empl.: 50; Minimum order: $15

For info on price: W.F. Porter; Application info: F.M. Porter; Customer service: W.F. Porter; Delivery info: W.F. Porter

Free literature available: Bulletin 740, Describes Tetco Model 120 Indicating Tachometers and drive components. Dial and digital types, portable, explosion-proof, watertight. Photos and technical data given.

Products manufactured: Counters, Indicators, Recorders, Tachometers

Local Sales Offices & Reps.

Ala	Huntsville, VESCO	205-881-8830
Cal	Berkeley, P. Rosen Co.	415-526-8286
Cal	Reseda, T.R. Slocum, Jr.	213-789-3355
Fla	Cocoa Beach, VESCO	305-784-0784
Haw	Honolulu, Berkley Engrg. & Equip. Co.	808-538-1921
Ill	Hinsdale, Johnson Engrg. & Sls. Co.	312-325-2272
Ind	Mishawaka, Law Instr. Co.	219-256-1110
Mass	Lexington, W.R. Hatfield Assoc.	617-861-0201
Mich	Lake Orion, Service Instr. Sls.	313-391-2266
Minn	St. Paul, Nelson Engineered Sls.	612-631-0646
Mo	St. Louis, C.O. Leaver Co.	314-968-1500
NJ	Fair Lawn, Bixon Assocs.	201-797-5356
NJ	Haddonfield, C.G. Thomson	609-429-5233
NY	Rochester, Holter Assocs.	716-381-7988
NY	Valley Stream, Idalee Elctrns. Corp.	516-825-8955
NC	Greensboro, Associated Agents	919-292-6508
Ohio	Cincinnati, Kammerer Sls. Co.	513-321-1916
Ohio	Cleveland, Fred R. Sharp Co.	216-464-3820
Pa	Ligonier, J.K. Woodwell, Jr.	412-238-2748
Tenn	Memphis, Engineered Instrs.	901-743-3402
Tex	Stafford, Jordan Equip. Co.	713-GY8-6212
FOR:	Can., Edmonton, Alb., Instr. Serv. Labs.	465-0327
FOR:	Can., St. Lambert, Que., Lasanne Serv. Ltd.	514-672-6430
FOR:	Can., Vancouver, B.C., Instr. Serv. Labs.	604-876-3361

ELECTRICAL INSTR. SVC., INC., 25 Dock St., Mt. Vernon, N.Y., 10550, Tel: 914-699-9717; QPL No: 16034A; Empl.: 35; Minimum order: $25

For info on price: R. Ngelia; Application info: M. Kane; Customer service: G. D. Frank; Delivery info: R. Neglia

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Batteries, Bridges, Calibrators, Comparators, Decade Boxes, Detectors, Dividers, Indicators, Meters, Multipliers, Potentiometers, Regulators, Services, Assembly, Production & Test, Shunts, Meter, Standards, Testers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, J. L. Highsmith Co.	205-881-3294
Ariz	Scottsdale, William Assocs.	602-947-4297
Colo	Denver, Williams Assocs.	303-343-4730
DC	Washington, Whitcomb Assocs.	202-737-0763
Fla	Orlando, J. L. Highsmith Co.	305-293-5202
Ill	Skokie, Saffro & Assocs.	312-588-0905
Kans	Shawnee Mission, Pivan Engrg. Co.	913-722-1030
Md	Baltimore, Whitcomb Assocs.	301-889-1245
Mass	Waltham, Measurement Consultants Corp.	617-890-4400
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, The Heimann Co.	612-861-6051
Mo	St. Louis, Pivan Engrg. Co.	314-567-3636
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Buffalo, R. F. Lamb Co.	716-874-4900
NY	Rochester, R. F. Lamb Co.	716-544-5580
NY	Schenectady, R. F. Lamb Co.	518-393-4844
NY	Syracuse, R. F. Lamb Co.	315-454-2469
NC	Charlotte, J. L. Highsmith Co.	704-333-7743
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling Co.	513-298-7573
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	Jenkintown, A M T	215-LI9-2080
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs., Inc.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Va	Richmond, J. L. Highsmith Co.	804-272-5888
Wash	Seattle, R. S. Drake Assocs., Inc.	206-725-2700

ELECTRICAL PLASTICS CORP., 500 Long Branch Ave., Long Branch, N.J., 07740, Tel: 201-870-9500; Empl.: 60; Minimum order: $35

For info on price: L. Classen; Application info: R. Brockner; Customer service: L. Classen; Delivery info: R. Kluge

Free literature available: EPC Stock Coil Forms and Bobbins Catalog #710 contains description of over 378 standard products including material selection guide, MIL specs and dimensions.

Products manufactured: Bobbins, Winding, Coil & Transformer, Cores, Magnetic, Cups, Encapsulation, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Los Angeles, E.A. Wilcox	213-723-6436
Cal	San Francisco, E.A. Wilcox	415-871-5350
Fla	Orlando, Buchannan & Abrams	305-898-7444
Ill	Chicago, J. Golten Co.	312-725-7870
Mass	Framingham, G & M Assoc.	617-872-4871
Mich	Dearborn, Villani-Pitcher	313-271-4600
Minn	St. Paul, Knox Assocs.	612-488-5402
NJ	Livingston, H. Thaw Sls. Co.	201-992-2711
NM	Albuquerque, A.Q. Elctrns.	505-255-8701
NY	Rochester, Schmitz Brothers	716-546-7628
Pa	Elkins Park, EMESCO Assoc.	215-224-3102
Pa	Haverford, D Humes Sls.	215-489-4163
Tex	Houston, Hisco	713-228-6662
Wash	Seattle, Powel & Assoc.	206-623-7060

ELECTRICAL STANDARDS DIV., E.S.R.S., Inc., 13418 Wyandotte St., N. Hollywood, Cal., 91605, Tel: 213-765-4224; Empl.: 6

For info on price: R. Stromquist; Application info: R. Wangerin; Customer service: R. Stromquist; Delivery info: E. Barnhart

Products manufactured: Dividers, Meters

Local Sales Offices & Reps.

Ariz	Scottsdale, Biedler & Assocs.	602-945-7821
Conn	Durham, Marr Elec. Co.	203-349-9691
Fla	Melbourne, Repcom Inc.	305-254-1877
NJ	Morris Plains, K. Garrison Assocs.	201-539-3142
Va	Annandale, J. Hopkins Assocs.	703-323-1641

Advertisment

Manufacturers of Taut Band design high voltage Electrostatic Voltmeters and Precision High Voltage Dividers with accuracies to the "State of the Art". Custom design dividers and instrumentation for unique application to customer specifications. Maintain standards directly traceable to the National Bureau of Standards.

ELECTRICAL TESTING LABS., INC., 2 East End Ave., New York, N.Y., 10021, Tel: 212-288-2600, TWX: 710-581-2440; Empl.: 141

Customer service: D. S. Schrum

Free literature available: CATALOG BROCHURE 200 list - lists services and facilities. Available on letterhead requests.

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ga	Chamblee, ETL Georgia Div.	404-458-7763
Ind	Elkhart, Gold Seal Div. of ETL	219-294-1332
NY	Elmhurst, KAL Div. of ETL	212-446-1550

ELECTRO CORP., 1845 57th St., Sarasota, Fla., 33580, Tel: 813-355-8411, Telex: 52-683; FSC No: 81692; Empl.: 120; Minimum order: $50

For info on price: R. Snite; Application info: R. Hollenbeck; Customer service: R. Snite; Delivery info: R. Snite

Free literature available: Magnetic Sensors - catalog contains engineering & specification data on non-contact speed sensors. Proximity Switches - catalog describes inductive proximity sensors & controls for industrial applications. Tachometers - catalog lists speed monitoring & control components & systems.

Products manufactured: Controls/Control Eqpt., Converters, Indicators, Switches, Tachometers, Transducers

Local Sales Offices & Reps.

Ariz	Phoenix, Mesa Engrg. & Sls. Assocs.	602-943-9213
Cal	Emeryville, Milligan-Spika	415-658-9044
Cal	Los Angeles, Basic Sys.	213-938-2833
Cal	Menlo Park, Long Assocs.	910-373-1170
Cal	San Diego, Mesa Elctrns.	714-278-8021
Cal	Santa Ana, Electramation	714-541-8142
Colo	Denver, Bond Assocs.	303-756-1234
Conn	Cheshire, Coakley, Boyd & Abbett	203-272-2261
Fla	Orlando, Datarep	305-843-5224
Fla	Pompano BH., Datarep	305-781-9279
Fla	St. Petersburg, Datarep	813-345-8503
Ill	Addison, Electro Corp.	312-543-5288
Ill	Chicago, Electro	312-543-5288
Ill	La Grange, Olson Engrg. & Sls. Corp.	312-482-3300
Ind	Anderson, F. R. Sharp Co.	317-644-1690
Iowa	Cedar Rapids, Technical Reps.	319-363-2489
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Birmingham, Electro-Mation Assocs.	313-564-6517
Minn	Minneapolis, Arjay Sls., Inc.	612-925-1833
Mo	Independence, Technical Reps.	816-737-1414
NY	E. Syracuse, Ossman Instrs., Inc.	315-437-6666
NY	Rochester, Ossman Instrs., Inc.	716-328-2230
NY	Vestal, Ossman Instrs., Inc.	607-785-9947
NY	White Plains, Swedelco, Inc.	914-946-1122
NC	Charlotte, Systems Service Corp.	704-377-3407
Ohio	Cleveland, F.R. Sharp Co.	216-464-3820
Ohio	Dayton, F.R. Sharp Co.	513-298-0011
Ore	Portland, Tekelectric Control Co.	503-246-5451
Pa	Erie, Ecco Elctrn. Sls. Co.	814-455-8110
Pa	Glenside, C.A. Briggs	215-885-2244
Tex	Houston, Whitson Engrg. Co.	713-645-1801
Tex	Plano, Whitson Engrg. Co.	214-423-5255
Wash	Seattle, Tekelectric Control Co.	206-283-7100

ELECTRO-CRAFT CORP., 1600 2nd St. South, Hopkins, Minn., 55343, Tel: 612-935-8226, TWX: 910-576-3132; Empl.: 300; Minimum order: $25
p. 1•946-949

For info on price: Sls. Dept.; Application info: K. P. Willasch; Customer service: D. Woodash; Delivery info: Sls. Dept.

Products manufactured: Amplifiers, Controls/Control Eqpt., Motor Electric Generator Sets, Motors, Servo Systems, Tachometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Oem Specialties	602-948-3360
Cal	Los Angeles, Electrocraft Corp.	213-889-3631
Colo	Denver, Electro-Craft Corp.	303-750-4040
Fla	Altamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-726-8871
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ga	Lilburn, Motion Technology Inc.	404-233-4368
Ill	Chicago, Electro-Craft Corp.	312-298-0687
Mass	Boston, Electro-Craft Corp.	617-226-0206
Minn	Minneapolis, Electro-Craft Corp.	612-935-8226
NJ	Williamstown, Electro-Craft Corp.	609-728-2450
NY	Melville, Electro-Craft Corp.	516-293-2188
NY	Rochester, Ferguson Sls. Co.	716-482-7757
NC	Charlotte, Motion Technology Inc.	704-525-9855
Ohio	Cleveland, A.H. Baier Co.	216-461-6161
Ohio	Dayton, A.H. Baier Co.	513-276-4128
Ore	Portland, Todd-Brian Inds.	503-297-3862
Tex	Dallas, Electro-Craft Corp.	214-241-0680
Wash	Seattle, Todd-Brian Inds.	206-827-5811
FOR:	Can., Montreal, Que., Electrodesign Ltd.	514-363-5120
FOR:	Can., Toronto, Ont., Electrodesign Ltd.	416-787-0991
FOR:	Can., Vanier, Ont., Electrodesign Ltd.	613-745-0541
FOR:	Can., Winnipeg, Man., Electrodesign Ltd.	204-338-5050

ELECTRO-DEVICES, INC., 4-6 Godwin Ave., Paterson, N.J., 07509, Tel: 201-274-8989; Empl.: 12

For info on price: O. E. Carlson; Application info: O. E. Carlson; Customer service: E. A. Fix; Delivery info: E. A. Fix

Products manufactured: Controls/Control Eqpt., Indicators

ELECTRO IMPULSE, Box 870, Red Bank, N.J., 07701, Tel: 201-741-0404; Empl.: 50; Minimum order: $25
p. 1•492,662-666

Customer service: M. Rubin

Free literature available: Conversion Factors-Engineer's Handbook, Gen Catalog 800, Intro to cooling units-tech data on cooling systems for electronics.

Products manufactured: Air Conditioners (For Equipment), Attenuators, Bridges, Calorimeters, Microwave, Couplers, Dummy Loads, Heat Exchangers & Systems, Meters, Monitors, Resistors, Terminals, Transformers, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Hawthorne, Barnard & Assocs.	213-973-5050
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Md	Ellicott City, VPI, Inc.	301-465-4060
Mass	Reading, Geder-Rotondi Assocs.	617-944-3105
NY	Bridgeport, Lightstone Corp.	315-699-5747
NY	Greenvale, B.D. Aaron & Co.	516-621-0630
Pa	Montgomeryville, VPI, Inc.	215-474-3200
Tex	Richardson, Spectra Sls. Corp.	214-234-3600
EXP:	Teaneck, N.J., Sylvan Ginsbury Ltd.	201-837-1100

ELECTRO LIFE, INC., 603 Maple La., Geneva, Ill., 60134, Tel: 312-232-0010; Empl.: 5

Customer service: J. B. White

Free literature available: Catalog sheets describing our highway traffic beacons, strobe lights for fire and security alarm systems, emergency vehicle, and warning lights for projecting loads on trucks.

Products manufactured: Lights

ELECTRO MATS. CORP. AMER., 605 Center Ave., Mamaroneck, N.Y., 10543, Tel: 914-698-8434, TWX: 710-566-1128; Minimum order: $50

For info on price: D. Davis; Application info: T. McCurdy; Customer service: T. McCurdy; Delivery info: Stock

Products manufactured: Adhesives (All Types), Coatings, Conductive Plastic Materials, Paints, Resistors, Solder (All Types), Thermistors

Local Sales Offices & Reps.

Cal	Livermore, EMCA	415-447-8300
Fla	Longwood, Lenz Engrg. Co.	305-831-9797
Mass	Newton, Normell Assocs.	617-969-5478
Minn	Minneapolis, D.G. Perry & Co.	
NY	Buffalo, Watmet	716-285-3595
Tex	Richardson, Mero Corp.	214-234-3365

ELECTRO-MECH COMPONENTS, 1826 N. Floradale Ave., So. El Monte, Cal., 91733, Tel: 213-442-7180; FSC No: 07150; Empl.: 75; Minimum order: $25
p. 1•2026,2027

For info on price: M. Ambrose; Application info: M. Peretik; Customer service: M. Ambrose; Delivery info: M. Ambrose

Products manufactured: Caps, Lenses, Indicator Light, Dials, Index Assemblies, Switch, Indicators, Keyboards, Alphanumeric & Decimal, Lamps, Lights, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, GND Sales Co.	602-971-9758
Cal	Los Angeles, Rep Assocs.	213-829-5401
Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Colo	Denver, Franklin Sls. Co.	303-922-3623
Conn	Milford, Todino Engrg.	203-TR4-6643
Fla	Casselberry, Publicover Assocs.	305-834-5775
Ill	Chicago, DJM Elctrn. Sls.	312-774-6525
Ind	Fort Wayne, Scott Elctrns., Inc.	219-743-1586
Ind	Indianapolis, Scott Elctrns., Inc.	317-897-9976
Ky	Louisville, Scott Elctrns., Inc.	502-583-3220
Md	Rockville, Quality Comps., Inc.	301-933-1623
Mass	Needham Heights, Todino Engrg. Sls.	617-444-7925
Mich	Plymouth, Scott Elctrns., Inc.	313-455-2440
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
NJ	Cherry Hill, Quality Comps.	609-428-6266
NY	Scarsdale, Bassin Tech. Sls. Co.	914-SC3-3334
Ohio	Cleveland, Scott Elctrns., Inc.	216-291-2600
Ohio	Dayton, Scott Elctrns., Inc.	513-294-0539
Pa	Pittsburgh, Scott Elctrns., Inc.	412-781-3112
Tex	Dallas, McCoy Assosc.	214-350-9931
Tex	Houston, Ev. Smith Sls. Co.	713-649-5756

Advertisment

IMMEDIATE DELIVERY
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ELECTRO-MECHANICAL INSTR. DIV., See Sheller-Globe Corp. Electro-Mechanical Instr. Div.

ELECTRO-MECHANICS CO., Box 1546, Austin, Tex., 78767, Tel: 512-451-8273; Empl.: 14

Customer service: R. L. Waters

Products manufactured: Analyzers, Antennas, Calibrators, Ferrite Material & Parts, Filters, Horns, Microwave, Magnetometers, RFI Measuring Equipment

Local Sales Offices & Reps.

Cal	Yorba Linda, Del Black Assocs.	714-524-0141
Md	Silver Spring, Gawler-Knoop Co.	301-589-4406
NY	Guilderland, Electro-Modular Sys. Inc.	518-456-2665
Tex	El Paso, Comms., Data & Control Sys.	915-584-1795
EXP:	New York, N.Y., Ad. Auriema, Inc.	212-466-2500

ELECTRO-MECHANISMS, INC., 1163 W. Fourth St., Azusa, Cal., 91702, Tel: 213-334-4927, TWX: 910-584-4855; Empl.: 25

Products manufactured: Solenoids, Switches

Local Sales Offices & Reps.

Ariz	Scottsdale, R. Thomas Co.	602-994-0401
Cal	Redwood City, Warren & Hickey Sls.	415-368-3849
Cal	San Diego, Van Gott & Assoc.	714-272-8452
Cal	San Gabriel, Van Gott & Assoc.	213-285-2148
Colo	Denver, Cristee-Meade Co.	303-753-9471
Conn	Old Saybrook, M. L. Assoc.	203-388-9718
Ill	Mt. Prospect, Magnuson Assoc.	312-956-0700
Md	Bethesda, Warren Mount Co.	301-657-9312
Mass	Marlboro, M. L. Assoc.	617-485-6190
Mich	Detroit, Group Ten	313-549-3910
Minn	St. Paul, Magnuson Assoc.	612-227-8495
NH	East Derry, M. L. Assoc.	603-432-5838
NJ	Berkeley Heights, R. P. Luce & Co.	201-464-6440
NY	Buffalo, Good Components	716-634-4400
NY	New Hyde Pk., R. P. Luce & Co.	516-437-4550
NC	Gastonia, Warren Mount Co.	704-867-2101
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Philadelphia, R. P. Luce & Co.	215-884-8365
Tex	Addison, R. Thomas Co.	214-233-8235
Wash	Bellevue, Ray Over Sls.	206-454-9187
FOR:	Can., Scarborough, Ont., Lake Engrg.	416-751-5980
FOR:	Can., St. Laurent, Que., Lake Engrg.	

ELECTRO-METRICS, Div. Penril Corp., 100 Church St., Amsterdam, N.Y., 12010, Tel: 518-843-2600; FSC No: 8A831; Empl.: 52; Minimum order: $25

For info on price: F.B. Powell; Application info: W.S. Lambdin; Customer service: R. Lyons; Delivery info: F. Powell

Products manufactured: Analyzers, Filters, Meters, Probes, Receivers

Local Sales Offices & Reps.

Ala	Huntsville, E.G. Holmes & Assoc.	
Cal	Yorba Linda, D. Black Assoc.	714-524-0141
Colo	Evergreen, Moutaintek, Inc.	303-674-5255
Fla	Orlando, E.G. Holmes & Assoc.	305-894-8901
Ga	Chamblee, E.G. Holmes & Assoc.	404-451-6161
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
Kans	Overland Park, Ensco-Rep Inc.	913-381-7557
Md	Silvers Spring, Gawler-Knoop Co.	301-589-4406
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
Mo	St. Louis, Ensco-Rep, Inc.	314-567-3935

NJ	E. Orange, Friedman Associates	201-673-2500
NM	Albuquerque, Mountaintek Inc.	505-268-0003
NY	Guilderland, Electro-Modular Sys.	518-456-2665
Ohio	Dayton, G.L. Ashby Assocs.	513-252-5627
Tex	Richardson, Scientific Devices	214-231-8016
Utah	Salt Lake City, Mountaintek Inc.	801-278-6056
Va	Virginia Beach, E.G. Holmes & Assoc.	801-481-6556
Wash	Seattle, G.M. Gillett & Assocs.	206-284-3344
EXP:	Amsterdam, NY, Electro-Metrics	518-843-2600
FOR:	Can., Burnaby, B.C., Megatronix Ltd.	604-526-3312
FOR:	Can., Montreal, Que., Megatronix, Ltd.	514-488-0404
FOR:	Can., Ottawa, Ont., Megatronix, Ltd.	613-729-4004
FOR:	Can., Weston, Ont., Megatronix, Ltd.	416-742-8015

ELECTRO-MODULE, INC., 2655 Metropolitan Place, Pomona, Cal., 91767, Tel: 714-593-3565, Telex: 670339; FSC No: 34217; Empl.: 150; Minimum order: $35

Customer service: D. Glynn

Products manufactured: Current Sensors, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Flashers, Inverters, Power Supplies, Regulators, Relays, Switches, Timers

Local Sales Offices & Reps.

Ind	Indianapolis, Rockford Controls	513-898-5452
Mass	Lexington, M.R.I.	617-861-6270
NY	Commack, Lawrence K. Haner, Assoc.	516-864-2220
Ohio	Dayton, Rockford Controls-Ohio	513-898-5452
Tex	Dallas, EBR	214-942-2716

ELECTRO MOTIVE CORP., Div. of International Electronics Corp., 316 S. Service Road, Melville, New York, 11746, Tel: 516-694-7700, TWX: 510-224-6427; Empl.: 2100 .... p. 2•194,195

For info on price: Sls. Dept.; Application info: Engrg. Dept.; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Complete catalog all products. Covers dipped, molded high reliability mica; polyester film, mylar, ceramic, paper, polypropylene capacitors; variable compression trimmers, padders; metal clad devices; electrolytics, tantalums.

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Diodes, Tubes

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Los Altos, Collins & Hyde	415-941-3355
Cal	Los Angeles, Collins & Hyde	213-666-4238
Colo	Denver, Walter Eng.	303-777-5585
Conn	Milford, Conti-Younger Assocs.	203-929-3294
Fla	Oviedo, Conley Assocs.	305-365-3283
Ill	Chicago, Electro Motive	312-237-4454
Ill	Streamwood, A. Holte & Assoc.	312-837-4066
Ind	Indianapolis, Electro Motive	317-545-4432
Kans	Prairie Village, Engrg. Svcs.	913-649-4000
Ky	Owensboro, Great Southern Elctrns.	502-685-4781
Mass	Waltham, Conti-Younger Assocs.	617-890-4582
Minn	St. Louis Park, Beta Engrg. Corp.	612-925-4422
Mo	St. Louis, Engineering Svcs. Co.	314-997-1515
NJ	Harrington Park, Metro Tech. Sls.	201-768-8495
NY	Endicott, Advanced Comps. Corp.	607-785-3191
NY	Jericho, Metro Tech. Sls.	516-935-3330
NY	North Syracuse, Advanced Comps. Corp.	315-699-2671
Ohio	Cincinnati, R. Makin Assoc.	513-232-5588
Pa	Ardmore, W.K. Metz	215-649-3966
Tex	Dallas, United Comps.	214-324-1448
Wash	Seattle, R. Thorp Co.	206-763-1236
FOR:	Can., Ont., Anbak Sls.	416-625-1061
FOR:	Can., Que., Anbak Sls.	514-636-8514

ELECTRO-NUMERICS CORP., 67 East Evelyn Ave., Mountain View, Cal., 94040, Tel: 415-965-8500; Empl.: 70

Products manufactured: Cells, Load, Converters, Counters, Indicators, Meters, Printers, Totalizers, Digital, Transducers

Local Sales Offices & Reps.

Ariz	Scottsdale, O.E.M. Specialties	602-948-3360
Cal	Belmont, Richards Assocs.	408-246-5860
Cal	So. Pasadena, Cameron G. Pierce Assocs.	213-682-1166
Colo	Denver, Omega Ltd.	303-758-1508
Conn	Hamden, Applied Meas., Inc.	203-288-5288
Ill	Chicago, Lighiner Assocs. Inc.	312-774-1500
Mass	Acton, Applied Meas., Inc.	617-263-2766
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
NJ	Camden, QED Elctrns., Inc.	215-925-8711
NJ	Fort Lee, Tecnimat	201-461-8686
NY	Liverpool, Rayelco Elctrns., Inc.	315-652-5272
Ohio	Cleveland, Carter, McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Ore	Portland, Brett & Assocs., Inc.	503-232-4184
Pa	Pittsburg, Carter, McCormic & Peirce	412-824-3760
Tex	Dallas, R. T. Martin Assoc.	214-358-3704
Tex	Houston, R. T. Martin Assoc.	713-462-4077
Wash	Seattle, Brett & Assoc.	
EXP:	Palo Alto, Cal., Western Int'l. Trade Co.	415-321-1240

ELECTRO-OPTICAL INDS., INC., 839 Ward Dr., Santa Barbara, Cal., 93111, Tel: 805-964-6701; Empl.: 40

Customer service: A.J. Cussen

Free literature available: "Radiometric Properties of Isothermal, Diffuse Wall Cavity Sources" Description: Total radiant power emission from various diffuse wall cavity sources is calculated without approximation. Results applied to the practical problems of cavity design and analysis.

Products manufactured: Amplifiers, Analyzers, Calibrators, Choppers, Filters, Generators, Heat Exchangers & Systems, Integrators, Electronic, Light Choppers, Modulators, All Kinds, Monitors, Oscilloscopes, Power Supplies, Pyrometers, Radiometers, Slide Rules (Circuitry Computing), Standards

ELECTRO-PACIFIC, INC., 5782 Thornwood Dr., Goleta, Calif., 93017, Tel: 805-964-4878; Empl.: 41; Minimum order: $25

For info on price: J.R. Lindbery; Application info: J.R. Lindbery; Customer service: J.R. Lindbery; Delivery info: P. Williams

Free literature available: Data sheets EPI Models 1-249 & 1-250 Laser power supplies for 12UDC battery operation for portable laser equip. such as surveying equip, levels etc.

Products manufactured: Amplifiers, Coils Including Assemblies & Forms, Controls/Control Eqpt., Converters, Generators, Inverters, Power Supplies, Reactors, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700

ELECTRO PACKAGING, INC., 176 Walker St., Lowell, Mass., 01854, Tel: 459-3731, Telex: 94-7490; Empl.: 350 p. 2•672-675

Customer service: B. Rio

Free literature available: Data Sheets Cross Reference lists on Competitive products.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit

Local Sales Offices & Reps.

Ala	Huntsville, Technology Mktg. Assocs.	205-883-7893
Ariz	Scottsdale, S.C. Blaker Co.	602-948-3061
Colo	Englewood, Holland Co.	303-789-4149
Conn	Meriden, Com-SI.	203-634-0179
Fla	Ormond Beach, Technology Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ill	Northbrook, R.T. Howlett & Assocs.	312-498-5444
Mass	Waltham, Com-SL	617-890-0011
NJ	North Caldwell, Masin-Esco	201-226-2550
NY	Schenectady, N. Alexander & Assocs.	518-377-0581
NY	Syosset, Masin-Esco	516-364-0310
Pa	Newton Square, Danton Assocs.	215-353-0500
Tex	Houston, Cunningham Co.	713-461-4197
Tex	Richardson, Cunningham Co.	214-231-2686
FOR:	Can.Dollard Des Ormeaux, Que., Empro Sls. Co.	514-683-3455

ELECTRO RENT, 1699 Elmhurst Rd., Elk Grove Village, Ill., 60007, Tel: 312-956-8380, TWX: 910-222-1847; Empl.: 75; Minimum order: $50

For info on price: T. WAllace; Application info: J. Frey; Customer service: J. Frey; Delivery info: T. Wallace

Free literature available: Catalog and equipment rental brochure.

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Burbank	213-843-3131
Cal	Mountain View	415-964-5500
Cal	Santa Ana	714-979-5620
Md	Rockville	301-881-8180
Mich	Detroit	313-891-8410
NJ	Plainfield	201-561-6466
Tex	Dallas	214-691-6086

ELECTRO-RACK PRODUCTS CO., 1742 So. Clementine St., Anaheim, Cal., 92802, Tel: 714-776-5420; Empl.: 25

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Metal

ELECTRO-SCIENCE LABS., 1601 Sherman Ave., Pennsauken, N. J., 08110, Tel: 609-663-7777, Telex: 83-4788; Empl.: 70

For info on price: C. M. Schreiber; Application info: A. Rose; Customer service: A. Gelb

Free literature available: Short form catalog of thick film and optoelectronic materials data sheets on individual products thick film resistors for high yield processing.

Products manufactured: Adhesives (All Types), Boards, Printed Circuit, Capacitors, Fixed, Circuits, Hybrid, Thick Film, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Films, Inks For Thick Film Microcircuits, Insulators & Insulation, Kits, Printed Circuit, Metals, Paints, Potentiometers, Resistors, Rubber, Seals, Services, Assembly, Production & Test, Solder (All Types), Substrates

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Burlingame, Hybrid Elctrns.	415-347-8217
Cal	Hacienda Heights, Electro-Science Labs.	213-330-5592
Cal	Sunnyvale, Electro-Science Labs.	408-732-5161
Colo	Denver, W. J. Purdy Co.	303-777-1411
Fla	Sarasota, W. J. Irvine Co.	813-955-9656
Kans	Shawnee Mission, Mid-America Elctrns. Mktg.	913-236-4800
Mass	Framingham, Microdon	617-879-3800
Minn	Minneapolis, C. E. Bohlig Co.	612-922-7011
NJ	Nutley, D/R Assocs.	201-667-5900
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
NY	Rochester, D/R Elctrns.	716-442-6980
Ohio	Dayton, Sidnell Co.	513-885-4161
Tex	Austin, Crockett Southwest Corp.	512-476-6801
Tex	Dallas, Crockett Southwest Corp.	214-251-1776
FOR:	Can., Rosemere, Que., D/R Elctrns., Ltd.	

ELECTRO SCI. INDS., 13902 N.W. Science Pk. Dr., Portland, Ore., 97229, Tel: 503-646-4141, Telex: 36-0273; FSC No: 11837; Empl.: 297; Minimum order: $25

For info on price: S. Gressel; Application info: J. Currier; Customer service: S. Gressel; Delivery info: S. Gressel

Free literature available: ESI Condensed Catalog; ESI Model 1234 IC (Linear) Tester Brochure; ESI Model 1248 IC (Digital) Tester Brochure; ESI System 25 Resistance Trimming Laser System Brochure

Products manufactured: Bridges, Calibrators, Capacitors, Fixed, Clamps & Clips, Comparators, Decade Boxes, Detectors, Dividers, Indicators, Leads, Test & Adaptors, Meters, Microcircuit Production Equip., Networks, Potentiometers, Resistors, Standards, Testers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs. Inc.	205-534-9771
Cal	Orange, Bill Lyon	714-633-4704
Cal	Palo Alto, T. White	415-327-1571
Conn	Seymour, B. Fobes	203-888-3258
Fla	Orlando, Gentry Assocs. Inc.	205-534-9771
Ill	Rosemont, Electro Sci. Ind.	312-696-4322
Mass	Waltham, D. Erickson	617-899-6633
NJ	Bergenfield, Electro Sci. Inds.	201-385-9493
NY	Camillus, Eric Hill	315-672-5498
NC	Burlington, Gentry Assocs. Inc.	919-227-3639
Ohio	Cleveland, Instr. Sys.	216-486-0782
Ohio	Dayton, Instr. Sys.	513-293-8095
Pa	Pittsburgh, Instrumentation Sys. Inc.	412-243-1111
Tex	Austin, Crockett Engrg.	512-476-6801
Tex	Dallas, Crockett Engrg. Co.	214-637-6120

ELECTRO STYLUS, 31 Cheyenne Blvd., Colorado Springs, Colo., 80906, Tel: 303-633-5969; Empl.: 10

Customer service: M. L. Murray

Products manufactured: Nameplates

ELECTRO SWITCH CORP., King Ave., Weymouth, Mass., 02188, Tel: 617-335-5200, TWX: 710-388-0377; Empl.: 200 .... p. 1•2028,2029

Products manufactured: Switches

Local Sales Offices & Reps.

Ariz	Scottsdale, OEM Specialties	602-948-3360
Cal	Oakland, W. Nott & Co.	415-654-3747
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-279-9412
Colo	Denver, Vinson Assocs.	303-757-5151
Fla	Boca Raton, Floritronics Inc.	305-368-0325
Fla	Winter Park, Floritronics, Inc.	305-886-4818
Ga	Atlanta, Holman-Lobsinger Co.	404-256-9120
Ill	Elk Grove Village, Electro Switch Corp.	312-593-2225
Md	Woodbine, Naudain Assocs.	301-252-5378
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
Minn	St. Paul, Kenco Co.	612-645-7717
Mo	No. Kansas City, H.J. Weisler & Assoc., Inc.	816-421-1679
Mo	St. Louis, H. J. Weisler & Assoc.	314-428-3934
NJ	Mt. Laurel, Naudain Assocs.	609-235-1801
NY	Melville, Electro Switch Corp.	516-249-3770
NY	Rochester, T. Ferguson Sls., Inc.	716-482-7757
NC	Winston-Salem, L.G. White Southern, Inc.	919-725-3612
Ohio	Columbus, Rockford Controls	614-231-5890
Ohio	Dayton, Rockford Controls Ohio	513-278-7362
Ohio	Euclid, Rockford Controls Ohio	216-731-5250
Pa	Pittsburgh, R. F. Clark	412-242-9500
Tex	Bellaire, Brice Co.	713-666-1788
Tex	Dallas, Brice Co.	214-233-9808
Wash	Seattle, C.B. Parsons & Co.	206-762-7373
Wisc	Wauwatosa, Larsen Assoc.	414-258-0529
EXP:	Canada, Don Mills, Ont., G.M. Fraser Ltd.	416-449-6600
EXP:	Conn. Litchfield, Norcon Div. Intrade Inc.	203-567-5865

ELECTRO-TECHNIQUES, INC., 215 Via Del Norte, Oceanside, Cal., 92054, Tel: 714-757-7770, Telex: 697-932; Empl.: 38; Minimum order: $50

For info on price: G. S. Tice; Application info: B. H. Tice

Free literature available: Short form catalog #5 = Lists all standard potentiometers built by electro-techniques; Short Form catalog #6 = Gives specs on all variations Series 850, 3/4" long multiturn, including switch-pot variations; Data sheet - Model 850 - 7/8" diameter, 3/4" long multi-turn.

Products manufactured: Potentiometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	Burlingame, Jack Logan & Assocs.	415-697-6100
Cal	Los Angeles, M.W. Riedel & Co.	213-283-7694
Colo	Littleton, Piper-Goyne	303-798-8955
Conn	Madison, A & M Elec. Reps.	203-421-4242
Fla	Palm Beach Gardens, Brosey Enterprises	305-622-6045
Ill	Glenview, Crimson Engrg.	312-724-1780
Kans	Wichita, E. Carbiener Assoc.	316-682-5782
Mich	Livonia, Rep-Tron	313-525-2700
NM	Albuquerque, Piper-Goyne	505-265-6794
NY	Conklin, Ramcom	607-775-0641
NY	New York, Addem Group	516-567-5900
Ore	Portland, J. W. Eckersley Co.	503-246-3183
Pa	Philadelphia, W. F. Assocs.	215-224-4120
Tex	Richardson, Spectra Sls. Co.	214-234-3600

ELECTRO-VOICE, INC., Sub. Gulton Inds., Inc., 600 Cecil St., Buchanan, Mich., 49107, Tel: 616-695-6831, TWX: 810-270-3135; Empl.: 1,000

Customer service: Sales Dept.

Free literature available: Complete catalog on microphones and loudspeakers for broadcast, recording, sound reinforcement, communications, and home entertainment.

Products manufactured: Attenuators, Filters, Handsets, Chestsets, Headphones, Headsets, Etc., Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Networks, Speaker Systems, Speakers, Tape Recording Accessories, Transducers, Transformers

Local Sales Offices & Reps.

Ala	Birmingham, M. K. Smith, Inc.	205-967-3080
Alas	Anchorage, H. J. Lang & Assocs.	907-279-5741
Ariz	Phoenix, J. R. Morgan Agency	602-252-3089
Ark	El Dorado, Dick Bellew Sls., Inc.	501-863-8325
Cal	Hollywood, J. Carter Assocs.	213-980-3450
Cal	San Francisco, Meyer, Ross & Fleming, Inc.	415-285-8880
Colo	Denver, Lindberg Co.	303-758-9033
Fla	Fort Lauderdale, Sproch Sls., Inc.	305-587-3792
Fla	Sarasota, Sproch Sls., Inc.	813-924-7768
Ga	Tucker, M. K. Smith, Inc.	404-938-7161
Haw	Honolulu, Dougherty Entprs. Co.	808-847-4144
Ill	Lincolnwood, Wm. M. Linz Assocs.	312-677-2000
Ind	Mulberry, Maish Sls.	317-296-2322
Kans	Olathe, B. C. Elctrn. Sls., Inc.	913-782-6696
La	Kenner, Dick Bellew Sls., Inc.	504-729-4550
Md	Baltimore, D. H. Brothers Co.	301-764-7189
Mass	Wellesley Hills, M. Scott Co.	617-235-0102
Mich	Detroit, Riley & Petchell Sls. Inc.	313-535-7000
Minn	St. Paul, SKOR	612-645-6461
Miss	Michigan City, J. Fisher Sls.	601-224-6470
Mo	Raytown, Midwest Mktg. Co.	816-358-6638
Mo	St. Louis, Midwest Mktg. Co.	314-894-1388
NJ	Ridgefield, Bi-State Marketers, Inc.	201-943-5888
NY	Buffalo, Waxman-Currant Sls., Inc.	716-873-0442
NC	Charlotte, M. K. Smith, Inc.	704-372-1026
Ohio	Columbia Station, C. L. Pugh & Assocs.	216-235-6028
Ohio	Columbus, C. L. Pugh & Assocs.	614-486-9678
Pa	Newtown Square, G. M. Conneen Co.	215-353-2241
Pa	Pittsburgh, C. L. Pugh & Assocs.	412-531-2731
Tenn	Memphis, Dick Bellew Sls., Inc.	901-365-9437
Tex	Dallas, Collins Co.	214-341-7866
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Edmond, Gemini Elctrns., Inc.	206-775-1229
Exp:	Chicago, Ill., Magnus Inter-America	312-334-1503
Exp:	Roslyn, N.Y., Telesco Int'l. Corp.	516-484-4920
FOR:	Can., Gananoque, Ont., E.V. of Canada, Ltd.	613-382-2141
FOR:	Can., Mississauga, Ont., Thorvin Elctrns., Inc.	416-274-1573
FOR:	Can., Montreal, H2W2J1, Audesco Elctrns., Ltd.	514-288-4122
FOR:	Can., Vancouver, B.C., Electro-Tec Marketers	604-736-6377

ELECTROCOM INDS., 1105 N. Ironwood Dr., S. Bend, Ind., 46615, Tel: 219-232-2743; FSC No: 27114; Minimum order: $15

Customer service: B. Jaffe

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Comm. Systems, Converters, Filters, Keyers, Tone, Networks, Reactors, Receivers, Services, Assembly, Production & Test, Teletypewriters & Equipment, Terminal Equipment, Digital, Transformers

ELECTROCUBE INC., 1710 So. Del Mar Ave., San Gabriel, Cal., 91776, Tel: 213-573-3300, TWX: 910-589-1609; Empl.: 125 .... p. 1•553; p. 2•121-125,1736,1737

Products manufactured: Capacitors, Fixed, Chokes, Coils Including Assemblies & Forms, Filters, Networks, Reactors, Resistors, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Delta Elctrns. Sls. Corp.	602-966-9903
Cal	Los Angeles, Ed Landa Co.	213-879-0770
Cal	Mountain View, West/Mark Assocs.	415-969-1700
Colo	Denver, West/Mark Assocs.	303-433-7181
Fla	Coca, Orbe Inc.	305-452-9568
Fla	Ft. Lauderdale, Orbe, Inc.	305-564-857
Fla	Winter Park, CBC, Inc.	904-383-6498
Ill	Downers Grove, Richmar Elctrn. Sls.	312-968-0118
Md	Stevenson, T. Griffin Co.	301-484-0251
Mass	Reading, C. Godfrey Co.	617-944-2230
Mich	Grosse Pointe Park, S. Greiner Assocs.	313-499-0188
Minn	Minneapolis, Electro-Serv Co.	612-827-2907
Mo	Hazelwood, Centech Sls.	314-731-4220
Mo	Raytown, Centech Sls.	816-358-8100
NM	Albuquerque, IMEC	505-883-9010
NY	Floral Park, MOS Assocs.	516-694-5923
NY	Rochester, Gislason Sls.	716-454-4741
Ohio	Cleveland, K.W. Elctrn. Sls.	216-831-8292
Ohio	Dayton, K.W. Elctrn. Sls.	513-890-2150
Pa	Paoli, T. Griffin Co.	215-647-1550
Pa	Waterford, K.W. Elctrn. Sls.	814-796-6714
Tex	Dallas, W. Reese Assocs.	214-638-6575
Tex	Houston, W. Reese Assocs.	713-621-3134
Wash	Bellevue, J. Findley Co.	206-454-5200
Wash	Seattle, H. Levinson Co.	206-323-5100
Wisc	Oak Creek, Richmar Elctrn. Sls.	414-475-0141
EXP:	N.Y., N.Y., C. Tennant, Sons & Co.	212-679-1300

Local Distributors

Cal	Carson, Hi-Rel Dist. Sls., 20507 S. Belshaw	213-537-6500
Cal	Sunnyvale, Acacia Sls., 384 San Aleso	408-735-0100
Ohio	Englewood, Argent Inds., 477 E. Wenger Rd.	513-836-8633
Ohio	Solon, REPCO, Inc., 6855 Cochran Rd.	216-248-8900
Pa	Erie, Erie Corp. Contractors, 1938 Buffalo Rd.	814-452-3762
Pa	Pittsburgh, Cameradio, 2801 Liberty Ave.	412-288-2600
Tex	Richardson, Altair Co., 405 N. Pland Rd.	214-231-5166

ELECTRODYNE CORP., 7315 Greenbush Ave., No. Hollywood, Cal., 91605

ELECTRON, INC., 12655 Coit Rd., Bratenahl, Ohio, 44108, Tel: 216-681-4700, Telex: 980240; Empl.: 85

For info on price: J. M. Wexler; Application info: F. P. Zaffarano; Customer service: R. C. Dederson

Products manufactured: Controls/Control Eqpt., Data Acquisition & Reduction Systems, Data Compressors, Digital, Drums Computer Memory, Readers, Recorders, Test Systems, Testers

ELECTRON-MACHINE CORP., Box M, Umatilla, Fla., 32784, Tel: 904-669-3101, Telex: 56-4300; Empl.: 55

Customer service: J. Gatch

Free literature available: Milmaster, Controller, Capacitance Monitor, X-Ray Gage, Refractometer

Products manufactured: Controls/Control Eqpt.

Local Sales Offices & Reps.

Ala	Anniston, Shelton Ind. Equip.	205-237-1749
Colo	Denver, Equipment Specialties Co.	303-433-3371
Del	Newark, Brennan-Davis Instr. Sls. Co.	302-731-5000
Ill	Chicago, Memeco, Inc.	312-774-0919
Mass	Acton, Six States Engrg.	617-263-8989
Mich	Birmingham, Brooks Equip. Co.	313-645-0950
Minn	Wayzata, Wm. A. Sternad, Consulting Engr.	612-473-4700
Mo	St. Louis, E.B. Miller Co.	314-966-8250
NJ	Haddonfield, Brennan-Davis Instr. Sls. Co.	609-429-7687
NJ	Kenilworth, Wolock & Lott	201-241-4333
NY	North Syracuse, V. Luven Company	315-458-8195
NC	Charlotte, MacGuire & Crawford Instr. Co.	704-366-3454
Ohio	Cincinnati, Surkamp & Rowe	513-891-1838
Ohio	Cleveland, Thorrat & Hanmer	216-333-5950
Okla	Tulsa, Telstar Instr. Corp.	918-628-1011
Ore	Portland, R.E. Donelson Co.	503-654-3137
Pa	Pittsburgh, Bollinger & Richards	412-561-2340
Tex	Bellaire, Cactus Engrg. Co.	713-665-2723
Vt	Springfield, Six States Engrg.	802-885-5253
Va	Richmond, Mickle-Milnor Engrg. Co.	804-266-8741
FOR:	Can., Montreal, Que., Industrial Projects, Ltd.	514-489-5769
FOR:	Can., Toronto, Ont., Industrial Projects, Ltd.	416-368-1923

ELECTRONAUTICS, Dept. Dielectric Comm., Newtown Rd., Littleton, Mass., 01460, Tel: 617-486-3578, TWX: 710-347-0650; Empl.: 155; Minimum order: $10

For info on price: N. J. Diehm; Application info: N. J. Diehm; Customer service: B. Lurvey; Delivery info: B. Lurvey

Products manufactured: Attenuators, Dummy Loads, Loads, Electronic Variable

Advertisment

Designing, Engineering & Manufacturing Loads from Waveguide Sizes WR28 thru WR650 *Low Power Terminations, Tongue Loads, Step Loads Cone Loads

*Hi Pow Dummy Loads from 40 watts to 8000 watts avg. power

*Special Configurations, Stripline Load Elements Attenuators Bushings, Damping Rings

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Write for new catalog and price lists

ELECTRONIC APPLICATIONS CO., 2213 Edwards Ave., So. El Monte, Cal., 91733, Tel: 213-442-3212; Empl.: 75 .... p. 1•1648-1659

For info on price: G. T. Stockton; Application info: A. Churik; Customer service: A. Churik; Delivery info: A. Churik

Free literature available: Catalogs

Products manufactured: Relays

Local Sales Offices & Reps.

Ala	Huntsville, Repcom	205-534-9959
Ariz	Phoenix, McKnight	602-257-8037
Cal	Los Angeles, El-Com Inc.	213-223-1351
Cal	Menlo Park, McKnight	415-325-2844
Colo	Sedalia, Jensen Reps.	303-688-4154
Conn	Trumbull, TX Sales	203-261-2088
Fla	Ft. Lauderdale, Repcom Inc.	305-564-1929
Fla	Jacksonville, Repcom Inc.	904-773-8381
Fla	Melbourne, Repcom Inc.	305-254-1877
Fla	Miami Springs, Repcom	305-887-8723
Fla	Orlando, Repcom	305-894-7217
Fla	Seminole, Repcom, Inc.	813-393-0584
Ga	Marietta, Repcom, Inc.	404-971-2831
Ga	Warner Robins, Repcom	912-923-1393
Ill	Chicago, Midwest Elctrn. Sls.	312-777-9700
Ind	Indianapolis, Midwest Elec.	317-926-3736
Iowa	Cedar Rapids, Midwest Elec.	319-362-4410
Md	Baltimore, M/E Assoc.	301-825-1130
Md	Towoon, Holden Engineering Sls. Co.	301-823-3763
Mass	Randolph, Tx Sls.	617-986-6080
Minn	Bloomington, Ladky Assoc.	612-884-2125
NJ	Little Falls, Carbone Assoc.	201-256-9191
NM	Albuquerque, McKnight	505-266-6423
Pa	Elkins Pk., Arnold Assoc., Inc.	
Pa	Erie, Ecco Elctrn. Sls.	814-455-8110
Pa	Jenkintown, Arnold Assoc.	215-887-7870
Tex	Dallas, E-Tron Sls.	214-348-4749
Tex	Dallas, Kentron Engrg.	214-352-7535
Wash	Seattle, Underwood	206-243-2133
Wisc	Waukesha, Midwest Elec.	414-542-5129
For:	Can., Toronto, Ont.	416-294-6797

ELECTRONIC ARRAYS, 550 Middlefield Rd., Mountain View, Cal., 94043, Tel: 415-964-4321, TWX: 910-379-6985; Empl.: 798

For info on price: B. Cushman; Application info: L. Hester; Customer service: H. Day

Free literature available: Short form catalog.

Products manufactured: Integrated Circuit Devices

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins Co.	205-539-1771
Ariz	Phoenix, Dorton Entprs.	602-263-0414
Cal	Huntington Beach, EA Western Region	714-968-3775
Cal	Los Angeles, Black, Ekizian & Strong	213-870-9191
Cal	Mt. View, Caltron/Pyle	408-964-3244
Cal	San Diego, Bestronics	714-278-2150
Colo	Denver, Thorson Co.	303-759-0809
Conn	Meriden, COM-SALE	203-634-0179
Conn	Wallingford, COM-SALE	203-269-7964
Fla	Largo, Col-Ins Co.	813-343-0978
Fla	Orlando, Col-Ins Co.	305-423-7615
Ga	Clarkston, Col-Ins Co.	404-934-7280
Ind	Indianapolis, Ihrig Assoc.	317-783-7630
Mass	Waltham, Com-Sale	617-890-0011
Mich	Grand Rapids, Elko Sls. Corp.	616-949-1451
Mich	Grosse Pointe Woods, Elko Sls. Corp.	313-884-1955
Minn	Minneapolis, Electronic Innovators	612-884-7471
NJ	Cherry Hill, EA Eastern Region	609-795-5066
NM	Albuquerque, Thorson Co.	505-265-5655
NY	Elmont, Crane & Egert Corp.	516-488-2100
NC	Raleigh, Col-Ins Co.	919-834-6591
Ohio	Brecksville, A. Nace Co.	216-526-4323
Ohio	Englewood, A. Nace Co.	513-836-7548
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Pittsburgh, A. Nace Co.	412-922-7225
Pa	Willow Grove, Harry Nash Assocs.	215-657-2213
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Va	Reston, Boyle Assocs.	703-620-9558
Wash	Bellevue, N.R. Schultz Co.	206-454-0300

ELECTRONIC COIL CORP., 347 New Britain Ave., Plainville, Conn., 06062, Tel: 203-747-1213; Empl.: 75; Minimum order: $50

For info on price: R. Gorski 203-747-1213; Application info: R. Gorski 203-747-1213; Customer service: D. Bray 203-747-1222; Delivery info: D. Bray 203-747-1222

Free literature available: Wire Stripping Ultra-fine Teflon & PV wires to AWG #36 Stranded 7/44 with final O.D. of .010", Electric Coils for relays, timing motors, solenoids, clocks, voice systems, memory drum systems, telephone systems etc.

Products manufactured: Coils Including Assemblies & Forms, Lead Assemblies & Receptacles, Services, Assembly, Production & Test

ELCTRN. COMM., INC., Sub. NCR, 1501 72nd St., N., St. Petersburg, Fla., 33733, Tel: 813-381-2000, TWX: 810-850-4127; Empl.: 1500

Products manufactured: Amplifiers, Antennas, Circuits, Hybrid, Thin-Film, Comm. Systems, Data Acquisition & Reduction Systems, Keyboards, Alphanumeric & Decimal, Modulators, All Kinds, Multiplexers, Receivers, Transmitters

Local Sales Offices & Reps.

Cal	Van Nuys	213-896-9963
Mass	Lexington	617-861-1063
Va	Arlington	703-525-7070

ELCTRN. CONCEPTS, INC., Box 627, Eatontown, N.J., 07724, Tel: 201-542-7880, TWX: 710-722-6691; Empl.: 80

Customer service: A. J. Muscillo

Products manufactured: Capacitors, Fixed, Films

Local Sales Offices & Reps.

Cal	Los Angeles, Corcoran Assocs.	213-823-2425
Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Ill	Park Ridge, Metcom Assocs.	312-696-1490
Mass	Waltham, Impact Sls. Co.	617-893-2850
Minn	Minneapolis, Revere Assocs.	612-781-2615
NJ	Irvington, Murray Gallagher	201-399-4350
NJ	Neptune, Com-Tek Elctrns.	201-477-6992
NY	Conklin, Comerota Assocs.	607-775-0641
NY	New Rochelle, Display Comps. Sls.	914-636-2969
Ohio	Mentor, Bishop Co.	216-255-6969
Tex	Seabrook, Stolle-Hamilton Co.	713-334-1909
Va	Reston, Boyle Assocs.	703-620-9558
Wash	Seattle, Underwood & Underwood	206-243-2133

ELECTRONIC CONTROL SYSTEMS, INC., Box 1232, Fairmont, W. Va., 26554, Tel: 304-363-8690; Empl.: 112; Minimum order: $50

Customer service: J. P. O'Leary

Products manufactured: Alarms, Cabinets & Accessories, Controllers, Programmable, Controls/Control Eqpt., Indicators, Meters, Monitors, Panels, Potentiometers, Switches, Thyristors (Includes Silicon Controlled Rectifiers)

Local Sales Offices & Reps.

Cal	La Mirada, F.C. Collins Co.	213-941-8515
Cal	Sunnyvale, Wilson, Leonik & Co.	408-732-9050
Del	Claymont, Elctrn. Control Sys.	302-405-8050
Mass	Northboro, Elctrn. Control Sys.	617-366-4940
NJ	Hackensack, C.H. Ribble Co.	201-342-2602
NJ	Moorestown, J. Speck Assocs.	609-234-4957
Ohio	Cleveland, Elctrn. Control Sys.	216-235-2992
Pa	Warminster, Elctrn. Control Sys.	215-674-4777
Pa	White Oak, Elctrn. Control Sys.	412-672-8500
SC	Taylors, Elctrn. Control Sys.	803-244-6147
Wisc	Brookfield, S.F. Boyd Co.	414-781-7170

ELECTRONIC COUNTERS & CONTROLS INC., 1500 McCormick Blvd., Mundelein, Ill., 60060, Tel: 312-362-8910; Empl.: 90

For info on price: F. A. Balmes; Application info: J. L. Mosak; Customer service: P. Sulek; Delivery info: P. Sulek

Free literature available: Digital preset counters, uni or bi-directional standard or custom sequential controls digital tachometers, ratio indicators, draw-speed indicators proximity & photoelectric switches shaft encoders.

Products manufactured: Cards, Logic, Comparators, Controllers, Programmable, Controls/Control Eqpt., Counters, Encoders, Indicators, Meters, Modules, Logic, Encapsulated, Monitors, Printers, Process Control Systems, Programmers, Sensors, Light, Switches, Tachometers, Timers

Local Sales Offices & Reps.

Ala	Birmingham, Com-Trol	205-823-0897
Alas	Anchorage, J.A. Tudor & Assocs.	907-274-6350
Cal	Marina Del Rey, Components West Sls.	213-821-6522
Colo	Boulder, R. Hendrickson	303-499-5603
Conn	Rocky Hill, Aid Engrg. Sls. Co.	203-673-3692
Ga	Atlanta, Hal Homer Assocs.	404-255-8669
Ill	Deerfield, Traco Eng. Co.	312-945-3520
Iowa	Sioux City, Lakeland Eng. Equip.	712-252-3611
Mass	Westboro, Aid Engrg. Sls. Co.	617-890-8181
Mich	Kalamazoo, E.B. Dewey Co.	616-344-6163
Mich	Troy, Control Sls. Assoc.	313-391-3235
Minn	St. Paul, Power/Mation Div.	612-645-0781
Mo	St. Louis, Tines Ind'l. Sls.	314-638-2936
NJ	Kenilworth, Wolock & Lott	201-241-4333
NY	Henrietta, Rush Instrs.	716-334-0452
NC	Charlotte, Amtek	704-596-6898
Ohio	Cincinnati, Drivex Corp.	513-742-2000
Ohio	Dayton, Albrecht Assocs.	513-236-9333
Ohio	Euclid, Control Dynamics Corp.	216-692-2818
Ohio	Toledo, P. Girkins	419-241-2101
Ore	Eugene, J.A. Tudor & Assoc.	503-686-1252
Ore	Portland, J.A. Tudor & Assocs.	503-288-5154
Pa	King of Prussia, Reinbrecht Assocs.	215-265-6180
Pa	Pittsburgh, Weiss Instrs.	412-371-3020
Tex	Bellaire, Brice Co.	713-666-1788
Tex	Dallas, Brice Co.	214-233-9808
Va	Richmond, S.D. Harmon & Co.	804-285-3168
Wash	Seattle, J.A. Tudor & Assocs.	206-682-7444
Wash	Spokane, J.A. Tudor & Assoc.	509-327-3328

ELECTRONIC COUNTERS, INC., 240 Humphrey St., Englewood, N.J., 07631, Tel: 201-567-5300; Empl.: 30

Customer service: L. Sonders

Free literature available: Technical Data Sheets for our line of Pulse Generators.

Products manufactured: Generators

Local Sales Offices & Reps.

Colo	Loveland, Kelley Entprs.	303-667-1376
DC	Washington, Eastern Instru.	301-839-3800
NY	Fayetteville, M. P. Andrews, Inc.	315-637-3144
NY	Great Neck, E. I. Inc.	516-466-9505
Pa	Philadelphia, Eastern Instru.	215-927-7777
Tex	Dallas, Airep Elctrn.	214-363-5291
Va	Richmond, Eastern Instru.	703-644-6622

ELECTRONIC DEV. CORP., 11 Hamlin St., Boston, Mass., 02127, Tel: 617-268-9696; FSC No: 12619; Minimum order: $15 .... p. 1•670-672

Customer service: R. Ross

Free literature available: Complete catalog containing full engineering specifications, applications, block diagrams and prices.

Products manufactured: Calibrators, Converters, Current Sources, Indicators, Meters, Power Supplies, References, D-C Voltage, Standards, Testers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-881-8008
Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Burbank, Basic Systems	213-938-2833
Cal	Los Altos, Wright Engrg.	415-941-4405
Colo	Boulder, R.A. Mayes Co.	303-444-0782
Conn	E. Hartford, Tekdata, Inc.	203-525-7647
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9767
Fla	Winterhaven, Lee Assocs.	813-294-5815
Ill	Des Plaines, Marsland Assocs.	312-298-2620
Ind	Indpls., Marsland Assocs.	317-924-3568
Md	Bethesda, Powell-Pendergraph Inc.	301-656-4535
Mass	Boston, Electronic Dev. Corp.	617-268-9696
Mich	Ferndale, Tiby Co.	313-547-3550
Minn	Mpls., Marsland Assocs.	612-545-4481
Mo	Florrissant, Marsland Assocs.	314-278-6949
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	E. Syracuse, Ossmann Instrs., Inc.	315-437-6666
NY	Great Neck, Powell-Pendergraph, Inc.	914-761-7792
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Cleveland, Tiby	216-371-5335
Ohio	Dayton, Tiby Co.	513-277-3822
Pa	Abington, Powell-Pendergraph, Inc.	215-657-0330
Tex	Dallas, R.A. Mayes Co.	214-235-3043
Tex	El Paso, R.A. Mayes Co.	Enterprise 750
Tex	Houston, R.A. Mayes Co.	713-468-8325
Utah	Salt Lake City, R.A. Mayes Co.	801-292-6781
Va	Richmond, Powell-Pendergraph, Inc.	703-264-2341
Wash	Bellevue, Topp Engrg.	206-747-5400
FOR:	Can., Mississauga, Ont., Webster Instr.	416-275-2270
FOR:	Can., Point Claire, Que., Webster Instr.	514-695-9787

ELCTRN. DEVICES, 21 Gray Oaks Ave., Yonkers, N.Y., 10710, Tel: 914-965-4400, TWX: 710-560-0021; Empl.: 200; Minimum order: $50

For info on price: D. Dean; Application info: J. D. Weiner; Customer service: M. Goldstein; Delivery info: D. Dean

Products manufactured: Bridges, Diodes, Multipliers, Rectifiers

Local Sales Offices & Reps.

Ariz	Scottsdale, Mercury Engrg. Sls.	602-945-1927

Cal	Conoja Park, Blazer Wolf	213-888-7432
Cal	Sunnyvale, RDX	408-734-4500
Colo	Denver, Walter Engrg.	303-777-5585
Fla	Light House Point, Saber Assoc.	305-943-3076
Fla	Orlando, Saber Assoc.	305-422-3686
Fla	St. Petersburg, Saber Assoc.	813-441-1301
Ga	Woodstock, Saber Assoc.	404-926-7660
Ill	Chicago, Berndt Assocs.	312-283-0713
Ill	Chicago, Rozner Sls.	312-283-0022
Kans	Overland Pk., Penzner-Mankus	913-DU 1-0004
Ky	Liberty, Depco	513-621-0162
Mass	Waltham, Betronic Assocs.	617-894-8400
Mich	Southfield, Rep Inc.	313-354-9066
Minn	St. Paul, Cahill Assocs.	612-739-8445
Mo	Hazelwood, Penzner-Mankus	314-731-4334
NY	Rochester, Electra Sls.	716-436-4030
NY	Syracuse, Electra Sls.	315-455-5783
NC	Raleigh-Durham, Saber Assoc.	919-787-9675
Ohio	Cleveland, Depco	216-289-8188
Ohio	Wadsworth, Depco	216-336-2600
Tex	Dallas, Dunbar Assocs.	214-239-7151
Wash	Seattle, F. Jackson & Co.	206-782-2211
EXP:	N.Y., Yonkers, Elctrn. Devices, N.Y.	914-965-4400
FOR:	Can., Montreal, Allied Elctrns.	514-488-5547

ELECTRONIC ENCLOSURES, Div. Wyle Labs, 225 South Aviation Blvd., El Segundo, Cal., 90245, Tel: 213-679-0181; Empl.: 150; Minimum order: $25

For info on price: A. Blinder; Application info: H. Sorey; Customer service: J. Gordon; Delivery info: D. Marlow

Products manufactured: Blowers & Fans & Accessories, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Racks, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	El Segundo, Elctrn. Enclosures	213-679-0181
Cal	San Jose, B. Belt	408-226-2611
Conn	Milford, Todino Engrg.	203-874-6643
Md	Rockville, Marktron	301-762-6210
Md	Timonium, Marktron, Inc.	301-252-7111
Mass	Needham, Todino Engrg.	617-444-7925
NJ	Pennsauken, Elctrn. Enclosures, Inc.	609-665-6810
NJ	Rockaway, D. Despins Elctrn. Enclosures	201-627-4276

ELECTRONIC ENGRG. CO. OF CAL., See EECO Elctrn. Engrg. Co. of Cal.

ELCTRN. ENTERPRISES, 65 7th Ave., Newark, N.J., 07104, Tel: 201-485-8500; FSC No: 97130; Empl.: 100; Minimum order: $25

For info on price: R. Dubin; Application info: H. C. Grunwald; Customer service: J. Torlucci; Delivery info: J. Torlucci

Products manufactured: Diodes, Heaters & Heating Elements, Modulators, All Kinds, Tubes

Local Sales Offices & Reps.

EXP:	N.Y., Westbury, Minthorne Int'l.	516-334-3303
FOR:	Can., Montreal, Que., Future Elctrns. Corp.	514-481-7701

ELECTRONIC HARDWARE CORP., Div. Hi-Tech Industries, Inc., 180-08 Liberty Ave., Jamaica, N.Y., 11433, Tel: 212-291-2710; Empl.: 100 .... p. 2•1081,1082

For info on price: H. Goodman; Application info: H. Goodman; Customer service: J. Quick; Delivery info: J. Quick

Free literature available: Catalog #MS70 - MS91528 Knobs, #68 - Knobs, #CS-1 - Knobs, #71 - Knobs.

Products manufactured: Dials, Handles For Cabinets, Circuit Boards, Racks, etc., Knobs

Local Sales Offices & Reps.

Cal	Los Altos, Schwerin Assoc.	415-941-3737
Cal	Orange, Current Prods. Sls.	714-633-7414
Colo	Denver, Electronic Sls.	303-771-6300
Fla	Miami Beach, Geartner Assoc.	305-861-3661
Fla	Orlando, Geartner Assoc.	305-299-1000
Ill	Chicago, Allen Woods & Assoc.	312-283-7400
Kans	Overland Park, Penzner-Mankus Assoc.	913-381-0004
Md	Pikesville, A. Wetterhahn Co.	301-484-6376
Mass	Waltham, Impact Sls. Co.	617-893-2850
Minn	Minneapolis, Betronics Sls. Co.	612-866-3035
NJ	Oaklyn, A. Wetterhahn Co.	609-858-3003
NJ	River Edge, Meg Sls.	201-265-9887
NY	Buffalo, Telesco Assoc.	716-834-1026
Ohio	Cincinnati, F.E. Kahsar Sls.	513-471-9011
Ohio	Hudson, F.E. Kahsar Sls.	216-653-6808
Pa	Philadelphia, A. Wetterhahn Co.	215-627-1535
Tex	Garland, G.V. Peck Co.	214-341-8311
Tex	Houston, G.V. Peck Co.	713-664-1435
Wash	Mercer Island, J.H. Andersen Assoc.	206-232-0484

ELCTRN. INSTR. & SPECIALTY, 42 Pleasant St., Stoneham, Mass., 02180, Tel: 617-438-5300; Empl.: 65; Minimum order: $25 .... p. 1•1660-1667

For info on price: W. K. Crawford; Application info: R. A. Painter; Customer service: W. K. Crawford; Delivery info: E. K. Rodham

Free literature available: Eight page catalog of wide spectrum of Reed Relays and data sheets on AC Solid State Relays.

Products manufactured: Converters, Relays

Local Sales Offices & Reps.

Cal	San Jose, Grosken Inc.	408-293-3108
Md	Woodbine, Naudain Assocs.	301-442-2270
Mass	Stoneham, Electronic Instr. & Specialty Corp.	617-438-5300
Mich	Birmingham, Forand Sls. Co.	313-644-0087
NJ	Mount Laurel, Naudain Assocs.	215-564-3194
NJ	Nutley, I. Brill	201-667-0653
Ohio	Cleveland, Buckeye Comps.	216-292-2889
Ohio	Dayton, Buckeye Comps.	513-278-4279
Tex	Houston, Texas Special Elctrn. Comps.	713-666-5871

Local Distributors

NJ	Clifton, Parts Masters, 411 Main Ave.	201-777-7706

ELECTRONIC MEASUREMENTS, 405 Essex Rd., Neptune, N.J., 07753, Tel: 201-922-9300, Telex: 132-424; Empl.: 70 .... p. 1•1187-1192

Products manufactured: Power Supplies

ELECTRONIC MEMORIES & MAGNETICS CORP., 12621 Chadron Ave., Hawthorne, Cal., 90250, Tel: 213-644-9881, TWX: 910-325-6213; Empl.: 7300

Products manufactured: Cores, Magnetic, Disc Packs, Magnetic, Integrated Circuit Devices, Memory Systems

Local Sales Offices & Reps.

Cal	Burlingame, EMM Corp.	415-692-4250
Cal	Los Angeles, EMM Corp.	213-477-3911
Colo	Littleton, Cropley Inc.	303-794-4231
Conn	Rocky Hill, EMM Corp.	203-529-7775
Fla	Ft. Lauderdale, Modemsplus, Inc.	305-587-3849
Ga	Atlanta, Modemsplus, Inc.	404-633-1212
Ill	Des Plaines, EMM Corp.	312-297-3110
Mass	Lexington, EMM Corp.	617-861-9650
Mich	Southfield, EMM Corp.	313-352-1040
Minn	Minneapolis, Datasery	612-546-4422
Mo	Clatton, EMM Corp.	314-863-0015
Neb	Omaha, Dataserv	402-551-4882
NJ	Saddle Brook, EMM Corp.	201-845-0450
NC	Charlotte, Modemsplus, Inc.	704-364-5158
Ohio	Cleveland, EMM Corp.	216-884-1980
Pa	Abington, EMM Corp.	215-887-4940
Pa	Pittsburgh, EMM Corp.	412-921-1221
Tenn	Nashville, Modemsplus, Inc.	615-868-1004
Tex	Dallas, EMM Corp.	214-243-2374
Tex	Houston, EMM Corp.	713-626-3592
Tex	McDade, EMM Corp.	918-366-8491
Utah	Salt Lake City, Cropley, Inc.	801-355-8321
Va	Annandale, EMM Corp.	703-941-2100
Wash	Seattle, EMM Corp.	206-623-1477

ELECTRONIC MODULES, INC., 2500 E. Foothill Blvd., Pasadena, Cal., 91107, Tel: 213-795-4231; Empl.: 15

Products manufactured: Amplifiers, Power Supplies, Regulators, Relays, Signal Conditioners & Equipment

ELCTRN. MOLDING CORP., 88 Mill St., Woonsocket, R.I., 02895, Tel: 401-769-3800, TWX: 710-387-1350; FSC No: 17117; Empl.: 100; Minimum order: $25 p. 2•676-679

For info on price: I. Dulude 401-769-3800; Application info: E. Boonstra 401-769-3800; Customer service: J. Bourassa 401-769-3800; Delivery info: I. Dulude 401-769-3800

Products manufactured: Backpanel Interconnect Systems, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Bushings, Glass, Plastic, Metal, Rubber, Etc., Chassis, Circuit Board Mounting, Clamps & Clips, Coils Including Assemblies & Forms, Connectors, Contacts, Electrical, Cords, Enclosures, Module, Plug-In, Fasteners, Feedthrus & Seals, Environmental, Handles For Cabinets, Circuit Boards, Racks, etc., Holders, Crystal, Integrated Circuit Packaging Systems, Jacks (All Types), Jumpers, Lamp Adapters, Packages, Integrated Circuit, Pads, Transistor Mounting, Panels, Pins, Plug Adapters, Posts, Probes, Racks, Services, Assembly, Production & Test, Socket Adapters, Sockets, Spacers, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Cal	San Diego, Qualtronics	714-560-8955
Cal	San Jose, K. Yerama	408-251-6900
NY	Plainview, B. Yellin	516-433-7669

ELECTRONIC NAVIGATION INDS., INC., 3000 Winton Rd. S., Rochester, N.Y., 14623, Tel: 716-473-6900, Telex: 97-8283; Empl.: 50 ......p. 1•674-676

For info on price: L. M. Salmen; Application info: L. M. Salmen; Customer service: L. M. Salmen; Delivery info: C. Cipro

Free literature available: We have an ENI catalog describing our complete line of Solid State, Broadband, Power Amplifiers & Power Multicouplers. Also includes technical data and design information on our RF Power Amplifiers and their application.

Products manufactured: Amplifiers, Attenuators, Generators, Meters, Oscillators, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices	205-536-1969
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Los Angeles, McDougall/McLaughlin Co.	213-477-8556
Cal	Portola Valley, Kipp Assocs.	415-851-0123
Colo	Denver, Williams Assocs.	303-373-4730
Fla	Ft. Lauderdale, Scientific Devices	305-721-4260
Fla	Orlando, Scientific Devices	305-841-8180
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Md	Silver Springs, Gawler Knoop Co.	301-589-4406
Mass	South Chelmsford, Independent Mktg. Reps.	617-256-8251
Mich	Ferndale, Tiby Co.	313-547-3550
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Greenvale, B.D. Aaron & Co.	516-621-0630
NY	Rochester, Elctrn. Navigation Ind's.	716-473-6900
NC	Burlington, Scientific Devices	919-228-6279
Ohio	Cleveland, Tiby Co.	216-371-5335
Ohio	Dayton, Tiby Co.	513-277-3822
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	Newtown Square, SWR Assocs.	215-356-8550
Tex	Austin, Data Mktg. Assocs.	512-451-5174
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Wash	Seattle, Underwood, Jensen & Assoc.	206-575-0123
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

ELCTRN. PRECISION COMPS. CORP., 11 W. Sandford Blvd., Mt. Vernon, N.Y., 10550, Tel: 914-664-2333; Empl.: 8; Minimum order: $25

For info on price: Patrica; Application info: D. Edwards; Customer service: Patrica; Delivery info: L. Brown

Free literature available: Literature on precision power resistors.

Products manufactured: Networks, Resistors, Shunts, Meter

Local Sales Offices & Reps.

NJ	Nutley, I. Brill	201-667-0653

ELECTRONIC RESEARCH CO., Div. Textron Inc., Box 913, Shawnee Mission, Kans., 66201, Tel: 913-631-6700, TWX: 910-749-6477; Empl.: 520; Minimum order: $35 .... p. 1•317,677-684

For info on price: B. Cook Ext. 46; Application info: B. Cook Ext. 46; Customer service: C. Hammond Ext. 62; Delivery info: B. Cook Ext. 46

Free literature available: Digital Instrument Product Index - Contains Abbreviated Specs, Prices, Options for 13 series of digital panel instruments including voltmeters, clocks, counters, timers, comparators, and stopwatches. Data Sheets - Complete Specs, Prices, Options on all instruments. Frequency Product Literature - Data Sheets, Design Sheets.

Products manufactured: Clocks (All Types), Comparators, Counters, Crystals, Current Sensors, Filters, Indicators, Meters, Oscillators, Preselectors, Synthesizers, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Digital instrument

Ala	Huntsville, Vesco	205-881-8830
Cal	Cupertino, T. L. Snitzer Co.	408-257-8333
Cal	Del Mar, T. L. Snitzer Co.	714-454-2191
Cal	Los Angeles, T. L. Snitzer Co.	213-836-6170
Colo	Littleton, Aztec Entrprs.	303-795-0250
Conn	Newton, Daner-Hayes, Inc.	
Fla	Orlando, Datarep, Inc.	305-843-5224
Fla	Pompano Beach, Datarep, Inc.	305-781-9279
Ind	Indianapolis, Couchman-Conant	317-849-9890
Kans	Baxter Springs, Production Automation Corp.	
Md	Rockville, Farrell Assoc.	301-424-9460
Mass	Newton Center, Daner-Hayes, Inc.	617-969-4650
Mass	Stoneham, Ken Corp.	617-438-5464
Mich	Royal Oak, Dave Ray & Assocs.	313-576-4705
Minn	Minneapolis, Production Automation Corp.	612-866-5700
Mo	Hazelwood, Production Automation Corp.	314-731-2331
Mo	Raytown, Production Automation Corp.	816-737-0066
NM	Albuquerque, J.S. Heaton Co.	505-293-3900
NY	Elbridge, L-Tron Corp.	315-689-3787
NY	Great Neck, Meas. Technology Inc.	516-482-3500
NY	Scottsville, L-Tron	716-436-4410
NY	Tonawanda, L-Tron	716-691-8887
NC	Winston Salem, Radco Co.	919-722-9671
Ohio	Aurora, EMA, Inc.	216-562-6104
Ohio	Centerville, EMA, Inc.	513-433-2800
Pa	Audubon, Daner-Hayes, Inc.	215-666-5005
Wash	Rush, S. Drake Assocs.	206-763-2755

Frequency product

Cal	Redwood City, J. S. Heaton Co.	415-369-4671
Colo	Denver, J. S. Heaton Co.	303-758-5130
Conn	New Canaan, S. Pierce Inc.	203-966-4630
Fla	Clearwater, Dyne-A-Mark Corp.	813-446-3229
Fla	Ft. Lauderdale, Dyne-A-Mark Corp.	305-771-6501
Fla	Orlando, Dyne-A-Mark Corp.	305-299-6303
Ill	Oak Brook, Whitmore Assocs.	312-325-4727
Ky	Ft. Mitchell, G. W. Thelen Co.	606-341-8181
Md	Silver Spring, Spectro Sys.	301-949-8261
Mass	Norwood, S. Pierce, Inc.	617-762-3164
Minn	Minneapolis, Nortec Sls. Inc.	612-835-7414
Mo	Hazelwood, Cen-Tech Sls.	314-731-4220
Mo	Raytown, Cen-Tech Sls.	816-358-8100
Mo	Springfield, Osbern Sls. Co.	417-887-1773
NJ	Riverdale, Comp Tech Sls.	201-935-5454
NM	Albuquerque, J. S. Heaton Co.	505-293-3900
NY	New Hyde Park, Comp-Tech Sls.	516-593-2628
Pa	Wyndmoor, Spectro Sys. Corp.	215-836-1545
Wash	Seattle, Blum & Assocs.	206-285-2590

ELCTRN. SEALS, 13766 Saticoy St., Van Nuys, Cal., 91402, Tel: 213-873-4982; FSC No: 12349; Empl.: 25; Minimum order: $75

Customer service: H. Adelman

Products manufactured: Connectors, Seals, Services, Assembly, Production & Test

ELECTRONIC SPECIALTY DIV., Datron Systems Inc., 18900 N.E. Sandy Blvd., Portland, Ore., 97220, Tel: 503-665-0121, TWX: 910-469-8782; QPL No: M5757; Minimum order: $35

For info on price: B. Sites; Application info: B. Hartman; Customer service: N. Pelham; Delivery info: N. Pelham

Products manufactured: Relays

Local Sales Offices & Reps.

Ala	Madison, B-C Elctrn. Sls.	205-837-5778
Ariz	Scottsdale, Goodreau Assocs.	602-994-9909
Cal	Los Angles, KCE Corp.	213-649-2622
Cal	Mountain View, Westrep	415-968-5800
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Colo	Denver, Cristee-Meade	303-753-9471
Conn	North Haven, Forsberg Sls.	203-239-5111
Fla	Seminole, Spartak Inc.	813-393-5402
Ga	, B-C Elctrn. Sls.	404-436-5169
Ill	Hinsdale, J.D. Allyn Co.	312-325-0495
Ind	Indianapolis, Berberich Assocs.	317-788-9221
Kans	Prairie Village, Engrg. Svc. Co.	913-649-4000
Md	Luthersville, L.D. Lowery	301-296-0379
Mass	Brockton Mass, Forsberg Sls.	617-522-6300
Mich	Walled Lake, Berberich Assoc.	313-624-2211
Minn	St. Paul, Countryman Assoc. Co.	612-645-9151
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NY	Smithtown, T.X. Sls.	516-979-8750
NY	Syracuse, C.W. Floring & Assoc.	315-478-2149
Ohio	Dayton, Berberich Assoc. Inc.	513-433-0342
Pa	Broomall, L.D. Lowery	215-356-5300
Pa	Harrisburg, L.D. Lowery	
Tex	Addison, R.R. Thomas Co.	214-233-8235
Va	Charlottesville, L.D. Lowery	804-973-6672
Va	Vinton, B-C Elctrn. Sls.	703-890-1128
Wash	Seattle, H.S. Thorpe	206-784-3333

ELECTRONIC SUPPORT SYSTEMS, 122 W. St. Charles Rd., Villa Park, Ill., 60181, Tel: 312-833-8277; Empl.: 20

Products manufactured: Boards, Printed Circuit

ELECTRONIC SYSTEMS & PROGRAMMING INC., 3355 W. El Segundo Blvd., Hawthorne, Cal., 90250, Tel: 213-973-0262; Empl.: 46; Minimum order: $25

For info on price: R. Potampa; Application info: K. F. Zimmermann; Customer service: H. F. Gainey; Delivery info: L. E. Oliver

Products manufactured: Jigs And Fixtures, Chassis & Circuit Board, Test Systems, Testers

Local Sales Offices & Reps.

Cal	Los Angeles, Burtis Instrumentation	213-887-1360
Tex	Houston, Ammon & Rizos	214-233-5591

ELECTRONIC TRANSFORMER CORP., 460 Totowa Ave., Paterson, N.J., 07509, Tel: 201-279-4445; FSC No: 72149; Empl.: 65

For info on price: M. Gorman; Application info: E. Bulwin; Customer service: A. Cezar; Delivery info: M. Haras

Products manufactured: Chokes, Coils Including Assemblies & Forms, Filters, Networks, Reactors, Transformers

Local Sales Offices & Reps.

NY	Bellmore, J. Anapol	516-826-2310
NY	Syracuse, Lenard Co.	315-479-9191
Ohio	Dayton, S. Tetelbaum	513-276-5808

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ELECTRONIC TRANSISTORS, 153-13 Northern Blvd., Flushing, N.Y., 11354, Tel: 212-539-6700, Telex: 960173; FSC No: 12045; Empl.: 45; Minimum order: $5

For info on price: M. Byrnes; Application info: M. Byrnes; Customer service: M. Byrnes; Delivery info: M. Lipton

Products manufactured: Diodes, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ill	Chicago, Weisz Assocs.	312-637-9117
Ohio	Dayton, L.S. Fedotin	513-275-9345
Ohio	St. Marys, Repp Co.	419-394-4724
EXP:	Westbury, N.Y., Minthorne Int. Co.	516-334-3303

ELECTRONICS ONE INC., 2166 Faulkner Rd. NE, Atlanta, Ga., 30324, Tel: 404-321-4960; Empl.: 7

Customer service: B.A. Bond Jr.

Products manufactured: Circuits, Printed, Multilayer, Services, Assembly, Production & Test, Testers, Timers

ELECTRONS CO., Unit of General Signal Corp., 65 Passaic Ave., Fairfield, N.J., 07006, Tel: 201-227-3830; FSC No: 80098; Empl.: 100

For info on price: D. J. Hall; Application info: E. Burns; Customer service: H. Benevento; Delivery info: N. Benevento

Free literature available: Industrial power tubes, Equipment Ground Fault Sensors; Telecommunications Surge Arrestors; Fire and Security Systems Thermal and Ionization detectors.

Products manufactured: Arresters, Electrical Surge, Lightning, Protectors, Spark Gaps, Tubes

Local Sales Offices & Reps.

Ala	Birmingham, Whitman Assoc.	205-252-3079
Cal	El Monte, Randolph Ind., Inc.	213-443-1701
Cal	San Francisco, Artwel Elec., Inc.	415-467-1880
Colo	Denver, Gaer Sls.	307-777-3740
Fla	Coconut Grove, Whitman Assoc.	305-856-6749
Fla	Gulf Breeze, Whitman Assoc.	904-932-5670
Fla	Jacksonville, Whitman Assoc.	904-354-5985
Fla	Tampa, Whitman Assoc.	813-877-6091
Ga	Atlanta, Whitman Assocs.	404-521-0977
Ill	Chicago, Weldy-Lamont Assoc., Inc.	312-777-8575
La	New Orleans, Rapco Assoc.	504-283-7321
Mass	Watertown, Northeast Mfrs. Assocs.	617-325-3252
Mich	Royal Oak, Continental Products Co.	313-546-4520
Miss	Jackson, Rapco Assoc.	601-969-3221
Mont	Missoula, Pacific Western Agencies	406-543-5296
NJ	Old Bridge, R. W. Duffy & Assocs.	201-251-6200
NY	Old Bridge, R. W. Duffy & Assoc.	201-251-6200
NY	Rochester, Canavan-Scanlon Assoc.	716-442-0720
NC	Charlotte, Norman Tindel Co.	704-334-4776
Ore	Portland, Pacific Western Agencies	503-228-7261
Pa	Pittsburgh, Brown Elec. Equip. Co.	412-563-4444
SC	Columbia, George W. Greene Agency	803-252-3032
Tenn	Knoxville, Whitman Assoc.	615-687-3578
Tex	Houston, J Edwards Co.	713-223-4731
Va	Richmond, Whitman Assoc.	703-266-3185
Va	Roanoke, Whitman Assoc.	703-774-6029
Va	Va. Beach, Whitman Assoc.	703-428-8717
Wash	Seattle, Pacific Western Agencies	206-623-3483
Wash	Spokane, Pacific Western Agencies	509-FA 6-4242
FOR:	Can., Streetsville, Ont., L & H Ents.	416-826-3828

ELECTROSTATICS INC., 7718 Clairemont Mesa Blvd., San Diego, Cal., 92111, Tel: 714-279-1414; FSC No: 34538; Empl.: 15; Minimum order: $30 ... p. 1•1184,1185

For info on price: Robert D. McCartney; Application info: Robert D. McCartney; Customer service: Edwin T. Foster; Delivery info: Edwin T. Foster

Free literature available: A catalog of low priced DC power supplies featuring single, dual, and triple models from 3 to 50 volts and 0.35 to 15A.

Products manufactured: Power Supplies

ELECTROTEC INC., 2837 Ladybird Ln., Dallas, Tex., 75220, Tel: 214-358-4221, TWX: 910-861-4123; Empl.: 32; Minimum order: $50

For info on price: W. Cloyd 214-358-4221; Application info: W. Cloyd 214-358-4221; Delivery info: D. Venable 214-358-4223

Free literature available: Microwave Integrated Circuit design parameters & assembly techniques for MIC users. Resistor Design design parameters for thin film resistor designers.

Products manufactured: Chemicals, Networks, Resistors

Local Sales Offices & Reps.

Cal	Burbank, Wright Engrg.	213-843-7240
Cal	Los Altos, Stout-Loeswick Inc.	415-948-3265
Mass	Lowell, Russell Engrg.	617-458-7146
Minn	Anoka, Magner & Assocs.	612-427-5550
NY	Bridgeport, Lightstone Corp.	315-699-5747
NY	Plainview, ERA	516-822-9890
Wisc	Milwaukee, MW Enterprises	414-352-9150

ELECTROVERT, 86 Hartford Ave., Mt. Vernon, N.Y., 10553, Tel: 914-664-6090, Telex: 1-37483; Empl.: 65; Minimum order: $50

Customer service: M. Lanoy

Free literature available: Wire cable harnesses, markers & accessories. Terminal blocks, strips & specialty types. Automatic soldering, fusing & tinning systems.

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Boards, Programming, Cable Assemblies & Harnesses, Clamps & Clips, Cleaners, Ultrasonic, Ducts, Wiring, Fasteners, Grommets, Holders, Circuit Board (Production Type), Machines/Machinery, Production, Solder Pots & Baths, Soldering Equipment, Strips, Terminal Blocks, Boards & Strips, Testers, Tubing, Wire & Cable Ties, Wire Markers

Local Sales Offices & Reps.

Ala	Huntsville, BJR Research Reps	205-881-1841
Ariz	Phoenix, Kay Ent.	602-242-6787
Ariz	Phoenix, Southwest Engrg.	602-933-0250
Cal	Burbank, Electrovert, Inc.	213-849-7833
Cal	Encino, CDH	213-345-3111
Cal	Glendale, Tooltronics, Inc.	213-240-4000
Cal	La Mirada, Dennis Don & Assoc.	714-523-5622
Cal	Santa Clara, Tooltronics	415-241-4000
Cal	Saratoga, Enterprise Engrg. Reps	408-255-7272
Colo	Boulder, Mile High Elctrns.	303-444-5615
Colo	Denver, B. T. Clark Inc.	303-936-4844
Fla	Clearwater, H. R. Gross & Co.	813-446-6649
Fla	Maitland, Rowe Engrg. Sls.	305-834-2700
Ga	Atlanta, Electrovert	404-451-9366
Ill	Chicago, Cumming & Foley Sls. Co.	312-725-8110
Ill	Chicago, EMF Co.	312-889-8323
Ill	Northlake, Electrovert, Inc.	312-562-1700
Ind	Carmel, Central States Machinery Co.	317-844-0178
Ind	Indianapolis, Dick Bennet Sls.	317-786-0196
Ind	Indianapolis, Marketing Engrgs.	317-546-1523
Kans	Prairie Village, Engrg. Serv. Co.	913-649-4000
Md	Silver Springs, ARA Elctrns.	301-565-2444
Mass	Newtonville, Edcom, Inc.	617-969-9710
Mass	Norwood, JMG, Inc.	617-762-5333
Mich	Grosse Point Park, J. L. Miner Assoc.	313-886-5878
Mich	Southfield, M. A. Percival Co.	313-356-5710
Minn	Minneapolis, Servco	612-941-7151
Minn	St. Paul, Countryman Assoc. Co.	612-645-9151
Mo	Raytown, Marty Taraski	816-358-4590
Mo	St. Louis, Engrg. Svc. Co.	314-997-1515
NJ	Hohokus, H. M. Linter & Son	201-445-2905
NJ	Livingston, Argo Engrg. Co.	201-992-4367
NY	Guiderland, Solder Pot	518-355-1829
NY	Plainview, R. Smith Assoc.	516-681-3155
NY	Rochester, L-Mar Assocs.	716-328-5240
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cincinnati, Nelcor	513-871-2816
Ohio	Cleveland, J. B. Clough Co.	216-431-2700
Ohio	Cleveland, K. R. Dodge	216-461-6482
Ore	Portland, Vandy Corp.	503-297-1900
Pa	Enon Valley, NEBco Assoc.	412-457-2333
Pa	Glenside, ARA Elctrns. Inc.	215-887-5250
Pa	Narberth, S. A. Jeffries, Inc.	215-664-8500
Pa	Reading, Beil & Whitaker	215-779-2610
Tenn	Memphis, Strickland Assoc.	901-332-6578
Tex	Dallas, J. Tuite Co.	214-381-2103
Tex	Irving, Electrovert, Inc.	214-255-1516
Tex	Irving, Tooltronics	214-251-2239
Tex	Richardson, P. J. Scanlon Co.	214-231-4661
Wash	Seattle, Electrical Agents NW Inc.	206-762-3314
Wash	Seattle, Vandy Corp.	206-789-3300
FOR:	Can., Montreal, Electrovert, Mfg.	514-488-2521

ELEXON POWER SYS., Div. Elpac Inc., 3131 S. Standard Ave., Santa Ana, Cal., 92705, Tel: 714-979-4440; Empl.: 160

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, BJR Mftg. Reps.	205-881-3569
Ariz	Phoenix, J.S. Heaton Co., Inc.	602-264-7887
Cal	Redwood City, J.S. Heaton Co., Inc.	415-369-4671
Colo	Denver, J.S. Heaton Co., Inc.	303-758-5130
Fla	Ft. Lauderdale, CBC Elctrns.	305-484-7330
Fla	Melbourne, Reynolds & Assoc. Inc.	305-727-3205
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ill	Chicago, Balhorn & Welch	312-889-5011
Ill	Oak Park, E. Schmeichel Co.	312-378-2070
Ind	Indianapolis, France Entprs.	317-894-0593
Iowa	Cedar Rapids, J. Vrbik Co.	319-377-8244
Kans	Shawnee Mission, K & M Sls Co.	913-262-1444
Md	Baltimore, Component Sls., Inc.	301-484-3647
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mass	Needham Heights, Todino Eng. Sls., Inc.	617-444-7925
Mich	Dearborn, Villani-Pitcher, Inc.	313-271-4600
Minn	St. Paul, L. Cahill & Assoc. Inc.	612-646-7217
NJ	Mt. Laurel, Naudian Assoc.	215-564-3194
NM	Albuquerque, J. S. Heaton Co.	505-293-3900
NY	New York, P. Saftler Assoc., Inc.	16-593-7880
NC	Raleigh, Component Sls., Inc.	919-782-8433
Ohio	Cincinnati, F. J. Campisano Co.	513-662-1616
Ohio	Medina, J.C. Hoffstetter Co.	216-241-4880
Okla	Tulsa, H. J. Daly Co.	918-627-4159
Pa	Doylestown, T.O.E. Sls. Inc.	215-348-2212
Tex	Dallas, Hillman Entprs.	214-827-4790
Wash	Bellevue, Testco	206-454-7422
FOR:	Can., Downsview, Ont., Cantronics Ltd.	416-661-2494

ELFAB CORP., 762 Wiley Post Rd., Addison, Tex., 75001, Tel: 214-233-3033, TWX: 910-860-5460; Empl.: 150; Minimum order: $50 .... p. 2•680,681

For info on price: B. Treece; Application info: J. Scaminaci, Jr.; Customer service: B. Treece; Delivery info: B. Treece

Free literature available: Literature on: Printed circuit connector backpanel assemblies.

Products manufactured: Backpanel Interconnect Systems, Boards, Printed Circuit, Connectors, Terminals

Local Sales Offices & Reps.

Ariz	Tempe, Delta Elctrns.	602-966-9903
Cal	Freemont, H.K. Foraker	415-657-2213
Cal	Woodland Hills, Elfab Corp.	213-883-7606
Colo	Boulder, Component Prods.	303-444-2730
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Glendale Hgts., Trend-Tronics	312-963-2210
Kans	Prairie Village, R. S. Sls., Inc.	913-381-8812
Md	Rockville, Mechtronics ~~Sls.~~	301-340-2130
Mich	Dearborn Hts., Ankofski Sls. Co.	313-565-6330
Minn	Minneapolis, Components Group	612-824-4222
NJ	Paramus, Win Cor Elctrn. Sls.	201-967-0242
NY	Cooperstown, A. Fitzelle Assocs.	607-547-9333
NY	Manhasset, Win-Cor Elctrn. Sls.	516-627-9474
Ohio	Dayton, Myers Assocs.	513-435-1309
Okla	Oklahoma City, Ammon & Rizos Co.	405-373-2748
Pa	Philadelphia, R.P. Luce & Co.	215-884-8365
Tex	Dallas, Ammon & Rizos Co.	214-233-5591
Tex	Houston, Ammon & Rizos Co.	713-781-6240
Wash	Tukwila, General Elctrns, Inc.	206-243-5141
FOR:	Can., Ottawa, OnT., Orion Electrns.	613-521-2739

ELGAR CORPORATION, 8225 Mercury Ct., San Diego, Cal., 92111, Tel: 714-565-1155, TWX: 910-335-1246; FSC No: 25965; Empl.: 85; Minimum order: $25 p. 1•1197-1199

For info on price: W. E. Foy Ext. 19; Application info: W. E. Foy Ext. 19; Customer service: Samuel A. Lewis, Ext. 41; Delivery info: W. E. Foy, Ext. 19

Free literature available: General Catalog (describes AC Power Sources & AC Line Conditioners), UPS Brochure (describes UPS models through 15 KVA), Inverter Data Sheets.

Products manufactured: Amplifiers, Converters, Inverters, Isolators, Oscillators, Power Supplies, Regulators, Suppressors, Testers

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Scottsdale, Barnhill Three, Inc.	602-947-7841
Cal	La Jolla, Ward/Davis Assocs.	714-459-3351
Cal	Lawndale, Ward/Davis Assocs.	213-452-7740
Cal	Sunnyvale, Ward/Davis Assocs.	408-245-3700
Colo	Denver, Barnhill Three, Inc.	303-750-1222
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Conn	New Canaan, McLellan Assocs.	203-966-2580
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Des Plaines, Cozzens & Cudahy, Inc.	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy, Inc.	317-244-2456
Md	Kensington, Electronic Mktg. Assocs.	301-881-5300
Mass	Holbrook, McLellan Assocs.	617-767-4771
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Cozzens & Cudahy, Inc.	612-884-4336
Mo	Edmundson, Cozzens & Cudahy, Inc.	314-423-1234
Mo	Kansas City, Cozzens & Cudahy, Inc.	816-454-5836
NM	Albuquerque, Barnhill Three, Inc.	505-299-7658
NY	Great Neck, Measurement Tech. Inc.	516-482-3500
NY	Pleasantville, SBM Representatives	914-769-1811
NY	Rochester, SBM Representatives	716-266-1400
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Pa	King of Prussia, Electronic Mktg. Assocs.	215-265-1600
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Houston, Barnhill Two, Inc.	713-688-9971
Tex	Richardson, Barnhiill Two, Inc.	214-231-2573
Wash	Seattle, SJI Corp.	206-624-9020
EXP:	San Diego, Cal., Elgar Intern'l. Corp.	714-565-1155

ELGENCO, INC., 1550 Euclid, Santa Monica, Cal., 90404, Tel: 213-451-1635; FSC No: 15455; Minimum order: $10 .... p. 1•685-690

Customer service: D. Cusworth

Products manufactured: Analyzers, Cards, Linear Function, Generators, Power Supplies

Local Sales Offices & Reps.

Cal	Sherman Oaks, Windsor Dynamics, Inc.	213-989-3631
Cal	Woodside, Windsor Dynamics, Inc.	415-854-4870
Conn	Glastonbury, Instrs. Reps.	203-633-0777
Mass	Lexington, Instr. Reps., Inc.	617-861-8620
NM	Albuquerque, Technology Mktg. Assoc.	505-298-4321
NY	Great Neck, Harvey J. Krasner Assoc.	516-487-0690
Pa	Newtown Square, Holdsworth & Co.	215-EL6-8550

ELGIN ELCTRNS., INC., Sub. Basic, Inc., Walnut St., Waterford, PA., 16441, Tel: 814-796-2601, TWX: 510-699-6659; Empl.: 600; Minimum order: $50

For info on price: G. Egelston; Application info: J. Seppala; Customer service: R. Borgia; Delivery info: R. Borgia

Products manufactured: Boards, Printed Circuit, Chargers, Battery, Eliminators, Battery, Generators, Power Supplies, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg., Inc.	205-772-9237
Cal	Los Alamitos, Anderson Assoc.	213-596-2313
Cal	Mountain View, Microwave Mktg. Assoc.	415-969-3355
Conn	Wilton, Elgin Electronics	203-762-7012
Fla	Eau Gallie, W. Bitter	305-254-3674
Haw	Honolulu, Communicators Inc.	
Ill	Woodridge, Elgin Electronics	312-964-4474
Mass	Concord, Elgin Electronics	617-369-3051
Mich	Rochester, K. Mor Assoc.	313-651-1890
Mont	Lakeside, W.J. McDougall	
PA	Waterford, Elgin Electronics	814-796-2601
Tex	Dallas, Utility Mktg. & Devel.	214-661-3284
Va	Fairfax, Tom Davis Mkts.	703-591-7390
Wash	Seattle, Del Com Sls. Co.	206-248-0900
EXP:	Can., Scarborough, Ont., R-O-R Assoc., Ltd.	416-291-7121

ELIN DIV., California Instrs. Co., Div. of Aiken Ind., 5150 Convoy St., San Diego, Cal., 92111, Tel: 714-279-8620; FSC No: 16067; Empl.: 80; Minimum order: $25

For info on price: W. W. Hanford; Application info: W. W. Hanford; Customer service: D. Chilcoat; Delivery info: W. W. Hanford

Free literature available: Cimron® Digital Multimeter Selection Guide Invertron® AC power source short form catalog.

Products manufactured: Amplifiers, Converters, Generators, Isolators, Power Supplies, Protectors, Regulators, Suppressors, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Ariz	Scottsdale, Williams Associates, Inc.	602-947-4297
Cal	Cupertino, T. Louis Snitzer Co.	408-257-8333
Cal	Los Angeles, T. Louis Snitzer Co.	213-836-6170
Colo	Denver, Williams Associates, Inc.	303-373-4730
Fla	Orlando, FM Assoc.	305-851-5710
Fla	Tequesta, FM Assoc.	305-746-3128
Haw	Honolulu, Aloha Associates	808-941-1574
Ill	Chicago, Sea	312-282-6694
Ind	Carmel, Sea	317-846-2593
Iowa	Cedar Rapids, Palatine Engrg. Sls. Co.	319-365-8071
Kans	Andover, Palatine Engrg. Sls. Co.	316-683-7512
Kans	Overland Pk., Palatine Engrg. Sls. Co.	913-262-5643
La	Baton Rouge, SESCO	504-927-7574
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Waytek	612-933-2133
Mo	St. Louis, Palatine Engrg. Sls. Co.	314-426-7055
NM	Albuquerque, Williams Associates, Inc.	505-255-1638
NY	Great Neck, Eastern Instr. of N.Y.	516-466-9505
NY	North Syracuse, NACO Elctrns.	315-699-2651
NC	Greensboro, FM Assoc.	919-294-2754

Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Philadelphia, Eastern Instr. of Phil.	215-927-7777
Tex	Houston, SESCO	713-668-7840
Tex	Richardson, SESCO	214-231-9364
Wash	Seattle, Data Com Assoc.	206-285-2525

ELMA ENGINEERING, 1066 E. Meadow Circle, Palo Alto, Cal., 94303, Tel: 415-494-7303, Telex: 345-560; Empl.: 50; Minimum order: $25

For info on price: J. E. Frederick; Application info: K. W. Widl; Customer service: W. Bougher; Delivery info: G. Albert

Products manufactured: Analyzers, Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Heaters & Heating Elements, Magnets, Power Supplies, Reactors, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Montgomery Bros.	602-253-3431
Cal	Laguna Beach, Marchi-Barus Assocs.	714-497-1815
Cal	Redwood City, Marchi Assocs.	415-364-3411
Colo	Denver, Montgomery Bros.	303-759-2749
Conn	Woodstock, Godfrey & Assocs.	203-928-0332
Minn	Minneapolis, I. T. Dahl Co.	612-926-4823
NJ	Paterson, Long, Poveromo & Assocs.	201-785-2492
NY	Rochester, H.C. Johnson Agencies	716-482-3000
Ohio	Cleveland, Allied Ents.	216-234-3838
Pa	St. Davids, R. Schadler Co.	215-687-5650
Tenn	Memphis, Engineered Instrs.	901-324-3871
Tex	Arlington, Davis-Dawson Co.	817-265-6426
Utah	Salt Lake City, Montgomery Bros.	801-363-3555

ELMAG CORP., 54 Clark St., Newark, N.J., 07104, Tel: 201-481-1600; FSC No: 23160; Empl.: 25; Minimum order: $50

For info on price: I. Black; Application info: F. Senft; Customer service: I. Black; Delivery info: I. Black

Products manufactured: Capacitors, Fixed, Filters

Local Sales Offices & Reps.

NJ	Hillsdale, Martin Klein Assoc.	201-664-8711
NY	E. Rockaway, Wm. Bellenkes Assoc.	516-887-1443
Ohio	Dayton, Irving Atkind Assoc.	513-837-4750
Pa	Narbeth, Samuel A. Jeffries	215-664-8500

EL-MENCO-, See Electro Motive Corp.

ELMWOOD SENSORS, INC., 1655 Elmwood Ave., Cranston, RI, 02907, Tel: 401-781-6500, TWX: 710-381-6413; Empl.: 400; Minimum order: $100

p. 1•1682,2308

For info on price: S. Hecht; Application info: S. Hecht; Customer service: A. Emerson; Delivery info: A. Emerson

Products manufactured: Controls/Control Eqpt., Relays, Switches, Thermometers, Resistance

Local Sales Offices & Reps.

Ala	Decatur, Tenn. Tech. Sls.	205-350-0630
Ark	Hot Springs, M. Young Assocs.	501-262-1365
Cal	Palo Alto, O'Donnell	415-327-3583
Cal	Torrance, O'Donnell	213-323-9243
Colo	Denver, P.A. Douden Co.	303-744-1497
Conn	Cheshire, G. Forman Co.	203-272-8509
Fla	Maitland, D & E Assocs.	305-644-3039
Ga	Marietta, K & E Asso.	404-427-0241
Ill	Hoffman Estates, Tech. Reps.	312-882-1414
Ind	Marion, O. Bromberg	317-664-5384
Iowa	Cedar Rapids, J.G. Twist Co.	310-393-8703
Ky	Louisville, O. Bromberg	502-245-8916
Mich	Farmington, Davis & Martensen	313-474-8300
Minn	Mpls., C. Listug Sls.	612-537-6740
Mo	St. Louis, E.J. Hill Co.	314-621-1818
NH	Durham, G. Forman	603-868-2282
NJ	Pitman, Colrud Co.	609-589-5866
NY	Binghamton, Canavan-Scanlon	607-724-7220
NY	Buffalo, Canavan-Scanlon	716-839-3373
NY	Larchmont, G.M. Moch Co.	914-834-3530
NY	Latham, L-Tron Corp.	518-785-5032
NY	Rochester, Canavan-Scanlon	716-442-0720
NY	Syracuse, Canavan-Scanlon	315-437-1271
Ohio	Cincinnati, O. Bromberg	513-771-9333
Ohio	Cleveland, Allied Entprs.	216-234-3838
Pa	Pittsburg, Allied Entprs.	216-234-3838
RI	Edgewood, G.H. Forman	401-781-1230
Tex	Fort Worth, T.J. Small Co.	817-332-6352
Va	Lynchburg, Royelec Sls. Assocs.	703-846-7117
Wash	Federal Way, Temco Northwest	206-838-0588
Wisc	Milwaukee, R. Zingler	414-964-8120

ELPA MARKETING IND., Thorens & Atlantic Ave., Garden City Park, NY, 11040, Tel: 516-746-3002

ELPOWER CORP., 2117 S. Anne St., Santa Ana, Cal., 92704, Tel: 714-540-6155, TWX: 910-595-1934; Empl.: 129

Customer service: J. Dunn

Free literature available: Complete catalogue with price sheet, discharge curves, other application data.

Products manufactured: Batteries, Chargers, Battery

Local Sales Offices & Reps.

Cal	Inglewood, Ungar Sls. Assocs.	213-678-5371
Cal	Oakland, Moulthrop Sls., Inc.	415-261-7676
Colo	Denver, K.C. Mkts.	303-733-5561
Fla	Orlando, Cartwright & Bean Inc.	305-896-2031
Fla	Plantation, Cartwright & Bean Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean Inc.	404-237-2273
Ill	Chicago, G. McL. Cole Co.	312-774-3535
La	Chalmette, Cartwright & Bean Inc.	504-279-4598
Mass	Newtonville, C. Segel Co.	617-969-6900
Mich	St. Clair Shores, J. Thorpe Co.	313-779-6363
Minn	Minneapolis, Heimann Co.	612-861-6051
Miss	Jackson, Cartwright & Bean Inc.	601-354-1368
Mo	Kansas, KSW Assocs.	816-363-5651
NJ	Cherry Hill, Trinkle Sls., Inc.	609-667-3500
NJ	East Orange, Masin-Esco, Inc.	201-674-6505
NY	Syosset, Masin-Esco, Inc.	516-364-0310
NY	Syracuse, Mar-Com Assocs.	315-437-2843
NC	Charlotte, Cartwright & Bean Inc.	704-333-6457
NC	Raleigh, Cartwright & Bean Inc.	919-832-7128
Ohio	Columbus, McFadden Sls., Inc.	614-221-3363
Tenn	Knoxville, Cartwright & Bean Inc.	615-693-7450
Tenn	Memphis, Cartwright & Bean Inc.	901-276-4442
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Wash	Seattle, R. Johnston Co.	206-524-5170

ELSYTEC, INC., 212 Michael Dr., Syosset, N.Y., 11791, Tel: 516-364-0560; Empl.: 25

Products manufactured: Analyzers

ELTEC INSTRUMENTS INC., Central Ind'l. Pk., Daytona Beach, Fla., 32014, Tel: 904-252-0411

For info on price: M. A. Cleaver; Application info: F. H. Oettel; Customer service: M. A. Cleaver; Delivery info: M. A. Cleaver

Products manufactured: Feedthrus & Seals, Environmental, Impedance Converters, Microwave, Meters, Resistors

ECM MOTOR CO., 1301 E. Tower Rd., Schaumburg, Ill., 60172, Tel: 312-885-4000; Empl.: 250

Customer service: E. Spence

Free literature available: Gear motor brochure providing mechanical & electrical specifications for unidirectional & reversible AC & DC motors, plus information sheets on universal & synchronous motors.

Products manufactured: Motors

Local Sales Offices & Reps.

Ark	Little Rock, Ind'l. Sls. Co.	501-562-5852
Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700
Conn	Thomaston, NBC	203-283-5959
Fla	Maitland, Hutto, Hawkins, Peregoy, Inc.	305-831-2474
Fla	Pompano Beach, Hutto, Hawkins, Peregoy, Inc.	305-943-9593
Ill	Chicago, M. Gottlieb Assoc.	312-775-1151
Ind	Ft. Wayne, J & B Engrg. Sls. Co.	219-483-2813
Ind	Indianapolis, M. Gottlieb Assoc.	317-846-5788
Ky	Nicholasville, W.H. Mathews	606-885-5047
La	New Orleans, Warriner Controls	504-861-4571
Md	Silver Spring, H.R. Sieber Co.	301-589-9110
Mass	Auburn, NBS	617-757-3131
Mich	Detroit, Nicón Assoc.	313-341-7688
Minn	Minneapolis, Applied Sls. Engrg.	612-544-3308
Mo	Kansas City, L.T. Silver	816-531-1144
Mo	St. Louis, Wells-White Co.	314-726-2511
NJ	Fort Lee, Sydney-Justin Assocs.	201-947-4371
NY	Rochester, Electra Sls. Corp.	716-436-4030
NY	Syracuse, Electra Sls. Corp.	315-455-5783
Ohio	Cincinnati, J. O. Olsen Co.	513-922-2176
Ohio	Cleveland, J. O. Olsen Co.	216-752-5444
Okla	Tulsa, T.J. Ray Co.	918-627-1515
Pa	Broomall, J. C. Whiddett Co.	215-353-6343
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Tenn	Bristol, Remco	615-968-4195
Tex	Dallas, Titan Reps Inc.	214-661-5350
Wash	Bellevue, Hays Indl. Sls.	206-883-8888
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529

EMCO HIGH VOLTAGE, 2444 Old Middlefield Way, Mt. View, Cal., 94086, Tel: 415-969-3056; Empl.: 10; Minimum order: $100

Customer service: W. F. Doherty

Free literature available: General Catalog

Products manufactured: Converters, Power Supplies

EMCON DIV., Illinois Tool Works Inc., 11620 Sorrento Valley :Rd., Box 85142, San Diego, Cal., 92138, Tel: 714-459-4355, TWX: 910-322-1130

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Cal	Irvine, Emcon Regional Office	714-833-9286
Cal	Mt. View, G.C. Woempner Co.	415-964-5454
Cal	San Diego, Emcon Home Office	714-459-4355
Colo	Denver, Camel Elctrns.	303-757-6191
Fla	Altomonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-447-2533
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Chicago, Emcon Regional Office	312-282-7383
Ind	Indianapolis, Emcon Regional Office	317-255-9658
Mass	Burlington, Emcon Regional Office	617-273-0365
Mich	Benton Harbor, R.C. Nordstrom Co.	616-857-4653
Mich	Lathrup Village, R.C. Nordstrom Co.	313-559-7373
Minn	St. Paul, Murnco	612-484-8200
NY	Elmont, F.E. Schmitt Co.	516-437-8150
NY	Liverpool, L-Mar Assocs.	315-457-2329
NY	Rochester, L-Mar Assocs.	716-328-5240
NY	Vestal, L-Mar Assocs.	607-729-6339
Ohio	Columbus, Rockford Controls	614-231-5890
Ohio	Dayton, Rockford Controls	513-278-7362
Ohio	Euclid, Rockford Controls	216-731-5250
Pa	Erie, Ecco Elctrns.	814-455-8110
Tenn	Memphis, Emcon Regional Office	901-386-7252
Tex	Houston, R.F. Kimball Co.	800-294-2805
Tex	Richardson, R.F. Kimball Co.	214-231-3447
Utah	Salt Lake City, Camel Elctrns.	801-355-6181
Wash	Seattle, Nemco	
EXP:	Chicago, Ill., Illinois Tool Works Inc.	312-693-3040
FOR:	Can., Montreal, Que., H.W. Brieger Sls.	514-482-0722

Local Distributors

Cal	Los Angeles, RPS Elctrns., 1501 S. Hill St.	213-748-1271
Cal	Sunnyvale, Acacia Sls., 384 San Aleso Ave.	408-735-0100
NY	Elmont, F. E. Schmitt Co., 311 Meacham Ave.	516-437-8150

EMERGENCY BEACON CORP., 15 River Street, New Rochelle, N.Y., 10801, Tel: 914-235-9400; Empl.: 56

For info on price: J. DeLorenzo; Application info: R. Scappatura; Customer service: R. Scappatura; Delivery info: J. DeLorenzo

Products manufactured: Alarms, Amplifiers, Antennas, Comm. Systems, Filters, Handsets, Chestsets, Headphones, Headsets, Etc., Meters, Receivers, Transmitters

EMERSON & CUMING, INC., Dielectric Mat'ls. Div., 869 Washington St., Canton, Mass., 02021, Tel: 617-828-3300, TWX: 710-348-1324; Empl.: 252

For info on price: E. DiCastro; Application info: R. Wittemaur; Customer service: R. Wittemaur; Delivery info: E. DiCastro

Free literature available: Stycast Brochure - casting resins; Eccobond Brochure - adhesives; Eccocoat Brochure - coatings; Eccosil Brochure - silicones; Eccofoam Brochure - dielectric foams; Eccomold Brochure - transfer molding epoxies;

Eccosorb Brochure - microwave absorbers; Eccoshield Brochure - microwave r.f. shielding; Eccospheres Brochure - hollow glass spheres.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Containers, Gaskets, Shielding, R-F-Also See Shields, R-F, Interferometer Systems, Kits, Shielding, Loads, Electronic Variable, Rubber, Seals, Shields, Tubing

Local Sales Offices & Reps.

Cal	Gardena, Emerson & Cuming, Inc.	213-321-6650
Fla	Cocoa Beach, DBM Research Corp.	305-783-2438
Ill	Northbrook, Emerson & Cuming, Inc.	312-272-6700
Md	Silver Spring, Emerson & Cuming, Inc.	301-949-2777
NY	Kings Park, Emerson & Cuming, Inc.	516-724-5216

Pa	Philadelphia, Emerson & Cuming, Inc.	215-848-2040
Tex	Richardson, Emerson & Cuming, Inc.	214-235-7394
Wash	Seattle, Minor B. Brown & Assoc.	206-932-5855

EMERSON, INDUSTRIAL CONTROLS DIV., 3300 Standard St., Santa Ana, Cal., 92702, Tel: 714-545-5581; Empl.: 400

For info on price: L. J. Boutin; Application info: L. J. Boutin; Customer service: H. Greene; Delivery info: H. Greene

Products manufactured: Controls/Control Eqpt., Power Supplies, Recorders

EMI GENCOM INC., 80 Express St., Plainview, N.Y., 11803, Tel: 516-433-5900, TWX: 510-221-1889; Empl.: 13

Customer service: L. M. Lieberman

Free literature available: General catalog with supplement and revised data sheets. Also, new accessories catalog and reprints of published technical papers, on request.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Diodes, Dividers, Gages, Generators, Meters, Photomultiplier Tube Housings, Power Supplies, Sensors, Light, Tubes

Local Sales Offices & Reps.

Ariz	Scottsdale, PLS Assocs.	602-957-9110
Cal	N. Hollywood, O'Halloran Assocs.	213-877-0173
Cal	Palo Alto, O'Halloran Assocs.	415-326-1493
Colo	Denver, PLS Assocs.	303-771-0140
Fla	Orange Park, Pulcir	904-264-7615
Ill	Chicago, Carter Elctrns.	312-585-5485
Ill	Chicago, Pivan Engrg.	312-539-4838
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Shawnee, Pivan Engrg.	913-722-1030
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Peirce	616-349-9666
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	St. Louis, Pivan Engrg.	314-567-3636
NJ	East Orange, Friedman Assocs.	201-673-2500
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	Fayetteville, M.P. Andrews	315-637-3144
Ohio	Cleveland, Carter, McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Elkins Park, Snow Assocs.	215-379-4700
Pa	Pittsburgh, Carter, McCormic & Peirce	412-824-3760
Tenn	Knoxville, Pulcir	615-693-3641
Tex	Dallas, Southwestern Eng. & Equip. Co.	214-826-6661
Tex	Houston, Southwestern Eng. & Equip. Co.	713-353-4333
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

EMPORIUM SPECIALTIES CO., INC., Box 65, Austin, Pa., 16720, Tel: 814-647-8661; Empl.: 150

For info on price: W. G. Munsell; Application info: D. English; Customer service: T. Lepold; Delivery info: W. G. Munsell

Products manufactured: Bearings, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cams, Connectors, Forms, Wire, Services, Assembly, Production & Test, Terminals, Tools, Wrenches

Local Sales Offices & Reps.

Ariz	Scottsdale, C.T. Fink & Assocs.	602-947-7981
Cal	Burbank, H.N. Petersen Sls. Co.	213-848-7091
Cal	Lynwood, D. West & Assocs.	213-636-6124
Cal	Oakland, MHR Sls. Agency	415-569-1564
Conn	Woodbury, Hart, Nininger & Campbell	203-263-4321
Fla	Lighthouse Point, E. Whalen	305-781-6996
Ill	Chicago, K.D. Engle Co.	312-539-1820
Ind	Indianapolis, T. Tuohy	317-356-3001
Md	Ellicott City, Special Prods.	301-465-5922
Mass	Gloucester, P. Hart	617-281-0679
Mich	St. Claire Shores, L. Donlon	313-775-6496
Minn	Anoka, Magner & Assocs.	612-427-5550
NJ	Montvale, H. Herzing	201-573-0967
NJ	Riverton, Given Assocs.	609-829-7249
NY	New York, A. Oppenheim	212-683-1093
NY	Roslyn Heights, R. Binder	516-621-8279
NY	Tonawanda, N.A. Throm & Assocs.	716-693-4468
NC	Charlotte, S.M. Clarke	704-376-8262
Ohio	Chagrin Falls, Bray Assocs.	216-247-4474
Ohio	Cleveland, G.F. Sindelar Co.	216-333-9945
Tex	Richardson, C.J. Garvey Co.	214-234-3371
Wisc	Wauwatosa, C. Garny	414-475-9290

EMPRO MFG. CO., INC., Box 26064, 10920 E. 59th St., Indianapolis, Ind., 46226, Tel: 317-823-4478; Empl.: 25; Minimum order: $10 .... p. 1•692,693

Free literature available: CATALOG 72 Full line catalog of Empro standard model DC ammeter shunts. Includes photographs and drawings of ten types, with dimensions of 177 different models. Six pages. BULLETIN 72A One page bulletin on the Empro DC ammeter shunt Model LAB for laboratory use. BULLETIN CM One page Empro bulletin showing examples of custom made DC ammeter shunts.

Products manufactured: Shunts, Meter

Local Sales Offices & Reps.

Ga	Atlanta, Brownell Electro Inc.	404-762-5181
Ill	Chicago, A & M Inst. Inc.	312-774-3500
Ill	LaGrange, Penn Engrg.	312-352-1037
Mass	Burlington, Mancib Co.	617-272-9450
NY	Flushing, D.F. Tobias & Co.	212-545-9191
Ohio	Cleveland, Weschler Elec. Corp.	216-251-4609
Pa	Philadelphia, Sunshine Scientific Inst.	215-673-5600

EMR TELEMETRY, Weston Instrument Co., Box 3041, Sarasota, Fla., 33578, Tel: 813-371-0811, TWX: 810-864-0406; Empl.: 525; Minimum order: $25

Free literature available: Condensed catalog plus individual spec. sheets for any product listed therein.

Products manufactured: Analyzers, Calibrators, Comm. Systems, Converters, Decommutators, Telemetering, Discriminators, Filters, Multiplexers, Oscillators, Transmitters

Local Sales Offices & Reps.

Cal	Cupertino, EMR-Telemetry	408-257-1813
Cal	Lancaster, EMR-Telemetry	805-948-7614
Cal	Playa Del Rey, EMR-Telemetry	213-821-8084
Fla	Sarasota, EMR-Telemetry	813-371-0811
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Kans	Overland Park, Carter Elctrns., Inc.	913-649-6996
Md	Rockville, Farrell Assocs.	301-424-9460
Md	Silver Spring, EMR-Telemetry	301-588-8200
Mass	Waltham, EMR-Telemetry	617-890-1183
Mich	Southfield, EMR-Telemetry	313-559-2580
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	Hazelwood, Carter Elctrns., Inc.	314-731-2237
Tex	El Paso, EMR-Telemetry	915-542-0966
Wash	Seattle, EMR-Telemetry	206-243-4330
Wisc	Milwaukee, Carter Elctrns., Inc.	414-464-5555

ENCOM PRODS. CO., INC., Lower Hopewell Rd., Oxford, Pa., 19363, Tel: 215-932-9265; Empl.: 10

Customer service: R. P. Mallalieu

Free literature available: Data sheets describing the various intercom/paging phones manufactured by ENCOM. Data sheet describing the ENCOM Model ETA-25 Power Amplifier for voice paging applications.

Products manufactured: Amplifiers, Comm. Systems, Public Address Systems

Local Sales Offices & Reps.

Pa	Pittsburgh, Control Assembly Co.	

Local Distributors

Ala	Birmingham, Sound Engrg. Svc., 2317-2nd Ave. S.	205-322-4408
Alas	Anchorage, Electronics Alaska, 507 E. Northern Lights	907-272-5447
Ariz	Phoenix, Comm. Consultants, 4111 E. McDowell	602-267-1411
Cal	Los Angeles, General Intercom, 1849 Arlington	213-731-6336
Cal	Oakland, Comm. Svc. Co., 600-16th St.	415-893-6970
Cal	San Dimas, Pacific Intercom, 730 E. Foothill	213-963-1225
Del	Wilmington, Megonigal Elex., 304 N. Maryland	302-652-3178
Fla	Hollywood, Comm. Svc. Co., 1932 Tyler	305-961-1157
Fla	Orlando, Dictograph/N. Fla., 1537 Smith	305-841-1360
Ga	Atlanta, JWM Corp./Comm. Div., 1141 Spring, NW	404-875-8175
Ill	Chicago, G & O Industries, 5752 N. Calif.	312-334-2294
Ill	Chicago, Industrial Comms., 5843 W. Div.	312-626-7500
Ill	Chicago, Modern Comms. Inc., 8333 Niles Ctr.	312-677-0700
Ill	Springfield, Elec. Specialty Co., 135 N. Illinois	217-787-0800
Ill	Elkhart, Penwood Sls. Corp., 115 N. Main St.	219-293-3615
Iowa	Des Moines, Temputer, Inc., 3833 E. 27th	515-265-1586
Kans	Kansas City, A. A. Richards Co., 1206 State Ave.	913-321-3977
Md	Ellicott City, B. F. Whitten Co., 3702 St. Johns La.	301-465-0797
Mass	Canton, Mass. Tel. Co., 11 Beaumont St.	617-828-8400
Mich	Detroit, Stanley's Comms., 13507 Keystone	313-366-6344
Minn	Minneapolis, Interior Comms., 7705 Morgan Ave. S.	612-866-4001
Mo	St. Louis, St. Louis Comms., 7811 Carondelet	314-726-2218
NJ	Beverly, Dynasonic Inc., 429 Cooper St.	609-386-6900
NJ	Bloomfield, Bingham Comms., 69 E. Passaic	201-748-3575
NJ	Elizabeth, Tel-A-Tune Music, 422 Trinity Pl.	201-965-1144
NJ	Mahwah, N. A. Philips, 91 McKee Dr.	201-529-3800
NY	Batavia, Demerly Comms., 104 Cedar St.	716-343-4946
NY	Buffalo, Hunter & Bell Inc., 858 Main St.	716-882-2210
NY	Marcellus, Div. Concepts, 3929 New Seneca	315-673-2088
NY	Woodside, Imperial Elex., 33-44; 61st St.	212-458-7275
NC	Winston-Salem, Long Engrg. Co., 961 Burke St.	919-725-2306
Ohio	Akron, Elec. Engrg. Co., 362 W. Bowery	216-762-9771
Ohio	Cleveland, Warwick Comms., 3125 Detroit	216-621-7127
Okla	Lawton, Automatic Music, 425 Ave. F	405-355-4926
Pa	Allentown, Daveland Co., 407 Linden St.	215-439-8701
Pa	Pittsburgh, Gray Sound, 10 California	412-761-6130
RI	Providence, Gertz Inc., 166 Broadway	401-421-5881
Tenn	Chattanooga, Sound Engrg. Co., 1209 S. Watkins	615-624-3381
Tex	Corpus Christi, Sound Distributors, 515 S. Water St.	512-882-2282
Va	Richmond, Cottrell Elex., 408 E. Main	703-648-8338
Wash	Seattle, Electronic Aids, 2642-42nd Ave. SW	206-937-3399
WVa	Wheeling, H. Black Co., 123 N. 23rd St.	304-277-1651
Wisc	Wauwatosa, Krueger Elex. Inc., 9021 Jack. Park	414-453-0650

ENCODER DIVISION, Litton Sys. Inc., 20745 Nordhoff St., Chatsworth, Cal., 91311, Tel: 213-341-6161, TWX: 910-494-1229; Empl.: 175

Products manufactured: Encoders

ENDEVCO, Div. Becton, Dickinson & Co., 30700 Rancho Viejo Rd., San Jaun Capistrano, Cal., 92675, Tel: 714-493-8181, TWX: 910-588-3272; FSC No: 95411; Empl.: 400; Minimum order: $25

Customer service: J. Wilson

Products manufactured: Accelerometers, Amplifiers, Analyzers, Calibrators, Detectors, Filters, Meters, Power Supplies, Recorders, Signal Conditioners & Equipment, Test Equipment, Testers, Transducers

Local Sales Offices & Reps.

Cal	Palo Alto, Endevco	415-969-3212
Fla	Palm Beach Gardens, Endevco	305-622-2122
Ill	Crystal Lake, Endevco	815-459-7226
Md	Towson, Endevco	301-752-0688
Mass	Bedford, Endevco	617-969-8063
Mich	Southfield, Endevco	313-557-6675
NJ	Haddonfield, Endevco	609-428-5285
Ohio	Akron, Endevco	216-929-3811

ENDICOTT COIL CO., 24 Charlotte St., Binghamton, N.Y., 13905, Tel: 607-797-1263; Empl.: 110 p. 1•1206; p. 2•396

For info on price: R. Beebe; Application info: R. Beebe; Customer service: R. Beebe; Delivery info: C. Biviano

Free literature available: E700 Power supply Bulletin & Specifications (DC to DC for glow discharge displays); E8600 Clicker for Audible Feedback of Completed Information Input; Linear Solenoid Data Sheet; E305 Vibrator for Shaking or Moving Small Parts; E29 & E30 Buzzers (AC only).

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Converters, Data Compressors, Digital, Inverters, Power Supplies, Services, Assembly, Production & Test, Solenoids, Valves, Solenoid, Vibrators

Local Sales Offices & Reps.

Cal	Palo Alto, Testco Inc.	415-326-5320
Cal	Panarama City, Testco Inc.	213-988-2671
Fla	Orlando, M.G. Assoc.	305-841-8793
Ill	Crystal Lake, Dessco	815-459-8688
Md	Timonium, Heller Assoc.	301-252-4780
Mass	Lexington, Sir Assoc.	617-862-1812
Mich	Detroit, Blumenberg Assoc.	313-557-1934
NY	Endicott, Tech-Mark Inc.	607-748-7473
NY	Williamsville, H. C. Johnson	716-632-7880
Ohio	Dayton, Dynel Co.	513-434-6467
Pa	Ardmore, Freedman Assoc.	215-649-3679
Tex	Richardson, Palatine Inc.	214-231-9489
Wash	Bellevue, Testco	206-454-7422
WVa	Glenshaw, H.C. Johnson	412-961-0414

ENERGY CONVERSION DEVICES, 1675 W. Maple Rd., Troy, Mich., 48084

ENERGY ELCTRN. PRODUCTS CORP., 6060 Manchester Ave., Los Angeles, Cal., 90045, Tel: 213-670-7880, TWX: 910-325-6161; Empl.: 17

Products manufactured: Integrated Circuit Devices, Transistors

ENERGY TECHNOLOGY CORP., See TOR Corp.

ENGDAHL ENTERPRISES, 2850 Monterey Ave., Costa Mesa, Cal., 92626, Tel: 714-540-0398; Empl.: 5

Customer service: P. D. Engdahl

Free literature available: Peak Shock Recorder describes a response spectrum recorder. Peak Shock Annunciator describes a response spectrum annunciator. Talk to Seismological Society of America describing a response spectrum recorder and annunciator.

Products manufactured: Accelerometers, Alarms, Annunciators, Data Acquisition & Reduction Systems, Meters, Recorders, Transducers

ENGELHARD MINERALS & CHEM., Engelhard Inds. Div., 430 Mountain Ave., Murray Hill, N.J., 07974, Tel: 201-464-7000

Customer service: A. Nabor Ext. 478

Free literature available: Literature on: Brazing alloys & flux for joining metals, Precious metal refining, Thick & thin films & powders, Clad metals, Modulus alloy, Contact assemblies, Plating solutions.

Products manufactured: Alloys, Brushes & Brush Assemblies, Chemicals, Circuits, Hybrid, Thick Film, Contact Strips, Finger, Contacts, Electrical, Films, Flux, Brazing & Soldering Materials, Fuses, Inks For Thick Film Microcircuits, Laminates, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Paints, Preforms, Precious Metal, Resistors, Rivets, Slip-Rings & Assemblies, Solder (All Types), Springs (All Types), Thermocouples, Elements & Accessories, Wire

Local Sales Offices & Reps.

Ala	Birmingham	205-871-3202
Cal	E. Palo Alto	415-968-2613
Cal	Los Angeles	213-724-1800
Ill	Skokie	312-673-1900
Mich	Southfield	313-557-1424
Tex	Dallas	214-350-4106
FOR:	Can., Toronto, Ont.	416-362-3211

ENGELMANN MICROWAVE, Skyline Dr., Montville, N.J., 07045, Tel: 201-334-5700, TWX: 710 987-8344; Empl.: 100; Minimum order: $15

For info on price: C. Schraufnagl; Application info: H. F. Bailey; Customer service: E. Wiest; Delivery info: E. Wiest

Products manufactured: Attenuators, Comparators, Couplers, Detectors, Discriminators, Dividers, Filters, Junctions, Hybrid, Microwave, Limiters, Mixers, Modulators, All Kinds, Switches, Terminals

Local Sales Offices & Reps.

Cal	Inglewood, L & M Engrg., Inc.	213-674-6850
Cal	Santa Clara, L & M Engrg. Inc.	408-243-2891
Conn	Stamford, Dage Corp.	203-324-3125
Fla	Fort Lauderdale, Snow Co.	305-563-2448
Ga	Smyrna, SparTech Assocs.	404-432-3644
Ill	Highland Park, Feller Assocs.	312-433-3651
Ind	Rochester, Feller Assocs.	219-223-2377
Md	Columbia, Neal Deoul Assocs.	301-997-4353
Mass	Lowell, Russell Engrg.	617-458-5146
NY	Bridgeport, Lightstone Corp.	315-699-5747
NY	Huntington, CDB Enterprises, Inc.	516-692-5200
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Wash	Bellevue, Ray Over Sls.	206-454-4551

ENGINEERED COMPONENTS CO., 3580 Sacramento Dr., San Luis Obispo, Cal., 93401, Tel: 805-544-3800; FSC No: 32440; Empl.: 75

For info on price: M. Clarke; Application info: B. Rorick

Free literature available: Insulator Catalog - over 100 component mounting insulators. Encapsulation Shell Catalog - more than 2,000 sizes in Round, Oblong, Square, and Module Configurations. Delay Line Brochures - description of Delay Lines. Capacitor Brochures - capacitors available TTLDM, ECLDM Brochures

Products manufactured: Capacitors, Fixed, Delay Lines, Filters, Generators, Networks, Oscillators

Local Sales Offices & Reps.

Ariz	Phoenix, Gramer Co.	602-279-1231
Cal	Downey, Groh Assocs.	213-923-0963
Cal	Palo Alto, R. W. Thompson Assocs.	
Cal	San Diego, Daniels & Doty Sls. Co.	714-560-6266
Colo	Boulder, R. G. Ents.	303-447-9211
Iowa	Des Moines, Beams	515-282-0292
Kans	Shawnee Mission, Beams	913-341-7744
Md	Hyattsville, Eastern Components	301-557-2925
Mass	Woburn, Jalco Assocs.	617-227-1515
Minn	Hopkins, Fred Peterson Co.	612-941-5400
Mo	Creve Couer, Beams	314-569-1060
NY	Brentwood, Cir-Tech Assocs.	516-231-4440
NY	De Ruyter, R. A. Murray Co.	315-852-9981
NY	Rochester, R. A. Murray Co.	716-467-4538
Ohio	Cleveland, Electro-Com	216-886-2404
Ohio	Dayton, Electro-Com	513-276-3993
Pa	Flourtown, Eastern Components	215-836-1616
Pa	York, Eastern Components	714-764-3114
Tex	Houston, Aid Electrns.	713-777-3882
Tex	Irving, Aid Elctrns.	214-259-4761
Wash	Kirkland, Freed Assocs.	206-822-8100

ENM, 5350 Northwest Hwy., Chicago, Ill., 60630, Tel: 312-775-8400; Empl.: 140

Products manufactured: Counters, Timers

ENTERPRISE DEVELOPMENT CORP, 5127 E. 65th St., Indianapolis, Ind., 46220, Tel: 317-251-1231; Empl.: 10; Minimum order: $5

For info on price: L. Kopernak; Application info: R. Kopernak; Customer service: L. Kopernak; Delivery info: A. Kopernak

Products manufactured: Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Cal	Redwood City, Sinai-Johnson, Inc.	415-365-6263
Cal	Van Nuys, Oberman-Renner Sls.	213-997-1124
Fla	Ormond Beach, J.F. Thompson Co.	904-677-2298
Ga	Tucker, Elrep Sls. Co.	404-938-7108
Ill	Skokie, M. Berman Sls.	312-679-2293
Ind	Indianapolis, Elctrn. Rep., Inc.	317-897-9326
Mass	Northboro, W.B. Pray Sls.	617-393-3434
Mich	Livonia, F. Peters & Assocs.	313-425-0086
Minn	Minneapolis, D. Borrett Co.	612-929-0028
Mo	Ballwin, R.J. Throckmorton Sls. Co.	314-227-7222
NY	Camillus, Callahan-Ferguson Co.	315-487-3870
Ohio	St. Mary's, T. Shelby & Co.	419-394-3377
Pa	Philadelphia, S.K. Macdonald, Inc.	315-545-1205
Tex	Richardson, Campion Sls. Co.	214-238-8145
Wash	Seattle, Larrabee & Assocs.	206-623-2521

ENVIRONMENTAL COMMUNICATIONS INC., 3150 Pullman St., Costa Mesa, Cal., 92627, Tel: 714-557-7800, TWX: 910-595-1781

Free literature available: Facility brochure-custom hybrid micro circuits.

Products manufactured: Alarms, Amplifiers, Attenuators, CATV Systems & Equipment, Circuits, Hybrid, Thin-Film, Comm. Systems, Comparators, Controls/Control Eqpt., Converters, Couplers, Current Sensors, Decoders, Demodulators, Detectors, Diodes, Discriminators, Display Devices/Displays, Dividers, Drivers, Switch, Drivers & Decoders For Readouts, Electronic Switches (Oscilloscope), Encoders, Films, Filters, Flashers, Generators, Hybrid Voltage Regulators, Integrated Circuit Devices, Integrators, Electronic, Lamp Drivers, Limiters, Microcircuit Production Equip., Mixer-Preamplifiers, Microwave, Mixers, Modulator/Demodulators, Modulators, All Kinds, Modules, Logic, Encapsulated, Monitors, Multiplexers, Multipliers, Networks, Oscillators, Preselector-Mixers, Receivers, Rectifiers, References, D-C Voltage, Regulators, Resistors, Restorers, Pulse Form, Services, Assembly, Production & Test, Shifters, Signal Conditioners & Equipment, Strip-Line Components, Microwave, Substrates, Timers, Transmitters

ENVIRONMENTAL CONTAINER SYS., INC., 3560 Rogue River Hwy., Box 188, Grants Pass, Ore., 97526, Tel: 503-479-5388; FSC No: 24995; Empl.: 100; Minimum order: $50 .... p. 1•60,61

For info on price: J. Innes; Application info: D. Becklin; Customer service: B. Jaeger; Delivery info: Mktg./Scheduling

Free literature available: 1. "Standard Case Catalog": Lists Approx. 1200 standard case sizes and styles available from stock tooling. Includes hardware, colors, and ordering information. 80 pages 2. "Instrumentation Operating Cases": Transportable shock mounted, rack-mount, operating enclosures. Sizes from 5 1/4" to 47 3/8" rack height. Accessory drawers and design options are described. 20 pages 3. "Tape Reel Cases": Fiberglass cases for 8 1/2" & 11" diameter tape reel. Case sizes for 2 reels, 4 reels & 6 reels. Waterproof and/or magnetically shielded. 2 pages 4. "Excalibur": Cloth laminated, fiberglass cases for camera equipment, electronic equipment, sporting rifles and shotguns, 4 pages

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Cases, Transit, Containers, Drawers, Sliding

Local Sales Offices & Reps.

Cal	Newport Beach, W. Burkhart	714-673-0681
Cal	Sebastopal, R. Connick	415-494-3661
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
NM	Albuquerque, R.A. Mayes Co.	505-293-8010
Tex	Dallas, E.A. Robertson, Inc.	214-942-2716

ENVIRONMENTAL RESEARCH GRP., 313 N. First St., Ann Arbor, Mich., 48103, Tel: 313-662-3104

Customer service: F. Hammer

Free literature available: Eight-page brochure discusses ERG's problem-solving capabilities in Chemical Analysis, Toxicology, and Radiation Studies, Air Pollution and Industrial Health Analysis.

Products manufactured: Services, Assembly, Production & Test

EPIC, INC., 150 Nassau St., New York, N.Y., 10038, Tel: 212-349-2470; Empl.: 8; Minimum order: $10

For info on price: P. Letica; Application info: P. Letica; Customer service: M. Couteau; Delivery info: F. Harding

Free literature available: Hand Vibrograph, Infrared Pyrometer Kustotherm, Electrical Clip-on AC Meters, Resistance Bridges, Capacitance Bridges, Standard Compressed Gas Capacitors, Micro-Optical Pyrometer

Products manufactured: Bridges, Capacitors, Fixed, Indicators, Lamps, Meters, Pyrometers, Recorders, Testers

EPOXY TECHNOLOGY, 65 Grove St., Watertown, Mass., 02172, Tel: 617-926-0136; FSC No: 33246; Empl.: 6

For info on price: J. Toppi; Application info: F. Kulesza; Customer service: A. Delmarsh; Delivery info: J. Toppi

Free literature available: Literature for The Microelectronic Industry Include Our Conductive Silver and Gold Epoxies for Chip Attachment as well as Non-Conductive Epoxies. Literature on our New Insulating Epoxy for Lid Sealing.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Inks For Thick Film Microcircuits

Local Sales Offices & Reps.

Cal Pacific Palisades, Wadsworth-Pacific Mfg. Assoc. Inc. 213-454-4313
Fla Longwood, Lenz Engrg. Co. 305-831-9797
Ill Lake Villa, R.W. Venn Co. 312-395-5353
Mass Newton, Normell Assocs. 617-969-5478
Mich New Baltimore, Tech-Tron Engrg. ...313-725-4600
NJ Califon, C.W. Price Co. 201-638-6850
NY Liverpool, Wadsworth Mfg. Assoc. Inc. 315-652-6865
Tex Richardson, Oeler & Menelaides, Inc. 214-234-6334
Utah Salt Lake City, Specialty Sls. Co. 801-262-2979
Wash Seattle 206-938-4166
EXP: Plainville, Mass., Teknis 617-695-3591

EPOXYCAST ELECTRONIC CASE CO., 222 Lake Ave., Yonkers, N.Y., 10701, Tel: 914-YO3-5900

For info on price: J. J. Wilentchik; Application info: J. J. Wilentchik; Customer service: A. Powers; Delivery info: A. Powers

Products manufactured: Cups, Encapsulation, Enclosures, Module, Plug-In

EPSCO, INC., 920 Westwood Dr., Addison, Ill., 60101, Tel: 312-543-0410; FSC No: 53003; Empl.: 9; Minimum order: $10 ....p. 1•1200,1201

Customer service: J. W. Storch

Products manufactured: Inverters, Power Supplies

Local Sales Offices & Reps.
Ohio Cleveland, Fred Sharp Co. 216-464-3820

Local Distributors
Ala Birmingham, Forbes Dist. Co., 1416 4 Ave. S. 205-251-4104
Ariz Phoenix, R.V. Weatherford Co.; 1917 No. 25th Dr. 602-272-7144
Ark Little Rock, Carlton-Bates Co., Scott Ham. at 69th 501-562-9100
Cal Garden Grove, Allied Elctrns., 12311 Ind. St. 213-598-6605
Cal Glendale, Western Elctrn. Supply, 229 S. Orange St. 213-246-4861
Colo Denver, R. V. Weatherford Co., 3905 So. Maripose 303-761-5432
Conn New London, Aikins Elctrn. Supply, 531 Broad St. 203-442-4406
Del Wilmington, Almo Elctrn. Corp., 1122 French St. 302-656-9467
DC College Park, Allied Elctrns., 4911 Niagara Rd. 301-345-4600
Fla Tampa, Lykes Elctrns., Box 24047 813-886-6621
Ga Atlanta, Spec. Distr. Co., 763 Juniper St. N.E. 404-873-2521
Haw Honolulu, Honolulu Elctrn., 819 Keeaumoku 949-5564
Idaho Twin Fall, Central Elctrn., 125 Second St. W.
Ill Chicago, Allied Elctrn., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Newark Elctrns., 500 N. Pulaski 312-638-4411
Ind Indianapolis, Graham Elctrns. Supply, 133 S. Pa. St. 317-634-8202
Iowa Cedar Rapids, Deeco, Inc., 2500 16th Ave., S.W. 319-365-7551
Kans Topeka, Interstate Elctrn. Supply, 2500 S. Kan. Ave. 913-235-2396
Ky Lexington, Radio-Elctrn. Equip., 480 Skain Ave. 606-255-6661
La New Orleans, Southern Radio Supply, 1909 Tulane Ave. 504-524-2324
Me Portland, Holmes Distr., 510 Cumberland 207-774-5901
Md College Park, Allied Elctrn., 4911 Niagara Rd. 301-345-4600
Mass Braintree, Allied Elctrn., 1 Century Cir. 617-848-4150
Mich Ann Arbor, Wedemeyer Elctrn. Supply Co., 2280 S. Ind. Hwy.
Minn Duluth, Northwest Radio of Duluth, 123 E. First St. 218-727-1565
Miss Jackson, Ellington Elctrn. Supply, 1425 Terry Rd. 601-355-0561
Mo Kansas City, Walters Radio Sup., 3627-35 Main St. 816-531-7015
Mont Billings, Elctrn. Supply Co., 250 11 St. W. 406-252-2197
Neb Lincoln, Scott Elctrn. Supply Co., 4040 Adams St. 402-434-8308
Me Portland, Holmes Distr., 510 Cumberland 207-774-5901
Nev Las Vegas, Indl. Elctrns., 300 W. Utah 702-384-2151
NH Concord, Evans Radio & Elctrns., Box 893 603-224-9961
NJ Kenolworth, Newark Elctrns., 303 Monroe Ave. 201-272-8410
NJ Rahway, Quad Parts Distr., 1561 Main St. 201-381-5400
NM Albuquerque, R. V. Weatherford Co., 6101 Marble Ave., N.E. 505-265-5671
NY Buffalo, Summitt Distr., 916 Main ...716-884-3450
NY New York, Newark Elctrns., 3000 S. Winton Rd. 716-473-6600
NC Raleigh, Southeastern Supply, 414 Hillsborough 919-828-2313
ND Minot, J-I Co., Inc., 330 N. Bdwy. 701-838-5466
Ohio Cleveland, RPC Elctrn. of Ohio, 749 Miner Rd. 216-461-4700
Okla Oklahoma City, Trice Wholesale Elctrns., 4701 N. Stiles 405-232-2291
Ore Portland, United Radio Supply, 123 N.E. 7th Ave. 503-233-5346
Pa Philadelphia, Almo Elctrn., 9815 Roosevelt 215-676-6000
RI Providence, W. Candreta & Co., 28 Wolcott St. 401-861-2100
SC Columbia, Dixie Radio Supply, 1900 Barnwell St. 803-253-5333
SD Mitchell, Elctrn. Supply Co., 119 E. 1st Ave. 605-996-4300
Tenn Kingsport, Radio Supply Co., 961 E. Sullivan 615-247-8111
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Utah Provo, Central Utah Elctrns., 735 S. State St. 801-373-7522
Vt White River Jct., Elctrn. Supply, S. Main 802-295-3536
Va Richmond, AVEC Elctrn. Corp., 2002 Staples Mill
Wash Seattle, Western Elctrns. Co., 717 Dexter Ave., N. 206-284-0200
Wash Seattle, Western Elctrn. Co., 717 Dexter Ave. N. 206-284-0200
WVa Charleston, McJunkin Corp., 1400 Hansford St. 304-348-4919
Wisc Milwaukee, Elctrn. Expeditors, 6045 N. Gr. Bay 414-228-8100
Wyo Casper, Fleming Supply Co., 332 East A St.

EPSCO, INC., 411 Providence Hwy., Westwood, Mass., 02090, Tel: 617-329-1500, TWX: 710-348-0484; FSC No: 99380; Empl.: 150; Minimum order: $25

Customer service: H. Clark

Free literature available: Data sheets/brochures with detailed specifications of data conversion systems; ECM, radar, TACAN, altimeter, IFF simulators; high power microwave signal sources and cavity oscillators.

Products manufactured: Converters, Data Acquisition & Reduction Systems, Radar Systems, Receivers, Synthesizers, Test Systems, Transponders

Local Sales Offices & Reps.
Ariz Tempe, PLS Assocs. 612-957-9110
Cal Anaheim, Blair Assocs. 714-635-1350
Cal San Jose, MCH Assocs. 408-246-7330
Colo Denver, PLS Assocs. 303-771-0140
Fla Fort Lauderdale, Snow Co. 305-563-2448
Fla Hallandale, Emec, Inc. 305-925-6366
Ill Northfield, Feller Assocs. 312-446-8065
Mass Waban, Bawer Assocs. 617-244-6572
NJ Hayworth, Central Assocs. 201-568-0808
NM Albuquerque, PLS Assocs. 505-255-2330
NY Plainview, Central Assocs. 516-433-0808
NY Syracuse, Syracuse Tech. Reps. 315-488-0222
Tex Fort Worth, C. Wolf & Assocs. 817-738-1996
Tex Houston, C. Wolf & Assocs. 714-721-2442
Va Annandale, J. Hopkins Assocs. 703-323-1641
Wash Seattle, Datacom Assocs. 206-285-2525

EQUIPTO, Aurora Equipment Co., 225 So. Highland Ave., Aurora, Ill., 60507, Tel: 312-859-1000; Empl.: 300

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Drawers, Sliding, Racks

EQUIPTO ENCLOSURE SYSTEMS, Div/Equipto Elec. Corp., 435 Woodlawn Ave., Aurora, Ill., 60507, Tel: 312-897-4691; FSC No: Multiple; Empl.: 40 ....p. 1•58,59

Customer service: C. W. Peterson

Free literature available: Complete catalog containing technical and ordering information as well as price books includes rack cabinets, consoles, accessories, blowers and fans.

Products manufactured: Blowers & Fans & Accessories, Cabinets & Accessories, Racks

Local Sales Offices & Reps.
Ala Huntsville, J.L. Highsmith & Co. 205-881-3294
Ariz Scottsdale, BFA Corp. 602-946-4215
Cal Menlo Park, Long & Assocs. 415-327-1300
Cal Santa Fe Springs, Sls. Engrs. Limited 213-921-4337
Colo Denver, BFA Corp. 303-744-3301
Conn Glastonbury, Edcom, Inc. 203-633-1380
Fla Hollywood, W.B. Wimberly Co. 305-961-6962
Fla Orlando, W.B. Wimberly Co. 305-423-2514
Ill Palatine, J. Clark Co. 312-358-5095
Mass Newtonville, Edcom, Inc. 617-969-9710
Mich Royal Oak, Group Ten 313-549-3910
Minn St. Paul, H.A. Cullen & Assocs. 612-646-7371
Mo Blue Springs, Cairns & Hayes Elctrn. Sls. Co. 816-229-1404
Mo St. Charles, Cairns & Hayes Elctrn. Sls. Co. 314-946-6677
NM Albuquerque, BFA Corp. 505-296-8303
NM Las Cruces, BFA Corp. 505-523-0601
NY Port Chester, Radiation Elctrns., Inc. 914-937-2300
NY Syracuse, Labtronics, Inc. 315-454-9314
NC Charlotte, J.L. Highsmith & Co. 704-333-7743
Ohio Cleveland, Group Ten 216-486-2800
Ohio Dayton, Group Ten 513-277-6531
Pa Valley Forge, J.E. Cuesta & Co. 215-265-5800
Tex Dallas, M. Kruvand Co. 214-827-8043
Tex Houston, M. Kruvand Co. 713-661-3007
Utah Salt Lake City, BFA Corp. 801-466-6522
Va Richmond, J.L. Highsmith & Co. 804-272-5888
Va Springfield, Scientific Devices/E-Tech 703-451-6500
Wash Seattle, Seatronics 206-767-4330

ERA ACOUSTICS, 311 E. Park St., Moonachie, N.J., 07074, Tel: 201-641-3650, TWX: 710-990-5064; Empl.: 100; Minimum order: $25

Customer service: J. Grieg

Free literature available: Poly-planar speaker product line, Poly-planar speaker application data.

Products manufactured: Speaker Systems, Speakers

ERA TRANSPAC CORPORATION

ERA TRANSPAC CORP., Sub. Electronic Research Assocs., 311B E. Park St., Dept. 1202, Moonachie, N.J., 07074, Tel: (201) 641-3650, TWX: 710-990-5064 p. 1•1202-1205

Products manufactured: Inverters, Power Supplies, Regulators

Local Sales Offices & Reps.
Ariz Scottsdale, DeAngelo, Rothman & Cheever 602-948-2240
Cal Culver City, DeAngelo, Rothman & Co. 213-398-6239
Fla Melbourne, Repcom 305-254-1877
Ill Park Ridge, R.F. Specialists 312-698-2044
Md Baltimore, Stemler Assocs.
Mass Canton, New England Elctrn. Sls. Co. 617-828-4835
NY Fayetteville, M.P. Andrews Co. 315-637-3144
NY Plainview, R.H. Smith Assocs. 516-681-3155
NY Spring Valley, R. Smith Assocs. 914-354-6067
Ohio Cincinnati, R. Makin Assocs. 513-232-5588
Tex Dallas, E.B. Robertson

ERASER CO., Box 1342, Syracuse, N.Y., 13201, Tel: 315-454-3237; Empl.: 25; Minimum order: $10

Customer service: J. Nett

Free literature available: Full Line Catalog

Products manufactured: Brushes & Brush Assemblies, Burnishers, Contact, Chemicals, Cleaners & Solvents, Heat Guns, Production, Holders, Circuit Board (Production Type), Machines/Machinery, Production, Wire Strippers, Wire Twisters

Local Sales Offices & Reps.
Ark Hot Springs, Meredith Young Assoc. 501-262-1365
Fla Orlando, W.A. Brown Comps. 305-425-5505
Ill Chicago, EMF Co., Inc. 312-889-8323
Mass Stoneham, Production Devices Corp. 617-438-2772
Minn Minneapolis, Prod. Auto Corp. 612-866-5700
NY Guilderland, The Solder Pot 518-355-1829
NC Raleigh, W. A. Brown Comps. 919-876-9601
Ohio Strongsville, Jim Finnegan & Co. 216-826-1033
Pa Ft. Washington, Kirk-Sandell Inc. 215-643-2100
Tex Richardson, Prod. Auto. Corp. 214-234-4002
Wash Kingston, F. A. Haight Co. 206-297-3212
Wisc Milwaukee, Wakefield-Krauthoff Co. 414-871-3381
EXP: N.Y., New York, American Trading Co., Inc. 212-943-5100

FOR:	Can., Montreal, Que., A D Tool Corp.	514-482-2548

Local Distributors

Ala	Huntsville, W. A. Brown Comp., 1314 Buford St. NW	205-539-4411
Cal	El Monte, C. Michael, 9674 Telstar Ave.	213-686-0141
Cal	El Segundo, Wassco, 410 S. Douglas St.	213-640-1060
Fla	Clearwater, Prod. Cupboardi, 2060 Palmeto St.	813-447-2581
Ga	Atlanta, Elect. Insulating Supp., 1255 Collier Rd.	404-355-1651
Ill	Chicago, EMF Co., 6135 W. Belmont	312-889-8323
Minn	Minneapolis, Prod. Auto. Corp., 7726 Morgan Ave. S.	612-866-5700
Miss	Jackson, O. Van Horn Co., 451 No. Gallatin St.	601-354-4321
NY	Guilderland, Solder Pot, Box 14	518-355-1829
NY	Syracuse, Jet Elctrn., Box 109 Oliva Dr.	315-454-3237
NC	Raleigh, W. A. Brown Co., 7204 Bolero Cir.	919-876-9601
Pa	Huntingdon Valley, H. Mann Inc., 3983 Mann Rd.	215-355-7200
Tex	Richardson, Prod. Auto. Corp., 777 S. Central Exp.	214-234-4002

ERC, See Electronic Research Co.

ERIE FREQUENCY CONTROL, Div. Erie Technological Prods., 453 Lincoln St., Carlisle, Pa., 17013, Tel: 717-249-2232, Telex: 84-2328; Minimum order: $25

Products manufactured: Crystals, Filters, Oscillators, Ovens

Local Sales Offices & Reps.

Cal	Palo Alto	415-327-1520
Cal	Santa Ana	714-835-4822
Fla	Maitland	305-644-0954
Ill	Des Plaines	312-297-5560
Ind	Fort Wayne	219-484-1528
Mass	Wakefield	617-245-7880
NJ	Pennsauken	609-655-4787
NC	Greensboro	919-299-1905
EXP:	Pa.	814-453-5611

ERIE TECHNOLOGICAL PRODUCTS, 644 W. 12 St., Erie, Pa., 16512, Tel: 814-453-5611, TWX: 510-696-6607; FSC No: Multiple; QPL No: Multiple; Empl.: 2300; Minimum order: $50
p. 1•314,315,556,1207,1837; p. 2•127-129

For info on price: R. F. Smith; Application info: P. M. Miller; Customer service: R. L. Whitney; Delivery info: R. L. Whitney

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Crystals, Filters, Oscillators, Ovens, Power Supplies, Rectifiers, Sockets

Local Sales Offices & Reps.

Cal	Palo Alto, Erie Technological Prods., Inc.	415-327-1520
Cal	Santa Ana, Erie Technological Prods., Inc.	714-835-4822
Fla	Maitland, Erie Technological Prods., Inc.	305-644-0954
Ill	Des Plaines, Erie Technological Prods., Inc.	312-297-5560
Ind	Fort Wayne, Erie Technological Prods., Inc.	219-484-1528
Mass	Wakefield, Erie Technological Prods., Inc.	617-245-7880
Mo	North Kansas City, LCOMP, Inc./Kansas City	816-221-2400
NJ	Pennsauken, Erie Technological Prods., Inc.	609-665-4787
NC	Greensboro, Erie Technological Prods., Inc.	919-299-1905
Pa	Erie, Erie Technological Prods., Inc.	814-453-5611
EXP:	Erie, Pa., Erie Technological Prods. Export Sls.	814-453-5611
FOR:	Can., Trenton, Ont., Erie Technological Prod. of Can. Ltd.	613-392-2581

ERIKSON SPECIALIZED TOOL CO., Box 424, Pico-Rivera, Cal., 90660, Tel: 213-699-3719; Empl.: 4; Minimum order: $10

Customer service: J. R. Erikson

Products manufactured: Pliers, Screwdrivers, Soldering Accessories, Tools, Wrenches

ESC ELCTRNS. CORP., 534 Bergen Blvd., Palisades Pk., N.J., 07650, Tel: 201-947-0400, TWX: 710-991-9780; Empl.: 120 p. 1•452,453,550,551

For info on price: B. Carr; Application info: R. Peressini; Customer service: B. Carr; Delivery info: B. Carr

Free literature available: 1. Delay Line Brochure LC Delay Line information. 2. LC Filters Brochure-LC Filters of printed circuit board mounting types and discussions of ESC Telephone Line Simulators and Equalizers and other LC Filters 3. Wide Band Video Transformers Bulletin.

Products manufactured: Coils Including Assemblies & Forms, Delay Lines, Equalizers, Filters, Networks, Synthesizers, Telephone Channel Test & Simulator Equipment, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Carter Assocs.	602-947-4355
Cal	Chatsworth, Westaironics Inc.	213-882-8977
Cal	Los Alamitos, Westaironics Inc.	213-431-1101
Cal	Los Altos, P M Sls.	415-941-4444
Cal	Marina Del Ray, Westaironics Inc.	213-821-7958
Fla	Cocoa Beach, Barrett Assocs.	305-784-2758
Fla	Maitland, Barrett Assocs.	305-678-0172
Fla	Melbourne, Barrett Assocs.	305-727-2491
Fla	N. Miami, Barrett Assocs.	305-681-4957
Fla	St. Petersburg, Barrett Assocs.	813-345-3585
Ill	Chicago, Carlson Elctrns. Sls. Co.	312-774-9022
Md	Glen Burnie, New Era Sls.	301-768-6666
Mass	Waltham, Betronic Assocs.	617-894-8400
Mich	Mt. Clemens, Compass Assocs.	313-468-8830
Minn	Minneapolis, J. J. Exon Inc.	612-566-5340
Mo	St. Louis, Carlson Elctrn. Sls. Co.	314-991-0262
NJ	Clifton, A. Clarfield Assocs.	212-757-6454
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	Rochester, Telesco Assocs.	716-271-3780
NC	Charlotte, J. Rudisill Assoc. Inc.	704-377-6901
Ohio	Dayton, Compass Assocs.	513-252-9939
Pa	Philadelphia, Mid-Eastern Assocs.	215-842-2810
Tex	Dallas, Mark Kruvand & Assoc.	214-827-8043
Tex	Houston, Mark Kruvand & Assoc.	713-661-3007
FOR:	Can., Downsview, Ont., Zaslow Sls. Co.	416-727-1211

ESCO PRODUCTS, Oak Ridge Rd., Oak Ridge, NJ, 07438, Tel: 201-697-3700; Empl.: 35

Products manufactured: Coatings, Lenses, Optical & Camera, Lenses, Readout & Display, Microscopes, Quartz, Fused, Silica, Fused, Tubing

ESICO, INC., Box 247, Deep River, Conn., 06417, Tel: 203-526-5361; Empl.: 40; Minimum order: $15

For info on price: R. Lee; Application info: G. E. Westerlund; Customer service: R. Lee; Delivery info: R. Lee

Products manufactured: Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Colo	Lakewood, Pathway, Inc.	303-232-7730
Ga	Atlanta, Electr-Mech Sls. Engrg. Co.	404-393-0444
Ill	Chicago, H. Halinton Engrg. Assoc.	312-763-2131
Ohio	Dayton, AMES Corp.	513-435-9730
Tex	Dallas, Production Eng. Sls. Inc.	214-369-3181

ESNA DIV., Amerace Corp., 2330 Vauxhall Rd., Union, N.J., 07083, Tel: 201-686-6000, TWX: 710-985-4677; Empl.: 1100; Minimum order: $50

For info on price: Sls. Dept.; Application info: G. Dietrich; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: General product bulletin No. 7014 visually identifies and describes the three major cana lines of self-locking fasteners and lists nation-wide sales offices.

Products manufactured: Fasteners, Pins

Local Sales Offices & Reps.

Cal	San Francisco	415-349-6011
Cal	Van Nuys	213-873-7420
Ill	Chicago	312-777-2929
Ind	Indianapolis	317-253-6526
Mass	Boston	617-545-3424
Mich	Southfield	313-646-6700
Minn	Minneapolis	612-835-4599
Mo	Kansas City	816-333-8394
Mo	St. Louis	314-968-1336
NJ	Union	201-686-6000
NY	Rochester	716-473-5088
Ohio	Cincinnati	513-825-8135
Ohio	Dayton	513-298-2346
Ohio	Strongsville	216-238-3351
Pa	Ardmore	215-642-8667
Tex	Dallas	214-231-2391
Wisc	Milwaukee	414-786-4456
FOR:	Can., Dorval, Que., Esna Ltd.	514-631-9013
FOR:	Can., Markham, Ont.	416-499-1221

ESSEX INTERNATIONAL, INC., Essex Controls Div., 445 Park Ave., Sycamore, Ill., 60178, Tel: 815-895-4501, TWX: 910-639-0611

Customer service: L. Bassill

Products manufactured: Cable, Cords, Wire

Local Sales Offices & Reps.

Cal	Anaheim, Essex Int'l., Inc.	213-625-7516
Colo	Denver, Essex Int'l., Inc.	303-399-0521
Ky	Georgetown, Essex Int'l., Inc.	502-863-3321
Mich	Berrien Springs, Essex Int'l., Inc.	616-473-4811
Minn	Minneapolis, Essex Int'l., Inc.	612-331-6370
Mo	St. Louis, Essex Int'l., Inc.	314-382-9000
Ohio	Dayton, Essex Int'l., Inc.	513-277-8964
Pa	Philadelphia, Essex Int'l., Inc.	215-236-7100
SC	Bennettsville, Essex Int'l., Inc.	803-479-6211
Tenn	Nashville, Essex Intl.	615-794-8451
Tex	Dallas, Essex Intl.	214-369-6541

ESSEX INTERNATIONAL CORP., 1601 Wall St., Ft. Wayne, Ind, 46802

ESSEX CONTROLS DIV., Essex International, Inc., 131 Godfrey St., Logansport, Ind., 46947, Tel: 219-753-7521, TWX: 810-295-0699; Minimum order: $25
p. 1•1668-1681

Customer service: A. M. Maloy

Free literature available: Distributor Catalog SC-7 Covering General Purpose Relays, Power Relays & Contactors, Miniature Sensitive Relays, Solenoids, Time Delays-Complete Engineering Data Dimensions & Prices.

Products manufactured: Relays, Switches

Local Sales Offices & Reps.

Cal	Anaheim, Essex Int'l., Controls Div.	213-625-7516
Cal	Burlingame, Leddy Assocs.	415-347-5247
Colo	Denver, R.G. Bowen Co.	303-722-4641
Conn	Madison, A & M Elctrn. Reps., Inc.	203-245-1031
Fla	Clearwater, Reynolds & Assocs.	813-726-2373
Fla	Ft. Lauderdale, Reynolds & Assocs.	305-581-6611
Fla	Hollywood, Reynolds & Assocs.	305-987-6720
Fla	Palm Beach Gardens, Reynolds & Assocs.	305-622-6850
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Fla	St. Petersburg, Reynolds & Assocs.	813-360-1484
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	Chicago, Essex Intern'l. Inc. Controls Div.	312-478-9151
Ind	Greenwood, Valentine & Schillinger & Assoc.	317-888-2260
Ind	Logansport, Essex Intern'l. Inc. Controls Div.	219-753-7521
Ind	South Bend, Valentine & Schillinger & Assoc.	219-291-6258
Iowa	Cedar Rapids, Palatine Sls., Inc.	319-365-8071
Kans	Andover, Palatine Sls., Inc.	316-683-7512
Kans	Overland Park, Palatine Sls. Inc.	913-262-6820
Md	Baltimore, W.S. Warrington & Assocs.	301-823-8759
Mass	Needham, A & M Elctrn. Reps.	617-444-8170
Mich	Berrien Springs, Essex Intern'l., Inc. Controls Div.	616-473-4811
Minn	Minneapolis, Essex Intern'l., Inc. Controls Div.	612-331-6370
Mo	St. Louis, Palatine Sls., Inc.	314-426-7055
NJ	South Hackensack, Essex Internt'l., Inc. Controls Div.	201-641-4407
NY	Dewitt, Essex Intern'tl., Inc. Controls Div.	315-446-0800
NC	Charlotte, Reynolds & Assocs.	704-527-2536
Ohio	Centerville, C.H. Dolfuss, Jr. & Co.	513-433-6776
Ohio	Rocky River, C.H. Dolfuss Jr. & Co.	216-333-7504
Okla	Tulsa, Palatine Sales	918-622-0321
Ore	Portland, C. K. Shanks & Assoc.	503-292-5656
Pa	Blue Bell, Essex Intern'tl., Inc. Controls Div.	215-542-8476
Tex	Austin, Palatine Sls.	512-451-7463
Tex	Houston, Palatine Sls.	713-777-4477
Tex	Richardson, Palatine Sls.	214-231-9489
Wash	Seattle, C. K. Shanks & Assoc.	206-632-4290

Local Distributors

Ala	Huntsville, Powell Elctrns., Inc., 803 Oster Dr.	205-539-2731
Ariz	Tucson, Inland Elctrn. Supply, 715 E. Bdwy.	602-624-4402
Ark	Fort Smith, Carlton-Bates Co., 302 North 6th St.	501-782-7258

Ark	Jonesboro, Bluff City Distributing Co., 324 Huntington	501-932-7811
Ark	Little Rock, Carlton-Bates Co., 69th & Scott Hamilton Dr.	501-562-9100
Cal	Burbank, Terminal Elctrns. Corp., 2402 W. Olive	213-843-1221
Cal	Fresno, Dunlap Elctrns., 1750 E. McKinley Ave.	209-268-6111
Cal	Hayward, Dunlap Elctrns., 25354 Cypress Ave.	415-352-1933
Cal	Mountain View, Terminal-Hudson Elctrns., Inc., 880 Maude Ave.	415-969-9240
Cal	Redwood City, Electrical Sls. Prods., 465 Convention Way	415-364-2621
Cal	San Leandro, Electro Comps. Dist., 1939 Republic Ave.	415-352-5210
Cal	Santa Clara, Fisher Switches, Inc., 3381 Edward Ave.	408-244-6182
Colo	Denver, Dixon Elec. Supply, Inc., 4880 E. Pacific Pl.	303-757-7453
Colo	Denver, Newark/Denver Elctrns., 2170 S. Grape St.	303-757-3351
Conn	Hamden, Wilshire Elctrns./Conn., 2554 State St.	203-281-1166
Fla	Daytona Beach, Hammond Elctrns., Inc., 719 N. Ridgewood Ave.	904-253-0531
Fla	Fort Myers, Hammond Elctrns., Inc., 2563- 4th St.	813-334-2277
Fla	Jacksonville, Hammond Elctrns., Inc., 250 East First St.	904-356-4851
Fla	Lakeland, Hammond Elctrns., Inc., 930 East Oak St.	813-686-4145
Fla	Miami, Electro-Standards Labs., Inc., 3560 N. W. 34th St.	305-633-6973
Fla	Miami, Electronic Equip. Co., 2701 N.W. 42nd Ave.	305-871-3500
Fla	Orlando, Hammond Elctrns., Inc., 911 West Central Blvd.	305-849-6060
Fla	Tampa, Hammond Elctrns., Inc., 1516 Cypress St.	813-253-0104
Ga	Atlanta, Specialty Distributing Co., 763 Juniper St. N.E.	404-873-2521
Ill	Chicago, Newark Elctrns., 500 North Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd.	312-697-8200
Ill	Peoria, Klaus Radio, Inc., 8400 N. Pioneer Pkwy.	309-691-4840
Ind	Evansville, Hutch & Son, Inc., 300 N. Main St.	812-425-7201
Ind	Fort Wayne, Fort Wayne Elctrns. Supply, Inc., 3606 E. Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns. Supply, Inc., 133 S. Pennsylvania St.	317-634-8486
Iowa	Cedar Rapids, Deeco, Inc., 2500-16th Ave. S.W.	319-365-7551
Kans	Wichita, Radio Supply Co., 115 Laura	316-267-5216
La	Metairie, Industrial Distributors, Inc., 710 Papworth Ave.	504-835-7281
Md	Baltimore, A S I Elctrns., 1728 - 30 Whitehead Rd., Meadows Industrial Pk.	301-265-5100
Md	Beltsville, Powell Elctrns., Inc., 10728 Hanna St.	301-474-1030
Md	Gaithersburg, Pioneer/Wash., 9100 Gaither Rd.	301-948-0710
Mass	Dedham, Gerber Elctrns. & Radio Supply Co., 852 Providence Hwy. (U.S. Rt. 1)	617-329-2400
Mich	Detroit, RS Elctrns., 12775 Lyndon Ave.	313-491-1012
Mich	Grand Rapids, Stotts-Friedman, 2035 Eastern Ave., S.E.	616-241-6731
Minn	St. Paul, Gopher Elctrns. Co., 2520 W. Larpenteur	612-645-0241
Miss	Columbus, Bluff City Distributing Co., 116 S. 22nd St.	601-328-6212
Miss	Greenville, Bluff City Distributing Co., Box 5606	601-334-4412
Miss	Tupelo, Bluff City Distributing Co., 210 South Glaster	601-842-6832
Mo	Kansas City, Burstein-Applebee, 3199 Mercier St.	816-531-5614
Mo	North Kansas City, LCOMP, 1520 Taney St.	816-221-2400
Mo	St. Louis, Interstate Ind'l. Elctrns., 4445 Gustine Ave.	314-481-6110
Mo	St. Louis, Olive Ind'l. Elctrns., 6662 Olive Blvd.	314-863-7800
NJ	Fairlawn, Relay Specialties, Inc., 1300 Plaza Rd.	201-797-3313
NJ	South Plainfield, Brownell-Electro, 500 Hadley Rd.	201-753-4600
NY	Buffalo, Summit Distributors, Inc., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd. (Rt. 110)	516-694-6800
NY	New York, Brownell-Electro, 85 Tenth Ave.	212-924-6000
NY	Rochester, Summit Elctrns., 292 Commerce Dr.	716-334-8110
NC	Charlotte, Dixie Radio Supply Co., 2220 South Tryon St.	704-377-5413
Ohio	Cincinnati, Hughes-Peters, Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Cleveland, Pioneer-Standard Elctrns., Inc., 4800 E. 131st St.	216-587-3600
Ohio	Columbus, Hughes-Peters, Inc., 481 East 11th Ave.	614-294-5351
Ohio	Dayton, J. A. Becker Co., 1341 East Fourth St.	513-226-1341
Ohio	Mansfield, Hoover Instr. Service, Inc., 401 North Home Rd.	419-529-3583
Okla	Tulsa, Oil Capitol Elctrns. Corp., 708 South Sheridan, Box GG - Admiral Station	918-836-2541
Ore	Portland, EOFF Elec. Co., 509 N.W. 10th Ave.	503-222-9411
Pa	Philadelphia, Powell Elctrns., Inc., S. Island Road & Enterprise Ave.	215-365-1900
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
Pa	Reading, G. D. Barbey Co., 333 N. 4th St.	215-376-7451
SC	Columbia, Dixie Radio Supply Co., 1900 Barnwell St.	803-253-5333
Tenn	Memphis, Bluff City Distributing Co., 234 East St.	901-725-9500
Tenn	Nashville, Electra Distributing Co., 1914 West End Ave.	615-329-3971
Tex	Dallas, Texas Instr. Supply Co., 6000 Denton Dr.	214-238-2011
Tex	Denison, Denison Radio Supply, 426 West Woodard St.	214-465-2336
Tex	Ft. Worth, Allied Elctrns., 401 East 8th St.	817-336-5401
Tex	Houston, Solid State Elctrns. Co. of Texas, 6400 Westpark Dr.	713-785-5205
Tex	Houston, Texas Instrs. Supply Co., 3939 Ann Arbor Dr.	713-785-4800
Va	Charlottesville, Piedmont Elec. Supply Corp., 1150 Rose Hill Dr.	703-296-6167
Wash	Seattle, Sterling Elctrns., 5608 6th Avenue So.	206-762-9100
Wisc	Milwaukee, Marsh Elctrns., Inc., 6047 W. Beloit Rd.	414-545-6500
Wisc	Milwaukee, Parts Mart Corp., 1314 N. 7th St.	414-276-4160
Exp:	New York, N.Y., Roburn Agencies, Inc., 349 West 14th St.	212-989-5939

ESSEX WIRE, 6235 S. Harlem Ave., Chicago, Ill., 60638

ESTERLINE ANGUS, 1201 Main St., Indianapolis, Ind., 46224, Tel: 317-244-7611; FSC No: 72264; Empl.: 300; Minimum order: $20 .... p. 1•864-867

For info on price: M. Vian; Application info: M. Vian; Customer service: B. Kiser; Delivery info: M. Vian

Free literature available: Keyboard programmable data acquisition systems, ammeters, voltmeters, milliammeters, inkless multipoint, PIP, XY and impact chart recorders. Also: event, frequency and temperature recorders; Servo recorders.

Products manufactured: Amplifiers, Cleaners, Ultrasonic, Data Acquisition & Reduction Systems, Data Loggers, Indicators, Integrators, Electronic, Meters, Monitors, Recorders, Tachometers, Transformers

Local Sales Offices & Reps.

Ala	Birmingham, Spader & Assocs.	205-879-1366
Ariz	Scottsdale, BFA Corp. of Ariz.	602-946-4215
Ark	Little Rock, Electra-Tech Midsouth, Inc.	501-562-4090
Cal	City of Industry, Esterline Angus Branch Off.	213-330-1621
Cal	Hayward, Esterline Angus Branch Off.	415-785-8232
Colo	Denver, Cliff Beabout Co.	303-831-7259
Fla	Orlando, Datarep, Inc.	305-843-5224
Fla	Pompano Beach, Datarep, Inc.	305-781-9279
Ga	Decatur, Spader & Assocs.	404-296-3024
Haw	Honolulu, Berkley Engrg. & Equip. Co.	808-538-1921
Ill	Elmhurst, Esterline Angus Branch Off.	312-833-4410
Ind	Indianapolis, C.D. Arnold Co.	317-546-4053
Iowa	Cedar Rapids, H.E. Ferris Co.	319-362-9156
Iowa	Des Moines, H.E. Ferris Co.	515-255-5008
La	New Orleans, Mid-South Sls. Co.	504-822-3030
Mass	Holliston, Esterline Angus Branch Off.	617-235-5343
Mich	Marquette, NWR Elctrns. Corp.	906-228-9660
Mich	Troy, G. R. Peters Assocs.	313-524-2920
Minn	Minneapolis, Electrical Jobbers Equip. Inc.	612-721-4815
Minn	Virginia, NWR Elctrns. Corp.	218-741-5080
Mo	Crestwood, C.B. Fall Co.	314-968-3850
Mo	Kansas City, C.B. Fall Co.	816-942-3912
NJ	Lodi, Esterline Angus Branch Off.	201-471-0084
NM	Albuquerque, BFA Corporation	505-292-1212
NM	Las Cruces, BFA Corporation	505-523-0601
NY	Buffalo, Robt F. Lamb Co.	716-874-4900
NY	Rochester, Robt F. Lamb Co.	716-544-5580
NY	Schenectady, Robt F. Lamb Co.	518-393-4844
NY	Syracuse, Robt F. Lamb Co.	315-454-2469
NC	Charlotte, Ranson, Wallace & Baesel, Inc.	704-334-4244
Ohio	Cincinnati, Beedle Equip. Co.	513-793-0140
Ohio	Cleveland, M.A. Blankenburg & Co.	216-251-7010
Okla	Oklahoma City, Kennedy Engrg. Co.	405-524-6048
Okla	Tulsa, Kennedy Engrg. Co.	918-835-9975
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Oreland, Esterline Angus Branch Off.	215-887-2268
Pa	Pittsburgh, Bollinger & Richards	412-561-2340
Tenn	Knoxville, G.W. Massey Co.	615-577-9553
Tex	Borger, Kennedy Engrg. Co.	806-273-2871
Tex	Dallas, Data Aids Assocs.	214-620-1551
Tex	Houston, Data Aids Assocs.	713-862-6685
Utah	Salt Lake City, Instrumentation Sls.	801-272-3793
Va	Fairfax, Hildenbrand Co.	703-280-2330
Wash	Bellevue, McLaren, Inc.	206-454-3400
WVa	Charleston, Vynock Engrg. Co.	304-722-4221
Wisc	Milwaukee, T.R. Bickler Assocs.	414-453-3772

Local Distributors

Ala	Birmingham, MG Elect. & Equip., 3112 Sixth Ave., S.	205-328-4525
Cal	Burlingame, Metric Resources, 822 Airport Blvd.	415-347-3067
Cal	City of Industry, Hamilton Instrumentation Inc., 137 A'N. Puente Ave.	213-330-3380
Ill	Niles, Cole-Parmer Instr. Co., 7425 N. Oak Park Ave.	312-647-0272
La	New Orleans, New Orleans Instr. Works, 3821 Magazine St.	504-897-0561
Md	Timonium, E.I.L. Instrmts., 1830 York Rd.	301-252-1260
Mich	TroyG. R. Peters Assoc., 1944 Crooks Rd.	313-524-2920
Neb	Omaha, Schneider Elect., 1102-08 Farnham	402-346-5550
NJ	Park Ridge, Gibbs & Stone, 116 Glendale Rd.	201-391-1255
NY	Buffalo, KOM Lamb, 1865 Kenmore Ave.	716-874-3530
Ohio	Cleveland, Marlin Mfg., 12404 Triskett Rd.	216-941-6200
Pa	Philadelphia, Aquatronics, 4th & Cumberland	215-739-0695
Tex	Fort Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Wash	Seattle, Eicher-Richards, 2727 N.E. Blakely	206-523-7888
Wisc	Milwaukee, Taylor Elec., Drawer 11	414-241-4321

ESTES ENGRG. CO., 930 Marine Dr., Port Angeles, Wash., 98362, Tel: 206-457-0904; FSC No: 22590; Empl.: 28

Customer service: S. E. Estes

Free literature available: Ignition shielding specifications & appplication listings for automotive engines (for use by 2-way radio communications systems).

Products manufactured: Braid, Cable, Cable, Capacitors, Fixed, Containers, Filters, Jumpers, Kits, Shielding, Lead Assemblies & Receptacles, Resistors, Services, Assembly, Production & Test, Shields, Suppressors, Wire, Wire Shielding

ETC TERMINAL PRODUCTS, Unit of ITT Cannon Elec., 29000 Aurora Rd., Solon, Ohio, 44139, Tel: 216-248-8800; Empl.: 380; Minimum order: $50 p. 2•695-706

Customer service: D. Dunn

Free literature available: OEM-6T - Electric Terminals & Splices for the OEM, PDQ-1 - Quick Connect Terminals AMC-5 - Terminals & Splices, PIG-4 - Electrical Pigtails, lamp socket assemblies & connectors, TB-2 - Terminal Blocks, Open & Closed Backs, CT-3 - Crimping Tools.

Products manufactured: Connectors, Cutters, Wire, Hand Operated, Splices, wire (Including, Butt & Cap Types), Strips, Terminal Blocks, Boards & Strips, Terminals, Tools, Wire & Cable Ties

Local Sales Offices & Reps.

Ala	Huntsville, ITT Cannon Elec.	205-881-6653
Ariz	Phoenix, ITT Cannon Elec.	602-273-0755
Cal	Los Altos, Recht Assocs.	415-941-0336

Cal San Carlos, LoDan, Inc. 415-592-4600
Cal San Marcos, ITT Cannon Elec. 714-743-4554
Cal Santa Ana, ETC Terminal Products 714-557-4700
Colo Denver, Camel Elctrns., Inc. 303-757-6191
Colo Englewood, ITT Cannon Elec. 303-770-1631
Conn Tolland, ITT Cannon Elec. 203-872-2119
Fla Deerfield Beach, Brandel-Stephens & Co. 305-427-8558
Fla Orlando, Brandel-Stephens & Co. 305-425-3202
Ga Atlanta, Brandel-Stephens & Co. 404-261-7579
Ill Des Plaines, ITT Cannon Elec. 312-297-3150
Ind Muncie, ITT Cannon Elec. 317-257-7879
Kans Leawood, Thunderbird Tech. Sls. & Svcs. 913-642-7220
Kans Wichita, Thunderbird Tech. Sls. & Svcs. 316-684-3941
Mass Swampscott, ITT Cannon Elec. 617-729-8950
Mich Detroit, ITT Cannon Elec. 313-543-0360
Minn Minneapolis, ITT Cannon Elec. 612-854-1973
Mo St. Louis, Thunderbird Tech. Sls. & Svcs. 314-567-6488
NY Dewitt, Tri Tech Elctrns. 315-446-2881
NY E. Rochester, Tri Tech Elctrns. 716-381-2722
NY Elmsford, ITT Cannon Elec.
NY Larchmont, Tri Tech Elctrns. 914-834-4423
Ohio Bedford, ITT Cannon Elec. 216-248-8800
Ohio Kettering, ITT Cannon Elec. 513-434-8181
Pa Feasterville, Professional Svc. Assocs. 215-355-6244
Pa Fort Washington, ETC Terminal Products 215-646-2801
Tex Dallas, ITT Cannon Elec. 214-661-0302
Tex Houston, ITT Cannon Elec. 713-721-3999
Tex Irving, Aid Elctrns., Inc. 214-259-4761
Va Alexandria, ITT Cannon Elec. 703-370-5733
Va Roanoke, ITT Cannon Elec. 703-362-0749
Wash Bellevue, ITT Cannon Elec. 206-454-3903
Wisc Milwaukee, DeVos-Prinz Sls. Corp. 414-272-0356
EXP: Santa Ana, Cal., ETC Terminal Products 714-557-4700
FOR: Can., Montreal, Que., ITT Cannon Elec. Can. 514-336-7660
FOR: Can., North Vancouver, B.C., Arwin Tech. Sls. 604-980-4346
FOR: Can., Whitby, Ont., ITT Cannon Elec. Can. 416-668-8881

ETCHIT, INC., 643 13th Ave. S., Hopkins, Minn., 55343, Tel: 612-935-5507; Empl.: 20; Minimum order: $40

For info on price: F. Bergland; Application info: R. H. Dunn; Customer service: F. Bergland; Delivery info: R. H. Dunn

Free literature available: Brochure

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.
Ind Columbus, Ritter 812-372-1534
NJ Caldwell, A.M. Bakken 201-349-4655
Tex Houston, Manco Metals 713-664-8084

EUBANKS ENGRG., 225 W. Duarte Rd., Monrovia, Calif., 91016, Tel: 213-358-4531, Telex: 675403; Empl.: 75; Minimum order: $25

For info on price: J. Reed; Application info: J. Reed; Customer service: J. Menart; Delivery info: S. Kirkland

Free literature available: Quick-Reference Catalogue; Eubanks; Automatic Wire Strippers.

Products manufactured: Machines/Machinery, Production, Wire Strippers

Local Sales Offices & Reps.
Ala Huntsville, Powertronics, Inc. 205-852-6347
Cal Glendale, Tool Tronics, Inc.
Cal Mountain View, Charles Morse 415-968-7722
Cal Pasadena, O.E.M. Sls. Co. 213-796-9937
Cal Santa Clara, Tool Tronics, Inc. 408-241-4000
Colo Boulder, Mile High Elctrns. 303-444-5615
Conn Bridgeport, Technical Instrs., Inc. 203-368-4582
Fla Titusville, Powertronics, Inc. 305-267-5699
Ill Lake Forest, Marsland Distributing Corp. 312-295-1616
Md Silver Springs, Ara Elctrns. Inc. 301-565-2584
Mass Wilmington, Technical Instrs., Inc. 617-944-3930
Mich Detroit, Electro Entprs., Inc. 313-521-1500*2
Minn Minneapolis, Production Automation Corp. 612-866-5700
Mo Hazelwood, Production Automation Corp. 314-731-2331
Mo Raytown, Production Automation Corp. 816-737-0066
NJ Livingston, Argo Engrg. Co. 201-992-4367
NY Spring Valley, Salit Assocs. 914-352-4443
NY Syracuse, Maloney Sls. Co. 315-488-3440
NC Raleigh, Powertronics, Inc. 919-787-9090
NC Thomasville, Powertronics, Inc. 919-476-6727
Ohio Cleveland, Electro Entprs., Inc. 216-261-7670
Ohio Dayton, Electro Entprs., Inc. 513-426-6071
Ore Portland, Vandy, Inc. 503-292-8633
Pa Glenside, Ara Elctrns. Inc. 215-887-5250
Pa Pittsburgh, Electro Entprs., Inc. 412-371-8497
Tex Dallas, Sivright Co. 214-357-6681
Wash Seattle, Vandy, Inc. 206-789-3300
FOR: Can., Thornhill, Ontario, Robert Neill Co. 416-889-9971

EVANS ASSOCS., Box 5055, Berkeley, Cal., 94705, Tel: 415-848-6839

Customer service: Sls. Dept.

Products manufactured: Amplifiers

Local Sales Offices & Reps.
Va Annandale, J. Hopkins Assoc. 703-323-1641

EVANS CORP., GEORGE 121 37th St., Moline, Ill., 61265, Tel: 309-762-9456; Empl.: 180 .... p. 1•493

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded)

EVAPORATED COATINGS, INC., 798 Welsh Rd., Huntingdon Valley, Pa., 19006, Tel: 215-WI 7-1465; Empl.: 17; Minimum order: $30

For info on price: R. W. Schaffer; Application info: C. H. Barto

Free literature available: General litereature as well as data sheets on several specialized coatings such as RFI shielding anti-static films, reflecting and low reflecting coatings.

Products manufactured: Coatings, Filters, Lenses, R-F, Services, Assembly, Production & Test, Shields

EVERETT/CHARLES, INC., 2806 Metropolitan Pl., Pomona, Cal., 91767, Tel: 714-593-2541; Empl.: 90

Application info: J. Ireland; Customer service: W. Frey

Products manufactured: Cable Assemblies & Harnesses, Cable Fault Locators, Probes, Testers, Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.
Cal Pleasanton, Everett/Charles 415-462-4772
Fla Winter Park, Everett/Charles 305-671-1246
Ill Aurora, Everett/Charles, Inc. 312-859-2636
Ill Chicago, K.W. Meyers 312-774-6440
NH Merrimack, Everett/Charles 603-424-4466
Tex Dallas, Bradenco 214-358-3278

EWALD INSTRS. CORP., Rte. 7R, Kent, Conn., 06757, Tel: 203-927-3278

Customer service: Sls. Dept.

Free literature available: S5 – welding eq't for small parts; HWT hand welding tools; DB die bonders; SS shielding strippers.

Products manufactured: Machines/Machinery, Production, Soldering Equipment, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices), Wire Strippers

EWC, INC., 725 Federal Ave., Kenilworth, N.J., 07033, Tel: 201-245-3200, TWX: 710 996 5993; FSC No: 15387; Empl.: 90

For info on price: C. G. Hiotis; Application info: S. Plepis; Customer service: W. J. Cyrana; Delivery info: W. J. Cyrana

Free literature available: Audio, Power and Inverter Transformers for Military and Commercial Applications.

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Converters, Filters, Power Supplies, Transducers, Transformers

Local Sales Offices & Reps.
Cal Santa Clara, Cummings & Assocs. 408-247-8656
Cal Woodland Hills, Cummings & Assocs. 213-340-6035
Conn Marion, Sands S Company, Inc. 203-628-4363
Fla Orlando, Duay Enterprises 305-277-3296
Fla Palm Beach Gardens, Bill Brozey 305-622-6045
NY Fairport, D. Kirby Co.
NC Swansboro, William Eschwei 919-326-5740
Ohio Vandalia, W. Williams 513-898-1224
Ohio Wickliffe, Walter J. Brauer & Assocs. 216-943-0601
Pa Pittsburgh, Hal B. Allison 412-921-3213

EXACT ELECTRONICS, Box 160, Hillsboro, Ore., 97123, Tel: 503-648-6661, TWX: 910-460-1188; Empl.: 60; Minimum order: $5

Customer service: P. V. Pryor

Free literature available: SHORT FORM CATALOG describes and illustrates 31 different items including function generators, phase generators, frequency synthesizers, and complex waveform synthesizers. The catalog also contains a model capability cross-reference chart and prices.

Products manufactured: Amplifiers, Generators, Synthesizers

Local Sales Offices & Reps.
Ala Huntsville, BCS Assocs. 205-881-6220
Ariz Tempe, PLS Assocs. 602-957-9110
Cal Culver City, Feeger, Lucas, Wolfe 213-559-7220
Cal Los Altos, J. Stone & Assocs. 415-948-4563
Cal Los Angeles, Basic Systems 213-938-2833
Cal Palo Alto, Coherent Mktg. Assoc. 415-327-2217
Cal San Diego, Feeger, Lucas, Wolfe, Inc. 714-277-0993
Colo Denver, PLS Assocs. 303-771-0140
Fla Orlando, BCS Assocs. 305-896-4881
Ill Chicago, Pivan Engrg., Inc. 312-539-4838
Ind Indianapolis, Pivan Engrg., Inc. 317-253-1681
Kans Shawnee Mission, Pivan Engrg., Inc. 913-722-1030
Md Kensington, Electronic Mktg. Assocs., Inc. 301-744-7700
Mass Waltham, Measurement Consultants Corp. 617-890-4400
Mich Farmington, Carter, McCormic & Peirce, Inc. 313-477-7700
Mich Kalamazoo, Carter, McCormic & Peirce, Inc. 616-349-9686
Minn Minneapolis, Pivan Engrg., Inc. 612-537-4501
Mo St. Louis, Pivan Engrg., Inc. 314-567-3636
NM Albuquerque, PLS Assocs. 505-255-2330
NY Great Neck, Measurement Tech., Inc. 516-482-3500
NC Greensboro, BCS Assocs. 919-273-1918
Ohio Cleveland, Carter, McCormic & Peirce, Inc. 216-333-5650
Ohio Dayton, Carter, McCormic & Peirce, Inc. 513-278-5873
Okla Tulsa, Palatine Sls., Inc. 918-622-0321
Pa King of Prussia, Electronic Mktg. Assoc. 215-248-5050
Pa Pittsburgh, Carter, McCormic & Peirce, Inc. 412-824-3760
RI Cumberland, Measurement Consultants Corp. 410-333-6000
Tex Austin, Palatine Sls., Inc. 512-451-7463
Tex Houston, Palatine Sls., Inc. 713-777-4477
Tex Richardson, Palatine Sls., Inc. 214-231-9489
Wash Seattle, Hayes Tech. 206-763-2210
Wisc Brookfield, Pivan Engrg., Inc. 414-786-1940
FOR: Can., Downsview, Ont., Electronetic Systems 416-661-3673
FOR: Can., Montreal, Que., Electronetic Systems 514-342-4112
FOR: Can., Ottawa, Ont., Electronetic Systems 613-733-3781
FOR: Can., Vancouver, B.C., Electronetic Systems 604-687-5696

EXAR, 750 Palomar Ave., Sunnyvale, Cal., 94086, Tel: 408-733-7700, TWX: 910-339-9233; Empl.: 50

Customer service: K. Davis

Products manufactured: Integrated Circuit Devices, Transistors

Local Sales Offices & Reps.
Ariz Scottsdale, Barnhill Five 602-947-5745
Cal Culver City, DeAngelo, Rothman & Co. 213-398-6239
Cal Redwood City, Logan Sls. 415-369-6726
Cal San Diego, DeAngelo, Rothman & Co. 714-560-5707
Cal Santa Ana, DeAngelo, Rothman & Co. 714-549-8092
Cal Sunnyvale, Exar Integrated Sys. 408-733-7700
Colo Denver, Barnhill Five 303-426-0222
Conn Wallingford, Com-Sale 203-269-7964
Fla Miami, Reptronics 305-251-5478
Fla St. Petersburg, Reptronics 813-522-8220
Ga Atlanta, Electro-Mech 404-393-0444
Ill Chicago, M&S Sls. 312-992-1053
Kans Wichita, Dy-Tronix 316-943-6221
Md Baltimore, Component Sls. 301-484-3647
Md Severna Park, Exar Integrated Sys. 301-647-6775
Mass Waltham, Com-Sale 617-890-0011
Mich Warren, DEM Elctrn. Sls. 313-755-6660
Minn Minneapolis, Electronic Innovators 612-884-7471
Minn St. Petersburg, Reptronics 813-522-8220
Mo Hazelwood, Dy-Tronix 314-731-5799
Mo Kansas City, Dy-Tronix 816-761-6543
NY Buffalo, J. McDonough Assoc. 716-839-2044
NY Manlius, J. McDonough Assoc.
NY Rochester, J. McDonough Assoc. 716-889-1919

NY	Williston Park, ABC Elctrn. Sls.	516-747-6610
NC	Raleigh, Component Sls.	919-782-8433
Ohio	Columbus, McFadden Sls.	614-221-3363
Pa	Willow Grove, H. Nash Assoc.	215-657-2213
Tenn	Nashville, Electro-Mech	615-883-1490
Wash	Bellevue, SD-R2 Products & Sls.	206-747-9424
FOR:	Can., Dollard Des Ormeaux, Que., R.F.Q. Ltd.	
FOR:	Can., Downsview Ont., R. Ohm Elctrns. Can.	416-661-2084
FOR:	Can., Mississauga, Ont., R.F.Q. Ltd.	416-625-8874

EXCEL PRODUCTS CO., INC., 700 Joyce Kilmer Ave., New Brunswick, N.J., 08903, Tel: 201-249-6600; Empl.: 360; Minimum order: $25

For info on price: L. Eige Ext. 212; Customer service: R. Louth Ext. 221; Delivery info: R. Louth Ext. 221

Free literature available: Contained in Excel Literature Along With Complete, Illustrated Descriptions of Products are the 'Products' Outstanding Features, Drawings, and Specs of All Items and Material Used In Their Manufacture.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Boards, Programming, Cabinets & Accessories, Cams, Cards, Logic, Chassis, Circuit Board Mounting, Connector Adapters, Connector Blocks, Mother Board, Connector Boxes & Strips, Power Outlet, Connectors, Contact Strips, Finger, Contacts, Electrical, Guides, Circuit Board, Holder & Carriers, Holders, Circuit Board (Production Type), Integrated Circuit Packaging Systems, Racks, Screens, Printed Circuit, Services, Assembly, Production & Test, Sockets, Solder (All Types), Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Terminal Blocks, Boards & Strips, Terminals

EXCEL SPECIALTY CORP., 6335 N. Broadway, Chicago, Ill., 60660, Tel: 312-262-4781; Empl.: 25

For info on price: M. Bank; Application info: M. Bank; Customer service: M. H. Gawron; Delivery info: B. King

Products manufactured: Cords, Jumpers, Lead Assemblies & Receptacles, Leads, Test & Adaptors, Services, Assembly, Production & Test

EXCELLON AUTOMATION, Div. Excellon Inds., 23915 Garnier St., Torrance, Cal., 90509

EXCELLON INDUSTRIES, 9522 W. Jefferson, Culver City, Cal., 94525

EXECUTONE, PRINTACT RELAY DIV., 29-10 Thomson Ave., Long Island City, N.Y., 11101, Tel: 212-EX2-4800, TWX: 710-582-2610; Empl.: 500; Minimum order: $25 .... p. 1•1683

For info on price: J. A. Richards; Application info: R. Terry; Customer service: R. Terry; Delivery info: R. Terry

Free literature available: PR-100 Catalog describes PC board relay which plugs directly into board without sockets or soldering. PR-102A - Relay BCD decoder with memory, PR-262D Technical note on P-C board preparation to accomodate the printout relay.

Products manufactured: Drivers & Decoders For Readouts, Relays

Local Sales Offices & Reps.

Cal	Orange, Sls. & Mktg. Assoc.	714-997-5720
Cal	San Francisco, R.R. Slater	415-392-9154
Cal	Tarzana, R. Capell Co.	213-987-2233
Colo	Colorado Springs, Elctrns. Mfg. Consult.	303-244-3217
DC	Wash, H. Wise Co.	202-363-9417
Fla	Palm Beach Gardens, Graham Assocs.	305-622-4049
Ill	Chicago, Allen Wood & Assocs.	312-283-7400
Ind	Indianapolis, Marketing Engineers	317-546-1523
Mass	Wakefield, Measurement Equip. Co.	617-245-4870
Mich	Dearborn Hgts., Ankofski Assocs.	313-565-6330
Minn	Anoka, K. Haugen & Assocs.	612-421-3395
NM	Albuquerque, IMEC	505-883-9010
NY	Jamaica, S. A. M. Assoc.	212-658-8881
Ohio	Englewood, Ad-El-Tek	513-836-2741
Pa	Philadelphia, H.A. Goodman	215-247-7116
Tex	Dallas, Caton Sls. Co.	214-661-5792
Wash	Seattle, R.R. Slater	206-622-3860

EXETRON CORP., 2390 Walsh St., Santa Clara, Cal., 95050, Tel: 408-247-7660, Telex: 357424; Empl.: 215; Minimum order: $25

For info on price: B. Dresser; Application info: D. Apte; Customer service: S. Koch; Delivery info: S. Koch

Products manufactured: Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Circuits, Printed, Multilayer, Integrated Circuit Devices, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ariz	Tempe, Delta Elctrn. Sls.	602-966-9903
Cal	Mountain View, Nor-Cal	451-961-8121
Cal	San Diego, J.T.L. Assoc.	714-277-8044
Cal	Woodland Hills, Elctrn. Comp. Mktg.	213-340-1745
Colo	Denver, Straube Assoc.	303-426-0890
Fla	Casselberry, E.I.R.	305-830-6900
Ill	Palatine, Choisser & Clanfield Elctrn. Sls.	312-358-8900
Mass	Burlington, Contact Sls.	617-273-1520
Mich	Grosse Pointe Woods, Elko Sls.	313-884-1955
Mo	St. Louis, Beneke & McCaul	314-434-6242
NJ	Cherry Hill, Barrett Assoc.	609-429-1551
NJ	Irvington, M.G.I.	201-399-4350
Ohio	Cleveland, D. Steffen & Assoc.	216-461-8333
Tenn	Bristol, Rakes Engrg. & Mktg.	615-968-4195
Tex	Dallas, Merino Sls.	214-239-9719
Wash	Bellevue, Western Tech. Sls.	206-641-3900
Wisc	Elm Grove, Choisser & Clanfield Elctrn. Sls.	414-476-0484

EXIDE POWER SYS. DIV., ESB, Inc., Box 5723, Philadelphia, Pa., 19120, Tel: 215-FI2-8000, TWX: 215-725-7397; Empl.: 2200

Products manufactured: Batteries, Oceanographic Equip. (Electronic), Power Supplies, Switches, Testers

Local Sales Offices & Reps.

Ala	Birmingham	205-879-5321
Ariz	Phoenix	602-279-6680
Cal	San Francisco	415-589-9005
Cal	San Francisco	415-761-1080
Cal	Santa Fe Springs	213-698-9981
Colo	Denver	303-623-7793
Conn	Hamden	203-288-6389
Del	Wilmington	302-994-1970
DC	Wash	202-362-5700
Fla	Jacksonville	904-356-7506
Fla	Miami	305-885-5709
Fla	Tampa	813-248-2173
Ga	Atlanta	404-351-2722
Haw	Honolulu	808-847-0623
Ill	Benton	618-439-6194
Ill	Countryside	312-352-3665
Ill	Peoria	309-685-7684
Ind	Fort Wayne	219-743-0020
Ind	Indianapolis	317-787-3434
Ind	South Bend	219-233-7823
Ky	Louisville	502-585-4500
La	Metairie	504-837-3504
Md	Towson	301-825-2611
Mass	Medford	617-395-7979
Mass	Springfield	413-785-1034
Mich	Dearborn	313-581-0400
Mich	E. Grand Rapids	616-456-7487
Mich	Flint	313-238-6811
Minn	Roseville	612-631-2150
Mo	Kansas City	816-842-7274
Mo	St. Louis	314-773-1644
Neb	Omaha	402-342-6528
NJ	Newark	201-642-0005
NY	Albany	518-869-6907
NY	Buffalo	716-854-1278
NY	East Syracuse	315-437-8481
NY	Rochester	716-865-3800
NY	Woodside	212-457-4700
NC	Charlotte	704-375-7966
NC	Greensboro	919-274-2222
Ohio	Cincinnati	513-851-3838
Ohio	Cleveland	216-241-6231
Ohio	Columbus	614-846-0224
Okla	Tulsa	918-932-2878
Ore	Portland	503-284-6710
Pa	Bethel Park	412-833-6500
Pa	King of Prussia	215-265-6060
Tenn	Chattanooga	615-267-5850
Tenn	Memphis	901-327-6236
Tenn	Nashville	615-262-9285
Tex	Dallas	214-243-5531
Tex	Houston	713-524-2033
Utah	Salt Lake City	801-359-5766
Va	Ashland	804-798-4511
Va	Roanoke	703-342-0763
Wash	Seattle	206-623-1377
WVa	Bluefield	304-327-5859
WVa	Charleston	304-346-5363
Wisc	New Berlin	414-544-5428

F-DYNE ELCTRNS., 449 Howard Ave., Bridgeport, Conn., 06605, Tel: 203-367-6431; Empl.: 310; Minimum order: $15 .... p. 2•130-133

For info on price: M. Koenigsberg; Application info: A. Horne; Customer service: M. Koenigsberg; Delivery info: R. Furst

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Filters, Networks

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns.	205-881-5031
Cal	Fremont, Spence Assocs.	415-656-9506
Cal	Van Nuys, Myco Sls.	213-988-2288
Colo	Denver, Walter Engrg.	303-777-5585
Conn	Wethersfield, Con/Pak	203-563-4784
Del	Wilmington, Dyna-Rep.	301-256-8300
Fla	Ft. Lauderdale, Beacon Elctrns.	305-622-2770
Fla	Maitland, Beacon Elctrns.	305-647-3498
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Ill	Elk Grove Village, Loren Green Assocs.	312-593-0282
Ind	Indianapolis, Loren Green Assoc.	317-293-9827
Kans	Shawnee, J. Guernsey Co.	913-631-2414
Mass	Needham, Com/Pak	617-444-1259
Mich	St. Clair Shores, J. M. Thorpe Co.	313-779-6363
Minn	Minneapolis, Loren Green Assoc.	612-781-1611
NJ	Haddonfield, Dyna-Rep.	609-795-1700
NY	Hempstead, Kahgan Sls.	516-538-2300
NY	Syracuse, Naylor Elec.	315-472-9183
NC	Greensboro, L & D, Inc.	919-292-3201
Ohio	Cleveland, Orr Assoc.	216-885-1324
Tex	Dallas, Cunningham Co.	214-231-2686
Tex	Houston, Cunningham Co.	713-461-4197
Va	Alexandria, Dyna-Rep.	703-354-1222
Va	Newport News, Dyna-Rep.	804-874-7729
FOR:	Can., Don Mills, Ont., B. D. Vallillee Elctrns.	416-447-8482

FABRI-TEK, INC., 5901 S County Rd. #18, Minneapolis, Minn., 55436, Tel: 612-935-8811, TWX: 910-576-2913

Products manufactured: Memory Systems

FABRI-TEK, INC., Computer Systems Div., 5901 S. County Rd. 18, Minneapolis, Minn., 55436, Tel: 612-935-8811, TWX: 910-576-2913; FSC No: 21542; Empl.: 2322; Minimum order: $75

For info on price: J. Erickson; Application info: J. Erickson; Customer service: G. Nelson; Delivery info: G. Nelson

Free literature available: Data sheets on all products - lists features & specifications Data sheets & reference manual on MP12 digital computer - contains all info. on operation & descriptions of standard MP12 software.

Products manufactured: Cores, Magnetic, Memories, Buffer, Memory Systems

Local Sales Offices & Reps.

Cal	Long Beach	213-420-2493
Cal	San Jose	408-246-8391
Colo	Denver	303-753-0631
Fla	Orlando	305-857-1050
Ill	Elk Grove Village	312-437-4116
Mass	Auburndale	617-969-5077
Mich	Northville	313-348-2161
NJ	Union	201-964-4770
Tex	Dallas	214-661-3155

FABRICAST, INC., 2517 Seaman Ave., So. El Monte, Cal., 91733, Tel: 213-443-3247; FSC No: 13345; Empl.: 8; Minimum order: $25 .... p. 1•950-955

Customer service: T. Elam

Free literature available: Catalogue

Products manufactured: Brushes & Brush Assemblies, Motor & Generator Armatures, Rotors, Stators, Slip-Rings & Assemblies

FACIT-ADDO, INC., 501 Winsor Dr., Secaucus, N.J., 07094, Tel: 201-866-5111, TWX: 710-992-8927; Empl.: 125

Customer service: O. Bjerkmann

Products manufactured: Calculators, Electrical & Electronic, Display Devices/Displays, Perforators, Printers, Readers, Recorders, Typewriters, Input-Output (All Types)

Local Sales Offices & Reps.

Cal	Los Altos, Cain-White, Co.	
Cal	Los Angeles, Facit-Addo, Inc.	213-385-4161
Cal	Sherman Oaks, Elctrn. Mktg. Specialists	213-990-4244
Colo	Denver, Rocky Mountain Office Machines	303-238-1381
Colo	Evergreen, Mountaintek	303-674-5255

Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Ill	Chicago, Data Elctrns. Co.	312-283-0300
Md	Wheaton, K-G Elctrns.	301-946-4055
Mass	Wakefield, Instr. Dynamics	617-245-5100
Mo	Florissant, Midwest Mktg. Assocs.	314-831-0342
NY	Elmont, Crane & Egert	516-448-2100
NY	Penfield, A & D Devices	716-586-8033
Ohio	Wickliffe, Data-tron	216-585-8421
Pa	King of Prussia, Riv-Co.	215-265-5211
Tex	Fort Worth, Carey Wolf & Assocs.	817-738-1996
Wash	Seattle, Showalter-Judd, Inc.	206-762-2310

FAIR-RITE PRODS. CORP., Wallkill, N.Y., 12589, Tel: 914-895-2055, TWX: 510-249-4819; Empl.: 210

p. 2•1215

For info on price: B. Tolen; Application info: W. Martin; Customer service: B. Tolen; Delivery info: B. Tolen

Free literature available: Catalog of Fair-Rite® Cores, Application Note: Use of Ferrites For Wide Band Transformers, Application Note: DC to AC Inverter Design, Fair-Rite® Shield Beads

Products manufactured: Cores, Magnetic, Ferrite Material & Parts, Shielding Beads, Ferrite

Local Sales Offices & Reps.

Cal	City of Industry, Micrometals	213-968-4718
Colo	Denver, Electronic Sales, Inc.	303-771-6300
Conn	W Hartford, R. S. Pettigrew & Assoc.	203-233-8533
Fla	Maitland, Barrett Assocs.	305-678-0172
Ill	Palestine, Fair-Rite Prod.	618-586-2556
Mass	W. Newton, R.S. Pettigrew & Co.	617-969-5770
Ohio	Cincinnati, F. J. Campisano & Assoc.	513-662-1616
Pa	Philadelphia, Mid-Eastern Assoc.	215-842-2810
Tex	Dallas, Stasco	214-239-5054
Va	Roanoke, A. B. Kreger & Co.	703-989-4738
Wash	Seattle, J. Bergford & Assoc.	206-866-0201

FAIRCHILD SEMICONDUCTOR, 464 Ellis St., Mountain View, Cal., 94040; Tel: 415-962-5011

Products manufactured: Amplifiers, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Diodes, Display Devices/Displays, Integrated Circuit Devices, Lamp Drivers, Lamps, Memory Systems, Microwave Integrated Circuits (MIC's), Multiplexers, Multipliers, Rectifiers, Regulators, Sensors, Light, Shift Registers, Switches, Transducers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville	205-883-7020
Ariz	Phoenix	602-264-4948
Cal	Los Angeles	213-466-8393
Cal	San Diego	714-279-6021
Cal	Santa Ana	714-558-1881
Cal	Santa Clara	408-244-1400
Colo	Lakewood	303-234-9292
Conn	Stamford	203-348-7701
Fla	Altamonte Springs	305-834-7000
Fla	Ft. Lauderdale	305-566-7414
Fla	Largo	813-585-3892
Ill	Schiller Park	312-671-4660
Ind	Fort Wayne	219-483-6453
Ind	Indianapolis	312-849-5412
Kans	Mission	913-432-7878
Md	Bladensburg	301-779-0954
Mass	Wellesley Hills	617-237-3400
Mich	Westland	313-425-3250
Minn	Edina	612-835-3322
NJ	Wayne	201-696-7070
NM	Albuquerque	505-265-5601
NY	Endwell	607-754-1094
NY	Melville	516-293-2900
NY	Poughkeepsie	914-452-4200
NY	Rochester	716-385-1130
NY	Syracuse	315-471-3391
NC	Raleigh	919-781-1000
Ohio	Dayton	513-278-8278
Ohio	Highland Hgts.	216-461-8288
Okla	Tulsa	918-663-7131
Pa	Fort Washington	215-886-6623
Tex	Dallas	214-234-3391
Tex	Houston	713-771-3547
Wash	Bellevue	206-454-4946
Wisc	Milwaukee	414-282-5260
FOR:	Can., Mississauga, Ont.	416-625-7070

FAIRCHILD SOUND EQUIP., Sub. Robins Inds., 75 Austin Blvd., Commack, N.Y., 11725, Tel: 516-543-5200; Empl.: 35; Minimum order: $25

Customer service: R. Belmont

Free literature available: Engineering data sheets covering our broad line of solid state audio components, including amplifiers, compressors, mixing consoles and specialized audio control devices.

Products manufactured: Amplifiers, Attenuators, Equalizers, Generators, Mixers, Monitors, Oscillators, Power Supplies, Public Address Systems

Local Sales Offices & Reps.

Ala	Birmingham, Adams & Assocs., Inc.	205-822-8109
Cal	Oakland, Hank Gabriel	415-465-5361
Colo	Westminster, Electro-Tek Sls., Inc.	303-255-4566
Fla	Tampa, Repelect	813-227-5051
Ga	Decatur, Adams & Assocs., Inc.	404-981-2207
Haw	Honolulu, Gene Piety Factors, Inc.	808-839-9059
Ill	Chicago, Gordon Duvall Co.	312-763-6785
Iowa	Des Moines, KSW Assocs.	515-279-9235
Mich	Southfield, Robert Milsk Co.	313-354-3310
Mo	Kansas City, KSW Assocs.	816-363-5651
Neb	Omaha, KSW Assocs.	
NJ	Cherry Hill, Landy Assocs.	609-424-4660
NY	Phelps, LSM Assocs.	315-548-4891
NY	Port Washington, Joseph Assocs.	516-883-1829
NC	Greensboro, Adams & Assocs., Inc.	919-272-6838
Ohio	Columbus, Mandabach Assocs.	614-235-0265
Tex	Houston, Wyborny Sls. Co.	713-772-0961
EXP:	N.Y., Roslyn, Telesco Internat'l Corp.	516-484-4920

FAIRCHILD SPACE & DEFENSE SYS. DIV., Fairchild Camera & Instr., 300 Robbins La., Syosset, N.Y., 11791, Tel: 516-931-4500, TWX: 510-221-1836; Empl.: 800

Products manufactured: Cameras, Comm. Systems, Computers, Converters, Data Acquisition & Reduction Systems, Lenses, Optical & Camera, Services, Assembly, Production & Test, Standards, Television Systems & Equipment Closed-Circuit

FAIRCHILD SYS. TECHNOLOGY, 1725 Technology Dr., San Jose, Cal., 95110, Tel: 408-998-0123, TWX: 910-338-0558; Empl.: 600

For info on price: L. Thompson; Application info: J. Campbell; Customer service: V. Klein; Delivery info: B. Davi

Free literature available: Catalogs: Qualifier 901 - Digital IC benchtop tester; Sentry 610 – Computer controlled 10 MHz LSI, memory tester; Sentry 1200 – Computer controlled memory and microprocessor tester.

Products manufactured: Testers

Local Sales Offices & Reps.

Ariz	Tempe, FST	602-966-7297
Cal	Los Angeles, Fairchild Sys. Tech.	213-678-3166
Cal	Sunnyvale, Fairchild Sys. Tech.	408-998-0123
Fla	Altamonte Springs, Fairchild Sys. Tech.	305-834-7070
Ill	Chicago, Fairchild Sys. Tech.	312-671-4480
Mass	Wellesley, FST	617-237-4787
Minn	Minneapolis, Fairchild Sys. Tech.	612-835-3322
NJ	Cherry Hill, FST	602-242-3100
NJ	Wayne, FST	201-696-7070

FALSTROM CO., 174 Falstrom Ct., Passaic, N.J., 07055, Tel: 201-777-0013; Empl.: 250

Customer service: R. E. Hill

Free literature available: Falstrom Metal Fabricated Products- shows variety of weldments, enclosures, chassis, racks, made for dozens of industries.

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Metal, Frames, Cabinet & Rack, Racks, Services, Assembly, Production & Test, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

FANON/COURIER CORP., SUBS., Resdel Engineering, 990 S. Fair Oaks, Pasadena, Cal., 91105, Tel: 213-799-9164

For info on price: M. Trotiner; Application info: M. Trotiner; Customer service: R. Dashner

Free literature available: Fanon short form catalog with complete product line of sound and communications products. Individual Courier data sheets on citizen band radios and monitor scanners.

Products manufactured: Amplifiers, Antennas, Baffles, Speaker, Comm. Systems, Drivers, Speaker, Handsets, Chestsets, Headphones, Headsets, Etc., Microphones, All Kinds, Public Address Systems, Receivers, Speaker Systems, Speakers, Transmitters

Local Sales Offices & Reps.

Cal	Burlingame, Elvey Proctor Co.	415-347-2994
Cal	Sunnyvale, Elvey Proctor Co.	
Cal	Van Nuys, C.H. Mitchell Co.	213-994-9466
Colo	Littleton, Kenealey Assocs.	303-771-8140
Conn	Wallingford, Adam-McGregor	203-269-5816
Ga	Savannah, L. Sherman Assocs.	912-925-3660
Ill	Skokie, M. Bermann Sls.	312-675-3740
Ind	Indianapolis, Dewey Powers Sls.	317-846-0790
Kans	Shawnee Mission, M. Bettis Co.	913-362-0772
Kans	Wichita, M. Bettis Co.	316-685-7441
Mass	Scituate, Adams-McGregor	617-545-2213
Minn	St. Paul, Carl-M Co.	612-699-8004
Mo	St. Louis, M. Bettis Co.	314-429-2099
NJ	Fair Lawn, Moses & Kline	201-791-8538
NY	Ballston Spa, Al Toupkin Sls.	518-587-3956
NY	Kenmore, Al Toupkin Sls.	716-873-8839
NY	Merrick, Moses & Kline	516-378-1804
NY	North Pelham, Moses & Kline	914-738-1163
Ohio	Youngstown, Repcom	216-788-9693
Ore	Portland, Ron Meritt Co.	503-292-8762
Pa	Willowgrove, R. Lewis Sls.	215-659-0704
RI	Lincoln, Adams-McGregor	401-726-1300
Tex	Dallas, Loss Co.	214-691-6039
Utah	Murray, Kenealey Assocs.	801-268-3111
Va	Falls Church, R. Lewis Sales	703-534-7732
Wash	Seattle, Ron Merritt Co.	206-682-7337
Ariz	Phoenix, Sal Bova Sls. Co.	602-266-1137
Cal	Foster City, Olson Sls. Co.	415-573-1600
Cal	Los Angeles, L.J. Ross Sls.	213-476-1601
Cal	No. Hollywood, M. Stobin Co.	213-983-1555
Cal	San Diego, Doyle & Assocs.	714-461-1926
Colo	Englewood, H.P. Mktg.	303-770-1158
Conn	Waterbury, Anderson Sls. Assocs.	203-753-2487
Fla	Atlantic Beach, Global Military Sls.	904-246-1400
Fla	North Miami, Winfield Elctrn. Sls.	305-945-6544
Fla	Tampa, Winfield Elctrn Sls.	813-884-6500
Ga	Norcross, D. Cooper Co.	404-448-5460
Ill	Chicago, Markal Sls. Co.	312-282-5800
Ill	Evanston, David-Martin Corp.	312-273-2600
Ind	Indianapolis, Shamrock Elctrn. Sls.	317-547-0080
Mass	Boston, Anderson Sls. Assocs.	617-227-2980
Minn	St. Paul, Carl-M Co.	612-699-8004
Mo	Raytown, Midwest Mktg.	816-358-6638
Mo	St. Louis, Midwest Mktg.	314-894-1388
NJ	Fair Lawn, Moses & Kline	201-791-8538
NJ	South Orange, S. Simberkoff Sls. Assocs.	201-763-7900
NY	Lockport, S. Simberkoff Sls. Assocs.	716-434-4426
NY	Merrick, Moses & Kline	516-378-1804
NY	North Pelham, Moses & Kline	914-738-1163
NY	North Syracuse, S. Simberkoff Sls. Assocs.	315-458-5469
Ohio	Akron, Shamrock Elctrn. Sls.	216-666-3796
Ohio	Beachwood, Kam Mktg.	216-464-7717
Pa	Cambridge Springs, Shamrock Elctrn. Sls.	814-398-8348
Pa	Philadelphia, S. Simberkoff Sls. Assocs.	215-743-2512
Tex	Dallas, Maynard-Gunn Sls.	214-528-9090
Tex	Dallas, Ram Mktg.	214-744-4881
Tex	El Paso, Sal Bova Sls.	915-591-6242
Tex	Houston, Maynard-Gunn Sls.	713-497-0544
Utah	Salt Lake City, H & P Mktg. of Colo.	801-466-6105
Va	Arlington, Howard Golenpaul & Assocs.	703-525-5898
Wash	Seattle, W.R. Lanphear & Co.	206-633-4900
Wisc	Colgate, Markal Sls. Co.	414-628-2801
EXP:	N.Y., New York, Roburn Agencies	212-989-5939

FANSTEEL INC., One Tantalum Pl., N Chicago, Ill., 60064, Tel: 312-689-4900, TWX: 910-235-1577; Empl.: 3000

Products manufactured: Contacts, Electrical, Diodes, Foil, Heat Sinks, Soldering, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Seals, Services, Assembly, Production & Test, Transistor, Diode, Thyristor Heat Dissipators, Wire

FARATRON CORP., 280 Green St., S. Hackensack, N.J., 07606, Tel: 201-488-1440, TWX: 710-990-5022; Empl.: 60

For info on price: A. Sanford; Application info: H. Aufiero; Customer service: B. Crawford; Delivery info: B. Crawford

Free literature available: Product sheets on our Present Standard Line of Power Supplies listing description, specifications, available options and pricing. Greibach product literature analoge instruments.

Products manufactured: Meters, Power Supplies

Local Sales Offices & Reps.

Cal	Torrance, Mitronics Ind.
Conn	Manchester, Addelco Corp.
Mass	Needham, Addelco Corp.
NY	Elbridge, L-Tron Corp.
NY	Great Neck, EAC Assocs.
NY	Syracuse, Nycom Corp.
Pa	Doylestown, Camco
Pa	Pittsburgh, Automated Equip. & Engrg.
Tex	Dallas, Thorson Co.
Tex	Houston, Thorson Co.

Advertisment

SINGLE AND MULTIPLE OUTPUT POWER SUPPLIES DESIGNED ESPECIALLY FOR THE OEM MARKET AND COVERING A WIDE RANGE OF REQUIREMENTS. ULTIMATE IN RELIABILITY AND RUGGEDNESS WITH UNIQUE SELF COOLING DESIGN.
FARATRON STOCKS AN EXTENSIVE STANDARD LINE TO SATISFY YOUR IMMEDIATE NEEDS AND SPECIFICATIONS. IMFORMATIVE LITERATURE AVAILABLE ON REQUEST.

FARIA METER CORP., 19 Faria Lane, Uncasville, Conn., 06382, Tel: 203-848-9271; Empl.: 150......p. 1•694

For info on price: J. C. Halbrooks; Application info: J. C. Halbrooks; Customer service: K. Willey; Delivery info: K. Willey

Free literature available: Catalog sheet on each type of product manufactured. Gives technical data, physical dimensions and options available.

Products manufactured: Meters, Switches, Tachometers

FARINON ELECTRIC, 935 Washington St., San Carlos, Calif., 94070, Tel: 415-593-8491, Telex: 34-8491; Empl.: 1000; Minimum order: $25

Customer service: K. O'Neil

Products manufactured: Amplifiers, Comm. Systems, Receivers, Transmitters

Local Sales Offices & Reps.

Cal	San Carlos	415-593-8491
Ga	Atlanta	404-451-1982
NJ	Somerville	201-526-2669
Tex	Houston	713-688-5569
FOR:	Can., Calgary, Alberta	
FOR:	Can., Dorval, Que.	514-636-0974
FOR:	Can., Edmonton, Alberta	403-422-0566

FARRAND CONTROLS, INC., 99 Wall St., Valhalla, N.Y., 10595, Tel: 914-RO 1-2600; Empl.: 75

For info on price: G. A. Quinn; Application info: W. Grace; Customer service: R. McCusker

Free literature available: Farrand Integrated Circuit Digital Readout Brochure, Farrand Step-by-Step Way to Grinder Automation

Products manufactured: Amplifiers, Controls/Control Eqpt., Couplings, Indicators, Recorders, Resolvers, Synchro, Servo Systems

Local Sales Offices & Reps.

Cal	Gardena, Meas. Dev.	213-321-2504
Cal	Hayward, Harron-Rickard Dist.	415-786-1300
Conn	No. Haven, Machining Sys. Inc.	203-288-7433
Ga	Atlanta, Scott Mach. Tool Co.	404-522-8311
Haw	Honolulu, H. S. Gray Co., Ltd.	808-839-2747
Ill	Elmhurst, Federal-Bryant Mach.	312-833-4800
La	Shreveport, Richards Mach. & Sup.	314-567-3131
Mass	E. Boston, Wigglesworth Mach.	617-567-7210
Mich	Troy, Applied Mfg. Sys.	313-689-8600
Mo	Springfield, Crossland Mach. Co.	
Neb	Omaha, Crossland Mach. Co.	402-571-2288
NJ	Morristown, Leon Assocs.	201-540-0209
NY	Pittsford, R/F Allen Mach.	716-385-2730
Ohio	Cincinnati, Tech. Equip. S.	513-771-3630
Ore	Portland, Star Machinery	503-226-3011
Pa	Media, G.S. Maier Co.	215-565-2010
SC	Mt. Pleasant, Smith-Courtney Co.	802-884-5689
Tex	Dallas, C. J. Harter & Son Mach.	214-FL7-1501
Va	Richmond, Smith-Courtney Co.	804-232-4581

FEDERAL PACKAGE CORP., 34016 Nevada Ave. N., Minneapolis, Minn., 55427

FEDERAL SCIENTIFIC CORP., See Nicolet Scientific Corp.

FEEDBACK, INC., 438 Springfield Ave., Berkeley Hghts., N.J., 07922, Tel: 201-464-5181; Empl.: 5

Customer service: M. A. Hewett

Free literature available: Electronic Test Equipment Catalog - Gives detailed specifications of products we offer. Includes application notes & explains principles of operation.

Products manufactured: Analyzers, Demodulators, Generators, Meters, Modulators, All Kinds

Local Sales Offices & Reps.

Fla	Lighthouse Point	305-946-0381
Ind	Indianapolis	317-926-6327

FENWAL ELCTRNS., 63 Fountain St., Framingham, Mass., 01701, Tel: 617-872-8841, TWX: 710-346-0678; Empl.: 250.......p. 1•2316

For info on price: W. M. Minnucci; Application info: W. M. Minnucci; Customer service: N. Brien; Delivery info: W. M. Minnucci

Free literature available: ISO- - CURVE & UNI-CURVE, RT, curve-matched interchangeable thermistors (L-2A & L-6A), thermistor capsule course cL-3A); E-I, curve-matched thermistors (L-7); hi-temp thermistors (L-8), thermistor housing manual (L-5A); thermistor manual

Products manufactured: Mounts, Probes, Resistors, Slide Rules (Circuitry Computing), Thermistors, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Col Ins Co.	205-539-1771
Ariz	Phoenix, Dorton Enterprises, Inc.	602-263-0414
Cal	Los Angeles, E. Landa Co.	213-879-0770
Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Suffield, Andrews Airtronics, Inc.	203-668-0446
Fla	Orlando, Col Ins Co.	305-423-7615
Ill	Chicago, Midwest Elctrn. Sls.	312-777-9700
Ind	Indianapolis, Midwest Elctrn. Sls.	317-926-3736
Iowa	Marion, Thomas & Modrcin Assocs.	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin Assocs.	913-432-2131
Md	Baltimore, B. White & Co.	301-484-5400
Mass	Lynfield, Andrews Airtronics, Inc.	617-245-5220
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
Minn	St. Paul, Northport Engr., Inc.	612-698-3841
Mo	Hazelwood, Thomas & Modrcin Assocs.	314-895-4700
NM	Alburquerque, Zeus, Inc.	505-256-9831
NY	De Ruyter, R.P. Kennedy Co.	315-682-2920
NY	Huntington, CDB Enterprises, Inc.	516-692-5200
NY	Red Hook, R.P. Kennedy Co.	914-876-2700
NY	Rochester, R.P. Kennedy Co.	716-271-6322
NC	Raleigh, Col Ins Co.	919-834-6591
Ohio	Cleveland, A.H. Baier Co. & Assocs.	216-461-6161
Ohio	Dayton, A.H. Baier Co. & Assocs.	513-276-4128
Okla	Tulsa, W.P. Fralia Co.	918-663-8707
Ore	Beaverton, Arneson Assocs.	503-643-5754
Pa	Ardmore, W.K. Metz, Inc.	215-649-3966
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Tex	Fort Worth, W.P. Fralia Co.	817-738-2394
Tex	Houston, W.P. Fralia Co.	713-772-1572
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Seattle, Arneson Assocs., Inc.	206-762-7664
Wisc	Waukesha, Midwest Elctrn. Sls.	414-542-5129
EXP:	Framingham, Mass., Fenwal Electronics	617-872-8841

Local Distributors

Ala	Huntsville, Thermal Corp., Box 5327	205-837-1122
Cal	Burlingame, Rose Elctrn. Distributing Co., 846 Stanton Rd.	415-697-0224
Cal	Los Angeles, Mil-Comm Distrs., 1616 Cotner Ave.	213-478-0525
Colo	Aurora, Jet Elctrns. Supply Co., 1455 Florence St.	303-364-7000
Colo	Denver, Indl. Elctrns. Corp., Box 22457	303-771-2636
Colo	Denver, Newark-Denver Elctrn. Supply, 2170 S. Grape St.	303-757-3351
Ill	Chicago, Newark Elctrns. Corp., 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd.	312-697-8200
Ind	Indianapolis, Graham Elctrn Supply, 133 South Pennsylvania St.	317-634-8486
Mass	Boston, DeMambro Elctrns., 1095 Commonwealth Ave.	617-787-1200
Mass	Newton, A. W. Mayer Co., 38 Border St.	617-965-1111
Minn	Minneapolis, Harry Stark, Inc., 112 Third Ave. N.	612-332-1325
Mo	Kansas City, Burstein-Applebee Co., 3199 Mercier St.	816-531-5614
Mo	St. Louis, Olive Indl. Elec., 6662 Olive St. Rd.	314-863-4051
NH	Manchester, DeMambro Elctrns., 1308 Elm St.	516-433-1700
NM	Albuquerque, Industrial Elctrns., 310 Valverde S.E.	505-256-9831
NY	Buffalo, Summit Distributors, 916 Main St.	716-884-3450
NY	Rochester, Summit Elctrns. of Rochester, 292 Commerce Dr.	716-334-8110
NC	Winston-Salem, Kirkman Elctrns., Inc., 901 W. Second St.	919-724-0541
Ohio	Cincinnati, United Radio, Summit Road & Rheinhold Dr.	513-761-4030
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9123
Pa	Philadelphia, Philadelphia Elctrns., 112 N. 12th St.	215-568-7444
RI	Providence, Wm. Dandreta & Co., 28 Wolcott St.	401-861-2800
Tex	Fort Worth, Patco Supply, 6100 Camp Bowie Blvd.	817-738-2394
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
For:	Can., Edmonton, Alb., Cardinal Indl. Elctrns. Ltd., 14804-119th Ave.	403-455-4122
For:	Can., Montreal West, Que., S. C. Hooker (Cda) Ltd., 144 Ronald Dr.	514-487-5151
For:	Can., Montreal, Que., D. Randall Div. of Neeco Inds. Ltd.	Zenith39420
For:	Can., Rexdale, Ont., D. Randall-Div. of Neeco Inds. Ltd., 80 Galaxy Blvd.	416-678-2890
For:	Can., Vancouver 2, BC, RAE Indl. Elctrns. Ltd., 1629 Main St.	604-687-2621

FENWAL, INC., Div. W. Kidde & Co., Inc., Main St., Ashland, Mass., 01721, Tel: 617-881-2000, TWX: 617-881-1609; FSC No: 73168; Empl.: 700; Minimum order: $25

For info on price: J. W. Rice; Application info: J. W. Rice; Customer service: E. Murphy; Delivery info: J. W. Rice

Products manufactured: Adhesives (All Types), Alarms, Comparators, Controls/Control Eqpt., Monitors, Probes, Pyrometers, Switches, Thermistors, Thermocouples, Elements & Accessories, Thermostats, Transducers

Local Sales Offices & Reps.

Cal	Oakland, Belilove Co., Engrs.	415-658-9011
Cal	Sherman Oaks, Pacific Thermal Sls., Inc.	213-986-6036
Colo	Denver, E & M Sls., Inc.	303-244-4291
Conn	Middletown, Dittman & Greer, Inc.	203-347-4655
Fla	Miami, Ludlum Assocs. Co.	305-592-6523
Ga	Atlanta, Applebee-Church, Inc.	404-451-2747
Ill	River Forest, F. I. Tourtelot Co.	312-771-6300
Ind	Indianapolis, Couchman-Conant, Inc.	317-849-9890
Iowa	Davenport, Volco Co.	319-326-5233
La	Baton Rouge, Ross & Pethtel, Inc.	504-293-0520
Md	Ellicott City, McCourt Co., Inc.	301-465-4515
Mich	Warren, Smith Instrument & Equip. Co.	313-755-3110
Minn	Minneapolis, Volco Co.	612-336-6631
Mo	Kansas City, R. Greene Co.	816-333-7585
Mo	St. Louis, R. Greene Co.	314-644-2666
NJ	Clifton, R.L. Faber & Assocs., Inc.	201-773-8900
NY	Buffalo, R. F. Lamb Co., Inc.	716-874-4900
NY	New York, R.L. Faber & Assocs., Inc.	212-947-4100
NC	Matthews, W.K. Hile Co., Inc.	704-847-9125
Ohio	Cincinnati, Arnold & Assocs.	513-851-7200
Ohio	Cleveland, Anderson-Bolds, Inc.	216-229-4700
Okla	Tulsa, Driscoll Automatic Control Co.	918-747-6625
Pa	Narberth, C. B. Ives & Co., Inc.	215-839-6850
Pa	Pittsburgh, Gilson Engrg. Sls.	412-931-6114
Tenn	Memphis, R. M. Jordan & Assocs.	901-452-7441
Tex	Dallas, D. Shuhart Co., Inc.	214-239-0186
Tex	Houston, Southwestern Controls	713-666-2801
Wash	Seattle, Seatronics, Inc.	206-767-4330
Wisc	Milwaukee, G. Hatch Co., Inc.	414-671-6550

FERRA FLUX CORP., 1801 Newport Circle, Santa Ana, Cal., 92705, Tel: 714-979-0225; Empl.: 50

Customer service: J. Erdag

Free literature available: Data sheets are available on both Audio, Digital and Instrumentation Head Assemblies and on Memory Drum Systems.

Products manufactured: Drums Computer Memory, Heads, Recording Playback, Erase, Memory Systems

FERRANTI ELEC., East Bethpage Rd., Plainview, N.Y., 11803, Tel: 516-293-8383; Empl.: 15

For info on price: M. Canellos; Application info: S. J. Gladys; Customer service: S. J. Gladys; Delivery info: G. Glavin

Products manufactured: Display Devices/Displays, Erasers, Magnetic Tape (Bulk), Meters, Shields, Transistors, Tubes, Yokes

FERRANTI-PACKARD, LTD. ELEC. DIV., 121 Industry St., Toronto, Can.M6M 4M3, Tel: 416-762-3661, Telex: 06-22007; Empl.: 140; Minimum order: $75

For info on price: D. W. Smart; Application info: D. W. Smart; Customer service: J. D. Greenwood; Delivery info: B. Ashton

Free literature available: Brochures on: Electromagnetic display systems and components. Fully automatic or semi-automatic sortation control systems.

Products manufactured: Controls/Control Eqpt., Display Devices/Displays, Indicators

FERRODYNE CORP., 4240 Glencoe Ave., Venice, Calif., 90291, Tel: 213-821-7933, TWX: 910-588-3780; Empl.: 80; Minimum order: $25

For info on price: R. Warmington; Application info: H. Kumano; Customer service: R. Warmington; Delivery info: R. Warmington

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Transformers

Local Sales Offices & Reps.

Cal	Pasadena, Dressen-Barnes	213-795-7731
Md	Simpsonville, Seltec Assoc.	301-596-5520
Mass	Needham, A & M Elec. Reps.	617-444-8170
NY	Elmira, A & D Devices	607-733-0405
NY	Hartsdale, Comp. Sls.	914-725-1050
NY	Rochester, A & D Devices	716-586-8033
NY	Verona, A & D Devices	315-337-7321
Tex	Plano, Zeus Eng.	214-423-7027
Wash	Seattle, Avionics-Liaison	206-767-3870

FERRONICS, INC., 60 N. Lincoln Rd., East Rochester, N.Y., 14445, Tel: 716-377-6820; Empl.: 60; Minimum order: $20

For info on price: M. J. Breiland; Application info: W. Lee Vroom; Customer service: E. Kolls; Delivery info: E. Kolls

Free literature available: Ferronics "Short Form" Catalog, Data Materials Div. Bulletin 501, Ferrite Beads, Bulletin 203, Wide Band Ferrite Cores, Bulletin 401

Products manufactured: Cores; Magnetic, Ferrite Material & Parts, Heads, Recording Playback, Erase, Kits, Shielding, Magnets, Shielding Beads, Ferrite

Local Sales Offices & Reps.

Ala	Huntsville, Comp. Sls.	
Ariz	Phoenix, J.A. Swanson Assocs.	602-949-1536
Cal	Santa Clara, Rodgers Assocs.	408-984-8110
Cal	Seal Beach, TEXEL,	213-596-9411
Fla	Tera Ceia, Comp. Sls.	813-894-4366
Ill	Chicago, Kennedy Engrg.	312-631-8283
Ind	Fort Wayne, Component Insulation Corp.	219-485-7114
Md	Baltimore, Bernard White	301-484-5400
Mass	Newton Lower Falls, New England Comp. Sls.	617-969-9523
Mich	Birmingham, Comp. Insulation	313-644-0087
Minn	Minnetonka, P.J. Codute Co.	612-933-2281
NJ	Ft. Lee, B. Cameron	201-461-2595
NY	Syracuse, N. J. Matchuk	315-488-3251
NC	Charlotte, McLean Sls. Co.	704-366-2675
Ohio	Cleveland, Comp. Insulation	216-521-3570
Ore	Portland, D. G. Weber	503-234-7671
Pa	Ardmore, Wm. K. Metz, Inc.	215-649-3966
Tex	Dallas, Gordon V. Peck Co.	214-341-8311
Wash	Seattle, D. G. Weber	
WVa	Spokane, D. G. Weber	

FERRO-TECH CORP., 6 Northwood Rd., Bloomfield, Conn., 06002, Tel: 203-242-0708; Empl.: 12; Minimum order: $100

For info on price: S. Buchbinder; Application info: R. Wolff; Customer service: J. Zavac; Delivery info: J. Zavac

Products manufactured: Transformers

FERROTRAN ELCTRN., 683 Broadway, New York, N.Y., 10012, Tel: 212-AL4-5810

p. 1•1209-1213; p. 2•1751

Customer service: E. Abbot

Free literature available: Company Catalog

Products manufactured: Power Supplies, Transformers

FERROXCUBE CORP., Mt. Marion Rd., Box 359, Saugerties, N.Y., 12477, Tel: 914-246-2811, TWX: 510-247-5410; Empl.: 300; Minimum order: $100

p. 2•1218-1225

For info on price: G. Ljutic; Application info: J. VanderPoec; Customer service: G. Ljutic; Delivery info: G. Ljutic

Products manufactured: Bobbins, Winding, Coil & Transformer, Chokes, Cores, Magnetic, Ferrite Material & Parts, Magnets, Memories, Buffer, Memory Systems, Shielding Beads, Ferrite, Suppressors

Local Sales Offices & Reps.

Ala	Huntsville, NAPECC	205-534-7351
Cal	North Hollywood, NAPECC	213-762-2118
Cal	San Diego, NAPECC	714-453-5440
Cal	Santa Clara, NAPECC	408-249-1134
Colo	Denver, NAPECC	303-922-8434
Conn	Shelton, Comark Assoc.	203-929-4884
Fla	Fort Lauderdale, NAPECC	305-772-2840
Ill	Elk Grove Village, NAPECC	312-593-8220
Ind	Indianapolis, NAPECC	317-257-6547
Kans	Olathe, B. C. Electronics Sls.	913-782-6696
Mass	Waltham, NAPECC	617-899-7100
Mich	Southfield, NAPECC	313-357-4288
Minn	Minneapolis, Siedare Assoc.	612-533-2294
Mo	St. Louis, B.C. Electronic Sls.	314-731-1255
NJ	Rochelle Park, NAPECC	201-843-4810
NY	Endicott, Tech-Mark Inc.	607-748-7473
NY	Fairport, Tech-Mark Inc.	716-223-1252
NY	Hempstead, Kahgan Sls. Co.	516-538-2300
NY	Hicksville, NAPECC	516-931-6200
NY	Liverpool, Tech-Mark Inc.	315-652-6229
NY	Pleasant Valley, Tech Mark, Inc.	914-635-3436
NC	Raleigh, Candor Co.	919-787-2652
Pa	King of Prussia, NAPECC	215-265-4240
SC	Myrtle Beach, Candor Co.	803-448-5213
Tex	Dallas, NAPECC	214-691-2141
Va	Richmond, NAPECC	804-282-6515
Wash	Bellevue, Ferroxcube Corp.	206-746-3600

Local Distributors

Cal	San Diego, NAPECC, 11568 Sorrento Valley Rd.	714-453-5440
Ill	Elk Grove Village, NAPECC, 175 Scott St.	312-593-8220
Mass	Waltham, NAPECC, 1393 Main St.	617-899-7103
NY	Hempstead, Kahgan Sales, 556 Peninsula Blvd.	516-538-2300
NY	Woodstock, Elna Ferrite, Box 395	914-246-5861
Pa	Flourtown, Eastern Comps., 1407 Bethlehem Pk.	215-836-1616

FERWALT INC. W. H., Hwy. 95 & Webb Rd., Lapwai, Idaho, 83540, Tel: 208-843-2281; Empl.: 15

p. 1•318,319

For info on price: R. J. Brant; Application info: R. J. Brant; Customer service: R. J. Brant; Delivery info: S. Pinson

Free literature available: Crystal oscillator catalog sheets, Temperature compensated crystal oscillator catalog sheets, Voltage controlled crystal and non-crystal catalog sheets, LC & RC oscillator catalog sheets, Oven regulated oscillator specifications

Products manufactured: Clocks (All Types), Oscillators, Standards, Timers

Local Sales Offices & Reps.

Pa	Philadelphia, W.F. Assocs.	215-CA4-4120
Wash	Seattle, IMI Corp.	206-244-8233

FIBERFIL DIV. DART IND., 1701 N. Heidelbach, Evansville, Ind., 47717, Tel: 812-424-3831, TWX: 810-353-0506

For info on price: Cust. Svc.; Application info: W. Lachowecki; Customer service: J. Kissinger; Delivery info: Cust. Svc.

Free literature available: 36 page engineering manual with charts and physical property comparison, test and application data.

Products manufactured: Plastic Raw Materials, Liquids, Pellets, Powders, Resins

Local Sales Offices & Reps.

Cal	Encino	213-783-3235
Ga	Atlanta	404-525-7184
Ill	Chicago	312-332-6242
Mass	Boston	617-742-1049
Mich	Detroit	313-961-9696
Minn	Minneapolis	612-335-0186
NY	New York	212-765-3690
Ohio	Cincinnati	513-721-3810
Ohio	Cleveland	216-771-7107
Okla	Oklahoma City	405-235-2001
Pa	Philadelphia	215-567-2450

FIBRA-SONICS ,INC., 4626 N. Lamon Ave., Chicago, Ill., 60630, Tel: 312-286-7377; Empl.: 20; Minimum order: $25

For info on price: A. R. Watson; Application info: A. R. Watson; Customer service: J. Kirchschlager; Delivery info: J. Kirchschlager

Free literature available: "Facts About Ultrasonic Soldering".

Products manufactured: Generators, Soldering Equipment

Local Sales Offices & Reps.

Cal	Gardena, Instrument Labs	213-770-0650
Colo	Denver, Electronic Sls.	303-771-6300
Ga	Atlanta, D. G. Machnery & Gage Co.	404-633-6201
Mass	Boston, P.J. Engrg. Sls. Co.	617-783-0510
Mich	Dearborn, Pitcher-Poulin	313-582-5420
Minn	Minneapolis, E. J. Doyle Co.	612-827-5847
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Scaneateles, Tech-Sonics Assocs.	315-685-6144
Ohio	Dayton, Rixan Assocs.	513-222-0011
Ore	Portland, Vandy	503-297-1900
Pa	Paoli, Stitzer Assocs.	215-644-5500
Tex	Dallas, Teamwork Inc.	214-243-5881

FIDELITY CHEM. PRODS. CORP., 472 Frelinqhuysen Ave., Newark, N.J., 07114, Tel: 201-242-4110; Empl.: 10; Minimum order: $20

For info on price: S. Siegel; Application info: M. Bick; Customer service: S. Siegel; Delivery info: S. Siegel

Products manufactured: Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Electroplating Equipment & Supplies

FIFTH DIMENSION, Box 483, Princeton, N.J., 08540, Tel: 609-924-5990, TWX: 510-685-9294; Empl.: 100; Minimum order: $45

For info on price: W. Kinney 669-452-1200; Application info: W. Kinney 669-452-1200; Customer service: A. Dubs 669-452-1200; Delivery info: A. Dubs 669-452-1200

Free literature available: Applications Booklet & Catalog on Mercury Film Switching describes methods of using non position sensitive mercury relays and switches. Test Data provided.

Products manufactured: Comm. Systems, Converters, Data Acquisition & Reduction Systems, Relays, Scanners, Signal Conditioners & Equipment, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Portis & Assocs.	602-947-4379
Cal	Encino, Porter Co.	213-788-2350
Cal	Menlo Pk., G.R. McKnight Co.	415-325-2844
Colo	Denver, A-G Elctrns.	303-759-4790
Fla	Orlando, Gra-Mar	305-841-2330
Mass	Burlington, Tritek Inc.	617-272-4550
Mich	Detroit, Nicon Assocs.	313-341-7688
Minn	Minneapolis, G.E. Arneson & Co.	612-920-2086
Mo	Kansas City, Harris Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NY	Staten Island, F.T. Battista Co.	212-979-4020
Pa	Berwyn, Tucker Assocs.	215-644-0142
Va	Alexandria, Vanguard Engrg. Sls.	703-768-1660
Wash	Seattle, H. Levinson Co.	206-323-5100

FIGARO ENGRG. INC., 3-7-3 Higashitoyonaka, Toyonaka City, Osaka, Japan, Tel: 06-849-2156; Empl.: 64; Minimum order: $32

Customer service: K. Tsukada

Free literature available: Catalog: TGS High Sensitive Gas-Electric Transducer for Combustible gases.

Products manufactured: Detectors

FILM CAPACITORS, INC., 100 8th St., Passaic, N.J., 07055, Tel: 201-779-2240; Minimum order: $25

For info on price: S. Lipmsn; Application info: S. Saposnik; Customer service: Margaret; Delivery info: Margaret

Free literature available: 1 - Application Chart 2 - High Voltage Capacitors 3 - High Voltage AC Capacitors 4 - Metallized Mylar High Voltage Capacitors 5 - Metallized Capacitors, (Mylar) 6 - Polystyrene Capacitors Hermetic Mylar Capacitors

8 – Teflon capacitors 9 – Polycarbonate capacitors 10 – Polypropylene capacitors

Products manufactured: Capacitors, Fixed, Capacitors, Variable

Local Sales Offices & Reps.

Ala	Gadsden, F. C.. Nickerson & Co.	205-547-7718
Cal	Mountain View, G. C. Woempner Co.	415-964-5454
Cal	Santa Monica, Rep Associates	213-829-5401
Fla	Oldsmar, F. C. Nickerson Co.	813-855-4209
Ga	Decatur, F.C. Nickerson Co.	404-321-4678
Ill	Chicago, Berndt Assocs.	312-283-0713
Md	Lutherville, Cunningham & Assocs.	301-296-4306
Mass	Chelmsford, Northeast Comps.	603-668-1372
Mich	Warren, DEM Elctrn. Labs	313-755-6660
NJ	Leonia, Kohl-Camber	201-944-6488
NY	Pittsford, D Hurley Sls.	716-586-6159
NC	Kannapolis, F. C. Nickerson & Co.	704-932-6772
Ohio	Akron, Augey Natalino Assoc.	216-725-6087
Tex	Dallas, G. Weinreich & Assocs.	214-DA 1-2800
Wash	Seattle, R Johnston Co.	206-524-5170

FILM MICROELECTRONICS, INC., 17 A St., Burlington, Mass, 01803, Tel: 617-272-5650; Empl.: 75; Minimum order: $10

For info on price: M. Lioz; Application info: M. Lioz; Customer service: M. Lioz; Delivery info: J. Gordon

Free literature available: Literature is available on our chip resistors chemical etchants, metallized substrates, pin diode drivers and hybrid circuit capabilities.

Products manufactured: Circuits, Hybrid, Thin-Film, Resistors, Substrates

FILTECH CORP., 10103 W. Pacific, Franklin Park, Ill., 60131, Tel: 312-678-8900, TWX: 910-227-4637; Empl.: 75

Customer service: J. A. Victor

Free literature available: Brochures: Quartz crystal filters, LC filters and monolithic crystal filters

Products manufactured: Filters

FILTRON COMPANY, INC., 200 Shames Drive, Westbury, N.Y., 11590, Tel: 516-997-3500; FSC No: 51932; Empl.: 50; Minimum order: $100

For info on price: E. Greenwood 516-997-3500; Application info: E. Greenwood 516-997-3500; Customer service: G. Barry516-997-3500; Delivery info: G. Barry 516-997-3500

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Delay Lines, Films, Filters

Local Sales Offices & Reps.

Ariz	Scottsdale, Inter-Mountain Engrg.	602-947-7379
Cal	Culver City, DeAngelo, Rothman	213-398-6239
Cal	Mt. View, Nor-CalAssoc.	415-961-8121
DC	Wash, Arco	202-393-5991
Mass	Newton Upper Falls, Brookdale Elec.	617-244-6969
Mich	Farmington, Carter, McCormick & Peirce	313-477-7700
NJ	Huntingdon Valley, ABC Sls.	215-464-2275
NJ	Tenafly, Garrettson Co.	201-568-2354
NM	Albuquerque, IMEC	505-883-9010
NY	Williston Pk., Garrettson Co., Inc.	516-747-6610
Tex	Dallas, Texas Microwave	214-231-5381
FOR:	Can., Ottawa, Ont., Aircraft Appliances & Equip., Ltd.	613-233-1852

FINNEY CO., 34 W. Interstate St., Bedford, Ohio, 44014, Tel: 216-232-6161; Empl.: 200; Minimum order: $25

For info on price: R. O. Phillips; Application info: R. O. Phillips; Customer service: R. O. Phillips; Delivery info: N. Harris

Products manufactured: Amplifiers, Antenna Feed Systems, Antenna Rotators, Antennas, Arresters, Electrical Surge, Lightning, Attenuators, Cable, Connectors, Converters, Couplers, Dividers, Filters, Meters, Mounts, Probes, Splicers, Coaxial Cable, Tools, Transformers

Local Sales Offices & Reps.

Cal	Fullerton, H. Hawthorne	714-528-4551
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Ga	Atlanta, Millar Electronics	404-261-6160
Ill	Chicago, Markal Sls.	312-282-5800
Ind	Indianapolis, Elctrn. Representatives, Inc.	317-897-9326
Kans	Shawnee Mission, Lowell, Kangas & Assocs.	913-631-3515
Md	Baltimore, E.K.P. Assocs.	301-944-6677
Md	Baltimore, E.K.P. Assocs.	301-788-6498
Mass	W. Springfield, L.B. Cole & Co.	413-781-3040
Mass	Wellesley Hills, L.B. Cole & Co.	617-237-1260
Miss	Clinton, J. Fisher Sls. Co.	601-924-7348
Miss	Michigan City, J. Fisher Sls. Co.	601-224-6470
Mo	St. Louis, Lowell, Kangas & Assocs.	314-821-4050
NJ	Edison, L.W. Keller & Assocs.	201-287-5476
NJ	Moorestown, Victor Piper	609-235-8006
NY	North Bellmore, L.W. Keller & Assocs.	516-785-2826
NY	North Syracuse, L.D. Allen, Inc.	315-458-7470
NY	Snyder, L.D. Allen	716-839-3300
NC	Raleigh, Millar Electronics	919-787-9564
Ohio	Westlake, T.G. Corpus	216-871-8832
Pa	Easton, E.K.P. Assocs.	215-258-6477
Tex	Ft. Worth, L. Smith	817-332-1909
Wash	Seattle, D. Miller Sls.	206-784-6800
Wisc	Colgate, Markal Sls.	414-628-2801

FIRING CIRCUITS INC., Muller Ave./Box 2007, Norwalk, Conn., 06852, Tel: 203-846-1633; Empl.: 110

Products manufactured: Controls/Control Eqpt., Power Supplies

FISHER SCI. CO., 711 Forbes Ave., Pittsburgh, Pa., 15219, Tel: 412-562-8300; Empl.: 2500

For info on price: W. Lorenz; Application info: K. Doverspike

Products manufactured: Analyzers, Baths, Controlled Temperature (Air & Liquid), Benches, Consoles, Stools, Tables, Cabinets & Accessories

Local Sales Offices & Reps.

Cal	Santa Clara	408-249-0660
Fla	Orlando	305-857-3600
Ga	Atlanta	404-261-4120
Ill	Chicago	312-379-9300
Md	Silver Spring	301-587-7000
Mass	Medford	617-391-6110
Mich	Livonia	313-261-3320
Mo	St. Louis	314-991-2400
NJ	Springfield	201-379-1400
NY	Rochester	716-464-8900
NC	Raleigh	919-876-2351
Ohio	Cincinnati	513-793-5100
Ohio	Cleveland	216-292-7900
Pa	King of Prussia	215-265-0300
Pa	Pittsburgh	412-781-3400
Tex	Houston	713-521-9351

FITCHBURG COATED PRODUCTS, Div. Litton Inds., P. O. Box 1106, Scranton, Pa., 18501, Tel: 717-347-2035; Empl.: 250

Customer service: R. Malloy

Free literature available: A free technical manual on the "Dry Electro-sensitive Recording Process" on request.

Products manufactured: Paper, Graphic Recording, Tapes, Films & Foils, Pressure Sensitive

FJW INDUSTRIES, 215 E. Prospect Ave., Mt. Prospect, Ill., 60056

FLEXPRINT DIV, Sanders Assocs., Inc., Grenier Field, Manchester, N H, 03060, Tel: 603-669-4615, TWX: 710-220-1845; Empl.: 700

Products manufactured: Boards, Printed Circuit, Circuits, Flexible, Circuits, Printed, Multilayer

FLIGHT SYS., INC., Box 25, Mechanicsburg, Pa., 17055, Tel: 717-697-0333; Empl.: 30

Products manufactured: Controls/Control Eqpt.

Local Sales Offices & Reps.

Pa	Paoli, T. Griffin Co.	215-647-1550

FLITE-TRONICS CO., INC., 3314 Burton Ave., Burbank, Cal., 91504, Tel: 213-849-1483; Empl.: 50 p. 1•1214,1215

Customer service: W. V. Viscarra

Products manufactured: Inverters, Power Supplies

FLUKE MFG. CO., INC. JOHN, Box 7428, Seattle, Wash., 98133, Tel: 206-774-2211, TWX: 910-449-2850; FSC No: 89536 .... p: 1•695

For info on price: J. Welte 206-774-2481; Application info: D. Buell 206-774-2473; Customer service: T. Brumfield 206-774-2323; Delivery info: J. Welte 206-774-2481

Free literature available: 1974-75 Test and Measurement Instruments Catalog general catalog covering all Fluke products. Digital Multimeter Brochure - One or more brochures covering latest digital voltmeter products in Fluke line. Automatic Calibration Systems Brochure - Covers Fluke's terminal/10 line of automatic calibration systems.

Products manufactured: Amplifiers, Attenuators, Bridges, Calibrators, Comparators, Converters, Counters, Dividers, Generators, Meters, Power Supplies, Printers, Probes, Receivers, Services, Assembly, Production & Test, Standards, Synthesizers, Test Systems

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Alas	Anchorage, Harry Lang Assocs.	907-279-5741
Ariz	Scottsdale, Barnhill Assoc. Inc.	602-947-7841
Cal	Burbank, Instr. Specialists Inc.	213-849-7181
Cal	San Diego, Instr. Specialists Inc.	714-752-6200
Cal	Santa Clara, Instr. Specialists Inc.	408-244-1505
Colo	Denver, Barnhill Assoc.	303-750-1222
Conn	Glastonbury, Instr. Reps. Inc.	203-633-0777
Fla	Orlando, BCS Assoc. Inc.	305-896-4881
Ga	Atlanta, BCS Assoc., Inc.	804-321-0980
Haw	Honolulu, Ind'l. Elctrns., Inc.	808-533-6095
Ill	Des Plaines, Cozzens & Cudahy, Inc.	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy, Inc.	317-244-2456
Ky	Louisville, BCS Assocs.	502-935-9634
Md	Kensington, Elctrn. Mktg. Assoc.	301-881-5300
Mass	Lexington, Instr. Reps. Inc.	617-861-8620
Mich	Detroit, WKM Assoc.	313-892-2500
Minn	Minneapolis, Cozzens & Cudahy, Inc.	612-884-4336
Mo	St. Louis, Cozzens & Cudahy, Inc.	314-423-1234
Mo.	Kansas City, Cozzens & Cudahy, Inc.	816-454-5836
NJ	Union, SBM Reps., Inc.	201-687-8737
NM	Albuquerque, Barnhill Assoc.	505-299-7658
NY	Pleasantville, SBM Reps., Inc.	914-769-1811
NY	Rochester, SBM Reps., Inc.	716-266-1400
NC	Greensboro, BCS Assoc.	919-273-1918
Ohio	Cleveland, WKM Assoc.	216-267-0445
Ohio	Dayton, WKM Assoc.	513-434-7500
Ore	Beaverton, Showalter Instrs.	503-646-3004
Pa	King of Prussia, Elctrn. Mktg. Assoc.	215-248-5050
Pa	Pittsburgh, WKM Assoc.	412-892-2953
Tex	Houston, Barnhill Assoc.	713-688-9971
Tex	Richardson, Barnhill Assoc.	214-231-2573
Va	Williamsburg, BCS Assoc.	804-877-4053
Wash	Seattle, Showalter Instrs.	206-455-4922

FLUKE TRENDAR CORP., 500 Clyde Ave., Mountain View, Cal., 94043, Tel: 415-965-0350, TWX: 910-379-6573; Empl.: 40

Customer service: N.P. Lyons

Free literature available: TESTCLIP sales brochure and How to Use Manual, T1000, T1010, and T2000 sales brochures, Questions and Answers, and Preparing to Test Manuals.

Products manufactured: Analyzers, Comparators, Probes, Test Systems, Testers

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Alas	Anchorage, H. J. Lang & Assocs.	907-279-5741
Ariz	Scottsdale, Barnhill Three, Inc.	602-947-7841
Cal	Burbank, Instr. Specialists, Inc.	213-849-7181
Cal	Glendale, Instr. Specialists, Inc.	213-243-9404
Cal	San Diego, Instr. Specialists, Inc.	714-565-2555
Cal	Santa Clara, Instr. Specialists, Inc.	408-244-1505
Colo	Denver, Barnhill Three, Inc.	303-934-5505
Conn	Glastonbury, Instr. Reps.	203-633-0777
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Des Plaines, Cozzens & Cudahy, Inc.	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy, Inc.	317-244-2456
Md	Kensington, Elctrn. Mktg. Assocs.	301-881-5300
Mass	Lexington, Instr. Reps.	617-861-8620
Mich	Detroit, W K M Assocs.	313-892-2500
Minn	Minneapolis, Cozzens & Cudhay, Inc.	612-884-4336
Mo	St. Louis, Cozzens & Cudhay, Inc.	314-423-1234
NJ	Union, S B M Reps., Inc.	201-687-8737
NM	Albuquerque, Barnhill Three, Inc.	505-299-7658
NY	Pleasantville, S B M Reps., Inc.	914-769-1811
NY	Rochester, S B M Reps., Inc.	716-266-1400
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cleveland, W K M Assocs.	216-267-0445
Ohio	Dayton, W K M Assocs.	513-434-7500
Ore	Beaverton, Showalter-Judd, Inc.	503-646-3004

Pa	King of Prussia, Elctrn. Mktg. Assocs.	215-265-1600
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Houston, Barnhill Two, Inc.	713-621-0040
Tex	Richardson, Barnhill Two, Inc.	214-231-2573
Wash	Bell, Showalter-Judd, Inc.	206-455-4922

FMC CORP., Organic Chems. Div., 633 Third Ave., New York, N.Y., 10017, Tel: 212-MU 7-7400; Empl.: 300

Products manufactured: Plastic Raw Materials, Liquids, Pellets, Powders, Resins

FMC CORPORATION, Semiconductor Products Operation, 264 Lexington, Homer City, Pa., 15748, Tel: 412-479-8011, TWX: 510-468-9220

Customer service: H. D. Wood

Free literature available: Syntron Silicon Rectifiers - #310072; Syntron Selenium Surge Suppressors - #301172; Silicon Controlled Rectifier Data - #323173; Syntron Selenium Rectifiers - #300D71; A complete line of Syntron Selenium, Silicon, and Silicon Controlled Power Rectifiers.

Products manufactured: Diodes, Rectifiers, Suppressors, Thyristors (Includes Silicon Controlled Rectifiers)

Local Sales Offices & Reps.

Ariz	Scottsdale, Fryco, Engrg. Reps.	602-945-3281
Cal	Los Angeles, C. E. Holmes Co.	213-256-2255
Colo	Denver, Gossard & Assocs.	303-985-0602
Fla	N. Miami Beach, L. Haas Co., Inc.	305-949-9143
Ill	Hinsdale, FMC Corp. Material Handling Equip. Div.	312-325-3250
Ind	Montgomery, Seawood	513-793-6702
Md	Baltimore, Callas Elctrns.	301-744-7711
Mass	Needham, Garrettson Co.	617-449-2640
Mich	Detroit, L.H. Dickelman	313-255-3300
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	St. Louis, H.J. Weisler & Assocs.	314-428-3934
NJ	Hasbrouck Heights, FMC Corp. Material Handling Equip. Div.	201-288-1845
NY	Penfield, J. Lazor Assocs.	716-385-3300
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Ohio	Brecksville, A. Nace Co.	216-526-4323
Pa	Media, W. Reeves Assocs.	215-566-6709
Tex	Richardson, Palatine Sls.	214-231-9489
Wash	Olympia, Bergford & Assocs.	206-866-2001
Wisc	Milwaukee, Syntron Semiconductor Sls.	414-273-6773

FOGG SYSTEM CO., 2101 So. Leyden, Box 22226, Denver, Col., 80222, Tel: 303-758-2979; Empl.: 7

Customer service: H. Fogg

Products manufactured: Amplifiers, Bridges, Calibrators, Filters, Integrators, Electronic

FORK STANDARDS, INC., 211 Main St., West Chicago, Ill., 60185, Tel: 312-231-3511; Empl.: 27 p. 1•320,321

Customer service: A. E. Toht

Free literature available: Catalog 72C and Mailer - contains broad looks at fork standards product line of tuning fork and crystal oscillators. Specialized units such as oven controlled crystal oscillators and oscillators with output regulation are included.

Products manufactured: Calibrators, Coders, Decoders, Generators, Modulator/Demodulators, Modules, Logic, Encapsulated, Oceanographic Equip. (Electronic), Oscillators, Power Supplies, Relays, Standards, Tuning Forks

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assoc.	205-536-1941
Cal	Sherman Oaks, Windsor Dynamics	213-989-3631
Cal	Woodside, Windsor Dynamics	415-854-4870
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Mass	Salem, Forbes Engrg.	617-744-1693
NC	Greensboro, Reynolds & Assoc.	919-275-3725
Ohio	Cleveland, Harvey Teplitz & Co.	216-371-2044
Ohio	Dayton, Harvey Teplitz & Co.	513-277-6531
Pa	Paoli, Tyler Griffin Co.	215-647-1550
EXP:	Westbury, N.Y., Minthorne Intl. Co.	516-334-3303

FORM-IT PRODUCTS INC., 1621 W Walnut St., Chicago, Ill, 60612, Tel: 312-421-7337; Empl.: 21; Minimum order: $10

Customer service: R. St. John

Free literature available: A catalog of our products and an inquiry sheet.

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Insulators & Insulation, Services, Assembly, Production & Test

FORMICA METAL PRODS. CO., INC., Corporation Way, Dept. M, Medford, Mass., 02155, Tel: 617-395-5656; Empl.: 35 p. 1•62,1540

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Racks

FORMULATED RESINS INC., Box 508, Greenville, R.I., 02828, Tel: 401-949-2060; Empl.: 15

For info on price: J. Leone; Application info: N. G. Harrington; Customer service: H. R. Oldham; Delivery info: C. Ridge

Free literature available: Dielectric Materials Selector Chart, News Release.

Products manufactured: Adhesives (All Types), Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Insulators & Insulation, Lubricants, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber

FOSTER TRANSFORMER CO., 3820 Colerain Ave., Cincinnati, Ohio, 45223, Tel: 513-681-2420, TWX: 810-461-2584; Empl.: 250; Minimum order: $2000

Customer service: A. W. Reynolds

Products manufactured: Transformers

Local Sales Offices & Reps.

Cal	Encino, V & L Assocs.	213-986-9703
Cal	San Carlos, Component Assocs.	415-591-9656
Cal	Santa Clara, Nova-Tronix Elctrn. Sls.	408-243-9530
Colo	Wheatridge, Waugaman Assocs. Inc.	303-423-1020
Fla	Melbourne, Hanson Assocs.	305-727-7474
Ill	Evanston, W.F. Swinke & Assocs.	312-869-3577
Ky	Ft. Mitchell, G. Thelen Co.	606-341-8181
Md	Towson, Kraft Elctrn. Sls.	301-828-5838
Mass	Brockton, Forsberg Sls.	207-522-6302
Mich	Farmington, Davis-Martensen Co.	313-474-8300
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
NJ	Ho-Ho-Kus, Alto Assoc.	201-447-1770
NJ	Moorestown, Maple Assocs.	609-234-0382
NY	Brooklyn, Alto Elctrns.	212-253-3904
NY	Pittsford, D. Hurley Sls.	716-586-6159
NC	Charlotte, B. Jackson Co.	704-366-6678
Ohio	Cleveland, Martin-Rettger	216-791-8787
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
Tex	Dallas, Tesco	214-631-6270
Wisc	Milwaukee, W.M. Braun & Assoc.	414-332-1040

FOUR-PHASE SYSTEMS, 19333 Vallco Pkwy., Cupertino, Cal, 95014, Tel: 408-255-0900, TWX: 910-338-0250

Products manufactured: Computers, Data Loggers, Display Devices/Displays, Recorders, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	Los Angeles	213-640-1438
Cal	San Francisco	415-692-4360
Conn	Hartford	203-549-0054
Conn	Stamford	203-357-1860
DC	Washington	202-785-9222
Fla	Miami	305-592-3620
Ga	Atlanta	404-351-0070
Ill	Chicago	312-694-3250
Ind	Indianapolis	317-923-1341
Kans	Kansas City	913-384-0080
Mass	Boston	617-245-9600
Mich	Detroit	313-557-8844
Minn	Minneapolis	612-854-4461
Mo	St. Louis	314-862-3030
NJ	Rochelle Park	201-845-0252
NY	New York	212-575-5656
Ohio	Cincinnati	513-771-0670
Ohio	Cleveland	216-661-0720
Ohio	Columbus	614-459-0414
Pa	Philadelphia	609-234-0200
Tex	Dallas	214-634-2240

FOURJAY INDUSTRIES, Box 1465 Northridge Br., Dayton, Ohio, 45414, Tel: 513-278-9417

Products manufactured: Baffles, Speaker, Grilles, Speakers

FOXBORO CO., 38 Neponset Avenue, Foxboro, Mass., 02035, Tel: 617-543-8750, Telex: 927-602; Empl.: 8500; Minimum order: $25

Free literature available: Brochures for different types of products, e.g., temperature, flow level, pH etc., and indicators, recorders or controllers, pneumatic and electronic. A general catalog for large users.

Products manufactured: Alarms, Amplifiers, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Computers, Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Current Sources, Dividers, Gages, Indicators, Integrators, Electronic, Meters, Monitors, Paper, Graphic Recording, Probes, Programmers, Receivers, Recorders, Services, Assembly, Production & Test, Signal Conditioners & Equipment, Thermocouples, Elements & Accessories, Totalizers, Digital, Transducers, Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.

Ala	Birmingham	205-871-0319
Ala	Mobile	205-471-4487
Cal	El Monte	213-443-4191
Cal	San Leandro	415-357-7520
Cal	Valencia	805-259-8080
Colo	Denver	303-757-6105
Conn	West Hartford	203-236-6121
Fla	Jacksonville	904-398-1545
Ga	Chamblee	404-458-2381
Haw	Honolulu	808-538-1921
Ill	Lansing	312-474-8822
Ill	Mt. Prospect	312-625-8430
Kans	Mission	913-262-1262
Kans	Wichita	316-682-9061
La	Baton Rouge	504-937-3955
La	Metairie	504-887-9450
La	Shreveport	318-865-6522
Me	Augusta	207-622-0601
Md	Baltimore	301-377-9000
Mass	Walpole	617-762-9350
Mich	Farmington Hills	313-851-8900
Minn	Minneapolis	612-835-2191
Mo	St. Louis	314-567-4377
NJ	Springfield	201-379-4000
NY	East Greenbush	518-477-9397
NY	New York	212-532-4682
NY	Rochester	716-244-4590
NY	Tonawanda	716-693-8455
NC	Charlotte	704-535-1111
Ohio	Cincinnati	513-851-1220
Ohio	Middleberg Hts.	216-842-9300
Okla	Tulsa	918-743-4096
Ore	Portland	503-282-4545
Pa	Media	215-565-4100
Pa	Pittsburgh	412-922-3000
SC	Greenville	803-233-4184
Tenn	Knoxville	615-588-9601
Tenn	Memphis	901-452-4427
Tex	Amarillo	806-374-8823
Tex	Beaumont	713-832-9949
Tex	Corpus Christi	512-854-4856
Tex	Dallas	214-238-8207
Tex	Houston	713-783-5400
Tex	Odessa	915-333-2791
Utah	Salt Lake City	801-486-0133
Va	Richmond	804-359-2479
Wash	Seattle	206-633-3660
WVa	South Charleston	304-744-5321
Wisc	Appleton	414-739-1153
FOR:	Can., Calgary 2, Alberta, Foxboro Co., Ltd.	403-264-0891
FOR:	Can., Edmonton, Alberta, Foxboro Co., Ltd.	403-469-2374
FOR:	Can., La Salle 650, Quebec, Foxboro Co., Ltd.	514-366-4210
FOR:	Can., Mississauga, Ontario, Foxboro Co., Ltd.	416-625-4111
FOR:	Can., Moncton, New Brunswick, Foxboro Co., Ltd.	506-855-5174
FOR:	Can., Montreal 201, Quebec, Foxboro Co., Ltd.	514-761-4534
FOR:	Can., Vancouver 6, British Columbia, Foxboro Co., Ltd.	604-291-7248
FOR:	Can., Winnipeg 21, Manitoba, Foxboro Co., Ltd.	204-775-1577

FRAZIER, INC., 1930 Valley View La., Dallas, Tex., 75234, Tel: 214-241-3441; Empl.: 30

Products manufactured: Amplifiers, Baffles, Speaker, Drivers, Speaker, Equalizers, Filters, Mixers, Networks, Speaker Systems, Speakers, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, Pacific Audio Sls. Inc.	213-747-7314
Cal	San Francisco, Equinox Sls. Co.	415-468-3000
Colo	Arvada, CB Elctrn. Mktg.	303-422-0561
Conn	W. Hartford, Robert Smith Co.	203-523-0512
Ga	Atlanta, Secom	404-261-8935

Haw	Honolulu, J.C. Elctrns.	808-537-6787
Ill	Chicago, R.R. Hutmacher Assoc.	312-631-3248
Mich	Ferndale, Shalco Inc.	313-547-4771
Minn	Moorhead, Northland Assocs.	218-233-4616
NJ	Greenbrook, Idiser Co.	201-968-0344
Ohio	Dayton, N. Browning Co. Ltd.	513-298-5973
Tex	Dallas, B. Amos & Assocs.	214-741-3674
Wash	Seattle, D. Smith Sls. Co.	206-633-3160

FREDERICK ELECTRONICS CORP., Hayward Rd. P.O. Box 502, Frederick, Md., 21701, Tel: 301-662-5901, Telex: 893438; Empl.: 215; Minimum order: $25

For info on price: B. Fogle; Application info: E. Russell; Customer service: B. Payton; Delivery info: D. Baker

Free literature available: Data brochures on all products; complete catalog of all products.

Products manufactured: Comm. Systems, Converters, Generators, Keyers, Tone, Memory Systems, Modulator/Demodulators, Oscillators, Receivers, Synthesizers

Local Sales Offices & Reps.

Cal	Santa Clara, Plantronics	408-249-1160
Cal	Valencia, Plantronics	805-255-7997
Conn	Trumbull, Plantronics	203-261-5642
Fla	Brandon, Plantronics	813-689-0220
Ill	Chicago, Plantronics	312-991-1120
Md	Bethesda, Warner Assocs.	202-469-8904
Mo	Ballwin, Plantronics	314-391-0209
NY	New York, Frederick Elctrns. Corp.	212-422-2449
Ohio	Cincinnati, Plantronics	513-232-7870
Pa	Shippensburg, Plantronics	717-532-4425
Tex	Dallas, Plantronics	214-341-9500
Wash	Seattle, Plantronics	206-624-8861
FOR:	Can., Montreal, Fred. Elctrns.	541-871-9652

FREDERICKS CO., Televac Div., Philmont & Anne Sts., Huntington Valley, Pa., 19006, Tel: 215-947-2500; Empl.: 75; Minimum order: $15

For info on price: J. Boericke; Application info: P. McReynolds; Customer service: H. Q. Simons; Delivery info: H. Q. Simons

Products manufactured: Gages, Seals, Services, Assembly, Production & Test, Switches, Thermocouples, Elements & Accessories, Timers

FREED TRANSFORMER CO., INC., 1718 Weirfield St., Brooklyn, N.Y., 11227; Empl.: 200
p. 1•716,717; p. 2•1738-1747

Products manufactured: Amplifiers, Bridges, Capacitors, Fixed, Chokes, Coils Including Assemblies & Forms, Compounds, Encapsulating, Insulating, Molding, Potting, Converters, Current Sources, Decade Boxes, Filters, Indicators, Inverters, Meters, Power Supplies, Reactors, Regulators, Testers, Transformers, Voltage Sources

FREQUENCY DEVICES, INC., 25 Locust St., Haverhill, Mass., 01830, Tel: 617-374-0761, TWX: 710-347-0314; Empl.: 25 .... p. 1•554,555

Customer service: S. M. Ruscio

Free literature available: Data Sheets 300 Series Voltage Tuneable Filters, 700 Series Fixed Frequency Filters, 730-760 Series Tuneable Filters, 744 Series Programable Filters, 400 Series Quadrature Oscillators, 440 Series Tuneable Oscillators, 450 Series Amplitude Regulated Oscillators, 510 Series Tone Encoders, 540-550 Series Tone Decoders, Application Briefs # 1-30.

Products manufactured: Decoders, Encoders, Filters, Generators, Oscillators, Power Supplies, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Tech. Sls.	205-881-1750
Cal	Mountain View, Tech-Ser	415-969-9020
Cal	Woodland Hills, Elctrn. Comp. Mktg.	213-340-1745
Colo	Englewood, Klein Aerospace Assocs.	303-781-4967
Fla	Clearwater, Brennan Assocs.	813-446-2670
Ill	Northfield, Torkelson Assoc.	612-835-2414
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Kans	Shawnee Mission, Tech. Sls. Assocs.	913-888-3330
Md	Silver Spring, Rep-Tron, Inc.	301-593-4844
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	Ferguson, Technical Sls.	314-725-5361
NJ	Fort Lee, Tecnimat	201-461-8686
NM	Albuquerque, Klein Aerospace Assocs.	505-344-8020
NY	Guilderland, Electro-Moduler Sys.	518-458-2665
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Pa	Pittsburg, Electro Sls. Assocs.	412-371-9449
Pa	Willow Grove, H. Nash Assocs.	215-657-2213
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Wash	Seattle, Avionics Liaison, Inc.	206-767-3870

FREQUENCY ELCTRNS., 3 Delaware Dr., New Hyde Pk., N.Y., 11040, Tel: 516-328-0100, TWX: 510-223-0418; Empl.: 185 .... p. 1•323-326

Products manufactured: Amplifiers, Calibrators, Clocks (All Types), Comparators, Connectors, Controls/Control Eqpt., Converters, Detectors, Discriminators, Dividers, Filters, Generators, Meters, Microwave Integrated Circuits (MIC's), Multipliers, Oscillators, Ovens, Receivers, Standards, Switches, Synthesizers

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scien.	205-837-1601
Cal	Sherman Oaks, Windsor Dynamics	213-989-3631
Cal	Woodside, Windsor Dynamics	415-854-4870
Fla	Orlando, Truex Assoc.	305-859-2160
Ill	Chicago, Pivan Engrg.	312-539-4838
Md	Rockville, Marktron Inc.	301-762-6210
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Ferndale, Tiby Co.	313-547-3550
Mo	St. Louis, Pivan Engrg.	314-567-3636
NJ	Englewood, Scien. Devices-East	201-871-3916
NY	Rochester, Ossmann Comps.	716-442-3290
NC	Winston Salem, Int'l. Scien.	919-722-1783
Ohio	Cleveland, Tiby Co.	216-371-5335
Pa	Glenside, Elcom Inc.	215-885-1325
Tex	Houston, R. Martin Assocs.	713-462-4077
Va	Charlottesville, Marktron, Inc.	703-973-5874
Wash	Renton, S. Wilson Co.	206-226-0650
EXP:	New York City, N.Y., Henley Elctrns.	212-985-5544

FREQUENCY ENGRG. LABS., Div. Harvard Inds., Inc., Box 527, Farmingdale, N.J., 07727, Tel: 201-938-9221, TWX: 201-938-2456; Empl.: 620; Minimum order: $125

Customer service: R. Peterson

Free literature available: Passive microwave components, sub-assemblies & instruments, including fixed & variable filters, phase shifters, high power filter-combiners, wavemeters, cavities, multiplexers, frequency synchronizers & phase noise analyzers.

Products manufactured: Amplifiers, Analyzers, Antennas, Calibrators, Cavities, Microwave, Comm. Systems, Comparators, Converters, Filters, Junctions, Hybrid, Microwave, Meters, Mixers, Monitors, Multipliers, Preselector-Mixers, Preselectors, Radar Systems, Receivers, Shifters, Synchronizers, Klystron & BWO, Synthesizers, Testers, Tuners

Local Sales Offices & Reps.

Cal	Sherman Oaks, Windsor Dynamics	213-989-3631
Cal	Woodside, Windsor Dynamics	415-854-4870
Md	Glen Burnie, Micro-Comp	301-761-4600
NY	Tuckahoe, ASCO Elctrns.	914-779-8110
Tex	Ft. Worth, C. Wolf Co.	817-738-1996
Tex	Houston, C. Wolf Co.	713-721-2442
Tex	Universal City, C. Wolf	512-658-6672

FREQUENCY WEST, INC., 3140 Alfred St., Santa Clara, Cal., 95050, Tel: 408-249-2850, TWX: 910-338-0163; FSC No: 8F150; Empl.: 60; Minimum order: $50

Free literature available: Complete specifications for fundamental oscillators, microwave sources and synthesizers. Linear transistorized power amplifiers specifications are included. Application notes on phase-locked signal source design and phase-locked oscillator tune-up procedure.

Products manufactured: Amplifiers, Generators, Oscillators

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	Palo Alto, Waldman Assocs.	415-961-4100
Colo	Denver, Thorson Co.	303-759-0809
Fla	Orlando, Currie, Peak & Frazier	305-855-0843
Ill	Chicago, Tech. Sls.	312-237-7210
Ind	Ft. Wayne, TX Sls.	219-489-4447
Kans	Shawnee, J. F. Guernsey Co.	913-631-2414
Md	Ellicott City, VPI	301-465-4060
Mass	Needham Hts., REPTRON	617-449-4141
Mo	St. Louis, HITT Assocs.	314-426-2322
NM	Albuquerque, Thorson Co.	505-265-5655
NY	N. Syracuse, NACO ELCTRNS.	315-699-2651
NY	Tuckahoe, Spectrum Sls.	914-793-1660
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Shaker Heights, TX Sls.	216-561-1900
Pa	Montgomeryville, VPI Assocs.	215-474-3200
Tex	Dallas, Thorson Co.	214-233-5744
Wash	Bellevue, Thorson Co.	206-455-9180

FREUDENBERG, INC. B., 50 Rockefeller Plaza, New York, N.Y., 10020, Tel: 212-757-9130; Empl.: 8

Customer service: W. J. Leonhardt

Products manufactured: Bridges, Machines/Machinery, Production, Testers, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

FRIEND'S MFG., Rd. 5, Box 74, Williamstown, N.J., 08094, Tel: 609-629-7919; Empl.: 2; Minimum order: $32

Customer service: H. Friend

Products manufactured: Cleaners & Solvents

FUJITSU LTD., 2-chone 6-1, Marunochi, Chiyoda-ku, Japan, 100, Tel: 03-216-3211; Empl.: 32380

FUJI ELECTROCHEMICAL CO., Hamagomu Bld. 5 36-11 Shinbashi, Minato-ku, Tokyo, Japan; Empl.: 3000

Products manufactured: Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Circulators, Ferrite, Coils Including Assemblies & Forms, Converters, Cores, Magnetic, Delay Lines, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Heads, Recording Playback, Erase, Inverters, Isolators, Memory Systems, Microwave Integrated Circuits (MIC's), Power Supplies, Transformers

FUNCTION MODULES, INC., Box 856, 711 W. 17th St., Costa Mesa, Cal., 92627, Tel: 714-645-6001, TWX: 910-596-1384; FSC No: 52467; Empl.: 50; Minimum order: $25

For info on price: S. Banis; Application info: S. Osgood; Customer service: S. Banis; Delivery info: S. Banis

Products manufactured: Amplifiers, Converters, Dividers, Multiplexers, Multipliers, Power Supplies

Local Sales Offices & Reps.

Ariz	Phoenix, Mesa Engrg. & Sls. Assocs.	602-224-1995
Cal	Pasadena, A-F Sales.	213-681-5631
Cal	San Diego, Mesa Engrg.	714-278-8021
Cal	Sunnyvale, RDP Instr., Inc.	408-735-9040
Colo	Denver, Lindberg Co.	303-758-9033
Fla	Altamonte Springs, Wmm Assocs. Inc.	305-831-4645
Fla	Clearwater, Wmm Assocs. Inc.	813-726-8871
Fla	Pompano Beach, Wmm Assocs. Inc.	305-943-3091
Ill	Hinsdale, Momak Sls.	312-654-4524
Iowa	Cedar Rapids, Palatine Engrg. Sls.	319-365-8071
Kans	Andover, Palatine Engrg. Sls.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Md	Baltimore, J.R. Daniel & Co.	301-825-3330
Mass	Needham, Massa & Maquire	617-329-0354
Mich	Farmington, Rep-Tron	313-478-1024
Minn	Minneapolis, Nortec Inc.	612-920-9526
Mo	St. Louis, Palatine Engrg. Sls.	314-426-7055
NM	Albuquerque, Lindberg Co.	505-345-2489
NY	Kingston, Ossmann Component Sales	914-338-5505
NY	Manhasset, Win-Cor Elctrn. Sls.	516-627-9474
NY	Rochester, Ossmann Component Sales	716-442-3290
NY	Syracuse, Ossmann Component Sales	315-454-4477
NY	Vestal, Ossman Component Sales	607-785-9949
NC	Greensboro, J.R. Daniel & Co.	919-294-1065
Ohio	Dayton, Neal Bear Corp.	513-299-3566
Ohio	West Richfield, Bear Mktg.	216-659-3331
Ore	Portland, Western Tech. Sls.	503-297-1711
Pa	Ambler, Wm Assocs.	215-643-4119
Pa	Delmont, T.F. Laslo & Assocs.	412-468-5045
Tex	Dallas, Comspec, Inc.	214-234-4137
Tex	Houston, Comspec, Inc.	713-461-4487
Tex	Houston, Palatine Engrg. Sls.	713-747-6537
Tex	Richardson, Palatine Engrg. Sls.	214-231-9489
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Bellevue, Western Tech. Sls.	206-454-3906

FURNAS ELEC. CO., 1197 McKee St., Batavia, Ill., 60510, Tel: 312-879-3410; Empl.: 1100; Minimum order: $10

For info on price: Sls. Dept.; Application info: Appl. Eng.; Customer service: J. B. Blass; Delivery info: Sls. Dept.

Products manufactured: Controls/Control Eqpt., Nameplates, Relays, Switches, Timers

Local Sales Offices & Reps.

Ark	Little Rock, Ransom Sls. Co.	501-225-7332
Cal	Los Angeles, Calhoun & Poxon Co.	213-225-2328
Cal	Sacramento, R.G. Mitchell Co.	916-444-3789
Cal	San Francisco, Furnas Elec. Co.	415-692-5656
Colo	Lakewood, Western Reps.	303-986-6025
Conn	North Haven, Furnas Elec. Co.	203-239-7185
Fla	Jupiter, J.C. Turner Assoc.	305-746-1487
Fla	Miami, J.C. Turner Assoc.	305-625-6556
Fla	Orlando, J.C. Turner Assoc.	305-859-4705
Ga	Atlanta, A. Brown Assoc.	404-457-6381
Ill	Chicago, Furnas Elec. Co.	312-521-7450
Ind	Fort Wayne, Neal Eng. Co.	219-484-5090
Ind	Indianapolis, Neal Eng. Co.	317-849-4201
Iowa	Davenport, R.L. Wildauer Co.	319-355-3121
Kans	Kansas City, R.E. Gooley	913-831-0200
Ky	Louisville, Neal Engr. Co.	502-267-8337
La	New Orleans, MacKenroth-Robbins & Assocs.	504-524-7662
Md	Baltimore, McCourt Co.	301-465-4515
Mass	Boston, Electrical Comp.	617-655-2225
Mass	Longmeadow, Electrical Comp.	617-655-2225
Mich	Detroit, W.C. Fay & Assoc.	313-851-4750
Mich	Grand Rapids, J.M. Perry Co.	616-949-0271
Minn	Minneapolis, H. Mercer Co.	612-933-7111
Miss	Jackson, MacKenroth-Robbins & Assoc.	601-355-3946
Mo	St. Louis, Kattelmann & Co.	314-434-6875
Neb	Omaha, Orlin I. Wahl	402-451-4276
NJ	Fairfield, Furnas Elec. Co.	201-227-5122
NM	Albuquerque, Elec. Locator & Sls. Co.	505-867-5340
NY	Buffalo, H.H. Cardozo	716-834-3377
NY	New York City, Furnas Elec. Co.	212-285-9732
NY	Rochester, F. Serr	716-586-6226
NY	Syracuse, R.H. Nichols	315-437-2813
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
NC	Greensboro, R.W. Chapman & Co.	919-275-6323
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Akron, R.R. Smith	216-334-2518
Ohio	Cincinnati, Fallon & Sterling Assoc.	513-232-7733
Ohio	Cleveland, M.M. Haley Co.	216-238-3650
Ohio	Dayton, W. Hammer & Assoc.	513-294-4531
Ohio	Toledo, M.M. Haley Co.	419-536-2849
Okla	Tulsa, Industrial Sls. & Engr. Co.	918-743-3610
Ore	Portland, Donal Co.	503-246-3131
Pa	Erie, Foster-McClinton Inc.	814-455-9111
Pa	Philadelphia, H.B. Stallings & Assoc.	215-566-4100
Pa	Pittsburgh, Foster-McClinton Inc.	412-561-4803
SC	Greenville, R.W. Chapman & Co.	803-232-5391
SC	W. Columbia, R.W. Chapman & Co.	803-796-9796
Tenn	Memphis, Ransom Sls. Co.	901-332-0036
Tenn	Nashville, A. Brown Assoc.	615-256-3003
Tex	Dallas, Titan Reps Inc.	214-661-5350
Tex	Houston, Beeco Corp.	713-661-3192
Tex	San Antonio, Dudley Co.	512-337-4804
Utah	Salt Lake City, Electrical Sls. Co.	801-486-1367
Va	Richmond, Marchant Electrical Sls. Co.	804-262-7333
Wash	Seattle, M. Richards Co.	206-323-2127
Wash	Spokane, Electro-Power Corp.	509-535-2931
WVa	Huntington, Foster-McClinton Inc.	304-736-5161
Wisc	Appelton, H. Mercer Co.	414-739-6223
Wisc	Milwaukee, H. Mercer Co.	414-786-6431
FOR:	Can., Calgary, Alb., Elec. Contr. Mach. Ltd.	403-244-0771
FOR:	Can., Halifax, NS, MarLite Co. Ltd.	902-429-5200
FOR:	Can., Moncton, NB, Marlite Co., Ltd.	506-382-8469
FOR:	Can., Montreal, Que, PD Assoc.	514-695-6369
FOR:	Can., St. Johns, New Found, Marlite Co. Ltd.	709-726-4500
FOR:	Can., Toronto, Ont., Furnas Elec. Can. Ltd.	416-759-6743
FOR:	Can., Vancouver, BC, Cansco Agencies Ltd.	604-291-7251
FOR:	Can., Winnipeg, Manitoba, Smith-Paterson & Assoc.	204-774-1855

FUSION SYSTEMS CORP., 11810 Parklawn Dr., Rockville, Md., 20852, Tel: 301-881-5934; Empl.: 19

Customer service: M. Greenblatt

Free literature available: An electrodeless high intensity ultraviolet lamp system with instant on-off, 3000 hour bulb lifetime, low heat, high curing speed. Non mercury bulbs available.

Products manufactured: Lamps

FUSITE DIV./EMERSON ELEC., 6000 Fernview Ave., Cincinnati, Ohio, 45212, Tel: 513-731-2020, TWX: 810-461-2810; Minimum order: $75

For info on price: J. Marsh; Application info: J. Bentley; Customer service: W. Grothaus; Delivery info: J. Marsh

Free literature available: Bulletin 421: Overview of products & specs.

Products manufactured: Connectors, Feedthrus & Seals, Environmental, Seals, Services, Assembly, Production & Test, Terminals, Wire

Local Sales Offices & Reps.

Conn	Old Saybrook, E.J. Hughes Assoc.	203-399-9100
Mass	Attleboro, E.J. Hughes Assoc.	617-226-0050
Mass	Beverly, E.J. Hughes Assoc.	617-927-7171

GABRIEL ELCTRNS. INC., Box 626, Scarborough Ind'l. Pk., Scarborough, Me., 04074, Tel: 207-883-5161; Empl.: 80; Minimum order: $35

For info on price: D. B. Crisman; Application info: D. B. Crisman; Customer service: M. Curry; Delivery info: M. Curry

Free literature available: Short form catalog on request. Information on standard parabolic antennas, high performance antennas (including ultra type) and horn reflectors. Details on mounts, elliptical waveguide, networks, circular waveguide, radomes and pressurizer.

Products manufactured: Antenna Feed Systems, Antennas, Couplers, Dehydrators, Flanges, Waveguide, Horns, Microwave, Mounts, Waveguides & Adapters

GAERTNER SCIENTIFIC CORP., 1261 Wrightwood Ave., Chicago, Ill., 60614, Tel: 312-281-5335; Empl.: 80; Minimum order: $15

For info on price: R. Kutko; Application info: E. G. Watson; Customer service: K. Kutko; Delivery info: J. Stozek

Products manufactured: Densitometers, Electronic, Gages, Interferometer Systems, Lamps, Lenses, Optical & Camera, Microscopes, Testers

GAGNE ASSOCS., INC., 1080 Chenago St., Dept. 3EE-27, Binghamton, N.Y., 13901, Tel: 607-723-9556; Empl.: 45; Minimum order: $10

For info on price: S. Morrisey; Application info: W. W. Schoch; Customer service: J. Edwards; Delivery info: S. Morrisey

Free literature available: Literature on: 1- "Shield-Stripp", "P-F" Dust Bellows2- "Porta-Flex", 3- "Sensiflex", 4- "Porta-Flex".

Products manufactured: Controls/Control Eqpt., Covers, Protective (Including Dust), Machines/Machinery, Production, Switches, Wire Strippers, X-Ray Inspection Equipment

GALILEO ELECTRO-OPTICS CORP., Galileo Pk., Sturbridge, Mass., 01518, Tel: 617-347-9191, TWX: 710-347-1190; Empl.: 200

For info on price: J. M. O'Neil; Application info: L. Owen; Customer service: J. M. O'Neil; Delivery info: J. M. O'Neil

Products manufactured: Comm. Systems, Converters, Detectors, Fiber Optic Bundles, Intensifiers, Image, Power Supplies, Substrates, Transmission Systems, Data, Tubes

Local Sales Offices & Reps.

Cal	El Segundo, Griot Assocs., Inc.	213-322-8383
Cal	Los Altos, Griot Assocs., Inc.	415-941-2533
Colo	Arvada, Cleveland Entrprs., Inc.	303-423-3707
Conn	Sherman, R. P. Mahan Co.	203-355-0231
Fla	Winter Park, McMahan Assocs.	305-645-0463
Ill	Chicago, Brooks Engrg. Co.	312-944-1227
Md	Beltsville, Kelly Scientific Instr.	301-937-4350
Mass	Wellesley, R. P. Mahan Co. (Fiber optics)	617-237-1040
Mich	Farmington, Sheridan Assocs., Inc.	313-477-3800
Minn	St. Paul, Northport Engrg., Inc.	612-698-3841
Mo	Florissant, Sheridan Assocs., Inc.	314-837-5200
NJ	Tenafly, Budd-Tronics (Fiber Optics)	201-569-2230
NM	Albuquerque, Cleveland Entprs., Inc.	505-345-2481
NY	Rochester, Irondequoit Inds.	716-544-6257
Ohio	Cincinnati, Sheridan Assocs., Inc.	513-761-5432
Ore	Beaverton, ES/Chase Co.	503-649-6177
Pa	Pittsburgh, Sheridan Assocs., Inc.	412-244-1640
Tex	Garland, R. S. Marston Co.	214-235-3577
Wash	Edmonds, ES/Chase Co.	206-774-3586
EXP:	Plainville, Mass., Teknis, Inc.	617-695-3591

GAMBLE, CHARLES T. INDS., New Jersey Ave. & Fairview St., Riverside, N.J., 08075, Tel: 609-461-1900, TWX: 510-682-3243; Empl.: 150; Minimum order: $25 p. 2•1492-1495

Customer service: E.P. McCabe

Free literature available: Precision Resistor Catalogue; Power "Vitreous Enamel" Wirewound Resistos; Precision Power Wirewounds; Resistor Engineering Data Book.

Products manufactured: Dividers, Networks, Resistors

Local Sales Offices & Reps.

Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Cal	San Diego, Miracle Assoc.	714-276-8619
Fla	Ft. Lauderdale, G. Bohman Assoc.	
Fla	Orlando, G. Bohman Assoc.	305-855-0274
Ill	Glenview, Crimson Eng.	312-724-1780
NY	Hempstead, Kahgan Sls. Corp.	516-538-2300
NY	Liverpool, WEI Inc.	315-652-8111
Pa	Erie, ECCO Elctrn. Sls.	814-452-3762
Tex	Richardson, Vista Assoc.	214-235-4547

GAMMA SCIENTIFIC INC., 3777 Ruffin Rd., San Diego, Cal., 92123, Tel: 714-279-8034, Telex: 697938; Empl.: 50; Minimum order: $25

For info on price: P. Householder; Application info: G. Unangst; Customer service: G. Unangst; Delivery info: P. Householder

Products manufactured: Densitometers, Electronic, Detectors, Lamps, Meters, Microscopes, Monitors, Photomultiplier Tube Housings, Radiometers, Recorders, Tubes

Local Sales Offices & Reps.

Ariz	Phoenix, Griot Assocs.	602-275-4991
Cal	El Segundo, Griot Assocs.	213-322-8383
Cal	Los Altos, Griot Assocs.	415-941-2533
Cal	Tustin, Griot Assocs.	714-838-2330
Fla	Winter Park, McMahan Assocs.	305-645-0463
Ill	Chicago, Brooks Engrg.	312-944-1227
Md	Kensington, C.W. Hench Assocs.	301-946-7822
Mass	Sudbury, DLG Assocs.	617-877-7880
Pa	Elkins Park, Snow Assocs.	215-379-4700
Tex	Plano, Optical Services Co.	214-442-2011
Wash	Bellevue, Griot Assocs.	206-454-8592

GAP INSTR. CORP., 110 Marcus Blvd., Hauppauge, N.Y., 11787, Tel: 516-273-0909, TWX: 510-227-6237; FSC No: 00607; Empl.: 50; Minimum order: $100

Customer service: W. P. Soboleski

Free literature available: Short Form Catalog Demonstrating Full Capability And/Or Individual Technical Data Sheets on Certain Equipments With Technical Specifications.

Products manufactured: Actuators, Amplifiers, Comparators, Computers, Controls/Control Eqpt., Converters, Display Devices/Displays, Indicators, Motors, Multipliers, Power Supplies, Repeaters, Servo, Servo Systems, Simulators

Local Sales Offices & Reps.

Cal	Long Beach, Maintronics Div. of Pac Ord	213-426-9486
Cal	Monrovia, E. M. I.	213-358-1881
Fla	Orlando, Brennan Assocs.	305-425-4382
Md	Simpsonville, A/O Elctrns.	301-531-6700
Mass	Attleboro, Elctrn. Sls. of New England	617-222-4078
Minn	Anoka, A & R Assocs.	612-421-0751
EXP:	N.Y.C., N.Y., Frathom Co., Div. of Henley Overseas Sls.	212-687-9390

GAR ENTERPRISES, 2031 N. Lincoln Ave., Pasadena, Cal., 91103, Tel: 213-798-0785; Empl.: 25

Customer service: G. Sugimoto

Products manufactured: Regulators, Testers

GARDINER SOLDER CO., Div. of Gardiner Metal Co., 4820 S. Campbell Ave., Chicago, Ill, 60632

GARDNER-DENVER, Grand Haven Div., 1333 Fulton St., Grand Haven, Mich., 49417, Tel: 616-842-0200, Telex: 22-8457; Empl.: 5000 ....p. 1•1541; p. 2•1697

Customer service: W. H. Christiansen

Free literature available: Bulletin 14-1, Portable Wire-Wrap® Tools - A complete line of portable air, electric, battery powered and manual tools for making solder- less wrapped electrical connections.

Products manufactured: Backpanel Interconnect Systems, Cutters, Wire, Hand Operated, Machines/Machinery, Production, Pumps, Vacuum, Screwdrivers, Tools, Wire Strippers, Wire Twisters, Wrenches

Local Sales Offices & Reps.

Ala	Birmingham, Gardner-Denver Co.	205-871-3543
Ariz	Phoenix, Gardner-Denver Co.	602-272-0451
Cal	Bakersfield, Gardner-Denver Co.	805-327-5713
Cal	San Diego, San Diego Egpt. & Supply	714-278-6000
Cal	San Francisco, Gardner-Denver Co.	415-589-3305
Cal	Whittier, Gardner-Denver Co.	213-692-1258
Colo	Denver, Gardner-Denver Co.	303-399-1321
Colo	Grand Junction, Gardner-Denver Co.	303-242-4157
Conn	Bloomfield, Gardner-Denver Co.	203-243-0311
Fla	Hialeah, Pan American Equip. Co.	305-691-4631
Ga	Atlanta, Gardner-Denver Co.	404-938-6633
Idaho	Wallace, Gardner-Denver Co.	208-752-6291
Ill	Broadview, Gardner-Denver Co.	312-681-2210
Ill	Quincy, Gardner-Denver Co.	217-223-8282
Ind	Indianapolis, Gardner-Denver Co.	317-634-2167
Kans	Shawnee Mission, Gardner-Denver Co.	913-888-1040
Ky	Louisville, Gardner-Denver Co.	502-363-2679
La	Lafayette, Gardner-Denver Co.	318-232-3190
La	New Orleans, Gardner-Denver Co.	504-347-1451
La	Shreveport, Gardner-Denver Co.	318-424-4446
Md	Ellicott City, Gardner-Denver Co.	301-465-1155
Mass	Hopkinton, Gardner-Denver Co.	617-435-6311
Mich	Livonia, Gardner-Denver Co.	313-525-9110
Minn	Duluth, Gardner-Denver Co.	218-729-9290
Minn	Minneapolis, Gardner-Denver Co.	612-888-4647
Mo	Bridgeton, Gardner-Denver Co.	314-291-2800
NJ	Mahwah, Gardner-Denver Co.	201-529-4760
NY	Buffalo, Gardner-Denver Co.	716-836-8300
NY	Rochester, Gardner-Denver Co.	716-254-1260
NC	Charlotte, Gardner-Denver Co.	704-366-8532
Ohio	Cleveland, Gardner-Denver Co.	216-524-1856
Ohio	Springdale, Gardner-Denver Co.	513-671-7270
Okla	Oklahoma City, Gardner-Denver Co.	405-677-5737
Okla	Tulsa, Gardner-Denver Co.	918-622-2800
Pa	Horsham, Gardner-Denver Co.	215-672-3003
Pa	Pittsburgh, Gardner-Denver Co.	412-923-1511
Tenn	Knoxville, Gardner-Denver Co.	615-523-6195
Tex	Corpus Christi, Gardner-Denver Co.	512-882-6155
Tex	Dallas, Gardner-Denver Co.	214-233-0100
Tex	Houston, Gardner-Denver Co.	713-626-2220
Tex	Odessa, Gardner-Denver Co.	915-563-1350
Utah	Salt Lake City, Gardner-Denver Co.	801-466-8610
Wash	Seattle, Gardner-Denver Co.	206-624-1115
Wisc	Milwaukee, Gardner-Denver Co.	414-774-2210
Wyo	Casper, Gardner-Denver Co.	307-235-5794
EXP:	Dallas, Tex., Gardner-Denver Int'l.	214-634-8491

GARDNER-DENVER CO., Box 47114, Dallas, Tex, 75247

GARY MFG., INC., 1010 Jersey Ave., New Brunswick, N.J., 08902, Tel: 201-545-2424; Empl.: 250

Products manufactured: Boards, Plug-In, Boards, Printed Wiring, Universal, Connectors, Contacts, Electrical, Integrated Circuit Packaging Systems, Packages, Integrated Circuit, Pins, Racks, Services, Assembly, Production & Test, Socket Adapters, Sockets, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, Mirco Elctrns.	602-944-2281
Cal	Mountainview, Westmark Assocs.	415-969-1700
Cal	Santa Ana, Spectrum Assocs.	714-835-4114
Colo	Denver, Westmark Assocs.	303-433-7181
Conn	Stratford, G. Rosen Co.	203-375-5456
Fla	Pompano Beach, V. G. Sls.	305-941-5544
Ill	Downers Grove, Richmar Elctrns.	312-968-0118
Ind	Indianapolis, J. Ihrig	317-783-7630
Iowa	Des Moines, BEAMS	515-282-0292
Kans	Overland Park, BEAMS	913-341-7744
Md	Baltimore, J. R. Daniels & Co.	301-825-3330
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Detroit, Nicon Assocs.	313-341-7688
Mo	Creve Couer, BEAMS	314-569-1060
NJ	Cherry Hill, J. N. Barrett Assocs.,	609-429-1551
NY	Mount Vernon, Friedman Smith Elec. Sls.	914-664-4866
NY	Syracuse, I. A. Hotze	315-479-6641
NC	Greensboro, J. R. Daniels & Co.	919-294-1965
Ohio	Medina, J. C. Hofstetter	216-725-4477
Tex	Dallas, R. Matthews Co.	214-233-0363
Wash	Kirkland, Freed Assocs.	206-822-8100

GATES ELCTRN. CO., 526 Van Nest Ave., Bronx, N.Y., 10460 .... p. 1•1216-1221

Products manufactured: Chargers, Battery, Eliminators, Battery, Power Supplies

GATES ENERGY PRODS., INC., 1050 S. Broadway, Denver, Colo., 80217, Tel: 303-744-4806, TWX: 910-931-2658; Empl.: 100

Products manufactured: Batteries, Power Supplies

Local Sales Offices & Reps.

Ariz	Scottsdale, FRYCO, Inc.	602-945-3281
Cal	Los Angeles, M. Geery	213-641-2325
Colo	Denver, Gates Energy Prods., Inc.	303-744-4806
Fla	Hollywood, Reynolds & Assocs.	305-987-6720
Fla	Melbourne, Reynolds & Assocs.	305-727-3205
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Minn	Minneapolis, HMR, Inc.	612-920-8200
Mo	Kansas City, H. Hanson Co.	816-444-9494
Mo	St. Louis, H. Hanson Co.	314-432-3611
Okla	Tulsa, Ammon & Rizos	918-633-8518
Ore	Portland, Almac Stroum Elect.	503-292-3534
Tex	Dallas, Ammon & Rizos	214-233-5591
Tex	Houston, Ammon & Rizos	713-729-1233
Wash	Seattle, Almac Stroum Elec.	206-763-2300

GATES, GEO. W. & CO., INC., Hempstead Tpke. & Lucille Ave., Franklin Sq., N.Y., 11010, Tel: 212-347-0787; Empl.: 8

Customer service: T. E. Schulz, Sr.

Products manufactured: Chemicals, Lamps, Lights, Power Supplies, Ultraviolet Inspection Lighting

G B INSTRUMENTS INC., 2030 Coolidge St., Hollywood, Fla., 33020, Tel: 305-920-0225, TWX: 510-954-9813; FSC No: 31601; Minimum order: $50

For info on price: B. Weiss; Application info: B. Weiss; Customer service: R. Richard; Delivery info: B. Weiss

Free literature available: X-Y Recorder Specs; Polar to cartesian converters (coordinate converters); Buffers; Meteorological transmission system; commercial computer systems.

Products manufactured: Computers, Converters, Multiplexers, Process Control Systems, Receivers, Recorders, Services, Assembly, Production & Test, Transmission Systems, Data

Local Sales Offices & Reps.

NM	Las Cruces, BFA Assoc.	505-523-0601

GBC - CLOSED CIRCUIT TV, 74 Fifth Ave., New York, N.Y., 10011; Empl.: 85; Minimum order: $10

For info on price: B. Clarke; Application info: S. Lefkowitz; Customer service: M. Dunn; Delivery info: Z. Richards

Free literature available: List Price Catalog; Executive Guide to CCTV; Distributor Price Schedule.

Products manufactured: Alarms, Amplifiers, Cable, CATV Systems & Equipment, Lenses, Optical & Camera, Monitors, Oceanographic Equip. (Electronic), Racks, Recorders, Tapes, Recording, Magnetic (All Types), Television Systems & Equipment Closed-Circuit, Tubes

Local Sales Offices & Reps.

Cal	Oakland, F.W. Moulthrop & Assoc.	415-261-7676
DC	Wash., GBC/CCTV Wash. Corp.	202-785-8182
Ill.	Chicago, GBC/CCTV Ill. Corp.	312-956-1286
Ind	Indianapolis, GBC/CCTV Ind. Corp.	317-257-1337
Mass	Boston, GBC/CCTV New England Corp.	617-261-2360
Mich	Detroit, GBC/CCTV Mich. Corp.	313-398-1630
Mo	St. Louis, GBC/CCTV Mo. Corp.	314-994-3211
NY	Buffalo, Waxman-Currant Sls.	716-873-0442
EXP:	New York, N.Y., GBC Export Corp.	212-989-4433

GC ELECTRONICS, Div. Hydrometals, 400 So. Wyman St., Rockford, Ill., 61101, Tel: 815-968-9661; Empl.: 550 p. 2•341,1696

Customer service: R. Keas

Free literature available: GC Electronics Catalog-tools, chemicals, service aids. Walsco Catalog-tape-phono drives & belts. Telco Catalog-antennas & installation accessories. Audiotex Catalog-home entertainment accessories. Calectro Handbook experimenter hobbyist items. Electrocraft Switch Catalog-switches & accessories. CB Catalog-CB & ham accessories.

Products manufactured: Adhesives (All Types), Alarms, Amplifiers, Antenna Rotators, Antenna Towers & Supports, Antennas, Arresters, Electrical Surge, Lightning, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Benches, Consoles, Stools, Tables, Boards, Printed Circuit, Burnishers, Contact, Bus Bars & Systems, Cable Assemblies & Harnesses, Cable, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Capacitors, Fixed, Capacitors, Variable, Chargers, Battery, Chemicals, Chokes, Circuit Breakers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Clamps & Clips, Cleaners & Solvents, Coatings, Coils Including Assemblies & Forms, Compounds, Encapsulating, Insulating, Molding, Potting, Connector Adapters, Connectors, Cords, Couplers, Cutters, Wire, Hand Operated, Demagnetizers, Diodes, Display Devices/Displays, Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Drivers, Nut, Dummy Loads, Eliminators, Battery, Etchants, Printed Circuit, Fasteners, Filters, Flux, Brazing & Soldering Materials, Fuses, Grilles, Grommets, Heat Sinks, Soldering, Integrated Circuit Devices, Inverters, Jack Adapters (All Types), Jacks (All Types), Jumpers, Kits, Breadboarding (For Engineers), Kits, Printed Circuit, Knobs, Lamps, Leads, Test & Adaptors, Lubricants, Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mounts, Phonographs, Parts & Accessories, Pickups, Telephone (For Recording), Pin Straighteners, Tube, Pliers, Plug & Jack Sets, Posts, Potentiometers, Power Supplies, Probes, Punches, Chassis, Rectifiers, Relays, Resistors, Rheostats, Rings, Retaining, Rods, Ground, Seizers, Semiconductor Wafer Fabrication, Sockets, Solder (All Types), Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Spacers, Speaker Systems, Speakers, Splicing Equipment, Magnetic Tape, Springs (All Types), Strain Reliefs, Cable & Wire, Suppressors, Switches, Tape Recording Accessories, Tape Winders, Terminals, Thermistors, Tools, Transducers, Transformers, Tubing, Tweezers, Hand & Vacuum, Wire, Wire & Cable Ties, Wire Strippers

GCA/DAVID W. MANN, 174 Middlesex Tpke., Burlington, Mass., 01803, Tel: 617-272-5600, Telex: 94-9352; Minimum order: $25

Customer service: A. C. Tobey

Products manufactured: Data Acquisition & Reduction Systems, Data Loggers, Encoders, Machines/Machinery, Production, Microcircuit Production Equip.

GCA/PRECISION SCIENTIFIC, 3737 W. Cortland St., Chicago, Ill., 60647, Tel: 312-227-2660, TWX: 910-221-3122; Empl.: 325; Minimum order: $10

For info on price: D. Bloss Ext. 322; Application info: R. DeSilvia Ext.353; Customer service: D. Bloss Ext. 322; Delivery info: D. Bloss Ext.322

Free literature available: Thelco Bulletin (320A) covers varied line of ovens, incubators, dryers, vacuum ovens, low temperature incubators, CO&I2 incubators, and similar constant temperature cabinets for research and production control.

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Controls/Control Eqpt., Dehydrators, Gages, Ovens, Pumps, Vacuum, Refrigerators, Environmental Test, Timers, Vibrators

Local Sales Offices & Reps.

Cal	Los Angeles	213-283-7815
Cal	San Francisco	415-391-1883
Del	Wilmington	302-995-1753
Ga	Marietta	404-432-8737
Mass	Boston	617-227-1515
NJ	Milford	201-686-9392
NY	Buffalo	716-856-4141
NC	Charlotte	704-332-4850
Ohio	Columbus	614-457-1807

GCA/SUNNYVALE DIV., 1050 Kifer Rd., Sunnyvale, Cal., 94086

GEMS SENSORS DIV., Delaval, Spring La., Farmington, Conn., 06032, Tel: 203-677-1311; Empl.: 160

For info on price: M. Wright; Application info: M. Wright; Customer service: R. Thibodeau; Delivery info: M. Wright

Free literature available: Complete technical information is supplied relative to level switches, flow switches, solid state relays and continuous readout-tank level indicating systems. Comprehensive educational material is also offered on the subject of "Intrinsic Safety".

Products manufactured: Controls/Control Eqpt., Indicators, Relays, Switches

Local Sales Offices & Reps.

Ala	Homewood, Activation	205-871-0353
Ala	Mobile, Activation	
Alas	Anchorage, C. V. Reser Co.	907-279-3911
Ariz	Phoenix, Bews & Wallace	602-275-4496
Ariz	Tucson, Bews & Wallace	602-795-4837
Cal	Burlingame, Delaval	415-342-3350
Cal	Downey, Delaval	213-923-7281
Colo	Arvada, Petromotive Co.	303-422-0990
Conn	Wethersfield, Delaval	203-563-3737
Fla	Tampa, State Instrs.	813-251-3991
Ga	Atlanta, Activation of Georgia	404-755-6691
Haw	Honolulu, Berkley Eng. & Equip. Co.	808-538-1921
Ill	Moline, R. R. Floody Co.	309-755-2483
Ill	Rockford, R. R. Floody Co.	815-399-1931
Ill	Westchester, Delaval	312-681-4806
Kans	Kansas City, E. A. Akin Engrg. Co.	913-831-3733
La	Metairie, Aries Marine & Ind. Sls.	504-889-0520
Md	St. Michael's, Ray Cantwell	301-745-9010
Mich	Madison Hts., Delaval	313-585-8200
Mich	Royal Oak, R. H. Jackson Co.	313-542-5059
Minn	Minneapolis, W. F. Hartfiel Co.	612-929-1631
Mo	St. Louis, Neff Power	314-647-3002
NM	Albuquerque, Lietz Equip. Co.	505-266-5821
NY	Manhasset, Northeast Engrg.	516-365-9633
NY	Rochester, Delaval	716-328-4760
NC	Charlotte, R. W. Chapman & Co.	704-525-2421
Ohio	Cincinnati, Gallagher Co.	513-761-1288
Ohio	Cleveland, Delaval	216-333-1805
OKla	Tulsa, Tulsa Gauge & Instr.	918-622-5061
Pa	Horsham, Delaval	215-674-1697
Pa	Pittsburgh, Delaval	412-343-5666
SC	Greenville, R. W. Chapman Co.	803-233-0053
Tenn	Antioch, Activation	615-889-6524
Tenn	Knoxville, Activation of Georgia	615-584-2771
Tenn	Memphis, Centro	901-526-0518
Tex	Dallas, Delaval	214-638-1712
Tex	Houston, Delaval	713-697-2897
Wash	Seattle, Fairman B. Lee Co.	206-244-7262
Wisc	Milwaukee, Delaval	414-342-1500

GENERAL AUTOMATIC CORP., 235 W. First St., Bayonne, N.J., 07002, Tel: 201-437-7500

Products manufactured: Relays, Switches

GENERAL AUTOMATION, 1055 South East St., Box 4883, Anaheim, Cal., 92803, Tel: 714-778-4800, TWX: 910-591-1695; Empl.: 1430; Minimum order: $50

Application info: D. Stoner Ext. 240; Customer service: J. Appel Ext. 515

Free literature available: Wide range of data sheets and technical brochures that describe all standard minicomputer products and systems presently available; two comprehensive texts on how to select both minicomputers and microprocessors for specific applications.

Products manufactured: Comm. Systems, Compressors, Data, Computers, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Data Compressors, Digital, Data Loggers, Process Control Systems

Local Sales Offices & Reps.

Ala	Huntsville	205-833-9620
Ariz	Tempe	602-967-7885
Cal	Sunnyvale	408-734-4840
Colo	Denver	303-758-7323
Conn	Stanford	203-327-6000
Fla	Altamonte Springs	305-831-5603
Ga	Atlanta	404-261-6203
Ill	Des Plaines	312-298-1830
Ill	Rockford	815-962-8000
Ind	Indianapolis	317-248-0377
La	Metairie	504-837-7071
Md	Silver Springs	301-587-7090
Mass	Waltham	617-899-8600
Mich	Farmington Hills	313-478-2640
Minn	Minneapolis	612-331-9060
Mo	St. Louis	314-997-1830
NJ	Cherry Hill	609-655-5112
NJ	Livingston	201-994-2750
NY	New York	212-682-7015
NY	Rochester	716-442-0780
NC	Greensboro	919-274-3134
Ohio	Cincinnati	513-563-0860
Ohio	Dayton	513-253-2195
Ohio	Rocky River	216-333-3544
Pa	Pittsburgh	412-922-3331
Tex	Dallas	214-661-5370
Tex	Houston	713-464-2815
Wash	Bellevue	206-747-0720
Wisc	Brown Deer	414-355-1220

GENERAL CONTROL CO., 1196 Soldiers Field Rd, Boston, Mass., 02134, Tel: 617-782-7440; Empl.: 25; Minimum order: $10

Customer service: M. Stone

Products manufactured: Switches

Local Sales Offices & Reps.

Mass	Boston, EACO Engrg. Corp.	617-782-7440

GENERAL DEVICES, INC., P.O. Box 253, Princeton, N.J., 08540, Tel: 609-924-2500, Telex: 84-6473; FSC No: 05285; Empl.: 32; Minimum order: $50

For info on price: M. Medvin; Application info: M. Kirzecky; Customer service: M. Medvin; Delivery info: M. Medvin

Products manufactured: Amplifiers, Brushes & Brush Assemblies, Calibrators, Comm. Systems, Commutators, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Data Loggers, Multiplexers, Oscillators, Scanners, Signal Conditioners & Equipment, Slip-Rings & Assemblies, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assoc.	205-536-1941
Conn	New Canaan, Nerem, Inc.	203-966-2580
Fla	Ft. Lauderdale, Reynolds & Assoc.	305-581-6611
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Fla	St. Petersburg, Reynolds & Assoc.	813-360-1484
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Mass	Wakefield, Nerem, Inc.	617-245-4426
NJ	Mountainside, Service & Technology Inc.	201-232-2666
NY	Farmingdale, Service & Technology Inc.	516-694-7330
NY	Pompey, S. F. Foster Co., Inc.	315-677-3333
NY	Webster, S.F. Foster Co.	716-872-5220
NC	Greensboro, Reynolds & Assoc.	919-275-3725
Wash	Seattle, Comptronics	206-284-4842
EXP:	Bala Cynwyd, Tech Impex, Inc.	215-667-3155

GENERAL DEVICES CO., INC., 525 S. Webster Ave., Indianapolis, Ind., 46219, Tel: 317-359-5407, Telex: 27-2169; Empl.: 125; Minimum order: $50 ..... p. 1•63-70

For info on price: S. Gray; Application info: R. D. Lambert; Customer service: R. L. Watson; Delivery info: S. Gray

Free literature available: Complete Catalog covering: chassis-trak solid-bearing, bottom mount and ball-bearing slides; chassis-trak handles; vent-rak cabinets, consoles, instrument cases, chassis and accessories; poxylube dry-film lubricants.

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Cable Retractors, Cases, Equipment, Instrument, Meter, Chassis, Metal, Containers, Drawers, Sliding, Handles For Cabinets, Circuit Boards, Racks, etc., Lubricants, Racks, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Schoeffler Assocs.	602-959-3011
Cal	Los Angeles, M.A. Stolaroff Co. Inc.	213-295-7781
Cal	Mountain View, G. Woempner Co.	415-964-5454
Cal	San Diego, M.A. Stolaroff Co., Inc.	714-234-6905
Cal	Van Nuys, J.R. Thomas	213-782-3820
Colo	Sedalia, Jensen Representatives	303-688-4154
Conn	Cheshire, Coakley, Boyd & Abbett, Inc.	203-272-2261
Fla	North Miami, Winfield Elctrn. Sales	305-945-6544
Fla	Tampa, Winfield Elctrn. Sales	813-884-6500
Ill	Rolling-Meadows, Lightner Assocs.	312-398-3000
Ind	Indianapolis, General Devices Co.	317-359-5407
Ind	Indianapolis, Mktg. Engrs., Inc.	317-546-1523
Ind	South Bend, Valentine Schillinger & Assocs.	219-291-6258
Kans	Shawnee Mission, Lowell & Kangas Assocs.	913-631-3515
Md	Bethesda, G. Rosen & Assocs.	301-530-8448
Mass	Needham, Coakley, Boyd & Abbett, Inc.	617-444-5470
Minn	St. Paul, Northport Engrg., Inc.	612-698-3841
Mo	St. Louis, Lowell & Kangas Assocs.	314-821-4050
NY	Fayettville, H.G. Richter, Inc.	315-637-6713
NY	Manhasset, Kaebler & Mack	516-627-6620
NC	Paw Creek, Ward Techn. Sls. Co.	704-399-3481
Ohio	Cleveland, Components, Inc.	216-842-2737
Ohio	Hamilton, Components, Inc.	513-721-2997
Tex	Dallas, R. Martin Assocs.	214-361-8584
Tex	Houston, R. Martin Assocs.	713-462-4077
Wash	Olympia, Bergford & Assocs.	206-866-2001
EXP:	Indianapolis, Ind., General Devices Co.	317-359-5407

GENERAL ELECTRIC, Battery Prods. Sect., Box 114, Gainesville, Fla., 32602, Tel: 904-462-3911; Empl.: 71500

Products manufactured: Batteries

GENERAL ELEC. CO., Communication Systems Div., Box 4197, Lynchburg, Va., 24502, Tel: 804-846-7311; Empl.: 4000

Customer service: R. A. Page

Products manufactured: Bridges, Comm. Systems, Controls/Control Eqpt., Printers, Terminal Equipment, Digital, Transceivers

GENERAL ELEC. CO., Elctrn. Comps. Sls. Dept., Sect. 998-2, 1 River Rd., Schenectady, N.Y., 12345
p. 1•958,959,1684,1685; p. 2•134-137,1698,1699

Products manufactured: Amplifiers, Arresters, Electrical Surge, Lightning, Cameras, Capacitors, Fixed, Cells, Photoconductive, Photoemissive, Photovoltaic, Chargers, Battery, Circuit Breakers, Clamps & Clips, Controls/Control Eqpt., Converters, Diodes, Display Devices/Displays, Encoders, Generators, Indicators, Intensifiers, Image, Isolators, Lamps, Lights, Meters, Mixer-Preamplifiers, Microwave, Mixers, Motor Electric Generator Sets, Motors, Oscillators, Power Supplies, Pyrometers, Reactors, Recorders, Rectifiers, Regulators, Relays, Seals, Shunts, Meter, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Solenoids, Spark Gaps, Substrates, Suppressors, Switches, Tachometers, Technical Books, Terminal Blocks, Boards & Strips, Thyristors (Includes Silicon Controlled Rectifiers), Timers, Transformers, Transistor, Diode, Thyristor Heat Dissipators, Transistors, Tubes

Local Sales Offices & Reps.

Ala	Huntsville	205-883-3151
Ariz	Phoenix	602-264-1751
Cal	Los Angeles	213-479-7763
Cal	Palo Alto	415-493-2600
Cal	San Diego	714-236-1266
Colo	Denver	303-388-5771
Conn	Bridgeport	203-334-1012
Fla	No. Palm Beach	305-844-5202
Ill	Chicago	312-777-1600
Ind	Fort Wayne	219-482-4557
Iowa	Cedar Rapids	319-364-9149
Mass	Wellesley	617-237-2050
Mich	Southfield	313-355-3552
Minn	Minneapolis	612-835-2550
Mo	Kansas City	816-221-4033
Mo	St. Louis	314-429-6941
NJ	Clifton	201-472-8100
NY	Albany	518-458-7755
NY	Great Neck	516-466-8800
NY	Rochester	716-461-5400
NY	Syracuse	315-456-3108
NC	Greensboro	919-273-6981
Ohio	Cleveland	216-266-2900
Ohio	Dayton	513-298-0311
Okla	Oklahoma City	405-943-9015
Pa	Erie	814-455-5466
Pa	Pittsburgh	412-921-9917
Pa	Wayne	215-962-1500
Tex	Dallas	214-661-8582
Tex	Houston	713-783-8170
Va	Falls Church	703-790-1700
Va	Waynesboro	703-943-1151
Wash	Seattle	206-575-2866
Wisc	Milwaukee	414-271-5000

GENERAL ELECTRIC, Ind'l Heating Business Dept, 1 Progress Rd, Shelbyville, Ind., 46176, Tel: 317-398-4411

Free literature available: GEP 1005 Electric heaters & components such as tubular, strip, cartridge and immersion heaters. Als duct, air and flanged and circulation heaters. GEP 1545 Soldering irons (electric) including ratings from 12 watts to 1250 watts-and-temperature controlled soldering irons.

Products manufactured: Heaters & Heating Elements, Soldering Equipment

Directory of Local Distributors Starts on page 401

Local Sales Offices & Reps.

Cal	Burlingame	415-697-6500
Cal	Los Angeles	213-589-6321
Cal	San Diego	714-224-1212
Colo	Denver	303-759-2749
Conn	Hamden	203-281-1795
Conn	Woodstock	203-928-0332
Fla	Miami	305-592-6523
Fla	Orlando	305-894-7761
Ill	Glen Ellyn	312-858-6320
Ind	Shelbyville	317-398-4411
La	Baton Rouge	504-275-5480
La	Lake Charles	318-439-8173
La	Monroe	318-323-3671
La	New Orleans	504-737-4181
Mich	Detroit	313-835-5100
Minn	Minneapolis	612-789-2535
Miss	Pascagoula	601-475-1248
Mo	Kansas City	816-561-4050
Mo	St. Louis	314-993-5810
Neb	Omaha	402-342-7044
NJ	Caldwell	201-228-2220
NY	Buffalo	716-634-9873
NC	Charlotte	704-523-2122
Ohio	Cincinnati	513-574-0800
Ohio	Hudson	216-467-3377
Ore	Portland	503-223-4197
Pa	Pittsburgh	412-795-4130
Pa	St. Davids	215-687-5650
Tenn	Chattanooga	615-821-0235
Tex	Dallas	214-826-6350
Utah	Salt Lake City	801-363-3555
Va	Richmond	804-359-6051
Wash	Seattle	206-762-4100
FOR:	Can., Toronto, Ont.	614-534-6511

GENERAL ELECTRIC CO., Instrument Prods. Dept., 40 Federal St., West Lynn, Mass., 01905, Tel: 617-594-7049; Empl.: 800; Minimum order: $100

For info on price: L. Atkins 617-594-7274; Application info: B. Kieser 617-594-7273; Customer service: L. Atkins; Delivery info: B. Kieser

Free literature available: GEP-307 Panel Meters Catalog; GEP-302 Switchboard Instruments Catalog; GEA-8619A Recorder Bulletin; GEA-9798 Transducer Bulletin; GEA-9729 Halogen Leak Detector Bulletin. The Ferret&T

Products manufactured: Controls/Control Eqpt., Current Sensors, Indicators, Meters, Probes, Recorders, Relays, Scales, Dial, Shunts, Meter, Thermometers, Resistance, Transducers

Refer to GE Electrn. Comps. Sls. Dept. for sales office information

GENERAL ELEC., Insulating Matl's., 1 Campbell Rd., Schenectady, N.Y., 12306, Tel: 518-374-2211, TWX: 518-556-2290; Empl.: 500

For info on price: R. J. Wachalec Ext. 55249; Application info: H. C. Lauroesch Ext. 55239; Customer service: A. R. Lacasse Ext. 54773; Delivery info: A. R. Lacasse Ext. 54773

Products manufactured: Adhesives (All Types), Compounds, Encapsulating, Insulating, Molding, Potting, Films, Paints, Tapes, Electrical Insulation

GENERAL ELEC. CO., Laminated & Insulating Matls. Bus. Dep., Coshocton, Ohio, 43812, Tel: 614-622-5310, TWX: 810-255-2921; Empl.: 1100; Minimum order: $50

For info on price: Sls. Off.; Application info: H. A. Schudel; Customer service: F. B. Simmons; Delivery info: F. B. Simmons

Free literature available: Industrial Laminates Brochure IL-401 Grades and Properties of Industrial Laminates.

Products manufactured: Laminates

Local Sales Offices & Reps.

Cal	Burlingame, Insulectro	415-692-2010
Cal	El Segundo, Insulectro	213-640-1470
Fla	Tampa, General Elec. Co.	813-251-1033
Ill	Elk Grove Village, Gen. Elec. Co.	312-439-9080
Ind	Indianapolis, General Elec. Co.	317-253-7592
Mass	Wellesley Hills, General Elec. Co.	617-235-9290
NY	Liverpool, General Elec. Co.	315-456-2144
NC	Greensboro, General Elec. Co.	919-288-0153
Ohio	Elyria, General Elec. Co.	216-322-3749
Pa	King of Prussia, General Elec. Co.	215-962-3685
Tex	Dallas, Bunker Inds.	214-630-1600

GENERAL ELEC. LAMP GLASS, See General Elec. Lamp Parts & Equip. Sales Oper.

GENERAL ELECTRIC CO., Battery Business Dept., Box 861, Gainesville, Fla., 32602, Tel: 904-377-6960

Products manufactured: Batteries, Chargers, Battery

Refer to Gen. Elec. Elctrn. Comps. Sls. Dept. for sales office information.

GENERAL ELECTRIC CO., Lamp Parts & Equip. Sls. Oper., 21800 Tungsten Rd., Cleveland, Ohio, 44117, Tel: 216-266-2451

Free literature available: Literature and technical data on lamps leads, bases, chemicals, tungsten, molybdenum, glass and fused quartz.

Products manufactured: Headers, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Quartz, Fused, Shields, Silica, Fused, Tubes, Tubing, Wire

Local Sales Offices & Reps.

Cal	Los Angeles	213-723-2541
Cal	San Jose	408-298-4126
Mass	Newton Upper Falls	617-332-6200
Mo	Lee's Summit	816-524-5300
NJ	West Orange	201-736-5305
Ohio	Cleveland	216-266-3788
Pa	Pittsburgh	412-531-5700

GENERAL ELECTRIC CO., Miniature Lamp Dept., Nela Park, Clevland, Ohio, 44112, Tel: 216-266-2121
p. 2•1144,1145

Products manufactured: Lamps, Lights

Local Sales Offices & Reps.

Alas	Achorange	907-333-7835
Cal	Los Angeles	213-723-2541
Cal	Oakland	415-569-3422
Cal	Portola Valley	415-854-4010
Colo	Denver	303-388-4611
Fla	Miami	305-693-3811
Ga	Atlanta	404-875-0921
Haw	Honolulu	808-537-3280
Ill	Chicago	312-332-4712
Ind	Indianapolis	317-547-5511
La	New Orleans	504-835-6421
Md	Baltimore	301-242-5700
Mass	Newton Upper Falls	617-332-6200
Mich	Detroit	313-883-0200
Minn	Minneapolis	612-331-4050
Mo	North Kansas City	816-471-0123
Mo	St. Louis	314-429-6930
NJ	Newark	201-622-8000
NY	New York	212-750-2000
NY	Rochester	716-461-5900
NY	Utica	315-733-0922
NC	Charlotte	704-376-6585
Ohio	Cincinnati	513-559-3607
Ohio	Cleveland	216-266-4337
Ohio	Columbus	614-294-4115
Okla	Oklahoma City	405-842-4028
Ore	Portland	503-221-5120
Pa	King of Prussia	215-688-5900
Pa	Pittsburgh	412-471-9050
Tenn	Memphis	901-948-2642
Tex	Dallas	214-358-5321
Tex	Houston	713-644-3264
Va	Richmond	703-355-3289
Wisc	Milwaukee	414-462-3860

GENERAL ELEC., Noryl Prods. Sect., Noryl Ave., Selkirk, N.Y., 12158, Tel: 518-439-9371

Free literature available: Noryl Engineering Plastics-describes property profiles and application areas of the three standard, four glass reinfored, one platable and three extrudable grades of Noryl thermoplastic resin. Processing, design and comparative data are described in depth.

Products manufactured: Plastic Raw Materials, Liquids, Pellets, Powders, Resins

Local Sales Offices & Reps.

Cal	Industry	213-965-4973
Cal	Oakland	415-535-2015
Ga	Atlanta	404-897-6245
Ill	Oakbrook	312-325-8090
Ind	Indianapolis	317-923-7221
Kans	Shawnee Mission	913-432-5851
Ky	Louisville	502-452-3701
Md	Baltimore	301-296-1010
Mass	Pittsfield	413-494-1110
Mass	Wellesley Hills	617-237-9125
Mich	Southfield	313-355-4460
Minn	Minneapolis	612-926-3111
Mo	St. Louis	314-429-7002
NJ	Cranford	201-276-8472
NY	East Rochester	716-381-8500
Ohio	Cleveland	216-523-6336
Ohio	Dayton	513-298-0311
Tex	Dallas	214-233-5683
FOR:	Can., Toronto 4 ,Ont.	416-534-6511

GENERAL ELEC., Plastics, 1 Plastic Ave., Pittsfield, Mass., 01201

Customer service: Sls. Off.

Free literature available: 1. General GE Plastics Brochure - CDP-74; 2. Lexan - CDC-570; 3. Noryl - CDX-80
4. Valov - VAL-5A; 5. Gen. Product Brochure 474; 6. Engineering Structual Foam - SFR-1

Products manufactured: Plastic Raw Materials, Liquids, Pellets, Powders, Resins

Local Sales Offices & Reps.

Cal	City of Industry	213-965-4973
Ga	Atlanta	404-897-6245
Ill	Oakbrook	312-325-8090
Ind	Indianapolis	317-923-7221
Kans	Shawnee Mission	913-432-5851
Ky	Louisville	502-454-5458
Md	Baltimore	301-944-7676
Mass	Pittsfield	413-494-1110
Mass	Wellesley Hills	617-237-9125
Mich	Southfield	313-355-4400
Minn	Minneapolis	612-835-3111
Mo	St. Louis	314-429-7002
NJ	Cranford	201-276-8472
NY	East Rochester	716-381-8500
Ohio	Cleveland	216-523-6336
Ohio	Dayton	513-298-0311
Tex	Dallas	214-233-5683

GENERAL ELEC., Semiconductor Prods., Electronics Pk., Box 1122, Syracuse, NY, 13201, Tel: 315-456-2798, TWX: 710-541-0498; Empl.: 400000

Free literature available: Short Form Catalog 451.119

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Diodes, Isolators, Rectifiers, Relays, Resistors, Thyristors (Includes Silicon Controlled Rectifiers), Transistor, Diode, Thyristor Heat Dissipators, Transistors

Refer to Gen. Elec. Elctrn. Comps Dept. for Sales office information

Local Distributors

Ala	Birmingham, Forbes Dist-Co., 1416 Fourth Ave.	205-251-4107
Ala	Huntsville, Cramer Elctrns. Inc., 2310 Bob Wallace Ave.	205-539-5722
Ala	Huntsville, Hamilton Electro Corp., 805 Oster Dr. N.W.	205-533-1170
Ariz	Phoenix, Hamilton Electro Corp., 2615 So. 21st St.	602-275-7851
Ariz	Phoenix, Kierulff Elctrns. Inc., 2633 E. Buckeye Rd.	602-273-7331
Ark	Little Rock, Carlton-Bates Co., 6821 Scott Hamilton Dr.	501-562-9100
Cal	Culver City, Hamilton Electro Corp., 10912 W. Washington Blvd.	213-870-7171
Cal	El Monte, G. S. Marshall Co., 9674 Telstar Ave.	213-686-0141
Cal	Irvine, Cramer Elctrns. Inc., 17201 Daimler St.	213-771-8300
Cal	Los Angeles, Kierulff Elctrns. Inc., 2585 Commerce Way	213-685-5511
Cal	Mountain View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	Mountain View, Hamilton/Avnet, 575 E. Middlefield Rd.	415-961-7000
Cal	Oakland, Brill Elctrns., 610 E. 10th St.	442-834-5888
Cal	Palo Alto, Kierulff Elctrns. Inc., 3969 E Bayshore Rd.	415-968-6292
Cal	Riverside, Electronic Supply, 2486 Third St	714-626-6796
Cal	San Diego, Hamilton Electro Corp., 8917 Complex Dr.	714-279-2421
Cal	San Diego, Kierulff Elctrns., Inc., 8797 Balboa	714-278-2112
Cal	Sunnyvale, Cramer Elctrns., 695 Veterans Blvd.	408-739-3011
Colo	Denver, Electronics Parts Co., 1212 So. Broadway	303-744-1992
Colo	Denver, Hamilton Electro Corp., 5921 N. Broadway	303-534-1212
Conn	Danbury, Schweber Elctrns., Finance Dr., Commerce Ind. Pk.	203-792-3500
Conn	Georgetown, Hamilton Elctro Corp., 643 Danbury Rd.	203-762-0361
Conn	No. Haven, Cramer Elctrns. Inc., 35 Dodge Ave.	203-239-5641
Conn	Waterbury, Bond Radio Supp, 639 WMain St.	203-757-0546
Fla	Hollywood, Cramer Elctrns. Inc., 4035 N. 29th Ave.	305-923-8181
Fla	Hollywood, Hamilton Electro Corp., 4020 N. 29th Ave.	305-925-5401
Fla	Hollywood, Schweber Elctrns., 2830 N. 28th Terrace	305-927-0511

Fla	Orlando, Cramer Elctrns. Inc., Box 20214	305-894-1511
Fla	Orlando, Hammond Elctrns. Inc., 911 W. Central Ave.	305-241-6601
Ga	Atlanta, Cramer Elctrns. Inc., 3923 Oakliff Ind. Ct.	404-448-9050
Ga	Atlanta, Lykes Elctrns., 1135 Chattahoochee Ave. NW	404-355-2223
Ga	Atlanta, Schweber Elctrns., 4126 Pleasantdale Rd.	404-449-9170
Ga	Norcross, Hamilton Electro, 6700-1-85 Suite 2B	404-448-0800
Ill	Chicago, Elctrn. Distrs. Co., 4900 N. Elston Ave.	312-283-4800
Ill	Chicago, Newark Elctrns Corp., 500 N. Pulaski Rd.	312-638-4411
Ill	Chicago, Semiconductor Specs Inc., Ohare Int. Airport Box 66125	
Ill	Elk Grove, Schweber Elctrns., 1380 Jarvis	412-593-2740
Ill	Mount Prospect, Cramer Elctrns., 1911 S. Busse Rd	312-593-8230
Ill	Schiller Park, Hamilton/Avnet Elctrn., 3901 No. 25th Ave.	312-678-6310
Ind	Castleton, Pioneer Standard, 82nd Street	317-849-7300
Ind	Evansville, Hutch & Son Inc., 300 N. Main	812-425-7201
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supp, 3606 Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns. Supp, 133 S. Pennsylvania St.	317-634-8202
Ind	Indianapolis, Semiconductor Spec. Inc., 1885 Banner Ave.	317-243-8271
Iowa	Cedar Rapids, DEECO Inc., 2500 16th Avenue SW	319-365-7551
Kans	Lenexa, Hamilton Electro Corp., 37 Lenexa Ind. Center 9900 Pflumm Rd.	913-888-8900
Ky	Louisville, Burks P I Co., 842 S 7th St.	502-589-3960
La	New Orleans, Lykes Elctrns. Corp. Epcor Div., 3308 Orleans Ave.	504-486-7441
Md	Baltimore, Cramer/Baltimore Inc., 922-24 W Patasco Ave.	301-796-5790
Md	Gaithersburg, Cramer-Washington Inc., 16021 Ind Dr.	301-948-0110
Md	Hanover, Hamilton Electro Corp., 7255 Standard Dr.	301-796-5000
Md	Rockville, Pioneer-Washington Elctrns. Inc., 1037 Taft St.	301-424-3300
Md	Rockville, Schweber Elctrns., 6540 Fisher La.	301-881-2970
Mass	Burlington, Hamilton Electro Corp., 185 Cambridge St.	617-273-2120
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy. Rte. 1	617-329-2400
Mass	Newton, Cramer Elctrns. Inc., 85 Wells Ave.	617-969-7700
Mass	Springfield, T.F. Cushing Inc., 1026 Bay St.	413-788-7341
Mass	Waltham, Schweber Elctrns., 213 3rd Ave.	617-890-8484
Mich	Detroit, RS Elctrns., 12775 Lyndon	313-491-1000
Mich	Detroit, Semiconductor Specs., 25127 W. Six Mile Rd.	313-255-0300
Mich	Grand Rapids, Newark Industrial, 2114 S. Division	616-331-6350
Mich	Livonia, Hamilton Elctrns., 12870 Farmington Rd.	313-522-4700
Mich	Troy, Schweber Elctrns., 86 Executive Dr.	313-583-9242
Minn	Edina, Cramer Elctrns. Inc. Cramer/Bonn Div., 7275 Bush Lake Rd.	612-835-7811
Minn	Mineapolis, Semiconductor Specs. Inc., 8030 Cedar Ave. S.	612-854-8841
Minn	St. Paul, Gopher Elctrns., 2520 W. Carpenteur Ave.	612-645-0889
Miss	Jackson, Ellington Elctrns. Sply Co., 1425 Terry Rd	601-355-0561
Mo	Hazelwood, Hamilton Electro Corp., 364 Brookes La.	314-731-1144
Mo	Joplin, Norman Elctrns. Supp., 402 Wall St.	417-624-0368
Mo	North Kansas City, L-Comp-Kansas City Inc., 1520 Tany St.	816-221-2400
Mo	University City, Olive Ind. Elctrns., 6662 Olive St. Rd.	314-873-7800
Neb	Lincoln, Scott Elctrns., 4040 Adams St.	402-464-8308
Neb	Omaha, Radio Equip. Co., 625 N. 18th St.	402-341-7700
NJ	Camden, General Radio Supp., 600 Penn St.	609-964-8560
NJ	Cedar Grove, Hamilton Electro Corp., 218 Little Falls Rd.	201-239-0800
NJ	Cherry Hill, Cramer Elctrns. Inc., 7300 Rte. 130 N.	609-424-5993
NJ	Moonachie, Cramer Elctrns. Inc., 1 Barrett Ave.	201-935-5500
NJ	Mt. Laurel, Hamilton Electro. Corp., E. Gate Ind. Pk.	609-234-2123
NJ	Somerset, Schweber Elctrns., 43 Belmont Dr.	201-469-6008
NM	Albuquerque, Cramer Elctrns. Inc., 137 Vermont NE	505-265-5767
NM	Albuquerque, Hamilton Electro Corp., 2450 Baylor Drive SE	505-765-1500
NM	Albuquerque, Kierulff Elctrns. Inc., 2524 Baylor Dr. SE	505-247-1055
NY	Cheetowaga, Standard Elctrns. Inc., 3523 Union Rd.	716-685-4220
NY	E. Syracuse, Cramer Elctrns. Inc., 6716 Joy Rd.	315-437-6671
NY	E. Syracuse, Hamilton Electro Corp., 6500 Joy Rd.	315-437-2642
NY	Endwell, Cramer Elctrns. Inc., 3220 Watson Blvd.	607-754-6661
NY	Farmingdale, Arrow Elctrns. Inc., 900 Broad Hollow Rd.	516-694-6800
NY	Hauppauge, Cramer Elctrns. Inc., 29 Oser Ave.	516-231-5600
NY	Rochester, Cramer Elctrns. Inc., 3000 S. Winton Rd.	716-275-0330
NY	Rochester, Hamilton Electro. Corp., 167 Clay Rd.	716-442-7820
NY	Rochester, Rochester Radio Supp., 140 W. Main St.	716-454-7800
NY	Rochester, Schweber Elctrns., 999 Buffalo Rd.	716-328-4180
NY	Rome, Rome Elctrns., 108 Spring St.	315-476-2033
NY	Westbury, Hamilton Electro. Corp., 70 State St.	516-333-5800
NY	Westbury, Schweber Elctrns., Jericho Tnpk.	516-334-7474
NC	Charlotte, Dixie Radio Supply, 2220 S. Tryon St.	704-377-5413
NC	Raleigh, Southeastern Radio Supp., 414 Hillsboro St.	919-828-2311
NC	Winston-Salem, Cramer Elctrns., 938 Burke St.	919-725-8711
Ohio	Akron, Sun Radio, 110 East Market St.	216-434-2171
Ohio	Beachwood, Schweber Elctrns., 23880 Commerce Pk. Rd.	216-464-2970
Ohio	Cincinatti, Hughes Peters Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Cleveland, Pioneer Standard Elctrns. Inc., 4800 E. 131 St.	216-587-3600
Ohio	Columbus, Elctrns. Marketing Corp., 1150 W. 3rd Ave.	614-299-4161
Ohio	Columbus, Hughes Peters Inc., 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Pioneer Standard Elctrns. Inc., 1900 Troy St.	513-236-9900
Ohio	Toledo, Warren Radio Co., 1002 Adams St.	419-248-3364
Ohio	Warren, Rem Elctrns. Supp., 264 W. Market St.	216-399-2777
Okla	Tulsa, Oil Capitol Elctrns. Corp., 708 S. Sheridan	918-836-2541
Pa	Allentown, Resco of Lehigh Valley, 425 Hanover St.	215-435-6743
Pa	Philadelphia, Almo Elctrns. Corp., Roosevelt of Bluegrass	215-676-6000
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
Pa	Pittsburgh, Semiconductor Specs. Inc., 538 Alpha Dr.	412-781-8120
Pa	York, Rosen Elctrns., 215 S. George St.	717-843-3875
RI	Warwick, Edwards Co. WH, 55 Electronics Dr.	617-329-2400
SC	Columbia, Dixie Radio Supp., 1900 Barnwell St.	803-253-5333
SC	Greenville, Dixie Radio Supp., 500 Pendleton St.	803-253-5357
Tenn	Chattanooga, Harpe Elctrns., 1845 Central Ave.	615-267-2381
Tenn	Kingsport, Radio Electric Supp., 961 E. Sullivan St.	615-247-8111
Tenn	Knoxville, Ind. Elctrns. Inc., Box 9125	615-573-7135
Tenn	Memphis, Bluff City Dist., 234 East St.	901-725-9500
Tenn	Nashville, Electra Distr., 1914 W. End Ave.	615-329-3971
Tex	Dallas, Cramer Elctrns. Inc., 2970 Blystone	214-661-9300
Tex	Dalles, Hamilton/Avnet Elctrns., 4445 Sigma Rd.	214-661-8661
Tex	Dallas, Norvell Elctrns. Inc., 10210 Monroe	214-350-6771
Tex	Dallas, Sterling Elctrns. Inc., 2875 Merrell Rd.	214-357-9131
Tex	Houston, Hamilton Electro. Corp., 1216 West Clay	713-526-4661
Tex	Houston, Sterling Elctrns. Inc., 4201 SW Freeway	713-627-9800
Utah	Salt Lake City, Ballard Supp., 44 E. Sixth South St.	801-394-5544
Utah	Salt Lake City, Hamilton Electro Corp., 647 W. Billinis Rd.	801-262-8451
Utah	Salt Lake City, Newark Elctrns. Inc., 259 Crossroads Sq.	801-486-1048
Va	Charlottesville, Virginia Radio Supp., 715 Henry St.	804-828-2311
Va	Roanoke, Peoples Radio TV Supp., 1015 Moorman Rd.	703-342-8933
Wash	Bellevue, Hamilton Electro Corp., 13407 Northrop Way	206-746-8750
Wash	Seattle, Almac/Stroum Elctrns., 5811 6th Ave. S.	206-763-2300
Wash	Tacoma, C&G Elctrns., 2502 Jefferson Ave.	206-272-3185
WVa	Charleston, Charleston Electrical Div., 1400 Hamsford Street	304-348-5211
Wisc	Milwaukee, Electronics Expeditors, 6045 N. Greenbay Ave.	414-228-8100
Wisc	West Allis, Marsh Radio Inc., 6047 W. Beloit Rd.	414-545-6500

GENERAL ELEC. CO., Silicone Prods. Dept., Waterford, N.Y., 12188, Tel: 518-237-3330; Empl.: 1300; Minimum order: $200

For info on price: H. Laumeister; Application info: R. Mahar; Customer service: W. Schultz; Delivery info: W. Schultz

Free literature available: Technical Data Book S-35 describes the many uses of RTV silicone rubber adhesive/sealants. Contains a selector guide giving uses and properties; application procedures and curing agent selection sections also included.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Insulators & Insulation, Lubricants, Rubber, Seals

Local Sales Offices & Reps.

Cal	City of Industry	213-965-3301
Cal	Oakland	415-535-2014
Fla	Orlando	305-855-5904
Ga	Atlanta	404-897-6280
Ill	Oak Brook	312-654-4570
Ind	Indianapolis	317-923-7221
Kans	Shawnee Mission	816-842-9745
Md	Gaitherburg	301-948-7170
Mass	Framingham	617-879-2985
Mich	Southfield	313-355-4400
Minn	Minneapolis	612-926-00266
Mo	St. Louis	314-429-6941
NJ	Cranford	201-276-5110
NY	Schenectady	518-346-2059
NY	Waterford	518-237-3330
NC	Greensboro	919-288-7906
Ohio	Dayton	513-298-0311
Ohio	Parma Heights	216-842-6776
Pa	Media	215-LO6-3841
Pa	W. Mifflin	412-466-6700
SC	Greenville	803-288-4453
Tenn	Memphis	901-774-3481
Tex	Dallas	214-EM9-2357
Tex	Houston	713-688-2593
Wash	Seattle	206-575-2920
EXP:	Export Operations, Waterford, N.Y.	518-237-3330

GENERAL ELEC., Valley Forge Space Tech. Ctr., Box 8555, Phila., Pa., 19101, Tel: 215-962-5474, TWX: 510-660-2034; Empl.: 2100

For info on price: T. Hontz 215-962-1033; Application info: T. Hontz 215-962-1033; Customer service: M. D. Fasano 215-962-3987; Delivery info: M. D. Fasano 215-962-3987

Products manufactured: Circuits, Hybrid, Thick Film, Services, Assembly, Production & Test

GENERAL ELEC., Wire & Cable, 1285 Boston Ave., Bridgeport, Conn., 06602, Tel: 203-334-1012, Telex: 964209

Free literature available: WC-3311 & WC-3119 wires and cables.

Products manufactured: Cable, Wire

Local Sales Offices & Reps.

Cal	Los Angeles	213-572-5330
Cal	Oakland	415-638-0725
Conn	Meriden	203-235-3264
Fla	Jacksonville	904-396-3896
Ga	Atlanta	404-633-4522
Ill	Chicago	312-496-3232
Ind	Indianapolis	317-923-7221

Ky	Louisville	502-452-3191
La	New Orleans	504-486-7267
Md	Baltimore	301-944-7676
Mass	Boston	617-969-8200
Mich	Detroit	313-355-4400
Mich	Grand Rapids	616-451-2094
Minn	Minneapolis	612-544-6699
Mo	Kansas City	816-842-9745
Mo	St. Louis	314-342-7794
NY	Albany	518-458-7243
NY	New York	212-683-6104
NY	Syracuse	315-456-7568
NC	Charlotte	704-372-8541
NC	Greensboro	919-288-0153
Ohio	Cincinnati	513-871-6300
Ohio	Cleveland	216-267-6300
Ore	Portland	503-221-5023
Pa	Philadelphia	215-289-6310
Pa	Pittsburgh	412-921-5150
Tenn	Nashville	615-329-3535
Tex	Dallas	214-350-4609
Tex	Houston	713-675-6681
Utah	Salt Lake City	801-364-1894
Wash	Seattle	206-575-2940
Wisc	Milwaukee	414-271-5000

GENERAL-ELECTRO MECHANICAL, 787 Hertel Ave., Buffalo, N.Y., 14207, Tel: 716-876-9685; Empl.: 121; Minimum order: $25 .... p. 1•956,957

Customer service: D. Stuhlmiller

Products manufactured: Brakes, Clutches

GENERAL ELECTRODYNAMICS CORP., 4430 Forest La., Garland, Tex., 75040, Tel: 214-276-1161, TWX: 910-860-5193; Empl.: 113

For info on price: T. Anderson Ext. 264; Application info: E. Olszewski Ext. 289; Customer service: J. Cox Ext. 272; Delivery info: T. Anderson Ext. 264

Free literature available: GEC will send out any of the enclosed brochures free when they are requested.

Products manufactured: Boards, Printed Circuit, Cable, CATV Systems & Equipment, Converters, Lenses, Optical & Camera, Monitors, Television Systems & Equipment Closed-Circuit, Tubes, X-Ray Inspection Equipment

GEN'L. ENVIRONMENTS CORP., Chicago Labs. Div., 7845 Nagle Ave., Morton Grove, Ill., 60053, Tel: 312-966-0770; Empl.: 12

Customer service: B. F. Loveless

Free literature available: Facility Books Upon Request

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Va	Springfield, General Environments Corp.	703-354-2000

GENERAL ILLUMINATION, INC., 2958 North Cleveland Ave., Roseville, Minn., 55113, Tel: 612-633-1388; FSC No: 18788; Empl.: 20; Minimum order: $25

Customer service: D. Van Loh

Free literature available: Catalog, Product Information Sheets on new products.

Products manufactured: Diodes, Lamps, Lights, Pins, Sockets

Local Sales Offices & Reps.

Ariz	Scottsdale, DeAngelo, Rothman & Cheever	602-948-2240
Cal	Culver City, National Electro Sls. Co.	213-391-6294
Conn	Woodbridge, Elctrn. Mktg. Co.	203-397-1461
Md	Baltimore, Stitzer Assocs.	301-823-2600
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	New York, F. Tylinski Co.	516-466-9070
NY	Rochester, Telesco Assocs.	716-271-3780
NY	Utica, Telesco Assocs.	315-733-3183
Ohio	Cleveland, Goory Sls. Co.	216-331-2055
Ohio	Dayton, Goory Sls. Co.	513-294-3747
Ore	Portland, Earl & Brown Co., Inc.	503-292-9145
Pa	Paoli, Stitzer Associates	215-644-5500
Wash	Seattle, Earl & Brown Co.	206-284-1121

GENERAL INSTR. CORP., AUTOMATIC MFG. DIV., Box 517, Chicopee, Mass, 01021, Tel: 413-594-4781, TWX: 710-353-6854; Empl.: 84

For info on price: A. A. Adessa; Application info: V. Friberg; Customer service: C. A. MacMaster; Delivery info: H. Moffatt

Products manufactured: Coils Including Assemblies & Forms, Filters, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg. Inc.	
Cal	Placentia, Starr Sls. Co.	
Conn	Newtown, Gerber Sls. Corp.	
Fla	Hollywood, Component Engrg. Sls. Co.	
Ill	Chicago, General Instr. Corp.	
Ind	Indianapolis, Morris, Cunningham & Assocs.	
Mass	Waltham, Gerber Sls. Corp.	
Minn	St. Paul, R. G. Ragon, Inc.	
NY	Buffalo, J. McDonough Assocs.	
NY	DeWitt, R. H. Hovey	
NY	Manlius, Quality Comps., Inc.	
Ohio	Cincinnati, G & H Sls. Co.	
Pa	Glenside, C. A. Beeson	
Tex	Dallas, Dunbar Assocs.	

GENERAL INSTR. CORP., SEMICONDUCTOR PRODS GRP., Capacitor Prods., 600 W. John St., Hicksville, N.Y., 11802, Tel: 516-733-3000, TWX: 510-221-1866; Empl.: 1200; Minimum order: $50 p. 2•169

Customer service: M. Hollander

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Scottsdale, Mercury Eng. Sls.	602-275-8579
Cal	Los Angeles, Clemick Neenan	213-476-1272
Cal	Palo Alto, Brooks Tech. Grp.	415-328-3232
Colo	Denver, Zeus/Elcom	303-771-6200
Fla	Hollywood, Component Engrng.	305-922-8917
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ind	Indianapolis, Needler Sls.	317-255-8056
Md	Towson, J. Bresson Assoc.	301-484-4457
Mich	Detroit, A. Blumenberg	313-557-1934
Minn	Minneapolis, NORTEC Sls.	612-835-7414
Miss	Jackson, Cartwright & Bean	601-981-1368
NJ	Leonia, Kohl-Camber	201-944-6488
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Buffalo, R.W. Mitscher	716-633-7970
NY	New York, Kohl-Camber	212-369-4222
NC	Charlotte, Cartwright & Bean	704-333-6457
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Pa	Narberth, J. Bresson Assoc.	215-839-6770
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, J. B. Guenther	214-691-8500
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Va	Lynchburg, J. Bresson Assoc.	804-237-1304
Wash	Redmond, Desco N.W.	203-455-9325

Local Distributors

Ala	Huntsville, Hallmark Elctrns. Corp., 2010 Bob Wallace Ave.	205-837-8700
Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	602-968-6292
Ariz	Phoenix, Mirco Elctrns., 2005 W. Peoria Ave.	602-944-2281
Ariz	Phoenix, Sterling Elctrns., 1930 No. 22nd Ave.	602-258-4536
Cal	Carson, Hi-Rel Distrs., 20507 S. Belshaw	213-537-6500
Cal	Chatsworth, Westates Elctrns. Corp., 20151 Bahama St.	213-241-4411
Cal	Glendale, R. V. Weatherford Co., 6921 San Fernando Rd.	213-849-3451
Cal	Melo Park, Bell Inds., 1070 O'Brien Dr.	415-323-9431
Cal	San Diego, Sterling Elctrns., 7405 Convoy Ct.	714-565-2441
Cal	Sun Valley, Sterling Elctrns., 11614 Pendleton St.	213-767-5030
Cal	Sunnyvale, Diplomat/Westland, 1118 Elko Dr.	408-734-1900
Cal	Woodland Hills, Jaco Elctrns., 21201 Oxnard St.	213-887-6400
Colo	Denver, Ind'l. Elctrns.	303-770-4400
Conn	Fairfield, U-tronics, Inc., 273 Linwood Ave.	203-255-2451
Conn	Hamden, Wilshire Elctrns., 2554 State St.	203-281-1166
Conn	Norwalk, Harvey/Conn., 112 Main St.	203-853-1515
DC	Washington, Pyttronics Inds., Inc.	301-953-3000
Fla	Orlando, Hallmark Elctrns. Corp., 7233 Lake Elenor Dr.	305-855-4020
Ill	Elk Grove, Diplomat/Lakeland, 2451 Brickvale Dr.	312-595-1000
Ill	Palatine, Ohm/Elctrns., 649 Vermont	312-359-5500
Ill	Skokie, Bell Ind's., 7701 N. Austin Ave.	312-282-5400
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave. S.W.	319-365-7551
Kans	Kansas City, Hallmark Elctrns. Corp., 9006 Rosehill Rd.	913-888-4747
Md	Baltimore, A. S. I. Elctrns., 1728 Whitehead Rd.	301-265-5100
Md	Baltimore, Hallmark Elctrns. Corp., 6660 Security Blvd.	301-265-8500
Md	Gaithersburg, Kierulff Elctrns., 16021 Ind'l. Dr.	301-948-0250
Md	Hyattsville, Milgray Elctrns., 5405 Lafayette Pl.	301-864-1111
Mass	Lynn, Land Elctrns., 9R Franklin St.	617-592-2220
Mass	Newton, Greene-Shaw Co., 70 Bridge St.	617-969-8900
Mass	Waltham, QPL Elctrn. Dist., 75 N. Beacon St.	617-891-0460
Mass	Watertown, Sterling Elctrns., 51 Spring St.	617-926-9720
Mich	Farmington, Diplomat/Northland	313-477-3200
Mich	Farmington, Harvey/Mich., 23461 Ind'l Park Dr.	313-477-1650
Minn	Edina, Harvey/Minnesota, 6969 Washington Ave. So.	612-941-6060
Minn	Minneapolis, Electro-Com Corp., 3816 Chandler Dr.	612-788-8601
Minn	Minneapolis, Industrial Comps.	612-831-2666
NJ	Bergenfield, Tech. Elctrn. Dist.	201-384-3643
NJ	Cherry Hill, Milgray/Delaware, 1165 Marlkress Rd.	609-424-1300
NJ	Clifton, Wilshire Elctrns., 312 Clifton Ave.	201-365-2600
NJ	Iselin, Brothers Elctrns.	201-388-7676
NJ	Parsippany, Tonar Elctrns., 1220 US Hwy 46	201-335-9400
NJ	Perth Amboy, Sterling Elctrns., 774 Pfeiffer Blvd.	201-442-8000
NJ	Rahway, Terminal Elctrns. Corp., 1463 Pinewood St.	201-381-5700
NJ	Trenton, Allen & Hurley Co., 23 S. Warren St.	609-393-3300
NM	Albuquerque, Industrial Elctrns., 310 Vale Verde S.E.	505-266-8721
NM	Albuquerque, Sterling Elctrns.	505-247-2486
NY	Binghamton, Harvey/Federal Elctrns., Box 1208	607-748-8211
NY	Buffalo, Summit Elctrns., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broadhollow Rd.	516-694-6800
NY	Farmingdale, Bart Elctrns., 195 Central Ave.	516-293-3144
NY	Farmingdale, Command Elctrns. Corp.	516-293-1212
NY	Farmingdale, Hallmark Elctrns. Corp., 167 Marine St.	516-293-7500
NY	Farmingdale, Pride Elctrns.	516-293-4020
NY	Farmingdale, Wilshire Elctrns., 1855 New Hwy. Unit B	516-293-5775
NY	Freeport, Mil Spec Wire & Cable Corp.	516-546-5454
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Jaco Elctrns., 195 Engineers Rd.	516-273-5500
NY	Johnson City, Wilshire Elctrns., 617 Main St., Westover Plaza	607-791-1236
NY	Mount Vernon, QAR Industrial Elctrn. Sls., 621 S. Columbus Ave.	914-694-2224
NY	Ontario Center, Kehoe Comp Sls.	315-524-2491
NY	Plainview, Fairmont Elctrn. Sls. Corp., 35 S. Service Rd.	516-694-8200
NY	Rochester, Simcona Elctrns. Corp., 275 Mt. Road Blvd.	716-328-3230
NY	Rochester, Summit Elctrns., 292 Commerce Dr.	716-334-8110
NY	West Babylon, Delmar Elctrns., 101 Eads St.	516-420-1234
NY	Woodbury, Diplomat Elctrns.	516-921-9373
NC	Raleigh, Pyttronics Inds., 4509 Creedmoor Rd.	919-782-6370
Ohio	Cleveland, Milgray Elctrns., 1821 E 40th St.	216-481-8800
Pa	Harrisburg, Pyttronics Inds., 2325 No. 7th St.	717-233-6591
Pa	Huntingdon Valley, Hallmark Elctrn. Corp., 458 Pike Rd.	215-355-2335
Pa	Huntingdon Valley, Shap Elctrns., 421 Pike Rd.	215-698-9550
Pa	Montgomeryville, Pyttronics Inds., Stump Rd., Box 433	215-242-6700
Pa	Philadelphia, Philadelphia Elctrns., 1225 Vine St.	215-568-7444
Pa	Pittsburgh, Pyttronics Inds.	412-276-6722
Tex	Dallas, Hallmark Elctrns. Corp., 9333 Forrest La.	214-231-5101
Tex	Dallas, K.A. Elctrns.	214-634-7870
Tex	Ft. Worth, Textronics Co.	817-731-8701
Tex	Houston, Sterling Elctrns., 4201 S.W. Freeway	713-623-6600
Tex	Richardson, Altair Co., 405 N. Plano Rd.	214-263-8783
Tex	San Antonio, Sterling Elctrns.	512-735-9173
Utah	Salt Lake City, Cramer Elctrns., 391 W. 2500 South	801-487-4131
Wash	Bellevue, Bell Inds., 12410 S.E. 32nd	206-747-1515

Wash	Seattle, Sterling Elctrns., 5608 6th Ave. So.	206-762-9100
Wash	Seattle, Zepher Elctrns.	206-242-2517
For:	Can., Montreal, Electronic Wholesalers Co., Ltd.	514-769-8861
For:	Can., Ottowa, Wackid Radio	613-728-1821
For:	Can., Scarborough, Carsten Elctrns., Ltd., 52 Howden Rd.	416-951-2371
For:	Can., Toronto, Electrosonic Ind'l. Sls., Ltd., 543 Yonge St.	416-924-9301

GENERAL INSTRUMENT CORP., 600 W. John St., Hicksville, NY, 11802, Tel: 516-733-3333

GENERAL INSTR. CORP., Entertainment Elctrns. Prods. Grp., F.W. Sickles Div., 165 Front St., Chicopee, Mass., 01013, Tel: 413-594-4781, TWX: 710-353-1301; Empl.: 800

Products manufactured: Transformers, Yokes

GENERAL INSTR. CORP., Microelectronics Div., 600 W. John St., Hicksville, N.Y., 11802, Tel: 516-733-3107, TWX: 510-221-1866

GENERAL INSTRUMENT CORP., Hybrid Div., 600 W. John St., Hicksville, N.Y., 11802, Tel: 516-733-3000

Products manufactured: Amplifiers, Choppers, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Converters, Drivers, Switch, Drivers & Decoders For Readouts, Filters, Generators, Hybrid Voltage Regulators, Integrated Circuit Packaging Systems, Integrated Circuit Devices, IC's, Active Filters, Integrators, Electronic, Lamp Drivers, Memory Systems, Modulator/Demodulators, Multiplexers, Multipliers, Networks, Power Supplies, Regulators, Relays

Refer to General Instr. Corp. Semiconductor Comps. Div for sales office information

GENERAL INSTR. CORP., Microelectronics Div., 600 W. John St., Hicksville, N.Y., 11802, Tel: 516-733-3107, TWX: 510-221-1866

Products manufactured: Circuits, Hybrid, Thick Film, Integrated Circuit Devices

Refer to Geneneal Instr. Semiconductor Comps. Div. for sls. off. Information

GENERAL INSTRUMENTS CORP., Semiconductor Comps. Div., 600 W. John St., Hicksville, N.Y., 11802, Tel: 516-733-3333, TWX: 510-221-1866; Empl.: 2000 p. 1•1844

Customer service: A. Abeles

Free literature available: General Catalog (36 pages) lists lead-mounted rectifiers, bridges, multipliers and other high-voltage rectifiers. Also lists Mosfets. Bridge Reference Guide-cross index showing comparison between GI's and competitors' bridges.
Silicon Rectifier cross reference guide. Lists over 1000 JEDEC and competitors' lead-mounted rectifiers replaceable with reduced number of GI units.

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Comparators, Converters, Current Sources, Decoders, Decommutators, Telemetering, Detectors, Diodes, Drivers, Solenoid, Drivers & Decoders For Readouts, Equalizers, Filters, Hybrid Voltage Regulators, Integrated Circuit Packaging Systems, Integrated Circuit Devices, IC's, Active Filters, Integrators, Electronic, Inverters, Memory Systems, Mixers, Modulators, All Kinds, Modules, Logic, Encapsulated, Monitors, Multiplexers, Multipliers, Oscillators, Power Drivers, Hybrid (High Current, High Voltage), Power Supplies, Rectifiers, References, D-C Voltage, Regulators, Relays, Shifters, Switches, Synchro Transmitters, Solid-State, Timers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Scottsdale, Mercury Engrg. Sls., Inc.	602-275-8579
Cal	El Segundo, Varigon Assocs.	213-679-0621
Cal	Los Altos, P.M. Sls., Inc.	415-941-4444
Cal	San Diego, Varigon Assocs.	714-290-5413
Colo	Wheatridge, Waugaman Assoc.	303-423-1020
Conn	Stratford, G. Rosen	203-375-5456
Fla	Hollywood, Comp. Engrg. Sls. Co.	305-922-8917
Ill	Park Ridge, Metcom	312-696-1490
Ind	Greenwood, V.S. & Assocs.	317-888-2260
Ind	Southbend, V.S. & Assocs.	219-291-6258
Iowa	Cedar Rapids, J.R. Sls.	319-377-8211
Kans	Wichita, Dy-Tronix	316-943-6221
Md	Baltimore, Comp. Sls.	301-484-3647
Mass	Framingham, G. Rosen	617-879-5505
Mich	Kentwood, Burcaw Co. & Assoc.	616-531-1000
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Hazelwood, Dy Tronix	314-731-5799
Mo	Kansas City, Dy Tronix	816-761-6543
NJ	Teaneck, R.T. Reid	201-692-0200
NY	Manlius, Quality Comps.	315-682-8885
NY	Snyder, Quality Comps.	716-839-4170
NC	Raleigh, Comp. Sls., Inc.	919-782-8433
Ohio	Cincinnati, G & H Sls. Co.	513-771-8231
Ohio	Grove City, G & H Sls. Co.	614-878-1128
Okla	Oklahoma City, Ammon & Rizos	405-373-2748
Ore	Portland, J.J. Backer Co.	503-297-3776
Pa	Narberth, J. Bresson Assocs.	215-839-6770
Tex	Dallas, Ammon & Rizos Co.	214-233-5591
Tex	Houston, Ammon & Rizos	713-781-6240
Wash	Seattle, J.J. Backer Co.	206-285-1300
FOR:	Can., Montreal, Que., General Instr. of Canada	514-636-9454
FOR:	Can., Toronto, Ont., General Instr. of Canada	416-763-4133

Local Distributors

Ala	Huntsville, Cramer Elctrns., 2005 Bob Wallace S.W.	205-539-5722
Ariz	Phoenix, Mirco Elctrn. Dist., 2104 W. Peoria Ave.	602-944-2281
Cal	Newport Beach, Semicomp Sls., 4100 Birch St.	714-833-3070
Cal	San Diego, Intermark Elctrns., 7354 Convoy St.	714-279-5200
Cal	Santa Ana, Intermark Elctrns., 2920 W. Warner	714-540-1322
Cal	Sunnyvale, Intermark Elctrns., 1020 Stewart Dr.	408-738-1111
Cal	Woodland Hills, Semiconductor Concepts, 21201 Oxnard St.	213-884-4560
Colo	Denver, Intermark Elctrns., 2600 W. Second Ave.	303-936-8284
Conn	Norwalk, Harvey Conn, 112 Main St.	203-853-1515
Fla	Hollywood, Cramer Elctrns., 4035 N. 29th Ave., Box WW	305-923-8181
Fla	Orlando, Cramer Elctrns., 345 Graham Ave., Box 20214	305-894-1511
Ill	Broadview, LCOMP-Chicago Inc., 2030 W. 16th St.	312-569-2340
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Elmhurst, Semiconductor Specialists, 195 Spangler Ave., Elmhurst Industrial Pk.	312-279-1000
Ill	Rosemont, Advent Elctrns., Inc., 7110 N. Lyndon St.	312-298-4210
Ind	Indianapolis, Semiconductor Specialists, Box 41645, Weir Cook Airport	317-243-8271
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave., S.W.	319-365-7551
Kans	Lenexa, Hall-Mark Elctrns., 9006 Rosehill Rd.	913-888-4747
Md	Gaithersburgh, Cramer Elctrns., 16021 Industrial Rd.	301-948-0110
Md	Savage, Pyttronic Inds., 8220 Wellmoor Ct.	301-792-7000
Mass	Newton, Greene-Shaw Co., 70 Bridge St.	617-969-8900
Mich	Farmington, Semiconductor Specialists, 33505 State	313-255-0300
Mich	Grand Rapids, Stotts Friedman Co., 2035 Eastern Ave., S.E.	616-241-6731
Minn	Minneapolis, Bergquist Co., 4350 W. 78th St.	612-835-2322
Minn	Minneapolis, Hall-Mark Elctrns., 9201 Penn Ave. S.	612-884-9056
Minn	Minneapolis, Semiconductor Specialists, 8030 Cedar Ave., S.	612-854-8841
Minn	St. Louis Park, Park Elctrns., 2206 Edgewood Ave.	612-925-3118
Mo	North Kansas City, LCOMP-Kansas City, 1520 Taney St.	816-221-2400
Mo	St. Louis, LCOMP-St. Louis, 2605 S. Hanley Rd.	314-647-5505
Mo	St. Louis, Semiconductor Specialists, 10062 Natural Bridge	314-428-6100
Neb	Lincoln, Scott Elec. Supply, 4040 Adams St.	402-464-6305
NJ	Linden, Kevtron, 1306 E. Elizabeth Ave.	201-925-5000
NM	Albuquerque, Century Elctrns., 121 Elizabeth N.E.	505-292-2700
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Commack, Connecting Comps., 61 Mall Dr.	516-543-8300
NY	Elmsford, Zeus Comps., 175 Clear Brook Rd.	914-592-4120
NY	Farmingdale, Bart Elctrns., 195 Q. Central Ave.	516-293-3144
NY	Forest Hills, Nasco, 99-08 Metropolitan Ave.	212-793-6500
NY	Hauppauge, Semiconductor Concepts, 195 Engineers Rd.	516-273-1234
NY	Johnson City, Wilshire Elctrns., 617 Main St.	607-797-1236
NY	New Hyde Park, Lafayette, 1327 Second Ave.	516-488-6600
NC	Raleigh, Pyttronic Inds., 4509 Creedmoor Rd.	919-782-6370
NC	Winston-Salem, Cramer Elctrns., 938 Burke St.	919-725-8711
Ohio	Cincinnati, Newark Elctrns., 9799G Princeton Rd.	513-874-5115
Ohio	Dayton, Semiconductor Specialists, 4500 Wadsworth Rd.	513-278-9455
Ohio	Dayton, Stotts-Friedman Co., 108-112 N. Jefferson St.	513-224-1111
Ohio	Solon, Repco, 6835 Cochran Rd.	216-248-8900
Pa	Erie, Erie Corporate, 1938 Buffalo Rd.	814-455-8110
Pa	Harrisburg, Pyttronic Inds., 2525 N. 7th St.	717-233-6591
Pa	Huntingdon Valley, Hallmark, 458 Pike Rd.	215-355-7300
Pa	Montgomeryville, Pyttronic Inds., 2 Stump Rd.	215-643-2850
Pa	Philadelphia, Philadelphia Elctrns., 112 N. 12th St.	215-568-7400
Pa	Pittsburgh, Semiconductor Specialists, 538 Alpha Dr.	412-781-8120
Tex	Dallas, Component Specialties, 2560 Electronics La.	214-357-4576
Tex	Dallas, K.A. Elctrns. Sls., 1220 Majesty	214-634-7870
Tex	Dallas, Semiconductor Specialists, Suite 112, 9990 Monroe Dr.	214-358-5211
Tex	Houston, Component Specialties, Suite 202, 7313 Ashcroft	713-771-7237
Tex	Houston, Lenert Co., 1420 Hutchins St.	713-225-1465
Utah	Salt Lake City, Alta Elctrns., 2280 S. Main St.	801-486-7227
Utah	Salt Lake City, Intermark Elctrns., 63 E. Stratford Ave.	801-486-3411
Wash	Seattle, Intermark Elctrns., 621 S. Michigan	206-767-3160
Wisc	Mequon, Taylor Elec., 1000 W. Donges Bay Rd.	414-241-4321

GENERAL MAGNETIC CO., 10001 Erwin Ave., Detroit, Mich., 48234, Tel: 313-921-7558; Empl.: 130; Minimum order: $500

For info on price: R. H. Campbell; Application info: C. Hohmann; Customer service: R. Miller; Delivery info: R. H. Campbell

Free literature available: We have a catalog listing the various sizes we mfg.

Products manufactured: Magnets

Local Sales Offices & Reps.

Cal	Los Angeles, G.B. Leland	213-851-5821
Ill	Chicago, H.J. Corey & Assoc.	312-539-6310
Ill	Chicago, R.T. Thompson	312-359-0159
Mass	Beverly, Gysan Assoc.	617-774-2012
NY	Wellsville, Walpole Assoc.	716-593-1941
Ohio	Euclid, Rockford Controls	216-731-5250

GENERAL MAGNETICS, 135 Bloomfield Ave., Bloomfield, N.J., 07003, Tel: 201-743-2700; FSC No: 99165; Empl.: 60 .... p. 1•242-251

Free literature available: Data sheets on various products detailing capabilities, specifications, size, weight and in most cases a photograph

Products manufactured: Amplifiers, Coils Including Assemblies & Forms, Computers, Converters, Demodulators, Detectors, Dividers, Generators, Modulator/Demodulators, Modulators, All Kinds, Multipliers, Oscillators, Regulators, Switches, Transformers

Local Sales Offices & Reps.

Cal	Lynwood, Dick West & Assoc.	213-636-6124

GENERAL MFG. CO., 724 Ruberta Ave., Glendale, Calif., 91201, Tel: 213-243-2069; FSC No: 10454; Minimum order: $20

For info on price: E. Galle; Application info: E. Galle; Customer service: V. Galle

Free literature available: Catalog

Products manufactured: Eyelets, Spacers, Terminals

Local Sales Offices & Reps.

Ill	Chicago, G.F. Sls. Co.	312-545-5562

GENERAL MICROWAVE CORP., 155 Marine St., Farmingdale, NY, 11735, Tel: 516-MY4-3600, TWX: 510-224-6406; FSC No: 11332; Empl.: 120; Minimum order: $25 .... p. 1•718

Customer service: Sls. Dept.

Free literature available: Switch brochure; Attenuator brochure; power meter brochure; radiation hazard monitor brochure

Products manufactured: Amplifiers, Analyzers, Attenuators, Bolometers, Bridges, Calorimeters, Microwave, Cameras, CATV Systems & Equipment, Comparators, Converters, Detectors, Dividers, Electronic Switches (Oscilloscope), Generators, Insertion Loss Measurement Systems, Junctions, Hybrid, Microwave, Limiters, Meters, Modulator/Demodulators, Modulators, All Kinds, Monitors, Mounts, Probes, Shifters, Slotted Lines, Microwave, Switches, Testers, Thermistors, Tubes, Tuners

Local Sales Offices & Reps.

Ga	Woodstock, Saber Assocs.	404-432-9625
Ill.	Mt. Prospect, Cain & Co.	312-253-3578
Kans	Andover, Palatine Sls., Inc.	316-683-7512
Kans	Overland Park, Palatine Sls., Inc.	913-262-5643
Md	Bethesda, S & S Assocs., Inc.	301-654-1434
Mass	Stoneham, REPCO	617-438-3113
Mo	St. Louis, Palatine Sls., Inc.	314-426-7055
NJ	West Orange, EF Technical Sls., Inc.	201-731-7203
NY	Huntington, EF Technical Sls., Inc.	516-368-5841
NY	Liverpool, R & D Assocs., Inc.	315-622-2350
NC	Raleigh, Saber Assocs.	919-834-3961
Ohio	Lancaster, Cain & Co.	614-654-4800
Pa	King of Prussia, S & S Assocs., Inc.	215-265-3450
Tex	Dallas, Cain & Co.	214-233-6809
FOR:	Can., Montreal H3P 1Y9 Quebec, Canadian Marconi Co.	514-343-3695
FOR:	Can., Ottawa K1P 5L6, Canadian Marconi Co.	613-235-5121

GENERAL MONITORS, INC., 3019 Enterprise St., Costa Mesa, Calif., 92626, Tel: 714-540-4895, Telex: 678-372; Empl.: 90

Products manufactured: Detectors

Local Sales Offices & Reps.

Ala	Huntsville, Instruments & Computer Tech., Inc.	205-837-6060
Alas	Anchorage, Alaska Controls, Inc.	907-272-3629
Ariz	Phoenix, R. A. Mayes Co.	602-279-5243
Cal	Costa Mesa, Technical Prods.	714-646-8585
Cal	Sacramento, E. Freitag	916-489-8831
Colo	Broomfield, R. A. Mayes Co.	303-466-6311
Ga	Atlanta, Measure-Trol Co.	404-255-7249
Ill	Chicago, Nomad Engrg.	312-764-0403
Iowa	Des Moines, Deco Engrg. Prods., Inc.	515-288-5721
La	Baton Rouge, C. Doyle Co.	504-921-5386
Mass	Randolph, Power Specialties	617-963-8910
Mich	Royal Oak, The Satullo Co.	313-549-3910
Minn	Minneapolis, E.R. Berg & Assoc.	612-890-1221
Mo	St. Louis, Fisk Process Equip.	314-426-1410
Neb	Omaha, Deco Engrg. Prods., Inc.	402-341-4836
NJ	East Orange, Industrial Flow Control, Inc.	201-672-5220
NM	Albuquerque, R. A. Mayes Co.	505-265-7989
NY	Elbridge, L-Tron Corp.	315-689-3787
NC	Charlotte, A. D. Penn Co.	704-847-4426
Ohio	Cincinnati, Surkamp & Rowe	513-891-1838
Ohio	Cleveland, Loesch Assocs., Inc.	216-241-4581
Okla	Tulsa, J. Schoeffler Co.	918-742-5331
Ore	Portland, Set-Point Control Inc.	503-233-5108
Pa	Philadelphia, Y. Wayne Miller, Inc.	215-247-9602
Tex	Houston, Groth Equip. Corp.	713-675-6151
Va	Richmond, Virginia Tech Assocs.	703-266-9654
Wash	Bellevue, Set-Point Control Inc.	206-454-0155
WVa	So. Charleston, Allied Controls Co.	304-768-7313

GENERAL RADIO CO., 300 Baker Ave., Concord, Mass., 01742, Tel: 617-369-8770, TWX: 710-347-1051; FSC No: 24655; Minimum order: $25 ...... p. 2•1748-1750

Customer service: R. W. Ingram Ext. 134

Products manufactured: Accelerometers, Amplifiers, Analyzers, Attenuators, Bridges, Cable, Calibrators, Capacitors, Fixed, Capacitors, Variable, CATV Systems & Equipment, Comparators, Connector Adapters, Connectors, Controls/Control Eqpt., Cords, Counters, Couplers, Data Acquisition & Reduction Systems, Decade Boxes, Detectors, Dividers, Filters, Generators, Indicators, Insertion Loss Measurement Systems, Jacks (All Types), Lamps, Leads, Test & Adaptors, Lights, Line Strechers, Microwave, Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Oscillators, Paper, Graphic Recording, Plug Adapters, Plug & Jack Sets, Plugs, Posts, Potentiometers, Printers, Probes, Recorders, Regulators, Resistors, RFI Measuring Equipment, Scanners, Signal Conditioners & Equipment, Slotted Lines, Microwave, Smith Chart Impedance Plotters, Automatic, Sockets, Standards, Synthesizers, Tachometers, Tees, Terminals, Test Equipment, Test Systems, Testers, Transducers, Transformers, Tubes

Local Sales Offices & Reps.

Cal	Irvine	714-540-9830
Cal	Palo Alto	415-948-8233
Ga	Atlanta	404-394-5380
Ill	Chicago	312-992-0800
Md	Gaithersburg	301-948-7071
Mass	Bolton	617-646-0550
NJ	Saddle Brook	212-964-2722
Ohio	Dayton	513-294-1500
Tex	Richardson	214-234-3357

GENERAL RAND CORP., 100 Menlo Park, Edison, N.J., 08817, Tel: 201-548-1591; Empl.: 12; Minimum order: $15

For info on price: C. Morton; Application info: F. Weber; Customer service: O. Yovanovits; Delivery info: O. Yovanovits

Products manufactured: Amplifiers, Bridges, Calibrators, Meters, Printers, Pumps, Vacuum, Recorders, Standards

GENERAL RELAY CORP., 20 Mercer St., Dover, N.J., 07801, Tel: 201-361-1400, TWX: 710-987-7929; Empl.: 90

Products manufactured: Relays, Solenoids

GENERAL RESISTANCE, INC., 75 Haven Ave., Mt. Vernon, N.Y., 10553, Tel: 914-699-8010, TWX: 710-562-0199; Empl.: 50; Minimum order: $50

For info on price: L. Batard; Application info: J. Jamieson; Customer service: L. Batard; Delivery info: L. Batard

Free literature available: Econistor brochure, Sequaristor brochure, Miniohm brochure, Instrument Catalogue Digest-440-3

Products manufactured: Attenuators, Bridges, Calibrators, Converters, Current Sources, Decade Boxes, Demodulators, Dividers, Filters, Networks, Power Supplies, References, D-C Voltage, Resistors, Standards, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs., Inc.	205-837-4304
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	El Monte, Telemart	
Cal	Los Altos, J. Stone & Assoc.	415-948-4563
Cal	South Pasadena, QPL, Inc.	213-682-3706
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Meriden, P.R. Sturgeon Co.	203-237-1112
Fla	Casselberry, EIR, Inc.	305-830-9600
Fla	Orlando, R.J. Cheney & Assoc.	305-894-7371
Ga	Atlanta, Grady Duckett Sls. Co.	404-451-3529
Ill	Chicago, Brock & Cushman	312-622-4110
Ill	Wheaton, Engrg. Prods. Assoc.	312-653-6826
La	Baton Rouge, SESCO Corp.	504-927-7574
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Mass	Framingham, J.M. Lancaster Co.	617-873-8893
Mich	Farmington, Anderson Elctrns.	313-476-9161
Mich	Farmington, R. Hummon Assoc.	313-474-0661
Minn	Minneapolis, Engrg. Prods. Assoc.	612-925-1883
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Syracuse, Nycom, Inc.	315-437-8343
NC	Charlotte, G. Duckett Sls. Co.	404-451-3529
NC	Matthews, W.K. Hile & Assoc.	704-847-3125
Ohio	Dayton, Rixan Assocs.	513-278-4216
Pa	Delmont, T.F. Laslo & Assoc.	412-468-5045
Pa	Media, W. Reeves Assoc.	215-566-6709
Tex	Houston, SESCO Corp.	713-668-7840
Tex	Richardson, SESCO Corp.	214-231-9364
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Va	Falls Church, Beacon North, Inc.	703-534-1673
Wash	Seattle, Seatronics, Inc.	206-767-4330
EXP:	Mt. Vernon, N.Y., General Resistance, Inc.	914-699-8010

Local Distributors

Ill	Dayton, Rixan Assoc., 5062 Wadsworth	513-278-4216

GENERAL SCANNING, 80 Coolidge Hill Rd., Watertown, Mass., 02172, Tel: 617-924-1010; Empl.: 60

Customer service: R. L. Hubbell

Free literature available: OEM recorder modules for instrumentation optical scanning components & systems.

Products manufactured: Actuators, Controls/Control Eqpt., Light Choppers, Motors, Recorders, Scanners

GENERAL SEMICONDUCTOR INDUSTRIES, INC., 2001 W. 10 Pl., Box 3078, Tempe, Ariz., 85281, Tel: 602-968-3101, TWX: 910-950-1942; FSC No: 24444; QPL No: 19500; Empl.: 175; Minimum order: $100

For info on price: E. Stumbaugh Ext. 18; Application info: D.W. Hutchins Ext. 21; Delivery info: E. Stumbaugh Ext. 18

Free literature available: TransZorb - Silicone transient voltage suppressors; Transistors - NPN silicon power switch; Zeners - Regulator and reference diodes.

Products manufactured: Arresters, Electrical Surge, Lightning, Diodes, Filters, Limiters, Protectors, Regulators, Suppressors, Transistors

Local Sales Offices & Reps.

Ariz	Tempe, Argus Sls.	602-967-8709
Cal	San Carlos, Kottmeier Assocs.	415-592-8333
Cal	Woodland Hills, Electronic Comp. Mktg.	213-340-1745
Colo	Denver, Camel Electronics	303-757-6191
Conn	Milford, Sales Engrg. Co.	203-877-2001
Conn	New Fairfield, Sales Engrg. Co.	203-746-9516
Fla	Orlando, Buchanan & Abrams Assocs.	305-898-7444
Ill	Chicago, Balhorn & Welch, Inc.	312-889-5011
Iowa	Cedar Rapids, Snider Sls. Co.	319-362-4410
Kans	Shawnee Mission, Technical Sls. Assoc.	913-888-3330
Md	Baltimore, Stemler Assocs., Inc.	301-944-8262
Mass	Andover, Sales Engrg. Co.	617-470-0800
Mich	Southfield, Representatives Elctrn. Prods., Inc.	313-354-9066
Minn	Minneapolis, Professional Sls. Ind.	612-835-1777
Mo	Ferguson, Technical Sls. Assocs.	314-725-5361
NJ	Barrington, Stemler Assocs.	215-644-3477
NJ	Cherry Hill, Stemler Assocs.	609-966-4070
NM	Albuquerque, EMI	505-292-2700
NY	Endicott, Advanced Comps. Corp.	914-471-1623
NY	Hempstead, Kahgan Sls. Corp.	516-538-2300
NY	N. Syracuse, Advanced Comps. Corp.	315-853-6438
NY	Scottsville, Advanced Comps. Corp.	716-889-1429
Ohio	Columbus, McFadden Sls. Co.	614-221-3363
Tex	Houston, Oeler & Menelaides	713-772-0730
Tex	Richardson, Oeler & Menelaides	214-234-6334
Va	Alexandria, Stemler Assocs.	703-548-7818
Wash	Redmond, Desco-Northwest	206-455-9325

GENERAL TV NETWORK, 520 W. Eight Mile Rd., Ferndale, Mich., 48220, Tel: 313-548-2500; Empl.: 25

Products manufactured: Television Systems & Equipment Closed-Circuit

GENERAL TIME CORP., Industrial Controls Div., 135 S Main St., Thomaston, Conn., 06787, Tel: 203-283-5881; Empl.: 350

Products manufactured: Brakes, Clutches, Controls/Control Eqpt., Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Indicators, Motors, Relays, Timers

Local Sales Offices & Reps.

Cal	Pasadena, C.A. Williams	213-793-1161
Cal	San Francisco, C. Myers	415-825-4770
Colo	Denver, R.L. Palmer Co.	303-771-6827
Conn	Thomaston, P. Allison	203-283-5881
Ga	Atlanta, Motion Technology	404-233-4368
Ill	Des Plaines, T. Sauer	312-296-7751
Kans	Shawnee Mission, E.L. Martin Co.	913-648-4746
Mass	Boston, T. Weafer	617-762-1466
Minn	Mpls, General Time	612-333-2815
Mo	St. Louis, Automation Components	314-872-7111
NY	New York City, General Time	201-289-5959
NY	Rochester, R. King	716-546-4766
NC	Charlotte, Motion Technology	704-525-9855
Ohio	Cincinnati, W. Tomlinson	513-421-3366
Ohio	Cleveland, A.F. Blaine	216-752-2083
Ore	Portland, C. Myers	415-825-4770

Pa	Philadelphia, General Time	215-696-3443
Tex	Dallas, Titan Reps.	214-661-5350
Wisc	Milwaukee, W. Ferguson	414-353-5422
FOR:	Can., Peterborough, Ont., Gen'l Time Can.	

GENERAL VALVE CORP., 110 Rte. 10 Box 222, E. Hanover, N.J., 07936, Tel: 201-887-9460, Telex: 136411

Customer service: G. E. Toohey

Products manufactured: Connectors, Controls/Control Eqpt., Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Los Angeles, Fluid Tech Sls. So.	714-530-8111
Cal	San Francisco, Valin Corp.	408-734-2590
Mo	St. Louis, Hitt Assocs.	314-HA 6-2322
NJ	East Hanover, General Valve Corp.	201-887-9460
NY	Rochester, Lloyd Hart Assocs.	716-244-3253
Ohio	Cincinnati, W. Watkins Assocs.	513-891-0313
Wisc	Elm Grove, Fluid Power Consultants	414-782-5508

GENISCO TECH. CORP., Special Products Div., 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-346-6773; Empl.: 350; Minimum order: $100

Customer service: K. Williamson

Free literature available: Instrumentation magnetic tape–Model 10-286; Model 10-276 Instrumentation Recorder high environment airborne or–tape recorders preliminary product bulletin digital magnetic tape cartridge.

Products manufactured: Recorders

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs.	205-837-4304
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Encino, Scientific Devices	213-872-1951
Cal	Los Alamitos, Scientific Devices	
Cal	Mountain View, Scientific Devices	415-964-4230
Cal	San Diego, Scientific Devices	714-279-6642
Colo	Denver, C.W. Fowler Co.	303-744-9595
DC	Wash, Mr. R. Kent White	301-839-5858
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Md	Baltimore, Scientific Devices	301-788-6611
Mass	Newton Centre, Daner-Hayes	617-969-4650
Mich	Detroit, Electro Sls. Assoc.	313-526-8800
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NM	Albuquerque, Thorson Co.	505-265-5657
Ohio	Cleveland, Electro Sls. Assoc.	216-261-5440
Ohio	Dayton, Electro Sls. Assoc.	513-426-5551
Pa	Bethayres, Control Instrs. Sls. Co.	215-676-1808
Pa	Pittsburgh, Electro Sls. Assoc.	412-371-9449
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Va	Norfolk, Scientific Devices	804-499-8133
Va	Springfield, Scientific Devices	703-451-6500
Wash	Seattle, R.S. Drake Assoc.	206-763-2755
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

GENISCO TECHNOLOGY CORP., Eldema Div., 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-346-6773; Empl.: 350; Minimum order: $50

Customer service: R. L. Chase

Free literature available: Eldema Condensed General Catalog +GTC-E200C; Eldema C-Series Solder-Pin Lamps #C500; Eldema C-Lites, D-Holders #CD 100 C; Sockets/Mountings for Led Lamps #Q 200A.

Products manufactured: Caps, Lenses, Indicator Light, Diodes, Display Devices/Displays, Lamps, Sockets, Switches

Local Sales Offices & Reps.

Ariz	Tempe, W. Bert Knight Co.	602-946-1088
Ark	El Dorado, D. Bellew Sls. Inc.	501-863-8325
Cal	Los Altos, E. Foley, Inc.	415-941-4525
Cal	Newport Beach, W.B. Knight Co.	714-833-8250
Colo	Denver, W.J. Purdy Co.	303-777-1411
Conn	Meriden, P.R. Sturgeon Co.	203-237-1112
Wash	D.C., S.K. MacDonald	202-265-3938
Fla	Miami Beach, Geartner Assocs.	305-861-3661
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Wilmette, Crest Assocs.	312-256-5202
Ind	Indianapolis, Mktg. Engrs. Inc.	317-546-1523
Iowa	Cedar Rapids, Palatine Sls. Inc.	319-365-8071
Kans	Andover, Palatine Sls. Inc.	316-683-7512
Kans	Overland Park, Palatine Sls. Inc.	913-262-5643
La	Kenner, D. Bellew Sls. Inc.	504-729-4550
Md	Baltimore, S.K. MacDonald Inc.	301-254-3380
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Minn	Minneapolis, F.B. Hill Co.	612-941-5270
Mo	St. Louis, Palatine Sls. Inc.	314-426-7055
NJ	Englewood Cliffs, Sprung-Nussbaum Inc.	201-947-6767
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	E. Aurora, Harries & Kershaw	716-652-1221
NC	Raleigh, R.W. Mitscher Co.	919-828-0575
Ohio	Columbus, T. Mulligan & Assocs.	614-457-2242
Pa	Philadelphia, S.K. MacDonald Inc.	215-545-1205
Pa	Pittsburg, S.K. MacDonald Inc.	412-366-2643
Tenn	Memphis, D. Bellew Sls. Inc.	901-365-9437
Tenn	Shelbyville, R.W. Mitscher Co.	615-684-4544
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Va	Virginia Beach, R.W. Mitscher Co.	804-484-0500
Wash	Seattle, Underwood & Underwood Inc.	206-243-3133

Local Distributors

Ark	Little Rk., Carlton-Bates, Box 3155	501-375-5375
Cal	Burlingame, Rose Elctrns., 846 Stanton Rd.	415-697-0224
Cal	Hollywood, Yale Radio, 6662 Sunset Blvd.	213-465-3186
Cal	Inglewood, Cal. Switch & Signal, 1009 Arbor Vitae	213-776-3550
Cal	Los Angeles, Cal. Elect. Supply, 1911 Armacost	213-879-0760
Cal	Los Angeles, Radio Prod. Sls., 1501 So. Hill	213-748-1271
Cal	Mt. View, Ratel Elctrns., 815 Maude Ave.	415-965-2010
Cal	Oakland, Brill Elctrns., 610 E. 10th St.	415-834-5888
Cal	Palo Alto, Zack Elctrns., 654 High St.	415-326-5432
Cal	Riverside, MacRudie Group, 3627 Merrill Ave.	714-683-7711
Cal	San Diego, Radio Prod. Sls., 7889 Claremont Mesa	
Cal	San Francisco, Zack Elctrns., 1444 Market St.	415-626-1444
Colo	Denver, Electronic Parts, 1277 Broadway	303-266-3755
Colo	Lakewood, Acacia Sls., 1111 W. 8th Ave.	303-232-2832
Conn	Hartford, R & S Elctrns., 95 Leggett St.	203-528-6581
Fla	Miami, Elect. Equip., 2701 N.W. 42nd Ave.	305-635-0421
Fla	Pensacola, Grice Elctrns., Box 1911	904-434-4281
Ind	Indianapolis, Graham Elctrns., 133 S. Penn St.	317-635-5453
Iowa	Cedar Rap., Iowa Radio Supply, 710 Centerpoint Rd.	319-364-6154
Kans	Wichita, Radio Supply Co., 115 Laura St.	316-267-5214
La	Baton Rouge, Ralphs, 1732 Plank Rd	504-344-3761
La	Lafayette, Ralphs, Drawer R	318-234-4507
La	New Orleans, Radio Parts, 1112 Magazine St.	504-581-5959
La	Shreveport, Industrial Elctrns., Box 4067	615-573-7135
Md	Baltimore, ASI, 1728 Whitehead Ave.	301-265-5100
Md	Bethesda, Empire Elctrns., 4907 Rugby Ave.	301-656-3300
Md	Rockville, Pioneer/Wash., 1037 Taft St.	301-427-3300
Md	Savage, Pyttronics, 8220 Wellmore Rd	301-792-7000
Mass	Lynn, Land Elctrns., 9 Rear Franklin St.	617-592-2220
Mass	Newton, Greene Shaw, 70 Bridge St.	617-969-8900
Mass	W. Newton, A.W. Mayer, 38 Border St.	617-267-5530
Mich	Muskegon, Fitzpatrick Elect., 444 Irwin Ave.	616-722-6621
Mich	Wyoming, Newark Ind. Elect., 3645 Linden S.E.	616-241-6681
Minn	Minneapolis, Electronics Center, 107 3rd Ave.	612-338-5881
Mo	St. Louis, Olive Ind. Elect., 6662 Olive St.	314-863-7800
NJ	Camden, General Radio Supply, 600 Penn St.,	609-964-5560
NJ	Cinnaminson, Wilshire Elctrns., 8555 Indl. Hwy.	609-786-8990
NJ	Little Falls, Ind'l. Prods., Cardinal Dr.	201-785-1830
NY	Babylon, Delmar Elctrns., 101 Eads St.	516-420-1234
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Carle Place, Electronic Precepts, 288 Westbury Ave.	516-997-5380
NY	Mt. Vernon, QAR Elctrns., 621 S. Columbus	914-699-2224
NY	Plainview, ACI, 28 S. Mall St.	516-293-6630
NY	Rochester, Rochester Radio, 140 W. Main St.	716-454-7800
NY	Rochester, Summit Dist., 292 Commerce	716-334-8810
NY	Rome, Rome Elctrns., 108 Spring St.	315-337-5400
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Okla	Oklahoma City, Trice Whsle Elctrns., 4701 N. Stiles	405-524-4415
Pa	Allentown, A.A. Peters, 404 Union Blvd.	215-434-5237
Pa	Allentown, Valley Elctrns., 101 N. 7th St.	215-435-9696
Pa	Altoona, Allegheny, 1720 Union Ave.	814-946-0871
Pa	Erie, J.V. Duncomke, 721 Parade St.	
Pa	Harrisburg, Pyttronics, Box 1967	717-233-6591
Pa	McKeesport, Barno Radio, 5403 W. Smithfield St.	412-751-5966
RI	Warwick, W.H. Edwards, 55 Electronic	401-781-8000
SC	Colombia, Dixie Radio, Box 408	
Tex	Dallas, Whsle. Elect. Supply, Ross at Central	214-824-3001
Tex	El Paso, Midland Specialty, 2235 Wyoming Ave.	915-533-9555
Tex	Houston, Kent Elctrns., 5626 Bonhomme	713-783-9805
Tex	Houston, Solid State Elect., 6400 Westpark	713-785-5436
Utah	Salt Lake, Kimball Elctrns., 360 Pierpont Ave.	801-328-2075
Va	Arlington, Arlington Elctrns., 3636 Lee Hwy	703-524-2412
Va	Charlottesville, Virginia Radio, 715 Henry St.	804-296-4186
Wash	Seattle, Interface, 300 2nd Ave.	206-285-3500
Wash	Seattle, Sterling Elect., 5608 6th St.	206-762-9100

GENISCO TECHNOLOGY CORP., Filter Div., 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-346-6773; Empl.: 350; Minimum order: $100

For info on price: D. Pizzo; Application info: C. Kelley; Customer service: C. Kelley; Delivery info: C. Kelley

Free literature available: EMI/RFI Mini Filters; Shielden Enclosure and Ground Support Equipment Radio Interference Filters; R.F.I. Filters R.F. Filtered Power Line Assemblies

Products manufactured: Amplifiers, Capacitors, Fixed, Coils Including Assemblies & Forms, Filters, Transformers

Local Sales Offices & Reps.

Cal	Los Altos, Ewing-Foley, Inc.	415-941-4525
Cal	San Diego, F. Nagel Co.	714-298-4850
Md	Severna Park, D. Hughes	301-647-6327
Minn	St. Paul, Countryman Assocs.	612-645-9151

GENISCO TECH. CORP., Genistron Div., 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-346-6773; Empl.: 350; Minimum order: $400

Customer service: D. Pizzo

Free literature available: EMI/RFI Mini-Filters #F102; Shielded Enclosure and , - etc. #103C; RFI Filters #F101C; Current Probes #F150; Genistron RFI/EMI Analysis , - etc.

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Current Sensors, Filters, Networks, Probes, Reactors, Relays, Services, Assembly, Production & Test, Suppressors, Switches

Local Sales Offices & Reps.

Cal	Los Altos, Ewing-Foley	415-941-4525
Cal	San Diego, F. Nagel	714-298-4850
Colo	Denver, I. Strong	303-292-6900
Md	Severna Pk., D. Hughes	301-647-6327
Minn	St. Paul, Countryman	612-645-9151

GENISCO TECH. CORP., Tape Div., 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-347-6773; Empl.: 450; Minimum order: $100

For info on price: K. Williamson; Application info: L. Turner; Customer service: L. Turner; Delivery info: L. Turner

Free literature available: Model 10-286 Brochure and specifications Model 10-276 Brochure and specifications Model ECR-10 Brochure and specifications Models 10-110 and 10-236 Brochure and specifications Model AU/ASH-27 Brochure

Products manufactured: Recorders, Tape Recording Accessories

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs.	205-837-4304
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Encino, Scientific Devices	213-872-1951
Cal	Los Alamitos, Scientific Devices	213-598-7678
Cal	Mt. View, Scientific Devices	415-964-4230
Cal	San Diego, Scientific Devices	714-279-6642
Colo	Denver, C. Fowler	303-744-9595
Conn	Newtown, Daner-Hayes	203-426-9094
Fla	Orlando, Scientific Devices	305-424-7932
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Md	Baltimore, Scientific Devices	301-788-6611
Mass	Newton Centre, Daner-Hayes	617-969-4650
Mich	Detroit, Electro-Sls. Assoc.	313-526-8800
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NM	Albuquerque, Thorson Co.	505-265-5657
NY	Rochester, Daner-Hayes	716-467-5100
Ohio	Cleveland, Electro-Sls. Assoc.	216-261-5440
Ohio	Dayton, Electro Sls. Assoc.	513-426-5551
Pa	Bethayres, Control Instr. Sls. Co.	215-676-1808
Pa	Pittsburgh, Electro Sls. Assoc.	412-371-9449
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Va	Norfolk, Scientific Devices	804-499-8133
Va	Springfield, Scientific Devices	703-451-6500
Wash	Seattle, R. S. Drake Assoc.	206-763-2755
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

GENISCO TECH. CORP., Rotating Test Div., 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-346-6773; Empl.: 350; Minimum order: $100

Customer service: F. Schodlbauer

Free literature available: Series 1100 Rate of Turn Table No. 1-RT; Genisco Centrifuge Model 1068; Genisco Rate Tables; Centrifuge Composite Catalog.

Products manufactured: Calibrators, Simulators

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices	205-536-1969
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Carson, Abco Co.	213-537-5152
Colo	Denver, C.W. Fowler Co.	303-744-9595
Conn	Newtown, Daner-Hayes	203-426-9044
Fla	Fort Lauderdale, Scientific Devices	305-721-4260
Fla	Orlando, Scientific Devices	305-424-7932
Ind	Indianapolis, M & L Assocs.	317-545-0643
Iowa	Cedar Rapids, Palatine Engrg.	319-365-8071
Kans	Andover, Palatine Engrg.	316-683-7512
Kans	Overland Park, Palatine Engrg.	913-262-5643
Mass	Newton Center, Daner-Hayes	617-969-4650
Mich	Plymouth, Meas. Instr., Inc.	313-352-2144
Minn	Eden Prairie, F. Peterson Co.	612-941-5400
Mo	St. Louis, Palatine Engrg.	314-426-7055
NM	Albuquerque, Thorson Co.	505-265-5655
NC	Burlington, Scientific Devices	919-228-6279
Ohio	Cincinnati, Meas. Instr., Inc.	513-531-2729
Ohio	Cleveland, Meas. Instr., Inc.	216-333-6611
Okla	Tulsa, Palatine Engrg.	918-622-0321
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Bethayres, Control Instr. Sls.	215-676-1808
Pa	Monroeville, Meas. Instr., Inc.	412-366-1906
Tex	Houston, Palatine Engrg.	713-777-4477
Tex	Richardson, Palatine Engrg.	214-231-9489
Wash	Bellevue, McLaren, Inc.	206-454-3400

GENISCO TECH. CORP., TRANSDUCERS, 18435 Susana Rd., Compton, Cal., 90221, Tel: 213-537-4750, TWX: 910-346-6773; Empl.: 350; Minimum order: $100

Customer service: R. DeSomer

Free literature available: Acceleration Switches and Accelerometers Selector Guide #200; Genisco/Data Sensors Pressure Transducers and Readouts Selector Guide #400.

Products manufactured: Accelerometers, Amplifiers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Incotech	205-837-6061
Cal	Long Beach, Saber Entprs.	213-595-5646
Colo	Denver, C.W. Fowler	303-744-9595
Conn	Marion, Sands Co.	203-628-4363
Fla	Ft. Lauderdale, Scientific Devices	305-721-4260
Fla	Orlando, Scientific Devices	305-424-7932
Ill	Skokie, Mauer Co.	312-677-4771
Ind	Indianapolis, M & L Assocs.	317-545-0643
Iowa	Cedar Rapids, Palatine Engrg.	319-365-8071
Kans	Andover, Palatine Engrg.	316-683-7512
Kans	Overland Park, Palatine Engrg.	913-262-5643
Md	Baltimore, Scientific Devices	301-788-6611
Mich	Royal Oak, Meas. Instr.	313-352-2144
Minn	Hopkins, F. Peterson	612-941-5400
Mo	St. Louis, Palatine Engrg.	314-426-7055
NC	Burlington, Scientific Devices	919-228-6279
Ohio	Cincinnati, Meas. Instr., Inc.	513-531-2729
Ohio	Cleveland, Meas. Instr., Inc.	216-333-6611
Okla	Tulsa, Palatine Engrg.	918-622-0321
Pa	Bethayres, Control Instr. Sls.	215-676-1808
Pa	Monroeville, Meas. Instr., Inc.	412-366-1906
Tex	Houston, Palatine Engrg.	713-777-4477
Tex	Richardson, Palatine Engrg.	214-231-9489
Va	Norfolk, Scientific Devices	804-499-8133
Va	Springfield, Scientific Devices	703-451-6500
Wash	Seattle, R.S. Drake	206-763-2755

GENTRON CORP., 6667 N. Sydney Pl., Milwaukee, Wisc., 53209, Tel: 414-351-1660; Empl.: 10; Minimum order: $100

Customer service: Factory

Free literature available: Micro Power Circuits, SCR Bridge Rectifiers & Assemblies, Motor Controls, Hybrid Circuits, Resistor Networks, Oscillators, Relays Solid State & Thermal.

Products manufactured: Bridges, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Controls/Control Eqpt., Flashers, Motors, Networks, Oscillators, Relays, Resistors, Suppressors, Switches, Thyristors (Includes Silicon Controlled Rectifiers)

GEORGE INSTRUMENT CO., GIC Thermodynamics Div., 4949 Delemere, Royal Oak, Mich., 48073, Tel: 313-576-4700, Telex: 23-5714; Empl.: 10; Minimum order: $25

For info on price: F. Leslie; Application info: F. Leslie; Customer service: J. Smith; Delivery info: J. Smith

Free literature available: GIC Thermodynamics Master Catalog (42 pages) showing all material required for sensing, reading, & controlling temperature (#GIC-574-5/M) GIC Thermodynamics Short
Form Catalog (12 pages) showing most commonly used thermocouples and accessories. (#GIC-774-50/M)

Products manufactured: Connectors, Plug & Jack Sets, Probes, Thermocouples, Elements & Accessories, Wire

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Conn	Durham, Marr Elec. Co.	203-349-9691
Ill	Northfield, Ensign Co.	312-446-7147
La	Baton Rouge, Ross & Pethtel	504-293-0520
Mich	Royal Oak, D. Ray & Assocs.	313-576-4705
Minn	Minneapolis, Control Assemblies	612-544-3364
NJ	Clifton, Long, Poveromo & Assocs.	201-785-2492
NJ	W. Patterson, Long, Poveromo & Assocs.	201-785-2492
NY	Brooklyn, Long, Poveromo & Assocs.	212-449-5281
NY	Buffalo, Trott Elctrns.	716-876-0880
Ohio	Cleveland, Scott Elctrns.	216-291-2600
Pa	Media, W. Reeves Assocs.	215-566-6709
Tex	Houston, Gaumer Co.	713-686-3483
Wisc	Milwaukee, C.D. Controls Div. of Gordon Hatch	414-671-6550

GEORATOR CORPORATION, Box 70, Manassas, Va., 22110, Tel: 703-368-2101; Minimum order: $25

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For info on price: C. E. Trefzger; Application info: J. Rahaw; Customer service: S. Vick; Delivery info: S. Vick

Free literature available: Data Sheets, Summary Data Sheet, Converters, 60 to 60 Hz Line Isolator Motor Generators, Permanent Magnet Alternators, Complete Box Catalog: Describes Full line of, 50, 60, 120, 180, 360, 420, 840 Hz Outputs.

Products manufactured: Alternators, Converters, Generators, Isolators, Motor & Generator Armatures, Rotors, Stators, Motor Electric Generator Sets, Power Supplies, Regulators, Stabilizers, Line Impedance, Tachometers

GEORATOR CORPORATION cont'd

Advertisment

Georator Corporation

Manufacturer of NOBRUSH Permanent Magnet Generators, frequency Converters, Alternators, Isolator-Stabilizer Motor Generators, and seperate rotors and stators. In frequencies of 25, 50, 60, 120, 180, 360, 400, 420, 800 and 840 Hz. In ratings from O.5 KVA to 25 KVA.

GEOTECH, See Teledyne Geotech.

GERBER SCIENTIFIC INSTR. CO., Box 305, Hartford, Conn., 06601, Tel: 203-644-1551, TWX: 710-427-2218; Empl.: 350

Products manufactured: Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Drafting Machines, Recorders, Simulators

Local Sales Offices & Reps.

Cal	Encino
Fla	Jacksonville
Ill	Skokie
Mich	Lathrup Village
NJ	Paramus
Tex	Arlington
Va	Arlington

GERMANIUM POWER DEVICES, Box 65, Shawsheen Village Sta., Andover, Mass., 01810, Tel: 617-475-5982, Telex: 94-7150; Empl.: 42; Minimum order: $100

For info on price: L. LeBow; Application info: D. Frost; Customer service: L. LeBow; Delivery info: L. LeBow

Free literature available: Short form catalogue Listing complex Germanium power devices

Products manufactured: Transistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne, Inc.	602-946-4437
Cal	Canoga Park, TKO Elctrns.	213-883-3822
Cal	Mt. View, Nor-Cal Assocs.	415-961-8121
Cal	San Diego, Col-Rob Elctrns.	714-565-6814
Colo	Littleton, Piper-Goyne, Inc.	303-798-8955
Colo	Wheatridge, Waugaman Assocs.	303-423-1020
Fla	North Miami, Winfield Elctrn. Sls. Co.	305-945-6544
Ga	Atlanta, Winfield Southeast Co.	404-636-3023
Ill	Addison, H. Grubb & Co.	312-543-8525
Iowa	Cedar Rapids, F. Snyder	
Kans	Shawnee Mission, Florence & Meyer	913-722-5210
Kans	Wichita, Florence & Meyer	316-838-7226
Minn	Hopkins, Grayden & Flemmer, Inc.	612-941-1120
Mo	St. Charles, Florence & Meyer	314-724-6690
NJ	Cherry Hill, Danco Elctrn. Sls. Corp.	710-896-2218
NM	Albuquerque, Piper-Goyne, Inc.	505-265-6794
NY	Larchmont, Hindston Walsh Assoc.	914-834-5781
NY	Syracuse, Nycom, Inc.	315-437-8343
Ohio	Cleveland, KW Elctrns.	216-831-8292
Ohio	Dayton, KW Elctrns.	513-890-2150
Okla	Broken Arrow, P. J. Scanlon Co.	918-251-5728
Ore	Portland, C. K. Shanks & Assoc.	503-292-5656
Pa	Allsion Park, KW Elctrns.	412-487-4300
Tex	Houston, P. J. Scanlon Co.	
Tex	Richardson, P. J. Scanlon Co.	214-231-4661
Wash	Seattle, C. K. Shanks & Assoc.	206-632-4290
Wisc	Milwaukee, H. Grubb & Co.	414-545-7810
FOR:	Can., Scarborough, Ont., International Rectifier Canada, Ltd.	416-755-7793

GHZ DEVICES, INC., 16 Maple Road, So. Chelmsford, Mass., 01824, Tel: 617-256-8101, TWX: 710-343-0404; Empl.: 66; Minimum order: $25

For info on price: R. Tremblay; Application info: C. Newton; Customer service: C. Elliason; Delivery info: C. Elliason

Free literature available: GHZ devices offers 2 short form catalogs; to cover complete microwave diode product line and the GHZ line of microwave control devices.

Products manufactured: Attenuators, Diodes, Limiters, Modulators, All Kinds, Shifters, Switches

Local Sales Offices & Reps.

Ala	Huntsville, F.M. Assocs., Ltd.	205-536-9990
Ariz	Scottsdale, Piper Goyne	602-946-4437
Cal	Los Angeles, Thorson Co.	213-937-0790

Cal	Palo Alto, Waldman Assocs.	415-961-4100
Cal	San Diego, Thorson Co.	714-298-8385
Cal	Tustin, Thorson Co.	714-544-5121
Colo	Denver, Thorson Co.	303-355-3521
Fla	Orlando, Currie, Peak & Frazier Inc.	305-855-0843
Fla	Orlando, F.M. Assocs., Ltd.	305-851-5716
Ill	Chicago, Techrep, Inc.	312-761-0548
Ind	Ft. Wayne, TX Sls. Inc.	219-485-0805
Ind	Indianapolis, TX Sls. Inc.	317-253-1966
Kans	Shawnee, F. Guernsey Co.	913-631-2414
Md	Ellicott City, Applied Engrg. Conslts.	301-465-1272
Mass	Needham Hts., O'Sullivan & Murphy at Reptron	617-449-4141
NY	Tuckahoe, Spectrum Sls. Inc.	914-793-1660
NC	Greensboro, F.M. Assocs. Ltd.	919-294-2754
Ohio	Dayton, K.W. Elctrn. Sls., Inc.	513-890-2150
Ohio	Shaker Heights, TX Sls., Inc.	216-561-1900
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Wash	Seattle, Thorson Co.	206-632-0710
FOR:	Can. Villa LaSalle 650, Que., Electrodesign, Ltd.	514-363-5120
FOR:	Can., Toronto, Ont., Electrodesign, Ltd.	416-787-0991
FOR:	Can., Vanier, Ont., Electrodesign, Ltd.	613-745-0541

GIBSON/EGAN CO., 21 Flower St., Arcadia, Calif., 91006, Tel: 213-446-5259; Empl.: 40; Minimum order: $15

For info on price: D. Clark; Application info: K. Kanberra; Customer service: G. Egan; Delivery info: G. Egan

Free literature available: Timing Belt Pulleys - stock list of thermoplastic pulleys; IC Carriers - wide assortment of IC carriers for flatpack, to's, and dip devices; Dip Stirips - description of various sizes of dual in line sockets; P.C. Card Guides - instant pc card rack for holding p.c. cards.

Products manufactured: Cups, Encapsulation, Gears & Gear Mechanisms (Precision), Guides, Circuit Board, Holder & Carriers, Holders, Circuit Board (Production Type), Pullers, Racks, Retainers, Sockets

Local Sales Offices & Reps.

Cal	San Jose, Smolen Assocs.	408-252-7358
Pa	Devon, B & A Assocs.	215-688-5173
Tex	Dallas, Scott Tech. Sls. Co.	214-352-7698

GILWAY SALES COMPANY, 29B Cummings Pk., Woburn, Mass., 01801, Tel: 617-935-4442; Empl.: 3; Minimum order: $25

For info on price: B. Murphy; Application info: G. Wade; Customer service: D. Volner; Delivery info: G. Wade

Free literature available: Catalog #152 list our complete line of T-3/4, T-1, and T-4 precision wound filament lamps. Filaments are straight, rugged, and centered. Lamps offer lens end and special bases.

Products manufactured: Lamps

GLASTIC CORP., 4321 Glenridge Rd., Cleveland, Ohio, 44121, Tel: 216-486-0100, TWX: 810-421-8827; Empl.: 375; Minimum order: $50

Customer service: Cust. Svc. Dept.

Free literature available: Laminate Catalog; Insulator and Channel Catalog; Pultruded Rod Catalog.

Products manufactured: Compounds, Encapsulating, Insulating, Molding, Potting, Laminates

GLATZER INDUSTRY CORP., 286 Huguenot St., New Rochelle, NY, 10801, Tel: 914-576-2700

GLENAIR, INC., 1211 Air Way, Glendale, Cal., 91201, Tel: 213-247-6000, TWX: 910-497-2066; FSC No: 06324; Empl.: 325

Customer service: R. Platz

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Caps, Connector, Connector Adapters, Connectors, Testers, Tools

Local Sales Offices & Reps.

Ala	Huntsville, Brandel-Stephens Co.	205-883-0445
Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Downey, Buffa Co.	213-923-4618
Cal	Glendale, Electro-Mech Prods.	213-848-0922
Cal	San Diego, Earle Assocs.	714-278-5441
Cal	Santa Clara, Nova-Tronix Elec. Sls.	408-243-9530
Colo	Englewood, Todd Assocs.	303-761-7801
Conn	Branford, W. McCoy Co.	203-488-2012
Fla	Orlando, Brandel-Stephens Co.	305-425-3202
Ga	Atlanta, Brandel-Stephens Co.	404-261-7579
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Marsten Sls. Co.	312-775-6611
Ind	Greenwood, Valentine-Schillinger Assoc.	317-888-2260
Ind	South Bend, Valentine-Schillinger Assoc.	219-291-6258
Md	Silver Spring, Carwithen Assocs.	301-589-9112
Mich	Plymouth, Romarc	313-455-0300
Minn	Minneapolis, Nygaard Sls.	612-881-3727
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Haddonfield, T. Mills Co.	609-429-1005
NJ	Wayne, GT Assocs.	201-694-6040
NM	Scottsdale, Goodreau Assocs.	602-994-9909
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	Levittown, GT Assoc.	516-731-3449
NY	Liverpool, Telesco Assocs.	716-872-6417
NY	Rochester, Telesco Assocs.	716-271-3780
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Ohio	Dayton, A.D. Dircksen & Assoc.	513-256-0351
Ohio	Dayton, D. Steffen & Assocs.	513-293-3145
Tex	Houston, AID Elctrns.	713-777-3882
Tex	Irving, AID Electronics, Inc.	214-259-4761
Wash	Redmond, Barrett Sls. Northwest Ltd.	206-885-6991

GLENMARC MFG. INC., 330 Melvin Dr., Northbrook, Ill., 60062, Tel: 312-272-9030; Empl.: 10

Customer service: D. Greenwood

Free literature available: Portionator brochure - epoxy metering & dispensing equip.

Products manufactured: Solder (All Types)

GLENTEK, INC., 1557 7th St., Santa Monica, Calif., 90401, Tel: 213-451-4511; FSC No: 26415; Empl.: 15

Customer service: R. C. Vasak

Products manufactured: Actuators, Amplifiers, Controls/Control Eqpt., Converters, Demodulators, Modulators, All Kinds, Multipliers, Power Supplies

GLIDDON METALS, Glidden-Durkee Div. SCM Corp., 900 Union Commerce Bldg., Cleveland, Ohio, 44115, Tel: 216-771-5121; Minimum order: $30

For info on price: J. F. Jasper 216-771-5121; Application info: H. D. Ambs 814-535-2571; Customer service: H. D. Ambs 814-535-2571; Delivery info: J. F. Jasper 216-771-5121

Products manufactured: Alloys, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals

GLOBE PLASTICS, 1342 S. Signal Dr., Pomona, Cal., 91766, Tel: 714-NA3-2747; Empl.: 15; Minimum order: $10

Products manufactured: Clamps & Clips, Cups, Encapsulation, Fasteners, Handles For Cabinets, Circuit Boards, Racks, etc., Kits, Marking (Dial, Instrument, Equipment, etc.), Pads, Transistor Mounting, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ill	Chicago, H. Halinton Engrg. Assocs., Inc.	312-763-2131
NY	Brooklyn, Verter Sls.	212-HI 4-3880

Advertisment

Injection & Transfer Molding - Custom Molding
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Quality Control/Mil Q9858
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Specialize in transistor pads, washers, header boards, frames, funnels, clips. Send for complete brochure. Let us quote on your plastic part requirements.

GLOBE UNION, INC., Globe Battery Div., 5757 N. Green Bay Ave., Milwaukee, Wisc., 53201, Tel: 414-228-1200, TWX: 910-262-3084; Empl.: 9957

For info on price: T. Ruhlmann 414-228-2396; Application info: D. Scarvaci 414-228-2394; Customer service: T. Ruhlmann 414-228-2396; Delivery info: T. Ruhlmann 414-228-2396

Products manufactured: Batteries, Chargers, Battery

Local Distributors

Ariz	Phoenix, Micro-Components, Box 15268 Arcadia Sta.	602-955-3193
Cal	Los Angeles, Mil-Com Dist., 1609 Pontius Ave.	213-477-2068
Cal	Los Angeles, Radio Prod Sls Inc., 1501 S. Hill St.	213-748-1271
Cal	Mountain View, Abacus Elctrns., 1065 Terra Bella Ave.	415-961-1500
Cal	Mountain View, Energy Sls., 2271 Nora Dr.	415-969-0000
Fla	Miami, Pro Can Inc., 2013 N.E. 160th St.	305-945-4253
Ill	Skokie, Bell Ind., 7701 N. Austin Ave.	312-965-7500
Ind	Indianapolis, Ra-Dis-Co., 814 N. Senate Ave.	317-637-5571
Iowa	Mason City, Alexander Dist., Box 381	
Mass	Burlington, Arrow Elctrn., 15"A" St.	617-273-0100
Minn	Bloomington, Arrow Elctrns. Inc., 9700 Newton Ave. S.	612-888-5522
Mo	Kansas City, Burnstein-Applebee Co., 3199 Mercier	816-531-5614
Mo	St. Louis, Olive Ind. Elctrns., 6662 Olive Blvd.	314-863-7800
NJ	Hanover, State Elctrns. Parts Corp., 36 Route 10	201-887-2550
NY	Plainview, Fairmont Elec. Sls. Corp., 35 S. Service Rd.	516-694-8200
NY	Syracuse, Stewart N. Smith, 325 E. Water St.	315-422-0323
Pa	Hatboro, Henwarr Inc., 218 Tanner Ave.	215-675-4104
Tex	Dallas, Mauratron Inc., 13333 Central Expwy	
Tex	Dallas, Solid State Elec. Co. of Tex., 2643 Manana Dr.	214-352-2601
Tex	Houston, Lenert Co., 420 Hutchins Dr.	713-225-1465
Tex	San Antonio, Sherman Elec. Supp., 702 San Pedro Ave.	512-226-0247
Va	Arlington, Perrott Engrg. Labs, 1020 N. Fillmore	703-528-5861
Wash	Seattle, James J. Backer Co., 221 W. Galer St.	206-285-1300

GLOWLITE CORP., Sub. ELT, Inc., Pauls Valley, Okla., 73075, Tel: 405-238-5541, TWX: 910-830-6590; Empl.: 300; Minimum order: $35

For info on price: J. Phillips; Application info: J. Phillips; Customer service: J. Abney; Delivery info: J. Abney

Free literature available: ELT, Inc. Glow Lite Div. Catalog informative description of neon lamp characteristics and terms, as well as a convenient, compact list of glow-lite products.

Products manufactured: Lamps, Lights

Local Sales Offices & Reps.

Ill	Chicago, ELT, Inc.	312-441-6650

GLUCO, INC., Box 336, Monroeville, Pa., 15146, Tel: 412-327-7575; FSC No: 83508; Empl.: 20

Customer service: Wm. Gluck

Free literature available: Molding presses for encapsulation of electronic components. Automatic assembly machines.

Products manufactured: Machines/Machinery, Production

GOE ENGRG. CO., Box 3485, City of Industry, Calif., 91746, Tel: 213-330-7401; FSC No: 00866; Empl.: 40; Minimum order: $15

Customer service: G. H. Reynolds

Products manufactured: Handles For Cabinets, Circuit Boards, Racks, etc., Terminals

Local Sales Offices & Reps.

Cal	Palo Alto, W. W. Tompkins & Co.	415-DA6-7940
Colo	Denver, T. Crump Co.	303-426-1443
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
NJ	S. Orange, S. Simberkoff Assocs.	201-763-7900
Tex	Arlington, D/FW Sls. Co.	817-461-0681

GEO SPACE, See Trak Systems

GOODRICH CHEM. CO., B.F., 6100 Oak Tree Blvd., Cleveland, Ohio, 44131, Tel: 216-524-0200

Customer service: D. G. Kuharik

Products manufactured: Compounds, Encapsulating, Insulating, Molding, Potting, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

Local Sales Offices & Reps.

Cal	Los Angeles	213-386-7436
Ga	Atlanta	404-355-2555
Ill	Oak Brook	312-654-4700
Mass	Wellesley Hills	617-235-8700

Mich	Southfield	313-357-3939
Mo	Kansas City	816-353-6440
NJ	Englewood Cliffs	201-461-5100
Pa	Fort Washington	215-643-6805
FOR:	Can., Kitchener, Ont.	519-742-3641

GOODRICH DIV., Conrac Corp., 3560 Chicago Dr., Hudsonville, Mich., 49426, Tel: 616-669-1000

Products manufactured: Machines/Machinery, Production

GOODYEAR AEROSPACE CORP., 1210 Massillon Road, Akron, Ohio, 44315, Tel: 216-794-3631, TWX: 810-431-2080; Empl.: 4000

Products manufactured: Computers

Local Sales Offices & Reps.

Cal	Los Angeles, Goodyear Tire & Rubber Co.	213-776-5577
DC	Washington, Goodyear Tire & Rubber Co.	202-331-9500
Fla	Ft. Walton Beach, Goodyear Tire & Rubber Co.	904-242-4231
Fla	Orlando, Goodyear Tire & Rubber Co.	305-894-2751
Mo	St. Louis, Goodyear Tire & Rubber Co.	314-731-1986
NY	Rome, Goodyear Tire & Rubber Co.	315-336-7020
Ohio	Dayton, Goodyear Aerospace Corp.	513-224-8301

GORDON, CLAUD S. CO., Sub. Pneumo Corp., 5710 Kenosha St., Richmond, Ill., 60071, Tel: 815-678-2211, Telex: 72-2427; Empl.: 200

Products manufactured: Cable, Connectors, Controls/Control Eqpt., Crayons, Coatings, Pellets, etc., Temperature Indicating, Furnaces, Labels, Temperature Indicating, Monitors, Probes, Pyrometers, Thermocouples, Elements & Accessories, Thermometers, Resistance, Wire

Local Sales Offices & Reps.

Cal	San Carlos, C. S. Gordon Co.	415-591-7070
Cal	Torrance, C. S. Gordon Co.	213-775-8688
Colo	Denver, J.M.C. Instr.	303-744-7035
Conn	Manchester, C. S. Gordon Co.	203-633-6887
Fla	Boca Raton, L. E. Rogers Co.	305-395-7922
Fla	Ruskin, L. E. Rogers Co.	813-645-1453
Ga	Atlanta, R. Freeman Assocs.	404-261-9065
Ind	Indianapolis, C. S. Gordon Co.	317-547-1057
Kans	Wichita, B. J. Alberts Co.	316-263-4941
La	Baton Rouge, Hahn Sls. Co.	504-356-2596
Mich	Milford, C.S. Gordon Co.	313-872-1837
NJ	Scotch Plaines, Buck Sls.	201-322-8747
NM	Farmington, J. Neff Co.	505-325-6449
NY	Buffalo, G. E. Bowker	716-876-8387
NC	Charlotte, A. D. Penn Co.	704-847-4426
Ohio	Cleveland, C. S. Gordon Co.	216-321-7777
Pa	Norristown, C. S. Gordon Co.	215-546-7255
Pa	West Mifflin, C. S. Gordon Co.	412-371-2600
Tex	Houston, C. S. Gordon Co.	713-224-2964
Utah	Salt Lake City, Wiscomb-Weidner Co.	801-328-3205
Va	Richmond, D.W. Larcen & Co., Inc.	804-288-4061
Wash	Seattle, Eustis Co., Inc.	206-623-7060
Wisc	Milwaukee, C. S. Gordon Co.	414-645-2380
EXP:	Westbury, N.Y., C. S. Gordon Export Dept.	516-334-3303

GORDON ENGINEERING CORP., Del Mar Dr., Brookfield, Conn., 06804, Tel: 203-775-1895; Empl.: 12

Customer service: L. Najman 203-775-0990

Products manufactured: Controls/Control Eqpt., Indicators, Switches

Local Sales Offices & Reps.

Ala	Huntsville, B J R Reps.	205-881-3569
Cal	San Francisco, Steven Engrg.	415-626-7979
Cal	Whittier, Marcott Ind.	213-723-0866
Colo	Denver, H. Kaub & Co.	303-399-1520
Conn	Ridgefield, Technical Mgr. Co.	203-438-2740
Ind	Wabash, Richard Scales Assocs.	219-563-4886
Mich	Troy, Morco Corp.	313-585-3910
Mo	St. Louis, Best Equip. Co.	314-991-3434
NY	White Plains, Swedelco, Inc.	914-946-1122
NC	Charlotte, Power Components	704-537-8099
Ohio	Cincinnati, H. C. Jahn	513-521-0172
Ohio	Twinsburg, J. Hubbard & Assoc.	
Pa	Hershey, Niets Assocs.	717-533-3679
Wash	Airway Hgts., Calvert Controls Inc.	
Wisc	Milwaukee, Star Engrg. Sls.	414-543-3469
FOR:	Can., North Vancouver, B.C., Southwell Controls, Ltd.	604-930-3688
FOR:	Can., Windsor, Ont., Canadian Border City	

GORDOS CORP., 250 Glenwood Ave., Bloomfield, N.J., 07003, Tel: 201-743-6800, Telex: 13-8209; Empl.: 600 p. 1•1700-1706,2053-2057

Products manufactured: Relays, Switches

Local Sales Offices & Reps.

Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Colo	Wheatridge, Waugaman Assocs.	303-423-1020
Conn	Cheshire, R.F. Duffy Assocs.	203-272-7789
Fla	Maitland, Barrett Assocs.	305-678-0172
Ga	Atlanta, Millar Elctrns., Inc.	
Mass	Braintree, R.F. Duffy Assocs.	617-335-7724
Mass	Detroit, L.H. Dickelman Co.	313-255-3300
Minn	St. Paul, Kenco Co.	
NJ	Cherry Hill, Gordon Co.	609-667-6644
NJ	Mountainside, Henry G. Richter Inc.	
NM	Albuquerque, Waugaman Assocs., Inc.	
NY	Fayettville, Henry G. Richter Inc.	
NC	Raleigh, Millar Elctrns., Inc.	
Ohio	Cleveland, A.H. Baier Co. & Assoc.	216-461-6161
Ohio	Dayton, A.H. Baier Co. & Assoc.	513-276-4128
Tex	Richardson, Zonk Engrg.	214-238-7651
Wash	Seattle, H. Levinson Co.	206-323-5100

GORDOS/GRISBY-BARTON, 3800 Industrial Dr., Rolling Meadows, Ill., 60008, Tel: 312-392-5900, TWX: 910-687-3789; Empl.: 150 p. 1•1700-1706

For info on price: Sls. Dept.; Application info: Tech. Sls. Dept.; Customer service: Cust. Sus. Dept.; Delivery info: Cust. Svs. Dept.

Free literature available: Technical data sheets for dip reed relays, molded reed relays, Hybrid relays, solid state relays.

Products manufactured: Controls/Control Eqpt., Relays

Local Sales Offices & Reps.

Cal	Pasadena, Luscombe Eng.	213-684-2000
Cal	San Mateo, Luscombe Eng.	415-342-7057
Colo	Denver, Goyne Assoc.	303-722-4674
Fla	Ft. Lauderdale, Orbe, Inc.	305-771-8915
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Mass	Andover, R. Purinton, Inc.	617-475-7055
Minn	St. Paul, Kenco Co.	612-645-7717
NJ	Mountainside, H.G. Richter Co.	201-233-4615
NM	Albuquerque, Goyne Assoc., Inc.	505-265-6794
NY	Fayetteville, H.G. Richter Co.	315-637-6713
NY	Mountainside, H.G. Richter Co.	212-962-5820
Ohio	Chagrin Falls, Pine Sls. & Eng. Co.	216-247-6198
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Tex	Garland, Whiteside Sls.	214-231-9771
Wash	Bellevue, N.R. Schultz Co.	206-454-0300

Local Distributors

Cal	Inglewood, Newark Elctrns., 4747 W. Century	213-678-0441
Cal	Inglewood, Time Elec-West, 900 W. Olive St.	213-649-6900
Colo	Denver, Newark Electronics, 2170 S. Grape St.	303-757-3351
Conn	Westport, Newark Elctrns., 25 Sylvan Rd.	203-226-6921
DC	Washington, Newark Elctrns., 10440 Baltimore Rd.	301-937-5085
Fla	Ft. Lauderdale, Newark Elctrns., 1360 N.W. 65th St.	305-587-2372
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	313-638-4411
Iowa	Cedar Rapids, Newark Elctrns., 1019 First Ave. SW	319-362-1171
Mass	Boston, Time Elctrns.-N.E., Woburn	617-935-8080
Mich	Detroit, Newark Elctrns., 20700 Hubbell	313-548-0250
Minn	Minneapolis, Control Design, 3433 E. 25th St.	612-721-1628
NJ	Kenilworth, Newark Elctrns., 303 Monroe Ave.	201-272-8410
NJ	Pennsauken, Resco, Apt. Hwy & Cen. Hwy	609-662-4000
NY	Plainview, Newark Elctrns., 80 Express St.	516-822-5000
NY	Rochester, Newark Elctrns., 3000 S. Winston Rd.	716-743-6600
NC	Greensboro, Hammond Elctrns., 2923 Pacific Ave.	919-275-6391
Ohio	Cleveland, Spec. Comp. Sls. Co., 23366 Commercial Pk. Rd.	216-464-0405
Pa	Philadelphia, Resco	215-925-6900
Tex	Dallas, Newark Elctrns., Box 38299	214-271-2511
Utah	Salt Lake, Newark Electronics, 2540 S. 300 W.	801-486-1048
Wisc	Milwaukee, Newark Elctrns., 3695 N. 126 St.	414-781-2450

GORMAN-REDLICH MFG. CO., 6 Curtis St., Athens, Ohio, 45701, Tel: 614-593-3150; Empl.: 4; Minimum order: $50

Customer service: J. T. Gorman

Products manufactured: Oscillators

Advertisment

Manufacturers of broad band crystal oscillators modules (± 5 PPM) over the temp. range -10°C to +60°C. Products cover 9 MHZ to 100 MHZ with bandwidths of 15% to 50%. Applications: Frequency source for counters, communication, navigation transmitters and receivers. Input 10V to 30V at 10MA to 50MA, output up to 10 VRMS. Freq. set to within 1 PPM with trimmer capacitor.

GOTHAM AUDIO CORP., 741 Washington St., New York, N.Y., 10014, Tel: 212-741-7411; Empl.: 14

For info on price: E. Passin; Application info: S. Temmer; Customer service: P. Golstein; Delivery info: P. Golstein

Products manufactured: Attenuators, Cable, Equalizers, Meters, Microphones, All Kinds, Mixers, Phonographs, Parts & Accessories, Recorders, Timers, Transformers

Local Sales Offices & Reps.

Cal	Hollywood, Gotham Audio Corp.	213-874-4444

GOULD INC., Allied Control Div., 100 Relay Rd., Plantsville, Conn., 06479, Tel: 203-628-9654, TWX: 710-473-0079; Empl.: 450 p. 1•1686

Customer service: R. E. Delaney

Free literature available: Relays & Sockets Catalog, Solenoid Valves Catalog

Products manufactured: Controls/Control Eqpt., Process Control Systems, Relays, Sockets, Timers, Valves, Solenoid

Local Sales Offices & Reps.

Ariz	Tempe, Delta Elctrns. Sls.	602-966-9903
Cal	Los Angeles, El-Com Sls.	213-223-2435
Cal	Menlo Park, Straube Assocs.	415-323-2476
Colo	Denver, Elctrn. Sls.	303-771-6300
Fla	Orlando, Geartner Assocs.	305-299-1000
Ga	Atlanta, O'Hara Assocs.	404-237-0600
Ill	Chicago, D. Dolin Sls.	312-286-6200
Kans	Olathe, Bob Rush Assocs.	913-782-1177
Md	Baltimore, J.R. Daniel & Co.	301-825-3330
Mass	Millis, Selmark Assocs.	617-376-2914
Mich	Dearborn, VPI, Inc.	313-271-4600
Minn	Minneapolis, Industrial Comps.	612-831-4547
NJ	Cherry Hill, J.N. Barrett Assoc.	215-627-0149
NJ	Pompton Lakes, R. Horne Assocs.	201-835-7400
NY	E. Syracuse, Honsinger Mktg. Assoc.	315-463-5718
NC	Burlington, P.J. Nahser Co.	919-226-8053
Ohio	Aurora, E.M.A., Inc.	216-562-6104
Ohio	Centerville, E.M.A., Inc.	513-433-2800
Okla	Oklahoma City, Ammon & Rizos Co.	405-373-2748
Pa	Pittsburgh, G.S. Root Co.	412-561-4125
Tex	Dallas, Ammon & Rizos Co.	214-233-5591
Tex	Houston, Ammon & Rizos Co.	713-729-1233
Wash	Seattle, F. Jackson Co.	206-782-2211
FOR:	Can., Montreal, Que., H.W. Brieger Sls.	514-482-0722

Local Distributors

Ala	Huntsville, Cramer/EW, 2310 Bob Wallace Ave.	205-539-5722
Ariz	Phoenix, Cramer/Ariz., 2816 N. 16th St.	602-263-1112
Cal	Los Angeles, El-Com, Inc., 5134 Valley Blvd.	213-223-1351
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Colo	Denver, Newark-Denver Elect., 2170 S. Grape St.	303-757-3351
Conn	Waterbury, Bond Radio, 439 W. Main St.	203-757-0546
Fla	Ft. Lauderdale, Peerless Radio, 1040 N.E. 43rd St.	305-566-5966
Ga	Atlanta, Lykes Elctrns., 1135 Chattahoochee	404-355-2223
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Ind	Indianapolis, Graham Elctrn., 133 S. Pennsylvania	317-634-8486
Kans	Wichita, Radio Supply, 115 Laura	316-267-5214

Md	Baltimore, Allied Control Sls. Corp., 1404 Bare Hills A	301-828-6416
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Oak Park, Newark Detroit Elect., 20700 Hubbell Ave.	313-548-0250
Minn	Minneapolis, Industrial Comps., 5280 W. 74th St.	612-831-2666
Mo	Kansas City, LCOMP-Kansas City, 1520 Taney St.	816-221-2400
NJ	Moonachie, Cramer/N.J., 1 Barrett Ave.	201-935-5600
NJ	Wayne, Gordon/Horne, 2282 Hamburg Tpke.	201-835-7400
NM	Albuquerque, Cramer/N.M., 137 Vermont N. E.	505-265-5767
NY	Hauppauge, Cramer, 29 Oser Ave.	516-231-5600
NY	Rome, Rome Elctrn., 108 Spring St.	315-337-5400
NC	Winston-Salem, Kirkman Elect., 901 W. 2nd St.	919-724-0541
Ohio	Akron, Akron Elctrns., 107 S. Arlington St.	216-762-8818
Okla	Tulsa, Cramer/Tulsa, 6336 E. 13 St.	918-836-3371
Ore	Portland, Eoff Elctrns., 509 N. W. Tenth Ave.	503-222-9411
Pa	Philadelphia, Philadelphia Elctrns., 1225 Vine St.	215-568-8288
Tenn	Nashville, Electra Distributing, 1914 West End Ave.	615-329-3971
Tex	Dallas, Sterling Elctrns., 2875 Merrell Rd.	214-357-9131
Utah	Salt Lake City, Alta-Land Elctrns., 2280 S. Main St.	801-486-7227
Va	Arlington, Republic Elctrns., 3004 Lee Hwy.	703-528-3973
Wash	Seattle, Western Elctrns., 717 Dexter Ave. N.	206-284-0200
Wisc	Milwaukee, Cramer/Wisc., 5626 N. 91st St.	414-462-8300

GOULD, INC., Portable Battery Div., 931 Vandalia, St. Paul, Minn., 55114, Tel: 612-452-1500; Minimum order: $150

Customer service: Zigmund

Free literature available: Complete line of seal-nickel cadnium and gilled electrolyte lead oxide rechangeable batteries.

Products manufactured: Batteries

Local Sales Offices & Reps:

Cal	Fountain Valley	714-531-1793
Cal	San Jose	408-238-3620
Ill	Rosemont	312-671-0671
Md	Towson	301-296-0825
Mass	Maynard	617-369-5651
Mass	Quincy	617-773-7980
Minn	St. Paul	612-452-1500
NY	Brooklyn	212-332-8641
Ohio	Cleveland	216-861-1877
Pa	Philadelphia	215-831-9520
Wisc	Schofield	715-359-3531

GOULD, INC., Instr. Sys. Div., 3631 Perkins, Cleveland, Ohio, 44114, Tel: 216-361-3315 .... p. 1•2341

Products manufactured: Amplifiers, Analyzers, Bridges, Data Acquisition & Reduction Systems, Data Loggers, Detectors, Display Devices/Displays, Indicators, Integrators, Electronic, Memory Systems, Monitors, Multiplexers, Oscillographs, Direct Writing, Oscilloscopes, Paper, Graphic Recording, Printers, Recorders, Signal Conditioners & Equipment, Terminals, Data Display (including Alphanumeric & Graphic), Transducers

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Instr., Inc.	205-539-4411
Cal	Burlingame, Gould Inc., Instr. Sys. Inc.	415-697-9345
Cal	Los Angeles, Gould Inc., Instr. Sys. Div.	213-685-7476
Colo	Denver, Gould Inc., Instr. Sys. Div.	303-758-4922
Conn	Stratford, Gould Inc., Instr. Sys. Div.	203-377-1332
Fla	Ft. Lauderdale, W.A. Brown Instrs.	305-776-4800
Fla	Ft. Walton Beach, W.A. Brown Instrs.	904-243-6424
Fla	Orlando, W.A. Brown Instrs.	305-425-5505
Ga	Atlanta, W.A. Brown Instrs.	404-939-1674
Ill	Rosemont, Gould Inc., Instr. Sys. Div.	312-671-5620
La	Gretna, W.A. Brown Instrs.	504-366-5766
Md	Lanham, Gould Inc., Instr. Sys. Div.	301-459-7350
Mass	Burlington, Gould Inc., Instr. Sys. Div.	617-272-0750
Mich	Southfield, Gould Inc., Instr. Sys. Div.	313-356-6600
Minn	Minneapolis, Gould Inc., Instr. Sys. Div.	612-546-7336
Mo	St. Louis, Gould Inc., Instr. Sys. Div.	314-878-6110
NJ	Fairfield, KLS Assocs., Inc.	212-233-4849
NJ	Saddle Brook, Gould Inc., Instr. Sys. Div.	201-845-0220
NY	East Rochester, Gould Inc., Instr. Sys. Div.	716-381-4095
NY	Schenectady, Gould Inc., Instr. Sys. Div.	518-370-1404
NC	Research Triangle Park, W.A. Brown Instrs.	919-489-1546
Ohio	Cleveland, Gould Inc., Instr. Sys. Div.	216-481-7221
Ohio	Dayton, Gould Inc., Instr. Sys. Div.	513-433-9586
Pa	Bala Cynwyd, Gould Inc., Instr. Sys. Div.	215-839-7066
Pa	Pittsburgh, Gould Inc., Instr. Sys. Div.	412-931-3660
Tenn	Knoxville, W. A. Brown Instrs.	615-584-2614
Tex	Dallas, Gould Inc., Instr. Sys. Div.	214-241-5131
Tex	Houston, Gould Inc., Instr. Sys. Div.	713-644-3671
Va	Richmond, Gould Inc., Instr. Sys. Div.	604-288-2888
Wash	Renton, Gould Inc., Instr. Sys. Div.	206-271-1100
FOR:	Can., Calgary, Alberta, Allan Crawford Assocs., Ltd.	403-276-9658
FOR:	Can., Dartmouth, Nova Scotia, Allan Crawford Assocs., Ltd.	902-469-7865
FOR:	Can., Montreal, Que., Allan Crawford Assocs. Ltd.	514-670-1212
FOR:	Can., Ottawa, Ont., Allan Crawford Assocs., Ltd.	613-829-9651
FOR:	Can., Toronto, Ont., Allan Crawford Assocs. Ltd.	416-678-1500
FOR:	Can., Vancouver, B.C., Allan Crawford Assocs., Ltd.	604-980-4831

GOULD INC., Ind'l. Battery Div., 467 Calhoun St., Trenton, N.J., 08607, Tel: 609-392-3111, TWX: 510-681-8489

Products manufactured: Batteries, Chargers, Battery, Eliminators, Battery, Inverters, Rectifiers, Transformers

GOW-MAC INSTR. CO., 100 Kings Rd., Madison, N.J., 07940, Tel: 201-377-3450, Telex: 136-331; Empl.: 45

Customer service: R. J. Mathieu

Products manufactured: Analyzers, Detectors, Probes

GOWANDA ELECTRONICS CORP., 179 Broadway Rd., Gowanda, N.Y., 14070, Tel: 716-532-2236, TWX: 710-529-1211; FSC No: 24226; QPL No: 15305D; Minimum order: $20

For info on price: G. Drake; Application info: K. Strohmeyer; Customer service: D. McLaughlin; Delivery info: D. McLaughlin

Products manufactured: Chokes, Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Cal	Redwood City, Parks & Pruitt Assocs.	315-364-1640
Cal	Van Nuys, W.J. Barron Co.	213-780-0509
Colo	Golden, J.F. Hurlbut Co.	303-279-7138
Conn	Stamford, R.B. Scanlon Co.	203-325-2718
Ill	Chicago, W.F. Hamilton Co.	312-545-7676
Iowa	Cedar Rapids, Snider Sls. Co.	319-362-4410
Mass	Reading, Lincoln Assocs.	617-944-9020
Minn	Minneapolis, Saturn Co.	612-881-0091
Mo	St. Louis, Beneke & McCaul	314-434-6242
NJ	Medford, Mech Elec Sls. Co.	609-654-8209
NY	Syracuse, Naylor Elec. Co.	315-472-9138
NC	Greensboro, L & D	919-292-3201
Ohio	Cleveland, Geotronix Mktg. Assocs.	216-238-8520
Tex	Dallas, R. E. Nesbitt Co.	214-357-4601
Wash	Olympia, Bergford and Assocs.	206-943-6664

GRADO LABS., INC., 4614 Seventh Ave., Brooklyn, N.Y., 11220, Tel: 212-435-5340

For info on price: R. Krieger; Application info: J. Chaipis; Customer service: M. Wildes; Delivery info: R. Krieger

Free literature available: Brochures Grado FT Series CD-4 Pickups in three categories: Professional Series, Flux-Bridger Series & Super Flux-Bridger Series. All contain "diamond" needles in either spherical elliptical or twin-tip.

Products manufactured: Transducers

Local Sales Offices & Reps.

Cal	San Francisco, Meyer, Ross & Fleming	415-285-8880
Cal	Van Nuys, Markman Co.	213-787-6151
Fla	Miami, World Wide Prods., Inc.	305-754-5475
Ga	Atlanta, Igou-Turner & Assocs.	404-451-7616
Ill	Chicago, T. Pappas & Assocs.	312-685-2338
Mass	Waltham, F. Barmakian	617-894-4849
Minn	Willmar, More Sls., Inc.	612-235-0034
Neb	Omaha, Tobias Co.	402-342-4028
NY	New York City, Somerset Assocs. Inc.	212-929-1824
Ohio	Cleveland, Schroeder Sls. Co.	216-268-3636
Pa	Willow Grove, Estersohn Assocs.	215-657-1414
Tex	Irving, Dobbs-Stanford Corp.	214-252-5502
Wash	Bellevue, Pacific Northwest Marketing	206-455-2300

GRALEX INDS., Div. Gen. Microwave, 155 Marine St., Farmingdale, N.Y., 11735, Tel: 516-694-3600, TWX: 510-224-6406; FSC No: 11332; Empl.: 25; Minimum order: $25 .... p. 1•718,719

For info on price: H. Steinberg 516-694-3607; Application info: H. Steinberg 516-694-3607; Customer service: D. Yulke 516-694-3600; Delivery info: H. Steinberg 516-694-3607

Free literature available: Data Sheets and Application Notes available for Series 36, Series 37, Series 45 Digital Panel Meters.

Products manufactured: Counters, Meters

Local Sales Offices & Reps.

Cal	Burlingame, Leddy Assoc.	415-347-5247
Cal	El Monte, Telemart Co.	213-444-7666
Colo	Littleton, Barron Farquhar Co.	303-794-3918
Conn	E. Hartford, Tekdata	203-525-7647
DC	Washington, H. Wise Co.	202-363-9417
Haw	Honolulu, Aloha Assocs.	
Ill	Lombard, Quadtron Assoc. Inc.	312-627-6800
Ky	Louisville, Scott Elctrns.	502-583-3220
Mass	Burlington, Tekdata	617-273-0198
Mass	Newton Centre, Daner-Hayes, Inc.	
Mich	Plymouth, Scott Elctrns.	313-455-2440
Minn	Minneapolis, L.F. Green & Assoc.	612-781-1611
Mo	Kansas City, R.R. Burton Sls. Co.	816-444-8300
NJ	Hackensack, C.R. Mayer Assoc.	201-487-3113
NY	Huntington, C.R. Mayer Assoc.	516-921-7876
NY	Rochester, H.C. Johnson Agencies	716-482-3000
Ohio	Cleveland, Scott Elctrns. Inc.	216-291-2600
Pa	Audubon, Daner-Hayes	215-666-5005
Pa	Pittsburgh, Scott Elctrns.	412-781-3112
Tex	Dallas, Cain & Co.	214-233-6809

GRAND TRANSFORMERS, Box 188, Grand Haven, Mich., 49417, Tel: 616-842-5430; Empl.: 175; Minimum order: $30

For info on price: G. G. Anderson; Application info: K. Williams; Customer service: F. Beradis; Delivery info: F. Beradis

Products manufactured: Services, • Assembly, Production & Test, Transformers

Local Sales Offices & Reps.

Cal	San Gabriel, Van Gott & Assocs.	
Fla	Orlando, Buchanan & Abrams Assocs.	
Ill	Streamwood, A Holte & Assocs.	312-837-4066
Mass	Newtonville, C. Segel Co.	617-969-6900
Mich	Grand Rapids, R. Van Riper Sls.	616-452-0464
NY	Floral Park, MOS Assocs.	516-694-5923
Ohio	Cleveland, D. Steffen & Assocs.	216-261-5055
Pa	Ardmore, Rothenheber & Wurts, Inc.	215-642-6911
Tex	Dallas, W.T. Blackburn Assocs.	214-351-9991

GRANT HARDWARE CO., Div. Buildex Inc., 525 High St., W. Nyack, N.Y., 10994, Tel: 914-EL8-4400, TWX: 914-358-3541; FSC No: 83508; Empl.: 300

Customer service: J. Bross 914-429-5367

Free literature available: An illustrated 28 page handbook: "Slides, What They Are. When They Are Used. Where They Are Used" explains factors related to the selection and use of industrial slides.

Products manufactured: Cabinets & Accessories, Cable Retractors, Mounts, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ariz	Phoenix, G.R. McKnight Co.	602-949-0809
Cal	Menlo Park, The McKnight Co.	415-325-2844

Cal	So El Monte, Grant Hardware Co.	213-686-2110
Colo	Denver, R.G. Bowen Co. Inc.	303-722-4641
Fla	Orlando, B. Wimberly Co.	305-423-2514
Ill	Des Plaines, Lincoln, Hodges & Associates	312-297-3810
Kans	Overland Park, J. Singer	913-381-3684
Mass	Lexington, E.F. Del Fino Co.	
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Minn	St. Paul, R. G. Ragon, Inc.	612-488-0201
NJ	Mountain Lakes, Components For Elctrns.	201-334-2921
NJ	Ridgefield, M - D Industries	201-941-3113
NY	Liverpool, Vertex Corp.	315-622-3060
NY	Syracuse, Vertex Corp.	315-458-2223
NC	Charlotte, Bill Henry Associates	704-375-8958
Ohio	Cincinnati, Tri State Mktg. Inc.	513-761-7993
Ohio	Cleveland, Carter McCormic & Peirce	216-333-5650
Pa	Pittsburgh, Carter McCormic & Peirce	412-824-3760
Tex	Dallas, Blackburn Associates	214-FL 1-9991
Wash	Bellevue, Rowe NorthwesT	

GRAPHIC CONTROLS CORP., Recording Chart Div., 189 Van Rensselaer St., Buffalo, N.Y., 14210, Tel: 716-853-7500; Empl.: 390

Products manufactured: Paper, Graphic Recording

Local Sales Offices & Reps.

Cal	Canoga Park	213-347-8621
Cal	Santa Clara	408-241-9960
Colo	Lakewood	303-238-5239
Conn	Windsor	203-688-8501
Ga	Atlanta	404-451-4738
Ill	Barrington	312-381-6540
La	Metairie	504-885-1226
Mass	Farmington	313-851-6340
Minn	Minneapolis	612-335-2341
Ohio	Cincinnati	513-522-5476
Ohio	Cleveland	216-241-2217
Okla	Tulsa	918-936-5246
Pa	Philadelphia	215-436-6100
Tex	Houston	713-781-9870
Wash	Bellevue	206-455-1755

GRAPHIC SYSTEMS, 925 Danville Rd., DL-10, Yanceyville, N.C., 27379

GRAPHITE METALLIZING CORP., 1036 Nepperhan Ave., Yonkers, N.Y., 10702, Tel: 914-968-8400, Telex: 13-1571; Empl.: 155 ... p. 1•960,961

Products manufactured: Bearings, Brushes & Brush Assemblies, Bushings, Glass, Plastic, Metal, Rubber, Etc., Clutches, Contacts, Electrical, Graphalloy Products, Graphite Parts, Joints, Rotary, Microwave, Posts, Slip-Rings & Assemblies

GRAYHILL INC., 569 Hillgrove Ave., LaGrange, Ill., 60525, Tel: 312-354-1040, TWX: 910-683-1850; FSC No: 5930; Empl.: 250; Minimum order: $25

p. 1•1696-1698,2034-2052; p. 2•1261,2021

Free literature available: G-374-General Catalog-Switches, Relays, Wire Ties, Termination Hardware, #238-Rocker DIP Switches, #231-Solid State Relays, #228-Wire Ties & Cable Clamps.

Products manufactured: Clamps & Clips, Fasteners, Insulators & Insulation, Kits, Switch Assembling, Lights, Posts, Relays, Services, Assembly, Production & Test, Sockets, Switch Hardware, Switches, Terminals, Wire & Cable Ties

Local Sales Offices & Reps.

Ala	Huntsville, Rep, Inc.	205-881-9270
Cal	Garden Grove, Impact Elctrns.	213-431-3581
Cal	Los Altos, Nickerson-Gray Assoc.	415-941-5777
Colo	Denver, Lindberg Co.	303-758-9033
Fla	Orlando, Geartner Assoc.	305-299-1000
Ga	Atlanta, Rep, Inc.	404-938-4358
Ill	Hinsdale, Hill-Gray Assoc.	312-325-4810
Ind	Ft. Wayne, Menze Sls.	219-747-5616
Iowa	Cedar Rapids, Reid Assoc.	319-362-6302
Kans	Overland Park, Penzner-Mankus Assoc.	913-DU1-0004
Md	Woodbine, Naudain Assoc.	301-252-5378
Mass	Wellesley Hills, M. Scott Co.	617-235-0102
Mich	Troy, C.B. Jensen & Assoc.	313-643-0506
Minn	St. Paul, Northport Engrg. Inc.	612-698-3841
Mo	Hazelwood, Penzner-Mankus Assoc.	314-731-4334
NJ	Mount Laurel, Naudain Assoc.	215-564-3194
NM	Albuquerque, Lindberg Co.	505-345-2489
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Ithaca, B. Dean Inc.	607-272-2187
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
Ohio	Cleveland, A.H. Baier Co. & Assoc.	216-461-6161
Ohio	Dayton, A.H. Baier Co. & Assoc.	513-276-4128
Okla	Tulsa, W.P. Fralia Co.	918-663-8707
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
SC	Greenville, R.W. Chapman & Co.	803-232-5391
Tex	Ft. Worth, W.P. Fralia Co.	817-738-2394
Tex	Houston, W.P. Fralia Co.	713-772-1572
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Seattle, Seatronics, Inc.	206-767-4330

GREAT WESTERN AVIATION, Box 20396, Denver, Colo., 80220, Tel: 303-355-4468; Empl.: 2

Customer service: T. O. Markel

Products manufactured: Antennas, Cable Assemblies & Harnesses, Cable, Connectors, Couplers, Lights, Transformers, Tubes

Local Sales Offices & Reps.

Cal	San Rafael, Levin-Schwartz	415-454-1940
Cal	Van Nuys, Szerlip Sls. Co.	213-782-1765
Colo	Denver, C. B. Elctrn. Mktg.	303-422-0561
Fla	Margate, Florida Elctrn. Sls.	305-972-0800
Ga	Norcross, Dean Cooper Sls. Co.	404-448-5460
Ill	Chicago, Q & B Inc.	312-725-4999
Iowa	Atlantic, Kimian Sls. Co.	712-243-1626
Mass	Northboro, W.B. Pray Sls.	617-393-3434
Mich	Grand Rapids, L. Drieborg	616-953-1242
Minn	Minneapolis, J. E. M. Anderson	612-823-6459
Mo	Independence, Kimian Sls.	816-796-4026
NJ	Moorestown, DiVincent & Legato	609-235-8299
NY	Jericho, Gim Sls. Corp.	516-433-4080
Ohio	Columbus, Mandabach & Assoc.	614-235-0265
Pa	Pittsburgh, Mandabach & Assoc.	412-279-2264
Tex	Houston, M. R. Summers Assoc.	713-524-7800

GREENLEE TOOL CO., 2136-12th St., Rockford, Ill., 61101, Tel: 815-963-4881

Products manufactured: Punches, Chassis

Local Sales Offices & Reps.

Cal	Monterey Park	213-268-9307
Ga	Atlanta	404-448-6121
NY	Long Island City	212-392-3414
Wisc	Milwaukee	414-481-5768
EXP:	Coral Gables, Fla.	305-443-7922

GREENRAY INDS., INC., 840 W. Church Rd., Mechanicsburg, Pa., 17055, Tel: 717-766-0223, TWX: 510-650-4939; Empl.: 60 ... p. 1•327

Products manufactured: Amplifiers, Clocks (All Types), Converters, Filters, Generators, Impedance Converters, Microwave, Multipliers, Oscillators, Standards, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Electronics Associates, Inc.	205-881-5031
Ariz	Tempe, Sedco Sales	602-968-7791
Cal	Burlingame, Westronics Assoc.	415-342-1425
Cal	Los Angeles, Cain Technology	213-476-2251
Colo	Boulder, H. Bass Assocs.	303-499-7509
DC	Washington, Hayden Assocs.	202-296-6059
Fla	Fort Lauderdale, Beacon Elctrns.	305-776-6074
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Ill	Mt. Prospect, Cain & Co.	312-253-3578
Mass	Reading, Geder-Rotondi Assoc.	617-944-3105
Mich	Grand Rapids, Thies & Assocs.	616-245-0319
Mo	Florissant, KM & B Tech. Sls.	314-831-0015
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Huntington, Andrews & Andrews, Inc.	516-692-8686
Ohio	Dayton, F. Ohmer Assoc.	513-434-1454
Okla	Tulsa, J.A. Green Co.	918-742-4657
Pa	Ambler, Wm. Assocs.	215-643-4119
SC	Spartanburg, Beacon Elctrns. Assocs.	803-582-4613
Tex	Dallas, J.A. Green Co.	214-631-7450
Tex	Houston, J.A. Green Co.	713-526-2959
Wash	Redmond, Barrett Sls. Northwest, Ltd.	206-885-6991
EXP:	Lemoyne, Pa., Elctrns. Int'l.	717-737-8858
FOR:	Can., St. Laurent, Que., Rutherford Agencies	514-744-4121

GREGG ELECTRIC INC., Electronics Div., 608 W. Emporia, Ontario, Cal., 91761, Tel: 714-983-1794; Empl.: 5

Customer service: R. Fehlman

Free literature available: Illustrated Bulletins Describing our low cost line of Integrated Circuit Digital Clocks, Calendars, Timing Instruments, and their Accessories.

Products manufactured: Chronometers, Clocks (All Types), Counters, Timers

GREGG ELECTRIC INC. cont'd

Advertisment

Manufacturers of low cost integrated circuit digital electronic clocks, calendars, and timing instruments. Options include xtal time base, BCD or ASCII outputs, battery back-up, relay contact outputs, etc. We will customize to your requirements. Contact our factory for quotations and further information.

GRIES REPRODUCER CO., Div. Coats & Clark Inc., 162 Beechwood Ave., New Rochelle, N.Y., 10801, Tel: 914-633-8600, TWX: 914-235-2188; Empl.: 600

For info on price: S. R. Dube; Application info: S. R. Dube; Customer service: J. Gadin; Delivery info: J. Gadin

Products manufactured: Bobbins, Winding, Coil & Transformer, Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Coils Including Assemblies & Forms, Fasteners, Rivets, Services, Assembly, Production & Test, Slides, Cabinet & Chassis, Tubing

GRISBY-BARTON, INC., See Gordos/Grisby-Barton

GRM CORP., Box 337, Medford, N.J., 08055, Tel: 609-267-7950; Empl.; 100; Minimum order: $25

p. 1•120,121

Customer service: T. A. McGarrity

Products manufactured: Alarms, Amplifiers, Attenuators, Chargers, Battery, Coders, Comm. Systems, Control Systems, Air Traffic, Controls/Control Eqpt., Couplers, Dummy Loads, Generators, Magnetizers, Monitors, Networks, Panels, Power Supplies, Services, Assembly, Production & Test

GROOV-PIN CORP., 1125 Hendricks Causeway, Ridgefield, N.J., 07657, Tel: 201-945-6780, TWX: 710-992-8963; FSC No: 73957; Empl.: 100; Minimum order: $25

For info on price: R. F. Reis; Application info: J. Pagliuca; Customer service: R. F. Reis

Free literature available: "Design Tips for Togetherness" 26-page brochure illustrates how Groov-Pin® press fit fasteners, Tap-Lok® self-tapping, self-locking inserts, and grooved Drive Studs are used in a variety of applications.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Fasteners, Pins

Local Sales Offices & Reps.

Ariz	Phoenix, Kennedy Sls.	602-275-7501
Cal	Hayward, D. Lewis Assocs.	415-785-9650
Cal	Woodland Hills, R.R. Sweet & Son	213-883-8651
Colo	Englewood, Todd Assocs.	303-761-7801
Conn	Stratford, P.E. Wolfe & Assocs.	203-377-4343
Fla	Orlando, A-Gen-Teers Entprs.	305-293-6269
Ga	Atlanta, R.R. Miller	404-993-2150
Ill	Wheaton, W.L. Barth, Jr.	312-653-4970
Iowa	Bettendorf, R.L. Burchett	319-355-6332
Mass	Southboro, T.P. Wolfe	617-481-1769
Mich	Detroit, H.B. Schweppe	313-872-8149
Minn	Minneapolis, Nelson & Son	612-920-3414
Miss	Jackson, Lawrence & Co.	601-982-9513
Mo	St. Louis, Smith-Bollinger & Co.	314-351-1177
NY	Oakdale, R.V. Davison	516-589-6388
NY	Rochester, Select Comps.	716-381-2620
NC	High Point, L.J. Mortimer & Assocs.	919-882-9015
Ohio	Dayton, Stork-Kelch & Assocs.	513-222-3232
Pa	Paoli, A. Buchanan	215-696-8323
SC	Columbia, L.J. Mortimer & Assocs.	803-254-2228
Tex	Dallas, Tech Sls. Co.	214-631-8820
Va	Roanoke, A.B. Kreger	703-989-4738
Wash	Seattle, F.W. Aurich & Co.	206-284-5561

GTE AUTOMATIC ELECTRIC INC., 400 N. Wolf Rd., Northlake, Ill., 60164, Tel: 312-562-7100, TWX: 910-226-1975; FSC No: Multiple; Empl.: 12,000; Minimum order: $50

Customer service: J. D. Ashby

Free literature available: "Selection Guide to AE Relays and Switches"(C-4071) A convenient aid to specifying the correct types and sizes of components, plus a considerable amount of reference data.

Products manufactured: Cable, Comm. Systems, Connector Blocks, Mother Board, Dials, Encoders, Handsets, Chestsets, Headphones, Headsets, Etc., Keyboards, Alphanumeric & Decimal, Receivers, Relays, Switches, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Burlingame	415-697-6400
Cal	North Hollywood	213-766-5203
Cal	San Diego	714-283-2095
Conn	Stamford	203-329-0981
Ga	Atlanta	404-261-7441
Mass	Newton	617-965-3770
Mich	Detroit	313-538-6040
Minn	Minneapolis	612-835-4222
Mo	Kansas City	816-241-4760
NY	Albany	518-438-3511
Ohio	Cleveland	216-267-6288
Ohio	Dayton	513-299-6481
Pa	Haverford	215-525-7575
Va	Falls Church	703-533-0636

GTE LENKURT INC., 1105 County Rd., San Carlos, Calif., 94070, Tel: 415-591-8461, TWX: 910-376-4396; Empl.: 4000

Products manufactured: Alarms, Antenna Feed Systems, Comm. Systems, Cords, Demodulators, Equalizers, Modulator/Demodulators, Modulators, All Kinds, Multiplexers, Receivers, Testers, Transmission Systems, Data, Transmitters

Local Sales Offices & Reps.

Ga	Atlanta	404-261-8282
Ill	Arlington Hgts.	312-398-6700
Tex	Dallas	214-363-0286
Va	Falls Church	703-533-3344

GTE SYLVANIA, INC., W.M. Chace Co., 1600 Beard Ave., Detroit, Mich., 48209, Tel: 313-842-7400; Empl.: 260

Products manufactured: Bi-Metals, Thermostatic

GTE SYLVANIA, INC., Chem. & Metallurgical Div., Towanda, Pa., 18848, Tel: 717-265-2121; Empl.: 1400

Products manufactured: Alloys, Crystals, Metal Oxides, Metals, Wire

Local Sales Offices & Reps.

Cal	Burlingame	415-697-3500
Conn	Hartford	203-246-0608
Ill	Melrose Park	312-345-0100
Mass	Danvers	617-777-1900
Mich	Dearborn	313-582-8754
NJ	Teterboro	201-288-9484
NY	Camillus	315-672-3111
NC	Charlotte	704-334-4671
Ohio	Dayton	513-223-6227
Pa	Philadelphia	215-477-5000
Pa	Pittsburgh	412-531-4975
Tex	Dallas	214-239-8171

GTE SYLVANIA, Circuit Module Oper., Elctrn. Comps. Grp., Box 360, Muncy, Pa., 17756, Tel: 717-546-3191; Empl.: 463

Products manufactured: Boards, Printed Circuit, Cards, Linear Function, Cards, Logic, Circuits, Printed, Multilayer, Modules, Logic, Encapsulated, Services, Assembly, Production & Test

GTE SYLVANIA INC., Consumer Prods. - Lighting Prods., 100 Endicott St., Danvers, Mass., 01923, Tel: 617-777-1900; Empl.: 8200

Products manufactured: Lamps

Local Sales Offices & Reps.

Cal	Burlingame	415-697-3500
Cal	Los Angeles	213-726-1666
Colo	Denver	303-399-1760
Conn	Hartford	203-249-7611
Fla	Orlando	305-859-6220
Ga	Atlanta	404-762-1781
Ill	Chicago	312-345-0100
Kans	Kansas City	913-371-3773
La	New Orleans	504-733-6970
Mich	Dearborn	313-582-8754
Mich	Southfield	313-559-5872
Minn	Minneapolis	612-331-9363
Mo	St. Louis	314-664-8975
NJ	Teterboro	201-288-9484
NY	Buffalo	716-668-0500
NY	New York City	212-486-3995
NC	Charlotte	704-334-4671
Ohio	Cincinnati	513-793-6440
Ohio	Cleveland	216-267-6800
Pa	Philadelphia	215-477-5000
Pa	Pittsburgh	412-781-4533
Tex	Dallas	214-239-8171
Tex	Houston	713-869-8671
Va	Springfield	703-354-3100
Wash	Seattle	206-763-2660

GTE SYLVANIA INC., Wilbur B. Driver Sub., 1875 McCarter Hwy., Newark, N.J., 07104, Tel: 201-481-3110; Empl.: 749

Products manufactured: Alloys, Cable, Foil, Metals, Substrates, Wire

Local Sales Offices & Reps.

Cal	Los Angeles	213-478-4021
Conn	West Hartford	203-233-4047
Ill	Melrose Park	312-344-4155
NJ	Teterboro	201-288-9484
NC	Charlotte	704-375-8568
SC	Orangeburg	803-534-6910

GTE SYLVANIA INC., Electrical Equip. Grp., 100 First Ave., Waltham, Mass., 02154, Tel: 617-890-9200; Empl.: 3500

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Bus Bars & Systems, Circuit Breakers, Controls/Control Eqpt., Limit Stops, Mechanical, Motors, Relays, Switchboards, Switches, Transformers

Local Sales Offices & Reps.

Clark Control

Ala	Birmingham	205-879-3457
Cal	Los Angeles	213-685-6770
Cal	San Francisco	415-479-7770
Ga	Atlanta	404-261-5970
Ga	Atlanta	404-762-1781
Ill	Chicago	312-767-5123
Ill	Elk Grove Village	312-439-8748
Ind	Gary	219-887-5645
Mass	Waltham	617-890-9200
Mich	Detroit	313-255-0660
Mich	Flint	313-688-2270
Minn	Minneapolis	612-331-9363
Mo	St. Louis	314-872-8240
NJ	Union	201-686-9000
NY	Buffalo	716-668-0500
NY	Syracuse	315-437-1431
Ohio	Akron	216-923-5274
Ohio	Cincinnati	513-272-0633
Ohio	Cleveland	216-851-2200
Ohio	Cleveland	216-851-2000
Ohio	Columbus	614-888-3428
Ohio	Youngstown	216-757-1516
Pa	Philadelphia	215-649-6511
Pa	Pittsburgh	412-341-5777
Tex	Houston	713-869-8671
Va	Hampton	804-838-8080
Va	Hampton	804-838-8080
Wisc	Milwaukee	

Union Insulating Co.

Ga	Decatur	404-389-4761
Md	Reisterstown	301-833-1662
Minn	Hastings	612-437-5763
Tenn	Nashville	615-242-3942
WVa	Davis	304-866-4166
WVa	Parkersburg	304-422-4571

Zinsco Electrical Prods.

Ariz	Phoenix	602-277-2649
Cal	Fresno	209-266-6669
Cal	Los Angeles	213-625-8971
Cal	Sacramento	916-452-7621
Cal	San Diego	714-283-6361
Cal	San Leandro	415-352-3450
Colo	Denver	303-892-9468
Fla	Orlando	305-859-6220
Fla	Pompano Beach	305-946-0772
Ga	Atlanta	404-762-1781
Md	Columbia	301-465-5878
Mo	Creve Coeur	314-872-8240
Mo	St. Louis	314-289-9500
Ore	Portland	503-222-1063
Pa	Folcroft	215-532-9300
Tenn	Memphis	901-276-5536
Tenn	Nashville	615-255-8084

GTE SYLVANIA INC., Elctrn. Comps. Grp., 100 First Ave., Waltham, Mass., 02154, Tel: 617-890-9200; Empl.: 4726

Products manufactured: Boards, Printed Circuit, CATV Systems & Equipment, Circuits, Printed, Multilayer, Test Equipment, Tubes, Yokes

Local Sales Offices & Reps.

Cal	Burlingame	415-697-3500
Cal	Los Angeles	213-726-1666
Ga	Atlanta	404-762-1781
Ill	Melrose Park	312-345-0100
Mass	Danvers	617-777-1900
NJ	Teterboro	201-288-9484
Ohio	Cleveland	216-267-6800
Tex	Dallas	214-239-8171

GTE SYLVANIA INC., Elctrn. Sys. Gp., 1800 N. Kent St., Washington, D.C., 22209, Tel: 703-841-9020; Empl.: 4200

Products manufactured: Alarms, Amplifiers, Analyzers, Antenna Feed Systems, Antenna Rotators, Antenna Switching Matrices, Antennas, Coders, Comm. Systems, Computers, Control Systems, Air Traffic, Couplers, Data Acquisition & Reduction Systems, Decoders, Detectors, Display Devices/Displays, Horns, Microwave, Lasers & Laser Systems, Modulator/Demodulators, Modulators, All Kinds, Radar Systems, Receivers, Simulators, Switchboards, Switches, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Tracking Systems, Transceivers, Transmission Systems, Data, Transmitters, Underwater Communication, Detection, Navigation, etc. Equipment

GTE SYLVANIA INC., Elctrn. Tube Div., Seneca Falls, N.Y., 13148, Tel: 315-568-5881; Empl.: 1092

Products manufactured: CATV Systems & Equipment, Testers, Tubes

Local Sales Offices & Reps.

Cal	Burlingame	415-697-3500
Cal	Los Angeles	213-726-1666
Ga	Atlanta	404-762-1781
Ill	Melrose Park	312-345-0100
Mass	Danvers	617-777-1900
NJ	Teterboro	201-288-9484
Ohio	Cleveland	216-267-6800
Tex	Dallas	214-239-8171

GTE SYLVANIA INC., Gibson Electric Subsidiary, Delmont, Pa., 15626, Tel: 412-468-4121; Empl.: 250

Products manufactured: Contacts, Electrical

Local Sales Offices & Reps.

NC	Charlotte	704-334-8940
Pa	Philadelphia	215-477-5000
FOR:	Can., Toronto, Ont.	416-364-5660

GTE SYLVANIA INC., Lighting Prods. Grp., Danvers, Mass., 01923, Tel: 617-777-1900; Empl.: 8200

Products manufactured: Caps, Lenses, Indicator Light, Circuit Breakers, Coils Including Assemblies & Forms, Deposition Equipment, Vacuum & Accessories, Flashers, Lamp Adapters, Lamps, Lights, Regulators, Relays, Sockets, Switches, Ultraviolet Inspection Lighting

Local Sales Offices & Reps.

Cal	Burlingame	415-697-3500
Cal	Los Angeles	213-726-1666
Colo	Denver	303-399-1760
Conn	Hartford	203-249-7611
Fla	Orlando	305-859-6220
Ga	Atlanta	404-762-1781
Ill	Chicago, (Melrose Park)	312-345-0100
Kans	Kansas City	913-371-3773
La	New Orleans	504-733-6970
Mich	Dearborn	313-582-8754
Mich	Southfield	313-559-5872
Minn	Minneapolis	612-331-9363
Mo	St. Louis	314-664-8975
NJ	Teterboro	201-288-9484
NY	Buffalo	716-675-0500
NY	New York	212-244-8820
NC	Charlotte	704-334-4671
Ohio	Cincinnati	513-793-6440
Ohio	Cleveland	216-267-6800
Pa	Philadelphia	215-477-5000
Pa	Pittsburgh	412-781-4533
Tex	Dallas	214-239-8171
Tex	Houston	713-869-8671
Va	Springfield	703-354-3100
Wash	Seattle	206-763-2660

GTE SYLVANIA INC., Miniature Lamp Div., 528 Elm St., Kearny, N.J., 07032, Tel: 201-997-1850

Products manufactured: Lamps

Local Sales Offices & Reps.

Cal	No. Hollywood, Bassett & Moore, Inc.
Colo	Arvada, Arrowhead Sls. Corp.
Conn	Waterbury, Coakley, Boyd, & Abbett, Inc.
Fla	Bradenton, Hutto, Hawkins, Peregoy, Inc.
Fla	Maitland, Hutto, Hawkins, Peregoy, Inc.
Fla	Pompano Beach, Hutto, Hawkins, Peregoy, Inc.
Ga	Atlanta, Millar Elctrns., Inc.
Ill	Oak Park, G. E. Finnegan
Ind	Indianapolis, R. O. Whitesell & Assoc.
Ind	Indianapolis, Southern Sls. Corp.
Iowa	Atlantic, Kimian Sls., Inc.
Mass	Needham, Coakley, Boyd, & Abbett, Inc.
Mich	Grand Rapids, R. O. Whitesell & Assoc.
Mich	Southfield, R. O. Whitesell & Assoc.
Mich	St. Joseph, R. O. Whitesell & Assoc.

Minn	Minneapolis, Stoss Assocs.	
Mo	Independence, Kimian Sls., Inc.	
Mo	Maryland Hgts., Kimian Sls., Inc.	
NJ	Long Valley, P. A. Sweeney	
NY	Camillus, Callahan & Ferguson Co.	
NY	Rochester, Fowler Beach Corp.	
NY	Tuckahoe, LCA Sls., Co.	
NC	Raleigh, Millar Elctrns., Inc.	
Ohio	Cincinnati, R. O. Whitesell & Assoc.	
Ohio	Columbus, R. O. Whitesell & Assoc.	
Ohio	Dayton, R. O. Whitesell & Assoc.	
Ohio	Lakewood, R. O. Whitesell & Assoc.	
Pa	Glenside, Shelmar Elctrns. Corp.	
Pa	Pittsburgh, R. O. Whitesell & Assoc.	
Tenn	Bristol, R. O. Whitesell & Assoc.	
Tex	Dallas, Dunbar Assocs.	
Utah	Salt Lake City, Arrowhead Sls. Corp.	
Wash	Seattle, Blum & Assoc.	
Wisc	Milwaukee, F. C. DuBois & Assoc.	
FOR:	Can., Mississauga, Ont. L4T 1G3, Munro Elctrn. Comps.	

GTE SYLVANIA INC., Miniature Lighting Prods., W. Main St., Hillsboro, N.H., 03244, Tel: 603-464-5533, TWX: 710-366-0387; Empl.: 700 .... p. 2•1147

Products manufactured: Caps, Lenses, Indicator Light, Lamps, Lights, Sockets

Local Sales Offices & Reps.

Cal	Los Altos, W.W. Posey Co.	415-948-7771
Cal	N. Hollywood, Bassett & Moore	213-766-2117
Colo	Arvada, Arrowhead Sls.	303-423-5556
Conn	Cheshire, Coakley, Boyd & Abbett	203-272-2262
Fla	Maitland, Hutto, Hawkins, Peregoy	305-831-2474
Fla	Pompano Beach, Hutto, Hawkins, Peregoy	305-943-9593
Ga	Atlanta, GTE Sylvania	404-762-1781
Ill	Oak Park, G. E. Finnegan	312-383-9098
Ind	Indianapolis, Southern Sls.	317-257-7575
Iowa	Atlantic, Kimian Sls.	712-243-1626
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Grand Rapids, R.O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assoc.	616-983-7337
Minn	Minneapolis, Stoss Assocs.	612-925-2757
Mo	Independence, Kimian Sls.	816-796-4026
Mo	Maryland Heights, Kimian Sls.	314-739-1655
NJ	Kearny, GTE Sylvania	201-997-1850
NY	Rochester, Fowler Beach Corp.	716-586-0468
NC	Raleigh, Millar Elctrns.	919-787-9564
Ohio	Cincinnati, R.O. Whitesell & Assoc.	513-521-2290
Ohio	Columbus, R. O. Whitesell	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assoc.	513-298-9546
Ohio	Lakewood, R.O. Whitesell & Assoc.	216-228-7525
Pa	Glenside, Shelmar Elctrns.	215-885-0800
Pa	Pittsburgh, R.O. Whitesell & Assoc.	412-344-7277
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, Dunbar Assoc.	214-239-7151
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Wash	Seattle, Blum & Assocs.	206-285-2590
Wisc	Milwaukee, F.C. Du Bois & Assoc.	414-774-3100

GTE SYLVANIA INC, Parts Div., 816 Lexington Ave., Warren, Pa, 16365

GTE SYLVANIA, INC., Western Gold & Platinum Sub., 555 Harbor Blvd., Belmont, Cal., 94002, Tel: 415-593-3121; Empl.: 320

Products manufactured: Flux, Brazing & Soldering Materials, Insulators & Insulation, Metals, Tubing, Wire

Local Sales Offices & Reps.

Cal	Torrance, Western Gold & Platinum Co.	213-375-6191
Ill	Lake Zurich, Western Gold & Platinum Co.	312-438-4488
Mass	Salem, Western Gold & Platinum Co.	617-745-1826
Minn	Minneapolis, Western Gold & Platinum Co.	612-920-3288
Pa	Drexel Hill, Western Gold & Platinum Co.	201-483-7467

GTI CORPORATION, 480 Manor Oak Two, 1910 Cochran Rd., Pittsburgh, Pa., 15220, Tel: 412-343-4070, Telex: 866-483; Empl.: 800

Products manufactured: Boards, Printed Circuit, Bus Bars & Systems, Caps, Connector, Caps, Lenses, Indicator Light, Circuits, Flexible, Covers, Protective (Including Dust), Eyelets, Feedthrus & Seals, Environmental, Forms, Wire, Headers, Holder & Carriers, Lenses, Readout & Display, Machines/Machinery, Production, Pins, Seals, Services, Assembly, Production & Test, Tubing

Local Sales Offices & Reps.

Cal	Santa Clara	408-244-2938
NJ	Red Bank	201-842-6682
Ohio	Centerville	513-433-7913

GTJ/TENSOR ELECTRONICS, 11558 Sorrento Valley Rd., San Diego, Cal., 92121, Tel: 714-453-7262, Telex: 69-5056; Empl.: 55

For info on price: W. Devine; Application info: J. Sayre; Customer service: D. Spurrier; Delivery info: D. Spurrier

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ala	Birmingham, Electro-Rep Assocs.	205-822-4484
Ala	Huntsville, Electro-Rep Assocs.	205-881-8315
Ariz	Scottsdale, BFA Corp. of Ariz.	602-946-4215
Cal	Downey, Trimarco, Inc.	213-861-8244
Cal	Redwood City, Parks & Pruitt Assocs.	415-364-1640
Conn	Brookfield, E. J. Hughes Assocs.	203-775-4541
Conn	Old Saybrook, E. J. Hughes Assocs.	203-339-7636
Fla	Clearwater, CBC Elctrns.	813-447-3375
Fla	Ft. Lauderdale, CBC Elctrns.	305-484-7330
Fla	Winter Park, CBC Elctrns.	305-644-2277
Ga	Decatur, Electro-Rep Assocs.	404-365-6349
Ill	Des Plaines, Butor Sls. Co.	312-298-0555
Ind	Indianapolis, Technical Representatives, Inc.	317-849-6454
Kans	Shawnee Mission, Mid-America Elctrn. Mktg. Inc.	913-236-4800
Md	Lutherville, Cunningham & Assocs.	301-296-4306
Mass	Attleboro, E. J. Hughes & Assocs.	617-226-0050
Mass	Beverly, E. J. Hughes & Assocs.	617-927-7171
Mich	Rochester, Kent Assocs.	313-651-1890
Minn	Minneapolis, D. G. Perry & Co.	612-920-3212
NJ	Clifton, A. Clarfield	212-757-6454
NJ	Haddonfield, Keefe Elctrn. Sls. Co.	609-429-4650
NY	Syracuse, T-Squared-L Elctrns.	315-463-8592
NC	Charlotte, Electro-Rep Assocs.	704-527-2530
NC	Raleigh, Electro-Rep Assocs.	919-828-8133
Ohio	Dayton, Sidnell Co.	513-433-7761
Tex	Richardson, Campion Sls. Co.	214-238-8145
Wash	Seattle, R. K. Squibb, Inc.	206-632-2450

GUARDIAN CALIFORNIA, 4030 W. Spencer St., Torrance, Cal., 90503, Tel: 213-772-8511, TWX: 910-344-7381; Empl.: 48

Products manufactured: Alarms, Coils Including Assemblies & Forms, Controls/Control Eqpt., Converters, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Drivers, Solenoid, Flashers, Relays, Timers

Local Sales Offices & Reps.

Ala	Birmingham, Immco Inc.	205-879-0739
Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Denver, Arrowhead Sls.	303-222-5645
Fla	Winter Park, Floritronics	305-424-5070
Ga	Marietta, Immco Inc.	404-435-0079
Haw	Honolulu, G Piety Factors	808-841-0185
Ill	Chicago, Guardian Elec. Mfg.	312-243-1100
Ind	Fort Wayne, Needler Sls.	219-447-2123
Md	Ellicott City, Mc Court Co.	301-465-4515
Mass	Concord, Sales Engrg. Co.	617-369-3943
Mich	Westland, Miltimore Sls.	313-349-5820
Mo	Kansas City, H.J. Weisler & Assocs.	
Mo	St. Louis, H.J. Weisler & Assocs.	
NM	Albuquerque, Arrowhead Sls.	505-247-0287
NY	Massapequa, Coughlin Assocs.	516-799-7743
NY	Rochester, Elcom Sales	716-385-1400
Ohio	Miamisburg, W. C. Schmidt	513-866-3640
Ohio	Richmond Heights, W. A. Rowell, Jr.	216-291-0647
Pa	Delmont, T.F. Laslo & Assocs.	
Pa	Doylestown, T.O.E. Sls.	215-348-5333
Tex	Dallas, W Reese Assocs.	214-638-6575
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Wash	Seattle, R. K. Squibb	206-632-2450
FOR:	Can., Williowdale, Ont., A.C. Simmonds & Sons	

GUARDIAN ELECTRIC CO. OF CAL., 4030 W. Spencer St., Torrance, Cal., 90503, Tel: 213-542-8651; Empl.: 50

Products manufactured: Cards, Linear Function, Controls/Control Eqpt., Counters, Current Sensors, Drivers, Solenoid, Insertion Loss Measurement Systems, Monitors, Relays, Timers

Refer to Guardian Elec. Co. for Sales Offices

GUARDIAN ELECTRIC CO., 1550 W. Carroll Ave., Chicago, Ill., 60607

Products manufactured: Relays, Sockets, Solenoids, Switches, Timers

Local Sales Offices & Reps.

Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Fla	Winter Park, Floritronics	305-886-4818
Ga	Atlanta, Electro-Mech. Eng. Sls.	404-256-4414
Haw	Honolulu, G. Piety Factors Inc.	808-841-0185
Ill	Chicago, F. Nitti	312-243-1100
Ind	Ft. Wayne, Needler Sls. Co.	219-447-2123
Ind	Indianapolis, Needler Sls. Co.	317-255-8056
Mass	West Concord, Sls. Eng. Co.	617-369-3943
Mich	Novi, Miltimore Sls.	313-476-2446
Minn	St. Paul, R.A. Karr	612-335-8552
Mo	Kansas City, H.J. Weisler & Assoc.	816-421-1679
Mo	St. Louis, H.J. Weisler & Assoc.	314-428-3934
NY	Binghamton, Elcom Sls.	607-723-9270
NY	Massapequa, Coughlan Assocs.	516-799-7743
NY	Rochester, Elcom Sls.	716-385-1400
NY	Whitesboro, Electro-Mech Sls. Eng. Co.	919-782-6452
Ohio	Cleveland, Depco	216-289-8188
Ohio	Miamisburg, W. Schmidt	513-298-4451
Pa	Doylestown, T.O.E. Sls. Inc.	215-348-2212
Tex	Dallas, Wm. Reese Assoc.	214-638-6575
Utah	Salt Lake City, Arrowhead Sls. Corp.	801-485-3362
Wash	Seattle, R.K. Squibb, Inc.	206-632-2450

GUDEBROD BROS. SILK CO., INC., Electronics Div., 12 South 12th St., Philadelphia, Pa., 19107, Tel: 215-WA2-1122

Products manufactured: Cords, Pads, Transistor Mounting, Retainers

Local Sales Offices & Reps.

Cal	Burbank	213-848-3962
Ill	Chicago	312-DE7-3025
Mass	Boston	617-HA6-5347
NY	New York	212-LA4-5858
NC	Charlotte	704-333-9591

GUDEMAN CORP., 340 W. Huron St., Chicago, Ill., 60610, Tel: 312-337-7400, TWX: 910-221-3863; Empl.: 180; Minimum order: $30 .... p. 2•138

For info on price: P. LoVecchio; Application info: T. Banach; Customer service: E. Kacheris; Delivery info: E. Kacher15

Products manufactured: Capacitors, Fixed, Filters

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne Co.	602-946-4437
Cal	Monrovia, Caltronic Sls.	213-359-2626
Cal	Mt. View, Melchior Assocs.	415-964-2321
Colo	Denver, Walker Assocs.	303-623-8713
Fla	Ft. Lauderdale, R.I. Smith Assocs.	305-772-5100
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Ft. Wayne, R. G. Frederick	219-745-2461
Ind	Indianapolis, Electro Reps	
Mass	Chelmsford, Underwood Sls.	617-256-8191
Minn	St. Paul, Cullen & Assocs.	612-646-7371
Mo	Kansas City, R.R. Burton Sls.	816-644-8300
NJ	Englewood Cliffs, E. Glass Assocs.	201-592-0200
NY	Liverpool, George Corp.	315-652-8317
NY	Rochester, J. Semple Co.	716-342-1413
NC	Winston-Salem, C. Dula Assocs.	919-768-7166
Ohio	Cincinnati, A.C. Wahl Assocs.	513-821-3270
Ohio	Fairborn, R.G. Siff	513-252-7785
Pa	King of Prussia, Monteiro Assocs.	215-265-0634
Tex	Dallas, Evans & McDowell	214-238-7157
Wash	Olympia, Bergford Assocs.	206-866-2001

GUILDLINE INSTRS., INC., 1997 Palmer Ave., Larchmont, N.Y., 10538, Tel: 914-834-8100; Empl.: 85; Minimum order: $25

For info on price: V. Stein; Application info: E. Nemeroff; Customer service: V. Stein; Delivery info: B. Wright

Free literature available: Condensed Catalog - detailing precision electrical measuring instruments for temperature and voltage calibration.

Products manufactured: Amplifiers, Baths, Controlled Temperature (Air & Liquid), Batteries, Bridges, Calibrators, Chamber, Environmental Test, Choppers, Comparators, Controls/Control Eqpt., Dividers, Indicators, Meters, Oceanographic Equip. (Electronic), Potentiometers, Resistors, Standards, Testers, Transformers

GULTON INDS., INC., Elctrn. Comps. Div., Metuchen, N.J., 08840, Tel: 201-548-2800, TWX: 710-998-0592; Empl.: 125; Minimum order: $35

For info on price: V. Braza; Application info: E. Price; Customer service: V. Braza; Delivery info: V. Braza

Free literature available: Thermistor Catalog; EMI Filter Catalog; Piezoelectric Catalog; Thermal Printhead Catalog & Application Data.

Products manufactured: Circuits, Hybrid, Thick Film, Filters, Printers, Probes, Thermistors, Transducers

Local Sales Offices & Reps.

Cal	Los Angeles, Cal. Cem, Inc.	714-835-2702
Cal	Los Angeles, California-Caltronic Sales	213-359-2626
Cal	Monrovia, California-Caltronic Sales	213-359-2626
Cal	Mountain View, Tri-Rep	415-965-1822
Cal	San Diego, California - Cem, Inc.	714-835-2702
Cal	Santa Ana, California - Cem, Inc.	714-835-2702
Colo	Denver, Comtech	303-756-6815
Fla	Palm Beach Gardens, Florida-Service Representative Assoc.	305-622-4049
Ill	Westchester, Wasson-Gallagher	312-261-7517
Iowa	Cedar Rapids, J.R. Sls. Engrg.	319-377-8211
Md	Hyattsville, Eastern Components	301-577-2925
Mass	Chelmsford, Underwood Sls.	617-256-8191
Mich	Grand Rapids, Elko Sls.	616-949-1451
Minn	St. Paul, H.A. Cullen	612-646-7371
NJ	Oakland, W. E. Venator Assoc.	201-337-5387
NM	Albuquerque, Elctrn. Mktg.	505-265-7837
NY	Rochester, J.L. Semple	716-342-1413
NC	Winston-Salem, Dula Assocs.	919-768-7166
Ohio	Cincinnati, A.C. Wahl	513-821-3270
Ohio	Fairborn, R.G. Siff & Assocs.	513-252-7785
Ohio	Lyndhurst, A.C. Wahl	513-821-3270
Okla	Tulsa, Allied Comps.	918-939-2848
Tex	Dallas, Allied Comps.	214-238-0408

GULTON INDS., Connector Div., 6400 Roland St., Buena Park, Cal., 90621, Tel: 714-523-3480, TWX: 910-596-1489; Empl.: 90

Customer service: Sales Dept.

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Connectors, Detectors, Feedthrus & Seals, Environmental, Headers, Lead Assemblies & Receptacles, Plugs, Seals, Services, Assembly, Production & Test, Terminals, Thermocouples, Elements & Accessories, Wire

Local Sales Offices & Reps.

Ariz	Scottsdale, Pete Murphy Assocs.	602-946-2457
Cal	Los Altos, P M Sls.	408-255-1771
Conn	W. Simsbury, Anchor Engrg.	203-658-6261
Md	Ellicott City, J. Winkler & Assocs.	301-465-8630
Mass	Wellesley Hills, Anchor Engrg.	671-235-6330
Minn	Minneapolis, Milt Westland Assocs.	612-884-4567
NM	Albuquerque, C. T. Carlberg Assocs.	505-265-1579
NY	Massapequa, Coughlin Assocs.	516-799-7743
Ohio	Dayton, A. D. Dircksen & Assocs.	513-256-0351
Tex	Irvine, Gordon V. Peck Co.	713-664-1435

GULTON INDS., INC., Measurement & Control Systems Div., Gulton Ind'l. Pk., E. Greenwich, R.I., 02818, Tel: 401-884-6800, TWX: 710-387-1500; Minimum order: $25 .... p. 1•868,869

Free literature available: Condensed Catalog of Instrumentation. Shows complete product line of Technirite analog and event recorders, Gulton printers, recorder building blocks, Rustrack miniature recorders, West controllers and Thermocouples.

Products manufactured: Amplifiers, Controls/Control Eqpt., Oscillographs, Direct Writing, Printers, Pyrometers, Recorders, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns. Assoc.	205-881-5031
Ariz	Scottsdale, Williams Assoc.	602-947-4297
Cal	Costa Mesa, Gulton M.C.S. Div.	714-646-4424
Cal	Palo Alto, E.V. Roberts & Assoc.	415-494-1671
Cal	San Diego, Lodan	714-279-6383
Colo	Denver, Williams Assoc. Inc.	303-373-4730
Conn	Glastonbury, Instr. Reps. Inc.	203-633-0777
Fla	Fort Lauderdale, Beacon Elctrn. Assoc.	305-622-2770
Fla	Jacksonville Beach, Lewis M. Crowe Co.	904-249-8888
Fla	Maitland, Beacon Elctrns. Assoc.	305-622-2770
Fla	Orlando, W.A. Brown Comp. Inc.	305-425-5505
Fla	St. Petersburg, Lewis M. Crowe Co.	813-894-0249
Ga	Atlanta, Beacon Elctrn. Assoc.	404-351-3654
Haw	Honolulu, Yett Co. Inc.	808-847-2521
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Ft. Wayne, Scott Elctrns.	219-743-1586
Ind	Hammond, B & B Instrs.	312-731-0878
Ind	Indianapolis, Pivan Engrg.	317-253-1681
Iowa	Des Moines, Harry E. Ferris Co.	515-255-5008
Kans	Olathe, Tech Reps	913-782-1177
La	New Orleans, Gilbert & Assocs.	504-866-7444
Md	Glen Burnie, Faber-Renoff	301-768-4554
Md	New Carrollton, W.A. Brown Equip. Comp. Inc.	301-577-4527
Mass	Lexington, Instr. Reps. Inc.	617-861-8620
Mass	Norwood, Gibson Engrg. Co.	617-769-3600
Mich	Detroit, S. Sterling Co.	313-255-1970
Mich	Farmington, Applied Instrs. Co.	313-476-9060
Minn	Minneapolis, Heimann Co.	612-861-6051
Minn	Minneapolis, Automated Controls,	612-377-7727
Mo	Hazelwood, Tech. Reps. Inc.	314-731-5200
Mo	Kansas City, Boschert Equip. Co.	816-561-4050
Mo	University City, E. Mooney Co.	314-725-8875
Ohio	Cincinnati, Scott Elctrns.	513-791-2513
Mo	Kansas City, Boschert Equip. Co.	861-561-4050
NJ	Metuchen, Gulton M.C.S. Div.	201-548-2800
NJ	Newark, Norman Bragar Co.	201-344-1100
NM	Albuquerque, Williams Assoc. Inc.	505-255-1638
NY	Buffalo, Niagara Elec. Sls. Co.	716-886-4000
NY	E. Syracuse, Niagara Elec. Sls. Co.	315-437-1656
NY	Rochester, Niagara Elec. Sls. Co.	716-271-1223
NY	Syracuse, Labtronics Inc.	315-454-9314
NC	Charlotte, James L. Highsmith & Co.	704-333-7743
NC	Raleigh, W. A. Brown Comp.,	919-876-9601
NC	Winston-Salem, W.A. Brown Comp. Inc.	919-725-5384
Ohio	Cincinnati, Schlemmer Assocs.	513-522-8340
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Columbus, Scott Elctrns.	614-236-8619
Ohio	Dayton, Comtel-Sterling Co.	513-298-7573
Okla	Tulsa, Kemp Engrg.	918-299-2636
Ore	Portland, Branom Instr. Co.	503-285-9861
Pa	King of Prussia, Applied Controls	215-265-3832
Pa	Murrysville, Bock Engring. Co.	412-327-3700
Pa	Pittsburgh, Comtel Sterling	412-922-5720
SC	Spartanburg, Beacon Elctrn. Assoc.	803-582-4613
Tenn	Memphis, Gilber & Assocs.	901-767-7894
Tex	Addison, Kemp. Engrg. Co.	214-661-0400
Tex	Arlington, Pan Tech. Engrg. Co.	817-261-4111
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Va	Alexandria, W.A. Brown Equip. Comp. Inc.	703-836-1800
Va	Richmond, James L. Highsmith & Co.	804-272-5888
Wash	Seattle, Arva-Hudson	206-622-0177
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940
Wisc	Menomonee Falls, Fritz Engrg. Sls. Co.	414-251-6590

Local Distributors

Alas	Anchorage, Denali Services Co., POB 4895	907-277-5594
Ariz	Phoenix, Metermaster, 2633 E. Backeye Rd.	602-273-7331
Ariz	Phoenix, R.V. Weatherford, 1917 N. 25th Dr.	602-272-7144
Ark	El Dorado, Indl. Elctrns. Supp., 413 W. Main St.	501-862-4901
Ark	Little Rock, Carlont-Bates Co., 6821 Scott Hamilton Dr.	501-375-2383
Cal	Culver City, E.V. Roberts, 9601 W. Jefferson Blvd.	213-870-9561
Cal	Gardena, Instr. Labs, 1323 W. 130th St.	213-770-0650
Cal	Glendale, R. V. Weatherford Co., 6921 San Fernando Rd.	213-849-3451
Cal	Inglewood, Newark Elctrns. Corp., 4747 W. Century Blvd.	213-678-0441
Cal	Los Angeles, Fisher/Brownell, 13936 S. Broadway	213-532-2170
Cal	Los Angeles, Metermaster, 5646 Jillson St.	213-685-4340
Cal	Palo Alto, Metermaster, 3969 E. Bayshore Rd.	415-968-0313
Cal	Palo Alto, R.V. Weatherford Co., 3240 Hillview Rd.	415-321-5373
Cal	San Diego, R.V. Weatherford Co., 7872 Raytheon Rd.	714-278-7400
Cal	Santa Clara, Fisher/Brownell, 3381 Edward Ave.	408-244-6182
Colo	Denver, Newark Elctrns. Corp., 2170 S. Grape St.	303-757-3351
Colo	Denver, Waco, 4616 Ironton St.	303-371-4370
Conn	Middletown, Mancib Co., POB 781	203-347-5629
Fla	Lakeland, A.A. Elctrns. Div. of Auto. Engrg. Co., 2112 S. Combee Rd.	813-682-6181
Fla	Orlando, Brownell Electro., 307 27th St.	305-843-6770
Ga	Atlanta, Brownell Electro, 3020 Commerce Way	404-762-5181
Haw	Honolulu, Yett Co., 429 Waiakamilo Rd.	808-847-2521
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Newark Elctrns. Corp., 550 N. Pulaski Rd.	312-638-4411
Ill	Elk Grove Village, Metermaster, 121 Gordon St.	312-593-8650
Ill	Oak Park, Pacific Indicator Co., 6603 W. North Ave.	312-383-0220
Ill	Worth, Premium Instrs. Co., 5821 W. 117th Pl.	312-371-0500
Ind	Chesterton, Instr. Sys., POB 13	219-926-3078
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supp., 3606 Maumee Ave.	219-742-4346
Ind	Indianapolis, Pioneer/Indiana, 6408 Castleplace Dr.	317-849-7300
Ind	South Bend, Radio Dist. Co., 1212 High St.	219-288-4666
Iowa	Ames, Skarshaug Engrg. & Testing Lab, 4803 W. Lincoln Way	515-292-1422
Kans	Wichita, Main Elctrns., 225 Ida St.	316-267-3581
La	Lafayette, Ralph's, 3004 Cameron St.	318-234-4507
La	Shreveport, Analytical Logging, 1610 Well Island Rd.	318-424-8126
La	Shreveport, Indl. Elctrn. Supp., 2424 Greenwood Rd.	318-222-9459
Md	Elkridge, Sunshine Scientific Instrs., 5800 Main St.	301-796-5600
Mass	Burlington, Mancib Co., Middlesex Tnpk. at A St.	617-272-9450
Mass	Norwood, Timer Srv., 90 Broadway	617-769-3600
Ill	Worth, Premium Instrs. Co., 5821 W. 117th Pl.	312-371-0500
Minn	Minneapolis, Instr. Control Co., 2401 E. Franklin Ave.	612-336-7744
Minn	Virginia, NWR Elctrns., POB 118	218-741-5080
Miss	Jackson, Ellington Elctrns. Supp., 1425 Terry Rd.	601-335-0561
Mo	St. Louis, Indl. Srvc. Labs, 4354 Olive St.	314-535-5760
Mo	St. Louis, Olive Indl. Elctrns., 6662 Olive Blvd.	314-863-7800
NJ	Newark, Norman Brager Prods Co., 350 Lafayette St.	201-344-1101
NJ	Princeton, Science Assocs., 230 Nassau St.	609-924-4470
NM	Albuquerque, WACO, 420 Washington SE	505-255-1638
NY	Albany, Edwain E. Taylor Co., 465 Central Ave.	518-489-5600
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Long Island City, Metermod ilstr. Corp., 48-15 31st Ave.	212-726-4850
NC	Charlotte, Brownell Electro, 5141 Bellhaven Blvd.	704-393-4341
NC	Charlotte, Sys. Svc. Corp., POB 17525	704-377-3407
NC	Matthews, W.K. Hile, POB 1015	704-847-9125
NC	Winston-Salem, Kirkman Elctrns., Drawer K Salem Sta.	919-724-0541
Ohio	Cincinnati, Hughes Peters, 4865 Duck Creek Rd.	513-351-2000
Ohio	Cleveland, Pioneer Standard Elctrns., Pioneer Elect-Instrs. Lab., 4800 E. 131 St.	216-587-3600
Ohio	Columbus, Hughes Peters, 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Pioneer/Dayton, Div. of Pioneer-Standard Elctrns., 1900 Troy St.	513-224-0971
Okla	Tulsa, Oil Capitol Elctrns. Corp., Admiral Sta. Box GG	918-836-2451
Pa	Philadelphia, Sunshine Scientific Instrs., 1810 Grant Ave.	215-673-5600
Pa	Pittsburgh, Air Serco, 3875 Bigelow Blvd.	412-621-6980
Pa	Pittsburgh, Cameradio, 2810 Liberty Ave.	412-288-2600
Pa	Pittsburgh, T.F. Campbell Co., 1521 Saw Mill Run Blvd.	412-881-8006
Tenn	Memphis, Bluff City Distr. Co., 234 East St.	901-725-9500

Tenn	Memphis, Brownell Electro., 217 Cumberland St.	901-452-2181
Tenn	Nashville, Brownell Electro, 1050 Acorn Dr.	615-889-8230
Tex	Beaumont, Ralph Indl. Elctrns., 1203 Broadway	713-833-9443
Tex	Dallas, Dallas Instrs., 10205 Plano Rd.	214-341-0504
Tex	Dallas, Economy Gauge, Div. of McGatlin, 11035 Harry Hines Blvd.	214-358-5381
Tex	Houston, American Analog, 11207 Sagehaven Dr.	713-481-6520
Tex	Houston, Van London Co., 2422 Robin Hood	713-526-1567
Tex	Stafford, Southwest Elctrns., 12725 Royal Dr.	713-494-6021
Utah	Salt Lake City, Control Equip. Co., 2255 S. 2nd W.	801-487-7741
Va	Richmond, Meridan Elctrs., Div. of Sterling Elec., 1001 W. Broad St.	804-355-6521
Wash	Seattle, Arva-Hudson, 1320 Prospect St.	206-622-0177
WVa	Charleston, Williams & Co., 1010 F. St.	304-744-5365
Wisc	Cedarburg, Automation Engrg. Co., 1200 Highway 143	414-377-7500
Wisc	Milwaukee, Electro-Mechano Co., 241 Erie St.	414-272-4050

GULTON INDS., INC., Servonic/Instrumentation Div., 1644 Whittier Ave., Costa Mesa, Cal., 92627, Tel: 714-642-2400, TWX: 910-596-1352; Empl.: 225; Minimum order: $50

For info on price: J. W. Strosnider; Application info: J. C. Pennock; Customer service: L. McKnight; Delivery info: Contracts

Free literature available: Will be supplied on request for any specific product.

Products manufactured: Accelerometers, Amplifiers, Gages, Microphones, All Kinds, Switches, Thermocouples, Elements & Accessories, Transducers

Local Sales Offices & Reps.

Cal	Burlingame, Banner Aircraft Int'l.	415-697-8310
Cal	Los Altos, Jay Stone & Assocs.	415-948-4563
Cal	Los Angeles, Thorson Co.	
Cal	Mission Viejo, Miracle & Assocs.	714-586-5510
Cal	San Diego, Miracle & Assocs.	714-276-8619
Colo	Littleton, Pond Assocs., Inc.	303-798-2904
Conn	No. Haven, Kitchen & Kutchin, Inc.	203-239-0212
Fla	Clearwater, Reynolds & Assocs.	813-726-2373
Fla	Ft. Lauderdale, Reynolds & Assocs.	305-581-6611
Fla	Hollywood, Reynolds & Assocs.	305-987-6720
Fla	Palm Beach Gardens, Reynolds & Assocs.	305-622-6850
Fla	Satellite, Reynolds & Assocs.	305-773-4700
Fla	St. Petersburg, Reynolds & Assocs.	813-360-1484
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	La Grange, Olson Engrg. & Sls.	312-482-3300
Ind	Anderson, Olson Engrg. & Sls. Corp.	317-644-1690
Kans	Leawood, Thunderbird Tech. Sls. & Svcs.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls. & Svcs.	316-684-3941
Md	Baltimore, Stemler Assocs., Inc.	301-944-8262
Mass	Lexington, Kitchen & Kutchin, Inc.	617-862-8230
Mich	Detroit, K.V.A. Assocs.	313-892-6000
Minn	Minneapolis, Westlund Assocs.	612-886-5002
Mo	St. Louis, Thunderbird Tech Sls. & Svcs.	314-567-6488
NJ	Cherry Hill, Stemler Assocs.	609-966-4070
NJ	Laurel Springs, Stemler Assocs.	215-644-3477
NJ	Springfield, SM Service & Tech., Inc.	201-232-2666
NY	Chappaqua, R. M. Glueck & Assoc.	914-238-3233
NC	Charlotte, Reynolds & Assocs.	
Ohio	Cleveland, Instrumentation Sys.	216-486-0782
Ohio	Dayton, Instrumentation Sys. Inc.	513-294-2838
Pa	Pittsburgh, Instrumentation Sys., Inc.	412-243-1111
Tex	Garland, Gordon V. Peck Co.	214-341-8311
Tex	Houston, Gordon V. Peck Co.	713-664-1435
Utah	Salt Lake City, Applied Engrg. Prods. Co.	801-582-4942
Va	Alexandria, Stemler Assocs.	703-548-7818
Wash	Bellevue, Thorson Co.	206-455-9880
Wisc	Milwaukee, Olson Engrg. & Sls. Corp.	414-873-7330

GULTON INDS., Piezo Prods. Div., Box 4300, Fullerton, Cal., 92634, Tel: 714-871-2150, TWX: 910-592-1247; Empl.: 100; Minimum order: $150

For info on price: H. Kelly; Application info: C. Edmiston; Customer service: C. Edmiston; Delivery info: R. Johnson

Free literature available: Gulton Glennite Piezoceramics catalog, H-700, contains the specifications of our materials, describes some standard shapes and sizes and provides basic engineering application notes.

Products manufactured: Ceramic Resonators, Crystals, Transducers

G.V. CONTROLS, INC., 80 Okner Parkway, Livingston, N.J., 07039

H-B INSTR. CO., 4315 N. American St., Phila., Pa., 19140, Tel: 215-329-9125; Empl.: 45; Minimum order: $20

For info on price: E. D. Hiergesell; Application info: C. G. Roveran; Customer service: C. G. Roveran; Delivery info: F. J. Freitag

Free literature available: The new H-B Relay/Thermostat Catalog features precision thermostats, solid state relays, and mercury plunger relays with capacacities up through 100 amps for all applications.

Products manufactured: Controls/Control Eqpt., Indicators, Meters, Relays, Services, Assembly, Production & Test, Standards, Switches, Thermostats

HACKENSACK CABLE CORP., 3275 Sunset Blvd., West Columbia, S.C., 29169, Tel: 803-796-3070; Empl.: 115; Minimum order: $25

Customer service: J. Floyd

Free literature available: Cable Catalog - wire ropes and cables made of stainless steel, galvanized steel, bronze, monel bare and coated with nylon and vinyl.

Products manufactured: Cords, Wire

Local Sales Offices & Reps.

Cal	Long Beach, Hackensack Cable Corp.	213-424-1659
Fla	Miami, J.M. Keely Sls.	305-634-8526
NJ	South Hackensack, Hackensack Cable Corp.	201-487-1036
Ohio	North Olmsted, Hackensack Cable Corp.	216-734-6190
Tex	Houston, R.D. Chapman	713-681-6221

HACKER INSTRS., INC., Box 646, Fairfield, N.J., 07006, Tel: 201-226-8450; Empl.: 10; Minimum order: $5

For info on price: K. S. Lanye; Application info: I. E. Hills; Customer service: I. E. Hills; Delivery info: K. S. Lanye

Products manufactured: Meters, Microscopes, Testers

HADLEY COMPONENTS DIV., GTI Corp., R.D. #2, Box 77, Hadley, Pa., 16130, Tel: 412-253-3161, Telex: 914-545

Customer service: R. C. Kaufman

Free literature available: Brochure outlining Hadley Components capabilities and current product lines.

Products manufactured: Capacitor, Hardware, Forms, Wire, Lead Assemblies & Receptacles, Resistor, Hardware, Services, Assembly, Production & Test, Wire

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Tempe, Gassner & Clark Co.	602-968-9037
Cal	Canoga Park, California Elctrn. Mktg.	213-884-7867
Cal	San Mateo, California Elctrn. Mktg.	415-574-1113
Cal	Santa Ana, California Elctrn. Mktg.	714-835-2702
Cal	Santa Clara, GTI Corp.	408-244-2938
Colo	Boulder, Mile High Elctrns.	303-444-5615
Conn	Brookfield, E.J. Hughes Assocs.	203-775-4541
Conn	Old Saybrook, E.J. Hughes Assocs.	203-399-7636
Fla	Longwood, Lenz Engrg.	305-831-9797
Ill	Westchester, Gassner & Clark Co.	312-345-4245
Ind	Indianapolis, Electronic Sls. & Engrg. Co.	317-849-4260
Mass	Attleboro, E.J. Hughes Assocs.	617-226-0050
Mass	Beverly, E.J. Hughes Assocs.	617-927-7171
Mich	Southfield, Eynon-Weyand Assocs.	313-354-3430
Minn	Minneapolis, D.G. Perry & Co.	612-920-3212
NJ	Brielle, Semi-Mat Co.	201-528-7439
NJ	Shrewsbury, GTI Corp.	201-842-6682
NY	Skaneatelis, MCK Assocs.	315-685-7122
NC	Charlotte, B. Henry Assocs.	704-375-8958
Ohio	Dayton, Sidnell Co.	513-885-4161
Ohio	Mentor, Bishop Co.	216-255-6969
Tex	Richardson, R.S. Marston Co.	214-235-3577

HALEX, INC., Box 2940, Torrance, Cal., 90509, Tel: 213-772-4461; Minimum order: $1000

For info on price: M. J. Bergquist Ext. 26; Application info: Y. Tonai Ext. 34; Customer service: R. C. Sivas Ext. 28; Delivery info: R. C. Sivas Ext. 28

Products manufactured: Amplifiers, Circuits, Hybrid, Thin-Film, Networks, Resistors

Local Sales Offices & Reps.

Ariz	Phoenix, W. W. Posey Co.	602-949-9395
Cal	Los Altos, W. W. Posey Co.	415-948-7771
Colo	Eastlake, Jensen Reps.	303-452-1609
Fla	Atamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-726-8871
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Northbrook, Raines-Brin Assocs.	312-498-0890
Mass	Norwood, R. Perron & Co.	617-762-8114
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Grand View, Beneke & McCaul	816-765-2998
NJ	Cranford, Idalee Elctrn. Corp.	
NY	Hyde Park, R.P. Kennedy Co., Inc.	914-229-2269
NY	Rochester, R. P. Kennedy Co.	716-271-6322
NY	Valley Stream, Idalee Elctrn. Corp.	516-825-8955
Wash	Seattle, Underwood & Underwood	206-243-2133

HALMAR ELECTRONICS, INC., 1544 W. Mound St., Columbus, Ohio, 43223, Tel: 614-276-0131, TWX: 810-482-1654; Empl.: 70; Minimum order: $20

For info on price: Sls. Dept.; Application info: Sls. Dept.; Customer service: T. Koerber; Delivery info: Sls. Dept.

Products manufactured: Controls/Control Eqpt., Current Sensors, Integrators, Electronic, Meters, Monitors, Power Supplies, Regulators, Relays, Switches, Totalizers, Digital, Transducers, Transformers

HAMAMATSU CORP., 120 Wood Ave., Middlesex, N. J., 08846, Tel: 201-469-6640, Telex: 83-3403; Empl.: 450 p. 1•2354,2355

Customer service: R. Eno

Products manufactured: Amplifiers, Cameras, Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Diodes, Lamps, Light Sources, Photoelectric, Lights, Photomultiplier Tube Housings, Power Supplies, Television Systems & Equipment Closed-Circuit, Tubes

Local Sales Offices & Reps.

Cal	Burlingame, California Eastern Labs	415-342-7744

HAMAMATSU TV CO., LTD., 1126 Ichino-Cho, Hamamatsu City, Shizuoka Pref., Japan, Tel: 0534-34-3311; Empl.: 530

For info on price: R. Eno 201-469-6640; Application info: R. Eno 201-469-6640; Customer service: C. Simola 201-469-6641; Delivery info: C. Simola 201-469-6641

Products manufactured: Analyzers, Bolometers, Cameras, Cells, Photoconductive, Photoemissive, Photovoltaic, Coils Including Assemblies & Forms, Detectors, Diodes, Lamps, Light Sources, Photoelectric, Monitors, Photomultiplier Tube Housings, Power Supplies, Sensors, Light, Shields, Television Systems & Equipment Closed-Circuit, Tracking Systems, Tubes

Local Sales Offices & Reps.

NJ	Middlesex, Hamamatsu Corp.	201-469-6640

HAMILTON STANDARD, Div. United Aircraft Corp., Windsor Locks, Conn., 06096, Tel: 203-623-1621, TWX: 710-420-0584

HAMILTON TECHNOLOGY, INC., a Sub. of HMW Industries Inc., Box 1609, Lancaster, Pa., 17604, Tel: 717-299-2581; Empl.: 1000

For info on price: S. L. Snyder; Application info: S. L. Snyder; Customer service: T. Murray; Delivery info: S. L. Snyder

Free literature available: Ultra-Thin metal strip and foil; Precision parts and assembly. New faciliities brochure provides complete properties of proprietary metals, commercial alloys, pure metals, precisin piece-parts and assembly.

Products manufactured: Alternators, Foil, Gears & Gear Mechanisms (Precision), Heads, Recording Playback, Erase, Laminations, Magnets, Metal Compounds, Foils, Powders, Sheet, Stock, Services, Assembly, Production & Test, Wire

Local Sales Offices & Reps.

Cal	Costa Mesa, Hamilton Tech., Inc.	714-546-0780
Cal	Los Angeles, E. A. Wilcox Co.	213-723-6436
Colo	Denver, Electro-Rep, Inc.	303-744-2655
Conn	W. Hartford, R. S. Pettigrew & Co.	203-233-8533
Ill	Chicago, Electro-Comp Sls., Inc.	312-763-3636
Mass	W. Newton, R. S. Pettigrew & Co.	617-969-5770
Minn	Navarre, MagCo, Inc.	612-471-8538
Mo	St. Louis, Holtgrieve & Co.	314-725-6602
NJ	Asbury Park, Lancaster Ind'l. Sls., Inc.	201-988-5401
NM	Albuquerque, Electro-Rep, Inc.	505-256-1749
Ohio	Grafton, A. W. Risser Co.	216-458-5091
Pa	Lancaster, Lancaster Ind'l. Sls., Inc.	717-397-2942
Wash	Seattle, E. A. Wilcox Co.	206-243-5450

HAMLIN INC., Lake & Grove Sts., Lake Mills, Wisc., 53551, Tel: 414-648-2361, TWX: 910-260-3740; Empl.: 800; Minimum order: $100
p. 1•1707,2058-2060; p. 2•1148,1149

For info on price: Cust. Serv. Desk; Customer service: Cust. Svc. Desk; Delivery info: Cust Svc Desk

Free literature available: Free descriptive literature with application help and specifications covering: Reed switches, dry and mercury-wetted; Sensors, temperature and proximity; Relays, opto-isolated solid state and hybrid; Liquid displays, dynamic scattering and field effect, for watches, clocks and instrumentation.

Products manufactured: Display Devices/Displays, Relays, Switches, Transducers

Local Sales Offices & Reps.

Ariz	Phoenix, Zeus, Inc.	602-258-7519
Cal	El Toro, Electronic Component Mktg.	714-830-3939
Cal	Palo Alto, Testco Inc.	415-494-2011
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Elctrn. Comp.	714-273-1346
Cal	Woodland Hills, Elctrn. Comps. Mktg.	213-340-1745
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Berlin, White Sls. Co.	203-224-0423
Fla	Hollywood, Wallace Elctrn. Sls.	305-961-6640
Fla	Tampa, Wallace Elctrn. Sls.	813-961-1037
Ga	Jonesboro, Wallace Elctrn. Sls.	404-471-6297
Ill	Des Plaines, Lincoln, Hodges	312-297-3810
Ill	Palatine, CC Elctrns. Sls.	312-358-8900
Ind	Indianpolis, R.H. Newsom Assoc.	317-849-4442
Iowa	Marion, Thomas & Modrcin	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin	913-432-2131
Md	Woodbine, Naudain Assoc.	301-422-2270
Mass	Needham, White Sls. Co.	617-444-3676
Mich	Dearborn, V.P.I. Inc.	313-271-4600
Minn	Minneapolis, R-J, Inc.	612-922-1425
Mo	Hazelwood, Thomas & Modrcin	314-895-4700
NJ	Mount Laurel, Naudain Assoc.	609-235-1801
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	DeRuyter, R.P. Kennedy Co., Inc.	315-662-3996
NY	Manhasset, Win-Cor Elctrn.	516-627-9474
NY	Red Hook, R.P. Kennedy Co., Inc.	914-876-2700
NY	Rochester, R. Kennedy	716-271-6322
NC	Greensboro, Wallace Elctrn. Sls.	919-292-0487
NC	Kernersville, Wallace Elctrn. Sls.	919-993-3993
Ohio	Cincinnati, G & H Sales Co.	513-771-8231
Ohio	Grove City, G & H Sales Co.	614-878-1128
Tenn	Memphis, Wallace Elctrn. Sls.	901-682-2281
Tex	Dallas, Allied Comp., Inc.	214-238-0408
Tex	Houston, Allied Comp., Inc.	713-691-3961
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Bellevue, Testco, Inc.	206-454-7422
Wisc	Waukesha, Lincoln Hodges	414-542-3087

Local Distributors

Ala	Huntsville, Mock Elctrns., 2310 Memorial Pkwy. S.	205-539-2401
Cal	Palo Alto, Testco, 941 Charleston Rd.	415-326-5320
Cal	Van Nuys, Patane Avionics, 5937 Kester Ave.	213-988-4455
Colo	Denver, Ind. Elctrns., Box 22457	303-771-2636
Conn	New Haven, Hatry Ectrns., 610 Blvd.	203-787-5921
Fla	Miami, ESL, 3560 N.W., 34th St.	305-633-6975
Ga	Augusta, Dixie Radio Supp., 1234 Gordon Pk. Rd.	404-722-2055
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Westmont, Bodelle Co., 47 Chestnut La.	312-323-9670
Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania	317-634-8486
Md	Gaithersburg, Pioneer/Washington, 9100 Gaither Rd.	301-948-0710
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy.	617-329-2400
Mich	Ann Arbor, Wedemeyer Elctrn. Supp., 2280 S. Ind. Hwy.	313-665-8611
Mich	Farmington, Harvey-Michigan, Inc., 23461 Ind. Pk. Dr.	313-477-1650
Minn	Edina, Harvey-Minnesota, Inc., 6969 Washington Ave. S.	612-941-6060
Miss	Pascegoula, May Elctrns., 2514 Market St.	601-762-1900
NJ	Pennsauken, Resco Elctrns., Airport Indl. Pk.	609-662-4000
NM	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Farmingdale, Norelcom Elctrns., 200 Allen Blvd.	516-249-7245
NY	Lynbrook, Peerless Radio Corp., 19 Wilbur St.	516-593-2121
NC	Greensboro, Hammond Elctrns., 2923 Pacific Ave.	919-275-6391
NC	Winston-Salem, Kirkman Elctrns., Drawer "K" Salem Sta.	919-724-0541
Ohio	Solon, Repco, 6835 Cochran Rd.	216-248-8900
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9124
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
RI	Providence, Wm. Dandreta & Co., 38 Wolcott St.	401-861-2800
SC	Columbia, Dixie Radio Supp. Co., 1900 Barnwell	803-253-5333
Tenn	Fort Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Dallas, KA Elctrn. Sls., 1220 Majesty Dr.	214-634-7870
Va	Richmond, Meridian Elctrns., 1001 W. Broad St.	
Wash	Seattle, Radar Elec. Co., 168 Western Ave. W.	206-282-2511

HANDY & HARMAN, 850 Third Ave., New York, N.Y., 10022, Tel: 212-752-3400; Empl.: 800

Customer service: T. M. Hansen

Free literature available: Bulletin 202A: 12 page booklet on alloys and fluxes. Advantages of silver alloy brazing; "The Logic of Precious Metal Cladding." How to gain properties of a precious metal while conserving use of costly material explained.

Products manufactured: Alloys, Flux, Brazing & Soldering Materials, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Preforms, Precious Metal, Wire

Local Sales Offices & Reps.

Cal	El Monte	213-283-8181
Ill	Elk Grove Village	312-437-3883
Mass	Attleboro	617-226-1000
Mich	Southfield	313-356-5390
NY	New York	212-752-3400
Ohio	Cleveland	216-333-2166
Tex	Dallas	214-351-5890

HANKSCRAFT CO., Motor Div., PO Box 120, Reedsburg, Wisc., 53959, Tel: 608-524-4341; Empl.: 400

Customer service: E. F. Gesteland

Free literature available: Catalog Sheet - Series 3440 D.C. Gearhead Motor - Gives demensions, characteristics and voltages and speeds available.

Products manufactured: Motors

Local Sales Offices & Reps.

Cal	Mountain View, Caltron-Pyle	415-964-3244
Cal	Westminster, Electric Motor Specialists	213-564-7323
Ga	Atlanta, V. Avis McCorvey Co.	404-636-2502
Ill	Libertyville, Matthews-Midwest Co.	312-362-8200
Ind	Indianapolis, W.F. Sondermann	317-849-2769
Md	Bethesda, Mount & Co.	301-530-9303
Mass	Salem, Forbes Engrg.	617-744-1693
Mich	Jackson, N. Scroggs Co.	517-782-5211
Minn	St. Paul, W.E. Taubert	612-776-1285
NJ	Mahwah, Kent Assocs.	201-327-7878
NY	Skaneateles, Henkell Mktg. Co.	315-685-6945
Ohio	Fairborn, Technical Assocs.	513-878-2484
Tex	Bellaire, Dynamic Comp. Sls., Inc.	713-668-7729
Wash	Seattle, R.K. Squibb, Inc.	206-632-2450

HANSEN MFG. CO., Div. P.R. Mallory & Co. Inc., Box 23, Princeton, Ind., 47670, Tel: 812-385-3415; Empl.: 350

Products manufactured: Motors, Slip-Rings & Assemblies

Local Sales Offices & Reps.

Cal	Fremont, H.K.F. Inc.	415-863-2200
Cal	Sherman Oaks, R.S. Hopkins Co.	213-788-5501
Conn	Essex, Winslow Elec. Co.	203-767-8229
Ill	River Forest, Fromm Co.	312-771-6000
Mich	Grand Rapids, J. Orr Assocs.	616-534-4029
NJ	Teaneck, H. Rude Assocs.	201-836-6778
NY	Rochester, H.C. Johnson Agency, Inc.	716-482-3000
Pa	Devon, Kiley Elec. Co.	215-687-9340
Tex	Dallas, Carey & Assocs.	214-363-7813
Tex	Houston, Carey & Assocs.	713-460-1111
Wash	Vancouver, H.K.F. Inc.	503-228-1683

HAPCO, Box 1205, Boulder, Colo., 80302, Tel: 303-447-0441; Empl.: 4

For info on price: P. Wojtisek; Application info: P. Wojtisek; Customer service: J. Snyder; Delivery info: P. Wojtisek

Products manufactured: Drafting Machines, Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Drills & Accessories, Hand & Power, Eyelets, Templates, Printed Circuit Design

HARBISON IND'L. PRODS., INC., 7205 Hibbs La., Levittown, Pa., 19057, Tel: 215-943-9000; Empl.: 115
p. 1•1544; p. 2•397

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Tex	Richardson, Corwin Assocs.	214-424-8333

HARDMAN INC., Belleville, N.J., 07109, Tel: 201-751-3000; Empl.: 85; Minimum order: $25

Customer service: T. M. Stefanelli

Free literature available: Double/Bubble: 2-part epoxy adhesive job-sized packet DPR Compounds: Pourable elastomers for mold-making Epoweld: Two-part, non-sag epoxy adhesive

Products manufactured: Adhesives (All Types), Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Insulators & Insulation, Kits, Cable-End Sealing, Meters, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber, Seals, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Los Altos, Astroel, Inc.	415-948-3636
Conn	Hartford, C. Segal Co.	203-236-2027
Fla	Maitland, D & E Assocs.	305-644-3039
Ill	Chicago, Techrep Inc.	312-761-0548
Mass	Newtonville, C. Segal Co.	617-969-6900
Mich	Ferndale, Tiby Co.	313-547-3550
NJ	Flemington, Eric Sheard	201-782-6492
NJ	Old Bridge, Seaco	201-679-8800
NY	Copake Falls, A.L. Perkins Co.	518-329-1428
NY	New York City, Henley & Co.	212-986-5544
Ohio	Cleveland, Tiby Co.	216-371-5335
Ohio	Dayton, Tiby Co.	513-277-3822
SC	Myrtle Beach, Candor Co.	803-448-8361
Tex	Dallas, Apogee Engrg. Svcs.	214-352-2083
Wash	Seattle, Atlas Packing & Rubber Co.	206-623-4697
Wash	Seattle, Houston Co.	206-622-0750
FOR:	Can., Toronto, Ont., Ware Chemical of Can. Ltd.	416-233-1234

HAROWE SERVO CONTROLS, 48 Westtown Rd., W. Chester, Pa., 19380, Tel: 215-692-2700, TWX: 510-663-0335; Empl.: 350; Minimum order: $100

For info on price: B. Schmitt; Application info: H. Smith; Customer service: B. Schmitt; Delivery info: B. Schmitt

Free literature available: Precision synchrus, resolvers, brushless synchros, stepper motors and controllers, motor generators, integrating tuchometers, precision speed reducers and counters for Servo Systems and Components.

Products manufactured: Controls/Control Eqpt., Encoders, Motors, Resolvers, Synchro, Synchros, Tachometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Fred Schoeffler Assoc. Inc.	602-948-3470
Cal	Hollywood, Westaironics	213-466-6201
Colo	Denver, Franklin Sls.	303-922-3623
Conn	Bloomfield, Zaslow Sls.	203-242-7781
Fla	Ormond Beach, Technology Mktg. Assoc.	904-672-2314
Ill	Chicago, Carlson Elctrn.	312-SP 4-4812
Ind	Ft. Wayne, McDonald Sls.	219-745-9214
Mass	Lowell, Zaslow Sls. Co.	617-458-8452

Minn	Minneapolis, Nortec Sls. Inc.	612-926-2855
Mo	St. Louis, Carlson Elctrn. Sls.	314-991-0262
NJ	Fairfield, R.C. Assocs.	201-664-1241
NY	Jericho, Electro Rep.	516-938-0540
Ohio	Cleveland, Rockford Controls	216-731-5250
Ohio	Dayton, Rockford Controls	513-274-1931
Tex	Addison, Parvin Sls. Co.	214-239-9148
Tex	Dallas, Kukla Elctrns.	214-661-3257
FOR:	Can., Pierrefonds, Que., Avotronics Ltd.	514-626-6511
FOR:	Can., Willowdale, Ont., Avotronics Ltd.	416-491-7941

HARREL, INC., 16 Fitch St., E. Norwalk, Conn., 06855, Tel: 203-866-2573

Customer service: W.J. Becker

Free literature available: General bulletin-single sheet summary of available products.

Products manufactured: Alarms, Bridges, Controllers, Programmable, Controls/Control Eqpt., Counters, Data Acquisition & Reduction Systems, Data Loggers, Dials, Gages, Meters, Monitors, Probes, Process Control Systems, Programmers, Pyrometers, Recorders, Standards, Thermistors, Timers, Transducers

Local Sales Offices & Reps.

Ala	Birmingham, McConnel Sls.	205-871-3501
Cal	Sherman Oaks, Windsor Dynamics, Inc.	213-989-3631
Cal	Walnut Creek, Viking Instr.	415-933-1221
Colo	Denver, Electro-Rep.	303-744-2821
Fla	Hialeah, Shaw Engrg. & Sls.	
Ill.	Glen Ellyn	312-668-6622
Ky	Williamstown, C. Burnitt Agency	606-823-6451
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NM	Albuquerque, Electro-Rep.	505-256-1749
NY	Cazenovia, P.M. Decew, Inc.	315-065-8602
NC	Matthews, Datatech	704-847-4464
Ohio	Willoughby	216-942-0920
Tex	Houston, Hatfield & Co.	713-468-1703

HARRINGTON & KING & PERFRTNG CO., 5655 Fillmore St., Chicago, Ill., 60644

HARRIS
COMMUNICATIONS AND INFORMATION HANDLING

HARRIS CORP., Computer Systems Div., 1200 Gateway Dr., Fort Lauderdale, Fla., 33309, Tel: 305-974-1700, TWX: 510-956-3096; FSC No: 29436; Empl.: 600

For info on price: A. S. Walder; Application info: J. D. Jones; Customer service: R. S. Patten; Delivery info: P. Stratford

Free literature available: Slash 4 Computer Systems; Slash 5 Computer Systems; DC-38-D Memory Systems; Vulcan (Virtual Core Manager) Operating Systems; Slash 4VMS (Virtual Memory Systems) Computer; Slash 4 Real Time Computer System; Disc Monitor System (DMS) Operating System.

Products manufactured: Computers, Memory Systems

Local Sales Offices & Reps.

Cal	Newport Beach	714-752-0910
Cal	Santa Clara	408-984-2811
Ill	Oak Brook	312-323-3437
Md	Rockville	301-762-5600
Mass	Waltham	617-890-5410
Mo	St. Louis	314-961-9927
NY	Huntington	516-549-8787
Ohio	Cleveland	216-461-1510
Pa	King of Prussia	215-337-2180
Tex	Dallas	214-243-3478

HARRIS SEMICONDUCTOR, Box 883, Melbourne, Fla., 32901, Tel: 305-727-5430, TWX: 510-959-6259; Empl.: 1265; Minimum order: $250

For info on price: Cust. Svcs.; Application info: E. Fernandez 305-727-5824; Customer service: B. DeGiovanni 305-727-5412; Delivery info: Cust. Svcs.

Products manufactured: Integrated Circuit Devices

Local Sales Offices & Reps.

Ariz	Scottsdale, Harris Semiconductor	602-946-3556
Cal	Long Beach, Harris Semiconductor	213-426-7687
Cal	Palo Alto, Harris Semiconductor	415-964-6443
Cal	San Diego, Celtec	714-279-7961
Colo	Denver, Checkmate Sls. Inc.	303-771-4920
DC	Washington, Harris Semiconductor	202-337-3170
Ill	Schaumburg, Harris Semiconductor	312-894-8824
Kans	Olathe, B. Rush Assocs.	913-782-1177
Md	Randallstown, Beacon North, Inc.	301-922-1248
Mass	Boston, Harris Semiconductor	617-237-5430
Minn	Deep Haven, Harris Semiconductor	612-473-4936
NY	Melville, Harris Semiconductor	516-249-4500
NC	Raleigh, R.W. Mitscher	919-828-0575
Ohio	Dayton, Harris Semiconductor	513-226-0636
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Philadelphia, Harris Semiconductor	215-687-6680
Tenn	Shelbyville, R.W. Mitscher	615-684-4544
Tex	Richardson, Harris Semiconductor	214-231-9031
Utah	Salt Lake City, Checkmate Sls., Inc.	801-268-3533
Va	Falls Church, Beacon North, Inc.	703-534-1673
Va	Troutville, R. W. Mitscher Co.	703-345-3283
Va	Virginia Beach, R. W. Mitscher Co.	804-481-7200
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
FOR:	Can., Mississauga, Ont., Munro Electric Component, Ltd.	416-676-1042

Local Distributors

Ala	Huntsville, Hamilton/Avnet, 805 Oster Dr. NW	205-533-1170
Ariz	Phoenix, Hamilton/Avnet, 2615 S 21st St.	602-275-7851
Ariz	Phoenix, Liberty Elctrns., 3130 N 27th Ave.	602-257-1272
Ariz	Phoenix, R.V. Weatherford, 1917 N 25th Dr.	602-272-7144
Cal	Anaheim, R.V. Weatherford, 1550 Babbit Ave.	714-633-9633
Cal	Culver City, Avnet Electro Sls., 10916 W Washington Blvd.	213-558-2345
Cal	Culver City, Hamilton Electro Sls., 10912 W Washington Blvd.	213-558-2121
Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Glendale, R.V. Weatherford, 6921 San Fernando Rd.	213-849-3451
Cal	Mountain View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	Mountain View, Hamilton/Avnet, 340 E. Middlefield Rd.	415-961-7000
Cal	Palo Alto, R.V. Weatherford, 3240 Hillview Ave.	415-493-5373
Cal	Pomona, R.V. Weatherford, 1095 E Third St.	714-623-1261
Cal	San Diego, Hamilton/Avnet, 8917 Complex Dr.	714-279-2421
Cal	San Diego, Liberty Elec., 8248 Mercury Ct.	714-565-9171
Cal	San Diego, R.V. Weatherford, 7872 Raytheon Rd.	714-278-7400
Colo	Denver, Elmar Electronics, 6777 E 50th Ave.	303-287-9611
Colo	Denver, Hamilton/Avnet, 5921 N Broadway	303-534-1212
Colo	Englewood, R.V. Weatherford, 3905 S Mariposa	303-761-5432
Conn	Danbury, Schweber, Commerce Industrial Park	800-645-7381
Conn	Georgetown, Hamilton/Avnet, 643 Danbury Rd.	203-762-0361
Conn	Norwalk, Harvey Elctrns., 112 Main St.	203-853-1515
Fla	Hollywood, Hamilton/Avnet, 4020 N 29th Ave.	305-925-5401
Fla	Hollywood, Schweber, 2830 N 28th Terr.	305-927-0511
Ga	Norcross, Hamilton/Avnet, 6700 I-85, Suite 2B	404-448-0800
Ill	Elk Grove, Schweber, 1380 Jarvis Ave.	312-593-2740
Ill	Schiller Park, Hamilton/Avnet, 3901 N 25th Ave.	312-678-6310
Kans	Lenexa, Hamilton/Avnet, 37 Lenexa Indl. Ctr.	913-888-8900
Md	Hanover, Hamilton/Avnet, 7255 Standard Dr.	301-796-5000
Md	Rockville, Schweber, 5640 Fisher La.	301-881-2970
Mass	Burlington, Hamilton/Avnet, 185 Cambridge St.	617-273-2120
Mass	Lexington, Harvey, 44 Hartwell Ave.	617-861-9200
Mass	Waltham, Schweber, 213 3rd Ave.	617-890-8484
Mich	Livonia, Hamilton/Avnet, 12870 Farmington Rd.	313-522-4700
Mich	Troy, Schweber, 86 Executive Dr.	313-583-9242
Minn	Edina, Hamilton/Avnet, 7683 Washington Ave. S.	612-941-3801
Minn	Edina, Schweber, 7015 Washington Ave. S.	612-941-5280
Mo	Hazelwood, Hamilton/Avnet, 392 Brookes Dr.	314-731-1144
NJ	Cedar Grove, Hamilton/Avnet, 218 Little Falls Rd.	201-239-0800
NJ	Mt. Laurel, Hamilton/Avnet, 113 Gaither Dr. E. Gate Indust. Pk.	609-234-2133
NJ	Somerset, Schweber, 43 Belmont Dr.	201-469-6008
NM	Albuquerque, Hamilton/Avnet, 2450 Baylor Dr. S.E.	505-765-1500
NM	Albuquerque, R.V. Weatherford, 6101 Marble N.E. Marberry Plaza #11	505-265-5671
NY	E. Syracuse, Hamilton/Avnet, 6500 Joy Rd.	315-437-2642
NY	Rochester, Hamilton/Avnet, 167 Clay Rd.	716-442-7820
NY	Rochester, Schweber, 2 Townline Cr.	716-461-4000
NY	Westbury, Hamilton/Avnet, 70 State St.	516-333-5800
NY	Westbury Schweber, Jericho Tpk.	516-334-7474
NY	Woodbury, Harvey, 60 Crossways Pk. W.	516-921-8700
Ohio	Beachwood, Schweber, 23880 Commerce Pk. Rd.	216-464-2970
Ohio	Cleveland, Hamilton/Avnet, 761 Beta Dr.	216-461-1400
Ohio	Dayton, Hamilton/Avnet, 118 Westpark Rd.	513-433-0610
Tex	Dallas, Hamilton/Avnet, 4445 Sigma Rd.	214-661-8661
Tex	Dallas, R.V. Weatherford, 10836 Grissom La.	214-243-1571
Tex	Houston, Hamilton/Avnet, 1216 W. Clay	713-526-4661
Tex	Houston, R.V. Weatherford, 3500 WTC Jester Blvd.	713-688-7406
Utah	Salt Lake City, Hamilton/Avnet, 647 W. Billinis Rd.	801-262-8451
Wash	Bellevue, Hamilton/Avnet, 13407 Northrup Way	206-746-8750
Wash	Seattle, Liberty Elctrns., 5305 Second Ave. S.	206-763-8200
Wash	Seattle, R.V. Weatherford, 541 Industrial Dr.	206-243-6340
For:	Can., Mississauga, Ont., Hamilton/Avnet	416-677-7432
For:	Can., Montreal, Que.	514-331-6443
For:	Can., Ottawa, Ont., Hamilton/Avnet	613-725-3071

HARSHAW CHEMICAL CO., Div./Kewanee Oil Co., 1945 E. 97th St., Cleveland, Ohio, 44106, Tel: 216-248-7400, TWX: 216-248-7400

Customer service: R. Eaton

Free literature available: Data sheets describing complete line of synthetic optical crystals, IR and UV detectors, nuclear instrument modules, radiation detectors and dosimetry materials and systems.

Products manufactured: Amplifiers, Analyzers, Counters, Crystal Blanks, Crystals, Detectors, Generators, Lenses, Optical & Camera, Modules, Logic, Encapsulated, Scalers, Binary, Decade, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, C. D. Wright Optical Products	714-838-6340
Cal	Los Angeles, V. Overby	714-838-6340
Cal	San Francisco, R. Lowe	415-968-2171
DC	Washington, W. Todd Nuclear Products	703-356-9570
Ga	Atlanta, A. Barber	404-255-4616
Ill	Chicago, N. Pawluk	312-325-4179
Mass	Norwood, K. Babeux	617-769-5065
NJ	Ramsey, M. Aguinas	201-327-8850
Ohio	Cleveland, T. Stack Nuclear Prods.	216-248-7400
Ohio	Solon, R. Kasulones Optical Prods.	216-248-7400
Tex	Houston, J. Owens	713-522-8377
Wash	Seattle, Showalter Instruments	206-624-9020

HARTMAN ELECTRICAL MFG., Div. A-T-O Inc., 175 N. Diamont St., Mansfield, Ohio, 44902, Tel: 419-524-1411, TWX: 810-448-2814

For info on price: D. Vogel; Application info: G. Danas; Customer service: G. Beck; Delivery info: G. Beck

Products manufactured: Actuators, Controls/Control Eqpt., Monitors, Motors, Relays, Solenoids, Switches, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, Airsupply Co.	606-267-3916
Cal	Dublin, Airsupply Co.	415-829-0870

Cal	San Diego, Airsupply Co.	714-298-1121
Cal	San Monica, Airsupply Co.	213-829-1781
Ga	Marietta, Airsupply Co.	404-422-8242
Ill	Berkeley, Airsupply Co.	312-544-7400
Ind	Indianapolis, Airsupply Co.	317-248-8391
Kans	Wichita, Airsupply Co.	316-683-7518
Mass	Boston, Airsupply Co.	617-232-5020
Minn	Bloomington, Airsupply Co.	612-884-8950
Mo	Bridgeton, Airsupply Co.	314-731-3011
NY	Clinton, Airsupply Co.	315-735-8341
NY	Huntington Station, Airsupply Co.	516-249-1410
Ohio	Columbus, Airsupply Co.	614-861-1129
Ohio	Dayton, Airsupply Co.	513-224-0728
Pa	Valley Forge, Airsupply Co.	215-933-8924
Tex	Fort Worth, Airsupply Co.	817-355-4541
Va	Arlington, Airsupply Co.	703-525-1191
Wash	Bellevue, Airsupply Co.	206-454-7922
EXP:	Rye, N.Y., American Avitron	914-937-5300

HARWIL CO., 903 Colorado Ave., Santa Monica, Calif., 90401, Tel: 213-394-4710; Empl.: 5; Minimum order: $5

Customer service: H. Hutchinson

Free literature available: 1) Coolant fluid flow switches for the electronic industry. Interlock & monitor coolant flow to ensure against very expensive overheating & failure. 2) Component Lead Bender - Eliminates trial and error lead bending. Fast, exact, thumbwheel adjusted spacing between beads.

Products manufactured: Controls/Control Eqpt., Machines/Machinery, Production, Switches, Tools

HATHAWAY INDUSTRIES INC., 11616 51st St., Tulsa, Okla., 74145, Tel: 918-663-0110, TWX: 910-845-2129; Empl.: 450; Minimum order: $25

Customer service: F. D. Leynaert

Free literature available: Brochures on: terminal blocks- mosaic displays - PMDC motors.

Products manufactured: Amplifiers, Connectors, Meters, Motors, Oscillographs, Direct Writing, Paper, Graphic Recording, Recorders, Signal Conditioners & Equipment, Strips, Tachometers, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Terminals

Ariz	Phoenix, Airsupply Co.	602-267-3916
Cal	Dublin, Airsupply Co.	910-343-6861
Cal	Santa Monica, Airsupply Co.	213-670-6722
Ga	Marietta, Airsupply Co.	404-422-8242
Ill	Berkeley, Airsupply Co.	312-544-7400
Ind	Indianapolis, Airsupply Co.	317-248-8391
Kans	Wichita, Airsupply Co.	316-683-7518
Mass	Boston, Airsupply Co.	617-232-5020
Minn	Bloomington, Airsupply Co.	612-884-8950
Mo	Bridgeton, Airsupply Co.	314-731-3011
NY	Clinton, Airsupply Co.	315-735-8341
NY	Huntington, Airsupply Co.	516-249-1410
Ohio	Columbus, Airsupply Co.	614-861-1129
Ohio	Dayton, Airsupply Co.	513-224-0728
Pa	Valley Forge, Airsupply Co.	215-933-8924
Tex	Fort Worth, Airsupply Co.	817-335-4541
Va	Arlington, Airsupply Co.	703-525-1191
Wash	Bellevue, Airsupply Co.	206-454-7922

Motors

Ariz	Phoenix, Airsupply Co.	602-267-3916
Cal	Dublin, Airsupply Co.	415-829-0870
Cal	Santa Monica, Airsupply Co.	213-670-6722
Fla	Orlando, Von Kamecke Assoc.	305-843-5294
Ga	Marietta, Airsupply Co.	404-422-8242
Ill	Berkeley, Airsupply Co.	312-544-7400
Ind	Indianapolis, Airsupply Co.	317-248-8391
Kans	Wichita, Airsupply Co.	316-683-7518
Mass	Boston, Airsupply Co.	617-232-5020
Minn	Bloomington, Airsupply Co.	612-884-8950
Mo	Bridgeton, Airsupply Co.	314-731-3011
NY	Clinton, Airsupply Co.	315-735-8341
NY	Huntington Sta., Airsupply Co.	516-249-1410
Ohio	Columbus, Airsupply Co.	614-861-1129
Ohio	Dayton, Airsupply Co.	513-224-0728
Pa	Valley Forge, Airsupply Co.	215-933-8924
Tex	Fort Worth, Airsupply Co.	817-335-4541
Va	Arlington, Airsupply Co.	703-525-1191
Wash	Bellevue, Airsupply Co.	206-454-7922
FOR:	Can., Rexdale, Ont., Frank Eakin Ltd.	416-245-3600

HATHAWAY INSTRUMENTS, INC., 5250 E. Evans Ave., Denver, Colo., 80222, Tel: 303-756-8301, TWX: 910-931-0568; Empl.: 150

For info on price: Sls. Dept.; Application info: L. G. Zacherl; Customer service: L. E. Carter; Delivery info: E. E. Poe

Free literature available: Power System Instrumentation, full line catalog

Products manufactured: Alarms, Annunciators, Comm. Systems, Data Loggers, Generators, Meters, Oscillographs, Direct Writing, Receivers, Recorders, Standards, Transmission Systems, Data, Transmitters

Local Sales Offices & Reps.

Cal	El Monte, Randolph Inds.	213-283-7901
Ga	Atlanta, M.J. Fein & Co.	404-938-0190
Ill	Wilmette, M.J. Fein & Co.	312-256-5828
Mass	Holliston, M.J. Fein & Co.	617-236-2546
NJ	Livingston, M.J. Fein & Co.	201-994-3575
NY	Scarsdale, M.J. Fein & Co.	914-472-1100
Wash	Seattle, Sperry Co.	206-932-1101

HAWKEYE INSTRUS., INC., 3545 Third Ave., Marion, Iowa, 52302, Tel: 319-377-8241; Empl.: 18; Minimum order: $25

Customer service: D. Meuler

Free literature available: Model 1800 bridge conditioner/amplifier bulletin; System 1830 dynamic recording system bulletin; System 910, digital data acquisition systém bulletin; Frictional Strain Gage Bulletin; Concrete Strain Gage Bulletin.

Products manufactured: Amplifiers, Bridges, Data Acquisition & Reduction Systems, Data Loggers, Indicators, Meters, Oscillographs, Direct Writing, Power Supplies, Signal Conditioners & Equipment, Transducers

HAYDON SWITCH & INSTR., INC., 1500 Meriden Rd., Waterbury, Conn., 06705, Tel: 203-756-7441, TWX: 710-477-2580; FSC No: 02005; QPL No: Multiple; Empl.: 96

Free literature available: CAT72-2 - Resilient & Hermetically Sealed Basic Switches & Switch Assemblies. CAT306A - Digital Timers, Stop Clocks, Pulse Counters. CAT102A - Big Inch, Open Frame & Brushless DC Crystal Chronetic Controlled Motors.

Products manufactured: Clocks (All Types), Counters, Indicators, Meters, Motors, Process Control Systems, Relays, Switches, Timers

Local Sales Offices & Reps.

Ala	Huntsville, Incotech, Inc.	205-837-6061
Cal	Los Angeles, Fetty/Schoenduve, Inc.	213-651-4050
Cal	Palo Alto, Fetty/Schoenduve, Inc.	415-321-7041
Colo	Denver, A. G. Electronics	303-722-5814
Fla	Fern Park, M.G. Assocs.	305-841-8793
Ill	Des Plaines, Coombs Assoc.	312-298-4830
Ind	Fort Wayne, Coombs Assoc.	219-743-4611
Md	Baltimore, R.P. Luce & Co.	301-752-8200
Minn	Minneapolis, Revere Assocs.	612-781-2615
Mo	Kansas City, Automatic General Elctrn. Sls. Co.	816-333-8206
Mo	St. Louis, Coombs Assoc.	314-567-3657
NY	Mineola, Transaero, Inc.	516-248-0400
NY	Syracuse, J. V. Costello	315-472-0322
Ohio	Cleveland, A. H. Baier Co.	216-461-6161
Ohio	Dayton, A. H. Baier Co.	513-276-4128
Pa	Philadelphia, R.P. Luce & Co.	215-884-8365
Wash	Bellevue, Willis Sls. Co.	206-454-3029
Wisc	Greendale, Coombs Assocs.	414-421-2300
EXP:	N.Y., Mineola, Transaero	516-248-0400

HBS EQUIPMENT DIV., 3543 East 16th St., Los Angeles, Calif., 90023, Tel: 213-262-1151

HEADWAY RESEARCH, INC., 3713 Forest La., Garland, Tex., 75042, Tel: 214-272-5431

Customer service: Sls. Dept.

Free literature available: Catalog - Complete information on Photo Resist Spinners and Wafer Cleaner/Dryers.

Products manufactured: Machines/Machinery, Production, Microcircuit Production Equip.

Local Sales Offices & Reps.

Cal	Santa Ana, Nelson Engrg.	714-545-2550
Cal	Sunnyvale, Wilson Entprs.	408-732-9050

HEATH CO., Dept. 180, Benton Harbor, Mich., 49022, Tel: 616-983-3961; Empl.: 1500 ......p. 1•720,721,874,1232

For info on price: Cust Relations; Application info: Tech Correspondence; Customer service: Cust Svc Dept

Free literature available: 1975 Heathkit Catalog Describes over 350 easy-to-assemble electronic kits including color TVs, audio equipment, ham radio gear, test instruments, marine electronics and many more. Heath/Schlumberger Assembled Instruments Catalog Describes a complete line of laboratory and test instruments for research and educational applications.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Alarms, Amplifiers, Analyzers, Antenna Rotators, Antennas, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Bridges, Cable, Calculators, Electrical & Electronic, Calibrators, Cleaners, Ultrasonic, Comm. Systems, Counters, Couplers, Decade Boxes, Dummy Loads, Electronic Switches (Oscilloscope), Eliminators, Battery, Generators, Inverters, Kits, Power Supply, Kits, Test Equipment, Meters, Microphones, All Kinds, Monitors, Oscilloscopes, Power Supplies, Probes, Receivers, Recorders, References, D-C Voltage, Soldering Guns, Irons & Desoldering Tools, Speaker Systems, Speakers, Technical Books, Test Equipment, Testers, Timers, Tools, Tracers, Curve, Transceivers, Tuners

Local Sales Offices & Reps.

Ariz	Phoenix, Heathkit Elctrn. Center	602-279-6247
Cal	Anaheim, Heathkit Elctrn. Center	714-776-9420
Cal	El Cerrito, Heathkit Elctrn. Center	415-236-8870
Cal	La Mesa, Heathkit Elctrn. Center	714-461-0110
Cal	Los Angeles, Heathkit Elctrn. Center	213-749-0261
Cal	Pomona, Heathkit Elctrn. Center	714-623-3543
Cal	Redwood City, Heathkit Elctrn. Center	415-365-8155
Cal	Woodland Hills, Heathkit Elctrn. Center	213-883-0531
Colo	Denver, Heathkit Elctrn. Center	303-422-3408
Conn	Avon, Heathkit Elctrn. Center	203-678-0323
Fla	Hialeah, Heathkit Elctrn. Center	305-823-2280
Fla	Tampa, Heathkit Elctrn. Center	813-884-3102
Ga	Atlanta, Heathkit Elctrn. Center	404-252-4341
Ill	Chicago, Heathkit Elctrn. Center	312-583-3920
Ill	Downers Grove, Heathkit Elctrn. Center	312-852-1304
Ind	Indianapolis, Heathkit Elctrn. Center	317-257-4321
Kans	Mission, Heathkit Elctrn. Center	913-362-4486
Ky	Louisville, Heathkit Elctrn. Center	502-245-7811
La	Kenner, Heathkit Elctrn. Center	504-722-6321
Md	Baltimore, Heathkit Elctrn. Center	301-661-4446
Md	Rockville, Heathkit Elctrn. Center	301-881-5420
Mass	Wellesley, Heathkit Elctrn. Center	617-237-1510
Mich	Detroit, Heathkit Elctrn. Center	313-535-6480
Mich	E. Detroit, Heathkit Elctrn. Center	313-772-0416
Minn	Hopkins, Heathkit Elctrn. Center	612-938-6371
Mo	St. Louis, Heathkit Elctrn. Center	314-291-1850
Neb	Omaha, Heathkit Elctrn. Center	402-391-2071
NJ	Fair Lawn, Heathkit Elctrn. Center	201-791-6935
NY	Amherst, Heathkit Elctrn. Center	716-835-3090
NY	Jericho, Heathkit Elctrn. Center	516-334-8181
NY	New York, Heathkit Elctrn. Center	212-765-4590
NY	No. White Plaines, Heathkit Elctrn. Center	914-761-7690
NY	Rochester, Heathkit Elctrn. Center	716-227-4750
Ohio	Cleveland, Heathkit Elctrn. Center	216-886-2590
Ohio	Columbus, Heathkit Elctrn. Center	614-475-7200
Ohio	Toledo, Heathkit Elctrn. Ctr.	419-537-1887
Ohio	Woodlawn, Heathkit Elctrn. Center	513-771-8850
Pa	Frazer, Heathkit Elctrn. Center	215-647-5555
Pa	Philadelphia, Heathkit Elctrn. Center	215-288-0180
Pa	Pittsburgh, Heathkit Elctrn. Center	412-824-3564
RI	Warwick, Heathkit Elctrn. Center	401-738-5150
Tex	Dallas, Heathkit Elctrn. Center	214-826-4053
Tex	Houston, Heathkit Elctrn. Center	713-623-2090
Va	Norfolk, Heathkit Elctrn. Ctr.	804-460-0997
Wash	Seattle, Heathkit Elctrn. Center	206-682-2172
Wisc	Milwaukee, Heathkit Elctrn. Center	414-873-8250

HECON CORP., 31 Park Rd., New Shrewsbury, N.J., 07724, Tel: 201-542-9200; Empl.: 200; Minimum order: $20

For info on price: W. Goodman Ext. 263; Application info: J. Becker Ext. 233; Customer service: G. Leininger Ext. 283

Free literature available: Catalogs: Electromechanical totalizing & controlling counters, Digital tape & ticket printers, print decades & printing mechanisms, Pneumatic/fluidic counters. Brochures: Digital cassette recorder reproducers, Electronic industrial controllers (counters). Application Notes: Electromechanical counters.

Products manufactured: Counters, Printers, Recorders, Totalizers, Digital

Local Sales Offices & Reps.

Cal	Marina Del Rey, Hecon Western Corp.	213-823-5386
Cal	Mountain View, Hecon Western Corp., Recording Instrs. Div.	415-961-6015
Conn	Stratford, Hecon Corp.	203-375-2836
Fla	Bradenton, Hutto-Hawkins-Peregoy, Inc.	813-755-4015
Fla	Maitland, Hutto-Hawkins-Peregoy, Inc.	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy, Inc.	305-943-9593
Ill	Hanover Park, Hecon Corp.	312-289-2859
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Mass	Boston, Hecon Corp.	617-262-5043
Minn	St. Paul, Howard A. Cullen & Assoc.	612-646-7371
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Laurel Springs, Hecon Corp.	609-784-2334
NJ	Wayne, Hecon Corp.	201-839-5454
Ohio	Port Clinton, Hecon Corp.	419-734-4556
Okla	Tulsa, Hecon Corp.	918-627-2774
Ore	Beaverton, Fry Controls, Inc.	503-643-5448
EXP:	Can., Rexdale, Ont., Hecon of Can., Ltd.	416-678-2441

Local Distributors

Cal	Burlingame, Control Devices Pacific, Box 1584, Station A, 400 Burlingame Ave.	415-343-2773
Cal	Los Angeles, California Wholesale Elec. Co., Box 3581 Terminal Annex	213-723-6711
Cal	Los Angeles, Pacific Elctrnc. Sls., 1628 Silverlake Blvd.	213-663-8060
Cal	San Francisco, Master Distrs., 364 Eleventh St.	415-626-0807
Cal	Santa Monica, Master Distrs., 1553 17th St.	213-395-2637
Conn	Middletown, Mancib Co., Randolph & Coe Rds.	203-346-6646
Conn	Stratford, State Elctrns. Parts Corp., 1269 Barnum Ave.	203-375-5961
Fla	Miami, Electro Standards Labs, 3560 N.W. 34th St.	305-633-6973
Ill	Addison, Lectron Controls Co., 524 S. Westgate St., Unit-C	312-543-8460
Ill	Chicago, D. Johns, Inc., 1320 West Lake St.	312-666-2210
Ill	Elgin, Allied Elctrns. Corp., 1355 Sleepy Hollow Rd.	312-697-8200
Ill	Mount Prospect, Automation Equip. Co., 1301 Greenwood Ave.	312-398-7550
Ill	Park Ridge, Automation Comp Sls., 1731 Evergreen La.	312-823-8075
Ind	Indianapolis, Graham Elctrns. Sup., 133 S. Pennsylvania	317-634-8202
Kans	Prairie Village, Parker & Foster, Inc., 7930 State Line	913-381-9330
Ky	Louisville, D. Johns of Kentucky, 1835 Cargo Ct.	502-491-3495
La	Kenner, Automation Specialists, 1939 3rd St. Box 790	504-721-3497
Md	Baltimore, E.I.L. Instrs., 1830 York Rd.	301-252-1260
Mass	Burlington, Mancib Co., "A" Street & Middlesex Turnpike	617-272-9450
Mass	Worcester, F. X. Bonneau Assocs., Box 163, West Side Station, #8 Suburban Rd.	617-754-7655
Mich	Detroit, E & E Engrg., Inc., 11941 Harper Ave.	313-371-2000
Minn	St. Paul, Power/Mation Div., 1441 Iglehart Ave.	612-645-0781
Minn	St. Paul, United Elec. Corp., 512 Sibley St.	612-333-1111
Mo	University City, E. W. Mooney Co., 7505 Delmar Blvd.	314-725-8875
NJ	Hanover, State Elctrns. Parts Corp., 36 Route 10	201-887-2550
NJ	Piscataway, Fromm Electric Supply Co., 50 Seeley Ave.	201-981-0400
NY	Albany, Edwin E. Taylor Co., 465 Central Ave.	518-489-5601
NY	Buffalo, KOM Lamb, Inc., 1865 Kenmore Ave.	716-874-3530
NY	Scarsdale, Logicomp Elctrns., 52 Fayette Rd.	914-723-3334
NC	Winston-Salem, Kirkman Elctrns., 901 W. 2nd St., Drawer K Salem Sta.	919-724-0541
Ohio	Cincinnati, United Radio, Inc., Summit Road & Reinhold Dr.	513-761-4030
Ohio	Dayton, Summit Inds., Inc., 4545 Gateway Circle	513-434-8192
Ohio	Highland Heights, R/D Elctrns. Div., Radio Distr. Co., 653 Alpha Dr. #67	216-461-9090
Ohio	Richfield, Capwell Distrs., 3031 Cleveland-Massillon Rd.	216-659-4158
Ohio	Toledo, Tóldedo Ind'l. Repair Svc., 2388 Airport Hwy.	419-382-2261
Ohio	Warren, Rem Electronics Supply Co., 525 S. Park Ave.	216-399-2777
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9123
Ore	Portland, Platt Electric Supply, 1305 N.W. Davis Box 3167	503-228-6121
Pa	Philadelphia, Royal Electric Supply Co., 3233 Hunting Park Ave.	
Pa	Philadelphia, Royal Electric Supply Co., 3300 W. Clearfield St.	215-221-1200
Pa	Reading, Barbey Elctrns., G. D. Barbey Co., 333 N. Fourth St.	215-376-6116
Pa	Wilkinsburg, Fuller Instr. Svc., Inc., 1125 North Ave.	412-241-6789
SC	Greenville, Barker Controls, Box 3884 Park Pl.	803-244-6495
Tex	Beaumont, Ralph's Ind'l. Elctrns., Box 3631, 1293 Broadway	713-833-9443
Tex	Dallas, Dallas Instrs., 10205 Plano Rd.	214-341-0504
Tex	Dallas, Wholesale Elctrn. Co., 2809 Ross Ave.	214-824-3001
Tex	Houston, Ralph's Ind'l. Elctrns., 4400 Wayside Dr., Suite 102	713-641-0267
Tex	Houston, T & J Instrs., 6316 Alder	713-666-2308
Tex	Odessa, Automation Engrg., A Div. Kobe, Inc., 2310 Steven Rd.	915-363-7391
Va	Alexandria, E.I.L. Instrs., 5390 Cherokee Ave.	703-354-4330
Va	Richmond, Avec Elctrns. Corp., 2002 Staples Mill Rd.	804-359-6071
Wash	Seattle, Platt Elec. Supply, 2767 6th St. So.	206-624-4083
Wisc	Cedarburg, Automation Engrg. Co., Box 322, 1220 Hwy. 143	414-377-7500

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Local Sales Offices & Reps.

Ala	Birmingham, J.F. Russel Co.	
Ariz	Phoenix, B.G. Sls. Co.	602-266-5624
Cal	Burlingame, Carelli EMA	415-697-8862
Colo	Aurora, A.E.S.	303-366-0208
Fla	Ft. Lauderdale, Unirep	
Ill	Skokie, M. Fields Co.	312-OR4-3018
Ind	Mulberry, Maish Sls.	
Mass	Farmingham, Northeastern Rep	617-877-4850
Mich	Bloomfield Hills, S.F. McMedhan	313-852-4308
Minn	Minneapolis, A.J. Warner	
Mo	St. Louis, K. Kelly & Co.	
NY	Camillus, W.M. Ferguson	
NY	Yonkers, J. Bron Elctrn.	914-779-7330
NC	Charlotte, De Witt-Austin Co.	704-366-4643
Ohio	Columbus, J.A. Mandabach	614-235-0265
Ore	Portland, J.W. Eckersley	503-246-3183
Pa	Holland, Parnell Sls. Co.	215-355-9330
Tex	Houston, B. Wylds Co.	

HEI, INC., Jonathan Ind'l. Ctr., Chaska, Minn., 55318, Tel: 612-448-3510, TWX: 910-578-0832; Empl.: 175

Products manufactured: Alarms, Circuits, Hybrid, Thick Film, Controls/Control Eqpt., Counters, Detectors, Diodes, Encoders, Kits, Training Aid, Punched Card Equipment, Readers, Transistors

Local Sales Offices & Reps.

Cal	Burlingame, Leddy Assocs.	415-347-5247
Cal	Carmichael, Leddy Assocs.	916-944-1694
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Fla	Clearwater, WMM Assocs.	813-726-8871
Ill	Chicago, G. MCL Cole Co.	312-774-3535
Md	Baltimore, Stitzer Assocs.	301-823-2600
Mass	West Concord, Sls. Engrg.	617-369-3943
Mich	Novi, Miltimore Sls.	313-476-2446
Mo	Florissant, Miller Assocs.	314-355-1642
NJ	Dover, Diamond Inc.	201-366-7518
NY	Bayside, Diamond Inc.	212-423-7330
NY	Fairport, Franklin Sls.	716-377-6584
NY	Syracuse, Franklin Sls.	315-472-5273
NY	Whitesboro, Franklin Sls.	315-736-5460
Ohio	Cleveland, A.H. Baier Co.	216-461-6161
Ohio	Dayton, A.H. Baier Co.	513-276-4128
Pa	Paoli, Stitzer Assocs.	215-644-5500
Tex	Dallas, W. Reese Assocs.	214-638-6575
Tex	Houston, W. Reese Assocs.	713-621-3134
Wash	Bellevue, Hays Ind'l.	206-455-3908
Wisc	Milwaukee, G. Mcl. Cole Co.	414-545-6083

HEINEMANN ELEC. CO., 2636 Brunswick Pike, Trenton, N.J., 08602, Tel: 609-882-4800; FSC No: 74193; Empl.: 624; Minimum order: $35 .... p. 1•1730,2061

For info on price: D. Vertuca Ext. 272; Application info: C. Littlewood Ext. 274; Customer service: R. Warner Ext. 270; Delivery info: G. Rosinski Ext. 265

Free literature available: Bulletin 303 Short Form Catalog

Products manufactured: Circuit Breakers, Motors, Protectors, Relays

Local Sales Offices & Reps.

Ala	Birmingham, J. Spader Co.	205-879-1366
Ariz	Phoenix, Martin & Assocs.	602-277-5421
Cal	Burlingame, Campbell & George	415-697-2965
Cal	Encino, Porter Co.	213-788-2350
Colo	Denver, P.A. Douden	303-744-1497
Fla	Boca Raton, Conley & Assoc. Inc.	305-305-6108
Fla	Oviedo, Conley & Assocs., Inc.	305-365-3283
Fla	Tampa, Conley	813 933-3183
Ga	Decatur, Spader & Associates	404-296-3024
Ill	Chicago, D. Dolin Sls.	312-286-6200
Ind	Marion, O. Bromberg	317-664-5384
Ky	Louisville, O. Bromberg	502-245-8916
Md	Ellicott City, McCourt	301-465-4515
Mass	Sturbridge, Branford Controls Co.	617-347-7367
Mich	Detroit, L. H. Dickelman Co.	313-255-3300
Minn	Minneapolis, H. Smith	612-881-3620
Mo	St. Louis, Hill & Co.	314-621-1818
NJ	Ridgewood, Ballou, Inc.	201-444-6990
NJ	Trenton, Kriegner Sls.	609-882-6330
NY	Binghamton, Canavan Scanlon	607-724-7220
NY	Rochester, Canavan-Scanlon	716-442-0720
NY	Syracuse, Canavan-Scanlon	315-437-1271
NC	Charlotte, J. Rudisill Assocs., Inc.	704-377-6901
Ohio	Cincinnati, O. Bromberg	513-771-9333
Ohio	Cleveland, Brown Elect. Prod.	216-861-0114
Okla	Tulsa, Comps. Inc.	918-583-9149
Pa	Pittsburgh, Brown Elec. Equip.	412-563-4444
Tex	Dallas, Glidden Electro Equip.	214-363-6539
Tex	Houston, Glidden Electro Equip.	713-681-1415
Wash	Mercer Island, J. Andersen	206-232-0484
Wisc	Milwaukee, Control Sales	414-964-3322

HEITZ, INC., KARL, 979 Third Ave., New York, N.Y., 10022, Tel: 212-421-5220

Customer service: M. Schlapfer

Free literature available: Pricelists and brochures on all our products.

Products manufactured: Cameras, Controls/Control Eqpt., Lenses, Optical & Camera, Magnifying Glasses, Inspection, Recorders

HELI-COIL PRODS., Div. Mite Corp., Shelter Rock La., Danbury, Conn., 06810, Tel: 203-743-7651, TWX: 710-456-0336; FSC No: 01556; Empl.: 300; Minimum order: $15

For info on price: D. Lxall; Application info: A. Mussnug; Customer service: D. Lxall; Delivery info: D. Lxall

Products manufactured: Fasteners

Local Sales Offices & Reps.

Cal	El Monte, Western Regional Office	213-579-0181
Ga	Atlanta, J. O. King, Inc.	404-355-7660
Ill	Downers Grove, S. W. Anderson Co.	312-964-2600
Mich	Detroit, A. A. Geisler Co.	313-255-1450
Tex	Arlington, Burgess Power Equip.	817-261-8241
EXP:	New York, N.Y., Resources & Facilities	212-687-4741

HELICAL PRODS. CO., INC., Box 2296, Santa Maria, Cal., 93454, Tel: 805-925-8651; FSC No: 13201; Empl.: 15

For info on price: D. Merrell; Application info: G. Boehm; Customer service: D. Merrell

Free literature available: Question and answers about flexible shaft couplings - the who, what and how of flexible couplings and how we approach the solution. MC series - motor couplings "A" series - aluminum commercial couplings Precision & instrument - precise and under Mil Spec.

Products manufactured: Couplings, Springs (All Types)

Local Sales Offices & Reps.

Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Conn	Milford, Zaslow Sls. Co.	203-878-1094
Ill	Chicago, Engineered Sls.	312-867-8434
Md	Baltimore, R. P. Luce Co.	301-752-8200
Mass	Lowell, Zaslow Sls. Co.	617-458-8452
Mass	Northboro, Zaslow Sls. Co.	617-393-8150
Minn	St. Paul, W. Taubert	612-636-6414
NJ	Berkeley Hts., R. P. Luce & Co.	201-464-6440
NY	DeRuyter, R. P. Kennedy Co.	315-682-2920
NY	New Hook, R. P. Kennedy Co.	914-758-8229
NY	New Hyde Park, R. P. Luce & Co.	516-437-4550
NY	Rochester, R. P. Kennedy Co.	716-271-6322
Ohio	Fairburn, Tech. Assocs.	513-878-2484
Pa	Philadelphia, R. P. Luce & Co.	215-884-8365

HELIX SPRING CORP., 35-10 10th St., Long Island City, N.Y., 11106, Tel: 212-YE2-0303; Empl.: 25; Minimum order: $50

Customer service: J. Freudenberger

Products manufactured: Coils Including Assemblies & Forms, Forms, Wire, Springs (All Types)

HELM INSTR. CO., 4511 South Ave., Toledo, Ohio, 43615, Tel: 419-531-0146; Empl.: 14

Products manufactured: Accelerometers, Alarms, Amplifiers, Analyzers, Calibrators, Cells, Load, Controls/Control Eqpt., Counters, Indicators, Monitors, Testers, Transducers

Local Sales Offices & Reps.

Ark	Little Rock, M. Robinson Co.	501-666-2170
Cal	La Jolla, R.S. Purinton	714-459-9185
Ill	Lagrange, Olson Eng.	312-482-3300
Ind	Fort Wayne, G.A. Stacy & Asc.	219-483-8331
Mo	St. Louis, Woodsons Machinery Co.	314-822-8836
NJ	Wyckoff, Vard-Smith Assocs.	
Pa	Oreland, N.H. Rogers & Co.	
Pa	Pittsburgh, WKM Asc. Inc.	412-892-2953
Tex	Houston, Mepco	713-941-6969

HENES MFG. CO., 4301 E. Madison St., Phoenix, Ariz., 85034, Tel: 602-275-4126; Empl.: 25

Products manufactured: Heat Guns, Production, Tools, Torches, Soldering, Welding & Access., Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Ariz	Scottsdale, Allen Assocs.	602-994-1305
Cal	Costa Mesa, Scrantom Engrg. Inc.	714-979-6373
Cal	Los Altos, C.D. Buerki Co.	415-941-3343
Conn	Bridgeport, Tech. Instrs., Inc.	203-368-4582
Ill	Roselle, Automated Process, Inc.	312-885-1095
Ind	Cumberland, Automated Process, Inc.	317-251-0708
Mass	Wilmington, Tech. Insts., Inc.	617-944-3930
Minn	Minneapolis, Automated Process, Inc.	612-545-4481
Mo	Hazelwood, Production Automation Corp.	314-731-2331
Mo	Raytown, Production Automation Corp.	816-737-0066
NJ	Saddle Brook, L & M Assocs.	201-843-8700
NY	Brentwood, L & M Assocs.	516-231-8363
NY	New York, L & M Assocs.	212-675-7486
NC	Raleigh, F.G. Speidel	919-787-4521
Ohio	Dayton, H. Noyes & Assocs.	513-274-2871
Ore	Yamhill, Walsh-Ehlers, Inc.	503-662-3207
Pa	Andalusia, L & M Assocs.	215-639-3100
Tex	Dallas, R.W. Mureen Co.	214-369-7561
Wash	Bellevue, Walsh-Ehlers, Inc.	206-454-2211
Wisc	Milwaukee, Automated Process, Inc.	414-354-4370
EXP:	New York, N.Y., E.D. Allmendinger, Inc.	212-269-0090

HENSCHEL CORP., 14 Cedar St., Amesbury, Mass., 01913, Tel: 617-388-1103, Telex: 94-7444; FSC No: 28199; QPL No: Multiple; Empl.: 120; Minimum order: $35

For info on price: F. L. Clark; Application info: F. L. Clark; Customer service: W. A. Ross; Delivery info: W. A. Ross

Free literature available: Catalog sheets enclosed are used to respond to technical inquiries.

Products manufactured: Alarms, Amplifiers, Annunciators, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Comm. Systems, Data Loggers, Indicators, Synchros

Local Sales Offices & Reps.

Cal	Los Angeles, Allied Ind.	213-685-4460
Cal	San Francisco, Dahl Beck Elc. Co.	415-392-5214
La	New Orleans, Carstone Corp.	504-525-2231
NJ	Jersey City, Henschel Corp.	201-434-1113
NJ	Morristown, C. Gilfillan	609-235-3376
Ohio	Cleveland, Electro-Marine Corp.	216-631-3082
Wash	Bellevue, Ralston Cunningham Assocs.	206-455-0316
Wisc	Superior, Benson Elec. Co.	715-394-5548
FOR:	Can., Montreal, J.E. Fouchaux (Can) Ltd.	514-844-7569

HERALD ELECTRONICS, 6611 N. Lincoln Ave., Chicago, Ill., 60645, Tel: 312-675-1100; Empl.: 13

For info on price: H. Katz; Customer service: C. Ward

Products manufactured: Amplifiers, Cable, Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Phonographs, Parts & Accessories, Speaker Systems, Speakers, Transformers

Local Sales Offices & Reps.

Cal	Foster City, Olson Sls.	415-573-1600
Fla	Pembroke Pines, Joe Wanger Sls.	305-987-8766
Ga	Norcross, Dean Cooper Co.	404-448-5460
Ind	Indianapolis, Ronald Munn Co.	317-897-9326
Mich	Detroit, Markal Sls.	312-282-5800
NY	Middle Village, BCD Sls.	212-894-1331
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HERMETIC SEAL CORP., 4232 Temple City Blvd., Rosemead, Cal., 91770, Tel: 213-283-0411, TWX: 910-587-3352; Empl.: 100

Products manufactured: Connectors, Feedthrus & Seals, Environmental, Headers, Lead Assemblies & Receptacles, Packages, Integrated Circuit, Seals, Services, Assembly, Production & Test, Terminals

HERTZ FILTER, 3 Aerial Way, Syosset, N.Y., 11791, Tel: 516-822-4770; Empl.: 22 .... p. 1•562,563

For info on price: B. Dworkin; Application info: R. Friedman; Delivery info: B. Dworkin

Products manufactured: Filters

HEWLETT PACKARD, 974 E. Arques Ave., Sunnyvale, Cal, 94088

HEWLETT-PACKARD CO., 1501 Page Mill Rd., Palo Alto, Cal., 94304, Tel: 415-493-1501, TWX: 910-373-1267; Empl.: 28000

Products manufactured: Amplifiers, Analyzers, Arresters, Electrical Surge, Lightning, Attenuators, Bolometers, Bridges, Cabinets & Accessories, Cable Fault Locators, Calculators, Electrical & Electronic, Calibrators, Cameras, Carriages, Probe, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Circuits, Hybrid, Thin-Film, Clamps & Clips, Comparators, Computers, Controls/Control Eqpt., Converters, Counters, Couplers, Current Sources, Data Acquisition & Reduction Systems, Data Loggers, Delay Lines, Detectors, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Diodes, Display Devices/Displays, Drivers & Decoders For Readouts, Gages, Generators, Holders, Crystal, Insertion Loss Measurement Systems, Integrators, Electronic, Interferometer Systems, Isolators, Kits, Training Aid, Lamps, Leads, Test & Adaptors, Lights, Locators, Open-Short, Memory Systems, Meters, Mounts, Oscillators, Oscillographs, Direct Writing, Oscilloscope Plug-Ins, Oscilloscopes, Paper, Graphic Recording, Power Supplies, Printers, Probes, Punched Card Equipment, Racks, Readers, Receivers, Recorders, RFI Measuring Equipment, Services, Assembly, Production & Test, Shifters, Signal Averagers, Signal Conditioners & Equipment, Slotted Lines, Microwave, Smith Chart Impedance Plotters, Automatic, Spectrometers, Standards, Switches, Synthesizers, Tape Recording Accessories, Tape Winders, Tees, Telephone Channel Test & Simulator Equipment, Teleprinters, Teletypewriters & Equipment, Terminals, Test Equipment, Test Systems, Testers, Thermometers, Resistance, Timers, Totalizers, Digital, Tracers, Curve, Transducers, Transistors, Viewing Hoods, Cathode Ray Tube, Waveguides & Adapters, X-Ray Inspection Equipment

Local Sales Offices & Reps.

Ala	Huntsville	205-881-4591
Ariz	Phoenix	602-244-1361
Ariz	Tucson	602-889-4661
Cal	Fullerton	714-870-1000
Cal	Los Angeles	213-776-7500
Cal	North Hollywood	213-877-1282
Cal	Sacramento	916-482-1463
Cal	San Diego	714-279-3200
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Conn	New Haven	203-389-6551
Fla	Ft. Lauderdale	305-731-2020
Fla	Orlando	305-859-2900
Ga	Atlanta	404-434-4000
Haw	Honolulu	808-955-4455
Ill	Skokie	312-677-0400
Ind	Indianapolis	317-546-4891
Iowa	Iowa City	319-338-9466
La	Kenner	504-721-6201
Md	Baltimore	301-944-5400
Md	Rockville	301-948-6370
Mass	Lexington	617-861-8960
Mich	Farmington	313-476-6400
Minn	St. Paul	612-645-9461
Mo	Kansas City	816-763-8000
Mo	Maryland Hghts.	314-567-1455
NJ	Cherry Hill	609-667-4000
NJ	Paramus	201-265-5000
NM	Albuquerque	505-265-3713
NM	Las Cruces	505-526-2485
NY	Albany	518-458-1550
NY	Endicott	607-754-0050
NY	New York	201-265-5000
NY	Poughkeepsie	914-454-7330
NY	Rochester	716-473-9500
NY	Syracuse	315-454-2486
NY	Woodbury	516-921-0300
NC	High Point	919-885-8101
Ohio	Cleveland	216-243-7300
Ohio	Columbus	614-436-1041
Ohio	Dayton	513-859-8202
Okla	Oklahoma City	405-721-0200
Ore	Tualatin	503-620-3350
Pa	King of Prussia	215-265-7000
Pa	Pittsburgh	412-782-0400
SC	Columbia	803-782-6493
Tex	Houston	713-781-6000
Tex	Richardson	214-231-6101
Tex	San Antonio	512-434-8241
Utah	Salt Lake City	801-487-0715
Va	Richmond	803-285-3431
Wash	Bellevue	206-454-3971
Wisc	Milwaukee	414-541-0550
FOR:	Can., Calgary, Alb.	403-287-1672
FOR:	Can., Dartmouth, N.S.	902-459-7820
FOR:	Can., Edmonton, Alb.	403-452-3670
FOR:	Can., Mississauga, Ont.	416-678-9430
FOR:	Can., Ottawa, Ont.	613-255-6530
FOR:	Can., Pointe Claire, Que.	514-697-4232

FOR:	Can., St-Foy, Que.	418-688-8710
FOR:	Can., Vancouver, B.C.	604-254-0531
FOR:	Can., Winnipeg, Man.	204-786-7581

HEWLETT PACKARD, 5301 Stevens Creek Blvd, Santa Clara, Cal., 95050

HEWLETT-PACKARD CO., Calculator Prods. Div., Box 301, Loveland, Colo., 80537, Tel: 303-667-5000, TWX: 910-930-9020

Free literature available: "HP Calculator-Aided Design: Computing Power For Engineers In Electronics" provides an overview of HP calculators in such design areas as: Analog Networks, Logic Designs, Microwave circuits, and Transformer design.

Products manufactured: Calculators, Electrical & Electronic, Computers

Local Sales Offices & Reps.

Ala	Huntsville	205-881-4591
Ariz	Phoenix	602-244-1361
Ariz	Tucson	602-889-4661
Cal	Fullerton	714-870-1000
Cal	Los Angeles	213-776-7500
Cal	North Hollywood	213-877-1282
Cal	Palo Alto	415-327-6500
Cal	Sacramento	916-482-1463
Cal	San Diego	714-279-3200
Conn	New Haven	203-389-6551
Fla	Ft. Lauderdale	305-731-2020
Fla	Orlando	305-859-2900
Ga	Atlanta	404-436-6181
Haw	Honolulu	808-955-4455
Ill	Skokie	312-677-0400
Ind	Indianapolis	317-546-4891
La	Kenner	504-721-6201
Md	Baltimore	301-944-5400
Md	Rockville	301-948-6370
Mass	Lexington	617-861-8960
Mich	Farmington	313-476-6400
Minn	St. Paul	612-645-9461
Mo	Kansas City	816-763-8000
Mo	Maryland Heights	314-567-1455
Nev	Las Vegas	702-382-5777
NJ	Englewood	303-771-3455
NJ	Paramus	201-265-5000
NM	Albuquerque	505-265-3713
NM	Las Cruces	505-526-2485
NY	Albany	518-458-1550
NY	Endicott	607-754-0050
NY	Poughkeepsie	914-454-7330
NY	Rochester	716-473-9500
NY	Syracuse	315-454-2486
NY	Woodbury	516-921-0300
NC	High Point	919-885-8101
Ohio	Cleveland	216-243-7300
Ohio	Columbus	614-846-1300
Ohio	Dayton	513-859-8202
Okla	Oklahoma City	405-721-0200
Ore	Tualatin	503-620-3350
Pa	East Providence	401-434-5535
Pa	King of Prussia	215-265-7000
Tenn	Memphis	901-274-7472
Tex	Houston	713-781-6000
Tex	Richardson	214-231-6101
Tex	San Antonio	512-434-4171
Utah	Salt Lake City	801-487-0715
Va	Richmond	804-285-3431
Wash	Bellevue	206-454-3971
WVa	Charleston	304-345-1640
Wisc	Milwaukee	414-541-0550

HEWLETT-PACKARD CORP., Colorado Springs Div., 1900 Garden of the Gods Rd., Colorado Springs, Colo., 80907

Products manufactured: Analyzers, Cameras, Display Devices/Displays, Generators, Oscilloscope Plug-Ins, Oscilloscopes, Probes, Pulsers, Logic Test, Testers

H-PACKARD, 19310 Pruneridge Ave., Cupertino, Cal., 95014

HEWLETT-PACKARD, HPA Div., 640 Page Mill Rd., Palo Alto, Cal., 94304, Tel: 415-493-1212, TWX: 910-373-1247 ....p. 1•1014,1015; p. 2•1150-1153

Customer service: G.Spear

Products manufactured: Diodes, Display Devices/Displays, Isolators, Lamps, Lights

Refer to Hewlett-Packard Co., Palo Alto, Cal. for sales office information.

Local Distributors

Ala	Huntsville, Hall-Mark Electronics, 4739 Commercial Dr.	205-837-8700
Ariz	Phoenix, Liberty Electronics, 3130 N. 27th Ave.	602-257-1272
Cal	Costa Mesa, Schweber Electronics, 3000 Redhill Ave.	714-556-3880
Cal	El Segundo, Liberty Electronics, 124 Maryland St.	213-322-8100
Cal	Mt. View, Elmar Electronics, 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Liberty Electronics, 8248 Mercury Ct.	714-565-9171
Colo	Denver, Elmar Electronics, 6777 E. 50th Ave.	303-287-9611
Conn	Danbury, Schweber Electronics, Finance Dr., Commerce Ind'l Park	203-792-3500
Conn	Hamden, Wilshire Electronics, 2554 State St.	203-281-1166
Fla	Ft. Lauderdale, Hall-Mark Electronics, 1302 W. McNab Rd.	305-971-9280
Fla	Hollywood, Schweber Electronics, 2830 No. 29th Terrace	305-927-0511
Fla	Orlando, Hall-Mark Electronics, 7233 Lake Ellenor Dr.	305-855-4020
Ga	Atlanta, Schweber Electronics, 4126 Pleasantdale Rd.	404-449-9170
Ill	Elk Grove Village, Hall-Mark Electronics, 180 Crossen	312-437-8800
Ill	Elk Grove Village, Schweber Electronics, 1380 Jarvis Ave.	312-593-2740
Iowa	Cedar Rapids, Hall-Mark Electronics, Executive Plaza, Suite 401, First Ave., S.E.	319-393-3556
Iowa	Cedar Rapids, Schweber Electronics, 4403 - 1st Ave., SE, Suite 302	319-393-0100
Kans	Lenexa, Hall-Mark Electronics, 9006 Rosehill Rd.	913-888-4747
Md	Rockville, Schweber Electronics, 5640 Fisher La.	301-881-3300
Mass	Burlington, Wilshire Electronics, One Wilshire Rd.	617-272-8200
Mass	Waltham, Schweber Electronics, 213 Third Ave.	617-890-8484
Mich	Troy, Schweber Electronics, 86 Executive Dr.	313-583-9242
Minn	Edina, Schweber Electronics, 7015 Washington Ave., So.	612-941-5280
Minn	Bloomington, Hall-Mark Electronics, 9201 Penn Avenue, So., Suite 10	612-884-9056
Mo	Earth City, Hall-Mark Electronics, 13789 Rider Trail	314-291-5350
NJ	Clifton, Wilshire Electronics, 312 Clifton Ave.	201-365-2600
NJ	Somerset, Schweber Electronics, 43 Belmont Dr.	201-469-6008
NY	Farmingdale, Wilshire Electronics, 1855 New Hwy. (Unit B)	516-293-5775
NY	Johnson City, Wilshire Electronics, 617 Main St.	607-797-1236
NY	Rochester, Schweber Electronics, 2 Townline Circle	716-461-4000
NY	Westbury, Schweber Electronics, Jericho Tpke.	516-334-7474
NC	Raleigh, Hall-Mark Electronics, 3000 Industrial Dr.	919-832-4465
Ohio	Beachwood, Schweber Electronics, 23880 Commerce Pk. Rd.	216-464-2970
Okla	Tulsa, Hall-Mark Electronics, 4846 So. 83rd E. Ave.	918-835-8458
Pa	Huntingdon Valley, Hall-Mark Electronics, 458 Pike Rd.	215-355-7300
Tex	Austin, Hall-Mark Electronics, 3100-A Ind'l Terrace	512-837-2814
Tex	Austin, Schweber Electronics, 2628 Longhorn Blvd.	512-837-2890
Tex	Dallas, Hall-Mark Electronics, 9333 Forest La.	214-231-5101
Tex	Dallas, Schweber Electronics, 14177 Proton Rd.	214-661-5010
Tex	Houston, Hall-Mark Electronics, 8000 Westglen, Box 36739	713-781-6100
Tex	Houston, Schweber Electronics, 7420 Harwin Dr.	713-784-3600
Wash	Seattle, Liberty Electronics, 5305 Second Ave. So.	206-763-8200
Wisc	West Allis, Hall-Mark Electronics, 237 S. Curtis	414-476-1270

HEWLETT-PACKARD, Green Pond Rd., Rockaway, N.J., 07204

HEWLETT PACKARD CORP., Microwave, Santa Rosa Div., 3273 Airway Dr., Santa Rosa, Cal., 95401

HEWLETT-PACKARD, San Diego Div., 16399 W. Bernardo Dr., San Diego, Cal., 92127, Tel: 714-487-4100

Free literature available: Recording instruments, including strip chart, x-y oscillographic, graphic, and magnetic tape recorders.

Products manufactured: Oscillographs, Direct Writing, Recorders

Refer to Hewlett-Packard, Palo Alto, Cal. for sales office Information.

HEXACON ELEC. CO., 621 W. Clay Ave., Roselle Park, N.J., 07204, Tel: 201-CH5-6200; Empl.: 150 p. 2•1700-1705

Products manufactured: Controls/Control Eqpt., Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Ariz	Tucson, Ross Ribaudo	602-299-1425
Cal	Burlingame, Dillon Stevens	415-697-3022
Cal	L.A., Dillon Stevens Co.	213-747-9221
Conn	Woodstock, HDQ & HV Neff	203-974-1281
Fla	Merritt Island, J.A. Kennedy Co.	305-452-9821
Ga	Morrow, R. Hartmann	404-366-5799
Ill	Chicago, EMF Co.	312-889-8323
Kans	Kansas City, L.E. Bruns	913-287-5242
Md	Phoenix, REBCO Sls.	301-592-8907
NJ	Edgewater Park, REBCO Sls.	609-386-7116
NY	New Hartford, V. Clair	315-735-8122
NY	New York, W.D. Blood & Co.	212-344-0210
NY	New York City, Dunn & Bryan	212-964-8091
Ohio	Strongville, J. Finnegan & Co.	216-826-1033
Ore	Milwaukie, Northcoast Mfrs. Agency Inc.	503-659-3811
SC	Greenville, J.B. Jackson	803-244-2508
Tenn	Memphis, H. Carson	901-398-6194
Tex	Richardson, P.J. Scanlon	214-AD 1-4661
Wash	Seattle, Northcoast Mfrs. Agency, Inc.	206-284-5024
Wisc	Milwaukee, Process Tech	414-464-6620-6621
EXP:	Hato Rey, P.R., M. Anderson	809-722-1654
FOR:	Can., Montreal, W. P. Q. Adtool	514-482-2548

HEYMAN MFG. CO., N. Michigan Ave., Kenilworth, N.J., 07033, Tel: 201-245-2345, TWX: 710-996-5986; Empl.: 86; Minimum order: $20

For info on price: R. Zednick; Application info: R. Zednick; Customer service: R. Zednick; Delivery info: M. Lauxman

Free literature available: Catalog 175 20 pages describing strain relief bushings, insulating bushings, hole plugs, cable clamps, wire ties. Provides dimensions and application data.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Grommets, Plug Buttons, Strain Reliefs, Cable & Wire, Terminals, Wire & Cable Ties

Local Sales Offices & Reps.

Wisc	Waukesha, Heyman Mfg. Co.

HGA ELCTRNS., INC., 519 S. Fifth Ave., Mt. Vernon, N.Y., 10550, Tel: 914-664-5393; Empl.: 3

For info on price: L. Grossman; Application info: E. Valentine; Customer service: L. Grossman; Delivery info: L. Grossman

Products manufactured: Amplifiers, Chargers, Battery, Clocks (All Types)

H H CONTROLS CO., INC., 16 Frost St., Arlington, Mass., 02174, Tel: 617-646-2626; Empl.: 22

For info on price: W. Edins; Application info: W. Edins; Customer service: D. H. Smith; Delivery info: G. Davis

Products manufactured: Encoders, Indicators, Servo Systems, Transducers

Local Sales Offices & Reps.

Cal	Montebello, TUCUL Engrg. Co.	213-728-7397
Ill	Park Ridge, Electrical Materials & Equip.	312-696-1540
Mass	Stoneham, K & D Elctrns.	617-438-3002
Ohio	Cleveland, Adcon Engrg. Co.	216-238-3916
Ore	Portland, A.L. Polich	503-246-5451
Tex	Houston, C. Butt Co.	713-526-3101
Va	Roanoke, Johnson Custom Controls	703-774-5550

HI-G INC., Spring St. & Rte. 75, Windsor Locks, Conn., 06096, Tel: 203-623-2481, TWX: 710-420-0592; FSC No: 02289; QPL No: M5757; Empl.: 490; Minimum order: $75 .... p. 1•1714-1729

Customer service: Sls. Dept

Free literature available: 16 page Relay Catalog Including M5757 QPL Cross Reference 20 page Timing & Sensing Catalog with full Details of Time Functions.

Products manufactured: Comparators, Relays, Timers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, L & D, Inc.	205-837-8480
Ariz	Scottsdale, Fryco	602-945-3281
Cal	Mountain View, G.C. Woempner Co.	415-964-5454
Cal	Woodland Hills, Interstate Mktg. Assoc.	213-883-7606
Colo	Denver, Omega Ltd.	303-758-1508
Conn	Fairfield, C. Weber	259-5386
Fla	Boca Raton, Conley & Assocs.	305-395-6108
Fla	Coral Springs, Shaw Engrg. & Sls.	305-752-7596
Fla	Oviedo, Conley & Assocs.	305-365-3283
Fla	Tampa, Conley & Assocs.	813-933-3183
Ill	Chicago, Engineered Sls. Co.	312-867-8434
Ind	Ft. Wayne, Given Corp.	219-432-5585
Kans	Overland Park, Reese & Assocs.	913-648-7748
Md	Baltimore, Bernard White & Co.	301-484-5400
Mass	Lexington, J.E. Boeing Co.	617-862-2500
Mich	Farmington, Davis & Martensen	313-474-8300
Mich	Grand Rapids, Elko Sls.	616-949-1451
Mich	Grosse Pointe Woods, Elko Sls.	313-884-1950
Minn	St. Paul, R.G. Ragon, Inc.	612-488-0201
Mo	St. Charles, Buse Sls. Co.	314-723-1122
NY	Binghamton, Canavan-Scanlon Assoc.	607-724-7220
NY	Jericho, HRC Comp-Tech, Inc.	516-822-5550
NY	Rochester, Canavan-Scanlon Assoc.	716-442-0720
NY	Syracuse, Canavan-Scanlon Assoc.	315-437-1271
NC	Greensboro, L & D, Inc.	919-292-3201
Ohio	Cincinnati, Components, Inc.	513-721-2997
Ohio	Cleveland, Components, Inc.	216-842-2737
Ohio	Dayton, P.E. Montplaisir	513-434-4316
Pa	Ardmore, Rothenheber & Wurts, Inc.	215-649-6300
Tex	Dallas, United Comps.	214-324-1448
Utah	Salt Lake City, Omega Ltd.	801-266-9617
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778
FOR:	Can., Cooksville, Ont., Anbak Sls. Can., Ltd.	416-625-1061
FOR:	Can., Dorval 780, Que., Anbak Sls. Can., Ltd.	514-636-8514

Local Distributors

Cal	Burbank, Terminal Elctrns. Corp., 2402 W. Olive	213-843-1221
Cal	Chatsworth, Westates Elctrns. Corp., 20151 Bahama St.	213-341-4411
Cal	Los Angeles, Radio Prod. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Terminal Elctrns. Corp., 880 Maude Ave.	415-969-9240
Cal	San Diego, Radio Prod. Sls., 7889 Clairmont Mesa Blvd.	714-292-5611
Cal	Sunnyvale, Bell Inds., 1161 N. Fairoaks Ave.	408-734-8570
Fla	Orlando, Hallmark Elctrns. Corp., 7233 Lake Ellenor Dr.	305-855-4020
Ill	Westmont, Bodelle Co., 47 Chestnut La.	312-323-9670
Ind	Indianapolis, Graham Elctrns. Sup., 133 S. Pennsylvania St.	317-634-8486
Md	Rockville, Wilshire Elctrns., 1037 Taft St.	301-340-7900
Md	Savage, Pyttronic Inds., Baltimore/Wash. Distr. Ctr., 8220 Wellmoor Ct.	301-792-7000
Mass	Lexington, Harvey/ R & D Elctrns., 44 Hartwell Ave.	617-861-9200
Minn	St. Paul, Ragon Elctrns., 1136 W. Larpenteur Ave.	612-488-0201
Mo	St. Charles, Lectronix, 306 Mc Donough St., Box 188	314-723-1122
NY	Binghamton, Harvey/Federal Elctrns., Box 1208 Vestal Pkwy E.	607-748-8211
NY	Hauppauge, Time Elctrn. Sls., 70 Marcus Blvd.	516-273-0100
NY	Woodbury, Harvey Radio Co., 60 Crossways Park W.	516-921-8700
NC	Raleigh, Pyttronics Inds., 4509 Creedmor Rd., Suite 110	919-782-6370
Ohio	Cleveland, Arrow Elctrns., 23945 Mercantile Rd.	216-464-2000
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Okla	Oklahoma City, Electro-Enterprises Inc., 6725 N. Miramar	405-478-1752
Pa	Harrisburg, Pyttronic Inds., 2525 N. Seventh St.	717-233-6591
Pa	Montgomeryville, Pyttronic Inds., Stump Rd.	215-643-2850
Tex	Dallas, Hallmark Elctrns. Corp., 9333 Forest La.	214-231-5101
For:	Can., Mississauga, Ont., Specialty Elctrns., Ltd., 2776 Slough St.	416-678-2104
For:	Can., Montreal, Que., Specialty Elctrns., Ltd., 1415 Pitfield Blvd.	514-336-4500

HEWLETT-PACKARD CO., Data Systems Div., 11000 Wolfe Rd., Cupertino, Cal., 95014, Tel: 408-257-7000, TWX: 910-338-0221

Products manufactured: Computers, Converters, Memory Systems, Printers, Readers, Teleprinters, Transmission Systems, Data

Refer to Hewlett Packard, Palo Alto, Cal. for sales office information

HICKOK ELECTRICAL INSTR., 10514 DuPont Ave., Cleveland, Ohio, 44108, Tel: 216-541-8060, TWX: 810-421-8286 .... p. 1•163,728

Products manufactured: Counters, Generators, Indicators, Meters, Oscilloscopes, Probes, Punched Card Equipment, Readers, Relays, Testers, Wire Nuts

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown	205-539-4411
Ariz	Scottsdale, BFA	602-946-4215
Cal	Culver City, FLW	213-559-7200
Cal	Newport Beach, FLW	213-877-0663
Cal	Palo Alto, Coherent Mktg.	415-327-2217
Cal	San Diego, FLW	714-277-0993
Colo	Denver, BFA Corp.	303-477-6570
Conn	Hamden, J & J Assoc.	203-624-7800
DC	Wash, Powell-Pendergraph	301-656-4535
Fla	Orlando, W.A. Brown	305-425-5505
Ga	Atlanta, W.A. Brown	404-939-1674
Haw	Honolulu, Precision Radio Ltd.	808-537-5291
Ill	Chicago, Midwest Elect. Sls.	312-626-0030
Ind	Indianapolis, Midwest Elect. Sls.	317-926-3736
Iowa	Cedar Rapids, Midwest Elect. Sls.	319-362-4410
La	Gretna, W.A. Brown	504-366-5766
Mass	Burlington, J & J Assoc	617-272-2606
Mich	Royal Oak, Group Ten	313-549-3910
Mo	St. Louis, Adelphi	314-821-1232
NJ	Plainfield, S. Glassman Assoc.	201-561-3866
NM	Albuquerque, BFA Corp.	505-296-8303
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Binghamton, Labtronics	607-748-0509
NY	Depew, Labtronics	716-685-4111
NY	Glen Cove, S. Glassman Assoc.	516-676-1039
NY	Schenectady, Labtronics	518-372-6649
NY	Syracuse, Labtronics	315-454-9314
NC	Durham, W.A. Brown	919-489-1546
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Abington, Powell-Pendergraph	215-657-0330
Tex	Austin, Martin, Zienkosky, Browne	512-454-4371
Tex	Dallas, Martin, Zienkosky, Browne	214-233-5535
Tex	Houston, Martin, Zienkosky, Browne	713-523-7333
Va	Richmond, Powell-Pendergraph	703-264-2341
Wash	Seattle, Datacom Assocs.	206-285-2525
Wisc	Waukesha, Midwest Elect. Sls.	414-542-5129

HIGH SPEED HAMMER CO., INC., 313 Norton St., Rochester, N.Y., 14621, Tel: 716-CO 6-6740; Empl.: 25; Minimum order: $4

Customer service: D. W. Marcellus

Free literature available: Precision Drilling Machines; Riveting Machines; Staking Machines; Wire Stripping Machines; Automated Assembly Machines; Optical Screwdrivers.

Products manufactured: Drills & Accessories, Hand & Power, Wire Strippers

Local Sales Offices & Reps.

NY	New Hyde Park, P. Casale	516-437-7876

HIGH VACUUM EQUIP. CORP., 2 Churchill Rd., Hingham, Mass., 02043, Tel: 617-749-9000, TWX: 710-348-0160; Empl.: 27; Minimum order: $20

For info on price: Sls. Dept.; Application info: J.R. Lombardo J. A. F. Trueman; Customer service: M. Danser; Delivery info: M. Danser

Free literature available: Capabilities Data Sheets, custom designed & mfg. systems & components (vacuum)

Products manufactured: Chamber, Environmental Test, Deposition Equipment, Vacuum & Accessories, Feedthrus & Seals, Environmental, Furnaces, Gages, Ovens, Valves, Vacuum

Local Sales Offices & Reps.

Ala	Newco & Assocs.	305-293-7700
Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Colo	Boulder, R.A. Mayes Co.	303-444-0782
Fla	Orlando, Newco & Assocs.	305-293-7700
Haw	Honolulu, The H. S. Gray Co., Ltd.	
Md	Bethesda, Bartlett Assocs., Inc.	301-656-3061
Mass	Hingham, HVEC	617-749-9000
NY	White Plains, Bartlett Assocs., Inc.	914-949-6476
Pa	Wayne, Bartlett Assocs., Inc.	215-688-7325
Tex	Houston, R.A. Mayes Co.	713-461-5385
Tex	Richardson, R.A. Mayes Co.	214-235-3043

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HIGHTEMP RESINS, INC., 225 Greenwich Ave., Stamford, Conn., 06902, Tel: 203-357-7401; Empl.: 5; Minimum order: $25

For info on price: H. Grisar; Application info: H. Isbenjian; Customer service: H. Isbenjian; Delivery info: H. Grisar

Products manufactured: Adhesives (All Types), Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Services, Assembly, Production & Test

HILLS-MCCANNA CO., 400 Maple Ave., Carpentersville, Ill., 60110, Tel: 312-426-4851, Telex: 722442; Empl.: 700; Minimum order: $25

For info on price: R. W. Hank; Application info: R. Glanz; Customer service: R. W. Hank; Delivery info: R. W. Hank

Free literature available: Bulletin A3 - shows complete line of electric or pneumatic actuators and controls, Bulletin E261 - details servo amplifier interface unit between actuator and process sensor.
Bulletin E262 - details complete data on Posi-meter®, a position indicating meter.

Products manufactured: Actuators, Controls/Control Eqpt., Valves, Vacuum

Local Sales Offices & Reps.

Cal	San Francisco, Hills-McCanna Co.	415-981-3829
Cal	Santa Fe Springs, Hills-McCanna Co.	213-864-3758
Colo	Denver, Collison Bros.	303-733-3791
Ga	Atlanta, Hills-McCanna Co.	404-448-7173
Ill	Hinsdale, Hills-McCanna Co.	312-325-5640
Mich	Madison Heights, Bradbury-Kenrick Assoc.	313-564-5410
Mo	St. Louis, Corva Corp.	314-878-4100
NJ	Edison, Hills-McCanna Co.	201-494-9400
Ohio	Cleveland, Hills-McCanna Co.	216-433-4520
Okla	Tulsa, C.J. Co.	918-627-8162
Pa	Pittsburgh, D.D. Foster Co.	412-281-0864
Tex	Houston, Hills-McCanna Co.	713-688-5747

HILTON INDUSTRIES INC., 190 Maple St., Glen Falls, N.Y., 12801; Empl.: 120

Customer service: M. E. Mesirov 518-793-3473

Free literature available: Manufacturers of sub-miniature wet slug tantalum capacitors and radial plus axial leaded solid state Tamta:l, capacitors.

Products manufactured: Capacitors, Fixed, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Ariz	Phoenix, G. R. McKnight Co.	602-257-8037
Cal	Los Angeles, Corcoran Assocs.	213-823-2425
Cal	Menlo Park, G. R. McKnight Co.	415-325-2844
Cal	Westminster, Corcoran Assocs.	714-893-4670
Conn	Madison, A & M Elctrn. Reps.	203-421-4242
Fla	Orlando, Buchanan & Abrams Assocs.	305-898-7444
Ill	Streamwood, Al Holte & Assocs.	312-837-4066
Mass	Needham, A & M Elctrn. Reps.	617-444-8170
Minn	Minneapolis, Al Holte & Assocs.	612-926-1523
NJ	Springfield, Service and Technology	201-232-2666
NJ	W. Trenton, Kriegner Sls. Co.	609-882-6330
NM	Albuquerque, G. R. McKnight Co.	505-266-8423
NY	Farmingdale, Service and Technology	516-694-2626
NY	Syracuse, Murcan Sls.	315-474-4889
Ohio	Columbus, Rockford Controls Ohio	614-231-5890
Ohio	Dayton, Rockford Controls Ohio	513-278-7362
Ohio	Euclid, Rockford Controls Ohio	216-731-5250
Ore	Portland, J.J. Backer Co.	503-297-3776
Tex	Richardson, Unidyne	214-234-3050
Tex	Stafford, Unidyne	813-494-6027
Va	Alexandria, Potomac Elctrns.	703-836-1630
Wash	Seattle, J.J. Backer Co.	206-285-1300

FOR:	Can., Port Credit, Ont., Baknor Industries Ltd.	416-274-1591

S. HIMMELSTEIN & CO., 2500 Estes Ave., Elk Grove Village, Ill., 60007, Tel: 312-439-8181; Empl.: 40; Minimum order: $25

For info on price: J. Hall; Application info: J. Hall; Customer service: R. Kuenstler; Delivery info: R. Kuenstler

Free literature available: Literature on: MCRT Torquemeters & Rotary Transformers, TVS Torque Verification System, Torque-Rite Air Tool Torque Control & Verification System, Precision Load Cell Specifications.
Battery Operated, Digital Transducer Readout, Digital Torque Display, & Precision Pressure Transducer Specifications.

Products manufactured: Amplifiers, Cells, Load, Controls/Control Eqpt., Indicators, Signal Conditioners & Equipment, Testers, Transducers, Transformers

Local Sales Offices & Reps.

Mass	Needham, Addelco Corp.	617-444-4754
Mich	Livonia, S. Himmelstein & Co.	313-427-2066
NJ	Cherry Hill, Markey Instrumentation	609-667-3809
NY	Eldridge, L-Tron Corp.	315-689-3787
NY	Latham, L-Tron Corp.	518-785-5032
NY	Rochester, L-Tron Corp.	716-436-4410
Wash	Bellevue, Topp Engrg. Sls. Corp.	206-747-5401

HIPOTRONICS, INC., Brewster, N.Y., 10509, Tel: 914-279-8091, TWX: 710-574-2420; Empl.: 155; Minimum order: $50 .... p. 1•722,723,1230,1231

For info on price: J. Robertson; Application info: J. Robertson; Customer service: L. Lambert; Delivery info: W. N. Boyer

Products manufactured: Cable Fault Locators, Capacitors, Fixed, Detectors, Dividers, Locators, Open-Short, Meters, Power Supplies, Probes, Reactors, Regulators, Services, Assembly, Production & Test, Shields, Test Systems, Testers, Transformers, Voltage Sources

Local Sales Offices & Reps.

Cal	Concord, J. Marinan	415-686-4382
Cal	Pasadena, RDX Corp.	213-681-3452
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-734-4500
Colo	Littleton, Aztec Entprs.	303-798-4573
Ga	Atlanta, J.P. Smith	404-233-1009
Haw	Honolulu, Aloha Assocs.	941-1574
Ill	Decatur, J. Connelly	217-865-2188
Ind	Ossian, V. Schumacher	219-622-4346
Mass	Bellingham, J. Kirkup	617-966-2121
NJ	Rivervale, J. Lebert	201-391-9400
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Cazenovia, Peter De Cew Agency	315-HT 3-3261
Pa	Downingtown, Kenn Ebert-Hipotronics, Inc.	215-269-5898
Tex	Fort Worth, D. Wells	817-244-2204
Wash	Seattle, RDX Corp.	206-682-6750

HISONIC, INC., 249 N. Troost, Olathe, Kan., 66061, Tel: 913-782-0012; FSC No: 11402; Empl.: 80; Minimum order: $35 .... p. 1•564,565,1233; p. 2•1755

For info on price: W. S. Bonebright; Application info: D. H. Hersh; Customer service: W. S. Bonebright; Delivery info: W. S. Bonebright

Free literature available: Brochure-Facilities information and general product line description.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Converters, Delay Lines, Discriminators, Equalizers, Filters, Inverters, Networks, Reactors, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	Mountain View, Caltron/Pyle	415-964-3244
Cal	No. Hollywood, Crown Elctrns.	213-877-3550
Colo	Littleton, Piper-Goyne	303-798-8955
Kans	Shawnee, J.F. Guernsey Co.	913-631-2414
NJ	Haddonfield, Gray Assocs.	609-429-5300
NY	Conklin, Ramcom, Inc.	607-775-0641
NY	E. Rockaway, W. Bellenkes Assocs.	516-599-8260
Tex	Irving, AID Elctrns., Inc.	214-259-4761

HISONIC, INC. cont'd

Advertisment

Hisonic has an established reputation of unexcelled competence in the design and quality manufacture of complex filter network as well as specialized inductors and transformers. Our staff is experienced and equipped to apply unique modern synthesis techniques to your requirements. Do not accept an answer of "impossible" unless you have consulted Hisonic.

HI-TEK CORP., 3115 W. Warner, Santa Ana, Cal., 92704, Tel: 714-540-3520, TWX: 910-595-1758; Empl.: 150

For info on price: D. Dickerman; Application info: S. Laxineta; Customer service: R. Williams; Delivery info: R. Williams

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

H.J.J. CO., Box 905, Los Gatos, Cal., 95030, Tel: 408-356-4040; Empl.: 4

Customer service: D. P. Cavallaro

Free literature available: Brochure On Screwholding Drivers.

Products manufactured: Screwdrivers

Local Sales Offices & Reps.

Cal	San Mateo, J. Hand	415-341-5516
Pa	Pittsburgh, A. Kostman	412-823-3430

HM ELECTRONICS, INC., 6151 Fairmount Ave., San Diego, Cal., 92120, Tel: 714-280-6050; Empl.: 12

For info on price: G. Johnson; Application info: H. Miyahira; Customer service: B. Tateyama; Delivery info: B. Tateyama

Products manufactured: Amplifiers, Oscillators, Oscilloscopes, Receivers, Synthesizers, Transceivers, Transmitters

Local Sales Offices & Reps.

Cal	Los Angeles, RF Assocs.	213-478-1586
Cal	Palo Alto, Coherent Mktg. Assocs.	415-327-2217
Minn	Minneapolis, Scientific Devices	612-544-3725
NC	Greensboro, FM Assocs.	919-294-2754

HOAGLAND INSTR., Box 550, Dayton, N.J., 08810, Tel: 201-329-4681, TWX: 710-480-5674; Empl.: 30 .. p. 1•1731

Products manufactured: Controls/Control Eqpt., Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Flashers, Relays, Services, Assembly, Production & Test, Switches, Timers

Local Sales Offices & Reps.

Mich	Detroit, L. H. Dickelman Co.	313-255-3300
Minn	St. Paul, Howard A. Cullen & Assocs.	612-646-7371
NJ	Cranford, Martech Assocs.	201-272-5510
NY	Manhasset, Martech Assocs.	516-627-1151
NC	Charlotte, F. Nickerson	919-527-4911
Ohio	Cincinnati, L.H. Dickelman Co.	513-671-6176
Ohio	Cleveland, L.H. Dickelman Co.	216-292-5643
Ore	Portland, Carmody Co., Inc.	206-682-2330
Wash	Seattle, Carmody	206-682-2330

HOBBS, Div. of Steward Warner, Ash at Yale Blvd., Springfield, Ill, 62705, Tel: 217-525-0330

HOBSON BROS., INC., 4940 W. Lawrence Ave., Chicago, Ill., 60630, Tel: 312-283-3600; Empl.: 90

For info on price: H.L. Behm; Application info: W.J. Leitmann; Customer service: H.L. Behm; Delivery info: J. Whalen

Products manufactured: Clamps & Clips, Connectors, Services, Assembly, Production & Test, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ind	Indianapolis, Specialty Mfrs.	317-635-2723
NY	Buffalo, R. W. Mitscher Co.	716-633-7970
Va	Virginia Beach, R. W. Mitscher Co.	804-481-7200

HOFFMAN ENGINEERING CO., Div. Federal Cartridge Corp., 9th & Tyler Sts., Anoka, Minn., 55303, Tel: 612-421-2240, TWX: 910-578-2211

For info on price: H. Maenke; Application info: R. Burley; Customer service: P. Pipenhagen; Delivery info: P. Pipenhagen

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Ducts, Wiring

Local Sales Offices & Reps.

Ala	Birmingham, C.W. Ashby Co.	205-879-1651
Ariz	Scottsdale, N.F. Ross	602-945-7262
Cal	Los Angeles, W.J. Trenbeth Engrg. Co.	213-645-4377
Cal	Walnut Creek, W.A. Borden Co.	415-937-5196
Colo	Denver, Gaer Sls.	303-777-3740
Conn	West Hartford, L. Bell	203-236-0395
Fla	Longwood, Shannon Assocs.	305-831-2245
Fla	St. Petersburg, Shannon Assocs.	813-822-3146
Ga	Atlanta, Holman-Lobsinger Co.	404-256-9120
Haw	Honolulu, Specialty Prods. Co.	808-531-0596
Ill	Chicago, KGA Engrg. Co.	312-889-2060
Ind	Indianapolis, Lester Sls. Co.	317-783-9251
Ky	Louisville, R & R Inc.	502-893-2571
La	Metairie, Schell-Ranna Co.	504-837-7837
Md	Baltimore, O.T. Hall & Son	301-467-5359
Mass	Framingham, H. Standish	617-879-1220
Mich	Farmington, W.L. Trombley & Son	313-477-5800
Mich	Grand Rapids, J.M. Perry Co.	616-949-0271
Minn	Minneapolis, R.D. Schwen Engrg. Inc.	612-854-4304
Mo	Kirkwood, Martin Electrical Sls. Inc.	314-966-8659
Mo	Raytown, Arehart-Barnds Sls. Co.	816-356-3488
Neb	Omaha, Electrical Prods. Co.	402-393-7350
NJ	Edison, Burgoyne Elec. Sls. Inc.	201-225-0450
NJ	Morristown, W.J. Waldron Assocs.	201-538-5607
NY	Camillus, J.C. Fox & T.R. Fox	315-488-0200
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Cleveland, M.M. Haley Co.	216-238-3650
Ohio	Dayton, W.W. Baerbalck & Assocs.	513-278-4217
Ohio	Jenks, W.G. Parker Co.	918-299-5449
Ore	Beaverton, D. Fry Co.	503-643-5448
Pa	Oreland, Cusick Electrical Sls. Inc.	215-886-2100
Pa	Pittsburgh, M.F. Smith & Assocs.	412-276-5363
SC	Greenville, R.W. Chapman & Co.	803-232-5391
SC	West Columbia, R.W. Chapman & Co.	803-256-2984
Tex	Dallas, Electrical Agencies Co.	214-747-0108
Tex	Houston, J. Edwards Co.	713-223-4731
Utah	Salt Lake City, J.H. Jones Co.	801-485-9372
Va	Richmond, J.H. Thrower	804-794-6819
Wash	Seattle, Muth-Richards Co.	206-323-2127
Wisc	Milwaukee, KGA Engrg. Co.	414-354-5900

HOFFMAN INDUSTRIAL PRODS., 170 Allen Blvd., Farmingdale, N.Y., 11735, Tel: 516-293-5244; Empl.: 30

Products manufactured: Connectors, Splices, wire (Including, Butt & Cap Types), Terminals, Tools, Wire & Cable Ties, Wire Strippers

Local Sales Offices & Reps.

DC	Washington, Selinger Assoc.	202-529-2044
Fla	Brandon, R. Herig	813-689-1573
Fla	Winter Park, Steele Tech. Sls.	305-644-6641
Ga	Atlanta, C. Roach	404-261-7184
Ill	Chicago, A. J. Ellis Co.	312-262-2708
Ill	Glynn Ellen, Anderson Elec.	
Ill	Oak Park, J. La Van	800-645-2014
Ind	Indianapolis, OEM Sls. Co.	317-545-1267
Kans	Wichita, B. Penn	316-682-9433
La	New Orleans, G. Bondurant Co.	504-833-6347
Mass	Springfield, W. Smith	800-645-2014
Mich	Detroit, Hoffman Bros.	313-873-7550
Mich	Lansing, Mktg. Professionals	517-484-0828
Minn	Mound, Moeller Sls.	612-472-1526
Mo	Chesterfield, H. Allensworth	314-469-3281
Mo	Fenton, R. Uthoff	314-343-4059
Mo	St. Louis, Midwestern Sls. Co.	314-961-0766
NJ	East Brunswick, I. Weschler	201-257-3951
NY	Farmingdale, Haines Products	516-420-1177
NY	Flushing, J. V. Marcus	212-463-0754
NY	Merrick, D. Obstgarten	212-682-0276
NY	New Rochelle, C. Erickson	914-636-8477
NC	Charlotte, J. Fairbanks	704-537-2753
NC	Statesville, J. Fowler	704-872-5117
Ohio	Chagrin Falls, American Traders	216-543-8155
Ohio	Shaker Heights, Martin-Rettger	216-283-5600
Pa	Cornwells Heights, D. Glick	215-757-9046
Pa	Phoenixville, J. Ludwick	800-645-2014
Pa	Pittsburgh, Karthauser Co.	412-931-5252
Tenn	Memphis, Hicks Sls. Agency	901-396-5725
Tenn	Memphis, S. F. Hiller	901-525-8463
Tex	Dallas, J. E. Bill Morton	214-341-1414
Tex	Garland, D. Reed	800-645-2014
Tex	Houston, C & C Sls. Co.	713-465-6856
Tex	Houston, D. Schick	800-645-2014
Wisc	Waukesha, J. C. Morkin	414-542-5129

P. R. HOFFMAN CO., Div. of Aiken Inds., Inc., 321 Cherry St., Carlisle, Pa., 17013, Tel: 717-243-2011; Empl.: 275

Customer service: J. W. Mountz

Free literature available: Literature on Cultured Quartz crystals, Literature on precision gringing, polishing, and measurement equipment and accessories for the processing of quartz, semiconductor, and optical materials.

Products manufactured: Abrasive Belts, Compounds, Cords, Powders, etc., Crystal Blanks, Crystals, Machines/Machinery, Production

HOLLINGSWORTH SOLDERLESS TERMINAL, Box 430, Phoenixville, Pa., 19460, Tel: 215-933-8947; Empl.: 300

Products manufactured: Connectors, Kits, Terminal, Machines/Machinery, Production, Terminals, Tools

HOLLIS ENGRG., INC., Charron Ave., Box 1189, Nashua, N.H., 03060, Tel: 603-889-1121, TWX: 710-228-1881; Empl.: 105

For info on price: R. T. Kosten; Application info: R. T. Kosten; Customer service: T. Diggins; Delivery info: R. T. Kosten

Free literature available: Hollis catalog 174 provides brief descriptions of the Hollis line of assembly, soldering, cleaning, lead-cutting and lead stabilizing systems.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Cleaners & Solvents, Machines/Machinery, Production, Solder Pots & Baths, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Ariz	Phoenix, L. C. Palmer	602-955-9390
Cal	Mountain View, Morse Assocs.	415-968-7722
Colo	Denver, West/Mark Assoc.	303-433-7181
Fla	Ft. Lauderdale, B. Melvin Prods. Equip.	305-566-8195
Ga	Atlanta, DG Machinery & Gage Co.	404-633-6201
Ill	Chicago, Solid State Elctrns.	312-889-8033
Md	Baltimore, D.K. Jones & Assocs.	301-752-0577
Mass	Hudson, E.P.E. Corp.	617-562-9123
Minn	Minneapolis, M. Westlund Assoc.	612-866-5002
NJ	Princeton, Krone & Rubin Assoc.	609-924-0200
NY	Webster, Krone & Rubin Assoc.	716-671-6709
Ohio	Dayton, A.M.E.S. Corp.	513-435-9730
Pa	Norristown, Glove Engrg. Co.	215-275-9875
Tex	Austin, Crockett Engrg.	512-451-8269
Tex	Dallas, Crockett Engrg.	214-251-1776
Wash	Seattle, R. Johnston Co.	206-524-5170

HAMMOND MANUFACTURING COMPANY (U.S.) INC., 1051 Clinton St., Buffalo, N.Y., 14240, Tel: 716-852-0010; Empl.: 600

For info on price: L. Sillery 519-822-2960; Application info: B. Reardon; Customer service: R. Hammond

Free literature available: Catalogue 84: Electronic Transformers and Housings; Catalogue 75: Electrical Transformers and Housings.

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Chassis, Metal, Transformers

HONEYWELL, Aerospace & Def., Honeywell Plaza, Minneapolis, Minn., 55408, Tel: 612-870-5200, TWX: 910-576-2692

Products manufactured: Accelerometers, Alarms, Batteries, Computers, Controls/Control Eqpt., Cores, Ceramic, Crystals, Detectors, Direction Finders, Display Devices/Displays, Gyros (All Types), Hydrophones & Accessories, Indicators, Lasers & Laser Systems, Magnetometers, Memory Systems, Modulator/Demodulators, Oceanographic Equip. (Electronic), Power Supplies, Radar Systems, Radiometers, Scanners, Services, Assembly, Production & Test, Substrates, Tracking Systems, Transducers

Local Sales Offices & Reps.

Cal	Fullerton	714-870-0120
Cal	Los Angeles	213-670-7500
Cal	San Diego	714-565-6000
Cal	Sherman Oaks	213-986-6310
Cal	Sunnyvale	408-732-0120
Fla	Orlando	305-894-3131
Fla	Shalimar	904-651-0310
Ga	Atlanta	404-321-2028
Iowa	Davenport	319-355-6456
Mass	Boston	617-782-3100
Mo	Creve Coeur	314-991-4100
NJ	Westfield	201-233-9200
NY	Elmsford	914-592-3200
NY	Liverpool	315-451-4000
NY	Plainview	516-931-1500
Ohio	Dayton	513-461-4480
Pa	Bala Cynwyd	215-835-2500
Tex	Dallas	214-661-5459
Tex	Houston	713-333-3622
Va	Arlington	703-524-8200
Wash	Mercer Island	206-232-5030

HONEYWELL INFORMATION SYSTEMS, 60 Walnut St., Wellsley, Mass., 02181, Tel: 617-237-4100

Customer service: Prod. Mktg.

Products manufactured: Comm. Systems, Computers, Data Acquisition & Reduction Systems, Printers, Terminals, Data Display (including Alphanumeric & Graphic)

HONEYWELL INC., Commercial Div., 200 Bond St., Wabash, Ind., 46992, Tel: 219-563-2161, TWX: 810-290-2725; Empl.: 350

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Racks

Local Sales Offices & Reps.

Colo	Denver, E. W. Johnson Co.	303-985-4810
Fla	Maitland, Beacon Elctrns.	305-647-3498
Fla	Palm Beach Gardens, Beacon Elctrns.	305-622-2770
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Ind	Ft. Wayne, R. O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assoc.	317-359-9283
Ky	Louisville, R. O. Whitesell & Assoc.	502-893-7303
Md	Lanham, Eastern Compts.	301-794-8610
Mass	Burlington, Schaal Assocs.	617-272-7940
Mich	Grand Rapids, R. O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R. O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R. O. Whitesell & Assoc.	616-983-7337
Minn	St. Paul, Northport Engrg.	612-698-3841
Ohio	Dayton, R. O. Whitesell & Assoc.	513-298-9546
Pa	Flowertown, Eastern Comps.	215-836-1616
Pa	Pittsburgh, R. O. Whitesell & Assoc.	412-242-0100
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Dallas, Blair Engrg. Sls.	214-352-8411
Tex	Houston, Blair Engrg.	713-772-0677

HONEYWELL INFORMATION SYSTEMS, 200 Smith St. MS061, Waltham, Mass., 02154, Tel: 617-237-4100; Empl.: 40000

Products manufactured: Comm. Systems, Computers, Disc Packs, Magnetic, Drums Computer Memory, Printers, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ala	Birmingham	205-323-2431
Ala	Mobile	205-479-8572
Ala	Montgomery	205-262-1127
Ariz	Phoenix	602-263-2240
Ark	Little Rock	501-376-2620
Cal	Fresno	209-486-4780
Cal	Long Beach	213-435-6578
Cal	Los Angeles	213-625-1271
Cal	Oakland	415-839-1300
Cal	Sacramento	916-927-2221
Cal	San Diego	714-565-6000
Cal	San Francisco	415-957-2500
Cal	Sunnyvale	408-732-0120
Colo	Englewood	303-771-2340
Conn	Westport	203-226-1051
Fla	Jacksonville	904-396-6971
Fla	Miami	305-592-5293
Fla	Orlando	305-894-3131
Fla	Tampa	813-870-0200
Ga	Atlanta	404-321-3321
Ga	Columbus	404-322-1625
Ga	Savannah	912-234-2283
Haw	Honolulu	808-537-5514
Ill	Chicago	312-454-1300
Ill	Chicago	312-671-1800
Ill	Lansing	312-568-4200
Ill	Oakbrook	312-325-7950
Ill	Peoria	309-692-0610
Ill	Rockford	815-965-3757
Ill	Springfield	217-529-0100
Ind	Evansville	812-477-9255
Ind	Fort Wayne	219-482-4567
Ind	Indianapolis	317-243-0831
Ind	Mishawaka (So. Bend)	219-259-8561
Iowa	Cedar Rapids	319-393-9200
Iowa	Des Moines	515-288-3601
Kans	Wichita	316-686-2348
Ky	Louisville	502-456-1220
La	Baton Rouge	504-348-0075
La	Bettendorf	319-355-6456
La	New Orleans	504-833-7241
La	Shreveport	318-425-4288
Me	Augusta	207-622-4701
Me	Portland	207-774-5811
Md	Lutherville	301-828-0900
Mass	Burlington	617-272-8115
Mass	Springfield	413-781-0132
Mass	Waltham	617-890-0400
Mass	Worcester	617-799-4132
Mich	Detroit	313-424-3500
Mich	Grand Rapids	616-451-0621
Mich	Lansing	517-694-3361
Minn	Edina	612-830-3500
Miss	Jackson	601-982-2090
Mo	Creve Coeur	314-991-4100
Mo	Kansas City	816-358-4200
Neb	Omaha	402-393-8300
NH	Manchester	603-625-9772
NJ	Mountainside	201-233-9200
NM	Albuquerque	505-345-1656
NY	Albany	518-456-7000
NY	Amherst	716-835-2770
NY	Elmsford	914-592-3200
NY	Manhasset	516-869-8200
NY	N.Y.	212-557-1200
NY	New York	212-555-1271
NY	Rochester	716-461-1600
NY	Syracuse	315-451-4000
NC	Charlotte	704-364-4770
NC	Charlotte	704-525-4485
NC	Greensboro	919-272-2162
NC	Raleigh	919-787-0170
Ohio	Akron	216-733-2244
Ohio	Cincinnati	513-771-8730
Ohio	Cleveland	276-881-0300
Ohio	Columbus	614-486-5971
Ohio	Dayton	513-461-4480
Ohio	Lima	419-222-5010
Ohio	Toledo	419-473-9721
Okla	Oklahoma City	405-947-1516
Okla	Tulsa	918-437-5934
Ore	Portland	503-233-8581
Ore	Salem	503-585-7197
Pa	Allentown	215-434-4244
Pa	Bala Cynwyd	215-835-2500
Pa	Harrisburg	717-564-8000
Pa	Pittsburgh	412-922-4422
RI	Providence	401-438-6000
SC	Charleston	803-722-8381
SC	Columbia	803-779-3240
SC	Greenville	803-232-3854
Tenn	Chattanooga	615-892-4242
Tenn	Johnson City	615-929-2195
Tenn	Knoxville	615-525-7396
Tenn	Memphis	901-396-6222
Tenn	Nashville	615-385-3400
Tex	Dallas	214-634-8880
Tex	Ft. Worth	817-336-5479
Tex	Houston	713-785-3200
Tex	San Antonio	512-341-4691
Utah	Salt Lake City	801-487-0681
Va	McLean	703-790-3000
Va	Norfolk	804-497-1067
Va	Richmond	804-285-8211
Va	Roanoke	703-344-3218
Wash	Mercer Island	206-232-5030
Wash	Tacoma	206-475-5393
WVa	Charleston	304-744-5341
Wisc	Appleton	414-733-4491
Wisc	Madison	608-238-9344
Wisc	Milwaukee	414-771-6300
FOR:	Can., Willowdale, Ont.	416-491-0660

HONEYWELL, Process Control Div./Ft. Wash., 1100 Virginia Dr., Ft. Washington, Pa., 19034, Tel: 215-643-1300, TWX: 510-661-0328

Products manufactured: Actuators, Alarms, Amplifiers, Computers, Connectors, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Detectors, Gages, Indicators, Meters, Motors, Mounts, Panels, Paper, Graphic Recording, Plug & Jack Sets, Potentiometers, Probes, Pyrometers, Racks, Recorders, Regulators, Relays, Switches, Thermistors, Thermocouples, Elements & Accessories, Transducers, Transmission Systems, Data, Transmitters, Valves, Solenoid, Wire

Local Sales Offices & Reps.

Ala	Birmingham	205-323-2431
Alas	Anchorage	907-344-0522
Ariz	Phoenix	602-263-2222
Ark	Little Rock	501-372-0166
Cal	Los Angeles	213-724-3500
Cal	San Francisco	415-826-9100
Colo	Englewood	303-771-2340
Conn	Hartford	203-549-3800
Fla	Orlando	305-894-3131

Ga	Atlanta	404-875-9561
Ill	Chicago	312-478-9266
Ill	Lansing	312-474-9300
Ind	Indianapolis	317-243-0831
Iowa	Davenport	319-355-6456
Kans	Wichita	316-522-3431
Ky	Louisville	502-459-5970
La	Baton Rouge	504-924-4236
Me	Portland	207-773-4751
Md	Lutherville	301-828-0900
Mass	Boston	617-787-5305
Mich	Farmington Hills	313-478-1300
Mich	Grand Rapids	616-451-0621
Minn	Minneapolis	612-835-5400
Miss	Jackson	601-366-6461
Mo	St. Louis	314-647-6100
Mont	Billings	406-252-5646
Neb	Omaha	402-393-8300
NJ	Westfield	201-233-9200
NM	Albuquerque	505-345-1656
NY	Long Island City	212-392-4300
NY	Syracuse (Liverpool)	315-451-4000
NC	Charlotte	704-364-4770
ND	Fargo	701-235-4221
Ohio	Cleveland	216-881-0300
Okla	Oklahoma City	405-848-2811
Ore	Portland	503-235-8411
Pa	Philadelphia	215-226-2400
SC	Columbia	803-779-3240
Tenn	Memphis	901-458-8511
Tex	Houston	713-785-3200
Utah	Salt Lake City	801-487-0681
Va	Richmond	804-285-8211
Wash	Seattle	206-232-5030
WVa	Charleston	304-744-5341
Wisc	Milwaukee	414-771-6300
NM	Albuquerque	505-345-1656
NC	Greensboro	919-292-1556
Ohio	Cleveland	216-881-0300
Ohio	Dayton	513-461-4480
Pa	Bala Cynwyd	215-835-2500
Pa	Pittsburgh	412-922-4422
Tex	Dallas	214-661-5459
Wash	Mercer Island	206-232-5030

HONEYWELL MICRO SWITCH DIV., See Micro Switch, Div. Honeywell

HONEYWELL, Residential Div., 2701 4th Ave., S., Mpls., Minn., 55408, Tel: 612-332-5222

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Controls/Control Eqpt., Detectors, Indicators, Relays, Switches, Thermostats, Transducers, Valves, Solenoid

Local Sales Offices & Reps.

Cal	Los Angeles	213-724-3500
Cal	San Francisco	415-826-9100
Colo	Englewood	303-771-2340
Ga	Atlanta	404-875-9561
Ill	Chicago	312-478-9266
Ill	Lansing	312-474-9300
Ind	Indianapolis	317-243-0831
Iowa	Des Moines	515-288-3601
Mass	Boston	617-787-5300
Mich	Southfield	313-352-1900
Minn	Edina	612-941-5430
Mo	Kansas City	816-358-4200
Mo	St. Louis	314-647-6100
NJ	Westfield	201-233-9200
NY	Long Island City	212-392-4300
NY	Syracuse	315-437-8493
NC	Charlotte	704-364-4770
Ohio	Cleveland	216-881-0300
Ohio	Columbus	614-486-5971
Pa	Blue Bell	215-643-5990
Pa	Pittsburgh	412-922-4422
Tenn	Nashville	615-297-0992
Tex	Dallas	214-363-5441
Va	McLean	703-893-4660
Wash	Mercer Island	206-232-5030
Wisc	Milwaukee	414-771-6300

HONEYWELL, INC., Test Instrs. Div., 4800 E. Dry Creek Rd., Box 5227, Denver, Colo., 80217, Tel: 303-771-4700; Empl.: 750 .... p. 1•724,725

Products manufactured: Amplifiers, Analyzers, Data Acquisition & Reduction Systems, Memory Systems, Oscillographs, Direct Writing, Power Supplies, Recorders, Signal Conditioners & Equipment

Local Sales Offices & Reps.

Cal	Los Angeles	213-724-3500
Cal	Sunnyvale	408-998-3131
Colo	Denver	303-771-2340
Fla	Orlando	305-894-3131
Ga	Atlanta	404-321-2524
Haw	Honolulu	808-841-6644
Ill	Lansing	312-474-9300
Ill	Skokie	312-674-9770
Md	Lutherville	301-828-0900
Mass	Bedford	617-275-2630
Mich	Southfield	313-478-1600
Minn	Minneapolis	612-830-3500
Mo	Creve Coeur	314-991-4100
NJ	Westfield	201-233-9200

HOPE ELCTRNS., Box 773, Clifton, N.J., 07013, Tel: 201-777-3522; Empl.: 20; Minimum order: $25 p. 1•1234; p. 2•1287

Customer service: Randolph Mossige

Products manufactured: Amplifiers, Attenuators, Controls/Control Eqpt., Detectors, Filters, Generators, Oscillators, Ovens, Power Supplies, Relays

Local Distributors

NJ	Clifton, Parts Masters, 411 Main Ave.	201-777-7706

HOPKINS ENGRG., 12900 Foothill Blvd., San Fernando, Cal., 91342, Tel: 213-361-8691, TWX: 910-496-1531; Empl.: 65 .... p. 1•566,567

Products manufactured: Filters, Services, Assembly, Production & Test, Suppressors

Local Sales Offices & Reps.

Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Glendale, G R U Assocs.	213-245-5586
Cal	San Carlos, Kottmeier Assocs., Inc.	415-592-8333
Colo	Wheatridge, Waugaman Assocs., Inc.	303-423-1020
Conn	Glastonbury, Barton-Caron Assocs.	203-633-9417
Kans	Olathe, B. Rush Assocs.	913-782-1177
Md	Lanham, Eastern Comps.	301-794-8610
Mass	Auburndale, Barton-Caron Assocs.	617-332-2021
Mich	Jackson, Norwood Scroggs Co.	517-750-1170
Minn	St. Paul, H. Cullen & Assoc.	612-646-7371
NJ	Wayne, Unicomp	201-696-2888
NY	Syracuse, H. R. Murray, Inc.	315-446-5555
Ohio	Dayton, Berberich Assocs., Inc.	513-252-9981
Pa	Flourtown, Eastern Comps.	215-836-1616
Tex	Dallas, Stevens Sls.	214-350-2476
Wash	Seattle, Blum & Assoc.	206-782-1600

HORIZONS INTERNATIONAL, INC., 716 Willow Rd., Menlo Park, Cal., 94025, Tel: 415-328-1111, TWX: 910-373-1170; Empl.: 150; Minimum order: $25 p. 1•962,963

For info on price: S. Robinson; Application info: C. Long; Customer service: J. Raynal; Delivery info: E. Warren

Free literature available: General Brochure Super "26" Information Sheet Super "32" Information Sheet Fan Information Sheet/Fan Price Sheet Computer Run Out On All Motors On Request

Products manufactured: Blowers & Fans & Accessories, Motors, Servo Systems, Tachometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Williams & Assocs.	602-947-4297
Cal	Menlo Park, Long & Assocs.	415-327-1300
Cal	Sherman Oaks, R. Meussdorfer & Assocs.	213-788-0771
Colo	Denver, Williams & Assocs.	303-373-4730
Conn	Milford, Todino Engrg. Sls.	203-874-6643
Fla	Ft. Lauderdale, Orbe, Inc.	305-564-8571
Ill	Chicago, Engineered Sls. Co.	312-867-8434
Md	Baltimore, R.L. Wilkinson	301-377-7800
Mass	Needham Heights, Todino Engrg. Sls.	617-444-7925
Mich	St. Claire Shores, J. M. Thorpe	313-779-6363
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NM	Albuquerque, Williams & Assocs.	505-255-1638
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Fayetteville, H.C. Johnson Agencies	315-637-9383
NY	Rochester, H.C. Johnson Agencies	716-482-3000
Ohio	Chagrin Falls, Drivex Corp.	216-247-6701
Pa	Glenside, R.L. Wilkinson	215-424-8400
Tenn	Bristol, R. Rakes	615-968-4195
Tex	Dallas, M. Kruvand Co.	214-827-8043
Tex	Houston, M. Kruvand Co.	
Wash	Seattle, Seatronics	206-767-4330
FOR:	Can., Rexdale, Ont. M9W 5A3, Eakin Ltd.	416-245-3600

HOSKINS MFG. CO., 4445 Lawton Ave., Detroit, Mich., 48208, Tel: 313-895-2860, TWX: 810-221-1409; Empl.: 400

Customer service: Sls. Serv. Sec.

Free literature available: Catalogs available include nickel-chromium resistance alloys, iron-chromium-aluminum resistance alloys, Hoskins; chromel-alumel* thermocouple alloys, and high temperature tungsten-rhenium thermocouple alloys. *Chromel-Alumel are registered trademarks.

Products manufactured: Magnets, Wire

Local Sales Offices & Reps.

Cal	Los Angeles, Hoskins Mfg. Co.	213-685-5550
Conn	Stamford, Hoskins Mfg. Co.	203-348-4442
Ill	Chicago, Hoskins Mfg. Co.	312-724-6880
Mich	Detroit, Hoskins Mfg. Co.	313-895-2860
Ohio	Cleveland, Hoskins Mfg. Co.	216-371-9529

HOTPACK CORP., 5148 Cottman Ave., Phila., Pa., 19135, Tel: 215-333-1700, TWX: 710-670-1694; Empl.: 130

Customer service: Sales Office

Free literature available: Short form catalog shows Hotpack's line of water jacketed incubators, fraction collector bio-refrigerators, portable refrigerated bath/circulators, steady state test chambers. The 8-page brochure also describes and illustrates the company's full line of equipment.

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Controls/Control Eqpt., Dehumidifiers (For Equipment), Furnaces, Ovens

Local Sales Offices & Reps.

NY	New York, Hotpack Corp.	212-247-5554

Local Distributors

Cal	Los Altos, Herb Waldeck Assoc., 12054 Brookmill Rd.	415-964-4699
Cal	Reseda, Bob Milner & Assoc., 7219 Canby Ave.	213-877-1444
Colo	Denver, PLS Assoc., Inc., 7418 E. Princeton Ave.	303-771-0141
Fla	Ft. Lauderdale, Hays Enterprises, 2120 N.E. 45th St.	305-772-4982
Ga	Atlanta, J. L. Morris Assoc., 3224 Peachtree Rd.	404-233-5118
Ill	Chicago, A. Stanley Co., 6059 N. Albany Ave.	312-973-7376
Iowa	Des Moines, H. E. Ferris Co., 4005 Plainview Dr.	515-255-5008
Md	Rockville, Guerra Technical Sls., Box 286	301-929-1444
Minn	Minneapolis, Gibbco Scientific Co., 1311 W. 25th St.	612-377-1200
Mo	St. Louis, Herdlein Scientific, 2050 Woodson Rd.	314-423-4834
NJ	Cherry Hill, F. Lucchesi, 224 Heritage Rd.	609-428-3537
NY	New York, G. Kobin, Box 776, Nad Sq. Sta.	212-247-5554
NY	No. Tonowanda, Harvey Instr., 1121 Oliver St.	716-694-9500
NC	Raleigh, G. W. Mitchell, Box 25129	919-833-8655
Ohio	Cincinnati, Witt Sales Co., Box 37294	513-761-5602
Pa	Pittsburgh, Giangarlo Scientific, 3237 Dawson St.	412-687-6415
Tenn	Germantown, John Sellers, 3267 Hiclory Creek	901-362-8651
Tex	Dallas, Southwestern Engrg. & Equip., 6260 E. Mockingbird La.	214-826-6661

HOUSTON INSTRUMENT, Div. Bausch & Lomb, 8500 Cameron Rd., Austin, Tex., 78753, Tel: 512-837-2820, TWX: 910-881-5782; Empl.: 10,000 .... p. 1•870-873

For info on price: J. Bell; Application info: W. Kriger; Customer service: R. Stevens; Delivery info: S. Haskell

Products manufactured: Recorders

Local Sales Offices & Reps.

Ala	Huntsville, J.L. Highsmith & Co.	205-881-3294
Ariz	Phoenix, Moxon, Inc.	602-273-7363
Cal	Culver City, Feeger Lucas Wolfe	213-559-7200
Cal	Long Beach, CTI Data Sys.	213-426-7375
Cal	San Mateo, Dayton Assocs.	415-347-9419
Colo	Englewood, Davis Assocs.	303-761-9228
Colo	Littleton, Aztec Entprs.	303-795-0250
Fla	Orlando, J.L. Highsmith & Co.	305-293-5202
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Downers Grove, Data Dev.	312-887-8480
Mass	Framingham, J.M. Lancaster Co.	617-873-8893
Mich	Detroit, Ridgway East, Inc.	313-538-3940

Minn	Minneapolis, Instrumentation Svcs., Inc.	612-544-8916
Mo	Hazelwood, Technical Reps.	314-731-5200
NJ	Palisades Park, Scientific Dev.-East	201-871-3916
NJ	Woodbrige, J.J. Wild, Inc.	201-636-7780
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Fayetteville, Doolittle Elctrns.	315-637-3222
NY	Jericho, J.J. Wild, Inc.	516-935-6600
NC	Charlotte, J.L. Highsmith & Co.	704-333-7743
Ohio	Chagrin Falls, Ridgway East, Inc.	216-247-4845
Ohio	Loveland, Ridgway East, Inc.	513-683-4350
Pa	King of Prussia, S & S Assocs.	215-265-3450
Tex	Houston, Comspec, Inc.	713-461-4487
Tex	Richardson, Comspec, Inc.	214-234-4137
Va	Fairfax, Nine Assocs.	703-273-1803
Va	Richmond, J.L. Highsmith & Co.	703-272-5888
Wash	Bellevue, Showalter Instrs.	206-455-4922
Wisc	Hales Corners, Arthur Engrg. Sls. Co.	414-425-5919

HOWARD INDUSTRIES, Div. of MSL, Box 287, Milford, Ill., 60953; Empl.: 500

Products manufactured: Blowers & Fans & Accessories, Motor & Generator Armatures, Rotors, Stators, Motors

Local Sales Offices & Reps.

Cal	Los Angeles, Techrep Assocs.	213-641-5830
Cal	Santa Clara, Richards & Assocs.	408-246-5860
Colo	Denver, Williams & Assocs.	303-373-4730
Conn	Torrington, Motoreps of New England	203-482-3193
Ga	Atlanta, W.E. Moran, Inc.	404-451-3000
Ill	Chicago, K.M.G. Sls. Co.	312-437-5815
Minn	Minnetonka, T.H. Ayre Assocs.	612-474-4125
Mo	St. Ann, Lawton Sls. Co.	314-725-1330
NJ	Red Bank, Motoreps of New York	201-741-3356
Ohio	Dayton, Electrical Sys. Co.	513-434-9822
Tex	Dallas, Evans & McDowell Assocs.	214-238-7157
Wash	Bellevue, Pacific Consits.	206-454-2503
Wisc	Racine, K.M.G. Sls. Co.	414-639-9005

HOWE RICHARDSON SCALE CO., 680 Van Houten Ave., Clifton, N.J., 07015, Tel: 201-GR1-3400; Empl.: 1150

Free literature available: Catalog – showing full line of industrial weighing equipment including bench, floor scales, truck and track scales, automatic packaging equipment.

Products manufactured: Scales, Dial

Local Sales Offices & Reps.

Ala	Birmingham	205-595-0587
Cal	Anaheim	714-630-6230
Cal	Hayward	415-782-5040
Colo	Denver	303-934-5616
Conn	Hartford	203-246-8576
Fla	Tampa	813-877-3082
Ga	Atlanta	404-355-2464
Ill	Broadview	312-345-7605
Iowa	Des Moines	515-244-2231
La	Jefferson	504-834-0082
Md	Baltimore	301-282-2600
Mass	Avon	617-588-3770
Mich	Troy	313-585-7070
Minn	Minneapolis	612-925-2995
Mo	Kansas City	816-221-0437
Mo	Maryland Heights	314-432-8300
Neb	Omaha	402-333-8754
NJ	Fairfield	201-227-1030
NY	Albany	518-459-2410
NY	Buffalo	716-684-5700
NY	Richmond Hill	212-847-7995
NC	Charlotte	704-394-1392
Ohio	Cincinnati	513-271-6640
Ohio	Cleveland	216-781-7300
Ore	Portland	503-224-3147
Pa	Philadelphia	215-744-6200
Pa	Pittsburgh	412-782-0611
Tenn	Memphis	901-743-3133
Tex	Garland	214-341-1727
Tex	Houston	713-782-1315
Va	Richmond	703-644-8774
Wash	Seattle	206-624-8646
Wash	Spokane	509-535-4295
Wisc	Milwaukee	414-453-1111

HOWELL INST. INC., 3479 W. Vickery Blvd., Ft. Worth, Tex., 76107, Tel: 817-336-7411; FSC No: 98869; Empl.: 150

Free literature available: Catalogs in the following categories: digital indicators, data acquisition systems, totalizers and batch counters, and turbine engine monitoring and test equipment.

Products manufactured: Analyzers, Controls/Control Eqpt., Counters, Data Acquisition & Reduction Systems, Data Loggers, Indicators, Meters, Monitors, Recorders, Tachometers

HOYT ELEC. INSTR. WORKS, Burton-Rogers Co., Sls. Div., 556 Trapelo Rd., Belmont, Mass., 02179, Tel: 800-225-1375; Empl.: 200 .... p. 1•726,727

Customer service: W. Burton 800-225-1375

Products manufactured: Meters

Local Sales Offices & Reps.

Cal	Hollywood, Duncan Engrg. Sls. Co.	213-462-5880
Colo	Denver, J. Dolliver	303-377-4740
Fla	St. Petersburg, W. Palmer Lanagan	813-822-1192
Ill	Chicago, Ringland M. Krueger Co.	312-282-8444
Ind	Fort Wayne, Val-Skol Sls.	219-742-9122
Ind	Indianapolis, Val-Skol Sls.	317-926-5063
Md	Baltimore, R.L. Wilkinson, Inc.	301-377-7800
Mass	Belmont, Burton-Rogers Co.	617-489-1520
Minn	Minneapolis, R.J. Siedare & Assoc.	612-533-2294
Mo	St. Louis, Ensco-Rep Inc.	314-542-3935
NJ	West Caldwell, Peterson-Rudnick Assocs.	201-226-4363
NY	Bronx, Peterson-Rudnick Assocs.	212-671-1923
NY	Rochester, Up State Comps.	716-288-5670
NC	Charlotte, K-I Assocs.	704-523-0324
Ohio	Cincinnati, Val-Skol Sls.	513-563-6790
Ohio	Cleveland, Val-Skol Sls.	216-229-2822
Pa	Glenside, R.L. Wilkinson	215-424-8400
Tex	Dallas, Stevens Sls.	214-350-2476
Wash	Bellevue, Elden Bowden Co.	206-822-5608
EXP:	Belmont, Burton-Rogers Co.	617-489-1520

Local Distributors

Ariz	Phoenix, Metermaster, Inc., 2633 E. Buckeye Rd.	602-273-7331
Cal	Los Angeles, Metermaster/LA, 5646 Jillson St.	213-685-4340
Cal	Palo Alto, Metermaster, Inc., 3995 Bayshore Rd.	415-968-0313
NJ	Little Falls, Hosica Labs, 715 Main St.	201-256-7724
Tex	Garland, Metermaster, 2809 National Dr.	214-271-2471

H.P.M. DIV., Koehring Co., Marion Rd., Mt. Gilead, Ohio, 43338, Tel: 419-946-0222; Empl.: 1200

Products manufactured: Machines/Machinery, Production

HRB-SINGER, INC., Science Park, Box 60, State College, Pa., 16801, Tel: 814-238-4311, TWX: 510-691-2610; Empl.: 575

Free literature available: Electromagnetic surveillance systems, interactive processing, environmental & behavioral sciences, airborne infrared surveillance systems & services.

Products manufactured: Amplifiers, Antennas, Converters, Couplers, Demodulators, Display Devices/Displays, Dividers, Duplexers, Microwave, Filters, Integrated Circuit Devices, Microwave Integrated Circuits (MIC's), Mixers, Multipliers, Oscillators, Receivers, Services, Assembly, Production & Test, Strip-Line Components, Microwave, Synthesizers, Tuners

Local Sales Offices & Reps.

DC	Wash, K.E. O'Neil	202-223-4100
FOR:	Can., Ottawa, Ont., J.R. Douglas	613-235-2812

HUGHES AIRCRAFT CO, Aerospace Grps., Centinela Ave & Teale St, Culver City, Cal., 90230

Products manufactured: Antenna Feed Systems, Antennas, Attenuators, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Boards, Programming, Cable Assemblies & Harnesses, Cable, Capacitors, Fixed, Cavities, Microwave, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Circuits, Printed, Multilayer, Circulators, Ferrite, Coatings, Coils Including Assemblies & Forms, Comm. Systems, Computers, Containers, Controllers, Programmable, Control Systems, Air Traffic, Controls/Control Eqpt., Converters, Couplers, Data Acquisition & Reduction Systems, Data Compressors, Digital, Decoders, Delay Lines, Demodulators, Detectors, Diplexers, Antenna, Direction Finders, Discriminators, Display Devices/Displays, Dividers, Drums Computer Memory, Duplexers, Microwave, Ferrite Material & Parts, Filters, Generators, Honeycomb Sheets, Panels, etc., Horns, Microwave, Impedance Converters, Microwave, Indicators, Integrated Circuit Packaging Systems, Integrated Circuit Devices, Intensifiers, Image, Inverters, Isolators, Junctions, Hybrid, Microwave, Laminates, Lasers & Laser Systems, Limiters, Lubricants, Masers, Materials, Self-Lubricating, Memory Systems, Mixers, Modulator/Demodulators, Modules, Logic, Encapsulated, Monitors, Mounts, Multiplexers, Multipliers, Networks, Packages, Integrated Circuit, Paints, Pedestals, Radar, Power Supplies, Radar Systems, Receivers, Recorders, Relays, Resistors, Scramblers, Data, Screens, Printed Circuit, Sensors, Light, Services, Assembly, Production & Test, Shifters, Shutters, Microwave, Signal Conditioners & Equipment, Simulators, Sliding Loads, Microwave, Slotted Lines, Microwave, Strip-Line Components, Microwave, Terminal Blocks, Boards & Strips, Terminal Equipment, Digital, Terminals, Terminals, Data Display (including Alphanumeric & Graphic), Test Systems, Tracking Systems, Transceivers, Transformers, Translators, Data, Transmission Systems, Data, Transmitters, Transponders, Waveguides & Adapters

HUGHES AIRCRAFT CO., Communication Prods. Dept., Microelectronic Prods. Div., 500 Superior Ave., Newport Beach, Cal., 92663, Tel: 714-548-0671, TWX: 910-596-1374 .... p. 1•361

Products manufactured: Crystals, Discriminators, Filters

Local Sales Offices & Reps.

Ala	Gadsden, F.C. Nickerson Co.	205-547-7718
Ariz	Phoenix, Toward Engrg. Assocs.	602-277-1453
Cal	Mountain View, Caltron Pyle	415-964-3244
Cal	Newport Beach, Hughes Aircraft Co.	714-548-0671
Cal	Van Nuys, Wes-K Assocs.	213-989-3070
Colo	Denver, Electronic Sls.	303-771-6300
Conn	No. Haven, Kitchen & Kutchin	203-239-0212
Fla	Oldsmar, F.C. Nickerson Co.	813-855-4209
Fla	Tampa, F.C. Nickerson Co.	813-885-1416
Ga	Decatur, F.C. Nickerson Co.	404-321-4678
Ill	Des Plaines, Coombs Assocs.	312-298-4830
Md	Baltimore, R.L. Wilkinson, Inc.	301-377-7800
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Minn	Minneapolis, Stach-Johnson, Inc.	612-925-2111
Mo	St. Louis, Beneke & McCaul, Inc.	314-567-3399
NY	Dewitt, Tri Tech Elctrns.	315-446-2881
NY	East Rochester, Tri Tech Elctrns.	716-381-2722
NY	Great Neck, Cooper-Simon & Co.	516-487-1142
NY	Larchmont, Tri Tech Elctrns.	914-834-4423
NC	Kannapolis, F.C. Nickerson	704-932-6772
Ohio	Dayton, R.G. Sidnell Co.	513-885-4161
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Narbeth, Electro-Comp Sls.	215-664-3576
Tex	Dallas, R. Mathews Elctrns.	214-233-0363
Tex	Houston, R. Matthews Elctrns.	713-664-7131
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
Wisc	Greendale, Coombs Assocs.	414-421-2300
EXP:	Newport Beach, Cal., Hughes Aircraft Co.	714-548-0671

HUGHES AIRCRAFT CO., CONNECTING DEVICES, 17150 Von Karman Ave., Irvine, Cal., 92705, Tel: 714-549-5701 .... p. 2•888,2022

Products manufactured: Cable Assemblies & Harnesses, Cable, Circuits, Flexible, Connectors, Contacts, Electrical, Tools

Local Sales Offices & Reps.

Cal	Newport Bch., W. E. S. T., Inc.	714-540-9040
Ill	Park Ridge, Probe Elctrns	312-696-2828
Kans	Overland Pk, Ensco-Rep	913-381-7557
Md	Towson, Kraft Elctrns. Sls.	301-828-5838
Mass	Stoneham, REPCO, Inc.	617-438-3113

Mich	Southfield, Luebbe Sls.	313-357-0355
Minn	Mpls., Siedare Assocs.	612-533-2294
Mo	St. Louis, Ensco-Rep.	314-567-3935
NJ	Newfoundland, Adamo Prod. Dvl.	201-697-2450
NY	Syracuse, T-Squared Elctrns. Co.	315-463-8592
Ohio	Cincinnati, Luebbe Sls.	513-871-4211
Ohio	Cleveland, Luebbe Sls.	216-333-0425
Ohio	Dayton, Luebbe Sls.	513 294-0426
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Tex	Irving, Space Elctrns.	214-251-2261
EXP:	Los Angeles, Cal., Hughes Int'l	213-534-2121

HUGHES AIRCRAFT CO., Electron Dynamics Div., 3100 W. Lomita Blvd., Torrance, Cal., 90509, Tel: 213-534-2121, TWX: 910-347-6238; Empl.: 1200

Products manufactured: Amplifiers, Bends & Twists, Microwave, Detectors, Diodes, Generators, Heat Exchangers & Systems, Heaters & Heating Elements, Isolators, Lasers & Laser Systems, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Power Supplies, Tubes

Local Sales Offices & Reps.

Ariz	Phoenix, Griot Assocs.	602-275-4991
Ariz	Scottsdale, Fryco	602-945-3281
Cal	Anaheim, Blair Assocs.	714-635-1350
Cal	El Segundo, Griot Assocs.	213-322-8383
Cal	Los Altos, Griot Assocs.	415-941-2533
Cal	San Jose, MCH Assocs.	408-246-7330
Cal	Tustin, Griot Assocs.	714-838-2330
Colo	Denver, Grifco	303-722-4674
Fla	Orlando, E. G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E. G. Holmes & Assocs.	404-451-6161
Ill	Chicago, Brooks Engrg. Co.	312-944-1227
Ill	Northfield, Feller Assocs.	312-446-8065
Ind	Rochester, Feller Assocs.	219-223-2377
Md	Wheaton, Sonco	301-942-9420
Mass	Chelmsford, Independent Mktg. Reps.	617-256-8251
Mich	Southfield, Air Design	313-353-3440
NH	Nashua, Independent Mktg. Reps.	603-888-3630
NJ	E. Orange, Friedman Assocs.	201-673-2500
NM	Albuquerque, Fry-Gates Co.	505-298-1875
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Pittsford, Graydon-Sherman	716-381-8838
NY	Tuckahoe, Asco Elctrns.	914-779-8110
Pa	Blue Bell, Sonco	215-542-1490
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Tex	Houston, Barnhill Two	713-688-9971
Tex	Richardson, Barnhill Two	214-231-2573
Utah	Salt Lake City, Grifco	
Va	Virginia Beach, E. G. Holmes & Assocs.	804-481-6556
Wash	Bellevue, Griot Assocs.	206-454-8592
Wash	Seattle, Datacom Assocs.	206-285-2525
FOR:	Can., Manotick, Ont., Giga-Tron Assocs.	613-692-4829

HUGHES AIRCRAFT CO, Ground Sys. Grp., 1901 Malvern St., Box 3310, Fullerton, Cal., 92634, Tel: 714-871-3232; Empl.: 5000

Products manufactured: Antenna Feed Systems, Antenna Rotators, Antenna Switching Matrices, Antenna Towers & Supports, Antennas, Boards, Printed Circuit, Boards, Programming, Cabinets & Accessories, Circuits, Printed, Multilayer, Circulators, Ferrite, Comm. Systems, Computers, Control Systems, Air Traffic, Converters, Data Acquisition & Reduction Systems, Data Compressors, Digital, Decoders, Decommutators, Telemetering, Delay Lines, Demodulators, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Diodes, Display Devices/Displays, Drums Computer Memory, Duplexers, Microwave, Integrators, Electronic, Intensifiers, Image, Isolators, Junctions, Hybrid, Microwave, Masers, Modulator/Demodulators, Modulators, All Kinds, Modules, Logic, Encapsulated, Multiplexers, Multipliers, Networks, Oceanographic Equip. (Electronic), Oscillators, Pedestals, Radar, Power Supplies, Radar Systems, Receivers, Recorders, Services, Assembly, Production & Test, Shift Registers, Shifters, Shutters, Microwave, Signal Conditioners & Equipment, Simulators, Slotted Lines, Microwave, Strip-Line Components, Microwave, Technical Books, Terminal Blocks, Boards & Strips, Terminal Equipment, Digital, Terminals, Terminals, Data Display (including Alphanumeric & Graphic), Test Systems, Tracking Systems, Transistor, Diode, Thyristor Heat Dissipators, Transmitters, Transponders, Underwater Communication, Detection, Navigation, etc. Equipment, Waveguides & Adapters

HUGHES AIRCRAFT CO., Hybrid Microelectronic Circuits Dept., Microelectronic Prods. Div., 500 Superior Ave., (E 4/5), Newport Bch., Cal., 92663, Tel: 714-548-0671, TWX: 910-596-1374 ....p. 1•889

Products manufactured: Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film

Refer to Communications Prods Dept., Microelectronic Products Div. for sales office information.

HUGHES AIRCRAFT CO., Image Devices Ind'l. Prods. Div., 6855 El Camino Real, Carlsbad, Cal., 92008, Tel: 714-729-9191, TWX: 910-322-1393; Empl.: 500

Products manufactured: Converters, Intensifiers, Image, Terminals, Data Display (including Alphanumeric & Graphic), Tubes

HUGHES AIRCRAFT CO., Ind'l. Prods. Div. Display Sys., 2020 Oceanside Blvd., Oceanside, Calif., 92054, Tel: 714-757-1200, TWX: 910-322-1380

Products manufactured: Converters, Terminal Equipment, Digital

HUGHES AIRCRAFT CO., Ind'l. Prods. Div. FACT Sys., Box 92904, Los Angeles, Cal., 90009, Tel: 213-670-9040, TWX: 213-653-582

Products manufactured: Testers

Local Sales Offices & Reps.

Ill	Park Ridge, Hughes Aircraft Co.	312-823-5126
Tex	Dallas, Bradenco	214-358-3278

Advertisment

FACT System offers a total systems approach to wiring verification by providing high speed random access circuit analyzers with a total complement of optional accessories. Includes rapid access fixturing, such as, LIFT (Low Insertion Force Technique), QUIC (Quick Universal Interface Connector), FACT-AID (Automatic Interconnection Devices) and Spring Probe Fixtures to meet the specific needs of each individual customer.

HUGHES AIRCRAFT CO., Ind'l. Prods. Div./Ind'l. Auto, 2020 Oceanside Blvd., Oceanside, Cal., 92054, Tel: 714-757-1200, TWX: 910-322-1380; Empl.: 600

Products manufactured: Controls/Control Eqpt., Indicators, Machines/Machinery, Production, Simulators, Testers

HUGHES AIRCRAFT CO., Ind'l. Prods. Div., Prod. Equip. Dept., 2020 Oceanside Blvd., Oceanside, Cal., 92054, Tel: 714-729-9191, TWX: 910-322-1380; Empl.: 500; Minimum order: $15

For info on price: C. A. Rollins Ext. 258; Application info: C. A. Rollins Ext. 258; Customer service: C. A. Rollins Ext. 258; Delivery info: J. C. Brown Ext. 265

Products manufactured: Alarms, Comm. Systems, Comparators, Controllers, Programmable, Controls/Control Eqpt., Converters, Indicators, Machines/Machinery, Production, Microcircuit Production Equip., Power Supplies, Process Control Systems, Simulators, Soldering Equipment, Terminal Equipment, Digital, Test Systems, Testers, Tubes, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Ariz	Scottsdale, Allen Assocs.	602-994-1305
Cal	Los Altos, C. D. Buerki Co.	415-941-3343
Cal	Los Angeles, International Sls.	213-670-1515
Fla	Clearwater, MacGregor Assocs.	813-446-7310
Fla	Coral Springs, MacGregor Assocs.	305-752-1924
Ga	Lilburn, MacGregor Assocs.	404-921-1300
Ill	Chicago, J. C. Angel Co.	312-878-0653
Kans	Kansas City, Ransom Assocs.	913-299-2789
Md	Baltimore, A. L. Myers Co.	301-426-5583
Mass	Acton, E. E. Specialists	617-259-9200
NJ	Saddle Brook, L & M Assocs.	201-843-8700
NY	Brentwood, L & M Assocs.	516-231-8363
NY	New York, L & M Assocs.	212-675-7486
NY	Penfield, Upstate Tech. Equip.	716-381-0930
NY	Solvay, Upstate Tech. Equip.	315-488-3101
NC	Charlotte, MacGregor Assocs.	704-375-1562
Ohio	Dayton, R. G. Sidnell & Co.	
Pa	Andalusia, L & M Assocs.	215-639-3100
Tex	Dallas, Bradenco	214-358-3278
Wash	Seattle, Penryn Sls. & Engrg.	206-634-0240

FOR:	Can., Manotick, Ont., Giga-Tron Assoc.	613-692-4829

HUGHES AIRCRAFT CO., MOS Dept. (E 3/5) Microelectronic Prods. Div., 500 Superior Ave., Newport Beach, Cal., 92663, Tel: 714-548-0671, TWX: 910-596-1374 ....p. 1•889

Products manufactured: Integrated Circuit Devices

Refer to Communications Prods Dept., Microelectronic Products Div. for sales office information.

HUGHEY & PHILLIPS, INC., 3050 N. California St., Burbank, Cal., 91505, Tel: 213-849-1104, TWX: 910-498-2252; FSC No: 94295; Empl.: 38; Minimum order: $15

For info on price: C. E. Stephens; Application info: C. E. Stephens; Customer service: C. L. Phillis; Delivery info: C. L. Phillis

Products manufactured: Controls/Control Eqpt., Flashers, Transformers

HULL CORP., Davisville Rd., Hatboro, Pa., 19040, Tel: 215-672-7800, TWX: 510-665-6822; Empl.: 275

Customer service: S. H. Bauer

Free literature available: Brochures describing presses and molds for encapsulating electrical and electronic components by transfer molding in thermosetting resins.

Products manufactured: Chamber, Environmental Test, Furnaces, Machines/Machinery, Production, Microcircuit Production Equip., Ovens, Pumps, Vacuum

Local Sales Offices & Reps.

Cal	Burlingame	415-692-4477
Ill	Elmhurst	312-279-8900
NC	Brevard	704-883-3061
Ohio	Cleveland	216-228-1318
Pa	Hatboro	215-672-7800
Tex	Dallas	

HUMISEAL DIV., Columbia Tech. Dept. 77, 26-60 Bklyn-Queens Expwy., Woodside, N.Y., 11377, Tel: 212-932-0800; QPL No: 46058; Empl.: 150; Minimum order: $20 ....p. 2•338,339,1270,1271

For info on price: Sls. Dept.; Application info: J. Waryold; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: HumiSeal Protective Coating, How To Select a Conformal Coating for P.C. Boards, Materials, Methods & Equipment for Cleaning Assemblies, Causes & Prevention of Blisters

Products manufactured: Coatings, Insulators & Insulation

Local Sales Offices & Reps.

Cal	Alhambra, M.W. Riedel Co.	213-283-7694
Cal	Mountain View, Weseloh & Assocs.	415-961-0565
Fla	Maitland, Barrett Assocs.	305-678-0172
Ill	Northbrook, R. T. Howlett & Assoc.	312-498-5444
Mass	Waltham, Betronic Assocs.	617-894-8400
NJ	Livingston, H. Thaw Sls.	201-992-2711
NY	Rochester, Gislason Sls.	716-454-4741
Ohio	Cleveland, Marlow Assocs.	216-932-0900
Tex	Dallas, R. D. Spooner	214-357-6636
Wash	Kirkland, R.R. Chase & Assoc.	206-454-2514
FOR:	Can., Montreal, Que., D/R Elctrns.	514-622-7381

HUMPHREY, INC., 9212 Balboa Ave., San Diego, Calif., 92123, Tel: 714-565-6631, TWX: 910-335-2001; Empl.: 96

Customer service: H. H. Kries

Free literature available: Brochures on: Rate transducers, solid state, electro-fluidic; single and three-axis models.

Products manufactured: Accelerometers, Blowers & Fans & Accessories, Gyros (All Types), Indicators, Potentiometers, Switches, Transducers

Local Sales Offices & Reps.

Cal	Burbank, TransDynamics	213-849-6262
Cal	San Diego, TransDynamics	714-298-8215
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Conn	Milford, Zaslow Sls. Co.	203-878-1094
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Kans	Wichita, Humphrey, Inc.	316-685-7563
Mass	Lowell, Zaslow Sls. Co.	617-458-8452
Mass	Northboro, Zaslow Sls. Co.	617-393-8150
Mich	Farmington, Carter, McCormick & Peirce	313-477-7700
NY	Holbrook, Aviatech Int'l.	516-981-9300

Ohio	Cleveland, Carter, McCormick & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormick & Peirce	513-278-5873
Pa	Philadelphia, Humphrey, Inc., Eastern Div.	215-542-9150
Pa	Pittsburgh, Carter, McCormick & Peirce	412-824-3760
Tex	Dallas, W.N. Rider Co.	214-357-2246
Wash	Seattle, TransDynamics	206-782-0064

Advertisment

Humphrey, Inc. designs and manufactures electro-mechanical and inertial reference instruments, including electro-fluidic angular rate sensors, gyroscopes (free, rate, directional, vertical); all-electric attitude and directional gyros and repeaters for general aviation and avionics OEMs; bore hole survey systems for offshore and inland drilling; angular and rectilinear displacement transducers; accelerometers and acceleration switches; planar accelerometers (Accelograph); pendulums; inertial reference systems for automotive, aircraft, and oceanographic performance testing. Proven and qualified as required for military and industrial applications.

HUNTER TOOLS, See Marshall Inds.

HURST MFG. CORP., Box 326, Princeton, Ind., 47670, Tel: 812-385-2564, TWX: 810-350-2341; Empl.: 140

Customer service: M. Meuser

Free literature available: General catalog No. 700

Products manufactured: Motors

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Los Angeles, Minarik Electric Co.	213-485-1391
Cal	Menlo Park, Long & Assoc.	415-327-1300
Colo	Denver, Shefler-Kahn Co.	303-232-0873
Fla	Orlando, Cartwright & Bean, Inc.	305-422-4531
Fla	Plantation, Cartwright & Bean, Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean, Inc.	404-237-2273
Ill	Chicago, D. Dolin Co.	312-286-6200
Ind	Princeton, W.S. Burton	812-385-2564
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Md	Glen Arm, Hodgins Assoc.	301-592-7047
Mass	Millis, Selmark Assoc.	617-376-2914
Mich	Grand Rapids, R. Van Riper Sls.	616-452-0464
Minn	Minneapolis, White Sls. Co.	312-929-4661
Miss	Jackson, Cartwright & Bean, Inc.	601-354-1368
NH	Plaistow, Selmark Assoc.	617-375-0305
NJ	Little Falls, D. Carbone	201-256-9191
NM	Albuquerque, Shefler-Kahn Co., Inc.	505-265-7077
NY	Newburgh, W. H. Zimmerman Co.	914-562-7330
NY	Rochester, W.H. Zimmerman Co.	716-586-4450
NY	Syracuse, W.H. Zimmerman Co.	15-474-4889
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
NC	Raleigh, Cartwright & Bean, Inc.	919-832-7128
Ohio	Chagrin Falls, Kilroy Sls. Co.	216-247-8997
Pa	Pittsburgh, G.S. Root Co.	412-561-4125
Tenn	Knoxville, Cartwright & Bean, Inc.	615-693-7450
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Dallas, John B. Guenther, Inc.	214-691-8500
Tex	Houston, John B. Guenther, Inc.	713-468-0232
Wash	Kingston, F.H. Haight Co.	206-297-3212
EXP:	Westbury, New York, Minthorne International	516-334-3303

HUTCHINSON INDUSTRIAL CORP., 44 W. Highland Park, Hutchinson, Minn., 55350, Tel: 612-879-2371; Empl.: 115 .... p. 1•1542,1543

Customer service: J. Green

Free literature available; Brochure and Data Sheets

Products manufactured: Boards, Printed Circuit, Circuits, Flexible, Circuits, Printed, Multilayer, Cores, Magnetic, Delay Lines, Dials, Encoders, Heaters & Heating Elements, Light Choppers, Plates, Core Loading (Memory), Scales, Dial, Services, Assembly, Production & Test, Thermometers, Resistance, Transducers

Local Sales Offices & Reps.

Cal	Santa Clara, King Assocs.	408-249-1022

HUTSON INDUSTRIES, 2019 W. Valley View, Dallas, Tex., 75234, Tel: 214-241-3511, TWX: 910-860-5537; Empl.: 200

Local Sales Offices & Reps.

Ariz	Scottsdale, Gassner & Clark	602-945-7979
Cal	Arcadia, Orion Sls.	213-355-6638
Cal	Northridge, Orion Sls.	213-886-4761
Cal	Tustin, Orion Sls.	714-832-9687
Colo	Denver, Electrodyne	303-757-7679
Conn	New Haven, Gerber Sls.	203-777-6279
Fla	Belleair Beach, Consultants for Industry	813-595-1486
Ga	Kennesaw, K&E Assocs.	404-974-4264
Ill	Chicago, L-TEC, Inc.	312-286-1500
Ind	Greenwood, Valentine/Schillinger & Assoc.	317-888-2260
Ind	South Bend, Valentine/Schillinger & Assoc.	219-291-6258
Md	Baltimore, Stemler Assoc.	301-944-8262
Mass	East Longmeadow, Gerber Sls.	413-525-3059
Mass	Waltham, Gerber Sls.	617-890-8040
Mich	Grosse Point Park, S. Greiner Assoc.	313-499-0188
Minn	Minneapolis, Bitronics Sls.	612-866-3035
Mo	Grandview, Beneke & McCaul, Inc.	816-765-2998
Mo	St. Louis, Beneke & McCaul, Inc.	314-231-1677
NJ	Cherry Hill, Stemler Assoc.	609-966-4070
NJ	Nutley, Falk-Baker Assoc.	201-661-2430
NJ	Turnersville, Stemler Assoc.	215-644-3477
NY	No. Syracuse, Advanced Comps.	315-699-2671
Ohio	Dayton, Midwest Mktg. Assoc.	513-433-2511
Ore	Beaverton, N.R. Schultz Co.	503-646-1345
Tex	Garland, Whiteside Sls. Co.	214-231-9771
Tex	Houston, Whiteside Sls.	713-498-2551
Va	Alexandria, Stemler Assoc.	703-548-7818
Wash	Bellevue, N.R. Schultz Co.	206-454-0300

HY-CAL ENGINEERING, 12105 Los Nietos Rd., Santa Fe Springs, Cal, 90607, Tel: 213-698-7785; Empl.: 50

Customer service: A. E. Bowman, Mktg Mgr

Free literature available: Bulletin A-104 describes resistance temperature sensors, indicating systems, reference temperature systems, thermocouples, calorimeters, radiometers, pyrheliometers. Includes data on equations for thermocouples, resistance temperature detectors, and heat flux instrumentation.

Products manufactured: Amplifiers, Bridges, Controls/Control Eqpt., Detectors, Indicators, Meters, Monitors, Networks, Probes, Radiometers, Scanners, Standards, Thermocouples, Elements & Accessories, Transducers, Transmission Systems, Data

HY-GAIN ELECTRONICS CORP., 8601 N.E. Highway 6, Lincoln, Neb., 68507, Tel: 402-464-9151, Telex: 48-6424; Empl.: 540; Minimum order: $50

For info on price: K. Simmons Ext. 222; Application info: K. Simmons Ext. 222; Customer service: J. Magnuson Ext. 260; Delivery info: C. Hoppe Ext. 270

Products manufactured: Antenna Rotators, Antenna Switching Matrices, Antenna Towers & Supports, Antennas, Arresters, Electrical Surge, Lightning, CATV Systems & Equipment, Coils Including Assemblies & Forms, Comm. Systems, Dummy Loads, Mounts, Receivers, Transceivers, Transmitters

Local Sales Offices & Reps.

Cal	Van Nuys, Hy-Gain Elctrns. Corp.	213-785-4532
Colo	Denver, G. Moss Elctrns., Inc.	303-985-8815
Fla	Miami, B-C Elctrn. Sls., Inc.	305-894-6071
Ga	Smyrna, B-C Elctrn. Sls., Inc.	404-436-5169
Ind	Indianapolis, Mid-Central Sls.	317-283-1727
Kans	Overland Park, H. Curry	913-888-6484
Md	Olney, A B & T Sls. Corp.	301-924-4976
Mass	Wellesley, Johnson Assocs.	617-235-3977
Mich	Ferndale, Shalco, Inc.	313-547-4771
Miss	Michigan City, J. Fisher Sls. Co.	601-224-6470
NJ	Fair Lawn, Moses & Kline	201-791-8538
NY	Rochester, Johnson Assocs.	716-473-6030
NY	Schenectady, Johnson Assocs.	518-393-3939
Ohio	Cleveland, H. Miller Sls. Co.	216-321-3900
Pa	King of Prussia, A B & T Sls. Corp.	215-265-1028
Tex	Dallas, Loss & Stewart Assocs.	214-691-6039
Va	Vinton, B-C Elctrn. Sls., Inc.	703-890-1128
Wash	Seattle, W.R. Lanphear Co.	206-633-4900
Wisc	Brookfield, Steffen Sls. Co.	414-781-7596
EXP:	Peterborough, Ont., Can., Lectron Radio Sls.	705-745-3231

HYCOMP INC., Box 250, Maynard, Mass., 01754, Tel: 617-897-4578; Empl.: 54

For info on price: N. S. Palazzini; Application info: J. J. Madden; Customer service: N. D. Oelschlegel; Delivery info: N. D. Oelschlegel

Products manufactured: Circuits, Hybrid, Thin-Film, Converters, Films, Networks, Resistors

Local Sales Offices & Reps.

Cal	Pasadena, Mar-Land Entprs..	213-681-9440
Md	Ellicott City, J. Winkler Assoc.	301-465-8630
Mass	Billerica, Matrix Sls.	617-667-9268
Mass	Burlington, Contact Sls.	617-273-1520
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NY	Rochester, W.H. Zimmerman, Inc.	716-586-4450
NY	Syracuse, W.H. Zimmerman, Inc.	315-474-4889

HYBREX, 6730 S. Tucson Blvd., Tucson, Ariz., 85734

Customer service: Sls. Dept. 602-294-1431

Products manufactured: Capacitors, Fixed, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps., Inc.	205-539-4411
Ariz	Tempe, J.F. Hurlbut Co.	602-968-5962
Cal	Glendale, Orion Sls.	213-240-3151
Cal	Palo Alto, Andot Tech Sls.	415-941-8858
Cal	San Diego, Orion Sls.	714-566-0360
Cal	Tustin, Orion Sls.	714-832-9687
Colo	Golden, J.F. Hurlbut Co.	303-279-7138
Conn	Guilford, Whitehead Assocs.	203-453-3762
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-564-8000
Fla	Orlando, W.A. Brown Comps.	305-425-5505
Mass	Boston, Whitehead Assocs.	617-542-7676
Mich	Farmington, Sheridan Assocs.	313-477-3800
Mo	Florissant, Sheridan Assocs.	314-837-5200
NJ	Union, J. Onore	201-355-0474
NY	Clinton, Advanced Comps.	315-853-6438
NY	Endicott, Advanced Comps.	607-785-3191
NY	Mt. Vernon, QED Elctrns.	914-664-0080
NY	North Syracuse, Advanced Comps.	315-699-2671
NY	Scottsville, Advanced Comps.	716-889-1429
NC	Winston-Salem, W.A. Brown Comps., Inc.	919-725-5384
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Cleveland, Sheridan Assocs.	216-524-8120
Ohio	Dayton, Sheridan Assocs.	513-277-8911
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640

HYBRID SYSTEMS CORP., 87 Second Ave., Burlington NW Ind'l. Pk., Burlington, Mass., 01803, Tel: 617-272-1522, TWX: 710-332-7584; Empl.: 250
p. 1•164-170,890; p. 2•1496,1497

For info on price: R. Cummings; Application info: W. Miller; Customer service: R. Cummings; Delivery info: R. Cummings

Free literature available: Data Conversion Module Catalog; Chip Resistor Catalog; Deltaverta Catalog

Products manufactured: Amplifiers, Cards, Linear Function, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Converters, Data Acquisition & Reduction Systems, Detectors, Dividers, Drivers, Switch, Enclosures, Module, Plug-In, Generators, Integrated Circuit Packaging Systems, Integrated Circuit Devices, IC's, Active Filters, Lamp Drivers, Modulator/Demodulators, Multiplexers, Multipliers, Networks, Power Supplies, Resistors, Signal Conditioners & Equipment, Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Los Altos, Hoeke-Reeser Assocs.	415-941-4080
Cal	Los Angeles, Cain Technology	213-476-2251
Cal	Norwalk, Bertrand-Zoolalian	213-921-9791
Cal	Orange, Cain Technology	714-997-7311
Colo	Boulder, R.A. Mayes Co.	303-444-0782
Conn	Washington Depot, Kanan Assocs.	203-868-0513
Fla	Ormond Beach, Technology Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ill	Hinsdale, Momak Sales	312-654-4524
Md	Randallstown, Beacon North Inc.	301-922-1248
Mass	Holbrook, McLellan Assocs.	617-767-4771
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
NJ	Haddonfield, Thomas Assocs.	609-854-3011
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Fayetteville, H.C. Johnson Agencies	315-637-9383

NY	Rochester, H.C. Johnson Agencies	716-482-3000
NY	Tuckahoe, Spectrum Sls.	914-793-1660
NC	Winston-Salem, RADCO Co.	919-722-9671
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Ore	Portland, Jas. J. Backer	503-297-3776
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Tex	Houston, R.A. Mayes Co.	713-461-5385
Tex	Richardson, R.A. Mayes Co.	214-235-3043
Utah	Centerville, R.A. Mayes Co.	801-292-6781
Va	Falls Church, Beacon Inc.	703-534-1673
Wash	Seattle, Jas. J. Backer	206-285-1300

HYCOM, 16841 Armstrong Ave., Irvine, Cal., 92705

HYKON MFG. CO., 163 E. State St., Box 923, Alliance, Ohio, 44601, Tel: 216-821-2320

Customer service: A. Duchon

Free literature available: A 10 page catalog featuring payout & take up wire and cable reels. Wire and cable length measuring meters. Portable live extention cord reels.

Products manufactured: Machines/Machinery, Production, Reels, Cord & Cable

HYPERTRONICS CORP., 154 Great Rd., Stow, Mass., 01775, Tel: 617-897-3236, Telex: 94-8338; FSC No: 50541; Empl.: 16; Minimum order: $25

For info on price: J. Kelley; Application info: D. Downey; Customer service: J. Kelley; Delivery info: J. Kelley

Free literature available: General Brochure (6 pages) - sampling of product line. Printed Circuit Connectors (24 pages) - K series, Modular Connectors (16 pages) - L series, Circular Connectors (Avail. Feb. 75) - C & D series.

Products manufactured: Connector Adapters, Connector Blocks, Mother Board, Connectors, Jacks (All Types), Plug & Jack Sets, Plugs, Sockets

Local Sales Offices & Reps.

Cal	Belmont, Ciance Assocs.	415-593-2000
Cal	N. Hollywood, Jewett Co.	213-789-8103
Conn	Bethany, Representatives Corp.	203-393-0024
DC	Wash, Tyler Griffin Co.	EN1-4821
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Ill	Oak Park, Joe Popp Sls. Co.	312-626-3711
Md	Baltimore, Tyler Griffin Co.	EN9-4821
Mass	Topsfield, Representatives Corp.	617-887-5050
Minn	Minneapolis, Electronic Innovators	612-884-7471
NJ	Fairlawn, C.R. Mayer Co.	201-791-8989
NY	Huntington, C.R. Mayer Co.	516-421-4322
Ohio	Medina, McShane, Inc.	216-725-4568
Pa	Paoli, Tyler Griffin Co.	215-647-1550

HYTRONICS CORP., 6231 72nd Ave. N., Pinellas Park, Fla., 33565, Tel: 813-546-2421; FSC No: 29525; Empl.: 50; Minimum order: $35

For info on price: G. J. Wilson; Application info: C. Clark; Customer service: P. Hall; Delivery info: M. Petruzzi

Free literature available: Hytronics literature illustrates the broad category of small coils and transformers that are custom-made to the design requirements of their customers.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, J. B. Hower & Co.	602-948-0430
Cal	Mountain View, Weseloh & Assocs.	415-961-0565
Cal	Santa Ana, Cal. Elctrns. Mktg.	714-835-2702
Colo	Denver, Omega Ltd.	303-758-1508
Fla	Madeira Beach, Harvey Pipe	813-391-3057
Mass	Canton, New England Elctrn. Sls. Corp.	617-828-4835
Mich	Grosse Pointe Park, Greiner Assocs.	313-499-0188
Minn	Minneapolis, Scott Elctrns.	612-929-2985
Ohio	Dayton, F. L. Ohmer	513-434-1454
Pa	Furlong, Avenir	215-348-8290
Tex	Richardson, Vista Engrg.	214-235-4547

I-T-E ELECTRICAL COMPONENTS GRP., 123 Smith St., E. Farmingdale, N.Y., 11735, Tel: 516-694-5400; Empl.: 400

For info on price: M. Robinson; Application info: T. Mooney; Customer service: M. Robinson; Delivery info: M. Robinson

Free literature available: EF 274 - EFCOR Products Catalog; CF 19 - Electrical Connector & Components Catalog; LT 42 - Industrial Electrical Fittings Bulletin; Shawmut Fuse Catalog & Applications Brochure.

Products manufactured: Conduit, Electrical, Connectors, Fuses, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Terminals, Tools, Wire & Cable Ties, Wire Nuts

Local Sales Offices & Reps.

Ala	Birmingham, W. F. Bishop Co.	205-822-4524
Alas	Anchorage, Rostel Corp.	
Ariz	Phoenix, T. Geiss & Assoc.	602-252-7694
Ark	Little Rock, Percy Williams & Co.	501-663-8069
Cal	Los Angeles, I-T-E Electrical Comps.	213-266-3364
Cal	Sacramento, I-T-E Electrical Comps.	916-371-6953
Colo	Denver, Stemco Sls. Co.	303-355-3573
DC	Washington, D.T. Ewing Assoc.	202-292-4777
Fla	Tampa, I-T-E Electrical Comps.	813-621-4773
Ga	Atlanta, W. F. Bishop Co.	404-522-8124
Ill	Bellwood, I-T-E Electrical Comps.	312-547-5900
Ind	Indianapolis, Pfeiffer-Boyle Sls. Co.	317-255-2553
Iowa	Cedar Rapids, A. Sell & Assoc.	319-393-4225
Kans	Kansas City, D. Hatfield Sls. Co.	913-281-0533
Ky	Louisville, Pfeiffer-Boyle Sls. Co.	502-896-9876
La	Metairie, I-T-E Electrical Comps.	504-455-2350
Md	Baltimore, D.T. Ewing Assoc.	301-823-2306
Mass	Braintree, B.N. Yanow & Co.	617-848-7300
Mich	Detroit, Popkin Bros.	313-832-1700
Minn	Minneapolis, Lawless Electrical Sls.	612-925-3663
Mo	St. Louis, Cooper Elec. Sls.	314-638-3434
NY	Brooklyn, B. Cooper, Inc.	212-383-1900
NY	Jamaica, Warshaw Elec. Co.	212-525-8150
NY	Syracuse, Elec. Sls. Agents, Inc.	315-437-1676
NC	Charlotte, E.F. Lombardi Co.	704-334-1637
Ohio	Cleveland, J. Natt & Assoc.	216-526-4200
Ore	Portland, Carlson, Ziegler & Assoc.	503-227-1181
Pa	Philadelphia, I-T-E Electrical Comps. Grp.	215-426-1500
Pa	Pittsburgh, I-T-E Electrical Comps. Grp.	412-922-5114
Tenn	Nashville, Matthews & Park, Inc.	615-242-3309
Tex	Dallas, I-T-E Electrical Comps. Grp.	214-638-8550
Utah	Salt Lake City, L. Vordos Agency	801-521-2111
Wash	Seattle, Valliant Sales Corp.	206-762-8780
Wisc	Milwaukee, Lawless Elect. Sls.	414-352-4850

ICI/MIDWEC, See Midwec Div. Independent Cable.

ICO/RALLY CORP., 2575 E. Bayshore Rd., Palo Alto, Cal., 94303, Tel: 415-324-0970, Telex: 348-335; FSC No: 51705; Empl.: 25; Minimum order: $25

For info on price: J. Triplett; Application info: W. H. Clark, Sls. Admin.; Customer service: J. Triplett; Delivery info: J. Triplett

Free literature available: 1974 Catalog "Wiring Accessories & Plastic Insulation Materials" Indexed by product - Heat Shrinkable Tubing, Wire Harnessing Devices, Sleeving & Tubing and Solderless Terminals..Catalog #0874-MC

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Cable Assemblies & Harnesses, Clamps & Clips, Connectors, Cords, Grommets, Heat Guns, Production, Insulators & Insulation, Spacers, Strain Reliefs, Cable & Wire, Tapes, Electrical Insulation, Terminals, Tools, Tubing, Wire & Cable Ties

Local Sales Offices & Reps.

Cal	Palo Alto	415-324-0970
NJ	Deptford	609-228-4600

ICON CORP., Sub. of U.S.M. Corp., 156 Sixth St., Cambridge, Mass., 02142, Tel: 617-868-6400, TWX: 710-321-1883; Empl.: 100; Minimum order: $25

For info on price: L. Smith; Application info: D. Jackson; Customer service: L. Smith; Delivery info: L. Smith

Free literature available: 1) Stepping Motor Technical Manual - Application guide, for design engineers, in the use of stepping motor positioning systems. 2) 1 Con Numerical Controls - Application guide, for design engineers, in the selection automatic digital positioning systems.

Products manufactured: Actuators, Controls/Control Eqpt., Motors

Local Sales Offices & Reps.

Cal	Los Angeles, Icon Corp.	714-556-7711
Cal	San Francisco, McFarland Assoc.	408-286-9333
Fla	Orlando, McMahon Assoc.	305-645-0463
Ill	Chicago, Icon Corp.	312-259-3778
Mich	Detroit, Xanthus	313-391-3235
Minn	Minneapolis, Applied Sls. Engrg.	612-544-3308
NY	North Port, Icon	516-271-1110
NY	Rochester, H. C. Johnson Agencies	716-482-3000
Ohio	Cincinnati, J. Murray Assoc.	513-662-1618
Ohio	Cleveland, Del Steffen Assoc.	216-461-8333

ICORE INT'L., INC., 180 N. Wolfe Rd., Sunnyvale, Cal., 94086, Tel: 408-732-5400, TWX: 910-339-9269; Minimum order: $125

Customer service: T. Green

Free literature available: Icore Conflex Systems - Harness Systems EMC Shielding - EMI Capabilities Thermoplastics Brochure - Plastic's Capabilities Conflex Wire - General Wire Data Elcon Universal Power Disconnects - General Brochure

Products manufactured: Backpanel Interconnect Systems, Braid, Cable, Cable Assemblies & Harnesses, Cable, Coils Including Assemblies & Forms, Conduit, Electrical, Connectors, Services, Assembly, Production & Test, Shields, Tubing, Wire, Wire Shielding

Local Sales Offices & Reps.

Ala	Huntsville, E. Finn	205-859-1750
Ariz	Scottsdale, Mercury Engrg. Sls.	602-275-8579
Cal	Sunnyvale, J. Marquez	408-732-5400
Fla	Casselberry, Publicover Assocs.	305-834-5775
Ill	Chicago, Drager Co.	312-478-5022
Iowa	Cedar Rapids, Palatine	
Kans	Wichita, Dytronix	316-943-6221
Md	Towson, Kraft Elctrn. Sls.	301-828-5838
Mass	Reading, Champagne Assocs.	617-944-3011
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Mo	Hazelwood, Dy-tronix	314-731-5799
NY	Commack, PMR	516-543-8300
NY	Fayetteville, F. Darcy Assocs.	315-637-6587
NY	Williston Park, ABC Elctrns. Sls. Co.	516-747-6610
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Pa	Huntingdon Valley, ABC Elctrn. Sls. Co.	215-464-2275
Tex	Richardson, Barry Sls.	214-234-0255
Wash	Seattle, Norwest Co.	206-282-3707

IDEAL INDUSTRIES INC., 4450 Becker Pl., Sycamore, Ill., 60178, Tel: 815-895-5181, TWX: 910-639-0613; Empl.: 650

For info on price: K. Doubler; Application info: N. R. Griffin; Customer service: D. Woodin; Delivery info: D. Woodin

Products manufactured: Blowers & Fans & Accessories, Caps, Connector, Clamps & Clips, Connectors, Cutters, Wire, Hand Operated, Demagnetizers, Soldering Equipment, Splices, wire (Including, Butt & Cap Types), Terminals, Testers, Tools, Wire & Cable Ties, Wire Markers, Wire Nuts, Wire Strippers

Local Sales Offices & Reps.

Ala	Birmingham, Ideal Industries, Inc.	205-822-4782
Ala	Mobile, Zeller & Constantine Inc.	205-471-1724
Ariz	Phoenix, Maddox Sls. Co.	602-274-3807
Cal	Los Angeles, Ideal Electrical Ind. Inc.	213-269-2141
Cal	Pico Rivera, Maddox Sls. Co.	213-949-5433
Cal	San Francisco, Maddox Sls. Co.	415-431-2953
Colo	Denver, E-O Sls. Co.	303-744-7031
Conn	Avon, Electrical Agencies, Inc.	203-673-9296
Conn	West Haven, Electrical Agencies, Inc.	203-WE3-2985
Fla	Miami, Curly Gross & Assoc.	305-666-7778
Fla	Temple Terrace, Ideal Ind. Inc.	813-872-2651
Ga	Atlanta, Ideal Industries Inc.	404-351-4256
Haw	Honolulu, H.H. Sawyer Co.	808-847-1411
Ill	Chicago, Ideal Industries Inc.	312-775-4343
Ill	Peoria, Ideal Industries Inc.	309-265-9631
Ind	Ft. Wayne, Ideal Industries Inc.	219-485-3625
Ind	Indianapolis, Ideal Industries Inc.	317-881-9994
Iowa	Cedar Rapids, F.C. Clatterbaugh Co.	319-364-5557
Iowa	Des Moines, F.C. Clatterbaugh Co.	515-282-3213
Kans	Leawood, Walker-Loudermilk Co.	913-648-7223
Kans	Prairie Village, Walker-Loudermilk Co.	918-362-4889
La	Metairie, Zeller & Constantine, Inc.	504-889-1995
Me	S. Berwick, Electrical Agencies, Inc.	207-384-5321
Md	Baltimore, O.T. Hall & Son Inc.	301-467-5359
Mass.	Boston, Electrical Agencies Inc.	617-268-9300
Mich	Birmingham, Ideal Industries Inc.	313-341-6426
Mich	Royal Oak, Associated Elec. Sls. Co.	313-541-0248

Mich	Southfield, Associated Elec. Sls. Co.	313-354-1177
Mich	Troy, Associated Elec. Sls. Co.	313-646-0745
Minn	Minneapolis, Elstad Sls. Co.	612-533-3033
Miss	Jackson, Zeller & Constantine, Inc.	601-982-2745
Mo	Webster Groves, Ideal Industries, Inc.	314-968-1832
Neb	Lincoln, F.C. Clatterbaugh Co.	402-489-5912
Neb	Omaha, F.C. Clatterbaugh Co.	402-391-2905
NJ	Beverly, Ideal Industries Inc.	609-871-6735
NJ	Hackensack, Ideal Industries Inc.	201-342-5813
NJ	Linden, Ideal Industries Inc.	201-925-0575
NM	Albuquerque, Maddox Sls. Co.	505-298-2422
NY	Canandaiqua, Ideal Industries Inc.	315-394-3411
NY	East Williston, Ideal Industries Inc.	516-741-5989
NY	Elnora, Ideal Industries Inc.	518-371-5129
NY	Oceanside, Ideal Industries Inc.	516-764-6118
NC	Charlotte, Ideal Industries Inc.	704-536-5794
NC	Greensboro, Ideal Industries Inc.	919-288-7121
Ohio	Cincinnati, Ideal Industries Inc.	513-471-0446
Ohio	Cleveland, Ideal Industries Inc.	216-831-1600
Okla	Oklahoma City, Hamco Sls.	405-946-6503
Okla	Tulsa, Hamco Sls.	918-627-2262
Ore	Portland, Northwest Agencies Inc.	503-227-5004
Pa	Philadelphia, Ideal Industries Inc.	215-VI4-6300
Pa	Pittsburgh, Ideal Industries Inc.	412-561-8335
SC	Columbia, Ideal Industries Inc.	803-722-1629
Tenn	Memphis, Ideal Industries Inc.	901-323-9162
Tenn	Nashville, Ideal Industries Inc.	615-356-2511
Tex	Dallas, Galvin Sls. Co.	214-692-1557
Tex	Houston, Galvin Sls. Co.	713-774-1141
Utah	Murray, Wright, Williams & Roup, Inc.	801-262-6132
Utah	Salt Lake City, Wright, Williams & Roup. Inc.	801-487-7821
Va	Richmond, Ideal Industries Inc.	804-262-5311
Wash	Kent, Northwest Agencies Inc.	206-UL2-8198
Wash	Seattle, Northwest Agencies Inc.	206-MA3-8882
Wisc	Pewaukee, Ideal Industries Inc.	414-464-3230

IDEAL PRECISION METER CO., 214 Franklin St., Brooklyn, N. Y., 11222, Tel: 212-383-6904; FSC No: 6625; QPL No: 10304-41; Empl.: 150; Minimum order: $50

Customer service: R. Friedman

Free literature available: Commercial Panel Meters, Military Ruggedized Meters & Instruments, Avionic Mechanisms and Instruments

Products manufactured: Indicators, Meters

Local Sales Offices & Reps.

Cal	San Francisco, Artwel Electric Inc.	415-467-1880
Cal	Van Nuys, Cardinal Assoc. Inc.	213-787-5511
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Ill	Chicago, Ropek-Cahill Inc.	312-287-7292
Iowa	Cedar Rapids, H. R. Brown Sls. Co.	319-366-0635
Md	Baltimore, M E & Assoc. Inc.	301-825-1130
Mich	Benton Harbor, Mc Nabb & Sasoc.	616-925-2166
Minn	Minneapolis, Furber Sls.	612-861-1518
NJ	Cherry Hill, M E & Assoc.	609-667-6110
NY	Liverpool, L.P. Garner	315-451-1323
Ohio	Cincinnati, F. E. Kahsar Sls.	216-653-6808
Tex	Dallas, Blackburn Assocs.	214-FL1-9991
Wash	Seattle, Seatronics, Inc.	206-767-4330
FOR:	Can. Scarborough, Ontario, Lake Engineering Co. Ltd.	416-751-5980

IEC CORPORATION, 3100 Longhorn Blvd., Austin, Tex, 78758, Tel: 512-836-0547; Empl.: 35

Customer service: J. B. McQueen

Free literature available: Catalog #2 (Illustrates our standard stocked slip ring assemblies, complete with descriptions and dimensions)

Products manufactured: Slip-Rings & Assemblies

IEC ELECTRONICS CORP., 319 E. Chestnut St., E. Rochester, N.Y., 14445, Tel: 716-586-7850; Empl.: 190

For info on price: R. Vogler; Application info: R. Vogler; Customer service: R. Vogler; Delivery info: L. Scheafer

Free literature available: Data Sheets and Accessories brochure describing the communications equipment line manufactured and marketed by IEC electronics. Equipment is VHF and UHF ultra high bands.

Products manufactured: Comm. Systems, Receivers, Services, Assembly, Production & Test, Transmitters

Local Sales Offices & Reps.

NY	Syracuse, C.W. Floring & Assoc. Inc.	315-478-2149
NY	Syracuse, Canavan-Scanlon	315-437-1271

IEE/SCHADOW, INC., 8081 Wallace Rd., Eden Prairie, Minn., 55343, Tel: 612-944-1820, Telex: 29-0556; Empl.: 75; Minimum order: $25 p. 1•2066-2073

For info on price: C. Pilon; Application info: H. Sinn; Customer service: L. Hanna; Delivery info: H. Sinn

Free literature available: Switch selection guide, incorporating our basic modular push button switches as well as our unique line of mechanical reflecting indicator buttons. Special sheets are also enclosed for customer convenience.

Products manufactured: Caps, Lenses, Indicator Light, Display Devices/Displays, Indicators, Lamps, Sockets, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Beacon	205-881-5031
Ariz	Phoenix, GND Sls. Co.	602-971-9758
Cal	Los Angeles, M.A. Stolaroff Co.	213-295-7781
Cal	Mt. View, Weseloh & Assocs.	415-961-0565
Cal	San Diego, M.A. Stolaroff Co.	714-234-6905
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
Fla	Ft. Lauderdale, Beacon	305-776-6074
Fla	Maitland, Beacon	305-647-3498
Ga	Atlanta, Beacon	404-351-3654
Ill	Chicago, ILIS, Inc.	312-631-1124
Ind.	Carmel, Giesting & Assocs.	317-844-8171
Md	Randallstown, Beacon	301-922-1248
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Benton Harbor, R. C. Nordstrom	616-857-4653
Mich	Lathrop Village, R.C. Nordstrom Co.	313-559-7373
Minn	Minneapolis, Elctrn. Innovators, Inc.	612-884-7471
Mo	Kansas City, Nevco	816-421-1751
Mo	St. Louis, Nevco	314-843-7406
NH	Dover, R. Perron & Co.	603-742-2321
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Manlius, R.W. Mitscher Co.	315-637-3777
NY	Pittsfield, R.W. Mitscher Co.	716-381-9115
NY	Valley Cottage, LRC Assocs.	914-634-7973
NY	W. Hurley, R.W. Mitscher Co.	914-679-6151
NC	Greensboro, Beacon	
Ohio	Cincinnati, Giesting & Assocs.	513-931-0812
Ohio	Dayton, Giesting & Assocs.	513-293-4044
Ore	Portland, C. K. Shanks & Assocs.	503-292-5656
SC	Spartanburg, Beacon	803-582-4613
Va	Falls Church, Beacon	703-534-1673
Wash	Seattle, C. K. Shanks & Assocs.	206-632-4290

Local Distributors

Cal	Inglewood, Time Elctrns. Wese, 900 W. Olive St.	213-649-6900
Cal	Mt. View, Target Elctrns., Box 4189	415-961-0565
NJ	Little Falls, IPC, Box 204	201-785-1830
NY	Hempstead, Elctrn. Equip. Co., 741 Peninsula Blvd.	516-538-5510
Wash	Seattle, Zepher Elctrn. Sls. Corp., 647 Industry Dr.	206-242-2517

IFE DIV., Plastic Mold & Eng. Co., 66 Taylor Dr., Rumford, R.I., 02916, Tel: 401-438-3315; Empl.: 175

For info on price: D. G. Barrett; Application info: J. J. Doherty; Customer service: D. Andrews; Delivery info: D. Andrews

Free literature available: Complete brochure describing wire-wrap packaging panels, plug in cards, card cages and racks, DIP sockets, off-the shelf racks and drawers.

Products manufactured: Boards, Plug-In, Boards, Printed Wiring, Universal, Boards, Programming, Chassis, Circuit Board Mounting, Chassis, Metal, Connectors, Integrated Circuit Packaging Systems, Racks, Services, Assembly, Production & Test, Socket Adapters, Sockets, Terminals

Local Sales Offices & Reps.

Cal	Santa Clara, Ruby Sls. Co.	408-739-5333
Conn	Cheshire, Lane Assocs.	203-272-6081
Fla	MelBourne, REPCOM	305-254-1877
Ill	Chicago, Gassner & Clark Co.	312-764-6121
Ind	Fort Wayne, Gassner & Clark Co.	219-456-1675
Mass	Waltham, Digital Sls. Assoc.	617-899-4300
Mich	Grand Rapids, R.P. Urban & Assocs.	616-245-0511
Minn	Eden Prairie, F. Peterson Co.	612-941-5400
NJ	Flanders, Spectrum Sls.	201-584-8944
NJ	Mt. Ephraim, Burdette Co.	609-931-1300
NY	Fairport, TAC Assocs.	716-377-1742
NY	Tuckahoe, Spectrum Sls., Inc.	914-793-1660
Ore	Hillsboro, Elmer Panko Co.	503-222-9595
Tex	Richardson, ZONK Engrg. Co.	214-238-7651

Va	Reston, Boyle Assocs.	703-620-9558
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529

ILC DATA DEVICE CORP., Airport Int'l. Plaza, Bohemia, N.Y., 11716, Tel: 516-567-5600, TWX: 510-228-7324; FSC No: 19645; Empl.: 320; Minimum order: $100 p. 1•171

For info on price: F. Johnson; Application info: J. Sheahan; Customer service: G. Cregan; Delivery info: F. Johnson

Free literature available: Short Form Brochure - Brief description of most products produced. Hybrid Technology Brochure - Description of hybrid capabilities.

Products manufactured: Amplifiers, Cards, Linear Function, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Comparators, Computers, Converters, Drivers & Decoders For Readouts, Filters, Generators, Indicators, Integrated Circuit Devices, IC's, Active Filters, Lamp Drivers, Modules, Logic, Encapsulated, Multiplexers, Networks, Relays, Signal Conditioners & Equipment, Synchro Transmitters, Solid-State, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Rep Inc.	205-881-9270
Ariz	Scottsdale, OEM Specialties	602-948-3360
Cal	Culver City, DeAngelo, Rothman & Co.	213-398-6239
Cal	Long Beach, Data Device	213-597-5744
Cal	Palo Alto, Coherent Mrktg. Assocs.	415-327-2217
Cal	San Diego, DeAngelo, Rothman & Co.	714-560-4707
Cal	Santa Ana, DeAngelo, Rothman & Co.	714-549-8092
Colo	Boulder, Herb Bass Assocs.	303-499-7509
Conn	Glastonbury, Instrt. Reps.	203-633-0777
Fla	Casselberry, EIR, Inc.	305-830-9600
Ill	Des Plaines, Cozzens/Cudahy Inc.	312-298-3600
Ind	Indianapolis, Cozzens/Cudahy Inc.	317-244-2456
Md	Bethesda, Powell Pendergraph	301-656-4535
Md	Reistertown, Powell-Pendergraph	
Mass	Lexington, Instrt. Reps.	617-861-8620
Minn	Mpls., Cozzens/Cudahy Inc.	612-884-4336
Mo	Kansas City, Cozzens/Cudahy	816-454-5836
Mo	St. Louis, Cozzens/Cudahy Inc.	314-423-1234
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Great Neck, Meas. Technology, Inc.	516-482-3500
NY	Syracuse, Nycom, Inc.	315-437-8343
Ohio	Dayton, McShane	513-433-8173
Ohio	Medina, McShane	216-725-4568
Ore	Beaverton, Arneson Assoc.	503-643-5743
Pa	Abington, Powell-Pendergraph	215-657-0330
Tex	Austin, MZB Co.	512-454-4371
Tex	Dallas, MZB Co.	214-235-5535
Tex	Houston, MZB Co.	713-523-7333
Va	Falls Church, Data Device	703-536-2212
Va	Richmond, Powell-Pendergraph Inc.	804-264-2341
Wash	Seattle, Arneson Assocs.	206-762-7664
For:	Can., Hamilton, Ont., Kenwood Controls & Equip.	416-544-0596
For:	Can., Montreal, Que., Kenwood Controls & Equip.	514-738-4969
For:	Can., Ottawa, Ont., Kenwood Controls & Equip.	613-722-8233

ILLINOIS CAPACITOR SLS. CO., 6284 W. Oakton, Morton Grove, Ill., 60053, Tel: 312-967-6270, Telex: 72-4361; Empl.: 10 p. 2•191

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Cal	Mountain View, Weseloh & Assocs.	415 961-0565
Cal	Orange, Sales & Mktg. Assocs.	714-997-5720
Cal	Van Nuys, Myco Sls.	213-988-2827
Colo	Denver, Nelson Co.	303-573-1516
DC	Wash, H. Wise & Co.	202-363-9417
Fla	Lake Park, Graham Assocs.	305-622-4049
Ga	Marietta, K & E Assocs.	404-427-0241
Ill	Morton Grove, T-Squared Assocs.	312-965-1515
Ind	Carmel, Rich Elctrn. Mktg.	317-844-8462
Iowa	Des Moines, Kathrinus-Kelly & Co.	
Kans	Shawnee Mission, Kathrinus-Kelly & Co.	913-722-0000
Mass	Brookline, Technology Prods. Grp.	617-731-0858
Mich	Warren, Dem Elctrns. Sls.	313-755-6660
Minn	Minneapolis, Thomas Mktg.	612-823-4880
Miss	Corinth, K & E Assocs.	601-287-5369
NJ	Randolph, MOS Assocs.	201-361-5773

NY DeRuyter, R. A. Murray Co.
NY Fairport, R. A. Murray Co. 716-254-2070
NY Floral Park, MOS Assocs. 516-694-5923
NY Rochester, R. A. Murray Co. 716-467-4538
Ohio Cleveland, Depco 216-289-8188
Ore Forest Grove, Bern Doran Sls. 503-357-3333
Pa King of Prussia, Monteiro Assocs. 215-265-0634
Pa Newtown Square, Danton Assocs. 215-353-0500
Tex Dallas, J. Clay Co. 214-350-1281
Wisc Oak Creek, Erdman Sls. Co. 414-643-0506

Local Distributors
Cal Mountain View, Weseloh Distrs., Box 4189 415-961-0565
Wisc Oak Creek, Badger Capacitor Sales, 6312 S. 27th St. 414-761-2120

ILLUMINATED PRODUCTS INC., 207 S. Helena St., Box 4011, Anaheim, Cal., 92803, Tel: 714-535-6037, TWX: 910-591-1185; FSC No: 87034; QPL No: Multiple; Empl.: 150; Minimum order: $50
p. 1•2062-2065; p. 2•1154-1158

Customer service: B. Selvey

Free literature available: SL-72A Catalog - Illuminated pushbutton switches and indicators, SC/973 Catalog - Miniature and Subminiature lamps

Products manufactured: Caps, Lenses, Indicator Light, Diodes, Lamps, Lights, Switches

Local Sales Offices & Reps.
Lamps
Ariz Tempe, Argus Sls. 602-967-8709
Cal Inglewood, Oak Inds. 213-678-4108
Cal Los Altos, Oak Inds. 415-941-1237
Colo Denver, I.W. Strong & Assocs. 303-292-6900
Conn Old Greenwich, Hoffman Engrg. 203-637-1719
Fla Orlando, Oak Inds. 305-671-4111
Ill Chicago, Engineered Sls. 312-867-8434
Kans Wichita, Dy-Tronix 316-943-6221
La Metaire, McKinney Sls. 504-887-1723
Md Baltimore, Callas Elctrns. 301-744-7711
Mass Reading, Oak Industries Inc. 617-944-0094
Mich Farmington Hills, H. Lowell Co. 313-851-7474
Minn Minneapolis, G. E. Arnerson & Co. 612-835-2177
Mo Hazelwood, Dy-Tronix 314-731-5799
Mo Kansas City, Dy-Tronix 816-761-6543
NJ Haddonfield, Gray Assocs. 609-429-5300
NY Rochester, Irondequoit Ind. 716-544-6257
NC Raleigh, Oak Industries Inc. 919-876-7591
Ohio Cincinnati, Oak Industries Inc. 513-851-4411
Okla Tulsa, McKinney Sls. 918-742-6791
Ore Beaverton, Arneson Assocs. 503-643-5754
Tex Bellaire, McKinney Sls. 713-655-3653
Tex Dallas, McKinney Sales Co. 214-631-9450
Wash Seattle, Arneson Assocs. 206-762-7664
EXP: Cal., Anaheim, Illuminated Prods. Inc. 714-535-6037

Switches & Indicators
Ariz Tempe, Argus Sales 602-967-8709
Cal Inglewood, Oak Inds. 213-678-4108
Cal Los Altos, Oak Inds. 415-941-1237
Colo Denver, I.W. Strong & Assoc. 303-292-6900
Fla Orlando, Oak Inds. 305-671-4111
Ill Northfield, Torkelson Assoc. 312-446-9085
Kans Wichita, Dy-Tronix 316-943-6221
La Metaire, McKinney Sls. 504-887-1723
Md Rockville, Marktron 301-762-6210
Md Timonium, Markton 301-252-7111
Mass Reading, Oak Inds. 617-944-0094
Mich Farmington Hills, H. Lowell Co. 313-851-7474
Minn Minneapolis, Torkelson Assoc. 612-835-2414
Mo Hazelwood, Dy-Tronix Inc. 314-731-5799
Mo Kansas City, Dy-Tronix, Inc. 816-761-6543
NJ Bergenfield, H. Gray Assocs. 201-384-3643
NJ Haddonfield, Gray Assocs. 609-429-5300
NY Rochester, Irondequoit Ind. 716-544-6257
NC Raleigh, Oak Inds. 919-876-7591
Ohio Cincinnati, Oak Inds. 513-851-4411
Okla Tulsa, McKinney Sales 918-742-6791
Ore Portland, Oak Inds. 503-292-0878
Tex Dallas, McKinney Sales 214-631-9450
Tex Houston, McKinney Sls. 713-665-3653

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Ala Huntsville, Hall-Mark Elect., 4739 Commercial 205-837-8700
Ariz Tempe, G. S. Marshall Co., 835 W. 22nd St. 602-968-6181
Cal El Monte, G. S. Marshall Co., 9674 Telstar Ave. 213-686-1500
Cal Irvine, G. S. Marshall Co., 17975 Sky Park Blvd. 714-664-2125
Cal San Diego, G. S. Marshall Co., 8057 Raytheon Rd., Suite 1 714-278-6350
Cal Sunnyvale, G. S. Marshall Co., 788 Palomar 408-732-1100
Colo Arvada, G. S. Marshall Co., 5633 Kendall Ct. 303-423-9670
Conn Hamden, Wilshire Elctrns./Conn., 2554 State St. 203-281-1166
Conn North Branford, G.S. Marshall Co., 200 Shaw Rd. 203-484-0433
Fla Ft. Lauderdale, Hall-Mark Elctrns., 1302 West McNab 305-971-9280
Fla Orlando, Hall-Mark Elctrns., Box 13950
Fla Palm Beach Gardens, G. S. Marshall Co., 10384 Riverside Dr. 305-622-8490
Ga Lawrenceville, Hall-Mark Elctrns., Rte. #1, Cedar Dr. 800-633-2918
Ill Des Plaines, G. S. Marshall Co., 300 E. Touhy Ave. 312-298-3700
Ill Elk Grove Village, Hall-Mark Elctrns., 180 Crossen Ave. 312-437-8800
Ill Rosemont, Advent Elctrns., 7110 Lyndon St. 312-298-4210
Kans Lenexa, Hall-Mark Elctrns., 9006 Rosehill Rd. 913-888-4747
Kans Wichita, Hall-Mark Elctrns., 7327 E. Indianapolis
Md Baltimore, Hall-Mark Elctrns., 6660 Security Blvd. 301-265-8500
Mass Burlington, Wilshire Elctrns./N.E., One Wilshire Rd. 617-272-8200
Mass Newton Highlands, G. S. Marshall Co., 88 Needham St. 617-965-5115
Mich Ann Arbor, Advent Elctrns., 254 S. Wagner Rd. 313-769-8650
Minn Bloomington, Hall-Mark Elctrns., 9201 Penn Ave. So., Suite 10 612-884-9056
Minn Minneapolis, G. S. Marshall Co., 4900 Viking Drive, Rm. 114 612-831-4904
Minn Minneapolis, Industrial Comps., Inc., 5280 W. 74th St. 612-831-2666
Mo St. Louis, Hall-Mark Elctrns. Corp., 6100 Madison Ave. 314-521-3800
Mo St. Louis, Olive Industrial Elctrns., 6662 Olive Blvd. 314-863-7800
NJ Cinnaminson, Wilshire Elctrns., 855 Industral Hwy. 215-627-1920
NJ Clifton, Wilshire Elctrns., 312 Clifton Ave. 201-365-2600
NY Farmingdale, G. S. Marshall Co., 230 Sherwood Ave. 516-293-4141
NY Farmingdale, Hall-Mark Elctrns. Corp., 167 Marine St. 516-293-7500
NY Farmingdale, Wilshire Elctrns./L.I., 1855 New Highway, Unite B 516-293-5775
NY Johnson City, Wilshire Elctrns./N.Y. State, 617 Main St., (Westover Plaza) 607-797-1236
NC Raleigh, Hall-Mark Elctrns., 300 Industrial Dr. 919-832-4465
Ohio Dayton, G. S. Marshall Co., 6388 N. Dixie Dr. 513-898-1100
Ohio Dayton, Hall-Mark Elctrns., 2775 Shelburen La. 513-294-0437
Ohio Wickliffe, Gateway Megatech, Inc., 30214 Lakeland Blvd. 216-944-8565
Okla Tulsa, Hall-Mark Elctrns., 4846 S. E. 83rd Ave. 918-835-8458
Pa Huntingdon Valley, Hall-Mark Elctrns., 458 Pike Rd. 215-355-7300
Tex Austin, Hall-Mark Elctrns., 3100-A Industrial Terrace 512-837-2814
Tex Dallas, G. S. Marshall Co., 14205 Proton 214-233-5200
Tex Dallas, Hall-Mark Elctrns. Corp., 9333 Forest La. 214-231-6111
Tex Dallas, Sterling Elctrns., 2875 Merrell Rd. 214-357-9131
Tex El Paso, Hall-Mark Elctrns., 2211 E. Missouri St.
Tex Houston, Hall-Mark Elctrns. Corp., Box 42190 713-781-6100
Wash Bellevue, G. S. Marshall, 1801 130th Ave. N.E. 206-883-1084
Wisc Mequon, Taylor Elec. Co., 1000 W. Donges Bay Rd. 414-241-4321
Wisc Milwaukee, Hall-Mark Elctrns. Corp., 11925 W. Ripley Ave. 414-476-1270

ILLUMINATION INDUSTRIES, 825 E. Evelyn Ave., Sunnyvale, Cal., 94086, Tel: 408-738-2744; Empl.: 165; Minimum order: $25

Customer service: Customer Service 408-245-4111 Ext. 74-79

Free literature available: Mercury and Xenon Lamps, Medium Pressure Ultra Violet Curing Lamps and Systems, Capillary Lamps. Power Supplies and Lamp Housings. Exposure Equipment.

Products manufactured: Lamps, Lights, Power Supplies, Semiconductor Wafer Fabrication, Sockets

Local Sales Offices & Reps.
Ariz Scottsdale, Allen Assocs. 602-994-1305
Cal Mountain View, R. Muenzer 415-964-0390
Cal Torrance, Mitronics Industries 213-323-7934
Colo Denver, Camel Elect. 303-757-6191
Fla Ft. Lauderdale, Semquip 305-772-3002
Kans Shawnee Mission, Mid America Mktg. 913-236-4800
NH Amherst, Martek Inds. 617-245-0940
NJ Nutley, D/R Assocs. 201-667-5900
NM Albuquerque, Thorson Co. 505-265-5655
Tex Dallas, Airep Elctrns. 214-363-5291
Wash Tukwila, General Elctrns. 206-243-5141

I M C MAGNETICS, Eastern Div., 570 Main St., Westbury, N.Y., 11590, Tel: 516-334-7070, TWX: 510-222-4469; Empl.: 175; Minimum order: $50
p. 1•494-497,964,965

Customer service: G. Egan

Free literature available: The Motor Catalog-EMistr, The Fan Catalog-EF1, Centrigugal Blowers Catalog-EB1, Vaneaxial Catalog- EV1R, Brushless DC Motor Broadside-Edcor-1

Products manufactured: Actuators, Alternators, Blowers & Fans & Accessories, Controls/Control Eqpt., Encoders, Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Motor & Generator Armatures, Rotors, Stators, Motors, Tachometers

Local Sales Offices & Reps.
Cal Los Altos, Recht Assocs. 415-941-0336
Cal Los Angeles, Elcom Sls. Co. 213-223-1351
Colo Denver, Linberg Co. 303-758-9033
Conn Newtown, Gerber Sls. Co. 203-426-3440
Fla Lighthouse Point, Saber Assocs. 305-943-3076
Ill Chicago, Berndt Assocs. 312-283-0713
Ind Ft. Wayne, Waid & Assocs. 219-422-4344
Md Baltimore, D.K. Jones & Assoc. 301-752-0577
Mass E. Longmeadow, Gerber Sls. Co. 413-525-3059
Mass Waltham, Gerber Sls. Co. 617-090-8040
Mich Dearborn, V.P.I., Inc. 313-271-4600
Minn Minneapolis, Stack Johnson 612-925-2111
Mo Kansas City, Harris-Hanson Co. 816-444-9494
Mo St. Louis, Harris-Hanson Co. 314-432-3611
NJ Haddonfield, Mesa Tech. Assoc. 609-429-9531
NY Great Neck, Trionics Assocs. 516-466-2300
NY Rochester, Fowler-Beach Corp. 716-586-0468
Ohio Dayton, BEK Assocs. 513-278-1343
Ore Portland, Brett-Ross 503-232-4184
Tex Dallas, Electra III Co. 214-243-5969
Utah Salt Lake City, Lindberg Co. 801-364-6409
Wash Seattle, Brett-Ross 206-935-8054
FOR: Can., Montreal, Que., Vitel Elctrns. 514-331-7393

IMC MAGNETICS CORP., New Hampshire Div., Rte. 16B, Rochester, N.H., 03867, Tel: 603-332-5300, TWX: 510-297-4466; Empl.: 200 .... p. 1•496,497

Customer service: F. C. Taylor

Free literature available: AIRMOVERS CATALOGUE

Products manufactured: Blowers & Fans & Accessories

Local Sales Offices & Reps.
Cal Los Altos, Recht Assocs. 415-941-0336
Cal Los Angeles, Elcom Sls. Co. 213-223-1351
Colo Denver, Lindberg Co. 303-758-9033
Conn Newtown, Gerber Sls. Co. 203-426-3440
Fla Ft. Lauderdale, Saber Elctrns. 305-943-3076
Ill Rolling Meadows, Sumer Inc. 312-394-4900
Md Baltimore, D.K. Jones & Assoc. 301-752-0577
Mass E. Longmeadow, Gerber Sls. Co. 413-525-3059
Mass Waltham, Gerber Sls. Co. 617-890-8040
Mich Dearborn, Villani-Pitcher, Inc. 313-271-4600
Minn Minneapolis, Nortec 612-835-4447
Mo Kansas City, Harris-Hanson Co. 816-444-9494
Mo St. Louis, Harris-Hanson Co. 314-432-3611
NJ Haddonfield, Mesa Technical Assocs. 609-429-9531
NM Albuquerque, Lindberg Co. 505-345-2489
NY Great Neck, Tronic Assocs. 516-466-2300
NY Rochester, Fowler-Beach 716-586-0468
Ohio Dayton, Bek Assocs. 513-278-1343
Ore Portland, Brett Assoc. 503-232-4184
Pa Pittsburgh, G.S. Root & Co. 412-561-4125
Tex Dallas, Electra III 214-243-5969
Utah Salt Lake City, Lindberg Co. 801-364-6409
Wash Seattle, Brett Assoc. 206-935-8054
For: Can., Montreal, Que., Vitel Elctrns. 514-331-6393
For: Can., Toronto, Ont., Vitel Elctrns. 416-622-6300

IMC MAGNETICS CORP., Western Div., 6058 Walker Ave., Maywood, Cal., 90270, Tel: 213-583-4785, TWX: 910-321-3089; FSC No: 99743; Empl.: 110

Customer service: M. Kloetzel

Free literature available: Stepper Motor Catalog and Application Notes; Solenoid Selector; Synchro Data Sheets; Flag Indicator Data Sheets; Remote Indicator Data Sheets.

Products manufactured: Actuators, Controls/Control Eqpt., Indicators, Motors, Resolvers, Synchro, Solenoids, Synchros

Local Sales Offices & Reps.

Cal	Los Altos, Recht Assocs.	415-941-0336
Cal	Los Angeles, El Com Sls.	213-223-1351
Colo	Denver, Lindberg Co.	303-758-9033
Conn	New Haven, Gerber Sls.	203-777-6279
Fla	Orlando, Duay Entprs.	305-277-3296
Ill	Chicago, Electro-Tech Mktg. Assoc.	312-588-4535
Mass	Waltham, Gerber Sls.	617-891-8040
Minn	Minneapolis, Stack-Johnson	612-925-2111
Mo	Kansas City, Harris-Hanson	816-444-9494
Mo	St. Louis, Harris-Hanson	314-962-0111
NJ	Haddonfield, Mesa Tech. Assoc.	609-429-9531
NY	E. Aurora, Harries & Kershaw	716-652-1221
NY	Great Neck, Trionic Assocs.	516-466-2300
Ohio	Dayton, Bek Assocs.	513-278-6851
Ore	Portland, Brett Assoc.	503-232-4184
Tex	Dallas, M. Kruvand Co. Inc.	214-827-8043
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Seattle, Brett Assoc.	514-681-1400

INCOR INSTRUMENTATION, INC., 144 Lamar St., West Babylon, N.Y., 11704, Tel: 516-643-70703rum132; FSC No: 23132; Empl.: 25

Products manufactured: Amplifiers, Attenuators, Converters, Data Acquisition & Reduction Systems, Filters, Integrators, Electronic, Inverters, Isolators, Oscillographs, Direct Writing, Power Supplies, Racks, Recorders, Signal Conditioners & Equipment, Thermocouples, Elements & Accessories, Voltage Sources

Local Sales Offices & Reps.

Conn	Newton, Daner-Hayes	203-426-9094
DC	Washington, Powell Pendergraph	301-656-4535
Ill	Des Plaines, Marsland Assocs.	312-775-1309
Ind	Indianapolis, Marsland Assoc.	317-924-3568
Mass	Newton Centre, Daner-Hayes	617-969-4650
Mich	Ann Arbor, H. C. Heym, Assoc.	313-971-6552
Mich	Saginaw, H. C. Heym, Assoc.	517-792-7928
Minn	Minneapolis, Marsland Assoc.	612-545-4481
MO	Kansas City, Marsland Assoc.	816-765-0641
NJ	Boonton, Eastern Metro Assoc.	201-335-7633
NY	Plainview, Eastern Metro Assoc.	516-931-1414
NY	Rochester, Daner-Hayes	315-986-3548
Ohio	Cleveland, Geotronix Mktg. Assoc.	216-526-2535
Ohio	Columbus, Geotronix Mktg. Assoc.	614-457-8472
PA	Audobon, Daner-Hayes	215-666-5005
PA	Glenshaw, Wainwright Tech.	412-487-3358
VA	Richmond, Powell-Pendergraph	804-264-2341
Wash	Seattle, Avionics Liaison	206-767-3870

INDIANA GEN'L. DIV., Electro-Mechanical Prods., 517 W. Walnut St., Oglesby, Ill., 61348, Tel: 815-883-8453, TWX: 910-642-2370; Empl.: 1,200

Products manufactured: Motors, Tachometers

INDIANA GENERAL, Elctrn. Prods., Crows Mill Rd., Keasbey, N.J., 08832, Tel: 201-826-5100, TWX: 710-998-0877; Empl.: 1,200

For info on price: H. Landsberger; Application info: M. Distefano; Customer service: H. Landsberger; Delivery info: M. Maurath

Free literature available: Ferramic Components - ferrites and associated hardware, Inverter-Rated Ferramics - inverter transformer design info with nomographs for core and wire selection, Broad Band-Rated Ferramics (16,000 perm) - with guaranteed electrical specifications, Attenuator-Rated Ferramics - for impedance modulus and DB charts for bead selection, Pulse-Rated Toroids with guaranteed electrical characteristics

Products manufactured: Cores, Magnetic, Ferrite Material & Parts

INDIANA GENERAL/DIV. EMM CORP., Magnet Prods., 405 Elm St., Valparaiso, Ind., 46383, Tel: 219-462-3131, TWX: 910-690-4891; Empl.: 1200

Products manufactured: Magnetizers, Magnets

Local Sales Offices & Reps.

Cal	Cupertino	408-996-2811
Ill	Villa Park	312-833-5698
Mass	Hingham	617-749-2003
NJ	Haddonfield	609-428-2706
NJ	Hillsdale	201-666-8668
Ohio	Cleveland	216-289-4600

INDIVIDUALIZED INSTRUCT. INC., Div. Economy Co., 1901 N. Walnut, Oklahoma City, Okla., 73105, Tel: 405-528-8444; Empl.: 250

Customer service: A. Kuebler

Free literature available: Phi-Deck Brochure; Phi-Deck Application Notes; Phi-Deck Price Schedule & Demonstrator Offer.

Products manufactured: Tape Recording Accessories

Local Sales Offices & Reps.

Cal	Culver City, Feeger Lucas Wolfe, Inc.	213-559-7200
Cal	Sunnyvale, AMASCO	408-733-8690
Colo	Littleton, Radco Elctrns.	303-794-4279
Ill	Chicago, J. Golten Co.	312-725-7570
Ohio	Akron, Shamrock Elctrn. Sls., Inc.	216-666-3796
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Va	Arlington, Gans-Fryling, Inc.	703-527-3262

INDUSTRIAL CONDENSER CORP., 3243 N. California Ave., Chicago, Ill., 60618, Tel: 312-463-2200; FSC No: 74861; Empl.: 200; Minimum order: $25

For info on price: J. Ostrowski; Application info: M. Forester; Customer service: M. Forester; Delivery info: J. Ostrowski

Free literature available: Capacitor Catalogs-1180-B Oil Filled; 1117-D Stabelex; 1134-A G & H Type Oil Filled; 1195-A Silverfilm; 1212-A Synthar; 1255-A Viscofilm; 1273-B Miniature Metalized; 1291 Metalized Polycarbonate; 1298 Metalized Polyester

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Cal	Los Angeles, W.S. Harmon Co.	213-937-1460
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
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Mass	Norwood, R. Perron Co.	617-762-8114
NH	Dover, R. Perron & Co.	603-742-2321
NJ	South Orange, S. Simberkoff Assocs.	201-763-7900
Ohio	Cleveland, A.H. Baier Co. & Assoc.	216-461-6161
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Pa	Broomall, L.D. Lowery, Inc.	215-528-5170
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INDUSTRIAL BLADES, Box 500, Staunton, Va., 24401

INDUSTRIAL CONTROL CO., Central Ave. at Pinelawn, Farmingdale, N.Y., 11735, Tel: 516-694-3000; Empl.: 20 p. 1•1916,1917

For info on price: G. Attura; Application info: G. Attura; Customer service: E. Kiritsis; Delivery info: E. Kiritsis

Products manufactured: Actuators, Amplifiers, Analyzers, Coils Including Assemblies & Forms, Computers, Controllers, Programmable, Controls/Control Eqpt., Converters, Dampers, Servo, Demodulators, Detectors, Generators, Indicators, Integrators, Mechanical & Electro-Mechanical, Reactors, Repeaters, Servo, Servo Systems, Testers

INDUSTRIAL DEVICES, Edgewater, N.J., 07020, Tel: 201-224-4700, Telex: 12-7459; Empl.: 200; Minimum order: $50 p. 2•1168-1171

For info on price: M. Diceglie; Application info: M. Diceglie; Customer service: M. Diceglie; Delivery info: E. Rupert

Free literature available: Form FDC - Pilot and indicator lights and accessories available off-the-shelf. Form PLF - Pilot Light Selection Guide covering unit-construction lights. Form QCA - Covering replaceable lamp incandescent pilot lights. Form MCG - Covering bi-pin cartridge lights. Form MSF - Covering T-2 Slide Base Lamps, Sockets, Pilot Light Assemblies.

Products manufactured: Caps, Lenses, Indicator Light, Clamps & Clips, Diodes, Knobs, Lamp Drivers, Lamps, Lenses, Readout & Display, Lights, Sockets, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Comp. Sls.	205-883-7794
Ariz	Phoenix, Shepherd Comps.	602-934-0425
Cal	Los Altos, Frauman Assocs	415-941-0660
Cal	Van Nuys, Shepherd Comps.	213-787-4610
Colo	Denver, Connors Inc.	303-934-5829
Conn	W. Simsbury, Anchor Engrg. Corp.	203-658-6261
Fla	Indian Harbor Beach, Comps. Sls. Corp.	305-773-0919
Fla	St. Petersburg, Comps. Sls.	813-894-4366
Ill	Chicago, K.D. Engle	312-539-1820
Kans	Overland Pk., Fixman Eng.	913-648-7748
Kans	Wichita, G. Fixman Engrg. Co.	316-MU 2-9433
Md	Baltimore, ME & Assocs.	301-825-1130
Mass	Newton Upper Falls, Anchor Engrg.	617-964-6205
Mich	Oak Pk., W. Spenser	313-398-8005
Minn	Wayzata, G.A. Kelly	612-473-0251
Mo	St. Louis, Fixman Engrg.	314-PA 5-5219
NJ	Cherry Hill, ME & Assocs.	609-667-6110
NY	Albany, Niagara Electric Sls.	518-869-0130
NY	Buffalo, Niagara Elec. Sls.	716-886-4000
NY	E. Syracuse, Niagara Electric Sls.	315-437-1656
NY	Manhasset, Kaelber & Mack, Inc.	516-MA 7-6620
NY	Rochester, Niagara Elec. Sls. Co.	716-BR 1-1223
NC	Raleigh, Comps Sls. Corp.	919-832-1897
Tenn	Chattanooga, Ind'l. Hardgoods Co.	615-267-0907
Tex	Dallas, Blackburn Assocs.	214-692-8885
Wash	Seattle, Fleehart & Sullivan	206-522-1533
EXP:	NJ Ft. Lee, J.A. Gross	201-944-3609
FOR:	Can., Windsor, Ont., W. Spenser Co.	519-969-1332

Local Distributors

Ala	Huntsville, Cramer EW/Huntsville, Inc., 2310 Bob Wallace Ave. S.W.	205-539-5722
Ariz	Phoenix, Cramer/Ariz., 2643 E. University Dr.	602-263-1112
Ariz	Tucson, Inland Elctrn. Supply, 715 E. Broadway	602-624-4402
Cal	Buena Park, Dow Radio Inc., 6001 Beach Blvd.	714-521-1906
Cal	Costa Mesa, Marvac Elctrns., 1870 Harbor Blvd.	714-642-0952
Cal	Fullerton, Orvac Elctrns., 1645 E. Orangethorpe Ave.	714-871-1020
Cal	Irvine, Cramer/Los Angeles, 17201 Daimler St.	714-979-3000
Cal	Los Angeles, Electric Switches, Box 3085, Term. Annex	213-664-1141
Cal	Oxnard, Dow Radio Inc., 921 S. Oxnard Blvd.	805-486-6353
Cal	Palo Alto, Zack Elctrns., 654 High St.	415-326-5432
Cal	Pasadena, Dow Radio Inc., 1759 E. Colorado Blvd.	213-681-3416337667J0730/A3/
Cal	Pasadena, Empire Elctrns., 37 E. Union	213-681-2711
Cal	San Diego, Cramer/San Diego, 8975 Complex Dr.	714-565-1881
Cal	San Diego, Shanks & Wright, 2045 Kettner Blvd.	714-239-0176
Cal	San Francisco, Zack Elctrns., 1444 Market St.	415-626-1444
Cal	San Jose, Quement Elctrns., 1000 S. Bascom Ave.	408-294-0464
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Cal	W. Los Angeles, California Elctrn. Supply, 1911 Armacost Ave.	213-477-8561
Colo	Colorado Springs, D. Walker Elctrns., 9 E. Vermijo Ave.	
Colo	Denver, Cramer/Denver, 5465 E. Evans Pl. at Hudson	303-758-2100
Colo	Denver, D. Walker Elctrns., 300 Bryant St.	303-935-2406
Colo	Durango, D. Walker Elctrns., 1129 Main Ave.	
Colo	Grand Junction, D. Walker Elctrns., 537 N. 1st St.	
Colo	Greely, D. Walker Elctrns., 1525 8th Ave.	
Colo	Pueblo, D. Walker Elctrns., 100 N. Victoria Ave.	
Conn	North Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Conn	Norwalk, Arrow Elctrns., 18 Isaac St.	203-838-4851
Conn	Stratford, State Elctrns. Parts, 1269 Barnum Ave.	203-375-5961
Conn	Waterbury, Bond Radio Elctrns., 439 W. Main St.	203-735-1184
Fla	Hollywood, Cramer EW/Hollywood, 4035 N. 29th Ave.	305-923-8181
Fla	Miami, ESL Elctrn. Dist. Div., 3560 N.W. 34th St.	
Fla	Orlando, Cramer EW/Orlando, 345 N. Graham Ave. Box 20214	305-894-1511
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Ind'l. Ct.	404-448-9050
Ga	Augusta, Dixie Radio Supply Co., 1234 Gordon Park Rd.	404-722-2055
Idaho	Boise, Kimball Elctrns., 418 N. Orchard	208-342-3559
Ill	Chicago, Electro-Kinetics, 4114 N. Nashville Ave.	312-286-4200
Ill	Mt. Prospect, Cramer/Chicago, 1911 South Busse Rd.	312-593-8230
Ill	Peoria, Warren Radio Co., 800 S.W. Jefferson	309-674-5998

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INDUSTRIAL ELCTRN. ENGRS., 7740 Lemona Ave., Van Nuys, Cal., 91405, Tel: 213-787-0311, TWX: 910-495-1707; Empl.: 250; Minimum order: $25 p. 2•1160-1167

For info on price: B. Weir Ext. 341; Application info: P. McEvoy Ext. 273; Customer service: B. Brandt Ext. 287; Delivery info: J. Ritacco Ext. 278

Free literature available: IEE PRODUCT SELECTOR - capsule descriptions of complete product line of digital readouts and display components and systems. PRODUCT PROFILES - complete technical description on each product series - mechanical, electrical, and performance data, with ordering specifying data.

SHORT FORM CATALOGS - technical, short form descriptions on each series or family of display products.

Products manufactured: Annunciators, Bezels, Shielded & Unshielded, Converters, Diodes, Display Devices/Displays, Drivers & Decoders For Readouts, Integrated Circuit Devices, Keyboards, Alphanumeric & Decimal, Lamp Drivers, Lamps, Lenses, Readout & Display, Lights; Monitors, Power Supplies, Services, Assembly, Production & Test, Sockets, Switches, Tachometers, Terminals, Data Display (including Alphanumeric & Graphic), Tubes

Local Sales Offices & Reps.

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Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Ill	Highland Park, Bransky Sls.	312-433-2375
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Md	Rockville, Marktron	301-762-6210
Md	Timonium, Marktron	301-825-8222
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Mich	Detroit, L. H. Dickelman	313-255-3300
Mo	St. Louis, Ensco/Rep.	314-567-3935
NJ	Haddonfield, TAI Sales	215-627-6615
NM	Albuquerque, Data Handling	505-268-4364
NY	Albany, Reagan/Compar Albany Inc.	518-489-7408
NY	Endwell, Reagan/Compar Albany Inc.	607-732-8743
NY	Fairport, Reagan/Compar Albany Inc.	716-271-2230
NY	New Hartford, Reagan/Compar Albany	315-732-3775
NY	Plainview, E.R.A.	516-522-9890
NC	Charlotte, Reynolds & Assocs.	704-527-2536
Ohio	Cleveland, Geotronix Mktg. Assocs.	216-526-2535
Ohio	Columbus, Geotronix Mktg. Assocs.	614-457-8472
Pa	Philadelphia, Tai Sales	215-627-6613
Pa	Pittsburgh, Russell F. Clark	412-242-9500
Tex	Dallas, E. B. Robertson, Inc.	214-942-2716
Utah	Salt Lake City, Checkmate Sls.	801-268-3533
Va	Charlottesville, Marktron, Inc.	301-762-6210
Wash	Mercer Island, J. H. Anderson Assocs.	206-232-0484
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For info on price: L. Roberts; Application info: W. Kirschner; Customer service: L. Roberts; Delivery info: J. Schmidt

Free literature available: 1974/5 issue of connector catalog including PC types, rack & panel, IC receptacles, display connectors transistor & power transistor sockets, CRT assemblies.

Products manufactured: Connector Adapters, Connector Blocks, Mother Board, Connector Boxes & Strips, Power Outlet, Connectors, Contacts, Electrical, Sockets, Terminal Blocks, Boards & Strips

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Ill	Chicago, M. Gottlieb Assocs.	312-775-1151
Ind	Indianapolis, Lat-Tronics	312-846-5788
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INDUSTRIAL MICA DIV., Columbia Tech. Corp., 223 S. Van Brunt St., Englewood, N.J., 07631, Tel: 201-568-7200; Empl.: 150 p. 1•1268,1269

Customer service: J. Maione

Products manufactured: Insulators & Insulation, Pads, Transistor Mounting, Spacers

INDUSTRIAL PRODUCTS DIV., Int'l Laser Systems, Inc., 2111 W. Central Blvd., Orlando, Fla., 32805, Tel: 305-843-4731, TWX: 810-850-0195; Empl.: 9

Customer service: D. O. Tate

Free literature available: Industrial Optical Data Communications Systems - both analog and digital GaAs laser transmitters and receivers

Products manufactured: Comm. Systems, Detectors, Lasers & Laser Systems, Modulator/Demodulators, Transmission Systems, Data

INDUSTRIAL TEST EQUIP., 21 Yennicock Ave., Port Washington, N.Y., 11050, Tel: 516-883-1700; FSC No: 90074; Minimum order: $10 p. 1•729,1235

Customer service: M. Schreibman

Free literature available: Catalog No. PH-71 - 4 page catalog describing line of phase meters and vector voltmeters. Catalog No. 969 - 8 page catalog describing line of AC power converters. Brochures - describing line of impedence comparators.

Products manufactured: Amplifiers, Bridges, Calibrators, Comparators, Converters, Detectors, Generators, Inverters, Meters, Modulators, All Kinds, Multipliers, Oscillators, Power Supplies, Regulators, Shifters, Standards, Testers

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NC	Winston Salem, Int'l. Sci. Instrs.	919-722-1783
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Wisc	Waukesha, Midwest Elctrn. Sls.	414-542-5129
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FOR:	Can., Ont., Giga-Tron Assoc.	613-692-4829

INDUSTRIAL TIMER CORP., Unit of Esterline Corp., U.S. Hwy 287, Parsippany, N.J., 07054, Tel: 201-887-2200; Empl.: 175; Minimum order: $10

For info on price: F. Bailey; Application info: F. Bailey; Customer service: S. Stewart; Delivery info: S. Stewart

Free literature available: Timing control condensed catalog Direct Reading Tape Programmers & Control Systems catalog.

Products manufactured: Programmers, Timers

Local Sales Offices & Reps.

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EXP:	Bloomfield, New Jersey, Buck International, Inc.	201-743-8110

INERTIAL MOTORS CORP., 280 N. Broad St., Doylestown, Pa., 18901, Tel: 215-345-1010; Empl.: 41

For info on price: E. S. Mihalko; Application info: T. D. Schmalbruch; Customer service: L. Rouleau; Delivery info: L. Rouleau

Free literature available: Position control catalogue describing the performance characteristics of low inertia shell motors, and application formulas.

Products manufactured: Motors

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INFO-LITE CORP., 46-10 104 St., Corona, N.Y., 11368, Tel: 212-476-1287; Empl.: 13 p. 1•2076; p. 2•1159

Products manufactured: Annunciators, Boards, Plug-In, Boards, Programming, Connectors, Controllers, Programmable, Cords, Counters, Display Devices/Displays, Flashers, Kits, Programming Board, Lamps, Lights, Matrices, Computer, Panels, Power Supplies, Process Control Systems, Programmers, Sockets, Switchboards, Switches

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Tex	Dallas, Glidden Electro Equip.	214-363-6539
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INFODEX, INC., 7 Cherry Ave., Waterbury, Conn., 06702, Tel: 203-757-9291; FSC No: 09087; Empl.: 25
p. 1•730-733

Customer service: E. H. Ulm

Free literature available: Phosphor Selection Guide-describes briefly the most popular phosphors in general purpose monitors &discusses suitability.

Products manufactured: Amplifiers, Display Devices/Displays, Monitors, Oscilloscopes, Scanners, Tapes, Recording, Magnetic (All Types), Tubes

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INFORMATION DISPLAYS, INC., 333 N. Bedford Rd., Mt. Kisco, N.Y., 10549, Tel: 914-241-1000, TWX: 710-571-2179; Empl.: 19

For info on price: C. Machover; Application info: C. Machover; Customer service: F. Lombardi; Delivery info: C. Machover

Products manufactured: Amplifiers, Converters, Display Devices/Displays, Drafting Machines, Generators, Recorders, Terminal Equipment, Digital

Local Sales Offices & Reps.

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Cal	Mission Hills, J. Long	213-365-9754
Colo	Denver, Williams-Assocs.	303-373-4730
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Colo	Littleton, Williams-Assocs.	303-798-6738
Md	Baltimore, S & S Assocs.	301-661-8979
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Mich	St. Clair Shores, Data-Tron	313-776-3685
Minn	Minneapolis, DeBeck Assocs.	612-822-4265
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INFORMATION HANDLING SERVICES, 5500 S. Valentia Way, Englewood, Colo., 80110, Tel: 303-771-2600; Empl.: 350

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Free literature available: "Brochures" of general nature for specific applications/markets "Teck Data Sheets" detailing each of our 25 services.

Products manufactured: Technical Books

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For info on price: J. E. Neal; Application info: S. Ferketich; Customer service: C. Hentis; Delivery info: S. Rawlings

Products manufactured: Disc Packs, Magnetic, Tapes, Recording, Magnetic (All Types), Testers

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INFORMATION TRANSFER INDUSTRIAL, INC., Box 357, Holcomb, N.Y., 14469, Tel: 315-657-7074; Empl.: 10

For info on price: J. E. Wiseman; Application info: M. P. Tubinis; Customer service: J. E. Wiseman; Delivery info: J. E. Wiseman

Free literature available: Bulletin OLR-001 Magnetic Latching Relays; Bulletin 7100 Scanners and AccessorieS.

Products manufactured: Data Acquisition & Reduction Systems, Data Loggers, Filters, Relays, Scanners, Switches

Local Sales Offices & Reps.

Conn	Madison, A & M Elctrn. Reps.	203-245-1031
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Mass	Needham, A & M Elctrn. Reps.	617-444-8170
NJ	Ridgewood, Ballou Inc.	212-964-464
NY	Buffalo, R. F. Lamb Co.	716-874-4900
NY	Rochester, R. F. Lamb Co.	716-544-5580
NY	Schenectady, R. F. Lamb Co.	518-393-4844
NY	Syracuse, R. F. Lamb Co.	315-454-2469
Pa	Norristown, Glove Engrg. Co.	215-275-9875
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EXP:	NY, Schenectady, EMB Tech. Corp.	518-372-5841

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- Catalogs Available

INFRARED INDUSTRIES, INC., 62 Fourth Ave., Waltham, Mass., 02154, Tel: 617-890-5400, TWX: 710-324-1199

Customer service: J. W. Meehan

Free literature available: Optical Filter, Designers Guide and Catalog Interference Filters from the Ultraviolet to the Infrared are fully described with tips to the designer. Detector Specification Sheets, complete description of Silicon, Lead Sulfide, Lead Selenide, and Indium Antinonide Photodetectors.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Diodes, Light Choppers

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INGERSOLL PRODS., Div. Borg-Warner Corp., 1000 W. 120th St., Chicago, Ill., 60643, Tel: 312-264-7800, TWX: 910-221-5081; Empl.: 750; Minimum order: $15
p. 1•72,73

Customer service: EmCor Sales

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Drawers, Sliding, Frames, Cabinet & Rack, Panels, Racks, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

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Cal	Del Mar, T. Louis Snitzer Co.	714-454-2191
Cal	Los Angeles, T. Louis Snitzer Co.	213-836-6170
Colo	Denver, Rope & Williamson	303-758-8507

Conn	Bridgeport, Tech. Instrs.	203-368-4582
Fla	Fort Lauderdale, W.A. Brown Instrs.	305-776-4800
Fla	Fort Walton Beach, W. A. Brown Instrs.	904-243-6424
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Ga	Atlanta, W.A. Brown Instrs.	404-939-1674
Ill	Des Plaines, Marsland Assocs.	312-775-1309
Ind	Indianapolis, Marsland Assocs.	317-924-3568
La	Gretna, W.A. Brown Instrs.	504-366-5766
Mass	Wilmington, Technical Instrs.	617-944-3930
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
Minn	Minneapolis, Marsland Assocs.	612-545-4481
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Fort Lee, K.E. Hughes Co.	201-944-1600
NJ	Haddonfield, Dyna Rep. Co.	215-627-2212
NY	Albany, Reagan Compar Albany Co.	518-489-4777
NY	Endwell, Reagan Compar Albany Co.	607-723-9661
NY	Fairport, Reagan Compar Albany Co.	716-721-2230
NY	New Hartford, Reagan Compar Albany Co.	315-732-3775
NY	New York, K. E. Hughes Co.	212-695-0082
NC	Research Triangle Park, W.A. Brown Instrs.	919-489-1546
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling Co.	513-298-7573
Ore	Beaverton, N.R. Schultz	503-643-1644
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Tenn	Knoxville, W. A. Brown Instrs.	615-584-2614
Tex	Dallas, J.A. Green Co.	214-631-7450
Tex	Houston, J.A. Green Co.	713-526-2959
Va	Alexandria, Dyna Rep. Co.	703-354-1222
Va	Newport News, Dyna Rep. Co.	804-874-7729
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
FOR:	Can., Downsview, Ont., Tracan Elctrns.	416-628-0052
FOR:	Can., Montreal, Que., Tracan Elctrns.	514-341-4163
FOR:	Can., Ottawa, Ont., Tracan Elctrns.	613-820-0269
FOR:	Can., West Vancouver, B.C., Tracan Electronics Western	604-926-3411

INGRAHAM DIV., McGraw Edison Co., 210 Redstone Hill Rd., Bristol, Conn., 06010, Tel: 203-582-6321, TWX: 710-454-1024; Empl.: 250

Customer service: W. A. Hinman

Products manufactured: Motors, Solenoids, Timers

INLAND ELCTRN. PRODS. CORP., 35 E. Glenarm, Pasadena, Cal., 91105, Tel: 213-682-1521; FSC No: 14953; Empl.: 10; Minimum order: $25

For info on price: A. Raines; Application info: William August; Customer service: A. Raines; Delivery info: D. Umland

Free literature available: Bulletin 201B - TR Series Transistor Radiators

Products manufactured: Transistor, Diode, Thyristor Heat Dissipators

INLAND MFG. CO., 1108 Jackson St., Omaha, Neb., 68102, Tel: 402-342-1108; Empl.: 175

Customer service: T. R. Gomez

Free literature available: 24-page brochure describing Inland Glass Bead cleaning systems for removing solder from transistors, etc.

Products manufactured: Cabinets & Accessories, Machines/Machinery, Production

INLAND MOTOR DIV. KOLLMORGAN, 501 First St., Rockford, Va., 24141, Tel: 703-639-3973, TWX: 710-875-3740; FSC No: 11384; Empl.: 472; Minimum order: $25 .... p. 1•966-969

For info on price: B. Webb; Application info: C. Hayes; Customer service: J. Davis; Delivery info: J. Davis

Products manufactured: Actuators, Amplifiers, Controls/Control Eqpt., Motor Electric Generator Sets, Motors, Tachometers

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-0800
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	Palo Alto, Thorson Co.	415-321-2414
Cal	San Diego, Thorson Co.	714-298-8385
Cal	Tustin, Thorson Co.	714-544-5121
Colo	Denver, Thorson Co.	303-355-3521
Conn	Guilford, R H Whitehead Jr. Assoc.	203-453-3762
Fla	Ormond Beach, Technology Mktg. Assoc.	904-672-2314
Ill	Chicago, Carlson Elctrn. Sls.	312-774-4812
Md	Silver Spring, Rep-Tron	301-593-4844
Mass	Boston, R H Whitehead Jr. Assoc.	617-542-7676
Mich	Bloomfield Hills, Roth Industrial Sls.	313-626-3171
Minn	Hopkins, Fred Peterson Co.	612-941-5400
Mo	St. Louis, Carlson Elctn. Sls.	314-991-0262
NJ	Haddonfield, Thomas Assocs. (TAI)	609-854-3011
NM	Albuquerque, Thorson Co.	505-265-5655
NY	New York, Bradley Assoc.	212-549-8500
NY	Penfield, A & D Devices	716-586-8033
NC	Winston-Salem, Burgin-Kreh Assoc.	919-768-4174
Ohio	Chagrin Falls, Jerry Kilroy Corp.	216-247-8997
Tex	Dallas, Thorson Co.	214-233-5744
Va	Lynchburg, Brugin-Kreh Assoc.	703-845-5600
Wash	Bellevue, Thorson Co.	206-455-9180

INNOVATION INDUSTRIES INC., 5012 S. Main St., Roswell, N.M., 88201, Tel; 505-622-4072; Empl.: 10; Minimum order: $25

For info on price: R. Primm; Application info: J. Copeland

Free literature available: Complete Catalog

Products manufactured: Alarms, Controls/Control Eqpt., Counters, Scanners

Local Sales Offices & Reps.

Cal	San Rafael, H. Wells Assocs.	415-454-5730
Cal	Santa Ana, H. Wells Assocs.	714-547-4455

INRECO, 8940 Ellis Ave., Los Angeles, Cal., 90034, Tel: 213-870-6664; Empl.: 30; Minimum order: $25

For info on price: H. S. Potter; Application info: H. S. Potter; Customer service: J. A. Wasson; Delivery info: J. A. Wasson

Free literature available: General catalog describing environmental simulation equipment including temperature, humidity, vibration & altitude chambers, along with temperature & humidity conditioning units.

Products manufactured: Chamber, Environmental Test, Refrigerators, Environmental Test

INSELEK, Dept. 6 University Park, 743 Alexander Rd., Princeton, N.J., 08540, Tel: 609-452-2222

INSTANT INSTRUMENTS INC., 306 River St., Haverhill, Mass., 01830, Tel: 617-373-9260; Empl.: 14; Minimum order: $25

For info on price: J. Bonfiglio; Application info: J. Bonfiglio; Customer service: N. Blye; Delivery info: N. Blye

Free literature available: Literature on low cost laboratory & modular regulated power supplies, keyboard, sloped & vertical panel enclosures, and instant breadboarding systems.

Products manufactured: Boards, Printed Circuit, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Converters, Diodes, Display Devices/Displays, Kits, Breadboarding (For Engineers), Kits, Power Supply, Kits, Printed Circuit, Power Supplies

Local Sales Offices & Reps.

Cal	Pasadena, Advanced Techniques	213-681-1093
Mass	Andover, Mech-Tron Co.	617-475-3531
NJ	Hazlet, MerMon Elctrn. Instrumentation	201-264-1851
Pa	Hatboro, MerMon Elctrn. Instrumentation	215-672-5565
FOR:	Can., Toronto, Ont., Canadian Instr.	416-769-1512

Advertisment

INSTANT INSTRUMENTS INC.
manufactures:
INSTRUMENT CASES
- Keyboard, Sloped & Vertical panel
Low cost off-the-shelf brushed alum.
- MINI-LAB POWER SUPPLIES
Logic & Linear outputs, variable & preset from 50 to 1000 mA
- MODULAR POWER SUPPLIES
single & dual from 25 to 3000 mA
- INSTANT BREADBOARD new method to mount.

INSTRU-LEC CORP., 520 Homestead Ave., Mt. Vernon, N.Y., 10550, Tel: 914-668-3754; FSC No: 13782; Empl.: 45; Minimum order: $20

For info on price: R. Hobert; Application info: R. Hobert; Customer service: N. L. Eckles; Delivery info: N. L. Eckles

Free literature available: Gear and Differential Brochures illustrating the various types of precision instrument components manufactured on premises.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Couplings, Gears & Gear Mechanisms (Precision), Reducers

INSTRUMENTS COMPONENTS CO., 7239 Industrial Park Blvd., Montor, Ohio, 44060, Tel: 951-3030; Empl.: 15

Customer service: J. Wereb

Free literature available: Constant Current Power Supplies - Applications & Specifications.

Products manufactured: Controls/Control Eqpt., Converters, Power Supplies

INSTRUMENT RESEARCH CO., Box 231, Lincoln, Mass., 01773, Tel: 617-897-7647; Empl.: 6

Customer service: E. Withey

Products manufactured: Amplifiers, Generators, Modulators, All Kinds, Power Supplies

Local Sales Offices & Reps.

Cal	Los Angeles, Sodaro Co.	213-876-6001
Colo	Evergreen, Fahnestock Assoc.	303-674-5255
NM	Albuquerque, Mountaintek	505-268-0003
EXP:	Fla., Hallandale, EMEC	305-925-6366

INSTRUMENT SPECIALTIES, 276 Bergen Blvd., Little Falls, N.J., 07424, Tel: 201-256-3500, TWX: 710-988-5732; Empl.: 170 .... p. 2•1226,1229

Free literature available: Catalog 14C Precision Springs, RF1-EM1 Shielding, Contact Strips and Rings, All From Beryllium Copper.

Products manufactured: Contact Strips, Finger, Contacts, Electrical, Gaskets, Shielding, R-F-Also See Shields, R-F, Shields, Springs (All Types)

Local Sales Offices & Reps.

Ariz	Phoenix, O'Donnel Assoc.	602-993-9740
Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Ill	Arlington Heights, Instrument Specialties Co.	312-392-0292
NC	Charlotte, McLean Sls. Co.	704-366-2675
Ohio	Cincinnati, J.G. McLaughlin & Assoc.	513-561-2285
Tex	Irving, Lee Sls. Co.	214-363-3831

INSTR. & CONTROL SYS., INC., 129 W. Laura, Addison, Ill., 60101, Tel: 312-543-6200; Empl.: 35

Customer service: H. Washington

Free literature available: Sheets on all Industrial Control Components and Electro-Pac UPS Systems and Inverters.

Products manufactured: Controls/Control Eqpt., Current Sensors, Electroplating Equipment & Supplies, Inverters, Motors, Power Supplies, Process Control Systems, Relays, Timers

Local Sales Offices & Reps.

Cal	Sunnyvale, RDP Instrs.	408-735-9040
Cal	Woodland Hills, Cummings & Co.	213-340-6035
Fla	Orlando, McKay, Smith & Assoc.	305-277-1513
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Ill	Lombard, Quadtron Assoc.	312-627-6800
Ill	Northfield, Sam Tallaksen Co.	312-441-6644
Ind	Indianapolis, Garstang Engrg. Co.	317-632-9903
Ind	Indianapolis, J. Mahaney	317-925-2090
Md	Rockville, Marktron, Inc.	301-762-6210
Mass	Needham Heights, Geo. Danek & Co.	617-444-8838
Mich	Saginaw, R. Von Berg	517-799-0873
Mich	Southfield, Static Controls	313-358-1460
Minn	Minneapolis, HMR	612-920-8200
Mo	Kansas City, Harris-Hanson Co.	816-HI4-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	East Orange, Friedman & Assoc.	201-673-2500
NJ	Old Bridge, Ross Co.	212-824-5424
NY	Utica, KLM Assoc.	315-735-8525
NC	Charlotte, McKay, Smith & Assoc.	704-527-0240
Ohio	Chagun Falls, Pine Sls. & Engrg.	216-247-6198
Tex	Dallas, G. Weinreigh & Assoc.	214-321-2800
Tex	Dallas, Glidden Electro Equip. Co.	214-363-6539
Tex	Houston, Glidden Electro Equip. Co.	713-681-1415
Utah	Salt Lake City, Stuart & Co.	801-466-8603
Va	Charlottesville, Marktron, Inc.	804-973-5874

INSTRUMENTATION ENGRG., 769A Susquehanna Ave., Franklin Lakes, N.J., 07417, Tel: 201-891-9300; Empl.: 197

For info on price: J. Gregory; Application info: T. Aufieri; Customer service: F. Borkowski; Delivery info: J. Gregory

Free literature available: The SYSTEM 390 Computerized Test Systems Catalog describes performance capabilities of delivered configurations satisfying analog/digital/hybrid requirements in production, service repair, and refurbishment environments.

Products manufactured: Test Systems, Testers

Local Sales Offices & Reps.

Cal	El Segundo, Instrumentation Engrg.	213-973-6611
Ill	Chicago, Solid State Elctrns. of Ill.	312-889-8033
Mass	Waltham, McBar Assocs.	617-890-0233
NJ	Palisades Park, Scientific Devices - East	201-871-3916
NY	Rochester, Ossman Instrs.	716-328-2230
NC	Charlotte, J. L. Highsmith Co.	704-333-7743
Pa	Glenside, ARA Elctrns.	215-887-5250
Tex	Arlington, CTR, Inc.	817-277-6001
Va	Springfield, Instrumentation Engrg.	703-451-1422

INSTRUMENTATION TECH. CORP., 18811 Napa St., Northridge, Cal., 91324, Tel: 213-886-2034; FSC No: 34090; Empl.: 30

For info on price: J. Ahlstron; Application info: J. Ahlstrn; Customer service: J. Ahlstron; Delivery info: D. Benson

Products manufactured: Calibrators, Comm. Systems, Comparators, Computers, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Data Loggers, Generators, Multiplexers, Simulators, Terminal Equipment, Digital, Verification Systems, Tape

INSTRUMENTS FOR INDUSTRY, INC., 151 Toledo St., Farmingdale, N.Y., 11735, Tel: 516-694-1414; Empl.: 25 .... p. 1•734,735

Products manufactured: Amplifiers, Antennas, Generators, Meters

Local Sales Offices & Reps.

Cal	Yorbalinda, Del Black Assocs.	714-524-0141
Colo	Evergreen, Mountaintek, Inc.	303-674-5255
Kans	Shawnee Mission, EIR Co.	913-362-0919
Mich	Detroit, Harvey Teplitz & Co.	313-537-9058
Mo	Leasburg, EIR Co.	314-245-6477
NJ	No. Plainfield, Brady Co.	201-753-7988
NM	Albuquerque, Mountaintek Inc.	505-268-0003
NY	Guilderland, Electro Modular Sys.	518-456-2665
Ohio	Cleveland, Harvey Teplitz & Co.	216-371-2044
Ohio	Dayton, Harvey Teplitz & Co.	513-277-6531
EXP:	Hollandale, Fla., Emec Inc.	305-925-6366
FOR:	Can., Mississauga, Ont., D.R. Beattie Ltd.	416-274-3000
FOR:	Can., Port Credit, Ont., D.R. Beattie Ltd.	416-278-7401
FOR:	Can., St. Eustache, Que., D.R. Beattie Ltd.	514-473-5744

INSTRUMENTS, INC., 3432 Midway Dr., San Diego, Cal., 92110, Tel: 714-223-7156; Empl.: 22

Customer service: D. C. Kalbfell

Products manufactured: Amplifiers

Local Sales Offices & Reps.

Wash	Seattle, Datacom Assocs.	206-285-2525

INTECH, INC., 1220 Coleman Ave., Santa Clara, Cal., 95050, Tel: 408-244-0500, TWX: 910-338-0254; FSC No: 33967; Empl.: 165

For info on price: M. Schall; Application info: R. L. Burkett; Customer service: M. Schall; Delivery info: M. Schall

Free literature available: Short Form Catalog (Modular Products) or individual data sheets Individual data sheets (Communications products)

Products manufactured: Amplifiers, Cards, Linear Function, Comm. Systems, Commutators, Converters, Integrated Circuit Devices, Modules, Logic, Encapsulated

Local Sales Offices & Reps.

Ariz	Scottsdale, Barnhill Five, Inc.	602-947-7841
06/		
Fla	Clearwater, Brennan Assocs	813-446-5006
Ill	Elk Grove Village, L.F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L.F. Green & Assocs.	317-293-9827
Md	Fulton, Gans-Fryling, Inc.	301-953-3724
Mass	Peabody, Intech Inc.	617-535-3058
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, L.F. Green & Assocs.	612-781-1611
Mo	St. Louis, Beneke & McCaul	314-567-3399
NJ	Clifton, Compar N.Y.	201-546-3660
Ohio	Dayton, WKM Assocs.	513-434-7500
Tex	Houston, Semiconductor Sls. Assocs.	713-461-4197
Tex	Richardson, Semiconductor Sls. Assocs.	214-231-6181
Va	Arlington, Gans-Fryling, Inc.	703-527-3262
Wash	Bellevue, NEMCO	206-747-6863
EXP:	New York, N.Y., Multiparts Corp.	212-944-4370

INTEGRATED CIRCUITS, INC., 13256 Northrup Way, Bellevue, Wash., 98005, Tel: 206-747-8556, TWX: 910-443-2302; Empl.: 45 .... p. 1•891,1236

Customer service: G. H. Kestner

Free literature available: Hybrid Capabilities Brochure - describing facilities, equipment and general specifications. Product Data Sheets on DC-DC Converters. Product Data Sheets on Filters.

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Converters, Filters, Hybrid Voltage Regulators, Power Supplies, Signal Conditioners & Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Technical Sls.	205-881-1750
Cal	El Toro, Electronic Component Mktg.	714-830-3939
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, Electronic Component Mktg.	714-295-6122
Cal	San Diego, Tech-Ser Inc.	714-222-1121
Cal	Woodland Hills, Electronic Component Mktg.	213-340-1745
Colo	Denver, Straube Assocs./Mtn. States	303-426-0890
Ind	Fort Wayne, W. W. Bieberich	219-432-2537
Mich	Detroit, R.P. Urban & Assocs.	313-535-2355
Mich	Grand Rapids, R.P. Urban & Assocs.	616-245-0511
NM	Albuquerque, Straube Assoc./Mtn. States	505-294-1880
Pa	King of Prussia, Shibley Assocs.	215-688-4021
Utah	Salt Lake City, Straube Assoc./Mtn. States	801-328-4513
Va	Fairfax, Shibley Assocs.	703-591-3008
Wash	Seattle, Integrated Circuits	206-747-8556

Advertisment

CUSTOM HYBRID MICROCIRCUITS Broad capability in military and commercial application. Specialists in custom design services and rapid response to customer needs.
DC-DC CONVERTERS High efficiency, low cost converters with input voltages in the range of 5V to 50V and any output voltages from 5V to 21 V. Standard models available.
ACTIVE FILTERS Total capability in custom and standard hybrid filters.

INTERGRATED MICROSYSTEMS INC., 1215 Terra Bella Ave., Mountain View, Cal., 94043, Tel: 415-965-3900; Empl.: 75

For info on price: A. Nusbaum; Application info: A. Nusbaum; Customer service: J. Laurence

Products manufactured: Cards, Linear Function, Cards, Logic, Circuits, Hybrid, Thick Film, Filters, Integrated Circuit Devices, IC's, Active Filters, Resistors

Local Sales Offices & Reps.

Ariz	Phoenix, Bestronics	602-248-7020
Cal	Los Angeles, Black, Ekizian, Strong Inc.	213-870-9191
Cal	Mountain View, Melchoir/Wesley Assoc.	415-964-2321
Cal	San Diego, Bestronics	714-278-2150
Ill	Park Ridge, R.F. Specialists	312-698-2044
Ind	Indianapolis, R.F. Specialists	
Mass	Billerica, Matrix Sls.	617-667-9268
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Mich	Grand Rapids, J.C. Hofstetter Co.	616-942-0650
Minn	Minneapolis, Elctrn. Innovators, Inc.	612-884-7471
NY	Camillus, ONTEC	315-488-2203
NY	Fayetteville, ONTEC	315-446-2580
NY	Grand Island, ONTEC	716-773-9319
NY	Northport, F. F. Marin Co.	516-261-5585
NY	Rochester, ONTEC	716-464-8636
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Tex	Houston, Semiconductor Sls. Assoc.	713-461-4197
Tex	Richardson, Semiconductor Sls. Assoc.	214-231-6181
Wash	Tukwila, General Elctrns. Inc.	206-243-5141

INTEGRATED PHOTOMATRIX, 1101 Bristol Rd., Mountainside, N.J., 07092, Tel: 201-233-7200; Empl.: 60

Products manufactured: Cameras, Cells, Photoconductive, Photoemissive, Photovoltaic, Circuits, Hybrid, Thick Film, Diodes, Integrated Circuit Devices, Switches

Local Sales Offices & Reps.

Cal	Pasadena, A F Sales Engrg.	213-681-5631
Cal	San Diego, Tauber & Assocs.	714-274-7242
Cal	Sunnyvale, Dynetics International	408-257-7776
Ill	Hinsdale, Hill-Gray Assocs.	312-325-4810
Mass	Amesbury, ATM World Trade	603-394-7874
Minn	Minneapolis, International Sls. Co.	612-831-8423
Mo	Kansas City, R. R. Burton Sls. Co.	816-471-2850
NH	So. Hampton, ATM World Trade	603-394-7874
NY	New York City, ATM World Trade	212-687-5244
Ohio	Cleveland, Ad-El-Tek	216-252-0488
Ohio	Englewood, Ad-El-Tek	513-836-2741
Tex	Plano, Whitson Engrg. Co.	214-423-5255
Wash	Seattle, J. B. Jolly Co.	206-938-4166

INTEL CORP., 3065 Bowers Ave., Santa Clara, Cal., 95051, Tel: 408-246-7501, TWX: 910-338-0026; Empl.: 2000

Products manufactured: Computers, Integrated Circuit Devices, Memory Systems

Local Sales Offices & Reps.

Cal	Irvine, Intel Corp.	714-838-1126
Mass	Lexington, Intel Corp.	617-861-1136
Minn	Bloomington, Intel Corp.	612-835-6722
Pa	Bala Cynwyd, Intel Corp.	215-664-6636

INTER-COMPUTER ELECTRONICS,, Div. American Electronics Laboratories, Inc., Box 507, Lansdale, Pa., 19446, Tel: 215-855-0922, TWX: 510-661-4976; Empl.: 1228; Minimum order: $25 .... p. 1•172,173

Customer service: H. W. Anderson

Free literature available: Literature covering A/D converters, D/A converters, Sample and Hold modules and Pulse and Transient Recorders.

Products manufactured: Amplifiers, Analyzers, Converters, Data Acquisition & Reduction Systems, Data Loggers, Decoders, Encoders, Generators, Multiplexers, Process Control Systems, Recorders

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Mountain View, IFM	415-961-2828
Cal	San Pedro, IFM	213-547-0829
Colo	Denver, Shefler-Kahn Co.	303-831-9087
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Mass	Burlington, Scientific Sys. Sls. Corp.	617-273-1660
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
Minn	Minneapolis, SEA, Inc.	612-425-4455
Mo	St. Louis, Kemco, Inc.	
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
NY	Syosett, Scientific Sys. Sls. Corp.	516-921-3737
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling Co.	513-298-7573
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Tex	Houston, Kemco Inc.	713-467-1061
Tex	Irving, Kemco Inc.	214-255-0537
Wash	Seattle, R. S. Drake Assocs.	206-RO 3-2755
Wisc	Waukesha, SEA, Inc.	414-547-6637
FOR:	Can., Ottawa, Ont., Louis Albert Assoc., Inc.	610-562-8918

INTER-MARKET, INC., 1946 Lehigh Ave., Glenview, Ill., 60025, Tel: 312-729-5330, TWX: 910-651-1997; Empl.: 10; Minimum order: $15 .... p. 2•1173

For info on price: R. M. Scott; Application info: K. Freed; Customer service: R. M. Scott; Delivery info: R. M. Scott

Free literature available: Subminiature miniature, bi-pin/neon/green neon lamps; indicator lights - incandescent and neon; Thumbwheel switches; lighted displays; industrial C.C.T.V.

Products manufactured: Display Devices/Displays, Lamps, Lights, Sockets, Switches, Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Ariz	Phoenix, Spectrum Assoc.	602-997-6324
Cal	San Carlos, Kottmeir Assoc.	415-592-8333
Cal	Santa Ana, Spectrum Assoc.	714-835-4114
Conn	Berlin, White Sls.	203-224-0423
Ill	Downers Grove, Richmar Elctrns	312-968-0118
Md	Glen Wood, Naudain Assoc.	301-442-2270
Mass	Needham, White Sls.	617-444-3676
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Mich	Grand Rapids, J.C. Hofstetter Co.	616-942-0650
Minn	St. Paul, Kenco Co.	612-645-7717
NJ	Harrington Pk., Metro Tech. Sls.	201-768-8495
NJ	Mt. Laurel, Naudain Assoc.	609-235-1801
NY	Jericho, Metro Tech. Sls.	516-935-3330
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-725-4477
Tex	Dallas, Erickson-Ulter Sls	214-243-6611
Wash	Seattle, C.K. Shanks & Assoc.	206-632-4290
Wisc	Oak Creek, Richmar Elctrns.	414-475-0141
FOR:	Can., Montreal, Que., Braydon Electro Ltd.	514-341-3330

INTER-TECH. GRP., INC., Box 23, Irvington-on-Hudson, N.Y., 10533, Tel: 914-LY 1-8822, TWX: 710-564-0802; Empl.: 8
p. 1•19,2356,2357; p. 2•1230

Products manufactured: Alloys, Bi-Metals, Thermostatic, Capacitors, Fixed, Cores, Magnetic, Foil, Heads, Recording Playback, Erase, Laminations, Shields, Tubes

Local Sales Offices & Reps.

Ariz	Phoenix, Palmer Assoc.	602-996-9077
Cal	San Carlos, Winco Sls.	415-365-6082
Cal	San Gabriel, R. G. Moye	213-283-1669
Colo	Denver, Palmer Assocs.	303-255-9961
Fla	Maitland, H. Sarkis	305-647-3671
Fla	Melbourne, Repcom	305-254-1877
Ill	Chicago, J. Golton Co.	312-725-7870
Md	Timonium, Heller	301-252-4780
Mass	Newton, Normell Assocs.	617-969-5478
Minn	Minneapolis, Int'l. Sls.	612-831-8423
NY	Lynbrook, H.B. Heft	516-LY 9-3351
NY	Syracuse, Naylor Elec.	315-GR 2-9183
Ohio	Dayton, BEK Assocs., Inc.	513-278-1343
Pa	Ardmore, Freedman Assoc.	215-649-3679
Tex	Dallas, J. Clay Co.	214-350-1281
Wash	Seattle, H. Levinson	206-323-5100

INTERDATA, 2 Crescent Pl., Oceanport, N.J., 07757, Tel: 201-229-4040, TWX: 710-722-65312; Empl.: 1100

For info on price: D. Von Donop; Application info: J. Gould; Customer service: J. Rechner; Delivery info: D. Von Donop

Products manufactured: Comm. Systems, Computers, Recorders

Local Sales Offices & Reps.

Ariz	Phoenix	602-968-2477
Cal	Los Angeles	213-640-0451
Cal	San Diego	714-565-0602
Cal	San Francisco	415-969-1180
Colo	Denver	303-758-0474
DC	Washington	703-525-4806
Fla	Orlando	305-851-6962
Ill	Chicago	312-437-5120
Mass	Boston	617-890-0557
Mich	Detroit	313-356-5515
Mo	Kansas City, 913-384-1606	
Ohio	Dayton	513-434-4193
Pa	Philadelphia	215-436-5579
Tex	Dallas	214-238-9656
Tex	Houston	713-783-3060
Wash	Bellevue	206-455-0680
Wash	Seattle	206-455-0680
FOR:	Can., Toronto	416-677-8990

INTERDESIGN INC., 1255 Reamwood Ave., Sunnyvale, Cal., 94086, Tel: 408-734-8666, TWX: 910-339-9374; Empl.: 50; Minimum order; $10

Customer service: G. Kurtz

Free literature available: Monochip Brochure; Technical Monochip Journal-quarterly (1 through 6); Pulse Generator Brochure-Model 1101; Thermocouple amplifier Data Sheet-Model 1201.

Products manufactured: Amplifiers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Generators, Indicators, Integrated Circuit Devices

INTERDYNE

INTERDYNE, Intercette Div., 14761 Califa St., Van Nuys, Cal., 91401, Tel: 213-787-6800, TWX: 910-495-1754; FSC No: 31598; Empl.: 80; Minimum order: $25

For info on price: W. Geist; Application info: R. Lewis

Free literature available: Digital Cassette Tape Drives, D.C. servo capstan drive system, ANSY ECMA compatible with cast frame. Interfaced cassette systems with RS 232 and machine interfaces, 1,2, or 3 drives.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Cable, Connectors

Local Sales Offices & Reps.

Ariz	Phoenix, Vari-Tron Sls.	602-997-0774
Cal	La Jolla, REP Sls.	714-454-1500
Cal	Los Altos, Parsons & Meister	415-941-4745
Colo	Boulder, Component Prod. Sls.	303-444-2730
Ill	Chicago, J.C. Angel & Co.	312-878-0653
Ind	Ft. Wayne, Temple Engrg.	219-743-0362
Md	Baltimore, B. White & Assocs.	301-484-5400
Mass	Stoneham, REPCO	617-438-3113
Minn	Minneapolis, Stoss Assocs.	612-925-2757
NJ	Wayne, K & J Assocs.	201-694-3334
NY	E. Setauket, K & J Assocs.	516-751-8686
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Ohio	Wickliffe, W.J. Brauer	216-943-0601
Pa	King of Prussia, Monteiro Assocs.	215-265-0634
Tex	Richardson, P.J. Scanlon Co.	214-231-4661
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778

INTERELECTRONICS CORP., 550 U.S. Rte. 303, Congers, N.Y., 10920, Tel: 914-EL8-8000 ....p. 1•1237

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Converters, Cords, Intensifiers, Image, Inverters, Power Supplies, Thermistors

INTERFACE, INC., 7401 Butherus Dr., Scottsdale, Ariz., 85260, Tel: 602-948-5555; FSC No: 32311; Empl.: 35; Minimum order: $50

For info on price: T. Johnson; Application info: T. Johnson; Customer service: B. P. Moran; Delivery info: B. P. Moran

Free literature available: Catalog 300-A offers concise Models & specification chart & price list. Data sheets for Low Range Minibeam & Sealed Super-Mini give same for new products. Ranges from 5 lbs to 200,000 lbs are included in the literature describing Interface load cells.

Products manufactured: Cells, Load, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins-Co.	205-539-1771
Ariz	Scottsdale, Electronic Entprs.	602-946-9860
Cal	Long Beach, Saber Ent.	213-595-5646
Cal	Mountain View, Gado Instr. Sls.	415-933-5566
Conn	Hamden, Northeast Engrg.	203-248-4481
Fla	Largo, Col-Ins-Co.	813-343-0978
Fla	Orlando, Col-Ins-Co.	305-423-7615
Ga	Clarkston, Col-Ins-Co.	404-934-7280
Ill	Des Plaines, Marsland Assoc.	312-298-2620
Ind	Indianapolis, Marsland Assoc.	317-924-3568
Md	Randlestown, Beacon North	703-534-1868
Mass	Danvers, Northeast Engrg.	617-774-3010
Mich	Farmington, Anderson Electrns.	313-476-9161
Minn	Minneapolis, Marsland Assoc.	612-545-4481
Mo	Florissant, Marsland Assoc.	314-278-6949
NM	Albuquerque, Electronic Entprs.	505-256-3561
NY	Elbridge, L-Tron	315-689-3787
NY	Manhasset, Northeast Engineer	516-365-9633
NC	Raleigh, Col-Ins-Co.	919-834-6591
Ohio	Cleveland, Instrumentation Systems	216-486-0782
Ohio	Dayton, Instrumentation Systems	513-294-2838
Ore	Portland, McLaren	503-297-2248
Pa	Jenkintown, PDC Corp.	215-887-9610
Pa	Pittsburgh, Instrumentation Syst.	412-243-1111
Tex	Fort Worth, Carey Wolf & Assoc.	817-738-1996
Tex	Houston, Carey Wolf & Assoc.	713-721-2442
Va	Falls Church, Beacon North	703-534-1868
Wash	Bellevue, McLaren	206-454-3400

INTERFACE ENGINEERING INC., 386 Lindelof Ave., Stoughton, Mass., 02072, Tel: 617-344-7383; FSC No: 14352; Empl.: 18 ....p. 1•174,175

For info on price: T. Scanlon; Application info: T. Scanlon; Customer service: J. Judd; Delivery info: J. Judd

Free literature available: "Angle Translators"-Summary of digital and analog angle translation modules and their key performance characteristics. The modules encompass all functions required in the developement of medium to high performance control systems.

Products manufactured: Alarms, Amplifiers, Bridges, Comm. Systems, Comparators, Computers, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Decommutators, Telemetering, Indicators, Monitors, Multiplexers, Signal Conditioners & Equipment, Simulators, Synchro Transmitters, Solid-State, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, RDX Corp.
Cal	Pasadena, RDX Corp.
Cal	San Diego, RDX Corp.
Cal	Sunnyvale, RDX Corp.
Va	Arlington, Gans-Fryling

Advertisment

INTERFACE ENGINEERING manufactures analog, synchro, and digital code converters, analog and digital function generators, digital angle operators, coordinate converters, digital couplers, and accessory power supplies and displays for the measurement, control, simulation, and display of shaft position.

INTERFACE TECHNOLOGY INC., 10500 Kahlmeyer Dr., St. Louis, Mo., 63132, Tel: 314-426-6880; Empl.: 30; Minimum order: $75

For info on price: M. E. Smith; Application info: M. E. Smith; Customer service: K. Zienta; Delivery info: K. Zienta

Free literature available: Touch-Tone User's Guide. This small booklet describes the touch-tone transmission technique and the terminal products available from Interface Technology, Inc. to support this growing application area.

Products manufactured: Display Devices/Displays, Encoders, Keyers, Tone, Keyboards, Alphanumeric & Decimal, Terminals, Data Display (including Alphanumeric & Graphic), Typewriters, Input-Output (All Types)

Local Sales Offices & Reps.

NY	Great Neck, H. J. Krasner & Assocs.	516-487-0690
Ohio	Akron, System Mktg. Corp.	216-666-5411

INTERLOK, 770 Airport Blvd., Burlingame, Cal., 94010, Tel: 415-347-7701; Empl.: 30; Minimum order: $50
p. 1•74-77; p. 2•1084-1086

For info on price: R. Vorce 348-5625; Application info: R. Vorce 348-5625; Customer service: A. Fluter 347-7701; Delivery info: R. Vorce 348-5625

Free literature available: Short From Product Catalog Model 12 Card Frame Model 15 Card Frams Model 30 Enclosures Model 34 Consoles Model 36 Enclosures Model 1500 Cabinets Model 1520 Cabinets The Collet Knob Catalog

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Knobs, Racks

Local Sales Offices & Reps.

Ariz	Phoenix, Bestronics	602-248-7020
Ark	Little Rock, J.Y. Schoonmaker Co.	501-375-2168
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Los Angeles, Black, Ekizan, Strong, Inc.	213-870-9191
Cal	San Diego, Bestronics	714-278-2150
Colo	Denver, W.J. Purdy Co.	303-777-1411
Conn	Meriden, P.R. Sturgeon Co.	203-237-1112
Ill	Hinsdale, Hill-Gray Assoc.	312-325-4810
Ind	Indiaanapolis, Sukup & Cox	317-253-5501
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
Minn	Minneapolis, HMR	612-920-8200
NJ	Bergenfield, Harold Gray Assocs.	201-384-3643
NM	Albuquerque, W.J. Purdy Co.	505-266-7959
NY	Syracuse, Mar-Com Assocs.	315-437-2843
Okla	Tulsa, J.Y. Schoonmaker Co.	918-936-1423
Pa	Enon Valley, Nebco Assoc.	216-457-2333
Pa	Havertown, Liberi Sls.	215-789-8150
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Tex	Houston, J.Y. Schoonmaker Co.	713-926-9510
FOR:	Can., Willowdale, Ont., A.C. Simmonds & Sons	416-491-1010

INTERMATIC, INC., Intermatic Plaza, Spring Grove, Ill., 60081, Tel: 815-675-2321, Telex: 25-265; Empl.: 700; Minimum order: $50

For info on price: J. Sechrist; Application info: J. Sechrist; Customer service: A. Dunn; Delivery info: A. Dunn

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, T. Geis & Assocs.	602-252-7694
Cal	Los Angeles, Intermatic, Inc.	213-627-1506
Cal	San Francisco, Keeler, White Co.	415-431-2900
Colo	Denver, E.O. Sales	303-744-7081
Fla	Coral Gables, J.H. Akerman	305-667-3864
Ga	Atlanta, C. Powell, Inc.	404-875-0755
Haw	Honolulu, H.H. Sawyer Co.	808-847-1411
Ind	Indianapolis, C.K. Warble Assocs.	317-632-1465
Iowa	Cedar Rapids, A. Sell & Assocs.	319-393-4225
Kans	Shawnee Mission, Stover & Assocs.	913-649-6600
Ky	Covington, Hackman Electrical Sls.	606-291-3800
La	New Orleans, W. Case & Assocs.	504-835-7713
Mass	Woburn, Yusen Assocs.	617-935-8500
Mich	Southfield, Linder Assocs.	313-353-4334
Minn	Golden Valley, Elstad Sales Co.	612-533-3033
Mo	Kirkwood, Martin Electrical Sls.	314-966-8659
Neb	Omaha, Midwest Equip. Co.	402-734-1020
NJ	Rahway, Nash & Cornell	201-381-2400
NM	Albuquerque, T. Deskin & Assocs.	505-242-3581
NY	New Hartford, F.W. Laver & Son	315-724-2304
NC	Charlotte, E.F. Lombardi	704-334-1637
Ohio	Bedford Heights, Riffle & Assocs.	216-439-5500
Okla	Jenks, W.G. Parker	918-299-5449
Ore	Portland, M.H. Gerrard	503-224-0864
Pa	Philadelphia, W.C. Welde & Sons	215-243-1120
Pa	Pittsburgh, H.W. Groetzinger Co.	412-322-6280
Tex	Dallas, T.C. Kissel Co.	214-742-2349
Tex	Houston, Kopinitz Co.	713-692-0022
Utah	Salt Lake City, J.R. Christensen & Assocs.	801-486-0031
Wash	Seattle, Tal Agencies	206-624-3355
Wisc	Wauwatosa, G.R. Adams & Assocs.	414-453-7130

INTERNATIONAL COMMUNICATIONS, A Milgo Co., 8600 NW 41st St., Miami, Fla., 33166, Tel: 305-592-7654, TWX: 810-848-6588; Empl.: 1400

Free literature available: Data communications products catalog.

Products manufactured: Comm. Systems, Modulator/Demodulators, Terminals, Data Display (including Alphanumeric & Graphic), Testers

Local Sales Offices & Reps.

Cal	Los Angeles, Intl. Comm. Corp.	213-641-3961
Cal	Oakland, Persons & Assocs.	415-569-6461
Cal	Sunnyvale, CSS Telecommunications Specialists	408-739-8366
Cal	Torrance, CSS Telecommunications Specialists	213-372-9360
Colo	Littleton, Cropley, Inc.	303-794-4231
Conn	Westport, T.H. Maguire & Assocs.	203-227-1976
DC	Washington, Intl. Comm. Corp.	202-296-4940
Fla	Ft. Lauderdale, Modemsplus	305-587-3849
Fla	Tampa, Modemsplus	813-223-7932
Ga	Atlanta, Intl. Comm. Corp.	404-996-6327
Ill	Alton, Information Prods.	314-355-4340
Ill	Chicago, HH Sls.	312-337-4478
Kan	Prairie Village, Giddings Co.	913-831-0727
Ky	Louisville, Data Processing Sciences	502-459-1206
Md	Silver Springs, Computer Complements Inc.	301-593-1559
Mass	Danvers, John Melanson & Assocs.	617-774-1220
Mich	Southfield, Data Processing Sciences	313-557-3164
Minn	Minneapolis, Delta Comms. Sys.	612-884-0202
Mo	Independence, Information Prods. Inc.	816-252-3700
NY	Great Neck, Harvey J. Krasner Assocs. Inc.	516-487-0690
NY	Herkimer, Gall & Annese Assocs.	315-458-7189
NY	Massapequa, L.E. Walz & Assocs.	516-798-3119
NY	New York, Int'l. Comm. Corp.	212-687-5040
Ohio	Cincinnati, Data Processing Sciences Corp.	513-961-0776
Ohio	Cleveland, Data Processing Sciences Corp.	216-886-2090
Ohio	Toledo, Data Processing Sciences Corp.	419-472-0111
Ohio	Vendalia, Data Processing Sciences Corp.	513-275-6781
Ohio	Worthington, Data Processing Sciences Corp.	614-224-4081
Ore	Beaverton, SJI	503-646-3004
Pa	Bala-Cynwyd, Applied Energy Systems Inc.	215-667-1010
Tenn	Nashville, Modemsplus, Inc.	615-868-1004
Tex	Richardson, Computer Mktg. Corp.	214-231-1426
Wash	Seattle, SJI Inc.	206-624-9020
Wisc	Milwaukee, Delta Commus. Sys.	414-774-1989
FOR:	Can., Montreal 252, Que., Electronetic Supt. Ltd.	514-342-4112
FOR:	Downsview, Ont., Can., Electronetic Supt. Ltd.	416-661-3673
FOR:	Ottawa 8, Ont., Can., Electronetic Supt. Ltd.	613-733-3781
FOR:	Vancouver, B.C., Can., Western Electronetic Supt. Ltd.	604-687-5696

INTERNATIONAL COMPS CORP., 105 Maxess Rd, Melville, N.Y., 11746, Tel: 516-293-1500, TWX: 510-224-6409; Empl.: 100; Minimum order: $50 p. 2•192,193

For info on price: M. Karasik; Application info: I. Greenburg; Customer service: R. Schuster; Delivery info: R. Rubenstein

Free literature available: Aluminum Electrolytic Capacitors; Tantalum Capacitors; Film Capacitors; Metallized Film Capacitors; Ceramic Disc Capacitors; Carbon Film Resistors; Carbon Composition Resistors.

Products manufactured: Capacitors, Fixed, Diodes, Meters, Potentiometers, Resistors, Tubes

Advertisment

INTEROHM RESISTORS - including carbon composition, and carbon film. INTERCAP CAPACITORS - miniature electrolytics, dipped tantalums, and miniature film. INTERNATIONAL SERVICEMASTER & 10M RECEIVING TUBES - all domestic & foreign types. ALL PRODUCTS ARE STOCKED IN DEPTH. LARGE QUANTITIES OF STANDARD VALUES AVAILABLE.

INTERN'L. COMPUTER PRODS., INC., 2925 Merrell Rd., Dallas, Tex., 75229, Tel: 214-350-6951; Empl.: 102

Customer service: G. Rocky

Free literature available: A 16 page brochure on the most versatile digital cassette family with descriptions, specifications and photographs.

Products manufactured: Recorders, Tape Recording Accessories, Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest Peripherals	602-995-1508
Cal	Sherman Oaks, Electronic Mktg Specialists	213-990-4244
Conn	Stamford, ICP East Coast Regional Off.	203-327-6263
Fla	Orlando, Technical Assocs.	305-894-7531
Minn	Minneapolis, Loonam Assocs.	612-831-1616
FOR:	Can., Ottawa, Ont., L. Albert Assocs.	613-737-5941

INTERNATIONAL CRYSTAL MFG., 10 N. Lee St., Oklahoma City, Okla., 73102, Tel: 405-CE 6-3741, TWX: 910-831-3177 p. 1•362-366,738

Products manufactured: Crystal Blanks, Crystals, Oscillators

INTERNATIONAL DATA SCIENCES, 100 Nashua St., Providence, R.I., 02904, Tel: 401-274-5100, TWX: 710-381-0285; Empl.: 35

Customer service: Sls. Dept.

Free literature available: Specification sheets describing various products. Short form catalog and technical article reprints also available. Telephone line matrix switches and special systems quoted on request.

Products manufactured: Cable Assemblies & Harnesses, Generators, Panels, Printers, Testers

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Alas	Anchorage, Consolidated Comm.	907-272-3591
Ariz	Scottsdale, Barnhill Three	602-947-7841
Cal	N. Hollywood, O'Halloran Assoc.	213-877-0173
Colo	Denver, Barnhill Three	303-934-5505
Conn	Wallingford, Instrument Assoc.	203-525-9367
Ill	Elk Grove Village, L.F. Green & Assoc.	312-593-0282
Ind	Indianapolis, L.F. Green Assoc.	317-293-9827
Kans	Shawnee Mission, Inland Assoc.	913-362-2366
Md	Gaithersburg, Wright Co.	301-948-5151
Mass	Bedford, Instr. Assoc.	617-275-0700
Minn	Minneapolis, L.F. Green & Assoc.	612-781-1611
Mo	Glencoe, Inland Assocs.	314-938-4992
NJ	Pennsauken, Megargel/Himmelstein Assoc.	609-622-3081
NJ	Ridgewood, Instrumentation Sls. Co.	201-445-5210
NM	Albuquerque, Barnhill Three	505-299-7658
NY	E. Syracuse, Ossmann Instr.	315-437-6666
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Dayton, Ashby Assocs.	513-252-5627
RI	Providence, Int. Data Sciences	401-274-5100
Tex	Richardson, Barnhill Two	214-231-2573
Wash	Seattle, Delcom Sls. Co.	206-248-0090

INTERNATIONAL ELECTRO EXCH. CORP., See IEE/Schadow, Inc.

INTERNATIONAL ELECTRO-MAGNETICS, Eric Dr. & Cornell Ave., Palatine, Ill., 60067, Tel: 312-358-4622; Empl.: 30 p. 1•16,17

Products manufactured: Cameras, Controls/Control Eqpt., Heads, Recording Playback, Erase, Mounts, Recorders, Tape Recording Accessories, Transducers

INT'L. ELCTRN. RESCH., 135 W. Magnolia Blvd., Burbank, Cal., 91508, Tel: 213-849-2481, TWX: 910-498-2206; FSC No: 98978; Empl.: 110; Minimum order: $25

Customer service: Order Desk

Free literature available: Product Technical Bulletins (individual) Short Form Catalog 1974/1975 General Catalog 1974/1975 22 Pg. Article "Semiconductor Thermal Mgmt." 17 Pg. Article "U.S. Navy SHP - Standard Packaging".

Products manufactured: Boards, Printed Circuit, Chassis, Circuit Board Mounting, Circuits, Printed, Multilayer, Coatings, Guides, Circuit Board, Heat Exchangers & Systems, Metal Oxides, Racks, Retainers, Shields, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ala	Huntsville, Murcota Corp.	205-539-8476
Ariz	Phoenix, Piper Sales Co.	602-946-4436
Cal	Burlingame, J. Logan	415-697-6100
Cal	Los Angeles, Ed Landa Co.	213-879-0770
Colo	Denver, Vinson Assocs.	303-757-5151
Conn	Canaan, Hathaway Elctrns.	800-225-1293
Fla	Clearwater, Lynch-Gentry Assocs.	813-443-2697
Ill	Mt. Prospect, Magnuson	312-956-0700
Kans	Leawood, Thunderbird Tech.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls.	316-684-3941
Mass	Lexington, Hathaway Elct.	617-861-7010
Mich	Utica, N. Case Assocs.	313-781-3900
Minn	St. Paul, Magnuson	612-227-8495
Mo	St. Louis, Thunderbird Tech.	314-567-6488
NJ	Clifton, Compar N.Y.	201-546-3660
NY	Buffalo, Ossmann Component Sls. Corp.	716-832-4271
NY	Kingston, Ossmann Component Sls. Corp.	914-338-5505
NY	Rochester, Ossmann Component Sls. Corp.	716-442-3290
NY	Syracuse, Ossmann Component Sls. Corp.	315-454-4477
NY	Vestal, Ossmann Component Sls. Corp.	607-785-9949
NC	Winston-Salem, Murcota Corp.	919-723-1001
Ohio	Centerville, N. Case Assocs.	513-435-1301
Ohio	Rocky River, N. Case Assocs.	216-333-4120
Pa	Philadelphia, Kenneth B. Erdman Co.	215-224-1833
Pa	Pittsburgh, R. F. Clark Co.	412-242-9502
Tex	Dallas, Blair Engrg.	214-352-8411
Wash	Seattle, F. Jackson Co.	206-782-2211
FOR:	Can., Burlington, Ont., White Radio	416-634-1845
FOR:	Can., Montreal, Que., White Radio	514-482-8091

INTERNATIONAL ELECTRONICS CORP., I.E.C./El-Menco Capacitors, 316 S. Service Rd., Melville, N.Y., 11746, Tel: 516-694-7700, TWX: 510-224-6427; Empl.: 3000 p. 2•194,195

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Diodes, Tubes

Local Sales Offices & Reps.

Conn	Milford, Conti-Younger	203-929-3294
Ill	Chicago, S. DiMarco	312-237-4454

Ill	Des Plaines, E. Flaxman Co.	312-298-8580
Mass	Waltham, Conti-Younger Assocs.	617-890-4582
Minn	St. Louis Park, Beta Engrg.	612-925-4422
NJ	Harrington Park, Metro Tech. Sls.	201-768-8495
NY	Endicott, Advanced Comps.	607-785-3191
NY	Jericho, Metro Tech. Sls.	516-935-3330
NY	No. Syracuse, Advanced Comps.	315-699-2671
Pa	Ardmore, W.K. Metz	215-MI9-3966
Tex	Dallas, United Comps.	214-324-1448
Wash	Seattle, R. Thorp Co.	206-763-1236

INTERNATIONAL IDENTIFICATIONS, 1917 Green Spring Dr., Timonium, Md., 21903, Tel: 301-252-1768; Empl.: 15

Customer service: W. B. Yahn

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Kits, Marking (Dial, Instrument, Equipment, etc.), Lead Assemblies & Receptacles, Leads, Test & Adaptors, Machines/Machinery, Production, Services, Assembly, Production & Test, Strips, Tubing, Wire, Wire Shielding

Advertisment

Flat woven cable, harness and cable assembly, wire and cable markers, lead assembly braided cable, hot stamping, cutting and stripping wire, back panel wiring, circumferential color coding of wire. Engineering and design assistance on all phases of interconnections and wire and cable marking.

INTERNATIONAL IMPORTERS, 2244 S. Western Ave., Chicago, Ill., 60608, Tel: 312-847-6363, TWX: 910-221-1394; Empl.: 35

Customer service: B.A. Moll Ext. 226

Products manufactured: Capacitors, Fixed, Diodes, Jacks (All Types), Microphones, All Kinds, Resistors, Speakers, Transistors, Tubes

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Cal	Marina Del Ray, Intervend	213-821-7936
Colo	Denver, Franklin Sls.	303-922-3623
Ill	Chicago, Minitron	312-774-6815
Ind	Indianapolis, W. Deem & Assoc.	317-844-2993
Iowa	Des Moines, Beams	515-282-0292
Kans	Shawnee Mission, Beams	913-888-6110
Mass	Waltham, MSN Assoc. Inc.	617-893-6211
Mich	Ferndale, Shalco	313-547-4771
Minn	St. Paul, D. Countryman & Assoc.	612-645-9151
Mo	St. Louis, Beams	314-781-6855
NY	NYC, C. Avery & Assoc.	212-823-5224
NY	Rye, C. Avery & Assoc.	914-967-7610
Pa	Philadelphia, Danton Assoc.	215-353-0500
Tex	Dallas, Techno Assoc.	214-357-9213

INT'L. INSTRS., Div. Sigma Instrs., 88 Marsh Hill Rd., Orange, Conn., 06477, Tel: 203-795-4711, TWX: 710-465-2897; Empl.: 275; Minimum order: $50

For info on price: J. Connolly; Application info: J. Connolly; Customer service: M. Schultz; Delivery info: M. Schultz

Free literature available: Catalog - individual data sheets

Products manufactured: Alarms, Controls/Control Eqpt., Indicators, Meters, Monitors, Relays

Local Sales Offices & Reps.

Ala	Huntsville, Brandel-Stephens & Co. Inc.	205-883-0445
Ariz	Phoenix, J. S. Heaton Co.	602-264-7887
Cal	Burlingame, Engineering Rep. Co.	415-692-2581
Cal	Los Angeles, Barnard & Assocs.	213-973-5050
Cal	San Diego, Engineering Rep. Co.	714-565-6366
Colo	Englewood, Tech Sls.	303-789-2864
Fla	Orlando, Brandel-Stephens & Co.	305-425-3202
Ga	Atlanta, Brandel-Stephens & Co.	404-261-7579
Ill	Westchester, Gassner & Clark Co.	312-345-4245
Kans	Shawnee Mission, Technical Sls. Assoc.	913-888-3330
La	Harahan, Williams Equipment Co.	504-737-4082
Md	Baltimore, J.R. Daniel & Co.	301-825-3330
Mass	Needham Heights, Northeast Reps.	617-449-3093
Mich	Detroit, Stress Analysis Services	313-535-1120
Minn	Minneapolis, Pilot Industrial Controls	612-941-7400
Mo	Ferguson, Technical Sls. Assocs.	314-725-5361
NJ	Stirling, NBS Assocs.	201-464-8500
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Fayetteville, H.C. Johnson Agencies	315-637-9383
NY	Rochester, H.C. Johnson Agencies	716-482-3000
NC	Charlotte, D.G.W., Inc.	704-334-7090
NC	Winston Salem, D.G.W., Inc.	919-768-7166
Ohio	Medina, Stress Analysis Services	216-725-7733
Okla	Tulsa, Telstar Instrument Corp.	918-628-1011
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Pa	Paoli, Stitzer Assocs.	215-644-5500
Tex	Dallas, J. B. Guenther, Inc.	214-691-8500
Tex	Houston, Instrumatics, Inc.	713-225-6626
Wash	Bellevue, General Elctrns., Inc.	106-885-4148

Local Distributors

Ariz	Phoenix, Metermaster, 2633 E. Buckeye Rd.	602-273-7331
Cal	Los Angeles, Metermaster, 5646 Jillson St.	213-685-4340
Cal	Palo Alto, Metermaster, 3995 E. Bayshore	415-968-0313
Colo	Denver, Metermaster Instr. Corp., 1165 So. Cherokee	303-722-5766
Conn	Middletown, Mancib Co., Box 467	203-346-6646
Fla	Ft. Lauderdale, A & M Instrs., 4257 N.E. 6th Ave.	305-565-2579
Ill	Chicago, E.I.L. Instrs., 221 W. 79th St.	312-874-8070
La	New Orleans, Ind. Instr. Works, 3305 Tchoupitoulas	504-895-5621
Md	Timonium, E.I.L. Instrs., 1830 York Rd.	301-252-1260
Mass	Burlington, Mancib Co., Middlesex Tpke.	617-272-9450
Mich	Royal Oak, Stillings Instr., 4850 Leafdale Rd.	313-549-6030
Minn	Minneapolis, Control Assemblies Co., 5735 Lindsey St.	612-544-3364
NY	Buffalo, Trott Elctrns., 932 Hertel Ave.	716-876-0880
NY	Rockville Center, A & M Instrs., 5 Nassau St.	516-678-6960
Ohio	Cleveland, Weschler Electric., 4250 W. 130th St.	216-251-4609
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-288-2600
RI	E. Greenwich, E.I.L. Instrs., 99 French Town Rd.	401-885-1773
Tex	Houston, Meters & Instr., 6502 Gulf Frwy.	713-644-1631
Wash	Seattle, Eicher Richards, 2727 N.E. Blakeley	206-523-7888

INTERNATIONAL NICKEL CO., Huntington Alloy Prods. Div., Huntington, W.Va., 25720

INTERNATIONAL POWER MACHINES CORP., 3328 Executive Blvd., Box 724, Mesquite, Tex., 75149, Tel: 214-288-7501, Telex: 73-0992; Empl.: 140

For info on price: F. Perkins; Application info: F. Perkins; Customer service: J. Herr; Delivery info: L. Parks

Products manufactured: Converters, Inverters, Power Supplies

Local Sales Offices & Reps.

Ark	North Little Rock, Kennedy Engrg. Co.	501-753-6306
Cal	, Emeryville .... Independent Engrg., Inc.	
Cal	San Diego, Independent Engrg.	714-995-5959
Colo	Denver, Benchmark Sys., Inc.	303-399-1062
DC	Washington, Instrucom, Inc.	202-223-1759
Fla	Orlando, R.J.C. Assocs.	305-894-7371
Ga	Atlanta, Forward Prods. Co.	404-255-1016
Haw	Honolulu, Island Rep., Inc.	808-531-4011
Ill	Schaumburg, Tech-Sys.	312-894-0015
NJ	Upper Montclair, D. Cunningham	201-783-4647
NY	Rochester, PCI Assocs.	716-334-6793
Ohio	Cleveland, P.E. Lax Co.	216-226-8815
Okla	Oklahoma City, Kennedy Engrg. Co.	405-524-6048
Okla	Tulsa, Kennedy Engrg. Co.	918-835-9975
Ore	Portland, Ingalls Engrg. Co.	503-232-7487
Pa	Croydon, J. LeSaint	215-788-8212
Pa	Pittsburgh, P.E. Lax Co.	412-833-5477
Tex	Houston, L.P. Spencer & Assocs.	713-337-2751
Utah	Salt Lake City, Benchmark Sys.	801-487-4955
Va	Danville, Instrucom, Inc.	804-799-1661

INTERNATIONAL POWER MACHIN cont'd

Advertisment

Manufacturer of 'Computer Grade' Uninterruptible Power Systems (UPS) providing 50 Hz, 60 Hz, & 415 Hz power in the range from 10 KVA to 300 KVA. Equipment is compatible with IBM system/370 computers.

INT'L. PRODS. INC., Box 405, Atchison, Kans., 66002, Tel: 913-EM 7-1934; Empl.: 3; Minimum order: $25

For info on price: L. Poos; Application info: T. Moorhead; Customer service: L. Poos; Delivery info: L. Poos

Products manufactured: Lamp Adapters, Lamps, Lights

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg. Assocs.	602-955-3193
Cal	Mountain View, Connolly & Co.	415-967-6988
Cal	Van Nuys, C.H. Mitchell Co.	213-994-9466
Colo	Greeley, Moss Elctrns.	303-353-1452
Fla	Melbourne, REPCOM Inc.	305-254-1877
Mass	Belmont, Elctrn. Comps. & Svc.	617-484-8680
Mich	Jackson, Norwood Scroggs Co.	517-782-5211
NJ	West Caldwell, Peterson-Rudnick Assocs.	201-CA6-4363
NY	Rochester, Ossmann Comp. Sls. Corp.	716-442-3290
NC	Charlotte, Power Engrg. Co.	704-537-8099
Ohio	Cleveland, Brownie & Assocs.	216-795-7472
Ore	Portland, J. E. Edstrom	503-775-8527
Tex	Houston, M. R. Summers Assocs.	713-524-7800
Wash	Seattle, W.J. Stulgis	206-AT2-7870

INTERNATIONAL RECTIFIER CORP., Semiconductor Div., 233 Kansas St., El Segundo, Cal., 90245, Tel: 213-678-6281, TWX: 910-348-6291; Empl.: 1200

p. 1•1842,1843

For info on price: F. Angier; Application info: B. Bixby; Customer service: F. Angier; Delivery info: F. Angier

Free literature available: A complete selection of cross references to IR product lines. Also an increasing number of application notes. Write for index.

Products manufactured: Arresters, Electrical Surge, Lightning, Bridges, Cells, Photoconductive, Photoemissive, Photovoltaic, Chargers, Battery, Circuits, Hybrid, Thick Film, Controls/Control Eqpt., Converters, Diodes, Eliminators, Battery, Fuses, Heat Exchangers & Systems, Inverters, Power Drivers, Hybrid (High Current, High Voltage), Power Supplies, Protectors, Readers, Rectifiers, References, D-C Voltage, Regulators, Relays, Sensors, Light, Suppressors, Switches, Thyristors (Includes Silicon Controlled Rectifiers), Transistors, Tubes

Local Sales Offices & Reps.

Alas	Anchorage, H.J. Lang & Assoc.	907-279-5741
Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	El Segundo, Int'l. Rectifier	213-678-2181
Cal	San Diego, Harvey King	714-276-7541
Cal	San Francisco, Thomas-Hartman Assocs.	415-969-0660
Cal	Santa Clara, Thomas-Hartman Assocs.	408-247-1252
Colo	Denver, Parker-Webster	303-770-1972
DC	Washington, Int'l. Rectifier	301-821-0292
Fla	Ft. Lauderdale, Dyne-A-Mark Corp.	305-771-6501
Ill	Des Plaines, Int'l. Rectifier	312-299-7181
Iowa	Cedar Rapids, Seltec Sls. Corp.	319-362-8155
Md	Baltimore, Int'l. Rectifier	301-821-0292
Mass	Lexington, Int'l. Rectifier	617-861-1820
Mich	Livonia, Int'l. Rectifier	313-477-3131
Minn	Minneapolis, Int'l. Rectifier	612-920-1200
Mo	Hazelwood, Int'l. Rectifier	314-895-3400
NJ	Palisades Park, Int'l. Rectifier	201-943-4554
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	New York, Int'l. Rectifier	212-565-0882
NC	Charlotte, Int'l. Rectifier	704-372-9190
Ohio	Cleveland, Int'l. Rectifier	216-261-2135
Ohio	Kettering, Int'l. Rectifier	513-299-2635
Okla	Tulsa, W. Pat Fralia Co.	918-663-8707
Pa	Abington, Int'l. Rectifier	215-886-0130
Tenn	Shelbyville, R.W. Mitscher Co.	615-684-4549
Tex	Fort Worth, W. Pat Fralia Co.	817-738-2394
Tex	Houston, W. Pat Fralia Co.	713-772-1572
Wash	Bellevue, Vantage Corp.	206-455-3460
Wisc	Brookfield, Int'l. Rectifier	414-784-2480
FOR:	Can., Dorval, Que., Int'l. Rectifier Can. Ltd.	514-631-4969

FOR: Can., Scarborough, Ont., Int'l. Rectifier Can. Ltd. 416-755-7793

Local Distributors
Ala Huntsville, Hall-Mark Elctrns., 4739 Commercial Dr. 205-837-8700
Ala Huntsville, Powell/Gulf Elctrns., 803 Aster Dr. 205-539-2731
Ariz Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd. 602-273-7331
Cal Costa Mesa, Schweber Elctrns., 3000 Red Hill Ave. 714-556-3880
Cal Inglewood, Newark Elctrns., 4747 Century Blvd. 213-678-0441
Cal Los Angeles, Kierulff Elctrns., 2585 Commerce Way 213-685-5511
Cal Los Angeles, RPS Elctrns., 1501 S. Hill St. 213-748-1271
Cal Mountain View, Abacus, 1065 Terra Bella Ave. 415-961-1500
Cal Oakland, Brill Elctrns., 610 E. 10th St. 415-834-5888
Cal Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd. 415-968-6292
Cal San Diego, Intermark Elctrns., 7354 Convoy Court 714-279-5200
Cal San Diego, Kierulff Elctrns., 8797 Balboa Ave. 714-278-2112
Cal San Diego, Liberty Elctrns., 8248 Mercury Ct. 714-565-9171
Cal Santa Ana, Intermark Elctrns., 2920 W. Warner 714-540-1322
Cal Sunnyvale, Intermark Elctrns, 1020 Stewart Dr. 408-738-1111
Colo Denver, Intermark Elctrns., 2600 W. Second Ave. 303-936-8284
Colo Denver, Kierulff Elctrns., 10890 E. 47th Ave. 303-371-6500
Conn Danbury, Schweber Elctrns., Finance Dr., Commerce Ind'l. Pk. 203-792-3500
Fla Ft. Lauderdale, Hall-Mark Elctrns., 1302 W. McNab 305-971-9280
Fla Hollywood, Schweber Elctrns., 284 N. 28th Terrace 305-927-0511
Fla Miami, Powell Elctrns., 1740 N.W. 69th Ave. 305-887-8761
Fla Orlando, Hall-Mark Elctrns., 7233 Lake Ellenor Dr. 305-855-4020
Fla Orlando, Powell Elctrns., 2032 Tomridge Way 305-859-1450
Ga Atlanta, Schweber Elctrns., 4126 Pleasantdale Rd. 404-449-9170
Ill Chicago, Allied Elctrns., 2400 W. Lake St. 312-829-9100
Ill Chicago, Newark Elctrns., 500 N. Pulaski Rd. 312-638-4411
Ill Elk Grove Village, Hall-Mark Elctrns., 180 Crossen St. 312-437-8800
Ill Elk Grove Village, Schweber Elctrns., 1380 Jarvis Ave. 312-593-2740
Ill Skokie, Bell Inds., 7701 North Austin Ave. 312-965-7500
Ind Fort Wayne, Fort Wayne Elctrns., 3606 Maumee Ave. 219-423-3422
Ind Indianapolis, Graham Elctrns., 133 S. Pennsylvania 317-634-8202
Iowa Cedar Rapids, Schweber Elctrns., Executive Plaza, Suite 302, 4403 First Ave., S.E. 319-319-366-0774
Kans Lenexa, Hall-Mark Elctrns., 9006 Rosehill Rd. 913-888-4747
Md Baltimore, Hall-Mark Elctrns., 6660 Security Blvd. 301-265-8500
Md Gaithersburg, Kierulff Elctrns., 16021 Industrial Dr. 301-948-0250
Md Rockville, Schweber Elctrns., 5640 Fisher Ave. 301-881-2970
Mass Waltham, Schweber Elctrns., 213 Third Ave. 617-890-8484
Mass Watertown, Sterling Elctrns., 51 Spring St. 167-926-9720
Mich Troy, Schweber Elctrns., 86 Executive Dr. 313-583-9242
Minn Edina, Schweber Elctrns., 7015 Washington Ave. 612-941-5280
Minn Minneapolis, Hall-Mark Elctrns., 4555 West 77th St. 612-925-2944
Minn Minneapolis, Stark Elctrns., 112 Third Ave. N. 612-333-3361
Mo Earth City, Hall-Mark Elctrns., 13789 Rider Trail 314-291-5350
Mo Saint Louis, Olive Ind'l. Elctrns., 6662 Olive Blvd. 314-863-7800
NJ Clifton, Wilshire Elctrns./N.J., 312 Clifton Ave. 201-365-2600
NJ Somerset, Schweber Elctrns., 43 Bellmont Dr. 201-469-6008
NY Buffalo, Summit Distrs., 916 Main St. 716-884-3450
NY Farmingdale, Arrow Elctrns., 900 Broadhollow Rd., Route 110 516-694-6800
NY Farmingdale, Hall-Mark Elctrns., 167 Marine St. 516-293-7500
NY Freeport, Milgray/N.Y., 191 Hanse Ave. 516-546-6000
NY Hicksville, L.I., Kierulff Elctrns., 49 Bethpage Rd. 516-433-5530
NY Rochester, Rochester Radio Supply, 140 W. Main St. 716-454-6300
NY Rochester, Schweber Elctrns., 2 Town Line Cir. 716-328-4180
NY Westbury, Schweber Elctrns., Jericho Turnpike 516-334-7474
NC Raleigh, Hall-Mark Elctrns., 3000 Industrial Dr. 919-832-4465
NC Raleigh, Schweber Elctrns., 10 Sunnybrook Rd. 919-832-8881
Ohio Beachwood, Schweber Elctrns., 23880 Commerce Park Rd. 216-464-2970
Ohio Cleveland, Arrow Elctrns., 23500 Mercantile Rd. 216-464-2000
Ohio Dayton, Esco Elctrns., 221 Crane St. 513-226-1133
Okla Tulsa, Hall-Mark Elctrns., 4846 S. 83rd E. Ave. 918-835-8458
Okla Tulsa, T.I. Supply, Box T, Admiral Station 918-437-4555
Ore Portland, United Radio Supply, 123 N.E. 7th 503-233-7151
Pa Erie, Mace Elctrns., 2631 W. 8th St. 814-838-3511
Pa Huntington Valley, Hall-Mark Elctrns., 458 Pike Rd. 215-355-7300
Pa Philadelphia, Almo Elctrns., Roosevelt Blvd. at Blue Grass Rd. 215-676-6000
Pa Philadelphia, Powell Elctrns., South Island Rd. 215-365-1900
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-288-2606
Tenn Knoxville, Industrial Elctrns., Box 9120 615-573-7135
Tex Austin, Schweber Elctrns., 2628 Longhorn Blvd. 512-837-2890
Tex Dallas, Hall-Mark Elctrns., 9333 Forest 214-231-6111
Tex Dallas, Kierulff Elctrns., 2750 Northaven 214-243-4521
Tex Dallas, Schweber Elctrns., 14177 Proton Rd. 214-233-5866
Tex Dallas, T.I. Supply, 6000 Denton Dr. 214-238-6974
Tex Houston, Hall-Mark Elctrns., 8000 West Glen 713-781-6100
Tex Houston, Harrison Equip., 1616 McGowen 713-224-9131
Tex Houston, Schweber Elctrns., 7420 Harwin Dr. 713-784-3600
Tex Houston, T.I. Supply, 3939 Ann Arbor Dr. 713-785-4800
Utah Salt Lake City, Intermark Elctrns., 63 E. Stratford 801-486-3411
Wash Seattle, Almac-Stroum Elec., 5811 6th Ave. S. 206-763-2300
Wash Seattle, Intermark Elctrns., 621 S. Michigan St. 206-767-3160
WVa Charleston, McJunkin Corp., 312 Mac Corkle Ave., S.E. 304-348-4930
wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500
Wisc Milwaukee, Hall-Mark Elctrns., 11925 W. Ripley Ave. 414-476-1270

INTERNATIONAL SENSOR SYSTEMS, INC., Aurora Industrial Pk., Box 345, Aurora, Neb., 68818, Tel: 402-694-6111; Empl.: 18; Minimum order: $100

Customer service: Sls. Dept.

Free literature available: Facilities and Capabilities brochure, Descriptions of facilities with photographs and a flow chart of typical Hybrid thick film system.

Products manufactured: Circuits, Hybrid, Thick Film, Networks, Resistor, Hardware

Local Sales Offices & Reps.
Cal Millbrae, Ashby Assocs. of N. Cal. 415-692-4442
Cal Studio City, Shortronics 213-789-0418
Kans Mission, Mid America Elctrns. 913-236-4800
NY Endicott, Tech-Mark Inc. 607-748-7473
Ohio Dayton, Ashby Assocs. 513-252-5627

INTERSIL, INC., 10900 N. Tantau Ave., Cupertino, Cal., 95014, Tel: 408-996-5000, TWX: 910-338-0228; FSC No: 32293; Empl.: 750; Minimum order: $50

Customer service: Customer Service 408-996-5257

Free literature available: Information on Low Power CMOS Monolithic Watch and Clock circuits. Devices Available for both Analog and Digital Application.

Products manufactured: Amplifiers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Integrated Circuit Devices, Transistors

Local Sales Offices & Reps.
Ariz Phoenix, Shefler-Kahn Co. 602-258-7893
Cal Carson, Intersil Inc. 213-532-3544
Cal Cupertino, Intersil, Inc. 408-257-5450
Cal San Diego, Intersil Inc. 714-278-6053
Colo Littleton, Simpson Assocs. 303-794-8381
Fla Casselberry, E.I.R. Inc. 305-830-9600
Ill Franklin Park, Dekotech, Inc. 312-455-5100
Ill Palos Heights, Intersil, Inc. 312-371-1440
Ind Ft. Wayne, Delesa Sls. 219-483-9537
Ind Indianpolis, Delesa Sls. 317-257-4683
Iowa Cedar Rapids, Elctrn. Sls. 319-364-4342
Kans Shawnee, J.F. Guernsey 913-631-2414
Md Glen Bernie, New Era Sls. Inc. 301-761-0085
Mass Burlington, Intersil, Inc. 617-273-2055
Mich Grand Rapids, J.L. Montgomery Assoc., Ltd. 616-774-9308
Mich Southfield, J.L. Montgomery Assoc. Ltd. 313-358-2616
Minn Minneapolis, Intersil, Inc. 612-925-1844
Mo St. Louis, Ensco-Rep Sls. 314-567-3935
NJ Cherry Hill, Barrett Assocs. 609-429-1551
NJ Englewood Cliffs, Intersil, Inc. 201-567-5585
NJ Irvington, MGI 201-399-4350
NM Albuquerque, Shefler-Kahn Co. 505-265-7077
NY Ithaca, Bob Dean, Inc. 607-272-2187
NY Syracuse, Intersil, Inc. 315-463-3368
Ohio Cleveland, K.W: Elctrns. Sls. 216-831-8292
Ohio Dayton, K.W. Elctrns. Sls. 513-890-2150
Ore Beaverton, ES/Chase Co. 503-649-6177
Pa Allison Park, K.W. Elctrns. Sls. 412-487-4300
Tex Dallas, Intersil Inc. 214-233-0611
Tex Houston, Vista Engr. Assocs. 713-661-0119
Tex Richardson, Vista Engr. Assocs. 214-235-4547
Utah Salt Lake City, Simpson Assocs. 801-486-3731
Va Falls Church, Beacon North, Inc. 703-534-1673
Wash Edmonds, ES/Chase Co. 206-774-3586

INTERSTATE ELECTRONICS, Box 1117, Anaheim, Cal., 92803, Tel: 714-772-2811, TWX: 910-591-1197; Empl.: 1000 .... p. 1•736,737

Customer service: J. Norburg

Free literature available: Interstate Shortform Catalog, 20 MHz Pulse Generators and 3MHz, 11MHz, and 20 MHz function generators Pulse Generator Catalog, 8-page catalog illustrates how applications requirements are matched with series 20 Performance Capabilities.

Products manufactured: Generators

Local Sales Offices & Reps.
Ariz Scottsdale, Meas. Consits. 602-994-9519
Cal Costa Mesa, Meas. Assocs. 714-540-7160
Cal Palo Alto, General Radio Co. 415-948-8233
Colo Boulder, Meas. Consits. 303-449-5294
Conn Hamden, J & J Assoc. 203-624-7800
Ga Atlanta, General Radio Co. 404-394-5380
Ill Elk Grove Village, L.F. Green & Assocs. 312-593-0282
Ind Indianapolis, L.F. Green & Assocs. 317-293-9827
Kans Olathe, Tech. Reps. Inc. 913-782-1177
Md Silver Spring, Sel-Tronics, Inc. 301-589-3391
Mass Burlington, J & J Assocs. 617-272-2606
Mich Royal Oak, Group 10 313-549-3910
Minn Minneapolis, L.F. Green Assocs. 612-781-1661
Mo Hazelwood, Tech. Reps., Inc. 314-731-5200
NJ Fairfield, KLS Assocs., Inc. 201-227-2900
NM Albuquerque, Meas. Consits. 505-265-6471
NM Las Cruces, Meas. Consits. 505-526-2491
NY Syracuse, Labtronics, Inc. 315-454-9314
Ohio Cleveland, Group Ten 216-486-2800
Ohio Dayton, Group 10 513-277-6531
Pa Melrose Park, R. Meyers Assoc. 215-224-1663
Tex Houston, Scientific Sls. Co. 713-666-5318
Tex Richardson, Scientific Sls. Co. 214-231-6541
Utah Murray, Meas. Consits. 801-268-3181

INTERSWITCH, 770 Airport Blvd., Burlingame, Cal., 94010, Tel: 415-347-8217, TWX: 910-374-2353; Empl.: 30; Minimum order: $50 .... p. 1•2074,2075

Free literature available: Brochures On: Thumbwheel Switches Program Matrix Boards Program Data Modules

Products manufactured: Boards, Programming, Connectors, Matrices, Computer, Modules, Logic, Encapsulated, Pins, Readers, Switches

Local Sales Offices & Reps.
Ariz Phoenix, Bestronics 602-248-7020

Ark	Little Rock, J.Y. Schoonmaker	501-375-2168
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Los Angeles, Black Ekizian Strong, Inc.	213-870-9191
Cal	San Diego, Bestronics	714-278-2150
Colo	Denver, W.J. Purdy Co.	303-777-1411
Conn	Meriden, P.R. Sturgeon Co.	203-237-1112
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Hinsdale, Hill-Gray	312-325-4810
Ind	Indianapolis, Sukup & Cox	317-253-5501
Mass	Babson Park, P. Sturgeon Co.	617-237-3506
Mich	Ferndale, Hilltronics Inc.	313-398-5556
Minn	Minneapolis, HMR, Inc.	612-920-8200
Miss	Jackson, Cartwright & Bean	601-981-1368
NJ	Bergenfield, H. Gray Assoc.	201-384-3643
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	Syracuse, Mar-Com Assocs.	315-437-2843
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean Co.	919-832-7128
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3131
Okla	Tulsa, J.Y. Schoonmaker Co.	918-936-1423
Pa	Enon Valley, NEBCO Assoc.	216-457-2333
Pa	Havertown, Liberi Sls.	215-789-8150
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, J. Schoonmaker	214-357-8481
Tex	Houston, J.Y. Schoonmaker	713-926-9510
FOR:	Can., Willowdale, Ont., A. C. Simmonds & Sons	416-491-1010

INTRONICS INC., 57 Chapel St., Newton, Mass., 02158, Tel: 617-332-7350, TWX: 710-335-6835; Empl.: 50

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Converters, Demodulators, Dividers, Integrated Circuit Devices, Multipliers, Power Supplies, Yokes

Local Sales Offices & Reps.

Cal	Chatsworth, Boyle Assocs.	213-861-9223
Cal	San Carlos, Courier Data	213-277-8884
Conn	Hamden, Scientific Devs.-Conn., Inc.	203-248-9361
Fla	Clearwater, Southeastern Comp. Sls.	703-522-6666
Mich	Dearborn Heights, Mitronics Sls. Co.	313-565-6330
Mo	St. Louis, Ensco-Rep., Inc.	314-567-3935
NJ	Fort Lee, Tecnimat	201-461-8686
NY	Rochester, Scientific Devs.-N.Y. Inc.	716-334-2445
Ohio	Wickliffe, Walter J. Brauer & Assocs.	216-943-0601
Pa	Berwyn, Tucker Assocs.	215-644-0142
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Va	Arlington, H.J. Hefferman Co.	703-522-6666

INVINCIBLE GEAR CO., 14938 Telegraph Rd., Detroit, Mich., 48239, Tel: 313-533-7524; Empl.: 25

Customer service: L. J. Smith

Free literature available: Description of gear types & size capacity & explanation of method employed for producing precision gears.

Products manufactured: Gears & Gear Mechanisms (Precision)

IPT CORP., 1140 W. Evelyn Ave., Sunnyvale, Cal., 94086, Tel: 408-732-7550, TWX: 910-379-6472; Empl.: 35

Products manufactured: Machines/Machinery, Production, Microcircuit Production Equip., Testers

Local Sales Offices & Reps.

Colo	Boulder, Mile High Elctrns.	303-444-5615
Fla	Pompano Beach, Semquip	305-772-3002
Ill	Chicago, L.F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L.F. Green Assocs.	317-293-9827
Md	Gaithersburg, Wright Co.	301-948-5151
Minn	Minneapolis, L.F. Green & Assocs.	612-781-1611
NJ	Wayne, K & J Assocs.	201-694-3334
NY	E. Setauket, K & J Assocs.	516-751-8686
NY	Rochester, K & J Assocs.	716-334-9487

IRCON INC., 7555 N. Linder Ave, Skokie, Ill., 60076, Tel: 312-967-5151, Telex: 72-4412; Empl.: 60

Products manufactured: Bridges, Controls/Control Eqpt., Indicators, Meters, Pyrometers

Local Sales Offices & Reps.

Ala	Birmingham, Spader & Assoc.	205-879-1366
Ariz	Scottsdale, J.T. Aldrich Co.	602-945-8598
Ark	Little Rock, Electra-Tech Midsouth	501-562-4090
Cal	Costa Mesa, Robinson Tech. Assoc.	714-557-1622
Cal	San Diego, R. Brainard Co.	714-274-1333
Cal	San Mateo, Ircon, Inc.	415-348-0122
Colo	Lakewood, Intermountain Instrs.	303-237-0444
Ga	Woodstock, Spader & Assoc.	404-428-0366
Ill	Libertyville, J. Miller Co.	312-362-0038
Ind	Indianapolis, Electro Engrg. & Sls.	317-547-5273
La	New Orleans, Mid-South Sls.	504-822-3030
La	Shreveport, JDJ Sls.	318-865-2393
Mass	Framingham, J.M. Lancaster Co.	617-873-8893
Mass	Pittsfield, Ircon, Inc.	413-445-4016
Mich	Berkley, G. Peters Assoc.	313-564-6325
Minn	Minneapolis, Arjay Sls.	612-925-1833
Mo	St. Louis, Arentsen Elctrns.	314-434-3605
NJ	Palisades Park, Scientific Devices-East	201-871-3916
NY	Baldwinsville, Alpha Co.	315-622-3993
NY	Williamsville, Alpha Co.	716-633-1342
NC	Matthews, Datatech, Inc.	704-847-4464
Ohio	Cincinnati, Schlemmer Assoc.	513-522-8340
Ohio	Grafton, A. Risser Co.	216-458-5091
Okla	Tulsa, P. King	918-836-2501
Pa	King of Prussia, Reinbrecht Assoc.	215-265-6180
Pa	Pittsburgh, Weiss Instrs.	412-371-3020
Tex	Houston, JD Inds.	713-468-8087
Wash	Bellevue, Kakar Corp.	206-454-1318
Wisc	Milwaukee, T.R. Bickler	414-453-3772

IRD MECHANALYSIS, INC., 6150 Huntley Rd., Columbus, Ohio, 43229, Tel: 614-885-5376, Telex: 24-5318; Empl.: 250

Customer service: E. Raub

Products manufactured: Accelerometers, Analyzers, Calibrators, Meters, Services, Assembly, Production & Test, Shields, Testers, Transducers

Local Sales Offices & Reps.

Cal	Industry	213-968-3219
Cal	Lafayette	415-781-5529
Conn	Fairfield	203-255-0893
Ga	Atlanta	404-237-4875
Ill	Chicago	312-726-2969
La	Baton Rouge	504-272-0355
Mich	Farmington	313-477-2066
Mo	St. Louis	314-644-4691
NJ	Springfield	201-379-1132
NY	New York City	212-687-6754
NY	Williamsville	716-632-6699
Pa	Rosemont	215-477-0922
Pa	Verona	412-795-1606
Tex	Houston	713-645-1846
Tex	Richardson	214-352-8312
FOR:	Can., Calgary, Alberta	403-264-2568
FOR:	Can., Montreal, Que.	514-697-9992
FOR:	Can., Stoney Creek, Ontario	416-662-7577

IRISH MAGNETIC RECORDING TAPE, 270-78 Newtown Rd., Plainview, N.Y., 11803, Tel: 516-293-5582, Telex: 96-7880; Empl.: 17; Minimum order: $50

Customer service: G. Krug

Products manufactured: Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Cal	San Francisco, Meyer, Ross & Fleming	415-285-8880
Cal	Van Nuys, Mike Roth Sls. of Cal.	213-989-3738
Colo	Aurora, A-E-S	303-366-0208
Fla	Longwood, Riddle-Williams Sls. & Mktg. Co.	305-862-8722
Ga	Jonesboro, Stanley K. Wallace Assoc.	407-471-6297
Ill	La Grange, Ed Severson & Assoc.	312-246-4883
Ind	Indianapolis, C. Scheffler	317-253-6337
La	Metairie, Jack F. McKinney Sls. Co.	504-887-1723
Mass	N. Scituate, W. A. Hendrickson Co.	617-545-0652
Mich	Southfield, Robert Milsk Co.	313-354-3310
Minn	St. Paul, Skor	612-645-6461
NY	Flushing, Bettan Sls.	212-591-7600
NY	Liverpool, Lewis & Dunnigan Co.	315-622-2133
Ohio	Cleveland, Spectra Sls. Co.	216-561-8900
Okla	Tulsa, Jack F. McKinney Sls. Co.	918-742-6791
Tex	Dallas, Jack F. McKinney Sls. Co.	214-631-9450
EXP:	Plainview, N.Y., Morhan Exporting Corp.	516-293-5582

ISC MAGNETICS DIV., Instr. Sys. Corp., 35 S. Service Rd., Plainview, N.Y., 11803, Tel: 516-293-0115, TWX: 510-226-6983; Empl.: 6 .... p. 1•252

Customer service: M. Schwartz

Products manufactured: Calibrators, Dividers, Generators, Indicators, Magnetizers, Magnetometers, Magnetoresistors, Hall, Magnets, Meters, Monitors, Multipliers, Probes, Resistors, Switches, Thermistors, Transducers

TELEPHONICS, DIV, Instr. Sys. Corp., 770 Park Ave., Huntington, N.Y., 11743, Tel: 516-549-6000, TWX: 510-226-6983; Empl.: 525

For info on price: C. Hamilton 516-549-6240; Application info: C. Hamilton 516-549-6240; Customer service: T. Reith 516-549-6038; Delivery info: T. Reith 516-549-6038

Products manufactured: Comm. Systems, Handsets, Chestsets, Headphones, Headsets, Etc., Microphones, All Kinds

ISOCHEM RESINS CO., 99 Cook St., Lincoln, R.I., 02865

Products manufactured: Adhesives (All Types), Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Insulators & Insulation, Materials, Self-Lubricating, Paints, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

ITE IMPERIAL, Rte. 309, Norristown Rd., Springhouse, Pa., 19477

ITEK CORP. MEAS. SYS. DIV., Christina St., Newton, Mass., 02161, Tel: 617-969-7300, TWX: 710-335-6783; Empl.: 100; Minimum order: $100

Customer service: L. J. Kelly

Products manufactured: Counters, Encoders, Indicators

Local Sales Offices & Reps.

Cal	Los Altos, Wright Engrg.	415-941-4405
Cal	Los Angeles, Measurement Sys. Div.	213-641-8251
Fla	Orlando, Measurement Sys. Div.	305-896-1455
Ill	Des Plaines, Marsland Assocs. Inc.	312-298-2620
Ind	Indianapolis, Marsland Assocs. Inc.	317-924-3568
Mich	Detroit, Electro Sls. Assocs.	313-521-1500
Minn	Minneapolis, Marsland Assocs. Inc.	612-545-4481
Mo	Florissant, Marsland Assocs. Inc.	314-278-6949
NJ	Union, Measurement Sys. Div.	201-964-3000
Ohio	Cleveland, Electro Sls. Assocs. Inc.	216-261-7670
Pa	Pittsburgh, Electro Sls. Assocs. Inc.	412-371-8497
Tex	Grand Prairie, Telemetry Sls. Corp.	214-262-2649

ITHACO, INC., 735 W. Clinton St., Ithaca, N.Y., 14850, Tel: 607-272-7640, TWX: 510-255-9307; Empl.: 120; Minimum order: $200 .... p. 1•8,9,568,739

For info on price: M. Jolly; Application info: J. Hanson; Customer service: T. Hoff; Delivery info: M. Jolly

Free literature available: Preamp Specification Brochures: Discussion of Amplifier Noise, Filters Discussion of Filters and Noise, Model 3170 Applications Information, 430/450 Amplifiers Plus Discussion of Noise Application Notes:

Heterodyning Lock-In Amplifier Variable Electronic Filters Use of Filters to Measure Noise

Products manufactured: Amplifiers, Attenuators, Choppers, Data Acquisition & Reduction Systems, Filters, Hydrophones & Accessories, Light Choppers, Meters, Oceanographic Equip. (Electronic), Signal Conditioners & Equipment

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Instr., Inc.	205-539-4411
Cal	Cupertino, T. Louis Snitzer Co.	408-257-8333
Cal	Del Mar, T. Louis Snitzer Co.	714-454-2191
Cal	Los Angeles, T. Louis Snitzer Co.	213-836-6170
Conn	Easton, Jarrold Corp.	203-255-4133
Fla	Fort Lauderdale, W.A. Brown Instrs., Inc.	305-776-4800
Fla	Orlando, W.A. Brown Instrs., Inc.	305-425-5505
Ga	Atlanta, W.A. Brown Instrs., Inc.	404-939-1674
Ill	Skokie, Mauer Co.	312-677-4771
La	Gretna, W.A. Brown Instrs., Inc.	504-366-5766
Mass	Waltham, Jarrold Corp.	617-891-8045
Mich	Royal Oak, Meas. Instrs., Inc.	313-352-2144
Minn	Minneapolis, Heimann Co.	612-861-6051
NM	Albuquerque, Grady Moore Assocs.	505-292-3322
NY	Northport, Lindgren Assocs.	516-261-7937
NC	Research Triangle Park, W.A. Brown Instrs., Inc.	919-489-1546
Ohio	Columbus, Measurement Instrs., Inc.	614-488-9751
Tenn	Knoxville, W.A. Brown Instr.	615-584-2614
Tex	Dallas, Southwestern Eng. & Equip. Co.	214-692-8097

Va	Norfolk, Scientific Devices-D.C., Inc.	804-499-8133
Va	Springfield, Scientific Devices-D.C., Inc.	703-451-6500
Wash	Bellevue, Scientific Devices-N.W.	206-454-0900

ITI ELECTRONICS, INC., 369 Lexington Ave., Clifton, N.J., 07015, Tel: 201-546-3900; Empl.: 50; Minimum order: $10

For info on price: E. G. Nichols; Application info: E. G. Nichols; Customer service: M. DeBliek; Delivery info: M. DeBliek

Products manufactured: Amplifiers, Attenuators, Bridges, Cable Assemblies & Harnesses, Coils Including Assemblies & Forms, Comm. Systems, Converters, Detectors, Equalizers, Filters, Panels, Power Supplies, Services, Assembly, Production & Test, Transformers

C. ITOH ELECTRONICS, INC., 280 Park Ave., New York, N.Y., 10017, Tel: 212-953-5452; Empl.: 100; Minimum order: $100 .... p. 1•176

Customer service: H. Weck

Free literature available: We have digital printers, alpha numeric, segment impact types.

Products manufactured: Printers

Local Sales Offices & Reps.

Ala	Huntsville, Technical Assocs.	205-881-8494
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Marina Del Rey, Delta Mutual Sls.	213-823-0643
Colo	Denver, BFA Corp.	303-744-3301
Fla	Orlando, Technical Assocs.	305-894-7531
Ill	Des Plaines, Coombs Assocs.	312-298-4830
Iowa	Cedar Rapids, Tech. Reps.	319-363-2489
Kans	Olathe, Tech. Reps.	913-782-1177
La	Shreveport, IBL Engrg. & Sls.	
Mass	Chelmsford, S & S elctrns.	617-256-8731
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Hazelwood, Technical Reps.	314-731-5200
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Mamaroneck, Cane Tech. Sls.	914-698-4411
NY	Rochester, L-Mar Assocs.	716-328-5240
Ohio	Cleveland, Components Inc.	216-842-2737
Okla	Oklahoma City, IBL Engrg. & Sls.	405-843-9434
Pa	Norristown, Data Engrg. Co.	215-279-8146
SC	Spartanburg, Technical Assocs.	803-579-2904
Tex	Dallas, IBL Engrg. & Sls.	214-363-2921
Utah	Salt Lake City, BFA Corp.	801-466-6522
Wash	Seattle, R. S. Drake Assocs.	206-763-2755

Local Distributors

Cal Burlingame, Itoronics Lab, 381 Beach Rd.

ITT CANNON ELECTRIC, 666 E. Dyer Rd., Santa Ana, Cal., 92702, Tel: 714-557-4700, TWX: 910-595-1131; FSC No: 71468; QPL No: Multiple; Empl.: 1700; Minimum order: $50 .... p. 2•687-693

Customer service: J. Tison

Free literature available: Connector Selection Guide.

Products manufactured: Cable Assemblies & Harnesses, Cable, CATV Systems & Equipment, Connectors, Sockets, Tools, Wire Strippers

Local Sales Offices & Reps.

Ala	Huntsville, Brandel-Stephens & Co.	205-883-0445
Ariz	Phoenix, ITT Cannon Elec.	602-273-0755
Cal	Los Altos, Recht Assocs.	415-941-0336
Cal	San Marcos, ITT Cannon Elec.	714-743-4554
Cal	Santa Ana, ITT Cannon Elec.	714-557-4700
Colo	Englewood, ITT Cannon Elec.	303-770-1631
Conn	Tolland, ITT Cannon Elec.	203-872-2119
Fla	Deerfield Beach, Brandel-Stephens & Co.	305-427-8558
Fla	Orlando, Brandel-Stephens & Co.	305-425-3202
Ga	Atlanta, Brandel-Stephens & Co.	404-261-7579
Ill	Des Plaines, ITT Cannon Elec.	312-297-3150
Ind	Muncie, ITT Cannon Elec.	317-257-7879
Kans	Leawood, Thunderbird Tech. Sls. & Svcs., Inc.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls. & Svcs.	316-684-3941
Mass	Swampscott, ITT Cannon Elec.	617-729-8950
Mich	Detroit, ITT Cannon Elec.	313-534-0360
Minn	Minneapolis, ITT Cannon Elec.	612-854-1973
Mo	St. Louis, Thunderbird Tech. Sls. & Svcs., Inc.	314-567-6488
NY	Dewitt, Tri-Tech Elctrns., Inc.	315-446-2881
NY	E. Rochester, Tri Tech Elctrns.	716-381-2722
NY	Elmsford, ITT Cannon Elec.	
NY	Larchmont, Tri Tech Elctrns.	914-834-4423
Ohio	Bedford, ITT Cannon Elec.	216-248-8800
Ohio	Kettering, ITT Cannon Elec.	513-434-8181
Pa	Feasterville, Professional Svc. Assocs.	215-355-6244
Pa	Fort Washington, ITT Cannon Elec.	215-646-2801
Tex	Dallas, ITT Cannon Elec.	214-661-0302
Tex	Houston, ITT Cannon Elec.	713-721-3999
Va	Alexandria, ITT Cannon Elec.	703-370-5733
Va	Roanoke, ITT Cannon Elec.	703-362-0749
Wash	Bellevue, ITT Cannon Elec.	206-454-3903
EXP:	Santa Ana, Cal., ITT Cannon Elec.	714-557-4700
FOR:	Can., Montreal, Que., ITT Cannon Elec. Can.	514-336-7660
FOR:	Can., North Vancouver, B.C., Arwin Tech. Sls.	604-980-4345
FOR:	Can., Whitby, Ont., ITT Cannon Elec.	416-668-8881

ITT COMPS. GRP., Electro Mechanical Comps., 1551 Osgood St., N. Andover, Mass., 01845, Tel: 617-688-1881

Products manufactured: Motors, Relays, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Rep., Inc.	205-881-9270
Cal	Mountain View, Nor-Cal	415-961-8121
Colo	Lakewood, Tri-Tronix	303-237-0774
Conn	Hamden, Impact Sales	203-281-1331
Fla	Indian Rock Beach, Tech-Rep Assocs.	813-595-2834
Ga	Tucker, Rep. Inc.	404-938-4358
Ill	Hinsdale, Hill-Gray Assocs.	312-325-4810
Iowa	Cedar Rapids, Reid Assocs.	319-362-6302
Kans	Wichita, M.E. Bettis Co.	316-685-7441
Mass	Waltham, Impact Sales	617-893-2850
Mich	Warren, DEM Elctrns.	313-755-6660
Minn	Minneapolis, S® Comps. Sls.	612-544-3022
NM	Albuquerque, Tri-Tronix	505-265-0172
NY	Syracuse, NYCOM	315-437-8343
NY	Valley Cottage, LRC Assocs.	914-634-7973
NC	Raleigh, Candor Co.	919-876-4999
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
SC	Myrtle Beach, Candor Co.	803-448-8361
Tenn	Chattanooga, Candor Co.	615-894-7454
Tex	Dallas, W. Reese Assocs.	214-638-6575
Va	Lynchburg, Candor Co.	804-846-6579
Wash	Bellevue, Vantage Corp.	206-455-3460

ITT ELECTRON TUBE, Box 100, Easton, Pa., 18042, Tel: 215-252-7331; Empl.: 550; Minimum order: $50

Customer service: W. Jakimer

Products manufactured: Lamps, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles	213-367-5988
Ill	Chicago	312-782-4359
Md	Baltimore	301-467-5733
Mass	Waltham	617-893-5579
NJ	Nutley	201-284-2762

ITT GENERAL CONTROLS, 801 Allen Ave., Glendale, Cal., 91201, Tel: 213-842-6131, TWX: 910-498-2225; Empl.: 1892

For info on price: Prod. Mgr.; Application info: Application Engineer; Customer service: S. Garner; Delivery info: S. Garner

Free literature available: All products are supported by Technical Data sheet and catalog.

Products manufactured: Controls/Control Eqpt., Counters, Printers, Valves, Solenoid

Local Sales Offices & Reps.

Cal	Burlingame	415-342-8391
Cal	Glendale	213-842-6131
Colo	Denver	303-572-8494
Ga	Atlanta	404-451-5895
Ill	Des Plaines	312-299-2237
Kans	Shawnee Mission	913-631-1188
Mich	Birmingham	313-642-1847
Minn	Minneapolis	612-929-6772
Mo	Manchester	314-391-8456
NJ	Teaneck	201-836-2444
NC	Charlotte	704-334-6511
Ohio	Dayton	513-298-8771
Ohio	Fairview Park	216-333-2306
Ohio	Troy	513-335-3583
Okla	Tulsa	918-627-9145
Pa	Folcroft	215-534-2800
RI	Warwick	401-739-6336
Tenn	Hendersonville	615-824-6838
Tex	Dallas	214-358-2555
Tex	Houston	713-666-4261

ITT GILFILLAN DIV. OF ITT, 7821 Orion Ave., Van Nuys, Calif., 91409, Tel: 213-988-2600, TWX: 910-495-1787; FSC No: 24930; Empl.: 1500; Minimum order: $100

Customer service: F. J. Brennan

Free literature available: The near and far reaches of space - ITT Gilfillan capabilities brochure, Quadradar - the world's most versatile air traffic control radar, Series 32 - the world's most advanced family of 3D surveillance radars.

Products manufactured: Antennas, Radar Systems, Receivers

ITT HARPER, 8200 Lehigh Ave., Morton Grove, ILL., 60053, Tel: 312-966-6000; Empl.: 875; Minimum order: $20

Customer service: R. Gilbert

Free literature available: Bulletin # 114 - Checklist of stock corrosion resistant fasteners.

Products manufactured: Fasteners, Rivets

Local Sales Offices & Reps.

Ala	Birmingham	205-324-5678
Cal	Berkeley	415-357-2655
Cal	Monterey Park	213-268-1345
Colo	Denver	303-433-7397
Fla	Hialeah	305-887-8151
Ga	Atlanta	404-355-0330
Ill	Elk Grove Village	312-595-7220
Ind	Indianapolis	317-244-7888
La	New Orleans	504-246-0000
Md	Baltimore	301-866-1600
Mass	Winchester	617-729-8700
Mich	Troy	313-585-7510
Mo	St. louis	314-781-9906
NY	Castleton-on-Hudson	518-732-7711
NY	Mt. Vernon	914-664-7555
NY	Rochester	813-877-9193
NC	Charlotte	704-376-1854
Ohio	Cincinnati	513-733-4411
Ohio	Cleveland	216-781-4411
Pa	Philadelphia	215-329-8900
Pa	Pittsburgh	412-242-8901
Tex	Dallas	214-241-2353
Tex	Houston	713-223-4204
Wash	Seattle	206-783-9200
Wisc	Milwaukee	414-272-3565

ITT-HIGBIE MFG. CO., Wagner Rd., Rochester, Mich., 48063, Tel: 313-651-5300, TWX: 810-232-1592; Empl.: 1500

Customer service: D. J. Campbell

Products manufactured: Tubing

Local Sales Offices & Reps.

Cal	Los Angeles, E.J. Brookes Co.	213-723-8431
Ill	Lombard, A.G. Pinder	312-627-4678
Mich	Rochester, ITT Higbie Mftg. Co.	313-651-5300
Mich	Tecumseh, M.G. Coulter	313-423-4300
NJ	Rumson, Phillips Tube Co.	201-842-5168
Tenn	Hermitage, Cap-I-Tol Sls.	615-254-8295
Tex	Dallas, W.P. Schoenfield	214-352-6200

ITT HOLUB INDUSTRIES, 413 West Elm, Sycamore, Ill., 60178, Tel: 815-895-6501; Empl.: 110; Minimum order: $50

For info on price: J. W. Hope; Application info: T. McNieve; Customer service: T. McNieve; Delivery info: R. Parsons

Free literature available: OSHA - 972 - Product des. by family.

Products manufactured: Clamps & Clips, Connectors, Cutters, Wire, Hand Operated, Meters, Wire & Cable Ties, Wire Nuts, Wire Strippers, Wrenches

ITT INDUSTRIAL & AUTOMATION SYSTEMS, 41225 Plymouth Rd., Plymouth, Mich., 48170, Tel: 313-427-9300, Telex: 23-5816; Empl.: 200

For info on price: G. McAlpine; Application info: W. Ferris; Customer service: M. Wylie; Delivery info: G. McAlpine

Free literature available: Soldering Systems: Brochure describes system modules and applications of typical systems.

Products manufactured: Detectors, Soldering Equipment

Local Sales Offices & Reps.

Ala	Birmingham, E. Pickett Co.	205-879-4726
Ariz	Phoenix, Bews & Wallace Co.	602-275-4496
Cal	Alhambra, H.E. Wales & Assocs.	213-576-0953
Cal	San Francisco, Process Equip. Co.	415-397-1496
Colo	Englewood, G.M. Wallace & Assocs.	303-771-5960
Conn	Bloomfield, Wetzel Tool Corp.	203-242-8535
Fla	Orlando, B. Woodruff, Inc.	305-424-2771
Ga	Atlanta, Crigler Engrg.	404-351-3733
Ill	Chicago, Mills-Winfield Engrg. Sls.	312-648-1373

Ind	Kokomo & Indianapolis, Stout, Loman & Thompson	317-459-8236
Ky	Louisville, Miller-Harrington Ind'l. Sls.	502-893-5859
La	New Orleans, Betz Engrg. Sls. Co.	504-486-5452
Mass	Boston, Harris & Underhill	617-426-3544
Mich	Farmington, Garrett-Burgess	313-477-7440
Mich	Lansing, A.D. Schneider & Co.	517-482-1337
Minn	Minneapolis, Mills-Winfield	612-920-1199
Minn	Minneapolis, W.H. Schulz Co.	612-544-0133
Mo	St. Louis, Ind'l. Process Equip.	314-534-3100
Mo	St. Louis, Process & Chemical Equip. Co.	314-771-4741
NJ	Mountain Lakes, Dearie & Farrell Co.	201-334-4848
NY	Rochester, Brook-Anco Corp.	716-271-4100
NC	Charlotte, F. D. Hurka Co.	704-366-0209
NC	High Point, Hersey-Thomas	919-882-1132
Ohio	Cuyahoga Falls, W.T. Kendall Co.	216-928-3636
Ohio	Dayton, Production Engrg. Sls.	513-278-4741
Okla	Oklahoma City, Southwestern Gage & Sls.	405-787-1734
Ore	Portland, N. Rupp Co.	503-228-4311
Pa	Bethel Park, D.A. Roberts & Sons	412-561-6404
Pa	Newtown Squares, Holco, Inc.	215-353-2060
SC	Greenville, Hersey-Thomas	803-232-5261
Tenn	Memphis, M-P Sls. Co.	901-274-6933
Tex	Dallas, Southwestern Gage & Sls.	214-358-5151
Tex	Houston, Southwestern Gage & Sls.	713-523-4606
Utah	Salt Lake City, Pelton Equip. Co.	801-484-3522
Va	Alexandria, Chemical Etching Equip. & Supply	703-971-2646
Wash	Bellevue, H.F. Soderling	206-885-2535
Wisc	Elm Grove, Mills-Winfield Engrg. Sls.	414-782-5372

ITT JENNINGS, INSTRUS. & SYSTEMS, Div. Int'l. Telephone & Telegraph Corp., 970 Mc Laughlin Ave., San Jose, Cal., 95116, Tel: 408-292-4025, TWX: 910-338-0159 .... p. 1•740,741

Products manufactured: Dividers, Meters, Power Supplies, Probes, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs., Inc.	205-533-5896
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Calabasas, Shovlowsky	213-348-3402
Cal	Palo Alto, Held & Mollard	415-965-9321
Colo	Denver, BFA Corp.	303-744-3301
Conn	Hartford, Newmar Assocs.	203-523-0402
Fla	Winterhaven, Lee Assocs.	813-294-5815
Ga	Chamblee, Lee Assoc.	404-457-7117
Ill	Northbrook, Electronic Instrument Assocs.	312-498-4500
Ind	Indianapolis, Electronic Instrument Assocs.	317-257-7231
Mass	Lynnfield, Newmar Assocs.	617-245-7960
Mo	St. Louis, Scherrer Inst.	314-644-5362
NM	Albuquerque, BFA Corp.	505-296-8303
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Binghamton, Ossman Instrs.	607-785-9947
NY	East Syracuse, Ossman Instr.	315-437-6666
NY	Great Neck, Eastern Instrumentation	516-466-9505
NY	Rochester, Ossman Instr.	716-328-2230
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Dayton, Whelan Corp.	513-434-7551
Okla	Norman, Data Mktg. Assocs., Inc.	405-364-8320
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Wash	Bellevue, Conrard-Carlson	206-455-1336
EXP:	Downsview, Ontario, Can., Meter Master	416-661-3190

ITT JENNINGS, Monrovia Plant, 1960 Walker Ave., Monrovia, Cal., 91016, Tel: 213-359-8281, TWX: 910-585-1830; Empl.: 160

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Films, Filters, Foil, Forms, Wire

Local Sales Offices & Reps.

Ariz	Scottsdale, R. R. Thomas Co.	602-994-0401
Cal	Los Altos, Horne Associates	415-948-5823
Cal	Monrovia, ITT Jennings Monrovia Plant	213-357-1185
Cal	San Diego, Bestronics, Inc.	714-278-2150
Fla	Palm Beach Gardens, Beacon Assoc.	305-622-2770
Ga	Atlanta, Beacon Assoc.	404-351-3654
Ill	Elmhurst, Schuten Assoc.	312-833-0980
Ind	Ft. Wayne, Delesa	219-483-7486
Iowa	Cedar Rapids, Reid Assoc.	319-362-6302
Md	Timonium, Marktron Inc.	301-762-6210
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Minn	St. Paul, R. G. Ragon Inc.	612-488-0201
NJ	Dunellen, ITT Jennings	201-968-6556
NJ	Tenafly, ABC Elctrn. Sls.	201-568-2354
NY	New Rochelle, Montclair Electronics	914-576-1400
NY	Syracuse, Nycom	315-437-8343
NY	Williston Park, ABC Elctrn. Sls.	516-747-6610
Ohio	Dayton, Whelan Corp.	513-434-7551
Pa	Bethayres, ABL Electronic Sales Co.	215-464-2275
SC	Spartanburg, Beacon Assoc.	803-576-7462
Tex	Dallas, R. R. Thomas Co.	214-363-8591
Wash	Bellevue, Ray Over Sls.	206-454-4551

ITT JENNINGS, VACUUM ELCTRN. PRODS., Div. Int'l. Telephone & Telegraph Corp., 970 McLaughlin Ave., San Jose, Cal., 95116, Tel: 408-292-4025, TWX: 910-338-0159; Empl.: 350

p. 1•1733-1738,2077-2079; p. 2•198-200

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Relays, Services, Assembly, Production & Test, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Brandel-Stephens	205-883-0445
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Palo Alto, Engineering Assocs.	415-494-7842
Colo	Denver, BFA Corp.	303-744-3301
Fla	Deerfield Beach, Brandel-Stephens	305-427-8558
Fla	Orlando, Brandel-Stephens	305-425-3202
Ga	Atlanta, Brandel-Stephens	404-261-7579
Ill	Chicago, Berndt Assocs.	312-283-0713
Kans	Shawnee Mission, Lowell-Kangas & Assoc.	913-631-3515
Md	Rockville, Marktron, Inc.	301-762-6210
Md	Timonium, Marktron, Inc.	301-252-7111
Mich	Troy, Peters Assoc.	313-524-2920
Mo	St. Louis, Lowell-Kangas & Assoc.	314-821-4050
NJ	Tenafly, ABC Elctrns. Sls.	201-568-2354
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	N. Tarrytown, ABC Elctrn. Sls.	914-631-2650
NY	Syracuse, Nycom Inc.	315-437-8343
NY	Williston Pk., ABC Elctrn. Sls.	516-747-6610
Ohio	Dayton, Whelan Corp.	513-434-7551
Pa	Huntington Valley, ABC Elctrn. Sls.	215-464-2275
Tex	Richardson, P.J. Scanlon	214-231-4661
Va	Charlottesville, Marktron	301-762-6210

ITT MACKAY MARINE, 2912 Wake Forest Rd., Raleigh, N.C., 27611, Tel: 919-828-4441; Empl.: 525

Products manufactured: Alarms, Amplifiers, Antennas, Comm. Systems, Direction Finders, Generators, Indicators, Inverters, Radar Systems, Receivers, Synthesizers, Teleprinters, Teletypewriters & Equipment, Transceivers, Transmitters, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

La	Metairie	504-887-4200
NJ	Elizabeth	201-527-0300
Wash	Seattle	206-283-4204

Advertisment

ITT Mackay Marinè designs and manufactures a complete line of communications and navigational equipment systems, includes Synthesized Receivers (15 kHz to 30 MHz), Synthesized Transmitters 2-30 MHz Solid State Transmitters and Receivers, Auto alarms, Keyers, Radio Direction Finders, Lorans, Omega Receivers, Antenna systems and Survival equipment.

ITT POMONA ELECTRONICS DIV., 1500 E. 9th St., Box 2767, Pomona, Cal., 91766, Tel: 714-623-3463, TWX: 910-581-3822; FSC No: 05276; Empl.: 100; Minimum order: $25 .... p. 2•727-787

For info on price: Sls. Dept.; Application info: J. J. Musarra; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Electronic Test Accessory Catalog

Products manufactured: Bars, Shorting, Boards, Printed Circuit, Cable Assemblies & Harnesses, Clamps & Clips, Connector Adapters, Connectors, Containers, Cords, Enclosures, Module, Plug-In, Jack Adapters (All Types), Jacks (All Types), Jumpers, Leads, Test & Adaptors, Meters, Plug Adapters, Plug & Jack Sets, Posts, Probes, Sockets, Terminals

Local Sales Offices & Reps.

Ala	Madison, South Eastern Assoc.	205-722-9816
Ariz	Phoenix, H.A. Moore Sls. Co.	602-274-4558
Ariz	Scottsdale, DeAngelo, Rothman & Cheever, Inc.	602-947-8626
Cal	Beverly Hills, Intercontinental Aviation	213-274-7578
Cal	Culver City, DeAngelo,Rothman	213-398-6239
Cal	La Selva Bch., Belchamber & French	408-722-0444
Cal	Palo Alto, Engineering Assoc.	415-494-7842
Cal	Pasadena, P. Nurches	213-681-8957
Colo	Aurora, AES, Inc.	303-EM 6-0208
Fla	No. Miami, L. Haas	305-949-9143
Ill	Lincolnwood, W.M. Linz	312-677-2000
Ind	Indianapolis, Blind & Assoc., Inc.	317-251-1249
Mass	Sharon, A Appell Assoc.	617-SU 4-3439
Mich	Kentwood, C. Geer	616-534-9449
Minn	Mpls., Northern States	612-888-3300
Mo	Crestwood, NEVCO	314-843-7406
Mo	Kansas City, NEVCO, Inc.	816-421-1751
NY	Long Island City, Tobias	212-545-9191
Ohio	Cleveland, P. Lohse	216-381-4424
Pa	Philadelphia, D.S. Linz	215-ES 9-0734
SC	Greenville, H. C. Norman	803-244-6254
Tex	Dallas, Techno Assocs.	214-FL 7-9213
Wash	Seattle, R.K. Squibb	206-632-2450
FOR:	Can., Whitby, Ont., ITT Cannon Electric	416-[illegible]-8881

ITT SEMICONDUCTOR, 3301 Electronics Way, West Palm Beach, Fla., 33407, Tel: 305-842-2411, TWX: 510-952-7605; Empl.: 1350

Products manufactured: Amplifiers, Capacitors, Fixed, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Converters, Counters, Diodes, Dividers, Drivers & Decoders For Readouts, Integrated Circuit Devices, Multiplexers, Rectifiers, Semiconductor Wafer Fabrication, Shift Registers, Timers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Rep, Inc.	205-881-9270
Ariz	Tempe, ITT Semiconductors	602-277-8168
Cal	Inglewood, ITT Semiconductors	213-649-4644
Cal	Mountain View, Nor-Cal Assocs.	415-961-8121
Cal	Palo Alto, ITT Semiconductors	415-961-5265
Cal	San Diego, JTL Assocs.	714-277-8044
Cal	Woodland Hills, Interstate Mktg.	213-883-7606
Colo	Denver, Checkmate Sls.	303-771-4920
Fla	Palm Beach Gardens, Trainor Sls.	305-622-1383
Fla	West Palm Beach, ITT Semiconductors	305-842-2411
Ill	Chicago, ITT Semiconductors	312-693-7070
Ill	Rolling Meadows, Sumer, Inc.	312-394-4900
Iowa	Cedar Rapids, S & O Sls. Co.	319-393-1845
Md	Baltimore, Coulbourn-DeGreif, Inc.	301-247-4646
Mass	Lexington, ITT Semiconductors	617-861-0880
Mich	Farmington, ITT Semiconductors	313-477-6060
Mich	Livonia, Rep-Tron	313-261-7446
Minn	Minneapolis, ITT Semiconductors	612-920-2943
Mo	Grandview, Beneke & McCaul, Inc.	816-765-2998
NY	Fayetteville, ITT Semiconductors	315-445-0560
NY	Huntington, Caravan Sls.	516-692-2839
NY	Jericho, ITT Semiconductors	516-938-1191
NY	Syracuse, Precision Power	315-477-3200
NY	Valley Cottage, LRC Assocs.	914-634-7973
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Pa	Wayne, ITT Semiconductors	215-688-6990
Tex	Dallas, ITT Semiconductors	214-242-8164
Wash	Tukwila, General Elctrns.	206-243-5141
EXP:	Mississauga, Ont., Can., ITT Semiconductors	416-625-9022
EXP:	Montreal, Que., Can., Vitel Elctrns.	514-331-7393

ITT SEMICONDUCTORS-CAPACITORS, 1551 Osgood St., No. Andover, Mass., 01845, Tel: 617-688-1881, TWX: 710-344-0718; Empl.: 30

Products manufactured: Capacitors, Fixed, Motors, Rectifiers, Relays, Sockets, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Rep Inc.	205-881-9270
Ariz	Scottsdale, R.R. Thomas Co.	602-994-0401
Cal	Mt. View, Nor Cal Assoc.	415-961-8121

Cal	San Jose, ITT	408-247-6400
Colo	Lakewood, Tri Tronix	303-237-0774
Conn	Hamden, Impact Sls.	
Fla	Indian Rocks Beach, Tech. Rep.	813-595-2834
Iowa	Cedar Rapids, Reid & Assoc.	319-362-6302
Mass	Waltham, Impact Sls.	617-893-2850
Mich	Warren, DEM Elct. Sls.	313-755-6660
Minn	Minneapolis, S & R Comp. Sls.	612-544-3022
NM	Albuquerque, Tri-Tronix	505-265-0172
NY	Syracuse, Nycom Inc.	315-437-8343
NY	Valley Cottage, LRC Assocs.	914-634-7973
NC	Raleigh, Candor Co.	919-787-2652
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
SC	Myrtle Beach, Candor Co.	803-448-5213
Tenn	Chattanooga, Candor Co.	615-894-7454
Tex	Dallas, R.R. Thomas Co.	214-363-8591
Va	Lynchburg, Candor Co.	703-846-6579
Wash	Bellevue, Vantage Corp.	206-455-3460

ITT SEMICONDUCTORS DISCRETE DEVICES, 500 Broadway, Lawrence, Mass., 01841

ITT SEMICONDUCTORS PASSIVE COMPONENTS, 1551 Osgood St., No. Andover, Mass., 01845

ITT SEMICONDUCTORS RECTIFIERS, 1551 Osgood St., No. Andover, Mass., 01845

ITT TELECOMMUNICATIONS, Apparatus Dept., Fulton Dr., Corinth, Miss., 38834, Tel: 601-287-3771, TWX: 510-984-0211; Empl.: 1100

Application info: M. Ayrer; Customer service: J. Livingston; Delivery info: J. Livingston

Products manufactured: Comm. Systems, Dials

ITT THERMOTECH, Div. Int'l. Telephone & Telegraph Corp., 1202 S. 5th St., Hopkins, Minn., 55343, Tel: 612-938-7671; Empl.: 515 .... p. 2•1231-1233

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Covers, Protective (Including Dust), Keyboards, Alphanumeric & Decimal, Services, Assembly, Production & Test, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg. Assoc., Inc.	602-277-1453
Cal	Belmont, C. Crisler	415-591-5363
Cal	Glendale, Secana Co.	213-240-7570
Colo	Denver, T. Mc Sherry	303-238-8361
Conn	W. Hartford, D. Kelley	203-233-0870
Conn	West Simsburg, R. Russ	203-658-6261
Fla	St. Petersburg, Florida Div.	813-347-2191
Ill	Chicago, J. Robinson	312-777-6200
Ill	Norridge, B. Reynolds	312-824-4129
Ind	Ft. Wayne, R. McCampbell	219-747-9697
Iowa	Des Moines, F. F. Wilcox	515-255-8416
Kans	Mission, Inland Assocs.	913-362-2366
Ky	Mt. Sterling, M.F. Eubanks	606-498-5955
Mass	Newton Upper Falls, Anchor Engrg.	617-964-6205
Mich	Detroit, G. Hall	313-864-1368
Mich	Farmington, L. George	313-477-5833
Minn	Minneapolis, W. J. Houlihan	612-544-3023
Mo	Glenco, R.L. Omer	314-938-4992
Mo	St. Louis, E. Monnig	314-991-2512
NJ	Union, Plastech	201-687-4810
NY	Fairport, P. B. Schumacher	716-223-2488
NY	Manhasset, Kaelber & Mack	516-627-6620
NC	Charlotte, Spartan Assoc.	704-523-8419
NC	Greensboro, Mfrs. Sls.	919-274-2474
Ohio	Cleveland, G. Richards	216-221-3634
Okla	Tulsa, T. J. Ray Co.	918-627-1515
Ore	Portland, C. E. Riggs	503-226-3286
Pa	Ardmore, Midlantic Plastic Sls.	215-649-2436
Tex	Dallas, Ammon & Rizos	214-233-5591
Tex	Houston, G. Knower	713-781-6240
Wash	Seattle, J. Perkins	206-623-5707
Wisc	Menomonee, D. Jensen	414-251-9230

J-B-T INSTRS., INC., Box 1818, New Haven, Conn., 06508, Tel: 203-772-2220, TWX: 710-465-3165; Empl.: 300 .... p. 1•742-745,2080-2087

Free literature available: TS-7-various types of MIL and commercial toggle switches. MT-40-types of sub-miniature toggle, rocker and paddle lever switches. 1172A-frequency and elapsed time meters, 12, 14 and 20 position rotary switches and other J-B-T products.

Products manufactured: Indicators, Meters, Switches

Local Sales Offices & Reps.

Cal	Inglewood, J. Berman Co.	213-678-1281
Cal	La Mesa, J. Berman Co.	714-583-6457
Cal	Oakland, Moulthrop Sls.	415-261-7676
Colo	Denver, Nelson Co.	303-573-1516
Conn	Wallingford, Adams-McGregor, Inc.	203-269-5816
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Ga	Atlanta, Millar Elctrns.	404-261-6160
Ill	Oak Park, G. Petitt Co.	312-369-8940
Ind	Fort Wayne, W.W. Bieberich	219-432-2537
Kans	Overland Park, T.L. Dowell & Assocs.	913-236-8200
Md	Reisterstown, Massey Assocs.	301-833-2039
Mass	Scituate, Adams-McGregor, Inc.	617-542-3773
Mich	St. Clair Shores, J.M. Thorpe Co.	313-779-6363
Minn	Minneapolis, Heimann Co.	612-861-6051
NY	Long Island City, D.F. Tobias & Co.	212-545-9191
NY	Syracuse, H.R. Murray, Inc.	315-446-5555
NC	Raleigh, Millar Elctrns., Inc.	919-787-9564
Ohio	Dayton, C.H. Dolfuss, Jr. & Co.	513-275-4831
Ohio	Rocky River, C.H. Dolfuss, Jr. & Co.	216-333-7504
Pa	Media, Snyder & Massey Assocs.	215-566-5400
Pa	Pittsburgh, G.S. Root & Co.	412-561-4125
RI	Lincoln, Adams-McGregor, Inc.	401-726-1300
Tex	Dallas, Lund & Co.	214-358-4335
Wash	Seattle, J.J. Backer Co.	206-285-1300

JACKSON BROS., (LONDON) LTD., 258 Bway., New York, N.Y., 10007, Tel: 212-WO 2-5485; Minimum order: $10 .... p. 2•196,197

Customer service: Swedgal Elctrns.

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Couplings, Dials, Drives & Drive Mechanisms (Dial), Encoders, Gears & Gear Mechanisms (Precision), Locks, Dial & Shaft, Terminal Blocks, Boards & Strips, Terminals, Transducers

Local Sales Offices & Reps.

Cal	Encino, V & L Assocs., Inc.	213-986-9703
Ill	Westchester, W.G. Brouillette	312-345-6500

JAESIC INDUSTRIES CO., 29830 Beck, Wixom, Mich., 48096, Tel: 313-624-6411; Empl.: 18; Minimum order: $250

For info on price: J. J. Tomecek; Application info: K. J. Sekenske; Customer service: J. W. Tomecek; Delivery info: F. Tomecek

Free literature available: Brochures

Products manufactured: Amplifiers, Cards, Linear Function, Cards, Logic, Chargers, Battery, Coders, Controls/Control Eqpt., Converters, Generators

Local Sales Offices & Reps.

Fla	Hollywood, R. L. Tomecek Co.	305-752-0226
Ill	Lombard, A. Bolin	312-627-6802
Mich	Ann Arbor, Lama Enterprises	313-761-4323
Mich	Detroit, Professional Med. Dist.	313-624-6413

JAIDINGER MFG. CO., INC., 1921 W. Hubbard St., Chicago, Ill., 60622, Tel: 312-421-1090; Empl.: 35; Minimum order: $10

Customer service: F. M. Smith

Free literature available: Brochure RS-65 describes and illustrates typical relays and switches we can produce, to customer's specifications, from modular components.

Products manufactured: Relays, Switches

JAMESBURY CORP., 640 Lincoln St., Worcester, Mass., 01605, Tel: 617-852-0200, TWX: 710-340-1268; Empl.: 800

Free literature available: Bulletin #233 Ball Valves for Vacuum Service 247 Butterfly Valves P137 Vacuum Service 213 Style B 3-piece Valves P137 Wafer-Sphere Butterfly Valves 251 Pneumatic piston actuators 252 Quadra-Powr spring-diaphragm actuators 215 Clincher Ball Valves

Products manufactured: Actuators, Valves, Vacuum

Local Sales Offices & Reps.

Ala	Pleasant Grove, Jamesbury Corp.	205-787-1429
Cal	Mill Valley, Jamesbury Corp.	415-982-0606
Cal	Westlake Village, Jamesbury Corp.	213-264-7508
Fla	Jacksonville, Jamesbury Corp.	904-768-0411
Ill	Prestbury, Jamesbury Corp.	312-858-1060
La	Baton Rouge, Jamesbury Corp.	504-344-1933
Mich	Milford, Jamesbury Corp.	313-547-5070
Mo	Kansas City, Jamesbury Corp.	816-531-2700
NY	New York, Jamesbury Corp.	212-964-8852
NY	Pittsford, Jamesbury Corp.	716-381-2282
NC	Charlotte, Jamesbury Corp.	704-376-6393
Ohio	Chagrin Falls, Jamesbury Corp.	216-543-4202
Ohio	Dayton, Jamesbury Corp.	513-579-0847
Pa	Newtown Square, Jamesbury Corp.	215-353-4670
Pa	Pittsburgh, Jamesbury Corp.	412-341-3338
Tex	Houston, Jamesbury Corp.	713-622-1671
Tex	Irving, Jamesbury Corp.	214-259-8460
Wash	Mercer Island, Jamesbury Corp.	206-682-6997
EXP:	Tenn., Murfreesboro, Jamesbury Corp.	615-256-0643
FOR:	Can., Ottawa 15, Ont., Jamesbury Canada Ltd.	613-746-2211

JAN HARDWARE MFG. CO., 47-27 36th St., Long Island City, N.Y., 11101, Tel: 212-361-0800; FSC No: 99813; QPL No: 3926; Empl.: 60; Minimum order: $25 .... p. 2•1088-1103

For info on price: I. Wasserman; Application info: R. Oddo; Customer service: J. RAy; Delivery info: L. Marra

Free literature available: Catalog including products listed in EEM.

Products manufactured: Alarms, Bezels, Shielded & Unshielded, Brakes, Bumpers, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cabinets & Accessories, Chassis, Metal, Clutches, Controls/Control Eqpt., Cords, Counters, Couplings, Dials, Display Devices/Displays, Drives & Drive Mechanisms (Dial), Encoders, Escutcheons, Foil, Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Handles For Cabinets, Circuit Boards, Racks, etc., Heat Exchangers & Systems, Heat Sinks, Soldering, Jack Covers, Jacks (All Types), Jigs And Fixtures, Chassis & Circuit Board, Knobs, Limit Stops, Mechanical, Locks, Dial & Shaft, Mounts, Panels, Plug & Jack Sets, Pointers, Dial, Potentiometers, Racks, Reducers, Scales, Dial, Shafts & Adapters, Shields, Sockets, Spacers, Terminal Blocks, Boards & Strips, Terminals, Testers

Local Sales Offices & Reps.

Cal	Carte Madera, P. O'Neal Assoc.	415-924-1691
Cal	Los Angeles, J.C. Simon Co.	213-939-2366
Fla	Clearwater, CBC Elctrns.	813-447-3375
Fla	Ft. Lauderdale, CBC Elctrns.	305-484-7330
Fla	Winter Park, CBC Elctrns.	305-644-2277
Ga	Avondale Estates, Candor Co.	404-458-6713
Haw	Honolulu, Aloha Assoc.	808-922-3810
Ill	Chicago, Croydon Elect.	312-237-4343
Ind	Huntington, Croydon Elect.	219-422-2311
Md	Woodbine, Naudain Assoc.	301-442-2270
Mass	Newton Lower Falls, New England Comp. Sls.	617-969-9523
Mo	Crestwood, Nevco	314-843-7406
Mo	Kansas City, Nevco	816-421-1751
NJ	Bergenfield, H. Gray Assoc.	201-384-3643
NY	Rochester, Lloyd Hart Assoc.	716-244-3253
NC	Raleigh, Candor Co.	919-876-4999
Ohio	Cleveland, Goory Sls.	216-331-2055
Ohio	Dayton, Goory Sls.	513-294-3747
Pa	Mount Laurel, Naudain Assoc.	215-564-3194
SC	Myrtle Beach, Candor Co.	803-448-8361
Tenn	Chattanooga, Candor Co.	615-894-7454
Tex	Dallas, Loss & Stewart Assoc.	214-691-6039
Va	Lynchburg, Candor Co.	804-846-6579
EXP:	Can., Scarborough, Ont., Banke Elctrns., Ltd.	416-291-7529

JANCO CORP., Box 3038-Glenoaks Sta., Burbank, Cal., 91504, Tel: 213-845-7473, TWX: 910-498-2701; FSC No: 91812; Empl.: 150 .... p. 1•2088-2091

For info on price: S. Kay, Jr.; Application info: L. Smart

Products manufactured: Bus Bars & Systems, Jumpers, Shunts, Meter, Switches, Timers

Local Sales Offices & Reps.

Ala	Knoxville, J.R. Stephenson Agency	615-588-7474
Ariz	Scottsdale, J.B. Hower & Co.	602-948-0430
Ark	Dallas, M. Kruvand Co.	214-827-8043
Cal	Menlo Park, McKnight Co.	415-325-2844
Colo	Denver, Brown Tech., Inc.	303-233-0863
Conn	Glastonbury, Barton-Caron Assocs.	203-633-0417
Fla	Orlando, MacKay, Smith & Assocs.	305-277-1513
Ga	Atlanta, N.D. Russell	404-255-2918
Ill	Chicago, Engineered Sls. Co.	312-867-8434
Kans	Wichita, T-Bird Tech. Sls. & Svc.	316-684-2941
Md	Silver Spring, H.R. Sieber Co.	301-589-9110
Mass	Auburndale, Barton-Caron Assocs.	617-332-0342
Minn	Minneapolis, Electro-Serv Co.	612-827-2907
Mo	St. Louis, T-Bird Sls. & Svc.	314-567-6488
NJ	Cherry Hill, Quality Comps. Co.	609-428-6266
NY	Albertson, C.F. Ward	516-742-5561

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NC	Charlotte, MacKay, Smith & Assoc.	704-527-0240
Ohio	Cleveland, Comps., Inc.	216-842-2737
Tenn	Knoxville, J.R. Stephenson Agency	615-588-7474
Tex	Dallas, Mark Kruvand Co.	214-827-8043
Wash	Seattle, Norwest Co.	206-282-3707

JANEL, INC., 1320 Valley Rd., Stirling, N.J., 07980, Tel: 201-647-5600; Empl.: 16

For info on price: M. Marcasciano; Application info: B. Huriock; Customer service: D. Stelle; Delivery info: C. Giacomo

Products manufactured: Cleaners, Ultrasonic, Gages, Heat Sinks, Soldering, Knives & Knife Sets, Lamps, Pliers, Screwdrivers, Soldering Accessories, Soldering Equipment, Tools, Tweezers, Hand & Vacuum, Wire Twisters, Wrenches

JAPANESE PRODS. CORP., 7 Westchester Plaza, Elmsford, N.Y., 10523, Tel: 914-592-8880; Empl.: 6

For info on price: S. Lane; Application info: S. Lane; Customer service: E. W. Brown; Delivery info: E. W. Brown

Products manufactured: Motors, Testers

JAVELIN DIV., Apollo Lasers, Inc., 6357 Arizonia Circle, Los Angeles, Cal., 90045, Tel: 213-641-4490, Telex: 69-8204; Empl.: 65

For info on price: T. Miller; Application info: T. Miller; Customer service: M. Rice; Delivery info: R. Perry

Free literature available: Javelin Catalog -literature on CCTV security equipment: cameras, monitors VTR's, video signal equipment, housings, pan/tilts, scanners, switchers, night vision equipment.

Products manufactured: Amplifiers, Lasers & Laser Systems, Lenses, Optical & Camera, Monitors, Recorders, Tapes, Recording, Magnetic (All Types), Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Cal	Los Angeles, R. S. Milecki	213-641-4490
Colo	Aurora, A. E. S.	303-366-0208
Fla	Port Charlotte, W. F. Hemminger	813-625-6050
Ga	Atlanta, C. Harrison Assocs.	404-633-3230
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Ind	Indianapolis, C. Scheffler Co.	317-253-6337
Mass	Newton Upper Falls, M. P. Video	617-965-5405
Minn	Minneapolis, Kodo Assoc.	612-881-1255
Mo	Kansas City, Nevco	816-421-1751
NY	Binghamton, Rayber Sls. Co.	607-724-1734
NY	Port Chester, Reich & Bernstein	914-939-5408
Ohio	Cleveland, Imtech Equip. Div.	216-825-3400
Pa	Newton Square, G. M. Coneen Co.	215-353-2241
Tex	Dallas, B. S. Amos & Assoc.	214-823-7820
Va	Anandale, Javelin Electrns.	703-978-7558
Wash	Seattle, Pacnor Mktg.	206-284-8020

JAVEX ELCTRNS., 9509 Oak Glen Rd., Cherry Valley, Cal., 92223, Tel: 714-845-3986; Empl.: 60

Customer service: C. J. Reimuller

Products manufactured: Attenuators, Boxes, Junction, Outlets & Wall Plates, Caps, Connector, Connectors, Couplers, Jacks (All Types), Plug Adapters, Plug & Jack Sets, Plug Caps & Shells, Plugs, Potentiometers, Sockets, Splicers, Coaxial Cable, Switches, Terminals

JAY-EL PRODS., 1859 W. 169th St., Gardena, Calif., 90247, Tel: 213-321-3260, TWX: 910-346-7633; FSC No: 06719; QPL No: Multiple; Empl.: 65; Minimum order: $25

For info on price: K. Woods; Application info: L. Miller; Customer service: K. Woods; Delivery info: K. Woods

Free literature available: Basic concepts of our switches and indicators plus ordering information and general outline dimensions.

Products manufactured: Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Indicators, Relays, Switches

Local Sales Offices & Reps.

Cal	Gardena, Jay-El Prods., Inc.	213-323-7130
Cal	Santa Clara, Nova Tronix, Representative	408-243-9530
Mass	Chelmsford, North East Components	603-668-1372
Pa	Lafayette Hill, R. Tschopp (Direct Sls.)	215-825-3666
Tex	Dallas, Allied Comp.	214-238-0408
Wash	Seattle, Norwest Co.	206-AT 2-3707

JB ELCTRN, TRANSFORMERS, INC., 2300 W. Armitage Ave., Chicago, Ill, 60647, Tel: 312-342-0080, TWX: 910-221-1283; Empl.: 150

Products manufactured: Coils Including Assemblies & Forms, Transformers

JDN ELECTRONICS, INC., 239 Morristown Rd., Gillette, N.J., 07933, Tel: 201-647-2400; Empl.: 5; Minimum order: $15

For info on price: M. Fussell; Application info: D. Bock; Customer service: D. Bock

Free literature available: JDN-Series A .1000DX .250 Long, JDN Series B .1250DX .335 Long, JDN Series C .1570DX.450 Long, JDN Series D .1570DX .415 Long, Data sheets describe components and list mechanical and electrical parameters for each series.

Products manufactured: Chokes, Coils Including Assemblies & Forms

Local Sales Offices & Reps.

Ala	Huntsville, Incotech	205-837-6061
Cal	Sunnyvale, Amasco	408-733-8690
Ill	Chicago, Chant-Aslan Assocs.	312-235-8443
Mass	Waltham, Betronic Assocs.	617-894-8400
NJ	Kenilworth, Ventronics	201-272-9262
Ohio	Chagrin Falls, Pine Sls. & Engrg. Co.	216-247-6198
Va	Fairfax, Schibley Assocs.	703-591-3008
Wash	Seattle, W. Spaulding Co.	206-282-9173

JEFFERSON ELEC., Div. Litton Inds., 840 S. 25th Ave., Bellwood, Ill., 60104, Tel: 312-626-7700; Empl.: 1200

Customer service: J. Mocko

Free literature available: Published as application guides, Jefferson Electric's comprehensive product catalogs offer the latest electrical data for transformers, ballasts and lighting equipment.

Products manufactured: Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Bennan Sls. Co.	602-945-2394
Ark	Little Rock, Southland Sls. Inc.	501-753-4013
Cal	Los Angeles, J.G. Pomeroy Co.	213-263-9381
Cal	San Francisco, Black & Egbert	415-282-0840
Colo	Denver, E-O Sls. Co.	303-744-7081
Fla	Orlando, O.C. Puckett Co.	305-422-7197
Fla	Temple Terrace, O.C. Puckett Co.	813-988-7077
Ga	Atlanta, Chastain-Powell, Inc.	404-875-0755
Haw	Honolulu, R.J. Austin & Assoc.	808-395-4011
Ill	Westchester, EMC, Electrical Mktg. Corp.	312-681-1180
Ind	Indianapolis, C. Warblee & Assoc.	317-632-1465
Kans	Kansas City, D. Hatfield Sls. Co.	913-281-0533
Ky	Covington, Hackman Electrical Sls.	606-291-3800
La	New Orleans, Corrigan Mktg. Agency	504-865-7301
Mass	Canton, North Coast Sls. Co.	617-828-4006
Mich	Dearborn, Electrical Materials	313-541-1650
Mo	St. Louis, Electrical Mktg. Inc.	314-726-2920
Neb	Omaha, W.J. Fritsch, Electric Equip. Sls. Co.	402-556-4998
NY	Hartford, F.W. Laver & Son	315-724-2304
NY	Jamaica, Warshaw Electric Co.	212-525-8150
NC	Charlotte, W.H. Lassiter, Sls. Co.	704-523-2736
Ohio	Bedford Heights, Riffle & Assoc.	216-439-5500
Pa	Philadelphia, Electrical Sls. Assoc.	609-541-7452
Pa	Pittsburgh, Squire & Main Assoc.	412-364-3700
Tenn	Memphis, Southland Sls. Agents	901-525-0142
Tenn	Nashville, Southland Sls. Agents	615-889-4738
Tex	Dallas, Rich Co.	214-742-1758
Tex	Houston, McIver & Slavin Co.	713-861-3888
Utah	Salt Lake City, J.D. Stephens Co.	801-355-3540
Wash	Seattle, Bangs Assoc.	206-762-0262
Wisc	Milwaukee, J. F. Nolan & Assoc.	414-781-1140

JENSEN SOUND LABS., Div. Pemcor, Inc., 4310 Trans World Rd., Schiller Park, Ill., 60176, Tel: 312-671-5680, TWX: 910-227-3728; Empl.: 42; Minimum order: $100

For info on price: R. Gold; Application info: R. Engelmann; Customer service: R. Gold; Delivery info: R. Gold

Free literature available: New 4/Color Catalogs, for high fidelity speaker systems and automotive speaker systems.

Products manufactured: Speaker Systems, Speakers

Local Sales Offices & Reps.

Ariz	Phoenix, Sal Bova Sls.	602-266-1137
Cal	Culver City, Marshank Sls.	213-559-2591
Cal	Redwood City, Sinai-Johnson, Inc.	415-365-6263
Colo	Aurora, Scowcroft & Assoc.	303-755-2422
Ga	Atlanta, B. M. Tyler & Assoc.	404-634-6121
Haw	Honolulu, G. Piety Factors	808-839-9059
Ill	LaGrange, E.N, Seversen & Assoc.	312-352-2055
Ind	Carmel, Alpha Sls. Corp.	317-846-7735
Kans	Overland Park, Nackman-Brod-Vann & Co.	913-381-6560
Md	Silver Springs, M.F. Taylor	301-589-4002
Mass	Norwood, Market Reps., Inc.	617-762-0155
Mich	Lake Orion, T.A. Firaneck Sls.	313-391-1177
Minn	Minneapolis, G & C Assocs.	612-927-5633
Mo	St. Louis, Nackman-Brod-Vann & Co.	314-991-2424
Neb	Omaha, Nackman-Brod-Vann	402-333-4346
NY	Phelps, LSM Assocs.	315-548-4891
NY	Yonkers, Adelman-Pinz Sls. Corp.	914-423-4747
Ohio	Cleveland, MS Sls. Corp.	216-382-2060
Okla	Oklahoma City, T. Wachendorfer Assoc.	405-721-9170
Ore	Portland, Fleehart & Sullivan	503-297-1033
Tex	Houston, T. Wachendorfer Assoc.	713-465-3092
Wash	Seattle, Fleehart & Sullivan	206-522-1533
EXP:	Chicago, Ill., J. D. Marshall Int'l.	312-583-6060

JENSEN TOOLS & ALLOYS, 4117 N. 44th St., Phoenix, Ariz., 85018, Tel: 602-959-2210, TWX: 910-950-1154; Empl.: 35

Customer service: J. Hogg

Products manufactured: Drills & Accessories, Hand & Power, Heat Guns, Production, Heat Sinks, Soldering, Knives & Knife Sets, Pliers, Screwdrivers, Solder (All Types), Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Tools, Torches, Soldering, Welding & Access., Wire Strippers, Wrenches

JERMYN, 712 Montgomery St., San Francisco, Cal., 94111, Tel: 415-362-7431; Empl.: 6

Customer service: G. Hall

Free literature available: 80 page full color catalog and complete price list including sockets logic checkers, heat sinks, heat pipes, heat transfer isolators, transistor and I. C. spacers, cooling modules and D. I. L. headers for discrete construction of small plug in units.

Products manufactured: Cable, Clamps & Clips, Coatings, Connectors, Cooling/Heating Modules, Thermoelectric, Heaters & Heating Elements, Kits, Breadboarding (For Engineers), Ovens, Pads, Transistor Mounting, Probes, Retainers, Sockets, Testers, Wire

Local Sales Offices & Reps.

Ariz	Tempe, J. F. Hurlbut Co.	602-968-5962
Cal	Garden Grove, Impact Elctrns.	213-431-3581
Colo	Denver, Cristee-Meade Co.	303-753-9471
Fla	Casselberry, E. I. R.	305-830-9600
Ill	Northbrook, R. T. Howlett	312-498-5444
Mass	Waltham, Impact Sls.	617-893-2850
NY	Huntington Station, Addem Group	516-567-5900
Pa	Birchrunville, Jadelectronics Assoc.	215-647-5151
Wash	Seattle, Fleehart & Sullivan	206-522-1533

JEROME INDUSTRIES CORP., 391 Lakeside Ave., Orange, N.J., 07050, Tel: 201-678-9595; Empl.: 75

For info on price: J. Digirolamo; Application info: J. Digirolamo; Customer service: C. Montagna; Delivery info: J. D. Trollo

Free literature available: Catalogue-shows plug-in adaptors and complete product line. Flyer-shows transformers manufactured.

Products manufactured: Chargers, Battery, Motors, Plug Adapters, Potentiometers, Power Supplies, Transformers

Local Sales Offices & Reps.

Cal	Santa Monica, REP Assocs.	213-829-5401
Fla	Oldsmar, L.A. Assocs.	813-855-4209
Ill	Downers Grove, Ed Joyner & Co.	312-968-8383
Md	Glen Arm, Hodgins Assoc.	301-592-7047
Mass	Framingham, Gerald Rosen Co.	617-879-5505
Mo	St. Louis, Gordon Fixman Engrg. Co.	314-725-5219
NY	Floral Park, M.O.S. Assoc.	516-694-5923
NY	Pompey, Stuart Foster Co.	315-677-3333
Tenn	Bristol, Rakes Engrg. & Mktg. Corp.	615-968-4195
Tex	Dallas, Precision Sls.	214-351-6964
Wash	Bellevue, Vantage Corp.	206-455-3460

JERROLD ELECTRONICS CORP., Distributor Sales Div., 200 Witmer Rd., Horsham, Pa., 19044, Tel: 215-674-4800, TWX: 510-665-6880

Products manufactured: Amplifiers, Antenna Feed Systems, Antennas, Attenuators, Bridges, Cable, CATV Systems & Equipment, Comparators, Converters, Couplers, Demodulators, Detectors, Filters, Generators, Insertion Loss Measurement Systems, Jacks (All Types), Meters, Modulators, All Kinds, Mounts, Networks, Switches, Television Systems & Equipment Closed-Circuit, Terminals, Test Equipment, Testers, Transformers

Local Sales Offices & Reps.

Cal	Redwood City, R. Snider	415-365-5050
Ga	Atlanta, O. Cavendish	404-432-3102
Mo	No. Kansas City, W. Woody	816-842-1555

JERSEY SPECIALTY CO., Box 248, Burgess Pl., Wayne, N.J., 07470, Tel: 201-694-6200; Empl.: 40; Minimum order: $50

Customer service: R. D. Foster

Free literature available: Catalog and Wire Sample Board.

Products manufactured: Cable, Wire

Local Sales Offices & Reps.

Cal	Los Angeles, Erlanger Sls. Co.	213-731-2238
Del	Newark, F. S. Carmine Co.	302-738-5966
Fla	Miami, Raulson & Co.	305-226-6013
Ga	Atlanta, H. W. Phillips Co.	404-237-7564
Ill	Chicago, Lassers & Co.	312-539-0170
Ind	Indianapolis, D. Powers Sls., Inc.	317-846-0790
Mass	Lynn, Keene Sls. Co.	617-595-2300
Mich	Brighton, Lectro Sls. Co.	313-632-7941
Minn	St. Louis Park, Smith Sls. Co.	613-377-3187
Mo	Raytown, M. Taraski Sls. Co.	816-358-1442
NJ	Teaneck, Fisher Elctrn. Assocs.	201-837-1200
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
NC	Charlotte, D. Austin Co.	704-366-4643
Ohio	Medina, T. Grant Assocs.	216-692-3050
Ore	Portland, R. M. Minthorne	503-246-4556
Tex	Dallas, Crockett Sls. Co.	214-748-8209
EXP:	New York, N.Y., Roburn Agencies	212-989-5939

JETTRON PRODS., 58 Rte. 10, Box 7, Hanover, N.J., 07936, Tel: 201-887-0571; FSC No: 04435; Empl.: 30; Minimum order: $20

For info on price: R. Jannacelli; Application info: E. Dietz; Customer service: J.M. Schill; Delivery info: D. Lanata

Free literature available: Magnetron Connectors, 50 Types Plus Input Terminal Outlines; Molded H.V. Cabel Assembly Outlines And Anode Terminal Types; Magnetron Connectors, 5 Types, Magnetron Tube Type Listing; Jettron Thermal Time Delay Relays, 45 P/N's.

Products manufactured: Cable Assemblies & Harnesses, Caps, Connector, Clamps & Clips, Connector Adapters, Connectors, Holder & Carriers, Holders, Crystal, Jigs And Fixtures, Chassis & Circuit Board, Lead Assemblies & Receptacles, Relays, Retainers, Services, Assembly, Production & Test, Sockets, Strips, Testers

Local Sales Offices & Reps.

Cal	El Monte, Western Controls	213-443-9376
Ill	Chicago, William F. Hamilton Co.	312-545-7676
Mass	Natick, Wayland Engrg. Sls.	617-655-6080
NY	New York, Eltron Export Co.	212-944-7635
FOR:	Can., Willowdale, Ont., Avotronics Ltd.	

JEWELL ELECTRICAL INSTRUMENTS, INC., Grenier Field, Manchester, N.H., 03105, Tel: 603-669-6400; Empl.: 500

Products manufactured: Controls/Control Eqpt., Indicators, Meters

Local Sales Offices & Reps.

Ariz	Scottsdale, E.V. Roberts & Assocs.	205-881-1213
Ark	Magnolia, J.Y. Schoonmaker Co.	501-234-3778
Cal	Culver City, E.V. Roberts & Assocs.	213-870-9561
Colo	Denver, R.G. Bowen Co.	303-722-4641
Conn	New Haven, Gerber Sls. Corp.	203-777-6279
Fla	Orlando, Cartwright & Bean Inc.	305-422-4531
Fla	Plantation, Cartwright & Bean Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean, Inc.	404-237-2273
Ill	Barrington, F.J. Peck Co.	312-381-3388
Ind	Indianapolis, L.M. DeVoe Co.	317-257-1227
Kans	Shawnee Mission, Kathrinus, Kelly & Co.	913-722-0000
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Mass	East Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Dearborn, Villani-Pitcher	313-271-4600
Minn	Edina, M. Foster Co.	612-941-7600
Mo	St. Louis, Kathrinus & Kelly	314-968-3800
NJ	Cherry Hill, Trinkle Sls., Inc.	609-667-3500
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Garden City, Comtronics Assocs.	516-741-8966
NY	N. Syracuse, L.D. Allen, Inc.	315-458-7470
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
Ohio	Beachwood, Elctrns. Salesmaster, Inc.	216-831-2900
Okla	Tulsa, J.Y. Schoonmaker	501-234-3778
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Tex	Houston, J.Y. Schoonmaker Co.	713-926-9510
Utah	Salt Lake City, R.G. Bowen Co.	801-364-4632
Wash	Seattle, F. Jackson Co.	206-363-3931

JFD ELECTRONICS COMPONENTS CORP., 15th Ave. at 62nd St., Bklyn., N.Y., 11219, Tel: 212-331-1000, TWX: 710-584-2462; Empl.: 325; Minimum order: $50

For info on price: L. Semmel; Application info: F Caserta; Customer service: M. Miller; Delivery info: M. Miller

Free literature available: Microceram Porcelain Ceramic Multilayer Capacitors; Piston Timmer Capacitors; Air Variable Capacitors; Subminiature Ceramic Disc Capacitors; Fixed and Variable Metalized Indicators, LC tuners; Modutrim Microminiature Ceramic Variable Capacitors.

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Coils Including Assemblies & Forms

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Los Altos, Recht Assocs.	415-941-0336
Cal	Van Nuys, MCA So. Cal.	213-785-0487
Colo	Denver, Omega Ltd.	303-758-1508
Fla	Altamonte Springs, SemTronic Assocs.	305-831-8233
Fla	Ft. Lauderdale, SemTronic Assocs.	305-771-0010
Ga	Atlanta, G. Duckett Sls. Co.	404-451-3529
Ill	Chicago, MCA Chicago	312-992-2090
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Indianapolis, Electro-Reps Inc.	317-255-4147
Kans	Prairie Village, Engrg. Svcs. Co.	914-649-4000
Md	Elicott City, Doss Elctrns.	301-465-1336
Mass	Framingham, MCA Boston	617-872-4843
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Minn	St. Louis Park, Beta Engrg. Corp.	612-925-4422
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NY	Jericho, HRC Comp-Tech, Inc.	516-822-5550
NY	New Hartford, MCA Upstate N.Y.	315-732-3507
NC	Charlotte, L.P. Spoon, Inc.	704-372-3290
Ohio	Cincinnati, Luebbe Sls.	513-871-4211
Ohio	Cleveland, Luebbe Sls.	216-333-0425
Ohio	Dayton, Luebbe Sls.	513-294-0426
Pa	King of Prussia, Monteiro Assocs., Inc.	215-265-0634
Tex	Dallas, United Comps.	214-861-4306
Wash	Seattle, H. Levinson Co.	206-EA 3-5100
Wisc	Milwaukee, Star Engrg. Sls.	414-543-3469
FOR:	Can., Toronto, Ont., Kaytronics Ltd.	416-638-5511
FOR:	Can., Montreal, Quebec, Kaytronics Ltd.	514-487-3434
FOR:	Can., Vancouver, B.C., Harry Levinson	206-EA 3-5100

J.D.N. ELECTRONICS INC., Box 156, 239 Morristown Rd., Gillette, N.J., 07933, Tel: 201-647-2400; Empl.: 5; Minimum order: $15

For info on price: M. Fussell; Application info: D. Bock; Customer service: D. Bock; Delivery info: M. Fussell

Free literature available: JDN Series A - 0.10 uh to 1000 uh shielded inductor, JDN Series B - 0.10 uh to 10000 uh shielded inductor, JDN Series C - 0.10 uh to 100000 uh shielded inductor, JDN Series D - 0.10 uh to 100000 uh shielded inductor, Mechanical dimensions on products plus, complete listing of electrical parameters and, applicable Mil specifications.

Products manufactured: Chokes, Coils Including Assemblies & Forms

Local Sales Offices & Reps.

Ala	Huntsville, Incotech Inc.	205-837-6061
Cal	Sunnyvale, Amasco	408-733-8690
Ill	Chicago, Chant-Aslan Association	312-235-8443
Mass	Waltham, Betronic Assocs.	617-894-8400
NJ	Kenilworth, Ventronics, Inc.	201-272-9262
Ohio	Chagrin Falls, Pine Sls. & Engrg. Co.	216-247-6198
Pa	King of Prussia, Schibley Assocs.	
Va	Fairfax, Schibley Assocs.	703-591-3008
Wash	Seattle, Walt Spaulding Co.	206-282-9173

JPI, INC., 1507 San Vicente Blvd., Santa Monica, Cal., 90402, Tel: 213-395-2018; Empl.: 3

Customer service: S. Kondo

Products manufactured: Boards, Printed Circuit, Boards, Printed Wiring, Universal, Coils Including Assemblies & Forms, Counters, Heads, Recording Playback, Erase, Indicators, Inverters, Lamps, Meters, Power Supplies, Readers, Speaker Systems, Tachometers, Testers

JOHANSON MFG. CORP., Box 329, Boonton, N.J., 07005, Tel: 201-334-2676, TWX: 710-987-8367; Empl.: 160; Minimum order: $35 .... p. 2•204

Customer service: P. Smeeton

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Tuners

Local Sales Offices & Reps.

Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-948-5590
Cal	Menlo Pk., Straube Assocs.	415-323-2476
Cal	Studio City, Shortronics, Inc.	213-789-0418
Colo	Denver, Straube Assoc.-Mountain States, Inc.	303-426-0890
Conn	Meriden, J. Murphy Assocs.	203-269-1812
Fla	Clearwater, Perrott Assocs.	813-726-1549
Fla	Orlando, Perrott Assocs., Inc.	305-275-1132
Ill	Rolling Meadows, Sumer, Inc.	312-394-4900
Ind	Greenwood, Valentine & Schillinger	317-888-2260
Ind	South Bend, Valentine & Schillinger	219-291-6258
Md	Silver Springs, Rep-Tron, Inc.	301-593-4844
Mass	Seekonk, J. Murphy Assocs.	617-761-7153
Minn	Minneapolis, Stoss Assocs.	612-925-2757
NM	Albuquerque, Straube Assoc.-Mountain States, Inc.	505-292-0295
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Mt. Vernon, Friedman-Smith Elctrn. Sls.	914-644-4866
Ohio	Cleveland, Electro-Com	216-886-2404
Ohio	Dayton, Electro-Com	513-276-3993
Pa	Feasterville, Professional Svc. Assocs.	215-355-6244
Tex	Ft. Worth, W. Pat Fralia Co.	214-264-3491
Utah	Salt Lake City, Straube Assoc.-Mountain States, Inc.	801-328-4513
Wash	Seattle, R. Johnston Co.	206-524-5170

Local Distributors

Cal	Oxnard, JACO Elctrns., Willard Hills Rd.	213-887-6400
Cal	Sunnyvale, Diplomat/Westland, 1118 Elko Dr.	408-734-1900
Fla	Orlando, Pelcor Co., 1607 Forsyth Rd.	305-275-1132
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Md	Baltimore, Radio Elec. Ser., 1026 Cromwell Bridge Rd.	301-823-0700
Mass	Medford, Blake Assocs., 74 Lawrence Rd.	617-391-7890
NY	Hauppauge, JACO Elect., 195 Engineer Rd.	516-273-5500
Pa	Philadelphia, Philadelphia El., 112 N. 12th St.	215-568-8288
Tex	Ft. Worth, PATCO Co., 6100 Camp Bowie Blvd.	214-264-3491

JOHANSON/MONOLITHIC DIELECTRICS DIV., Box 6456, Burbank, Cal., 91505, Tel: 213-848-4465, TWX: 910-498-2735; Empl.: 75; Minimum order: $25 p. 2•205

Customer service: H. Huber

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Scottsdale, Q.T. Wiles	602-948-5590
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	Sherman Oaks, J.B. Microelctrns.	213-789-0418
Colo	Boulder, Straube/Mountain States, Inc.	303-443-8600
Conn	Durham, J. W. Murphy Assocs.	203-269-1812
Fla	Orlando, Pelcor	305-275-1132
Ill	, Sumer Inc.	312-394-4900
Ind	South Bend, Valentine & Schillinger	219-291-6258
Md	Silver Springs, Rep-Tron, Inc.	301-593-4844
Mass	Seekonk, J. W. Murphy Assoc.	617-761-7153
Minn	Minneapolis, Stoss Assocs.	612-925-2757
NJ	Mt. Vernon, Friedman-Smith Elect. Sls.	914-664-4866

NY	Fayetteville, Graydon-Sherman, Inc.	315-637-9861
Ohio	Cleveland, Electro-Com	216-886-2404
Okla	Tulsa, W. P. Fralia Co., Inc.	918-663-8707
Pa	Philadelphia, Professional Service Assoc.	215-722-8222
Pa	Pittsburgh, Electro-Com	216-886-2404
Tex	Fort Worth, W. Pat Fralia Co.	214-264-3491
Wash	Seattle, R. Johnson Co.	206-524-5170
FOR:	Can., Que., Braydon Electro, Ltd.	514-341-3330

JOHNATHAN MFG., 1101 South Acacia Ave., Fullerton, Calif.

JOHNSON CO., E.F., 299 10th Ave., Waseca, Minn., 56093, Tel: 507-835-2050; Empl.: 1400
p. 2•201-203,707-712

For info on price: Mktg.; Application info: Mktg.; Customer service: Cust. Svc. Dept.; Delivery info: Mktg.

Free literature available: Capacitors Catalog, JCM Miniature Coaxial Connectors Catalog, Electrical Hardware Catalog.

Products manufactured: Capacitors, Variable, Comm. Systems, Connectors, Jacks (All Types), Plugs, Posts, Terminals, Transceivers, Transmitters

Local Sales Offices & Reps.

Ariz	Phoenix, Clemick-Neenan & Assoc.	602-254-2327
Cal	Los Angeles, Clemick-Neenan & Assocs.	213-476-1272
Cal	Redwood City, Logan Sls. Co.	415-369-6726
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Conn	Meriden, P.R. Sturgeon Co.	203-237-1112
Fla	Bradenton, Hutto-Hawkins-Peregoy, Inc.	813-755-4015
Fla	Maitland, Hutto-Hawkins-Peregoy, Inc.	305-831-2474
Fla	Pompany Beach, Hutto-Hawkins-Peregoy, Inc.	305-943-9593
Ga	Atlanta, Millar Elctrns. Inc.	404-261-6160
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Iowa	Cedar Rapids, J. Vrbik Co.	319-377-8244
Kans	Overland Park, T.L. Dowell & Assocs.	913-238-8200
La	Chalmette, McFadden Sls. Inc.	614-221-3363
Md	Baltimore, J. Bresson Assocs.	215-839-6770
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Minn	Minneapolis, S. Clothier Co.	612-888-4666
Miss	Jackson, Cartwright & Bean	504-354-1368
Mo	Shrewsbury, T.L. Dowell & Assocs.	314-647-7067
NJ	Palisades Park, E.F. Johnson Co.	201-461-6463
NY	Elmont, F.E. Schmitt Co.	516-437-8150
NY	Syracuse, Mor-Com Assocs.	315-437-2843
NC	Raleigh, Millar Elctrns., Inc.	404-261-6160
Ohio	Columbus, McFadden Sls., Inc.	614-221-3363
Ore	Portland, J.J. Backer Co.	503-297-3776
Ore	Salem, J.J. Backer Co.	503-362-0717
Pa	Narberth, J. Bresson Assocs.	215-839-6770
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Tenn	Memphis, Cartwright & Bean Inc.	901-276-4442
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Va	Lynchberg, J. Bresson Assocs.	215-839-6770
Wash	Seattle, J.J. Backer Co.	206-285-1300
EXP:	New York, Roburn Agencies	212-989-5939
FOR:	Can., Calgary, Alb., A.C. Simmonds & Sons	403-242-3207
FOR:	Can., Montreal, Que., A.C. Simmonds & Sons	514-352-5250
FOR:	Can., Smith Falls, Ont., A.C. Simmonds & Sons	613-283-2727
FOR:	Can., Vancouver, B.C., A.C. Simmonds & Sons	604-324-3921
FOR:	Can., Willowdale, Ont., A.C. Simmonds & Sons	416-491-1010
FOR:	Can., Winnipeg, Man., A.C. Simmonds & Sons	204-489-2088

Local Distributors

Ala	Huntsville, Mock Elctrns., 2310 Memorial Pkwy.	205-539-2401
Ariz	Phoenix, Dalis Radio & TV Supply, 917 North 7th St.	
Ariz	Phoenix, Sterling Elctrns., 2001 East University	602-258-4531
Ariz	Tucson, Inland Elctrns. Supply, 715 E. Broadway	602-624-4402
Cal	Irvine, Terminal Elctrns., 1791 Reynolds Ave.	714-549-8611
Cal	Los Angeles, California Elctrns. Supply, 1911 Armacost Ave.	213-826-8333
Cal	Los Angeles, Henry Radio, 11240 Olympic Blvd.	213-272-1440
Cal	Los Angeles, RPS Elctrns., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	Oakland, Brill Elctrns., 610 E. 10th	415-834-5888
Cal	Palo Alto, 415-326-5432, 654 High St.	415-3256-5432
Cal	Riverside, Electronic Supply, 2486 3rd St.	714-787-9220
Cal	San Diego, Mock III Sls., 5150 Convoy St.	714-560-0515
Cal	San Diego, Shank & Wright, 2045 Kettner Blvd.	714-239-0176
Cal	San Diego, Sterling Elctrns., 6158 Mission Gorge Rd.	714-283-6575
Cal	San Francisco, Zack Elctrns., 1444 Market St.	415-626-1444
Cal	San Jose, Quement Elctrns., 1000 So. Bascom Ave.	408-998-5900
Cal	Santa Barbara, Channel Radio Supply Co., 18 E. Ortega St.	805-965-8551
Cal	Woodland Hills, Jaco Elctrns., 21201 Oxnard	213-887-6400
Colo	Denver, Electronic Parts, 1212 So. Bdwy.	303-744-1992
Colo	Denver, Elmar Elctrns., 5701 E. Evans Ave.	303-758-5711
Colo	Denver, Newark/Denver, 2170 S. Grape St.	303-757-3351
Colo	Lakewood, Acacia Sls., 11111 W. 8th Ave., Unit B	303-232-2882
Fla	Miami, Electronic Equip., 2701 N.W. 42nd Ave.	305-871-3500
Fla	Orlando, Hammond Elctrns., 911 W. Central Ave.	305-241-6601
Fla	Tampa, Lykes Elctrns., Box 24047	
Ga	Atlanta, Ack Radio Supply, 554 Deering N.W.	404-351-6340
Ga	Atlanta, Lykes Elctrns. Corp., 1135 Chattahoochee Ave.	404-355-2223
Ill	Chicago, Allied Elctrns., 2400 W. Lake St.	312-421-2400
Ill	Chicago, Electronic Distributing, 4900 N. Elston Ave.	312-283-4800
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Geneva, Melvin Elctrns., 825 W. State St.	312-232-8050
Ill	Palatine, OHM/Elect., 649 Vermont Ave.	312-359-5500
Ill	Peoria, Klaus Radio & Elec. Co., 8400 N. Pioneer Parkway	309-691-4840
Ind	Fort Wayne, Ft. Wayne Elctrn. Supply, 3606 Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania St.	317-634-8486
Ind	Indianapolis, RaDisCo, Inc., 814 N. Senate Ave.	317-637-5571
Ind	South Bend, Radio Distributing, 1212 High St.	219-288-4666
Iowa	Cedar Rapids, DEECO, Inc., 2500 16th Ave., S.W.	319-365-7551
Kans	Wichita, Interstate Elctrns. Supply, 1330 E. 1st St.	
Kans	Wichita, Radio Supply Co., 115 Laura	
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
La	New Orleans, Southern Radio Supply, 1909 Tulane Ave.	504-524-2343
Md	Baltimore, Radio Elec. Svc., 1026 Cromwell Bridge Rd.	301-823-0070
Md	Bethesda, Empire Elctrn. Supply, 4907 Rugby Ave.	301-656-3300
Md	Rockville, Capitol Radio Wholesalers, 12270 Wilkins Ave.	301-881-2270
Mass	Boston, Demambro Elctrns., 1095 Commonwealth Ave.	617-787-1200
Mass	Boston, Sager Electrical Supply, 172 High St.	617-542-2281
Mass	Cambridge, Wilshire Elctrns./New Eng., 205 Alewife Brook Pkwy	617-491-3300
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy.	617-329-2400
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mass	Newton, Greene-Shaw Co., 70 Bridge St.	617-969-8900
Mass	Springfield, Cushing, T. F., 1026 Bay St.	413-788-7341
Mass	W. Newton, A. W. Mayer, 38 Border St.	617-965-1111
Mass	Watertown, Sterling Elctrns., 51 Spring St.	
Mich	Ann Arbor, Wedemeyer Elctrn. Supply, 2280 S. Industrial Hwy.	313-665-8611
Mich	Detroit, R. S. Elctrns., 12775 Lyndon	313-491-1000
Minn	Minneapolis, Electronic Center, 127 3rd Ave., N.	612-338-5881
Minn	Minneapolis, Newark-Minneapolis Elects. Corp., 336 Hoover St., N.E.	612-331-6350
Minn	Minneapolis, Stark Elctrns., 112 3rd Ave. N.	612-332-1325
Minn	St. Paul, Gopher Elctrns., 2520 W. Larpenteur Ave.	612-645-0889
Mo	Kansas City, Burstein Applebee Co., 3199 Mercier St.	816-531-5614
Mo	Kansas City, Walters Radio Supply, 3635 Main St.	816-531-7015
Mo	St. Louis, Olive Indl. Elctrns., 6662 Olive Blvd.	314-863-7800
NH	Concord, Evans Radio, Inc., Rt. 3 at Bow Junction	
NJ	Camden, General Radio Supply, 600 Penn St.	609-964-5560
NJ	Green Brook, Green Brook Elec., 269 U.S. Highway 22 East	
NJ	Hanover, State Elctrn. Parts, 36 Rt. #10	201-887-2550
NJ	Little Falls, IPC Corp., Cardinal Dr.	201-785-1830
NJ	Pennsauken, Radio Elec. Svc., Airport Industrial Pk.	609-662-4000
NJ	Rahway, Terminal Elects. Corp., Pinewood St.	201-381-5700
NJ	Springfield, Federated Purchaser, 155 U.S. Rt. #22	201-376-8900
NJ	Springfield, Route Elctrns., U.S. Rt. #22	
NM	Albuquerque, Electronic Parts Co., 2620 Rhode Island St., N.E.	505-293-6161
NY	Binghampton, Stack Ind. Elects., 45-49 Washington St.	607-723-6326
NY	Buffalo, Genesee Radio, 2550 Deleware	716-873-9661
NY	Buffalo, Standard Elect., 3519 Union Rd.	716-685-4220
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broadhollow Rd.	516-694-6800
NY	Farmingdale, Broadline Elctrns. Distributors, 119 Marine St.	516-420-8320
NY	Farmingdale, Harrison Radio Co., 20 Smith St.	516-293-7990
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Jaco Elctrns., 195 Engineers Rd.	516-273-5981
NY	Long Island City, Dalis, H.L., 35-24th St.	212-361-1100
NY	Lynbrook, Peerless Radio Corp., 19 Wilbur St.	212-523-3456
NY	New York, Barry Elctrns. Corp., 512 Broadway	212-925-7000
NY	Port Washington, Restart Elctrns., 820 Port Washington Blvd.	516-883-3500
NY	Rochester, Rochester Radio Supply, 140 W. Main St.	716-454-7800
NY	Rochester, Simcona Elctrns., 275 Mt. Read Blvd.	716-328-3230
NY	Rochester, Summit Elctrns., 292 Commerce Dr.	716-334-8110
NY	Rome, Rome Elctrns., 216 Erie Blvd. E.	315-337-5400
NY	White Plains, Westchester Elctrns., 602 Mamaroneck Ave.	914-949-2400
NY	Woodbury, Harvey Radio Co., 60 Crossway Park W.	516-921-8700
NC	Raleigh, Southeastern Radio Supply Co., 414 Hillsborough St.	
NC	Winston-Salem, Kirkman Elctrns., 901 W. 2nd St.	919-724-0541
Ohio	Akron, Akron Elect. Supply, 107 S. Arlington	216-762-8818
Ohio	Cincinnati, Hughes-Peters, Inc., 4865 Duck Creed Rd.	513-351-2000
Ohio	Cleveland, Pioneer Cleveland Elctrns., 4800 E. 131st St.	216-587-3600
Ohio	Cleveland, R.P.C. Elctrns., 749 Miner Rd.	
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, Esco, Inc., 221 Crane St.	513-224-9192
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Ohio	Dayton, Stotts Friedman Co., 108 N. Jefferson St.	513-224-1111
Okla	Okklahoma City, Trice Wholesale Elctrns., 4701 N. Stiles	405-524-4411
Okla	Portland, United Radio Supply, 123 N.E. 7th Ave.	503-233-7151
Okla	Tulsa, Capitol Elctrns., 708 S. Sheridan	918-836-2541
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9123
Ore	Portland, Portland Radio Supply, 1234 S.W. Stark St.	503-228-8647

Pa	Braddock, M. Leff Radio Parts, 225 Braddock Ave.	412-271-2800
Pa	Montgomery, Pyttronics inds., Montgomeryville Ind. Rb	215-643-2850
Pa	Philadelphia, Almo Elctrns. Corp., 9815 Roosevelt Blvd.	215-676-6000
Pa	Philadelphia, Herbach & Rademan, 401 E. Erie Ave.	215-426-1700
Pa	Philadelphia, Philadelphia Elctrns., 112 N. 12th St.	215-568-8288
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-288-2600
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
RI	Providence, Dandretta, Wm., Co., 28 Wolcott St.	401-861-2800
Tenn	Knoxville, Industrial Elctrns., Gov. John Sevier Hwy.	
Tenn	Nashville, Electra Distributing Co., 1914 West End Ave.	615-329-3971
Tex	Dallas, All State Elctrns., 516 S. Good-Latimer	
Tex	Dallas, Sterling Elctrns., 2875 Merrell Rd.	
Tex	Dallas, Wholesale Elctrns. Supply, 2809 Ross Ave.	214-824-3001
Tex	Ft. Worth, Allied Elctrns., 401 East 8th St.	817-336-5401
Tex	Ft. Worth, Swieco, Inc., 1512 E. Lancaster	817-335-6521
Tex	Garland, Newark Dallas, 707 Easy St.	214-271-2511
Tex	Houston, Geophysical Supply Co., 1500 Crawford St.	713-224-0621
Tex	Houston, Harrison Equip., 1616 McGowen	713-224-9131
Tex	Houston, Wofford Elctrns. Co., 7537 Edna St.	713-644-1838
Utah	Salt Lake City, Kimball Elctrns., 350 Pierpont Ave.	801-328-2075
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th St.	801-355-2971
Va	Charlottesville, Virginia Radio Supply, 715 Henry Ave.	703-296-4184
Va	Roanoke, Peoples Radio & TV, 1015 Moorman Rd., N.W.	703-342-8933
Wash	Seattle, ALMAC/Stroum Elctrns., 5811 6th Ave. S.	206-763-2300
Wash	Seattle, Interface Elctrns. Corp., 300 2nd Ave. W.	206-285-3500
Wash	Seattle, Radar Elec. Co., 168 Western Ave. W.	206-282-2511
Wash	Seattle, Sterling Elctrns., 5608 6th Ave. S.	
Wash	Seattle, Western Elctrns., 717 Dexter Ave. N.	206-284-0200
WVA	Beckley, Halley Elctrns. Co., 713 S. Oakwood Ave.	
Wisc	Madison, Satterfield Elctrns., 1900 S. Park St.	608-257-4801
Wisc	Milwaukee, Electronic Expeditors, 6045 N. Green Bay Ave.	
Wisc	Milwaukee, Parts Mart, Inc., 1314 N. 7th St.	414-276-4160
Wisc	West Allis, Marsh Radio Supply, 6047 W. Beloit Rd.	414-545-6500
For:	Can., Montreal 427, Que., A.C. Simmonds & Sons, Ltd., Place Versailles, Suite 315, 7275 est rue Sherbrooke	514-352-5250
For:	Can., South Burnaby, B.C., A.C. Simmonds & Sons, Ltd., 7010 Sussex Ave.	604-434-9002
For:	Can., Vancouver, B.C., A.C. Simmonds & Sons, Ltd., 8175 Main St.	604-324-3921
For:	Can., Willowdale, Ont., A.C. Simmonds & Sons, Ltd., 285 Yorkland Blvd.	416-491-1010
For:	Can., Winnipeg, Manitoba, A.C. Simmonds & Sons, Ltd., 109 Ruby St.	204-489-2086

JOLO INDUSTRIES, INC., 11861 Cardinal Circle, Garden Grove, Cal., 92643, Tel: 714-636-4940; Empl.: 10; Minimum order: $15

For info on price: T. Giampiccolo; Delivery info: J. Bavol

Free literature available: Product data sheets to all letter head requests.

Products manufactured: Connectors, Guides, Circuit Board, Jacks (All Types), Plug Adapters, Sockets

Local Sales Offices & Reps.

Cal	Burlingame, Leddy Assocs.	415-347-5247
Fla	N. Miami, Irby & Connolly	305-949-5197
Fla	Orlando, Irby & Connolly	305-894-8471
Md	Riverdale, Riggs Assocs.	301-927-3380
Mass	Brookline, Harman Assocs.	617-232-6687
NJ	Riverton, Given Assocs.	609-829-7249
NY	Manhasset, Everett Mktg. Corp.	516-627-7750
NY	Vestal, Systems Hardware Reps.	607-729-6339
Ohio	Cleveland, Geotronix Mktg. Assocs.	216-526-2535
Ohio	Columbus, Geotronix Mktg. Assocs.	614-457-8472
SC	Greenville, Egan Assocs.	803-288-4450
Wash	Kirkland, Lehr Assocs.	206-827-4581
FOR:	Can., Scarborough, Ont., Lake Engrg. Co.	416-751-5980

Advertisment

Manufacture Quality Electronic Components Dual in-Line IC Sockets, Dual in-Line Headers, Connectors, Strip Sockets, P.C. Test Jacks, P.C. Card Ejector, P.C. Card Guide, P.C. Card Edge Connectors and Custom Connectors. All JOLO Sockets Feature Closed-Entry Insulators, Excellent Lead Retention Characteristics, Pedestal Design For Flux Removal and Anti-Wicking Capability.

JONARD INDUSTRIES CORP., 134 Marbledale Rd., Tuckahoe, N.Y., 10707, Tel: 914-793-0700, TWX: 710-562-0107; Empl.: 65; Minimum order: $25 p. 2•1706-1709

For info on price: M. Zyzyzk; Application info: J. Roman; Customer service: S. J. McKinnon

Products manufactured: Brushes & Brush Assemblies, Burnishers, Contact, Calibrators, Cases, Equipment, Instrument, Meter, Cleaners & Solvents, Connectors, Drivers, Nut, Gages, Heat Guns, Production, Heat Sinks, Soldering, Holder & Carriers, Holders, Circuit Board (Production Type), Kits, Breadboarding (For Engineers), Kits, Switch Assembling, Kits, Test Equipment, Leads, Test & Adaptors, Lubricants, Meters, Microscopes, Pliers, Probes, Pullers, Scissors, Screwdrivers, Scribers, Seizers, Services, Assembly, Production & Test, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Testers, Tools, Torches, Soldering, Welding & Access., Tweezers, Hand & Vacuum, Wire, Wire Strippers, Wire Twisters, Wrenches

Local Distributors

Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Inglewood, Newark Elctrns., 4747 W. Century Blvd.	213-678-0441
Colo	Englewood, National Camera, 2000 W. Union Ave.	303-789-1893
Fla	Miami, Electro-Standards Labs., 35-60 NW 34th St.	305-633-6975
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd.	312-697-8200
La	Lafayette, Ralph's of Lafayette, 3004 Cameron St.	318-234-4507
NY	Mount Vernon, Elctrn. Tool, 15 Bertel Ave.	914-664-0088
NY	New York, Graybar Elec., 420 Lexington Ave.	212-532-4000
Okla	Tulsa, S & S Radio Sup., 537 S. Kenosha	918-582-8242
Pa	Plymouth Meeting, Techni-Tool, Apollo Rd.	215-825-4990
Tex	Dallas, Specialized Prods., 2324 Shorecrest Dr.	214-358-4663

Advertisment

MANUFACTURERS OF PRECISION HAND TOOLS FOR THE ELECTRONIC, TELECOMMUNICATION AND AEROSPACE INDUSTRIES SUCH AS WRAPPING TOOLS, CONNECTOR TOOLS, GAUGES, BURNISHERS, ADJUSTERS, CONNECTOR INSERTION AND REMOVAL TOOLS, ETC.

JONES ELCTRNS., HIRAM, 11607 Vanowen St., No. Hollywood, Cal., 91605, Tel: 213-875-0213; FSC No: 04867; Empl.: 8; Minimum order: $20 .... p. 2•682-685

Customer service: E. W. Reed

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Contacts, Electrical, Jacks (All Types), Terminals

Local Sales Offices & Reps.

Tex	Dallas, Packard Assocs.	214-357-5713
Tex	Houston, Lenert Co.	713-225-1465
Tex	Paris, Amrad Corp.	214-785-4544
EXP:	N.Y., New York, C. Tennant	212-679-1300

JONESVILLE PAPER TUBE CORP., 474 Beck Rd., Jonesville, Mich., 49250, Tel: 517-849-9963; Empl.: 40

Products manufactured: Tubing

JORDAN CONTROLS, 5607 W. Douglas Ave., Milwaukee, Wisc., 53218, Tel: 414-461-9200; Empl.: 55-60; Minimum order: $25

For info on price: R. Hall; Application info: D. Minue; Customer service: R. Hall; Delivery info: R. Hall

Free literature available: "Remote Positioning Controls for Industry" - catalog describing products, applications & theory.

Products manufactured: Actuators, Amplifiers, Controls/Control Eqpt., Servo Systems

Local Sales Offices & Reps.

Cal	Santa Ana, Electramation	714-541-4434
Cal	Santa Clara, Johnson Assocs.	408-984-4626
Colo	Denver, D.E. Bond Assocs.	303-756-1234
Conn	Simsbury, Canner Assocs.	203-658-5074
Ga	Atlanta, F.B. Culwell & Assocs.	404-939-1660
Ill	Chicago, Clarkson Engrg. Co.	312-286-2314
Ind	Indianapolis, Garstang Engrg. Co.	317-632-9903
Kans	Shawnee Mission, W. Hickman Co.	913-362-8066
Mass	Lynn, Canner Assocs.	617-599-4740
Mich	Birmingham, Electro-Mation Assoc.	313-564-6517
Minn	St. Paul, Kenco Co.	612-645-7717
Mo	St. Louis, Ray Co.	314-241-5376
Neb	Omaha, W. Hickman Co.	402-334-0861
NJ	Newark, N. Brager Co., Inc.	201-344-1100
NY	Buffalo, J.W. Simpson Co.	716-634-3995
NY	New York, N. Brager Co. Inc.	212-697-1050
NC	Charlotte, Beck Sls. & Engrg. Co.	704-366-5366
Ohio	Chagrin Falls, J. Kilroy Corp.	216-247-8997
Pa	Bala Cynwyd, Jackson-Bowden Automation	215-664-9611
Pa	Erie, Foster-McClinton Inc.	814-453-5786
Pa	Pittsburgh, Foster-McClinton Inc.	412-561-4803
Tex	Dallas, Peso-Production Engrg.	214-369-3181
Va	Roanoke, Johnson Custom Control	703-774-5550
Wash	Bellevue, Southwell Controls Ltd.	206-454-1140
WVa	Huntington, Foster-McClinton Inc.	304-736-5161
EXP:	New Haven, Conn., Master-Wright	203-288-1638

JORDAN ELECTRIC CO., 14707 Keswick St., Van Nuys, Cal., 91405, Tel: 213-781-3849; FSC No: 5905; Empl.: 50; Minimum order: $25

For info on price: K. Landers; Application info: R. Jordan; Customer service: K. Landers

Free literature available: Catalog; samples when ordered on company purchase order

Products manufactured: Resistors, Shunts, Meter

Local Sales Offices & Reps.

Ariz	Phoenix, Micro Elctrns. Dist.	602-944-2281
Ariz	Phoenix, Moltronics of Ariz.	602-272-7951
Ariz	Phoenix, Parts Elctrns.	601-258-6476
Cal	San Diego, Ohm Spun Elctrns.	714-277-6230
Cal	Santa Clara, Mauldin Co.	408-249-7660

JOSLYN ELCTRN. SYS., Div. Joslyn Mfg. & Supply Co., 6868 Cortona Dr., Box 817, Goleta, Cal., 93017, Tel: 805-968-3551; FSC No: 23663; Empl.: 100; Minimum order: $30

For info on price: W. O. Hecht; Application info: J. J. Gilmour; Customer service: W. O. Hecht; Delivery info: W. O. Hecht

Products manufactured: Arresters, Electrical Surge, Lightning, Counters, Limiters, Protectors, Spark Gaps, Suppressors

JSH ELECTRONICS, INC., 8549 Higuera St., Culver City, Cal., 90230, Tel: 213-559-6900, TWX: 910-340-6356; FSC No: 2B436; Empl.: 127; Minimum order: $25

For info on price: L. W. Novin; Application info: B. Segal; Customer service: A. de Villeneuve; Delivery info: A. de Villeneuve

Free literature available: 64 page price list covering almost 30,000 types of Electron Tubes and Semiconductors

Products manufactured: Tubes

Local Sales Offices & Reps.

Mass	Belmont, Cunningham Sales Co.	617-489-2180
Mich	Birmingham, Forand Sales Co.	303-644-0087

JUDSON RESCH. & MFG. CO., Conshohocken, Pa., 19428, Tel: 215-828-3011; Empl.: 30; Minimum order: $20

Customer service: R. Gibson 215-828-0433

Products manufactured: Detectors

JUDD WIRE DIV., Electronized Chems. Corp., S Bedford St., Burlington, Mass., 01803, Tel: 413-863-4357, TWX: 510-290-2147; Empl.: 70

Customer service: M. Walker

Products manufactured: Cable, Wire

Local Sales Offices & Reps.

Ariz	Scottsdale, Carter Assocs.	602-947-4355
Cal	Los Altos, Ewing-Foley	415-941-4525
Cal	Woodland Hills, Cal-Ward Sls.	213-883-2202
Fla	Pompano Beach, Technology Mktg.	305-942-0774
Md	Baltimore, Burgin-Kreh Assoc.	710-862-1450
Mass	Marlborough, O.K. Engrg.	617-481-6400
Mich	Sturgis, Kesler Assoc.	616-651-7619
Minn	Edina, W.L. Ruth & Assoc.	612-941-6350
NJ	Hackensack, TRAK Sls.	201-487-5075
NY	Syracuse, D. Dwyre	315-472-8282
Ohio	Dayton, Whelan Corp.	513-434-7551
Pa	Haddonfield, Mesa Tech. Assoc.	609-429-9531
Tex	Dallas, Stevens Sls. Co.	214-350-2476
Va	Lynchburg, Burgin-Kreh Assoc.	804-845-5600
Wash	Olympia, Bergford Assoc.	206-866-2001

JULIE RESEARCH LAB., 211 West 61st St., New York, N.Y., 10023, Tel: 212-245-2727; Empl.: 40; Minimum order: $50

For info on price: Sls. Dept.; Application info: Sls. Dept./Engrg.; Customer service: Prod. Dept.; Delivery info: Sls. Dept.

Free literature available: General Catalogue-(in preparation). CC-11 Short Form-categorical listing/description. LOCOST Portfolio-complete packet on Julie Ate. Resistor Bulletins-specifications on resistors. Instrument Data Sheets.

Products manufactured: Amplifiers, Bridges, Crystals, Current Sources, Data Acquisition & Reduction Systems, Decade Boxes, Dividers, Indicators, Meters, Networks, Power Supplies, References, D-C Voltage, Resistors, Scanners, Shunts, Meter, Standards, Test Systems, Testers, Voltage Sources

Local Sales Offices & Reps.

Cal	Pasadena, Luscombe Engineer	213-684-2000
Cal	San Mateo, Luscombe Engineer	415-342-7057
Mass	E. Pepperill, Leger Labs.	617-433-6940
Tex	San Antonio, Teletronics Labs., Inc.	512-735-6179

K & S ENGINEERING, 6917 W. 59th St., Chicago, ILL., 60638

Products manufactured: Services, Assembly, Production & Test, Tubing

K-W ENGINEERING WORKS, N50 W16328 Pin Oak Ct., Menomonee Falls, Wisc., 53051, Tel: 414-781-8616; Empl.: 37

Customer service: H. Kaetel

Products manufactured: Antennas, Coils Including Assemblies & Forms, Mounts

KAHGAN ELECTRONICS CORP., 556 Peninsula Blvd., Hempstead, NY, 11550, Tel: 516-538-2300; Empl.: 12

For info on price: B. Stapler; Application info: B. Stapler; Customer service: B. Quisenberry; Delivery info: B. Quisenberry

Free literature available: Mica capacitors, low cost and subminiature. Low cost, low voltage, standardized ceramic capacitors; Aluminum Electrolytic Capacitors-Single Ended (Radial Leads); Solid, Dipped Tantalum Capacitors-Single Ended (Radial Leads); Metal Oxide Film Resistors (1/2 to 5 watts)-Flame-proof Coating.

Products manufactured: Capacitors, Fixed, Resistors

Local Sales Offices & Reps.

Ariz	Phoenix, G. R. McKnight Co.	602-257-8037
Cal	City of Industry, Micrometals	213-968-4718
Cal	Menlo Park, G. R. McKnight Co.	415-325-2844
Conn	West Simsbury, Anchor Engrg. Corp.	203-658-6261
Fla	Altamonte Springs, Semtronics Assocs.	305-831-8233
Fla	Ft. Lauderdale, Semtronics Assocs.	305-771-0010
Ill	Des Plaines, E. Flaxman Co.	312-298-8580
Kans	Shawnee, J. F. Guernsey Co.	913-631-2414
Mass	Wellesley Hills, Anchor Engrg. Corp	617-235-6330
Mich	Detroit, Nicon Assocs.	313-341-7688
Minn	Minneapolis, Thomas Mktg.	612-823-4880
NM	Albuquerque, G. R. McKnight Co.	505-266-6423
Pa	Reading, Beil-Whitaker	215-779-2610
Tex	Addison, Southland Comps.	214-231-2008
Va	Alexandria, Potomac Elctrns.	703-836-1630
Wash	Redmond, Desco Northwest	206-455-9325

KAHLE ENGRG. CO., 3344 Hudson Ave., Union City, N.J., 07087, Tel: 201-867-6500; Empl.: 50

For info on price: C. A. Napor; Application info: C. A. Napor; Customer service: E. Stiefel; Delivery info: C. A. Napor

Free literature available: Our literature covers CRT production; mercury switch manufacture; lamps and component manufacture; hermetically sealed capacitors, diodes; exhaust machines; capacitor testing; brazing, soldering and welding systems.

Products manufactured: Cams, Furnaces, Machines/Machinery, Production, Ovens, Soldering Accessories, Soldering Equipment, Testers

Advertisment

KAHLE Automatic Production Machines and Machine Systems are custom engineered for precision, high speed processing or assembling of lamps, tubes, semi-conductors, diodes, transistors, electrical subassemblies, switches, vacuum bottles, etc. Hermetic seal and exhaust machines include those for most vacuum and gasfilled devices; two or three piece lead-and-cap, lead-slug butt welding by resistance or capacitor discharge welding machines with 100-200 per minute capacity; cat-whisker or current carrying element welding. Glass machinery of all types.

KALART VICTOR CORP., Hultenius St., Plainville, Conn., 06062, Tel: 203-747-1663

For info on price: H. Nettleton; Application info: H. Nettelton; Customer service: J. J. Costag; Delivery info: J. J. Costag

Free literature available: Form #TB55-TeleBeam II new solid state large screen television projector.

Products manufactured: CATV Systems & Equipment

KAMAN SCIENCES CORP., 1500 Garden of the Gods Rd., Colorado Springs, Colo., 80907, Tel: 303-599-1500; Empl.: 450; Minimum order: $50

For info on price: G. Cooper 303-599-1891; Application info: S. Smith 303-599-1892; Customer service: H. Ramey 303-599-1864; Delivery info: G. Cooper 303-599-1891

Products manufactured: Accelerometers, Cable, Transducers

Local Sales Offices & Reps.

Cal	Temple City, Kaman Sciences	213-579-4867
Conn	Simsbury, Kaman Sciences	203-821-6989
Pa	Bethayres, Control Instr. Sls. Co.	215-676-1808

KANDU CORPORATION, 5635 Kendall Ct., Arvada, Colo., 80002, Tel: 303-421-8031; Empl.: 19; Minimum order: $5

Customer service: K. Norris

Free literature available: E-3 Lists prototype P.C. supplies and accessories Etching and plating supplies. 4C Describes custom metal products

Products manufactured: Chemicals, Cleaners & Solvents, Drills & Accessories, Hand & Power, Electroplating Equipment & Supplies, Etchants, Printed Circuit, Kits, Printed Circuit, Laminates, Nameplates, Services, Assembly, Production & Test, Templates, Printed Circuit Design

KAPPA NETWORKS, 165 Roosevelt Ave., Carteret, N.J., 07008, Tel: 800-631-5653; Empl.: 40 ....p. 1•461-464

Products manufactured: Coils Including Assemblies & Forms, Delay Lines, Equalizers, Synthesizers, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, R.R. Thomas Co.	602-994-0401
Cal	Alhambra, M.W. Ridel Co.	213-283-7694
Ill	Chicago, Electro Tech. Assoc.	
Mass	Burlington, Burlington Sls.	617-272-7655
Minn	Minneapolis, Heimann Co.	612-861-6051
NJ	Carteret, Kappa Networks	201-541-1600
NJ	Cherry Hill, Benco Sales	609-779-9282
NY	Roslyn Heights, Livera-Polk Assoc.	516-484-1276
Ohio	Cincinnati, Tri State Mktg.	513-761-7993
Tex	Dallas, R.R. Thomas Co.	214-363-8591
Utah	Salt Lake City, Monarch Distributing & Representing	801-266-9617
Wash	Seattle, Delcom Sls. Co.	206-248-0090

KAPPA SCIENTIFIC CORP., Box 30585, Santa Barbara, Cal., 93105, Tel: 805-967-2396; Empl.: 4

Customer service: F. R. Marshall

Free literature available: Send for: Data sheets describing Kerr cells for Photography. Q-switching and light modulation, also High Voltage Pulse Generators, with nanosecond speed and very low jitter.

Products manufactured: Generators, Modulator/Demodulators, Networks

Advertisment

Kerr cells featuring picosecond response and apertures to 25mm for photography, Q-switching, and light modulation. Specialists in fast, high amplitude pulse generators with outputs to 30 Kilovolts or more, subnanosecond speed and very low jitter. Applications to electro optical modulators, spark gap triggering, laser excitation. Custom requirements are invited.

KATES SCIENTIFIC INSTRS., INC., 23 Converse Ave., Newton, Mass., 02158, Tel: 617-527-2711; Empl.: 18

For info on price: M. Kates; Application info: M. Kates; Customer service: D. Kates

Products manufactured: Braid, Cable, Cards, Logic, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Coils Including Assemblies & Forms, Controls/Control Eqpt., Integrated Circuit Packaging Systems, Modules, Logic, Encapsulated, Services, Assembly, Production & Test, Wire

KATO ENGINEERING CO., 1415 1st Ave., Mankato, Minn., 56001, Tel: 507-387-4011; Empl.: 450

For info on price: M. C. Madsen; Application info: F. Batemon; Customer service: J. Findblom; Delivery info: G. Cliff

Free literature available: Numerous brochures describing KATO generators, motors, power conversion motor - generator sets and complete engine-generator control systems are available from KATO Engineering Company.

Products manufactured: Controls/Control Eqpt., Generators, Motor & Generator Armatures, Rotors, Stators, Motor Electric Generator Sets, Motors, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Cal	San Rafael, H. Wells Assocs.	415-454-5730
Conn	Trumble, Roswell Engrg.	203-268-4382
Ill	Deerfield, Electrocon Inc.	312-948-0320
La	Metarie, General Power & Control Corp.	504-834-1345
Minn	St. Paul, DeBeck Assocs.	612-690-1557
NH	Ashland, Roswell Engrg.	603-968-7022
NY	Seaford, Greer Tech. Sls., Inc.	516-785-6919
Ore	Portland, W. Haynes Assoc.	503-236-2744
Tex	Dallas, General Power Equip. Co.	214-368-4655
Tex	Houston, General Power Equip. Co.	713-524-1895
Va	Virginia Beach, R.H. Graham	804-425-1388
FOR:	Can., Chomeday, Laval, Que., T. G. McDougall	514-332-0712
FOR:	Can., North Vancouver, B.C., C. L. Thompson, Ltd.	604-987-9388

FOR: Can., Winnipeg, Man., C. L. Thompson, Ltd. 204-783-0848

KAWECKI BERYICO INDS., INC., 220 East 42nd St., New York, NY, 10017, Tel: 212-682-7143, TWX: 710-581-5199; Empl.: 1925

For info on price: R. McLaughlin Ext. 217; Application info: C. B. Harlan; Customer service: R. McLaughlin; Delivery info: R. McLaughlin

Products manufactured: Alloys, Cores, Ceramic, Eyelets, Foil, Jigs And Fixtures, Chassis & Circuit Board, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Pliers, Screwdrivers, Services, Assembly, Production & Test, Tools, Tubing, Wrenches

Local Sales Offices & Reps.

Cal	Long Beach, Kawecki Berylco Ind., Inc.	213-595-4525
Cal	Palo Alto, Kawecki Berylco Ind., Inc.	415-323-9625
Conn	Thomaston, Eyelets for Industry, Inc.	203-283-8213
Conn	Thomaston, Summit Finishing Div.	
Ga	Atlanta, Kawecki Berylco Inds., Inc.	404-458-7824
Ill	Des Plaines, Kawecki Berylco Inds., Inc.	312-824-6133
Mass	Boston, Metalonics Div.	617-268-4450
Mass	Waltham, Kawecki Berylco Inds., Inc.	617-890-8270
Mich	Dearborn, Kawecki Berylco Inds., Inc.	313-292-0300
NJ	Palisades Park, Duramic Prods.	201-947-8313
NY	New York, Kawecki Berylco Inds., Inc.	212-697-4360
Ohio	Cleveland, Kawecki Berylco Inds., Inc.	216-464-8860
Ohio	Dayton, Kawecki Berylco Inds., Inc.	513-298-1433
Ore	Springfield, National Metallurgical Div.	503-746-7670
Pa	Reading, Kawecki Berylco Inds., Inc.	215-929-0781
Pa	Revere, Penn Rare Metals Div.	215-847-5121
Wash	Wenatchee, Wenatchee Works	509-663-2165

KAY ELEMETRICS CORP., 12 Maple Ave., Pine Brook, N.J., 07058, Tel: 201-227-2000, TWX: 710-734-4347; Empl.: 86 .... p. 1•746-749

Customer service: J. Connors

Free literature available: GENERAL R.F. TEST EQUIPMENT equipment for tests in the audio thru microwave range. PRECISION, STEPPED ATTENUATOR attenuators for the Audio thru Microwave frequency ranges. CATV TEST EQUIPMENT-Video thru UHF Test equipment for CATV.

Products manufactured: Amplifiers, Analyzers, Attenuators, Bridges, CATV Systems & Equipment, Detectors, Electronic Switches (Oscilloscope), Generators, Insertion Loss Measurement Systems, Meters, Switches, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Barnhill Assocs.	602-947-7841
Cal	Canoga Park, Kay Elemetrics Corp.	213-883-4610
Colo	Denver, Barnhill Assocs.	303-934-5505
Conn	Hamden, J & J Assocs.	203-624-7800
Ill	Northfield, Feller Assocs.	312-446-8065
Mass	Burlington, J & J Assocs.	617-272-2606
NM	Albuquerque, Barnhill Assocs.	505-299-7658
Tex	Houston, Barnhill Assocs.	713-688-9971
Tex	Richardson, Barnhill Assocs.	214-231-2573

KD COMPONENTS, INC., 3016 S. Orange Ave., Santa Ana, Cal., 92707, Tel: 714-545-7108; Minimum order: $25

Customer service: M. Day

Free literature available: Technical and ordering information on single layer and multilayer ceramic capacitors for 125°C and 200°C temperatures. Voltage ranges from 25 to 15000.

Products manufactured: Capacitors, Fixed

Local Distributors

Tex	Houston, Lenert Co., 1420 Hutchins	713-225-1465

KEDMAN CO., Box 267, Salt Lake City, Utah, 84110

KEITHLEY INSTRUMENTS INC., 28775 Aurora Rd., Cleveland, Ohio, 44139, Tel: 216-248-0400; Empl.: 200; Minimum order: $15

For info on price: V. Disantis Ext. 261; Application info: C. Garfinkel Ext. 286; Customer service: V. Disantis Ext. 261; Delivery info: V. Disantis Ext. 261

Free literature available: Full-Line Catalog (All products except below), Keithley Engineering Notes (Models 164, 165, 168, 171, 180, 190, 227, 244), Product Information Bulletins (Models 103A, 160, 160B, 163, 167, 225, 427, 616, 616/6169, 840, 26000, 35020, 35050)

Products manufactured: Amplifiers, Bridges, Calibrators, Detectors, Indicators, Meters, Monitors, Power Supplies, Testers, Voltage Sources

Local Sales Offices & Reps.

Cal	Cupertino, T.L. Snitzer Co.	408-257-8333
Cal	Del Mar, T.L. Snitzer Co.	714-454-2191
Cal	Los Angeles, T.L. Snitzer Co.	213-836-6170
Colo	Littleton, Aztec Entprs., Inc.	303-795-0250
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	Hazelwood, Tech. Reps., Inc.	314-731-5200
Mo	Independence, Tech. Reps., Inc.	816-737-1414
NJ	Flemington, Keithley Instrs., Inc.	201-782-5555
NM	Albuquerque, Aztec Entprs., Inc.	505-255-2440
Ore	Portland, McLaren, Inc.	503-297-2248
Tex	Austin, Palatine Sls.	512-451-7463
Tex	Houston, Palatine Sls.	713-777-4477
Tex	Richardson, Palatine Sls., Inc.	214-231-9489
Tex	Tulsa, Palatine Sls.	918-622-0321
Wash	Bellevue, McLaren, Inc.	206-454-3400
Wisc	Milwaukee, Carter Elctrns., Inc.	414-464-5555
EXP:	Cleveland, Ohio, Keithley Int'l. Sls. Corp.	216-248-0400

KELK, GEORGE LTD., 48 Lesmill Rd., Don Mills, Ont., Canada, Tel: 416-445-5850; Empl.: 60; Minimum order: $10

For info on price: P. R. Wharton; Application info: C. H. Draper; Customer service: J. Mitchell; Delivery info: J. Mitchell

Products manufactured: Amplifiers, Cells, Load, Dividers, Inverters, Regulators, Tachometers

KELTEC FLORIDA, A Division of Aiken Industries, Inc., Box 1348, Fort Walton Beach, Fla., 32548, Tel: 904-651-1210, TWX: 510-730-7775; FSC No: 09062; Empl.: 197; Minimum order: $100

Customer service: Mktg. Dept.

Products manufactured: Amplifiers, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Tempe, PLS Assocs.	602-957-9110
Cal	Los Altos, Stout-Loeswick	415-948-3265
Cal	Los Angeles, Cain Technology	213-476-2251
Colo	Denver, PLS Assocs.	303-771-0140
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Fort Wayne, RF Specialists	219-485-8982
Iowa	Cedar Rapids, Palatine Sls.	319-365-8071
Kans	Overland Park, Palatine Sls.	913-262-5643
Md	Ellicott City, VPI	301-465-4060
Mass	Needham Heights, Reptron	617-449-4141
Mich	Detroit, Micro Sls. Corp.	313-482-1229
Mo	St. Louis, Palatine Sls.	314-426-7055
NJ	Rockaway Borough, Gray & Reed Assocs.	201-625-0223
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	Huntington Station, Gray & Reed Assocs.	516-433-3333
NY	Syracuse, Labtronics	315-454-9314
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Dayton, Micro Sls. Corp.	513-885-4171
Pa	Montgomerysville, VPI	215-474-3200
Tex	Richardson, Lear Assoc.	214-231-5388
Utah	Salt Lake City, PLS Assocs.	801-272-3681
Va	Merrifield, VPI	703-573-7837
Wash	Seattle, Delcom Sls. Co.	206-248-0090

KELTRON, 223 Crescent St., Waltham, Mass., 02154, Tel: 617-894-0525; Empl.: 100

Products manufactured: Counters, Drivers & Decoders For Readouts, Power Supplies, Printers, Timers

Local Sales Offices & Reps.

Cal	Mountain View, Tri-Rep	415-965-1882
Cal	Santa Fe Springs, Sls. Engrs., Ltd.	213-921-4337
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Ill	Chicago, Scientific Sls.	312-775-7594
Ind	Indianapolis, Scientific Sls.	317-253-4606
Mich	Detroit, Ridgway-East	313-538-3940
Minn	Bloomington, Scientific Sls.	612-881-3300
NJ	Harrington Park, Metro Tech. Sls.	201-768-8495
NY	Jericho, Metro Tech. Sls.	516-935-3330
Ohio	Chagrin Falls, Ridgway-East	216-247-4845
Ohio	Loveland, Ridgway-East	513-683-4350
Pa	Abington, Bach-Stewart	215-885-1550
Wash	Bellevue, A. Smith Co.	206-746-6670

KELVIN, 5919 Noble Avenue, Van Nuys, Cal., 91411, Tel: 213-782-6662, Telex: 651417; FSC No: 07088; Empl.: 250; Minimum order: $35

Customer service: Sls. Dept.

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	Mountain View, G.C. Woempner Co.	415-964-5454
Cal	San Diego, Harvey King	714-276-7541
Colo	Boulder, R-G Entprs.	303-447-9211
Conn	Milford, Todino Engrg. Sls.	203-874-6643
Fla	Fort Lauderdale, Orbe	305-564-8571
Ga	Smyrna, B-C Elctrns.	404-436-5169
Ill	Des Plaines, Coombs Assoc.	312-298-4830
Iowa	Des Moines, Beams	515-282-0292
Kans	Overland Park, Beams	913-341-7744
Md	Baltimore, Callas Elctrns.	301-744-7711
Mass	Needham Hgts., Todino Engrg.	617-444-7925
Mich	Grosse Pointe Park, S. Greiner	313-499-0188
Minn	St. Paul, Cahill Assocs.	612-646-7217
Mo	Creve Couer, Beams	314-569-1060
NJ	Haddonfield, Gray Assoc.	609-429-5300
NM	Albuquerque, Piper-Goyne	505-265-6794
NY	Great Neck, Trionic	516-466-2300
NY	Pompey, S.F. Foster	315-677-3333
NY	Webster, S.F. Foster	716-872-5220
Ohio	Akron, Augnat Assoc.	216-725-6087
Ohio	Dayton, Augnat Assoc.	513-223-5002
Pa	Pittsburgh, Augnat Assoc.	412-281-8283
Tex	Dallas, Reese Assoc.	214-638-6575
Wash	Seattle, H. Levinson	206-323-5100

KEMLITE LABS., INC., 1819 W. Grand Ave., Chicago, Ill., 60622, Tel: 312-829-6050; Empl.: 65; Minimum order: $10

For info on price: P. Hamlin; Application info: H. W. Klauer; Customer service: J. Daniels, Jr.; Delivery info: J. Daniels, Jr.

Free literature available: Brochure Lists Many Of Our Standard Photographic Flashtubes and Reflector Flashtubes.

Products manufactured: Lamps

KEMTRON ELECTRON PRODS., INC., 14 Prince Pl., Newburyport, Mass., 01950, Tel: 617-462-4464

Products manufactured: Diodes

KENCO ALLOY & CHEMICAL CO., INC., 418 W. Belden Ave., Addison, Ill., 60101, Tel: 312-543-6060; Empl.: 12

For info on price: M. Bush; Application info: K. Barry; Customer service: E. Wolfgram; Delivery info: T. Whalen

Free literature available: General Catalog of solders, fluxes, cleaners, coatings & PCB processing chemicals.

Products manufactured: Chemicals, Cleaners & Solvents, Coatings, Flux, Brazing & Soldering Materials, Solder (All Types), Soldering Accessories

Local Sales Offices & Reps.

Ariz	Phoenix, K. Jahn Co.	602-956-9060
Cal	Mountain View, Morse Assocs.	415-968-7722
Fla	Largo, Doug Shower Assocs.	813-446-6505
Mass	Hudson, E.P.E. Corp.	617-562-9123
Minn	St. Paul, Nordic Elctrns.	612-226-2210
Mo	Springfield, Del-Tech Assocs.	417-881-3667
NJ	Princeton, Krone & Rubin Assocs.	609-924-0200
NY	Webster, Krone & Rubin Assocs.	716-671-6709
Ohio	Dayton, Buckeye Comps.	513-278-4279
Tex	Dallas, Atlan Inds.	214-243-6216
Wash	Seattle, F. Jackson Co.	206-782-2211
EXP:	Ill., Addison, Kenco Alloy & Chemical Co.	312-543-6060

KENTON ENGRG. CORP., 8232 Christiana Ave., Skokie, Ill., 60076, Tel: 312-677-8280; FSC No: 18308; Empl.: 18

For info on price: A. R. Friesel; Application info: R. E. Zenner; Customer service: E. A. Roberts

Products manufactured: Memory Systems, Meters, Tape Recording Accessories

KENTUCKY ELECTRONICS, INC., 1204 Industrial Dr., Box 507, Owensboro, Ky., 42301, Tel: 502-684-0431; Empl.: 300; Minimum order: $100

For info on price: R. Soblosky; Application info: E. E. Yorns; Customer service: T. Payne; Delivery info: T. Payne

Free literature available: Facilities Brochure - Outlines general capabilities.

Products manufactured: Cans, Capacitor, Relay; Semiconductor, Transformer, etc, Caps, Connector, Clamps & Clips, Connectors, Eyelets, Fasteners, Forms, Wire, Pins, Services, Assembly, Production & Test, Wire

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest Engrg.	602-993-0250
Cal	Atherton, Wadsworth-Pacific Mfg. Assocs.	415-321-3619
Cal	Pacific Palisades, Wadsworth-Pacific Mfg. Assocs.	213-454-4313
Conn	Madison, A & M Electronic Reps.	203-245-1031
Ill	Park Ridge, R. McIntosh	312-825-8070
Mass	Needham, A & M Electronic Reps.	617-444-8170
NJ	Haddenfield, Keefe Electronic Sls.	609-429-4650
NY	Williamsville, Henderson Assocs.	716-634-8650
Tex	Dallas, Waddle Sls. Co.	214-638-2860

Advertisment

Deep-drawn and stamped metal parts, wire forms, and fine wire. KE specializes in close-tolerance, precision parts and close-tolerance, critical-surface wire. Main plant has low-tonnage presses (to 35-ton) and low-to-medium tonnage eyelet machines (to No. 20).. Subsidiary does contract tool and die work and medium-tonnage stamping (to 100-ton). Custom assembly services available at both plants.

KEPCO, INC., 131-38 Sanford Ave., Flushing, N.Y., 11352, Tel: 212-461-7000, TWX: 710-582-2631; Empl.: 200 .... p. 1•1239-1301

For info on price: C. Parrish; Application info: P. Birman; Customer service: E. Becker; Delivery info: B. Ruppert

Free literature available: "Using Operational Power Supplies" "Kepco power supply catalog & handbook" Kepco international catalog (in French & German)

Products manufactured: Generators, Power Supplies, Regulators

Local Sales Offices & Reps.

Ala	Huntsville, J.L. Highsmith Co.	205-881-3294
Ariz	Tempe, J.F. Hurlbut Co.	602-968-5962
Cal	Los Angeles, Windsor Dynamics	213-989-3631
Cal	S. Francisco, Windsor Dynamics	415-854-4870
Colo	Denver, J.F. Hurlbut Co.	303-279-7796
Conn	Farmington, R. Perron Co.	203-673-4825
Conn	Trumball, R. Perron Co.	203-268-9631
Fla	Orlando, J.L. Highsmith Co.	305-293-5202
Ill	Chicago, Midwest Elctrn. Sls.	312-777-9700
Iowa	Cedar Rapids, Midwest Elctrn. Sls.	319-362-4410
Kans	Shawnee Mission, K. Kelly & Co.	913-722-0000
Md	Baltimore, Eastern Instrumentation	301-744-3675
Md	Silver Spring, Eastern Instrumentation	301-681-6500
Mass	Boston, R. Perron Co.	617-762-8114
Mich	Detroit, Carter McCormick & Peirce Inc.	313-477-7700
Minn	Minneapolis, E.C. Elctrn. Sls.	612-927-7777
Mo	St. Louis, Kathrinus, Kelly & Co.	314-968-3800
NH	Dover, R. Perron & Co.	603-742-2321
NM	Albuquerque, Technology Mktg. Assoc.	505-298-4321
NY	New York, Eastern Instrumentation	516-466-9505
NY	Rochester, NACO Elctrns. Corp.	716-223-1156
NY	Syracuse, Naco Elctrns. Corp.	315-699-2651
NY	Utica, NACO Elctrns. Corp.	315-732-1801
NC	Charlotte, J.L. Highsmith Co.	704-333-7743
Ohio	Cleveland, Carter McCormick & Peirce Inc.	216-333-5650
Ohio	Dayton, Carter McCormick & Peirce Inc.	513-278-5873
Pa	Philadelphia, Eastern Instrumentation	215-927-7777
Pa	Pittsburgh, Carter McCormick & Peirce	412-472-4415
Tex	Dallas, Airep Elctrns. Inc.	214-827-2120
Va	Norfolk, Eastern Instrumentation	804-497-0001
Va	Richmond, J.L. Highsmith Co.	703-272-5888
Wash	Seattle, H. Levinson Co.	206-323-5100
Wisc	Milwaukee, Midwest Elctrn. Sls.	414-542-5129
For:	Can., Halifax, N.S., Radionics Ltd.	902-455-0670
For:	Can., Montreal, Que., Radionics Ltd.	514-735-4565
For:	Can., Ottawa, Ont., Radionics Ltd.	613-521-8251
For:	Can., Vancouver, B. C., Radionics Ltd.	604-732-7317
For:	Can., Winnipeg, Radionics Ltd.	204-475-1732
For:	Can.,Toronto, Ont., Radionics	416-638-0218

KERTRON, INC., 7516 Central Ind'l. Dr., Riviera Beach, Fla., 33404, Tel: 305-848-9606, TWX: 510-952-7611; Empl.: 160

Products manufactured: Transistors

Local Sales Offices & Reps.

Ariz	Tempe, Sedco Inc.	602-950-1149
Cal	Palos Verdes Peninsular, B. Gray & Assocs.	213-373-1820
Cal	Redwood City, Parks & Pruitt	415-364-1640
Colo	Denver, Camel Elctrns.	303-757-6192
Ill	Chicago, Derndt Assoc.	312-283-0713
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Md	Silver Spring, Rep-Tron	301-593-4844
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Southfield, Reps. Elctrn. Prods.	313-354-9066
Mo	St. Louis, Engrg. Svcs.	314-997-1515
NY	East Rockaway, W. Bellenkes & Assoc.	516-887-1443
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Okla	Tulsa, Palatine Engrg. Sls.	918-622-0321
Pa	Ambler, WM Assocs.	215-643-4119
Tenn	Bristol, Rakes Engrg. & Mktg. Co.	615-968-4195
Tex	Richardson, Palatine Engrg. Sls.	214-231-9489

KESSLER-ELLIS PRODS., 120 1st Ave., Atlantic Highlands, N.J., 07716, Tel: 201-291-0500, Telex: 13-2496; FSC No: 28222; Empl.: 30; Minimum order: $15 .... p. 1•254-259

For info on price: L. Glecson; Application info: R. Laird; Customer service: L. Glecson; Delivery info: L. Glecson

Free literature available: Bulletin #1200 General Catalog, Bulletin #12 ER type of counters, Bulletin #20 Elapsed time indicators, Bulletin #21 Electronic line-both totalizing & predetermining, Bulletin #14 Pneumatic Predetermining & Totalizing counters.

Products manufactured: Controls/Control Eqpt., Counters, Indicators, Switches, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ala	Atlanta, Electro Mech. Inc.	404-393-0444
Ariz	Phoenix, Palmer Assocs.	602-996-9077
Cal	San Gabriel, Van Gott Assocs.	213-285-2148
Colo	Denver, Palmer Assocs.	303-255-9961
Fla	Clearwater, WMM Assoc.	813-447-2533
Ill	Des Plaines, Lincoln Hodges	312-297-3810
Ind	Indianapolis, F. Sedlack	317-545-1141
Md	Silver Springs, H.R. Siebar	301-589-9110
Mass	Woburn, Gilway Sls. Co.	617-935-4442
Mich	Dearborn, Pitcher-Paulin	313-582-5450
Minn	Minneapolis, R.J. Sls.	612-922-1425
NJ	Atlantic Highlands, R. L. Dalton	201-291-0500
NY	Rochester, L. Marchese	716-544-4300
Ohio	Cleveland, E. Bock & Assocs.	216-331-5212
Pa	Media, W. Reeves	215-566-6709
Tex	Houston, W. Carey Assocs.	713-460-1111
Wash	Seattle, C. Parsons	206-762-7373
Wisc	Waukesha, Rockwell, Brown, Lincoln, Hodges	414-542-3087

KESTER SOLDER DIV., Litton Systems Inc., 4201 Wrightwood Ave., Chicago, Ill., 60639, Tel: 312-235-1600; Empl.: 350

Customer service: B. Mullins

Free literature available: Distributor Catalog; OEM Catalog.

Products manufactured: Cleaners & Solvents, Flux, Brazing & Soldering Materials, Solder (All Types), Soldering Equipment

Local Sales Offices & Reps.

Cal	Anaheim	714-871-0280
NJ	Newark	201-589-0246

KEUFFEL & ESSER CO., 20 Whippany Rd., Morristown, N.J., 07960, Tel: 201-285-5181; Empl.: 2200

For info on price: J. Montesi 201-285-5358; Application info: R. Wayne 201-285-5181; Customer service: J. Montesi 201-285-5358

Products manufactured: Cleaners, Ultrasonic, Drafting Machines, Drafting Symbols, Dry Transfer, Pressure Sensitive, etc. (Including Lettering), Films, Paper, Graphic Recording

Local Sales Offices & Reps.

Alas	Anchorage	907-277-2506
Cal	Los Angeles	213-747-7601
Cal	S. San Francisco	415-873-6850
Colo	Denver	303-733-2451
Fla	Jacksonville	904-398-6471
Fla	Orlando	305-423-1641
Ga	Norcross	404-448-6352
Ill	Northbrook	312-564-0880
Kans	Wichita	316-265-8505
Md	Baltimore	301-727-5290
Mich	Troy	313-549-9100
Mo	Kansas City	816-842-9077
Mo	St. Louis	314-773-8500
NJ	Teterboro	201-288-3900
NJ	Trenton	609-882-8000
NY	E. Syracuse	315-437-1417
NY	Long Island City	212-361-2190
NY	New York	212-687-6510
Ohio	Cleveland	216-241-7807
Ohio	Cuyahoga Falls	216-929-8371
Ohio	Toledo	419-475-3427
Pa	Ft. Washington	215-643-2570
Tex	Dallas	214-742-8084
Tex	Houston	713-227-6231
Tex	San Antonio	512-223-3811
Va	Arlington	703-524-9000
Va	Norfolk	703-625-2591
Wash	Seattle	206-623-5535
Wisc	Milwaukee	414-444-1890
FOR:	Can., Montreal 376, P.Q.	514-735-4171
FOR:	Can., Ottawa 13, Ont.	613-725-2048
FOR:	Can., Ste. Foy, Que.	418-688-9049
FOR:	Scarborough, Ont.	416-751-5600

KEWAUNEE SCIEN. EQUIP. CORP., 4012 Logan St., Adrian, Mich., 49221, Tel: 313-263-5731; Empl.: 750

For info on price: C. A. Schindler; Application info: D. Richards; Customer service: J. McElfresh; Delivery info: J. McElresh

Products manufactured: Benches, Consoles, Stools, Tables, Blowers & Fans & Accessories, Chamber, Environmental Test

KEY TRONIC CORP., Bldg. 14, Spokane Ind'l. Pk., Spokane, Wash., 99216, Tel: 509-928-8000, TWX: 510-773-1885; Empl.: 350

Customer service: Mktg. Dept.

Products manufactured: Encoders, Keyboards, Alphanumeric & Decimal, Kits, Switch Assembling, Lights, Switchboards, Switches

KEYSTONE CARBON CO., Thermistor Div., St. Marys, Pa., 15857, Tel: 814-781-1591; Empl.: 1100 p. 1•2317,2318

Products manufactured: Bearings, Brushes & Brush Assemblies, Controls/Control Eqpt., Indicators, Limiters, Monitors, Networks, Probes, Resistors, Thermistors

Local Sales Offices & Reps.

Cal	San Carlos, Electro Pacific	415-593-1334
Cal	San Gabriel, Van Gott & Assoc.	213-285-2148
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Elk Grove Village, Knoblock & Assoc.	312-593-5940
Ind	Fort Wayne, R.O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assoc.	317-452-6065
Ky	Louisville, R.O. Whitesell & Assoc.	502-893-7303
La	Chalmette, Cartwright & Bean	504-279-4598
Md	Baltimore, Coulbourn DeGreif	301-247-4646
Mass	Reading, C.E. Godfrey Co.	617-944-2230
Mich	Grand Rapids, J.L. Montogomery Co.	616-774-9308
Mich	Southfield, J.L. Montgomery Assoc.	313-358-2616
Minn	Minneapolis, Stoss Assocs.	612-925-2757
Miss	Jackson, Cartwright & Bean	601-981-1368
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NY	Pompey, S.F. Foster Co.	315-677-3333
NY	Webster, S.F. Foster Co.	716-265-2072
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Cincinnati, R.O. Whitesell & Assoc.	513-521-2290
Ohio	Columbus, R.O. Whitesell & Assoc.	614-888-9396

Ohio Dayton, R.O. Whitesell & Assoc. 513-298-9546
Ohio Lakewood, R.O. Whitesell & Assoc. 216-228-7525
Pa Fort Washington, GCM, Inc. 215-646-7535
Pa Pittsburgh, R.O. Whitesell & Assoc. 412-344-7277
Tenn Knoxville, Cartwright & Bean 615-693-7450
Tenn Memphis, Cartwright & Bean 901-276-4442
EXP: Westbury, N.Y., Minthorne Int'l. 516-334-3303
For: Can., Markham, Ont., Tel-Mar Elctrn. Sls., Ltd. 416-887-5612

KEYSTONE ELCTRNS. CORP., 49 Bleeker St., New York, N.Y., 10012, Tel: 212-475-4600; FSC No: 91833; Empl.: 50; Minimum order: $20 .... p. 2•713-715

For info on price: B. Luque; Application info: A. Arrons; Customer service: D. Rosenberg; Delivery info: L. Schwaid

Free literature available: Standardized Electronic Components catalog includes: Battery Holders and Connectors, Clips, Terminal Boards, Perforated Boards, Plug-In Housings, Spacers and Standoffs, Transistor Sockets and Associated Hardware.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cabinets & Accessories, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Cases, Equipment, Instrument, Meter, Clamps & Clips, Connectors, Contact Strips, Finger, Contacts, Electrical, Containers, Couplings, Cups, Encapsulation, Enclosures, Module, Plug-In, Eyelets, Fasteners, Headers, Holders, Crystal, Insulators & Insulation, Jack Covers, Jacks (All Types), Jumpers, Kits, Breadboarding (For Engineers), Kits, Printed Circuit, Kits, Terminal, Kits, Test Equipment, Laminates, Locks, Dial & Shaft, Pads, Transistor Mounting, Pins, Plug Adapters, Plug & Jack Sets, Plugs, Probes, Retainers, Services, Assembly, Production & Test, Sockets, Spacers, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.
Cal Culver City, H. Feldman Co. 213-870-5973
Cal Daly City, R. Del Bucchia Assocs. 415-756-1664
Colo Arvada, Arrowhead Sls. 801-487-3444
Fla N. Miami, Len Hass Co. 305-949-9143
Ill Chicago, Memac Sls. 312-545-1033
Kans Overland Park, Penzner Assocs. 913-381-0004
Md Lutherville, Cunningham & Assocs. 301-296-4306
Mass Waltham, Conti-Younger Assocs. ... 617-890-4582
NJ Moorestown, L.E. Brown Assocs. 609-234-0382
NJ Murray Hill, Cambridge-Allen Assocs. 201-464-7987
NJ Riveredge, Cambridge Assocs. 201-MU2-5844
NY Fayetteville, Martin P. Andrews Inc. 315-637-3144
NC Charlotte, Maitland K. Smith 704-372-1026
Ohio Cleveland, Del Steffen & Assocs. ... 216-461-8333
Tex Dallas, Texas Sls.
Tex Garland, Texas Sales Co. 214-270-5451
Wash Seattle, R. K. Squibb, Inc. 206-632-2450

K.G.S. ELCTRNS., 2029 N. Lincoln Ave., Pasadena, Cal., 91103, Tel: 213-798-0786; Empl.: 25
p. 1•1238,1752; p. 2•1752-1754

Customer service: G. Sugimoto

Products manufactured: Amplifiers, Chargers, Battery, Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Inverters, Power Supplies, Transformers

KIDDE, WALTER & CO., Belleville Div., 675 Main St., Belleville, N.J., 07109, Tel: 201-759-5000, TWX: 710-995-4925; Empl.: 1266; Minimum order: $100

Customer service: Sales Off.

Free literature available: Kidde's Fire & Intrusion Alarm Systems & Components brochure illustrates and describes intrusion systems and components and fire alarm systems and components.

Products manufactured: Alarms, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Transducers

Local Sales Offices & Reps.
Cal San Francisco 415-863-6858
Cal Signal Hill 213-595-5488
Ga Atlanta 404-451-6122
Ill LaGrange 312-352-1910
Md Baltimore 301-247-4545
NJ Totowa 201-785-4224
Tex Irving 214-259-3756
Wash Seattle 206-283-1616
FOR: Can., Pointe Claire, Quebec, Walter Kidde & Co. of Can., Ltd. 514-695-8230

KILOVAC CORP., Box 4422, Santa Barbara, Cal., 93103, Tel: 805-684-4560, TWX: 910-336-1141; FSC No: 18741; Empl.: 100; Minimum order: $50 .... p. 1•1740-1748

For info on price: J. L. Dysart; Application info: R. Maseda; Customer service: M. Casten; Delivery info: M. Casten

Free literature available: Kilovac Vacuum Relays - General Catalogue - 18 pages, Kilovac Vacuum Relays - 4 page summary, Dow-Key Coaxial Relays - 12 page General Catalog, 1 Page Dow-Key Summary and Prices.

Products manufactured: Antenna Switching Matrices, Attenuators, Coils Including Assemblies & Forms, Relays, Switches

Local Sales Offices & Reps.
Ariz Tempe, Gassner & Clark (Arizona) 602-968-9037
Cal Los Angeles, Rep. Assocs. 213-829-5401
Cal San Carlos, Electro Pacific 415-593-1334
Conn Washington Depot, Kanan Assocs. 203-868-0513
Fla Madeira Beach 813-391-3057
Ill Westchester, Gassner & Clark 312-345-4245
Iowa Cedar Rapids, H.R.Brown Sls. Co. ... 319-366-0635
Kans Leawood, Vasen Sls. 913-649-0679
Kans Shawnee Mission, M. Bettis 913-362-0772
Kans Wichita, M.E. Bettis Co. 316-685-7441
Md Baltimore, Burgin-Kreh 301-788-5200
Mass Reading, Kanan Assocs. 617-944-8484
Minn St. Paul, De Beck 612-690-1557
Mo St. Louis, M. Bettis 314-429-2099
NJ Riverton, Given 609-829-7249
NM Albuquerque, Data Handling 505-268-4364
NY Buffalo, Lamb 716-874-4900
NY Great Neck, Trionic 516-466-2300
NY Rochester, Lamb 716-544-5580
NY Schenectady, Lamb 518-393-4844
NY Syracuse, Lamb 315-454-2469
NC Charlotte, DGW, Inc. 704-334-7090
NC Winston-Salem, DGW, Inc. 919-768-7166
Ohio Cleveland, Components 216-842-2737
Ohio Hamilton, Components 513-721-2997
Okla Tulsa, Norvell Assocs., Inc. 918-663-1247
Tex Dallas, Norvell Assocs. 214-350-6771
Tex Houston, Norvell 713-774-2568
Va Lynchburg, Burgin-Kreh 804-845-5600

KILOVOLT CORP., 238 High St., Hackensack, N.J., 07602, Tel: 201-488-7373; Empl.: 22; Minimum order: $25 .... p. 1•1302-1305

For info on price: S. Rothman; Application info: W. Haschec; Customer service: E. Brown; Delivery info: A. Baratta

Free literature available: General Catalog-High voltage power supplies & insulator testers

Products manufactured: Capacitors, Fixed, Connectors, Diodes, Dividers, Electrodes, High-Voltage, Meters, Power Supplies, Probes, Relays, Resistors, Spark Gaps, Switches, Testers, Transformers

Local Sales Offices & Reps.
Cal Sherman Oaks, Windsor Dynamics, Inc. 213-989-3631
Cal Woodside, Windsor Dynamics 415-854-4870
Conn Meriden, Abbott-Allison Co., Inc. 203-237-9232
Ill Chicago, P. Lind Elctrns. Co. 312-774-1246
Mich Farmington, Carter, McCormic & Peirce 313-477-7700
Mich Kalamazoo, Carter, McCormic & Peirce 616-349-9666
Minn Circle Pines, Lind Elctrns. 612-786-5770
Ohio Cleveland, Carter McCormic & Peirce 216-333-5650
Ohio Dayton, Carter, McCormic & Peirce 513-278-5873
Pa Pittsburgh, Carter, McCormic & Peirce 412-824-3760
Tex Dallas, J.A. Green Co. 214-631-7450
Tex Houston, J.A. Green Co. 713-526-2959

KINEMETRICS, INC., 336 Agostino Rd., San Gabriel, Cal., 91776, Tel: 213-287-9731; Empl.: 44

For info on price: H. T. Halverson; Application info: H. T. Halverson; Customer service: K. L. Benuska; Delivery info: H. T. Halverson

Free literature available: 1. "Kinemetrics Short Form Catalog", Gives technical descriptions for Kinemetrics instruments for gephysics, seismology, and structural dynamics. 2. "Specific Products Division Short Form Catalog", Gives technical descriptions for Specific Products standard time and frequency receivers.

Products manufactured: Accelerometers, Antennas, Comparators, Data Acquisition & Reduction Systems, Receivers, Recorders, Services, Assembly, Production & Test, Signal Conditioners & Equipment, Testers, Transducers

Local Sales Offices & Reps.
NJ Berkeley Heights, Kinemetrics, Inc. 201-464-3933
FOR: Can., Toronto 269, Ont., B. H. McGregor 416-699-5521

KINETIC SYSTEMS CORP., Maryknoll Dr., Lockport, Ill., 60411, Tel: 815-838-0005; Empl.: 32

For info on price: Laurie; Application info: L. A. Klaisner; Customer service: W. C. Martin; Delivery info: Laurie

Free literature available: KineticSystems' catalog describes a complete line of computer interface modules manufactured to the CAMAC standard. Application information and an introduction to the standard is included.

Products manufactured: Converters, Counters, Data Acquisition & Reduction Systems, Process Control Systems, Scalers, Binary, Decade, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.
Cal LaCanada, Spectrum Sciences 213-790-1181
Mass Burlington, Scientific Sys. Sls. Corp. 617-273-1660
Wash Seattle, Spectrum Sciences 206-624-2373

KINETIC TECH., INC., 3393 De La Cruz Blvd., Santa Clara, Cal., 95050, Tel: 408-296-9305, TWX: 910-338-0122; Empl.: 13

For info on price: G. Williams; Application info: G. Williams; Customer service: S. Odell; Delivery info: S. Odell

Free literature available: Standard Product Brochure; Special Product Brochure; Touch Tone Receiver System Description data sheet; C-Message Filters Specifications Brochure; Standard Product Data Sheets; Application Notes.

Products manufactured: Amplifiers, Analyzers, Filter Synthesizers, Filters

Local Sales Offices & Reps.
Cal Altadena, Trimarco, Inc. 213-681-7760
Cal San Francisco, F. Glynn Mktg. Research 415-563-3982
Colo Denver, Omega Ltd. 303-758-1508
Md Baltimore, Compar Chesapeake 301-484-5400
Mich Utica, Norm Case Assoc. 313-781-3900
Minn Minneapolis, Electro-Serv. 612-827-2907
Ohio Dayton, Norm Case Assocs. 513-435-1301
Ohio Fairview Park, Norm Case Assocs. 216-333-4120
Pa Ambler, Wyncote Instr. Co. 215-643-2440
Tex Richardson, Campion Sls. 214-238-8145

KINETRON CORP., 1416 Roller Rd, Asbury Park, N.J., 07712, Tel: 201-776-9595; Empl.: 12; Minimum order: $25

Customer service: V. H. Triwedi

Free literature available: General catalog-All types of custom sheet metal fabrication including cans, covers, chassis, brackets etc. Also stock drawn & fabricated cans & covers, weld studs & inserts. Brochure-Stock Transformer Mounting Brackets.

Products manufactured: Cabinets & Accessories, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Cases, Equipment, Instrument, Meter, Chassis, Metal, Containers, Fasteners, Services, Assembly, Production & Test, Shields

KING-SEELEY THERMOS CO., Box 423, Kendallville, Ind., 46755, Tel: 219-347-1000; Empl.: 450

Products manufactured: Controls/Control Eqpt., Relays, Thermostats

KINGS ELECTRONICS, 40 Mabledale Rd., Tuckahoe, N.Y., 10707, Tel: 914-793-5000, TWX: 710-562-0110; FSC No: 91836; Empl.: 360; Minimum order: $25

For info on price: E. Corcorin; Application info: F. Pack; Customer service: Sls. Dept; Delivery info: Sls. Dept.

Free literature available: Catalogs for all types of coaxial connectors and flat cable connectors.

Products manufactured: Attenuators, Cable Assemblies & Harnesses, Connectors, Relays, Switches, Terminals

Local Sales Offices & Reps.
Ala Huntsville, Interep Assocs. 205-881-3677
Alas Anchorage, H. Lang Assocs. 907-279-5741

Cal	Daly City, R. Del Bucchia & Assoc.	415-756-1664
Cal	Westminster, A. A. Dowers Co.	714-894-1123
Colo	Denver, Camel Elctrns.	303-757-6191
Fla	St. Petersburg, Kirkwood Assocs.	
Ill	Chicago, D. Dolin Sls. Co.	312-286-6200
Iowa	Marion, Thomas & Modrcin Assocs.	319-377-6261
Md	Lutherville, Dougherty Sls. Co.	301-823-0431
Mass	Wellesley Hills, M. Scott Co.	617-235-0102
Mo	St. Louis, Boweng Co.	314-429-7327
NJ	Haddonfield, Gray Assocs.	609-429-5300
NY	E. Syracuse, Fountain, Young & Co.	315-437-7733
NY	Massapequa, Coughlin Assocs.	516-799-7743
Ohio	Dayton, F. L. Ohmer & Assoc.	513-434-1454
Tex	Dallas, Bradenco	214-358-3278
Wash	Seattle, R. K. Squibb	206-632-2450
FOR:	Can., Malton, S. C. Hooker Ltd.	
FOR:	Can., Montreal W., Que., Kings Canada	514-487-5151

KINGSLEY MACH. CO., Aero-Space Div., 850 Cahuenga Blvd. - EEM, Hollywood, Calif., 90038, Tel: 213-469-7243

Customer service: J. M. Butler

Products manufactured: Machines/Machinery, Production

KINSEKISHA LAB. LTD., 23-17 2-chome Miyasaka, Setagaya-ku Tokyo, Japan, Tel: 429-2111, Telex: J24-22659; Empl.: 735

Products manufactured: Counters, Crystal Blanks, Crystals, Delay Lines, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Oscillators, Thermostats

KISTLER INSTR. CO., see Sunstrand Data Control, Inc.

KLEIN, MATHIAS & SONS, INC., 7200 McCormick Rd., Chicago, Ill., 60645, Tel: 312-588-6820, Telex: 72-4431

For info on price: R. Franklin; Application info: M. Kelly; Customer service: R. Franklin; Delivery info: R. Franklin

Free literature available: Catalog 117 - General Tool & Safety, 117 PTG - Pocket Version of Catalog 117, KT2 - Envelope Size Tool Guide, CW1 - Construction Workers Bulletin, Consumer Price List, RM Bulletin - Roll N Measure Bulletin.

Products manufactured: Cases, Equipment, Instrument, Meter, Clamps & Clips, Cutters, Wire, Hand Operated, Drills & Accessories, Hand & Power, Drivers, Nut, Knives & Knife Sets, Scissors, Screwdrivers, Tools, Wire Strippers, Wrenches

KLIPSCH & ASSOCS. INC., Box 688, Hope, Ark, 71801, Tel: 501-777-6751; Empl.: 43

For info on price: B. Moers; Application info: Eng. Dept.; Customer service: B. Moers; Delivery info: L. McClellan

Free literature available: Catalog, price list, dealer list, Pocket Size Mailers, Spec Sheets.

Products manufactured: Speaker Systems

Local Sales Offices & Reps.

Ariz	Phoenix, R. Fissell Co.	602-264-4031
Cal	Burbank, Mike Ross & Assoc.	213-842-2104
Cal	Palo Alto, J. Thornton Co.	415-327-8960
Colo	Denver, Justiss, Wilson, & Co.	303-934-3741
Fla	Tampa, Repelect	813-227-5051
Md	Gaithersburg, Electronic Marketers	301-948-5623
Mass	Holliston, W. H. Bell	617-429-2424
Mich	Livonia, F. Peters & Assoc.	313-425-0086
Mo	Springfield, J. C. Fricks	417-831-3674
NY	Gloversville, D. Croucher	212-799-7118
NY	New York, RMS Marketing	212-799-7118
Wash	Seattle, R. Johnston Co.	206-524-5171

KNOL ENTERPRISE, 200 Suburban Rd., San Luis Obispo, Cal., 93401, Tel: 805-544-4881; Empl.: 4

Customer service: P. Knol

Products manufactured: Attenuators, Circuits, Printed, Multilayer, Timers

KNOWLES ELCTRNS., INC., 3100 N. Mannheim Rd., Franklin Park, Ill., 60131, Tel: 312-455-3600, Telex: 72-8397

Free literature available: Sub-miniature microphones, receivers, and speakers.

Products manufactured: Annunciators, Microphones, All Kinds, Transducers

KOLLSMAN INSTR. CO., 575 Underhill Blvd., Syosset, N.Y., 11791, Tel: 516-921-4300, TWX: 510-221-2191; Empl.: 1600

Products manufactured: Display Devices/Displays, Gages, Indicators, Lenses, Optical & Camera, Lenses, Readout & Display, Motors, Pyrometers, Scanners, Servo Systems, Tachometers, Tracking Systems, Transducers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Cal	Long Beach	213-595-5441
DC	Arlington	703-979-1200
Tex	Dallas	214-350-1396

KOOLTRONICS INC., Box 504, Princeton, N.J., 08540, Tel: 609-799-1466, Telex: 843345; Empl.: 100

For info on price: R. Armbruster; Application info: W. G. Stewart; Customer service: R. Armbruster; Delivery info: C. Weil

Products manufactured: Air Conditioners (For Equipment), Blowers & Fans & Accessories, Heat Exchangers & Systems

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns	205-881-5031
Ariz	Tempe, Jarko Assocs.	602-966-3020
Cal	Canoga Pk., Ebert Entprs.	213-887-7578
Cal	San Mateo, Halbar Assoc.	
Colo	Denver, McLoud & Raymond	303-756-1589
Fla	Maitland, Beacon Elctrns	305-647-3498
Ga	Atlanta, Beacon Elctrns	404-351-2654
Ill	Palatine, J. Clark Co.	312-358-5095
Kan	Shawnee Mission, Inland Assoc.	913-362-2366
Md	Randallstown, Beacon North Inc.	301-922-1248
Minn	Minneapolis, C. R. Gibb Co.	612-377-1200
Mo	Glencoe, Inland Assoc.	314-938-4992
NY	Syracuse, Naylor Elec. Co.	315-472-9183
Ohio	Sylvania, Deo-Volente & Assoc.	419-882-2830
Pa	Bala Cynwyd, Elec-Tech Inc.	215-687-5305
SC	Spartanburg, Beacon Elctrns	803-582-4613
Tex	Dallas, Blackburn Assoc.	214-351-9991
Va	Falls Church, Beacon North Inc.	703-534-1673

KORRY MFG. CO., 223 8th Ave. N., Seattle, Wash., 98109, Tel: 206-624-4066, TWX: 910-444-2295; Empl.: 156; Minimum order: $30

Customer service: J. A. Hevly

Free literature available: Short Form Catalog; Facilities Brochure; Brochure Catalog.

Products manufactured: Diodes, Display Devices/Displays, Indicators, Lights, Sockets, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assoc. Co.	205-837-0221
Cal	Mountain View, Westrep	415-968-5800
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Conn	New Canaan, S. Pierce, Inc.	203-966-4639
Fla	Maitland, Craft Assoc. Co.	305-645-2242
Ga	Atlanta, Craft Assoc. Co.	404-393-0400
Haw	Pico Rivera, Westrep	213-949-2551
Ill	Chicago, Engineered Sls. Co.	312-867-8434
Ind	Fort Wayne, McDonald Sls. Co.	219-747-3650
Kans	Overland Park, Ensco-Rep	913-381-7557
Md	Glen Arm, Hodgins Assoc.	301-592-7047
Mass	Norwood, S. Pierce, Inc.	617-762-3164
Mo	St. Louis, Ensco-Rep	314-542-3935
NY	New Rochelle, Display Comps. Sls. Co.	914-636-4664
Ohio	Dayton, Whelan Corp.	513-434-7551
Tex	Fort Worth, W.P. Fralia Co.	817-738-2394

K R ELECTRONICS, INC., 91 Avenel St., Avenel, N.J., 07001, Tel: 201-636-1900

Products manufactured: Filters

KRATOS, 403 S. Raymond Ave., Bin 45, Pasadena, Cal, 91109, Tel: 213-449-3090, TWX: 910-588-3288; FSC No: 34830; Empl.: 340; Minimum order: $50 p. 1•177,253,750,751

For info on price: F. LaChapelle; Application info: D. Risk; Customer service: F. LaChapelle; Delivery info: F. LaChapelle

Free literature available: Catalog - Switchboard Instruments, Catalog - Panel Meters, Catalog - Pressure Gauges, Catalog - Aircraft Instruments, Brochures - Computer Graphics, Brochures - Batching/Weighing

Products manufactured: Alarms, Comparators, Controllers, Programmable, Controls/Control Eqpt., Converters, Current Sensors, Detectors, Display Devices/Displays, Gages, Indicators, Meters, Monitors, Process Control Systems, Relays, Switches, Terminals, Data Display (including Alphanumeric & Graphic), Timers, Transducers, Transmitters

Local Sales Offices & Reps.

Cal	San Carlos, Electro-Pacific	415-593-1334
Conn	Bethel, Kratos Eastern Sls. Off.	203-792-9302
Fla	Miami, Ludlum Assoc.	305-592-6523
Fla	Orlando, Ludlum Assoc.	305-894-7761
Ga	Atlanta, Electro-Mech Sls. Engrg. Co.	404-256-4414
Ill	Addison, R. Edward Stemm, Inc.	312-279-2440
Md	Glen Arm, Hodgins Assocs.	301-592-7047
Mass	Peabody, JSR Assocs.	617-532-0348
Minn	St. Paul, Cullen & Assocs.	612-646-7371
Mo	St. Louis, PEM Sales Co.	314-427-7200
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	N. Massapequa, C. B. Hopkins Co.	516-796-0066
NY	Syracuse, Labtronics, Inc.	315-454-9314
Ohio	Cleveland, Imtech Corp.	216-826-3400
Okla	Tulsa, Knight Engineering Company, Inc.	918-749-7785
Tex	Hurst, Kratos Dallas Sls. Off.	817-268-4165
Wash	Bellevue, Doland Co.	206-454-4952
Wisc	West Allis, Electric Power & Light Equipment Co.	414-258-8488

KRECKMAN, HERB CO., Cresco, Pa., 18326, Tel: 717-595-2212; Empl.: 4

Customer service: H. Kreckman

Free literature available: Catalog - Showing Communications Antennas in various forms from 25 to 470 MHZ.

Products manufactured: Antennas

KRIS INC., 1026 S. Washington, Cedarburg, Wisc., 53012, Tel: 414-377-5700, Telex: 2-6886

Products manufactured: Amplifiers, Comm. Systems

Local Sales Offices & Reps.

Cal	Glendale, Richard Armstrong Sls.	213-245-5344
Ga	East Point, Paul Hayden Assoc.	404-766-0261
Mass	Boston, Sam Adelman Assocs.	617-443-9260
Minn	Burnsville, Chip Carlson Sls.	612-890-7893
Pa	Pittsburg, Don Small Assoc.	412-561-6432
Utah	Murray, Kennealey Assocs.	801-268-3111
Wash	Seattle, DMS/VANTAGE	206-784-6800

KRL ELECTRONICS, 28 Bridge St., Manchester, N.H., 03101, Tel: 603-668-3210; Empl.: 25 .... p. 2•1498,1499

Products manufactured: Networks, Resistors, Thermistors, Thermometers, Resistance, Thermostats

Local Sales Offices & Reps.

Cal	Mt. View, Shaw-Tech, Inc.	415-961-4775
Colo	Denver, Omega Ltd.	303-758-1508
Ill	Palatine, C & C Elctrn. Sls.	312-358-8900
Ind	Indianapolis, Sheridan Assocs.	317-547-7777
Kans	Overland Park, Sheridan Assocs.	913-383-1636
Mass	Burlington, Contact Sls.	617-273-1520
Mich	Farmington, Sheridan Assocs.	313-477-3800
Mo	Florissant, Sheridan Assocs.	314-837-5200
NY	Port Washington, R.E. Breuer Co.	516-883-7810
NC	Raleigh, Candor Co., Inc.	919-876-4999
Ohio	Beachwood, Sheridan Assocs.	216-831-0130
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Dayton, Sheridan Assocs.	513-277-8911
Okla	Tulsa, Norvell Assocs.	918-663-1247
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640
SC	Myrtle Beach, Candor Co., Inc.	803-448-8361
Tenn	Chattanooga, Candor Company, Inc.	615-894-7454
Tex	Dallas, Norvell Assocs.	214-350-6771
Tex	Houston, Norvell Assocs.	713-774-2568
Va	Lynchburg, Candor Company, Inc.	804-846-6579
Wash	Bellevue, J. Wandell Co.	206-454-4648

Local Distributors

SC	Myrtle Bch., Candor Co., Box 2220	803-448-5213
Tex	Dallas, Norvell Assocs., 10210 Monroe Dr.	214-350-6771
Tex	Houston, Norvell Assocs., 6640 Hillcroft Ave.	713-774-2568
Tex	Tulsa, Norvell Assocs., 3340 Memorial Blvd.	918-663-1247
Wash	Seattle, Earl & Brown Co., Box 9285	206-284-1121

KROHN-HITE CORP., 580 Massachusetts Ave., Cambridge, Mass., 02139, Tel: 617-580-1660, TWX: 710-320-6583; Empl.: 120; Minimum order: $10 p. 1•569,753-755

For info on price: E. C. Lutfy; Application info: S. L. Guinta; Customer service: E. C. Lutfy; Delivery info: E. C. Lutfy

Products manufactured: Amplifiers, Filters, Generators, Meters

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Scottsdale, Barnhill Three Inc.	602-947-7841
Cal	Inglewood, L&M South., Inc.	213-674-6850
Cal	San Jose, L&M Engrg., Inc.	408-292-3220
Colo	Denver, Barnhill Three, Inc.	303-750-1222
Conn	Glastonbury, Instrument Reps., Inc.	203-633-0777
Fla	Orlando, Gentry Assocs.	305-894-4401
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Des Plaines, Cozzens & Cudahy Inc.	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy Inc.	317-244-2456
Mass	Lexington, Instrument Reps., Inc.	617-861-8620
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Mo	St. Louis, Cozzens & Cudahy Inc.	314-423-1234
NJ	Haddonfield, Dyna Rep Co.	609-795-1700
NM	Albuquerque, Barnhill Three, Inc.	505-299-7658
NY	Elmont, Crane & Egert Corp.	516-488-2100
NY	Syracuse, Ossman Instr.	315-437-6666
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tex	Houston, Barnhill Two Inc.	713-688-9971
Tex	Richardson, Barnhill Two Inc.	214-231-2573
Va	Alexandria, Dyna Rep Co.	703-354-1222
Wash	Bellevue, Showalter Instruments, Inc.	206-624-4035

KRYLON, Div. Borden, Box 390, Norristown, Pa., 19404, Tel: 215-279-1950, TWX: 510-660-0335; Empl.: 200

Customer service: B. Adams

Products manufactured: Cleaners & Solvents, Coatings

Local Sales Offices & Reps.

Ala	Atlanta, Cartwright & Bean	404-255-5262
Cal	Los Angeles, G.B. White & Assoc.	213-749-4168
Cal	Millbrae, G.B. White & Assoc.	415-EM 6-8234
Colo	Denver, Western Indus. Sls. & Svcs.	303-758-3972
Ill	Chicago, Q & B Inc.	312-725-4999
Ind	, Mktg. Engineers	317-545-1523
Kans	Shawnee Mission, Thomas & Modrcin Assoc.	913-HE 2-2131
Mass	Ellingwood	617-423-4075
Mich	Detroit, Riley & Petchell Sls.	313-838-9100
Minn	Minneapolis, Godden-Olson	612-927-4434
NY	New York, Newhope Corp.	212-LE 2-7372
NY	Syracuse, Paston-Hunter Co.	315-437-2992
Ohio	Cleveland, J. O. Olsen Co.	216-752-5444
Pa	Philadelphia, K. B. Erdman	215-CA 4-1833
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, H. Frazier	214-824-0117
Tex	Houston, H. Frazier	713-461-2866
Wash	Seattle, R. Merritt Co.	206-682-7337

KRYSTINEL CORP., Fox Island Rd., Port Chester, N. Y., 10573, Tel: 914-937-5252, TWX: 914-937-5370; Empl.: 135 p. 2•1234,1235

Customer service: S. Snead

Free literature available: Complete catalog: Lists Ferrite, Slugs, Coil Forms, Insert Tuning Cores, Threaded Cores, Cap Cores, Balun Cores, Bobbins, Toroids, Washers, Shield Beads, Sleeves.

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Cores, Magnetic, Ferrite Material & Parts, Shields

Local Sales Offices & Reps.

Cal	LaHabra, Magnetic Materials	213-694-2063
Cal	Los Altos, Horne Assocs.	415-948-0788
Colo	Golden, B. Callister & Assocs.	303-761-0992
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Chicago, C & A Assocs.	312-235-8443
Mo	Blue Springs, Cairns & Hayes Elctrns. Sls. Co.	816-229-1404
Mo	St. Charles, Cairns & Hayes Elctrns. Sls. Co.	314-946-6617
NJ	Kenilworth, Ventronics Inc.	201-272-9262
NJ	South Orange, S. Simberkoff Assocs.	201-763-7900
NY	Buffalo, J. R. Henderson & Assocs.	716-634-8650
Tex	Houston, Cunningham Co.	713-461-4197
Wash	Bellevue, Rep. Tronix	206-454-5190

KULITE SEMICONDUCTOR PROD., 1030 Hoyt Ave., Ridgefield, N.J., 07657, Tel: 201-945-3000, Telex: 135458; Empl.: 140; Minimum order: $25

Customer service: J. W. G. Budd

Free literature available: Literature describing complete line of products including semiconductor strain gages, pressure transducers, accelerometers, load cells, and temperature sensors.

Products manufactured: Accelerometers, Amplifiers, Cells, Load, Gages, Microphones, All Kinds, Transducers, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins-Co.	205-539-1771
Cal	Hollywood, B. J. Wolfe Entprs.	213-877-5518
Cal	Walnut Crk., Dale-Dahl Assocs.	415-933-9595
Colo	Littleton, Aztec Entprs	303-795-0250
Conn	Hamden, Northeast Engrg.	203-248-4481
Fla	Orlando, Col-Ins-Co.	305-423-7615
Ga	Clarkston, Col-Ins-Co.	404-934-7280
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Md	Kensington, Kinney Tech Prod	301-727-2122
Mass	Danvers, Northeast Engrg	617-774-3010
Mich	Detroit, WKM Assoc.	313-892-2500
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, Ozark Elctrn Mktg	314-423-7200
NM	Albuquerque, Aztec Entprs	505-255-2440
NY	Manhasset, Northeast Engrg	516-365-9633
NY	Melville, Astrorep Inc.	516-423-2266
NC	Raleigh, Col-Ins-Co.	919-834-6591
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ore	Portland, Brett-Ross	503-232-4184
Pa	Jenkintown, PDC Corp.	215-887-9610
Tex	Arlington, Pan/Tech Engrg	817-261-4111
Wash	Seattle, Brett-Ross	206-935-8054

KULKA ELEC. CORP., 520 S. Fulton Ave., Mt. Vernon, N.Y., 10551, Tel: 914-664-4024, TWX: 710-562-0104; Empl.: 500

Customer service: P. Lauria

Free literature available: 17B Catalog - Terminal Boards & Toggle Switches Individual Catalog Sheets - Spec Sheets: Standards Printed Circuit Mount Insulated Feed-Thru Marker & Insulated Strips Military Kliptites Pressure-Contact Stud & Turret Snapblocks Wire Wrap Thermoplastic Printed Circuit Mount Thermoplastic Insulated Feed-Thru Thermoplastic High Barrier

Products manufactured: Connectors, Sockets, Strips, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Los Angeles, E E Strassner	213-666-1511
Cal	Redwood City, Warren-Hickey Sls.	415-368-3849
Colo	Denver, Koether-Cox	303-733-5561
Conn	Cheshire, Coakley, Boyd & Abbett	203-272-2261
Fla	North Miami, Winfield Elctrns. Sls.	305-945-6544
Ga	Atlanta, Winfield Southeast	404-636-3023
Ill	Chicago, Hanke Co.	312-593-8500
Ind	Fort Wayne, New Era Sls	219-743-5371
Kan	Shawnee Mission, Lowell-Kangas & Assocs.	913-631-3515
La	Metairie, J. F. McKinney Sls.	504-887-1723
Md	Bromall, L.D. Lowery	215-356-5300
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Ferndale, Shalco	313-547-4771
Mo	St. Louis, Lowell-Kangas & Assocs.	314-821-4050
NJ	South Orange, Simberkoff Sls.	201-763-7900
NM	Albuquerque, Shefler-Kahn	505-265-7077
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	New York, Simberkoff Sls.	212-943-7023
NY	Rochester, Telesco Assocs.	716-271-3780
NY	Utica, Telesco Assocs.	315-733-3183
Ohio	Dayton, Neal Bear	513-299-3566
Ohio	Richfield, Bear Mktg	216-659-3131
Okla	Tulsa, J. F. McKinney Sls.	918-742-6791
Ore	Portland, Earl & Brown	503-245-2283
Pa	Broomall, L.D. Lowery	215-356-5300
Pa	Pittsburgh, Trymac Co.	412-823-8400
Tex	Bellaire, J. F. McKinney Sls.	713-774-3232
Tex	Dallas, J. F. McKinney Sls.	214-631-9450
Wash	Seattle, Earl & Brown	206-274-1121
FOR:	Can., Ajax, Ont., Munro Elctrn. Comps.	416-676-1042

KURZ-KASCH, INC., Electronics Div., 2876 Culver Ave., Dayton, Ohio, 45429, Tel: 513-296-0330; Empl.: 70

Customer service: J. Keller

Free literature available: Kurz-Kasch will supply upon request catalogs or data sheets of any product shown in EEM. All literature is self-descriptive.

Local Sales Offices & Reps.

Cal	Los Angeles, W.S. Harmon Co.	213-937-1460
Colo	Denver, Walter Engineering	303-777-5585
Conn	Wallingford, Adams-McGregor, Inc.	203-269-5816
Ill	Libertyville, R. Klipp Assoc.	312-362-4676
Iowa	Des Moines, KSW Associates	515-279-9235
Mass	Scituate, Adams-McGregor, Inc.	617-545-2213
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Minn	St. Paul, Skor	612-645-6461
Mo	Kansas City, KSW Assocs.	816-358-5240
Mo	St. Louis, KSW Associates	
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Rochester, Marsey Sls., Inc.	716-442-9700
NC	Charlotte, M. F. Taylor Co.	704-537-4878
Ohio	Cleveland, Carter, McCormic & Pierce	
Ohio	Dayton, Carter, McCormic & Pierce	512-278-5873
Ore	Portland, D.G. Weber Co.	503-234-7671
RI	Lincoln, Adams-McGregor, Inc.	401-726-1300
Tex	Dallas, G. V. Peck Co.	214-328-3511
Tex	Houston, The Gordon V. Peck Co.	713-664-1435
EXP:	New York, N.Y., Singer Products Co.	

KURZ-KASCH, INC., Knob Div., 711 Hunter Rd., Wilmington, Ohio, 45177, Tel: 513-382-0966 ... p. 2•1104

Customer service: A.L. King

Free literature available: Kurz-Kasch will supply upon request catalogs or data sheets of any product shown in EEM. All literature is self-descriptive.

Products manufactured: Knobs, Services, Assembly, Production & Test

Refer to Kurz-Kasch Electronics Div. for sales office information.

KYROS CORP., Box 406, Madison, Wisc., 53701, Tel: 608-238-3587; Empl.: 4

Customer service: R. Cox

Products manufactured: Tape Search Equipment

L & L SPECIAL FURNACE CO., 166 Conchester Rd., Twin Oaks, Pa., 19016, Tel: 215-HU5-6334; Empl.: 32

Customer service: G. Lewicki

Free literature available: Econo Master Furnaces. Unique new Modular furnaces. Available with tubes, conveyor belts, alloy muffles, recirculation. Temperatures to 2350°F. Dyna-Trol Furnaces. Unique box furnaces for temperatures to 2300°F. Available with fans, various controls. Elements located on multi-walls.

Products manufactured: Furnaces

L & R MFG., 577 Elm St., Kearny, N.J., 07032

LABELON CORP., 10 Chapin St., Canandaigua, N.Y., 14424, Tel: 315-394-6220, TWX: 510-254-7147; Empl.: 160

Customer service: H. J. Kratoville

Products manufactured: Labels, Pressure-Sensitive, Adhesive, Tapes, Films & Foils, Pressure Sensitive

Local Sales Offices & Reps.

Cal	Los Angeles, R. L. Smith Co.	213-746-1710
Ill	Chicago, P. Coridon & Assoc.	312-286-5144
NY	New York, Labelon Corp.	212-947-4049

LABORATORY DATA CONTROL, Div. M. Roy Corp., Box 10235, Riviera Beach, Fla., 33404, Tel: 305-844-5241; Empl.: 52

For info on price: J. Wagner; Delivery info: J. Wagner

Products manufactured: Integrators, Electronic, Paper, Graphic Recording, Recorders

Local Sales Offices & Reps.

Ala	Huntsville, Newcomb, Assoc.	205-852-0304
Del	Newark, Benchmark	302-366-8797
Ill	Joliet, Utopia Instr.	815-727-5431
Iowa	Ames, Midwest Instr.	515-292-5413
Mass	Boston, Richman Assoc.	
Mass	Holliston, Richman Assoc.	617-879-5011
Minn	Minneapolis, Midwest Inst.	612-333-0319
Mo	St. Louis, Gateway Scientific	314-725-3464
NJ	South Amboy, Laboratory Data Control	201-721-9331
NM	Albuquerque, Air Row Inc.	505-268-1733
NC	Raleigh, Newcomb Assoc.	919-893-5721
Tex	Houston, Antek Instr.	713-691-2265
Wash	Seattle, VWR Scientific	206-682-3460

LAKE CHEMICAL CO., 250 N. Washtenaw Ave., Chicago, Ill., 60612, Tel: 312-826-1700; Empl.: 65

Free literature available: #74-0 Catalog, Covering Our Full Line of Fluxes and Sealants.

Products manufactured: Flux, Brazing & Soldering Materials

LAKESHORE ELECTRIC CORP., 205 Willis, Bedford, Ohio, 44146, Tel: 216-232-0200, Telex: 980-253; Empl.: 40

Products manufactured: Cabinets & Accessories, Chargers, Battery, Controls/Control Eqpt., Panels, Switchboards, Switches

Local Sales Offices & Reps.

Cal	Redondo Beach, Control Switches, Inc.	213-772-1582
Cal	San Francisco, Artwel Elec., Inc.	415-467-1880
Colo	Commerce City, Elec. Power Equip. Co.	303-288-0753
Fla	Jacksonville, R.J. Hines	904-641-9503
Fla	Miami, A.C. Chaney & Assoc.	305-633-1651
Ga	Atlanta, R.W. Allen	404-725-5561
Haw	Honolulu, Pacific Energy Equip.	808-373-1039
Ill	Chicago, Weldy-Lamont Assoc.	312-777-8575
Iowa	Des Moines, I.L. Davidson Co.	515-288-0958
Md	Lutherville, M.P. West, Inc.	301-252-7080
Mass	Sharon, Adcour	617-784-3996
Mich	Detroit, Webco, Inc.	313-862-4673
Minn	Minneapolis, Pinkney & Assocs.	612-786-9270
Mont	Billings, Holeman GM Diesel, Inc.	406-252-4191
NY	Buffalo, H.C. Zang	716-877-3677
NY	Greenvale, O. Smith-Johannsen & Co.	516-484-5630
NC	Charlotte, C. Alley Assocs.	704-523-1532
Ohio	Cincinnati, Alexander Equip. Co.	513-221-7520
Ohio	Shaker Heights, R.F. Reske & Assoc.	216-932-5293
Pa	Croyden, R. Cunningham & Assoc.	215-677-8559
Pa	Pittsburgh, Waggoner-Ver Hill Assoc.	412-241-5203
Tenn	Knoxville, Tubbs Agency	615-577-0689
Tenn	Memphis, Underwood Sls. Co.	901-527-0333
Tex	Garland, Stout-Jennings-Schmidt Co.	214-272-5585
Tex	Houston, Stout-Jennings-Schmidt Co.	713-729-1994
Va	Richmond, T.L. Haynes & Co.	804-285-9326
Wisc	Cedarburg, Weldy-Osbon Assoc.	414-377-2400
FOR:	Can., Montreal 460, Que., Sytrolec Controls, Ltd.	514-324-8991

LA MARCHE MFG. CO., 106 Bradrock Drive, Des Plaines, Ill., 60018, Tel: 312-299-1188, Telex: 282-524; QPL No: 15736; Empl.: 225 .... p. 1•1308,1309

Customer service: A. Rotschild

Free literature available: Complete float battery charger and D.C. to A.C. Inverter catalog.

Products manufactured: Chargers, Battery, Converters, Eliminators, Battery, Inverters, Power Supplies, Relays

Local Sales Offices & Reps.

Alas	Anchorage, J.P. Bagoy	907-274-8531
Ariz	Phoenix, W.C. Osborn	602-279-5556
Ark	El Dorado, L. Byrne	501-UN3-9435
Cal	El Cerrito, B. Saletta	415-236-9191
Cal	Encino, D. Meyers	213-981-6552
Colo	Denver, W. Pape	303-455-3643
Fla	Jupiter, J. Marsh	305-746-4911
Ga	Atlanta, J. H. Chambers	404-875-8086
Ill	Deerfield, T. Waters	312-948-0320
Ind	Ft. Wayne, J. McDonald	219-747-3650
Iowa	Eldridge, L. Garrett	319-391-5211
La	New Orleans, H. Chambers	504-525-6677
Md	Annapolis, P. Martini	301-267-7462
Mass	Sharon, R. Jacobs	617-784-3996
Mich	Detroit, B. Schafer	313-862-4673
Mich	Grand Rapids, J. Perry	616-949-0271
Minn	Minneapolis, W. Ruva	612-721-7444
Mo	Kansas City, H. Burton	816-531-1077
Mo	St. Louis, R. Link	314-966-3506
Mont	Billings, D. Parker	406-245-6349
NJ	Collingswood, C.W. Wright	609-858-4887
NY	Syracuse, A. Komar	315-437-2845
NY	Uniondale, A. Crowe	516-485-2622
NC	Charlotte, H.E. Gray Jr.	704-375-3249
Ohio	Columbus, A. Ulrich	614-253-2705
Okla	Tulsa, L.W. Hubbell	918-R13-9851
Ore	Portland, W. Haynes	503-236-2744
Tenn	Jackson, D. Hallman	901-423-1366
Tex	Dallas, D. Cooper	214-271-5494
Tex	Houston, E. Meyer	713-928-3181
Tex	Odessa, B. McEntyre	915-332-1429
FOR:	Can., Springhill Nova Scotia, D. Surrette	902-597-3767
FOR:	Can., Vancouver B.C., Simson-Maxwell Co.	604-736-5431
FOR:	Can., Ville St. Laurent Que., D. Surrette	514-336-4192

LAMBDA ELCTRNS., 515 Brd. Hollow Rd., Melville, N.Y., 11746, Tel: 516-694-4200, TWX: 510-224-6484; Empl.: 500 .... p. 1•1310,1311,1846

Products manufactured: Chokes, Circuits, Hybrid, Thick Film, Hybrid Voltage Regulators, Limiters, Locks, Dial & Shaft, Meters, Power Supplies, Protectors, Racks, Reels, Cord & Cable, Regulators, Slides, Cabinet & Chassis, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix	602-996-1010
Cal	No. Hollywood	213-875-2744
Cal	Sunnyvale	408-738-2541
Fla	Altamonte Springs	305-831-8010
Ill	Arlington Heights	312-593-2550
Md	Baltimore	301-465-1133
Mass	Lexington	617-861-8585
Minn	Minneapolis	612-935-6194
NJ	Cherry Hill	609-424-2170
NY	Melville	516-694-4200
NY	Poughkeepsie	914-297-4800
NY	Rochester	716-454-6770
Ohio	Cleveland	216-585-7808
Pa	Norristown	215-279-5644
Tex	Dallas	214-341-5130
Tex	Houston	713-464-6554
Va	McLean	703-356-0141
EXP:	N.Y., Melville	516-694-4200
FOR:	Can., Pointe Claire, Que.	514-697-6520
FOR:	Can., Toronto, Ont.	416-486-0794

LAMINATED FABRICATORS, 1145 San Mateo Ave., San Bruno, Calif., 94066, Tel: 415-583-5092; Minimum order: $5

Customer service: H. L. Jacobs

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Insulators & Insulation, Laminates, Nameplates, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips

LAMPS, INC., see Illuminated Products, Inc.

LANGEVIN, 2030 Placentia Ave., Costa Mesa, Cal., 92627, Tel: 714-642-8083; FSC No: 11135; Empl.: 12

Customer service: P. Hanson

Products manufactured: Programmers, Switches

LANSDALE TRANSISTOR & ELCTRNS., Bldg. 4, Shetland Ind'l. Pk., Andover, Mass., 01810, Tel: 617-933-3500; Empl.: 10

Products manufactured: Integrated Circuit Devices

LAPP INSULATOR DIV., INTERPACE CORP., Radio Specialties, 350 Sumner St., LeRoy, N.Y., 14482, Tel: 716-967-6221, TWX: 716-967-2511; Empl.: 1310

For info on price: S. P. Lapp, Ext. 403; Application info: G. Bolin, Ext. 409; Customer service: R. Bullock, Ext. 244

Free literature available: Catalog No. 590 contains description, ratings and specifications on antenna tower insulators, standoff insulators, entrance insulaton and special radio insulators.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Capacitors, Fixed, Capacitors, Variable, Insulators & Insulation, Seals

Local Sales Offices & Reps.

Ala	Birmingham, C.W. Ashby Co.	205-879-1651
Ark	Little Rock, C. H. Stout	501-372-2555
Fla	Jacksonville, Belcher & Assocs.	904-724-7811
Ga	Atlanta, E. A. Thornwell	404-351-6535
Kans	Kansas City, Power Equip. Sls.	913-384-3898
Ky	Lexington, Dyer-Pederson Agency	606-266-7412
La	Shreveport, C. H. Stout	318-221-5555
Md	Annapolis, Rumsey Elec. Co.	301-268-9644
Miss	Jackson, C. H. Stout of Miss.	601-354-4326
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Okla	Tulsa, C. B. Anderson Elec. Co.	918-836-4661
Pa	Pittsburgh, Muller, Harper & Assocs.	412-931-6460
Tenn	Memphis, C. H. Stout of Tenn	901-362-1616
Tex	Dallas, E. B. Robertson	214-942-2711
Va	Richmond, Rumsey Elec. Co.	804-335-4379

LARSON AERO DEV., Box 135, Concord, Calif., 94522, Tel: 415-228-7870; Empl.: 15

Products manufactured: Accelerometers, Gyros (All Types), Indicators, Meters, Potentiometers, Recorders, Relays, Testers, Transducers

Local Sales Offices & Reps.

Fla	Maitland, D & E Assoc.	305-644-3039
Mich	Detroit (Ferndale), TIBY Co.	313-547-3550
Ohio	Cleveland, TIBY Co.	216-371-5335
Ohio	Dayton, TIBY Co.	513-277-3822

LARSON INSTR. CO., INC., Greenbush Rd., Orangeburg, N.Y., 10962, Tel: 914-359-3800; Empl.: 14 .... p. 1•756,757

Products manufactured: Amplifiers, Bridges, Controls/Control Eqpt., Meters, Probes, Pyrometers, Recorders, Relays, Shunts, Meter, Transducers, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, L-Tronix Assoc.	213-256-2224
Cal	Palo Alto, Mauldin Co.	415-326-5291
Ind	Richmond, Kennedy Sls.	317-966-1933
Pa	Ingomar, R. W. Moulton Assocs.	412-366-3333
Wash	Seattle, Instr. Engrg.	206-682-1123
FOR:	Can., Montreal, Que., Brian Engrg.	514-735-1671

LASER INC., Laser Lane, Box 537, Sturbridge, Mass., 01566, Tel: 617-347-7314; Empl.: 12

For info on price: A.D. Battista; Application info: W.H. Shiner; Customer service: W.H. Shiner; Delivery info: A.D. Battista

Free literature available: Complete catalog of our products. This 24 page catalog contains 8 pages of general information and many descriptions, with photos, of industrial welding & drilling with laser equipment.

Products manufactured: Fiber Optic Bundles, Lasers & Laser Systems, Lenses, Optical & Camera, Machines/Machinery, Production, Microscopes, Monitors, Power Supplies, Services, Assembly, Production & Test, Television Systems & Equipment Closed-Circuit, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Cal	Sherman Oaks, Windsor Dynamics	213-989-3631
Cal	Woodside, Windsor Dynamics	415-854-4870
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Ill	Chicago, Victor Welding	
Ind	Indianapolis, Tech Sls. & Mktg.	317-356-3658
Md	Silver Spring, Spectroscopy Sys.	301-949-8261
Mass	Waltham, Betronic Assocs.	617-894-8400
NY	Mineola, J.B. Lilly Co.	516-746-2226
NY	Syracuse, Labtronics	315-454-9314
Ohio	Dayton, H. Teplitz & Co.	513-277-6531
Pa	Wyndmoor, Spectroscopy Sys.	215-836-1545
Tex	Houston, Optics & Elctrns.	713-666-8622
Wisc	Milwaukee, Bentley Welding Supply Co.	414-476-1222
EXP:	Weston, Mass., Maridyne Int'l Corp.	617-899-3510

LASER SYSTEMS CORP., 117 N. First St., Ann Arbor, Mich., 48108, Tel: 313-761-7150; Empl.: 6

Customer service: R. E. Miller

Products manufactured: Alarms

LASER TECHNOLOGY, INC., 10624 Ventura Blvd., N. Hollywood, Calif., 91604, Tel: 213-763-7091; Empl.: 24

Customer service: H. B. McLaughlin

Products manufactured: Honeycomb Sheets, Panels, etc., Scribers, Semiconductor Wafer Fabrication

LATTIN RADIO LABS., 1431 Sweeney, Box 44, Owensboro, Ky., 42301, Tel: 502-683-2868; Empl.: 3; Minimum order: $55

Customer service: W. J. Lattin

Products manufactured: Coils Including Assemblies & Forms

LDJ ELECTRONICS, 1064 Naughton Ave., Troy, Mich., 48084, Tel: 313-689-3623; Empl.: 12

For info on price: I. Bergel; Application info: L. Jackson; Customer service: I. Bergel; Delivery info: L. Jackson

Products manufactured: Analyzers, Calibrators, Coils Including Assemblies & Forms, Generators, Indicators, Integrators, Electronic, Magnetizers, Magnetometers, Magnetoresistors, Hall, Magnets, Meters, Probes, Testers, Transducers

LDJ ELECTRONICS cont'd

Advertisment

LDJ magnetizing and magnetic test equipment is designed for the production and quality control testing of magnetic materials and assemblies. Standard products include: magnetizers, demagnetizers, calibrators, gaussmeters, fluxmeters, coercimeters, and BH Meters, including tooling and fixtures to be used with the above. Features include digital readouts, hard-copy print-outs, automation and measurements that can be obtained with the push of a single button, and special designs for customers' particular application.

LEACH CORP., 5915 Avalon Blvd, Los Angeles, Cal., 90003, Tel: 213-232-8221, TWX: 910-321-2303; FSC No: 5945; QPL No: 6106; Empl.: 500; Minimum order: $100 p. 1•1749-1755

For info on price: J. Weaver; Application info: E. Combs; Customer service: J. Weaver; Delivery info: J. Weaver

Free literature available: 8 page short form catalog covering all product lines, plus various technical reprints. 12 part "How-To-Pick-A-Relay" advertising insert series.

Products manufactured: Circuits, Hybrid, Thick Film, Controls/Control Eqpt., Monitors, Relays, Sockets, Switches, Timers

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assocs.	205-837-0221
Cal	San Mateo, Halbar Assocs.	415-349-4700
Colo	Denver, Brown Technical	303-233-0863
Conn	Trumbull, Blake Assocs.	617-391-7890
Fla	Maitland, Craft Assocs.	305-645-2242
Ga	Atlanta, Craft Assocs.	404-393-0400
Md	Rockville, Markton, Inc.	301-762-6210
Mass	Medford, Blake Assocs.	617-391-7890
Mo	Ferguson, Leach Corp.	314-524-2880
NJ	Fort Lee, Leach Corp.	201-461-6550
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Pittsford, Graydon-Sherman	315-637-9861
Ohio	Dayton, Leach Corp.	513-434-8151
Pa	Feasterville, PSA, Inc.	215-355-6244
Tex	Dallas, Caton Sales	214-661-5792
Va	Charlottesville, Marktron, Inc.	301-762-6210
Wash	Bellevue, Leach Corp.	206-822-9247

Local Distributors

Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Inglewood, Time Elctrns. West, 900 W. Olive St.	213-649-6900
Ga	Atlanta, Electro Air Corp., 2270 Marietta Blvd.	404-351-3545
Mass	Woburn, Time Elctrns./New England, 116 Cummings Pk.	617-935-8080
NY	Hauppauge, Time Elctrns. Sls., 70 Marcus Blvd.	516-273-0100
Pa	Clifton Hgts., Time/Mid-Atlantic, 359 E. Madison Ave.	215-622-2500
Tex	Dallas, Assocd. Aircraft Supply, 5021 W. Jefferson Blvd.	214-331-4381
Wash	Seattle, Liberty Elctrns./Northwest, 5305 2nd Ave. S.	206-763-8200

LEADER INSTRUMENTS CORP., 151 Dupont St, Plainview, N.Y., 11803, Tel: 516-822-9300; Empl.: 15; Minimum order: $50

For info on price: S. Eisonborg; Application info: P. Redko; Customer service: M. Ambrico; Delivery info: D. Myers

Free literature available: 1) Complete full line catalog describing entire line of equipment-specifications applications and pricing; 2) full line short form catalog essentially same as above, but in condensed form.

Products manufactured: Calibrators, Generators, Meters, Oscilloscope Plug-Ins, Oscilloscopes, Power Supplies, Probes

LEAR SIEGLER, INC., 3171 S. Bundy Dr., Santa Monica, Calif., 90406, Tel: 213-391-7211, TWX: 910-343-6463; Empl.: 21000

Customer service: G. A. Moak

Products manufactured: Actuators, Air Conditioners (For Equipment), Amplifiers, Analyzers, Bearings, Bins, Part Storage, Brakes, Bus Bars & Systems, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cabinets & Accessories, Chargers, Battery, Clutches, Comm. Systems, Controls/Control Eqpt., Couplings, Dehumidifiers (For Equipment), Dehydrators, Drills & Accessories, Hand & Power, Encoders, Equalizers, Gears & Gear Mechanisms (Precision), Generators, Grilles, Gyros (All Types), Indicators, Knobs, Motor Electric Generator Sets, Motors, Oceanographic Equip. (Electronic), Power Supplies, Public Address Systems, Pumps, Vacuum, Regulators, Relays, Repeaters, Servo, Services, Assembly, Production & Test, Servo Systems, Speaker Systems, Speakers, Switches, Telephone Channel Test & Simulator Equipment, Television Systems & Equipment Closed-Circuit, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Testers, Transducers, Transmission Systems, Data, Tubing, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Cal	Anaheim, Lear Siegler, Inc., Elctrn. Instr. Div.	714-774-1010
Cal	Burbank, Lear Siegler, Inc., Bogen Div.	213-843-3111
Colo	Englewood, LSI Evironmental Technology Div.	303-770-3300
Mass	Burlington, LSI Instrument Div.	617-273-0058
Mich	Grand Rapids, LSI Instrument Div.	616-241-7000
Mich	Southfield, Acts Computing Corp.	313-557-6800
NJ	Paramus, LSI Bogen Div.	201-343-5700
NY	Rye, American Avitron, Inc.	914-937-5300
Ohio	Maple Heights, LSI Power Equip. Div.	216-662-1000
Okla	Oklahoma City, LSI Telecomms.	405-525-2171
Tex	Dallas, LSI Power Equip. Div.	214-247-1212
Va	Arlington, Div. Sls. Off.	703-521-1010
Wash	Seattle, LSI Instr. Div.	206-725-6077
EXP:	Rye, New York, American Avitron, Inc.	914-937-5300

LEAR SIEGLER, Elctrn. Instr. Div., 714 N. Brookhurst St., Anaheim, Cal., 92803, Tel: 714-774-1010, TWX: 910-591-1157; Empl.: 600; Minimum order: $50 p. 2•716,717

Free literature available: Pin Bar Product Brochure-Giving performance, mechanical and plating specifications for the entire line of solderless bus bars including two free sample bars.

Products manufactured: Bus Bars & Systems

Local Sales Offices & Reps.

Cal	San Francisco, Shannon Assoc.	415-941-2217
Colo	Denver, Moss Elec.	303-353-1452
Ga	Atlanta, Grady Duckett	404-451-3529
Ill	Chicago, Mauer Co.	312-677-4771
Mass	Boston, ABC Elec.	617-542-9162
Mich	Detroit, Hummon Assoc.	313-474-0661
Minn	Minneapolis, Macnamara Assoc.	612-472-4919
NJ	Haddonfield, Mid-Atlantic Elec.	609-428-8288
NJ	Tenafly, ABC Elec.	201-568-2354
NM	Albuquerque, Moss Elec.	505-821-6101
NY	Tarrytown, ABC Elec.	914-631-2650
NY	Williston Park, ABC Elec.	516-747-6610
NC	Charlotte, Grady Duckett	404-451-3529
Ohio	Cleveland, Geotronix	216-526-2535
Ohio	Columbus, Geotronix	614-457-8472
FOR:	Can., Toronto, Ont., LSI/AA&E	416-459-0920

Local Distributors

Cal	Los Altos, Shannon Assocs., One First St.	415-941-2217
Colo	Greeley, G. Moss Elect., Drawer "J"	303-353-1452
Ga	Atlanta, Grady Duckett Sls., Box 29067	404-451-3529
Ill	Skokie, Mauer Co., Suite 29, 9701 Kenton	312-677-4771
Mass	Needham, ABC Elctrn. Sls., 50 Kearney Rd.	617-449-2640
Mich	Farmington Hills, W.R. Hummon & Assoc., 23414 Industrial Pk.	313-474-0661
Minn	Mound, Macnamara Assoc., Box 38	612-472-4919
NJ	Haddonfield, Mid Atlantic Corp., 140 Haddon Ave.	609-428-8288
NJ	Tenafly, ABC Elect. Sls., 121 Oak St.	201-568-2354
NM	Albuquerque, G. Moss Elect., Box 708	505-821-6101
NY	N. Tarrytown, ABC Elect. Sls., 2 Willard Ave.	914-631-2650
NY	Williston Pk., ABC Elect. Sls., 99 Hillside Ave.	516-747-6610
Ohio	Cleveland, Geotronix Mktg., Box 41068	216-526-2535
Ohio	Columbus, Geotronix Mktg., Box 20313	614-457-8472

LEAR SIEGLER, INC., Transportation Support Div., 11135 Condor Avenue, Fountain Valley, Cal., 92708, Tel: 714-546-3060, Telex: 678454; Empl.: 200

Products manufactured: Air Conditioners (For Equipment)

LEAR SIEGLER, INC., Romec Div., 241 S. Abbe Rd., Elyria, Ohio, 44035, Tel: 216-323-3211, TWX: 216-322-7265; Empl.: 230

For info on price: Mktg. Dept.; Application info: Engrg. Dept.; Customer service: Svc. Dept.; Delivery info: Mktg. Dept.

Products manufactured: Controls/Control Eqpt., Couplings, Dehumidifiers (For Equipment), Dehydrators, Heat Exchangers & Systems, Motors, Pumps, Vacuum, Services, Assembly, Production & Test, Switches, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Los Angeles
Cal	Santa Monica
Ga	Atlanta
Ga	Marietta
Mass	Waltham
NJ	Palisades Park
Tex	Dallas
Tex	Fort Worth
Exp.	Rye N.Y., American Avitron
FOR:	Can., Rexdale, Ont., A.A.E. Aerospace Prods.

LEBOW ASSOCIATES, INC., 1728 Maplelawn Rd., Troy, Mich., 48084, Tel: 313-643-0220, TWX: 810-232-4818; Empl.: 80; Minimum order: $20

For info on price: R. Haggerson; Application info: R. Phillips; Customer service: R. Martin; Delivery info: P. Rice

Products manufactured: Amplifiers, Cells, Load, Indicators, Slip-Rings & Assemblies, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Vaughn Electrosources	205-881-8830
Ariz	Phoenix, RDX Corp.	602-267-8162
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-734-4500
Colo	Denver, PLS Assocs.	303-771-0140
Conn	W. Hartford, Instrument Assocs.	203-525-9367
Fla	Cocoa Beach, Vaughn Electrosources	303-784-0784
Ill	Chicago, Pivan Engrg.	312-539-4838
Ind	Indianapolis, Pivan Engrg.	317-253-1681
Kans	Mission, Pivan Engrg.	913-722-1030
Mass	Bedford, Instrument Assocs.	617-275-0700
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engrg.	612-537-4501
Mo	St. Louis, Pivan Engrg.	314-567-3636
NJ	Bogota, Neville & Vespo Inc.	201-487-1505
NM	Albuquerque, PLS Assocs.	505-355-0120
NY	Williamsville, Maxwell Bennett Co.	716-634-2107
Ohio	Cleveland, S. Sterling	216-442-8080
Ohio	Dayton, S. Sterling	513-298-7573
Ore	Portland, ARVA, Inc.	503-292-8762
Pa	Pittsburgh, S. Sterling	412-922-5720
Tex	Dallas, Tech. Prods.	214-357-9603
Tex	Houston, Tech. Prods.	713-777-7360
Wash	Seattle, ARVA, Inc.	206-622-0177
Wisc	Brookfield, Pivan Engrg.	414-786-1940

LECTROETCH, 14925 Elderwood Ave., E. Cleveland, Ohio, 44112, Tel: 216-451-8080/; Empl.: 20; Minimum order: $7

For info on price: E. A Badt; Application info: E. A. Badt; Customer service: J.F. Zemter; Delivery info: J.F. Zemter

Free literature available: Electrochemical marking manual complete catalog of all products illustrated price list.

Products manufactured: Kits, Marking (Dial, Instrument, Equipment, etc.), Machines/Machinery, Production

Local Sales Offices & Reps.

Ala	Birmingham, Porter Landrum Assoc.	205-967-2095
Cal	El Segundo, Applied Prods. Co.	213-678-6441
Conn	So. Glastonbury, E.D. Geiger	203-633-7646
Fla	Boca Raton, Aeromark Corp.	305-395-3320
Ill	Chicago, W.C. Kamin Co.	312-371-2870

Mass	Belmont, A.D. Geiger Co.	617-489-3322
Mich	Grosse Ile, C.H. Webster	313-676-6510
Mo	Kansas City, Liepsner & Co.	816-421-2511
Mo	St. Louis, Wagner Engraving Co.	314-535-3393
NY	Rochester, R.A. Haehl	716-467-6074
Ohio	Mayfield Heights, J.G. Seifert	216-442-0380
Pa	Feasterville, J.C. Moore	215-357-6086
Pa	Pittsburgh, E.A. McKinney	412-281-3138

LECTROHM DIV. OF CAPCO, INC., Box 1028, Grand Junction, Colo., 81501, Tel: 303-243-8480, TWX: 910-896-4346; Empl.: 200; Minimum order: $35

For info on price: M. Klinect; Application info: J. Younker

Products manufactured: Resistors

Local Sales Offices & Reps.

Cal	Encino, V & L Assocs.	213-986-9703
Cal	Los Altos, Frauman Assocs.	415-941-0660
Colo	Littleton, Goyne Assocs.	303-298-8955
Ill	Chicago, Rinaldi Sls. Co.	312-763-4848
Kans	Prairie Village, Engrg. Svs. Co.	913-649-4000
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Minn	St. Paul, Countryman Assocs.	612-645-1951
Mo	St. Louis, Engrg. Svs. Co.	314-997-1515
NM	Albuquerque, Goyne Assocs.	505-265-6794
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Manlius, R.W. Mitscher Co.	315-637-3777
NC	Raleigh, R. W. Mitscher Co.	919-828-0575
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Ohio	Dayton, D. Steffen & Assocs.	513-293-3145
Pa	Birchrunville, Jadelectronic	215-647-5151
Tenn	Shelbyville, R. W. Mitscher Co.	615-684-4544
Va	Virginia Beach, R. W. Mitscher Co.	804-481-7200
Wisc	Milwaukee, Star Engrg.	414-543-3469

LECTRO MAGNETICS, INC., 6056 W. Jefferson Blvd., Los Angeles, Cal., 90016, Tel: 213-870-9383; FSC No: 29098; Empl.: 45; Minimum order: $25

For info on price: F.J. Nichols; Application info: J.C. Senn; Customer service: F.J. Nichols; Delivery info: G. Muir

Free literature available: Catalogs: RF Shielded Rooms: Prefabricated & all welded types 2. RFI/EMC Power Line Filters per MIL-STD-220A & MIL-F-15733

Products manufactured: Capacitors, Fixed, Chamber, Environmental Test, Chokes, Containers, Filters, Honeycomb Sheets, Panels, etc., Kits, Shielding, Shields

Local Sales Offices & Reps.

Ala	Huntsville, J.L. Highsmith & Co.	205-881-3294
Ariz	Phoenix, J.S. Heaton Co.	602-264-7887
Cal	Los Altos, Frauman Assoc.	415-941-0660
Cal	Santa Monica, McDonald Assoc.	213-393-7195
Colo	Denver, Scientific Devices, S.W.	303-573-9466
Fla	Orlando, J.L. Highsmith & Co.	305-293-5202
Ill	Belleville, E.E. Pauley Co.	618-233-3524
Ill	Chicago, Tollaksen & Assoc.	312-441-6644
Md	Wheaton, Magyar & Assoc.	301-871-8833
Mass	Waltham, Meas. Consits. Corp.	617-890-4400
NM	Albuquerque, Scientific Devices, S.W.	505-268-6729
NY	East Syracuse, Ossmann Instrs.	315-437-6666
NC	Charlotte, J.L. Highsmith & Co.	704-333-7743
Ohio	Dayton, Ashby Assoc.	513-252-5627
Pa	Philadelphia, Magyar & Assoc.	215-763-5044
Tex	Dallas, Scientific Devices, S.W.	214-231-8106
Tex	Houston, Scientific Devices, S.W.	713-623-4250
Tex	San Antonio, Scientific Devices, S.W.	512-694-6251
Wash	Seattle, Rush S. Drake Assoc.	206-763-2755
FOR:	Can., Mississauga, Ont., RFQ LTD.	

Advertisment

LectroMagnetics(LMI) is a leading supplier in all types of shielded enclosures of the modular and all welded types. Complete turn key facilities are designed and installed by licensed engineers and contractors.

LMI's Filter Division manufactures a wide range of RFI/EMI power line Filters to Government, U/L, FCC and to customer specifications.

LECTROTECH, INC., 5810 N. Western Ave., Chicago, Ill., 60659, Tel: 312-769-6262

Products manufactured: Generators, Oscilloscopes, Power Supplies, Probes, Test Equipment, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, P.Z. Ray Assocs.	602-942-2502
Cal	Culver City, H. Feldman Co.	213-397-4471
Cal	San Francisco, Tech. Sls. Assocs.	415-467-1434
Fla	Ormond Beach, J.F. Thompson Co.	904-677-2298
Ga	Atlanta, Murphy & Cota	404-875-2525
Ill	Skokie, M. Berman Sls.	312-OR5-3740
Kans	Shawnee Mission, Maury Bettis Co.	913-362-0772
Md	Silver Springs, Mid-Atlantic Sls.	215-657-2815
Mich	Detroit, R. Milsk Co.	313-354-3310
Minn	St. Paul, C.M. Sales Co.	612-699-8004
NY	East Northport, F. Tabman Sls	212-263-4646
NY	Syracuse, W. Tauber Co.	315-446-7094
Ohio	Cleveland, H. Miller Sls.	216-321-3900
Tex	Dallas, Loss & Stewart Assocs.	214-691-6039
Wash	Seattle, D.G. Weber Co.	503-254-0686
EXP:	Westbury, N. Y., Minthorne Intl Co.	516-334-3303

LEDEX INC., 123 Webster St., Dayton, Ohio, 45402, Tel: 513-224-9891, TWX: 810-459-1646; FSC No: 81840; Empl.: 515; Minimum order: $25
p. 1•262,263,970,1756-1759,2092-2096

Customer service: Cust. Svc. Supv.

Free literature available: Solenoids, switches, stepping motors and interface circuits are shown in the General Catalog, A-9500. Detailed catalogs on each product are also available upon request.

Products manufactured: Actuators, Comm. Systems, Controls/Control Eqpt., Lamps, Lights, Motors, Rectifiers, Relays, Solenoids, Suppressors, Switches, Timers

Local Sales Offices & Reps.

Ariz	Scottsdale, B-5 Inc.	602-947-5745
Cal	Palo Alto, Testco	415-326-5320
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Colo	Denver, B-5 Inc.	303-426-0222
Conn	Trumbull, SIR Assocs.	203-268-2560
Fla	Hollywood, W.B. Wimberly Co.	305-961-6962
Fla	Orlando, W.B. Wimberly Co.	305-423-2514
Ill	La Grange Park, Bierhaus Sls., Inc.	312-354-5100
Kans	Leawood, Thunderbird Tech. Sls. & Svcs.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls. & Services	316-684-3941
Mass	Lexington, SIR Assocs.	617-862-1812
Mich	Benton Harbor, R.C. Nordstrom & Co.	616-857-4653
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-559-7373
Minn	Minnetonka, T.H. Ayre Assocs.	612-474-4125
Mo	St. Louis, Thunderbird Tech. Sls. & Svcs.	314-567-6488
NY	Liverpool, L.P. Garner Assocs.	315-451-1323
NY	Oceanside, Bittan Assocs.	516-678-6222
NC	Raleigh, A.B. Andrews & Co.	919-833-5565
Ohio	Dayton, Dynel Co.	513-434-6467
Pa	Philadelphia, V.S. Malta	215-836-5122
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
Tex	Richardson, Thunderbird Tech. Sls. & Svcs. Inc.	214-690-0763
Wash	Bellevue, Testco	206-454-7422
Wisc	Milwaukee, Bierhaus Sls. Inc.	414-332-0900

LEECRAFT MFG. CO., INC., 21-16 44th Rd., Long Island City, N.Y., 11101, Tel: 212-392-8800; Empl.: 250
p. 2•1182,1183

Customer service: T. Marine

Free literature available: Specification Sheets: 1) Solid State L-E-D Indicators, 2) Lampholder (subminiature) 3) Trim-Line Indicator Lights, 4) Tineon Pilot Lights Product Lighting Guide No.1-73 4 Pages, Product Lighting Guide No.1-70-C 12 Pages; Indicator Lights, Product Lighting Guide No. LG-970/1 20 Pages; Lampholders, Indicator Lights, Electrical Assemblies.

Products manufactured: Diodes, Lamps, Lights, Services, Assembly, Production & Test, Sockets, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Murcota	205-536-9121
Ark	Hot Springs, Meridith Young & Assocs.	501-262-1365
Cal	Chatsworth, Hansen	213-882-8181
Colo	Arvada, Arrowhead Sls. Co.	303-423-5556
Conn	Bloomfield, Zaslow Sls.	203-242-7781
Fla	No. Miami, Winfield Elctrns.	305-945-6544
Ga	Atlanta, Murcota	919-723-1001
Ill	Hinsdale, Hill & Gray	312-325-4810
Ind	Indianapolis, Southern Sls.	317-257-7575
Iowa	Des Moines, K-S-W	515-279-9235
Ky	Louisville, Southern Sls. Co.	919-723-1001
Md	Lutherville, L. Lowery	301-823-2172
Mass	Lowell, Zaslow Sls.	617-458-8452
Mich	Troy, C. Jensen	313-643-0506
Minn	St. Paul, R. Ragon	612-488-0201
Miss	Jackson, Meredith Young Assoc.	601-366-8185
Mo	Kansas City, K-S-W	816-358-5240
Mo	St. Louis, K-S-W	314-781-6111
NJ	Parlin, Cooper Simon & Co. Inc.	516-487-1142
NY	Cazenvia, B. H. Tollefson Assoc., Inc.	716-271-4141
NY	Great Neck, C. Simon & Co.	516-487-1142
NC	Winston Salem, Murcota	919-723-1001
Ohio	Cleveland, Anderson-Bolds	216-229-4700
Okla	Tulsa, Erickson-Vilter Sls.	214-243-6611
Ore	Portland, A. Stroum	503-292-3534
Pa	Broomall, L. D. Lowery	215-356-5300
Pa	Pittsburgh, R. W. Moulton Assoc.	412-366-3333
Tenn	Chattanooga, Knox Talley	615-266-3611
Tex	Dallas, Erickson-Vilter Sls.	214-243-6611
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Va	Charlottesville, L.D. Lowery Inc.	804-973-6672
Wash	Seattle, Almac Stroum	206-763-2300
EXP:	Long Island City, NY, Leecraft Int'l. Corp.	212-392-8800
FOR:	Can., Richmond, Ontario, Leecraft Industries, Ltd.	
FOR:	Can., Scarborough, Ont., Lake Engrg.	416-751-5980

Local Distributors

Cal	Culver City, Western Electromotive, 8467 Steller Dr.	213-870-7621
Cal	El Monte, Kimball Stark, 3035 N. Tyler Ave.	213-283-7979
Cal	Garden Grove, Allied Elctrns, 12311 Industry St.	714-894-7581
Cal	Inglewood, Newark Electronics, 4747 W. Century Blvd.	213-678-0441
Cal	Los Angeles, Fisher/Brownell, 13936 S. Broadway	213-532-2170
Cal	Sacramento, Sacramento Elctrns.	916-441-4821
Cal	Santa Clara, Fisher/Brownell, 3381 Edward Ave.	408-244-6182
Colo	Denver, Newark Denver Supplyy, 2170 S. Grape St.	303-757-3351
Conn	WWaterbury, Suburban Supply Corp., 117 Benedict St.	203-757-1251
Fla	Orlando, E. W. Cramer, 345 N. Graham Ave.	305-894-1511
Fla	Orlando, Hammond Elctrns., 911 W. Central AVe.	305-241-6601
Ill	Chicago, Newark Elctrns. Corp., 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns. Corp., 1355 Sleepy Hollow	312-421-2400
Ill	Peoria, Klaus Radio, 8400 N. Pioneer Pkwy.	309-691-4840
Ill	Western Springs, Industribution Inc., Box 228	312-325-0296
Ind	Evansville, Hutch & Son, Inc., 300 N. Main St.	812-425-7155
Ind	Indianapolis, Ra-Dis-Co., 814 N. Senate Ave.	317-637-5571
Ind.	Indianapolis, Graham Elctrns. Supply, 133 S. Pennsylvania St.	317-634-8486
Ky	Louisville, P. I. Burks Co., 659 S. Ninth St.	502-583-2871
La	New Orleans, Southern Radio Supply Co., 1909 Tulane Ave.	504-524-2345
Md	Baltimore, Radio Elec. Sve. Co., 1026 Cromwell Bridge Rd.	301-823-0071
Md	Rockville, Capitol Radio Wholesalers, 12270 Wilkens Ave.	301-881-2270
Md	Rockville, Cramer E. W. Inc., 16021 Industrial Dr.	301-948-0110
Mass	Boston, Sager Electrical Supply, 172 High St.	617-542-2281
Mass	Newton, Cramer Elctrns, Inc., 85 Wells Ave.	617-969-7700
Mich	Ann Arbor, Wedemeyer Elec. Supply, 2280 S. Industrial Hwy.	313-665-8611
Mich	Detroit, Newark Elctrns. Corp., 20700 Hubbell Ave.	313-548-0250
Mich	Detroit, RS Elctrns., 12775 Lyndon Ave.	616-241-3483
Mich	Wyoming, Newark Ind. Elect., 3645 Linden Ave. S. E.	616-241-6681
Minn	St. Paul, Gopher Elctrns., 2520 W. Larpenteur Ave.	612-645-0241
Mo	St. Louis, LCOMP St. Louis, Inc., 2605 S. Hanley Rd.	314-647-5505
NJ	Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd.	609-424-1300
NJ	Hanover, State Elctrns., Inc., 36 Route #10	201-887-2550
NJ	Kenilworth, Newark Elctrns., 303 Monroe Ave.	201-272-8410
NJ	Pennsauken, Resco Elctrns, Airport Industrial Pk.	609-662-4000

Directory of Local Distributors Starts on page 401

NJ	Springfield, Federated Purchasers, Inc., 155 U.S. Route #22	201-376-8900
NY	Binghamton, Stack Indl. Elctrns., 10 Susquehanna St.	607-723-6326
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Elmsford, Ancar/Elctrns., One Nepperhan Ave.	914-592-7100
NY	Farmingdale, Arrow Elctrns., 900 Broadhollow Rd.	516-694-6800
NY	Rochester, Summit Distrs., Inc., 292 Commerce Dr.	716-334-8110
NC	Greensboro, Hammond Elctrns., 2923 Pacific Ave.	919-275-6319
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-434-2171
Ohio	Cincinnati, Hughes Peters, Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Cincinnati, Newark Elctrns., 9799G Princeton Rd.	513-874-5115
Ohio	Cleveland, Pioneer Standard Elect., 4800 E. 131 St.	216-587-3600
Ohio	Dayton, Pioneer Standard, 314 Leo St.	513-224-0871
Ohio	Dayton, S. Friedman, 108-112 N. Jefferson	513-224-1111
Ore	Portland, Almas Almac Stroum Elctrns., Box 25444, 4475 S. W. Scholls Ferry Rd.	503-292-3534
Pa	Philadelphia, Almo Indl., Elctrns., Roosevelt Blvd. & Blue Grass Rd.	215-676-6000
Pa	Philadelphia, Herbach Rademan, Inc., 401 E. Erie Ave.	215-426-1700
Pa	Philadelphia, Philadelphia Elctrns., Inc., 112 N. 12th St.	215-568-7400
Pa	Pittsburgh, Cameradio, Inc., 2801 Liberty Ave.	412-288-2988
Pa	Reading, G. D. Barbey Co., 333 N. 4th St.	215-376-7451
RI	Providence, W. Dandretta & Co., 28 Wolcott St.	401-861-2800
Tenn	Kingsport, Radio Elec. Supply Corp., 961 E. Sullivan St.	615-247-8111
Tenn	Nashville, Electra Distributing Corp., 1914 West End Ave.	615-329-3971
Tex	Fort Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Garland, Newark Elctrns., 707 Easy St.	214-271-2511
Va	Richmond, Sterling/Meridian Elctrns., 1001 W. Broad St.	804-353-0040
Wash	Seattle, Almac Stroum Elctrns., 5811 6th Ave., S.	206-763-2300
Wisc	Milwaukee, Parts Mart Corp., 1314 N. 7th St.	414-276-4160
Exp:	Can., Richmond Hills, Ont., Leecraft Inds. Ltd., 382 Enford Rd.	416-889-2744
Exp:	Long Island City, N.Y., Leecraft Int. Corp., 21-16 44th Rd.	212-392-8800
For:	Can., Don Mills, Ont., Saynor Elctrns., Ltd., 99 Scarsdale Rd.	416-445-2340
For:	Can., Montreal, Que., Payette Radio, 730 St. James St..	514-878-4771
For:	Can., Montreal, Que., Cesco Elctrns., Ltd., 4050 Jean Talon St.	514-735-5511
For:	Can., Toronto, Ont., Electro Sonic, Inc., 543 Yonge St.	416-494-1555
For:	Can., Toronto, Ont., Zentronics, Ltd., 185 Bridgeland Ave.	416-789-5111
For:	Can., Vancouver, B.C., L. A. Varah, Ltd., 1250 W. 6th St.	604-873-3211
For:	Can., Winnipeg, Man., Cam Gard Supply Co., Ltd., 1777 Ellis Ave.	204-786-8401

LEEDS & NORTHRUP CO., Sumneytown Pike, North Wales, Pa., 19454, Tel: 215-643-2000; Empl.: 4800

Products manufactured: Amplifiers, Analyzers, Baths, Controlled Temperature (Air & Liquid), Bridges, Calibrators, Capacitors, Fixed, Capacitors, Variable, Clocks (All Types), Comm. Systems, Comparators, Computers, Controllers, Programmable, Controls/Control Eqpt., Converters, Current Sensors, Data Acquisition & Reduction Systems, Data Loggers, Decade Boxes, Display Devices/Displays, Dividers, Drives & Drive Mechanisms (Dial), Furnaces, Indicators, Integrated Circuit Devices, Meters, Monitors, Paper, Graphic Recording, Potentiometers, Power Supplies, Printers, Probes, Pyrometers, Recorders, References, D-C Voltage, Scanners, Services, Assembly, Production & Test, Standards, Switches, Testers, Thermocouples, Elements & Accessories, Thermometers, Resistance, Totalizers, Digital, Transducers, Transmission Systems, Data, Transmitters, Voltage Sources, Wire

Local Sales Offices & Reps.

Ala	Birmingham	205-870-5310
Ala	Mobile	205-342-8929
Ariz	Phoenix	602-966-3870
Cal	Anaheim	714-635-6040
Cal	San Mateo	415-349-6656
Colo	Denver	303-759-2701
Conn	West Hartford	203-232-4474
Del	Wilmington	302-478-6970
DC	Washington	301-621-1353
Fla	Miami	305-428-2861
Fla	Orlando	305-851-3911
Ga	Atlanta	404-938-8946
Ill	Chicago	312-775-4141
Ill	Lansing	312-474-7070
Ind	Indianapolis	317-545-4364
Iowa	Davenport	319-355-6481
Kans	Mission	913-432-3727
Ky	Louisville	502-426-2985
La	Baton Rouge	504-921-5487
La	Shreveport	318-861-1861
Md	Baltimore	301-465-9494
Mass	Boston	617-326-8816
Mich	Detroit	313-398-3035
Mich	Grand Rapids	616-458-3691
Minn	Minneapolis	612-835-7722
Mo	Kansas City	913-432-3727
Mo	St. Louis	314-726-0853
Neb	Omaha	402-895-0886
NJ	Union	201-686-5200
NY	Albany	518-785-1354
NY	Buffalo	716-836-5900
NY	New York	212-687-4133
NY	Rochester	716-235-1700
NY	Syracuse	315-446-8446
NC	Winston-Salem	919-723-1087
Ohio	Akron	216-253-9086
Ohio	Canton	216-492-7400
Ohio	Cincinnati	513-791-2274
Ohio	Cleveland	216-291-2100
Ohio	Columbus	614-891-1615
Ohio	Toledo	419-531-4489
Okla	Tulsa	918-622-4515
Ore	Portland	503-292-8945
Pa	Allentown	215-434-4417
Pa	Erie	814-838-7708
Pa	Harrisburg	717-737-8628
Pa	Philadelphia	215-646-5500
Pa	Pittsburgh	412-561-7808
Pa	Sharon	412-346-3585
SC	Columbia	803-256-1495
Tenn	Knoxville	615-693-1838
Tenn	Memphis	901-365-9026
Tex	Beaumont	713-838-6848
Tex	Dallas	214-234-3363
Tex	Houston	713-784-2720
Utah	Salt Lake City	801-266-6931
Va	Richmond	804-272-7573
Va	Roanoke	703-345-9532
Wash	Seattle	206-455-4450
WVa	Charleston	304-342-6678
Wisc	Milwaukee	414-774-6000

LEEPOXY PLASTICS, 3324 Ferguson Rd., Ft. Wayne, Ind., 46809, Tel: 219-747-7411; Empl.: 15

Customer service: S. H. Christie

Free literature available: Selector Guide - Adhesives

Products manufactured: Adhesives (All Types), Compounds, Encapsulating, Insulating, Molding, Potting

Local Distributors

Cal	Paramount, J. S. Switzer, 15116 Downey Ave.	213-634-6363

LEHIGHTON ELECTRONICS, INC., RD1 4Mi. West on Rt. 443, Lehighton, Pa, 18235, Tel: 717-386-4156; Empl.: 40; Minimum order: $25

For info on price: L.Miller; Application info: A. R. Blew; Customer service: L. Miller; Delivery info: L. Miller

Free literature available: IC & transistor carrier board-device trays, digital controller P.C. Boards, control panels, electronic ass'ys to equip., switchgear, elevated temp. aging rack (diodes) ambient transistor aging rack.

Products manufactured: Alarms, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Boards, Programming, Cable Assemblies & Harnesses, Cards, Linear Function, Cards, Logic, Controllers, Programmable, Kits, Printed Circuit, Power Supplies, Services, Assembly, Production & Test, Testers, Timers

Local Sales Offices & Reps.

DC	Washington, Arco Engrg. Inc.	202-393-5991
NJ	Haddonfield, Sunday-O-Brien	609-429-4013

LEHIGHTON ELECTRONICS, INC cont'd

Advertisment

Let Lehighton Electronics, Inc. be your one stop high quality fast delivery source for artwork, printed circuit boards and assemblies, special and catalog test, production and automation equipment and switchgear. Please send your specifications and drawings for fast competitive pricing.

LEICO INDS., INC., 250 West 57th St., New York, N.Y., 10019, Tel: 212-765-5290; Minimum order: $30

For info on price: L. L. Eisenmann; Application info: L. L. Eisenmann; Customer service: E. Buchsbaum; Delivery info: P. Kasner

Products manufactured: Alloys, Connectors, Crystals, Diodes, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Plug Adapters, Plug & Jack Sets, Thermocouples, Elements & Accessories, Tubing, Wire

LEKTRA LABS., INC., 129-07 18th Ave., College Point, N.Y., 11356, Tel: 212-939-7171; Empl.: 60

For info on price: F. L. Chilton; Application info: C. Sershen; Customer service: C. Shershen; Delivery info: L. Nappi

Products manufactured: Controls/Control Eqpt., Switches, Timers

LEMO U.S.A. INC.

LEMO USA, 2015 Second St., Berkeley, Cal., 94710, Tel: 415-548-1966, Telex: 33-5393

For info on price: D. Winocour; Application info: B. Wersen; Customer service: D. Winocour; Delivery info: D. Winocour

Products manufactured: Connector Adapters, Connectors

Local Sales Offices & Reps.

Cal	Berkeley, Caltron Industries	415-548-1966
Cal	Los Angeles, Ezra Mintz Assocs.	213-645-2066
Ill	Parkridge, Central States Assocs.	312-692-2101
Mass	Lexington, Zieco	617-861-8300

Advertisment

Quick Connect/Dis-connect cylindrical connectors for round cables. Coaxial, multi-contact, and high voltage types. All metal shells are satin-chrome plated and complement other high quality front panel components.

LENK MFG. CO., INC., See Wall-Lenk Mfg. Co.

LENOX-FUGLE ELCTRNS., INC., 100 Sylvania Pl., S. Plainfield, N.J., 07080, Tel: 201-756-1164; Empl.: 18

Products manufactured: Coils Including Assemblies & Forms

LENOX INSTR. CO., 121 E. Luray St., Philadelphia, Pa., 19120, Tel: 215-DA 4-4543; Empl.: 40

Products manufactured: Fiber Optic Bundles, Lenses, Optical & Camera, Lenses, Readout & Display, Microscopes, Television Systems & Equipment Closed-Circuit

LENZ ELECTRIC MFG. CO., 1751 N. Western Ave., Chicago, Ill., 60647, Tel: 312-276-4454

Products manufactured: Cable, Wire, Wire Shielding

LEPEL HIGH FREQUENCY LABS., 59-21 Queens-Midtown Expwy., Maspeth, N.Y., 11378, Tel: 212-HA 6-4580; Empl.: 200; Minimum order: $25

For info on price: J. Chiuffi; Application info: P. Capolongo; Customer service: R. Rosenberg; Delivery info: J. Chiuffi

Products manufactured: Heaters & Heating Elements, Machines/Machinery, Production

Local Sales Offices & Reps.

Ala	South Birmingham, Dilcher Engrg. Co.	205-252-3300

Ariz	Scottsdale, Mercury Engrg. Sls., Inc.	602-945-1927
Cal	Irvine, Lepel High Frequency Labs., Inc.	714-540-1650
Conn	Simsbury, T. V. Evans	203-658-5579
Fla	St. Petersburg, Dilcher Engrg. Co.	813-343-1041
Ga	Atlanta, Dilcher Engrg. Co.	404-261-1678
Ill	Chicago, Lepel High Frequency Labs., Inc.	312-637-7244
Mass	Wakefield, Eastern Appliance Co.	617-245-8530
Mich	Mount Clemens, E. L. Kemper & Assocs.	313-468-9797
Minn	Minneapolis, C. W. Stone Co.	612-FE 9-0611
Mo	St. Louis, Brandwine Equip. Co.	314-993-5810
NC	Charlotte, Dilcher Engrg. Co.	704-364-9272
Ohio	North Canton, H. D. Denton	216-499-3091
Pa	Havertown, E. G. Murphy	215-446-4414
Tenn	Chattanooga, Young Equip. Sls.	615-265-3862
Tex	Houston, Selle Alloys & Equip. Co.	713-524-3013
Wash	Seattle, Eustis Co., Inc.	206-623-7060

LEVITON MFG. CO., INC., 59-25 Little Neck Pkwy., Little Neck, N.Y., 11362, Tel: 212-229-4040, TWX: 710-582-2632

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Boxes, Junction, Outlets & Wall Plates, Cable, Caps, Connector, Clamps & Clips, Controls/Control Eqpt., Cords, Fuses, Lamp Adapters, Plug Caps & Shells, Plugs, Socket Adapters, Sockets, Switch Mounting Plates, Switches, Wire

LFE CONTROL SYSTEM INDUSTRIES, 2920 Sand Ysidro Way, Santa Clara, Cal., 95051, Tel: 408-732-9400, TWX: 910-339-9282; Empl.: 100

For info on price: D. G. Ridgeway 408-732-9400; Application info: D. J. Gaushell 408-732-9400; Customer service: W. J. Robertson 408-732-9591; Delivery info: D. G. Ridgeway 408-732-9400

Free literature available: Modscan Systems-Modular computer-driven data acquisition & control systems 2. Series 400 Trend Displays. Supplies simultaneous viewing of any two process variables. CSI 7000 Remote Terminal-Supplies remote acquisition of data and transmission to a central Minicomputer.

Products manufactured: Data Acquisition & Reduction Systems, Multiplexers, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	Santa Clara	408-732-9400
Ill	Arlington Heights	312-956-0930
Tex	Houston	713-661-5390

LFE CORPORATION, Process Control Div., 1601 Trapelo Rd., Waltham, Mass., 02154, Tel: 617-890-2000, TWX: 710-324-0681; Empl.: 490

For info on price: R. Gubisch; Application info: R. Gubisch; Customer service: J. Incatasciato; Delivery info: G. Holderer

Free literature available: New catalog describes (API) analog panel meters, meter-relays, digital panel meters, temperature indicators, temperature controllers, and other display and control instruments.

Products manufactured: Comparators, Controls/Control Eqpt., Counters, Detectors, Dials, Display Devices/Displays, Meters, Monitors, Pyrometers, Recorders, Relays, Semiconductor Wafer Fabrication, Thermocouples, Elements & Accessories, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Phoenix, Zeus Inc./Elcom Div.	602-253-6104
Cal	Irvine, LFE Corp./Process Control Div.	714-979-8472
Cal	Santa Clara, LFE Corp./Process Control Div.	408-732-9611
Colo	Denver, Zeus Inc./Elcom Div.	303-770-4400
Fla	Boca Raton, Conley Assocs.	305-395-6108
Fla	Oviedo, Conley Assocs.	305-365-3283
Fla	Tampa, Conley Assocs.	813-933-3183
Ga	Douglasville, 20th Century Mktg.	404-942-6483
Ill	Arlington Heights, LFE Corp./Process Control Div.	312-593-5551
Kans	Prairie Village, LFE Corp./Process Control Div.	913-649-0121
Mass	Waltham, LFE Corp./Process Control Div.	617-890-2000
Mich	Royal Oak, George Instr. Co.	303-576-4700
Minn	Minneapolis, CMI	612-757-5090
NJ	Oakland, LFE Corp./Process Control Div.	201-337-6163
NM	Albuquerque, Zeus Inc./Elcom Div.	505-268-3941
NY	New Hartford, KLM Assocs.	315-735-8525
NY	North Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-442-0820
Ohio	Chesterland, LFE Corp./Process Control Div.	216-423-3131
Ohio	Dayton, LFE Corp./Process Control Div.	513-434-8873
Pa	Newtown Square, LFE Corp./Process Control Div.	215-353-0772
Tex	Houston, Carey-Wolf & Assocs.	713-721-2442
Utah	Salt Lake City, Zeus Inc./Elcom Div.	801-486-2317
Wash	Seattle, Comptronics	206-284-4842

LH RESEARCH, INC., 2052 S. Grand Ave., Santa Ana, Cal., 92705, Tel: 714-546-5279; Empl.: 100 p. 1•1306,1307

For info on price: J. C. Graham; Application info: J. C. Graham; Customer service: L. Reeve; Delivery info: L. Reeve

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Ariz	Scottsdale, DeAngelo, Rothman & Cheever	602-948-2240
Cal	Los Altos, Parsons & Meister	415-941-4745
Cal	Pasadena, A-F Sls. Engrg.	213-795-7081
Fla	Winter Park, Young & Lawrence Assoc.	305-647-6929
Md	Laytonsville, G-T Assocs.	301-949-8060
Minn	Minneapolis, Electro-Serv.	612-827-2907
NH	Nashua, Bell Controls	603-882-6984
NY	Endicott, Tech-Mark Assoc.	607-748-7473
NY	Great Neck, Tronic Assoc.	516-466-2300
Ohio	Cleveland, Goetronix Mktg. Assocs.	216-526-2535
Pa	Ambler, Denco-Data Engrg.	215-542-9876
Tex	Irving, Space Elctrns.	214-251-2261
Wash	Seattle, C.K. Shank & Assocs.	206-632-4290

LIBBEY OWENS-FORD CO., Liberty Mirror Div., 811 Madison Ave., Toledo, Ohio, 43695, Tel: 419-247-4797

For info on price: Ms M. Gillespie 412-224-1800; Application info: D. W. Barkley 412-224-1800; Customer service: D. R. Grove 419-247-4797; Delivery info: T. Conroy 412-224-1800

Products manufactured: Coatings

Local Sales Offices & Reps.

Cal	Los Angeles	213-388-0641
Ill	Chicago	312-236-2490
NJ	Fort Lee	201-947-8000
Ohio	Cincinnati	513-563-8920
Ohio	Toledo	419-247-4797
Tex	Dallas	214-521-3782

LIBERTY CONTROLS, INC., 500 Brookforest Ave., Shorewood, Ill., 60431, Tel: 815-725-2241; Empl.: 60; Minimum order: $50 p. 1•1760-1765

For info on price: R. J. Rudisill; Application info: R. J. Rudisill; Customer service: R. A. Bauer; Delivery info: R. A. Bauer

Products manufactured: Coils Including Assemblies & Forms, Panels, Racks, Relays, Solenoids

Local Sales Offices & Reps.

Cal	Santa Monica, REP Assoc.	213-829-5401
Fla	Sarasota, R.F. Carlson	813-388-3086
Ill	Chicago, Schuten Assoc.	312-833-0980
Mass	Braintree, Systems Comps.	617-275-2890
Mich	Grand Rapids, R. P. Urban & Assocs.	616-245-0511
Minn	St. Paul, Countryman Assocs.	612-645-9151
Mo	St. Louis, R. Carlson	314-961-4485
NJ	Fort Lee, Necco	201-461-2789
NY	Buffalo, Niagara Elec. Sls.	716-886-4000
NY	Rochester, Niagara Elec.	716-271-1223
Ohio	Cleveland, E. Bock	216-331-5212
Pa	Bryn Mawr, Vantage Sls.	215-525-0304
Tex	Dallas, D. Shuhart Co.	214-239-0185

LICON DIV., Illinois Tool Works, 6615 W. Irving Park Rd., Chicago, Ill., 60634, Tel: 312-282-4040, TWX: 910-221-0275; Empl.: 450; Minimum order: $50

For info on price: R. Schmidt; Application info: R. Schmidt; Customer service: A, Strassenberg; Delivery info: A. Strassenberg

Free literature available: Designers Keyboard Brochure with designers work sheet, A colorful 24-page lighted switch guide, and a general 40 page condensed catalog covering all Licon products.

Products manufactured: Caps, Lenses, Indicator Light, Controls/Control Eqpt., Diodes, Keyboards, Alphanumeric & Decimal, Lamps, Switches

Local Sales Offices & Reps.

Cal	Los Angeles, Licon	213-723-1181
Cal	Menlo Pk., McKnight Co.	415-325-2844
Colo	Lakewood, Licon	303-232-9588
Conn	Meriden, R. Stornello	203-237-6361
Fla	Clearwater, Perrott Assoc.	813-726-1549
Fla	Orlando, Perrott Assoc.	305-275-1132
Ga	Atlanta, Electro Mech.	404-393-0444
Kans	Overland Pk., Penzner-Mankus	913-381-0004
Kans	Wichita, Penzner-Mankus	316-264-2662
Md	Baltimore, Coulbourn DeGreif Inc.	301-247-4646
Mass	Burlington, J. Griffin	617-273-0365
Mich	Birmingham, Licon	313-642-9876
Minn	Minneapolis, Comstrand Inc.	612-560-5300
Mo	Hazelwood, Penzner-Mankus	314-731-4334
Neb	Lincoln, Mktg. Assoc.	402-464-5244
NJ	Haddonfield, TAI Corp.	609-854-3011
NY	Buffalo, Telesco Assoc.	716-834-1026
NY	Massapequa, J.F. Coughlin	516-799-7743
NY	Rochester, Telesco Assoc.	716-271-3780
NY	Utica, Telesco Assoc.	315-733-3183
NC	Raleigh, Electro Mech.	919-782-6452
Ohio	Columbus, Rockford Controls	614-231-5890
Ohio	Dayton, Rockford Controls	513-278-7362
Ohio	Euclid, Rockford Controls	216-731-5250
Pa	Monroeville, Rockford Controls	412-373-2531
Tex	Dallas, Evans-McDowell	214-238-7157
Tex	Houston, Evans-McDowell	713-783-2900
Wash	Bellevue, Barrett Sls.	206-885-6991
FOR:	Can., Don Mills, Ont., Illinois Tools	

LINDEN LABS., INC., Box 920, State College, Pa., 16801, Tel: 814-355-5491; FSC No: 20872; Empl.: 50; Minimum order: $50

For info on price: D. A. Beisswanger; Application info: P. A. Rishel; Customer service: D. A. Beisswanger; Delivery info: D. A. Beisswanger

Free literature available: Technical data on complete line of piezoelectric materials and transducers. Short form catalog.

Products manufactured: Ceramic Resonators, Crystals, Detectors, Hydrophones & Accessories, Microphones, All Kinds, Transducers

LINE ELECTRIC CO. UNIT ESTERLINE CORP., U.S. Hwy. 287, Parsippany, N.J., 07054, Tel: 201-887-8200; Empl.: 175; Minimum order: $5

For info on price: I. Kasper; Application info: C. Stewart; Customer service: I. Kasper; Delivery info: I. Kasper

Free literature available: Line Relay Catalog

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Relays, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Murcota Corp.	205-539-8476
Cal	Oakland, Sierra-Pacific Engrg., Inc.	415-635-6909
Cal	Santa Fe Springs, Sierra Pacific Engrg.	213-921-9634
Conn	Berlin, White Sls. Co.	203-224-0423
Fla	Clearwater, Lynch Gentry Assocs.	813-443-2697
Ind	Indianapolis, Val-Skol Sls., Inc.	317-926-5063
Mass	Needham, White Sls. Co.	617-444-3676
NJ	Leonia, Associated Controls & Equip.	201-944-9218
NY	Rochester, ONTEC	716-464-8636
NC	Winston-Salem, Murcota Corp.	919-723-1001
Ore	Forest Grove, Bern Doran Sls.	503-357-3333
Pa	Abington, Industrial Mktg. Specialists	215-659-0444
Tex	Dallas, Techno Assocs.	214-357-9213
EXP:	Bloomfield, N.J., Buck International Co.	201-743-8110

LINEAC CORP., 222 Lake Ave., Yonkers, N.Y., 10701, Tel: 914-YO3-5900 p. 2•2097

For info on price: J. Wilentchik; Application info: J. Wilentchik; Customer service: A. Powers; Delivery info: A. Powers

Free literature available: Bulletin #P502 - Program Dip Switches From 1 to 32 positions; single or multi throw; 1 to 8 poles; Mount on Board, Panel or in standard DIP receptacles.

Products manufactured: Switches

LINEAR INSTRS. CORP., 17282 Eastman St., Irvine, Cal., 92705, Tel: 714-546-6776, Telex: 68-5613; Empl.: 50; Minimum order: $25

For info on price: J. Mixon; Application info: J. Mixon; Customer service: C. Hamilton; Delivery info: N. Lorance

Free literature available: Laboratory Recorders; Log/Linear Recorders; Integrating Recorders; Recorder Buyer's Guide.

Products manufactured: Amplifiers, Paper, Graphic Recording, Recorders

LINEAR NETWORKS CO., Box 775, Westminster, Cal., 92683, Tel: 213-430-9342; FSC No: 5915; Empl.: 7

Customer service: J. L. Hogin

Products manufactured: Filters

LINEAR SYSTEMS, INC., 220 Airport Blvd., Watsonville, Cal., 95076, Tel: 408-722-4177, TWX: 910-330-6371; Empl.: 70

For info on price: P. F. Zimmer; Application info: P. F. Zimmer; Customer service: J. L. Peloso; Delivery info: J. L. Peloso

Free literature available: Full line catalogue 16 page, full color Product data sheets by model Misc. product information fliers and brochures

Products manufactured: Comm. Systems, Microphones, All Kinds, Power Supplies, Receivers, Transceivers, Transmitters

Local Sales Offices & Reps.

Cal	Culver City, W. Alderson Co.	213-870-9286
Cal	S. Lake Tahoe, L & H Mktg. Co.	916-544-5053
Cal	San Jose, L & H Mktg. Co.	408-268-8629
Colo	Arvada, CB Elctrn. Mktg.	303-422-0561
Conn	Hartford, S. Cohn Assocs.	203-522-0596
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Norcross, D. Cooper Co.	404-448-5460
Ill	Chicago, R.R. Hutmacher Assocs.	312-631-3248
Ind	Fort Wayne, New/Era Sls.	219-423-1164
Ind	Indianapolis, New/Era Sls.	317-257-7333
Iowa	Atlantic, Kimian Sls.	712-243-1626
Md	Baltimore, Par-Nell Sls.	301-655-2944
Mich	Oak Park, Wolverine Elctrn. Sls.	313-547-4089
Minn	Minneapolis, Jensen & Olsen Sls.	612-941-7181
Mo	Independence, Kimian Sls.	816-796-4026
Mo	Maryland Heights, Kimian Sls.	314-739-1655
NY	North Syracuse, L.D. Allen	315-458-7470
NY	Valley Cottage, S. Cohn Assocs.	914-268-9216
Ohio	Cleveland, Eastern Regional Sls Off.	216-235-6865
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3131
Ore	Portland, Earl & Brown Co.	503-245-2283
Pa	Enon Valley, NEBco Assocs.	216-457-2333
Pa	Holland, Par-Nell Sls.	215-355-9330
Tex	Dallas, Collins Co.	214-341-7866
Wash	Seattle, Earl & Brown Co.	206-284-1121
WVa	Princeton, NEBCO Assocs.	
FOR:	Can., Montreal, Que., E S Gould Mktg	514-342-4441

LINEMASTER SWITCH CORP., Box 52, Woodstock, Conn., 06281, Tel: 203-974-1000; FSC No: 97918; Empl.: 100; Minimum order: $10/

For info on price: Sls. Dept.; Application info: A. Munroe; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Catalog 74 (16 pages) Electric foot switches, anti-trip controls, foot operated Air Valves, special OEM foot controls, stock and custom cordsets OTS Reprint 1975 edition. Over 150 standard foot control in 17 basic families, with brief description including operation, circuitry and electrical ratings.

Products manufactured: Cable Assemblies & Harnesses, Cable, Switches

Local Sales Offices & Reps.

Ill	Addison, Line Master Switch Corp.	312-543-4550

LION PRECISION CORP, 60 Bridge St., Newton, Mass., 02195, Tel: 617-969-4710; FSC No: 25404; Empl.: 30; Minimum order: $20

For info on price: P. S. Vail; Application info: L. Michelson; Customer service: A. Pearle; Delivery info: J. Carsow

Free literature available: Literature contains specifications, features, applications, drawings, photos, etc. of spring, displacement, bow, diameter, thickness, tension, force, semiconductor thickness, ribbon, caliper, taper, pressure, flow, emissivity and reflectivity gages.

Products manufactured: Analyzers, Controls/Control Eqpt., Detectors, Gages, Indicators, Meters, Process Control Systems, Transducers

LIPPS, INC., 1630 Euclid St., Santa Monica, Cal., 90404, Tel: 213-393-0449; Empl.: 100 .... p. 1•20-23

Products manufactured: Heads, Recording Playback, Erase

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs. Inc.	205-837-4304
Conn	Guilford, Whitehead Assocs.	203-453-3762
Mass	Boston, Whitehead Assocs.	617-542-7676
Mo	St. Louis, Kemp Engr. Corp.	314-821-0587
Okla	Tulsa, Kemp Engrg. Corp.	918-299-2636
Tex	Dallas, Kemp Engrg. Corp.	214-661-0400

LISK, G.W. CO., 2 South St., Clifton Springs, N.Y., 14432, Tel: 315-462-2611, Telex: 97-8395; Empl.: 125; Minimum order: $30

For info on price: R. A. Nelson; Application info: M. D. Walborn; Customer service: A. Landschoot; Delivery info: A. Landschoot

Free literature available: Cat 8 Special Design to Order Military-Aerospace Linear DC Solenoid; Cat 9 Standard Industrial Linear DC Solenoids; Standard Industrial Rotary Solenoids (DC).

Products manufactured: Actuators, Air Cleaners & Filters (Shielded & Unshielded), Coils Including Assemblies & Forms, Solenoids

Local Sales Offices & Reps.

Ariz	Phoenix, Palmer Assocs.	602-996-9077
Cal	Whittier, J.J. Crowley	213-943-4115
Colo	Denver, Palmer Assocs.	303-255-9961
Ga	Roswell, Wyco	404-428-2576
Ill	Chicago, K-W Assocs.	312-792-2618
Md	Baltimore, W.V. Fox Assocs.	301-323-9544
Mich	Farmington Hills, W.R. Hummon & Assocs.	313-474-0661
Minn	Minneapolis, Murphy Assocs.	612-884-9701
Ohio	Cincinnati, Tri-State Mktg.	513-761-7993
Okla	Tulsa, Blair Engrg.	918-663-9850
Tex	Dallas, Blair Engrg.	214-352-8411
Tex	Houston, Blair Engrg.	713-667-9864
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529
FOR:	Can., Stoney Creek, Ont., Simmonds Aerocessories of Can. Ltd.	416-664-6203

LITHIC SYSTEMS, INC., Box 478, Saratoga, Cal., 95070, Tel: 408-867-5600; FSC No: 51083; Empl.: 6; Minimum order: $25

Customer service: R. A. Hirschfeld

Free literature available: Short-Form Brochure "Integrated Circuits for the Communications Industry".

Products manufactured: Amplifiers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Detectors, Dividers, Flashers, Integrated Circuit Devices, IC's, Active Filters, Lamp Drivers, Mixers, Modulators, All Kinds, Semiconductor Wafer Fabrication

Local Sales Offices & Reps.

Cal	Mt. View, Norcal Assocs.	415-961-8121
Cal	Tustin, Orion Sls.	714-832-9687
Ill	Rolling Meadows, Lightner Assocs.	312-398-3000

LITRONIX, 19000 Homestead Rd., Cupertino, Cal., 95014, Tel: 408-257-7910, TWX: 910-338-0022; FSC No: 50579; Empl.: 5000; Minimum order: $150 p. 2•1174-1179

For info on price: D. Fraser; Application info: D. Fraser; Customer service: L. Golden; Delivery info: L. Golden

Free literature available: Our line short form/catalog lists all standard products: Led Lamps, Opto Isolators, Photo Transistors, Numeric Displays, Alpha Numeric Displays.

Products manufactured: Calculators, Electrical & Electronic, Crystals, Diodes, Display Devices/Displays, Integrated Circuit Devices, Isolators, Lamps, Lights, Sensors, Light, Timers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Rep. Inc.	205-881-9270
Ariz	Scottsdale, Q.T. Wiles & Assoc.	602-947-5791
Cal	Los Angeles, Q.T. Wiles & Assoc.	213-478-0183
Cal	Mountain View, Trident Assoc.	415-967-7031
Cal	Tustin, Q. T. Wiles	714-832-4952
Colo	Denver, Parker-Webster Co.	303-770-1972
Conn	Meriden, New England Tech. Sls.	203-634-0298
Fla	Altamonte Springs, Semtronics Assoc.	305-831-8233
Fla	Ft. Lauderdale, Semtronics Assoc. Inc.	305-771-0010
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ga	Tucker, Rep Inc.	404-938-4358
Ill	Elk Grove Village, J. G. Twist Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell	219-432-5591
Ind	Indianapolis, R.O. Whitesell	317-359-9283
Ind	Kokomo, R.O. Whitesell	317-452-6065
Iowa	Cedar Rapids, J. G. Twist Co.	319-393-8703
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
Kans	Wichita, J. G. Twist Co.	316-686-6685
Ky	Louisville, R.O. Whitesell	502-893-7303
Md	Baltimore, Component Sls.	301-484-3647
Mass	Burlington, New England Tech. Sls.	617-272-0434
Mich	Grand Rapids, R.O. Whitesell	616-451-8901
Mich	Southfield, R.O. Whitesell	313-358-2020
Mich	St. Joseph, R.O. Whitesell	616-983-7337
Minn	Edina, M. Foster Tech. Sls.	612-835-2252
Mo	St. Louis, J. G. Twist Co.	314-432-2830
NM	Albuquerque, Tri-Tronix Inc.	505-265-8409
NY	DeWitt, Tritech	315-446-2881
NY	E. Rochester, Tritech	716-381-2722
NY	Larchmont, Tritech	914-834-4423
NY	Manhasset, Win-Cor	516-627-9474
NC	Raleigh, Component Sls.	919-782-8433
Ohio	Cincinnati, R.O. Whitesell	513-521-2290
Ohio	Cleveland, R.O. Whitesell	216-228-7525
Ohio	Columbus, R.O. Whitesell	614-888-9396
Ohio	Dayton, R.O. Whitesell	513-298-9546
Pa	Ft. Washington, G.C.M.	215-646-7535
Pa	Pittsburgh, R.O. Whitesell	412-344-7277
Tex	Houston, Semi Conductor Sls.	713-464-4197
Tex	Richardson, Semi Conductor Sls.	214-231-6181
Utah	Salt Lake City, Parker-Webster	801-486-3737
Wash	Bellevue, Tri-Tronix	206-454-0940
Wisc	Wauwatosa, J. G. Twist Co.	414-475-7755
For:	Can., Montreal, Que., Vitel Elctrns.	514-331-7393
For:	Can., Toronto, Ont., Vitel Elctrns.	416-622-6300

Local Distributors

Ala	Huntsville, Hamilton-Avnet	205-533-1170
Ariz	Phoenix, Hamilton-Avnet, 2615 So. 21st St.	602-275-7851
Ariz	Phoenix, Moltronics, Inc., 2746 W. Palm La.	602-272-7951
Ariz	Phoenix, R.V. Weatherford, 1917 N. 25th Dr.	602-272-7144
Cal	Anaheim, R.V. Weatherford, 1550 Babbitt Ave.	714-633-9633
Cal	Culver City, Hamilton Electro Sls., 10912 W. Washington Blvd.	213-558-2121
Cal	Glendale, R.V. Weatherford, 6921 San Fernando Rd.	213-849-3451
Cal	Mt. View, Hamilton-Avnet, 575 E. Middlefield Rd.	415-961-7000
Cal	Palo Alto, R.V. Weatherford, 3240 Hillview Ave.	415-493-5373
Cal	Pamona, R.V. Weatherford, 1095 E. 3rd St.	714-623-1261
Cal	San Diego, Hamilton-Avnet, 8917 Complex Dr.	714-279-2421
Cal	San Diego, Moltronics, Inc.	714-278-5020
Cal	San Diego, R.V. Weatherford, 7872 Raytheon Rd.	714-278-7400
Cal	Southgate, Moltronics, Inc., 5610 E. Imperial Hwy.	213-773-6521
Colo	Denver, Hamilton-Avnet, 5921 N. Broadway	303-534-1212
Colo	Englewood, R.V. Weatherford, 3905 S. Mariposa	303-761-5432
Conn	Georgetown, Hamilton-Avnet, 643 Danbury Rd.	203-762-0361
Conn	Hamden, Arrow Elctrns., 295 Treadwell	203-248-3801
Fla	Hollywood, Hamilton-Avnet, 4020 N. 29th Ave.	305-925-5401
Ga	Norcross, Hamilton-Avnet, 6700 I-85, Suite 2B	404-448-0800
Ill	Rosemont, Advent Elctrns., 7110-16 N. Lyndon St.	312-298-4210
Ill	Schiller Park, Hamilton-Avnet, 3901 N. 25th Ave.	312-678-6310
Ind	Indianapolis, Pioneer-Standard, 6408 Castle Place Dr.	317-849-7300
Kans	Lenexa, Hamilton-Avnet, 37 Lenexa Industrial Ctr.	913-888-8900
Md	Gaithersburg, Pioneer-Wash. Elctrns., 9100 Gaither Rd.	301-948-0710
Md	Hanover, Hamilton-Avnet, 7255 Standard Dr.	301-796-5000
Mass	Burlington, Hamilton-Avnet, 185 Cambridge St.	617-273-2120
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy.	617-329-2400
Mich	Livonia, Hamilton-Avnet, 12870 Farmington Rd.	313-522-4700
Mich	Livonia, Pioneer-Mich.	313-525-1800
Minn	Minneapolis, Hamilton-Avnet, 7683 Washington Ave.	612-941-3801
Mo	Hazlewood, Hamilton-Avnet, 364 Brookes La.	314-731-1144

NJ	Cedar Grove, Hamilton-Avnet, 218 Little Falls Rd.	201-239-0800
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Ave.	609-235-1900
NJ	Mt. Laurel, Hamilton-Avnet, 113 Gaither Dr., E. Gate Ind'l. Pk.	609-234-2133
NM	Albuquerque, Century Elctrns., 129 Vermont St., N.E.	505-292-2700
NM	Albuquerque, Hamilton-Avnet, 2450 Baylor Dr., S.E.	505-765-1500
NM	Albuquerque, R.V. Weatherford, 6101 Marble Ave., N.E.	505-265-5671
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	E. Syracuse, Hamilton-Avnet, 6500 Joy Rd.	315-437-2642
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Semiconductor Concepts, 175 Engineers Rd.	516-273-1234
NY	Rochester, Hamilton-Avnet	716-442-7820
NY	Rochester, Summit Distrs., 292 Commerce Dr.	716-334-8110
NY	Westbury, Hamilton-Avnet, 70 State St.	516-333-5800
NC	Greensboro, Pioneer-STD Elctrns., 2906 Baltic Ave.	919-273-4441
NC	Winston-Salem, Kirkman Elctrns., 910 W. Second St.	919-724-0541
Ohio	Cleveland, Hamilton-Avnet, 761 Beta Dr.	216-461-1400
Ohio	Cleveland, Pioneer-Standard, 4800 E. 131st St.	216-587-3600
Ohio	Dayton, Arrow elctrns., 3100 Plainfield Rd.	513-253-9176
Ohio	Dayton, Hamilton-Avnet, 118 Westpark Rd.	513-433-0610
Ohio	Dayton, Pioneer-Standard, 1900 Troy St.	513-236-9900
Pa	Pittsburgh, Pioneer-Standard, 560 Alpha Dr.	412-782-2300
Tex	Dallas, Component Specialties	214-357-4576
Tex	Dallas, Hamilton-Avnet, 4445 Sigma Rd.	214-661-8661
Tex	Dallas, R.V. Weatherford, 10836 Grissom La.	214-243-1571
Tex	Houston, Component Specialties, 7313 Ashcroft	713-771-7237
Tex	Houston, Hamilton-Avnet, 1216 W. Clay St.	713-526-4661
Tex	Houston, R.V. Weatherford, 3500 W. T.C. Jester Blvd.	713-688-7406
Utah	Salt Lake City, Hamilton-Avnet, 647 W. Billins Rd.	801-262-8451
Wash	Bellevue, Hamilton-Avnet, 13407 Northrup Way	206-746-8750
Wash	Seattle, R.V. Weatherford, 541 Industry Dr.	206-243-6340
For:	Can., Mississauga, Tor., Hamilton-Avnet, 6291-19 Dorman Rd.	416-677-7432
For:	Can., Montreal, Que., Hamilton-Avnet, 935 Montee de Liesse St. Laurant	514-331-6443
For:	Can., Montreal, Que., Prelco Elctrns., 480 Port Royal St. W.	514-389-8051
For:	Can., Montreal, Que., Future Elctrns., 5647 Ferrier St.	514-735-5775
For:	Can., Ottawa, Ont., Prelco Elctrns. Ltd.	613-237-6150
For:	Can., Ottawa, Ont., Future Elctrns.	613-232-7757
For:	Can., Vancouver, B.C., L.A. Varah's Ltd., 2077 Alberta St.	604-873-3211
For:	Can., Willowdale, Ont., Electro Sonic, 1100 Gordon Baker Rd.	416-494-1666

LITTELFUSE, INC., 800 E. Northwest Hwy., Des Plaines, Ill., 60016, Tel: 312-824-1188
p. 1•2098,2099; p. 2•1180,1181

Customer service: B. Cotter

Free literature available: Catalog #18: Technical information on fuses, fuseholders, clips and blocks, circuit breakers. Littelites Product Guide: Guide to selecting correct indicator lights; cartridge lamps; subminiature, miniature lampholders; snap-mount plastic lites.

Products manufactured: Circuit Breakers, Clamps & Clips, Fuses, Lights, Panels, Relays, Sockets, Switches

Local Sales Offices & Reps.

Ala	Gadsden, F.C. Nickerson Co.	205-547-7718
Ariz	Phoenix, H. Moore Sls. Co.	602-257-8007
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Inglewood, J. Berman Co.	213-766-1281
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Conn	West Hartford, C. Segel Co.	203-236-2027
Fla	Oldsmar, F.C. Nickerson Co.	813-855-4209
Ga	Atlanta, F.C. Nickerson Co.	404-321-4678
Ill	Arlington Heights, C.P. Dombrow Co.	312-253-3326
Ind	Indianapolis, L.M. DeVoe Co.	317-257-1227
Iowa	West Des Moines, T.L. Dowell & Assocs.	515-225-1620
Kans	Overland Park, T.L. Dowell & Assocs.	913-236-8200
Md	Silver Spring, Ansell Engrg. Co.	301-949-1655
Mass	Newtonville, C. Segel Co.	617-969-6900
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
Minn	Edina, M. Foster Tech. Sls.	612-835-2252
Mo	St. Louis, T.L. Dowell & Assocs.	314-968-4234
NJ	Englewood, Bressler & Baum Assocs.	201-569-7600
NJ	N. Caldwell, Masin Esco., Inc.	201-226-2550
NM	Albuquerque, W.J. Purdy Co.	505-266-7959
NY	Buffalo, R.W. Mitscher	716-633-7970
NY	Syosset, Masin Esco, Inc.	516-364-0310
NC	Kannapolis, F.C. Nickerson Co.	704-932-6772
Ohio	Richfield, Bear Mktg.	216-659-3131
Ore	Portland, J.V. Belusko Co.	503-222-4279
Pa	Enon Valley, Nebco Assocs.	216-457-2333
Pa	Narbeth, S.A. Jeffries, Inc.	215-664-8500
Pa	Reading, Beil & Whitaker	215-779-2610
Tenn	Memphis, A. Engelman	901-458-6263
Tex	Dallas, Lund & Co.	214-358-4335
Va	Virginia Beach, R.W. Mitscher Co.	804-481-7200
Wash	Seattle, Earl & Brown Co.	206-284-1121
Exp:	Chicago, Ill.	312-824-1188
FOR:	Can., Willowdale, Ont., A.C. Simmonds & Sons, Ltd.	416-491-1010

LITTON ABS/OEM PRODS DIV., 34 Maple Ave., Pine Brook, N.J., 07058

LITTON INDS., Electron Tube Div., 960 Industrial Rd., San Carlos, Calif., 94070, Tel: 415-591-8411, TWX: 910-376-4900; FSC No: 80080; Empl.: 950

Customer service: E. D. Taylor

Free literature available: Product Summary . This brochure describes most of the unclassified microwave tubes, solid-state microwave devices, and cathode ray tubes available from Litton Industries Electron Tube Division.

Products manufactured: Amplifiers, Coils Including Assemblies & Forms, Couplers, Diodes, Generators, Intensifiers, Image, Modulators, All Kinds, Oscillators, Power Supplies, Shields, Tubes

Local Sales Offices & Reps.

DC	Washington	202-554-2570
Ga	Warner Robins	912-923-3397
NJ	West Long Branch	201-542-7101
Ohio	Dayton	513-258-1243
Pa	Williamsport	717-326-3561
Tex	Dallas	214-369-2184

LITTON SYSTEMS, INC., Potentiometer Div., 226 E. Third St., Mt. Vernon, N.Y., 10550, Tel: 914-664-7733, TWX: 710-562-0129; QPL No: Multiple; Empl.: 300

For info on price: E. Cubbin

Free literature available: Precision potentiometer catalog illustrating complete line of conductive plastic, wire wond and slidewire single and multiturn potentiometer elements, wipers and speed controls.

Products manufactured: Alarms, Brushes & Brush Assemblies, Controls/Control Eqpt., Dividers, Generators, Potentiometers, Resistors, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Technology Instr. Assocs.	205-883-7893
Cal	Norwalk, Comar Co.	213-921-8695
Cal	Sunnyvale, Comar Co.	408-245-3193
Fla	Ormand Beach, Technology Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ill	Chicago, Ropek-Cahill	312-287-7292
Iowa	Cedar Rapids, Midwest Meridian Corp.	319-365-6561
Md	Baltimore, R.A. Wafer Assocs.	301-744-1133
Mass	Allson, Vector Sls.	617-787-2790
Mich	Lakeview, Midwest Meridian Corp.	517-352-7775
Mo	St. Louis, B & H Assocs.	314-427-7200
Mo	St. Louis, Mid West Meridian Corp.	314-878-4441
NY	New York, Trionic Assocs., Inc.	516-466-2300
NY	Syracuse, C. W. Floring Assocs.	315-478-2149
Ohio	Dayton, Rixan Assocs., Inc.	513-278-4216
Pa	Newton Square, Quarracino & Hunter	215-353-4300
Tex	Saginaw, Midwest Meridian Corp.	214-251-3933
FOR:	Can., Ottawa, Wilson Entprs.	613-224-9878
FOR:	Can., Toronto, Wilson Entprs.	416-766-0510

LITTON SYS., INC., Guidance & Control Sys. Div., 5500 Canoga Ave., Woodland Hills, Calif., 91346; Empl.: 3000

Products manufactured: Computers, Memory Systems

LIVERMORE DATA SYSTEMS, INC., 2050 Research Dr., Livermore, Cal., 94550, Tel: 415-447-2252, TWX: 910-386-8343; Empl.: 110; Minimum order: $15

For info on price: J. G. Nugen; Application info: J. G. Nugen; Customer service: J. E. Bannister; Delivery info: B. H. Shore

Products manufactured: Comm. Systems, Couplers, Modulator/Demodulators, Multiplexers

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-0653
Cal	Palo Alto, Digicom	415-327-9081
Colo	Denver, Thorson Co.	303-759-0809
Ill	Des Plains, Cozzens & Cudahy	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy	317-244-2456
Mass	Framingham, Victor Assoc.	617-879-5710
Mich	Southfield, Nation Wide Communications	
Minn	Minneapolis, Cozzens & Cudahy	612-884-4336
Mo	Kansas City, Cozzens & Cudahy	816-454-5836
Mo	St. Louis, Cozzens & Cudahy	314-423-1234
NY	Roslyn Hts., Travco Assoc.	516-621-3223
Ore	Beaverton, Tarbell Communications	503-643-1631
Ore	Lake Oswego, Cartel	503-636-5226
Va	Fairfax, Nine Assocs.	703-273-1803
FOR:	Can., Thornhill, Manitoba, Harding Corp.	416-881-0707

LMB HEEGER, INC., 729 Ceres Ave., Los Angeles, Cal., 90021, Tel: 213-627-9310; Empl.: 11

For info on price: O. Heeger 213-627-9319; Application info: O. Heeger 213-627-9319; Customer service: R. Heeger 213-627-9310; Delivery info: R. Heeger 213-627-9310

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Cleaners & Solvents, Coolants, Circuit & Components, Enclosures, Module, Plug-In, Flux, Brazing & Soldering Materials, Panels

Local Sales Offices & Reps.

Ala	Birmingham, J. F. Russell Sls.	
Ariz	Phoenix, B.G. Sls.	602-266-5624
Cal	Burlingame, Carelli-EMA	415-697-8862
Cal	Los Angeles, Heeger	213-627-9319
Colo	Aurora, A.E.S. Inc.	303-366-0208
Fla	Fort Lauderdale, Unirep Inc.	305-527-1556
Ill	Skokie, Mort Fields Co.	312-OR4-3018
Ind	Mulberry, Marsh Sls.	
Mass	Framingham Center, Northeastern Rep.	617-877-4850
Mich	Bloomfield Hills, S.F. McMechan	313-852-4308
Minn	Minneapolis, A.J. Warner Co.	612-729-7371
Mo	St. Louis, Kathrinus-Kelly & Co.	
NY	Yonkers, J. Brown Ele. Reps.	914-779-7330
Ohio	Columbus, J.A. Mandabach	614-235-0265
Ore	Portland, J.W. Eckersley	503-246-3183
Pa	Holland, Parnell-Sls. Co.	215-355-9330
Tex	Houston, W. Wylds	713-467-0072

LOCKHEED AIRCRAFT SVC., Ont. Intl. Airport, P.O. Box 33, Ont., Cal., 91761, Tel: 714-984-1234, TWX: 714-556-9517

Products manufactured: Antennas, Converters, Data Acquisition & Reduction Systems, Decommutators, Telemetering, Racks, Recorders, Services, Assembly, Production & Test

LOCKHEED ELCTRNS. CO., Rte. #22, Watchung, N.J., 07060, Tel: 201-757-1600, TWX: 710-997-9541; Empl.: 1600

Products manufactured: Boards, Printed Circuit, Circuits, Flexible, Circuits, Printed, Multilayer, Computers, Control Systems, Air Traffic, Cores, Ceramic, Cores, Magnetic, Memory Systems, Radar Systems, Recorders, Services, Assembly, Production & Test, Technical Books, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Cal	Cupertino, Lockheed Elctrn. Co.	408-257-3357
Cal	Downey, Lockheed Elctrn. Co.	213-869-1187
Ga	Atlanta, Lockheed Elctrns. Co.	404-266-0730
Ill	Elmhurst, Lockheed Elctrns. Co.	312-833-4600

Mass	Lexington, Lockheed Elctrns. Co.	617-861-1880
Mich	Southfield, Lockheed Elctrns. Co.	313-557-5037
Minn	Bloomington, Lockheed Elctrns. Co.	612-888-6080
NJ	Fort Lee, Lockheed Elctrns. Co.	201-947-8107
Pa	West Conshohocken, Lockheed Elctrns. Co.	215-825-2880
Tex	Richardson, Lockheed Elctrns. Co.	214-231-6163
Va	Arlington, Lockheed Elctrns. Co.	703-525-3600

LOGICPULSE, 18758 Bryant St., Northridge, Cal., 91324, Tel: 213-993-0225; Empl.: 3

Customer service: W.W. Fisher

Free literature available: Bulletin/Specification

Products manufactured: Generators

LOGIMETRICS INC., 121-03 Dupont Street, Plainview, NY, 11803, Tel: 516-681-4700, TWX: 510-221-1833; FSC No: 6625; Empl.: 35; Minimum order: $50 p. 1•758,759,909

For info on price: M. H. Feigenbaum; Application info: M. H. Feigenbaum; Customer service: M. H. Feigenbaum; Delivery info: B. Divack

Products manufactured: Amplifiers, Generators, Power Supplies, Synthesizers

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices S.E.	205-536-1969
Ariz	Phoenix, R.L. Davis Co.	602-955-2266
Cal	Los Angeles, L & M Engrg	213-674-6850
Cal	Palo Alto, R.F. Assocs.	415-327-5531
Colo	Denver, Scientific Devices Intermountain	303-573-9466
Conn	Hamden, Instrument Consultants, Inc.	203-288-5246
Fla	Ft. Lauderdale, Scientific Devices S.E.	305-721-4260
Fla	Orlando, Scientific Devices S.E.	305-841-8180
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Kans	Shawnee Mission, Pivan Engrg., Inc.	913-722-1030
Md	Lanham, Brimberg Assocs.	301-552-2200
Mass	Waban, Instrument Consultants, Inc.	617-969-9881
Mich	Detroit, S. Sterling	313-255-1970
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, Pivan Engrg., Inc.	314-567-3636
NJ	Hazlet, Mer Mon Elctrn. Instrumentation	201-264-1851
NM	Albuquerque, I.M.E.C.	505-883-9010
NY	Binghamton, Labtronics, Inc.	607-748-0509
NY	Jericho, Dal-Tech Devices, Inc.	516-433-7448
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Ulster Park, Labtronics, Inc.	518-372-6649
NC	Burlington, Scientific Devices S.E.	919-228-6279
ND	Minneapolis, Torkelson Assocs.	612-835-2414
Ohio	Cleveland, S. Sterling	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Tex	Houston, Scientific Devices S.W.	713-623-4250
Tex	Richardson, Scientific Devices S.W.	214-231-8106
Wash	Bellevue, Brennan Assocs.	206-454-9332

LOGITEK, INC., 42 Central Dr., Farmingdale, N.Y., 11735, Tel: 516-694-3080; Empl.: 25

Products manufactured: Controls/Control Eqpt., Detectors, Flashers, Monitors, Relays, Timers

Local Sales Offices & Reps.

Cal	Palo Alto, Adtek Assocs.	415-323-5414
Cal	Sun Valley, Weightman & Assocs.	213-768-5750
Fla	Orlando, Dost Assocs.	305-831-1118
Iowa	Cedar Rapids, Palatine Engrg. Sls., Inc.	319-365-8071
Kans	Andover, Palatine Engrg. Sls., Inc.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls., Inc.	913-262-5643
Md	Baltimore, Coulbourn DeGreif, Inc.	301-247-4646
Mass	Needham Heights, Northeast Reps., Inc.	617-449-3034
Mo	St. Louis, Palatine Engrg. Sls., Inc.	314-426-7055
NJ	Clifton, Compar Corp.	201-546-3660
Ohio	Cleveland, Ad-El-Tek Co.	216-252-0488
Ohio	Englewood, Ad-El-Tek Co.	513-836-2741
Okla	Tulsa, Palatine Engrg. Sls., Inc.	918-622-0321
Pa	Philadelphia, Technicraft Co.	215-IV 3-4700
Tex	Houston, Palatine Engrg. Sls., Inc.	713-777-4477
Tex	Richardson, Palatine Engrg. Sls., Inc.	214-231-9489

LONDON CHEMICAL CO., 240 Foster Ave., Bensenville, Ill., 60106; Empl.: 25

Products manufactured: Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Flux, Brazing & Soldering Materials, Machines/Machinery, Production

Local Sales Offices & Reps.

Cal	Burbank, London Chemical West, Inc.	213-846-8666
Fla	Miami, Norm Black, Assoc.	305-651-4132
Md	Baltimore, D.K. Jones	301-752-0577
Mass	Waltham, Etchomatic, Inc.	617-893-2020
Minn	Minn., Servco, Inc.	612-941-7151
NY	Skaneateles, Spar-Kleen Prods.	315-685-5711
Ohio	Cleveland, Hodson Co.	216-587-4500
Pa	Montgomeryville, Buerger Co.	215-699-7591
Tex	Dallas, Steven-Daniels Corp.	214-241-2333
EXP:	Rensenville, Ill., London Chemical Co. Inc. International Dept.	312-287-9477

LONDON CO., 811 Sharon Dr., Westlake, Ohio, 44145, Tel: 216-871-8900; Empl.: 35 p. 1•760-765

For info on price: R. Specht; Application info: J. Bush; Customer service: R. Specht; Delivery info: R. Specht

Free literature available: Test equipment for the audio, mid frequency and component market.

Products manufactured: Analyzers, Bridges, Generators, Meters, Switches, Testers

Local Sales Offices & Reps.

Cal	Burbank, Wright Engrg.	213-843-7240
Cal	Los Altos, Wright Engrg.	415-941-4405
Conn	Glastonbury, Instr. Reps., Inc.	203-633-0777
Ill	Chicago, Bernot Assoc.	312-283-0713
Mass	Lexington, Instr. Reps., Inc.	617-861-8620
Mich	Royal Oak, Group Ten	313-549-3910
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Satullo Co.	513-277-6531
Pa	Audubon, Holmes Assoc.	215-666-0636

LORANGER MFG. CORP., Box 948, Warren, Pa., 16365, Tel: 814-723-2250; Empl.: 350; Minimum order: $50

For info on price: R. Ehrman; Application info: A. Loranger Jr.; Customer service: P. Seber; Delivery info: R. Ehrman

Free literature available: Literature on: The LMC #2910-300-4050 tool.

Products manufactured: Sockets

Local Sales Offices & Reps.

Ariz	Scottsdale, C.T. Fink & Assocs.	602-992-9884
Cal	Los Angeles, Elmo Engrg. Assocs.	213-461-4871
Cal	Sunnyvale, B. Oppenheim, Inc.	408-733-9000
Conn	New Haven, McBar Assocs.	203-865-4376
Fla	Longwood, Lenz Engrg. Co.	305-831-9797
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Mass	Waltham, McBar Assoc.	617-890-0233
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
NJ	Flanders, D. Zingone	201-584-7845
NY	Rochester, Upstate Comp. Sls.	716-288-1080
Tex	Richardson, C.J. Garvey Co.	214-234-3371
Wash	Seattle, H.S. Thorpe Co.	206-784-3333
FOR:	Can., Toronto, Ont., C. Edwards	416-921-6986

LORCH ELCTRNS. CORP., 105 Cedar La., Englewood, N.J., 07631, Tel: 201-569-8282, TWX: 710-991-9718

For info on price: A. E. Steinhauer; Application info: J. Lorch; Customer service: A. Remes; Delivery info: A. Remes

Products manufactured: Amplifiers, Antenna Feed Systems, Attenuators, Cavities, Microwave, Comparators, Converters, Couplers, Demodulators, Detectors, Dividers, Duplexers, Microwave, Filters, Impedance Converters, Microwave, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Multipliers, Preselector-Mixers, Receivers, Shifters, Strip-Line Components, Microwave, Switches, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices S.E.	205-536-1969
Ariz	Phoenix, Williams Assocs.	602-947-4297
Cal	Inglewood, L & M Engrg South	213-674-6850
Cal	San Jose, L & M Engrg. Inc.	408-292-3220
Colo	Denver, Williams Assocs.	303-373-4730
Fla	Fort Lauderdale, Scientific Devices-Southeast	305-721-4260
Fla	Orlando, Scientific Devices S.E.	305-841-8180
Fla	St. Petersburg, Scientific Devices-Southeast	813-576-5194
Ill	Chicago, Pivan Engrg., Inc.	312-539-4838
Ind	Indianapolis, Pivan Engrg., Inc.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg., Inc.	913-722-1030
Md	Silver Spring, Eastern Instrumentation	301-744-3675
Mass	Reading, Geder-Rotondi Assocs.	617-944-3105
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engrg., Inc.	612-537-4501
Mo	St. Louis, Pivan Engrg., Inc.	314-567-3636
NJ	W. Orange, R. Felsenheld, Jr.	201-731-7203
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Liverpool, R & D Assocs.	315-622-2350
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling	513-298-7573
Pa	Jenkintown, AMT	215-549-2080
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Tex	Houston, Scientific Devices S.W.	713-623-4250
Tex	Richardson, Scientific Devices S.W.	214-231-8106
Tex	San Antonio, Ashcraft	512-824-7267
Va	Suffolk, Eastern Instrumentation	804-497-0001
Wash	Seattle, G.M. Gillett & Assocs.	206-284-3344
Wisc	Brookfield, Pivan Engrg., Inc.	414-786-1940
EXP:	New York, N.Y., Ad. Auriema, Inc.	212-466-2500
FOR:	Can., Ottawa K1G 3N4, Ont., L. Albert Assocs.	613-737-5941

LORCH DEVICES INC., 105 Cedar Lane, Englewood, N.J., 07631, Tel: 201-569-8282, TWX: 710-991-9718

For info on price: J. Lorch; Application info: A. E. Steinhauer; Customer service: A. Remes; Delivery info: A. Remes

Products manufactured: Amplifiers, Antenna Feed Systems, Attenuators, Cavities, Microwave, Circuits, Printed, Multilayer, Comparators, Converters, Couplers, Delay Lines, Demodulators, Detectors, Diplexers, Antenna, Dividers, Drivers, Switch, Dummy Loads, Duplexers, Microwave, Filters, Generators, Impedance Converters, Microwave, Isolators, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Mismatches, Microwave, Precision, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Monitors, Multipliers, Preselector-Mixers, Preselectors, Receivers, Shifters, Strip-Line Components, Microwave, Switches, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices	205-536-1969
Ariz	Phoenix, Williams Assocs.	602-947-4297
Cal	Canoga Pk., Microwave Mktg.	213-883-6181
Colo	Denver, Williams Assoc.	303-373-4730
Fla	Fort Lauderdale, Scientific Devices - Southeast	305-721-4260
Fla	Orlando, Scientific Devices - Southeast	305-843-1826
Fla	St. Petersburg, Scientific Devices-Southeast	813-576-5194
Ill	Chicago, Pivan Eng., Inc.	312-539-4838
Ind	Indianapolis, Pivan Engrg.	317-253-1681
Kan	Shawnee Mission, Pivan Engg	913-722-1030
Md	Silver Spring, Eastern Instrumentation	301-744-3675
Mass	Andover, Bee Assoc.	617-475-2124
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engg	612-537-4501
Mo	St. Louis, Pivan Engg	314-567-3636
NJ	West Orange, R. Felsenheld, Jr.	201-731-7203
NM	Albuquerque, Williams-Assocs.	505-255-1638
NY	Utica, B.D. Hummel Co.	315-736-7821
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling	513-298-7573
Pa	Jenkintown, AMT	215-549-2080
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Tex	Houston, Scientific Devices-SW	713-623-4250
Tex	Richardson, Scientific Devices-SW	214-231-8106
Tex	San Antonio, Scientific Devices-SW	512-736-3164
Va	Suffolk, Eastern Instrumentation	804-497-0001
Wash	Seattle, G. M. Gillett & Assocs.	206-284-3344
Wisc	Brookfield, Pivan Engg	414-786-1940
EXP:	New York, N.Y., Ad. Auriema Inc.	212-466-2500
FOR:	Can., Ottawa, Ont., L. Albert Assocs.	613-737-5941

LPS RESEARCH LABS, 2050 Cotner Ave., Los Angeles, Cal., 90025, Tel: 213-478-0095, TWX: 910-342-7557/; Empl.: 61; Minimum order: $250

For info on price: L. Erdman; Application info: B. Einson; Customer service: L. Erdman; Delivery info: R. Dube

Free literature available: Catalogs explain what the product is and how to use it. Explains testimonials!

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Lubricants

Local Sales Offices & Reps.

Cal	San Franicisco, D. C. Dostal	415-584-2159
Fla	Miami, M. Kelly	305-253-1294
Ga	Stone Mountain, E. R. Eigen	404-469-2698
Ill	Hanover Park, J. A. McArdle	312-685-7612
Ill	Woodridge, R. Parker	312-685-7612
Mass	Walpole, A. Hession	617-668-0218
Minn	Edina, R. D. O'Bryan	612-993-0344
NJ	Barnegat, J. L. Markley	201-544-1170
Ohio	Vermillion, J. Lacinak	215-234-7400
Tex	Arlington, A. V. Heavin	817-265-9067
Va	Midlothian, F. T. Mayo	804-355-3392
Wash	Bellevue, D. Pearce	206-682-6860

LRC INC., 101 Digital Dr., Hudson, N.H., 03051, Tel: 603-883-9351, TWX: 710-228-1377; Empl.: 50; Minimum order: $20

For info on price: J. Susi; Application info: F. Solla; Customer service: R. Woodman; Delivery info: J. Susi

Free literature available: Solid State Switch Drivers, Resistor Ladder Networks, Chip Resistors, Custom Hybrid Ckts. Metallized Substrates

Products manufactured: Attenuators, Circuits, Hybrid, Thin-Film, Converters, Drivers, Switch, Networks, Resistors, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	San Diego, KCE Corp.	714-278-7640
Cal	San Francisco, Jack Logan & Assoc.	415-697-6100
Cal	Tustin, Thorson Co.	714-455-5121
Colo	Denver, Thorson Co.	303-355-3521
Conn	Hamden, Impact Sls.	203-281-1331
Fla	Orlando, Gra-Mar Inc.	305-894-3351
Ill	Palatine, CC Electronics	312-358-8900
Mass	Waltham, Impact Sls.	617-893-2850
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
NH	Hudson, LRC Inc.	603-883-9351
NJ	Clifton, Compar Inc.	201-546-3660
NM	Albuquerque, IMEC	505-344-2212
NY	Rochester, Schomburg & Burke Grp.	716-244-0920
Ohio	Dayton, Berberich Assoc.	513-433-0342
Pa	Jenkintown, AMT	215-549-2080
Va	Baileys Crossroads, QT Elctrn. Sls.	703-671-4357
Wash	Seattle, Thorson Co.	206-632-0710
FOR:	Can., Don Mills, Ont., J-Tronics	416-429-6324

LSI COMPUTER SYSTEMS, INC., 22 Cain Dr., Plainview, N.Y., 11803, Tel: 516-293-3850; Empl.: 20; Minimum order: $50

Free literature available: Capabilities Brochure; D Series Dividers; Red Series Dividers; C1200 Clock Circuit.

Products manufactured: Clocks (All Types), Converters, Dividers, Integrated Circuit Devices, Memory Systems, Multiplexers, Packages, Integrated Circuit, Scalers, Binary, Decade, Services, Assembly, Production & Test

LUFT INSTRS., INC., Old Winter St., Lincoln, Mass., 01773, Tel: 617-259-9215; Empl.: 25; Minimum order: $100

Customer service: L. Luff

Products manufactured: Alarms, Comparators, Controllers, Programmable, Controls/Control Eqpt., Electroplating Equipment & Supplies, Servo Systems, Testers

GULTON INDUSTRIES, Luminator Div., 1200 E. Dallas N. Pkwy., Plano, Tex, 75074, Tel: 214-424-6511, Telex: 073-2373; Empl.: 300; Minimum order: $25

For info on price: R. P. Winks; Application info: R. P. Winks; Customer service: J. Pavlik; Delivery info: J. Pavlik

Products manufactured: Inverters, Sockets, Switches

Local Sales Offices & Reps.

Cal	Pacific Palisades, Ledbetter Assocs.	213-454-2421
Ill	Chicago, Terhune-Van Effen	312-346-0053
Md	Wheaton, W. Jordan Co.	202-949-1962
Mass	Boston, Sands-Barnard Assocs.	617-631-7533
Tex	Dallas, Blair Engrg. Sls. Co.	214-352-8411
Wash	Kirkland, R.R. Chase & Assocs.	206-454-2514

LUNDY ELCTRNS. & SYS., INC., Robert La., Glen Head, N.Y., 11545, Tel: 516-671-9000, TWX: 510-223-0605; Empl.: 707

For info on price: J. Guy; Application info: B. Stein; Customer service: D. Casadonte; Delivery info: D. Casadonte

Products manufactured: Actuators, Cable, Character Recognition Systems, Converters, Display Devices/Displays, Filters, Gaskets, Shielding, R-F-Also See Shields, R-F, Motors, Printers, Punched Card Equipment, Readers, Scanners, Shields, Testers, Transceivers, Transmitters

Local Sales Offices & Reps.

Cal	Los Angeles	213-487-4040
Colo	Boulder,	303-443-2606
Fla	Pompano Beach	305-943-1500
Ga	Atlanta	404-458-7339
Ill	Chicago	312-726-3103
Mass	Ipswich	617-356-5761
NJ	Moorestown	201-434-1533
NC	Charlotte	704-394-1161
Tex	Houston	713-521-0818
Va	Annandale	703-941-1900

LUXO LAMP CORP., Monument Park, Port Chester, N.Y., 10573, Tel: 914-937-4433, Telex: 137-336; Empl.: 100

Customer service: R. Newton

Free literature available: Price lists; Brochures; Flyers.

Products manufactured: Lamps, Magnifying Glasses, Inspection

Local Sales Offices & Reps.

Cal	Corte Madera, E. Myer	415-924-4680
Cal	Hollywood, J. Barnett	213-462-4576
Conn	Norwalk, N. Tarrant	203-866-2420
Fla	Port Charlotte, W. Hemminger Co.	813-625-6050
Ga	Atlanta, Dotson & Co.	404-325-9173
Ill	Evanston, J.S. Sprenger	312-475-0848
Md	Baltimore, H. Abrams	301-486-3040
Mich	Plymouth, W. Ryan	313-779-5760
Minn	St. Louis Park, J. Lee Co.	612-920-1525
Mo	Kansas City, Nevco	816-421-1751
NY	Port Chester, Luxo Lamp Corp.	914-937-4433
NY	Whitesboro, A. Coletti	315-736-6989
NC	Charlotte, Coleman Co.	704-525-2046
Ore	Portland, T.E. Ferris	503-646-8659
Tex	Conroe, T. O'Neill	713-273-1215

LVC INDS. INC., Co-Ord Switch Bloc-Lite Divs., 135-25 37th Ave., Flushing, N.Y., 11354, Tel: 212-939-9777; FSC No: 32759; Empl.: 29; Minimum order: $25
p. 1•2010,2011,2100; p. 2•1137

For info on price: L. Cartelli; Application info: J. Muller; Customer service: N. Pennetti; Delivery info: T. Rade

Products manufactured: Annunciators, Antenna Switching Matrices, Boards, Plug-In, Boards, Programming, Caps, Lenses, Indicator Light, Connectors, Controls/Control Eqpt., Cords, Counters, Display Devices/Displays, Dividers, Generators, Kits, Breadboarding (For Engineers), Kits, Programming Board, Lamp Adapters, Lamps, Lights, Matrices, Computer, Monitors, Panels, Pins, Receivers, Services, Assembly, Production & Test, Sockets, Switchboards, Switches, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, Dyna Sls. Co.	213-268-1175
Colo	Denver, Franklin Sls. Co.	303-922-3623
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Springfield, Service & Technology	201-232-2666
NY	Farmingdale, Service & Technology	516-694-7330
Pa	Phila., V.S. Malta	215-836-5122
Wash	Seattle, W. Spaulding Co.	206-282-9173

LYON METAL PRODUCTS, INC., 47 Railroad Ave., Aurora, Ill., 60507, Tel: 312-892-8941; Empl.: 1200

For info on price: J. Jurgelonis; Application info: M. Miller; Customer service: S. Thompson; Delivery info G. Anderson

Free literature available: Catalog 100-B - illustrates and describes the entire Lyon steel equipment line Catalog 200-A - pictures and descriptions of Lyon office furniture.

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Racks

Local Sales Offices & Reps.

Cal	Los Angeles	213-330-2261
Cal	San Francisco	415-347-7067
DC	Washington	703-683-2755
Ga	Atlanta	404-237-9205
Ill	Chicago	312-263-4255
Mass	Boston	617-825-0100
Mich	Detroit	313-352-5860
Minn	Minneapolis	612-927-5695
Mo	Kansas City	816-363-6801
NY	New York City	212-695-5441
NY	Syracuse	315-478-0947
NC	Charlotte	704-527-0410
Ohio	Cincinnati	513-221-4688
Ohio	Cleveland	216-241-3535
Pa	Philadelphia	215-687-6232
Pa	Pittsburgh	412-344-5577
Tenn	Memphis	901-682-9664
Tex	Dallas	214-691-7341

3M CO., See Listing Under Letter "T"

M-TRON INDUSTRIES, Box 630, 100 Douglas St., Yankton, S.D., 57078, Tel: 605-665-9321, TWX: 910-668-3603; Empl.: 500; Minimum order: $15
p. 1•383

Customer service: Sales Dept.

Free literature available: A guide and catalogue to specify M-Tron crystals.

Products manufactured: Crystal Blanks, Crystals, Holders, Crystal

Local Sales Offices & Reps.

Cal	Los Alamitos, Anderson Assocs.	213-596-2313
Cal	Los Angeles, Wallace & Wallace	213-747-0401
Cal	Redwood City, Logan Sls.	415-369-6726
Cal	San Diego, Celtec Co.	714-279-7961
Colo	Denver, McLoud & Raymond	303-756-1589
Conn	Meridan, P.R. Sturgeon Co.	203-237-1112
Fla	Indian Rocks Beach, Tech-Rep Assocs.	813-595-2834
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Fla	Tampa, Hutto-Hawkins-Peregoy	813-837-2512
Ga	Atlanta, Millar Elctrns.	404-261-6160
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Ind	Fort Wayne, Given Corp.	219-432-5585
Ind	Indianpolis, Kingston Sharkey & Assoc.	317-353-9406
Iowa	W. Des Moines, T.L. Dowell & Assoc.	515-255-6583
Kans	Overland Park, T.L. Dowell & Assoc.	913-649-6069
La	Chalmette, Cartwright & Bean	504-279-4598
Md	Silver Spring, Mid-Atlantic Sls.	301-593-7749
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Mass	Lexington, J.E. Boeing Co.	
Mich	Benton Harbor, McNabb & Assoc.	616-925-2166
Miss	Jackson, Cartwright & Bean	601-981-1368
Mo	Shrewsbury, T.L. Dowell & Assoc.	314-647-7067
NY	Elmont, F.E. Schmitt Co.	516-437-8150
NY	Huntington Station, Addem I	516-567-5900
NC	Raleigh, Millar Elctrns., Inc.	919-787-9564
Ohio	Columbus, Weller Elctrnc. Sls.	614-885-7819
Ohio	Dayton, BEK Assoc.	513-278-1343
Ore	Salem, M.K. Widdekind Co.	503-363-6445
Pa	Glenside, Elcom, Inc.	215-885-1325
Pa	Laverock, M. Weinberg Assoc.	215-549-1122
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Wash	Seattle, M. Stobin Co.	206-772-2121
Wash	Seattle, Pacnor Mktg.	206-284-8020

MAC PANEL CO., Box 5027, 215 Church Ave., High Pt., N.C., 27262, Tel: 919-882-8138; Empl.: 20

Products manufactured: Boards, Plug-In, Boards, Programming, Connectors, Cords, Matrices, Computer, Panels, Services, Assembly, Production & Test, Tape Recording Accessories, Tapes, Recording, Magnetic (All Types), Tools

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs., Inc.	205-536-1941
Ariz	Phoenix, Zeus, Inc.	602-258-7519
Cal	Los Altos, Casey Associates	415-941-6892
Cal	Los Angeles, Costello, Little & Co.	213-870-5951
Colo	Denver, Zeus, Inc.	303-771-6200
Fla	Bradenton, Reynolds & Assocs., Inc.	813-778-5219
Fla	Ft. Lauderdale, Reynolds & Assoc., Inc.	305-581-6611
Fla	Melbourne, Reynolds & Assocs., Inc.	305-727-3205
Ga	Atlanta, Reynolds & Assocs., Inc.	404-252-5360
Ill	Chicago, Megatek, Inc.	312-889-1277
Md	Rockville, J.J. Wild	301-424-8490
Mass	Needham, J.J. Wild, Inc.	617-444-2366
Mich	Detroit, B. Hocker & Assocs.	313-531-1403
Minn	St. Paul, Bonament Heyda Co.	612-484-8531
NJ	Mendham, J.J. Wild	201-543-4782
NM	Albuquerque, Zeus, Inc.	505-256-9831

NY	Hastings on Hudson, J.J. Wild, Inc.	914-963-3803
NY	Jericho, J.J. Wild, Inc.	516-935-6600
NC	High Point, Mac Panel Co.	919-882-8138
Ohio	Cleveland Heights, B Nocker & Assocs.	216-932-0984
Ohio	Dayton, B. Hocker & Assocs.	513-298-8638
Ore	Portland, J J Backer Co.	503-297-3776
Pa	Southampton, J.J. Wild, Inc.	215-357-6645
Tex	Dallas, K.O. Brown & Co.	214-357-3996
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Seattle, J.J. Backer Co.	206-285-1300

MACDONALD & CO., 213 S. Brand Blvd., Glendale, Calif., 91204, Tel: 213-241-1101, TWX: 910-497-4782; Empl.: 18

Customer service: D. W. MacDonald

Free literature available: Production tools for electronic assembly

Products manufactured: Adhesives (All Types), Chemicals, Clamps & Clips, Cleaners, Ultrasonic, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Drivers, Nut, Heat Guns, Production, Heat Sinks, Soldering, Holders, Circuit Board (Production Type), Jigs And Fixtures, Chassis & Circuit Board, Knives & Knife Sets, Lamps, Lubricants, Pliers, Scissors, Screwdrivers, Solder (All Types), Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Testers, Tools, Tweezers, Hand & Vacuum, Wire Twisters, Wrenches

Local Sales Offices & Reps.

Cal	Sunnyvale, Wyman Engrg. Sls.	408-735-0598
Colo	Denver, Soldering Supply Specialists	303-455-0104
Ill	Chicago, EMF Co.	312-889-8323
Ind	Indianapolis, Blind & Assoc.	317-251-1249
Md	Baltimore, D. K. Jones & Assoc.	301-752-0577
Mich	Grand Rapids, C. A. Geer Co.	616-534-9449
Minn	St. Paul, Ragon Elctrns.	612-488-0201
Mo	Kansas City, Burke Sls. Co.	816-842-5511
NJ	Haddonfield, Mills Equip. Co.	609-429-1005
NY	New York, Van Valkenburg Assoc.	212-254-3722
NC	Winston-Salem, Kirkman Elctrns.	
Ohio	Cleveland, P. Lohse Co.	216-381-4424
FOR:	Can., Brossard, P.Q., Gammon Ind'l	819-861-6177
FOR:	Can., Vancouver 2, B.C., RAE Industrial Electronics	

MACHINE COMPONENTS CORP., 70 Newtown Rd., Plainview, N.Y., 11803, Tel: 516-694-7222; FSC No: 15531; Empl.: 20

For info on price: D. L. Dubov; Application info: D. L. Dubov; Customer service: R. Kanter; Delivery info: R. Kanter

Free literature available: Catalog #18 - Describes standard stock clutches brakes, couplings - torques to 20 in. lb. Catalog #19 - Intermittent motion devices, electromechanical. Catalog #20 - X and XY axis joy stick toggle switches

Products manufactured: Brakes, Clutches, Counters, Couplings, Drives & Drive Mechanisms (Dial), Electronic Switches (Oscilloscope), Gears & Gear Mechanisms (Precision), Index Assemblies, Switch, Shafts & Adapters, Switches

Local Sales Offices & Reps.

Cal	San Jose, McFarland Assoc.	408-286-9333
Ind	Indianapolis, Pacer Sls. & Eng'g Co.	317-849-1481
Mass	Woburn, Stockwell Technical Sls. Co.	617-935-5770
Wash	Mercer Island, J. H. Andersen Assoc.	206-232-0484

MACRODATA, 6203 Variel Avenue, Woodland Hills, Cal., 91364, Tel: 213-887-5550; Empl.: 125

Products manufactured: Semiconductor Wafer Fabrication, Testers

MACRODYNE INC., 1900 Maxon Rd., Box 1079, Schenectady, N.Y., 12301, Tel: 518-372-5619; Empl.: 16; Minimum order: $25

Customer service: D.J. Antos

Free literature available: ERDAC III Brochure 2 MACHINE MINDER Transducer Brochure-monitoring the power spectrum to control process variables. 3 Laser Dopler Velocimeter Brochure-precise, non-contact measurement techniques for high speed fluid flow applications in wind tunnel & turbine research.

Products manufactured: Analyzers, Converters, Counters, Current Sensors, Data Acquisition & Reduction Systems, Lasers & Laser Systems, Memories, Buffer, Memory Systems, Meters, Oscilloscopes, Process Control Systems, Recorders, Services, Assembly, Production & Test, Testers, Transducers

MADISON LABORATORIES, Box 608, Madison, Conn, 06443, Tel: 203-245-4280; Empl.: 8; Minimum order: $15

For info on price: M.S. MacDonald; Application info: D. H. MacDonald; Customer service: D.H. MacDonald; Delivery info: M. S. MacDonald

Free literature available: Product Reference Guide - small brochure listing our level switches and solid state controls

Products manufactured: Controls/Control Eqpt., Relays, Switches

Local Sales Offices & Reps.

Cal	Glendale, James L. McCoy Co.	213-246-2134
NY	New York City, Mc Intosh EquiP. Corp.	212-349-3288
Pa	Philadelphia, Technicraft Co.	215-182-2323
Tenn	Memphis, Engineered Instr	901-743-3402

MAG-CON, INC., 85-2nd Ave. S.E., New Brighton, Minn., 55112, Tel: 612-633-8820, TWX: 910-576-3116; Empl.: 150; Minimum order: $15

Customer service: M. Lorge 612-633-5892

Free literature available: Bulletins on: Temp. monitoring equipment; Resistance temp. detectors for above; Resistance sensing power relays; Rotary speed sensors & monitors; Portable, hand-held temp. meter; Facilities & service related to manufacture of custom magnetics.

Products manufactured: Alarms, Amplifiers, Chargers, Battery, Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Current Sensors, Demagnetizers, Detectors, Eliminators, Battery, Inverters, Magnetizers, Meters, Monitors, Power Supplies, Probes, Reactors, Regulators, Relays, Services, Assembly, Production & Test, Switches, Tachometers, Transducers, Transformers

Local Sales Offices & Reps.

Ariz	Tucson, Gar Kachel Co.	602-795-5202
Cal	Altadena, D. Murray Entprs.	213-681-5031
Cal	San Francisco, Tech. Sls. Dev. Co.	415-346-1655
Fla	Orlando, Fluid Scientific, Inc.	305-851-5310
Md	Wheaton, Magyar & Assocs.	301-871-8833
Mass	Allston, Magyar & Assocs.	617-566-9759
NJ	Middlesex, Magyar & Associates	201-752-4848
Ohio	Brecksville, A. Nace Co.	216-526-4323
Pa	Philadelphia, Magyar & Assocs.	215-763-5044
Pa	Pittsburgh, A. Nace Co.	412-922-7225
Tex	Houston, R & K Engrg. & Sls., Inc.	713-465-8367
Wisc	Cedarburg, T.F.L. Assocs.	414-377-7030

MAGIC DOT, 3361 Republic Ave., Minneapolis, Minn., 55426, Tel: 612-925-4410, TWX: 910-576-3477; Empl.: 18

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Murcota	205-539-8476
Ariz	Phoenix, Thorson Co..	602-956-5300
Cal	Burlingame, Brooks Tech. Group	415-374-5411
Cal	Downey, Trimarco	213-861-8244
Cal	San Diego, W. Hadden Assocs.	714-565-9444
Colo	Denver, Thorson Co.	303-355-3521
Conn	Hamden, Kanan Assocs.	203-288-9276
Fla	Clearwater, Lynch-Gentry	813-443-2697
Fla	Winter Park, Lynch-Gentry	305-671-7649
Ill	Chicago, Croydon Elctrn. Inc.	312-781-3900
Ind	Fort Wayne, S & S Elctrns. Inc.	219-743-4611
Iowa	Cedar Rapids, Technical Reps. Inc.	319-363-2489
Md	Baltimore, Compar Chesapeake, Inc.	301-484-5400
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Utica, N. Case Assocs.	313-781-3900
Minn	Minneapolis, C. Bohlig Co..	612-922-7011
Mo	Hazelwood, Technical Reps.	314-731-5200
Mo	Independence, Technical Reps.	816-737-1414
NJ	Clifton, Compar N. Y., Inc.	201-546-3660
NJ	Haddonfield, S. O'Brien	609-429-1526
NY	Albany, Compar Albany	518-489-7408
NY	Endwell, Compar Albany	607-723-8743
NY	Fairport, Compar Albany	716-271-2230
NY	Liverpool, Compar Albany	315-471-3356
NC	Winston-Salem, Murcotta	919-723-1002
Ohio	Centerville, N. Case Assocs.	513-435-1301
Ohio	Fairview Park, N. Case Assocs.	216-333-4120
Tex	Dallas, Allied Comps.	214-238-0408
Tex	Houston, Allied Comps.	713-782-5406
Wash	Bellevue, SDR2 Prods. & Sls.	206-747-9424

MAGITRAN CO., 311 E. Park St., Moonachie, N.J., 07074, Tel: 201-641-3650, TWX: 710-990-5064; Empl.: 100; Minimum order: $25

For info on price: J. Grieg; Application info: J. Crompton

Free literature available: Poly-Planar Speaker Products, Poly-Planar Speaker Application Data

Products manufactured: Speaker Systems, Speakers

Local Sales Offices & Reps.

Ala	Birmingham, Maitland Smith	205-967-3080
Cal	No. Hollywood, M. Stobin Co.	213-983-1555
Cal	San Mateo, Olson Sls.	415-347-7071
Conn	Waterbury, J. Sequenzia	203-753-2487
Fla	Miami, Raulson & Co.	305-264-6003
Ga	Marietta, Maitland Smith	404-971-2831
Ill	Chicago, Lassers & Co.	312-539-0170
Kans	Prairie Village, N. Spencer Assoc.	913-432-3700
Ky	Campbellsville, R. B. Herron Assoc.	502-465-5631
Md	Kensington, Forti-Austin Assoc.	301-949-1706
Mo	St. Louis, N. Spencer Assoc.	314-994-1916
Neb	Omaha, N. Spencer Assoc.	402-393-6574
NJ	Englewood, J. Bressler Co.	201-569-7600
NJ	Willingboro, Forti-Austin Assoc.	609-871-9290
NY	New York, J. Bressler Co.	212-564-4105
NY	Yonkers, J. Brown Sls.	914-779-7330
NC	Charlotte, Maitland Smith	704-372-1026
Ohio	Dayton, S. McWilliams	513-277-9245
Pa	Meadville, D. Hilliard Assoc.	814-336-3443
Tex	Houston, Ranger Elctrns.	713-626-1432
Wash	Seattle, K. Bolster Sls.	206-772-2121
Exp.	N.Y., N.Y., Auriema Inc.	212-466-2500

MAGNECRAFT ELEC. CO., 5575 N. Lynch Ave., Chicago, Ill., 60630, Tel: 312-282-5500, TWX: 910-221-5221; Empl.: 400; Minimum order: $50

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For info on price: D. Didricksen; Application info: W. Greenwood; Customer service: W. Greenwood; Delivery info: D. Nordquist

Free literature available: Over 1060 stock relays for custom application. This 36 page, 2 color catalog includes photos, prices, ordering information, drawings, and specifications.

Products manufactured: Relays, Sockets

Local Sales Offices & Reps.

Ala	Huntsville, BJR Research & Mfg.	205-881-3569
Ariz	Phoenix, Gramer & Co.	602-279-1231
Cal	Los Angeles, Universal Comp. Corp.	213-641-4255
Cal	San Carlos, Kottmeier Assoc.	415-592-8333
Colo	Denver, Camel Elctrn. Inc.	303-757-6191
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
Fla	Altamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assoc.	813-447-2538
Fla	Pompano Beach, WMM Assoc.	305-943-3091
Ga	Duluth, BJR Research & Mfg	404-476-1453
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Ft. Wayne, Menze Sls. Inc.	219-747-5616
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Detroit, R.P. Urban & Assoc.	313-535-2355
Mich	Grand Rapids, R.P. Urban & Assoc.	616-245-0511
Minn	Minneapolis, S. Johnson Inc.	612-925-2111
Mo	Kansas City, K & M Sales	816-471-1355
Mo	St. Louis, K & M Sales	314-423-2420
NH	Dover, R. Perron & Co.	603-742-2321
NJ	South Orange, S. Simberkoff & Assoc.	201-763-7900
NY	New York, S. Simberkoff & Assoc.	212-943-7023
NY	Syracuse, W. A. Franklin Sls	315-472-5273
NC	Burlington, S. Simberkoff & Assoc.	919-584-6450
Ohio	Cleveland, Weschler Electric Corp.	216-251-4609
Ohio	Dayton, Weschler Electric Corp.	513-274-6972
Okla	Tulsa, H.J. Daly Co.	918-627-4159
Ore	Portland, Earl & Brown Co.	503-245-2283
Pa	Bristol, S. Simberkoff & Assoc.	215-785-1132
Tex	Dallas, Evans-McDowell Assocs.	214-238-7157
Tex	Dallas, McKinney Sls.	214-631-9450
Wash	Seattle, Earl & Brown Co.	206-284-1121
Exp:	Chicago, Ill., Magnecraft Int'l.	312-282-5500
For:	Can., EtoBicoke, Ont., C.A. Pipe & Assocs.	416-622-3403
For:	Can., Montreal, Que., Vitel Elctrns.	514-331-7393

Local Distributors
Ala Andalusia, Wholesale Elctrn Supply Co., Box 1437 ... 205-222-5100
Ala Birmingham, M G. Elctrn & Equip Co., 3112 6th Ave. S. ... 205-328-4525
Ala Huntsville, Hall-Mark Elctrns, Box 1133 205-539-0691
Ariz Phoenix, Dalis Elctrns Supply Inc., 917 N. 7th St. 602-258-8151
Ariz Phoenix, Kierulff Elctrns, 2633 E. Buckeye Rd 602-273-7331
Ariz Phoenix, Parts Elctrns., 1310 7th St. 602-258-6476
Cal Burlingame, Rose Elctrns, 846 Stanton Rd. 415-697-0224
Cal Emeryville, B & B Distributors, 1400 62nd St. 415-843-3254
Cal Garden Grove, Allied Elctrns of Cal. Inc., 12821 Knott Ave. ... 714-894-7581
Cal Hollywood, Hollywood Radio & Elctrns, 5250 Hollywood Blvd. ... 213-466-3181
Cal Inglewood, Newark Elctrns, 4747 W. Century Blvd. ... 213-678-0441
Cal Los Angeles, Kierulff Elctrns, 2585 Commerce Way ... 213-685-5511
Cal Palo Alto, Kierulff Elctrns, 3969 E. Bayshore Rd. 415-968-6292
Cal Sacramento, Sacramento Elec., 1219 South St. 916-441-4821
Cal San Diego, Kierulff Elctrns, 8797 Balboa 714-278-2112
Cal Sun Valley, Q.C. Components, Inc., 8913 Lankershim Blvd. ... 213-768-6111
Cal Sunnyvale, Bell Industries, 1161 N. Fairoaks, Box 8050 ... 408-734-8570
Colo Aurora, Jet Elctrns, 1447 Florence St. 303-364-1000
Colo Denver, Fistells Elctrns Supply Co., 1001 Bannock ... 303-244-4691
Conn East Hartford, R & S Electronics, 95 Leggett St. 203-528-6581
Conn Stratford, State Elctrns Parts Corp., 1269 Barnum Ave. ... 203-375-5961
Fla Miami, Electronic Equip Co., Inc., 2701 N.W. 42nd Ave. ... 305-871-3500
Fla Orlando, Hall-Mark Elctrns, 7233 Lake Ellenor Dr. 305-855-4020
Fla Tampa, Lykes Elctrns, 5426 W. Crenshaw, P.O. Box 24047 ... 813-886-6621
Ga Atlanta, Ack Radio Supply Co., 554 Deering Rd., N.W. ... 404-351-6340
Ga Chamblee, Lance Engrg Inc., 2080 Peachtree Ind. Ct. ... 404-458-6286
Haw Honolulu, Electrical Equip. Co., 656 Queen St. 808-533-3884
Ill Alton, Ebinger Radio Inc., 1155 Broadway, Rear Ct. ... 217-462-9783
Ill Chicago, Allied Elctrns Corp., 2400 W. Washington Blvd. ... 312-421-2400
Ill Chicago, Newark Elctrns Corp., 500 N. Pulaski Rd. ... 312-638-4411
Ill Decatur, York Radio & TV Corp., 590 N. Broadway ... 217-423-3484
Ill Elk Grove Village, Hall-Mark Elctrns, 180 Crossen Ave. ... 312-437-8800
Ill Mt. Prospect, Cramer Electrns, 1911 Busse Rd. 312-593-8230
Ill Peoria, Klaus Radio & Elec. Co., 8400 N. Pioneer Pkwy. ... 309-691-4840
Ind Evansville, Hutch & Son, 300 N. Main St. 812-425-7201
Ind Fort Wayne, Fort Wayne Elctrns, 3606 E. Maumee Ave. ... 219-423-3422
Ind Indianapolis, Graham Elctrns Supply, Inc., 133 S. Pennsylvania St. ... 317-634-8202
Iowa Cedar Rapids, Deeco Inc., 2500 16th Ave. S.W. 319-365-7551
Iowa Cedar Rapids, Iowa Radio Supply Co., 719 Center Pt. Rd. N.E. ... 319-364-6154
Kan Lenexa, Hall-Mark Elctrns, 9006 Rosehill Rd. 913-888-4747
Kan Wichita, Radio Supply Co., 115 Laura 316-267-5216
La Baton Rouge, Davis Wholesale Elctrn Supply Co., 3575 Choctaw Dr. ... 504-357-6427
La LaFayette, Ralph's of LaFayette, Inc., 3004 Cameron St. ... 318-234-4507
La New Orleans, Lykes Elctrns, 3308 Orleans Ave. 504-486-7441
Md Baltimore, Hall-Mark Elctrns, 6660 Security Blvd. 301-285-8500
Md Baltimore, Radio Electric Service Co. of Baltimore, Inc., 1026 Cromwell Bridge Rd. 301-823-0070
Md Rockville, Pioneer Washington Elctrns, 1037 Taft St. ... 301-424-3300
Mass Boston, DeMambro Elctrns, 1095 Commonwealth Ave. ... 617-7876-1200
Mass Needham Hts., Kierulff Elctrns, 14 Charles St. 617-449-3600
Mass Newton, Cramer Elctrns, Inc., 85 Wells Ave. 617-969-7700
Mass Woburn, Newark Elctrns, 13A Wheeling Ave. 617-935-8350
Mich Ann Arbor, Wedemeyer Electric Supply Co., 2280 S. Industrial Hwy. ... 313-665-8611
Mich Romulus, Pioneer/Mich, 6337 N. Beverly Plaza 313-729-8500
Minn Minneapolis, Hall-Mark Elctrns, 4555 W. 77th St. 612-925-2944
Mo St. Louis, Hall-Mark Elctrns, 6100 Madison Ave. 314-521-3800
Mo St. Louis, Olive Ind. Elctrns, Inc., 6662 Olive Blvd. 314-863-7800
Mo St. Louis, Vansickle Radio Elec., 1915-17 Washington ... 314-621-5000
Mont Billings, Electronic Supply, 250 Eleventh St. 406-252-2197
Neb Lincoln, Scott Elctrn Supply Corp, 4040 Adams St. ... 402-434-8308
NJ Rutherford, Kierluff Elctrns, 5 Industrial Dr. 201-935-2120
NM Albuquerque, Kierulff Elctrns, 2524 Baylor Dr. S.E. ... 505-247-1055
NY Albany, E.E. Taylor Co., 465 Central Ave. 518-438-4461
NY Buffalo, Standard Elctrns, Inc., 3519 Union Rd. 716-685-4220
NY Buffalo, Summit Distributors, 916 Main St. 716-884-3450
NY E. Farmingdale, Harrison Elctrns Corp., 20 Smith St. ... 516-293-7990
NY Farmingdale, Hall-Mark Elctrns, 167 Marine St. 516-293-7500
NY Lynbrook, Peerless Radio Corp., 19 Wilbur St. 516-593-2121
NY Mt. Vernon, QAR Industrial Elctrns Sls, Inc., 621 S. Columbus Ave. ... 914-699-2224
NY Rochester, Rochester Radio Supply Co., 140 W. Main St. ... 716-454-6300
NY Rochester, Simcona Elctrns Corp., 275 Mt. Read Blvd. ... 716-328-3230
NY Syosset, Lafayette Radio, 111 Jericho Tpk 516-921-7700
NC Concord, MacVictor Elctrn Supply, Box 3236, Hwy. 29 + Florence Ave. ... 704-786-4175
NC Gastonia, United Electronic Supply Co. of Gastonia, Inc., 805 W. Airline Ave. 704-867-4401
NC Raleigh, Hall-Mark Elctrns, 3000 Industrial Dr. 919-832-4465
NC Winston-Salem, Kirkman Elctrns, Inc., 901 W. 2nd St. ... 919-724-0541
Ohio Cleveland, W. Pattison Supply Co. 4550 Willow Pkwy., (Cuyahoga Heights) ... 216-441-3000
Ohio Columbus, Hughes-Peters Inc., 481 E. 11th Ave. 614-294-5351
Ohio Dayton, ESCO Inc., Crane St. ... 513-224-9192
Okla Oklahoma City, Electronic Supply Co., 212 N.W. 10th St. ... 405-232-5215
Okla Tulsa, Hall-Mark Elctrns, 4846 S. 83rd E. Ave. 918-835-8458
Okla Tulsa, S & S Radio Supply, 537 S. Kenosha 918-582-8242
Ore Portland, Almac/Stroum, 8888 S.W. Canyon Rd. 503-292-3534
Ore Portland, North Coast Electric Co., 625 N.W. Evertt St. ... 503-228-5111
Pa Huntingdon Valley, Hall-Mark Elctrns, Box 125 215-355-7300
Pa Philadelphia, Simco Elctrns, Inc., 3907-11 N. Broad St. ... 215-229-1880
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-288-2600
RI Providence, W. Dandreta & Co., 28 Wolcott St. 401-861-2800
RI Warwick, W.H. Edwards, Inc., 55 Electronic Dr. 401-781-8000
SC Charleston, Wholesale Radio Supply Co. 515 E. Bay St. ... 803-722-2634
SC Greenville, Sawyer Elctrns, 1210 Poinsett Hwy 803-235-0438
Tenn Chattanooga, Curle Elctrns, 1813 S. Market St. 615-266-4728
Tenn Kingsport, Radio Electric Supply Co., 961 E. Sullivan St. Box 827 ... 615-247-8111
Tenn Nashville, Electra Distributing Co., 1914 W. End Ave. ... 615-329-3971
Tex Dallas, Hall-Mark Elctrns, 9333 Forest La. 214-231-6111
Tex Fort Worth, Allied Elctrns, 401 E. 8th St. 817-336-5401
Tex Garland, Newark Elctrns, 707 Easy St. 214-271-2511
Tex Houston, Altair Co., 9501 Baythorne Dr. 713-462-3029
Tex Houston, Hall-Mark Elctrns, Box 42190 713-781-6100
Tex Houston, Newark Elctrns, 6902 Harwin Dr. 713-782-4800
Tex Odessa, Automation Eng. Suc., Inc., 2310 Steven Rd. ... 915-362-7391
Tex Richardson, Altair Co., Box 26, 405 N. Plano Rd. 214-231-5166
Tex Stafford, Southwest Elctrns, Inc., 12725 Royal Dr., Box 848 ... 713-494-6021
Tex Waco, Hargis Co., 1205 Washington Ave. 817-754-5667
Utah Salt Lake City, Stuart Electric Supply Co., 2999 S. 300 West ... 801-466-8605
Utah Salt Lake City, W.H. Bintz, 433 W. 3rd South 801-363-5821
Va Arlington, Arlington Elctrns Wholesalers, Inc., 3636 Lee Hwy. ... 703-524-2412
Va Richmond, Meridian Electric, 1001 W. Broad St. 703-355-6521
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave. S. ... 206-763-2300
Wash Tacoma, Consolidated Electrical Distributors (Love Electric Co.), 1914 Market St. 206-383-5981
Wisc Appleton, Electronic Expeditors, 1037 W. Wisconsin Ave. ... 414-731-4187
Wisc Mequon, Taylor Electric Co., 1000 W. Donges Bay Rd. ... 414-241-4321
Wisc Milwaukee, Hall-Mark Elctrns, 11925 W. Ripley Ave. ... 414-476-1270

MAGNET WIRE INC., 25 Walker St., New York, NY, 10013, Tel: 212-226-0900; Empl.: 6; Minimum order: $15

Customer service: J. Wasserman

Products manufactured: Cable

MAGNETEC CORP., A Hi-G Subsidiary, 96 Granby St., Bloomfield, Conn., 06002, Tel: 203-243-8941, TWX: 710-420-0592; Empl.: 55 ... p. 1•1708-1713

Products manufactured: Solenoids

Local Sales Offices & Reps.
Ala Huntsville, Interep Assoc. ... 205-881-3677
Ariz Scottsdale, Fryco ... 602-945-3281
Cal Mountain View, G. C. Woempner Co. 415-964-5454
Cal Woodland Hills, Interstate Mktg. Assoc. 213-883-7606
Colo Denver, Omega Ltd. ... 303-758-1508
Conn Fairfield, C. Weber ... 203-259-5386
Fla Coral Springs, Shaw Engrg. & Sls. 305-752-7598
Ga Atlanta, Interep Assocs. ... 404-394-7756
Ill Chicago, Engineered Sls. Co. ... 312-867-8434
Ind Ft. Wayne, Given Corp. ... 219-432-5585
Kans Overland Park, Reese & Assocs. ... 913-648-7748
Kans Wichita, Buse Sls. Co. ... 316-685-8036
Mass Lexington, J. E. Boeing Co. ... 617-862-2500
Mich Grand Rapids, Representatives Elctrn. Prod. 616-942-1320
Mich Southfield, Representatives Elctrn. Prod. 313-354-9066
Minn St. Paul, R. G. Ragon, Inc. ... 612-488-0201
Mo St. Charles, Buse Sls. Co. ... 314-946-6430
NY Binghamton, Canavan-Scanlon Assoc. 607-724-7220
NY Jericho, HRC Comp-Tech, Inc. ... 516-822-5550
NY Rochester, Canavan-Scanlon Assoc. 716-442-0720
NY Syracuse, Canavan-Scanlon Assoc. 315-437-1271
Ohio Cincinnati, Components, Inc. ... 513-721-2997
Ohio Cleveland, Components, Inc. ... 216-842-2737
Ohio Dayton, P. E. Montplaisir ... 513-434-4316
Pa Ardmore, Rothenheber & Wurts, Inc. 215-649-6300
Tex Dallas, United Comps. ... 214-324-1448
Utah St. Lake City, Omega Ltd. ... 801-266-9617
Wash Bellevue, Ruggles Tech. Sls. ... 206-455-2778
FOR: Can., Dorval, Que., Anbak Sls. Can., Ltd. 514-636-8514
FOR: Can., Mississauga, Ont., Anbak Sls. Can., Ltd. 416-625-1061

MAGNETIC CIRCUIT ELEMENTS, 2455A Garden Rd., Monterey, Cal., 93940, Tel: 408-373-0456, TWX: 910-360-7088; FSC No: 09349; Empl.: 24; Minimum order: $15

For info on price: K. Dethlefsen; Application info: J. Conklin; Customer service: K. Dethlefsen; Delivery info: K. Dethlefsen

Free literature available: Complete catalogue of standard parts.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Converters, Inverters, Transformers

Advertisment

MCE offers an extensive line of standard inductors and transformers with package options. These include 60 and 400 Hz transformers, lamination type or toroidal chokes, and precision inductors. Miniature high frequency, high temperature and high voltage units for power supplies are our specialty. Complete catalogue including engineering data and prices on request.

MAGNETIC METALS CO., Hayes Ave. at 21st St., Camden, N.J., 08105, Tel: 609-964-7842, TWX: 710-891-7054; Empl.: 500; Minimum order: $35

For info on price: J. Roche; Application info: G. B. Finke; Customer service: R. L. Breen; Delivery info: R. L. Breen

Free literature available: Transformer lamination catalog; cut core catalog; tape core design manual; ferrite core catalog.

Products manufactured: Cores, Magnetic, Foil, Laminations, Motor & Generator Armatures, Rotors, Stators, Testers

Local Sales Offices & Reps.

Cal	Westminster, Magnetic Metals Co.	714-892-6627
Ill	Chicago, Magnetic Metals Co.	312-437-7440
Minn	Minneapolis, D. G. Perry & Co.	612-920-3212
NC	Bethania, Candor Co.	919-924-1480
EXP:	Philadelphia, Pa., Ballagh & Thrall, Inc.	215-564-4020

MAGNETIC TECHNOLOGY, Vernitron Corp., 21001 Kittridge St., Canoga Pk., Cal., 91303, Tel: 213-887-7700, TWX: 910-494-1217; Empl.: 125 p. 1•971-974

Products manufactured: Actuators, Motors, Tachometers

Local Sales Offices & Reps.

Cal	Los Altos, Servo Data	415-964-1325
Cal	Los Angeles, Halbar	213-387-8283
Conn	Hartford, Aid Engrg. Sls. Co.	203-673-3692
Fla	Cocoa, Orbe Inc.	305-452-9568
Fla	St. Petersburg, Orbe	813-894-0687
Ill	Chicago, Engr. Sls.	312-867-8434
Md	Baltimore, Wilkinson Inc.	301-377-7800
Mass	Westboro, Aid Engrg. Sls. Co.	617-890-8181
Mich	Detroit, A. Blumenberg Assoc.	313-557-1934
Minn	Minneapolis, Revere Assoc.	612-781-2615
Mo	Florissant, Sheridan Assoc.	314-837-5200
NJ	Harrington Pk., Metro Tech.	201-768-8495
NY	Jericho, Metro Tech.	516-935-3330
NY	Pittsford, Magna Sales Corp.	716-586-8748
Ohio	Beachwood, Sheridan Assoc.	216-831-0130
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Dayton, Sheridan Assoc.	513-277-8911
Pa	Glenside, R.L. Wilkinson, Inc.	215-424-8400
Pa	Pittsburgh, Sheridan Assoc.	412-244-1640

MAGNETICO, INC., 182 Morris Ave., Holtsville, N.Y., 11742, Tel: 516-654-1166; Empl.: 45 p. 2•1770

For info on price: H. Eicher; Application info: Ch. Engr.; Customer service: T. Sullivan

Products manufactured: Amplifiers, Bobbins, Winding, Coil & Transformer, Chokes, Coils Including Assemblies & Forms, Converters, Decade Boxes, Filters, Inverters, Networks, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Mass Brookline, Technology Prods. Group

MAGNETICO, INC. cont'd

Advertisment

Magnetico Manufactures a complete line of laminated and toroidal transformers. A complete line of precision Scott "T" and reference transformers for use in solid state synchro to digital and digital to synchro converters. Other standard products include power transformers, inductors, inverter transformers, DC to DC converter transformers, ratio transformers, pulse, wide band and hybrid transformers.

MAGNETICS, Div/Spang Industries, Inc., Box 391, Butler, Pa., 16001, Tel: 412-285-4711, TWX: 710-373-3821; Empl.: 650

For info on price: E. J. McClellan; Application info: R. G. Noah; Customer service: E. J. McClellan; Delivery info: E. J. McClellan

Products manufactured: Alloys, Cores, Magnetic, Ferrite Material & Parts, Foil, Laminations, Metal Compounds, Foils, Powders, Sheet, Stock, Seals, Shields, Wire

Local Sales Offices & Reps.

Cal	S. El Monte, J. A. McMillin	213-686-0920
Cal	San Jose, L. J. Anglin	408-253-0591
Colo	Arvada, B. P. Brenner	303-420-3927
Fla	St. Petersburg, D.A. King	813-896-4420
Ill	Chicago, H.G. Pretat	312-255-6011
Mass	South Deerfield, B.E. Gray	413-665-2225
Minn	Hopkins, F. Peterson Co.	612-941-5400
NY	Rochester, Fowler-Beach Corp.	716-586-0468
NC	Greensboro, E.A. Siebenaler	919-288-0053
Ohio	Findlay, H.A. Beck	419-424-0592
Pa	Doylestown, F.A. Sank	215-794-7312
RI	Westerly, T. G. Fitch	401-322-8844
Tex	Garland, F.H. Hall	214-272-5697
EXP:	New York, N.Y., B. Freudenberg, Inc.	212-757-9130
FOR:	Can., Agincourt, Ont., F. P. Taylor, Ltd.	416-291-6538

MAGNETICS, DIV. OF SPANG INDUSTRIES, INC., Ind'l. Control Div., Sandy Lake, Pa., 16145, Tel: 412-376-7515, TWX: 510-461-3334; Empl.: 150

Application info: S. Barretta; Delivery info: L. Hughes

Products manufactured: Amplifiers, Controls/Control Eqpt., Power Supplies, Reactors, Regulators, Transformers

MAGNOS, INCORPORATED, Old School House Rd., Harvard, Mass., 01451, Tel: 617-456-8880; Empl.: 4

For info on price: S. Cohen 617-484-8680; Application info: S. Cohen 617-484-8680; Customer service: A. H. Fredrick 617-456-8880; Delivery info: A. H. Fredrick 617-456-8880

Free literature available: GAUSSMETERS - Solid State Hall effect magnetic field snrength meters; HALL PROBES - Transverse, Axial and special probes; FLUXMETERS - Discrete scale and digital scale instruments for general purpose or laboratory measurement. Electrical output on all models; SPECIAL COILS - For determination of intrinsic or extrinsic material properties. Field generating coils, Helmholtz or simple solenoids; MATERIAL TEST SYSTEMS - Hysteresigraphs for BH loop tracing of hard and soft materials. Thin film BH loopers; QUALITY CONTROL EQUIPMENT - Coercivity and Remanence systems for hard or soft materials. Production oriented with digital readout and printout optior; DEMAGNETIZERS and MAGNETIZERS - Tool and material demagnetizers and electro-magnetic magnet chargers.

Products manufactured: Coils Including Assemblies & Forms, Demagnetizers, Indicators, Magnetizers, Magnets, Meters, Power Supplies, Testers

Local Sales Offices & Reps.

Cal	San Carlos, Electronic Engrg Assocs.	415-593-2189
Mass	Belmont, Electronic Comps. & Svcs.	617-484-8680

MAGNOS, INCORPORATED cont'd

Advertisment

Specialists in instrumentation for; Magnetic Measurement, Magnetic Material Tests, Quality Control Systems. Manufacturer of Fluxmeters, Hall Gaussmeters, Coercivity Meters, Electromagnets and associated Power Supplies. Solenoids, Helmholtz Coils and Material Test Coil Sets to specifications.

MAGNUM ELEC. CORP., Drawer 247, 6385 Dixie Hwy., Erie, Mich., 48133, Tel: 313-848-2555; Empl.: 75; Minimum order: $25

For info on price: A. Gonzales; Application info: F. Wojcik; Customer service: A. Gonzales; Delivery info: A. Gonzales

Free literature available: Magstrip catalog - barrier strips - how to order - suggested applications - options optional hardware, quick connects, marking, mounts, colors, jumpers, screws, new products

Products manufactured: Connectors, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Cal	Fremont, H.K. Foraker Co.	415-657-2213
Cal	Lynwood, D. West & Assocs.	213-636-6124
Conn	East Haven, Eagle Assocs.	203-235-9036
Fla	Ft. Lauderdale, R.I. Smith Assocs.	305-772-5100
Fla	Largo, R.I. Smith Assocs.	813-585-2980
Ill	Des Plaines, Control Sls.	312-296-5595
Ind	Ft. Wayne, Baehr, Greenleaf & Assocs.	219-447-1608
Mich	Utica, E.H. Hufferd Co.	313-731-6003
Minn	Minneapolis, E. Melius Assocs.	612-854-4270
NJ	Haddonfield, TAI Corp.	215-627-6615
NY	Great Neck, Frank Tylinski Co.	516-466-9070
NY	Rochester, E.J. Schomburg Co.	716-244-0920
Ohio	Cincinnati, Baehr, Greenleaf & Assocs.	513-891-3826
Ohio	Cleveland, Baehr, Greenleaf & Assocs.	216-221-9030
Ohio	Columbus, Baehr, Greenleaf & Assocs.	614-486-4046
Tenn	Greenvale, ACM Southeast	615-639-9141
Wisc	Milwaukee, Control Sls.	414-964-3322

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Local Distributors

Cal	Fremont, Terminal Sales, 40970 Fremont	415-656-7722
Minn	Minneapolis, Control Design, 3433 E. 25th St.	612-721-1629

MAGNUSONIC DEVICES, INC., 290 Duffy Ave., Hicksville, N.Y., 11801, Tel: 516-938-4700, TWX: 510-221-1850; Empl.: 200

For info on price: K. A. Both; Application info: A. Garamy; Customer service: K. A. Both; Delivery info: K. A. Both

Free literature available: 7 and 9 track IBM compatible heand (all speeds), flying heads, floppy disc and cassette/cartridge heads.

Products manufactured: Heads, Recording Playback, Erase

Local Sales Offices & Reps.

Cal	Covina, DCM Assocs.	213-331-7114
Mass	Burlington, New England Tech. Sls. Co.	617-272-0434
Tex	Dallas, Evans & McDowell Assocs.	214-238-7157

MAIN ELECTRNS., INC., 225 Ida, Wichita, Kan., 67211, Tel: 316-267-3581; Empl.: 10

Products manufactured: Dials, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Kans	Shawnee Mission, Main Elctrns.	913-362-2121

MAJOR DATA CORP., 1796 Monrovia Ave., Costa Mesa, Cal., 92627, Tel: 714-646-2455; Empl.: 10

Customer service: B. Sears

Products manufactured: Annunciators, Computers, Display Devices/Displays, Tubes

Local Sales Offices & Reps.

Cal	Montebello, Tucul Engrg. Co.	213-728-7397
Cal	Santa Anna, Shelly Assocs.	714-540-9330
D.C.	Wash, Arco Engrg.	202-393-5991

Ill	Chicago, Engineered Sls. Co.	312-867-8434
La	New Orleans, I B L Engrg. & Sls., Inc.	504-895-4793
Mass	Newton Upper Falls, Brookdale/Elctrns. Engrg.	617-244-6969
NJ	Haddonfield, Gray Assocs.	609-429-5300
NY	Fayetteville, M. P. Andrews, Inc.	315-637-5291
NY	Scarsdale, Bassin Tech. Sls. Co.	914-723-3334
Ohio	Dayton, Ashby Assocs., Inc.	513-252-5627
Tex	Dallas, I B L Engrg. & Sls., Inc.	214-363-2921
Tex	Houston, I B L Engrg. & Sls., Inc.	713-781-5171
FOR:	Can., Montreal, Que., Electrodesign, Ltd.	514-363-5120

MALCO, A MICRODOT CO., 5150 W. Roosevelt Rd., Chicago, Ill., 60650, Tel: 312-287-6700, TWX: 910-221-1296; Empl.: 400

Free literature available: Coaxial Connectors- Catalog #100-1 Multi-Pin Connectors- Catalog #200-1 Rack & Panel Connectors- Catalog #300-1 Wire Terminals- Catalog #400-1 Printed Circuit Terminals- Catalog #500-1 Back Plane Assemblies- Catalog #600-1 Cardedge Connectors- Catalog #700-1
Electronic Hardware- Catalog #800-1 Wire and Cable- Catalog #900-1

Products manufactured: Cable Assemblies & Harnesses, Cable, Connector Adapters, Connectors, Contacts, Electrical, Cords, Machines/Machinery, Production, Sockets, Terminal Blocks, Boards & Strips, Terminals

MALLINCKRODT, INC., 2nd & Mallinckrodt Sts., St Louis, Mo., 63147, Tel: 314-731-4141, TWX: 910-761-0443; Empl.: 2500; Minimum order: $100

For info on price: C. S. Kettler; Application info: C. S. Kettler; Customer service: B. D. Williams; Delivery info: B. D. Williams

Free literature available: Product brochure including specifications on Transist AK® line of electronic grade chemicals.

Products manufactured: Chemicals, Cleaners & Solvents, Metal Oxides

P.R. MALLORY & CO., 3029 East Washington St., Indianapolis, Ind., 46201; Empl.: 7500

Local Sales Offices & Reps.

Cal	Los Angeles	213-921-7939
Cal	San Francisco	415-348-2081
Fla	Orlando	305-855-6353
Ill	Chicago	312-775-9455
Mass	Watertown	617-924-2214
Mich	Detroit	313-645-1490
NJ	Cinnaminson	609-829-7902
NJ	Hillsdale	201-666-3600
Ohio	Dayton	513-299-5505

MALLORY BATTERY, P.R. Mallory, S. Broadway, Tarrytown, N.Y., 10591, Tel: 914-591-7000

Products manufactured: Batteries

(Refer to Mallory, P.R. & Co. Inc. for sales office information.)

MALLORY CAPACITOR CO., Div. P.R. Mallory, 3029 E. Washington, Box 372, Indianapolis, Ind., 46201, Tel: 317-636-5353 .... p. 1•26,27; p. 2•206-209

Products manufactured: Alarms, Capacitors, Fixed

Local Sales Offices & Reps.

Ala	Huntsville, P.R. Mallory	205-539-1751
Ariz	Scottsdale, P.R. Mallory	602-947-0241
Cal	Los Angeles, P.R. Mallory	714-523-7992
Cal	San Francisco, P.R. Mallory	415-348-2081
Colo	Denver, P.R. Mallory	303-758-7788
Fla	Orlando, P.R. Mallory	305-855-6353
Ill	Chicago, P.R. Mallory	312-775-9455
Ind	Indianapolis, P.R. Mallory	317-636-5353
Mass	Boston, P.R. Mallory	617-924-2214
Minn	Minneapolis, P.R. Mallory	612-944-2870
Mo	St. Louis, P.R. Mallory	314-727-8695
NJ	Hillsdale, P.R. Mallory	201-666-3600
NY	Plandome, Fred Spellman Co.	516-627-3399
NY	Rochester, P.R. Mallory	716-647-3410
NC	Statesville, P.R. Mallory	704-872-0586
Ohio	Dayton, P.R. Mallory	513-299-5505
Ore	Portland, Earl & Brown Co.	503-292-9145
Pa	Philadelphia, P.R. Mallory	215-844-8891
Tex	Dallas, P.R. Mallory	214-324-2448
Wash	Seattle, Earl & Brown Co.	206-284-1121

MALLORY CONTROLS, P.R. Mallory, Box 327, Frankfort, Ind., 46041, Tel: 317-654-5501, TWX: 317-634-4214

Products manufactured: Plug & Jack Sets, Potentiometers, Resistors, Switches

(Refer to Mallory, P.R. & Co. Inc. for sales office information.)

MALLORY DISTRIBUTOR PRODS. CO., P.R. Mallory & Co., Box 1558, Indianapolis, Ind., 46201

MALLORY TIMERS, P.R. Mallory, 3029 E. Washington St., Indpls., Ind., 46201, Tel: 317-636-5353, TWX: 317-634-4214; Empl.: 2,000

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Indicators, Motors, Timers

(Refer to Mallory, P.R. & Co. Inc. for sales office information.)

MANGER ELEC. CO., INC., W. Henry St., Stamford, Conn., 06902, Tel: 203-348-7761; Minimum order: $50

For info on price: J. A. Markus; Application info: J. V. Judge; Customer service: J. V. Judge; Delivery info: B. Lusita

Free literature available: Summary sheet giving history of our company; catalog which details the scope of wire processing at Manger.

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cords, Jumpers, Labels, Pressure-Sensitive, Adhesive, Lead Assemblies & Receptacles, Services, Assembly, Production & Test, Terminals, Wire & Cable Ties, Wire Markers, Wire Shielding

Local Sales Offices & Reps.

Cal	Palos Verdes Estates, Sid Schulman & Assoc.	213-373-6564
Md	Baltimore, Fian Lott Co.	301-744-4611
Mich	Rochester, Keu-Mor Assoc.	313-651-1890

MANHATTAN ELEC. CABLE CORP., 1 Station Plaza, Rye, N.Y., 10580, Tel: 212-875-7130, Telex: 12-6141; Empl.: 75; Minimum order: $50

For info on price: F. Mindek; Application info: T. Blick; Customer service: K. Berg.

Free literature available: Electronic wire & cable catalog containing complete data & information on the wide range of electronic & electrical types of wire & cable marketed by Manhattan Cable

Products manufactured: Braid, Cable, Cable, Cords, Wire

Local Sales Offices & Reps.

Cal	Burlingame, Manhattan Elec. Cable	415-697-7016
Cal	Los Angeles, Bassett & Moore Inc.	213-766-2117
Cal	San Francisco, Logan Sales Co.	415-369-6726
Colo	Denver, K.C. Marketeres Inc.	303-733-5561
Ga	Atlanta, Hollingsworth & Still Inc.	404-394-3270
Ill	Chicago, Manhattan Elec. Cable	312-344-5040
Ill	Melrose Park, Manhattan Elec. Cable	312-344-5040
Mass	Boston, Keene Sales Co. Inc.	617-595-2300
Mich	Detroit, Shalco Inc.	313-547-4771
Mo	St. Louis, Midwestern-Manhattan Elec. Cable	314-865-5050
NY	Brooklyn, Manhattan Elec. Cable	212-875-7130
NY	Camillus, Callahan-Ferguson Co.	315-487-3870
NY	New York, Bressler & Baum Assoc.	212-564-4105
NY	Rye, Manhattan Elec. Cable	914-967-4080
Ohio	Cleveland, Electronic Sales Masters	216-831-9555
Ohio	Independence, Manhattan Elec. Cable	216-749-7500
Pa	Philadelphia, Stinson Assoc. Inc.	215-896-7378
Tex	Dallas, Lund & Co. Inc.	214-358-4335
Tex	Houston, Texas-Manhattan Elect. Insulated Cable	713-227-5228
Wash	Seattle, R.K. Squibb Inc.	206-ME2-2450

MANN, HENRY INC., Mann Rd., Box 496, Huntingdon Valley, Pa., 19006, Tel: 215-355-7200, TWX: 800-523-1960; Empl.: 50; Minimum order: $20

For info on price: B. Schick; Application info: J. Massi; Customer service: L. Suder; Delivery info: L. Suder

Free literature available: Literature on all Printed Circuit Board processing equipment, component lead forming, cut and layover tools, holding fixtures, assembly tools and equipment, etc.

Products manufactured: Adhesives (All Types), Benches, Consoles, Stools, Tables, Cabinets & Accessories, Calculators, Electrical & Electronic, Carts & Dollies, Instrument & Equipment, Chemicals, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Containers, Cords, Cutters, Wire, Hand Operated, Demagnetizers, Drills & Accessories, Hand & Power, Drivers, Nut, Heat Guns, Production, Heat Sinks, Soldering, Holders, Circuit Board (Production Type), Jigs And Fixtures, Chassis & Circuit Board, Kits, Connector, Knives & Knife Sets, Lamps, Machines/Machinery, Production, Magnifying Glasses, Inspection, Meters, Pads, Transistor Mounting, Pliers, Pumps, Vacuum, Racks, Scissors, Screwdrivers, Scribers, Seizers, Solder (All Types), Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Testers, Tools, Torches, Soldering, Welding & Access., Tweezers, Hand & Vacuum, Wire Strippers, Wire Twisters, Wrenches

MARATHON BATTERY CO., c/o Marathon Manufacturing Co., 1900 Marathon Bldg., 600 Jefferson Box 61589, Houston, Tex., 77002, Tel: 817-776-0650, TWX: 910-894-5203; Empl.: 400; Minimum order: $1000

Customer service: R. Tarpey

Products manufactured: Batteries, Chargers, Battery, Eliminators, Battery, Motor Electric Generator Sets, Motors

Local Sales Offices & Reps.

Cal	San Carlos, R. DelBucchia & Assoc.	415-756-1664
Cal	Westminster, A.A. Dowers, Inc.	213-596-4485
Colo	Denver, Brown Tech.	303-233-0863
Fla	Winter Pk., Young & Lawrence	305-647-6929
Ill	Chicago, Gassner & Clark Co.	312-345-4245
Ind	Indianapolis, Southern Sls.	317-257-7575
Iowa	Hiawatha, Gassner & Clark Co.	319-393-5763
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	St. Paul, Howard Cullen Assocs.	612-646-7371
NM	Albuquerque, Bowden Assoc.	505-268-7676
NY	Buffalo, R. Mitscher	716-633-7970
Ohio	Cleveland, Components, Inc.	216-842-2737
Pa	Phila., C. Newson	215-248-3377
Wash	Seattle, R. Squibb	206-632-2450
Wisc	Oak Creek, Erdman Sls.	414-761-2120

MARCONI INSTRS., Div. Marconi Elctrns. Inc., 100 Stonehurst Ct., Northvale, N.J., 07647, Tel: 201-767-7250, TWX: 710-991-9752; Empl.: 19
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Products manufactured: Analyzers, Attenuators, Bridges, Counters, Filters, Generators, Meters, Monitors, Oscillators, Receivers, Telephone Channel Test & Simulator Equipment, Television Systems & Equipment Closed-Circuit, Test Equipment, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Lee	205-533-5896
Ariz	Phoenix, Moxon Elctrns.	602-273-7363
Cal	Irvine, Moxon Elctrns.	714-556-6500
Cal	San Diego, Moxon Elctrns.	714-292-4820
Cal	Santa Clara, Moxon Elct.	408-249-2491
Colo	Denver, PLS Assoc.	303-771-0140
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ga	Chamblee, Lee Assocs., Inc.	404-457-7117
Ill	Chicago, K.W. Meyers	312-774-6440
Ind	Indpls., K. Meyers	317-243-6681
Md	Bethesda, S & S	301-654-1434
Mass	Stoneham, Ken Corp.	617-438-5464
Minn	Mpls., K.W. Meyers	612-920-7080
Mo	Raytown, P. A. C.	816-737-0066
NJ	Saddle Brook, L & M Assocs.	201-843-8700
NM	Albuquerque, PLS Assoc.	505-255-2330
NY	Brentwood, L & M Assocs.	516-231-8363
NY	Fayetteville, Savage Sales Co.	315-682-2131
NY	New York City, L & M Assocs.	212-675-7486
NC	Raleigh, Lee Assocs., Inc.	919-787-5818
Ohio	Waldo, Ohio Instr.	614-726-4242
Pa	Andalusia, L & M	215-639-3100
Tex	Dallas, Bradenco	214-358-3278
Utah	Salt Lake City, PLS Assoc.	801-272-3681
Wash	Seattle, R.S. Drake Assoc.	206-763-2755

MARK EYELET & STAMPING, 185 Wakelee Rd., Wolcott, Conn., 06716, Tel: 203-756-8847; Empl.: 50

For info on price: G. Hunting; Delivery info: C. Rinaldi

Products manufactured: Connectors, Eyelets, Fasteners, Grommets, Rivets, Terminals

Local Sales Offices & Reps.

Cal	Glendale, Bruce Entprs.	213-245-6538
Ill	Chicago, Weber Assocs.	312-943-5225
Iowa	Cedar Rapids, Snider Sls.	
Mich	Detroit, W. L. Crawford	313-836-8121
Minn	St. Paul, C. Vandervort	612-489-5222

Pa	Wayne, Miller & Smith Co.	215-687-0750
Tex	Richardson, P.J. Scanlon Co.	214-231-4661

MARK SPECIALTIES, 1780 Monrovia, Costa Mesa, Cal., 92627, Tel: 714-642-7757; Empl.: 4; Minimum order: $25

Customer service: R. Hackstock

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Solenoids

MARKAL CO., 250 N. Washtenaw Ave., Chicago, Ill., 60612, Tel: 312-826-1700; Empl.: 65; Minimum order: $25

For info on price: J. Laicour; Application info: D. Lytton; Customer service: E. G. Carlsen; Delivery info: M. Kaplan

Free literature available: We have Markal Paint Eight Page Catalog, Ball Paint Marker Catalog & Protective Coating Catalog

Products manufactured: Coatings, Crayons, Coatings, Pellets, etc., Temperature Indicating

MARKEL, L. FRANK & SONS, School La., Norristown, Pa., 19404, Tel: 215-272-8960, TWX: 510-660-0190; FSC No: 03890; Empl.: 395; Minimum order: $25
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For info on price: J. F. Carpenter, Jr.; Customer service: E. Pascal; Delivery info: H. Doerner

Products manufactured: Cable, Tapes, Electrical Insulation, Tubing, Wire

Local Sales Offices & Reps.

Ariz	Pheonix, K. Jahn Co.	602-956-9060
Ark	Hot Springs, Meredith Young Assocs.	501-262-1365
Cal	L.A., National Wire & Cable	213-225-5611
Cal	Los Angeles, C.D. LaMoree	213-225-5631
Cal	Torrance, Insulation Supply	213-320-9400
Colo	Denver, Ward Elec. Supply	303-222-3541
Conn	Sherman, R.P. Mahan Co.	203-355-0231
Fla	Clearwater, WMM Assocs.	813-447-2533
Ill	Chicago, J. Glenn	312-847-6400
Kans	Overland Park, Mathews & Co.	913-642-9063
Mass	Wellesley, R. Mahan	617-237-1040
Mich	Farmington, L. George Agency	313-474-1505
Minn	Eden Prairie, F. Peterson	612-941-5400
Mo	Webster Groves, Hippler	314-961-8499
NJ	Colonia, H.B. Heft Assocs.	201-381-5389
NY	Lynbrook, H.B. Heft	516-599-3351
NY	Rochester, Gislason	716-454-4741
NC	Charlotte, H.T. Altman Co.	704-399-8926
Ohio	Chagrin Falls, Electrolock	216-543-5125
Okla	Oklahoma City, J. Cole	405-235-2447
Ore	Portland, C. Riggs	503-226-3286
Pa	Munhall, PEI Sls. Corp.	412-462-6300
Pa	Phila., C. Newson	215-248-3377
Tenn	Chattanooga, Jackson	615-267-4260
Tex	Tyler, Cline & Son, Inc.	214-595-1038
Wash	Seattle, C. Riggs	206-623-5707
Wisc	Elm Grove, J.J. Glenn & Co.	414-352-7262
FOR:	Can., Burlington, Ont., Neeco Inds.	416-632-1403

MARKEM CORP., 1000 Congress St., Keene, NH, 03431, Tel: 603-352-1130, TWX: 710-366-1800; Empl.: 775

Customer service: T. Pallarino

Free literature available: Capabilities Brochure describing in-plant marking systems available for Electronics Industry - component marking, pressure sensitive labels including rating plate labels.

Products manufactured: Labels, Pressure-Sensitive, Adhesive, Machines/Machinery, Production, Nameplates, Wire Markers

Local Sales Offices & Reps.

Cal	Industry, Markem Corp.	213-965-3345
Ill	Elk Grove Village, Markem Corp.	312-625-2866
Mo	St. Louis, Mft. Supplies Co.	314-231-7886
NH	Keene, Markem Corp.	603-352-1130
NJ	Springfield, Markem Corp.	201-467-0870
NC	Charlotte, Markem Corp.	704-525-1445
Ohio	Cincinnati, L. G. Freeman Co.	513-721-1080
Ohio	Medina, Markem Corp.	216-238-5125
Tex	Richardson, Markem Corp.	214-231-8297

MARLIN MANUFACTURING CORP., 12404 Triskett Rd., Cleveland, Ohio, 44111, Tel: 216-941-6200; Empl.: 55; Minimum order: $25

For info on price: P. Hruby; Application info: D. Park; Customer service: P. Hruby; Delivery info: P. Hruby

Products manufactured: Connectors, Panels, Plug Adapters, Plug & Jack Sets, Probes, Thermocouples, Elements & Accessories, Wire

Local Sales Offices & Reps.

Mass	Norwell, Bordewieck Engrg. & Sls.	617-659-4915
NY	Troy, HJM Sls. Co.	518-283-5599
NC	Charlotte, Sloan Assocs.	704-523-2133
Ohio	Cincinnati, Seawood Sls. Co.	513-793-6702
Pa	Broomall, AM Tech. Sls. Co.	215-356-0574
Pa	Pittsburgh, AM Tech. Sls. Co.	412-885-3363
Tenn	Chattanooga, Coleman Assocs.	615-821-0235
Va	Richmond, Sloan Assocs.	804-359-6051

MARLOW INDUSTRIES, INC., 3640 A Marquis Dr., Garland, Tex., 75402, Tel: 214-494-2521, TWX: 910-860-5161; Empl.: 10; Minimum order: $50

Customer service: R. L. Smythe

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Controls/Control Eqpt., Cooling/Heating Modules, Thermoelectric, Feedthrus & Seals, Environmental, Photomultiplier Tube Housings, Substrates

Local Sales Offices & Reps.

Ariz	Phoenix, Griot Assocs.	602-275-4991
Cal	El Segundo, Griot Assocs.	213-322-8383
Cal	Los Altos, Griot Assocs.	415-941-2533
Cal	Tustin, Griot Assocs.	714-838-2330
Tex	Dallas, W.P. Fralia Co.	214-264-3491
Tex	Houston, W.P. Fralia Co.	713-772-1572
Wash	Bellevue, Griot Assocs.	206-454-8592

MAROTTA SCI. CONTROLS, INC., Boonton Ave., Boonton, N.J., 07005, Tel: 201-334-7800, TWX: 710-987-8358; FSC No: 99657; Empl.: 165; Minimum order: $30

For info on price: P. Johnson; Application info: T. Havness; Customer service: T. Rogers; Delivery info: B. Stritch

Products manufactured: Controllers, Programmable, Controls/Control Eqpt., Valves, Solenoid

Local Sales Offices & Reps.

Ala	Huntsville, General Hydraulics Corp.	205-536-6341
Cal	Tustin, Marotta Scientific Controls	714-544-2160

HUNTER TOOLS, Marshall Industries, 9674 Telstar Ave., El Monte, Calif, 91731, Tel: 213-686-0141, TWX: 910-587-1565; Empl.: 75

For info on price: J. Spiri; Application info: J. Spiri; Customer service: D. Hunter; Delivery info: D. Hunter

Products manufactured: Drivers, Nut, Heat Sinks, Soldering, Pliers, Pullers, Screwdrivers, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Testers, Tools, Transistor, Diode, Thyristor Heat Dissipators, Wrenches

Local Sales Offices & Reps.

Cal	Los Angeles, Gignac, Oldfield & Weaver	213-747-9544
Cal	San Francisco, Meyer, Ross & Fleming	415-285-8880
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Fla	Ft. Lauderdale, Unirep Inc.	
Ga	Atlanta, Murphy & Cota	404-875-2525
Ill	Chicago, J. J. McBride Sls., Inc.	312-775-1080
Ind	Indianapolis, Elctrn. Reps.	317-897-9326
Kans	Leawood, J. D. How Assoc.	913-649-0542
Md	Phoenix, Rebco Sls.	301-592-8907
Mass	Lynn, J. Grant	617-595-6411
Mich	Detroit, Burcaw Co. & Assoc.	313-533-7700
Minn	Minneapolis, Jensen & Olsen Sls.	612-941-7181
Mo	Liberty, Lectro-Reps.	816-781-2522
NY	Elmhurst, Wilson Assoc.	212-899-0929
NY	Rochester, Marsey Sls.	716-442-9700
Ohio	Cincinnati, Paten Sls. Co.	513-574-0813
Ohio	St. Marys, Shelby & Co.	419-394-3377
Ore	Portland, J. V. Belusko Co.	503-222-4279
Pa	Willow Grove, Dick Lewis	215-659-0704
Tex	Dallas, Techno Assoc.	214-357-9213
Utah	Salt Lake City, Arrowhead Sls. Corp.	801-487-3444
Va	Richmond, Taylor Bros., Inc.	804-644-2391

MARSHALL INDUSTRIES, Kinatechnic Sys., 9674 Telstar Ave., El Monte, Cal., 91731, Tel: 213-686-0141, TWX: 910-587-1565; Empl.: 500

For info on price: R. Frost; Application info: R. Merrill; Customer service: R. Frost; Delivery info: R. Frost

Free literature available: Complete 94 page catalog covering all aspects of facilities layout, assembly station specifications, industrial seating and material handling.

Products manufactured: Benches, Consoles, Stools, Tables, Cleaners, Ultrasonic, Machines/Machinery, Production

Local Sales Offices & Reps.

Ariz	Tempe	602-968-6181
Cal	Sunnyvale	408-739-8720
Colo	Arvada	303-423-9670
Conn	N. Branford	203-288-9241
Fla	Palm Beach Gardens	305-622-8590
Ill	Des Plaines	312-298-0440
Mass	Newton Highland	617-965-5310
NY	Farmingdale	516-293-4120
Ohio	Dayton	513-898-1100
Tex	Dallas	214-233-7650
Wash	Bellevue	206-883-1084

MARSTAN RESISTOR, Balco Elctrns., Inc., 307 Washington St., Orange, N.J., 07050, Tel: 201-677-1200, TWX: 710-994-5812; FSC No: 5905; QPL No: Multiple; Empl.: 50; Minimum order: $50

For info on price: R. W. Hagerty; Application info: R. W. Hagerty; Customer service: L. James; Delivery info: R. W. Hagerty

Free literature available: Precision wirewound resistors.

Products manufactured: Dividers, Networks, Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Schoeffler Assocs.	
Cal	Culver City, Sodaro Co.	213-870-6001
Conn	Meriden, Abbott-Allison	203-237-9232
Ill	Northbrook, R.T. Howlett & Assocs.	312-498-5444
Kans	Overland Park, B. Rush Assocs.	913-831-4259
Mich	Northbrook, R.T. Howlett & Assocs.	312-498-5444
NJ	Harrington Pk, Metro Tech Sls.	201-768-8495
NY	Jericho, Metro Tech Sls.	516-935-3330
Wash	Seattle, J. B. Jolly	206-938-4166
Wisc	Milwaukee, Gentron Co.	414-543-8110
EXP:	New York, N.Y., Multiparts Corp.	212-944-4372
EXP:	Westbury, N.Y., Minthorne International Inc.	516-334-3303
FOR:	Can., Montreal, Quebec, Electrodesign, Ltd.	514-389-5914
FOR:	Can., Ottowa, Ont., Electrodesign, Ltd.	613-745-0541
FOR:	Can., Quebec, Electrodesign	514-363-5120
FOR:	Can., Toronto, Ont., Electrodesign	416-787-0991

MASTECH, INC., 478 E. Brighton Ave., Syracuse, N.Y., 13210, Tel: 315-478-3133, TWX: 710-541-1546; Empl.: 20; Minimum order: $100

Customer service: R. F. Merrithew

Free literature available: 2610-202-216, Semiconductor Device Test Sets, (Short Form Catalog)

Products manufactured: Testers

Local Sales Offices & Reps.

Cal	Los Angeles, Dyna Sls. Co.	213-268-1175
Mass	Chelmsford, Equipment Sls. Co.	617-256-8547
Wash	Bellevue, Scientific Devices - Northwest	206-454-0900

MASTER APPLIANCE CORP., 2420 18th St., Racine, Wisc., 53403, Tel: 414-633-7791; Empl.: 80
p. 2•1710-1713

Customer service: S. Radwill

Free literature available: Full Line Catalog & Price List Single Page Full Line Sheet Master-Mite Page Parts Price Lists Air Cleaner Catalog Pages

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Blowers & Fans & Accessories, Heat Guns, Production, Tools, Torches, Soldering, Welding & Access., Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

NJ	Cherry Hill, M/E & Assocs.	609-667-6110
NY	Great Neck, Harris & Aldrich Sls. Inc.	516-466-4122
EXP:	Mt. Prospect, Ill., Master Appliance Corp.-Overseas Div.	312-358-8677

MASTER ELCTRN. CONTROLS, 1553 17th St., Santa Monica, Cal., 90404, Tel: 213-393-3177; Empl.: 27; Minimum order: $15

For info on price: K.A. Holladay; Application info: I. Nizam; Customer service: D. Colmenero; Delivery info: K.A. Holladay

Products manufactured: Controls/Control Eqpt., Relays, Sockets, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, Master Distributors	213-395-2637
Cal	San Francisco, Master Dist.	415-626-0807
Ill	Park Ridge, G. E. Collins Sls.	312-823-8075

NY	Scarsdale, Bassin Tech. Sls. Co.	914-SC 3-3334
Ohio	Columbus, Ind'l. Comp. Sls.	614-486-3045

MASTER SPECIALTIES CO., 1640 Monrovia St., Costa Mesa, Cal., 92627, Tel: 714-642-2427; Empl.: 350

Products manufactured: Display Devices/Displays, Lamps, Lights, Switches

Local Sales Offices & Reps.

Cal	Costa Mesa	714-642-2427
Cal	Mountain View	415-961-3640
Cal	San Diego	714-279-4812
Colo	Denver	303-758-7741
Fla	Titusville	305-269-3040
Ga	Morrow	404-363-9947
Ill	Schiller Park	312-671-4586
Mass	Lynn	617-599-0566
Minn	St. Paul	612-854-7535
NJ	Barrington	609-546-9044
NY	Avon	716-342-3630
NY	Valley Stream	516-561-2334
Ohio	Wickliffe	216-946-5552
Tex	Dallas	214-357-9459
Wash	Bellevue	206-746-4440

MASTERITE CORPORATION, 2841 Lomita Blvd., Torrance, Cal., 90505, Tel: 213-775-3471, TWX: 910-347-6237; FSC No: 05041; Empl.: 380; Minimum order: $50

For info on price: C. J. Huebert; Application info: C. J. Huebert; Customer service: R. C. Reese; Delivery info: R. C. Reese

Free literature available: Masterite brochures include P.C.B. Connectors which are available in several sizes with a choice of contact centers; .050, .100, .125, .156 Also available are brochures "Plates and Connecting Devices for Wire Wrap" and "Flexible Interconnects"

Products manufactured: Boards, Printed Wiring, Universal, Boards, Programming, Cable Assemblies & Harnesses, Cable, Connectors

Local Sales Offices & Reps.

Ariz	Phoenix, S.O. Rush	602-959-3594
Cal	Mountain View, West/Mark Assoc.	415-969-1700
Colo	Denver, West/Mark Assoc.	303-433-7181
Fla	St. Petersburg, Russell Assoc.	813-526-2939
Ga	Atlanta, Russell Assoc.	404-255-8422
Ill	Wood Dale, L. Bacher Assoc.	312-766-1922
Kans	Overland Park, Penzner-Mankus Assoc.	913-381-0004
Mass	Waltham, UNESCO	617-890-6680
Mich	Grand Rapids, R.P. Urban Assoc.	616-245-0511
Minn	St. Paul, Countryman Assoc.	612-645-9151
Mo	Hazelwood, Penzner-Mankus Assoc.	314-731-4334
NJ	Livingston, Varrelman-Gorman Co.	201-992-2505
NM	Albuquerque, Thorson Co.	505-265-5655
NY	Camillus, Varrelman-Gorman Co.	315-458-4774
NY	Centerport, Varrelman-Gorman Co.	212-463-5000
Ohio	Tipp City, Tech. Comps.	513-667-1216
Okla	Broken Arrow, P.J. Scanlon Co.	918-251-1427
Pa	Newtown Square, Hagy Assoc.	215-459-0504
Tex	Richardson, P.J. Scanlon Co.	214-231-4661

MATERIALS FOR ELCTRNS., INC., 149-32 132nd St., Jamaica, N.Y., 11430, Tel: 212-322-9400

Products manufactured: Antennas, Capacitors, Fixed, Coatings, Metals, Seals, Thermocouples, Elements & Accessories

MATERIALS RESCH. CORP., Route 303, Orangeburg, N.Y., 10962, Tel: 914-359-4200, TWX: 710-576-2656; Empl.: 300

Products manufactured: Alloys, Chamber, Environmental Test, Coatings, Crystals, Deposition Equipment, Vacuum & Accessories, Detectors, Evaporation Equipment, Electron Beam, Feedthrus & Seals, Environmental, Forms, Wire, Furnaces, Gages, Materials, Self-Lubricating, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Microcircuit Production Equip., Networks, Ovens, Pumps, Vacuum, Quartz, Fused, Scribers, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test, Substrates, Valves, Vacuum, Wire

Local Sales Offices & Reps.

Ariz	Tempe, Materials Research Corp.	602-949-5662
Cal	Mountain View, Materials Research Corp.	415-964-7272
Mass	Allston, J. W. Fox	617-429-1300
Mo	Maryland Heights, J. True	314-739-3326
Tex	Dallas, S. Smith	214-235-9008
Tex	Richardson, Materials Research Corp.	214-235-9008

MATHESON GAS PRODUCTS, Box 85, East Rutherford, N.J., 07073, Tel: 201-933-2400, TWX: 710-989-0173; Empl.: 500; Minimum order: $10

Customer service: T. Swanson 415-793-2559

Free literature available: Matheson General Gas Catalog: Separate section devoted to electronic gases and gas mixtures for use in the semiconductor industry. Equipment section for high purity regulators and handling equipment.

Products manufactured: Chemicals, Controls/Control Eqpt., Couplings, Dials, Gages, Regulators, Technical Books, Testers, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Cucamonga	714-987-4611
Cal	Newark	415-793-2559
Fla	Morrow	404-478-7274
Ill	Joliet	815-727-4848
Mass	Gloucester	617-283-7700
Tex	La Porte	713-471-2544
FOR:	Can., Edmonton, Alberta	403-476-6214
FOR:	Can., Whitby, Ontario	416-668-3397

MATRIX CORP., 520 N. 11th Ave., Beech Grove, Ind., 46107, Tel: 317-786-4601; Empl.: 10 .... p. 1•178,266

Customer service: K. D. Bantlett

Products manufactured: Boards, Programming, Controllers, Programmable, Controls/Control Eqpt., Process Control Systems, Programmers, Scanners, Timers

Local Sales Offices & Reps.

Ill	Chicago, SEA Inc.	312-282-6694
Ind	Carmel, Sea Inc.	317-846-2593
Minn	Mpls., SEA Inc.	612-425-4455
Tex	Dallas, Sys. Engrg. Sls.	214-231-9364
Tex	Houston, System Engrg.	713-668-7840
Wisc	Waukesha, SEA Inc.	414-547-6637

MATRIX ENGINEERING CORP., 17000 S. Western Ave. 19, Gardena, Cal., 90247, Tel: 213-770-0521; Empl.: 9; Minimum order: $10

Customer service: G. Austin

Free literature available: MATRIX ENGINEERING CORPORATION presents work positioners and fixtures for: Assembly, Inspection, Testing, Servicing.

Products manufactured: Benches, Consoles, Stools, Tables, Holders, Circuit Board (Production Type), Jigs And Fixtures, Chassis & Circuit Board, Panels, Pullers, Racks, Services, Assembly, Production & Test, Soldering Accessories, Soldering Equipment, Tools

Local Sales Offices & Reps.

Ariz	Phoenix, Davis Co.	602-955-2266
Cal	Anaheim, Production Sys. Inc.	714-533-1120
Cal	Ontario, West Coast Ents.	714-903-3914
Cal	San Jose, Hefte Industries	408-264-8319
Colo	Denver, Soldering Supply Specialists	303-455-1352
Ill	Chicago, EMF Co. Inc.	312-889-8323
Mass	Burlington, Contact East Inc.	617-272-5051
Ore	Portland, Murphy Ind. Supply Co.	503-226-6081
Pa	Feasterville, H. Mann Inc.	215-355-7200
Tex	Dallas, Atlan Inds.	214-243-6216
Utah	Salt Lake City, Technical Devices Co.	801-277-1029
FOR:	Can., Burlington, Ont., Arbell Equipment Ltd.	416-632-9494

Local Distributors

Ala	Huntsville, Mock Ents., 2310 Memorial Pkwy	205-539-2401
Cal	Anaheim, Production Sys., 2021 Via Burton	213-533-1120
Cal	Inglewood, N66 Inc., 3819 W. Imperial Hwy	213-671-5455
Ill	Chicago, E.M.F. Co., 6135 W. Belmont	312-889-8323
Mass	Burlington, Contact East, 7 Cypress Dr.	617-272-5051
Ore	Portland, Murphy Indus. Supply, 3057 N.W. Yeon Ave.	503-226-6081
Pa	Huntingdon Val., Henry Mann, Box 496, Mann Rd.	215-355-7200
Pa	Plymouth Meeting, Techni-Tool, Apollo Rd.	215-825-4990

MATRIX SYSTEMS CORP., 9411 Lurline Ave., Chatsworth, Cal., 91311, Tel: 213-882-2008; Empl.: 10 p. 1•1800-1802

Customer service: J. Singleton

Products manufactured: Attenuators, Converters, Modules, Logic, Encapsulated, Relays, Scanners, Switches

Local Sales Offices & Reps.

Cal	Los Angeles, Dynasales Co.	213-268-1175
Cal	Mountain View, IFM, Inc.	415-961-2828
Conn	Hamden, Instrument Consultants, Inc.	203-288-5246
Fla	Satellite Beach, Reynolds & Assocs.	305-727-3205
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	Chicago, Pivan Engrg., Inc.	312-539-4838
Ind	Indianapolis, Pivan Engrg., Inc.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg.	913-722-1030
Mass	Waban, Instrument Consultants, Inc.	617-969-9881
Mich	Detroit, Comtel-Sterling Assocs.	313-255-1970
Minn	Minneapolis, Pivan Engrg., Inc.	612-537-4501
Mo	St. Louis, Pivan Engrg., Inc.	314-542-3636
NY	Cortland, RJC Assocs.	607-753-3909
NY	Scarsdale, Bassin Tech. Sls. Co.	914-723-3334
Ohio	Cleveland, Comtel-Sterling Assocs.	216-442-8080
Ohio	Dayton, Comtel-Sterling Assocs.	513-298-7573
Okla	Tulsa, Carter Assocs.	918-749-3311
Pa	Pittsburgh, Comtel-Sterling Assocs.	412-922-5720
Tex	Garland, Carter Assocs.	214-276-7151
Tex	Houston, Carter Assocs.	713-644-1307
Va	Fairfax, Schibley Assocs.	703-591-3008
Wisc	Brookfield, Pivan Engrg., Inc.	414-786-1940
Exp:	NY, NY, May Lee Inds.	212-532-9200
FOR:	Downsview, Ontario, Can., Can-Tech Elctrns. Co.	416-661-9797

MATTHEWS & CO., JAS. H., Marking Systems Div., 6619 Penn. Ave., Pittsburgh, Pa., 15206, Tel: 412-362-6500, Telex: 86-6215; Empl.: 250; Minimum order: $15

Customer service: J. R. Ash

Products manufactured: Kits, Marking (Dial, Instrument, Equipment, etc.), Machines/Machinery, Production, Nameplates, Wire Markers

Local Sales Offices & Reps.

Cal	Bell Gardens, J.E. Hinshaw	213-927-3495
Cal	San Francisco, T.E. Graves	415-474-8300
Ga	Atlanta, C.W. Powell	404-233-8426
Ill	Chicago, S.C. Gurtner	312-263-6573
NJ	Clifton, S. Zeeble	201-643-4377
NY	Buffalo, J.V. Mason	716-856-7812
Ohio	Cincinnati, H.C. Bathe	513-631-0133
Ohio	Cleveland, G.H. Shumaker	216-696-6676
Pa	Philadelphia, S. Zeeble	215-563-2243
Pa	Pittsburgh, J. R. Ash	412-362-6500
Pa	Pittsburgh, R.F. Abbs	412-362-6500
Tenn	Memphis, J.J. Ford	901-525-0316
Tex	Dallas, L.S. Maguire	214-742-1760
Wash	Seattle, L.E. Kasper	206-624-0265
EXP:	Pittsburgh, Pa., C.A. Prezikowski	412-362-6500

MAURATRON, INC., 2741 Satsuma, Dallas, Tex., 75229, Tel: 214-243-3329; Empl.: 7; Minimum order: $10 .... p. 1•1312,1313

For info on price: A. Deasey; Application info: J. E. Sykes; Customer service: A. Deasey; Delivery info: C. Hunter

Products manufactured: Batteries, Blowers & Fans & Accessories, Chargers, Battery, Diodes, Power Supplies, Resistors, Retainers, Timers, Transistor, Diode, Thyristor Heat Dissipators, Tubing

Local Sales Offices & Reps.

Cal	San Diego, Tauber & Assocs.	714-274-7242
Md	Lutherville, Cunningham & Assoc.	301-296-4306
Mass	Northboro, Henik Assocs.	617-891-5660
Tex	Dallas, V.J. Sykes Assocs.	214-243-2221

Local Distributors

Cal	W. Los Angeles, Mil-Comm Distributor, 1616 Cotner	213-478-0525

MAUREY INSTRUMENT CORP., 555 W. 60th St., Chicago, Ill., 60629, Tel: 312-581-4555; FSC No: 03942; Empl.: 75; Minimum order: $25

For info on price: E. Maurey; Application info: E. Maurey; Customer service: T. Podge; Delivery info: T. Podge

Free literature available: Literature is available describing full lines of single turn and linear motion wirewound and conductive plastic potentiometers as well as wirewound trimmers.

Products manufactured: Potentiometers, Resistors, Slip-Rings & Assemblies, Switches

Local Sales Offices & Reps.

Ariz	Tempe, Whitronics, Inc.	602-966-4417

Fla	, Shaw Engrg. & Sls.	305-752-7596
Ill	Glenview, Crimson Engrg. Co.	312-724-1780
NM	Albuquerque, A.L.S. Elctrns.	505-294-8555
NY	Jamestown, W.R. Arnold, Inc.	716-664-5402
Wisc	Glenview, Crimson Engrg. Co.	312-724-1780

MAURY MICROWAVE CORP., 8610 Helms Ave., Cucamonga, Calif., 91730, Tel: 714-987-4715; FSC No: 13047; Empl.: 26; Minimum order: $40

For info on price: S. Shirley Ext. 31; Application info: B. Wambach Ext. 26; Customer service: A. Lopez Ext. 20; Delivery info: A. Lopez Ext. 20

Free literature available: A short form catalog and one page product summary of Maury Microwave's product line of precision coaxial, waveguide and microwave instrumentation is available.

Products manufactured: Adapters, Waveguide, Antenna Feed Systems, Antennas, Attenuators, Bends & Twists, Microwave, Bolometers, Calibrators, Cavities, Microwave, Comparators, Connector Adapters, Connectors, Couplers, Delay Lines, Detectors, Dividers, Dummy Loads, Filters, Flanges, Waveguide, Holders, Crystal, Horns, Microwave, Insertion Loss Measurement Systems, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Meters, Mismatches, Microwave, Precision, Monitors, Mounts, Oscillators, Preselectors, Probes, Receivers, Services, Assembly, Production & Test, Shifters, Sliding Loads, Microwave, Slotted Lines, Microwave, Standards, Suppressors, Switches, Tees, Terminals, Tubing, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ariz	Tempe, Jarko Assoc.	602-966-3020
Cal	Cupertino, Dura Elctrn. Sls.	408-255-2084
Colo	Parker, TMA, Inc.	303-841-3435
Fla	Satellite Beach, Reynolds Assoc.	305-773-4700
Ga	Atlanta, Reynolds Assoc.	404-252-5360
Md	Greenbelt, Riffe Assoc., Inc.	301-474-8600
Mass	Lexington, Zieco, Inc.	617-861-8300
NJ	Moorestown, Stern Assocs., Inc.	609-234-0661
NM	Albuquerque, TMA, Inc.	505-298-4321
NY	East Rockaway, Long Island, W. Bellenkes Assoc. Inc.	516-887-1443
Ohio	Dayton, F. L. Ohmer & Assoc.	513-434-1454

MAXI-SWITCH CO., 9697 East River Road, Minneapolis, Minn., 55433, Tel: 612-755-7660; Empl.: 100 .... p. 1•2262-2265

Products manufactured: Keyboards, Alphanumeric & Decimal, Relays, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Young & Lawrence	205-539-6575
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Canoga Park, R. Kruse	213-341-3020
Colo	Denver, Williams Assocs.	303-373-4730
Fla	Ft. Lauderdale, Young & Lawrence	305-563-6717
Fla	St. Petersburg, Young & Lawrence	813-894-0026
Fla	Winter Park, Young & Lawrence	305-647-6929
Ill	Crystal Lake, Mesa Inc.	312-639-3359
Md	Towson, H. White Co.	609-667-3202
Mass	Chelmsford, M. Flynn	617-256-6229
Mich	Grand Rapids, R.P. Urban & Assocs.	616-245-0511
Minn	St. Paul, Quantum Sls.	612-831-8583
NJ	Cherry Hill, H. White Co.	609-428-4544
NJ	East Orange, D. A. Rugg Co.	201-675-4822
NM	Albuqurque, Williams Assocs.	505-255-1638
NY	Penfield, J.E. Blair	716-586-1419
NC	Raleigh, Candor	919-828-5716
Ohio	Cincinnati, Tri-State Mktg.	513-761-7993
SC	Myrtle Beach, Candor Co.	803-448-5213
Tex	Dallas, J. A. Green Co.	214-631-7450
Tex	Houston, J. A. Green Co.	713-526-2959
Va	Lynchburg, Candor	703-846-6579

MAXWELL LABS., INC., 9244 Balboa Ave., San Diego, Calif., 92123, Tel: 714-279-5100, TWX: 910-335-2063; Empl.: 300

For info on price: Sls. Dept.; Application info: Sls. Dept.; Customer service: V. Tallarida; Delivery info: V. Tallarida

Free literature available: Capacitors 303R/401R/760 (Haefely); Generators 513; Switches 807/808/812; Questionnaires: capacitors/switches/power supplies/; Reprints; Magneform 1201R; Magneform machines 1202; Application 1501 & 1502A.

Products manufactured: Capacitors, Fixed, Diodes, Discharge Systems, Energy, Generators, Lasers & Laser Systems, Modulators, All Kinds, Networks, Power Supplies, Spark Gaps, Switches, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, Halbar Assoc.	213-387-8283
Ill	Chicago, Berndt Assoc.	312-283-0713

MBC ENGINEERING INC., 2501 Walsh Ave., Santa Clara, Cal., 95050, Tel: 408-244-9242; Empl.: 25; Minimum order: $100

For info on price: D. Munson; Application info: D. Munson; Customer service: L. Romelfanger; Delivery info: L. Romelfanger

Free literature available: Brochure describing facility and equipment.

Products manufactured: Circuits, Printed, Multilayer

MCCOY ELECTRONICS, Sub Oak Inds. Inc., Chestnut & Watts, Mount Holly Springs, Pa., 17065, Tel: 717-486-3411, TWX: 510-650-3548; Empl.: 457 p. 1•367-381

Products manufactured: Crystal Blanks, Crystals, Filters, Oscillators

Local Sales Offices & Reps.

Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Inglewood, D. Foyer-McCoy Elctrns. Co.	213-678-4108
Cal	Los Altos, OAK Inds. Inc.	415-941-1237
Colo	Denver, I.W. Strong & Assocs.	303-292-6900
Fla	Altamonte Springs, Oak Inds., Inc.	305-735-4495
Ill.	Chicago, Brock & Cushman	312-622-4110
Ind	Fort Wayne, Menze Sls.	219-747-5616
Iowa	Cedar Rapids, Lorenz Sls.	319-393-9125
Md	Silver Springs, Eastern Instrumentation	301-681-6500
Mass	Norwood, JMG, Inc.	617-762-5333
Mich	Jackson, Norwood Scroggs Co.	517-750-1170
Minn	Edina, Wagner Consits. Corp.	612-941-6310
Mo	Kansas City, Automatic Gen. Elctrn. Sls.	816-333-8206
NJ	Clifton, Albert Clarfield	212-757-6454
NJ	Haddonfield, Gray Assocs.	609-429-5300
NY	Pompey, S.F. Foster Co.	315-677-3333
NY	Webster, S.F. Foster Co.	716-872-5220
NC	Raleigh, OAK Inds. Inc.	919-876-7591
Ohio	Cincinnati, OAK Inds. Inc.	513-851-4411
Ore	Salem, Pacnor Mktg., Inc.	503-636-6445
Tex	Richardson, R.F. Kimball Co.	214-231-3447
Wash	Seattle, Pacnor Mktg.	206-284-8020
EXP:	Teaneck, N.J., Sylvan Ginsbury Ltd.	201-837-1100

MCFADDEN ELCTRNS. CO., 8953 S. Atlantic Blvd., South Gate, Calif., 90281, Tel: 213-564-5958; FSC No: 25750; Empl.: 11

For info on price: B. W. McFadden; Application info: B. W. McFadden; Customer service: S. McFadden; Delivery info: B. W. McFadden

Free literature available: Cockpit Simulation Control Loaders and Instruments Catalog, Low Torque Dynamometers, DC Power Amplifiers, Motion Simulation Tables.

Products manufactured: Amplifiers, Controls/Control Eqpt., Servo Systems, Simulators, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Incotec	205-837-6061
Ind	Indianapolis, Tri-State Tech. Sls.	317-924-3568
Mass	Salem, Forbes Engrg.	617-744-1693
FOR:	Can., Ville LaSalle, Que., Electrodesign Ltd.	514-363-5120

MCG ELECTRONICS INC., 279 Skidmore Rd., Deer Park, N.Y., 11729

Products manufactured: Arresters, Electrical Surge, Lightning, Protectors, Suppressors

Local Sales Offices & Reps.

Cal	Los Angeles, Dyna Sls.	213-268-1175
Fla	Maitland, Beacon	305-647-3498
Ga	Atlanta, Beacon	404-351-3654
Mass	Framingham, Victor Assoc.	617-879-5710
Mich	Utica, N. Case Assoc.	313-731-6003
NJ	Mt. Vernon, Sonkin Assocs.	914-668-9809
NY	Conklin, Ramcom	716-632-6913
Pa	Newtown Square, Holdsworth & Co.	
Va	Falls Church, D. Snow-Beacon	703-534-1673
Wisc	Germantown, Germantown	414-255-2120

MCGILL MFG. CO. INC., Electrical Div., 909 Lafayette St., Valparaiso, Ind., 46383, Tel: 219-464-4911, TWX: 910-690-4892; Empl.: 395

Customer service: P. Bain VP Sls. Ext. 376

Free literature available: Catalog #89 illustrates and describes McGill precision switches including snap action, (standard, miniature and sub-miniature), toggle, rocker, push button types and specials. 1 to 20 Amp.

Products manufactured: Switches

Local Sales Offices & Reps.

Ark	Hot Springs, M. Young Assocs.	501-262-1365
Cal	Los Angeles, Clemick-Neenan & Assocs.	213-476-1272
Cal	San Francisco, Maddox Sls. Co.	415-431-2953
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	, R. J. Eckert	312-297-3233
Ind	Arcadia, D. Rickards	317-253-8689
Ind	Dyer, A. Knezevich	312-297-3233
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Benton Harbor, Ken-Mor Assocs.	616-927-3134
Minn	Minneapolis, Elec. Comp. Sls.	612-933-2594
Mo	St. Louis, Larco Sls., Inc.	314-863-1242
NJ	Mount Laurel, Naudain Assocs.	609-235-1801
NY	Baldwin, C. Glianna	516-378-2700
NY	Pompey, S.F. Foster Co.	315-677-3333
Ohio	Cleveland, G. Stofer & Bro. Co.	216-333-0733
Ohio	Tipp City, W. Lenz	513-277-5509
SC	Columbia, H. Heaton	803-779-4016
Tex	Dallas, Raley Sls. Co.	214-368-1783
Tex	Houston, Carey & Assocs.	713-460-1111
Wash	Seattle, Stroheker, Inc.	206-623-0357

MCGRAW-EDISON CO., Edison Electronics Div., Grenier Field, Manchester, N.H., 03103, Tel: 603-669-0940, TWX: 710-220-1747; Empl.: 450 .. p. 1•661

For info on price: W. Manson; Application info: D. Cox; Customer service: D. Cox; Delivery info: D. Cox

Products manufactured: Attenuators, Cable, Calibrators, CATV Systems & Equipment, Coils Including Assemblies & Forms, Connectors, Delay Lines, Detectors, Gages, Generators, Indicators, Meters, Monitors, Networks, Oscillators, Resistors, Switches, Telephone Channel Test & Simulator Equipment, Terminals, Testers, Transducers, Transformers, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, P.J. Nahser	205-881-5590
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Encino, Eltec Sys.	213-981-9881
Colo	Denver, Williams-Assocs.	303-343-2911
Conn	Wallingford, Adams-McGregor, Inc.	203-269-5816
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Fla	St. Petersburg, Saber Assocs.	813-441-1301
Ga	Kenneshaw, P.J. Nahser	404-422-8053
Ga	Woodstock, Saber	404-432-9625
Idaho	Bois, Tarbell Comms.	208-343-0285
Ill	Chicago, Midwest Elctrns. Sls.	12-777-9700
Ind	Indianapolis, Midwest Elctrns. Sls.	312-926-3736
Iowa	Cedar Rapids, S & O Sls.	319-393-1845
Kans	Swanee Mission, Tech. Sls. Assocs.	913-888-3330
Md	Silver Spring, Gawler Knoop Co.	301-598-4406
Mass	Scituate, Adams-McGregor, Inc.	617-545-2213
Mich	Ferndale, Tiby Co.	313-547-3550
Mo	Ferguson, Tech. Sls.	314-725-5361
NJ	Boonton, Eastern Metro Assocs.	201-335-7881
NM	Alberquerque, Williams Assocs.	505-255-1638
NY	Guilderland, Electro-Modular Sys. Inc.	518-456-2665
NY	Plainview, Eastern Metro Assocs.	516-931-1414
NC	Burlington, P. J. Nahser Co. Inc.	919-226-8053
NC	Raleigh, Saber Assocs.	919-834-3961
Ohio	Cleveland, Tiby Co.	216-371-5335
Ohio	Dayton, Tiby Co.	513-277-3822
Ore	Beaverton, Tarbell Comms.	503-643-1631
RI	Lincoln, Adams-McGregor	401-726-1300
Tex	Dallas, Diversity Comms. Co.	713-772-0730
Wash	Bellevue, Tarbell Comms.	206-454-9716
Wisc	Waukesha, Midwest elctrns. Sls.	414-542-5129

MCKAY DYMEK CO., 675 N. Park Ave., Box 2100, Pomona, Cal., 91766, Tel: 800-854-7769, TWX: 800-472-7782; Empl.: 15; Minimum order: $155

For info on price: L. Engard 714-623-1581; Application info: L. Engard 714-623-1581; Customer service: F. Coker 714-623-1581; Delivery info: L. Engard 714-623-1581

Free literature available: #1 - Sheet on Shielded Ferrite Rod Antenna for AM broadcast band 540 - 1600 khz. #2 - Sheet on Hi Fi AM Tuner as used in broadcast Stations all over the U.S.A.

Products manufactured: Antennas, Receivers

MCKEE-PEDERSEN INSTRS., P.O. Box 322, Danville, Calif., 94526, Tel: 415-937-3630; Empl.: 8

Customer service: R. G. McKee

Free literature available: An 8-page brochure describes all the MP-System electronic modules and housings. A 4-page brochure describes MPI graphic recorders. A 4-page brochure describes electro-optical instruments.

Products manufactured: Amplifiers, Bridges, Current Sources, Meters, Potentiometers, Power Supplies, Recorders, Voltage Sources

MCL, INC., 10 North Beach Ave., LaGrange, Ill., 60525, Tel: 312-354-4350, TWX: 910-683-1899; Empl.: 80 p. 1•910-915,917-925

Products manufactured: Amplifiers, Cavities, Microwave, Filters, Generators, Modulators, All Kinds, Multipliers, Oscillators, Preselectors, Transmitters

Local Sales Offices & Reps.

Cal	Cupertino, Allis Assocs.	408-379-2883
Cal	Orange, Pacific Microwave, Inc.	714-633-7991
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Mt. Prospect, Cain & Co.	312-253-3578
Md	Baltimore, Stemler Assocs.	310-944-8262
Mass	Reading, Geder-Rotondi Assocs.	617-944-3105
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	Plainview, Eastern Metro Assocs.	516-931-1414
Ohio	Dayton, Cain & Co.	513-254-6521
Ohio	Reynoldsburg, Cain & Co.	614-861-2119
Tex	Dallas, Texas Avionics Co.	214-363-6324
Va	Alexandria, Stemler Assocs.	703-548-7818

MCLEAN ENGRG. LABS., 70 Washington Rd., Princeton Jctn., N.J., 08550, Tel: 609-799-0100; Empl.: 74; Minimum order: $25 p. 1•499-503,975

For info on price: P. Blakely; Application info: P. M. Stewart; Customer service: P. Blakely; Delivery info: P. Blakely

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Blowers & Fans & Accessories, Controls/Control Eqpt., Gaskets, Shielding, R-F-Also See Shields, R-F, Grilles, Heat Exchangers & Systems, Honeycomb Sheets, Panels, etc., Motors, Shields

Local Sales Offices & Reps.

Ala	Huntsville, W. Brown	205-539-4411
Ariz	Phoenix, PLS Assocs.	602-957-9110
Cal	Cupertino, T. Snitzer	408-257-8333
Cal	Del Mar, T. Snitzer	714-454-2191
Cal	L.A., T. Snitzer	213-836-6170
Colo	Denver, PLS Assoc.	303-771-0140
Conn	Bridgeport, Technical Instrs.	203-FO 8-4582
Fla	Ft. Lauderdale, W. Brown	305-776-4800
Fla	Orlando, W. Brown	305-425-5505
Ga	Tucker, W. Brown	404-939-1674
Ill	Elmhurst, Scott Assocs.	312-279-5681
Kans	Kansas City, Harris-Hanson	816-HI 4-9494
La	Gretna, W.A. Brown Inst. Co.	504-366-5766
Mass	Wilmington, Tech. Instrs.	617-944-3930
Mich	St. Clair Shores, J. Thorpe	313-779-6363
Minn	Mpls., Scott Elctrn.	612-929-2985
Mo	St. Louis, Harris-Hanson	314-432-3611
NJ	Ft. Lee, K. Hughes	201-944-1600
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	Albany, J. Reagan	518-489-4777
NY	New Hartford, J. Reagan	315-732-3775
NY	Rochester, J. Reagan	716-473-2115
NC	Winston-Salem, W. Brown	919-768-3600
Ohio	Cleveland, Marlow Assocs.	216-932-0900
Tex	Dallas, J.A. Green Co.	214-ME 1-7450
Tex	Houston, J.A. Green Co.	713-JA 6-2959
Va	Alexandria, Dyna Rep. Co.	703-354-1222
FOR:	Can., Montreal, Que., Brian Engrg.	514-735-1671
FOR:	Can., Rexdale, Ont., Brian Engrg.	416-248-0226

MEASUREMENT SYS., INC., 523 West Ave., Norwalk, Conn., 06850, Tel: 203-838-5561; Empl.: 14

For info on price: F. J. Stevens; Application info: M. H. Mehr; Customer service: F. J. Stevens; Delivery info: F. J. Stevens

Free literature available: C-3 "Tracking control products for the Human Operator" 8 page condensed catalog providing brief description of over 40 products. G174 "Control Grips". 8 page brochure describing standard products and custom configurations providing an almost limitless number of control options.

Products manufactured: Bridges, Controls/Control Eqpt., Converters, Switches, Tracking Systems, Transducers

Local Sales Offices & Reps.

Cal	Encino, Kingway & Assocs.	213-788-4124
Cal	Fullerton, Kingway & Assocs.	213-788-4124
Iowa	Cedar Rapids, S & O Sls. Inc.	319-393-1845
Mass	Burlington, Tekdata Inc.	617-273-0198
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
Tex	Richardson, P.J. Scanlon Co.	214-231-4661

MECHANICAL ENGRAVING CO., INC., 10 Van Cortlandt Ave., E., Bronx, N.Y., 10468, Tel: 212-LU 4-8600; FSC No: 99040; Empl.: 35; Minimum order: $15

For info on price: B.W. Mandel; Customer service: J.T. Mandel; Delivery info: J.T. Mandel

Products manufactured: Cams, Chassis, Metal, Dials, Indicators, Nameplates, Panels, Scales, Dial, Services, Assembly, Production & Test, Strips, Terminal Blocks, Boards & Strips

MECHANICAL ENTERPRISES, 601 Dale Dr., Silver Spring, Md., 20910, Tel: 703-321-8282, TWX: 710-832-0942

For info on price: R. H. Twyford; Application info: R. H. Twyford; Customer service: G. Russell; Delivery info: G. Russell

Free literature available: Keyboard designer's kit including data on all mercutron and gold v-bar switches, keytops, and keyboard accessories.

Products manufactured: Keyboards, Alphanumeric & Decimal, Switch Hardware, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Reps	205-881-5031
Ariz	Phoenix, KCE Corp.	602-955-5250
Cal	Burlingame, J. Logan & Assoc.	415-697-6100
Cal	Los Angeles, KCE Corp.	213-649-2622
Colo	Denver, Franklin Sls. Co.	303-922-3623
Fla	Palm Beach Gardens, Beacon Reps	305-622-2770
Ga	Atlanta, Beacon Reps	404-351-3654
Ill	Des Plaines, Coombs Assocs.	312-298-4830
Ind	Fort Wayne, Coombs Assocs.	219-747-0402
Md	Glen Arm, Hodgins Assocs.	301-592-7047
Mass	Lexington, Circuit Sls. Co.	617-861-0567
Mich	Jackson, Norwood Scroggs	517-750-1170
Mo	St. Louis, Beneke & McCaul, Inc.	314-567-3399
NY	Mt. Vernon, D. Sonkin Assocs.	914-668-9809
NY	Rochester, L. Hart	716-244-3253
Ohio	Dayton, Bear Mktg.	513-299-3566
SC	Spartanburg, Beacon Reps	803-582-4613
Tex	Dallas, I.B.L. Engrg. & Sls.	214-363-2921
Wisc	Greendale, Coombs Assoc.	414-421-2300

MECHANICAL ENTERPRISES, INC., 8000 Forbes Pl., Springfield, Va., 22151, Tel: 703-321-8282, TWX: 710-832-0942; Empl.: 25

For info on price: R. Twyford; Application info: R. Twyford; Customer service: G. Russell; Delivery info: G. Russell

Free literature available: Complete catalog & list containing specifications on 3 basic keyboard switches, including lighted and alternate action, 6 varieties of doubleshot molded keytops & 44 small deyboard arrays.

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns	205-881-5031
Ariz	Phoenix, KCE Corp.	602-258-7519
Cal	Burlingame, J. Logan	415-697-6100
Cal	Los Angeles, KCE Corp.	213-649-2622
Cal	San Diego, KCE Corp.	714-278-7640
Colo	Denver, Franklin Sls.	303-922-3623
Fla	Ft. Lauderdale, Beacon Electrns.	305-776-6074
Fla	Maitland, Beacon Elctrns	305-647-3498
Ga	Atlanta, Beacon Elctrns	404-351-3654
Ill	Chicago, Coombs Assoc. Inc.	312-298-4830
Ind	Fort Wayne, Coombs Assocs., Inc.	219-747-0402
Md	Glen Arm, Hodgins Assocs.	301-592-7047
Mass	Lexington, Circuit Sls. Co.	617-861-0567
Mich	Jackson, Norwood Scroggs & Co.	517-750-1170
Miss	Hernando, Beacon Elctrns.	601-368-9008
Mo	St. Louis, Beneke & McCaul	314-434-6242
NY	Mt. Vernon, D. Sonkin Assocs.	914-668-9809
NY	Rochester, Lloyd Hart	716-244-3253
NC	Greensboro, Beacon Elctrns.	919-674-9432
Ohio	Dayton, Neal Bear Corporation	513-299-3566
Ohio	Richfield, Neal Bear Corporation	216-659-3131
SC	Spartanburg, Beacon Elctrns.	803-576-4613
Tex	Dallas, IBL Engrg. & Sls.	214-363-2921
Wisc	Greendale, Coombs Assocs.	414-421-2300

MECHANICAL PROD., Div. Aiken Ind., 1824 River St., Jackson, Mich., 49204, Tel: 517-782-0391, TWX: 810-253-0827; Empl.: 200; Minimum order: $50

Customer service: R. Reed

Products manufactured: Circuit Breakers

Local Sales Offices & Reps.

Cal	Panorama City, Mechanical Prods.	213-781-8966

MEGATEK CORP., 1055 Shafter St., San Diego, Cal., 92106, Tel: 714-224-2721; Empl.: 25; Minimum order: $25

For info on price: C. Foley; Application info: W. Foley; Customer service: W. Foley; Delivery info: C. Foley

Free literature available: "7 Economical ways to solve your computer graphics problems:" A collection of data sheets and application notes on inexpensive approaches to computer graphics.

Products manufactured: Display Devices/Displays

Local Sales Offices & Reps.

Ala	Birmingham, Technical Assocs.	205-854-0616
Ariz	Phoenix, Data Sys. Mktg.	602-277-4732
Cal	La Mesa, Data Sys. Mktg.	714-447-5411
Cal	Newport Beach, Data Sys. Mktg.	714-540-2312
Cal	Poway, Data Sys. Mktg.	714-466-2172
Cal	San Francisco, Data Sys. Mktg.	415-391-1111
Colo	Littleton, Data Sys. Mktg.	303-795-1960
Fla	Orlando, Technical Assocs.	305-894-7531
Haw	Honolulu, Aloha Assocs.	808-941-1574
Kans	Prairie Village, Engineering Svcs. Co.	913-649-4000
Mass	Cambridge, Techexport	617-661-9424
Mich	Centerline, Dietrich & Assocs.	313-754-6450
Mo	St. Louis, Engineering Svcs.	314-997-1515
NJ	Tenafly, Budd-Tronics	201-569-2230
Ohio	Cleveland, Dietrich & Assocs.	216-781-1855
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
SC	Spartanburg, Technical Assocs.	803-579-2904
Utah	Bountiful, Data Sys. Mktg.	801-295-3457
Wash	Bellvue, Data Sys. Mktg.	206-455-2999
FOR:	Can., Rexdale, Ont., Ahearn & Soper, Ltd.	416-247-7141

MEGAVOLT, INC., Sub. Julie Research Labs., 211 W. 61st St., New York, N.Y., 10023, Tel: 212-245-2727; Empl.: 8

Customer service: H. Tekel

Free literature available: Manufacture of high voltage power supplies, insulation testers, and dividers.

Products manufactured: Cable, Dividers, Drivers, Nut, Meters, Modulators, All Kinds, Power Supplies, Regulators, Relays, Spark Gaps, Standards, Switches, Testers, Transformers

Advertisment

Specialists in the design, manufacture and testing of High Voltage Power Supplies and insulation testers.

Custom units at standard prices are our specialty.

Voltage rating range from 1 KV to 1000 KV and powers up to 1 Megawatt. Our dividers have accuracies to 0.001% and are certified traceable to N B S.

Contact Harry Tekel for immediate quotations. 212-245-2727

MEGURO ELECTRONIC INSTR. CO., 5-1 2-Chome Chu-Cho Meguro-ku, Tokyo, Japan, Tel: Tokyo 715-1211, TWX: 2468208 MEGURO J; Empl.: 230

Products manufactured: Calibrators, Generators, Meters, Oscillators, Oscilloscopes

MEKO INSTRUMENT CO., 1311 Air Way, Glendale, Cal., 91201, Tel: 213-240-4664; Empl.: 10

Customer service: M. F. Gonsalues

Free literature available: Electrical and mechanical specification catalogue.

Products manufactured: Counters, Meters, Relays

Local Sales Offices & Reps.

Cal	Encino, Porter Co.	213-788-2350
Cal	Mountain View, Weseloh & Assoc.	415-961-0565
Cal	Palos Verdes Peninsula, R. Carretta Co.	213-375-6648
Colo	Denver, Parker-Webster Co.	303-770-1972
Fla	Orlando, Geartner Assocs.	813-393-2974
Ga	Marietta, K & E Assocs.	404-427-0241
Haw	Honolulu, Aloha Assocs.	808-941-1574
Md	New Carrollton, W. A. Brown	703-836-1800
Mass	Millis, Selmark Assoc. Inc.	617-376-2914
NJ	Fort Lee, B. Cameron Assocs.	201-461-2595
NY	Burnt Hills, K. D. Corsetti	518-399-9200
Ohio	Cleveland, E. E. Bock & Assocs.	216-331-5212
Ohio	Dayton, BEK Assocs.	513-278-1343
Tex	Garland, G. V. Peck Co.	214-341-8311
Tex	Houston, G. V. Peck Co.	713-664-1435
Va	Alexandria, W. A. Brown	703-836-1800

Wash	Seattle, W. Spaulding Co.	206-282-9173
WVa	Charleston, W. A. Brown	304-342-2700
FOR:	Can., H8R 3H9, Quebec, Electrodesign Ltd.	514-363-5120

MELCOR-MATERIALS ELCTRN. PRODS., 990 Spruce St., Trenton, N.J., 08638, Tel: 609-393-4178, Telex: 84-3314; FSC No: 32333; Empl.: 36; Minimum order: $25

Customer service: M. A. Levine

Free literature available: 1. General catalog containing specifications, ratings and prices of all standard single stage heat pumps 2. Folder containing specifications and ratings of frigichip miniaturized heat pumps.

Products manufactured: Cooling/Heating Modules, Thermoelectric

Local Sales Offices & Reps.

Ill	Skokie, Spartan Engrg. Co.	312-674-2950

Advertisment

Creators of the Solderable Ceramic Thermoelectric Cooling Module and the "Frigichip" Miniaturized Module. Applications in Electro-optical Systems (Infrared Detectors, Photomultiplier Tube Housings), Medical and Biomedical Apparatus and Instruments, Institutional Refrigeration, etc. Highest reliability and efficiency. Modules and Assemblies supplied in OEM quantities and prices.

MELOY LABORATORIES INC., Instrus. & Sys. Div., 6715 Electronic Dr., Springfield, Va., 22151, Tel: 703-354-2600, Telex: 899-440; Empl.: 475; Minimum order: $10

Customer service: Mktg. Ext. 311-313

Products manufactured: Alarms, Analyzers, Calibrators, Controls/Control Eqpt., Converters, Counters, Generators, Multipliers, Oscillators, Sensors, Light, Standards, Timers, Tuning Forks

Local Sales Offices & Reps.

Cal	Los Altos, Collins & Hyde	415-941-3355
Mass	Hingham, Meloy Labs Inc.	617-749-4842
Mo	Kansas City, Nevco, Inc.	816-421-1751
NC	Wake Forest, Meloy Labs	919-556-1345

MELTRONICS INC., Route #3 Box 225, Leeds, Ala., 35094, Tel: 205-699-2186; Empl.: 20

Customer service: J. Miele

Products manufactured: Actuators, Antenna Rotators, Brakes, Clutches, Controls/Control Eqpt., Gears & Gear Mechanisms (Precision), Motors, Reducers, Solenoids

MEMCOR DIV. E-SYSTEMS, See E-Systems, Memcor Div.

MEMODYNE CORP., 369 Elliot St., Newton Upper Falls, Ma., 02164, Tel: 617-527-6600, Telex: 922537; Empl.: 14; Minimum order: $25

For info on price: K. Corbett; Application info: J. Pastoriza; Customer service: M. Furey; Delivery info: K. Corbett

Free literature available: Incremental Recorder Handbook; Data Sheets on all products; Short Form Catalog.

Products manufactured: Data Loggers, Recorders, Terminal Equipment, Digital

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier	205-536-5650
Ariz	Glendale, ED Assocs.	602-247-5818
Cal	Los Altos, H-R Assocs.	415-941-4080
Cal	Los Angeles, Cain Technology	213-476-2251
Colo	Westminster, Harvey Data Sys.	303-427-5299
Fla	Orlando, Currie, Peak & Frazier	305-855-0843
Haw	Honolulu, Hawaii Data Sys.	808-946-1533
Ill	Chicago, Elctrn. Instr. Assoc.	312-271-3774
Ind	Indianapolis, Elctrn. Instr. Assoc.	317-257-7231
Mass	Holbrook, McLellan Assocs.	617-767-4771
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
NJ	Wayne, G. & A. Sls.	201-256-8500
NM	Albuquerque, J & D Assocs.	505-255-2377
NY	Binghamton, Labtronics	607-748-0509
NY	Depew, Labtronics	716-685-4111
NY	Syracuse, Labtronics	315-454-9314
NY	Ulster Park, Labtronics	914-471-2806
NC	Greensboro, Currie, Peak & Frazier	919-273-3040
Ohio	Cleveland, Electro Sls. Assoc.	216-261-5440
Ohio	Dayton, Electro Sls. Assoc.	513-426-5551
Pa	Ambler, Wyncote Instrumentation	215-643-2440
Pa	Pittsburgh, Electro Sls. Assoc.	412-371-9449
Tex	Dallas, Bouco Sls. Assocs.	214-247-6708
Tex	Houston, Bouco Sls. Assocs.	713-661-9640
Va	Arlington, H. J. Heffernan Co.	703-522-6666
Wash	Seattle, Datacom Assocs.	206-285-2525
EXP:	Can., Laval, Que., Harvard Elctrn. Sls. Co.	514-681-1400

MEMOREX CORP., San Thomas at Central Expwy., Santa Clara, Cal., 95052, Tel: 408-987-1000; Empl.: 5300

Customer service: J. Pingree 408-987-3578

Free literature available: Brochures on: Computer peripheral equipment and media, audio/video tape for consumer & professional use, and word processing supplies.

Products manufactured: Comm. Systems, Disc Packs, Magnetic, Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Ala	Birmingham	205-870-4240
Cal	Los Angeles	213-380-4790
Colo	Denver	303-399-1943
Conn	Hartford	203-568-1370
Ga	Atlanta	404-321-0200
Ill	Oak Brook	312-325-8420
Mass	Waltham	617-890-0700
Mich	Southfield	313-354-0240
Minn	Minneapolis	612-835-6635
Mo	St. Louis	314-725-9687
NY	Buffalo	716-631-5410
NY	Long Island	212-541-7780
Ohio	Cincinnati	513-721-7120
Ore	Portland	503-228-9341
Pa	Bala Cynwyd	215-835-2190
Tex	Dallas	214-233-1031
Va	Richmond	804-288-3116
Wash	McLean	703-821-3300

MEPCO/ELECTRA, SUBSTRATE DIV., 10439 Roselle St., San Diego, Cal., 92121, Tel: 714-453-4733, TWX: 910-322-1134; Empl.: 50

Products manufactured: Substrates

Local Sales Offices & Reps.

Ala	Huntsville	205-534-7351
Cal	Los Angeles, N.A.P. Elctrn. Comps.	213-762-2118
Cal	North Hollywood	213-762-2118
Cal	San Diego	714-453-9250
Cal	Santa Clara, N.A.P. Elctrn. Comps.	408-249-1134
Colo	Denver	303-922-8434
Conn	Shelton, Comark Assoc.	203-929-4884
Fla	Fort Lauderdale	305-772-2840
Fla	Winter Park	305-678-2522
Ill	Elk Grove Village	312-593-8220
Ind	Indianapolis	317-257-6547
Kans	Olatha, BC Elctrns.	913-782-6696
Mass	Waltham	617-899-7100
Mich	Southfield	313-357-4288
Minn	Minneapolis, Siedare Assoc., Inc.	612-533-2294
Mo	Hazelwood, BC Elctrns.	314-731-1255
NJ	Montvale	201-391-3511
NY	Endicott, Tech-Mark, Inc.	607-748-7473
NY	Fairport, Tech-Mark, Inc.	716-223-1252
NY	Hempstead, Kahgan Sls. Corp.	516-538-2300
NY	Hicksville	516-931-6200
NY	Liverpool, Tech-Mark, Inc.	315-652-6229
NC	Raleigh, Candor Co., Inc.	919-787-2652
Pa	King of Prussia	215-265-4240
SC	Myrtle Beach, Candor Co., Inc.	803-448-5213
Tex	Dallas, N.A.P. Elctrn. Comps.	214-691-2141
Va	Richmond	703-282-6515
Wash	Bellevue, Western Tech. Sls.	206-454-3906

MEPCO/ELECTRA, INC., Columbia Rd., Morristown, N.J., 07960, Tel: 201-539-2000, TWX: 710-986-7473

Free literature available: - MEPCO/ELECTRA PRODUCT GUIDE - illustrates and briefly describes our entire product line which includes: capacitors, electrolytic; film; ceramic and trimmers. Fixed Resistors, carbon film; metal film. Variable Resistors, cermet; carbon; wirewound.

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Circuits, Hybrid, Thick Film, Cores, Ceramic, Networks, Potentiometers, Resistors, Substrates, Thermistors

Local Sales Offices & Reps.

Ala	Huntsville, North American Philips Elctrn. Comp. Corp.	205-534-7351
Ariz	Phoenix, N.A.P.E.C.C.	602-279-9588
Cal	North Hollywood, N.A.P.E.C.C.	213-762-2118
Cal	San Diego, N.A.P.E.C.C.	714-453-5440
Cal	Santa Clara, N.A.P.E.C.C.	408-249-1134
Colo	Denver, N.A.P.E.C.C.	303-922-8434
Conn	Shelton, Comark Assocs.	203-929-4884
Fla	Fort Lauderdale, N.A.P.E.C.C.	305-772-2840
Ill	Elk Grove Village, N.A.P.E.C.C.	312-593-8220
Ind	Indianapolis, N.A.P.E.C.C.	317-257-6547
Kans	Olathe, BC Elctrn. Sls.	913-782-6696
Mass	Waltham, N.A.P.E.C.C.	617-899-7100
Mich	Southfield, N.A.P.E.C.C.	313-357-4288
Minn	Minneapolis, Siedare Assocs.	612-533-2294
Mo	Hazelwood, BC Elctrn. Sls.	314-731-1255
NY	Endicott, Tech-Mark, Inc.	607-748-7473
NY	Fairport, Tech-Mark, Inc.	716-223-1252
NY	Hicksville, N.A.P.E.C.C.	516-931-6200
NY	Liverpool, Tech-Mark, Inc.	315-652-6229
NC	Raleigh, Candor Co.	919-787-2652
Ohio	Dayton, N.A.P.E.C.C.	513-278-7351
Pa	King of Prussia, N.A.P.E.C.C.	215-265-4240
SC	Myrtle Beach, Candor Co.	803-448-5213
Tenn	Chattanooga, Candor Co.	615-894-7454
Tex	Dallas, N.A.P.E.C.C.	214-691-2141
Va	Lynchburg, Candor Co.	804-846-6579
Va	Richmond, N.A.P.E.C.C.	804-282-6515
Wash	Bellevue, N.A.P.E.C.C.	206-746-3600

MERCER CONTROLS CORP., 96 Mercer St., New York, N.Y., 10012, Tel: 212-966-5815, Telex: 14-1484; Empl.: 15; Minimum order: $20

For info on price: D. Shaw; Application info: D. Shaw; Customer service: B. Kulack; Delivery info: Stock

Free literature available: Variable speed controls for permanent split capacitor, single phase AC induction motors to 1/4 HP. Speed range 20:1. Regulation - 1% load, 1% line.

Products manufactured: Controls/Control Eqpt.

Local Sales Offices & Reps.

Conn	Torrington, Motoreps of New England	203-482-3193
Ill	River Forest, Allen/Sizer Assoc.	312-366-3324
Mich	Detroit, C.H. Alexander Assocs.	313-535-4714
Minn	Minnetonka, T. H. Ayres Assoc. Inc.	612-474-4125
Miss	St. Louis, Delltron Co.	314-434-3804
NJ	Red Bank, Motoreps of New York	201-741-3356
NY	New York, Mercer Controls	212-966-5815
Ohio	Dayton, Electrical Syst. Co.	513-434-9822
Tex	Houston, Southland Engrg. & Sls.	713-782-4575
Va	Bellevue, Pacific Consultants	206-454-2503
Wisc	Wauwatosa, Larson Assocs.	414-258-0529

MERCURY ELECTRONICS CORP., 339 E Cottage Place, York, Pa., 17403, Tel: 717-854-9557; Empl.: 35

Customer service: C. R. Bruns 717-854-9557

Free literature available: Brochure

Products manufactured: Cable Assemblies & Harnesses

Local Sales Offices & Reps.

Pa	West Chester, S. E. Balint	

MERET INC., 1815 24th St., Santa Monica, Cal., 90404, Tel: 213-828-7496, Telex: 65-2468; Empl.: 12; Minimum order: $50

For info on price: M. B. Prince; Application info: D. B. Medued; Customer service: M. B. Prince; Delivery info: M. B. Prince

Free literature available: Hybrid Optoelectronic Modules - includes light sources with driving circuitry, defector packages with amplifiers, and total systems including fiber optic cables.

Products manufactured: Amplifiers, Circuits, Hybrid, Thin-Film, Comm. Systems, Detectors, Diodes, Lasers & Laser Systems, Sensors, Light, Transceivers, Transmission Systems, Data

MERIAM INC., Box 2134, Hammond, Ind., 46323, Tel: 219-980-1909, Telex: 72-5449; Empl.: 4; Minimum order: $100

For info on price: A. Jones 219-980-1909; Application info: E. Cronch 219-980-1909; Customer service: Miss Marlini; Delivery info: Miss Marlini 219-980-3566

Products manufactured: Punched Card Equipment

MERIX CHEM. CO., 2234 East 75th St., Chicago, Ill., 60649, Tel: 312-221-8242; Empl.: 15; Minimum order: $25

For info on price: J. Parus; Application info: E. O. Sonneman; Customer service: R. Newman; Delivery info: R. Newman

Products manufactured: Cleaners & Solvents, Coatings, Conductive Plastic Materials, Fabrics, Conductive, Lubricants, Phonographs, Parts & Accessories, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

MERRIMAC INDS., INC., 41 Fairfield Pl., West Caldwell, N.J., 07006, Tel: 201-228-3890, TWX: 710-734-4314; Empl.: 110

Customer service: F. J. Weber

Products manufactured: Attenuators, Circulators, Ferrite, Comparators, Couplers, Dividers, Isolators, Junctions, Hybrid, Microwave, Limiters, Mismatches, Microwave, Precision, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Networks, Shifters, Strip-Line Components, Microwave, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns.	205-881-5031
Cal	Orange, J.E. Hachten Co.	714-998-6020
Cal	Palo Alto, J.E. Hachten Co.	415-326-1252
Colo	Boulder, Herb Bass Assoc.	303-499-7509
Va	Alexandria, Vanguard Engrg.	703-768-1660
Wash	Seattle, Jon B. Jolly	206-938-4166

MERRIMACK MAGNETICS, 361 Aiken St., Lowell, Mass., 01850, Tel: 617-458-1487; Empl.: 200

Customer service: R. Ross

Products manufactured: Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, J. S. Heaton Co.	602-264-7887
Cal	Menlo Pk., J.S. Heaton Co., Inc.	415-369-4671
Conn	No. Haven, Comp. Rep.	203-239-9762
FOR:	Can., Cooksville, Ont., Anbak Sls., Ltd.	416-625-1061

MET-L-WOOD CORP., 6755 65th St., Chicago, Ill., 60638, Tel: 312-585-7575, Telex: 25-6106; Empl.: 110

For info on price: C. B. Correnti; Application info: C. B. Correnti; Customer service: V. Lutze; Delivery info: V. Lutze

Free literature available: General Brochure - general product info; Bulletin 661 - Cabinetry panels.

Products manufactured: Cabinets & Accessories, Honeycomb Sheets, Panels, etc., Laminates

Local Sales Offices & Reps.

Cal	San Jose, H.J. Carlson	408-226-9049
Fla	Largo, Dow Assocs.	813-595-9195
Ill	Chicago, R.R. Clemens	312-585-7575
Ill	Chicago, T.J. Neirinckx	312-585-7575
NJ	No. Haledon, J.P. Gagliano	201-427-5133
Ohio	Columbus, G.V. Pagorek	614-891-6856
Pa	Media, V.J. Higgins	215-566-9188

METAL BELLOWS CORP., 1075 Providence Hwy., Sharon, Mass., 02067, Tel: 617-668-3050; Empl.: 300

For info on price: S. Jackson; Application info: S. Jackson; Customer service: E. Mendeloff; Delivery info: S. Jackson

Products manufactured: Actuators, Braid, Cable, Couplings, Feedthrus & Seals, Environmental, Pumps, Vacuum, Seals, Shields

Local Sales Offices & Reps.

Cal	Chatsworth, Metal Bellows Co.	213-341-4900
Mo	Hazelwood, Strother & Assoc.	314-521-5100
NJ	Colt's Neck, J. L. Reddan	201-462-4624
Ohio	Port Clinton, W. C. Johnson	419-625-0943
Tex	Duncanville, J. Stephens	214-298-6994
FOR:	Can., Burnaby, B.C., Philip French Sls.	604-437-0312
FOR:	Can., Mississauga, Ont., Philip French Sls.	416-678-9261
FOR:	Can., Dorval 760, Que., Philip French Sls. Ltd.	514-636-1484

METALIZED CERAMICS, Huntington Industrial Pk., Providence, R.I., 02907, Tel: 401-943-2200; Empl.: 600

For info on price: J. T. Feeley; Application info: F. C. Rydwansky, Jr.; Customer service: R. Halpert; Delivery info: J. T. Feeley

Free literature available: Tech Data Sheets - Packages; Tech Data Sheets - Microwave & Opto Diode Housings; Design Guidelines - Multilayer Ceramics; Design Guidelines - Screened Dielectrics; Hybrid Package Design & Applications.

Products manufactured: Packages, Integrated Circuit, Services, Assembly, Production & Test, Substrates

Local Sales Offices & Reps.

Cal	Cupertino, Metalized Ceramics Corp.	408-996-1350
Tex	Richardson, Metalized Ceramics Corp.	214-238-0505

METALPHOTO CORP., 18531 South Miles Rd., Cleveland, Ohio, 44128, Tel: 216-475-0555; Empl.: 50

Customer service: M. Hizak

Free literature available: Metalphoto&R products, processes and applications.

Products manufactured: Labels, Pressure-Sensitive, Adhesive, Machines/Machinery, Production, Nameplates

METAVAC, INC., 45-68 162nd St., Flushing, N.Y., 11358, Tel: 212-HI5-0400; Empl.: 40; Minimum order: $100

Customer service: S.D. Feiman

Free literature available: O-1 list capabilities to supply thin film coatings and components for optical applications. E-1 catalog list resistors, attenuators and conductive coatings.

Products manufactured: Attenuators, Coatings, Films, Filters, Lenses, Optical & Camera, Lenses, Readout & Display, Resistors, Services, Assembly, Production & Test, Strip-Line Components, Microwave, Terminals

METEX CORP., 970 New Durham Rd., Edison, N.J., 08817, Tel: 201-287-0800, TWX: 710-998-0578; Empl.: 240

Products manufactured: Adhesives (All Types), Air Cleaners & Filters (Shielded & Unshielded), Bezels, Shielded & Unshielded, Braid, Cable, Coatings, Conductive Plastic Materials, Contact Strips, Finger, Contacts, Electrical, Gaskets, Shielding, R-F-Also See Shields, R-F, Honeycomb Sheets, Panels, etc., Kits, Shielding, Rubber, Shields, Wire, Wire Shielding

Local Sales Offices & Reps.

Ariz	Scottsdale, Inter-Mountain Engrg.	602-947-7379
Cal	Los Altos, Frauman Assocs.	415-941-0660
Cal	Los Angeles, Universal Comps.	213-641-4225
Colo	Denver, Walter Engrg.	303-777-5585
Conn	, Conners & Mann	617-769-2570
Fla	, Semtronic Assoc. Inc.	305-831-8233
Ga	Smyrna, B.C. Elctrn. Sls. Co.	404-436-5169
Ill	Chicago, R.M. Krueger Co.	312-282-8444
Mass	Westwood, Connors & Mann	617-769-2570
Minn	St. Paul, R.G. Ragon, Inc.	612-488-0201
Mo	St. Charles, Cairns & Hayes Elctrn. Sls.	314-946-6677
NY	Great Neck, Trionic Assocs.	212-762-4320
NY	Syracuse, C.W. Floring & Assocs.	315-478-2149
Ohio	Dayton, Jay Engrg. Co.	513-253-2151
Pa	Media, Snyder & Massey Assocs.	215-566-5400
Tex	Richardson, P.J. Scanlon Co.	214-231-4661
Va	Fairfax, Snyder & Massey Assocs.	703-273-1413
Wash	Seattle, Jon B. Jolly, Inc.	206-938-4166

METHODE ELCTRNS., INC., 7447 W. Wilson Ave., Chicago, Ill., 60656, Tel: 312-867-9600, TWX: 910-221-2468; Empl.: 900

For info on price: D. Mason; Application info: J. Klimek; Customer service: I. Lubor; Delivery info: I. Lubor

Products manufactured: Backpanel Interconnect Systems, Bars, Shorting, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Bus Bars & Systems, Cable Assemblies & Harnesses, Cable, Chemicals, Circuits, Flexible, Circuits, Printed, Multilayer, Connector Blocks, Mother Board, Connectors, Contact Strips, Finger, Contacts, Electrical, Guides, Circuit Board, Headers, Inks For Thick Film Microcircuits, Jack Adapters (All Types), Jacks (All Types), Panels, Plugs, Services, Assembly, Production & Test, Shields, Socket Adapters, Sockets, Switches, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Board Assocs.	602-994-9388
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Cal	El Segundo, Varigon Assocs.	213-679-0621
Fla	Winter Pk., Young & Lawrence	305-647-6929
Ill	Chicago, J. Howe	312-867-9600
Ind	Indianapolis, Schroeder & Loomis	317-251-4571
Ky	Fort Mitchell, G. W. Thelen Co.	606-341-8181
Mass	Needham, Massa & Maguire	617-329-0354
Mich	Dearborn, VPI	313-271-4600
Minn	St. Paul, R. G. Ragon	612-488-0201
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Haddonfield, T. A. I.	609-854-3011
NJ	Mountain Lakes, Components for Elctrns.	201-334-2921
NY	Pompey, S. F. Foster Co.	315-677-3333
SC	Myrtle Beach, Candor Co.	803-448-5213
Tex	Dallas, McKinney Sls. Co.	214-631-9450
Wash	Bellevue, Ray Over Sls. Co.	206-454-9187

METHODS RESEARCH CORP., 34 Asbury Ave., Farmingdale, N.J., 07727

METRA INSTRUMENTS, INC., 1161 San Antonio Rd., Mt. View, Cal., 94043, Tel: 415-961-7249; Empl.: 22

For info on price: F. Fitting; Application info: F. Fitting; Customer service: D. Marquez; Delivery info: P. Andrews

Products manufactured: Alarms, Annunciators, Data Acquisition & Reduction Systems, Display Devices/Displays, Monitors, Multiplexers, Printers, Scanners

Local Sales Offices & Reps.

Cal	San Francisco, Technical Sls. Dev.	415-346-1655
Cal	Sante Fe Springs, D.A. Matthews/Assocs.	213-693-5432
Fla	Port St. Lucie, Techl. Svcs. Assocs.	305-334-5266
Ill	Chicago, Liz Indl. Sls. Co.	312-943-5122
Md	Fulton, Gans-Fryling	301-837-6311
Mass	Newton Centre, Daner-Hayes	617-969-4650
Mass	Peabody, JSR Assocs.	617-532-0348
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
NJ	S. Orange, Daner-Hayes	201-763-1771
NY	Port Washington, Daner-Hayes	516-883-4576
NY	Rochester, Daner-Hayes	716-467-5100
NC	Matthews, W.K. Hile Co.	704-847-9125
Ohio	Cincinnati, A. Parker, Jr.	513-563-1843
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Okla	Tulsa, Pan Tech. Engrg. Co.	918-747-2494
Ore	Portland, Brett Assocs.	503-232-4184
Pa	Audubon, Daner-Hayes	215-666-5755
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tenn	Knoxville, W.K. Hile	615-690-1061
Tex	Arlington, Pan Tech Engrg.	817-261-4111
Tex	Houston, Pan Tech Engrg.	713-623-0640
Va	Arlington, Gans-Fryling	703-527-3262
Wash	Seattle, Brett Assocs.	206-935-8054
FOR:	Can., Calgary, Alberta, Cantech Controls, Ltd.	403-252-8151
FOR:	Can., Edmonton, Alberta, Cantech Controls, Ltd.	403-425-9810
FOR:	Can., Halifax, Nova Scotia, Cantech Controls, Ltd.	902-429-9103
FOR:	Can., St. Laurent, Que., Cantech Controls, Ltd.	514-636-8364
FOR:	Can., Vancouver, B. C., Cantech Controls, Ltd.	604-736-2851
FOR:	Can., Scarborough, Ont., Cantech Controls, Ltd.	416-438-6907

METRIC ENGRG., Div. Oven Ind's., Box 290, Mechanicsburg, Pa., 17055, Tel: 717-766-0741; Empl.: 30; Minimum order: $20

For info on price: T. M. Nolan; Application info: R. E. Eckert; Customer service: T. M. Nolan; Delivery info: T. M. Nolan

Products manufactured: Regulators

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs.	205-536-1941
Ariz	Scottsdale, S.C. Blaker Co.	602-948-3061
Cal	Encino, El-Tec, Inc.	213-981-9881
Cal	San Carlos, Westronics Assoc.	415-592-1417
Fla	Melbourne, Reynolds & Assoc.	305-727-3205
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	Skokie, Saffro & Assocs.	312-588-0905
La	Baton Rouge, Covington Instr. Co.	504-924-1784
Mass	Reading, Geder & Rotundi	617-944-3105
Minn	Minneapolis, C. E. Bohlig Co.	612-922-7011
Mo	St. Peters, K.M. & B. Tech. Sls.	314-278-3159
NY	Huntington, Andrews & Andrews, Inc.	516-692-8686
NY	Syracuse, Mike Antil	315-463-0266
NC	Greensboro, Reynolds & Assocs.	919-275-3725
Ohio	Medina, McShane	216-725-4568
Pa	Ambler, W&M Assocs.	215-643-4119
Tex	Dallas, Bouco Sales Assocs.	214-247-6708
Va	Falls Church, Beacon Elctrn. Assoc.	703-534-1673
EXP:	Lemoyne, Pa., Elctrn. International	717-737-8858
FOR:	Can., Ajax, Ont., R. D. Assocs.	416-294-6796

METRIC SYSTEMS CORP., 736 N. Beal St., Ft. Walton Beach, Fla., 32548, Tel: 904-242-2111; Empl.: 135; Minimum order: $50

For info on price: Mktg. Dept.; Application info: Mr. Henne; Customer service: D. Evans

Products manufactured: Analyzers, Annunciators, Antenna Towers & Supports, Boards, Printed Circuit, Calibrators, Cards, Linear Function, Cards, Logic, Comm. Systems, Computers, Converters, Data Acquisition & Reduction Systems, Flashers, Generators, Indicators, Monitors, Receivers, Recorders, Simulators, Tape Search Equipment, Terminal Equipment, Digital, Timers, Tracking Systems, Translators, Data

Local Sales Offices & Reps.

Fla	Orlando, Datarep Inc.	305-843-5224

METRIX INSTRUMENT CO., Box 36501, Houston, Tex., 77036, Tel: 713-668-2386; Empl.: 26

Customer service: H. W. Kinne

Free literature available: 1975 Vibration Catalog - Vibration Inst'n. Bulletin DW-103 - DATAWATCH® Alarm Monitors and Signal Transmitters.

Products manufactured: Accelerometers, Alarms, Amplifiers, Analyzers, Converters, Indicators, Meters, Monitors, Switches, Testers, Transducers

Local Sales Offices & Reps.

Ala	Birmingham, Lewis M. Crowe Co	205-629-5475
Ariz	Phoenix, Roy E. Coulson Co.	602-947-8331
Cal	Encino, Arens Inds.	212-986-5560
Cal	San Francisco, Technical Sls. Div.	415-346-1655
Conn	Newton, Daner-Hayes	203-426-9094
DC	Washington, Wright Co	202-296-0979
Fla	St. Petersburg, Lewis M. Crowe Co	813-894-0249
Ill	Chicago, Martec Assocs.	312-956-8090
La	Baton Rouge, Carter Elctrns.	504-272-3175
Md	Gaithersburg, Wright Co	202-296-0979
Mass	Newton Centre, Daner-Hayes	617-969-4650
Mich	Detroit, Basic Service Corp.	313-837-8820
NJ	Englewood, Tridon Sls. Co.	201-569-8011
NY	NYC, Tridon Sls Co	201-569-8011
Ohio	Englewood, Gemini, Inc.	513-890-5394
Ohio	N. Canton, M. S. Jacobs	216-494-5480
Okla	Tulsa, Quigg Equip.	918-587-0166
Pa	Philadelphia, Control Equip.	215-676-1460
Pa	Pittsburgh, M.S. Jacobs & Assoc.	412-923-2090
Tenn	Knoxville, Lewis M. Crowe Co	615-693-4226
Tex	Lubbock, Killian Inds.	806-792-8768
WVa	Charleston, M. S. Jacobs & Assoc.	304-343-8906

METROLOGIC INSTRUMENTS, INC., 143 Harding Ave., Bellmawr, N.J., 08030, Tel: 609-933-0100; Empl.: 51

For info on price: S. Decicco; Application info: G. Punis; Delivery info: S. Decicco

Free literature available: Catalog describes the company's line of HE-NE lasers, education laboratories, holography systems, optical benches and accessories.

Products manufactured: Lasers & Laser Systems, Meters, Monitors, Power Supplies, Radiometers, Substrates, Tubes

METROPOLITAN CIRCUITS INC., 1261 Logan, Costa Mesa, Cal, 92626, Tel: 714-549-2204; Empl.: 400

Customer service: R. Florez

Products manufactured: Boards, Printed Circuit, Circuits, Printed, Multilayer

METROPOLITAN WIRE CORP., Industrial Div., Washington & George, Wilkes-Barre, Pa., 18705, Tel: 717-825-2741

Customer service: Cust. Svc.

Free literature available: 1M175 Applications brochure - Super Erecta shelf mobile & stationary materials handling equipment PCB-773 Data Sheet - printed circuit board baskets MC-873 Data Sheet - meter carriers.

Products manufactured: Carts & Dollies, Instrument & Equipment, Containers, Holder & Carriers, Holders, Circuit Board (Production Type), Racks

METROSONICS, INC., Box 18090, Rochester, N.Y., 14618, Tel: 716-442-0760; Empl.: 20

Free literature available: db-201 General Purpose Sound Level Meters db-400 Sound Level Recorders db-501 Octane Band Analyzers db-600 Sound Level Analyzers

Products manufactured: Analyzers, Calibrators, Meters, Microphones, All Kinds, Recorders

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Conn	Hamden, Northeast Engr.	203-248-4481
Fla	Orlando, BCS Assocs.	305-896-4881
Ind	Indianapolis, Tri-State Tech. Sls.	317-924-3568
Mass	Danvers, Northeast Engrg.	617-774-3010
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Mo	St. Louis, Adelphi Inc.	314-821-1232
NY	Dewitt, db Assocs.	315-446-0220
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Ohio	Dayton, Electrosales Assocs.	513-426-5551
Pa	King of Prussia, Valley Instr.	215-265-1020
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449

METROSONICS, INC. cont'd

Advertisment

Specialists in sound measurement instrumentation. Designers and manufacturers of acoustical equipment including miniature general purpose sound level meters and sophisticated recording and analysis products. Complete system design capability for industrial and environmental applications including interfacing transducers, computers, etc.

MEYERCORD CO., 365 E. North Ave., Carol Stream, Wheaton, Ill., 60187, Tel: 312-682-6200, Telex: 72-2449; Empl.: 683; Minimum order: $25

For info on price: A.M. Batchen 312-682-6226; Application info: R.A. Jando 312-682-6228; Customer service: R.G. Kline 312-682-6351; Delivery info: E. Prochaska 312-682-6316

Products manufactured: Delcalcomania, Labels, Pressure-Sensitive, Adhesive, Nameplates

Local Sales Offices & Reps.

Cal	Fremont	415-794-6522
Cal	Los Angeles	213-723-8661
Ga	Atlanta	404-237-3422
Kans	Leawood	913-648-3480
Mass	Fayville	617-879-0447
Mich	Detroit	313-538-5819
Mich	Grand Rapids	616-451-3773
Minn	Brooklyn Center	612-566-3380
Mo	St. Louis	314-965-0857
NY	Mamaroneck	914-698-0710
Ohio	Chesterland	216-729-4644
Ore	Portland	503-244-3144
Pa	Abington	215-885-2820
Tex	Houston	713-528-0962
Tex	Winnsboro	214-342-6307
Wisc	Milwaukee	414-272-8294

MFE CORPORATION, Keewaydin Dr., Salem, N.H., 03079, Tel: 603-893-1921, TWX: 710-366-1887; Empl.: 224 .... p. 1•179-181,876-879,1016

Products manufactured: Heads, Recording Playback, Erase, Monitors, Motors, Paper, Graphic Recording, Printers, Recorders, Scanners, Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Phoenix, Moxon Elctrns.	602-273-7363
Cal	Goleta, Thorson Co.	805-964-8751
Cal	Irvine, Moxon Elctrns.	714-556-6500
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	Mt. View, Thorson Co.	415-964-9300
Cal	San Diego, Mokon Elctrns.	714-292-4820
Cal	Santa Clara, Moxon Elctrns.	408-249-2491
Cal	Tustin, Thorson Co.	714-544-5121
Colo	Denver, Thorson Co.	303-759-0809
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9767
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ga	Chamblee, Lee Assocs.	404-457-7117
Haw	Honolulu, Industrial Elctrns., Inc.	808-533-6095
Ill	Elk Grove Village, L.F. Green Assocs.	312-593-0282
Ind	Indianapolis, L.F. Green Assocs.	317-293-9827
Md	Anapolis, Bartek	301-261-2987
Md	Silver Spring, Gawler Knoop Co.	301-589-4406
Mass	Natick, Andruss-Peskin Co.	617-653-3919
Mich	Royal Oak, Group Ten	313-549-3910
Minn	Minneapolis, L.F. Green & Assocs.	612-781-1611
NJ	Kinnelon, Science Supply Corp.	201-838-8746
NJ	N. Plainfield, Brady Co.	201-753-7988
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
NY	Buffalo, H.C. Johnson Agencies, Inc.	716-632-7880
NY	Fayettvile, H.C. Johnson Agencies, Inc.	315-637-9383
NY	Great Neck, Science Supply Corp.	516-487-1173
NY	Rochester, H.C. Johnson Agencies, Inc.	716-482-3000
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Glenshaw, H.C. Johnson Agencies, Inc.	412-961-0414
Pa	Philadelphia, V.S. Malta Co.	215-836-5122
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Va	Norfolk, Scientific Devices/E-Tech	804-499-8133
Wash	Bellevue, Thorson Co.	206-455-9180

MF ELECTRONICS CORP., 118 E. 25th St., New York, N.Y., 10010, Tel: 212-674-5360, TWX: 710-581-4109 p. 1•384-387

Products manufactured: Oscillators

Local Sales Offices & Reps.

Cal	North Hollywood, B.J. Wolfe Entprs.	213-877-5518
Conn	Meriden, Abbott-Allison Co.	203-237-9232
NY	Huntington, C.R. Mayer Co.	516-921-7876

M.I.A.L. U.S.A., INC., 165 Franklin Ave., Nutley, N.J., 07110, Tel: 201-667-1600, TWX: 710-989-1443; Empl.: 10; Minimum order: $35

For info on price: J. W. Yuhas; Application info: J. W. Yuhas; Customer service: R. Birtwistle; Delivery info: R. Birtwistle

Free literature available: MIAL U.S.A. offers Ceramic disc capacitors, all styles of Polystyrene capacitors both general purpose and professional, solid Tantalum capacitors (dipped style) and Metal Film resistors.

Products manufactured: Capacitors, Fixed, Resistors

Local Sales Offices & Reps.

Cal	Walnut Creek, MacPherson Sls.	415-937-1482
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Colo	Golden, J.F. Hurlbut	303-279-7138
Ill	Rolling Meadows, Lightner	312-398-3000
Mich	Detroit, R.S. Lohmann Co.	313-474-6144
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
NJ	Nutley, Falk-Baker Assocs.	201-661-2431
NY	Pompey, S.F. Foster	315-667-3333
NC	Raleigh, A.B. Andrews & Co.	919-833-5565
Pa	Oreland, Brown-Oberlies	215-887-1325
Tex	Addison, Parvin Sls. Co.	214-239-9148

MI2 DATA SYSTEMS INC., Design Elements Div., 930 Kinnear Rd., Columbus, Ohio, 43212, Tel: 614-481-8881; Empl.: 110

For info on price: G. Gerhard; Application info: G. Gerhard; Customer service: D. Buelow; Delivery info: G. Gerhard

Free literature available: Product Data Sheets on acoustic couplers, direct access data sets, and other data transmission equipment cover features and specifications of each device. Product catalog giving a capsule review of all MI2 data systems products.

Products manufactured: Comm. Systems, Converters, Couplers, Data Compressors, Digital, Modulator/Demodulators, Multiplexers, Printers, Recorders, Teleprinters, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ga	Atlanta, R. Geiger	404-455-1830
Ohio	Cincinnati, L. Sherman	513-531-2729
Pa	Berwyn, L. Phelan	215-647-0797

MICA CORPORATION, 10900 Washington Blvd., Culver City, Calif., 90230, Tel: 213-559-4223, TWX: 910-340-6365; FSC No: 06216; QPL No: Multiple; Empl.: 300; Minimum order: $100

For info on price: W. Kennedy; Application info: P. Benke; Customer service: G. Rogers; Delivery info: G. Rogers

Free literature available: Epoxy Glass and Polyimide Glass Laminates, Ohmega Resistor-Conductor Laminate, Conductor Metalized Substrates for Hybrid Circuitry, Micapak Lamination Service, Hybrid Circuitry and Thin Copper Claddings.

Products manufactured: Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Printed, Multilayer, Laminates

Local Sales Offices & Reps.

Cal	Mountain View, West Mark Assocs.	415-969-1700
Fla	Orlando, R. F. Carlson Co.	305-422-3996
Md	Lutherville, Nationwide Circuit Prods.	301-296-0009
NH	Amherst, Nationwide Circuit Prods.	603-889-2122
NJ	Cedar Grove, Nationwide Circuit Prods.	201-857-1333
NY	Utica, Nationwide Circuit Prods.	315-735-7686
Tex	Dallas, Stevens Sls.	214-350-2476
Wash	Seattle, R Johnston Co.	206-524-5170

MICHIGAN MAGNETICS, 203 W. Third St., Vermontville, Mich, 49096, Tel: 517-726-0590; Empl.: 95; Minimum order: $15

For info on price: B. L. Killinger; Application info: M. Fox; Customer service: B. Killinger; Delivery info: B. Killinger

Products manufactured: Heads, Recording Playback, Erase

Local Sales Offices & Reps.

Cal	Burlingame, J. Logan Assoc.	415-697-6100
Cal	Los Angeles, C. L. Repp Co.	213-820-1715
Conn	Kensington, N. Stachelek	203-223-6423
Ill	Chicago, J. Twist	
Minn	St. Paul, Countryman	612-645-9151
NY	Great Neck, R. Breuer	516-466-3030
EXP:	New York, Singer Products	212-432-1400

MICONICS INDUSTRIES INC., 135 Ailene Way, Syosset, N.Y., 11701

MICRITE METAL MFG., INC., 21531 Strathern St., Canoga Park, Cal., 91304, Tel: 213-348-1610; Empl.: 16 p. 2•1236-1239

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Cases, Equipment, Instrument, Meter, Chassis, Metal, Containers, Cups, Encapsulation, Horns, Microwave, Metal Oxides, Services, Assembly, Production & Test, Shields

Local Sales Offices & Reps.

Ariz	Phoenix, Dorton Entprs.	602-263-0414
Cal	Fountain Valley, Stangenberg & Assoc.	714-968-5049
Cal	Santa Clara, King & Assocs.	408-240-1022
Ill	Parkridge, Central States Assocs.	312-692-2101
Mass	Woburn, Jalco Assocs.	617-227-1515
Mo	Kansas City, Burke Sls. Co.	816-842-5511

MICRO-CIRCUITS CO., INC., Dept EEM I, New Buffalo, Mich., 49117, Tel: 616-469-2727 ..... p. 2•342,343

Free literature available: Catalog-Descriptions of our line of electrically conductive coatings. Ten basic ways to use electrically conductive coatings.

Products manufactured: Coatings, Inks For Thick Film Microcircuits, Paints, Shields

MICRO COMPONENTS CORP., 99 Bald Hill Rd., Cranston, RI, 02920, Tel: 401-737-3200, TWX: 710-381-1757; Empl.: 120

Customer service: E. Rasmanis

Products manufactured: Alarms, Amplifiers, Choppers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Converters, Diodes, Integrated Circuit Devices, Semiconductor Wafer Fabrication, Transistors

Local Sales Offices & Reps.

Cal	San Jose, Allgood-North	408-288-6731
Colo	Denver, Omega Ltd.	303-758-1508
Ill	Chicago, M & S Sls. Co.	312-992-1053
Mass	Westboro, Tech. Mktg. Serv. Co.	617-366-8462
Minn	Minneapolis, Siedare Assocs.	910-576-3171
Mo	Webster Groves, Boyce Assocs.	341-961-8235
NY	Plainview, Erde Assocs.	516-822-5357
Ohio	Cincinnati, R. Makin Assocs.	513-232-5588
Wash	Seattle, Blair-Hirsh Co.	206-783-3423

MICRO DEVICES CORP., Box 501 - Far Hill Sta., Dayton, Ohio, 45419; Empl.: 450

Products manufactured: Circuit Breakers, Controls/Control Eqpt., Current Sensors, Fuses, Indicators, Limiters, Monitors, Protectors, Thermocouples, Elements & Accessories, Thermostats

Local Sales Offices & Reps.

Ala	Decatur, Tenn-Tech Sls.	205-350-0630
Cal	Fremont, Hartfield, Kennan & Freytag	415-863-2200
Cal	Los Angeles, Hartfield, Kennan & Freytag	213-225-1318
Colo	Denver, Thorson Co.	303-759-0809
Conn	Madison, L.J. Carr, Inc.	203-245-4890
Fla	Maitland, D & E Assocs.	305-644-3039
Ill	Arlington Heights, W.J. Davis	312-545-0166
Ind	Marion, O.H. Bromberg & Assocs.	317-664-5384
Ky	Louisville, O.H. Bromberg & Assocs.	502-245-8916
Mich	Rochester, R. Shurte	313-375-0888
Minn	Minneapolis, C. Listug	612-537-6740
Mo	Raytown, G.F. Beckett & Co.	816-358-0404
Mo	Saint Louis, Thunderbird	314-567-6488
NJ	Denville, Grimm, Siegel Assocs.	201-877-2154
NY	Binghamton, Elcom Sls.	607-723-9270
NY	East Northport, Grimm, Siegel Assocs.	516-757-7642
NY	Plainview, Grimm, Siegel Assocs.	516-938-9721
NY	Rochester, Elcom Sls.	716-385-1400
NY	Whitesboro, Elcom Sls.	315-732-6445
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Cincinnati, O.H. Bromberg & Assocs.	513-381-5728
Ohio	Cleveland, Allied Entprs.	216-234-3838
Ohio	Dayton, O.H. Bromberg & Assocs.	513-434-8788
Pa	Devon, Kiley Elec. Co.	215-687-9340
SC	Greenville, R.W. Chapman & Co.	803-232-5391
Tex	Fort Worth, T.J. Small Co.	817-332-6353
Wash	Vancouver, Hartfield, Kennan & Freytag	503-228-1683
Wisc	Milwaukee, R.C. Zingler Co.	414-964-8120

MICRO INSTRUMENT CO., Marine & Power Instr. Div., Box 1565, Escondido, Cal., 92025, Tel: 714-746-2010, TWX: 910-322-1156; Empl.: 20; Minimum order: $10

Customer service: C. L. Marks

Free literature available: "M.I.C. Live Wires" - new power monitoring techniques and applications. Distributed to qualified power engineers. "M.I.C. Navigation News" - information on the latest changes in the Omega system and new navigation products.

Products manufactured: Alarms, Detectors, Meters, Monitors, Oscillographs, Direct Writing, Oscilloscope Plug-Ins, Probes, Recorders, Testers

Local Sales Offices & Reps.

Ala	Birmingham, Spader & Assocs.	205-879-1366
Cal	Emeryville, Independent Engrg. Assoc.	415-658-4476
Cal	Santa Fe Springs, Underground Svc. & Supply Co.	213-941-7833
Colo	Denver, Utility Prods., Inc.	303-758-3103
Conn	East Hartford, Tekdata, Inc.	203-525-7647
Fla	Orlando, Datarep, Inc.	305-843-5224
Ga	Decatur, Spader & Assocs.	404-296-3024
Ill	Chicago, Electronic Instr. Assocs.	312-271-3774
Ind	Indianapolis, M & L Assocs.	317-546-1155
Md	Silver Springs, Rep-Tron, Inc.	301-593-4844
Mass	Burlington, Tekdata, Inc.	617-273-0198
Mich	Detroit, Electro Entprs. Inc.	313-521-1500
NJ	Cherry Hill, L. H. Walke Co.	609-424-3766
NJ	East Orange, Friedman Assocs.	201-673-2500
Ohio	Dayton, Electro Entprs., Inc.	513-420-6071
Ore	Portland, Arnett Sls.	503-292-9746
Pa	Pittsburgh, Electro Entprs., Inc.	412-371-8497

MICRO LINE DIV. BAUSCH & LOMB, 2 Girts Rd., Jamestown, N.Y., 14701, Tel: 716-488-1958, Telex: 91-547; Empl.: 50

Products manufactured: Coatings, Counters, Disc Packs, Magnetic, Encoders, Services, Assembly, Production & Test

MICRO MASK, INC., 716 N. Pastoria Ave., Sunnyvale, Cal., 94086

MICRO-MEASUREMENTS DIV., Vishay Intertechnology, Inc., Box 306; Romulus, Mich., 48174, Tel: 313-941-3900, Telex: 23-0328; Empl.: 235

For info on price: G. J. Guminski; Application info: L. B. Sayles; Customer service: G. J. Guminski; Delivery info: G. J. Guminski

Free literature available: Short Form Catalog 95 describes M-M Strain Gages, Temperature Sensors, Fatigue Life Gages, Crack Propagation Gages, Manganin Gages, Bondable Resistors, and related accessories (adhesives, protective coatings, wires, solders, surface preparation supplies, installation tools, etc.)

Products manufactured: Gages, Transducers

Local Sales Offices & Reps.

Cal	Santa Clara, Johnson Assoc.	408-984-4626
Cal	Wilmington, Premtronics Inc.	213-830-5871
Colo	Denver, Davis Assoc.	303-744-6644
Ga	Atlanta, Craft Assocs.	404-393-0400
Ill	Glen Ellyn, G.B. Hall Co.	312-858-1700
Mass	Natick, Andruss-Peskin Corp.	617-653-3919
NM	Albuquerque, Rustco Entrps.	505-296-6474
Ohio	Medina, Stress Analysis Svcs.	216-725-7733
Pa	Chadds Ford, Stress & Test Sls.	215-793-1008
Pa	Frazer, Measurement Sls.	215-644-7142
Tex	Dallas, Tech. Prods.	214-357-9603
Wash	Seattle, Brett Assocs.	206-935-8054

MICRO-MO ELECTRONICS INC., 3691 Lee Rd., Cleveland, Ohio, 44120, Tel: 216-921-1131, Telex: 98-0650; Empl.: 50

For info on price: S. Frakes 216-921-1131; Application info: J. W. Linko 617-453-1719; Customer service: S. Frakes 216-921-1131; Delivery info: S. Frakes 216-921-1131

Free literature available: Short form catalog - Contains all electrical, thermal, and mechanical specifications.

Products manufactured: Amplifiers, Controls/Control Eqpt., Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Motors, Tachometers

MICRO NETWORKS, 324 Clark St., Worcester, Mass., 01606, Tel: 617-852-5400, TWX: 710-340-0067; Empl.: 160

For info on price: B. Smith; Application info: D. Pouliot; Customer service: A. Peterson; Delivery info: D. Pouliot

Free literature available: Short Form Catalog - data sheets application notes

Products manufactured: Amplifiers, Circuits, Hybrid, Thin-Film, Converters, Data Acquisition & Reduction Systems, Hybrid Voltage Regulators, Integrated Circuit Devices

Local Sales Offices & Reps.

Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Burlingame, Leddy Assocs.	415-347-5247
Cal	Santa Ana, Calif. Elctrns. Mktg., Inc.	714-835-2702
Fla	Winter Park, Young & Lawrence Assoc.	305-647-6929
Haw	Honolulu, Aloha Assocs.	808-941-1575
Ill	Chicago, Communication Engrs.	312-761-0548
Mass	Lexington, J.E. Boeing, Inc.	617-862-2500
Mich	Detroit, Rathsburg Assoc., Inc.	313-882-1717
Minn	St. Louis Park, Beta Engrg. Corp.	612-925-4422
Mo	St. Louis, Beneke & McCaul, Inc.	314-434-6242
NY	Jamaica, S-J Sales Assoc.	212-291-3232
NY	Syracuse, Nycom, Inc.	315-437-8343
Ohio	Dayton, Midwest Mktg. Assoc.	513-433-2511
Pa	Berwyn, Tucker Assoc.	215-644-0142
Tex	Dallas, J. Clay Co.	214-350-1281
Wash	Seattle, J.B. Jolly, Inc.	206-938-4166

MICRO-NOW INSTR. CO., 6104 N. Pulaski Rd., Chicago, Ill., 60646, Tel: 312-478-1151; Empl.: 15; Minimum order: $25

For info on price: G. Zielinski; Application info: R. Houget; Customer service: G. Zielinski

Free literature available: Catalog of products, and current engineering bulletins.

Products manufactured: Amplifiers, Generators, Mixers, Multipliers, Power Supplies, Receivers, Spectrometers, Synchronizers, Klystron & BWO

Local Sales Offices & Reps.

Cal	Los Angeles, Mc Dougall/Mc Laughlin Co.	213-477-8556
Colo	Boulder, H. Bass Assocs.	303-499-7509
NJ	Westfield, Gray & Reed	201-AD3-6116
NM	Albuquerque, IMEC	505-344-2212
NY	Huntington Station, Gray & Reed Assocs.	516-GE3-3333
Tex	Dallas, Texas Avionics Co.	214-368-3566

MICRO-OHM CORP., Box 287, South Laguna, Cal., 92677, Tel: 213-442-3310; FSC No: 20940; Empl.: 109; Minimum order: $25

Customer service: C. A. Schwab

Free literature available: Quality Precision - Precision Wirewound, Commercial Power, Film and Carbon Film Resistors.

Products manufactured: Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Gassner & Clarke	602-945-7979
Cal	Orange, Sls. & Mktg. Assocs.	714-997-5720
Cal	Redwood City, Siani Johnson, Inc.	415-365-6263
Cal	San Diego, B. Tauber	714-274-7242
Colo	Denver, Electrodyne	303-757-7679

MICRO POWER SYSTEMS INC., 3100 Alfred St., Santa Clara, Cal., 95050

MICRO SWITCH, Div. Honeywell Inc., 11 W. Spring St., Freeport, Ill., 61032, Tel: 815-232-1122, TWX: 910-642-0922; Empl.: 3000 ..... p. 1•2101

Free literature available: Catalogs 50, 51, 52 - Switches, Various Types, Catalog NTC - "No Touch" Photoelectric controls and proximity controls. Product Brochure SN - solid state pushbutton switches. Product Brochure SD - Solid state keyboards. DC Motors Brochure - Low inertia high performance DC motors with fast acceleration and deceleration.

Products manufactured: Alarms, Caps, Lenses, Indicator Light, Controls/Control Eqpt., Indicators, Keyboards, Alphanumeric & Decimal, Light Sources, Photoelectric, Motors, Relays, Switch Handle Boots, Switches

Local Sales Offices & Reps.

Cal	Los Angeles	213-723-6611
Cal	San Jose	408-732-0120
Colo	Englewood	303-771-2340
Conn	Hartford	203-549-3800
Ga	Atlanta	404-321-2565
Ill	Skokie	312-478-9266
Iowa	Davenport	319-355-6456
Mass	Bedford	617-275-2440
Mich	Southfield	313-424-3569
Minn	Minneapolis	612-835-5400
Mo	Creve Coeur	314-991-4100
NJ	Westfield	201-233-9200
NY	Elmsford	914-592-3200
NY	Rochester	716-461-1600
NY	Syracuse (Liverpool)	315-451-4000
Ohio	Cleveland	216-881-0300
Ohio	Dayton	513-461-4480
Pa	Blue Bell, Merion-Towle House	215-643-5820
Tenn	Memphis	901-396-6222
Tex	Dallas	214-661-5459
Va	McLean	703-790-3525
Wash	Mercer Island	206-233-2010
Wisc	Milwaukee	414-771-6300

MICRO SYSTEMS, INC., 2106 W. Peoria, Phoenix, Ariz., 85029, Tel: 602-997-5931; Empl.: 30

Customer service: Sls. Dept.

Free literature available: Brochure (20-page) describing Micro 500-series logic-circuit testers; Booklet containing technical reprints and descriptions of company products and services.

Products manufactured: Analyzers, Test Systems, Testers

MICRO SYSTEMS INT'L., Box 3529, Sta. C, Ottowa, Can.

MICRO-TEL CORP., 6310 Blair Hill La., Baltimore, Md., 21209, Tel: 301-823-6227; Empl.: 50

Customer service: Sls. Dept.

Free literature available: Data Sheets containing technical specifications on all products manufactured.

Products manufactured: Calibrators, Comm. Systems, Converters, Counters, Generators, Receivers, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Scottsdale, J. Smith & Assocs.	602-947-2495
Cal	Cupertino, T. Louis Snitzer Co.	408-257-8333
Cal	Los Angeles, T. Louis Snitzer Co.	213-836-6170
Colo	Boulder, J. Smith & Assoc.	602-947-2495
Fla	Orlando, Gentry Assocs.	305-894-4401
NJ	Hazlet, Mer Mon	201-264-1851
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	Huntington, N. Ellen	516-368-5841
NC	Burlington, Gentry Assocs.	919-227-3639

MICRODATA CORP., 17481 Red Hill Ave., Irvine, Cal., 92705, Tel: 714-540-6730, TWX: 910-595-1764; Empl.: 375

Products manufactured: Comm. Systems, Computers, Memory Systems

Local Sales Offices & Reps.

Cal	Los Angeles, Microdata Corp.	213-596-5404
Cal	San Jose, Microdata Corp.	408-225-3235
Ill	Deerfield, Microdata Corp.	312-948-9440
Md	Rockville, Microdata	301-881-6282
Mass	Foxboro, Microdata	617-543-6306
Mich	Farmington, Microdata Corp.	313-477-8686
NY	Hauppauge, Microdata Corp.	516-724-4807
Pa	King of Prussia, Microdata	215-337-1839
Tex	Dallas, Microdata Corp.	214-239-8186

MICRODOT, See Ailtech, Western Opers.

MICRODYNAMICS, 9855 Dupree, So. El Monte, Cal., 91733, Tel: 213-579-1166; Empl.: 40

Customer service: J. Foster

Free literature available: Automated Omega Probe Station Probe Card Manufacturing Station Fixed Array Probe Card for testing & laser trimming Multiprobe cards - IC/TF Movable Magnetic Probe Card

Products manufactured: Calculators, Electrical & Electronic, Clocks (All Types), Probes, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Mountain View, Karl Suss KG	415-961-1720
Cal	Santa Ana, Schlines-Richardson	714-832-1949
Fla	Sarasota, W. J. Irvine Co.	813-955-9656
Kans	Prairie Village, Dougherty & Assocs.	913-649-3515
Mass	Needham Heights, COM/PAK	617-444-1259
Minn	St. Paul, MURNCO	612-484-8200
Mo	St. Louis, J. E. Metz Co.	314-993-1979
NJ	Sparta, Production Technology	201-729-7159
NY	Niagara Falls, Watmet	716-285-3595
Ohio	Dayton, Sidnell Co.	513-885-4161
Tex	Dallas, Crockett Southwest Co.	214-251-1776
Wisc	Milwaukee, Process Technology	414-464-6620

MICROFLECT CO., 3575 25th S.E., Salem, Ore., 97302, Tel: 503-363-9267, TWX: 510-599-0107; Empl.: 85

For info on price: G. Kreitzberg; Application info: J. Kreitzberg; Customer service: R. Kreitzberg; Delivery info: R. Kreitzberg

Products manufactured: Antenna Towers & Supports, Mounts

MICROLAB/FXR, 10 Microlab Rd., Livingston, N.J., 07039, Tel: 201-992-7700, TWX: 710-994-4850; FSC No: 00929; Empl.: 185; Minimum order: $25

Customer service: M. J. DiPrimo

Products manufactured: Adapters, Waveguide, Amplifiers, Antennas, Attenuators, Bends & Twists, Microwave, Bolometers, Calorimeters, Microwave, Cavities, Microwave, Chokes, Circulators, Ferrite, Connector Adapters, Converters, Couplers, Detectors, Diodes, Dividers, Dummy Loads, Filters, Flanges, Waveguide, Horns, Microwave, Isolators, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Kits, Test Equipment, Kits, Training Aid, Limiters, Line Strechers, Microwave, Meters, Mismatches, Microwave, Precision, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Monitors, Mounts, Multipliers, Preselector-Mixers, Preselectors, Probes, Receivers, Shifters, Sliding Loads, Microwave, Slotted Lines, Microwave, Standards, Strip-Line Components, Microwave, Switches, Tees, Terminals, Testers, Transmitters, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Los Angeles, McDougall/McLaughlin Co.	213-477-8556
Cal	San Jose, M.C.H. Assoc.	408-246-7330
Fla	Clearwater, R.F. Brennan, Inc.	813-446-5006
Ill	Park Ridge, R.F. Specialists, Inc.	312-698-2045
Ind	Indianapolis, R.F. Specialists, Inc.	317-783-7630
Md	Ellicott City, V P I Inc.	301-465-4060
Mass	Stoneham, Robertson Elctrn. Prods. Co.	617-438-3113
NY	Great Neck, Robert L. Diamond, Inc.	516-482-8387
NC	Winston-Salem, The Candor Co., Inc.	919-924-1480
Pa	Montgomeryville, V P I, Inc.	215-474-3200
Wash	Seattle, Datacom Assocs.	206-329-2989

MICROMETALS, 228 N. Sunset, City of Industry, Cal., 91744, Tel: 213-968-4718, TWX: 910-584-1878; FSC No: 12856; Empl.: 30; Minimum order: $20

For info on price: K. Baker; Application info: J. Cox; Customer service: L. Raymond; Delivery info: L. Raymond

Free literature available: Complete catalog of Iron Powder Cores Q. Curves for Iron Powder Toroidal Cores

Local Sales Offices & Reps.

Cal	Santa Clara, King Assocs.	408-249-1022
Fla	Dunedin, W. J. Irvine Co.	813-733-5382
Mass	Wellesley Hills, Anchor Engrg.	617-235-6330
Minn	Hopkins, F. Peterson Co.	612-941-5400
NY	Hempstead, Kahgan Sls.	516-538-2300
NY	Rochester, L. Hart Assocs.	716-244-3253

MICRON INDUSTRIES CORP., Constant Voltage Div., 1830 N. 32nd Ave., Stone Park, Ill., 60165, Tel: 312-345-0788; Empl.: 54; Minimum order: $25

For info on price: J. Topel; Application info: D. Davenport; Customer service: J. Topel; Delivery info: J. Topel

Free literature available: Impervitran Bulletin showing line of standard machine tool transformers and molded transformers. OEM Bulletin showing OEM capabilities for regulated DC power supplies and AC voltage regulators.

Products manufactured: Power Supplies, Regulators, Transformers

MICROPAC INDUSTRIES, INC., 905 E. Walnut St., Garland, Tex., 75040, Tel: 214-272-3571, TWX: 910-860-5186; Empl.: 200

Products manufactured: Circuits, Hybrid, Thick Film, Hybrid Voltage Regulators

Local Sales Offices & Reps.

Ala	Huntsville, Burgin-Kreh	205-883-7893
Ariz	Tempe, Argus Sls.	602-948-1499
Cal	Los Altos, Cain, White & Co.	415-948-6533
Fla	Orlando, G. F. Bohman	305-855-0274
Ill	Des Plaines, Coombs Assoc.	312-298-4830
Md	Baltimore, Burgin-Kreh Assoc.	301-788-5200
Mich	Southfield, Reps. Assoc.	313-354-9066
Minn	Minneapolis, Bitronics Sls. Co.	612-835-7744
NJ	Ridgewood, Instrumentation Sls. Co.	201-445-5210
NY	Syracuse, T2 Elctrns.	315-463-8592
NC	Winston Salem, Burgin Kreh	919-768-4174
Ohio	Cleveland, D. Steffen & Assoc.	216-461-8333
Ohio	Dayton, D. Steffen & Assoc.	513-293-3146
Ore	Beaverton, ES/Chase Co.	503-649-6177
Va	Lynchburg, Burgin-Kreh Assoc.	703-845-5600
Wash	Edmonds, ES/Chase Co.	206-774-3586
Wisc	Greendale, Coombs Assoc.	414-421-2300

MICROPHASE CORP., 35 River Rd., Cos Cob, Conn., 06807, Tel: 203-661-6200, TWX: 710-579-2926; Empl.: 105

Customer service: R. J. Crocco

Free literature available: Catalog Pages On: LTM series low-pass filters, HI series interdigital band-pass filters, CDL series limiter detectors, contiguous band multiplexers, detector mounts, amplifers, detectorvideo log amps, detecting multi-plexers, mixers, front ends & receivers.

Products manufactured: Amplifiers, Cavities, Microwave, Converters, Couplers, Detectors, Diodes, Dividers, Duplexers, Microwave, Filters, Holders, Crystal, Junctions, Hybrid, Microwave, Limiters, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Modules, Logic, Encapsulated, Monitors, Mounts, Multiplexers, Oscillators, Preselector-Mixers, Preselectors, Receivers, Switches, Tuners

Local Sales Offices & Reps.

Mo	Glen Burnie, R. L. Engrg.	301-760-5533
NY	Syracuse, Ossmann Instruments Inc.	315-437-6666

MICROSONICS, INC., Div. Sangamo Elec. Co., 60 Winter St., Weymouth, Mass., 02188, Tel: 617-337-4200, TWX: 710-388-6833; Empl.: 125; Minimum order: $100

Customer service: J. Klayman

Products manufactured: Amplifiers, Delay Lines, Filters, Memory Systems, Oscillators

Local Sales Offices & Reps.

Cal	Los Angeles, Tauber Assocs.	213-368-4011
Cal	San Carlos, Kottmeier Assocs.	415-592-8333
Cal	San Diego, Tauber Assocs.	714-274-7242
Fla	Ormond Beach, Technology Mktg. Assoc.	904-672-2314
Fla	Pompano Bch., Technology Mktg. Assoc.	305-942-0774
Ind	Ft. Wayne, G & D Electrn. Sls., Inc.	219-432-5585
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Weymouth, Reptron	617-449-4141
NJ	Cherry Hill, Danco	609-424-5590
NY	Rochester, Ontec	716-464-8636
NC	Winston-Salem, Burgin-Kreh Assoc.	919-768-4174
Ohio	Cleveland, Whelan Corp.	216-692-1266
Ohio	Dayton, Whelan Corp.	513-434-7551
Pa	Fairview Vill., Danco	215-627-2218
Tex	Richardson, Lear Assocs.	214-231-5388
Va	Lynchburg, Burgin-Kreh	703-845-5600

MICROTRAN CO., INC., 145 E. Mineola Ave., Valley Stream, N.Y., 11580, Tel: 516-561-6050, TWX: 510-225-8412; FSC No: 50; Empl.: 100; Minimum order: $50 .... p. 2•1757-1769

For info on price: B. Tanner; Application info: W. Benscher; Customer service: B. Tanner; Delivery info: B. Ciancia

Free literature available: Transformer Catalog: Highlights new P.C. Powers, Telephone Coupling, Studio-Broadcast, DC-DC Converter - F237: P.C. Power Supply Xfmrs. for +5V & ±15V supplies - F158: Lists schematics and components for DC-DC Converters - F243: Magnetically Shielded Studio-Grade Mike Input Xfmrs. F185: Magnetically Shielded Low-Level Chopper Input Xfmrs. - Nomograph: Transistor Xfmr. Load Impedances determination - F139: Professional Bulk Tape Erasers, Demagnetizers, Audio Accessories.

Directory of Local Distributors Starts on page 401

Products manufactured: Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Converters, Decade Boxes, Demagnetizers, Demodulators, Editing Equipment, Tape, Eliminators, Battery, Erasers, Magnetic Tape (Bulk), Filters, Hybrid Voltage Regulators, Inverters, Kits, Power Supply, Microphone Accessories (Including Stands, Holders, Booms), Networks, Pickups, Telephone (For Recording), Power Supplies, Reactors, Regulators, Transducers, Transformers

Local Sales Offices & Reps.

Ala	Gadsden, F. Nickerson	205-547-7718
Ariz	Scottsdale, F. Schoeffler	602-959-3011
Cal	Los Altos, Westec Elctrns.	415-948-8880
Cal	Norwalk, Bertrand-Zoolalian	213-921-9791
Cal	San Diego, Bertrand-Zoolalian	714-560-5832
Colo	Denver, Gossard & Assocs.	303-985-0602
Fla	Miami Beach, Geartner Assocs.	305-861-3661
Fla	Orlando, Geartner Assocs.	305-299-1000
Ga	Decatur, F. Nickerson	404-321-4678
Ill	Highland Park, Bransky Sls. Co.	312-433-2375
Kans	Shawnee, J. Guernsey Co.	913-631-2414
Md	Baltimore, J. R. Daniel	301-825-3330
Mass	Wakefield, Meas. Equip. Co.	617-245-4870
NJ	Englewood Cliffs, E. Glass Assocs.	212-586-8440
NC	Kannapolis, F. Nickerson Co.	704-932-6772
Ohio	Cincinnati, J. Olsen	513-922-2176
Ohio	Cleveland, J.O. Olsen	216-752-5444
Pa	Jenkintown, Arnold Assocs.	215-887-7870
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Tex	Grand Prairie, Howell Sls., Inc.	214-AN2-5153
Wash	Seattle, Westec Elctrns., Inc.	206-CH3-7070
EXP:	N.Y., Valley Stream, Microtran Co.	516-561-6050

Local Distributors

Ala	Birmingham, MG Elctrns. & Equip., 3112 6th Ave. S.	205-328-4525
Ariz	Phoenix, Moltronics, Inc., 2746 W. Palm La.	910-951-1512
Cal	San Diego, Moltronics, Inc., 7960 Convoy Ct.	714-278-5020
Cal	Santa Clara, Moltronics, Inc., 337 Matthew St.	408-244-7600
Cal	South Gate, Moltronics, Inc., 5610 E. Imperial Hwy.	213-773-6521
Colo	Denver, Electronic Parts Co., 1212 S. Broadway	303-744-1992
Conn	Hamden, Arrow Elctrns., 295 Treadwell St.	203-248-3801
Fla	Orlando, Hall-Mark Elctrns., 7233 Lake Ellenor Dr.	810-850-0183
Ga	Atlanta, Lykes Elctrns. Corp., 1135 Chattahoochee	810-751-3501
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	910-221-0268
Ind	Indianapolis, Graham Elctrns., 133 S. Penn St.	317-634-8486
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave. S.W.	319-365-7551
Kans	Wichita, Radio Supply Co., 115 Laura St.	316-267-5216
Md	Savage, Pyyttronic Inds., Inc., 8200 Wellmoor Ct.	301-792-7000
Mass	Waltham, QPL Elctrn. Distr., Inc., 47 Calvary St.	617-891-0460
Mich	Oak Park, Newark-Detroit, 20700 Hubbell Ave.	313-548-0250
Minn	Minneapolis, Newark Elctrns., 336 Hoover St. N.E.	612-331-6350
Mo	Berkeley, Hall-Mark Elctrns., 6100 Madison Ave.	910-760-1630
NJ	Moorestown, Arrow/Angus, Pleasant Valley Ave.	710-897-0829
NJ	Springfield, Federated Purchaser, Inc., 155 U.S. Rte. 22	201-376-8900
NM	Albuquerque, Electronics Parts Co., 2620 Rhode Island N.E.	505-293-6161
NY	Binghamton, Federal Elctrns., Box 1208	510-252-0893
NY	Buffalo, Summit Distrs., Inc., 916 Main St.	710-522-1692
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NC	Raleigh, Hall-Mark Elctrns., 3000 Industrial Dr.	510-928-1831
Ohio	Cleveland, Pattison Supply Co., 4550 Willow Pkwy.	216-441-3000
Pa	McKeesport, Barno Radio Co., 5403 W. Smithfield St.	412-751-5971
Tenn	Nashville, Electra Distributing Co., 1914 W. End Ave.	615-255-8444
Tex	Dallas, Hall-Mark Elctrns., 9333 Forest La.	910-867-4721
Tex	Houston, Lenert Co., 1420 Hutchins	713-225-1465
Wash	Seattle, Sterling Elctrns., 5608 6th Ave. S.	206-762-9100

MICROWAVE ASSOCS., Northwest Industrial Pk., Burlington, Mass., 01803, Tel: .617-272-3000, TWX: 710-332-6789

Products manufactured: Adapters, Waveguide, Alarms, Amplifiers, Analyzers, Attenuators, Bends & Twists, Microwave, CATV Systems & Equipment, Cavities, Microwave, Chokes, Circulators, Ferrite; Comm. Systems, Couplers, Detectors, Diodes, Dividers, Duplexers, Microwave, Filters, Integrated Circuit Packaging Systems, Interferometer Systems, Isolators, Limiters, Microwave Integrated Circuits (MIC's), Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Mounts, Multipliers, Receivers, Shifters, Shutters, Microwave, Strip-Line Components, Microwave, Switches, Tees, Terminals, Transmitters, Tubes, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Tech. Mktg. Assocs.	205-883-7893
Ariz	Scottsdale, Microwave Assocs.	602-947-5431
Cal	Long Beach, Microwave Assocs.	213-426-9531
Cal	Sunnyvale, Microwave Assocs.	408-733-0330
Fla	Ormond Beach, Tech. Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Tech. Mktg. Assocs.	305-942-0774
Fla	Seminole, Tech. Mktg. Assocs.	813-393-3214
Ill	Franklin Park, Dekotech, Inc.	312-455-5100
Ind	Fort Wayne, Delesa Sls.	219-483-9537
Ind	Indianapolis, Delesa Sls.	317-257-4683
Iowa	Cedar Rapids, Seltec Sls. Corp.	319-362-8155
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Burlington, Burlington Sls., Inc.	617-272-7655
Mich	Ann Arbor, IM Tech, Inc.	313-663-0230
NY	Great Neck, ERA, Inc.	516-482-9320
NY	Syracuse, T2 Elctrns.	315-463-8592
NC	Winston-Salem, Burgin-Kreh Assocs.	919-768-4174
Ohio	Cleveland, IM Tech, Inc.	216-826-3400
Ohio	Dayton, IM Tech, Inc.	513-837-5610
Pa	Fort Washington, G.C.M., Inc.	215-646-7535
Tex	Richardson, Microwave Assocs.	214-234-2463

MICROWAVE DEVELOPMENT LABS., INC., 87 Cresent Rd., Needham Hgts., Mass., 02194, Tel: 617-449-0700, TWX: 710-325-1739; Empl.: 180; Minimum order: $25

For info on price: R. Tucker; Application info: R. Tucker; Customer service: W. Berry; Delivery info: M. Hale

Free literature available: Three ring binder with individual catalogs & data sheets- Individual bulletins & catalogs can be mailed separately for many of our products.

Products manufactured: Adapters, Waveguide, Attenuators, Bends & Twists, Microwave, Cavities, Microwave, Chokes, Couplers, Detectors, Dividers, Dummy Loads, Duplexers, Microwave, Filters, Flanges, Waveguide, Generators, Holders, Crystal, Horns, Microwave, Impedance Converters, Microwave, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Mixers, Seals, Shifters, Shutters, Microwave, Switches, Tees, Terminals, Tubing, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Orange, J. E. Hachten Co.	714-998-6020
Cal	Palo Alto, J. E. Hachten Co.	415-326-1252
Fla	Orlando, Hi Co Assocs., Inc.	305-273-0571
Md	Lanham, Brimberg Assoc.	301-552-2200
Mass	Wayland, Wayland Engrg. Sls.	617-655-6080
NY	DeWitt (Syracuse), D.B. Assocs., Inc.	315-446-0220
NY	Great Neck, Trionic Assocs., Inc.	516-466-2300
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Tex	Dallas, Texas Microwave	214-231-5381
Wash	Seattle, Jon B. Jolly	206-938-4166
EXP:	Stamford, Conn., Dage Corp.	203-324-3123
FOR:	Can., Don Mills, Ontario, Tacan Assocs., Inc.	416-445-7490

MICROWAVE DIODE CORP., 13 Pleasant St., Colebrook, N.H., 03576, Tel: 603-237-4822; Empl.: 15; Minimum order: $35

For info on price: D. E. Shea; Application info: D. E. Shea; Customer service: G. P. Jacques; Delivery info: D. Hamel

Free literature available: Catalog and Specification Sheets

Products manufactured: Converters

Local Sales Offices & Reps.

Cal	Santa Ana, Rical Assocs.	714-557-6543
Md	Towson, L. H. Kolman & Co.	301-752-8756
Mass	Waltham, Betronic Assocs.	617-894-8400

MICROWAVE POWER DEVICES, Adams Ct., Plainview, N.Y., 11803, Tel: 516-433-1400, TWX: 510-221-1862; Empl.: 53

Customer service: R. J. Sheloff

Free literature available: Solid state CW power amplifiers, solid state linear amplifiers, low noise solid state amplifiers, solid state IF amplifiers, solid state AM Modulators, solid state pulse amplifiers, and lab amplifiers.

Products manufactured: Amplifiers, Converters, Modulators, All Kinds, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	204-534-9771
Ariz	Phoenix, R. A. Mayes Co.	602-279-5243
Cal	Inglewood, L & M Engrg. S.	213-674-6850
Cal	San Jose, L & M Engrg.	408-292-3220
Colo	Boulder, R.A. Mayes Co.	303-444-0782
Fla	Orlando, Gentry Assocs.	305-894-4401
Fla	St. Petersburg, Gentry Assocs.	813-867-7820
Ill	Mt. Prospect, Cain & Co.	312-253-3578
Kans	Prairie Village, Engrg. Servs. Co.	913-649-4000
Md	Silver Springs, Eastern Instrumentation Corp.	301-681-6500
Mass	Needham, Addelco Corp.	617-444-4754
Mo	St. Louis, Engrg. Serv. Co.	314-997-1515
NJ	Palisades Park, Scientific Devices - East	201-871-3916
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	N. Syracuse, Naco Elctrns. Corp.	315-699-2651
NY	Rochester, Naco Elctrns. Corp.	716-244-4720
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Dayton, Cain & Co.	513-253-8144
Ohio	Lancaster, Cain & Co.	614-654-4800
Pa	Philadelphia, Eastern Instrumentation of Philadelphia	215-927-7777
Tex	Houston, R.A. Mayes Co.	713-461-5385
Tex	Richardson, R.A. Mayes Co.	214-235-3043
Utah	Centerville, R.A. Mayes Co.	801-292-6781
EXP:	Fla., Hallandale, Emec Inc.	305-925-6366
FOR:	Can., Montreal, Que., Electrodesign Ltd.	514-363-5120
FOR:	Can., Toronto, Ont., Electrodesign Ltd.	416-787-0991
FOR:	Can., Vanier, Ottawa, Electrodesign Ltd.	613-745-0541
FOR:	Can., Winnipeg, Manitoba, Electrodesign Ltd.	204-338-5050

MICROWAVE SEMICONDUCTOR CORP., 100 School House Rd., Somerset, N.J., 08873, Tel: 201-469-3311, TWX: 710-480-4730; Empl.: 190

Products manufactured: Amplifiers, Generators, Transistors

MICROWAVE PRODS., INC., 9533 Irondale Ave., Chatsworth, Cal., 91311, Tel: 213-882-3434; Empl.: 70

For info on price: C. T. Troesken; Application info: W. Perry; Customer service: W. Perry; Delivery info: C. T. Troesken

Products manufactured: Antennas, Circulators, Ferrite, Couplers, Filters, Isolators, Mixers, Strip-Line Components, Microwave

MICROWAVE/SYS., INC., 1 Adler Dr., E. Syracuse, N.Y., 13057, Tel: 315-437-9951, TWX: 710-541-0406; Empl.: 50

Customer service: D. L. Bush

Products manufactured: Amplifiers, Analyzers, Calibrators, Couplers, Detectors, Discriminators, Dividers, Generators, Meters, Mixers, Monitors, Radar Systems, Receivers, Synchronizers, Klystron & BWO

Local Sales Offices & Reps.

Cal	Anaheim, Blair Assocs.	714-635-1350
Cal	Portola Valley, Kipp Assocs.	415-851-0123
Colo	Denver, PLS Assocs.	303-771-0110
DC	Washington, SONCO	301-942-9420
Fla	Orlando, E.G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E.G. Holmes & Assocs.	404-451-6161
Ill	Chicago, Pivan Eng.	312-539-4838
Kans	Shawnee Mission, Pivan Eng.	913-722-1030
Mass	Waltham, Meas. Consits. Corp.	617-890-4400
Mich	Detroit, S. Sterling Co.	313-255-1970
Mo	St. Louis, Pivan Eng.	314-567-3636
NJ	Englewood, Scientific Devices E.	201-871-3916
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	Syracuse, Ossmann Instrs.	315-437-6666
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Pa	Blue Bell, SONCO	215-242-8460
Pa	Pittsburgh, S. Sterling Co.	412-922-5726
Tex	Richardson, Lear Assocs.	214-231-5388

Wash	Bellevue, Scientific Devices N.W.	206-454-0900

MID-EASTERN INDS., Div. of Eanco, Inc., 660 Jerusalem Rd., Scotch Plains, N.J., 07076, Tel: 201-233-5900, TWX: 510-665-6752; FSC No: 06179; Empl.: 30; Minimum order: $25 .... p. 1•1315-1318

For info on price: D. R. Ellenback; Application info: R. Hauseur or D. Ellenback; Customer service: R. Daisey; Delivery info: M. Fullman

Free literature available: Catalog arranged so that you can quickly find the power supply that has the features and voltage current output you want.

Products manufactured: Chargers, Battery, Converters, Eliminators, Battery, Inverters, Power Supplies, Regulators

Local Sales Offices & Reps.

Cal	Los Angeles, Dyna Sls.	213-268-1175
Colo	Denver, D. E. Bond Assocs.	203-756-1234
Conn	Guilford, R. H. Sturdy Co.	203-966-2580
Conn	New Canaan, R. H. Sturdy Co.	203-966-2580
Fla	Alamonte Spg., WMM Assocs.	305-862-4700
Fla	Clearwater, WMM Assocs., Inc.	813-446-0075
Fla	No. Palm Beach, WMM Assoc. Inc.	305-848-9042
Fla	Pompano Bch., WMM Assocs., Inc.	305-943-3091
Ill	Evanston, Mauer & Co.	312-869-1644
Ill	Skokie, Mauer & Co.	312-677-4771
Ind	Indianapolis, Mauer & Co.	317-547-3259
Iowa	Ft. Dodge, Heimann	515-576-2374
Md	Baltimore, J. R. Daniel & Co.	301-825-3330
Mass	Wellesley Hls., R. Sturdy	617-235-2330
Mich	Brighton, Dietrich & Assoc.	313-961-4540
Mich	Centerlaine, Dietrich & Assoc.	313-754-6450
Minn	Mpls., Heimann Co.	612-861-6051
NJ	Hazlet, Mer Mon Elec. Inst.	201-264-1851
NJ	Susssex, Eanco	201-875-3860
NM	Albuquerque, D. E. Bond Assoc.	505-296-9111
NY	Huntington, C.R. Mayer Co.	516-WA 1-7876
Ohio	Cleveland, Dietrich & Assoc.	216-781-1855
Ohio	Dayton, Dietrich & Assoc.	513-223-6042
Pa	Mt. Penn, Mer Mon Elctrn. Instrumentation	215-779-1640
Pa	Pittsburgh, Dietrich & Assoc.	412-892-2992
Pa	Willow Grove, J. R. Daniel Co.	215-674-3880
Wash	Seattle, Eicher-Richards Co.	206-LA 3-7888

MID-WEST METAL PRODS., INC., 456 E. Donovan Rd., Kansas City, Kans., 66115, Tel: 913-342-8171; Empl.: 200

Products manufactured: Benches, Consoles, Stools, Tables, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Cabinets & Accessories, Cable Assemblies & Harnesses, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Circuits, Flexible, Frames, Cabinet & Rack, Jack Covers, Jigs And Fixtures, Chassis & Circuit Board, Panels, Racks, Services, Assembly, Production & Test

MIDGET LOUVER CO., 800 Main Ave., Norwalk, Conn., 06852, Tel: 203-866-2342; Empl.: 10

Free literature available: Circular 10-A and price list; also additional stuffers.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Cabinets & Accessories

MIDLAND INTERNATIONAL CORP., 1909 Vernon St., No. Kansas City, Mo., 64116, Tel: 816-474-5080, Telex: 42-6344; Empl.: 200; Minimum order: $1000

For info on price: J. Hart; Application info: D. Saxon; Customer service: J. Hart; Delivery info: J. Hart

Products manufactured: Antennas, Batteries, Comm. Systems, Converters, Crystals, Cutters, Wire, Hand Operated, Filters, Flashlights & Lanterns, Meters, Microphones, All Kinds, Pickups, Telephone (For Recording), Power Supplies, Public Address Systems, Receivers, Recorders, Speaker Systems, Speakers, Testers, Transceivers

Local Sales Offices & Reps.

Ala	Birmingham, Adams & Assocs.	205-822-8109
Alas	Anchorage, C. E. Garrett	907-279-7585
Ark	El Dorado, D. Bellew Sls.	501-863-8325
Cal	Emoryville, Assc. Rep & Whse.	415-653-3838
Cal	Torrance, Barston & Doran	213-325-4140
Colo	Englewood, E.S.P. Co.	303-781-4409
Ind	Indianapolis, Kingston - Sharkey Assocs.	317-353-9406
Iowa	Des Moines, Beams	515-282-0292
La	Kenner, D. Bellen Sls.	504-729-4550
Md	Seabrook, Taylor Mktg.	301-864-4011
Mass	Lynne, Keene Sls. Co.	617-595-2300
Mich	Brighton, Leetro Sls. Co.	313-632-7941
Minn	Minneapolis, H.M.R.	612-920-8200
NJ	Teaneck, S. Axelrod Assocs.	201-836-6661
NY	Syracuse, W. Tauber Co.	315-446-7094
NC	Greensboro, Adams & Assocs.	919-272-6838
Ohio	Columbus Station, C.L. Pugh & Assocs.	216-235-6028
Pa	Laverock, M. Weinberg Assocs.	215-549-1122
Tenn	Memphis, G. Vanable	901-365-9437
Tex	Dallas, Roman Sls. Co.	214-358-2152
Wash	Seattle, James J. Backer Co.	206-285-1300
EXP:	Mo Kansas City, R. B. Thetford	816-842-0511

MIDWEC DIV., Independent Cable, Box 417 G, Scottsbluff, Neb., 69361, Tel: 308-632-4127, TWX: 910-627-0061; Empl.: 300; Minimum order: $50 p. 2•187-190

For info on price: D. Williamson; Application info: J. Tierney; Customer service: J. Tierney; Delivery info: D. Williamson

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engr. Assoc.	602-955-3193
Cal	Long Beach, Emerson Kirk Engr.	213-439-9559
Cal	Mountain View, Caltron/Pyle Inc.	415-964-3244
Colo	Denver, Checkmate Sls.	303-771-4920
Conn	Washington Depot, Kanan Assocs.	203-868-0513
Ga	Atlanta, G. Duckett Sls.	404-451-3529
Ill	Northbrook, Raines Brin Assoc.	312-498-0890
Md	Baltimore, Kaufholz Assoc.	301-488-6561
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Plymouth, Romarc	313-455-0300
Minn	St. Paul, Knox Assoc.	612-488-5402
Neb	Lincoln, Mktg. Assoc.	402-464-5244
NY	Port Washington, P.D. Aaron	516-883-0600
NY	Syracuse, L.D. Allen Inc.	315-458-7470
NC	Charlotte, G. Duckett Sls.	404-451-3529
Ohio	Cincinnati, J. Olsen Co.	513-922-2176
Ohio	Cleveland, J. Olson Co.	216-752-5444
Ore	Portland, C.K. Shanks Assoc.	503-292-5656
Pa	Newton Square, Kaufholz Assoc.	215-356-5000
Pa	Pittsburgh, J. Olsen Co.	412-279-2550
Tex	Dallas, United Comps.	214-324-1448
FOR:	Can., Montreal, Que., Vitel Elctrns.	514-331-7393
FOR:	Can., Toronto, Ont., Vitel Elctrns.	416-622-6300

Local Distributors

Cal	Belmont, Eric Electronics, 111 Glenn Way	415-593-8284
Mass	Newton, Greene-Shaw, 70 Bridge St.	617-969-8900
NY	Buffalo, Summit Dr.	
NY	Port Washington, Connector Concepts, Box 511	516-883-0600
Ohio	Cleveland, Gateway, 30214 Lakeland Blvd.	216-944-8565
Pa	Huntington Valley, Hallmark, 458 Pike Rd.	215-355-7300

MIDWEST ELECTRONIC INDUSTRIES, 4945 W. Belmont Ave., Chicago, Ill., 60641, Tel: 312-626-0030, TWX: 910-221-5247; Empl.: 64

For info on price: E. Taylor; Application info: E. Chapman; Customer service: C. Sweeney; Delivery info: K. Kramer

Products manufactured: Amplifiers, Microphones, All Kinds, Speakers

Local Sales Offices & Reps.

Ind	Indianapolis	317-426-3736
Iowa	Cedar Rapids	319-362-4410
Wisc	Waukesha	414-542-5129

MIIDA ELECTRNS., 14 Henderson Dr., W. Caldwell, NJ, 07006

MIKRON INSTR. CO., Box 211, Ridgewood, N.J., 07451, Tel: 201-891-7330; Empl.: 15

For info on price: J. E. Galbraith; Application info: J. E. Galbraith; Customer service: K. B. Davis; Delivery info: K. B. Davis

Free literature available: Sales brochures for each model.

Products manufactured: Bolometers, Controls/Control Eqpt., Detectors, Pyrometers, Radiometers

Local Sales Offices & Reps.

Ariz	Tempe, Lietz Equip. Co.	602-968-4991
Cal	Gardena, Instr. Lab.	213-770-0650
Cal	Palo Alto, Instr. Lab.	415-328-1040
Colo	Denver, TESSCO	303-744-1119
Conn	Westport, A. J. Abrams Co.	203-226-3010
Fla	Winter Haven, Engineered Equip. Co.	813-294-6520
Haw	Mililani Town, H. C. Burgess & Assocs.	808-623-3118
Ill	Westchester, Murphy & Dickey	312-344-5660
Iowa	Cedar Rapids, H. E. Ferris	319-362-9156
Iowa	Des Moines, H. E. Ferris	515-255-5008
La	Baton Rouge, Alford, Woods & Childs	504-275-5480
Mass	Lowell, Moisan Assocs.	617-452-5003
Mich	Dearborn, Ind. Temperature Control	313-278-2210
Mich	Grand Rapids, Ind. Temp. Control	616-538-3488
Minn	Minneapolis, G. J. Winikates & Co.	612-546-5770
Mo	St. Louis, EV Miller Co.	314-821-2610
NJ	Brielle, H. W. Good Co.	201-528-5251
NJ	Riverdale, B. Most Assocs.	201-839-4333
NM	Albuquerque, Lietz Equip. Co.	505-266-5821
NY	E. Rochester, Thermal Systems	716-377-1970
NY	N. Syracuse, Thermal Systems	315-458-5202
NY	Orchard Park, Thermal Systems	716-662-5560
NC	Charlotte, J. L. Highsmith & Co.	704-333-7743
Ohio	Brecksville, D & B Engrg. Sls.	216-526-6320
Ohio	Cincinnati, G. H. Drysdale & Assocs.	513-752-2069
Okla	Tulsa, Wallace Equip. Co.	918-747-6749
Ore	Portland, Branom Instr. Co.	503-285-9861
Pa	Bridgeville, Instr. Servs.	412-221-3600
Tenn	Oak Ridge, Tech. Equip. Supp.	615-483-4285
Tex	Houston, Alford, Woods & Childs	713-488-2730
Va	Richmond, Advance Control Equip.	804-270-7182
Wash	Seattle, Branom Instr. Co.	206-762-6050
WVa	St. Albans, Instr. Servs.	304-722-2953
Wisc	Menomonee Falls, Fritz Engrg. Sls. Co.	414-251-6590
FOR:	Calgary, 27, Alberta, Can., Lee Instr. & Supp.	403-252-4222
FOR:	Downs View, Ont., Can., Tubefit Ltd.	416-743-1661
FOR:	Lachine, Que., Can., Instro-Test Ltd.	514-637-1231
FOR:	Sarnia, Ont., Can., Tubefit Ltd.	519-344-5271
FOR:	Vancouver 9, B.C., Can., Branom Instr. Co.	604-736-7794

MIL ELECTRONICS, 176 Walker St., Lowell, Mass., 01854, Tel: 617-453-4142, Telex: 94-7490; Empl.: 35 p. 1•1319-1324

For info on price: B. W. Eldridge; Application info: B. W. Eldridge; Customer service: M. Gaudette; Delivery info: M. Gaudette

Free literature available: Catalog 7406-dc-dc encapsulated power converters. Catalog 735-ac-dc encapsulated power supplies.

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Dev.	205-536-1969
Ala	Huntsville, Scientific Dev SE	
Ariz	Tempe, Hall Co.	303-789-4149
Cal	Lynwood, Dick West & Assocs.	213-636-6124
Cal	San Carlos, Winco Sls.	415-365-6082
Colo	Englewood, Hall Co.	303-789-4149
Conn	North Haven, Northeast Reps.	203-239-2507
Fla	Fort Lauderdale, Scientific Devs S.E.	
Fla	Orlando, Scientific Dev - Southeast	305-841-8180
Ill	Wilmette, Crest Assocs.	312-256-5205
Ind	Indianapolis, Crest Assocs.	
Mass	Medway, Surel Int'l.	617-533-2041
Mass	Needham, Northeast Reps.	617-449-3034
Mass	Needham Heights, Northeast Reps.	
Mich	Bloomfield Hills, Ellinger Sls.-Mich.	313-642-0203
Minn	Minneapolis, R-J Inc.	612-922-1425
NJ	Marmora, Holdsworth & Co.	
NY	Schenectady, N. W. Alexander & Assocs.	518-377-0581
NY	Tuckahoe, Spectrum Sls.	914-793-1660
NC	Burlington, Scientific Devs., S.E.	
Ohio	Chagrin Falls, Crest Comp Sls.	216-543-9808
Pa	Newton Square, Holdsworth & Co.	215-356-8550
Tex	Dallas, Precision Sls.	214-351-6964
Va	Annandale, J. Hopkins Assocs.	703-280-2086
Wash	Bellevue, A. Smith Co.	
FOR:	Can., Don Mills, Ont., G. M. Fraser Ltd.	

MIL SPEC WIRE & CABLE CORP., 404 N. Main St., Freeport, N.Y., 11520, Tel: 516-546-5454

Products manufactured: Cable, Cable Retractors, Tubing, Wire, Wire Shielding

MILERTRONICS, 525-A Airport Rd., Greenville, S.C., 29607, Tel: 803-242-9232; Empl.: 8

For info on price: G. G. Miler, Jr.; Application info: M. D. Webb; Customer service: P. G. Arms; Delivery info: M. D. Webb

Free literature available: Application Notes 101 READ ONLY MEMORIES and 201 DESIGN AND PROGRAMMING OF PROGRAMMABLE ROM MEMORY BOARDS. Brochures: ROM Programmers. DM-2000 Diode Matrix Programmer (Universal).

Products manufactured: Boards, Programming, Integrated Circuit Devices, Programmers

Local Sales Offices & Reps.

Ala	Huntsville, F.M. Assocs.	205-536-9990
Conn	Ellington, Daner-Hayes	203-875-5157
Fla	Orlando, F. M. Assocs.	305-851-5710
Ga	Atlanta, F. M. Assocs.	305-851-5710
Mass	Newton Centre, Daner-Hayes	617-969-4650
NJ	Port Washington, Daner-Hayes	516-883-4576
NC	Greensboro, F. M. Assocs.	919-294-2754
Pa	Erie, Ecco Elctrn. Sls.	814-452-3762
Va	Fairfax, Nine Assocs.	703-273-1803

Advertisment

MilerTronics div. of George Miler Inc. designs and manufactures IC test equipment. Product line includes ROM programmers and accessories and diode matrix programmers. The MilerTronics ROM programmers include a remote socket. These programmers will operate fully automatically using the MilerTronics duplicator or tape cassette accessories and can be interfaced with computers. MilerTronics also designs and builds custom microprocessor systems.

MILGO ELECTRONIC CORP., 8600 N.W. 41st Street, Miami, Fla., 33166, Tel: 305-592-8600, TWX: 810-848-6588; Empl.: 1485

Products manufactured: Comm. Systems, Modulator/Demodulators, Terminals, Data Display (including Alphanumeric & Graphic), Testers

MILLEN MFG. CO. INC., JAMES, 150 Exchange St., Malden, Mass., 02148, Tel: 617-324-4108; FSC No: 76487; Empl.: 500; Minimum order: $25
p. 2•1240-1253

For info on price: A. B. Caputo; Application info: O. I. Haszard; Customer service: A. B. Caputo; Delivery info: A. B. Caputo

Free literature available: General Catalog- 12 pages. Condensed Listing; Price List- 2 pages - Items in General Catalog; Shaft Hardware Bulletin- 8 pages. Dials-Couplings-Drives-Shaft Hardware; Oscilloscope/Magnetic Shield Bulletin- 24 pages; Selecting Magnetic Materials; Use of Magnetic Foil.

Products manufactured: Amplifiers, Antenna Feed Systems, Bezels, Shielded & Unshielded, Boards, Plug-In, Bridges, Capacitors, Variable, Caps, Connector, Chamber, Environmental Test, Chokes, Clamps & Clips, Coatings, Coils Including Assemblies & Forms, Connectors, Containers, Counters, Couplers, Couplings, Delay Lines, Detectors, Dials, Discriminators, Display Devices/Displays, Drives & Drive Mechanisms (Dial), Jacks (All Types), Knobs, Locks, Dial & Shaft, Meters, Modulators, All Kinds, Monitors, Networks, Oscilloscope Plug-Ins, Oscilloscopes, Plug & Jack Sets, Plugs, Pointers, Dial, Posts, Power Supplies, Probes, RFI Measuring Equipment, Scales, Dial, Shields, Shifters, Sockets, Standards, Switches, Terminal Blocks, Boards & Strips, Terminals, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, W.S. Harmon Co.	213-937-1460
Cal	Millbrae, Polach & Bensinger, Inc.	415-697-2525
Cal	Pasadena, D. Ellis Co.	213-681-9108
Conn	Newtown, Gerber Sls. Corp.	203-426-3440
Ill	Streamwood, Al Holte & Assoc.	312-837-4066
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
NY	Great Neck, J. DiBlasi Assoc.	516-482-4040
NY	Pittsford, D. Hurley Sls., Inc.	716-586-6159
Pa	Havertown, Liberi Sls.	215-789-8150
Tex	Richardson, Air Quip Sls. Co.	214-234-3285
EXP:	Lakehurst, N.J., Tech. Equip. Co.	201-349-1716

Local Distributors

Cal	Palo Alto, Zack Elctrns., 654 High St.	415-326-5432
Fla	Miami, Elctrn. Equip. Co., 2701 N.W. 42nd Ave.	305-871-3500

MILLER, J.W. CO., See Bell Inds.

MILLER, L.C. CO., 717 Monterey Pass Rd., Monterey Park, Calif., 91754, Tel: 213-268-3611; Empl.: 49

Customer service: R. D. Kelly

Products manufactured: Heaters & Heating Elements, Soldering Accessories, Soldering Equipment

MILLER, SANFORD CORP., See Sanford-Miller Corp.

MILLER-STEPHENSON CHEM. CO., INC., Box 628, Danbury, Conn., 06810, Tel: 203-743-4447; Empl.: 500

For info on price: F. H. Bodnar; Application info: J. R. Laverdure; Customer service: F. H. Bodnar; Delivery info: F. H. Bodnar

Products manufactured: Adhesives (All Types), Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Lubricants

Local Sales Offices & Reps.

Ariz	Phoenix, H.C. Torrey Assoc.	602-944-0352
Cal	Los Angeles, Miller-Stephenson Chem.	213-624-3887
Colo	Denver, Ind. Hardware Co.	303-426-1443
Fla	Merritt Isle, J. A. Kennedy	305-452-9821
Ill	Chicago, Miller-Stephenson Chem.	312-761-4272
FOR:	Can., Toronto, Miller-Stephenson Chem.	416-364-0111

Local Distributors

For:	Fr., Montgeron, POLYTRONIX S.A.	903-22-50
For:	G. B., Scotland, D. Fraser & Co.	Uddingston 3476
For:	Ger., Hamburg, Detakta	0411/513051
For:	It., Milano, Aldo Garzanti S.A.S.	654-621
For:	Lebanon, Beirut, Freon® Products Middle East	20845LE
For:	Neth., Amsterdam, G. L. Loos & Co's.	020-822851
For:	Spain, Valencia, JASO	23 70 90
For:	Swit., Basle, Matera AG Basle	061 06 30

Advertisment

Aerosol Products for electronics, computers/communications/maintenance

MS-122 Fluorocarbon Release Agent
MS-150 En-Rust Rust Inhibitor
MS-160 Freon T-P 35 Solvent
MS-166 En-Stat Static Eliminator
MS-170 1,1,1-Trichloroethane
MS-180 Freon TF Solvent
MS-185 Freon TA Solvent
MS-190/MS-190HD Flux Removers
MS-200 Magnetic Tape Head Cleaner
MS-220 Aero-Duster
MS-226 Cobra Extension Brush Kit
MS-230 Contact Re-Nu
MS-238 "Clean 'n Lube" Contact Cleaner
MS-240 Quik-Freeze
MS-260 Cleaner Plastic/Glass/Metal
MS-400 Strippable Masking Film
MS-450 Protective Varnish
MS-111 Epoxy Stripper, Resins, Curing Agents

MILLER, W. A. CO., Mingo Loop, Oquossoc, Me., 04964, Tel: 207-864-3344; Empl.: 32

Customer service: R. Wentzell

Free literature available: Upon request literature with approximate pricing describing our custom-built Ruggedized Formica Cases, cabinets, and enclosures

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter

MILLS RESISTOR CO., 10810 Kaylor St., Los Alamitos, Cal., 90720, Tel: 213-598-2454; FSC No: 34238; Empl.: 22

For info on price: M. Gough; Application info: T. Mills; Customer service: T. Mills; Delivery info: M. Gough

Free literature available: General Catalog; Metric Catalog; Precision Power Resistor Release; Miniature (MR 510) Resistor Page; Dual Miniature Resistor Specification.

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Cal	Clairemont, Nelgo Assocs.	714-621-1224
Cal	Los Altos, Frauman Assocs.	415-941-0660
Fla	Belleair Beach, Consultants for Industry	813-595-1486
Ind	Carmel, Rich Elctrns. Mktg.	317-844-8462
Mo	Kansas City, Nevco	816-421-1751
NY	Valley Stream, Levison Sls. Co.	516-561-9696
Tex	Houston, Ev Smith Sls.	713-649-5756
Va	Lynchburg, J. A. Griffin	804-384-5236
Wash	Bellevue, Rowe/Northwest	206-455-2686

MILWAUKEE RESISTOR CORP., 700 W. Virginia St., Milwaukee, Wisc., 53204, Tel: 414-271-9900; FSC No: 82807; QPL No: 15109; Empl.: 90; Minimum order: $25
p. 2•1500,1501

For info on price: C. Gormanson; Application info: R. Amacher; Customer service: C. Gormanson; Delivery info: C. Gormanson

Free literature available: Product Bulletins Covering Our Line of Wire-Wound Power Resistors in the Range of 3-2000 Watts, and Grid Resistors 2000 Watts and Above.

Products manufactured: Alarms, Resistor, Hardware, Resistors

Local Sales Offices & Reps.

Ala	Gadsden, F.C. Nickerson Co.	205-547-7718
Cal	Mountain View, Wes-K Assocs.	415-964-5454
Cal	San Diego, Wes-K Assocs.	714-276-7541
Cal	Van Nuys, Wes-K Assocs.	213-989-3070
Colo	Denver, Nelson Co.	303-733-5528
Conn	West Haven, Johnson Assocs.	203-932-0162
Fla	Oldsmar, F.C. Nickerson Co.	813-855-4209
Fla	Tampa, F.C. Nickerson Co.	813-885-1416
Ga	Atlanta, F.C. Nickerson Co.	404-321-4678
Ill	Evanston, W.F. Swinke & Assocs.	312-248-4343
Ind	Ft. Wayne, W.W. Bieberich	219-432-2537
Ind	New Albany, W.W. Bieberich	812-945-3187
Iowa	Cedar Rapids, Technical Reps.	319-363-2409
Kans	Olathe, Technical Reps.	913-782-1177
Mass	Wellesley, Johnson Assocs.	617-235-3977
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
Mo	Maryland Heights, Kattelmann & Co.	314-434-6875
NH	E. Wakefield, Johnson Assoc.	603-522-8512
NJ	Haddonfield, Braddock Assocs.	609-429-0087
NY	Forest Hills, Miller Co.	212-263-4446
NY	Rochester, Gislason Sls.	716-454-4741
NC	Kannapolis, F.C. Nickerson Co.	704-932-6772
Ohio	Cincinnati, Val-Skol Sls.	513-563-6790
Ore	Portland, R.M. Minthorne Co.	503-246-4556
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Exp:	Teaneck, N.J., S. Ginsbury, Ltd.	201-837-1100
EXP:	Downsview, Ont., Can., F. Eakin Ltd.	416-638-0451

MINCO PRODUCTS INC., 7300 Commerce Lane, Minneapolis, Minn., 55432, Tel: 612-786-3121, TWX: 910-576-2848; Empl.: 200; Minimum order: $20

Customer service: L. Hanson

Free literature available: 1) Bulletin TS-100 - Temperature sensors for general purpose, industrial, and laboratory applications. 2) Bulletin HE-100 - Heating elements and assemblies. Thin flexible patch, strip and spot heaters.

Products manufactured: Circuits, Flexible, Heaters & Heating Elements, Thermocouples, Elements & Accessories, Thermometers, Resistance

Local Sales Offices & Reps.

Ala	Huntsville, Technical Sls.	205-881-1750
Cal	Los Gatos, Industrial Mktg. Assocs.	408-358-1734
Cal	South Pasadena, Pentagon Co.	213-799-7141
Ill	Chicago, Thermo/Cense	312-792-2760
Md	Wheaton, Magyar & Assocs.	301-871-8833
Mass	Allston, Magyar & Assocs.	617-566-9759
NJ	Livingston, A.A. Budde & Assoc.	201-994-1210
NJ	Middlesex, Magyar & Assocs.	201-752-4848
Ohio	Brecksville, A. Nace Co.	216-526-4323
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Philadelphia, Magyar & Assocs.	215-763-5044
Tex	Richardson, Air Quip Sls. Co.	214-234-3285
Wash	Bellevue, McLaren, Inc.	206-454-3400
WVa	Charleston, Skaff Engrg. Co.	304-342-0131

MINE SAFETY APPLIANCES CO., 400 Penn Center Blvd., Pittsburgh, Pa, 15235, Tel: 412-241-5900, TWX: 710-797-3895; Empl.: 2000; Minimum order: $10

Free literature available: Data Sheets on all products including Description, Application, Specifications and ordering information

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Alarms, Analyzers, Batteries, Blowers & Fans & Accessories, Calibrators, Chargers, Battery, Coatings, Comm. Systems, Counters, Detectors, Meters

Local Sales Offices & Reps.

Ala	Birmingham	205-592-2077
Ariz	Tucson	602-623-1814
Cal	Los Angeles	213-875-2905
Cal	San Diego	714-Ze 2-5720
Cal	San Francisco	415-871-6700
Conn	Bridgeport	203-335-9639
DC	Washington	202-621-1221
Ill	Chicago	312-921-7474
Ind	Indianapolis	317-547-4407
Kans	Lenexa	913-888-2628
La	New Orleans	504-486-5368
Md	Baltimore	301-828-6363
Mass	Boston	617-364-2828
Mich	Detroit	313-272-7717
Mo	St. Louis	314-533-2550
NJ	Mountainside	201-232-3490
NY	New York	212-697-1350
NY	Tonawanda	716-694-2737
Ohio	Cleveland	216-461-6300
Ore	Portland	503-Co 9922
Pa	Philadelphia	215-622-2121
Pa	Pittsburgh	412-241-6332
RI	Esmond	401-231-6900
Tex	Dallas	214-631-2670
Tex	Houston	713-785-4040
Utah	Salt Lake City	801-355-7517
Wash	Seattle	206-763-9666
WVa	Bluefield	304-327-5171

MINELCO, DIV. GENERAL TIME CORP., 135 S. Main St., Thomaston, Conn., 06787, Tel: 203-283-8261, TWX: 710-475-1091; FSC No: 07479; Empl.: 66

For info on price: M. Tanski Ext. 270; Application info: W. Gillis; Customer service: M. Tanski; Delivery info: M. Tanski

Free literature available: Short Form Catalog (SFC-1) includes brief description of all products on four pages. Data sheets on each product also available.

Products manufactured: Indicators, Potentiometers, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Alhambra, M.W. Riedel & Co.	213-283-7694
Cal	Daly City, R Del Bucchia & Assoc.	415-756-1664
Ga	Atlanta, Beacon Elec. Assoc.	404-351-3654
Ill	Wilmette, Crest Assoc.	312-256-5202
Iowa	Cedar Rapids, Jr Sls. Eng.	319-377-8211
Kans	Overland Park, Penzner-Mankus Assoc.	913-381-0004
Mass	Waltham, Conti-Younger Assoc.	617-890-4582
Mich	Oak Park, Willard Spenser Co.	313-398-8005
Minn	St. Paul, Northport Eng.	612-698-3841
NY	Huntington Station, Addem Group	516-567-5900
NY	Syracuse, Rep Tech	315-437-2845
Ohio	Cleveland, Geotronix Mktg. Assoc.	216-243-8520
Tex	Dallas, Bradenco Corp.	214-358-3278
Wash	Seattle, RK Squibb	206-632-2450
EXP:	Huntington Station, N.Y., Airsupply Intl.	212-291-8885

MINI-CIRCUITS LAB., Div. Scientific Comps. Corp., 2913 Quentin Rd., Brooklyn, N.Y., 11229, Tel: 212-252-5252; Empl.: 15 .... p. 2•1291

Products manufactured: Attenuators, Detectors, Dividers, Indicators, Mixers, Modulators, All Kinds, Multipliers, Transformers

Local Sales Offices & Reps.

Cal	Los Altos, Cain-White & CO.	415-948-6533
Cal	N. Hollywood, Crown Elctrns.	213-877-3550
Ill	Mount Prospect, Cain & Co.	312-253-3578
Mass	So. Chelmsford, IMR	617-256-8251
NY	East Rockaway, W Bellenkes Assoc.	516-LY 9-8260
Ohio	Dayton, Cain & Co.	219-482-4411
Ohio	Reynoldsburg, Cain & Co.	614-861-2119
Pa	Lafayette Hill, M. Lader & Co.	215-825-3177
Tex	Dallas, Cain & Co.	214-233-6809
Va	Woodbridge, M. Lader & Co.	703-494-4731

MINI-SYSTEMS, INC., 20 David Rd., North Attleboro, Mass., 02761, Tel: 617-695-0206, TWX: 710-348-0564; FSC No: 50316; Empl.: 58; Minimum order: $10 p. 2•1502,1503

For info on price: D. Rice; Application info: P. Boivin; Customer service: G. Robertson; Delivery info: J. Sweeney

Free literature available: Precision Thick Film Chip Resistors (MIL-Spec. Hi Rel applications); Miniature Single, Dual, Triple Op Amps; FET Input Op Amps; Chip Attenuators; Hybrid Jumpers and padders.

Products manufactured: Amplifiers, Attenuators, Capacitors, Fixed, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Diodes, Jumpers, Packages, Integrated Circuit, Pads, Transistor Mounting, Resistors, Seals, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ariz	Phoenix, J.S. Heaton Co.	602-264-7887
Colo	Denver, J.S. Heaton Co.	303-758-5130

MINNEAPOLIS SPEAKER CO., 3806 Grand Ave. S., Minneapolis, Minn., 55409, Tel: 612-825-1010; Minimum order: $10

Customer service: Sls. Off.

Free literature available: Form C74 Full Line Descriptive Catalog; Form MB474 Mini-Speaker Brochure; Form 671 Descriptive Brochure Describing Loudspeaker Construction, "All About Speakers".

Products manufactured: Speaker Systems, Speakers

Local Sales Offices & Reps.

Ala	Birmingham, J.F. Russell Sls. Co.	205-822-2196
Cal	Gardena, Bidwell Sls. Assocs.	213-770-0300
Cal	Oakland, Sinclair Elctrns. Assoc.	415-451-7485
Fla	Pembroke Pines, J. Wanger Sls. Co.	305-987-8766
Ill	Chicago, T. Pappas & Assoc.	312-685-2338
Iowa	Marion, Thomas & Modrcin Assoc.	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin Assoc.	913-432-2131
Md	Baltimore, Par-Nell Sls. Co.	301-655-2944
Mass	Bedford, Chamberlin & Murray	617-274-0044
Mich	Bloomfield Hills, Central Elctrns. Sls. Co.	313-852-4308
Mo	Hazelwood, Thomas & Modrcin Assoc.	314-838-6446
NY	Roslyn Heights, S.I.R. Sls., Inc.	516-621-7485
NY	Syracuse, Wm. Tauber Co.	315-446-7094
Ohio	Cincinnati, J.O. Olsen Co.	513-825-0678
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Ore	Portland, J. LeBrun Co.	503-244-6805
Pa	Holland, Par-Nell Sls. Co.	215-355-9330
Pa	Pittsburgh, J.O. Olsen Co.	412-341-8391
SC	Greenville, H.C. Norman Sls. Co.	802-244-6254
Tex	Dallas, Techno Assocs.	214-357-9213

MINNESOTA RUBBER CO., 3630 Wooddale Ave., Minneapolis, Minn., 55416, Tel: 612-929-6781; Empl.: 800; Minimum order: $10

Customer service: R. K. Mattocks

Products manufactured: Feedthrus & Seals, Environmental, Rubber, Seals, Services, Assembly, Production & Test

MITEG INC., 100 Ricefield La., Hauppauge, N.Y., 11787, Tel: 516-543-8873, TWX: 510-226-3781; Empl.: 25

For info on price: A. Kiiss; Application info: A. Kiiss; Customer service: A. Faverio; Delivery info: A. Faverio

Products manufactured: Amplifiers, Converters, Mixer-Preamplifiers, Microwave, Mixers, Multipliers, Oscillators

Local Sales Offices & Reps.

Ariz	Scottsdale, Fryco Inc.	602-945-3281
Cal	Mountain View, Microwave Mktg. Assocs.	415-969-3355
Cal	North Hollywood, Crown Elctrns.	213-877-3550
Fla	Orlando, Gra-Mar	
Mass	Natick, Spectrum Energy	617-237-4030
Minn	Minneapolis, Saturn Co.	
NJ	Haworth, Central Assocs.	201-568-0808
NJ	Moorestown, N. Stern	609-234-0661
NY	Plainview, Central Assocs.	516-433-0808
Ohio	Dayton, Ashby Assocs.	513-252-5627
Va	Alexandria, Dyna Rep Co.	703-354-1222
FOR:	Can., Don Mills, Ont., B. D. Vallillee Elctrns Ltd.	416-447-8482

MITSUBISHI INT'L CORP., MGA Div., 7045 N. Ridgeway Ave., Lincolnwood, Ill., 60645

MKC ELECTRONICS, 454 E. Donovan Rd., Kansas City, Kans., 66115, Tel: 913-371-1351; Empl.: 26

Customer service: V. M. Mathews

Products manufactured: Controls/Control Eqpt., Counters, Drivers, Solenoid, Relays, Timers

MKS INSTRS., INC., 25 Adams Street, Burlington, Mass., 01803, Tel: 617-272-9255; Empl.: 50; Minimum order: $25

Customer service: E. Mortberg

Products manufactured: Controls/Control Eqpt., Detectors, Gages, Transducers

M M ELCTRN. ENCLOSURES, 111 Bloomingdale Rd., Hicksville, N.Y., 11801, Tel: 516-935-9400, TWX: 510-221-1857

Products manufactured: Cases, Equipment, Instrument, Meter, Cases, Transit, Containers

Local Sales Offices & Reps.

Ala	Huntsville, BJR Inds.	205-881-3569
Ariz	Scottsdale, Vinson	602-947-7371
Cal	Los Angeles, Daton Engrg. Co.	213-479-4211
Cal	Santa Clara, Vico Sls. Co.	408-298-5944
Colo	Denver, Vinson Assocs.	303-757-5151
Conn	Kensington, N.S. Stachalek	203-VA 8-4587
Fla	Indian Rocks Bch., Tech. Rep.	813-595-2834
Fla	Melbourne, Tech. Rep. Assocs.	305-723-9140
Ga	Jonesboro, Tech. Rep. Assocs.	404-753-0111
Ill	Northfield, Adcon Assocs.	312-446-6486
Kans	Mission, Tech. Sls. Assocs.	913-831-2888
Mass	W. Acton, K.B. Reidy	617-CO 3-7146
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Minn	Mpls., Hasse & Assocs.	612-588-0551
Mo	St. Louis, Tech-Sls.	314-725-5361
NJ	Haddonfield, M & S Assocs.	609-HA 9-7055
NJ	Raritan, J & L Assocs.	201-722-0682
NM	Albuquerque, Vinson Assocs.	505-298-7442
NY	Utica, R. J. Davis Assoc.	315-724-5773
Ohio	Cleveland, Carter, McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
Tex	Dallas, Blair Engrg. Sls.	214-352-8411

MOBAY CHEM. CORPORATION, Pittsburgh, Pa., 15205, Tel: 412-923-2700

Products manufactured: Coatings, Insulators & Insulation, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

MOBIL ELECTRONICS, INC., Box 1132, Anderson, Ind., 46015, Tel: 317-642-7976; Empl.: 6-9; Minimum order: $10

For info on price: H. P. Hart; Application info: J. M. Hart; Customer service: H. Z. Hart; Delivery info: H. Z. Hart

Free literature available: on all products

Products manufactured: Amplifiers, Baffles, Speaker, Boards, Printed Circuit, Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Comm. Systems, Converters, Couplers, Decoders, Encoders, Generators, Grilles, Handles For Cabinets, Circuit Boards, Racks, etc., Meters, Panels, Racks, Receivers, Services, Assembly, Production & Test, Speaker Systems, Switches, Transceivers, Transmitters

MOBIL-TRONICS, Box 1022, Tustin, Cal., 92680, Tel: 714-832-6744; Empl.: 2

Customer service: B. Somodi

Free literature available: Mobil-Tronics' catalog presents over 100 instrument and utility carts, scope carts, stainless steel carts, lab carts, and test equipment carts for use in all industries.

Products manufactured: Carts & Dollies, Instrument & Equipment

MODPAK, 31 A Green St., Waltham, Mass., 02154, Tel: 617-891-7048, TWX: 710-324-6484; Empl.: 4

For info on price: C. Lindbohm; Application info: A. Cerullo; Customer service: A. Cerullo; Delivery info: C. Lindbohm

Free literature available: Literature & information describing MODPAK'S electronic packaging devices and MODPAK'S new circuit boxes and prototype engineering kit

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Connectors, Containers, Frames, Cabinet & Rack, Holders, Circuit Board (Production Type), Integrated Circuit Packaging Systems, Kits, Breadboarding (For Engineers), Kits, Shielding, Kits, Test Equipment, Packages, Integrated Circuit, Racks, Services, Assembly, Production & Test, Shields, Strip-Line Components, Microwave

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs.	205-536-1941
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Burbank, Wright Omnia	213-843-7240
Cal	Los Altos, Wright Eng.	415-941-4405
Cal	San Diego, Wright Omnia	213-843-7240
Colo	Denver, Thorson Co.	303-355-3521
Fla	Palm Beach, Reynolds & Assoc.	305-622-4336
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Mass	Waltham, Russell Engrg. Sls.	617-458-7146
NY	Buffalo, Harries & Kershaw	716-652-1221
NY	Mt. Vernon, Friedman-Smith	914-664-4866
NY	Rochester, Harries & Kershaw	716-671-6365
NY	Syracuse, Harries & Kershaw	315-637-9871
Pa	Plymouth Meeting, Ron-Mar Co.	215-825-2841
Tex	Dallas, Stevens Sls.	214-350-2476
Va	Alexandria, Vanguard	703-768-1660

MODULAR AUDIO PRODUCTS, INC., 1385 Lakeland Ave., Bohemia, N.Y., 11716, Tel: 516-567-9620; FSC No: 52202; Empl.: 5; Minimum order: $35

For info on price: J. Brick; Application info: M. Gittleman; Customer service: K. Zajick; Delivery info: K. Zajick

Free literature available: Audio Products Catalog - Complete line of amplifier and special effects devices for audio console and system construction.

Products manufactured: Amplifiers, Integrated Circuit Devices, Power Supplies

Local Sales Offices & Reps.

Ill	Hinsdale, J. D. Allyn Co.	312-325-0495
Ohio	Dayton, Rixan Assoc.	513-278-4216
EXP:	Cal., San Diego, Total Electronics Int'l.	714-224-3291

MODULAR DEVICES, INC., 1385 Lakeland Ave., Airport International Plaza, Bohemia, N. Y., 11716, Tel: 516-567-9620; FSC No: 52202; Empl.: 20; Minimum order: $35

For info on price: J. Brick; Application info: M. Gittleman; Customer service: J. Brick; Delivery info: K. Zajick

Free literature available: SP-100 servo amplifier condensed catalog SP-200 operational amplifier catalog

Products manufactured: Amplifiers, Equalizers, Integrated Circuit Devices, Inverters

Local Sales Offices & Reps.

Cal	San Diego, Total Elctrns. Int'l.	714-224-3291
Ill	Hinsdale, J.D. Allyn Co.	312-325-0495
Ohio	Dayton, Rixan Assocs.	513-278-4216

Advertisment

Off the shelf and custom designed amplifiers, specializing in AC servo amplifiers and related modules: DC operational amplifiers and power amplifiers; professional quality audio amplifiers and special effects devices; military quality intercom equipment. If you have an amplifier requirement, check with MDI first! We probably have it on the shelf now, and if not, we're still able to reduce your engineering costs in designing it.

MODULAR POWER, 7364 Convoy Ct., San Diego, Cal., 92111, Tel: 714-279-1641; Empl.: 20

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs., Ltd.	205-536-9990
Ariz	Phoenix, Mesa Engrg.	602-943-9213
Cal	Costa Mesa, Robinson Tech. Assocs.	714-557-1622
Cal	San Diego, Mesa Engrg.	714-278-8021
Cal	San Jose, MCH Assocs.	408-246-7330
Cal	Westlake Village, Edwards Assocs.	213-889-1057
Colo	Littleton, Eissler Sls. & Service	303-794-1779
Conn	Newton, C. Lueders & Co.	203-426-3339
Fla	Orlando, FM Assocs., Ltd.	305-851-5710
Fla	Tequesta, FM Assocs., Ltd.	305-746-3126
Ill	Palantine, C & C Elctrn. Sls.	312-358-8900
Kans	Shawnee Mission, Tech. Sls. Assocs.	913-888-3330
Mass	Needham, C.J. Lueders	617-449-0345
Minn	Minneapolis, Bitronics Sls. Co.	612-866-3035
Mo	Ferguson, Tech. Sls. Assocs.	910-761-0565
NJ	Moorestown, Comp. Conslts.	609-234-3666
NJ	Palisades Park, Scientific Devices-East	201-871-3916
NM	Albuquerque, Elctrn. Entprs.	505-256-3561
NM	Las Cruces, Elctrn. Entprs.	505-524-0126
NC	Greensboro, FM Assocs., Ltd.	919-294-2754
Ohio	Worthington, Ohio Instr. Co.	614-885-0743
Tex	Dallas, REMTEK	214-369-8146
Tex	Houston, Remtek	713-664-2113
Wash	Seattle, Blum & Assocs.	206-782-1600

MODUTEC, INC., 18 Marshall St., Norwalk, Conn., 06854, Tel: 203-853-3636, TWX: 710-468-2039; Empl.: 300 .... p. 1•773-779,2319

For info on price: R. A. Eck; Application info: L. A. Velez; Customer service: W. J. Beke; Delivery info: B. Kunkel

Free literature available: Catalog #622 - Panel Meters, Control Meter Catalog #CM-1011, Pyrometer Catalog #PYR-1104

Products manufactured: Indicators, Meters, Pyrometers, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns. Assocs.	205-881-5031
Cal	Los Gatos, Luscombe Engrg. Co.	408-354-6496
Cal	Pasadena, Luscombe Engrg. Co.	213-684-2000
Colo	Arvada, Arrowhead Sls. Co.	303-423-5556
Fla	Fort Lauderdale, Beacon Electronic Assoc.	305-776-6074
Fla	Maitland, Beacon Elctrn. Assocs.	305-647-3498
Ga	Atlanta, Beacon Elctrn. Assocs.	404-351-3654
Ill	Wilmette, Crest Assocs.	312-256-5202
Ind	Indianapolis, Crest Assocs.	317-844-2800
Kans	Prairie Village, Engrg. Service Co.	913-649-4000
Md	Randallstown, Beacon Elec. Inc.	301-922-1248
Mass	Canton, New England Electronic Sls. Corp.	617-828-4835
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Minn	Minneapolis, R.J. Inc.	612-922-1425
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Englewood Cliffs, Sprung/Nussbaum, Inc.	201-947-6767
NJ	Marmora, Holdsworth & Co.	609-398-4340
NM	Albuquerque, Aztec Enterprises, Inc.	505-255-2440
NY	DeRuyter, R.P. Kennedy Co.	315-682-2299
NY	Red Hook, R.P. Kennedy Co.	914-876-2700
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Ohio	Cleveland, Carter, McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Pa	Monroeville, Carter, McCormic & Peirce	412-372-4415
Pa	Newtown Square, Holdsworth & Co.-SWR	215-356-8550
SC	Spartanburg, Beacon Elctrn. Assocs.	803-582-4613
Tex	Houston, Scientific Sls. Co.	713-666-5318
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Utah	Salt Lake City, Arrowhead Sls. Co.	801-487-4716
Va	Falls Church, Beacon Elctrns.	703-534-1673
Wash	Seattle, R.K. Squibb, Inc.	206-632-2450
EXP:	New York, Frathom Co.	212-687-9390
FOR:	Can., Burlington, Ont., Motion Control Devices	416-637-9369

MOHAWK DATA SCIENCES CORP., Corporate Headquarters, Utica, N.Y., 13503, Tel: 315-792-2002; Empl.: 5000

Customer service: S. J. Keane, V.P. Direct Sls 315-792-2022

Free literature available: Card equip. Tape equip.

Products manufactured: Perforators, Printers, Punched Card Equipment, Readers, Recorders, Transmission Systems, Data

Local Sales Offices & Reps.

Cal	Anaheim	714-772-0803
Cal	San Mateo	415-573-6400
Fla	Orlando	305-841-3091
Mass	Waltham	617-890-5870
Mich	Southfield	313-352-9160
Pa	King of Prussia	215-337-1910

MOHAWK OEM SALES, 1008 West 8th Ave., King of Prussia, Pa., 19406, Tel: 215-337-1910, Telex: 84-6453; Empl.: 5400; Minimum order: $100

For info on price: F. Graziano 315-792-2183; Application info: J. Rodenhausen 215-337-1910; Customer service: C. Randall 315-792-2234; Delivery info: F. Graziano 315-792-2183

Free literature available: 34-page catalog describing and picturing complete MDS OEM product line: printers tape drives, card readers, disk drives, keyboards, and paper tape equipment.

Products manufactured: Comm. Systems, Computers, Controllers, Programmable, Converters, Data Loggers, Encoders, Keyboards, Alphanumeric & Decimal, Modulator/Demodulators, Perforators, Printers, Punched Card Equipment, Readers, Recorders, Teleprinters, Terminal Equipment, Digital, Translators, Data, Transmission Systems, Data

Local Sales Offices & Reps.

Cal	Anaheim	714-772-0803
Cal	Los Angeles	213-933-5571
Cal	San Mateo	415-573-6400
Fla	Orlando	305-841-3091
Ill	Oak Brook	312-654-8630
Ind	Indianapolis	317-243-7547
Mass	Waltham	617-890-5870
Mich	Southfield	313-352-9160
Mo	Clayton	314-727-0175
NY	Liverpool	315-457-3248
NY	Utica	315-792-2022
Ohio	Independence	216-398-4700
Pa	Wayne	215-687-8452
Tenn	Nashville	615-383-1393
Tex	Houston	713-681-6601
Va	Richomnd	804-359-9283
Wisc	Wauwatosa	414-771-7830
EXP:	Utica, N.Y.	315-792-2045

MOLDING TECHNOLOGY INC., Ivyland, Pa., 18974, Tel: 215-355-3110; Empl.: 80

Customer service: D. C. Campbell

Free literature available: Four page brochure from Molding Technology Incorporated, Ivyland, Pa. 18974, describing their "Total Concept Service" for Molds, Trim and Forming Systems used by the Electronics and Electrical Industries.

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Alta Loma, Metro-Line Western	714-987-4112
Cal	Westminster, Metro-Line Western	714-839-8880
Fla	Ft. Lauderdale, E & E Engrg. Svc.	305-791-0754
NY	Niagara Falls, Waters Metal Prods. Ltd.	716-285-3595
NC	Charlotte, E & E Engrg. Svc.	704-333-9790

MOLDTRONICS, INC., 707 Roger St., Downers Grove, Ill., 60515, Tel: 312-968-7000; Empl.: 170; Minimum order: $25

For info on price: B. Qualizza; Application info: J. Collins; Customer service: B. Qualizza; Delivery info: B. Qualizza

Free literature available: PLASTIC MODULE CASES - DIP HEADERS - COIL FORMS/24 page illustrated brochure describing an assortment of miniature plastic cases for potting electronic components, many with metal inserts.

Products manufactured: Bobbins, Winding, Coil & Transformer, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cups, Encapsulation, Headers, Lenses, Readout & Display, Pads, Transistor Mounting, Services, Assembly, Production & Test, Sockets

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Canoga Park, Snavely Assocs.	213-348-5258
Cal	San Diego, Miracle & Assocs.	714-276-8619
Cal	San Jose, United Sls. Co.	408-379-0800
Colo	Denver, Thorson Co.	303-759-0809
Fla	Orlando, Hi-Co Assocs.	305-273-0571
Ga	Atlanta, Davidson Co.	404-993-4570
Ill	Hinsdale, Hill-Gray Assocs.	312-325-4810
Ind	Indianapolis, Stoltenberg Sls. Co.	317-547-1169
Iowa	Marion, Thomas & Modrcin Assocs.	319-377-6261
Kan	Shawnee Mission, Thomas & Modrcin Assocs.	913-432-2131
Md	Woodbine, Naudain Assocs.	301-252-5378

Mass	Wellesley Hills, Michael Scott Co.	617-235-0102
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	Hazelwood, Thomas & Modrcin Assocs.	314-895-4700
NJ	Mount Laurel, Naudain Assocs.	609-235-1801
NY	Rochester, Fowler Beach Corp.	716-586-0468
Ohio	Dayton, Harry G. Lake Co.	513-277-8181
SC	Columbia, Davidson Co.	803-788-3538
Tenn	Nashville, Davidson Co.	615-356-2905
Tex	Garland, Gordon V. Peck Co.	214-341-8311
Wash	Bellevue, Henry Paulman Sls.	206-455-3311

MOLECU-WIRE CORP., P.O. Box 495, Farmingdale, N.J., 07727, Tel: 201-922-9400, TWX: 710-723-6943; Empl.: 150

Products manufactured: Wire

Local Sales Offices & Reps.

Cal	La Canada, R. D. Dahl Co.	213-790-6111
Ill	Chicago, Kennedy Engrg.	312-631-8283
Minn	Wayzata, Schlenker & Assoc.	612-473-5417
Mo	St. Louis, Renner & Co.	314-434-3623
NJ	N. Plainfield, Tri-J Corp.	201-469-9300
Ohio	Cleveland, Qualiform Insul.	216-671-8300
Ohio	Oregon, Meej Sls.	419-698-1026
Pa	Pittsburgh, Patterson Elec. Co.	412-244-1818
Wash	Seattle, Comptronics	206-284-4842

MOLEX INC., 2222 Wellington Ct., Lisle, Ill., 60532, Tel: 312-969-4550 .... p. 2•1068,1069

Customer service: Cust. Svc.

Free literature available: M-100 Catalog (General Product Catalog) M-200 Catalog - specific terminal and connector housing information. M-300 Catalog - switch product catalog. M-400 Catalog - printed circuit board interconnection systems and devices.

Products manufactured: Connector Blocks, Mother Board, Connectors, Contacts, Electrical, Sockets, Switches, Terminals, Tools

Local Sales Offices & Reps.

Cal	Encino, R.H. McDonald & Assocs.	213-986-5832
Cal	Mt. View, Cindel Sls.	415-965-2630
Colo	Denver, Thorson Co.	303-759-0809
Fla	Altamonte Springs, WMM Assocs.	305-831-5067
Fla	Clearwater, WMM Assocs.	813-447-2533
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Crystal Lake, E.S. Healy & Assocs.	815-459-4386
Ind	Crawfordsville, D. Miller & Assocs.	317-362-6348
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Mass	Andover, Sales Engrg. Co.	617-470-0800
Mich	Benton Harbor, Hampton Askin & Assocs.	616-925-0341
Mich	Southfield, D.D. Douglas & Assocs.	313-352-7180
Minn	Minneapolis, C. Diehl	612-854-4448
Mo	St. Louis, P. Still & Assocs.	314-993-2077
NM	Albuquerque, Cleveland Ents.	505-345-2481
NY	Lynbrook, P. Saftler & Assocs.	516-593-7880
NY	Rochester, L-Mar Assocs.	716-328-5240
Ohio	Mansfield, R. Meckling Assocs.	419-526-1250
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640
Tenn	Chattanooga, Peirson, Deakins & McGinness	615-821-4501
Tex	Richardson, Palatine Sls. Inc.	214-231-9489
Va	Lynchburg, Barnhill & Assocs.	804-846-4624
Wash	Bellevue, H. Paulman Sls.	206-455-3311

MOLEX PRODUCTS, INC., 5224 Katrine, Downers Grove, Ill., 60515, Tel: 312-969-4550, TWX: 910-695-3229

Customer service: Cust. Svc. Personnel

Free literature available: M100 Catalog - General Product Line; M200 Catalog - Connectors and Terminals, M300 Catalog - Molex Switches, M400 Catalog - Printed Circuit Interconnections.

Products manufactured: Connector Blocks, Mother Board, Connectors, Machines/Machinery, Production, Sockets, Switches, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Cal	Encino, R. H. McDonald & Assocs.	213-986-5832
Cal	Mountain View, Cindel Sales, Inc.	415-965-2630
Colo	Denver, Thorson Co.	303-759-0809
Fla	Clearwater, WMM Assocs.	813-447-2533
Ill	Crystal Lake, E.S. Healy & Assocs.	815-459-4386
Ind	Crawfordsville, Dale A. Miller & Assocs.	317-362-6348
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Mass	Andover, Sls. Engrg. Co.	617-470-0800
Mich	Benton Harbor, Hampton, Askin & Assocs.	616-925-0341
Mich	Southfield, D.D. Douglass & Assocs.	313-352-7180
Minn	Bloomington, Chuck Diehl	612-854-4448
Mo	St. Louis, Palmer Still & Assocs.	314-993-2077
NJ	Riverton, Valley Sls.	609-829-2892
NM	Albuquerque, Cleveland Enterprises, Inc.	505-345-2481
NY	Lynbrook, P. Saftler & Assocs.	516-593-7880
NY	Rochester, L-Mar Assocs.	716-328-5240
Ohio	Mansfield, Ralph Meckling & Assocs.	419-526-1250
Pa	Pittsburgh, Sheridan Assocs., Inc.	412-244-1640
Tenn	Chattanooga, Peirson, Deakins & McGinness	615-821-4501
Tex	Richardson, Palatine Sls., Inc.	214-231-9489
Va	Lynchburg, Barnhill & Assocs.	804-846-4624

MOLON MOTORS & COIL CORP., 3737 Industrial Ave., Rolling Meadows, Ill., 60008, Tel: 312-259-3750; Empl.: 300

Customer service: L. Breden 312-259-8700

Free literature available: 1. Brochure describing Molon's product line of custom designed open frame motors and gear motors. 2. Literature describing Molon's permanent magnet synchronous motors and 7 1/2° stepper motors.

Products manufactured: Blowers & Fans & Accessories, Motors, Pumps, Vacuum

Local Sales Offices & Reps.

Cal	Sunnyvale, RDX Corp.	408-734-4500
Cal	Woodland Hills, G.M. Stevenson	213-348-5506
Colo	Denver, Parker Webster	303-770-1972
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Minn	St. Paul, Dale Merrick Co.	612-636-0444
NJ	Cranford, Hy Rel Assocs.	201-276-5677
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
Ohio	Cleveland, E.B. Kaercher	216-TE1-8098
Pa	Cornwall Hghts., W.D. Staats	215-ME9-5231
Tex	Dallas, W. Reese Assoc.	214-638-6575

MONA INDS., INC., Box 397, River Street Station, Paterson, N.J., 07524, Tel: 201-274-8220; Empl.: 60

Products manufactured: Chemicals, Cleaners & Solvents

MONITOR LABS, INC., 4202 Sorrento Vly. Blvd., San Diego, Cal., 92121, Tel: 714-453-6260, TWX: 910-337-1278; Empl.: 75; Minimum order: $25

For info on price: Prod. Line Mgr.; Application info: Prod. Line Mgr.; Customer service: Cust. Svc. Mgr.; Delivery info: Prod. Line Mgr.

Products manufactured: Analyzers, Clocks (All Types), Data Acquisition & Reduction Systems, Data Loggers, Scanners, Switches

Local Sales Offices & Reps.

Ala	Huntsville, F.M. Assocs.	205-536-9990
Ariz	Scottsdale, Measurement Consits.	602-994-9519
Cal	Lawndale, Ward/Davis Assocs.	213-542-7740
Cal	San Diego, Ward/Davis Assocs.	714-459-3351
Cal	Sunnyvale, Ward/Davis Assocs.	408-245-3700
Colo	Boulder, Measurement Consits.	303-449-5294
Fla	Orlando, F.M. Assocs.	305-851-5710
Fla	Tequesta, F.M. Assocs.	305-746-3126
Ill	Chicago, Dalec	312-283-0300
Ind	Indianapolis, Dalec	317-784-6360
Md	Rockville, MESA, Inc.	301-881-8430
Mass	Nonatum, ETA Assocs.	617-527-4544
Mich	Southfield, Data-Tron	313-354-6421
Minn	Minneapolis, Dalec	612-786-9666
Mo	Hazelwood, Technical Reps.	314-731-5200
NJ	Union, SBM Assocs.	201-687-8737
NM	Albuquerque, Measurement Consits.	505-265-6471
NY	Pleasantville, SBM Assocs.	914-769-1811
NY	Rochester, SBM Assocs.	716-266-1400
NC	Greensboro, F.M. Assocs.	919-294-2754
Ohio	Dayton, Data-Tron	513-223-8421
Ohio	Wickliffe, Data-Tron	216-585-8421
Pa	Pittsburgh, K. J. Lesker Co.	412-892-2996
Tex	Houston, Harvey Assoc.	713-464-7641
Tex	San Antonio, Data Applications Corp.	512-732-7176
Wash	Seattle, Showalter/Instruments	206-455-4922
FOR:	Can., Calgary, Alb., Canadian Dynamics	403-269-2202
FOR:	Can., Downsview, Ont., Datamex, Ltd.	416-661-1404
FOR:	Can., Montreal, Datamex, Ltd.	514-731-9328
FOR:	Can., Ottawa, Ont., Datamex, Ltd.	613-825-4255
FOR:	Can., Vanvouver, B.C., Canadian Dynamics	604-325-3201

MONITOR PRODS., Box 1966, 3018 San Luis Rey Rd., Oceanside, Cal., 92054, Tel: 714-433-4510, TWX: 910-322-1381; Empl.: 60; Minimum order: $50 p. 1•388-397

Customer service: Sls. Order Desk

Free literature available: Oven Oscillator Data Sheet, General Catalog, 74 EEM Reprint, Digital Oscillators & Logic Clocks, TCXO's, Filters, Crystals, Comml, Crystals, Military

Products manufactured: Clocks (All Types), Crystals, Filters, Integrated Circuit Devices, Oscillators, Ovens, Standards, Terminal Equipment, Digital

Local Sales Offices & Reps.

Cal	W. Covina, Groh Assocs.	213-923-0963
Colo	Denver, Electrodyne, Inc.	303-757-7679
Fla	Ft. Lauderdale, Tech. Rep. Assocs.	305-792-0962
Fla	Indian Rock Bch., Tech. Rep. Assocs., Inc.	813-595-2834
Iowa	Cedar Rapids, H. R. Brown Assoc.	319-366-0635
NY	Great Neck, Trionic Assoc.	516-466-2300
Ohio	Dayton, Berberich Assocs.	513-252-9981
Tex	Dallas, Tesco	214-358-3521

MONOLITHIC MEMORIES INC., 1165 E. Arques Ave., Sunnyvale, Cal., 94086

MONROE, THE CALCULATOR CO., Div. Litton Inds., 550 Central Ave., Orange, N.J., 07050, Tel: 201-673-6600, TWX: 710-994-5840; Empl.: 3000; Minimum order: $50

Products manufactured: Analyzers, Calculators, Electrical & Electronic, Comm. Systems, Computers, Data Acquisition & Reduction Systems, Integrated Circuit Devices, Recorders, Terminal Equipment, Digital, Transmission Systems, Data

MONSANTO, Box 8, St. Peters, Mo., 63376, Tel: 314-272-6281, TWX: 910-760-1591; Empl.: 1000

Products manufactured: Crystals

Local Sales Offices & Reps.

Cal	Santa Clara, Monsanto Co.	408-243-0414
Mass	Westwood, Monsanto Co.	617-329-2530
Mo	St. Peters, Monsanto Co.	314-272-6281
Tex	Garland, Monsanto Co.	214-272-6974

MONSANTO-ELCTRN. SPEC. PRODS., 3400 Hillview Ave., Palo Alto, Cal., 94304, Tel: 415-493-3300, TWX: 910-373-1767; Empl.: 500; Minimum order: $250

For info on price: W. Reed; Application info: M. Bottini; Customer service: F. August; Delivery info: F. August

Free literature available: Short form catalog of optoelectronic devices

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Diodes, Display Devices/Displays, Isolators, Lamps, Lights, Relays, Switches

MONTEVIDEO TECHNOLOGY INC., 4716 Wilford Way, Edina, Minn., 55435, Tel: 612-920-1050; Empl.: 160; Minimum order: $50

For info on price: W.L. Nees; Application info: W.L. Nees; Customer service: W.C. Knutsen; Delivery info: W.C. Knutsen

Free literature available: Catalog Describing Aircraft Grade Servo Motors, Motor Tachometers, Digital Indicators and Related Mechanisms That Are Used In Military & Commercial Aircraft and Other Airborne Equipment. The Product Line Had Its Origin In 1962 And Has Been Marketed Under Trade Names "Cedar Engineering", "Cedar" and "Cedar Avionics."

Products manufactured: Coils Including Assemblies & Forms, Controls/Control Eqpt., Counters, Display Devices/Displays, Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Generators, Indicators, Motors, Tachometers, Transducers

MOODY TOOLS, INC., 42 - 46 Dudley St., Providence, R.I., 02905, Tel: 401-421-5032; Empl.: 11; Minimum order: $60

Customer service: J. H. Moody

Free literature available: Catalog of present line, a sheet announcing 41 New Tools plus distributor and dealer price lists.

Products manufactured: Drills & Accessories, Hand & Power, Drivers, Nut, Magnets, Screwdrivers, Scribers, Tools, Wrenches

Local Sales Offices & Reps.

Cal	Long Beach, L. P. Feeley & Assocs.	213-595-5421
Cal	San Carlos, A. Williams	415-591-7043
Colo	Denver, J. Connors	303-934-5829
Fla	Riviera Beach, C.M. Allen	305-844-2593
Ga	Atlanta, R.B. Allen	404-255-8267
Ill	Chicago, Witz-Knight, Inc.	312-685-3181
Kans	Overland Park, D.H. Donegan	913-384-0460
NY	Manlius, W. Ferguson	315-682-9301
NY	New York, A. Mizner Assocs., Inc.	212-683-4948
NC	Charlotte, T.T. Patterson	704-366-4174
Ore	Portland, R. Minthorne Co.	503-246-4556
Pa	King of Prussia, L. Spangenberg	215-265-2130
Pa	Pittsburgh, A. Kostman	412-421-9204
RI	East Providence, G. Goddard Assocs.	401-434-3824
Tenn	Nashville, M.M. Hnatio	615-834-4225

MOREY CORP., 2659 Wisconsin Ave., Downers Grove, Ill., 60515, Tel: 312-964-2300; FSC No: 04377; Empl.: 150; Minimum order: $25

For info on price: E. J. Cunningham; Application info: E. J. Hollowed; Customer service: E. J. Cunningham; Delivery info: R. R. Morey

Free literature available: Product & general facility brochure.

Products manufactured: Cable Assemblies & Harnesses, Cable Retractors, Capacitors, Fixed, Capacitors, Variable, Chokes, Coils Including Assemblies & Forms, Comm. Systems, Cords, Couplers, Filters, Jack Covers, Lead Assemblies & Receptacles, Oscillators, Reels, Cord & Cable, Screens, Printed Circuit, Terminal Blocks, Boards & Strips, Transformers

MORIRICA ELCTRNS., LTD., 205 Tozuka-machi, Tozuka-ku, Yokohama, Japan, Tel: 045-881-2331; Empl.: 350

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic

Local Sales Offices & Reps.

Ill	Skokie, Solar Systems Inc.

MORRIS, J.I. CO., 372 Elm St., Southbridge, Mass., 01550, Tel: 617-764-4394; Empl.: 45

For info on price: J. B. Dirlam; Application info: J. B. Dirlam; Customer service: T. Holden; Delivery info: T. Holden

Products manufactured: Fasteners

MOS TECHNOLOGY, INC., Valley Forge Corp. Ctr., 950 Rittenhouse Rd., Norristown, Pa., 19401, Tel: 215-666-7950, TWX: 510-660-4033; Empl.: 350; Minimum order: $250

Customer service: J. C. Hertsch

Free literature available: Mos LSI, application notes and specifications/data sheets available on complete product line.

Products manufactured: Encoders, Integrated Circuit Devices, Shift Registers

MOSTEK CORP., 1215 W. Crosby Rd., Carrollton, Tex., 75006, Tel: 214-242-0444; Empl.: 1800

For info on price: J. Garrett Ext. 357; Application info: K. Daugherty Ext. 432; Customer service: C. Crutcher Ext. 359; Delivery info: J. Tadlock Ext. 359

Free literature available: Literature on complete line of RAMs, ROMs, shift registers, timing and display circuits, calculator circuits, CMOS, and special products.

Products manufactured: Integrated Circuit Devices

Local Sales Offices & Reps.

Ala	Huntsville, Component Mktg.	205-881-5333
Ariz	Phoenix, Howe & Howe Sls.	602-264-7971
Cal	Fountain Valley, Mostek Corp.	714-554-1611
Cal	Los Altos, Mostek Corp.	415-941-3030
Cal	Redwood City, J. Heaton Co.	415-369-4671
Cal	San Diego, H. King	714-276-7541
Cal	Santa Ana, Rical Assoc.	714-557-6543
Colo	Wheatridge, Waugaman Assocs.	303-423-1020
Fla	Clearwater, CBC	813-447-3375
Fla	Coral Springs, Mostek Corp.	305-752-8140
Fla	Ft. Lauderdale, CBC	305-484-7330
Fla	Winter Park, CBC	305-644-2277
Ill	Elk Grove Village, J. G. Twist Co.	312-593-0200
Ill	Wheaton, Mostek	312-682-9505
Ind	Fort Wayne, R. O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R. O. Whitesell & Assocs.	317-452-6065
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
Ky	Louisville, R. O. Whitesell & Assocs.	502-893-7303
Md	Baltimore, J. R. Daniel & Co.	301-825-3330
Mass	Burlington, New England Tech. Sls.	617-272-0434
Mass	Waltham, Mostek Corp.	617-899-9107
Mich	Grosse Point Park, Greiner Assocs.	313-499-0188
Minn	Minneapolis, HMR	612-920-8200
Mo	St. Louis, J. G. Twist Co.	314-432-2830
NJ	East Hanover, HLM Assocs.	201-386-0794
NY	Liverpool, J. Semple Assocs.	315-458-4775
NY	Northport, HLM Assocs.	516-757-1606
NY	Rochester, J. Semple Assocs.	716-544-8582
NC	Greensboro, J. R. Daniel & Co.	919-885-4634
NC	Raleigh, A. B. Andrews Co.	919-833-5565
Ohio	Brecksville, Mostek Corp.	216-526-6747
Ohio	Cincinnati, R. O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R. O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, R. O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R. O. Whitesell & Assocs.	513-298-9546
Okla	Tulsa, W. Pat Fralia Co.	918-663-8707
Pa	Ft. Washington, Mostek Corp.	215-628-9050
Pa	Horsham, CMS Mktg.	215-672-8300
Pa	Pittsburgh, R. O. Whitesell & Assocs.	412-344-7277
Tex	Ft. Worth, W. Pat Fralia Co.	817-738-2394
Tex	Houston, W. Pat Fralia Co.	713-772-1572
Wash	Seattle, General Elctrns.	206-243-5141
Wisc	Wauwatosa, J. G. Twist Co.	414-475-7755
FOR:	Can., Downsview 475, Ont., Cantronics Ltd.	416-661-2494
FOR:	Can., Montreal, Que., Cantronics Ltd.	514-341-5207

MOTOROLA COMMS. DIV., Parts Dept., 1313 E. Algonquin Rd., Schaumburg, Ill., 60172, Tel: 312-397-3500, TWX: 910-693-1592

Customer service: J. Willson 312-397-1000 Ex. 3204

Products manufactured: Antenna Towers & Supports, Antennas, Arresters, Electrical Surge, Lightning, Attenuators, Batteries, Benches, Consoles, Stools, Tables, Cabinets & Accessories, Cable, Calibrators, Capacitors, Fixed, Capacitors, Variable, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chargers, Battery, Comm. Systems, Comparators, Connectors, Counters, Cutters, Wire, Hand Operated, Diodes, Dummy Loads, Eliminators, Battery, Filters, Fuses, Generators, Handsets, Chestsets, Headphones, Headsets, Etc., Heat Sinks, Soldering, Inverters, Kits, Marking (Dial, Instrument, Equipment, etc.), Lamps, Meters, Microphones, All Kinds, Monitors, Oscillators, Pliers, Plug Buttons, Potentiometers, Power Supplies, Probes, Public Address Systems, Receivers, Resistors, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Speakers, Synthesizers, Tubes, Wire

Local Sales Offices & Reps.

Cal	El Segundo	213-644-1101
Cal	Foster City	415-349-3111
Ga	Forest Park	404-762-6183
NJ	Glen Rock	201-447-4000
Ohio	Parma	216-267-2210
Tex	Dallas	214-241-2151

MOTOROLA INC., Component Prods. Dept., 2553 N. Edgington, Franklin Park, Ill., 60131, Tel: 312-451-1000, TWX: 910-227-0799 .... p. 1•398

Customer service: C. Chopp

Free literature available: K1100A - Crystal Clock Oscillator, K1114A - K1115A - K1116A Economy Class Crystal Clock Oscillator, K1117A - K1123A Clock Generator for INTEL 8080 Microprocessor, K1112A - K1122A - Clock Generator for Motorola M6800 Microprocessor, Preliminary Data Sheets

Products manufactured: Integrated Circuit Devices, Oscillators

Local Sales Offices & Reps.

Ala	Huntsville, Barnhill Assocs.	205-883-9394
Ariz	Scottsdale, F. Board Assocs.	602-994-9388
Cal	Inglewood, J. Berman Co.	213-776-1281
Cal	San Carlos, Kottmeier Assocs.	415-592-8333
Fla	Altamonte Springs, Semtronic Assocs.	305-831-8233
Fla	Fort Lauderdale, Semtronic Assocs.	305-771-0010
Ill	Franklin Park, Component Prods. Dept. Motorola Inc.	312-451-1000
Ill	Skokie, Mar-Con Assocs.	312-675-6450
Ind	Indianapolis, Sheridan Assocs.	317-547-7777
Md	Timonium, Barnhill Assocs.	301-252-5610
Mass	Natick, Wayland Engrg. Sls.	617-655-6080
Mich	Farmington, Sheridan Assocs.	313-477-3800
Mo	Florissant, Sheridan Assocs.	314-837-5200
NJ	Keasby, Addem 3	516-567-5900
NY	Buffalo, Ossmann Comp. Sls.	716-832-4271
NY	Deer Park, Addem 12	516-567-5900
NY	Huntington Station, Addem 1	516-567-5900
NY	Kingston, Ossmann Comp. Sls.	914-338-5505
NY	Massapequa Park, Addem 4	516-567-5900
NY	Rochester, Ossmann Comp. Sls.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls.	315-454-4477
NY	Vestal, Ossmann Comp. Sls.	607-785-9949
NC	Raleigh, Barnhill Assocs.	919-876-5617
Ohio	Beachwood, Sheridan Assocs.	216-831-0130
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Dayton, Sheridan Assocs.	513-277-8911
Okla	Tulsa, H.J. Daly Co.	918-627-4159
Ore	Portland, Almac/Stroum Electronics	503-292-3534
Pa	Bala Cynwyd, Vantage Sls. Co.	215-667-0990
Pa	Pittsburgh, Sheridan Assocs.	412-242-1640
Tenn	Johnson City, Barnhill Assocs.	615-928-0184
Tex	Dallas, R.M. Electronics	214-233-0363
Tex	Houston, R.M. Electronics	713-664-7131
Va	Lynchburg, Barnhill Assocs.	804-846-4624
Wash	Seattle, Almac/Stroum Electronics	206-763-2300

MOTOROLA SEMICONDUCTOR PRODS., Tech. Info. Ctr. T902, 5005 E. McDowell Rd., Phoenix, Ariz., 85008, Tel: 602-244-3464, TWX: 910-951-1334; Empl.: 10000

Products manufactured: Capacitors, Fixed, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Controls/Control Eqpt., Diodes, Integrated Circuit Devices, Isolators, Multipliers, Rectifiers, References, D-C Voltage, Regulators, Resistors, Suppressors, Technical Books, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ala	Huntsville	205-533-1650
Ariz	Phoenix	602-244-6364
Cal	Encino	213-986-6850
Cal	Menlo Park	415-854-1910
Cal	San Diego	714-560-4644
Cal	Santa Ana	714-558-2601
Colo	Denver	303-770-2122
Conn	Hamden	203-281-0771
Fla	Maitland	305-644-3422
Fla	Palm Beach Gardens	305-622-2700
Fla	Pompano Beach	305-782-4464
Fla	St. Petersburg	813-576-6030
Ga	Atlanta	404-255-2043
Ill	Chicago	312-992-2320
Ill	Schiller Park	312-678-7205
Ind	Ft. Wayne	219-485-1691
Ind	Indianapolis	317-849-7060
Iowa	Cedar Rapids	319-393-8632
Kans	Mission	913-384-3050
Md	Hyattsville	301-779-1100
Mass	Lexington	617-861-1350
Mich	Garden City	313-261-6200
Mich	Saugatuck	616-857-2159
Minn	Minneapolis	612-545-0251
Mo	St. Louis	314-872-7681
NJ	Cherry Hill	609-665-3783
NJ	River Edge	201-488-1200
NM	Albuquerque	505-266-5763
NY	Fishkill	914-896-8970
NY	Hauppauge	516-231-9000
NY	Rochester	716-381-7220
NY	Syracuse	315-454-9373
NC	Raleigh	919-782-7604
Ohio	Cleveland	216 461-3160
Ohio	Dayton	513-294-2231
Ohio	Worthington	614-846-9460
Okla	Tulsa	918-664-5227
Ore	Portland	503-297-2235
Pa	Ft. Washington	215-643-4500
SC	Columbia	803-788-0585
Tex	Dallas	214-661-9829
Tex	Houston	713-688-4583
Wash	Bellevue	206-455-3700
Wisc	Wauwatosa	414-476-5554

Local Distributors

Ala	Huntsville, Hall-Mark Elctrns.	205-539-0691
Ariz	Phoenix, Hamilton/Avnet Elctrns.	602-275-7851
Ariz	Phoenix, Liberty Elctrns./Arizona	602-257-1272
Cal	El Segundo, Liberty Elctrns. Corp.	213-322-8100
Cal	Irvine, Cramer/Los Angeles	213-771-8300

Cal	Los Angeles, Hamilton Electro Sls.	213-870-7171
Cal	Mountain View, Elmar Elctrns.	415-961-3611
Cal	Mountain View, Hamilton/Avnet Elctrns.	415-961-7000
Cal	San Diego, Hamilton/Avnet Elctrns.	714-279-2421
Cal	San Diego, Liberty Elctrns./San Diego	714-565-9171
Cal	Sunnyvale, Cramer/San Francisco	408-739-3011
Colo	Commerce City, Elmar Elctrns.	303-287-9611
Colo	Denver, Hamilton/Avnet Elctrns.	303-534-1212
Conn	Danbury, Schweber Elctrns.	203-792-3500
Conn	North Haven, Cramer Elctrns.	203-239-5641
Fla	Hollywood, Cramer Elctrns.	305-923-8181
Fla	Hollywood, Hamilton/Avnet	305-925-5401
Fla	Hollywood, Schweber Elctrns.	305-927-0511
Fla	Orlando, Cramer Elctrns.	305-894-1511
Ga	Norcross, Hamilton/Avnet Elctrns.	404-448-0800
Ill	Chicago, Newark Elctrns. Corp.	312-638-4411
Ill	Chicago, Semiconductor Specialists	312-279-1000
Ill	Schiller Park, Hamilton/Avnet Elctrns.	312-678-6310
Ind	Indianapolis, Graham Elctrns. Supply	317-634-8202
Kans	Lenexa, Hamilton/Avnet Elctrns.	913-888-8900
Md	Rockville, Cramer Elctrns.	301-948-0110
Md	Rockville, Pioneer/Washington Elctrns.	301-424-3300
Md	Rockville, Schweber Elctrns.	301-881-2970
Md	Savage, Pyttronic Inds.	301-792-7000
Mass	Burlington, Hamilton/Avnet Elctrns.	617-273-2120
Mass	Lexington, Harvey Elctrns.	617-861-9200
Mass	Newton Centre, Cramer Elctrns.	617-969-7700
Mich	Detroit, RS Elctrns.	313-491-1012
Mich	Livonia, Hamilton/Avnet Elctrns.	313-522-4700
Minn	Edina, Cramer/Minneapolis	612-835-7811
Minn	Edina, Hamilton/Avnet Elctrns.	612-941-3801
Mo	Hazelwood, Hamilton/Avnet Elctrns.	314-731-1144
NJ	Cedar Grove, Hamilton/Avnet Elctrns.	201-239-0800
NJ	Moorestown, Arrow Elctrns.	609-235-1900
NJ	Mt. Laurel, Hamilton/Avnet Elctrns.	609-234-2133
NJ	Pennsauken, Radio Elect. Svc. Co.	609-662-4000
NJ	Somerset, Schweber Elctrns.	201-469-6008
NM	Albuquerque, Hamilton/Avnet Elctrns.	505-765-1500
NY	East Syracuse, Cramer/Syracuse	315-437-6671
NY	Hauppague, Cramer Elctrns.	516-231-5600
NY	Rochester, Cramer Elctrns.	716-275-0300
NY	Westbury, Schweber Elctrns.	516-334-7474
NY	Woodbury, Harvey Elctrns.	516-921-8700
NC	Winston-Salem, Cramer Elctrns.	919-725-8711
Ohio	Cleveland, Pioneer-Standard Elctrns.	216-587-3600
Ohio	Dayton, Hamilton/Avnet Elctrns.	513-433-0610
Ohio	Dayton, Pioneer/Dayton	513-236-9900
Ohio	Solon, Cramer/Cleveland	216-248-8400
Pa	Pittsburgh, Cameradio	412-288-2600
SC	Columbia, Dixie Radio Supply.Co.	803-253-5333
Tex	Dallas, Hall-Mark Elctrns.	214-231-6111
Tex	Dallas, Hamilton/Avnet Elctrns.	214-661-8661
Tex	Dallas, Sterling Elctrns.	214-357-9131
Tex	El Paso, Midland Specialty Co.	915-533-9555
Tex	Houston, Hamilton/Avnet Elctrns.,	713-526-4661
Tex	Houston, Sterling Elctrns.	713-623-6600
Utah	Salt Lake City, Cramer Elctrns.	801-487-4131
Wash	Bellevue, Hamilton/Avnet Elctrns.	206-746-6720
Wash	Seattle, Liberty Elctrns.	206-763-8200
For:	Can., London, Ont., CM Peterson Co.	519-434-3204
For:	Can., Mississauga, Ont., Hamilton/Avnet	416-677-7432
For:	Can., Montreal, P.Q., Electronic Wholesalers Co.	514-769-8851
For:	Can., Montreal, P.Q., Hamilton/Avnet	514-735-6393
For:	Can., Ottawa, Ont., Electronic Wholesalers Co.	613-237-4703
For:	Can., Ottawa, Ont., Hamilton/Avnet	613-725-3071
For:	Can., Toronto, Ont., Zentronics, Ltd.	416-787-1271
For:	Can., Vancouver, B.C., L. A. Varah	604-873-3211
For:	Can., Vancouver, B.C., Bowtek Elec. Co.	604-736-7677
For:	Can., Winnipeg, Man., Jang Elctrns.	204-786-7521

MPB CORP., Precision Park, Keene, N.H., 03431, Tel: 603-352-0310, TWX: 710-366-1801; Empl.: 1600

Products manufactured: Bearings, Bushings, Glass, Plastic, Metal, Rubber, Etc.

Local Sales Offices & Reps.

Cal	Glendale	213-245-6413
Conn	Milford	203-877-3208
Ill	Rolling Meadows	312-259-7800

MOXON INC., 2222 Michelson Dr., Irvine, Cal., 92664, Tel: 714-833-2000, TWX: 910-596-1362; FSC No: 22623; Empl.: 85; Minimum order: $50 .... p. 1•752,2343

Free literature available: Sales brochures describing in detail Timing Systems, Digital Data Generators, LVDT and Torque Transducers, Power Supplies, Signal Conditioning Equipment and CATV Equipment. Products produced to Mil and Commerical Specifications.

Products manufactured: Amplifiers, Calibrators, CATV Systems & Equipment, Converters, Encoders, Gages, Generators, Indicators, Power Supplies, Signal Conditioners & Equipment, Television Systems & Equipment Closed-Circuit, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scientific Instrs.	205-837-1601
Ariz	Phoenix, Moxon Elctrns.	602-945-3737
Cal	Irvine, Moxon Elctrns.	714-556-6500
Cal	San Diego, Moxon Elctrns.	714-292-4820
Cal	Santa Clara, Moxon Elctrns.	408-249-2491
Fla	Orlando, Truex Assocs.	305-859-2160
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	Stoneham, Ken Corp.	617-438-5464
Mich	Farmington, Carter McCormic & Peirce	313-477-7700
Mich	Kalamazoo, Carter McCormic & Peirce	616-349-9666
NJ	Union, S B M Reps Inc.	201-687-8737
NY	Pleasantville, S B M Reps. Inc.	914-769-1811
NY	Rochester, S B M Reps. Inc.	716-266-1400
NC	Winston Salem, Int'l. Scientific Instrs.	919-722-1783
Ohio	Cleveland, Carter McCormick & Peirce	216-333-5650
Ohio	Dayton, Carter McCormic & Peirce	513-278-5873
Pa	Pittsburgh, Carter McCormick & Peirce	412-824-3760
Tex	Dallas, Martin, Zienkosky, Browne & Assocs.	214-233-5535
Tex	Houston, Martin, Zienkosky, Browne & Assocs.	713-523-7333
Wash	Seattle, R. Drake Assocs.	206-763-2755

MPC PRODS. CORP., 4200 W. Victoria Ave., Chicago, Ill., 60646, Tel: 312-583-5100, TWX: 910-221-2576; FSC No: 019710; Empl.: 115

Customer service: Sls. Dept.

Products manufactured: Actuators, Amplifiers, Controls/Control Eqpt., Drives & Drive Mechanisms (Dial), Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Motors, Potentiometers, Servo Systems, Tachometers

MRC ALARM SYSTEMS & DEVICES CO., 700 W. Virginia St., Milwaukee, Wisc., 53204, Tel: 414-271-4343 .... p. 1•1017

Products manufactured: Alarms

Local Sales Offices & Reps.

Cal	Pinole, Bryce Bogue	415-758-1010
Cal	Westlake Village, K. Jensen	213-889-1606
Ga	Chamblee, R. J. Shafer	404-458-7483
Haw	Honolulu, J. J. Harding Co., Ltd.	808-841-0941
Pa	Bala-Cynwyd, M. Friedman Assocs.	215-839-3450
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
FOR:	Can., Kitchener, Ont., Poetker Comms., Ltd.	519-576-1010

MU-DEL ELCTRNS., 2426 Linden La., Silver Spring, Md., 20910, Tel: 301-587-6087; Empl.: 14; Minimum order: $50

For info on price: I. Kuzminsky; Application info: I. Kuzminsky; Customer service: I. Kuzminsky; Delivery info: H. E. Blum

Free literature available: Catalog Sheets

Products manufactured: Amplifiers, Attenuators, Comm. Systems, Converters, Couplers, Diplexers, Antenna, Dividers, Filters, Mixer-Preamplifiers, Microwave, Mixers, Multiplexers, Multipliers, Networks, Oscillators, Preselectors, Receivers

Local Sales Offices & Reps.

Ala	Huntsville, Anderson Assocs.	205-881-8770
Fla	Orlando, Unirep	305-295-4817
Md	Greenbelt, Riffe Assocs.	301-474-8600
Mass	Reading, L. DeBrigard	617-944-5661
NM	Albuquerque, Moore-Eiler Assocs.	505-292-3322
NY	Greenvale, B. D. Aaron & Co.	516-621-0630
Pa	Huntington Valley, Rabal Assocs.	215-947-4825
Tex	Arlington, J. T. Houston Assoc.	817-265-2931

MUELLER ELECTRIC CO., 1589 H East 31st St., Cleveland, Ohio, 44114, Tel: 216-771-5225; FSC No: 5999; Empl.: 156; Minimum order: $3 .... p. 2•718,719

Customer service: Sls. Dept.

Free literature available: 8-page general catalog G1 illustrates and describes complete line of electric test and battery clips and clip insulators.

Products manufactured: Cable, Clamps & Clips, Insulators & Insulation

Local Sales Offices & Reps.

Ariz	Phoenix, Maddox Sls. Co.	602-274-3807
Cal	Pico Rivera, Maddox Sls. Co.	213-949-5433
Cal	San Francisco, Maddox Sls. Co.	415-431-2953
Colo	Denver, L B Putnam Co.	303-825-5066
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Libertyville, R. Klipp Assocs.	312-362-4676
Ind	Indianapolis, Sukup & Cox Inc.	317-253-5501
Kans	Shawnee Mission, K & M Sls. Co.	913-262-1444
La	Chalmette, Cartwright & Bean	504-279-4598
Md	Baltimore, E-K-P Assocs.	301-788-6498
Mass	Lynn, Keene Sls. Co.	617-595-2300
Mich	Ferndale, Hilltronics Inc.	313-398-5556
Minn	Minneapolis, A.S. Miller & Sons	612-727-1952
NY	Buffalo, R W Mitscher Co.	716-663-7970
NY	Port Washington, Joseph Assocs.	516-883-7770
NC	Cary, Cartwright & Bean	919-832-7128
NC	Charlotte, Cartwright & Bean	704-537-7965
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Columbus, Mandabach & Assoc.	614-235-0265
Ore	Portland, Richard Legg Co.	503-292-8824
Pa	Easton, E-K-P Assocs.	215-258-6477
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Waco, Sanders-Willis Co.	817-776-1742
Utah	Salt Lake City, L B Putnam Co.	801-277-0375
EXP:	Can., Toronto, Downsview, W H Cooper & Co.	416-630-3900

MULTI-ELMAC CO., 22700 Heslip Dr., Novi, Mich., 48050, Tel: 313-349-3990; Empl.: 150

For info on price: T. Alsheskie, X44; Application info: R. DeVoll, X43; Customer service: T. Alsheskie, X44; Delivery info: T. Alsheskie, X44

Products manufactured: Controls/Control Eqpt., Receivers, Transmitters

Local Sales Offices & Reps.

Cal	Orange, Multi-Elmac Co.	714-997-1251
Colo	Denver, Howard Sls.	303-936-0134
Mich	Linden, R. Zerull	313-735-7497
Mo	Marshall, T.J. McCune	816-886-5308
Pa	Morrisville, E.F. Weiss	215-295-8254
Tex	Rockwall, Southwestern Sls. Co.	214-722-6515

MULTICORE SOLDERS, Div. Avnet, Long Island Expwy., Westbury, N.Y., 11590, Tel: 516-334-7450, TWX: 510-222-2219; Empl.: 1000

Products manufactured: Cleaners & Solvents, Coatings, Flux, Brazing & Soldering Materials, Kits, Test Equipment, Solder (All Types), Testers

Local Sales Offices & Reps.

Mo	Kansas City, Forristal-Young Sls. Co.	316-358-6771

MULTIMETRICS, See Comstron-Seg Multimetrics

MUPAC CORP., 646 Summer St., Brockton, Mass., 02402, Tel: 617-588-6110, TWX: 710-345-0194; Empl.: 70; Minimum order: $35

For info on price: E. Olson; Application info: B. Leary; Customer service: E. Olson; Delivery info: E. Olson

Free literature available: Sixteen page catalog listing hardware in a wirewrap* mode to package micro electronic systems.

Products manufactured: Boards, Plug-In, Boards, Printed Wiring, Universal, Cable, Chassis, Circuit Board Mounting, Chassis, Metal, Connectors, Drawers, Sliding, Jack Covers, Jumpers, Panels, Racks, Sockets, Terminals, Tools

Local Sales Offices & Reps.

Cal	Anaheim, Lodan, Inc.	213-924-1691
Cal	San Carlos, Lodan, Inc.	415-592-4600
Colo	Littleton, Eissler Sls. & Svcs.	303-794-1779

Conn	North Haven, Forsberg Sls.	203-239-5111
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Orlando, Saber Assocs.	305-422-3686
Ga	Woodstock, Saber Assocs.	404-432-9625
Ill	Morton Grove, T-Squared Assocs.	312-965-1515
Md	Silver Springs, Rep-Tron, Inc.	301-593-4844
Mass	Brockton, Forsberg Sls.	617-522-6300
Minn	Minneapolis, C.E. Bohlig Co.	612-922-7011
Mo	Blue Springs, Chesco	816-229-1404
Mo	St. Charles, Chesco	314-946-6677
NJ	Flanders, K & R Engrg Sls Co.	201-584-5235
NY	Bayside, K & R Engrg Sls Co.	212-225-8879
NY	Syracuse, Marcom Assocs.	315-437-2845
Ohio	Chagrin Falls, Midwest Mktg. Assocs.	216-247-6655
Ohio	Dayton, Midwest Mktg. Assocs.	513-433-2511
Pa	Harleysville, T. Jackson Assocs.	215-643-5560
Tex	Dallas, EBR, Inc.	214-942-2716

MURA CORP., 50 S. Service Rd., Jericho, N.Y., 11753, Tel: 516-334-2700; Empl.: 25

For info on price: J. Gaffney; Application info: B. Lipsky; Customer service: B. Lipsky; Delivery info: B. Lipsky

Products manufactured: Display Devices/Displays, Indicators, Lamps, Lights, Meters, Microphones, All Kinds, Probes, Rectifiers

MURATA CORPORATION OF AMERICA, 2 Westchester Plaza, Elmsford, N.Y., 10523, Tel: 914-592-9180, Telex: 13-7332; Empl.: 12

Customer service: Cust. Svc.

Products manufactured: Filters, Heaters & Heating Elements, Resistors, Thermistors, Transducers, Tuning Forks

Refer to Murata Corp. of America, Capacitor Div. for sales office information.

MURATA CORP. OF AMERICA, Capacitor Div., Rockmart Ind'l. Pk., Rockmart, Ga., 30153, Tel: 404-684-7143, Telex: 54-2999 .... p. 2•211

Customer service: G. Beylouny

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ala	Huntsville, 20TH Century Mktg.	205-772-9237
Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Inglewood, J. Berman	213-649-6111
Cal	Mountain View, Cindel	415-965-2630
Cal	Van Nuys, MCA Southern California	213-785-0487
Colo	Denver, Omega, Ltd.	303-758-1508
Fla	Fort Lauderdale, Semtronic Assocs.	305-771-0010
Ga	Atlanta, Grady Duckett Sls. Co.	404-451-3529
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Indianapolis, Electro-Reps	317-255-4147
Kans	Prairie Village, Engrg. Svcs. Co.	914-649-4000
Md	Ellicott City, Doss Elctrns.	301-465-1336
Mass	Framingham, MCA Boston	617-872-4843
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Minn	St. Louis Park, Beta Engrg.	612-925-4422
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NY	Jericho, HRC Comp-Tech	516-822-5550
NY	New Hartford, MCA Upper N.Y. State	315-732-3507
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Pa	Philadelphia, S.K. MacDonald	215-545-1205
Tex	Dallas, Blackburn Assocs.	214-692-8885
Wash	Seattle, Harry Levinson Co.	206-EA3-5100

MURATA MFG. CO. LTD., Nagaoka-Shi, Kyoto, Japan, Tel: 075-921-9111; Empl.: 1800

Products manufactured: Amplifiers, Capacitors, Fixed, Capacitors, Variable, Chamber, Environmental Test, Circuits, Hybrid, Thick Film, Coatings, Coders, Cores, Magnetic, Ferrite Material & Parts, Filters, Heaters & Heating Elements, Insulators & Insulation, Magnets, Networks, Oscillators, Ovens, Paints, Potentiometers, Resistors, Spark Gaps, Switches, Thermistors, Transducers, Tubes, Tuning Forks

Local Sales Offices & Reps.

Ga	Rockmart, Murata Corp. of America	404-684-7143
NY	Elmsford, Murata Corp. of America	914-592-9180

MYLEE DIGITAL SCIENCES, 155 Weldon Pkwy., Maryland Heights, Mo., 63043, Tel: 314-567-3420; Empl.: 80

For info on price: C. Bogner; Application info: G. Graves; Customer service: J. Acup; Delivery info: G. Graves

Free literature available: IMS - General product features; A-L6 - Small systems; A-18 - General system; Plan 3 - Multistore.

Products manufactured: Comm. Systems, Computers

Local Sales Offices & Reps.

Ala	Birmingham, Automation Inc.	205-595-7787
Alas	Anchorage, Alaska Digital	907-272-4414
Cal	Los Angeles, Franklen Computer Sys.	213-483-4711
Cal	Mountain View, Mylee Digital Sciences	415-965-2227
Cal	San Diego, Saber Sys.	714-296-2162
Colo	Denver, Total Business Sys.	303-333-4256
Fla	Longboat Key, Inventrol Sys., Inc.	813-383-1424
Ga	Atlanta, H & B Office Machines	404-872-4236
Haw	Honolulu, Automated Data Sys.	808-536-8556
Ill	Northfield, Mylee Digital Sciences	312-446-3002
Ind	Indianapolis, Indianapolis Office Machines	317-353-9336
Iowa	West Des Moines, Eiectronic Business Sys., Inc.	515-225-2489
Kans	Kansas City, Midwest Data Sys.	816-363-0470
Ky	Louisville, Accounting Machines Sls. & Service	502-583-4417
La	Metairie, Delta Business Machines, Inc.	504-368-3402
Md	Towlson, Natl. Business & Security Sys.	301-296-0600
Mass	Boston, Systems Automation, Inc.	617-246-1620
Mich	Ann Arbor, Data Machines Corp.	313-761-0450
Minn	Minneapolis, Information Products, Inc.	612-721-6391
Miss	Clinton, Regional Sls. Corp.	601-924-5696
NJ	Cinnaminson, Mylee Digital Sciences	
NY	Rochester, Business Machines of NYS	716-271-2010
NC	Charlotte, Auto Data Corp.	704-366-5721
Ohio	Northfield, B. Prescott	216-467-4727
Ore	Portland, Abbott & Lind	503-282-3245
Pa	Horsham, Mylee Digital Sciences	215-674-4517
Tenn	Memphis, Automation Inc.	901-396-7248
Tex	Dallas, Selectronic Business Mach.	214-363-2531
Utah	Salt Lake City, Herrscher & Co.	801-363-4551
Va	Richmond, American Business Mach.	804-499-9856
Wash	Spokane, Murphy's Business Equip.	509-325-2551

NAMCO CONTROLS, Acme-Cleveland Co., 170 E. 131st St., Cleveland, Ohio, 44108, Tel: 216-268-4200; Empl.: 220; Minimum order: $17

For info on price: Mrs. Cerino; Application info: R. H. Kantner; Customer service: R. Passow; Delivery info: W. Kocianic

Free literature available: "Namco" and "Snap-Lock" Limit Switches miniature to hazardous locations; Proximity Switches - "rf" and magnetic sensing; Pushbutton Control Stations - butt & reed type contacts; Solid State Relays; Reed Switches; Solenoids - miniature to heavy-duty & Coils for A.C.-D.C. applications.

Products manufactured: Coils Including Assemblies & Forms, Controls/Control Eqpt., Drivers, Solenoid, Modules, Logic, Encapsulated, Solenoids, Switches

Local Sales Offices & Reps.

Cal	Thousands Oaks	805-495-47070
Fla	Pompano Beach	305-942-9880
Ga	Marietta	404-427-0241
Ill	Chicago	312-427-0496
La	Kenner	504-722-6363
Mass	Danvers	617-777-0450
Mich	Detroit	313-851-6614
Mo	Kansas City	816-781-3770
Mo	St. Louis	314-965-5880
NJ	Montclair	201-744-6222
NC	Charlotte	704-392-2155
Ohio	Cincinnati	513-271-1530
Ohio	Cleveland	216-942-1496
Ohio	Jefferson	216-576-4074
Ohio	Tiffin	419-447-1291
Ore	Portland	503-760-3400
Pa	Willow Grove	215-659-6900
Tex	Dallas	214-363-8900
Tex	Houston	713-464-4662
Wisc	Walworth	414-275-2771
FOR:	Can., North Burnaby, B.C.	604-291-2361
FOR:	Can., Toronto	416-787-0687

NANO PULSE INDUSTRIES, INC., 249-D E. Emerson Ave., Orange, Cal., 92665, Tel: 714-998-2380, TWX: 910-593-1617; Empl.: 165; Minimum order: $1 p. 2•1773,1774

For info on price: J. Rogers; Application info: B. Grissom; Customer service: J. Rogers; Delivery info: J. Ito

Free literature available: Pulse Transformer Brochure, Memory Design Info Reprints.

Products manufactured: Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Dorton Ent.	602-263-0414
Cal	San Gabriel, Van Gott & Assocs.	213-285-2148
Cal	Santa Barbara, Astralonics	805-498-2183
Fla	Maitland, Ellis & Assoc.	305-645-1101
Ill	Chicago, El-Rad Mfg. Co.	312-478-7300
Mass	Burlington, J & J Assocs.	617-272-2606
Minn	Minneapolis, Elctrn. Innovators	612-884-7471
NC	Greensboro, L & D Inc.	919-292-3201
Tex	Dallas, Merino Sls. Co.	214-239-9719

NARDA MICROWAVE CORP., Plainview, N.Y., 11803, Tel: 516-433-9000, TWX: 510-221-1867; FSC No: 99899; Empl.: 335; Minimum order: $30

For info on price: R. Nopper Ext. 720; Application info: J. J. Lautermilch Ext. 723; Customer service: D. Marlowe Ext. 227; Delivery info: R. Nopper Ext. 720

Free literature available: Technical notes on microwave measurements, complete catalog of products, various short form catalogs on directional couplers, coaxial attenuators and terminations - technical note on broadband swept oscillators and signal generators.

Products manufactured: Adapters, Waveguide, Amplifiers, Analyzers, Antennas, Attenuators, Bends & Twists, Microwave, Bolometers, Bridges, Cable, Calibrators, Calorimeters, Microwave, Comm. Systems, Comparators, Connector Adapters, Connectors, Converters, Couplers, Demodulators, Detectors, Diplexers, Antenna, Discriminators, Dividers, Drivers, Switch, Dummy Loads, Duplexers, Microwave, Filters, Flanges, Waveguide, Generators, Horns, Microwave, Insertion Loss Measurement Systems, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Meters, Microwave Integrated Circuits (MIC's), Mixers, Modulators, All Kinds, Monitors, Mounts, Oscillators, Probes, Receivers, Semiconductor Wafer Fabrication, Shifters, Slotted Lines, Microwave, Strip-Line Components, Microwave, Suppressors, Switches, Terminals, Thermistors, Transmitters, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Menlo Pk., Straube Assocs.	415-323-2476
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Fla	Orlando, E.G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E.G. Holmes & Assocs.	404-451-6161
Ill	Chicago, Scientific Sls. Co.	312-775-7594
Ind	Indianapolis, Scientific Sls. Co.	317-253-4606
Kans	Shawnee Mission, EIR Co.	913-362-0919
Md	Kensington, Elctrn. Mktg. Assocs.	301-881-5300
Mass	Burlington, Tritek, Inc.	617-272-4550
Mich	Detroit, Micro Sls. Corp.	313-482-1229
Minn	Bloomington, Scientific Sls. Co.	612-881-3300
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Pennsauken, Megargel/Himmelstein Assoc.	215-629-1072
NJ	Westfield, Gray & Reed Assoc., Inc.	201-233-6116
NM	Albuquerque, Inter-Mountain Engrg. Co.	505-883-9010
NY	E. Syracuse, Ossmann Instrs., Inc.	315-437-6666
NY	Huntington Sta., Gray & Reed Assoc.	516-433-3333
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs., Inc.	607-785-9947
Ohio	Cleveland, Micro Sls. Corp.	216-243-7430
Ohio	Dayton, Micro Sls. Corp.	513-298-3033
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Va	Virginia Beach, E.G. Holmes & Assocs.	804-481-6556
Wash	Seattle, Showalter-Judd, Inc.	206-624-9020
FOR:	Can., Downsview, Ont., Electronetic Sys., Ltd.	416-661-3673
FOR:	Can., Montreal, Que., Electronetic Sys., Ltd.	514-342-4112
FOR:	Can., Ottawa, Ont., Electronetic Sys., Ltd.	613-733-3781

NATIONWIDE ELCTRN. SYS., See NES

NATEL ENGINEERING CO., 8954 Mason Ave., Canoga Park, Cal., 91306, Tel: 213-882-9620, TWX: 910-494-1959; Empl.: 35 .... p. 1•184-187

Products manufactured: Amplifiers, Converters, Data Acquisition & Reduction Systems, Demodulators, Detectors, Indicators, Modulator/Demodulators, Signal Conditioners & Equipment, Synchro Transmitters, Solid-State

NATIONAL BERYLLIA CORP., Greenwood Ave, Haskell, N.J., 07420, Tel: 201-839-1600, TWX: 710-988-5363; Empl.: 300

Products manufactured: Alloys, Circuits, Printed, Multilayer, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Cores, Ceramic, Couplers, Crystals, Graphite Parts, Headers, Insulators & Insulation, Integrated Circuit Packaging Systems, Packages, Integrated Circuit, Pads, Transistor Mounting, Seals, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test, Substrates, Thermocouples, Elements & Accessories, Transistor, Diode, Thyristor Heat Dissipators, Tubing

NATIONAL CAMERA INC., 2000 W. Union Ave., Englewood, Colo., 80110, Tel: 303-789-1893; Empl.: 56; Minimum order: $5

For info on price: E. Kuhlman; Application info: E. Kuhlman; Customer service: H. Love; Delivery info: E. Kuhlman

Free literature available: FLASHER catalog of unique or hard-to-find tools, test instruments, technical supplies. Instruction manuals and specifications for photographic equipment test instruments. Sample copy of magazine for photo equipment technicians. Sheet describing technical literature on photographic equipment.

Products manufactured: Batteries, Cabinets & Accessories, Calculators, Electrical & Electronic, Cleaners & Solvents, Cleaners, Ultrasonic, Drills & Accessories, Hand & Power, Gages, Magnifying Glasses, Inspection, Meters, Microscopes, Pliers, Rings, Retaining, Rivets, Screwdrivers, Services, Assembly, Production & Test, Solder (All Types), Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Tachometers, Testers, Tools, Torches, Soldering, Welding & Access., Tweezers, Hand & Vacuum, Wire Strippers, Wire Twisters

NAT'L CERAMIC CO., 500 Southard St., Trenton, N.J., 08602, Tel: 609-394-5373; Empl.: 50; Minimum order: $33

For info on price: E. A. Domber; Application info: J. M. Welke; Customer service: E. A. Domber; Delivery info: A. B. Hunt

Free literature available: Ceramic insulators and/or metal part assemblies using ceramic insulators. All insulators JAN-I-8, MIL-I-10-A and MIL-I-23264

Products manufactured: Insulators & Insulation, Tubing

Local Sales Offices & Reps.

Iowa	Cedar Rapids, J. R. Sls. Engr.	319-377-8211
NY	Liverpool, Wadsworth Mfg. Assocs.	315-652-6865

NATIONAL CONNECTOR, Div of Fabri Tek, Inc., 9210 Science Center Dr., Minneapolis, Minn., 55428, Tel: 612-533-3533, TWX: 910-576-2717; Empl.: 250

Customer service: P. Van Wyngeeren

Free literature available: Connector Design Guide - Plate & Molded Types Telephone Connectors Printed Circuit Board Headers High Reliability PC Connectors

Products manufactured: Connector Adapters, Connectors, Contact Strips, Finger, Contacts, Electrical, Sockets, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-2194
Ariz	Phoenix, M R Engrg. Sls. Co.	602-959-5150
Cal	Burlingame, Jack Logan & Assocs.	415-697-6100
Cal	Escondido, Cirolia Elctrn. Sls.	714-743-3015
Cal	Woodland Hills, Elcon Elctrns.	213-884-4852
Conn	North Haven, Kitchen & Kutchin	203-239-0212
Fla	Indialantic, J. Talbot	305-724-2386
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, D. Mitro	305-422-3686
Ill	Oak Brook, Whitmore & Assoc.	312-325-4727
Ind	Fort Wayne, Delesa Sls.	219-483-9537
Ind	Indianapolis, F. Thomas	317-257-4683
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Mass	N. Andover, R. Hicks	617-686-6975
Mass	Westwood, B. Reinherz	617-762-9272
Minn	Minneapolis, S & R Sls	612-544-3022
Mo	Kansas City, Thro Ind. Sls. Co.	913-362-2533
NJ	Springfield, F.F. Sylvester Assoc.	201-944-6964
NY	Fayetteville, Martin P. Andrews	315-637-3144
NC	Winston-Salem, L. G. White Southern	919-725-3612
Ohio	Richfield, Bear Mktg.	216-659-3131
Pa	Narberth, Jerry Bresson Assocs.	215-839-6770
Tex	Richardson, Concept Sls.	214-387-1434
Va	Lynchburg, Burgin-Kreh Assocs.	804-845-5600
FOR:	Can., Thornhill, Ont., Elctrns. Components Int.	416-889-0212

NATIONAL ELECTRONIC SUPPLY, INC., 7231-B Garden Grove Blvd., Garden Grove, Cal., 92641, Tel: 213-430-7525, TWX: 910-596-1316; Empl.: 32; Minimum order: $10

Customer service: M. Hartstein

Free literature available: Capacitor catalog and mil-spec capacitor directory. Complete pricing and manfacturer's information displayed in easy-to-understand language.

Products manufactured: Capacitor, Hardware, Capacitors, Fixed

Local Sales Offices & Reps.

Minn	Minneapolis, Components Group	612-824-4222

NATIONAL ELECTRONICS, Varian Div., Box 269, Geneva, Ill., 60134, Tel: 312-232-4300, TWX: 910-237-1685; Empl.: 400

Products manufactured: Display Devices/Displays, Drivers & Decoders For Readouts, Integrators, Electronic, Semiconductor Wafer Fabrication, Tubes

Local Sales Offices & Reps.

Cal	Los Altos	415-968-7633
Ill	Geneva	312-232-4300

NATIONAL SEMICONDUCTOR CORP., 2900 Semiconductor Dr., Santa Clara, Cal., 95051, Tel: 408-732-5000, TWX: 910-339-9240; Empl.: 15000

Customer service: R. Weaver

Products manufactured: Amplifiers, Calculators, Electrical & Electronic, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Clocks (All Types), Comparators, Computers, Controllers, Programmable, Converters, Counters, Data Acquisition & Reduction Systems, Decoders, Diodes, Display Devices/Displays, Drivers, Solenoid, Drivers & Decoders For Readouts, Encoders, Integrated Circuit Devices, Isolators, Keyboards, Alphanumeric & Decimal, Lamp Drivers, Memories, Buffer, Memory Systems, Modulator/Demodulators, Modulators, All Kinds, Multiplexers, Multipliers, Power Supplies, References, D-C Voltage, Regulators, Shift Registers, Timers, Transducers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Inter Rep. Assocs., Inc.	205-881-3677
Ala	Huntsville, National Semiconductor	205-881-0622
Ariz	Scottsdale, Fred Board Assocs.	602-994-9388
Ariz	Scottsdale, National Semiconductor	602-945-8473
Cal	Buena Park, P. H. Wastal & Assoc.	714-826-7434
Cal	Mountain View, National Semiconductor	415-961-4740
Cal	Palo Alto, Quad Rep, Inc.	415-964-3532
Cal	San Diego, S.R. Electronics	714-565-8411
Cal	San Leandro, Quad Rep, Inc.	415-352-5942
Cal	Sherman Oaks, National Semiconductor	213-783-8272
Cal	Tustin, National Semiconductor	714-832-8113
Colo	Denver, Electrodyne Inc.	303-757-7679
Conn	Danbury, National Semiconductor	203-744-2350
Conn	Westport, National Semiconductor	203-226-6833
Conn	Westport, P.A.L. Comps. Inc.	203-226-6835
Fla	Clearwater, Dyne A Mark	813-441-4702
Fla	Ft. Lauderdale, Dyne A Mark	305-771-6501
Fla	Miami, National Semiconductor	305-446-8309
Fla	Orlando, Dyne A Mark	305-299-6303
Ga	Atlanta, Inter Rep. Assoc.	404-394-7756
Ill	Chicago, Gassner & Clark Co.	312-764-6121
Ill	Mt. Prospect, Delta Tech. Sls.	312-437-9412
Ill	Mt. Prospect, National Semiconductor	312-394-2030
Ind	Ft. Wayne, Advanced Comp. Sls.	219-432-2546
Ind	Indianapolis, Advanced Comp. Sls.	317-545-6441
Ind	Indianapolis, National Semiconductor	317-255-5822
Iowa	Cedar Rapids, Gassner & Clark Co.	319-393-5763
Md	Glen Burnie, Micro Comp. Inc.	301-761-4600
Md	Glen Burnie, National Semiconductor	301-760-5220
Mass	Lexington, KCA Components	617-861-9024
Mass	Lexington, National Semiconductor	617-861-6090
Mich	Farmington, National Semiconductor	313-477-0400
Mich	Grand Rapids, Representative Elctrn. Prod.	616-942-1320
Mich	Southfield, Representative Elctrn. Prod.	313-354-9066
Minn	Minneapolis, National Semiconductor	612-888-3060
Minn	Minneapolis, Stan Clothier Co.	612-888-4666
Mo	Hazelwood, Cen Tech	314-731-4220
Mo	Raytown, Cen Tech	816-358-8100
NJ	Cranford, National Semiconductor	201-272-3344
NJ	Englewood Cliffs, National Semiconductor	201-461-5959
NJ	Englewood Cliffs, P.A.L. Comps. Inc.	201-461-3410
NJ	Haddonfield, Thomas Assocs, Inc.	609-854-3011
NM	Albuquerque, A.Q. Elctrns.	505-255-8701
NY	Greenvale, P.A.L. Comps. Inc.	516-484-4900
NY	Rochester, Electra Sls. Corp.	716-436-4030
NY	Syracuse, Electra Sls. Corp.	315-455-5783
NY	Syracuse, National Semiconductor	315-455-5858
NC	Raleigh, Inter Rep. Assoc.	919-781-2370
Ohio	Chagrin Falls, Micro Tec.	216-247-5481
Ohio	Dayton, National Semiconductor	513-434-0097
Okla	Tulsa, Carter Assocs. Inc.	918-749-3311
Ore	Beaverton, Vantage Corp.	503-644-6111
Tex	Dallas, National Semiconductor	214-233-6801
Tex	El Paso, Carter Assocs.	915-533-2681
Tex	Garland, Carter Assocs.	214-276-7151
Tex	Houston, Carter Assocs.	713-621-6930
Wash	Bellevue, National Semiconductor	206-454-4600
Wash	Bellevue, Vantage Corp.	206-455-3460
FOR:	Can., Downsview, National Semiconductor	416-630-5751
FOR:	Can., Montreal, Weber Electronic Ltd.	514-738-9415

Local Distributors

Ala	Huntsville, Hall-Mark Elctrns., 2010 Bob Wallace Ave., S.W.	205-539-0691
Ala	Huntsville, Hamilton/Avnet Elctrns., 805 Oster Drive N.W.	205-533-1170
Ariz	Phoenix, Hamilton/Avnet Elctrns., 2615 S. 21st St.	602-269-1391
Ariz	Phoenix, Liberty Elctrns., 3130 North 27th Ave.	602-257-1272
Ark	Little Rock, Carlton Bates, Scott Hamilton at 69th St.	501-562-9100
Cal	Culver City, Avnet Elctrns., 10916 Washington Blvd.	213-558-2345
Cal	Culver City, Hamilton Electro Sales, 10912 W. Washington Blvd.	213-558-2121
Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Mountain View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	Mountain View, Hamilton/Avnet Elctrns., 340 Middlefield Rd.	415-961-7000
Cal	San Diego, Hamilton/Avnet Elctrns., 8917 Complex Dr.	715-279-2421
Cal	San Diego, Liberty Electronics/San Diego, 8248 Mercury Ct.	714-565-9171
Cal	Sunnyvale, Bell Inds., 1161 N. Fairoaks	408-734-8570
Colo	Commerce City, Elmar Elctrns./Denver, 6777 East 50th Ave.	303-287-9611
Colo	Denver, Hamilton/Avnet Elctrns., 5921 North Bdwy	303-534-1212
Conn	Georgetown, Hamilton/Avnet Elctrns., 643 Danbury Rd.	203-762-0361
Conn	Hamden, Wilshire Elctrns./Conn., 2554 State St.	203-281-1166
Conn	Norwalk, Harvey/Elctrns., 112 Main St.	203-853-1515
Fla	Hollywood, Hamilton/Avnet Elctrns., 4020 North 29th Ave.	305-925-5401
Fla	Miami, Powell Elctrns. Corp., Box 514	305-592-3260
Fla	Orlando, Hall-Mark Elctrns., 7233 Lake Ellenor Dr.	305-855-4020
Fla	Orlando, Hammond Elctrns., Inc., 911 West Central Blvd.	305-241-6601
Ga	Norcross, Hamilton/Avnet Elctrns., 6700 1-85 Access Rd.	404-448-0800

Ill	Elk Grove Village, Hall-Mark Elctrns. Corp., 180 Crossen Ave.	312-437-8800
Ill	Rosemont, Advent Elctrns., 7110 Lyndon Ave.	312-298-4210
Ill	Rosemont, Kierulff Elctrns., 9340 William St.	312-678-8560
Ill	Schiller Park, Hamilton/Avnet Elctrns., 3901 North 25th Ave.	312-678-6310
Ind	Indianapolis, Harvey-Indiana, Inc., 8557 Zionsville Rd.	317-297-4910
Ind	Indianapolis, Pioneer Indiana Elctrns., Inc., 6408 Castleplace Dr.	317-849-7300
Iowa	Cedar Rapids, Advent Elctrns., 1834 Blairs Ferry Rd., N.E.	319-393-8811
Kans	Lenexa, Hall-Mark Elctrns. Corp., 9000 Rosehill Rd.	913-888-4747
Kans	Lenexa, Hamilton/Avnet Elctrns., 37 Lenexa Industrial Center	913-888-8900
Md	Gaithersburg, Kierulff Elctrns., 16021 Industrial Dr.	301-948-0250
Md	Gaithersburg, Pioneer Washington Elctrns., 9100 Gaither Rd.	301-948-0710
Md	Hanover, Hamilton/Avnet Elctrns., 7255 Standard Dr.	301-796-5000
Mass	Burlington, Hamilton/Avnet Elctrns., 185 Cambridge	617-273-2120
Mass	Burlington, Wilshire Elctrns., One Wilshire Rd.	617-272-8200
Mass	Lexington, Harvey-Elctrns., 44 Hartwell	617-861-9200
Mass	Needham Heights, Kierulff Elctrns, 14 Charles St.	617-449-3600
Mich	Farmington, Harvey Michigan Inc., 23461 Industrial Parkway Dr.	313-477-1650
Mich	Kentwood, Harvey Michigan Inc., 4860 South Division Rd.	
Mich	Livonia, Hamilton/Avnet Elctrns., 12670 Farmington Rd.	313-522-4700
Mich	Livonia, Pioneer/Michigan, 13485 Stamford	313-525-1800
Minn	Bloomington, Hall-Mark Elctrns., 9201 Penn Ave. So., Suite 10	612-884-9056
Minn	Edina, Hamilton/Avnet Elctrns., 7683 Washington Ave. So.	612-941-3801
Mo	Earth City, Hall-Mark Elctrns. Corp., 13789 Rider Trail	314-291-5350
Mo	Hazelwood, Hamilton/Avnet Elctrns., 382 Brooks La.	314-731-1144
NJ	Cedar Grove, Hamilton/Avnet Elctrns., 218 Little Falls Rd.	201-239-0800
NJ	Cinnaminson, Wilshire Elctrns., 855 Industrial Highway	609-786-8990
NJ	Mount Laurel, Hamilton/Avnet Elctrns., 113 Gaither Dr., East Gate Industrial Pk.	609-234-2133
NJ	Rutherford, Kierulff Elctrns., Industrial Dr.	201-935-2120
NM	Albuquerque, Century Elctrns., Inc., 129 Vermont Avenue, N.E.	505-265-7839
NM	Albuquerque, Hamilton/Avnet Elctrns., 2450 Baylor Dr. S.E.	505-765-1500
NY	Binghamton, Harvey/Federal Elctrns., Box 1208	607-748-8211
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	East Syracuse, Hamilton/Avnet Elctrns., 6500 Joy Road	315-437-2642
NY	Hauppauge, Semiconductor Concepts, 195 Engineers Road	516-273-1234
NY	Rochester, Hamilton/Avnet Elctrns., 167 Clay Rd.	716-442-7820
NY	Rochester, Summit Elctrns. of Rochester Inc., 292 Commerce Dr.	716-334-8110
NY	Westbury, Hamilton/Avnet Elctrns., 70 State Street	516-333-5800
NY	Woodbury, Harvey Elctrns., 60 Cross Ways Park West	516-921-8700
NC	Greensboro, Hammond Elctrns. of Carolina, Inc., 2923 Pacific Ave.	919-275-6391
NC	Greensboro, Pioneer/Carolina Elctrns., 2906 Baltic Avenue	919-273-4441
NC	Raleigh, Hall-Mark Elctrns., 3000 Industrial Dr.	919-832-4465
Ohio	Cleveland, Hamilton/Avnet Elctrns., 761 Beta Dr., Suite E	216-461-1400
Ohio	Cleveland, Pioneer Standard, 4800 East 131 St.	216-587-3600
Ohio	Dayton, Hamilton/Avnet Elctrns., 118 Westpark Rd.	513-433-4055
Ohio	Dayton, Pioneer Standard, 1900 Troy St.	513-236-9900
Okla	Oklahoma City, Radio, Inc., 903 North Hudson	405-CE5-1561
Okla	Tulsa, Hall-Mark Electronics Corp., 4846 South 83rd East Ave.	913-835-8458
Okla	Tulsa, Radio Inc., Ind'l. Elctrns., 1000 South Main	918-587-9124
Ore	Portland, Almac/Stroum Elctrns., 4475 School Ferry Rd.	503-292-3534
Pa	Erie, Mace Elctrns., 2631 West 8th St.	814-838-3511
Pa	Huntington Valley, Hall-Mark Elctrns. Corp., 458 Pike Rd., Pike Ind'l. Pk.	215-355-7300
Pa	Pittsburgh, Cameradio, 2801 Liberty Ave.	412-288-2600
Pa	Pittsburgh, Pioneer/Pittsburgh, 560 Alpha Dr.	412-782-2300
SC	Greenville, Hammond Elctrns. of Carolina, 100 Augusta Street	803-233-4121
Tex	Austin, Hall-Mark Elctrns. Corp., 3100-A Industrial Terr.	512-837-2814
Tex	Dallas, Hall-Mark Elctrns. Corp., 9333 Forest La.	214-231-6111
Tex	Dallas, Hamilton/Avnet Elctrns., 4445 Sigma Rd.	214-661-8661
Tex	Houston, Hall-Mark Elctrns. Corp., 8000 Westglen	713-781-6100
Tex	Houston, Hamilton/Avnet Elctrns., 1216 West Clay	713-526-4661
Utah	Salt Lake City, Century Elctrns., Inc., 2150 South 300 W, Suite 1-J	801-466-6000
Utah	Salt Lake City, Hamilton/Avnet Elctrns., 647 Billinis Road W.	801-262-8451
Wash	Bellevue, Hamilton/Avnet Elctrns., 13407 Northrup Way	206-746-8750
Wash	Seattle, Almac/Stroum Elctrns., 5811 Sixth Ave., So.	206-763-2300
Wash	Seattle, Liberty Elctrns. Northwest, 5305 - 2nd Ave., S.	206-RO3-8200
Wisc	Milwaukee, Taylor Electric Co., Drawer 11N	414-241-4321
For:	Can., Downsview, Ont., Semad Elctrns., Ltd., 1111 Finch Ave. W.	416-635-9880
For:	Can., Mississauga, Ont., Hamilton/Avnet Elctrns., Ltd., 6291 - 19 Dorman Rd.	416-677-7432
For:	Can., Montreal 12, Que., Preico Elctrns., Ltd., 480 Port Royal St., W.	514-389-8051
For:	Can., Ottawa, Ont., Hamilton/Avnet Elctrns., 880 Lady Ellen Pl.	613-725-3071
For:	Can., St. Laurent, Que., Hamilton/Avnet Elctrns., Ltd., 2670 Paulus	514-331-6443
For:	Can., Vancouver 15, B.C., Intek Elctrns. Ltd., 7212 Main St.	604-324-6831
For:	Can., Willowdale, Ont., Electro Sonic Ind'l Sls., 100 Gordan Baker Rd.	416-494-1666

NATIONAL SEMICONDUCTORS, 331 Cornelia St., Plattsburgh, N.Y., 12901, Tel: 518-561-3160, TWX: 610-421-3362; Empl.: 150; Minimum order: $25 p. 1•1018,1019

Customer service: Duncan F. Clifton 518-561-3170

Free literature available: Literature On: CdS, CdSe and Si Photo detectors, optocouplers, phototransistors. Light emitting diodes.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Diodes, Isolators, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, BJR Research	205-881-3569
Ariz	Phoenix, KCE Corp.	
Cal	Los Altos, Shannon Assoces.	415-941-2217
Cal	Varigon, El Segundo	213-679-0621
Conn	Farmington, Keyco Assocs.	203-677-1771
Fla	Ft. Lauderdale, Tech-Rep Assocs.	305-792-0962
Fla	Indian Rocks Beach, Tech-Rep Assocs.	813-595-2834
Ill	Glenview, Nero Elctrn.	312-729-5075
Kans	Shawnee Mission, Florence & Meyer Inc.	913-722-5210
Mass	Needham, Keyco Assocs.	617-449-2600
Mich	Farmington, Davis-Martensen Co.	313-474-8300
Minn	St. Paul, Northport Engrg.	612-698-3841
NJ	Nutley, D/R Assoc. of N.J.	201-667-5900
NY	Huntington, Andrews & Andrews, Inc.	516-692-8686
NY	Rochester, D/R Elctrns.	716-442-6980
NC	Greensboro, L & D Inc.	919-292-3201
Ohio	Cleveland, D. Steffen	216-461-8333
Ohio	Columbus, T. Mulligan & Assocs.	614-457-2242
Ohio	Dayton, D. Steffen	513-293-3145
Ore	Beaverton, Arneson Assocs.	503-643-5754
Pa	Phila., H.A. Goodman	215-247-7116
Tex	Dallas, J. Clay Co.	214-350-1281
Wash	Seattle, Arneson Assocs.	206-762-7664
FOR:	Rosemere, Que., Can., D/R Elctrn. Ltd.	514-622-7381

NATIONAL SONICS, Div. Envirotech Corp., 120 Milbar Blvd., Farmingdale, N.Y., 11735, Tel: 516-694-5110, Telex: 14-4545; Empl.: 65

Customer service: J. Kristoffersen

Free literature available: Dry Product Control - Control dry product in bins, silos etc. Conveyor line counting and sorting. Liquid Level Control - Level control of any kind of liquid. Interface detection of two liquids. Sladge Density Control - Monitoring and controlling density of municipal and industrial sladges and slurries

Products manufactured: Controls/Control Eqpt., Indicators, Switches, Transducers

NAT'L-STANDARD CO., Niles, Mich., 49120, Tel: 616-683-8100, TWX: 810-270-3153; Empl.: 1000

Customer service: J. L. Dayton

Products manufactured: Wire

NATIONAL TEL-TRONICS, Div. Electro Audio Dynamics, Inc., State Road Hill, Meadville, Pa., 16335, Tel: 814-724-6440, Telex: 91-4405; Empl.: 200; Minimum order: $35 p. 2•720-723

For info on price: M. Keller; Customer service: J. George; Delivery info: S. Rynd

Free literature available: Product Catalogs

Products manufactured: Cable Assemblies & Harnesses, Cable, Circuits, Printed, Multilayer, Clamps & Clips, Connectors, Insulators & Insulation, Jack Adapters (All Types), Jacks (All Types), Leads, Test & Adaptors, Panels, Plug Adapters, Plug & Jack Sets, Plugs, Posts, Probes, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Ala	Huntsville, J. Eberle & Assocs.	205-881-8315
Cal	Burlinghame, Carelli-EMA	415-697-6286
Cal	Van Nuys, Shepherd Comps.	213-787-4610
Fla	Ft. Lauderdale, Sproch Sls., Inc.	305-587-3792
Ill	Chicago, Rozner Sls. Co.	312-283-0022
Ind	Indianapolis, Tech. Reps. Inc.	317-849-6454
Mass	Framingham, G-M Assocs.	617-872-0333
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, J. J. Mueller	314-353-3656
NJ	Marlton, N. Krouse Assoc.	609-424-3543
NJ	Nutley, Falk-Baker Assoc.	201-661-2436
NY	Pompey, S.F. Foster Co.	315-677-3333
Ohio	Chagrin Falls, D.C. Prior Co.	216-247-7999
Ohio	Cincinnati, R. Makin Assocs.	513-232-5588
Pa	Philadelphia, R. Cooper Sls.	215-624-5486
Tex	Dallas, Allied Comps.	214-348-6660
Wash	Seattle, Pacnor Mktg., Inc.	206-284-8020
EXP:	Plainview, N.Y., Empire Exporters Inc.	516-293-5582
FOR:	Can., Hamilton, Ont., Cartwright Southall Assoc.	416-528-0294

Local Distributors

Ariz	Phoenix, Parts Elctrns., 1310 North 7th	602-258-6476
Cal	N. Redondo Beach, Mark Elec., 2315 1/2 Artesia Blvd.	213-772-2141
Cal	San Jose, Peninsula Elec., 980 S. First St.	408-294-3594
Colo	Denver, Electronic Parts, 1277 Broadway	303-893-3050
Conn	Bridgeport, Hatry Elctrns., 2465 Main St.	203-335-3124
Conn	Hartford, Hatry Electronics, 500 Ledyard St.	203-527-1881
Fla	Tampa, Lykes Elctrns., 121 S. Ashley	813-229-1885
Md	Bethesda, Empire Elec. Supply, 4907 Rugby Ave.	301-656-3300
Mass	Lynn, Land Elctrns., 9 Franklin St.	617-592-2220
NY	N.Y. City, Center Ind. Elec., 15 East 16th St.	212-989-6363
NY	Rochester, Simcona Elec., Box 1903	716-328-3230
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	
Pa	Harrisburg, Pyttronics Ind., 2525 N. 7th St.	717-233-6591
Tenn	Nashville, Electra Dist., 19-14 W. End	615-255-8444
Tex	Ft. Worth, Swieco, Inc., 1512-18 E. Lancaster	817-335-6521

NATIONAL WIRE & CABLE CORP., Dept EEM, Service Div., 136 San Fernando Rd., Los Angeles, Cal., 90031, Tel: 213-225-5611, TWX: 910-321-4155; FSC No: 04569; Empl.: 114; Minimum order: $50 p. 2•2028-2047

For info on price: H.F. Korte; Application info: F. Motley; Customer service: J.B. Wiley; Delivery info: H.F. Korte

Free literature available: Complete catalog.

Products manufactured: Cable Assemblies & Harnesses, Cable, Services, Assembly, Production & Test, Shields, Tubing, Wire

Local Sales Offices & Reps.

Ariz	Phoenix, K. Jahn Co.	602-956-9060

Ark	Fort Smith, Electro-Related Products	501-783-7323
Cal	La Jolla, Rep. Sls. Co.	714-454-1500
Cal	Los Angeles, National Wire & Cable Corp.	213-225-5611
Cal	San Mateo, National Wire & Cable Corp.	415-344-3066
Colo	Arvada, Arrowhead Sls. Co.	03-423-5556
Conn	Wethersfield, Com/Pak Ltd., Inc.	203-563-4784
Fla	Maitland, J.W. Barrett Assocs.	305-678-0172
Fla	North Miami, J.W. Barrett Assocs.	305-681-4957
Fla	Orlando, National Wire & Cable Corp.	305-898-3801
Ill	Northfield, H.S. Tollaksen Co.	312-441-6644
Md	Glen Burnie, Faion Lott Co.	301-744-4611
Mass	Needham Heights, Com/Pak Ltd.	617-444-1259
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Minn	Minneapolis, Tech. Assocs.	612-929-6721
Mo	Hazelwood, Production Automation	314-731-2331
Mo	Raytown, Production Automation	816-737-0066
NY	Huntington, National Wire & Cable Corp., Int'l.	516-757-6549
NY	Ontario Center, Kehoe Comp. Sls.	315-524-2491
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Ohio	Dayton, Luebbe Sls. Co.	513-294-0426
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Pa	Wynnewood, H.J. Fairbanks Co.	215-642-5816
Tex	Fort Worth, J.H. Gibbs Assocs.	817-237-1455
Utah	Salt Lake City, Arrowhead Sls. Co.	801-487-4716
Wash	Olympia, Bergford Assocs.	206-866-2001
FOR:	Can., Downsview, Ontario, Cantronics, Ltd.	412-661-2494

NAUGLER ENGRG., INC., Off Dunham Rd., Beverly, Mass., 01915, Tel: 617-922-5634; FSC No: 05222; Empl.: 5; Minimum order: $8

For info on price: C. A. Osborn; Application info: C. A. Osborn; Customer service: C. A. Osborn; Delivery info: T. Johnson

Free literature available: Catalog #700 Describes line of flexible couplings with unique leaf design for shafts up to 1/2" dia. with both set screw and clamp type hubs available.

Products manufactured: Couplings

NCI, INC., 5900 Australian Ave., W. Palm Beach, Fla., 33407, Tel: 305-842-3201, TWX: 510-952-7618; FSC No: 26769; Empl.: 460; Minimum order: $100

Customer service: C. C. Johnson

Free literature available: NCI tantalum capacitor catalog listing each product and specification thereof as manufactured by NCI.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Tempe, Sedco Sls	602-968-7791
Cal	Los Alamitos, J.S. Heaton Co.	213-598-6676
Cal	Mountain View, Caltron-Pyle	415-964-3244
Cal	San Diego, J.S. Heaton Co.	714-452-1456
Colo	Denver, J.S. Heaton Co.	303-758-5130
Fla	Fort Lauderdale, CBC	305-484-7330
Fla	Winter Park, CBC, Inc.	305-644-2277
Ill	Chicago, Brock & Cushman, Inc.	312-622-4110
Iowa	Cedar Rapids, J. Vrbik Co.	319-377-8244
Kans	Shawnee Mission, K & M Sls & Assocs.	913-262-1444
Mass	Burlington, New England Tech. Sls.	617-272-0434
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
Minn	St. Paul, R.G. Ragon, Inc.	612-488-0201
NJ	Englewood Cliffs, E. Glass Assocs.	212-586-8440
NY	Ontario Center, Kehoe Comps.	315-524-2491
Ohio	Medina, J.C. Hofstetter	216-241-4880
Pa	Fort Washington, GCM Assocs.	215-646-7535
Tex	Garland, Carter Assocs.	214-276-7151
Va	Lynchburg, Barnhill & Assocs.	804-846-4624
Wash	Seattle, Blum & Assocs.	206-782-1600
EXP:	Montreal, Que., Can., Cantronics, Ltd.	514-733-0749

NCR, S. Main & K Sts., Dayton, Ohio, 45409

NCR MICROELECTRONICS DIV., 8181 Byers Rd., Miamisburg, Ohio, 45342

NEC, see Nippon Electric

NEC AMERICA INC., See Nippon Elec./NEC America

NEC AMERICA, INC., 277 Park Ave., New York, N.Y., 10017, Tel: 212-758-1666, TWX: 710-581-3376; Empl.: 200 ..... p. 1•2261; p. 2•1184

Products manufactured: Capacitors, Fixed, Diodes, Display Devices/Displays, Fiber Optic Bundles, Integrated Circuit Devices, Lasers & Laser Systems, Potentiometers, Relays, Switches, Thyristors (Includes Silicon Controlled Rectifiers), Transistors, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles	213-973-2071
Del	Newark	302-738-0150
Ill	Chicago	312-828-9494
Va	Falls Church	703-560-2010

Local Distributors

Cal	Burlingame, California Eastern Lab., 1 Edwards Ct.	415-342-7744
Cal	Canoga Park, Nucleonic Prods. Co., 6660 Tariel Ave.	213-887-1010
Mich	Farmington, Harvey Michigan, 23461 Industrial Pk. Dr.	313-477-1650
Minn	Minneapolis, World Products, 5100 Edina Industrial Blvd., Box 35263	612-835-2117

NEC MICROSYSTEMS, Div. of North Electric Co., 1150 NW 70th St., Ft. Lauderdale, Fla., 33309, Tel: 305-974-5400, TWX: 510-956-9897; Empl.: 75; Minimum order: $50 ..... p. 1•892

For info on price: L. Brande; Application info: E. Lane; Customer service: L. Brande; Delivery info: L. Brande

Free literature available: Capabilities brochure - custom hybrid microcircuits

Products manufactured: Circuits, Hybrid, Thick Film, Drivers & Decoders For Readouts, Filters, Hybrid Voltage Regulators, Integrated Circuit Devices, IC's, Active Filters

Local Sales Offices & Reps.

Cal	Laguna Beach, W.D. Bird	714-494-5800
Cal	Los Altos, W. W. Posey Co.	415-948-7771
Conn	North Haven, Kitchen & Kutchin	203-239-0212
Ill	Northfield, Such & Assocs.	312-446-8934
Md	Silver Spring, Spectro Sys.	301-494-8261
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Mich	Ferndale, Shalco	313-547-4771
Mo	Grandview, Beneke & McCaul	816-765-2998
Mo	St. Louis, Beneke & McCaul	314-434-6242
NJ	E. Hanover, HLM Assoc.	201-386-0794
NY	Northport, HLM Assoc.	516-423-1818
NY	Syracuse, Lenard Co.	315-479-9191
Ohio	Chagrin Falls, Midwest Mktg. Assoc.	216-247-6655
Ohio	Dayton, Midwest Mktg. Assoc.	513-433-2511
Pa	Wyndmoor, Spectro Sys	215-836-1545
Tex	Garland, R. Forsyth	214-243-0140

NEFF INSTRUMENT CORP., 1088 E. Hamilton Rd., Duarte, Cal., 91010, Tel: 213-357-2281, TWX: 910-585-1833; Empl.: 55; Minimum order: $10

Customer service: Sls. Dept.

Free literature available: Amplifiers: Instrumentation Amplifier products and accessories, , System 620: amplifier-per-channel data acquisition system. Input Connection Practices for Differential Amplifiers: discussion of correct input techniques necessary to achieve high accuracy performance of Instrumentation amplifiers.

Products manufactured: Amplifiers, Data Acquisition & Reduction Systems, Data Compressors, Digital, Multiplexers

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Glendale, Instrument Specialists, Inc.	213-849-7181
Cal	San Diego, Instrument Specialists, Inc.	714-565-2555
Cal	Santa Clara, Instrument Specialists, Inc.	408-244-1505
Colo	Englewood, Zeus, Inc.	303-770-4400
Conn	Glastonbury, Instrument Reps., Inc.	203-633-0777
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Iowa	Cedar Rapids, Technical Reps., Inc.	319-363-2489
Mass	Lexington, Instrument Reps., Inc.	617-861-8620
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	Hazelwood, Technical Reps., Inc.	314-731-5200
Mo	Independence, Technical Reps., Inc.	816-737-1414
NJ	Union, SBM Reps., Inc.	201-687-8737
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Pleasantville, SBM Reps., Inc.	914-769-1811
NY	Rochester, SBM Reps., Inc.	716-266-1400
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Ohio	Dayton, Electro Sls. Assocs.	513-426-5551
Ore	Beaverton, Showalter Instr.	503-646-3004
Pa	Jenkintown, PDC Corp.	215-887-9610
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tex	Houston, Barnhill Two, Inc.	713-621-0040
Tex	Richardson, Barnhill Two, Inc.	214-231-2573
Utah	Salt Lake City, Zeus Inc.	801-486-3217
Wash	Seattle, Showalter Instr.	206-624-7020
Wisc	Milwaukee, Carter Elctrns., Inc.	414-464-5555
FOR:	Can., Calgary, Alb., A. Crawford Assocs. Ltd.	403-261-0780
FOR:	Can., Longuevil, Que., A. Crawford Assocs. Ltd.	514-670-1212
FOR:	Can., Mississauga, Ont., A. Crawford Assoc., Ltd.	416-678-1500
FOR:	Can., North Vancouver, A. Crawford Assocs. Ltd.	604-980-4831
FOR:	Can., Ottawa, Ont., A. Crawford Assocs. Ltd.	613-829-9651

NELSON ROSS ELCTRNS., 5 Delaware, Lake Success, N.Y., 11040, Tel: 516-328-1100, TWX: 510-223-0414; FSC No: 82199; Empl.: 150; Minimum order: $25 ..... p. 1•784,785

For info on price: E. F. Feldman; Application info: E. F. Feldman; Customer service: V. Roebeck; Delivery info: E. F. Feldman

Free literature available: Spectrum Analyzer Catalog 0.5Hz - 25 MHz, Plug-In Spectrum Analyzers 0.5 Hz - 25 MHz, Synchro Sweep Generators 10 Hz - 500 kHz, Communications Spectrum Analyzers 10 Hz to 400 MHz, Microwave Spectrum Analyzers 10 MHz - 6.5 GHz, Low Frequency Spectrum Analyzers 0.5 Hz - 25 MHz, Broad Band Spectrum Analyzers 100 Hz - 25 MHz, RF - VHF - TV Spectrum Analyzers 1 to 300 MHz

Products manufactured: Analyzers, Detectors, Generators, Monitors, Receivers

Local Sales Offices & Reps.

Ala	Huntsville, J. L. Highsmith	205-881-3294
Alas	Anchorage, Arva-Hudson, Inc.	907-272-5231
Ariz	Scottsdale, BFA Corp. of Ariz.	602-946-4215
Cal	Cupertino, T. Snitzer	408-257-8333
Cal	Del Mar, T. Snitzer	714-454-2191
Cal	Los Angeles, T. Snitzer	213-836-6170
Colo	Boulder, H. Bass Assocs.	303-499-7509
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Fla	Orlando, J. Highsmith	305-293-5202
Ill	Elk Grove Village, L. Green	312-593-0282
Ind	Indianapolis, L. Green	317-293-9827
Kans	Prairie Vlg., Engrg. Svcs.	913-649-4000
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Detroit, Group Ten, Inc.	313-549-3910
Minn	Mpls., L. Green	612-781-1611
Mo	St. Louis, Engrg. Svcs.	314-997-1515
NM	Albuquerque, IMEC	505-883-9010
NY	Great Neck, Meas. Tech.	516-482-3500
NY	Liverpool, R & D Assocs.	315-622-2350
NC	Charlotte, J. Highsmith	704-333-7743
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Ohio	Lake Oswego, Arva-Hudson, Inc.	503-227-4916
Pa	Philadelphia, Eastern Instrumentation of Phila.	215-927-7777
Tex	Richardson, Lear Assoc.	214-231-5388
Tex	San Antonio, Data Appls. Corp.	512-732-7176
Wash	Seattle, Arva-Hudson, Inc.	206-622-0177
For:	Can., Downsview, Ont., Electronetic Sys., Ltd.	416-661-3673
For:	Can., Montreal, Que., Electronetic Sys., Ltd.	514-342-4112
For:	Can., Ottawa, Ont., Electronetic Sys. Ltd.	613-733-3781
For:	Can., Vancouver, B.C., Electronetic Sys. Ltd.	604-687-5688

NELSON STUD WELDING TRW INC., 28th & Toledo Ave., Lorain, Ohio, 44035, Tel: 216-245-6931; Empl.: 500

For info on price: R. Pomeroy; Application info: J. Jenkins; Customer service: J. Kilbride; Delivery info: V. Hug

Free literature available: Metalworking Brochure - Booklet detailing stud welding in metalworking industry.

Products manufactured: Fasteners, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Ala	Birmingham	205-871-8109
Colo	Denver	303-744-3495
Conn	Hartford	203-236-5218

Fla	Jacksonville	904-786-6734
Ga	Atlanta	404-261-3479
Ind	Ft. Wayne	219-484-5356
Iowa	Davenport	319-323-2139
Kans	Overland Park	913-381-3060
La	Metairie	504-737-1082
Md	Rockville	301-762-9511
Md	Towson	301-821-6862
Mass	Needham Heights	617-449-0131
Mich	Grand Rapids	616-455-9020
Mich	Southfield	313-357-3700
Minn	Minneapolis	612-884-4108
Mo	St. Louis	314-567-5320
Neb	Omaha	402-341-5272
NJ	Palisades Park	201-947-2291
NY	New York	212-565-1585
NY	Tonawanda	715-694-6535
NC	Winston-Salem	919-724-2262
Ohio	Cincinnati	513-771-1581
Ohio	Cleveland	216-524-5470
Ohio	Columbus	614-258-6705
Okla	Tulsa	918-627-3487
Ore	Portland	503-281-7693
Pa	Pittsburgh	412-922-2515
Pa	York	717-843-5585
SC	Columbia	803-798-0415
Tenn	Memphis	901-452-6770
Tenn	Nashville	615-256-1739
Tex	Dallas	214-358-1588
Tex	Houston	713-524-7429
Utah	Salt Lake City	801-322-4122
Va	Richmond	804-233-5520
Wisc	Milwaukee	414-351-0705
FOR:	Can., Calgary 24, Alberta	403-287-1243
FOR:	Can., Dorval 730, Quebec	514-636-8170

NERA, INC., 133 The Great Rd., Bedford, Mass., 01730, Tel: 617-275-2500; Empl.: 20; Minimum order: $25

Customer service: D. Kuyamjian

Free literature available: Brochures Data Sheets application notes describing applications Water Quality System Brochure: describing system for automatic water quality data acquisition Model 4 Series Specifications - Interface specifications for environmental data acquisition system Application Note: Data display formats Environmental data reduction system

Products manufactured: Comm. Systems, Data Acquisition & Reduction Systems, Data Loggers

Local Sales Offices & Reps.

Cal	Port Hueneme, Whitney Assocs.	805-488-4434
Cal	San Diego, Whitney Assocs.	714-453-1181
Fla	Sarasota, Continental Shelf Assocs.	813-349-7182
La	Gretna, Continental Shelf Assocs.	504-340-3502
Md	Fulton, Gans - Fryling, Inc.	301-837-6311
Mass	Cohassett, E-M Assocs.	617-383-6133
NC	Charlotte, S. J. Perkinson Co.	704-366-1892
Va	Arlington, Gans - Fryling, Inc.	703-527-3262
Wash	Edmunds, Ocean Research Instrs.	206-774-6824

NES, INC., 1536 Brandy Pkwy., Streamwood, Ill., 60103, Tel: 312-289-8820; Empl.: 145 .... p. 1•182,183

For info on price: R. Lounsbury; Application info: R. Lounsbury; Customer service: C. Manning; Delivery info: R. Casperson

Free literature available: CATALOGS & DATA SHEETS ON: DIGITAL PANEL METERS DATA LOGGING, ACQUISITION, & REDUCTION SYSTEM CIRCUIT CARDS COMMUNICATION EQUIPMENT DIGITAL CLOCKS APPLICATION NOTE INDEX

Products manufactured: Accelerometers, Alarms, Amplifiers, Analyzers, Bi-Metals, Thermostatic, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Boards, Programming, Bolometers, Bridges, Cabinets & Accessories, Calculators, Electrical & Electronic, Calibrators, Cameras, Cards, Linear Function, Cards, Logic, Cells, Load, Chamber, Environmental Test, Chassis, Circuit Board Mounting, Clocks (All Types), Coders, Comm. Systems, Comparators, Compressors, Data, Computers, Controls/Control Eqpt., Converters, Counters, Couplers, Current Sensors, Data Acquisition & Reduction Systems, Data Compressors, Digital, Data Loggers, Decoders, Decommutators, Telemetering, Deposition Equipment, Vacuum & Accessories, Detectors, Display Devices/Displays, Drivers & Decoders For Readouts, Duplicators, Enclosures, Module, Plug-In, Encoders, Expanders, Data, Filters, Gages, Generators, Indicators, Integrators, Electronic, Kits, Breadboarding (For Engineers), Magnetometers, Magnetoresistors, Hall, Memories, Buffer, Memory Systems, Meters, Modulator/Demodulators, Modules, Logic, Encapsulated, Monitors, Motors, Multiplexers, Multipliers, Oceanographic Equip. (Electronic), Oscillators, Paper-Tape Preparation Systems, Perforators, Pickups, Telephone (For Recording), Potentiometers, Power Supplies, Prescalers, Preselectors, Printers, Process Control Systems, Programmers, Pulsers, Logic Test, Pyrometers, Racks, Readers, Receivers, Recorders, Relays, Scanners, Scramblers, Data, Sensors, Light, Services, Assembly, Production & Test, Shunts, Meter, Signal Conditioners & Equipment, Switches, Tachometers, Teleprinters, Teletypewriters & Equipment, Terminal Equipment, Digital, Test Systems, Testers, Thermistors, Thermocouples, Elements & Accessories, Thermometers, Resistance, Thermostats, Timers, Totalizers, Digital, Tracking Systems, Transducers, Translators, Data, Transmission Systems, Data, Transmitters, Transponders, Typewriters, Input-Output (All Types), Underwater Communication, Detection, Navigation, etc. Equipment, Verification Systems, Tape

Local Sales Offices & Reps.

Fla	St. Petersburg, Comtech Assocs.	813-527-3281
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Waltham, McBar Assocs.	617-890-0233
Minn	Minneapolis, R-J Inc.	612-922-1425
NY	DeWitt, DB Assocs.	315-446-0220
NY	Great Neck, Industron Assoc.	516-487-2620
Pa	King of Prussia, S & S Assocs.	215-265-3450

NESHAMINY TRANSFORMER, Div. Neshaminy Elctrn., Edison-Furlong Rd., Furlong, Pa., 18925, Tel: 215-794-7411; Empl.: 130; Minimum order: $150 p. 2•1775,1776

For info on price: F. Klein; Application info: W. Smith; Customer service: F. Klein; Delivery info: F. Klein

Products manufactured: Chokes, Coils Including Assemblies & Forms, Converters, Filters, Power Supplies, Transformers

Local Sales Offices & Reps.

Cal	Altadena, D. Wagner Assoc.	213-MU 1-4060
Fla	Maitland, Peregoy, Inc.	305-831-2474
Ill	Chicago, Ever-Flo Sls. Corp.	312-775-1418
NH	Nashua, Bell Controls	603-882-6984
NJ	Haddonfield, Thomas	609-UL 4-3011
NY	Rockville Centre, Magneco Inds.	516-764-4000
NY	Syracuse, W. Zimmerman	315-GR 4-4889
Pa	Philadelphia, Thomas Assocs.	215-627-6615

NESOR ALLOY CORP., 666 Passaic Ave., W. Caldwell, N.J., 07006, Tel: 201-575-0400; Empl.: 230; Minimum order: $100

For info on price: M. Feldman; Customer service: B. Rosen; Delivery info: M. Jacobsen

Products manufactured: Wire

NEUSES, INC. P.K., 1401 Rohlwing Rd., Rolling Meadows, Ill., 60008, Tel: 312-253-6555; Empl.: 8

Customer service: V. Pelletier

Free literature available: Literature on all items listed in EEM.

Products manufactured: Burnishers, Contact, Gages, Kits, Marking (Dial, Instrument, Equipment, etc.), Screwdrivers, Services, Assembly, Production & Test, Testers, Tools, Wrenches

NEW ENGLAND INSTR., 14 Kendal Lane, Natick, Mass., 01760, Tel: 617-873-9711, TWX: 710-346-0398; Empl.: 250; Minimum order: $25 .... p. 2•1666-1671

For info on price: E. Burroughs; Application info: D. Hoos; Customer service: E. Burroughs; Delivery info: E. Burroughs

Free literature available: 12-page Condensed Catalog of Precision Potentiometers Featuring Single-Turn & Linear Motion Models in Wirewound, Conductive Plastic, Conductive Plastic Film, & Hybrid Designs.

Products manufactured: Potentiometers, Resistors, Rheostats, Switches

Local Sales Offices & Reps.

Ariz	Scottsdale, E.J. Foley & Assoc.	602-945-2665
Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Denver, Electrodyne	303-757-7679
Conn	Wethersfield, Underwood Sls.	203-563-3046
Fla	Fort Lauderdale, R.I. Smith Assocs.	305-772-5100
Ga	Atlanta, Electro-Mech Sls. Eng. Co.	404-256-4414
Ill	Oak Park, J. Popp Sls. Co.	312-626-3711
Kans	Overland Park, Penzner-Mankus Assoc.	913-381-0004
Kans	Wichita, Penzner-Mankus Assoc.	316-264-2662
Md	Silver Spring, Rep-Tron, Inc.	301-593-4844
Mass	Chelmsford, Underwood Sls.	617-256-8191
Mich	Farmington, W.R. Hummon & Assoc.	313-474-0661
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
Mo	Hazelwood, Penzner-Mankus Assoc.	314-731-4334
NJ	Newfoundland, T.A. Adamo Prod. Dev. Inc.	201-697-2450
NY	Kingspark, T.A. Adamo Prod. Dev. Inc.	603-474-9112
NY	New Hartford, KLM Assocs.	315-735-8525
NY	No. Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-442-0820
NC	Raleigh, Electro-Mech Sls. Eng. Co.	919-782-6452
Ohio	Cincinnati, Tri-State Mktg.	513-761-7993
Pa	King of Prussia, Monteiro Assocs.	215-265-0634
Tex	Dallas, Evans & McDowell Assoc.	214-238-7157
Wash	Renton, S. Wilson Co.	206-226-0650

NEW ERA PRODS., 4480 Broadview Rd., Cleveland, Ohio, 44109, Tel: 216-351-1097; Empl.: 25; Minimum order: $5

Customer service: M. Zehner

Products manufactured: Alarms, Calibrators, Inverters, Leads, Test & Adaptors, Lighting Equipment, Emergency, Reels, Cord & Cable, Services, Assembly, Production & Test, Tachometers, Test Equipment, Testers

NEW HAMPSHIRE BALL BEARINGS, INC., Peterborough, N.H., 03458, Tel: 603-924-3311, TWX: 710-364-1805; Empl.: 750; Minimum order: $200

For info on price: Sls. Dept.; Application info: Engrg. Dept.; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Miniature and Instrument Bearings, Precision Bearing Assemblies, Precision Steel Balls, Rod End and Spherical Bearings.

Products manufactured: Bearings

Local Sales Offices & Reps.

Cal	Los Angeles	213-776-5330
Ill	Des Plaines	312-827-6646
NY	Plainview	516-938-2011
Tex	Dallas	817-268-3141
Tex	Ft. Worth	817-284-1451

Local Distributors

Cal	Los Angeles, Jamaica Bearings, 8621 Bellanca Ave.	213-649-0480
Fla	Miami, Florida Bearings, 3164 N. Miami Ave.	305-573-8424
Ga	Atlanta, Dixie Bearings, 276 Memorial Dr.	404-522-7620
Iowa	Cedar Rapids, Iowa Midland Supply, 708 Third St. SE	319-366-3555
Minn	Minneapolis, Arrowhead Bearings, 1609 Hennepin Ave.	612-335-1111
Mo	Kansas City, Bearing Distrs., 1919 Baltimore St.	816-471-0666
NY	Jamaica, Jamaica Bearings, 138-72 Queens Blvd.	212-526-1350
Okla	Tulsa, Allied Brg. Supply, Box 3263	918-583-0164
Pa	Pittsburg, Bearings, Inc., 5536 Baum Blvd.	
Tex	Dallas, Bearing Chain & Supply, 1630 Prudential Dr.	214-631-8310
Wash	Bellevue, J. E. Phillips Co., Box 764	206-747-6538

NEWMAN CORP., M. M., Marblehead, Mass., 01945, Tel: 617-631-7100; Empl.: 8; Minimum order: $10

For info on price: F. McCarron; Application info: P. Cohen; Customer service: F. McCarron; Delivery info: P. Cohen

Free literature available: Descriptive Bulletin on Spiral Wrap Tubing; Descriptive Bulletin on Antex Solder Irons.

Products manufactured: Caps, Forms & Tapes, Heat Shrinkable, Cords, Heat Guns, Production, Insulators & Insulation, Kits, Cable-End Sealing, Soldering Guns, Irons & Desoldering Tools, Spacers, Strain Reliefs, Cable & Wire, Tubing, Wire Markers

NEW-TRONICS CORP., 15800 Commerce Park Dr., Brookpark, Ohio, 44142, Tel: 216-267-3150; Empl.: 200; Minimum order: $100

For info on price: P. Fritz; Application info: W. C. McNeil; Customer service: R. Chakerian; Delivery info: P. Fritz

Free literature available: Citizens-band and monitor antenna catalog, UHF amateur antennas & accessories, VHF amateur antennas & accessories

Products manufactured: Antennas, Cable

Local Sales Offices & Reps.

Cal	Foster City, Olson Sls.	415-573-1600
Cal	Woodland Hills, Chick Ryel & Co.	213-883-8118
Colo	Colorado Springs, Norris & Co.	303-635-9319
Colo	Denver, Norris & Co.	303-988-6430
Fla	Pembroke Pines, J. Wanger Sls.	305-987-8766
Ga	Atlanta, Murphy & Cota Co.	404-875-2525
Ill	Skokie, M. Bermann Sls.	312-675-3740
Ind	Indianapolis, Sukup & Cox Inc.	317-253-1215
Iowa	West Des Moines, Irvine Assocs.	515-225-7900
Mich	Bloomfield Hills, S. McMechan	313-852-4308
Mo	Liberty, Lectro Reps	816-781-2522
NY	Flushing, Bettan Sls. Inc.	212-591-7600
NC	Burlington, Murphy & Cota Co.	919-584-1577
Ohio	Brookpark, W. J. Corrigan	216-267-3150
Ohio	Twinsburg, F. Ohman Inc.	216-425-7445
Pa	Levittown, Sher Sls. Inc.	215-946-6200
Tex	Dallas, I. Harrison	214-239-2479
Wash	Seattle, Fleehart & Sullivan Inc.	206-522-1533
EXP:	New York, N.Y., Roburn Agencies Inc.	212-989-5939
FOR:	Can., Dorval, Que., Superior Int'l. Elctrns.	514-683-6331

N.Y. TESTING LABS., INC., 81 Urban Ave., Westbury, N.Y., 11590, Tel: 516-334-7770, TWX: 212-297-1449; Empl.: 50; Minimum order: $50

Customer service: J. Gaspari

Products manufactured: Furnaces, Gages, Ovens, Services, Assembly, Production & Test, Testers

NEWCOMB AUDIO PRODUCTS CO., 12881 Bradley Ave., Sylmar, Cal., 91342, Tel: 213-367-1921

Products manufactured: Amplifiers, Phonographs, Parts & Accessories, Public Address Systems, Receivers, Recorders

Local Sales Offices & Reps.

Ala	Birmingham, M.F. Taylor Co.	205-853-3673
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Winter Haven, M.F. Taylor Co.	813-294-2941
Iowa	Des Moines, K.S.W. Assocs.	515-279-9235
La	New Orleans, Crockett Sls. Co.	504-486-4590
Md	Silver Spring, M.F. Taylor Co.	301-589-4002
Mass	Belmont, A. Reinherz	617-484-7784
Mich	Ferndale, Shalco, Inc.	313-547-4771
Minn	Minneapolis, Jensen-Olsen Sls.	612-941-7181
Mo	Kansas City, K.S.W. Assocs.	816-363-5651
NJ	Teaneck, Fisher Elctrns. Assocs.	201-836-6661
NY	Grand Island, L.J. McTaggart	716-773-9222
NC	Charlotte, M.F. Taylor	704-537-4878
Ohio	Mansfield, K. White	419-756-3363
Pa	Pittsburgh, M.F. Taylor	412-823-8400
Tenn	Memphis, Crockett Sls. Co.	901-388-5410
Tex	Dallas, Crockett Sls. Co.	214-748-8209
Wash	Seattle, Vantage Corp.	206-784-6800

NEWPORT LABS., INC., 630 E. Young St., Santa Ana, Cal., 92705, Tel: 714-540-4914, TWX: 910-595-1787; Empl.: 175; Minimum order: $25

Free literature available: Sales catalog includes information on complete line of panel mounted digital instrumentation for voltage, current, frequency, time and temperature.

Products manufactured: Amplifiers, Comparators, Converters, Counters, Data Loggers, Indicators, Meters, Tachometers, Thermometers, Resistance, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown	205-539-4411
Ariz	Scottsdale, Measurement Consits.	602-994-9519
Cal	Pasadena, A&F Sls.	213-681-5631
Cal	Sunnyvale, RPD Instrs.	408-735-9040
Colo	Boulder, Meas. Consits.	303-449-5294
Conn	Hartford, Victor Assocs.	203-246-5643
Fla	Ft. Lauderdale, W.A. Brown	305-776-4800
Fla	Orlando, W.A. Brown	305-425-5505
Ga	Atlanta, W.A. Brown	404-939-1674
Ill	Chicago, Data Elctrns.	312-283-0300
Ind	Indianapolis, Data Elctrns.	317-784-6360
La	Gretna, W.A. Brown	504-366-5766
Md	Rockville, Mesa, Inc.	301-881-8430
Mass	Framingham, Victor Assocs.	617-879-5710
Mich	Southfield, Data-Tron	313-354-6421
Minn	Minneapolis, Data Elctrns.	612-786-9666
Mo	Crestwood, C.B. Fall	314-968-3850
Mo	Kansas City, C.B. Fall	816-942-3912
NJ	Pennsauken, Megargel & Himmelstein	609-662-3081
NM	Albuquerque, Meas. Consits.	505-265-6471
NY	Buffalo, R.F. Lamb	716-874-4900
NY	Elmont, Crane & Egert	516-488-2100
NY	Rochester, R.F. Lamb	716-544-5580
NC	Research Triangle Park, W.A. Brown	919-489-1546
Ohio	Dayton, Data-Tron	513-223-8421
Ohio	Wickliffe, Data-Tron	216-585-8421
Tex	Dallas, Martin, Zienkowsky, Browne, & Assoc.	214-233-5535
Tex	Houston, Martin, Zienkowsky, Browne, & Assoc.	713-523-7333
Utah	Murray, Meas. Consits.	801-268-3181
Wash	Seattle, Underwood, Jensen & Assoc.	206-575-0123

NEY, CO, J.W., Maplewood Ave., Bloomfield, Conn., 06002

NH RESEARCH, INC., 1510 S. Lyon St., Santa Ana, Calif., 92705, Tel: 714-835-1616, Telex: 67-8377; FSC No: 24862; Empl.: 20; Minimum order: $50

Customer service: N. Paik

Free literature available: Short-form catalog or specific data sheets of the NH Research product line.

Products manufactured: Amplifiers, Analyzers, Calibrators, Controls/Control Eqpt., Converters, Current Sensors, Current Sources, Dividers, Filters, Generators, Isolators, Meters, Monitors, Oscillators, Power Supplies, Regulators, Shifters, Stabilizers, Line Impedance, Standards, Synthesizers, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Scottsdale, Measurement Consits. Ltd.	602-948-8410
Cal	Santa Ana, Schlines-Richardson	714-832-1949
Colo	Boulder, Measurement Consits. Ltd.	303-449-5294
Fla	Gulfport, Greenstein Assocs.	813-381-6490
Ill	Chicago, Pat Lind Elctrns. Co.	312-774-1246
Ind	Indianapolis, Pat Lind Elctrns. Co.	317-547-9178
Mass	Waltham, W.M. Hague Co.	617-899-5600
Mich	Detroit, Electro Sales Assocs.	313-526-8800
Minn	Circle Pines, Pat Lind Elctrns. Co.	612-786-5770
NJ	Haddonfield, Dyna Rep Co.	609-795-1700
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Albuquerque, Measurement Consits., Ltd.	505-265-6471
NY	Huntington, Hansen Assocs.	212-947-0379
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Cleveland, Electro Sales Assocs.	216-261-5440
Ohio	Dayton, Electro Sales Assocs.	513-426-5551
Pa	Pittsburgh, Electro Sales Assocs.	412-371-9449
Tex	El Paso, LH Industries	915-544-5124
Utah	Murray, Measurement Consits. Ltd.	801-268-3181
Va	Alexandria, Dyna Rep Co.	703-354-1222
Wash	Bellevue, Showalter Instr.	206-624-9020
FOR:	Can., Mississauga, Ont., Allan Crawford Assocs.	416-678-1500

NICHICON AMERICA CORP., 6435 N. Proesel Ave., Chicago, Ill., 60645, Tel: 312-679-6530

Products manufactured: Capacitors, Fixed

NICOLET INSTRUMENTS CORP., 5225 Verona Rd., Madison, Wisc., 53711, Tel: 608-271-3333, TWX: 910-286-1713; Empl.: 201 .... p. 1•780,781

Customer service: B. Hervey

Free literature available: 1090 Brochure. A description of the operation and display capability of the Digital Oscilloscope. Specifications of the mainframe and various plug-ins are included.

Products manufactured: Oscilloscopes

Local Sales Offices & Reps.

Cal	Encino, Scientific Devices	213-872-1951
Cal	Los Alamitos, Scientific Devices	213-598-7678
Cal	Mountainview, Scientific Devices	415-964-4230
Cal	San Diego, Scientific Devices	714-279-6642
Colo	Littleton, Nicolet Instr.	303-798-3561
Ga	Decatur, Nicolet Instr.	404-243-1219
Ill	Des Plaines, Scientific Devices-Midwest	312-297-5240
Kans	Lenexa, Scientific Devices-Midwest	913-631-3818
La	Baton Rouge, Systems Engrg. Sls. Co.	504-272-3730
Md	Silver Spring, Sel-Tronics, Inc.	301-589-3391
Mass	Auburndale, Nicolet Instr.	617-969-7420
Minn	Minneapolis, Scientific Devices-Midwest	612-544-1616
Mo	St. Louis, Scientific Devices-Midwest	314-842-2535
NJ	Fairfield, KLS Assocs., Inc.	201-227-2900
NY	Liverpool, Rayelco Elctrns., Inc.	315-652-5272
Ohio	Cleveland, Data Equip. Sls. Co.	216-252-3151
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
Tex	Houston, Systems Engrg. Sls. Co.	713-668-7840
Tex	Richardson, Systems Engrg. Sls. Co.	214-231-9364
Wash	Bellevue, Scientific Devices-Northwest	206-454-0900
For:	Can., Mississauga, Ont., Allan Crawford Assocs.	416-678-1500

NICOLET SCIENTIFIC CORP., 245 Livingston St., Northvale, N.J., 07647, Tel: 201-767-7100, TWX: 710-991-9619; Empl.: 85; Minimum order: $50

For info on price: R. S. Rothschild; Application info: R. S. Rothschild; Customer service: A. Pini; Delivery info: R. S. Rothschild

Products manufactured: Analyzers

Local Sales Offices & Reps.

Cal	Irvine, Nicolet Scientific	714-549-1199
Colo	Littleton, Nicolet Instrument	303-798-3561
Ga	Decatur, Nicolet Instrument	404-243-1219
Ill	Palatine, Nicolet Scientific	312-358-6520
Mass	Auburndale, Nicolet Instrument	617-969-7420
NJ	Medford, Nicolet Scientific	215-467-7070
NY	Liverpool, Rayelco Elctrns.	315-652-5272
Ohio	Dayton, LI/CORP	513-434-6367
Pa	West Chester, Nicolet Scientific	301-942-2020
Tex	Plano, Nicolet Instrument	214-424-8611
Wash	Bellevue, Scientific Devices/Northwest	206-454-0900

NIHON DEMPA KOGYO CO., LTD., 1-21-2 Nishihara, Shibuya-Ku, Tokyo, Japan, Tel: 03-460-2111; Empl.: 800

Products manufactured: Crystal Blanks, Filters, Oscillators

NIPPERT CO., 825 Pittsburgh Dr., Delaware, Ohio, 43015, Tel: 614-363-1981; Empl.: 350; Minimum order: $100

For info on price: D. E. Breese; Application info: D. E. Breese; Customer service: D. Heinlein; Delivery info: D. Heinlein

Free literature available: Bulletin N-101: Cold-Formed Components, Bulletin N-102: Cold-Formed Heat Sinks with Integral Weld Rings, Bulletin N-104: Custom Drawn Shapes.

Products manufactured: Commutators, Crystals, Headers, Services, Assembly, Production & Test, Slip-Rings & Assemblies

NIPPON-DENSAN CORP., 1821 University Ave., St. Paul, Minn., 55104

NITRON DIV., McDonnell Douglas Corp., 10420 Bubb Rd., Cupertino, Cal., 95014

NJE CORP., Box 50, Culver Rd., Dayton, N.J., 08810, Tel: 201-329-4616, TWX: 710-480-5674; Empl.: 125 p. 1•1326-1331

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Col-Ins-Co.	205-539-1771
Ariz	Phoenix, BFA Corp.	
Cal	Sherman Oak, Electronic Mktg. Specialists	213-990-4244
Cal	Sunnyvale, Electronic Mktg. Specialists	408-245-9291
Colo	Denver, BFA Corp.	303-744-3301
Conn	Hamden, Instrument Consultants	203-288-5246

Fla	Orlando, Col-Ins-Co.	305-423-7615
Ind	Ft. Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-452-6065
Iowa	Marion, B. Rush Assoc.	319-377-0551
Kans	Olathe, B. Rush Assoc.	913-782-1177
Md	Silver Spring, Reptron Inc.	301-593-4844
Mass	Waban, Instr. Consultants	617-969-9881
Mo	St. Louis, B. Rush Assoc.	314-426-3656
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Manhasset, Win-Cor Elctrn. Sls. Corp.	516-627-9474
NY	Pittsford, T-Squared Elctrns. Co.	716-381-2551
NY	Syracuse, T-Squared Elctrns. Co.	315-463-8592
NC	Raleigh, Col-Ins-Co.	919-834-6591
Okla	Tulsa, Kemp Engrg.	918-299-2636
Pa	Pennsauken, Megargel-Himmelstein Assoc.	215-629-1072
Tex	Addison, Kemp Engrg.	214-661-0400
Tex	Houston, Kemp Engrg.	713-688-1431
Wash	Bellevue, Brennan Assoc.	206-454-9332

NL INDS., INC., Elctrns. Dept., Box 726-1981 Port City Blvd., Muskegon, Mich., 49445, Tel: 616-777-2602, TWX: 510-394-4130; Empl.: 60 .... p. 1•2320-2323

Products manufactured: Arresters, Electrical Surge, Lightning, Current Sensors, Discharge Systems, Energy, Fuses, Heaters & Heating Elements, Indicators, Limiters, Meters, Ovens, Probes, Protectors, Regulators, Resistors, Suppressors, Switches, Thermistors, Thermometers, Resistance, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Murphy & Cota	205-529-8476
Cal	Inglewood, Tracker	213-645-6060
Cal	Palo Alto, Testco	415-326-5320
Colo	Wheat Ridge, RMS Sls.	303-423-6693
Ill	Chicago, D. Dolin Sls. Co.	312-286-6200
Ind	Greenwood, V. Schillinger & Assocs.	317-888-2260
Ind	South Bend, V. Schillinger & Assocs.	219-291-6258
Md	Baltimore, R. A. Wafer Assocs.	301-744-1133
Mass	Newton, Normell Assocs.	617-969-5478
Mich	Detroit, Burcaw Co. & Assocs.	313-533-7700
Minn	St. Paul, R.G. Ragon, Inc.	612-488-0201
Mo	Kansas City, Nevco, Inc.	816-421-1751
NJ	Fairlawn, G. Harris & Assocs.	201-796-5200
NJ	Haddonfield, Thomas Assocs., Inc.	609-854-3011
NY	Syracuse, W.A. Franklin Sls. Corp.	315-474-2954
NY	Whitesboro, W.A. Franklin Sls. Corp.	315-736-5460
NC	Winston-Salem, Murphy & Cota	919-723-1001
Ohio	Cleveland, Jay Engrg. Co.	216-252-0486
Ohio	Dayton, Jay Engrg. Co.	513-253-2151
Okla	Tulsa, Norvell Assocs., Inc.	918-663-1247
Tex	Dallas, Norvell Assocs., Inc.	214-350-6771
Tex	Houston, Norvell Assocs.	713-774-2568
Wash	Seattle, D. Smith Sls. Co.	206-833-3160

NL INDUSTRIES, INC., Metal Div., 111 Broadway, New York, N.Y., 10006, Tel: 212-732-9400

Products manufactured: Flux, Brazing & Soldering Materials, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Solder (All Types), Tubing

N L INDS., INC., Paint Div., 111 Broadway, New York, N. Y., 10006, Tel: 212-732-9400

Products manufactured: Coatings, Paints

N L INDS., INC., Steel Package Div., 15th & State Sts., Granite City, Ill., 62040, Tel: 618-451-9760

Products manufactured: Containers

NOBEX

components

NOBEX DIV., Griffith Plastics Corp., 1027 California Dr., Box 4365, Burlingame, Cal., 94010, Tel: 415-342-8170, TWX: 910-374-2840; FSC No: 32767; Empl.: 35; Minimum order: $10

For info on price: P. Long; Application info: J. A. Griffith; Customer service: P. Meyers; Delivery info: P. Long

Free literature available: Instrument Knob Catalog #300, Clear Dial Skirted Knob Catalog #361, DIGIBEZEL Catalog #351, Instrument Case Catalog #371, Binding Post Catalog #381.

Products manufactured: Bezels, Shielded & Unshielded, Caps, Lenses, Indicator Light, Cases, Equipment, Instrument, Meter, Dials, Knobs, Lenses, Readout & Display, Meters, Posts, Testers

Local Sales Offices & Reps.

Cal	Burlingame, J. Logan & Assocs.	415-697-6100
Cal	Inglewood, V & L Assocs.	213-671-7688
Fla	Delray Beach, F. A. Cullman Co.	305-276-5071
Ill	Chicago, Comm. Engrs.	312-761-0548
Ind	Ft. Wayne, McDonald Sls. Co.	219-745-9214
La	Metairie, McKinney Sls. Co.	504-887-1723
Md	Baltimore, M/E Assocs.	301-825-1130
Mass	N. Scituate, W.A. Hendrickson Co.	617-545-0652
Minn	Minneapolis, Wenco Sls.	612-866-3639
NJ	Cherry Hill, M/E Assocs.	609-667-6110
NY	Bayside, W. Jay Assocs.	212-762-4238
Okla	Tulsa, McKinney Sls. Co.	918-742-6791
Tex	Bellaire, McKinney Sls. Co.	713-665-3653
Tex	Dallas, McKinney Sls. Co.	214-631-9450
Va	Richmond, M/E Assocs.	703-266-3457
Wash	Seattle, C.K. Shanks & Assoc.	206-632-4290

Local Distributors

Cal	Burlingame, Rose Elctrns., Inc., 846 Stanton Rd.	415-697-0224
Cal	Los Angeles, Electric Switches, Inc., 2478 Fletcher Dr.	213-664-1141
Mass	Newton, Greene-Shaw Co., 70 Bridge St.	617-969-8900
NY	Bohemia, Car-Lac Elctrns., 75 Orville Dr.	516-567-4200
NY	Buffalo, Summit Distributors, 916 Main St.	716-884-3450
Okla	Tulsa, Oil Capitol Elctrns., 708 S. Sheridan	918-836-2541
Tex	Dallas, K-A Electronic Sls., 1220 Majesty	214-634-7870
Wisc	Mequon, Taylor Electric Co., 1000 W. Dones Bay	414-241-4321

SELF-ORGANIZING SYS., See Cosar Corp.

NON LINEAR FILTERS, Box 338, Trumbull, Conn., 06611, Tel: 203-268-6309; Empl.: 12

Free literature available: IPI low pass and IPVC-1 voltage controlled (over a 500:1 frequency range) low pass non-linear filters.

Products manufactured: Amplifiers, Filters, IC's, Active Filters

NON-LINEAR SYS., INC., Box N, Del Mar, Cal., 92014, Tel: 714-755-1134, TWX: 910-322-1132; Empl.: 76

For info on price: H. P. Heisig; Application info: P. Akin

Products manufactured: Clocks (All Types), Comparators, Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Data Acquisition & Reduction Systems, Data Compressors, Digital, Data Loggers, Detectors, Gages, Generators, Meters, Monitors, Multiplexers, Printers, Recorders, Scanners, Signal Conditioners & Equipment, Test Systems, Testers, Totalizers, Digital

NORELCOM ELECTRONICS, 200 Allen Blvd., Farmingdale, N.Y., 11735, Tel: 516-249-7262, TWX: 510-224-6519; Empl.: 40; Minimum order: $10

For info on price: A. Baldon; Application info: A. Rogers; Customer service: L. Frodell; Delivery info: L. Frodell

Free literature available: Electronic Hardware Catalog #173A; GE RTV Silicone Catalog; Raychem Heat Shrinkable Tubing Catalog; Thermalloy Heat Sink & Mfg. Pad Catalog.

Products manufactured: Cable, Capacitors, Fixed, Chokes, Coils Including Assemblies & Forms, Compounds, Encapsulating, Insulating, Molding, Potting, Connectors, Cords, Diodes, Fuses, Insulators & Insulation, Knobs, Lamps, Lubricants, Pads, Transistor Mounting, Rectifiers, Rubber, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive, Transistor, Diode, Thyristor Heat Dissipators, Transistors, Tubing, Wire, Wire & Cable Ties

Local Sales Offices & Reps.

NJ	Livingston, H. Thaw Sls. Co.	

NORPLEX DIV., Universal Oil Products, Norplex Dr., LaCrosse, Wisc., 54601, Tel: 608-784-6070, Telex: 29-3422; Empl.: 850

Products manufactured: Laminates

Local Sales Offices & Reps.

Ariz	Phoenix, Karl Jahn Co.	602-956-9060
Cal	Alhambra, Ralph Little & Assocs.	213-282-2114
Cal	Santa Clara, Ralph Little & Assocs.	408-247-7750
Colo	Sedalia, Jensen Reps. Co.	303-466-6061
Conn	West Hartford, R.S. Pettigrew & Co.	203-233-8533
Fla	Largo, Almac Assocs.	813-581-0444
Ga	Tucker, Cartier & Wilson Co.	404-939-2547
Ill	Wheaton, Norplex Div, UOP	312-653-1283
Ind	Indianapolis, Norplex Division, UOP	317-788-1998
Iowa	Cedar Rapids, J. Vrbik Co.	319-377-8244
Mass	West Newton, R.S. Pettigrew & Co.	617-969-5770
Mich	Detroit, Hohlfeldt Engrg., Inc.	313-839-4592
Minn	Minneapolis, Norplex Div., UOP	612-835-5530
Mo	St. Louis, Phelan-Tramelli Sls. Agency	314-727-3400
NJ	Union, Plastech, Inc.	201-687-4810
NY	East Rochester, J.N. Powderly Co.	716-381-2540
Ohio	Cleveland, R.A. Paisley	216-333-0569
Ohio	Dayton, Wm. S. McClellan Assocs.	513-299-5161
Okla	Tulsa, T.J. Ray Co.	918-627-1515
Pa	Ardmore, Midlantic Plastics Sls. Co.	215-649-2436
Tex	Arlington, N & W Sls., Inc.	817-461-4443
Wash	Olympia, Bergford & Assocs.	206-866-2001
Wisc	Menomonee Falls, Ind'l Sls. Tech., Inc.	414-781-7232
FOR:	Can., Agincourt, Ont., J. Best	416-690-3254

NORSAL INDUSTRIES, INC., 34 Grand Blvd., Brentwood, N.Y., 11717, Tel: 516-231-4040, TWX: 510-227-9865; FSC No: 19136; Empl.: 15; Minimum order: $25

For info on price: C. Feldman; Application info: N. Spector; Customer service: C. Feldman; Delivery info: R. Feldman

Products manufactured: Adapters, Waveguide, Attenuators, Boards, Programming, Cavities, Microwave, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Printed, Multilayer, Circulators, Ferrite, Connectors, Couplers, Demodulators, Detectors, Dividers, Dummy Loads, Duplexers, Microwave, Films, Filters, Isolators, Junctions, Hybrid, Microwave, Limiters, Line Strechers, Microwave, Mismatches, Microwave, Precision, Mixers, Modulators, All Kinds, Monitors, Multiplexers, Probes, Resistors, Shifters, Strip-Line Components, Microwave, Switches, Tees

Local Sales Offices & Reps.

Cal	Los Angeles, E. Mintz Assoc.	213-645-2066
Cal	Mt. View, Don Lay Assoc.	415-968-7500
Fla	Clearwater, Brennan Assoc.	813-446-5006
Ill	Chicago, Communication Engineers	312-761-0548
Mo	Kansas City, R. R. Burton Sls.	816-444-8300
Mo	Maryland Hgts., Delltron Co.	314-434-3804
NY	Melville, Astrorep	516-423-2266
Ohio	Dayton, F. L. Ohmer, Assoc.	513-434-1454
Pa	Lafeyette Hill, M. Lader Co.	215-825-3177
Tex	Addison, RMC & Assoc.	214-363-0166
Wisc	Milwaukee, Star Engrg.	414-543-3469

NORTH AMERICAN PHILIPS CONTROLS CORP., Cheshire Industrial Park Box E, Cheshire, Conn., 06410, Tel: 203-272-0301, TWX: 710-455-4048; Empl.: 850

For info on price: L. Connor; Application info: F. Vitone; Customer service: R. Wozniak; Delivery info: R. Wosniak

Free literature available: 4-page "Permanent Magnet Synchronous Motor Selection Guide" lists in chart form comparative electrical, physical and operating characteristics of 13 models of synchronous motors.

Products manufactured: Controls/Control Eqpt., Counters, Detectors, Display Devices/Displays, Flashers, Indicators, Motors, Relays, Switches, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Components	205-539-4411
Cal	North Hollywood, No. Amer. Philips Controls	213-877-0536
Cal	Palo Alto, Harris Engrg.	415-328-3370
Colo	Littleton, Simpson Assocs.	303-794-8381
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-776-4800
Fla	Orlando, W.A. Brown Comps.	305-425-5505
Ill	Rolling Meadows, Sumer	312-394-4900
Ind	Ft. Wayne, Temple Engrg.	219-744-4331
Kans	Wichita, Dy-Tronix, Inc.	316-943-6221
Md	Lutherville, L.D. Lowery	301-823-2172

Mass	Braintree, No. Amer. Philips Controls	617-648-2576
Mich	Dearborn Heights, Temple Engrg.	313-565-6330
Minn	Mpls, Nortec Sls.	612-835-7414
Mo	Hazelwood, Dy-Tronix Inc.	314-731-5799
Mo	Kansas City, Dy-Tronix Inc.	816-761-6543
NJ	Livingston, A.A. Budde	201-994-1210
NJ	Union City, Malin Assocs. Co.	201-348-3770
NY	Rochester, Woodams-Montbach	716-544-8721
NC	Raleigh, W.A. Brown Comps.	919-876-9601
NC	Winston-Salem, W.A. Brown Comps.	919-725-5384
Ohio	Cleveland, C. Robinson Co.	216-381-9049
Ohio	Dayton, C. Robinson Co.	513-275-2412
Pa	Broomall, L.D. Lowery	215-528-5170
Tex	Dallas, R. Kimball Co.	214-231-3447
Utah	Salt Lake City, Simpson Assocs., Inc.	801-486-3731
Va	Charlottesville, L.D. Lowery	703-973-6672
Wash	Bellevue, W.M. Buehler Co.	206-455-5512
FOR:	Can., Toronto, Ont., Philips Elctrns. Inds., Ltd.	416-425-5161

Local Distributors

Cal	Sun Valley, Sterling Elctrns., 11614 Pendleton St.	213-767-5030
Fla	Ft. Lauderdale, Peerless Radio Corp., 1040 N.E. 43rd Ct.	305-566-5966
Pa	Horsham, Pioneer/Pennsylvania, 205 Witmer Rd.	215-674-5710
Tex	Houston, Altair Co., 9501 Baythorne Dr.	713-462-3029
Tex	Richardson, Altair Co., 405 N. Plano Rd.	214-231-5166

NORTH AMERICAN PHILIPS CONTROLS, Husky Park, Frederick, Md., 21701, Tel: 301-663-5141, TWX: 710-862-0901; Empl.: 310; Minimum order: $40

For info on price: B. L. Reeder; Application info: G. Borke; Customer service: P. Longo; Delivery info: M. Gieroux

Free literature available: 4-page guide to general purpose relays, displayed are operating, electrical and mechanical characteristics as well as dimensional data.

Products manufactured: Relays, Solenoids, Switches

Local Sales Offices & Reps.

Ala	Huntsville, W. Brown	205-539-4411
Cal	No. Hollywood, North Amer. Philips Controls Corp.	213-877-0536
Cal	Palo Alto, Harris Engrg.	415-328-3370
Colo	Denver, Williams-Assocs.	303-343-2911
Conn	Cheshire, North Amer. Philips Controls Corp.	203-272-0301
Fla	Ft. Lauderdale, W. Brown	305-776-4800
Fla	Orlando, W. Brown	305-425-5505
Ill	Rolling Meadows	312-394-4900
Ind	Ft. Wayne, Temple Engrg.	219-744-4331
Kans	Wichita, Dy-Tronix, Inc.	316-943-6221
Md	Towson, J-H Elctrn. Sls. Co.	301-825-4440
Mass	Braintree, North Amer. Philips Controls Corp.	617-848-2576
Mich	Dearborn Heights, Temple Engineering	313-565-6330
Minn	Mpls., Nortec Sls.	612-920-9526
Mo	Hazelwood, Dy-Tronix	314-731-4677
Mo	Kansas City, Dy-Tronix	816-761-6543
NJ	Dumont, Wilson Assoc.	201-385-7447
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	New York, Wilson Assoc.	212-889-0929
NY	Rochester, Woodams-Montbach	716-544-8721
NC	Raleigh, W.A. Brown	919-876-9601
NC	Winston-Salem, W. Brown	919-725-5384
Ohio	Cleveland, C. Robinson	216-381-9049
Ohio	Dayton, C. Robinson	513-275-2412
Pa	Fort Washington, G. C. M. Assocs.	215-646-7535
Tex	Richardson, R.F. Kimball Inc.	214-231-3447
Wash	Bellevue, W.M. Buehler Co.	206-455-5512
EXP:	NY, N.Y., Frathom Co.	212-687-9390
FOR:	Can., Toronto, Ont., Pye-Tmc	416-249-7044

Local Distributors

Cal	Sun Valley, Sterling Elctrns., 11614 Pendleton St.	213-767-5030
Fla	Ft. Lauderdale, Peerless Radio Corp., 1040 NE 43rd Ct.	305-566-5966
Pa	Horsham, Pioneer/Penn., 205 Witmer Rd.	215-674-5710
Tex	Houston, Altair Co., 9501 Baythorne Dr.	713-462-3029
Tex	Richardson, Altair Co., 405 N. Plano Rd.	214-231-5166

NORTH AMERICAN PRINTED CIRCUIT DIV., Tyco Labs., Inc., Box 145, Stafford, Conn., 06075, Tel: 203-684-2703; Empl.: 140

Products manufactured: Boards, Printed Circuit, Circuits, Printed, Multilayer

NORTH ATLANTIC INDS., 200 Terminal Dr., Plainview, N.Y., 11803, Tel: 516-681-8600, TWX: 510-221-1879; FSC No: 07342; Empl.: 175; Minimum order: $25 p. 1•188,772

For info on price: P. G. Wittenberg; Application info: P. G. Wittenberg; Customer service: W. Cullum; Delivery info: B. Carolyn

Free literature available: Condensed catalog, individual data sheets & application notes on AC instrumentation & resover/synchro/digital conversion

Products manufactured: Analyzers, Bridges, Calibrators, Comparators, Converters, Decade Boxes, Demodulators, Detectors, Dividers, Indicators, Meters, Repeaters, Servo, Resolvers, Synchro, Servo Systems, Shifters, Simulators, Standards, Synchro Transmitters, Solid-State, Testers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ala	Mobile, BCS Assoc.	205-666-2796
Cal	Encino, Scientific Devices	213-872-1951
Cal	Los Alamitos, Scientific Devices	213-598-7678
Cal	Mountain View, Scientific Devices-CA	415-964-4230
Cal	North Hollywood, Elect. Standards Repair Svc.	213-765-4224
Cal	North Hollywood, North Atlantic Dist. Off.	213-982-0442
Cal	San Diego, Scientific Devices-CA	714-279-6642
Conn	Hamden, J & J Assocs.	203-624-7800
Fla	Orlando, BCS Assocs.	305-896-4881
Ga	Decatur, BCS Assocs.	404-321-0980
Ill	Chicago, P. Lind	312-774-1246
Ind	Indianapolis, P.Lind	317-547-9178
Iowa	Cedar Rapids, Tech Reps	319-363-2489
Ky	Valley Station, BCS Assoc.	502-935-9634
Md	Lanham, Brimberg Sls. Co.	301-552-2200
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Troy, G. R. Peters Assocs.	313-524-2920
Minn	Circle Pines, P. Lind	612-786-5770
Mo	Hazelwood, Tech. Reps.	314-731-5200
Mo	Independence, Tech Reps.	816-737-1414
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cleveland, Dynatron	216-835-2270
Pa	Exton, Scientific Mktg.	215-363-7377
Tex	El Paso, System Design Consits.	915-544-5124
Tex	Houston, Scien. Sls.	713-666-5318
Tex	Richardson, Sci. Sls.	214-231-6541
Va	Williamsburg, BCS Assocs.	703-245-1786
Wash	Bellevue, Sci. Devices N.W.	206-454-0900
EXP:	N.Y., Plainview, North Atlantic	516-681-8600

Advertisment

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If you are using ILC/DDC or Analog Devices, North Atlantic Industries has the second source and also state-of-the-art S/D-D/S.

Test Equipment
Digital Phase Angle Voltmeters, Synchro/Resolver Bridges, Simulators Angle Position Indicators 0.1° to .001°

NORTH ELECTRIC CO., Electronics Div., Portland Way N., Galion, Ohio, 44833, Tel: 419-468-8100, TWX: 810-248-2907; Empl.: 1000

Free literature available: "NEC TODAY" Brochure - Overview of all of North's divisions with descriptions of each division's product line. "QUALITY ENGINEERED POWER SUPPLIES" Brochure - Photos & descriptions of the facilities and product capabilities of North's Electronetics Division, including ordering information for power supplies.

Products manufactured: Chargers, Battery, Chokes, Coils Including Assemblies & Forms, Converters, Inverters, Power Supplies, Switches, Transformers

Local Sales Offices & Reps.

Cal	Laguna Beach, North Elec. Co.	714-494-5800
Ill	Des Plaines, Marsland Assoc.	312-775-1309
NJ	Cherry Hill, Benco Sls.	609-779-9282
NJ	Fair Lawn, Bixon Assoc.	201-797-5356
NJ	Livingston, G & A Elctrns., Inc.	201-992-3087
Ohio	Canton, CSA Equip. Sls.	216-456-1359
Va	Oakton, Product Management Corp.	703-385-9306

NORTH HILLS ELCTRNS., Alexander Pl., Glen Cove, N.Y., 11542, Tel: 516-671-5700; FSC No: 98821; Empl.: 45; Minimum order: $25 p. 1•189,264,265,1332,1333; p. 2•399,1388,1771

Free literature available: Summary Product Sheets on All Products.

Products manufactured: Alarms, Boards, Programming, Calibrators, Coils Including Assemblies & Forms, Comm. Systems, Comparators, Converters, Couplers, Current Sources, Display Devices/Displays, Dividers, Integrators, Electronic, Power Supplies, References, D-C Voltage, Scanners, Switches, Transducers, Transformers, Transmission Systems, Data, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices-Southeast	205-536-1969
Cal	Los Angeles, Sodaro Co.	213-478-7733
Fla	Ft. Lauderdale, Scientific Southeast	305-721-4260
Fla	Orlando, Scientific Devices-Southeast	305-841-8180
Fla	St. Petersburg, Scientific Devices-Southeast	813-521-1720
Minn	Minneapolis, Heimann Co., Inc.	612-861-6051
NY	Great Neck, Industron Assocs., Inc.	516-487-2620
NC	Burlington, Scientific Devices-Southeast	919-228-6279

NORTHEAST SCIENTIFIC CORP., 30 Wetherbee St., Acton, Mass., 01720, Tel: 617-263-2711; Empl.: 10; Minimum order: $100

Customer service: C. Moritz

Free literature available: Catalog

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Cal	Santa Clara, Ray Marg	408-248-5199
DC	Washington, Whitcomb Assocs.	202-737-0763
Ill	Des Plaines, Marsland Assocs., Inc.	312-775-1309
Ind	Indianapolis, Marsland Assocs., Inc.	317-924-3568
Md	Baltimore, Whitcomb Assocs.	301-889-1245
Minn	Minneapolis, Marsland Assocs.	612-545-4481
Mo	St. Peters, Marsland Assocs.	314-278-6949
NH	Salem, Bilowich Enterprises	603-898-5408
Pa	Audubon, Holmes Assocs.	215-666-0636

NORTHERN ENGINEERING LABS., 357 Beloit St., Burlington, Wisc., 53105, Tel: 414-763-3591; FSC No: 00815; Empl.: 200; Minimum order: $25 p. 1•399

Customer service: D. Griebel

Free literature available: Twenty page technical brochure on frequency control devices (catalog #373) and pamphlet on "Writing Crystal Specifications."

Products manufactured: Crystal Blanks, Crystals, Oscillators, Ovens

Local Sales Offices & Reps.

Cal	Palo Alto, R.W. Thompson Assocs.	415-494-7516
Cal	Pasadena, P. Nurches Co.	213-796-5844
Colo	Aurora, Robbins & Assocs.	303-399-6618
Ill	Oak Park, E. Schmeichel Co.	312-524-0307
Kans	Olathe, Tech. Reps. Inc.	913-782-1177
Mass	Needham, Hatch Assocs.	617-444-3310
Minn	Chanhassen, Barnes Sls Assocs.	612-474-2907
NJ	Bergenfield, H. Gray Assocs.	201-384-3643
NY	Syracuse, Nayor Elctrns. Co.	315-656-2251
Ohio	Wickliffe, W.J. Brauer & Assocs.	216-943-0601
Tex	Addison, Southland Comps., Inc.	214-233-0603

NORTHFIELD PRECISION INSTR. CORP., 4400 Austin Blvd., Island Park, N.Y., 11558, Tel: 516-431-1112; FSC No: 12639

Customer service: M. Farber

Products manufactured: Clutches, Couplings

NORTON ASSOCS., INC., 10 Di Tomas Ct., Copiague, N.Y., 11726, Tel: 516-842-4666; FSC No: 08739

Customer service: R. Norton

Free literature available: Specification sheets on Norton magnetic heads for tape & film.

Products manufactured: Heads, Recording Playback, Erase

NORTRONICS CO., INC., 8101 Tenth Ave., N., Minneapolis, Minn., 55427, Tel: 612-545-0401; Empl.: 600; Minimum order: $35

For info on price: E. Bedell; Application info: J. Dundovic; Customer service: P. Lund; Delivery info: P. Lund

Free literature available: Design digest for audio recording; design digest for mini-digital recording design digest for digital recording; recorder care maintenance manual; nortronics head replacement guide; - application oriented literature & catalogues for the user.

Products manufactured: Demagnetizers, Editing Equipment, Tape, Erasers, Magnetic Tape (Bulk), Heads, Recording Playback, Erase, Tape Recording Accessories

NOTHELFER WINDING LABS, See NWL Transformer

NOVA ELECTRIC MFG. CO., 263 Hillside Ave., Nutley, N.J., 07110, Tel: 201-661-3434; Empl.: 50 p. 1•1334-1337

Products manufactured: Converters, Inverters, Power Supplies, Regulators

Local Sales Offices & Reps.

Cal	Los Angeles, Basic Sys.	213-938-2833
Cal	Mountain View, Gado Instr.	415-961-2222
Colo	Boulder, A.L.S. Elctrns.	303-447-2436
Conn	Hamden, Victor Assoc.	203-646-6448
Fla	Maitland, Rowe Engrg. Sls.	305-834-2700
Ill	Chicago, Ampol Svcs. & Engrg.	312-545-4600
Ind	Carmel, Rich Elctrn. Mktg.	317-844-8462
Md	Bethesda, Powell-Pendergraph	301-656-4535
Mass	Framingham, Victor Assoc.	617-879-5710
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Minneapolis, R-J Inc.	612-922-1425
NM	Albuquerque, A.L.S. Elctrns.	505-294-8555
NY	Elmont, Crane & Egert Corp.	516-488-2100
NY	Fayetteville, M.P. Andrews Mfrs. Rep.	315-637-5291
NC	Charlotte, J. Rudisill Assoc.	704-377-6901
Ohio	Aurora, EMA Inc.	216-562-8516
Ohio	Centerville, EMA Inc.	513-433-2800
Ore	Portland, Richard Legg Co.	503-792-8824
Pa	Philadelphia, Powell-Pendergraph	215-657-0330
Pa	Pittsburgh, Wainwright Tech. Sls.	412-487-5055
Tex	Dallas, R. Martin Assoc	214-358-3704
Tex	Houston, R. Martin Assoc.	713-462-4077
Va	Richmond, Powell-Pendergraph	804-264-2341
EXP:	N.Y., N.Y., Henley & Co.	212-986-5544
FOR:	Can., Calgary, Alberta, Canadian Dynamics	403-243-2018
FOR:	Can., Lachine, Que., Electrodesign Ltd	514-363-5120
FOR:	Can., Toronto, Ont., Electrodesign Ltd	416-787-0991
FOR:	Can., Vancouver, B.C., Canadian Dynamics	604-325-3201
FOR:	Can., Vanier, Ont., Electrodesign Ltd	613-745-0541

NSI, INSTRUMENT DIV., 2613 Industrial La., Garland, Tex., 75041, Tel: 214-278-3545; Empl.: 38; Minimum order: $25

Customer service: D. Hoppens

Free literature available: Solid State Cooling: Guide to Solid State Cooling: photos, performance curves, size and application data

Products manufactured: Controls/Control Eqpt., Cooling/Heating Modules, Thermoelectric, Power Supplies

Advertisment

Standard and custom solid state thermoelectric coolers and associated temperature controls/power supplies. Specialists in coolers for industrial use and high reliability space or military applications. Temperatures to -110°C. Capabilities include complete thermal systems design and fabrication including heat exchangers, fans, and vacuum chambers.

N-T-T/PEERLESS, 40 Jytek Dr., Leominister, Mass., 01453, Tel: 617-537-6001, TWX: 710-347-0326; Minimum order: $25

Customer service: W. E. Schwartz

Products manufactured: Cable Assemblies & Harnesses, Cable, Clamps & Clips, Cleaners, Ultrasonic, Connectors, Cords, Insulators & Insulation, Jack Adapters (All Types), Jacks (All Types), Lead Assemblies & Receptacles, Microphone Accessories (Including Stands, Holders, Booms), Networks, Plug Adapters, Plug & Jack Sets, Posts, Probes, Sockets, Spacers, Speaker Systems, Speakers, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Cal	Burlingame, Carelli-EMA	415-697-6286
Cal	Van Nuys, Markman Co.	213-787-6151
Fla	Fort Lauderdale, Sproch Sls.	305-587-3792
Ga	Atlanta, Hollingsworth & Still	404-394-3270
Ill	Hoffman Estates, G. Sangwin Co.	312-884-0186
Mass	Wellesley, L. Cole	617-237-1260
Mich	Milford, Polyphase Sls.	313-685-3003
Minn	Minneapolis, Heimann Co.	612-861-6051
NY	New York, Newhope Co.	212-532-7372
NY	Rochester, Marsey Sls.	716-442-9700
Ohio	Columbus, Mandabach & Assoc.	614-235-0265
Ore	Salem, Pacnor Mktg.	503-363-6445
Pa	Willow Grove, R. Lewis Sls.	215-659-0704
Tex	Dallas, Berthold Sls.	214-526-8329
Wash	Seattle, Pacnor Mktg.	206-284-8020
Wisc	Brookfield, G. Sangwin Co.	414-782-3240

NU-CONCEPT COMPUTER SYSTEMS, INC., Route 309 and Advance Lane, Colmar, Pa., 18915, Tel: 215-822-8400

For info on price: T. Dvorak; Application info: J. Moretz; Customer service: T. Dvorak; Delivery info: T. Dvorak

Free literature available: Dy-Nos-Stick Digital Test Probe Brochure - Specifications & description, Digital Diagnostics leaflet - Digital trouble-shooting requisites, PAK-X-TRAC brochure - Specifications & description

Products manufactured: Probes, Soldering Guns, Irons & Desoldering Tools

NU-METRICS, RD 1 Box 489, Vanderbilt, Pa., 15486, Tel: 412-628-0400; Empl.: 23

For info on price: R. T. Semsey; Application info: R. T. Semsey; Customer service: J. D. Bowman; Delivery info: J. D. Bowman

Products manufactured: Counters

NUCLEAR MEAS. CORP., 2460 N. Arlington Ave., Indianapolis, Ind., 46218, Tel: 317-546-2415, TWX: 810-341-3137; Empl.: 46; Minimum order: $10

For info on price: L. G. Vaughn; Application info: L. G. Vaughn; Customer service: M. Hansen; Delivery info: M. Hansen

Free literature available: Bulletin AM-4 Continuous Air Monitors - Nuclear Bulletin GA-2T0-Gamma Alarms-Nuclear Bulletin PC-4-Laboratory Counting System1-Nuclear

Products manufactured: Detectors, Scalers, Binary, Decade

Local Sales Offices & Reps.

Cal	Menlo Park, Robt. W. Healy Co.	415-828-6044
Colo	Denver, T. Buirley	303-841-2754
DC	Washington, Hildenbrand Co., Inc.	703-280-2330
Fla	Jacksonville, Pulcir, Inc.	904-743-5700
Ill	Chicago, Memeco, Inc.	312-774-0919
Mass	Marblehead, Nucleonic Div. M.M. Newman Corp.	617-631-7100
NY	Syosset, Scientific Sys. Sls. Corp.	516-921-3737
NC	Charlotte, MacGuire & Crawford, Inc.	704-366-3454
Pa	Pittsburgh, Scientific-Pittsburgh	412-655-2800
Tex	Houston, R. Martin Assocs.	713-462-4077
Wash	Bellevue, Showalter Elctrns.	206-455-4922

NUCLEAR RESCH. CORP., Street Rd. & 2nd St. Pike, Southampton, Pa., 18966, Tel: 215-357-5015; FSC No: 96696; Empl.: 25

For info on price: E. M. Pollock; Application info: A. J. Cassell; Customer service: A. J. Cassell; Delivery info: A. J. Cassell

Products manufactured: Amplifiers, Controls/Control Eqpt., Counters, Gages, Indicators, Meters, Scalers, Binary, Decade, Test Equipment, X-Ray Inspection Equipment

NUCLEONIC PRODS., Box 1454, 6660 Variel Ave., Canoga Pk., Cal., 91303, Tel: 213-887-1010, TWX: 910-494-1954; Empl.: 101; Minimum order: $35

For info on price: H. Nierenberg; Application info: H. Nierenberg; Customer service: A. Blakemore; Delivery info: A. Blakemore

Products manufactured: Capacitors, Fixed, Crystals, Diodes, Integrated Circuit Devices, Inverters, Magnets, Metals, Power Supplies, Rectifiers, Transistors

NUCLEUS CORP., 25131 Dequindre, Madison Hgts., Mich., 48071, Tel: 313-399-3610; Empl.: 37

For info on price: L. Zeleney; Application info: L. Zeleney; Customer service: L. Adami; Delivery info: L. Adami

Free literature available: Fifth wheel instrumentation; vehicle performance test electronics.

Products manufactured: Boards, Printed Circuit, Controls/Control Eqpt., Converters, Counters, Decoders, Dials, Display Devices/Displays, Indicators, Integrated Circuit Packaging Systems, Kits, Power Supply, Kits, Test Equipment, Machines/Machinery, Production, Meters, Packages, Integrated Circuit, Screens, Printed Circuit, Services, Assembly, Production & Test, Solder (All Types), Stands, Instruments, Test Systems

NUCOR CORP., Power Supply Div., 2 Richwood Pl., Denville, N.J., 07834, Tel: 201-627-4200, TWX: 710-987-8487; Empl.: 115

Products manufactured: Chamber, Environmental Test, Meters, Power Supplies

Local Sales Offices & Reps.

Cal	Long Beach, Cairns Engrg. Sls.	213-432-7444
Fla	Clearwater, Brennan Assocs.	305-466-5006
Ill	Chicago, Electro-Tech Mktg. Assoc.	312-588-4535
Iowa	Cedar Rapids, Palatine Sales	319-365-8071
Kans	Overland Park, Palatine Sls.	913-262-5643
Md	Timonium, DeShawn Assocs.	301-252-4878
Mass	Burlington, R.J. Sickles Assoc.	617-272-7285
Mich	Warren, DEM Elctrn. Sls.	313-755-6660
Mo	St. Louis, Palatine Sls.	314-426-7055
NY	Cortland, R.J.C. Associates	607-753-3909
NY	Huntington Station, Addem Group	516-567-5900
Okla	Tulsa, Vista Engrg.	918-627-7557
Tex	Richardson, Vista Engrg.	214-235-4547

NURAD, INC., 2165 Druid Pk. Dr., Baltimore, Md., 21211, Tel: 301-462-1700; Empl.: 40

Free literature available: "Airborne ECM Horn Antennas" A brochure on the use of airborne horn antennas for Electronic Warfare. Omni Directional Quad Polarized antenna system for remote TV broadcasts.

Products manufactured: Antenna Feed Systems, Antennas, Attenuators, CATV Systems & Equipment, Honeycomb Sheets, Panels, etc., Horns, Microwave, Mounts, Switches, Waveguides & Adapters

NUSONICS, INC., Box 248, Paramus, N.J., 07652, Tel: 201-265-2400; Empl.: 30

Products manufactured: Analyzers, Meters, Oceanographic Equip. (Electronic)

NVF CO., Box 68, Yorklyn, Del., 19736, Tel: 302-239-5281; Empl.: 1500

Products manufactured: Cases, Equipment, Instrument, Meter, Containers, Insulators & Insulation, Laminates, Services, Assembly, Production & Test, Tubing

NWL TRANSFORMERS, Nothelfer Winding Labs., Box 455, Trenton, N.J., 08603, Tel: 609-298-7300; Empl.: 100; Minimum order: $100 ..... p. 1•1325; p. 2•1325,1772

For info on price: R. Graham; Application info: D. Singh; Customer service: C. Zigrand; Delivery info: C. Wszolek

Free literature available: Our transformer reactor information booklet describes NWL deisgn and manufacture of custom electrical equipment. It is directed to those with special design requirements not met by standard "off the shelf" catalog units. The following information is available in this literature: transformer, reactor, power supply and application information.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Filters, Power Supplies, Reactors, Transformers

Local Sales Offices & Reps.

Mass	Randolph, Naton Assoc	617-986-6417
NY	Elmira Hgts., REECO	607-733-1387
Tex	Dallas, Titan Reps	214-357-8266

Directory of Local Distributors Starts on page 401

NYE, WILLIAM F., INC., P.O. Box G-927, New Bedford, Mass., 02742, Tel: 617-996-6721; Empl.: 10; Minimum order: $6

Customer service: G. B. Mock

Free literature available: Summary catalog on synthetic lubricants for wide temperatures, high lubricity, chemical resistance, oil creep control, motion damping, plastic and elastomer compatibility and electric contacts.

Products manufactured: Lubricants

NYTRONICS COMPS. GROUP INC., Sub Nytronics, Orange St., Darlington, S.C., 29532, Tel: 803-393-5421; FSC No: 83125; Empl.: 500; Minimum order: $50 p. 2•212-229,400-421,1504-1507

For info on price: M. W. Windham Ext. 320; Application info: W. Early Ext. 325; Customer service: M. Parnell Ext. 217; Delivery info: M. Parnell Ext. 217

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Delay Lines, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Inc.	205-539-4411
Ariz	Phoenix, Clemick & Neenan & Assocs.	602-279-7649
Cal	Los Altos, W.W. Posey	415-948-7771
Cal	Los Angeles, Clemick & Neenan & Assoc.	213-476-1272
Colo	Denver, P. Webster	303-770-1972
Fla	Fort Lauderdale, W.A. Brown Comp. Inc.	305-776-4800
Fla	Orlando, W.A. Brown Comp. Inc.	305-425-5505
Ga	Atlanta, W.A. Brown Comp. Inc.	404-457-4069
Ill	Chicago, Balhorn & Welch Inc.	312-889-5011
Ind	Indianapolis, Southern Sls. Corp.	317-257-7575
Md	Bethesda, Warren Mount Comp.	301-657-9312
Mass	Bedford, F.R. Lesser	617-275-7558
Mich	Ann Arbor, H.C. Heym Assoc.	313-971-6552
Mich	Saginaw, H.C. Neym Assoc.	517-799-0873
Minn	Edina, Wagner Conslts.	612-941-6310
NY	Fairport, W.A. Franklin Sls. Corp.	716-377-6584
NY	Syracuse, W.A. Franklin Sls. Corp.	315-472-5273
NY	Valley Cottage, LRC Assocs.	914-634-7973
NY	Whitesboro, W.A. Franklin Sls. Corp.	315-736-5460
NC	Gastonia, W.A. Brown Comp. Inc.	704-867-2101
NC	Winston Salem, W.A. Brown Comp. Inc.	919-725-5384
Ohio	Cleveland, Imtech Inc.	216-826-3400
Ohio	Dayton, Imtech Inc.	
Okla	Tulsa, Palatine Sls., Inc.	918-622-0321
Pa	Narbeth, J. Bresson Assoc.	215-839-6770
Pa	Pittsburgh, Imtech, Inc.	
Tex	Austin, Palatine Sls., Inc.	512-451-7463
Tex	Houston, Palatine Sls., Inc.	713-777-4477
Tex	Richardson, Palatine Sls., Inc.	214-231-9489
Utah	Salt Lake City, P. Webster	
Wash	Seattle, Seatronics, Inc.	206-767-4330

Local Distributors

Ala	Huntsville, Cramer Elect., 2310 Bob Wallace Ave. S.W.	205-539-5722
Cal	Carson, Hi Rel, 20507 S. Belshaw Ave.	213-537-6500
Cal	Sunnyvale, Bell Industries, Box 8050	408-734-8570
Colo	Denver, Newark Elec., 2170 S. Grape St.	303-757-3351
DC	Beltsville, Newark Elec., 10440 Baltimore	301-937-5085
Fla	Ft. Lauderdale, Newark Elect., 1360 N.W. 65th Ave.	305-587-2372
Ga	Atlanta, Cramer Elect., 3923 Oak Cliff	404-448-9050
Ill	Chicago, Newark Elect., 500 N. Pulaski Rd.	312-638-4411
Ind	Ft. Wayne, Ft. Wayne Elect., 3606 E. Maumee	219-742-4346
Iowa	Cedar Rapids, Newark Elect., 1019 First Ave. S.W.	312-362-1171
Md	Baltimore, Radio Elect., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Newton, Cramer Elect., 85 Wells Ave.	617-969-7700
Minn	Minneapolis, Newark Elect., 2028 E. 46th St.	216-361-4700
NJ	Kenilworth, Newark Elect., 303 Monroe Ave.	201-272-8410
NJ	Rahway, Terminal Elect., 1463 Pinewood St.	201-381-5700
NY	Hauppauge, Jaco Elect., 195 Engineers Rd.	516-273-5981
NY	Plainview, ACI Elect., 28 South Mall St.	516-293-6630
NC	Winston Salem, Cramer Elect., 938 Burke St.	919-725-8711
Ohio	Cleveland, Newark Elect., 2028 E. 46th St.	216-361-4700
Pa	Philadelphia, Philadelphia, 1225 Vine St.	215-568-8288
Tex	Dallas, Wholesale Elect., Ross at Central	214-824-3001
Utah	Salt Lake City, Newark Elect., 2540 S. 300 W.	801-486-1048
Wash	Bellevue, Bell Industries, 12410 S.E. 32nd St.	206-747-1515
Wisc	Brookfield, Newark Elect., 3695 No. 126th St.	414-781-2450

OAK INDS. INC., Switch Div., Dept. EL, Crystal Lake, Ill., 60014, Tel: 815-459-5000, TWX: 910-634-3353; FSC No: 76854; QPL No: 3786; Empl.: 2000; Minimum order: $100

Customer service: Mktg. Dept.

Products manufactured: Controls/Control Eqpt., Relays, Solenoids, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-kahn	602-258-7893
Cal	Inglewood, J. Kent	213-678-4108
Cal	Los Altos, D. Jacoby	415-941-1237
Colo	Denver, I.W. Strong	303-292-6900
Fla	Orlando, Dan Green	305-671-4111
Haw	Honolulu, Pegart Int'l. Hawaii	808-839-6574
Ill	Crystal Lake, Oak Inds. Inc.	815-459-5000
La	Metairie, J. McKinney Sls.	504-887-1723
Mass	Reading, R. Kolarik	617-944-0094
Mich	St. Joseph, J. Carlson	616-983-3032
Minn	Edina, Wagner Consits. Corp.	612-941-6310
Mo	Raytown, Centech Corp.	816-358-8100
NJ	Haddonfield, Gray Assocs.	609-429-5300
NJ	Mountainside, H. Richter	201-233-4615
NJ	Nutley, Falk-Baker Assoc.	201-661-2430
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
NY	Fayetteville, H. G. Richter, Inc.	315-637-6713
NY	New York, H. G. Richter, Inc.	212-962-5820
NC	Raleigh, R. Burns	919-876-7591
Ohio	Cincinnati, C. Preston	513-851-4411
Okla	Tulsa, J.F. McKinney Sls. Co.	918-742-6791
Ore	Portland, B. Bartos	503-292-0878
Tex	Dallas, J. McKinney Sls.	214-631-9450
Tex	Houston, J.F. McKinney Sls. Co.	713-774-3232
EXP:	Ill., Crystal Lake, Oak Industries Inc.	815-459-5000
FOR:	Can., Aurora, Ont., Harper-Oak, Ltd.	416-727-3191

Local Distributors

Ala	Huntsville, Hall Mark Elctrns., 4739 Commercial Dr.	205-837-8700
Ariz	Phoenix, Parts Elect. of Ariz., 1310 N. 7th St.	602-258-6476
Ariz	Tempe, G.S. Marshall Co., 835 W. 22nd St.	602-968-6181
Cal	El Monte, G.S. Marshall Co., 9674 Telstar Ave.	213-686-1500
Cal	Irvine, G.S. Marshall Co., 17975 Sky Park Blvd.	714-556-6400
Cal	San Diego, G.S. Marshall Co., 8057 Raytheon Rd.	714-278-6350
Cal	Sunnyvale, G.S. Marshall Co., 788 Palomar Ave.	408-732-1100
Colo	Arvada, G.S. Marshall Co., 5633 Kendall Ct.	303-423-9670
Conn	No. Branford, G.S. Marshall Co., 200 Shaw Rd.	203-484-0480
Fla	Ft. Lauderdale, Hall Mark Elctrns., 1302 W. McNab	305-971-9280
Fla	Orlando, Hall Mark Elctrns., 7233 Lake Ellenor Dr.	305-855-4020
Fla	Palm Beach Gardens, G.S. Marshall Co., 10384 Riverside Dr.	305-622-8490
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Des Plaines, Edmar Elctrns., 1275 Rand Rd.	312-298-8580
Ill	Des Plaines, G.S. Marshall Co., 300 E. Touhy Ave.	312-298-3700
Ill	Elk Grove Village, Hall Mark Elctrns., 180 Crossen Ave.	312-437-8800
Ill	Peoria, Klaus Radio, 8400 N. Pioneer Pkwy.	309-691-4840
ILL	Palatine, Ohm/Elctrns., 649 Vermont Ave.	312-359-5500
Ind	Indianapolis, Graham Elctrns., 133 S. Pa.	317-634-8486
Kans	Lenexa, Hall Mark Elctrns., 9006 Rosehill Rd.	913-888-4747
Md	Baltimore, Hall Mark Elctrns., 6660 Security Blvd.	301-265-8500
Md	Hyattsville, Milgray/Washington, 5405 Lafayette Pl.	301-864-1111
Mass	N. Wilbraham, Industrial Comps., 2551 Boston Rd.	413-596-3854
Mass	Newton Highland, G.S. Marshall Co., 88 Needham St.	617-965-5115
Mass	Watertown, DRW Elctrns., 600 Pleasant St.	617-923-1900
Minn	Bloomington, Hall Mark Elctrns., 9201 Penn Ave. S., Ste. 10	612-884-9056
Minn	Minneapolis, Industrial Comps., 5280 W. 74th St.	612-831-2666
Mo	Earth City, Hall Mark Elctrns., 13789 Rider Trail	314-291-5350
NJ	Springfield, Federated Purchaser, 155 U.S. Rte. 22	201-376-8900
NY	Binghamton, Harvey/Federal Elctrns., Box 1208 Vestal Pkwy.	607-748-8211
NY	Farmingdale, DRW Elctrns., 100 Milbar Blvd.	516-249-2660
NY	Farmingdale, G.S. Marshall Co., 230 Sherwood Ave.	516-293-4141
NY	Farmingdale, Hall Mark Elctrns., 167 Marine St.	516-293-7500
NC	Raleigh, Hall Mark Elctrns., 3000 Industrial Dr.	919-832-4465
Ohio	Dayton, G.S. Marshall Co., 6388 N. Dixie Dr.	513-898-1105
Ohio	Medina, DRW Elctrns., 7409 Spencer Lake Rd.	216-225-0020
Okla	Tulsa, Hall Mark Elctrns., 4846 S. 83rd East Ave.	918-835-8458
Okla	Tulsa, S & S Radio Suppply, 537 S. Kenosha	918-582-8242
Pa	Huntingdon Valley, Hall Mark Elctrns., 458 Pike Rd.	215-355-7300
Pa	Philadelphia, Herbach & Rademan, 401 E. Erie Ave.	215-426-1700
Tex	Austin, Hall Mark Elctrns., 3100-A Industrial Terr.	512-837-2814
Tex	Dallas, G.S. Marshall Co., 14205 Proton	214-233-5200
Tex	Dallas, Hall Mark Elctrns., 9333 Forest La.	214-231-6111
Tex	Dallas, Solid State Elect. Co. of Tex., 2643 Manana	214-352-2601
Tex	Houston, Hall Mark Elctrns., 8000 Westglen	713-781-6100
Tex	Houston, Solid State Elect. Co. of Tex., 6400 Westpark Dr., Ste. 295	713-785-5205
Tex.	El Paso, Hall Mark Elctrns., 2211 E. Missouri St.	915-545-1763
Wash	Bellevue, G.S. Marshall Co., 1801 130th Ave., N.E.	206-883-1084
Wash	Seattle, Radar Electric Co., 168 Western Ave., W.	206-282-2511
Wisc	Milwaukee, Hall Mark Elctrns., 11925 W. Ripley Ave.	414-476-1270

OAKTRON INDS., INC., Monroe, Wisconsin, 53566, Tel: 608-325-2121; Empl.: 250 p. 1•26,27

For info on price: J. Disch; Application info: J. Disch; Customer service: J. Disch; Delivery info: M. West

Free literature available: C-75 Home & Industry Catalog; A-75 Automotive Catalog Sound Engineering Data Sheets

Products manufactured: Alarms, Baffles, Speaker, Controls, Fader, Drivers, Speaker, Grilles, Speaker Systems, Speakers, Transducers, Transformers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Ariz	Phoenix, R. Fissell Co.	602-264-4031
Cal	Los Altos, Ewing-Foley, Inc.	415-941-4525
Cal	No. Hollywood, J. Carter Assoc.	213-980-3450
Colo	Arvada, C B Elctrn. Mktg.	303-422-0561
DC	Washington, Lienau Assoc.	301-770-6800
Fla	No. Miami, Winfield Elect. Sls.	305-945-6544
Fla	Tampa, Winfield Elect. Sales	813-884-6500
Ga	Atlanta, Millar Elect.	404-261-6160
Ill	Chicago, Markal Sls.	312-282-5800
Ind	Indianpolis, Shamrock Elect.	317-547-0080
Md	Rockville, Lienau Assoc.	301-770-6800
Mass	Braintree, Rudolph & MacInnis	617-843-0908
Mass	Norwood, Rudolph & MacInnes	617-769-5450
Mich	Ferndale, Shalco Inc.	313-547-4771
Minn	St. Paul, Carl-M Co.	612-699-8004
Mo	Kansas City, Nevco, Inc.	816-421-1751
Mo	St. Louis, Nevco, Inc.	314-843-7406
NY	Rochester, J. Brown Elect. Sls.	716-266-2728
NY	Yonkers, J. Brown Elect. Sls.	914-779-7330
NC	Raleigh, Millar Elect.	919-787-9564
Ohio	Akron, Shamrock Elect.	216-666-3796
Ohio	Dayton, Shamrock Elect.	513-298-3052
Ore	Salem, Pacnor Mktg.	503-363-6445
Pa	Philadelphia, Lienau Assoc.	215-464-9444
Pa	Pittsburgh, Tanner Co.	412-561-4687
Tenn	Memphis, Al. Engleman Co.	901-458-6263
Tex	Irving, Antle Smith Sls.	214-259-8707
Wash	Seattle, Pacnor Mktg.	206-284-8020
EXP:	Chicago, Ill., E.D. Magnus Assoc.	312-334-1503

OAL ASSOCS., INC., Box 788, Westbury, N.Y., 11590, Tel: 516-334-1940; Empl.: 10

Customer service: O. Lohkemper

Free literature available: Bulletin 1R-100D - Infra Red Radiation Heating

Products manufactured: Chamber, Environmental Test, Controls/Control Eqpt., Furnaces, Heaters & Heating Elements, Lamps, Lights, Soldering Equipment

Local Sales Offices & Reps.

Cal	Northridge, Pat Dooley Co.	213-360-2231
Fla	Winter Haven, S & S Sls. Reps.	813-293-7304
Ill	Palatine, Jos. Clark Co.	312-358-5095
Mass	Chelmsford, Equipment Sls. Co.	617-256-8547
Mich	Southfield, S.L. Sellers & Assocs.	313-444-1070

M. P. ODELL CO., 26612 Center Ridge Rd., Cleveland, Ohio, 44145, Tel: 216-871-8000; Empl.: 7; Minimum order: $5

For info on price: N. Odell; Application info: M. P. Odell; Customer service: M. S. Harmon; Delivery info: N. Odell

Products manufactured: Cleaners & Solvents, Machines/Machinery, Production, Ovens

OGALLALA ELCTRNS., Div. Arnold Engrg. Co., Box 59, Ogallala, Neb., 69153, Tel: 308-284-4093; Empl.: 30; Minimum order: $25

Customer service: H. L. Harrington

Free literature available: "Electromagnet Brochure" A 12 page illustrated "Quick Facts" booklet looks at special purpose electromagnets, permanent-magnet assemblies and related magnetic products for high precision applications.

Products manufactured: Coils Including Assemblies & Forms, Magnets

Local Sales Offices & Reps.

Mass	Belmont, Electronic Comps. & Srvcs.	617-484-8680

OHIO CARBON CO., 12508 Berea Rd., Cleveland, Ohio, 44111, Tel: 216-252-6100; FSC No: 76868; Minimum order: $250

For info on price: D. Marquard; Application info: J. Kupets; Customer service: D. Marquard; Delivery info: D. Marquard

Free literature available: Brush Grade Selector Form 1250, Karak Brochure carbon-graphite applications, material specifications.

Products manufactured: Bearings, Brushes & Brush Assemblies, Bushings, Glass, Plastic, Metal; Rubber, Etc., Contacts, Electrical, Graphite Parts, Materials, Graphite, Materials, Self-Lubricating, Resistors

Local Sales Offices & Reps.

Cal	Los Angeles, Marwood Ltd.	213-628-3241
Cal	San Francisco, Marwood Ltd.	415-431-7893
Ga	Atlanta, W. Gilbert	404-255-8152
Ill	Arlington Hgts., Eschner & Keranen	312-259-8184
Ill	Chicago, M. Smith	312-787-3371
Kans	Shawnee Mission, K&M Sls.	913-262-1444
Mass	Sharon, Adcour Engrg. Reps.	617-784-3996
Mich	Bay City, Allsopp Assoc.	517-684-6120
Mo	St. Louis, K&M Sls.	314-423-2420
NJ	Andover, W. Proshek	201-347-6205
Ohio	Cleveland, Greenleaf Assoc.	216-333-5480
Ore	Portland, Marwood Ltd.	503-223-5130
Pa	Sewickley, R. Clark	412-923-1980
Wash	Seattle, Marwood Ltd.	206-623-4747

OHIO SEMITRONICS, INC., 1205 Chesapeake Ave., Columbus, Ohio, 43212, Tel: 614-486-9561; FSC No: 12066; Empl.: 30 .... p. 1•782,783,1848,1849,2344-2346

For info on price: A. Leatherman; Application info: A. Leatherman; Customer service: J. Gillard

Free literature available: HE7-2A, Halltron Hall Effect Probes; CT4-1, Current Transducers DC to KHz; HE-7-4, Wideband Current XDCRS AC to MHz; HE-7-6, Watt Transducers; HE-7-10, Watt Meter; WH74-1, Watt Hour Meter; HE7-3A, Hall Multipliers; ME8-2, Magnetic Antenna.

Products manufactured: Controls/Control Eqpt., Cooling/Heating Modules, Thermoelectric, Crystals, Current Sensors, Detectors, Generators, Integrators, Electronic, Meters, Monitors, Multipliers, Probes, Signal Conditioners & Equipment, Transducers

OHMITE MFG. CO., 3601 W. Howard St., Skokie, Ill., 60076, Tel: 312-675-2600, TWX: 910-223-0805 p. 1•1799,2266; p. 2•1508-1515,1673-1675,1777

Products manufactured: Attenuators, Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Decade Boxes, Dividers, Dummy Loads, Potentiometers, Regulators, Relays, Resistors, Rheostats, Switches, Timers, Transformers

Local Sales Offices & Reps.

Alas	Anchorage, H.J. Lang & Assocs.	907-279-5741
Ariz	Phoenix, Darci Sales	602-948-2240
Cal	Garden Grove, Impact Elctrns., Inc.	213-431-3581
Cal	Palo Alto, Ohmite Mfg. Co.	415-494-6953
Colo	Denver, I.W. Strong & Assocs.	303-292-6900
Conn	Waterbury, Coakley, Boyd & Abbett, Inc.	203-756-8766
Fla	Orlando, Cartwright & Bean	305-896-2031
Iowa	W. Des Moines, T.L. Dowell & Assocs.	515-225-1620
Kans	Kansas City, T.L. Dowell & Assocs.	913-649-6069
La	Chalmette, Cartwright & Bean	504-279-4598
Mass	Needham, Coakley, Boyd & Abbett, Inc.	617-444-5470
Mich	Birmingham, Ohmite Mfg. Co.	313-642-6040
Minn	St. Paul, Cahill Assocs.	612-646-7217
Mo	St. Louis, T.L. Dowell & Assocs.	314-647-7067
NJ	Pennsauken, Ohmite Mfg. Co.	609-663-1703
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	Great Neck, L.I., Cooper-Simon & Co.	516-487-1142
NC	Charlotte, Polytec Svs.	704-332-6191
Ohio	Birmingham, Ohmite Mfg. Co.	216-261-6000
Ohio	Dayton, Ohmite Mfg. Co.	513-277-6543
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, Erickson & Vilter Sls.	214-243-6611
Wash	Western Tech. Sls., Western Tech. Sls.	206-641-3900
EXP:	Canada, Ontario, A.C. Simmonds & Sons Ltd.	416-491-1010

O. K. MACHINE & TOOL CORP., 3455 Conner St., Bronx, N.Y., 10475, Tel: 212-994-6600, Telex: 12-5091; Empl.: 100; Minimum order: $25

For info on price: J. Camen; Application info: J. Camen; Customer service: J. Camen; Delivery info: G. Polanco

Free literature available: Catalog 36A includes technology of wire-wrapping, tool specifications, terminal spacing charts, illustrations and charts for bits and sleeves. Aimed at telecommunications and electronics fields.

Products manufactured: Connectors, Cutters, Wire, Hand Operated, Machines/Machinery, Production, Pliers, Soldering Guns, Irons & Desoldering Tools, Terminals, Tools, Wire Strippers

OKONITE CO., Box 340, Ramsey, N.J., 07446, Tel: 201-825-0300; Empl.: 1800

For info on price: H. A. Penhale; Application info: J. R. Hogan; Customer service: H. N. Bush; Delivery info: H. N. Bush

Products manufactured: Cable, Tapes, Electrical Insulation, Tubing, Wire

Local Sales Offices & Reps.

Ala	Birmingham	205-592-8968
Cal	Los Angeles	213-685-7610
Cal	S. San Francisco	415-589-2362
Colo	Denver	303-759-2776/7
Fla	Jacksonville	904-721-2800
GA	Smyrna	404-434-3388
Ill	LaGrange	312-352-7200
La	New Orleans	504-944-0259
Mass	Hingham	617-749-3374/5
Mich	Royal Oak	313-588-3525
Minn	Minneapolis	612-888-7925
Mo	Frontenac	314-997-2320
Mo	Kansas City	816-471-6991
NJ	Cherry Hill	215-567-5739
NY	Syracuse	315-479-8313
NC	Charlotte	704-535-6535
Ohio	Cincinnati	513-761-1333
Ohio	Cleveland	216-661-2550
Okla	Tulsa	918-743-2543
Ore	Portland	503-228-3172
Pa	Pittsburgh	412-344-8181
Tex	Dallas	214-243-3318
Tex	Houston	713-691-3716
Utah	Salt Lake City	801-484-7642
Va	Vienna	703-938-4770
Wisc	Milwaukee	414-476-4550

OLYMPUS CORP. AMERICA, Two Nevada Dr., New Hyde Park, N.Y., 11040, Tel: 516-488-3880; Empl.: 120

For info on price: J. Jurek; Application info: W. J. Seidl; Customer service: R. Kester; Delivery info: R. Kester

Products manufactured: Fiber Optic Bundles, Lenses, Optical & Camera, Microscopes

OMEGA ENGRG., INC., Box 4047, Stamford, Conn., 06907, Tel: 203-359-1660; Empl.: 75; Minimum order: $10 .... p. 1•2324-2327

For info on price: M. Cardillo; Application info: D. Babbitt; Customer service: S. Bartosik; Delivery info: M. Cardillo

Free literature available: 1975 Omega Temperature Measurement Handbook, Bulletin A 674 - Color Coded Thermocouple Connectors & Jack Panels, Bulletin C 765 - Thermocouple Readout Meters, Bulletin 474 - Melting Point Standards

Products manufactured: Amplifiers, Bolometers, Bridges, Connectors, Controls/Control Eqpt., Crayons, Coatings, Pellets, etc., Temperature Indicating, Current Sensors, Detectors, Indicators, Labels, Temperature Indicating, Meters, Mounts, Panels, Potentiometers, Probes, Pyrometers, Switches, Thermistors, Thermocouples, Elements & Accessories, Thermometers, Resistance, Transducers, Tubing, Wire

OMNETICS
INCORPORATED

OMNETICS, INC., Box 113, Syracuse, N.Y., 13211, Tel: 315-699-5262; FSC No: 52516; Empl.: 65; Minimum order: $25

Customer service: J. F. Cleary

Free literature available: Specification sheets on all products. Price lists on all products. Complete binder catalog upon request. Short form catalog mailer. Application notes.

Products manufactured: Controls/Control Eqpt., Timers

Local Sales Offices & Reps.

Ark	Fort Smith, Electro-Related Products	501-646-7756
Cal	La Habra, Nolan Assocs.	213-694-2145
Cal	Oakland, Powermatics	415-635-6826
Colo	Denver, TESSCO	303-744-1119
Conn	Trumbill, SIR Assocs.	203-268-2560
Fla	North Miami, L. Haas Co.	305-949-9143
Ill	Des Plaines, Control Sls.	312-774-1674
Kans	Shawnee Mission, Technical Sls. Assocs.	913-888-3330
La	Metairie, Electro Related Products	504-888-2908
Mass	Lexington, SIR Assocs.	617-862-1812
Mich	Troy, Control Sls. Assocs.	313-391-3236
Mo	St. Louis, Technical Sls. Assocs.	314-725-5361
NJ	Pitman, Colrud Co.	609-589-5866
NJ	Ridgewood, BAllou	212-964-4640
NM	Albuquerque, TESSCO	505-298-2415
NY	Skaneatles, MCK Assocs.	315-685-7122
NY	Syracuse, Omnetics, Inc.	315-699-5262
NC	Charlotte, W. E. MacDonald Co.	704-372-7012
Ohio	Cleveland, E. E. Bock & Assocs.	216-331-5212
Ohio	Dayton, W. Hammer & Assocs.	513-294-4531
Ore	Beaverton, D. Fry Co.	504-643-5448
Pa	Erie, ECCO Elctrn. Sls.	814-455-8110
Tex	Houston, M. R. Summers Assocs.	713-524-7800
Va	Richmond, Marchant-Field Sls. Co.	804-262-7333
Va	Vienna, W. E. MacDonald Co.	703-938-4242
Wash	Seattle, D. Fry Co.	503-643-2391
WVa	Charleston, W. E. MacDonald Co.	304-342-8557
Wisc	Cedarburg, TFL Assocs.	414-377-7030

Local Distributors

Ark	Crossett, Lanius Elctrns., 118 Main St.	501-364-3015
Ark	Ft. Smith, Wise Whsl. Elec., 1001 Towson Ave.	501-783-8925
Cal	El Segundo, Alpha Components Corp., 115 Eucalyptus Dr.	213-322-7780
Cal	Redwood City, Electrical Sls. Prod., 465 Convention Way	415-364-2621
Colo	Denver, TESSCO, 1340 S. Sherman	303-744-1119
Fla	Miami, Electro-Standards Labs, 3560 NW 34th St.	305-633-6975
Fla	Tampa, Leader Elec. Dist., 3411 S. Dale Mabry	813-835-1891
Ill	Chicago, Fluid-Tek, 6348 S. Central	312-582-2872
Ill	Franklin Park, Lumenite Elec. Co., 2331 N. 17th Ave.	312-455-1450

Directory of Local Distributors Starts on page 401

Mass	Cambridge, H. Young Jr., 45 Landsdowne St.	617-547-3873
Mass	West Springfield, Control Eng'g Inc., 1702 Riverdale St.	413-739-5134
NJ	Fairlawn, Relay Specialties, 1300 Plaza Rd.	201-797-3313
NY	Rochester, K.M.V.G., 315 Mt. Read Blvd.	716-328-2800
NY	Rochester, Simcona Elec. Corp., 275 Mt. Read Blvd.	716-328-3230
NY	Woodside, Switches Unlimited, 49-11 43rd Ave.	212-651-0945
Ohio	Columbus, Columbus Elec. Works, 767-783 N. 4th St.	614-294-4651
Ohio	Dayton, Duellman Elec., 131 Wayne Ave.	513-461-5010
Ore	Portland, Platt Elec. Supply, 1305 NW Davis	503-228-6121
Pa	Braddock, M. Leff Radio Parts, 225 Braddock Ave.	412-271-2800
Pa	Erie, Erie Corporate Cont., 1938 Buffalo Rd.	814-455-8110
Wash	Seattle, Radar Elec. Co., 168 Western Ave. W.	206-282-2511
Wisc	Mequon, Taylor Elec. Co., 1000 W. Donges Bay Rd.	414-241-4321

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OMNI SPECTRA, 24600 Hallwood Ct., Farmington, Mich., 48024, Tel: 312-477-1234; Empl.: 250
p. 2•724,725

Products manufactured: Attenuators, Connector Adapters, Connectors, Couplers, Detectors, Dividers, Integrated Circuit Packaging Systems, Line Strechers, Microwave, Microwave Integrated Circuits (MIC's), Sockets, Tees, Tools, Tuners

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-536-5306
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Culver City, DeAngelo, Rothman & Co.	213-398-6239
Cal	Los Altos, Cain-White & Co.	415-948-6533
Cal	San Carlos, LoDan, Inc.	415-592-4600
Colo	Denver, Zeus, Inc.	303-770-4400
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, Gassner & Clark Co.	312-345-4245
Iowa	Hiawatha, Gassner & Clark Co.	319-393-5763
Md	Randallstown, C.L. Malinow & Co., Inc.	301-922-2092
Mass	Brockton, Forsberg sls.	617-522-6300
Minn	Minneapolis, C.E. Bohlig Co.	612-922-7011
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Bayside, R. Diamond Inc.	212-423-7330
NY	Fayetteville, Graydon-Sherman, Inc.	315-637-9861
NC	Burlington, Gentry Assocs.	919-227-3630
Ohio	Cincinnati, Comps., Inc.	513-721-2997
Ohio	Cleveland, Comps., Inc.	216-842-2737
Pa	Media, Snyder & Massey Assocs.	215-566-5400
Tex	Dallas, Texas Microwave	214-231-5381
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Wash	Seattle, H. Levinson Co.	206-323-5100

OMNI-SPECTRA, Arizona Div., 1040 W. Alameda Dr., Tempe, Ariz., 85282, Tel: 602-966-1471, TWX: 910-950-1296; Empl.: 165

Customer service: F. S. Parin

Free literature available: Voltage controlled and mechanically tuned oscillators for ECM, radar and communication applications. Low noise, broad band and minimum post tuning drift characterize voltage controlled oscillators.

Products manufactured: Alarms, Detectors, Oscillators

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Cal	Van Nuys, C.W. Swift & Assocs.	213-989-1133
Md	Randallstown, C.L. Malinow & Co.	301-922-2092
Mass	Medford, Blake Assocs., Inc.	617-391-7890
NY	Fayetteville, Graydon-Sherman, Inc.	315-637-9861
Tex	Dallas, Texas Microwave Elctrn.	214-358-1172

OMNITEC CORPORATION, 2405 S. 20th St., Phoenix, Ariz., 85034, Tel: 602-258-8246, TWX: 910-951-4247; FSC No: 09736; Empl.: 50

For info on price: F. Willes; Application info: F. Willes; Customer service: J. Ingram; Delivery info: J. Ingram

Products manufactured: Couplers, Modulator/Demodulators, Printers, Telephone Channel Test & Simulator Equipment, Teletypewriters & Equipment, Terminal Equipment, Digital

Local Sales Offices & Reps.

Ala	Huntsville, W. A. Brown Instr.	205-539-4411
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Sherman Oaks, Elctrn. Mktg. Spec.	213-990-4244
Cal	Sunnyvale, Elctrn. Mktg. Spec.	408-245-9291
Colo	Denver, BFA Corp.	303-744-3301
Conn	Hamden, J & J Assocs.	617-272-2606
Fla	Ft. Lauderdale, W. A. Brown Instr.	305-776-4800
Fla	Indialantic, W. A. Brown Instr.	305-723-0766
Fla	Orlando, W. A. Brown Instr.	305-425-5505
Ga	Atlanta, W. A. Brown Instr.	404-939-1674
Ill	Des Plaines, Lincoln, Hodges & Assoc.	312-297-3810
La	Gretna, W. A. Brown Instr.	504-366-5766
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Burlington, J & J Assocs.	617-272-2606
NJ	Ft. Lee, Tech. Mktg. Assoc.	201-224-6911
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	E. Syracuse, Ossmann Instrs.	315-437-6666
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
NY	Wappingers Falls, Ossmann Instrs.	914-297-7777
NC	Durham, W. A. Brown Instr.	919-489-1546
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Pa	King of Prussia, S & S Assocs.	215-265-3450
Tenn	Knoxville, W. A. Brown Instr.	615-584-2614
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Utah	Salt Lake City, BFA Corp.	801-466-6522
Wisc	Waukesa, Lincoln, Hodges & Assoc.	414-542-3087

OMTRONICS MFTG., INC., 2406 Leavenworth, Omaha, Neb., 68105, Tel: 402-348-9500, TWX: 910-622-8220; Empl.: 125; Minimum order: $10
p. 2•1516-1525

For info on price: B. Matejka; Application info: J. Matejka, Sr.; Delivery info: B. Matejka

Products manufactured: Resistors

Local Sales Offices & Reps.

Ariz	Phoenix, Dorton Entprs., Inc.	602-263-0414
Cal	Redwood City, Woodworth Co.	415-365-0252
Cal	Santa Ana, RMS Assocs.	714-556-4155
Colo	Arvada, Arrowhead Sls.	303-423-5556
Ill	LaGrange Park, Bierhaus Sls.	312-354-5100
Iowa	Cedar Rapids, J. Vrbik Co.	319-377-8244
Kans	Overland Park, Penzner Assocs.	913-381-0004
Kans	Wichita, Penzner-Mankus Assocs.	316-264-2662
Md	Towson, Habco Elctrns., Inc.	301-825-9637
Mass	Canton, New England Elctrn. Sls.	617-828-4835
Minn	Minneapolis, Hasse & Assocs.	612-535-2671
Mo	Hazelwood, J.C. Mankus Assocs.	314-731-4334
NJ	Kenilworth, Ventronics, Inc.	201-272-9262
NY	Rochester, L.G. Marchese Assocs.	716-544-4300
Ohio	Cincinnati, Comps., Inc.	513-863-0526
Ohio	Cleveland, Comps., Inc.	216-842-2737
Tex	Forth Worth, W. Pat Fralia Co.	817-738-2394
Utah	Salt Lake City, Arrowhead Sls.	801-485-3362
Wash	Seattle, Carlyle Tech. Sls.	206-622-4288
EXP:	Stamford, Ct., Dage Corp.	203-324-3123

Local Distributors

Ala	Birmingham, ACK Radio Supply, 3101 4th Ave. So.	205-322-0588
Ariz	Phoenix, Mirco Elctrnc., 2005 W. Peoria Ave.	602-944-2281
Cal	Chatsworth, Westates Elctrns., 20151 Bahama St.	213-341-4411
Cal	Costa Mesa, Comps. Center, 1240 Logan Ave.	714-979-0433
Colo	Denver, Elctrn. Parts, 1212 So. Bdwy.	303-744-1992
Fla	Miami, Elctrn. Equip., 2201 N.W. 42nd Ave.	305-871-3500
Ill	Rosemont, Advent Elctrns., 7110 No. Lyndon	312-297-6200
Mass	Newton, Greene-Shaw Co., 70 Bridge St.	617-969-8900
Mo	St. Louis, L/Comp St. Louis, 2605 So. Hanley Rd.	314-647-5505
Neb	Omaha, Radio Equip., 625 No. 18th St.	402-341-7700
NY	Farmingdale, Arrow Elctrns., 900 Broadhollow Rd.	516-694-6800
Ohio	Cleveland, Hamilton Avnet, 26111 Brush Ave.	216-289-0550
Okla	Tulsa, Hall Mark Elctrns., 4846 So. 83 Ave. E.	918-835-8458
Pa	Huntingdon Valley, Hall Mark Elctrns., 458 Pike Rd.	215-355-7300
SC	Greenville, Hammond Elctrns., 100 Augusta St.	803-233-4121
Tex	Houston, Hall Mark Elctrns., 8000 Westglen	713-781-6100
Wash	Seattle, R. E. Priebe Co., 2211 Fifth Ave.	206-682-8242

ON-GUARD CORP. OF AMERICA, 350 Gotham Pkwy., Carlstadt, NJ, 07072, Tel: 201-939-5822, TWX: 710-989-0282; Minimum order: $50

Free literature available: Catalog #972-Alarms and Accessories Catalog #727-Home Security Systems and back up Catalog Sheet #2016-alarms & forged wheel locks Catalog Sheet #2017-Smoke & heat detectors Catalog Sheet #2018-splash guards

Products manufactured: Alarms, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Switches, Thermostats, Wire

Local Sales Offices & Reps.

Ala	Birmingham, Morris F. Taylor Co.	205-853-3181
Cal	Emeryville, Assoc. Rep. Warehouse C.	415-653-3838
Cal	Van Nuys, Art Szerlip Sls.	213-782-1765
Colo	Englewood, ESP Co.	303-781-4409
Fla	Miami, Seaman Sls. Inc.	305-271-5728
Ga	Decatur, Morris F. Taylor Co.	404-243-8591
Ill	Chicago, D. Dolinn Sls. Co.	312-286-6200
Iowa	Des Moines, B.E.A.M.S.	515-282-0292
Kans	Shawnee, B.E.A.M.S.	913-341-7744
Md	Silver Spring, Morris F. Taylor Co.	301-589-4002
MD	Silver Spring, Morris F. Taylor Co.	301-946-3569
Mass	Northboro, W. B. Pray Sls.	617-393-3434
Mich	Ferndale, Irving J. Flanders Assoc.	313-545-4633
Minn	St. Louis Park, Smith Sls. Co.	612-377-3187
Mo	Creve Couer, B.E.A.M.S.	314-569-1060
NY	Roslyn Heights, Sir Sls.	516-621-7485
NY	State Grand Island, McTaggert Assoc.	716-634-2030
NC	Charlotte, Morris F. Taylor Co.	704-523-7932
Ohio	Akron, Shamrock Elctrn. Sls.	216-666-3796
Ohio	Cincinnati, Kirschner Sls.	513-891-5602
Pa	Philadelphia, Morris F. Taylor Co.	215-698-9757
Pa	Pittsburgh, Morris F. Taylor Co.	412-823-8337
Tex	Houston, Sidney Katzoff Assoc.	713-666-1636
EXP:	NY Westbury, Minthorne International	516-334-3303

ONAN DIV-ONAN CORP., 1400 73rd Ave. N.E., Minneapolis, Minn., 55432, Tel: 612-786-6322

Customer service: R.L. Westrum

Free literature available: Standby Folder (F-322-D) "A Guide to the Selection & Installation of Onan Standby Electric Generating Systems".

Products manufactured: Annunciators, Chargers, Battery, Generators, Power Supplies

ONEIDA ELECTRONICS MFG., 843 N. Cottage St., Meadville, Pa., 16335, Tel: 814-336-2125; Empl.: 25; Minimum order: $25

Customer service: D. L. Smith

Free literature available: Complete Oneida Electronic Mfg., Inc. Product-Parts Catalog available upon request.

Products manufactured: Adhesives (All Types), Clamps & Clips, Lamps, Resistors, Sockets

Local Sales Offices & Reps.

Cal	Los Altos, W.W. Poseys Co.	415-948-7771
Cal	Sacramento, W.W. Posey Co.	916-428-5768
Cal	Van Nuys, A. Szerlip Sls. Co.	213-782-1765
Colo	Westminister, Electro-Tex Sls.	303-255-4566
Fla	Ormond Beach, J. F. Thompson Sls. Co.	904-677-2298
Haw	Mililani, C&L Distrs.	808-949-1087
Ill	Chicago, Lassers & Co.	312-539-0170
Kans	Shawnee Mission, K&M Sls. Co.	913-262-1444
Md	Silver Springs, Mid-Atlantic Sls. Co.	301-593-7749
Mass	North Boro, W.B. Pray Sls. Co.	617-393-3434
Mich	Milford, Polyphase Sls. Co.	313-685-3003
Minn	St. Louis Park, Smith Sls. Co.	612-377-3187
NJ	Princeton, S. Enright Sls. Co.	
NY	Yonkers, J. Brown Sls. Co.	914-779-7330
NC	Charlotte, M.K. Smith	704-372-1026
Ohio	Akron, Shamrock Elctrn. Sls.	216-666-3796
Pa	Bethlehem, L.T. Benner	215-865-3014
Pa	Pittsburgh, Tanner Co.	412-561-4687
Tex	Hurst, Ranger Elctrns. Co.	817-281-2736
Wash	Seattle, Fleehart & Sullivan	206-522-1533
EXP:	Chicago, Ill., E.D. Magnus & Assocs.	312-334-1502

OPAD ELEC. CO., INC., 43-12 Walker St., New York, N.Y., 10013, Tel: 212-WO 6-0380; FSC No: 94940

For info on price: H. L. Opad; Customer service: G. Cohen

Products manufactured: Chargers, Battery, Controls/Control Eqpt., Detectors, Electroplating Equipment & Supplies, Eliminators, Battery, Kits, Power Supply, Machines/Machinery, Production, Monitors, Power Supplies, Rectifiers, Regulators, Testers

OPAMP LABS, INC., 1033 N. Sycamore Ave, Los Angeles, Cal., 90038, Tel: 213-934-3566; FSC No: 24699; Empl.: 18 .... p. 1•10,11

Customer service: B. J. Losmandy

Free literature available: Free 30 page Catalog and Audio Applications. Contains Audio Consoles (Kits and Wired), Amplifiers-Mic. Eq. ACN. Line. Tape. Disc. Power. Oscillators-Audio, Tape Bias., Power Supplies.

Products manufactured: Amplifiers, Integrated Circuit Devices, Power Supplies

OPCOA, INC., 330 Talmadge Rd., Edison, N.J., 08817, Tel: 201-287-0355, TWX: 710-998-0555; Empl.: 150

Products manufactured: Display Devices/Displays, Indicators, Lights

Local Sales Offices & Reps.

Ariz	Scottsdale, Carter Assocs.	602-947-4355
Cal	Menlo Park, Straube Assocs., Inc.	415-323-2476
Cal	Woodland Hills, Interstate Mktg. Assoc.	213-883-7606
Colo	Englewood, W. J. Purdy Co.	303-770-5311
Conn	North Haven, Comp. Rep. Assocs., Inc.	203-239-9762
Fla	Bradenton, Reynolds & Assocs.	813-778-5219
Ga	Atlanta, Reynolds & Assocs.	404-422-2114
Ill	Chicago, Delta Tech. Sls.	312-693-3380
Ind	Greenwood, Valentine-Schillinger	317-888-2260
Md	Elkridge, J. Bresson Assocs.	301-796-5220
Mass	Needham, Comp. Rep. Assocs., Inc.	617-444-2484
Mich	Southfield, R. O. Whitesell & Assocs.	313-358-2020
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Hazelwood, Technical Reps, Inc.	314-524-6900
Mo	Peculiar, Technical Reps, Inc.	816-331-7744
NM	Albuquerque, Straube Assocs., Inc.	505-294-1880
NY	Dewitt, Bowser & Sapecky Assocs.	315-446-5920
NY	Jamaica, S-J Sls.	212-291-3232
Ohio	Cincinnati, G & H Sales Co.	513-771-8231
Ore	Beaverton, N. R. Schultz Co.	503-646-1345
Pa	Narberth, J. Bresson Assocs.	215-839-6770
Tex	Ft. Worth, W. P. Fralia Co.	817-738-2394
Tex	Houston, W. P. Fralia Co.	713-772-1572
Va	Lynchburg, J. Bresson Assocs.	215-839-6770
Wash	Bellevue, N. R. Schultz Co.	206-GL 4-0300
EXP:	Edison, N. J., Opcoa, Inc.	201-287-0355

OPT INDS. INC., Data Products Div., 300 Red School Lane, Phillipsburg, N.J., 08865, Tel: 201-454-2600; Empl.: 160; Minimum order: $500

For info on price: J. Smith; Application info: B. Slack; Customer service: P. Jones; Delivery info: P. Jones

Products manufactured: Chokes, Coils Including Assemblies & Forms, Equalizers, Filters, Modulator/Demodulators, Networks, Power Supplies, Transformers

Local Sales Offices & Reps.

Cal	Encino, El/Tec
Fla	St. Petersburg, Kirkwood Assoc.
Ill	Chicago, Croyden Elctrns.
Md	Bethesda, Warren Mount Assoc.
Mass	Needham Heights, Com/Pak
NJ	Union, J. Onore
NY	Hempstead, Kahgan Sls.
NY	Syracuse, Franklin Sls.

OPTEL CORP., Box 2215, Princeton, N.J., 08540

OPTICAL ELECTRONICS, INC., Box 11140, Tucson, Ariz., 85734, Tel: 602-624-8358, TWX: 910-952-1283; FSC No: 5962; Empl.: 26; Minimum order: $15

For info on price: Mrs. Mac; Application info: R. Gerdes; Customer service: S. E. Day; Delivery info: Mrs. Mac

Free literature available: Analog modules including operational amplifiers and analog function modules.

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Comparators, Converters, Dividers, Filters, Generators, Integrated Circuit Devices, Integrators, Electronic, Multipliers, Oscillators, Power Supplies, Timers

Local Sales Offices & Reps.

Ariz	Tempe, J.F. Hurlbut Co.	602-968-5962
Colo	Golden, J.F. Hurlbut Co.	303-279-7796
Pa	Abington, Bach-Stewart Assocs.	215-885-1550
Tex	Richardson, Applied Science Accounts	214-231-6958
Va	Annandale, J. Hopkins Assocs.	703-323-1641

OPTICS INTERNATIONAL, Box 101, Tenafly, N.J., 07670, Tel: 201-567-4799; Empl.: 10; Minimum order: $50

For info on price: R. J. Schmitt; Application info: R. Cole; Customer service: J. Johnson; Delivery info: M. Ryan

Free literature available: Custom optics brewster angle prisms, corner cube reflectors, plane and spherical mirrors, polarizing prisms, retardation plates, narrow band interference filters, neutral density filters, front surface mirrors, high precision optical coatings.

Products manufactured: Coatings, Crystals, Filters, Lenses, Optical & Camera, Quartz, Fused, Silica, Fused

OPTIMA ENCLOSURES, Div. Scientific Atlanta, 2166 Mountain Ind'l Blvd., Tucker, Ga., 30084, Tel: 404-939-6340, TWX: 810-766-3967; Empl.: 70; Minimum order: $50 .... p. 1•78,79

For info on price: B. Holman; Application info: R. Dawsey; Customer service: B. Holman; Delivery info: B. Holman

Free literature available: Short form Catalog Describes general line of products with photos and brief technical descriptions.

Products manufactured: Benches, Consoles, Stools, Tables, Blowers & Fans & Accessories, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Metal, Drawers, Sliding, Frames, Cabinet & Rack, Grilles, Handles For Cabinets, Circuit Boards, Racks, etc., Racks, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-536-5306
Ariz	Scottsdale, Barnhill Five	602-947-5745
Cal	Los Altos, Frauman Assocs.	415-941-0660
Cal	Palos Verdes, Edwards Assocs.	213-377-0975
Colo	Denver, Barnhill Five	303-426-0222
Fla	Orlando, Gentry Assocs.	305-894-4401
Fla	St. Petersburg, Genrty Assocs.	813-867-7820
Ga	Tucker, Scien.-Atlanta	404-939-6340
Ill	Des Plaines, Cozzens & Cudahy	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy	317-244-2456
Md	Bladensburg, Scien.-Atlanta	301-779-1515
Mass	Lexington, Zieco	617-861-8300
Mich	Grand Rapids, Representatives Elec. Prod	616-942-1320
Mich	Southfield, Representative Elec. Prod.	313-354-9066
Minn	Minneapolis, Cozzens and Cudahy, Inc.	612-884-4336
Mo	St. Louis, Cozzens & Cudahy	314-423-1234
NJ	Leonia, Scien.-Atlanta	201-461-3650
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Cleveland, C.A. Robinson Co.	216-381-9049
Ohio	Dayton, C.A. Robinson Co.	513-275-2412
Tex	Ft. Worth, Carey-Wolf	817-738-1996
Tex	Garland, Carey-Wolf	214-494-1212
Tex	Houston, Carey-Wolf	713-721-2442
Wash	Seattle, S.J.I. Corp.	206-624-9020

OPTIMATION, INC., Sub. Julie Research Labs., Inc., 9259 Independence Ave., Chatsworth, Cal., 91311, Tel: 213-882-6490, TWX: 910-494-1219; Empl.: 26

Products manufactured: Amplifiers, Calibrators, Current Sources, Display Devices/Displays, Generators, Oscillators, Standards, Testers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs., Inc.	205-881-6220
Cal	Newport Beach, Feeger, Lucas, Wolfe, Inc.	714-540-4412
Cal	North Hollywood, Feeger, Lucas, Wolfe, Inc.	213-877-5518
Cal	Palo Alto, Coherent Mktg.	415-327-2217
Cal	San Diego, Feeger, Lucas, Wolfe, Inc.	714-277-0993
Conn	Hamden, Applied Measurements, Inc.	203-288-5288
Fla	Orlando, BCS Assocs., Inc.	305-896-4881
Ga	Atlanta, BCS Assocs., Inc.	404-874-9925
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Md	Beltsville, R. Davies Assocs.	301-937-2215
Mass	West Acton, Applied Measurements, Inc.	617-263-2766
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501
Mo	Hazelwood, Technical Representatives, Inc.	314-731-5200
Mo	Peculiar, Technical Representatives, Inc.	816-737-1414
NY	Mount Vernon, Q.E.D. Elctrns., Inc.	914-664-0080
NY	Rochester, SBM Reps., Inc.	716-266-1400
NC	Greensboro, BCS Assocs., Inc.	919-273-1918
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Pa	Melrose Park, R. Meyers Assoc.	215-224-1663
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Wash	Bellevue, Scientific Devices-Northwest	206-454-0900
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940

OPTIMAX, INC., Box 105, Advance Lane, Colmar, Pa., 18975, Tel: 215-822-1311, TWX: 510-661-7370; Empl.: 30; Minimum order: $50

For info on price: R. Barry; Application info: D. Gardner; Customer service: R. West; Delivery info: R. Barry

Free literature available: Optimax catalog

Products manufactured: Amplifiers

Local Sales Offices & Reps.

Cal	Los Altos, Hoeke and Reeser Assoc.	415-941-4080
Cal	Los Angeles, McDougall/McLaughlin	213-477-8556
Fla	Palm Bay, Spar Tech Assocs.	305-727-8045
Ga	Smyrna, Spar Tech Assocs.	404-432-3644
Ill	Park Ridge, RF Specialists	312-698-2044
Ind	Ft. Wayne, RF Specialists	219-485-8982
Md	Silver Spring, Spectroscopy Sys.	301-949-8261
Mass	Lexington, Lancer Assocs.	617-861-1720
Mich	Warren, DEM Elctrn. Sls.	313-755-6660
Mo	St. Louis, Boweng Reps	314-429-7327
NJ	Palisades Park, Scientific Devices	201-945-3962
NY	E. Syracuse, Ossmann Instrs.	315-437-6666
Pa	Wyndmoor, Spectroscopy Sys.	VE6-1545
Tex	Dallas, Texas Microwave/Elec.	214-231-7281

OPTIMIZED DEVICES INC., 220 Marble Ave., Pleasantville, N.Y., 10570, Tel: 914-769-6100; Empl.: 22

For info on price: A. Zuch; Application info: A. Zuch; Customer service: J. ODonnel; Delivery info: J. Murtha

Free literature available: Model 6000 Computer Operated Test System, Model Computer Operated Screwdriver, Series 19 Capacitor Test Bridges, Model 3000 Automatic Relay Test System, Model CH-1 Component Handler, Model 1900 Capacitance Test System.

Products manufactured: Analyzers, Bridges, Generators, Screwdrivers, Test Systems, Testers

Local Sales Offices & Reps.

Cal	Los Angeles, DynaSales Co.
NM	Albuquerque, Electronic Enterprises
NM	Las Cruces, Elctrn. Enterprises

NY	New York City, Hy Lewis Assoc.	
Wash	Seattle, Datacom Assocs.	

Advertisment

Automatic and computer operated testing systems for circuits, boards and components. Specialists in custom designs and unusual applications. Call us for a free price estimate and proposal.

OPTO-METRIC TOOLS, Sub/E. Leitz, Link Crescent, Rockleigh, N.J., 07647, Tel: 201-767-1320; Empl.: 200

Products manufactured: Comparators, Fiber Optic Bundles, Gages, Interferometer Systems, Lamps, Lenses, Optical & Camera, Magnifying Glasses, Inspection, Microscopes, Simulators, Television Systems & Equipment Closed-Circuit, Testers

Local Sales Offices & Reps.

Cal	Burlingame, E. Leitz, Inc.	415-697-9182

OPTRON, INC., 1201 Tappon Cir., Carrollton, Tex., 75006, Tel: 214-242-6571, TWX: 910-860-5958; FSC No: 32694; Empl.: 230; Minimum order: $25

For info on price: Mktg.; Application info: Mktg.; Customer service: Cust. Svc.; Delivery info: Cust. Svc.

Free literature available: Shortform Catalog-Individual Data Sheets

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Diodes, Encoders, Isolators, Lamps, Light Sources, Photoelectric, Lights, Punched Card Equipment, Readers, Sensors, Light, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Murcota Corp.	205-539-8376
Ariz	Phoenix, T. Goodreau & Assocs.	602-243-5141
Cal	Glendale, Orion Sls.	213-240-3151
Cal	San Carlos, Kottmeier Assocs.	415-592-8333
Cal	San Diego, Orion Sls.	714-299-8322
Cal	Tustin, Orion Sls.	714-832-9687
Colo	Wheat Ridge, Waugaman Assocs.	303-423-1020
Fla	Clearwater, Lynch-Gentry Assocs.	813-443-2697
Ill	Chicago, Carlson Elctrn. Sls.	312-774-9022
Md	Baltimore, Stemlen Assocs.	301-944-8262
Mass	Haverhill, L-K Assocs.	617-373-1313
Mass	Sudbury, Heinecke Corp.	617-443-3200
Mich	Detroit, R.P. Urban Assocs.	313-535-2355
Mich	Grand Rapids, R.P. Urban Assocs.	616-245-0511
Minn	Minneapolis, ECR, Inc.	612-831-4547
Mo	St. Louis, Carlson Elctrn. Sls.	314-991-0262
NJ	Cherry Hill, Stemlen Assocs.	609-966-4070
NJ	Fort Lee, Necco	201-461-2789
NJ	Freehold, Necco	201-462-1361
NJ	Laurel Springs, Stemlen Assocs.	215-644-3477
NM	Albuquerque, Electronic Mktg., Inc.	505-265-7837
NY	Endicot, Advanced Comps. Corp.	607-785-3191
NY	N. Syracuse, Advanced Comps. Corp.	315-699-2671
NY	Scottsville, Advanced Comps. Corp.	716-889-1429
NC	Winston Salem, Murcota Corp.	919-723-1001
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Ohio	Dayton, D. Steffen & Assocs.	513-293-3145
Tex	Dallas, M. Kruvand Co.	214-827-8043
Tex	Houston, M. Kruvand Co.	713-661-3007
Va	Alexandria, Stemlen Assocs.	703-548-7818
Va	Reston, Boyle Assocs.	703-620-9558
Wash	Tukwila, General Elctrns., Inc.	206-243-5141
Wisc	Wauwatosa, Carlson Elctrn. Sls.	414-476-2790

Local Distributors

Cal	Sunnyvale, Diplomat/Westland, 1118 Elko Dr.	408-734-1900
Ill	Westmont, Bodelle Co., 47 Chestnut La.	312-323-9670
Tex	Dallas, Component Specialties, 2560 Electronic Ln.	214-357-4576
Tex	Houston, Component Specialties, 7313 Ashcroft	713-771-7237
Utah	Salt Lake City, Diplomat/Altaland, 2280 S. Main St.	801-486-7227

ORBIT INDS., Div. Countis Inds., Box 1444, San Luis Obispo, Calif., 93401, Tel: 805-544-1770; Empl.: 10

Products manufactured: Tools, Tweezers, Hand & Vacuum

ORBIT INSTR. CORP., 131 Eileen Way, Syosset, N.Y., 11791, Tel: 516-WA 1-6310, TWX: 510-221-2122; FSC No: 11263; Empl.: 65

For info on price: P. Sherman; Application info: M. Gersten; Customer service: P. Sherman; Delivery info: P. Sherman

Products manufactured: Amplifiers, Analyzers, Brakes, Clutches, Controls/Control Eqpt., Counters, Gears & Gear Mechanisms (Precision), Indicators, Reducers, Repeaters, Servo, Servo Systems, Switches, Tracking Systems, Transducers

Local Sales Offices & Reps.

Cal	San Diego, W. Gorman Co.	714-222-9424
Tex	Dallas, R. O. Spooner Co.	214-357-6636

ORIEL CORP. OF AMERICA, 15 Market St., Stamford, Conn., 06902, Tel: 203-357-1600, TWX: 710-474-3563; Empl.: 49; Minimum order: $50

Customer service: A. Smith

Free literature available: Instruments and components for UV, visible and IR research including optical bench and table equipment, lasers and accessories, light sources and monochromators, light detection equipment, optical filters and optical components.

Products manufactured: Coatings, Converters, Filters, Lamps, Lasers & Laser Systems, Lenses, Optical & Camera, Lights, Machines/Machinery, Production, Power Supplies, Radiometers, Services, Assembly, Production & Test, Ultraviolet Inspection Lighting

Local Sales Offices & Reps.

Cal	Newport Beach	714-546-5871

ORMOND INC., 11969 E. Rivera Rd., Santa Fe Springs, Cal., 90670, Tel: 213-698-0641, TWX: 910-586-1635; Empl.: 40; Minimum order: $85

Customer service: A. Denny Ext. 26

Free literature available: Literature on: load cells, digital displays, digital printers, aircraft weighing systems, & scales.

Products manufactured: Cells, Load

OSBORNE TRANSFORMER CORP., 3834 Mitchell Jen Ave., Detroit, Mich., 48207, Tel: 313-579-0700; Empl.: 30

Products manufactured: Coils Including Assemblies & Forms, Reactors, Transformers

OSHINO ELECTRIC LAMP WORKS, LTD, 2-5-2, Minami-Shinagawa, Shinagawa-ku, Tokyo, Japan, Tel: 03-471-8548; Empl.: 250

Products manufactured: Diodes, Lamps, Sockets, Switches

Local Sales Offices & Reps.

Cal	Costa Mesa, WAMCO Tech. Sls., Inc.	714-833-9361
Ill	Chicago, Cimco Int'l. Inc.	312-782-5621

OSTBY & BARTON CO., Box 6267, Providence, R.I., 02904, Tel: 401-739-7310; Empl.: 175; Minimum order: $25

For info on price: G. J. Cavanaugh; Application info: E. Jackson; Customer service: R. L. Porter; Delivery info: J. Burns

Free literature available: Spring-loaded test probes; custom designed & manufactured test fixtures; wire wrapping equipment.

Products manufactured: Brushes & Brush Assemblies, Contacts, Electrical, Probes, Testers, Tools

Local Sales Offices & Reps.

Ill	Glen Ellyn, H.F. Wilson Engrg. Co.	312-469-8473
Nev	Reno, Standard Pneumatic Motor Co.	702-329-6311
RI	Warwick, Market Development	401-739-7610

OTTO ENGRG., INC., Otto Controls Div., 36 Main St., Carpentersville, Ill., 60110, Tel: 312-428-7171; FSC No: 21649; Empl.: 42; Minimum order: $15 ... p. 1•1545,2267

For info on price: R. E. Sparks; Application info: R. E. Sparks; Customer service: J. Graves; Delivery info: J. Graves

Products manufactured: Switches

Local Sales Offices & Reps.

Cal	Alhambra, M.W. Riedel & Co.	213-283-7694
Cal	Redwood City, Woodworth Co.	415-365-0252
Ill	Glen Ellyn, Rockford Controls Co.	312-469-6016
Mass	Chelmsford, Northeast Comps.	617-256-8758
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NY	Great Neck, F. Tylinski Co.	516-466-9070
Ohio	Cleveland, A.H. Baier Co.	216-461-6161
Ohio	Dayton, A.H. Baier Co.	513-276-4128
Wash	Bellevue, J. Findlay Co.	206-454-5200

OVEN INDUSTRIES, INC., Box 229, Silver Spring Indl. Pk., Mechanicsburg, Pa., 17055, Tel: 717-766-0721; Empl.: 30; Minimum order: $20

For info on price: T. M. Nolan; Application info: R. E. Eckert; Customer service: T. M. Nolan; Delivery info: T. M. Nolan

Products manufactured: Controls/Control Eqpt., Heaters & Heating Elements, Ovens, Regulators, Standards

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assocs.	205-536-1941
Ariz	Scottsdale, S.C. Blaker Co.	602-948-3061
Cal	Encino, El-Tec, Inc.	213-981-9881
Cal	San Carlos, Westronics Assoc.	415-592-1417
Fla	Melbourne, Reynolds & Assoc.	305-727-3205
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	Skokie, Saffro & Assocs.	312-588-0905
La	Baton Rouge, Covington Instr. Co.	504-924-1784
Mass	Reading, Geder & Rotundi Assocs.	617-944-3105
Minn	Minneapolis, C.E. Bohlig Co.	612-922-7011
Mo	St. Peters, K.M. & B. Tech. Sls.	314-278-3159
NY	Huntington, Andrews & Andrews	516-692-8686
NY	Syracuse, Mike Antil	315-463-0266
NC	Greensboro, Reynolds & Assocs.	919-275-3725
Ohio	Medina, McShane, Inc.	216-725-4568
Pa	Ambler, W & M Assocs.	215-643-4119
Tex	Dallas, Bouco Sls. Assocs.	214-247-6708
Va	Falls Church, Beacon Elctrn. Assoc.	703-534-1673
EXP:	Ajax, Ont., Can., R.D. Assocs.	416-294-6796
EXP:	Pa., Lemoyne, Elctrns. Int'l.	717-737-8858

OVENAIRE, Div. Walter Kidde & Co., 706 Forrest St., Charlottesville, Va., 22901, Tel: 804-977-8050, TWX: 510-587-5461; Empl.: 125 ... p. 1•400-403

Customer service: Norman Broadbent

Free literature available: Ovens-16 page catalog illustrating crystal ovens and component ovens, propertional control and thermostat control. Oscillators-4-page short form catalog illustrating packaged high stability crystal oscillators

Products manufactured: Oscillators, Ovens, Standards

Local Sales Offices & Reps.

Ala	Huntsville, L & D, Inc.	205-881-7760
Ariz	Phoenix, J. S. Heaton Co. Inc.	602-264-7887
Ark	El Dorado, D. Bellew Sls.	501-863-8325
Cal	San Mateo, Melvin Sl.	415-349-7445
Cal	Van Nuys, R.L. Assocs.	213-780-1666
Fla	Maitland, Ellis & Assocs.	305-645-1101
Ill	Chicago, TX Sls., Inc.	312-455-6199
Ind	Fort Wayne, TX Sls., Inc.	219-489-4447
Ind	Indpls., TX Sls., Inc.	317-253-1966
La	Kenner, D. Bellew Sls.	504-729-4550
Md	Luthersville, L. E. Brown Assoc.	301-296-4306
Mass	Randolph, Naton Assocs., Inc.	617-986-6417
Minn	St. Paul, Countryman	612-645-9151
Mo	Blue Springs, Chesco	816-229-1404
Mo	St. Charles, Chesco	314-946-6677
NJ	Moorestown, L. E. Brown Assoc.	609-234-0382
NY	Buffalo, Quality Comps.	716-839-4170
NY	Smithtown, TX Sls., Inc.	516-979-8750
NC	Greensboro, L & D, Inc.	919-292-3201
Ohio	Cleveland, TX Sls., Inc.	216-561-1900
Tenn	Memphis, D. Bellew Sls.	901-365-9437
Tex	Dallas, Stevens Sls.	214-350-2476
Wash	Seattle, Carlyle Tech. Sls.	206-622-4288

OVERLY-HAUTZ CO., 8617 Clinton Rd., Cleveland, Ohio, 44144, Tel: 216-281-1500; Empl.: 100; Minimum order: $25

Customer service: P. Siliko

Free literature available: MB-400 Motor Base Brochure, Shorewall Brochure, Facilities Brochure.

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Enclosures, Module, Plug-In, Frames, Cabinet & Rack, Racks, Services, Assembly, Production & Test, Stands, Instruments

OWATONNA TOOL CO., 395 Eisenhower Dr., Owatonna, Minn., 55060, Tel: 507-451-5310; Empl.: 1035

For info on price: L. Wavrin Ext. 225; Customer service: T. Nutting Ext. 409

Free literature available: Catalog No. G-71, includes complete OTC line of maintenance tools and equipment; Catalog No. H-72, power work holding systems.

Products manufactured: Couplings, Gages, Testers, Wrenches

Local Sales Offices & Reps.

Ala	Birmingham, J.R. Kuehn	205-853-0980
Cal	Arcadia, R. Long	213-447-0081
Cal	La Habra, R. Fitzgerald	213-697-8626
Cal	San Jose, G. Packer	408-378-1853
Cal	Santa Ana, G. Weers	213-283-2933
Colo	Aurora, K. Buerk	303-751-9369
Conn	Killingworth, W. Buckingham	203-663-2271
Fla	Tampa, L. Rickett, Jr.	813-884-1046
Ga	Riverdale, C. Crews	404-471-8046
Idaho	Pocatello, W. Noesen	208-232-2045
Ill	Chicago, G.J. Reilly	312-274-6993
Ind	Lebanon, T. Payne	317-482-1376
Iowa	Des Moines, D. Vandermeulin	515-276-2290
Iowa	Des Moines, M. Seskis	515-265-0843
Md	Derwood, G. Miller, Jr.	301-948-2892
Mass	Concord, B. L. Boyd	617-369-5938
Mich	Madison Heights, R. Lock	313-645-2120
Mich	Troy, D.V. Johnson	313-689-5413
Minn	Minneapolis, C. Johnson	612-888-4957
Mo	Florissant, P. Stumpe	314-741-4444
NJ	Convent Station, C. Knill	201-538-3846
NJ	Middletown, D.A. Peterson	201-671-4395
NJ	Parlin, J. Stowers	201-727-6020
NJ	Willingboro, C.V. Bareikis	609-871-0399
NY	Rochester, J. Jenkinson	716-385-3217
NC	Charlotte, R.J. Ludes, Sr.	704-366-4963
Ohio	Columbus, J. Moeller	614-885-1478
Ohio	Conneaut, D. Dye	216-593-1226
Ohio	Lakewood, D. Brown	216-228-9563
Ohio	Westlake, D.O. Schneider	216-871-8820
Ore	Tigard, J. Davenport	503-639-6644
Tenn	Memphis, R. Ludes	901-396-7469
Tex	Euless, L. Johnson	817-267-4828
Tex	Houston, W. Parker	713-468-6157
Tex	Richardson, J.W. Cissne	214-235-6127
Wisc	Kenosha, E.T. Beckman	414-654-1778

OWENS-ILLINOIS, INC., Box 1035, Toledo, Ohio, 43666, Tel: 419-242-6543, TWX: 810-442-1812; Empl.: 56000

OXFORD INSTR. CORP., Box 1829, 48 Maryland Ave., Annapolis, Md., 21404, Tel: 301-268-2350; Empl.: 3

Customer service: J. E. Templeton

Products manufactured: Controls/Control Eqpt., Generators, Indicators, Magnets, Recorders

OXFORD SPEAKER CO., 4647 W. 47th St., Chicago, Ill., 60632, Tel: 312-585-4491, TWX: 910-221-5029; Empl.: 300

Products manufactured: Speaker Systems, Speakers

Local Sales Offices & Reps.

Ala	Gadsden, F.C. Nickerson	205-547-7718
Alas	Anchorage, R. Merritt Co.	
Ariz	Culver City, H. Feldman Co.	213-870-5973
Cal	Culver City, H. Feldman Co.	213-870-5973
Cal	San Francisco, Tech. Sls. Assoc.	414-467-1434
Colo	Denver, Nelson Co.	303-733-5528
Fla	Ormond Beach, J.F. Thompson	904-677-2298
Ga	Decatur, F.C. Nickerson	404-631-4481
Ill	Chicago, G. MCL Cole Co.	312-774-3535
Ind	Indianapolis, D. Powers Sls. Inc.	317-846-0790
Mass	N. Scituate, W.A. Hendrickson Co.	617-545-0652
Mich	Oak Park, J. Shay Assocs.	313-546-0194
Minn	Minneapolis, J.E.M. Anderson	
Mo	Kansas City, Forristal-Young Sls. Co.	816-358-6771
Neb	Omaha, Forristal-Young Sls. Co.	402-333-0800
NY	Liverpool, Lewis & Dunnigan Co.	315-622-2133
NY	Tuckahoe, L-C-A Sls. Co.	
NC	Kannapolis	
Ohio	Columbus, Mandabach & Assocs.	614-235-0265
Ore	Portland, R. Merritt Co.	
Pa	Philadelphia, L-C-A Sls. Co.	215-GR7-3298
Tex	Dallas, Wyborny Sls. Co.	
Wash	Seattle, R. Merritt Co.	206-682-7337
Wisc	Milwaukee, G. MCL Cole Co.	414-545-6083
EXP:	New York, N.Y., Roburn Agencies, Inc.	219-989-5939

PACE INC., 9337 Fraser Ave., Silver Spring, Md., 20910, Tel: 301-587-1696, Telex: 89-8476; Empl.: 35; Minimum order: $40

For info on price: R. Deblinger; Application info: R. Deblinger; Customer service: R. Deblinger; Delivery info: Sls. Off.

Free literature available: PACE Catalog - Detailed descriptions of PACE Equipment and Services; PACE All Products Flyer - "Yours" Brief desc. of PACE Products; PACE Desoldering for any Budget - Ped-A-Vac descriptive brochure.

Products manufactured: Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Ala	Madison, South Eastern Assoc.	205-772-9616
Ariz	Phoenix, Tooltronics	602-257-0768
Cal	Glendale, Tooltronics	213-240-4000
Cal	Santa Clara, Tooltronics	408-241-4000
Colo	Lakewood, Pathway	303-232-7730
Fla	Miami, N. Black Assoc.	305-651-4132
Haw	Honolulu, Pacific Instrumentation	808-373-1287
Ill	Mt. Prospect, E.T. Champion & Assoc.	312-593-1150
Kans	Baxter Springs, Production Automation Corp.	316-856-3600
Md	Baltimore, A.L. Myers Co.	301-426-5583
Mass	Woburn, MacHugh Assoc.	617-935-4650
Minn	Minneapolis, Production Automation Corp.	612-866-5700
Mo	Raytown, Production Automation Corp.	816-737-0066
Ohio	Cleveland, Data Equip. Sls.	216-252-3151
Okla	Tulsa, Production Automation Corp.	918-932-1051
Tex	Richardson, Production Automation Corp.	214-234-4002
Wash	Bellevue, Doland Co.	206-454-4952

PACE WIRE & CABLE CORP., 3590 Oceanside Rd., Oceanside, N.Y., 11572, Tel: 516-678-2275; Empl.: 35

Products manufactured: Braid, Cable, Cable, Wire

PACIFIC COMMUNICATIONS, 2126 So. Lyon St., Santa Ana, Cal., 92705, Tel: 714-546-0147; Empl.: 26

For info on price: G. Grunewald; Application info: G. Gruenwald; Customer service: G. Gruenwald; Delivery info: J. Day

Products manufactured: Comm. Systems, Receivers, Transmitters

PACIFIC ELECTRICORD CO., 747 W. Redondo Beach Blvd., Box 10, Gardena, Cal., 90247, Tel: 213-532-6600, TWX: 910-346-7619; Empl.: 350; Minimum order: $250

For info on price: P. Liput; Customer service: A. McLeod; Delivery info: A. McLeod

Free literature available: Catalog #1073 describes stock and custom power supply cords and cord sets.

Products manufactured: Braid, Cable, Cable, Cords, Plug Caps & Shells, Plugs, Switches, Wire

PACIFIC TECHNOLOGY, 235 Airport Way, Renton, Wash., 98055, Tel: 206-623-9080; Empl.: 60

Customer service: L. C. Rama

Products manufactured: Controls/Control Eqpt., Memory Systems, Monitors, Shift Registers

Local Sales Offices & Reps.

Ala	Huntsville, Vesco	205-881-8830
Ariz	Scottsdale, Utility Prods.	602-947-9326
Cal	El Monte, Randolph Industries, Inc.	213-283-7901
Cal	Palo Alto, Coherent Mktg. Assocs.	415-327-2217
Colo	Englewood, Utility Prods., Inc.	303-771-9080
Conn	Glastonbury, Instrument Reps., Inc.	203-633-0777
Ill	Chicago, Scientific Sls. Corp.	312-775-7594
Ind	Indianapolis, Scientific Sls. Corp.	317-253-4606
Md	Baltimore, Elctrn. Mktg. Assoc.	301-744-7700
Mass	Lexington, Instrument Reps., Inc.	617-861-8620
Minn	Bloomington, Scientific Sls. Corp.	612-881-3300
Mo	St. Louis, Floyd Gilliam Assoc.	314-961-5555
NY	Buffalo, Robinson Assoc.	716-886-7350
NC	Charlotte, J. Rudisill Assocs., Inc.	704-377-6901
Ohio	Cleveland, Peter Lax Co.	216-226-8815
Okla	Tulsa, Telstar Instrument Corp.	918-628-1011
Pa	Pittsburgh, Peter Lax Co.	412-833-5477
Tex	Houston, W. W. Scherwitz Co.	713-527-8866
Wash	Bellevue, Topp Engrg. Sls.	206-747-5400
FOR:	Can., Toronto, Ont., Nortech Control Equip. Co.	416-622-7820
FOR:	Can., Montreal 355, Quebec, Associated Instrumentation & Controls	514-384-7211
FOR:	Can., Vancouver, British Columbia, T. W. MacKay & Son, Ltd.	604-731-6561

PACKAGED RESINS DIV., Bacon Inds., Inc., 192 Pleasant St., Watertown, Mass., 02172, Tel: 617-926-2550; Empl.: 18; Minimum order: $25

For info on price: Order Desk; Application info: T. Willett; Customer service: T. Willett

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

PAGEANT/M.A. MILLER CO., 605 Northern Blvd., Chinchilla, Pa., 18501, Tel: 717-587-4771; Empl.: 14; Minimum order: $25

For info on price: R. Gardner; Application info: A. Wormser; Customer service: R. Gardner; Delivery info: Stock

Products manufactured: Bearings, Phonographs, Parts & Accessories

Local Sales Offices & Reps.

Ark	Jonesboro, B. McCaughan Sls.	402-346-5330
Cal	San Rafael, Sid Levin Sls.	415-454-1940
Cal	Van Nuys, A. Szerlip Sls. Co.	213-782-1765
Fla	Longwood, Williams Sls. & Mktg.	305-862-8722
Ga	Atlanta, Murphy & Cota	404-875-2525
Ill	Skokie, 2M Sls. Co.	312-674-3018
Md	Baltimore, Associated Sls. Reps.	301-661-2888
Mich	Lake Orion, T. Firaneck Sls.	313-391-1177
Minn	Minneapolis, H.M.R.	612-920-8200
Neb	Omaha, Mag Co. Sls.	402-346-5330
NY	Camillus, Callahan-Ferguson Co.	315-487-3870
NY	Wantagh, Audio Plus	516-781-2223
Ohio	Akron, Audio Mktg. Assocs.	216-864-8988
Ore	Portland, J. V. Be Lusko Co.	503-222-4279
Pa	Elkins Pk., I. Perlman Co.	
Tenn	Knoxville, R. K. Swan & Assocs.	615-523-7482
Tex	Dallas, Poole Inds.	214-742-7541
Tex	Houston, Ranger Elctrns. Co.	713-529-2811

PAKTRON DIV., Illinois Tool Works, Inc., 900 Follin Lane, S.E., Vienna, Va., 22180, Tel: 703-281-2810, TWX: 710-833-0682; FSC No: 19396; Minimum order: $1000

For info on price: C. Miller; Application info: K. Christensen; Customer service: C. Miller; Delivery info: C. Miller

Free literature available: Standard Catalog; Micromatic Catalog; Filmatic Catalog; Application Note Series; Facilities Brochure.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Cal	Mountain View, G. Woempner Co.	415-964-5454
Cal	Newport Beach, Paktron Regional Sls. Off.	714-833-9286
Cal	San Diego, Emcon	714-459-4355
Colo	Denver, Camel Elctrns., Inc.	303-757-6191
Fla	Altamonte Springs, W M M Assocs.	305-831-4645
Fla	Clearwater, W M M Assocs.	813-447-2533
Fla	Pompano, W M M Assocs.	305-943-3091
Ill	Chicago, Elctrn. Div., Illinois Tool Works, Inc.	312-693-3040
Ind	Indianapolis, Paktron Regional Sls. Off.	317-255-9658
Mass	Burlington, Paktron Regional Sls. Off.	617-273-0365
Mich	Benton Harbor, R.C. Nordstrom & Co.	616-857-4653
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-559-7373
Minn	St. Paul, Murnco	612-484-8200
Mo	North Kansas City, H. J. Weisler & Assocs.	816-421-1679
Mo	St. Louis, H. J. Weisler & Assocs.	314-HA 8-3934
NY	Elmont, F.E. Schmitt Co.	516-437-8150
NY	New York, Landseas Corp.	212-265-8323
NY	Rochester, L-Mar Assocs.	716-328-5240
NY	Vestal, L-Mar Assocs.	607-729-6339
NC	Smithfield, Byrd & Barbour Sls.	919-934-8136
Ohio	Columbus, Rockford Controls, Inc.	614-231-5890
Ohio	Dayton, Rockford Controls, Inc.	513-278-7362
Ohio	Euclid, Rockford Controls, Inc.	216-731-5250
Pa	Erie, ECCO Electronic Sls.	814-452-3762
Tenn	Memphis, Paktron Regional Sls. Off.	901-386-7252
Tex	Houston, R.F. Kimball & Co.	800-294-2805
Tex	Richardson, R.F. Kimball & Co.	214-231-3447
Wash	Seattle, Nemco	206-322-6200
FOR:	Can., Toronto 20, Ont., P. J. Heenan Ltd.	416-223-3619

Local Distributors

Ala	Huntsville, Hall-Mark, 4739 Commercial Dr.	205-837-8700
Cal	Goleta, Radio Prod. Sls., 350 E. South Kellog	805-964-6823

Cal	Los Angeles, Radio Product Sls., 1501 S. Hill St.	213-748-1271
Cal	San Diego, Radio Prod. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Conn	Stratford, Stepco, 1269 Barnum Ave.	203-375-5961
Fla	Ft. Lauderdale, Hall-Mark, 1302 West McNab Rd.	305-971-9280
Fla	Orlando, 7233 Lake Ellenor Dr., 305-855-4020	
Ga	Lawrenceville, Hall-Mark, Route 1	404-963-9728
Ill	Skokie, Bell Inds., 7701 N. Austin Ave.	312-965-7500
Ind	Ft. Wayne, Harvey-Ind., 2226 Abbey Dr.	800-382-4517
Ind	Indianapolis, Harvey-Indiana, 8505 Zionsville Rd.	317-297-4910
Mich	Farmington, Harvey-Mich, 23461 Industrial Pk. Rd.	313-477-1650
Mich	Kentwood, Harvey-Mich, 4860 S. Div.	616-531-9300
Minn	Edina, Harvey-Minn, 6969 Washington Ave. S.	612-941-6060
NJ	Hanover, State Elctrns., 36 Route 10	201-887-2550
NM	Albuquerque, Century Elec., 121 Elizabeth N.E.	505-292-2700
NY	Farmingdale, Iris Elctrns., 91 Milbar Blvd.	516-420-8400
NY	Rochester, Simcona Elec., 275 Mt. Read Blvd.	716-328-3230
NC	Raleigh, Hall-Mark, 3000 Ind'l. Dr.	919-832-4465
Ohio	Dayton, Sunray Elec., 3191 Plainfield Rd.	513-253-4114
Pa	Erie, Erie Corporate Cont., 1938 Buffalo Rd.	814-455-8110
Tex	Dallas, Component Specialties, 2560 Elctrns. La.	214-357-4576
Tex	Houston, Component Specialties, 7315 Ashcroft	713-771-7237
Utah	Salt Lake City, Century Elec., 2150 South 300 W.	801-466-6000
Utah	Salt Lake City, W.H. Bintz, 433 West Third So.	801-363-5821

PALL CORP., 30 Sea Cliff Ave., Glen Cove, N.Y., 11542, Tel: 516-671-4000, TWX: 510-223-0606; Empl.: 1300

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Dehumidifiers (For Equipment), Filters, Switches

Local Sales Offices & Reps.

Cal	Pasadena	213-684-2131
NJ	, Pall Trincor Corp.	201-245-8400

PALL TRINITY MICRO CORP., Rte. 281, Cortland, N.Y., 13045, Tel: 607-756-7535, TWX: 510-252-0791; Empl.: 300; Minimum order: $25

For info on price: D. J. Taylor; Application info: D. J. Taylor; Customer service: D. J. Taylor; Delivery info: R. Chierchio

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Dehumidifiers (For Equipment), Dehydrators, Filters

Local Sales Offices & Reps.

Ala	Birmingham, Brownlee-Morrow Engrg.	205-967-2873
Ala	Mobile, F. A. Thomas Co.	205-471-1593
Ala	Pelham, G. S. Edwards Co.	205-663-0707
Cal	S. El Monte, Pall Western Corp.	213-686-2786
Cal	Sunnyvale, Mensco	408-739-8690
Colo	Denver, Ross Equip. Co.	303-759-4215
Conn	Hamden, Pond Tech. Sls.	203-288-6278
Fla	Tampa, J. M. Clontz Assocs.	813-935-1988
Ga	Atlanta, Thomas Engrg. Co.	404-261-5070
Haw	Honolulu, Berkley Engrg.	808-538-1921
Ill	Villa Park, Enpro Inc.	312-279-2525
Iowa	Clinton, H. G. Klug Co.	319-243-3642
Ky	Paducah, LECO Inc.	502-554-9653
La	Baton Rouge, AWC Inc.	504-275-5480
Mass	North Reading, J. R. Chisholm Corp.	617-664-5711
Mich	Kalamazoo, Hose & Seals Inc.	616-375-1290
Mich	Trenton, North Central Engrg.	313-675-3157
Minn	Minneapolis, Industra Co.	612-929-6224
Mo	Kansas City, Condit Co.	816-561-4660
Mo	St. Louis, Durkin Equip. Co.	314-542-1444
Mo	St. Louis, Process & Chemical Equip.	314-771-3741
Neb	Omaha, H. G. Klug Co.	402-553-1377
NJ	Vauxhall, Pall Trincor Corp.	201-245-8400
NY	Cortland, E.P.S. Corp.	607-753-9308
NY	Malone, Bentek Inc.	518-483-4654
NY	New York City, Pall Trincor Corp.	212-269-4779
Ohio	Cleveland, Lester Johnson Co.	216-751-7040
Okla	Tulsa, Condit Co.	918-743-6651
Ore	Portland, Set Point Control	503-288-8868
Pa	Pittsburgh, Biltmore Products Co.	412-563-0808
SC	Greenville, Abernathy-Thomas Engrg.	803-288-2833
Tenn	Kingsport, Abernathy-Thomas Engrg.	615-245-6151
Tenn	Memphis, LECO Inc.	901-754-4800
Tex	El Paso, Engineered Equip.	915-533-4221
Tex	Houston, AWC Inc.	713-488-2730
Utah	Salt Lake City, T. R. Brown & Assoc.	801-486-7241
Va	Richmond, Dynamation Inc.	804-649-7666
Wash	Bellevue, Set Point Control	206-454-0155
Wisc	Milwaukee, Chipley & Zeman Inc.	414-228-1300
FOR:	Can., Montreal, Que., Pall Canada Ltd.	514-735-5311

PALOMAR ENGRS., Box 455, Escondido, Cal., 92025, Tel: 714-747-3343; Empl.: 6

Customer service: J. Althouse

Free literature available: A brochure for each of our seven products on request.

Products manufactured: Bridges, Decoders, Generators, Keyers, Tone, Modulators, All Kinds, Standards, Transformers

PAMOTOR, INC., 770 Airport Blvd., Burlingame, Cal., 94010, Tel: 415-347-1203, TWX: 910-374-2353; Empl.: 30 p. 1•504-507

Free literature available: Brochures: "Fans Blowers & Accessories" & "Pentaflow Premium Fans"

Products manufactured: Blowers & Fans & Accessories

Local Sales Offices & Reps.

Ariz	Phoenix, Bestronics	602-248-7020
Ark	Little Rock, J.Y. Schoonmaker Co.	501-375-2168
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Cal	Los Angeles, Black, Ekizian, Strong, Inc.	213-870-9191
Cal	San Diego, Bestronics	714-278-2150
Colo	Denver, W. J. Purdy Co.	303-777-1411
Conn	Meriden, P. R. Sturgeon	203-237-1112
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean, Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Hinsdale, Hill-Gray	312-325-4810
Ind	Indianapolis, Sukup & Cox	317-253-5501
Mass	Babson Park, P. R. Sturgeon Co.	617-237-3506
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
Minn	Edina, M. Foster	612-835-2252
Miss	Jackson, Cartwright & Bean	601-981-1368
NJ	Bergenfield, H. Gray Assoc.	201-384-3643
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	Syracuse, Mar-Com Assocs.	315-437-2843
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean Co.	919-832-7128
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3131
Okla	Tulsa, J.Y. Schoonmaker Co.	918-936-1423
Pa	Enon Valley, Nebco Assoc.	216-457-2333
Pa	Havertown, Liberi Sls.	215-789-8150
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4422
Tex	Dallas, J. Schoonmaker Co.	214-357-8481
Tex	Houston, J.Y. Schoonmaker Co.	713-926-9510
FOR:	Can., Willowdale, Ont., A. C. Simmonds & Sons	416-491-1010

PAN-L-FAST, 13205 Sherman Way, N. Hollywood, Cal., 91605, Tel: 213-875-0831; Empl.: 5

Products manufactured: Fasteners

PANAMETRICS INC., 221 Cresent St., Waltham, Mass., 02154, Tel: 617-899-2719, Telex: 92-3406; Empl.: 60; Minimum order: $25

For info on price: D. F. Garland; Application info: K. A. Fowler; Customer service: D. F. Garland; Delivery info: D. F. Garland

Products manufactured: Amplifiers, Analyzers, Generators, Indicators, Testers, Timers, Transducers, X-Ray Inspection Equipment

Local Sales Offices & Reps.

Cal	Downey, Uresco Co.	213-773-3828
Conn	Gailes Ferry, NDT Engrg.	203-464-7636
Mich	Chelsea, Michigan Nondestructive Gage Co.	313-994-5117
Pa	Downingtown, Testech	215-269-2705
Pa	Pittsburgh, American NDT	412-536-2345
Tex	Dallas, NDE-Aids	214-363-3217

PANASONIC, IND'L. ELCTRN. COMPS., Matsushita Elec. Corp. Amer., 200 Park Ave., New York, N.Y., 10017, Tel: 212-973-8427

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Controls/Control Eqpt., Delay Lines, Diodes, Display Devices/Displays, Drivers, Speaker, Films, Filters, Foil, Handsets, Chestsets, Headphones, Headsets, Etc., Heads, Recording Playback, Erase, Integrated Circuit Devices, Isolators, Limiters, Microphones, All Kinds, Networks, Oscillators, Phonographs, Parts & Accessories, Potentiometers, Power Supplies, Protectors, Rectifiers, Relays, Resistors, Speaker Systems, Speakers, Substrates, Switches, Thermistors, Thyristors (Includes Silicon Controlled Rectifiers), Transducers, Transformers, Transistors, Tubes, Tuners, Yokes

Local Sales Offices & Reps.

Ala	Huntsville, Rep, Inc.	205-881-9270
Cal	Los Angeles, Elctrns. for Industry	213-641-3277
Cal	San Jose, Allgood-North	408-288-6731
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Fla	Casselberry, EIR, Inc.	305-830-9600
Fla	Palm Beach, EIR, Inc.	305-585-6689
Ga	Atlanta, Rep, Inc.	404-876-1591
Ill	Chicago, Brock & Cushman	312-622-4110
Ill	Franklin Park, Matsushita Elec. Corp. Amer. Elctrn. Comps. Dept.	312-455-3105
Iowa	Des Moines, B.E.A.M.S., Inc.	515-282-0292
Kans	Shawnee Mission, B.E.A.M.S., Inc.	913-888-6110
Mass	Cambridge, Vector Sls., Inc.	617-491-5700
Mich	Detroit, NICON Assocs.	313-341-7688
Mich	Farmington, Panasonic Distr. Ctr. Automotive Comps.	313-477-1107
Minn	St. Paul, Skor	612-645-6461
Mo	St. Louis, B.E.A.M.S., Inc.	314-781-6855
NJ	River Edge, Meg Elctrn. Sls.	201-265-9887
NY	Buffalo, Kehoe Comp. Sls.	716-856-9272
NY	Ontario Center, Kehoe Comp. Sls.	315-524-2491
NC	Charlotte, Anthom, Inc.	704-527-1515
Ohio	Columbus, T. Mulligan & Assocs.	614-457-2242
Ore	Portland, Almac/Stroum Elctrns.	503-292-3534
Pa	King of Prussia, Monteiro Associates, Inc.	215-265-0634
Tex	Addison, Dunbar Assocs.	214-239-7151
Utah	Salt Lake City, Arrowhead Sls. Corp.	801-485-3362
Va	Fairfax, T. Davis Marketers	703-591-7390
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300
EXP:	Toronto 150, Ont., Can., Canadian Gen. Elec.	416-537-4481

PANASONIC SPD DIV., OEM Ind'l. Battery Dept., Box 3980, Grand Central Sta., New York, N.Y., 10017, Tel: 212-973-8054

Customer service: K. Love

Free literature available: General Battery Catalog Ni-Cad Battery Catalog sealed lead acid (gel cells) Lithium batteries Silicone Photo Detectors Panaquick battery chargers.

Products manufactured: Batteries, Cells, Photoconductive, Photoemissive, Photovoltaic, Chargers, Battery, Meters

PANDUIT CORP., 17301 Ridgeland Ave., Tinley Park, Ill., 60477, Tel: 312-532-1800, Telex: 25-4560; QPL No: 06383 p. 2•2048-2051

For info on price: B. Kenny; Application info: B. Kenny; Customer service: H. Kunce; Delivery info: H. Kunce

Free literature available: Bulletin CC-2, an eight page condensed catalog covering the complete line of Panduit® wiring components. It contains concise data to aid in selection of component to meet the application.

Products manufactured: Clamps & Clips, Connectors, Cutters, Wire, Hand Operated, Ducts, Wiring, Fasteners, Kits, Terminal, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Strips, Terminals, Tools, Tubing, Wire, Wire & Cable Ties, Wire Markers, Wire Nuts, Wire Strippers

Local Sales Offices & Reps.

Ala	Birmingham, James E. Heusser Agency	205-836-3896
Alas	Anchorage, H.J. Lang & Assocs.	907-279-5741
Ariz	Phoenix, Panduit Corp.	602-252-4515
Ark	Little Rock, Byron Carson Co.	501-568-3342
Cal	Los Altos, Ewing-Foley, Inc.	415-941-4525
Cal	San Diego, Panduit Corp.	714-270-2827
Cal	Westminster, Panduit Corp.	714-554-2300
Colo	Denver, Panduit Corp.	303-756-7747
Conn	Glastonbury, Barton-Caron Assocs.	203-633-9417
Fla	Boca Raton, Floritronics	305-368-0325
Fla	Winter Park, Floritronics	305-886-4818

Ga	Atlanta, Panduit Corp.	404-252-6483
Haw	Honolulu, A. J. Vivas Co.	808-946-6233
Ill	Tinley Park, Panduit Corp.	312-532-1800
Ind	Fort Wayne, Val-Skol Sls., Inc.	219-742-9122
Ind	Indianapolis, Val-Skol Sls., Inc.	317-926-5063
Iowa	Marion, Thomas & Modrcin Assoc.	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin Assoc.	913-432-2131
Ky	Jeffersontown, A.L. Pickens Co.	502-491-4215
La	Gretna, Panduit	504-366-1022
Md	Rockville, L.G. White & Co.	301-792-0660
Mass	Auburndale, Barton-Caron Assocs.	617-332-2021
Mich	Flint, Panduit Corp.	313-233-0501
Mich	Jenison, Panduit Corp.	616-942-0420
Mich	Southfield, Panduit Corp.	313-354-1830
Minn	Minneapolis, Electric Comp. Sls.	612-933-2594
Mo	Hazelwood, Thomas & Modrcin Assoc.	314-895-4700
NJ	Leonia, Panduit Corp.	201-461-7790
NY	Albany, Panduit Corp.	518-869-6913
NY	Kenmore, Panduit Corp.	716-834-8119
NY	Rochester, Panduit Corp.	716-244-9480
NY	Syracuse, Panduit Corp.	315-476-6161
NC	Winston-Salem, L.G. White Southern, Inc.	919-725-3612
Ohio	Cincinnati, Val-Skol Sls., Inc.	513-563-6790
Ohio	Cleveland, Val-Skol Sls., Inc.	216-526-2156
Ohio	Columbus, Val-Skol Sls., Inc.	614-291-4123
Okla	Oklahoma City, Panduit Corp.	405-848-6916
Ore	Portland, Panduit Corp.	503-248-1971
Pa	King of Prussia, L.G. White-Keystone, Inc.	215-265-1817
Pa	Pittsburgh, Myles F. Smith & Assoc.	412-276-5363
Tenn	Cookeville, A.L. Pickens Co.	615-528-1047
Tenn	Memphis, Byron Carson Co.	901-396-4553
Tex	Dallas, Panduit Corp.	214-638-7280
Tex	Houston, Panduit Corp.	713-784-1680
Wash	Bellevue, Panduit Corp.	206-454-7267
Wisc	Appleton, H. Mercer Co.	414-739-6223
Wisc	Brookfield, H. Mercer Co.	414-786-6431

PANEL CONTROLS CORP., 1000 Mt. Elliott Ave., Detroit, Mich., 48207, Tel: 313-568-2400; Empl.: 22

Customer service: P. Van Osdol

Products manufactured: Cases, Equipment, Instrument, Meter, Containers, Racks

Local Sales Offices & Reps.

Ala	Chattanooga, Jackson & Assocs.	615-267-4260
Ariz	Phoenix, Davia Pkg. Supplies	602-942-5484
Cal	Westminster, Contronic Devices	714-897-2266
Ill	Glenview, F.W. Castle Co.	312-724-3075
Mass	Burlington, Contract East	617-272-5051
Mich	Dearborn, F.B. Wright Co.	313-843-8250
Minn	Anoka, A. & R. Assocs.	612-421-0751
Mo	Maryland Heights, Allied Assocs.	314-291-1120
NJ	Mountain Lakes, J.P. Dearie Co.	201-334-4848
NC	Durham, R.H. Davis Co.	919-596-8472
Ohio	Dayton, Dynel Co.	513-434-6467
Ore	Portland, Commercial Products Co.	503-286-4040
Tex	Dallas, W.W. Cannon Co.	214-357-2846
Utah	Salt Lake City, American Handling & Packaging	801-487-4673
Wash	Seattle, Commercial Products Co.	206-767-5313

PANELGRAPHIC CORP., Box 254, Caldwell, N.J., 07006, Tel: 201-227-1500, TWX: 710-734-4367; Empl.: 100; Minimum order: $95

For info on price: D. Appel; Application info: E. Greason; Customer service: W. Perra; Delivery info: W. Perra

Products manufactured: Cabinets & Accessories, Dials, Display Devices/Displays, Filters, Nameplates, Scales, Dial, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps.	205-539-4411
Ariz	Phoenix, C. P. McKight Co.	602-257-8037
Cal	Canoga Park, M.J. Murphy	213-341-1472
Cal	Menlo Park, G.R. McKnight	415-325-2844
Colo	Denver, Goyne Assoc.	303-798-8955
Fla	Ft. Lauderdale, W. A. Brown Comps.	305-776-4800
Fla	Orlando, W.A. Brown Comps.	305-425-5505
Ill	Elmhurst, Panelgraphic	312-834-4849
Ill	Rolling Meadows, Sumer, Inc.	312-394-4900
Mass	Lexington, Measurements Equip.	617-245-4870
Mich	Southfield, J. L. Montgomery Assoc.	313-358-2616
Minn	Minneapolis, TWC Sales	612-636-1770
NJ	Mt. Lakes, Comp. for Electronics	201-334-2921
NM	Albuquerque, G. R. McKnight	505-266-6423
NY	Rochester, L. Hart	716-244-3253
NC	Raleigh, W. A. Brown	919-725-5384
NC	Winston Salem, W.A. Brown Comp.	919-725-5384
Ohio	Cincinnati, Components	513-721-2997
Ohio	Cleveland, Components Inc.	216-842-2737
Pa	Media, Snyder & Massey	215-566-5400
Tex	Dallas, McCoy Assoc.	214-350-9931
Tex	Houston, McCoy	713-649-5756
Va	Fairfax, Snyder & Massey	703-273-1413
Wash	Bellevue, Hickey Eng. Sales	206-454-0460

PANELOC CORP., Front & Main Sts., Collinsville, Conn., 06022, Tel: 203-693-8363; FSC No: 23893; Empl.: 24; Minimum order: $25

For info on price: B. Ehrhardt; Application info: G. M. Williams, Jr.; Customer service: B. Ehrhardt; Delivery info: B. Ehrhardt

Free literature available: Quick Operating Fasteners Self locking fasteners

Products manufactured: Fasteners

PAR-METAL PRODS. DIV., Eon Corp., 1260 Atlantic Ave., Brooklyn, N.Y., 11216, Tel: 212-772-5800; Empl.: 75; Minimum order: $50

For info on price: H. L. Miller; Application info: H. L. Miller; Customer service: W. Jones; Delivery info: W. Jones

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Chassis, Circuit Board Mounting, Panels, Racks, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ill	Skokie, Saffro & Assoc.	312-588-0905
Md	Baltimore, ME & Assoc.	301-825-1130
Mass	Lynfield, New Mar Assoc.	617-245-7960
NY	New York, Miller Co.	212-263-4446
Tex	Dallas, Techno Assoc.	214-357-9213

Local Distributors

	Rockville, Capital Radio, 12270 Wilkins Ave.	301-881-2270
Cal	Oakland, Brill Ectrns., 610 E. 10th St.	834-5888
Md	Bethesda, Empire Ectrn. Sup., 4907 Rugby Ave.	301-OL6-3300
NJ	Greenbrook, Greenbrook Elec., 269 U.S. Hwy. 22	201-968-3500
NJ	Hanover, State Ectrns., 36 Rte. 10	201-887-2550
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	L.I.C., H.L. Dalis, 35-35 24th St.	212-361-1100
Tex	Houston, Geophysical Sup. Co., 1500 Crawford	713-224-0621

PARA-KOTE, INC., Box 516, Marshall, Minn., 56258, Tel: 507-532-3789, TWX: 910-565-1330; Empl.: 35

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Products manufactured: Coatings, Services, Assembly, Production & Test, Transformers

PARABAM, INC., 3017 E. Las Hermanas St., Compton, Cal., 90221, Tel: 213-537-1771; Empl.: 22; Minimum order: $25

Customer service: J. N. Day

Free literature available: Custom manufacturing of fiberglass products; prototype production or quantity production; Astrodome and Observatory Shelters; Containers; Auto Bodies; Panels; Trailer Structures; Hoods; Concrete Forms; Custom Molded Shapes and Fiberglass Tooling.

Products manufactured: Containers, Services, Assembly, Production & Test, Servo Systems, Tracking Systems

PARAMETRIC INDS., INC., 742 Main St., Winchester, Mass., 01890, Tel: 617-729-7333; FSC No: 21455; Empl.: 50; Minimum order: $25

For info on price: J. D. Haskins; Application info: G. R. Sotiropoulos; Delivery info: J. D. Haskins

Products manufactured: Detectors, Diodes, Oscillators

Local Sales Offices & Reps.

Cal	Campbell, Allis Assocs.	408-379-2883
Colo	Boulder, H. Bass Assocs.	303-449-7509
Kans	Wichita, E. Carbiener Assocs.	316-682-5782
NJ	Leonia, Sprung/Nussbaum	201-947-6767
Pa	Glenside, Lewis Slubin & Co.	215-886-9291
Tex	Dallas, Stevens Sls. Co.	214-350-2476
Wash	Seattle, Datacom Assocs.	206-285-2525

PARAMOUNT INDUSTRIES, INC., 1430 Progress Rd., Ft. Wayne, Ind., 46808, Tel: 219-484-4111; Empl.: 44

Free literature available: Arbor list of square, rectangular and round sizes available.

Products manufactured: Tubing

Local Sales Offices & Reps.

FOR:	Can., Scarborough, Ont., Lake Engrg. Co. Ltd.	416-751-5980

PARAPLEGICS MFG., 304 N. York Rd., Bensenville, Ill., 60106, Tel: 312-625-7740; Empl.: 65; Minimum order: $25

For info on price: V. Caricato; Customer service: V. Caricato; Delivery info: I. Pryble

Free literature available: Job Shop - Sub-Contract of electro-mechanical & electronics assembly - cable & harness fabrication - circuit board assembly (wave & hand solder), wire wrapping, control panel asbly. Encapsulation of components & circuit boards coaxial cable assembly.

Products manufactured: Cable Assemblies & Harnesses, Cards, Linear Function, Cards, Logic, Services, Assembly, Production & Test

PASO SOUND PRODUCTS INC., 251 Park Ave. S., New York, N.Y., 10010, Tel: 212-254-2282; Empl.: 50; Minimum order: $25

For info on price: S. Goldberl; Application info: P. Mastrangelo; Customer service: A. Sgueglia; Delivery info: A. Sgueglia

Free literature available: Three Catalogs: General Line #33, Intercommunication Equipment #66, and Packaged Sound Systems #55 With Application Data 47, 48, 50, 51, 53, 54.

Products manufactured: Amplifiers, Comm. Systems, Horns, Microwave, Microphones, All Kinds, Mixers, Speaker Systems, Speakers, Transformers

Local Sales Offices & Reps.

Fla	North Miami Beach, L. Haas Co.	305-949-9143
Ga	East Point, P. Hayden Assocs.	404-766-0261
Ill	La Grange, E. N. Seversen & Assocs.	312-352-2055
Ind	Indianapolis, C. Scheffler Co.	317-253-6337
Mich	Brighton, Lectro Sls. Co.	313-632-7941
Minn	Minneapolis, A. J. Warner Co.	612-729-7371
Mo	Raytown, M. Taraski Sls. Co.	816-358-1442
NY	Jericho, Gim Sls. Corp.	516-433-4080
NY	Yonkers, J. Brown Electronic Sls. Reps.	914-779-7330
Ohio	Medina, J. H. Podolny Co.	216-725-8814
Tex	Houston, B. Rogers & Co.	713-626-5370
FOR:	Can., St. Laurent, Montreal, Que., PACO Electronics Ltd.	514-748-6787

PASTERNACK ENTERPRISES, 8538 Hamilton Ave., Huntington Beach, Cal., 92646, Tel: 714-536-7511; FSC No: 7F118; Empl.: 7; Minimum order: $35

Customer service: M. Pasternack

Free literature available: Data Sheet Package Describing All Products

Products manufactured: Amplifiers, Cable, Connectors, Demodulators

Local Sales Offices & Reps.

Cal	Los Angeles, RF Assocs.	213-478-1586
Cal	Palo Alto, RF Assocs.	415-327-5531
Colo	Boulder, A.L.S. Elctrns.	303-447-2436
Mass	Andover, Bee Assocs.	617-475-2124
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
NM	Albuquerque, A.L.S. Elctrns.	505-294-8555
NY	Huntington Station, Gray & Reed Assocs.	516-GE3-3333
NY	Syracuse, Syracuse Tech. Reps.	315-488-0222
Ohio	Cleveland, Comtel Sterling Co.	216-442-8080
Pa	Newton Square, SWR Assocs.	215-356-8550
Tex	Dallas, Southern Engrg. Co.	214-357-0669
Va	Bailey's Crossroads, Q.T. Elctrns. Sls.	703-671-4357
EXP:	Stamford, Conn., J.P. Int'l. Corp.	203-348-2691

PAYNE ENGRG. CO., Box 70, Scott Depot, W. Va., 25560, Tel: 304-755-4353, Telex: 88-5452; Empl.: 16; Minimum order: $10

For info on price: F. M. Griffin; Application info: F. M. Griffin; Customer service: I. Endicott; Delivery info: L. McElwee

Products manufactured: Controls/Control Eqpt., Fuses, Inverters, Limiters, Power Supplies, Rectifiers, Relays, Switches

Local Sales Offices & Reps.

Cal	Santa Fe Springs, Sierra-Pacific Eng.
Conn	Ridgefield, Himes Co.
Ga	Atlanta, H. Homer & Assoc.
Ill	Chicago, Ash Equip. Co.
Mass	Worcester, F. X. Bonneau Assoc.
Mich	St. Clair Shores, T. E. Redmond
Minn	St. Paul, Power/Mation Div.
Mo	St. Louis, Tines Ind. Sls.
NJ	Kenilworth, Wolock & Lott

NY	Oriskany, Knightsbridge Ind.	
NY	White Plains, Swedelco	
Ohio	Cincinnati, J. W. Murray & Assoc.	
Ohio	Cleveland, Collart Co.	
Okla	Tulsa, Components	
Pa	Frazer, Engineered Specialty Prods.	
Pa	Pittsburgh, Process Engrg. Co.	
Tex	Houston, Cordel Corp.	
Va	Richmond, Frazier & Co.	
Wisc	Oconomowoc, Power/Mation Division	
FOR:	Can., Toronto, Sigma Instrs. Can. Ltd.	

PCA ELCTRNS., INC., 16799 Schoenborn St., Sepulveda, Cal., 91343, Tel: 213-892-0761, TWX: 910-496-1525; Empl.: 35; Minimum order: $25

For info on price: Sls. Desk; Application info: Engrg. Dept.; Customer service: Sls. Desk; Delivery info: Sls. Desk

Products manufactured: Delay Lines, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg. Assocs., Inc.	602-277-1453
Cal	Mountain View, Caltron/Pyle	415-964-3244
Cal	San Diego, J.T.L. Assocs.	714-277-8044
Fla	Altamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-447-2533
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Westchester, W. G. Brouillette & Assocs., Inc.	312-345-6500
Iowa	Marion, Thomas & Modrcin Assocs., Inc.	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin Assocs., Inc.	913-432-2131
Md	Baltimore, R. P. Luce & Co., Inc.	301-752-8200
Mass	Stoneham, REPCO	617-438-3113
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Hazelwood, Thomas & Modrcin Assocs., Inc.	314-838-6446
NJ	Berkeley Heights, R. P. Luce & Co., Inc.	201-464-6440
NY	Fayetteville, H. C. Johnson Agencies	315-637-9383
NY	Guilderland, H. C. Johnson Agencies	518-465-9681
NY	New Hyde Park, R. P. Luce & Co., Inc.	516-437-4550
NY	Rochester, H. C. Johnson Agencies, Inc.	716-482-3000
Ohio	Cleveland, Weschler Elec. Co.	216-251-4609
Ohio	Dayton, Weschler Elec. Corp.	513-274-6972
Pa	Glenshaw, H. C. Johnson Agencies	412-961-0414
Pa	Philadelphia, R. P. Luce & Co., Inc.	215-884-8365
Tex	Dallas, Blackburn Assocs.	214-351-9992

PCB PIEZOTRONICS, INC., 5800 Transit Rd., Depew, N.Y., 14043, Tel: 716-684-0001, TWX: 710-263-1371; Empl.: 35

Products manufactured: Accelerometers, Amplifiers, Analyzers, Cells, Load, Signal Conditioners & Equipment, Transducers

Local Sales Offices & Reps.

Cal	Long Beach, Saber Entprs.	213-595-5646
Cal	Santa Clara, Richards Assocs.	408-246-5860
Conn	Hamden, Northeast Engrg., Inc.	203-248-4481
Fla	Orlando, Physimetrics, Inc.	305-894-8081
Ga	Atlanta, Physimetrics, Inc.	404-261-8720
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Md	Fulton, Gans-Fryling, Inc.	301-837-6311
Mass	Danvers, Northeast Engrg., Inc.	617-774-3010
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Pierce, Inc.	
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, Adelphi, Inc.	314-821-1232
NM	Albuquerque, Rustco Entprs.	505-296-6474
NY	Liverpool, Rayelco Elctrns., Inc.	315-652-5272
NY	Manhasset, Northeast Engrg., Inc.	516-365-9633
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-278-5873
Ore	Portland, Brett Assocs.	503-232-4184
Pa	Jenkintown, AMT	215-549-2080
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
Tex	Dallas, Tech. Prods., Inc.	214-357-9603
Va	Arlington, Gans-Fryling, Inc.	703-527-3262
Wash	Seattle, Brett Assocs.	206-935-8054

PCS., INC., 5467 Hill 23 Dr., Flint, Mich., 48507, Tel: 313-744-0225, TWX: 810-235-8667; Empl.: 90; Minimum order: $25

For info on price: A. D. Harmala; Application info: A. D. Harmala; Customer service: T. Wadsworth; Delivery info: A. D. Harmala

Free literature available: Micropac 80 - stand alone microcomputer development system. Has a full line of digital, analog & communications I/O. Micropac OEM - microcomputer system tailored to the OEM's application. Micropac RT - remote I/O for computers using a microcomputer at the process interface.

Products manufactured: Computers, Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Multiplexers

Local Sales Offices & Reps.

Cal	Culver City, Feeger Lucas & Wolfe	213-559-7200
Cal	Fullerton, PCS	714-992-4311
Cal	Los Altos, J. Stone & Assocs.	415-948-4563
Cal	Newport Beach, Feeger Lucas & Wolfe	
Cal	San Diego, Feeger Lucas & Wolfe	714-277-0993
Conn	Glastonbury, Lincoln Tech. Sls.	203-633-1380
Ill	Chicago, Solid State Elctrns. Ill.	312-889-8033
Kans	Shawnee Mission, Inland Assocs.	913-362-2366
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Reading, Lincoln Tech. Sls.	617-944-9594
Mich	Grand Rapids, Reps. Elctrns. Prods.	616-942-1320
Mich	Southfield, Reps. Elctrns. Prods.	313-354-9066
Minn	St. Paul, Cullen & Assocs.	612-646-7371
Mo	Glencoe, Inland Assocs.	314-938-4992
NJ	Bricktown, PCS	201-477-8080
NY	Mamaroneck, Cane Tech. Sls.	914-698-4411
Ohio	Cleveland, Instrumentation Sys.	216-486-0782
Ohio	Dayton, Instrumentation Sys.	513-294-2838
Pa	King of Prussia, S & S Assocs.	215-265-3450
Pa	Pittsburgh, Instrumentation Sys.	412-243-1111
Tex	Dallas, Evans & Mc Dowell Assocs.	214-238-7157
Tex	Houston, Evans & Mc Dowell Assocs.	713-772-1257
Wash	Bellevue, Topp Engrg. Sls. Corp.	206-747-5400
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529

PEARCE-SIMPSON, INC., Div/Gladding Corp., 4701 N.W. 77th Ave., Miami, Fla., 33166, Tel: 305-592-5550; Empl.: 200

For info on price: D. Henry; Application info: D. Henry; Customer service: M. Goldblatt; Delivery info: P. Zazzali

Products manufactured: Antennas, Comm. Systems, Direction Finders, Receivers, Transceivers

PEARSON ELCTRNS. INC., 4007 Transport St., Palo Alto, Cal., 94303, Tel: 415-326-7285; FSC No: 05280; Empl.: 20; Minimum order: $236

For info on price: C.Porter; Application info: D. Everton; Customer service: C. Porter; Delivery info: C. Porter

Products manufactured: Current Sensors, Dividers, Transformers

PECO CORP., 450-9 Landress Ave., Milpitas, Cal., 95035, Tel: 408-262-4050, Telex: 346-347; Empl.: 70; Minimum order: $10

For info on price: R. Jensen; Application info: J. Bellamy; Customer service: J. Bellamy

Free literature available: Catalogs upon request.

Products manufactured: Cards, Logic, Controls/Control Eqpt., Counters, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Modules, Logic, Encapsulated, Monitors, Racks, Relays, Switches, Transducers

Local Sales Offices & Reps.

Cal	Huntington Beach, W. Spell	714-963-6444
Cal	Milpitas, A. Khan	408-262-4050
Ga	Atlanta, J. Luttrell & Assocs.	404-237-4551
Ill	Chicago, F. M. Smith	312-763-3656
Mass	Cochituate, W. F. Humphrey Co.	617-653-7918
Mo	Creve Coeur, Williams Equipment Co.	314-997-1030
NJ	Bogota, Neville & Vespo	201-487-1505
NJ	Mine Hill, T. Regenczuk	201-366-5977
NJ	Willingboro, J. D. Miller	609-877-2031
NY	Rochester, H. M. Cross & Sons	716-442-6200
Ohio	Toledo, P. Hensing	419-478-4506
Tex	Dallas, Production Engrg. Sls. Org.	214-369-3181

PEERLESS RADIO CORP., 19 Wilbur St., Lynbrook, N.Y., 11563, Tel: 516-593-2121, TWX: 510-225-8422; Empl.: 40; Minimum order: $10

For info on price: Sls. Dept.; Application info: Sls. Dept.; Customer service: T. Corozzo; Delivery info: P. Hartill

Free literature available: Literature is available for all custom switch products Toggle, Pushbutton, Indicators, Manual Control, Reed, Magnetic etc.

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Fla	Oakland Park	305-566-5966

PENN AIRBORNE PRODS., Industrial Hwy., Southampton, Pa., 18966, Tel: 215-355-3400; FSC No: 25805; Empl.: 33; Minimum order: $25

Customer service: F. Pipito

Free literature available: Bulletin 201 Potentiometers-Portable; Bulletin 301 Bridges-Portable.

Products manufactured: Bridges, Indicators, Meters, Modules, Logic, Encapsulated, Potentiometers, Resistors, Standards, Testers

Local Sales Offices & Reps.

Cal	Palo Alto, Mauldin Co.	415-326-5291
Haw	Honolulu, Atecs Corp.	808-841-6694
Iowa	Des Moines, H.E. Ferris	515-255-1757
Mich	Royal Oak, Stillings Instr. Sys.	313-549-6030
Neb	Omaha, Interstate Ind'l. Inst.	402-331-3535
Ohio	Dublin, Analytco	614-889-1224
Ohio	W. Carrollton, Analytco	513-434-8940
Pa	Downingtown, Reinbrecht	215-265-6180
Pa	Pittsburgh, W. Wells	412-833-1632
Tex	Houston, Wilson-Mohr Inc.	713-781-2768
Va	Richmond, Instrument Technical Representatives	703-288-7198

PENN ENGRG. & MFG. CORP., Doylestown, Pa., 18901, Tel: 215-766-8853, TWX: 510-665-9338; FSC No: 46384; Empl.: 130; Minimum order: $10

For info on price: Sls. Dept.; Application info: J. Guba; Customer service: J. Guba; Delivery info: Sls. Dept.

Products manufactured: Fasteners, Machines/Machinery, Production, Terminals

PENN FIBRE & SPECIALTY, 2020 E. Westmoreland St., Phila., Pa., 19134, Tel: 215-RE 9-4862; Empl.: 40; Minimum order: $15

For info on price: W. H. Frey; Application info: W. K. Davis; Customer service: R. Wagner; Delivery info: E. Timms

Free literature available: Comparative Sample Chart of plastics and non-metallics showing typical properties and costs of materials most commonly used for electrical insulation in fabricated parts.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Fasteners, Gaskets, Shielding, R-F-Also See Shields, R-F, Insulators & Insulation, Laminates, Tubing, Wire Markers

Local Sales Offices & Reps.

Ill	Chicago, B. Finder & Assocs. Inc.	312-262-2020

PENN KEYSTONE CORP., Division St., Ansonia, Conn., 06401, Tel: 203-734-3301, Telex: 96-3554; FSC No: 03034; Empl.: 65; Minimum order: $25

For info on price: E. M. Parker; Application info: John Babina; Customer service: John Babina; Delivery info: E. M. Parker

Free literature available: Peaklite Indicator Lights - Series 7500 etal. An illustrated bulletin with fly sheets, describing a unique family of products for front-of-panel and rear-of-panel lighting. Message display is emphasized.

Products manufactured: Annunciators, Caps, Lenses, Indicator Light, Display Devices/Displays, Indicators, Lamps, Lights

Local Sales Offices & Reps.

Cal	Huntington Beach, ASC Sls. Co.	714-847-7515
Ind	Fort Wayne, Ryan Sls. Co., Inc.	219-483-9567
NJ	Pitman, Colrud Co.	609-589-5866
NY	Rochester, L. Hart Assoc., Inc.	716-244-3253
Ohio	Cincinnati, Tri-State Mktg., Inc.	513-761-7993
Tex	Arlington, Ion Associates, Inc.	817-461-9661

PENNTUBE PLASTICS, Madison Ave. & Holly St., Clifton Heights, Pa., 19018, Tel: 215-622-2300; Empl.: 145

Products manufactured: Tubing

Local Sales Offices & Reps.

Cal	Burlingame, Quintec Inds.	415-692-2010
Cal	El Segundo, Quintec Inds.	231-640-1400
Cal	San Diego, Quintec Inds.	714-276-6604
Colo	Denver, Industrial Elctrns., Inc.	303-771-2636

Conn	Woodbury, Hart, Nininger & Campbell Assocs.	203-263-4321
Fla	Largo, Almac Assocs.	813-581-0444
Ga	Atlanta, D. Wix	404-361-2550
Ill	Arlington Hgts., A. H. Walkie	312-394-8313
Ind	Indianapolis, Hoster & Sieloff Assocs.	317-844-9921
Kans	Overland Park, Ensco-Rep, Inc.	913-381-7557
Mich	Birmingham, Carmco, Inc.	313-642-2068
Minn	Minneapolis, D. A. Schultz Co.	612-FE9-7701
Mo	St. Louis, Ensco-Rep, Inc.	314-567-3935
NY	Mineola, R. A. Colucci Co.	516-746-0397
NY	Rochester, Potter Assocs.	716-288-3750
NC	Sanford, G. Simpson	919-776-3701
Ohio	North Olmsted, G. Blaney	216-777-4322
Pa	Aston, J. F. Walls	215-459-8377
Tex	Richardson, C. J. Garvey Co.	214-234-3371
Wash	Kirkland, Lehr Assocs.	206-827-4581
FOR:	Can., Montreal, Que., A. Gilchrist, Ltd.	514-735-3603
FOR:	Can., Rexdale, Ont., A. Gilchrist Ltd.	416-749-8755

PENTRONIX, 1735 Cicotte, Lincoln Park, Mich., 48146, Tel: 313-388-3100, Telex: 23-0398; Empl.: 12; Minimum order: $25

For info on price: A. Bazner; Application info: J. Schultz; Customer service: F. Wheeler; Delivery info: A. Bazner

Free literature available: Multipak Powder Compacting Press Brochure featuring three mode presses and anvil type presses.

Products manufactured: Machines/Machinery, Production

PERFECT GEAR & INSTR. DIV., Div. Designatronics, 18141 Napa, Northridge, Calif., 91324, Tel: 213-885-1781, TWX: 910-493-1241

Customer service: A. Cazier

Products manufactured: Brakes, Clutches, Couplings, Dials, Drives & Drive Mechanisms (Dial), Encoders, Gears & Gear Mechanisms (Precision), Limit Stops, Mechanical, Servo Systems

PERFECTION MICA CO., Magnetic Shield Div., 740 Thomas Dr., Bensenville, Ill., 60106, Tel: 312-766-7800, TWX: 910-256-4815; Empl.: 43 ....p. 2•1255-1257,2055

Products manufactured: Cable, Chamber, Environmental Test, Containers, Indicators, Insulators & Insulation, Kits, Shielding, Photomultiplier Tube Housings, Shields, Wire, Wire Shielding

Local Sales Offices & Reps.

Ala	Huntsville, Murcota Corp.	205-539-8476
Cal	San Carlos, Kottmeier Assoc.	415-592-8333
Cal	Woodland Hills, Cal-Ward Sls. Co.	213-833-2202
Colo	Denver, E. Johnson	303-985-4810
Conn	Wethersfield, Com/Pak	203-563-4784
Fla	Clearwater, L. Gentry Assoc.	813-443-2697
Ill	Hinsdale, Momak Sls.	312-654-4524
Kans	Shawnee Mission, Midwestern Sls. Co.	913-648-6414
Md	Bethesda, Mount & Co.	301-530-0012
Mass	Needham Heights, Com/Pak	617-444-1259
Minn	Minneapolis, E. Melius & Assoc.	612-854-4270
Mo	St. Louis, Midwestern Sls. Co.	314-961-6880
NJ	Moorestown, Electrical Comps., Inc.	609-235-3012
NJ	Mountain Lakes, Comps. for Elctrns.	201-334-2921.
NM	Albuquerque, IMEC	505-883-9010
NY	Buffalo, Telesco Assoc.	716-834-1026
NY	Rochester, Telesco Assoc.	716-271-3780
NY	Utica, Telesco Assoc.	
NC	Winston-Salem, Murcota Corp.	919-723-1001
Ohio	Dayton, F. Ohmer Assoc.	513-434-1454
Tex	Richardson, Air Quip Sls. Co.	214-234-3285
Utah	Salt Lake City, P. Bowthorpe Agency	801-521-9677
Wash	Seattle, J.B. Jolly	206-938-4166

PERKIN-ELMER CORP., Elctrn. Prods. Dept., Main Ave., Norwalk, Conn., 06856, Tel: 203-762-4786, TWX: 710-468-3213; Empl.: 40

For info on price: J. Sonntag 203-762-6574; Application info: W. Woschetzky 203-762-6574; Delivery info: J. Sonntag 203-762-6574

Free literature available: Short form catalog of Vernistat (A. C. Potentiometer) Function Generator, Transformer and Digital Converter Product Lines

Products manufactured: Converters, Generators, Potentiometers, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Mercury Engrg. Co.	602-945-1927
Cal	San Diego, Qualtronics Corp.	714-224-6555
Colo	Denver, Electrodyne Inc.	303-757-7679
Fla	Ft. Lauderdale, Snow Co.	305-563-2448
Ind	Greenwood, Valentine-Schillinger & Assoc.	317-888-2260
Ind	South Bend, Valentine-Schillinger & Assoc.	219-291-6258
Kans	Overland Park, ENSCO-Rep. Inc.	913-381-7557
Md	Temple Hills, Wyncote Instrumentation Co.	301-423-8523
Mich	Grand Rapids, Thies & Assocs.	616-457-2052
Minn	Eden Prairie, F. Peterson Co.	612-941-5400
Mo	St. Louis, ENSCO-Rep Inc	314-567-3935
NY	Syracuse, C.W. Floring & Assoc.	315-478-2149
Pa	Ambler, Wyncote Instrumentation Co.	215-643-2440
Tex	Dallas, Southern Engrg. Co.	214-357-0669
Wash	Bellevue, Conrard-Carlson Engrg. Co.	206-455-1336

PERKIN-ELMER CORP., Instr. Div., Main Ave., Norwalk, Conn., 06856, Tel: 203-762-1000, TWX: 710-468-3213; Empl.: 7300

Products manufactured: Amplifiers, Converters, Generators, Lenses, Optical & Camera, Potentiometers, Transformers

PERKIN-ELMER ULTEK INC., Box 10920, Palo Alto, Cal., 94303, Tel: 415-967-2100, TWX: 910-379-6442; Empl.: 180

Customer service: J. A. Leever Ext. 282

Free literature available: High vacuum equipment and Randex sputtering deposition equipment

Products manufactured: Chamber, Environmental Test, Deposition Equipment, Vacuum & Accessories, Detectors, Evaporation Equipment, Electron Beam, Feedthrus & Seals, Environmental, Furnaces, Gages, Ovens, Pumps, Vacuum, Services, Assembly, Production & Test, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Huntington Beach, Perkin-Elmer Ultek	714-968-1030
Cal	San Jose, Perkin-Elmer Ultek	408-292-7044
Ill	Wilmette, Perkin-Elmer Ultek	312-256-2688
Md	Gaithersburg, Perkin-Elmer Ultek	301-926-3200
Mass	Stoneham, H. W. Gath Assoc.	617-438-5428
NJ	Mountainside, Perkin-Elmer Ultek	201-232-1750
Ohio	N. Olmsted, Perkin-Elmer Ultek	216-331-4798
Tex	Richardson, Yardrough Southwest	214-690-0800

PERMA POWER DIV., Chamberlain Mfg. Corp., 845 Larch Ave, Elmhurst, Ill., 60126, Tel: 312-279-3600; Empl.: 1500

For info on price: N. Ackerman; Customer service: E. Michna; Delivery info: M. Shatz

Free literature available: Radio Control Catalog, describes available systems; Ampli-Vox Sound Systems Catalog, public address systems; Ladder Catalog, aluminum ladders; Perma Power Complete Line catalog, product groups.

Products manufactured: Amplifiers, Controls/Control Eqpt., Public Address Systems, Regulators, Speaker Systems, Speakers, Transformers

Local Sales Offices & Reps.

Ark	El Dorado, D. Bellew Sls.
Cal	San Francisco, Technical Sls. Assocs.
Cal	Van Nuys, Oberman-Renner Sls. Co.
Colo	Aurora, A. E. S.
Conn	West Hartford, R. Smith Co.
Ill	Lincolnwood, W. Linz & Assoc.
Ind	Ft. Wayne, N. Hoemig Sls. Co.
Mich	Plymouth, J. Malcolm Flora
Minn	St. Paul, W. Engelbretson Co.
Mo	Jefferson City, C. A. Vignola Assoc.
NJ	Cherry Hill, Trinkle Sls.
NY	Manhassat, Landau & Mack
NY	Phelps, L. S. M. Assocs.
NC	Greensboro, Adams & Assocs.
Ohio	Columbus, J. W. Lehner Co.
Tex	Dallas, Berthold Sls. Co.
Wash	Seattle, Fleehart & Sullivan

PERMAG CORP., 88-06 Van Wyck Expwy., Jamaica, N.Y., 11418, Tel: 212-657-1818; Empl.: 50

Customer service: C. Hemming

Free literature available: Literature on Magnetic Assemblies, Ferramics, ALNICO and Ceramics, Berlox and Heat Sinks.

Products manufactured: Cores, Ceramic, Cores, Magnetic, Demagnetizers, Ferrite Material & Parts, Magnetizers, Magnets

Local Sales Offices & Reps.

Cal	Los Angeles, Permag Pacific Corp.	213-776-5656
Cal	Menlo Park, Permag Sierra Corp.	415-369-0303
Ga	Atlanta, Permag Dixie Corp.	404-351-0994
Ill	Elk Grove Village, Permag Central Corp.	312-956-1140
Mass	Billerica, Permag Northeast Corp.	617-273-2890
Ohio	Toledo, Permag Magnetics Corp.	419-385-4621
Tex	Dallas, Permag Southwest Corp.	214-748-6909

PERMALUSTER, INC., 1844 N. Keystone St., Burbank, Calif., 91504, Tel: 213-849-4543; Empl.: 9

For info on price: H. D. Walker; Application info: H. D. Walker; Customer service: J. Ross

Free literature available: Technical catalog describing Permaluster process, properties of thin film insulation, thermal and mechanical properties, working techniques and applications.

Products manufactured: Coatings, Coils Including Assemblies & Forms, Films, Shields, Wire

PERMANENT MAGNET CO., 4437 Bragdon St., Indianapolis, Ind., 46226, Tel: 317-547-1336; Empl.: 150; Minimum order: $35

Customer service: J. M. Amigh

Products manufactured: Magnets

Local Sales Offices & Reps.

Cal	Pasadena, T.W. Yeakle	213-684-2275
Ill	Hillside, L.M. Holt, Permanent Magnet Co.	312-449-7660
Ind	Indianapolis, Hoster & Sieloff Assocs.	317-884-9921
Mass	Wakefield, Denning Assocs.	617-334-4099
Minn	Minneapolis, Peterson Entprs.	612-784-6628
NY	Manhasset, Kaelber & Mack, Inc.	516-627-6620

PERRY AMPLIFIER, 138 Fuller St., Brookline, Mass., 02146, Tel: 617-734-0844; Empl.: 18

For info on price: H. Rodman; Application info: G. Perry; Customer service: H. Rodman; Delivery info: P. Turcotte

Free literature available: Amplifier Catalog

Products manufactured: Amplifiers, Power Supplies

Advertisment

Ultra low noise (IDB typical) transistor amplifiers for use with infrared detectors and electrical transducers; voltage mode, current mode and automatic bias control. Standard models are available to match all infrared detectors and transducers produced in the U.S. and Europe. Multi-Element amplifier arrays are available in all operating modes with hybrid modules containing up to 100 signal channels.

Standard secondary function amplifiers such as; logarythmic, AGC, video, RF, etc., are also available from stock.

PERTEC, Peripheral Equip. Div., 9600 Irondale Ave., Chatsworth, Cal., 91311, Tel: 213-882-0030, TWX: 910-494-2093; Empl.: 523

For info on price: R. Gabai Ext. 485; Application info: R. Gabai Ext. 485; Customer service: J. Zedalis Ext. 561; Delivery info: L. Hemmerich Ext. 564

Free literature available: Data Sheets and Brochures Describing Technical Specifications, Applications, and Interface Requirements for Tape Transports, Disk Drives for Minicomputer Peripherals.

Products manufactured: Memory Systems, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ala	Birmingham, T.A. Instrs.	205-881-8494
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Encino, Pertec PED	213-996-1333
Cal	Los Altos, Pertec PED	415-964-9966
Cal	Santa Ana, Pertec PED	714-542-2348
Colo	Denver, BFA Corp.	303-744-3301
Conn	Stamford, Pertec PED	203-327-2260
Fla	Orlando, T.A. Instrs.	305-894-7531
Ill	Rosemont, Pertec PED	312-696-2460

Kans	Shawnee Mission, EIR Co.	913-362-0919
Mass	Waltham, Pertec PED	617-890-6230
Minn	Minnetonka, Pertec PED	612-933-1030
Mo	Hazelwood, EIR Co.	314-895-4100
NM	Albuquerque, BFA Corp.	505-296-8303
NM	Las Cruces, BFA of Arizona	505-523-0601
Ohio	Vandalia, Pertec PED	513-898-3150
Pa	Malvern, Pertec PED	915-644-4910
SC	Spartanburg, T.A. Instrs.	803-579-2904
Tex	Dallas, Pertec PED	214-692-0052
Tex	Dallas, Remtek	214-369-8146
Tex	Houston, Remtek	713-664-2113
Utah	Salt Lake City, BFA Corp.	801-466-6522
Wash	Seattle, Rush Drake Assocs.	206-763-2755

PERTEC CORP., 101 Continental Blvd., Ste. 435, El Segundo, Cal., 90245, Tel: 213-640-1540, TWX: 910-494-2093; Empl.: 1000

For info on price: W. T. Chambers 882-0030; Application info: J. Lembas 882-0030; Customer service: J. Zedalis 882-0030; Delivery info: T. Boren 882-0030

Free literature available: Sales Brochures/Data Sheets on the Following: (1) Tape Drives T5000 Series; T6000 Series; T7000 Series; T8000A Series; T9000 Series, (2) Memory Drives D3000 Series Disk, (3) FD400 Flexible Disk, (4) 7100 CRT Terminal.

Products manufactured: Drives & Drive Mechanisms (Dial), Terminals, Data Display (including Alphanumeric & Graphic), Transports, Tape (all kinds)

Local Sales Offices & Reps.

Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Encino, Pertec	213-996-1333
Cal	Los Altos, Pertec	415-964-9966
Cal	Santa Ana, Pertec	714-542-2348
Colo	Denver, BFA Corp.	303-744-3301
Conn	Stamford, Pertec	203-327-2260
Fla	Orlando, T. A. Instrs.	305-894-7531
Ill	Rosemont, Pertec	312-696-2460
Kans	Mission, E.I.R. Co.	
Kans	Shawnee, E.I.R. Co.	913-362-0919
Mass	Waltham, Pertec	617-890-6230
Minn	Minnetonka, Pertec	612-933-1030
Mo	Hazelwood, E.I.R. Co.	314-895-4100
NM	Albuquerque, BFA Corp.	505-296-8303
Ohio	Vandalia, Pertec	513-898-3150
Pa	Malvern, Pertec	215-644-4910
SC	Spartanburg, T. A. Instrs.	803-579-2904
Tex	Dallas, Pertec	214-387-2817
Tex	Dallas, Remtex	214-387-2817
Tex	Houston, Remtek	713-664-2113
Utah	Salt Lake City, BFA Corp.	801-466-6522
Wash	Seattle, Rush Drake Assoc.	206-763-2755

PESCHEL INSTRS., INC., 1412 Viscaya Pkwy., Cape Coral, Fla., 33904, Tel: 813-542-3164; FSC No: 92656; Empl.: 13; Minimum order: $15

For info on price: M. S. Mailly; Application info: F. Peschel; Customer service: W. J. Strobel; Delivery info: M. S. Mailly

Free literature available: Peschel Instruments' 25 page catalog of high voltage power supplies and test equipment, provides full specifications and prices on their line of standard units.

Products manufactured: Cable Fault Locators, Chokes, Converters, Current Sources, Detectors, Power Supplies, Probes, Reactors, Testers, Transformers

Local Sales Offices & Reps.

Fla	Orlando, Boynton & Assocs.	305-423-0555
Mass	Boston, Sandman Elec. Co.	617-442-7600
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
SC	West Columbia, R.W. Chapman & Co.	803-796-9796
Tenn	Concord, R.W. Chapman & Co.	615-966-6120

Advertisment

We manufacture a broad line of high voltage test equipment, power supplies and magnetic components as a standard line and built to order. Our 28 yrs. in business covers broad experience in DC-DC to 500 watts and 100KV; Regulated power supplies to 100KV at 0.01%; transformers and AC test sets to 300KV RMS & DC units to 400KV. Specials built to order.

PFC MANUFACTURING DIV., Community Dr., Great Neck, N.Y., 11022, Tel: 516-487-0500, TWX: 510-223-0888

PHAOSTRON INSTRUMENT, 151 Pasadena Ave., So. Pasadena, Cal., 91030, Tel: 213-255-1471, TWX: 910-321-4134; FSC No: 77221; Empl.: 250; Minimum order: $50

For info on price: B. Alexander; Application info: B. Alexander; Customer service: B. Alexander; Delivery info: b. Cox

Free literature available: Panel Meters (Anaolog) and Avionic Mechanisms.

Products manufactured: Meters

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest Engrg.	602-993-0250
Cal	Redwood City, Parks & Pruitt	415-364-1640
Cal	So. Pasadena, Phaostron	213-255-1471
Colo	Denver, Omega Ltd.	303-758-1508
Conn	Thomaston, N. Bennett Assoc.	203-283-5959
Ill	Hinsdale, Hill-Gray Assocs.	312-325-4810
Iowa	Cedar Rapids, J. R. Sales Co.	319-377-8211
Kans	Overland Park, Penzner Mankus Assoc.	913-381-0004
Mass	Auburn, N. Bennett Assoc.	617-757-3131
Mich	Detroit, Burcaw Co.	313-533-7700
Minn	Minneapolis, L. F. Green Assoc.	612-781-1611
Mo	Hazelwood, Penzner Mankus Assoc.	314-731-4334
NJ	Haddonfield, Thomas Assocs.	609-854-3011
NY	Great Neck, Trionic Assocs.	516-466-2300
NY	Syracuse, Lenard Co.	315-479-9191
Ohio	Cleveland, H. Baier Corp.	216-461-6161
RI	Thomaston, N. Bennett Assoc.	203-283-5959
Tex	Dallas, McCoy Assocs.	214-350-9931
Tex	Houston, E. Smith Sls. Co.	713-649-5756
Utah	Salt Lake City, Omega Ltd.	801-266-9617

PHILADELPHIA QUARTZ CO., Box 840, Valley Forge, Pa., 19482, Tel: 215-687-8400, TWX: 510-668-3432; Empl.: 800

Customer service: R. Attig

Free literature available: (PQ Bulletin #18-25) Describes the functions of and techniques for using QUSO microfine silica suspensions for polishing silicon wafers.

Products manufactured: Adhesives (All Types), Cleaners & Solvents, Metal Oxides, Semiconductor Wafer Fabrication

PHILAMON, INC., 33 Dubon Ct., Farmingdale, N.Y., 11735, Tel: 516-249-2700, TWX: 510-224-6512; Empl.: 27
p. 1•405,1020

Products manufactured: Choppers, Filters, Light Choppers, Oscillators, Tuning Forks

PHILIPS ELMET CORP., 1560 Lisbon Rd., Lewiston, Me., 04240, Tel: 207-784-3591; Empl.: 200; Minimum order: $100

Customer service: R. J. Boutin

Products manufactured: Contacts, Electrical, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Wire

Local Sales Offices & Reps.

NJ	Ramsey, R. A. Vachon	201-825-4070

PHILIPS TEST & MEASURING INSTRS., INC., 400 Crossways Pk. Dr., Woodbury, N.Y., 11797, Tel: 516-921-8880, TWX: 510-221-2120; Empl.: 25; Minimum order: $10

For info on price: E. Chwalisz; Application info: S. Rauch; Customer service: E. Chwalisz; Delivery info: E. Chwalisz

Products manufactured: Analyzers, Cameras, Counters, Generators, Kits, Training Aid, Meters, Oscilloscopes, Printers, Probes, Receivers, Recorders, Scanners

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Phoenix, Cleveland Ent.	602-996-6130
Cal	N. Hollywood, Philips Test & Measuring Inst.	213-762-2997
Cal	Santa Clara, Philips Test & Measuring Instrs.	408-243-7363
Colo	Arvada, Cleveland Entprs., Inc.	303-423-3707
Conn	Hartford, Victor Assocs.	203-246-5643
Del	Delaware, Wright Co.	301-948-5151
DC	Washington, D.C., Wright Co.	301-948-5151
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9796
Fla	Winterhaven, Lee Assocs.	813-294-5815
Haw	Honolulu, J.B. Jolly, Inc.	206-938-4166
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Iowa	Cedar Rapids, Palatine Sls.	319-365-8071
Kans	Andover, Palatine Sls.	316-683-7512
Kans	Overland Park, Palatine Sls.	913-262-5643
Md	Gathersburg, Wright Co.	301-948-5151
Mass	Framingham, Victor Assocs.	617-879-5710
Mich	Centerline, Dietrich & Assocs.	313-754-6450
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, Palatine Sls.	314-426-7055
NJ	Willingboro, Philips Test & Measuring Instr.	609-877-2293
NM	Albuquerque, Cleveland Entprs., Inc.	505-345-2481
NY	Syracuse, Tesco Mktg. Assocs.	315-463-4566
NY	Woodbury, Philips Test & Measuring, Inst.	516-921-8880
NC	Raleigh, Lee Associates, Inc.	919-787-5818
Ohio	Cleveland, Dietrich & Assocs.	216-781-1855
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Okla	Tulsa, Palatine Sls., Inc.	918-622-0321
Pa	Philadelphia, Philips Test & Measuring Inst.	215-677-5770
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
Tex	Austin, Palatine Sls., Inc.	512-451-7463
Tex	Houston, Palatine Sls., Inc.	713-777-4477
Tex	Richardson, Palatine Sls., Inc.	214-231-9489
Va	Virginia, Wright Co.	301-948-5151
Wash	Richland, Jon B. Jolly	509-783-6523
Wash	Seattle, J.B. Jolly, Inc.	206-938-4166

PHILLIPS MFG. CO., National Ultrasonic Div., 7334 N. Clark St., Chicago, Ill., 60626, Tel: 312-338-6200, Telex: 25-4507; Empl.: 75

Products manufactured: Cabinets & Accessories, Chamber, Environmental Test, Cleaners & Solvents, Cleaners, Ultrasonic, Generators, Machines/Machinery, Production, Racks, Transducers

Local Sales Offices & Reps.

Ariz	Phoenix, Arizona Abrasive & Supply Co.	602-244-9357
Cal	Pico Rivera, Acto-Kleen Co.	213-723-8505
Cal	San Mateo, Batina Machinery Co.	415-342-9554
Colo	Englewood, Todd Assocs.	303-761-7801
Conn	Ansonia, Foy Electro Chemical Co.	203-735-3331
Fla	Clearwater, Datco Inc.	813-531-4256
Haw	EWA Beach, Panther Chemical Co.	
Ill	Chicago, A. Wudi	312-338-6200
Ill	Chicago, W. Blomberg	312-338-6200
Ill	Rockford, R.R. Floody Co.	815-399-1931
La	New Orleans, Hester Engrg. Co.	504-866-2998
Md	Baltimore, W.L. Lawrence	301-235-4161
Mich	Detroit, J. Matteson	313-341-4030
Mich	Kalamazoo, L. Riege	616-342-6437
Minn	Minneapolis, Minnesota Ind'l. Tool Co.	612-333-8281
Mo	Kansas City, Ellfeldt Machinery Co.	816-842-5494
NJ	Teaneck, J. Dempsey	212-685-9137
NM	Albuquerque, R. Berg & Sons	505-299-8173
NY	Great Neck, W & A Holland, Inc.	516-487-8877
NY	New York, R. Balton	212-685-9137
NY	Skaneateles, R.M. Krause	315-685-5196
NY	Stow, K. Merrill	716-789-2645
NC	Charlotte, J. & P. Assocs.	704-525-5331
Ohio	Cincinnati, B. Bruns & Assoc.	513-931-4425
Ohio	Toledo, R. Deckelman	419-243-7161
Pa	Lancaster, Lightner Ind'l. Finishings	717-393-5541
Pa	Pittsburgh, L. Nourie, Inc.	412-561-1628
RI	North Scituate, R. Poyton	401-521-3522
Tex	Arlington, JMC Sls. Co.	817-261-1621
Wash	Seattle, Process Systems, Inc.	206-246-0224
WVa	Charleston, Preiser Scientific	304-343-5515
Wisc	Milwaukee, Industrial Abrasives Co.	414-383-5700

PHILMORE MFG. CO. INC., 40 Inip Dr., Inwood, N.Y., 11696, Tel: 516-239-6161; Empl.: 25; Minimum order: $25

For info on price: M. Greenker; Application info: E.M. Rothenstein; Customer service: M. Greenker; Delivery info: I. Koff

Free literature available: Philmore Master Catalog #745 Philmore Industrial Catalog #M16 Philmore Consumer Mini-Catalog #100

Products manufactured: Amplifiers, Cable, Capacitors, Fixed, Capacitors, Variable, Clamps & Clips, Connectors, Cords, Grilles, Jacks (All Types), Knobs, Leads, Test & Adaptors, Lights, Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Networks, Pickups, Telephone (For Recording), Plug Adapters, Plug & Jack Sets, Posts, Potentiometers, Power Supplies, Sockets, Soldering Guns, Irons & Desoldering Tools, Speakers, Switches, Testers, Tools, Transformers

PHIPPS & BIRD, P.O. Box 2V, Richmond, Va., 23205

PHOENIX DATA INC., 3384 W. Osborn Rd., Phoenix, Ariz., 85017, Tel: 602-278-8528, TWX: 910-951-1364; Empl.: 57 .... p. 1•190-193

Customer service: R. D. Brunnemer

Products manufactured: Amplifiers, Comm. Systems, Commutators, Converters, Data Acquisition & Reduction Systems, Data Loggers, Meters, Multiplexers

Local Sales Offices & Reps.

Ariz	Tempe, J. Cain Assocs.	602-838-3404
Cal	Burbank, EM Southwest	213-846-9373
Cal	San Diego, Dorado Sls.	714-487-1974
Cal	Sunnyvale, RDP Instrs., Inc.	408-735-9040
Fla	Orlando, Datarep	305-843-5224
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Electronic Instrs. Assocs.	312-271-3774
Ind	Indianapolis, Electronic Instrs. Assocs.	317-257-7231
Kans	Shawnee Mission, Inland Assocs.	913-362-2366
Md	Ellicott City, Whitco	301-366-1216
Mass	Norwood, Forster Assocs.	617-543-5041
Mo	Glencoe, Inland Assocs.	314-938-4992
NJ	Fort Lee, Tecnimat	201-461-8686
NJ	Pennsauken, Megargel/Himmelstein	215-629-1072
NY	Schenectady, Alexander Assocs.	518-377-0581
Tex	Richardson, Barry Sls.	214-234-0255
Wash	Bellevue, Topp Engrg. Sls. Corp.	206-747-5401

PHOENIX TRANSFORMER CO., 1818 E. Madison, Phoenix, Ariz., 85034, Tel: 602-254-9747, TWX: 910-951-0631; Empl.: 50

Products manufactured: Chokes, Coils Including Assemblies & Forms, Filters, Regulators, Transformers

Advertisment

A complete facility for engineering and production of military and industrial transformers designed for your exact application. Stock and facility for volume production. We specialize in constant voltage units. Call or write for prompt quotations.

PHOENIX WIRE, INC., 100 Teflon Ave., S. Hero, Vt., 05486, Tel: 802-372-4561; Empl.: 25

Customer service: A. Legge

Free literature available: Folder describing specail subminiature & microminiature hook-up wires & cables especially valuable in miniaturization applications.

Products manufactured: Cable, Services, Assembly, Production & Test, Tubing, Wire

Advertisment

Micro-Miniature High-Reliability Wires. Phoenix Wire specializes in the custom application of Teflon to fine wires. Guages 14 to 60 of any composition can be insulated with less than .000025 to over .006 inches of Teflon. Custom cut & strip service for all types of insulated wires also available. Call us for all types of Teflon Hook-up Wires-Teflon Tubing, and Teflon Magnet Wire.

PHONE-AID CO., Sub. of Wells-Gardner Elctrns., 2701 N. Kildare, Chicago, Ill., 60639, Tel: 312-252-4610; Empl.: 25; Minimum order: $100

For info on price: J. Remec; Application info: Dr. Matthew; Customer service: J. Remec; Delivery info: Dr. Matthew

Products manufactured: Cable, Comm. Systems

PHOTO CHEMICAL PRODS. CAL., 1715 Berkeley, Santa Monica, Cal., 90404, Tel: 213-828-9561; Empl.: 60

For info on price: J. T. Cain; Application info: J. T. Cain; Customer service: R. Taylor; Delivery info: S. Jocsing

Products manufactured: Cabinets & Accessories, Caps, Lenses, Indicator Light, Coatings, Delcalcomania, Dials, Display Devices/Displays, Escutcheons, Kits, Marking (Dial, Instrument, Equipment, etc.), Labels, Pressure-Sensitive, Adhesive, Laminates, Lenses, Readout & Display, Lights, Nameplates, Scales, Dial, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ariz	Tempe, N. A. Page	602-838-1128
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Colo	Denver, W. J. Purdy Co.	303-777-1411
Ill	La Grange, Bierhaus Sls.	312-345-5100
Md	Bethesda, W. Mount Co.	301-657-9312
Mass	Needham, W. Mahoney	617-444-3372
Mich	Lathrup Village, R. C. Nordstrom & Co.	313-333-4417
Minn	Minnetonka, T. H. Ayre Assocs.	612-474-4125
Mo	Kansas City, L. F. Florence Co.	816-561-7222
NJ	Nutley, Falk-Baker Assocs.	201-661-2430
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	N. Syracuse, H. R. Murray	315-446-5555
Ohio	Dayton, Dynel Co.	513-789-8150
Pa	Haverton, Liberi Sls.	215-789-8150
Tex	Dallas, W. Reese Assocs.	214-638-6575
Wisc	Milwaukee, Bierhaus Sls.	414-332-0900

PHOTO RESEARCH CORP., Division Kollmorgen Corp., 3000 N. Hollywood Way, Burbank, Cal., 91505, Tel: 213-849-6017; Empl.: 40; Minimum order: $10

Customer service: F. Grover

Free literature available: A wide variety of product bulletins describing complete photometer/radiometer light measuring instrumentation line. Also technical reprints on many of the products.

Products manufactured: Light Sources, Photoelectric, Meters, Radiometers, Test Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns	205-881-5031
Cal	N. Hollywood, O'Halloran Assoc.	213-877-0173
Cal	Palo Alto, O'Halloran Assoc.	415-326-1493
Cal	San Diego, O'Halloran Assoc.	714-224-2824
Fla	Ft. Lauderdale, Beacon Elctrns	305-776-6074
Fla	Maitland, Beacon Elctrns	305-647-3498
Ga	Atlanta, Beacon Elctrns	404-351-3654
Haw	Honolulu, Pacific Instrumentation	808-373-1287
Ill	Hoffman Estate, Mist Engrg	312-885-3432
Md	Silver Spring, Spectroscopy Sys.	301-949-8261
Mass	Billierica, Drew Assocs.	617-667-6643
Mo	St. Louis, G. Fixman Engrg. Co.	314-725-5219
NJ	East Orange, Friedman Assocs.	201-673-2500
NM	Albuquerque, Southwestern Engrg. & Equip.	505-265-6775
NC	Greensboro, Beacon Elctrns	
Ohio	Rising Sun, Mecom, Inc.	419-457-3231
SC	Spartanburg, Beacon Elctrns	803-582-4613
Tex	Dallas, Southwestern Engrg. & Equip. Co.	214-826-6661
Tex	Houston, Southwestern Engrg. & Equip. Co.	713-353-4333
Wash	Bellevue, C.W. Fowler Co.	206-454-8600

PHOTOBELL CO., INC., 12M East 22nd St., New York, N.Y., 10010, Tel: 212-674-2121; Empl.: 30; Minimum order: $10

Customer service: A. Edelman

Free literature available: Photoheads and Prices, Bulletin RP, Reflex photohead applications RPX, 115V Reflex photorelays, RPXLA, Drop through count sensors, CPDTR1 Photoelectric burglar alarms, BP Safety light curtain for machy SAO, Conveyorized Inspections 3535IT
Daylight control of lamps, etc. Capacitance proximity uses, RCA

Products manufactured: Alarms, Character Recognition Systems, Controls/Control Eqpt., Counters, Detectors, Indicators, Services, Assembly, Production & Test, Switches

Advertisment

Photoelectric and capacitive devices, methods, ideas for machines, instruments, production lines; to trigger, control, sort, alarm, count, inspect, reject, measure, sense. Low prices, custom designs for infrared and visible light projectors, receivers, reflex photoheads, solid-state logic circuits to fit need. Intrusion alarms, smoke sensors, safety guards.

PHOTOCIRCUITS DIV., KOLLMORGEN CORP., 31 Sea Cliff Ave., Glen Cove, N.Y., 11542, Tel: 516-448-1000, TWX: 516-671-3155; Empl.: 850

Customer service: J. Tabak

Products manufactured: Boards, Printed Circuit, Chemicals, Circuits, Printed, Multilayer, Coatings, Motors

PHOTOMATION, INC., Box 460, Mountain View, Cal., 94041, Tel: 415-967-8992; Empl.: 12; Minimum order: $10

For info on price: S. Pedersen; Application info: R. Heinsoth

Free literature available: Catalog #731 Photoelectric Controls as used in automation.

Products manufactured: Controls/Control Eqpt., Counters, Scanners

Local Sales Offices & Reps.

Cal	Millbrae, Call Assoc.
Fla	Orlando, B. Woodruff, Inc.
Haw	Honolulu, Amfac Distribution Co.
Ill	Glen Ellyn, Control Dynamics
Ind	Indianapolis, Sukup & Cox, Inc.
Kans	Kansas City, Process Svce. & Equip. Co.
Mass	Sturbridge, Electrical Apparatus Co.
Mich	Detroit, R.D. Ernest & Assoc.
Minn	Minneapolis, Pilot Industries Corp.
Mo	St. Louis, Schwaig Engrg. Co.
NY	Brooklyn, Eastern Elctrn. Sls.
NY	Syracuse, Thomas J. McGough
Ohio	Cincinnati, Jeffrey Equip Co.
Ohio	Cleveland, Adcon Eng. Co.
Ore	Portland, Dynatech
Pa	Narberth, Clayton A. Denault
Tenn	Chattanooga, C.H. Cloer & Assoc.
Tex	Houston, Electrical Instr & Meter Co.
Utah	Salt Lake City, E. C. Coffin Co.
Va	Richmond, Martin's Control & Equip. Co.
Wash	Airway Heights, Calvert Controls
Wash	Medical Lake, Calvert Controls Inc.
Wash	Seattle, C. Stebbins
WVa	Charleston, Engrg. Prods. Co.
Wisc	Milwaukee, G.H. Fredericks & Co.

PHOTRON INSTRUMENT CO., 6516 Detroit Ave., Cleveland, Ohio, 44102, Tel: 216-281-7020; Empl.: 10

Products manufactured: Meters, Oscillographs, Direct Writing, Recorders

Advertisment

GALVANOMETERS: Low cost, for OEM applications; miniaturized and conventional types. A wide range of coil impedance and torque is offered and may be tailored to customer requirement. Frequency response available from d.c. to 75 Hz. Suitable for solid state or high resistance circuitry. OSCILLOGRAPHS: Custom engineered for OEM, complete or subassemblies.

PHYSICAL DATA, INC., 5160 N. Lagoon Ave., Portland, Ore., 97217, Tel: 503-283-5116; Empl.: 12; Minimum order: $25

For info on price: B. Gibbons; Application info: G. Caspell; Customer service: B. Gibbons; Delivery info: B. Gibbons

Products manufactured: Analyzers, Recorders

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Scottsdale, Measurement Consultants	602-944-9519
Cal	Inglewood, C. Fowler Co.	213-678-5211
Cal	Menlo Park, C. Fowler Co.	415-322-5374
Colo	Boulder, Measurement Consultants	303-449-5294
Conn	Hamden, Equipment Sls.	203-248-5581
Fla	Miami, Lee Assocs.	305-525-9796
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ga	Chamblee, Lee Assocs.	404-457-7117
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, C. Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	Chelmsford, Equipment Sls.	617-256-8547
Mich	Detroit, Comtel-Sterling	313-255-1970
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NM	Albuquerque, Measurement Consultants	505-265-6471

NY	Williamsville, M. Bennett Assocs.	716-634-2107
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Cleveland, Comtel-Sterling	216-442-8080
Ohio	Dayton, Comtel-Sterling	513-298-7573
Pa	Pittsburgh, Comtel-Sterling	412-922-5720
Utah	Murray, Measurement Consultants	801-268-3181
Wash	Bellevue, C. Fowler Co.	206-454-8600
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

PHYSICAL ELECTRONICS LABS., 1185 O'Brien Dr., Menlo Park, Cal., 94025, Tel: 415-323-9092; Empl.: 25

Customer service: R. A. Craig

Products manufactured: Discriminators, Filters, Generators, Limiters, Oscillators, Tuners

Local Sales Offices & Reps.

Cal	Los Altos, Cain-White Co.	415-948-6533
Cal	Los Angeles, Cain Tech. Inc.	213-476-2251
Fla	Clearwater, Brennan Assocs., Inc.	813-446-5006
Ill	Mt. Prospect, R. Forlaw dba Cain & Co.	312-253-3578
Md	Lanham, Brimberg Assocs., Inc.	301-552-2200
Mass	Reading, Geder-Rotundi Assocs.	617-944-3105
NJ	Livingston, G & A Sls.	201-992-3087
NY	North Syracuse, NACO Elctrns. Corp.	315-699-2651
Ohio	Dayton, J. Tennison dba Cain & Co.	513-254-6521
Ohio	Reynoldsburg, R. Hansel, dba Cain & Co.	614-861-2119
Tex	Dallas, Cain & Co.	214-233-6809
Wash	Seattle, Datacom Assocs.	206-325-5193

PHYSICAL ELECTRONICS INDUSTRIES, 6509 Flying Cloud Dr., Eden Prairie, Minn., 55343, Tel: 612-941-5540, Telex: 29-0407; Empl.: 90

For info on price: M. Gorder; Application info: M. Gorder; Customer service: L. Yarger; Delivery info: M. Gorder

Free literature available: Auger Electron Spectrometers; Thin Film Analyzer for an elemental analysis of thin films; Scanning Auger Microprobe for comprehensive surface elemental analysis; *Condensed product catalogue; ESCA/Auger Electron Spectrometer for surface elemental analysis with ESCA or Auger Electron Spectroscopy.

Products manufactured: Spectrometers

Local Sales Offices & Reps.

Cal	San Jose	408-247-7767
Ill	Park Ridge	312-297-7730
Mass	North Attleboro	617-695-7504
NJ	Springfield	201-376-3650
Tex	Richardson	214-231-8661

PIC DESIGN DIVISION, Benrus Corp., Box 335, Benrus Ctr., Ridgefield, Conn., 06877, Tel: 203-431-1500, TWX: 710-467-0666; Empl.: 150; Minimum order: $10

For info on price: Sls. Dept. 203-431-1500; Application info: E. Hansen 203-431-1517; Customer service: J. Able 203-431-1506; Delivery info: Expediting Dept. 203-431-1521

Free literature available: PIC Catalog #37 explicitly defines over 35,000 precision mechanical components and assemblies supplied from stock.

Products manufactured: Bearings, Brakes, Cams, Clutches, Counters, Couplings, Dials, Drives & Drive Mechanisms (Dial), Fasteners, Gearheads & Speed Reducers, Gears & Gear Mechanisms (Precision), Handles For Cabinets, Circuit Boards, Racks, etc., Jigs And Fixtures, Chassis & Circuit Board, Kits, Breadboarding (For Engineers), Kits, Training Aid, Knobs, Limit Stops, Mechanical, Locks, Dial & Shaft, Nameplates, Pins, Pointers, Dial, Potentiometers, Power Supplies, Reducers, Rings, Retaining, Spacers, Springs (All Types)

Local Sales Offices & Reps.

Ill	Chicago, F. Tye Sls. Co.	312-283-1227
Ind	Fort Wayne, Hoemig Sls. Co.	219-483-6913
Ohio	Cleveland, J. O. Olsen Co.	216-752-5444
Pa	Philadelphia, K. B. Erdman Co.	215-224-1833
Tex	Dallas, Robco Inc.	214-631-7191

PICKERING & CO., Meas. & Controls Div., 101 Sunnyside Blvd., Plainview, N.Y., 11803, Tel: 516-681-0200; Empl.: 300

For info on price: A. Eidmann; Application info: R. P. Zupa; Customer service: A. Eidmann; Delivery info: A. Eidmann

Products manufactured: Indicators, Transducers

Local Sales Offices & Reps.

Cal	Los Angeles, Fetty/Schoenduve, Inc.	213-651-4050
Colo	Denver, Walter Engrg. Assoc.	303-777-5585
Ill	Lombard, Quadtron Assoc. Inc.	312-627-6800
Mass	Norwell, Bordewieck Engrg. Sls. Co.	617-659-4915
Mich	Ferndale, Tiby Co.	313-547-3550
NJ	North Caldwell, Masin, Esco, Inc.	201-226-2550
NY	Liverpool, Rayelco Elect. Inc.	315-652-5272
NY	Syosset, Masin Esco, Inc.	516-364-0310
Ohio	Cleveland, Tiby Co.	216-371-5335
Pa	Bethayres, Control Instr. Sls. Co.	215-OR 6-1808
Tex	Dallas, G. Weinreich & Assoc.	214-321-2800
Wash	Seattle, G. M. Gillett	206-284-5324

PICO CRIMPING TOOLS CO., 9832 Jersey Ave., Santa Fe Springs, Calif., 90670, Tel: 213-723-2150; Empl.: 12

Products manufactured: Tools

PICO ELCTRNS. INC., 50 S. Macquesten Pkwy., Mount Vernon, N.Y., 10551, Tel: 914-699-5514 ... p. 2•1778-1783

Customer service: J. Sweeney

Free literature available: Catalog 2002, Ultra-Miniature Transformers

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	Orange, Sls. & Mktg. Assocs.	714-997-5720
Cal	Santa Clara, Fisher Assocs.	408-733-7350
Colo	Littleton, Piper-Goyne	303-798-8955
Conn	Waterbury, Selmark Assocs.	203-754-3060
Ga	Atlanta, Grady Duckett Sls. Co.	404-451-3529
Mass	Millis, Selmark Assocs. Inc.	617-376-2914
Minn	Minneapolis, F. B. Hill & Co.	612-941-5270
Mo	St. Charles, Buckman & Assocs.	314-724-6690
NH	Plaistow, Selmark Associates Inc.	603-382-4796
NM	Albuquerque, Piper-Goyne	505-294-1436
Ohio	Dayton, BEK Assocs. Inc.	513-278-1343
Tex	Houston, Vista Engrg.	713-661-0119
Tex	Richardson, Vista Engrg.	214-235-4547
Wash	Seattle, W. Spaulding Co.	206-282-9173

PICONICS INC., Cummings Rd., Tyngsboro, Mass., 01879, Tel: 617-649-7501, TWX: 710-347-6663; Empl.: 48

Products manufactured: Coils Including Assemblies & Forms, Transformers

Local Sales Offices & Reps.

Cal	No. Hollywood, Jewett Co.	213-789-8103
Cal	Palo Alto, J/M Assocs.	415-327-1261
Fla	Longwood, Lenz Engrg.	305-831-9797
Mass	Wayland, Wayland Engrg. Sls. Co.	617-655-6080
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NY	Huntington, Regulus Ind'l. Sls. Co.	516-271-7966
NY	Utica, Micro Comp. Sls.	315-733-2460
Pa	Lansdowne, W. F. Satterthwaite & Co.	215-623-5100
Tex	Addison, Southland Comps.	214-233-0603
EXP:	Huntington, N.Y., Regulus Ind'l. Sls. Co.	516-271-7966
FOR:	Can., Waters Metal Prods.	716-285-3595

PIEZO CRYSTAL CO., 100 "K" St., Carlisle, Pa., 17013, Tel: 717-249-2151; Empl.: 250

Customer service: S. Stone

Free literature available: General product catalog giving major performance characterisitcs and popular closure configurations.

Products manufactured: Crystal Blanks, Crystals, Discriminators, Filters

PIEZO TECHNOLOGY INC., Box 7877, 2400 Diversified Way, Orlando, Fla., 32804, Tel: 305-425-1574, TWX: 810-850-4136; FSC No: 25120; Empl.: 320 ... p. 1•406,407

For info on price: H. C. Schinaman; Application info: H. C. Schinaman; Customer service: D. Worrell; Delivery info: D. Worrell

Free literature available: Data Sheets: Stock Monolithic Crystal Filters, 5 to 180 MHz, Reprint: "Communications Systems Benefit from Monolithic Crystal Filters"

Products manufactured: Crystals, Filters

Local Sales Offices & Reps.

Cal	San Mateo, Melvin Sls. Co.	415-349-7444
Cal	Van Nuys, R.L. Assocs.	213-780-1666
Colo	Denver, Walter Engrg. Assoc.	303-777-5585
Fla	Maitland, Ellis & Assocs.	305-645-1101
Ill	Chicago, T.B. Hunter Assocs.	312-777-2500
Ind	Greenwood, V. Schillinger & Assocs.	317-888-2260
Md	Baltimore, C.O. Emrich	301-747-8348
Mass	Randolph, TX Sls., Inc.	617-986-6080
Mich	Brighton, V. Schillinger & Assocs.	
Minn.	St. Paul, Barnes Sls. Assocs.	612-474-2907
NJ	Haddonfield, Mesa Tech. Assocs.	609-429-9531
NY	Buffalo, Quality Comps., Inc.	716-839-2044
NY	Smithtown, TX Sls. Inc.	516-979-8750
NC	Greensboro, L&D, Inc.	919-292-3201
Tex	Dallas, Stevens Sls.	214-350-2476

PIHER INT'L. CORP., 1239 Rand Rd., Des Plaines, Ill., 60016, Tel: 312-297-1560, Telex: 28-2514; Empl.: 3000

Products manufactured: Potentiometers, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Cal	Pico Rivera, Westrep	213-949-2251
Ill	Mt. Prospect, Delta Tech. Sls.	312-437-9412
Kans	Shawnee Mission, Admack Sls.	913-432-5550
Minn	St. Louis Park, Beta Engrg.	612-925-4422
Mo	Kansas City, T. Mac Collough	816-561-5758
NJ	Cherry Hill, Trinkle Sls.	
NM	Albuquerque, Cleveland Entprs.	505-345-2481
NY	Garden City, Comtronic Assoc.	
NY	Rochester, Ossmann Component Sls. Corp.	716-442-3290
Ohio	Cincinnati, Sheridan Assoc.	513-761-5432
Tex	Dallas, Norvell Assocs.	214-350-6771
Wash	Seattle, C.K. Shanks & Assoc.	206-632-4290
FOR:	Can., Downsview, Ont., Weber Elctrns.	416-638-1322

PINLITES, See Refac/Pinlites

PIONEER ELEC. & RESCH. CO., 743 Circle Dr., Forest Park, Ill., 60130, Tel: 312-771-8242

Customer service: J. W. Bullock

Products manufactured: Lights, Tachometers

PIONEER INSTRUMENTATION, 4800 E. 131st St., Cleveland, Ohio, 44105, Tel: 216-587-3600; Empl.: 10

Customer service: L. Sullin

Products manufactured: Calibrators, Comparators, Meters, Standards

Local Sales Offices & Reps.

Ill	Chicago, Pen-Vel Assocs.	312-248-4343
NY	Mamaroneck, Cane Tech. Sls.	914-698-4411
Ohio	Cleveland, Pioneer/Instrumentation	216-587-3600
Pa	Media, W. Reeves Assocs.	215-566-6709

PIONEER MAGNETICS, 1745 Berkeley St., Santa Monica, Cal., 90404, Tel: 213-829-3305, TWX: 910-343-6249; FSC No: 08676

For info on price: A. Hagiwara; Application info: G. Held; Customer service: G. Held; Delivery info: A. Hagiqara

Products manufactured: Converters, Current Sensors, Power Supplies, Testers, Wire Strippers

PITTMAN CORP., Sellersville, Pa., 18960, Tel: 215-257-5117, TWX: 510-661-5086; Empl.: 92; Minimum order: $40 ... p. 1•976,977

For info on price: C. Pittman; Application info: C. Pittman; Customer service: C. Pittman; Delivery info: J. Parker

Free literature available: Data sheets descriptive of miniature low voltage; DC servo motors, gearmotors, and motor-tachometers commercial.

Products manufactured: Motors, Tachometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Williams-Assocs.	602-947-4297
Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700
Colo	Denver, Williams-Assocs.	303-373-4730
Fla	Ft. Lauderdale, Tropi-Tec Co.	305-523-4988
Ill	Chicago, K-W Assocs.	312-792-2618
Ind	Fort Wayne, Neal Engrg. Co.	219-484-5090
Ind	Indianapolis, Neal Engrg. Company	317-849-4201
Mass	Salem, Forbes Engrg.	617-744-1693
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Mich	Grand Rapids, J. C. Hofstetter Co.	616-942-0650
Mo	St. Louis, Gordon Fixman Engrg.	314-725-5219
NJ	Summit, R.A. Potter Assocs.	201-277-0220
NM	Albuquerque, Williams-Assocs.	505-255-1638
NY	Buffalo, Application Specialists	716-834-3377
NY	East Syracuse, Application Specialists	315-437-2813
NY	Rochester, Application Specialists	716-586-6226
NC	Charlotte, Electro-Rep Assocs., Inc.	704-527-2530
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010

Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Okla	Tulsa, Blair Engrg. Sls. Co.	918-663-9850
Ore	Portland, Donal Co.	503-246-3131
Tex	Dallas, Blair Engrg. Sls. Co.	214-352-8411
Tex	Houston, Blair Engrg. Sls. Co.	713-667-9864

PLASTIC CAPACITORS, INC., 2620 N. Clvbourn Ave., Chicago, Ill., 60614, Tel: 312-348-3735, TWX: 910-221-1354; FSC No: 99120; Empl.: 125

For info on price: D. Powalish; Application info: Sls. Dept.; Customer service: S. Ludwig; Delivery info: S. Ludwig

Free literature available: Engineering oriented booklet of conversion factors and electronic formulae. Ideal for use with a pocket calculator. Booklet will fit in most calculator pouches.

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Networks, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, B.J.R., Inc.	205-881-3569
Cal	Los Altos, Parsons & Meister, Inc.	415-941-4745
Cal	Los Angeles, E.E. Strassner Co.	213-666-1511
Conn	Meriden, Eagle Assocs.	203-235-9036
Ill	Chicago, Carlson Elctrn. Sls. Co.	312-774-4812
Ind	Fort Wayne, W.W. Bieberich, Inc.	219-432-2537
Ind	New Albany, W.W. Bieberich, Inc.	812-945-3187
Kans	Shawnee Mission, Carlson Elctrn. Sls. Co.	913-432-2144
Md	Hyattsville, Eastern Comps.	301-577-2925
Mass	Boston, Eagle Assocs.	617-444-3446
Minn	Minneapolis, J. J. Exon Co.	612-566-5340
Mo	St. Louis, Carlson Elctrn. Sls. Co.	314-991-0262
NJ	Springfield, F.F. Sylvester Assoc.	201-376-3324
NY	Baldwinsville, E. Scovel Co.	315-652-9798
NY	Rushville, E. Scovel Co.	315-584-6522
Ohio	Cleveland, Electro-Com	216-886-2404
Ohio	Dayton, Electro-Com	513-276-3993
Pa	Flourtown, Eastern Comps., Inc.	215-836-1616
Pa	York, Eastern Comps., Inc.	717-764-3114
Tex	Dallas, Packard Assocs.	214-357-5713
Wisc	Milwaukee, Carlson Elctrn. Sls. Co.	414-476-2790
EXP:	New York, N.Y., B. Freudenberg	212-757-9130

PLASTICS ENGRG. CO., 3518 Lakeshore Rd., Sheboygan, Wisc., 53081, Tel: 414-458-2121, TWX: 910-264-3873; Empl.: 475

For info on price: L. L. Korb Ext. 323; Application info: L. L. Korb Ext. 323; Customer service: J. D. Ellis Ext. 331; Delivery info: J. Potochnik Ext. 244

Free literature available: Brochure "PLENCO" Gives descriptions, applications, typical values for PLENCO molding compounds (phenolics; melamine-phenolics and alkyds) and PLENCO phenolic resins. Also describes molding processes and PLENCO facilities.

Products manufactured: Compounds, Encapsulating, Insulating, Molding, Potting, Plastic Raw Materials, Liquids, Pellets, Powders, Resins

Local Sales Offices & Reps.

Ill	Arlington Heights, H. Sanders	312-437-6930
Ill	La Grange Park, O. B. Buss	311-354-4285
Ill	Schaumburg, J. Wood	312-894-7038
Mich	Marshall, B. L. Young	616-781-5415
Mo	Manchester, K. A. Pickell	314-527-0476
NJ	North Plainfield, S. C. Dusza	201-757-2059
Ohio	Grafton, E. D. Larrick	216-458-4570
Pa	Doylestown, R. P. Draper	215-348-3666
Pa	Erie, N. B. Duffett	814-833-4386
Wisc	Plymouth, R. T. Johnson	414-892-8556
Wisc	Sheboygan, F. Shaw	414-452-7849

PLATT LUGGAGE, 2301 S. Prairie, Chicago, Ill., 60616, Tel: 312-225-6670; Empl.: 75

For info on price: M. Platt; Application info: M. Platt; Customer service: J. Persons; Delivery info: J. Persons

Free literature available: 4-page product sheet and pricing on complete line of tool cases for servicemen and technicians.

Products manufactured: Cases, Equipment, Instrument, Meter

P. L. C. ELECTRONICS INC., 39-50 Crescent St., Long Island City, NY, 11101, Tel: 212-937-2605; Empl.: 25; Minimum order: $10

For info on price: Sls. Dept.; Customer service: Svc. Dept.

Free literature available: Full description 32 page catalog details 17 different professional security systems that are prepackaged for distributor sales to electronic technicians and service dealers.

Products manufactured: Alarms, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices

Local Sales Offices & Reps.

Ala	Mobile, Hollingsworth & Still	205-478-8108
Colo	Denver, R. Bowen & Assocs.	303-744-2501
Fla	Orlando, Hollingsworth & Still	904-669-4738
Ga	Atlanta, Hollingsworth & Still	404-394-3270
Ill	Chicago, Cumming & Foley Sls. Co.	312-725-8110
Ind	Indianapolis, Charles Scheffler Co.	317-253-6337
Iowa	Des Moines, B.E.A.M.S.	515-282-0292
Kans	Lenexa, B.E.A.M.S.	913-888-6110
La	Monroe, Dixie Elctrn. Assocs.	318-387-8893
Mich	Lake Orion, Ted Firaneck Sls.	313-391-1177
Minn	Minneapolis, Dick Borrett Co.	612-929-0028
Mo	Creve Cover, B.E.A.M.S.	314-569-1060
NC	Charlotte, Hollingsworth & Still	704-536-7047
Ohio	Medina, T. Grant Assocs.	216-725-6528
Ore	Salem, Pacnor Mktg.	503-363-6445
Pa	Newtown Square, G. M. Conneen Co.	215-353-2241
Tenn	Gallatin, Dixie Elctrn. Assocs.	615-452-1744
Tex	Dallas, R. E. Nesbitt Co.	214-357-4601
Wash	Seattle, Pacnor Mktg.	206-284-8020

PLESSEY INC., Materials Div., 320 Long Island Expwy. S., Melville, N.Y., 11746, Tel: 516-694-7900, TWX: 510-224-6411; Empl.: 700

Free literature available: Five facility brochures as follows: Plessey Melville, Plessey EMD, Plessey Frenchtown, Plessey Montvale, Plessey Micro Science, Each describes products and capabilities.
Plus, Plessey Materials borchure which gives brief overview of products and capabilities of entire Division.

Products manufactured: Alloys, Contact Strips, Finger, Contacts, Electrical, Films, Inks For Thick Film Microcircuits, Laminates, Laminations, Metal Oxides, Metals, Motors, Pads, Transistor Mounting, Paints, Preforms, Precious Metal, Rivets, Seals, Services, Assembly, Production & Test, Solder (All Types), Substrates, Thermistors, Wire

Local Sales Offices & Reps.

Ariz	Mesa, Plessey Inc.	602-969-7281
Cal	Los Angeles, Plessey Inc.	213-390-7844
Cal	Mt. View, Plessey Inc.	415-965-1400
Cal	San Diego, Plessey Inc.	714-560-8433
Colo	Boulder, Mile High Elctrns.	303-444-5615
Ill	Schiller Park, Plessey Inc.	312-671-2686
Md	Rockville, Plessey Inc.	301-340-3220
Mass	Reading, Plessey Inc.	617-944-7000
NJ	Bernardsville, Plessey Inc.	201-766-2200
NY	Melville, Plessey Inc.	516-694-7900
Ohio	Akron, Plessey Inc.	216-644-7643
Tex	Dallas, Plessey Inc.	214-235-2307

PLESSEY CERAMIC DIV., Plessey N.J. Inc., 8th & Harrison Sts., Frenchtown, N.J., 08825, Tel: 201-996-2121, TWX: 510-235-3399; Empl.: 198

For info on price: W. Weaver; Application info: B. Spillman

Products manufactured: Alloys, Circuits, Hybrid, Thick Film, Coils Including Assemblies & Forms, Cores, Ceramic, Networks, Packages, Integrated Circuit, Seals, Spacers, Transistor, Diode, Thyristor Heat Dissipators, Tubes, Tubing

Local Sales Offices & Reps.

Ariz	Mesa, Plesasey Materials	602-969-7281
Cal	Los Angeles, Plessey Materials	213-390-7844
Cal	Mountain View, Plessey Materials	415-965-1400
Cla	San Diego, Plessey Materials	714-560-8433
Colo	Boulder, Mile High Electronics	303-444-5615
Ill	Schiller Park, Plessey Materials	312-671-2686
Md	Rockville, Plessey Materials	301-340-3220
Mass	Reading, Plessey Materials	617-944-7000
NJ	Bernardsville, Plessey Materials	201-766-2200
NY	Melville, Plessey Materials	516-694-7900
Ohio	Akron, Plessey Materials	216-644-7643
Tex	Dallas, Plessey Materials	214-235-2307

PLESSEY ELECTRO-PRODUCTS, 3860 Centinela Ave., Los Angeles, Cal., 90066, Tel: 213-390-3585, TWX: 910-343-6483; Minimum order: $25 .... p. 1•267

For info on price: P. H. Dalton; Application info: R. Coulter; Customer service: P. Dalton; Delivery info: P. Dalton

Free literature available: Bulletin 500 Applications brochure

Products manufactured: Indicators, Integrators, Electronic, Timers

PLESSEY ENVIROMENTAL SYS., 3939 Ruffin Rd., San Diego, Cal., 92123, Tel: 714-278-6500, Telex: 695053; Empl.: 75

For info on price: S. Liflander; Application info: G. N. Clausen; Customer service: J. Delozier; Delivery info: S. Liflander

Free literature available: A product catalog that describes and illustrates the instruments and equipment manufactured by the company.

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Counters, Data Loggers, Dummy Loads, Gages, Indicators, Oceanographic Equip. (Electronic), Recorders, Transducers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Md	Rockville, C. Blakely	301-946-0082

PLESSEY SEMICONDUCTORS, 1674 McGaw Ave., Santa Ana, Cal., 92705, Tel: 714-540-9979, TWX: 910-595-1930; FSC No: 52648; Empl.: 9

For info on price: D. Clark X35; Application info: W. B. Boris X49; Customer service: D. Chant X27; Delivery info: D. Clark X35

Free literature available: Applications; data sheets; short form catalog; price list; data book

Products manufactured: Amplifiers, Cells, Photoconductive, Photoemissive, Photovoltaic, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Counters, Demodulators, Detectors, Diodes, Dividers, Drivers, Switch, Generators, Integrated Circuit Devices, Microwave Integrated Circuits (MIC's), Mixers, Modulators, All Kinds, Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Altos, Hoeke-Reeser Assocs.	415-941-4080
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	San Diego, Thorson Co.	714-298-8385
Cal	Tustin, Thorson Co.	714-544-5121
Colo	N. Denver, West/Mark Assoc.	303-433-7181
Fla	St. Petersburg, Kirkwood Assocs.	813-894-8240
Ill	Park Ridge, R F Specialists	312-698-2044
Ind	Fort Wayne, R. F. Specialists	219-485-8982
Kans	Prairie Village, Engr. Services Co.	913-649-4000
Mass	Wayland, Wayland Engrg. Sls.	617-655-6080
Mo	St. Louis, Engr. Services Co.	314-997-1515
NM	Albuquerque, Thorson Co.	505-265-5655
NY	Plainview, B. Erde	516-822-5357
Ohio	Cincinnati, Luebbe Sls Co.	513-871-4211
Pa	Easton, Mid Eastern Assocs.	215-253-3100
Pa	Philadelphia, Mid Eastern Assocs.	215-842-2810
Tex	Dallas, Thorson Co.	602-956-5300
Tex	Houston, Thorson Co.	713-771-3504
Wash	Olympia, Bergford & Assoc.	206-866-2001

PLEXUS, INC., 7345 E. Evans Rd., Scottsdale, Ariz., 85260

P M C ELECTRONICS CO., INC., 1120 Industrial Hwy., Southampton, Pa, 18966, Tel: 215-322-2925; Empl.: 100; Minimum order: $100

For info on price: J. Horan; Application info: J. Becker; Customer service: B. Petherbridge; Delivery info: B. Petherbridge

Products manufactured: Boards, Printed Circuit, Boards, Printed Wiring, Universal, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Fla	Orlando, Gra-Mar	305-894-3351
NJ	Haddon Field, Mesa Tech. Assocs.	609-Ha 9-9531
NY	Port Washington, Total Mktg. Action	516-883-2432
NY	Syracuse, D. H. Dwyer	315-472-8282

POLARAD ELCTRN. INSTRS., 5 Delaware Dr., Lake Success, N.Y., 11040, Tel: 516-328-1100, TWX: 510-223-0414; FSC No: 82199; Empl.: 150; Minimum order: $25 .... p. 1•784,785

For info on price: E. F. Feldman; Application info: E. F. Feldman; Customer service: S. Lim; Delivery info: E. F. Feldman

Free literature available: Polarad Microwave Instrumentation Catalog, Microwave Signal Generators & Sources 800 MHz - 21 GHz, Microwave Receivers & Field Intensity Meters 1-21 GHz, Microwave Antennas, Retrofit Data for older Polarad Signal Generators & Sources Application Data re Microwave Signal Generators

Products manufactured: Analyzers, Antennas, Generators, Meters, Modulators, All Kinds, Monitors, Multipliers, Oscillators, Receivers, Synchronizers, Klystron & BWO, Testers

Local Sales Offices & Reps.

Alas	Anchorage, Arva-Hudson, Inc.	907-272-5231
Ariz	Scottsdale, BFA Corp. of Ariz.	602-946-4215
Cal	Cupertino, T. Snitzer	408-257-8333
Cal	Del Mar, T. Snitzer	714-454-2191
Cal	Los Angeles, T. Snitzer	213-836-6170
Colo	Boulder, H. Bass Assocs.	303-499-7509
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Fla	Orlando, J. Highsmith	305-293-5202
Ill	Elk Grove Village, L. Green	312-593-0282
Ind	Indpls., L. Green	317-293-9827
Kans	Prairie Vlg., Engrg. Svcs.	913-649-4000
Md	Lanham, Brimberg Assocs., Inc.	301-552-2200
Md	Silver Spring, Eastern Instrumentation Corp.	301-681-6500
Mass	Wakefield, P. Jenks Assoc.	617-246-1590
Mich	Detroit, Group Ten, Inc.	313-549-3910
Minn	Mpls., L. F. Green	612-781-1611
Mo	St. Louis, Engrg. Svcs.	314-997-1515
NM	Albuquerque, IMEC	505-883-9010
NY	Great Neck, Meas. Tech.	516-482-3500
NY	Liverpool, R&D Assocs.	315-622-2350
Ohio	Cleveland, Group Ten, Inc.	216-486-2800
Ohio	Dayton, Group Ten, Inc.	513-277-6531
Ore	Lake Oswego, Arva-Hudson, Inc.	503-227-4916
Pa	Phila., East Instrumentation Phila. Inc.	215-927-7777
Tex	Richardson, Lear Assoc.	214-231-5388
Tex	San Antonio, Data Applications	512-732-7176
Wash	Seattle, Arva-Hudson, Inc.	206-622-0177
FOR:	Can., Downsview, Ont., Electronetic Sys. Ltd.	416-661-3673
FOR:	Can., Montreal, Que., Electronetic Sys. Ltd.	514-342-4112
FOR:	Can., Ottawa, Ont., Electronetic Sys. Ltd.	613-733-3781
FOR:	Vancouver, B.C., Electronetic Sys. Ltd.	604-687-5696

POLYFLON CORP., 35 River St., New Rochelle, N.Y., 10801, Tel: 914-636-7222, TWX: 710-563-0619; Empl.: 60; Minimum order: $25

For info on price: R. McLaughlin; Application info: P. Russo; Customer service: R. McLaughlin; Delivery info: R. McLaughlin

Free literature available: Products & Services-Condensed catalogue; Individual Data Sheets: fixed RF capacitors, trimmer capacitors, microwave components, UHF cavities, DC Blocking Capacitors, Mylar Capacitors.

Products manufactured: Antennas, Boards, Printed Circuit, Capacitors, Fixed, Capacitors, Variable, Filters, Foil, Laminates, Seals, Services, Assembly, Production & Test, Shields, Slotted Lines, Microwave, Tees, Terminal Blocks, Boards & Strips, Terminals, Waveguides & Adapters

Local Sales Offices & Reps.

Fla	Lighthouse Point, Ed Whalen Assocs.	305-781-6996
Ill	Arlington Heights, Bunting & Assocs.	312-392-3370
EXP:	New Rochelle, N.Y., Polyflon Corp.	914-636-7222

POLYPHASE INSTR. CO., 126 E. Fourth St., Bridgeport, Pa., 19405, Tel: 215-279-4660; Empl.: 150

For info on price: R. H. Simmons; Application info: R. H. Simmons; Customer service: R. H. Simmons; Delivery info: P. Benedetti

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Converters, Equalizers, Filters, Networks, Panels, Reactors, Transformers

Local Sales Offices & Reps.

DC	Wash, Arco Eng. Co.	202-393-5991
Fla	Seminole, Massey Assoc.	813-393-3206
Ill	Chicago, Berndt Assoc.	312-283-4900
Ind	Carmel, J. Riley	317-844-0114
Mass	Raddolph, Naton Assoc.	617-986-6417
NJ	Plainfield, Glassman Assoc.	201-561-3866
NY	Glen Cove, Glassman Assoc.	516-676-1039
NY	Utica, B. D. Hummel Co.	315-736-7821
Pa	Ft. Washington, GCM Assoc.	215-646-7535

PORTER, H.K., INC., 74 Foley St., Somerville, Mass., 02143, Tel: 617-776-8200, Telex: 92-1420; Empl.: 250

Customer service: A. L. Holmes

Free literature available: Hand & Power Operated Cutters A200B

Products manufactured: Cutters, Wire, Hand Operated, Drivers, Nut, Jacks (All Types), Tools

PORTESCAP US, 730 Fifth Ave., New York, N.Y., 10019

POSITRONIC INDS., 1906 S. Stewart, Springfield, Mo., 65804, Tel: 417-883-3434, Telex: 43-6445; Empl.: 90 p. 2•788,789

For info on price: M. Dock; Application info: J. Gentry; Customer service: W. Gilbert; Delivery info: W. Gilbert

Products manufactured: Connectors, Contacts, Electrical, Fasteners, Handles For Cabinets, Circuit Boards, Racks, etc., Pins, Sockets, Spacers, Terminals, Tools

Local Sales Offices & Reps.

Ariz	Scottsdale, Schoeffler Assoc.	602-948-3470
Cal	Canoga Park, Balzer-Wolf Assocs.	213-888-7432
Cal	Mountain View, G. Woempner	415-964-5454
Colo	Littleton, Lange Sls.	303-798-1397
Conn	Fairfield, Schumacher & Yarrington	203-259-0772
Fla	Ft. Lauderdale, CBC Electronics	305-484-7330
Ga	Norcross, Comptron	404-921-6929
Ill	Des Plaines, Control Sls.	312-296-5595
Kans	Shawnee Mission, Florence & Meyer	913-722-5210
Kans	Wichita, M. Meyer	316-838-7226
Mich	Dearborn Hts., Ankofski Assoc.	313-565-6330
Minn	Minneapolis, Components Group	612-824-4222
Mo	Springfield, Positronic Inds.	417-883-3434
Mo	St. Charles, Buckman Assocs.	314-724-6690
NJ	Moorestown, Comp. Conslts.	609-234-3666
NY	Cooperstown, Fitzelle Assoc.	607-547-9333
NY	Farmingdale, Haines Products	516-420-1177
Ohio	Dayton, Myers Assocs.	513-435-1309
RI	Rhode Island, Schumacher & Yarrington	401-884-5671
Tex	Richardson, Zonk Engrg. Co.	214-238-7651

Local Distributors

Cal	Gardena, Bell Inds., 306 E. Alondra	213-321-5802
Cal	Inglewood, Times West, 900 W. Olive	213-673-5900
Cal	Sunnyvale, Acacia Sls., 384 San Aeso	408-735-0100
Colo	Denver, Acacia Sls., 758 S. Jason	303-232-2882
Mass	Waltham, Impact Elctrns., 223 Crescent St.	617-893-2850
Tex	Dallas, Computor Comps., 732 Wiley Post Rd.	214-239-0271

POTTER & BRUMFIELD, Div of AMF, 1200 E. Broadway, Princeton, Ind., 47671, Tel: 812-385-5251, TWX: 810-350-2343; Empl.: 3500 p. 1•1803

Free literature available: Catalog 100 lists over 1000 standard relays, stocked and sold by leading electronic parts distributors. Models include electromechanical, dry reed, mercury-wetted, hybird, solid state and time delay relays.

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Circuit Breakers, Covers, Protective (Including Dust), Relays, Sockets, Switches, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe Sls.	602-264-7971
Cal	Los Altos, E. Recht Assocs.	415-941-0336
Cal	Los Angeles, Black, Ekizian & Strong, Inc.	213-870-9191
Cal	San Diego, Bestronics	714-278-2150
Cal	San Juan Capistrano, Potter & Brumfield	714-493-4503
Colo	Littleton, Simpson Assocs.	303-794-8381
Conn	Canaan, Hathaway Elctrncs., Inc.	800-225-1293
Fla	N. Miami Beach, Irby & Connolly, Inc.	305-949-5197
Fla	Orlando, Irby & Connolly, Inc.	305-894-8471
Ga	Atlanta, Cartwright & Bean, Inc.	404-255-5262
Ill	Chicago, Balhorn & Welch, Inc.	312-889-5011
Ill	LaGrange Park, Bierhaus Sls., Inc.	312-354-5100
Ind	Fort Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Associates, Inc.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-452-6065
Kans	Overland Park, P-M-A Corp.	913-381-0004
Kans	Wichita, P-M-A Corp.	316-264-2662
Ky	Louisville, R.O. Whitesell & Assocs.	502-893-7303
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Md	Glen Burnie, Micro-Comp, Inc.	301-761-4600
Mass	Braintree, Potter & Brumfield	617-848-6550
Mass	Lexington, Hathaway Elctrns., Inc.	617-861-7010
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Edina, M. Foster Co.	612-835-2252
Miss	Jackson, Cartwright & Bean, Inc.	601-981-1368
Mo	Hazelwood, P-M-A Corp.	314-731-4334
NJ	Cherry Hill, J. McCoy, Inc.	609-428-3444
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Buffalo, Ossmann Comp. Sls. Corp.	716-832-4271
NY	Garden City, Comtronic Assocs.	516-741-8966
NY	Kingston, Ossmann Comp. Sls. Corp.	914-338-5505
NY	Rochester, Ossmann Comp. Sls. Corp.	716-442-3290
NY	Syracuse, Ossmann Component Sales Corp.	315-454-4477
NY	Vestal, Ossmann Component Sales Corp.	607-785-9949
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
NC	Raleigh, Cartwright & Bean, Inc.	919-832-7128
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, Scott Elctrns., Inc.	216-291-2600
Ohio	Columbus, Scott Electronics, Inc.	614-236-8619
Ohio	Dayton, R.O. Whitsell & Associates, Inc.	513-298-9546
Okla	Tulsa, Comps., Inc.	918-583-9149
Pa	Camp Hill, Beil & Whitaker, Inc.	717-233-1254
Pa	Harrisburg, Beil & Whitaker, Inc.	717-652-0184
Pa	Orefield, Beil & Whitaker, Inc.	215-395-0150
Pa	Philadelphia, Jack McCoy, Inc.	215-922-7333
Pa	Pittsburg, Scott Electronics, Inc.	412-781-3112
Pa	Reading, Beil & Whitaker, Inc.	215-779-2610
Tenn	Knoxville, Cartwright & Bean, Inc.	615-693-7450
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Dallas, J.B. Guenther, Inc.	214-691-8500
Tex	Houston, J.B. Guenther, Inc.	713-468-0232
Utah	Salt Lake City, Simpson Assocs.	801-486-3731
Wash	Seattle, R. Johnston Co.	206-524-5170
Wisc	Milwaukee, E.A. Dickinson & Assocs.	414-264-1080

POTTER CO., Box 337 North Hwy 51, Wesson, Miss., 39191, Tel: 601-643-2216, TWX: 510-981-4072; FSC No: 13050; Empl.: 200; Minimum order: $25 p. 1•570,571; p. 2•230,231

For info on price: W. Murray; Application info: H. Mutz; Customer service: W. Murray; Delivery info: W. Murray

Free literature available: UL Recognized EMI Filters, High Voltage Bluseal Film Capacitors, Maxi-Brute Low Pass EMI Filters, Bluseal Film Capacitors

Products manufactured: Capacitors, Fixed, Chokes, Filters

Local Sales Offices & Reps.

Ariz	Phoenix, Chaparral	602-996-9648
Cal	Los Angeles, Products Supply Co.	213-659-1858
Cal	Malibu, Potter Co.	213-457-7835
Cal	Redwood City, Parks & Pruitt Assoc.	415-364-1640
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Colo	Denver, Omega Limited	303-758-1508
Fla	Ft. Lauderdale, G.F. Bohman Assocs.	305-564-3081
Fla	Orlando, G.F. Bohman Assocs.	305-855-0274
Ill	Park Ridge, R.F. Specialists	312-698-2044
Ind	Ft. Wayne, R.F. Specialists	219-485-8982
Mass	Pittsfield, Potter Co.	413-499-2677
Mich	Grand Rapids, Thies & Assocs.	616-245-0319
Minn	Minneapolis, Stack-Johnson	612-925-2111
Miss	Wesson, Potter Co.	601-643-2216
NJ	Haddonfield, Gray Assocs.	609-429-5300
NY	Binghamton, El-Com Sls., Inc.	607-723-9270
NY	Mineola, R.A. Colucci Co.	516-746-0397
NY	Rochester, El-Com Sls., Inc.	716-385-1400
NY	Whitesboro, El-Com Sls., Inc.	315-736-2421
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
Ohio	Brecksville, A. Nace Co.	216-526-4323
Ohio	St. Marys, Potter Co.	513-278-5030
Okla	Tulsa, W. Pat Fralia Co.	918-663-8707
Pa	Pittsburgh, Allen Nace Co.	412-922-7225
Tex	Fort Worth, W.P. Fralia Co.	214-264-3491
Tex	Houston, W.P. Fralia Co.	817-738-2394
Utah	Salt Lake City, Omega Limited	801-226-9617
Wash	Kirkland, Lehr Assocs.	206-827-4581
FOR:	Can., Toronto, Ont., Connector Sts. Ltd.	610-492-1398

POTTER INSTR. CO., 532 Broad Hollow Rd., Melville, N.Y., 11746, Tel: 516-694-9000, TWX: 510-224-6485; Empl.: 1500

Products manufactured: Comm. Systems, Computers, Data Acquisition & Reduction Systems, Heads, Recording Playback, Erase, Memory Systems, Perforators, Printers, Readers, Recorders, Tape Recording Accessories, Terminal Equipment, Digital, Transmission Systems, Data

POWER CONTROL CORP., Box 11432, Pittsburgh, Pa., 15238, Tel: 412-782-3120; Empl.: 65; Minimum order: $15

For info on price: W. J. Happel; Application info: W. J. Happel; Delivery info: H. Baird

Products manufactured: Amplifiers, Boards, Printed Circuit, Chargers, Battery, Controls/Control Eqpt., Converters, Inverters, Monitors, Power Supplies, Relays, Testers, Thyristors (Includes Silicon Controlled Rectifiers)

Local Sales Offices & Reps.

Mass	Boston, Eaco Engrg. Corp.	617-782-7440
Mich	Saginaw, Von Berg & Assocs.	517-799-0873
NJ	Plainfield, Brady Co.	201-753-7988
NY	Rochester, H.C. Johnson Agency	716-482-3000
Ohio	Cleveland, Whitehill Industrial	216-464-0298
Pa	Philadelphia, Rothenheber & Wurts	215-649-6300

POWER CONVERSION INC., 70 MacQuesten Pkwy. S., Mt. Vernon, N.Y., 10550, Tel: 914-699-7333; Empl.: 60; Minimum order: $50

Customer service: S. Chodosh

Free literature available: A brochure presenting voltage - time characteristics at room temperature and -20°F of Eternacell® Lithium organic electrolyte batteries ranging in capacity from 0.5 to 10 ampere-hours.

Products manufactured: Batteries

POWER DESIGNS, INC., 1700 Shames Dr., Westbury, N.Y., 11590, Tel: 516-333-6200, TWX: 510-222-6561; Empl.: 200 .... p. 1•1418-1425

For info on price: R. Roth; Application info: M. Waimberg; Customer service: M. Conklin; Delivery info: R. Roth

Free literature available: General Catalogue; Data sheet on stock models; stock models; instruction manual excerpts on non-standard & custom models including outline dwgs; short form catalogues.

Products manufactured: Calibrators, CATV Systems & Equipment, Chargers, Battery, Converters, Current Sources, Dividers, Eliminators, Battery, Loads, Electronic Variable, Power Supplies, References, D-C Voltage, Regulators, Stabilizers, Line Impedance, Transformers, Voltage Sources

Local Sales Offices & Reps.

Ariz	Phoenix, Zeus Inc. (Hytronic Meas.)	602-253-6104
Cal	North Hollywood, O'Halloran Assocs.	213-877-0173
Cal	Palo Alto, O'Halloran Assocs.	415-326-1493
Cal	San Diego, O'Halloran Assocs.	714-224-2824
Colo	Denver, Zeus Inc. (Hytronic Meas.)	303-770-4400
Fla	Casselberry, EIR, Inc.	305-830-9600
Ill	Elk Grove Village, L.F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L.F. Green & Assocs.	317-293-9827
Mass	Waltham, Mc Bar Assocs.	617-890-0233
Mich	Detroit, H. Teplitz & Co.	313-537-9058
Minn	Minneapolis, L.F. Green & Assocs.	612-781-1611
Nev	Clark County, Zeus Inc. (Hytronic Meas.)	602-253-6104
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	East Syracuse, Ossmann Instrs.	315-437-6666
NY	Mt. Vernon, OED Elctrns.	914-664-0080
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
Ohio	Cleveland, H. Teplitz & Co.	216-371-2044
Ohio	Dayton, H. Teplitz & Co.	513-277-6531
Pa	Abington, Powell-Pendergraph	215-657-0330
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Va	Richmond, Powell-Pendergraph	703-264-2341
Wash	Bellvue, Topp Engrg.	206-747-5401
FOR:	Can., Montreal, Que., Datamex	514-731-9328

POWER, INC., Marketing Div., 12809 Eagle Ridge Dr., Burnsville, Minn., 55378, Tel: 612-890-1360; Empl.: 500; Minimum order: $15 .... p. 1•1339,1340

Customer service: D. Carlson

Free literature available: Custom Battery Packs with Chargers

Products manufactured: Batteries, Chargers, Battery

POWER INSTRS., INC., 7352 N. Lawndale Ave., Skokie, Ill., 60076; Empl.: 20; Minimum order: $20

For info on price: N. Cohen 312-676-2300; Application info: R. H. Redfield 312-676-2301; Customer service: R. Lee 312-274-9110; Delivery info: N. Cohen 312-676-2300

Products manufactured: Controls/Control Eqpt., Converters, Counters, Indicators, Light Sources, Photoelectric, Lights, Tachometers, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Vaughn Electrosources Co.	205-881-8830
Cal	Santa Monica, Davidson Assocs.	213-829-1731
Fla	Cocoa Beach, Vaughn Electrosources Co.	305-784-0784
Kans	Lenexa, S. Sterling Co.	913-888-2995
Mich	Detroit, S. Sterling Co.	313-255-1970
Mo	St. Louis, S. Sterling	314-567-3636
Tex	Dallas, Teamwork, Inc.	214-243-5881
Wisc	Milwaukee, W. Klinger & Son	414-351-1775

PMC

POWER/MATE CORP., 514 S. River St., Hackensack, N.J., 07601, Tel: 201-343-6294, TWX: 710-990-5023; Empl.: 280 .... p. 1•1341

For info on price: R. Allison; Application info: D. Skulnik; Customer service: D. West; Delivery info: M. Hochaupt

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	Mountain View, Thorson Co.	415-964-9300
Cal	San Diego, Thorson Co.	714-298-8385
Cal	Tustin, Thorson Co.	714-544-5121
Colo	Denver, Thorson Co.	303-759-0809
Conn	Hartford, Victor Assocs.	203-246-5643
Fla	Ft. Lauderdale, W. A. Brown Instr.	305-776-4800
Fla	Orlando, W. A. Brown Instr.	305-425-5505
Ga	Atlanta, W. A. Brown Instr.	404-939-1674
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
Md	Rockville, Marktron	301-762-6210
Md	Timonium, Marktron	301-252-7111
Mass	Framingham, Victor Assocs.	617-879-5710
Mich	Detroit, R.P. Urban & Assocs.	313-535-2355
Mich	Grand Rapids, R.P. Urban & Assocs.	616-245-0511
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
Mo	Grandview, Beneke & McCaul	816-765-2998
Mo	St. Louis, Beneke & McCaul	314-567-3399
NJ	Hackensack, PMC	201-343-6294
NM	Albuquerque, Rustco	505-296-6474
NY	Elmont, Crane & Egert Corp.	516-488-2100
Ohio	Aurora, EMA Inc.	216-562-6104
Ohio	Centerville, EMA Inc.	513-433-2800
Pa	Philadelphia, QED Elctrns.	215-925-8711
Tex	Dallas, R. Martin Assoc.	214-361-8584
Tex	Houston, R. Martin Assoc.	713-462-4077
Vt	Burlington, Victor Assoc.	802-862-2172
Wash	Seattle, Thorson Co.	206-455-9180
EXP:	Hackensack, N.J., Power/Mate	201-343-6294
FOR:	Can: Mississauga, Ont., Webster Instrs.	416-275-2270

POWER MONOLITHICS INC., 121 International Dr., Corpus Christi, Tex., 78410, Tel: 512-883-6251; Minimum order: $75 .... p. 1•1845

For info on price: R. Whalen; Application info: L. Ferguson; Customer service: R. Whalen; Delivery info: R. Whalen

Free literature available: Power Hybrid Voltage Regulators 4 and 14 terminal 3.3A & 5A Pos or Neg Regulators 5 and 9 terminal 10A & 15A Pos & Neg Regulators 20 and 25 Amp Pos Regulators

Products manufactured: Hybrid Voltage Regulators, Integrated Circuit Devices, Transistors

Local Distributors

Cal	Burlingame, Logan Assocs., 844 Stanton Rd.	415-697-6100
Cal	Los Angeles, Black, C. Kizian & Strong, 1728 So. La., Cienega Blvd.	213-870-9191
Fla	Clearwater, Lynch-Gentry, 1932 Drew St.	813-443-2697
Ill	Rolling Meadows, Sumer Inc., 5050 Newport Dr.	312-394-4900
Mass	Lexington, Kitchen & Kutchin, Inc., 177 Bedford St.	617-862-8230
Minn	Minneapolis, Nortec Sls., 4530 W. 77th Ave.	612-835-7414
NJ	Haddonfield, Sunday & Obrien, 15 Potter St.	609-429-4013
NY	Hempstead, Kahgan Sales Corp., 556 Peninsula Blvd.	516-538-2300
NY	Rochester, Ossman Comp. Sls., 280 Metro Park	716-442-3290
NC	Winston-Salem, Murcota, Inc., 1106 Burke St.	919-723-1001
Ohio	Cincinnati, Sheridan Assocs., Box 37826	513-761-5432

POWER ONE, 531 Dawson Dr., Camarillo, Cal., 93010, Tel: 805-484-2806, TWX: 910-336-1297; Empl.: 35 p. 1•1414-1417

For info on price: D. Weisse; Application info: L. Wallace; Customer service: L. Wallace; Delivery info: D. Weisse

Free literature available: 16 page catalog listing 52 models of open frame power supplies from 5 to 200 VDC at 15 to 300 watts. Manual of each power supply.

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Cal	San Diego, Col-Rob Elect.	714-565-6814
Cal	Santa Clara, Richards Assocs.	408-246-5860
Cal	Woodland Hills, Burtis Instrs.	213-887-1360
Fla	Miami, Reptronics, Inc.	305-251-5478
Fla	St. Petersburg, Reptronics, Inc.	813-522-8220
Ill	Wheaton, Engineering Products Assoc.	312-665-0061
Ind	Indianapolis, Holsapple Assocs.	317-899-2890
Mass	Waltham, Digital Sls. Assoc.	617-899-4300
Minn	Minneapolis, Engrg. Prods. Assoc.	612-925-1883
NJ	Madison, Livera-Polk Assoc.	201-377-3220
NY	Burnt Hills, Mktg. Rep.	518-399-9200
NY	Roslyn Heights, Livera-Polk Assoc.	516-484-1276
Pa	Norristown, Denco-Data Engrg.	215-279-8146
RI	N. Scituate, Digital Sls. Assoc.	401-647-2675
Tex	Dallas, Reese Assoc.	214-638-6575
Tex	Houston, Reese Assoc.	713-621-3134
Wash	Richland, J. B. Jolly	509-783-6523
Wash	Seattle, J. B. Jolly	206-938-4166
FOR:	Can. Weston, Ont., Duncan Instrs. LTD	416-742-4448

Local Distributors

Cal	Santa Clara, Richards Assocs., 1659 Scott Blvd.	408-246-5860
Cal	Woodland Hills, Burtis Power Dist., 6324 Variel Ave.	213-887-1360
Ind	Indianapolis, Holsapple & Assocs., 8640 E. Washington	317-899-2890
Mass	Waltham, Digital Sls. Assoc., 9 Spring St.	617-899-4300
NY	Roslyn Hts., Livera-Polk Assoc., 275 Warner Ave.	201-377-3220
Tex	Dallas, W. Reese Assocs., 3131 Stemmons Frwy.	214-638-6575
Tex	Houston, W. Reese Assocs, 4151 Southwest Frwy.	713-621-3134
For:	Can., Weston, Ont. M9L 1Y4, Duncan Instr. Ltd., 65 Millwick Dr., Unit 6	416-742-4448

POWER PAC, INC., 18 Marshall St., South Norwalk, Conn., 06854, Tel: 203-866-4484; FSC No: 53998; Empl.: 45; Minimum order: $25

For info on price: C. Mittel; Application info: W. Anderes; Customer service: C. Mittel; Delivery info: C. Bubba

Free literature available: Econopac, Power Card, Modules, Dual Output Modules System Pac

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Ariz	Phoenix, RDX Corp	602-267-8162
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	Sunnyvale, RDX Corp.	408-734-4500
Fla	Orlando, Fausett of Fla.	305-894-6071
Ill	Wilmette, Crest Assocs.	312-286-5202
Ind	Indianapolis, Crest Assocs.	317-844-2800
Md	New Carrolton, W. A. Brown-Equip. Co.	301-577-4527
Mass	Burlington, TEKDATA	617-273-0198
Mich	Farmington Hills, Lowell Co.	313-851-7474
NY	Mt. Vernon, D. Sonkin Assocs.	914-668-9809
Pa	Jenkintown, AMT	215-549-2080
Va	Alexandria, W. A. Brown-Equip. Co.	703-836-1800
WVa	Charleston, W. A. Brown-Equip. Co.	304-342-2700

POWER-PACK, INC., 1 St. John St., Dover, NH, 03820, Tel: 603-749-2929

POWER PHYSICS CORP., Box 626, Eatontown, N.J., 07724, Tel: 201-542-1393, TWX: 710-722-6646; Empl.: 110; Minimum order: $25

For info on price: C. Dee; Application info: M. Baker; Customer service: C. Dee; Delivery info: C. Dee

Free literature available: General catalog

Products manufactured: Circuits, Hybrid, Thick Film, Diodes, Hybrid Voltage Regulators, Rectifiers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Incotech	205-837-6061
Ariz	Phoenix, Shefler-Kahn Co.	602-258-7894
Cal	Los Alamitos, J. S. Heaton Co.	714-821-9600
Cal	Menlo Park, J. S. Heaton Co.	415-369-4671
Cal	San Diego, Cel-Tec	714-279-7961
Colo	Denver, Shefler-Kahn Co.	303-831-9087
Conn	North Haven, Kitchen & Kutchen	203-239-0212
Fla	Clearwater, Bohman Assocs.	813-442-5606
Fla	Ft. Lauderdale, Bohman Assocs.	
Fla	Orlando, Bohman Assocs.	305-855-0274
Ga	Atlanta, EMA	919-722-5151
Ill	Chicago, Lightner Assocs.	312-774-1500
Md	Towson, Habco Elec.	301-825-9637
Mass	Lexington, Kitchen & Kutchen	617-862-8230
Mich	Lathrup, R.C. Nordstron & Co.	313-444-4417
Minn	Minneapolis, Technical Assocs. Inc.	612-929-6721
NY	, LRC Assoc.	914-634-7973
NY	, MCK Assoc.	315-685-7122
NC	Winston-Salem, Elctrn. Mktg. Assoc., Inc.	919-722-5151
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242
Ore	Portland, Underwood & Underwood	503-245-2342
Pa	King of Prussia, Monteiro Assocs.	215-265-0634
Tex	Dallas, Merino Sls. Co.	214-239-9719
Va	Lynchburg, Habco Elec.	804-384-5236
Wash	Seattle, Underwood & Underwood	206-243-2133

POWER-SONIC CORP., Box 5242, 3106 Spring St., Redwood City, Cal., 94063, Tel: 415-364-5001; Empl.: 4

For info on price: B. A. Ender; Application info: G. C. Clum; Customer service: B. Ender; Delivery info: G. C. Clum

Free literature available: Specification sheet listing all models, voltage, capacity, dimensions, discharge characteristics, terminal configuration, as well as general characteristics of power-sonic batteries. Technical brochure: characteristics, curves, application notes, charging.

Products manufactured: Batteries, Chargers, Battery

Local Sales Offices & Reps.

Cal	Marina Del Rey, Intervend Inds., Ltd.	213-821-7936
Cal	San Diego, Qualtronics	714-560-8955
Ill	Chicago, Ropek-Cahill	312-287-7292
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Orchard Lake, Ellinger Sls.	313-626-1170
Minn	Minneapolis, Jos-Co Sls. Engrg.	612-927-5858
NY	Wantagh, Dony Tech Sls.	516-826-5550

Advertisment

We specialize exclusively in gelled electrolyte lead-acid batteries and chargers. Our batteries are sealed, maintenance free, may be discharged and charged in any position. Cycle or standby (float) applications.

Full product line– 6, 12, 18 volts; capacities ranging from 1 to 15 ampere-hours. Minimum lead time.

POWER SYSTEMS & CONTROLS, INC., 3206 Lanvale Ave., Richmond, Va., 23230, Tel: 804-355-2803; Empl.: 40

For info on price: R. A. Amos; Application info: C. Gregory; Customer service: A. Moore; Delivery info: S. Frazier

Free literature available: 1) Series 700C Uninterruptible Computer Power Supply, 40KW through 720KW 2) Model 1200 Voltage Band Monitor, 3) Series RF Computer Power Filter

Products manufactured: Monitors, Motor Electric Generator Sets, Power Supplies

Local Sales Offices & Reps.

Cal	LaCrescenta, Power Systems & Controls	213-248-9018

Iowa	Des Moines, Beckley Electric Co.	515-288-3201
Mass	Framingham, C. Pappas Assocs.	617-877-2984
Mo	Florissant, C. Mark Corp.	314-921-4444
NJ	Old Bridge, Media Prods.	201-257-8076
NY	Great Neck, H.J. Krasner Assocs.	516-487-0690
Ohio	Cincinnati, Data Processing Sciences Corp.	513-961-0776
Okla	Tulsa, Data Processing Svcs.	918-582-2114
Tex	Richardson, Computer Mktg. Corp.	214-231-1426

POWER TECHNOLOGY, INC., Box 4403, 7925 Mablewave Cutoff, Little Rock, Ark., 72204, Tel: 501-568-1995; Empl.: 17 .... p. 1•119,1338

Customer service: T. H. Burgess

Free literature available: Power Supply Catalogs; IL & ILC Series laser Diode Pulsers; DC Motor Speed Controls; 117 or 230 V AC to 12V DC Converter.

Products manufactured: Comm. Systems, Controls/Control Eqpt., Converters, Lasers & Laser Systems, Power Supplies

POWER WAVES INC., Box 1353, Asbury Park, N.J., 07712, Tel: 201-774-8322; Empl.: 6; Minimum order: $100

Customer service: I. Ulman

Products manufactured: Counters, Dielectric Heating Equipment, Filters, Furnaces, Meters

Local Sales Offices & Reps.

Cal	San Francisco, Microwave of Cal.	415-467-1071
NJ	Middletown, Juno-Mutz	201-774-8322

POWERCUBE CORP., 214 Calvary St., Waltham, Mass., 02154, Tel: 617-891-1830, TWX: 710-324-0300; FSC No: 31557; Empl.: 70

For info on price: Sls. Department; Application info: J. Prestidge; Customer service: L. Sampson; Delivery info: L. Sampson

Products manufactured: Converters, Inverters, Power Supplies

Local Sales Offices & Reps.

Cal	Palo Alto, Brooks Tech. Grp.	415-328-3232
Cal	Woodland Hills, Interstate Mktg.	213-883-7606
Colo	Littleton, Simpson Assocs.	303-794-8381
Conn	East Hartford, Tekdata	203-525-7647
Fla	Boca Raton, Conley & Assocs.	305-395-6108
Fla	Oviedo, Conley & Assocs.	305-365-3283
Fla	Tampa, Conley & Assocs.	813-933-8183
Ill	Park Ridge, R F Specialists	312-698-2044
Ind	Fort Wayne, R F Specialists	219-485-8982
Iowa	Cedar Rapids, Technical Reps.	319-363-2489
Kans	Olathe, Technical Reps.	913-782-1177
Md	Baltimore, J. R. Daniel & Co.	301-825-3330
Mass	Burlington, Tekdata	617-273-0198
Minn	Minneapolis, Bitronics Sls. Co.	612-835-7744
Mo	Hazelwood, Technical Reps.	314-731-5200
NJ	Clifton, Compar New York	201-546-3660
NY	Albany, Reagan/Compar Albany	518-489-7408
NY	Endwell, Reagan/Compar Albany	607-723-8743
NY	Fairport, Reagan/Compar Albany	716-271-2230
NY	New Hartford, Reagan/Compar Albany	315-732-3775
Ohio	Milford, Knight Tech. Sls.	513-248-0193
Ore	Portland, Almac/Stroum Elctrns.	503-292-3534
Tenn	Bristol, Remco	615-968-4195
Tex	Dallas, Electra III Co.	214-243-5969
Utah	Salt Lake City, Simpson Assocs.	801-486-3731
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300
FOR:	Can., Toronto, Ont., Norgay Entprs.	416-233-2930

POWERTEC, INC., 9168 DeSoto Ave., Chatsworth, Cal., 91311, Tel: 213-882-0004, TWX: 910-494-2092; Empl.: 300 .... p. 1•1426,1427

For info on price: J. Poturny; Application info: S. Cole; Customer service: B. Turkish; Delivery info: M. Watson

Free literature available: OEM D.C. Power Supplies, Sub-Modular D.C. Power Supplies, High Frequency Switching Power Supplies, D.C. Power Supplies Short Form Catalog.

Products manufactured: Inverters, Power Supplies

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Smith Assocs.	602-947-2495
Cal	Los Altos, Powertec, Inc.	415-941-6200
Colo	Boulder, J. Smith Assocs.	303-442-7100
Fla	Orlando, Powertec, Inc.	305-277-2458
Ill	Chicago, D. Dolin Sls.	312-286-6200
Iowa	Cedar Rapids, Comstrand	319-363-7495
Kans	Overland Pk., Sheridan Assoc.	913-383-1636
Md	Silver Spring, QED Elctrns. Inc.	301-588-8134
Mich	Farmington, Sheridan Assocs.	313-477-3800
Minn	Minneapolis, Comstrand Inc.	612-560-5300
Mo	Florissant, Sheridan Assocs.	314-837-5200
NH	Goffstown, Powertec, Inc.	603-497-4004
NJ	Tenafly, ABC/Garrettson Sls.	201-568-2354
NM	Albuquerque, J. Smith Assocs.	505-255-2111
NY	Melville, Powertec	516-549-0790
NY	Tarrytown, ABC/Garrettson Sls.	914-631-2650
NY	Williston Park, ABC/Electronic Sls.	516-747-6610
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Cleveland, Sheridan Assocs.	216-831-0130
Pa	Bethayers, ABC/Electronic Sls.	215-464-2275
Pa	Pittsburg, Sheridan Assocs.	412-244-1640
Tex	Dallas, Powertec	214-387-0529
Wash	Bellevue, A. Smith Co.	206-746-6770
FOR;	Can., Montreal, Que., John Weiss Co., Ltd.	514-489-6887

POWERTECH, INC., 9 Baker Ct., Clifton, N.J., 07011, Tel: 201-478-6205; FSC No: 32953; Empl.: 25

Customer service: A. M. Polner

Free literature available: POWER TRANSISTORS...Wall Chart describes a complete range of High-Current High-Voltage Silicon Power Transistors. Major specifications of each type are included for device selection. Each chart includes a postage-paid reply card enabling you to receive a complete catalogue with detailed specifications and price lists.

Products manufactured: Transistors

PPM, INC., 32 West Monroe St., Bedford, Ohio, 44146, Tel: 216-232-1880; Empl.: 10 .... p. 1•201,786

Free literature available: Thermal Digital Printers, Data Loggers & Strain, Gage Conditioners Described in Series of PPM Data Sheets

Products manufactured: Alarms, Amplifiers, Bridges, Calibrators, Clocks (All Types), Data Acquisition & Reduction Systems, Data Loggers, Generators, Indicators, Monitors, Power Supplies, Printers, Recorders, Scanners, Signal Conditioners & Equipment, Standards, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Ariz	Glendale, Ed. Assocs.	602-247-5818
Cal	Long Beach, Saber Entprs.	213-595-5646
Colo	Westminister, Harvey Data Sys.	303-427-5299
Conn	Hamden, J. & J. Assocs.	203-624-7800
Md	Rockville, E. Winston & Co.	301-881-5780
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Ferndale, Tiby Co.	313-547-3550
NM	Albuquerque, J & D Assocs.	505-255-2377
NY	Syracuse, J.D. Birchard	315-469-4689
NY	Westbury, OAL Assocs.	516-334-1940
NC	Charlotte, Bimco	704-366-5092
Ohio	Cleveland, Tiby Co.	216-371-5335
Ohio	Dayton, Tiby Co.	513-277-3822

PRACTICAL AUTOMATION, INC., Trap Falls Rd., Shelton, Conn., 06484, Tel: 203-929-5381; Empl.: 150; Minimum order: $15

For info on price: R. Banzaca X29; Application info: E. Bokina X27; Customer service: J. Ives X31; Delivery info: B. Tobin X30

Free literature available: Digital printers, numeric and alphanumeric for data and terminal applications. Printing digital voltmeters and thermometers pulse printers & counters.

Products manufactured: Counters, Meters, Printers, Recorders

Local Sales Offices & Reps.

Cal	Montebello, Tucul Engrg.	213-728-7397
Cal	San Carlos, Electro Pacific	415-593-1334
Colo	Denver, Tessco	303-744-1119
Conn	Southbury, J. J. Wild	203-264-9494
Fla	Hialeah, Shaw Engrg. & Sls.	305-822-6141
Ill	Arlington Heights, Martec Assocs., Inc.	312-296-3331
Md	Towson, Kraft Elctrn. Sls.	301-828-5838
Mass	Needham, J. J. Wild	617-444-2366
Mich	Grand Rapids, R. P. Urban & Assocs.	616-245-0511
Minn	Mpls., Wenco Sls.	612-866-3639
NJ	Woodbridge, J. J. Wild	201-636-7780
NY	Jericho, J. J. Wild	516-935-6600
NY	New Hartford, KLM Assocs.	315-735-8525
NY	Rochester, KLM Assocs.	716-442-0821
NY	Syracuse, KLM Assocs.	315-458-2199
NC	McLeansville, Ron Ingle Assocs.	919-697-0787
Ohio	Chagrin Falls, J. Kilroy	216-247-8997
Pa	Newtown Sq., Holdsworth	215-356-8550
Tex	Dallas, Glidden Engrg. & Elctrn. Eqpt.	214-363-6539
Tex	Houston, Glidden Engrg. & Elctrn. Eqpt.	713-681-1415
Wash	Seattle, R. Johnston Co.	206-524-5170

PRD ELCTRNS., INC., Sub. of Harris Corp., 6801 Jericho Tpke., Syosset, N.Y., 11791, Tel: 516-334-7810, TWX: 510-222-4494; FSC No: 77327; Empl.: 1450; Minimum order: $25

For info on price: C. Calabrese; Application info: R. A. Lebowitz; Customer service: D. Palmer; Delivery info: R. Lebowitz

Free literature available: Application Note #22. Vector Voltmeter Measurement Techniques; Quick Guide to the RF and Microwave Instruments and Components from PRD Electronics, Inc.; VAST Operational.

Products manufactured: Adapters, Waveguide, Amplifiers, Analyzers, Attenuators, Bolometers, Bridges, Calibrators, Calorimeters, Microwave, Carriages, Probe, CATV Systems & Equipment, Cavities, Microwave, Couplers, Detectors, Dividers, Generators, Isolators, Kits, Training Aid, Meters, Mismatches, Microwave, Precision, Mixers, Monitors, Mounts, Multipliers, Oscillators, Power Supplies, Probes, Receivers, Slotted Lines, Microwave, Switches, Synthesizers, Terminals, Test Systems, Testers, Thermistors, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Cal	Burbank, PRD Elctrns.	213-842-9566
Cal	Cupertino, T. Louis Snitzer Co.	408-257-8333
Cal	Del Mar, T. Louis Snitzer Co.	714-454-2191
Cal	Los Angeles, T. Louis Snitzer Co.	213-836-6170
Colo	Littletown, Aztec Entprs.	303-795-0250
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, Pivan Engrg.	312-539-4838
Ind	Indianapolis, Pivan Engrg.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg.	913-722-1030
Md	Silver Spring, Eastern-Instrumentation	301-681-6500
Mass	Waltham, Measurement Conslts.	617-890-4400
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engrg.	612-537-4501
Mo	St. Louis, Pivan Engrg.	314-567-3636
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Plainview, Eastern-Metro Assoc.	516-931-1414
NC	Burlington, Gentry Assocs.	19-227-3639
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, PRD c/o Marcus/Gordon	513-256-9984
Ohio	Dayton, S. Sterling Co.	513-298-7573
Pa	Philadelphia, Eastern Instru.	215-927-7777
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Tex	Houston, Data Appls. Corp.	713-661-4501
Tex	Richardson, Data Appls. Corp.	214-231-4846
Tex	San Antonio, Data Applications Corp.	512-732-7176
Wash	Seattle, Arva, Inc.	206-622-0177
Wisc	Brookfield, Pivan Engrg.	414-786-1940

PRECISION DIPBRAZE/TOR., see Energy Technology Corp.

PRECISION DYNAMICS CORP., Elctrns. Div., 3031 Thornton, Burbank, Cal., 91504, Tel: 213-845-7606, Telex: 65-1386; Empl.: 60; Minimum order: $100

For info on price: S. Charles; Application info: A. Schimmelman; Customer service: S. Charles; Delivery info: S. Charles

Free literature available: Catalogs with application's information and pricing data on request. These include information on standard PDC modules as well as PDC dual-in-line sockets.

Products manufactured: Converters, Counters, Display Devices/Displays, Drivers & Decoders For Readouts, Integrated Circuit Devices, Lamps, Sockets, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Cal	San Diego, Ohm Spun Sls.	714-277-6230
Cal	Sunnyvale, Cutlass Elctrns.	408-733-5885
Cal	Torrance, Cutlass Elctrns.	213-324-7360
Ill	Arlington Heights, Hagan Sls. Co.	312-394-0617
Mass	Newton Upper Falls, Brookdale Elctrns.	617-244-6969
Minn	Minneapolis, Electronic Innovators	612-884-7471
NJ	Pennsauken, Megargel/Himmelstein Assoc.	609-662-3081
NY	Kew Garden Hills, Jacques Edeline	212-861-6387

PRECISION DYNAMICS CORP. cont'd

Advertisment

When your lead time is short, our off-the-shelf PDC series display modules can save you time and money on moderate volume or prototype applications. We have modules in a wide range of digit sizes. They include LED, incandescent and seven-segment numeric as well as dot-matrix alphanumeric. They're pre-wired for BCD logic and are ready to mount to your panel with just two screws. Ask for our catalog.

PRECISION ELECTRONICS, INC., 0101 King Ave., Franklin Park, Ill, 60131, Tel: 312-678-5350; Empl.: 75

For info on price: W. Stow; Application info: A. A. Hart; Customer service: J.. Nielsen; Delivery info: C. R. Franzen

Free literature available: Cat. # 1274 P.A.- Sound; Cat 2972-5034 Hi-Fi; Cat 2272-600 Hi-Fi; "G" Series Booklet-Commercial Sound.

Products manufactured: Amplifiers, Attenuators, Microphone Accessories (Including Stands, Holders, Booms), Receivers, Speaker Systems, Speakers, Tuners

Local Sales Offices & Reps.

Ala	Birmingham, M. K. Smith	205-967-3080
Cal	Los Angeles, E. E. Strassner Co.	213-666-1511
Cal	San Francisco, Meyer, Ross & Fleming	415-285-8880
DC	Washington, H. Wise & Co.	202-363-9417
Ga	Mariette, M. K. Smith	404-971-2831
Haw	Honolulu, Gene Piety Factors	
Ill	Franklin Park, Precision Elctrns	312-678-5350
La	Metairie, J. F. McKinney Sls.	504-887-1723
Minn	Minneapolis, J. E. Anderson	612-823-6459
NH	Londonderry, Associated Sys.	603-434-0731
NC	Charlotte, M. K. Smith	704-372-1026
Ohio	Columbus, Weller Elctrns. Sls.	614-885-7819
Okla	Tulsa, J. F. McKinney Sls.	918-742-6791
Tex	Dallas, J. F. McKinney Sls.	214-631-9450
EXP:	Plainview, N.Y., Morhan Exporting Corp.	516-293-5582
FOR:	Can., Dorval 740 Quebec, Superior Intl. Elctrns.	

PRECISION ELEC. CO., Federal Rd., Kezar Falls, Me., 04047, Tel: 207-625-3243, TWX: 710-990-7506; Empl.: 25

For info on price: R. Magline 201-666-3200; Application info: R. A. Kidder 207-625-3243; Customer service: R. O'Neill 207-625-3243; Delivery info: S. Aspinall 207-625-3243

Free literature available: Full Line Catalog; Mini Catalog; Soldering Iron Tip Brochure.

Products manufactured: Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Tweezers, Hand & Vacuum

Local Sales Offices & Reps.

Cal	El Monte, Federated Sls. Co.	213-283-8374
Cal	Mill Valley, Roy Cohen Sls. Co.	415-383-3555
Ill	Westchester, W. Gallagher Inc.	312-344-0690
La	New Orleans, Crockett Sls. Co.	504-486-4590
Md	Baltimore, E-K-P Assocs.	301-788-6498
Mass	Nahant (Boston), F. H. Hart Co.	617-581-0381
Mich	Farmington, Carter, McCormic & Pierce	313-477-7700
Mo	Raytown, Marty Taraski Sls. Co.	816-358-1442
NY	Liverpool (Rochester), W. T. Elliott	315-652-3690
NY	New York (Jackson Hts.), C. Landis Sls. Co.	212-458-7900
Ohio	Columbus, Mandabach Assocs.	614-235-0265
Ohio	Dayton, Carter McCormic & Pierce	513-278-5873
Pa	Aston, E-K-P Assocs.	215-459-4517
Pa	Easton, E-K-P Assocs.	215-691-5250
Pa	Pittsburgh, Mandabach Assocs.	412-279-2264
Tenn	Memphis, Crockett Sls. Co.	901-388-5410
Tex	Dallas, Crockett Sls. Co.	214-748-8209
Wash	Seattle, Don Smith Sls. Co.	206-633-3160
EXP:	Westwood, N.J., Lonor Sls. Intern'l. Ltd.	201-666-3200

PRECISION LAMP, INC., 950 N. Rengstorff Ave., Mountain View, Cal., 94043, Tel: 415-965-1333, Telex: 348498; Empl.: 25; Minimum order: $25

For info on price: M. Lawrence; Application info: G. Verwer; Customer service: M. Lawrence; Delivery info: M. Lawrence

Products manufactured: Lamps, Lights

Local Sales Offices & Reps.

Ariz	Phoenix, Controlyne, Inc.	602-254-9565
Cal	Anaheim, LoDan, Inc.	714-956-1560
Cal	Menlo Park, Straube Assocs.	415-323-2476
Colo	Denver, Straube Assocs.	303-426-0890
Conn	North Haven, Comp Rep Dists.	203-239-9762
Fla	Miami, Winfield Elctrn. Sls. Co.	305-945-6544
Ill	Chicago, G. McL. Cole Co.	312-774-3535
Ind	Fort Wayne, W.W. Bieberich Co.	219-432-2537
Ind	New Albany, W.W. Bieberich Co.	812-945-3187
Iowa	Des Moines, KSW Assocs.	513-279-9235
Md	Baltimore, Kaufholz Assocs.	301-488-6561
Mass	Needham, Comp. Rep. Distrs.	617-444-2484
Mich	Grand Rapids, J.L. Montgomery Assocs.	616-774-9308
Mich	Southfield, J.L. Montgomery Assocs.	313-358-2616
Minn	Minneapolis, R-J Inc.	612-922-1425
Mo	Kansas City, KSW Assocs.	816-358-5240
Mo	St. Louis, KSW Assocs.	314-781-6111
NJ	Upper Montclair, Controlyne, Inc.	201-746-8900
NM	Albuquerque, Straube Assocs.	505-292-0295
NY	Massapequa, R.D. McGrath	516-798-0400
Ohio	Cleveland, Goory Sales Co.	216-331-2055
Pa	Newtown Square, Kaufholz Assocs.	215-356-5000
Tex	Dallas, Scott Tech. Sls.	214-352-7698
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Wash	Bellevue, W.M. Buehler Co.	206-455-5512
Wisc	Milwaukee, G. McL. Cole Co.	414-545-6083

PRECISION MECHANISMS CORP., 44 Brooklyn Ave., Westbury, N.Y., 11590, Tel: 516-ED 3-5955; FSC No: 08127; Empl.: 24 .... p. 1•1200,1919

For info on price: M. Gagnon; Application info: L. N. Canick; Customer service: M. Kornhauser; Delivery info: M. Gagnon

Free literature available: Bulletins 102, 103, 104, 106, 108, 109, 110 Designer's manual for assembly large variety geared mechanisms from stocked components. Self contained infinitely adjustable cam switches, limit stops. Slip clutches and antibacklash gears. Bulletin III tape perforator.

Products manufactured: Actuators, Clutches, Controls/Control Eqpt., Couplings, Drives & Drive Mechanisms (Dial), Gears & Gear Mechanisms (Precision), Indicators, Kits, Breadboarding (For Engineers), Limit Stops, Mechanical, Perforators, Reducers, Servo Systems, Switches, Timers

Local Sales Offices & Reps.

Cal	Cupertino, Eakins ASSOC.	408-255-6494
NY	Rochester, A & D Devices	716-586-8033

PRECISION METAL PRODS. CO., 41 Elm St., Stoneham, Mass., 02180, Tel: 617-438-3650, TWX: 710-393-0113; FSC No: 86577; Empl.: 54; Minimum order: $10

For info on price: R. A. Waite; Application info: C. F. Gerry; Customer service: R. D. Weadick; Delivery info: R. D. Weadick

Free literature available: PRESSERTS-CAPTIVE HARDWARE: 24-page catalog describing inserts and studs for thin metal and thread strength. No special tools required. TERMINALS-MINI-PINS: Complete 40-page booklet describing contact pins and soldering terminals for printed circuits and module applications.

Products manufactured: Fasteners, Pins, Spacers, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, J. Osborn Assocs.	602-996-1291
Cal	Corte Madera, P. Oneal & Assocs.	415-924-1691
Cal	Garden Grove, Impact Elctrns., Inc.	213-431-3581
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Fla	Winter Park, Steele Tech. Sls.	305-644-6641
Ga	Atlanta, Mr. G. O'Hara	404-237-0600
Ill	Chicago, Rusz Sls. Co.	312-631-7322
Ind	Fort Wayne, New/Era Sls., Inc.	219-432-1164
Ind	Indianapolis, New/Era Sls., Inc.	317-257-7333
Md	Baltimore, M/E Assocs.	301-825-1130
Mass	Andover, Sls. Engrg. Co.	617-470-0800
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-559-7373
Minn	Hopkins, F. Peterson Co.	612-941-5400
NJ	Cherry Hill, M/E & Assocs.	609-667-6110
NY	Mount Vernon, Zauderer Assocs., Ins.	914-664-7385
NY	Syracuse, C.W. Floring & Assocs.	315-478-2149
Ohio	Cleveland, Electro-Com	216-886-2404
Ohio	Dayton, Electro-Com	513-276-3993

Tex	Arlington, Chaparral Inds.	817-265-2418
Wash	Kirkland, W.J. Stulgis Co.	204-822-3867
FOR:	Can., Ville St. Laurent, P.Q., A. Deskin Sls. Corp.	514-331-2860

PRECISION MONOLITHICS INC., 1500 Space Dr., Santa Clara, Cal.; 95050, Tel: 408-246-9222, TWX: 910-338-0528; Empl.: 250 .... p. 1•893

Products manufactured: Amplifiers, Converters, Drivers & Decoders For Readouts, Integrated Circuit Devices, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps.	205-539-4411
Ariz	Tempe, Argus Sales, Inc.	602-967-8709
Cal	El Toro, Elctrn. Comp. Mktg.	714-830-3939
Cal	Newport Beach, R. Debowey	714-752-1760
Cal	San Diego, Elctrn. Comp. Mktg.	714-295-6122
Cal	Woodland Hills, Elctrn. Comp. Mktg.	213-340-1745
Colo	Englewood, Checkmate Sls.	303-771-4920
Conn	Wallingford, Com-Sale	203-269-7964
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-776-4800
Fla	Orlando, W.A. Brown Comps.	305-425-5505
Ga	Atlanta, W.A. Brown Comps.	404-457-4069
Ill	Arlington Heights, J. Kennaugh	312-437-6697
Ill	Chicago, G. McL. Cole Co.	312-774-3535
Ind	Indianapolis, Jerry Ihrig Assoc., Inc.	317-783-7630
Md	Baltimore, Stemler Assocs.	301-944-8262
Mass	Waltham, Com-Sale	617-890-0011
Mich	Detroit, A. Blumenberg Assocs.	313-557-1934
Minn	St. Paul, Cahill Assocs.	612-646-7217
Mo	Hazelwood, Dytronix, Inc.	314-731-5799
Mo	Kansas City, Dytronix, Inc.	816-761-6543
NJ	Cherry Hill, Stemler Assocs.	609-966-4070
NJ	Keasbey, Addem II	516-567-5900
NJ	Laurel Springs, Stemler Assocs.	215-644-3477
NM	Albuquerque, Thorson Co.	505-265-5655
NY	Huntington Station, Addem	516-567-5900
NY	Rochester, Ontec Assocs.	716-464-8636
NY	Smithtown, Sales Office (Mr. Mike Neidich)	516-785-3331
NC	Raleigh, W.A. Brown Comps.	919-876-9061
NC	Winston-Salem, W.A. Brown Comps.	919-725-5384
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Ore	Portland, SJI, Corp.	
Tex	Houston, Oeler & Menelaides, Inc.	713-772-0730
Tex	Richardson, Oeler & Menelaides, Inc.	214-234-6334
Utah	Salt Lake City, Checkmate Sales	801-268-3533
Va	Alexandria, Stemler Assocs.	703-548-7818
Wash	Seattle, Showalter-Judd, Inc.	206-624-9020
Wisc	Milwaukee, G. McL. Cole Co.	414-545-6083

PRECISION PAPER TUBE CO., 1049 S. Noel Ave., Wheeling, Ill., 60090, Tel: 312-537-4250; Empl.: 185; Minimum order: $35

Customer service: D. Speer

Products manufactured: Bobbins, Winding, Coil & Transformer, Bumpers, Bushings, Glass, Plastic, Metal, Rubber, Etc., Caps, Forms & Tapes, Heat Shrinkable, Caps, Lenses, Indicator Light, Coils Including Assemblies & Forms, Connectors, Containers, Covers, Protective (Including Dust), Cups, Encapsulation, Grommets, Insulators & Insulation, Laminates, Machines/Machinery, Production, Shafts & Adapters, Shields, Spacers, Tubing

Local Sales Offices & Reps.

Ariz	Phoenix, Tanler & Co.	602-279-1252
Cal	Los Angeles, C.E. Riggs, Inc./C.D. Lamoree Co.	213-225-5631
Conn	West Hartford, R.S. Pettigrew & Co.	203-233-8533
Mich	Grand Junction, Goodell Sls. Co.	616-434-6757
Mo	St. Louis, Tanler & Co.	314-645-0590
NJ	Rocky Hill, Krone & Rubin Assoc.	609-924-0200
NY	Webster, J. Giovenco	716-671-6709
Ohio	Cincinnati, I.W. Grothouse Assoc.	513-385-6562
Ohio	Westlake, Buckeye Bobbin & Mfg. Div.	216-871-9020
Ore	Portland, C.E. Riggs Inc./C.D. Lamorree Co.	503-226-3286
Wash	Seattle, C.E. Riggs Inc./C.D. Lamorree Co.	206-623-5707
EXP:	Can., Mississauga, Ont., Anbak Sls., Can., Ltd.	416-625-1061

PRECISION RESISTOR CO., INC., 109 U.S. Hwy. 22, Hillside, N.J., 07205, Tel: 201-926-3036; FSC No: 48615; Empl.: 40; Minimum order: $25

For info on price: W. F. Kirgan; Application info: R. L. Wright; Customer service: W. F. Kirgan; Delivery info: W. F. Kirgan

Products manufactured: Resistors, Shunts, Meter, Standards

PRECISION STANDARDS CORP., 1701 Reynolds, Santa Ana, Cal., 92705, Tel: 714-546-0431, 800-854-3253, TWX: 800-854-3253; Empl.: 25; Minimum order: $25

For info on price: M. Hill; Application info: S. Eitel; Customer service: T. Smith; Delivery info: M. Hill

Products manufactured: Bridges, Calibrators, Meters, Standards, Testers

Local Sales Offices & Reps.

FOR:	Can., Montreal, Que., Electro-design	514-363-5120
FOR:	Can., Toronto, Ont., Electro-design	416-787-0991
FOR:	Can., Vanier-Ottowa, Ont., Electro-design	613-745-0541

PRECISION TIMER CO., 13 Westbrook Ind'l. Park, Westbrook, Conn., 06498, Tel: 203-399-6253; Empl.: 25 p. 1•268,269

Products manufactured: Clocks (All Types), Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Data Acquisition & Reduction Systems, Data Loggers, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Display Devices/Displays, Dividers, Electroplating Equipment & Supplies, Encoders, Flashers, Generators, Indicators, Integrated Circuit Devices, Meters, Motors, Power Drivers, Hybrid (High Current, High Voltage), Process Control Systems, Programmers, Recorders, Relays, Services, Assembly, Production & Test, Standards, Switches, Testers, Timers, Totalizers, Digital, Transmitters, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Conn	Westbrook, Precision Timer Co.	203-399-6253
Ill	Lombard, Quadtron Assocs.	312-627-6800
Mass	Millis, Selmark Assoc.	617-376-2914
NH	Plaiston, Selmark Assocs., Inc.	603-382-4796

PRECISION TUBE, Church Rd. & Wissahickon, No. Wales, Pa., 19454, Tel: 215-699-5801, Telex: 84-6439; FSC No: 82413; Empl.: 170; Minimum order: $25

For info on price: M. F. Balch; Application info: A. J. West; Customer service: B. Dudinetz; Delivery info: B. Dudinetz

Free literature available: Catalog;Semi-rigid coaxial cable, cable assemblies, and delay lines made to customer's exact specifications.

Products manufactured: Cable, Delay Lines

Local Sales Offices & Reps.

Ariz	Scottsdale, Carter Assocs.	602-947-4355
Cal	Mt. View, Walter Assoc., Inc.	415-965-4131
Cal	Santa Ana, RMS Assocs.	714-556-4155
Fla	Melbourne, Hanson Assocs.	305-727-7474
Ga	Alpharetta, K. Ekmark	404-475-4872
Ill	Crystal Lake, MESA, Inc.	312-639-3359
Ind	Indianapolis, Sukup & Cox, Inc.	317-253-1215
Iowa	Cedar Rapids, Snider Sls. Co.	319-362-4410
Mass	Burlington, Tri Tek, Inc.	617-272-4550
Minn	St. Louis Park, Xylem Co.	612-920-9626
Mo	St. Charles, Buse Sls. Co.	314-946-6430
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NY	Huntington, CDB Enterprises, Inc.	516-692-5200
NY	Utica, B. D. Hummel Co.	315-736-7821
NC	Charlotte, McLean Sls. Co.	704-366-2675
Tex	Richardson, Lawrence Sls.	214-235-5504
Va	Fairfax, Schibley Assocs.	703-591-3008
Wash	Seattle, Blum & Assocs.	206-285-2590

PREFORMED LINE PRODUCTS CO., Box 91129, Cleveland, Ohio, 44101, Tel: 216-461-5200; Empl.: 450; Minimum order: $50

Customer service: W. J. Voelker

Products manufactured: Connectors, Services, Assembly, Production & Test, Spacers, Splices, wire (Including, Butt & Cap Types), Wire & Cable Ties

Local Sales Offices & Reps.

Ala	Birmingham, Belcher & Assocs.	205-322-1733
Ala	Birmingham, Glenn, Hirhman & Mills	205-591-6520
Ark	Little Rock, C.H. Stout, Inc.	501-374-8201
Ark	Rogers, Preformed Line Prods. Co.	501-636-7600
Cal	Palo Alto, Preformed Line Prods. Co.	415-493-0170
Cal	San Francisco, K.M. Ryals Co.	415-495-7090
Cal	Woodland Hills, Smith Co. Div.	213-887-8600
Colo	Denver, Peterson Co.	303-388-6322
Colo	Littleton, R.J. Hodona	303-798-6729
Fla	Jacksonville, Belcher & Assocs.	904-724-7811
Fla	Long Wood, Belcher & Assocs.	305-830-7327
Fla	Miami, Belcher & Assocs.	305-371-1700
Fla	St. Petersburg, Belcher & Assocs.	813-822-3531
Ga	Atlanta, Belcher & Assocs.	404-255-5481
Ga	Decature, Glenn, Huhman & Mills, Inc.	404-284-4431
Ga	Tucker, Preformed Line Prods. Co.	404-938-6820
Haw	Honolulu, J.W. Smith	808-988-3079
Ill	Schiller Park, JSG Elec. Co.	312-678-5990
Ind	Indianapolis, Cory, Crum & English, Inc.	317-545-8593
Iowa	Cedar Rapids, F.C. Clatterbaugh Co.	319-364-5557
Iowa	Des Moines, F.C. Clatterbaugh Co.	515-282-3213
Ky	Bowling Green, Dyer-Pederson Agency	502-842-9346
Ky	Lexington, Dyer-Pederson Agency	606-266-7412
Ky	Morganfield, Dyer-Pederson Agency	502-389-1744
La	Baton Rouge, C.H. Stout of La. Inc.	504-927-8097
La	New Orleans, C.H. Stout of La. Inc.	504-486-3707
La	Shreveport, C.H. Stout of Shreveport, Inc.	318-425-5485
Md	Annapolis, P.J. Martini & Assocs.	301-267-7462
Md	Reistertown, Electrical Distributors Co.	301-833-4604
Mass	Framingham, E.L. Flowers & Sons	617-879-4250
Mich	Dearborn, G.R. Horne & Co.	313-561-1360
Mich	Jackson, G.R. Horne & Co.	517-536-4387
Minn	Faribualt, Dale E. Putrah & Assoc.	507-334-4431
Minn	Minneapolis, Bergstrom-Verbarg Co.	612-FE9-0028
Miss	Jackson, C.H. Stout of MS, Inc.	601-354-4326
Mo	Kansas City, Cleaves-Bessmer, Inc.	816-353-6011
Mo	St. Louis, Ken Way Co.	314-961-3062
Neb	Lincoln, F.C. Clatterbaugh Co.	402-489-5912
Neb	Omaha, Preformed Line Prods.	402-391-6570
NM	Albuquerque, McKinley Sls. Co.	505-294-7349
NY	Eastchester, M.N. Snyder & Sons, Inc.	914-337-6000
NY	Horseheads, Canavan-Scanlon Assoc.	607-739-0810
NY	Rochester, Canavan-Scanlon Assoc.	716-442-0720
NY	Syracuse, Canavan-Scanlon Assoc.	315-437-1271
Ohio	Vermilion, R.S. Howley Co.	216-967-7000
Okla	Oklahoma City, C.B. Anderson Elec. Co.	405-751-2771
Okla	Tulsa, C.B. Anderson Elec. Co.	918-TE6-4661
Ore	Portland, Shaffer & Nelson, Inc.	503-234-7437
Pa	Conshohocken, Electrical Distributions Co.	215-825-1305
Pa	Pittsburgh, Burns Elec. Co.	412-823-5874
SC	Columbia, Engr. Sls. Co. of Carculina, Inc.	803-253-4004
Tenn	Memphis, C.H. Slout of TN, Inc.	901-362-1616
Tenn	Nashville, J.S. Baron Assocs.	615-883-4748
Tex	Dallas, E.B. Robertson, Inc.	214-942-2711
Tex	Houston, E.B. Robertson, Inc.	713-785-6800
Tex	Lubbock, E.B. Robertson, Inc.	806-746-6527
Tex	Rio Hondo, B.J. Kohler Assocs.	512-226-5184
Tex	San Antonio, E.B. Robertson, Inc.	512-824-0597
Utah	Salt Lake City, Shaffer & Nelson, Inc.	206-523-0664
Wash	Seattle, Shaffer & Nelson, Inc.	206-523-0664
Wash	Spokane, Shaffer & Nelson, Inc.	509-624-1339

PREMAX PRODS. DIV., Chisholm-Ryder Co., Highland & College Aves., Niagara Falls, N.Y., 14305, Tel: 716-285-9186; FSC No: 74183; Empl.: 350; Minimum order: $15

For info on price: M. A. Finley; Application info: J. Maglio; Customer service: M. A. Finley; Delivery info: M. A. Finley

Products manufactured: Antennas, Mounts, Rods, Ground

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Culver City, DeAngelo, Rotham & Co.	213-398-6239
Cal	La Selva Beach, Belchamber & French	408-722-0444
Colo	Denver, G. Moss Elctrns., Inc.	303-985-8815
Colo	Greeley, G. Moss Elctrns., Inc.	303-353-1452

Directory of Local Distributors Starts on page 401

DC	Washington, S.K. Macdonald, Inc.	202-265-3938
Kans	Shawnee Mission, K & M Sls. Co.	913-262-2444
La	La Combe, Scott Ormsby & Assocs.	504-882-7248
Md	Baltimore, S.K. Macdonald, Inc.	302-254-3380
Mass	Northboro, W.B. Pray Sls., Inc.	617-393-3434
NY	Rockville Centre, L.I., Willgold Elctrn. Sls. Corp.	516-764-4022
Ohio	Cincinnati, J.O. Olsen Co.	513-825-0678
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Ore	Portland, R.M. Minthrone Co.	503-246-4556
Pa	Philadelphia, S.K. Macdonald, Inc.	215-545-1205
Pa	Pittsburgh, S.K. Macdonald, Inc.	412-366-2643
Tex	Carrollton, E. L. Wilks Co.	214-242-5321
EXP:	New York City, N.Y., M. Simons & Son Co.	212-227-5513

PREMIER METAL PRODS. CO., Div. Sunshine Mining Co., 337 Manida St., Bronx, N.Y., 10474, Tel: 212-991-6600; Empl.: 70; Minimum order: $25

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Free literature available: Cabinets and Enclosures Catalog: 16 pages in full color (Trimline Series); 30 pages Illustrated General Lines and Accessories; 24 pages of technical drawings.

Products manufactured: Blowers & Fans & Accessories, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Metal, Drawers, Sliding, Frames, Cabinet & Rack, Grilles, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Panels, Racks, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ala	Birmingham, Adams & Assocs.	205-822-8109
Ariz	Scottsdale, G. DARCI	602-948-2240
Cal	Culver City, DeAngelo, Rothman & Co.	213-398-6239
Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Conn	Meriden, Eagle Assocs.	203-467-6542
Fla	Orlando, Adams & Assocs.	305-894-7185
Ga	Decatur, Adams & Assocs.	404-981-2207
Ill	Chicago, Ellinger Sls.	312-763-1570
Md	Towson, Habco Elctrns.	301-825-9637
Mass	Needham, Eagle Assocs.	617-444-3446
Minn	Minneapolis, J.E.M. Anderson Co.	612-823-6459
Mo	Kansas City, R.R. Burton Sls. Co.	816-444-8300
Mo	St. Louis, Delltron Co.	314-869-1351
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
NY	Mt. Vernon, Sonkin Assocs.	914-668-9809
NY	New Hyde Park, Harris & Aldrich Sls.	516-488-2622
NC	Greenboro, Adams & Assocs.	919-272-6838
Ohio	Cleveland, ImTech Inc.	216-826-3400
Pa	Easton, E-K-P Assocs.	215-258-6477
Pa	Philadelphia, Eastern Instrumentation	215-927-7777
Tenn	Knoxville, Adams & Assocs.	615-577-4241
Tex	Garland, G.V. Peck	214-341-8311
Tex	Houston, G.V. Peck	713-MO4-1435
EXP:	Hallandale, Fla., Emec, Inc.	305-925-6366

Local Distributors

Ala	Opelika, Southern Elctrns., 309 S. 10th St.	205-745-6478
Cal	Burlingame, Rose Elec. Distrs., 846 Stanton Rd.	415-697-0224
Cal	San Jose, Quement Elctrns., Box 6000, 1000 S. Bascom Ave.	408-998-5900
Conn	Bridgeport, Westconn Elctrns. Inc., 195 Colorado Ave.	203-367-7747
Conn	E. Hartford, R & S Elctrn. Dist., 95 Leggett St.	203-528-9901
Conn	Waterbury, Bond Radio Elec. Co., 439 W. Main St.	203-757-0546
Fla	Miami, Electronic Equip. Co., 2701 N.W. 42nd Ave.	305-871-3500
Ind	Ft. Wayne, Ft. Wayne Ele. Supply, 3606 E. Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania St.	317-634-8486
La	Lafayette, Ralph's Elctrns., 1732 Plank Rd.	504-344-3761
Md	Bethesda, Empire Elctrn. Supply, 4907 Rugby Ave.	301-OL-6-3300
Mass	Boston, Sager Elctrn. Corp., 172 High St.	617-542-2281
Mass	Newton, Greene Shaw Co., Chapel Bridge Pk., 70 Bridge St.	617-WO-9-8900
Mich	Ann Arbor, Purchase Radio Supply, 327 E. Hoover Ave.	313-668-8696
NJ	Edison, William Elctrns., 1863 Woodbridge Ave.	201-985-3700
NJ	Hanover, State Elctrns. Pts., 36 Route #10	201-887-2550
NJ	Springfield, Federated Purchasers, 155 U.S. Rte. #22	212-DI-9-3050
NJ	Springfield, Route Elctrns., Echo Plaza Rte. 22	201-467-0166
NJ	Union City, Nidisco Inc., 2812 Kennedy Blvd.	201-863-2111
NY	Albany, E. E. Taylor Co., 465 Central Ave.	518-438-4461
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Elmsford, Ancar Elctrns. Supply, One Nepperhan Ave.	914-LY-2-7100
NY	Farmingdale, Arrow Elctrns. Inc., 900 Broad Hollow Rd.	212-995-2100
NY	Farmingdale, Broadline Elec. Dist., 119 Marine St.	516-420-8320
NY	Hempstead, Electronics Equip. Co., 741 Peninsula Blvd.	212-895-5757
NY	L.I.C., H.L. Dalis, Inc., 35-35 24th St.	212-361-1100
NY	Lynbrook, Peerless Radio Dist. Corp., 19 Wilbur St.	212-523-3456
NY	New York, Martin Audio Corp., 320 W. 46 St.	212-541-5900
NY	Poughkeepsie, Chief Elctrns., 14 N. Bridge St.	914-471-1300
NY	Rochester, Summit Distrs., 292 Commerce Dr.	716-334-8110
NY	Rockville Ctr., Midway Indl., 24 Maple Ave.	516-764-2400
NY	Syosset, Lafayette Radio Corp., 111 Jericho Tpke.	516-921-7700
NY	White Plains, Westchester Elctrns., 602-610 Mamaroneck Ave.	914-965-1063
NY	Woodbury, Harvey Radio Corp., 60 Crossways Pk. W.	516-895-9260
Ohio	Dayton, ESCO Inc., 221 Crane St.	513-226-1133
Pa	Allentown, A. A. Peters, 404 Union Blvd.	215-434-5237
Pa	Altoona, Allegheny Elctrns., 800 Chestnut Ave.	814-946-0871
Pa	Philadelphia, Herbach & Rademan, 401 E. Erie Ave.	215-426-1700
Pa	Philadelphia, Philadelphia Elctrns., 112 N. 12th St.	215-568-7400
Pa	Philadelphia, Simco Inc., 3907-11 N. Broad St.	215-BA9-1880
Pa	Reading, Barbey Elctrns., Inc., 333 N. 4th St.	215-376-6116
Pa	West Chester, West Chester Elec. Supply, 716 E. Market St.	215-696-7500
RI	Providence, Wm. Dandreta Co., 28 Wolcott St.	401-861-2800
RI	Warwick, W.H. Edwards Inc., 55 Electric Dr.	401-781-8000
Tex	Dallas, All State O.E.M. Div., Summer Elec., Co., 510 S. Good Latimer Expwy.	214-651-0242
Tex	Ft. Worth, Swieco Inc., 1512-18 E. Lancaster	817-335-6521
Tex	Houston, Lenert Co., 1420 Hutchins	713-225-1465
Va	Arlington, Arlington Elctrns., 3636 Lee Hwy.	703-524-2412
Wash	Seattle, Radar Elec. Co., 168 Western Ave. W.	206-282-2511

PREMIER MICROWAVE, 35 New Broad St., Port Chester, N.Y., 10573, Tel: 914-939-8900; FSC No: 15870; Empl.: 60; Minimum order: $100

Customer service: J. Simmonds

Free literature available: Brochures illustrating "Rotary Joints," "MICROWAVE FILTERS" "MICROWAVE FRONT ENDS" and "MICROWAVE FERRITE DEVICES."

Products manufactured: Adapters, Waveguide, Amplifiers, Antenna Feed Systems, Antennas, Attenuators, Bends & Twists, Microwave, Cavities, Microwave, Chokes, Circulators, Ferrite, Converters, Couplers, Couplings, Delay Lines, Detectors, Discriminators, Dividers, Dummy Loads, Duplexers, Microwave, Filters, Flanges, Waveguide, Gaskets, Shielding, R-F-Also See Shields, R-F, Generators, Horns, Microwave, Impedance Converters, Microwave, Isolators, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Meters, Mismatches, Microwave, Precision, Mixers, Modulators, All Kinds, Mounts, Networks, Preselector-Mixers, Preselectors, Probes, Receivers, Shifters, Shutters, Microwave, Slotted Lines, Microwave, Strip-Line Components, Microwave, Switches, Tees, Terminals, Transformers, Transmitters, Tubing, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ariz	Scottsdale, O.E.M. Specialties	602-948-3360
Cal	No. Hollywood, Crown Elctrn.	213-877-3550
Cal	San Mateo, Melvin Sls. Co.	415-349-7444
Fla	Orlando, BC Elctrns. Sls. Corp.	305-894-6071
Ga	Smyrna, BC Electrnc. Sls. Corp.	404-436-5169
La	Metairie, J. F. McKinney Sls. Co.	504-887-1723
Md	Catonsville, Callas Elctrns. Dist.	301-744-7711
Mass	Natick, Gerald Rosen Co.	617-879-5505
Mo	St. Louis, G Fixman Engrg.	314-725-5219
NY	Huntington, C.D.B. Entprs.	516-692-5220
Ohio	Dayton, BEK Assocs.	513-278-1343
Okla	Tulsa, J. F. McKinney Sls.	918-742-6791
Tex	Bellaire, J. F. McKinney Sls. Co.	713-665-3653
Tex	Dallas, J. F. McKinney Sls.	214-631-9450
Va	Vinton, BC Elctrnc. Sls. Corp.	703-890-1128
EXP:	Cal., No. Hollywood, Air Frame Mfg. & Supply	213-765-2600
EXP:	New York, N.Y., Singer World Prods. Inc.	212-432-1400
FOR:	Can., Ville Lasalle 650, Que., Electrodesign Ltd.	514-363-5120

PRESS-ON PRODS., 39 Factory Rd., Addison, Ill., 60101, Tel: 312-543-9466; Empl.: 40

For info on price: T. Cummins; Application info: T. Cummins; Customer service: J. Tonne; Delivery info: J. Tonne

Free literature available: Catalog with samples attached of various Type gasketing tapes (pressure sensitive adhesive backed).

Products manufactured: Services, Assembly, Production & Test, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive

PRESIN CO., INC., Trap Falls Rd., Shelton, Conn., 06484, Tel: 203-929-5381; Empl.: 150

Customer service: Sls. Desk

Products manufactured: Capacitors, Fixed, Controls/Control Eqpt., Counters, Networks, Printers, Protectors, Recorders, Suppressors, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Cal	Montebello, Tucul Engrg.	213-728-7397
Cal	San Carlos, Electro Pacific	415-593-1334
Colo	Denver, Tessco	303-744-1119
Fla	Hialeah, Shaw Engrg. & Sls.	305-822-6141
Ill	Arlington Heights, Martec Assocs.	312-956-8090
Md	Towson, Kraft Elctrn.	301-828-5838
Mich	Detroit, R.P. Urban & Associates	313-535-2355
Mich	Grand Rapids, R.P. Urban & Associates	616-245-0511
Minn	Mpls., Wenco Sls.	612-866-3639
NJ	Ridgewood, Ballou, Inc.	201-444-6990
NY	New Hartford, KLM Associates Inc.	315-735-8525
NY	Rochester, KLM Associates Inc.	716-442-0821
NY	Syracuse, KLM Associates Inc.	315-458-2199
NC	McLeansville, Ron Ingle Assoc.	919-697-0787
Ohio	Chagrin Falls, J. Kilroy	216-247-8997
Pa	Newtown Sq., Holdsworth	215-356-8550
Tex	Dallas, Glidden Engrg. & Elctrn. Equip. Corp.	214-363-6539
Tex	Houston, Glidden Engrg. & Elctrn. Equip. Corp.	713-681-1415
Wash	Seattle, R. Johnston Co.	206-524-5170

PRESTOLITE WIRE DIVISION, An Eltra Co., Box 649, Port Huron, Mich., Tel: 313-985-6131

Products manufactured: Cable, Wire

PRESTON SCIENTIFIC INC., 805 E. Cerritos Ave., Anaheim, Cal., 92805, Tel: 714-776-6400, Telex: 66-5432; Empl.: 85; Minimum order: $25

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For info on price: N. Hummel, 714-776-6400; Application info: N. Hummel, 714-776-6400; Customer service: C. Currier, 714-776-6400; Delivery info: M. Montooth, 714-776-6403

Free literature available: Amplifier (DC) Technical Data Sheets: 8300XWB Series, XWBRC Series, Amplifier User Survey Report, Balanced Precision-Technical Discussion of CMV/CMRR, Bias Current Drift, 10 New Options Brochure. A/D Conversion Technical Data Sheets: GMAD1, 2 & 3 ADC Systems, GMAD-01 Ultra East (1 to 10 MHz) ADC, GMAD4 ADC Systems, Data Acquisition Systems & Components.

Products manufactured: Amplifiers, Converters, Data Acquisition & Reduction Systems, Multiplexers

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scientific Instrs.	205-837-1601
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Anaheim, Preston-Ana	714-776-6400
Cal	San Jose, MCH Assocs.	408-246-7330
Colo	Denver, Williams Assocs.	303-373-4730

Conn	Avon, Inst. Dynamics Inc.	203-678-1088
Fla	Orlando, Truex Assocs.	305-859-2160
Ind	Indianapolis, Holsapple & Assocs.	317-899-2890
Kans	Shawnee Mission, Techn. Sls. Assocs.	913-888-3330
Md	Greenbelt, Riffe Assocs.	301-474-8600
Mass	Wakefield, Instr. Dynamics Inc.	617-245-5100
Mich	Royal Oak, Hocker Assocs.	313-549-3910
Mo	Ferguson, Techn. Sls. Assocs.	314-725-5361
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Pittsford, Ossmann Instruments	716-385-2770
NY	Westbury, Tech-Rep Engrg. Sls.	516-997-7946
NC	Winston-Salem, Radco	919-722-9671
Ohio	Dayton, Hocker Assocs.	513-298-8638
Ohio	N. Olmsted, Hocker Assocs.	216-734-4433
Pa	Jenkintown, Stein Instrumentation Corp.	215-885-2370
Tex	Dallas, R. Martin Assocs.	214-361-8584
Tex	Houston, R. Martin Assocs.	713-462-4077
Wash	Bellevue, Brennan Assocs.	206-454-9332

PRIME COMPUTER INC., 145 Pennsylvania Ave., Framingham, Mass., 01701

PRIMO COMPANY LTD., 25-1, 6-Chome, Mure, Mitakashi, Tokyo, Japan, Tel: 0422-43-3121, Telex: 2822-326J; Empl.: 400 .... p. 1•30

Products manufactured: Comm. Systems, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds

Local Sales Offices & Reps.

Ill	Chicago, Primo Microphone Inc.	312-595-1022

PRIMO MICROPHONE INC., 2468 Delta La., Elk Grove Village, Ill., 60007, Tel: 312-595-1022, Telex: 28-3474; Empl.: 6

Products manufactured: Handsets, Chestsets, Headphones, Headsets, Etc., Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Transformers

Local Sales Offices & Reps.

Ind	Fort Wayne, Morris-Cunningham Assoc.	219-485-3612
Ind.	Indianapolis, Morris-Cunningham Assoc.	317-255-2548
Tex	Addison, Parvin Sls.	214-661-5374
Tex	Houston, Parvin Sls.	713-784-9900

PRINCETON APPLIED RESCH. CORP., Box 2565, Princeton, N.J., 08540, Tel: 609-452-2111, Telex: 84-3409; Empl.: 225; Minimum order: $50

For info on price: S. Elkins; Application info: S. Letzter; Customer service: S. Elkins; Delivery info: S. Elkins

Free literature available: Photon Counting Catalog #T-335, contains complete specifications on Princeton Applied Research Corporation ratemeters, digital counters, amplifier discriminators, quantum photometers and photon counting accessories. Signal Averager Catalog #T-220B, contains complete specifications of our MOdel 162 Dual Channel Boxcar, Model 160 Single Channel Boxcar, Model TDH-9 100 Point Averager and Model CW-1 Single Channel Boxcar. Preamplifier specifications and accessories as well as several application summaries are included.
Lock-In Amplifiers Catalog #T218B contains complete specifications of all Princeton Applied Research Lock-ins, light choppers, ratiometers, low noise preamplifiers and current sensitive preamps. This Lock-In catalog also contains short section on How Lock-ins work, where to use them, how to choose one, a section on noise and 9 typical applications. Optical Multichannel Analyzer Catalog #T-336 describes Princeton Applied Research's 500 channel OMA. Complete specs on our Model 1205B Detector assembly.
Model 1205D Intensified Detector Head and Model 1205E IR Enhanced Vidicon Detector Head. Cooled Detector Heads are also described as well as several application summaries.

Products manufactured: Amplifiers, Analyzers, Cases, Equipment, Instrument, Meter, Controls/Control Eqpt., Converters, Data Acquisition & Reduction Systems, Detectors, Indicators, Integrators, Electronic, Magnetometers, Meters, Monitors, Multipliers, Signal Averagers, Signal Conditioners & Equipment, Transducers, Transformers

Local Sales Offices & Reps.

Cal	Anaheim, Princeton Applied Resch. Corp.	714-635-6710
Cal	Burlingame, Princeton Applied Resch. Corp.	415-347-0786
Colo	Denver, GRIFCO	303-722-4674
Fla	Orlando, E. G. Holmes & Assoc.	305-894-8901
Ga	Chamblee, H.G. Holmes & Assoc.	404-451-6161
Ill	Deerfield, Princeton Applied Resrch. Corp.	312-498-5858
Kans	Shawnee Mission, EIR Co.	913-362-0919
Md	Rockville, Princeton Applied Resch. Corp.	301-881-3120
Mass	Bedford, Princeton Applied Resch. Corp.	617-275-2100
Mo	Hazelwood, EIR Co.	314-895-4100
NM	Albuquerque, Fry Gates Co.	505-298-1875
Ohio	Cleveland, Princeton Applied Resrch. Corp.	216-333-1244
Tex	Dallas, Southwestern Engrg. & Equip. Co.	214-826-6661
Tex	Houston, Southwestern Engrg. & Equip. Co.	713-623-2580
Va	Virginia Beach, E.G. Holmes & Assoc.	804-481-6556
FOR:	Can., Longueuil, Quebec, Allan Crawford Assoc.	514-670-1212
FOR:	Can., Mississauga, Ont., Allan Crawford Assoc.	416-678-1500
FOR:	Can., Ottawa, Ont., Allan Crawford Assoc.	613-829-9651
FOR:	Can., Vancouver, B.C., Allan Crawford Assoc.	604-253-7136

PRINCETON ELCTRN. PRODS., Box 101, New Brunswick, N.J., 08902, Tel: 201-297-4448; Empl.: 70

For info on price: W. M. Herbener; Application info: R. Lenskold; Customer service: R. Lenskold; Delivery info: R. Lenskold

Products manufactured: Comm. Systems, Converters, Counters, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Display Devices/Displays, Integrators, Electronic, Memories, Buffer, Scanners, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Tubes

Local Sales Offices & Reps.

Ariz	Phoenix, Moxon Elctrns.	602-273-7363
Cal	Irvine, Moxox Elctrns.	714-556-6500
Cal	San Diego, Maxon Elctrns.	714-292-4820
Cal	Sunnyvale, Moxox Elctrns.	408-249-2491
DC	Washington, QED Elctrns:	301-588-8134
Ind	Fort Wayne, R.O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assoc.	317-359-9283
Ky	Louisville, R. O. Whitesell & Assoc.	502-893-7303
Md	Rockville, Wiltronix	301-460-1454
Mass	Cambridge, Media Systems	617-876-0164
Mich	Farmington, George Tallman	313-557-0974
Mich	Southfield, R. O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R. O. Whitesell & Assoc.	616-983-7337
Ohio	Columbus, R. O. Whitesell & Assoc.	614-888-9396
Ohio	Lakewood, R. O. Whitesell & Assoc.	216-228-7525
Okla	Norman, Data Marketing Assoc. Inc.	405-364-8320
Pa	Norristown, Data Engrg. Co.	215-272-1444
Pa	Pittsburg, R. O. Whitesell & Assoc.	412-344-7277
Tex	Dallas, Data Marketing Assoc. Inc.	214-661-0300
Tex	Houston, Data Marketing Assoc. Inc.	713-686-9627

PRINTACT RELAY DIV., Executone Inc., Box 1430EM, Long Island City, N.Y., 11101, Tel: 212-EX2-4800; Empl.: 500 .... p. 1•1683

Products manufactured: Relays

Local Sales Offices & Reps.

Cal	Orange, Sales & Mktg. Assoc.	714-997-5720
Cal	San Francisco, R. Slater	415-392-9154
Cal	Tarzana, R. Capell Co.	213-987-2233
Colo	Colorado Springs, E.M.C./P. Hale	303-244-3217
DC	Washington, H. Wise	202-363-9417
Ill	Chicago, A. Woods & Assoc.	312-283-7400
Ind	Indianapolis, Marketing Engineers	317-546-1523
Mass	Wakefield, Measurement Equip. Co.	617-245-4870
Mich	Dearborn Hgts., Ankofski Assoc.	313-565-6330
Minn	Anoka, K. Haugen & Assoc.	612-421-3395
Mo	Grandview, K-MAR Engrg. & Sls.	816-763-3466
NM	Albuquerque, IMEC	505-883-9010
NY	Jamaica, S.A.M. Assocs.	212-658-8881
Ohio	Englewood, AD-EL-TEK	513-836-2741
Pa	Phila., H. Goodman	215-CH 7-7116
Wash	Seattle, R. R. Slater	206-622-3860
FOR:	Can., Toronto, Ont., ANRO Electronic Ltd.	416-661-2607

PROCESS & INSTRS. CORP., 1943 Broadway, Brooklyn, N.Y., 11207, Tel: 212-452-8380; Empl.: 28

For info on price: E. Greenspan; Application info: J. Greenspan

Free literature available: Our firm designs and manufactures scientific instruments as per enclosed circular.

Products manufactured: Services, Assembly, Production & Test

PRODUCTION DEVICES, 7857 Raytheon Rd., San Diego, Cal, 92111, Tel: 714-278-1141

Customer service: D. Press

Free literature available: Brochures on all products-8 1/2 x 11.

Products manufactured: Generators, Machines/Machinery, Production, Probes, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Elmar Assocs.	205-881-0274
Ariz	Phonenix, B. G. Sls. Co.	602-266-7252
Cal	Encino, Wayne Dinsmore	213-622-2849
Cal	San Francisco, Technical Sls. Assocs.	415-467-1434
Cal	Simi, Wayne Dinsmore	805-527-1097
Colo	Colorado Springs, Norris & Co.	303-635-9319
Colo	Denver, Norris & Co.	303-988-6430
Ga	Atlantic, Elmar Assocs.	404-261-4345
Ill	Chicago, Markal Sls. Corp.	312-282-5800
Ind	Indianapolis, Mid-Central Sls. Co.	317-283-1727
Ky	Louisville, Mid-Cental Sls. Co.	502-239-5614
Md	Silver Springs, Sherr Assocs.	301-593-2477
Mass	Lynn, Keene Sls. Co.	617-595-2300
Minn	Minneapolis, John E. M. Anderson Co.	612-823-6459
Mo	St. Louis, Baumhauer & Assocs.	314-843-4123
NY	Massapequa Park, Brown Elctrn. Sls.	914-779-7330
NY	Rochester, Brown Elctrn. Sls.	716-266-2728
NY	Yonkers, Brown Elctrn. Sls.	914-779-7330
NC	Burlington, E. P. Ester Co.	919-584-1568
Ohio	Cleveland, H. Miller Sls. Co.	216-321-3900
Ohio	Jamestown, Hank Miller Sls.	513-675-2059
Ore	Portland, R. M. Minthorne Co.	503-246-4556
Pa	Pittsburg, H. Miller Sls.	412-782-1882
Tex	Dallas, Berthold Sls. Co.	214-526-8329

PRODUCTS FOR RESEARCH, INC., 78 Holten St., Danvers, Mass., 01923, Tel: 617-774-3250, Telex: 94-0287; Empl.: 26

Customer service: H. Martin

Free literature available: Catalogue No. 103 gives complete performance and general spec's. on our entire line of photomultiplier housing and support equipment.

Products manufactured: Chamber, Environmental Test, Oceanographic Equip. (Electronic), Photomultiplier Tube Housings, Power Supplies

Local Sales Offices & Reps.

Cal	North Hollywood, O'Halloran Assocs.	213-877-0173
Cal	Palo Alto, O'Halloran Assocs.	415-326-1493
Cal	San Diego, O'Halloran Assocs..	714-224-2824
Ill	Aurora, Dwight Smith & Assoc.	312-896-0828
Md	Wheaton, Applied Science Mktg.	301-933-2566
NM	Albuquerque, Thorson Co.	505-265-5655
Va	Vienna, Applied Science Mktg.	703-281-3638

PROGRAM DATA CO., 739 E. 223 St., Carson, Cal., 90745, Tel: 213-830-3016; Empl.: 20; Minimum order: $25

For info on price: R. Russo 213-830-3016; Application info: R. Russo 213-830-3016; Customer service: R. Russo 213-830-3016; Delivery info: J. Hatfield 213-830-3049

Free literature available: Probing Fixtures, PC Board Test, Probe Contacts, Pneumatic Connectors, Probe Heads, Boards, Programming.

Products manufactured: Boards, Programming, Connectors, Jigs And Fixtures, Chassis & Circuit Board,-Probes, Test Systems, Testers

PROGRAMMED POWER, INC., 141 Jefferson Dr., Menlo Park, Cal., 94025, Tel: 415-323-8454, Telex: 34-8323; Empl.: 15; Minimum order: $20

For info on price: N. Funnell; Application info: R. L. Cooper; Customer service: N. Funnell; Delivery info: N. Funnell

Free literature available: Data sheets and pricing information on our complete family of power line disturbance monitors and frequency converters, including article reprints of interest.

Products manufactured: Converters, Detectors, Inverters, Monitors, Power Supplies, Recorders

Local Sales Offices & Reps.

Ariz	Phoenix, R. A. Mayes Co.	602-279-5243
Cal	Oakland, Advanced Technology	415-452-1401
Cal	Van Nuys, Gordon-Elliot	213-873-6862
Colo	Boulder, R. A. Mayes Co.	303-444-0782
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Fla	Orlando, E. G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E. G. Holmes & Assocs.	404-451-6161
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Glen Ellyn, J.T. Becker Assocs.	312-858-1911
Ind	Indianapolis, Holsapple Assocs.	317-899-2890
Kans	Olathe, Technical Reps.	913-782-1177
Md	Silver Spring, Tri-Tech Engrg.	301-585-8280
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Waytek	612-933-2133
Mo	Hazelwood, Technical Reps.	314-731-5200
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	DeWitt, db Assocs.	315-446-0220
NY	Great Neck, Meas. Technology Inc.	516-482-3500
Ohio	Cleveland, Group Ten	216-486-2800
Ohio	Dayton, Group Ten	513-277-6531
Pa	Norristown, Data Engrg. Co.	215-279-8146
Tex	Houston, R.A. Mayes Co.	713-461-5385
Tex	Richardson, R.A. Mayes Co.	214-235-3043
Utah	Centerville, R.A. Mayes Co.	801-292-6781
Wash	Seattle, Dayne Hansen & Assocs.	206-248-1884

PROJECTS UNLIMITED, INC., 3680 Wyse Rd., Dayton, Ohio, 45414, Tel: 513-890-1918, TWX: 810-450-2523; Empl.: 49; Minimum order: $15
p. 1•270,271

For info on price: D. L. Wyse; Application info: G. Stephens; Customer service: D. L. Wyse; Delivery info: C. Chambers

Products manufactured: Alarms, Amplifiers, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Connectors, Flashers, Generators, Networks, Posts, Probes, Relays, Services, Assembly, Production & Test, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Anaheim, L & M Sls.	714-774-0492
Cal	Menlo Park, Long & Assocs.	415-327-1300
Colo	Denver, Williams Assocs.	303-373-4730
Ill	Addison, R. Stemm, Inc.	312-279-2440
Ind	Fort Wayne, R.O. Whitesell	219-432-5591
Ind	Indianapolis, R.O. Whitesell Co.	317-359-9283
Ind	Kokomo, R.O. Whitesell Co.	317-452-6065
Iowa	Cedar Rapids, Palatine Sls. Co.	319-365-8071
Kans	Andover, Palatine Sls. Co.	316-683-7512
Kans	Overland Park, Palatine Sls. Co.	913-262-5643
Ky	Louisville, R.O. Whitesell	502-893-7303
Mass	Sharon, Adcour	617-784-3396
Mich	Grand Rapids, R.O. Whitesell Co.	616-451-8901
Mich	Southfield, R.O. Whitesell Co.	313-358-2020
Mich	St. Joseph, R.O. Whitesell Co.	616-983-7337
Mo	St. Louis, Palatine Sls. Co.	314-426-7055
NM	Albuquerque, Williams Assoc.	505-255-1638
NY	Glen Head, J.A. Keeneth Co.	516-676-1355
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R.O. Whitesell	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assocs.	
Ohio	Dayton, R.O. Whitesell	513-298-9546
Okla	Tulsa, Palatine Sls. Co.	918-622-0321
Pa	Concordville, J. Hanlon Jr.	215-459-4276
Pa	Pittsburgh, R.O. Whitesell	412-244-7277
Tenn	Bristol, Rakes Engrg. & Mktg. Corp.	615-968-4195
Tex	Austin, Palatine Sls. Co.	512-451-7463
Tex	Dallas, Palatine Sls. Co.	214-231-9489
Tex	Houston, Palatine Sls. Co.	713-777-4477
Wash	Seattle, F. Jackson Co.	206-782-2211

PRO-LOG CORP., 825 Airport Rd., Monterey, Cal., 93940

PROMEMCO, INC., 181 Bridge Rd., Hauppauge, N.Y., 11787, Tel: 516-582-9388; Empl.: 22
p. 1•1847; p. 2•1784

Products manufactured: Amplifiers, Capacitors, Fixed, Computers, Converters, Drivers & Decoders For Readouts, Integrated Circuit Devices, Kits, Breadboarding (For Engineers), Memory Systems, Services, Assembly, Production & Test, Transformers, Transistors

Local Sales Offices & Reps.

NJ	Tenafly, ABC Elctrn. Sls. Co.	201-568-2354
NY	Tarrytown, ABC Elctrn. Sls. Co.	914-631-2650
NY	Williston Park, ABC Elctrn. Sls. Co.	516-747-6610
Pa	Bethayres, ABC Elctrn. Sls. Co.	215-464-2275

PROTECTOWIRE CO., Hanover, Mass., 02339, Tel: 617-826-2626; Empl.: 17; Minimum order: $15

For info on price: C. J. Lane; Application info: J. T. King; Customer service: C. M. Sullivan; Delivery info: C. J. Lane

Free literature available: Brochures describe protectowire's line of UL and FM approved fire detection products and alarm systems. Featuring unique line type heat sensitive cables for fire detection in a wide variety of applications.

Products manufactured: Alarms, Annunciators, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Cable, Cable Fault Locators

PROTO MATIC CO., 11699 Chesterdale Rd., Cincinnati, Ohio, 45246, Tel: 513-771-1780; Empl.: 30; Minimum order: $25

For info on price: R. Carver; Application info: R. Carver; Customer service: V. Dahl; Delivery info: V. Dahl

Free literature available: Facilities Brochure - Describes electronic mfg. service capability. Stepping Motor Controller Brochure - Describes controller used for cross-slide compensation and diamond trueing on centerless grinders. May be used whenever precision motion control is required.

Products manufactured: Cards, Logic, Controls/Control Eqpt., Deposition Equipment, Vacuum & Accessories, Integrated Circuit Devices, Services, Assembly, Production & Test, Testers

PSC TECHNOLOGY INC., 1200 Grand Central Ave., Glendale, Cal., 91201, Tel: 213-245-8424; Empl.: 65; Minimum order: $25

For info on price: D. E. Stults; Application info: R. Christopherson; Customer service: S. Hatounian; Delivery info: D. E. Stults

Free literature available: Gamma 70 - 70 mm data recording and/or oscilloscope camera. UV-3850 - High speed lead pattern printer for IC's. Contact prints onto Super 8mm, 35 mm, 32mm, 70mm copper coated polyimide base film.

Products manufactured: Cameras, Machines/Machinery, Production

PSG INDUSTRIES INC., 1225 Tunnel Road, Perkasie, Pa., 18944, Tel: 212-257-3621; Empl.: 74; Minimum order: $50

For info on price: R. Whitekettle; Application info: R. Whitekettle; Customer service: L. Solliday; Delivery info: Cust. Svc.

Free literature available: HY-Switch Thermostat - High accurancy, low cost Thermostats, Sub Miniature Thermostats - High accuracy ultra-small Thermostats (.625" long X .093" wide) SSTC Series Solid State Thermostats - High accuracy Thermostats that will handle load to 5 amps.

Products manufactured: Alarms, Bi-Metals, Thermostatic, Controls/Control Eqpt., Relays, Services, Assembly, Production & Test, Sockets, Switches, Thermistors, Thermocouples, Elements & Accessories, Thermometers, Resistance, Thermostats

PTS ELECTRONICS INC., Box 272, Bloomington, Ind, 47401, Tel: 812-824-9331; Empl.: 170

Customer service: J. D. Craig

Products manufactured: Cleaners & Solvents, Services, Assembly, Production & Test, Testers, Tools, Tuners

Local Sales Offices & Reps.

Ala	Birmingham	205-323-2657
Cal	Sacramento	916-482-6220
Cal	San Diego	714-280-7070
Colo	Arvada	303-423-7080
Fla	Jacksonville	904-389-9952
Fla	Miami	305-685-9811
Ind	Bloomington	812-824-9331
Kans	Kansas City	913-831-1222
La	Metairi	504-885-2349
Md	Silver Spring	301-565-0025
Mass	Springfield	413-734-2737
Mich	Detroit	313-862-1783
Minn	Minneapolis	612-824-2333
Mo	St. Louis	314-428-1299
NJ	E. Paterson	201-791-6380
NY	Buffalo	716-891-4935
NC	Charlotte	704-332-8007
Ohio	Cincinnati	513-821-2298
Ohio	Cleveland	216-845-4480
Okla	Oklahoma City	405-947-2013
Ore	Portland	503-282-9636
Pa	Philadelphia	215-724-0999
Pa	Pittsburgh	412-761-7648
Tenn	Memphis	901-365-1918
Tex	Houston	713-644-6795
Tex	Longview	214-753-4334

PULSE ENGRG., INC., Box 12235, San Diego, Cal, 92112, Tel: 714-279-5900, TWX: 910-335-1527; Empl.: 300; Minimum order: $250

For info on price: J. Collins; Application info: B. McColey; Customer service: J. Collins; Delivery info: J. Collins

Products manufactured: Circuits, Hybrid, Thick Film, Coils Including Assemblies & Forms, Delay Lines, Networks, Reactors, Resistors, Transformers

Local Sales Offices & Reps.

Cal	San Diego	714-279-5900
Cal	Santa Clara	408-248-6040
Cal	Studio City	213-872-0735
Fla	Boca Raton	305-391-3803
Ill	Chicago	312-992-3720
Mass	Waltham	617-894-0950
Pa	Abington	215-887-4343

PULSE TECHNIQUES, INC., 1411 Palisade Ave., Teaneck, N.J., 07666, Tel: 201-837-2575

Customer service: E. R. Shenk

Free literature available: Catalog describing audio program equalizers & program and sound effects filters.

Products manufactured: Amplifiers, Equalizers, Filters

PURE CARBON CO., INC., 441 Hall Ave., St. Marys, Pa., 15857; Empl.: 750

Products manufactured: Bearings, Brushes & Brush Assemblies, Bushings, Glass, Plastic, Metal, Rubber, Etc., Graphalloy Products, Graphite Parts, Materials, Self-Lubricating

Local Sales Offices & Reps.

Cal	LaCanada, Pure Carbon Co.	213-790-1830
Conn	Bristol, Pure Carbon Co.	203-247-5019
Ga	Marietta, Pure Carbon Co.	404-436-9067
Ill	East Peoria, Pure Carbon Co.	309-699-1935
Ill	Park Ridge, Pure Carbon Co.	312-825-7686
Ind	Hammond, W.C. Boldt	219-931-7091
Mich	Plymouth, Pure Carbon Co.	313-453-7310
NJ	Carlstadt, Hoyt Sls. Co.	201-935-0044
NY	Camillus, Pure Carbon Co.	315-487-1439
Ohio	Centerville, Pure Carbon Co.	513-433-1314
Onio	Chagrin Falls, Pure Carbon Co.	216-338-3900
Tex	Fort Worth, R.E. Porter	817-281-1415
Wash	Seattle, Pure Carbon Co.	206-542-1844
Wisc	Lake Mills, Pure Carbon Co.	414-648-8205

PYLON CO., INC., 51 Newcomb St., Attleboro, Mass., 02703, Tel: 617-222-3726; Empl.: 30; Minimum order: $25

Free literature available: Pogo® Catalog 102 Contains various types of spring-loaded test probes for making temporary electrical connection for the purpose of testing. For testing p.c. boards, back-planes, microcircuits, etc.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Connectors, Contacts, Electrical, Eyelets, Fasteners, Holder & Carriers, Jigs And Fixtures, Chassis & Circuit Board, Leads, Test & Adaptors, Pins, Probes, Rivets, Sockets, Terminals, Testers

Local Sales Offices & Reps.

Cal	Fremont, Hartfield, Kennan & Freytag Co.	415-863-2200
Cal	Los Angeles, Hartfield, Kennan & Freytag Co.	213-225-1318
ILL	Elk Grove Village, Somers-Reagan	312-593-2713
Mass	Plainville, Teknis	617-695-3591
NJ	Summit, R. Potter	201-277-0220
Pa	Lafayette Hill, MCD Assocs.	215-828-0560
Tex	Dallas, Sivright Co.	214-357-6681
VA	Lynchburg, Royelec Sls. Assocs.	703-846-7117
Wash	Vancouver, Hartfield, Kennan & Freytag Co.	503-228-1683
FOR:	Can., Scarborough 707, Ont., Finnan Engineered Prod. Co.	416-438-6070

PYROFERRIC - N. Y., INC., Bronx Blvd. at 216th St., Bronx, N.Y., 10467, Tel: 212-654-3930; Empl.: 35

Customer service: J. A. Roberts

Free literature available: Data Packet

Directory of Local Distributors Starts on page 401

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Cores, Magnetic

Local Sales Offices & Reps.

Cal	Los Angeles, Yarbrough Sls. Co.	213-254-5101

PYROFILM RESISTOR CO., INC., 60 S. Jefferson Rd., Whippany, N.J., 07981, Tel: 201-887-8100, TWX: 710-726-8220; Empl.: 200 .... p. 2•1526-1528

Products manufactured: Attenuators, Dividers, Networks, Resistors, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Holcombe Sls. Agency, Inc.	205-534-1035
Cal	Los Angeles, E. Landa Co.	213-879-0770
Cal	Mountain View, Don Lay Assocs.	415-968-7500
Cal	San Carlos, Winco	415-365-6082
Colo	Denver, R. Smith Assoc.	303-399-1132
Fla	Orlando, Irby & Connoly, Inc.	305-894-8471
Ga	Atlanta, Holcombe Sls. Agency, Inc.	404-233-2837
Ill	Chicago, Berndt Assocs.	312-283-0713
Ind	Carmel, Berndt Assocs.	317-844-0114
Md	Columbia, Neal Deoul Assocs.	301-997-4353
Mass	Lowell, Russell Engrg. Svc. Co.	617-458-7146
Mich	Royal Oak, Satullo Co.	313-549-3910
Minn	St. Paul, Northport Engineering	612-698-3841
NJ	Madison, Livera-Polk Assocs.	201-377-3220
NM	Albuquerque, IMEC	505-344-2212
NY	Camillus, Ontec	315-487-0596
NY	Fayetteville, Ontec	315-446-2587
NY	Grand Island, Ontec	716-773-9319
NY	Huntington, CDB Entprs.	516-692-5200
NY	Rochester, Ontec	716-464-8636
NY	Roslyn Heights, Livera-Polk Assocs.	516-484-1276
NC	Burlington, P.J. Nahser, Co.	919-226-8053
Ohio	Cleveland, Satullo Co.	216-486-2800
Ohio	Dayton, Satullo Co.	513-277-6531
Tex	Dallas, Hillman Enterprises	214-827-4790
Wash	Bellevue, Ray Over Sls.	206-454-4551
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

Local Distributors

Cal	Los Angeles, Mil-Comm, 1618 Cotner Ave.	213-879-0770
NY	Yonkers, Legri S. Resistor, 389-393 Riverdale Ave.	914-969-6000
Tex	Houston, Lenert Co., Box 2184, 1420 Hutchins	713-225-1465

Q-TECH CORP., 11529 W. Pico Blvd., Los Angeles, Cal., 90064, Tel: 213-473-1105 .... p. 1•408,409

Products manufactured: Crystals, Filters, Oscillators

Local Sales Offices & Reps.

Cal	San Diego, Tauber Assocs.	714-274-7242
Ind	Auburn, D. Flanagan	219-925-1757
Md	College Park, J & B Elctrns.	301-864-4011
Mass	Burlington, Burlington Sls., Inc.	617-272-7655
NY	New York, AstroRep Inc.	516-423-2266
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Tex	Houston, TCI Elctrns.	713-774-5019
Wash	Seattle, W. Spaulding Co.	206-282-9173

QANTEX, the peripherals division of North Atlantic Inds., 200 Terminal Dr., Plainview, N.Y., 11803, Tel: 516-681-8350, TWX: 510-221-1879; Empl.: 175; Minimum order: $25

For info on price: L. Malmed; Application info: L. Malmed; Customer service: L. Malmed; Delivery info: B. Carolyn

Free literature available: Catalogs, interface manuals, & application notes on digital tape drives & tape storage systems.

Local Sales Offices & Reps.

Cal	Burbank, E-M Southwest	213-845-4400
Cal	San Leandro, IMS Assocs.	415-483-2093
Colo	Littleton, Cropley Inc.	303-794-4231
Ill	Chicago, Data Elctrns. Co.	312-283-0300
Ind	Indianapolis, Data Elctrns. Co.	317-784-6360
Mass	Wellesley Hills, Datamart	617-235-5520
Minn	Minneapolis, Data Elctrns. Co.	612-786-9666
Tex	Dallas, Evans-McDowell	214-238-7157
Tex	Houston, Evans-McDowell	713-772-1257
Utah	Salt Lake City, Cropley Inc.	801-355-8321
Wash	Bellevue, Scientific Devices NW	206-454-0900

QTRON CORP., 1320 E. St. Gertrude Pl., Santa Ana, Cal., 92705, Tel: 714-556-1184; FSC No: 75-2848591; Empl.: 20; Minimum order: $25

For info on price: W. Sliff; Application info: C. Knox; Customer service: D. Franck; Delivery info: D. Franck

Free literature available: Upon Request A 12 Page Catalog On Reed Relays Including Price Sheets and Valuable Engineering Information

Products manufactured: Coils Including Assemblies & Forms, Relays

Local Sales Offices & Reps.

Cal	Los Angeles, Dorr Wagner Assoc.	213-681-4060
Colo	Denver, Comtech	303-756-6815
Ill	Arlington Heights, Hagan Sls.	312-394-0617
Ind	Indianapolis, Marketing Engineers	317-546-1523
Ky	Liberty, Depco	513-621-0162
Minn	Minneapolis, Components Group	612-824-4222
NY	Commack, L.K. Haner	516-864-2220
Ohio	Cleveland, Depco	216-289-8188
Ore	Portland, Wes-Tek	503-297-1711
Tex	Houston, E. Smith Sls.	713-649-5756
Wash	Bellevue, Wes-Tek	206-641-3900

Q.V.S., INC., 20 North 15th St., East Orange, N.J., 07017, Tel: 201-673-3996; FSC No: 89820; Empl.: 45

Customer service: F. D. Fogle

Products manufactured: Meters, Relays, Services, Assembly, Production & Test, Testers

QUADRASTAT CONTROLS CORP., 4429 San Fernando Rd., Glendale, Cal., 91204, Tel: 213-245-1098, TWX: 910-497-4783; Empl.: 15; Minimum order: $25

For info on price: A. Chadney; Application info: P. D. Adams; Customer service: A. Chadney; Delivery info: A. Chadney

Free literature available: Brochures show the complete "QUADCO" line of self-locking and gate-type Control Heads, as used by Heavy Equipment OEM's to mechanically control a power source.

Products manufactured: Controls/Control Eqpt.

QUALCO, One First St., Los Altos, Cal., 94022, Tel: 415-964-7666; Empl.: 11 .... p. 2•790,791

Customer service: J. C. Meyer

Products manufactured: Machines/Machinery, Production, Microcircuit Production Equip., Socket Adapters, Sockets, Testers

QUAM-NICHOLS CO., 234 E. Marquette Rd., Chicago, Ill., 60637, Tel: 312-488-5800; Empl.: 200; Minimum order: $15

For info on price: G. Johns; Application info: W. G. Little; Customer service: G. Johns; Delivery info: G. Johns

Free literature available: Catalog #74 – General line loudspeakers

Products manufactured: Speakers

Local Sales Offices & Reps.

Cal	Inglewood, Ungar Sls. Assocs.	213-649-6238
Cal	Oakland, Moulthrop Sls.	415-261-7676
Fla	Orlando, Cartwright & Bean	305-422-4531
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Chicago, R. R. Hutmacher Assoc.	312-631-3248
Ind	Indianapolis, R. Milsk Co.	317-546-5468
Kans	Overland Park, T. L. Dowell	913-236-8200
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Southfield, R. Milsk Co.	313-354-3310
Minn	Edina, M. Foster Co.	612-835-2252
NJ	Cherry Hill, Trinkle Sls	609-795-4200
NY	Camillus, Callahan-Ferguson	315-487-3870
NY	Flushing, Bettan Sls	212-591-7600
Ohio	Beachwood, Electronic Salesmasters	216-831-9555
Ore	Portland, J. V. BeLusko Co.	503-222-4279
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, El Wilco Inc.	214-242-5329

QUAN-TECH, Div. Scientific-Atlanta, Inc., Randolph Park W., Rte. #10, Randolph Township, N.J., 07801, Tel: 201-361-3100, TWX: 710-987-7946; Empl.: 50; Minimum order: $25 .... p. 1•787-790

Customer service: G. M. Carney

Free literature available: Wave & Spectrum Catalog-Product Data Sheets plus some technical literature. Noise File-Product data sheets plus technical literature. Application note on flutter measurement in magnetic tape recorders. Data sheets on all instruments in our product line.

Products manufactured: Amplifiers, Analyzers, Filters, Generators, Meters, Standards, Test Equipment, Testers, Tracking Systems

Local Sales Offices & Reps.

Ala	Huntsville, J. L. Highsmith & Co.	205-881-3284
Cal	Palo Alto, Coherent Mktg. Assoc.	415-327-2217
Cal	Pasadena, A-F Sls. Engrg.	213-681-5631
Colo	Golden, J. Hurlbut	303-279-7138
Fla	Orlando, J. L. Highsmith & Co.	305-293-5202
Ill	Chicago, K. Meyers	312-774-6440
Ind	Indianapolis, K. Meyers	317-243-6681
Mass	Stoneham, Ken Corp.	617-438-5464
Minn	Mpls., K. Meyers	612-920-7080
NY	Liverpool, Rayelco	315-652-5272
NY	Plainview, Eastern Metro Assocs.	516-931-1414
NC	Charlotte, J. L. Highsmith & Co.	704-333-7743
Ohio	Dayton, Micro Sls. Corp.	513-433-8171
Tex	Dallas, Airep Elctrns.	214-827-2120
Wash	Seattle, Datacom Assocs.	206-285-2525
EXP:	NJ, Teaneck, Sylvan Ginsbury	201-837-1100
FOR:	Can., Calgary, Alberta, Can. Marconi	403-243-7751
FOR:	Can., Don Mills, Ont., Can. Marconi	416-445-9900
FOR:	Can., Edmonton, Alberta, Can. Marconi	403-429-3387
FOR:	Can., Halifax, N.S., Can. Marconi	902-454-8321
FOR:	Can., Montreal, Que., Can. Marconi	514-341-7630
FOR:	Can., Ottawa, Ont., Can. Marconi	613-232-1672
FOR:	Can., St. John's, N.F., Canadian Marconi	709-726-2422
FOR:	Can., Vancouver, B. C., Can. Marconi	604-291-2331
FOR:	Can., Winnipeg, Man., Can. Marconi	204-775-0348

QUANTALOG, INC., 42 Enterprise Drive, Ann Arbor, Mich, 48103, Tel: 313-769-4936; Empl.: 16

For info on price: J. Dute; Application info: J. Dute; Customer service: E. Therkelsen; Delivery info: J. Dute

Free literature available: Transient Recorders: Model 1720 QuantaLatch featuring 1k memory; 50k samples/sec 4000 Series QuantaLatch with 4k memory, 10&6 samples/sec. Remote Data Acquisition & Logging: Model 1740 System featuring central control and recording station plus one or more 16-channel data stations.

Products manufactured: Data Acquisition & Reduction Systems, Data Loggers, Recorders

Local Sales Offices & Reps.

Alas	Anchorage, H. J. Lang & Assocs.	907-279-5741
Cal	North Hollywood, O'Halloran Assocs.	213-877-0173
Cal	Palo Alto, O'Halloran Assoc.	415-326-1493
Cal	San Diego, O'Halloran Assocs.	714-224-2824
Fla	Clearwater, Reynolds & Assocs.	813-726-2373
Fla	Ft. Lauderdale, Reynolds & Assocs.	305-581-6611
Fla	Hollywood, Reynolds & Assocs.	305-987-6720
Fla	Palm Beach, Reynolds & Assocs.	305-622-6850
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Fla	St. Petersburg, Reynolds & Assocs.	813-360-1484
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	Northbrook, Electronic Instr. Assocs.	312-498-4500
Ind	Indianapolis, Electronic Instr. Assocs.	317-257-7231
Md	Silver Springs, Eastern Instrumentation	301-681-6500
Mich	Farmington, Anderson Elctrns.	313-476-9161
NY	Great Neck, Eastern Instrumentation	516-466-4500
NY	Syracuse, Tesco Mktg Assocs.	315-463-4566
NC	Raleigh, Eastern Instrumentation	919-876-7600
Ohio	Dayton, Hocker Assocs.	513-298-8638
Ohio	North Olmsted, Hocker Assocs.	216-734-4433
Pa	Abington, Bach-Stewart Assocs.	215-885-1550
Tex	Houston, Scientific Sls. Co.	713-666-5318
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Wash	Bellevue, Brennan Assocs.	206-454-9332

QUANTRAD CORPORATION, 139 Illinois St., El Segundo, Cal., 90245, Tel: 213-535-0854, TWX: 910-348-6676; Empl.: 40; Minimum order: $25

For info on price: H. Long 213-322-2086; Application info: R. Fox 213-322-2086; Customer service: H. Holdaway 213-322-2460; Delivery info: C. Strope 213-322-1452

Free literature available: Brochures on: Laser resistor trimmers, pulsed Argon, Krypton, Xenon and Ion Lasers, Image Converter Cameras, Photodiodes, Electro Optical Systems and Long Coherence Holographic Systems.

Products manufactured: Cameras, Cells, Photoconductive, Photoemissive, Photovoltaic, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Generators, Intensifiers, Image, Lasers & Laser Systems, Lights, Microcircuit Production Equip., Monitors, Perforators

Local Sales Offices & Reps.

DC	Washington, Scientific Sys. Sls. Corp.	202-726-4161
Fla	Winter Haven, S & S Sls. Reps.	813-293-7304
Mass	Burlington, Scientific Sys. Sls. Corp.	617-273-1660
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Syosset, Scientific Sys. Sls. Corp.	516-921-3737

QUANTROL ELECT. INC., 1820 Mills Ave., El Paso, Tex., 79901, Tel: 915-532-4651; Empl.: 20; Minimum order: $20

For info on price: E. K. Chamberlin; Application info: R. R. Chamberlin; Customer service: E. K. Chamberlin; Delivery info: M. J. Jaurez

Free literature available: Electrical and physical specifications on available photoconductors and opto isolators.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Diodes, Sensors, Light

Local Sales Offices & Reps.

Fla	Melbourne, Reynolds & Assocs.	305-727-3205
Minn	Minneapolis, Heimann Co.	612-861-6051
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432

QUANTRONIX CORP., 225 Engineers Rd., Smithtown, N.Y., 11787, Tel: 516-273-6900, Telex: 96-7782; Empl.: 70; Minimum order: $25

For info on price: P. Risucci; Application info: R. J. Bruno; Customer service: S. Taylor

Free literature available: Laserscribe®- functional specifications for wafer scribing; Series 114 Nd:Yag laser systems; Series 300 Acousto Optic Devices; Series 500 energy/power measuring instruments; Series 700 Laser Micromachining Systems.

Products manufactured: Lasers & Laser Systems, Machines/Machinery, Production, Modulator/Demodulators, Monitors, Scribers, Semiconductor Wafer Fabrication

Local Sales Offices & Reps.

Ariz	Phoenix, Trembly Assocs.	
Cal	Palo Alto, Quantronix Corp.	415-327-6381
Colo	Broomfield, Figaro, Klebba Assocs.	
Fla	Ft. Lauderdale, Semquip	
NM	Albuquerque, Trembly Assocs.	
Tex	Dallas, Quantronix	

QUARTZITE PROCESSING, INC., 6 Holyoke St., Malden, Mass., 02148, Tel: 617-322-1380; Empl.: 11

For info on price: J. H. Westerman 617-322-1380; Customer service: P. S. Yanofsky 617-322-1380; Delivery info: P. S. Yanofsky 617-322-1380

Free literature available: Man Made Materials Which Require Diamond Tooling

Products manufactured: Cores, Ceramic, Ferrite Material & Parts, Insulators & Insulation, Quartz, Fused, Services, Assembly, Production & Test, Tubing

QUIETROLE CO., 395 St. John, Spartenburg, S.C., 29302, Tel: 803-583-1451; Minimum order: $5

Customer service: R. O. Monk

Products manufactured: Cleaners & Solvents, Lubricants

Local Sales Offices & Reps.

Mo	St. Louis, B & C Sls. Co.	
Ohio	Euclid, W. Peters Co.	216-261-2330
Tex	Dallas, E.L. Wilks Co.	214-242-5321
FOR:	Can., Downsview, Ont., L. Finkler Ltd.	

R-COLUMBIA PRODUCTS, INC., 2008 St. John's Ave., Highland Park, Ill., 60035, Tel: 312-432-7915; Empl.: 6

Products manufactured: Cleaners & Solvents, Comm. Systems, Handsets, Chestsets, Headphones, Headsets, Etc., Magnets, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds

RAACO CORP., 372 Ely Ave., So. Norwalk, Conn, 06854

RADATRON CORP., 2424 Niagara Falls Blvd., N. Tonawanda, NY, 14120, Tel: 716-731-4171; Empl.: 85

For info on price: J. Howells; Application info: J. Howells; Customer service: L. Pauly; Delivery info: L. Pauly

Products manufactured: Antennas, Lamps, Lights, Power Supplies, Receivers

Local Sales Offices & Reps.

Cal	San Rafael, E. W. Brandt Co.	415-454-0840
Cal	W. Covina, Don Forth	213-967-2893
Ga	Savannah, Len Sherman Assoc.	912-925-3660
Ill	Skokie, Mike Bermann Sls.	312-675-3740
Ind	Indianapolis, Dewey Power Sls.	317-846-0790
Md	Olney, A B & T Sls.	301-924-4976
Mich	Grand Rapids, Cecil Geer Co.	616-534-9449
Minn	Burnsville, C. Carlson	612-890-7893
Mo	Raytown, Marty Taraski Sls.	816-358-1442
NY	Farmingdale, Chester Drexler Sls.	516-249-8206
NC	Charlotte, Electro Rep Assoc.	704-527-2530
Ohio	Columbus, J. Lehner	614-268-5260
Tenn	Memphis, L. Jones	901-683-7616
Tex	Dallas, Collins Co.	214-341-7866
Wash	Seattle, DMS/Vantage	206-784-6800

RADIAL CONTROLS, 2555 E. 55th Place, Indianapolis, Ind., 46220, Tel: 317-255-2796; Empl.: 25; Minimum order: $10

Customer service: R. Newsom

Free literature available: 16 page catalog on plastic knobs, 4 page catalog on aluminum knobs.

Products manufactured: Knobs

RADIATION DEVICES CO., Box 8450, Baltimore, Md., 21234, Tel: 301-665-2764; Empl.: 6; Minimum order: $5

Customer service: F. M. Rybak

Free literature available: Broad line of RF and microwave amplifiers, multicouplers, filters described in data sheets and application notes. Receivers for ATC, ELT and monitoring featuring battery operation.

Products manufactured: Amplifiers, Antennas, Bridges, Calibrators, Couplers, Demodulators, Detectors, Dividers, Dummy Loads, Filters, Limiters, Meters, Modulator/Demodulators, Receivers, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, Kay Ents.	602-242-6787
Cal	Encino, CDH Assocs.	213-345-3111
Cal	Yucca Valley, CDH Assocs.	213-345-3111
Colo	Lakewood, Harvey Data Sys.	303-427-5299
Fla	Orlando, Gra-Mar	305-894-3351
NM	Albuquerque, J & D Assocs.	505-255-2377

RADIATION DYNAMICS, INC., 1800 Shames Dr., Westbury, N.Y., 11590, Tel: 516-334-3990; Empl.: 180

For info on price: R. L. Malnati; Application info: J. H. Bly; Customer service: R. G. Burgess

Products manufactured: X-Ray Inspection Equipment

RADIO DEVELOPMENT LAB., 121 Brook Ave, Deer Park, NY, 11729, Tel: 516-242-0999; Empl.: 6; Minimum order: $10

For info on price: F. Goldstein; Application info: S. Russo; Customer service: S. Russo; Delivery info: S. Russo

Free literature available: Data Sheets, New Product releases.

Products manufactured: Amplifiers, Converters, Filters, Integrated Circuit Devices, Preselector-Mixers, Receivers

RADIO MATERIALS CO., Div. P.R. Mallory, 4242 W. Bryn Mawr Ave., Chicago, Ill., 60646, Tel: 312-478-3600, TWX: 910-221-2915; FSC No: 91418; Empl.: 500; Minimum order: $25

For info on price: J. Kirschner; Application info: J. Kirschner; Customer service: B. Merritt; Delivery info: Sls.Svc.

Free literature available: 28 Page General Catalog; Ceramic Resonator application notes describing typical applications and characteristics.

Products manufactured: Capacitors, Fixed, Ceramic Resonators, Circuits, Hybrid, Thick Film, Crystals, Spark Gaps, Substrates

Local Sales Offices & Reps.

Ariz	Phoenix, R. Stitzer	602-944-6808
Cal	Burlingame, RMC Div. of P.R. Mallory	415-348-2081
Cal	La Mirada, RMC Div. of P.R. Mallory	213-921-7939
Conn	Meriden, Eagle Assocs.	203-235-9036
Ill	Chicago, RMC Div. of P.R. Mallory	312-478-3600
Mass	Needham, Eagle Assocs.	617-444-3446
NY	Plandome, F. Spellman Co.	516-627-3399
NY	Syracuse, N.J. Matchuk Co.	315-488-3251
Ore	Portland, Earl & Brown Co.	503-245-2283
Pa	Philadelphia, R. Cooper	215-624-5486
Wash	Seattle, Earl & Brown Co.	206-284-1121
EXP:	Indianapolis, Ind., Mallory Int'l. Co.	317-636-5353
EXP:	Toronto, Ontario, Canada, P.J. Heenan Ltd.	416-223-3619

RADIO SWITCH, State Hwy. 79, Marlboro, N.J., 07746, Tel: 201-462-6100; Minimum order: $15

Customer service: W. Schwarz

Products manufactured: Switches

RAGEN DATA SYSTEMS, INC., 125 Schmitt Blvd., Farmingdale, N.Y., 11735, Tel: 516-293-1333, TWX: 510-224-6405; Empl.: 52

Products manufactured: Amplifiers, Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Dials, Indicators, Power Supplies, Servo Systems, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, Western Aircraft, Inc.	213-477-1548
Cal	San Diego, Temp Tech	714-560-0545
Iowa	Cedar Rapids, Palatine	319-365-8071
Kans	Andover, Palatine	316-683-7512
Mass	Stoneham, Data Engrg. Svcs.	617-245-6666
Minn	Minneapolis, Bitronics Sls. Co.	612-866-3035
Mo	St. Louis, Palatine	314-426-7055
NY	Great Neck, EAC Assocs.	516-466-9798
Tex	Dallas, Barry Sls. Co.	214-234-0255
Va	Alexandria, Vanguard Engrg.	703-768-1660
Wash	, Thorson Co.	206-455-9180

RAGEN PRECISION INDS., INC., 9 Porete Ave., N. Arlington, N.J., 07032; Empl.: 250

Products manufactured: Boards, Printed Circuit, Circuits, Printed, Multilayer, Display Devices/Displays, Integrated Circuit Devices, Lamps, Machines/Machinery, Production, Memory Systems, Soldering Equipment

RAGEN SEMICONDUCTOR, 50 S. Jefferson Rd., Whippany, N.J., 07981

RAILWAY COMM., Rycom Instrs., 9351 E. 59th St., Raytown, Mo., 64133, Tel: 816-353-2100; Empl.: 37; Minimum order: $10

For info on price: E. E. Tuel; Application info: E. E. Tuel; Customer service: G. Craven; Delivery info: H. D. Aggeler

Free literature available: "T" Carrier Test Equipment; Buried Cable Fault Locators; Levelmeters/Voltmeters.

Products manufactured: Analyzers, Counters, Locators, Open-Short, Meters, Receivers, Testers, Totalizers, Digital

Local Sales Offices & Reps.

Cal	Oakland, Dolphin Engrg. Co.	415-451-8262
Cal	Santa Fe Springs, Kennedy Engrg. Co.	213-868-9965
Colo	Denver, Claredon Co.	303-238-4462
DC	Washington, InstruCom	202-223-1759
Fla	St. Petersburg, Comtech Assocs.	813-527-3281
Ill	Schaumburg, Kay Sls.	312-397-1215
Kans	Prairie Village, Giddings Co.	913-831-0727
MO	Cameron, Communication Sys. Assocs.	816-632-7616
Tex	Richardson, Horizon Engrg. Sls. Co.	214-238-9121
Wash	Seattle, Reeves Supp. Co.	206-789-1234
FOR:	Can., Toronto, Ont., Tele-Radio Sys. Ltd.	416-661-3221

RAM CHEMS., Div. Whittaker Corp., 210 E. Alondra Blvd., Gardena, Calif., 90248, Tel: 213-FA 1-0710; Empl.: 65; Minimum order: $25

For info on price: D. Saylor; Application info: M. E. Gould; Customer service: D. Saylor; Delivery info: D. Saylor

Products manufactured: Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Lubricants, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber

RAMSEY ENGINEERING, 1853 W. County Rd. C, St. Paul, Minn., 55113, Tel: 612-633-5150, Telex: 29-7001; Empl.: 160; Minimum order: $25

Customer service: J. Miller

Free literature available: RH-202: Manually operated integrated circuit handler, RH-903: Automatic three (3) category sort integrated circuit handler., RH-905: Automatic five (5) category sort integrated circuit handler. RS-5618: Automatic integrated circuit lead straightener.

Products manufactured: Machines/Machinery, Production

Directory of Local Distributors Starts on page 401

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices-Southeast	205-232-8317
Cal	Encino, Scientific Devices-California	213-872-1951
Cal	Los Alamitos, Scientific Devices-California	213-598-7678
Cal	Mountain View, Scientific Devices-California	415-964-4230
Cal	San Diego, Scientific Devices-California	714-279-6642
Conn	Hamden, Scientific Devices-Connecticut	203-248-9361
Fla	Ft. Lauderdale, Scientific Devices-Southeast	305-721-4260
Fla	Orlando, Scientific Devices-Southeast	305-424-7932
Fla	St. Petersburgh, Scientific Devices-Southeast	813-521-1720
Ill	Desplaines, Scientific Devices-Midwest	312-297-5230
Ind	Indianapolis, Scientific Devices-Midwest	317-783-2111
Kans	Lenexa, Scientific Devices-Midwest	913-631-3818
Mass	Waltham, Scientific Devices-New England	617-894-5637
Mich	Milford, Scientific Devices-Midwest	313-363-2282
Minn	Minneapolis, Scientific Devices-Midwest	612-544-1616
Mo	St. Louis, Scientific Devices-Midwest	314-842-2535
NJ	Palisades Park, Scientific Devices-East	201-871-3916
NY	Rochester, Scientific Devices-New York	716-334-2445
NC	Burlington, Scientific Devices-Southeast	919-584-8311
Ohio	Cleveland, Scientific Devices-Midwest	216-261-2000
Ohio	Dayton, Scientific Devices-Midwest	513-298-9904
Okla	Norman, Data Mktg. Assoc.	405-364-8320
Tex	Dallas, Data Mktg. Assoc.	214-661-0300
Tex	Houston, Data Mktg. Assoc.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Va	Norfolk, Scientific Devices-E/Tech	703-499-8133
Va	Springfield, Scientific Devices-E/Tech	703-451-6500
Wash	Seattle, Avionics Liaison	206-767-3870

RAMTEK CORP., 292 Commercial St., Sunnyvale, Cal., 94086, Tel: 408-735-8400, TWX: 910-339-9379; Empl.: 130

For info on price: C. W. Nordby Ext. 280; Application info: G. S. Brink Ext. 205; Customer service: H. P. Kulp Ext. 270; Delivery info: A. A. Middlebrook Ext. 215

Free literature available: GX-100 brochure and FS-2000 brochure. Describes the features and functions of the GX-100 and FS-2000 series of raster scan graphic displays.

Products manufactured: Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ala	Huntsville, W. A. Brown Instrs.	205-539-4411
Ariz	Phoenix, Data Systems Mktg.	602-277-4732
Cal	Newport Beach, Data Systems Mktg.	714-540-2312
Colo	Littleton, Data Systems Mktg.	303-795-1960
Fla	Orlando, W. A. Brown Instrs.	305-425-5505
Ga	Atlanta, W. A. Brown Instrs.	404-939-1674
Ind	Munster, Bexdata, Ltd.	312-221-1411
La	Gretna, W. A. Brown Instrs.	504-366-5766
Md	Beltsville, Ron Davies Assocs.	301-937-2215
Mass	Chelmsford, S & S Elctrns.	617-256-8731
Mich	Southfield, Tallman Assocs.	313-557-0974
Minn	Edina, Bexdata Ltd.	612-835-5220
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Albuquerque, Data Systems Mktg.	505-299-6027
NY	Syracuse, Naco Elctrns.	315-699-2651
NC	Research Tri. Park, W. A. Brown Instrs.	919-489-1546
Pa	Bryn Mawr, Hopkins Assocs.	215-527-2252
Pa	Pittsburgh, Compu Graph	412-366-5056
Tex	Dallas, Remtek	214-369-8146
Tex	Houston, Remtek	713-664-2113
Utah	Bountiful, Data Systems Mktg.	801-295-3457
Wash	Bellevue, Data Systems Mktg.	206-454-1676

RANDOLPH PRODS. CO., 12th St., Carlstadt, N.J., 07072, Tel: 201-438-3700; Empl.: 60

Customer service: H. Randalph

Products manufactured: Adhesives (All Types), Cleaners & Solvents, Coatings, Paints

RANTEC DIV., Emerson Elec. Co., 24003 Ventura Blvd., Calabasas, Calif., 91302, Tel: 213-347-5446, TWX: 910-494-1218; Empl.: 265; Minimum order: $100

Customer service: V. S. Kerness Ext. 254

Free literature available: Catalogs on: antennas; Cassegrain Feeds/Flat Plate Arrays/ TACAN - Electronic Instrumentation; Time/Group Test Sets Anechoic Systems; Absorber-Turnkey Chambers Power Supplies; MIL SPECD, Modular.

Products manufactured: Analyzers, Antenna Feed Systems, Antennas, Chamber, Environmental Test, Converters, Generators, Modulators, All Kinds, Power Supplies, Testers, Timers, Tracking Systems

RATELCO, INC., 610 Pontius Ave. N., Dept. EEM, Seattle, Wash., 98109, Tel: 206-624-7770; Empl.: 50; Minimum order: $5

For info on price: N. Kun; Application info: B. Lince; Customer service: D. Terpstra; Delivery info: N. Kun

Products manufactured: Amplifiers, Antennas, Chargers, Battery, Comm. Systems, Converters, Eliminators, Battery, Inverters, Panels, Power Supplies, Racks, Regulators, Testers, Timers, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Weldy Assocs., Inc.	602-947-1263
Ark	Little Rock, M. Robinson Co., Inc.	501-663-1830
Cal	Los Angeles, Matzinger Assocs.	213-624-8001
Cal	Redwood City, Howe-Stephens Co.	415-366-9592
Colo	Denver, Hamilton Assocs., Inc.	303-770-2345
Ga	Atlanta, A. P. Beamish	404-252-5567
Haw	Kailua, R. A. Kemp Co.	808-839-5593
Ill	Chicago, Electrical Materials & Equip. Co.	312-696-1540
La	Metairie, J. J. Aertker Jr. Co.	504-888-0677
Mass	Framingham, E. L. Flowers & Sons	617-879-4250
Minn	Minneapolis, Klass Co., Inc.	612-338-8427
Mo	St. Louis, Petefish Engrg. Co.	314-821-0587
NM	Albuquerque, Bryant Co.	505-296-5158
NY	Bay Shore, F. E. Klaus	516-665-3504
NY	Massapequa, Crest Assocs.	516-799-8053
Pa	Ingomar, R. W. Moulton & Assocs.	412-366-3333
Pa	Radnor, J. Claflin Co.	215-MU8-1990
Tenn	Chattanooga, J.R. Murray Co.	615-267-3889

Advertisment

Designers and manufacturers of Constant Voltage Battery Chargers and Eliminators, Ringing Generators, Dry CEMF Cells, DC-DC Converters, DC-AC Inverters, Communications Power Distribution Boards, Uninterruptible Power Systems (U.P.S.), AC-DC Test Bench Power Supply Units (Battery Eliminators), Alternator Power Converters, Mobile 2-Way Truck Intercoms.

RAULAND, Div. Zenith Radio Corp., 2407 W. North Ave., Melrose Pk., Ill., 60160, Tel: 312-345-4700

Customer service: Sls. Dept.

Products manufactured: Tubes

RAWAY BEARING CORP., 8 Melnick Rd., Monsey, N.Y., 10952, Tel: 914-352-4944; FSC No: 3110; Empl.: 5

For info on price: A. Baskin; Delivery info: H. Grossman

Free literature available: Catalogue

Products manufactured: Bearings

RAY-O-VAC DIV., ESB Inc., 101 E. Washington Ave., Madison, Wisc., 53703, Tel: 608-252-7400; Empl.: 2931; Minimum order: $100

For info on price: H. Coakley 608-252-7483; Application info: D. Wilberg 608-252-7725; Customer service: E. Peterson 608-252-7722; Delivery info: E. Peterson 608-252-7722

Products manufactured: Batteries, Flashlights & Lanterns

Local Sales Offices & Reps.

Cal	North Hollywood, Bassett & Moore	213-877-7129
Cal	Oakland, Moulthrop Sls.	415-261-7676
Cal	Placentia, Bassett & Moore	213-877-7129
Colo	Denver, W. J. Purdy Co.	303-777-1411
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Chicago, G. Mcl. Cole Co.	312-774-3535
Ind	Indianapolis, Sukup & Cox	317-253-1215
Mass	Needham, Mullin Tech. Sls.	617-444-4780
Mich	Detroit, R.C. Merchant Co.	313-535-6000
Mich	St. Joseph, R.C. Merchant Co.	616-983-7378
Minn	Minneapolis, Jensen-Olsen Sls.	612-941-7181
Mo	Kansas City, Forristal-Young Sls.	816-358-6771
Mo	St. Louis, Forristal-Young Sls.	314-645-2360
Neb	Omaha, Forristal-Young Sls.	402-333-0800
NJ	Cherry Hill, Trinkle Sls.	609-795-4200
NJ	Teaneck, Fisher Elctrn. Assocs.	201-837-1200
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	Camillus, Trademark Elctrns.	315-487-3870
NY	Port Washington, Fisher Elctrn. Assocs.	516-883-0600
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3131
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, Tesco/Texport	214-690-4004
Wash	Seattle, Fleehart & Sullivan	206-522-1533
Wisc	Milwaukee, G. McL. Cole	414-545-6083

RAYCHEM CORP., 300 Constitution Dr., Menlo Park, Cal., 94025, Tel: 415-329-3333, TWX: 910-373-1728; Empl.: 3160

Products manufactured: Cable, Caps, Forms & Tapes, Heat Shrinkable, Cups, Encapsulation, Insulators & Insulation, Solder Pots & Baths, Terminals, Tubing, Wire, Wire Markers

Local Sales Offices & Reps.

Cal	Irvine, Raychem Corp.	714-833-3630
Cal	San Diego, Raychem Corp.	714-280-5990
Cal	Sherman Oaks, Raychem Corp.	213-788-9872
Colo	Denver, Raychem Corp.	303-758-1936
Conn	Norwalk, Raychem Corp.	203-853-2700
Fla	Orlando, Raychem Corp.	305-855-4214
Ga	Atlanta, Raychem Corp.	404-261-3657
Ill	Des Plaines, Raychem Corp.	312-298-1100
Kans	Overland Park, Raychem Corp.	913-649-6930
Md	Bethesda, Raychem Corp.	301-652-9057
Mass	Hingham, Raychem Corp.	617-749-6850
Minn	Minneapolis, Raychem Corp.	612-529-9114
Mo	Berkeley, Raychem Corp.	314-521-5111
NJ	Bloomfield, Raychem Corp.	201-744-6261
NJ	Maple Shade, Raychem Corp.	609-667-4280
NY	Dix Hills, Raychem Corp.	516-864-4400
Ohio	Cleveland, Raychem Corp.	216-692-2141
Ohio	Warren, Raychem Corp.	216-856-4979
Pa	Johnstown, Raychem Corp.	814-255-1142
Pa	West Chester, Raychem Corp.	215-692-8660
Tenn	Knoxville, Raychem Corp.	615-667-3027
Tex	Dallas, Raychem Corp.	214-350-8871
Wash	Bellevue, Raychem Corp.	206-455-0903
EXP:	Dorval 760, Quebec Can., Raychem Canada Ltd.	514-636-1680
EXP:	Toranto l9, Ont, Can., Raychem Canada Ltd.	416-789-7425

RAYMOND ENGRG. INC., 217 Smith St., Middletown, Conn., 06457, Tel: 203-347-5611, TWX: 710-428-7944; FSC No: 92059; Empl.: 625

Customer service: J. S. Hinchliffe 203-632-1000

Free literature available: Raycorder Digital Cassette Recorder; Magnetic Tape Memory, Model 6401; Military Magnetic Tape Products; Positive Torque Control With Power-Dyne

Products manufactured: Accelerometers, Actuators, Fuses, Memory Systems, Recorders, Switches, Timers, Wrenches

RAYTEK, INC., 1277 Terra Bella Ave., Mountain View, Cal., 94043, Tel: 415-961-1650, Telex: 348351; Empl.: 35; Minimum order: $50

Customer service: M. R. Wank

Free literature available: Description and application of portable and fixed IR thermometers for non-contact temperature measurement and control.

Products manufactured: Bolometers, Probes, Pyrometers, Radiometers, Transducers

Local Sales Offices & Reps.

Cal	Los Angeles, McCamey-Jones, Inc.	213-263-9812
Cal	San Francisco, Priz Co.	415-326-9333
Fla	Clearwater, J. Barber Co.	813-442-8713
Ga	Jonesboro, W.L. Anderson Co.	404-478-9648
Ill	Park Ridge, L.R. Fitz Co.	312-631-5488
Ind	Indianapolis, Couchman-Conant, Inc.	317-849-9890
La	Baton Rouge, R.S. & P. Sls.	504-937-4828
Mass	Acton, Abbott Assocs.	617-263-5047
Mich	Orchard Lake, W.C. Fay Co.	313-851-4750

Minn	Minneapolis, Bican Co.	612-827-4734
Mo	St. Louis, R. Greene Co.	314-644-2666
Neb	Omaha, H.G. Klug Co.	402-553-1377
NJ	Fair Lawn, Par Assocs.	201-447-3722
NM	Albuquerque, A.L.S. Elctrns.	505-298-2575
NC	Charlotte, Sloan Assocs.	704-523-2122
Ohio	Cincinnati, A.H. Parker, Jr.	513-563-1843
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Mt. Lebanon, Advance Instrs., Inc.	412-341-3252
Pa	Wayne, R. Schadler Co.	215-687-0969
Tenn	Chattanooga, Coleman Assocs.	615-821-0235
Tex	Dallas, Dixon Engrg.	214-321-0240
Tex	Houston, Dixon Engrg.	713-644-8052
Va	Richmond, Sloan Assocs.	804-359-6051
Wash	Bellevue, McLaren, Inc.	206-454-3400
Wisc	Brookfield, S.F. Boyd Co.	414-781-7170

RAYTHEON CO., Distributor Prods. Oper., Fourth Ave., Burlington, Mass., 01803, Tel: 617-272-6400, TWX: 710-332-7641 .... p. 1•2283-2285; p. 2•1105-1113

For info on price: B. Knight; Application info: J. Hickey; Customer service: B. Knight; Delivery info: B. Knight

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Isolators, Jacks (All Types), Knobs, Lights, Locks, Dial & Shaft, Posts, Switches, Tubes

Local Sales Offices & Reps.

Cal	El Monte, Cook Entprs.	213-686-2120
Cal	Oakland, Moulthrop Sls.	415-261-7676
Colo	Denver, Connors, Inc.	303-934-5829
Fla	N. Miami, L. Haas Co.	305-949-9143
Ga	Atlanta, Hollingsworth & Still	404-394-3270
Haw	Honolulu, G. Piety Factors	
Ill	Chicago, GNB Assocs.	312-673-4050
Ind	Indianapolis, Cardinal Sls. Co.	317-253-1513
Minn	Edina, Mel Foster Co.	612-835-2252
Mo	Kansas City, Forristal & Young Sls.	816-358-6771
Mo	St. Louis, Forristal & Young Sls.	314-645-2360
Neb	Omaha, Forristal & Young Sls.	402-333-0800
NJ	Cherry Hill, Trinkle Sls.	609-795-4200
NJ	Teaneck, Fisher Elctrn. Assoc.	201-837-1200
NY	Rochester, Marsey Sls. Co.	716-442-9700
Ohio	Beachwood, Electronic Salesmasters	216-831-9555
Ohio	Cleveland, Imtech	216-826-3400
Ohio	Dayton, Imtech	513-837-5610
Ore	Portland, D.G. Weber Co.	503-234-0686
Tenn	Memphis, Crockett Sls. Co.	901-388-5410
Tex	Dallas, Crockett Sls. Co.	214-748-8209

RAYTHEON CO., Indl. Comps. Oper., 465 Centre St., Quincy, Mass., 02169, Tel: 617-479-5300, TWX: 710-337-6879

Customer service: R. Punchard

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Circuits, Hybrid, Thick Film, Hybrid Voltage Regulators, Isolators, Knobs, Modules, Logic, Encapsulated, Regulators, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles	213-641-3103
Cal	Mountain View	415-964-4754
Fla	Longwood	305-830-6670
Ill	Elmhurst	312-833-6760
Mass	Waltham	617-899-8080
NY	Great Neck	516-482-8480
NY	Rome	315-337-2500
Ohio	Dayton	513-254-3571
Tex	Dallas	214-233-2939
Va	Arlington	703-979-6100
EXP:	Lexington, Mass.	617-862-6600
FOR:	Can., Waterloo, Ont.	519-745-6831

RAYTHEON CO., Spec. Microwave & Device Oper., 130 Second Ave., Waltham, Mass., 02154, Tel: 617-890-8080, TWX: 710-324-6568

Customer service: D. Bauks

Products manufactured: Lasers & Laser Systems, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

RAYTHEON CO., Microwave & Power Tube Div., 190 Willow St., Waltham, Mass, 02154

RAYTHEON SEMICONDUCTOR, 350 Ellis St., Mountain View, Cal., 94042, Tel: 415-968-9211, TWX: 910-379-6481; FSC No: 07933; Empl.: 950; Minimum order: $500

Customer service: B. O'Connell Ext 280

Products manufactured: Integrated Circuit Devices, Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, Chaparral	602-996-9648
Ariz	Scottsdale, Raytheon Semiconductor	602-947-6621
Cal	Irvine, Raytheon Semiconductor	714-833-9042
Cal	Mountain View, Raytheon Semiconductor	415-964-4754
Cal	San Diego, Daniels & Doty Sls. Co.	714-560-6266
Colo	Boulder, Straube Assoc.	303-443-8600
Colo	Denver, Straube Assocs.	303-426-0890
Fla	Clearwater, Perrott Assocs.	813-726-1549
Fla	Fort Lauderdale, Raytheon Semiconductor	305-792-8400
Fla	Orlando, Perrott Assocs.	305-275-1132
Ill	Chicago, Carlson Elctrn. Sls.	312-774-9022
Ill	Des Plaines, Raytheon Semiconductor	312-297-5540
Kans	Shawnee Mission, Carlson Elctrn. Sls.	913-432-2144
Md	Glen Burnie, Raytheon Semiconductor	301-760-3917
Mass	Burlington, Raytheon Semiconductor	617-272-8500
Mich	Birmingham, J. C. Hofstetter Co.	313-643-7203
Mich	Grand Rapids, J. C. Hofstetter Co.	616-942-0650
Minn	Minneapolis, Raytheon Semiconductor	612-920-8710
Minn	New Brighton, Raytheon Semiconductor	612-636-7696
Mo	St. Louis, Carlson Elctrn.	314-991-0262
NJ	Englewood, Raytheon Semiconductor	201-567-4911
NJ	Pennsauken, Raytheon Semiconductor	609-663-4066
NM	Albuquerque, Straube Assoc.	505-294-1800
NY	Melville, Raytheon Semiconductor	516-420-0700
Ohio	Dayton, J. C. Hofstetter Co.	513-296-1010
Ohio	Medina, J. C. Hofstetter co.	216-241-4880
Ore	Beaverton, E. S. Chase Co.	503-649-6177
Tex	Dallas, Mark Kruvand Co.	214-827-8043
Tex	Houston, Mark Kruvand Co.	713-661-3007
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Wash	Edmonds, E. S. Chase Co.	206-774-3586
Wisc	Milwaukee, Carlson Elctrn. Sls.	414-476-2790
Wisc	Wauwatosa, Carlson Elctrns.	414-476-2790
EXP:	Lexington, Mass., Raytheon Overseas Ltd.	617-862-6600
FOR:	Can., Scarborough, Ont., Lake Engrg. Co.	416-751-5980
FOR:	Can., St. Laurent 381, Que., Lake Engrg. Co.	514-747-2441

RBM CONTROLS, See Essex Controls Div.

RCA CORP., Commercial Communications Systems Div., Front & Cooper, Camden, N.J., 08102, Tel: 609-963-8000, TWX: 710-892-0905

Customer service: G. M. Lewis

Free literature available: Broadcast Audio Equipment, Catalog AU.742000 TR-600 advanced technology quadraplex VTR, catalog TA.3400 TKP-45A portable broadcast/teleproduction camera, catalog CA.1410

Products manufactured: Amplifiers, Erasers, Magnetic Tape (Bulk), Microphones, All Kinds, Recorders, Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Ala	Birmingham, RCA Broadcast Sys.	205-871-1155
Cal	Hollywood, RCA Broadcast Sys.	213-461-9171
Cal	San Francisco, RCA Broadcast Sys.	415-343-2741
Colo	Denver, RCA Broadcast Sys.	303-433-8484
DC	Washington, RCA Broadcast Sys.	703-558-4212
Fla	Jacksonville, RCA Broadcast Sys.	904-398-4588
Fla	West Palm Beach, RCA Broadcast Sys.	305-622-1100
Ga	Atlanta, RCA Broadcast Sys.	404-634-6131
Ill	Chicago, RCA Broadcast Sys.	312-782-0700
Ind	Indianapolis, RCA Broadcast Sys.	317-546-4001
Kans	Kansas City: Overland Park, RCA Broadcast Sys.	913-642-3185
Mass	Boston: Wellesley, RCA Broadcast Sys.	617-237-6050
Mich	Detroit: Southfield, RCA Broadcast Sys.	313-357-0080
Minn	Minneapolis, RCA Broadcast Sys.	612-920-6395
Mo	St. Louis, RCA Broadcast Sys.	314-862-3660
NJ	Camden, RCA Broadcast Sys.	609-963-8000
NY	New York, RCA Broadcast Sys.	212-586-3000
NC	Charlotte, RCA Broadcast Sys.	704-366-0626
Ohio	Cincinnati, RCA Broadcast Sys.	513-825-1550
Pa	McMurray, RCA Broadcast Sys.	412-941-5570
Tex	Austin, RCA Broadcast Sys.	512-345-2224
Tex	Dallas, RCA Broadcast Sys.	214-638-6200
Wash	Seattle, RCA Broadcast Sys.	206-285-2375

RCA ELECTRONIC COMPS., 415 S. Fifth St., Harrison, N.J., 07029, Tel: 201-485-3900

Customer service: R. B. Means 201-485-3900

Products manufactured: Amplifiers, Batteries, Capacitors, Fixed, Chargers, Battery, Decade Boxes, Diodes, Display Devices/Displays, Gages, Generators, Isolators, Lasers & Laser Systems, Leads, Test & Adaptors, Meters, Oscilloscopes, Power Supplies, Probes, Resistors, Sockets, Tape Recording Accessories, Tapes, Recording, Magnetic (All Types), Television Systems & Equipment Closed-Circuit, Transformers, Transmitters, Tubes

Local Sales Offices & Reps.

Cal	Hollywood	213-461-9171
Cal	Los Altos	415-948-8961
Fla	Riviera Beach	305-842-0141
Ga	Atlanta	404-634-6131
Ill	Des Plaines	312-827-0033
Ind	Ft. Wayne	219-432-9461
Ind	Indianapolis	317-546-4001
Kans	Overland Park	913-642-7656
Mass	Needham Heights	617-444-7200
NJ	Cherry Hill	609-424-4773
NJ	Edison	201-485-3900
NY	Syracuse	315-474-8221
Pa	Lancaster	717-397-7661
Va	Arlington	703-558-4286

RCA, IND'L. TUBE DIV., New Holland Ave., Lancaster, Pa., 17604, Tel: 717-397-7661

Free literature available: Literature on tubes and devices for broadcasting, communications, microwaves, electro optics, image projection, radiation detection, and image display.

Products manufactured: Diodes, Lasers & Laser Systems, Oscillators, Television Systems & Equipment Closed-Circuit, Tubes

Local Sales Offices & Reps.

Cal	Hollywood	213-461-9171
Cal	Los Altos	415-948-8996
Fla	Riviera Beach	305-842-0141
Ill	Des Plaines	312-827-0033
Kans	Overland Park	913-642-7656
Mass	Needham	617-444-7200
NJ	Cherry Hill	609-424-4773
NJ	Edison	201-485-3900
NY	Syracuse	315-474-8221
Va	Arlington	703-558-4286

RCA PARTS & ACCESSORIES, 2000 Clements Bridge Rd., Deptford, N.J., 08096, Tel: 609-963-8000

Products manufactured: Amplifiers, Antennas, Cleaners & Solvents, Couplers, Resistors

RCA SERVICE CO., Div. RCA Corp., Govt. Svcs. 202-1, Camden, N.J., 08101, Tel: 609-779-5176, TWX: 710-892-0905; Empl.: 6000

Customer service: J. J. Connors

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Colo	Colorado Springs	303-475-8810
Fla	Indiatlantic	305-727-7120
Va	Arlington	703-558-4441

RCA SOLID STATE DIV., Route 202, Somerville, N.J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Minimum order: $100

Customer service: P. R. Thomas X5177

Products manufactured: Amplifiers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Diodes, Display Devices/Displays, Drivers & Decoders For Readouts, Integrated Circuit Devices, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ala	Huntsville	205-881-4100
Ariz	Scottsdale	602-947-7235
Cal	Hollywood	213-461-9171
Cal	Los Altos	415-948-8996
Cal	San Diego	714-279-0420
Cal	Tustin	714-832-5302
Colo	Denver	303-433-8841
Conn	Stamford	203-329-2041
Fla	Riviera Beach	305-842-1577
Ga	Atlanta	404-634-6131
Ill	Des Plaines	312-827-0033
Ind	Fort Wayne	219-432-9461
Ind	Indianapolis	317-546-4001
Kans	Overland Park	913-642-7656

Mass	Needham Heights	617-444-7200
Mich	Birmingham	313-644-1151
Minn	Minneapolis	612-929-0676
NJ	Cherry Hill	609-424-3650
NJ	Edison	201-485-3900
NY	Huntington Station	516-293-0180
NY	Syracuse	315-474-8221
Ohio	Pepper Pike	216-831-0030
Tex	Dallas	214-638-6200
Va	Arlington	703-558-4161
Wash	Bellevue	206-747-8534

RCA SOLID STATE DIV., COS/MOS IC Mktg., Rte. 202, Somerville, N. J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Minimum order: $100

For info on price: Mktg.; Application info: Engineering HOT LINE; Customer service: P. R. Thomas; Delivery info: Mktg.

Free literature available: COS/MOS product brochure, COS-278C

Products manufactured: Integrated Circuit Devices
See RCA Solid State Div. for Sls. Reps.

RCA SOLID STATE DIV., Linear Integrated Circuits, Rte. 202, Somerville, N. J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Minimum order: $100

For info on price: G. M. O'Neal; Application info: M. V. Hoover; Customer service: P. R. Thomas; Delivery info: G. M. O'Neal

Free literature available: Linear Integrated Circuits catalog, 6D6-8Z0F

Products manufactured: Amplifiers, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Integrated Circuit Devices
See RCA Solid State Div. for Sls. Reps.

RCA SOLID STATE DIV., Liquid Crystal Products, Route 202, Somerville, N.J., 08876, Tel: 201-722-3200, TWX: 710-480-9333

For info on price: P.L. Farina, Ext. 5401; Application info: G.J. Granieri, Ext. 5408; Delivery info: P.L. Farina, Ext. 5401

Products manufactured: Display Devices/Displays

RCA SOLID STATE DIV., Micro Processors, Route 202, Somerville, N.J., 08876, Tel: 201-722-3200, TWX: 710-480-9333

For info on price: V. E. Hills, Ext. 2072; Application info: V. E. Hills, Ext. 2072; Customer service: P. R. Thomas, Ext. 5177; Delivery info: V. E. Hills, Ext. 2072

Products manufactured: Integrated Circuit Devices

RCA SOLID STATE DIV., MOS IC Products, Route 202, Somerville, N.J., 08876

For info on price: M. Ciampaglia, Ext. 2158; Application info: T. G. Athanas, Ext. 3741; Customer service: P. R. Thomas, Ext. 5177; Delivery info: M. Ciampaglia, Ext. 2158

Products manufactured: Integrated Circuit Devices, Metal Oxides

RCA SOLID STATE DIV., RF & Microwave Devices, Rte. 202, Somerville, N. J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Minimum order: $100

For info on price: F. J. Rohr X3435; Application info: B. Maximow X2465; Customer service: P. R. Thomas X5177; Delivery info: F. J. Rohr X3435

Products manufactured: Transistors
See RCA Solid State Div. for Sls. Reps

RCA SOLID STATE DIV., Thyristors & Rectifiers, Rte. 202, Somerville, N.J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Minimum order: $100

For info on price: L. H. Gibbons; Application info: T. C. McNulty; Customer service: P. R. Thomas; Delivery info: L. H. Gibbons

Free literature available: Thyristors/Rectifiers catalog, THC-500D

Products manufactured: Diodes, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers)
See RCA Solid State Div. for Sls. Reps.

RCA SOLID STATE DIV., Transistors, Rte. 202, Somerville, N.J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Minimum order: $100

For info on price: Power Mktg. Mgr.; Application info: D. E. Burke; Customer service: P. R. Thomas; Delivery info: Power Mktg. Mgr.

Free literature available: Power Transistor Directory, PTD-187D

Products manufactured: Transistors
See RCA Solid State Div. for Sls. Reps.

RCA SERVICE CO., Tech. Prods. Svc. Div. RCA Corp., Bldg. 204-2, Cherry Hill, Camden, N.J., 08101, Tel: 609-779-4129, TWX: 710-892-0905; Empl.: 6000

For info on price: B. L. Grossman; Application info: V. A. Littlefield; Customer service: B. L. Grossman; Delivery info: V. A. Littlefield

Free literature available: 33ASR Teletype equipped for Alternate TWX/Dataphone use; 38ASR Teletype used for Dataphone; Extel with standard print, 5 and 8 level.

Products manufactured: Comm. Systems, Radar Systems, Receivers, Teleprinters, Teletypewriters & Equipment, Television Systems & Equipment Closed-Circuit, Transmission Systems, Data

Local Sales Offices & Reps.

Cal	Montebello, RCA Service Co.	213-685-3069
Ga	Atlanta, RCA Service Co.	404-355-6110
Ill	Skokie, RCA Service Co.	312-965-7550
NJ	Jersey City, RCA Service Co.	201-451-2222
Ohio	Strongsville, RCA Service Co.	216-238-9555
Pa	Philadelphia, RCA Service Co.	215-467-3300
Tex	Dallas, RCA Service Co.	214-631-8770

RCL ELECTRONICS DIV., AMF Inc., 700 S. 21st St., Irvington, N.J., 07111, Tel: 201-374-3311, TWX: 710-999-5511; Empl.: 750
p. 1•454-460,2286-2295; p. 2•1530-1542

Customer service: C. Smith 603-627-3831

Free literature available: Resistor Engineering Handbook. Precision/Power Wire Wound Resistors. Switch Engineering Handbook. Complete information on miniature rotary switches. Delay Line Engineering Handbook. Electromagnetic Delay Lines Including Complete Information on DIP Configurations.

Products manufactured: Delay Lines, Networks, Resistors, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Interep	205-881-3677
Ariz	Mesa, Toribre Ent.	602-832-1134
Cal	(No.) Los Altos, Held & Mollard, Inc.	415-941-6041
Cal	So. Woodland Hills, Interstate Mktg.	213-883-7606
Colo	Wheatridge, Waugaman	303-423-1020
Conn	No. Haven, Kitchen & Kutchin	203-239-0212
Fla	Altamonte Springs, Semtronic Assoc.	305-831-8233
Fla	St. Petersburg, Semtronic Assoc.	813-867-6835
Ga	Marietta, K&E Assoc.	404-427-0241
Ill	Chicago, Gassner & Clark	312-764-6121
Ind	Indianapolis, L. DeVoe	317-257-1227
Iowa	Cedar Rapids, Palatine Sls.	319-365-8071
Kans	Andover, Palatine Sls.	316-683-7512
Kans	Overland Park, Palatine Sls.	913-262-5643
Md	Baltimore, Burgin-Kreh	301-788-5200
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Mich	Farmington, Davis-Martenson	313-474-8300
Minn	Minnetonka, T. Ayre	612-474-4125
Mo	St. Louis, Palatine Sls.	314-426-7055
NJ	(So.) Haddonfield, T.A.I.	609-854-3011
NJ	Irvington, MGI	201-399-4350
NY	Rochester, W. Zimmerman	716-586-4450
NY	Syracuse, W.H. Zimmerman	315-474-4889
NC	Winston Salem, Burgen-Kreh	919-768-4174
Ohio	Cleveland, KW Elctrn. Sls.	216-831-8292
Ohio	Dayton, KW Elctrn. Sls.	513-890-2150
Okla	Oklahoma City, Ammon & Rizos	405-947-1051
Ore	Portland, Almac/Stroum	503-292-3534
Pa	Waterford, KW Elctrn. Sls.	412-487-4300
Tex	Dallas, Ammon & Rizos	214-233-5591
Tex	Houston, Ammon & Rizos	713-729-1233
Va	Lynchburg, Burgin-Kreh	703-845-5600
Wash	Seattle, Almac/Stroum	206-763-2300
FOR:	Alaska, Almac Stroum	206-232-8228
FOR:	Can., Brit. Ca., Almac/Stroum (Portland)	503-292-3534
FOR:	Can., Malton, Ont., S. Hooker	416-677-3554
FOR:	Can., Montreal, Que., S. Hooker	514-487-5151

Local Distributors

Cal	Sunnyvale, Bell Ind., 1161 N. Fairoaks Ave.	408-734-8570
Cal	Woodland Hills, Rampart Components, 21201 Oxnard St.	213-887-7260
Colo	Lakewood, Acacia Sls., 11111 W. 8th Ave.	303-232-2882
Ill	Elk Grove Village, GBL, 75 Gaylord St.	312-569-2730
Ill	Rosemont, Advent Elctrns., 7110 N. Lycon Ave.	312-298-4210
Iowa	Cedar Rapids, Advent Elctrns., 1834 Blairs Ferry Rd. N.E.	319-393-8811
Md	Baltimore, Arrow Elctrns., 4801 Benson Ave.	301-247-5200
Md	Baltimore, Radio Elec., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Burlington, Arrow Elctrns., 15 A St.	617-273-0100
NY	Hauppauge, Rampart Components, 195 Engineers Rd.	516-273-1111
NY	Rochester, Simcona, 275 Mt. Read Blvd.	716-328-3230
Ohio	Solon, Repco, 6835 Cochran Rd.	216-248-8900
Pa	Erie, Erie Corp. Contractor, 1938 Buffalo Rd.	814-455-8110
Pa	Philadelphia, Almo, Roosevelt Blvd. at Blue Grass Rd.	215-676-6000
Utah	Salt Lake City, Diplomat/Alta, 2280 S. Main St.	801-486-7220
Vt	Richmond, Hooker Vt., Bridge St.	514-487-5151
Wash	Seattle, Almas Stroum/Seattle, 5811 6th Ave. S.	206-763-2300
Wisc	Mequon, Taylor Elec. Co., 1000 W. Donges Bay Rd.	414-241-4321

RDI/REED DEVICES, INC., 21 W. 183 Hill Ave., Glen Ellyn, Ill., 60137, Tel: 312-858-2050, Telex: 72-1527; FSC No: 53337; Minimum order: $50 ....p. 2•792-795

For info on price: B. Wolber; Application info: H. Roeser; Customer service: B. Wolber; Delivery info: B. Wolber

Free literature available: Cat. #100: Complete description of 43 Snaptrack T.M. relay & timer sockets, edge connector assemblys, Power Supplies for IC's; Bulletin 102: 4 sizes Snaptrack TM channel for mounting pcb's;
Bulletin 103: Molded octal socket assembly for single or gang mounting. Cat. #200: Barrier Terminal Strips for PCB's. 3 sizes, 6 styles including right angle mount.

Products manufactured: Boards, Printed Wiring, Universal, Connectors, Power Supplies, Sockets, Switches, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, G. R. McKnight Co.	602-257-8037
Ark	Eldorado, D. Bellew Sls.	501-863-8325
Cal	Menlo Park, G. R. McKnight Co.	415-325-2844
Cal	Woodland Hills, Cummings & Assocs.	213-340-6035
Colo	Denver, Mundix Co.	303-893-2390
Fla	Miami, S.K. Wallace Assoc.	305-961-6640
Fla	Tampa, S. K. Wallace Assoc.	813-961-1037
Ga	Atlanta, A. Brown Assoc.	404-457-6381
Ill	Glen Ellyn, Rockford Controls	312-469-6016
Kans	Wichita, Avionics	316-264-6201
La	Kenner, D. Bellew Sls.	504-729-4550
Mass	Waltham, Betronic Assocs.	617-894-8400
Mich	Brighton, H. H. Barnum Co.	313-229-2961
Mich	Lowell, H. H. Barnum Co.	616-451-0980
Minn	Minneapolis, HMR	612-920-8200
Mo	Florissant, Miller Assocs.	314-355-1642
NY	Buffalo, H.C. Johnson Ags.	716-632-7880
NY	Fayetteville, H.C. Johnson Ags.	315-637-9383
NY	Great Neck, Cooper-Simon & Co., Inc.	516-487-1142
NY	Rochester, H.C. Johnson Ags.	716-482-3000
NC	Greensboro, S. K. Wallace Assoc.	919-292-0487
Ohio	Columbus, Rockford Controls Ohio	614-231-5890
Ohio	Dayton, Rockford Controls Ohio	513-898-5452
Ohio	Euclid, Rockford Controls Ohio	216-731-5250
Pa	Elkins Park, K. B. Erdman Co.	215-224-1833
Tenn	Memphis, D. Bellew Sls.	901-365-9437
Tenn	Nashville, A. Brown Assoc.	615-256-3003
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Utah	Salt Lake City, Control Agency, Inc.	801-466-8601
Wash	Seattle, R. Johnston & Co.	206-524-5170

Local Distributors

Ark	Little Rock, Carlton-Bates Co., 6821 Scott Hamilton	501-562-9100
Cal	Burlingame, Rose Elex, 846 Stanton Rd.	415-697-0224
Cal	Los Angeles, Electro Comps., 122 So. Misson	213-264-7100
Colo	Aurora, Component Specialties, 3178 Noma St.	303-341-0160
Conn	Hartford, Hartford Elec. Supp., Box 748	203-233-3694
Fla	Miami, Electro Standard Labs, 3560 Northwest 34 St.	305-633-6973
Ga	Atlanta, Electrical Control Prods., 3762 N.W. Freeway Access	404-455-1216
Haw	Honolulu, Electrical Equip., 656 S. Queen St.	808-533-3884
Ill	Arlington Hts., S & R Corp., 2420 E. Oakton	312-593-2545

Ill	Chicago, Newark Elex., 500 N. Pulaski	312-638-4411
Ill	Moline, Jim Otis & Assoc., 4520 River Dr.	309-762-9311
Ind	Indianapolis, Ra-Dis-Co, 814 N. Senate	317-637-5571
Kans	Wichita, Interstate Elec. Supply, 1330 E. 1st St.	316-264-6316
Ky	Louisville, P.I. Burks Co., 842 S. 7th St.	502-589-3960
La	New Orleans, Southern Radio, 1909 Tulane	504-524-2343
Mass	Cambridge, Apollo Elex., 101 Binney St.	617-868-3120
Mich	Detroit, La Salle Elec. Supply, 470 Brainard	313-831-0470
Minn	Minneapolis, Control Design, 3433 E. 25th	612-721-1629
Mo	St. Louis, LComp, 2605 S. Hanley	314-647-5505
Neb	Lincoln, Scott Elex., 4040 Adams	402-434-8308
NJ	Jersey City, Cuny & Guerber, 3468 Kennedy	201-653-0222
NJ	So. Plainfield, Brownell Electro., 500 Hadley	201-753-4600
NY	Buffalo, Summit, 916 Main St.	716-884-3450
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NC	Winston-Salem, Kirkman Elec., Drawer K	919-724-0541
Ohio	Dayton, ESCO Inc., 221 Crane	513-224-9192
Okla	Tulsa, Radio Inc., 1000 S. Main	918-587-9123
Ore	Eugene, Vitus Elec., 140 E. 5th Ave.	503-345-4377
Pa	Philadelphia, Philadelphia Elex., 112 N. 12th St.	215-568-7400
SC	Greenville, Black Elec., 203 Westfield	803-233-4142
Tenn	Memphis, Brownell Electro, 3053 Tranquility	901-332-9254
Tex	Stafford, Southwest Elex., 12725 Royal Dr.	713-494-6021
Utah	Salt Lake City, Standard Supply, 225 E. 6th South	801-355-2971
Va	Lynchburg, Midstate Elec., 1217 Church	804-846-6555
Wash	Seattle, Radar Elec., 168 Western	206-282-2511
Wisc	Milwaukee, Marsh Elex., 6047 W. Beloit	414-545-6500

RE-EL CIRCUITS, INC., 520 Victor Street, Saddle Brook, N.J., 07662, Tel: 201-843-3738; Empl.: 15 p. 1•123,204

Products manufactured: Alarms, Amplifiers, Annunciators, Attenuators, Boards, Printed Circuit, Chassis, Circuit Board Mounting, Comm. Systems, Controls/Control Eqpt., Converters, Decoders, Encoders, Modulator/Demodulators, Multiplexers, Receivers, Switches, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Testers, Transmitters

Local Sales Offices & Reps.

Mass	Needham, White Sls. Co.	617-444-3676
NY	E. Northport, Jarms Assoc.	516-368-4096
NY	Fayetteville, M. P. Andrews Mfrs. Rep.	315-637-5291

RECORDER SYS DIV., See Gulton Inds, Meas. & Control Sys. Div.

RECOTON CORP., 46-23 Crane St., Long Island City, N.Y., 11101, Tel: 212-392-6442

For info on price: P. Wish; Application info: P. Wish; Customer service: R. Diaz; Delivery info: R. Diaz

Free literature available: 3 complete product catalogs for audio, diamond needle and record, tape and music accessory products.

Products manufactured: Cable, Connector Adapters, Demagnetizers, Microphones, All Kinds, Phonographs, Parts & Accessories, Tape Recording Accessories

Local Sales Offices & Reps.

Ala	Birmingham, Morris Taylor Co.	205-853-3181
Ariz	Phoenix, SWM Sls. Corp.	602-258-6868
Cal	Culver City, Marshank Sls. Corp.	213-559-2591
Cal	Walnut Creek, Mac Pherson Sls. Co.	415-937-1482
Colo	Aurora, SPS Assocs.	303-341-1776
Fla	Casselberry, Morris Taylor Co.	305-838-0821
Haw	Mililani, C & L Dists.	808-623-2762
Ill	Chicago, W. Doyle Co.	312-274-6685
Kans	Leawood, W. Menezes & Assocs.	913-649-2680
La	Metairie, Tape City U.S.A.	504-888-2505
Md	Silver Spring, Morris Taylor Co.	301-946-3569
Mass	Lynn, Keene Sls. Co.	617-595-2300
Mich	Southfield, Aztec Sls. Corp.	313-642-0777
Minn	Maple Grove, R. C. Sls. Co.	612-425-5543
NJ	Lake Pine, Morris Taylor	609-983-1712
NM	Albuquerque, SWM Sls. Corp.	505-296-2620
NY	New York, Newhope Corp	212-532-7372
NY	Yonkers, J. Brown Electr. Sls. Reps.	914-779-7330
NC	Charlotte, Morris Taylor Co.	704-523-7932
Ohio	Cleveland, M.S. Sls. Co.	216-382-2060
Pa	Philadelphia, Morris Taylor Co.	215-698-9757
Tex	Houston, Spivey-LeBoeuf Assocs.	713-649-1221
Utah	Salt Lake City, SPS Assocs.	801-485-1294
Wash	Yakima, Barnsley-Weis Assocs.	509-453-5537

RECTIFIER COMPONENTS CORP., 1112 Lousons Rd., Union, N.J., 07083, Tel: 201-687-5410; Empl.: 75; Minimum order: $50 p. 1•1850,1851

For info on price: D. L. Mohn; Application info: D. L. Mohn; Customer service: J. Hambor; Delivery info: B. Murphy

Products manufactured: Bridges, Diodes, Multipliers, Rectifiers

Local Sales Offices & Reps.

Ill	Chicago, M & S Sls. Co.	312-992-1053
Md	Towson, Habco Elctrns.	301-825-9637
Mass	Needham Hts., Todino Engrg. Sls. Co.	617-444-7925
Mich	Detroit, A. Blumenberg Assoc.	313-557-1934
NY	Glen Cove, S. Glassman Assocs.	516-676-1039
Pa	Willow Grove, H. Nash Assocs.	215-657-2213
Wash	Seattle, Underwood & Underwood	206-243-2133
FOR:	Can., Hamilton, Ont., Cartwright-Southall Assocs., Inc.	416-528-0294

RED POINT CORP., 105 W. Spazier, Burbank, Calif., 91503, Tel: 213-842-4895; Empl.: 12; Minimum order: $15

Customer service: R. P. Craig

Free literature available: Bulletins 9-70 and 10-67

Products manufactured: Chamber, Environmental Test, Machines/Machinery, Production, Ovens, Pumps, Vacuum

REDACTRON CORP., 100 Parkway Dr. S., Hauppauge, N.Y., 11787, Tel: 516-543-8700; Empl.: 475

Customer service: T. Reantillo

Free literature available: Description & Interface Information on: Magnetic Tape Cassette Transport, Magnetic Card Transport, Cartridge Transport, 1,000 Line Resolution CRT Monitor.

Products manufactured: Monitors, Recorders

Local Sales Offices & Reps.

Cal	Cupertino, Eakins Assocs.	408-255-6494
Cal	Palo Alto, Eakins Assocs. Inc.	415-328-7871
Cal	Pasadena, Advanced Techniques	213-681-1093
Colo	Englewood, Davis Assocs.	303-761-9228
Conn	Hartford, Newmar Assocs.	203-523-0402
Fla	Orlando, Gra-Mar Inc.	305-894-3351
Kans	Shawnee Mission, IBL Engrg. & Sls., Inc.	913-262-1374
Md	Silver Springs, QED Elctrns.	301-588-8134
Mass	Lynnfield, Newmar Assocs.	617-245-7960
Mich	Detroit, Hocker Assocs.	313-531-1403
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Mamaroneck, Cane Tech. Sls., Inc.	914-698-4411
Ohio	Cleveland, Hocker Assocs.	216-734-4433
Ohio	Dayton, Hocker Assocs.	513-298-8638
Ohio	N. Olmstead, Hocker Assocs.	216-734-4433
Okla	Oklahoma City, IBL Engrg. & Sls., Inc.	405-843-9434
Pa	King of Prussia, White-Keystone, Inc.	215-265-1817
Tex	Bellair, IBL Engrg. & Sls.	713-661-2511
Tex	Dallas, IBL Engrg. & Sls., Inc.	214-EM3-2921
Tex	Houston, IBL Engrg. & Sls., Inc.	713-781-5171
Wash	Bellevue, Conrad-Carlson Assocs.	206-455-1336

REDINGTON COUNTERS, INC., 130 Addison Rd., Windsor, Conn., 06095, Tel: 203-688-6207

Customer service: T. Nelson

Free literature available: RCI Full Catalog RCI #35, RCI Condensed Catalog RCI #36, RCI Model 300 Blue Line Electrical Counters RCI #38, RCI Model 500 Predeterming Counters RCI #39

Products manufactured: Controls/Control Eqpt., Counters

Local Sales Offices & Reps.

Ala	Birmingham, McConnell Sls. & Engrg. Corp.	205-871-3501
Ark	Fort Smith, Electro-Related Prods.	501-783-7323
Cal	Los Angeles, R.B. Clapp Co. Inc.	213-225-2395
Cal	San Francisco, Automated Process Controls Co.	415-467-6162
Colo	Loveland, Kelley Entprs.	303-667-1376
Fla	Winter Park, Steele Tech. Sls.	305-644-6641
Ga	Atlanta, B. Fancher Assocs.	404-448-7078
Ind	Ft. Wayne, Neal Engrg. Co.	219-484-5090
Ind	Indianapolis, Neal Engrg. Co.	317-849-4201
Ky	Louisville, Neal Engrg. Co.	502-267-8337
Mass	Wellesley, Staley-Dautel Assocs.	617-235-1643
Mich	Detroit, Basic Service Corp.	313-837-8820
Minn	St. Paul, J.D. Co.	612-454-5552
NY	Buffalo, Good Comps. Corp.	716-634-4400
NY	Manhasset, R. Fara Assocs.	516-627-1151
NC	Matthews, W.K. Hile Co.	704-847-9125
Ohio	Cleveland, Jay Industrial Sls. Co.	216-831-9393
Ohio	Dayton, Neal Engrg.	513-299-6448
Okla	Tulsa, Summit Sls. Inc.	918-743-7794
Ore	Wilsonville, J.L. Kearns Co.	503-236-1165
Pa	Pittsburgh, R.W. Moulton & Assocs.	412-366-3333
Tenn	Knoxville, W.K. Hile Co.	615-588-1061
Tex	Addison, L. Elliott Co.	214-239-8533
Tex	Missouri City, L. Elliott Co.	713-499-1571
Va	Chester, W. K. Hile Co.	804-271-0014
EXP:	Cheshire, Conn., Techmark Corp.	203-272-7131
FOR:	Can., Markham, Ont., Scott Controls	416-499-0932

REED SWITCH DEV. CO., 34 Lincoln Ave., Greenwich, Conn., 06830, Tel: 203-661-9410; Empl.: 2; Minimum order: $10

Customer service: J. S. Hammond

Products manufactured: Controls/Control Eqpt., Magnets, Switches

REEVE ELECTRONICS, INC., 601 EEM W. Lake St., Chicago, Ill., 60606, Tel: 312-726-9755; Empl.: 40

Products manufactured: Adapters, Waveguide, Attenuators, Bends & Twists, Microwave, Calorimeters, Microwave, Cavities, Microwave, Chokes, Controls/Control Eqpt., Couplers, Dielectric Heating Equipment, Dividers, Dummy Loads, Generators, Heaters & Heating Elements, Junctions, Hybrid, Microwave, Loads, Electronic Variable, Machines/Machinery, Production, Meters, Oscillators, Shifters, Soldering Equipment, Switches, Tees, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Powertronics, Inc.	205-852-6347
Ariz	Phoenix, Montgomery Bros.	602-253-3431
Cal	Burlingame, Montgomery Bros.	415-697-6500
Colo	Denver, Montgomery Bros.	303-759-2749
Fla	Titusville, Powertronics, Inc.	305-267-5699
Ill	St. Charles, R.B. Engrg. Co.	312-584-8245
Kans	Baxter Springs, Production Automation Corp.	316-856-3600
Md	Silver Spring, ARA Elctrns.	301-565-2584
Mass	Wilmington, Technical Instrs.	617-944-3930
Mich	Troy, C. H. Armstrong Co.	313-524-1414
Minn	Minneapolis, Production Automation Corp.	612-866-5700
Mo	Hazelwood, Production Automation Corp.	314-731-2331
Mo	Raytown, Production Automation Corp.	816-737-0066
NC	Raleigh, Powertronics, Inc.	919-787-9090
NC	Thomasville, Powertronics, Inc.	919-476-6727
Okla	Tulsa, Production Automation Corp.	918-932-1051
Ore	Portland, Montgomery Bros.	503-223-4197
Tex	Richardson, Production Automation Corp.	214-234-4002
Utah	Salt Lake City, Montgomery Bros., Inc.	801-363-3555
Wash	Seattle, Montgomery Bros.	206-762-4100
Wisc	Milwaukee, W. M. Braun & Assoc.	414-332-1040
FOR:	Can., Thornhill, Ont., R. Neill Co.	416-889-9971

REEVES-HOFFMAN DIV., Dynamics Corp. of Amer., 400 W. North St., Carlisle, Pa., 17013, Tel: 717-243-5929, TWX: 510-650-3510; Empl.: 718; Minimum order: $25 p. 1•410,411

For info on price: D. Kingery; Application info: D. Kingery; Customer service: R. Stone; Delivery info: R. Stone

Products manufactured: Crystal Blanks, Crystals, Filters, Holders, Crystal, Mounts, Oscillators

Local Sales Offices & Reps.

Cal	Hollywood, Westaironics	714-831-2369
Cal	Marino Del Rey	213-821-7950
Cal	Santa Clara, L & M Assocs.	408-243-2891
Ill	Deerfield, Hutchinson Assocs.	312-945-6882
Iowa	Cedar Rapids, Seltec Sls.	319-362-8155

Md	Baltimore, R. F. Assocs.	301-465-5944
Mass	Wakefield, H. Jappe Co.	617-245-9359
Mich	Farmington, W. R. Hummon & Assoc.	313-474-0661
Mo	St. Louis, Engrg. Svcs. Co.	
NJ	Ridgefield, G. M. Moch Co.	
NY	E Aurora, E.A. Kershaw & Co.	716-652-1221
NY	Larchmont, G.M. Moch Co.	914-834-3530
Ohio	Cincinnati, Tri-State Mktg.	513-761-7993
Pa	Philadelphia, C.H. Newson & Assoc.	215-248-3377
SC	Myrtle Beach, Candor Co.	803-448-5213
Tex	Richardson, Semi Conductor Sls.	214-231-6181

REFAC ELCTRNS./PINLITES, 1275 Bloomfield Ave., Fairfield, N.J., 07006, Tel: 201-575-8820, TWX: 710-734-4348; Empl.: 50 .... p. 2•1185

Products manufactured: Converters, Counters, Display Devices/Displays, Drivers & Decoders For Readouts, Enclosures, Module, Plug-In, Lamps, Terminal Equipment, Digital, Totalizers, Digital, Tubes

Local Sales Offices & Reps.

Ala	Huntsville, Elmar Assocs.	
Ariz	Scottsdale, E. J. Foley & Assocs.	602-945-2665
Cal	Burlingame, J. Logan & Assocs.	415-697-6100
Cal	Pasadena, Components Corp.	213-681-7448
Colo	Denver, I. W. Strong & Assoc.	303-292-6900
Conn	Stratford, G. Rosen Co.	203-375-5456
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ga	Atlanta, Elmar Assocs.	404-938-2821
Ill	Westchester, Gassner & Clark Co.	312-345-4245
Md	Towson, L. H. Kolman & Co.	301-752-8756
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Grand Rapids, Representatives Elctrn. Prod.	616-942-1320
Minn	St. Paul, Northport Eng., Inc.	612-698-3841
Mo	Kansas City, L. F. Florence Co.	816-561-7222
NY	New York, Contact Refac Elctrns.	201-575-8820
NC	Raleigh, Elmar Assocs.	919-787-2841
Ohio	Dayton, J. C. Hofstetter Co.	513-298-0662
Tex	Dallas, Glidden Electro Equip. Co.	214-363-6539
Wash	Seattle, R. Johnston Co.	206-524-5171
Exp:	New York, N.Y., Refac Export Corp.	212-687-4741
For:	Can., Pointe Claire, Que., Avotronics, Ltd.	514-697-2135
For:	Can., Willowdale, Ont., Avotronics, Ltd.	416-499-3164

REFAC ELCTRNS/WILD ROVER, 1275 Bloomfield Ave., Fairfield, N.J., 07006, Tel: 201-227-9195, TWX: 710-991-9615; Empl.: 50 .... p. 1•2268

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Elmar Assocs.	
Ariz	Scottsdale, E. J. Foley & Assocs.	602-945-2665
Cal	Los Gatos, Luscombe Engrg. Co.	408-354-6496
Cal	Pasadena, Luscombe Engrg. Co.	213-684-2000
Colo	Denver, I.W. Strong & Assocs.	303-292-6900
Conn	Stratford, G. Rosen Co.	203-375-5456
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ga	Atlanta, Elmar Assocs.	404-938-2821
Ill	Chicago, Carlson Elctrn. Sls.	312-774-4812
Md	Towson, L.H. Kolman & Co.	301-752-8756
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Grand Rapids, Representatives Elctrn. Prod.	616-942-1320
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	Kansas City, L.F. Florence Co.	816-561-7222
NC	Raleigh, Elmar Assocs.	919-787-2841
Ohio	Dayton, J.C. Hofstetter Co.	513-298-0662
Tex	Dallas, Glidden Electro Equip. Co.	214-363-6539
Wash	Seattle, R. Johnston Co.	206-524-5171
Wisc	Milwaukee, Carlson Elctrn. Sls. Co.	414-476-2790
Exp:	New York, NY, Refac Export Corp.	
For:	Can., Pointe Claire, Que., Avotronics, Ltd.	514-697-2135
For:	Can., Willowdale, Ont., Avotronics, Ltd.	416-499-3164

REGENCY ELECTRONICS, INC., 7707 Records St., Indianapolis, Ind., 46226, Tel: 317-547-3581; Empl.: 450

For info on price: W. Ayres; Application info: W. Ayres; Customer service: A. Culpepper

Free literature available: Catalogues for: Comm. Systems, FM; Comm. Systems, Radiotelephone: Counters, frequency; Crystals, Quartz; Receivers, Monitoring, Communications; Transmitters, Tone; Comm. Systems, Carrier Current; Comm. Systems, Frequency Shift; Comm, Systems, Selective Paging; Crystals, Frequency Control; Receivers, Fixed Frequency; Receivers, Tone; Transmitters, UHF/VHF.

Products manufactured: Attenuators, Comm. Systems, Counters, Crystals, Receivers, Transmitters

Local Sales Offices & Reps.

Ariz	Phoenix, L. McMillan	602-949-9437
Cal	Foster City, Olson Sls.	415-573-1600
Cal	Orange, I. Greene	714-637-1356
Cal	Woodland Hills, C. Ryel Co.	213-883-8118
Fla	Miami, L.P. Hench Co.	305-251-4343
Ga	Atlanta, B. Bowlin	404-948-6604
Iowa	Des Moines, J.D. Irvine Assoc.	515-225-7900
Md	Timonium, Tesco, Inc.	301-252-5610
Mass	Cohasset, Montague Assocs., Inc.	617-383-0634
Mich	Southfield, R. Milsk Co.	313-354-3310
NY	Buffalo, M. Farber, Assoc.	716-856-3543
NY	Long Island, Willgold Sls. Corp.	516-764-4022
Ohio	Canton, L. Pilcher	216-494-2148
Okla	Tulsa, B. Favors	918-936-9291
Ore	Portland, J. LeBrun Co.	503-244-6805

REGDON CORP., 3715 Grand Blvd., Brookfield, Ill, 60513, Tel: 312-485-5152; FSC No: 27190; Empl.: 50; Minimum order: $15 .... p. 1•1804,1805

For info on price: D. Siemeck; Application info: N. Krasowsky; Customer service: D. Siemeck; Delivery info: D. Siemeck

Products manufactured: Coils Including Assemblies & Forms, Solenoids

Local Sales Offices & Reps.

Ariz	Phoenix, Spectrum & Assoc.	602-997-6324
Cal	San Francisco, Shonin, Inc.	415-467-8701
Cal	Santa Ana, Spectrum & Assoc.	714-835-4114
Conn	Madison, United Components	203-562-4002
Ga	Atlanta, Mr. George O'hara	404-237-0600
Ill	Downers Grove, Richmar Elect. Corp.	312-968-0118
Mich	Walled Lake, T. Mulligan & Assoc.	313-624-0174
Minn	Minneapolis, R.J. Inc.	612-922-1425
NY	New York, LRC Assocs.	
NY	Pittsford, NoCo Inc.	716-461-4750
NY	Valley Cottage, LRC Assocs.	914-634-7973
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242
Pa	Birchrunville, Jadelectronics	215-647-5151
RI	Saunderstown, United Components	617-226-0556
Tex	Dallas, W. Reese & Assoc.	214-638-6575
Tex	Houston, W. Reese & Assoc.	713-621-3134

REGMO DATA CORP., 6992 Oxford St., Minneapolis, Minn., 55426, Tel: 612-925-3800; Minimum order: $25 p. 1•272; p. 2•344

For info on price: R. Otterlei; Application info: R. M. Plaisted; Delivery info: R. Otterlei

Products manufactured: Cleaners & Solvents, Coatings, Process Control Systems, Switches, Timers

REI SALES CO., 120 Cambridge St., Burlington, Mass., 01803, Tel: 617-273-2777 .... p. 1•796,797

Products manufactured: Computers, Meters, Oscillators, Oscilloscopes, Recorders

REICH ASSOCIATES INC., PO Box 73, Plano, Tex, 75074, Tel: 214-424-7904; Empl.: 10; Minimum order: $25

Customer service: E. Reich

Free literature available: Application notes on nitrogen and dye lasers and information on families of high voltage power supplies.

Products manufactured: Converters, Detectors, Lasers & Laser Systems, Power Supplies

Local Sales Offices & Reps.

Ga	Atlanta, Physimetrics	404-261-8720
NM	Albuquerque, Southwestern Eng. & Eqp. Co.	505-265-6775
NY	Mineola, J. B. Lilly Co.	516-746-2226
Tex	Dallas, Southwestern Eng. & Eqp.	214-826-6661
Tex	Houston, TCI Elctrns.	713-774-5019

RELAY SERVICE CO., 1310 N. Pulaski Rd., Chicago, Ill., 60651, Tel: 312-AL 2-2700; Empl.: 40; Minimum order: $7

For info on price: C. H. Badger; Application info: F. Vivacue

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Coils Including Assemblies & Forms, Relays, Switches

Local Sales Offices & Reps.

Kans	Mission, Midland Sls. Engrg. Assocs.	913-CO2-6565
Mich	Farmington, Lloyd George Assocs.	313-474-1505
NJ	Cranford, Hy-Rel Assocs.	201-276-2677

RELAY SPECIALTIES INC., 1300 Plaza Rd., Fair Lawn, N.J., 07410, Tel: 201-797-3313; Empl.: 57; Minimum order: $15

For info on price: B. Albanese; Application info: S. Gershberg; Customer service: B. Sauer; Delivery info: J. Abrams

Free literature available: Catalog on electronic control components. Relays-Timers-Counters-Switches-Sockets-Temperature controls-Photo Electric Controls-Buzzers and cabinets.

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Counters, Relays, Switches, Timers

RELCO PRODS., 5594 E. Jefferson Ave., Denver, Colo., 80237, Tel: 303-756-1143; FSC No: 14454; Empl.: 7; Minimum order: $50

Customer service: R. Ruehle

Products manufactured: Meters, Probes, Thermometers, Resistance, Transducers

RELIABILITY INC., 5325 Glenmont, Dept. A, Houston, Tex., 77036, Tel: 713-666-3261, TWX: 910-881-1739 p. 1•1428,1429

Customer service: B. Miller

Free literature available: Catalog which describes all products completely.

Products manufactured: Chamber, Environmental Test, Ovens, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, EMA, Inc.	405-837-6061
Ariz	Scottsdale, Electronic Entrps.	602-946-9860
Cal	Glendale, Orion Sales	213-240-3151
Cal	San Diego, Orion Sales	714-566-0095
Cal	Sunnyvale, Amasco	408-733-8690
Cal	Tustin, Orion Sales	714-832-9687
Conn	Washington Depot, Kanan Assoc.	203-868-0513
Ind	Indianapolis, Sheridan Sales	317-547-7777
Mass	Reading, Kanan Assoc.	617-944-8484
Mass	Waltham, W. M. Hague Co.	617-899-5600
Mich	Farmington, Sheridan Sales	313-477-3800
Mo	Florrisant, Sheridan Sales	314-837-5200
NJ	Berkely Heights, AMC	201-464-5100
NM	Albuquerque, Electronic Entprs.	505-256-3561
NM	Albuquerque, Piper-Goyne Inc.	505-294-1436
NY	Syracuse, T-Squared Elctrns.	315-463-8592
NC	Winston Salem, EMA, Inc.	919-722-5151
Ohio	Beachwood, Sheridan Sales	216-831-0130
Ohio	Dayton, Sheridan Sales	513-277-8911
Ohio	Reading, Sheridan Sales	513-761-5432
Pa	Pittsburgh, Sheridan Sales	412-244-1640
SC	Greenville, EMA, Inc.	803-268-1125
Tex	Richardson, Semiconductor Sls. Assoc.	214-231-6181
Wash	Tukwila, General Elctrns.	206-243-5141
Wash	Vancouver, General Elctrns.	206-693-0025

Local Distributors

Cal	El Segundo, Tex. Instr. Sup. Co., 831 Douglas St.	213-776-4490
Cal	Los Angeles, Tex. Instr. Supp. Co.	213-776-4490
Cal	Sunnyvale, Tex. Instr. Sup. Co., 776 Palomer	408-732-5555
Colo	Denver, Tex. Instr. Supp. Co., 9725 E. Hampden	303-751-1780
Colo	Denver, Tex. Instr. Supp. Co.	203-757-7671
Ill	Arlington Hts., Tex. Instr. Supp. Co., 2420 E. Oakton Rd.	312-593-7660
Mass	Waltham, Tex. Instr. Supp. Co., 404 Toten Pond Rd.	617-890-0510
Minn	Edina, Tex. Instr. Supp. Co., 7615 Metro Blvd.	612-835-5353
NJ	Clark, Tex. Instr. Supp. Co., 301 Central Ave.	201-382-6400
NM	Albuquerque, Goyne Assocs.	505-265-6794
NY	Huntington Sta., Tex. Instr. Supp. Co., 2 Huntington Quadrangle	516-293-2660
NY	Syracuse, T Squared Elctrns.	315-463-8592
Ohio	Cincinnati, Sheridan Sls.	513-761-5432
Okla	Tulsa, Tex. Instr. Supp. Co., Box Drawer T	918-437-4555
SC	Greenville, Egan Assocs.	803-228-4450

Tex	Austin, Tex. Instr. Supp. Co.	512-258-1636
Tex	Dallas, Tex. Instr. Supp. Co., 6000 Denton	214-238-6821
Tex	Houston, Tex. Instr. Supp. Co., 3939 Ann Arbor	713-785-4800
Tex	Richardson, Semiconductor Sls. Assocs.	214-231-6181
Va	Arlington, Tex. Instr. Supp. Co., 1500 Wilson Blvd.	703-524-5885
Wash	Bellevue, SD.R2 Prods. & Sls.	207-747-9424

RELIANCE ELECTRIC CO., 24701 Euclid Ave., Cleveland, Ohio, 44117, Tel: 216-266-7000; Empl.: 20000

Products manufactured: Analyzers, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Controls/Control Eqpt., Gearheads & Speed Reducers, Indicators, Inverters, Meters, Motor & Generator Armatures, Rotors, Stators, Motor Electric Generator Sets, Motors, Racks, Reducers, Relays, Services, Assembly, Production & Test

RENBRANDT, INC., 6 Parmelee St., Boston, Mass., 02118, Tel: 617-445-8910; Empl.: 25

Products manufactured: Couplings

RENCO CORP., 26 Coromar Dr., Goleta, Cal., 93017, Tel: 805-968-1525; Empl.: 75 .... p. 1•202,203

Products manufactured: Encoders, Tachometers

Local Sales Offices & Reps.

Cal	Santa Fe Springs, Sales Engrs. Ltd.	213-921-4337
Fla	Orlando, MacKay, Smith & Assocs.	305-277-1513
Ill	Chicago, Electro Tech. Mktg.	312-588-4535
Iowa	Cedar Rapids, Palatine Sls.	319-385-8071
Kans	Andover, Palatine Sls.	316-683-7512
Kans	Overland Park, Palatine Sls.	913-262-5643
Mass	Andover, Mech-Tron Co.	617-475-3531
Mich	Detroit, Ridgway East	313-538-3940
Mo	St. Louis, Palatine Sls.	314-428-7055
NY	Roslyn Heights, Travco Assocs.	516-621-3223
NC	Charlotte, MacKay, Smith & Assocs.	704-527-0240
Ohio	Chagrin Falls, Ridgway East	216-247-4845
Ohio	Loveland, Ridgway East	513-683-4350
Okla	Tulsa, Palatine Sls.	918-622-0321
Tex	Austin, Palatine Sls.	512-451-7463
Tex	Richardson, Palatine Sls.	214-231-9489
Wash	Seattle, Thorson Co.	206-632-0710

RENTAL ELECTRONICS, 99 Hartwell Ave., Lexington, Mass., 02173, Tel: 617-862-6905, Telex: 92-3494; Empl.: 70 .... p. 1•792-795

Free literature available: INSTRUMENT RENTAL CATALOG - Complete listing and description of rental equipment. Includes the advantages of renting equipment; information on rental, rental/purchase and leasing services available; and prices.
TEST EQUIPMENT CATALOG - Complete listing and description of slightly used electronic test equipment available for sale. Discount prices included.

Products manufactured: Amplifiers, Analyzers, Attenuators, Bridges, Calculators, Electrical & Electronic, Calibrators, Cameras, Chamber, Environmental Test, Computers, Converters, Counters, Couplers, Decade Boxes, Detectors, Filters, Generators, Inverters, Meters, Oscillators, Oscillographs, Direct Writing, Oscilloscope Plug-Ins, Oscilloscopes, Power Supplies, Recorders, Resistors, RFI Measuring Equipment, Scanners, Services, Assembly, Production & Test, Shifters, Standards, Synthesizers, Testers, Tracers, Curve, Voltage Sources, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, General Radio Corp.	205-883-7538
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Anaheim, Rental Elctrns., Inc.	714-879-0561
Cal	Lawndale, Ward/Davis Assoc.	213-542-7740
Cal	Mountain View, Rental Elctrns., Inc.	415-968-8845
Cal	Sunnyvale, Ward/Davis Assoc.	408-245-3700
Colo	Denver, BFA Corp.	303-744-3301
Conn	Glastonbury, Instr. Rep.	203-633-0777
Fla	Ft. Lauderdale, Rental Elctrns., Inc.	305-771-3500
Fla	Lighthouse Pt., Saber Assoc.	305-943-3076
Ga	Atlanta, General Radio Corp.	404-457-2485
Ill	Des Plaines, Cozzens & Cudahy	312-298-3600
Ill	Des Plaines, Rental Elctrns., Inc.	312-827-6670
Ind	Indianapolis, Cozzens & Cudahy	317-244-2456
Md	Gaithersburg, Rental Elctrns., Inc.	301-948-0620
Mass	Burlington, Rental Elctrns., Inc.	617-273-2770
Mass	Burlington, REI Sls.	617-273-2777
Mass	Lexington, Instr. Rep.	617-861-8620
Mich	Detroit, S. Sterling	313-255-1970
Minn	Minneapolis, Cozzens & Cudahy	612-844-4336
Mo	Edmondson, Cozzens & Cudahy	314-423-1234
NJ	Oakland, Rental Elctrns., Inc.	201-337-3757
NM	Las Cruces, BFA Corp.	505-523-0601
NY	E. Syracuse, Ossman Instrs.	315-437-6666
NY	Great Neck, Eastern Instr.	516-466-9505
NC	Winston-Salem, General Radio	
Ohio	Cleveland, S. Sterling	216-422-8080
Okla	Norman, Data Mktg.	405-364-8320
Pa	Pittsburgh, S. Sterling	412-922-5720
Tex	Dallas, Rental Elctrns., Inc.	214-661-8082
Tex	Houston, Data Mktg. Assoc.	713-686-9627
Va	Alexandria, Dyna Rep Co.	703-354-1222
Wash	Seattle, R.S. Drake Assoc.	206-763-2755
FOR:	Can., Rexdale, Ont., Rental Elctrns., Inc.	416-677-7513

REO INDS, INC., 633 3rd St., N.W., Massillon, Ohio, 44646, Tel: 216-833-9951; Empl.: 150

Customer service: T. J. Albert

Free literature available: Brochure describes product applications and services available.

Products manufactured: Cabinets & Accessories

REPCO INC., Special Product Dept., Box 7065, Orlando, Fla., 32804, Tel: 305-843-8484, TWX: 810-850-0120; Empl.: 350

For info on price: J. Dirmann 305-843-8498; Application info: B. Schermerhorn 305-843-8498; Customer service: W. Nelson 305-843-8484; Delivery info: B. Schermerhorn 305-843-8498

Free literature available: Brochures, R.F. links, 10-8 hand held portable radio, 10-2 hand held portable radio, m/p mobile portable radio.

Products manufactured: Comm. Systems, Receivers, Recorders, Transceivers, Transmitters

Local Sales Offices & Reps.

Advertisment

VHF/UHF portable hand-held transceivers, mobile/portable radios-low and high band. RF communications links. Transmitters and receiver units. Power outputs from .5 to 50 watts. Solid state throughout. Modular plug-in-block circuits, small size, FCC type accepted easy maintenance, high reliability.

REPUBLIC ELCTRNS. CORP., 176 E. 7th St., Paterson, NJ, 07524, Tel: 201-279-0300, TWX: 710-988-5908; Empl.: 125; Minimum order: $15 .... p. 2•232,233

For info on price: G. Wolter; Application info: G. Wolter; Customer service: C. Taylor; Delivery info: C. Taylor

Free literature available: Bulletin KI describes a complete line of subminiature general purpose and temperature compensating ceramic capacitors. Included are tight tolerance NPO units.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Phoenix, MR Sales	602-959-5150
Cal	Los Angeles, Corcoran Assoc.	213-823-2425
Cal	Ramona, Advanced Tech. Sls.	714-789-1676
Fla	Miami Beach, Geartner	305-861-3661
Fla	Orlando, Geartner	305-299-1000
Ill	Chicago, Ropek & Cahill	312-287-7292
Iowa	Cedar Rapids, J.R. Sales Engrg.	319-377-8211
Kans	Overland Park, Reese Assoc.	913-648-7748
Md	Bethesda, W. Mount Co.	301-657-9312
Mass	Allston, Vector Sls.	617-787-2790
Minn	Hopkins, Grayden & Flemmer	612-941-1120
NJ	Paterson, Mucon Corp.	201-279-0300
NJ	Wallington, Comp-Tech Sls.	201-935-5454
NY	Liverpool, J.L. Semple Assoc.	315-458-4775
NY	New Hyde Park, Comp-Tech. Sls.	516-593-2628
NY	Rochester, J.L.Semple Assoc.	716-342-1413
NC	Charlotte, J. Rudisill Assocs.	704-377-6901
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242
Okla	Tulsa, H.J. Daly Co.	918-627-4159
Pa	Ardmore, Rothenheber & Wurts	215-649-6300
Wash	Seattle, Blum & Assoc.	206-285-2590

REQUIRED PRODUCTS, Box 3083, Stanford, Cal., 94305, Tel: 408-738-4329; Empl.: 4; Minimum order: $25

Customer service: C. E. Merkel

Free literature available: Data sheets

Products manufactured: Amplifiers, Power Supplies

RESDEL CORP., Bldg. #22-County Airport, Rio Grande, N.J., 08242, Tel: 609-886-1111; Empl.: 12; Minimum order: $35

For info on price: W. O. Taylor; Application info: W. A. Taylor; Customer service: W. O. Taylor; Delivery info: W. O. Taylor

Products manufactured: Bobbins, Winding, Coil & Transformer, Bushings, Glass, Plastic, Metal, Rubber, Etc., Coils Including Assemblies & Forms, Cups, Encapsulation, Spacers, Tubing

Advertisment

Centrifugally cast epoxy tubing, with or without fillers, for electrical and mechanical applications. Cast in lengths of 57 inches with no taper inside or outside. Some of the present applications are encapsulating and potting forms, stand-offs, connecting links, spacers, insulators, bolt and cooling holes in castings.

RESDEL ENGRG. CORP., 300 E. Live Oak Ave., Arcadia, Cal., 91006, Tel: 213-684-2600, TWX: 910-582-3219; Empl.: 170

Customer service: R. Bennett 213-445-5955 Ext. 302

Products manufactured: Amplifiers, Comm. Systems, Couplers, Receivers, Recorders, Synthesizers, Transmission Systems, Data, Transmitters

RESEARCH DEVICES, 616 Springfield Ave., Berkeley Heights, N.J., 07922, Tel: 201-464-0668; Empl.: 6

For info on price: B. G. Cohen; Customer service: M. W. Focht; Delivery info: V. R. Saba

Free literature available: 1-Data Sheets on Infrared Microscopes; 2-Application notes on uses of IR Microscopy in solid state device manufacture.

Products manufactured: Cameras, Machines/Machinery, Production, Microscopes, Semiconductor Wafer Fabrication

Advertisment

Research Devices Model D infrared microscope. Direct observation and photography of defects in integrated circuits, transistors, LED's and other solid state devices. Problems such as faulty metallizations, internal precipitates, die attach and bonding nonuniformities, may be detected on slices and chips. Call for applications information, or for a free demonstration.

RESEARCH, INC., Box 24064, Minneapolis, Minn., 55424, Tel: 612-941-3300, TWX: 612-292-4066; Empl.: 160

For info on price: H. Atkins; Application info: G. Gauvin; Customer service: W. Baer; Delivery info: H. Atkins

Free literature available: INFRARED RADIANT HEATING: Basic radiant heating and control concepts, including focussed and area heating pattersn. PYROMATION HEATING SYSTEMS: A series of short application articles concerning infrared process heating in the electronics industry.

Products manufactured: Chamber, Environmental Test, Computers, Controls/Control Eqpt., Power Supplies, Programmers, Transducers

RESEARCH INSTRUMENT CO., 643 Stewart Ave., Garden City, N. Y., 11530, Tel: 516-248-1001; Empl.: 12; Minimum order: $25

Customer service: M. Stoll

Free literature available: "The Pluses of Hermetic Sealing", "Universal Multi-Station GRADIENT Flat Pack Sealer", "Pressurized Sealer", "Crystal Grower", "Boat Puller", "CCTV Microscope", "Solvent Lap"

Products manufactured: Controls/Control Eqpt., Furnaces, Machines/Machinery, Production, Meters, Microcircuit Production Equip., Microscopes, Ovens, Seals, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test, Soldering Equipment, Television Systems & Equipment Closed-Circuit, Test Equipment

Local Sales Offices & Reps.

Cal	Santa Barbara, F. Pennucci	805-967-4116
NY	Ossining, Int'l. Scientific Sls.	914-762-0685
NY	Rochester, Upstate Tech. Equip.	716-377-6058
NY	Solvay, Upstate Tech. Equip.	315-458-5573
Tex	Houston, R.L. Stoll Assocs.	713-772-8282

RESEARCH PRODS. CORP., 1015 E Washington Ave., Madison, Wisc, 53701, Tel: 608-257-8801

Customer service: T. Alery

Free literature available: Aluminum, washable air filters.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Filters

RESISTANCE PRODS., 914 S. 13th St., Harrisburg, Pa., 17104, Tel: 717-236-5081, TWX: 510-650-4920; Empl.: 87

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Fred Board Assocs.	602-944-9388
Cal	Mountain View, G.C. Woempner	415-964-5454
Cal	San Marino, Van Gott & Assoc.	213-285-2148
Colo	Denver, Walter Engrg. Assoc.	303-777-5585
Fla	Winter Park, Steele Technical Sls.	305-644-6641
Ga	Atlanta, G.S. O'Hara	404-237-0600
Ill	Bellwood, Fiat Engrg. Assoc.	312-547-6200
Ind	So Bend, Valentine-Schillinger Co.	219-291-6258
Kans	Leawood, Vasen Sls. Co.	913-649-0679
Mass	Canton, New England Elec. Sls. Co.	617-828-4835
Minn	St. Paul, Furber Sales	612-861-1518
Mo	St. Louis, Vasen Sls. Co.	314-725-5219
NY	Floral Park, Mos Assocs.	516-694-5923
NY	Syracuse, C. W. Floring & Assoc., Inc.	315-478-2149
Ohio	Cleveland, D. Steffen Assocs.	216-461-8333
Ohio	Dayton, Del Steffen Assoc.	513-293-3145
Pa	Flourtown, Avenir	215-348-8290
Tex	Addison, MMS Comps.	214-661-5160
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
EXP:	N.Y., Westbury, Minthorne Int'l. Co., Inc.	516-334-3303
FOR:	Can., Ottawa, Ont., Wilson Ent.	416-224-9878
FOR:	Can., Toronto, Ont., Wilson Enterprises	416-766-0510

RESISTORS, INC., 5226 W. 26th St., Chicago, Ill., 60650, Tel: 312-BI2-1540; Empl.: 50 ....p. 2•1544,1545

Products manufactured: Resistors

Local Sales Offices & Reps.

Cal	Los Angeles, W.S. Harmon Co.	213-937-1460
Cal	Palo Alto, W.W. Tompkins & Co.	415-326-7940
Ill	Chicago, L-Tec, Inc.	312-286-1500
Iowa	Cedar Rapids, J.R. Sls. Engrg.	319-377-8211
Mass	Needham, White Sls. Co.	617-444-3676
Mich	Lathrup Village, R.C. Nordstrom & Co.	313-353-0210
NJ	Moorestown, A.A. Foley Assocs.	609-235-2390
NY	New York City, Symon Assocs.	212-757-3638
Ohio	Wickliffe, W.J. Brauer & Assocs.	216-943-0601
Pa	Pittsburgh, W.J. Brauer & Assocs.	412-921-3213
Tex	Garland, Whiteside Sls. Co.	214-231-9771
Wisc	Milwaukee, Honkamp Sls. Co.	414-463-2530

MOXON, INC., see SRC Div. Moxon, Inc.

REYNOLDS INDS., INC., Box 1170, Marina Del Rey, Cal., 90291, Tel: 213-823-5491; FSC No: 99747; Empl.: 150; Minimum order: $50

For info on price: J. Korbel; Application info: R. Craig; Customer service: J. Korbel; Delivery info: J. Korbel

Products manufactured: Connector Adapters, Connectors, Lead Assemblies & Receptacles, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Mass	Stow, Musello Assocs.	617-369-5900
NJ	Moorestown, Reynolds Inds.	609-234-0613
Tex	Irvine, A.I.D. Elctrns.	214-259-4761
Wash	Seattle, S. Wilson Co.	206-226-0650

REYNOLDS METALS CO., Box 27003, Richmond, VA., 23261, Tel: 804-282-2311, TWX: 710-956-0112

Products manufactured: Alloys, Bus Bars & Systems, Cable, Foil, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Tubing, Wire

Local Sales Offices & Reps.

Ala	Birmingham	205-592-4994
Ariz	Phoenix	602-272-7961
Ark	Little Rock	501-374-6472
Cal	Los Angeles	213-937-3680
Cal	San Francisco	415-692-3011
Colo	Denver	303-756-1591
Conn	Hartford	203-278-1760
DC	Washington	202-833-3760
Fla	Coral Gables	305-666-1866
Fla	Tampa	813-877-8057
Ga	Atlanta	404-393-1000
Ill	Galesburg	309-342-6204
Ill	Park Ridge	312-696-1400
Ind	Fort Wayne	219-637-5177
Ind	Indianapolis	317-247-6246
Kans	Kansas City	913-262-2121
Kans	Wichita	316-265-7245
Ky	Louisville	502-897-7101
La	New Orleans	504-833-3713
Md	Towson	301-823-4141
Mass	Chestnut Hill	617-734-3770
Mich	Detroit	313-354-4111
Mich	Grand Rapids	616-241-4677
Minn	Minneapolis	612-927-4424
Mo	St. Louis	314-726-5700
NJ	South Plainfield	201-561-0500
NY	New York	212-355-7700
NY	Buffalo	716-877-2565
NY	Rochester	716-271-5060
NY	Syracuse	315-437-2947
NC	Charlotte	704-536-0494
Ohio	Cincinnati	513-771-8640
Ohio	Cleveland	216-845-5000
Ohio	Columbus	614-228-2092
Ohio	Toledo	419-729-1681
Ohio	Youngstown	216-757-3163
Ore	Portland	503-666-3841
Pa	Bala-Cynwyd	215-839-4820
Pa	Pittsburgh	412-563-0030
Tenn	Memphis	901-396-3435
Tenn	Nashville	615-254-7597
Tex	Dallas	214-661-1120
Tex	Houston	713-622-7810
Utah	Salt Lake City	801-328-8138
Wash	Seattle	206-623-2503
Wisc	Milwaukee	414-475-1051

RF INTERONICS, 100 Pine Air Dr., Bay Shore, N.Y., 11706, Tel: 516-231-6400, TWX: 510-227-6233; FSC No: 13619; QPL No: 15733; Empl.: 150; Minimum order: $25 .... p. 1•572,573

For info on price: Sls. Dept.; Application info: Engrg. Dept.; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Filter catalog

Products manufactured: Attenuators, Capacitors, Fixed, Coils Including Assemblies & Forms, Filters

Local Sales Offices & Reps.

Ariz	Scottsdale, Williams-Assocs.	602-947-4297
Cal	Alhambra, M.W. Riedel Co.	213-283-7694
Cal	San Jose, United Sales Co.	408-379-0800
Colo	Denver, Williams-Assocs.	303-373-4730
Fla	Ft. Lauderdale, Tech-Rep Assocs	305-792-0962
Fla	Indian Rocks Beach, Tech-Rep Assocs	813-595-2834
Ill	Oak Park, J. Popp Sls.	312-626-3711
Kans	Overland park, Ensco-Rep. Inc.	913-381-7557
Md	Bethesda, Mechtronics Sls.	301-340-2130
Mass	Wakefield, Meas. Equip. Co.	617-245-4870
Mich	Detroit, A. Blumenberg Assocs.	313-557-1934
Minn	Minnetonka, P.J. Codute & Co.	612-933-2281
Mo	St. Louis, Ensco-Rep Inc.	314-542-3935
NJ	Cherry Hill, H.J. White Co.	609-428-4544
NM	Albuquerque, Williams-Assocs.	505-255-1638
NY	Fairport, W.A. Franklin Sls.	716-377-6584
NY	Great Neck, Trionic Assocs.	516-466-2300
NY	Syracuse, W.A. Franklin Sls.	315-474-5273
NY	Whitesboro, W.A. Franklin Sls.	315-736-5460
Ohio	Cincinnati, Tri-State Mktg	513-761-7993
Tex	Richardson, Campion Sales	214-238-8135
EXP:	New York, N.Y., Ad. Auriema, Inc.	212-466-2516
FOR:	Can., Don Mills, Ont., Bruce Vallillee Elec	416-447-8482

R F D, INC., 5024 Nassau St., Tampa, Fla., 33607, Tel: 813-872-1502; FSC No: 21992; Empl.: 32; Minimum order: $50

For info on price: S. Bailey; Application info: C. Beaty; Customer service: T. Facer; Delivery info: T. Facer

Free literature available: Microwave products catalog.

Products manufactured: Amplifiers, Oscillators, Preselector-Mixers, Preselectors, Receivers, Transmitters

Local Sales Offices & Reps.

Cal	Los Altos, Stout/Loeswick Assoc.	415-948-3265
Cal	Woodland Hills, Interstate Mktg. Assoc.	213-883-7608
Colo	Boulder, H. Bass Assoc.	303-499-7509
Fla	Clearwater, Southeastern Comp. Sls.	813-531-8324
Ill	Chicago, RF Specialists	312-698-2044
Md	Baltimore, Applied Engrg. Consits.	301-465-1272
Mass	Burlington, Tritek, Inc.	617-272-4550
NJ	Clemerton, Applied Engrg. Consits.	609-783-5121
NJ	Westfield, Gray & Reed Assoc.	201-233-6116
NY	Huntington Station, Gray & Reed Assoc.	516-433-3333

RFL INDS., Comms. Div., Powerville Rd., Boonton, N.J., 07005, Tel: 201-334-3100, TWX: 710-987-8352; Empl.: 250; Minimum order: $10 .... p. 1•122

For info on price: W. Estler Ext. 213; Application info: R. Gilman Ext. 276; Customer service: W. Fettes Ext.246; Delivery info: W. Estler Ext. 213

Free literature available: Voice Frequency Carrier Equipment may be used for transmission of data signals derived from nearly any source. Typical are telemetry, supervisory control, telegraph and data applications.

Products manufactured: Amplifiers, Bridges, Coders, Comm. Systems, Converters, Data Acquisition & Reduction Systems, Equalizers, Limiters, Modulator/Demodulators, Multipliers, Networks, Oscillators, Receivers, Transducers, Transformers, Transmission Systems, Data, Transmitters

Local Sales Offices & Reps.

Alas	Anchorage, H Lang & Assoc.	907-279-5741
Ariz	Phoenix, Portis & Assocs.	602-947-4379
Cal	Los Gatos, Luscombe Engrg. Co.	408-354-6496
Cal	Pasadena, Luscombe Engrg. Co.	213-684-2000
Colo	Lakewood, Claredon Co.	303-238-4462
DC	Wash, Instrucom, Inc.	202-223-1759
Fla	St. Petersburg, Comtech Assoc. Inc.	813-527-3281
Haw	Honolulu, Aloha Assoc.	808-941-1574
Idaho	Boise, Tarbell Communications	208-343-0285
Ill	Schaumburg, Kay Sls.	312-397-1215
La	New Orleans, Mid South Sls.	504-822-3030
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
Mo	Cameron, Comm. Systems	816-632-7616
NH	Nashua, Bell Controls	603-882-6984
Ohio	Columbus, RFL Industries	614-888-7255
Ore	Portland, Tarbell Com.	503-643-1631
Tex	Houston, Control Interface, Inc.	713-464-6571
Tex	Richardson, Horizon Engrg. Sls. Co.	214-238-9121
Utah	Salt Lake City, Cannon Engrg. & Sls. Co.	801-328-9404
Wash	Bellevue, Tarbell Communications	206-454-9716

RFL INDS., Instr. Div., Powerville Rd., Boonton, N.J., 07005, Tel: 201-334-3100, TWX: 710-987-8352; Empl.: 250; Minimum order: $10 .... p. 1•791

For info on price: F. Price Ext. 202; Application info: R. Schmehl Ext. 235; Customer service: W. Fettes Est. 246; Delivery info: F. Price Ext. 202

Free literature available: How to Magnetize, Measure and Stabilize Permanent Magnets, describes, Magnetic Instrumentation ranging from simplified operator controlled apparatus to complete automated processing systems.

Products manufactured: Analyzers, Calibrators, Demagnetizers, Dividers, Indicators, Magnetizers, Magnetometers, Magnets, Meters, Power Supplies, Probes, Standards, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Glendale, IFM Inc.	213-246-7261
Cal	Mountain View, IFM, Inc.	415-961-2828
Colo	Denver, Williams Assocs.	303-373-4730
Conn	Middletown, The Mancib Co.	203-347-5629
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9767
Fla	Winter Haven, Lee Assocs.	813-294-5815
Haw	Honolulu, Aloha Assocs.	808-941-1574
Idaho	Boise, Tarbell Comm., Inc.	208-343-0285
Ill	Des Plaines, Marsland	312-298-2620
Ind	Indpls, Marsland	317-924-3568
Mass	Burlington, Mancib Co.	617-272-9450

Mich	Farmington, Carter, McCormic & Pierce, Inc.	313-477-7700
Minn	Mpls, Marsland Assocs., Inc.	612-545-4481
Mo	Kansas City, Marsland	314-278-6949
NJ	Haddonfield, Dyna Rep Co.	609-795-1700
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Elbridge, L-Tron Corp.	315-689-3787
NY	Latham, L-Tron Corp.	518-785-5023
NY	Tonawanda, L-Tron	716-691-8887
NC	Raleigh, Lee Assocs.	919-787-5818
Ohio	Cleveland, Carter, McCormic & Pierce	216-333-5650
Ohio	Dayton, Carter, McCormic & Pierce	513-278-5873
Ore	Beaverton, Tarbell Comm., Inc.	503-643-1631
Pa	Monroeville, Carter, McCormic & Pierce	412-372-4415
Tex	Houston, Scientific Sls.	713-666-5318
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Va	Alexandria, Dyna Rep. Tech. Svcs.	703-354-1222

RFL INDS., Thermocontrol Div., Boonton, N.J., 07005, Tel: 201-334-3100, TWX: 710-987-8352; Empl.: 250; Minimum order: $10 .... p. 1•2328,2329

For info on price: B. Kendall Ext. 237; Application info: J. Simon Ext. 282; Customer service: W. Fettes Ext. 246; Delivery info: B. Kendall Ext. 237

Free literature available: A Guide for selection and installation of RFL Electronic controllers, where precise process temperature control is required for industrial applications.

Products manufactured: Controls/Control Eqpt., Meters, Monitors, Mounts, Probes, Thermistors, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps., Inc.	205-539-4411
Ariz	Scottsdale, Williams	602-947-4297
Cal	Glendale, IFM Inc.	213-246-7261
Cal	Mountain View, IFM, Inc.	415-961-2828
Colo	Denver, Williams Assocs.	303-373-4730
Conn	Wallingford, Adams-McGregor	203-269-5816
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-776-4800
Fla	Orlando, W.A. Brown Comps., Inc.	305-425-5505
Ga	Atlanta, W.A. Brown Comps.	404-457-4069
Haw	Honolulu, Aloha Assocs.	808-941-1574
Idaho	Boise, Tarbell Comms., Inc.	208-343-0285
Ill	Palatine, J.E. Zenner Assoc.	312-358-6520
Md	Kensington, Elctrn. Mktg. Assoc. Inc.	301-881-5300
Mass	Scituate, Adams-McGregor	617-545-2213
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Minn	Minneapolis, Waytek Co.	612-933-2133
NJ	Boonton, RFL Inds., Inc.	201-334-3100
NJ	Union, Garwood Assocs.	201-964-8366
NM	Albuquerque, Williams	505-255-1638
NY	Elbridge, L-Tron Corp.	315-689-3787
NY	Latham, L-Tron Corp.	518-785-5032
NY	Tonawanda, L-Tron	716-691-8887
NC	Raleigh, W.A. Brown Comps.	919-876-9601
NC	Winston-Salem, W.A. Brown Comps., Inc.	919-725-5384
Ohio	Cleveland, Carter, McCormic & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Ore	Beaverton, Tarbell Comms. Inc.	503-643-1631
Pa	King of Prussia, Elctrn. Mktg. Assoc.	215-265-1600
Pa	Monroeville, Carter, McCormic & Peirce	412-372-4415
RI	Lincoln, Adams-McGregor	401-726-1300
Tex	Dallas, McGatlin Instr. Co.	214-243-6061
Wash	Bellevue, Tarbell Comms.	206-454-9716

Local Distributors

Ala	Mobile, Brownell Electro, 3450 Armour Dr.	205-479-5405
Cal	Burlingame, Rose Elctrns., 846 Stanton Rd.	415-697-0224
Cal	Los Angeles, Fisher-Brownell, 13936 S. Broadway	213-532-2170
Cal	Mt. View, IFM, Inc., 80 W. El Camino Real	415-961-2828
Cal	San Pedro, IFM, Inc., 1300 S. Beacon St.	213-547-0829
Cal	Santa Clara, Fisher-Brownell, 3381 Edward Ave.	408-244-6182
Conn	Waterbury, Suburban Supply, 117 Benedict St.	203-757-1251
Fla	Orlando, Brownell Electro, 307 27th St.	305-843-6770
Ga	Atlanta, Brownell Electro, 3026 Commerce	404-762-5181
Ind	Indianapolis, Rockwell Engrg., 2121 E. 45th St.	417-251-9453
Mass	Boston, Sager Electrical, 172 High St.	617-542-2281
Mass	Burlington, Instrs./Div of Mancib, A Street	617-272-9450
Mass	Cambridge, Brownell Electro, 271 Vassar St.	617-864-7500
Mich	Farmington, C,M,&P Distrs., 23995 Freeway Pk.	313-477-7700
Minn	Minneapolis, Waytek, Inc., 5656 Lincoln Dr.	612-933-2133
NJ	S. Plainfield, Brownell Electro, 500 Hadley Rd.	201-753-4600
NJ	Springfield, Federated Purchaser, 155 Rte. 22	201-376-8900
NY	Buffalo, Trott Elctrns., 932 Hertel Ave.	716-876-0880
NY	New York, Brownell Electro, 85 10th Ave.	212-924-6000
NC	Charlotte, Brownell Electro, 5141 Belhaven	704-394-4341
Pa	Philadelphia, Brownell Electro, 10980 Dutton	215-632-3030
Tenn	Memphis, Brownell Electro, 3053 Tranquillity	901-332-9254
Tenn	Nashville, Brownell Electro, 1050 Acorn Dr.	615-889-8230

RG ENTERPRISES INC., Box 667, Scottsdale, Ariz., 85252, Tel: 602-948-9888; Empl.: 2

Customer service: R. C. Granite

Free literature available: A data sheet describing spec's, usage & pricing on a line tools for manual lead forming. Five models are available from 1/8W to 2W.

Products manufactured: Machines/Machinery, Production

Local Distributors

Cal	El Monte, Marshall Industries, 9674 Telstar Ave.	213-686-0141
Cal	El Segundo, Wassco, 410 S. Douglas St.	213-772-8171
Cal	Glendale, Macdonald & Co., 213 S. Brand Blvd.	213-241-1101
Cal	Los Angeles, Engineering & Elctrn. Devices, Inc., 1024 N. McCadden Pl.	213-463-4175
Cal	Torrance, Unitool Div. of Erem Corp., 3740 Skypark Dr.	213-772-0751
Conn	Madison, A & M Electronic Rep's, Aileen Dr.	202-245-1031
Ind	Huntington, Triad-Utrad, 305 N. Briant St.	
Pa	Huntingdon Valley, H. Mann, Inc., 3983 Mann Rd.	215-355-7200
Tex	Dallas, Specialized Prods. Co., 2324 Short Crest Dr.	214-358-4663
Wyo	Cheyenne, Houge Radio & Supply Co., 1102 Logan Ave.	307-632-6474

RHG ELCTRNS. LAB., 161 E. Ind. Ct., Deer Park, N.Y., 11729, Tel: 516-242-1100, TWX: 510-227-6083; Empl.: 65 p. 2•1389

Customer service: S. Wolin

Products manufactured: Amplifiers, Comm. Systems, Converters, Couplers, Demodulators, Discriminators, Dividers, Integrated Circuit Devices, Microwave Integrated Circuits (MIC's), Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Preselector-Mixers, Receivers, Transmission Systems, Data, Transmitters, Tuners

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Los Altos, Cain-White & Co.	415-948-6533
Cal	Los Angeles, Thorson Co.	213-937-0790
Cal	San Diego, Thorson Co.	714-298-8385
Cal	Tustin, Thorson Co.	714-544-5121
Fla	Orlando, Gentry Assocs.	305-894-4401
Md	Annapolis, Hayden Assocs.	202-296-6059
Mass	Reading, Geder-Rotundi Assocs.	617-944-3105
NJ	W. Orange, E F Tech. Sls.	201-731-7203
NM	Albuquerque, IMEC Co.	505-883-9010
NY	Huntington, E F Tech. Sls.	516-368-5841
NY	N. Syracuse, KLM Assocs.	315-458-6214
NY	New Hartford, KLM Assocs.	315-736-5466
NY	Rochester, KLM Assocs.	716-442-0820
NC	Burlington, Gentry Assocs.	919-227-3639
Pa	Lafayette Hill, M. Lader	215-825-3177
Tex	Dallas, Cain & Co., Inc.	214-233-6809
Wash	Seattle, Thorson Co.	206-632-0710

RHOMBUS INDS., INC., 22119 Vermont Ave., Torrance, Cal., 90502, Tel: 213-325-7440, TWX: 910-349-7512; Empl.: 30

Products manufactured: Delay Lines

Local Sales Offices & Reps.

Ariz	Scottsdale, S. C. Blaker Co.	602-948-3061
Mass	Waltham, Impact Sls. Co.	617-893-2850
Minn	Minneapolis, Merrill Franklin Co.	612-835-6422
Tex	Irving, Space Elctrns.	214-251-2266
EXP:	Cal, Los Angeles, Product Supply Co.	213-659-1858

RICHARD-LEE CO., Box 724, New Providence, N.J., 07974, Tel: 201-665-1333; Empl.: 6

Customer service: H. Kundrat

Products manufactured: Amplifiers, Comparators, Controls/Control Eqpt., Converters, Counters, Integrators, Electronic, Meters, Monitors, Oscillators, Tachometers, Totalizers, Digital, Transducers

RICHLOK CORP., 5825 N. Tripp Ave., Chicago, Ill., 60646

RIESTER & THESMACHER CO., 6880 Lake Abrams Dr., Cleveland, Ohio, 44130, Tel: 216-243-5550; Empl.: 80

Customer service: T. D. Burt

Free literature available: Descriptive Brochure, Facilities List

Products manufactured: Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Frames, Cabinet & Rack, Racks, Services, Assembly, Production & Test

RIL ELCTRNS., INC., Street Rd. at 2nd St. Pike, Southampton, Pa., 18966, Tel: 215-EL 5-1361; Empl.: 25

For info on price: D. G. Shylan; Application info: J. R. Brochon; Customer service: D. G. Shylan; Delivery info: D. G. Shylan

Products manufactured: Amplifiers, Chargers, Battery, Controls/Control Eqpt., Gages, Meters, Recorders, Test Equipment, Testers

RIPLEY CO., INC., 1 Factory St., Middletown, Conn., 06457, Tel: 203-346-6677; Empl.: 120; Minimum order: $10

Customer service: R. S. Clark

Free literature available: Blower catalolg showing line of small blowers for electronic cooling. Timer catalog showing timers for many types of application. Cable preparation tools - CATV & Coaxial.

Products manufactured: Blowers & Fans & Accessories, Controls/Control Eqpt., Services, Assembly, Production & Test, Timers

Local Sales Offices & Reps.

Ariz	Scottsdale, S.C. Blaker Co.	602-948-3061
Cal	Downey, Sierra Pacific Engrg. Co.	
Cal	Mountain View, Connolly & Co.	415-967-6988
Conn	Cheshire, Techmark Corp.	203-272-7131
Fla	Hialeah, Shaw Engrg. & Sls.	305-822-6141
Ill	Elmhurst, Schuten Assocs.	312-833-0980
Ill	Park Ridge, G. Collins Sls. Co.	312-823-8075
Kans	Shawnee Mission, M.E. Bettis Co.	913-362-0772
Mass	Wellesley Hills, M. Scott Co.	617-235-0102
Minn	New Brighton, T W C Sls. Co.	612-636-1770
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Rochester, Application Specialists, Inc.	716-586-8226
NY	Skaneateles, Henkell Mktg. Co.	315-685-6945
Ohio	Cincinnati, G & H Sls. Co.	513-771-8231
Ohio	Cleveland, Scott Electronics, Inc.	216-291-2600
Tex	Dallas, E.F. Aymond Co.	214-826-7620
Tex	Dallas, J.C. Sauls Co.	214-742-9419

RISK INDS, INC., GEORGE, GRI Plaza, Kimball, Neb., 69145, Tel: 308-235-4645, TWX: 910-620-9040; Empl.: 80; Minimum order: $15

For info on price: T. Onigkeit; Application info: R. Nickels; Customer service: T. Onigkeit; Delivery info: T. Onigkeit

Free literature available: Bulletin No. S-12 - Pushbutton Switch Catalog, Bulletin No. KB-10 - Keyboard Catalog, Bulletin No. BA-1 - Burglar Alarm Catalog

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, MR Engrg. Sls. Co.	602-959-5150
Cal	Redwood City, Woodworth Co.	415-365-0252
Cal	Van Nuys, C.T.S. Sls.	213-786-4661
Ind	Greenwood, Valentine & Schillinger	317-888-2260
Ind	South Bend, Valentine & Schillinger	219-291-6258
Iowa	Cedar Rapids, VRBIK Co.	319-377-8244

Mich	Ferndale, Shalco, Inc.	313-547-4771
Minn	Minneapolis, Merrill Franklin Co.	612-835-6422
Mo	Florissant, Nevco	314-843-7406
Mo	Kansas City, Nevco Inc.	816-421-1751
Mo	St. Louis, Nevco	314-843-7406
NJ	Springfield, Shortess, Rawson & Assocs.	201-467-8585
NY	Syracuse, I. A. Hotze Co.	315-479-6641
Ohio	Cleveland, Del Steffen & Assocs.	216-461-8333
Ohio	Dayton, Del Steffin & Assocs.	513-293-3145
Pa	Paoli, Tyler Griffin	215-647-1550
Tex	Dallas, McCoy Assocs.	214-350-9931
Tex	Houston, E. V. Smith Sls.	713-649-5756
Tex	Houston, McCoy Assocs.	
EXP:	Laguna Niguel, Cal., Ind. Export Management	714-493-2589
EXP:	Philadelphia, Pa., ALM Elctrns. Inds., Ltd.	215-877-3105

R L C ELCTRNS., INC., 83 Radio Cir., Mt. Kisco, N.Y., 10549, Tel: 914-241-1334; FSC No: 12598; Empl.: 45

Customer service: Sls. Dept.

Free literature available: Catalog describes in 80 pages all information concerning switches, filters, attenuators, terminations, detectors, line stretchers, etc.

Products manufactured: Adapters, Waveguide, Attenuators, Couplers, Detectors, Dividers, Dummy Loads, Filters, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Mixers, Switches, Terminals, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Cupertino, Dura Elctrn. Sls.	408-255-2084
Cal	Los Angeles, Thorson Co.	213-937-0790
Mass	S. Chelmsford, I M R	617-256-8251
Mo	St. Peters, Marsland Assoc.	314-278-6949
NY	Plainview, Central Assoc.	516-433-0808
Pa	Elkins Park, Snow Assocs.	215-379-4700
Tex	Dallas, Texas Microwave	214-231-5381
Va	Woodbridge, M. Lader Company	703-494-4731
EXP:	Yonkers, New York, R. I. Mendels Co.	914-965-4210

RO ASSOCS., INC., 3705 Haven Ave., Menlo Park, Cal., 94025, Tel: 415-322-5321, TWX: 910-378-5929; Empl.: 60
p: 1•1430,1431

For info on price: F. Kamp; Application info: F. Kamp; Customer service: S. Vavro; Delivery info: S. Vavro

Free literature available: Catalog-Complete technical description of standard products plus article "The Principles and Facts About Switching Power Supplies".

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	Santa Clara, Richards Assocs.	408-246-5860
Colo	Boulder, H. Bass Assocs.	303-499-7509
Fla	Miami, Lee Assocs.	305-525-9767
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ill	Rolling Meadows, Lightner Assocs.	312-398-3000
Md	Fulton, Gans-Fryling Inc.	301-837-6311
Mass	Lynnfield, Research Instrs.	617-245-9530
Mass	Newton, Techmar Inc.	617-444-8130
Mich	, Holsapple & Assoc.	317-899-2890
Minn	Minneapolis, Data Electronics Co.	612-786-9666
NJ	Ft. Lee, Technimat	201-461-8686
NM	Albuquerque, Fry-Gates Co.	505-298-1875
NY	Ithaca, B. Dean Inc.	607-272-2187
NC	Raleigh, Lee Assocs.	919-787-5818
Tex	Dallas, McCoy Assoc. Co.	214-350-9931
Tex	Houston, Ev Smith Sls. Co.	713-649-5756
Va	Arlington, Gans-Fryling Inc.	703-527-3262
FOR:	Can., Toronto, Ont., B.H. Mc Gregor	416-699-5521

ROBERTSHAW CONTROLS CO., Box 449, Columbus, Ohio, 43216, Tel: 614-875-2351, TWX: 810-335-2560; Empl.: 500; Minimum order: $25

For info on price: J. Putsock; Application info: R. A. Heber; Customer service: J. Putsock; Delivery info: R. A. Heber

Free literature available: General Catalog D-73, Robertshaw "Command Series" Oil-Tight Pushbutton Switches - Switch and Component Ordering Information.

Products manufactured: Switches

Local Sales Offices & Reps.

Ga	Atlanta, B. Fancher & Assoc.	404-448-7078
Minn	Minneapolis, Stack-Johnson, Inc.	612-925-2111
NY	Rochester, Upstate Comp. Sls.	716-288-1080
NC	Charlotte, B. Fancher & Assocs.	704-376-1753
Va	Richmond, Advance Control Equip. Co.	703-288-0124

ROBERTSHAW CONTROLS CO., Ind'l. Instr. Div., 1701 Byrd Ave., Box 26544, Richmond, Va., 23261, Tel: 804-282-9561, TWX: 710-956-0121; Minimum order: $20

Customer service: L. E. Huff

Products manufactured: Computers, Controls/Control Eqpt., Gages, Indicators, Integrators, Electronic, Meters, Monitors, Recorders, Switches, Transducers, Transmitters

Local Sales Offices & Reps.

Ala	Birmingham, J.W. Eshelman	205-879-3462
Ariz	Phoenix, Special Sys. Co.	602-964-5807
Cal	Anaheim, Robertshaw Controls	213-860-2491
Cal	San Diego, G. L. Parkhurst Co.	714-232-0721
Cal	So. San Francisco, Robertshaw Controls	415-871-7767
Cal	Taft, Oilfield Controls, Inc.	805-763-1561
Colo	Denver, Peterson Co.	303-388-6322
Conn	Hamden, Pond Tech.	203-288-6278
DC	Washington, Caton, Waller & Assocs., Inc.	301-269-0304
Fla	Lakeland, Curry Controls	813-646-4832
Ga	Atlanta, L. Rawson Co.	404-228-2351
Haw	Kailau, Oahu, CBC, Inc.	808-262-6561
Ill	Elk Grove Village, Robertshaw	312-437-6060
Ind	Indianapolis, Electro Engrg. & Sls., Inc.	317-547-5273
Iowa	Clinton, H. G. Klug, Inc.	319-243-3642
Ky	Louisville, Control Prods. Co.	502-367-6421
La	Baton Rouge, Allen Assocs.	504-926-4687
La	New Orleans, Turner & Co.	504-834-3848
La	Shreveport, Deeco Co.	318-742-0856
Md	Baltimore, Reco Inc.	301-647-0926
Mass	Boston, Stickney Engrg. Assoc.	617-449-3733
Mich	Detroit, G. R. Peters Assoc.	313-546-1166
Mich	Portage, G. R. Peters Assoc.	616-327-8390
Minn	Minneapolis, Northwest Power Equip.	612-646-7904
Mo	Kansas City, Power Specialties	816-531-6550
Mo	St. Louis, C. F. Gast Co.	314-993-2870
Mont	Billings, Industrial Sys.	406-252-6671
Neb	Omaha, H. G. Klug Co.	402-553-1377
NJ	Beverly, T. R. Van Ornam Co.	609-387-1964
NJ	Morrestown, D. J. Hettich	609-235-3411
NY	Albany, S. F. Sheldon Co.	518-684-2356
NY	Buffalo, Nickles Engrg. Co.	716-773-5399
NY	Liverpool, Nickles Engrg. Co.	315-457-8224
NY	New York, Buck Sls.	201-322-8747
NY	Rensselaer, Ashley Equip. Co.	518-436-9151
NY	Rochester, Nickles Engrg. Co.	716-586-4988
NC	Charlotte, G. M. Johnston	704-364-0722
NC	Charlotte, Robertshaw Controls	704-376-7495
Ohio	Cincinnati, Rawdon Myers, Inc.	513-791-4224
Ohio	Cleveland, E. J. Hodan & Assoc.	216-331-9344
Okla	Tulsa, Myers-Aubrey Co.	918-622-3500
Ore	Portland, Arthur Forsythe	503-297-3121
Pa	Ft. Washington, Robertshaw Controls	215-646-8031
Pa	Pittsburgh, Gilson Engr.	412-931-6114
SC	Greenville, Robertshaw Controls Co.	803-233-2787
Tenn	Knoxville, Robertshaw Controls	615-546-0550
Tenn	Memphis, Huckabee Industrial Sls., Inc.	901-388-4110
Tex	Corpus Christi, Duke - Lane Co.	512-888-5222
Tex	Dallas, Controls Intl. Co.	214-233-9397
Tex	Houston, Robertshaw Controls	713-498-0500
Tex	Odessa, The Barnco Co.	915-332-0293
Utah	Salt Lake City, Peterson Co.	801-487-5621
Wash	Richmond, Advance Control Equip. Co.	703-288-0124
Wash	Seattle, A. Forsyth Co.	206-283-5716
Wash	Spokane, A. Forsyth	509-326-2700
Wisc	Milwaukee, Allen Engrg.	414-353-5070
Wisc	Milwaukee, Robertshaw Controls	414-464-6446
Wyo	Casper, Moltec	307-234-5309
EXP:	Richmond, Va., Robertshaw Controls Intl. Mktg.	804-282-9561
FOR:	Can., Ontario, Robertshaw Controls	416-255-3451

ROBICON CORP., Plus Ind'l. Pk., Pittsburgh, Pa., 15239, Tel: 412-327-7000, Telex: 812-441; Empl.: 175; Minimum order: $50

For info on price: R. Sheppard; Application info: G. Lacki; Customer service: D. Lorenzi; Delivery info: S. Lagerbauer

Products manufactured: Controls/Control Eqpt.

Local Sales Offices & Reps.

Ala	Decatur, Pace	205-353-8067
Cal	Costa Mesa, Robinson Tech. Assocs.	714-557-1622
Cal	San Francisco, Automated Process Controls Co.	415-467-6162
Ga	Atlanta, Pace	404-458-7225
Ill	Park Ridge, Thermo/Cense	312-792-2760
Kans	Shawnee Mission, W. Hickman Co.	913-362-8066
Mass	Framingham, J.M. Lancaster Co.	617-873-8893
Mich	Southfield, Harris-Blancett & Assoc.	313-352-9505
Mo	St. Louis, F. Gilliam Assoc.	314-961-5555
Neb	Omaha, W. Hickman Co.	402-895-0262
NJ	S. Orange, Smith Co.	201-763-1770
NY	Buffalo, Robinson Assocs.	716-886-7350
NY	Latham, Robinson Assocs.	518-785-5844
NY	Rochester, Robinson Assocs.	716-342-3130
NY	Syracuse, Robinson Assocs.	315-478-0241
NC	Charlotte, R. Chapman Co.	704-525-2421
NC	Raleigh, R. Chapman Co.	919-782-2624
Ohio	Cincinnati, Cetco	513-671-6871
Ohio	Cleveland, A.W. Risser Co.	216-458-5091
Ohio	Toledo, Cubbedge Controls	419-535-5530
Okla	Tulsa, Terry Co.	918-743-3249
Pa	King of Prussia, Reinbrecht Assoc.	215-265-6180
Pa	Pittsburgh, Weiss Instrs.	412-371-3020
Tex	Houston, R & K Engineering	713-465-8367
Wash	Bellevue, A. Smith Co.	206-746-6770
WVa	Charleston, Hedrick Engineering	304-925-7655

Advertisment

SCR thyristor power control and conversion equipment. Robicon supplies standard SCR devices and custom packaged systems in fields of temperature control for process and comfort industries; speed/position control for motor drives to 2000 HP, both unidirectional and static reversing; and materials melting systems to 10,000 KVA.

ROBINSON-NUGENT, INC., 802 East 8th St., New Albany, Ind., 47150, Tel: 812-945-0211, TWX: 810-540-4082; Empl.: 250; Minimum order: $100

For info on price: S. M. Shine; Application info: M. Amster; Customer service: L. Winn; Delivery info: B. Hubler

Products manufactured: Boards, Plug-In, Chassis, Metal, Connectors, Integrated Circuit Packaging Systems, Plugs, Services, Assembly, Production & Test, Socket Adapters, Sockets, Terminals, Tools

Local Sales Offices & Reps.

Ariz	Phoenix, GND Sls.	602-971-9758
Cal	El Monte, Cook Ent.	213-686-2120
Cal	Redwood City, Logan Sls. Co.	415-369-6726
Cal	San Diego, Celtec Co.	714-279-7961
Colo	Englewood, W.J. Purdy Co.	303-777-1411
Fla	Oviedo, Conley & Assoc.	305-365-3283
Ill	Park Ridge, Metcom Assoc.	312-696-1490
Ind	Indianapolis, Technical Reps.	317-546-4967
Ky	Mt. Sterling, M.F. Eubank Sls. Co.	606-498-5955
Mass	Clinton, F.J. Coleman Co.	617-894-1855
Mich	Sturgis, Kesler & Assoc.	616-651-7619
Minn	Minneapolis, Stan Clothier Co.	612-888-4666
NM	Albuquerque, W.J. Purdy Co.	505-266-7959
NY	Huntington, C.R. Mayer Co.	516-921-7876
NY	Syracuse, Canavan-Scanlon Assoc.	315-437-1271
Ohio	Cincinnati, Tri-State Mktg.	513-761-7993
Ore	Portland, J.V. BeLusko Co.	503-222-4279
Pa	Broomall, L.D. Lowery, Inc.	215-356-5300
SC	Greenville, Elect. Mktg. Assoc.	803-268-1125
Tex	Irving, Space Elect. Corp.	214-251-2261

Local Distributors

Ala	Birmingham, M-G Elctrns., 3112 6th Ave.	205-328-4525
Ariz	Phoenix, Moltronics, 3617 N. 35th Ave.	602-272-7951
Cal	Los Angeles, RPS, 1501 S. Hill	213-748-1271
Cal	Riverside, Elec. Supp., 2486 3rd St.	714-787-9220
Cal	Sunnyvale, Intermark Elec., 1020 Stewart Dr.	408-738-1111
Colo	Denver, Intermark, 2600 W. 2nd Ave.	303-936-8284
Fla	Orlando, Hammond Elec., 911 W. Central Blvd.	305-849-6060
Ill	Westmont, Bodelle Co., 47 Chestnut	312-323-9670
Ind	Indianapolis, Harvey-Ind., 8505 Zionsville	317-297-4910
Ky	Louisville, Peerless Elec., 1815 S. 7th	502-636-3336

Md	Baltimore, Radio Elec. Svc., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Burlington, B & W Assoc., "B" St.	617-272-4420
Mich	Farmington, Harvey-Michigan, 23461 Ind. Pk. Dr.	313-477-1650
Minn	Minneapolis, Electro-Com, 3816 Chandler	612-788-8601
Mo	St. Louis, L-Comp St. Louis, 2605 S. Hanley	314-647-5505
Neb	Lincoln, Scott Elec., 4040 Adams St.	402-464-8308
NY	Bohemia, Carlac, 75 Orville Dr.	516-567-4200
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NC	Greensboro, Hammond Elec., 838 Huffman St.	919-275-6391
Ohio	Dayton, Esco, 221 Crane St.	513-226-1133
Pa	Philadelphia, Almo, Roosevelt Blvd. & Blue Grass Rd.	215-676-6000
SC	Greenville, Hammond Elec., 100 Augusta St.	803-233-4121
Tex	Dallas, Component Spec., 2560 Elec. La.	214-357-4576
Tex	Houston, Geophysical Supp., Box 52230	713-224-0621
Va	Charlottesville, Virginia Radio, 715 Henry Ave.	804-296-4184
Wash	Seattle, Radar Elec. Co., 168 Western Ave.	206-282-2511

ROBISON ELCTRNS., 3580 Sacramento Dr., San Luis Obispo, Cal., 93401, Tel: 805-544-8000; Empl.: 70

Products manufactured: Cups, Encapsulation, Pads, Transistor Mounting

Local Sales Offices & Reps.

Ariz	Phoenix, Gramer & Co.	602-279-1231
Cal	Downey, Groh Assocs.	213-923-0963
Cal	Palo Alto, R.W. Thompson Assocs.	
Cal	San Diego, Daniels & Doty Sls.	714-560-6266
Colo	Boulder, R.G. Enterprises	303-447-9211
Iowa	Des Moines, Beams, Inc.	515-282-0290
Kans	Shawnee Mission, Beams Inc.	913-341-7744
Md	Hyattsville, Eastern Comps.	301-557-2925
Mass	Woburn, Jalco Assocs.	617-227-1515
Minn	Hopkins, F. Peterson Co.	612-941-5400
Mo	Creve Coeur, Beams, Inc.	314-569-1060
NY	Brentwood, Cir-Tech Assocs.	516-231-4440
NY	De Ruyter, R.A. Murray Co.	315-852-9981
NY	Rochester, R.A. Murray Co.	716-467-4538
Ohio	Cleveland, Electro-Com	216-886-2404
Ohio	Dayton, Electro-Com	513-276-3993
Pa	Flourtown, Eastern Comps.	215-836-1616
Pa	York, Eastern Comps.	714-764-3114
Tex	Houston, Aid Elctrns.	713-777-3882
Tex	Irvine, Aid Elctrns.	214-259-4761
Wash	Kirkland, Freed Assocs.	206-822-8100

ROCKLAND INSULATED WIRE & CABLE, 87 Broadway, Haverstraw, N.Y., 10927, Tel: 914-429-3103; FSC No: 12111; Minimum order: $25

Free literature available: Catalog #471 contains a listing of miniature and sub-miniature PVC insulated wires & cables indicating items available from stock & special order.

Products manufactured: Cable, Wire

ROCKLAND SYS. CORP., 230 W. Nyack Rd., W. Nyack, N.Y., 10994, Tel: 914-623-6666, TWX: 710-575-2631; Empl.: 55; Minimum order: $50
p. 1•416,574,798,799

For info on price: D. Kohn; Application info: D. Kohn; Customer service: J. P. Marcella; Delivery info: J. P. Marcella

Free literature available: 1974 Short Form Catalog, Technical Data Sheets, Application Bulletins, Electronic Products Reprint "Frequency Synthesizers". 1973 IEEE Intercon Technical Papers "New Developments in Signal Generators".

Products manufactured: Analyzers, Equalizers, Filter Synthesizers, Filters, Generators, Signal Conditioners & Equipment, Synthesizers

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs., Inc.	205-533-5896
Ariz	Phoenix, Cleveland Entprs.	602-996-8130
Cal	Mountain View, IFM	415-961-2828
Cal	San Pedro, IFM	213-547-0829
Colo	Arvada, Cleveland Entprs.	303-423-3707
Conn	Hamden, Instrument Consultants	203-288-5246
Fla	Ft. Lauderdale, Lee Assocs.	305-525-9796
Fla	Winter Haven, Lee Assocs., Inc.	813-294-5815
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Md	Rockville, Mesa, Inc.	301-881-8430
Mass	Newton, Instrument Conslts.	617-969-9881
Mich	Detroit, LI/Corp.	513-434-6367
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, Carter Elctrns.	314-731-2237
NJ	Riverton, Mesa	609-786-0284
NM	Albuquerque, Cleveland Enterprises	505-345-2481
NY	Port Chester, Radiation Electronics	914-937-2300
NY	Rochester, Scientific Devices	716-334-2445
NC	Raleigh, Lee Assocs., Inc.	919-787-5818
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Tex	Dallas, Data Mktg. Assoc.	214-661-0300
Tex	Houston, Data Mktg.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Wash	Seattle, Delcom Sls. Co.	206-248-0090
Wisc	Milwaukee, Carter Elctrns.	414-464-5555
FOR:	Can., Downsview 463, Ont., Radionics Ltd.	416-638-0218
FOR:	Can., Montreal 376, Que., Radionics Ltd.	514-735-4565
FOR:	Can., Ottawa, Ont., Radionics Ltd.	613-521-8251
FOR:	Can., Vancouver, B.C., Radionics Ltd.	604-732-7317
FOR:	Can., Winnipeg, Man.	204-475-1732

ROCKWELL INT'L., Microelectronics Device Div., Box 3669, 3430 Miraloma Ave., Anaheim, Cal., 92803, Tel: 714-632-3729, TWX: 910-591-1179; FSC No: 34576

For info on price: W. A. Treleaven 714-632-3698; Application info: J. E. Bass 714-632-3860; Customer service: R. F. Voigt 714-632-3729; Delivery info: C. D. Bopf 714-632-0624

Free literature available: Product Descriptions & Application Notes.

Products manufactured: Integrated Circuit Devices, Modulator/Demodulators

Local Sales Offices & Reps.

NY	Smithtown	516-979-0183

RODAN IND'S., 2905 Blue Star St., Anaheim, Ca., 92806, Tel: 714-630-0081, TWX: 910-591-1684; FSC No: 15454; Empl.: 48; Minimum order: $15

For info on price: R. W. Dankert; Application info: A. Storamski; Customer service: J. H. Burns; Delivery info: J. H. Burns

Free literature available: Thermistor Manual enclosed

Products manufactured: Networks, Probes, Resistors, Thermistors, Transducers

Local Sales Offices & Reps.

Ariz	Scottsdale, De Angelo, Rothman & Cheever	602-948-2240
Cal	Los Altos, Stout-Loeswick	415-948-3265
Fla	Boca Raton, Southeastern Component Sls.	305-391-9067
Fla	Clearwater, Southeastern Component Sls.	813-531-8324
Ill	Chicago, J. Popp Sls. Co.	312-626-3711
Ind	Ft. Wayne, Menze Sls. Co.	219-747-5616
Iowa	Cedar Rapids, Snider Sls.	319-362-4410
Kans	Leawood, H.C. Heyde Co.	913-649-8628
Md	Baltimore, Burgin-Kreh Assoc.	301-788-5200
Mass	Andover, Sales Engrg.	617-470-0800
Mich	Troy, C. B. Jensen Assocs.	313-643-0506
Minn	Minneapolis, E.C. Elctrn. Sls.	612-831-0229
NY	Great Neck, F. Tylinski Co.	516-466-9070
NC	Winston-Salem, Burgin-Kreh Assoc.	919-768-4174
Pa	Ardmore, R. Freedman Assoc.	215-649-3679
Tex	Addison, Southland Components	214-233-0603
Va	Lynchburg, Burgin-Kreh Assoc.	703-845-5600
Wash	Seattle, R.K. Squibb Co.	206-632-2450
EXP:	New York City, N.Y., Singer Prod. Inc.	212-432-1400

RODELCO, 356A Commack Rd., Deer Park, N.Y., 11729, Tel: 516-643-5110; Empl.: 9; Minimum order: $500

Customer service: A. Dahiher

Products manufactured: Amplifiers, Transmitters

ROGAN CORP., 3455 Woodhead Dr., Northbrook, Ill., 60062, Tel: 312-498-2300, TWX: 910-686-0008

Products manufactured: Dials, Knobs

Local Sales Offices & Reps.

Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Arvada, Arrowhead Sls.	303-423-5556
Conn	North Haven, Comp Rep Assocs.	203-239-9762
Haw	Hanalei, TJR Sls. Co.	
Mass	Needham, Comp Rep Assocs.	617-444-2484
Mich	Grand Rapids, Montgomery Assocs.	616-774-9308
Mich	Southfield, Montgomery Assocs.	313-358-2616
Minn	Minneapolis, R.W. Marshall Co.	612-929-0457
NJ	Pitman, Colrud Co.	609-589-5866
Ohio	Dayton, J.C. Hofstetter Co.	513-298-0662
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Tex	Dallas, W. Reese Assocs.	214-638-6575
Tex	Houston, W. Reese Assocs.	713-621-3134
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Va	Lynchburg, Royelec	703-846-7117
Wash	Bellevue, SD-R2 Sls.	206-747-9424

ROGERS CORP., Rogers, Conn., 06263, Tel: 203-774-9605, TWX: 710-448-0047; Empl.: 1500

Products manufactured: Bars, Shorting, Bearings, Boards, Printed Circuit, Bus Bars & Systems, Cable, Circuits, Flexible, Circuits, Printed, Multilayer, Insulators & Insulation, Laminates, Materials, Self-Lubricating, Services, Assembly, Production & Test, Switchboards

Local Sales Offices & Reps.

Ariz	Phoenix, J. Opel	602-996-4850
Cal	Altadena, Space Engrg.	213-681-4421
Cal	Orange, F. R. Fahland	714-998-2580
Cal	Woodland Hills, A. W. Riel	213-347-7435
Colo	Littleton, G. B. Lange	303-798-1397
Conn	Essex, D. Dewey, Jr.	203-767-1118
Conn	Willimantic, G. D. Smith	203-774-9605
Fla	Jupiter, Cherry Assocs.	305-746-4591
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Ill	Hazel Crest, J. R. Menees	312-798-5800
Md	Simpsonville, R. J. Stout	301-997-9199
Mass	Waltham, DeVeer Sls. Engrg.	617-899-5900
Mich	Belleville, J. E. Ellward	313-645-0433
Mich	Bloomfield Hills, T. G. Erickson	313-645-0433
Mich	Onsted, B. Widegren	313-535-4926
Mich	Westland, J. Dyer	313-645-0433
Minn	Fridley, H. R. Crowder	612-560-1340
Mo	Hazelwood, Production Automation Corp.	314-731-2331
Mo	Raytown, Production Automation Corp.	816-737-0066
NJ	Mount Laurel, P. Taparauskas	609-235-4747
NY	Pittsford, P. R. Pratt	716-461-1167
NY	Roslyn, D. R. Dunay	516-621-8723
Ohio	Xenia, J. Link Forte	513-426-8993
Pa	Newtown Square, Hagy Assocs.	215-459-0504
Pa	Sharon, H. A. Harriman	412-347-3129
RI	Slatersville, D. A. Belden	617-332-1285
Tex	Richardson, Air-Quip Sales	214-234-3285
Va	Boones Mill, J. L. Settles	703-342-3120
Wash	Seattle, Arneson Assocs.	206-762-7664

ROGERS CORP., Box 700, Chandler, Ariz., 85224

RHODE & SCHWARZ SLS., 14 Gloria La., Fairfield, N.J., 07006, Tel: 201-575-0750, Telex: 133310; Empl.: 15

Products manufactured: Accelerometers, Amplifiers, Analyzers, Antennas, Attenuators, Bridges, Calibrators, Capacitors, Fixed, Carts & Dollies, Instrument & Equipment, CATV Systems & Equipment, Clocks (All Types), Coders, Comparators, Connector Adapters, Converters, Couplers, Data Acquisition & Reduction Systems, Decade Boxes, Delay Lines, Demodulators, Detectors, Direction Finders, Dividers, Dummy Loads, Filters, Generators, Indicators, Insertion Loss Measurement Systems, Line Strechers, Microwave, Meters, Mismatches, Microwave, Precision, Modulators, All Kinds, Monitors, Multipliers, Networks, Probes, Receivers, Recorders, Relays, Resistors, Slotted Lines, Microwave, Smith Chart Impedance Plotters, Automatic, Standards, Switches, Synchronizers, Klystron & BWO, Synthesizers, Tees, Terminals, Test Equipment, Testers, Transformers, Transmitters

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices SE	205-536-1969
Fla	Orlando, Scientific Devices SE	305-841-8180
Ind	Indianapolis, L.F. Green Assocs.	317-293-9827
Mass	Waltham, Scientific Devices NE	617-894-5637
NC	Burlington, Scientific Devices SE	919-222-6279
Ohio	Dayton, LI Corp.	513-434-6367
Pa	Abington, Bach-Stewart Assocs.	215-885-1550
Va	Bailey's Crossroads, Q. T. Elctrns. Sls. Inc.	703-671-4357
Wash	Belleview, Scientific Devices NW	206-454-0900

ROHN MFG., Div. Unarco Inds., Box 2000, Peoria, Ill., 61601, Tel: 309-697-4400, TWX: 910-652-0646; Empl.: 250

Products manufactured: Antenna Towers & Supports, Antennas, Benches, Consoles, Stools, Tables, Insulators & Insulation, Mounts, Tubing, Wire

Local Sales Offices & Reps.

Cal	Burlingame, Wm. J. Purdy Co.	415-347-7701
Cal	Woodland Hills, Chick Ryel & Co.	213-883-8118

Colo	Denver, R.G. Bowen Co.	303-722-4641
Fla	Coral Gables, Mart Haller	305-444-4617
Fla	Lakeland, Dixie Elctrn. Assoc.	813-682-6624
Iowa	Des Moines, B.E.A.M.S.	515-282-0292
Mass	N. Scituate, W.A. Hendrickson Co.	617-545-0652
Minn	Minneapolis, Jensen & Olsen Sls.	612-941-7181
NJ	Teaneck, S. Fisher Elctrn. Assoc.	201-837-1200
NM	Albuquerque, C.T. Carlberg & Assoc.	505-265-1579
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
NY	Tuckahoe, L-C-A Sls. Co.	914-961-4700
Ohio	St. Marys, T. Shelby & Co.	419-394-3377
Tex	Dallas, B. Townsend	214-241-6703
Wash	Seattle, DMS/Vantage	206-784-6800

ROL-A-CHART DIV., Wm. A. Steward Co., Box 367, Diamond Springs, Cal., 95619, Tel: 916-622-2437; Empl.: 8

Customer service: A. Steward

Free literature available: Guide to visual control magnet catalolg

Products manufactured: Magnets

ROLM CORP., 18922 Forge Dr., Cupertino, Cal., 95014, Tel: 408-257-6440, TWX: 910-338-0247; Empl.: 126

Products manufactured: Cards, Logic, Comm. Systems, Computers, Converters, Memory Systems

Local Sales Offices & Reps.

Cal	La Habra, Rolm Corp.	213-784-8500
Cal	Palo Alto, Rolm Corp.	415-965-2224
Colo	Denver, Thorson Co.	303-355-3521
DC	Washington, Rolm Corp.	703-893-2696
Kans	Shawnee Mission, EIR Co.	913-362-0919
Mass	Boston, Rolm Corp.	617-237-5752
Mo	Hazelwood, EIR Co.	314-895-4100
NY	New York, Rolm Corp.	914-297-9533
Ohio	Dayton, Rolm Corp.	513-874-5406
Tex	Dallas, Rolm Corp.	214-661-8905
Va	McLean, Rolm Corp.	703-893-2696
Wash	Seattle, Showalter-Judd, Inc.	206-762-2310

ROMARNETICS, INC., 18728 Bryant St., Northridge, Cal., 91324, Tel: 213-886-1812; Empl.: 15 .... p. 2•1785

Customer service: R. Easton

Free literature available: Catalog of our Printed Circuit Type Power Transformers, Standard Line.

Products manufactured: Transformers

RONOR SYSTEMS, 321 Sandbank Rd., Cheshire, Conn., 06410, Tel: 203-272-6847; Empl.: 12

Customer service: N. D. Ostrowski

Products manufactured: Cable Assemblies & Harnesses, Connectors, Services, Assembly, Production & Test

ROSEMOUNT INC., Box 35129, Minneapolis, Minn., 55435, Tel: 612-941-5560; Empl.: 1200

Products manufactured: Alarms, Baths, Controlled Temperature (Air & Liquid), Controls/Control Eqpt., Gages, Indicators, Monitors, Process Control Systems, Standards, Suppressors, Thermometers, Resistance, Transducers, Transmitters

Local Sales Offices & Reps.

Cal	Bellflower, Rosemount Inc.	213-866-8224
Cal	Chatsworth, Rosemount Inc.	213-341-3944
Cal	San Diego, Rosemount Inc.	714-565-9133
Cal	San Jose, Rosemount Inc.	408-269-7550
Colo	Boulder, Rosemount Inc.	303-447-9231
Ga	Atlanta, Rosemount Inc.	404-256-4806
Ill	Chicago, Rosemount Inc.	312-963-0750
La	Baton Rouge, Rosemount Inc.	504-926-8916
Mass	Boston, Rosemount Inc.	617-861-0750
Mich	Detroit, Rosemount Inc.	313-626-0900
Minn	Minneapolis, Arjay Sls. Inc.	612-925-1833
Mo	St. Louis, Rosemount Inc.	314-731-6881
NJ	Englewood, Rosemount Inc.	201-568-6366
NC	Charlotte, Rosemount Inc.	704-333-1271
Ohio	Cleveland, Rosemount Inc.	216-777-3961
Ohio	Dayton, Rosemount Inc.	513-433-6383
Pa	Philadelphia, Rosemount Inc.	215-353-3344
Tex	Dallas, Rosemount Inc.	817-267-3514
Tex	Houston, Rosemount Inc.	713-664-8891
Va	Richmond, Rosemount Inc.	804-285-3424
Wash	Seattle, Rosemount Inc.	206-747-4900

ROSS CONTROLS CORP., 381 Elliot St., Newton, Mass., 02164, Tel: 617-891-9600; Empl.: 6

Products manufactured: Recorders, Tape Recording Accessories

Local Sales Offices & Reps.

Cal	Corona Del Mar, Williams Assoc.	714-675-8161
Cal	Sunnyvale, Pacific Entprs.	408-245-3517

ROSS ENGINEERING CORP., 559 Westchester Dr., Campbell, Cal., 95008, Tel: 408-377-4621; FSC No: 23598; Empl.: 27 .... p. 1•1806,1807

Customer service: H. C. Ross

Free literature available: Brochures on High Voltage: Devices, relays, switches contactors, digital multimeters, dividers, voltmeter, probes, solenoid, drivers, spark gaps, toroids, spheres & corona shields, safety accessories, resistors & capacitors, etc.

Products manufactured: Antenna Switching Matrices, Arresters, Electrical Surge, Lightning, Calibrators, Capacitors, Fixed, Chargers, Battery, Circuit Breakers, Detectors, Dividers, Drivers, Solenoid, Meters, Multipliers, Power Supplies, Probes, Protectors, Relays, Resistors, Services, Assembly, Production & Test, Spark Gaps, Switches, Testers

Local Sales Offices & Reps.

Cal	Mt. View, ENCOM	415-969-0330
Cal	San Diego, ENCOM	714-299-0993
Mich	Dearborn, D. Seyfried Co.	313-274-4900
Mo	St. Louis, G. DuBois Co.	314-961-0632
NJ	Haddonfield, M & S Assocs.	609-429-7055
NY	Cazenovia, P. DeCew Agency	315-655-8602
ND	Fargo, Dakota Elec. Supply	701-327-9440
Ohio	Cleveland, K.R. Dodge Co.	216-461-6482
Pa	Philadelphia, M & S Assocs.	215-229-7575
EXP:	N.Y., New York, Ardry Trading Co.	212-582-5058
FOR:	Can., Toronto, Ontario, Electro Design Ltd.	416-787-0991
FOR:	Can., Ville La Salle, Ore., Electro Design, Ltd.	514-363-5120

ROSTONE CORP., 2781 S. Concord Rd., Lafayette, Ind., 47902, Tel: 317-474-2421; Empl.: 600

For info on price: T. E. Deller; Application info: T. E. Deller; Customer service: T. E. Deller; Delivery info: F. L. Cason

Free literature available: ROSITE material data sheets and 8 page brochure explains services, facilities, and capabilities of Rostone Corporation's custom molding, compounding, and engineering operation.

Products manufactured: Insulators & Insulation, Services, Assembly, Production & Test

ROTATING COMPONENTS DIV., Aeroflex Labs. Inc., South Service Rd., Plainview, N.Y., 11803, Tel: 516-694-6700, TWX: 510-224-6417; Empl.: 50 .... p. 1•979

Free literature available: I. MIL SPEC Fans. 2. MIL SPEC Blowers 3. AC Synchronous Motors 4. Tachometer Generators Part Nos. Tech Data, Dimensions and How to Order for above.

Products manufactured: Blowers & Fans & Accessories, Motor & Generator Armatures, Rotors, Stators, Motors, Tachometers

Local Sales Offices & Reps.

Cal	Aptos, Allen & Sweeney Assoc.	408-688-7114
Cal	Torrance, Allen & Sweeney Assoc.	213-373-3318
Conn	Thomaston, Tygren Co.	203-264-6880
Ill	Lombard, Quadtron Assocs.	312-627-6800
Kans	Wichita, D & O Engrg Co.	316-264-7358
Md	Lutherville, P. Knox & Co.	301-252-1288
Mass	Stoneham, K & D Assoc.	617-438-3121
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	St. Paul, Vikeland Sls.	612-645-4647
Ohio	Fairborne, Tech. Assoc.	513-878-2484
Pa	Jenkintown, Stein Instrumentation	215-885-2370
Tex	Houston, AID Elctrns.	713-777-3882
Tex	Irving, AID Elctrns.	214-259-4761
Wash	Seattle, G. M. Gillett & Assoc.	206-284-3344
EXP:	New York City, New York, Frathom Co.	212-687-9390

ROTRON, INC., Hasbrouck La., Woodstock, N.Y., 12498, Tel: 914-679-2401, TWX: 510-247-9033; Empl.: 950 .... p. 1•516-524

Customer service: T. McCanna

Free literature available: Quick reference catalog-brief description of performance, demensions, materials of complete product line.

Products manufactured: Blowers & Fans & Accessories, Heat Exchangers & Systems, Inverters, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn	602-258-7893
Cal	Burbank, Rotron/Pacific	213-849-7871
Cal	Mt. View, Nor-Cal Assocs.	415-961-8121
Colo	Denver, F. Gossard Associates	303-985-0602
Fla	Orlando, G. Bohman	305-855-0274
Ga	Atlanta, Electro-Mech Engrg. Sls.	404-393-0444
Haw	Honolulu, R. Clark	808-531-5897
Ill	Chicago, Mid West Elctrn. Sls.	312-777-9700
Ind	Indianapolis, MidWest Elctrn. Sls.	317-926-3736
Iowa	Cedar Rapids, Midwest Elctrn. Sls.	319-393-1845
Kans	, CenTech Inc.	816-358-8100
Mass	Lexington, Circuit Sls.	617-861-0567
Mich	Farmington, W.R. Hummon & Assoc.	313-474-0661
Minn	Mpls, E.C. Elctrn. Sls.	612-831-0229
Mo	Hazelwood, CenTech, Inc.	314-838-6446
NJ	Springfield, F. Sylvester	201-376-3324
NM	Albuquerque, Shefler-Kahn	505-265-7077
NY	Woodstock, Rotron Inc.	914-OR 9-2401
NC	Charlotte, Over & Over	704-527-3070
Ohio	Cincinnati, F. J. Campisano	513-662-1616
Ohio	Cleveland, Comp., Inc.	216-842-2737
Okla	Okla Cy, Ammon & Rizos	405-373-2748
Pa	Ardmore, B. R. Roome	215-649-4101
Tenn	Nashville, Electro-Mech Engrg. Sls.	615-883-1490
Tex	Dallas, Ammon & Rizos	214-233-5591
Tex	Houston, Ammon & Rizos	713-781-6240
Wash	Seattle, Blum & Assocs.	206-285-2590
EXP:	N.Y., NY, A. Auriema	212-466-2500
FOR:	Can., Hamilton, Ont., Cartwright Southall Assoc.	416-528-0294
FOR:	Can., Montreal, Que., McIntyre Agencies	514-731-9617

Local Distributors

Ala	Huntsville, Cramer/Ew Huntsville, 2310 Bob Wallace Ave., S.W.	205-539-5722
Ala	Huntsville, Hall-Mark Elctrns., 4739 Commonwealth Ave.	205-837-8700
Ariz	Phoenix, Cramer/Arizona, 2816 No. 16th St.	602-263-1112
Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	602-273-7331
Ariz	Phoenix, R.V. Weatherford, 1917 North 25th Dr.	602-272-7144
Cal	Anaheim, R.V. Weatherford, 1550 Babbit	714-547-0891
Cal	Glendale, R.V. Weatherford, 6921 San Fernando Rd.	213-849-3451
Cal	Irvine, Cramer/Los Angeles, 17201 Daimler St.	213-771-8300
Cal	Los Angeles, Kierulff Elctrns., 2585 Commerce Way	213-685-5511
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	Palo Alto, R.V. Weatherford, 3240 Hillview Ave.	415-321-5373
Cal	Pomona, R.V. Weatherford, 1095 E. Third St.	714-623-1261
Cal	San Diego, Cramer/San Diego, 8975 Complex Dr.	714-565-1881
Cal	San Diego, Kierulff Elctrns., 8797 Balboa Blvd.	714-278-2112
Cal	San Diego, R.V. Weatherford, 7842 Raytheon Rd.	714-278-7400
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Colo	Denver, Cramer/Denver, 5465 E. Evans Pl.	303-758-2100
Colo	Denver, Kierulff Elctrns., 10980 E. 47th Ave.	303-343-7090
Colo	Englewood, R.V. Weatherford, 3905 So. Mariposa	303-761-5432
Conn	North Haven, Cramer/Connecticut, 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/Ew Hollywood, 4035 No. 29th Ave.	305-923-8181
Fla	Orlando, Cramer/Ew Orlando, 345 N. Graham Ave.	305-894-1511
Fla	Orlando, Hall-Mark Elctrns.; 7233 Lake Ellenor Dr.	305-855-4020
Ga	Atlanta, Cramer/Ew Atlanta, 3923 Oakcliff Industrial Ct.	404-448-9050
Ill	Mt. Prospect, Cramer/Chicago, 1911 So. Busse Rd.	312-593-8230
Kans	Lenexa, Hall-Mark Elctrns., 9006 Rose Hill Rd.	913-888-4747
Md	Gaithersburg, Cramer/Ew Washington, 16021 Industrial Dr.	301-948-0110
Md	Gaithersburg, Kierulff Elctrns., 16021 Industrial Dr.	301-948-0250
Md	Hanover, Cramer/Ew Baltimore, 7255 Standard Dr.	301-796-5790
Mass	Needham Heights, Kierulff Elctrns., 14 Charles St.	617-449-3600
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Farmington, Harvey-Michigan, 23461 Industrial Park Dr.	313-477-1650

Mich	Livonia, Cramer/Detroit, 13193 Wayne Rd.	313-425-7000
Minn	Edina, Cramer/Minnesota, 7275 Bush Lake Rd.	612-835-7811
Mo	Earth City, Hall-Mark Elctrns., 13789 Rider Trail	314-291-5350
For:	Can., Willowdale, Ont. M2H3B3, Electro Sonic Industrial Sales, 1110 Gordon Baker Rd.	416-494-1660
NJ	Cherry Hill, Cramer/Pennsylvania, Cherry Hill Ind'l. Site, Springdale Rd.	609-424-5993
NJ	Cherry Hill, Cramer/Pennsylvania, Springdale Rd., Cherry Hill Ind'l. Site	609-424-5993
NJ	Moonachie, Cramer/New Jersey, 1 Barrett Rd.	201-935-5600
NJ	Pennsauken, Resco Elctrns., Airport Ind'l. Pk., Airport & Central Highways	609-662-4000
NJ	Rutherford, Kierulff Elctrns., Industrial Dr.	201-935-2120
NJ	Saddlebrook, Arrow Elctrns., 285 Midland Ave.	201-797-5800
NM	Alberquerque, Cramer/New Mexico, 137 Vermont N.E.	505-265-5767
NM	Alberquerque, R.V. Weatherford, 6101 Marble, N.E.	505-265-5671
NY	East Syracuse, Cramer/Syracuse, 6716 Joy Rd.	315-437-6671
NY	Endwell, Cramer/Binghamton, 322 Watson Blvd.	607-754-6661
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Hauppauge, Cramer/Long Island, 29 Oser Ave.	516-231-5600
NY	Hicksville, Kierulff Elctrns., 49 Bethpage Rd.	516-433-5530
NY	Rochester, Cramer/Rochester, 3000 Winton Rd. South	716-275-0300
NC	Raleigh, Hall-Mark Elctrns., 3000 Industrial Dr.	919-832-4465
NC	Winston-Salem, Cramer/Ew Winston-Salem, 938 Burke St.	919-725-8711
Ohio	Cincinnati, Cramer/Tri-State, 666 Redna Ter.	513-771-6441
Ohio	Cleveland, Cramer/Cleveland, 5835 Harper Rd.	216-248-8400
Okla	Tulsa, Hall-Mark Elctrns., 7489 E. 46th Pl. So. Box 45	918-835-8458
Tex	Dallas, Cramer/Dallas, 13740 Midway Rd.	214-350-1355
Tex	Dallas, Hall-Mark Elctrns., 9333 Forrest La.	214-231-6111
Tex	Dallas, R.V. Weatherford, 10836 Grisson La.	214-243-1571
Tex	Houston, Hall-Mark Elctrns., 8000 Westglen	713-781-6100
Tex	Houston, R.V. Weatherford, 3500 West T.C. Jester Blvd.	713-688-7406
Utah	Salt Lake City, Cramer/Utah, 391 W. 2500 S.	801-487-3681
Wash	Seattle, Cramer/Seattle, 5602 6th Ave. S.	206-762-5755
Wash	Seattle, Kierulff Elctrns., 5940 Sixth Ave. So.	206-763-1593
Wash	Seattle, R.V. Weatherford, 541 Industry Dr.	206-762-4200
Wisc	Oak Creek, Cramer/Wisconsin, 430 W. Rawson Ave.	414-764-1700
For:	Can., Montreal 357, P.Q., Prelco Elctrns., Ltd., 480 Port Royal St., W.	514-389-8051
For:	Can., Montreal, Que., Payette Radio, 730 St. James West	514-866-6681
For:	Can., Scarborough MIR3C 3C8, Carsten Elctrns. Ltd., Unit 5-25 Howden Rd.	416-751-5002
For:	Can., Vancouver 10, B.C., L.A. Varah, 2077 Alberta St.	604-873-3211

ROWE INDUSTRIES, INC., 6225 Benore Rd., Toledo, Ohio, 43612, Tel: 419-729-9761, TWX: 810-442-1734; Empl.: 100; Minimum order: $25 p. 2•796-798,2052-2054

For info on price: K. Robinson; Application info: D. C. Richard; Customer service: D. L. Mang; Delivery info: J. Netry

Products manufactured: Antennas, Braid, Cable, Bus Bars & Systems, Cable Assemblies & Harnesses, Cable, Caps, Connector, Chamber, Environmental Test, Chargers, Battery, Circuits, Flexible, Clamps & Clips, Coils Including Assemblies & Forms, Conduit, Electrical, Connector Adapters, Connector Blocks, Mother Board, Connector Boxes & Strips, Power Outlet, Connectors, Contacts, Electrical, Cords, Couplers, Detectors, Electrodes, High-Voltage, Feedthrus & Seals, Environmental, Gaskets, Shielding, R-F-Also See Shields, R-F, Isolators, Jack Adapters (All Types), Jacks (All Types), Kits, Connector, Lead Assemblies & Receptacles, Leads, Test & Adaptors, Plug Adapters, Plug & Jack Sets, Plug Caps & Shells, Plugs, Probes, Services, Assembly, Production & Test, Shields, Socket Adapters, Sockets, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Tees, Terminals, Test Equipment, Wire, Wire & Cable Ties, Wire Shielding

Local Sales Offices & Reps.

Ala	Huntsville, Rowe Enterprize	205-837-3643
Ariz	Scottsdale, Biedler & Assocs.	602-275-5505
Cal	Newbury Park, Val C. Robinson	805-529-1331
Cal	San Carlos, Westronics	415-592-1417
Cal	Thousand Oaks, V. C. Robinson	805-529-1331
Colo	Arvada, Winn & Assocs.	303-421-9466
Fla	North Palm Beach, E. Furey & Assocs.	305-848-2037
Ill	Greenville, Tri "J" Power, Inc.	618-664-1698
Ill	Riverside, Mannella & Assocs.	312-447-7724
Md	Baltimore, R.A. Wafer Assocs.	301-744-1133
Mass	Shrewsbury, Ashworth & Cullen, Inc.	617-844-9688
Mo	St. Louis, Repco, Inc.	314-343-9313
NY	Binghamton, Canavan-Scanlon Assocs.	607-724-7220
NY	Rochester, Canavan-Scanlon Assocs.	716-442-0720
NY	Syracuse, Canavan-Scanlon Assocs.	315-437-1271
NC	Charlotte, Dula Assocs.	704-334-7090
NC	Winston-Salem, Dula Assocs.	919-768-7166
Ohio	Beachwood, Richardson-Champ Assocs.	216-292-4954
Ohio	Cincinnati, Com-Tek	513-793-3611
Pa	Plymouth Meeting, R. Mar Co.	215-825-2841
Tex	Dallas, United Comps.	214-324-1448
Wash	Seattle, Underwood & Underwood	206-243-2133
FOR:	Can., Oakville, Ont., Haltronics, Ltd.	416-844-2121

ROYCE ELECTRONICS CORP., 1142 Clay St., No. Kansas City, Mo., 64116, Tel: 816-842-0252

Customer service: A. Rudsell; Delivery info: P. Kennedy

Products manufactured: Antennas, Batteries, Comm. Systems, Power Supplies, Speakers

Local Sales Offices & Reps.

Cal	Los Angeles, Cavanah & Fier	213-483-9760
Cal	San Francisco, ARWC	415-653-3838
Colo	Denver, Ron Bowen & Assoc.	303-744-2501
Del	Chesnut Hills, Divincent & Legato	302-731-1475
Fla	Pembroke Pines, Joe Wanger Sls. Co.	305-987-8766
Ga	Atlanta, Ross & Assoc.	404-548-5568
Ill	Chicago, CEMS	312-685-9500
Ind	Indianapolis, Lyons & Assoc.	317-352-0475
Mich	Detroit, Rod Butchart & Assoc.	313-773-7870
Minn	Minneapolis, Terry Ripley & Assoc.	612-881-8282
Mo	Kansas City, Vern Kingkade & Assoc.	816-474-5230
Neb	Elkhorn, Vern Kingkade & Assoc.	402-289-2909
NJ	Moorestown, Divincent & Legato Assoc.	609-235-8299
NM	Albuquerque, C.T. Carlsburg & Assoc.	505-265-1579
NY	N.Y.C., Fisher Sls.	201-837-1200
Ohio	Akron, D.F.H.	614-876-7823
Ore	Oak Grove, J.B. Sls. Co.	503-654-8617
Pa	Pittsburgh, F.P. Yarrusi	412-221-4676
Tex	Houston, Buck Rodgers & Assoc.	713-626-5370
Utah	Salt Lake, Rasmussen & Cavanah	801-467-6615

RSM SENSITRON SEMICONDUCTOR, DIV. RSM ELECTRON POWER, INC., 221 W. Industry Ct., Deer Park, N.Y., 11729, Tel: 516-586-7600; Empl.: 180; Minimum order: $100 p. 1•1852-1855

For info on price: M. M. Dietz; Application info: C. Fischer; Customer service: M. Leischner; Delivery info: M. M. Dietz

Products manufactured: Bridges, Diodes, Rectifiers, Transistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Deangelo Rothman Cheever Co.	602-948-2240
Cal	Culver City, DeAngelo, Rothman Co.	213-398-6239
Cal	Lafayette, Phillips Assocs.	415-284-2579
Fla	Casseleberry, EIR Inc.	305-830-9600
Ill	Chicago, Brock & Cushman Inc.	312-622-4110
Ind	Carmel, Rich Elctrn. Mktg.	317-844-8462
Md	Baltimore, Stemler Assocs.	301-944-8262
Mass	Waltham, Datcom Inc.	617-891-4600
Minn	Minneapolis, S & RSls.	612-544-3022
NM	Albuquerque, A.Q. Elctrns.	505-255-8701
NY	Burnt Hills, K. Corsetti Sls.	518-399-9200
NY	Hempstead, Kahgan Sls.	516-538-2300
Ohio	Dayton, Buckeye Comps.	513-278-4279
Tex	El Paso, A.G. Elctrns.	915-545-2363
Wash	Tukwila, General Elctrns.	206-243-5141
EXP:	Can., Montreal, Que., Elpro Elctrns. Ltd.	514-389-8051
FOR:	Can., Mississauga, Ont., Elpro Elctrns. Ltd.	416-678-0401
FOR:	Can., Ottowa, Ont.	
FOR:	Can., Ottowa, Ont., Elpro Elctrns. Ltd.	

Local Distributors

Ariz	Ariz, Sterling Elctrns., Box 20867	602-258-4531
Ariz	Scottsdale, Vanguard Supply, 10333 N. Scottsdale Rd.	602-948-2240
Cal	Gardena, Bell Inds., 306 E. Alondra	213-321-5802
Cal	Sepulveda, Milgray Elctrns., 8718 Woodley Ave.	213-894-4011
Cal	Sunnyvale, Bell Inds., 1161 North Fairoaks Ave.	408-734-8570
Cal	Sunnyvale, Intermark Elctrns., 1020 Stewart Dr.	408-738-1111
Cal	Sunnyvale, Westland Elctrns., 1118 Elko Dr.	408-734-1900
Cal	Woodland Hills, Semiconductor Concepts, 21201 Oxnard St.	213-884-4560
Fla	Miami, All American Transistor, 120 N.E. 79th St.	305-754-5531
Fla	Pompano Beach, Zeus Comps., 1470 S.W. 12th Ave.	305-942-4312
Md	Baltimore, Technico Inc., 1404 Bare Hills Ave.	301-828-6416
Mass	Burlington, Zeus Comps., 32 Winn St.	617-273-0750
Mass	Framingham, Future Elctrns., 225 Worcester Rd.	800-225-0380
Mass	Natick, Lafayette Industrial Elctrns., 1400 Worcester	617-879-6300
Mich	Farmington, Diplomatic Northland Elctrns., 32708 W. Eight Mile Rd.	313-477-3200
Minn	Minneapolis, Diplomat/Electro Com Corp., 3816 Chandler Drive	612-788-8601
NM	Albuquerque, Sterling Elctrns., 3530 Pan American Fwy. N.E.	505-345-6601
NY	Buffalo, Summit Distrs., 96 Main St.	716-884-3450
NY	Elmsford, Zeus Comps., 175 Clearbrook Co.	914-592-4120
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Forest Hills, Nasco, 9908 Metropolitan Ave.	212-793-6500
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Semiconductor Concepts, Engineers Rd.	516-273-1234
NY	Hauppauge, Time Elctrns., 70 Marcus Blvd.	516-273-0100
NY	New Hyde Park, Lafayette Ind'l. Elctrns., 1327 - 2nd Ave.	516-488-6600
NY	Plainview, A.C.I. Elctrns. Corp., 28 South Mall	516-293-6630
NY	Rochester, Summit Distrs., 292 Commerce Dr.	716-334-8110
Ohio	Dayton, Esco, Inc., 221 Crane st.	513-226-1133
Ore	Eugene, United Radio Supply, 974 W. Sixth Ave.	503-342-3381
Ore	Portland, United Radio Supply, 123 N.E. Seventh Ave.	503-233-7151
Pa	Philadelphia, Almo Elctrns., Roosevelt Blvd. & Blue Grass Rd.	215-676-6000
Tex	Dallas, Component Specialties, 2560 Electronic La.	214-357-4576
Tex	Houston, Component Specialties, 7315 Ashcroft	713-771-7237
Tex	Houston, Sterling Elctrns., Box 1229	
Wash	Seattle, Radar Elec., 168 Western Ave. W.	206-282-2511
Wash	Seattle, Zepher Elctrns., 647 Industry Ave.	206-242-2517

RTRON CORP., 7324 Lawndale, Skokie, Ill., 60076, Tel: 312-679-7180; FSC No: 19130; Minimum order: $25

Customer service: N. Williams

Free literature available: Catalogs on RFI Filters, U.L. Recognized for Data Processing, and MIL Spec. Types.

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Filters, Networks, Suppressors

Local Sales Offices & Reps.

Cal	Costa Mesa, Component Sls.	714-557-3040
Cal	Los Altos, Horne Assoc.	415-948-0788
Cal	San Diego, SR Elctrns.	714-565-8411
Fla	Lighthouse Point, Saber Assoc.	305-943-3076
Ill	Chicago, Rinaldi Inc.	312-763-4848
Mass	Dover, Charles Ferris Co.	617-785-1771
Minn	St. Paul, Cahill Assoc.	612-739-8445
NJ	Plainfield, S. Glassman Assoc.	201-561-3866
NY	E. Rochester, Douglas Taylor	716-385-1630
NY	Glen Cove, S. Glassman Assoc.	516-676-1039
Ohio	Cleveland, Component/Insulation Corp.	216-521-3570
Pa	Jenkintown, Arnold Assoc.	215-PI 2-0600
Tex	Garland, Whiteside Sls.	214-231-9771
Va	Annandale, J. Hopkins Assoc.	703-323-1641

RUSSCO ELECTRONICS MFG. INC., 1070 Brookhaven Dr., Clovis, Cal., 93612, Tel: 209-299-2167

For info on price: S. Watts; Application info: R. Friend; Customer service: S. Watts; Delivery info: R. Najarian or Russ Friend

Free literature available: Studio Pro or Cuemaste Broadcast Turntables Model 505 Monaural Console Model 505-S Stereo Console Model MM-260 - Stereo 60 Watt Amplifier Model MA-225 - Stereo 25 Watt Amplifier

Products manufactured: Amplifiers, Mixers, Phonographs, Parts & Accessories, Speaker Systems

RUSSELL INDS., INC., 96 Station Plaza, Lynbrook, N.Y., 11563, Tel: 516-887-9000

Products manufactured: Foil, Kits, Shielding, Shields, Tapes, Electrical Insulation

RUSTRAK INSTR. DIV., See Gulton Inds., M.C.S. Div.

RUTHERFORD RESEARCH PRODS. CO., Box 162, Rutherford, N.J., 07070, Tel: 201-933-2091; Empl.: 25

Customer service: Dr. A. Blanck

Free literature available: Catalogs: Technology of Rutherford Research Plastics & Electrical Insulation Failure Analysis – Product Evaluation – Redesign.

Products manufactured: Bridges, Calibrators, Capacitors, Fixed, Coils Including Assemblies & Forms, Meters, Probes, Services, Assembly, Production & Test, Testers, Wire Twisters

RYCOM INSTRUMENTS, 9351 E. 59th St., Raytown, Mo., 64133, Tel: 816-353-2100; FSC No: 14410; Empl.: 40; Minimum order: $10

For info on price: H. Aggeler; Application info: R. Cooper; Customer service: G. Craven; Delivery info: K. Boone

Free literature available: Complete product line of test instruments for telephone, power, utilities and communications users, carrier (FDM) "T"-carrier, transmission and line analyzers, cable fault locators.

Products manufactured: Analyzers, Cable Fault Locators, Counters, Meters, Testers, Totalizers, Digital, Transmission Systems, Data

Local Sales Offices & Reps.

Cal	Oakland, Dolphin Engrg.	415-451-8262
Cal	Santa Fe Sprgs., Kennedy Engrg.	213-868-9965
Colo	Lakewood, Claredon	303-238-4462
DC	Washington, Instrucom	202-223-1759
Fla	St. Petersburg, Souder (Comtech)	813-527-3281
Ill	Chicago, Kay Sls.	312-397-1200
Mo	Cameron, Comm Sys. Assoc.	816-632-7616
Tex	Richardson, Horizon Engr.	214-238-9121
Wash	Seattle, Reeves Supply	206-789-1234

RYE INDS., INC., 125 Spencer Pl., Mamaroneck, N.Y., 10543, Tel: 914-698-0080; Empl.: 50

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cable, Caps, Connector, Clamps & Clips, Connector Adapters, Connectors, Cords, Couplers, Handsets, Chestsets, Headphones, Headsets, Etc., Jack Adapters (All Types), Jacks (All Types), Microphones, All Kinds, Pickups, Telephone (For Recording), Plug Adapters, Plug & Jack Sets, Plug Caps & Shells, Plugs, Posts, Probes, Services, Assembly, Production & Test, Socket Adapters, Sockets, Switches, Tape Recording Accessories, Tapes, Electrical Insulation, Transducers, Transformers, Tubing, Wire

Local Sales Offices & Reps.

Cal	Los Angeles, Marshank	213-938-2591
Colo	Colorado Springs, Norris	303-685-9319
Ga	Marietta, Clymer Entprs.	404-971-2831
Haw	Honolulu, Av-Tronic Sls.	
Ill	Chicago, W.J. Doyle	
Kans	Overland Pk., Penzner	913-DU 1-0004
Mass	Cohasset, Montague	617-383-0634
Ore	Portland, Van Voorhees	503-287-6633
Pa	Havertown, J. Mustico	215-HI 6-1961
Tex	Addison, Campion Sls.	214-239-9196

S & A ELECTRONICS, Div. Scott & Fetzer Co., 202 W. Florence, Toledo, Ohio, 43605, Tel: 419-693-0528; Empl.: 100

For info on price: M. Gregg; Application info: M. Gregg; Customer service: M. Gregg; Delivery info: Order Desk

Free literature available: General Line Catalogue on request.

Products manufactured: Antenna Towers & Supports, Antennas, Arresters, Electrical Surge, Lightning, Couplers, Insulators & Insulation, Transformers

S & EI MFG., Box 832, Northridge, Cal., 91324, Tel: 213-349-4111, TWX: 910-493-1252; Empl.: 85

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Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Phoenix, MR Engrg. Sls. Co.	602-959-5150
Cal	San Diego, Circolia Elctrn. Sls.	714-747-3015
Ill	Chicago, Ropek-Cahill Inc.	312-287-7292
Mass	Needham, Hatch Assocs.	617-444-3310
Minn	Minneapolis, Technical Assocs.	612-929-6721
NJ	Cherry Hill, Danco Corp.	609-627-2218
NY	Hempstead, Kahgan Sls.	516-538-2300
Ohio	Dayton, Berberich & Assocs.	513-252-9981
FOR:	Can., Montreal, Que., Speciality Elctrns. Ltd.	514-336-4500

SAFEWAY PRODUCTS, 440 Middlefield St., Middlefield, Conn., 06455, Tel: 203-346-6601; Empl.: 130

For info on price: C. M. Slade; Application info: C. M. Slade; Customer service: H. Groepper; Delivery info: C. M. Slade

Free literature available: "SAFEWAY HEAT ELEMENTS"-16 page illustrated brochure provides guidelines for designing heat elements into your OEM product; reference data on materials available and their thermal conductivity. "ETCHED FOIL ELEMENTS"-8 page illustrated brochure describes resistive and conductive circuitry, examples, design considerations, and engineering data and specifications.

Products manufactured: Heaters & Heating Elements

SAFT AMERICA INC., 212 Durham Ave., Metuchen, N.J., 08840, Tel: 201-548-2800, TWX: 710-998-0528; Empl.: 270; Minimum order: $100

For info on price: P. L. Mendelsohn; Application info: C. E. Hopper; Customer service: S. Greco; Delivery info: S. Greco

Free literature available: Brochure "Sealed Rechargeable Nickel-Cadmium Cells VR Series" - Describes the sealed cylindrical type cells including performance and standard battery assembly manufactured by SAFT.

Products manufactured: Batteries

Local Sales Offices & Reps.

Cal	Torrance, T. Pierce	213-378-3623
Tex	Fort Worth, J. B. Schusler	817-237-4620

SAMARIUS, INC., 300 Seymour Ave., Derby, Conn., 06418, Tel: 203-735-7405, TWX: 710-451-2495; FSC No: 5905; Empl.: 50

Customer service: R. C. Heitz

Products manufactured: Potentiometers, Resistors

Local Sales Offices & Reps.

Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700
Md	Silver Spring, Globe	301-587-0060
Mo	St. Louis, Boweng	314-429-7327
Pa	Media, W. Reeves	215-566-6709

SAMS, HOWARD W. & CO., 4300 W. 62nd. St., Indianapolis, Ind., 46268, Tel: 317-291-3100

Products manufactured: Technical Books

Local Sales Offices & Reps.

Cal	Burlingame, Elvey-Proctor Co.	415-347-2994
Cal	Gardena, Bidwell Sls. Assocs.	213-770-0300
Colo	Denver, Bowen & Assocs.	303-744-2501
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	404-237-2273
Ga	Atlanta, Cartwright & Bean	404-237-2273
Ill	Chicago, B. Burns & Assocs.	312-775-1233
Ind	Indianapolis, R. Milsk Co.	317-546-5468
Kans	Overland Park, T. L. Dowell & Assocs.	913-649-6069
La	Chalamette, Cartwright & Bean	504-279-4598
Md	Silver Springs, Lowery Assocs.	301-439-3542
Mass	Needham, Mullin Techn. Sls.	617-444-4780
Mich	Southfield, R. Milsk Co.	313-354-3310
Minn	Minneapolis, D. Borrett & Co.	612-929-0028
Miss	Jackson, Cartwright & Bean	601-981-1368
Mo	St. Louis, Kathrinus, Kelly, & Co.	314-968-3800
NJ	South Orange, S. Simberkoff Assoc.	201-763-7900
NM	Albuquerque, C.T. Carlberg & Assoc.	505-265-1579
NY	Lockport, Simberkoff Sls., Inc.	716-434-4426
NC	Charlotte, Cartwright & Bean	704-537-7965
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Columbus, C. L. Pugh Co.	614-486-9678
Ore	Portland, J.V. Belusko Co.	503-222-4279
Pa	Broomall, Lowery Assocs.	215-528-5170
Pa	Harrisburg, Lowery Assocs.	717-233-0917
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, Lund & Co.	214-358-4335

SAN FERNANDO ELEC. MFG., 1501 1st St., San Fernando, Cal., 91341, Tel: 213-365-9411, TWX: 910-496-1535; Empl.: 1000; Minimum order: $25

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Filters

Local Sales Offices & Reps.

Ariz	Tucson, West-Cap Arizona	602-294-2646
Cal	Sunnyvale, Ruby Sales Co. II	408-739-5333
Conn	Stratford, G. Rosen Co.	203-375-5456
Fla	Clearwater, Perrott Assocs.	813-531-7483
Fla	Orlando, Perrott Assocs.	305-275-1132
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Md	Glen Burnie, Micro-Comp	301-761-4600
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Orchard Lake, Ellinger Sls. Corp.	313-626-1170
Minn	St. Paul, Smith Engrg. Assoc.	612-646-4851
NJ	Haddenfield, TAI Assocs.	609-854-3011
NY	Chester, San Fernando Elec. Mfg.	914-469-9620
Tex	Dallas, San Fernando Elec. Mfg.	214-521-3662
Wash	Seattle, Blair Hirsh Co.	206-783-3423
FOR:	Can., Toronto, Ont., Karl Atkinson - San Fernando Elec. Mfg.	416-364-3644

SANDERS ASSOCS. INC., Corp. Hdqts., Daniel Webster Hwy., Nashua, NH, 03060, Tel: 603-885-4321

SANDERS ASSOCIATES, Defensive Systems Div., 95 Chanel St., Nashua, N.H., 03060, Tel: 603-885-3010

Customer service: P. F. Murphy

Free literature available: Sanders manufacturers LEAD SULFIDE (PbS) and SILICON (Si) photoconductive DETECTORS for optical radiation from the infrared to visible to ultraviolet region. These detectors are tailored to the customers specifications, including MIL specs.Sanders also offers custom, high performance, special wavelength lasers.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Lasers & Laser Systems

SANDERS ASSOCIATES, Federal Systems Grp., 95 Canal St., Nashua, N.H., 03060, Tel: 603-885-6660, TWX: 710-228-1894; FSC No: 94117; Empl.: 6000

Customer service: Mktg. Dept.

Products manufactured: Analyzers, Antenna Feed Systems, Antenna Switching Matrices, Antennas, Computers, Detectors, Filters, Lasers & Laser Systems, Modulator/Demodulators, Radar Systems, Receivers, Services, Assembly, Production & Test, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.
Ala Huntsville, Sanders Assoc. 205-881-1940
Cal Los Angeles, Sanders Assoc. 213-641-2251
NY Rome, Sanders Assoc. 315-337-6660
Ohio Dayton, Sanders Assoc. 513-254-6289
Va Crystal City, Sanders Assoc. 703-920-5204

SANDERS ASSOCIATES, Instrument & Hydraulics Div., Grenier Field, Manchester, N.H., 03103, Tel: 603-669-4615, TWX: 710-220-1845; Empl.: 200

Customer service: G. Shomphe Ext. 424

Products manufactured: Accelerometers, Blowers & Fans & Accessories, Comparators, Gyros (All Types)

SANDERS ASSOCIATES, Microwave Div., Grenier Field, Manchester, N.H., 03103, Tel: 603-669-4615, TWX: 710-220-1845

SANDERS ASSOCIATES, Products Div.-Modens, 95 Canal St., Nashua, N.H., 03060, Tel: 603-885-2744, TWX: 710-228-1894; Empl.: 6000

Customer service: James J. Shea

Free literature available: BROCHURES - Modem Cards, Modem Packs, Modem 101 Tester Modem Card Literature & Various Types of Full Duplexes.

Products manufactured: Modulator/Demodulators

Local Sales Offices & Reps.
Ala Huntsville, W.A. Brown 205-539-4411
Cal Los Alamitos, Scientific Devices 213-598-7678
Fla Orlando, W.A. Brown 305-425-5505
Ga Atlanta, W.A. Brown 404-939-1674
Ill Elk Grove Village, L. Green Assoc.
312-593-0282
Ind Indianapolis, L. Green Assoc. 317-293-9827
Kans Prairie Village, Engineering Serv. 913-649-4000
La Gretna, W.A. Brown 504-366-5766
Mo St. Louis, Eng. Services 314-997-1515
NY Elmont, Crane & Egert 516-488-2100
NY Syracuse, Labtronics, Inc. 315-454-9314
NC Res. Tri. Park, W.A. Brown 919-489-1546
Ohio Dayton, LI/Corp 513-434-6367
Pa King of Prussia, RivCo 215-265-5211
Tenn Knoxville, W.A. Brown 615-584-2614
Tex Richardson, Data Applns. 214-231-4846
Va Springfield, Sci. Devices 703-451-6500
Wash Bellevue, Sci. Devices 206-454-0900

SANDERS ASSOCIATES, Products Div. - Spectrum Analyzer, 95 Canal St., Nashua, NH, 03060, Tel: 603-885-5400, TWX: 710-228-1894; Empl.: 6000

Customer service: F. A. Bellucci

Free literature available: Brochure - Sanders Model SA-240, Real-Time Digital Spectrum Analy. Options - 2401: Computer Output; 2402: Computer Input; 2403: Averaging; 2404: 12-bit Input; 2405: Dual Memory/I&Q; 2407: Phase/I&Q.

Products manufactured: Analyzers

Local Sales Offices & Reps.
Ala Huntsville, W. A. Brown Inc. 205-539-4411
Cal Los Alamitos, Scien. Device 213-598-7678
Conn Hamden, Pat Jenks 203-281-0810
Fla Orlando, W. A. Brown Inc. 305-425-5505
Ga Atlanta, W. A. Brown Inc. 404-939-1674
Ill Elk Grove Village, Loren Green Assoc.
312-593-0282
Ind Indianapolis, Loren Green Assoc. ... 317-293-9827
La Gretna, W. A. Brown Inc. 504-366-5766
Md Rockville, Mesa 301-881-8430
Mass Wakefield, Pat Jenks Assoc. 617-246-1590
Minn Minneapolis, Loren Green Assoc. ... 612-781-1611
Mo St. Louis, Eng. Serv. Comp. 314-997-1515
NJ Cinnaminson, Mesa Inc. 609-786-0284
NY Syracuse, Labtronics 315-454-9314
NC Res. Tri. Park, W. A. Brown Inc. 919-489-1546
Ohio Cleveland, Electro
Okla Norman, Data Mktg. Assoc. 405-364-8320
Tenn Knoxville, W. A. Brown Inc. 615-584-2614
Tex Dallas, Data Mktg. Assoc. 214-661-0300

SANDERS DATA SYSTEMS, Daniel Webster Hwy., Nashua, N.H., 03060, Tel: 603-885-2222; Empl.: 5500

Products manufactured: Computers, Control Systems, Air Traffic, Converters, Data Acquisition & Reduction Systems, Data Compressors, Digital, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Disc Packs, Magnetic, Display Devices/Displays, Recorders, Yokes

SANFORD-MILLER CORP., 89 Throop Ave., Brooklyn, N.Y., 11206, Tel: 212-EV7-0600; Empl.: 10; Minimum order: $15 .... p. 1•1863

For info on price: A. Scheer; Application info: E. Rodd; Customer service: M. Nemeth; Delivery info: M. Nemeth

Free literature available: Catalog and Price List, Elevator Control Rectifier List, Catalog encompasses selenium & silicon rectifiers, transformers, chokes, power supplies and Inverters.

Products manufactured: Bridges, Capacitors, Fixed, Chargers, Battery, Chokes, Converters, Diodes, Electroplating Equipment & Supplies, Eliminators, Battery, Kits, Power Supply, Power Drivers, Hybrid (High Current, High Voltage), Power Supplies, Protectors, Rectifiers, Suppressors, Transformers

Local Sales Offices & Reps.
Cal Lynwood, Dick West & Assoc. 213-636-6124

Local Distributors
Ala Huntsville, Mock Elctrns., 2310 Memorial Pkwy. S.
Ark Little Rock, Carlton-Bates Co., 69 & Scott Hamilton Dr. 501-375-2383
Cal San Francisco, Dahl-Beck Elctrns., 580 Howard St.
Conn Waterbury, Bond Radio Elctrns., 439 W. Main St.
203-753-1184
Fla Orlando, Hammond Elctrns., 911 W. Central Ave.
Ga Atlanta, Specialty Dist. Co., 764 Jumper St., N.E.
Ind So. Bend, Radio Dist. Co., 1212 High St.
219-287-2911
Ky Louisville, P.I. Burks Co., 842 So. 7 St.
502-589-3960
La New Orleans, Southern Radio Supply, 1909 Tulane Ave.
Md Rockville, Capital Radio Wholesalers, 12227 Wilkins Ave. 301-881-2270
Mass Worcester, Radio Maintenance, 80 Thomas St.
Mich Benton Harbor, Benton Harbor Elctrns., 922 Woodward Ave. S. 616-WA5-0069
Minn Duluth, Northwest Radio, 123 E. 1 St.
218-727-1565
Miss Jackson, Ellington Elctrn. Supply, 1425 Terry Rd.
601-355-0561
Mo Joplin, Four State Radio, 402 Wall St.
Neb Omaha, Radio Equipt. Co., 625 N. 18 St.
NC Greenboro, Hammond Elctrns., 2923 Pacific Ave.
919-275-6391
Ohio Lima, Lima Radio Parts, 600 N. Main St.
419-223-5075
Okla Tulsa, Radio Inc., 1000 S. Main St.
Pa Reading, Barbey Elctrns., 333 N. 4 St.
215-376-7451
Pa West Chester, West Chester Elctrns., 716 E. Market St. 215-923-1520
SC Greenville, Sawyer Elctrns., 1210 Poinsett Hwy.
803-CE5-0438
Tenn Nashville, Electra Distrib Co., 1914 West End Ave.
Tex El Paso, Medland Specialty Co., 2235 Wyoming Ave. 915-533-3555
Va Richmond, Meridian Elctrns., 1001 W. Broad St.
703-355-0669

SANGAMO ELEC. CO., Capacitor Div., Box 128, Pickens, S.C., 29671, Tel: 803-878-6311, TWX: 810-397-2496 .... p. 2•236,237

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.
Ariz Scottsdale, P. Murphy & Assoc. 602-946-2457
Cal Newberry Park, Astralonics 805-498-2183
Cal Placentia, El-Kap 714-528-3750
Cal Redwood City, Sangamo 415-364-5066
Cal San Diego, Celtec Co. 714-279-7961
Cal San Leandro, Quadrep East 415-352-5942
Cal Summerland, Astralonics 805-969-1711
Colo Denver, Parker-Webster 303-770-1972
Fla Clearwater, Dyne-A-Mark 813-441-4702
Fla Ft. Lauderdale, Dyne-A-Mark Corp.
305-771-6501
Fla Orlando, Dyne-A-Mark 305-299-6303
Ill Palatine, Sangamo 312-359-6080
Kans Shawnee Mission, K & M Sls. & AAssoc.
913-262-1444
Md Randallstown, Beacon North 301-922-1248
Mass Braintree, Sangamo 617-848-0532
Mich Farmington, W.R. Hummon & Assoc.
313-474-0661
Minn Mpls., S. Clothier 612-888-4666
Mo St. Louis, K & M Sls. & Assoc. 314-423-2420
NM Albuquerque, A-Q Elctrns. 505-255-8701
NY DeWitt, Sangamo Elec. Co. 315-446-2299
NY Elmont, F. E. Schmitt 516-437-8150
NY Ontario Center, Kehoe Comp. Sls.
315-524-2491
Ohio Rocky River, Sangamo 216-331-5222
Okla Tulsa, T.J. Ray Co. 918-627-1515
Ore Portland, C.K. Shanks & Assocs. 503-292-5656
Pa Ft. Washington, G. C. M., Inc. 215-646-7535
SC Pickens, Sangamo Elec. Co. 803-878-6311
Tex Dallas, Ammon & Rizos Co. 214-233-5391
Tex El Paso, A-Q Elctrns. 915-545-2363
Tex Houston, Ammon & Rizos Co. 713-781-6240
Utah Salt Lake City, Parker-Webster Co.
801-486-3737
Va Falls Church, Beacon North 703-534-1673
Wisc Wauwatosa, Larsen Assoc. 414-258-0529
FOR: Can., Hamilton, Ont., Cartwright Southall Assoc.
416-528-0294

SANGAMO ELECTRIC CO., Box 3347, Springfield, Ill., 62714, Tel: 217-544-6411, TWX: 910-242-0533; Empl.: 1600 .... p. 1•800,801

Customer service: C. Castle

Products manufactured: Comm. Systems, Recorders

Local Sales Offices & Reps.
Cal El Segundo 213-640-0847
Cal San Jose 408-371-3110
Conn Watertown 203-274-8900
DC Washington 301-652-9272
Ga Atlanta 404-252-1255
Ill Springfield 217-544-6411
Md Suitland 301-839-3117
Mass Burlington 617-272-2729
Mich Dearborn 313-562-9100
NM Albuquerque 505-898-9053
Ohio Columbus 614-451-5461
Pa Cornwells Heights 215-757-6100
Tex Dallas 214-239-6465

SANKEN ELEC. CO., 1-22-8 Nishi-Ikebukuro, Toshima-Ku, Tokyo, Japan

SANTA BARBARA RESCH. CTR., 75 Coromar Dr., Goleta, Cal., 93017, Tel: 805-968-3511, TWX: 213-871-5210; Empl.: 710; Minimum order: $50

Customer service: E. Dawson

Free literature available: SBRC Brochure & Technical Bulletins

Products manufactured: Amplifiers, Cells, Photoconductive, Photoemissive, Photovoltaic, Detectors, Diodes, Heat Exchangers & Systems, Lenses, Optical & Camera, Radiometers, Scanners

SANTA CRUZ ENGRG. INC., 300 Harvey Blvd. W., Santa Cruz, Cal., 95060, Tel: 408-427-3131; Empl.: 10

Customer service: A. Marez

Free literature available: Price List - 1-2 pages of price & del. Tech. Bulletin - SCE 221-I signal generator, 4 pages on Desc. of item

Products manufactured: Amplifiers, Generators, Receivers, Signal Averagers, Testers

SARA SCIENTIFIC CO., P.O. Box 321, San Francisco, Calif., 94101, Tel: 415-421-3172; Empl.: 3; Minimum order: $25

Customer service: S. Fishman

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic, Generators, Heat Guns, Production, Lights, Machines/Machinery, Production

SARGENT WELCH SCI. CO., Vacuum Prods. Div., 7300 N. Linder Ave., Skokie, Ill., 60076, Tel: 312-677-0600, TWX: 910-223-4541

Free literature available: Vacuum Products Catalog.

Products manufactured: Analyzers, Baths, Controlled Temperature (Air & Liquid), Carts & Dollies, Instrument & Equipment, Chamber, Environmental Test, Furnaces, Gages, Meters, Ovens, Potentiometers, Pumps, Vacuum, Recorders, Thermistors, Timers, Tubing

Local Sales Offices & Reps.
Ala Birmingham 205-251-5125
Cal Anaheim 714-772-3550
Colo Denver 303-399-8220
Mich Detroit 313-931-0337
NJ Springfield 201-376-7050
Ohio Cincinnati 513-771-3850
Ohio Cleveland 216-587-3300
Tex Dallas 214-357-9381

SARKES TARZIAN, INC., Semiconductor Div., 415 No. College Ave., Bloomington, Ind., 47401, Tel: 812-332-1435; Empl.: 500

For info on price: F. Lucas; Application info: R. Muldoon; Customer service: C. Sundt; Delivery info: C. Sundt

Free literature available: Power Semiconductor Devices, 16 page catalog of rectifiers, Diodes, SCRs, rectifier assemblies, up to 250 amp, and 50,000 PIV

Products manufactured: Diodes, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers)

Local Sales Offices & Reps.

Ala	Huntsville, Murcota	205-539-8476
Ark	El Dorado, D. Bellew Sls. Co.	501-863-8325
Cal	Redwood City, Parks & Pruitt Assocs.	415-364-1640
Cal	San Gabriel, Van Gott & Assocs.	213-285-2148
Colo	Denver, Nelson Co.	303-733-5528
Fla	North Miami, Winfield Elctrn. Sls.	305-945-6544
Ga	Atlanta, Murcota	404-875-2525
Ill	Chicago, Saffro & Assocs.	312-588-0905
Ind	Indianapolis, Marketing Engrs.	317-546-1523
Kans	Leawood, Thunderbird Sls. Co.	913-642-7220
Kans	Wichita, Thunderbird Sls. Co.	316-684-3941
La	Kenner, D. Bellew Sls. Co.	504-729-4550
Mass	Reading, C.E. Godfrey Co.	617-944-2230
Mich	Warren, Dem Elctrn. Sls.	313-755-6660
Minn	Minneapolis, Scott Elctrn. Sls.	612-929-2985
Mo	St. Louis, Thunderbird Sls.	314-567-6488
NJ	S. Orange, S. Simberkoff Sls.	201-763-7900
NY	New York City, S. Simberkoff Sls.	212-943-7023
NC	Burlington, Murcota	919-584-1577
NC	Winston Salem, 919-723-1001	
Ohio	Cleveland, Del Steffen & Assocs.	216-461-8333
Ohio	Dayton, D. Steffen & Assocs.	513-293-3145
Pa	Philadelphia, Professional Svcs. Assocs.	215-722-8222
Tex	Dallas, RM Elctrns.	214-233-0363
Wash	Bellevue, SD-R2 Prods. & Sls.	206-747-9424
FOR:	Can., Downsview, Ont., F. Eakin Ltd.	416-638-0451

SAWYER INDS., 5649 Peck Rd., Arcadia, Cal., 91006, Tel: 213-442-5981, TWX: 910-587-3534; FSC No: 18098; Empl.: 140; Minimum order: $50

Customer service: G. J. Graydon

Products manufactured: Actuators, Chargers, Battery, Controls/Control Eqpt., Converters, Current Sources, Inverters, Motors, Ovens, Power Supplies, Regulators, Standards, Transformers

Local Sales Offices & Reps.

Mass	Newton, Omni-Sys. Sls. Inc.	617-527-3169
NJ	Tenafly, Budd-Tronics, Inc.	201-569-2230
EXP:	Montreal 101, Quebec, Can., Canadian Advanced Production Conslts. Ltd.	

SAXTON PRODS., 215 N. Rte. 303, Congers, N.Y., 10920, Tel: 914-268-6848; Empl.: 230; Minimum order: $100

Customer service: R. Hibshman

Products manufactured: Antennas, Cable, CATV Systems & Equipment, Clamps & Clips, Connectors, Cords, Handsets, Chestsets, Headphones, Headsets, Etc., Jack Adapters (All Types), Jacks (All Types), Lead Assemblies & Receptacles, Microphones, All Kinds, Pickups, Telephone (For Recording), Plug Adapters, Plug & Jack Sets, Speakers, Tees, Wire

Local Sales Offices & Reps.

Cal	Canoga Park, L. Gould	213-463-3123
Cal	Cerritos, Saxton Prod.	213-342-9847
Cal	Millbrae, P. Rush	415-697-4995
Cal	Sherman Oaks, Vantage Sls.	213-789-4921
Cal	Topanga, D. Epstein	213-346-9631
Conn	Hartford, J. Colavecchio	203-522-0596
Ga	Stone Mountain, A. Stayton	404-469-2779
Ill	Chicago, D. Abo	312-327-9642
Ill	Des Plaines, R. Davis	312-298-7689
Md	Greenbelt, M. Needle	301-345-8026
Pa	Philadelphia, L. Feinstein	215-677-6497
Pa	Pittsburgh, S. Schindel	412-366-1481
Tenn	Knoxville, J. Dickens	615-947-8068
Tex	Dallas, D. McMonigle	817-457-2476

SCANBE CANOGA INDUSTRIES, 3445 Fletcher Ave., El Monte, Cal., 91731, Tel: 213-579-2300, TWX: 910-587-3437; Empl.: 200

Customer service: L. Cooper

Free literature available: SHORT FORM CATALOG: General description of product lines indicating overall views and data. DISTRIBUTOR CATALOG: Products sold through national distributor outlets.

Products manufactured: Boards, Plug-In, Boards, Printed Wiring, Universal, Drawers, Sliding, Guides, Circuit Board, Integrated Circuit Packaging Systems, Kits, Printed Circuit, Pullers, Racks, Sockets

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Phoenix, G.R. McKnight Co.	602-257-8037
Cal	Costa Mesa, Cen-Tec Sls.	714-645-9157
Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Cal	San Diego, Earl Assocs.	714-278-5441
Colo	Sedalia, Jensen Reps. Co.	303-688-4154
Conn	Cheshire, Coakley, Boyd & Abbett	203-272-2261
Fla	Clearwater, WMM Assocs.	813-447-2533
Ill	Chicago, L-Tec, Inc.	312-286-1500
Kans	Mission, Inland Assocs.	913-362-2366
Md	Ellicott City, Doss Elctrns.	301-465-1336
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	St. Clair Shores, J. M. Thorpe	313-779-6363
Minn	Minneapolis, Electro-Serv. Co.	612-827-2907
Mo	Glencoe, Inland Assocs.	314-938-4992
NM	Albuquerque, G.R. McKnight Co.	505-266-6423
NY	DeWitt, Tri-Tech Elctrns., Inc.	315-446-2881
NY	Great Neck, H. J. Krasner	516-487-0690
NC	Winston-Salem, W.A. Brown Comps.	919-725-5384
Ohio	Akron, A. Natalino	216-725-6087
Pa	Feasterville, Professional Svc. Assocs.	15-355-6244
Tex	Dallas, E-Tron Sls.	214-348-4749
Wash	Bellevue, SD-R2 Products & Sls.	206-747-9424
FOR:	Can., Montreal, J. G. Weiss Co., Ltd.	514-489-6887

Local Distributors

Ala	Huntsville, Powell Elctrns., 803 Oster Dr.	205-539-2731
Ariz	Phoenix, Moltronics, 3617 N. 35th St.	602-272-7951
Cal	Burlingame, Rose Elctrns., 846 Stanton Rd.	415-697-0224
Cal	Santa Clara, Moltronics, 337 Mathew	408-244-7600
Cal	So. Gate, Moltronics, 5610 E. Imperial	213-773-6521
Colo	Denver, Elctrn. Parts, 1212 S. Broadway	303-744-1992
Fla	Orlando, Hall-Mark Elctrns., 7233 Lake Ellnor	305-855-4020
Ill	Elk Grove Village, Hall-Mark Elctrns., 180 Crossen	312-437-8800
Md	Beltsville, Treeko Sales, 10739 Tucker St.	301-937-8260
	Woburn, Time Elctrns., 116 Cummings Pk.	617-935-8080
Mass	Waltham, QPL Elctrns., 47 Calvary St.	617-891-0460
Mich	Livonia, Pioneer Std., 13485 Stamford	313-525-1800
Minn	Minneapolis, Ind'l. Comp., 5280 W. 74th St.	612-831-2666
Mo	St. Louis, Olive Elctrns., 6667 Olive St.	314-863-7800
NJ	Roselle, Garden State, 407 Hope	201-241-9000
NY	Bohemia, Car-Lac, 75 Orville Dr.	516-567-4200
NY	Buffalo, Summit Distr., 919 Main St.	716-884-3450
NY	Rochester, Summit Elctrns., 292 Commerce	716-334-8110
Ohio	Cincinnati, Hughes-Peters, 4865 Duck Creek	513-351-2000
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Ore	Portland, Almac/Stroum, 8888 SW Canyon	503-292-3534
Pa	Montgomeryville, Pyttronics, Box 433 Stump	215-643-2850
Tex	Dallas, Specialized Prod., 2324 Shore Crest	214-358-4663
Tex	Houston, Hall-Mark Elect., 8000 Westglen	713-781-6100
Wisc	W Allis, Marsh Radio Supply, 6047 W. Beloit	414-545-6500

SCHAEVITZ ENGRG., U.S. 130, Union Ave., Pennsauken, N.J., 08110, Tel: 609-662-8000, TWX: 710-892-0714; Empl.: 190; Minimum order: $25

For info on price: J. Lynch; Application info: R. Anderson; Customer service: R. Gorczyca; Delivery info: J. Lynch

Free literature available: Literature giving performance data, dimensions and application information on transducers (lvdt's) to measure displacement, dimension, pressure, force, acceleration, level and on lvdt signal conditioning.

Products manufactured: Accelerometers, Amplifiers, Calibrators, Cells, Load, Controls/Control Eqpt., Data Acquisition & Reduction Systems, Gages, Indicators, Meters, Signal Conditioners & Equipment, Testers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, INCOTECH	205-837-6061
Ariz	Phoenix, Measurment Consultants	602-948-8410
Cal	Huntington Beach, S. Kennon Sls.	714-838-1888
Cal	San Carlos, Elctrn. Engrg.	415-593-2189
Colo	Boulder, Meas. Conslt.	303-449-5294
Fla	Orlando, Datarep	305-843-5224
Ill	Northfield, Torkelson Assoc.	312-446-9085
Ind	Indianapolis, Torkelson Assoc.	317-244-7867
La	Metairie, MG Elctrns. & Equip.	504-834-6002
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Mpls., Industra	612-929-6224
Mo	St. Louis, Ozark Elctrn.	314-423-7200
NJ	Cherry Hill, Markey Engrg.	609-667-3809
NM	Albuquerque, Meas. Conslts.	505-265-6471
NY	Rochester, Schuler Engrg.	716-328-2347
NC	Winston-Salem, Radco Co.	919-722-9671
Ohio	Columbus, Meas. Instrs.	614-488-9753
Tenn	Knoxville, Tool Crib, Inc.	615-525-6195
Tex	Dallas, Concept Sales	214-387-1434
Utah	Murray, Meas. Conslt.	801-268-3181
Wash	Bellevue, A. Smith	206-746-6770
FOR:	Can., Weston, Ont., Megatronix Ltd.	416-742-8015

SCHAUER MFG. CORP., 4500 Alpine Ave., Cincinnati, Ohio, 45242, Tel: 513-791-3030, Telex: 21-4576; Empl.: 254; Minimum order: $10

For info on price: R. C. Parsons; Application info: R. C. Parsons; Customer service: C. Waddell; Delivery info: C. Waddell

Free literature available: Catalog #670 concerning Zener Diodes and Silicon Varistors with inserts on application data. Catalogs on our automotive products are form numbers: #2560,2561,2563 and 2564.

Products manufactured: Chargers, Battery, Diodes, Gages, Meters, Power Supplies, Resistors, Testers

Local Sales Offices & Reps.

Cal	Burbank, Lingronics	213-848-8372
Cal	Palto Alto, Ellis Enterprises	415-328-5151
Conn	Meriden, Eagle Assocs.	203-377-1200
Ga	, B-C Elctrn. Sls.	404-436-5169
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Mich	Detroit, Rathsburg Assocs.	313-882-1717
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
Mo	Kansas City, Nevco, Inc.	816-421-1751
NY	Long Island City, D.F. Tobias Co.	212-549-9191
Ohio	Cleveland, John O. Olsen Co.	216-752-5444
Pa	Philadelphia, Kenneth B. Erdman Co.	215-224-1833
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Wash	Seattle, D. Miller Sls. Co.	206-784-6800

SCHLUMBERGER, See Heath Co.

SCHNEIDER ELECTRONICS, INC., 11 Riverside Ave., Medford, Mass., 02155; Empl.: 3

Products manufactured: Comparators, Counters, Gages, Generators, Meters, Synthesizers

SCHNEIDER INSTR. CO., 8115 Camargo Rd., Cincinnati, Ohio, 45243, Tel: 513-561-6803; Empl.: 17

For info on price: C.A. Schneider; Application info: C.A. Schneider; Customer service: W.C. Tharp; Delivery info: C.A. Schneider

Free literature available: Brochure describing automatic water quality monitors and related telemetering and data logging equipment.

Products manufactured: Comm. Systems, Data Acquisition & Reduction Systems, Data Loggers

Local Sales Offices & Reps.

Ala	Birmingham, Spader & Assocs.	205-879-1366
Ga	Atlanta, Spader & Assocs.	404-296-3024

SCHOTT CORP., 3140 Harbor Lane N., Minneapolis, Minn., 55441, Tel: 612-544-2751, TWX: 910-576-2964; FSC No: 80023; Empl.: 150; Minimum order: $75

For info on price: O. W. Schott; Application info: O. W. Schott; Customer service: P. O. Berendes; Delivery info: P. O. Berendes

Free literature available: Brochure describing types available and capacity to produce custom-made units.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Transformers

Local Sales Offices & Reps.

Cal	Bellflower, Royer Assocs.	213-869-2517
Cal	Walnut Creek, Murray Assocs.	415-937-7577
Mass	Needham, Hatch Assocs.	617-444-3310
Minn	Minneapolis, S & R Sls.	612-544-3022
NJ	Springfield, F.F. Sylvester Assocs.	201-376-3324

SCHRACK ELECTRICAL SALES CORP., 1140 Broadway, New York, N.Y., 10001, Tel: 212-683-0790; Empl.: 3; Minimum order: $10 ....p. 1•1808-1813

For info on price: E. Sobin; Application info: H. Siegell; Customer service: P. DeBiasi; Delivery info: H. Siegell

Free literature available: On all products advertised in EEM.

Products manufactured: Covers, Protective (Including Dust), Plugs, Relays, Sockets

Local Sales Offices & Reps.

Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Cal	Sherman Oaks, R.S. Hopkins Co.	213-788-5501
Colo	Littleton, Lange sls. Co.	303-798-1297
Conn	Old Saybrook, M.L. Assocs.	203-388-9718
Fla	Miami, E. Healy	305-961-6640
Ill	Chicago, R.M. Krueger Co.	312-282-8444
Md	Baltimore, D.K. Jones & Assoc.	301-752-0577
Mass	Marlboro, M.L. Assocs.	617-485-6190
Mich	Dearborn, Pitcher Inc.	313-582-5450
Minn	Minneapolis, A.J. Warner Inc.	612-729-7371
NH	East Derry, M.L. Assoc.	603-432-5050
NJ	S. Plainfield, S. Glassman Assocs.	201-561-3866
NY	Glen Cove, S. Glassman Assocs.	516-676-1039
NY	Syracuse, Lenard Co.	315-479-9191
Ohio	Englewood, Ad-El-Tek, Inc.	513-836-8471
Ohio	North Royalton, Ad-El-Tek, Inc.	216-237-4472
Ore	Portland, Pacific Elec. Sls.	503-235-3456
Pa	Ardmore, R.D. Freedman Assocs.	215-649-3679
Tex	Houston, Spectra Sls. Corp.	713-524-7800
Tex	Richardson, Spectra Sls. Corp.	214-234-3600
FOR:	Can., Toronto, Ont., Canector Sls. Ltd.	416-752-1800

SCHURMAN PRODUCTS INC., Weymouth Ind'l Pk., E. Weymouth, Mass., 02189, Tel: 617-337-8701; Empl.: 6

For info on price: G. Holsapple 617-337-8701; Application info: G. Holsapple 617-337-8701; Customer service: R. Cardinal 617-331-3601; Delivery info: R. Cardinal 617-331-3601

Products manufactured: Soldering Accessories

Local Sales Offices & Reps.

Colo	Denver, Connors	303-934-5829
Minn	Minneapolis, D. Swanson & Co.	612-789-5636
NJ	Caldwell, A. Cerf & Co.	201-226-2263
Ohio	Strongsville, J. Finnegan & Co.	216-826-1033
Pa	Warminster, A. Cerf & Co.	215-343-1339
Tex	Arlington, C.W. Cortez & Co.	817-469-8499

SCHWEITZER, PETER J. DIV., Kimberly Clark Corp., Lee, Mass., 01238, Tel: 413-243-1000, TWX: 413-243-2121; Empl.: 750

For info on price: T. W. Steinert; Application info: T. W. Steinert; Customer service: A. Baruzzi; Delivery info: A. Baruzzi

Products manufactured: Films, Foil, Insulators & Insulation, Tapes, Films & Foils, Pressure Sensitive

SCIENTIFIC-ATLANTA, Optima Div., 2166 Mountain Ind'l. Blvd., Tucker, Ga., 30084, Tel: 404-939-6340, TWX: 810-766-3967; Empl.: 100

Customer service: B. Holman

Free literature available: Color brochures and a catalog which includes outline drawings, prices, and complete model information.

Products manufactured: Benches, Consoles, Stools, Tables, Blowers & Fans & Accessories, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Chassis, Metal, Covers, Protective (Including Dust), Drawers, Sliding, Enclosures, Module, Plug-In, Frames, Cabinet & Rack, Grilles, Handles For Cabinets, Circuit Boards, Racks, etc., Panels, Racks, Slides, Cabinet & Chassis, Stands, Instruments

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-536-5306
Ariz	Scottsdale, Barnhill Five	602-947-5745
Cal	Los Altos, Frauman Assocs.	415-941-0660
Cal	Palos Verdes, Edwards Assocs.	213-377-0975
Colo	Denver, Barnhill Five	303-426-0222
Fla	Orlando, Gentry Assocs.	305-894-4401
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SEL-REX CO. DIV. OXY METAL INDUSTRIES CORP., 75 River Rd., Nutley, N.J., 07110, Tel: 201-667-5200, TWX: 710-989-1423; Empl.: 250

Free literature available: SEL-REX STRIP-PLATING MACHINES - Brochure describes several plating systems engineered for a variety of individual production requirements whether for plating selectively or over-all.

Products manufactured: Chargers, Battery, Chemicals, Coatings, Converters, Electroplating Equipment & Supplies, Inks For Thick Film Microcircuits, Machines/Machinery, Production, Magnets, Metals, Microcircuit Production Equip., Paints, Power Supplies, Rectifiers, Resistors, Screens, Printed Circuit

Local Sales Offices & Reps.

Cal	Burlingame, Oxy Metal Inds. Corp.	415-697-7123
Cal	Chatsworth, Sel-Rex Co.	213-882-9444
Cal	Los Angeles, Oxy Metal Inds. Corp.	213-262-4101
Cal	Santa Ana, Sel-Rex Co.	714-557-4141
Ga	Atlanta, Oxy Metal Inds. Corp.	404-458-9101
Ill	Berkeley, Oxy Metal Inds. Corp.	312-449-8510
Ill	Loves Park, Oxy Metal Inds. Corp.	815-633-6576
Ind	Indianapolis, Oxy Metal Inds. Corp.	317-359-8244
Mich	Madison Heights, Parker Co.	313-583-9300
Mich	Warren, Oxy Metal Inds. Corp.	313-539-3400
Mo	St. Louis, Oxy Metal Inds. Corp.	314-993-2602
NJ	Mt. Laurel, Oxy Metal Inds. Corp.	609-234-2331
NJ	Nutley, Oxy Metal Inds. Corp.	201-667-5200
Ohio	Cincinnati, Oxy Metal Inds. Corp.	513-793-6690
Ohio	Cleveland, Oxy Metal Inds. Corp.	216-267-2320
Ore	Portland, Oxy Metal Inds. Corp.	503-288-5134
RI	Warwick, Sel-Rex Co.	401-781-0700
Wash	Seattle, Oxy Metal Inds. Corp.	206-767-6082
Wisc	Brookfield, Oxy Metal Inds. Corp.	414-781-5964

SEMICOA, INC., 333 McCormick Ave., Costa Mesa, Cal., 92626, Tel: 714-979-1900, TWX: 910-595-1961; FSC No: 34156; Empl.: 65; Minimum order: $50

For info on price: B. Holtzman 714-979-1900; Application info: S. Faden 714-979-1901; Customer service: B. Kroeze 714-979-1902; Delivery info: J. Gunther 714-979-1903

Free literature available: Short form transistor catalog, Short form chip catalog, Detailed specification sheets, High power, high voltage devices, RF devices

Products manufactured: Diodes, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ariz	Scottsdale, EST-Tronics	602-948-8444
Cal	Los Angeles, Trimarco	213-861-8244
Cal	San Diego, Trimarco	213-861-8244
Cal	Santa Clara, Caltron-Pyle	415-964-3244
Fla	Casselberry, EIR	305-830-9600
Ill	Chicago, Metcom Assoc.	312-696-1490
Mass	Burlington, Contact Sls., Inc.	617-273-1520
Minn	Minneapolis, Furber Sls. Co.	612-861-1518
Mo	Kansas City, L.F. Florence Co.	816-561-7222
NJ	South Orange, Simberkoff Assocs.	201-763-7900
NY	Buffalo, Simberkoff Assocs.	716-434-4426
NC	Burlington, Simberkoff Assocs.	919-584-6450
Ohio	Dayton, Crest Component Sls.	216-543-9808
Pa	Narbeth, Electro-Comp.	215-664-3576
Tex	Dallas, Evans-McDowell Assoc.	214-238-7157
Wash	Seattle, Arneson Assocs.	206-762-7664

SEMICON ASSOC., INC., Box 832, Lexington, Ky., 40501, Tel: 606-255-2446; Empl.: 35

Products manufactured: Services, Assembly, Production & Test

SEMICONDUCTOR CIRCUITS, INC., 306 River St., Haverhill, Mass., 01830, Tel: 617-373-9104, TWX: 710-347-0269; Empl.: 130; Minimum order: $30
p. 1•1444-1457

Products manufactured: Converters, Kits, Power Supply, Power Supplies

Local Sales Offices & Reps.

Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Pasadena, A-F Sls. Engrg. Inc.	213-681-5631
Cal	Sunnyvale, Lee/Allan Assocs.	408-732-2030
Colo	Denver, BFA Corp.	303-744-3301
Conn	Middletown, McBar Assocs.	203-865-4376
Fla	Casselberry, EIR	305-830-9600
Haw	Honolulu, Aloha Assocs.	
Ill	Elk Grove Village, L.F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L.F. Green & Assocs.	317-293-9827
Mass	Waltham, McBar Assocs.	617-890-0233
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	Fridley, L.F. Green & Assocs.	612-781-1611
Mo	Grandview, K-Mar Engrg. & Sls.	816-763-3466
NJ	Bogota, Neville & Vespo, Inc.	201-487-1507
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	North Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-288-9460
NY	Utica, KLM Assocs.	315-735-8525
Ohio	Cleveland, Geotronix Mktg. Assoc.	216-526-2535
Ohio	Columbus, Geotronix Mktg. Assoc.	614-457-8472
Pa	Ambler, Data Engrg. Co.	215-542-9876
Tex	Dallas, Ralph Matthews Elctrns.	214-233-0363
Tex	Houston, Ralph Matthews Elctrns.	713-664-7131
Utah	Salt Lake City, BFA Corp.	801-466-6522
Va	Fairfax, Nine Assocs.	703-273-1803

SEMICONDUCTOR TECHNOLOGY, INC., 124-14 22nd Ave., College Point, N.Y., 11356, Tel: 212-445-4466, TWX: 710-582-2571; Empl.: 45; Minimum order: $25

For info on price: F. G. Seigel; Application info: F. G. Seigel; Customer service: J. Barilla; Delivery info: J. Hika

Free literature available: Short Form Catalogue with Application Notes.

Products manufactured: Diodes, Rectifiers, Transistors

Local Sales Offices & Reps.

Cal	Los Angeles, Relcom	213-559-9388
Cal	San Carlos, Lo Dan	415-592-4600
Cal	San Diego, Southwest Tech. Sls.	714-565-2295
Ill	Chicago, Rinaldi	312-763-4848
Md	Hyattsville, Eastern Comps.	301-577-2925
Mass	Waltham, Tech Sls.	617-890-1102
Mich	Utica, Norm Case Assocs.	313-731-6003
Minn	Minneapolis, C.E. Bohlig Assocs.	612-922-7011
Mo	Grandview, Beneke & Mc. Caul	316-765-2998
Mo	St. Louis, Beneke & Mc. Caul	314-434-6242
NY	Great Neck, Cooper Simon & Co.	516-487-1142
NY	Syracuse, Electra Sls. Corp.	315-455-5783
Ohio	Centerville, Norm Case Assocs.	513-435-1301
Ohio	Fairview Park, Norm Case Assocs.	216-333-4120
Ore	Portland, Underwood & Underwood	
Pa	Flourtown, Eastern Comps.	215-836-1616
Wash	Seattle, Underwood & Underwood	206-243-2133

SEMTECH CORP., 652 Mitchell Rd., Newbury Park, Cal., 91320, Tel: 213-628-5392; TWX: 910-336-1264; FSC No: 14099; QPL No: Multiple; Empl.: 598
p. 1•1856,1857

Free literature available: Semtech Condensed Catalog

Products manufactured: Bridges, Capacitors, Fixed, Diodes, Multipliers, Rectifiers, Regulators, Suppressors

Local Sales Offices & Reps.

Ala	Huntsville, Southeastern Assoc.	205-772-9616
Ariz	Scottsdale, Sls. Engr., Inc.	602-945-5781
Cal	Palo Alto, Semtech Northwestern Sls. Off.	415-494-3113
Cal	San Diego, F. Nagel Co.	714-298-4850
Colo	Denver, Electrodyne	303-467-7067
Fla	Winter Park, Semtech Southeastern Dist. Sls. Off.	305-644-5404
Ill	La Grange, Semtech Central Regional Sls. Off.	312-352-3227
Ind	Ft. Wayne, G & D Elctrn. Sls.	219-432-5585
Md	Baltimore, Burgin-Kreh Assoc.	301-788-5200
Md	Rockville, Semtech	301-424-6663
Mass	Weston, Ebbco, Inc.	617-891-8670
Minn	Minneapolis, S. Clothier Co.	612-888-4666
Mo	Hazelwood, Centech, Inc.	314-731-4220
Mo	Raytown, Centech, Inc.	816-358-8100
NJ	Clifton, Compar NY	201-546-3660
NJ	Springfield, Semtech Eastern Regional Sls. Off.	301-654-4884
NM	Albuquerque, Rustco Entprs.	505-296-6474
NC	Winston-Salem, Burgin-Kreh Assoc.	919-768-4174
Ohio	Cincinnati, Scott Elctrns.	513-791-2513
Ohio	Cleveland, Scott Elctrns.	216-291-2600
Ohio	Columbus, Scott Elctrns.	614-236-8619
Ohio	Dayton, Scott Elctrns.	513-223-2652
Ore	Portland, Western Techn. Sls.	503-297-1711
Pa	Pittsburgh, Scott Elctrns.	214-387-3551
Tex	Dallas, Semtech	214-387-3551
Utah	Salt Lake City, Electrodyne	801-467-7067
Va	Lynchburg, Burgin-Kreh Assoc.	703-845-5600
Wash	Bellevue, Western Tech. Sls.	206-641-3900
FOR:	Can., Ont., B.D. Vallille Elec., Ltd.	416-447-8482

SENCORE, INC., 3200 Sencore Dr., Sioux Falls, S.D., 57107, Tel: 605-339-0100, TWX: 910-660-0300; Empl.: 250

Customer service: R. Bowden

Free literature available: Update 4 color catalog of entire Sencore line of test instruments and accessories, including oscilloscopes, tube testers, transistor testers, color generators, multimeters, sound analyzers and others.

Products manufactured: Generators, Meters, Oscilloscopes, Power Supplies, Test Equipment, Testers

Local Sales Offices & Reps.

Cal	Burlingame	415-697-5854
Ga	College Park	404-768-0606
Ill	Downers Grove	312-852-6800

NY	Albany	518-869-0996
Va	Alexandria	703-751-3556

SENNHEISER ELCTRN. CORP., 10 W. 37th St., New York, N.Y., 10018, Tel: 212-239-0190; Empl.: 28

For info on price: C. Hofman; Application info: H. A. Ankermann; Customer service: U. Sattler; Delivery info: E. Kruse

Free literature available: Complete 108 page catalog describing in detail all Sennheiser products will be sent free of charge upon request.

Products manufactured: Meters, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Speakers, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, Morris Tait Assocs.	213-877-4424

SENSITIVE RESEARCH INSTRS., 25 Dock St., Mt. Vernon, N. Y., 10550, Tel: 914-699-9717; FSC No: 32590; QPL No: 16034A; Empl.: 35; Minimum order: $25

For info on price: R. Neglia; Application info: M. Kane; Customer service: G. D. Frank; Delivery info: R. Neglia

Free literature available: "SENSITIVE RESEARCH" AC/DC Electrostatic Voltmeters - Data Bulletin SRT-100 covers features, applications and characteristics of Electrostatic Voltmeters with a range span of from 120 V to 140 KV. Sensitive Research AC/DC Wattmeters and Volt Amp Wattmeters New Catalog Section 5 is an eight page catalog section providing specifications and general information on usage of AC/DC Wattmeters and Volt-Amp-Wattmeters.

Products manufactured: Calibrators, Dividers, Indicators, Magnets, Meters, Multipliers, References, D-C Voltage, Resistors, Services, Assembly, Production & Test, Shunts, Meter, Standards, Transducers, Transformers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, J. L. Highsmith & Co.	205-881-3294
DC	Washington, Whitcomb Assocs.	202-737-0763
Fla	Orlando, J. L. Highsmith & Co.	305-293-5202
Ill	Skokie, Saffro & Assocs.	312-588-0905
Kans	Shawnee Mission, Pivan Engrg. Co.	913-722-1030
Md	Baltimore, Whitcomb Assocs.	301-889-1245
Mass	Waltham, Measurement Conslts. Corp.	617-890-4400
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, Pivan Engrg. Co.	314-567-3636
NY	Buffalo, R. F. Lamb Co.	716-874-4900
NY	Rochester, R. F. Lamb Co.	716-544-5580
NY	Schenectady, R.F. Lamb Co.	518-393-4844
NY	Syracuse, R. F. Lamb Co.	315-454-2469
NC	Charlotte, J. L. Highsmith & Co.	704-333-7743
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Okla	Norman, Data Mktg. Assocs., Inc.	405-364-8320
Pa	Jenkintown, AMT	215-LI9-2080
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Tex	Dallas, Data Mktg. Assocs., Inc.	214-661-0300
Tex	Houston, Data Mktg. Assocs., Inc.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Va	Richmond, J. L. Highsmith & Co.	804-272-5888
Wash	Seattle, R. S. Drake Assocs., Inc.	206-725-2700

Advertisment

SENSITIVE RESEARCH INSTS.
Manufacturers of Polyrangers, Electrostatic Voltmeters, Wattmeters, AC & DC Voltmeters and Ammeters, all offered in both portable and panel mountings in ranges from microvolts to 140,000 volts, and microamperes to 1000 amps.
Typical Models:
ESH & ESD Electrostatic Voltmeters
VAW Volt Amp Wattmeters
100 KV NBS Design Park Divider
Custom Designs available. Write for a SENSITIVE RESEARCH catalog.

SENSITROL, INC., 200 S. 4th St., P.O. Box 150, Albion, Ill., 62806, Tel: 618-445-2323; Empl.: 19; Minimum order: $35

For info on price: S. Seitz Ext. 56; Application info: E. M. Pelter, Jr. Ext. 53; Customer service: S. Seitz Ext. 56; Delivery info: S. Seitz Ext. 56

Products manufactured: Controls/Control Eqpt., Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Monitors, Protectors, Relays, Timers

Local Sales Offices & Reps.

Ariz	Scottsdale, Electronic Entprs	602-266-9841
Cal	LaJolla, Rep. Sls Co.	714-271-1426
Cal	Long Beach, Emerson Kirk Engrg.	213-439-9559
Fla	North Miami, Mark Elctrn Sls Co.	305-947-5080
NJ	Fairlawn, C. R. Mayer Co.	516-921-7876
NJ	Hackensack, C. R. Mayer Co.	201-487-3113
NM	Albuquerque, Electronics Entrprs.	505-256-3561
NM	Las Cruces, Electronics Entrprs	505-524-0126
NY	Huntington, C. R. Mayer Co.	516-921-7876
Va	Reston, Boyle Assocs.	703-620-9558
FOR:	Can., Downsview Ont., Anro Elctrn Inds	416-661-2607
FOR:	Can., Montreal Que., B. R. Connectron	514-332-0220

SENSOR CORP., Box 140, Scottdale, Pa., 15683, Tel: 412-887-4080; Empl.: 12

Products manufactured: Alarms, Amplifiers, Analyzers, Boards, Plug-In, Boards, Programming, Cards, Linear Function, Cards, Logic, Coils Including Assemblies & Forms, Comparators, Computers, Controls/Control Eqpt., Converters, Counters, Current Sensors, Detectors, Diodes, Display Devices/Displays, Dividers, Drivers, Solenoid, Electroplating Equipment & Supplies, Encoders, Gages, Generators, Heads, Reflective, Indicators, Integrated Circuit Devices, Light Sources, Photoelectric, Machines/Machinery, Production, Meters, Monitors, Oscillators, Power Supplies, Programmers, Relays, Scanners, Sensors, Light, Services, Assembly, Production & Test, Shift Registers, Switches, Tachometers, Test Systems, Testers, Timers, Totalizers, Digital, Transducers

Local Sales Offices & Reps.

Conn	Durham, Marr Electric Co.	203-349-9691
Fla	Oldsmar, L & A Assocs.	813-855-4209
Mich	Detroit, Owen Engrg.	313-538-5515
Mo	St. Louis, W. Adler	314-423-7200

SENSOR TECHNOLOGY, 21012 Lassen St., Chatsworth, Cal., 91311, Tel: 213-882-4100, TWX: 910-494-4776; Empl.: 175; Minimum order: $35

For info on price: I. Rubin; Application info: J. Cotter; Customer service: B. Hanson; Delivery info: I. Rubin

Free literature available: Complete Catalog, "Sensor Tech Opto Electronic Components & Systems".

Products manufactured: Amplifiers, Cells, Photoconductive, Photoemissive, Photovoltaic, Circuits, Hybrid, Thin-Film, Controls/Control Eqpt., Detectors, Diodes, Display Devices/Displays, Fiber Optic Bundles, Isolators, Lamps, Lights, Punched Card Equipment, Readers, Resistors, Transistors

Local Sales Offices & Reps.

Cal	Redwood City, Logan Sales	415-369-6726
Colo	Denver, Omega Ltd.	303-758-1508
Fla	Lighthouse Pt., Saber Assocs.	305-943-3076
Ill	Chicago, Balhorn & Welch	312-889-5011
Mass	Worcester, W. Porter Sls.	617-852-4396
Mich	Detroit, A. Blumenberg Assocs.	313-557-1934
Minn	Minnetonka, T.H. Ayre Assocs. Inc.	612-474-4125
NJ	Cherry Hill, Bi-Tech, Inc.	609-667-7374
NM	Albuquerque, The Thorson Co.	505-265-5655
NY	Dewitt, Bowser & Sapecky Assoc.	315-446-5920
NY	Great Neck, Cooper-Simon & Co.	516-487-1142
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Ohio	Dayton, Giesting Assocs.	513-931-0812
Tex	Dallas, Erickson-Vilter Sls.	214-243-6611
Va	Fairfax, Sohibley Assocs., Inc.	703-591-3008

SENSORS, INC., 3908 Varsity Dr., Ann Arbor, Mich., 48104, Tel: 313-973-1400

Customer service: D. Giles

Free literature available: Brochures describing C1, L22, L66 & S15 thermopile detectors...complete electrical/mechanical specifications, performance charts, applications, ordering information. Average Temperature Radiometer brochure gives description, complete specifications, applications information.

Products manufactured: Detectors, Pyrometers, Radiometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Electrn. Entprs.	602-946-3802
Cal	S. Pasadena, Deniston/JDA	213-254-7755
Cal	San Carlos, Elctrn. Engrg. Assocs.	415-593-2189
Mich	Chelsea, Michigan Nondestructive Gage Co.	313-685-2960
Minn	Minneapolis, Automated Controls	612-377-7727
NJ	Medford, Walter Lanchak Co.	215-923-5050
NM	Albuquerque, Elctrn. Ents.	505-256-3561
NC	Charlotte, J.L. Highsmith & Co.	704-333-7743
Tex	Stafford, Jordan Equipment Co.	713-498-6033

SENSOTEC, INC., 1400 Holly Ave., Columbus, Ohio, 43212, Tel: 614-294-5436; Empl.: 55

Customer service: J. Feil

Free literature available: Strain Gage Transducers & Instruments: Pressure, 0.5 to 30,000 psi, gage, absolute, differential; Load Cells, 0.1 to 200,000 pounds; Signal Conditioners And Digital Readout.

Products manufactured: Amplifiers, Bridges, Cells, Load, Controllers, Programmable, Controls/Control Eqpt., Filters, Gages, Indicators, Power Supplies, Recorders, Signal Conditioners & Equipment, Transducers

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-734-4500
Colo	Denver, Thorson Co.	303-759-0809
Conn	Milford, Todino Engrg. Sls.	203-874-6643
Ill	Chicago, Pivan Engrg. Inc.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Inc.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg. Inc.	913-722-1030
La	Baton Rouge, SESCO, Inc.	504-927-7574
Md	Rockville, Farrell Assocs. Inc.	301-424-9460
Mass	Needham Hgts., Todino Engrg. Sls.	617-444-7925
Mich	Detroit, S. Sterling	313-255-1970
Minn	Minneapolis, Pivan Engrg. Inc.	612-537-4501
Mo	St. Louis, S. Sterling	314-567-3636
NJ	Paramus, Tower Sls. Eng. Corp.	201-265-2878
NM	Albuquerque, Thorson Co.	505-265-5655
NY	New Hartford, KLM Assocs.	315-735-8525
NY	North Syracuse, KLM Associates	315-458-6214
NY	Rochester, KLM Associates	716-442-0820
Ohio	Cleveland, S. Sterling	216-442-8080
Ohio	Dayton, S. Sterling	513-298-7573
Pa	Philadelphia, Scientific Dev.	215-825-9515
Pa	Pittsburgh, Process Engrg.	412-561-2242
Pa	Pittsburgh, S. Sterling	412-922-5720
Tex	Houston, SESCO, Inc.	713-668-7840
Tex	Richardson, SESCO, Inc.	214-231-9364
Wash	Seattle, RDX Corp.	206-682-6750
Wisc	Brookfield, Pivan Engrg. Inc.	414-786-1940
FOR:	Can., Quebec, Electrodesign	514-363-5120
FOR:	Can., Toronto, Electrodesign	416-787-0991
FOR:	Can., Vanier, Electrodesign	613-745-0541

SEQUENTIAL INFORMATION SYSTEMS, 249 N. Saw Mill River Rd., Elmsford, N.Y., 10523, Tel: 914-592-5930, TWX: 710-567-1212; Empl.: 60; Minimum order: $100

Customer service: F. Gordon

Free literature available: General Motor Catalog - Motorspecs on 13 different motors; General Encoder Catalog - Incremental & absolute encoders up to 21 bits; Industrial Encoders - Incremental & absolute to 14 bits and 20,000 pulses; Display Systems - Incremental, speed, ratio position and absolute readouts.

Products manufactured: Controls/Control Eqpt., Encoders, Meters, Motor & Generator Armatures, Rotors, Stators, Motors, Switches, Tachometers, Timers

Local Sales Offices & Reps.

Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Campbell, Sedillo Co.	408-374-5220
Cal	Santa Barbara, Kannard Assocs.	805-682-1928
Colo	Denver, BFA Corp.	303-744-3301
Conn	Old Lyme, Aid Engrg. Sls. Co.	203-673-3692
Conn	Rocky Hill, Aid Engrg. Sls. Co.	203-673-3692
Ill	Chicago, Pivan Engrg., Inc.	312-539-4838
Ind	Indianapolis, Pivan Engrg., Inc.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg., Inc.	913-722-1030
Md	Silver Spring, Spectroscopy Sys	301-949-8261
Mass	Westboro, Aid Engrg. Sls. Co.	617-890-8181
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engrg., Inc.	612-537-4501
Mo	St. Louis, Pivan Engrg., Inc.	314-567-3636
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Upper Williamsville, Maxwell Bennett Assocs.	716-634-2107

Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Pa	Western Pittsburgh, S. Sterling Company	412-922-5720
Pa	Wyndmoor, Spectroscopy Sys.	215-VE6-1545
Tex	Dallas, Data Aids	214-620-1551
Tex	Houston, Data Aids	713-862-6685
Utah	Salt Lake City, BFA Corp.	801-466-6522
Wash	Seattle, Penryn Sls. & Engrg. Co.	206-634-0240
Wisc	Brookfield, Pivan Engrg., Inc.	414-786-1940

SERMETEL TELEFLEX INC., 155 Limerick Rd., Limerick, Pa, 19468, Tel: 215-948-5100, TWX: 710-637-1263; Empl.: 150

Customer service: E. A. Wykstra X18

Products manufactured: Adhesives (All Types), Boards, Printed Circuit, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Lubricants, Paints, Seals, Services, Assembly, Production & Test, Wire

Local Sales Offices & Reps.

Cal	Lawndale	213-973-1142
Okla	Midwest City	405-732-1392

SERVO-TEK PRODS. CO., 1086 Goffle Rd., Hawthorne, N.J., 07506, Tel: 201-427-3100; Empl.: 86 p. 1•980,981

Products manufactured: Controls/Control Eqpt., Drives & Drive Mechanisms (Dial), Indicators, Motors, Tachometers

Local Sales Offices & Reps.

Cal	Van Nuys, Servo-Tek Calif.	213-786-0690
Fla	Ft. Lauderdale, P.N. Bredesen	305-587-0117
Mass	Salem, Forbes Engrg. Co.	617-744-1693
Ohio	Dayton, Albrecht & Assocs. Inc.	513-885-3888

SERVOMETER CORP., 501 Little Falls Rd., Cedar Grove, N.J., 07009, Tel: 201-785-4630; FSC No: 18469; Empl.: 65; Minimum order: $25

For info on price: E. Toth 201-785-4633; Application info: F. Duggan 201-785-4637; Customer service: D. Walker 201-785-4634; Delivery info: B. Murawski 201-785-4636

Free literature available: Bellows Contact Springs-describes line of stocked contact springs Flexible Shaft Couplings - Describes line of precision electrodeposited nickel bellows type shaft couplings. Electroforms - describes servometers unique capabilities in the field of electroforming

Products manufactured: Contacts, Electrical, Couplings, Feedthrus & Seals, Environmental, Services, Assembly, Production & Test, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Cerritos, Bearings, Seals & Gears (Memtech Div.)	213-860-2422
Cal	Redwood City, Bearings, Seals & Gears	415-365-5444
Ind	Indianapolis, H. G. Lake Co.	317-783-7254
Mass	Salem, J.M. Assocs.	617-745-1826
NY	East Aurora, Clarke Thrasher	716-652-0423
Ohio	Dayton, H. G. Lake Co.	513-277-8181
Ohio	Richmond Heights, H. G. Lake Co.	216-486-1477
Ore	Gresham, Bearings, Seals & Gears	503-665-5434
Pa	Ambler, L. J. McCormick Jr.	215-643-7899

SERVOTRON CORP., See National Power Prods.

SERVOTRONICS, INC., 3901 Union Rd., Buffalo, N.Y., 14225, Tel: 716-633-5990, TWX: 710-523-1855; Empl.: 81

For info on price: R. Dabinski; Application info: P. R. Bauer; Customer service: P. A. Bauer; Delivery info: R. Dabinski

Free literature available: Torque Motors-"How to design advantage of High force Linear-Displacement Torque Motors" describes design principles, what they do, how they work and where their used. Metallic Seals-Apex or Omega type explains design features and advantage of each type lists standard sizes and options available.

Products manufactured: Actuators, Motors, Services, Assembly, Production & Test, Solenoids, Valves, Solenoid

SESCOM, INC., Box 590, Gardena, Cal., 90247, Tel: 213-770-3510, TWX: 910-346-7023; Empl.: 21

Products manufactured: Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, B. Fissell Co.	602-264-4031
Cal	Oakland, H. Gabriel	415-465-5361
Ill	Chicago, T. Pappas & Assoc.	312-685-2338
Kans	Overland Park, W. Menzes & Assocs.	913-649-2680
Md	Rockville, Lienau Assocs., Inc.	301-770-6800
Mass	Framingham, VF Sls. Inc.	617-237-6544
NY	Brooklyn, I. Brown Co. Inc.	212-493-1379
Pa	Philadelphia, Lienau Assocs., Inc.	215-HO4-9444
Tex	Dallas, Wyborny Sls. Co.	
Tex	Houston, Wyborny Sls. Co.	713-772-0961
EXP:	Inglewood, Sescom, Inc.	213-770-3510
EXP:	Los Angeles, Calif., E.E. Strassner Sls. Inc.	213-666-1511

SETRA SYSTEMS INC., 12 Huron Dr., Natick, Mass., 01760, Tel: 617-655-4645; Empl.: 25

Customer service: W. Stern

Free literature available: Catalogs

Products manufactured: Accelerometers, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Craft Associated	205-837-0221
Cal	Los Angeles, DynaSls. Co.	213-268-1175
Colo	Wheat Ridge, RMS Sls.	303-423-6693
Fla	Maitland, Craft Assocs.	305-645-2242
Ga	Atlanta, Craft Assocs.	404-393-0400
Ill	Arlington Heights, Martec Assocs.	312-956-8090
Kans	Leawood, Leemark Engrs.	913-648-0124
Mass	Framingham, J.M. Lancaster Co.	617-873-8893
Mich	Ferndale, Tiby Co.	313-547-3550
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NY	Huntington, Hansen Assocs.	212-947-0379
NY	Penfield, A&D Devices	716-586-8033
Ohio	Cleveland, Tiby Co.	216-371-5335
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Jenkintown, Stein Instrumentation	215-885-2370
Tex	Dallas, McGatlin Instr. Co.	214-243-6061
Wash	Bellevue, McLaren	206-535-3400

SEVEN SCIENCES, INC., 1405 Civic Center Drive, Santa Clara, Cal., 95050, Tel: 408-249-8400; Empl.: 10; Minimum order: $59

For info on price: D. Linker 408-249-8400; Application info: L. Azar 408-249-8401; Customer service: A. Howard 408-249-8400; Delivery info: D. Linker 408-249-8400

Free literature available: Brochures: 1000 Series; battery power supplies, 2000 Series; battery chargers, 3000 Series; battery chargers, Model 100; DC-DC converter.

Products manufactured: Chargers, Battery, Converters, Power Supplies

Local Sales Offices & Reps.

Cal	Los Angeles, V & L Assocs.	213-986-9703
Cal	Palo Alto, Microwave Mktg. Assocs.	415-969-3355
Colo	Denver, K. C. Marketers	303-733-5561
NM	Albuquerque, A. L. S. Elctrns.	505-298-2575
FOR:	Can., Mississauga, Ont., Munro Elctrn. Components Ltd.	416-676-1042

S G C INC., 13737 SE 26th St., Bellevue, Wash., 98005, Tel: 206-746-6310, Telex: 3288311; Empl.: 18; Minimum order: $25

For info on price: D. L. Stoner, 206-746-6310; Application info: D. L. Stoner, 206-746-6310; Customer service: G. Thompson, 206-746-6311; Delivery info: T. Rockney, 206-746-6311

Free literature available: Complete descriptive literature and price lists of entire line of SSB equipment.

Products manufactured: Antennas, Comm. Systems, Crystals, Receivers, Transmitters

Local Sales Offices & Reps.

Cal	Benica, Mar-Pac	707-745-4068
Fla	Pompano Beach, Comark	305-785-2000
La	New Orleans, R. Daigle Assoc.	504-367-5309
Mass	Sudbury, Commercial Mktg. Assoc.	617-443-9442
Wash	Bellevue, S G C Int'l.	206-746-6310

SGL ABRASIVES, North Pitt St. Ext., Carlisle, Pa., 17013, Tel: 717-243-3471, TWX: 510-560-3513; Empl.: 200

Products manufactured: Abrasive Belts, Compounds, Cords, Powders, etc.

Local Sales Offices & Reps.

Ala	Birmingham, P. Bancroft	205-823-0557
Cal	Maywood, J. Mullaney	213-585-5697
Ill	Northfield, B. Boak	312-446-3374
NC	Charlotte, T. Arnold	704-535-4279
Pa	Allentown, Coleman Assoc.	215-797-0401
Pa	Hazleton, Barrett Haentjens Co.	717-455-7711
Pa	New Cumberland, J. Tio	717-774-2351
Pa	Newtown Square, E. Parkin	215-644-5849
Tex	Houston, T. Dolan	713-667-8812
Wisc	Racine, Webster Weiss	414-639-3634
Wisc	West Bend, T. Sullivan	414-334-4385

SGL BATTERIES MANUFACTURING CO., A Subsidiary of SGL Industries, Inc., 14650 Dequindre, Detroit, Mich., 48212, Tel: 313-868-6410; Empl.: 60

Customer service: R. J. Hollander

Free literature available: Brochure on Batteries.

Products manufactured: Batteries

SGL ELCTRONICS, 300 Harvard Avenue, Westville, N.J., 08093, Tel: 609-456-7300, TWX: 710-944-0758; Empl.: 60; Minimum order: $25 p. 2•1254

For info on price: R. P. Pagliaro; Application info: J. E. Graham; Customer service: D. Seitzinger; Delivery info: D. Seitzinger

Free literature available: SGL electronics condensed catalog describes technical data on its line of magnetic laminations "C" cores tape wound and ring cores, and magnetic shielding.

Products manufactured: Connectors, Cores, Magnetic, Foil, Laminations, Services, Assembly, Production & Test, Shields

Local Sales Offices & Reps.

Cal	La Habra, Magnetic Materials	213-694-2063
Fla	Orlando, Buchanan & Abrams Assoc.	305-898-7444
Ill	Chicago, P.K. Pitt	312-478-3124
Mich	Farmington, W.R. Hummon	313-474-0661
Minn	St. Paul, R.G. Ragon	612-488-0201
NJ	Murray Hill, Cambridge Allen	212-682-5844
NY	DeRuyter, R. P. Kennedy Co.	315-682-2299
NY	Red Hook, R. P. Kennedy Co.	914-876-2700
NY	Rochester, R.P. Kennedy Co.	716-271-6322
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242
Tex	Dallas, Southwest Elctrn. Inds.	214-233-9816
Tex	Houston, Dunkel Elctrns Assoc.	713-729-1670
Wash	Kirkland, Freed Assoc.	206-822-8100
FOR:	Can., Dorval, Que., Anbak Sls.	514-636-8514
FOR:	Can., Mississauga, Ont., Anbak Sls.	416-625-1061

SGL GRAPHICS, Div. of SGL Inds., Inc., John Fitch Industrial Park, Warminster, Pa., 18974, Tel: 215-672-3600; Empl.: 45

Customer service: T. Wallis

Free literature available: Product and application information; specifications.

Products manufactured: Nameplates, Services, Assembly, Production & Test, Tubing

SGL HOMALITE, Div. of SGL Inds., Inc., 11 Brookside Dr., Wilmington, Del., 19804, Tel: 302-652-3686; Empl.: 30; Minimum order: $35 p. 2•1254

For info on price: B. Eastman; Application info: B. Eastman; Customer service: L. Rose; Delivery info: L. Rose

Free literature available: Specifications, applications data, and typical uses.

Products manufactured: Adhesives (All Types), Bezels, Shielded & Unshielded, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Dials, Display Devices/Displays, Nameplates, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Scales, Dial, Services, Assembly, Production & Test, Shields, Tubing

Local Sales Offices & Reps.

Cal	Los Gatos, Luscombe Engrg.	408-354-6496
Cal	Pasadena, Luscombe Engrg.	213-684-2000
Mass	Newton, Normell Assocs.	617-969-5478
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
Minn	Minneapolis, Int'l. Sls. Co.	612-831-8423
NJ	Cherry Hill, B & G Assocs.	609-235-4878
NY	Lynbrook, H.B. Heft Assocs.	516-599-3351
Wash	Seattle, J.B. Jolly	206-938-4166

SGL PLASTICS, Route 248, Nazareth, Pa., 18064, Tel: 215-759-0280; Empl.: 50

Customer service: J. D. Guiducci

Free literature available: A new six page brochure describes SGL Plastics plant and equipment capability together with illustrations of products currently in production.

Products manufactured: Services, Assembly, Production & Test

SGL PRINTED CIRCUITS, Div. SGL Inds., Inc., 827 Black Oak Ridge Rd., Wayne, N.J., 07470, Tel: 201-835-2765; Empl.: 29 .... p. 2•356

Customer service: P. Codella

Free literature available: Service brochure available.

Products manufactured: Boards, Printed Circuit, Boards, Printed Wiring, Universal, Circuits, Flexible, Circuits, Printed, Multilayer, Kits, Printed Circuit, Screens, Printed Circuit, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Fla	Orlando, Buchanan & Abrams	305-899-7622
Mo	Springfield, Osbern Sales Co.	417-881-0142
NJ	Fairfield, Glad Assocs.	201-227-5555

SGL WABER ELECTRIC, 300 Harvard Avenue, Westville, NJ, 08093, Tel: 609-456-5400, TWX: 710-944-0758; Empl.: 50; Minimum order: $35 p. 2•356

Customer service: A. Andrews

Free literature available: New 16 page, three color catalog including illustrations and descriptions of over 250 different pre-wired (ready to plug in) electrical power outlet strips and wheeled mobile utility and instrument carts.

Products manufactured: Benches, Consoles, Stools, Tables, Boxes, Junction, Outlets & Wall Plates, Bus Bars & Systems, Carts & Dollies, Instrument & Equipment, Circuit Breakers, Conduit, Electrical, Connector Boxes & Strips, Power Outlet, Controls/Control Eqpt., Cords, Ducts, Wiring, Indicators, Plugs, Services, Assembly, Production & Test, Switches

Local Sales Offices & Reps.

Ala	Mobile, Hollingsworth & Still	205-478-8108
Cal	Hollywood, Lewis Assocs.	213-877-0461
Cal	San Rafael, G. E. Johnson	415-456-1196
Colo	Denver, Walter Eng. Assoc.	303-777-5585
Conn	Wallingford, Adams-McGregor	203-369-5816
Fla	Orlando, Hollingsworth & Still	305-671-4515
Ga	Atlanta, Hollingsworth & Still	404-394-3270
Haw	Honolulu, Gene Piety Factors	808-841-0185
Ind	Indianapolis, R. Milsk Co.	317-546-5468
Iowa	Des Moines, Kathrinus-Kelly & Co.	515-255-4584
Iowa	Fort Dodge, Heimann Co.	515-576-2375
Kans	Shawnee Mission, Kathrinus-Kelly & Co.	913-722-0000
Md	Silver Springs, Sherr Assocs.	301-593-2477
Mass	Scituate, Adams-McGregor	617-545-2213
Mich	Southfield, R. Milsk Co.	313-354-3310
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, kathrinus-Kelly	314-968-3800
NM	Albuquerque, C. T. Carlberg & Assoc.	505-265-1579
NY	Liverpool, J. Brown Elctrn. Sls.	315-451-1471
NY	New Hyde Park, Harris & Aldrich Sls.	516-488-2622
NY	Rochester, J. Brown Elctrn Sls.	716-266-2728
NY	Yonkers, J. Brown Elctrn. Sls.	914-779-7330
NC	Charlotte, Hollingsworth & Still	704-536-7047
Ohio	Dayton, Elctrn. Salesmasters	513-837-2379
Ore	Salem, Pacnor Mktg.	503-363-6445
Pa	Philadelphia, D. S. Linz Co.	215-379-0734
Pa	Pittsburgh, Tanner, Co.	412-561-4687
RI	Lincoln, Adams-McGregor	401-726-1300
Tex	Dallas, Lund & Co.	214-358-4335
Wash	Seattle, Pacnor Mktg.	206-284-8020

SGS ATES

SGS-ATES SEMICONDUCTOR, 435 Newtonville Ave., Newtonville, Mass., 02160, Tel: 617-969-1610; Empl.: 7000

For info on price: T. Hastings; Application info: U. Broggi; Customer service: T. Hastings; Delivery info: T. Hastings

Free literature available: Short form catalog; Audio Circuit Brochure; Individual Device Data Sheet

Products manufactured: Amplifiers, Integrated Circuit Devices, Multipliers, Semiconductor Wafer Fabrication, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Comp. Mktg.	205-881-5333
Ariz	Tempe, J.F. Hurlbut Co.	602-968-5962
Cal	Mountain View, Caltron/Pyle Inc.	415-964-3244
Cal	Santa Ana, Rical Assocs.	714-557-6543
Colo	Golden, J.F. Hurlbut Co.	303-279-7138
Fla	Pompano Beach, V.G. Sales Co.	305-941-5544
Fla	Winter Park, V.G. Sales Co.	305-831-8699
Ill	Bellwood, Fiat Engrg.	312-547-6200
Ind	Indianapolis, Lattronics Mfg.	317-846-5788
Mass	Waltham, Conti-Younger Assocs.	617-890-4582
Mich	Grosse Pointe Park, Greiner Assocs.	313-499-0188
Minn	Minneapolis, L. F. Green Assocs.	612-781-1611
NJ	Cherry Hill, J.N. Barrett Assocs.	609-429-1551
NJ	Fort Lee, Northern Elctrn. Comps.	201-461-2789
NY	Pompey, S.F. Foster Co.	315-677-3333
NY	Webster, S.F. Foster Co.	716-872-5220
Ohio	Cleveland, Imtech Inc.	216-826-3400
Ohio	Dayton, Imtech Inc.	513-837-5610
Tex	Dallas, Blackburn Assocs.	214-351-9991
Va	Reston, Boyle Assocs.	703-620-9558
Wash	Seattle, R. Johnston Co.	206-524-5170

Local Distributors

Cal	Los Angeles, Energy Elctrns. Prods., 6060 Manchester Ave.	213-641-9020
Mass	Burlington, Wilshire Elctrns., 1 Wilshire Rd.	617-272-8200
Tex	Dallas, KA Elctrns. Sls., 1220 Majesty Dr.	214-634-7870
Wash	Seattle, Radar Elec. Co., 168 Western Ave. W.	206-282-2511

SHAFFSTALL EQUIPMENT INC., 5149 E. 65th St., Indianapolis, Ind., 46220, Tel: 317-251-1476; Empl.: 13

For info on price: E.L. Shaffstall; Customer service: J. Ashby

Products manufactured: Readers, Recorders

SHAKESPEARE, Box 246, Columbia, S.C., 29202, Tel: 803-779-5800; Empl.: 268; Minimum order: $225

For info on price: R. Bedenbaugh; Application info: T. Bryant; Customer service: R. Scott; Delivery info: R. Scott

Free literature available: Full antenna Line Catalog; Royal Line Catalog-insert catalog, with full line of antennas and accessories; Marine Antenna Catalog-Full color catalog.

Products manufactured: Antennas, Tubing

Local Sales Offices & Reps.

Cal	Los Angeles, Wallace & Wallace	213-747-0401
Cal	Sausalito, B.H. Ballard Co.	415-332-0105
Colo	Aurora, A.E.S. Sls.	303-366-0208
Fla	Ft. Lauderdale, Sproch Sls.	305-587-3792
Ga	Savannah, Len Sherman Assocs.	912-925-3660
Ill	Chicago, Lassers & Co.	312-539-0170
Ind	Indianapolis, Kingston-Sharkey Assoc.	317-353-9406
Mich	Grand Rapids, L. Drieborg Co.	616-453-1242
Minn	St. Paul, Carl M. Co.	612-699-8004
Neb	Lincoln, Marketing Assocs.	402-464-5244
NY	S. Farmingdale, C. Drexler Co.	516-249-8206
Ohio	Youngstown, Repcom of Ohio	216-788-9404
Tex	Houston, B. Wylds Co.	713-467-0072
Utah	Murray, Kenealey Assocs.	801-268-3111
Va	Gwynn, L.H. Arnold Co.	804-725-7111

SHALLCO, INC., Box 1089, Smithfield, N.C., 27577, Tel: 919-934-3135, TWX: 510-939-1455; Empl.: 25; Minimum order: $20 .... p. 1•28,29,2272-2275; p. 2•1543

For info on price: M. Sutton; Application info: M. Sutton; Customer service: E. Lee; Delivery info: E. Lee

Free literature available: Catalog 101-attenuators, audio & RF, Catalog 102-rotary switches, Catalog 300-precision wirewound resistors

Products manufactured: Attenuators, Demagnetizers, Equalizers, Networks, Resistors, Standards, Switches

Local Sales Offices & Reps.

Cal	Los Angeles, WCV Co.	213-772-4479
Cal	Mountain View, WCV Co.	415-961-5096
Colo	Denver, Vinson Assocs.	303-757-5152
Fla	Winter Park, Ridge Instr. Co.	305-293-4711
NJ	So. Orange, SSAI	201-763-7900
NY	Rochester, D. Hurley Sls.	716-586-6159
NC	Smithfield, Byrd & Barbour Sls., Inc.	919-934-8136
Tex	Dallas, Unidyne, Inc.	214-234-3281
Wash	Seattle, Underwood & Underwood, Inc.	206-243-2133

SHALLCROSS, See Cutler Hammer Shallcross.

SHANNON LUMINOUS MAT'LS., Div. Shannon-Glow Inc., 7356 Santa Monica Blvd., Hollywood, Cal., 90046, Tel: 213-876-2660; Empl.: 10; Minimum order: $10

Free literature available: 1-Black Light & Luminous Products; 2-Flourescent Tracer Products.

Products manufactured: Detectors, Kits, Test Equipment, Lamps, Lights, Lubricants, Ultraviolet Inspection Lighting

Local Sales Offices & Reps.

Cal	Downey, Uresco	213-773-3828

SHAPIRO SCIENTIFIC INST., 3500 E. Coast Hwy., Corona del Mar, Cal., 92625, Tel: 714-675-1024; Empl.: 5

For info on price: B. Kilpatrick

Free literature available: Condensed Specifications on: Transient Waveform Generator Model 1001, Specification, Paper Tape Program Reader Model 1101 & Waveform Conditioner Model 21. Operating Instructions, Model 1001 System.

Products manufactured: Generators

SHARP ELECTRONICS CORP., 10 Keystone Pl., Paramus, N.J., 07652, Tel: 201-265-5600, Telex: 134-327

Free literature available: Descriptive brochures - Specification sheets - for Calculator Models EL-8106/8107, PC-1002, CS-365P, CS-364P and CS-2153.

Products manufactured: Calculators, Electrical & Electronic

Local Sales Offices & Reps.

Cal	Long Beach
Ill	La Grange

SHELDAHL, INC., Electrical Prods. Div., Box 170, Northfield, Minn., 55057, Tel: 507-645-5633, TWX: 910-565-2180; Empl.: 219; Minimum order: $300 p. 2•355

Application info: J. McKee; Customer service: J. Mazzitelli

Free literature available: Brochures describing flexible printed circuit manufacture. Literature describing flexible circuit applications with samples attached. Engineering brochure with design guidelines and circuit calculator available upon letterhead request.

Products manufactured: Circuits, Flexible, Laminates, Tapes, Films & Foils, Pressure Sensitive

Local Sales Offices & Reps.

Cal	Encino, R.H. McDonald & Assocs.	213-986-5832
Cal	Fremont, H.K. Foraker Co.	415-657-2213
Colo	Boulder, Component Prods. Sls. Co.	303-444-2730
Fla	Cocoa, Orbe, Inc.	305-452-9568
Fla	Ft. Lauderdale, Orbe, Inc.	305-564-8571
Fla	Orlando, MacKay, Smith, & Assocs.	305-277-1513
Ill	Arlington Hts., R. Diethert Co.	312-593-7600
Iowa	Des Moines, B.E.A.M.S.	515-282-0292
Kans	Shawnee Mission B.E.A.M.S.	913-341-7744
Mass	Norwood, Sheldahl	617-762-5703
Mich	Benton Harbor, Hampton, Askin & Assocs.	616-925-0341
Mich	Troy, McPhail Corp.	313-689-6444
Mo	St. Louis B.E.A.M.S.	314-569-1060
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Jamaica, S-J Sls. Assocs.	212-291-3232
NC	Raleigh, R.W. Mitscher Co.	919-828-0575
Ohio	Columbus, McFadden Sls., Inc.	614-221-3363
Tenn	Shelbyville, R.W. Mitscher Co.	615-684-4544
Tex	Houston, Aid Elctrns., Inc.	713-777-3882
Tex	Irving, Aid Elctrns., Inc.	214-259-4761
Va	Troutville, R.W. Mitscher Co.	703-345-3283
Va	Virginia Beach, R.W. Mitscher Co.	804-481-7200
Wisc	Waukesha, R. Diethert Co.	414-547-6575
FOR:	Don Mills, Can. Ont., B.D. Vallillee Elctrns. Ltd.	416-447-8482

SHELLER-GLOBE CORP., Electro-Mechanical Instr. Div., Box 216, Perkasie, Pa., 18944, Tel: 215-249-9330, TWX: 510-665-9583; Empl.: 130 .... p. 1•668,669

Products manufactured: Indicators, Meters, Testers

Local Sales Offices & Reps.

Cal	Los Angeles, El-Com, Inc.	213-223-1351
Cal	San Carlos, D.H. Ross Co.	415-591-4411
Colo	Denver, K-C Marketers, Inc.	303-PE3-5561
Fla	Tampa, Nickerson Co.	813-885-1416
Ill	Chicago, Ropek & Cahill, Inc.	312-287-7292
Ind	Carmel, Rich Elctrn. Mktg.	317-844-8462
Kans	Shawnee Mission, Robinson & Assocs.	913-262-1374
Md	Silver Spring, H.R. Sieber Co.	301-589-9110
Mass	Boston, Anderson Sls. Co.	617-CA7-2980
Minn	Minneapolis, H.M.R., Inc.	612-920-8200
NJ	Haddonfield, T A I	609-UL4-3011
NY	Mt. Vernon, D. Sonkin Assocs.	914-MO8-9809
NY	Syracuse, Nycom, Inc.	315-437-8343
NC	Charlotte, Electro-Rep. Assocs., Inc.	704-527-2530
Ohio	Cleveland, Loesch Assocs., Inc.	216-241-4581

Pa	Philadelphia, Repco	215-722-3622
Tex	Richardson, Campion Sls. Co.	214-238-8145
Wash	Seattle, Underwood & Underwood	206-243-2133
FOR:	Can., Toronto, Ont., Wilson Enterprises	416-766-0510

SHELLY ASSOCS., Sub. of Datatron Inc., Box 11427, Santa Ana, Cal., 92711, Tel: 714-540-9330, TWX: 910-595-1589; Empl.: 45 .... p. 2•1186-1189

For info on price: G. Madole; Application info: D. Bloom; Customer service: L. Zahuranec; Delivery info: L. Zahuranec

Products manufactured: Annunciators, Bezels, Shielded & Unshielded, Display Devices/Displays, Indicators, Lamps, Lenses, Readout & Display, Lights

Local Sales Offices & Reps.

Ala	Huntsville, Tech. Reps.	205-881-5925
Ariz	Scottsdale, Williams Assoc.	602-947-4297
Cal	Anaheim, LoDan Inc.,	714-956-1560
Cal	Beverly Hills, I.A.S.	213-274-7578
Cal	San Carlos, Lo Dan Inc.	415-592-4600
Cal	San Diego, LoDan Inc	714-279-6383
Colo	Denver, Williams-Assoc.	303-373-4730
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
Fla	Ft. Lauderdale, Tech. Reps.	305-792-0962
Fla	Indian Rocks Beach, Tech. Reps.	813-595-2834
Ill	Broadview, L-Comp	312-865-7600
Ill	Chicago, G. McI. Cole Co.	312-774-3535
Md	Baltimore, Callas Elctrns.	301-744-7711
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Walled Lake, Berberich Assoc.	313-624-2211
Minn	Minneapolis, G.E. Arneson & Co.	612-835-2177
Mo	N. Kansas City, L-Comp	816-221-2400
Mo	St. Louis, L-Comp	314-647-5505
NH	Dover, R. Perron & Co.	603-742-2321
NJ	Harrington Park, Metro Tech. Sls.	201-768-8495
NM	Albuquerque, Williams-Assoc.	505-255-1638
NY	Fayetteville, Marty Andrews	315-637-3144
NY	Jamaica, Material for Electronics	212-322-9400
NY	Jericho, Metro Tech. Sls.	516-935-3330
Ohio	Dayton, Berberich Assoc.	513-433-0342
Pa	King of Prussia, White-Keystone	215-265-1817
Tex	Ft. Worth, Dyna Reps.	817-451-1392
Wash	Seattle, R. Thorpe & Co.	206-763-0545
FOR:	Can., Downsview, Ont., Tracan	416-638-0052
FOR:	Can., Montreal, Que., Tracan	514-341-4163
FOR:	Can., W. Vancouver B.C., Tracan	604-926-3411

Local Distributors

Cal	Alhambra, Ultex Corp., 2215 W. Valley Blvd.	213-289-9115
Cal	Mountain View, Ratel Elctrns., 815 Maude Ave.	415-965-2010
Fla	Indian Rocks Beach, Tech Rep., Box 508	813-595-2834
Ill	Broadview, LComp Chicago Inc., 2030 W. 16th St.	312-865-7600
Md	Baltimore, Callas Elctrns., 6409 Frederick	301-744-7711
Mass	Norwood, Value-Added Elctrns., 159 Morse St.	617-762-8114
Minn	Minneapolis, G.E. Arneson & Co., 4900 Viking Dr.	612-835-2177
Mo	St. Louis, LComp St. Louis Inc., 2605 S. Hanley Rd.	314-647-5505
NJ	Harrington Park, Metro Tech., 39 Blue Field Ave.	201-768-8495
NY	Jericho, Metro Tech., 333 N. Broadway	516-935-3330
Ohio	Dayton, Empire Systems, 94 Compark Dr.	513-433-0342
Tex	Ft. Worth, Dynareps, P.O. Box 8446	814-451-1392
Wash	Seattle, Shannon Ltd., 655 S Orcas	206-763-0545

SHESTER ENGINEERING CO., 8530 W. Washington Blvd., Culver City, Cal., 90230, Tel: 213-837-3332; Empl.: 9; Minimum order: $20

For info on price: J. M. Bingen; Application info: G. Shester; Customer service: J. M. Bingen; Delivery info: G. Shester

Products manufactured: Demagnetizers, Diodes, Magnetizers, Magnets, Power Supplies, Transformers

SHIGOTO INDS., LTD., 350 Fifth Ave., New York, N.Y., 10001, Tel: 212-695-0200; Empl.: 362 p. 1•2276; p. 2•2060

For info on price: M. Rubin; Application info: I. Weinstein; Customer service: E. Kramer; Delivery info: R. Evans

Free literature available: Catalogs Available- 1. Speakers, 2. Electronic Parts, 3. Resistors, 4. Reflex Horn Speakers, 5. Electronic Alarm Sirens, 6. Miniature and Subminiature Lamps, 7. Sharp Photo Optics, 8. Bolts/Screws/Nuts-Fasteners, 9. Capacitors, 10. Motors, 11. Closed Circuit TV Systems, 12. Microphones & Headphones

Products manufactured: Alarms, Amplifiers, Antennas, Arresters, Electrical Surge, Lightning, Batteries, Bearings, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Boards, Printed Circuit, Bobbins, Winding, Coil & Transformer, Bridges, Cable, Capacitors, Fixed, Capacitors, Variable, CATV Systems & Equipment, Cells, Photoconductive, Photoemissive, Photovoltaic, Chargers, Battery, Chokes, Clamps & Clips, Coils Including Assemblies & Forms, Comm. Systems, Connector Adapters, Connectors, Contact Strips, Finger, Cords, Counters, Couplers, Demagnetizers, Dials, Diodes, Display Devices/Displays, Drivers, Speaker, Eliminators, Battery, Fasteners, Flashers, Fuses, Grilles, Handsets, Chestsets, Headphones, Headsets, Etc., Heads, Recording Playback, Erase, Indicators, Insulators & Insulation, Integrated Circuit Devices, Inverters, Isolators, Jack Adapters (All Types), Jacks (All Types), Kits, Training Aid, Knives & Knife Sets, Knobs, Labels, Pressure-Sensitive, Adhesive, Laminations, Lamps, Lead Assemblies & Receptacles, Leads, Test & Adaptors, Lenses, Optical & Camera, Lights, Magnets, Meters, Microphones, All Kinds, Motor & Generator Armatures, Rotors, Stators, Motors, Nameplates, Networks, Phonographs, Parts & Accessories, Pickups, Telephone (For Recording), Plug Adapters, Plug & Jack Sets, Plugs, Posts, Potentiometers, Power Supplies, Public Address Systems, Rectifiers, Regulators, Relays, Resistors, Rheostats, Scissors, Screwdrivers, Sensors, Light, Services, Assembly, Production & Test, Shunts, Meter, Socket Adapters, Sockets, Solenoids, Speaker Systems, Speakers, Springs (All Types), Switches, Television Systems & Equipment Closed-Circuit, Terminal Blocks, Boards & Strips, Terminals, Testers, Thermistors, Thermostats, Timers, Tools, Transformers, Transistors, Tubes, Tuners, Wire, Wire Nuts

Local Sales Offices & Reps.

Ill	Park Ridge, Metcom Assocs. Corp.	312-696-1490
Md	Towson, Wyncote Instrumentation Co.	301-821-5422
Mich	Farmington, Miltimore Sls. Inc.	313-476-2446
Ohio	Chagrin Falls, Pine Sls. & Engrg. Co.	216-247-6198
Pa	Ambler, Wyncote Instrumentation Co.	215-643-2440

SHOWA MUSEN KOGYO CO., LTD., 5-5 6-Chome Togashi, Shinagawa-Ku Tokyo, Japan, Tel: 785-1111; Empl.: 1300

Products manufactured: Clamps & Clips, Connector Adapters, Connector Boxes & Strips, Power Outlet, Connectors, Insulators & Insulation, Jack Adapters (All Types), Jacks (All Types), Keyboards, Alphanumeric & Decimal, Panels, Plug Adapters, Plugs, Posts, Sockets, Switches, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Cal	Gardena, SMK Elctrns. Corp. of America	213-770-8915

SHURE BROTHERS, INC., 222 Hartrey Ave., Evanston, Ill., 60204, Tel: 312-DA8-9000, TWX: 910-231-0048

Customer service: 679-5830

Free literature available: Vocal Master Sound System Catalog - AL335; SR Professional Sound Reinforcement Equipment Catalog - AL470; High Fidelity Products Catalog - AL210; Microphones & Circuitry for Public Address, Tape Recording & Communications Catalog - AL 314; Professional Microphone Products Catalog - AL312.

Products manufactured: Accelerometers, Amplifiers, Attenuators, Cases, Equipment, Instrument, Meter, Equalizers, Filters, Generators, Handsets, Chestsets, Headphones, Headsets, Etc., Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Mixers, Networks, Phonographs, Parts & Accessories, Public Address Systems, Slide Rules (Circuitry Computing), Speaker Systems, Speakers, Transformers

SHURITE METERS, 428 Chapel St., New Haven, Conn., 06508, Tel: 203-787-5824, TWX: 710-465-3165; Minimum order: $25

Customer service: W. Fitzgerald 203-772-2220

Free literature available: Catalog 100B - Describes and illustrates various case styles and ranges available in inexpensive AC and DC Panel Meters.

Products manufactured: Meters

Local Sales Offices & Reps.

Cal	Inglewood, J. Berman Co.	213-678-1281
Cal	La Mesa, J. Berman Co.	714-583-6457
Cal	Oakland, Moulthrop Sls.	415-261-7676
Colo	Denver, Nelson Co.	303-573-1516
Conn	Wallingford, Adams-McGregor	203-269-5816
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Ga	Atlanta, Millar Elctrns.	404-261-6160
Ill	Oak Park, G. Petitt Co.	312-369-8940
Ind	Fort Wayne, W.W. Bieberich	219-432-2537
Kans	Overland Park, T.L. Dowell & Assocs.	913-236-8200
Md	Reisterstown, Massey Assocs.	301-833-2039
Mass	Scitaute, Adams-McGregor	617-542-3773
Mich	St. Clair Shores, J.M. Thorpe Co.	313-779-6363
Minn	Minneapolis, Heimann Co.	612-861-6051
NY	Long Island City, D.F. Tobias & Co.	212-545-9191
NY	Syracuse, H.R. Murray	315-446-5555
NC	Raleigh, Millar Elctrns.	919-787-9564
Ohio	Dayton, C.H. Dolfuss, Jr. & Co.	513-275-4831
Ohio	Rocky River, C.H. Dolfuss, Jr. & Co.	216-333-7504
Pa	Media, Snyder & Massey Assocs.	215-566-5400
Pa	Pittsburgh, G.S. Root & Co.	412-561-4125
RI	Lincoln, Adams-McGregor	401-726-1300
Tex	Dallas, Lund & Co.	214-358-4335
Wash	Seattle, J.J. Backer Co.	206-285-1300

SIEMENS CORP., Comps Div., Box 1390, Scottsdale, Ariz., 85252 .... p. 1•1858-1862

Products manufactured: Diodes

SIEMENS CORP., 186 Wood Ave., S., Iselin, N.J., 08830, Tel: 201-494-1000; Empl.: 800

Products manufactured: Amplifiers, Arresters, Electrical Surge, Lightning, Capacitors, Fixed, Cells, Photoconductive, Photoemissive, Photovoltaic, Chokes, Cores, Magnetic, Crystals, Diodes, Display Devices/Displays, Ferrite Material & Parts, Filters, Integrated Circuit Devices, Intensifiers, Image, Isolators, Lamps, Lasers & Laser Systems, Lights, Magnetoresistors, Hall, Power Supplies, Protectors, Recorders, Rectifiers, Relays, Resistors, Suppressors, Switches, Thyristors (Includes Silicon Controlled Rectifiers), Transistors, Tubes

Local Sales Offices & Reps.

Ala	Huntsville, Interep Assocs.	205-881-3677
Ariz	Scottsdale, Siemens	602-947-2231
Cal	Burlingame, Siemens	415-697-6851
Cal	El Segundo, Varigon Assocs.	213-679-0621
Cal	San Diego, S. R. Elctrns.	714-565-8411
Cal	San Leandro, Quadrep	415-352-5942
Cal	Sunnyvale, Quadrep	408-733-7300
Cal	Torrance, Siemens	213-370-3611
Colo	Denver, Omega Limited	303-758-1508
Conn	West Simsburg, Anchor Engrg. Corp.	203-658-6261
Fla	Clearwater, Perrott Assocs.	813-726-1529
Fla	Orlando, Perrott Assocs.	305-275-1132
Ga	Atlanta, Interep Assocs.	404-394-7756
Ill	Chicago, Siemens Corp.	312-671-2810
Iowa	Cedar Rapids, Gassner & Clark	319-393-5763
Md	Baltimore, J.A. Maguire Co.	301-377-0223
Mass	Newton Upper Falls, Anchor Engrg. Corp.	617-964-6205
Minn	St. Paul, Cahill Assocs.	612-646-7217
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Pennsauken, J.A. Maguire & Co.	609-665-5136
NM	Albuquerque, A. Q. Elctrns.	505-255-8701
NY	Plainview, E.R.A., Inc.	516-822-9890
NY	Rochester, Electra Sls.	716-436-4030
NY	Syracuse, Electra Sales	315-455-5783
NY	Syracuse, T-Squared	315-463-8592
NC	Winston-Salem, J.A. Maguire	919-723-5980
Ohio	Cleveland, C. Dolfuss Co.	216-333-7504
Tex	Dallas, Siemens	214-424-8333
Utah	Salt Lake City, Omega, Ltd.	801-266-9617
Wash	Bellevue, R. Over Sales	206-454-4551

SIEMENS CORP.-COMPUTEST PRODUCTS, Power Engrg. Div., 3 Computer Dr., Cherry Hill, N.J., 08002, Tel: 609-424-2400; Empl.: 225

Products manufactured: Test Systems, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, PLS Inc.	602-957-9110
Cal	Los Gatos, Yoshikawa Assocs.	408-374-3086
Cal	North Hollywood, E. Momjian Assocs.	213-764-4891
Cal	Sunnyvale, Siemens Corp.	408-734-8484
Colo	Denver, PLS Inc.	303-771-10599
Conn	Avon, Instrument Dynamics Inc.	203-678-1088
Fla	Orlando, Gentry Assocs.	305-894-4401
Kans	Prairie Village, Engineering Svcs.	913-649-4000
Md	Bethesda, Powell-Pendergraph Inc.	301-656-4535
Mass	Wakefield, Instrument Dynamics Inc.	617-245-5100
Mich	Royal Oak, Hocker Assocs.	313-549-3910
Minn	Minneapolis, Engineering Prods Assoc.	612-925-1883
Mo	St. Louis, Engineering Svcs.	314-997-1515
NJ	Berkley, AMC, Inc.	201-464-5100
NY	Liverpool, R & D Assocs.	315-622-2350
NC	Burlington, Gentry Assocs.	919-227-3639
NM	Albuquerque, PLS Inc.	505-255-2330
Ohio	Dayton, Hocker Assocs.	513-298-8638
Ohio	N. Olmstead, Hocker Assocs.	216-734-4433
Pa	Abington, Powell-Pendergraph Inc.	215-657-0330
Tex	Dallas, Data Aids Assocs.	214-620-1551
Tex	Houston, Data Aids Assocs.	713-862-6685
Va	Richmond, Powell-Pendergraph Inc.	804-264-2341
Wash	Seattle, Datacom	206-285-2525

SIERRA ELEC., Div. Sola Basic Inds., 15100 S. Figueroa St., Gardena, Calif., 90248, Tel: 213-321-1000; Empl.: 500; Minimum order: $25

For info on price: C. L. Keeshen; Application info: C. L. Keeshen; Customer service: D. Kaufman; Delivery info: D. Kaufman

Products manufactured: Antenna Feed Systems, Connector Boxes & Strips, Power Outlet, Indicators, Jack Adapters (All Types), Jack Covers, Jacks (All Types), Plug & Jack Sets, Relays, Sockets, Switch Mounting Plates, Switches

SIERRA SCIENTIFIC CORP., 2189 Leghorn St., Mountain View, Cal., 94043, Tel: 415-969-9315; Empl.: 35

Customer service: D. Gilblom

Free literature available: Technical descriptions and specificationf of television cameras and displays for medical, industrial, scientific, and OEM applications.

Products manufactured: Cameras, Monitors, Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Cal	Millbrae, Ashby Assocs. of No. Cal.	415-692-4442
Cal	Pasadena, A-F Sls. Engrg.	213-681-5631
Fla	Orlando, Datarep	305-843-5224
Fla	Pompano Beach, Datarep	305-781-9279
Mass	Attleboro, Elctrn. Sls. of New England	617-222-4078
Mass	Cambridge, Media Systems	617-876-0164
NJ	Totowa, H.M. Holzberg Assocs.	201-256-0455
Ohio	Dayton, Genelco	513-299-1819
Okla	Norman, Data Mktg Assocs.	405-364-8320
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Va	Vienna, Sutter & Co.	703-938-0505

SIERRACIN/MAGNEDYNE INC., 5580 El Camino Real, Box 458, Carlsbad, Calif., 92008, Tel: 714-729-7191, TWX: 910 322-1391; Empl.: 55

p. 1•982,983

Customer service: C. McElhiney

Free literature available: Data sheets and reduced drawings.

Products manufactured: Actuators, Motors, Tachometers

Local Sales Offices & Reps.

Ariz	Scottsdale, Kachina Assocs.	602-947-4472
Cal	Manhattan Beach, Tri-Tek	213-545-4649
Cal	Palo Alto, Harris Engrg. Assocs.	415-328-3370
Colo	Denver, Rope & Williamson	303-758-8507
Fla	St. Petersburg, Russell Assocs.	813-526-1134
Ill	Chicago, J. Popp Sls.	312-626-3711
Mich	Detroit, B E S C O	313-559-0444
Mich	Grand Rapids, B E S C O	616-942-1190
NJ	Wayne, SHL & Assocs.	201-523-1714
Ohio	Cleveland, D. Steffen & Assoc.	216-461-8333
Ohio	Dayton, D. Steffen & Assoc.	513-293-3145
Pa	Valley Forge, Gil-Tronics, Inc.	215-933-8525

SIERRACIN/THERMAL SYS., 13920 S. Broadway, Los Angeles, Cal., 90061, Tel: 213-FA1-4350, TWX: 910-346-6774; FSC No: 11416; Empl.: 110; Minimum order: $25

For info on price: E. W. Swanson; Application info: E. W. Swanson; Customer service: D. Jenson; Delivery info: D. Jenson

Free literature available: General Capabilities and Facility Brochure describing our ability to produce flexible electrical heating elements, temperature sensors and solid state electronic controllers and signal conditioning.

Products manufactured: Controls/Control Eqpt., Heaters & Heating Elements, Monitors, Ovens, Probes, Standards, Thermocouples, Elements & Accessories, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs.	205-837-4304
Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Costa Mesa, Scrantom Engr.	714-979-6373
Cal	Palo Alto, Harris Engr. Assoc.	415-328-3370
Colo	Boulder, R.A. Mayes Co.	303-444-07782
Conn	Guilford, R.H. Whitehead Assoc.	203-453-3762
Fla	Ft. Lauderdale, Orbe	305-564-8571
Ill	Oak Park, J. Popp Sls. Co.	312-626-3711
Kans	Overland Park, Penzner-Mankus Assocs.	913-381-0004
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	Boston, R.H. Whitehead Assocs.	617-542-7676
Mich	Plymouth, ROMARC	313-455-0300
Mo	Hazelwood, Penzner-Mankus Assoc.	314-731-4334
NJ	East Orange, Friedman Assoc.	201-673-2500
NM	Albuquerque, R.A. Mayes Co.	505-292-2330
NY	Buffalo, H.C. Johnson Agen.	716-632-7880
NY	Rochester, H.C. Johnson Agen.	716-482-3000
NC	Winston-Salem, Electronic Mktg. Assoc.	919-722-5151
Ohio	Cincinnati, Giesting & Assocs.	513-931-0812
Pa	Glenside, Elcom	215-885-1325
SC	Greenville, Electronic Mktg. Assoc.	803-268-1125
Tex	Dallas, Apogee Engr. Svcs.	214-352-2083
Wash	Renton, D & D Sls	206-226-4120

SIFCO METACHEMICAL, Div. Steel Improv. & Forging, 5708 Schaaf Rd., Independence, Ohio, 44131, Tel: 216-881-8600; Empl.: 25; Minimum order: $25

For info on price: J. White X345; Application info: J. Norris X348; Customer service: R. Jarnigan X346; Delivery info: V. Ehrenscheider X347

Free literature available: General and technical data on DALIC brush plating deposits and applications.

Products manufactured: Chemicals, Electroplating Equipment & Supplies, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Pasadena, Piddington Assoc.	213-795-8029

SIGMA INSTRUMENTS, INC., 170 Pearl St., Braintree, Mass., 02184, Tel: 617-843-5000, TWX: 710-348-1161; Empl.: 1050; Minimum order: $30

Customer service: Cust. Svc. Dept.

Free literature available: Relay Stock Catalog; Stepping Motor Catalog; Panel Meter Catalog.

Products manufactured: Alarms, Amplifiers, Controllers, Programmable, Controls/Control Eqpt., Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Drivers, Chopper, Drives & Drive Mechanisms (Dial), Encoders, Indicators, Isolators, Meters, Monitors, Motors, Power Drivers, Hybrid (High Current, High Voltage), Reactors, Relays, Sockets, Switches, Testers, Timers

Local Sales Offices & Reps.

Meters

Ala	Huntsville, Brandel-Stephens & Co.	205-883-0445
Ariz	Phoenix, J S Heaton Co.	602-264-7887
Cal	Burlingame, Engrg. Reps. Co.	415-692-2481
Cal	Hawthorne, Barnard & Assocs.	213-973-5050
Cal	San Diego, Engrg. Reps. Co.	714-296-2925
Colo	Englewood, Tech Sls.	303-789-2864
Conn	Middletown, Roy Dennis Co.	203-344-3273
Fla	Deerfield Beach, Brandel-Stephens & Co.	305-399-8558
Fla	Orlando, Brandel-Stephens & Co.	305-425-3202
Ga	Atlanta, Brandel-Stephens & Co.	404-261-7579
Ill	Chicago, Gassner & Clark Co.	312-764-6121
Kans	Kansas City, Technical Sls. Assocs.	913-888-3330
La	Harahan, Williams Equip. Co.	504-737-4082
Md	Baltimore, J.R. Daniel Co.	301-825-3330
Mass	Needham, Northeast Reps.	617-449-3034
Mich	Detroit, Stress Analysis Svcs.	313-535-1120
Minn	Minneapolis, Pilot Sls. & Engrg.	612-546-4328
Mo	Ferguson, Technical Sls. Assocs.	314-725-5361
NJ	Stirling, NBS Assocs.	201-464-8500
NM	Albuquerque, J.S. Heaton Co.	505-293-3900
NY	Albany, H.C. Johnson Agencies	518-456-9681
NY	Binghamton, H.C. Johnson Agencies	607-723-6500
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Rochester, H.C. Johnson Agencies	716-482-3000
NY	Syracuse, H.C. Johnson Agencies	315-637-9383
NC	Charlotte, D.G.W., Inc.	704-334-7090
NC	Winston-Salem, D.G.W., Inc.	919-768-7166
Ohio	Medina, Stress Analysis Svcs.	216-725-7733
Okla	Tulsa, Telstar Inst. Corp.	918-628-1011
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Pa	Philadelphia, Stitzer Assocs.	215-644-5500
Tex	Dallas, J.B. Guenther	214-528-6286
Tex	Houston, J.B. Guenther	713-468-0232
Wash	Tukwila, General Elctrns.	206-243-5141

Motors

Ariz	Phoenix, J S Heaton Co.	602-264-7887
Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Jose, J. T. McFarland Assocs.	408-268-2600
Colo	Denver, Thorson Co.	303-759-0809
Conn	Torrington, Motoreps of New England	203-482-3193
Ga	Lilburn, Motion Technology	404-233-4368
Ill	Des Plaines, Control Sls.	312-774-1674
Ind	Indianapolis, L.M. DeVoe Co.	317-257-1227
Kans	Kansas City, Technical Sls. Assocs.	913-888-3330
Md	New Carrollton, W.A. Brown Equip-Comp	301-577-4527
Mich	Troy, Control Sls. Assocs.	313-391-3235
Minn	Minnetonka, T.H. Ayre, Assoc.	612-474-4125
Mo	Ferguson, Technical Sls. Assocs.	314-725-5361
NJ	Camden, QED Elctrns.	215-925-8711
NJ	Red Bank, Motoreps of N.Y.	201-741-3356
NM	Albuquerque, J.S. Heaton Co.	505-293-3900
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Rochester, H.C. Johnson Agencies	716-482-3000
NC	Charlotte, Motion Technology	704-525-9855
Ohio	Chagrin Falls, Drivex Corp.	216-247-6701
Ohio	Cincinnati, Drivex Corp.	513-825-3583
Okla	Broken Arrow, P.J. Scanlon Co.	918-251-1427
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Tex	Dallas, P.J. Scanlon Co.	214-231-4661
Va	Alexandria, W.A. Brown Equip-Comp.	703-360-5375
Wash	Tukwila, General Elctrns.	206-243-5141
Wisc	Milwaukee, Control Sls.	414-964-3322

Relays

Ala	Huntsville, Brandel-Stephens & Co.	205-883-0445
Ariz	Phoenix, J S Heaton Co.	602-264-7887
Cal	El Segundo, Varigon Assocs.	213-679-0621
Cal	Los Altos, Ewing-Foley, Inc.	415-941-4525
Cal	San Diego, Daniels & Doty Sls. Co.	714-560-6266
Conn	North Haven, Northeast Reps.	203-239-2507
Fla	Deerfield Beach, Brandel-Stephens & Co.	305-399-8558
Fla	Orlando, Brandel-Stephens & Co.	305-425-3202
Ga	Atlanta, Brandel-Stephens & Co.	404-261-7579
Ill	Des Plaines, 312-774-1674	
Ind	Indianapolis, L.M. DeVoe Co.	317-257-1227
Kans	Kansas City, Technical Sls. Assocs.	913-888-3330
Md	Baltimore, Coulbourn DeGrief, Inc.	301-247-4646
Mass	Needham, Northeast Reps.	617-449-3034
Mich	Southfield, R.C. Nordstrom & Co.	313-559-7373
Minn	Edina, Wagner Consltg. Corp.	612-941-6310
Mo	Ferguson, Technical Sls. Assocs.	314-725-5361
NJ	Irvington, M. Gallagher, Inc.	201-399-4350
NM	Albuquerque, J.S. Heaton Co.	505-293-3900
NY	Binghamton, H.C. Johnson Agencies	607-723-6500
NY	Buffalo, H.C. Johnson Agencies	716-632-7880
NY	Rochester, H.C. Johnson Agencies	716-482-3000
NY	Syracuse, H.C. Johnson Agencies	315-637-9383
NC	Charlotte, D.G.W., Inc.	704-334-7090
NC	Winston-Salem, D.G.W., Inc.	919-768-7166
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3131
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414
Pa	Media, W. Reeves Assocs.	215-566-6709
Tex	Dallas, P.J. Scanlon Co.	214-231-4661
Wash	Tukwila, General Elctrns.	206-243-5141

Wisc	Milwaukee, Control Sls.	414-964-3322

SIGMA SYS. CORP., 3163 Adams Ave., San Diego, Calif., 92116, Tel: 714-283-3193; Empl.: 8; Minimum order: $15

Customer service: T. Stewart

Free literature available: Heat Gun - temperature controlled: brochure describes features (some patented), applications, economic factors of use. Model C precision temperature chamber controller for upgrade/retrofit on old and modern chambers. Gives specs, instructions & function connections. Liquid carbon dioxide conditioners: for temperature chamber users. Brochure describes cleaning (by distillation), drying and prechilling liquid Co2 plus method of distribution in vapor stage thru uninsulated lines. Precision temperature chambers. Brochure gives features & specs on line of std. chambers, sizes from 25 to 150 liters.

Products manufactured: Chamber, Environmental Test, Controls/Control Eqpt., Heat Guns, Production

Advertisment

Liquid cardon dioxide conditioners for temperature chamber users. Sigma's model CDC-12 cleans (by distillation), drys and precools liquid Carbon Dioxide and permits its distribution in vapor stage through uninsulated lines. Also standard & custom chambers plus retrofit three mode controllers.

SIGNAL TRANSFORMER CO., 1 Junius St., Brooklyn, N.Y., 11212, Tel: 212-498-5111, Telex: 12-5709; Empl.: 90 .... p. 2•1791-1802

For info on price: A. Leibonitz; Application info: J. Millman; Customer service: A. Skurnick; Delivery info: S. Jaffee

Products manufactured: Chokes, Transformers

SIGNALITE DIV., Gen. Instr., 1933 Heck Ave., Neptune, N.J., 07753, Tel: 201-775-2490, TWX: 201-775-2255; Empl.: 300; Minimum order: $30

For info on price: N. Fraser; Application info: T. Wolstencroft; Customer service: B. Bry; Delivery info: B. Bry

Free literature available: Neon glow lamps - definition & specs; Comm gaps, Spark gap, Regulators - brief tech bulletins; Noise source catalogue - definition & specs.

Products manufactured: Arresters, Electrical Surge, Lightning, Diodes, Display Devices/Displays, Lamps, Regulators

Local Sales Offices & Reps.

Cal	Los Altos, W.W. Posey Co.	415-948-7771
Cal	N. Hollywood, Chicago Miniature	213-877-0887
Colo	Denver, Lindberg Co.	303-758-9033
Conn	Newton, Gerber Sls. Corp.	203-426-3440
Fla	Hollywood, Component Engr. Sls.	305-922-5230
Ill	Elk Grove Village, J.G. Twist Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell Assocs.	317-452-6065
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell & Assocs.	502-893-7303
Mass	East Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Grand Rapids, R.O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Minneapolis, Nortec Sls. Inc.	612-835-7414
Miss	Corinth, Rakes Engr. & Mkt. Corp.	601-287-2055
Mo	St. Louis, J.G. Twist Co.	314-432-2830
NJ	Neptune, Signalite	201-775-2490
NY	Syracuse, Nycom Inc.	315-437-8343
NC	Charlotte, B. Henry Assocs.	704-375-8958
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Columbus, R.O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assocs.	513-298-9546
Ohio	Lakewood, R.O. Whitesell & Assocs.	216-228-7525
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Pa	Pittsburgh, R.O. Whitesell & Assocs.	412-344-7277
Tenn	Bristol, Rakes Engr. & Mkt. Corp.	615-968-4195
Tex	Dallas, J.B. Guenther	214-691-8500
Tex	Houston, J.B. Guenther	713-468-0232
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Va	Woodbridge, M. Lader Co.	202-296-2497
Wash	Seattle, Blum & Assocs.	206-285-2590
Wisc	Wauwatosa, J.G. Twist Co.	414-475-7755
FOR:	Can., Montreal, Gen. Instr. Can.	514-636-9454
FOR:	Can., Toronto 338, Ont., Gen. Instr. Can.	416-763-4133

SIGNET SCIENTIFIC CO., Box 6489, Burbank, Cal., 91510, Tel: 213-849-6071, TWX: 910-498-2212; Empl.: 35; Minimum order: $25

Customer service: D. Salisbury

Products manufactured: Controls/Control Eqpt., Heaters & Heating Elements, Lights, Monitors, Oceanographic Equip. (Electronic), Ovens, Switches, Transducers

SIGNETICS CORP., 811 E. Arques Ave., Sunnyvale, Cal., 94086, Tel: 408-739-7700, TWX: 910-339-9220; Minimum order: $250

Products manufactured: Integrated Circuit Devices, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Phoenix, Signetics Corp.	602-971-2517
Cal	Encino, Signetics Corp.	213-990-2610
Cal	Irvine, Signetics Corp.	714-833-8980
Cal	San Diego, Signetics Corp.	714-560-0242
Cal	Sunnyvale, Signetics Corp.	408-736-7565
Colo	Denver, Parker/Webster Co.	303-770-1972
Conn	Hamden, Kanan Assocs.	203-288-9276
Fla	Altamonte Springs, Wmm Assocs.	305-831-4645
Fla	Clearwater, Signetics Corp.	813-531-3359
Fla	Pompano Beach, Signetics Corp.	305-782-8225
Ga	Douglasville, 20th Century Mktg.	404-942-6483
Ill	Rolling Meadows, Signetics Corp.	312-259-8300
Ind	Indianapolis, Signetics Corp.	317-545-3232
Kans	Olathe, B.C. Elctrn. Sls.	913-782-6696
Md	Rockville, Signetics Corp.	301-881-5710
Mass	Lexington, Signetics Corp.	617-861-0840
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Detroit, Rathsburg Assocs.	313-882-1717
Minn	Minneapolis, Signetics Corp.	612-884-7451
Mo	Hazelwood, B.C. Elctrn. Sls.	314-731-1255
NJ	Medford, Signetics Corp.	609-665-5071
NJ	Piscataway, Signetics Corp.	201-981-0123
NM	Albuquerque, Staley Co.	505-294-2660
NY	Dewitt, Tri Tech Elctrns.	315-446-2881
NY	E. Rochester, Tri Tech Elctrns.	916-381-2722
NY	Larchmont, Tri Tech Elctrns.	914-834-4423
NY	Wappingers Falls, Signetics Corp.	914-297-4074
NY	Woodbury, Signetics Corp.	516-364-9100
Ohio	Centerville, N. Case Assocs.	513-433-0966
Ohio	Fairview Park, N. Case Assocs.	216-333-4120
Ore	Portland, Western Tech. Sls.	503-297-1711
Tex	Dallas, Signetics Corp.	214-661-1296
Tex	Houston, Signetics Corp.	713-771-9265
Utah	Salt Lake City, Parker/Webster	801-486-3737
Wash	Bellevue, Western Tech. Sls.	206-641-3900

Local Distributors

Ariz	Phoenix, Hamilton/Avnet Elctrns., 2615 S. 21st St.	602-275-7851
Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	602-273-7331
Cal	Culver City, Hamilton Electro Sls., 10912 W. Washington	213-870-7171
Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Los Angeles, Kierulff Elctrns., 2585 Commerce Way	213-685-5511
Cal	Mountain View, Hamilton/Avnet Elctrns., 575 East Middlefield Rd.	415-961-7000
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	San Diego, Cramer Elctrns., 8913 Complex Dr., Suite E	714-565-1881
Cal	San Diego, Hamilton/Avnet Elctrns., 8917 Complex Dr.	714-279-2421
Cal	San Diego, Kierulff Elctrns., 8797 Balbooa Ave.	714-278-2112
Cal	Sunnyvale, Cramer Elctrns., 720 Palomar	408-739-3011
Colo	Denver, Cramer Elctrns., 5465 Evans Pl. at Hudson	303-758-2100
Colo	Denver, Hamilton/Avnet Elctrns., 5921 N. Broadway	303-534-1212
Conn	Georgetown, Hamilton/Avnet Elctrns., 643 Danbury Rd.	203-762-0361
Conn	Hamden, Arrow Elctrns., 295 Treadwell St.	203-248-3801
Conn	North Haven, Cramer Elctrns., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Hamilton/Avnet Elctrns., 4020 No. 29th Ave.	305-925-5401
Fla	Hollywood, Schweber Elctrns., 2830 N. 28th Terrace	305-927-0511
Fla	Orlando, Hammond Elctrns., 911 W. Central Blvd.	305-241-6601
Ga	Atlanta, Schweber Elctrns., 4126 Pleasantdale Rd., Suite 14	404-449-9170
Ga	Norcross, Hamilton/Avnet Elctrns., 6700 Interstate 85 Access Rd.	404-448-0800
Ill	Elk Grove, Schweber Elctrns., 1380 Javis Ave.	312-593-2740
Ill	Elmhurst, Semiconductor Specialists, 195 Spangler Ave.	312-279-1000
Ill	Schiller Park, Hamilton/Avnet Elctrns., 3901 No. 25th Ave.	312-678-6310
Ind	Indianapolis, Semiconductor Specialists, Box 41630	317-243-8271
Kans	Lenexa, Hall-Mark Elctrns., 9006 Rosehill Rd.	913-888-4747
Kans	Lenexa, Hamilton/Avnet Elctrns., 37 Lenexa Ind'l. Center, 9900 Pflumm Rd.	913-888-8900
Md	Hanover, Hamilton/Avnet Elctrns., 7255 Standard Dr.	301-796-5000
Md	Rockville, Pioneer Washington Elctrns., 1037 Taft St.	301-424-3300
Md	Rockville, Schweber Elctrns., 5640 Fisher La.	301-881-2970
Mass	Burlington, Hamilton/Avnet Elctrns., 185 Cambridge St.	617-273-2120
Mass	Newton, Cramer, 85 Wells Ave.	617-969-7700
Mass	Waltham, Schweber Elctrns., 213 Third Ave.	617-890-8484
Mich	Farmington, Semiconductor Specialists, 33505 State St.	313-478-2700
Mich	Livonia, Hamilton/Avnet Elctrns., 12870 Farmington Rd.	313-522-4700
Mich	Troy, Schweber Elctrns., 86 Executive Drive	313-583-9242
Minn	Edina, Hamilton/Avnet Elctrns., 7683 Washington Ave. S.	612-941-3801
Minn	Edina, Schweber Elctrns., 7015 Washington Ave., S.	612-944-5280
Minn	Minneapolis, Semiconductor Specialists, 8030 Cedar AVe. S.	612-845-8844
Mo	Hazelwood, Hamilton/Avnet Elctrns., 364 Brookes La.	314-731-1144
Mo	St. Louis, Hall-Mark Elctrns., 6100 Madison Ave.	314-521-3800
NJ	Cedar Grove, Hamilton/Avnet Elctrns., 218 Little Falls Rd.	201-239-0800
NJ	Cherry Hill, Milgray-Delaware Valley, 1165 Marlkress Rd.	609-424-1300
NJ	Moorestown, Arrow/Angus Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Mt. Laurel, Hamilton/Avnet Elctrns., 113 Gaither Dr., E. Gate Ind'l. Pk.	609-234-2133
NJ	Saddlebrook, Arrow Elctrns., 285 Midland Ave.	201-797-5800
NJ	Somerset, Schweber Elctrns., 43 Belmont Dr.	201-469-6008
NM	Albuquerque, Cramer Elctrns., 137 Vermont, N.E.	505-265-5767
NM	Albuquerque, Hamilton/Avnet Elctrns., 2450 Baylor Dr. S.E.	505-765-1500
NY	Buffalo, Summit Dist., 916 Main ST.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Rochester, Schweber Elctrns., 2 Townline Circle	716-461-4000
NY	Syracuse, Hamilton/Avnet Elctrns., 6500 Joy Rd.	315-437-2642
NY	Westbury, Hamilton/Avnet Elctrns., 70 State St.	516-333-5800
NY	Westbury, Schweber Elctrns., Jericho Tpk.	516-334-7474
NC	Greensboro, Hammond Elctrns., Box 21728	919-275-6391
Ohio	Beechwood, Schweber Elctrns., 23880 Commerce Pk Rd.	216-464-2970
Ohio	Cleveland, Arrow Elctrns., 23500 Mercantile Rd.	216-464-2000
Ohio	Cleveland, Pioneer Standard Elctrns., 4800 E. 131st St.	216-587-3600
Ohio	Kettering, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
OHio	Dayton, Hamilton/Avnet Elctrns., 118 W. Park Rd.	513-433-0610

Tex	Austin, Schweber Elctrns., 2628 Longhorn B	512-837-2890
Tex	Dallas, Cramer Elctrns., 13740 Midway Rd.	214-661-9300
Tex	Dallas, Hamilton/Avnet Elctrns., 4445 Sigma Rd.	214-661-8661
Tex	Dallas, Schweber Elctrns., 14177 Proton	214-661-5010
Tex	Houston, Component Specialties, 7313 Ashcroft, Suite 202	713-771-7237
Tex	Houston, Hamilton/Avnet Elctrns., 1216 W. Clay St.	713-526-4661
Tex	Houston, Schweber Elctrns., 7420 Harwin Dr.	713-784-3600
Utah	Salt Lake City, Alta Elctrns., 2280 S. Main St.	801-486-7227
Utah	Salt Lake City, Hamilton/Avnet Elctrns., 647 West Billins Rd.	801-262-8451
Wash	Bellevue, Hamilton/Avnet Elctrns., 13407 Northrup Way	206-746-8750
Wash	Seattle, Cramer Elctrns., 5602 6th Ave. S.	206-762-5722

SILICON GENERAL INC., 7382 Bolsa Avenue, Westminster, Cal., 92683

SILICON GENERAL INC., 2712 McGaw Ave., Irvine, Cal., 92705

SILICON SYSTEMS INC., 2913 Daimler St., Santa Ana, Cal., 92705, Tel: 714-979-0941; Empl.: 11; Minimum order: $100

Customer service: E. F. Klein

Products manufactured: Integrated Circuit Devices, Semiconductor Wafer Fabrication, Services, Assembly, Production & Test

SILICON TRANSISTOR CORP., Katrina Rd., Chelmsford, Mass., 01824

SILICONIX, INC., 2201 Laurelwood Rd., Santa Clara, Cal, 95054, Tel: 408-246-8000; FSC No: 17856; Empl.: 1000; Minimum order: $250

For info on price: R. Landon Ext. 121; Application info: R. Landon Ext. 121; Customer service: S. Buckwald Ext. 210; Delivery info: S. Buckwald Ext. 210

Free literature available: Applications literature on discrete FETs, current limiters, voltage-controlled resistors, plus ICs for analog switching, A/D conversion, micropower multiple op amps.

Products manufactured: Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Comparators, Converters, Diodes, Drivers, Switch, Integrated Circuit Devices, Multiplexers, Resistors, Switches, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Rep., Inc.	205-881-9270
Ariz	Phoenix, Siliconix, Inc.	602-264-3330
Cal	Long Beach, Siliconix, Inc.	213-420-1307
Cal	Santa Clara, Siliconix, Inc.	408-246-8000
Colo	Denver, Parker Webster Co.	303-770-1972
Colo	Denver, Siliconix, Inc.	303-778-1918
Fla	Clearwater, Perrott Assocs.	813-531-5513
Fla	Orlando, Perrott Assocs.	305-275-1132
Ga	Atlanta, Rep	404-876-1591
Ill	Wheeling, Siliconix, Inc.	312-541-0131
Iowa	Cedar Rapids, Comstrand	319-363-7495
Md	Camp Springs, Siliconix, Inc.	301-899-3110
Mass	Waltham, Siliconix, Inc.	617-890-7181
Minn	Minneapolis, Comstrand	612-560-5300
Minn	Minneapolis, Siliconix, Inc.	612-838-2515
NY	Baldwin, R.O.M.E.	516-589-8285
NY	Bethpage, Siliconix, Inc.	516-796-4680
NY	Pittsford, T2 Elctrns.	716-381-2551
NY	Syracuse, T2 Elctrns.	315-463-8592
Pa	Erie, Ecco Sls. Co.	814-455-8110
Pa	Ft. Washington, GCM Assoc.	215-646-7535
SC	Spartansburg, Beacon Assocs.	803-582-4613
Tex	Houston, Semiconductor Sls. Assoc.	713-461-4197
Tex	Richardson, Semiconductor Sls. Assoc.	214-231-8151
Wash	Seattle, B. Hirsh Co.	206-783-3423
Wisc	Greendale, J.M. Sls. Co.	414-421-6990

SILTEC CORP., 3717 Haven Ave., Menlo Park, Cal., 94025, Tel: 415-365-8600, Telex: 34-5503; Empl.: 250; Minimum order: $50

For info on price: W. D. Jordan; Application info: G. R. Duncan; Customer service: G. D. Duncan; Delivery info: J. Gontang

Free literature available: Crystal Growing Furnace - Model 860C, resistance heated, production furnace for growing silicon crystals by Czochralski technique. Diameters over 4 inches and charge weight up to 12 kg. Crystal Slicing Machine - Model NAV 701B, uses I.D. diamond wheels for precision wafering of brittle materials. Polishing Machine - Model 320A, high capacity high quality and automatic polishing of silicon wafers. Uses 1 step, no damage, polishing process. Dielectric Defect Detector - Model 201, uses Electrolytic/Electrophoretic Decoration process to detect pinhole defects in dielectric layers. Wire Bond Pull Tester - Model 220, permits non-destructive screening and testing of fine wires and bonds in semiconductors.

Products manufactured: Crystals, Detectors, Machines/Machinery, Production, Ovens, Semiconductor Wafer Fabrication

Local Sales Offices & Reps.

Ariz	Phoenix, Sterns and Assocs.	602-996-9077
Cal	Menlo Park, Siltec Corp.	415-365-8600
NJ	Belleville, RHB Sls. Co.	201-687-6220
Pa	Franconia, RHB Sls. Co.	215-368-2017
RI	Woonsecket, TEC Sls. of New England	401-766-3531
Tex	Dallas, Metron-Central	214-234-1411

SIMMONDS PRECISION, Engine Systems Div., Norwich, N.Y., 13815, Tel: 607-334-3264, TWX: 510-261-7776; Empl.: 390

For info on price: L. S. Colwell; Application info: L. S. Colwell; Customer service: R. Figary

Free literature available: High temp cable assemblies; Mica paper capacitors; Cables & connectors; High temp sensing systems (2).

Products manufactured: Cable, Capacitors, Fixed, Connectors, Discharge Systems, Energy, Feedthrus & Seals, Environmental, Filters, Lead Assemblies & Receptacles, Networks, Probes, Seals, Spark Gaps, Thermocouples, Elements & Accessories, Tubes

SIMMONS FASTENER CORP., 1745 North Broadway, Albany, N.Y., 12201, Tel: 518-463-4234, TWX: 710-441-8284; Empl.: 250; Minimum order: $25

For info on price: H. H. Rose; Application info: H. H. Rose; Customer service: F. J. Pufpaff; Delivery info: F. J. Pufpaff

Free literature available: 36-page catalog presents features, photos, illustrations, engineering drawings and application information on company's full line of quick-operating fasteners for electronics and other industrial uses.

Products manufactured: Clamps & Clips, Fasteners, Services, Assembly, Production & Test, Wire & Cable Ties

Local Sales Offices & Reps.

Cal	Los Angeles, El-Com Sls. Co.	213-223-1351
Cal	Mountain View, Hylad Entprs.	415-961-1250
Fla	Orlando, Triflex	305-841-1632
Ill	Crystal Lake, E. S. Healy & Assocs.	815-459-4386
Iowa	Cedar Rapids, F. A. Noll	319-364-3271
Mass	Needham, White Sls. Co.	617-444-3676
Mich	Warren, w. T. Peterson Co.	313-754-8600
Minn	Minneapolis, R. E. Kenney Co.	612-929-6222
NY	Pelham, Facilities Unlimited	914-946-3416
Ohio	Cincinnati, A. C. Wahl & Assocs.	513-821-3270
Pa	Philadelphia, C. H. Stratton Co.	215-247-7869
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2292
Tex	Dallas, Tech Sls. Co.	214-631-8820
Wash	Seattle, G. M. Gillett & Assocs.	206-284-3344

SIMPSON ELECTRIC CO., 853 Dundee Rd., Elgin, Ill., 60120, Tel: 312-697-2260; Empl.: 1000 .... p. 1•802-805

For info on price: Sls. Off.; Application info: J. Petroselli; Customer service: G. Olofson; Delivery info: Sls. Off.

Free literature available: 4400 General Catalog contains all products and pricing (Free).

Products manufactured: Bridges, Calibrators, Cases, Equipment, Instrument, Meter, Controls/Control Eqpt., Counters, Indicators, Meters, Monitors, Oscilloscopes, Probes, Pyrometers, Recorders, Relays, Sensors, Light, Shunts, Meter, Standards, Tachometers, Testers, Thermocouples, Elements & Accessories, Thermometers, Resistance

Local Sales Offices & Reps.

Alas	Anchorage, H.J. Lang	279-5741
Cal	Burlingame, W.J. Purdy Assoc.	415-347-7701
Cal	Monrovia, Simpson Sls.	213-359-8132
Cal	Sacramento, W.J. Purdy Assoc.	916-422-0128
Colo	Denver, R.G. Bowen Co.	303-722-4641
Conn	Meriden, P.R. Sturgeon	203-237-1112
DC	Washington, S.K. MacDonald	202-265-3938
Fla	Orlando, Cartwright & Bean	305-422-4531
Ga	Atlanta, Cartwright & Bean	404-255-5262
Ill	Elgin, T. Franks	312-697-2260
Ind	Indianapolis, L.M. De Voe Co.	317-257-1227
Iowa	Des Moines, K. Kelly	515-255-4584
Kans	Shawnee Mission, K. Kelly	913-722-0000
La	Chalmette, C. Bean	504-279-4598
Md	Baltimore, S.K. MacDonald, Inc.	301-254-3381
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Mich	Detroit, R.C. Merchant Co.	313-535-6000
Mich	St. Joseph, R.C. Merchant Co.	616-983-7378
Minn	Edina, M. Foster & Co.	612-835-2252
Miss	Jackson, Cartwright & Bean Co.	601-981-1368
Mo	St. Louis, Kelly	314-968-3800
NM	Albuquerque, C.T. Carlberg	505-265-1579
NY	Great Neck, Simpson N.Y.	212-683-0674
NY	North Syracuse, L.D. Allen Inc.	315-458-7470
Ohio	Cleveland, Baehr-Greenleaf & Assoc.	216-221-9030
Okla	Tulsa, J.Y. Schoonmaker Co.	918-936-1423
Ore	Portland, Earl & Brown	503-245-2283
Pa	Pittsburgh, S.K. MacDonald Inc.	412-366-2643
Tenn	Memphis, Cartwright & Bean Co.	901-276-4442
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Wash	Seattle, Earl & Brown	206-284-1121
Wisc	Milwaukee, E. Dickinson	414-264-1080
EXP:	Elgin, Simpson Electric	312-697-2260

SINCLAIR RADIO LABS., 122 Rayette Road, Concord, Ontario, Can. L4K 1B6, Tel: 416-669-1244; Empl.: 100; Minimum order: $50

For info on price: J. Morrison; Application info: J. Morrison; Customer service: M. Peace; Delivery info: M. Peace

Products manufactured: Amplifiers, Antennas, Attenuators, Filters, Mounts, Tees, Transformers

Local Sales Offices & Reps.

NY	Tonawanda
FOR:	Can., Dorval, Que.
FOR:	Can., N. Burnaby, B.C.

SINCLAIR RADIONICS, INC., 375 Park Ave., New York, N.Y., 10022, Tel: 212-688-6623

For info on price: D. Presser; Application info: D. Presser; Customer service: M. Wilkes; Delivery info: H. Smith

Products manufactured: Calculators, Electrical & Electronic

SINGER CO., 1150 McBride Rd., Little Falls, N.J., 07424

SINGER CO., American Meter Div., 13500 Philmont Ave., Philadelphia, Pa., 19116, Tel: 215-673-2100, TWX: 710-670-0965

Customer service: Ind'l. Sls. Off.

Free literature available: Bulletin 350-Gas Metering Instrumentation, Bulletin 351-Environmental Control, GC-100-Puneumatic/Electric Mechanical Instrumentation.

Products manufactured: Controls/Control Eqpt., Filters, Meters, Transmitters

Local Sales Offices & Reps.

Ala	Birmingham
Ariz	Phoenix
Cal	Burlingame
Cal	Fullerton
Colo	Denver
Ga	Atlanta
Ill	Hinsdale
Mass	Waltham
Mich	Chelsea
Minn	Minneapolis
Mo	Kansas City
Neb	Omaha
NY	New York
Okla	Tulsa
Ore	Lake Oswego
Pa	Pittsburgh
Pa	Wynnewood
Tex	Garland
Tex	Houston
Wash	Seattle
Wisc	Beaver Dam

SINGER CO., Controls Co. of Amer., 9655 W. Soreng Ave., Schiller Park, Ill., 60176, Tel: 312-678-4150; Empl.: 1500

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Coils Including Assemblies & Forms, Controls/Control Eqpt., Motors, Solenoids, Switches, Valves, Solenoid

Local Sales Offices & Reps.

Ill	Schiller Park	312-678-4150

SINGER CO., HRB - Singer, Inc., Box 60, Science Park, State College, Pa., 16801, Tel: 814-238-4311

Products manufactured: Amplifiers, Antennas, Converters, Detectors, Modulators, All Kinds, Receivers

SINGER, IND'L. TELEPRINTER CORP., 286 Eldridge Rd., Fairfield, N.J., 07006

SINGER CO., Kearfott Div., 1150 McBride Ave., Little Falls, N.J., 07424, Tel: 201-256-4000, TWX: 710-988-5700; Empl.: 6000

Customer service: D.B. Katz

Free literature available: Brochures/data sheets about gyros, accelerometers, digital computers, a/d-d/a and s/d-d/s converters, test equipment, motors, motor generators, synchros/resolvers, servos.

Products manufactured: Accelerometers, Amplifiers, Analyzers, Blowers & Fans & Accessories, Bridges, Choppers, Comm. Systems, Computers, Connectors, Controls/Control Eqpt., Converters, Dampers, Servo, Demodulators, Display Devices/Displays, Gearheads & Speed Reducers, Gyros (All Types), Indicators, Motors, Potentiometers, Radar Systems, Reducers, Repeaters, Servo, Resolvers, Synchro, Seals, Servo Systems, Shifters, Standards, Synchro Transmitters, Solid-State, Synchros, Tachometers, Testers, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest e/m Engrg., Inc.	602-944-1521
Cal	Glendale, Singer Co., Kearfott Div.	213-247-8076
Cal	Santa Clara, Richards Assocs.	408-246-5860
Fla	Melbourne, Tech-Rep Assocs., Inc.	305-723-9140
Ga	Atlanta, Tech-Rep Assocs., Inc.	404-939-8339
Ill	Oakbrook, Singer Co., Kearfott Div.	312-654-0800
Mo	St. Louis, Singer Co., Kearfott Div.	314-521-0100
NJ	Clifton, Singer Co., Kearfott Div.	201-256-4000
NJ	Little Falls, Singer Co., Kearfott Div.	201-256-4000
NC	Raleigh, Candor Co., Inc.	919-787-2652
Ohio	Dayton, Singer Co., Kearfott Div.	513-222-8942
Ore	Portland, J.J. Backer Co.	503-297-3776
SC	Myrtle Beach, Candor Co., Inc.	803-448-5213
Tenn	Chattanooga, Candor Co., Inc.	615-894-7454
Tex	Irving, Singer Co., Kearfott Div.	214-352-1764
Va	Lynchburg, Candor Co., Inc.	703-846-6579
Wash	Renton, Singer Co., Kearfott Div.	206-228-4356

SINGER CO., Librascope Div., 833 Sonora Ave., Glendale, Cal., 91201, Tel: 213-245-8711, TWX: 910-497-2266; Empl.: 1600

Customer service: R. O. Vaughan

Free literature available: Data sheets for all Librascope Products listed in EEM describe special features; list operational, engineering and environmental specifications and applications data.

Products manufactured: Computers, Controls/Control Eqpt., Display Devices/Displays, Encoders, Lenses, Optical & Camera, Memory Systems, Oceanographic Equip. (Electronic)

SINGER INSTRUMENTATION, Los Angeles Oper., 5340 Alla Rd., Los Angeles, Cal., 90066, Tel: 213-822-3061, TWX: 910-343-6969; Empl.: 260

For info on price: G. Rothhammer; Application info: D. Reed; Customer service: B. Ecker; Delivery info: B. Ecker

Free literature available: Short Form Catalog covers: RFI Test Equipment, Two-Way Radio Communications Test Equipment, Synchno Resoner Test Equipment.

Products manufactured: Amplifiers, Analyzers, Bridges, Generators, Meters, RFI Measuring Equipment, Standards

Local Sales Offices & Reps.

Ariz	Tucson, Ross Comms.	602-885-5368
Cal	Covina, Ross Comms.	213-966-9121
Cal	Cupertino, Ross Comms.	408-257-1411
Colo	Denver, KC Mkts.	303-733-5561
Ga	Atlanta, Secom Sys.	404-261-8935
Ill	Evanston, Electronic Prods.	312-869-7038
Kans	Shawnee Mission, EIR Co.	913-362-0919
Md	Kensington, Electronic Mktg. Assocs.	301-881-5300
Mass	Bedford, Chamberlin & Murray	617-274-0044
Mich	Rochester, Webster Comms.	313-375-0420
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Englewood, Bressler & Baum Assocs.	201-569-7600
NJ	Union, SBM Reps.	201-687-8737
NY	Rochester, SBM Reps.	716-266-1400
Ohio	Cincinnati, Cartwright Comms.	513-825-4202
Ore	Beaverton, Tarbell Comms.	503-643-1631
Pa	King of Prussia, Electronic Mktg. Assocs.	215-248-5050
Tex	Richardson, Horizon Engrg. Sls. Co.	214-238-9121
Va	Madison Heights, Electronic Mktg. Assocs.	804-847-6335
Wash	Bellevue, Tarbell Comms.	206-454-9716
Wisc	Milwaukee, Electronic Prods.	414-962-4818
Wisc	Shiocton, Electronic Prods.	414-986-3839

SINGER CO., Palo Alto Oper., 3176 Porter Dr., Palo Alto, Cal., 94304, Tel: 415-493-3231, TWX: 910-373-1765; Empl.: 170; Minimum order: $10

For info on price: S. Davis; Application info: B. Scarr; Customer service: J. Kadack

Free literature available: Singer Instrumentation Catalog, Singer Review "Design of a Broadband RF and M/W Sweep Generator", Singer Review "A System for the Precise Calibration of Air Navigational Receivers".

Products manufactured: Amplifiers, Analyzers, Attenuators, Cable Fault Locators, Couplers, Detectors, Generators, Insertion Loss Measurement Systems, Oscillators, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9711
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Lawndale, Ward-Davis Assocs.	213-542-7740
Cal	LaJolla, Ward-Davis Assocs.	714-459-3351
Cal	Sunnyvale, Ward-Davis Assocs.	408-245-3700
Colo	Denver, Williams Assocs.	303-373-4730
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
Kans	Shawnee Mission, EIR Co.	913-362-0919
Md	Kensington, Elctrn. Mktg. Assocs.	301-881-5300
Mass	Waltham, Meas. Conslts.	617-890-4400
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Union, SBM Reps.	201-687-8737
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Pleasantville, SBM Reps.	914-769-1811
NY	Rochester, SBM Reps.	716-266-1400
NC	Burlington, Gentry Assocs.	919-277-3639
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Ohio	Norman, Data Mktg. Assocs.	405-364-8320
Ore	Beaverton, Showalter-Judd	503-646-3004
Pa	King of Prussia, Elctrn. Mktg. Assocs.	215-265-1600
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Wash	Seattle, Showalter-Judd	206-624-9020
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

SINGER - TELE-SIGNAL, 250 Crossways Pk. Dr., Woodbury, N.Y., 11797, Tel: 516-921-9400, TWX: 510-221-2121; FSC No: 10241; Empl.: 400; Minimum order: $50

For info on price: C. Egan; Application info: F. Wagner; Customer service: L. Della Rocca; Delivery info: C. Egan

Free literature available: System & module data sheets on request (618C 2206CS) 150 different sheets

Products manufactured: Amplifiers, Comm. Systems, Comparators, Converters, Demodulators, Generators, Integrated Circuit Devices, Modulator/Demodulators, Panels, Receivers, Signal Conditioners & Equipment, Terminal Equipment, Digital, Translators, Data, Transmitters

Local Sales Offices & Reps.

Cal	Los Angeles, H. Lucas	213-483-4800
Cal	Sacramento, R. Hutter	916-488-8145
DC	Wash, M. Walker	202-223-4100
Fla	Orlando, Singer Tele-Signal	305-851-4420
NY	Webster, Singer/Tele-Signal	716-872-4839
Pa	Philadelphia, Singer Tele-Signal	215-568-1165
Tex	Plano, Singer Tele-Signal	214-424-8615

SITCO ANTENNAS, 10330 N.E. Marx St., Portland, Ore., 97220, Tel: 503-253-2000; Empl.: 18

Products manufactured: Amplifiers, Antenna Towers & Supports, Antennas, CATV Systems & Equipment, Connectors, Mounts, Transformers, Wire

SITEK, INC., 1078 W. Evelyn, Sunnyvale, Cal., 94086, Tel: 408-735-9800, TWX: 910-339-9253; Empl.: 35; Minimum order: $50

For info on price: M. Andrews; Application info: R. Bernekie; Customer service: R. Bernekie; Delivery info: B. Shoemaker

Free literature available: 1420 linear tester brochure; 3200A digital test brochure.

Products manufactured: Testers

Local Sales Offices & Reps.

Cal	Encino, Scientific Devices	213-872-1951
Cal	Los Angeles, Scientific Devices	213-641-4800
Cal	Mt. View, Scientific Devices	415-964-4230
Cal	San Diego, Scientific Devices	714-279-6642
Colo	Denver, Parker Webster Co.	303-770-1972
Conn	Hamden, Scientific Devices	203-248-9361
Fla	Casselberry, E.I.R., Inc.	305-830-9600
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Kans	Overland Park, Carter Elctrns., Inc.	913-649-6996
Md	Baltimore, Scientific Devices/E-Tech.	301-788-6611
Mass	Waltham, McBar Assocs.	617-890-0233
Mich	Detroit, Micro Sls. Corp.	313-366-6084
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	Hazelwood, Carter Elctrns., Inc.	314-731-2237
NJ	Palisades Park, Scientific Devices-E.	201-871-3916
NM	Albuquerque, Scientific Devices-Albuquerque	505-268-6729
NY	Rochester, Scientific Devices-NY	716-334-2445
Ohio	Cleveland, Micro Sls. Corp.	216-243-7430
Ohio	Dayton, Micro Sls. Corp.	513-298-3033
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Ore	Portland, Western Tech. Sls., Inc.	503-297-1711
Pa	Plymouth Meeting, Scientific Devices	215-825-9515
Tex	Dallas, Data Mktg. Assocs.	214-358-4643
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Va	Norfolk, Scientific Devices/E-Tech.	703-499-8133
Va	Springfield, Scientific Devices/E-Tech.	703-451-6500
Wash	Bellevue, Western Tech. Sls., Inc.	206-454-3906
Wisc	Milwaukee, Carter Elctrns., Inc.	414-464-5555

SIVERS LAB, Box 747, Corona del Mar, Cal., 92625, Tel: 714-673-3787; Empl.: 200

Customer service: E. M. Cleland

Free literature available: General Catalog (printed bi-annually - current 1973-74) Switches-74 Brochures & application notes on specific products per "Economic Mini-Sweeper" enclosed.

Products manufactured: Adapters, Waveguide, Attenuators, Bends & Twists, Microwave, Circulators, Ferrite, Counters, Couplers, Detectors, Dummy Loads, Filters, Generators, Horns, Microwave, Isolators, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Meters, Modulators, All Kinds, Oscillators, Receivers, Shifters, Slotted Lines, Microwave, Switches, Tees, Terminals, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	Corona del Mar, Cleland & Co.	213-673-3787
Cal	Mountain View, Walter Assocs.	415-965-4136
Tex	Arlington, J.T. Houston Assocs.	817-265-2931

SJOBERG, C. & SON, INC., 415 Station St., Cranston, R.I., 02910, Tel: 401-461-8220; Empl.: 20; Minimum order: $20

Customer service: C. Sjoberg Jr.

Free literature available: Catalog sections on flat clips, "U" shaped clips, terminals, strain reliefs, specialty hardware, applying tools, and textile hardware

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Clamps & Clips, Connectors, Contacts, Electrical, Eyelets, Fasteners, Grommets, Insulators & Insulation, Machines/Machinery, Production, Pliers, Services, Assembly, Production & Test, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Strips, Switch Hardware, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

NY	Mattydale, W.M. Onyx Co.	315-446-7930

Advertisment

We specialize in the development and manufacture of terminals, "Little Gem" connector clips, strain reliefs, etc. together with the machines and dies for applying. Special terminals and related hardware will be developed to your specifications if our stock items do not meet your requirements. Requests for samples, catalogs, and quotations are invited.

SKAN-A-MATIC CORP., Box S, Elbridge, N.Y., 13060, Tel: 315-689-3961, TWX: 710-545-0220; Empl.: 50; Minimum order: $18

For info on price: B. J. Cottrell ext. 30; Application info: D. E. Kopp, Appl. Engr. ext. 35; Customer service: B. J. Cottrell ext. 30; Delivery info: B. J. Cottrell ext. 30

Free literature available: Complete catalog of subminiature photoelectric detectors and controls. Control Module Catalog - A building block approach to specialized electronic control systems.

Products manufactured: Alarms, Amplifiers, Cells, Photoconductive, Photoemissive, Photovoltaic, Controls/Control Eqpt., Detectors, Diodes, Indicators, Lamps, Scanners, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Luscombe Engrg. Co.	602-274-8128
Cal	Pasadena, Luscombe Engrg. Co.	213-684-2000
Cal	San Mateo, Luscombe Engrg. Co.	415-342-7057
Colo	Lakewood, Intermountain Instrs.	303-237-0443
Conn	Meriden, Abbott-Allison Co.	203-237-9232
Fla	Orlando, Datarep, Inc.	305-843-5224
Ill	La Grange, Olson Engrg. & Sls. Corp.	312-482-3300
Ind	Anderson, K. E. Schneider	317-644-1690
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	E. Bridgewater, Abbott-Allison Co.	617-245-0250
Mich	Birmingham, Electro-Mation Assocs.	313-564-6517
Minn	Minneapolis, Loren Green Assocs.	612-781-1611
Mo	St. Louis, J. Durbin Co.	314-966-6500
NJ	Bogota, Neville & Vespo Corp.	201-487-1505
NY	Elbridge, L-Tron Corp.	315-689-3787
NC	Charlotte, Systems Service Corp.	704-377-3407
Ohio	Cleveland, Fred R. Sharp Co.	216-464-3820
Pa	Glenside, C.A. Briggs Co.	215-885-2244
Pa	Pittsburgh, R.W. Moulton & Assocs.	412-366-3333
Tex	Houston, Scientific Sls. Co.	713-666-5318
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Wisc	Milwaukee, Olson Engrg. & Sls. Corp.	414-873-7330

SKINNER POLYNOID DIV., Skinner Precision Inds., Inc., 95 Edgewood Ave., New Britain, Conn., 06050, Tel: 203-225-6421, TWX: 203-225-2591; Empl.: 500; Minimum order: $25

For info on price: N. O'Neil; Application info: W. J. Adams; Customer service: A. Patti; Delivery info: A. Patti

Free literature available: Design Bulletin #1 & #2; Price List; Discount Schedule; Applications; Specification Form; Technical Paper.

Products manufactured: Actuators, Motors

Local Sales Offices & Reps.

Ill	Oak Brook, Skinner Prec. Ind. Inc.	312-654-1886
NY	Brooklyn, Eastern Elctrn. Sls. Co.	212-763-5180
Pa	Ardmore, Rothenheber & Wurts, Inc.	215-649-6300

SKYDYNE A BROOKS & PERKINS CO., River Rd., Port Jervis, N.Y., 12771, Tel: 914-856-6655, TWX: 510-260-1249; Empl.: 130; Minimum order: $25

Customer service: L. W. Morris

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Cases, Transit, Containers, Covers, Protective (Including Dust), Laminates, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ala	Huntsville, Ridge Instr	205-837-3211
Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Hawthorne, WCV Co., Inc.	213-772-4479
Cal	Los Altos, Weslab	415-948-8885
Colo	Denver, Crump Co.	303-426-1443
Ill	Chicago, Berndt Assocs.	312-283-0713
Ind	Carmel, Berndt Indiana Br.	317-844-0114
Kans	Leawood, Thunderbird Tech. Sls.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls.	316-684-3941
Md	Baltimore, M/E Assocs.	301-825-1130
Mass	Lexington, J.E. Boeing	617-862-2500
Mich	Royal Oak, Group Ten	313-549-3910
Mo	St. Louis, Thunderbird Tech. Sls.	314-567-6488
NJ	Cherry Hill, M/E Assoc.	609-667-6110
NJ	Florham Pk., L. McFadden	201-377-6014
NY	Fayetteville, M. P. Andrews, Inc.	315-637-3144
Ohio	Cleveland, Group Ten	216-482-2800
Ohio	Dayton, Group Ten	513-277-6531
Tex	Ft. Worth, Dyna Reps.	817-451-1392
Wash	Seattle, WesLab Sls. Corp.	206-243-7070
Wisc	Brookfield, Berndt (Mil. Br.)	414-786-6950
EXP:	N.Y., New York, W.D. Blood Co.	212-344-0210
FOR:	Can., Stoney Creek, Ont., Simmonds Aerocessories of Canada	416-664-6203

SLAUGHTER CO., Moore & Hailey Sts., Ardmore, Okla., 73401, Tel: 405-223-4773, TWX: 910-830-6972; FSC No: 05611 .... p. 1•806-809

For info on price: Sls.; Application info: Appication Eng.; Customer service: Sls.; Delivery info: Sls.

Free literature available: Handbook of Automatic Testing, Armature & Stator Testing Notes, Basic Facts About High Voltage Testing, Condensed Catalog/Price List - Test Equipment, Catalog Strobuscopes

Products manufactured: Bridges, Comparators, Controllers, Programmable, Lights, Locators, Open-Short, Meters, Probes, Tachometers, Testers

SLOAN COMPANY, 7704 San Fernando Rd., Sun Valley, Cal., 91352, Tel: 213-875-1123, TWX: 910-498-2250; Empl.: 21 .... p. 2•1190-1197

For info on price: S. Daniel, 213-875-1124; Application info: J. Bailey, 213-875-1124; Customer service: S. Daniel; Delivery info: S. Daniel, 213-875-1125

Free literature available: Brochures: Panel Mount Fixed LED Indicator Light; LED Relampable Indicator Light; Sloan Cartridge Indicators; Panel Mount Fixed Lamp; Panel Mount Front Relampable Indicator Lights; Front Relampable Indicator Lights; Two terminal front relampable indicator lights; P175 Design Kit.

Products manufactured: Caps, Lenses, Indicator Light, Diodes, Lamps, Lights, Sockets

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg., Inc.	205-772-9237
Ariz	Scottsdale, E.J. Foley & Assocs.	602-945-2665
Cal	Los Angeles, P. Wiley Co.	213-663-8028
Cal	San Carlos, D.H. Ross Co.	415-591-4411
Colo	Denver, Comtech, Inc.	303-756-6815
Conn	Meriden, Eagle Assocs.	203-235-9036
Ga	Douglasville, 20th Century Mktg. Inc.	404-942-6483
Ill	Des Plaines, E. Flaxman Co.	312-298-8580
Ind	Carmel, Berndt Assocs., Inc.	317-844-0114
Kans	Wichita, L.F. Florence Co.	316-838-7226
Md	Bethesda, W. Mount Co.	301-657-9312
Mass	Pinehurst, Eagle Assocs.	617-444-3446
Mich	Jackson, N. Scroggs Co.	517-750-1170
Minn	Minneapolis, Electro-Serv Co.	612-827-2907
Mo	Kansas City, L.F. Florence Co.	816-561-7222
Mo	St. Louis, L.F. Florence Co.	314-227-5897
NJ	Cherry Hill, Quality Components	609-428-6266
NJ	Englewood Cliffs, E. Glass Assocs.	212-586-8440
NM	Albuquerque, F.R.Y.-Gates Co.	505-298-1875
NY	Rochester, H.R. Murray, Inc.	716-244-1100
NY	Syracuse, H.R. Murray, Inc.	315-446-5555
NC	Gastonia, Warren Mount Co.	704-867-2101
Ohio	Dayton, N. Case Assocs.	513-433-0966
Ohio	Rocky River, N. Case Assocs.	216-333-4120
Tex	Dallas, W. Reese Assocs.	214-638-6575
Tex	Houston, W. Reese Assocs.	713-621-3134
Wash	Seattle, D. Smith Sls.Co.	206-633-3160
FOR:	Can., Ottawa, Ont., Wilson Entprs.	514-224-9878
FOR:	Can., Toronto, Ont., Wilson Entprs.	416-766-0510

SLOAN TECHNOLOGY CORP., 535 E. Montecito St., Santa Barbara, Cal., 93103, Tel: 805-963-4431, TWX: 910-334-4901; Empl.: 130; Minimum order: $20

For info on price: B. Moore; Application info: S. Maxman; Customer service: J. Wafer; Delivery info: B. Moore

Free literature available: 1974-75 Sloan Product Catalog - Technical Description, Specifications and application on Vacuum Deposited Thin Film Deposition and Sputtering Equipment.

Products manufactured: Chamber, Environmental Test, Crystals, Deposition Equipment, Vacuum & Accessories, Evaporation Equipment, Electron Beam, Feedthrus & Seals, Environmental, Interferometer Systems, Monitors, Recorders, Testers, Transformers

Local Sales Offices & Reps.

Colo	Denver, G. O'Brien Sls. Agency	303-477-4713
Ga	Atlanta, G.H. Crossley Assocs.	404-261-4278
Ill	Park Ridge, B. Ellis & Assocs.	312-298-7626
Mass	Boston, Industrial Equip. & Sls.	617-227-8112
NY	Clifton Park, Empire Technology, Inc.	518-371-2480
NY	Rochester, Empire Technology, Inc.	716-225-5820
Ore	Yamhill, Walsh-Ehlers Co.	503-662-3207
Pa	Pittsburgh, Kurt J. Lesker Co.	412-892-2996
Tex	Richardson, Yarbrough Southwest Co.	214-690-0800
Wash	Bellevue, Walsh-Ehlers Co.	206-454-2211

SMITH INC., HERMAN H., 812 Snediker Ave., Brooklyn, N.Y., 11207, Tel: 212-272-9400, TWX: 710-584-2363; Empl.: 200; Minimum order: $100 p. 2•813-893

For info on price: C. Gold; Application info: F. Kaufman; Customer service: S. Latner; Delivery info: B. Knittel

Products manufactured: Bearings, Boards, Plug-In, Boards, Printed Circuit, Bumpers, Cabinets & Accessories, Cable Assemblies & Harnesses, Cable, Cases, Equipment, Instrument, Meter, Clamps & Clips, Connector Blocks, Mother Board, Connector Boxes & Strips, Power Outlet, Connectors, Cords, Couplings, Etchants, Printed Circuit, Fasteners, Feedthrus & Seals, Environmental, Grommets, Handles For Cabinets, Circuit Boards, Racks, etc., Heat Sinks, Soldering, Holders, Test Lead, Insulators & Insulation, Jack Adapters (All Types), Jacks (All Types), Jumpers, Kits, Connector, Kits, Terminal, Knobs, Leads, Test & Adaptors, Lights, Locks, Dial & Shaft, Pads, Transistor Mounting, Plug Adapters, Plug & Jack Sets, Plug Buttons, Plug Caps & Shells, Plugs, Posts, Probes, Punches, Chassis, Racks, Shafts & Adapters, Socket Adapters, Sockets, Spacers, Strain Reliefs, Cable & Wire, Suppressors, Switch Hardware, Switch Mounting Plates, Switches, Terminal Blocks, Boards & Strips, Terminals, Tools, Transistor, Diode, Thyristor Heat Dissipators, Tubing, Wire, Wire & Cable Ties

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn	602-258-7893
Cal	Los Angeles, E.E. Strassner Co.	213-666-1511
Cal	Redwood City, Warren-Hickey Sls.	415-368-3849
Colo	Denver, Shefler-Kahn	303-831-9087
Conn	Waterbury, Coakley, Boyd & Abbett	203-272-2261
Fla	Bradenton, Hutto Hawkins Peregoy	813-755-4015
Fla	Maitland, Hutto Hawkins Peregoy	305-831-2474
Fla	Pompano Beach, Hutto Hawkins Peregoy	305-943-9593
Ga	Atlanta, Millar Elctrns.	404-261-6160
Ill	Chicago, J.J. McBride Sls.	312-775-1080
Ind	Indianapolis, Schroeder & Loomis	317-251-4571
Kans	Overland Park, Lowell Kangas & Assoc.	913-631-3515
La	Metairie, J.F. McKinney Sls.	504-887-1723
Md	Lutherville, L.D. Lowery	301-823-2172
Md	Silver Spring, L.D. Lowery	301-439-3542
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Ferndale, Shalco	313-547-4771
Minn	Minneapolis, C.R. Gibb	612-377-1200
Mo	St. Louis, Lowell Kangas & Assoc.	314-821-4050
NM	Albuquerque, Shefler-Kahn	505-265-7077
NY	North Syracuse, L.D. Allen	315-458-7470
NY	Snyder, L.D. Allen	716-839-3300
NY	Yonker, J. Brown Elctr.	914-779-7330
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3331
Okla	Tulsa, J.F. McKinney Sls.	918-742-6791
Ore	Portland, Dale Weber	503-234-7671
Pa	Broomall, L.D. Lowery	215-356-6300
Pa	Pittsburg, Trymax Co.	412-823-8400
RI	Harrisburg, L.D. Lowery	717-233-0917
Tex	Bellaire, J.F. McKinney Sls.	713-774-3232
Tex	Dallas, J.F. McKinney Sls.	214-631-9450

Va	Charlottesville, L.D. Lowery	804-973-6672
Va	Fredricksburg, L.D. Lowery	703-371-5099
Wash	Seattle, D. Weber Co.	206-623-5990
Wash	Spokane, D. Weber Co.	509-624-3908
FOR:	Toronto 19, Atlas Radio Corp.	416-781-6174

SNAP-ON-TOOLS, 8192-A 28th Ave., Kenosha, Wisc., 53140, Tel: 414-654-8681; Empl.: 2500

Customer service: D. Sorbie

Products manufactured: Alternators, Analyzers, Benches, Consoles, Stools, Tables, Chargers, Battery, Couplings, Cutters, Wire, Hand Operated, Detectors, Drills & Accessories, Hand & Power, Drivers, Nut, Flashlights & Lanterns, Gages, Machines/Machinery, Production, Meters, Oscilloscopes, Pliers, Pumps, Vacuum, Screwdrivers, Soldering Guns, Irons & Desoldering Tools, Stands, Instruments, Testers, Tools, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices), Wire Twisters, Wrenches

SODECO DIV., Landis & Gyr, Inc., 4 Westchester Plaza, Elmsford, N.Y., 10523, Tel: 914-592-4400, TWX: 710-567-1219; Empl.: 65; Minimum order: $25

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Products manufactured: Bearings, Controls/Control Eqpt., Counters, Indicators, Motors, Printers, Switches, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Electronic Assos., Inc.	205-881-5031
Ariz	Tempe, Trembly Assocs.	602-966-4468
Cal	Los Altos, Recht	415-941-0336
Cal	Los Angeles, Universal Comps.	213-641-4255
Colo	Denver, Thorson Co.	303-759-0809
Conn	Old Lyme, Aid Engrg.	203-673-3692
Conn	Rocky Hill, Aid Engrg.	203-673-3692
Fla	Ft. Lauderdale, Beacon Elctrns.	305-776-6074
Fla	Maitland, Beacon Elctrns.	305-647-3498
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Haw	Honolulu, Berkley Engrg.	808-538-1921
Ill	Rolling Meadows, Sumer	312-394-4900
Md	Glen Arm, Hodgins Assocs.	301-592-7047
Md	Towson, Hodgins Assocs.	301-296-0414
Mass	Westboro, Aid Engrg.	617-890-8181
Mich	Detroit, L. Dickelman	313-255-3300
Minn	New Brighton, TWC Sls.	612-636-1770
Miss	Hernando, Beacon Elctrns.	601-368-9008
Mo	Kansas City, R.R. Burton Sls. Co.	816-444-8300
Mo	St. Louis, Delltron Co.	314-869-1351
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	Buffalo, Application Specialists	716-834-3377
NY	East Syracuse, Application Specialists.	315-437-2813
NY	Mt. Vernon, D. Sonkin	914-668-9809
NY	Rochester, Application Specialists	716-586-6226
NC	Greensboro, Beacon Elctrns.	919-674-9432
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Dallas, RMA/Southland	214-361-8584
Tex	Houston, RMA/Southland	713-462-4077
Wash	Mercer Island, J. Andersen	206-232-0484

Local Distributors

Ind	Indianapolis, B & B Motor & Controls, 3512 Rockville Rd.	317-248-0396
NY	New York, B & B Motor & Controls, 96 Spring St.	212-966-5777
NY	Rochester, B & B Motor & Controls, 3259 Winton Rd. S.	716-473-6640

SOLA ELECTRIC, 1717 Busse Rd., Elk Grove Village, Ill., 60007, Tel: 312-439-2800, Telex: 28-3451; Empl.: 450; Minimum order: $500

Customer service: AC Prods. Grp.

Free literature available: Catalog +630-Voltage Regulators Sizes, description, electrical characteristics of constant voltage transformers, line regulators and computer line regulators. Catalog +624-Theory, Design and Operation-design criteria for Ferro-Resonance Transformers, Line Voltage Regulators.

Products manufactured: Connector Adapters, Power Supplies, Reactors, Regulators, Stabilizers, Line Impedance, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, Hytronic Div. of Zeus, Inc.	602-253-6104
Cal	Inglewood, J. Berman Co.	213-678-1281
Cal	Oakland, Moulthrop Sls. Inc.	415-261-7676
Colo	Denver, Hytronic Div. of Zeus, Inc.	303-388-4081
Fla	Orlando, Cartwright & Bean, Inc.	305-896-2031
Fla	Plantation, Cartwright & Bean, Inc.	305-791-3989
Ga	Atlanta, Cartwright & Bean, Inc.	404-237-2273
Ill	Chicago, GNB Assocs., Inc.	312-673-4050
Ind	Fort Wayne, Baehr, Greenleaf & Assoc., Inc.	219-483-6864
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Mass	Norwood, JMG, Inc.	617-762-5333
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
Mich	St. Joseph, R.C. Merchant & Co.	616-983-7378
Minn	Minneapolis, Stack-Johnson, Inc.	612-925-2111
Miss	Jackson, Cartwright & Bean, Inc.	601-354-1368
Mo	Kansas City, Forristal-Young Sls. Co.	816-358-6771
Mo	St. Louis, Forristal-Young Sls. Co.	314-645-2360
Neb	Omaha, Forristal-Young Sls. Co.	402-393-6191
NJ	Cherry Hill, Trinkle Sls., Inc.	609-667-3500
NM	Albuquerque, Hytronic Div. of Zeus, Inc.	505-268-3941
NY	Mineola, Wilco Sls.	516-294-9840
NY	Rochester, L-Mar Assocs.	716-328-5240
NY	Syracuse, L-Mar Assocs.	315-446-2135
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
NC	Raleigh, Cartwright & Bean, Inc.	919-832-7128
Ohio	Cincinnati, Baehr, Greenleaf & Assoc.	513-891-3826
Ohio	Columbus, Baehr, Greenleaf & Assoc.	614-486-4046
Ohio	Lakewood, Baehr, Greenleaf & Assoc.	216-221-9030
Ore	Portland, Earl & Brown Co.	503-292-9145
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Dallas, Robert E. Nesbitt Co.	214-357-4601
Tex	Houston, Robert E. Nesbitt Co.	713-224-3633
Utah	Salt Lake City, Hytronic Div. of Zeus, Inc.	801-466-4924
Wash	Seattle, Earl & Brown Co.	206-284-1121

Local Distributors

Ala	Birmingham, J. W. Clary Co., 1713 Second Ave. S.	205-322-2488
Ala	Birmingham, M. G. Electronic & Equip., 3112-6th Ave. S.	205-328-4525
Alas	Anchorage, Yukon Radio Supply, 3222 Commercial Dr.	
Ariz	Little Rock, D. White Elctrns., 1222 Main St.	501-376-1391
Ariz	Phoenix, Cramer Elctrns., 2643 E. University Dr.	602-263-1112
Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	
Ariz	Phoenix, Mirco Elctrn. Distrs., 2104 W. Peoria Ave.	
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	714-894-7581
Cal	Glendale, Western Elctrn. Supply, 229 S. Orange	213-246-4861
Cal	Inglewood, Newark Elctrns., 4747 W. Century Blvd.	213-678-0441
Cal	Los Angeles, Kierulff Elctrns., 2585 Commerce Way	213-685-5511
Cal	Mountain View, Abacus Elctrns., 1065 Terra Bella Ave. Box B	415-961-1500
Cal	Oakland, Brill Elctrns., 610 East 10th St.	415-834-5888
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	
Cal	Riverside, Electronic Supply, 2486 Third St.	714-683-5591
Cal	Sacramento, Dunlap Elctrns., 1800 18th St.	
Colo	Denver, Cramer/Denver Elctrns., 5465 E. Evans Pl. at Hudson	303-758-2100
Colo	Denver, Industrial Elctrns., Box 22457	
Colo	Denver, Newark-Denver Elctrn. Supply, 2170 S. Grape St.	303-757-3351
Conn	Hamden, Wilshire Elctrns./Conn., 2554 State St.	203-281-1166
Conn	Hartford, Electrical Supplies, 3466 Main St.	203-527-7111
Conn	Waterbury, Bond Radio Elctrns., 439 West Main St.	203-753-1184
Fla	Hollywood, Cramer/EW, 4035 N. 29th Ave.	305-923-8181
Fla	Jacksonville, Southeast Elctrns., 1125 Rosselle St.	904-356-3007
Fla	Miami, Electro Standards Lab., 3560 N. W. 34th St.	305-633-6975
Fla	Miami, Electronic Equip., 2701 N.W. 42nd Ave.	305-635-0421
Fla	Orlando, Brownell Electro, 307 27th St.	305-843-6770
Fla	Orlando, Hammond Elctrns., 911 W. Central Blvd.	305-241-6601
Fla	Pensacola, Grice Elctrns., 320 E. Gregory	904-433-4616
Fla	Tampa, Lykes Elctrns., 5426 W. Crenshaw	813-886-6621
Ga	Atlanta, Brownell Electro, 3020 Commerce Way	404-767-8761
Ga	Atlanta, Lykes Elctrns., 1135 Chattahoochee, NW	404-355-2223
Ga	Atlanta, Specialty Dist., 763 Juniper St. N. E.	404-873-2521
Haw	Honolulu, Nylen Bros. & Co., 820 S. Beretania ST. Box 2958	
Haw	Honolulu, Victor Kim Elctrns., 625 South St.	
Idaho	Boise, Oakley Wholesale, 7605 Idaho St.	208-343-7937
Ill	Broadview, LComp-Chicago, 2030 W. 16th St.	312-865-7600
Ill	Chicago, Electronic Dists., 4900 N. Elston Ave.	312-283-4800
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow Rd.	312-697-8200
Ill	Mt. Prospect, Cramer-Chicago, 1911 S. Busse Rd.	312-593-8230
Ill	Palatine, OHM/Electronics, 649 Vermont Ave.	312-359-5500
Ill	Peoria, Klaus Radio, 8400 N. Pioneer Pkwy.	309-691-4840
Ill	Rockford, J & M Electronics, 2001-9th St.	815-963-6445
Ill	Rockford, Mid-West Assoc., 225 S. 6th St.	815-962-8036
Ill	Schaumburg, Motorola, 1301 E. Algonquin	
Ill	Skokie, Sargent-Welsh Scientific, 7300 N. Linder Ave.	312-267-5300
Ind	Evansville, Ohio Valley Sound, 20 E. Sycamore St.	812-425-6173
Ind	Fort Wayne, Fort Wayne Electronics Supply, 3606 Maumee Ave.	219-742-4346
Ind	Indianapolis, Graham Elctrns. Sply., 133 S. Pennsylvania	317-634-8486
Ind	Indianapolis, RA-DIS-CO, 814 N. Senate Ave.	317-637-5571
Ind	South Bend, Radio Distributing, 1212 S. High St.	219-288-4666
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave. SW	319-365-7551
Kans	Wichita, Radio Supply, 115 Laura	316-AM7-5216
Ky	Lexington, Radio Elctrns. Equip., 480 Skain St.	606-255-6661
Ky	Louisville, E. & H. Elec. Supply, 804 S. 5th St.	502-587-0991
Ky	Louisville, P. I. Burks Co., 842 South Seventh St.	502-583-2871
La	Lafayette, Ralphs of Lafayette, 3004 Cameron St.	318-234-4507
La	New Orleans, Lykes Elctrns., 3308 Orleans Ave.	504-486-7441
La	New Orleans, Radio Parts, 1331 Prytania St.	504-581-5959
La	New Orleans, Southern Radio Supply, 1909 Tulane Ave.	504-524-2345
La	Shreveport, Industrial Elctrn. Supply, 2422 Southern Ave.	318-422-9459
Md	Baltimore, A S I Elctrns., 1728-30 Whitehead Rd.	301-265-5100
Md	Baltimore, Radio Elec. Srvc., 1026 Cromwell Bridge Rd.	301-823-0070
Md	Gaithersburg, Cramer/EW, 16021 Industrial Dr.	301-948-0110
Md	Rockville, Capitol Radio Wholesalers, 12270 Wilkins Ave.	301-881-2270
Md	Rockville, Pioneer-Washington Elctrns., 1037 Taft St.	301-424-3300
Mass	Cambridge, H. Young Jr., 72 Rogers St.	
Mass	Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy	617-491-3300
Mass	Newton Center, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mass	North Wilbraham, Industrial Comps., 2551 Boston Rd.	413-596-3854
Mass	Watertown, Sterling Elctrns., 51 Spring St.	617-926-9720
Mass	Worcester, R M Elctrns., 80 Thomas St.	617-756-8311
Mich	Ann Arbor, Wedemeyer Elctrn. Supply, 2280 S. Industrial Hgwy.	313-665-8611
Mich	Detroit, Fife Elctrn. Supply, 1211 Trumball	
Mich	Detroit, Newark/Detroit Elctrns., 20700 Hubbell	313-548-0250
Mich	Detroit, R. S. Elctrns., 12775 Lyndon Ave.	313-491-1000
Mich	Flint, Shand Electronics, 2401 S. Dort Hgwy.	313-743-8940
Mich	Grand Rapids, R. S. Elctrns., 300 36th St. S E	616-459-4611
Mich	Jackson, Fulton Radio Supply, 1208 Greenwood Ave.	517-784-6107
Mich	Kalamazoo, All-Phase Electric Sply., 710 Gibson St.	616-381-1114
Mich	Lansing, Fulton Radio Supply, 2707 Alpha St.	517-489-6519

Mich	Madison Heights, Lysinger Photo Supply, 30391 Stephenson Hwy.	313-583-1070
Mich	Marquette, NWR Elctrns., 1010 W. Washington St.	906-226-7578
Mich	Muskegon, Western Elctrn. Supply, 1781 Fifth St.	616-722-7628
Mich	Oak Park, Cadillac Electric Supply, 20700 Hubbell Ave.	313-548-0260
Mich	Wyoming, Newark Ind'l. Elctrns., 3645 Linden Ave.	616-241-6681
Minn	Edina, Cramer/Bonn, 7275 Bush Lake Rd.	612-941-4860
Minn	St. Paul, Gopher Elctrns., 2520 W. Larpenteur Ave.	612-645-0889
Miss	Jackson, Ellington Elctrn. Supply, 1425 Terry Rd.	601-355-0561
Mo	Kansas City, Burstein-Applebee, 3190 Mercier St.	816-531-5614
Mo	Kansas City, Walters Radio Supply, 3627-35 Main St.	816-531-7015
Mo	No. Kansas City, LComp-Kansas City, 1520 Taney St.	816-221-2400
Mo	St. Louis, LComp-St. Louis, 2605 S. Hanley Rd.	314-647-5505
Mo	St. Louis, Melvill B. Hall, 3001 Spruce St.	314-371-7000
Mont	Great Falls, Holm James Distrs., 320 6th St. So.	406-761-2420
Neb	Lincoln, Scott Elctrn. Sy, 4040 Adams St.	402-434-8308
Neb	Omaha, Omaha Radio Equip., 625 N. 18th St.	402-341-7700
NJ	Moonachie, Cramer, 1 Barratt Ave.	201-687-7870
NJ	Springfield, Federated Elctrns. Div., 155 U.S. Rte. 22	201-376-8900
NM	Albuquerque, Hyer-Cramer/ Elctrns., 137 Vermont, N.E.	505-265-5767
NY	Albany, E. E. Taylor Co., 465 Central Ave.	518-489-5600
NY	Binghamton, Harvey Federal Elctrns., Box 1208 - Vestal Pkwy.	607-748-8211
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Huntington Station, Texas Instr. Supply, #2 Huntington Quad	
NY	Long Island City, H. L. Dalis, 35-35 24th St.	212-361-1100
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	Plainview, Texas Instr. Supply, 245 Newton Rd.	516-293-2660
NY	Rochester, Requa Electrical Supply, 2005 Brghtn-Hentta, Town Line Rd.	716-442-2020
NY	Rochester, Simcona Elctrns., 275 Mt. Read Blvd.	716-328-3230
NC	Ashville, Southeastern Radio Supply, 1065 Patton Ave.	704-253-1146
NC	Charlotte, Brownell Electro, 5141 Belhaven Blvd.	704-392-7451
NC	Greensboro, Hammond Electronics, 2923 Pacific Ave.	919-275-6391
NC	Raleigh, Southeastern Radio Supply, 414 Hillsboro St.	919-828-2311
NC	Winston-Salem, Cramer/EW, 938 Burke St.	919-725-8711
NC	Winston-Salem, Kirkman Elctrns., 901 W. Second Ave.	919-724-0541
Ohio	Akron, Akron Elctrns., 107 S. Arlington St.	216-762-8818
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-434-2171
Ohio	Cincinnati, Hughes-Peters, 4865 Duck Creek Rd.	513-381-7625
Ohio	Cincinnati, Newark-Herrlinger Elec., 9799 Princton	513-241-5282
Ohio	Cleveland, Pioneer-Cleveland, 4800 E. 131st St.	216-587-3600
Ohio	Columbus, Hughes-Peters, 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, J. A. Becker Co., 1341 E. 4th St.	513-226-1341
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Ohio	Dayton, Stotts-Friedman, 108 N. Jefferson St.	513-224-1111
Ohio	Lima, Lima Radio Parts Co., 150 W. Grand Ave.	419-225-1220
Ohio	Solon, Radio & Elctrn. Parts, 6835 Cochran Rd.	216-248-8900
Ohio	Toledo, Warren Radio, 1002 Adams St.	419-248-3364
Ohio	Warren, REM Elctrns. Supply, 264 W. Market St.	216-399-2777
Ohio	Youngstown, Ross Radio, 325 W. Federal St.	216-746-8881
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9123
Okla	Tulsa, S & S Radio Supply, 537 S. Kenosha St.	918-582-8242
Ore	Portland, Eoff Electric, 509 N.W. 10th St.	503-222-9411
Ore	Portland, Platt Elec. Supply, 1305 N. W. Davis	503-228-6121
Ore	Portland, United Radio Supply, 123 N. E. 7th Ave.	503-233-7151
Pa	Altoona, Allegheny Elctrns., 800 Chestnut Ave.	
Pa	Braddock, Leff Radio Parts Co., 225 Braddock Ave.	
Pa	Drexel Hill, Kass Elctrns., 2502 Township Line Rd.	215-568-3500
Pa	Erie, Warren Radio, 1315 Peach St.	814-454-5285
Pa	Harrisburg, Pyttronic Inds., Box 1967 Balto, Wabash Ind'l. Ctr.	717-233-6591
Pa	Philadelphia, Herbach & Rademan, 401 E. Erie Ave.	215-426-1700
Pa	Pittsburgh, Cameradio Co., Inc., 2801 Liberty Ave.	412-288-2600
Pa	Pittsburgh, Fisher-Scientific, 711 Forbes Ave.	412-391-1330
Pa	Pittsburgh, McCollough Elec., 419 Fort Pitt Blvd.	412-261-2420
Pa	Pittsburgh, R. P. C. Elctrns., 620 Alpha Dr.	412-782-3770
Pa	Reading, Barbey Elctrns., 333 N. 4th St.	215-376-7451
Pa	Westchester, Westchester Elec. Supply, 716 E. Market St.	215-696-7500
RI	Providence, Wm. Dandretta & Co., 28 Wolcott St.	401-861-2800
SC	Charleston, Wholesale Radio Supply, 515 E. Bay St.	803-722-2634
SC	Columbia, Dixie Radio Sply., 1900 Barnwell St.	803-253-5333
SC	Greenville, Hammond Electronics, 100 Augusta St.	803-233-4121
Tenn	Kingsport, Radio Elec. Supply, 961 E. Sullivan St.	615-247-8111
Tenn	Knoxville, Roden Electrical Supply, 124-144 Oklahoma	615-524-9851
Tenn	Memphis, Bluff City Dist., 234 East St.	901-725-9500
Tenn	Memphis, Brownell Electro, 3053 Tranquillity Dr.	901-323-7693
Tenn	Nashville, Electra Distributing, 1914 West End Ave.	615-255-8444
Tex	Corpus Christi, Wicks Radio Equip., 513 S. Staples	512-884-8285
Tex	Dallas, Texas Instr. Supply, 6000 Denton Dr.	214-238-3333
Tex	Dallas, Wholesale Elctrn. Supply, 2809 Ross Ave.	214-824-3001
Tex	El Paso, Midland Specialty, 2235 Wyoming Ave.	915-533-9555
Tex	Fort Worth, Allied Elctrns., 401 E. 8th St.	
Tex	Houston, Curtin/Matheson Scien., 4220 Jefferson St.	713-923-1661
Tex	Houston, Harrison Equip. Co., 1616 McGowen	713-224-9131
Tex	Houston, Sterling Elctrns., 4201 Southwest Frwy.	713-623-6600
Tex	McAllen, McAllen Radio Elctrns., 413-415 S. Bdwy.	512-682-2361
Tex	Port Arthur, J & M Industrial Supply, 700 Seventh St.	713-883-2055
Tex	Stafford, Southwest Elctrns., 12725 Royal Dr.	
Tex	Texarkana, McCollough Electric, 1222 Main St.	214-792-6923
Utah	Salt Lake City, Standard Supply, 225 E. Sixth St. S.	801-355-2971
Va	Charlottsville, Virginia Radio Supply, 715 Henry Ave.	703-296-4184
Va	Norfolk, Priest Elctrns., 6431 Tidewater Dr.	703-855-3017
Va	Richmond, Meridan Elctrns., 1001 W. Broad St.	703-355-6521
Wash	Seattle, Almac/Stroum Elctrns., 5811 Sixth Ave. So.	206-763-2300
Wash	Seattle, Cramer/Seattle, 5602 Sixth Ave. S.	206-762-5755
Wash	Seattle, Radar Elec., 168 Western Ave. W.	
Wash	Seattle, Seattle Radio Supply, 2117 Second Ave.	206-624-2341
Wash	Seattle, Western Elctrns., 717 Dexter Ave. No.	206-284-0200
Wash	Spokane, Northwest Elctrns., 730 E. First Ave.	509-534-2644
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500
Wisc	Milwaukee, Parts Mart, 1314 N. 7th St.	414-276-4160

SOLAR ELCTRNS. CO., 901 N. Highland, Hollywood, Cal., 90038, Tel: 213-462-0806; FSC No: 13222; Empl.: 10; Minimum order: $1

Customer service: A. T. Parker

Free literature available: Catalog shows complete line of instruments, components and accessories essential for EMI testing.

Products manufactured: Amplifiers, Antennas, Filters, Generators, Insertion Loss Measurement Systems, Meters, Probes

Advertisment

A UNIQUE LINE OF INSTRUMENTS, COMPONENTS AND ACCESSORIES TO ASSIST THE RFI/EMC ENGINEER IN COMPLYING WITH MIL-STD-461 AND OTHER EMI SPECS. TRANSIENT GENERATORS, AUDIO POWER SWEEP GENERATORS, LISNS, CURRENT PROBES, ISOLATION TRANSFORMERS, EMI POWER METERS, FEED-THRU CAPACITORS, EMI FILTERS AND WAVE FILTERS.

SOLATRON ENTERPRISES, 421 E. Beach Ave., Inglewood, Calif., 90302, Tel: 213-678-4981; Empl.: 20; Minimum order: $25

Customer service: D. S. Rathje

Products manufactured: Bridges, Machines/Machinery, Production, Meters, Sockets, Testers

SOLDER REMOVAL CO., 1077 E. Edna Pl., Covina, Cal., 91722, Tel: 213-331-0985, TWX: 910-584-1820; Empl.: 30

Customer service: T. H. Naylor 213-966-8321

Products manufactured: Coatings, Soldering-Accessories, Soldering Guns, Irons & Desoldering Tools, Tools

Local Sales Offices & Reps.

Ala	Huntsville, South Eastern Assocs., Inc.	205-539-9816
Ariz	Phoenix, Maddox Sls. Co.	602-274-3807
Cal	Los Angeles, Maddox Sls. Co.	213-949-5433
Cal	San Francisco, Maddox Sls. Co.	415-431-2953
Ill	Joilet, Hanat & Hall, Inc.	815-722-0436
Kans	Shawnee Mission, M. E. Bettis Co.	913-362-0772
Md	Phoenix, REBCO Sls.	301-592-8907
Mass	Wayland, Ellingwood, Inc.	617-265-6400
NJ	Wayne, G.T. Assocs.	201-694-6040
NM	Albuquerque, Maddox Sls. Co.	505-298-2422
NY	Syracuse, M.C. Antil, Inc.	315-468-2370
Ohio	Cleveland, Buckeye Components	216-292-2889
Ohio	Dayton, Buckeye Components	513-278-4279
Tex	Dallas, E. Tron Sls.	214-348-4749

SOLID STATE INC., 46 Farrand St., Bloomfield, N.J., 07003, Tel: 201-429-8700, TWX: 710-994-4780; Empl.: 60; Minimum order: $25

For info on price: Sls.; Application info: A. Citro; Customer service: Jayne; Delivery info: Mary

Free literature available: RF applications (micro wave); PUT applications.

Products manufactured: Amplifiers, Diodes, Hybrid Voltage Regulators, Integrated Circuit Devices, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ariz	Tempe, J. Cain Assoc.	602-838-3404
Cal	Seal Beach, Texel Sls.	213-596-9411
Fla	Casselberry, E. I. R.	305-426-0606
Ill	Chicago, C L Greenslade Sls.	312-561-0156
Mich	Farmington, Reptron	313-478-1024
NY	New York, Solid State Inc.	212-964-5682

SOLID STATE DEVICES, INC., 14830 Valley View Ave., LaMirada, Cal., 90638, Tel: 213-921-9660, TWX: 910-583-4807; Empl.: 100 ....p. 1•1864,1865

Products manufactured: Diodes, Rectifiers, Transistors

Local Sales Offices & Reps.

Cal	Escondido, Cirolia Elctrn. Sls.	714-743-3015
Cal	Los Altos, Stout-Loeswick Elect. Mktg.	415-948-3265
Fla	Kissimmee, Nickerson Co.	305-846-6755
Fla	Oldsmar, Nickerson Co.	813-855-4209
Fla	Tampa, Nickerson Co.	813-885-1416
Ga	Decatur, Nickerson Co.	404-631-4481

Mass	Brookline, Technology Prods.	617-731-0858
Mich	Warren, DEM Elctrns.	313-755-6660
Minn	Minneapolis, Bitronics Sls.	612-835-7744
NJ	Wallington, Comp-Tech Sls.	201-935-5454
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	Rochester, Ontec	813-885-8633
Ohio	Englewood, Daytech Sls.	513-836-8633
Tex	Dallas, J. Clay Co.	214-350-1281
Va	Fairfax, Schibley Assocs.	703-591-3008
Wash	Seattle, Underwood & Underwood	206-243-2133
Wisc	Brookfield, Berndt Assocs.	414-786-6950

SOLID STATE ELECTRONICS CORP., 15321 Rayen St., Sepulveda, Cal., 91343, Tel: 213-894-2271; Empl.: 15 .... p. 1•126,1816

Products manufactured: Amplifiers, Analyzers, Choppers, Coders, Coils Including Assemblies & Forms, Comm. Systems, Comparators, Controls/Control Eqpt., Converters, Decade Boxes, Decoders, Demodulators, Detectors, Discriminators, Drivers, Chopper, Filters, Generators, Indicators, Keyers, Tone, Meters, Mixers, Modulator/Demodulators, Modulators, All Kinds, Monitors, Multiplexers, Oscillators, Power Supplies, Receivers, Relays, Tachometers, Transducers, Transformers

SOLID STATE SCIENTIFIC, Montgomeryville Ind'l. Pk., Montgomeryville, Pa., 18936, Tel: 215-855-8400, TWX: 510-661-7267; Empl.: 400

Products manufactured: Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Integrated Circuit Devices, Transistors

Local Sales Offices & Reps.

Cal	Newport Beach	714-546-9621
Ill	Arlington Heights	312-437-8373
Pa	Norristown	215-279-8424

SOLIDSTATE CONTROLS, INC., 600 Oakland Park Ave., Columbus, Ohio, 43214, Tel: 614-263-1886, Telex: 245-338; Empl.: 70

For info on price: J. N. Holscher; Application info: H. W. Bates; Customer service: J. VanSkoy; Delivery info: T. A. Curran

Free literature available: Static inverters - Transfer switches for use with static inverters - Battery chargers - Complete static uninterruptible power systems.

Products manufactured: Chargers, Battery, Inverters, Switches

Local Sales Offices & Reps.

Ala	Birmingham, Spader & Assocs.	205-879-1366
Cal	San Francisco, Garland Affolter Engrg. Corp.	415-397-1800
Cal	San Gabriel, Garland Affolter Engrg. Corp.	213-287-1149
Colo	Denver, Peterson Co.	303-388-6322
Fla	Lake Wales, Carter-Watsey & Assocs.	813-676-1474
Fla	Miami Shores, Carter-Watsey & Assocs.	305-635-5361
Ga	Atlanta, M.J. Fein & Co./C.A. Legg	404-938-0190
Ga	Decatur, Spader & Assocs.	404-296-3024
Ill	Glen Ellyn, J.T. Becker Assocs.	312-858-1910
Ind	Indianapolis, Utility & Ind'l. Prods., Inc.	317-924-3607
Iowa	Bettendorf, Deco Engrg. Prods., Inc.	319-355-2679
Iowa	Des Moines, Deco Engrg. Prods., Inc.	515-274-9356
La	New Orleans, Gregory-Salisbury & Co.	504-524-5207
Mass	Holliston, M.J. Fein & Co.	617-429-4008
Mich	Royal Oak, C.H. Armstrong Co.	313-544-1305
Minn	Minneapolis, Electrical Jobbers Equip., Inc.	612-721-4815
Miss	Jackson, Gregory-Salisbury & Co.	601-362-1761
Mo	Crestwood, C.B. Fall Co.	314-968-3850
Neb	Omaha, Deco Engrg. Prods., Inc.	402-341-4836
NJ	Livingston, M.J. Fein & Co.	201-994-3575
NY	Scarsdale, M.J. Fein & Co.	914-472-1100
Ohio	Columbus, Meas. Instrs., Inc.	614-488-9753
Okla	Tulsa, D. Allert Co.	918-743-7705
Ore	Portland, Garland Affolter Engrg. Corp.	503-223-7349
Pa	Media, Sys. Control Assocs.	215-565-2077
Tenn	Memphis, Gregory-Salisbury & Co.	901-365-6660
Tex	Arlington, Pan Tech. Engrg.	817-261-4111
Tex	Houston, Pan Tech. Engrg.	713-623-0640
Utah	Salt Lake City, Peterson Co.	801-487-5621
Wash	Bellevue, Garland Affolter Engrg. Corp.	206-454-2485

SOLITRON DEVICES, 8808 Balboa Ave., San Diego, Cal., 92123, Tel: 714-278-8780, TWX: 910-335-1221; Empl.: 900

Products manufactured: Amplifiers, Calculators, Electrical & Electronic, Diodes, Integrated Circuit Devices, Rectifiers, Transistors

SOLITRON DEVICES, Transistor Div., 1177 Blue Heron Rd., Riviera Beach, Fla., 33404, Tel: 305-848-4311, TWX: 510-952-7610; FSC No: 21845; Empl.: 417; Minimum order: $100

For info on price: J. J. Bilger; Application info: J. Lamm; Customer service: M. Giraud; Delivery info: D. Harrison

Free literature available: Solitron Short Form Catalog On Power Transistors, Hybrids Etc. Transistor Chip Catalog.

Products manufactured: Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Crystals, Diodes, Hybrid Voltage Regulators, Rectifiers, Regulators, Relays, Semiconductor Wafer Fabrication, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Owen Rowe Ents.	205-837-3643
Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	Canoga Park, TKO	213-883-3822
Cal	San Diego, Col-Rob	714-565-6814
Cal	San Jose, Com-Cal	408-268-7337
Colo	Denver, Piper-Goyne, Inc.	303-934-6971
Conn	Wallingford, Com-Sale	203-269-7964
Fla	Orlando, Cartwright & Bean	305-422-4531
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-255-5262
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Indianapolis, Electro Reps.	317-255-4147
La	Chalmette, Cartwright & Bean	504-279-4598
Mass	Waltham, Com-Sale	617-890-0011
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Minn	Edina, Wagner Consultants	612-941-6310
Miss	Jackson, Cartwright & Bean	601-981-1368
Mo	Saint Charles, Buckman & Assocs.	314-724-6690
NJ	Haddonfield, M & S Assocs., Inc.	609-429-7055
NM	Albuquerque, Piper-Goyne	505-265-6794
NY	Jamaica, S-J Sls. Assocs.	212-291-3232
NY	Syracuse, Nycom	315-463-1665
NY	Tappan, Solitron Devices	914-359-5050
NY	West Nyack, Rubin Sales & Assocs.	914-623-9237
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Ohio	Dayton, Luebbe Sls. Co.	513-294-0427
Ore	Portland, C. K. Shanks & Assocs.	503-292-5656
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Richardson, P. J. Scanlon Co.	214-231-4661
Wash	Seattle, C. K. Shanks & Assocs.	206-ME2-4290
EXP:	Riviera Beach, Solitron Devices	305-848-4311

SOLITRON DEVICES, INC., 256 Oak Tree Rd., Tappan, N.Y., 10983, Tel: 914-359-5050, TWX: 710-576-2654

SOLITRON/MICROWAVE, Box 278, Port Salerno, Fla., 33492, Tel: 305-287-5000, TWX: 510-953-7500; FSC No: 95077; Empl.: 125

For info on price: D. Kiplinger; Application info: R. Sulzer; Customer service: F. Tiemeyer; Delivery info: R. Sulzer

Products manufactured: Connector Adapters, Connectors, Delay Lines, Resistors, Strip-Line Components, Microwave, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns. Assoc.	205-881-5031
Ariz	Scottsdale, Piper-Goyne	602-946-4437
Cal	Los Angeles, RF Assocs.	213-478-1586
Cal	Mountain View, Westrep	415-968-5800
Cal	Palo Alto, RF Assocs.	415-494-3331
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Colo	Littleton, Piper-Goyne	303-798-9855
Fla	Ft. Lauderdale, Beacon Elctrns.	305-776-6074
Fla	Maitland, Beacon Elctrns.	305-647-3498
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Ill	Hinsdale, Momak Sales	312-654-4524
Ind	Indianapolis, Sukup & Cox	317-253-1215
Kans	Shawnee-Mission, Florence & Meyer	913-722-5210
Kans	Wichita, Florence & Meyer	316-838-7226
Md	Ellicott City, Doss Elctrns.	301-465-1336
Mass	Wakefield, Nerem	617-245-4426
Mich	Southfield, Luebbe Sales	313-357-0355
Minn	Edina, Wagner Consultants	612-941-6310
Mo	St. Charles, Florence & Meyer	314-724-6690
NJ	Haddonfield, M & S Assocs.	609-429-7055
NM	Albuquerque, Piper-Goyne	505-265-6794
NY	Bayside, R. Diamond	212-423-7330
NY	Syracuse, Nycom, Inc.	315-437-8343
NY	West Nyack, B. Rubin Assocs.	609-429-7055
Ohio	Cincinnati, Luebbe Sales	513-871-4211
Ohio	Cleveland, Luebbe Sales	216-333-0425
Ohio	Dayton, Luebbe Sales	513-294-0426
Pa	Delmont, Luebbe Sales	412-468-4019
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Plano, Zeus Engrg.	214-231-4661
Wash	Seattle, Blum & Assocs.	206-285-2590

SOMERSET RADIATION LAB., Box 946, Arlington, Va., 22216

Products manufactured: Attenuators, Modulators, All Kinds, Multipliers, Oscillators, Switches

SONIC INTERNATIONAL CORP., 10330 NE Marx, Portland, Ore., 97220, Tel: 503-665-0187; Empl.: 30; Minimum order: $100

For info on price: M L. Roth; Application info: M. L. Roth; Customer service: M. L. Roth; Delivery info: K. Miles

Products manufactured: Handsets, Chestsets, Headphones, Headsets, Etc., Speaker Systems, Speakers

Local Sales Offices & Reps.

Ariz	Pheonix, S. Bova Sls.	602-266-1137
Cal	Brisbane, Metropolitan Sls.	415-467-9100
Cal	N. Hollywood, M. Stobin	213-983-1555
Cal	Northbridge, Products West	213-993-0263
Colo	Inglewood, J. Hanf	303-761-9421
Fla	Jacksonville Beach, Vantage Sls.	904-246-6756
Fla	Miami Beach, E & J Assoc.	305-531-4260
Ga	E. Point, P. Hayden Co.	404-766-0261
Ill	Chicago, Hirsh Sls.	312-583-8877
Ind	Indianapolis, B. Richey & Assocs.	317-542-0605
Kans	Overland Park, Nackman-Brod-Vann	913-381-6560
Md	Baltimore, Bernie Smith Assoc.	301-247-0033
Md	Joppa, J. Merican Co.	301-679-6969
Mass	Newtonville, Arbetter Sls.	617-969-4128
Mich	Southfield, P. Entin Assoc.	313-557-4897
Minn	Minneapolis, Felson & Moscoe Co.	612-831-1897
Mo	St. Louis, Nackman-Brod-Vann Co.	314-991-2424
Neb	Omaha, Nackman-Brod-Vann Co.	402-333-4346
NY	N.Y., B & S Sls.	212-736-3035
NY	New York, J. Kaufman	
NY	Rochester, V. Lulla Assoc.	716-244-7772
NC	Greensboro, P. Hayden Co.	919-288-6754
Ohio	Cleveland, KAM Mktg.	216-464-7717
Pa	Pittsburgh, F. Fleischmann	412-681-4848
Pa	Trevose, E. & J. Sls.	215-355-7847
SC	Columbia, Carolina Mktg.	803-794-7359
Tex	Dallas, Ram Mktg.	214-744-4881
Tex	El Paso, S. Bova Sls.	915-591-6242
Utah	S.L.C., Austin Riggs	801-363-4408
Va	Richmond, Robco Entprs.	804-264-2901
Wash	Vancouver, J. Wasson & Assocs.	206-694-6728

SONY CORP. OF AMERICA, 47-47 Van Dam St., Long Island City, N.Y., 11101

SORENSEN CO., 676 Island Pond Rd., Manchester, N.H., 03103, Tel: 603-668-4500, TWX: 710-220-1339; Empl.: 600; Minimum order: $25 .... p. 1•1433-1442

For info on price: B. McCue; Application info: H. Termin; Customer service: R. E. Maitland; Delivery info: R. E. Maitland

Free literature available: Sorensen 1974/75 Catalog

Products manufactured: Power Supplies, Regulators

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs. Inc.	205-881-6220
Ariz	Scottsdale, Barnhill Three	602-947-7841
Cal	Burbank, Instrument Specialists, Inc.	213-849-7181
Cal	San Diego, Instrument Specialists, Inc.	714-232-2017
Cal	Santa Clara, Instrument Specialists, Inc.	408-244-1505
Colo	Denver, Barnhill Three	303-750-1222
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Chicago, Pivan Engrg. Co.	312-539-4838
Ind	Indianapolis, Pivan Engrg. Co.	317-253-1681
Kans	Shawnee Mission, Pivan Engrg. Co.	913-722-1030
Md	Belair, Dyna Rep. Co.	703-354-1222
Mich	Detroit, Comtel-Sterling Co.	313-255-1970
Minn	Minneapolis, Pivan Engrg. Co.	612-537-4501

Directory of Local Distributors Starts on page 401

Mo	St. Louis, Pivan Engrg. Co.	314-567-3636
NJ	Haddonfield, Dyna Rep Co.	609-795-1700
NM	Albuquerque, Barnhill Three	505-299-7658
NY	Great Neck, Meas. Technology Inc.	516-482-3500
NY	Pleasantville, SBM Assocs.	914-769-1811
NY	Rochester, SBM Assocs.	716-266-1400
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Cleveland, Comtel-Sterling Co.	216-442-8080
Ohio	Dayton, Comtel-Sterling Co.	513-298-7573
Pa	Pittsburgh, Comtel-Sterling Co.	412-922-5720
Tex	Houston, Barnhill Two	713-688-9771
Tex	Richardson, Barnhill Two	214-231-2573
Va	Alexandria, Dyna Rep Co.	703-354-1222
Wash	Seattle, R.S. Drake Assocs., Inc.	206-963-2755
Wisc	Brookfield, Pivan Engrg. Co.	414-786-1940

SORENSEN LIGHTED CONTROLS, 505 New Park Ave., W. Hartford, Conn., 06110 .... p. 2•1198,1199

Products manufactured: Lamps, Lights

SOSHIN ELEC. CO., 1-18-18 Nakamogome, Ota-Ku, Tokyo, Japan, Tel: (03) 775-2111, Telex: 246-6377; Empl.: 1100

Products manufactured: Capacitors, Fixed, Filters

SOTCHER MEASUREMENT, Box 857, Cupertino, Cal., 95014, Tel: 408-732-9171; Empl.: 6; Minimum order: $12

Customer service: F. Sotcher

Free literature available: Model 101, The Fault Finder, Leakage Current Detector Model 301, The Short Stop, Leakage Current Testor Model 401, Outlet Tester Model 510, The Power Monitor Model 620, Generator Test Set Model 714, Low Voltage Alarm

Products manufactured: Alarms, Detectors, Loads, Electronic Variable, Meters, Monitors, Testers

Local Sales Offices & Reps.

Fla	Tampa, E. L. Ebert Sls. Agency	813-837-2867
Tenn	Knoxville, Electronic Sls.	615-577-0689

Local Distributors

Haw	Wahiawa, Wahiawa Rentals, 825 C Olive Ave.	808-621-6084
Ill	Elk Grove Village, IMI Equip. & Supp., 130 Crossen Ave.	312-593-7606
NJ	Moorestown Rental Serv. Supp., Route 73	609-235-6100

SOUND TECHNOLOGY, 10601 S. Saratoga-Sunnyvale Rd., Cupertino, Cal., 95014, Tel: 408-257-9171; Empl.: 11

Products manufactured: Analyzers, Generators, Oscillators, Transformers

SOUTH SHORE METAL PRODS., INC., 88 E Allen Blvd., Farmingdale, N.Y., 11735, Tel: 516-249-3322; Empl.: 26; Minimum order: $25

For info on price: A. G. Bauer; Application info: A. G. Bauer; Customer service: C. Bianco; Delivery info: T. Farkas

Free literature available: Catalog on standard drawn cans

Products manufactured: Bezels, Shielded & Unshielded, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Cases, Equipment, Instrument, Meter, Containers, Escutcheons, Heat Sinks, Soldering, Services, Assembly, Production & Test

Advertisment

S.S. offers a stock size line of deep drawn cans trimmed to customer's length requirement at no extra cost. Will also produce special sizes and shapes complete with mounting brackets, studs, etc. - mumetal and other shielding type enclosures are regularly shipped. Tape control drilling and machining available for panel boards, plug in strips, etc. Quality control program to MIL-1-45208.

SOUTHERN ELCTRNS CORP., see F-Dyne Electronics Co.

SOUTHERN ELECTRONICS CO., 726 So. Flower St., Burbank, Cal., 91502, Tel: 213-845-2458; Empl.: 310 p. 2•240,241

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Filters, Networks

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Electronics	205-881-5031
Cal	Fremont, Spence Assocs.	415-656-9506
Cal	Van Nuys, Myco Sls.	213-988-2288
Colo	Denver, Walter Engrg.	303-777-5585
Conn	Wethersfield, Con/Pak	203-563-4784
Del	Wilmington, Dyna-Rep	301-250-8300
Fla	Ft. Lauderdale, Beacon Electronics	305-622-2770
Fla	Maitland, Beacon Electronics	305-647-3498
Ga	Atlanta, Beacon Electronics	404-351-3654
Ill	Elk Grove Village, Loren Green Assocs.	312-593-0282
Ind	Indianapolis, Loren Green Assoc.	317-293-9827
Kans	Shawnee, J. Guernsey Co.	913-631-2414
Mass	Needham, Com/Pack	617-444-1259
Mich	St. Clair Shores, J. M. Thorpe Co.	313-779-6363
Minn	Minneapolis, Loren Green Assoc.	612-781-1611
NJ	Haddonfield, Dyna Rep	609-795-1700
NY	Hempstead, Kahgan Sls.	516-538-2300
NY	Syracuse, Naylor Elec.	315-472-9183
NC	Greensboro, L & D, Inc.	919-292-3201
Ohio	Cleveland, Orr Assoc.	216-885-1324
Tex	Dallas, Cunningham Co.	214-231-2686
Tex	Houston, Cunningham Co.	713-461-4197
Va	Alexandria, Dyna Rep	703-354-1222
Va	Newport News, Dyna Rep	804-874-7729
FOR:	Can., Don Mills, Ont., B. D. Vallillee Elctrns.	416-447-8482

SPACE POWER ELCTRNS, Jeffrey Lane, RD 1, Glen Gardner, N.J., 08826

SPACETAC, INC., Sub. Corning Glass Works, Crosby Dr., Bedford, Mass., 01730, Tel: 617-275-1710, TWX: 710-326-7567; Empl.: 185

Customer service: Sls. Off.

Free literature available: Flyer on modular memory controlled pcm encoders; A complete company capabilities brochure.

Products manufactured: Amplifiers, Analyzers, Comm. Systems, Converters, Decommutators, Telemetering, Encoders, Memory Systems, Power Supplies, Substrates

Local Sales Offices & Reps.

Cal	Orange	714-541-5275
Md	Columbia	301-953-3360

SPEC PLASTICS INC., 7224 Atoll Ave., No. Hollywood, Cal., 91605, Tel: 213-982-0300; Empl.: 43; Minimum order: $25

For info on price: T. Reid; Application info: T. Reid; Customer service: R. Fuller; Delivery info: R. Fuller

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Connectors, Cups, Encapsulation, Enclosures, Module, Plug-In, Holder & Carriers, Integrated Circuit Packaging Systems, Packages, Integrated Circuit, Pads, Transistor Mounting, Racks

SPECIAL MICROWAVE DEVICES OPER., Raytheon Co., 130 Second Ave., Waltham, Mass., 02154, Tel: 617-890-8080, TWX: 710-324-6568

Customer service: W. C. Jones

Products manufactured: Amplifiers, Attenuators, Circulators, Ferrite, Converters, Detectors, Diodes, Filters, Generators, Isolators, Limiters, Modulators, All Kinds, Multipliers, Oscillators, Shifters, Switches, Terminals, Transistors

Local Sales Offices & Reps.

Cal	Los Angeles	213-641-3103
Cal	Mountain View	415-964-4754
Fla	Longwood	305-830-6670
Ill	Elmhurst	312-833-6760
Mass	Waltham	617-890-8080
NY	Great Neck	516-482-8480
NY	Rome	315-337-2500
Ohio	Dayton	513-254-3571
Tex	Dallas	214-233-2939
Va	Arlington	703-979-6100

SPECIALTIES MFG. CO., INC., 23425 Harper, St. Clair Shores, Mich., 48080, Tel: 313-771-2700; Empl.: 6 p. 1•2277

Customer service: C. Novikoff

Products manufactured: Plugs, Switch Handle Boots, Switch Mounting Plates, Switches

Local Sales Offices & Reps.

Ark	El Dorado, D. Bellew Sls.	501-863-8325
Ga	Atlanta, Hollingsworth & Still	404-255-8200
Ill	Chicago, B. Burns & Assoc.	312-775-1233
Ind	Indianapolis, Sukup & Cox	317-253-5501
La	Kenner, D. Bellew Sls.	504-729-4550
Mo	St. Louis, Kathrinus Kelly-Boswell Co.	314-962-5627
NJ	Caldwell, Art Cerf & Co.	201-226-2263
NY	Bronx, Peterson-Rudnick Assoc.	212-671-1923
NC	Charlotte, Hollingsworth & Still	704-536-7047
Ohio	Cleveland, Marlow Assocs.	216-381-4500
Ohio	Xenia, Marlow Assocs.	513-426-6270
Ore	Portland, Pacific Elec. Sls.	503-235-4137
Tex	Dallas, Collins Co.	214-341-7866

SPECIALTY CONNECTOR CORP., 3560 Madison Ave., Indianapolis, Ind., 46227, Tel: 317-787-6368; Empl.: 100; Minimum order: $30

For info on price: W. Foltz; Application info: M. H. Burdett; Customer service: W. Foltz; Delivery info: W. Foltz

Products manufactured: Connector Adapters, Connectors

Local Sales Offices & Reps.

Cal	Los Angeles, M.A. Stolaroff	213-295-7781
Cal	Palo Alto, W.W. Tompkins & Co.	415-326-7940
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Conn	Meriden, Eagle Assocs.	203-235-9036
Ga	Atlanta, Grady Duckett Sls. Corp.	404-451-3529
Ill	Oak Park, W. Gallagher	312-261-7517
Ill	Weschester, W. Gallagher	312-344-0690
Ind	Fort Wayne, S & S Elctrns.	219-743-4611
NJ	Bergenfield, H. Gray Assocs.	201-384-3643
NJ	Mount Laurel, Naudain Assocs.	609-235-1801
NJ	Syracuse, Naylor Electric Co.	315-472-9183
Ohio	Akron, A. Natalino Assocs.	216-725-6087
Tex	Richardson, Oeler & Menelaides, Inc.	214-234-6334
Wash	Seattle, H.S. Thorpe & Co.	206-784-3333

SPECTRA-PHYSICS, INC., 1250 W. Middlefield Rd., Mountain View, Calif., 94040, Tel: 415-961-2550, TWX: 910-379-6941; Empl.: 1000; Minimum order: $100

For info on price: J. Calvert; Application info: C. Schulthess; Customer service: J. Cole; Delivery info: J. Calvert

Products manufactured: Lasers & Laser Systems, Monitors, Power Supplies, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles	714-496-6886
Ill	Chicago	312-386-5104
Mass	Boston	617-734-4661
NJ	Avenel	201-381-1552
NM	Albuquerque	505-881-7577
Tex	Dallas	214-528-5142

SPECTRA SONICS, 770 Wall Ave., Ogden, Utah, 84404, Tel: 801-392-7531; Empl.: 25

For info on price: R. Welch; Application info: W. G. Dilley; Customer service: J. Dilley; Delivery info: J. Dilley

Products manufactured: Amplifiers, Equalizers, Filters, Mixer-Preamplifiers, Microwave, Mixers, Networks, Power Supplies, Testers, Tracers, Curve

SPECTRA-STRIP CORP., 7100 Lampson Ave., Garden Grove, Cal., 92642, Tel: 714-892-3361, TWX: 910-596-1314; Empl.: 200 ....p. 2•2056,2057

Products manufactured: Adhesives (All Types), Cable Assemblies & Harnesses, Cable, Circuits, Flexible, Circuits, Printed, Multilayer, Connectors, Jumpers, Sockets, Wire

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps. Inc.	205-539-4411
Ariz	Phoenix, G.R. McKnight Co.	602-257-8037
Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Cal	Newport Beach, Mission Mktg. Group	714-833-1802
Cal	San Diego, Hadden Assocs.	714-565-9444
Colo	Denver, Thorson Co.	303-759-0809
Conn	Wethersfield, Com/Pak Inc.	203-563-4784
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-776-4800
Fla	Orlando, W.A. Brown Comps.	305-425-5505
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Ga	Atlanta, W.A. Brown Comps.	404-457-4069
Ill	Chicago, GNB Assocs.	312-673-4050
Ind	Indianapolis, R.H. Newsom Assoc.	317-849-4442
Mass	Needham Heights, Com/Pak Inc.	617-444-1259
Mich	Wyoming, N. Case Assocs.	616-531-2729
Minn	Minneapolis, PSI	612-835-1777
Mo	Kansas City, Nevco	816-421-1751
Mo	St. Louis, Nevco	314-843-7406
NJ	Clifton, Compar N. Y. Inc.	201-546-3660
NY	East Syracuse, Fountain Young & Co.	315-437-7733
NC	Raleigh, W.A. Brown Comps.	919-876-9601

NC	Winston-Salem, W.A. Brown Comps.	919-725-5384
Ohio	Centerville, N. Case Assocs.	513-433-0966
Ohio	Fairview Park, N. Case Assocs.	216-333-4120
Ore	Aloha, E.S. Chase Co.	503-649-6177
Pa	Ft. Washington, Kirk-Sandell Inc.	215-643-2100
Tex	Dallas, McCoy Assocs.	214-350-9931
Tex	Houston, Ev. Smith Sls. Co.	713-649-5756
Utah	Bountiful, Logistic Specialties	801-292-3030
Va	Charlottesville, Kirk-Sandell	804-977-2033
Wash	Edmond, E.S. Chase Co.	206-774-3586

Local Distributors

Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	714-894-7581
Cal	Irvine, Terminal Elec., 1791 Reynolds	714-549-8611
Cal	Mountain View, Terminal Elctrns., 880 Maude Ave.	415-969-9240
Cal	Palo Alto, Storm Prod., 4039 Transport	415-326-2913
Ill	Chicago, Allied Elec., 2400 Washington	312-421-2400
Mass	Burlington, C. E. Scrymegeour Co., 13 Grant Ave.	617-272-0060
Minn	Minneapolis, Ind. Components, 5280 W. 74th St.	612-831-2666
NH	Londonderry, Yankee Elec. Supp., Grenier Ind. Pk.	603-625-9746
NJ	Rahway, Terminal Elctrns., 1421 Pinewood St.	201-381-5700
NY	Buffalo, Summitt Elec., 916 Main St.	716-884-3450
NY	Farmingdale, Vertex Elec., 91 Milbar Blvd.	516-239-9880
NY	Tuckahoe, Bi-Tronics, Inc., 76 Main St.	914-961-4700
Ohio	Dayton, Astro Ind., 3189 Plainfield Rd.	513-253-5118
Pa	Harrisburg, Pyttronic Ind., Box 1967	717-233-6591
Tex	Dallas, Solid State Elec., Box 20299	214-352-2601
Tex	Ft. Worth, Allied Elec., 401 E. 8th St.	817-336-5401
Tex	Houston, Solid State Elctrns., Box 36849	713-785-5436
Utah	Salt Lake City, Standard Supp., 225 E. 6th S. St.	801-355-2971
Wash	Seattle, Interface Elec., 300 W. 2nd	206-285-3500

SPECTROL ELECTRONICS CORP., 17070 East Gale Ave., City of Industry, Cal., 91745, Tel: 213-964-6565, TWX: 910-584-1314; Empl.: 600; Minimum order: $50 p. 2•1676-1681

Customer service: Dist. Sls. Dept.

Products manufactured: Dials, Potentiometers, Switches

Local Sales Offices & Reps.

Ala	Huntsville, Rep, Inc.	205-881-9270
Ariz	Phoenix, Howe & Howe Sls.	602-264-7971
Cal	Mountain View, Factory Sls. Off.	415-964-3260
Cal	San Diego, Daniels & Doty Sls.	714-560-6266
Colo	Denver, Lindberg Co.	303-758-9033
Conn	North Haven, Kitchen & Kutchin	203-239-0212
Fla	Altamonte Springs, Semtronic Assocs.	305-831-8233
Fla	Ft. Lauderdale, Semtronic Assocs.	305-771-0010
Ill	Hinsdale, Momak Sls.	312-654-4524
Iowa	Hiawatha, Gassner & Clark	319-393-5763
Md	Baltimore, Gould Inc.-Daniel Div.	301-825-3330
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Mich	Dearborn, V.P.I., Inc.	313-271-4600
Minn	St. Paul, Murnco	612-484-8200
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NM	Albuquerque, Lindberg Co.	505-345-2489
NY	Oceanside, Bittan Assocs.	516-678-6222
NY	Syracuse, Tri-Tech Elctrns.	315-446-2881
NC	Charlotte, R.W. Chapman Co.	704-525-2421
NC	Raleigh, R.W. Chapman Co.	919-782-2624
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Ohio	Dayton, Luebbe Sls. Co.	513-294-0426
Okla	Oklahoma City, Ammon & Rizos Co.	405-947-1051
Ore	Beaverton, Vantage Corp.	503-644-6111
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
SC	Greenville, R.W. Chapman Co.	803-232-5392
Tex	Dallas, Ammon & Rizos Co.	214-233-5591
Tex	Houston, Ammon & Rizos Co.	713-781-6240
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Bellevue, Vantage Corp.	206-455-3460
FOR:	Can., Malton, Deskin Sls.	416-677-5517
FOR:	Can., Vancouver, Deskin Sls.	604-324-6331
FOR:	Can., Ville St. Laurent, Deskin Sls.	514-331-2860

Local Distributors

Ala	Huntsville, Powell Elec., 803 Oster Dr.	205-539-2731
Ariz	Phoenix, R.V. Weatherford, 1917 N. 25th	602-272-7144
Ariz	Phoenix, Sterling Elec., 2001 E. University	602-258-4531
Cal	Anaheim, Weatherford Co., 1550 Babbitt Ave.	714-633-9633
Cal	Glendale, Weatherford Co., 6921 San Fernando	213-849-3451
Cal	Inglewood, Newark Elec., 4747 W. Century	213-678-0441
Cal	Los Angeles, Kierulff, 2585 Commerce Way	213-685-5511
Cal	Mt. View, Abacus, 1065 Terra Bella	415-961-1500
Cal	Palo Alto, Kierulff, 3973 E. Bayshore	415-968-6292
Cal	Palo Alto, Weatherford Co., 3240 Hillview Ave.	415-493-5373
Cal	Pomona, Weatherford Co., 1095 E. 3rd St.	714-623-1261
Cal	San Carlos, Sterling Elec., 1061 Industrial	415-592-2353
Cal	San Diego, Kierulff, 8797 Balboa Ave.	714-278-2112
Cal	San Diego, Weatherford Co., 7878 Raytheon Rd.	714-278-7400
Cal	Sun Valley, Sterling Elec., 11614 Pendleton St.	213-767-5030
Colo	Denver, Newark/Denver El., 2170 S. Grape	303-757-3351
Colo	Englewood, R.V. Weatherford, 390 S. Mariposa	303-761-5432
Conn	Fairfield, U Tronics, 272 Linwood Ave.	203-255-4521
Conn	N. Haven, Cramer Elec., 35 Dodge Ave.	203-239-5641
Fla	Ft. Lauderdale, Newark Elec., 1360 N.W. 65th	305-587-2372
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff In.	404-448-9050
Ill	Arlington Hts., T.I. Supp., 2420 E. Oakton	312-593-7660
Ill	Rosemont, Kierulff, 9340 William	312-678-8560
Ill	Rosemont, Newark, 500 N. Pulaski	312-638-4411
Ind	Indianapolis, Graham, 133 S. Pennsylvania	317-634-8486
Iowa	Grand Rapids, Deeco, Inc., 2500 16th, S.W.	319-365-7551
La	Lafayette, Ralph's, 3004 Cameron St.	318-234-4507
La	Metairie, Sterling Elec., 4613 Fairchild	504-887-7610
Md	Baltimore, Technico, Inc., 1404 Bare Hills	301-828-6416
Md	Gaithersberg5Kierulff El., 16021 Ind.	301-948-0250
Mass	Dedham, Gerber Elec., 852 Providence Hwy.	617-329-2400
Mass	Needham, Kierulff, 14 Charles St.	617-449-3600
Mass	Newton, Cramer, 85 Wells Ave.	617-969-7700
Mass	Newton, Greene-Shaw, 70 Bridge St.	617-969-8900
Mich	Detroit, Newark Elec., 20700 Hubbell Ave.	313-548-0250
Mich	Farmington, Northland, 32708 W. Eight Mile	313-477-3200
Mich	Wyoming, Newark Elec., 3645 Linden, S.E.	616-241-6651
Minn	Minneapolis, Stark's, Inc., 112 3rd Ave. N.	612-332-1325
Minn	St. Paul, Gopher Elec., 2520 W. Larpenteur	612-645-0241
Mo	N. Kansas, LCOMP Kansas City, 1520 Taney St.	816-221-2400
Mo	St. Louis, LCOMP St. Louis, 2605 S. Hanley	314-647-5505
NJ	Camden, General Radio, 600 Penn St.	609-964-8560
NJ	Kenilworth, Newark Elec., 303 Monroe Ave.	201-272-8410
NJ	Moorestown, Arrow/Angus, Pleasant Valley	215-235-1900
NJ	Rutherford, Kierulff Elec., 5 Ind. Dr.	201-935-2120
NM	Albuquerque, Weatherford Co., Marberry Plaza	505-265-5671
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elec., 900 Broad Hollow Rd.	516-694-6800
NY	Hicksville, Kierulff, 49 Bethpage Rd.	516-433-5530
NY	Johnson City, Wilshire Elec., 617 Main St.	607-797-1236
NY	Rome, Rome Elec., 216 Eerie Blvd. E.	315-337-5400
NC	Greensboro, Hammond Elec., 2923 Pacific	919-275-6391
Ohio	Cincinnati, Newark Elec., 9799 G. Princeton	513-874-5115
Ohio	Cleveland, Arrow Elec., 23945 Merchantile	216-464-2000
Ohio	Cleveland, Newark Elec., 2028 E. 46th Ave.	216-361-4700
Ohio	Cleveland, RPC Elec., 749 Miner Rd.	216-461-2700
Ohio	Dayton, Arrow Elec., 3100 Plainfield Rd.	513-253-9176
Ohio	Dayton, Kierulff, 2030 Drill Ave.	513-278-9411
Okla	Tulsa, T.I. Supp., 12151 E. Skelly	918-437-4555
Pa	Philadelphia, Kierulff Elec., 109 Gaither Dr.	215-922-0810
Pa	Pittsburgh, Barno Radio, 5403 W. Smithfield	412-462-7575
Pa	Pittsburgh, RPC Elec., 620 Alpha Dr.	412-782-3770
SC	Greenville, Hammond Elec., 100 Augusta St.	803-233-4121
Tex	Dallas, R.V. Weatherford, 10836 Grissom La	214-243-1571
Tex	Dallas, T.I. Supp., 6000 Denton Dr.	214-238-3011
Tex	Garland, Newark Elec., 707 Easy St.	214-271-2511
Tex	Houston, Newark Elec., 6902 Harwin Dr.	713-782-4800
Tex	Houston, Sterling Elec., 4201 Southwest Fwy.	713-623-6600
Tex	Houston, T.I. Supp., 3939 Ann Arbor Dr.	713-785-4800
Utah	Salt Lake City, Newark Elec., 2540 S. 300 W.	801-486-1048
Wash	Seattle, Kierulff Elec., 5640 Sixth Ave. S.	206-763-1550
Wash	Seattle, Weatherford Co., 541 Industry Dr.	206-243-6340
Wisc	Oak Creek, Cramer Elec., 430 W. Rawson	414-764-1700

SPECTRONICS, INC., 830 E. Arapaho Dr., Richardson, Tex., 75080, Tel: 214-234-4271, Telex: 73-0890; Empl.: 300; Minimum order: $25 p. 1•1021

Customer service: Central Mktg.

Free literature available: Optoelectronic Components Book - Complete electrical and electro-optic characteristics on all standard components. Infrared Products Book - Complete description of all standard and custom capability of Infrared Detectors and special emitters. Optical Switches & Reflective Sensor Assemblies - Summary of standard products.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Controls/Control Eqpt., Detectors, Diodes, Encoders, Isolators, Lamps, Sensors, Light, Transistors

Local Sales Offices & Reps.

Cal	, Diamond Bar	714-598-2297
Mass	Methuen, Spectronics	617-687-0714

SPECTRUM CONTROL, INC., 152 E. Main St., Fairview, Pa., 16415, Tel: 814-474-5593, TWX: 510-669-6848; Empl.: 200 p. 1•575-583

Products manufactured: Capacitors, Fixed, Filters, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Cal	Fullerton, M.A. Stolaroff Co.	714-879-5998
Cal	Los Angeles, M.A. Stolaroff Co.	213-295-7781
Cal	San Diego, M.A. Stolaroff Co.	714-234-6905
Ill	Chicago, Gassner & Clark Co.	312-345-4245
Iowa	Hiawatha, Gassner & Clark Co.	319-393-5763
Minn	Minneapolis, Barnes Sls. Assoc.	612-474-2907
NJ	Martinsville, Spectrum Control Inc.	201-469-6056
FOR:	Can., Montreal, Que., Space Elctrn. Sls. Corp.	514-735-5775

SPECTRUM DYNAMICS, 11 B North Ave., Burlington, Mass., 01803, Tel: 617-273-1850, TWX: 710-332-6878; Empl.: 62; Minimum order: $25

Customer service: C. McNamara

Products manufactured: Boards, Programming

Local Sales Offices & Reps.

Ala	Huntsville, Beacon	205-881-5031
Cal	Los Angeles, Dyna Sls.	213-268-1175
Colo	Denver, W. J. Purdy	303-777-1411
Fla	Ft. Lauderdale, Beacon	305-776-6074
Ga	Atlanta, Beacon	404-351-3654

Haw	Honolulu, Aloha Assoc.	808-941-1574
Ill	Chicago, Kennedy Engr.	312-631-8283
Kans	Wichita, G. Fixman Engr.	316-682-9433
Mass	Burlington, Spectrum Dynm.	617-273-1850
Minn	Minneapolis, Milt Westlund Assoc.	652-866-5002
Mo	St. Louis, G. Fixman Engrg.	314-725-5219
NM	Albuquerque, W. J. Purdy	505-266-7959
NY	Fayetteville, M. P. Andrews Mfg.	315-637-3144
NY	Port Chester, Radiation Elctrns.	914-937-2300
Pa	Bala Cynwyd, Electech	215-687-5305
SC	Spartanburg, Beacon	803-582-4613
Tex	Richardson, Carl Tinch Sls. Co.	214-231-1322

SPECTRUM TECHNOLOGY INC., 300 Frederic Lopez Rd., Goleta, Cal., 93017, Tel: 805-964-7791; Empl.: 75

Customer service: B. Bertrando

Free literature available: Complete line of logic clocks, crystal oscillators, TCXO's and frequency modules for commercial and government applications.

Products manufactured: Integrated Circuit Devices, Modulators, All Kinds, Oscillators, Standards

Local Sales Offices & Reps.

Ariz	Scottsdale, I.M.E.C.	602-947-7379
Cal	Encino, EL/TEC, Inc.	213-981-9881
Cal	Mountain View, West/Mark Assocs.	415-969-1700
Colo	Littkton, Lange Sls.	303-798-1397
Conn	Milford, Todino Engrg. Sls.	203-847-6643
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Fla	Temple Terrace, Saber Assocs.	813-988-8686
Ill	Westchester, W.G. Brouillette & Assoc.	312-345-6500
Mass	Needham, Todino Engrg. Sls.	617-444-7925
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Minn	Minneapolis, Tech. Assocs.	612-929-6721
Mo	Grandview, Beneke & McCaul, Inc.	816-765-2998
Mo	St. Louis, Beneke & McCaul, Inc.	314-231-1677
NJ	Haddonfield, Mesa Tech. Assocs.	609-429-9531
NJ	Springfield, F.F. Sylvester Assocs.	201-376-3324
NM	Albuquerque, I.M.E.C.	505-883-9010
NY	Camillus, ONTEC	716-464-8636
NY	Grand Island, ONTEC	716-464-8636
NY	Rochester, ONTEC	716-464-8636
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Ohio	Dayton, Luebbe Sls. Co.	513-294-0426
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
SC	Greenville, J. Egan Assocs.	803-288-4450
Va	Fairfax, Schibley Assocs.	703-591-3008
Wash	Mercer Island, Northwest Mufacturers Agents	206-284-7002
FOR:	Montreal 260, Que., Can., Solid State Engrg.	514-481-3313

SPEED DETECTORS, INC., 32 W. Monroe St., Bedford, Ohio, 44146, Tel: 216-232-1880; Empl.: 60

Products manufactured: Controls/Control Eqpt., Counters, Indicators, Meters, Tachometers, Timers, Totalizers, Digital

Local Sales Offices & Reps.

Ariz	Glendale, Harvey Data Systems	602-247-5818
Cal	Long Beach, Saber Entprs.	213-595-5646
Colo	Westminster, Harvey Data Systems	303-427-5299
Conn	Hamden, J & J Assocs.	203-624-7800
Md	Rockville, E. Winston & Co.	301-881-5780
Mass	Burlington, J & J Assocs.	617-272-2606
Mich	Ferndale, Tiby Co.	313-547-3550
NY	Syracuse, J. D. Birchard	315-469-4689
NY	Westbury, OAL Assocs.	516-334-1940
NC	Charlotte, Bimco	704-366-5092
Ohio	Cleveland, Tiby Co.	216-371-5335
Ohio	Dayton, Tiby Co.	513-277-3822

SPELLMAN HIGH VOLTAGE ELCTRNS. CORP., 1930 Adee Ave., Bronx, N.Y., 10469, Tel: 212-671-0300, TWX: 710-593-4135; Empl.: 40; Minimum order: $100

p. 1•1460-1471

For info on price: H. Moresco; Application info: M. Civin; Customer service: H. Moresco; Delivery info: S. Hoffman

Free literature available: Short form catalog #7400 - General products, Application notes #7210 - RF high voltage technology, Application notes #7220 - RF high voltage versatility, High voltage testing - STP-473 - How to test a H.V. power supply

Products manufactured: Converters, Power Supplies, Transformers

Local Sales Offices & Reps.

Cal	Pasadena, A-F Sls.	213-681-5631
Colo	Arvada, Cleveland Entprs.	303-423-3707
Fla	Satellite Beach, Reynolds Assocs.	305-773-4700
Ill	Chicago, Ropek-Cahill	312-287-7292
Md	Hyattsville, Eastern Components	301-577-2925
Mass	Concord, Nortech Engrg. Sls.	617-259-0032
NJ	Tenafly, Budd-Tronics	201-569-2230
NM	Albuquerque, Cleveland Enterprises	505-345-2481
NY	Schenectady, N.W. Alexander & Assoc.	518-377-0581
Pa	Flourtown, Eastern Components	215-836-1616
Tex	Dallas, R. Martin Assoc.	214-361-8584
Tex	Houston, R. Martin Assoc.	713-462-4077
FOR:	Can., Vancouver 9 B.C.; Broman Engrg.	604-731-6222

SPEMCO SWITCHES, See Specialties Mfg. Co.

SPERRY MICROWAVE COMPONENTS, Gainesville, Fla., 32601, Tel: 904-372-0411; Empl.: 375

Products manufactured: Amplifiers, Diodes, Integrated Circuit Devices, Oscillators, Power Supplies, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles	213-670-4882
NY	Great Neck	516-574-1435
Ohio	Dayton	513-433-9451

SPRAGUE ELEC. CO., 481 Marshall St., No. Adams, Mass., 01247, Tel: 413-664-4411, TWX: 710-369-1360; Empl.: 9600

Products manufactured: Amplifiers, Analyzers, Bridges, Capacitor, Hardware, Capacitors, Fixed, Capacitors, Variable, Circuits, Hybrid, Thick Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Decade Boxes, Diodes, Filters, Integrated Circuit Devices, Machines/Machinery, Production, Meters, Networks, Receivers, Resistors, RFI Measuring Equipment, Scribers, Standards, Suppressors, Switches, Testers, Thermistors, Thyristors (Includes Silicon Controlled Rectifiers), Timers, Tracers, Curve, Transformers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Sprague Elec. Co.	205-883-0520
Ariz	Tempe, Sprague Elec. Co.	602-279-5435
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Cal	Inglewood, Sprague Elec. Co.	213-649-2600
Cal	Los Angeles, KCE Corp.	213-649-2622
Cal	San Diego, KCE Corp.	714-278-7640
Colo	Denver, Sprague Elec. Co.	303-756-3611
Conn	Trumbull, Sprague Elec. Co.	203-261-2551
DC	Washington, Sprague Elec. Co.	202-244-6006
Fla	Longwood, Sprague Elec. Co.	305-831-3636
Ill	Schiller Park, Sprague Elec. Co.	312-678-2262
Ill	St. Ann, Sprague Elec. Co.	314-291-2500
Ind	Indianapolis, Sprague Elec. Co.	317-253-4247
Mass	Waltham, Sprague Elec. Co.	617-899-9100
Mich	Jackson, Sprague Elec. Co.	517-787-3934
Minn	Minneapolis, HMR, Inc.	612-920-8200
Mo	St. Ann, Sprague Elec. Co.	314-291-2500
NJ	Cherry Hill, Sprague Elec. Co.	609-795-2299
NJ	Wayne, Sprague Elec. Co.	201-696-8200
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	Mamaroneck, Wm. Rutt, Inc.	914-698-8600
NY	Melville, Sprague Elec. Co.	516-549-4141
NY	Syracuse, Mar-Com Assocs.	315-437-2843
NC	Winston-Salem, Electronic Mktg. Assocs.	919-722-5151
Ohio	Chagrin Falls, Sprague Elec. Co.	216-247-6488
Ohio	Dayton, Sprague Elec. Co.	513-278-0781
Tex	Richardson, Sprague Elec. Co.	214-235-1256
Va	Lexington, Sprague Elec. Co.	703-463-9161
Wash	Seattle, Sprague Elec. Co.	206-632-7761
FOR:	Can., Toronto 15, Ont., Sprague Elec. of Can., Ltd.	416-766-6123
FOR:	Can., Ville St. Laurent 9, P.Q., Sprague Elec. of Can., Ltd.	514-747-7811

SPRAGUE PRODUCTS CO., 481 Marshall St., No. Adams, Mass., 01247, Tel: 413-664-4481, TWX: 710-369-1363; FSC No: 56289

p. 1•585-587,810,811,1866-1872,2282; p. 2•242-301,1546, 1547,1790

For info on price: A. Lopresto 413-664-4471; Application info: K. Blanchard 413-664-4481; Customer service: R. Lemere 413-664-4481; Delivery info: A. Lopresto 413-664-4471

Free literature available: Catalog C-563 - Components for industrial, military, commercial electronics. 96 pages of capacitors, semiconductors, resistors, interference filters, L.E.D. devices, pulse transformers, switches, test instruments.

Products manufactured: Amplifiers, Analyzers, Bridges, Capacitor, Hardware, Capacitors, Fixed, Capacitors, Variable, Caps, Connector, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Clamps & Clips, Converters, Decade Boxes, Diodes, Display Devices/Displays, Films, Filter Synthesizers, Filters, Generators, Integrated Circuit Devices, IC's, Active Filters, Integrators, Electronic, Machines/Machinery, Production, Meters, Networks, Power Drivers, Hybrid (High Current, High Voltage), Receivers, Resistors, RFI Measuring Equipment, Scribers, Standards, Suppressors, Switches, Testers, Thermistors, Thyristors (Includes Silicon Controlled Rectifiers), Timers, Tracers, Curve, Transformers, Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, KCE Corp.	602-258-7519
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Cal	Los Angeles, KCE Corp.	213-649-2622
Cal	Sacramento, W. J. Purdy Co.	916-422-0128
Cal	San Diego, KCE Corp.	714-278-7640
Col	Denver, W. J. Purdy Co.	303-777-1411
Fla	Fort Lauderdale, UniRep, Inc.	305-527-1556
Haw	Honolulu, Hawaii Elctrns. Sls.	808-845-8207
Ill	Chicago, D. Dolin Sls. Co.	312-286-6200
Ind	Mulberry, Maish Sls.	317-638-8484
Mass	Waltham, Sprague Prods. Co.	617-899-9840
Minn	Minneapolis, HMR, Inc.	612-920-8200
Mo	Kansas City, Nevco, Inc.	816-421-1751
Mo	St. Louis, Nevco, Inc.	314-843-7406
NJ	Cherry Hill, Trinkle Sls. Inc.	609-795-4200
NJ	Cranford, G. G. Burnett	201-276-2149
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	Mamaroneck, W. Rutt, Inc.	914-698-8600
NY	Syracuse, Paston-Hunter Co.	315-437-2992
NC	Winston-Salem, Elctrns. Mrktg. Assocs.	919-722-5151
Ohio	Beachwood, Elctrn. Salesmasters	216-831-9555
SC	Greenville, Elctrn. Mrktg. Assoc.	803-268-1125
Tex	Dallas, Lund & Co.	214-358-4335
Wash	Seattle, Fleehart & Sullivan, Inc.	206-522-1533

SPRAGUE-GOODMAN ELECTRONICS, INC., 371 Willis Ave., Mineola, N.Y., 11501, Tel: 516-746-1385; Empl.: 25

Customer service: J. Goodman

Free literature available: Catalogs covering Pistoncap® glass & quartz trimmers, ceramic trimmers, & ptfe trimmers.

Products manufactured: Capacitors, Variable

Local Sales Offices & Reps.

Ala	Huntsville, Sprague Elec. Co.	205-883-0520
Ariz	Tempe, Sprague Elec. Co.	602-279-5435
Cal	Burlingame, W. J. Purdy Co.	415-347-7701
Cal	Inglewood, Sprague Elec. Co.	213-649-2600
Cal	Los Angeles, KCE Corp.	213-649-2622
Cal	San Diego, KCE Corp.	714-278-7640
Colo	Denver, Sprague Elec. Co.	303-753-1136
Colo	Denver, W. J. Purdy Co.	303-777-1411
Conn	Trumbull, Sprague Elec. Co.	203-261-2551
Fla	Melbourne, J. J. Smith Assocs.	305-727-3163
Ill	Schiller Park, Sprague Elec. Co.	312-678-2262
Ind	Indianapolis, Sprague Elec. Co.	317-253-4247
Md	Pikesville, A. Wetterhahn Co.	301-484-6376
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Jackson, Sprague Elec. Co.	517-787-3934
Minn	Minneapolis, HMR	612-920-8200
Mo	St. Ann, Sprague Elec. Co.	314-291-2500
NH	Dover, R. Perron & Co.	603-742-2321
NJ	Oaklyn, A. Wetterhahn Co.	609-858-3003
NM	Albuquerque, W. J. Purdy Co.	505-266-7959
NY	East Rockaway, W. Bellenkas Assoc.	516-887-1443
NY	Pittsford, T-Squared Elctrns. Co.	716-381-2551
NY	Syracuse, T-Squared Elctrns. Co.	315-463-8592
NC	Winston-Salem, Electronic Mktg. Assoc.	919-722-5151
Ohio	Beachwood, Electronic Salesmasters	216-831-9555
Ohio	Dayton, Sprague Elec. Co.	513-278-0781
Tenn	Huntsville, Sprague Elec. Co.	205-883-0502
Tex	Dallas, E. F. Aymond Co.	214-826-7620
Vt	Dover, R. Perron & Co.	603-742-2321
Wash	Seattle, Sprague Elec. Co.	206-632-7761
FOR:	Can., Don Mills, Ont., B. D. Vallillee Elctrns., Ltd.	416-447-8482

SPRENGNETHER INSTR. CO., W.F., 4567 Swan St., St. Louis, Mo., 63110, Tel: 314-535-1682; Empl.: 25

Free literature available: Catalog pages & prices.

Products manufactured: Amplifiers, Clocks (All Types), Comm. Systems, Meters, Recorders, Transducers

SQUARE D CO., 4041 N. Richards, Dept. SA-711 Box 472, Milwaukee, Wisc., 53201, Tel: 414-332-2000, Telex: 2-6647; Empl.: 15000 .... p. 1•273,1814,1815

Products manufactured: Alternators, Boxes, Junction, Outlets & Wall Plates, Brakes, Cards, Logic, Circuit Breakers, Clamps & Clips, Connectors, Controllers, Programmable, Controls/Control Eqpt., Counters, Ducts, Wiring, Indicators, Limit Stops, Mechanical, Modules, Logic, Encapsulated, Process Control Systems, Relays, Resistors, Switchboards, Switches, Terminal Blocks, Boards & Strips, Terminals, Timers, Transformers, Valves, Solenoid

SRC DIV., MOXON INC., See Moxon Inc.

S S A C PRECISION PRODUCTS INC., Box 395, Liverpool, N.Y., 13088, Tel: 315-457-9610

For info on price: R. Shutt; Application info: R. Shutt; Customer service: D. Reynolds; Delivery info: D. Reynolds

Free literature available: Solid state flashers, timers and relays for industrial and commercial applications. Voltages from 12 to 230 AC/DC. Load rating to 12 amperes/180 amperes surge.

Products manufactured: Controls/Control Eqpt., Flashers, Lamp Drivers, Lights, Relays, Switches, Timers

Local Sales Offices & Reps.

Cal	N. Hollywood, Crown Elctrns.	213-877-3550
Cal	San Francisco, Artwel Elec.	415-467-1880
Conn	Old Lyme, Conn. Valley Ent.	203-434-5844
Mich	Troy, Xanthus	313-391-3235
Minn	St. Paul, Steve Foster	612-454-5552
Mo	St. Louis, Richter Assocs.	314-567-1829
NY	Rochester, Upstate Component Sls.	716-288-1080
NY	Rye, Charles Auery Assoc.	914-967-7610
Pa	Jenkintown, Arnold Assocs.	215-742-0600
Tenn	Chattanooga, Hayden Roberts	615-267-5922

Local Distributors

Cal	Los Angeles, Master Distr., Box 25662	213-395-2637
Fla	Winter Pk., Sta-Con, 680 Clay St.	305-645-2215
NJ	Fairlawn, Relay Specialties, Box 223-1300 Plaza Rd.	201-797-3313
NC	Shelby, Dixie Ind'l Supp., Box 127, Hgwy. 74E	704-482-5641

STACKPOLE CARBON CO., Carbon Div., St. Marys, Pa., 15857, Tel: 814-781-1234, TWX: 510-693-4511; FSC No: 78488

Products manufactured: Brushes & Brush Assemblies, Contacts, Electrical, Graphite Parts, Materials, Graphite

STACKPOLE CARBON CO., Electronic Comps. Div./Soft Fernites/Fixed Comp. Resistors, St. Mary's, Pa., 15857, Tel: 814-781-1234, TWX: 510-693-4511

Products manufactured: Cores, Magnetic, Ferrite Material & Parts, Resistors, Yokes

Refer To: SCC/Elctrn. Comps. Div. - Fixed Comp. Resistors For Sales Office Information

STACKPOLE CARBON CO., Elctrn. Comps. Div.-Fixed Comp. Resistors, Kane, Pa., 16735, Tel: 814-837-7000, TWX: 510-695-8404; FSC No: 78488

Products manufactured: Resistors

Local Sales Offices & Reps.

Ariz	Phoenix, Bestronics	602-248-7020
Cal	Los Angeles, Black, Ekizion & Strong Inc.	213-870-9191
Cal	Millbrae, F. Auman	415-445-2250
Cal	San Diego, Bestronics	714-278-2150
Colo	Denver, Check Mate Sls.	303-771-4920
Conn	Plantsville, R. J. Pisaneschi	203-628-9505
Fla	N. Palm Beach, Lectro Mech.	305-842-2458
Ga	Peachtree City, J.A. Creighton	404-461-9836
Ill	Arlingtton Heights, J. L. Clingingsmith	312-392-1639
Ill	Chicago, Stackpole Carbon Co.	312-297-0270
Ill	Kankakee, R. Burgess	815-939-7385
Ind	Bloomington, R.E. Riggs	812-339-6166
Kans	Overland, Ensco-Rep	913-381-7557
La	Baton Rouge, R.F. Gallagher	504-924-4995
Md	Baltimore, Stemler Assoc., Inc.	301-944-8262
Mass	Boxford, E.F. Delaney,Jr.	617-887-2090
Mich	Birmingham, J.E. Vollmer Jr.	313-644-3571
Minn	Minneapolis, Bitronics Sls. Co.	612-835-7744
Minn	Minneapolis, HMR Inc.	612-920-8200
Mo	St. Louis, Ensco-Rep. Inc.	314-567-3935
NJ	Englewood Cliffs, Sprung/Nussbaum	201-947-6767
NY	Buffalo, R.W. Mitscher	716-633-7970
NY	Fayetteville, R.W. Mitscher	315-637-9575
NC	Raleigh, R.W. Mitscher	919-828-0575
Ohio	Hudson, D. J. Mohr	216-653-2255
Pa	Oreland, Brown-Oberlies Inc.	215-887-1325
Pa	Pittsburgh, H.S. Swoyer	412-256-2538
Tenn	Shelbyville, R. W. Mitscher	615-684-4544
Tex	Dallas, M.N. Herbst	214-239-2497
Va	Virginia Bch., R.W. Mitscher	804-481-7200
Wash	Bellevue, Vantage	206-455-3460

STACKPOLE CARBON COMPANY, Magnet Div., Kane, Pa., 16735, Tel: 814-837-7000, TWX: 510-695-8360

Products manufactured: Magnets

STACKPOLE COMPONENTS CO., Box 14466, Raleigh, N.C., 27610, Tel: 919-828-6201, TWX: 510-928-0520; FSC No: 78488 .... p. 1•2278-2281

Products manufactured: Keyboards, Alphanumeric & Decimal, Potentiometers, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Bestronics	602-248-7020
Cal	Los Angeles, Black, Ekizian, Strong	213-870-9191
Cal	Millbrae, F.A. Auman	415-445-2250
Cal	San Diego, Bestronics	714-278-2150
Colo	Denver, Checkmate Sls. Inc.	303-771-4920
Conn	Plantsville, R.J. Pisaneschi	203-628-9505
Fla	N. Palm Beach, Lectro Mech.	305-842-2458
Ga	Peachtree City, J.A. Creighton	404-461-9836
Ill	Arlington Heights, J.L. Clingingsmith	312-392-1639
Ill	Chicago, Stackpole Carbon Co.	312-297-0270
Ill	Kankakee, R. Burgess	815-939-7385
Ind	Bloomington, R.E. Riggs	812-339-6166
Kans	Overland Park, Ensco-Rep	913-381-7557
La	Baton Rouge, R.F. Gallagher	504-924-4995
Md	Baltimore, Stemler Assoc.	301-944-8262
Mass	Boxford, E.F. Delaney, Jr.	617-887-2090
Mich	Birmingham, J.E. Vollmer, Jr.	313-644-3571
Minn	Minneapolis, Bitronics Sls. Co.	612-835-7744
Mo	St. Louis, Ensco-Rep	314-567-3935
NJ	Englewood Cliffs, Sprung/Nussbaum	201-947-6767
NY	Buffalo, R.W. Mitscher	716-633-7970
NC	Raleigh, R.W. Mitscher	919-828-0575
Ohio	Hudson, D.J. Mohr	216-653-2255
Pa	Oreland, Brown Oberlies	215-887-1325
Pa	Pittsburgh, H.S. Swoyer	412-256-2538
Tenn	Shelbyville, R.W. Mitscher	615-684-4544
Tex	Dallas, M.N. Herbst	214-239-2497
Va	Virginia Beach, R.W. Mitscher	804-481-7200
Wash	Bellevue, Vantage Corp.	206-455-3460

STACO, INC., 2240 E. 3rd St., Dayton, Ohio, 45403, Tel: 513-253-1191, TWX: 810-459-1798; FSC No: 83008; Empl.: 125; Minimum order: $50 .... p. 2•1808,1809

For info on price: M. R. Marshall; Application info: D. James; Customer service: M. R. Marshall; Delivery info: M. R. Marshall

Free literature available: A new 60 page Variable Transformer Catalog, including a complete product line from 0-8 amps to 450 amps, 120 Volt to 560 Volt Types.

Products manufactured: Power Supplies, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, E.E. Strassner Co.	213-666-1511
Cal	Santa Clara, Thomas-Hartman Assocs.	408-247-1252
Colo	Denver, R.G. Bowen Co.	303-722-4641
Conn	Canaan, Hathaway Elctrns., Inc.	203-824-7215
Fla	North Miami, Winfield Electronic Sls. Co.	305-945-6544
Ga	Atlanta, Millar Elctrn. Sls.	404-261-6160
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Skokie, Saffro & Assocs.	312-588-0905
Ind	Indianapolis, Southern Sls. Co.	317-257-7575
Kans	Shawnee Mission, Kathrinus-Kelly	913-722-0000
La	Metairie, McKinney Sls. Co.	504-887-1723
Md	Hyattsville, Eastern Comps.	301-577-2925
Mass	Lexington, Hathaway Elctrns., Inc.	617-861-7010
Mich	Ferndale, Shalco, Inc.	313-547-4771
Minn	Minneapolis, C. Gibb Co.	612-377-1200
Mo	St. Louis, Kathrinus-Kelly Co.	314-968-3800
NJ	Wayne, Howard Kagan Assocs.	201-684-7682
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Buffalo, R.F. Lamb Co.	716-874-4900
NY	Rochester, R.F. Lamb Co.	716-544-5580
NY	Syracuse, R.F. Lamb Co.	315-454-2469
NY	Valley Stream, Levison Sls. Co.	516-561-9696
NC	Raleigh, Millar Elctrns., Inc.	919-787-9564
Ohio	Cleveland, Marlow Assocs.	216-932-0900
Ohio	Dayton, Marlow Assocs.	513-426-6270
Okla	Tulsa, McKinney Sls. Co.	918-742-6791
Pa	Flourtown, Eastern Comps.	215-836-1616
Pa	York, Eastern Comps.	717-764-3114
Tex	Dallas, McKinney Sls. Co.	214-631-9450
Wash	Seattle, R.K. Squibb Co.	206-632-2450

STACOSWITCH, INC., 1139 Baker St., Costa Mesa, Cal., 92626, Tel: 714-549-3041, TWX: 910-595-1507; QPL No: Multiple; Empl.: 100; Minimum order: $25 p. 2•1114,1115

For info on price: J. Shafer; Application info: K. Johnson; Customer service: J. Shafer; Delivery info: J. Shafer

Free literature available: Lighted and Unlighted Pushbutton Switches - 48 page catalog. Light Isolator Cells (for backlighted displays) - 12 page catalog.

Products manufactured: Annunciators, Index Assemblies, Switch, Lights, Services, Assembly, Production & Test, Sockets, Switchboards, Switches

Local Sales Offices & Reps.

Cal	Newark, Snyder Sls.	415-792-8323
Conn	Marion, Sands Co.	203-628-4363
Fla	Lighthouse Pt., Saber Assocs.	305-943-3076
Ill	Glendale Hts., Trend-Tronics	312-963-2210
Ind	Fort Wayne, J & B Engrg. Sls.	219-483-2813
Md	Rockville, Marktron	301-762-6210
Mich	Grand Rapids, R.P. Urban & Assocs.	616-245-0511
NJ	Wayne, G.T. Assocs.	201-694-6040
NY	Syracuse, Lenard Co.	315-379-9191
Pa	Media, W. Reeves Assocs.	215-566-6709
Tex	Addison, R. R. Thomas Co.	214-233-8235
Wash	Seattle, Arneson Assocs.	206-762-7664

STANCOR/ESSEX INTERNATIONAL, INC., 3501 W. Addison, Chicago, Ill., 60618, Tel: 312-463-7400, TWX: 910-221-5466; FSC No: 80089

For info on price: J. Farr; Application info: E. P. Kelly; Customer service: J. Farr; Delivery info: J. Farr

Free literature available: Catalog #407 - detailed specifications of 1,300 stock transformers for industrial applications. Catalog #721-74 - lists 800 flybacks, yokes and transformers for television replacement.

Bulletin V-2000 - Describes the stancor voltage corrector.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Isolators, Reactors, Regulators, Transformers

Local Sales Offices & Reps.

Ariz	Tempe, W.B. Knight Co.	602-946-1088
Cal	Millbrae, Polach & Bensinger Inc.	415-697-2525
Cal	Newport Beach, W. Bert Knight Co.	714-833-8250
Colo	Denver, R.G. Bowen Co.	303-722-4641
Fla	Orlando, Hollingsworth & Still, Inc.	305-671-4515
Ga	Atlanta, Hollingsworth & Still, Inc.	404-394-3270
Ill	Oak Park, G. Petitt Co.	312-261-0342
Ill	Peoria, G. Petitt Co.	309-699-3301
Kans	Shawnee Mission, Lowell-Kangas & Assocs.	913-631-3515
La	Chalmette, Cartwright & Bean, Inc.	504-279-4598
Md	Rockville, Lienau Assocs.	301-770-6800
Mass	Wellesley Hills, M. Scott Co.	617-235-1020
Mich	Detroit, R.C. Merchant Co.	313-535-6000
Mich	St. Joseph, R.C. Merchant & Co.	616-983-7378
Minn	Minneapolis, R. Ripley & Assocs.	612-881-8282
Mo	St. Louis, Lowell-Kangas Assocs.	314-821-4050
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Elmont, F.E. Schmitt Co.	516-437-8150
NC	Charlotte, Hollingsworth & Still, Inc.	704-536-7047
Ohio	Columbus, McFadden Sls. Co.	614-221-3363
Ore	Portland, Earl & Brown Co.	503-292-9145
Pa	Cornwall Hts., Lienau Assocs.	215-757-8819
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Tenn	Memphis, Cartwright & Bean of Tenn., Inc.	901-276-4442
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R.E. Nesbitt Co.	713-224-3633
Wash	Seattle, Earl & Brown Co., Inc.	206-284-1121
EXP:	New York, N.Y., Roburn Agencies, Inc.	212-989-5939

STANDARD CONDENSER CORP., 1065 W. Addison St., Chicago, Ill., 60613, Tel: 312-327-5440; Minimum order: $25

For info on price: R. T. McLean; Application info: A. Batal; Delivery info: D. Peters

Products manufactured: Capacitors, Fixed, Resistors, Suppressors

Local Sales Offices & Reps.

Ill	Chicago, Rinaldi Inc.	312-763-4848
Mich	Farmington, Davis-Martensen Co.	313-474-8300
Minn	St. Paul, Cahill & Assoc.	612-646-7217
NY	Syracuse, J.V. Costello	315-472-0322
Pa	Jenkintown, Arnold & Assoc.	215-PI2-0600

STANDARD CONTROLS, 2401 S. Bayview St., Seattle, Wash., 98144, Tel: 800-426-0366, TWX: 910-444-2164; FSC No: 13624; Empl.: 45 .... p. 1•2347

For info on price: R. Schnoberger; Application info: T.A. Notman; Customer service: R. Schnoberger; Delivery info: R. Schnoberger

Free literature available: 24 Page Product Brochure

Products manufactured: Amplifiers, Cells, Load, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Tech. Sls.	205-881-1750
Cal	Costa Mesa, Scrantom Engrg., Inc.	714-979-6373
Cal	Los Altos, J.C. Meyer & Assocs.	415-964-8844
Colo	Denver, Grifco	303-722-4674
Ill	Des Plaines, Marsland Assocs.	312-775-1309
Ind	Indianapolis, Marsland Assocs.	317-924-3568
Md	Kensington, Electronic Mktg. Assoc.	301-744-7700
Mass	Peabody, JSR Assoc.	617-532-0348
Mich	Farmington, W. R. Hummon & Assocs., Inc.	313-474-0661
Minn	Minneapolis, Stack-Johnson, Inc.	612-925-2111
Mo	St. Peters, Marsland Assocs., Inc.	314-278-6949
NJ	Palisades Park, Tech-Rep Engr. Sls.	201-945-7669
NY	Fairport, Naco Elctrns. Corp.	716-244-4720
NY	Nesconset, Tech-Rep Engr. Sls.	516-724-3564
NY	North Syracuse, NACO Electronics Corp.	315-699-2651
NY	Rochester, NACO Elctrns. Corp.	716-244-4720
NY	Utica, NACO Elctrns. Corp.	315-732-1801
NC	Charlotte, Ranson, Wallace & Baesel, Inc.	704-334-4244
Ohio	Cleveland, Del Steffen & Assoc.	216-461-8333
Ohio	Dayton, Del Steffen & Assoc.	513-293-3146
Pa	King of Prussia, Electronic Mktg. Assoc.	215-265-1600
Tex	Houston, Scientific Sls. Co.	713-666-5723
Tex	Richardson, Scientific Sls. Co.	214-231-6541
Wash	Seattle, Standard Controls	206-723-1705
FOR:	Can., Willowdale, Ont., ASW Controls & Instrs., Ltd.	416-494-1541

STANDARD CRYSTAL CORP., 1 Cupania Circle, Monterey Park, Cal., 91754, Tel: 213-724-5004; Minimum order: $25

Customer service: J. B. Fisher

Products manufactured: Controls/Control Eqpt., Crystal Blanks, Crystals

Local Sales Offices & Reps.

Cal	Costa Mesa, E. Murray Assoc.	714-642-3282
Mich	Grand Rapids, R. P. Urban Assoc.	616-245-0511

STANDARD ENVIRONMENTAL SYSTEMS, INC., 392 Minnisink Rd., Totowa, N.J., 07512, Tel: 201-256-2200, TWX: 710-988-5722; Empl.: 30

For info on price: D.E. Wilson, Jr.; Application info: K.A. Ladzinski; Customer service: L.Miller; Delivery info: J.F. Wrohlewski

Free literature available: "Simulators of Geophysical Environments," including law & high temp, humidity, altitude, corrosive atmosphere, errosive atmosphere, pressure, explosion, thermal shock.

Products manufactured: Air Conditioners (For Equipment), Baths, Controlled Temperature (Air & Liquid), Cabinets & Accessories, Chamber, Environmental Test, Heat Exchangers & Systems, Ovens

Local Sales Offices & Reps.

Ga	Tucker, Ridge Instrument	
Mass	Wilmington, Tech. Instrs.	
NM	Albuquerque, J. Smith & Assocs.	
NY	Syracuse, Tesco Assocs.	
Tex	Dallas, Merit Co.	

STANDARD GRIGSBY INC., 920 Rathbone Ave., Aurora, Ill., 60507, Tel: 312-897-8417, TWX: 910-232-3138; Empl.: 350; Minimum order: $50

For info on price: R. Riemland; Application info: B. Sefton; Customer service: R. Riemland; Delivery info: R. Riemland

Free literature available: Rotary and Lever Switch, 32 page catalog Rotary Printed Circuit Board Assemblies-2 pg. Brochure Linear Slide Switch, 4 page catalog Printed Circuit and Solderless Terminals-2 page Brochure PB 400 Pushbutton Switches (miniature & modular) 12 page Brochure

Products manufactured: Switches

Local Sales Offices & Reps.

Ala	Huntsville, Elctrn. Mktg. Assoc.	205-837-6061
Ariz	Tempe, Argus Sls.	602-966-7442
Cal	Culver City, DeAngelo Rothman & Co.	213-398-6239
Cal	Redwood City, Parks & Pruitt Assocs.	415-364-1640
Cal	San Diego, DeAngelo Rothman & Co.	714-560-5707
Colo	Wheatridge, Waugaman Assocs.	303-423-1020
Conn	Milford, Conti-Younger Assoc.	203-929-3294
Fla	Altamonte Springs, WMM Assoc.	305-831-4645
Fla	Clearwater, WMM Assoc.	813-447-2533
Fla	Pompano Beach, WMM Assoc.	305-943-3091
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Indianapolis, Southern Sls. Corp.	317-257-7575
Iowa	Cedar Rapids, Elctrn. Sls. Co.	319-364-4342
Md	Rockville, Mechtronics Sls.	301-340-2130
Mass	Waltham, Conti-Younger Assoc.	617-890-4582
Mich	Benton Harbor, McNabb & Assoc.	616-925-2166
Minn	Minneapolis, Stack-Johnson	612-925-2111
NJ	Mountain Lakes, Comps. For Elctrns.	201-334-2921
NY	Buffalo, J. McDonough Assocs.	716-839-2044
NY	Manlius, Bowser & Sapecky Assoc.	
NY	Rochester, Quality Comps.	716-839-4170
NC	Cary, Electronic Mktg. Assoc.	919-467-6319
NC	Winston Salem, Electronic Mktg. Assoc.	919-722-5151
Ohio	Cincinnati, F. J. Campisano Co.	513-662-1616
Ohio	So. Euclid, F.J. Campisano Co.	216-381-4949
Ore	Beaverton, ES/Chase Co.	503-649-6177
SC	Greenville, Elctrn. Mktg. Assoc.	803-268-1125
Tex	Dallas, McCoy Assoc., Co.	214-350-9931
Tex	Houston, Ev Smith Sls Co.	713-649-5756
Wash	Edmonds, ES/Chase Co.	206-774-3586
FOR:	Can., Downsview, Ont., Kaytronics, Ltd.	416-638-5511
FOR:	Can., Montreal267, Que., Kaytronics, Ltd.	514-487-3434

STANDARD LOGIC INC., 2215 S. Standard Ave., Santa Ana, Cal., 92707, Tel: 714-979-4770, TWX: 910-595-1707; Empl.: 130; Minimum order: $25

For info on price: J. Machicek; Application info: H. Welsh; Customer service: J. Machicek; Delivery info: J. Machicek

Free literature available: DIP/Logic Packaging Handbook; Semi Automatic Wire-Wrapping Machines; Floppy Disks; Fixed Head Disks; ECL C-A-S-H Cards; A Disc Memory Buyer's Guide; Electronic Wire Stripper.

Products manufactured: Backpanel Interconnect Systems, Boards, Plug-In, Bus Bars & Systems, Cable Assemblies & Harnesses, Cards, Logic, Chassis, Circuit Board Mounting, Controllers, Programmable, Converters, Crystals, Enclosures, Module, Plug-In, Frames, Cabinet & Rack, Kits, Breadboarding (For Engineers), Machines/Machinery, Production, Memory Systems, Oscillators, Racks, Wire Strippers

STANDARD MEMORIES, INC., 2801 E. Oakland Park Blvd., Ft. Lauderdale, Fla., 33306, Tel: 305-566-7611, TWX: 510-955-9828; Empl.: 150

For info on price: D. Chandler; Application info: J. A. Deving; Customer service: D. Chandler

Products manufactured: Memory Systems

Local Sales Offices & Reps.

Cal	Santa Ana, Western Regional Office	714-540-3605
NJ	Fair Haven, Eastern Regional Office	201-842-3160
Tex	Dallas, Midwestern Regional Office	214-369-4528

STANDARD POWER, INC., 1400 S. Village Way, Santa Ana, Cal., 92705, Tel: 714-558-8512, TWX: 910-595-1760; Empl.: 95 .... p. 1•1472-1475

Products manufactured: Power Supplies

Local Sales Offices & Reps.

Ariz	Scottsdale, R.R. Thomas Co.	602-994-0401
Cal	Palo Alto, O'Donnell Assoc.	415-327-9260
Cal	Torrance, O'Donnell Assoc.	213-323-9243
Colo	Denver, Parker-Webster Co.	303-770-1972
Fla	Ft. Lauderdale, Tech Rep Assocs.	305-792-0962
Fla	Indian Rocks Beach, Tech Rep Assocs.	813-595-2834
Ga	Atlanta, Tech Rep Assocs.	404-252-9288
Ill	Mt. Prospect, Delta Tech. Sls. Corp.	312-437-9412
Kans	Olathe, BC Elctrn. Sls.	913-782-6696
Md	Glen Arm, Barnhill & Assocs.	301-252-5610
Mass	West Concord, Sls. Engrg.	617-369-3943
Mich	Sterling Heights, Gompass Assocs.	313-979-3690
Minn	Minneapolis, Arneson & Co.	612-835-2177
Mo	Hazelwood, BC Elctrn. Sls.	314-731-1255
NJ	Ridgefield, Haber Ramp Corp.	201-945-5250
NY	Buffalo, Precision Sls.	716-856-5974
NY	N. Syracuse, Precision Sls.	315-458-2223
NC	Raleigh, Barnhill & Assoc.	919-787-5774
Ohio	Dayton, Compass Assoc.	513-252-9939
Pa	Norristown, Data Engrg.	215-272-1444
Pa	Pittsburgh, Bishop Co.	216-255-6969
Tenn	Johnson City, Barnhill & Assoc.	615-928-0184
Tex	Dallas, R.R. Thomas Co.	214-363-8591
Va	Lynchburg, Barnhill & Assoc.	703-846-4624
Wash	Bellevue, W.M. Buehler	206-243-6340
EXP:	Los Angeles, Cal., Constantex	213-838-6950

STANDARD WIRE & CABLE CO., 3440 Overland Ave., Los Angeles, Cal., 90034, Tel: 213-870-9231, TWX: 910-340-6758; Empl.: 105 .... p. 2•2058,2059

Products manufactured: Cable Assemblies & Harnesses, Cable, Cords, Wire, Wire Shielding

Local Sales Offices & Reps.

Ariz	Phoenix, Standard Wire & Cable Co.	602-269-2501
Cal	Palo Alto, Standard Wire & Cable Co.	415-328-3082
Fla	Orlando, Buchanan & Abrams Assoc.	305-898-7444
Ga	Atlanta, Electro-Mech, Inc.	404-393-0444
Ill	Hinsdale, Momak Sls.	312-654-4524
Ind	Fort Wayne, R. G. Frederick Co.	219-745-2461
Md	Towson, L.H. Kolman & Co.	301-752-8756
Mass	Attleboro, Standard Wire & Cable Co.	617-226-1500
Minn	Minneapolis, E.C. Electronic Sls.	612-831-0229
NJ	Cinnaminson, Scott Sls.	609-829-2991
NY	DeWitt, Tri-Tech Elctrns.	315-446-2881
Ohio	Cleveland, O'Neill - Ruffing & Co.	216-331-4273
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Wash	Vancouver, Standard Wire & Cable Co.	206-696-4645

STANFORD APPLIED ENGINEERING, 340 Martin Ave., Santa Clara, Cal., 95050, Tel: 408-243-9200, TWX: 910-338-0132; Empl.: 600

For info on price: J. Pollock; Application info: L. Vermont

Products manufactured: Boards, Printed Circuit, Boards, Printed Wiring, Universal, Cards, Logic, Chassis, Circuit Board Mounting, Circuits, Flexible, Circuits, Printed, Multilayer, Coils Including Assemblies & Forms, Connectors, Delay Lines, Filters, Holder & Carriers, Integrated Circuit Packaging Systems, Pullers, Racks, Services, Assembly, Production & Test, Sockets, Switches, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, BFA CORP.	602-946-4215
Cal	Costa Mesa, Stanford Applied Engrg.	714-540-9256
Cal	Newport Beach, Mission Mktg.	714-833-1802
Cal	Palo Alto, Brooks Tech. Group	415-328-3232
Cal	San Diego, Harvey King	714-276-7541
Cal	Santa Clara, Stanford Applied Engrg.	408-243-9200
Colo	Boulder, Stanford Applied Engrg.	303-449-9100
Colo	Denver, Electrodyne	303-757-7679
Colo	Denver, Integrated Elctrns.	303-534-6121
Conn	Cheshire, Coakley, Boyd & Abott, Inc.	203-272-2261
Fla	Casselberry, EIR, Inc.	305-830-9600
Fla	Palm Beach, EIR	305-585-6689
Fla	Plantation, EIR	305-791-6390
Ga	Atlanta, Electro-Mech	404-393-0444
Haw	Honolulu, Adtech, Inc.	808-941-0708
Ill	Addison, Stanford Applied Engrg.	312-620-8820
Ill	Rosemont, Advent Elctrns.	312-298-4210
Md	Baltimore, Stemler Assocs.	301-944-8262
Mass	N. Billerica, Stanford Applied Engrg., Connector Tech. Oper.	617-667-3806
Mass	Needham, Coakley, Boyd & Abbott, Inc.	617-444-5470
Mass	Newton, Greene-Shaw Co.	617-969-8900
Mich	Farmington, Sheridan Assocs.	313-477-3800
Minn	Minneapolis, M. Westlund Assocs.	612-884-5022

Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Cherry Hill, Stemler Assoc.	609-966-4070
NJ	Laurel Springs, Stemler Assoc.	215-644-3477
NJ	Ridgefield, Haber-Ramp Corp.	201-945-5250
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Buffalo, Summit Dists.	716-884-3450
NY	Laurel Springs, Stemler Assoc.	215-644-3477
NY	Marlton, Stemler Assoc.	609-966-4070
NY	N. Syracuse, Precision Power Devices	315-458-2223
NY	Rochester, Telesco Assoc.	716-271-3780
NY	Utica, Telesco Assoc.	315-733-3183
NY	West Babylon, Stanford Applied Engrg.	516-420-8111
NC	Raleigh, Electro-Mech	
Ohio	Beachwood, Sheridan Assocs.	216-831-0130
Ohio	Cincinnati, Sheridan Assocs.	513-761-5432
Ohio	Dayton, Sheridan Assocs.	513-277-8911
Ohio	Reading, Sheridan Assocs.	513-761-5432
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Pa	Pittsburgh, Sheridan Assocs.	412-244-1640
Tenn	Nashville, Electro-Mech	615-883-1490
Tex	Dallas, M. Kruvand Co.	214-827-8043
Tex	Houston, M. Kruvand Co.	713-661-3007
Utah	Salt Lake City, Alta Elctrns.	801-486-7227
Va	Alexandria, Stemler Assoc.	703-548-7818
Wash	Redmond, Barrett Sls. Northwest	206-885-6991
FOR:	Can., Rexdale, Ont., Frank Eakin, Ltd.	416-638-0451
FOR:	Can., Toronto, Ont., Zentronics, Ltd.	416-789-5111

STANFORD APPLIED ENGRG., INC., Advanced Packaging Div., 2165 S. Grand Ave., Santa Ana, Cal., 92705, Tel: 714-540-9256, TWX: 910-595-1122; Empl.: 150

Products manufactured: Boards, Printed Circuit, Bus Bars & Systems, Connector Adapters, Connectors, Contacts, Electrical, Drawers, Sliding, Racks, Sockets, Terminals

Local Sales Offices & Reps.

Cal	San Diego, Mesa Elctrns.	714-278-8021
Cal	Santa Ana, SAE	714-540-9256
Cal	Santa Clara, SAE Sls.	408-243-9200
Colo	Boulder, Rocky Mtn. Regional Sls.	303-449-9100
Conn	New Haven, Gerber Sls. Co.	203-777-6279
Fla	Miami, S. K. Wallace Assocs.	305-691-1654
Fla	Tampa, S. K. Wallace Assoc.	813-932-3568
Ga	Jonesboro, S. K. Wallace Assocs.	404-471-6297
Ill	River Grove, SAE	312-453-9337
Md	Silver Springs, QED Elctrns.	301-588-8134
Mass	Springfield, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Co.	617-890-8040
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Minn	Minneapolis, M. Westlund Assoc.	612-884-4567
Mo	Kansas City, Harris Hanson Co.	816-444-9494
Mo	St. Louis, Harris Hanson	314-432-3611
NJ	Camden, Q E D Elctrns.	215-925-8711
NJ	Morristown, Graydon-Sherman	201-538-9246
NY	Fayetteville, R. Sherman	315-637-9863
NY	New York, East Regional Sls.	212-687-1220
NC	Greensboro, S. K. Wallace Assocs.	919-292-0487
Okla	Tulsa, Kemp Engrg. Co.	918-628-0309
Tenn	Memphis, S. K. Wallace Assocs.	901-682-2281
Tex	Dallas, SAE	214-661-9112
Wash	Bellevue, Rowe/Northwest	206-455-2686

STANTON MAGNETICS, INC., Terminal Dr., Plainview, N.Y., 11803, Tel: 516-OV1-0200; Empl.: 300

Customer service: Sales Dept.

Products manufactured: Handsets, Chestsets, Headphones, Headsets, Etc., Phonographs, Parts & Accessories

Local Sales Offices & Reps.

Cal	Beverly Hills, Trego Sls. Co.	213-274-8351
Cal	Redwood City, H & K Sls.,	415-369-6244
Colo	Aurora, Scowcroft & Assocs.	303-755-2422
Conn	Stamford, John B. Anthony Co.	203-322-9202
Conn	West Haven, Robert S. Reiss Assocs.	203-933-8542
Fla	Ft. Lauderdale, Unirep	305-527-1556
Ill	Skokie, Irving W. Rose Assocs.	312-674-6790
Kans	Overland Park, William Menezes & Assoc.	913-649-2680
Md	Bethesda, Gene Rosen & Assocs.	301-530-8448
Mass	Marblehead, Willson Sls. Co.	617-631-4016
Mich	St. Clair Shores, Rod Butchart & Assocs.	313-773-7870
Minn	St. Paul, Smith Engrg. Assocs.	612-646-4851
NC	Charlotte, L. D. Roddey Sls.	704-375-5712
Ohio	Cleveland, F. A. Daugherty Co.	216-Hi9-1122
Ohio	Lakewood, Maybern Co.	216-333-2531
Pa	McMurray, C. S. Cooper & Assocs.	412-941-6473
Tex	Dallas, Charles Lucas Sls. Co.	214-330-8181
Wash	Seattle, Henry Joncas Co.	206-364-8609

STANTRON DIV., Wyco Metal Products, 6914 Beck Ave., North Hollywood, Cal., 91605, Tel: 213-875-0800, TWX: 910-499-2177; Empl.: 55 .... p. 1•92-95

Products manufactured: Blowers & Fans & Accessories, Cabinets & Accessories, Panels, Racks, Slides, Cabinet & Chassis

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Los Angeles, Ed Landa Co.	213-879-0770
Cal	Oakland, Moulthrop Sls. Inc.	415-261-7676
Colo	Aurora, Robbins & Assocs.	303-399-6618
Conn	Hamden, P. Jenks Assocs. Inc.	203-281-0810
Ill	Chicago, Berndt Assocs.	312-283-0713
Md	Silver Springs, Ara Elctrns., Inc.	301-565-2444
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mo	Florrisant, Nevco, Inc.	314-838-4898
Mo	Kansas City, Nevco, Inc.	816-421-1751
NJ	Wayne, G.T. Assocs.	201-694-6040
NM	Albuquerque, Shefler-Kahn Co.	505-265-7077
Ohio	Cincinnati, J.O. Olsen Co.	513-922-2176
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Pa	Glenside, Ara Elctrns., Inc.	215-887-5250
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Tex	Irving, Lee Sls. Co.	214-363-3831
Wash	Seattle, D. Smith Sls.	206-633-3160

STAR PORCELAIN CO., 71 Muirhead Ave., Box 1267, Trenton, N.J., 08638, Tel: 609-392-3154; Empl.: 180; Minimum order: $200

For info on price: R. J. Schmidt; Application info: R. J. Schmidt; Customer service: R. J. Schmidt; Delivery info: H. Everett

Free literature available: Bulletin #6266-Engineering Properties of Star Ceramics Together With Ceramic Design Information.

Products manufactured: Cores, Ceramic, Filters, Insulators & Insulation, Tubing

STAR TRON CORP., 58 Curtis St., Providence, R.I., 02909, Tel: 401-274-5090; FSC No: 32494; Empl.: 30

For info on price: Sls. Off. 401-274-5091; Application info: D. D'Amico 401-274-5092; Customer service: A. Colafrancesco 401-274-5090; Delivery info: A. Colafrancesco 401-274-5090

Products manufactured: Bolometers, Connectors, Resistors

Local Sales Offices & Reps.

Cal	Encino, El/Tec	213-981-9881

STARTRONICS, INC., Moulton St., Georgetown, Mass., 01833, Tel: 617-352-6200, TWX: 710-347-0310

STATEK CORP., 1233 Alvarez Ave., Orange, Cal., 92668, Tel: 714-639-7810, Telex: 65-5430; FSC No: 51791; Empl.: 80; Minimum order: $30 .... p. 1•412-415

For info on price: Sales; Application info: R. Nelson; Customer service: R. Nelson; Delivery info: B. McIntire

Free literature available: Specification sheets: crystals, oscillators, oscillato;r kits; Application Notes: Transistor - series resonant circuits; CMOS - parallel resonant circuits Various technical notes

Products manufactured: Circuits, Hybrid, Thin-Film, Clocks (All Types), Crystals, Filters, Lenses, Optical & Camera, Oscillators, Standards, Timers

STATHAM INSTRUMENTS, INC., 2230 Statham Blvd., Oxnard, Cal., 93030, Tel: 805-487-8511; Empl.: 660

Products manufactured: Amplifiers, Analyzers, Carts & Dollies, Instrument & Equipment, Cells, Load, Chamber, Environmental Test, Connectors, Detectors, Display Devices/Displays, Gages, Ovens, Refrigerators, Environmental Test, Seals, Services, Assembly, Production & Test, Spectrometers, Transducers

Local Sales Offices & Reps.

Ariz	Scottsdale, Hagestad & Co.	602-945-0902
Cal	Los Angeles, Burtis Instrumentation Sls.	
Cal	Santa Clara, Statham Instrs., Inc.	408-246-2277
Cal	Van Nuys, Stratham Instrs., Inc.	213-873-4636
Cal	Woodland Hills, Statham Instrs., Inc.	213-883-2932
Colo	Denver, Telemetry Sls. Corp.	303-424-5574
Fla	Longwood, Lenz Engrg. Co.	305-831-9797
Fla	Winter Park, Statham Instrs., Inc.	305-644-0632
Ind	Ellettsville, R. Graham, B.S. Mareachen	812-876-5382
La	Baton Rouge, Alford, Woods, Childs Engrg. Inc.	504-275-5480
La	Harvey, Strander Corp.	504-367-4389
Md	Bethesda, S & S Assocs.	301-654-1434
Mass	Peabody, JSR Assocs.	617-532-0348
Mass	Waltham, McBar Assocs.	617-890-0233
Mich	Detroit, WKM Assocs., Inc.	313-892-2500
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	Hazelwood, Statham Instrs., Inc.	314-895-7777
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Englewood Cliffs, Statham Instrs., Inc.	201-569-5588
NJ	Teaneck, R.T. Reid Assoc., Inc.	201-692-0200
NM	Albuquerque, C.T. Carlberg & Assoc.	505-265-1579
NY	Binghamton, Bucci Assocs.	607-798-7141
NY	Lancaster, Lawrence Ind'l. Sls.	716-685-1993
NY	Rochester, G.P. Troy	716-586-4867
Ohio	Cleveland, WKM Assocs., Inc.	216-267-0445
Ohio	Medina, McShane Inc.	216-725-4568
Okla	Broken Arrow, P.J. Scanlon Co.	918-251-5728
Pa	King of Prussia, S & S Assocs.	215-265-3450
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Dallas, Statham Instrs., Inc.	214-358-4871
Tex	Houston, AWC	713-488-2730
Tex	Richardson, P.J. Scanlon Co.	214-231-4661

STAVER CO., INC., 41 N. Saxon Ave., Bay Shore, N.Y., 11706, Tel: 516-666-8000, TWX: 510-227-6142; Empl.: 90; Minimum order: $50 .... p. 2•1200

For info on price: M. Girard; Application info: A. Skrobisch; Customer service: M. Girard; Delivery info: P. Sito

Free literature available: General Catalog on Staver Electronic Hardware, Heat Sink Catalog-Staver Thermoflag & Thermovane Heat Sinks, Data Sheets on Signalex Readouts

Products manufactured: Annunciators, Bezels, Shielded & Unshielded, Caps, Lenses, Indicator Light, Display Devices/Displays, Drivers & Decoders For Readouts, Eyelets, Holders, Crystal, Indicators, Pads, Transistor Mounting, Plug Caps & Shells, Services, Assembly, Production & Test, Shields, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ariz	Scottsdale, E.E. Black & Assocs.	602-947-2007
Cal	Encino, R.H. McDonald & Assocs.	213-986-5832
Cal	Santa Clara, Shiell Assocs.	408-732-6280
Conn	Greenwich, Eisenbeis Sls. Co.	203-869-2008
Fla	Eustis, R.K. Welter Co.	904-357-7796
Ga	Lithonia, Erickson Prods.	404-482-8858
Ill	Chicago, McBride Sls.	312-775-1080
Ind	Indianapolis, Lat-Tronics	317-846-5788
Mich	Grand Rapids, Elko Sls.	616-949-1451
NJ	Collingswood, Kaygar Assocs.	609-398-5229
NY	Manlius, Bowser & Sapecky Assocs.	315-682-8885
NY	Valley Stream, Levison Sls. Co.	516-LO1-9696
Ore	Portland, J.J. Backer Co.	503-297-3776
Tex	Garland, G.V. Peck Co.	214-341-8311
Va	Portsmouth, F.B.D. Sls.	804-484-3162
Wash	Seattle, J.J. Backer Co.	206-285-1300

STELLEX INDUSTRIES, 33 Canal St., Rochester, N. Y., 14608, Tel: 716-235-7070; Empl.: 35; Minimum order: $25

Customer service: J. Durham

Products manufactured: Relays, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips, Timers

STERLING INSTR., Div. Designatronics, Inc., 55 S. Denton Ave., New Hyde Pk., NY, 11040, Tel: 516-328-3300, TWX: 510-223-0642; Empl.: 150

Customer service: M. Ruggeiro

Products manufactured: Bearings, Brakes, Bushings, Glass, Plastic, Metal, Rubber, Etc., Cams, Clutches, Counters, Couplings, Dials, Drives & Drive Mechanisms (Dial), Fasteners, Gears & Gear Mechanisms (Precision), Handles For Cabinets, Circuit Boards, Racks, etc., Indicators, Kits, Breadboarding (For Engineers), Knobs, Limit Stops, Mechanical, Nameplates, Pins, Reducers, Rings, Retaining, Servo Systems, Spacers, Switches, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, Tri Fab Sls. Rep. Co.	602-265-3341
Cal	Burlingame, J. Logan & Assocs.	415-697-6100
Cal	Chatsworth, Sterling W. Coast	213-822-6226
Colo	Denver, McSherry	303-238-8361
Fla	Orlando, Irby & Connolly, Inc.	305-894-8471
Ga	Atlanta, Electro-Mech. Sales Eng. Co.	404-393-0444
Ill	Chicago, A. Woods & Assoc.	312-283-7400
Mass	Woburn, R.W. Hatfield	617-933-2324
Mich	Lathrup Village, R.C. Nordstrom	313-559-7373
NJ	So. Amboy, Addem II	201-721-6449

NY	Clarence, Rep-Tech.	716-684-6250
NY	Syracuse, Rep. Tech.	315-454-2445
NC	Charlotte, Reynolds Cowardin Assoc.	704-523-0324
Ohio	Columbus, Rockford Controls Ohio Inc.	614-231-5890
Ohio	Dayton, Rockford Controls	513-278-7362
Ohio	Euclid, Rockford Controls	216-731-5250
Pa	Glenolden, McDermott Assoc.	215-328-9180
Tex	Richardson, Zonk Eng. Co.	214-238-9651
Va	Richmond, Reynolds Cowardin Assoc.	703-266-3457
Va	Roanoke, Reynolds Cowardin Assoc.	
Wash	Seattle, Ray Johnston Co. Inc.	205-524-5170
FOR:	Can., Pierre Fonds, Que., Avotronics, Ltd.	514-697-2135
FOR:	Can., Willowdale, Ont., Avotronics, Ltd.	705-493-9711

STERLING MFG. CO., 1845 E. 30th St., Cleveland, Ohio, 44114, Tel: 216-781-7136; Empl.: 175; Minimum order: $50

For info on price: J. L. Fine; Application info: W. Cizek; Customer service: M. Cooper; Delivery info: M. Cooper

Free literature available: Auto Antenna Catalogue Form #AC 1172, Panel Meter Catalogue Form # 1906, Pocket Meter Catalogue.

Products manufactured: Antennas, Meters, Testers

Local Sales Offices & Reps.

Cal	, Sales Engineers Ltd.	213-921-4337
Mass	Waltham, Deveer Sls. & Engr.	617-889-5900
Mich	Edwardsburg, Dash Sls.	616-699-5820
NY	Wantagh, Arnold Schuman Co.	516-826-5550
NC	Raleigh, Leigh Sls.	919-787-9090

STERLING TRANSFORMER CORP., 510 Driggs Ave., Brooklyn, N.Y., 11211, Tel: 212-782-4200; Empl.: 55; Minimum order: $25 .... p. 2•1803-1807

For info on price: A. Gartner; Application info: W. Winchell; Customer service: A. Gartner; Delivery info: A. Garner

Free literature available: Catalog Tranformers & Chokes.

Products manufactured: Coils Including Assemblies & Forms, Filters, Reactors, Transformers

Local Sales Offices & Reps.

Cal	Palo Alto, Mauldin Co.	415-326-5291
Cal	Van Nuys, Timco Sls.	213-781-7370
Conn	Southington, Rantec, Inc.	203-621-5941
Mass	Waltham, Rantec, Inc.	617-890-5110
NY	Rockville Centre, Willgold Elec. Sls.	516-RO 4-4022

STERLING, Div. Reichhold Chems., Inc., Sewickley, Pa., 15143, Tel: 412-766-7600, TWX: 710-668-3877; Empl.: 96

Products manufactured: Coatings, Compounds, Encapsulating, Insulating, Molding, Potting

Local Sales Offices & Reps.

Conn	Northford, D.H. Rausch	203-484-0094
Ill	Oak Brook, Sterling Div.	312-887-0315
Minn	Minneapolis, Bergquist Co.	615-925-2322
NC	Charlotte, R.W. Chapman & Co.	704-525-2421
Ohio	Chagrin Falls, Electrolock, Inc.	216-247-4245
Pa	Sewickley, R.P. Heinick	412-766-7600
Wisc	Oconomowoc, D.R. Stackowicz	414-871-7525

STETTNER-TRUSH INC., 67 Albany St., Cazenovia, N.Y., 13035, Tel: 315-655-8141, TWX: 710-541-1530; Empl.: 20

For info on price: G. Trush; Application info: G. Trush; Delivery info: V. Harmon

Products manufactured: Attenuators, Capacitors, Fixed, Capacitors, Variable, Filters, Motors, Networks, Resistors, Suppressors, Switches

Local Sales Offices & Reps.

Cal	San Mateo, Melvin Sls. Co.	415-349-7444
Cal	Santa Fe Springs, Comp. Svcs., Inc.	213-664-8445
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Conn	North Haven, Kitchen & Kutchin, Inc.	203-239-0212
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Rosemont, STC, Inc.	312-671-4208
Ind	Bloomington, J. Hershman	812-339-9563
Mass	Lexington, Kitchen & Kutchin, Inc.	617-862-8230
Minn	Minneapolis, Technical Assocs., Inc.	612-929-7274
Mo	St. Louis, Beneke & McCanl	314-434-6242
NJ	Fort Lee, R. Cameron Assocs.	201-461-2595
NC	Raleigh, A.B. Andrews & Co.	919-833-5565
Utah	Salt Lake City, Arrowhead Sls.	801-487-4716
FOR:	Can., Concord, Ont., C & R Devices, Ltd.	416-669-9870

STEVENS-ARNOLD, INC., 7 Elkins St., So. Boston, Mass., 02127, Tel: 617-268-1170; Empl.: 100; Minimum order: $25 .... p. 1•1476,1477

For info on price: M.J. Ross; Application info: G.M. Karon; Customer service: M.J. Ross; Delivery info: M.J. Ross

Free literature available: Catalog 602 Ultra-Miniature DC/DC Converter Module Power Supplies. Catalog 604/605 Triple Output Modular DC/DC Converter Transformer.

Products manufactured: Choppers, Converters, Power Supplies, Transformers

Advertisment

Stevens-Arnold has Sales Engineering Representatives in principal cities of the United States and Canada. To obtain the name of your nearest representative, call 617-268-1170 collect and ask for Customer Service.

Foreign Representatives in Australia, Belguim, France, India, Israel, Netherlands, Sweden, Switzerland, and West Germany.

STEVENS, GEO. MFG. CO., 6001 N. Keystone Ave., Lincolnwood, Ill., 60646, Tel: 312-588-1300, TWX: 910-221-5139; Minimum order: $25

For info on price: E. Sterner; Application info: J. Stevens; Customer service: F. Franke; Delivery info: A. Ericson

Free literature available: We manufacture the most complete line of Coil Winding Equipment in the country. We produce standard type machines, adaptations and complete engineered equipment to customer and product specification.

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.

Ariz	Phoenix, Electrical Specialty Co.	602-275-5739
Cal	Los Angeles, Electrical Specialty Co.	213-724-9600
Colo	Denver, Electrical Specialty Co.	303-321-0226
Ind	Indianapolis, Blind & Assocs.	317-251-1249
Mass	Stoneham, Production Devices Corp.	617-438-2772
Mich	Fort Wayne, Blind & Assocs.	219-748-7705
NJ	Montclair, M. H. Tardif	201-744-5884
Ore	Portland, Electrical Specialty Co.	503-227-3601
Tex	Richardson, P. J. Scanlon	214-231-4661
Wash	Seattle, Electrical Specialty Co.	206-682-3434

STEVENS PRODS., INC., 128 N. Park St., E. Orange, N.J., 07019, Tel: 201-672-2140; Empl.: 50; Minimum order: $35

Customer service: J. Thomson

Free literature available: Glass laminated epoxy insulators molded in ready to use form. Mandrel list of open stock tooling for coil forms and potting forms.

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Insulators & Insulation, Laminates, Services, Assembly, Production & Test, Tubing

STEWART-WARNER MICROCIRCUITS, 730 E. Evelyn Ave., Sunnyvale, Cal., 94086, Tel: 408-245-9200, TWX: 910-339-9210; Empl.: 200

Products manufactured: Comparators, Converters, Counters, Drivers & Decoders For Readouts, Integrated Circuit Devices, Lamp Drivers, Multiplexers, Shift Registers

STICHT CO., INC. HERMAN H., 27 Park Pl., New York, N.Y., 10007, Tel: 212-732-8163; Empl.: 35

For info on price: D. Sticht; Application info: R. Sticht; Customer service: R. Sticht

Free literature available: Bull.1081 Hand Tachometers Bull.1071 Stationary Tachometers Bull.806 Vibrating Reed Tachometers, Bull.810 Running Time Meters, Bull.9141 Miniature Running Time Meters, Bull.421 Dwarf Megohmer, Bull.435 Standard Mark II Magohmer.

Products manufactured: Bridges, Indicators, Lights, Meters, Tachometers, Testers

Local Sales Offices & Reps.

Ill	Westchester, Murphy & Dickey	312-344-5660
Md	Baltimore, W.H. Cooke & Co., Inc.	301-685-1511
Mich	Berkley, G.R. Peters Assocs.	313-564-6325
Minn	Minneapolis, Volco Co.	612-336-6631
Mo	St. Louis, C.O. Leaver Co.	314-WO8-1500
NY	Buffalo, R.F. Lamb Co.	716-874-4900
NY	Newtonville, T. Carse Sls. Co.	518-785-5844
NY	Rochester, R.F. Lamb Co.	716-544-5580
NY	Syracuse, R.F. Lamb Co.	315-454-2469
NC	Matthews, W.K. Hile Co.	704-847-9123
Ohio	Cincinnati, Beedle Equip. Co.	513-793-0140
Ohio	Shaker Heights, Martin-Rettger, Inc.	216-283-5600
Ore	Portland, J.L. Kearns Co., Inc.	503-236-1165
Pa	King of Prussia, WisTex	215-337-1240
Pa	Pittsburgh, R.F. Clark Co.	412-242-9500
Tex	Bellaire, Brice Co.	713-666-1788
Tex	Dallas, Brice Co.	214-233-9808

STOCK DRIVE PRODS., Div. Designatronics, Inc., 55 S. Denton Ave., New Hyde Pk., N.Y., 11040, Tel: 516-328-0200; Empl.: 160

Customer service: R. Lindemann

Products manufactured: Bearings, Brakes, Bushings, Glass, Plastic, Metal, Rubber, Etc., Clutches, Coatings, Counters, Couplings, Dials, Drives & Drive Mechanisms (Dial), Fasteners, Gears & Gear Mechanisms (Precision), Indicators, Knobs, Motors, Mounts, Servo Systems, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, Tri Fab Sls. Rep. Co.	602-265-3341
Cal	Burlingame, J. Logan & Assoc.	415-697-6100
Cal	Chatsworth, Sterling West Coast	213-822-6226
Colo	Denver, McSherry & Assoc.	303-238-8361
Fla	Orlando, Irby & Connolly Inc.	305-894-8471
Ga	Atlanta, Electro-Mechanical Sales Engng.	404-393-0444
Ill	Chicago, A. Woods & Assoc. Inc.	312-283-7400
Mass	Woburn, R. W. Hatfield	617-933-2324
Mich	Lathrup Village, R. C. Nordstrom & Co.	313-559-7373
NJ	So. Amboy, Addem II	201-721-6449
NY	Clarence, Rep-Tech Inc.	716-684-6250
NY	New Hyde Park	516-328-3300
NY	Syracuse, Rep-Tech Inc.	315-454-2445
NC	Charlotte, Reynolds Cowardin Assoc.	704-523-0324
Ohio	Columbus, Rockford Controls Ohio Inc.	614-231-5890
Ohio	Dayton, Rockford Controls Ohio Inc.	513-278-7362
Ohio	Euclid, Rockford Controls Ohio Inc.	216-731-5250
Pa	Glenolden, McDermott Assoc.	215-328-9180
Tex	Richardson, Zonk Eng. Co.	214-238-7651
Va	Richmond, Reynolds Cowardin Assoc.	703-266-3457
Va	Roanoke, Reynolds Cowardin Assoc.	
Wash	Seattle, R. Johnston Co. Inc.	205-524-5170
FOR:	Can., Ontario, Avotronics Ltd.	705-493-9711
FOR:	Can., Quebec, Avotronics Ltd.	514-697-2135

STORM PRODUCTS CO., 112 S. Glasgow St., Inglewood, Ca., 90301, Tel: 213-776-8141; Empl.: 225; Minimum order: $15

For info on price: C. Barnett; Customer service: I. Joyce

Free literature available: A complete list (including prices) of precut wire leads for hookup and wire wrapping.

Products manufactured: Cable Assemblies & Harnesses, Cable, Cords, Services, Assembly, Production & Test, Tubing, Wire, Wire Markers, Wire Shielding, Wire Twisters

STOW LABS., INC., Kane Ind'l. Dr., Hudson, Mass., 01749, Tel: 617-562-9347, Telex: 94-8330; Empl.: 15

For info on price: A. N. Puro; Application info: C. Kadlec; Customer service: A. N. Puro; Delivery info: A. N. Puro

Free literature available: Describes PITRAN®, a silicon NPN planar transistor having emitter-base junction mechanically coupled to diaphragm. Differential pressure applied to diaphragm produces large, reversible change in gain of transistor. Thermometer literature describes an industrial temperature measuring system featuring factory calibrated interchangeable sensors and electronics available in several models with linear analog and digital output.

Products manufactured: Amplifiers, Indicators, Meters, Power Supplies, Switches, Thermometers, Resistance, Transducers, Transistors

Local Sales Offices & Reps.

Mass	Framingham, J. M. Lancaster Co.	617-873-8893
Mich	Detroit, Marsh Equip. Co.	313-869-9200
Mo	St. Louis, Delltrone Co.	

NJ	N. Plainfield, Brady Co.	201-753-7988
NY	Albany, T. Carse Sls. Co.	518-785-5844
Va	Falls Church, Jay Co.	
EXP:	N.Y., NY, Multiparts	212-944-4370

STRUTHERS-DUNN, INC., Lamb's Rd., Pitman, N.J., 08071, Tel: 609-589-7500, TWX: 510-686-7510; Empl.: 450; Minimum order: $50

For info on price: Sls. Dept.; Application info: C. C. Jones; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: c/1010 Distributor catalog: contains latest information and prices for all relays stocked by distributors.

Products manufactured: Alarms, Cards, Logic, Coils Including Assemblies & Forms, Controllers, Programmable, Controls/Control Eqpt., Modules, Logic, Encapsulated, Monitors, Process Control Systems, Relays, Sockets, Switches, Testers, Timers

Local Sales Offices & Reps.

Ala	Huntsville, Rep, Inc.	205-881-9270
Ariz	Scottsdale, DeAngelo, Rothman & Cheever, Inc.	602-948-6983
Ark	Little Rock, Ransom Sls. Co.	501-225-7332
Cal	Culver City, DeAngelo, Rothman & Co., Inc.	213-398-6239
Cal	Palo Alto, Held & Mollard	415-965-9321
Cal	San Diego, DeAngelo, Rothman & Co.	714-560-5707
Fla	Miami, Ludlum Assocs. Co.	305-592-6523
Fla	Orlando, Ludlum Assocs. Co.	305-894-7761
Ga	Tucker, Rep, Inc.	404-938-4358
Ill	Glen Ellyn, Rockford Controls Co.	312-469-6016
Iowa	Bettendorf, White Equipment Co.	319-355-5623
Kans	Wichita, Avionics Engrg. Sls. Co.	316-264-6201
La	Baton Rouge, Automation Specialists, Inc.	504-927-4931
La	Kenner, Automation Specialists, Inc.	504-721-3497
Md	Baltimore, Stemler Assocs., Inc.	301-944-8262
Mass	Sturbridge, Branford Controls Corp.	617-347-7367
Mich	Dearborn, Struthers-Dunn Controls	313-565-4200
Minn	Minneapolis, HMR, Inc.	612-920-8200
Mo	Kansas City, E. A. Mais Co.	816-942-6300
Mo	St. Louis, Jeffrey Equip. Co.	314-966 3506
NJ	Denville, Grimm, Siegel Assocs., Inc.	201-625-1900
NJ	Pitman, Struthers-Dunn, Inc.	609-589-7500
NY	Buffalo, H. C. Zang Agency	716-877-3677
NY	Henrietia, Rush Instrs.	716-334-0452
NC	Charlotte, J. Rudisill Assocs., Inc.	704-377-6901
Ohio	Cincinnati, Beedle Equip. Co.	513-793-0140
Ohio	Columbus, Rockford Controls Ohio	614-231-5890
Ohio	Euclid, Rockford Controls Ohio	216-731-5250
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Pa	Philadelphia, Struthers-Dunn, Pitman, N.J.	609-589-7500
Pa	Pittsburgh, R. F. Clark Co.	412-242-9500
Tenn	Memphis, Ransom Sls. Co.	901-332-0036
Tex	Dallas, W. Pat Fralia Co.	214-264-3491
Tex	Ft. Worth, W. Pat Fralia Co.	817-738-2394
Tex	Houston, C.S.C. Instrs.	713-784-2745
Va	Alexandria, Stemler Assocs. Inc.	703-548-7818
Wash	Seattle, Eicher-Richards Co.	206-523-7888
FOR:	Can., Toronto, Ont., Struthers-Dunn Relay Div., Renfrew Elec. Co. Ltd.	416-461-3511

Local Distributors

Ala	Birmingham, M-G Elec. & Equip., 3112 Sixth Ave.	205-328-4525
Ariz	Phoenix, Kierulff Elec., 2633 E. Buckeye	602-273-7331
Ark	Little Rock, Carlton-Bates, 6821 Scott Hamiton Dr.	501-562-9100
Cal	Hollywood, Hollywood Radio, 5250 Hollywood	213-466-3181
Cal	Palo Alto, Kierulff Elec., 3969 E. Bayshore	415-968-6292
Colo	Denver, Newark-Denver Elec., 2170 S. Grape	303-757-3351
Conn	Bridgeport, Tower-Olschan, 15 Dewey St.	203-367-7401
Fla	Orlando, Brownell Electro, 307-27th St.	305-843-6770
Ga	Atlanta, Brownell-Electro, 3020 Commerce Way	404-762-5181
Ill	Chicago, Newark Elec., 500 N. Pulaski	312-638-4411
Ill	Peoria, Klaus Radio & Elec., 8400 N. Pioneer	309-691-4840
Ind	Indianapolis, Graham Elec. Supply, 133 S. Pa. Ave.	317-634-8202
Iowa	Davenport, Republic Elec., 737 Charlotte	319-322-6204
Kans	Wichita, Interstate Elec., 1330 E. 1st	316-264-6317
Ky	Louisville, E&H Elec. Supply, 804 S. Fifth	502-587-0991
La	Metairie, M-G Elec. & Equip., 638 Papworth Ave.	504-834-6002
Me	Portland, Stanley J. Leen, 52 Union St.	207-774-6266
Md	Baltimore, Graybar Elec., 3701 E. Monument	301-342-5500
Mass	Allston, Apparatus Service, 355 Everett St.	617-787-1300
Mich	Grand Rapids, Purchase Elec., 100 Grandville	616-458-1476
Minn	Minneapolis, Stark Elec. Supply, 112-3rd Ave., N.	612-332-1325
Miss	Jackson, Atlantic Ind., Box 9191	601-353-0351
Mo	N.K.C., LCOMP, 1520 Taney St.	816-221-2400
Mont	Missoula, Montana Mercantile Co., 1600 N. Ave., W	406-543-5151
Neb	Omaha, Graybar Elec., Box 1234	402-346-7676
NJ	Hanover, State Elec. Parts, 36 Route 10	201-887-2550
NJ	S. Plainfield, Brownell-Electro, 500 Hadley Rd. & Durham Ave.	201-753-4600
NY	New York, Brownell-Electro, 85 Tenth Ave.	212-924-6000
NY	Rochester, Requa Electric, Box 1130	716-442-2020
NC	Charlotte, Brownell-Electro, Box 16368	704-394-4341
Ohio	Cincinnati, Hughes Peters, 4865 Duck Creek	513-351-2000
Okla	Tulsa, Radio, Inc., 1000 S. Main St.	918-587-9123
Ore	Eugene, Vitus Elec. Supply, 140 E. 5th St.	503-345-4377
Pa	Philadelphia, Herbach & Rademan, 401 E. Erie Ave.	215-426-1700
RI	Pawtucket, New England Electric Supply, 265 Pine St.	401-725-7400
SC	Greenville, Hammond Elec., 1000 Augusta St.	803-233-4121
Tenn	Memphis, Brownell-Electro, 3053 Tranquility	901-332-9254
Tex	Dallas, Wholesale Elec., 2808 Ross	214-824-3001
Va	Richmond, Meridian Elec., 1001 W. Broad St.	804-353-6648
Wash	Seattle, Eicher-Richards, 2727 N.E. Blakeley	206-523-7888
WVa	S. Charleston, Allied Controls, Box 8306, S.	304-768-7313
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit	414-545-6500

STRUTHERS-DUNN, INC., Sys. Div., 4140 Utica Ridge Rd., Bettendorf, Iowa, 52722, Tel: 319-359-7501, TWX: 910-525-1176; Empl.: 100; Minimum order: $25

For info on price: R. G: Alessandrini; Application info: L. Thompson; Customer service: R. G. Alessandrini; Delivery info: R. G. Alessandrini

Free literature available: VIP Programmable Controller, Bulletin 79630 solid state industrial logic control system for operating automatic equipment. Specs & operating data S-D77 Programmable Controller, Bulletin 79633 solid state industrial logic control system for small machines. Specs & operating data

Products manufactured: Cards, Linear Function, Cards, Logic, Comparators, Controllers, Programmable, Controls/Control Eqpt., Converters, Counters, Decoders, Modules, Logic, Encapsulated, Monitors, Testers, Timers, Totalizers, Digital

Local Sales Offices & Reps.

NY	Henrietta, Rush Instrs.	716-334-0452
Tex	Houston, C.S.C. Instrs. Div. Automation Specialists	713-784-2745

STURDILITE ANGLE STEEL DIV., Kewanee Scientific Equip. Corp., Plainwell, Mich., 49080, Tel: 616-685-5402; Empl.: 140

For info on price: S. Hambright; Application info: J. Dravies; Customer service: S. Hambright; Delivery info: S. Hambright

Free literature available: 24 Page Catalog

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories

SUMMIT ENGINEERING CORP., Box 938, Bozeman, Mont., 59715, Tel: 406-587-0636, TWX: 910-975-1950; Empl.: 70; Minimum order: $12

For info on price: R. A. Hall; Application info: R. A. Hall; Customer service: J. Riebhoff; Delivery info: V. Shadoan

Free literature available: 1. Catalogue of R.F. components 4 pg 2. Positioning controls catalog 8 pg 3. Individual data sheets on each product

Products manufactured: Controls/Control Eqpt., Counters, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Diodes, Dividers, Mixers, Modulators, All Kinds, Motors, Switches, Transformers

Local Sales Offices & Reps.

Cal	Sherman Oaks	213-789-7277
Cal	Sunnyvale	408-736-5210
Fla	Lake Mary	
Fla	Tampa	813-248-5078
Ga	Atlanta	404-255-8900
Ill	Downers Grove	312-852-6060
Mass	Auburn	617-757-0010
Mass	Medfield	617-359-2040
Mich	Warren	313-758-5000
Mo	Gladstone	816-454-7140
Ohio	Cincinnati	513-825-4111
Ohio	Cleveland	216-524-3971
Pa	Mt. Lebanon	412-343-9660
Pa	West Chester	215-692-8040
Tex	Arlington	817-261-0384
Wisc	Wauwatosa	414-475-6661
FOR:	an., Pt. Clair, Que.	514-695-7602

SUNSHINE SCI. INSTRS., INC., 1810 Grant Ave., Philadelphia, Pa., 19115, Tel: 215-OR 3-5600; Empl.: 30; Minimum order: $10

Customer service: B. Sunshine

Products manufactured: Amplifiers, Analyzers, Clocks (All Types), Coatings, Controls/Control Eqpt., Converters, Counters, Detectors, Indicators, Leads, Test & Adaptors, Meters, Multipliers, Recorders, Scales, Dial, Services, Assembly, Production & Test, Servo Systems, Shunts, Meter, Switches, Test Equipment, Testers, Timers

Local Sales Offices & Reps.

Cal	LaMirada, P. H. DuBois	714-521-1481
Md	Elkridge, Sunshine Scientific	301-796-5600

SUPEREX ELECTRONICS CORP., 151 Ludlow St., Yonkers, N.Y., 10705, Tel: 914-965-6906, Telex: 13-1584; Empl.: 112; Minimum order: $50

Customer service: M. Buchalter

Free literature available: Catalog of special purpose headphone, boom microphone, and accessories from $1.98 to $125.00.

Products manufactured: Coils Including Assemblies & Forms, Handsets, Chestsets, Headphones, Headsets, Etc., Microphones, All Kinds, Tapes, Recording, Magnetic (All Types)

SUPERIOR CABLE DIV., Superior Continental Corp., Box 489, Hickory, N.C., 28601, Tel: 704-328-2171, TWX: 510-934-1204; Empl.: 600

Customer service: J. Moore

Free literature available: Telephone Cable Catalog; Coiled Cord & Line Cord Catalog; Cable Mfg. Facilities Booklet; T-Screen Cable Brochure; Filled Cable Brochure; Drop Wire Brochure; Coaxial Cable Brochures;

Products manufactured: Cable, Cords, Wire

Local Sales Offices & Reps.

Ala	Tuscaloosa, C. Oxford	205-339-4403
Cal	Chico, G. Swithenbank	916-343-4314
Cal	Menlo Park, R. Westwood	415-349-3003
Ga	Atlanta, K. Powley	404-255-2030
Ill	Glen Ellyn, T. Lyons	312-858-2880
NC	Hickory, F. Logan	704-256-9361
NC	Hickory, N.C. Cox	704-328-1682
NC	Mebane, T. Gardner	919-563-4321
Tenn	Bristol, R. Tester	615-968-3999
Tenn	Gallatin, E. Huffman	615-452-7299
Tex	Dallas, B. Barbour	214-243-1722
Tex	Dallas, B. Pitts	214-328-0343
Wash	Enumclaw, P. Armentrout	206-939-0738

SUPERIOR ELECTRIC CO., 1000 Middle St., Bristol, Conn., 06010, Tel: 203-582-9561, TWX: 710-454-0682; FSC No: 58474; Empl.: 1000; Minimum order: $75

p. 1•205,984-987,1443,1546; p. 2•799,1786-1789

Customer service: K. E. Meissner

Free literature available: Superior Electric Electrical Connector Bulletin C670-1, Powerstat Variable Transformer Catalog P773-2, Stabiline Automatic Voltage Regulators Bulletin SVR666-5, Slo-Syn Synchronous/Stepping Motors & Controls Catalog MD174-1

Products manufactured: Connectors, Controls/Control Eqpt., Jacks (All Types), Machines/Machinery, Production, Motors, Plug & Jack Sets, Plugs, Posts, Power Supplies, Readers, Regulators, Simulators, Transformers

Local Sales Offices & Reps.

Cal	Redwood City, Superior Elec.	415-369-8203
Cal	Van Nuys, Superior Elec.	213-786-3626
Colo	Denver, W. J. Purdy Co.	303-777-1411
Fla	Maitland, Hutto, Hawkins, Peregoy, Inc.	305-831-2474
Ill	Glen Ellyn, Superior Elec.	312-858-2960
Md	College Park, Superior Elec.	301-277-3235
Mass	Wellesley Hills, Superior Elec.	617-237-0750
Mich	Detroit, Superior Elec.	313-543-3450
NY	E. Rochester, Superior Elec.	716-381-9210
NY	Tarrytown, Superior Elec.	914-631-8600
NC	Charlotte, Superior Elec.	704-535-5846
Ohio	Medina, Superior Elec.	216-723-1515
Pa	Ft. Washington, Superior Elec.	215-646-6116
Tex	Dallas, Superior Elec.	214-368-4688
Wash	Seattle, J.J. Backer Co.	206-295-1300
FOR:	Can., Bristol, Superior Elec.	203-582-9561
FOR:	Can., Toronto, Ont., American Superior Elec. Co. Ltd.	416-255-2318

SUPERIOR FLUX & MFG. CO., 653 Alpha Dr., No. 58, Cleveland, Ohio, 44143, Tel: 216-461-3315; Empl.: 9; Minimum order: $10

Customer service: B. J. Garfinkel

Products manufactured: Flux, Brazing & Soldering Materials

Local Sales Offices & Reps.

RI	Rumford, J. Doherty	401-434-5945

SWITCHCRAFT, INC., 5555 N. Elston, Chicago, Ill., 60630, Tel: 312-792-2700, TWX: 910-221-5199; Empl.: 500

For info on price: N. Luksik; Application info: N. Luksik; Customer service: G. Bouley

Free literature available: Short Form Catalog - a condensed listing of a multitude of switchcraft electronic components

Products manufactured: Attenuators, Cable Assemblies & Harnesses, Connector Adapters, Connectors, Jack Adapters (All Types), Jack Covers, Jacks (All Types), Kits, Connector, Kits, Marking (Dial, Instrument, Equipment, etc.), Kits, Switch Assembling, Mixers, Panels, Switches

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe	602-264-7971
Cal	Los Angeles, P.F. Wiley Co.	213-663-8028
Cal	San Carlos, D.H. Ross Co.	415-591-4411
Colo	Greeley, G. Moss Elctrns.	303-353-1452
Fla	Orlando, Cartwright & Bean	305-422-4531
Ga	Atlanta, Cartwright & Bean	404-255-5262
Haw	Honolulu, Dougherty Entprs.	808-531-7548
Ill	Chicago, B. Burns & Assocs.	312-775-1233
Ind	Indianapolis, Mktg. Engrs.	317-546-1523
Iowa	Des Moines, T.L. Dowell & Assocs.	515-225-1620
Kans	Overland, T.L. Dowell & Assocs.	913-649-6069
La	Chalmette, Cartwright & Bean	504-279-4598
Mass	Boston, Anderson Sls. Assocs.	617-227-2980
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
Minn	Edina, M. Foster Tech. Sls. Inc.	612-835-2252
Miss	Jackson, Cartwright & Bean	601-981-1368
Mo	St. Louis, T.L. Dowell & Assocs.	314-968-4234
NJ	No. Caldwell, Masin-Esco, Inc.	201-226-2550
NM	Albuquerque, G. Moss Elctrns., Inc.	505-299-5101
NY	Syosset, Masin-Esco Inc.	516-364-0310
NY	Syracuse, Mar-Com Assocs.	315-437-2843
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Richfield, Bear Mktg.	216-659-3131
Ore	Portland, Earl & Brown Co.	503-245-2283
Tenn	Knoxville, Cartwright & Bean	615-693-7450
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Richardson, J.R. Lavender & Co.	214-231-5040
Wash	Seattle, Earl & Brown Co.	206-284-1121
EXP:	Can., Toronto, Ont., Atlas Elctns. Ltd.	416-781-6174
FOR:	Toronto 19, Ont., Can., Atlas Elctrns. Ltd.	416-781-6174

SWS SILICONES, Div. of Stauffer Chemical Co., Box 428, Adrian, Mich., 49221, Tel: 313-263-5711, TWX: 510-450-2606; Empl.: 500; Minimum order: $100

Customer service: A. J. Korving

Free literature available: Silicone greases, encapsulants, RTVs and fluids as well as silicone rubber.

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Insulators & Insulation, Kits, Cable-End Sealing, Lubricants, Rubber, Transistor, Diode, Thyristor Heat Dissipators

SYCOR, 100 Phoenix Dr., Ann Arbor, Mich., 48104, Tel: 313-971-0900, TWX: 810-223-6011; Empl.: 750

For info on price: R. M. Connor; Application info: R. M. Connor; Customer service: R. M. Connor; Delivery info: K. Wallo

Free literature available: Model 135 - ECMA/ANSI Compatible Cassette Recorder, Model 145 - Diskette Recorder Compatible with IBM 3740.

Products manufactured: Recorders

SYNCHRO-START PRODUCTS, INC., Box 147, 8109 N. Lawndale Ave., Skokie, Ill., 60076, Tel: 312-673-7730, Telex: 724-424; Empl.: 125

Customer service: G. Soule

Products manufactured: Governors, Centrifugal, Solenoids, Switches

Local Sales Offices & Reps.

Cal	Santa Rosa, R. Anderson	707-542-8207
Cal	Tustin, M. Johnson Co.	714-832-7282
Mass	Sharon, Adcour	617-784-3996
NY	Forest Hills, J. Miller Co.	212-263-4446
Ohio	Chagrin Falls, Pine Sls. & Engrg. Co.	216-247-6198
Okla	Tulsa, P & P Sls.	918-622-1523
Pa	Devon, Goodall Industritl Equip. Co.	215-353-4120
Tex	Richardson, Woodbury Co.	214-742-7508
Wash	Seattle, Fairman B. Lee Co.	206-244-7262

SYNERGISTIC PRODUCTS, Sub. Cavitron Corp., 1902 McGraw Ave., Irvine, Cal., 92705, Tel: 714-540-7755, Telex: 655339; Empl.: 200; Minimum order: $25

For info on price: J. Jones; Application info: J. Jones; Customer service: Mktg Dept; Delivery info: Mktg Dept

Free literature available: Mark IV & 1718C Pantograph Dip Insertion Systems Brochure, P/2/P Wire Termination Systems Brochure, Model 2300 Econo Dip Brochure, Multimatic Drilling Systems Brochure, SPI All Products one page Flyer.

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.

Ariz	Phoenix, Arrowhead Sls. Corp.	602-277-7148
Cal	Santa Clara, Banks Sls.	408-246-6311
Colo	Arvada, Arrowhead Sls Corp.	303-423-5556
Conn	Hartford, Cable Assocs.	203-525-5016
Fla	Lighthouse Pt., Saber Assocs.	305-943-3076
Ill	Itasca, English Sls. Co.	312-773-9449
Md	Silver Springs, ARA Elctrns.	301-565-2584
Mich	Detroit, Electro Ent.	313-521-1500
Minn	Minneapolis, Bican Co.	612-827-4734
NH	Londonderry, Cable Assocs.	603-434-5234
NJ	Wayne, K & J Assocs.	201-694-3334
NY	E. Setauket, K & J Assocs.	516-751-8686
Ohio	Cleveland, Electro Ent.	216-261-7670
Ohio	Dayton, Electro Ent.	513-426-6071
Pa	Bala Cynwyd, Electech	215-667-0973
Pa	Pittsburgh, Electro Ent.	412-371-8497
Tex	Dallas, Crockett Southwest Co.	214-251-1776
FOR:	Can., Burlington, Ont., Arbell Equip. Ltd.	416-632-9494

SYNTHANE TAYLOR CORP., An Alco Standard Corporate Partner, Box 835, Valley Forge, Pa., 19482, Tel: 215-666-0300; Empl.: 1000; Minimum order: $100

For info on price: F. McNally; Application info: G. J. Muller; Customer service: F. McNally; Delivery info: F. McNally

Products manufactured: Bearings, Bobbins, Winding, Coil & Transformer, Circuits, Flexible, Circuits, Printed, Multilayer, Insulators & Insulation, Laminates, Tubing

Local Sales Offices & Reps.

Cal	LaVerne	714-593-1341
Cal	Los Angeles	213-966-7461
Cal	San Francisco	415-591-8929
Conn	Avon	203-678-0385
Ga	Atlanta	404-237-0416
Ill	Arlington Heights	312-437-8660
Ill	Chicago	312-569-2838
Ind	Indianapolis	317-923-2102
Md	Baltimore	301-828-9365
Mass	Boston	617-969-5945
Mich	Detroit	313-646-8868
Minn	Minneapolis	612-888-5207
Mo	Kansas City	913-432-3355
Mo	St. Louis	314-721-1300
NJ	Newark	201-447-4597
NY	Binghamton	607-722-7850
NY	Northport	516-757-7171
NY	Rochester	716-586-0413
Ohio	Cleveland	216-371-3775
Ohio	Dayton	513-859-4100
Pa	Pittsburgh	412-391-7230
Tenn	Knoxville	615-525-1991
Tex	Dallas	214-231-9939
Va	Richmond	804-358-3465
Wisc	Milwaukee	414-962-0890

SYNTRONIC INSTRUMENTS INC., 100 Industrial Rd., Addison, Ill., 60101, Tel: 312-543-6444, TWX: 910-651-2191; Empl.: 120 .... p. 2•424-429

Customer service: Paul Evans

Free literature available: General catalogue containing data sheets on deflection yokes, focus coils and related hardware for mounting on cathode ray tubes. Product Index-A guide to our wide line of precision deflection components including their most important operating characteristics

Products manufactured: Coils Including Assemblies & Forms, Mounts, Scanners, Tools, Yokes

Local Sales Offices & Reps.

Cal	Arcadia, A.M. Wood Co.	213-447-3511
Cal	Los Altos, Frauman Assocs.	415-941-0660
Colo	Wheatridge, Waugaman Assocs.	303-423-1020
Conn	New Canaan, W. Couch	203-966-4630
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Md	Reisterstown, Massey Assocs.	301-833-2039
Mass	Norwood, S. Pierce, Inc.	617-762-3164
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
NJ	Fairlawn, G.D. Harris Assocs.	201-796-5200
Pa	Media, Snyder & Massey Assoc.	215-566-5400
Tex	Irving, Space Electronics	214-251-2261
EXP:	Teaneck, N.J., S. Ginsbury Ltd.	201-837-1100

SYRACUSE ELCTRNS. CORP., Box 566, Syracuse, N.Y., 13201, Tel: 315-488-4911; Empl.: 60; Minimum order: $25

For info on price: D. Lawrie; Application info: D. Lawrie; Customer service: M. Squires; Delivery info: M. Squires

Free literature available: 1. Full Catalog 40 pages covering a broad line of timers 2. Application Guide for electronic timers a quick reference

Products manufactured: Relays, Timers

Local Sales Offices & Reps.

Cal	San Rafael, Wells Assocs.	415-454-5730
Cal	Sherman Oaks, Gee Assocs.	213-788-5961
Colo	Boulder, R. A. Mayes Co.	303-444-0782
Conn	Glastonburry, Barton-Caron Assocs.	203-633-9417
Ill	Chicago, Automation Equip.	312-631-9673
Ill	Mount Prospect, Automation Equip. Co. Inc.	312-398-7550
Ind	Angola, Southern Sls.	219-665-3961
Ind	Indianapolis, Southern Sls.	317-253-3359
Mass	Auburndale, Barton-Caron Assocs.	617-332-2021
Mich	Dearborn, Pitcher-Poulin	313-582-5450
Minn	Minneapolis, K. C. Brooks	612-544-3179
Mo	St. Louis, Elec. Controls	314-645-2400
NM	Albuquerque, R. A. Mayes Co.	505-293-8010
NY	Baldwinsville, Scibetta Reps.	315-622-3993
NY	Bogota, Neville & Vespo	201-487-1505
NC	Greensboro, Motion Control Sys.	919-272-4181
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Pa	Ardmore, Rothenheber	215-642-6911
Pa	Pittsburgh, Trymac Co.	412-823-8400
Tenn	Memphis, R. Jordan Assocs.	901-452-7441

SYSCON INT'L., INC., 205 Sycamore St., So. Bend, Ind., 46622, Tel: 219-287-5916, Telex: 25-8325; Empl.: 12; Minimum order: $10

For info on price: T. W. Eaglesham; Application info: T. W. Eaglesham; Customer service: P. Martin; Delivery info: P. Martin

Free literature available: Catalog 1F-60 - "Weecoil" subminiature 1F transformers & coils Short Form Catalog - Temperature sensors, pyrometers, indicators & controllers.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Controls/Control Eqpt., Monitors, Probes, Thermocouples, Elements & Accessories, Transducers, Transformers

SYSTEMS DATA INC., 1941 W. Market St., Akron, Ohio, 44313, Tel: 216-867-2197; Empl.: 12

For info on price: W. B. Frantz; Application info: J. L. Sickafoose; Customer service: C. W. Owen; Delivery info: Project Engr.

Products manufactured: Compressors, Data, Computers, Controllers, Programmable, Data Acquisition & Reduction Systems, Data Compressors, Digital, Data Loggers, Multiplexers, Readers, Recorders, Scanners, Services, Assembly, Production & Test, Terminals, Data Display (including Alphanumeric & Graphic), Test Systems, Totalizers, Digital, Transmission Systems, Data

Local Sales Offices & Reps.

Mich	Detroit, W-K-M Assocs.	313-892-2500
Ohio	Cleveland, W-K-M Assocs.	216-267-0445
Ohio	Dayton, W-K-M Assocs.	513-434-7500
Pa	Pittsburgh, W-K-M Assocs.	412-892-2953

SYSTEMS ELECTRONICS, 1935 W. 96 St., Cleveland, Ohio, 44102, Tel: 216-651-8208; Empl.: 50

Customer service: E. F. Bedford

SYSTEMS INSTRS. RESCH., INC., 331 Luckie St., N.W., Atlanta, Ga., 30313, Tel: 404-522-6317; Empl.: 10

Customer service: H. D. Edwards

Products manufactured: Data Acquisition & Reduction Systems, Recorders, Test Systems, Testers

SYSTONICS, INC., Box 121, Winchester, Mass., 01890, Tel: 617-729-4439; Empl.: 3

Customer service: R. C. Thomas 617-729-5127

Free literature available: Product Sheet & PL - Oxidation Systems Product Sheet & PL - Diffusion Systems, Technical Notes, Phosphorous Diffusion, Pyrogenic Oxidation, Source Systems

Products manufactured: Machines/Machinery, Production

SYSTRON-DONNER CORP., 1 Systron Dr., Concord, Cal., 94518, Tel: 415-676-5000, TWX: 910-481-9472; FSC No: 52542; Empl.: 1400; Minimum order: $15 p. 1•812,813

For info on price: D. Herbert; Application info: H. Mette; Customer service: R. Hall; Delivery info: D. Herbert

Products manufactured: Analyzers, Clocks (All Types), Counters, Dials, Duplexers, Microwave, Generators, Line Strechers, Microwave, Meters, Potentiometers, Power Supplies, Printers, Readers, Test Systems, Timers, Voltage Sources

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices	205-536-1969
Cal	Encino, Scientific Devices	213-872-1951
Cal	Los Alamitos, Scientific Devices	213-598-7678
Cal	Mountain View, Scientific Devices	415-964-4230
Cal	San Diego, Scientific Devices	714-279-6642
Colo	Boulder, Scientific Devices	303-449-9466
Conn	Hamden, Scientific Devices	203-248-9361
Fla	Fort Lauderdale, Scientific Devices	305-721-4260
Fla	Orlando, Scientific Devices	305-841-8180
Ill	Des Plaines, Scientific Devices	312-297-5240
Kans	Lenexa, Scientific Devices	913-631-3818
Mass	Waltham, Scientific Devices	617-894-5637
Mich	Milford, Scientific Devices	313-363-2282
Minn	Minneapolis, Scientific Devices	612-544-1616
Mo	St. Louis, Scientific Devices	314-842-2535
NJ	Palisades Park, Scientific Devices	201-871-3916
NM	Albuquerque, Scientific Devices	505-293-3494
NY	Rochester, Scientific Devices	716-334-2445
NC	Burlington, Scientific Devices	919-228-6270
Ohio	Cleveland, Scientific Devices	216-835-2270
Ohio	Dayton, Scientific Devices	513-298-9904
Pa	New Kensington, Scientific Devices	412-339-1445
Pa	Plymouth Meeting, Scientific Devices	215-825-9515
Tex	Houston, Scientific Devices	713-623-4250
Tex	Richardson, Scientific Devices	214-231-8106
Tex	San Antonio, Scientific Devices	512-736-3164
Va	Norfolk, Scientific Devices	804-499-8133
Va	Springfield, Scientific Devices	703-451-6500
Wash	Bellevue, Scientific Devices	206-454-0900
FOR:	Can., Montreal, Que., Baytronix, Ltd.	514-336-9240
FOR:	Can., Vancouver, B.C., Canadian Dynamics, Ltd.	604-325-3201

SYSTRON DONNER, Data Products Div., 735 Detroit Ave., Concord, Cal., 94518, Tel: 415-798-9900, TWX: 910-481-5780; Empl.: 140; Minimum order: $15 p. 1•812,813

Customer service: D. Squires 415-798-9900

Free literature available: A catalog on time code instruments listing over 50 different instruments and options available.

Products manufactured: Amplifiers, Clocks (All Types), Computers, Cords, Data Acquisition & Reduction Systems, Dividers, Generators, Integrators, Electronic, Multipliers, Printers, Tape Search Equipment, Test Systems, Testers

Refer to Systron-Donner Corp. for sales office information

SYSTRON-DONNER INSTR. DIV., 10 Systron Dr., Concord, Cal., 94518, Tel: 415-676-5000, TWX: 910-481-9479; FSC No: 52542; Empl.: 650; Minimum order: $15 p. 1•812,813

For info on price: D. Herbert; Application info: H. Mette; Customer service: D. Fare; Delivery info: H. Mette

Free literature available: 256-page general instrument catalog on all Systron-Donner Test and Measuring Instruments.

Products manufactured: Analyzers, Counters, Current Sources, Data Loggers, Generators, Indicators, Meters, Monitors, Power Supplies, Prescalers, Standards, Synthesizers, Testers, Timers, Totalizers, Digital, Voltage Sources

Refer to Systron-Donner Corp. for sales representative information.

SYSTRON-DONNER INERTIAL DIV., 1090 San Miguel Rd., Concord, Cal., 94518, Tel: 415-682-6161, TWX: 910-481-9478; Empl.: 416; Minimum order: $75

Customer service: B. B. Sage

Products manufactured: Accelerometers, Comm. Systems, Computers, Data Compressors, Digital, Gyros (All Types), Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Vesco	205-881-3830
Cal	Alhambra, Applied Technologies Assocs.	213-289-9181
Cal	San Diego, L. L. Stoakes	714-274-6281
Cal	San Francisco, Applied Technologies Assocs.	408-733-4130
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Conn	Milford, Zaslow Sls. Co.	203-878-1094
DC	Washington, VCL	202-628-4380
Fla	Orlando, E. G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E. G. Holmes & Assocs.	404-451-6161
Ill	Chicago, Carlson Elctrns. Sls.	312-774-4812
Mass	Lowell, Zaslow Sls. Co.	617-458-8452
Mass	Northboro, Zaslow Sls. Co.	617-393-8150
NJ	Fort Lee, Technimat	201-461-8685
NY	Copiague, Sencor	516-842-7676
NY	Edicott, Tech-Mark	607-748-7473
NY	Fairport, Tech-Mark	716-223-1252
NY	Pleasant Valley, Tech-Mark	914-635-3436
Ohio	Dayton, Ashby Assocs.	513-252-5627
Okla	Tulsa, Kemp Engrg. Co.	918-299-2636
Pa	Philadelphia, Sencor	215-698-9661
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Wash	Seattle, Applied Technologies Assocs.	213-289-9181
Wisc	Milwaukee, Carlson Elctrn. Sls.	414-476-2790

SYSTRON-DONNER, Kruse Electronics Div., 735 Palomor Ave., Sunnyvale, Cal., 94086, Tel: 408-735-9660, TWX: 910-339-9309; Empl.: 75; Minimum order: $15 p. 1•812,813

For info on price: J. Johnson; Application info: J. Johnson; Delivery info: J. Johnson

Products manufactured: Generators, Meters, Oscillators, Tubes

Refer to Systron-Donner Corp. for sales representative information.

SYSTRON-DONNER MICROWAVE DIV., 14844 Oxnard St., Van Nuys, Cal., 91409, Tel: 213-786-1760, TWX: 910-495-1786; Empl.: 200 p. 1•812,813

Products manufactured: Adapters, Waveguide, Analyzers, Antenna Feed Systems, Antenna Rotators, Antennas, Attenuators, Bends & Twists, Microwave, Cable Assemblies & Harnesses, Chokes, Circulators, Ferrite, Computers, Counters, Couplers, Detectors, Dividers, Dummy Loads, Duplexers, Microwave, Filters, Flanges, Waveguide, Generators, Horns, Microwave, Isolators, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Meters, Mixers, Mounts, Power Supplies, Printers, Probes, Radar Systems, Seals, Shifters, Simulators, Sliding Loads, Microwave, Strip-Line Components, Microwave, Switches, Synthesizers, Tees, Terminals, Test Systems, Tubing, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville	205-536-1969
Ariz	Phoenix	602-956-5519
Cal	Encino	213-872-1951
Cal	Los Alamitos	213-598-7678
Cal	Mountain View	415-964-4230
Cal	San Diego	714-279-6642
Colo	Denver	303-573-9466
Conn	Hamden	203-248-9361
Fla	Ft. Lauderdale	305-721-4260
Fla	Orlando	305-841-8180
Haw	Honolulu	808-941-1574
Ill	Des Plaines	312-297-5240
Kans	Lenexa	913-631-3818
Mass	Waltham	617-894-5637
Mich	Milford	313-363-2282
Minn	Minneapolis	612-544-1616
Mo	St. Louis	314-842-2535
NJ	Palisades Park	201-871-3916
NM	Albuquerque	505-268-6729
NY	Rochester	716-334-2445
NC	Burlington	919-228-6279
Ohio	Cleveland	216-835-2270
Ohio	Dayton	513-298-9904
Pa	New Kensington	412-339-1445
Pa	Plymouth Meeting	215-825-9515
Tex	Houston	713-623-4250
Tex	Richardson	214-231-8106
Tex	San Antonio	512-736-3164
Va	Norfolk	804-499-8133
Va	Springfield	703-451-6500
Wash	Bellevue	206-454-0900
FOR:	Can., Brampton, Ont.	416-453-1252
FOR:	Can., Montreal, Oue.	514-336-9240
FOR:	Can., Ottawa, Ont.	613-728-0113
FOR:	Can., Vancouver, B.C.	604-325-3201

SYSTRON DONNER TRYGON DIV., 1200 Shames Dr., Westbury, N.Y., 11590, Tel: 516-997-6200, TWX: 510-222-0492; FSC No: 52542; Empl.: 160; Minimum order: $15 p. 1•1507-1512

Customer service: H. Rait

Free literature available: Complete catalog on "DC Power Supplies" for laboratory, systems and OEM applications.

Products manufactured: Converters, Power Supplies

Refer to Systron-Donner Corp. for sales representative information.

T-BAR INC., 141 Danbury Rd., Wilton, Conn., 06897, Tel: 203-762-8351, TWX: 710-479-3216; Empl.: 120; Minimum order: $25 p. 1•814,1817,2296,2297

For info on price: T. Infantino; Application info: J. Seiden; Customer service: M. Holt; Delivery info: T. Infantino

Free literature available: High-density Switching Components, Series 6900, Pluggable Switching Modules, designed to switch many parallel circuits simultaneously. Series 2900, Automatic Selector Units for both random and sequential selection of up to 128 positions can be accomplished.

Products manufactured: Comm. Systems, Relays, Switches

Local Sales Offices & Reps.

Ariz	Tempe, J. F. Hurlbut Co.	602-968-5962
Cal	Palo Alto, Engineering Assocs.	415-494-7842
Cal	San Gabriel, Van Gott & Assocs.	213-285-2148
Colo	Golden, J. F. Hurlbut Co.	303-279-7796
Conn	Madison, A & M Electronic Reps.	203-421-4242
Fla	Miami, Geartner Assocs.	305-861-3661
Fla	Orlando, Geartner Assocs.	305-299-1000
Ill	Chicago, Saffro & Assocs.	312-588-0905
Ind	Fort Wayne, McDonald Sales Co.	219-747-3650
Md	Silver Spring, Carwithen Assocs.	301-589-9112
Mass	Needham, A & M Electronic Reps, Inc.	617-444-8170
Mich	Dearborn Hts., McDonald Sales Co.	313-278-7500

Minn	Minneapolis, C. E. Bohlig Co.	612-922-7011
Miss	Corinth, Rakes Engrg.	601-287-5369
NJ	Fort Lee, Tecnimat	201-461-8686
NY	New Hartford, KLM Assocs.	315-735-8525
NY	No. Syracuse, KLM Assocs.	315-458-6214
NY	Rochester, KLM Assocs.	716-442-0820
Ohio	Aurora, EMA, Inc.	216-562-6104
Ohio	Centerville, EMA Inc.	513-433-2800
Pa	Ambler, Wyncote Instrumentation	215-643-2440
Tenn	Bristol, Rakes Engrg.	615-968-4195
Tex	Dallas, McCoy Assocs. Co.	214-350-9931
Tex	Houston, Unidyne	713-494-6021
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
EXP:	Wimborne, Dorset, FR Elex, Flight Refuelling Ltd.	Wimborne 2121
FOR:	Can., B.C., Vancouver, John G. Weiss Co., Ltd.	604-987-3833
FOR:	Can., Ont., Toronto, John G. Weiss Co., Ltd.	416-766-0843
FOR:	Can., P.Q., Montreal, John G. Weiss Co., Ltd.	514-489-6887

Local Distributors

Cal	Hollywood, Terminal Elctrns., 5250 Hollywood Blvd.	215-466-3181
Cal	Santa Clara, Fisher/Brownell, 3381 Edward Ave.	408-244-6182
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Mass	Newton, Cramer, 85 Wells Ave.	617-969-7700
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th	817-336-5401
Tex	Stafford, Southwest Elctrns., 12725 Royal Dr.	713-494-6021

T-F ELECTRONICS INC., 1701 Evergreen Ave., Austin, Tex., 78704, Tel: 512-444-9674; Empl.: 12

Products manufactured: Calibrators, Filters, Generators, Oscillators, Standards, Tuning Forks

TA INSTRUMENT CASE CO., 4625 Alger St., Los Angeles, Cal, 90039, Tel: 213-242-8855; Empl.: 31

For info on price: J. N. Thraves; Application info: J. N. Thraves; Customer service: J. Garrison; Delivery info: J. Garrison

Free literature available: "Consoliner Series" Brochure-describes standard aluminum housing designed for 19" panel, rack mounted equipment. 12 standard sizes from 5-7/32" to 25-7/32 X 19" are available by catalog number. King-Size Instrument Cases-standard drawn sizes meet Mil-Spec Quality standards Dual Access-describes dual access capability to house two instruments in one body or provide immediate access to the instrument chassis.

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Cases, Transit, Containers

Local Sales Offices & Reps.

Cal	Los Angeles, TA Instr. Case Co.	213-242-8855
Cal	Mountain View, Connolly & Co.	415-967-6988
Cal	San Diego, Wm. Gibson	714-223-6120
Cal	Sunland, Crescenta Metal Prods.	213-352-1895
Colo	Denver, Omega Ltd.	303-758-1508
Conn	Sherman, R. P. Mahan Co.	617-237-1040
Fla	Orlando, Gra-Mar	305-894-3351
Ga	Atlanta, Electro-Mech	404-393-0444
Iowa	Cedar Rapids, J-R Sls. Engr.	319-377-8211
Kans	Wichita, D-O Engr.	316-264-7358
Md	Lutherville, Milan Assocs.	301-825-1120
Miss	Fulton, Electro-Mech Sls. Eng. Co.	601-862-3378
Mo	St. Louis, Industrial Metal Working	314-878-4310
NJ	Lodi, Braddock Inds.	201-478-1354
NC	Charlotte, Electro-Mech Sls. Eng. Co.	704-523-0324
NC	Raleigh, Electro-Mech Sls. Eng. Co.	919-782-6452
Ohio	Cincinnati, F.D. Borchelt	513-851-7586
Tex	Fort Worth, John H. Smith Co.	817-267-1202
Utah	Salt Lake City, Omega, Ltd.	801-266-9617

TAB BOOKS, Monterey & Pinola Aves., Blue Ridge Summit, Pa., 17214, Tel: 717-794-2191

For info on price: B. Sites; Customer service: S. Buffington

Free literature available: Catalog - describes over 300 titles in the following categories: Appliance Repair, Audio, Hi-Fi & Stereo, Automotive & Engine Technology, Basic Electronics Technology, Broadcasting, Communications & CB Radio, Computer Programming & Technology, Electric Motors, Electronic Book/Kits, Hobby & Experiment, Medical Electronics, Model Radio Control, Television Servicing.

Products manufactured: Kits, Training Aid, Technical Books

TALLY CORP., 8301 S. 180th St., Kent, Wash., 98103, Tel: 206-251-5500, Telex: 320-200; Empl.: 500

Customer service: Mktg. Dept.

Free literature available: Data sheets, equipment specifications, and interface manuals for all products.

Products manufactured: Perforators, Printers

TALK-A-PHONE CO., 5013 No. Kedzie Ave., Chicago, Ill., 60625, Tel: 312-539-1100

Products manufactured: Comm. Systems

TANN CONTROLS CO., 20210 Sherwood St., Detroit, Mich., 48234, Tel: 313-366-3370; Empl.: 20

For info on price: L. Kay; Application info: A. Sikorski; Customer service: A. Sikorski; Delivery info: L. Kay

Free literature available: Catalog sheets and specs. on each product - Electro-Mechanical Switches, Electronic Switches, Relays, Alarms.

Products manufactured: Alarms, Amplifiers, Controls/Control Eqpt., Indicators, Relays, Switches

TANSITOR ELCTRNS., Div. Aerotron, West Rd., Bennington, Vt., 05201, Tel: 802-442-5473, TWX: 710-360-1782; Empl.: 300

For info on price: M. Moon; Application info: G. Green; Customer service: M. Moon; Delivery info: M. Moon

Free literature available: The following literature supplied upon request. Complete product catalogue, data sheets, parameters of tantalum capacitors, application information and delivery information.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper Sls. Co.	602-946-4437
Cal	Pico Rivera, Westrep	213-949-2551
Cal	Santa Clara, Richards Assoc.	408-246-5860
Conn	Bethel, J. E. Boeing Co.	203-748-5802
Fla	Oviedo, Conley & Assoc.	305-365-3283
Ill	Chicago, L-Tec, Inc.	312-286-1500
Iowa	Cedar Rapids, J.R. Sls. Engrg., Inc.	319-377-8211
Md	Baltimore, L.H. Kolman & Co.	301-752-8756
Mass	Lexington, J. E. Boeing Co.	617-862-2500
Minn	St. Paul, H. A. Cullen & Assoc.	612-646-7371
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NJ	Leonia, Kohl-Camber	201-944-6488
NC	Smithfield, Byrd & Barbour Sls.	919-934-8136
Ohio	Akron, Augnat Assoc.	216-725-6087
Ohio	Dayton, Augnat Assoc.	513-223-5002
Ore	Portland, R. Legg Co.	503-292-8824
Tex	Dallas, United Comps.	214-324-1448
FOR:	Can., Montreal, Que., Kaytronics, Ltd.	514-487-3434
FOR:	Can., Toronto, Ont., Kaytronics, Ltd.	416-638-5511

TAPESWITCH CORP. AMER., 320 Brd. Hollow Rd., Farmingdale, N.Y., 11735, Tel: 516-694-6312; Empl.: 100; Minimum order: $15 .... p. 1•2300

For info on price: D. W. Bury; Application info: F. Dale; Customer service: V. Shove; Delivery info: D. W. Bury

Free literature available: Industrial User Catalog - C-4 General Catalog information on complete line of ribbon switches, switching mats, electric safety edges, footswitches, road switches and other components.

Products manufactured: Alarms, Contact Strips, Finger, Controls/Control Eqpt., Indicators, Limit Stops, Mechanical, Switches

TASKER SYSTEMS, 20131 Sunburst St., Chatsworth, Cal., 91311, Tel: 213-341-3010, TWX: 910-494-1214; FSC No: 09017; Empl.: 250; Minimum order: $200

Customer service: G. B. Etzler

Products manufactured: Analyzers, Antenna Feed Systems, Antenna Rotators, Antennas, Comm. Systems, Control Systems, Air Traffic, Data Acquisition & Reduction Systems, Decoders, Delay Lines, Modulator/Demodulators, Modulators, All Kinds, Pedestals, Radar, Radar Systems, Receivers, Simulators, Testers, Tracking Systems

Local Sales Offices & Reps.

Mass	Lexington, C. Hopkins	617-861-8300
NJ	Red Bank, T. Schweers	201-747-5353
Va	Arlington, J. Seelinger	703-524-4477

tau-tron inc

TAU-TRON INC., 11 Esquire Rd., N. Billerica, Mass., 01862, Tel: 617-667-3874, TWX: 710-347-1570; Empl.: 40

For info on price: R. K. Heathcock; Application info: J. E. Hanley; Customer service: J. E. Hanley; Delivery info: R. K. Heathcock

Free literature available: Short Form catalog, Data Sheets, and Technical Application Notes describing the use of Tau-Tron's high speed digital instrumentation in communications, memory, and general laboratory testing.

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Comparators, Counters, Generators, Oscillators, Testers, Totalizers, Digital, Transmitters

Local Sales Offices & Reps.

Ariz	Tempe, J. F. Hurlbut Co.	602-968-5962
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	Sunnyvale, RDX Corp.	408-734-4500
Colo	Golden, J. F. Hurlbut Co.	303-279-7796
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Megatek, Inc.	312-889-1277
Md	Rockville, MESA, Inc.	301-881-8430
Minn	Minneapolis, Waytek	612-933-2133
NJ	Cinnaminson, MESA, Inc.	609-786-0284
Tex	Dallas, Bradenco Corp.	214-358-3278

Advertisment

INSTRUMENTS FOR HIGH-SPEED DIGITAL TESTING State-of-the-art circuit design and manufacturing/packaging techniques make possible the highest speed digital instruments currently available. Instrumentation covers the band from DC to 1 GHz and includes communication test equipment (BERT), digital signal sources, systems for testing semiconductor memories, and customized products.

TAURUS CORP., Academy Hill, Lambertville, N.J., 08530, Tel: 609-397-2390; Minimum order: $25 p. 1•71,219

Customer service: J. D. Kreuter

Free literature available: Teflon Terminal Catalog Circuitrak P.C. Board Holders Catalog Static & Serial Punched Card Readers Catalog

Products manufactured: Guides, Circuit Board, Programmers, Punched Card Equipment, Terminals

Local Sales Offices & Reps.

Cal	Los Angeles, R. Sweet	213-477-4517
Cal	Pasadena, Sci. Sls.	213-793-1244
Fla	Clearwater, Brennan Assoc.	813-446-5006
Ind	Ft. Wayne, Hoeming Sls.	219-483-6913
NJ	Ft. Lee, K. Hughes	201-944-1600
NY	New York, K. Hughes	212-695-0082
Ohio	Wickliffe, W.J. Brauer	216-943-0601
Pa	Pittsburgh, W.J. Brauer	412-921-3213

TAYLOR INDUSTRIES INC., Fisher Road, Howell, Mich., 48843, Tel: 517-546-0450, TWX: 810-251-6266; Empl.: 50; Minimum order: $25

For info on price: L. Smith; Application info: R. Schiedler; Customer service: L. Smith; Delivery info: L. Smith

Products manufactured: Clamps & Clips, Ducts, Wiring, Fasteners, Panels, Rivets

Local Sales Offices & Reps.

Ariz	Scottsdale, N.F. Ross Co.	602-945-7262
Cal	Los Angeles, Taylor Industries	805-937-6400
Colo	Denver, Gaer Sls., Inc.	303-758-3223
Conn	Byram, Brunner Assocs	516-921-2052
Conn	Storrs, R.C. Campbell Co.	203-456-1212
Ga	Atlanta, A. Brown Assocs.	404-457-6381
Kans	Kansas City, Conrad Co.	913-621-3021
Mich	Farmington Hills, R. McBride Co.	313-474-2300
Minn	Minneapolis, R.D. Schwen Engrg. Co.	612-854-4304
Mo	St. Louis, G. Hagen & Co.	314-961-2222
NJ	Morristown, Waldron Assocs.	201-538-5607
Ohio	Cincinnati, Phillips Sls	513-791-3926
Ohio	Cleveland, Matthew M. Haley Co.	216-842-4747
Okla	Tulsa, Andres & Boruch	214-821-3601

Ore	Beaverton, D. Fry Co.	503-643-5448
Pa	Penndel, R. May Assocs.	215-757-1581
Pa	West Newton, W.H. Schmitt Assocs.	412-872-5007
Tex	Dallas, Andres & Boruch	214-821-3601
Tex	Houston, Bean-McDaniel & Assocs	713-649-8606
Va	Richmond, J. H. Thrower Co.	804-794-6819

TAYLOR INSTR. PROCESS CONTROL DIV., Sybron Corp., 95 Ames St., Rochester, N.Y., 14601, Tel: 716-235-5000, TWX: 716-235-4893; Empl.: 1900; Minimum order: $25

For info on price: Sls. Dept.; Application info: R. J. Branigan; Customer service: W. B. Hile; Delivery info: Sls. Dept.

Free literature available: A four-page brochure outlining design, applications and features of the new Multi-Scan Potentiometric recorders, indicators, and controllers, including alarm options and balancing techniques.

Products manufactured: Actuators, Alarms, Amplifiers, Analyzers, Computers, Controls/Control Eqpt., Converters, Gages, Indicators, Integrators, Electronic, Meters, Potentiometers, Process Control Systems, Recorders, Scales, Dial, Services, Assembly, Production & Test, Testers, Timers, Transducers, Transmitters, Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.

Ala	Birmingham	205-879-5942
Ala	Mobile	205-344-4981
Cal	Los Angeles	213-662-3191
Cal	San Leandro	415-569-1661
Colo	Denver	303-795-8330
Del	Wilmington	302-478-2440
Fla	Lakeland	813-688-8441
Ga	Atlanta	404-458-8301
Ga	Savannah	912-233-8589
Ill	Chicago Heights	312-755-3103
Ill	Oak Park	312-379-0876
Ind	Indianapolis	317-257-3317
Iowa	West Des Moines	515-283-1422
Kans	Kansas City	913-236-8555
La	Baton Rouge	504-921-8111
La	New Orleans	504-482-3136
Me	Portland	207-774-7392
Md	Baltimore	301-788-6633
Mass	Needham	617-444-4130
Mass	Springfield	413-733-3721
Mich	Dearborn Heights	313-278-4000
Mich	Kalamazoo	616-345-7931
Minn	Hopkins	612-935-7771
Mo	St. Louis	314-966-5660
NJ	Succasunna	201-584-1234
NY	Buffalo	716-877-5245
NY	New York	212-586-3544
NY	Rochester	716-244-0430
NY	Schenectady	518-374-8403
NC	Charlotte	704-372-2360
NC	Greensboro	919-273-0818
NC	Wilmington	919-763-8683
Ohio	Akron	216-535-1545
Ohio	Cincinnati	513-272-3636
Ohio	Parma	216-398-6292
Okla	Tulsa	918-628-1280
Ore	Portland	503-665-6111
Pa	Fort Washington	215-643-7300
Pa	Pittsburgh	412-531-3301
SC	Columbia	803-788-5918
SC	Greenville	803-233-7464
Tenn	Knoxville	615-588-2485
Tenn	Memphis	901-274-8842
Tex	Amarillo	806-352-4781
Tex	Beaumont	713-892-1213
Tex	Corpus Christi	512-882-1171
Tex	Dallas	214-690-1130
Tex	Houston	713-462-6402
Utah	Salt Lake City	801-272-3482
Va	Richmond	804-272-1461
Wash	Bellevue	206-455-2666
WVa	South Charleston	304-744-3473
Wisc	Appleton	414-739-6851
Wisc	Milwaukee	414-543-6550

TAYLOR-WINFIELD CORP., 1052 Mahoning Ave. NW, Warren, Ohio, 44482, Tel: 216-399-8861, Telex: 098-2433; Empl.: 600; Minimum order: $25

Products manufactured: Furnaces, Generators, Heaters & Heating Elements, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

Local Sales Offices & Reps.

Cal	Monrovia, Denton & Anderson Co.	213-359-9304
Colo	Denver, Duboc-Lane & Monckton, Inc.	303-623-1261
Ill	La Grange, Denton & Anderson Co.	312-482-8660
Mich	Birmingham, Denton & Anderson Co.	313-647-5520
Minn	Minneapolis, Parker Sls.	612-920-1323
Mo	Ballwin, Denton & Anderson Co.	314-821-3220
NY	Hamburg, Denton & Anderson Co.	716-826-6272
NY	Plainview, Denton & Anderson Co.	516-694-6055
NC	Charlotte, J.W. Fraser & Co.	704-523-2414
Ohio	Cleveland, Denton & Anderson Co.	216-831-2010
Ohio	Dayton, Denton & Anderson Co.	216-831-2010
Pa	Warminster, Denton & Anderson Co.	215-322-1262
Tenn	Chattanooga, Jones-Sylor Co., Inc.	615-265-1601
Tex	Garland, Denton & Anderson Co.	214-270-7635

TDC, DIV. FREQ. TECHNOLOGY INC., Box 365, Littleton, Mass., 01460, Tel: 617-456-3374; FSC No: 53875; Empl.: 50; Minimum order: $100

Free literature available: Brochures on EPOXYCAST High-Voltage Transformers, STABILC Stable AC Power Sources, STABILARC Ballasts for HID Lamps, and Machine Tool Control Transformers.

Products manufactured: Transformers

Local Sales Offices & Reps.

Cal	Oakland, J. H. Ormond Co.	415-893-7700
Cal	Seal Beach, Cesco	213-430-9084
Conn	New Canaan, Jedco Assocs.	203-966-2580
Ill	Park Ridge, Probe Elctrns.	312-696-2828
Md	Baltimore, W. S. Warrington & Assocs.	301-823-8759
Minn	Minneapolis, Revere Assocs.	612-781-2615
NJ	Springfield, F. F. Sylvester Assocs.	201-376-3324
NY	Buffalo, H. C. Johnson Agencies	716-632-7880
NY	Fayetteville, H. C. Johnson Agencies	315-637-9383
NY	Rochester, H. C. Johnson Agencies	716-482-3000
Ohio	Cleveland, Orr Assocs.	216-885-1324
Pa	Ardmore, W. K. Metz	215-649-3966
Pa	Glenshaw, H. C. Johnson Agencies	412-961-0414
Wash	Seattle, Avionics Liason, Inc.	206-767-3870

TDK ELECTRONICS CO., LTD., 14-6 2-Chome, Uchikanda, Chiyoda-ku, Tokyo 101, Japan, Tel: 03-257-2527; Empl.: 4775

Products manufactured: Capacitors, Fixed, Capacitors, Variable, CATV Systems & Equipment, Chokes, Coils Including Assemblies & Forms, Converters, Cores, Magnetic, Crystals, Delay Lines, Dummy Loads, Ferrite Material & Parts, Filters, Inverters, Isolators, Lighting Equipment, Emergency, Lights, Magnets, Matrices, Computer, Memory Systems, Modules, Logic, Encapsulated, Networks, Power Supplies, Reactors, Substrates, Suppressors, Tapes, Recording, Magnetic (All Types), Thermistors, Transformers

Local Sales Offices & Reps.

Cal	El Segundo, TDK Corp. of America	213-644-8625
Ill	Chicago, TDK Corp. of America	312-973-1222
NY	New York, TDK Corp. of America	516-746-0880
Tex	El Paso, TDK Corp. of America	915-778-4203

TDK ELCTRNS. CORP., 23-73 48th St., Long Island City, N.Y., 11103, Tel: 212-721-6881

Products manufactured: Capacitors, Fixed, Capacitors, Variable, Chokes, Circulators, Ferrite, Coils Including Assemblies & Forms, Cores, Magnetic, Delay Lines, Filters, Magnets, Matrices, Computer, Memory Systems, Networks, Resistors, Tape Recording Accessories, Tapes, Recording, Magnetic (All Types), Thermistors, Transducers, Transformers

TEABERRY ELECTRONICS, 4655 Massachusetts Ave., Indianapolis, Ind., 46218

Products manufactured: Comm. Systems, Receivers, Transmitters

TEC, INC., 9800 N. Oracle Rd., Tuscon, Ariz., 85704, Tel: 602-297-1111, TWX: 910-952-1377; Empl.: 300; Minimum order: $25 .... p. 2•1201-1204

For info on price: J. Bastys; Application info: L. Lorence; Customer service: K. Herlong; Delivery info: K. Herlong

Free literature available: Complete Product Catalog (#2027), Short-Form Catalog (#986), Data-Monitor Annunciators (#1019), DATA-PANEL Display Systems (#1024), LED Readout Modules (#2031)

Products manufactured: Annunciators, Diodes, Display Devices/Displays, Drivers & Decoders For Readouts, Gaskets, Shielding, R-F-Also See Shields, R-F, Keyboards, Alphanumeric & Decimal, Lamp Drivers, Lamps, Lights, Power Supplies, Switches, Terminals, Data Display (including Alphanumeric & Graphic), Wrenches

Local Sales Offices & Reps.

Ariz	Phoenix, Gramer & Co.	602-279-1221
Cal	El Segundo, Varigon & Assocs.	213-644-3611
Cal	Mountain View, Cindel, Inc.	415-965-2630
Cal	San Diego, Varigon & Assocs.	714-299-5413
Colo	Sedalia, Jensen Rep. Co.	303-688-4154
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Ga	Atlanta, Elmar Associates.	404-261-4345
Haw	Honolulu, Aloha Assocs.	808-941-1575
Ill	Des Plaines, Lincoln-Hodges	312-297-3810
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Norwell, Bordewieck Engineering & Sls. Co.	617-659-4915
Mich	Dearborn, Pitcher-Poulin, Inc.	313-582-5450
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Hazelwood, Techn. Representatives, Inc.	314-731-5200
NM	Albuquerque, Data Handling Co.	505-268-4364
NY	Mt. Vernon, Friedman-Smith	914-664-4866
NY	Syracuse, Advanced Comps.	315-699-2671
NC	Winston-Salem, Burgin-Kreh Assocs.	919-768-4174
Ohio	Brecksville, A. Nace Co.	216-526-4323
Ore	Portland, Western Tech. Sls.	503-297-1711
Pa	Pittsburgh, A. Nace Co.	412-922-7225
Pa	Willow Grove, Techparts	215-657-0100
Tex	Dallas, Ralph Matthews Elctrns.	214-233-0363
Tex	Houston, R. Matthews Elctrns.	713-664-7131
Va	Lynchburg, Burgin-Kreh Assocs.	804-845-5600
Wash	Bellevue, Western Tech. Sls.	206-641-3900
Wisc	Waukesha, Lincoln-Hodges	414-542-3087
FOR:	Can., Markham, Ontario, Audio Elctrns.	416-495-0720

Local Distributors

Cal	Hawthorne, Century Aero Corp., 12523 Crenshaw Blvd.	213-772-1166
Cal	Mountain View, Ratel Elctrns., 815 Maude Ave.	415-965-2010
Fla	Oakland Park, Peerless Radio Corp. of Fla., 1040 NE 43rd Ct.	305-566-5966
Ill	Westmont, Bodelle Co., 47 Chestnut La.	312-323-9670
Mass	Norwell, Bordewieck Elctrn. Supply Co., 427 Washington St.	617-659-4915

TECH-ETCH, INC., 10 Ind'l. Pk. Rd., Hingham, Mass., 02043, Tel: 617-749-0993; Empl.: 81; Minimum order: $75.

For info on price: R. Gurwitel; Application info: J. Kenworthy; Customer service: P. Thomas; Delivery info: R. Gurwitel

Products manufactured: Circuits, Flexible, Dials, Nameplates, Scales, Dial, Services, Assembly, Production & Test

TECH LABS., INC., Bergen & Edsall Blvds., Palisades Pk., N.J., 07650, Tel: 201-944-2221; Empl.: 65; Minimum order: $35 .... p. 1•2298,2299

For info on price: K. K. Garrison; Application info: A. Konrad; Customer service: C. Schulz; Delivery info: C. Schulz

Free literature available: Switch/attenuators (short form), Attenuator catalog (includes technical and application data), Program switch, Thumbwheel switches.

Products manufactured: Attenuators, Decade Boxes, Networks, Resistors, Switches

Local Sales Offices & Reps.

Ark	Magnolia, P. Jameson	501-234-3778
Cal	Encino, V/L Assocs.	213-986-9703
Cal	Palo Alto, Held & Mollard, Inc.	415-965-9321
Conn	Thomaston, Nelson-Bennett	203-283-5959
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Ga	Atlanta, Grady Duckett Sls.	404-451-3529
Ill	Glenview, Crimson Engrg. Co.	312-724-1780
Md	Baltimore, Whitcomb Assocs.	301-889-1245
Mass	Auburn, Nelson-Bennett	617-757-3131
Mich	Jackson, N. Scroggs Co.	517-750-1170
Minn	, Siedare Assocs.	612-533-2294
NJ	Haddonfield, F.W. Churchill	609-429-7871
NJ	Palisades Park, Tech. Labs.	201-944-2221

NY	Buffalo, R. A. Murray	716-632-6913
NY	Commack, L. K. Haner Assoc.	516-864-2220
Ohio	Cincinnati, A. C. Wahl & Assoc.	513-821-3270
Ohio	Lyndhurst, A. C. Wahl & Assoc.	216-449-1788
Pa	Pittsburgh, Waggoner-VerHill Assoc.	412-241-5202
Tex	Dallas, Southwest Elctrns.	214-233-9816
Tex	Houston, Southwest Elctrns.	713-729-1670

TECH MATERIALS INC., 5 Wellington Rd., Lincoln, R.I., 02865, Tel: 401-728-7200; Empl.: 75; Minimum order: $250

For info on price: P. Shaw; Application info: S. Hopp; Customer service: B. Allen; Delivery info: P. Shaw

Free literature available: 1. Handbook for Clad Metals - complete handbook on clad inlays and overlaps and their application. 2. Design Aid for Solder Clads - comprehensive treatment of toplay and overlay solder clads and their uses.

Products manufactured: Alloys, Metals, Seals

Local Sales Offices & Reps.

Cal	Los Angeles, E. J. Brookes Co.
Cal	Santa Clara, E. J. Brookes Co.
Ill	Zion, A. O. Capp Co.
Ind	Fort Wayne, J. C. Butler Sls, & Engrg.
Ind	Indianapolis, J. C. Butler Sls. & Engrg.
Ohio	Milford, J. C. Butler Sls. & Engrg.

TECH SERV., INC., BRS/LVE Div, 5301 Holland Dr., Beltsville, Md, 20705, Tel: 301-474-3400, TWX: 710-828-0515; Empl.: 110; Minimum order: $25

Customer service: P. D. Donahue

Free literature available: Animal Environment Electromechanical Control Solid State Control

Products manufactured: Cards, Logic, Computers, Controls/Control Eqpt., Converters, Counters, Drivers, Solenoid, Generators, Kits, Test Equipment, Modules, Logic, Encapsulated, Printers, Readers, Recorders, Timers

TECH SPRAY, INC., Box 949, Amarillo, Tex., 79105, Tel: 806-372-8523; Empl.: 20; Minimum order: $50

For info on price: P. Gunzelmau; Application info: T. Larson; Customer service: P. Gunzelman; Delivery info: P. Gunzelman

Free literature available: Catalog FP10 illustrated catalog with product descriptions, Mil Specs, Technical & Usage data.

Products manufactured: Cleaners & Solvents, Coatings, Lubricants

Local Sales Offices & Reps.

Cal	Burlingame, Carelli EMA	415-697-6286
Cal	La Selva Beach, Belchomber & French	408-722-0444
Cal	Van Nuys, A. Szerlip Sls. Co.	213-782-1765
Colo	Denver, McLoud & Raymond	303-756-1589
Fla	Tampa, Wallace Assoc.	813-961-1037
Ill	Chicago, B. Burns Assocs.	312-775-1233
Ind	Indianapolis, Electronic Reps.	317-897-9326
Mass	Lynn, Keene Sls.	617-595-2300
Mich	Milford, Polyphase Sls.	313-685-3003
Minn	Minneapolis, D. Barrett Co.	612-929-0028
Mo	Jefferson City, C. A. Vegrola	314-893-3205
NY	N. Bellmore, L. W. Keller Assoc.	516-785-2826
NY	Rochester, Maisey Sls.	716-442-9700
Ohio	Medina, T. Grant Assoc.	216-725-6528
Ore	Portland, J. V. BeLusko Co.	503-222-4279
Pa	Philadelphia, D. Linz Co.	215-379-0734
Tex	Dallas, Crockett Sls. Co.	214-748-8209
EXP:	Miami, Fla., Electronics Int'l.	305-635-8670
FOR:	Can., Dorval, Que., Superior Elctrns.	514-683-6331

TECHMAR CORP., 2232 Cotner Ave., Los Angeles, Cal., 90064, Tel: 213-478-0046; Empl.: 6 .... p. 1•96,97

Free literature available: 17-page catalog of rack-mounting kits & parts, PC card cages, portable instrument enclosures, mini-consoles, subassembly housings with & without heat sinks, power supplies, IC packaging system. Price list enclosed.

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Drawers, Sliding, Integrated Circuit Packaging Systems, Panels, Power Supplies, Racks

TECHNI-RITE ELCTRNS, see Recorder Systems Div.

TECHNI-TOOL, INC., Total Spectrum, Tool Supplier, Apollo Road, Plymouth Meeting, Pa., 19462, Tel: 215-825-4990, Telex: 834-763; Empl.: 20; Minimum order: $25

For info on price: J. Immediato; Application info: W. Bezar; Customer service: M. Sill; Delivery info: M. Hurley

Products manufactured: Adhesives (All Types), Burnishers, Contact, Clamps & Clips, Cleaners & Solvents, Cleaners, Ultrasonic, Coatings, Counters, Demagnetizers, Detectors, Drills & Accessories, Hand & Power, Drivers, Nut, Fiber Optic Bundles, Gages, Heat Guns, Production, Heat Sinks, Soldering, Holders, Circuit Board (Production Type), Jigs And Fixtures, Chassis & Circuit Board, Kits, Marking (Dial, Instrument, Equipment, etc.), Kits, Training Aid, Knives & Knife Sets, Lamps, Lubricants, Machines/Machinery, Production, Microscopes, Pliers, Probes, Pumps, Vacuum, Scissors, Screwdrivers, Slide Rules (Circuitry Computing), Solder Pots & Baths, Soldering Accessories, Soldering Equipment, Testers, Tools, Tweezers, Hand & Vacuum, Wire Twisters, Wrenches

Local Sales Offices & Reps.

Fla	Miami, N. Black Assocs.	305-651-4132
Mass	Burlington, Tekdata	617-273-0198
Mo	Kansas City, Nevco, Inc.	816-361-8290
NY	Shirley, Pacenter	516-281-3810
Ohio	Cincinnati, Modern Indl. Sls. Co.	513-542-6969
Pa	Upper Darby, J. J. Mahoney	215-734-1244
Utah	Salt Lake City, Technical Devices	801-486-6401

TECH. DEVICES CO., 11250 Playa Ct., Culver City, Calif., 90230, Tel: 213-870-3751; FSC No: 04772; Empl.: 21; Minimum order: $10

For info on price: J. Cochran; Application info: D. N. Winther; Customer service: J. Cochran; Delivery info: J. Cochran

Free literature available: MARK I WAVE SOLDERING MACHINE; MARK V LEAD FORMER; MARK IX LEAD TRIMMER; MARK II WIRE CUTTER & STRIPPER; MARK III CIRCUIT CARD FIXTURE.

Products manufactured: Holders, Circuit Board (Production Type), Machines/Machinery, Production, Soldering Equipment, Wire Strippers

Local Sales Offices & Reps.

Ark	Little Rock, Carlton-Bates	501-562-9100
Cal	Inglewood, Tracker, dba Weightman & Assocs.	213-645-6060
Cal	Menlo Park, West Engrg. Sls. Co.	415-325-2885
Colo	Denver, Todd-Associates, Inc.	303-744-2313
Fla	Orlando, Buchanan & Abrams Assocs., Inc.	305-423-8995
Fla	Orlando, W. B. Wimberly Co.	305-GA5-3083
Ill	Chicago, Ringland M. Krueger Co. Inc.	312-AV 2-8444
Ind	Indianapolis, Blind & Assocs., Inc.	317-251-1249
Kans	Lenexa, Smith-Williams Co.	913-TU 8-3995
Md	Phoenix, REBCO Sls.	301-592-8907
Mass	Woburn, R. W. Hatfield Co.	617-933-2324
Mich	Kentwood, The C.A. Geer Co.	616-534-7449
Minn	St. Paul, Sales Service Machine Tool Co.	612-MI 6-8663
NY	Farmingdale, Haines Prods., Inc.	516-420-1177
NY	Syracuse, M. C. Antil Jr. Co.	315-463-0266
Ohio	Cleveland, P. Lohse & Co.	216-381-4424
Pa	Lansdowne, W. F. Satterthwaite & Co.	215-623-5100
Tex	Dallas, R. E. Nesbitt Co.	214-FL 7-4601
Tex	Houston, R. E. Nesbitt Co.	713-224-3633
Wash	Seattle, Process Sys.	206-246-0224

TECHNICAL MAT'L., 700 Fenimore Rd., Mamaroneck, N.Y., 10543, Tel: 914-698-4800, TWX: 710-566-1100; Empl.: 250

Products manufactured: Amplifiers, Antennas, Cabinets & Accessories, Comm. Systems, Connectors, Converters, Cords, Couplers, Dummy Loads, Filters, Panels, Receivers, Synthesizers, Terminals, Transmitters

Local Sales Offices & Reps.

Ariz	Tempe, T.M.C. Sys.	602-967-7874
Ga	Atlanta, Scientific Sls. Co.	404-252-5360
Tex	Houston, Blackburn Assocs., Inc.	214-351-9991
Va	Springfield, T.M.C. Sys. & Power	703-354-7400
Wash	Seattle, Underwood & Underwood, Inc.	206-243-4853
EXP:	N.Y., Mamaroneck, T.M.C.	914-698-4800

TECHNICAL RESEARCH & MFG., INC., Kelly Ave. Grenier Field, R.F.D. #3, Manchester, N.H., 03103, Tel: 603-668-0120, TWX: 710-220-6785; Empl.: 25

Products manufactured: Amplifiers, Attenuators, CATV Systems & Equipment, Couplers, Detectors, Dividers, Drivers, Switch, Duplexers, Microwave, Impedance Converters, Microwave, Junctions, Hybrid, Microwave, Mixer-Preamplifiers, Microwave, Mixers, Multipliers, Receivers, Services, Assembly, Production & Test, Shifters, Strip-Line Components, Microwave, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, R F Assocs.	213-478-1586
Cal	Palo Alto, R F Assocs.	415-494-3331
Colo	Loveland, Kelley Assocs.	303-667-1376
Ill	Chicago, Technical Sls.	312-237-7210
Mass	Needham Hgts., Reptron	617-449-4141
Mo	St. Louis, G. Fixman Engrg. Co.	314-725-5219
NJ	Livingston, G & A Elctrns., Inc.	201-992-3087
Ohio	Cincinnati, Gallagher Co.	513-761-1288
Pa	Willow Grove, H. Nash Assocs.	215-657-2213
Tex	Houston, R. Martin Assocs.	713-462-4077
Va	Annandale, J. Hopkins Assocs.	703-323-1641
FOR:	Can., Montreal, 252, Que., Componetics Ltd.	514-342-4117

TECHNICAL WIRE PRODUCTS, INC., 129 E. Dermody St., Cranford, N.J., 07016, Tel: 201-272-5500, TWX: 710-996-5961; FSC No: 07700; Empl.: 101; Minimum order: $35

For info on price: R. S. Blank Ext. 39; Application info: J. Blazejewski Ext. 54; Customer service: R. S. Blank Ext. 39; Delivery info: R. S. Blank Ext. 39

Free literature available: A complete design guide describing tecknit's emi shielding and conductive materials and products.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Bezels, Shielded & Unshielded, Coatings, Conductive Plastic Materials, Connectors, Contacts, Electrical, Fabrics, Conductive, Gaskets, Shielding, R-F-Also See Shields, R-F, Honeycomb Sheets, Panels, etc., Kits, Shielding, Paints, Rubber, Shields

Local Sales Offices & Reps.

Ala	Huntsville, South Eastern Assocs., Inc.	205-539-9816
Ariz	Scottsdale, Williams Assocs., Inc.	602-947-4297
Cal	Los Alamitos, Heaton Co., Inc., J.S.	714-821-9600
Cal	Redwood City, Heaton Co., Inc., J.S.	415-369-4671
Cal	Santa Barbara, Technical Wire Products	805-963-1867
Colo	Denver, Williams Assocs., Inc.	303-373-4730
Conn	Enfield, Measurement Equip. Co.	203-745-9050
Fla	Altamonte Springs, WMM Assocs., Inc.	305-831-4645
Fla	Clearwater, WMM Assocs., Inc.	813-447-2533
Fla	Pompano Beach, WMM Assocs., Inc.	305-943-3091
Ill	Chicago, Angel & Co.	312-878-0653
Ind	Fort Wayne, Scott Electronics, Inc.	219-743-1586
Ind	Indianapolis, Scott Electronics, Inc.	317-897-9976
Md	Baltimore, Kaufholz Assocs.	301-488-6561
Mass	Wakefield, Measurement Equip. Co.	617-245-4870
Minn	St. Paul, Heyda Co., Bonament	612-484-8531
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Cranford, Technical Wire Prods., Inc.	201-272-5500
NM	Albuquerque, Williams Assocs., Inc.	505-255-1638
NY	Rochester, Murray, Inc., H.R.	716-244-1100
NY	Syracuse, Murray, Inc., H.R.	315-446-5555
NC	Raleigh, S & R Sls & Assocs.	919-876-2208
Ohio	Cleveland, Scott Electronics, Inc.	216-291-2600
Ohio	Columbus, Scott Electronics, Inc.	614-236-8619
Ohio	Dayton, Scott Electronics, Inc.	513-223-2652
Pa	Pittsburgh, Scott Electronics, Inc.	412-781-3112
Tex	Richardson, Corwin Assocs., Inc.	214-424-8333
Wash	Bellevue, Over Sales, Ray	206-454-9187
FOR:	Can., Toronto 392, Ont., Electrodesign Ltd.	416-787-0991
FOR:	Can., Vanier, Ont., Electrodesign Ltd.	613-745-0541
FOR:	Can., Ville La Salle 650, Que., Electrodesign Ltd.	514-363-5120

TECHNIPOWER, INC., Benrus Center, Ridgefield, Conn., 06877, Tel: 203-431-1300, TWX: 710-467-0666; FSC No: 13850; Empl.: 200 .... p. 1•1478,1479

For info on price: A. R. Saenz 203-431-1306; Application info: A. R. Saenz 203-431-1306; Customer service: J. Pease 203-431-1308

Free literature available: Design/Data catalog listing commercial, industrial, and mil qualified power supplies. Special sections devoted to extensive thermal data, NEMA terminology, and metric conversion tables.

Products manufactured: Chargers, Battery, Converters, Heat Exchangers & Systems, Inverters, Power Supplies

Local Sales Offices & Reps.

Cal	Pasadena, Luscombe Engrg.	213-684-2000
Cal	San Mateo, Luscombe Engrg.	415-342-7057
Colo	Denver, Electrodyne	303-757-7676
Conn	Meriden, A. Allison	203-237-9232
Fla	Ridgefield, Technipower	203-431-1300
Ill	Chicago, Allen Woods & Assoc.	312-283-7400
Kans	Overland Park, Ensco-Rep	913-381-7557
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	East Bridgewater, Abbott Allison	617-245-0250
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Minneapolis, R-J, Inc.	612-922-1425
Mo	St. Louis, Ensco-Rep, Inc.	314-567-3935
NM	Albuquerque, William J. Purdy Co.	505-266-7959
NY	Ridgefield, Technipower	203-431-1300
Ohio	Dayton, Sculley & Ingling	513-298-9575
Pa	Newtown Square, Holdsworth & Co.	215-356-8550
Pa	Pittsburgh, G.S. Root & Co.	412-561-4125
Tex	Houston, Scientific Sls.	713-666-5723
Tex	Richardson, Scientific Sls.	214-231-6541
Wash	Renton, Baxley-Wilson Co.	206-226-0650
EXP:	Can., Burlington, Ont., White Radio Ltd.	416-634-1845
EXP:	Can., Montreal, Que., White Radio Ltd.	514-482-8091

TECHINQUES, INC., 235 Jackson St., Englewood, N.J., 07631, Tel: 201-569-5900; Empl.: 60

Products manufactured: Boards, Printed Circuit, Etchants, Printed Circuit, Kits, Marking (Dial, Instrument, Equipment, etc.), Kits, Printed Circuit, Screens, Printed Circuit

Technitrol, Inc.

TECHNITROL, INC., 1952 E. Alleghany, Philadelphia, Pa., 19134, Tel: 215-426-9105; FSC No: 90095; Empl.: 350; Minimum order: $50 p. 1•466,467; p. 2•1810,1811

For info on price: Sls. Dept.; Application info: W. A. Chamberlin; Customer service: Sls. Dept.; Delivery info: Sls. Dept.

Free literature available: Transformer Handbook and Technical Notes - Describes and lists popular types of transformers, technical notes provide useful formulae. Delay Line Catalog - Lists popular delay lines and useful formulae. TTL Delay Module - Provides data on new dynamic TTL compatible delay module.

Model 4604 - Describes high speed memory tester Model 4603 - Describes versatile core memory exerciser Series 2000 Module Describes modules for build in house.

Products manufactured: Coils Including Assemblies & Forms, Delay Lines, Generators, Services, Assembly, Production & Test, Test Systems, Testers, Timers, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Q. T. Wiles	602-948-5590
Cal	Los Angeles, Q. T. Wiles	213-478-0183
Cal	San Diego, Q. T. Wiles	714-565-6897
Cal.	Tustin, Q. T. Wiles	714-832-4952
Colo	Denver, Comtech Inc.	303-756-6815
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Ill	Wauconda, Cudaly Sls.	312-526-2484
Mass	Burlington, Tek Data	617-273-0198
Mass	Newton, Normell Assoc.	617-969-5478
NY	Fairport, TAC Assoc.	716-377-1742
Pa	Philadelphia, Technitrol	215-426-9105
FOR:	Can., Brampton, Ont., Bagtronix Ltd.	416-453-1252
FOR:	Can., Montreal, Que., Bagtronix Ltd.	514-336-9242
FOR:	Can., Ottawa, Ont., Bagtronix Ltd.	613-728-0113

TECHNITROL, INC. cont'd

Advertisment

Technitrol has full capability for design, packaging, production of subminiature transformers; from stringent MIL-spec varieties to simple unencapsulated units, packaged singly or in multiples. A complete line of lumped parameter delay lines is available featuring new dynamic delay module with its TTC compatibility. The Technitrol Systems Division features a complete line of memory exercisers; core, platewire, semiconductor.

TECHNO-COMPS. CORP., 7803 Lemona, Van Nuys, Cal., 91405, Tel: 213-781-1642, TWX: 910-495-2015; FSC No: 17826; QPL No: Multiple; Empl.: 70; Minimum order: $50

For info on price: D. Ross; Application info: T. Hoerth; Customer service: R. Rosas; Delivery info: M. Eliasson

Free literature available: Short Form Catalog; Individual Data Sheets; QPL Qualification Sheets; Established Reliability Qualification Sheets; Three Ring Binder containing entire product line; Trimmer terms and definitions book

Products manufactured: Connectors, Potentiometers, Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Argus Sls.	602-967-8709
Cal	Inglewood, Oak Inds. Corp.	213-678-4108
Cal	Los Altos, Oak Inds. Corp.	415-941-1237
Fla	Orlando, Oak Inds. Corp.	305-671-4111
Ill	Chicago, Delta Tech. Sls.	312-437-9412
Kans	Leawood, H.C. Heyde Co.	913-649-8628
Md	Timonium, Marktron, Inc.	301-252-7111
Mass	Needham, A & M Elctrns.	617-444-8170
Mich	Farmington Hills, Sterling-Lowell Co.	313-581-7474
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
NJ	Haddonfield, T.M. Mills Co.	609-429-1005
NJ	Pompton Lakes, R. Horne Assoc.	201-835-7400
NY	No. Syracuse, Advanced Comps.	315-699-2671
Ohio	Centerville, EMA, Inc.	513-433-2800
Ore	Portland, Oak Industries	503-292-0878
Tex	Ft. Worth, W. Fralia	817-738-2394
EXP:	Colo., Denver, I. W. Strong	303-292-6900
FOR:	Can., Ottawa, Ont., E. G. Lomas	613-725-2177

Local Distributors

Cal	Los Angeles, Radio Products Sls., 1501 S. Hill	213-748-1271
Fla	Clearwater, Southland, 1771 N. Hercules	813-443-4514
NJ	Wayne, Gordon/Horne, 2282 Hamburg Tnpk.	201-835-7400
NY	N. Syracuse, ANDCO, Box 276	315-699-2671
Tex	Ft. Worth, Patco Supply, Box 12625	817-738-2394

TECHSONICS, Box 251, El Prado, N.M., 87529, Tel: 505-758-4555; Empl.: 10; Minimum order: $15

Customer service: A. E. Sowers

Free literature available: 0573 Son-Tector ultrasonic detectors 5072 Power converter information

Products manufactured: Analyzers, Converters, Detectors, Testers

TECNETICS, INC., 1624 Range St. Box 910, Boulder Industrial Park, Boulder, Colo., 80302, Tel: 303-442-3837, TWX: 910-940-3246; Empl.: 45 p. 1•1491-1496

For info on price: S. Broyles; Application info: V. Garrison; Customer service: S. Broyles; Delivery info: S. Broyles

Free literature available: 1975 Technetics catalog (available in Jan 75) DC-DC, AC (400 Hz) - DC power supplies.

Products manufactured: Converters, Power Supplies

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Comps., Inc.	205-539-4411
Ariz	Phoenix, C.T. Carlberg & Assocs.	602-997-0774
Cal	Inglewood, L & M Engrg.	213-674-6850
Cal	San Jose, L & M Engrg., Inc.	408-243-2891
Colo	Denver, Electro-Rep	303-744-2821
Conn	New Canaan, S. Pierce, Inc.	203-966-4630
Fla	Ft. Lauderdale, W.A. Brown Comps., Inc.	305-776-4800
Fla	Orlando, W.A. Brown Comps., Inc.	305-425-5505
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
Kans	Overland Park, Ensco-Rep, Inc.	913-381-7557
La	Gretna, W.A. Brown Comps., Inc.	504-368-5766
Md	Silver Spring, Eastern Instrumentation Corp.	301-681-6500
Mass	Norwood, S. Pierce, Inc.	617-762-3164
Mich	Royal Oak, Satullo Co.	313-549-3910
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
Mo	St. Louis, Ensco-Rep, Inc.	314-567-3935
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Fayetteville, M.P. Andrews, Inc.	315-637-3144
NY	Great Neck, Eastern Instrumentation	516-466-9505
NC	Winston-Salem, W.A. Brown Comps., Inc.	919-725-5384
Ohio	Cleveland, Satullo Co.	216-486-2800
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
Tex	Dallas, R.R. Thomas Co.	214-363-8591
Wash	Seattle, R.S. Drake Assocs.	206-763-2755

TED CORPORATION, 11415 Johnson Dr., Shawnee Mission, Kans., 66203, Tel: 913-631-6211; FSC No: 05209; Minimum order: $12

For info on price: R. H. Zehr; Application info: D. J. Patrick; Customer service: C. J. Smith; Delivery info: D. J. Patrick

Products manufactured: Connectors

Local Sales Offices & Reps.

Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Kans	Shawnee, J.F. Guernsey Co.	913-631-2414
NY	West Babylon, G. Newman	516-643-2220
Pa	Oreland, Brown-Oberlies	215-887-1325

TEK-WAVES, INC., See Frequency Elctrns.

TEKELEC, INC., 2623 Saddle Ave., Oxnard, Cal., 93030, Tel: 805-485-5445, TWX: 910-336-1280; Empl.: 60; Minimum order: $25

For info on price: P. McFarland; Application info: P. Wasserman; Customer service: P. McFarland; Delivery info: P. McFarland

Free literature available: Engineering Unit Digital Panel Meters; TA300 Series Digital Panel Meters; TA365 4 1/2 Digit Digital Multimeter; TA355 & TA356 3 1/2 Digital Multimeters; TA357 Digital Multimeter; "Which LCD is Best" A selection guide for liquid crystal displays; "Report on Digital Voltmeters".

Products manufactured: Converters, Meters, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, RDX Corp.	
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-734-4500
Colo	Arvada, Arrowhead Sls.	303-423-5556
Fla	Orlando, Gra Mar	305-894-3351
Ill	Chicago, Scientific Sls.	312-775-7594
Ind	Indianapolis, Scientific Sls.	317-253-4606
Kans	Leawood, Leemark Engineers	913-648-0124
Md	Silver Springs, Q.E.D. Elctrns.	301-588-8134
Mass	Newton Centre, Daner Hayes	617-969-4650
Mich	Dearborne, Villani-Pitcher	313-271-4600
Minn	Bloomington, Scientific Sls.	612-881-0668
NJ	Parlin, JMR Sls.	201-727-5335
NY	Jamaica, JMR Sls.	212-658-8881
Ohio	Cleveland, Arthur Baier Co. & Assocs.	216-461-6161
Ohio	Dayton, Arthur Baier Co. & Assocs.	513-276-4128
Pa	Abington, Bach-Stewart	215-885-1550
Tex	Houston, Enviromation	613-526-6872
Utah	Salt Lake City, Arrowhead Sls.	801-487-4716
Wash	Seattle, Underwood Jensen & Assoc.	206-575-0123
FOR:	Can., Kanata, Ont., Kenwood Controls	613-836-4202
FOR:	Can., Montreal, Que., Kenwood Controls	514-738-4969
FOR:	Can., St. Catherines, Ont., Kenwood Controls	416-278-2701

TEKELEC INC., 2623 Saddle Dr., Oxnard, Cal., 93030, Tel: 805-485-5445, TWX: 910-336-1280; Empl.: 102; Minimum order: $25 p. 1•815; p. 2•1205

For info on price: M. Thompson; Application info: P. D. Wasserman; Customer service: P. McFarland; Delivery info: P. McFarland

Directory of Local Distributors Starts on page 401

Free literature available: Digital Panel Meters - TA300 Series - Price Sheet, TEKELEC Digital Panel Meters Brochure, TEKELEC Engineering Unit Digital Panel Meters Brochure, "Which LCD is best?" - Liquid Crystal Display Article, TEKELEC Digital Multimeters - Price Sheet, TEKELEC 3 1/2 Digit Multimeters Brochure - Model TA355 and TA356, TEKELEC 3 1/2 Digit Multimeters Brochure - Multex - Model TA357, TEKELEC 4 1/2 Digit Multimeters Brochure - Model TA365, Report on Digital Voltmeters Article, Business Reply Card.

Products manufactured: Converters, Display Devices/Displays, Meters, Monitors

Local Sales Offices & Reps.

Cal	Pasadena, RDX Corp.	213-681-3451
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-734-4500
Colo	Arvada, Arrowhead Sls.	303-423-5556
Fla	Orlando, Gra-Mar	305-894-3351
Ill	Chicago, Scientific Sls. Corp.	312-775-7594
Ind	Indianapolis, Scientific Sls. Corp.	317-253-4606
Kans	Leawood, Leemack Engs., Inc.	913-648-0124
Md	Silver Spring, Q.E.D. Elctrns.	301-588-8134
Mass	Newton Centre, Daner-Hayes	617-969-4650
Mich	Dearborn, Villani-Pitcher	313-271-4600
Minn	Bloomington, Scientific Sls. Corp.	612-8[illegible]1-0668
NJ	Parlin, JMR Engrg. Sls.	201-727-5335
NY	Jamaica, JMR Engrg. Sls.	212-658-8881
Ohio	Cleveland, A.H. Baier Co. & Assoc.	216-461-6161
Ohio	Dayton, A.H. Baier Co. & Assoc.	513-276-4128
Pa	Abington, Bach-Stewart	215-885-1550
Tex	Houston, Environmation	713-526-6872
Utah	Salt Lake City, Arrowhead Sls.	801-487-4716
Wash	Seattle, Underwood & Underwood	206-243-2133
Wash	Seattle, Underwood Jensen & Assocs.	206-575-0123
FOR:	Can., Ottowa, Ont., Kenwood Controls	416-544-0596

TEKTRONIX, INC., Box 500, Beaverton, Ore., 97077, Tel: 503-644-0161, TWX: 910-467-8708; Empl.: 11500

Products manufactured: Amplifiers, Analyzers, Cable Fault Locators, Calculators, Electrical & Electronic, Cameras, Carts & Dollies, Instrument & Equipment, Comparators, Converters, Cords, Counters, Current Sensors, Data Acquisition & Reduction Systems, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Display Devices/Displays, Filters, Generators, Memory Systems, Meters, Monitors, Multiplexers, Oscillators, Oscilloscope Plug-Ins, Oscilloscopes, Perforators, Power Supplies, Probes, Recorders, Services, Assembly, Production & Test, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Test Equipment, Test Systems, Testers, Tracers, Curve, Viewing Hoods, Cathode Ray Tube

Local Sales Offices & Reps.

Ala	Huntsville	205-881-2912
Ariz	Phoenix	602-244-9795
Cal	Concord	415-687-8350
Cal	Irvine	213-778-5225
Cal	San Diego	714-292-7330
Cal	Santa Clara	408-249-5500
Cal	Van Nuys	213-987-2600
Colo	Denver	303-771-8012
Conn	Milford	203-877-1494
Fla	Fort Lauderdale	305-731-1220
Fla	Orlando	305-894-3911
Fla	Pensacola	904-476-1897
Ga	Atlanta	404-451-7241
Haw	Honolulu	808-847-1138
Ill	Chicago	312-593-2830
Ind	Indianapolis	317-546-2408
Kans	Kansas City	913-262-8770
La	New Orleans	504-837-8454
Md	Baltimore	301-321-7000
Md	Rockville	301-948-7151
Mass	Boston	617-890-4550
Mich	Detroit	313-358-3122
Minn	St. Paul	612-484-8571
Mo	St. Louis	314-731-4696
NJ	Springfield	201-379-1670
NM	Albuquerque	505-268-3373
NY	Albany	518-785-3353
NY	Long Island	516-364-9060
NY	Poughkeepsie	914-454-7540
NY	Rochester	716-244-2600
NY	Syracuse	315-455-6661
NC	Raleigh	919-782-5624
Ohio	Cleveland	216-884-6558
Ohio	Columbus	614-888-4040
Ohio	Dayton	513-859-3681
Okla	Oklahoma City	405-848-3361
Ore	Portland	503-639-7691
Pa	Fort Washington	215-542-1440
Pa	Pittsburgh	412-373-3250
Tex	Dallas	214-233-7791
Tex	Houston	713-783-1910
Tex	San Antonio	512-736-2641
Utah	Salt Lake City	801-484-8501
Va	Hampton	804-826-4020
Wash	Seattle	206-575-0180

TEL LABS, INC., 1050 Second St., Manchester, N.H., 03102, Tel: 603-625-8994, TWX: 710-220-1844; FSC No: 94322; QPL No: Multiple; Empl.: 180; Minimum order: $10 .... p. 2•1688-1691

For info on price: G. Steady; Application info: G. Steady; Customer service: C. Whittaker; Delivery info: C. Whittaker

Free literature available: Full line catalogue covering fixed wirewound resistors. Catalogue covers both precision and power resistors.

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrn. Sls.	205-881-5031
Ariz	Phoenix, MR Engrg. Sls. Co.	602-959-5150
Cal	Mountain View, West/Mark Assocs.	415-969-1700
Cal	Palos Verdes Estates, Schulman & Assocs.	213-373-6564
Colo	Denver, West/Mark Assocs.	303-433-7181
Conn	Madison, A & M Elctrn. Rep.	203-421-4242
Fla	Ft. Lauderdale, Beacon Elctrn. Assocs.	305-776-6074
Fla	Maitland, Beacon Elctrn. Assocs.	305-647-3498
Ga	Atlanta, Beacon Elctrn. Assocs.	404-351-3654
Ill	Northfield, Feller Assocs.	312-446-8065
Mass	Needham, A & M Elctrn. Rep.	617-444-8170
Miss	Hernando, Beacon Elctrn. Sls.	601-368-9008
NJ	Collingswood, K. Randall Co.	609-854-3323
NJ	Dumont, Rand Assocs.	201-385-7447
NY	Buffalo, Ossmann Comp. Sls. Corp.	716-832-4271
NY	Kingston, Ossmann Comp. Sls. Corp.	914-338-5505
NY	Plainview, Rand Assocs.	516-420-8989
NY	Rochester, Ossmann Comp. Sls. Corp.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls. Corp.	315-454-4477
NY	Vestal, Ossmann Comp. Sls. Corp.	607-785-9949
NC	Greensboro, Beacon Elctrn. Sls.	919-674-9432
Ohio	Cleveland, Weschler Elec. Corp.	216-251-4609
Ohio	Dayton, Weschler Elec. Corp.	513-274-6972
SC	Spartanburg, Beacon Elctrn. Assocs.	803-582-4613
Tex	Richardson, Unidyne, Inc.	214-234-3050
Tex	Stafford, Unidyne, Inc.	713-494-6027

TELAUTOGRAPH CORP., 8700 Bellanca Ave., Los Angeles, Cal., 90045, Tel: 213-776-5022, TWX: 910-328-6117; Empl.: 300; Minimum order: $50

Customer service: W. Kelker

Free literature available: Brochure "The Telephone That Writes" Describes Telepen Communications System.

Products manufactured: Comm. Systems, Paper, Graphic Recording

Local Sales Offices & Reps.

Cal	Los Angeles	213-776-3556
Cal	San Francisco	
Ga	Atlanta	404-636-3194
Ill	Chicago	312-622-7111
La	New Orleans	504-282-4635
Mich	Detroit	313-275-4220
NJ	Clifton	201-772-2740
Tex	Houston	713-688-9505
EXP:	Los Angeles, Cal.	213-776-5022

TELE-DYNAMICS/WANLASS, Div. of AMBAC, 525 Virginia Dr., Ft. Washington, Pa., 19034, Tel: 215-643-6161, TWX: 510-661-0654; Empl.: 400 p. 1•1480-1489

Products manufactured: Power Supplies, Regulators

Local Sales Offices & Reps.

Cal	El Segundo, Tele-Dynamics	213-640-0785
Cal	Encino, V & L Assoc.	213-986-9703
Cal	Palo Alto, Testco, Inc.	415-494-2011
Cal	San Diego, Earle Assoc.	714-278-5441
Colo	Denver, D. E. Bond Assoc.	303-756-1234
Conn	Washington Depot, Kanan Assocs.	203-868-0513
DC	Washington, Wright Co.	301-948-5151
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Ill	Downers Grove, Richmar Elctrns.	312-968-0118
Ind	Ft. Wayne, Temple Engrg. Sls., Inc.	219-744-4331
Kans	Wichita, Dy-Tronix, Inc.	316-943-6221
Md	Gaithersburg, Wright Co.	301-948-5151
Mass	Reading, Kanan Assocs.	617-944-8484
Mich	Dearborn, Pitcher-Poulin, Inc.	313-582-5450
Minn	Minneapolis, Elctrn. Innovators Inc.	612-888-5000
Mo	Hazelwood, Dy-Tronix, Inc.	314-731-5799
Mo	Kansas City, Dy-Tronix, Inc.	816-761-6543
NJ	Parlin, JMR Sls., Inc.	201-727-5335
NM	Albuquerque, Trembly Assoc.	505-293-4444
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	Jamaica, JMR Sls. Inc.	212-658-8881
NY	Rochester, Telesco Assocs.	716-271-3780
NY	Syracuse, R.F. Lamb Co.	315-454-2469
NC	Charlotte, Reynolds & Assoc.	704-527-2536
Ohio	Cleveland, Instrumentation Sys., Inc.	216-486-0782
Ohio	Dayton, Instrumentation Sys., Inc.	513-294-2838
Pa	Glenside, Elcom, Inc.	215-885-1715
Pa	Pittsburgh, Instrumentation Sys., Inc.	412-243-1111
Tex	Houston, Spectra sls.	713-524-7800
Tex	Richardson, Spectra Sls. Corp.	214-234-3600
Wash	Bellevue, Testco, Inc.	206-454-7422
Wisc	Oak Creek, Richmar Elctrns.	414-475-0414

Local Distributors

Ala	Birmingham, Allied Electronics, 2900 Bessemer Rd.	205-787-1408
Ala	Huntsville, Cramer/EW Huntsville, 2310 Bob Wallace Ave. S.W.	205-539-5722
Ariz	Phoenix, Cramer Electronics, Inc., 2643 E. University Dr.	602-267-7321
Cal	Brisbane, Newark Electronics, 440 Valley Dr.	415-468-2900
Cal	El Segundo, T.I. Supply, 831 Douglas St.	213-776-4490
Cal	Garden Grove, Allied Electronics, 12311 Industry St.	213-598-8671
Cal	Goleta, RPS, Suite E, 350 S. Kellogg Ave.	805-964-4764
Cal	Inglewood, Newark Electronics, 4747 W. Century Blvd.	213-678-0441
Cal	Irvine, Cramer/Los Angeles, 17201 Daimler St.	714-979-3000
Cal	Los Angeles, RPS, 1501 South Hill St.	213-748-1271
Cal	Palo Alto, Testco, 941 Charleston Rd.	415-326-5320
Cal	Palo Alto, Zack Electronics, 654 High St.	415-326-5432
Cal	San Diego, Cramer/San Diego, 8913 Complex Dr.	714-565-1881
Cal	San Diego, RPS, 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	San Francisco, Zack Electronics, 1444 Market St.	415-626-1444
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Cal	Sunnyvale, T.I. Supply, 776 Palomar Ave.	408-732-5555
Cal	Van Nuys, Patane Avionics, Inc., 5937 Kester Ave.	213-988-4455
Colo	Denver, Cramer/Denver, 5465 E. Evans Pl.	303-758-2100
Colo	Denver, Newark Electronics, 2170 S. Grape St.	303-757-3351
Colo	Denver, T.I. Supply, 9725 E. Hampden Ave.	303-751-1780
Conn	Bethel, Pioneer/New England, 154 Greenwood Ave.	203-792-1182
Conn	North Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Conn	Westport, Newark Electronics, 25 Sylvan Road S.	203-226-6921
Fla	Fort Lauderdale, Allied Electronics, 800 N.W. 57th Ct.	305-772-6464
Fla	Fort Lauderdale, Newark Electronics, 1360 N.W. 65th St.	305-587-2372
Fla	Hollywood, Cramer/EW Hollywood, 4035 N. 29th Ave.	305-923-8181
Fla	Orlando, Cramer/EW Orlando, 345 N. Graham Ave.	305-894-1511
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Ind'l Court	404-448-9050
Ill	Arlington Hts., T.I. Supply, 2420 E. Oakton Rd.	312-593-7660
Ill	Chicago, Newark Electronics, 500 N. Pulaski Rd.	312-638-4411
Ill	Elgin, Allied Electronics, 1355 Sleepy Hollow Rd.	312-697-8200

Directory of Local Distributors Starts on page 401

Ill Mt. Prospect, Cramer/Chicago, 1911 S. Busse Rd. 312-593-8230
Ind Indianapolis, Pioneer/Indiana, 6408 Castleplace Dr. 317-849-7300
Iowa Cedar Rapids, Newark Electronics, 1019 First Ave., S.W. 319-362-1171
Iowa Davenport, Allied Elctrns., 1205 E. River Dr. 319-323-8051
La Alexandria, Ralph's of Lafayette, 601 N. Third St. 318-443-4517
La Baton Rouge, Ralph's of Lafayette, 1732 Plank Rd. 504-344-8114
La Lafayette, Ralph's of Lafayette, 3004 Cameron St. 315-234-4507
La Lake Charles, Ralph's of Lafayette, 911 Fourth Ave. 318-439-2493
La Morgan City, Ralph's of Lafayette, 715 Brashear St. 504-384-9831
La New Iberia, Ralph's of Lafayette, 1900 E. Main St. 318-369-9816
Me Falmouth, Allied Electronics, Falmouth Shopping Center 207-781-2866
Md Beltsville, Newark Electronics, 10440 Baltimore Ave. 301-937-5085
Md Gaithersburg, Cramer/EW Wash., 16021 Industrial Dr. 301-948-0110
Md Gaithersburg, Pioneer Standard, 9100 Gaither Rd. 301-948-0710
Md Hanover, Cramer/EW Baltimore, 7255 Standard Dr. 301-796-5790
Md Rockville, Wilshire Elctrns./Wash., 1037 Taft St. 301-340-7900
Mass Braintree, Allied Electronics, One Century Circle, Campanelli Ind'l Park 617-848-4150
Mass Newton, Cramer/Newton, 85 Wells Ave. 617-969-7700
Mass Waltham, T.I. Supply, 504 Totten Pond Rd. 617-890-0510
Mass Woburn, Newark Electronics, 13A Wheeling Ave. 617-935-8350
Mich Livonia, Cramer/Detroit, 13193 Wayne Rd. 313-425-7000
Mich Livonia, Pioneer Standard, 13485 Stamford 313-525-1800
Mich Oak Park, Newark Electronics, 20700 Hubbell Ave. 313-548-0250
Mich Wyoming, Newark Electronics, 3645 Linden Ave. S.E. 616-241-6681
Minn Edina, Cramer/Bonn, 7275 Bush Lake Rd. 612-827-3541
Minn Edina, T.I. Supply, 7615 Metro Blvd., Suite 202 612-835-5353
Minn Minneapolis, Harry Stark's, 112 Third Ave. N. 612-332-1325
Minn Minneapolis, Newark Electronics, 336 Hoover St. N.E. 612-331-6350
Miss Pascagoula, Ralph's of Lafayette, 2112 Ingalis Ave. 601-769-1672
Mo Kansas City, T.I. Supply 816-753-4750
Mo St. Louis, Olive Industrial Elctrns., 6662 Olive Blvd. 314-863-7800
Neb Omaha, Allied Electronics, 625 N. 18th St. 402-341-7700
NJ Cherry Hill, Cramer/Pa., 12 Springdale Rd. 609-424-5993
NJ Clark, T.I. Supply, 301 Central Ave. 201-382-6400
NJ Kenilworth, Newark Electronics, 303 Monroe Ave. 201-272-8410
NJ Moonachie, Cramer/N.J., 1 Barrett Ave. 201-935-5600
NJ Moorestown, Arrow/Angus, Pleasant Valley Ave. 609-235-1900
NJ Pennsauken, Cramer Electronics, 7300 Route 130 North 609-662-5061
NM Albuquerque, Cramer/New Mexico, 137 Vermont N.E. 505-265-5767
NM Albuquerque, Newark Electronics 505-296-9495
NY Buffalo, Summit Distributors, 916 Maine St. 716-884-3450
NY East Syracuse, Cramer/Syracuse, 6716 Joy Rd. 315-437-6671
NY Endwell, Cramer/Binghamton, 3220 Watson Blvd. 607-754-6661
NY Fishkill, T.I. Supply 914-896-9630
NY Hauppauge, Cramer/L.I., 29 Oser Ave. 516-231-5600
NY Huntington Station, T.I. Supply, 2 Huntington Quad. 2NO4-Suite 516-293-2660
NY Plainview, Newark Electronics, 80 Express St. 516-822-5000
NY Rochester, Cramer/Rochester, 3000 S. Winton Rd. 716-473-6600
NY Rochester, Summit Distributors, 292 Commerce Dr. 716-334-8110
NC Greensboro, Pioneer/Carolina, 2906 Baltic Ave. 919-273-4441
NC Winston-Salem, Cramer/EW Winston-Salem, 938 Burke St. 919-725-8711
Ohio Cincinnati, Cramer/Tri-States, 666 Redna Terrace 513-771-6441
Ohio Cincinnati, Newark Electronics, 9799-G Princeton Rd. 513-874-5115
Ohio Cleveland, Cramer/Cleveland, 5835 Harper Rd. 216-248-8400
Ohio Cleveland, Newark Electronics, 2028 E. 46th St. 216-361-4700
Ohio Cleveland, Pioneer Standard, Box 05100, 4800 E. 131 St. 216-587-3600
Ohio Dayton, Pioneer Standard, 1900 Troy St. 513-236-9900
Okla Tulsa, T.I. Supply, Drawer "T", Admiral Station 918-437-4555
Pa Horsham, Pioneer/Pa., 203 Witmer Rd. 215-674-5710
Pa Monroeville, Cramer/Pittsburgh, 616 Beatty Dr.
Pa Philadelphia, Allied Electronics, 3707-11 N. Broad St. 215-229-1880
Pa Philadelphia, Philadelphia Electronics, 112 North 12th St. 215-568-7400
Pa Pittsburgh, Pioneer Standard, 560 Alpha Dr. 412-782-2300
Pa Reading, Allied Electronics, 333 N. Fourth St. 215-376-7451
Tex Austin, T.I. Supply, Box 2909, 2601 N. Lamar 512-258-1636
Tex Beaumont, Ralph's of Lafayette, 1293 Broadway 713-833-9443
Tex Dallas, Cramer/Texas, 13740 Midway Rd. 214-350-1355
Tex Dallas, T.I. Supply, 6000 Denton Dr. 214-238-6821
Tex Fort Worth, Allied Electronics, 401 E. 8th St. 817-336-5401
Tex Garland, Newark Electronics, 707 Easy St. 214-271-2511
Tex Houston, Newark Electronics, 6902 Harwin Dr. 713-782-4800
Tex Houston, Ralph's of Lafayette, 4400 S. Wayside Dr. 713-641-0267
Tex Houston, T.I. Supply, 3939 Ann Arbor Dr. 713-785-4800
Utah Salt Lake City, Allied Electronics, 350 Pierpoint Ave. 801-328-2075
Utah Salt Lake City, Cramer/Utah, 391 W. 2500 South 801-487-3681
Utah Salt Lake City, Newark Electronics, 2540 S. 300 West 801-486-1048
Va Arlington, T.I. Supply, 1500 Wilson Blvd., AM Bldg., Suite 616 703-524-5885
Wash Bellevue, Testco, 10845 N.E. 8th 206-454-7422
Wash Seattle, Cramer/Seattle, 5602 6th Ave. S. 206-762-5755
Wisc Brookfield, Newark Electronics, 3695 N. 126th St. 414-781-2450
Wisc Oak Creek, Cramer/Wisconsin, 430 W. Rawson Ave.
For: Can., Downsview, Ont., Cramer Electronics/Canada, 920 Alness St., Unit #9 416-661-9222

TELECOMMUNICATIONS INDUSTRIES, 1375 Akron St., Copiague, N.Y., 11726, Tel: 516-842-5000, Telex: 144631; Empl.: 150 .... p. 1•2301

Products manufactured: Arresters, Electrical Surge, Lightning, Discharge Systems, Energy, Suppressors, Testers

Local Sales Offices & Reps.
Ga Atlanta 404-394-2754
Mo Kansas City 816-756-0055

TELECTRO SYS. CORP., 96-18 43rd Ave., Corona, N.Y., 11368, Tel: 212-651-8900; Empl.: 65

Products manufactured: Alarms, Amplifiers, Blowers & Fans & Accessories, Coils Including Assemblies & Forms, Comm. Systems, Computers, Duplicators, Preselectors, Recorders, Tape Recording Accessories, Tape Search Equipment, Tape Winders, Television Systems & Equipment Closed-Circuit, Test Equipment, Testers

TELEDYNE AEROSPACE SYSTEMS, 1007 E. 10th St., Fairmont, Minn., 56031, Tel: 507-235-3355, TWX: 910-565-2120; FSC No: 24600; Empl.: 50; Minimum order: $75

For info on price: R. L. Johnson; Application info: D. Lewis; Customer service: R. L. Johnson; Delivery info: T. Olson

Free literature available: Custom electrical interconnection cable and harness systems and sub systems.

Products manufactured: Cable Assemblies & Harnesses, Cable, Services, Assembly, Production & Test

Local Sales Offices & Reps.
Ala Huntsville, Repcom 205-534-9959
Cal Millbrae, Ashby Assocs. of No. Cal. 415-692-4442
Fla Melbourne, Repcom 305-254-1877
Ga Warner Robins, O. C. Bowman 912-923-1393
Md Bethesda, Warren Mount Co. 301-657-9312
Mass Weston, J. Goode Assoc. 617-235-3900
Minn Minneapolis, P. Ericson & Assocs. 612-884-1969
NJ Somerville, J & L Assocs. 201-722-0682
Ohio Dayton, Ashby Assocs. Inc. of Ohio 513-252-5627
Pa Jenkintown, Warren Mount Co. 215-886-0383
Tex Richardson, Zonk Engrg. 214-238-7651

TELEDYNE BIG BEAM, 290 E. Prairie St., Crystal Lake, Ill., 60014, Tel: 815-459-6100, Telex: 72-2460

Customer service: Cust. Svc.

Free literature available: Emergency Lighting Equipment 48 pages; Portable Lighting Equipment Personal 4 pages; Service 4 pages; Photo/News Releases.

Products manufactured: Batteries, Chargers, Battery, Flashers, Flashlights & Lanterns, Kits, Power Supply, Lighting Equipment, Emergency, Power Supplies

Local Sales Offices & Reps.
Ala Birmingham, C. Fedorenchik 205-592-4692
Ariz Little Rock, Byron Carson Co. 501-568-3342
Ariz Phoenix, R.A. Young of Arizona, Inc. 602-274-3576
Cal Cerritos, E. L. Steensen Assocs. 213-921-8686
Cal San Carlos, Lumineering Sales/Service 415-592-3008
Colo Denver, I. W. Strong & Assocs., Inc. 303-292-6900
Fla Orlando, Ralston-Lowe-Murray, Inc. 305-896-3713
Fla St. Petersburg, Ralston-Lowe-Murray, Inc. 813-821-0243
Ga Atlanta, Southeast Techsales Co. Inc. 404-355-7021
Ill Lincolnwood, Tilkin & Cagen Associates 312-676-0382
Ind Indianapolis, Tilkin & Cagen Assocs. 317-925-7776
Iowa Dubuque, Bill Vahl Lighting Sls. 319-582-6304
Kans Kansas City, Conrad Co. Inc. 913-621-3021
Ky Jeffersontown, A.L. Pickens Co. 502-491-4215
La New Orleans, United Sales Assocs., Inc. 504-733-8711
Md Catonsville, T. G. Weinstein Co. 301-788-3636
Mass Marblehead, Sands/Barnard Assocs. 617-631-7533
Mich Grosse Pointe Park, J. L. Miner Assocs. 313-886-5878
Minn Minneapolis, P. Ohlin Sls. Co. 612-929-6924
Miss Jackson, United Sales Assocs., Inc. 601-956-2406
Mo St. Louis, A. Haumesser Co. 314-781-1225
NH Merrimack, Sands/Barnard Assocs. 603-424-2702
NJ Teaneck, T. G. Weinstein Co. 201-836-1033
NY Syracuse, Upstate Lighting Fixtures Sls. 315-455-5821
NC Charlotte, C. M. Furman Co. 704-375-2332
Ohio Cincinnati, Redmond-Lewis & Assocs. 513-931-5060
Ohio Cleveland, Miller-Curtis Assocs., Inc. 216-749-0040
Okla Oklahoma City, C. B. Anderson Electric Co. 405-235-0716
Okla Tulsa, C. B. Anderson Electric Co. 918-836-4661
Ore Portland, A. Shaw Co. 503-235-0545
Pa Pittsburgh, Gormley Elect. 412-371-4111
Tenn Memphis, B. Carson Co. 901-396-4553
Tex Amarillo, C. B. Anderson Electric Co. 806-376-6443
Tex Corpus Christi, G & E Sls. 512-855-2606
Tex Dallas, Adra Elec. 214-522-3940
Tex Houston, Lighting & Electrical Sls. Co., Inc. 713-923-7781
Wisc West Allis, R. S. Knoblauch & Associates 414-421-2120

TELEDYNE CAMERA SYS., 131 N. Fifth Ave., Arcadia, Cal., 91006, Tel: 213-359-6691, Telex: 67-5423; Empl.: 96; Minimum order: $50

For info on price: D. M. Richichi Ext. 272; Customer service: D. M. Richichi Ext. 272; Delivery info: S. Jackman Ext. 248

Products manufactured: Cameras, Television Systems & Equipment Closed-Circuit

TELETYPE CORP., 5555 Touhy Ave., Skokie, Ill., 60076, Tel: 312-982-2000, TWX: 910-223-3611; FSC No: 59433; Empl.: 6000

Customer service: M. A. Pedote 312-982-3370

Products manufactured: Comm. Systems, Readers, Teleprinters, Teletypewriters & Equipment, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	City of Commerce	213-724-6040
NJ	Fairfield	201-575-8240

TELEDYNE-CRYSTALONICS, 147 Sherman St., Cambridge, Mass., 02140, Tel: 617-491-1670, TWX: 710-320-1196; FSC No: 12498; QPL No: Multiple; Empl.: 155; Minimum order: $50

For info on price: T. J. Paradise; Application info: R. Antalik; Customer service: B. Kilgarriff; Delivery info: B. Kilgarriff

Products manufactured: Diodes, Integrated Circuit Devices, Relays, Switches, Transistors

Local Sales Offices & Reps.

Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Marina Del Ray, Westaironics Inc.	213-821-7958
Cal	San Carlos, Kottmeir Assoc.	415-592-8333
Fla	Orlando, R. Simmons	305-831-8688
Fla	Plantation, W. Popnick	305-941-5544
Fla	Pompano Beach, V.G. Sls.	305-941-5544
Ill	Palatine, C & C Electronics	312-358-8900
Ind	Ft. Wayne, T.X. Sls.	219-489-4447
Md	Rockville, Mechtronics Sls.	301-340-2130
Mass	Brookline, Technology Prod. Group	617-731-0858
Minn	St. Paul, R.G. Ragon	612-488-0201
NJ	Newfoundland, S. Tobol	201-697-4383
NJ	Wallington, Comp-Tech Sls.	201-935-5454
NY	New Hyde Park, Comp-Tech Sls.	516-593-2628
NY	Rochester, J. Semple Assoc.	716-342-1413
Ohio	Dayton, R.P. Calhoun	513-299-6894
Pa	Bala Cynwd, Vantage Sls.	215-667-0990
SC	Greenville, Electronic Mktg. Assoc.	803-268-1125
Wash	Bellevue, SD-R&S2	206-747-9424
FOR:	Can. Montreal, Que., Cantronics (Que.)	514-341-5207
FOR:	Can., Downsview, Ont., Cantronics Ltd.	416-661-2494

TELEDYNE/GEOTECH, Box 28277, Dallas, Tex., 75228, Tel: 214-271-2561, Telex: 73-2394; FSC No: 99019; Empl.: 440; Minimum order: $50 .... p. 1•470

Customer service: G. Gerlach

Free literature available: Complete line of meteorological, geophysical, and intrusion sensors and processors; complete data acquisition and control systems for the pipeline industry.

Products manufactured: Accelerometers, Alarms, Amplifiers, Calibrators, Cells, Load, Comm. Systems, Data Acquisition & Reduction Systems, Data Loggers, Heads, Recording Playback, Erase, Multiplexers, Oscillators, Radiometers, Recorders, Transducers

TELEDYNE INET, 711 Knox St., Gardena, Cal., 90248, Tel: 213-327-0913, Telex: 67-7228

For info on price: M. Beguelin; Application info: M. Beguelin; Customer service: J. Marshall; Delivery info: M. Beguelin

Free literature available: Describes our Uninterruptible Power Systems, Electric Motor Generator sets, solid state Frequency Convertors, Line Voltage Regulators, and motor speed controls.

Products manufactured: Controls/Control Eqpt., Converters, Generators, Inverters, Motor Electric Generator Sets, Power Supplies, Regulators

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs	205-536-9990
Ariz	Phoenix, Zeus	602-253-6104
Cal	El Cerrito, Saletta Sls	415-236-9191
Cal	Glendale, R.A. Young & Co.	213-242-2171
Colo	Denver, Hamilton Assocs.	303-244-2901
Colo	Englewood, Zeus	303-770-4400
Fla	Orlando, FM Assocs	305-851-5710
Fla	W. Palm Beach, FM Assocs	305-746-3126
Ill	Addison, Mid West Mktg	312-279-2442
Ill	Franklin Park, Rich	312-678-3100
Md	Bethesda, M.E. Whitney Assocs.	301-654-8634
Mass	Hollbrook, McLellan Assocs	617-767-4771
Mass	Natick, Spectrum Engrg, Inc.	617-237-4030
Mich	Detroit, WKM Assocs	313-892-2500
Minn	St. Paul, Knox Assoc	612-488-5402
NJ	Westwood, Teledyne Inet.	201-243-3194
NM	Albuquerque, Zeus	505-268-3941
NY	New York City, G & A Sls	212-256-8500
NC	Greensboro, FM Assocs	919-294-2754
Ohio	Cleveland, WKM Assocs	216-267-0445
Ohio	Dayton, WKM Assocs	513-434-7500
Pa	Philadelphia, Maris Equip. Co.	215-225-0720
Pa	Pittsburgh, WKM Assocs	412-892-2953
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504
Utah	Salt Lake City, Zeus	801-486-2317
Wash	Bellevue, W.M. Buehler	206-455-5512

TELEDYNE KINETICS, 410 S. Cedros Ave., Solana Beach, Cal., 92075, Tel: 714-755-1181, TWX: 910-322-1135; Empl.: 80

For info on price: D. Pyle; Application info: D. Pyle; Customer service: J. Risley; Delivery info: J. Risley

Free literature available: Folder of Technical Literature containing information on TKC connectors and stripall thermal wire strippers.

Products manufactured: Connectors, Relays, Slip-Rings & Assemblies, Switches, Wire Strippers

Local Sales Offices & Reps.

Cal	Burlingame, J. E. Striker Co.	145-342-1425
Colo	Parker, Technology Mktg. Assoc.	303-341-3435
Fla	Indian Rocks Bch., Tech-Rep	813-595-2834
Ill	Deerfield, W. Krueger Assoc.	312-945-3720
Mass	Stoneham, Repco	617-438-3113
NJ	Dover, P. Rydlewski	201-366-7518
NM	Albuquerque, Technology Mktg. Assoc.	505-298-4321
NY	Bayside, R. L. Diamond, Inc.	212-423-7330
Ore	Portland, Houston Co.	503-235-4174
Wash	Bellevue, Testco	206-454-7422

TELEDYNE MEC., 3165 Porter Dr., Palo Alto, Cal., 94304, Tel: 415-493-1770, TWX: 910-373-1746; Empl.: 650

Customer service: F. H. May

Free literature available: Data sheets describing Teledyne MEC's expertise in Frequency Memory Sub-Systems, Power Supplies, TWTs, Amplifiers, Modulators, Microwave Acoustics, Microwave Integrated Circuits, Acousto-Optics, and Solid State Sub-Systems.

Products manufactured: Amplifiers, CATV Systems & Equipment, Delay Lines, Equalizers, Filters, Fuses, Integrated Circuit Packaging Systems, Oscillators, Power Supplies, Synthesizers, Transducers, Transmitters, Tubes

Local Sales Offices & Reps.

Ariz	Phoenix, Thorson Co.	602-956-5300
Cal	Palo Alto, Teledyne MEC	415-493-1770
Colo	Denver, Thorson Co.	303-355-3521
Conn	Stamford, Teledyne MEC	203-325-2535
Fla	Palm Bay, SparTech Assocs.	305-727-8045
Ga	Smyrna, SparTech Assocs.	404-432-3644
Ill	Mount Prospect, Cain & Co.	312-253-3578
Md	Bethesda, Teledyne MEC	301-530-2220
Mass	Reading, Teledyne MEC	617-944-4094
NM	Albuquerque, Thorson Co.	505-265-5655
Ohio	Dayton, Teledyne MEC	513-253-8144
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504

TELEDYNE MICRONETICS, 7155 Mission Gorge Rd., San Diego, Calif., 92120, Tel: 714-583-3525, TWX: 910-335-2085; Empl.: 50

Products manufactured: Amplifiers, Antenna Feed Systems, Antennas, Horns, Microwave, Pedestals, Radar, Radar Systems, Receivers, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Colo	Parker, Technology Mktg.	303-841-3435
DC	McClean, E. T. Phillips	703-893-2157
Fla	Clearwater, Brennan Assocs.	813-446-5006
Kans	Wichita, Dy-Tronix	316-943-6221
Mass	Burlington, Tritek	617-272-4550
Mo	Hazelwood, Dy-Tronix	314-731-5799
NM	Albuquerque, Technology Mktg.	505-298-4321

TELEDYNE MICROWAVE, 1290 Terra Bella Ave., Mountain View, Cal., 94040, Tel: 415-968-2211, TWX: 910-379-6939; FSC No: 24402; Empl.: 105; Minimum order: $100

For info on price: K. Mills; Application info: K. Mills; Customer service: M. Harrison; Delivery info: M. Harrison

Free literature available: Complete product line catalog

Products manufactured: Circulators, Ferrite, Filters, Isolators, Oscillators, Switches, Tuners

Local Sales Offices & Reps.

Cal	Los Altos, Cain White Co.	415-948-6533
Cal	Los Angeles, Cain Technology	213-476-2251
Fla	Clearwater, Brennan Assoc.	813-446-5006
Ill	Mt. Prospect, Cain & Co.	312-253-3578
Md	Columbia, N. Deoul Assoc.	301-997-4353
Mass	Burlington, Tritek	617-272-4550
NJ	Clementon, Applied Engrg. Conslts.	609-627-7290
NJ	Fort Lee, Technical Mktg. Assocs.	201-224-6911
NY	Fayetteville, G. Sherman	315-637-9861
Ohio	Dayton, Cain & Co.	513-254-6521
Ohio	Lancaster, Cain & Co.	614-654-4800
Tex	Dallas, Thorson Co.	214-233-5744

TELEDYNE PENN-UNION ELEC., Box 723, Edinboro, Pa., 16412, Tel: 814-734-1631, Telex: 914-490; Empl.: 500

For info on price: N. Williams Ext. 240 & 266; Application info: D. Lipp Ext. 228; Customer service: H. G. Mokszanowski Ext. 245; Delivery info: R. McLaughlin Ext. 221

Products manufactured: Connectors, Kits, Terminal, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Ala	Birmingham, C.S. Phillips & Son	205-870-0640
Alas	Anchorage, B.L. Owens & Assoc.	907-272-2613
Ariz	Phoenix, E.S. Condon Co.	602-279-3549
Cal	Los Angeles, E.S. Condon Co.	213-726-7926
Cal	San Francisco, F.M. Nicholas Co.	415-467-6220
Colo	Denver, Electrical Agencies Co.	303-623-8245
Conn	Avon, Electrical Agencies	203-673-9296
Conn	New Canaan, R. Zucco Co.	203-966-0233
Conn	West Haven, Electrical Agencies	203-933-2985
Fla	Jacksonville, Arnold-Bryant	904-737-5116
Fla	Miami, Arnold-Bryant	305-661-0715
Fla	St. Petersburg, Arnold-Bryant	813-343-6959
Ga	Atlanta, I.A. Hoge Assoc.	404-758-6815
Haw	Honolulu, D.R. Schwab	808-537-1658
Ill	Elk Grove Village, Hanke Co.	312-593-8500
Ind	Indianapolis, Roth-Mooney Elec. Agency	317-545-1288
Iowa	Cedar Rapids, A. Sell & Assoc.	319-393-4225
Iowa	Davenport, A. Sell & Assoc.	319-285-9413
Iowa	Des Moines, A. Sell & Assoc.	515-274-4633
Kans	Overland Park, T & W Sls.	913-649-4411
La	Bossier City, Jeanes Enterprises	318-746-8033
La	Metairie, Jeanes Enterprises	504-721-6221
Me	S. Berwick, Electrical Agencies	207-384-5321
Mass	S. Boston, Electrical Agencies	617-268-9300
Mich	Dearborn, D.P. Seyfried Co.	313-274-4900
Minn	Edina, W.L. Ruth & Assoc.	612-941-6350
Miss	Jackson, Jeanes Enterprises	601-956-7462
Mo	St. Louis, R.E. Kennedy Co.	314-965-7650
Neb	Omaha, A. Sell & Assoc.	402-391-4068
NM	Albuquerque, T. Deskin & Assoc.	505-242-3581
NY	Jamaica, Warshaw Electric	212-525-8150
NY	Loudenville, Mills, Talbot Co.	518-458-1297
NY	Rochester, Mills, Talbot Co.	716-244-1311
NC	Cary, F. Woods Agency	919-467-6366
Ohio	Cincinnati, J.G. Gates Co.	513-521-4335
Ohio	Cleveland, K.R. Dodge Co.	216-461-6482
Okla	Oklahoma City, And Power Sls.	405-751-5861
Ore	Portland, Northwest Agencies	503-227-5004
Pa	Drexel Hill, W.B. Siegfried Assoc.	215-353-2000
Pa	Pittsburgh, H.E. Ransford Co.	412-884-3425
SC	Lexington, F. Woods Agency	803-356-3738
Tenn	Memphis, Jeanes Enterprises	901-386-7850
Tex	Arlington, F.A. Roso Co.	817-461-7903
Tex	Houston, J.M. Johnson Co.	713-688-2236
Utah	Salt Lake City, Melville Sls. Co.	801-363-3363
Va	Ashland, Campbell & Assoc.	804-798-4743
Va	Roanoke, Campbell & Assoc.	703-343-6452
Wash	Seattle, Northwest Agencies	206-623-8882
WVa	Charleston, H.E. Ransford Co.	304-342-3203
Wisc	Milwaukee, A.W. Schwind Co.	414-276-9988

TELEDYNE PHILBRICK, 17 Allied Dr. Rte 128, Dedham, Mass., 02026, Tel: 617-329-1600, TWX: 710-348-6726; Empl.: 250; Minimum order: $25 p. 1•208-217

For info on price: Cust Svc; Application info: F. Goodenough; Delivery info: Cust Svc

Products manufactured: Amplifiers, Converters, Dividers, Generators, Inverters, Power Supplies, Regulators

Local Sales Offices & Reps.

Ala	Huntsville, Incotech, Inc.	205-837-6061
Ariz	Phoenix, Zeus, Inc.	602-258-7519
Cal	Culver City, DeAngelo Rothman & Co.	213-391-2694
Cal	Redwood City, J.S. Heaton Co.	415-369-4671
Colo	Englewood, Zeus, Inc.	303-770-4400
Conn	E. Hartford, Tekdata, Inc.	203-525-7647
Fla	Boca Raton, Conley Assocs.	305-395-6108

Fla	Oveido, Conley & Assocs.	305-365-3283
Fla	Tampa, Conley & Assocs.	813-933-3183
Haw	Kailua, Lanikai Elctrns.	808-262-6286
Ill	Chicago, Data Elctrns. Co.	312-283-0303
Ind	Indianapolis, Data Elctrns. Co.	317-784-6360
Kans	Mission, Mid-West Mktg.	913-384-3737
Md	Kensington, Elctrn. Mktg. Assocs.	301-881-5300
Mass	Burlington, Tek Data	617-273-0198
Mich	Farmington, Carter, McCormick & Peirce	313-477-7700
Mich	Kalamazoo, Carter, McCormic & Peirce	616-349-9666
Minn	Minneapolis, Data Elctrns. Co.	612-786-9666
Mo	Florissant, Mid-West Mktg.	314-831-0342
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Elmont, Crane & Egert	516-488-2100
NY	N. Syracuse, KLM Assocs.	315-458-6214
NY	New Hartford, KLM Assocs.	315-735-8525
NY	Rochester, KLM Assocs.	716-442-0820
NC	Raleigh, Condor Co.	919-876-4999
Ohio	Cleveland, Carter, McCormick & Peirce	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce	513-278-5873
Okla	Norman, Data Mktg.	405-364-8320
Pa	King of Prussia, Elctrn. Mktg. Assocs.	215-265-1600
Pa	Pittsburgh, Carter, McCormick & Peirce	412-824-3760
SC	Myrtle Beach, Candor Co.	803-448-5213
Tenn	Chattanooga, Candor Co.	615-894-7454
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg.	718-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Redmond, Desco, N.W.	206-455-9325
FOR:	Can., Downsview, Ont., Cesco Elctrns. Ltd.	416-661-0220
FOR:	Can., Montreal 301, Que., Cesco Elctrns. Ltd.	514-735-5511
FOR:	Can., Ottawa, Ont., Cesco Elctrns. Ltd.	613-729-5118
FOR:	Can., Quebec, Que., Cesco Elctrns. Ltd.	418-524-4641
FOR:	Can., Vancouver 15, B.C., Intek Elctrns. Ltd.	604-324-6831

TELEDYNE RELAYS, 3155 W. El Segundo Blvd., Hawthorne, Cal, 90205, Tel: 213-973-4545, TWX: 910-325-6600; Empl.: 302 .... p. 1•1818-1824

Customer service: C. Criswell

Free literature available: Product catalog containing tabulated listing of military TO-5, commercial TO-5, mini-T, solid state industrial, solid state military, and hardware. A condensed form is available, known as our "short form catalog".

Products manufactured: Relays, Sockets

Local Sales Offices & Reps.

Ariz	Scottsdale, Sls. Engrg. Inc.	602-945-5781
Cal	Hawthorne, Teledyne Relays	213-973-4545
Cal	San Mateo, Teledyne Relays NORCAL	415-574-1915
Colo	Englewood, Todd Assoc. Inc.	303-761-7801
Conn	Stratford, G. Rosen Co.	203-375-5456
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Ill	Downers Grove, Teledyne Relays, MWRO	312-964-1950
Ill	Mt. Prospect, Delta Tech. Sls.	312-437-9412
Ind	Indianapolis, Ihrig Assocs.	317-783-7630
Kans	Overland Pk., Ensco Rep.	913-381-7557
Mass	Framingham, G. Rosen Co.	617-879-5505
Mich	Birmingham, J.C. Hofstetter Co.	313-643-7203
Mich	Grand Rapids, J.C. Hofstetter Co.	616-942-0650
Minn	Minneapolis, S. Clothier Co.	612-888-4666
Mo	Kansas City, Harris-Hanson	816-444-9494
Mo	St. Louis, Ensco-Rep.	314-567-3935
NJ	Eatontown, Teledyne Relays	201-542-6884
NM	Albuquerque, A.Q. Elctrns.	505-255-8701
NY	Mount Vernon, Friedman-Smith Elctrns.	914-664-4866
NY	Syracuse, I.A. Hotze Co.	315-479-6641
NC	Raleigh, R.W. Mitscher Co.	919-828-0575
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Pa	Bala Cynwyd, Vantage Sls. Co.	215-667-0990
Tenn	Shelbyville, R.W. Mitscher Co.	615-684-4544
Tex	El Paso, A.Q. Elctrns.	915-545-2363
Tex	Houston, Vista Assocs.	713-661-0119
Tex	Richardson, Vista Assocs.	214-235-4547
Va	Alexandria, Potomac Elctrns. Inc.	703-836-1630
Wash	Bellevue, W.M. Buehler Co.	206-455-5512
FOR:	Can., St. Laurent, Que., A. Deskin Sls.	514-331-2860
FOR:	Canada, Malton, Ontario, A. Deskin Sls.	416-677-5517
FOR:	Canada, Vancouver, B.C., A. Deskin Sls.	604-324-6331

Local Distributors

Ariz	Phoenix, Kierulff Elctrns., 2633 E. Buckeye Rd.	602-273-7331
Ariz	Phoenix, Liberty Elctrns., 3130 N. 27th Ave.	602-257-1272
Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Los Angeles, Kierulff Elctrns., 2585 Commerce Way	213-685-5511
Cal	Mt. View, Elmar Elctrns., 2288 Charleston Rd.	415-961-3611
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	San Diego, Kierulff Elctrns., 8797 Balboa Ave.	714-278-2112
Cal	San Diego, Liberty Elctrns., 8248 Mercury Ct.	714-565-9171
Colo	Commerce City, Elmar Denver Elctrns., 6777 E. 50th Ave.	303-287-9611
Colo	Denver, Kierulff Elctrns., 10890 E. 47th Ave.	303-371-6500
Fla	Orlando, Milgray/Florida, 5400 Diplomat Cir.	305-647-5747
Ill	Rosemont, Advent Elctrns., 7110 Lyndon St.	312-298-4210
Ind	Indianapolis, Pioneer/Indianapolis, 6408 Castle Place Dr.	317-849-7300
Kans	Overland Park, Milgray/Kansas City Inc., 6901 W. 63rd St.	913-236-8800
Md	Hyattsville, Milgray/Washington, 5405 Lafayette Pl.	301-864-1111
Md	Rockville, Pioneer/Maryland, 1037 Taft St.	301-424-3300
Mass	Boston, Demambro Elctrns., 1095 Commonwealth Ave.	617-787-1200
Mass	Burlington, Milgray/New England, 79 Terrace Hall Ave.	617-272-6800
Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-525-1800
NM	Albuquerque, Elmar Elctrns., 2632 Pennsylvania N.E.	505-292-1111
NJ	Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd.	609-424-1300
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
Ohio	Cleveland, Milgray/Cleveland, 1821 E. 40th St.	216-881-8800
Ohio	Cleveland, Pioneer/Cleveland, 4800 E. 131st St.	216-587-3600
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Pa	Philadelphia, Milgray/Delaware Valley	215-228-2000
Pa	Pittsburgh, Pioneer/Pittsburgh, 560 Alpha Dr.	412-782-2300
Tex	Dallas, Solid State Elctrns., 2643 Manana Dr.	214-352-2601
Tex	Houston, Solid State Elctrns., 6400 Westpark Dr.	713-785-5436
Wash	Seattle, Kierulff Elctrns., 5940 Sixth Ave. S.	206-763-1550
Wash	Seattle, Liberty Elctrns. N.W., 5305 Second Ave. S.	206-763-8200
For:	Can., Malton, Ont., A. Deskin Sls., 2759 Thamesgate Dr.	416-677-5517
For:	Can., St. Laurent, Que., A. Deskin Sls., 290 Benjamin Hudon St.	514-331-2860
For:	Can., Vancouver, B.C., A. Deskin Sls., 272 S.W. Marine Dr.	604-324-6331

TELEDYNE SEMICONDUCTOR, 1300 Terra Bella Ave., Mountain View, Cal., 94040, Tel: 415-968-9241, TWX: 910-379-6494; Empl.: 2000

Customer service: Prod. Mktg. Group

Products manufactured: Amplifiers, Circuits, Hybrid, Thin-Film, Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Comparators, Converters, Diodes, Discharge Systems, Energy, Integrated Circuit Devices, IC's, Active Filters, Lamp Drivers, Memory Systems, Multiplexers, Power Supplies, Rectifiers, References, D-C Voltage, Regulators, Semiconductor Wafer Fabrication, Timers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, Incotech	205-837-6061
Ariz	Tempe, Sedco Sls.	602-968-7791
Cal	Escondido, Cirolia Elctrn. Sls.	714-743-3015
Cal	Hawthorne, Teledyne Semiconductor	213-973-4551
Cal	Mountain View, Teledyne Semiconductor	415-965-1455
Cal	Redwood City, J.S. Heaton Co.	415-369-4671
Cal	Santa Ana, Rical Assocs.	714-557-6543
Colo	Denver, Walker Assocs.	303-623-8713
Fla	Maitland, H.H. Peregoy	305-831-2474
Fla	Pompano Beach, H.H. Peregoy	305-943-9593
Ill	Des Plaines, Teledyne Semiconductor	312-299-6196
Ind	Fort Wayne, Given Corp.	219-432-5585
Iowa	Cedar Rapids, PMA Corp.	319-362-9177
Kans	Overland Park, PMA Corp.	913-381-0004
Kans	Wichita, PMA Corp.	316-264-2662
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Md	Towson, Teledyne Semiconductor	301-825-1920
Mass	Bedford, Teledyne Semiconductor	617-275-2070
Mass	Waltham, Dynasel Assoc.	617-890-6777
Mich	Benton Harbor, R.C. Nordstrom	616-857-4653
Mich	Lathrup Village, R.C. Nordstrom	313-559-7373
Minn	Minneapolis, Teledyne Semiconductor	612-888-0540
Mo	Hazelwood, PMA Corp.	314-731-4334
NJ	Fort Lee, Tech-Sales Corp.	201-944-3642
NJ	Haddonfield, Sundzy O'Brien	609-429-4013
NY	Buffalo, Bowser & Sapecky Assocs.	716-839-4170
NY	Manlius, Bowser & Sapecky Assocs.	315-682-8885
NY	Poughkeepsie, Teledyne Semiconductor	914-471-9322
NC	Winston-Salem, Burgin-Kreh Assocs.	919-768-4174
Ohio	Dayton, N. Bear Corp.-Bear Mktg.	513-299-3566
Ohio	Richfield, N. Bear Corp.-Bear Mktg.	216-659-3131
Tex	Dallas, Evans-McDowell Assocs.	214-238-7157
Tex	Houston, Evans-McDowell Assocs.	713-772-1257
Va	Lynchburg, Burgin-Kreh Assocs.	804-845-5600
Wash	Bellevue, SD. R2	206-747-9424

TELEMET CO., 185 Dixon Ave., Amityville, N.Y., 11701, Tel: 516-541-3600, TWX: 516-227-9850; Empl.: 80; Minimum order: $25

Customer service: A. Bolletino

Free literature available: 1) Full Catalog Of All Products 2) Individual Data Sheets Of All Products 3) Short Form Catalog - Video Test Equipment 4) Short Form Catalog - Video Switching Equipment

Products manufactured: Amplifiers, CATV Systems & Equipment, Demodulators, Generators, Modulators, All Kinds, Television Systems & Equipment Closed-Circuit, Test Equipment

Local Sales Offices & Reps.

Cal	Riverside	714-683-0641
Ga	Atlanta	404-294-5809
NY	Brewster	914-279-3231
Ohio	Cleveland Heights	216-321-7523
Tex	Dallas	214-241-0928
EXP:	Amityville, N.Y.	516-541-3600

TELESIS LABORATORY, Box 387, 41 1/2 S. Paint St., Chillocothe, Ohio, 45601, Tel: 614-773-1414; Empl.: 5

For info on price: J. Robertson; Application info: J. Robertson; Customer service: D. Ortmman; Delivery info: S. Harding

Free literature available: Brochures describe product technical specifications and application suggestions

Products manufactured: Amplifiers, Analyzers, Counters, Data Acquisition & Reduction Systems, Keyboards, Alphanumeric & Decimal, Meters, Oscillators, Switches

TELETYPE CORP., 5555 Touhy Ave., Skokie, Ill., 60076, Tel: 312-982-2000, TWX: 910-223-3611; Empl.: 5,000

Customer service: Sls. Dept.

Products manufactured: Comm. Systems, Teleprinters, Teletypewriters & Equipment, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Cal	City of Commerce	213-724-6040
NJ	Fairfield	201-575-8240

TELEVISION MICROTIME, INC., 1280 Blue Hills Ave., Bloomfield, Conn., 06002, Tel: 203-242-0761, TWX: 710-425-2390; Empl.: 80

For info on price: E. J. Dahl; Application info: D. E. Acker; Customer service: J. L. Stickley; Delivery info: V. Mellon

Free literature available: Applications notes on time base; correction systems for video tape recorders.

Products manufactured: Amplifiers, CATV Systems & Equipment, Delay Lines, Networks, Television Systems & Equipment Closed-Circuit

TELEX COMMUNICATIONS, INC., 9600 Aldrich Ave., So., Minneapolis, Minn., 55420, Tel: 612-884-4051

For info on price: J. Dow 612-884-4061; Customer service: A. Vikla 612-884-4061; Delivery info: S. Chaika 612-844-4061

Free literature available: ED2151 - Educational Headphones; ED2227 - Cassette Equipment; ED2268 - Tape Duplicating System; BI2230 - Broadcast/Indust. Tape Equip.; BI2166 - Communication Headphones; BI2313 - TMS100 - 16 hr Cartridge Changer; BI2252 - 1400 Professional Tape Equip.; AP2118 - Pilots Microphones & Headsets.

Products manufactured: Amplifiers, Comm. Systems, Duplicators, Handsets, Chestsets, Headphones, Headsets, Etc., Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds, Recorders, Tape Recording Accessories, Transducers

Local Sales Offices & Reps.

Cal	Burbank, Koessler Sls., Inc.	213-849-5716
Cal	Oakland, H. Gabriel Rep. Co.	415-465-5361
Cal	West Covina, J.F. Northcutt Co.	213-331-2447
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Fla	Miami, World Wide Prods.	305-754-5475
Ga	Chamblee, Techn. Sys.	404-457-0426
Ill	Lincolnwood, Wm. M. Linz Co.	312-677-2000
Ill	Romeoville, P. Bunker	815-838-1023
Ind	Indianapolis, Sukup & Cox, Inc.	317-253-1215
Iowa	Atlantic, Kimian Sls. Co.	712-243-1626
Kans	Prairie Village, Roach, Spencer & Assocs.	913-432-3700
Md	Baltimore, D. Brothers Co.	301-764-7189
Mass	Wellesley Hills, M. Scott Co.	617-235-0102
Mich	Detroit, Riley & Petchell Sls., Inc.	313-838-9100
Mo	Chesterfield, Roach, Spencer & Assoc.	
NY	Flushing, Bettan Sls., Inc.	212-969-7600
NY	Rochester, Marsey Sls., Inc.	716-442-9700
NY	Woodhaven, Alan Sarfaty	212-846-1952
Ohio	Cleveland, Imtech	216-826-3400
Okla	Tulsa, J.Y. Schoonmaker	918-936-1432
Pa	Newtown Square, G.M. Conneen Co.	215-353-2241
Tex	Dallas, J.Y. Schoonmaker	214-357-8481
Tex	Houston, J.Y. Schoonmaker	713-926-9510
Wash	Seattle, Fleehart & Sullivan	206-522-1533

TELONIC ALTAIR, Box 277, Laguna Beach, Calif., 92652, Tel: 714-494-9401, TWX: 910-596-1320; Empl.: 130; Minimum order: $25

For info on price: Mktg. Dept.; Application info: Mktg. Dept.; Customer service: Order Control; Delivery info: Order Control

Free literature available: Catalog 57 June 1973 Filters, Attenuators, Components, RF & Microwave Brochures: Telonic Attenuators; Telonic Sweep Generators 1200 Series; Telonic Sweep Generator Accessories & VSWR Measurement Systems; Telonic Sweep/Signal Generators Modular 2003 Series; Telonic Test Instrumentation for TV & Radio Production.

Products manufactured: Amplifiers, Attenuators, Bridges, Calibrators, Detectors, Filters, Generators, Impedance Converters, Microwave, Kits, Test Equipment, Meters, Monitors, Oscilloscopes, Preselectors, Tees, Terminals, Test Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Scottsdale, J. Smith Assocs.	602-947-2495
Cal	Cupertino, T. L. Snitzer Co.	408-257-8333
Cal	Del Mar, T. L. Snitzer Co.	714-454-2191
Cal	Los Angeles, T. L. Snitzer Co.	213-836-6170
Fla	Orlando, Gentry Assocs.	305-894-4401
Haw	Honolulu, Harkon Hawaii	808-538-7178
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Kans	Lenexa, S. Sterling Co.	913-888-2995
Md	Lanham, Brimberg Assocs.	301-552-2200
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
Mo	St. Louis, S. Sterling Co.	314-542-3636
NM	Albuquerque, J. Smith Assocs.	505-255-2111
NY	Flushing, F & F Associates	516-334-1160
NY	Syracuse, Tesco Assocs.	315-463-4566
NC	Burlington, Gentry Assocs., Inc.	919-227-3639
Ohio	Cleveland, S. Sterling Co.	215-442-8080
Pa	Ambler, WM Assocs.	215-643-4119
Tex	Dallas, Texas Avionics Co.	214-368-3566

TELREX LABS., Asbury Park, N.J., 07712, Tel: 201-775-7252; Empl.: 15; Minimum order: $25

For info on price: C. C. Ercolino; Application info: C.C. Ercolino; Customer service: N.V. Ercolino; Delivery info: N. V. Ercolino

Free literature available: Commercial Brochure Describing the various communication antennas & systems.

Products manufactured: Antenna Rotators, Antenna Towers & Supports, Antennas, Cable, Transformers

TELSTAR ELECTRONICS CORP., 700 Hummel Ave., Southold, N.Y., 11971, Tel: 516-765-9292; Empl.: 15

Customer service: R. S. Marston

Products manufactured: Clocks (All Types), Data Acquisition & Reduction Systems, Data Loggers, Hydrophones & Accessories, Multiplexers, Oceanographic Equip. (Electronic), Printers, Receivers, Scanners

TELTRON, 940 Willow St., Pottstown, Pa., 19464, Tel: 215-326-2127; Empl.: 22; Minimum order: $35

Application info: C. A. Mock 215-326-2128; Customer service: Cust. Serv. Dept.; Delivery info: J. Mauger, Jr. 215-326-2127

Products manufactured: Cameras, CATV Systems & Equipment, Coils Including Assemblies & Forms, Television Systems & Equipment Closed-Circuit, Tubes, X-Ray Inspection Equipment, Yokes

Local Sales Offices & Reps.

Cal	Pasadena, A-F Sls. Engrg.	213-681-5631

Local Distributors

Ark	El Dorado, Ind. Elctrn., 413 W. Main St.	501-862-4901
Cal	Culver City, JSH Elctrns., 8549 Higuera St.	213-837-0177
Conn	Rockville, Denson Elctrns., Longview St.	203-875-5198
Del	Dover, Elctrnc. Surveillance, 20 Lockerman	302-284-9421
La	Kenner, MAR Elctrns., 3521 E. La. State	504-729-4524
Me	Auburn, Audio Serv., Box 393	207-783-8801
Mich	Detroit, R. P. Hermes Co., 9600 Whittier	313-886-4566
NJ	Elizabeth, Thor Elec. Corp., 741 Livingston	201-354-2420
NJ	Elizabeth, Unity Elctrns., 107 Trumbull	201-351-4200
NM	Albuquerque, Integrated Sys., 142 Monroe NE	505-255-8127
NY	Ossining, Dodd Elctrns., Snowden Ave.	914-762-4200
NY	Rosedale, Temtron Elctrns., 138-91 Francis Lewis	212-978-5896
Ohio	Dayton, Dayton Communications, 2971 Bluefield	513-278-7937
Pa	Reading, Beil-Whitaker, Inc., 3623 Jacksonwald	215-779-2610
Va	Arlington, Concord Communications, 1203 N. Highland	703-525-5777

TELVAC INSTR. CO., 14614 Raymer St., Van Nuys, Cal., 91405, Tel: 213-994-9471; Empl.: 3

Customer service: L. Ratcliff

Free literature available: Product Catalog

Products manufactured: Soldering Accessories, Testers, Tools, Tweezers, Hand & Vacuum

Local Sales Offices & Reps.

Ill	Hinsdale, Hill-Gray Assocs.
Md	Baltimore, Milan Assoc., Inc.
Mass	Babson Park, P.R. Sturgeon Co., Inc.
NY	Mineola, L.I., Willco Sls.
NY	Syracuse, E. Dutcher

TEMPIL DIV., Hamilton Blvd.; So. Plainfield, N.J., 07080, Tel: 201-757-8300, Telex: 138-662; Empl.: 30

For info on price: A. F. Flevry; Application info: M. Olesin; Customer service: J. A. Lamb; Delivery info: J. A. Lamb

Products manufactured: Coatings, Crayons, Coatings, Pellets, etc., Temperature Indicating, Heat Sinks, Soldering, Labels, Temperature Indicating, Monitors, Paints

TEMPLEMAN, D.R. CO., 8 Park St., Plainville, Conn., 06062, Tel: 203-747-2709; Empl.: 30

Customer service: O. W. Bray

Products manufactured: Forms, Wire, Rings, Retaining, Springs (All Types)

TEMPLINE, 17209 South Broadway, Gardena, Cal., 90248, Tel: 213-324-6969; Empl.: 20

Customer service: T. R. Anderson

Products manufactured: Amplifiers, Bobbins, Winding, Coil & Transformer, Bridges, Cable Assemblies & Harnesses, Coils Including Assemblies & Forms, Controls/Control Eqpt., Heaters & Heating Elements, Indicators, Probes, Signal Conditioners & Equipment, Thermistors, Thermocouples, Elements & Accessories, Thermometers, Resistance, Transducers, Transmitters, Wire

Local Sales Offices & Reps.

Cal	San Diego, L.L. Stoakes, Inc.	714-274-6281
Conn	Hamden, Northeast Engrg. Inc.	203-248-4481
Md	Silver Springs, Spectroscopy Sys.	307-949-8261
Mass	Danvers, Northeast Engrg., Inc.	617-774-3070
NM	Albuquerque, Telemetry Sls. Corp.	505-266-7861
NY	Manhasset, Northeast Engrg. Inc.	516-365-9633
Ohio	Englewood, Gemini, Inc.	513-890-5394
Tex	Trinidad, Telemetry Sls. Corp.	214-778-2533

TEMPO INSTRUMENT, INC., 51 E. Bethpage Rd., Plainview, N.Y., 11803, Tel: 516-694-4400, TWX: 510-224-6421; FSC No: 07031; Empl.: 140; Minimum order: $25

For info on price: B. Tuttle; Application info: R. D. Egyud; Customer service: B. Tuttle; Delivery info: B. Tuttle

Products manufactured: Cable Fault Locators, Calibrators, Comparators, Controls/Control Eqpt., Detectors, Dividers, Flashers, Generators, Locators, Open-Short, Meters, Monitors, Regulators, Relays, Switches, Timers, Transducers

Local Sales Offices & Reps.

Industrial Prods. Group.

Cal	City of Commerce, Pacific Scientific Co.	213-927-5333
Cal	San Carlos, Pacific Scientific Co.	415-592-6300
Mich	Farmington, Electro-Matic Co.	313-477-7270
NJ	Hohokus, Alto	201-447-1770
NY	Rochester, H.C. Johnson	716-482-3000
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425

Military Prods. Group.

Cal	Chatsworth, Tempo	213-993-1311
Conn	Essex, Lafage Assocs.	203-767-0465
Fla	North Pinellas Park, Russell Assocs.	813-526-1134
Ill	Northbrook, Raines/Brin Assocs.	312-498-0890
Md	Baltimore, Coulbourn-DeGreif Co., Inc.	301-247-4646
Md	Baltimore, Stemler	301-944-8262
Mass	Newton, Daner/Hayes, Inc.	617-969-4650
Mass	Woburn, Stockwell Tech. Sls.	617-935-5770
Mich	Southfield, Luebbe Sls. Co.	313-357-0355
Mo	Kansas City, PEM Sls. Co.	816-333-6012
Mo	St. Louis, PEM Sls. Co.	314-434-4425
NJ	Cherry Hill, Stemler Assoc.	609-966-4070
NJ	Clifton, Avionics Equip. Inc.	201-772-1956
NY	Bayshore, Russell Assocs.	516-666-6500
NY	Buffalo, Russell Assocs.	716-634-3377
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Dayton, Luebbe Sls. Co.	513-294-0426
Pa	Audubon, Daner/Hayes, Inc.	215-666-5005
Tex	Arlington, Cal-Tex Ind.	817-461-0303
Va	Alexandria, Stemler	703-548-7818
Wash	Bellevue, M. Poggi Co.	206-454-2323
EXP:	NYC, Aero-Spectrum Inc.	212-752-4770

TEMPTRONIC CORPORATION, 40 Glen Ave., Newton, Mass., 02159, Tel: 617-965-3420, Telex: 92-2526; Empl.: 30; Minimum order: $25

For info on price: H. Lyden; Application info: T. Gerendas; Customer service: F. Healy; Delivery info: J. Crozier

Free literature available: ThermoSpot for testing components at temperature right on the tester -70/+200°C, ThermoChuck for testing wafers, chips, hybrids at temperature right on the prober -60/+300°C, ThermoStream for testing modules, circuitboards at temperature right on the tester -60/+200°C.

Products manufactured: Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Controls/Control Eqpt., Cooling/Heating Modules, Thermoelectric, Heat Exchangers & Systems, Machines/Machinery, Production, Semiconductor Wafer Fabrication, Test Systems

Directory of Local Distributors Starts on page 401

Local Sales Offices & Reps.

Cal	Palo Alto, Coherent Mktg. Assocs.	415-327-2217
Fla	Longwood, Lenz Engrg. Co.	305-831-9797
Ill	Des Plaines (Chicago), Cozzens & Cudahy, Inc.	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy, Inc.	317-244-2456
Kans	Kansas City, Cozzens & Cudahy	816-454-5836
Md	Rockville, Ed Winston & Co.	301-881-5780
Minn	Minneapolis, Cozzens & Cudahy, Inc.	612-884-4336/7
Mo	St. Louis, Cozzens & Cudahy, Inc.	314-423-1234
NY	Elmont, Crane & Egert Corp.	516-488-2100
Tex	Dallas, Comspec, Inc.	214-234-4137
Tex	Houston, Comspec, Inc.	713-461-4487

TEMTRON ELEXS, 138-69 Francis Lewis Blvd., Rosedale, N.Y., 12472, Tel: 212-978-5896; Empl.: 12; Minimum order: $25

For info on price: H. Schwartz 212-978-5896; Application info: A. Sussman 201-224-6146; Customer service: C. Mann 212-978-5896; Delivery info: M. Ramirez 212-978-5896

Free literature available: Catalogue which contains our receiving & industrial tubes and camera tubes.

Products manufactured: Transistors, Tubes

Local Sales Offices & Reps.

NJ	Hackensack, C. Mayer Assocs.	201-487-3113
NY	Huntington, C. Mayer Assocs.	516-921-7876

TENNELEC, INC., Box D, Oak Ridge, Tenn., 37830, Tel: 615-483-8404, TWX: 810-572-1018; Empl.: 200; Minimum order: $50

For info on price: J. Bradley; Application info: B. Stark; Customer service: R. Chambers; Delivery info: J. Bradley

Products manufactured: Amplifiers, Analyzers, Converters, Counters, Data Acquisition & Reduction Systems, Data Loggers, Detectors, Generators, Power Supplies, Prescalers, Receivers, Scalers, Binary, Decade, Timers

Local Sales Offices & Reps.

Cal	La Canada, Spectrum Sciences	213-790-1181
DC	Washington, Scientific Sys. Sls. Corp.	202-726-4161
Fla	Jacksonville, Pulcir, Inc.	904-743-5700
Ill	Mt. Prospect, Contemporary Science, Inc.	312-255-3793
Mass	Burlington, Scientific Sys. Sls. Corp.	617-273-1660
NM	Albuquerque, V. Roberts Assocs.	505-345-2486
NY	Port Chester, Radiation Elctrns., Inc.	914-937-2300
NY	Syosset, Scientific Sys. Sls. Corp.	516-921-3737
Ohio	Westerville, Contemporary Science, Inc.	614-882-6908
Tenn	Knoxville, Pulcir, Inc.	615-693-3641
Tex	Dallas, Overall Engrg.	214-233-2311
Wash	Seattle, Spectrum Sciences	206-624-2373

TENNEY ENGRG., INC., 11000 Springfield Rd., Union, N.J., 07083, Tel: 201-686-7870, TWX: 710-985-4725; Empl.: 175; Minimum order: $25

For info on price: F. H. Gardner; Application info: F. H. Gardner; Customer service: F. Paulauskas; Delivery info: F. H. Gardner

Free literature available: 101 THJR, 102 Vibration, 104 T-14,40,64, 105 Agree 106 T-5, 107 MR-1 Bath, 108 T-JR, 109 T & TH-10 & 27, 110 "S" Vacuum, 112 Space JR, 113 Walk-in Rooms, 117 Tenneyzphere, 118 Tenneystrat, 121 Thermal Shock, 123 Bench Master R, 124 Tempgard R, 125 MR-9 Bath, 126 Tenneyten, 127 Tenneythirty.

Products manufactured: Alarms, Baths, Controlled Temperature (Air & Liquid), Chamber, Environmental Test, Controls/Control Eqpt., Cooling/Heating Modules, Thermoelectric, Dehumidifiers (For Equipment), Ovens, Refrigerators, Environmental Test, Testers

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Menlo Park, Long Assocs.	415-327-1300
Cal	Van Nuys, Environment Assocs.	213-994-1404
Colo	Denver, Williams Assoc.	303-373-4730
Conn	Hamden, Equipment Sls. Co.	203-248-5581
Fla	Lake Worth, I. R. Associates	305-655-3392
Fla	Orlando, FM Assocs.	305-851-5710
Ill	Des Plaines, Marsland Assocs.	312-298-2620
Ind	Indianapolis, Marsland Assocs.	317-924-3568
Md	Lanham, Brimberg Assocs.	301-552-2200
Mass	Chelmsford, Equip. Sls.	617-256-8547
Minn	Minneapolis, Marsland Assocs.	612-545-4481
Mo	Kansas City, Marsland Assocs.	816-765-0641
Mo	St. Peters, Marsland Assocs.	314-278-6949
NJ	Moorestown, Salem Scientific	609-235-4565
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Fayetteville, M.P. Andrews	315-637-3144
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Cleveland, Dietrich & Assocs.	216-781-1855
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Ore	Beaverton, Showalter Instr. Inc.	503-646-8946
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
Tex	Dallas, Carey, Wolf & Assocs.	214-823-5383
Tex	Ft. Worth, Carey, Wolf & Assoc.	817-738-1996
Tex	Houston, Carey, Wolf & Assoc.	713-721-2442
Wash	Bellevue, Showalter Instr. Inc.	206-455-4922

TENOR CO., INC., 17020 W. Rogers Dr., New Berlin, Wisc., 53151, Tel: 414-782-3800; Empl.: 35; Minimum order: $25

For info on price: P. Yoblin; Application info: Sls. Engrg.; Customer service: P. Yoblin; Delivery info: P. Yoblin

Free literature available: Bull. 200A, 250A, 2410-2420 - Stepping drum programmers; Bull. 700A - Solid state logic cards.

Products manufactured: Cards, Logic, Controls/Control Eqpt., Counters, Modules, Logic, Encapsulated, Programmers, Switches, Timers

TEN-TEC INC., Industrial Park, Sevierville, Tenn., 37862, Tel: 615-453-7172; Empl.: 60; Minimum order: $10

For info on price: D. Tomcik; Application info: J. Bruchfield; Customer service: J. Beeler; Delivery info: D. Tomcik

Products manufactured: Amplifiers, Cabinets & Accessories, Calibrators, Cases, Equipment, Instrument, Meter, Comm. Systems, Power Supplies, Receivers, Transceivers, Transmitters

TERADO CORP., 1068 Raymond Ave., St. Paul, Minn., 55108, Tel: 612-646-2868; Empl.: 25; Minimum order: $10

For info on price: S. D. Munson; Application info: W. M. Sorenson; Customer service: J. Wickstrom; Delivery info: F. B. Albright

Free literature available: D.C. to A.C. inverters, standby power systems, voltage adjusters, battery chargers, D.C. power supplies, portable A.C. power supplies.

Products manufactured: Batteries, Chargers, Battery, Converters, Inverters, Power Supplies, Regulators, Transformers, Vibrators

Local Sales Offices & Reps.

Cal	Redwood City, Sinai/Johnson, Inc.	415-365-6263
Cal	Torrance, Barstow & Doran Inc.	213-325-4140
Ill	Chicago, Weisz Assocs.	312-637-9117
Mass	Northboro, W.B. Pray Sls., Inc.	617-393-3434
Minn	Mpls., A. J. Warner	612-729-7371
NJ	Caldwell, Art Cerf & Co.	201-226-2263
NY	Plainview, Morhan Exporting Corp.	516-293-5582
Tex	Dallas, Maynard Sls. Co.	214-742-2384

TERADYNE, INC., 183 Essex St., Boston, Mass., 02111, Tel: 617-482-2700, TWX: 710-321-1055; Empl.: 1300

Customer service: Sls. Dept.

Free literature available: GENERAL CATALOG-describes all of Teradyne's automatic test systems and instruments for electronic device and subassembly users and manufacturers.
The catalog also describes Teradyne's laser trimming systems.

Products manufactured: Connectors, Sockets, Test Systems, Testers

Local Sales Offices & Reps.

Ariz	Tempe, Teradyne	602-967-7549
Cal	Chatsworth, Teradyne Digital Sys.	213-993-1343
Cal	Costa Mesa, Teradyne	714-979-4590
Cal	Sunnyvale, Teradyne	408-732-8770
Fla	Lauderhill, Teradyne	305-735-3880
Ill	Chicago, Teradyne Applied Sys.	312-725-2011
Ill	Des Plaines, Teradyne	312-298-8610
Ind	Indianapolis, Teradyne	317-297-4682
Mass	Lowell, Teradyne	617-458-1256
Mich	Dearborn Heights, Teradyne	313-336-5550
Minn	Bloomington, Teradyne	612-854-7177
NJ	Parsippany, Teradyne	201-334-9770
NY	Great Neck, Teradyne	516-829-5040
NY	Syracuse, Teradyne	315-454-4486
Pa	Allentown, Teradyne	215-821-9109
Tex	Richardson, Teradyne	214-231-5384
Va	Vienna, Teradyne	703-938-2800

TERADYNE COMPS., 900 Lawrence St., Lowell, Mass., 01852, Tel: 617-454-9195, TWX: 710-343-1758; FSC No: 31413; Empl.: 500; Minimum order: $50

For info on price: H. T. Neavitt 617-454-9195; Application info: L. B. Johnson 603-889-5156; Customer service: A. T. Genovese 617-454-9195; Delivery info: A. T. Genovese 617-454-9195

Products manufactured: Connectors, Sockets

Local Sales Offices & Reps.

Cal	Fullerton, Teradyne Comps., Inc.	714-871-1930
Cal	Inglewood, J. Berman Co.	213-776-1281
Cal	Palos Verdes Pen., Mr. Alex Paul, Western Regional Mgr.	203-541-5314
Cal	Santa Clara, Nova-Tronix	408-243-9530
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Fla	Ft. Lauderdale, Tech-Rep Assocs.	305-792-0962
Fla	Largo, Tech-Rep Assocs.	813-595-2834
Ill	Park Ridge, Metcom Assocs. Corp.	312-696-1490
Md	Towson, J-H Elctrn. Sls. Co.	301-825-4440
Minn	New Brighton, TWC Sales	612-636-1770
NY	Commack, Hingston Walsh Assoc.	516-543-0241
NY	Larchmont, Hingston-Walsh Assocs.	914-834-5781
NY	Liverpool, L-Mar East	315-457-2329
NY	Rochester, L-Mar Assocs.	716-328-5240
NY	Vestal, L-Mar East	607-729-6339
Ohio	Centerville, ImTech, Inc.	513-885-4181
Ohio	Cleveland, ImTech, Inc.	216-826-3400
Pa	Fort Washington, G.C.M., Inc.	215-646-7535
Pa	Pittsburgh, ImTech, Inc.	412-247-1050
Tex	Dallas, Evans & McDowell Assoc.	214-238-7157
Tex	Sugarland, Evans & McDowell Assoc.	713-783-2900

TESCOM INSTR. DIV., 2600 Niagara La. N., Minneapolis, Minn., 55441, Tel: 612-546-4351, Telex: 29-0488; Empl.: 200

For info on price: H. Gunderson; Application info: M. Faller; Customer service: H. Gunderson; Delivery info: A. Brockhouse

Free literature available: Welding Equipment for Miniature and Electronic Applications is found in the Tescom Catalog and Little Torch Brochures. Also Soldering and hand tools.

Products manufactured: Controls/Control Eqpt., Gages, Microscopes, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Tools, Torches, Soldering, Welding & Access., Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

TESTEX INC., See Automedia Inc.

TEXAS INSTRUMENTS, Connector Systems, 34 Forest St., Attleboro, Mass., 02703, Tel: 617-222-2800
p. 2•1032,1033

Customer service: B. Spence

Products manufactured: Backpanel Interconnect Systems, Boards, Plug-In, Cards, Logic, Connectors, Sockets

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns.	205-881-5031
Ariz	Phoenix, Shefler Kahn Co.	602-258-7893
Cal	Los Altos, Ewing-Foley Inc.	415-941-4525
Cal	Los Angeles, M. A. Stolaroff Co.	213-295-7781
Cal	San Diego, M. A. Stolaroff Co.	714-234-6905
Colo	Boulder, R. G. Enterprises	303-447-9211
Conn	Milford, Todino Engrg. Sls.	203-874-6643
Fla	Ft. Lauderdale, Beacon Elctrns.	305-776-6074
Fla	Maitland, Beacon Elctrns.	305-647-3498
Ga	Atlanta, Beacon Elctrns.	505-351-3654
Ill	Hinsdale, Momac Sls.	312-654-4524
Ind	Greenwood, Valentine Schillinger & Assocs.	317-888-2260
Ind	South Bend, Valentine Schillinger & Assocs.	219-291-6258
Kans	Prarie Village, Engrg. Svcs. Co.	913-649-4000
Md	Randallstown, Beacon North	
Mass	Needham Hts., Todino Engrg. Sls.	617-444-7925
Mich	Detroit, Nicon Assocs.	313-341-7688
Minn	Minneapolis, E. C. Elctrns. Sls.	612-831-0229
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NM	Albuquerque, Shefler Kahn Co.	505-265-7077
NY	Camillus, Noco, Inc.	315-672-3988
NY	Garden City, Comtronic Assocs.	516-741-8966
NY	Pittsford, Noco, Inc.	716-461-4750
Ohio	Cleveland, A. H. Baier Co. & Assocs.	216-461-6161
Ohio	Dayton, A. H. Baier Co. & Assocs.	413-276-4128
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Dallas, R. Matthews Elctrns.	214-233-0363
Tex	Houston, R. Matthews Elctrns.	713-664-7131

Va	Falls Church, Beacon North	703-534-1673
Wash	Seattle, Blair Hirsh Co.	206-783-3423
FOR:	Can., Montreal, Que., Allied Elctrnc. Sls.	514-488-5547

Local Distributors

Ala	Huntsville, Cramer/EW, 2310 Bob Wallace Ave., S.W.	203-539-5722
Ariz	Phoenix, Cramer/Arizona, 2816 N. 16th St.	602-263-1112
Ariz	Phoenix, Micro Elctrns. Distrs., 2104 W. Peoria Ave.	602-944-2281
Ariz	Phoenix, R.V. Weatherford, 1917 N. 25th Dr.	602-272-7144
Cal	Anaheim, R.V. Weatherford Co., 1550 Babbitt Ave.	714-547-0891
Cal	Glendale, R.V. Weatherford Co., 6921 San Fernando Rd.	213-849-3451
Cal	Irvine, Cramer/Los Angeles, 17201 Daimler St.	213-771-8300
Cal	Los Angeles, T.I. Supply Co., 5200 W. 104th St.	213-776-4490
Cal	Palo Alto, Kierulff Elctrns., 3969 E. Bayshore Rd.	415-968-6292
Cal	Palo Alto, R.V. Weatherford Co., 3240 Hillview Ave.	415-493-5373
Cal	Pomona, R.V. Weatherford Co., 1095 E. Third St.	714-623-1261
Cal	San Diego, Cramer/San Diego, 8913 E. Complex Dr.	714-565-1881
Cal	San Diego, R.V. Watherford Co., 7872 Raytheon Rd.	714-278-7400
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Cal	Sunnyvale, T.I. Supply Co., 776 N. Palomar Ave.	408-732-5555
Colo	Denver, Cramer/Denver, 5465 E. Evans Pl. at Hudson	303-758-2100
Colo	Denver, T.I. Supply Co., 9725 E. Hampden Ave.	303-751-1780
Colo	Englewood, R.V. Weatherford Co., 3905 S. Mariposa	303-761-5432
Conn	Fairfield, U-Tronics, 273 Linwood Ave.	203-255-4521
Conn	N. Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/EW Hollywood, 4035 N. 29th Ave.	305-923-8181
Fla	Orlando, Cramer/EW Orlando, 345 N. Graham Ave.	305-894-1511
Fla	Tampa, U-Tronics, 5421 Jet View Cir.	
Ga	Atlanta, Cramer/EW Atlanta, 3923 Oakcliff Indl. Ct.	404-451-5421
Ill	Arlington Heights, T.I. Supply Co., 2420 E. Oakton Rd.	312-593-7660
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Chicago, Semiconductor Specialists Inc., Box 66125, O'Hare International Airport	
Ill	Des Plaines, Newark Elctrns., 2500 E. Davon	312-298-1420
Ill	Elmhurst, Semiconductor Specialists Inc., 195 W. Spangler	312-279-1000
Ill	Hickory Hills, Neward Elctrns., 7667 W. 95th St.	
Ill	Mt. Prospect, Cramer/Chicago, 1911 S. Busse Rd.	312-593-8230
Ind	Anderson, Elctrn. Supply, 2228-2230 N. Columbus Ave.	317-644-3381
Ind	Ft. Wayne, Fort Wayne Elctrns. Supply, 3606 E. Maumee Ave.	219-742-4346
Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania St.	317-635-5453
Ind	Indianapolis, Semiconductor Specialists, Box 41630, Weir Cook Airport	317-243-8271
Ind	Lafayette, Lafayette Radio Supply, 406-408-North St.	317-742-4006
Ind	Muncie, Muncie Elctrns. Supply, 222 N. Madison St.	317-288-8837
Iowa	Cedar Rapids, Deeco Inc., 2500 16th Ave. S.W.	
Md	Baltimore, Arrow/Angus, 5207 E. Dr. Shop Ctr.	301-247-5200
Md	Baltimore, Cramer/EW Baltimore, 922-924 Papapsco Ave.	301-354-0100
Md	Gaithersburg, Cramer/EW, 16021 Industrial Dr.	301-948-0110
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy., U.S. Rte #1	617-329-2400
Mass	Newton, Cramer/Intl., 85 Wells Ave.	617-969-7700
Mass	Waltham, T.I. Supply Co., 504 Totten Pond Rd.	617-890-0510
Mich	Detroit, R.S. Elctrns., 12775 Lydon Rd.	313-491-1000
Mich	Grand Rapids, R.S. Elctrns., 300 & 36th St. S.E.	616-241-3487
Mich	Livonia, Cramer/Detroit, 13193 Wayne Rd.	313-425-7000
Minn	Edina, Cramer/Minn., 7275 Bush Lake Rd.	612-835-5350
Minn	Minneapolis, Newark Elctrns., 336 Hoover St., N.E.	612-331-6350
Minn	Minneapolis, Semiconductor Specialists, 8030 Cedar Ave. S.	612-854-8841
Minn	Minneapolis, T.I. Supply Co., 7615 Metro Blvd.	612-835-5353
Mo	Kansas City, Semiconductor Specialists, 3805 N. Oak Trfwy.	816-452-3900
Mo	Kansas City, T.I. Supply Co., 7743 Troost Ave.	816-753-4750
Mo	St. Louis, Semiconductor Specialists Inc., 10062 Natural Bridge	314-428-6100
NJ	Clark, T.I. Supply Co., 301 Central Ave.	201-382-6400
NJ	Monachie, Cramer/NJ, 1 Barrett Ave.	201-935-5600
NJ	Moorestown, Arrow/Angus, Pleasant Valley Ave.	609-235-1900
NJ	Saddlebrook, Arrow Elctrns., 285 Midland Ave.	201-797-5800
NM	Albuquerque, Cramer/NM, 137 Vermont N.E.	505-265-5767
NM	Albuquerque, R.V. Weatherford Co., 6101 Marble Ave. N.E.	505-265-5671
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., 900 Broad Hollow Rd.	516-694-6800
NY	Fishkill, T.I. Supply Co., 167 Main St.	914-896-9630
NY	Freeport, Milgray Elctrns., 191 Hansi Ave.	516-546-6000
NY	Hauppague, Cramer/L.I., 20 Oser Ave.	516-231-5600
NY	Hauppague, Semi-Conductor Concepts, Engineers Rd.	516-273-1234
NY	Melville, T.I. Supply Co., 2 Huntington Qud., Ste 2N04	
NY	Rochester, Rochester Radio Supply, 140 W. Main St.	716-454-7800
NC	Winston-Salem, Cramer/EW Winston-Salem, 938 Burke St.	919-725-8711
Ohio	Cincinnati, Cramer Tri-States, 666 Redna Ter.	513-771-6441
Ohio	Cleveland, Cramer Elctrns., 5835 Harper Rd.	216-248-7740
Ohio	Cleveland, Newark Elctrns., 2028 E. 46th St.	216-361-4700
Ohio	Dayton, Esco Inc., 221 Crane St.	513-226-1133
Okla	Tulsa, Cramer/Tulas, 6336 E. 13th St.	918-836-3371
Okla	Tulsa, T.I. Supply Co., Draw "T", Admiral Sta.	918-437-4555
Ore	Portland, Almac/Stroum Elctrns., 8888 S.W. Canyon Rd.	503-292-3534
Pa	Pennsauken, Cramer/Pennsylvania, 7300 Rte 130 N.	215-923-5950
Pa	Pittsburg, Semicnoductor Specialists, 538 Alpha Dr.	412-781-8120
Tex	Austin, T.I. Supply Co., Box 2909	512-454-2531
Tex	Dallas, R.V. Weatherford Co., 10836 Grisson La.	214-243-1571
Tex	Dallas, Solid State Elec. Co. of Tex., 2643 Manana Dr.	214-352-2601
Tex	Dallas, T.I. Supply Co., 6000 Denton Dr.	214-238-6925
Tex	Houston, R.V. Weatherford Co., Box 42249	
Tex	Houston, T.I. Supply Co., 3939 Ann Arbor Dr.	713-785-4800
Utah	Salt Lake City, Alta Elctrns.	
Utah	Salt Lake City, Cramer/Utah, 391 W. 2500 So.	801-487-3681
Va	Arlington, T.I. Supply Co., 1500 Wilson Blvd.	703-524-5885
Wash	Seattle, Almac/Stroum Elctrns., 5811 Sixth Ave., S.	206-763-2300
Wash	Seattle, Cramer/Seattle, 5602 6th Ave. S.	
Wash	Seattle, R.V. Weatherford Co., 541 Industry Dr.	206-243-6340
Wisc	Brokfield, Newark Elctrns., 3695 N. 126th St.	414-781-2450
Wisc	Oak Creek, Cramer/Wisconsin, 430 W. Lawson Ave.	414-462-8300
For:	Can., Downsview, Ont., Cramer/Can., 920 Alness Ave.	416-781-6631
For:	Can., Montreal, Que., Elctrn. Wholesalers, 1935 Church Ave.	514-769-8861
For:	Can., Ottawa, Ont., Wackid Radio/T.V. Labs, 312 Parkdale	613-728-1821
For:	Can., Scarborough, Ont., Carsten Elec. Ltd., 54 Howden Rd.	416-751-2371
For:	Can., Toronto, Ont., Electrosonic Indl. Sls., 543 Young St.	416-924-9301
For:	Can., Vancouver, B.C., RAE Elctrns., 1629 Main St.	604-687-2621

TEXAS INSTRUMENTS, Control Prods. Div., 35 Forrest St., Attleboro, Mass., 02703, Tel: 617-222-2280, TWX: 710-346-0566

For info on price: B. Spence ext. 536; Application info: M. Peel ext. 218; Customer service: D. Nievera ext. 7327; Delivery info: B. Spence ext. 536

Free literature available: Literature covers edgeboard connectors, DIP sockets, keyboards, circuit breakers, switches, temperature controllers, thermostats, motor starting relays, and DTC controls.

Products manufactured: Bi-Metals, Thermostatic, Braid, Cable, Circuit Breakers, Connectors, Contact Strips, Finger, Contacts, Electrical, Controls/Control Eqpt., Current Sensors, Keyboards, Alphanumeric & Decimal, Limiters, Metals, Ovens, Protectors, Relays, Sockets, Suppressors, Switches, Transistor, Diode, Thyristor Heat Dissipators, Wire, Wire Shielding

Local Sales Offices & Reps.

Ala	Cullman	205-734-9160
Cal	Inglewood	213-645-1921
Cal	Sunnyvale	408-732-1840
Fla	Orlando	305-644-3535
Ill	Glenview	312-729-5710
Ind	Fort Wayne	219-484-0606
Ind	Indianapolis	317-787-5039
Iowa	Iowa City	319-351-7792
Ky	Louisville	502-451-2920
Ky	Versailles	606-873-3163
Md	Towson	301-296-8961
Mich	Central Lake	616-544-5931
Mich	Grand Rapids	616-245-3359
Mich	Southfield	313-353-0830
Mich	Tecumseh	313-423-8559
Minn	Minneapolis	612-835-5711
Mo	St. Louis	314-993-4546
NJ	Clark	201-574-9800
NY	East Syracuse	315-463-9291
NY	Fishkill	914-896-6793
NY	Huntington Station	516-293-2720
NC	Charlotte	704-375-2432
Ohio	Cleveland	216-464-2990
Ohio	Dayton	513-253-6128
Pa	Fort Washington	215-643-6450
Tenn	Brentwood	615-834-2637
Tex	Dallas	214-238-2524
Wisc	Wauwatosa	414-771-7210
FOR:	Can., Richmond Hill, Ont.	416-889-7373
FOR:	Can., St. Laurent, Que.	514-332-3550

TEXAS INSTRS. INC., Dig. Sys. Div., Box 1444, Houston, Tex., 77001, Tel: 713-777-1301

Products manufactured: Comm. Systems, Computers, Data Acquisition & Reduction Systems, Gages, Paper, Graphic Recording, Potentiometers, Recorders, Services, Assembly, Production & Test, Teleprinters, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic), Test Systems, Testers, Transducers, Transmission Systems, Data, Typewriters, Input-Output (All Types)

Local Sales Offices & Reps.

Ala	Huntsville	205-837-7530
Ariz	Phoenix	602-249-1313
Cal	Orange	714-547-9221
Cal	San Francisco	415-392-0229
Cal	Sunnyvale	408-732-1840
Colo	Denver	303-751-1780
Conn	Hamden	203-281-0074
Fla	Orlando	305-644-3535
Ga	Atlanta	404-458-7791
Ill	Schiller Park	312-671-0300
Ind	Indianapolis	317-248-8555
Mass	Waltham	617-890-7400
Mich	Southfield	313-353-0830
Minn	Minneapolis	612-835-5711
NJ	Clark	201-574-9800
NY	New York	212-541-9540
NY	Rochester	716-461-1800
Ohio	Cleveland	216-464-2990
Ohio	Dayton	513-253-6128
Pa	Ft. Washington	215-643-6450
Tex	Dallas	214-238-5318
Tex	Houston	713-777-1623
Va	Arlington	703-527-2800
Wash	Bellevue	206-455-1711
Wisc	Wauwatosa	414-475-1690
EXP:	Can., Richmond Hill, Ont., Texas Instr.	416-889-7373
FOR:	Can., St. Laurent, Quebec, Texas Instr.	514-332-3552

TEXAS INSTRUMENTS, Precision Controls Dept., 34 Forrest St., Attleboro, Mass., 02703, Tel: 617-222-2800; Empl.: 5000

Customer service: Precision Controls Dept.

Products manufactured: Circuit Breakers, Current Sensors, Keyboards, Alphanumeric & Decimal, Switches

Local Sales Offices & Reps.

Ala	Cullman	205-734-9160
Cal	Inglewood	213-645-1921
Cal	Sunnyvale	408-732-1840
Fla	Orlando	305-644-3535
Ill	Glenview	312-729-5710
Ind	Ft. Wayne	219-484-0606
Ind	Indianapolis	317-787-5039
Iowa	Cedar Rapids	319-362-3159
Ky	Louisville	502-451-2920
Md	Towson	301-296-8961
Mass	Waltham	617-890-7400
Mich	Grand Rapids	615-245-3359
Mich	Southfield	313-353-0830
Mich	Tecumseh	313-423-8559
Minn	Minneapolis	612-835-5711
Mo	St. Louis	314-993-4546
NJ	Clark	201-574-9800
NY	East Syracuse	315-463-9291
NY	Fishkill	914-896-6793
NY	Huntington Station	516-293-2720
NC	Charlotte	810-621-7813
Ohio	Cleveland	216-464-3584
Ohio	Dayton	513-298-0206
Ohio	Sidney	513-492-1222
Pa	Ft. Washington	215-643-6450
Tenn	Brentwood	615-834-2637
Tex	Dallas	214-238-6901
Wisc	Wauwatosa	414-771-7210
FOR:	Can., Richmond Hill, Ont.	416-889-7373
FOR:	Can., St. Laurent, 386, Que.	514-332-3550

TEXSCAN CORP., 2446 N. Shadeland Dr., Indianapolis, Ind., 46219, Tel: 317-357-8781, TWX: 810-341-3184; Empl.: 225; Minimum order: $25 .... p. 1•816,817

For info on price: R. Shevlot; Application info: R. Stelle; Customer service: C. Conger; Delivery info: M. Everett

Free literature available: Complete catalog on sweep signal generators spectrum analyzers. Complete catalog on attenuators, filters & oscillators.

Products manufactured: Analyzers, Attenuators, Bridges, Detectors, Filters, Generators, Mismatches, Microwave, Precision, Monitors, Oscillators, Oscilloscopes, Probes, Switches, Television Systems & Equipment Closed-Circuit, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scientific Inst.	205-837-1601
Cal	Los Angeles, R.F. Assocs.	213-478-1586
Cal	Palo Alto, R.F. Assocs.	415-494-3331
Conn	Hamden, Instr. Consits., Inc.	203-288-5246
Fla	Orlando, Truex Assoc.	305-859-2160
Haw	Honolulu, Aloha Assoc.	808-941-1574
Ill	North Brook, E.I.A.	312-271-3774
Ind	Indianapolis, E.I.A.	317-257-7231
Iowa	Cedar Rapids, Tech. Reps Inc.	319-363-2489
Md	Wheaton, Sonco Inc.	301-942-9420
Mass	Waban, Instr. Consits., Inc.	617-969-3372
Mich	Detroit, Micro Sls.	313-482-1229
Mo	Hazelwood, Techn. Reps Inc.	314-731-5200
Mo	Independence, Techn. Reps Inc.	816-737-1414
NJ	Dover, R. Diamond Inc.	201-366-7518
NJ	Hazlet, Mer-Mon Elctrns.	201-264-1851
NM	Albuquerque, A.L.S. Elctrns.	505-298-2575
NY	Bayside, R. Diamond	212-423-7330
NY	Syracuse, Labtronics	315-454-9314
NC	Winston-Salem, Radco Co.	919-722-9671
Ohio	Cleveland, Micro Sls.	216-725-4560
Ohio	Dayton, Micro Sls.	513-885-4171
Pa	Hatboro, Mer-Mon Elect.	215-672-5565
Tex	Dallas, Airep Elect.	214-363-5291
Wash	Seattle, Dewar Assoc.	206-763-2233
FOR:	Can., Montreal, Radionics	514-735-4565

TEXTOOL PRODUCTS, INC., 1410 W. Pioneer Dr., Irving, Tex., 75061, Tel: 214-259-2676; Empl.: 140

Customer service: R. White

Free literature available: Catalog featuring Price and Technical Information on our Standard Line of Test Sockets.

Products manufactured: Graphite Parts, Services, Assembly, Production & Test, Socket Adapters, Sockets

Local Sales Offices & Reps.

Ala	Huntsville, Tech Rep.	
Ariz	Scottsdale, Hagestad & Co.	602-945-0902
Cal	Cupertino, Bogen & Assoc.	408-257-4461
Cal	Pasadena, Mulvin & Co.	213-682-2737
Fla	Indian Rocks Beach, Tech Rep.	813-595-2834
Fla.	Largo, Tech Rep.	
Ill	Chicago, DJM Elctrn. Sls.	312-774-6525
NJ	Verona, C.K. Wall Co.	201-746-4832
Wash	Seattle, B. Hirsh	206-783-3423

THALNER ELECTRONIC LABS, INC., 7235 Jackson Rd., Ann Arbor, Mich., 48103, Tel: 313-761-4506

Customer service: R. Thalner

Free literature available: Data sheets provide complete description & specifications for Model VC-405 Video Frame Counter/Timer, Model 310 Video/Pulse Distribution Amplifier, Model SS-221 Video Screen Splitter and Model 110 Audio Program/Intercom.

Products manufactured: Amplifiers, Television Systems & Equipment Closed-Circuit

THERM-O-DISC, INC., South Main St., Mansfield, Ohio, 44907, Tel: 419-756-5911; Empl.: 1200; Minimum order: $150

For info on price: R. Massa; Application info: R. Massa; Customer service: W. Lomax; Delivery info: W. Lomax

Products manufactured: Controls/Control Eqpt., Fuses, Relays, Switches, Thermostats, Timers

THERM-O-LAB CORP., 6940 Farmdale Ave., N. Hollywood, Calif., 91605, Tel: 213-875-0105; Empl.: 30; Minimum order: $50

For info on price: R. L. Weible; Application info: A. R. Booker; Customer service: D. McBride; Delivery info: D. McBride

Free literature available: Complete catalogs describing information on applications of custom heating elements. Technical data on thermal studies.

Products manufactured: Heaters & Heating Elements

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe Sls.
Cal	Los Altos, Westec Elctrns.
Colo	Denver, Electronic Sls.
Ill	Chicago, Ash Equip. Co.
Kans	Prairie Village, Engineering Svcs. Co.
Minn	Lakeville, Caco Co.
Mo	St. Louis, Engineering Svcs. Co.
NY	Queens Village, L. A. Buscaglia
Ohio	Dayton, E. V. Swenson
Pa	Media, W. Reeves Assocs.
FOR:	Can., Ville La Salle, Que., Electodesign Ltd.

THERMALLOY, INC., 2021 W. Valley View, Dallas, Tex, 75234, Tel: 214-243-4321, TWX: 910-860-5542; Empl.: 250; Minimum order: $50 .... p. 1•1874-1880

For info on price: P. Clayton; Application info: J. Pritchett; Customer service: P. Clayton; Delivery info: P. Clayton

Free literature available: Semiconductor Mounting Pads, Compact Cooling Packages for the Electronics Industry, Insulators & Mounting Kits for Semiconductor Devices, Heat Sinks for Semiconductor Devices, Guides, Pullers, Ejectors for PC Boards, Cool It With Thermalloy, Inc. High Power Coolers.

Products manufactured: Adhesives (All Types), Bushings, Glass, Plastic, Metal, Rubber, Etc., Clamps & Clips, Compounds, Encapsulating, Insulating, Molding, Potting, Covers, Protective (Including Dust), Heat Exchangers & Systems, Insulators & Insulation, Pads, Transistor Mounting, Pullers, Sockets, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ala	Huntsville, Interep Assoc.	205-881-3677
Ariz	Scottsdale, Q.T. Wiles & Assoc.	602-948-5590
Cal	Los Angeles, Q.T. Wiles & Assoc.	213-478-0183
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, Q.T. Wiles & Assoc.	714-565-6893
Cal	Tustin, Q.T. Wiles & Assoc.	714-832-4952
Colo	Denver, Lindberg	303-758-9033
Fla	Clearwater, Dyne-A-Mark	813-441-4702
Fla	Ft. Lauderdale, Dyne-A-Mark	305-771-6501
Fla	Orlando, Dyne-A-Mark	305-299-6303
Ga	Atlanta, Interep Assoc.	404-394-7756
Ill	Elk Grove Village, John G. Twist Co.	312-593-0200
Ind	Ft. Wayne, R.O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assoc.	317-452-6065
Iowa	Cedar Rapids, Palatine Sls.	319-365-8071
Kans	Andover, Palatine Sls.	316-683-7512
Kans	Overland Park, Palatine Sls.	913-262-5643
Ky	Louisville, R.O. Whitesell & Assoc.	502-893-7303
Md	Bethesda, W. Mount Co.	301-657-9312
Mass	Andover, Sls. Engrg. Co.	617-470-0800
Mich	Grand Rapids, R.O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assoc.	616-983-7337
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	St. Louis, Palatine Sls., Inc.	314-426-7055
NJ	Springfield, F.F. Sylvester & Assoc.	201-376-3324
NM	Albuquerque, Lindberg Co.	505-345-2489
NY	No. Syracuse, Advanced Comps. Corp.	315-699-2671
NC	Charlotte, Over & Over, Inc.	704-527-3070
Ohio	Cincinnati, R.O. Whitesell & Assoc.	513-521-2290
Ohio	Columbus, R.O. Whitesell & Assoc.	614-888-8396
Ohio	Dayton, R.O. Whitesell & Assoc.	513-298-9546
Ohio	Lakewood, R.O. Whitesell & Assoc.	216-228-7525
Okla	Tulsa, Carter Assoc.	918-749-3311
Pa	Jenkintown, Warren Mount Co.	215-886-0383
Pa	Pittsburgh, R.O. Whitesell & Assoc.	412-344-7277
Pa	York, Warren Mount Co.	717-757-5823
Tenn	Bristol, Rakes Engrg. & Mktg. Corp.	615-968-4195
Tex	El Paso, Carter Assoc.	915-533-2681
Tex	Garland, Carter Assoc.	214-276-7151
Tex	Houston, Carter Assoc.	713-621-6930
Tex	Salt Lake City, Lindberg Co.	801-364-6409
Wisc	Wauwatosa, John G. Twist Co.	414-475-7755
FOR:	Can., Malton, Ont, Deskin Sls. Corp.	416-677-5517
FOR:	Can., Vancouver, Deskin Sls. Corp.	604-324-6331
FOR:	Can, Montreal, Deskin Sls. Corp.	514-331-2860

Local Distributors

Ala	Huntsville, Hall-Mark Elctrns., 2010 Bob Wallace Ave.	205-539-0691
Ariz	Phoenix, R. V. Weatherfod, 1917 N. 25th Dr.	602-272-7144
Ariz	Tempe, G. S. Marshall, 835 W. 22nd St.	602-968-6181
Cal	Anaheim, R. V. Weatherford, 1550 Babbitt Ave.	714-547-0891
Cal	El Monte, G. S. Marshall, 9674 Telstar Ave.	213-686-0141
Cal	El Segundo, T. I. Supp., 831 S. Douglas St.	
Cal	Glendale, R. V. Weatherford, 6921 San Fernando Rd.	213-849-3451
Cal	Irvine, G. S. Marshall, 17975 Sky Park Blvd.	714-556-6400
Cal	Palo Alto, R. V. Weatherford, 3240 Hillview Ave.	415-321-5373
Cal	Pomona, R. V. Weatherford, 1095 E. 3rd St.	714-623-1261
Cal	San Diego, G. S. Marshall, 8057 Raytheon Rd.	714-278-6350
Cal	San Diego, Intermark Elctrns., 7354 Convoy Ct.	714-279-5200
Cal	San Diego, R. V. Weatherford, 7872 Raytheon Rd.	714-278-7400
Cal	Santa Ana, Intermark Elctrns., 2920 W. Warner Ave.	714-540-1322
Cal	Sunnyvale, G. S. Marshall, 788 Palomar Ave.	408-732-1100
Cal	Sunnyvale, Intermark Elctrns., 1020 Stewart Dr., Box 9085	408-738-1111
Colo	Arvada, G. S. Marshall, 5633 Kendall Ct.	303-423-9670
Colo	Denver, Intermark Elctrns., 2600 W. Second St.	303-936-8284
Colo	Denver, T. I. Supp., 2149 S. Holly St.	303-757-7671
Colo	Englewood, R. V. Weatherford, 3905 S Mariposa	303-761-5431
Conn	Fairfield, U-TRONICS, 273 Linwood Ave.	203-255-4521
Conn	Waterbury, Suburban Supp., 117 Benedict, Box 230	203-757-1251
Fla	Ft. Lauderdale, Hall-Mark Elctrns., 1302 W. McNab Rd.	305-971-9280
Fla	Orlando, Hall-Mark Elctrns., 7233 Lake Ellenor Dr.	305-855-4020
Ga	Atlanta, Lykes Elctrns., Box 19837	404-355-2223
Ill	Arlington Heights, T. I. Supp., 2420 E. Oakton Rd.	312-593-7660
Ill	Chicago, Semiconductor Specialists, Box 66125, O'Hare Intl. Airport	312-279-1000

Ill	Elgin, Allied Elctrns., 1355 S Hollow Rd.	312-697-8200
Ill	Elk Grove, Hall-Mark Elctrns, 180 Crossen Ave.	312-437-8800
Ind	Evansville, Hutch & Son, 300 N. Main St.	812-425-7155
Ind	Ft. Wayne, Fort Wayne Elctrns. Sup., 3606 Maumee Ave.	219-423-3422
Ind	Indianapolis, Harvey Indiana, 8505 Zionsville Rd.	317-297-4910
Kans	Lenexa, Hall-Mark Elctrns., 9006 Rosehill Rd.	913-888-4747
Md	Baltimore, Hall-Mark Elctrns., 6660 Security Blvd.	301-265-8500
Md	Baltimore, Radio Elec. Serv. Co. of Balt., 1026 Cromwell Bridge Rd.	301-823-0070
Md	Rockville, Pioneer Washington Elctrns., 1037 Taft St.	301-424-3300
Mass	Boston, Demambro Elctrns., 1095 Commonwealth Ave.	617-787-1200
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy., U.S. Rte. #1	617-329-2400
Mich	Farmington, Harvey/Michigan, 23461 Ind. Pk. Rd.	313-477-1650
Minn	Bloomington, Hall-Mark Elctrns., 9201 Penn Ave. S., Suite 10	612-884-9056
Minn	Edina, Harvey-Minnesota, 6969 Washington Ave., S.	612-941-6060
Minn	Minneapolis, Stark Elctrns. Supp., 112 Third Ave. N.	612-332-1325
Mo	Earth City, Hall-Mark Ectrns., 13789 Rider Trail	314-291-5350
Mo	University City, Olive Ind Elctrns., 6662 Olive Blvd.	314-863-7800
Mo	University City, Olive Ind. Elctrns., 6662 Olive Blvd.	314-863-7800
NJ	Cinnaminson, Wilshire Elctrns., 855 Ind. Hwy.	609-786-8990
NJ	Clark, T. I. Supp., 301 Central Ave.	201-382-6400
NJ	Clifton, Wilshire Elctrns., 312 Clifton Ave.	201-365-2600
NJ	Moorestown, Arrow Angus, Pleasant Valley Ave. Box 126	609-235-1900
NM	Albuquerque, R. V. Weatherford, 6101 Marble Ave., N.E.	505-265-5671
NY	Binghamton, Harvey Elctrns., Box 1208 Vestel Pkwy E.	607-748-8211
NY	Bohemia, Car-Lac Elctrn. Ind. Sls., 75 Orville Dr.	516-567-4200
NY	Buffalo, Summit Distr., 916 Main St.	716-884-3450
NY	Farmingdale, Norelcom Elctrns., 200 Allen Blvd.	516-249-7262
NY	Farmingdale, Wilshire Elctrns., 1855 New Highway, Unit B	516-293-5775
NY	Rochester, Rochester Radio Supp., 140 W. Main St.	716-454-7800
NY	Rochester, Summit Elctrns of Rochester, 292 Commerce Dr.	716-334-8110
NC	Greensboro, Hammond Elctrns. of Carolina, 2923 Pacific Ave.	919-275-6391
NC	Raleigh, Hall-Mark Elctrns., 3000 Ind. Dr.	919-832-4465
Ohio	Cleveland, Elctrns. Mktg., 1890 Bromton Dr.	216-292-6236
Ohio	Cleveland, W. M. Pattison Supp., 4550 Willow Pkwy., Box 6178	216-441-3000
Ohio	Columbus, Elctrns. Mktg., 1150 W. Third Ave.	614-299-4161
Ohio	Dayton, Elctrns. Mktg., 2400 E. Dorothy La.	En-1140
Ohio	Dayton, ESCO, 221 Crane St.	513-226-1133
Ohio	Twinsburgh, Elctrns Mktg., 946 Concord Cir.	216-425-2942
Ohio	Westerville, Elctrns. Mktg., 154 Brisbane Ave.	614-866-3493
Okla	Tulsa, Hall-Mark Elctrns., 4846 S. 83rd E. Ave.	918-835-8458
Okla	Tulsa, Radio, Inc., 1000 S. Main	918-587-9123
Okla	Tulsa, T. I. Supp., Drawer T, Admiral Sta.	918-437-4555
Pa	Pittsburgh, Cameradio Elctrns., 2801 Liberty Ave.	412-288-2600
SC	Greenville, Hammond Elctrns of Carolina, 100 Augusta St., Box 2308	803-233-4121
Tenn	Kingsport, Radio Elec. Supp., 961 East Sullivan St.	615-247-8111
Tenn	Nashville, Electra Dist., 1914 W. End Ave.	615-329-3971
Tex	Dallas, Hall-Mark Elctrns., 9333 Forest La.	214-231-6111
Tex	Dallas, R. V. Weatherford, 10836 Grissom La.	214-243-1571
Tex	Dallas, T. I. Supp., 6000 Denton Dr.	214-238-6821
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Hall-Mark Elctrns., 8000 Westglen	713-781-6100
Tex	Houston, R. V. Weatherford, 3500 W. T.C. Jester Blvd.	
Tex	Houston, T. I. Supp., 3939 Ann Arbor Dr.	713-758-4800
Utah	Salt Lake City, Intermark Elctrns., 63 E. Stratford Ave.	801-486-3411
Wash	Seattle, Intermark Elctrns., 621 S. Michigan St.	206-767-3160
Wash	Seattle, R. V. Weatherford, 541 Industry	206-762-4200
Wash	Seattle, Radar Elec., 168 Western Ave. W.	206-282-2511
Wisc	Maquon, Taylor Elec., 1000 W. Donges Bay Rd.	414-241-4321
Wisc	Milwaukee, Hall-Mark Elctrns., 11925 W. Ripley Ave.	414-476-1270
For:	Can. Montreal, Que., Deskin Sls., 290 Benjamin Hudon St.	514-331-2860
For:	Can., Malton, Ont., Deskin Sls., 2759 Thamesgate Dr.	416-677-5517
For:	Can., Vancouver, B.C., Deskin Sls., 272 S.W. Marine Dr.	604-324-6331

THERMAX WIRE CORP., 32-02 Linden Pl., Flushing, N.Y., 11354, Tel: 212-939-8300, TWX: 710-582-2551; Empl.: 160

Customer service: J. Spinella

Products manufactured: Braid, Cable, Cable, Wire

Local Sales Offices & Reps.

Ala	Huntsville, G. White Assocs.	804-846-4624
Ariz	Phoenix, South West Engrg.	602-993-0250
Cal	Mtn. View, Sonic Wire Sls.	415-965-4646
Cal	Van Nuys, Sonic Wire Sls.	213-781-3490
Colo	Denver, West Mark Assocs.	303-433-7181
Fla	Pompano Beach, Varrelman-Gorman Co.	305-941-5544
Fla	Winter Park, Varrelman-Gorman Co.	305-425-1611
Ill	Chicago, Dearborn Wire Co.	312-696-1000
Md	Glen Arm, Glen White Assocs.	301-252-5610
Mass	Clinton, F. J. Coleman Co.	617-894-1858
Mich	Grand Rapids, Thies Assocs.	616-245-0319
Mich	Jenison, Thies Assocs.	
Minn	Edina, Wagner Components	612-941-6310
Mo	St. Chas., Finnigan Wire & Cable	314-724-6690
NJ	Boonton, Varrelman-Gorman Co.	201-838-3272
NJ	Dover, V & G Co.	201-992-2505
NJ	Livingston, Varrelman-Gorman Co.	201-992-2505
NY	Camellus, Varrelman-Gorman Co.	315-458-4774
NY	Centerport, Varrelman-Gorman Co.	212-IN3-5000
NC	Raleigh, G. White Assoc.	919-876-5617
Ohio	Cinncinnati, A.C. Wahl Co.	513-821-3270
Tenn	Johnson City, G. White Assoc.	615-928-0184
Tex	Dallas, United Components	214-324-1448
Va	Lynchburg, G. White Assoc.	804-846-4624
Wash	Bellevue, Rayover Sls.	206-454-4551

THERMO ELEC. CO., INC., 109 Fifth St., Saddle Brook, N.J., 07662, Tel: 201-843-5800, TWX: 710-990-5108; Empl.: 350

For info on price: J. Adamo; Application info: Local Office; Customer service: J. Adamo; Delivery info: J. Adamo

Free literature available: Complete looseleaf binder type catalog, Individual catalog section for each product.

Products manufactured: Cable, Connectors, Controls/Control Eqpt., Gages, Indicators, Meters, Monitors, Probes, Pyrometers, Switches, Thermocouples, Elements & Accessories, Transducers, Wire

Local Sales Offices & Reps.

Cal	North Hollywood, Thermo Elc.	213-765-5276
Cal	San Francisco, Thermo Elec.	415-654-8290
Colo	Denver, Ross Equipment Co.	303-759-4215
Ga	Atlanta, Thermo Elec.	404-633-9584
Ill	Hinsdale, Thermo Elec.	312-325-2840
Ind	Indianapolis, Thermo Elec. Enterprise 9508	
Ky	Louisville, Thermo Elec. Enterprise 9510	
La	Baton Rouge, Alford, Woods & Childs	504-275-5480
Md	Baltimore, Arobone & Cline	215-248-1243
Mass	Norwood, Thermo Elec.	617-769-2370
Mich	Detroit, Thermo Electric	216-433-4510
Minn	Minneapolis, Thermo Elec. Zenith 9510	
Mo	Kansas City, Thermo Elec.	214-352-7778
Mo	St. Louis, Thermo Elec. Enterprise 9510	
NJ	Fair Lawn, Thermo Elec.	201-791-9683
NY	New York, Thermo Elec.	212-564-2560
NY	Rochester, Thermo Elec.	716-377-4632
Ohio	Cincinnati, Thermo Elec. Enterprise 9510	
Ohio	Cleveland, Thermo Elec.	216-433-4510
Ohio	Columbus, Thermo Elec. Enterprise 9510	
Pa	Philadelphia, Arobone & Cline	215-248-1243
Pa	Pittsburgh, Thermo Elec.	216-433-4510
Tex	Dallas, Thermo Elec.	214-352-7778
Tex	Houston, Thermo Elec.	713-644-5466
Va	Richmond, Arobone & Cline	703-643-7373
WVa	Charleston, Process Instr. Equip. Co.	304-344-2237
Wash	Bellevue, Antec Corp.	206-232-1094
WVa	Charleston, Thermo Elec., Enterprise 0875	
FOR:	Can., Brampton, Ont., Thermo Elec. Ltd.	416-451-0813
FOR:	Can., Montreal, Que., Thermo Elec. Ltd.	514-331-2032
FOR:	Can., New Brunswick, NS, Thermo Elec. Ltd.	514-747-7511
FOR:	Can., Saskatchewan, Alb., Thermo Elec. Ltd.	403-252-4222
FOR:	Can., Toronto, Ont., Thermo Elec. Ltd.	416-451-0813
FOR:	Can., Vancouver, BC, Northern Columbia Process Equip. Ltd.	604-987-7194
FOR:	Can., Winnipeg, Manitoba, R. E. Sparrow Ltd.	204-786-5698

THERMO SYS., INC., 2500 Cleveland Ave., N., St. Paul, Minn., 55113, Tel: 612-633-0550, Telex: 297482; Empl.: 50

Customer service: F. L. Paul

Free literature available: General Anemometry Catalog - This 100 page edition describes Thermo-Systems' complete velocity and temperature measurement products and applications in three indexed sections.

Products manufactured: Counters, Meters, Signal Conditioners & Equipment, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assoc.	205-837-0221
Cal	San Marino, Dale-Dahl Assocs.	213-682-3417
Cal	Walnut Creek, Dale-Dahl Assocs.	415-933-9595
Colo	Parker, Technology Mktg. Assoc.	303-841-3435
Fla	Maitland, Craft Assoc. Co.	305-645-2242
Ga	Atlanta, Craft Assoc. Co.	404-393-0400
Kans	Prairie Village, Engrg. Serv. Co.	913-649-4000
Md	Fulton, Gans-Fryling	301-837-6311
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Mo	St. Louis, Engrg. Serv. Co.	314-997-1515
NJ	Ringwood, Thermo-Systems	201-839-0720
NM	Albuquerque, Technology Mktg. Assoc.	505-298-4321
Ohio	Dayton, Instrumentation Sys.	513-294-2838
Ore	Portland, McLaren	503-297-2248
Pa	Pittsburgh, Instrumentation Sys.	412-243-1111
Tex	Houston, Roger Martin Assoc.	713-462-4077
Va	Arlington, Gans-Fryling	703-527-3262
Wash	Bellevue, McLaren	206-454-3400

THERMOELECTRICS, See Borg-Warner Thermoelectrics.

Free literature available: Transit cases, re-usable shipping containers Thermodyne capabilities and products

Products manufactured: Cabinets & Accessories, Cases, Transit, Containers

THERMOMETRICS, INC., 15 Jean Pl., Edison, N.J., 08817, Tel: 201-548-2299; Empl.: 30

Products manufactured: Bridges, Controls/Control Eqpt., Detectors, Thermistors, Transducers

THERMOTECH, See ITT Thermotech.

THETA INSTR. CORP., 24 Dwight Pl., Fairfield, N.J., 07006, Tel: 201-227-1700; Empl.: 85

Products manufactured: Alarms, Amplifiers, Analyzers, Bridges, Calibrators, Comm. Systems, Comparators, Computers, Controls/Control Eqpt., Converters, Counters, Couplings, Data Acquisition & Reduction Systems, Data Loggers, Decoders, Demodulators, Detectors, Dials, Display Devices/Displays, Drivers & Decoders For Readouts, Drives & Drive Mechanisms (Dial), Encoders, Generators, Indicators, Meters, Modulators, All Kinds, Modules, Logic, Encapsulated, Multiplexers, Networks, Repeaters, Servo, Scales, Dial, Servo Systems, Shifters, Standards, Testers, Totalizers, Digital, Transducers, Translators, Data, Transmission Systems, Data

Local Sales Offices & Reps.

Cal	Encino, King-Way Assocs.	213-788-4124
Ohio	Chagrin Falls, Kilroy Corp.	216-247-8997
Ore	Portland, J.N. Kuvallis Co.	503-284-6808

THIN FILM SERVICES, Box 188, Gile, Wisc., 54525, Tel: 715-561-2031; Empl.: 3; Minimum order: $150

Customer service: R. G. Ahonen

Free literature available: Folder describing services available at Thin Film Services.

Products manufactured: Circuits, Hybrid, Thin-Film, Coatings, Deposition Equipment, Vacuum & Accessories, Films, Services, Assembly, Production & Test

THINCO, INC., Davisville Rd., Hatboro, Pa., 19040, Tel: 215-675-5000, TWX: 510-665-6822

For info on price: J. L. Hull; Application info: T. Jennings; Customer service: J. L. Hull; Delivery info: J. L. Hull

Free literature available: Data sheets describing specifications of vacuum-deposited chip capacitors and inductors.

Products manufactured: Capacitors, Fixed, Coils Including Assemblies & Forms, Filters, Networks

THOMAS & BETTS CO., 36 Butler St., Elizabeth, N.J., 07206, Tel: 201-354-4321, TWX: 201-354-6621; FSC No: 59730; Empl.: 2000

For info on price: A. Beiswinger; Customer service: R. Nehring

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Cable Assemblies & Harnesses, Caps, Connector, Clamps & Clips, Coatings, Connectors, Heat Guns, Production, Kits, Terminal, Labels, Pressure-Sensitive, Adhesive, Meters, Plugs, Posts, Reels, Cord & Cable, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Strips, Terminal Blocks, Boards & Strips, Terminals, Testers, Tools, Tubing, Wrenches

Local Sales Offices & Reps.

Ariz	Phoenix, Thomas & Betts Co.	602-258-1823
Cal	Los Angeles, Thomas & Betts Co.	213-268-3191
Cal	Santa Clara, Thomas & Betts Co.	408-243-7827
Colo	Denver, I.W. Strong & Assoc.	303-292-6900
Ga	Atlanta, Thomas & Betts Co.	404-355-6260
Ill	Arlington Heights, Thomas & Betts Co.	312-439-3100
Mass	Braintree, Thomas & Betts Co.	617-843-0373
Mich	Keego Harbor, The Thomas & Betts Co.	313-682-2711
Minn	Minneapolis, Thomas & Betts Co.	612-333-2419
Mo	St. Louis County, Thomas Betts	314-731-3338
NJ	Elizabeth, Thomas & Betts Co.	201-352-2265
NJ	Moorestown, Thomas & Betts Co.	609-234-0505
NY	Chittenango, Thomas & Betts Co.	315-687-2051
NC	Charlotte, Thomas & Betts Co.	704-525-5354
Ohio	Cincinnati, Thomas & Betts Co.	513-271-6686
Ohio	Cleveland, Thomas & Betts Co.	216-243-8123
Pa	Philadelphia, Thomas & Betts Co.	215-934-5114
Tenn	Memphis, Thomas & Betts Co.	901-365-4080
Tex	Houston, Thomas & Betts Co.	713-461-0610
Va	Richmond, Thomas & Betts Co.	703-272-1480

THOMAS ELCTRNS., INC., 100 Riverview Dr., Wayne, N.J., 07470, Tel: 201-696-5200, TWX: 710-988-5836; QPL No: 01852; Empl.: 230

For info on price: B. Setticase; Application info: B. Setticase; Customer service: B. Houghton; Delivery info: B. Houghton

Products manufactured: Tubes

Local Sales Offices & Reps.

Cal	Los Altos, Cain-White & Co.	415-948-6533
Cal	Pasadena, A-F Sls. Engrg., Inc.	213-681-5631
Colo	Wheatridge, Waugaman Assocs., Inc.	303-423-1020
Md	Hyattsville, Eastern Comps.	301-577-2925
Mass	Norwood, Stan Pierce, Inc.	617-762-3164
Okla	Broken Arrow, P. J. Scanlon Co.	
Pa	Flourtown, Eastern Comps.	215-836-1616
Tex	Richardson, P. J. Scanlon Co.	214-231-4661
Exp:	Fairfield, N.J., Pantronics, Inc.	201-575-1177
Exp:	Teaneck, N.J., Sylvan Ginsbury	201-837-1100
For:	Can., Montreal, Specialty Elctrns., Inc.	514-336-4500
FOR:	Can., Ont., Mississouga, Specialty Elctrns.	416-678-2104

THOMAS & SKINNER, INC., Box 150-B, 1120 E. 23rd St., Indpls., Ind., 46206, Tel: 317-923-2501, Telex: 027-335; Empl.: 200; Minimum order: $25

p. 1•818,819

Customer service: G. J. Cunningham

Free literature available: Thomas & Skinner, Inc. Manufactures Permanent Magnets, Transformer Laminations, and Magnetic Instrumentation for the magnetization, measurement, stabilization and/or testing of magnets.

Products manufactured: Analyzers, Calibrators, Cores, Magnetic, Demagnetizers, Hysteresisgraphs, Indicators, Laminations, Magnetizers, Magnets, Meters, Services, Assembly, Production & Test, Testers

Local Sales Offices & Reps.

Cal	Los Angeles, T. & Skinner, Inc.	213-532-0960
Cal	Mt. View, Melchior-Wesley Assocs.	415-964-2321
Ill	Chicago, T. & Skinner, Inc.	312-743-5511
Ind	Indianapolis, Thomas & Skinner, Inc.	317-923-2501
NH	Londonderry, R.H. Davis	603-432-7858
NJ	Rahway, T. & Skinner, Inc.	201-574-0550
Ore	Portland, C.K. Shanks & Assocs.	503-292-5656
FOR:	Scarborough, Ont., Can., Paisley Products of Can. Ltd.	416-755-2216

THOMSON-CSF ELECTRON TUBES INC., 50 Rockefeller Plaza, New York, N.Y., 10020, Tel: 212-489-0400; Empl.: 7

Products manufactured: Tubes

THOR ELCTRNS. CORP., 741 Livingston St., Elizabeth, N.J., 07207, Tel: 201-354-2420; Empl.: 15; Minimum order: $10

For info on price: A. Crudele; Customer service: D. Bowen; Delivery info: D. Bowen

Free literature available: Catalogs on electronic tube, diodes, transistors.

Products manufactured: Diodes, Integrated Circuit Devices, IC's, Active Filters, Rectifiers, Resistors, Transistors, Tubes

THORDARSON MEISSNER, Electronic Ctr., Mt. Carmel, Ill., 62863, Tel: 618-262-5121, TWX: 510-525-2254; FSC No: 96256; Empl.: 600

Customer service: Ind. Sls.

Free literature available: Pocket Industrial/Military Catalog; Switch & Timer Catalog; Switch & Timer Brochure; Fine Wire Tensioning Device Brochure

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Switches, Timers, Transformers, Yokes

Local Sales Offices & Reps.

Cal	Encino, King-Way Assocs.	213-788-4124
Fla	North Miami, Winfield Elctrn. Sls. Co.	305-945-6544
Mass	Needham, Mullin Tech. Sls. Co.	617-444-4780
Mich	Dearborn, Pitcher-Poulin	313-725-4999
NJ	Cherry Hills, Trinkle Sales Inc.	609-795-4200
NY	N. Syracuse, L.D. Allen, Inc.	315-458-7470
Ohio	Cleveland, Imtech, Inc.	216-826-3400
Tex	Dallas, J. McKinney Sls.	214-631-9450
EXP:	Miami, Fla., Louis D. Coheny Cia	305-635-8670

3M COMPANY, Electronic Products Div., 3M Center, St. Paul, Minn., 55101, Tel: 612-733-1452

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Products manufactured: Backpanel Interconnect Systems, Cable Assemblies & Harnesses, Cable, Chemicals, Circuits, Flexible, Clamps & Clips, Coatings, Connectors, Etchants, Printed Circuit, Fasteners, Integrated Circuit Packaging Systems, Jumpers, Laminates, Packages, Integrated Circuit, Pliers, Sockets, Strip-Line Components, Microwave, Substrates, Tools, Wire, Wire & Cable Ties

Local Sales Offices & Reps.

Alas	Anchorage	907-279-6481
Cal	Los Angeles	213-726-1511
Cal	So. San Francisco	415-761-1155
Ga	Atlanta	404-451-1661
Haw	Honolulu	808-841-0147
Ill	Chicago	312-585-7800
Mass	Boston	617-449-0300
Mich	Detroit	313-477-5000
Minn	St. Paul	612-733-5960
Mo	St. Louis	314-991-1320
NJ	West Caldwell	201-227-9100
NY	Buffalo	716-894-5214
NC	High Point	919-883-0141
Ohio	Cincinnati	513-242-2313
Ohio	Cleveland	216-267-1800
Pa	Philadelphia	215-742-0200
Tex	Dallas	214-327-7311
Wash	Seattle	206-244-7200

Local Distributors

Ala	Huntsville, Powell Elctrns. Inc., 803 Oster Dr. Box 1095	205-539-2731
Cal	Mt. View, Powell Elctrns. Inc., 411 Fairchild Dr.	415-964-0820
Cal	Mt. View, Ratel Elctrns., 815 Maude Ave.	415-965-2010
Cal	San Diego, Richey Elctrns., 5258 Kearny Villa	714-565-4444
Cal	Sun Valley, Richey Elctrns., 10871 La Tuna Canyon Rd.	213-875-2862
Colo	Denver, B-5, Inc., 7100 Broadway, Bldg. 3-1	303-426-0222
Conn	Hamden, Impact Sales Co., 60 Connelly Pkwy. Bldg. # 2 Rm. 8	203-281-1331
Fla	Miami Springs, Powell Elctrns., Inc., 1744 N.W. 69th Ave., Box 660514	305-592-3260
Ill	Chicago, Prehler Electric, 2300 N. Kilbourn	312-384-6100
Ill	Mt. Prospect, Magnuson Elctrns., 2420 Oakton St. Box 130	312-956-0700
Ind	Indianapolis, Sheridan Assocs., 4002 Meadows Dr.	317-547-7777
Iowa	Des Moines, Beams, Inc., 2426 Welbeck Rd.	515-279-3015
Kans	Overland Park, Sheridan Assocs., 10100 Santa Fe Dr. Mark I Bldg., Suite 101	913-383-1636
Md	Beltsville, Powell Elctrns., Inc., 10728 Hanna St.	301-937-4030
Md	Gaithersburg, Deanco, Inc., 16879 Oakmont Ave.	301-948-5444
Mass	Waltham, Impact Sales Co., 223 Crescent St.	617-893-2850
Mich	Farmington, Sheridan Assocs., Box 529 24543 Indoplex Dr.	313-477-3800
Minn	St. Paul, Ragon Elctrns., Inc., 1136 W. Larpenteur Ave.	612-488-0201
Mo	Florissant, Sheridan Assocs., Box 677	314-837-5200
NJ	Parsippany, Deanco, Inc., 146 A Parsippany Rd.	201-386-1300
NY	Farmingdale, D.R.W. Electronics, 100 Milbar Blvd.	516-249-2660
NY	Ithaca, Deanco, Inc., 714 W. Clinton St.	607-272-2198
NC	Raleigh, Deanco, Inc., Roger Executive Center 3301 Women's Club Dr. Suite 146	919-782-9226
Ohio	Beachwood, Sheridan Assocs., Inc., 23224 Commerce Park Rd.	216-831-0130
Ohio	Cincinnati, Sheridan Assocs., Box 37826	513-761-5432
Ohio	Cleveland, Prehler Electric, 12200 Brookpark Rd.	216-267-2650
Ohio	Columbus, Electronic Mktg. Corp., 1150 W. Third Ave.	614-299-4161
Ohio	Dayton, Sheridan Assocs., Inc., Box 423 Suite 250 - Shiloh Bldg. 5045 N. Main St.	513-277-8911
Okla	Tulsa, Norvell Elctrns., Inc., 3340 S. Memorial Dr.	918-663-1247
Pa	Philadelphia, Powell Elctrns., Inc., S. Island Rd. Box 8765	215-365-1900
Pa	Pittsburgh, Sheridan Assocs., 1717 Penn Ave. - Suite 5009	412-244-1640
Tex	Dallas, Norvell Elctrns., Inc., 10210 Monroe	214-350-6771
Tex	Dallas, Powell Elctrns., Inc., 2860 Walnut Hill Lane, Suite 105	214-350-4186
Tex	Houston, Norvell Elctrns., Inc., 6440 Hillcroft	713-774-2568

3M CO., Industrial Electrical Prods. Div., 3M Center, St. Paul, Minn., 55101, Tel: 612-733-0219; Empl.: 37000

Products manufactured: Adhesives (All Types), Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Controls/Control Eqpt., Films, Insulators & Insulation, Magnets, Semiconductor Wafer Fabrication, Shields, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive, Tubing

Local Sales Offices & Reps.

Cal	Los Angeles	213-726-1511
Cal	S. San Francisco	415-761-1155
Ga	Chamblee	404-451-1661
Ill	Bedford Park	312-458-2200
Mass	Needham Heights	617-449-0300
Minn	St. Paul	612-733-1110
Mo	St. Louis	314-991-1320
NJ	Caldwell	201-227-9100
NY	Buffalo	716-894-5214
NY	New York	212-285-9600
NC	High Point	919-883-0141
Ohio	Cincinnati	513-242-2313
Ohio	Cleveland	216-267-1800
Pa	Philadelphia	215-742-0200
Tex	Dallas	214-327-7311
Wash	Seattle	206-244-7200

THWING-ALBERT INSTR. CO., 10960 Dutton Rd., Philadelphia, Pa., 19154, Tel: 215-NE 7-0100, TWX: 710 670 1763; Empl.: 50; Minimum order: $20

For info on price: R. A. Solomon; Application info: T. J. Roache; Customer service: T. J. Roache; Delivery info: T. J. Roache

Products manufactured: Bridges, Cells, Load, Indicators, Services, Assembly, Production & Test, Testers, Transducers

Local Sales Offices & Reps.

Cal	Long Beach, Saber Enterprises	213-595-5646
Cal	San Francisco, LaFrance Entprs.	415-567-4488
La	New Orleans, Wm. S. Huey Co.	504-866-6341
Ill	Park Forest, F.L. Brooke Co.	312-479-2544
Mass	Lexington, W. R. Hatfield Assocs.	617-861-0201
Minn	Minneapolis, E. J. Doyle Co.	612-827-5847
NY	Rochester, Holter Assocs.	716-381-7988
Ore	Portland, Extech, Ltd.	503-292-9219
Tex	Houston, Whitson Sullivan Co.	713-645-1801
Tex	Plano, Whitson Engrg. Co.	214-423-5255

TIMBER-TOP, INC., 199E N. Main St., Freeport, N.Y., 11520, Tel: 516-FR 9-0850; Empl.: 5

Customer service: W. E. Fischer

Products manufactured: Clamps & Clips

Advertisment

TTI's SYNCLAMPS are the ONLY quick-releasing, self-locking and INSTANT NULLING SYNCHROCLAMPS! Their INTEGRAL STOPS permit component mounting and nulling (techniques that can save 70% OR MORE of the mounting and nulling time!). SYNCLAMPS meet the MAXIMUM MIL SHOCK AND VIBRATION: 2000 ft-lbs/2000 cps! They also have the LOWEST INSTALLED COST of any type of clamp! A size and style for ANY size component and ANY application!!

TIMES WIRE & CABLE, Sub. INSILCO Corp., 358 Hall Ave., Wallingford, Conn., 06492, Tel: 203-265-2361, TWX: 710-476-0763; Empl.: 250

Products manufactured: Cable Assemblies & Harnesses, Cable, Connectors, Delay Lines, Wire

Local Sales Offices & Reps.

Ala	Huntsville, 20th Century Mktg.	205-772-9237
Ariz	Scottsdale, Mercury Engrg.	602-945-1927
Cal	Mountain View, Westrep-North	415-968-5800
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-279-9412
Colo	Denver, Zeus, Inc.	303-771-6200
Fla	Altamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-726-8871
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Chicago, Balhorn & Welch, Inc.	312-889-5011
Kans	Overland Pk., Penzner Mankus Assoc.	913-DU 1-0004
Kans	Wichita, Penzner-Mankus Assoc.	316-264-2662
Md	Towson, J-H Elctrn. Sls.	301-VA 5-4440
Mass	Clinton, F. J. Coleman & Co.	617-894-1855
Mich	Ferndale, Hilltronics	313-398-5556
Mo	Hazelwood, Penzner	314-731-4334
NM	Albuquerque, Zeus, Inc.	505-256-9831
NY	Syracuse, Electra Sls., Inc.	315-455-5783
NC	Charlotte, D. G. W., Inc.	704-334-7090
NC	Winston-Salem, D.G.W., Inc.	919-768-7166
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Okla	Okla. Cy., Ammon & Rizos	405-947-1051
Okla	Tulsa, Ammon & Rizos	918-663-8518
Pa	Flourtown, Precision Elctrns.	215-MI 6-8383
Tex	Dallas, Ammon & Rizos	214-233-5591
Tex	Houston, Ammon & Rizos	713-PA 9-1233
Utah	Salt Lake City, Zeus, Inc.	801-486-2317
Wash	Seattle, Seatronics	206-767-4330
EXP:	N.Y., N.Y., Tennant & Sons	212-889-8530
FOR:	Can., Malton, Ont., A. Deskin Sls. Corp.	416-677-5517
FOR:	Can., Vancouver, B.C., A. Deskin Sls. Corp.	604-253-6396
FOR:	Can., W. Montreal, Que., A. Deskin Sls. Corp.	514-384-1420

TITAN TOOL SUPPLY CO., INC., 68 Comet, Buffalo, N.Y., 14216, Tel: 716-873-9907; Empl.: 8; Minimum order: $25

For info on price: D. Wise; Application info: T. Kahn; Customer service: T. Kahn; Delivery info: D. Wise

Free literature available: Catalog - All microscopes Catalog - Bulbs & lights

Products manufactured: Lamps, Microscopes

TITCHENER, E.H. & CO., 8 Titchener Pl., Binghamton, N.Y., 13902, Tel: 607-772-1161, TWX: 510-252-1985; Empl.: 235

Customer service: Sales Dept.

Free literature available: Product Design Ideas by Titchener & New Concepts in Wire Design by Titchener - both showing case histories & design concepts. WIRE-GRIP Circuit Board Puller sheet - shows two sizes of stock circuit board pullers available and a description of same.

Products manufactured: Antenna Towers & Supports, Antennas, Blowers & Fans & Accessories, Cabinets & Accessories, Carts & Dollies, Instrument & Equipment, Chassis, Circuit Board Mounting, Chassis, Metal, Forms, Wire, Frames, Cabinet & Rack, Grilles, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Holders, Circuit Board (Production Type), Mounts, Pullers, Racks, Rings, Retaining, Services, Assembly, Production & Test, Soldering Accessories

Local Sales Offices & Reps.

Cal	Huntington Beach, ASC Sls. Co.	714-847-7515
Fla	Winter Park, Young & Lawrence Assocs.	305-647-6929
Ill	Skokie, R.L. Matson	312-676-3650
Mass	Hudson, R.C. Morgan	617-935-6279
Minn	Burnsville, D. patrie Co.	612-890-6386
NJ	Cedar Grove, G.E. Lewis	201-773-1460
NY	Binghamton, F.J. Grashof	607-772-1161
Ohio	Cincinnati, L. Kenning	513-661-2278
Ohio	Cleveland Heights, W.M. Wehner	216-932-8383
Pa	Bluebell, J.J. Protevi	215-272-3325

TMC SYSTEMS (ARIZ.), INC., 930 West 23rd St., Tempe, Ariz., 85282, Tel: 602-967-7874, TWX: 910-950-1943; FSC No: 22929; Empl.: 65; Minimum order: $50 .... p. 1•418,419

For info on price: E. Gagliardi; Application info: D. Robinson; Customer service: E. Gagliardi; Delivery info: E. Gagliardi

Free literature available: Crystal, filter & oscillator application/specification forms. Data sheets describing typical filter & oscillator custom designs, previously supplied in production quantities & representative of TMC's state-of-the-art capabilities.

Products manufactured: Crystals, Filters, Oscillators

Advertisment

Computer aided designs for all classes of filter networks from 10 Khz to 25 mhz. Computerized test facilities for filter attenuation, delay and phase performance. Crystal oscillators including 14 pin DIL package for low cost digital clock applications. Koldweld sealed crystals for critical applications. MIL-spec. compliance as required. Data on typical design performance in catalog.

TODD PRODUCTS CORP., 123 Milbar Blvd., Farmingdale, N.Y., 11735, Tel: 516-293-3440, TWX: 510-224-6584; Empl.: 30 .... p. 1•1497-1502

Products manufactured: Chargers, Battery, Converters, Current Sources, Inverters, Power Supplies, Regulators, Voltage Sources

Local Sales Offices & Reps.

Ariz	Scottsdale, J. Smith Assocs.	602-943-4131
Cal	Fullerton, Product Data Co.	714-870-9151
Cal	Los Altos, Product Data Co.	415-941-4410
Colo	Boulder, J. Smith Assocs.	303-449-7509
Ill	Chicago, SEA Inc.	312-282-6694
Ind	Carmel, SEA Inc.	317-846-2593
Mass	Braintree, Bordewieck Engrg.	617-843-0845
Mich	Southfield, DATA-TRON	313-354-6421
Minn	Minneapolis, SEA Inc.	612-425-4455
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Cherry Hill, Williams Assocs.	609-424-4110
NJ	Woodcliff Lake, F&F Assocs.	201-778-6767
NM	Albuquerque, J. Smith Assocs.	505-255-2111
NY	Flushing, F&F Assocs.	516-334-1160
NY	Guilderland, Electro-Modular Sys.	518-456-2665
Ohio	Dayton, DATA-TRON	513-223-8421
Ohio	Wickliffe, DATA-TRON	216-585-8421
Tex	Dallas, Dwayne Clement & Assoc.	214-239-6105
Wash	Seattle, R. S. Drake Assocs.	206-763-2755
Wisc	Milwaukee, Sea Inc.	414-547-6637

TODD SYSTEMS, 4 Radford Pl., Yonkers, N.Y., 10701, Tel: 914-963-3400; Empl.: 45 .... p. 2•1812-1815

Products manufactured: Chokes, Transformers

TOHOKU METAL INDS., LTD., No 13-10, 7-chome, Ginza, Chou-ku, Tokyo, Japan, Tel: Tokyo 542-6171; Empl.: 3000

Products manufactured: Bobbins, Winding, Coil & Transformer, Coils Including Assemblies & Forms, Controls/Control Eqpt., Converters, Cores, Magnetic, Crystals, Filters, Foil, Magnets, Matrices, Computer, Memory Systems, Shields, Switches, Transducers, Transformers, Wire

Local Sales Offices & Reps.

Cal	Gardena	213-329-4137

TOLEDO SCALE, Div. Reliance Elect. Co., 5225 Telegraph Rd., Toledo, Ohio, 43612, Tel: 419-470-6200, Telex: 28-6463

Free literature available: 1. TOLEDO SCALES FOR INDUSTRY, broadside of range of industrial products 2. TOLEDO ELECTRONIC WEIGHING FOR INDUSTRY, sketch of industrial electronic products

Products manufactured: Cells, Load, Scales, Dial

Local Sales Offices & Reps.

Ala	Birmingham	205-328-0904
Ala	Mobile	205-478-5064
Ala	Montgomery	205-263-7215
Alas	Anchorage	907-333-1313
Ariz	Phoenix	602-252-4767
Ark	Little Rock	501-562-6770
Cal	Fresno	209-485-3533
Cal	Los Angeles	213-724-3200
Cal	Oakland	415-569-4015
Cal	Sacramento	916-922-4783
Cal	San Diego	714-286-1841
Cal	Stockton	209-464-9469
Colo	Denver	303-573-8283
Conn	New Haven	203-795-0201
Del	Wilmington	302-764-4250
DC	Washington	301-277-3646
Fla	Jacksonville	904-355-8365
Fla	Miami	305-652-3383
Fla	Orlando	305-425-3110
Fla	Pensacola	904-438-6470
Fla	Tampa	813-626-8127
Ga	Albany	912-435-8911
Ga	Augusta	404-722-1580
Ga	Chamblee	404-451-9004
Haw	Kailua	808-261-2214
Idaho	Boise	208-343-8611
Ill	Chicago	312-626-3665
Ill	Decatur	217-428-0923
Ill	Montgomery	312-897-1578
Ill	Peoria	309-673-3865
Ill	Rockford	815-398-3995
Ind	Evansville	812-423-5217
Ind	Fort Wayne	219-744-1307
Ind	Hammond	219-844-5000
Ind	Indianapolis	317-635-2561
Ind	South Bend	219-289-5526
Ind	Terre Haute	812-232-5654
Iowa	Davenport	319-391-6400
Iowa	Des Moines	515-265-4224
Kans	Topeka	913-357-5191
Kans	Wichita	316-264-1358
Ky	Lexington	606-277-3411
Ky	Louisville	502-895-4241
La	Baton Rouge	504-355-3683
La	Lafayette	318-234-4043
La	Monroe	318-387-3142
La	New Orleans	504-482-6900
La	Shreveport	318-423-8665
Me	Portland	207-772-3451
Md	Baltimore	301-342-1677
Mass	Boston	617-254-8540
Mass	Worcester	617-754-3244
Mich	Detroit	313-838-3000
Mich	Escanaba	906-786-5200
Mich	Flint	313-767-7200
Mich	Grand Rapids	616-451-2079
Minn	Minneapolis	612-781-6948
Miss	Jackson	601-352-3694
Mo	Joplin	417-623-6577
Mo	Kansas City	816-842-8805
Mo	Springfield	417-881-3763
Mo	St. Louis	314-776-0702
Mont	Billings	406-259-5616
Mont	Great Falls	406-453-7231
Neb	Omaha	402-331-9476
Nev	Reno	702-323-1827
NH	Manchester	603-622-8253

Directory of Local Distributors Starts on page 401

NJ	Newark	201-227-6080
NJ	Trenton	609-882-3900
NY	Albany	518-456-2511
NY	Buffalo	716-684-0440
NY	Endwell	607-748-8275
NY	Long Island City	212-361-9050
NY	Rochester	716-482-6967
NY	Syracuse	315-472-4338
NC	Asheville	704-274-3771
NC	Charlotte	704-334-9779
NC	Greensboro	919-273-7555
NC	Raleigh	919-828-1750
NC	Wilson	919-243-4915
ND	Fargo	218-233-5763
Ohio	Akron	216-644-8404
Ohio	Cincinnati	513-931-8000
Ohio	Cleveland	216-351-9411
Ohio	Columbus	614-228-2451
Ohio	Dayton	513-298-5244
Ohio	Toledo	419-479-2201
Okla	Oklahoma City	405-232-9279
Okla	Tulsa	918-584-2491
Ore	Portland	503-288-5496
Pa	Emmaus	215-965-9038
Pa	Erie	814-864-2922
Pa	Harrisburg	717-939-9331
Pa	Philadelphia	215-725-8000
Pa	Pittsburgh	412-681-5935
RI	Providence	401-434-2800
Tenn	Knoxville	615-687-5941
Tenn	Memphis	901-324-7164
Tenn	Nashville	615-256-2173
Tex	Abilene	915-692-3751
Tex	Arlington	817-277-6111
Tex	El Paso	915-533-6712
Tex	Houston	713-526-2993
Tex	Lubbock	806-744-4115
Tex	San Antonio	512-226-6176
Utah	Salt Lake City	801-486-7104
Vt	Burlington	802-862-3534
Va	Norfolk	703-855-3176
Va	Richmond	703-355-7447
Va	Roanoke	703-342-8989
Va	Winchester	703-662-5925
Wash	Seattle	206-624-4560
Wash	Spokane	509-747-0181
Wash	Yakima	509-248-1484
WVa	Charleston	304-343-0131
Wisc	Green Bay	414-432-2404
Wisc	La Crosse	608-784-1317
Wisc	Milwaukee	414-543-7140
Wisc	Wausau	715-848-4188

TOPAZ ELECTRONICS SAN DIEGO

TOPAZ ELECTRONICS, 3855 Ruffin Rd., San Diego, Cal., 92123, Tel: 714-279-0831, TWX: 910-335-1526; Empl.: 140; Minimum order: $25 p. 1•592,593,1503-1506; p. 2•1816,1817

For info on price: L. E. Rasmussen; Application info: J. Reed; Customer service: C. S. Walker; Delivery info: L. E. Rasmussen

Free literature available: Eight page technical brochure (#LT22) titled ULTRA-ISOLATION TRANSFORMERS AND AC POWER SYSTEMS. This brochure describes the applications of Ultra-Isolation Transformers for AC noise attenuation.

Products manufactured: Converters, Filters, Inverters, Isolators, Power Supplies, Regulators, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Ariz	Scottsdale, J. Smith & Assocs.	602-947-2495
Cal	Anaheim, Topaz Elctrns.	714-279-0831
Cal	Los Angeles, Topaz Elctrns.	714-279-0831
Cal	San Diego, Topaz Elctrns.	714-279-0831
Cal	San Francisco, Topaz Elctrns.	408-732-2030
Colo	Boulder, J. Smith & Assocs.	303-442-7100
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, Balhorn & Welch	312-889-5011
Ind	Indianapolis, Mktg. Engrs., Inc.	317-546-1523
Iowa	Cedar Rapids, Palatine Sls., Inc.	319-365-8071
Kans	Andover, Palatine Sls., Inc.	316-683-7512
Md	Bethesda, Bartlett Assocs.	301-656-3061
Mass	Wayland, Wayland Engrg. Sls.	617-655-6080
Mich	Detroit, R C Nordstrom Co.	313-444-4417
Mo	St. Louis, Palatine Sls., Inc.	314-426-7055
NJ	Englewood Cliffs, Power Conversion & Control	201-569-0015
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	Binghamton, Elcom Sls.	607-723-9270
NY	Rochester, Elcom Sls.	716-385-1400
NY	Whitesboro, Elcom Sls.	315-732-6445
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Dayton, Bear Mktg.	513-299-3566
Ohio	Richfield, Bear Mktg.	216-659-3131
Pa	Doylestown, T.O.E. Sls.	201-568-5747
Tex	Dallas, Allied Comps. Inc.	214-238-0408
Tex	Houston, Allied Comps. Inc.	713-782-5406
Wash	Seattle, W. Underwood & Assocs.	206-242-7200

TOR CORPORATION, 14715 Arminta St., Van Nuys, Cal., 91402, Tel: 312-786-6524, TWX: 910-495-1746; FSC No: 15957; Empl.: 30; Minimum order: $25

For info on price: D. Griffin; Application info: S. Rackauskas; Customer service: D. Griffin; Delivery info: D. Griffin

Free literature available: Company Brochure, Technical Bulletins.

Products manufactured: Insulators & Insulation, Pads, Transistor Mounting, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ariz	Phoenix, K.C.E.	602-955-5250
Cal	Sunnyvale, Cutlass Elctrns. North	408-733-5885
Cal	Torrance, Cutlass Elctrns.	213-324-7360
Colo	Sedalia, Lyle Jensen	303-688-4154
Fla	Miami, Ludlum Assocs. Co.	305-592-6523
Ga	Atlanta, G. S. O'Hara	404-451-9020
Ill	Chicago, Berndt Assocs., Inc.	312-283-0713
Ind	Indianapolis, Advanced Comp. Sls.	317-545-6441
Iowa	Des Moines, Beams	515-282-0292
Mass	Quincy, Electro-Mechanical Sls. Co.	617-773-3527
Mass	Tewksbury, Electro-Mechanical Sls. Co.	617-851-7271
Mo	Kansas City, Beams	913-888-6110
Mo	St. Louis, Beams	314-781-6855
NY	Fayetteville, M.P. Andrews, Inc.	315-637-3144
NY	Huntington, C.R. Mayer Co.	516-921-7876
Ohio	Chagrin Falls, Crest Comp. Sls.	216-543-9808
Pa	Philadelphia, Mid-Western Assocs.	215-842-2810
Va	Reston, Boyle Assocs.	703-620-9558

TORELCO INC., 14 Paine Ave., Irvington, N.J., 07111, Tel: 201-374-8641; Empl.: 25

For info on price: R. Hillebrand; Customer service: L. Schafer; Delivery info: L. Schafer

Free literature available: Bulletin: Contains pictures of coils and describes capabilities in the field of coil winding.

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Transformers

TORIN CORP., Kennedy Dr., Torrington, Conn., 06790, Tel: 203-482-4422, TWX: 710-439-2343; Empl.: 1500 p. 1•508-515

Products manufactured: Blowers & Fans & Accessories

Local Sales Offices & Reps.

Cal	Santa Clara, Torin Corp.	408-246-8585
Cal	Van Nuys, Torin Corp.	213-892-0741
Conn	West Hartford, Torin Corp.	203-568-3790
Ill	Arlington Heights, Torin Corp.	312-593-0660
Ill	Bloomington, Torin Corp.	309-828-5932
Ill	Elgin, Cole Dynamics	312-742-3000
Ind	Rochester, Torin Corp.	219-223-3181
Iowa	Cedar Rapids, Torin Corp.	319-393-5612
Ky	Louisville, Torin Corp.	502-896-4363
Md	Rockville, Marktron, Inc.	301-762-6210
Md	Towson, Marktron, Inc.	301-825-8222
Mich	Farmington, Torin Corp.	313-476-5151
Minn	St. Paul, Hultgren & Strutzel	612-645-9121
NY	E. Syracuse, Torin Corp.	315-437-4674
NY	Rochester, Torin Corp.	716-586-8750
Ohio	Cleveland, Torin Corp.	216-464-2161
Ohio	Dayton, Torin Corp.	513-434-1255
Pa	Doylestown, Torin Corp.	215-348-5917
Tex	Dallas, Torin Corp.	214-942-8822

Local Distributors

Ariz	Tempe, G.S. Marshall Co., 835 W. 22nd St.	602-968-6181
Cal	El Monte, G.S. Marshall Co., 9674 Telstar Ave.	213-686-0141
Cal	Irvine, G.S. Marshall Co., 17975 Sky Pk. Blvd.	714-556-6400
Cal	San Diego, G.S. Marshall Co., 8057 Raytheon Rd.	714-278-6350
Cal	Sunnyvale, G.S. Marshall Co., 788 Palomar Ave.	408-732-1100
Colo	Arvada, G.S. Marshall Co., 5633 Kendall Ct.	303-423-9670
Conn	Bethel, Pioneer/New England, 154 Greenwood Ave.	203-792-1219
Conn	N. Branford, G.S. Marshall Co., 200 Shaw Rd.	203-484-0486
Fla	Palm Beach Gardens, G.S. Marshall Co., 10384 Riverside Dr.	305-622-8490
Ill	Des Plaines, G.S. Marshall Co., 300 E. Touhy Ave.	312-298-3700
Kans	Kansas City, G.S. Marshall Co.	913-648-6414
Md	Gaithersburg, Pioneer/Washington Elctrns., 9100 Gaither Rd.	301-948-0710
Mass	Newton Highland, G.S. Marshall Co., 88 Needham St.	617-965-5115
Mich	Detroit, G.S. Marshall Co.	313-779-8055
Minn	Edina, G.S. Marshall Co., 4900 Viking Dr.	612-831-4904
NY	Farmingdale, G.S. Marshall Co., 230 Sherwood Ave.	516-293-4141
NC	Greensboro, Pioneer/Carolina Elctrns., 2906 Baltic Ave.	919-273-4441
Ohio	Dayton, G.S. Marshall Co., 6388 North Dixie Dr.	513-898-1105
Pa	Horsham, Pioneer/Delaware Valley, 203 Witmer Rd.	215-674-5710
Tex	Dallas, G.S. Marshall Co., 14205 Proton Rd.	214-233-5200
Wash	Bellevue, G.S. Marshall Co., 1801 130th Ave. N.E.	206-883-1084

TOROTEL INC., 13402 S. 71 Hwy., Grandview, Mo., 64030, Tel: 816-761-6314, TWX: 910-777-7037; Empl.: 275 p. 1•417; p. 2•430-439,1819-1821

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Converters, Crystals, Delay Lines, Discriminators, Dummy Loads, Equalizers, Filters, Inverters, Networks, Oscillators, Power Supplies, Reactors, Transformers

Local Sales Offices & Reps.

Ariz	Tempe, Gassner & Clark	602-968-9037
Cal	Los Altos, Parsons & Meister	415-941-4745
Cal	Los Angeles, El Com Sls. Co.	213-223-1351
Fla	Pompano Beach, Varrelman-Gorman Co.	305-941-5544
Fla	Winter Park, Varrelman-Gorman Co.	305-831-8688
Ill	Chicago, Gassner & Clark	312-764-6121
Kans	Shawnee Mission, Florence & Meyer	913-722-5210
Md	Rockville, Mechtronics Sls.	301-340-2130
Mass	Weston, J.J. Goode Assocs.	617-235-3900
Minn	St. Paul, H. A. Cullen & Assocs.	612-646-7371
NY	Manhasset, Win-Cor Elec. Sls.	516-627-9474
NY	Syracuse, T-Squared Elctrns. Co.	315-463-8592
NC	Charlotte, Over & Over	704-366-8441
Ohio	Dayton, H. Teplitz & Co.	513-277-6531
Pa	Birchrunville, Jadelectronic Assocs.	215-647-5151
Tex	Dallas, Oeler & Menelaides	214-234-6334
Tex	Houston, Oeler & Menelaides	713-772-0730
Wash	Bellevue, Western Tech. Sls.	206-641-3900

TORQ ENGINEERED PRODUCTS, INC., 32 W. Monroe St., Bedford, Ohio, 44146, Tel: 216-232-4100; Empl.: 135

Free literature available: Data sheets on torq switch reveals roles played by centrifugal switches in electric motor operation

Products manufactured: Controls/Control Eqpt., Governors, Centrifugal, Switches

TORQUE SYSTEMS, 225 Crescent St., Waltham, Mass., 02154, Tel: 617-891-0230; Empl.: 45 p. 1•992-997

Products manufactured: Actuators, Amplifiers, Controls/Control Eqpt., Motors, Power Supplies, Servo Systems

Local Sales Offices & Reps.

Cal	Los Angeles, C. L. Repp Co.	213-820-1715
Cal	San Jose, J. T. McFarland Assoc.	408-286-9333
Fla	Orlando, MacKay, Smith & Assoc.	305-277-1513
Ill	Chicago, Electro-Tech Mktg. Assoc.	312-588-4535
Kans	Wichita, Dy-Tronix	316-943-6221
Minn	Minneapolis, J. J. Exon Co.	612-566-5340
Mo	Hazlewood, Dy-Tronix	314-731-5799
Mo	Kansas City, Dy-Tronix	816-761-6543
NC	Charlotte, MacKay, Smith & Assoc.	704-527-0240
Va	Roanoke, Johnson Custom Controls Co.	703-774-5550

TORR LABS., 2228 Cotner Ave., Los Angeles, Cal., 90064, Tel: 213-477-1224; Empl.: 75

For info on price: P. B. Nosser; Application info: V. E. DeLucia; Customer service: P.B. Nosser; Delivery info: P. B. Nosser

Products manufactured: Antenna Switching Matrices, Cable, Chamber, Environmental Test, Controls/Control Eqpt., Deposition Equipment, Vacuum & Accessories, Evaporation Equipment, Electron Beam, Flashers, Gages, Lamps, Punched Card Equipment, Relays, Seals, Switches, Testers, Thermostats, Tubes, Valves, Vacuum, X-Ray Inspection Equipment

Local Sales Offices & Reps.

Cal	Glendale, G.R.V. Assocs.	213-245-5586
Cal	Los Altos, Horne Assocs.	415-948-0788
Colo	Greeley, G. Moss	303-353-1452
Ill	Chicago, J. Popp Sls. Co.	312-626-3711
Ill	Wheaton, A. Joyner	312-668-5775
Mo	St. Louis, Scherrer Instrs., Inc.	314-644-5362
NJ	Haddonfield, M & S Assocs.	609-429-7055
FOR:	Can., Toronto, Ont., Patlon Aircraft & Inds., Ltd.	416-239-7389

TORWICO ELCTRNS., INC., Rte. 70, Lakewood, N.J., 08701, Tel: 201-364-1800, TWX: 201-363-1611; Empl.: 240 .... p. 2•1818

Products manufactured: Amplifiers, Chokes, Coils Including Assemblies & Forms, Current Sensors, Reactors, Services, Assembly, Production & Test, Terminals, Transformers

Local Sales Offices & Reps.

Cal	Tarzana, R. Capell	213-987-2233
Conn	Middletown, N.E. Reps., Inc.	203-239-2507
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Md	Baltimore, W.S. Warrington & Assoc.	301-823-8759
Mass	Needham Hgts., N.E. Reps., Inc.	617-449-3034
Mo	St. Charles, Buse Sls.	314-946-6430
NJ	Haddonfield, TAI Assocs.	609-854-3011
NY	Fayetteville, H.C. Johnson	315-NE 7-9383
NY	Great Neck, Trionic	516-466-2300
NY	Guiderland, H.C. Johnson Agencies	518-456-9681
NY	Rochester, H.C. Johnson	716-482-3000
NY	Williamsville, H.C. Johnson	716-632-7880
Ohio	Cincinnati, A.C. Wahl & Assocs.	513-821-3270
Ohio	Kent, Norco Ind'l	216-666-3774
Pa	Glenshaw, H.C. Johnson Agencies	412-961-0414

TOYO COMM. EQUIP. CO. LTD., 484 3 Chome Tsukakoshi, Kawasaki, Kanagawa, Japan, Tel: Tokyo 406-3355, TWX: 2423001 TOYOCO J; Empl.: 1800

Products manufactured: Crystal Blanks, Crystals, Filters, Oscillators, Transceivers

TPL COMMUNICATIONS CO., 13125 Yukon Ave., Hawthorne, Cal., 90250, Tel: 213-679-0131; Empl.: 35

For info on price: S. Reubenstein; Application info: S. Reubenstein; Customer service: P. Sahs; Delivery info: P. Sahs

Free literature available: Product Line Brochure, Product Spec. Brochures.

Products manufactured: Amplifiers, Transceivers

Local Sales Offices & Reps.

Cal	Cupertino, Wallace & Wallace	408-996-2224
Cal	Los Angeles, Wallace & Wallace	213-747-0401
Colo	Denver, Connors Inc.	303-934-5829
Ga	Smyrna, B-C Elctrns. Sls.	404-436-5169
Ill	Chicago, Ellinger Sls.	312-763-1570
Kans	Shawnee Mission, Maury-Bettis Co.	913-362-0772
Mass	Bedford, Chamberlin & Murray	617-274-0044
Mich	Rochester, Cartwright Comm.	313-375-0420
Minn	St. Paul, Skor	612-645-6461
NJ	Fair Lawn, Moses & Kline	201-791-8538
NY	Liverpool, Lewis-Dunnigan Co.	315-622-2133
Ohio	Cincinnati, Cartwright Comm.	513-825-4202
Pa	Levitown, Sher Sls.	215-946-6200
Tex	Dallas, Maynard & Gunn Sls.	214-528-9090
Wash	Seattle, Fleehart & Sullivan	206-522-1533
EXP:	Hallandale, Fla., EMEC, Inc.	

TRA-CON, INC., 55 North St., Medford, Mass., 02155, Tel: 617-391-5550; Empl.: 35; Minimum order: $25

Customer service: Sls. Dept.

Free literature available: Literature on high-performance epoxy resin systems for electronic, aerospace and industrial adhesive; potting and casting applications using pre-packaged BIPAX&R kits.

Products manufactured: Adhesives (All Types), Compounds, Encapsulating, Insulating, Molding, Potting, Kits, Cable-End Sealing, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Rubber

Local Sales Offices & Reps.

Cal	Mountain View, K. Anderson Co.	415-961-6007
Colo	Denver, Cristee-Meade Co.	303-753-9471
NY	Irvington, H. Shprentz Co.	914-591-7970
Tex	Houston, Puffer Supp. Co.	713-668-9457

TRACOR, INC., 6500 Tracor La., Austin, Tex., 78721, Tel: 512-926-2800; Empl.: 5000; Minimum order: $25

Customer service: M. Ames

Products manufactured: Amplifiers, Analyzers, Antennas, Comparators, Controls/Control Eqpt., Couplers, Generators, Meters, Oceanographic Equip. (Electronic), Receivers, Recorders, Standards

Local Sales Offices & Reps.

Analytical Instrs.

Cal	Danville, Western Scientific Assoc.	415-837-4622
Cal	Richmond, Tegal	415-232-1757
Fla	Clearwater, Datco, Inc.	813-531-4255
Ga	Chamblee, Southern Analytical Co.	404-451-5262
Haw	Kaneohe, W.L. Yauger, Inc.	808-239-7187
Ill	Chicago, A.E.D., Inc.	312-348-6550
Ind	Indianapolis, Tech. Sls. & Mktg.	317-356-3658
La	Baton Rouge, Teklab, Inc.	504-926-3667
NJ	Union, Tracor, Inc.	201-964-1631
Ohio	West Carrollton, P.J. Navin	513-434-8940
Tex	Austin, Targa, Inc.	512-926-2800

Ind'l Instrs. Time & Frequency

Ala	Huntsville, BCS Assocs.	205-881-6220
Cal	Calabasas, M. Shovlowsky	213-348-3402
Colo	Denver, BFA Corp.	303-744-3301
Fla	Ft. Lauderdale, BCS Assocs.	
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Chicago, Midwest Microwave	312-283-4900
Md	Rockville, T E Corp.	301-340-0303
Mass	Waltham, Technical Entprs.	617-890-5300
NM	Albuquerque, BFA Corp.	505-268-4387
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Garden City, PM Elctrns.	516-248-4858
NC	Greensboro, BCS Assocs.	919-273-1918
Pa	Melrose Park, R. Meyers Assoc.	
Wash	Seattle, Showalter-Judd, Inc.	206-624-9020

Ind'l Instrs. TV

Ala	Huntsville, BCS Assocs.	205-881-6220
Cal	Anaheim, Broadcast Comms. Devices	714-528-9505
Colo	Evergreen, Didier Denver	303-674-6000
Fla	Ft. Lauderdale, BCS Assocs., Inc.	
Fla	Orlando, BCS Assocs.	305-896-4881
Md	Rockville, T E Corp.	301-340-0303
Mass	Waltham, Technical Entprs.	517-890-5300
Mich	Milford, H.M. Dyer Elctrns.	313-685-2560
NY	Garden City, PM Elctrns.	516-248-4858
NC	Greensboro, BCS Assocs.	919-273-1918

Medical Instrs.

Cal	Oakland, J. Taylor & Assocs.	415-832-4056
Cal	Whittier, Electro Medical Instrumentation	213-698-3018
Fla	Titusville, Tele-Acoustics	305-267-1600
Ga	Atlanta, Tracor, Inc.	404-633-9571
Ga	Austell, Telemetrics	404-252-1030
Ill	Chicago, Audiological Svc. & Supply Co.	312-281-1531
Md	Frederick, D.B. Creighton Assoc.	301-473-8127
Md	Rockville, Tracor, Inc.	301-762-3623
Mass	Lawrence, Medical Engrg. Assoc.	617-683-8711
Minn	Minneapolis, Electro-Medic, Inc.	612-926-2010
Mont	Billings, Montana Precision Meas.	406-245-3296
NJ	Staten Island, Medacoustics, Inc.	212-979-4262
NC	Greenville, Carolina Acoustics	919-752-1436
Ohio	Cleveland, Environmental Technology Corp.	216-464-3888
Okla	Oklahoma City, Oklahoma Audiometer Svc. Co.	406-245-3296
Ore	Portland, Sanderson Safety Supply Co.	502-234-0456
SC	Greenville, Safeco Equip. Co.	
Tenn	Kingsport, Safeco Equip. Co.	615-246-4164
Tex	Austin, Audio-Medical Sys.	512-926-5094
Tex	Houston, Audio-Elctrns.	713-744-4832
Wash	Seattle, Safety & Supply Co.	206-762-8500

Navigation

Cal	Sausalito, B.H. Ballard Co.	415-332-0105
Fla	Tampa, Promar	813-876-7677
La	Gretna, Maricon Instrs.	504-366-1842
Md	Rockville, T E Corp.	301-340-0303
Mass	Sudbury, Commercial Mktg. Assoc.	

TRAK MICROWAVE CORPORATION, 4726 Eisenhower Blvd., Tampa, Fla., 33614, Tel: 813-884-1411; Empl.: 120; Minimum order: $50

Customer service: T. L. Roberts

Products manufactured: Amplifiers, Cavities, Microwave, Circuits, Hybrid, Thin-Film, Circulators, Ferrite, Ferrite Material & Parts, Generators, Isolators, Microwave Integrated Circuits (MIC's), Oscillators

Local Sales Offices & Reps.

Ala	Huntsville, Scientific Devices-Southeast	205-536-1969
Cal	Orange, J.E. Hachten Co.	213-681-2361
Cal	Palo Alto, J.E. Hachten Co.	415-316-1252
Colo	Denver, Omega Ltd.	303-758-1508
Fla	Ft. Lauderdale, Scientific Devices-Southeast	305-721-4260
Fla	Orlando, Scientific Devices-Southeast	305-841-8180
Mass	Natick, Wayland Engrg. Sls.	617-655-6080
NM	Albuquerque, Premmco, Inc.	505-265-0115
NY	Skaneateles, Robtron	315-685-5731
NY	Tuckahoe, Asco Elctrns., Inc.	914-779-8110
NC	Burlington, Scientific Devices-Southeast	919-228-6279
Ohio	Dayton, F. L. Ohmer & Assocs.	513-434-1454
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Tex	Dallas, Cain & Co.	214-233-6809
Utah	Salt Lake City, Monarch Distributing & Representing	801-226-9617
Va	Woodbridge, M. Lader Co.	703-494-4731
Wash	Seattle, J.B. Jolly, Inc.	206-938-4166
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

TRAK SYSTEMS, Div. TRAK Microwave Corp., 4722 Eisenhower Blvd., Tampa, Fla., 33614, Tel: 813-884-1411, Telex: 52-827; FSC No: 11165; Empl.: 42; Minimum order: $50

Customer service: D. H. Sturgill

Free literature available: TIMING EQUIPMENT - Such as Time Code Generators, Tape Control Units, etc. CUSTOMIZED COMPUTER SYSTEMS - designing and building controllers, automated material handling systems & interface devices for computer-to-computer & computer to peripheral applications.

Products manufactured: Chargers, Battery, Clocks (All Types), Comm. Systems, Converters, Data Acquisition & Reduction Systems, Data Loggers, Generators, Indicators, Receivers, Standards, Tape Search Equipment, Terminal Equipment, Digital, Translators, Data

Local Sales Offices & Reps.

Ill	Mt. Prospect, Cain & Co.	312-253-3578
Ohio	Lancaster, Cain & Co.	614-654-4800
Pa	Lafayette Hill, M. Lader Co.	215-825-3177
Tex	Dallas, Cain & Co.	214-233-6809
Va	Woodbridge, M. Lader Co.	703-494-4731
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

TRAM CORP., Box 187, Winnisquam, N.H., 03289, Tel: 603-524-0622; Empl.: 40

Customer service: K. Zades

Products manufactured: Transceivers

TRAN SPECTRA INC., Box 9, Airport Rd., Greenfield, Tenn., 38230, Tel: 901-235-2218; Empl.: 250

For info on price: T. M. Smith; Application info: R. E. Lenhardt; Customer service: T. M. Smith; Delivery info: T. M. Smith

Free literature available: Miniature aluminum electrolytic capacitors, aluminum electrolytic capacitors for audio crossover networks, and special design capacitors.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Cal	Bellflower, Royer Assocs.	213-869-2516
Conn	Meriden, Electro Prods. Sls.	203-235-4040
Fla	Palm Beach Gardens, Brosey Ents.	305-622-6045
Ill	Chicago, Tran Spectra	312-736-0236
Ill	Skokie, Mar-Con Assocs.	312-675-6450
Mass	Waltham, Electro Prods. Sls.	617-899-1570
Tenn	Greenfield, Tran Spectra	901-235-2218

TRANEX INC., 1599 Stierlin Rd., Mountain View, Cal., 94043, Tel: 415-968-9292; FSC No: 17474; Empl.: 130; Minimum order: $25

For info on price: H. Waltz; Application info: P. Menting; Customer service: H. Waltz; Delivery info: K. Wagner

Free literature available: 8 pg. Brochure - Facility & capability

Products manufactured: Chokes, Coils Including Assemblies & Forms, Reactors, Transformers

Local Sales Offices & Reps.

Cal	Mountain View	415-968-9292
Cal	Santa Ana	714-835-8684

Colo	Colorado Springs	303-392-3432

TRANS-MET ENGRG., 601 S. Palm St., La Habra, Cal., 90631, Tel: 213-691-2266; Empl.: 20; Minimum order: $5

For info on price: R. Mazzarella; Application info: D. Hornbaker; Customer service: D. Rall; Delivery info: J. O'Brien

Free literature available: 210A Nontact Non-Contact Temp. Sensor for Sheet Material; 224 - Fibertemp - Temp. Sensor for Fiber; 215 - Wiretemp - Temp. Sensor for Wire; 226 - Rolltemp - Temp. Sensor for Roll; 227 - Portatemp - Digital Pyrometer - Portable; 228 - Rolltronic - Roll. Temp. Control System.

Products manufactured: Controls/Control Eqpt., Meters, Monitors, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assocs.	205-837-2202
Cal	Redwood City, Marchi Assocs.	415-364-3411
Conn	Westport, A. J. Abrams	203-226-3010
Ill	Chicago, Thermo/Cense	312-792-2760
Iowa	Des Moines, H.E. Ferris Co.	515-255-1757
Mich	Royal Oak, D. Ray Assocs.	313-576-4700
Minn	Minneapolis, Arjay Sls.	612-925-1833
NY	East Rochester, Thermal Systems	716-377-1970
NY	New York, E. C. Smith & Assoc.	201-783-6668
NC	Matthews, W.K. Hile Co.	704-847-9125
Ohio	Brecksville, D & B Engr	216-526-6320
Ohio	Cincinnati, G. Drysdale & Assoc	513-752-2069
Ore	Portland, McLarne	206-454-3400
Pa	Pittsburgh, Process Eng	412-561-5050
Exp	New Haven, Conn, Masten-Wright Corp	203-288-1638
FOR:	Can,Toronto, Ont., Armatek Control	416-251-3111

TRAN-TEC CORPORATION, Box 1022, Columbus, Neb., 68601, Tel: 402-564-2748; Empl.: 25; Minimum order: $35

Customer service: C. Schroeder

Products manufactured: Insulators & Insulation, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Cal	Redwood City, Woodworth Co.	415-365-0252
Cal	Santa Fe Springs, Sierra-Pacific Engrg. Co.	213-921-9634
Colo	Aurora, Robbins & Assocs.	303-343-7728
Fla	Pinellas Park, Russell Assocs.	813-526-1134
Ga	Atlanta, Russell Assocs.	404-225-8422
Ind	Indianapolis, Scott Elctrns, Inc.	317-635-8951
Iowa	Cedar Rapids, J. VRBIK Co.	319-377-8244
Kans	Overland Park, Ensco-Rep Inco.	913-381-7557
Md	Bel Air, Russell Assocs.	301-879-9180
Mass	Wakefield, H.C. Jappe Co.	617-245-9359
Mich	Milford, Polyphase	313-685-3003
Mo	Saint Louis, Ensco-Rep Inc.	314-567-3935
NJ	Fair Haven, Russell Assocs.	201-747-0600
NY	Bay Shore, Russell Assocs.	516-666-6500
NY	Syracuse, Naylor Electric Co.	315-472-9183
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Tex	Dallas, Russell Assocs.	214-369-3173
Wash	Bellevue, Russell Assocs.	206-455-3694
EXP:	Schenectady, N.Y., EMB Elctrns. Corp.	518-372-5841
For	Can., Scarborough, Ont., Gandhi-Ball Assocs.	416-438-9320

TRANS-TEK, INC., Rte. 83, Ellington, Conn., 06029, Tel: 203-872-8351; FSC No: 27109; Empl.: 20

For info on price: B. Eddy; Application info: M. Blanchette; Customer service: B. Eddy; Delivery info: G. Thibeault

Free literature available: Data sheet, SERIES 240 Displacement Transducer; Data sheet, SERIES 200 Displacement Transducer; Data sheet, SERIES 100 Linear Velocity Transducer; Data sheet, SERIES 600 Angular Displacement Transducer; Data sheet, SERIES 350 Gaging Transducer.

Products manufactured: Encoders, Gages, Indicators, Power Supplies, Transducers

TRANSCO PRODS., INC., 4241 Glencoe Ave., Venice, Cal., 90291, Tel: 213-821-7911, TWX: 910-343-6469; Empl.: 358

Products manufactured: Antenna Feed Systems, Antenna Switching Matrices, Antennas, Attenuators, Couplers, Dividers, Filters, Horns, Microwave, Junctions, Hybrid, Microwave, Mixer-Preamplifiers, Microwave, Mixers, Receivers, Relays, Switches, Terminals, Waveguides & Adapters

Local Sales Offices & Reps.

Cal	San Jose, B. F. Helms	408-268-2325
Fla	Clearwater, Southeastern Component Sls., Inc.	813-531-8324
Md	Ellicott City, VPI, Inc.	301-465-4060
NH	Concord, R. C. Bishop	617-891-1683
NY	Bayside, R. L. Diamond Inc.	212-423-7330
Ohio	Middletown, W. Tudor Morris	513-423-0332
Tex	Ft. Worth, Carey, Wolf & Assocs.	817-738-1996

TRANSCOM ELECTRONICS, INC., Box 9, La Mesa, Cal., 92041, Tel: 714-460-4181, TWX: 910-322-1345; Empl.: 10

Customer service: R. L. Kotnik

Free literature available: HF SSB Transceivers VHF FM Transmitters UHF FM Transmitters VHF FM Receivers UHF FM Receivers

Products manufactured: Amplifiers, Comm. Systems, Control Systems, Air Traffic, Couplers, Receivers, Scramblers, Data, Services, Assembly, Production & Test, Synthesizers, Transceivers, Transmitters

TRANSCON MFG. CO., 2655 Perth St., Box 20825, Dallas, Tex., 75220, Tel: 214-357-8301, TWX: 910-861-4169; Empl.: 16

Products manufactured: Clamps & Clips, Cords, Pads, Transistor Mounting, Strain Reliefs, Cable & Wire, Tubing, Wire & Cable Ties

TRANSDATA INC., 6510 Proprietors Rd., Columbus, Ohio, 43085, Tel: 614-885-9891, Telex: 246-686; Empl.: 35

For info on price: D. H. Wilhelm; Application info: D. A. Gephart; Customer service: D. H. Wilhelm; Delivery info: D. H. Wilhelm

Free literature available: Standard catalog showing transducer models and standard modifications. Specification sheets for specially engineered Power Factor, Phase angle, Temperature, and Frequency models

Products manufactured: Meters, Testers, Transducers

Local Sales Offices & Reps.

Ark	Little Rock, C. H. Stout	501-374-8201
Cal	Los Angeles, Matzinger Assocs.	213-624-8001
Cal	Oakland, W. Nott Co.	415-654-3747
Fla	Maitland, Rowe Engrg. Sls.	305-834-2700
Fla	St. Petersburg, Rowe Engrg. Sls.	813-522-6317
Ga	Atlanta, M. J. Fein & Co.	404-938-0190
Ill	Glen Ellyn, J. T. Becker Assoc.	312-858-1911
Ill	Wilmette, M. J. Fein & Co.	312-256-5828
Ind	Indianapolis, Utility & Indl. Prods.	317-924-3607
La	Shreveport, C. H. Stout of Shreveport	318-425-5485
La	New Orleans, C. H. Stout of La.	504-486-3707
Mass	Holliston, M. J. Fein & Co.	617-429-4008
Miss	Jackson, C. H. Stout of Miss.	601-354-4326
Mo	St. Louis, Electrorep	314-872-7300
NJ	Livingston, M. J. Fein & Co.	201-994-3575
NY	Scarsdale, M. J. Fein & Co.	914-472-1100
Ohio	Cleveland, Weschler Elec. Co.	216-251-4609
Ohio	Columbus, W. L. Blake Co.	614-888-7680
Pa	Media, Systems Control Assoc.	215-565-2077
Pa	Pittsburgh, Muller, Harper & Assoc.	412-931-6460
Tenn	Memphis, C. H. Stout of Tenn.	901-362-1616
Tex	Houston, Gettys-Eads-Adair	713-781-3005
FOR:	Can, Downsview, Ont., Aptec Engrg. Ltd.	416-661-9722
FOR:	Can, Vancouver, B. C., Canadian Dynamics Ltd.	604-325-3201

TRANSDUCERS, INC., 12140 E. Rivera Rd., Whittier, Ca., 90606, Tel: 213-945-3741, TWX: 910-586-1899; Empl.: 103

For info on price: R. Nordstrom; Application info: D. Elgar; Customer service: W. Reynolds; Delivery info: R. Nordstrom

Free literature available: Pressure Transducers - Ranges From 5 PS1 through 12,500 PSI - absolute Gage and differential. Load Cells Ranges from 1 pound through 5 million pounds Digital readouts.

Products manufactured: Amplifiers, Bridges, Cells, Load, Services, Assembly, Production & Test, Transducers

Local Sales Offices & Reps.

Ala	Huntsville, Int'l. Scientific Instrs.	205-837-1601
Ariz	Scottsdale, Inter-Mountain Engrg. Co.	602-947-7379
Cal	San Diego, L.L. Stoakes, Inc.	714-274-6281
Cal	Santa Clara, Richards Associates	408-246-5860
DC	Washington, Wright Co., Inc.	202-296-0979
Fla	Orlando, R. J. Cheney & Assocs.	305-894-7371
Ill	Chicago, SEA, Inc.	312-282-6694
Ind	Carmel, SEA, Inc.	317-846-2593
Kans	Merriam, Tech Representatives, Inc.	913-432-4110
La	Harvey, SECO	504-347-4646
Md	Gaithersburg, Wright Co., Inc.	301-948-5588
Mass	Norwood, Hoder-Rogers, Inc.	617-769-2445
Mich	Farmington, Carter McCormic & Peirce, Inc.	313-477-7700
Mich	Kalamazoo, Carter, Mc Cormic & Pierce, Inc.	616-349-9666
Minn	Minneapolis, SEA, Inc.	612-425-4455
Mo	Hazelwood, Tech Representatives	314-524-6900
Mo	Peculiar, Tech Reps., Inc.	816-331-7744
NM	Albuquerque, Inter-Mountain Engrg. Co.	505-344-2212
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Ulster Park, Labtronics, Inc.	518-372-6649
NC	Matthews, W. K. Hile Co., Inc.	704-847-9125
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-278-5873
Ohio	Worthington, Carter, McCormic & Peirce, Inc.	614-888-4466
Ore	Portland, Brett Associates, Inc.	503-232-4184
Pa	Abington, Bach-Stewart Assocs.	215-885-1550
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
RI	Rumford, R. J. Hoder	401-438-2726
Tenn	Knoxville, W. K. Hile Co., Inc.	615-588-1061
Tex	Dallas, R. Martin Associates	214-358-3704
Tex	Dallas, Techn. Prods. Inc.	214-357-9603
Tex	Houston, R. Martin Assoc.	713-462-4077
Va	Chester, W. K. Hile Co., Inc.	804-271-0014
Wash	Seattle, Brett Associates, Inc.	206-935-8054
Wisc	Waukesha, SEA, Inc.	414-547-6637
FOR:	Can., Don Mills, Ont., Intertechnology, Ltd.	416-447-0738

TRANSICOIL, INC., Worcester, Pa., 19490, Tel: 215-277-1300, TWX: 510-660-0132; Empl.: 110

Customer service: P. Schoenacher

Products manufactured: Actuators, Amplifiers, Controls/Control Eqpt., Converters, Dampers, Servo, Drives & Drive Mechanisms (Dial), Gears & Gear Mechanisms (Precision), Generators, Indicators, Integrators, Mechanical & Electro-Mechanical, Motor & Generator Armatures, Rotors, Stators, Motors, Multipliers, Repeaters, Servo, Resolvers, Synchro, Servo Systems, Shifters, Synchros, Tachometers, Transducers

Local Sales Offices & Reps.

Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Altadena, Don Murray Entprs.	213-681-5031
Conn	Enfield, Measurement Equip. Co.	203-745-9050
Fla	Hollywood, Reynolds & Assocs.	305-987-6720
Fla	Palm Beach Gardens, Reynolds & Assocs.	305-622-6850
Fla	Satellite Beach, Reynolds & Assocs.	305-773-4700
Fla	St. Petersburg, Reynolds & Assocs.	813-360-1484
Ga	Atlanta, Reynolds & Assocs.	404-252-5360
Ill	Chicago, R.M.P. Sales, Inc.	312-631-9545
Kans	Overland Park, ENSCO-REP, Inc.	913-381-7557
Md	Baltimore, Stemler Assocs., Inc.	301-944-8262
Mass	Wakefield, Measurement Equip. Co.	617-245-4870
Mich	Mt. Clemens, Compass Assocs.	313-468-8830
Mo	St. Louis, ENSCO-REP, Inc.	314-567-3935
NJ	Barrington, Stemler Assocs., Inc.	215-644-3477
NJ	Cherry Hill, Stemler Assocs., Inc.	609-966-4070
NJ	Clifton, Avionics Engrg. Sales, Inc.	201-772-1956
NY	Buffalo, Bowser & Sapecky Assocs., Inc.	716-839-4170
NY	Manlius, Bowser & Sapecky Assocs., Inc.	315-682-8885
Ohio	Dayton, Compass Assoc.	513-252-9939
Pa	Worcester, Transicoil, Inc.	215-277-1300
Wash	Bellevue, W.M. Buehler Co.	206-455-5512
EXP:	Worcester, Pa., Transicoil	215-277-1300

TRANSISTOR DEVICES, 85 Horsehill Rd., Cedar Knolls, N.J., 07927, Tel: 201-267-1900; Empl.: 240; Minimum order: $30

Customer service: J. Apelian

Free literature available: TDM Catalog - high performance power supply modules, TDMD Catalog - dual output power supply modules, TDI Catalog - high efficiency switching power supplies, XL Series Catalog - low cost regulated power supplies Dynaload Catalog - solid state electrical loads test equipment.

Products manufactured: Inverters, Power Supplies, Testers, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, Technology Mktg. Assocs.	205-883-7893
Cal	Costa Mesa, Measurement Assocs. So.	714-540-7160
Cal	Palo Alto, Coherent Mktg. Assocs.	417-327-2217
Fla	Ormond Beach, Technology Mktg Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assoc.	305-942-0774
Ill	Elmhurst, Scott Assocs.	312-279-5681
Md	Ellicott City, A/O Electronics	301-997-8033
Mass	Lexington, E.F. Delfino, Inc.	617-862-1118
NY	Liverpool, Systems Hardware Reps.	315-451-4925
NY	Rochester, L-Mar	716-328-5240
NY	Vestal, Systems Hardware Reps.	607-729-6339
Ohio	Medina, McShane Inc.	216-725-4568
Pa	Fort Washington, GCM Inc.	215-646-7535
Tex	Houston, Vista Assocs.	713-661-0119
Tex	Richardson, Vista Assocs.	214-235-4547
EXP:	New York, N.Y., Singer Products	212-432-1400

TRANSISTOR ELECTRONICS INC., Box 6191, Minneapolis, Minn., 55425

TRANSITRON ELCTRN. CORP., Precision Connector Div., 168 Albion St., Wakefield, Mass., 01880, Tel: 617-245-4500, TWX: 710-643-6718; Empl.: 4200

Products manufactured: Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Diodes, Integrated Circuit Devices, Rectifiers, References, D-C Voltage, Semiconductor Wafer Fabrication, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, Transitron Elctrn. Corp.	602-278-3596
Cal	Long Beach, Transitron Elctrn. Corp.	213-595-5472
Cal	Mountainview, Transitron Elctrn. Corp.	415-968-1710
Colo	Denver, R. G. Entprs.	303-744-2464
Fla	Orlando, Transitron Elctrn. Corp.	305-241-4526
Ill	Chicago, Transitron Elctrn. Corp.	312-693-3360
Ill	Oak Brook, Schuten Assocs.	312-654-8645
Kans	Prairie Village, Engrg. Svcs.	913-649-4000
Md	Baltimore, Callas Elctrns.	301-744-7711
Mich	Novi, Miltimore Sls.	313-349-5820
Minn	St. Louis Park, Transitron Elctrn. Corp.	612-546-4331
Mo	St. Louis, Engrg. Svcs.	314-726-2233
NJ	Nutley, Necco	201-661-5059
NJ	South Orange, Transitron Elctrn. Corp.	201-763-4780
NY	Rochester, Ontario Tech. Sls.	716-464-8636
NC	Raleigh, A. B. Andrews	919-833-5567
Ohio	Dayton, Transitron Elctrn. Corp.	513-276-4141
Pa	Ambler, G.C.M. Inc.	215-646-7535
Tex	Richardson, Transitron Elctrn. Corp.	214-234-2406
Wash	Bellevue, ElecSel Corp.	503-649-6177

TRANSMAGNETICS, INC., 210 Adams Blvd., Farmingdale, N.Y., 11735, Tel: 516-293-3100, TWX: 510-224-6420; FSC No: 17755; Empl.: 28; Minimum order: $100 .... p. 1•124,125

Customer service: F. Haber

Products manufactured: Amplifiers, Controls/Control Eqpt., Converters, Demodulators, Dividers, Encoders, Indicators, Modulators, All Kinds, Monitors, Multiplexers, Multipliers, Repeaters, Servo, Synchro Transmitters, Solid-State, Transformers

Local Sales Offices & Reps.

Ariz	Tempe, John Cain & Assocs.	602-838-3404
Md	Columbia, A.O. Inc.	301-924-3693
Minn	Minneapolis, Thurston Assocs.	612-929-7801
Wash	Bellevue, Topp Eng'g. Sls.	206-747-5400

TRANSPARENT CONDUCTORS INC., 26 Coromar Dr., Box 549, Goleta, Cal., 93017, Tel: 805-968-3561, TWX: 910-334-1180; Empl.: 10

Customer service: B. Feldman

Free literature available: Data Sheet On Liquid Crystal Displays - Large Area Dynamic Scattering Series Ld

Products manufactured: Display Devices/Displays

Local Sales Offices & Reps.

Cal	Los Angeles, Orion Sls.	213-240-3151
Conn	Coscob, Colavecchio Assoc.	203-869-8409

TRANSPARENT CONDUCTORS INC cont'd

Advertisment

Manufacturer of Liquid Crystal Displays featuring Hermetically sealed large area displays for applications such as Changeable Signs, Clocks, Visual Paging Systems, Scoreboards, Remote Readouts and other displays requiring Long Distance and/or Large Audience and/or High Ambient Light Viewing. Quotations for Custom LCD Requirements are invited.

TRANSTECTOR SYSTEMS, 532 Monterey Pass Rd., Monterey Park, Cal., 91754, Tel: 213-283-9278; FSC No: 30992; Empl.: 16; Minimum order: $25 ... p. 1•2302,2303

For info on price: S. Robbins; Application info: S. Robbins; Customer service: K. Hazen; Delivery info: M. Jo Mathews

Free literature available: Catalogue of AC and DC components for transient, over voltage and undervoltage protection, commercial protectors for facility or branch service protection - related transient voltage measuring monitoring instruments.

Products manufactured: Arresters, Electrical Surge, Lightning, Detectors, Indicators, Limiters, Monitors, Power Supplies, Protectors, Recorders, Suppressors

Local Sales Offices & Reps.

Cal	Burlingame, Leddy Assocs.	415-347-5247
Cal	Encino, Porter Co.	213-788-2350
Ga	Atlanta, Continental Controls	404-449-1271
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Mt. Prospect, Anatronic Associates	312-296-2468
Md	Lutherville, Cunningham & Assocs.	301-296-4306
Mass	Sturbridge, Branford Controls Corp.	617-347-7447
NJ	Ridgewood, Ballou, Inc.	201-444-6990
NY	Pittsford, NoCo, Inc.	716-461-4750
Ohio	Vandalia, W.J. Brauer & Assocs.	513-898-1224
Ohio	Wickliffe, W.J. Brauer & Assocs.	216-943-0601
Pa	Pittsburgh, W.J. Brauer & Assocs.	412-921-3213
Tex	Dallas, Glidden Electro Equip.	214-363-6539
Tex	Houston, Glidden Electro Equip.	713-681-1415

TRENDAR, 500 Clyde Ave., Mountain View, Cal., 94040, Tel: 415-965-0350, TWX: 910-379-6573

Customer service: N. Lyons

Free literature available: T200 Testclip - Hand Held in Circuit Digital IC Tester 1000 Portable Go/No-Go Digital Circuit Board Tester 1010 Production-Digital Circuit Board Tester 2000 Large Volume Digital Circuit Board Tester

Products manufactured: Clamps & Clips, Comparators, Probes, Test Systems, Testers

Local Sales Offices & Reps.

Ala	Huntsville, BSC Assoc.	205-881-6220
Ariz	Scottsdale, Barnhill 3	602-947-7841
Cal	Burbank, Instrument Specialists	213-849-7181
Cal	San Diego, Instrument Specialists	714-565-2555
Cal	Santa Clara, Instrument Specialists	408-244-1505
Colo	Denver, Barnhill 3	303-934-5505
Fla	Orlando, BCS Assoc.	305-896-4881
Ill	Des Plaines, Cozzens & Cudahy	312-298-3600
Ind	Indianapolis, Cozzens & Cudahy	317-244-2456
Mass	Lexington, Instrument Rep.	617-861-8620
Mich	Detroit, WKM Assoc.	313-892-2500
Minn	Minneapolis, Cozzens & Cudahy	612-884-4336
Mo	St. Louis, Cozzens & Cudahy	314-423-1234
NJ	Union, SBM Assoc.	201-687-8737
NM	Albuquerque, Barnhill 3	505-299-7658
NY	Pleasantville, SBM Assoc.	914-769-1811
NY	Rochester, SBM Assoc.	716-226-1400
NC	Greensboro, BCS Assoc.	919-273-1918
Ohio	Cleveland, WKM Assoc.	216-267-0445
Ohio	Dayton, WKM Assoc.	513-434-7500
Pa	Pittsburgh, WKM Assoc.	412-892-2953
Tex	Houston, Barnhill 2	713-621-0040
Tex	Richardson, Barnhill 2	214-231-2573

TRG, Div. of Alpha Inds., 20 Sylvar Rd., Woburn, Mass., 01801, Tel: 617-935-5150, TWX: 710-393-1236; FSC No: 53536; Empl.: 31; Minimum order: $100

For info on price: D. Loger; Application info: J. Cotton; Customer service: H. Miller; Delivery info: D. Loger

Free literature available: Microwave Millimeter Products and Capabilities Catalog

Products manufactured: Adapters, Waveguide, Amplifiers, Antenna Feed Systems, Antennas, Attenuators, Bends & Twists, Microwave, Bolometers, Calorimeters, Microwave, Circulators, Ferrite, Couplers, Delay Lines, Detectors, Diodes, Dividers, Dummy Loads, Filters, Flanges, Waveguide, Holders, Crystal, Horns, Microwave, Isolators, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Meters, Mixers, Modulators, All Kinds, Mounts, Radiometers, Receivers, Shifters, Slotted Lines, Microwave, Switches, Tees, Terminals, Tubing, Tuners

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs., Inc.	205-534-9771
Ariz	Phoenix, PLS Assocs., Inc.	602-957-9110
Cal	Los Altos, Stout-Loeswick	415-948-3265
Cal	Woodside, Windsor Dynamics, Inc.	415-854-4870
Colo	Denver, PLS Assocs., Inc.	303-771-0140
Fla	Orlando, Gentry Assocs., Inc.	805-894-4401
Ill	Elk Grove Village, L. F. Green & Assocs.	312-593-0282
Ind	Indianapolis, L. F. Green & Assocs.	317-293-9827
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Md	Woodbine, Morar Assocs.	301-442-2089
Mass	Lexington, Lancer Assoc.	617-861-1720
Mich	Ferndale, Tiby Co.	313-547-3550
Minn	Minneapolis, L. F. Green & Assocs.	612-781-1611
Mo	St. Louis, Engrg. Svcs. Co.	314-726-2233
NM	Albuquerque, PLS Assocs., Inc.	505-255-2330
NY	E. Syracuse, Ossmann Instrs.	312-437-6666
NY	Huntington, L.I., CDB Entprs., Inc.	516-692-5200
NC	Burlington, Gentry Assocs., Inc.	919-227-3639
Ohio	Cleveland, Tiby Co.	216-371-5335
Tex	Dallas, Texas Microwave/Electronics	214-231-5381
Utah	Salt Lake City, PLS Assocs., Inc.	801-272-3681
Wash	Renton, S. Wilson Co.	206-226-0650

TRI CORP., 505 W. Olive Ave., Sunnyvale, Cal., 94086

TRI-DATA CORP., 800 Maude Ave., Mountain View, Cal., 94043, Tel: 415-969-3700, TWX: 910-379-6978; Empl.: 173; Minimum order: $25

For info on price: G. Brewster; Application info: G. Brewster; Customer service: S. Horton; Delivery info: J. Cherney

Free literature available: Product literature for cartrifile tape recorders, flexible disk systems, sealed disk systems, automaton data entry systems, software programs, disk operating systems.

Products manufactured: Data Loggers, Memory Systems, Recorders, Tapes, Recording, Magnetic (All Types)

Local Sales Offices & Reps.

Cal	Newport Beach, Tri-Data Corp.	714-833-3722
Fla	Orlando, E.G. Holmes & Assocs.	305-894-8901
Ga	Chamblee, E.G. Holmes & Assocs.	404-451-6161
Kans	Mission, Inland Assocs.	913-362-2366
Md	Silver Spring, L.G. White & Co.	301-585-3141
Mass	Lexington, Tri-Data Corp.	617-861-7007
Mo	Glencoe, Inland Assocs.	314-938-4992
NJ	Cherry Hill, Williams Assocs.	609-424-4110
NJ	Fort Lee, Tri-Data Corp.	201-947-2092
NM	Albuquerque, Rustco Enterprises	505-296-6474
Tex	Austin, Martin Zienkosky, Browne, Assoc.	512-454-4371
Tex	Dallas, Martin Zienkosky, Browne, Assoc.	512-454-4371
Tex	Houston, Martin Zienkosky, Browne Assoc.	713-523-7333
Va	Virginia Beach, E.G. Holmes & Assocs.	804-481-6556

TRI-EX TOWER CORP., 7182 Rasmussen Ave., Visalia, Calif., 93277, Tel: 209-732-8383; Empl.: 31

For info on price: C. Blyleven; Application info: R. Carlson; Delivery info: R. Vargas

Products manufactured: Antenna Rotators, Antenna Towers & Supports, Antennas, Indicators, Lighting Equipment, Emergency, Mounts

TRI-SAGE, INC

TRI-SAGE INC., 1212 Pittsford-Victor Rd., Pittsford, NY, 14534, Tel: 716-381-2220, TWX: 510-253-1532; FSC No: 52992; Empl.: 100; Minimum order: $25

For info on price: F. Burham; Application info: F. Burham; Customer service: D. Schwenk; Delivery info: D. Schwenk

Free literature available: Facilities Brochure Process & Technical Brochure Applications Notes.

Products manufactured: Circuits, Hybrid, Thick Film, Networks, Resistors

Local Sales Offices & Reps.

Ala	Gadsden, Nickerson Co.	205-547-7718
Ariz	Tempe, Sedco Sls.	602-968-7791
Cal	Lafayette, Phillips Assocs.	415-284-2579
Cal	Los Angeles, M. A. Stolaroff Co.	213-295-7781
Cal	San Diego, M. A. Stolaroff Co.	714-234-6905
Conn	Milford, Todino Engrg. & Sls. co.	203-874-6643
Fla	Kissimmee, Nickerson Co.	305-846-6755
Fla	Oldsmar, Nickerson Co.	813-855-4209
Ga	Decatur, Nickerson Co.	404-321-4678
Kans	Shawnee Mission, Technical Sls. Assocs.	913-888-3330
Md	Baltimore, B. White & Co.	301-484-5400
Mass	Needham Hgts., Todino Engrg. & Sls. Co.	617-444-7925
Minn	Minneapolis, D. G. Perry & Co.	612-920-3212
Mo	St. Louis, Technical Sls. Assocs.	314-725-5361
NJ	Englewood Cliffs, E. Glass Assocs.	212-586-8440
NY	Fayetteville, Graydon-Sherman, Inc.	315-637-9861
NC	Franklin, Nickerson Co.	704-524-6363
NC	Kannapolis, Nickerson Co.	704-932-6772
Ohio	Vandalia, W. J. Brauer & Assoc.	513-898-1224
Ohio	Wichliffe, W. J. Brauer & Assoc.	216-943-0601
Okla	Tulsa, H. Daly Co.	918-627-4159
Pa	Ardmore, W.K. Metz	215-649-3966
Pa	Pittsburgh, W. J. Brauer & Assoc.	412-921-3213
Tex	Dallas, R. Matthews Elctrns.	214-233-0363
Tex	Houston, R. Matthews Elctrns.	713-664-7131

Advertisment

Tri-Sage, Inc. specializes in custom designs utilizing thick film microelectronic techniques. We also offer many standard circuits. Packages include DIP's, SIP's, molding, potting, conformal coating or substrate only. We manufacture resistor networks, RC filters and active hybrids. We provide fine line gold printing for chip bonding & RF applications. Prototypes are typically produced in 4 weeks.

TRI-TRONICS CO., 619 Enterprise Drive, Dept. EE, Oak Brook, Ill., 60521, Tel: 312-654-3255; Empl.: 12; Minimum order: $6

For info on price: E. Yelich; Application info: R. A. Anderson; Customer service: D. Hacquebord; Delivery info: E. Yelich

Free literature available: Illustrated catalog describes over 120 controls and accessories.

Products manufactured: Alarms, Controls/Control Eqpt., Counters, Light Sources, Photoelectric

Local Sales Offices & Reps.

Colo	Lakewood, Hess Elctrn. Control	303-421-4000
Conn	West Hartford, A. Hatton Assoc.	203-233-3613
Ill	Aurora, Dwight Smith & Assoc.	312-896-0828
Mass	Pine Hurst, Julie Assocs.	617-667-1958
Mo	St. Louis, W.W. Munroe Equip.	314-968-2500
Ohio	Columbus, Rockford Controls Ohio Inc.	614-231-5890
Ohio	Dayton, Rockford Controls Ohio Inc.	513-898-5452
Ohio	Euclid, Rockford Controls Ohio Inc.	216-731-5250
Pa	Chalfont, Mid-Lantic Assoc.	215-249-3301
Pa	Erie, Rockford Controls Ohio Inc.	412-373-2531

TRIAC ELECTRONICS, 200 Park Ave., Ste. 303E, New York, N.Y., 10017, Tel: 212-687-0620; Empl.: 24; Minimum order: $300

For info on price: M. Walpow; Application info: S. Black; Customer service: M. Stanley; Delivery info: M. Stanley

Products manufactured: Alarms, Arresters, Electrical Surge, Lightning, Batteries, Capacitors, Fixed, Circuit Breakers, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Conductive Plastic Materials, Controls/Control Eqpt., Coolants, Circuit & Components, Cords, Counters, Current Sensors, Detectors, Diodes, Drivers, Solenoid, Electroplating Equipment & Supplies, Eliminators, Battery, Generators, Heat Exchangers & Systems, Honeycomb Sheets, Panels, etc., Indicators, Inverters, Laminates, Loads, Electronic Variable, Monitors, Motors, Probes, Protectors, Rectifiers, Reducers, Regulators, Relays, Shifters, Substrates, Suppressors, Switches, Thermistors, Thermostats, Thyristors (Includes Silicon Controlled Rectifiers), Timers, Transducers, Transformers, Tubes, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

TRIAD-UTRAD, Distributor Svcs., 305 N. Briant St., Huntington, Ind., 46750, Tel: 219-356-6500, TWX: 810-333-1532; Empl.: 450 .... p. 2•1822-1829

For info on price: S. Fisher; Application info: D. Myers; Customer service: P. Monsey; Delivery info: P. Monsey

Free literature available: #TR75-76, Industrial Transformer Catalog; Transformers, Chokes, Power Supplies, Circuit Cards. #TV75-76, Replacement Guide: Yokes & Flybacks for TV Replacement, #TCT-74, Engineering Bulletin on Telephone Coupling Transformers, #TY-73, Engineering Bulletin on Transitor Power Supply Transf. Engineering Bulletin on Toroidal & Power Inductors.

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Chargers, Battery, Chokes, Coils Including Assemblies & Forms, Inverters, Power Supplies, Pullers, Reactors, Regulators, Transformers, Yokes

Local Sales Offices & Reps.

Alas	Anchorage, H.J. Lang & Assocs.	907-279-5741
Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Ark	El Dorado, D. Bellew Sls. Co.	501-863-8325
Cal	No. Hollywood, J. Carter	213-980-3450
Cal	Redwood City, Logan Sls. Co.	415-369-6726
Colo	Denver, McLoud & Raymond Co.	303-756-1589
Conn	Madison, A&M Elctrn. Reps.	203-245-1031
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Ga	Atlanta, Murphy & Cota	404-875-2525
Ill	Wilmette, J. Wasserman Assocs.	312-256-3566
Ind	Fort Wayne, New/Era Sls.	219-432-1164
Ind	Indianapolis, New/Era Sls.	317-257-7333
Iowa	Des Moines, T. L. Dowell, Inc.	515-225-1620
Kans	Overland Park, T.L. Dowell, Inc.	913-236-8200
La	Kenner, D. Bellew Sls. Co. Inc.	504-729-4550
Md	Baltimore, E-K-P Assocs.	301-788-6498
Mass	Needham, A&M Elctrn. Reps.	617-444-8170
Mich	St. Clair Shores, J.M. Thorpe Co.	313-779-6363
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
Mo	St. Louis, T.L. Dowell, Inc.	314-968-4234
NM	Albuquerque, Shefler-Kahn Co. Inc.	505-265-7077
NY	Rochester, Marsey Sls.	716-442-9700
NY	Rockville Centre, Willgold Elctrn. Sls. Corp.	516-764-4022
NC	Burlington, Murphy & Cota	919-584-1577
Ohio	Cincinnati, F.E. Kahsar Sls.	513-471-9011
Ohio	Hudson, F.E. Kahsar Sls.	216-653-6808
Okla	Tulsa, J.V. Schoonmaker	918-936-1423
Ore	Portland, J.J. Backer Co.	503-297-3776
Pa	Easton, E-K-P Assocs.	215-258-6477
Pa	Pittsburgh, Trymax Co.	412-823-8400
Tenn	Memphis, D. Bellew Sls. Co.	901-365-9437
Tex	Dallas, J. Y. Schoonmaker Co.	214-357-8481
Wash	Seattle, J.J. Backer Co.	206-285-1300
EXP:	Westbury, N.Y., Minthorne Int'l.	516-334-3303

TRIDAIR INDS., Fastener Div., 3000 W. Lomita Blvd., Torrance, Calif., 90505, Tel: 213-530-2200, TWX: 910-347-6239; Empl.: 300; Minimum order: $25

For info on price: Quot. Dept.; Application info: Tech. Sls.; Customer service: Order Svcs. Dept.; Delivery info: Order Svcs. Dept.

Products manufactured: Fasteners, Pins, Rings, Retaining

Local Sales Offices & Reps.

Cal	Santa Monica, Air Supply Co.	213-871-0520
Mass	Waltham, Elctrn. Fasteners	617-890-7780
Minn	Minneapolis, Aerospace Computer Supplies	612-884-4725
NY	Plainview, Merit Fasteners	516-242-1800

TRIDAK, INC., 5 Valley Rd., Danbury, Conn., 06810, Tel: 203-744-3060; Minimum order: $15

Customer service: F. Gurski

Free literature available: Complete data sheets on our Model 200, 260-270 and 280 metering dispense machines; data sheet on our micro manipulator.

Products manufactured: Machines/Machinery, Production, Meters

TRIMM, INC., 400 W. Lake, Box 489, Libertyville, Ill., 60048, Tel: 312-362-3700; Empl.: 90 .... p. 2•895

Products manufactured: Attenuators, Boxes, Junction, Outlets & Wall Plates, Caps, Lenses, Indicator Light, Connectors, Cords, Handsets, Chestsets, Headphones, Headsets, Etc., Jacks (All Types), Panels, Plugs, Potentiometers, Racks, Sockets, Switches, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Palo Alto, JM Assocs.	415-327-1260
Md	Kensington, Forti-Austin Assocs.	301-949-1706
NJ	Willingboro, Forti-Austin Assocs.	609-871-9290
RI	Cumberland, Perry Assocs.	401-333-5054
Tex	Dallas, Techno Assocs.	214-FL7-9213

TRIO LABS, INC., 80 Dupont St., Plainview, N.Y., 11803, Tel: 516-681-0400, TWX: 510-221-1861; Empl.: 150

Customer service: J. Crawford

Products manufactured: Converters, Current Sources, Inverters, Power Supplies, Regulators

Local Sales Offices & Reps.

Ariz	Scottsdale, Thorson/Phoenix	602-956-0800
Cal	Palo Alto, Held & Mollard	415-965-9321
Colo	Denver, Thorson/Denver	303-759-0809
Conn	Hamden, Scientific Comps.	203-272-2160
Md	Upper Marlboro, RL Engrg.	301-760-5533
Mich	Southfield, Luebbe Sls. Co.	313-357-0335
Minn	Saint Paul, Cahill Assocs.	612-739-8445
Mo	Maryland Heights, Delltron, Inc.	313-434-3804
Ohio	Cincinnati, Luebbe Sls. Co.	513-871-4211
Ohio	Cleveland, Luebbe Sls. Co.	216-333-0425
Ohio	Dayton, Luebbe Sls. Co.	513-294-0426
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Tex	Dallas, Norvell Assocs., Inc.	214-350-6771
Tex	Houston, Norvell Assocs. Inc.	713-774-2568

TRIO-TECH, INC. OF CALIF., 2435 N. Naomi St., Burbank, Calif., 91504, Tel: 213-846-9200, TWX: 910-498-2709; Empl.: 57; Minimum order: $25

Customer service: Sls. Desk

Free literature available: Data sheets and technical reports covering TRACER-flo® Process of fine and gross leak hermeticity testing, Bubble Testers, Bulk-to-Stick Loaders, CENTRISAFE® and environmental centrifuges.

Products manufactured: Detectors, Machines/Machinery, Production, Services, Assembly, Production & Test, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Meas. Conslts.	602-994-9519
Colo	Boulder, Meas. Conslts.	303-449-5294
Fla	Sarasota, W. J. Irvine Co.	813-955-9656
Ill	Des Plaines, Maher Engrg. Co.	312-824-2124
Kans	Baxter Springs, Production Automation	316-856-3600
Mass	Wilmington, Technical Instr.	617-944-3930
Minn	Minneapolis, Production Automation	612-866-5700
Mo	Hazelwood, Production Automation	314-731-2331
Mo	Raytown, Production Automation	816-737-0066
NM	Albuquerque, Meas. Conslts.	505-265-6471
NM	Las Cruces, Meas. Conslts.	505-526-2491
NY	Hartsdale, Powell-Pendergraph	914-761-7792
NY	Niagara Falls, Watmet, Inc.	716-285-3595
Pa	Colmar, E. L. Assocs.	215-822-2510
Tex	Dallas, Stu Hamilton Assocs.	214-350-4344
Utah	Murray, Meas. Consits.	801-268-3181

TRIPLETT CORP., 286 Harmon Rd., Bluffton, Ohio, 45817, Tel: 419-358-5015, TWX: 810-490-2400 ... p. 1•821

For info on price: B. Selvage; Application info: B. Selvage; Customer service: N. Edinger; Delivery info: N. Edinger

Products manufactured: Analyzers, Calibrators, Cases, Equipment, Instrument, Meter, Detectors, Indicators, Kits, Test Equipment, Meters, Probes, Recorders, Shunts, Meter, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893

Cal	Inglewood, J. Berman Co., Inc.	213-649-6111
Cal	Millbrae, Polach & Bensinger	415-697-2525
Colo	Denver, Shefler-Kahn	303-623-1567
Conn	Wallingford, Adams-McGregor	203-269-5816
Fla	Maitland, Hutto-Hawkins-Peregoy, Inc.	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy, Inc.	305-943-9593
Ga	Atlanta, Millar Elctrns.	404-261-6160
Haw	Honolulu, Kems, Inc.	808-847-1395
Ill	Oak Park, G. Petitt Co.	312-369-8940
Ind	Ft. Wayne, W. Bieberich Inc.	219-432-2537
Ind	New Albany, W. Bieberich Inc.	812-945-3187
Kans	Overland Park, T. Dowell Inc.	913-236-8200
Md	Reisterstown, Massey Assoc.	301-833-2039
Mass	Boston, Adams-McGregor	617-542-3773
Mich	Grosse Point Woods, Elko Sls. Corp.	313-884-1955
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, T.L. Dowell, Inc.	314-968-4234
NJ	North Caldwell, Masin Esco Inc.	201-226-2550
NY	Rochester, L. G. Marchese Assoc.	716-544-4300
NY	Syosset, Masin Esco Inc.	516-364-0310
NC	Raleigh, Millar Elctrns.	919-787-9564
Ohio	Centerville, C.H. Dolfuss Jr. & Co.	513-433-6776
Ohio	Rocky River, C.H. Dolfuss Jr. & Co.	216-333-7504
Ore	Portland, J.J. Backer Co.	503-297-3776
Pa	Media, Snyder & Massey Assoc., Inc.	215-566-5400
Pa	Pittsburgh, G.S. Root	412-561-4125
RI	Lincoln, Adams-McGregor	401-726-1300
Tex	Dallas, Lund & Co.	214-358-4335
Wash	Seattle, J.J. Backer Co.	206-285-1300

Local Distributors

Ala	MObile, Brownell-Electro, 3450 Armour Dr.	205-479-5405
Ariz	Phoenix, Metermaster Div., 2633 E. Buckeye Rd.	602-273-7331
Cal	Gardena, Key Instrs., 1520 W. Rosecrans	213-321-5891
Cal	Glendale, R.V. Weatherford, 6921 San Fernando	213-849-3451
Cal	Los Angeles, Croft Elec., 1016 W. 8th St.	213-626-6894
Cal	Los Angeles, Metermaster Div., 5646 Jillson St.	213-685-4340
Cal	Palo Alto, Metermaster Div., 3995 E. Bayshore	415-968-0313
Cal	San Diego, Metermaster Div., 8797 Balboa Ave.	714-278-2112
Cal	Santa Clara, Dynametron, 3343 Edward Ave.	408-246-6535
Cal	Sonoma, Schmidt Elec., 122 E. Napa St.	707-938-8416
Colo	Denver, Meter-master, 1165 S. Cherokee	303-722-5766
Conn	Middletown, Mancib Co., Box 781	203-346-6646
Fla	Ft. Lauderdale, A & M, 4257 N.E. 6th Ave.	305-565-2579
Fla	Orlando, Brownell-Electro, 307 27th St.	305-843-6775
Ga	Atlanta, Brownell-Electro, Drawer 82730	404-762-5181
Haw	Honolulu, Kems, Inc., 239 Puuhale Rd.	808-847-1395
Ill	Chicago, A & M, 6251 W. Touhy Ave.	312-774-3500
Ill	Chicago, E.I.L., 221 W. 79th St.	312-874-8070
Ill	Elk Grove, Vil. Metermaster, 121 Gordon St.	312-593-8650
Ill	Elk Grove, Vil. Meter-makers, 2450A Lunt Ave.	312-439-5050
Ill	Oak Park, Pacific Indicator, 6603 W. North Ave.	312-261-1330
Kans	Overland Park, Brooks Elec., 3761 W. 95th	913-648-3131
Kans	Shawnee Mission, Sturtz Inst., 4705 Mission Rd.	913-236-4705
La	Harahan, Industrial Inst. Works, 134 Laitram La.	504-733-8355
Md	Elkridge, Sunshine Sc., 5800 Main St.	301-796-5600
Md	Savage, Pyttronic, 8220 Wellmoor Ct.	301-953-3000
Md	Timonium, E.I.L., 1830 York Rd.	301-252-1260
Mass	Burlington, Mancib Co., Middlesex Tpk at "A" St.	617-272-9450
Mich	Ferndale, Ram Meter, Inc., 1100 Hilton Rd.	313-547-1000
Mich	Lansing, Main Elec., 5558 S. Pennsylvania	517-882-5035
Minn	Minneapolis, Instr. Control, 2401 E. Franklin	612-336-7744
Mo	St. Louis, Ind. Serv., 4354 Olive	314-535-5760
NH	Portsmouth, A & M, 1039 Ilington St.	603-431-7912
NJ	Belleville, Marshall Inst., 236 Washington	201-751-1190
NJ	S. Plainfield, Brownell-Electro, 500 Hadley Rd.	201-753-4600
NY	Buffalo, Trott Elctrns., 932 Hertel Ave.	716-876-0880
NY	L.I.C., Metermod Inst., 48-15 31st Ave.	212-726-4850
NY	Rockville Ctr., A & M, 5 Nassau St.	516-678-6960
NC	Charlotte, Brownell-Electro, Box 16368	704-394-4341
Ohio	Cleveland, Pioneer/Std., 4800 E. 131st St.	216-587-3600
Ohio	Cleveland, Weschler Elec., 4250 W. 130th	216-251-4609
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Okla	Tulsa, Tri-State Inst., Box 4746	918-936-0489
Pa	Phila., Sunshine Sc., 1810 Grant Ave.	215-673-5600
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-288-2600
Pa	Pittsburgh, E.I.L., 1844 Ardmore Blvd.	412-731-5230
Tenn	Memphis, Brownell-Electro, 3053 Tranquillity	901-332-9254
Tenn	Nashviulle, Brownell-Electro, 1050 Acorn Dr.	615-889-8230
Tex	Beaumont, Straughn Elec., 3235 Highland Ave.	713-838-4563
Tex	Dallas, Ultra Inst., 9995 Monroe Dr.	214-357-0297
Tex	Garland, Metermaster, 2809 National Dr.	214-271-2471
Tex	Houston, Quality Inst., 4832 Caroline	713-524-0528
Tex	Odessa, Whitlock Inst., 1306 N. Texas	915-337-3412
Va	Richmond, I.T.R., 1425 Blue Jay La.	804-288-7198
Wash	Seattle, Eicher-Richards, 2727 N.E. Blakeley	206-523-7888
Wisc	Milwaukee, Electro-Mechano, 241 E. Erie St.	414-272-4050

TRIPP-LITE, 133 N. Jefferson, Chicago, Ill., 60606, Tel: 312-346-3040; Minimum order: $10

Customer service: Order Desk

Products manufactured: Inverters, Lighting Equipment, Emergency, Power Supplies

TRIRIDGE CORP., Elec. Comps. & Sys., Box 12420, Pittsburgh Airport, Pittsburgh, Pa., 15231, Tel: 412-899-2288; FSC No: 31951; Empl.: 50; Minimum order: $25

For info on price: H. Lokomski; Application info: P. Sklack; Customer service: H. Lokomski; Delivery info: H. Lokomski

Free literature available: 16-page Catalog showing line of standard Reed Relay products dimension for application, switching capabilities, and coil resistance.

Products manufactured: Relays

Local Sales Offices & Reps.

Cal	Mt. View, West/Mark Assocs.	415-969-1700
Cal	San Gabriel, V. Gott & Assocs.	213-285-2148
Colo	Denver, Omega, Ltd.	303-758-1508
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assoc.	305-422-3686
Fla	St. Petersburg, Saber Assoc.	813-441-1301
Ga	Woodstock, Saber Assocs.	404-432-9625
Ill	Glendale Hts., Trend-Tronics	312-963-2210
Ind	Ft. Wayne, McDonald Sls. Co.	219-747-3650
Md	Hyattsville, Eastern Components	301-577-2925
Mass	Reading, C.E. Godfrey Co.	617-944-2230
Mich	Dearborn, Pitcher-Poulin, Inc.	313-582-5450
Minn	Minneapolis, Scott Elctrn. Sls.	612-929-2985
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NY	Camillus, Noco	315-672-3988
NY	Manhasset, Win-Cor Elctrn. Sls. Corp.	516-627-9474
NY	Pittsford, Noco	716-461-4750
NC	Raleigh, Saber Assoc.	919-834-3961
Ohio	Centerville, N. Case Assocs.	513-425-1301
Ohio	Dayton, N. Case Assocs.	513-433-0966
Ohio	Fairview Park, N. Case Assocs.	216-333-4120
Pa	Enon Valley, Nebco Assocs.	216-457-2333
Pa	Flourtown, Eastern Components	215-836-1616
Pa	York, Eastern Components	717-764-3114
Tex	Dallas, R. Matthews Elctrns.	214-233-0363
Tex	Houston, R. Matthews Elctrns.	713-664-7131
Wash	Seattle, Nemco	206-322-6200

TRIRIDGE CORP. cont'd

Advertisment

Triridge is a full capability Reed relay house, we have the capability from low level to high voltage and the full gambit of Reed relay switching capabilities. Our facilities can produce for the Engineer prototype order, or the high volume production order. All relays are top quality and 100% tested at competitive market prices.

TRIVEX, 3180 Redhill Ave., Costa Mesa, Cal., 92626, Tel: 714-546-7781; Empl.: 100

For info on price: E. F. Thompson; Application info: R. Engle; Customer service: D. Hirchak; Delivery info: E. F. Thompson

Free literature available: Model 40/80 Brochure describes Treiex plug to plug replacement system for IBM 2848/2260 systems. replacement system for IBM 2848/2260 systems. Model 720/740 Serial Impact Printer - spec describing printer.

Products manufactured: Printers, Terminals, Data Display (including Alphanumeric & Graphic)

Local Sales Offices & Reps.

Ill	Rosemont, 312-696-2380	
NJ	Ramsey	201-825-1900

TROMPETER ELECTRONICS, INC., 8936 Comanche, Chatsworth, Cal., 91311, Tel: 213-882-1020, TWX: 910-494-1210; FSC No: 14949; Empl.: 75; Minimum order: $25

For info on price: E. Miller; Application info: L. Tichy; Customer service: J. Escover; Delivery info: Stock

Free literature available: T-10 Catalog: describes patch panels, jacks, cords, networks and connectors along with matrices, switches and systems in coax, twinax and triax, from D.C. to 3 GHz.

Products manufactured: Antenna Switching Matrices, Attenuators, Bridges, Cable Assemblies & Harnesses, Cable, Connector Adapters, Connectors, Cords, Dividers, Jacks (All Types), Matrices, Computer, Modules, Logic, Encapsulated, Panels, Plug Adapters, Plug & Jack Sets, Relays, Switches, Tees, Terminals, Tools

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier, Inc.	205-536-5650
Cal	Los Angeles, Trompeter Elctrns., Inc.	213-882-1020
Cal	Menlo Park, Long & Assocs.	415-327-1300
Colo	Littleton, Aztec Entprs.	303-795-0250
Conn	Milford, Todino Engrg. Sls.	203-874-6643
Fla	Orlando, Currie, Peak & Frazier, Inc.	305-855-0843
Ill	Chicago, J. C. Angel	312-878-0653
Md	Silver Spring, Sel-Tronics, Inc.	301-589-3391
Mass	Needham Heights, Todino Engrg. Sls., Inc.	617-444-7925
Minn	Minneapolis, Engrg. Prods. Assocs.	612-925-1883
NJ	Saddlebrook, L & M Assocs.	201-843-8700
NM	Albuquerque, Aztec Entprs.	505-255-2440
NY	Brentwood, L & M Assocs.	516-231-8363
NY	New York, L & M Assocs.	212-675-7486
NY	Rochester, Upstate Component Sls. Inc.	716-288-1080
NC	Greensboro, Currie, Peak & Frazier, Inc.	919-273-3040
Ohio	Berea, Geotronix Mktg. Assoc.	216-243-8520
Ohio	Columbus, Geotronix Mktg. Assoc.	614-457-8472
Pa	Andalusia, L & M Assocs.	215-639-3100
Tex	Austin, Martin, Ziekosky, Browne & Assoc.	512-454-4371
Tex	Dallas, Martin, Ziekosky, Browne & Assoc.	214-233-5535
Tex	Houston, Martin, Ziekosky, Browne & Assoc.	713-523-7333
FOR:	Can., Calgary, Alberta, Westronic Engrg. Sls. Ltd.	403-253-5585
FOR:	Can., Montreal, Quebec, Componetics Ltd.	514-342-4117
FOR:	Can., Vancouver 10, BC, Westronics Engrg. Sls. Ltd.	604-872-0636

TROMPETER ELECTRONICS, INC cont'd

Advertisment

"Special cable, connectors, patching and switching for Video, T.V., data, and instrumentation systems.' Patching includes patch panels, patch cords, and many special accessories in coax, triax, twinax, and quadrax noise-rejecting cable systems. Switching includes custom built matrices and multipole - multithrow relays including Digital control for coax, isolated coax, triax and twinax cable systems. Frequencies from D.C. up through 3 GHz. Technical discussion of noise rejecting cable systems in catalog."

TRONIC CORP., Box 247-E, Belmont, Cal., 94002, Tel: 415-593-1487, Telex: 34-8457; Empl.: 5; Minimum order: $35

For info on price: B. Keeler 913-263-2440; Application info: H. Stanly 415-593-1487; Customer service: B. Keeler 913-263-2440; Delivery info: B. Keeler 913-263-2440

Products manufactured: Cleaners, Ultrasonic, Machines/Machinery, Production

Local Sales Offices & Reps.

Cal	Belmont, C. B. Process	415-592-4545
Cal	Long Beach, Viets Engrg.	213-426-2107
Colo	Broomfield, F. J. Leonard Co.	303-466-2307
Fla	Hollywood, Victor Metal Finishing	305-981-1969
Haw	Honolulu, C & F Machinery	808-524-1033
Ind	Indianapolis, Hi-B	317-357-8521
Kans	Mission, Grady Co.	913-262-1231
Mich	Southfield, American Envivosales	313-559-6145
Minn	Minneapolis, Chemquip Corp.	612-374-3610
NJ	Mountain Lakes, Desrie & Farrell	201-334-4848
NY	Lyons, Finishing Sys.	315-946-6661
NC	Statesville, Brown Equip.	704-872-3669
Ohio	Akron, Friess Vacublast	216-836-9011
Okla	Oklahoma City, Tri-Mech Co.	405-478-2558
Ore	Portland, Precision Chemical	503-244-7636
Pa	Pittsburgh, Checker Inds.	412-795-4414
Tex	Houston, Allies Machinery & Supply	214-358-1401
Wisc	Menomonee Falls, Fritz Engrg.	414-251-6590

TRUE DATA CORP., 2701 S. Halladay, Santa Ana, Cal., 92707

TRUMP-ROSS IND:'L. CONTROLS, Div. of Datametrics, Inc., 265 Boston Rd., Billerica, Mass., 01862, Tel: 617-663-3451; Empl.: 55

For info on price: R. Brunelle; Application info: S. Futran; Customer service: R. Brunelle; Delivery info: R. Brunelle

Free literature available: Incremental Encoders & Systems Handbook - Theory of operation of incremental encoders, glossary of terms, condensed catalog, and block diagrams of typical applications.

Products manufactured: Encoders, Tachometers, Testers

Local Sales Offices & Reps.

Cal	Encino, King-Way Associates	213-788-4124
Cal	San Carlos, Electro-Pacific	415-593-1334
Colo	Littleton, Radco Electronics	303-794-4279
Ill	Chicago, Thermo/Cense	312-792-2760
Mass	Waltham, J. W. Simpson Co.	617-899-7700
Mich	Royal Oak, Dave Ray & Associates	313-576-4705
NJ	South Orange, The Smith Co.	201-763-1770
NY	Rochester, KLM Assocs.	716-442-0820
NY	Syracuse, KLM Assocs.	315-458-6214
NC	Winston-Salem, Radco Co.	919-722-9671
Ohio	Chagrin Falls, The J. Kilroy Corp.	216-247-8997
Pa	Jenkintown, Stein Instrumentation Corp.	215-885-2370
Tex	Richardson, Concept Sls.	214-231-3040
Wash	Bellevue, Al Smith Co.	206-746-6770

TRUTONE ELCTRNS., INC., 7315 Fulton Ave., No. Hollywood, Cal., 91605, Tel: 213-875-0423; Empl.: 25; Minimum order: $5

Customer service: Sls. Dept.

Free literature available: Complete catalog of sound products. Tuners - amplifiers - receivers - accessories.

Products manufactured: Amplifiers, Receivers, Tuners

Local Sales Offices & Reps.

Ala	Birmingham, Adams & Assocs.	205-822-8109
Ariz	Phoenix, J.R. Morgan Agency	602-252-3089
Cal	Santa Clara, Wayne Wainwright	408-247-2310
Colo	Littleton, J.E. Gray	303-795-8223
Conn	West Hartford, R. Smith Co.	203-523-0512
Fla	Miami, World Wide Prods.	305-949-3457
Ga	Decatur, Adams & Assocs.	404-981-2207
Ill	Skokie, M. Bermann Sls.	312-675-3740
Md	Olney, D. Buckley	301-774-9338
Mich	Pontiac, T.A. Sls.	313-335-4285
Minn	Moorhead, Northland Assocs.	218-233-4616
Miss	Michigan City, J. Fisher Sls.	601-224-6470
Mo	Kansas City, Nevco Inc.	816-421-1751
NY	Jamaica, G.E. Miller Assocs.	516-433-5590
NY	Phelps, LSM Assocs.	315-548-4891
NC	Greensboro, Adams & Assocs.	919-272-6838
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Ore	Lake Oswego, McMillan Elctrns.	503-636-6257
Tenn	Memphis, L.E. Jones	901-683-7616
Tex	Dallas, Techno Assocs.	214-357-9213

TRW CAPACITOR DIV., 301 West 'O' Str., Ogallala, Neb., 69153, Tel: 308-284-3611, TWX: 910-620-0321; FSC No: 5910; Minimum order: $100 .... p. 2•302-314

For info on price: A. Tompkins Ext. 362; Application info: T. Vonkampen Ext. 306; Customer service: K. Fleshman Ext. 360; Delivery info: K. Fleshman Ext. 360

Products manufactured: Capacitors, Fixed, Diodes, Rectifiers, Transistors

Local Sales Offices & Reps.

Ala	Huntsville, TRW Elctrns.	205-772-9656
Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-948-5590
Cal	Los Angeles, Q.T. Wiles & Assocs.	213-649-1232
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, Q.T. Wiles & Assocs.	714-565-6893
Cal	Tustin, Q.T. Wiles & Assocs.	714-832-4952
Cal	Woodland Hills, TRW Elctrns.	213-883-9033
Colo	Denver, Straube Assocs.	303-426-0890
Conn	Rowayton, TRW Elctrns.	203-853-4466
Fla	Ft. Lauderdale, TRW Elctrns.	305-721-1700
Fla	Orlando, TRW Elctrns.	305-857-3650
Ill	Elk Grove, J.G. Twist Co.	312-593-0200
Ind	Ft. Wayne, R.O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-452-6065
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell & Assoc.	502-893-7303
Md	Ellicott City, TRW Elctrns.	301-465-1777
Mass	Waltham, TRW Elctrns.	617-899-6100
Mich	Grand Rapids, R.O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assoc.	616-983-7337
Minn	Minneapolis, TRW Elctrns.	612-835-5454
Mo	St. Louis, J.G. Twist Co.	314-432-2830
NM	Albuquerque, Straube Assocs.	505-292-0295
NY	Melville, TRW Elctrns.	516-293-9000
NY	Rochester, TRW Electrns.	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R.O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assocs.	513-298-9546
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Narberth, TRW Elctrns.	215-667-3400
Pa	Pittsburgh, R.O. Whitesell & Assocs.	412-344-7277
Tex	Dallas, TRW Elctrns.	214-637-6650
Tex	Houston, TRW Elctrns.	713-771-7812
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Va	Roanoke, TRW Elctrns.	703-345-4965
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
Wisc	Waukesha, J.G. Twist Co.	414-475-7755

Local Distributors

Ala	Huntsville, Cramer-Ew, 2310 Bob Wallace Ave.	205-539-5722
Ariz	Phoenix, Liberty Elctrn., 3130 N. 27th Ave.	602-257-1272
Cal	Glendale, R. V. Weatherford, 6921 San Fernando	213-849-3451
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Colo	Denver, Cramer Elctrn., 5465 E. Evans Pl.	303-758-2100
Conn	North Haven, Cramer Elctrn., 35 Dodge Ave.	203-239-5641
Fla	Orlando, Cramer-Ew, 345 N. Graham Ave.	305-894-1511
Ga	Atlanta, Cramer-Atlanta, 3923 Oakcliff	404-488-9050
Ill	Chicago, Allied Elctrn., Box 6569	312-421-2400
Ill	Elk Grove, Hall-Mark Elctrn., 180 Crossen Ave.	312-437-8800
Kans	Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd.	913-888-4747
Md	Hanover, Cramer-Baltimore, 7255 Standard Dr.	301-796-5790
Mass	Boston, Demambro Elctrn., 1095 Commonwealth	617-787-1200
Minn	Minneapolis, Hall-Mark Elctrn., 4555 W. 77th St.	612-925-2944
Mo	Earth City, Hall-Mark Elctrn., 13789 Rider Trail	314-291-5350
NJ	Clifton, Wilshire Elctrn., 312 Clifton Ave.	201-365-2600
NJ	Moonachie, Crameer Elctrn., 1 Barrett Ave.	201-935-5600
NM	Albuquerque, Cramer Elctrn., 137 Vermont N.E.	505-265-5767
NY	Hauppauge, Cramer Elctrn., 29 Oser Ave.	516-231-5600
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NC	Winston Salem, Cramer-Ew, 938 Burke St.	919-725-8711
Ohio	Columbus, Elctrn. Mktg., 1150 W. Third Ave.	614-299-4161
Okla	Tulsa, Hall-Mark Elctrn., 4846 S. 83rd E. Ave.	918-835-8458
Pa	Philadelphia, Phila Elctrn., 1225 Vine St.	215-568-7444
Tex	Dallas, Hall-Mark Elctrn., 9333 Forest La.	214-231-6111
Utah	Salt Lake, Cramer Elctrn., 391 W. 2500 South	801-487-4131
Va	Charlottesville, Virginia Radio, Box 1189	703-296-4184
Wash	Seattle, Liberty Elctrn., 5305 2nd Ave. S.	206-763-8200
Wisc	Milwaukee, Hall-Mark Elctrn., 11925 W. Ripley Ave.	414-476-1270

TRW/CINCH CONNECTORS, Electronic Comp. Div. of TRW Inc., 1501 Morse Ave., Elk Grove Village, Ill., 60007, Tel: 312-439-8800 .... p. 2•896,897

For info on price: W. Walthall; Application info: W. Walthall; Customer service: A. Fosco; Delivery info: A. Fosco

Products manufactured: Boards, Plug-In, Boards, Programming, Caps, Connector, Clamps & Clips, Connector Adapters, Connector Blocks, Mother Board, Connectors, Contacts, Electrical, Covers, Protective (Including Dust), Integrated Circuit Devices, Jacks (All Types), Plug & Jack Sets, Plugs, Shields, Sockets, Strips, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Ala	Huntsville, TRW Cinch Divs.	205-772-9656
Ariz	Scottsdale, TRW Cinch Divs.	602-994-0441
Cal	Cerritos, TRW Cinch Divs.	213-924-5711
Cal	Mountain View, TRW Cinch Divs.	415-969-2252
Cal	Tustin, TRW Cinch Divs.	714-544-8751
Colo	Denver, Straube Assoc.	303-426-0890
Conn	Rowayton, TRW Cinch Divs.	203-853-4466
Fla	Ft. Lauderdale, TRW Cinch Divs.	305-721-1700
Fla	Orlando, TRW Cinch Divs.	305-894-6881
Ill	Elk Grove Village, TRW Cinch Divs.	312-593-0200
Ill	Rosemont, TRW Cinch Divs.	312-298-1340
Ind	Indianapolis, R.O. Whitesell	317-359-9283
Mass	Reading, TRW Cinch Divs.	617-944-3020
Mich	Southfield, TRW Cinch Divs.	313-357-3700
Minn	Minneapolis, TRW Cinch Divs.	612-835-5454
Mo	St. Louis, TRW Cinch Divs.	314-727-7370
NJ	Clifton, TRW Cinch Divs.	201-546-0990
NM	Albuquerque, Straube Assocs.	505-294-1880
NY	Manilus, TRW Cinch Divs.	315-637-3282
NY	Melville, TRW Cinch Divs.	516-293-9000
NY	Rochester, TRW Cinch Divs.	716-461-3070
NC	Charlotte, TRW Cinch Divs.	704-376-6811
Ohio	Dayton, TRW Cinch Divs.	513-298-9862
Okla	Oklahoma City, TRW Cinch Divs.	405-524-2040
Pa	Glenside, TRW Cinch Divs.	215-887-7520
Pa	Newtown, TRW Cinch Divs.	215-968-5819
Tex	Dallas, TRW Cinch Divs.	214-637-6650
Tex	Houston, TRW Cinch Divs.	713-772-5541
Utah	Salt Lake City, Straube Assoc.	801-328-4513
Va	Springfield, TRW Cinch Divs.	703-321-7930
Wash	Seattle, D. Smith Sls.	206-633-3160

Local Distributors

Ala	Birmingham, M. G. Elctrns.	205-328-4525
Ala	Huntsville, Cramer/E. W.	205-539-5722
Alas	Fairbanks, Intercoastal, Inc.	
Alas	Fairbanks, Yukon Radio Supp. Corp.	907-452-1011
Ariz	Phoenix, Cramer Elctrns. Inc.	602-267-7321
Ariz	Phoenix, Kierulff Elctrns.	602-273-7331
Ariz	Phoenix, R. V. Weatherford Co.	602-272-7144
Ariz	Phoenix, Sterling Elctrns.	602-258-4531
Ark	Fort Smith, Carlton Bates Co.	501-782-7258
Ark	Little Rock, Carlton Bates Co.	501-562-9100
Cal	Anaheim, R. V. Weatherford Co.	714-633-9633
Cal	Fresno, J. C. Arbuckle	209-264-6554
Cal	Glendale, R. V. Weatherford Co.	213-849-3451
Cal	Hayward, Dunlap Elctrns.	415-352-1933
Cal	Hollywood, Yale Radio Elec. Co.	213-465-3186
Cal	Los Angeles, Kierulff Elctrns.	213-685-5511
Cal	Mt. View, Elmar Elctrns.	415-961-3611
Cal	Palo Alto, Kierulff Elctrn.	415-968-6292
Cal	Palo Alto, R. V. Weatherford Co.	415-493-5373
Cal	Pomona, R. V. Weatherford Co.	714-623-1261
Cal	Riverside, Elctrn. Supp.	714-683-7300
Cal	Sacramento, Dunlap Elctrns.	916-444-8070
Cal	San Diego, Kierulff Elctrns.	714-278-2112
Cal	San Diego, R. V. Weatherford Co.	714-278-7400
Cal	San Francisco, Zack Radio Supp. Corp.	415-626-1444
Cal	Santa Barbara, Channel Radio Supp. Co.	805-965-8551
Cal	Sun Valley, Sterling Elctrns.	213-767-5030
Colo	Commerce City, Elmar Elctrn.	303-287-9611
Colo	Denver, Elctrn. Parts Co.	303-744-1992
Colo	Denver, Newark Elctrns.	303-757-3351
Colo	Englewood, R. V. Weatherford Co.	303-761-5432
Conn	East Haven, J. V. Elctrns.	203-469-2321
Conn	Hamden, Wilshire Elctrns./Conn.	203-281-1166
Conn	Waterbury, Bond Radio Elctrns.	203-753-1184
Fla	Hollywood, Cramer/E. W.	305-923-8181
Fla	Jacksonville, Southeast Elctrns.	904-356-3007
Fla	Miami, Elctrn. Equip. Co.	305-871-3500
Fla	Orlando, Cramer/E. W.	305-894-1511
Fla	Orlando, Hall-Mark Elctrns. Corp.	305-855-4020
Fla	Orlando, Hammond Elctrns.	305-849-6060
Fla	Pensacola, Grice Elctrns.	904-433-4616
Fla	Tampa, Lykes Elctrns.	813-886-6621
Ga	Atlanta, Cramer/E. W. Atlanta	404-448-9050
Ga	Atlanta, Lykes Elctrns. Corp.	404-355-2223
Ga	Atlanta, Specialty Dist.	404-873-2521
Haw	Honolulu, Honolulu Elctrns.	808-949-5564
Haw	Honolulu, Precision Radio Ltd.	808-537-5291
Idaho	Idaho Falls, Schwendimans Wholesale Dist.	208-522-2492
Idaho	Twin Falls, United Elctrn. Wholesalers	208-733-7324
Ill	Arlington Hts., Tex. Instr. Supp.	312-593-7660
Ill	Champaign, Klaus Radio, Inc.	217-356-1896
Ill	Chicago, Elctrn. Dist.	312-283-4800
Ill	Chicago, Newark Elctrns.	312-638-4411
Ill	Elgin, Allied Elctrns.	312-697-8200
Ill	Elk Grove Vill., Lakeland Elctrns., Inc.	312-595-1000
Ill	La Salle, Klaus Radio, Inc.	815-223-7400
Ill	Mt. Prospect, Cramer/Chicago	312-593-8230
Ill	Palatine, Ohm Elctrns. Inc.	312-359-5500
Ill	Peoria, Klaus Radio, Inc.	309-691-4840
Ill	Quincy, Klaus Radio, Inc.	217-223-7560
Ill	Rockford, J & M Elctrns.	815-963-6445
Ill	Skokie, Bell Elctrns.	312-965-7500
Ill	Villa Park, Melvin Elctrns.	312-279-5015
Ind	Evansville, Hutch & Son Inc.	812-425-7201
Ind	Evansville, Ohio Valley Sound Svc.	812-425-6173
Ind	Fort Wayne, Fort Wayne Elctrn.	219-742-4346
Ind	Indianapolis, Graham Elctrns.	317-634-8202
Ind	Indianapolis, Pioneer/Ind.	317-849-7300
Ind	Indianapolis, Ra-Dis-Co.	317-637-5571
Ind	South Bend, Radio Dist. Co.	219-287-2911
Iowa	Cedar Rapids, DEECO, Inc.	319-365-7551
Iowa	Davenport, Klaus Radio	319-323-9761
Iowa	Davenport, Warren Radio Co.	319-323-8051
Iowa	Des Moines, Radio Trade Supp. Co.	515-288-7237
Kans	Topeka, Acme Radio, Inc.	913-235-1363
Kans	Wichita, Radio Supp. Co.	316-267-5216
Ky	Louisville, P. I. Burks Co.	502-583-2871
La	Lafayette, Ralph's of Lafayette	318-234-4507
La	New Orleans, Lykes Elctrns.	504-486-7441
La	New Orleans, Radio Parts, Inc.	504-581-5959
La	New Orleans, Southern Radio Supp. Co.	504-524-2343
La	Shreveport, Ind'l. Elctrn. Supp.	318-422-9459
Md	Baltimore, Arrow Elctrn.	202-737-1700
Md	Baltimore, Radio Elec. Svc.	301-823-0070
Md	Bethesda, Empire Elctrn. Supp. Co.	301-656-3300
Md	Gaithersburg, Kierulff Elctrns.	301-948-0250
Md	Hagerstown, Stoddard Supp.	301-733-3390
Md	Hyattsville, Milgray/Washington Inc.	301-864-1111
Md	Rockville, Capitol Radio Wholesalers	301-881-2270
Md	Rockville, Pioneer/Washington	301-424-3300
Mass	Boston, DeMambro Elctrns.	617-787-1200
Mass	Boston, Sager Elec. Supp.	617-542-2281
Mass	Burlington, Wilshire Elctrns./New England	617-272-8200
Mass	Dedham, Gerber Radio Supp.	617-329-2400
Mass	Newton, Greene Shaw Co.	617-969-8900
Mass	Newton Centre, Cramer Elctrns.	617-969-7700
Mass	No. Wilbraham, Ind'l. Components Corp.	413-596-3854
Mass	Springfield, T. F. Cushing Co.	413-788-7341
Mass	Watertown, Sterling Elctrns.	617-926-9720
Mass	West Newton, A. W. Mayer Co.	617-965-1111
Mass	Worcester, R. M. Elctrns.	617-756-8311
Mich	Ann Arbor, Wedemeyer Elec. Supp.	313-665-8611
Mich	Detroit, R. S. Elctrns.	313-491-1000
Mich	Flint, Shand Elctrns. Inc.	313-743-8940
Mich	Lansing, Fulton Radio Supp.	517-489-6519
Mich	Livonia, Pioneer/Michigan	313-525-1800
Mich	Marquette, N. W. R. Elctrns. Corp.	906-226-7578
Mich	Muskegon, Fitzpatrick Elec.	616-722-6621
Mich	Oak Park, Newark Elctrns.	313-548-0250
Mich	Wyoming, Newark Elctrns.	616-241-6681
Minn	Edina, Harvey-Minnesota	612-941-6060
Minn	Minneapolis, Newark Elctrns.	612-331-6350
Minn	Minneapolis, Stark Elec. Supp.	612-332-1325
Minn	St. Paul, Gopher Elctrns.	612-645-0241
Miss	Jackson, Ellington Elctrn. Supp.	601-355-0561
Mo	Joplin, Four State Radio & Supp.	417-624-0368
Mo	Kansas City, Burstein-Applebee Co.	816-531-5614
Mo	Kansas City, Radiolab, Inc.	816-561-9935
Mo	St. Louis, Interstate Ind'l. Elec.	314-481-6110
Mo	St. Louis, Olive Ind'l. Elctrns.	314-863-7800
Mo	St. Louis, Van Sickle Radio Elctrns.	314-621-5000
Mont	Billings, Elctrn. Supp. Co.	406-252-2197
Neb	Lincoln, Scott Elctrn. Supp.	402-434-8308
Neb	Omaha, Radio Equip. Co.	402-341-7700
Nev	Las Vegas, Metcalf Elctrns.	702-384-2151
Nev	Reno, Dunlap Elctrns.	702-329-1308
NH	Concord, Evans Radio, Inc.	603-224-9961
NJ	Camden, General Radio Supp. Co.	609-964-8560
NJ	Clark, Tex. Instrs. Supp.	201-382-6400
NJ	Clifton, Wilshire Elctrns./N.J.	201-365-2600
NJ	Hanover, State Elec. Parts Corp.	201-887-2550
NJ	Kenilworth, Newark Elctrns.	201-272-8410
NJ	Moorestown, Arrow/Angus	609-235-1900
NJ	Pennsauken, Radio Elec. Svc. Co.	609-662-4000
NJ	Rahway, Valley Elctrn. Supp.	201-381-5404
NJ	Saddlebrook, Arrow Elctrns.	201-797-5800
NM	Albuquerque, Cramer/N.M.	505-265-5767
NM	Albuquerque, Kierulff Elctrns.	505-247-1055
NY	Albany, E. E. Taylor Co.	518-489-5600
NY	Binghamton, Harvey Elctrns.	607-748-8211
NY	Binghamton, Stack Ind'l. Elctrns.	607-723-6326
NY	Buffalo, Summit Dist.	716-884-3450
NY	Commack, Connecting Components Corp.	516-543-8300
NY	Elmira, Brady Supp. Corp.	607-733-6591
NY	Farmingdale, Arrow Elctrns.	516-694-6800
NY	Farmingdale, Harrison Elctrns. Corp.	516-293-7990
NY	Glens Falls, Ray Supp.	518-792-5848
NY	Hauppauge, Rampart Components	516-273-1111
NY	Lynbrook, Peerless Radio Corp.	516-593-2121
NY	Poughkeepsie, Higgins-Sheer Elec. Dist.	914-471-3510
NY	Rochester, Cramer Elctrns.	716-275-0300
NY	Rochester, Rochester Radio Supp.	716-454-6300
NY	Rochester, Simcona Elctrns. Corp.	716-328-3230
NY	Rome, Rome Elctrns.	315-337-5400
NY	Syosset, Milo Elctrns. Corp.	516-364-1111
NY	White Plaines, Westchester Elctrns.	914-949-2400
NY	Woodbury, Harvey Elctrns.	516-921-8700
NC	Greensboro, Hammond Elec. of Carolina	919-275-6391
NC	Raleigh, Southeastern Radio Supp.	919-828-2311
NC	Winston Salem, Cramer/E. W.	919-725-8711
Ohio	Akron, Akron Elctrns. Supp.	216-762-8818
Ohio	Cincinnati, Hughes Peters, Inc.	513-351-2000
Ohio	Cincinnati, Newark Elctrns.	513-874-5115
Ohio	Cleveland, Pioneer/Cleveland	216-587-3600
Ohio	Cleveland, W. M. Pattison Supp. Co.	216-441-3000
Ohio	Columbus, Elctrns. Mktg. Corp.	614-299-4161
Ohio	Columbus, Hughes Peters, Inc.	614-294-5351
Ohio	Dayton, ESCO, Inc.	513-226-1133
Ohio	Dayton, Pioneer/Dayton	513-236-9900
Ohio	Toledo, Warren Radio Co.	419-248-3364
Ohio	Warren, REM Elctrn. Supp.	216-399-2777
Okla	Bartlesville, Cummins Elctrns. Supp.	918-336-4448
Okla	Oklahoma City, Trice Wholesale Elctrns.	405-524-4411
Okla	Tulsa, Hall-Mark Elctrns. Corp.	918-835-8458
Okla	Tulsa, Oil Capitol Elctrns.	918-836-2541
Okla	Tulsa, Radio, Inc.	918-587-9123
Ore	Eugene, Vitus Elec. Supp. Co.	503-345-4377
Ore	Medford, Verl G. Walker Co.	503-773-7557
Ore	Portland, Central Dist.	503-234-0711
Ore	Portland, Portland Radio Supp.	503-228-8647
Ore	Portland, United Radio Supp.	503-233-7151
Ore	Salem, J. W. Elctrns.	503-363-2371
Pa	Allentown, A. A. Peters, Inc.	215-434-5237
Pa	Devon, Peak Elctrns.	215-687-9822
Pa	Drexel Hill, Kass Elctrns. Dist.	215-449-2300
Pa	Erie, Warren Radio	814-454-5285
Pa	McKeesport, Barno Radio Corp.	412-751-5966
Pa	Philadelphia, Almo Elctrns. Corp.	215-676-6000
Pa	Philadelphia, Herbach-Rademan, Inc.	215-426-1700
Pa	Philadelphia, Philadelphia Elctrns.	215-568-7400
Pa	Pittsburgh, Cameradio Elctrns.	412-288-2600
Pa	Pittsburgh, McCullough Elec. Co.	412-261-2420
Pa	Pittsburgh, R. P. C. Elctrns.	412-782-3770
Pa	Reading, The George Barbey Co.	215-376-7451
Pa	Scranton, Prusell Elctrns.	717-346-2011
Pa	St. Mary, B & R Elctrns.	814-834-2814
Pa	York, Rosen Elctrns.	717-843-3875
RI	Providence, Wm. Dandreta & Co.	401-861-2800
RI	Warwick, W. H. Edwards Co., Inc.	410-781-8000
SC	Charleston, Wholesale Radio Supp.	803-747-9672
SC	Columbia, Dixie Radio Supply	803-253-5333
SC	Greenville, Hammond Elctrns.	803-233-4121
Tenn	Kingsport, Radio Elec. Supp.	615-247-8111
Tenn	Knoxville, Bondurant Bros Co.	615-577-0473
Tenn	Knoxville, Industrial Elctrns.	615-573-7135
Tenn	Memphis, Bluff City Dist. Co.	901-725-9500
Tenn	Nashville, Electra Dist. Co.	615-329-3971
Tex	Abilene, R & R Elctrns. Supp.	915-677-2974
Tex	Amarillo, R & R Elctrns. Supp.	806-374-2866
Tex	Corpus Christi, Wicks Radio Equip. Co.	512-884-8285
Tex	Dallas, All State Elctrns.	214-358-4171
Tex	Dallas, Hall-Mark Elctrns. Corp.	214-231-6111
Tex	Dallas, Tex. Instr. Supp.	214-238-6821
Tex	El Paso, Midland Specialties Co.	915-533-9555
Tex	Ft. Worth, Allied Elctrns.	817-336-5401
Tex	Ft. Worth, Swieco, Inc.	817-335-6521
Tex	Garland, Newark Elctrns.	214-271-2511
Tex	Houston, Harrison Equip. Co.	713-224-9131
Tex	Houston, Sterling Elctrns.	713-627-9800
Tex	Lubbock, R & R Elctrns. Supp.	806-765-7727
Tex	McAllen, Rio Radio Supp.	512-682-5224
Tex	San Antonio, Electrotex	512-735-9271
Utah	Salt Lake City, Cramer/Utah	801-487-4131
Utah	Salt Lake City, Standard Supp. Co.	801-355-2971
Va	Arlington, Arlington Elctrn. Wholesalers	703-524-2412
Va	Charlottesville, Virginia Radio Supp.	703-296-4184
Va	Norfolk, Priest Elctrns.	703-855-0141
Va	Richmond, Meridan Elctrn. Equip. Co.	804-353-6648
Va	Roanoke, Peoples Radio & TV Supply Co.	703-342-8933
Wash	Bellingham, Advanced Elctrn.	206-734-3400
Wash	Seattle, Almac/Stroum Elctrns.	206-763-2300
Wash	Seattle, Liberty Elctrns.	206-763-8200
Wash	Seattle, R. V. Weatherford Co.	206-243-6340
Wash	Seattle, Western Elctrns. Co.	206-284-0200
Wash	Spokane, Northwest Elctrns.	509-535-7652
Wash	Tacoma, Wible Radio Supp. Co.	206-474-9471
Wash	Walla Walla, Inland Elctrns. Supp.	509-529-2241
Wash	Yakima, Lay & Nord	509-453-5596
WVa	Huntington, Elctrn. Supp. Inc.	304-523-6443
Wisc	Madison, Satterfield Elctrns.	608-257-4801
Wisc	Milwaukee, Elctrn. Expeditors, Inc.	414-228-8100
Wisc	Milwaukee, Part Mart Corp.	414-276-4160
Wisc	West Allis, Marsh Elctrns.	414-545-6500

TRW/CINCH-GRAPHIK, ELCTRN. COMPS., Div. TRW INC., 200 S. Turnbull Canyon Rd., City of Industry, Cal., 91744, Tel: 213-333-1201, TWX: 910-584-1861 .... p. 2•896,897

Directory of Local Distributors Starts on page 401

Customer service: J. Pyle

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Circuits, Printed, Multilayer, Screens, Printed Circuit

(Refer to TRW/Cinch Connectors for Sales Office Information)

TRW/CINCH-MONADNOCK, AN ELCTRN. COMPS., Div. TRW Inc., 18301 E. Arenth Ave., Box 1222, City of Industry, Cal., 91749, Tel: 213-964-6581, TWX: 910-584-1303

Customer service: C. Miller

Products manufactured: Fasteners, Grommets, Pads, Transistor Mounting, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

NJ	W Long Branch	201-229-0077

TRW ELEC. FUNCTIONS, Davis & Copewood Sts., Camden, N.J., 08103, Tel: 609-365-5500, TWX: 710-891-7087

Customer service: S. Ledgemood

Products manufactured: Amplifiers, Capacitors, Variable, Couplers, Diplexers, Antenna, Filters, Oscillators, Preselectors

Local Sales Offices & Reps.

Ala	Huntsville, TRW Sales Off.	205-772-9656
Ariz	Scottsdale, Q. T. Wiles & Assoc.	602-947-5791
Cal	Los Angeles, Q. T. Wiles & Assoc.	213-649-1232
Cal	Menlo Park, Straube Assoc.	415-323-2476
Cal	San Diego, Q. T. Wiles & Assoc.	714-565-6893
Cal	Tustin, Q. T. Wiles & Assoc.	714-832-4952
Colo	Boulder, Straube Assoc.	303-443-8600
Conn	Rowayton, TRW Sls. Off.	203-853-4466
Fla	Fort Lauderdale, TRW Sales Off.	305-721-1700
Fla	Orlando, TRW Sls. Off.	305-894-6881
Ill	Elk Grove Village, J. G. Twist Co.	312-593-0200
Ind	Ft. Wayne, R. O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R. O. Whitesell & Assoc.	317-453-6868
Iowa	Cedar Rapids, J. G. Twist Co.	319-393-8703
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
Ky	Louisville, R. O. Whitesell & Assoc.	502-893-7303
Md	Ellicott City, TRW Sls. Off.	301-465-1777
Mass	Waltham, TRW Sls. Off.	617-899-6100
Mich	Grand Rapids, R. O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R. O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R. O. Whitesell & Assoc.	616-983-7337
Minn	Minneapolis, TRW Sls. Off.	612-835-5454
Mo	St. Louis, J. G. Twist Co.	314-432-2830
NM	Albuquerque, Straube Assoc.	505-294-1880
NY	Rochester, TRW Sls. Off.	716-461-3070
Ohio	Cincinnati, R. O. Whitesell & Assoc.	513-521-2290
Ohio	Cleveland, R. O. Whitesell & Assoc.	216-228-7525
Ohio	Columbus, R. O. Whitesell & Assoc.	614-888-9396
Ohio	Dayton, R. O. Whitesell & Assoc.	513-298-9546
Okla	Oklahoma City, TRW Sls. Off.	405-524-2040
Ore	Beaverton, N. R. Schultz Co.	503-646-1345
Pa	Narberth, TRW Sls. Off.	215-667-3400
Pa	Pittsburgh, R. O. Whitesell & Assoc.	412-344-7277
Tenn	Bristol, R. O. Witesell & Assoc.	615-968-4195
Tex	Dallas, TRW Sls. Off.	214-637-6650
Tex	Houston, TRW Sls. Off.	713-771-7812
Utah	Salt Lake City, Straube Assoc.	802-328-4513
Va	Roanoke, TRW Sls.	703-345-4965
Wash	Bellevue, N. R. Schultz Co.	206-454-0300
Wisc	Waukesha, J. G. Twist Co.	414-786-6330

TRW/GLOBE MOTORS, 2275 Stanley Ave., Dayton, Ohio, 45404, Tel: 513-228-3171; Empl.: 500; Minimum order: $50 .... p. 1•988-991

Application info: J. Hohne; Customer service: R. Orth

Products manufactured: Actuators, Blowers & Fans & Accessories, Clutches, Gearheads & Speed Reducers, Generators, Motor & Generator Armatures, Rotors, Stators, Motors, Reducers

Local Sales Offices & Reps.

Ala	Huntsville, TRW Elctrns.	205-772-9656
Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-948-5590
Cal	Dublin, Straube Assocs.	415-828-1550
Cal	Los Angeles, Q.T. Wiles & Assocs.	213-478-0183
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	Tustin, Q.T. Wiles & Assocs.	714-832-4952
Colo	Denver, Straube Assocs.	303-426-0890
Conn	Orange, Comtronics Assocs.	203-795-3515
Conn	Rowayton, TRW Elctrns.	203-853-4466
Fla	Orlando, TRW Elctrns	305-857-3650
Ill	Elk Grove Village, J.G. Twist Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-453-6868
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell & Assocs.	502-893-7303
Mass	Waltham, TRW Elctrns.	617-899-6100
Mich	Grand Rapids, R.O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Minneapolis, TRW/ECD	612-835-5454
Mo	St. Louis, J.G. Twist Co.	314-432-2830
NY	Garden City, Comtronic Assocs.	516-741-8966
NY	Rochester, TRW/ECD	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R.O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assoc.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assoc.	513-298-9546
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Narberth, TRW Elctrns	215-667-3400
Pa	Pittsburgh, R.O. Whitesell Assocs.	412-344-7277
Tenn	Bristol, R.O. Whitesell & Assocs.	615-968-4195
Tex	Dallas, TRW/ECD	214-387-3030
Tex	Houston, TRW/ECD	713-772-5541
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Va	Roanoke, TRW Elctrns.	703-345-4965
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
Wisc	Wauwatosa, J.G. Twist Co.	414-475-7755
EXP:	Port Credit, Ont., Leonard Elec. Ltd.	416-274-3454

TRW ELECTRONICS, 10880 Wilshire Blvd., Los Angeles, Cal, 90024, Tel: 213-475-6777

TRW/HOLYOKE WIRE & CABLE, 775 New Ludlow Rd., South Hadley, Mass., 01075, Tel: 413-533-3961, TWX: 710-351-6636; Empl.: 410; Minimum order: $75

For info on price: G. T. Miles; Application info: W. J. Gaffney; Customer service: R. J. Krzynowek; Delivery info: G. Zirakian

Free literature available: Manufacture electrical insulated wire, cable, and cable assemblies, and harnesses, for the Automotive - Home Entertainment - Computer - Instrumentation Industrial - & Telephone Markets.

Products manufactured: Braid, Cable, Cable Assemblies & Harnesses, Cable, Cords, Services, Assembly, Production & Test, Wire, Wire Shielding

Local Sales Offices & Reps.

Ala	Huntsville	205-772-9656
Ariz	Scottsdale	602-994-0441
Cal	Cerritos	213-924-5711
Cal	Mountain View	415-969-2252
Colo	Boulder	303-443-8600
Conn	Rowayton	203-853-4466
Fla	Fort Lauderdale	305-721-1700
Fla	Orlando	305-894-6881
Ill	Elk Grove Village	312-593-0200
Ind	Indianapolis	317-359-9283
Mass	Reading	617-944-3020
Mich	Detroit	313-873-1150
Minn	Minneapolis	612-835-5454
Mo	St. Louis	314-727-7370
NJ	Clifton	201-546-0990
NY	Melville L.I.	516-293-9000
NY	Rochester	716-461-3070
Ohio	Dayton	513-298-9862
Pa	Springhouse	215-542-9470
Tex	Dallas	214-637-6650
Wash	Seattle	206-633-3160

TRW/IRC FIXED RESISTORS, 2850 Mt. Pleasant St., Burlington, Iowa, 52601

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, TRW	205-772-9656
Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-948-5590
Cal	Los Angeles, Q.T. Wiles & Assocs.	213-649-1232
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, Q.T. Wiles & Assocs.	714-565-6893
Cal	Tustin, Q.T. Wiles & Assocs.	714-832-4952
Colo	Boulder, Straube Assocs.	303-443-8600
Conn	Rowayton, TRW	203-853-4466
Fla	Ft. Lauderdale, TRW	305-721-1700
Fla	Orlando, TRW	305-894-6881
Ill	Elk Grove Village, J.G. Twist Co.	312-593-0200
Ind	Ft. Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-452-6065
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell & Assocs.	502-893-7303
Md	Baltimore, TRW	301-366-5075
Md	Ellicott City, TRW	301-465-1777
Mass	Waltham, TRW	617-899-6100
Mich	Grand Rapids, R.O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Minneapolis, TRW	612-835-5454
Mo	St. Louis, J.G. Twist Co.	314-432-2830
NM	Albuquerque, Straube Assocs.	505-294-1880
NY	Garden City, Comtronics Assocs.	516-741-8966
NY	Rochester, TRW	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R.O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assocs.	513-298-9546
Okla	Oklahoma City, TRW	405-524-2040
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Ore	Portland, N.R. Schultz Co.	503-292-5656
Pa	Narberth, TRW	215-667-3400
Pa	Pittsburgh, R.O. Whitesell & Assocs.	412-344-7277
Tex	Dallas, TRW	214-637-6650
Tex	Houston, TRW	713-771-7812
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Va	Roanoke, TRW	703-345-4965
Wisc	Waukesha, J.G. Twist Co.	414-786-6330

TRW/IRC RESISTORS, 401 N. Broad St., Philadelphia, Pa., 19108, Tel: 215-923-8230, TWX: 710-670-1392; Empl.: 1000 .... p. 2•1548-1568

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, TRW Sls. Off.	205-772-9656
Ariz	Scottsdale, Q.T. Wiles & Assoc.	602-948-5590
Cal	Dublin, Straube Assoc.	415-829-1550
Cal	Los Angeles, Q.T. Wiles & Assoc.	213-478-0183
Cal	Menlo Park, Straube & Assoc.	415-323-2476
Cal	San Diego, Q.T. Wiles & Assoc.	714-565-6893
Cal	Tuslin, Q.T. Wiles & Assoc.	714-832-4952
Cal	Woodland Hills, TRW Sls. Office	213-883-9033
Colo	Denver, Straube & Assoc.	303-426-0890
Conn	Orange, TRW Sls. Off.	203-795-3515
Conn	Rowayton, TRW Sls. Office	203-853-4466
Fla	Fort Lauderdale, TRW Sls. Office	305-721-1700
Fla	Orlando, TRW Sls. Off.	305-857-3650
Ill	Elk Grove Village, Twist & Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell Assoc.	219-432-5591
Ind	Indianapolis, R.O. Whitesell	317-359-9283
Ind	Kokomo, R.O. Whitesell Assoc.	317-452-6065
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Wichita, J.G. Twist Co.	316-686-6685
Ky	Louisville, R.O. Whitesell Assoc.	502-893-7303
Md	Baltimore, TRW Sls. Office	301-825-5075
Mass	Waltham, TRW Sls. Off.	617-899-6100
Mich	Grand Rapids, R.O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R.O. Whitesell	313-358-2020
Mich	St. Joseph, R.O. Whitesell Assoc.	616-983-7337
Minn	Minneapolis, TRW Sls. Off.	612-835-5454
Mo	St. Louis, Twist & Co.	314-432-2830
NM	Albuquerque, Straube Assocs.	505-292-0295
NY	Melville, TRW Sls. Office	516-293-9000
NY	Rochester, TRW Sls. Off.	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assoc.	513-521-2290
Ohio	Columbus, R.O. Whitesell & Assoc.	614-888-9396
Ohio	Dayton, R.O. Whitesell	513-298-9546
Ohio	Lakewood, R.O. Whitesell & Assoc.	216-228-7525
Okla	Oklahoma City, TRW Sls. Office	405-524-2040

Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Narberth, TRW Sls. Off.	215-667-3400
Pa	Pittsburgh, R.O. Whitesell & Assoc.	412-344-7277
Tex	Dallas, TRW Sls. Off.	214-387-3030
Tex	Houston, TRW Sls. Office	713-772-5541
Utah	Salt Lake City, Straube Assoc./Mountain States	801-328-4513
Va	Roanoke, TRW Sls. Off.	703-345-4965
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
Wisc	Wauwatosa, J.G. Twist Co.	414-475-7755
EXP:	Phila., Pa.	215-922-8900

TRW/IRC POTENTIOMETERS, 2801 72nd St. N., St. Petersburg, Fla., 33733, Tel: 813-347-2181, TWX: 810-863-0357; Empl.: 550 .... p. 2•896,897

Customer service: G. Smith

Products manufactured: Attenuators, Dials, Potentiometers, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, TRW Elctrn. Comps.	205-772-0656
Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-947-5791
Cal	Danville, Straube Assocs.	415-837-3234
Cal	Los Angeles, Q.T. Wiles & Assocs.	213-649-1232
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, TRW Elctrn. Comps.	714-565-6893
Colo	Boulder, Straube Assocs/Mountain States	303-443-8600
Conn	Rowayton, TRW Elctrn. Comps.	203-853-4466
Fla	Orlando, TRW Elctrn. Comps.	305-894-6881
Ill	Elk Grove Village, J.G. Twist Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-453-6868
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell & Assocs.	502-893-7303
Mass	Waltham, TRW Elctrn. Comps.	617-899-6100
Mich	Grand Rapids, R.O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Minneapolis, TRW Elctrns.	612-835-5454
NM	Albuquerque, Straube Assocs/Mountain States	505-294-1880
NY	Rochester, TRW Elctrn. Comps.	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R.O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assocs.	513-298-9546
Okla	Oklahoma City, TRW Elctrn. Comps.	405-524-2040
Ore	Portland, C.K. Shanks & Assocs.	503-292-5656
Pa	Narbeth, TRW Elctrn. Comps.	215-667-3400
Pa	Pittsburgh, R.O. Whitesell & Assocs.	412-344-7277
Tenn	Bristol, R.O. Whitesell & Assocs.	615-968-4195
Tex	Dallas, TRW Elctrn. Comps.	214-637-6650
Tex	Houston, TRW Elctrn. Comps.	713-771-7812
Utah	Salt Lake City, Straube Assocs./Mountain States	810-328-4513
Va	Roanoke, TRW Elctrn. Comps.	703-345-4965

TRW SEMICONDUCTOR, 14520 Aviation Blvd., Lawndale, Cal., 90260, Tel: 213-679-4561, TWX: 910-325-6206; FSC No: 01281; Empl.: 1055; Minimum order: $100

For info on price: Distr. Sls. Ext. 452; Application info: M. Dagucon Ext. 459; Customer service: Distr. Sls. Ext. 452; Delivery info: Distr. Sls. Ext. 452

Free literature available: RF & Power Semiconductor catalogs are current and handy reference tools.

Products manufactured: Amplifiers, Circuits, Hybrid, Thick Film, Circuits, Hybrid, Thin-Film, Diodes, Dividers, Integrated Circuit Devices, Microwave Integrated Circuits (MIC's), Transistors

Local Sales Offices & Reps.

Ala	Huntsville, TRW Elctrn. Comps.	205-772-9656
Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-948-5590
Cal	Los Angeles, Q.T. Wiles & Assocs.	213-649-1232
Cal	Menlo Park, Straub Assocs.	415-323-2476
Cal	Tustin, Q.T. Wiles & Assocs.	714-832-4952
Colo	Boulder, Straub Assocs.	303-426-0890
Conn	Orange, Comtronics Assoc.	
Conn	Rowayton, TRW Elctrn. Comps.	203-853-4466
Fla	Ft. Lauderdale, TRW Electr. Comps.	305-721-1700
Fla	Orlando, TRW Elctrn. Comps.	305-894-6881
Ill	Elk Grove, J.G. Twist Co.	312-593-0200
Ind	Fort Wayne, R.O. Whitesell & Assocs.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assocs.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-453-6868
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell Assocs.	502-893-7303
Md	Ellicott City, TRW Elctrns. Comps.	301-465-1777
Mass	Waltham, TRW Elctrn. Comps.	617-899-6100
Mich	Grand Rapids, R.O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assocs.	616-983-7337
Minn	Minneapolis, TRW Elctrn. Comps.	612-835-5454
Mo	St. Louis, J.G. Twist Co.	314-432-2830
NM	Albuquerque, Straube Assocs.	505-292-0295
NY	Rochester, TRW Elctrn. Comps.	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R.O. Whitesell & Assocs.	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assocs.	614-888-9396
Ohio	Dayton, R.O. Whitesell & Assocs.	513-298-9546
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Narberth, TRW Elctrn. Comps.	215-667-3400
Pa	Pittsburgh, R.O. Whitesell & Assocs.	412-242-0100
Tex	Dallas, TRW Elctrns. Comps.	214-637-6650
Tex	Houston, TRW Elctrn. Comps.	713-772-5541
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Va	Roanoke, TRW Elctrn. Comps.	703-345-4965
Wash	Bellevue, N.R. Schultz Co.	206-454-0300
Wisc	Wauwatosa, J.G. Twist Co.	414-475-7755
FOR:	Can., Richmond, B.C., Lake Engrg. Co., Ltd.	604-277-0414
FOR:	Can., Scarborough, Ont., Lake Engrg. Co., Ltd.	416-751-5980
FOR:	Can., St. Laurent 381, Que., Lake Engrg. Co., Ltd.	514-747-2441

Local Distributors

Ala	Huntsville, Hall-Mark Elctrns., 2010 Bob Wallace Ave.	205-539-5722
Ariz	Phoenix, Cramer/Ariz., 2643 University Dr.	602-267-7321
Ariz	Phoenix, Liberty Elctrns., 3130 N. 27th Ave.	602-257-1272
Ariz	Phoenix, R.V. Weatherford Co., 1917 N. 25th Dr.	602-272-7144
Cal	Anaheim, R.V. Weatherford Co., 1550 Babbitt Ave.	714-547-0891
Cal	Chatsworth, Westates Elctrn. Corp., 20151 Bahama St.	213-341-4411
Cal	Gardena, Bell Inds., 306 E. Alondra Blvd.	213-321-5802
Cal	Glendale, R.V. Weatherford Co., 6921 San Fernando Rd.	213-849-3451
Cal	Irvine, Cramer/Los Angeles, 17201 Damler St.	714-979-3000
Cal	Mountain View, Elmar Elctrns., 2288 Charlston Rd.	415-961-3611
Cal	Palo Alto, R.V. Weatherford Co., 3240 Hillview Ave.	415-493-5373
Cal	Pomona, R.V. Weatherford Co., 1095 E. Third St.	714-623-1261
Cal	San Diego, Cramer/San Diego, 8913 Complex Dr., Ste. E.	714-565-1881
Cal	San Diego, R.V. Weatherford Co., 7872 Raytheon Rd.	714-278-7400
Cal	Sunnyvale, Bell Inds., 1161 N. Fairoaks Ave.	408-734-8570
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Cal	Woodland Hills, Semiconductor Concepts, 21201 Oxnard St.	213-884-4560
Colo	Denver, Cramer/Denver, 5465 E. Evans Pl. At Hudson	303-758-2100
Colo	Englewood, R.V. Weatherford Co., 3905 S. Mariposa	303-761-5432
Conn	North Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/EW Hollywood, 4035 N. 29th Ave.	305-923-8181
Fla	Orlando, Cramer/EW Orlando, 345 N. Graham Ave.	305-894-1511
Fla	Orlando, Hall-Mark Elctrns. Corp., 7233 Lake Elinor Dr.	305-855-4020
Ga	Atlanta, Cramer/EW Atlanta, 3923 Oakcliff Indl. Ct.	404-448-9050
Ill	Elk Grove Village, Hall-Mark Elctrns. Corp., 180 Crossen Ave.	312-437-8800
Ill	Mt. Prospect, Cramer/Chicago, 1911 S. Busse Rd.	312-593-0230
Ind	Indianapolis, Harvey-Indiana, 8505 Zionsville Rd.	317-297-4910
Kans	Lenexa, Hall-Mark Elctrns. Corp., 9006 Rosehill Rd.	913-888-4747
Md	Baltimore, Hall-Mark Elctrns. Corp., 6660 Security Blvd.	301-265-8500
Md	Gaithersburg, Cramer/EW Wash., 16021 Industrial Dr.	301-948-0110
Md	Hanover, Cramer/EW Baltimore, 7255 Standard Dr.	301-796-5790
Md	Savage, Pyttronic Inds., 8220 Wellmoor Ct.	301-792-7000
Mass	Boston, DeMambro Elctrns., 1095 Commonwealth Ave.	617-787-1200
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Farmington, Harvey-Michigan, 23461 Industrial Park Dr.	313-477-1650
Mich	Livonia, Cramer/Detroit, 13193 Wayne Rd.	313-425-7000
Minn	Bloomington, Hall-Mark Elctrns. Corp., 9201 Penn Ave. S., Suite 10	612-884-9056
Minn	Edina, Cramer/Bonn, 7275 Bush Lake Rd.	612-835-7811
Mo	St. Louis, Hall-Mark Elctrns. Corp., 6100 Madison	314-521-3800
NJ	Cherry Hill, Cramer/Pa., 12 Springdale Rd.	215-923-5950
NJ	Cinnaminson, Wilshire Elctrns., 855 Industrial Hwy.	609-786-8990
NJ	Clifton, Wilshire Elctrns., 312 Clifton Ave.	201-365-2600
NJ	Moonachie, Cramer/N.J., 1 Barrett Ave.	201-935-5600
NY	Buffalo, Summit Distr., 916 Main st.	716-884-3450
NY	East Syracuse, Cramer/Syracuse, 6716 Joy Rd.	315-437-6671
NY	Endwell, Cramer/Binghamton, 3220 Watson Blvd.	607-754-6661
NY	Farmingdale, Hall-Mark Elctrns. Corp., 167 Marine St.	516-293-7500
NY	Hauppauge, Cramer/L.I., 29 Oser Ave.	516-231-5600
NY	Hauppauge, Semiconductor Concepts, Engineers Rd.	516-273-1234
NY	Rochester, Cramer/Rochester, 3000 Winton Rd. S.	716-275-0300
NY	Rochester, Rochester Radio, 140 W. Main St.	716-454-7800
NY	Rochester, Summit Distr., 292 Commerce Dr.	716-334-8110
NC	Raleigh, Hall-Mark Elctrns. Corp., 3000 Industrial Blvd.	919-832-4465
NC	Raleigh, Pyttronic Inds., 4509 Creedmoor Rd.	919-782-6370
NC	Winston-Salem, Cramer/EW Winston-Salem, 938 Burke St.	919-725-8711
Ohio	Cincinnati, Cramer/Tri-States, 666 Redna Terr.	513-771-6441
Ohio	Cleveland, Cramer/Cleveland, 5835 Harper Rd.	216-248-8400
Ohio	Columbus, Electronic Mktg. Corp., 1150 W. Third Ave.	614-299-4161
Okla	Tulsa, Hall-Mark Elctrns. Corp., 4846 S. 83rd E. Ave.	918-835-8458
Pa	Carnegie, Pyttronic Inds., 14 East Mall Plaza	412-276-6722
Pa	Harrisburg, Pyttronic Inds., 2525 N. 7th St.	717-233-6591
Pa	Huntington Valley, Hall-Mark Elctrns. Corp., 458 Pike Rd.	215-355-7300
Pa	Montgomeryville, Pyttronic Inds., Montgomeryville Industrial Ctr., Stump Rd.	215-643-2850
Pa	Philadelphia, Almo Elctrns., 9815 Roosevelt Blvd.	215-676-6000
Tex	Austin, Hall-Mark Elctrns. Corp., 3100 A. Industrial Terr.	512-837-2814
Tex	Dallas, Cramer/Tex., 2970 Blystone La.	214-350-1355
Tex	Dallas, Hall-Mark Elctrns. Corp., 9333 Forest La.	214-231-5101
Tex	Houston, Hall-Mark Elctrns. Corp., 8000 Westglen	713-781-6100
Utah	Salt Lake City, Cramer/Utah, 391 West 2500 S.	801-487-3681
Wash	Seattle, Liberty Electronics/Northwest, 5305 S. Second Ave.	206-763-8200
Wash	Seattle, R.V. Weatherford Co., 541 Industry Dr.	206-243-6340
Wisc	Milwaukee, Hall-Mark Elctrns. Corp., 11925 W. Ripley Ave.	414-476-1270

Directory of Local Distributors Starts on page 401

Wisc	Oak Creek, Cramer/Wisc., 430 Rawson Ave.	414-764-1700
For:	Can., Downsview, Ont., Cramer/Can., 920 Alness Ave., Unit # 9	416-781-6631
For:	Can., Scarborough, Ont., Lake Engrg. Co., Ltd., 123 Manville Rd.	416-751-5980

TRW/UTC TRANSFORMERS, 150 Varick St., New York, N.Y., 10013, Tel: 212-255-3500, TWX: 710-581-2722; Empl.: 335

Products manufactured: Amplifiers, Coils Including Assemblies & Forms, Filters, Transformers

Local Sales Offices & Reps.

Ala	Huntsville, TRW Ectrn. Comps.	205-772-9656
Ariz	Scottsdale, Q.T. Wiles & Assocs.	602-947-5791
Cal	Los Angeles, Q.T. Wiles & Assocs.	213-649-1232
Cal	Menlo Park, Straube Assocs.	415-323-2476
Cal	San Diego, Q.T. Wiles & Assocs.	714-565-6893
Cal	Tustin, Q.T. Wiles & Assocs.	714-832-4952
Colo	Boulder, Straube Assocs.	303-443-8600
Conn	Rowayton, TRW Elctrns. Comps.	203-853-1161
Fla	Fort Lauderdale, TRW Elctrns. Comps.	305-721-1700
Fla	Orlando, TRW Ectrn. Comps.	305-894-6881
Ill	Elk Grove Village, J. G. Twist Co.	312-593-0200
Ind	Fort Wayne, R. O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R. O. Whitesell & Assoc.	317-452-6065
Iowa	Cedar Rapids, J. G. Twist Co.	319-365-1401
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
Ky	Louisville, R. O. Whitesell & Assoc.	502-893-7303
Mass	Waltham, TRW Elctrn. Comps.	617-899-6100
Mich	Grand Rapids, R. O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R. O. Whitesell & Assoc.	317-452-6065
Mich	St. Joseph, R. O. Whitesell & Assoc.	616-983-7337
Minn	Minneapolis, TRW Elctrns.	612-835-5454
Mo	St. Louis, J. G. Twist Co.	314-432-2830
NM	Albuquerque, Straube Assocs/Mtn. States	505-294-1880
NY	Garden City, Comtronic Assocs.	516-741-8966
NY	Rochester, TRW Elctrns. Comps.	716-461-3070
Ohio	Cincinnati, R.O. Whitesell & Assocs.	513-521-2290
Ohio	Cleveland, R. O. Whitesell & Assoc.	216-228-7525
Ohio	Columbus, R.O. Whitesell & Assoc.	614-888-9396
Ohio	Dayton, TRW Elctrn. Comps.	617-899-6100
Okla	Okla. City, TRW Elctrns.	405-524-2040
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Pa	Narberth, TRW Elctrn. Comps.	215-667-3400
Pa	Pittsburgh, R. O. Whitesell & Assocs.	412-344-7277
Tex	Dallas, TRW Ectrn. Comps.	214-637-6650
Tex	Houston, TRW Elctrns.	713-771-7812
Utah	Salt Lake City, Straube Assocs./Mtn. States	801-328-4513
Va	Roanoke, TRW Elctrns.	703-345-4965
Wash	Bellevue, N.R. Schultz	206-454-0300
Wisc	Waukesha, J. G. Twist Co.	414-786-6330
FOR:	Can., Willowdale, Ontario, A.C. Simmonds & Sons, Ltd.	416-491-1010

TT ELCTRNS., INC., 2214 S. Barry Ave., Los Angeles, Cal., 90064, Tel: 213-478-8224; FSC No: 07766
p. 1•588-591

For info on price: S.J. Sodaro; Application info: S.J. Sodaro; Customer service: D. Stackpole; Delivery info: D. Stackpole

Free literature available: Catalog of filters.

Products manufactured: Equalizers, Filters, Networks

Local Sales Offices & Reps.

Cal	Culver City, Sodaro	213-478-7733

TTS, 2928 Nebraska Ave., Santa Monica, Cal., 90404, Tel: 213-829-2611; Empl.: 10

For info on price: L. Winters; Application info: L. Winters; Customer service: B. Winters; Delivery info: L. Winters

Free literature available: 1) Accessory Numeric Keyboards ANK-16T, ANK-16E, ANK-16U; 2) Friction TO Sprocket Mod Kit SMK-802; 3) Increase Character Per Line Kits TMK 90, 96, 105, 132B; 4) Cart AM-1.

Products manufactured: Carts & Dollies, Instrument & Equipment, Comm. Systems, Keyboards, Alphanumeric & Decimal, Modulator/Demodulators, Readers, Teleprinters, Teletypewriters & Equipment, Terminal Equipment, Digital

TUCKER ELECTRONICS CO., 1717 So. Jupiter Rd., Garland, Tex., 75040, Tel: 800-527-4642, Telex: 73-0401; Empl.: 42

For info on price: G. McLaney; Application info: C. Aclin; Customer service: R. Alexander; Delivery info: R. Alexander

Free literature available: General Catalog: 160 pages of test instruments, over 150 manufacturers, more than 5000 instruments, including scopes, counters, signal generators, meters, bridges, and many more.

Products manufactured: Adapters, Waveguide, Amplifiers, Analyzers, Antenna Rotators, Antenna Towers & Supports, Antennas, Attenuators, Bridges, Calculators, Electrical & Electronic, Calibrators, Calorimeters, Microwave, Cameras, Capacitors, Fixed, Chamber, Environmental Test, Comm. Systems, Comparators, Controls/Control Eqpt., Converters, Counters, Couplers, Current Sources, Decade Boxes, Detectors, Filters, Gages, Generators, Indicators, Insertion Loss Measurement Systems, Inverters, Meters, Monitors, Mounts, Multipliers, Oscillators, Oscillographs, Direct Writing, Oscilloscope Plug-Ins, Oscilloscopes, Ovens, Power Supplies, Prescalers, Printers, Probes, Receivers, Recorders, References, D-C Voltage, Regulators, Services, Assembly, Production & Test, Simulators, Slotted Lines, Microwave, Standards, Synthesizers, Technical Books, Tracers, Curve, Transceivers, Voltage Sources

TURNER DIV., Conrac Corp., 909 17th St., N.E., Cedar Rapids, Iowa, 52402, Tel: 319-365-0421, Telex: 46-4437; Empl.: 250

For info on price: L. Goodell; Customer service: D. Miller

Free literature available: 2721-C Communications Microphone Catalog, 2721-S Public Address & Paging Catalog, 2721-A CB Antenna Catalog.

Products manufactured: Antennas, Microphone Accessories (Including Stands, Holders, Booms), Microphones, All Kinds

Local Sales Offices & Reps.

Ala	Birmingham, M.F. Taylor Co.	205-853-0336
Cal	Culver City, W. Alderson Co., Inc.	213-837-1398
Cal	Redwood City, Sinai-Johnson	415-365-6263
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Casselberry, M.F. Taylor Co.	305-838-0821
Ind	Carmel, Weeks Assocs.	317-846-0296
Iowa	Des Moines, K-S-W Assocs.	515-279-9235
La	Lacombe, S. Ormsby & Assocs.	504-882-7248
Md	Catonsville, M.F. Taylor Co.	301-747-5718
Md	Silver Springs, M.F. Taylor Co.	301-946-3569
Mass	Needham, Piper Assocs.	617-449-1144
Mass	Plymouth, Piper Assocs.	617-746-6522
Mich	Rochester, R.A. Albrecht Co.	313-651-7081
Minn	Minneapolis, S. Clothier Co.	612-888-4666
Mo	Kansas City, K-S-W Assocs.	816-358-5240
Mo	St. Louis, K-S-W Assocs.	314-781-6111
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Rockville Centre, Willgold Elctrn. Sls. Corp.	516-764-4022
NC	Charlotte, M.F. Taylor Co.	704-523-7932
Ohio	Cleveland, IMTech	216-826-3400
Ohio	Columbus, Weller Elctrns. Sls., Inc.	614-885-7819
Ohio	Dayton, IMTech	513-837-5610
Ore	Salem, M.K. Widdekind Co.	503-363-6445
Pa	Philadelphia, M.F. Taylor Co.	215-676-5332
Tex	Addison, Parvin Sls. Co.	214-239-9148
Tex	Dallas, E.L. Wilks Co.	214-242-5321
Tex	Houston, Parvin Sls. Co.	713-721-1054
Wash	Seattle, M.K. Widdekind Co.	206-284-8020
Wisc	Brookfield, Steffen Sls.	414-781-7596

TYCO CRYSTAL PRODUCTS DIV., 1510 McGee Trafficway; Kansas City, Mo., 64108, Tel: 816-842-9731, TWX: 910-771-2181; Empl.: 600; Minimum order: $1000

Customer service: R. Gundy

Products manufactured: Crystal Blanks, Crystals, Filters, Oscillators

TYLAN CORP., 19220 So. Normandie, Torrance, Cal., 90502, Tel: 213-532-3420, TWX: 910-346-7647; Empl.: 95

For info on price: D. B. LeMay; Application info: D. B. LeMay; Customer service: D. B. LeMay; Delivery info: L. Lorringer

Free literature available: Mass Flow Measurement and Control of Gases - Describes instruments for measuring and controlling low flow rates of gases. DS-0015-0374. Describes gas control systems for semiconductor processing.

Products manufactured: Controls/Control Eqpt., Meters, Probes, Process Control Systems, Signal Conditioners & Equipment, Transducers

Local Sales Offices & Reps.

Cal	Cupertino, Tylan Corp.	408-248-8718
Cal	Torrance, Tylan Corp.	213-532-3420
Fla	Fort Lauderdale, Semquip Inc.	305-772-3002
Mass	Peabody, Tylan Corp.	617-532-1228
NJ	Morris Plains, Tylan Corp.	201-540-8333
NC	Matthews, W.K. Hile Co.	704-847-9125
Tex	Richardson, Tylan Corp.	214-234-8184

TYTON CORP., 2300 W. Florist St., Milwaukee, Wisc., 53209, Tel: 414-228-8210, TWX: 910-262-3094; FSC No: 53421; QPL No: 23190-12; Minimum order: $50

For info on price: D. Herzberg; Application info: R. Lauffenburger; Customer service: D. Herzberg; Delivery info: D. Herzberg

Free literature available: Tyton Ties Bulletin No. 100B Attached.

Products manufactured: Clamps & Clips, Wire & Cable Ties, Wire Markers

Local Sales Offices & Reps.

Ariz	Scottsdale, T. Goodreau & Assocs.	602-994-9909
Fla	Tampa, L. J. Vidal & Assocs.	813-251-2583
Ga	Atlanta, Southeast Techsales	404-355-7021
Ill	Chicago, Vahey & Assocs.	312-775-1190
Mo	St. Charles, J. Erlinger Co.	314-946-6845
NY	Woodbury, Brunner Assocs.	516-921-2052
Ohio	Cleveland, Industrial Sls. Assocs.	216-721-7500
Tex	Arlington, Chaparral Inds.	817-265-2418

UBER GRAFIC INSTRS., Box 4, Palo Alto, Calif., 94302, Tel: 415-327-4732; Empl.: 2

Customer service: D. F. Kroener

Free literature available: Catalog Page & Price List.

Products manufactured: Knives & Knife Sets, Tools

UCHIDA OF AMERICA CORP., 11 W. 42nd St., New York, N.Y., 10036, Tel: 212-239-7418; Empl.: 5; Minimum order: $100

For info on price: R. Mirsky; Application info: T. Nakayama; Customer service: R. Mirsky; Delivery info: T. Nakayama

Free literature available: Complete models and ratings are listed, with outstanding features of each model, application fields, and specifications.

Products manufactured: Fuses, Meters, Perforators, Probes, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Ala	Birmingham, P. Hayden Assoc.	
Cal	Mill Valley, Roy Colen	415-383-3555
Cal	Van Nuys, C.H. Mitchell Co.	213-994-9466
Fla	Orlando, P. Hayden Assocs.	
Ga	East Point, P. Hayden Assocs.	404-766-0261
Ill	Skokie, M. Bermann Sls.	312-675-3740
Ind	Indianapolis, Technical Rep Inc.	317-849-6454
Iowa	Atlantic, Kimian Sls. Inc.	712-243-1626
Mass	Sharon, A. Appell Assoc.	617-784-3439
Mich	Rochester, D. Albrecht & Co.	313-652-2520
Mo	Independence, Kimian Sls.	816-796-4026
NY	New York, Newhope Corp.	212-532-7372
NY	Phelps, L S M Assocs.	315-548-4891
NC	Greensboro, P. Hayden Assocs.	
Ohio	Columbus, Mandabach & Assocs.	614-235-0265
Tex	Hurst, Ranger Elctrns., Co.	713-626-1432
EXP:	New York, Uchida of America Corp.	212-239-7418

UDEL MANUFACTURING, Box 2028, Covina, Cal., 91722, Tel: 213-331-5680; Empl.: 6; Minimum order: $9F424

For info on price: A. F. Young; Customer service: A. F. Young; Delivery info: R. M. Geiger

Free literature available: Brochure of sizes, price list, General description of selection, use and frequency determination of ultrasonic cleaning equipment.

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic

Local Sales Offices & Reps.

Ariz	Tempe, Gassner & Clark	602-968-9037
Cal	West Covina, Udel Mfg. Co.	213-331-5680
Fla	Ft. Lauderdale, B. Melvin Production Equip. Co.	305-566-8195
Fla	Lake Wales, B. Melvin Production Equip. Co.	813-676-6821

Ill	Mt. Prospect, E. T. Champion & Assocs.	312-593-1150
Mass	Newton Highlands, Marshall Inds.	617-965-5115
NY	Northport, Production Sls. Assocs.	516-757-0336
Ohio	Cincinnati, J. O. Olsen Co.	513-922-2176
Ohio	Cleveland, J. O. Olsen Co.	216-752-5444
Pa	Pittsburgh, J. O. Olsen Co.	412-279-2550
Tex	Dallas, Marshall Inds.	214-233-5200
Wash	Bellevue, Marshall Inds.	206-883-1084

UFAD CORP., 700 36th St. S.E., Grand Rapids, Mich., 49508, Tel: 616-241-6000; Empl.: 15

Customer service: A. D. Heibel

Free literature available: Free spec. sheets available for all products. See list. DA-72 - Programmable Distortion Analyzer; 850 - Lab-All, Multi-Function Signal Analysis; 724 - OEM Active Filtering System; 732 - Programmable True RMS-DC Converter; 731 - Manual True RMS-DC Converter.

Products manufactured: Analyzers, Filters, Meters, Oscillators

Local Sales Offices & Reps.

Conn	Hamden, Scientific Devices	203-248-9361
Md	Greenbelt, J.E. Cuesta & Co.	301-552-1200
Mass	Waltham, Scientific Devices	617-894-5637
Pa	Valley Forge, J.E. Cuesta & Co.	215-265-5800

UID ELECTRONICS DIV., AMF Inc., 4105 Pembroke Rd., Hollywood, Fla., 33021, Tel: 305-981-1211, TWX: 510-954-9810; Minimum order: $50 .... p. 1•2306

Customer service: D. R. Venator

Free literature available: UID Switch and Power Transistor Socket Catalog #4791 upon request. The contents include product description and applications. Custom designs are shown in a special section to stimulate cost reduction approaches to switching applications.

Products manufactured: Knobs, Sockets, Switches

Local Sales Offices & Reps.

Ariz	Scottsdale, B-5	602-947-5745
Cal	Garden Grove, Impact Elctrns.	213-431-3581
Cal	Menlo Park, G.R. McKnight Co.	415-325-2844
Colo	Denver, B-5	303-934-5505
Conn	Vernon, G-M Assoc.	203-646-4443
Fla	Orlando, Gra-Mar	305-894-3351
Ill	Elk Grove Village, J.G. Twist Co.	312-593-0200
Ind	Ft. Wayne, R.O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R.O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R.O. Whitesell & Assocs.	317-452-6065
Iowa	Cedar Rapids, J.G. Twist Co.	319-393-8703
Kans	Prairie Village, J.G. Twist Co.	913-236-4646
Ky	Louisville, R.O. Whitesell & Assoc.	502-893-7303
Md	Lutherville, L. D. Lowery, Inc.	301-296-0379
Md	Silver Springs, L. D. Lowery Inc.	301-439-3542
Mass	Framingham, G-M Assocs.	617-872-4871
Mich	Grand Rapids, R.O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assoc.	616-983-7337
Minn	Minneapolis, R-J, Inc.	612-922-1425
Mo	St. Louis, J.G. Twist Co.	314-432-2830
NY	Buffalo, Ossmann Comp. Sls. Corp.	716-832-4271
NY	Jamaica, S-J Sls. Assocs.	212-291-3232
NY	Kingston, Ossmann Comp. Sls. Corp.	914-338-5505
NY	Rochester, Ossmann Comp. Sls. Corp.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls. Corp.	315-454-4477
NY	Vestal, Ossmann Comp. Sls. Corp.	607-785-9949
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Pa	Broomall, L. D. Lowery, Inc.	215-356-5300
Pa	Camp Hill, Beil & Whitaker	717-233-1254
Pa	Harrisburg, Beil & Whitaker	717-652-0184
Pa	Orefield, Beil & Whitaker	215-395-0150
Pa	Reading, Beil & Whitaker	215-779-2610
SC	Mauldin, Powertronics	919-476-6727
Tenn	Bristol, Remco	615-968-4195
Tex	Dallas, Allied Comps.	214-238-0408
Tex	Houston, Allied Comps.	713-782-5406
Va	Charlottesville, L. D. Lowery, Inc.	804-973-6672
Va	Fredericksburg, L. D. Lowery, Inc.	703-371-5099
Wash	Seattle, R. Johnston, Co.	206-524-5170
Wisc	Wauwatosa, J.G. Twist	414-786-6330

Local Distributors

Cal	Lakeside, Mouser Electrical Corp., 11511 Woodside	714-449-2220
Cal	Los Angeles, Elec. Switches, 2478 Fletcher Ave.	213-660-1310
Ill	Rockford, G.C. Elctrns., 400 S. Wyman St.	815-968-9661
Mass	Bellingham, Dowiak Assoc., 356 Hartford Ave.	617-966-0404
NJ	Little Falls, I.P.C. Corp., Cardinal Dr.	201-785-1830

ULTRA CARBON CORP., Box 747, Bay City, Mich., 48706, Tel: 517-894-2911; Empl.: 150

Products manufactured: Graphite Parts, Heaters & Heating Elements, Jigs And Fixtures, Chassis & Circuit Board, Materials, Graphite, Services, Assembly, Production & Test

ULTRASONIC CORP., Box 672, Pipestone, Minn., 56164, Tel: 507-825-5441; Empl.: 10

Customer service: S. Lodahl

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic, Transducers

ULTRASONIC INSTRS. INT'L., INC., 165 EM Marine St., Farmingdale, N.Y., 11735, Tel: 516-293-5577; Empl.: 15

Products manufactured: Cleaners & Solvents, Cleaners, Ultrasonic, Machines/Machinery, Production

ULTRONIX, INC., 461 N. 22nd St., Grand Junction, Col., 81501, Tel: 303-242-0810, TWX: 910-929-6965; Empl.: 250; Minimum order: $50

For info on price: K. McCallister; Application info: M. R. Chesselet; Customer service: L. White; Delivery info: L. White

Free literature available: Complete catalog of wirewound resistors and networks. Tech notes and data sheets for application and use of precision and power wirewound resistors.

Products manufactured: Networks, Resistors

Local Sales Offices & Reps.

Ala	Huntsville, Comprehensive Conslt. Co.	205-772-3746
Ariz	Phoenix, Southwest Engrg.	602-993-0250
Cal	Redwood City, Parks and Pruit Assocs.	415-364-1640
Cal	San Diego, AAA Sls. Co.	714-565-0122
Cal	San Gabriel, Van Gott & Assoc.	213-285-2148
Conn	Hamden, Impact Sls. Co.	203-281-1331
Ill	Des Plaines, E. Flaxman	312-298-8580
Kans	Shawnee Mission, M.E. Bettis Co.	913-362-0772
Mass	Waltham, Impact Sls. Co.	617-893-2850
Mich	Warren, DEM Elctrn. Sls.	313-755-6660
Minn	Minneapolis, S. Clothier Co.	612-888-4666
Mo	St. Louis, M.E. Bettis Co.	314-429-2099
NJ	Cherry Hills, Danco Corp.	609-424-5590
NY	Garden City, Comtronic Assoc.	516-741-8966
NY	Oriskany, Knightsbridge Inds.	315-736-0131
NC	Greensboro, L & D Inc.	919-292-3201
Ohio	Cincinnati, J.O. Olsen Co.	513-922-2589
Ohio	Cleveland, J.O. Olsen Co.	216-752-5444
Ore	Beaverton, Arneson Assoc.	503-643-5754
Pa	Fairview Village, Danco Corp.	609-424-5590
Tex	Dallas, J.B. Guenther, Inc.	214-528-6286
Tex	Houston, J.B. Guenther, Inc.	713-468-0232
Wash	Seattle, Arneson Assoc.	206-762-7664
EXP:	Stamford, Conn., Dage Corp.	203-324-3123

ULVAC CORP., 1220 Lantern Hill, Fairfield, Conn., 06430, Tel: 203-259-8118; Empl.: 600; Minimum order: $50

Customer service: A. Plaisted

Products manufactured: Chamber, Environmental Test, Controls/Control Eqpt., Deposition Equipment, Vacuum & Accessories, Evaporation Equipment, Electron Beam, Furnaces, Gages, Metal Compounds, Foils, Powders, Sheet, Stock, Metals, Ovens, Pumps, Vacuum, Services, Assembly, Production & Test, Spectrometers, Valves, Vacuum

UNDERWRITERS SAFETY, 7300 W. Wilson Ave., Chicago, Ill., 60656, Tel: 312-867-4600, TWX: 910-221-3474; Empl.: 145; Minimum order: $25

For info on price: N. Hamot; Application info: G. Shea; Customer service: N. Hamot; Delivery info: N. Hamot

Free literature available: Power Terminal Blocks; Fuse Blocks; Quick-Connect Terminal Blocks; Circuit Breakers.

Products manufactured: Circuit Breakers, Clamps & Clips, Connectors, Panels, Terminal Blocks, Boards & Strips

UNGAR, DIV., Eldon Inds., Inc., 233 E. Manville St., Compton, Cal., 90220, Tel: 213-774-5950, Telex: 67-3183

Products manufactured: Heat Guns, Production, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Ala	Birmingham, M.F. Taylor Co.	205-853-3181
Cal	Burlingame, Elvey-Proctor Co.	415-347-2994
Cal	Inglewood, Ungar Sls. Assocs.	213-776-7340
Colo	Denver, K-C Marketers	303-733-5561
Fla	Casselberry, M.F. Taylor Co.	305-838-0821
Ill	Chicago, G. McL. Cole Co.	312-774-3535
Ind	Indianapolis, Tech. Reps.	317-849-6454
Iowa	Des Moines, KSW Assocs.	515-279-9235
La	New Orleans, Texport Co.	504-486-6073
Md	Catonsville, M.F. Taylor Co.	301-747-5718
Md	Silver Spring, M.F. Taylor Co.	301-946-3569
Mass	Needham, Mullin Tech. Sls. Co.	617-444-4780
Mich	Southfield, R. Milsk Co.	313-354-3310
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	Kansas City, KSW Assocs.	816-358-5240
NY	Buffalo, R.W. Mitscher Co.	716-633-7970
NY	Oceanside, Bittan Assocs.	516-678-6222
NC	Charlotte, M.F Taylor Co.	704-523-7932
Ohio	Lakewood, Baehr, Greenleaf & Assocs.	216-221-9030
Okla	Tulsa, Texport Co.	918-939-1727
Ore	Portland, J.J. Backer Co.	503-297-3776
Pa	Philadelphia, M.F. Taylor Co.	215-698-9757
Pa	Pittsburgh, Covert & Newman Co.	412-563-0303
Tenn	Memphis, Texport Co.	901-683-0880
Tex	Richardson, Texport Co.	214-238-7117
Wash	Seattle, J.J. Backer Co.	206-285-1300
Wisc	Milwaukee, G. McL. Cole Co.	414-545-6083

UNHOLTZ-DICKIE CORP., 3000 Whitney Ave., Hamden, Conn., 06518, Tel: 203-288-3358; Empl.: 49; Minimum order: $25 .... p. 1•471,851

Free literature available: Our catalog containing illustrations and information on our product line of vibration test systems and controls, vibration instruments and accelerometers available on request.

Products manufactured: Accelerometers, Alarms, Amplifiers, Analyzers, Calibrators, Controls/Control Eqpt., Equalizers, Filters, Generators, Indicators, Meters, Power Supplies, Signal Averagers, Signal Conditioners & Equipment, Testers, Transducers, Vibrators

Local Sales Offices & Reps.

Ala	Huntsville, W. Brown	205-539-4411
Cal	Redondo Beach, Unholtz-Dickie Corp.	213-378-9418
Conn	Hamden, W.W. Jarowey Co.	203-288-3010
Fla	Ft. Lauderdale, W. Brown	305-776-4800
Fla	Orlando, W. Brown	305-425-5505
Ga	Atlanta, W. Brown	404-457-4069
Ill	Northfield, Torkelson Assocs.	312-446-9085
Ind	Indianapolis, Torkelson Assocs.	317-244-7867
Kans	Wichita, Aero-Hill Sls.	316-943-6371
Mich	Farmington, Anderson Elctrns.	313-476-9161
Minn	Minneapolis, Torkelson Assocs.	612-835-2414
NY	No. Merrick, Space-Tronics	516-868-1800
NC	Raleigh, W. Brown	919-876-9601
NC	Winston-Salem, W. Brown	919-725-5384
Ohio	Cleveland, Dietrich & Assocs.	216-781-1855
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992

UNIFORM TUBES, MicroDelay Division, Collegeville, Pa., 19426, Tel: 215-539-0700, TWX: 510-660-6107; FSC No: 93306; Empl.: 16; Minimum order: $75 p. 2•2064,2065

For info on price: E. Shoemalter, Application info: L. Deery; Customer service: E. Shoemalter; Delivery info: C. Neafcy

Products manufactured: Cable Assemblies & Harnesses, Cable, Delay Lines, Tubing, Waveguides & Adapters

Local Sales Offices & Reps.

Ariz	Scottsdale, Gleason Sls.	602-946-3992
Cal	Los Altos, Marketek, Inc.	415-941-0882
Cal	Newport Bch., Uniform Tubes	714-642-5950
Cal	Van Nuys, C.W. Swift & Assoc.	213-989-1133
Colo	Denver, Crump Co.	303-426-1443
Conn	Meriden, J. Anderson	203-269-1812
Fla	Boca Raton, Floritronics Inc.	305-368-0325
Fla	Winter Park, Floritronics Inc.	305-886-4818
Ga	Decatur, H.N. Walfon Co.	404-482-2794
Ill	Des Plaines, Coombs Assocs.	312-298-4830
Ill	Schiller Pk., Uniform Tubes	312-671-2717
Ind	Fort Wayne, Coombs Assocs.	219-747-0402
Mass	Medford, Blake Assocs.	617-391-7890
Mass	Newburyport, J. Murphy	617-465-0304
Mass	Seekonk, J. Murphy	617-SO 1-7153

Mich Milford, T. Mulligan & Assocs. 313-363-5575
Mo Grandview, Beneke & McCaul, Inc. 816-765-2998
Mo St. Louis, Beneke & McCaul 314-434-6242
NJ Denville, William Helm 201-625-4327
NY Mt. Vernon, Friedman-Smith Elctrn. Sls. 914-664-4866
NY Rochester, A. Scott Baregard 716-546-7280
NC Charlotte, J. H. Smith 704-394-4210
Ohio Columbus, T. Mulligan & Assocs. 614-457-2242
Okla Tulsa, W. Pat Fralia Co. 918-663-8707
Pa Bala Cynwyd, Vantage Sls. 215-667-0990
Tex Dallas, W. Pat Fralia Co. 214-357-1607
Tex Ft. Worth, W. Pat Fralia & Co. 817-738-2394
Tex Houston, W. Pat Fralia & Co. 713-772-1572
Wash Redmond, Barrett Sls. 206-885-6991
Wisc Greendale, Coombs Assoc. 414-421-2300
EXP: N.Y., New York, Ad. Auriema, Inc. 212-466-2500
FOR: Can., Don Mills, Ont., Braydon Electro 416-447-0230
FOR: Can., Montreal, Que., Braydon Electro 514-341-3330

UNIMAX SWITCH CORP., Riker-Maxson Sub., Ives Rd., Wallingford, Conn., 06492, Tel: 203-269-8701, TWX: 710-476-1397; FSC No: 80207; Empl.: 300; Minimum order: $25 .... p. 1•2304,2305

For info on price: J. W. Pogmore; Application info: D. M. Baribault; Customer service: K. Boyle; Delivery info: K. Boyle

Free literature available: Precision snap action switches and metal cased switches and assemblies; Lighted pushbutton controls in accordance with MIL-S-22885. Lighted pushbutton controls, one and two lamp units. Keylock switches. One, two and three pole lighted and unlighted snap action switches and indicators.

Products manufactured: Indicators, Switches

Local Sales Offices & Reps.
Ala Huntsville, Rep., Inc. 205-881-9270
Ariz Scottsdale, DeAngelo, Rothman & Cheever, Inc. 602-948-2240
Cal Los Altos, Ewing-Foley 415-941-4525
Cal LA, M.A. Stolaroff 213-295-7781
Colo Denver, Straube Assocs. 303-426-0890
Conn Bloomfield, Zaslow Sls. 203-242-7781
Fla Oviedo, Conley & Assoc. 305-365-3283
Ga Tucker, Rep., Inc. 404-938-4358
Ill Chicago, Wasson-Gallagher 312-261-7517
Ill Westchester, Wasson-Gallagher 312-884-0690
Ind Marion, O.H. Bromberg 317-664-5384
Iowa West Des Moines, Greg Newell Inc. 515-225-8522
Ky Louisville, O. H. Bromberg 502-245-8916
Md Rockville, L.G. White 301-770-6556
Mass Lowell, Zaslow Sls. 617-458-8452
Mass Northboro, Zaslow Sls. 617-393-8150
Mich Grosse Pointe Park, Greiner Assoc. 313-499-0188
Minn Mpls., Jos-Co. Sls. Engrg. 612-835-5858
Mo St. Louis, Hill & Co. 314-621-1818
NJ Denville, Grimm, Siegel Assoc. 201-625-1900
NM Albuquerque, Straube Assoc. 505-292-0295
NY Binghamton, Canavan-Scanlon Assoc. 607-724-7220
NY Buffalo, Canavan-Scanlon Assoc. ...716-839-3373
NY Rochester, Canavan-Scanlon Assoc. 716-442-0720
NY Syracuse, Canavan-Scanlon Assoc. 315-437-1271
NC Winston-Salem, L.G. White 919-725-3612
Ohio Cincinnati, O.H. Bromberg 513-771-9333
Ohio Medina, J. Hofstetter 216-241-4880
Pa King of Prussia, White-Keystone 215-265-1817
Tex Dallas, Glidden Electro. Equip. 214-363-6539
Tex Houston, Glidden Electro Equip. 713-681-1415
Utah Salt Lake City, Straube Assoc. 801-328-4513
Wash Mercer Island, J. H. Andersen 206-232-0484
FOR: Can., Burlington, Ont., Motion Control Dev. 416-637-9369

Local Distributors
Ariz Phoenix, Electro Comps., 1641 E. McDowell 602-258-2665
Cal Los Angeles, Fisher/Brownell, 13936 S. Bdwy. 213-532-2170
Cal Los Angeles, Minarik Elec. Co., 224 E. Third St. 213-624-3161
Cal Santa Clara, Fisher/Brownell, 3381 Edward Ave. 408-244-6182
Colo Aurora, Comp. Specialties, 3178 Nome St. 303-341-0160
Colo Colo. Spgs., D & M Elctrns., 715 N. Weber St. 303-633-4666
Colo Denver, Fistell's Elec. Supply, 1001 Bannock St. 303-244-4691
Conn Danbury, Greene Elec. Sup., 69 Main St. 203-748-5648
Conn Hartford, Capitol Light & Sup., 200 Locust St. 203-527-8115
Fla Miami, Elctrn. Equip., 2701 NW 42 Ave. 305-871-3500
Fla Orlando, Orlando Armature, 600 W. Central 305-423-0555
Ga Atlanta, Lance Engrg., 2080 Peachtree 404-458-6286
Ill Niles, WICO Corp., 6400 W. Grosse Pt. 312-685-3000
Ill Westmont, Bodelle Co., 47 Chestnut La. 312-323-9670
Ind Evansville, Ohio Valley Sound, 20 E. Sycamore 812-425-6173
Ind Indianapolis, Graham Elctrns., 133 S. Pennsylvania 317-634-8486
Ind Kokomo, Wholesale Elec., 215 W. Sycamore 317-457-1136
Ind South Bend, Koontz-Wagner Elect., 3801 Voorde Dr. 219-232-2051
Ind Vincennes, Ohio Valley Sound, 902 Main St. 812-882-3615
Ky Ashland, Ashland Elec., 2430 Carter Ave. 606-324-4107
Ky Louisville, Marine Elect. Apparatus, 102 W. Main St. 502-587-6511
Ky Owensboro, Ohio Valley Sound, 600 W. Third St. 502-683-6727
Md Rockville, Capitol Radio, 12227 Wilkins Ave. 301-881-2270
Md Silver Spring, Tech. Dist., 1219 Fidler La. 301-585-7512
Mass Bellinglam, Dowiak Assoc., Rt. 126 617-966-0404
Mass Boston, Sager Elec. Supply, 172 High St. 617-542-2281
NH Concord, Evans Radio, Route 3A 603-224-9961
NY Buffalo, Summit Distrs., 916 Main St. 716-884-3450
NY Hempstead, Elctrn. Equip., 741 Peninsula Blvd. 516-538-5510
NY Islip, Air Powered Tools, 142 Freeman Ave. 516-662-2616
NY Sodus, AED Distrs., 27 State St. 315-483-6561
NY W. Nyack, Douglaston Elect., 173 Western Hwy. 914-358-6966
NY Woodside, Switches Unlimited, 49-11 43rd St. 212-651-0935
NC Winston-Salem, Kirkman Elect., 901 W. 2nd St. 919-724-0541
Ohio Cincinnati, Midwest Equip. Co., 11315 Williamson Rd. 513-793-4060
Ohio Cleveland, W.M. Pattison Sup., 4550 Willow Pkwy. 216-441-3000
Ohio Dayton, Duellman Elec., 131 Wayne Ave. 513-461-5010
Ore Portland, Tekelectric Sup., 5940 S.W. Hood 503-246-5451
Pa Philadelphia, Herbach & Rademan, 401 E. Erie Ave. 215-426-1700
Pa Pittsburgh, RPC Elect., 620 Alpha Dr. 412-782-3770
RI Providence, Providence Elect., 951 N. Main St. 401-351-2500
Tex Dallas, Ind. Equip. Co., 4914 Greenville 204-368-5881
Tex Odessa, Superior Elect., 208 S. Williams 915-332-0276
Utah Salt Lake City, Std. Supply Co., 225 E. 6th, S. 801-355-2971
Wash Seattle, Tekelectric Sup., 4411 23rd Ave. W. 206-283-7100

UNION CARBIDE CORP., Carbon Products Div., 270 Park Ave., New York, N.Y., 10017, Tel: 212-551-2345

Products manufactured: Bearings, Brushes & Brush Assemblies, Contacts, Electrical, Heat Exchangers & Systems, Materials, Graphite, Power Supplies

UNION CARBIDE, CHEMICALS & PLASTICS, 270 Park Ave., New York, N.Y., 10017, Tel: 212-551-4641

Products manufactured: Chemicals, Cleaners & Solvents, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Coolants, Circuit & Components, Etchants, Printed Circuit, Insulators & Insulation, Lubricants, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Refrigerants, Spray

UNION CARBIDE CORP., Components Dept., Box 5928, Greenville, S.C., 29606, Tel: 803-963-6300, Telex: 57-0496; Empl.: 2000 .... p. 2•316-319

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.
Ariz Phoenix, Union Carbide-Comps. Dept. 602-264-7332
Cal Marina Del Rey, Union Carbide-Comps. Dept. 213-821-8824
Cal Mt. View, Union Carbide-Comps. Dept. 415-969-9390
Cal San Diego, Celtec Co. 714-279-7961
Colo Denver, Parker-Webster Co. 303-770-1972
Fla Clearwater, G. F. Bohman Assocs. 813-442-5606
Fla Fort Lauderdale, G.F. Bohman Assocs. 305-564-3081
Fla Orlando, G.F. Bohman Assocs. 305-855-0274
Ill Rosemont, Union Carbide-Comps. Dept. 312-298-8340
Ind Indianapolis, L. M. DeVoe Co. 317-257-1227
Iowa Cedar Rapids, Seltec Sls. Corp. 319-393-1114
Kans Andover, Palatine Engineering Sls. 316-683-7512
Kans Overland Park, Palatine Engrg. Sls. 913-262-5643
Mass Needham Heights, Union Carbide-Comps. Dept. 617-444-5400
Mich Birmingham, Union Carbide-Comps. Dept. 313-642-9800
Minn Minneapolis, S. Clothier Co. 612-888-4666
Mo St. Louis, Palatine Engrg. Sls., Inc. 314-426-7055
NY Liverpool, Union Carbide-Comps. Dept. 315-451-0720
NY Tarrytown, Union Carbide-Comps. Dept. 914-345-2047
Ohio Cincinnati, Baehr, Greenleaf & Assocs. 513-891-3826
Ohio Columbus, Baehr, Greenleaf & Assocs. 614-486-4046
Ohio Lakewood, Baehr, Greenleaf & Assocs. 216-221-9030
Okla Oklahoma City, Parvin Sls. Co. 405-942-4581
Pa Frazer, Union Carbide-Comps. Dept. 215-644-8864
SC Greenville, Union Carbide-Comps. Dept. 803-271-7012
Tex Addison, Parvin Sls. Co. 214-239-9148
Tex Houston, Parvin Sls. Co. 713-784-9900
Utah Salt Lake City, Parker-Webster Co. 801-486-3737
EXP: Can., Ville St. Laurent, Que., Deskin Sls. Corp. 514-331-2860
EXP: Greenville, S.C., Union Carbide-Comps. Dept. 803-963-6300
EXP: Malton, Ont., Can., Deskin Sls. Corp. 416-677-5517
EXP: Vancouver, B.C., Can., Deskin Sls. Corp. 604-324-6331

UNION CARBIDE CORP., Corporate Development, Components Dept., 270 Park Ave., New York, N.Y., 10017

Products manufactured: Abrasive Belts, Compounds, Cords, Powders, etc., Alloys, Capacitors, Fixed, Coatings

Local Sales Offices & Reps.
Ariz Phoenix 602-264-7332
Cal Marina Del Rey 213-821-8824
Cal Mountain View 415-969-9390
Ill Rosemont 312-298-8340
Mass Needham Hgts. 617-444-5400
Mich Birmingham 313-642-9800
NY Liverpool 315-451-0720
NY Tarrytown 914-345-2047
Ohio Cleveland 216-221-0600
Pa Frazier 215-644-8864
SC Greenville 803-271-7012

UNION CARBIDE CORP., Corporate Development, Crystal Prods. Dept., 270 Park Ave., New York, N.Y., 10017

Products manufactured: Comm. Systems, Crystals, Lasers & Laser Systems, Modulator/Demodulators, Monitors, Power Supplies, Scribers, Semiconductor Wafer Fabrication, Substrates

Local Sales Offices & Reps.
Cal Mountain View 415-965-2128
Cal San Diego 714-279-4500
Mass Needham Hgts. 617-444-5400

UNION CARBIDE, Battery Prods. Div., 270 Park Ave., New York, N.Y., 10017, Tel: 212-551-3833; Minimum order: $100 .... p. 1•1514,1515

Customer service: J. F. McCullough 212-551-3833

Products manufactured: Batteries, Flashlights & Lanterns, Lamps

Local Sales Offices & Reps.

Cal	El Monte	213-579-0401
Cal	San Francisco	415-765-1000
Ga	Atlanta	404-633-6161
Ill	Chicago, East Central Div.	312-822-7000
Mass	Needham Hts	617-444-5400
NJ	Cherry Hill	609-235-6200
NJ	Westwood	201-664-7400
Ohio	Cleveland	216-621-4200
Tex	Dallas	214-631-0010

UNION CARBIDE, Films Packaging Div., 6733 W. 65th St., Chicago, Ill., 60638, Tel: 312-735-1234

Products manufactured: Tubing

UNION CARBIDE CORP., Linde Div., 270 Park Ave., New York, N.Y., 10017, Tel: 212-551-3763

Products manufactured: Capacitors, Fixed, Cases, Transit, Coatings, Controls/Control Eqpt., Crystals, Detectors, Flux, Brazing & Soldering Materials, Insulators & Insulation, Lasers & Laser Systems, Services, Assembly, Production & Test, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools, Torches, Soldering, Welding & Access., Tubes, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

UNIROYAL, INC., 1230 Ave. of Americas, New York, N.Y., 10020, Tel: 212-489-4000; Empl.: 65,000

Customer service: T. Jens 203-573-3717

Products manufactured: Adhesives (All Types), Bumpers, Bushings, Glass, Plastic, Metal, Rubber, Etc., Chemicals, Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Computers, Containers, Insulators & Insulation, Labels, Pressure-Sensitive, Adhesive, Mounts, Plastic Raw Materials, Liquids, Pellets, Powders, Resins, Tubing

Local Sales Offices & Reps.

Cal	Santa Ana	714-545-5551
Cal	South San Francisco	415-873-5880
Cal	Vernon	213-583-2331
Colo	Denver	303-388-2481
Fla	Miami	305-633-6381
Ga	Atlanta	404-366-4650
Ill	Chicago	312-254-5700
Kans	Lenexa	913-888-1207
Md	Baltimore	301-485-8904
Mass	Dedham	617-329-2060
Mass	Springfield	413-781-8620
Minn	St. Louis Park	612-546-2528
Mo	St. Louis	314-429-6908
NJ	Jersey City	201-432-4222
NY	Buffalo	716-668-0404
NC	Charlotte	704-334-0893
Ohio	Cincinnati	513-242-5807
Ohio	Port Clinton	419-732-2151
Pa	McKees Rocks	412-771-3500
Pa	Philadelphia	215-742-7010
Tenn	Memphis	901-527-2413
Tex	Dallas	214-631-2310
Tex	Houston	713-644-9161
Utah	South Salt Lake City	801-484-8841
Va	Richmond	703-271-6091
Wash	Seattle	206-767-7066

UNIT INDUSTRIES, INC., 3137 Century Blvd., South Gate, Cal., 90280, Tel: 213-569-7181; Empl.: 14

Customer service: J. Abouchar

Products manufactured: Brushes & Brush Assemblies, Services, Assembly, Production & Test, Slip-Rings & Assemblies

UNITED CHEMICON, 731 James St., Ste: 306, Syracuse, N.Y., 13203, Tel: 315-474-2954, TWX: 710-541-0453

Customer service: P. Maler

Free literature available: 160WV to 500WV ALUMINUM ELECTROLYTIC CAPACITORS (cat. no. 1139); 6.3 WV to 100 WV ALUMINUM ELECTROLYTIC CAPACITORS (cat. no. 1138); KX Series 6.3 WV to 63 WV ALUMINUM ELECTROLYTIC CAPACITORS (cat. no. 1140); KX Series 6.3 WV to 63 WV AUTOMOTIVE ALUMINUM ELECTROLYTIC CAPACTIROS (cat. no. 1140).

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Ariz	Scottsdale, DeAngelo, Rothman, & Cheever, Inc.	602-948-2240
Cal	Culver City, DeAngelo, Rothman Co.	213-398-6239
Cal	Menlo Park, Straube Assocs.	415-323-2476
Colo	Denver, Straube Assocs.	303-426-0890
Ill	Chicago, M. Gottlieb Assocs.	312-775-1151
Ind	Indianapolis, Lattronics	317-846-5788
Kans	Wichita, Dy-Tronix	316-943-6221
Md	Westminster, F.B.D. Sls. Corp.	301-876-2396
Mass	Lexington, Circuit Sls. Co.	607-861-0567
Mich	Farmington, Hummon & Assocs.	313-474-0661
Minn	Minneapolis, Heimann Co.	612-861-6051
Miss	Meridian, Herron Assocs.	601-483-9306
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Teaneck, R.T. Reid Assocs.	201-692-0200
NM	Albuquerque, Straube Assocs.	505-292-0295
NY	Fairport, F. Hall	716-223-5102
NY	Syracuse, Franklin Sls. Corp.	315-474-2954
NY	Whitesboro, H. Lessman	315-736-5460
NC	Cary, F.B.D. Sls.	919-467-7595
Ohio	Cincinnati, Herrick Co.	513-351-4441
Ohio	Rocky River, Geo. L. Herrick Co.	216-333-0333
Ore	Portland, Underwood & Underwood	
Pa	Abington, R.T. Pearson Sls.	215-887-0186
Tex	Dallas, E.F. Aymond Co.	214-826-7620
Utah	Salt Lake City, Straube Assocs.	801-328-4513
Va	Portsmouth, F.B.D. Sls. Corp.	804-484-3162
Wash	Seattle, Underwood & Underwood	206-243-2133

UNITED ELEC. CONTROLS CO., 85A School St., Watertown, Mass., 02172, Tel: 617-WA 6-1000, TWX: 617-092-2445; Empl.: 350

For info on price: D. Holm; Application info: G. May; Customer service: G. May; Delivery info: D. Holm

Free literature available: Catalog T-5 Temperature & Pressure Controls, Recorders, Thermometers; Bulletin B Mineral Insulated Thermocouples; Bulletin 910 Electronic Temperature Controls for Thermocouples.

Products manufactured: Controls/Control Eqpt., Detectors, Probes, Switches, Thermistors, Thermocouples, Elements & Accessories, Thermostats

Local Sales Offices & Reps.

Cal	Anaheim	714-635-3730
Ill	Rolling Meadows	312-259-6700
NJ	Edison	201-738-1900
Ohio	Cleveland	216-261-8141
FOR:	Can., Ont.	416-625-5082

UNITED MINERAL & CHEM. CORP., 129 Hudson St., New York, N.Y., 10013, Tel: 212-966-4330, TWX: 710-581-5799; Empl.: 78

For info on price: M. Meeker; Application info: M. Jasen; Customer service: R. Cohen

Products manufactured: Alloys, Attenuators, Bi-Metals, Thermostatic, Capacitors, Fixed, Capacitors, Variable, Chemicals, Chokes, Coils Including Assemblies & Forms, Cores, Magnetic, Crayons, Coatings, Pellets, etc., Temperature Indicating, Ferrite Material & Parts, Films, Foil, Insulators & Insulation, Metal Compounds, Foils, Powders, Sheet, Stock, Metal Oxides, Metals, Packages, Integrated Circuit, Potentiometers, Resistors, Tapes, Electrical Insulation, Tapes, Films & Foils, Pressure Sensitive, Wire

Local Sales Offices & Reps.

CHEMICAL DEPARTMENT

Cal	Mountain View, Tech Ser. Inc.	415-969-9020
Cal	Torrance, Tech Ser. Inc.	213-324-3672
Conn	West Hartford, R.S. Pettigrew & Co. Inc.	203-233-8533
Minn	St. Louis Park, Xylem, Inc.	612-920-9626
NM	Albuquerque, John Quirk Assocs.	505-255-6981
NY	Syracuse, Rep Tech Inc.	315-437-2845
Tex	Richardson, Ralph Marston	214-235-3577

ELECTRONIC COMPONENTS

Cal	Inglewood, Ungar Sales Assocs.	213-776-7340
Fla	Orlando, Irby & Connolly	305-894-8471
Ill	Skokie, Saffro & Assocs.	312-588-0905
Ind	Indianapolis, Schroeder-Loomis, Inc.	317-251-4571
Kans	Prairie Village, Thro Industrial Sales Co.	913-362-2533
Mass	Newton Lower Falls, New England Comp. Sls.	617-969-9523
Mich	Ferndale, Hilltronics, Inc.	313-398-5556
NY	Syracuse, N.J. Matchuk Co.	315-488-3251
NC	Thomasville, Powertronics, Inc.	919-476-6727
Ohio	Cleveland, Greenleaf & Assocs.	216-333-5480
Pa	Philadelphia, H.A. Goodman Co.	215-247-7116
Tex	Richardson, Thorton-Leeper	214-231-6891
FOR:	Can., Markham, Ont., Tel-Mar Elctrn. Sales Ltd.	416-887-5612

UNITED PAGE INC., 481 Getty Ave., Paterson, N.J., 07503, Tel: 201-279-7500; Empl.: 60; Minimum order: $25

For info on price: F. Geisler; Application info: S. Specter; Customer service: W. Spielev; Delivery info: W. Speilev

Free literature available: Complete 64 page buyers guide of special purpose, industrial tubes, transmitting, foreign tubes, cathode ray tubes (now on press old catalog h/w. Individual spec sheets on all tubes as required.

Products manufactured: Tubes

Local Sales Offices & Reps.

Cal	Encino, United-Page	213-881-0300
Colo	Denver, Elctrn. Sls.	303-771-6300
Ill	Park Ridge, Metcom Assocs.	312-696-1490
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Paterson, United-Page	201-279-7500
NJ	Westwood, R.C. Assocs.	201-664-1241
NY	East Meadow, Stanley Shapiro Assocs.	516-483-4185
Pa	Glenside, Koebert, R.F.	215-887-2310
Tex	Dallas, Southland Components	214-233-0603

UNITED PRODS. CO., Div. Designatronics, 55 S. Denton Ave., New Hyde Pk., N.Y., 11040, Tel: 516-328-3300

Customer service: M. Scheck

Products manufactured: Capacitors, Variable, Coils Including Assemblies & Forms, Cores, Ceramic, Cores, Magnetic, Terminals, Transformers

Local Sales Offices & Reps.

Cal	Milbrae, Melvin Sls.	415-697-6922
Ky	Louisville, Waddle & Assocs.	502-897-6419
Mass	Topsfield, Representatives Corp.	617-426-0541

UNITED REFINING & SMELTING CO., 3700 N. Runge Ave., Franklin Park, Ill., 60131, Tel: 312-455-8800; Empl.: 32

Products manufactured: Alloys, Metals

UNITED SENSOR & CONTROL CO., 85 School St., Watertown, Mass., 02172, Tel: 617-926-1000, TWX: 617-092-2445; Empl.: 25

Customer service: J. Algeo

Free literature available: Catalog S-8 Thermocouples - For high & low temperature probing & measuring total temperature Catalog S-7 Probes - For measuring temperature, total and static pressure velocity and flow direction of fluids, gases & liquids.

Products manufactured: Probes, Thermocouples, Elements & Accessories

Local Sales Offices & Reps.

Cal	Anaheim, United Electric Controls Co.	714-635-3730
Ill	Rolling Meadows, United Elec. Controls Co.	312-259-6700
NJ	Edison, United Electric Controls Co.	201-738-1900
Ohio	Cleveland, United Electric Controls Co.	216-8141

UNITED STATES CRYSTAL CORP., 3605 McCart St., Ft. Worth, Tex., 76110, Tel: 817-921-3014; Empl.: 35; Minimum order: $25

Customer service: T. Nastase

Products manufactured: Crystals

Local Sales Offices & Reps.

Cal	Orange, I. Green Mktg.	714-637-1313
Colo	Arvada, C.B. Mktg.	303-422-0561
Fla	Orlando, B.C. Elctrn. Sls.	404-436-5169
Ga	Smyrna, B.C. Elctrn. Sls.	404-436-5169
Ill	Chicago, Q & B Inc.	312-725-4999
Ind	Mulberry, Maish Sls.	317-296-2322
Md	Seabrook, Taylor Mktg.	301-864-4011
Mass	Northboro, Pray Sls.	617-393-3434
Mich	Pontiac, T.A. Elctrn. Sls.	313-335-4285
Minn	Minneapolis, Kodo Assocs.	612-881-7188
NY	Tuckahoe, LCA Sls. Co.	914-961-4700
Ohio	Columbus, J.W. Lehner Co.	614-268-5260
Tex	Dallas, Roman Sls.	214-358-2152
Wash	Seattle, R.K. Squibb	206-632-2450

UNITED SYSTEMS, 918 Woodley Rd., Dayton, Ohio, 45403, Tel: 513-254-6251, TWX: 810-459-1728; FSC No: 16152; Empl.: 135; Minimum order: $25

For info on price: B. Schryver; Application info: P. Rohrer; Customer service: S. Hommel; Delivery info: B. Schryver

Free literature available: New 1974/75 Catalog lists complete test and measurement instrumentation

Products manufactured: Calibrators, Clocks (All Types), Comparators, Converters, Counters, Data Acquisition & Reduction Systems, Data Loggers, Generators, Indicators, Meters, Monitors, Perforators, Printers, Scanners, Synthesizers, Thermometers, Resistance, Timers, Totalizers, Digital

Local Sales Offices & Reps.
Ala Huntsville, J.L. Highsmith & Co. 205-881-3294
Cal Culver City, F. Lucas Wolfe, Inc. 213-559-7200
Cal Mountain View, IFM, Inc. 415-961-2828
Colo Denver, Grifco 303-722-4674
Fla Orlando, J.L. Highsmith & Co. 305-293-5202
Ill Des Plaines, Marsland Assocs. 312-298-2620
Ind Indianapolis, Marsland Assocs. 317-924-3568
Kans Overland Park, Carter Elctrns. 913-649-6996
Md Silver Springs, Eastern Instrumentation Corp. 301-681-6500
Mass Burlington, R. J. Sickles Assocs. 617-272-7285
Mich Detroit, Comtel-Sterling Co. 313-255-1970
Minn Minneapolis, Marsland Assocs. 612-545-4481
Mo Hazelwood, Carter Elctrns. 314-731-2237
NM Albuquerque, F. Gates Co. 505-298-1875
NY Fayetteville, M.P. Andrews, Inc. 315-637-3144
NY Great Neck, E. I. Inc. 516-466-9505
NC Charlotte, J.L. Highsmith & Co. 704-333-7743
Ohio Cleveland, Comtel-Sterling Co. 216-442-8080
Ohio Dayton, Comtel-Sterling Co. 513-298-7573
Pa Philadelphia, Eastern Instrumentation 215-927-7777
Pa Pittsburgh, Comtel-Sterling Co. 412-922-5720
Tex Richardson, Scientific Sls. Co. 214-231-6541
Va Richmond, J.L. Highsmith ad Co. 804-272-5888
Wash Bellevue, Topp Engrg. Sls. Corp. 206-747-5401

UNITRACK DIV., Calabro Plastics, Inc., 8738 W. Chester Pike, Upper Darby, Pa., 19082, Tel: 215-789-3820; Empl.: 25; Minimum order: $15 p. 1•98,99

For info on price: R. Marchetti; Application info: R. Marchetti; Customer service: M. O'Connor; Delivery info: M. O'Connor

Free literature available: Catalog describes the full line of UNITRACK P.C. Card Guides (metal and plastic), Versamount brackets, Vers-Cage card racks, Pak-Rak p.c. card storing and shipping container, and Kooler Krown & Triac Koller - heat dissipators.

Products manufactured: Cases, Transit, Guides, Circuit Board, Holders, Circuit Board (Production Type), Racks, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.
Ala Huntsville, J.L. Highsmith & Co. 205-881-3294
Cal Burbank, A.C. Stearns Co. 213-849-5776
Cal San Francisco, FENSCO 415-362-4930
Fla Orlando, J.L. Highsmith & Co. 305-293-5202
Ill Des Plaines, Lincoln Hodges & Assoc. 312-297-3810
Md Rockville, Mechtronics Sls. 301-340-2130
Mass Brockton, Forsberg Sls. 617-522-6300
Minn St. Paul, Countrymen Assoc. Co. 612-645-9151
NJ Mountain Lakes, J.P. Dearie 201-334-4848
NC Charlotte, J.L. Highsmith & Co. 704-333-7743
Ohio Dayton, Compass Assocs. 513-252-9939
Pa West Chester, January Mktg. & Sls. 215-793-2265
Tex Arlington, ION Assoc. 817-461-9661
Wash Tukwila, General Elctrns. 206-243-5141

Local Distributors
Cal Los Angeles, El-Com, Inc. 213-223-1351
Cal Sunnyvale, Ruby Stok Co. 408-739-5333
Fla Orlando, L. Highsmith & Co. 305-293-5202
Ill Lake Bluff, J & R Enterprises 312-945-6739
Mass Waltham, Henik Assoc. 617-891-5660
Mass Woburn, Rush Industries 617-935-2400
Mich Farmington, CMP Distributor Div. ... 313-477-7700
NY Rochester, Rochester Radio Supply Co. 716-454-6300
NC Winston-Salem, Kirkman Elctrns., Inc 919-724-0541
Ohio Dayton, ESCO, Inc. 513-226-1133
Pa Philadelphia, Philadelphia Elctrns., Inc. 215-568-7400
Tenn Nashville, Electra Distributing Co. 615-329-3971
Wash Tukwila, General Elctrns., Inc. 206-243-5141

UNITRODE CORP., 580 Pleasant St., Watertown, Mass., 02172, Tel: 617-926-0404, TWX: 710-327-1296; Empl.: 1000

Products manufactured: Circuits, Integrated, Silicon Monolithic, Unpackaged Chips, Diodes, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.
Ala Huntsville, 20th Century Mktg. 205-772-9237
Ariz Scottsdale, F. Board Assocs. 602-994-9388
Cal Burlingame, Brooks Tech. Group 415-328-3232
Cal Newbury Park, Astralonics 805-498-3988
Cal San Diego, S. R. Elctrns. 714-565-8411
Cal Sherman Oaks, Unitrode Corp. 213-783-1301
Colo Littleton, Simpson Assocs. 303-794-8381
Conn Washington Depot, Kanan Assocs. 203-868-0513
Fla Boca Raton, Conley & Assocs. 305-395-6108
Fla Oviedo, Conley & Assocs. 305-365-3283
Fla Tampa, Conley & Assocs. 813-933-3183
Ga Douglasville, 20th Century Mktg. 404-942-6483
Ill Chicago, Carlson Elctrn. Sls. Co. 312-774-9022
Md Glen Burnie, New Era Sls. Inc. 301-768-6666
Mass Reading, Kanan Assocs. 617-944-8484
Mich Grand Rapids, J. L. Montgomery Assoc. 616-774-9308
Mich Southfield, J. L. Montgomery Assoc. 313-358-2616
Minn Minneapolis, C.E. Bohlig 612-922-7011
Mo St. Louis, Carlson Elctrn. Sls. 314-991-0262
NY Albany, Reagan/Compar Albany 518-489-7408
NY Endwell, Reagan/Compar Albany ... 607-723-8743
NY Fairport, Reagan/Compar Albany ... 716-271-2230
NY Melville, Unitrode Corp. 516-549-5400
NY New Hartford, Reagan/Compar Albany 315-732-3775
NC Burlington, P.J. Nahser 919-226-8053
Ohio Cincinnati, Baehr, Greenleaf & Assoc. 513-891-3826
Ohio Cleveland, Baehr, Greenleaf & Assoc. 216-221-9030
Ohio Columbus, Baehr, Greenleaf & Assoc. 614-486-4046
Ohio Dayton, Baehr, Greenleaf & Assoc. 513-426-5485
Ohio West Carrollton, Unitrode Corp. 513-859-5872
Pa Ft. Washington, GCM Assocs. 215-646-7535
Pa Ft. Washington, Unitrode Corp. 215-542-9112
Pa Pittsburgh, Covert & Newman Co. 412-563-0303
Tex Houston, Semiconductor Sls. Assoc. 713-461-4197
Tex Richardson, Semiconductor Sls. Assocs. 214-231-6181
Utah Salt Lake City, Simpson Assocs. 801-486-3731
Wash Bellevue, SD-R&S2 206-747-9424
EXP: Downsview, Ont., Can., Kaytronics Ltd. 416-638-5511
EXP: Montreal, P.Q., Can., Kaytronics Ltd. 514-487-3434

UNITRON CORP., 700 Barr St., Ft. Wayne, Ind., 46802, Tel: 219-422-6656; Empl.: 5

Customer service: W. C. Dodenhoff

Free literature available: Single product information sheets on each subject product.

Products manufactured: Alarms, Chargers, Battery, Controls/Control Eqpt., Detectors, Flashers, Indicators, Monitors, Relays, Thermostats, Timers

UNITRON
INCORPORATED

UNITRON INC., 1624 N. First St., Box 1331, Garland, Tex., 75040, Tel: 214-276-8591, Telex: 73-0644; FSC No: 6130; Empl.: 55; Minimum order: $50 ..... p. 1•1516-1523

Customer service: R. L. Beutel

Free literature available: General Catalog - contains individual specification sheets on each product; Short Form Catalog - contains listing of all standard products and some important specifications each.

Products manufactured: Controls/Control Eqpt., Converters, Inverters, Power Supplies

UNITRON SCIENTIFIC, INC., 66 Needham St., Newton Highlands, Mass., 02161, Tel: 617-969-8600, TWX: 710-335-1684; Empl.: 200; Minimum order: $15

For info on price: J. Dill; Application info: J. Coyle; Customer service: J. Dill; Delivery info: J. Dill

Free literature available: Literature on full line of microscopes and refractor telescopes.

Products manufactured: Microscopes

UNIVERSAL AD-YU ELCTRNS., INC., 2517 E. Norwich St., Milwaukee, Wisc., 53207, Tel: 414-482-4100; FSC No: 90101; Empl.: 10

Customer service: R. Fehrenbach

Products manufactured: Amplifiers, Attenuators, Comparators, Delay Lines, Detectors, Filters, Generators, Meters, Networks, Shifters, Standards

Local Sales Offices & Reps.
Cal Burbank, R. Olander & Co. 213-843-5200
Ill Northfield 312-446-4166
Kans Leawood, G. Vasen 913-649-0679
Mass Acton, E.E. Specialists 617-259-9200
Mo St. Louis, G. Fixman Engrg. 314-725-5219
NM Albuquerque, Elctrn. Entprs. 505-256-3561
NM Las Cruces, Elctrn. Entprs. 505-524-0126
Ohio Dayton, Micro Sls. Corp. 513-298-3033
Pa Philadelphia, E.C.I. 215-836-1616
Wash Seattle, Dewar & Assoc. 206-763-2233

UNIVERSAL INSTRUMENTS CORP., Box 825, Binghamton, N.Y., 13902, Tel: 607-772-7522, TWX: 510-252-1990; Empl.: 820

For info on price: R. C. Cook 607-772-7415; Application info: D. W. Ackerman 607-772-7438; Customer service: J. Driscou 607-772-7505; Delivery info: G. C. Mayo 607-772-7410

Products manufactured: Machines/Machinery, Production

Local Sales Offices & Reps.
Colo Denver, Universal Instrs. Corp. 303-798-6505
Colo Littleton, Universal Instrs. Corp.
Conn Trumbull, Universal Instrs. Corp. 203-378-5613
Fla St. Petersburg, Universal Instrs. Corp. 813-392-5265
Ill Chicago, Solid State Elctrns. of Ill. 312-889-8033
Ill Palatine, Universal Instrs. Corp. 312-358-4831
Ind Cedar Lake, Universal Instrs. Corp. 219-374-9555
Mich Ann Arbor, Universal Instrs. Corp. 313-761-9166
NH Manchester, Universal Instrs. Corp. 603-669-6500
NY Binghamton, Universal Instrs. Corp. 607-772-7414
NC Raleigh, Universal Instrs. Corp. 919-782-1436
Pa Levittown, Universal Instrs. Corp. ... 215-943-9244
Tex Dallas, Universal Instrs. Corp. 214-339-5121
EXP: N.Y., N.Y., Extron Entprs. Inc. 212-752-4278
FOR: Can., Montreal, Que., Willer Engrg. Ltd. 514-748-6169
FOR: Can., Toronto, Ont., Willer Engrg. Ltd. 416-783-3373

UNIVERSAL RELAY CORP., 42 White St., New York, N.Y., 10013, Tel: 212-925-6900, TWX: 710-581-4461; Empl.: 30

For info on price: S. Soloway; Application info: B. Kassel; Customer service: M. Greenberg; Delivery info: J. Wells

Free literature available: Complete Catalog Plus Free Slide Rule

Products manufactured: Choppers, Relays, Solenoids, Switches

UNIVERSAL SECURITY INSTRS., 2829 Potee St., Baltimore, Md., 21225, Tel: 301-355-9000; Empl.: 60; Minimum order: $5

For info on price: A. Brochin; Application info: A. Brochin; Customer service: D. Jones; Delivery info: D. Jones

Free literature available: Catalog sheets & catalogs, glossies - etc. - on entire line.

Products manufactured: Alarms, Batteries, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Cabinets & Accessories, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Cords, Cutters, Wire, Hand Operated, Fasteners, Foil, Fuses, Horns, Microwave, Indicators, Motors, Relays, Speakers, Switches, Terminal Blocks, Boards & Strips, Terminals, Timers, Vibrators, Instrument (Stiction Elimination), Wire, Wire Nuts, Wire Strippers

Local Sales Offices & Reps.
Cal Culver City, W. Alderson Co. 213-837-1398
Cal San Francisco, Featherstone Sls. Co. 415-467-3133
Fla Miami, Sochin Sls. Co. 305-235-6048
Ga Norcross, D. Cooper Co. 404-448-5460
Ill Chicago, B. Burns & Assoc. 312-775-1233
Ind Indianapolis, Electronic Reps., Inc. 317-897-9326
Md Baltimore, J. Fournier 301-636-5237
Mass Framingham, Northeast Rep., Inc. 617-879-2300
Mich Southfield, Aztec Sls. Corp. 313-642-0777
Mo Grandview, Moeller/Pickett & Assoc. 816-765-1224
NY Liverpool, Lewis & Dunnigan Co. 315-622-2133
Ohio Richfield, Bear Mktg. Co. 216-659-3131
Pa Dresher, Diversified Sls. 215-643-1003
Tenn Memphis, Mid South Sls. Assoc. 901-276-4442
Tex Hurst, Ranger Elctrns. Inc. 817-281-2736
Wash Tukwila, J. Stroum, Co. 206-575-0175

UNIVERSAL SHIELDING CORP., 45 S. Service Rd., Plainview, N.Y., 11803, Tel: 516-420-9538; Empl.: 15

Customer service: J. Rance

Products manufactured: Cabinets & Accessories, Shields

UNIVERSAL VOLTRONICS CORP., 27 Radio Cir. Dr., Mt. Kisco, N.Y., 10549, Tel: 914-241-1300, TWX: 710-571-2142; Empl.: 75; Minimum order: $25
p. 1•1524-1527

For info on price: N. Segretto; Application info: B. Ressler; Customer service: V. Gianguzzi; Delivery info: N. Segretto

Free literature available: 1. H.V. DC Power Supplies Components and Equipment Catalogue (Includes unregulated and precision regulated DC power supplies up to 2000 KVDC; isolation TX dividers and terminations) 2. Applied H.V. Products Catalogue (Includes AC power supplies; impulse generators)

Products manufactured: Cable, Meters, Power Supplies, Regulators, Testers, Transformers

Local Sales Offices & Reps.

Cal	Encino, King Way Assocs.	213-788-4124
Cal	Redwood City, Pruitt-Parks	415-364-1640
Fla	Winter Park, McMahan Assocs.	305-645-0463
Ill	Oak Brook, Schuten Assocs.	312-833-0980
Md	Ellicott City, A/O Elctrns.	301-531-6700
Mass	Waltham, Waitt Tech. Sls.	617-891-8195
Minn	Mpls., R.J. Sls.	612-922-1425
NM	Albuquerque, F.Y. Gates Co.	505-298-1875

Local Distributors

Cal	Encino, Kingway Assocs., 16400 Ventura Blvd.	213-788-4124
Cal	Redwood City, Parks & Pruitt Assoc., 555 Veterans Blvd.	415-364-1640
Fla	Winter Pk., McMahan Assoc., 1350 Orange Ave.	305-645-0463
Ill	Elmhurst, Schuten Assocs., 643 S. Eighty-three	312-833-0980
Md	Simpsonville, A/O Elctrns., 10202 Don Leigh Dr.	301-997-8033
Mass	Waltham, Universal Voltronics, 751 Main St.	617-891-8195
Minn	Minneapolis, R-J Inc., 7100 France Ave. S.	612-922-1425
NM	Albuquerque, Fry Gates Co., 147 Madison Ave.	505-298-1875

UNIVERSITY SOUND, Altec Corp., 1515 S. Manchester, Anaheim, Cal., 92803, Tel: 714-774-2900, Telex: 655415; Empl.: 1000; Minimum order: $20

For info on price: B. McCalister 405-354-5311; Application info: C. W. Round 714-774-2900; Customer service: W. Norris 405-354-5311; Delivery info: B. McCalister 405-354-5311

Free literature available: Condensed catalogs and all specification sheets on entire product line.

Products manufactured: Amplifiers, Comm. Systems, Microphones, All Kinds, Networks, Speaker Systems, Speakers

Local Sales Offices & Reps.

Cal	Carson, Bidwell Sales Assocs.	213-770-0300
Cal	Oakland, Hank Gabriel	415-465-5361
Colo	Arvada, C. B. Elctrn. Mktg.	303-422-0561
Fla	Miami Beach, Seaman Sls. Inc.	305-271-5728
Ga	Atlanta, Murphy & Cota	404-875-2525
Haw	Honolulu, Gene Piety Factors, Inc.	808-839-9059
Ill	Chicago, Lassers & Co.	312-539-4722
Ind	Indianapolis, F. McSweeney	317-849-5726
Md	Kensington, Forti-Austin	301-949-1706
Mass	Norwood, Rudolph & MacInnis	617-769-5450
Mich	Detroit, Burcaw Co. & Assocs.	313-533-7700
Minn	Minneapolis, Kodo Assocs.	612-881-1255
Mo	Kansas City, Nevco, Inc.	816-421-1751
NY	Flushing, Bettan Sls., Inc.	212-969-7600
NY	Phelps, LSM Assocs.	315-548-4891
Ohio	North Olmsted, Avcom, Inc.	216-777-5001
Pa	Enon Valley, Nebco Assocs. Inc.	216-457-2333
Tex	Dallas, Miller & Assocs.	214-661-5002
Wash	Seattle, Vector Corp.	206-322-4343
EXP:	Anaheim, Cal., Altec	714-774-2900
FOR:	Can., North Vancouver, B.C., C. L. Thompson, Ltd.	604-987-9388
FOR:	Can., Toronto 9, Ontario, J. R. Tilton, Ltd.	416-762-7571

UP-RIGHT SCAFFOLDS, Div. Up-Right, Inc., 1013 Pardee St., Berkeley, Calif., 94710, Tel: 415-843-0770, TWX: 415-891-9272; Empl.: 130

Products manufactured: Antenna Towers & Supports

Local Sales Offices & Reps.

Cal	Berkeley	415-843-0770
Cal	Los Angeles	213-255-5282
Cal	San Diego	714-295-8042
Colo	Denver	303-222-2017
DC	Washington	202-393-7165
Ga	Atlanta	404-523-2263
Ill	Chicago	312-631-3380
La	New Orleans	504-523-7965
Mass	Somerville	617-666-2880
Mich	Detroit	313-962-6100
Minn	Minneapolis	612-336-1898
Mo	Kansas City	816-221-5485
Mo	St. Louis	314-241-4350
NJ	Teterboro	201-487-6464
NY	Syracuse	315-437-7845
NC	Charlotte	704-333-4638
Ohio	Cincinnati	513-621-3758
Ohio	Cleveland	216-241-7109
Pa	Philadelphia	215-564-0943
Pa	Pittsburgh	412-261-4696
Tenn	Memphis	901-525-3136
Tex	Dallas	214-946-2373
Tex	Houston	713-528-1187
Wash	Seattle	206-682-0855

UPI SEMICONDUCTOR DIV., United Page Inc., 481 Getty Ave., Patterson, N.J., 07503; Minimum order: $25

For info on price: Luke Morelli 279-7500; Application info: M Formi 279-7500; Customer service: G. Giordan; Delivery info: G. Giordan

Free literature available: Short form technical data catalog of over 2,000 solid state devices-rectifiers, diodes, transistors. Individual complete spec sheets of all UPI devices.

Products manufactured: Diodes, Rectifiers, Transformers, Transistors

Local Sales Offices & Reps.

Cal	Encino, UPI Semiconductor	213-881-0300
Colo	Denver, Electrn. Sls.	303-771-6300
Ill	Park Ridge, Metcom Assocs.	312-696-1490
Mo	Hazelwood, Dytronix	314-731-5799
NJ	Paterson, United Page	201-279-7500
NJ	Westwood, R. C. Assocs.	201-664-1241
NY	East Meadow, Stanley Shapiro Assoc.	516-483-4185
Pa	Glenside, Koebert, R. F.	215-887-2310
Tex	Dallas, Southland Componens	214-233-0603

USCC/CENTRALAB, ELEC. DIV., Globe-Union Inc., 4561 Colorado Blvd., Los Angeles, Cal., 91504, Tel: 213-240-4880, TWX: 910-498-2222; Empl.: 625; Minimum order: $50 .... p. 1•320,594,595; p. 2•320-327

For info on price: T. Davies; Application info: J. Horn; Customer service: T. Davies; Delivery info: T. Davies

Free literature available: Miniature Ceramic Capacitors for High Reliability Applications. Miniature Ceramic Capacitors for High Volume Applications. EMI/RFI Filters.

Products manufactured: Capacitors, Fixed, Filters

Local Sales Offices & Reps.

Ala	Huntsville, Rep. Inc.	205-881-9270
Ariz	Phoenix, Clemick-Neenan & Assoc.	602-279-7649
Cal	Los Angeles, Clemick-Neenan	213-476-1272
Cal	Mt. View, Caltron/Pyle	415-964-3244
Colo	Denver, Electro-Rep., Inc.	303-744-2821
Fla	Ft. Lauderdale, Dyne-A-Mark Corp.	305-771-6501
Ga	Tucker, Rep. Inc.	404-938-4358
Ill	Des Plaines, Centralab	312-827-4487
Kans	Shawnee Mission, Thomas Modrcin Assoc.	913-432-2131
Md	Towson, Jerry Bresson Assoc.	215-839-6770
Mass	Needham, Hatch Assoc.	617-444-3310
Mich	Detroit, R.C. Merchant & Co.	313-535-6000
Minn	Minneapolis, Technical Assoc.	612-929-6721
Mo	Hazelwood, Thomas-Modrcin Assoc.	314-895-4700
NJ	Irvington, E.F. Alber	201-375-7458
NM	Albuquerque, Staley Co.	505-294-2660
NY	Albany, Reagan/Compar Albany, Inc.	518-489-7408
NY	Plainview, E.R.A.	516-822-9890
NC	Raleigh, Carlwright & Bean, Inc.	919-832-7128
Ohio	Columbus, McFadden Sls., Inc.	614-221-3363
Ohio	Mentor, Bishop Comp.	216-255-6969
Pa	Narberth, Jerry Bresson Assoc.	215-839-6770
Tex	Houston, Aid Elctrns., Inc.	713-777-3882
Tex	Irving, Aid Elctrns., Inc.	214-259-4761
Va	Lynchburg, J. Bresson, Assoc.	215-839-6770
Wash	Seattle, H.S. Thorpe Comp.	206-784-3333
Wisc	Milwaukee, Centralal	414-228-2781
FOR:	Can., Ajax, Ont., Centralal-Can. Ltd.	416-683-1540

U. S. COMPONENTS Inc.

U.S. COMPONENTS, 1320 Zerega Ave., Bronx, N.Y., 10462, Tel: 212-824-1600, TWX: 710-593-2141; FSC No: 97954; Empl.: 85; Minimum order: $50

For info on price: S. Slivko; Application info: B. Prott; Delivery info: H. Jones

Free literature available: 11 catalogs on electrical connectors covering rack and panel and screwlock devices in miniature, subminiature, microminiature, miniature-crimp removable, edge board, two-unit P.C. and I/O wrap-crimp connectors. Catalog feature specifications, basic configurations, materials, finishes, both for mil. and commercial connectors.

Products manufactured: Connector Blocks, Mother Board, Connectors

Local Sales Offices & Reps.

Ala	Huntsville, Young & Lawrence Assocs.	205-539-6575
Ariz	Phoenix, Chaparral	602-996-9648
Cal	Mountain View, Westrep	408-265-0312
Cal	Pico Rivera, Westrep	213-949-2551
Fla	Winter Park, Young & Lawrence Assocs.	305-647-6929
Haw	Honolulu, B. Kolans & Co.	
Ill	Chicago, Phoenix Co.	312-237-2828
Ind	Huntington, Phoenix Co.	219-422-2311
Kans	Shawnee Mission, Thomas & Modrcin Assocs.	913-HE2-2131
Md	Ellicott City, R.F. Assocs.	301-465-5944
Mass	Scituate, Cirolia Leblanc Sls. Co.	617-545-1710
Mich	Birmingham, Forand Sls. Co.	313-644-0087
Minn	Minnetonka, K.L. Tannehill	612-935-0353
Mo	Hazelwood, Thomas & Modrcin Assocs.	314-838-6446
NJ	Madison, Livera-Polk Assocs.	201-FR7-3220
NY	Fayetteville, R.W. Jackson Co.	315-637-3851
NY	Roslyn Heights, Livera-Polk Assocs.	516-484-1276
NC	Greensboro, L & D Inc.	919-292-3201
Ohio	Vandalia, W.J. Brauer Assocs.	216-943-0601
Pa	Philadelphia, C.H. Newson & Assocs.	215-248-3377
Pa	Pittsburgh, W.J. Brauer Assocs.	412-921-3213
Tex	Dallas, Elcom	214-EM8-3578

U.S. ELCTRNS., 500 Long Branch Ave., Long Branch, N.J., 07740, Tel: 201-870-9500; Empl.: 40; Minimum order: $35

For info on price: L. Classen; Application info: R. Bruckner; Customer service: L. Classen; Delivery info: R. Kluge

Free literature available: Catalog #720 Describes Packaged Transformer Kits Ferrite E Cores, Channel Frames and Potting Cases. Technical Data Covers Material Selection Guide, Tolerances, and Aging Tests.

Products manufactured: Coils Including Assemblies & Forms, Ferrite Material & Parts, Services, Assembly, Production & Test, Solenoids

Local Sales Offices & Reps.

Cal	San Gabriel, Van Gott & Assoc.	213-285-2148
Fla	Orlando, Buchanan & Abrams	305-898-7444
Ill	Libertyville, R. Klipp Assoc.	312-362-4876
Mich	Dearborn, Villani-Pitcher	313-271-4600
Minn	St. Paul, Knox Assocs.	612-488-5402
NJ	Livingston, Thaw Sls.	201-992-2711
NM	Albuquerque, A. Q. Elctrns.	505-255-8701
NY	Rochester, Schmitz Bros.	716-546-7628
Ohio	Cincinnati, Val-Skol Sales	
Pa	Schwenksville, D. Homes Sls.	215-489-4163
Tex	Addison, Southland Eng. & Sls.	214-233-0603
Tex	El Paso, A. Q. Elctrns.	915-533-2681
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778

US
INSTRUMENT
RENTALS, INC.

U.S. INSTR. RENTALS, INC., 951 Industrial Rd., San Carlos, Cal., 94070

Customer service: R. Snyder

Free literature available: A categorized cross reference of the latest rental test equipment plus a primer on when rental is appropriate and the economics of rent vs. buy.

Products manufactured: Services, Assembly, Production & Test

U.S. SCIENTIFIC INSTRS., 61 North Beacon St., Boston, Mass., 02134, Tel: 617-787-2411; Empl.: 50; Minimum order: $15

For info on price: K. Lehman; Application info: W. A. Ward; Customer service: K. Lehman; Delivery info: K. Lehman

Free literature available: Technical Literature: 3015-1 - type 3015 Storbrite, 3018-1 - type 3018 Variable Pulse Source, 3019-1 - type 3019 Compact Arc Lamp Pulser, 3027-1 - CP Series Compact Arc Lamps, 3013-1 - Trigger Transformers, 3100-1 - FY Series Trigger Pacs

Products manufactured: Discharge Systems, Energy, Flashers, Lamp Drivers, Lamps, Lights, Power Supplies, Tachometers, Transformers, Tubes

Local Sales Offices & Reps.

Cal	Garden Grove, Impact Elctrns., Inc.	714-893-8551
Md	Silver Spring, Spectroscopy Sys.	301-949-8261
Mich	Detroit, Harvey Tpelitz & Co.	313-537-9058
NJ	Leonia, B. Kohl	201-944-6488
NY	N. Syracuse, NACO Elctrns.	315-699-2651
Ohio	Cleveland, H. Teplitz & Co.	216-371-2044
Ohio	Dayton, H. Teplitz & Co., Inc.	513-277-6531

USM CORP., Fastener Group, 510 River Rd., Shelton, Conn., 06484, Tel: 203-735-9341, TWX: 710-451-3734; Empl.: 375

For info on price: G. Zonas; Application info: R. Hoffman; Customer service: G. Zonas; Delivery info: G. Zonas

Free literature available: (1.) Manual - shows how POP rivets simplify product design and assembly, reduce fastening time and costs. Specifications on all POP rivets and setting tools. (2.) Eyeleting Guide - Facts and figures, sizes and materials; shows how to cut fastening costs.

Products manufactured: Eyelets, Fasteners, Grommets, Rivets

U.S. TERMINALS INC.

U.S. TERMINALS, 7502 Camargo Rd., Cincinnati, Ohio, 45243, Tel: 513-561-8145, TWX: 810-461-2290; FSC No: 12615; Minimum order: $30

For info on price: G. L. Stepp; Application info: G. L. Stepp; Customer service: E. Vanden Eynden; Delivery info: E. Vanden Eynden

Free literature available: Catalog of standard products.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Connectors, Cords, Grommets, Insulators & Insulation, Jacks (All Types), Pins, Plug & Jack Sets, Sockets, Terminal Blocks, Boards & Strips, Terminals

Local Sales Offices & Reps.

Ariz	Phoenix, Gramer & Co.	602-279-1231
Ill	Chicago, L-Tec, Inc.	312-286-1500
Iowa	Cedar Rapids, J.R. Sls. Engrg., Inc.	319-377-8211
Mass	Needham, A & M Elctrn. Rep.	617-444-8170

Advertisment

- Slip lock Teflon terminals
- Press type Teflon terminals
- Printed circuit terminals
- Sockets test point & jacks
- Grounding terminals
- Binding posts–Teflon–install fast
- High voltage connectors (miniature)
- DIP/DIL/IC & transistor sockets
- Miniature patch cords & receptacles
- Automatic installation equipment

UTAH ELECTRONIC DIV., Utah-American Corp., 1124 E. Franklin St., Huntington, Ind., 46750, Tel: 219-356-5800; Empl.: 1000 .... p. 1•31

Products manufactured: Attenuators, Baffles, Speaker, Controls, Fader, Grilles, Networks, Sound Absorbing Materials, Speaker Systems, Speakers, Transformers

Local Sales Offices & Reps.

Cal	Culver City, Marshank Sls. Co.	213-559-2591
Cal	San Francisco, Featherstone Sls. Co.	415-467-3133
Colo	Colorado Springs, Norris & Co.	303-635-9319
Haw	Honolulu, Pegart Int'l.	808-538-7818
Ill	Chicago, W.J. Doyle Co.	312-274-6685
Ind	Indianapolis, New/Era Sls.	317-257-7333
Kans	Leawood, W. Menezes & Assoc.	913-649-2680
La	Lacombe, S. Ormsby Sls.	504-882-7248
Mass	Wellesley, L. Cole, Inc.	617-237-1260
Mich	Rochester, R.A. Albrecht & Co.	313-651-7081
Minn	Minneapolis, C.R. Gibb Co.	612-377-1200
NJ	Newark, Fisher Elctrns.	201-836-1200
NY	Grand Island, L.J. McTaggart Assoc.	716-773-9222
NC	Greensboro, Adams & Assocs.	919-272-6838
Ohio	Cleveland, F.A. Daugherty Co.	216-449-1122
Ore	Portland, D.G. Weber Co.	503-234-7671
Pa	Easton, E-K-P Assocs.	215-258-6477
Pa	McMurray, C.S. Cooper & Assoc.	412-941-6473
Tex	Houston, Spivey-LeBoeuf Assoc.	713-649-1221
EXP:	Plainview, N.Y., Empire Exporters, Inc.	516-293-5582

UTE MICROWAVE, 3500 Sunset Ave., Asbury Park, N.J., 07712, Tel: 201-922-1009, Telex: 132-461; FSC No: 26231; Empl.: 15

Customer service: L. Nilson

Free literature available: 8 page catalog describing Ferrite, Filter and special products mfd. by UTE Microwave.

Products manufactured: Cavities, Microwave, Circulators, Ferrite, Duplexers, Microwave, Filters, Isolators, Meters, Preselector-Mixers, Preselectors, Shifters, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds Assocs.	205-536-1941
Ariz	Scottsdale, Fryco	602-495-3821
Cal	Costa Mesa, Measurement Assocs.	714-540-7160
Cal	Cupertino, Allis Assocs.	408-379-2883
Fla	Satellite Beach, Reynolds Assocs.	305-773-4700
Ga	Atlanta, Reynolds Assocs.	404-252-5360
Mo	Florissant, Sheridan Assoc.	314-837-5200
NJ	Hazlet, Mer-Mon Sls.	201-264-1851
NM	Albuquerque, A.L.S. Elec.	505-298-2575
NY	E. Rockaway, Bellenkes Assocs.	516-887-1443
NY	Utica, B.D. Hummel Co.	315-736-7821
Pa	Hatboro, Mer-Mon Sls.	215-672-5565
Tex	Richardson, P. Scanlon Co.	214-231-4661
Va	Baileys Crossroads, Q.T. Elctrn.	703-671-4357
EXP:	Stamford, Conn., Microwave Int'l	203-322-6911

V-M CORPORATION, Box 1247, Benton Harbor, Mich, 49022, Tel: 616-925-8841, TWX: 810-270-3104

For info on price: R. Roth; Application info: C. J. Stevens; Customer service: R. Roth; Delivery info: C. J. Stevens

Free literature available: Catalog sheets on automatic record changer packages, replacement changers; education systems cassette tape recorders, player and duplicators.

Products manufactured: Phonographs, Parts & Accessories, Recorders

Local Sales Offices & Reps.

Cal	LaHabra, Audio Merchandise & Assoc.	213-914-6703
Col	Denver, Central West Mktg. Co.	303-771-9397
Colo	Littleton, Mueller, Chuck	303-771-8140
Ga	Roswell, Glenn, William	404-993-3944
Ill	Deerfield, Consumer Mktg. Assoc.	312-823-2075
Mass	W. Springfield, Nelson, Carl	413-781-3040
Mass	Wellesley, Cole, Larry	617-237-1260
Mich	Southfield, Bragg, Bruce	313-352-8458
Minn	Minneapolis, Jensen-Olsen Sls. Co.	612-941-7181
Mo	Jefferson City, Vignola Assoc., Carmine	314-893-3205
NH	Manchester, Klene, Roger	603-623-5425
NJ	Moorestown, Di Vincent & Legato Assoc.	609-235-8299
NJ	Teaneck, Fisher Elctrns. Assoc.	201-837-1200
NY	Ballston Lake, Dworkin, Gene	518-877-8586
NY	Grand Island, Mc Taggart Assoc., L. 5.	716-773-9222
Ohio	Akron, Shamrock Sls.	216-666-3796
Pa	Churchville, Kunz & Assoc., Don	215-357-5020
Tex	Garland, Lawson, Lex	214-278-2219
Utah	Murray, Kenealey Assocs.	801-268-3111

VACO PRODUCTS CO., 510 No. Dearborn St., Chicago, Ill., 60610, Tel: 312-467-0123, TWX: 910-221-2231; Empl.: 125 .... p. 2•1056,1057,1714-1717

Products manufactured: Clamps & Clips, Connectors, Cutters, Wire, Hand Operated, Drivers, Nut, Kits, Connector, Kits, Terminal, Pliers, Rings, Retaining, Screwdrivers, Terminals, Testers, Tools, Wire Strippers, Wrenches

Local Sales Offices & Reps.

Cal	Gardena, Vaco/West Distribution Center	213-324-4934

VACTEC, INC., 2423 Northline Blvd., Maryland Heights, Mo., 63043, Tel: 314-872-8300, TWX: 910-764-0811; Empl.: 225; Minimum order: $10 .... p. 1•1022,1023

For info on price: J. Mundschenk; Application info: N. Wolff; Customer service: J. Mansfield; Delivery info: J. Mundschenk

Free literature available: PCD-6 = Photoconductive Cells VTL 5C = LED Axial VACTROLS VTS1A = Si. Solar Cells VTL1 - Hermetic Sealed VACTROLS, VTS-2 = Si. Low Capacitance Detectors VTL3 = Axial VACTROLS, VTS3A = Blue Enhanced Si. Detectors VTL9 = General Purpose VACTROLS VTTA-1 = Phototransistors & Photodarlingtons, VTLTA-1 = Opto-Isolators, SPV-5 = Selenium Photovoltaic Cells, P3100 = Portable Photometer VTL2C2 = To-5 Led/Vactrols.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Diodes, Isolators, Meters, Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, Arrowhead Sls. Corp.	602-277-7148
Cal	Encino, King-Way Assocs.	213-788-4124
Cal	Los Altos, Schwerin Assocs.	415-941-3737
Cal	Santa Barbara, Schwerin Assocs.	805-967-7317
Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Conn	Madison, A & M Elctrn. Reps.	203-421-4242
Fla	Orlando, Buchanan & Abrams Assocs.	305-898-7444
Ill	Chicago, T.B. Hunter Assocs.	312-777-2500
Ind	Fort Wayne, Scott Elctrns., Inc.	219-743-1586
Ind	Indianapolis, Scott Elctrns., Inc.	317-897-9977
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Md	Baltimore, R.L. Wilkinson, Inc.	301-377-7800
Mass	Needham, A & M Elctrn. Reps.	617-444-8170
Mich	Detroit, H.D. Mysing	313-537-5460
Minn	Edina, M. Foster Co.	612-835-2252
Mo	St. Louis, Engrg. Svcs. Co.	314-997-1515
NY	Syracuse, C.W. Beach Co.	315-446-9587
Ohio	Cincinnati, Scott Elctrns.	513-791-2513
Ohio	Cleveland, Scott Elctrns.	216-291-2600
Ohio	Columbus, Scott Elctrns., Inc.	614-236-8619
Ohio	Dayton, Scott Elctrns., Inc.	513-294-0539
Pa	Pittsburgh, Scott Elctrns.	412-781-3112
Pa	Willow Grove, Techparts	215-659-6900
Tex	Dallas, Allied Comps.	214-238-0408
Tex	Houston, Allied Comps.	713-691-3961
Utah	Salt Lake City, Arrowhead Sls. Corp.	801-487-4716
Va	Lynchburg, Royelec Elctrn. Reps.	804-239-0130
Wash	Seattle, B. Hirsh Co.	206-783-3423
EXP:	Chicago, Ill., J.D. Marshall Int'l., Inc.	312-583-6060
FOR:	Can., Montreal, Que., B. Manis Assocs.	514-336-5400

Local Distributors

Cal	Palo Alto, Zack Elctrns., 654 High St.	415-326-5432
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Mo	St. Louis, Interstate Ind'l Elctrn., 4445 Gustine	314-481-5110
Mo	St. Louis, Olive Ind'l Elec., 6662 Olive Blvd.	314-863-7800

VACTRONIC LAB. EQUIP., INC., 65 Brightside Ave., E. Northport, N.Y., 11731, Tel: 516-AN 1-2660; Empl.: 18; Minimum order: $10

For info on price: R. Morris; Application info: R. Salat; Customer service: R. Salat; Delivery info: R. Morris

Products manufactured: Chamber, Environmental Test, Deposition Equipment, Vacuum & Accessories, Detectors, Feedthrus & Seals, Environmental, Gages, Pumps, Vacuum, Valves, Solenoid, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Palo Alto, Andot Tech. Sls. Co.	415-325-0058
Mass	Wellesley, Westbom-Hiller Assocs.	617-235-9241
NM	Albuquerque, Technology Mktg. Assoc.	505-298-2415

VACTRONIC LAB. EQUIP., INC cont'd

Advertisment

We manufacture a complete line of High Vacuum Equipment, including a small table top diffusion pumped systems, to completely automated production (custom built) units. Solid state ionization gauge controls, valves, pumps, couplings, feed-throughs, baseplates & collars ... all sold separately as well as completely assembled systems, ready to operate. Send us your requirements, we will be happy to quote promptly. Our equipment is in use throughout the world since 1959.

VACUUM PRODS., INC., 25 Dock St., Mt. Vernon, N.Y., 10550, Tel: 914-664-7330; Empl.: 5; Minimum order: $25

For info on price: G. Frank; Application info: M. Kane; Customer service: B. Grassmyer; Delivery info: B. Grassmyer

Products manufactured: Thermocouples, Elements & Accessories

VALHALLA SCIENTIFIC, INC., 7707 Convoy Ct., San Diego, Cal., 92111, Tel: 714-277-2732; Empl.: 15; Minimum order: $15

Customer service: H. Clark

Free literature available: Digital multimeter/counters digital ohmmeters, and precision current calibrators.

Products manufactured: Calibrators, Current Sources, Dividers, Meters, Multipliers

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier, Inc.	205-536-5650
Ariz	Phoenix, Mesa Engrg.	602-244-1995
Cal	Orange, Marble Assocs.	714-549-9358
Cal	San Diego, Mesa Engrg.	714-278-8021
Cal	San Jose, MCH Assocs.	408-246-7330
Colo	Parker, Technology Mktg. Assocs.	303-841-3435
Conn	Hamden, Instr. Conslts., Inc.	203-248-4174
Fla	Orlando, Currie, Peak, & Frazier, Inc.	305-855-0843
Haw	Honolulu, E.M.C. Corp.	808-847-1138
Ill	Northbrook, Elctrn. Instr. Assocs.	312-498-4500
Ind	Indianapolis, Elctrn. Instr. Assocs.	317-257-7231
Kans	Kansas City, R.R. Burton Sls. Co.	816-444-8300
Md	Silver Spring, Sel-Tronics	301-589-3391
Mass	Waban, Instr. Conslts., Inc.	617-969-9881
Minn	Minneapolis, Revere Assocs.	612-781-7700
Mo	St. Louis, Delltron Co.	314-434-3804
NM	Albuquerque, Technology Mktg. Assocs.	505-298-4321
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Mt. Vernon, Q.E.D. Electronics, Inc.	914-664-0080
NY	Syracuse, Labtronics, Inc.	315-454-9314
NC	Greensboro, Currie, Peak & Frazier, Inc.	919-273-3040
Ohio	Cleveland, DESCO	216-252-3151
Pa	Melrose Park, R.A. Meyers Assocs.	215-224-1663
Tex	Richardson, Spectra Sls. Corp.	214-234-3600

VALPEY CORP., A Valtec Co., 1400 Highland St., Holliston, Mass., 01746, Tel: 617-429-4322; Empl.: 150

Free literature available: Brochure describes optical fabrication capabilities in usable manner. In addition to specific data on product scope and dimensional parameter, Valpey co-relates a series of optical fabrication capabilities with fundamental explanations, at surface finish, materials, flatness, shape, angles, etc.

Products manufactured: Crystals, Delay Lines, Filters, Lenses, Optical & Camera, Quartz, Fused, Services, Assembly, Production & Test, Substrates

VAN NORMAN MOLDING CO., 9599 S. 78th Ave., Bridgeview, Ill., 60455, Tel: 312-284-0118; Empl.: 80

Customer service: R.I. Andre 312-284-0118

Products manufactured: Services, Assembly, Production & Test

VANGUARD RELAY CORP., 225 Cortland St., Lindenhurst, N.Y., 11757, Tel: 516-226-5000

Customer service: B. S. Gilman

Free literature available: Cat #SF: condensed catalogue on relays, Cat #TDS: condensed catalogue on timers, Cat#70: 18 page general catalogue, individual spec. sheets on all relays & timers.

Products manufactured: Relays, Timers

Local Sales Offices & Reps.

Md	Baltimore, Stitzer Assoc.	301-823-2600
NJ	W. Caldwell, Peterson-Rudmick Assoc.	201-CA 6-4363
NY	New York, Peterson-Rudmick Assoc.	212-671-1923
Pa	Paoli, Stitzer Assoc.	215-644-5500

Advertisment

VANGUARD manufactures an extensive line of general purpose relays and hybrid Time Delay Relays covering a broad range of industrial applications. Relay types from 1 to 4 poles and 2 to 20 amps. Models include open, plug-in, enclosed, printed circuit use, antenna, sensitive and contactor with many models listed by U/L. Time delay relays are plug-in and panel mounted units having solid state circuitry and relay output. VANGUARD offers you quality products, competitive pricing, responsive service and dependable deliveries. Full literature available upon request.

VARADYNE INDUSTRIES, INC., 1547 18th St., Santa Monica, Cal., 90404, Tel: 213-829-2984, TWX: 910-343-6856; FSC No: 26654; QPL No: 55681; Empl.: 180; Minimum order: $50 .... p. 2•328-333

For info on price: P. Bowling Ext. 218; Application info: D. Juve Ext. 249; Customer service: P. Bowling Ext. 218; Delivery info: P. Bowling Ext. 218

Products manufactured: Capacitors, Fixed, Resistors, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Technology Mktg. Assoc.	205-883-7893
Ariz	Phoenix, H. Henschen & Assoc.	602-275-4411
Cal	Glendale, Orion Sls.	213-240-3151
Cal	Mountain View, Nor-Cal Assocs.	415-961-8121
Cal	San Diego, Orion Sls.	714-299-8322
Cal	Tustin, Orion Sls.	714-832-9687
Colo	Denver, Electrodyne	303-757-7679
Conn	North Haven, Kitchen & Kutchen	203-239-0212
Fla	Ormond Beach, Technology Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774
Ill	Park Ridge, R. F. Specialists	312-698-2044
Ind	Fort Wayne, Delesa Sls.	219-483-9537
Ind	Indianapolis, Delesa Sls.	317-257-4683
Kans	Wichita, Dy-Tronix	316-943-6221
Md	Baltimore, Coulbourn-DeGreif	301-247-4646
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Mich	Detroit, A. Blumenberg Assocs.	313-557-1934
Minn	St. Paul, H.A. Cullen & Assocs.	612-646-7371
Mo	Hazelwood, Dy-Tronix	314-731-5799
Mo	Kansas City, Dy-Tronix	816-761-6543
NJ	Teaneck, R.T. Reid Assocs.	201-692-0200
NY	Buffalo, Bowser & Sapecky	716-839-2044
NY	Manlius, Bowser & Sapecky	315-682-8885
NY	Rochester, Bowser & Sapecky	716-889-1919
NC	Raleigh, Component Sls.	919-782-8433
Ohio	Cleveland, D. Steffen & Assoc.	216-461-8333
Ohio	Dayton, D. Steffen & Assoc.	513-293-3145
Pa	Fort Washington, GCM Assocs.	215-646-7535
Tex	Dallas, Evans & McDowell Assoc.	214-238-7157
Tex	Houston, Evans & McDowell Assoc.	713-783-2900
Wash	Seattle, Demarest & Assoc.	206-523-0600

VARFLEX CORP., 514 W. Court St., Rome, N.Y., 13440, Tel: 315-336-4400; FSC No: 79074; Empl.: 135; Minimum order: $30 .... p. 2•1274,1275

Customer service: Sls. Dept.

Free literature available: A folder containing 25 actual samples of braided electrical sleevings, extruded PVC tubing, tying cord and lead wire.

Products manufactured: Cords, Insulators & Insulation, Rubber, Tapes, Electrical Insulation, Tubing

Local Sales Offices & Reps.

Ariz	Phoenix, Elec. Specialty	602-275-5736
Cal	Los Angeles, Electrical Spec. Co.	213-724-9600
Cal	San Diego, Elec. Specialty Co.	714-239-1345
Cal	So. San Francisco, Electrical Spec. Co.	415-589-9611
Colo	Denver, Elec. Specialty	303-321-0226
Ga	Chamblee, Prehler Elec. Insulation	404-451-4266
Ill	Chicago, Prehler Elec. Insulation	312-384-6100
Ky	Louisville, E & H Elec. Supply	502-587-0991
Mass	Nahant, F.H. Hart	617-581-0381
Minn	St. Paul, Prehler Elec. Insulation	612-452-2470
Mo	University City, E.P. Gund	314-862-1650
NY	Carle Pl., W. R. Murphy	516-333-6122
NY	Liverpool, W.T. Elliott	315-652-3690
Ohio	Cleveland, Prehler Elec. Insulation	216-267-2650
Ore	Portland, Elec. Specialty	503-227-3601
Pa	Ardmore, Martin Elec. Co.	215-649-6332
Pa	Phila., Prehler Elec. Insulation	215-725-5913
Pa	Pittsburgh, E.B. Beach Co.	412-242-0400
Tex	Garland, Hisco	214-272-5411
Tex	Houston, Hisco	713-228-6662
Utah	Salt Lake City, Elec. Specialty	801-487-9805
Wash	Seattle, Elec. Specialty	206-682-3434
FOR:	Can., Toronto, Ont., Elec. Insulation & Fibre Co., Ltd.	416-624-0700

VARI-L CO., 3883 Monaco Pkwy., Denver, Colo., 80207, Tel: 303-321-1511, TWX: 910-931-0590; FSC No: 05375; Minimum order: $50
p. 1•600,1831-1833; p. 2•147,441-443,1392-1407, 1831-1833

For info on price: C. Kiser; Application info: J. Kiser; Customer service: C. Kiser; Delivery info: C. Kiser

Free literature available: Catalogue 672, Individual product bulletins

Products manufactured: Amplifiers, Attenuators, Chokes, Coils Including Assemblies & Forms, Converters, Couplers, Detectors, Dividers, Filters, Impedance Converters, Microwave, Junctions, Hybrid, Microwave, Microwave Integrated Circuits (MIC's), Mixer-Preamplifiers, Microwave, Mixers, Modulator/Demodulators, Modulators, All Kinds, Multipliers, Networks, Oscillators, Reactors, Switches, Transformers

Local Sales Offices & Reps.

Ariz	Scottsdale, Cleveland Entprs.	505-298-7671
Cal	Cupertino, Dura Elctrns.	408-255-2084
Cal	Santa Ana, C.E.M.	714-835-2702
Cal	Woodland Hills, C.E.M.	213-884-7867
Colo	Arvada, Cleveland Entprs.	303-423-3707
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-831-0742
Ga	Woodstock, Saber Assocs.	404-432-9625
Kans	Leawood, H.C. Heyde Co.	913-649-8628
Md	Ellicott City, Applied Engrg. Conslts.	301-465-1272
Mass	Burlington, Tritek Inc.	617-272-4550
NM	Albuquerque, Cleveland Entprs.	505-345-2481
NY	Fayetteville, Graydon-Sherman Inc.	315-637-9861
NY	Tuchahoe, Associated Elctrns.	914-779-8110
NC	Raleigh, Saber Assocs.	919-834-3961
Ohio	Cincinnati, Luebbe Sls.	513-871-4211
Ohio	Cleveland, Luebbe Sls.	216-333-0425
Ohio	Dayton, Luebbe Sls.	513-294-0426
Pa	Delmont, T. Laslo	412-468-4019
Tex	Dallas, Texas Avionics Co.	214-368-3566
For:	Can., Ottawa, Ont., Wilson Entprs.	416-224-9878
For:	Can., Toronto, Ont., Wilson Entprs.	416-766-0510

VARIAN ASSOCS., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731; Empl.: 8800

Products manufactured: Amplifiers, Analyzers, Attenuators, Calorimeters, Microwave, Cavities, Microwave, Chamber, Environmental Test, Coils Including Assemblies & Forms, Computers, Converters, Couplers, Deposition Equipment, Vacuum & Accessories, Detectors, Diodes, Dividers, Duplexers, Microwave, Evaporation Equipment, Electron Beam, Feedthrus & Seals, Environmental, Filters, Flanges, Waveguide, Furnaces, Gages, Generators, Indicators, Interferometer Systems, Isolators, Lamps, Limiters, Loads, Electronic Variable, Magnets, Memory Systems, Meters, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Multipliers, Oscillators, Ovens, Paper, Graphic Recording, Power Supplies, Printers, Pumps, Vacuum, Receivers, Seals, Services, Assembly, Production & Test, Shutters, Microwave, Strip-Line Components, Microwave, Switches, Television Systems & Equipment Closed-Circuit, Terminal Equipment, Digital, Terminals, Transformers, Transistors, Transmitters, Tubes, Valves, Vacuum, X-Ray Inspection Equipment

VARIAN ASSOCS., Eastern Tube Div., 8 Salem Rd., Beverly, Mass., 01915, Tel: 617-922-6000, TWX: 710-347-1394

Products manufactured: Amplifiers, Duplexers, Microwave, Flanges, Waveguide, Generators, Isolators, Limiters, Oscillators, Power Supplies, Shifters, Shutters, Microwave, Switches, Tubes

Local Sales Offices & Reps.

Ariz	Scottsdale, Varian Assocs.	602-947-5461
Cal	Los Altos, Varian Assocs.	415-968-7630
Cal	Santa Monica, Varian Assocs.	213-828-5588
Fla	Clearwater, Varian Assocs.	813-446-8513
Ga	Atlanta, Varian Assocs.	404-252-0045
Ill	Park Ridge, Varian Assocs.	312-825-6686
Md	Cheverly, Varian Assocs.	301-773-7010
Mass	Waltham, Varian Assocs.	617-890-4560
NJ	Mt. Laurel, Varian Assocs.	609-428-6800
NJ	Springfield, Varian Assocs.	201-376-6600
NY	Syracuse, Varian Assocs.	315-437-2568
Ohio	Dayton, Varian Assocs.	513-298-7318
Tex	Richardson, Varian Assocs.	214-235-2385

VARIAN ASSOCS., Instrument Div., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-8100, TWX: 910-373-1731

Products manufactured: Analyzers, Detectors, Lamps, Magnets, Paper, Graphic Recording, Spectrometers

Local Sales Offices & Reps.

Cal	Downey	213-927-3415
Cal	Los Altos	415-968-8141
Colo	Wheatridge	303-421-4044
Ga	Atlanta	404-252-0400
Ill	Park Ridge	312-825-7772
Ky	Louisville	502-893-2573
Md	Cheverly	301-772-3683
Mass	Waltham	617-890-8430
Mo	St. Louis	314-524-0880
NJ	Cherry Hill	609-428-8880
NJ	Springfield	201-379-7610
NY	Syracuse	315-463-8861
Ohio	Euclid	216-261-2115
Ore	Portland	503-297-4737
Pa	Pittsburgh	412-243-4947
Tex	Dallas	817-268-1612
Tex	Houston	713-783-1800
FOR:	Can., Georgetown, Ontario	416-457-4130

VARIAN ASSOC., Solid State East Div., Micro-Link Prods., 8 Salem Rd., Beverly, Mass., 01915, Tel: 617-922-6000, TWX: 710-347-1394

Products manufactured: Antennas, Capacitors, Fixed, Converters, Diodes, Mounts, Receivers, Strip-Line Components, Microwave, Television Systems & Equipment Closed-Circuit, Transmitters

Local Sales Offices & Reps.

Ariz	Scottsdale	602-947-5461
Cal	Los Altos	415-968-7630
Cal	Santa Monica	213-828-5588
Fla	Clearwater	813-446-8513
Ga	Atlanta	404-252-0045
Ill	Park Ridge	312-825-6686
Md	Cheverly	301-773-7010
Mass	Waltham	617-890-4560
NJ	Mt. Laurel	609-428-6800
NJ	Springfield	201-376-6600
NY	Syracuse	315-437-2568
Ohio	Dayton	513-298-7318
Tex	Richardson	214-235-2385

VARIAN ASSOCS., Vacuum Div., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731; Empl.: 550

Products manufactured: Analyzers, Chamber, Environmental Test, Coatings, Controls/Control Eqpt., Deposition Equipment, Vacuum & Accessories, Detectors, Furnaces, Gages, Interferometer Systems, Ovens, Pumps, Vacuum, Valves, Vacuum

Local Sales Offices & Reps.

Cal	Downey, Varian Vacuum Div.	213-927-2601
Cal	Los Altos, Varian Vacuum Div.	415-968-4936
Fla	Clearwater, Varian Vacuum Div.	813-446-8513
Ill	Park Ridge, Varian Vacuum Div.	312-825-3103
Md	Cheverly, Varian Vacuum Div.	301-772-7433
Mass	Waltham, Varian Vacuum Div.	617-890-5750
NJ	Springfield, Varian Vacuum Div.	201-376-6610
NY	Syracuse, Varian Vacuum Div.	315-437-3307
Ohio	Cleveland, Varian Vacuum Div.	216-261-2115
Tex	Richardson, Varian Vacuum Div.	214-235-4586

VARIAN DATA MACHINES, Box E, Irvine, Cal., 92614, Tel: 714-833-2400, TWX: 910-596-1358; Empl.: 800; Minimum order: $50

For info on price: J. Jacobsen; Application info: D. Zatyko; Customer service: J. Gay; Delivery info: D. Jenkins

Products manufactured: Comm. Systems, Computers, Converters, Data Acquisition & Reduction Systems, Printers, Recorders

Local Sales Offices & Reps.

Ala	Huntsville	205-539-4616
Cal	Garden Grove	714-897-9515
Cal	San Diego	714-276-9462
Cal	Sunnyvale	408-736-5630
Colo	Denver	303-770-2151
Fla	Orlando	305-645-2577
Ga	Atlanta	404-252-0047
Ill	Park Ridge	312-692-7184
Md	Cheverly	301-773-6770
Mass	Waltham	617-890-6072
Mich	Southfield	313-645-9950
Mo	St. Louis	314-524-0880
NJ	Englewood Cliffs	201-569-2323
NM	Albuquerque	505-298-5570
NY	Englewood Cliffs	212-325-5248
NY	Rochester	716-586-3273
Ohio	Strongsville	216-238-6960
Pa	Philadelphia	215-643-2355
Pa	Pittsburgh	412-486-2443
Tex	Dallas	214-231-5145
Tex	Houston	713-781-0105
Wash	Seattle	206-641-4500

VARIAN DATA MACHINES, 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731; Empl.: 125

Products manufactured: Converters, Data Acquisition & Reduction Systems, Printers, Terminal Equipment, Digital

Local Sales Offices & Reps.

Cal	Downey	213-937-2673
Cal	San Diego	714-298-9292
Cal	Sunnyvale	408-736-3030
Fla	Orlando	305-299-2001
Ga	Atlanta	404-252-0047
Ill	Park Ridge	312-692-7184
Md	Cheverly	301-773-6770
Mass	Waltham	617-890-6072
Mich	Southfield	313-645-9950
NJ	Englewood Cliff	201-469-2323
NM	Albuquerque	505-288-5579
NY	Rochester	716-586-3273
Pa	Ft. Washington	213-643-2356
Tex	Houston	713-781-0105
Tex	Richardson	214-231-5145
Wash	Bellevue	206-455-2518

VARIAN ELECTRON TUBE & DEVICE GRP., 301 Ind'l. Way, San Carlos, Cal., 94070, Tel: 415-592-1221, TWX: 910-376-4893

Products manufactured: Adapters, Waveguide, Amplifiers, Antennas, Attenuators, Calorimeters, Microwave, Capacitors, Fixed, Cavities, Microwave, Coils Including Assemblies & Forms, Comm. Systems, Converters, Couplers, Diodes, Display Devices/Displays, Dividers, Drivers & Decoders For Readouts, Duplexers, Microwave, Filters, Flanges, Waveguide, Fuses, Generators, Heat Exchangers & Systems, Intensifiers, Image, Isolators, Junctions, Hybrid, Microwave, Lamps, Limiters, Magnets, Microwave Integrated Circuits (MIC's), Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Monitors, Multipliers, Oscillators, Power Supplies, Receivers, Seals, Sensors, Light, Services, Assembly, Production & Test, Shutters, Microwave, Sockets, Strip-Line Components, Microwave, Switches, Tachometers, Terminals, Transistors, Tubes

Local Sales Offices & Reps.

Ariz	Scottsdale	602-947-5461
Cal	Los Angeles	
Cal	San Francisco	
Fla	Ft. Lauderdale	305-943-9495
Ga	Atlanta	404-252-0045
Ill	Park Ridge	312-825-6686
Md	Cheverly	301-773-7010
Mass	Waltham	617-890-4560
NJ	Mt. Laurel	609-428-6800
NJ	Springfield	201-376-6600
NY	Syracuse	315-437-2568
Ohio	Dayton	513-298-7318
Tex	Richardson	214-235-2385
EXP:	Palo Alto, Cal.	415-943-4000

VARIAN PALO ALTO MICROWAVE TUBE DIV., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731

Products manufactured: Amplifiers, Attenuators, Calorimeters, Microwave, Coils Including Assemblies & Forms, Couplers, Detectors, Filters, Isolators, Magnets, Power Supplies, Services, Assembly, Production & Test, Tubes

VARIAN SOLID STATE EAST BEVERLY DIV., Salem Rd., Beverly, Mass., 01915, Tel: 617-922-6000, TWX: 710-347-1394

Products manufactured: Amplifiers, Cavities, Microwave, Converters, Couplers, Detectors, Diodes, Duplexers, Microwave, Generators, Junctions, Hybrid, Microwave, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Multipliers, Oscillators, Power Supplies, Receivers, Strip-Line Components, Microwave, Switches

Local Sales Offices & Reps.

Ariz	Scottsdale	602-947-5461
Cal	Los Altos	415-968-7630
Cal	Santa Monica	213-828-5588
Fla	Clearwater	813-446-8513
Ga	Atlanta	404-252-0045
Ill	Park Ridge	312-825-6686
Md	Cheverly	301-773-7010
Mass	Waltham	617-890-4560
NJ	Mt. Laurel	609-428-6800
NJ	Springfield	201-376-6600
NY	Syracuse	315-437-2568
Ohio	Dayton	513-298-7318
Tex	Richardson	214-235-2385

VARIAN, SOLID STATE WEST DIVISION, 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731

Products manufactured: Amplifiers, Crystals, Diodes, Filters, Generators, Multipliers, Oscillators, Receivers, Tubes, Tuners

Local Sales Offices & Reps.

Ariz	Scottsdale	602-947-5461
Cal	Los Altos	415-968-7630
Cal	Santa Monica	213-828-5588
Fla	Clearwater	813-446-8513
Ga	Atlanta	404-252-0045
Ill	Park Ridge	312-825-6686
Md	Cheverly	301-773-7010
Mass	Waltham	617-890-4560
NJ	Mt. Laurel	609-428-6800
NJ	Springfield	201-376-6600
NY	Syracuse	315-437-2568
Ohio	Dayton	513-298-7318
Tex	Richardson	214-235-2385
FOR:	Can., Georgetown, Ont., Varian Assocs. of Can. Ltd.	416-457-4130

VARO, INC., Electrokinetics Div., 402 E. Gutierrez St., Santa Barbara, Cal., 93102, Tel: 805-963-2055, TWX: 910-334-1177; FSC No: 02101; Empl.: 85; Minimum order: $100 .... p. 1•278,1532

For info on price: R. F. Suchan; Application info: R. F. Suchan; Customer service: R. W. Harvey; Delivery info: R. W. Harvey

Free literature available: Alternators, generators, electromechanical rotary actuators and A.C. and D.C. motors.

Products manufactured: Actuators, Alternators, Generators, Motors, Valves, Solenoid

VARO ELECTRON DEVICES, INC., 2203 W. Walnut St., Garland, Tex., 75040, Tel: 214-272-3561, TWX: 910-860-5093; FSC No: 27777; QPL No: Multiple; Empl.: 175 .... p. 1•2360

Customer service: W. T. Boyd

Free literature available: Brochure available with outline drawings and specifications of various image converters, image intensifiers, zoom tubes, gated intensifiers, microchannel plate inverter tubes.

Products manufactured: Intensifiers, Image, Tubes

Local Sales Offices & Reps.

NJ	Eatontown	201-229-1400
Ohio	Dayton	513-253-8935
Va	Springfield	703-941-5144

VARO SEMICONDUCTOR, INC., 1000 N. Shiloh Rd., Garland, Tex., 75040, Tel: 214-272-4551, TWX: 910-860-5178; Empl.: 1500 .... p. 1•1881-1895

For info on price: M. Hawkins; Application info: M. Hawkins; Customer service: T. Miller; Delivery info: T. Miller

Products manufactured: Bridges, Controls/Control Eqpt., Diodes, Multipliers, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers)

Local Sales Offices & Reps.

Ariz	Phoenix, W.W. Posey Co.	602-949-5873
Cal	Los Altos, W.W. Posey Co.	415-948-7771
Cal	Los Angeles, Corcoran Assocs.	213-823-4589
Colo	Arvada, Sage Sales	303-841-2487
Conn	North Haven, Comp Rep Assocs.	203-239-9762
Fla	Orlando, Buchanan & Abrams Assocs.	305-898-7444
Ill	Lombard, Varo Semiconductor	312-593-8860
Ind	Indianapolis, Tech. Reps, Inc.	317-849-6454
Iowa	Des Plaines, Coombs Assocs.	312-298-4830
Md	Baltimore, Dyna Rep. Co.	301-256-8300
Mass	Needham, Comp Rep Assocs.	617-444-2484
Mich	Farmington, Davis-Martensen Co.	313-474-8300
Minn	Minneapolis, L.F. Green Assocs.	612-781-1611
Mo	Kansas City, Beneke & McCaul, Inc.	816-765-2998
Mo	St. Louis, Beneke & McCaul	314-434-6242
NJ	Haddonfield, Dyna Rep. Co.	609-795-1700
NY	Great Neck, Cooper-Simon & Co.	516-487-1142
NY	Ithaca, B. Dean, Inc.	607-272-2187
NC	Charlotte, Buchanan & Abrams Assocs.	704-332-4974
Ohio	Dayton, J.C. Hofstetter Co.	513-296-1010
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Ore	Portland, C.K. Shanks & Assocs.	503-292-5656
Tex	Garland, Whiteside Sls. Co.	214-231-9771
Tex	Houston, Whiteside Sls. Co.	713-498-2551
Utah	Salt Lake City, Sage Sales	801-531-0531
Va	Alexandria, Dyna Rep. Co.	703-354-1222
Va	Newport News, Dyna Rep. Co.	804-874-7729
Wash	Seattle, C.K. Shanks & Assoc.	206-632-4290
Wisc	Brookfield, Varo Semiconductor	414-782-7590
FOR:	Downsview, Ont., Cantronics, Inc.	416-661-2494
FOR:	Montreal, Que., Cantronics, Inc.	514-341-5207

Local Distributors

Ala	Huntsville, Cramer-Huntsville, 2310 Bob Wallace Ave.	205-539-5722
Ariz	Phoenix, Cramer-Ariz., 2643 E. University	602-263-1112
Cal	Chatsworth, Westates Elctrns., 20151 Bahama St.	213-341-4411
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Irvine, Cramer-L.A., 17201 Daimler St.	714-979-3000
Cal	San Diego, Cramer-San Diego, 8975 Complex Dr.	714-565-1881
Cal	Sepulveda, Milgray-Cal., 8718 Woddley Ave.	213-894-4011
Cal	Sunnyvale, Bell Ind's., 1161 N. Fairoaks	408-734-8570
Cal	Sunnyvale, Cramer-San Francisco, 720 Palomar Ave.	408-739-3011
Colo	Denver, Cramer-Denver, 5465 E. Evans Pl.	303-758-2100
Conn	North Haven, Cramer-Conn., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer-Hollywood, 4035 N. 29th Ave.	305-923-8181
Fla	Orlando, Cramer-Orlando, 345 N. Graham Ave.	305-894-1511
Fla	Orlando, Milgray-Fla., 5400 Diplomat Cir.	305-647-5747
Ga	Atlanta, Cramer-Atlanta, 3923 Oakcliff Ind. Ct.	404-448-9050
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow	312-697-8200
Ill	Mt. Prospect, Cramer-Chicago, 1911 S. Busse Rd.	312-593-8230
Ill	Skokie, Bell Elctrns., 7701 N. Austin	312-282-5400
Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania	317-634-8486
Md	Baltimore, Cramer-Baltimore, 922-24 Patapsco Ave.	301-354-0100
Md	Gaithersburg, Cramer-Wash., 16021 Industrial Dr.	301-948-0110
Md	Hyattsville, Milgray-Wash., 5405 Lafayette Pl.	301-864-1111
Mass	Burlington, Milgray-New England, 79 Terrace Hall Ave.	617-272-6800
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Livonia, Cramer-Detroit, 13193 Wayne Rd.	313-425-7000
Minn	Edina, Cramer-Bonn, 7275 Bush Lake Rd.	612-835-7811
NJ	Cherry Hill, Milgray-Del. Valley, 1165 Marlkress Rd.	609-424-1300
NJ	Pennsauken, Cramer-Pa., 7300 Rte. 130 N.	215-923-5950
NJ	Union, Cramer-N.J., 949 Ball Ave.	201-687-7870
NM	Albuquerque, Cramer-N.M., 137 Vermont N.E.	505-265-5767
NY	E. Syracuse, Cramer-Syracuse, 6716 Joy Rd.	315-437-5571
NY	Endwell, Cramer-Binghamton, 3220 Watson Blvd.	607-754-6661
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Cramer-L.I., 29 Oser Ave.	516-231-5600
NY	Rochester, Cramer-Rochester, 300C S. Winton Rd.	716-275-0300
NC	Winston- Salem, Cramer/Winston-Salem, 938 Burke St.	919-725-8711
Ohio	Cincinnati, Cramer-Tri-States, 666 Redna Terrace	513-771-6441
Ohio	Cleveland, Cramer-Cleveland, 5835 Harper Rd.	216-248-8400
Ohio	Cleveland, Milgray-Cleveland, 1821 E. 40th St.	216-881-8800
Tex	Dallas, Cramer-Texas, 2970 Blystone Ln.	214-350-1355
Tex	Fort Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Altair Co., 9501 Baythorne, Box 40313	713-462-3029
Tex	Richardson, Altair Co., 405 N. Plano Rd.	214-231-5166
Utah	Salt Lake City, Cramer-Utah, 391 W. 2500 So.	801-487-4131
Wash	Bellevue, Bell Ind's., 1900 132nd N.E.	206-747-1515
Wash	Seattle, Cramer-Seattle, 5602 6th Ave. S.	206-762-5755
Wisc	Oak Creek, Cramer-Wisc., 430 W. Rawson Ave.	414-764-1700
For:	Can., Downsview, Ont., Cramer-Can., 920 Alness St.	416-661-9222
For:	Can., Vancouver, B.C., R.A.E. Ind., 1620 Main St.	604-687-2621
For:	Can., Willowdale, Ont., Electro Sonic, Ind'l. Sls. Ltd., 1100 Gordon Baker Rd.	416-494-1666

VECTOR ELECTRONIC CO., INC., 12460 Gladstone Ave., Dept. EP, Sylmar, Cal., 91342, Tel: 213-365-9661, TWX: 910-496-1539; FSC No: 82893; Empl.: 110; Minimum order: $15

p. 1•100-103; p. 2•358-363,1058-1061

For info on price: J. Robertson; Application info: F. L. Hill; Customer service: B. Little; Delivery info: J. Nelson

Free literature available: For Drawings for custom card and module cages.

Products manufactured: Attenuators, Bezels, Shielded & Unshielded, Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Boards, Programming, Bus Bars & Systems, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Chemicals, Clamps & Clips, Coils Including Assemblies & Forms, Connector Adapters, Connector Boxes & Strips, Power Outlet, Connectors, Contacts, Electrical, Containers, Cords, Dummy Loads, Enclosures, Module, Plug-In, Etchants, Printed Circuit, Eyelets, Frames, Cabinet & Rack, Gaskets, Shielding, R-F-Also See Shields, R-F, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Holders, Circuit Board (Production Type), Insulators & Insulation, Integrated Circuit Packaging Systems, Integrated Circuit Devices, Jumpers, Kits, Breadboarding (For Engineers), Kits, Printed Circuit, Kits, Terminal, Kits, Test Equipment, Kits, Training Aid, Laminates, Pads, Transistor Mounting, Panels, Pins, Plug Adapters, Plug Caps & Shells, Plugs, Pullers, Racks, Retainers, Socket Adapters, Sockets, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Distributors

Ariz	Phoenix, Dalis Radio/T.V. Supply, 917 N. 7th St.	602-258-8151
Cal	Inglewood, Newark Elctrns., 4747 W. Century	213-638-4411
Cal	Irvine, Terminal Electron., 1791 Reynolds	714-549-8611
Cal	Los Angeles, RPS Elctrns., 1501 S. Hill	213-748-1271
Cal	Mt. View, Abacus Elctrns., 1065 Terra Bella	415-961-1500
Cal	Mt. View, Elmar Elctrns., 2288 Charleston	415-961-3611
Cal	Oakland, Brill Elctrns., 610 E. 10th St.	415-834-5888
Cal	Pasadena, Empire Elctrns., 37 E. Union St.	213-681-7671
Cal	Riverside, Electronic Supply, 2486 Third St.	714-683-8110
Cal	Sacramento, Dunlap Elctrns., 1800 18th St.	916-444-8070
Cal	San Diego, Shanks & Wright, 2045 Kettner	714-239-0176
Cal	San Jose, Quement Elctrns., Box 6000	408-294-0464
Fla	Tampa, Lykes Elctrns., Box 24047	813-886-6621
Ill	Chicago, Newark Elctrns., 500 N. Pulaski	312-638-4411
Ill	Elgin, Allied Elctrns., 1355 Sleepy Hollow	312-697-8200
Ill	Palatine, Ohm/Elctrns., 649 Vermont Ave.	312-359-5500
Ill	Peoria, Klaus Radio, 8400 N. Pioneer Pkwy.	309-691-4840
Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania	317-634-8486
Ind	Indianapolis, Ra Dis Co., Inc., 814 N. Senate	317-637-5571
Ky	Louisville, P.I. Burks, Box 1015	502-589-3960
Md	Baltimore, ASI Elctrns., 1728-30 Whitehead	301-265-5100
Md	Beltsville, Powell Elctrns., 10728 Hanna St.	301-474-1030
Md	Rockville, Capitol Radio, 12270 Wilkens	301-942-7505
Mass	Boston, Sager Elect. Supply, 172 High St.	617-542-2281
Mass	Dedham, Gerber Elctrns., 852 Providence	617-329-2400
Mass	Lynn, Land Elect. Supply, 9 R. Franklin	617-592-2220
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Ann Arbor, Wedemeyer Elect., 2280 S. Indust'l. Hwy.	313-665-8611
Mich	Detroit, Newark Elctrns., 20700 Hubbell Ave.	313-548-0250
Mich	Detroit, R S Elctrns., 12775 Lyndon St.	313-491-1000
Minn	St. Paul, Gopher Elctrns., 2520 W. Larpenteur	612-645-0241
Mo	St. Charles, Lectronix, Inc., 306 McDonough	314-946-6424
Mo	St. Louis, Olive Ind. Elect., 6662 Olive Blvd.	314-863-7800
NJ	Camden, General Radio, 600 Penn St.	609-964-8560
NJ	Hanover, State Elctrn. Parts, 36 Route 10	201-887-8146
NM	Albuquerque, Electronic Parts, 2620 Rhode Island NE	505-265-8401
NY	Buffalo, Summit Distrs., 916 Main St.	716-884-3450

NY	Rochester, Simcona Elctrns., 275 Mt. Read	716-328-3230
NY	Rockville Centre, Midway Industrial, 24 Maple Ave.	516-764-2400
NY	Woodbury, Harvey Radio, 60 Crossways Pk. W.	516-921-8700
NC	Raleigh, Southeastern Radio, 414 Hillsboro St.	919-828-2311
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington	216-762-8818
Ohio	Cleveland, Pioneer Standard, 4800 E. 131st St.	216-587-3600
Ohio	Columbus, H. Peters Co., 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, ESCO, Inc., 221 Crane St.	513-224-9192
Ohio	Dayton, Stotts Friedman, 108 N. Jefferson	513-224-1111
Okla	Oklahoma City, Trice Wholesale, 4701 N. Stiles	405-524-4411
Ore	Portland, United Radio, 123 7th Ave NE	503-233-5346
Pa	Philadelphia, Powell Elctrns., South Island Rd.	215-365-1900
Pa	Pittsburgh, Cameradio, 2801 Liberty Ave.	412-391-7400
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
RI	Providence, Wm. Dandreta & Co., 28 Wolcott St.	401-861-2800
Tex	Dallas, Wholesale Elect., 2809 Ross Ave.	214-824-3001
Tex	Fort Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Harrison Equip., 1616 McGowen	713-224-9131
Utah	Ogden, Ballard Supply, 3109 Washington	801-394-5541
Wash	Seattle, Almac Stroum, 5811 Sixth Ave. S.	206-763-2300
Wash	Seattle, Radar Elec. Co., 168 Western Ave.	206-282-2511
Wisc	Milwaukee, Marsh Elctrns., 6047 Beloit Rd.	414-545-6500
Wisc	Milwaukee, Parts Mart, 1314 N. 7th Ave.	414-276-4160
Exp:	Cal., Los Angeles, Trans World Trade, Box 1037	213-472-0444

VECTOR GENERAL, INC., 21300 Oxnard St., Woodland Hills, Cal., 91364, Tel: 213-346-3410, TWX: 910-494-2764; FSC No: 32602; Empl.: 97; Minimum order: $50

For info on price: C. M. Ceranowski; Application info: J. Roberts; Customer service: F. Kohout; Delivery info: L. L. Longstaffe

Free literature available: Technical descriptions of Vector General's Interactive Graphic Display Systems interfaced to a wide range of minicomputers; associated graphics peripheral input devices; and graphic applications software.

Products manufactured: Dials, Display Devices/Displays, Generators, Keyboards, Alphanumeric & Decimal, Light Sources, Photoelectric, Tubes

Local Sales Offices & Reps.

Cal	Saratoga	408-996-3361
Cal	Woodland Hills	213-346-3410
Md	Baltimore	301-788-3722
Mass	Westford	617-692-3385
Mich	Ann Arbor	313-994-1331
Pa	Downingtontown	215-269-3021
Tex	Dallas	214-690-8035
EXP:	Los Angeles, Cal., Harper-Robinson	213-670-6401

ECTROL, INC., 1010 Westmore Ave., Rockville, Md., 20850, Tel: 301-424-6900; Empl.: 52; Minimum order: $25

For info on price: K. Berger; Application info: B. Strayton; Customer service: K. Berger; Delivery info: K. Berger

Products manufactured: Amplifiers, Controls/Control Eqpt., Power Supplies, Relays

Local Sales Offices & Reps.

Cal	Los Angeles, Basic Sys. Corp.	213-938-2833
Cal	San Francisco, Artwell Elec. Co.	415-467-1880
Ill	Chicago, Markson Assocs.	312-267-1905
Md	Baltimore, B. White & Co. Inc.	301-484-5400
Mass	Sharon, Adcour & Assocs.	617-784-3996
Mich	Farmington Hills, H. Lowell Co.	313-851-7474
NJ	Ridgewood, Ballou Inc.	201-444-6990
NY	Lancaster, Lawrence Industrial Sls.	716-685-1993
Ore	Portland, Dyna Tech.	503-265-1455
Pa	Valley Forge, Gil-Tronics	215-933-8525
Wisc	Milwaukee, E.A. Dickinson & Assocs.	414-264-1080

VECTRON LABS., INC., 121 Water St., Norwalk, Conn., 06854, Tel: 203-853-4433, TWX: 710-468-3796; FSC No: 27802; Empl.: 80; Minimum order: $30
p. 1•420,421

For info on price: Sls.; Application info: Sls.; Customer service: Cust. Svc.; Delivery info: Sls.

Free literature available: "Crystal Oscillators, Frequency Standards". "Howto Specify Crystal Controlled Oscillators".

Products manufactured: Amplifiers, Clocks (All Types), Controls/Control Eqpt., Generators, Integrated Circuit Devices, Oscillators

Local Sales Offices & Reps.

Ala	Huntsville, FM Assocs.	205-536-9990
Cal	Los Angeles, Fetty/Schoenduve	213-651-4050
Cal	Palo Alto, Fetty/Schoenduve	415-321-7041
Fla	Jupiter, FM Assocs.	305-746-2996
Fla	Orlando, FM Assocs.	305-851-5710
Ill	Skokie, Heth Inc.	312-282-8737
Ind	Indianapolis, Ihrig Assocs.	317-783-7630
Kans	Overland Park, Ensco-Rep., Inc.	913-381-7557
Mich	Grand Rapids, R. P. Urban Assocs.	616-245-0511
Minn	Burnsville, Heth, Inc.	612-333-8494
Mo	St. Louis, Ensco-Rep	314-567-3935
NJ	Woodcliff Lake, F & F Assoc.	201-778-6767
NY	Flushing, F & F Assoc	516-334-1160
NY	Syracuse, Rep Tech	315-437-2845
NC	Greensboro, FM Assocs.	919-294-2754
Ohio	Brecksville, A. Nace Co.	216-526-4323
Ohio	Englewood, A. Nace Co.	513-836-7548
Pa	Newtown Sq., SWR Assocs.	215-356-8550
Pa	Pittsburgh, A. Nace Co.	412-922-7225
Tex	Dallas, Texas Avionics	214-363-6324
Va	Springfield, Temsco	703-569-2700
Wash	Seattle, Datacom	206-285-2525

VEEDER-ROOT, 70 Sargeant St., Hartford, Conn., 06102, Tel: 203-527-7201, Telex: 9-9219; Empl.: 1200
p. 1•274,275

For info on price: A. Piergrossi; Application info: S. Rosenthal; Customer service: Wm. Travis

Free literature available: Total Capability: Counting/Controlling/Digital Printing: Complete line of totalizers, predetermining counters, printing devices and input devices. Catalog gives full description, stock items, specifications and application information.

Products manufactured: Controls/Control Eqpt., Converters, Counters, Data Acquisition & Reduction Systems, Display Devices/Displays, Generators, Indicators, Meters, Printers, Recorders, Switches, Tachometers, Timers, Totalizers, Digital, Transducers

Local Sales Offices & Reps.

Cal	Burlingame	415-697-6830
Cal	Glendale	213-245-8421
Conn	Hartford	203-247-0133
Ga	Rome	404-235-0756
Ill	Des Plaines	312-824-0188
Md	Baltimore	301-296-2177
Mich	Detroit	313-886-4485
Minn	Minneapolis	612-831-1711
NJ	Ridgewood	201-445-2401
NY	Rochester	716-244-0550
NC	Charlotte	704-364-3653
Ohio	Cincinnati	513-271-6200
Ohio	Cleveland	216-229-2634
Pa	Willow Grove	215-887-0708
SC	Greenville	803-288-2133
Tex	Arlington	214-252-3360
For:	Can., Montreal, Quebec, Veeder-Root Co. Ltd.	514-747-1213
FOR:	Can., Toronto, Ontario, Veeder-Root Co. Ltd.	416-239-3094

VEETRONIX, Box 209, 136 W. 7th St., Cozad, Neb., 69130, Tel: 308-784-4000; Empl.: 25 .... p. 1•2307

Products manufactured: Keyboards, Alphanumeric & Decimal, Switches

VEGA PRECISION LABS., 800 Follin La., Vienna, Va., 22180, Tel: 703-938-6300, Telex: 89-2521; Empl.: 165
p. 1•928

Customer service: T. E. Eazarsky Ext. 220

Products manufactured: Antennas, Dividers, Generators, Radar Systems, Receivers, Simulators, Tracking Systems, Transmitters, Transponders

Local Sales Offices & Reps.

Cal	El Cajon	714-448-3240
Fla	Panama City	904-763-9666
NY	Rome	315-337-2900

VELONEX, INSTRUMENT DIV., 560 Robert Ave., Santa Clara, Cal., 95050, Tel: 408-244-7370, TWX: 910-338-0114; Empl.: 60; Minimum order: $30

Customer service: E. Rudee

Free literature available: High Power Pulse Generator Catalogs; highly environmentalized DC/DC power supply catalog; Precision high voltage power supply data sheets.

Products manufactured: Amplifiers, Converters, Discharge Systems, Energy, Generators, Modulators, All Kinds, Power Supplies, References, D-C Voltage, Standards, Testers, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Costa Mesa, Measurement Assocs.	714-540-7160
Cal	Oakland, Advanced Technology	415-452-1401
Colo	Boulder, R.A. Mayes Co.	303-444-0782
Conn	Hamden, P. Jenks, Assocs.	203-281-0810
DC	Washington Gans-Frying	703-527-3262
Fla	Orlando, E.G. Holmes, Assocs.	305-894-8901
Ga	Chamblee, E.G. Holmes, Assocs.	404-451-6161
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
Md	Fulton, Gans-Fryling, Inc.	301-837-6311
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Detroit, Hocker Assocs.	313-549-3910
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
NM	Albuquerque, R.A. Mayes & Co.	505-292-2330
NY	Plainview, Eastern Metro Assocs.	516-931-1414
NY	Rochester, Scientific Devices	716-334-2445
Ohio	Cleveland, Hocker Assocs.	216-235-6504
Ohio	Dayton, Hocker Assocs.	513-298-8638
Pa	Melrose Park, R. Meyers Assocs.	215-224-1663
Tex	Houston, R.A. Mayes Co.	713-461-5385
Tex	Richardson, R.A. Mayes Co.	214-235-3053
Va	Arlington, Gans-Fryling, Inc.	703-527-3262
Va	Virginia Beach, E.G. Holmes & Assocs.	804-481-6556
FOR:	Can., Brampton, Ont., Baytronix Ltd.	416-453-1252
FOR:	Can., Montreal, Que., Baytronix Ltd.	514-336-9240
FOR:	Can., Ottawa, Ont., Baytronix Ltd.	613-728-0113

VELONEX, DISPLAY PRODS., 560 Robert Ave., Santa Clara, Cal., 95050, Tel: 408-244-7370; Empl.: 60; Minimum order: $35

For info on price: E. Rausch; Application info: R. A. Pecotich; Customer service: E. Rausch; Delivery info: E. Rausch

Free literature available: Application Bulletin I-101 System Integration of Impac Digital Panel Meters provides definition of specifications, theory of operation and information necessary to accomplish interface of all models of Impac Digital Panel Meters.

Products manufactured: Converters, Counters, Display Devices/Displays, Meters

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Phoenix, R.A. Mayes Co.	602-279-5243
Cal	Glendale, Meko Instr. Co.	213-240-4664
Cal	Los Altos, Hoeke-Reeser	415-941-4080
Colo	Broomfield, R.A. Mayes Co.	303-466-6311
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Chicago, K.W. Meyers Co.	312-774-6440
Ind	Indianapolis, K.W. Meyers Co.	317-243-6681
Md	Fulton, Gans-Fryling, Inc.	301-837-6311
Mass	Wakefield, P. Jenks Assocs.	617-240-1590
Minn	Minneapolis, K.W. Meyers Co.	612-920-7080
NJ	Union, SBM Reps	201-687-8737
NM	Albuquerque, R.A. Mayes Co.	505-265-7989
NY	Pleasantville, SBM Reps	914-769-1811
NY	Rochester, SBM Reps	716-266-1400
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Medina, McShane, Inc.	216-725-4568
Okla	Norman, Data Mktg. Assoc.	405-364-8320
Pa	Philadelphia, R. Meyers	215-224-1663
Tex	Dallas, Data Mktg. Assoc.	214-661-0300
Tex	Houston, Data Mktg. Assoc.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Va	Arlington, Gans-Frying, Inc.	703-527-3262
Wash	Bellevue, Desco Northwest	206-455-9325

VEMALINE PRODS. CO., 455 W. Main St., Wyckoff, N.J., 07481, Tel: 201-891-3200; FSC No: 08730; Empl.: 47; Minimum order: $50

For info on price: R. Pagan; Application info: C. Dawkins; Customer service: J. Kitson; Delivery info: D. Struck

Products manufactured: Caps, Lenses, Indicator Light, Clamps & Clips, Clutches, Couplings, Dials, Display Devices/Displays, Drives & Drive Mechanisms (Dial), Fasteners, Handles For Cabinets, Circuit Boards, Racks, etc., Knobs, Lamps, Lights, Locks, Dial & Shaft, Scales, Dial, Services, Assembly, Production & Test, Shafts & Adapters, Switch Hardware, Switches, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ala	Madison, B-C Elec. Sls.	205-837-5778
Airz	Phoenix, Mr Engr. Co.	602-959-5150
Cal	Encino, El/Tec	213-981-9881
Cal	Santa Clara, Ruby Sls. Corp.	408-739-5333
Conn	Meriden, Electro Prods. Sls.	203-235-4040
Fla	Ft. Lauderdale, Orbe	305-564-8571
Ga	Smyrna, B-C Elex. Sls.	404-436-5169
Ill	Chicago, Ropek-Cahill	312-287-7292
Ind	Evanston, R.M.P. Sls.	312-631-9545
Kans	Olathe, B. Rush Assocs.	913-782-1177
Mass	Waltham, Electro Prods. Sls.	617-899-1570
Mich	Grand Rapids, R. P. Urban Assoc.	616-245-0511
Minn	Minneapolis, Bitronics Sls. Co.	612-835-7744
NY	Buffalo, R.A. Murray Co. Inc.	716-632-6913
NY	Deruyter, R.A. Murray Co. Inc.	315-682-2920
NY	Williamsville, R.A. Murray Co. Inc.	716-632-4987
Ohio	Cincinnati, Loesch Assoc.	606-331-4332
Ohio	Cleveland, Loesch Assoc.	216-241-4581
Pa	Abington, IMS Co.	215-659-0444
Tex	Dallas, Blackburn Assoc.	214-351-9991
EXP:	New Rochelle, N. Y., Montclair Elctrns.	914-576-1400

VENT-RAK, DIV., General Devices Co., Inc., 525 S. Webster Ave., Indianapolis, Ind., 46219, Tel: 317-359-5407, Telex: 27-2169; Empl.: 125; Minimum order: $50 .... p. 1•67-70

For info on price: J. Bradford; Application info: R. D. Lambert; Customer service: G. Feest; Delivery info: J. Bradford

Free literature available: Catalogs covering Vent-RAK 1000-Series, 3000-Series, 6000-Series and 7000-Series Electronic Cabinets; 4600-Series Consoles and Instrument Cases; Vent-RAK chassis and Vent-RAK Accessories (Cable Retactors and writing shelves)

Products manufactured: Benches, Consoles, Stools, Tables, Cabinets & Accessories, Cable Retractors, Cases, Equipment, Instrument, Meter, Chassis, Metal, Containers, Drawers, Sliding, Racks

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Schoeffler Assoc.	602-948-3470
Cal	Los Angeles, M. A. Stolaroff Co.	213-295-7781
Cal	Mtn. View, G. C. Woempner Co.	415-964-5454
Cal	San Diego, M. A. Stolaroff Co.	714-234-6905
Cal	Van Nuys, J. R. Thomas	213-782-3820
Colo	Sedalia, Jensen Representatives	303-688-4154
Conn	Cheshire, Coakley, Boyd & Abbett, Inc.	203-272-2261
Fla	North Miami, Winfield Electronic Sls.	305-945-6554
Fla	Tampa, Winfield Electronic Sls.	813-884-6500
Ill	Rolling Meadows, Lightner Assocs., Inc.	312-398-3000
Ind	Indianapolis, Marketing Engineers	317-546-1523
Ind	South Bend, Valentine & Schillinger & Assoc.	219-291-6258
Kans	Shawnee Mission, Lowell Kangas & Assoc.	913-631-3515
Md	Bethesda, G. Rosen & Assocs., Inc.	301-530-8448
Mass	Needham, Coakley, Boyd & Abbett, Inc.	617-444-5470
Minn	St. Paul, Northport Engrg., Inc.	612-698-3841
Mo	St. Louis, Lowell-Kangas & Assoc.	314-821-4050
NY	Fayetteville, H.G. Richter, Inc.	315-637-6713
NY	Manhasset, Kaelber & Mack	516-627-6620
NC	Paw Creek, Ward Tech. Sls. Co.	704-399-3481
Ohio	Cincinnati, Components	513-721-2997
Ohio	Cleveland, Components	216-842-2737
Tex	Dallas, R. Martin Assocs.	214-361-8584
Tex	Houston, R. Martin Assocs.	713-462-4077
Wash	Olympia, Bergford Assoc.	206-866-2001
EXP:	Indianapolis, Ind., General Devices Co.	317-359-5407

VENUS SCIENTIFIC, INC., 399 Smith St., Farmingdale, N.Y., 11735, Tel: 516-293-4100, TWX: 510-224-6492; Empl.: 85 .... p. 1•1024,1025,1534,1535

Customer service: T. T. Krilovich

Free literature available: Send for Venus 1975 Catalog showing the complete line or miniature high voltage power supplies for military and commercial applications. Venus also builds custom supplies.

Products manufactured: Converters, Power Supplies, Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper-Goyne, Inc.	602-946-4437
Cal	Los Altos, Westec Elctrns./North	415-948-8880
Cal	Pasadena, Advanced Techniques	213-681-1093
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Ill	Park Ridge, R. F. Specialists	312-698-2044
Ind	Ft. Wayne, J&B Engrg. Sls. Co.	219-483-2813
Kans	Olathe, B. Rush Assocs.	913-782-1177
Mass	Norwood, S. Pierce, Inc.	617-762-3164
Minn	St. Paul, H.A. Cullen & Assocs.	612-646-7371
NJ	Cherry Hill, H.J. White Co.	609-428-4544
NY	Plainview, E.R.A. Inc.	516-822-9890
NY	Syracuse, Nycom Inc.	315-437-8343
Ohio	Columbus, T. Mulligan & Assocs.	614-457-2242
Tex	Richardson, P.J. Scanlon Co.	214-231-4661
Va	Alexandria, Vanguard Engrg. Sls.	703-768-1660
Wash	Seattle, Westec Elctrns./NW	206-CH3-7070
FOR:	Ottawa, Can., Orion Elctrns.	613-521-2739

VERMONT PRECISION RESISTOR CO., Box 1170, Stowe, Vt., 05672, Tel: 802-253-8567; Empl.: 15; Minimum order: $25

For info on price: J. Wagner; Application info: J. Wagner; Customer service: T. Freeman; Delivery info: T. Freeman

Free literature available: Brochure.

Products manufactured: Resistors

Local Sales Offices & Reps.

NH	Nashua, Bell Controls	603-882-6984

VERNAY LABORATORIES, INC., S. College St., Yellow Springs, Ohio, 45387, Tel: 513-767-7261; Empl.: 500

Customer service: A. LePera

Free literature available: Valve brochure; Int'l Rubber & Plastics Chart; Conversion Chart; Facilities Brochure.

Products manufactured: Bushings, Glass, Plastic, Metal, Rubber, Etc., Feedthrus & Seals, Environmental, Rubber, Seals, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Fla	Pompano Beach, Veri-Tech., Inc.	305-946-6373

VERNITECH, Div. of Vernitron Corp., 300 Marcus Blvd., Deer Pk., N.Y., 11729, Tel: 516-586-5100, TWX: 510-227-6079; Empl.: 150
p. 1•220-227,276,277,999-1003,1920-1923; p. 2•1207

Products manufactured: Actuators, Amplifiers, Brakes, Clutches, Controls/Control Eqpt., Converters, Counters, Dampers, Servo, Display Devices/Displays, Encoders, Generators, Indicators, Integrators, Mechanical & Electro-Mechanical, Motor Electric Generator Sets, Motors, Resolvers, Synchro, Servo Systems, Tachometers, Vibrators, Instrument (Stiction Elimination)

Local Sales Offices & Reps.

Cal	Los Angeles, Halbar	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700
Colo	Wheatridge, Technology Mktg. Assoc.	303-423-6106
Conn	N. Haven, Kitchen & Kutchin	203-239-0212
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ill	Rogers Park, Communications Engrs.	
Ind	Fort Wayne, T-X Sls.	219-485-0805
Iowa	Cedar Rapids, T-X Sls.	319-393-6278
Kans	Overland Park, Dy-Tronix	816-931-3030
Md	Baltimore, R.P. Luce & Co., Inc.	301-752-8200
Mass	Lexington, Kitchen & Kutchin	617-VO 2-8230
Mich	Grand Rapids, Urban Assoc.	616-245-0511
Minn	Minneapolis, Merrill Franklin Co.	612-835-6422
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Berkeley Heights, R.P. Luce & Co., Inc.	201-464-6440
NM	Albuquerque, Technology Mktg.	505-298-4321
NY	Endicott, Tech-Mark, Inc.	607-748-7473
NY	New Hyde Park, R.P. Luce & Co., Inc.	516-437-4550
NY	New Rochelle, R.P. Luce & Co., Inc.	215-632-1187
Ohio	Dayton, Rixan Assocs.	513-BA 2-0011
Ohio	Shaker Heights, T-X Sls.	216-561-1900
Pa	Philadelphia, R.P. Luce & Co., Inc.	215-884-8365
Tex	Dallas, Gipe Assocs.	214-350-1912
Tex	Dallas, J.B. Guenther	
EXP:	Montreal, Can., Vitel Elctrns.	514-331-7393

VERNITRON CORP., Control Components Div., 2440 W. Carson St., Torrance, Cal., 90501, Tel: 213-328-2504, TWX: 910-349-6250 .... p. 1•1004,1924

Customer service: R. Campbell

Free literature available: "New 1975 catalog available defining complete line of synchros, resolvers, selsyns, torgsyn, remote positiones, wide angle brushless dc torque motors, electromechanical assemblies and indicators."

Products manufactured: Indicators, Motors, Repeaters, Servo, Resolvers, Synchro, Servo Systems, Synchros, Transformers

Local Sales Offices & Reps.

Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	San Mateo, Halbar Assocs.	415-349-4700
Conn	North Haven, Kitchen & Kutchin	203-239-0212
Fla	St. Petersburg, Orbe Inc.	813-894-0687
Ill	Hillside, TX Sls.	312-449-0600
Md	Baltimore, Callas Elctrns.	301-744-7711
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Mich	Lathrup Village, R.C. Nordstrom Co.	313-559-7373
Minn	Eden Prairie, F. Peterson Co.	612-941-5400
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Cherry Hill, Lanson Assocs.	609-424-4670
NJ	Harrington Park, Metro Tech. Sls.	201-768-8495
NY	Endicott, Tech Mark, Inc.	214-748-7473
NY	Jericho, Metro Tech. Sls.	516-935-3330
Ohio	Dayton, Rixan Assocs.	513-222-0011
Tex	Dallas, M. Kruvand Co.	214-827-8043

VERNITRON ELEC. COMPS., Beau Prods., 117 Union Ave., Laconia, N.H., 03246, Tel: 603-524-5101, TWX: 710-364-1843; Empl.: 100 .... p. 2•1062-1064

Products manufactured: Connector Adapters, Connector Blocks, Mother Board, Connector Boxes & Strips, Power Outlet, Connectors, Jumpers, Plugs, Strips, Terminal Blocks, Boards & Strips

Local Sales Offices & Reps.

Cal	Santa Ana, RMS Assocs.	714-541-3295
Cal	Santa Clara, Nova-Tronix Elec. Sls.	408-243-9530
Colo	Denver, R.G. Bowen Co.	303-722-4641
Fla	Orlando, Cartwright & Bean, Inc.	305-422-4531
Ga	Atlanta, Cartwright & Bean, Inc.	404-237-2273
Ill	Oak Park, Wasson-Gallagher	312-383-6572
Ind	Indianapolis, Scott Elctrns., Inc.	317-897-9976
Mass	Norwood, R. Perron & Co.	617-762-8114
Mich	Lathrup Village, R.C. Nordstrom Co.	313-444-4417
Minn	Minneapolis, Heimann Co.	612-861-6051
Miss	Jackson, Cartwright & Bean, Inc.	601-354-1368
NH	Dover, R. Perron & Co.	603-742-2321
NJ	Cherry Hill, ME & Assoc.	609-667-6110
NJ	Denville, Grimm, Siegel Assoc.	201-625-1900
NM	Albuquerque, C.T. Carlberg & Assoc.	505-265-1579
NY	Rochester, B.H. Tollefson Assoc.	716-271-4141
NC	Charlotte, Cartwright & Bean, Inc.	704-333-6457
Ohio	Cleveland, Scott Elctrns., Inc.	216-291-2600
Pa	Pittsburgh, Scott Elctrns., Inc.	412-781-311
Tenn	Memphis, Cartwright & Bean, Inc.	901-276-4442
Tex	Dallas, W. Reese & Assoc.	214-638-6575
Wash	Seattle, R.K. Squibb Inc.	206-632-2450
FOR:	Can., Toronto, Ont., Brimark Elctrns. Ltd.	416-461-3511

VERNITRON PIEZOELECTRIC DIV., 232 Forbes Rd., Bedford, Ohio, 44146, Tel: 216-232-8600, TWX: 810-427-2274; Empl.: 185; Minimum order: $45
p. 1•596-599

For info on price: M. A. Rickman; Customer service: R. Roch; Delivery info: R. Roch

Products manufactured: Ceramic Resonators, Filters

Local Sales Offices & Reps.

Ariz	Phoenix, Gassner & Clark Co.	602-968-9037
Cal	Los Angeles, E. Mintz	213-645-2066
Cal	Palo Alto, Fetty/Schoenduve, Inc.	415-321-7041
Conn	Farmington, R. Perron & Co.	203-673-4825
Conn	Trumbull, R. Perron & Co.	203-268-9631
Mass	Norwood, R. Perron & Co.	617-762-8114
NH	Dover, R. Perron & Co.	603-742-2321
NY	New York, Metro-Long Island Corp.	212-799-9474
Ohio	Bedford, Vernitron Piezoelectric Div.	216-232-8600
Tex	Dallas, Oeler & Menelaides	214-234-6334
Tex	Houston, Oeler & Menelaides	713-772-0730
Wash	Seattle, R. Johnston Co.	206-524-5170

VERO ELECTRONICS, 171 Bridge Rd., Hauppauge, N.Y., 11787, Tel: 516-234-0400, TWX: 510-227-8890; Empl.: 25; Minimum order: $10 ....p. 2•364-366

Customer service: R. Troise

Products manufactured: Boards, Plug-In, Boards, Printed Circuit, Boards, Printed Wiring, Universal, Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Chassis, Circuit Board Mounting, Chassis, Metal, Clamps & Clips, Connectors, Enclosures, Module, Plug-In, Frames, Cabinet & Rack, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Holders, Circuit Board (Production Type), Integrated Circuit Packaging Systems, Integrated Circuit Devices, Kits, Breadboarding (For Engineers), Kits, Printed Circuit, Panels, Pins, Pullers, Racks, Services, Assembly, Production & Test, Sockets, Terminals

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrns.	205-881-5031
Cal	Cupertino, T. Louis Snitzer Co.	408-257-8333
Cal	Los Angeles, Dyna Sls. Co.	213-268-1175
Colo	Denver, A-G Elctrns.	303-722-5814
Conn	Milford, Todino Engrg.	203-874-6643
Fla	Clearwater, Reynolds & Assoc.	813-726-2373
Fla	Ft. Lauderdale, Reynolds & Assoc.	305-581-6611
Fla	Hollywood, Reynolds & Assoc.	305-987-6720
Fla	Palm Beach, Reynolds & Assoc.	305-662-4336
Fla	Satellite Beach, Reynolds & Assoc.	305-773-4700
Fla	St. Petersburg, Reynolds & Assoc.	813-360-1484
Ga	Atlanta, Beacon Elctrns.	404-351-3654
Ill	Chicago, Kennedy Engrg.	312-631-8283
Ind	Ft. Wayne, McDonald Sls.	219-747-3650
Md	Towson, Habco Elctrns.	301-825-9637
Mass	Needham Heights, Todino Engrg.	617-444-7925
Minn	St. Paul, Cullen & Assocs.	612-646-7371
Neb	Lincoln, Mktg. Assocs.	502-434-5244
NJ	Ft. Lee, K.E. Hughes Co.	201-944-1600
Pa	Jenkintown, Stein Instrumentation	215-885-2370
SC	Spartanburg, Beacon Elctrns.	803-582-4613
Tex	Garland, G.V. Peck Co.	214-341-8311
Tex	Houston, G.V. Peck Co.	713-664-1435
Wash	Kirkland, Todd-Brian Inds.	206-827-5811

Local Distributors

Cal	Los Angeles, Dyna Service, 1020 S. Atlantic	213-268-1175
Ill	Chicago, Redel Labs, 6713 N. Oliphant	312-631-8283
Md	Baltimore, Resco, 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Cambridge, Appolo Elect., 101 Binney St.	617-868-3120
NY	Buffalo, Summit Dist., 916 Main St.	716-884-3450
NY	Rochester, Summit Dist., 292 Commerce Dr.	716-334-8110
Tex	Garland, Electrolot, 3529 Asset St.	214-341-8311
Wisc.	Mequon, Taylor Elect., 1000 W. Donges Bay Rd.	414-241-4321

VIABLE SYSTEMS INC., Box 438, 299 Second Ave., Needham, Mass., 02192, Tel: 617-449-4570; Empl.: 15

Products manufactured: Amplifiers, Analyzers, Converters, Digitizers, Pencil Follower (Inc. Coordinate & Graphic), Generators, Paper-Tape Preparation Systems, Preselector-Mixers, Readers, Receivers, Servo Systems, Totalizers, Digital, Transmitters, Transponders

Local Sales Offices & Reps.

Ala	Huntsville, Comprehensive Consultant Co.	205-837-6404
Ohio	Dayton, P.J. Bockestedt & Assocs.	513-233-0849

VIBRA-METRICS, INC., 150 Bradley St., E. Haven, Conn., 06512, Tel: 203-467-6335; Empl.: 13

Products manufactured: Accelerometers, Amplifiers, Integrators, Electronic, Meters, Probes, Testers, Transducers, Vibrators

Local Sales Offices & Reps.

Ala	Huntsville, Incotech	205-837-6061
Ariz	Phoenix, RAMCO	
Cal	Anaheim, Bartholomew Eng. Assoc.	213-775-8697
Colo	Boulder, RAMCO	303-444-0782
Conn	Hamden, Northeast Engrg.	203-248-4481
Fla	Jupiter, Jupiter Eng. Co.	305-746-3984
Ill	Des Plaines, Maher Engrg.	312-824-2124
Mass	Danvers, Northeast Engrg.	617-774-3010
Mo	St. Louis, Adelphi	314-821-1232
NM	Albuquerque, RAMCO	505-292-2330
NY	Fayetteville, Components for Industry	315-637-9601
NY	Manhassett, Northeast Engrg.	516-265-9633
Ohio	Cleveland, Dietrich & Assoc.	216-781-1855
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Pa	King of Prussia, Letronix	
Pa	Pittsburgh, Dietrich & Assoc.	412-892-2992
Tex	Arlington, Lane Engrg.	
Tex	Houston, RAMCO	713-461-5385
Tex	Richardson, RAMCO	214-235-3043
Utah	Centerville, RAMCO	801-292-6781
Va	Norfolk, Scientific Devices-D.C.	703-499-8133
Va	Springfield, Scientific Devices-D.C.	703-451-6500
Wash	Bellevue, Topp Eng. Sls.	206-747-5400
FOR:	Can., Rexdale, Ont., John G. Weiss Co.	416-766-0843

VIBRAC CORP., 11 Alpha Rd., Chelmsford, Mass., 01824, Tel: 617-256-6581; Empl.: 35

For info on price: Q. R. Searle; Application info: J. R. Hendershot, Jr.

Products manufactured: Brakes, Clutches, Controls/Control Eqpt., Converters, Motors, Tachometers, Testers, Transducers

VIBRATION INSTRS. CO., 1614 Orangethorpe Way, Anaheim, Cal., 92801, Tel: 714-879-6085; FSC No: 32102; Empl.: 15; Minimum order: $50

Customer service: M.P. Marsh

Free literature available: Literature describes line of tracking filters, tracking analyzers, tracking ratio synthesizers, digital and analog phase meters, sweep generators, and charge amplifiers.

Products manufactured: Amplifiers, Analyzers, Comparators, Controls/Control Eqpt., Converters, Filters, Generators, Meters, Monitors, Multipliers, Signal Conditioners & Equipment

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs., Inc.	205-533-5896
Colo	Boulder, Moore-Eiler Assoc.	303-665-3351
Conn	Hamden, Equip. Sls. Co.	203-248-5581
Fla	Winter Haven, Lee Assocs., Inc.	813-294-5815
Ga	Chamblee, Lee Assocs., Inc.	404-457-7117
Ill	Chicago, Berndt Assocs., Inc.	312-283-0713
La	Baton Rouge, Sesco	504-272-3730
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	Chelmsford, Equip. Sls. Co.	617-256-8547
Mich	Detroit, S. Sterling Co.	313-255-1970
NM	Albuquerque, Moore-Eiler Assoc.	505-292-3322
NY	Liverpool, Rayelco Elctrns.	315-652-5272
NC	Raleigh, Lee Assocs., Inc.	919-787-5818
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Tex	Richardson, Sesco	214-231-9364

VLCHEK PLASTICS CO., Middlefield, Ohio, 44062, Tel: 216-632-1631; Empl.: 125; Minimum order: $35

Customer service: J. Rogers

Products manufactured: Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ill	Glen Ellyn, H. Hulseberg Co.	312-766-3200
NJ	Edison, Affiliated Sls. Co.	201-572-0777

VICLAN, 1105 W. Morena Blvd., San Diego, Cal., 92738, Tel: 714-276-9470, TWX: 910-335-1264; Empl.: 80; Minimum order: $25

For info on price: J. Waldal; Application info: B. Wiener; Customer service: M. L. Seaver; Delivery info: L. Bates

Products manufactured: Capacitors, Fixed, Filters, Resistors

Local Sales Offices & Reps.

Ariz	Scottsdale, E.J. Foley & Assoc.	602-945-2665
Cal	Newport Beach, Mission Mktg. Group	714-833-1802
Cal	Palo Alto, Brooks Tech. Group	415-328-3232
Conn	Washington Depot, Kanan Assoc.	203-868-0513
Fla	Clearwater, Lynch Gentry Assoc.	813-443-2697
Ill	Glenview, Crimson Engr. Co.	312-724-1780
Ind	Indianapolis, R.H. Newsom Assoc.	317-849-4442
Md	Baltimore, Compar Chesapeake	301-484-5400
Mass	Reading, Kanan Assoc.	617-944-8484
NJ	Clifton, Compar New York	201-546-3660
NJ	Haddonfield, Sunday O'Brien	609-429-4013
NY	Camillus, Howard C. Murray & Assoc.	315-487-0634
NC	Winston-Salem, Murcotta Corp.	919-723-1002
Tex	Dallas, Merino Sls. Co.	214-239-9719
Wash	Bellevue, SD-R2	206-747-9424
EXP:	Jamaica, Materials for Elctrns.	212-322-9400

VICON®

VICON INDUSTRIES INC., 130 Central Ave., Farmingdale, N.Y., 11735, Tel: 516-293-2200; Empl.: 115

Customer service: Sls. Dept.

Free literature available: Flyers; Catalogs; Short Form Catalogs; Data Sheets

Products manufactured: Television Systems & Equipment Closed-Circuit

Local Sales Offices & Reps.

Cal	N. Hollywood, Mike Stobin Co.	213-983-1555
Cal	Redwood City, Sinai-Johnson	415-365-6263
Colo	Denver, Ron Bowen & Assocs.	303-744-2501
Ga	Atlanta, J.E. Joyner & Assocs.	404-691-1776
Ill	Oak Park, Denco Sls. Co.	312-848-4244
Ind	Ft. Wayne, Norm Hoemig Sls. Co.	219-747-0826
Md	Baltimore, Commercial Video Reps	301-235-9120
Mass	Needham, Piper Assocs.	617-449-1144
Mich	Detroit, Burcaw Co. & Assocs.	313-533-7700
Minn	St. Paul, Skor	612-645-6461
Mo	Ellisville, J. L. Grunder Co.	314-227-7558
Nm	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Binghamton, Rayben Sls. Co.	607-724-1734
NY	Freeport, Vaughan Sls.	516-546-4141
Ohio	Columbus, Weller Elctrn. Sls.	614-885-7819
Ore	Portland, Earl & Brown Co.	503-245-2283
Tex	Dallas, Techno Assocs.	214-357-9213

Advertisment

VICON offers a complete line of CCTV accessories including pan and tilt drives, scanners, lenses, switchers, video signal equipment, enclosures, mounting and consoles.

VICTOR COMPTOMETER CORP., 3900 N. Rockwell St., Chicago, Ill., 60618, Tel: 312-539-8200; Empl.: 7,500

Free literature available: Victor 5010 Data Terminal describes compact, low-cost stand alone printer. Series 3600 gives benefits of statistical electronic printing calculator.

Products manufactured: Calculators, Electrical & Electronic, Comm. Systems, Printers, Underwater Communication, Detection, Navigation, etc. Equipment

Local Sales Offices & Reps.

Ala	Birmingham	205-252-2176
Ala	Mobile	205-476-2245
Ariz	Phoenix	602-267-7533
Ark	Little Rock	501-376-0505
Cal	City of Industry	213-965-4961
Cal	Long Beach	213-426-8892
Cal	Los Angeles	213-385-0261
Cal	Oakland	415-562-9741
Cal	Sacramento	916-441-3156
Cal	San Diego	714-283-7001
Cal	San Francisco	415-583-6250
Cal	Santa Clara	408-244-1100
Cal	Van Nuys	213-787-2530
Colo	Denver	303-266-3291
Conn	Hartford	203-265-6741
Del	Wilmington	302-764-7070
Fla	Hallandale	305-925-3356
Fla	Jacksonville	904-396-7751
Fla	Orlando	305-841-9251
Ga	Atlanta	404-874-3846
Haw	Honolulu	808-847-0831
Ill	Bensenville	312-595-1310
Ill	Chicago	312-527-0800
Ind	Indianapolis	317-635-1336
Ind	South Bend	219-287-2348
Kans	Wichita	316-942-1403
Ky	Louisville	502-458-5381
La	Baton Rouge	504-927-4180
La	Metarie	504-831-2601
Md	Towson (Baltimore)	301-821-6710
Mass	Boylston	617-869-2126
Mass	Waltham (Boston)	617-890-3800
Mich	Burton	313-743-7130
Mich	Kentwood	616-698-6910
Mich	Southfield (Detroit)	313-355-5330
Minn	Mendota Heights	612-454-8600
Mo	Kansas City	816-842-7966
Mo	St. Louis	314-535-9900
Neb	Omaha	402-393-8228
NJ	Union (Newark)	201-687-4700

NM	Albuquerque	505-345-4545
NY	Albany	518-434-8197
NY	Baldwin	516-868-3230
NY	Buffalo	716-838-5100
NY	Elmsford	914-592-5941
NY	New York	212-752-7330
NY	Rochester	716-288-0860
NY	Syracuse	315-437-1344
NC	Charlotte	704-375-7708
NC	Raleigh	919-851-1566
Ohio	Akron	216-644-8861
Ohio	Cincinnati	513-984-1060
Ohio	Cleveland	216-621-7120
Ohio	Columbus	614-263-8806
Ohio	Dayton	513-298-5277
Ohio	Toledo	419-475-4659
Ore	Portland	503-646-0535
Pa	Mechanicsburg (Harrisburg)	717-761-3121
Pa	Philadelphia	215-533-9200
Pa	Pittsburgh	412-343-4033
RI	Cranston (Providence)	401-944-8300
Tenn	Memphis	901-324-5551
Tenn	Nashville	615-383-9151
Tex	Dallas	214-631-5430
Tex	Fort Worth	817-924-3284
Tex	Houston	713-782-8964
Tex	San Antonio	512-227-6321
Utah	Salt Lake City	801-328-9787
Va	Arlington	703-527-1060
Va	Falls Church	703-573-0550
Va	Norfolk	804-583-4511
Va	Richmond	703-359-4091
Wash	Bellevue	206-624-7980
Wash	Spokane	509-327-9541
WVa	Charleston	304-343-0193
Wisc	Brookfield (Milwaukee)	414-781-8260

VICTOR WIRE & CABLE CORP., 3601 Holdrege Ave., Los Angeles, Cal., 90016, Tel: 213-870-9933; Empl.: 30
p. 2•2066,2067

Customer service: J. Vore

Products manufactured: Cable Assemblies & Harnesses, Cable, Wire, Wire Shielding

VICTOREEN INSTRUMENT DIV., 10101 Woodland Ave., Cleveland, Ohio, 44104, Tel: 800-321-9990, TWX: 810-421-8287; Empl.: 300; Minimum order: $25
p. 1•2358,2359; p. 2•1065,1572-1581,2358,2359

For info on price: G. Winfield; Application info: J. Baker; Customer service: R. White; Delivery info: W. Becerra

Free literature available: Comprehensive short form catalog of high voltage, high resistance, high power electronic components.

Products manufactured: Arresters, Electrical Surge, Lightning, Detectors, Diodes, Resistors, Seals, Spark Gaps, Suppressors, Terminals, Tubes

Local Sales Offices & Reps.

Cal	Fullerton, Victoreen Instr. Div.	714-870-1524
Ill	Mt. Prospect, Contemporary Science, Inc.	312-255-3793
Ill	Westchester, W. G. Brouillette & Assoc.	312-345-6500
Mass	Canton, Victoreen Instr. Div.	617-227-6724
NJ	Mercerville, Victoreen Instr. Div.	212-744-7646
Ohio	Cleveland, Victoreen Instr. Div.	216-795-8200
Tenn	Chattanooga, Victoreen Instr. Div.	404-577-2736
Tex	Richmond, Victoreen Instr. Div.	713-342-3018
Va	Newport News, Victoreen Instr. Div.	703-548-8446

VICTORY ENGRG. CORP., Victory Rd., Springfield, N.J., 07081, Tel: 201-379-5900, TWX: 710-983-4430; Empl.: 300; Minimum order: $25

For info on price: J. Bacek; Application info: B. Jacobs; Customer service: G. Theile; Delivery info: J. Bacek

Products manufactured: Bolometers, Bridges, Controls/Control Eqpt., Detectors, Kits, Breadboarding (For Engineers), Monitors, Probes, Resistors, Thermistors

Local Sales Offices & Reps.

Ala	Huntsville	205-881-9270
Ariz	Phoenix	602-279-1221
Cal	Los Angeles	213-651-4050
Cal	Palo Alto	415-321-7041
Colo	Denver	303-222-5645
Conn	Hamden	203-281-1331
Fla	Clearwater	813-531-5513
Fla	Miami	305-624-5832
Fla	Orlando	305-275-1132
Ga	Atlanta	404-876-1591
Ill	Chicago	312-286-1500
Ind	Fort Wayne	219-743-1586
Ind	Indianapolis	317-635-8951
Md	Towson	301-825-9637
Mass	Waltham	617-893-2850
Mich	Farmington	313-474-8300
Minn	Minneapolis	612-881-6683
NJ	Bergenfield	201-384-3643
NY	Rochester	716-586-0468
Ohio	Cincinnati	513-791-2513
Ohio	Cleveland	216-291-2600
Ohio	Columbus	614-236-8619
Ohio	Dayton	513-223-2652
Pa	King of Prussia	215-265-0634
Pa	Pittsburgh	412-781-3112
Tex	Dallas	214-363-1671
Tex	Houston	713-621-3760
Wash	Seattle	206-783-3423
EXP:	New York, N.Y.	212-679-1300
FOR:	Can., Montreal	514-336-4500

VIDAIRE ELECTRONICS MFG., 150 Buffalo Ave., Freeport, N.Y., 11520, Tel: 516-623-6696; Empl.: 20; Minimum order: $25

For info on price: M. Shapiro; Application info: G. Miller; Customer service: B. Knight; Delivery info: B. Knight

Free literature available: #C-26 Catalog All Electronic Products CN-71 Catalog Phono Cartridges and Needles

Products manufactured: Antennas, Cable, Comm. Systems, Converters, Couplers, Filters, Handsets, Chestsets, Headphones, Headsets, Etc., Meters, Microphones, All Kinds, Mixers, Phonographs, Parts & Accessories, Power Supplies, Rectifiers, Speaker Systems, Speakers, Tapes, Electrical Insulation, Testers

Local Sales Offices & Reps.

Ala	Birmingham, J. F. Russell Sls. Co.	205-871-8287
Cal	Burbank, Michael Ross Assoc.	213-842-2104
Cal	Burlingame, Carelli-Ema	415-697-6286
Cal	Van Nuys, Art Szerlip Sls Co.	213-782-1765
DC	Washington, Lenau SAssoc.	301-229-7333
Fla	Port Charlotte, W. F. Hemminger Co.	813-625-6050
Ga	Atlanta, H. W. Phillips Co.	404-237-7564
Ill	Wilmette, J. Wasserman Assoc.	312-256-3566
Ind	Indianapolis, P. Stone Sls. Co.	317-257-9777
La	New Orleans, Crockett Sls. Co.	
Md	Mitchellville, Lienau Assoc.	301-262-1709
Md	Rockville, Lenau Assoc.	301-770-6800
Mass	Northboro, W.B. Pray Sls.	617-393-3434
Mich	Bloomfield, S. F. McMechan	313-852-4308
Minn	St. Paul, Carl-M Co.	612-699-8004
Mo	Raytown, M. Taraski	816-358-1442
NY	W. Seneca, D. Evans	716-675-7288
NC	Charlotte, H. W. Phillips Co.	704-394-5544
Ohio	St. Mary's, REPP Co.	419-392-4724
Ore	Portland, J. V. Belusko Co.	503-222-4279
Pa	Bethlehem, Les Benner	215-865-3014
Pa	Broomall, Lienau Assoc.	215-356-4210
Pa	Pittsburgh, Tanner Co.	412-561-4687
Tenn	Memphis, Crockett Sls. Co.	901-388-5410
Tex	Dallas, Crockett Sls. Co.	214-748-8209
Va	Charlottesville, Lienau Assoc.	703-295-5234
Va	Great Falls, Lienau Assoc.	703-759-3128
Va	Winchester, Lienau Assoc.	703-662-6467
EXP:	New York, NY, Singer Prods. Co.	212-432-1400

VIDAR AUTODATA INC., 265 N. Whisman Rd., Mt. View, Cal., 94043, Tel: 415-965-3050; Empl.: 125

For info on price: W. Klees; Application info: M. Jacobs; Customer service: C. Chandler; Delivery info: W. Klees

Free literature available: Autodata Eight Brochure - Fully describes the disign and application of the Autodata Eight microprocessor - based monitor/alarm/control system. Ordering and option information is fully detailed.

Products manufactured: Converters, Data Acquisition & Reduction Systems, Data Loggers, Meters, Monitors, Signal Conditioners & Equipment

Local Sales Offices & Reps.

Colo	Lakewood, Figaro-Klebba Assoc.	303-466-8228
Conn	Glastonbury, Instr. Reps.	203-633-0777
Ga	Atlanta, Vidar Corp. District Off.	404-457-2497
Ill	Chicago, Pivan Engrg.	312-539-4838
Ind	Indianapolis, Pivan Engrg.	317-253-1681
Kans	Mission, Pivan Engrg.	913-722-1030
Mass	Lexington, Instr. Reps.	617-861-8620
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Pivan Engrg.	612-537-4501
Mo	St. Louis, Pivan Engrg.	314-567-3636
NJ	Haddonfield, Dyna Rep	609-795-1700
NM	Albuquerque, Trembly Assoc.	505-293-4444
NY	East Syracuse, Ossman Instrs.	315-437-6666
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Austin, Crockett Southwest Co.	512-451-8269
Tex	Dallas, Crockett Southwest Co.	214-251-1776
Va	Alexandria, Dyna Rep. Co.	703-354-1222
Wash	Seattle, R.S. Drake	206-763-2755
Wisc	Brookfield, Pivan Engrg.	414-786-1940
FOR:	Can., Calgary, Alberta, Allan Crawford Assoc.	403-261-0780
FOR:	Can., Longueuil, Que., Allan Crawford Assoc.	514-670-1212
FOR:	Can., Mississauga, Ont., Allan Crawford Assoc.	416-678-1500
FOR:	Can., Ottawa 3, Ont., Allan Crawford Assoc.	613-725-3354

VIDCO, INC., 8888 S.W. Canyon Rd., Portland, Ore., 97225, Tel: 503-292-4104; Empl.: 4

Customer service: C. B. Gibson, Jr.

Products manufactured: Converters

Local Sales Offices & Reps.

Ala	Huntsville, Lee Assocs.	205-533-5896
Ariz	Phoenix, R. A. Mayes Co.	602-279-5243
Cal	Costa Mesa, Marble Assocs.	714-540-6391
Cal	Mountain View, Gado Instrument Sls.	415-961-2222
Cal	San Diego, Mesa Engrg. & Sls.	714-278-8021
Colo	Boulder, R. A. Mayes Co.	303-444-0782
Fla	Winter Haven, Lee Assocs.	813-294-5815
Ga	Chamblee, Lee Assocs.	404-457-7117
Ind	Indianapolis, R. A. Mayes Co.	317-243-6681
Md	Rockville, Mesa	
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Minn	St. Louis Park, R. A. Mayes Co.	612-920-7080
NJ	Cinnaminson, Mesa	609-786-0284
NM	Albuquerque, R. A. Mayes Co.	505-292-2330
NY	DeWitt, DB Assocs.	315-446-0220
NY	Huntington Station, E. P. Nelson	
NC	Raleigh, Lee Assocs.	919-782-7541
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Ohio	Dayton, Electro Sls. Assocs.	513-426-5551
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tex	Houston, R. A. Mayes Co.	713-461-5385
Tex	Richardson, R. A. Mayes Co.	214-235-3043
Utah	Centerville, R. A. Mayes Co.	801-292-6781
Wash	Seattle, Underwood Assocs.	206-242-7200

VIDEO RESEARCH CORPORATION, 6985 Garden Rd., Riviera Beach, Fla., 33404, Tel: 305-842-2867; Empl.: 85; Minimum order: $50

Customer service: V.A. Ratner

Products manufactured: Comm. Systems, Data Acquisition & Reduction Systems, Decoders, Demodulators, Editing Equipment, Tape, Generators, Heads, Recording Playback, Erase, Meters, Monitors, Recorders, Tape Recording Accessories, Tape Search Equipment

VIGOR CO., Div. of Jadow, B. & Sons, Inc., 53 W. 23 St., New York, N.Y., 10010, Tel: 212-741-9500; Empl.: 95; Minimum order: $10

For info on price: J. Leibsohn 212-741-9545; Application info: H. C. Jadow 212-741-9509; Customer service: J. Leibsohn 212-741-9545; Delivery info: J. Leibsohn 212-741-9545

Free literature available: Aron Alpha adhesive - cyanoacrylate adhesive; Instant Locksall - Locking Compound; Instant Wood Bonder - Bonds wood, leather and porous material; Arontite - Sealant; Tweezers; Pliers.

Products manufactured: Adhesives (All Types), Cleaners, Ultrasonic, Drills & Accessories, Hand & Power, Pliers, Scissors, Screwdrivers, Tools, Tweezers, Hand & Vacuum, Wrenches

Local Sales Offices & Reps.

Cal	Costa Mesa	213-645-4033
Ga	College Pk.	404-763-3369
Ill	Chicago	312-282-4366
NY	NY	212-741-9500

VIKING INDS., INC., 9324 Topanga Cyn Blvd., Chatsworth, Cal., 91311, Tel: 213-882-6275, TWX: 910-494-2094; Empl.: 650

For info on price: T. Meehan 213-341-4330; Customer service: B. Mendell; Delivery info: J. Prideaus

Free literature available: "The Pushover" and Vitel "F" , Low cost termination tool and standard format 50 contact solderless connector. "Thorkom"-Low cost miniature circular connector series, "Viking - Printed Circuit and Packaging devices for commercial & military applications.", "Viking - Underwater Connectors", "Vitel - Miniature Ribbon Connectors" - most intensively tested connector for telephone industry., "Vipower" - Heavy Duty electrical connectors for commerical, industrial & military application., "Viking - Relay Sockets" and "Relay and Socket Selector", "Systems Installation Hardware" - Terminal covers, vibration isolators, line supports, brackets, "Flip Loc".

Products manufactured: Clamps & Clips, Connectors, Seals, Services, Assembly, Production & Test, Testers

Local Sales Offices & Reps.

Ala	Huntsville, REP	205-881-9270
Ariz	Phoenix, Zeus	602-258-7519
Cal	Anaheim, Lo Dan	213-924-1691
Cal	San Carlos, Lo Dan	415-592-4600
Cal	San Diego, Lo Dan	714-279-6383
Colo	Denver, Zeus	303-770-4400
Conn	No. Haven, Forsberg Sls.	203-239-5111
Fla	Pompano Beach, V.G. Sales	305-941-5544
Fla	Winter Park, V.G. Sales	305-831-8688
Ga	Tucker, Rep, Inc.	404-938-4358
Ill	Westchester, Wasson-Gallagher Co.	312-261-7517
Ind	Indianapolis, Advanced Comp. Sls.	317-545-6441
Md	Rockville, Mechtronic Sls.	301-340-2130
Mass	Brockton, Forsberg Sls.	617-522-6300
Mass	Wakefield, Viking Inds.	617-245-4110
Mich	Grand Rapids, J. L. Montgomery & Assocs.	616-774-9308
Mich	Southfield, J. L. Montgomery & Assocs.	313-358-2616
Minn	Minneapolis, ECR, Inc.	612-831-4548
Mo	Blue Springs, Chesco	816-229-1404
Mo	St. Charles, Chesco	314-946-6677
NJ	Keasbey, ADDEM 2	516-567-5900
NM	Albuquerque, ZEUS, Inc.	505-256-9831
NY	Long Island, ADDEM 1	516-567-5900
NY	Rochester, Electra Sls.	716-436-4030
NY	Syracuse, Electra Sls. Corp.	315-455-5783
NC	Smithfield, Byrd & Barbour Sls.	919-934-8136
Ohio	Cincinnati, R. Makin Assocs.	513-232-5588
Ore	Beaverton, N. R. Schultz Co.	503-643-1644
Tex	Dallas, J. B. Guenthere	214-691-8500
Tex	Houston, J. B. Guenthere	713-468-0232
Utah	Salt Lake City, Zeus	801-486-2317
Wash	Bellevue, N. R. Schultz Co.	206-454-0300

IKING WIRE CO., INC., Shelter Rock Rd., Box 104, Danbury, Conn., 06810, Tel: 203-744-4600, TWX: 710-456-1217; FSC No: 51777; Empl.: 175; Minimum order: $100

For info on price: R.E. Murray Ext. 28; Application info: W.W. Key Ext. 12; Customer service: R.E. Murray Ext. 28; Delivery info: T. Nassif Ext. 23

ree literature available: Price list of product description Magnet wire data chart.

roducts manufactured: Wire

ocal Sales Offices & Reps.

Cal	Chatsworth, Magnet Wire Sls. Co.	213-882-7620

Advertisment

Viking Wire manufactures round film insulated copper magnet wire, 23 thru 56 ga. A.W.G. - All popular insulations including - Enamel, Polyurethane, Pyre M.L., Formvar Bondables, Isonel (Polyester) with special films made to your order. Order to NEMA, MIL, or your specification.

IRGINIA PANEL CORP., Box 1106, 1400 New Hope Rd., Waynesboro, Va., 22980, Tel: 703-942-8376, TWX: 710-839-0406; Empl.: 60 .... p. 2•1067

roducts manufactured: Boards, Plug-In, Boards, Programming, Connectors, Cords, Jacks (All Types), Jumpers, Matrices, Computer, Panels, Services, Assembly, Production & Test, Tools

ocal Sales Offices & Reps.

Cal	West Lake Village, J. E. Taylor Jr.	213-889-0748
Ind	Indianapolis, A.A. Billian Co.	317-253-3134
Ky	Louisville, W. G. Hudgens	502-896-6611
Md	Silver Spring, M.L. Councell	301-587-1755
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NY	Huntington, L.I., Hansen Assocs.	516-692-4688
Tex	Mesquite, Spectra Sls.	214-234-3600
Va	Norfolk, M.L.Councell Assoc.	703-583-0522
Va	Richmond, M.L.Councell Assoc.	703-282-6533

VISIDYNE INC., 19 Third Ave., Northwest Industrial Park, Burlington, Ma., 01803, Tel: 617-273-2820; Empl.: 32

For info on price: D. H. Ainslie; Application info: D. H. Ainslie; Customer service: J. Eichel; Delivery info: J. Eichel

Products manufactured: Readers

Local Sales Offices & Reps.

Ala	Huntsville, Clark Assocs.	205-536-6366
Cal	Santa Clara, Applied Microfilm	408-249-1364
Ill	Evanston, Microsystems Inc.	312-864-1454
Mass	Boston, C-O-M Svc. Bureau	617-357-5715
Mass	Burlington, Visidyne	617-273-2820
Mass	Cambridge, Applied Microfilm	617-491-0830
Minn	Minneapolis, Northwest Micromation Sys.	612-332-5742
Neb	Omaha, Standard Blueprint Co.	402-341-7890
NJ	Paramus, Datamation Sys.	201-343-2411
NJ	Turnersville, Microfilm Analysts Co.	609-227-3366
Ohio	Mansfield, D. Barr	419-884-2031
Va	Norfolk, Micro Labs	703-627-8906

VISHAY RESISTIVE SYSTEMS GRP., Vishay Intertechnology Inc., 63 Lincoln Hwy., Malvern, Pa., 19355, Tel: 215-644-1300, TWX: 510-668-8944; Empl.: 500; Minimum order: $50 .... p. 2•1571,1687

For info on price: I. Yeager; Application info: R. Grasso; Customer service: I. Yeager; Delivery info: I. Yeager

Free literature available: Designer catalogs and detailed application bulletins along with an "In-Plant Station" bulletin that outlines how to build precision resistors in the users facility.

Products manufactured: Attenuators, Bridges, Decade Boxes, Dividers, Networks, Potentiometers, Resistors, Standards

Local Sales Offices & Reps.

Ala	Huntsville, F M Assoc. Ltd.	205-536-9990
Ariz	Scottsdale, Runyon Co., Inc.	602-959-6060
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Cal	Santa Clara, Westrep	408-984-0350
Colo	Englewood, Checkmate Sls.	303-771-4920
Conn	North Haven, Comp Rep Assoc.	203-239-9762
Fla	Boca Raton, Conley Assocs. Inc.	305-395-6108
Fla	Orlando, FM Assocs.	305-851-5710
Fla	Oviedo, Conley Assocs. Inc.	305-365-3283
Fla	Tampa, Conley Assocs. Inc.	813-933-3183
Ill	Rolling Meadows, Lightner Assocs.	312-398-3000
Kans	Shawnee Mission, Techn. Sls.	913-888-3330
Md	Lutherville, J.A. Dougherty Sls.	301-321-7890
Mass	Needham, Comp Rep	617-444-2484
Mich	Jackson, N. Scroggs	517-750-1170
Mich	Oak Park, W. Spenser Co.	313-398-8005
Minn	Mpls., Comstrand, Inc.	612-560-5300
Mo	Ferguson, Technical Sls. Assoc.	314-725-5361
NJ	Flanders, K & R Engrg. Sls. Co.	201-584-5235
NM	Albuquerque, Data Handling	505-268-4364
NY	E. Aurora, Harries & Kershaw	716-652-1221
NY	Fayetteville, Harries & Kershaw	315-637-9871
NY	Webster, Harries & Kershaw	716-671-6365
NC	Greensboro, F. M. Assocs.	919-294-2754
Ohio	Cleveland, A. H. Baier	216-461-6161
Ohio	Dayton, A H Baier Co. & Assoc.	513-276-4128
Pa	Westchester, D. Curley Assocs.	215-647-4500
Tex	Seabrook, Stolle-Hamilton	713-223-5127
Wash	Seattle, F. Jackson	206-782-2211

VISHAY INTERTECHNOLOGY, INC., Reon Resistor Div., 63 Lincoln Hwy, Malvern, Pa, 19355, Tel: 215-644-1300; QPL No: Multiple; Empl.: 25; Minimum order: $50 .... p. 2•1687

For info on price: I. Yeager; Application info: R. Grasso; Customer service: I. Yeager; Delivery info: I. Yeager

Free literature available: 4 page fold-out bulletin describing electrical, mechanical, and application features.

Products manufactured: Potentiometers

Local Sales Offices & Reps.

Ala	Huntsville, F M Assocs.	205-536-9990
Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Pico Rivera, Westrep	213-949-2551
Cal	San Diego, Westrep	714-276-0751
Cal	Santa Clara, Westrep	408-984-0350
Colo	Englewood, Checkmate Sales	303-771-4920
Conn	N. Haven, Comp. Rep. Assoc.	203-239-9762
Fla	Boca Raton, Conley Assocs.	305-395-6108
Fla	Orlando, F M Assocs.	305-851-5710
Fla	Oviedo, Conley Assocs.	305-365-3283
Fla	Tampa, Conley Assocs.	813-933-3183
Ill	Rolling Meadows, Lightner Assocs.	312-398-3000
Kans	Shawnee Mission, Technical Sales	913-888-3330
Md	Lutherville, J. A. Dougherty Sls. Co.	301-321-7890
Mass	Needham, Comp. Rep. Assoc.	617-444-2484
Mich	Jackson, Norwood Scroggs Co.	517-750-1170
Mich	Oak Park, Willard Spenser Co.	313-398-8005
Minn	Minneapolis, Comstrand, Inc.	612-560-5300
Mo	Ferguson, Technical Sales Assocs.	314-725-5361
NJ	Flanders, K & R Engrg. Sls. Co.	201-584-5235
NM	Albuquerque, Data Handling Co.	505-268-4364
NY	East Aurora, Harries & Kershaw	716-652-1221
NY	Fayetteville, Harries & Kershaw	315-637-9871
NY	Webster, Harries & Kershaw	716-671-6365
NC	Greensboro, F M Assocs.	919-294-2754
Ohio	Cleveland, A. H. Baier Co. & Assoc.	216-461-6161
Ohio	Dayton, A. H. Baier Co. & Assoc.	513-276-4128
Pa	West Chester, Dick Curley Assocs.	215-692-4470
Tex	Seabrook, Stolle-Hamilton Co.	713-334-1909
Wash	Seattle, F. Jackson Co.	206-782-2211

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VISUAL INFORMATION INSTITUTE INC., Box 33, Xenia, Ohio, 45385, Tel: 513-372-8637; FSC No: 27432; Empl.: 9

For info on price: J.H. Harshbarger 513-372-8637; Application info: J.H. Harshbarger 513-372-8637; Customer service: P.R. Lewis 513-372-8635; Delivery info: P.R. Lewis 513-372-8635

Products manufactured: Television Systems & Equipment Closed-Circuit, Test Equipment

Local Sales Offices & Reps.

Cal	Millbrae, Ashby Assocs. of N. Cal.	415-692-4442
Cal	Pasadena, A-F Sales Engrg.	213-681-5631

Advertisment

Specializing in test instrumentation for all television scan rates, interlace ratios, and formats including RGB, sequential, and encoded color as well as high resolution monochrome. Standard products offered for both display evaluation and signal transmission testing. Customer requirements for modified or special instruments met economically and with short delivery cycles.

V.J. ELECTRONICS, Div. Glenair Inc., 1211 Air Way, Glendale, Cal., 91201, Tel: 213-247-6000, TWX: 910-497-2066; FSC No: 06324; Empl.: 325

Customer service: R. Platz

Products manufactured: Testers

Local Sales Offices & Reps.

Ala	Huntsville, Brandel-Stephens Co.	205-883-0445
Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Downey, Buffa Co.	213-923-4618
Cal	Glendale, Electro-Mech Prods.	213-848-0922
Cal	San Diego, Earle Assocs.	714-278-5441
Cal	Santa Clara, Nova-Tronix Elec. Sls.	408-243-9530
Colo	Englewood, Todd Assocs.	303-761-7801
Conn	Branford, W. McCoy Co.	203-488-2012
Fla	Orlando, Brandel-Stephens Co.	305-425-3202
Ga	Atlanta, Brandel-Stephens Co.	404-261-7579
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Marsten Sls. Co.	312-775-6611
Ind	Greenwood, Valentine-Schillinger Assoc.	317-888-2260
Ind	South Bend, Valentine-Schillinger Assoc.	219-291-6258
Md	Silver Spring, Carwithen Assocs.	301-589-9112
Mich	Plymouth, Romarc	313-455-0300
Minn	Minneapolis, Nygaard Sls.	612-881-3727
Mo	Kansas City, Harris-Hanson Co.	816-444-9494
Mo	St. Louis, Harris-Hanson Co.	314-432-3611
NJ	Haddonfield, T. Mills Co.	609-429-1005
NJ	Wayne, GT Assocs.	201-694-6040
NM	Scottsdale, Goodreau Assocs.	602-994-9909

NY	Buffalo, Telesco Assocs.	716-834-1026
NY	Levittown, GT Assocs.	516-731-3449
NY	Liverpool, Telesco Assocs.	716-872-6417
NY	Rochester, Telesco Assocs.	716-271-3780
Ohio	Cleveland, D. Steffen & Assocs.	216-461-8333
Ohio	Dayton, A.D. Dircksem & Assoc.	513-256-0351
Tex	Houston, AID Elctrns.	713-777-3882
Tex	Irving, AID Elctrns.	214-259-4761
Wash	Redmond, Barrett Sls. Northwest Ltd.	206-885-6991

VOICE IDENTIFICATION INC., Box 714, Somerville, N.J., 08876, Tel: 201-526-3408; Empl.: 6

Customer service: W. E. Hughes

Free literature available: Illustrated brochures and specification sheets describing sound spectrograph and telephone number decoder/register.

Products manufactured: Analyzers, Decoders, Tape Search Equipment, Testers

VOLTEK INC., 407 N. Maple Dr., Beverly Hills, Cal., 90210, Tel: 213-272-7991; Empl.: 8; Minimum order: $25

Products manufactured: Cable, Connectors, Converters, Power Supplies, Transformers

Local Sales Offices & Reps.

Ariz	Phoenix, C.W. Fowler Co.	602-274-5537
Cal	Chula Vista, C.W. Fowler Co.	714-422-5408
Cal	Inglewood, C.W. Fowler Co.	213-678-5211
Cal	Menlo Park, C.W. Fowler Co.	415-322-5374
Colo	Denver, C.W. Fowler Co.	303-744-9595
Ind	Ft. Wayne, Scott Elctrns.	219-743-1586
Ind	Indianapolis, Scott Elctrns.	317-897-9976
Ky	Louisville, Scott Elctrns.	502-583-3220
Mass	Burlington, Lancer Assocs.	617-272-6445
Mich	Plymouth, Scott Elctrns.	313-455-2440
Minn	Minneapolis, A.J. Warner Co.	612-729-7371
NM	Albuquerque, C.W. Fowler Co.	505-299-7676
Ohio	Cincinnati, Scott Elctrns.	513-791-2513
Ohio	Cleveland, Scott Elctrns.	216-291-2600
Ohio	Columbus, Scott Elctrns.	614-236-8610
Ohio	Dayton, Scott Elctrns.	513-294-0539
Okla	Tulsa, T.J. Ray Co.	918-627-1515
Pa	Camp Hill, Beil & Whitaker	717-233-1254
Pa	Harrisburg, Beil & Whitaker	717-652-1084
Pa	Orefield, Beil & Whitaker	215-395-0150
Pa	Pittsburgh, Scott Elctrns.	412-781-3112
Pa	Reading, Beil & Whitaker	215-779-2610
Va	Alexandria, Potomac Elctrns.	703-836-1630
Wash	Bellevue, C.W. Fowler Co.	206-454-8600

VOLTEX CO., INC., 115 Marine St., Farmingdale, N.Y., 11735, Tel: 516-CH 9-2336; FSC No: 3611; Empl.: 25; Minimum order: $25

For info on price: N. Rothenberg; Application info: N. Rothenberg; Customer service: S. Vogel; Delivery info: S. Vogel

Products manufactured: Controls/Control Eqpt., Current Sources, Drivers, Solenoid, Filters, Meters, Monitors, Oscilloscopes, Power Supplies

Local Distributors

Cal	Costa Mesa, Cen-Tec Sls., 1857 Parkglen Circle	714-645-9157
Mass	Reading, Champagne Assocs., 2 Linden St.	617-944-3011
Minn	New Brighton, Dalska Sls., Box 12751	612-631-2941

Advertisment

Voltex manufactures and designs a complete line of standard and custom power supplies and systems. Inexpensive, reliable, OEM power system requirements are our forte. AC to DC power supplies, DC-DC convertors, DC-AC invertors, switching regulators and power supplies, SCR regulator and pre-regulated power supplies, high power three phase input power supplies, and multi-output regulated systems are available or can be designed to meet YOUR requirements. Send us your requirements for a prompt quotation.

VOLTRONICS CORP., West St., E. Hanover, N.J., 07936, Tel: 201-887-1517, TWX: 710-986-8253; FSC No: 18736; QPL No: Multiple; Empl.: 60; Minimum order: $30

Customer service: Sls. Off.

Free literature available: New Sub-miniature Glass & Precision Glass & Quartz Trimmer Capacitors Catalogues Concentric Ring Air, High Frequency Trimmers Catalogue Microelectronic Subminiature Trimmer Capacitors Catalogue New Multiturn Trimmer Capacitors for Electronic Watches, Engr. Data Sheet

Products manufactured: Capacitors, Fixed, Capacitors, Variable

Local Sales Offices & Reps.

Ariz	Scottsdale, Runyon Co.	602-959-6060
Cal	Encino, EL/TEC, Inc.	213-981-9881
Cal	Mt. View, Weseloh & Assocs.	415-961-0565
Colo	Denver, Camel Elctrns.	303-757-6191
DC	Washington, M. Lader Co.	202-296-2497
Fla	St. Petersburg, Kirkwood & Associates	813-894-8240
Ill	Westchester, Gassner & Clark	312-345-4245
Ind	Fort Wayne, Gassner & Clark Co.	219-456-1675
Iowa	Hiawatha, Gassner & Clark Co.	319-393-5763
Kans	Shawnee Mission, Florence & Meyer, Inc.	913-722-5210
Mass	Natick, Wayland Engrg. Sls.	617-655-6080
Minn	St. Paul, Countryman Associates	612-645-9151
Mo	St. Louis, Florence & Meyer, Inc.	
NJ	Wallington, Comp-Tech Sls.	201-935-5454
NY	New Hyde Park, Comp-Tech Sls.	516-593-2628
NY	Syracuse, Trademark Elctrn. Assoc.	315-478-2149
Ohio	Cincinnati, F.J. Campisano Co.	513-662-1616
Ore	Portland, Western Tech. Sls.	503-224-5107
Pa	Jenkintown, Arnold Associates	215-887-7870
Tex	Richardson, Semiconductor Sls. Assoc.	214-231-6181
Va	Woodbridge, M. Lader Co.	703-494-4731
Wash	Bellevue, Western Tech. Sls.	206-454-3906
FOR:	Toronto, Ont., Vitel Elctrns.	416-622-6300
FOR:	Can., Montreal, Que., Vitel Elctrns.	514-331-7393

Local Distributors

Cal	Sunnyvale, Acacia Sls., 384 San Aleso	408-735-0100
Cal	Van Nuys, Patane Avionics, 5937 Kester Ave.	213-988-4455
Colo	Lakewood, Acacia Sls., 11111 W. 8th Ave.	303-232-2882
NY	Plainview, Fairmont Elctrns., 35 S. Service	516-694-8200

Advertisment

Complete line of precision trimmer capacitors, non-rotating, with glass, quartz, and air dielectrics, MIL-C-14409C styles. New sub-miniature trimmer for gigaherz, stripline and substrate mounting. World-wide representation. New sub-miniature sizes 40% smaller than MIL. New multiturn, high resolution trimmers for electronic watches.

VORNE INDS., INC., 5023 W. Belmont Ave., Chicago, Ill., 60641, Tel: 312-725-3077; Empl.: 12

For info on price: D. Schaeffer; Application info: A. Vorne; Customer service: D. Schaeffer; Delivery info: D. Schaeffer

Products manufactured: Counters

VTM MICROWAVE, 3225 Prairie Ave., Boulder, Colo., 80301, Tel: 303-449-6200; Empl.: 10

For info on price: A. M. Marfut; Application info: M. R. Boyd; Customer service: A. M. Marfut; Delivery info: A. M. Marfut

Free literature available: Catalog & Application Notes; New Product Data Sheets; VTM Handbook.

Products manufactured: Tubes

VU-DATA CORP., 7170 Convoy Ct., San Diego, Cal., 92111, Tel: 714-279-6572, TWX: 910-335-1586; FSC No: 24160; Empl.: 50; Minimum order: $10 ....p. 1•848-850

For info on price: H. Wardein; Application info: H. Wardein; Customer service: W. A. Kraus; Delivery info: H. Wardein

Free literature available: Product Summary Catalog; Portable Oscilloscopes; Monitor Oscilloscopes & Monitor Meters; Tape Recorder Analyzer; Oscilloscope Cameras.

Products manufactured: Analyzers, Cameras, Meters, Oscilloscopes, Probes, Tape Recording Accessories

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Instr.	205-539-4411
Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Encino, Scientific Devices-Cal.	213-872-1951
Cal	Los Alamitos, Scientific Devices-Cal.	213-598-7678
Cal	Mountain View, Scientific Devices-Cal.	415-964-4230
Cal	San Diego, Scientific Devices-Cal.	714-279-6642
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Fla	Fort Lauderdale, W.A. Brown Instrs.	305-776-4800
Fla	Fort Walton Beach, W.A. Brown Instrs.	904-243-6424
Fla	Indialantic, W.A. Brown Instrs.	305-723-0766
Fla	Orlando, W.A. Brown Instrs.	305-425-5505
Ga	Atlanta, W.A. Brown Instrs.	404-939-1674
Ill	Des Plaines, Scientific Devices-Midwest	312-297-5240
Kans	Lenexa, Scientific Devices-Midwest	913-631-3818
La	Gretna, W.A. Brown Instrs.	504-366-5766
Md	Silver Spring, Sel-Tronics	301-589-3391
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Milford, Scientific Devices-Midwest	313-363-2282
Minn	Minneapolis, Scientific Devices-Midwest	612-544-1616
Mo	St. Louis, Scientific Devices-Midwest	314-842-2535
NJ	Fairfield, KLS Assocs.	201-227-2900
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Syracuse, DB Assocs.	315-446-0220
NC	Research Triangle Park, W.A. Brown Instr.	919-489-1546
Ohio	Cleveland, Scientific Devices-Midwest	216-835-2270
Ohio	Dayton, Scientific Devices-Midwest	513-298-9904
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Ore	Beaverton, Showalter Instrs.	503-646-3004
Pa	Philadelphia, Eastern Instr. Phil.	215-927-7777
Tenn	Knoxville, W.A. Brown Instrs.	615-584-2614
Tex	Dallas, Data Mktg. Assocs.	214-661-0300
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Utah	Salt Lake City, Zeus, Inc.	801-466-4924
Wash	Bellevue, Showalter Instrs.	206-455-4922

W-F PRODUCTS, 1107 S. Pearl St., Denver, Colo., 80210

WABASH RELAY & ELCTRNS., Box 708, Wabash, Ind., 46992, Tel: 219-563-2191, TWX: 810-290-2722; Empl.: 200; Minimum order: $50 ....p. 1•1825-1836

Customer service: D. L. Snodgrass

Free literature available: Our 8 page catalog lists our standard reed relays, mercury wetted relays and solid state relays. A sampling of standard part numbers is also given.

Products manufactured: Cards, Logic, Relays, Switches, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, Mr. Engrg. Sls. Co.	602-959-5150
Cal	Los Angeles, Halbar	213-387-8283
Cal	San Mateo, Halbar	415-349-4700
Cal	Santa Ana, Calif. Elctrn. Mktg.	714-835-2702
Colo	Denver, Walter Engrg.	303-777-5585
Conn	Thomaston, N.B.S. Assocs.	203-283-5959
Fla	Ormond Beach, Tech. Mktg. Assoc.	904-672-2314
Fla	Pompano Beach, Tech. Mktg. Assoc.	305-942-0774
Ill	Palatine, M.J. Petersen Assocs.	312-358-8855
Mass	Waltham, DeVeer Sls. Co.	617-899-5900
Minn	St. Paul, Skor	612-645-6461
NJ	Clark, Dolan Assocs.	201-382-2797
NY	Rochester, Upstate Comp. Sls.	716-288-1080
Ore	Portland, J.J. Backer Co.	503-297-3777
Pa	Doylestown, Bucks Assocs.	215-348-8223
Tex	Dallas, Stevens Sales Co.	214-350-2476
Wash	Seattle, J.J. Backer Co.	206-285-1300

WABCO AEROSPACE DEPT., Swissvale P.O., Pittsburgh, PA., 15218, Tel: 412-242-5000, TWX: 710-664-2096; Empl.: 250; Minimum order: $25

For info on price: G. A. Dawes; Application info: G. A. Dawes; Customer service: P. La Hive; Delivery info: P. La Hive

Products manufactured: Display Devices/Displays, Relays

Local Sales Offices & Reps.

Ariz	Phoenix, Southwestelm Engrg., Inc.	602-993-0250

Cal	Newport Beach, W. Bert Knight Co.	714-833-8250
Cal	Santa Clara, Nova-Tronix	408-243-9530
Colo	Denver, Franklin Sls. Co.	303-922-3623
Conn	Wethersfield, Underwood Sls. Corp.	203-563-3046
Fla	Ft. Lauderdale, Tech-Rep. Assocs.	305-792-0962
Fla	Indian Rocks Beach, Tech-Rep.Assocs.	813-595-2834
Ga	Atlanta, Tech-Rep. Assocs.	404-252-9288
Ill	Des Plaines, Lincoln, Hodges & Assoc.	312-297-3810
Kans	Wichita, M.E. Bettis Co.	316-685-7441
Kans.	Shawnee Mission Ka, M.E. Bettis Co.	913-362-0722
Md	Baltimore, Chesapeake Mktg. Assoc.	301-486-3345
Mass	Chelmsford, Underwood Sls. Corp.	617-256-8191
Mich	Grand Rapids, Elko Sls. Corp.	616-949-1451
Mich	Grosse Pointe Woods, Elko Sls. Corp.	313-884-7893
Minn	Minneapolis, F.B. Hill Co.	612-941-5270
Mo	St. Louis, M.E. Bettis Co.	314-429-2099
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NJ	Keasby, Addem Group	516-567-5900
NY	Huntington Station, Addem Group	516-567-5900
Ohio	Cleveland, A.H. Baier Co.	216-461-6161
Ohio	Dayton, A.H. Baier Co.	513-576-4128
Tex	Dallas, Scott Tech. Sls.	214-352-7698
Wisc	Milwaukee, Lincoln, Hodges & Assoc.	414-542-3087
EXP:	Pittsburgh, Pa., WABCO	412-242-5000

WABER ELECTRIC, See SGL Waber Electric.

WADSWORTH ELECTRIC MFG. CO., 20 W. 11th St., Covington, Ky., 41011, Tel: 606-431-0900; Minimum order: $25

Customer service: H. C. Morrison

Products manufactured: Circuit Breakers, Connector Boxes & Strips, Power Outlet, Ducts, Wiring, Motors, Panels, Switches

Local Sales Offices & Reps.

Cal	Los Angeles, M. Brothers	213-749-7587
Cal	San Francisco, Black & Egbert Assocs.	415-282-0840
Colo	Denver, Empire Electrical Sls. Co.	303-986-1838
Conn	Meriden, MacRae-Patton, Inc.	203-238-1965
Fla	Clearwater, J.F. Graff	813-442-1734
Ga	Atlanta, J. C. White	404-938-0433
Ill	Chicago, Wadsworth Elec. Mfg. Co.	312-467-1245
Ind	Indianapolis, A.L. Clifford & Co.	317-639-5248
Kans	Overland Park, H.R. Stein	913-381-4303
Ky	Highland Heights, F.A. Thoeny	606-441-2610
La	New Orleans, S.M. Redmann, Inc.	504-486-5421
Md	Baltimore, A. E. Storrs	301-484-3887
Mass	Framingham, J.J. O'Neill	617-235-6792
Mich	Detroit, Wadsworth Elec. Mfg. Co.	313-872-0277
Minn	Minneapolis, D. T. Atkinson	612-888-6521
NJ	Fair Lawn, J.R. Barker	201-797-6354
NY	New Hartford, F. Walter Laver & Son, Inc.	315-724-0184
NC	Greensboro, A.W. Cheek	919-288-2213
Ohio	Cincinnati, T.P. Hebenstreit	513-851-5516
Ohio	South Euclid, H. I. Covitt	216-382-4473
Okla	Jenks, W.G. Parker Co.	918-299-5449
Ore	Portland, Bruce-Emmett Co.	503-235-2151
Pa	Bethel Park, D.W. Phillips	412-833-5155
Pa	Philadelphia, Wadsworth Elec. Mfg. Co.	215-627-4691
Tex	Irving, J.D. Martin Co.	214-259-7511
Wisc	Brown Deer, J.A. Cantrell	414-355-5550

WAGNER ELEC., Tung-Sol Div., 630 W. Mt. Pleasant Ave., Livingston, N.J., 07039, Tel: 201-WY2-1100, TWX: 710-994-4865 .... p. 2•1208,1209,1582

Free literature available: T-501 - Wagner high reliability metal film resistors, A-14 - tung-sol subminiature lamps, A-21 tung-sol lamps, T-439 - Digivac 1000 data sheet, T-431 - optimum contrast digital displays, T-497 - silicon rectifiers and stacks, T-410 - tung-sol photocontrols, Digivac 200 Data Sheet.

Products manufactured: Cells, Photoconductive, Photoemissive, Photovoltaic, Circuit Breakers, Diodes, Display Devices/Displays, Flashers, Lamps, Lights, Power Supplies, Rectifiers, Regulators, Relays, Resistors, Tubes

Local Sales Offices & Reps.

Ariz	Scottsdale, Inter-Mountain Engrg.	602-947-7379
Cal	El Segundo, Wagner Elec. Corp. Tung-Sol Div.	213-322-0708
Cal	Palo Alto, Held & Mollard	415-965-9321
Cal	Tustin, Orion Sls.	714-823-9687
Colo	Denver, Walter Engrg.	303-777-5585
Fla	Altamonte Springs, Semtronic Assocs.	305-831-8233
Fla	North Miami, A.J. Giammanco & Assoc.	305-891-7794
Ill	Elk Grove Village, Wagner Elec. Corp. Tung-Sol Div.	312-439-1810
Kans	Overland Park, T.L. Dowell & Assocs.	913-236-8200
Md	Baltimore, R. A. Wafer Assocs.	301-744-1133
Mass	Needham Heights, Todino Engrg.	617-444-7925
NM	Albuquerque, IMEC	505-883-9010
NC	Raleigh, A.B. Andrews & Co.	919-833-5565
Ohio	Akron, Augnat Assocs.	216-725-6087
Ore	Portland, C.K. Shanks & Assocs.	503-292-5656
Tex	Addison, Parvin Sls. Co.	214-239-9148
Tex	Houston, Paruin Sls. Co.	713-784-9900
Wash	Seattle, Underwood & Underwood	206-243-2133

WAHL CLIPPER CORP., 2902 Locust St., Sterling, Ill., 61081, Tel: 815-625-6525; Minimum order: $2

Customer service: N. H. Wallen

Free literature available: Catalog sheets describing the Iso-Tip manufactured by Wahl and accessories. Catalog sheets are 4-color.

Products manufactured: Heat Guns, Production, Soldering Accessories, Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Ariz	Phoenix, R. Fissell Co.	602-264-4031
Cal	Alhambra, C. G. Putnam Co.	213-283-0435
Cal	San Francisco, C. G. Putnam Co.	415-552-2311
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Fort Lauderdale, Unirep	305-527-1556
Ga	Atlanta, Elmar Assocs.	404-261-4345
Haw	Honolulu, G. Piety Factors, Inc.	808-839-9051
Ill	Hoffman Estates, G. Sangwin Co.	312-884-0186
Ind	Indianapolis, Electronic Reps.	317-897-9326
Md	Baltimore, EKP Assocs.	301-788-6498
Mass	Wellesley, L. Cole, Inc.	617-237-1260
Mass	West Springfield, L. Cole, Inc.	413-781-3040
Mich	Rochester, R.A. Albrecht & Co.	313-615-7081
Minn	St. Paul, C-M Co.	612-699-8004
Mo	Raytown, B & C Sls. Co.	816-358-6638
NJ	Edison, L. W. Keller & Assocs., Inc.	516-785-2826
NY	E. Syracuse, Honsinger Mktg. Assocs.	
NY	Nanuet, L. W. Keller & Assocs., Inc.	516-785-2826
NY	No. Bellmore, L. W. Keller & Assocs., Inc.	516-785-2826
Ohio	St. Marys, T. Shelby & Co., Inc.	419-394-3377
Pa	Ashton, EKP Assocs.	215-459-4517
Pa	Bethlehem, EKP Assocs.	215-691-5250
Pa	Easton, EKP Assocs.	215-258-6477
Tex	Dallas, Maynard & Gunn	214-742-2384
Tex	Houston, Maynard & Gunn	713-497-0544
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
Wisc	Brookfield, G. Sangwin Co.	414-782-3240

WAHL, WM. CORP., 12908 Panama St., Los Angeles, Cal., 90066, Tel: 213-391-7234, TWX: 910-343-6867; Empl.: 28

Products manufactured: Meters, Pyrometers

Local Sales Offices & Reps.

Ala	Odenville, L. M. Crowe Co.	205-629-5475
Alas	Anchorage, Alaska Expediters	907-279-1923
Ariz	Scottsdale, Inter-Mountain Engrg.	602-947-7379
Cal	Pasadena, RDX Corp.	213-681-3451
Cal	San Diego, RDX Corp.	714-278-6863
Cal	Sunnyvale, RDX Corp.	408-732-4500
Colo	Littleton, Radco Elctrns.	303-794-4279
Fla	St. Petersburg, L. M. Crowe Co.	813-894-0249
Ga	Atlanta, L. M. Crowe Co.	401-255-2700
Ill	South Holland, RAECO, Inc.	312-331-6001
Ind	Indianapolis, Raeco	317-257-4761
Iowa	Cedar Rapids, Mueller Sls. Corp.	319-365-1196
Kans	Overland Park, J. Shurtleff Co.	913-831-9222
Mass	Peabody, JSR Assocs.	617-532-0348
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Golden Valley, Mueller Sls. Corp.	612-544-8888
Mo	St. Louis, J. Shurtleff Co.	913-831-9222
NY	Buffalo, Seelbach & Schmitt	716-839-2300
NY	Westbury, Tech-Rep Engrg. Co.	516-997-7946
NC	Greensboro, Associated Agents	919-292-6508
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Okla	Tulsa, J. Shurtleff Co.	919-WE 6-7269
Pa	King of Prussia, Inistex	215-337-1240
Pa	Pittsburgh, L. H. Boleky Co.	412-761-8994
Tenn	Knoxville, L. M. Crowe Co.	615-693-4226
Tex	Houston, Allied Engrg. & Supply Co.	713-528-5625

Local Distributors

Ala	Odenville, Lewis M. Crowe Co., Route 1, Box 129-A	205-629-5475
Alas	Anchorage, Alaska Expediters, 3685 Arctic Blvd.	907-279-1923
Ariz	Scottsdale, Inter-Mtn. Engrg., 4533 N. Scottsdale Rd., Suite 212	602-947-7379
Cal	Pasadena, RDX Corp., 110 S. Euclid Ave.	213-681-3451
Cal	Sunnyvale, RDX Corp., 1287 Lawrence St.	408-734-4500
CaL	San Diego, RDX Corp., 8072 Engineer Rd.	714-278-6863
Colo	Littleton, RADCO Elctrns., 2552 Ridge Rd.	303-794-4279
Fla	St. Petersburg, Lewis M. Crowe Co., Box 7505	813-894-0249
Ill	So. Holland, RAECO, 550 Armory Dr.	312-331-6001
Iowa	Cedar Rapids, Mueller Sls. Corp., 1119 Wenig Rd., N.E.	319-365-1196
Kan	Overland Park, John Shurtleff Co., 7520 W. 63rd St.	913-831-9222
Mass	Peabody, JSR Assocs., 14 Raymond Circle	617-532-0348
Mich	Detroit, Comtel-Sterling Co., 17500 McNichols Rd.	313-255-1970
Minn	Golden Valley, Mueller Sls. Corp., 2420 Nevada Ave. N.	612-544-8888
NJ	Palisades Park, Tech-Rep Engrg., 116 John St. Room 1102	212-349-5943
NY	Buffalo, Seelbach & Schmitt, 13 Lincoln Rd.	716-839-2300
NC	Greensboro, Associated Agents, Box 7220	919-292-6508
Ohio	Cleveland, Comtel-Sterling Co., 5827 Mayfield Rd.	216-442-8080
Ohio	Dayton, Comtel-Sterling Co., Kett Box 2036	513-298-7573
Okla	Tulsa, J. Shurtleff Co., 3140 E. 15th St.	918-936-7269
Ore	Portland, F. B. Lee, 106 N.E. Holladay	
Pa	King of Prussia, Wistex, G. Washington Off. Bldg., 216 Goddard Blvd.	215-337-1240
Pa	Pittsburgh, L. H. Boleky Co., 534 Lincoln Ave.	412-761-8994
Tenn	Knoxville, L. M. Crowe Co., 228 Engert Rd.	205-629-5475
Tenn	Memphis, John V. Wright & Co., 3837 Marston Rd.	901-362-8344
Tex	Houston, ALLESCO, 7313 Ashcroft, Suite 204	713-771-0115
Wash	Seattle, F. B. Lee, Box 66099	206-244-7262

WAKEFIELD ENGRG., INC., Teal & Audubon Rd., Wakefield, Mass., 01880, Tel: 617-245-5900, TWX: 710-348-6713; Empl.: 240; Minimum order: $50

For info on price: B. Grafton; Application info: D. Hegarty; Customer service: B. Emery; Delivery info: B. Emery

Free literature available: COOLERS for Power Semiconductors and High Power Relays; CAT 103A on Standard Cooling Accessories/Distributor Products; CAT 13 on Forced Convection Coolers; CAT 30 on Heat Exchangers.

Products manufactured: Adhesives (All Types), Compounds, Encapsulating, Insulating, Molding, Potting, Heat Exchangers & Systems, Heat Sinks, Soldering, Testers, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

Ariz	Phoenix, Zeus, Inc.	602-253-6104
Cal	Los Altos, Recht Assocs.	415-941-0336
Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Colo	Denver, Zeus, Inc.	303-770-4400
Conn	Newtown, Gerber Sls.	203-426-3440
Fla	Ft. Lauderdale, G.F. Bohman Assocs.	305-564-3081
Fla	Orlando, G.F. Bohman Assocs.	305-855-0274
Ga	Atlanta, Electro-Mech Sls. Engrg. Co.	404-256-4414
Ill	Rolling Meadows, Sumer, Inc.	312-394-4900
Kans	Overland Park, PMA Corp.	913-381-0004
Kans	Wichita, PMA Corp.	316-522-4101
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	E. Longmeadow, Gerber Sls. Co.	413-525-3059
Mass	Waltham, Gerber Sls. Co.	617-890-8040
Mich	Grand Rapids, J.L. Montgomery Assocs.	616-774-9308
Mich	Southfield, J.L. Montgomery Assocs.	313-358-2616

Minn	Minneapolis, Nortec Sls.	612-835-7414
Mo	Hazlewood, PMA Corp.	316-264-2662
NJ	Haddonfield, Sunday-O'Brien	609-429-4013
NM	Albuquerque, Zeus, Inc.	505-268-3941
NY	Great Neck, E.R.A., Inc.	516-822-9890
NY	Skaneateles, MCK Assocs.	315-685-7122
NC	Raleigh, Electro-Mech Sls. Engrg. Co.	919-782-6452
Ohio	Columbus, T. Mulligan & Assocs.	614-457-2242
Ore	Beaverton, N.R. Schultz Co.	503-643-1644
Tenn	Nashville, Electro-Mech Sls. Engrg.	615-883-1490
Tex	Dallas, Electra III	214-243-5969
Utah	Salt Lake City, Zues, Inc.	801-466-4924
Va	Lynchburg, Burgin-Kreh	804-845-5600
Wash	Bellevue, N.R. Schultz Co.	206-454-0300

Local Distributors

Ala	Birmingham, Ack Radio Supp.	205-322-0588
Ala	Huntsville, Cramer/Ew Huntsville, 2310 Bob Wallace Ave. SW	205-539-5722
Ariz	Phoenix, Cramer/Ariz., 2643 E. University	602-263-1112
Ark	Little Rock, Carlton-Bates Co., 6821 Scott Hamilton Dr.	501-562-9100
Cal	Inglewood, Newark Elctrns. Corp., 4747 W. Century Blvd.	213-678-0441
Cal	Irvine, Cramer/L.A., 17201 Daimler St.	714-979-3000
Cal	Los Angeles, California Elec. Sply., 1911 Armacost W.	213-826-8333
Cal	San Diego, Cramer/San Diego, 8975 Complex Drive	714-565-1881
Cal	Sunnyvale, Cramer/San Fran., 720 Palomar Ave.	408-739-3011
Colo	Denver, Cramer/Denver, 5465 E. Evans Place at Hudson	303-758-2100
Colo	Denver, Newark-Denver Elctrns., 2170 So. Grape St.	303-757-3351
Conn	Westport, Newark Elctrns., 25 Sylvan Rd. South	203-226-6921
Conn	North Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Fla	Fort Lauderdale, Newark Electronics, 1360 N.W. 65th St.	305-587-2372
Fla	Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue	305-923-8181
Fla	Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214	305-894-1511
Fla	Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr.	305-855-4020
Ga	Atlanta, Ack Radio Supp.	404-351-6340
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Industrial Court	404-448-9050
Ill	Chicago, Newark Elctrns., 500 N. Pulaski Rd.	312-638-4411
Ill	Elk Grove Village, GBL Elctrns.	312-593-3220
Ill	Mt. Prospect, Cramer/Chicago, 1911 South Busse Road	312-593-8230
Ill	Palatine, Ohm/Elctrns., 645 Vermont Ave.	312-359-5500
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-423-3422
Ind	Indianapolis, Graham Elctrns., 133 S. Penn St.	317-634-8202
Ind	Indianapolis, Pioneer Standard, 6408 Castle Pl.	317-849-7300
Iowa	Cedar Rapids, Newark Elctrns.	319-362-1171
Kans	Great Bend, Radio Supply Inc., 1910 Tenth St.	316-793-3507
Kans	Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd.	913-888-4747
Kans	Salina, Radio Supply Inc., 1809 So. Broadway	913-823-6353
Kans	Wichita, Radio Supply Co., 115 Laura	316-267-5214
Md	Baltimore, Cramer/Baltimore, 922-24 Patapsco Avenue	301-354-0100
Md	Beltsville, Newark Elctrns., 10440 Baltimore	301-937-5085
Md	Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive	301-948-0110
Md	Savage, Pyttronic Ind., 8200 Wellmoor Ct.	301-792-7000
Mass	Boston, Newark Elctrns, 13A Wheeling Ave.	617-935-8350
Mass	Newton, Cramer/International, 85 Wells Ave.	617-969-7700
Mass	Woburn, Rush Inds., Inc., 122 Cummings Dr.	617-935-2400
Mich	Ann Arbor, Wedemeyer Elctrn. Supply Co., 2280 S. Ind'l. Hwy.	313-665-8611
Mich	Detroit, RS Elctrns., 12775 Lyndon St.	313-491-1000
Mich	Livonia, Cramer/Detroit, 13193 Wayne Road	313-425-7000
Mich	Livonia, Pioneer/Michigan	313-525-1800
Mich	Oak Park, Newark-Detroit Elec., Inc., 20700 Hubbell Ave.	313-548-0250
Mich	Wyoming, Newark Elctrns., 3645 Linden S.E.	616-241-6681
Minn	Edina, Cramer/Bonn, 7275 Bush Lake Road	612-835-7811
Minn	Minneapolis, Newark-Minneapolis Elec. Corp., 336 Hoover St. NE	612-331-6350
Mo	Earth City, Hall-Mark Elctrns.	304-291-5350
Neb	Lincoln, Scott Elctrns.	402-464-8308
NJ	Camden, General Radio Supply, 600 Penn St.	609-964-8560
NJ	Cherry Hill, Cramer Elctrns., 12 Springdale Rd.	609-424-5993
NJ	Kenilworth, Newark Elctrns., 303 Monroe Ave.	201-272-8410
NJ	Moonachie, Cramer/N.J., 1 Barrett Ave.	201-935-5600
NJ	Springfield, Route Electr. Inc., Echo Plaza, Rte. #22	201-379-7710
NM	Albuquerque, Cramer/N.M., 137 Vermont N.E.	505-265-5767
NY	Bohemia, Car-Lac Elctrn. Ind'l. Sls., 75 Orville Dr.	516-567-4200
NY	East Syracuse, Cramer/Syracuse, 6716 Joy Road	315-437-6671
NY	Freeport, Milgray Elctrns., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Cramer/Long Island, 29 Oser Avenue	516-231-5600
NY	Plainview, Newark Elctrns., 80 Express St.	516-822-5000
NY	Rochester, Cramer/Rochester, 3259 Winton Road South	716-275-0300
NY	Rochester, Newark Elctrns., 3000 S. Winton Rd.	716-473-6600
NC	Raleigh, Pytronic Inds., 4509 Creedmoor Rd.	919-782-6370
NC	Winston-Salem, Cramer/EW, 938 Burke Street	919-725-8711
NC	Winston-Salem, Kirkman Elctrns., Inc., 901 W. Second St.	919-724-0541
Ohio	Cincinnati, Cramer/Tri-States, 666 Redna Terr.	513-771-6441
Ohio	Cincinnati, Hughes-Peters, Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Cincinnati, Newark Elctrns., 9799 G Princeton Rd.	513-874-5115
Ohio	Cleveland, Cramer/Cleveland, 5835 Harper Road	216-248-8400
Ohio	Cleveland, Newark Electronics, 3304 E 87 St.	216-641-2800
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216-587-3600
Ohio	Cleveland, RPC Elctrns., 749 Miner Rd.	216-461-4700
Ohio	Columbus, Hughes-Peters, Inc., 481 E. 11th Ave.	614-294-5351
Ohio	Dayton, John Becker Electric Co.	513-226-1341
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Okla	Oklahoma City, Trice Wholesale Elctrns.	405-524-4411
Ore	Portland, Central Dist., 955 N.E. Union	503-234-0711
Pa	Carnegie, Pytronic Inds., 14 E. Mall Plaza	412-276-6722
Pa	Harrisburg, Pyttronic Inds. Inc., 2325 No. 7th St.	717-233-6591
Pa	Montgomeryville, Pyttronic Inds. Inc., Stump Rd., Box 433	215-643-2850
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
RI	Warwick, W.H. Edwards Co.	401-781-8000
Tex	Dallas, Cramer/Texas, 2970 Blystone Lane	214-350-1355
Tex	Garland, Newark Elctrns., 707 Easy St.	214-271-2511
Tex	Houston, Altair Co.	713-462-3029
Tex	Houston, Newark Elctrns., 6902 Harwin Dr.	713-782-4800
Tex	Richardson, Altair Co.	214-231-5166
Utah	Salt Lake City, Cramer/Utah, 391 West 2500 South	801-487-4131
Utah	Salt Lake City, Newark-Salt Lake City, 259 Crossroad Sq.	801-486-1048
Wash	Seattle, Cramer/Seattle, 5802 6th Avenue S.	206-762-5755
Wash	Seattle, Sterling Elctrns., 5608 6th Ave. So.	206-762-9100
WVa	Wheeling, RPC Electronics, 1301 Main St.	304-232-7630
Wisc	Milwaukee, Newark Electronics, 3695 N. 126th St.	414-781-2450
Wisc	Oak Creek, Cramer/Wisconsin, 430 W. Rawson Ave.	414-764-1700

WAKEFIELD ENGRG., INC. cont'd

Advertisment

COMPONENTS DIVISION: Semiconductor Cooling Products....Heat Sinks; Aluminum Extrusion Shapes; Clamps for Compression Type SCRs and Diodes with Heat Sinks or Liquid Cooled Bus Blocks; Thermal Joint Compound; Thermally Conductive Epoxies for Bonding, Coating or Casting; Forced Convection Cooling Packages; Heat Exchangers; Custom Stamped, Extruded or Copper Assemblies.

SYSTEMS DIVISION: Semiconductor and IC Life Test and Burn-in Systems & Components.

WAKEFIELD ENGRG., INC., Systems Div., Audubon Rd., Wakefield, Mass., 01880, Tel: 617-245-5900, TWX: 710-348-6713; Empl.: 250

Customer service: S. Brylinsky

Free literature available: Guideline Booklet to Component Burn-In Technology: SD-41 Programmable Tray Bulletin: SD-42 Equipment Bulletin:
AC Switching Power Supply Data Sheet: basic configuration of AC switching power supplies and their various output ratings. Liquid Vapor Bulletin: module used for power device burn-in.

Products manufactured: Ovens, Power Supplies, Testers

Local Sales Offices & Reps.

Ariz	Scottsdale, Jack Hagestad	602-945-0902
Conn	Hamden, Equipment Sales	203-248-5581
Fla	Orlando, Newco & Assocs.	305-293-7700
Ill	Wheaton, Engrg. Prods. Assocs.	312-653-6826
Ind	Kokomo, Teledyne TAC	317-453-7671
Md	Lanham, Brimberg Assocs.	301-552-2200
Mass	Chelmsford, Equipment Sales	617-256-8547
Minn	Minneapolis, Engrg. Prods. Assocs.	612-925-1883
NY	Hartsdale, Powell-Pendergraph, Inc.	914-761-7792
Ohio	Dayton, Assembly Materials & Equipment Systems	513-435-9730
Pa	Berwyn, Tucker Assocs.	215-644-0142
Tex	Dallas, Techn. Processes Co.	214-352-3957

WALDES KOHINOOR, INC., 47-16 Austel Pl., Long Island City, N.Y., 11101, Tel: 212-392-3100, Telex: 126-829; Empl.: 500

For info on price: A. Berger; Application info: J. Altman; Customer service: G. Scionti; Delivery info: G. Scionti

Free literature available: 128-page TRUARC® TECHNICAL MANUAL offers complete engineering data for retaining rings .040" to 10" dia; plus assembly tools, Government and industry standards, typical applications.

Products manufactured: Fasteners, Pliers, Rings, Retaining

Local Sales Offices & Reps.

Cal	Anaheim, R. P. Winship	213-749-8271
Ga	Atlanta, D. C. Fillingame	404-394-0366
Ill	Bolingbrook, G. P. Watkins	312-739-6329
Ind	Noblesville, R. C. Davis	317-773-6311
Iowa	Bettendorf, F. J. Bradley	319-355-3100
Kans	Shawnee, Benson Engrg. Co.	913-631-4113
Ky	Louisville, Petrie-Ingram Co.	502-459-0280
Mass	Worcester, D. Kelleher	617-757-3929
Mich	Southfield, Armstrong, Doran	313-559-4828
NY	Floral Park, A. Bernstein	212-343-3339
NY	Mount Vernon, H. D. Hartman	914-MO 4-2020
NY	Penfield, T. G. Koltes Assoc.	716-377-9080
Ohio	Cleveland, Petrie-Ingram Co.	216-442-5530
Ohio	Dayton, Petrie-Ingram Co.	513-298-3108
Pa	King of Prussia, J. C. Botta	215-265-0424
Tenn	Millington, O. L. Spry	901-872-2415
Tex	Dallas, Benson Engrg. Co.	214-352-7541
Wisc	Brookfield, R. V. Petershack	414-784-0385

WALDOM ELECTRONICS, INC., 4623 W 53rd St, Chicago, Ill., 60632, Tel: 312-585-1212, Telex: 25-4604; FSC No: 92219; Minimum order: $25
p. 1•104,105,1070-1074; p. 2•1070-1074,1262-1266

For info on price: Cust. Svc. Dept.; Application info: M. Halley; Customer service: E. Beutler; Delivery info: E. Beutler

Free literature available: Catalog #7G7, Waldom General Line Catalog (sample attd), Catalog #7FOM-1, Waldom/Molex Catalog (sample attd), Catalog #WB-73, Waldom/Bivar Catalog (sample Attd), Price Schedule #7U5 Resale Price List (7U4 attd - 7U5 in print will be available after first of the year).

Products manufactured: Adhesives (All Types), Alarms, Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Bumpers, Bushings, Glass, Plastic, Metal, Rubber, Etc., Capacitor, Hardware, Caps, Connector, Cases, Equipment, Instrument, Meter, Clamps & Clips, Coils Including Assemblies & Forms, Connector Adapters, Connectors, Contacts, Electrical, Cords, Cutters, Wire, Hand Operated, Dials, Drives & Drive Mechanisms (Dial), Fasteners, Grommets, Guides, Circuit Board, Handles For Cabinets, Circuit Boards, Racks, etc., Holder & Carriers, Holders, Circuit Board (Production Type), Indicators, Integrated Circuit Devices, Jack Covers, Jacks (All Types), Kits, Connector, Kits, Terminal, Knobs, Lights, Machines/Machinery, Production, Nameplates, Packages, Integrated Circuit, Pads, Transistor Mounting, Pins, Plug & Jack Sets, Plug Buttons, Plugs, Pointers, Dial, Posts, Pullers, Racks, Reducers, Resistor, Hardware, Scales, Dial, Shields, Sockets, Spacers, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Switch Mounting Plates, Switches, Terminal Blocks, Boards & Strips, Terminals, Tools, Wire & Cable Ties, Wire Nuts, Wire Strippers

Local Sales Offices & Reps.

Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Costa Mesa, Cen-Tec Sls.	714-645-9157
Cal	Inglewood, Ungar Sls. Assocs.	213-776-7340
Cal	Sacramento, W. J. Purdy Co.	916-422-0128
Cal	San Francisco, Tech. Sls. Assocs.	415-467-1434
Colo	Denver, W.J. Purdy Co.	303-777-1411
Fla	No. Miami, Winfield Elec. Sls. Co.	305-945-6544
Fla	Tampa, Winfield Elec. Sls. Co.	813-884-6500
Ga	Atlanta, H.W. Phillips Co.	404-237-7564
Ill	Chicago, Ellinger Sls. Corp.	312-763-1570
Ind	Indianapolis, Elctrn. Reps.	317-897-9326
Mass	Braintree, Rudolph & Mac Innis	617-843-0908
Mich	Orchard Lake, Ellinger Sales Corp.	313-626-1170
Minn	Maple Crove, R.C. Sls.	612-425-5543
Minn	Minneapolis, E. Melius & Assocs.	612-854-4270
Mo	Kansas City, Nevco, Inc.	816-421-1751
Mo	St. Louis, Nevco, Inc.	314- 843-7406
NJ	Parsippany, Total Mktg. Action	201-227-4073
NM	Albuquerque, W.J. Purdy Co.	505-266-7959
NY	Flushing, M. Bettan Sls.	212-591-7600
NY	Phelps, LSM Assocs.	315-548-4891
NY	Port Washington, Total Mktg. Action	516-883-2432
Ohio	Cleveland, Marlow Assocs.	216-932-0900
Ohio	Xenia, Marlow Assocs.	513-426-6270
Ore	Portland, J.V. BeLusko Co.	503-222-4279
Pa	Easton, E-K-P Assocs.	215-258-6477
Pa	Fort Washington, Kirk-Sandell	215-643-2100
Tex	Houston, B. Rogers & Co.	713-626-5370
For:	Can., Vancouver, B.C., Omintronix	604-277-5953
FOR:	Can., Montreal, Que., Omnitronix, Ltd.	514-735-0987

Local Distributors

Ala	Huntsville, Powell Elctrns., 803 Oster Dr.	205-539-2731
Ala	South Birmingham, Forbes Distributing, 1416 Fourth Ave.	205-251-4104
Ariz	Tucson, Inland Elctrns., 715 E. Bdwy.	602-624-4402
Ark	Little Rock, Carleton-Bates Co., 6821 Scott Hamilton	501-562-9100
Cal	Costa Mesa, Component Center, 1240 E. Logan Ave.	714-979-0433
Cal	Mountain View, Abacus Elctrns., 1065 Terra Bella Ave.	415-961-1500
Cal	Mountain View, Powell Elctrns., 411 Fairchild Dr.	415-964-0820
Cal	Sacramento, Dunlap Elctrns., 1800 18th St.	916-444-8070
Cal	San Diego, Shanks & Wright, 2045 Kettner Blvd.	714-239-0176
Cal	Southgate, CEC Moltronics, 5610 E. Imperial Hwy.	213-773-6521
Colo	Denver, Acacia Sls., 11111 W. 8th Ave.	303-232-2882
Colo	Denver, Electronic Parts Co., 1212 S. Bdwy.	303-744-1992
Conn	Hartford, Hatry of Hartford, 500 Ledyard St.	203-527-1881
Fla	Miami, Electronic Equip., 2701 N.W. 42nd Ave.	305-871-3500
Fla	Orlando, Powell Elctrns., 2032 Palmridge Way	305-859-1450
Ga	Atlanta, Lykes Elctrns., 1135 Chattahoochee Ave. N.W.	404-355-2223
Haw	Honolulu, Precision Radio Ltd., 1160 S. King St.	808-537-5291
Ill	Champaign, Klaus Radio, 905 S. Neil St.	217-356-1896
Ill	Mt. Prospect, Cramer Elctrns., 1911 S. Busse Rd.	312-593-8230
Ill	Palatine, OHM Elctrns., 649 Vermont Ave.	312-359-5500
Ill	Peoria, Klaus Radio/Peoria, 8400 N. Pioneer Pkwy.	309-691-4840
Ill	Rosemont, Advent Elctrns., 7110 N. Lyndon	312-298-4210
Ind	Evansville, Hutch & Son, 300 N. Main St.	812-425-7155
Ind	Evansville, Ohio Valley Sound, 20 E. Sycamore St.	812-425-6173
Ind	Indianapolis, RA-DIS-CO, 814 N. Senate	317-637-5571
Iowa	Cedar Rapids, Deeco, Inc., 2520 16th Ave. S. W.	319-365-7551
Kans	Wichita, Radio Supply Co., 115 Laura	316-267-5216
Ky	Louisville, P. I. Burks Co., 824 S. Seventh St.	502-589-3960
La	Lafayette, Ralph's, 3004 Cameron St.	318-234-4507
Md	Beltsville, Powell Elctrns., 10728 Hanna St.	301-474-1030
Mass	Dedham, Gerber Elctrns., 852 Providence Hwy.	617-329-2400
Mass	Lynn, Land Elctrns., 9R Franklin St.	617-592-2220
Mass	Newton, Cramer Elctrns., 85 Wells Ave.	617-969-7700
Mich	Ann Arbor, Wedemeyer Elctrns., 215 N. Fourth Ave.	313-665-8611
Minn	St. Paul, Gopher Elctrns., 2520 W. Larpenteur	612-645-0241
Miss	Jackson, Ellington Elctrn. Supply, 1425 Terry Rd.	601-355-0561
Mo	St. Louis, Olive Inds. Elctrns., 6662 Olive Blvd.	314-863-7800
Mo	St. Louis, Van Sickle, 1915 Washington St.	314-621-5000
Neb	Lincoln, Scott Elctrn. Supply, 4040 Adams St.	402-434-8308
Nev	Reno, Edco, 720 Tahoe St.	702-323-2766
NM	Albuquerque, Elctrn. Parts Co., 2620 Rhode Island St. N.E.	505-293-6161
NY	Bohemia, Car-Lac Elctrn. Supply, 75 Orville Dr.	516-567-4200
NY	Buffalo, Summit Radio Distributing, 916 Main St.	716-884-3450
NY	Johnson City, Wilshire Elctrns., 617 Main St.	607-797-1236
NY	Lynbrook, Peerless RAdio Corp., 19 Wilbur St.	212-523-3456
NY	Rochester, Simcona Elctrns., 275 Mt. Read Blvd.	716-328-3230
NC	Charlotte, Dixie Radio Supply, Box 10563	704-377-5413
NC	Raleigh, Southeastern Radio Supply, 414 Hillsborough St.	919-828-2311
Ohio	Cincinnati, United Radio, Summit Rd. & Reinhold Dr.	513-761-4030
Ohio	Columbus, Hughes-Peters, Inc., 481 E. 11th Ave.	614-294-5351
Ohio	Solon, Repco, 6835 Cochran Rd.	216-248-8900
Ohio	Dayton, ESCO, 221 Crane St.	513-226-1133
Okla	Tulsa, Oil Capitol Elctrns., 708 S. Sheridan	918-836-2541
Pa	Drexel Hill, Kass Elctrns., 2502 Township Line Rd.	215-449-2300
Pa	Erie, Mace Elctrns., 2631 W. 8th St.	814-838-3517
Pa	Phildadelphia, Powell Elctrns., So. Island Rd. & Entpr.	215-365-1900
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
RI	Warwick, W. H. Edwards Co., 55 Elctrns Dr.	401-781-8000
SC	Columbia, Dixie Radio Supply, 1900 Barnwell St.	803-253-5332
SC	Greenville, Dixie Radio Supply, Box 46	803-232-5357
Tenn	Nashville, Electra Distributing Co., 1914 W. End Ave.	615-329-3971
Tex	El Paso, Midland Specialty, 2235 Wyoming Ave.	915-533-9555
Tex	Houston, Geophysical Supply, 1500 Crawford	713-224-0621
Tex	Houston, Newark-Houston, 6902 Harwin Dr.	713-782-4800
Tex	San Antonio, Sherman Elctrns., 720 San Pedro Ave.	512-226-0247
TEx	Dallas, Wilkinson Brothers, 2406 Ross Ave.	214-747-1571
TEx	Fort Worth, Swieco, Inc., 1518 E. Lancaster	817-335-6521
Utah	Salt Lake City, Kimball Elctrns., 350 Pierpont Ave.	801-328-2075
Va	Arlington, Arlington Elctrns., 3636 Lee Hwy.	703-524-2412
Va	Norfolk, Priest Elctrns., 6431 Tidewater Dr.	804-855-2021
Wisc	Milwaukee, Marsh Radio Elctrns., 6047 W. Beloit Rd.	414-545-6500
Wisc	Milwaukee, Parts Mart, 1314 N. 7th St.	414-276-4160

WALKER SCIENTIFIC, INC., Rockdale St., Worcester, Mass., 01606, Tel: 617-852-3674; Empl.: 83

For info on price: B. Langley; Application info: B. Langley; Customer service: E. Pederson; Delivery info: B. Langley

Products manufactured: Analyzers, Coils Including Assemblies & Forms, Generators, Hysteresisgraphs, Indicators, Integrators, Electronic, Magnetometers, Magnets, Meters, Multipliers, Power Supplies, Probes, Testers

Local Sales Offices & Reps.

Ariz	Phoenix, C.W. Fowler Co.	602-274-5537
Cal	inglewood, C.W. Fowler Co.	213-678-5211
Cal	Menlo Park, C.W. Fowler Co.	415-322-5374
Colo	Denver, C.W. Fowler Co.	303-744-9595
Fla	Jacksonville, Pulcir, Inc.	904-743-5700
Ill	Mt. Prospect, Contemporary Science	312-255-3793
Md	Beltsville, Kelly Scientific Instrs., Inc.	301-937-4350
Mass	Burlington, Scien. Sys. Sls.	617-273-1660
NM	Albuquerque, Southwest Engrg. & Equip.	505-265-6776
NY	Syosett, Scientific Sys. Sls. Corp.	516-921-3737
Ohio	Westerville, Contemporary Science	614-882-6908
Tenn	Knoxville, Pulcir, Inc.	615-693-3641
Tex	Dallas, Southwest Engrg. & Equip. Co.	214-826-6661
Tex	Houston, Southwest Engrg. & Equip. Co.	713-623-2580
Wash	Bellevue, C.W. Fowler Co.	206-454-8600
FOR:	Can., Downsview, Ont., Aptec Eng.	416-661-9722
FOR:	Can., Montreal, P.Q., Aptec Engrg., Ltd.	514-735-1737

Advertisment

Walker/Magnemetrics: Magnetic Measuring Instrumentation

- Hysteresisgraphs
- Coercivity Meters
- Fluxmeters
- Gaussmeters (Hall & NMR)

Walker/Magnion: Laboratory Magnet Systems

- Laboratory Magnets (Iron core and Air core)
- Laboratory Power Supplies (Regulated and Unregulated)
- Susceptibility systems
- Magnetic Field Control Instruments
- Sweep Instruments

WALL A. T. CO., 55 Service Ave., Warwick, R.I., 02889, Tel: 401-739-0740, TWX: 710-382-1535; Empl.: 52

For info on price: R. Huntsman; Application info: F. B. Read Jr.; Customer service: C. T. Chwalek; Delivery info: R. Huntsman

Products manufactured: Metals, Seals, Tubes, Tubing

Local Sales Offices & Reps.

Ill	Elk Grove, R. P. Wave
Nj	Cliff Side Park, J. A. Roberge
Ny	Fairport, L. Bagley
EXP:	Stamford, Conn., Dage Corp.

WALL-LENK MFG. CO., Box 3349, Dept. EEM-71, Kinston, N.C., 28501, Tel: 919-527-4186; Empl.: 65; Minimum order: $10 .... p. 2•1718,1719

For info on price: S. Whitfield; Application info: M. McNutt; Customer service: S. Whitfield; Delivery info: S. Whitfield

Free literature available: Catalogs 1-669F and LC774

Products manufactured: Flux, Brazing & Soldering Materials, Heat Guns, Production, Solder (All Types), Soldering Accessories, Soldering Equipment, Soldering Guns, Irons & Desoldering Tools, Torches, Soldering, Welding & Access.

Local Sales Offices & Reps.

Cal	Carson, Bidwell Sls. Co.	213-770-0300
Ill	Chicago, Midwest Elctrn. Sls.	312-777-9700
Kans	Mission, Inland Assocs.	913-362-2366
Md	Towson, Habco Elctrns.	301-825-9637
Mich	St. Clair Shores, J. M. Thorpe	313-779-6363
Minn	Minneapolis, C.R. Gibb	612-377-1200
NJ	Bergenfield, H. Gray Assocs.	201-384-3643
NY	Rushville, Ellis Scovel	315-584-6522
Ohio	Cleveland, Electro Com	216-886-2404
Pa	King of Prussia, L. Spangenberg	215-265-2130
RI	Lincoln, Adams McGregor	401-726-1300
Wash	Seattle, D. Miller Sls.	206-784-6800

WALLACE S. K. ASSOCS., 13902 N. Dale Mabry/Ste 216, Tampa, Fla., 33607, Tel: 961-1037

For info on price: W. C. Jaudon 813-961-1037; Application info: E.Healy 305-961-6640

Products manufactured: Actuators, Amplifiers, Baffles, Speaker, Cabinets & Accessories, Cable, Comm. Systems, Display Devices/Displays, Grilles, Relays, Resistors, Switches, Tubes

Local Sales Offices & Reps.

Fla	Hollywood	305-961-6640
Fla	Tampa	813-961-1037
Ga	Jonesboro	404-471-6297
Nc	Greensboro	919-292-0487
Nc	Kernersville	919-993-3993
Tenn	Memphis	901-682-2281

WALLER CORP., PO Box 340, Crystal Lake, Ill., 60014, Tel: 815-459-6510, TWX: 910-634-3351; Empl.: 50

Customer service: J. M. Skala

Free literature available: Waller's OEM catalog of AM-FM-MPX stereo chassis plus AM-FM and special frequency tuners with I.F. strips and MPX, on request.

Products manufactured: Amplifiers, Boards, Printed Circuit, Comm. Systems, Receivers, Tuners

WANG LABORATORIES, INC., 836 North St., Tewksbury, Mass., 01876, Tel: 617-851-4111, TWX: 710-343-6769; Empl.: 2000

Products manufactured: Calculators, Electrical & Electronic, Computers

Local Sales Offices & Reps.

Ala	Birmingham	205-591-2000
Ala	Mobile	205-479-0645
Alas	Anchorage	907-272-6115
Ariz	Phoenix	602-263-9196
Ark	Little Rock	501-666-7115
Cal	Fresco	209-233-7445
Cal	Los Angeles	213-776-2985
Cal	Sacramento	916-489-7326
Cal	San Diego	714-565-8541
Cal	San Mateo	415-573-6311
Cal	Santa Cruz	408-423-5560
Cal	Tustin	714-832-4720
Colo	Denver	303-572-1536
Conn	Hartford	203-246-6571
Conn	Woodbridge	203-281-0565
DC	Washington	202-785-2105
Fla	Ft. Lauderdale	305-966-3106
Fla	Jacksonville	904-396-1415
Fla	Orlando	305-894-9631
Fla	Tallahassee	904-877-7060
Fla	Tampa	813-877-8240
Ga	Atlanta	404-451-0178
Haw	Honolulu	808-941-7525
Ill	Des Plaines	312-298-7990
Ill	Morton	309-265-9113
Ill	Park Ridge	312-823-5793
Ill	Rock Island	309-788-3339
Ind	Highland	216-923-2280
Ind	Indianapolis	317-257-5381
Kans	Prairie Village	913-236-5454
Kans	Wichita	316-682-9420
Ky	Louisville	502-897-5143
La	Baton Rouge	504-927-5129
La	Bossler City	318-425-1900
La	Metairie	504-837-1622
Md	Rockville	301-770-6410
Md	Towson	301-821-8212
Mass	Tewksbury	617-851-4111
Mass	Waltham	617-890-6621
Mass	Worcester	617-798-8771
NY	Syracuse	315-437-7279
Mich	Grand Rapids	616-458-6595
Mich	Lansing	517-371-1120
Mich	Southfield	313-352-7112
Minn	Bloomington	612-884-7328
Mo	St. Louis	314-968-5350
Neb	Omaha	402-556-2733
NH	East Derry	603-329-6358
NJ	Springfield	201-467-3600
NM	Albuquerque	505-265-5608
NY	Lake Success	516-437-2500
NY	Latham	518-785-3234
NY	Rochester	716-442-5930
NY	Williamsville	716-688-6397
NC	Charlotte	704-527-0223
NC	Greensboro	919-272-5683
NC	Raleigh	919-782-8893
Ohio	Cincinnati	513-771-3445
Ohio	Cleveland	216-381-6525
Okla	Oklahoma City	405-524-4489
Okla	Tulsa	918-663-1410
Ore	Portland	503-297-2501
Pa	Bryn Mawr	215-525-7637
Pa	Harrisburg	717-564-8650
Pa	Pittsburgh	412-343-3500
RI	Cranston	401-943-1164
SC	Mt. Pleasant	803-884-5141
Tenn	Chattanooga	615-894-5516
Tenn	Knoxville	615-588-1308
Tenn	Memphis	901-452-6296
Tenn	Nashville	615-385-1262
Tex	Austin	512-444-1791
Tex	Beaumont	713-832-6428
Tex	Corpus Christi	512-855-2162
Tex	Dallas	214-241-9278
Tex	El Paso	915-565-8853
Tex	Ft. Worth	817-927-0461
Tex	Houston	713-783-7200
Tex	Lubbock	806-762-0204
Tex	San Antonio	512-344-1102
Utah	Salt Lake City	801-487-5791
Va	Newport News	804-595-8803
Va	Richmond	804-359-6320
Wash	Seattle	206-283-3800
Wash	Spokane	509-535-9836
WVa	Charleston	304-346-0345
Wisc	Madison	608-255-4411
Wisc	Milwaukee	414-224-0771

WARD LEONARD ELEC. CO. INC., Sub. Riker-Maxson, 31 South St., Mt. Vernon, N.Y., 10550, Tel: 914-664-1000, TWX: 710-562-0144; FSC No: 63743; QPL No: 15109; Empl.: 600; Minimum order: $50

For info on price: G. Platenyk; Application info: J. Schieb; Customer service: C. Blank; Delivery info: C. Blank

Free literature available: WIRE-WOUND RESISTOR CATALOG details axial lead, fixed, adjustable, strip, disc, types. CONTROL DIGEST 100 lists relays, timers, contactors, field rheostats, motor starters, pushbuttons.

Products manufactured: Amplifiers, Chargers, Battery, Controls/Control Eqpt., Regulators, Relays, Resistors, Transformers

Local Sales Offices & Reps.

Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Los Altos, Recht Assoc.	415-941-0336
Fla	North Miami, Winfield Elctrn. Sls.	305-945-6544
Ga	Decauter, Electro Rep. Assoc.	404-636-8533
Ill	Elmhurst, Ward Leonard	312-279-5490
Ind	Fort Wayne, Lingeman & Assoc.	219-485-4743
Md	Baltimore, Faion Lott & Co.	301-744-4611
Mass	Framingham, Murata/J. F. D.	617-872-4843
Minn	St. Louis Pk., Beta Engrg.	612-925-4422
Mo	St. Louis, Scherrer Instrs.	314-644-5362
NY	Mt. Vernon, Ward Leonard	914-664-1000
NY	New Hartford, Ward Leonard	315-732-3507
NY	Williamsville, Ward Leonard	716-634-4300
NC	Charlotte, Electro Rep. Assoc.	704-527-2530
Ohio	Cleveland, Ward Leonard	216-382-8444
Pa	Phila., S. MacDonald	215-545-1205
Tex	Richardson, Spectra Sls.	214-234-3600
EXP:	New York, NY, ITT Export Corp.	212-797-3300

WARNECKE ELECTRON TUBES, INC., 175 W. Oakton St., Des Plaines, Ill., 60018, Tel: 312-299-4436, TWX: 910-233-4597; Empl.: 50

Products manufactured: Lamps, Tubes

Local Sales Offices & Reps.

NJ	Tenafly, Budd-Tronics, Inc.	201-569-2230
Ohio	Dayton, Ashby Assocs.	513-252-5627

WARNER ELEC. BRAKE & CLUTCH CO., 449 Gardner St., S. Beloit, Ill., 61080, Tel: 815-389-3771; Empl.: 1200

For info on price: J. Dewey

Products manufactured: Actuators, Brakes, Clutches, Controls/Control Eqpt., Counters, Motors

Local Sales Offices & Reps.

Ala	Birmingham	205-252-5151
Cal	Palos Verdes Peninsula	213-377-5461
Cal	Simi Valley	805-522-4330
Conn	Vernon	203-646-5337
Fla	Titusville	305-269-3061
Ga	Lilburn	404-469-1551
Ill	Chicago	312-775-7570
Iowa	Bettendorf	309-762-0112
Mass	Westboro	617-326-7100
Mich	Troy	313-689-7515
Minn	Minneapolis	612-335-7277
Minn	Prior Lake	612-335-7277
Mo	Warrensburg	816-421-8499
NJ	Madison	201-377-4800
NY	Liverpool	315-458-0500
NY	No. Syracuse	315-458-0500
NC	Greensboro	919-275-7879
Ohio	Cincinnati	513-891-4813
Ore	Portland	503-666-6980
Pa	Exton	215-233-1216
Pa	Philadelphia	215-233-1216
Tex	Dallas	214-327-1268
Wisc	Milwaukee	414-871-8022

WARREN G-V COMMUNICATIONS, Div. Sola Basic Inds., 101 Okner Pkwy., Livingston, N.J., 07039, Tel: 201-992-6200, TWX: 710-994-4852; Empl.: 200; Minimum order: $25

Customer service: E. McMullen

Free literature available: Brochure describing various controls and protective devices Also includes application advantages and terminology definitions for thermal relays.

Products manufactured: Chargers, Battery, Comm. Systems, Controls/Control Eqpt., Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Detectors, Eliminators, Battery, Flashers, Generators, Inverters, Monitors, Power Supplies, Relays, Switches, Thermostats, Timers

Local Sales Offices & Reps.

Cal	Los Angeles, M.A. Stolaroff Co.	213-AX 5-7781
Minn	Minneapolis, HMR, Inc.	612-335-7734

WARWICK PRODS CO., 7909 Rockside Rd., Independence, Ohio, 44131, Tel: 216-524-4404; Empl.: 18; Minimum order: $10

For info on price: T. J. Storey; Application info: R. F. Beverstock; Customer service: T. J. Storey; Delivery info: T. J. Storey

Products manufactured: Cabinets & Accessories, Cases, Equipment, Instrument, Meter, Cases, Transit, Containers, Kits, Test Equipment

Local Sales Offices & Reps.

Mass	Boston, R. Krauth	617-522-8421
NJ	West Caldwell, Peterson-Rudnick Assocs.	201-226-4363
NY	Bronx, Peterson-Rudnick Assocs.	212-671-1923
NY	Canadaigua, W. Winship	315-394-3292

WATERBURY PRESSED METAL CO., Parts Div., 407 Brookside Rd., Waterbury, Conn., 06714, Tel: 203-756-8891; Empl.: 85

For info on price: J. Cipriano; Application info: C. Mellette; Customer service: M, Joy; Delivery info: F. Estes

Products manufactured: Cable Assemblies & Harnesses, Fasteners, Mounts, Shields, Transistor, Diode, Thyristor Heat Dissipators

Local Sales Offices & Reps.

FOR:	Can., Brampton, Ont.	416-453-5581

WATERS MFG., INC., Longfellow Ctr., Wayland, Mass., 01778, Tel: 617-358-2777; QPL No: Multiple; Empl.: 95

Customer service: H. A. Daziel

Free literature available: POTENTIOMETER CATALOG: Complete descriptions of precision and semi-precision potentiometers - both conductive plastic and wirewound. Story of MystR-Linear Motion Transducers.. TORQUE WATCH GAUGE CATALOG: Precise measurement of static torque.
PROFESSIONAL AUDIO CONTROLS CATALOG: Describes both rotary and linear motion attenuators and Pan-Pots.

Products manufactured: Attenuators, Indicators, Potentiometers, Resistors, Testers

Local Sales Offices & Reps.

Ariz	Tempe, Argus Sls.	602-967-8709
Cal	Los Angeles, Elsner-Rambo Co.	213-664-2928

Cal	Redwood City, Woodworth Co.	415-365-0252
Colo	Denver, Omega Ltd.	303-758-1508
Conn	Trumbull, Sir Assocs.	203-268-2560
Fla	Hollywood, J.A. Simberkoff	305-925-4560
Ga	Atlanta, V. Avis McCorvey Co.	404-636-2502
Mass	Lexington, Sir Assocs.	617-862-1812
Mich	Detroit, R.P. Urban & Assocs.	313-535-2355
Mich	Grand Rapids, R.P. Urban & Assocs.	616-245-0511
Minn	Hopkins, F. Peterson Co.	612-941-5400
Mo	St. Louis, Ozark Elctrn. Mktg., Inc.	314-423-7200
NJ	So. Orange, S. Simberkoff Assocs.	201-763-7900
Ohio	Dayton, H. Teplitz & Co.	513-277-6531
Okla	Tulsa, W. Pat Fralia Co.	918-663-8707
Pa	Philadelphia, S. Simberkoff Assocs.	215-455-9579
Tex	Fort Worth, W. P. Fralia Co.	817-738-2394
Tex	Houston, W.P. Fralia Co.	713-772-1572
Utah	Salt Lake City, Omega Limited	801-266-9617
Wash	Seattle, Avionics Liaison, Inc.	206-767-3870

WATKINS-JOHNSON CO., 3333 Hillview Ave., Palo Alto, Cal., 94304, Tel: 415-493-4141, TWX: 910-373-1253

For info on price: Appls. Engrg.; Application info: Appls. Engrg.; Customer service: S. Craighead; Delivery info: Appls. Engrg.

Products manufactured: Amplifiers, CATV Systems & Equipment, Cavities, Microwave, Chokes, Counters, Crystals, Demodulators, Diodes, Direction Finders, Discriminators, Display Devices/Displays, Filters, Furnaces, Generators, Horns, Microwave, Limiters, Mixer-Preamplifiers, Microwave, Mixers, Modulators, All Kinds, Monitors, Multipliers, Oscillators, Power Supplies, Receivers, Soldering Equipment, Switches, Synthesizers, Test Systems, Transformers, Tubes, Tuners

Local Sales Offices & Reps.

Cal	Inglewood	213-670-4850
Cal	Palo Alto	415-493-4141
Cal	Scotts Valley	408-438-2100
Fla	Orlando	305-851-2391
Md	Gaithersburg	301-948-7550
Mass	Burlington	617-272-7235
NJ	New Shrewsbury	201-842-2422
Ohio	Fairborn	513-426-8303
Tex	Dallas	214-239-9131

WATKINS-JOHNSON CO., Production Equip., 440 Mount Hermon Rd., Scotts Valley, Cal., 95060, Tel: 408-438-2100 EXT.217, TWX: 910-598-4403; Empl.: 1500

Customer service: M. K. Durham

Products manufactured: Furnaces

Local Sales Offices & Reps.

Ariz	Phoenix, Meas. Conslts.	602-994-9519
Cal	Long Bch., Scrantom Engrg.	714-979-6373
Cal	Santa Clara, F.J. Toffey Assoc.	408-377-8817
Colo	Broomfield, Measurement Consultants	303-449-5294
Conn	Bridgeport, Tech. Instr.	203-368-4582
Fla	Sarasota, W. J. Irvine Co.	813-955-9656
Ill	Lake Villa, R.W. Venn Co.	312-395-5353
Mass	Wilmington, Tech. Instr.	617-944-3930
NM	Albuquerque, Meas. Conslts.	505-265-6471
NY	Rochester, Upstate Tech. Equip.	716-454-4455
NY	Solvay, Upstate Tech. Equip.	315-488-3101
Ohio	Dayton, Sidnell Co.	513-433-7761
Pa	Warminster, Eastern Elctrn. Assocs.	215-674-1535
Tex	Austin, Crockett Engrg.	512-451-8269
Tex	Dallas, Crockett Engrg.	214-251-1776
Tex	El Paso, Measurement Conslts.	505-526-2491
FOR:	Can., Longueuil, Que., A. Crawford Assoc.	514-670-1212
FOR:	Can., Mississaga, Ont., A. Crawford Assoc.	416-678-1500
FOR:	Can., Ottawa, Ont., A. Crawford Assoc.	613-725-3354
FOR:	Can., Vancouver, B.C., A. Crawford Assoc.	604-253-7136

WATLOW ELEC. MFG. CO., 12001 Lackland Rd., St. Louis, Mo., 63141, Tel: 314-878-4600; Empl.: 230

Products manufactured: Controls/Control Eqpt., Heaters & Heating Elements, Thermocouples, Elements & Accessories, Thermostats

Local Sales Offices & Reps.

Cal	Inglewood, Carlin Assocs.	213-673-4711
Cal	Mt. View, H.A. Clahsen	415-964-6364
Ga	Atlanta, R. Starnes	404-458-2068
Ill	Chicago, J. Priest & Assocs.	312-992-1220
Mass	Natick, Electrical Comp.	617-655-2225
Mich	Detroit, D. Martignon	313-651-0500
Mo	Kansas City, R. White	816-587-9270
Mo	St. Louis, R. Greene Co.	314-644-2666
NJ	Fair Lawn, Par Assocs.	201-447-3722
NY	Buffalo, H. H. Cardozo	716-834-3377
NY	E. Syracuse, R. H. Nichols	315-437-2813
NY	Lindenhurst, E. Berruti	516-884-4777
NY	Rochester, J. F. Serr	716-586-6226
Ohio	Cincinnati, M. Jordahl	513-683-4500
Ohio	Cleveland, Dale Street & Assoc.	216-886-1266
Pa	Warrington, G. Baker	215-343-6170
Tex	Arlington, Davis-Dawson Co.	817-265-6426

WAVELINE, INC., Box 718, W. Caldwell, N.J., 07006, Tel: 201-226-9100, TWX: 710-734-4324; FSC No: 00443; Empl.: 95; Minimum order: $50

For info on price: M. Humecky; Customer service: D. Morsillo; Delivery info: B. Robertson

Products manufactured: Adapters, Waveguide, Antennas, Attenuators, Bends & Twists, Microwave, CATV Systems & Equipment, Chokes, Comm. Systems, Couplers, Detectors, Dividers, Dummy Loads, Filters, Flanges, Waveguide, Generators, Holders, Crystal, Horns, Microwave, Joints, Rotary, Microwave, Junctions, Hybrid, Microwave, Line Strechers, Microwave, Loads, Electronic Variable, Meters, Mixers, Mounts, Probes, Seals, Shifters, Shutters, Microwave, Sliding Loads, Microwave, Switches, Tees, Terminals, Testers, Tubes, Tubing, Tuners, Waveguides & Adapters

Local Sales Offices & Reps.

Ala	Huntsville, Beacon Elctrn. Assocs.	205-881-5031
Cal	Anaheim, Blair Assocs.	714-635-1350
Cal	Cupertino, Allis Assocs.	408-379-2883
Fla	Maitland, Beacon Elctrn. Assn.	305-647-3498
Fla	Palm Beach Garden, Beacon Elctrn.	305-622-2770
Ga	Atlanta, Beacon Elctrn.	404-351-3654
Ill	Northfield, Feller Assocs.	312-446-8065
Ind	Rochester, Feller Assoc.	219-233-2377
Md	Glen Arm, Hodgins Assocs.	301-592-7047
Mass	Needham Hgts., Reptron, Inc.	617-449-4141
NJ	Teaneck, Sylvan Ginsbury, Ltd.	201-837-1100
NJ	W. Caldwell, Waveline, Inc.	201-226-9100
NY	Skaneateles, Robtron, Inc.	315-685-5731
SC	Spartanburg, Beacon Elctrn. Assoc.	803-582-4613
Tex	Richardson, Lear Assocs.	214-231-5388
FOR:	Can., Aurora, Ont., John Herring & Co.	416-727-1345

WAVETEK, 9045 Balboa Ave., San Diego, Cal, 92123, Tel: 714-279-2200, TWX: 910-335-2007; Minimum order: $25 .... p. 1•852-859

For info on price: C. Anderson; Application info: J. A. Roth; Customer service: P. Brance; Delivery info: C. Anderson

Products manufactured: Attenuators, Generators, Meters, Synthesizers, Terminals, Test Equipment

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Instrs.	205-539-4411
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Lawndale, Ward/Davis Assoc.	213-542-7740
Cal	San Diego, Ward/Davis Co.	714-459-3351
Cal	Sunnyvale, Ward/Davis Assoc.	408-245-3700
Colo	Denver, BFA Corp.	303-744-3301
Conn	Hamden, P. Jenks Assocs.	203-281-0810
Fla	Ft. Lauderdale, W.A. Brown Instrs.	305-776-4800
Fla	Orlando, W.A. Brown Instrs.	305-425-5505
Ga	Atlanta, W.A. Brown Instrs.	404-939-1674
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Andover	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
La	Gretna, W.A. Brown Instrs.	504-366-5766
Md	Silver Spring, Eastern Instrumentation	301-681-6500
Mass	Wakefield, P. Jenks Assocs.	617-246-1590
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	St. Louis, Palatine Engrg. Sls.	314-426-7055
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Great Neck, Eastern Instrumentation	516-466-9505
NY	N. Syracuse, NACO Elctrns. Corp.	315-699-2651
NC	Durham, W.A. Brown Instrs.	919-489-1546
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Okla	Norman, Data Mktg. Assoc.	405-364-8320
Pa	Philadelphia, Eastern Instrumentation	215-927-7777
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Dallas, BFA Corp.	801-466-6522
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assocs.	512-828-0937
Utah	Salt Lake City, BFA Corp	801-466-6522
Wash	Seattle, R.S. Drake Assocs.	206-763-2755
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

WAVETEK INDIANA, INC., 66 N. First Ave., Beech Grove, Ind., 46107, Tel: 317-783-3221, TWX: 810-341-3226; Empl.: 150 .... p. 1•852-859

Customer service: J. Wiley

Free literature available: Catalog, -Wavetek Generation & Measurement Equipment. Flyer, -Test Equipment for the CATV Industry

Products manufactured: Amplifiers, Attenuators, CATV Systems & Equipment, Generators, Oscilloscopes

Local Sales Offices & Reps.

Ala	Huntsville, W.A. Brown Instrs.	205-539-4411
Ariz	Scottsdale, BFA Corp.	602-946-4215
Cal	Lawndale, Ward/Davis Assoc.	213-542-7740
Cal	San Diego, Ward/Davis Assoc.	714-459-3351
Cal	Santa Clara, Ward/Davis Assoc.	408-245-3700
Colo	Denver, BFA Corp.	303-744-3301
Conn	Hamden, P. Jenks Assoc.	203-281-0810
DC	Washington, Eastern Instrumentation	301-681-6500
Fla	Ft. Lauderdale, W.A. Brown Instrus.	305-776-4800
Fla	Ft. Walton Beach, W.A. Brown Instrus.	904-243-6424
Fla	Orlando, W.A. Brown Instrus.	305-425-5505
Ga	Atlanta, W.A. Brown Instrus.	404-939-1674
Ill	Chicago, Carter Elctrns.	312-585-5485
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Kans	Overland Park, Carter Elctrns.	913-649-6996
La	Gretna, W.A. Brown Instrus.	504-366-5766
Mass	Wakefield, P. Jenks Assoc.	617-246-1590
Mich	Detroit, WKM Assocs.	313-892-2500
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	St. Louis, Carter Elctrns.	314-731-2237
NM	Albuquerque, BFA Corp.	505-292-1212
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Great Neck, L.I., Eastern Instrumentation	516-466-9505
NY	N. Syracuse, Naco Elctrns.	315-699-2651
NY	Rochester, Naco Elctrns.	716-244-4720
NY	Schenectady, Naco Elctrns.	518-783-5855
NY	Utica, Naco Elctrns.	315-732-1801
NC	Research Triangle Park, W.A. Brown Instrus.	919-489-1546
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ohio	Dayton, WKM Assocs.	513-434-7500
Pa	Philadelphia, Eastern Instrumentation	215-927-7777
Pa	Pittsburgh, WKM Assocs.	412-892-2953
Tex	Dallas, Data Mktg. Assoc.	214-661-0300
Tex	Houston, Data Mktg. Assoc.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Wash	Seattle, R. S. Drake Assoc.	206-763-2755
Wisc	Milwaukee, Carter Elctrns.	414-464-5555
FOR:	Can., Longueuil, P.Q., A. Crawford Assoc.	
FOR:	Can., Mississauga, P.Q., A. Crawford Assoc.	
FOR:	Can., Ottowa, A. Crawford Assoc.	
FOR:	Can., Vancouver, B. C., A. Crawford Assoc.	

WEBBER MANUFACTURING CO., 8634 Brookville Rd., Indianapolis, Ind., 46206, Tel: 317-357-8681; Empl.: 40

Customer service: R. C. Webber

Free literature available: Brochure No. 9400 (enclosed)

Products manufactured: Chamber, Environmental Test

WEBER TECH PRODUCTS, 1340 Monroe Ave. N.W., Grand Rapids, Mich., 49505, Tel: 616-363-7735; Empl.: 36

Customer service: W. Lough

Free literature available: Clean Rooms - Brochures describing, total facilities, modular devices, and portable units Air Conditioning - Brochures outlining types & sizes of units with specifications.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Air Conditioners (For Equipment)

WECKESSER CO. INC., 4444 W. Irving Park Rd., Chicago, Ill., 60641, Tel: 312-282-8626; Empl.: 90; Minimum order: $5

For info on price: D. E. Haines; Application info: D. E. Haines; Customer service: W. F. Morrissey; Delivery info: W. F. Morrissey

Products manufactured: Clamps & Clips, Fasteners, Wire & Cable Ties

Local Sales Offices & Reps.

Ariz	Phoenix, EGR Co.	602-959-0320
Ark	Poyen, Comp. Parts	501-337-9580

Cal	Los Angeles, El-Com. Inc.	213-223-1351
Cal	San Carlos, D.H. Ross Co.	415-591-4411
Colo	Denver, Franklin Sls. Co.	303-922-3623
Conn	Milford, Plastic Comps. Co.	203-877-2723
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Ga	Atlanta, Millar Elctrns.	404-261-6160
Iowa	Des Moines, KSW Assocs.	515-279-9235
Mich	Oak Park, D. P. Stewart & Assoc.	313-399-7565
Minn	Minnetonka, T.H. Ayre & Assoc.	612-474-4125
Mo	Kansas City, KSW Assocs.	816-358-5240
Mo	St. Louis, KSW Assocs.	314-781-6111
NC	Raleigh, Millar Elctrns.	919-787-9564
Ohio	Chagrin Falls, Alexander Ind'l. Sls.	216-247-4133
Ohio	Kettering, Alexander Ind'l. Sls.	513-293-3651
Pa	Philadelphia, Acar Electronic Hardware	215-722-8511
Tenn	Madison, Comp. Parts	615-859-5832
Tex	Dallas, J.B. Guenther, Inc.	214-528-5286
Tex	Houston, J.B. Guenther, Inc.	713-468-0232
Wash	Seattle, R. Johnston Co.	206-524-5170
Wisc	Milwaukee, E.A. Dickinson & Assocs.	414-264-1080
EXP:	Chicago, Ill., Weckesser Int'l.	312-545-2688

WEINSCHEL ENGRG. CO., Box 577, Gaithersburg, Md., 20760, Tel: 301-948-3434, TWX: 710-828-9705; Empl.: 225; Minimum order: $35

For info on price: R. Bastien

Free literature available: Data Sheets or Brochures on all products; Short-Form Catalog; Microwave Measuring and Generation Instruments Catalog; RF Attenuators and Components Catalog; Application and Technical Notes.

Products manufactured: Amplifiers, Analyzers, Attenuators, Bolometers, Bridges, Cable, Calibrators, Comparators, Connector Adapters, Connectors, Couplers, Detectors, Diodes, Dividers, Dummy Loads, Generators, Indicators, Insertion Loss Measurement Systems, Meters, Mismatches, Microwave, Precision, Mixers, Modulators, All Kinds, Mounts, Oscillators, Plug & Jack Sets, Power Supplies, Receivers, Resistors, Standards, Suppressors, Switches, Tees, Terminals, Testers, Thermistors, Tuners

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Cal	Burbank, Instr. Specialist	213-849-7181
Cal	Santa Clara, Instr. Specialist	408-244-1505
Colo	Denver, PLS Assocs.	303-771-0140
Fla	Orlando, BCS Assocs.	305-896-4881
Ill	Des Plaines, Cozzens & Cudahy	312-298-3600
Ind	Indpls., Cozzens & Cudahy	317-244-2456
Md	Wheaton, Sonco	301-942-9420
Mass	Lexington, Lancer Assoc.	617-861-1720
Minn	Mpls., Cozzens & Cudahy	612-884-4336
Mo	St. Louis, Cozzens & Cudahy	314-423-1234
NJ	Ft. Lee, Tech. Mktg.	201-224-6911
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	No. Syracuse, Naco Elctrns.	315-699-2651
NY	Rochester, NACO Elctrns.	716-244-4720
NY	Utica, Naco Elctrns.	315-732-1801
NC	Greensboro, BCS	919-273-1918
Pa	Philadelphia, Eastern Inst.	215-927-7777
Tex	Ft. Worth, C. Wolf Co.	817-738-1996
Tex	Houston, C. Wolf Co.	713-721-2442
Wash	Seattle, R. Drake	206-763-2755

WELCO INDS. INC., 9027 Shell Ave., Cincinnati, Ohio, 45236, Tel: 513-891-6600, TWX: 810-461-2574; Empl.: 103; Minimum order: $35

For info on price: C. White; Application info: H. Story; Customer service: L. Riesenberg; Delivery info: L. Riesenberg

Products manufactured: Controls/Control Eqpt., Converters, Inverters, Motors

Local Sales Offices & Reps.

Fla	Miami, Ludlum Assoc. Co.	305-885-2514
Ga	Atlanta, H. Homer & Assocs.	404-255-8669
Ill	Park Ridge, L. Fitz Co.	312-631-5488
Mass	Salem, Forbes Engrg. Co.	617-744-1693
Mich	Troy, DBA Control Sls. Assoc.	313-391-3235
Minn	St. Paul, Craighead & Assoc.	612-645-0784
Mo	Kansas City, Horsepower Control Sys.	816-471-6363
NJ	Kenilworth, Wolock & Lott Co.	201-241-4333
NY	Rochester, Ross Equip. Co.	716-271-5660
NC	Charlotte, Ind'l. Drives & Controls	704-535-5414
Ohio	Richfield, Wood-Compton Co.	216-659-6126
Pa	Media, H.B. Stallings & Assocs.	215-566-4100
Va	Richmond, S.D. Harmon & Co.	804-285-3168
Wisc	Kenosha, Transmission Equip. Design	414-652-3412

WELLS ELECTRONICS, INC., Plastics Div., 1701 S. Main St., South Bend, Ind., 46613, Tel: 219-287-5941; Empl.: 85

Products manufactured: Cups, Encapsulation, Holder & Carriers, Services, Assembly, Production & Test, Sockets

Local Sales Offices & Reps.

Ariz	Phoenix, K. Jahn Co.	602-956-9060
Cal	Sunnyvale, Wells Plastics of Cal.	408-734-3435
Fla	Clearwater, Saber Assocs.	
Fla	Lighthouse Point, Saber Assocs.	305-943-3076
Fla	Longwood, Saber Assocs.	305-422-3686
Ga	Woodstock, Saber Assocs.	404-432-9625
Ill	Skokie, Heth, Inc.	312-282-8737
Mass	Auburndale, Schutter-Young Corp.	
Mass	Beverly, Schutter-Young Corp.	617-922-6121
Mich	Detroit, McShane, Inc.	313-366-6084
Minn	Burnsville, Heth, Inc.	616-333-8494
Minn	Minneapolis, D.G. Perry & Co.	612-920-3212
NJ	Teaneck, R.T. Reid & Assocs.	201-692-0200
NY	Fayetteville, M.P. Andrews, Inc.	315-637-3144
Ohio	Dayton, McShane, Inc.	513-298-3441
Ohio	Medina, McShane, Inc.	216-725-4568
Pa	Bala Cynwyd, Electech, Inc.	215-687-5305
Tex	Dallas, Springer Tech. Sls.	214-357-5281
For:	Can., Mont., Que., Subtec Ltd.	514-482-2392
For:	Can., Ottawa, Ont., Subtec Ltd.	613-521-2739
For:	Can., Ottawa, OnT., Subtec Ltd.	613-224-0106
For:	Can., Toronto, Ont., Subtec Ltd.	416-533-2381

WELWYN CANADA DIV., Dale Electronics Inc., Box 2484, 1255 Brydges St., London, Ont., Can., Tel: 519-451-9490; Empl.: 115; Minimum order: $25

For info on price: K. Steers; Application info: C. A. Norris; Customer service: K. Steers; Delivery info: K. Steers

Free literature available: Beyschlag Precision Carbonfilm Resistors 1/8 watt through 2 watts 10 ohms thru 5.1 meg. ±5% tolerance is standard ±2% tol. available on request. "M" Series Metal Film, Precision, -1/4 thru 2 watts standard tol. ±1% and 0.5% .27 OHMS thru 100 meg. Metal oxide film types F07 F20 RL07 RL20 1/4 and 1/2 watt standard tol. ±2% and 5%. ±1% tol. available. 47 cycle to 470K POWER OXIDE "F.P." Series 2 watt thru 10 watts. Std. Tol. ±5% & 10% Lower Tol. available 20 cycle to 91K High voltage "F" Series 1/2 watt and 1 watt ±2%, 5% and 10% tol. 2 meg to 150K meg Ultra High Value 1/4 and 1/2 watt ± 1% thru 10% tol. M, and MH, Series 60 meg to 1000K meg.

Products manufactured: Attenuators, Circuits, Hybrid, Thick Film, Filters, Networks, Resistors

Local Sales Offices & Reps.

FOR:	Can., Montreal, Que., McIntyre Agencies	514-731-9618
FOR:	Can., Winnipeg, Man., Diversified Tech. Reps.	

WER INDUSTRIAL, Div. Emerson Elec. Co., 3036 Alt Blvd., Grand Island, N.Y., 14072, Tel: 716-773-2321; Empl.: 440; Minimum order: $25

For info on price: C. Hollis; Application info: C. Hollis; Customer service: T. DiNoto; Delivery info: C. Hollis

Products manufactured: Brakes, Clutches, Controls/Control Eqpt., Counters, Motor Electric Generator Sets, Power Supplies

Local Sales Offices & Reps.

Ariz	Sun City, Devoe Engrg. Co.	602-974-1023
Cal	Burlingame, Engineering Reps. Co.	415-692-2581
Cal	Fullerton, Devoe Engrg. Co.	714-871-8076
Colo	Littleton, R.L. Palmer Co.	303-771-6827
Conn	Avon, WER Hartford District Office	203-678-0424
Conn	Unionville, Tor-Axial Drive Comps.	203-673-3592
Fla	Clearwater, Arroyo Process Equip.	813-446-0564
Fla	Jacksonville Beach, Arroyo Process Equip.	904-246-0575
Ga	N.W. Atlanta, H. Homer & Assocs.	404-255-8669
Ill	Northbrook, WER Chicago District Office	312-498-5940
Ind	Elkhart, Shaum Electric Co.	219-264-4189
Mass	North Reading, WER Boston Regional Office	617-664-3512
Mich	Farmington, WER Detroit District Office	313-477-5409
Mo	St. Louis, WER St. Louis District Office	314-878-5105
NJ	Kenilworth, Wolock & Lott	201-241-4333
NY	Buffalo, Ross Equip. Co.	716-634-0990
NY	Elmira, Ross Equip. Co.	607-734-1324
NY	Irvington On The Hudson, Wolock & Lott	212-233-2730
NY	Rochester, Ross Equip. Co.	716-271-5660
NY	Syracuse, Ross Equip. Co.	315-463-6691
NC	Charlotte, WER Charlotte	704-537-4364
Ohio	Cincinnati, WER Cincinnati Regional Office	513-232-2285
Ohio	Cuyahoga Falls, WER Akron	216-929-9301
Ohio	Rocky River, WER Cleveland District Office	216-521-5201
Ohio	Toledo, P. H. Girkins	419-241-2101
Ohio	Warren, WER Penn.-Ohio Regional Office	216-929-9301
Pa	Downingtown, WER Philadelphia	215-269-0716
Tex	Dallas, WER Dallas	214-369-0961
Va	Richmond, Sam D. Harmon & Co.	804-285-3168
Wash	Bellevue, Garland Affolter Engrg. Corp.	206-454-2485
Wisc	Mequon, WER Milwaukee District Office	414-242-3633
FOR:	Can., Burnaby, B.C., Lloyd Controls Ltd.	604-291-0484
FOR:	Can., Dartmouth, N.S. B2Y3Z1, Ind'l. Sys. Ltd.	902-466-2461
FOR:	Can., Dollard des Ormeaux 970, Que., WER Montreal Regional Office	514-683-7640
FOR:	Can., Lachine, Que., Peerless Engrg. Sls. Ltd.	514-636-8300
FOR:	Can., Vancouver 9, B.C., Grove Processing Equip. Ltd.	604-879-7771
FOR:	Can., Weston, Ont., Peerless Engrg. Sls. Ltd.	416-742-8702

WERTRONIX CORP., 2673 Culver Ave., Dayton, Ohio, 45429, Tel: 513-299-5586, Telex: 288205; Empl.: 50; Minimum order: $50 .... p. 1•998

Customer service: Sales

Products manufactured: Actuators, Blowers & Fans & Accessories, Brakes, Controls/Control Eqpt., Motor & Generator Armatures, Rotors, Stators, Motors, Services, Assembly, Production & Test, Tachometers

Local Sales Offices & Reps.

Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Santa Monica, Davidson Assocs.	213-829-1731
Colo	Denver, W.J. Purdy Co.	303-777-1411
Fla	Clearwater, Perrott Assocs.	813-726-1549
Fla	Orlando, Perrott Assocs.	305-275-1132
Ill	Chicago, Engineered Sales Co.	312-867-8434
Md	Baltimore, R.L. Wilkinson, Inc.	301-377-7800
Mass	Woburn, Stockwell Tech. Sls. Co.	617-935-5770
Minn	Minnetonka, T.H. Ayre Assocs.	612-474-4125
Mo	St. Louis, Boweng Tech.	314-429-7327
NM	Albuquerque, W.J. Purdy Co.	505-266-7959
NY	Fairport, D.J. Kirby Co.	716-254-2070
Ohio	Fairborn, Technical Assocs.	513-878-2484
Okla	Tulsa, Kemp Engineering Co.	918-299-2636
Pa	Glenside, R.L. Wilkinson, Inc.	215-424-8400
Tex	Addison, Kemp Engrg. Co.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Va	Fairfax, Nine Assocs.	703-273-1803
Wash	Bellevue, SD-R&S2 Products & Sls.	206-747-9424

WESCO ELECTRICAL CO., 201 Munson St., Greenfield, Mass., 01301, Tel: 413-774-4358; FSC No: 12673; QPL No: MIL-C-25; Empl.: 140; Minimum order: $35 .... p. 2•334-337

For info on price: J. R. DeSanty; Application info: J. R. DeSanty; Customer service: M. Cimler; Delivery info: M. Wandeleski

Free literature available: Film-Foil & Metallized film capacitors. Specializing in precision (close tolerance) & custom design.

Products manufactured: Capacitors, Fixed

Local Sales Offices & Reps.

Cal	Santa Ana, Rical Assocs.	714-557-6543
Colo	Golden, Bob Callister & Assocs.	303-761-0992
Conn	Madison, A & M Elctrn. Reps.	203-245-1031
Fla	Altamonte Springs, Semtronic Assocs.	305-831-8233
Fla	Ft. Lauderdale, Semtronic Assocs.	305-771-0010
Ill	Chicago, L-TEC, Inc.	312-286-1500
Ind	Columbus, J.H. Weaver Co.	812-372-3625
Md	Towson, Habco Elctrns., Inc.	301-825-9637
Mass	Needham, A & M Elctrn. Reps.	617-444-8170
NJ	Madison, Livera-Polk Assocs.	201-377-3220
NY	Roslyn Heights, Livera-Polk Assocs.	516-484-1276
NC	Knightdale, Leigh Sls.	919-266-0105
Tex	Dallas, Blackburn Assocs.	214-351-9991
Wash	Redmond, Desco Northwest	206-445-9325

WEST COAST RESCH. CORP., Box 25061, Los Angeles, Calif., 90025, Tel: 213-478-8833; FSC No: 51276; Empl.: 21

Free literature available: Transducer bulletin & ampliducer models; transducer monitors; absorption dynamometers; bonded strain gage accelerometer; signal conditioning instrumentation plug-in modules.

Products manufactured: Accelerometers, Amplifiers, Analyzers, Bridges, Cells, Load, Controls/Control Eqpt., Converters, Gages, Indicators, Lamps, Meters, Monitors, Power Supplies, Probes, Signal Conditioners & Equipment, Slip-Rings & Assemblies, Testers, Thermometers, Resistance, Totalizers, Digital, Transducers

Local Sales Offices & Reps.

Cal	Concord, Gado Instr. Sls.	415-933-5566
Cal	Mt. View, Gado Instr. Sls.	415-961-2222
Cal	San Diego, Miracle & Assocs.	714-276-8619
Colo	Englewood, Klein Aerospace	303-781-4967
Ill	Lombard, Quadtron Assocs.	312-627-6800
Mass	Woburn, Bar-Tech Assocs.	617-935-1568
SC	Greenville, Greentron	803-277-3537
Va	Arlington, S & M Assocs.	703-354-1192
FOR:	Can., Scarborough, Ont., Intl. Rectifier Can., Ltd.	416-755-7793

Advertisment

West Coast Research manufactures the broadest line of strain gage transducers as well as signal conditioning and readouts for pressure, force, torque, flow, acceleration, displacement and temperature. Orginators of multiple range, multiple variable transducers, miniature load cells. Complete dynamometers, slip-rings, anemometers and wind tunnel equipment.

WESTAMP, INC., 1542 15th St., Santa Monica, Cal., 90404, Tel: 213-393-0401; Empl.: 45

For info on price: J. Manda; Application info: J. Manda; Customer service: S. Johnson; Delivery info: S. Johnson

Free literature available: Descriptions and technical specifications of PWM servo amplifiers, 100W to 10kW.

Products manufactured: Amplifiers, Controls/Control Eqpt., Servo Systems

WESTERN COATING CO., Box 598, Royal Oak, Mich., 48073, Tel: 313-588-3311; Empl.: 10

Free literature available: Westcoat - A hot melt coating; Maskcoat - Plating stopoff; Melting pots and tanks; Polarflex 10 - Hot melt coating

Products manufactured: Coatings, Compounds, Encapsulating, Insulating, Molding, Potting, Films

Local Sales Offices & Reps.

Cal	San Gabriel, Western Coating Co.	213-283-9331
Fla	Miami, Palmer Supplies Co.	305-633-8007
Ohio	Rocky River, Griff Otte	216-331-4139
Pa	Havertown, Pakoil Co.	215-446-5273
Tex	Dallas, Ahart Tool & Engrg. Co.	214-747-6004

WESTERN COIL & ELEC. CO., 215 State St., Racine, Wisc., 53403, Tel: 414-632-4741; Empl.: 15

Products manufactured: Cabinets & Accessories, Jigs And Fixtures, Chassis & Circuit Board, Lamps, Services, Assembly, Production & Test

Local Sales Offices & Reps.

Ill	Crystal Lake, C.B. Bruse	815-459-2230

WESTERN DIGITAL CORP., 3128 Red Hill Ave., Newport Beach, Cal., 92663, Tel: 714-557-3550, TWX: 910-595-1139; FSC No: 52840; Empl.: 800; Minimum order: $50

For info on price: F. Little; Application info: F. Little; Customer service: S. Goodrich; Delivery info: L. Duchene

Free literature available: Data Sheets; App. Notes; Data Com Brochure-WDC's line of data com mos/ls1; Calculator Brochure-WDC's line of mos/ls1 calculator circuits

Products manufactured: Comm. Systems, Integrated Circuit Devices, Memories, Buffer

Local Sales Offices & Reps.

Ala	Huntsville, Tech-Rep Assocs.	205-881-5925
Cal	Los Altos, W.W. Posey Co.	415-948-7771
Fla	Indian Rocks Beach, Tech-Rep Assocs.	813-595-2834
Md	Rockville, Marktron, Inc.	301-762-6210
Md	Towson, Marktron, Inc.	301-825-8222
Mass	Medford, Blake Assocs.	617-391-7890
Mich	Detroit, A. Blumenberg Assocs.	313-557-1934
Minn	Minneapolis, S & R Sls.	612-544-3022
Mo	Kansas City, Nevco, Inc.	816-421-1751
NJ	Fort Lee, Northern Elctrn. Comps.	201-461-2789
NY	Endicott, Tech-Mark, Inc.	607-748-7473
NY	Fairport, Tech-Mark, Inc.	716-223-1252
NY	Liverpool, Tech-Mark, Inc.	315-652-6229
NY	Pleasant Valley, Tech-Mark, Inc.	914-635-3436
Ohio	Aurora, Engrg. Mktg. Assocs.	216-562-6104
Ohio	Dayton, Engrg. Mktg. Assocs.	513-433-2800
Ore	Beverton, Arneson Assocs.	503-643-5754
Pa	Birchrunville, Jadelectronic Assocs.	215-647-5151
Tex	Dallas, R.R. Thomas Co.	214-363-8591
Wash	Seattle, Arneson Assocs.	206-762-6210
EXP:	New York, N.Y., AD Auriema	

WESTERN ELCTRN. PRODS. CO., 107 Los Molinos, San Clemente, Cal., 92672, Tel: 714-492-4677; FSC No: 13988; Minimum order: $10

Free literature available: Automatic measuring wire cutter (for wire and tubing); coaxial cable strippers (hand and motorized); no-nick thermal wire strippers.

Products manufactured: Machines/Machinery, Production, Wire Strippers

Local Sales Offices & Reps.

Ariz	Phoenix, B. Kinkner Assocs.	602-944-4691
Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Cal	Pasadena, P. Nurches Co.	213-681-8957
Conn	Sherman, R. P. Mahan Co. Inc.	203-355-0231
Fla	Delray Beach, J. P. Dearie Co.	305-276-7462
Ill	Glenview, F. William Castle Co.	312-724-3075
Mass	Wellesley, R. P. Mahan Co., Inc.	617-237-1040
Minn	Minneapolis, Xylem Co.	612-920-9626
Mo	Joplin, RM Engrg. & Sls.	417-781-4591
NJ	Mountain Lakes, J. P. Dearie Company	201-334-4848
Ohio	Cincinnati, Schlemmer Assocs.	513-522-8340
Tex	Houston, Jordan Equip. Co., Inc.	713-498-6212
Wash	Kingston, F. H. Haight Co.	206-297-3212
EXP:	Torrance, Cal., Unitool Corp.	213-772-0751

WESTERN ELECTRONIC SYSTEMS, 4067 Transport St., Palo Alto, Cal., 94303, Tel: 415-494-3931; Empl.: 15

Customer service: R.K. Johnson

Products manufactured: Backpanel Interconnect Systems, Boards, Plug-In, Boards, Printed Wiring, Universal, Connectors, Sockets, Testers

Local Sales Offices & Reps.

Cal	Santa Ana, Cir-Plex Entpr.	714-542-3521
Cal	Santa Clara, Bank Sls.	408-246-6311
Colo	Westminster, Harvey Data Systems	303-427-5299
Conn	Tariffville, M & M Assocs.	203-658-4827
Ill	Glenview, F.W. Castle Co.	312-724-3075
Mich	Detroit, Electro Entprs.	313-521-1500
NC	Charlotte, B. Henry Assocs.	704-375-8958
Ohio	Dayton, Electro Entprs.	513-426-6071
Pa	Pittsburgh, Electro Entprs.	412-371-8497
Tex	Dallas, R. W. Mureen Co.	214-369-5761

WESTERN GEAR CORP., Electro Prods. Oper., 14724 East Proctor, City of Industry, Cal, 91749, Tel: 213-796-4390, TWX: 910-346-6704; Empl.: 300

Customer service: F. Grew, 213-638-7821

Products manufactured: Actuators, Gears & Gear Mechanisms (Precision), Motors

Local Sales Offices & Reps.

Ala	Birmingham	205-252-4711
Cal	Belmont	415-593-7611
Cal	Lynwood	213-636-0911
NJ	Secaucus	201-348-3400
Pa	Pittsburgh	412-471-0744
Tex	Houston	713-626-9880
Va	Arlington	703-528-5010
Wash	Everett	206-259-0922

WESTERN MAGNETICS, INC., 1733 Flower St., Glendale, Cal., 91201, Tel: 213-247-4660; Empl.: 100

Customer service: N. Mueller X30

Products manufactured: Heads, Recording Playback, Erase

WESTERN MICROSYSTEMS, INC., 8733 Magnolia Ave., Santee, Cal., 92071, Tel: 714-449-0425; Minimum order: $200

Customer service: W.J. Dwyer

Free literature available: Nichrome-Nickel-Gold substrates for thin film hybrids. Thin film chip resistors for hybrid circuits. Conductor-resistor or conductor only thin film substrate etching and assembly.

Products manufactured: Circuits, Hybrid, Thin-Film, Networks, Resistors, Services, Assembly, Production & Test

WESTERN THERMISTOR CORPORATION, 303 Via El Centro, Oceanside, Cal., 92054, Tel: 714-433-4484; Empl.: 10; Minimum order: $10

Customer service: R. L. Winter

Free literature available: Chip thermistors with leads and coatings, Data Sheets - 10 ohms to 500,000 ohm thermistors Rt/R25 ratio tables hybrid chip thermistors without leads.

Products manufactured: Thermistors

Local Sales Offices & Reps.

Ariz	Scottsdale, E. J. Foley & Assocs.	602-945-2665
Cal	El Monte, Telemart Co.	213-444-7666
Cal	San Carlos, Winco Sls.	415-365-6082
Cal	San Diego, Daniels & Doty Sls.	714-560-6266
Colo	Denver, J. S. Heaton Co.	303-758-5130
Ill	Glenview, Crimson Engrg. Co.	312-724-1780
Ind	Indianapolis, R.H. Newsom & Assocs.	317-849-4442
Mass	Reading, Kanan Assocs.	617-944-8484
Minn	Minneapolis, Merrill Franklin Co.	612-835-6422
Mo	St. Louis, Beneke & McCaul	314-434-6242
NY	Rochester, G.P. Troy	716-586-4867
Ohio	Rock River, N. Case Assocs.	216-333-4120
Pa	Philadelphia, K.B. Erdman	215-224-1833
Wash	Seattle, J. J. Backer Co.	206-285-1300
FOR:	Can., Don Mills, Ont., J-Tronics	416-429-6324

WESTINGHOUSE CANADA LTD., Box 510, Hamilton, Ont., Can., Tel: 416-528-8811, Telex: 021-655

Customer service: D. S. Farquharson

Products manufactured: Comm. Systems, Converters, Display Devices/Displays, Terminal Equipment, Digital, Terminals, Data Display (including Alphanumeric & Graphic)

WESTINGHOUSE ELEC. CORP., 6 Gateway Ctr., Pittsburgh, Pa, 15222

WESTINGHOUSE ELEC. CORP., Electronic Tube Div., Box 284, Elmira, N.Y., 14902, Tel: 607-739-7951; Empl.: 2000

Products manufactured: Cable, Detectors, Gages, Intensifiers, Image, Switches, Television Systems & Equipment Closed-Circuit, Thermocouples, Elements & Accessories, Transducers, Tubes

Local Sales Offices & Reps.

Cal	Los Angeles	213-482-9660
Cal	Sunnyvale	408-735-2191
Colo	Denver	303-825-0441
Fla	Orlando	305-843-7030
Ill	Oak Brook	312-887-8909
Ind	Fort Wayne	219-483-6476
Md	Baltimore	301-765-2355
NY	Hempstead	510-489-2200
Ohio	Dayton	513-228-9631
Pa	Pittsburgh	412-255-4518
Tex	Dallas	214-631-2811

WESTINGHOUSE ELEC., Ind'l. Equip., Box 300, Sykesville, Md., 21784, Tel: 301-795-2800; Empl.: 300

Products manufactured: Alloys, Amplifiers, Cleaners & Solvents, Cleaners, Ultrasonic, Converters, Generators, Heaters & Heating Elements, Inverters, Machines/Machinery, Production, Welding Equipment & Access. (Excluding Equip. for Semiconductor Devices)

WESTINGHOUSE ELEC., Lamp Div., Parts Sls., 1 Westghse Plaza, Bloomfield, N. J., 07003, Tel: 201-465-3325

Products manufactured: Lamps, Ultraviolet Inspection Lighting

Local Sales Offices & Reps.

Ark	Little Rock	501-375-2471
Cal	Los Angeles	213-482-9660
Cal	San Francisco	415-445-2000
Colo	Denver	303-825-0441
Conn	Hartford	203-249-5792
Fla	Miami	305-634-5461
Ga	Atlanta	404-361-5200
Ill	Chicago	312-461-7200
Ind	Indianapolis	317-632-3301
La	New Orleans	504-486-6141
Md	Baltimore	301-792-7600
Md	Laurel	301-953-2300

Mass	Belmont	617-IV 4-6020
Mich	Southfield, 313-352-9000	617-IV 4-6020
Minn	Minneapolis	612-927-6551
Mo	Kansas City	816-483-4711
Mo	St. Louis	314-421-6911
NJ	East Orange	201-465-2482
NY	New York	212-692-3211
NY	Richmond Hill	212-VI 7-9800
NY	Rochester	716-232-4380
NC	Charlotte	704-377-3471
Ohio	Cincinnati	513-475-7301
Ohio	Cleveland	216-475-7301
Pa	Bala Cynwyd, 215-MO 7-7600	216-475-7301
Pa	Pittsburgh	412-255-3800
Tex	Dallas	214-631-2811
Utah	Salt Lake City	801-486-8751
Va	Richmond	703-649-9061
Wash	Tukwila	206-623-7001

WESTINGHOUSE ELEC. CORP., Relay-Instr. Div., 95 Orange St., Newark, N.J., 07101, Tel: 201-465-0222; Empl.: 1200

Products manufactured: Meters, Recorders, Shunts, Meter, Transducers

Local Sales Offices & Reps.

Ala	Birmingham	205-871-0366
Ala	Mobile	205-344-4273
Ariz	Phoenix	602-258-7211
Ark	Little Rock	501-376-3462
Cal	Bakersfield	805-327-7633
Cal	Compton	213-638-7781
Cal	Emeryville	415-652-3770
Cal	Fresno	209-233-0576
Cal	Los Angeles	213-482-9660
Cal	Riverside	714-682-6551
Cal	Sacramento	916-922-7071
Cal	San Diego	714-279-0233
Cal	San Francisco	415-445-2000
Cal	Sunnyvale	408-735-2601
Colo	Denver	303-825-0441
Conn	Hartford	203-249-5792
DC	Washington	202-833-5000
Fla	Jacksonville	904-356-5811
Fla	Miami	305-634-5461
Fla	Tampa	813-837-7171
Ga	Albany	912-436-0144
Ga	Atlanta	404-885-5200
Haw	Honolulu	808-839-0311
Idaho	Boise	208-344-2502
Ill	Aurora	312-897-4293
Ill	Chicago	312-461-7200
Ill	Danville	217-442-1901
Ill	Peoria	309-673-0754
Ill	Rockford	815-398-3591
Ind	Evansville	812-425-7146
Ind	Ft. Wayne	219-483-6476
Ind	Hammond	219-844-9400
Ind	Indianapolis	317-632-3301
Ind	So. Bend	219-287-1051
Iowa	Cedar Rapids	319-366-0781
Iowa	Davenport	319-323-2761
Iowa	Des Moines	515-283-2081
Kans	Wichita	316-263-2295
Ky	Louisville	502-459-5440
La	Baton Rouge	504-344-9448
La	New Orleans	504-486-6141
La	Shreveport	318-425-2435
Me	Augusta	207-623-4571
Md	Towson	301-828-5400
Mass	Boston	617-542-0600
Mass	Springfield	413-734-3101
Mass	Worcester	617-853-2680
Mich	Grand Rapids	616-456-1531
Mich	Jackson	517-787-3630
Mich	Saginaw	517-793-8680
Mich	Southfield	313-352-9000
Minn	Duluth	218-727-1541
Minn	Minneapolis	612-927-6551
Miss	Jackson	601-354-2373
Mo	Kansas City	816-421-7122
Mo	St. Louis	314-421-6911
Mont	Butte	406-792-2301
Neb	Omaha	402-397-2820
NJ	E. Orange	201-465-0222
NM	Albuquerque	505-265-6647
NY	Albany	518-459-1820
NY	Buffalo	716-854-3966
NY	New York	212-692-3211
NY	Olean	716-372-0040
NY	Rochester	716-232-4380
NY	Syracuse	315-463-9581
NY	Watertown	315-788-7700
NC	Charlotte	704-377-3471
NC	Greensboro	919-273-5563
NC	Raleigh	919-834-4375
Ohio	Akron	216-376-2171
Ohio	Cincinnati	513-475-7400
Ohio	Cleveland	216-579-2121
Ohio	Columbus	614-272-4000
Ohio	Dayton	513-228-9601
Ohio	Toledo	419-255-2205
Ohio	Youngstown	216-744-8911
Okla	Oklahoma City	405-232-8565
Okla	Tulsa	918-583-3191
Ore	Eugene	503-342-3083
Ore	Portland	503-224-4200
Pa	Allentown	215-433-3296
Pa	Bala Cynwyd	215-667-7600
Pa	Erie	814-453-4381
Pa	Johnstown	814-288-1559
Pa	Pittsburgh	412-255-3800
Pa	Wilkes Barre	717-825-7337
Pa	Williamsport	717-326-4289
SC	Columbia	803-256-1511
SC	Greenville	803-232-5695
Tenn	Chattanooga	615-267-9146
Tenn	Kingsport	615-247-5167
Tenn	Knoxville	615-522-8101
Tenn	Memphis	901-526-8546
Tenn	Nashville	615-327-4911
Tex	Amarillo	806-372-3259
Tex	Beaumont	713-898-1157
Tex	Corpus Christi	512-883-9236
Tex	Dallas	214-631-2811
Tex	El Paso	915-542-1744
Tex	Houston	713-621-9000
Tex	Odessa	915-337-1822
Tex	San Antonio	512-223-9181
Utah	Salt Lake City	801-486-8751
Va	Richmond	703-285-3909
Va	Roanoke	703-342-8925
Wash	Seattle	206-623-7001
Wash	Spokane	509-535-3521
WVa	Bluefield	304-325-3651
WVa	Charleston	304-346-9606
WVa	Fairmont	304-363-0400
WVa	Huntington	304-529-7146
WVa	Wheeling	304-232-4100
Wisc	Appleton	414-739-2313
Wisc	Madison	608-257-4517
Wisc	Milwaukee	414-264-6400

WESTINGHOUSE ELEC. CORP., Semiconductor Div., Youngwood, Pa., 15697, Tel: 412-925-7272, TWX: 510-468-2840; Empl.: 800 .... p. 1•1896-1909

Products manufactured: Bridges, Diodes, Rectifiers, Thyristors (Includes Silicon Controlled Rectifiers), Transistors

Local Sales Offices & Reps.

Ariz	Phoenix, Bestronics	602-248-7020
Cal	Los Angeles, Black-Ekizian-Strong	213-870-9191
Cal	San Diego, Bestronics	714-278-2150
Cal	Sunnyvale, Westinghouse Elec.	408-735-2191
Conn	Newtown, Gerber Sls. Corp.	203-426-3440
Fla	Clearwater, CBC Elec.	813-447-3375
Fla	Ft. Lauderdale, CBC Elec.	305-484-7330
Fla	Winter Park, CBC Elec.	305-644-2277
Ill	Oak Brook, Westinghouse Elec.	312-887-8909
Md	Towson, Westinghouse Elect.	301-828-5400
Mass	Boston, Westinghouse Elec.	617-542-0600
Mass	E. Longmeadow, Gerber Sls. Corp.	413-525-3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Farmington, Sheridan Assocs.	313-477-3800
Minn	Minneapolis, Comstrand, Inc.	612-560-5300
Mo	Florissant, Sheridan Assocs.	314-837-5200
Mo	Hazelwood, Dy-Tronix Inc.	314-731-5799
Mo	Kansas City, Dy-Tronix Inc.	816-761-6543
NY	Clinton/Utica, Advanced Comp. Corp.	315-853-6438
NY	Endicott, Advanced Comp. Corp.	607-785-3191
NY	Hempstead, Westinghouse Elec.	516-489-2200
NY	N. Syracuse, Advanced Comp. Corp.	315-699-2671
NY	Scottsville, Advanced Comp. Corp.	716-889-1429
NC	Charlotte, Westinghouse Elec.	704-377-3471
Ohio	Beachwood, Sheridan Assoc.	216-831-0130
Ohio	Cincinnati, Sheridan Assoc.	513-761-5432
Ohio	Dayton, Sheridan Assoc.	513-277-8911
Pa	Bala Cynwyd, Westinghouse Elec.	215-667-7600
Pa	Youngwood, Westinghouse Elec.	412-925-7272
Wisc	Milwaukee, Westinghouse Elec.	414-931-4462

Local Distributors

Ala	Huntsville, Cramer/Huntsville, 2310 Bob Wallace Ave., S.W.	205-539-5722
Ala	Birmingham, ACK Semiconduuctors, Inc., 3101 Fourth Ave. So.	205-322-0588
Ariz	Phoenix, Cramer/Phoenix, 2643 E. University Dr.	602-267-7321
Ariz	Phoenix, Hamilton/Avnet of Ariz., 2615 So. 21st St.	602-275-7851
Cal	Culver City, Hamilton Electro Sales, 10912 W. Washington Blvd.	213-870-7171
Cal	Inglewood, Newark Electronics, 4747 W. Century Blvd.	213-678-0441
Cal	Irvine, Cramer/Los Angeles, 17201 Daimler	714-979-3000
Cal	Mountain View, Hamilton/Avnet Electronics, 575 E. Middlefield Rd.	415-961-7000
Cal	San Diego, Cramer/San Diego, 8913 Complex Dr.	714-565-1881
Cal	San Diego, Hamilton/Avnet of San Diego, 8917 Complex Dr.	714-279-2421
Cal	Sunnyvale, Cramer/San Francisco, 720 Palomar Ave.	408-739-3011
Colo	Denver, Cramer/Denver, 5465 E. Evans	303-758-2100
Colo	Denver, Hamilton/Avnet of Denver, 5921 N. Broadway Box 16407	303-534-1212
Conn	No. Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/E.W., Inc., 4035 No. 29th St.	305-923-8181
Fla	Orlando, Cramer/E. W., Inc., 345 Graham Ave., Box 20214	305-894-1511
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Indl. Center	404-448-9050
Ga	Atlanta, Specialty Distributing, 763 Juniper St., N. E., Box 6326	404-873-2521
Ga	Augusta, Specialty Distributing, 1251 Gordon Park Rd., Box 1728	404-722-1526
Ill	Elmhurst, Semiconductor Specialists, Inc., 195 Spangler Ave.	312-279-1000
Ill	Schiller Park, Hamilton/Avnet Elctrns., 3900 N. 25th Ave.	312-678-6310
Ind	Fort Wayne, Fort Wayne Electronics Supply Inc., 3606 E. Maumee	219-423-3422
Ind	Indianapolis, RA-DIS-CO, 814 N. Senate Ave.	317-637-5571
Md	Gaithersburg, Cramer/E. W., Inc., 16021 Industrial Dr.	301-948-0110
Md	Hanover, Cramer/Baltimore, 7255 Standard Dr.	301-796-5790
Md	Hanover, Hamilton/Avnet of Baltimore, 7255 Standard Dr.	301-796-5000
Md	Savage, Pyttronic Inc., 8220 Wellmoor Ct.	301-792-7000
Mass	Newton Center, Cramer Elctrns., Inc., 85 Wells Ave.	617-969-7700
Mass	Waltham, Schweber Elctrns., 213 Third Ave.	617-890-8484
Mich	Farmington, Semiconductor Specialists, Inc., 33505 State St.	313-478-2700
Mich	Farmington, Sheridan Sales Co., 24534 Indoplex Circle	313-477-3800
Minn	Minneapolis, Semiconductor Specialists, Inc., 8030 Cedar Ave. So.	612-854-8841
Mo	North Kansas City, LComp Kansas City, Inc., 1520 Tanev St.	816-221-2400
NJ	Cherry Hill, Cramer/Pa., Springdale Rd., Cherry Hill Ind'l. Site	609-424-5993
NJ	Cinnaminson, Wilshire Elctrns., 855 Industrial Hwy. - Unit 5	609-786-8990
NJ	Moonachie, Cramer/N.J., 1 Barrett Ave.	201-935-5600
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Ave.	609-235-1900
NM	Albuquerque, Cramer/Albuquerque, 137 Vermont N.E.	505-265-5767
NY	East Syracuse, Cramer/Syracuse, 6716 Joy Rd.	315-437-6671
NY	Endwell, Cramer/Binghamton, 3220 Watson Blvd.	607-754-6661
NY	Freeport, Milgray Elctrns., Inc., 191 Hanse Ave.	516-546-6000
NY	Hauppauge, Cramer/Systems, 29 Oser Ave.	516-231-5600
NY	Rochester, Cramer/Rochester, 3000 S. Winton Rd.	716-275-0300
NY	Westbury, Schweber Elctrns., Jericho Tpke.	516-334-7474
NC	Winston-Salem, Cramer/Winston-Salem, 938 Burke St.	919-725-8711
Ohio	Beachwood, Sheridan Sls. Co., 23224 Commerce Pk. Rd.	216-831-0130
Ohio	Cincinnati, Sheridan Sales Co., Box 37825	513-761-5432
Ohio	Columbus, Hughes-Peters, Inc., 481 E. Eleventh Ave.	614-294-5351
Pa	Pittsburgh, Cameradio Elctrns., 2801 Liberty Ave.	412-288-2600
Tex	Dallas, Hall-Mark Elctrns. Corp., 9333 Forest La.	214-231-6111
Tex	Houston, Altair Co., 9501 Baythorne Dr.	713-462-3029
Tex	Houston, Hall-Mark Elctrns. Corp., 8000 Westglen Dr.	713-781-6100
Tex	Richardson, Altair Co., 405 N. Plano Rd., Box 26	214-231-5166

Utah Salt Lake City, Cramer/Salt Lake City, 391 W. 2500 South 801-487-4131
Wash Bellevue, Hamilton/Avnet, 13407 Northrup Way 206-746-8750
Wash Seattle, Cramer/Seattle, 5602 6th Ave. So. 206-762-5755
WVa Charleston, McJunkin Corp., 1400 Hansford St., Box 513 304-348-4965
Wisc Mequon, Taylor Electric Co., 1000 W. Donges Bay Rd. 414-241-4321

WESTMORELAND PLASTICS CO., 135 Gertrude St., Latrobe, Pa., 15650, Tel: 412-539-1612; Empl.: 125

Products manufactured: Knobs, Lights, Services, Assembly, Production & Test

Local Sales Offices & Reps.
Cal Fremont, Hartfield, Kennan & Freytag 415-863-2200
Cal Los Angeles, Hartfield, Kennan & Freytag 213-225-1318
Ill Skokie, B. Brown Sls. Co. 312-673-0660
Ind Indianapolis, D. Hilligoss 317-849-1636
Kans Shawnee Mission, Lauber-Kruper, Inc. 913-831-0140
Mass Woburn, R.W. Hatfield Co. 617-933-2324
Mich Detroit, F.R. Burczyk Assoc. 313-872-6620
Mo Kirkwood, Lauber-Kruper Inc. 314-966-4735
Pa Allentown, S.D. Adams & Co. 215-395-1031
Pa Emmaus, J.S. Adams & Co. 215-965-2391
Tenn Hendersonville, B. Lucas Assocs. 615-824-5818
Wash Vancouver, Hartfield, Kennan & Freytag 503-228-1683
FOR: Can., Toronto, Ont., Harvey Waldman & Co. Ltd. 416-787-0133

WESTON COMPS. DIV., Weston-Archbald, Archbald, Pa., 18403, Tel: 717-876-1500, TWX: 510-656-2902; FSC No: 94271; Empl.: 820; Minimum order: $50

For info on price: L. Hoover; Application info: J. Kopa; Customer service: L. Hoover; Delivery info: L. Hoover

Free literature available: "Lots of Pots," Weston short form catalog detailing brief mechanical and electrical specifications for wirewound, cermet as well as all mil approved trimming potentiometers.

Products manufactured: Potentiometers, Resistors

Local Sales Offices & Reps.
Ala Huntsville, 20th Century Mktg. 205-772-9237
Ariz Scottsdale, Piper Sls. 602-949-8424
Cal San Diego, Ohm-Spun Elctrns. 714-277-6230
Cal Santa Clara, Nova-Tronix 408-243-9530
Cal Van Nuys, Wes-K Assocs. 213-989-3070
Colo Denver, Camel Elctrns., Inc. 303-757-6191
Conn Hamden, Impact Elctrns. 203-281-1331
Fla Clearwater, Perrott Assocs. 813-531-5513
Fla Orlando, Perrott Assocs. 305-275-1132
Ill Skokie, Mar-Con Assocs. 312-675-6450
Kans Overland Park, Ensco-Rep, Inc. 913-381-7557
Md Baltimore, B. White & Co. 301-484-5400
Mass Waltham, Impact Elctrns. 617-893-2850
Mich Southfield, Representatives Elctrn. Prod. 313-354-9066
Minn St. Paul, R. Ragon 612-488-0201
Mo St. Louis, Ensco-Rep, Inc. 314-567-3935
NJ Camden, QED Elctrns. 609-365-2450
NY Albany, Compar Albany 518-489-4777
NY Huntington Station, Addem 516-567-5900
Ohio Dayton, J.C. Hofstetter Co. 513-298-0662
Ohio Medina, J.C. Hofstetter 216-241-4880
Pa Archbald, Weston Comp. Div. 717-876-1500
Tex Richardson, Vista Assocs. 214-235-4547
Wash Seattle, Underwood & Underwood 206-243-2133
FOR: Can., Hamilton 10, Ont., Cartwright Southall Assocs. 416-528-0294
FOR: Can., Montreal 251, Que., McIntyre Agencies 514-731-9617

WESTON INSTRS., INC., 614 Frelinghuysen Ave., Newark, N.J., 07114, Tel: 201-243-4700; Empl.: 1100 p. 2•1116-1120

For info on price: R. L. Craig; Application info: J. Watson; Customer service: P. Barba; Delivery info: P. Barba

Products manufactured: Cases, Equipment, Instrument, Meter, Counters, Magnets, Meters, Monitors, Tachometers, Thermometers, Resistance

Local Sales Offices & Reps.
Ala Huntsville, Kemp Instrs. Co. 205-837-4304
Cal Los Angeles, Weston Instrs., Inc. 213-268-9271
Fla Orlando, Col-Ins-Co., Inc. 305-423-7615
Ill Chicago, Weston Instrs., Inc. 312-352-3500
Iowa Cedar Rapids, Palatine Engrg. Sls. 319-365-8071
Kans Kansas City, Palatine Engrg. Sls. 913-262-5643
Kans Wichita, Palatine Engrg. Sls. 316-683-7512
Md Columbia, Weston Instrs. 301-730-1400
Mass Boston, Weston Instrs., Inc. 617-246-1800
Mich Detroit, Nicon Assocs. 313-341-7688
Mo St. Louis, Palatine Engrg. Sls. 314-426-7055
NJ Fort Lee, Tecnimat 201-461-8686
NJ Newark, Weston Instrs., Inc. 210-243-4707
NY Syracuse, Weston Instrs., Inc. 315-454-3226
Ohio Cincinnati, Luebbe Sls. Co. 513-871-4211
Ohio Cleveland, Luebbe Sls. Co. 216-333-0425
Ohio Dayton, Luebbe Sls. Co. 513-294-0426
Okla Tulsa, Kemp Engrg. Co. 918-299-2636
Pa Philadelphia, Weston Instrs., Inc. 215-665-8270
Tex Dallas, Kemp Engrg. Co. 214-661-0400
Tex Houston, Weston Instrs., Inc. 713-681-1358
Wash Seattle, S.E.A. 206-232-6550

WESTON SCHLUMBERGER, Weston Components, Archbald, Pa., 18403, Tel: 717-876-1500, TWX: 510-656-2902; FSC No: 94271; QPL No: Multiple; Empl.: 955; Minimum order: $50

For info on price: F. J. Butteri; Application info: J. F. Cousins; Customer service: J. J. Kopa; Delivery info: L. M. Hoover

Products manufactured: Potentiometers

Local Sales Offices & Reps.
Ala Huntsville, 20th Century Mktg. Inc. 205-772-9237
Ariz Scottsdale, Piper-Goyne, Inc. 602-949-8424
Cal San Diego, Ohm-Spun Elctrns. 714-277-6230
Cal Santa Clara, Nova-Tronix 408-243-9530
Cal Van Nuys, Wes-K Assocs. 213-989-3070
Colo Denver, Camel Elctrns. 303-757-6191
Conn Hamden, Impact Elctrns. 203-281-1331
Fla Clearwater, Perrott Assocs. 813-726-1549
Fla Orlando, Perrott Assocs. 305-275-1132
Ill Skokie, Marcon Assocs. 312-675-6450
Kans Overland Park, Ensco-Rep, Inc. 913-381-7557
Md Baltimore, B. White & Co. 301-484-5400
Mass Waltham, Impact Sls. Co. 617-893-2850
Mich Southfield, Representatives Elctrn. Prods. 313-354-9066
Minn St. Paul, R. G. Ragon, Inc. 612-488-0201
Mo St. Louis, Ensco-Rep, Inc. 314-567-3935
NJ Camden, QED Elctrns. 609-365-2450
NY Albany, Reagan/Compar, Albany, Inc. 518-489-4777
NY Huntington Station, Addem 516-567-5900
Ohio Dayton, J. C. Hofstetter Co. 513-296-1010
Ohio Medina, J. C. Hofstetter Co. 216-241-4880
Tex Houston, Vista Assocs. 713-661-0119
Tex Richardson, Vista Assocs. 214-235-4547
Wash Seattle, Underwood & Underwood 206-243-2133

Local Distributors
Ala Birmingham, MG Elctrns., 3112 Sixth Ave. S. 205-328-4525
Ariz Phoenix, Mirco, 2005 W. Peoria Ave. 602-944-2281
Cal Carson, Hi Rel Distributor Sls., 20507 Belshaw 213-774-8200
Cal Costa Mesa, Components Center Inc., 1240 "E" Logan Ave. 714-979-0433
Cal Gardena, Bell Industries, 306 E. Alondra Blvd. 213-321-5802
Cal San Diego, Electronic Distributor, 3650 Clairemont Dr. 714-274-7242
Cal Sunnyvale, Acacia Sls., 384 San Alesco Ave. 408-735-0100
Cal Woodland Hills, Rampart, 21201 Oxnard St. 213-887-6400
Colo Lakewood, Acacia Sls., 11111 W. 8th Ave. 303-232-2882
Conn Stratford, State Elctrns. Parts, 1269 Barnum Ave. 203-375-5961
Fla Orlando, Pelcor, Box 14267 305-273-6080
Ill Elk Grove Village, GBL Elctrns., 75 Gaylord St. 312-593-3220
Ill Westmont, Bodelle Co., 47 Chestnut Lane 312-323-9670
Ind Indianapolis, Graham Elctrns., 133 S. Penn. St. 317-634-8486
Kans Kansas City, Tennant Elctrns., 6320 Kansas Ave. 913-287-2100
Md Baltimore, Arrow Elctrns., 4801 Benson Ave. 301-247-5200
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Md Beltsville, Treeko Sls., 4937 Harford Ave. 301-937-8260
Md Bethesda, Empire Elctrn. Supply, 4907 Rugby Ave. 301-OL6-3300
Mass Waltham, Impact Sls., 223 Crescent St. 617-893-2850
Mich Detroit, RS Elctrns., 12775 Lyndon Ave. 313-491-1012
Minn St. Paul, Ragon Elctrns., 1136 W. Larpenteur Ave. 612-488-0201
Mo St. Louis, Olive Industrial Elctrns., 6662 Olive Blvd. 314-863-7800
NJ Haddonfield, Mid-Atlantic, 140 Haddon Ave. 609-428-8288
NJ Hanover, State Elctrns., 36 Route 10 201-887-2550
NJ Perth Amboy, Sterling Elctrns., 774 Pfeiffer Blvd. 201-442-8000
NY Farmingdale, Iris Elctrns., 91 Milbar Blvd. 516-420-8400
NY Freeport, Milgray Elctrns., 191 Hanse Ave. 516-546-6000
NY Plainview, Fairmont Elctrn. Sls., 35 S. Svc. Rd. 516-694-8200
NY West Babylon, Delmar Elctrns., 101 Eads St. 516-420-1234
NY Woodbury, Tennant Elctrns., 1 Crossways Pk. W. 516-364-9070
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9172
Ohio Dayton, Stotts Friedman, 108-112 N. Jefferson St. 513-253-9172
Pa Devon, Peak Elctrns. Corp., 999 W. Valley Rd. 215-687-9822
Pa Erie, ADVACOM, Inc., 1938 Buffalo Rd. 814-455-8110
Pa Hatboro, Henwarr, 218 Tanner Ave. 215-675-4104
Pa Huntingdon Valley, Shap Elctrns., 421-E Pike Rd. 215-698-9550
Tex Dallas, Solid State Elctrns., Box 20299 214-352-2601
Tex Fort Worth, Tex-Tronics, 1108 E. Lancaster 817-335-8111
Tex Houston, Solid State of Tex., 6400 W. Park Dr. 713-785-5436
Va Charlottesville, Virginia Radio, 715 Henry Ave. 804-296-4184
Wash Seattle, Interface Elctrns., 300 Second Ave. W. 206-285-3500
Wash Seattle, Zepher Elctrns. Sls., 647 Industry Dr. 206-242-2517

WESTRONICS, 5050 Mark IV Pkwy. Box 4619, Fort Worth, Tex., 76106, Tel: 817-625-2311; Empl.: 150; Minimum order: $20

Customer service: Sls. Dept.

Free literature available: Short form product catalogs, Application data sheets

Products manufactured: Indicators, Recorders

Local Sales Offices & Reps.
Cal Los Angeles, McCamey-Jones, Inc. 213-263-9812
Cal Palo Alto, Priz-Co. 415-326-9333
Cal San Diego, McCamey-Jones, Inc. 714-270-4333
Colo Lakewood, Intermountain Instr., Inc. 303-237-0443
Conn Durham, Marr Elec. Co. 203-349-9691
Fla Cantonment, C.B. Metcalf Co. 904-476-7710
Fla Orlando, Currie, Peak & Frazier, Inc. 305-855-0843
Ill Schaumburg, Carvel Engrg. Co. 312-885-8800
Ind Indianapolis, Tech Sls. & Mktg. 317-356-3658
La Baton Rouge, Del Rio 504-927-9167
Md Baltimore, Adcons, Inc. 301-655-5542
Mass Wakefield, Stickney Engrg. Assocs. 617-245-4212
Mich Royal Oak, Dave Lay Assocs. 313-576-4700
Minn Minneapolis, Arjay Sls., Inc. 612-925-1833
Mo St. Louis, C.F. Gast Co. 314-993-2870
NJ Bogota, Neville & Vespo, Inc. 201-487-1505
NJ Cinnaminson, Control Equip. Co. 609-829-1447
NY Elbridge, L-Tron Corp. 315-689-3787
NY Latham, L-Tron Corp. 518-785-5032
NY Tonawanda, L-Tron Corp. 716-691-8887
NC Charlotte, Systems Svc. Corp. 704-377-3407
Ohio Cincinnati, G.H. Drysdale & Assocs. 513-752-2069
Ohio Twinsburg, Crown Equip. Co. 216-656-2023
Okla Tulsa, Lucas Controls Co. 918-749-6491
Ore Portland, Brett Assocs., Inc. 503-232-4184
Pa Pittsburgh, Gilson Engrg. Sls., Inc. 412-931-6114
RI Narragansett, Westronics, Inc. 401-789-3763
Tenn Hixson, G. Grant Co. 615-875-4633
Tenn Memphis, B. White Assocs. 901-276-4437
Tex Fort Worth, Southwest Controls Co. 817-268-1569
Tex Houston, Haltom Co. 713-782-5625
Tex Houston, Westronics, Inc. 713-467-5582
Wash Medical Lake, Calvert Controls, Inc. 509-244-3601
Wash Seattle, Brett Assocs. 206-935-8054

Directory of Local Distributors Starts on page 401

WHEELOCK SIGNALS, 273 Branchport Ave., Long Branch, N.J., 07740, Tel: 201-222-6880, TWX: 201-222-7091; Empl.: 100

Products manufactured: Bells, Buzzers, Gongs, Sirens & Aural Warning Devices, Relays

Local Sales Offices & Reps.

Ariz	Phoenix, Portis & Assoc.	602-947-4379
Conn	No. Haven, Comp. Rep. Assoc.	203-239-9762
Fla	Orlando, Gra-Mar	305-841-2330
Kans	Shawnee, J.F. Guernsey Co.	913-631-2414
Mass	Needham, Comp. Rep. Assoc.	617-444-2484
Minn	Mpls, R.W. Marshall Co.	612-929-0457
NY	Clarence, Rep Tech	716-684-6250
NY	East Northport, R.W. Keen Assoc.	516-757-7642
NY	Syracuse, Rep Tech	315-437-2845
Ohio	Dayton, Mid West Mktg.	513-433-2511
Pa	Ambler, Wyncote Instr.	215-643-2440
Tex	Dallas, Texport Elctrn. Sls.	214-358-3521
Va	Falls Church, Wycote Instr. Co.	703-532-3364
EXP:	Ohio, Chagrin Falls, Midwest Mktg.	

WHITE INSTRS., INC., Box 698, Austin, Tex., 78767, Tel: 512-892-0752; FSC No: 03945; Empl.: 35

For info on price: T.H. White; Application info: C.V. Ryswyk; Customer service: T.H. White; Delivery info: T.H.Whitre

Free literature available: Bulletins describing active and passive networks and feed-back circuits. Booklet on sound system equalization and bulletins describing sound system equalizers and real time analyzers.

Products manufactured: Analyzers, Equalizers, Filters, Generators, Networks

Advertisment

Manufacturers of wave filters, active and passive, in the audio spectrum and below. Standard and custom low, high, band pass and reject designs-- Butterworth, Chebishev, Bessel or elliptic response characteristics-- wide range of source and load impedances. Tuned, self-contained units ready to use-- no external components to add. Rapid manufacture and delivery of production quantities. Fast prototype service.

WHITMOR WIRE & CABLE, 13161 Sherman Way Bldg. B, No. Hollywood, Cal., 91605, Tel: 213-764-6296; FSC No: 15851; Empl.: 23 .... p. 2•2072

For info on price: J. J. Serago; Application info: H. R. Weiss; Customer service: D. Norris; Delivery info: D. Norris

Products manufactured: Braid, Cable, Cable, Services, Assembly, Production & Test, Wire, Wire Shielding

Local Distributors

Ill	No. Hollywood, Wirenetics Co., 13151 Sherman Way	213-765-5041

Advertisment

Electrical wire & cable manufactured to your individual needs and specifications. No minimum quantity. Most quotations given over first telephone call. Cables manufactured from customer furnished wire or ours. Many deliveries from stock. Complete MIL capabilities and flexibility permit short delivery time in days if necessary.

WHITSO, INC., 9326 Byron St., Schiller Park, Ill., 60176, Tel: 312-678-5200; Empl.: 200

Products manufactured: Services, Assembly, Production & Test, Terminals, Wire & Cable Ties

Local Sales Offices & Reps.

Cal	El Segundo, C.W. Saxon & Assocs.	213-EA2-2111
Ind	Indianapolis, Harkins Engrg. Sls. Co.	317-846-2949
Mass	Waltham, Progressive Sls. Assocs.	617-899-4800
Minn	Anoka, Inds. Mfg. Svc.	612-421-6027
NY	Mt. Vernon, Elctrns. Sls.	914-MO4-4866
Ohio	Canfield, Mktg. Worldwide	216-533-6856
Okla	Oklahoma City, R.E. Chappell	405-751-0097
Pa	Narberth, S.A. Jeffries, Inc.	215-MO4-8500

WIDE BAND ENGRG. CO. INC., Box 21652, Phoenix, Ariz., 85036, Tel: 602-254-1570; Empl.: 6

For info on price: M. G. Ticknor; Application info: S. Ticknor; Customer service: S. Ticknor; Delivery info: M. G. Ticknor

Free literature available: SFC-1 Short form catalog with brief description of each of our 1-500 MHz broadband devices.

Products manufactured: Amplifiers, Analyzers, Attenuators, Bridges, CATV Systems & Equipment, Comparators, Couplers, Detectors, Dividers, Filters, Insertion Loss Measurement Systems, Loads, Electronic Variable, Switches, Terminals, Transformers

WIK-IT ELCTRNS. CORP., 140 Commercial St., Sunnyvale, Cal., 94086, Tel: 408-732-8560; Empl.: 12; Minimum order: $30

Customer service: D. A. Wellsch

Products manufactured: Soldering Guns, Irons & Desoldering Tools

Local Sales Offices & Reps.

Cal	Culver City, H. Feldman Co.	
Cal	Los Altos, Ewing-Foley	415-941-4525
Ga	Atlanta, Hollingsworth & Still Co.	404-255-8200
Ill	Lincolnwood, B. Stein & Co.	

WILBRECHT ELECTRONICS, INC., 240 Plato Blvd., St. Paul, Minn., 55107, Tel: 612-222-2791, Telex: 297-428; Empl.: 250; Minimum order: $75

Customer service: J. A. Judge

Products manufactured: Resistors, Switches

Local Sales Offices & Reps.

Ariz	, Toward Engrg.	602-955-3193
Cal	, Collins & Hyde	415-941-3355
Ill	, Memac Sls.	312-545-1033

WILD ROVER, See Refac/Wild Rover.

WILDER ENGRG. PRODS, INC., 4445 N. Ravenswood Ave., Chicago, Ill., 60640; Empl.: 30

Products manufactured: Amplifiers, Speaker Systems, Speakers

WILEY & SONS INC., J., Box 4192, Grand Central Sta., New York, N.Y., 10017

WILKINSON CO., 31011 Agoura Rd., Westlake Village, Cal., 91361, Tel: 213-889-0050; Empl.: 28; Minimum order: $25

For info on price: J. Gutierrez; Customer service: J. Gutierrez; Delivery info: J. Gutierrez

Products manufactured: Alloys, Contact Strips, Finger, Forms, Wire, Metals, Preforms, Precious Metal, Tubing, Wire

WILLCO SALES, 302 Willis Ave., Mineola, N.Y., 11501, Tel: 516-294-9840; Empl.: 2

Customer service: W. F. Cosgrove

Products manufactured: Cabinets & Accessories, Cable, Meters, Power Supplies, Regulators, Resistors, Soldering Guns, Irons & Desoldering Tools, Stabilizers, Line Impedance, Tools, Transformers

WILLIAMS PRECIOUS METAL DIV., Williams Gold Refining, 2978 Main St., Buffalo, N.Y., 14214, Tel: 716-837-1000; Minimum order: $50

Customer service: R. Fentner

Free literature available: Williams capabilities brochure with Precious Metals Reference Data and Most Commonly Used Precious Metal Alloys.

Products manufactured: Metals, Preforms, Precious Metal

Local Sales Offices & Reps.

Cal	Fullerton, N. Nesbitt Co.	714-993-6330
Cal	Mountain View, Charter Ind'l. Sls. Co.	415-961-5514
Conn	Old Saybrook, E.J. Hughes Assocs.	203-399-9100
Ill	Zion, A.O. Capp Co.	312-872-8311
Ind	Indianapolis, J.C. Butler Sls. & Engr. Corp.	317-253-5143
Kans	Mission, Mid America Elctrns. Mktg. Inc.	913-236-4800
Mass	Attleboro, E.J. Hughes Assocs.	617-226-0050
Mass	Beverly, E.J. Hughes Assocs.	617-927-7171
NJ	Wyckoff, Component Parts Unlimited	201-445-6242
NY	Penfield, J. Lazor Assocs.	716-385-3300
Pa	Broomall, A.M. Tech. Sls. Co.	215-356-0574
Pa	Pittsburgh, A.M. Tech. Sls. Co.	412-885-3363
Tex	Richardson, R. Marston Co.	214-235-3824

WILMAR ELCTRNS. INC., 2430 Amsler St., Torrance, Cal., 90505, Tel: 213-326-6668; FSC No: 25248; Empl.: 20

Customer service: Z. Heifetz

Products manufactured: Current Sensors, Flashers, Monitors, Regulators, Relays, Testers

Local Sales Offices & Reps.

Cal	San Francisco, E. & Gregory Co.	415-989-4137
Ill	Skokie, Custom Electrical Sys.	312-679-1424
NH	Nashua, Bell Controls Inc.	603-882-6984
Pa	Jenkintown, Tech. Instr. Sls. Co.	215-885-6571
Wash	Seattle, Seatronics, Inc.	206-767-4330

Advertisment

WILMAR ELECTRONICS, INC. is a manufacturer of Protective Relay, Power Monitors and Solid State Sensors.

Over/undervoltage relays, over/underfrequency relays, reverse power relays, phase failure & phase sequence relays; current, differential, paralleling, overload relays and monitors.

WILMORE ELCTRNS. CO., Box 2973, W. Durham Sta., Durham, N.C., 27705, Tel: 919-489-3318; Empl.: 30 p. 1•537-539,1536-1538

Customer service: J. L. Harris

Products manufactured: Chargers, Battery, Controls/Control Eqpt., Converters, Inverters, Power Supplies

WILTRON CO., 930 E. Meadow Dr., Palo Alto, Cal, 94303, Tel: 415-321-7428, TWX: 910-373-1156; FSC No: 20944; Empl.: 76; Minimum order: $10

Customer service: W. L. Baxter

Products manufactured: Amplifiers, Analyzers, Attenuators, Bridges, Cable Fault Locators, Couplers, Delay Lines, Detectors, Filters, Generators, Meters, Oscillators, Shifters, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Currie, Peak & Frazier	205-536-5650
Ariz	Phoenix, Ariz-Mesa Engrg. Sls.	602-943-9213
Cal	Palo Alto, Wiltron Co.	415-321-7428
Cal	Anaheim, Blair Assocs.	714-635-1350
Cal	San Diego, Mesa Engrg. Sls. Assocs.	714-278-8021
Cal	San Jose, MCH Assocs.	408-246-7330
Colo	Boulder, H. Bass Assocs.	303-499-7509
Fla	Orlando, Currie, Peak & Frazier	305-855-0843
Ill	Chicago, Scientific Sls. Corp.	312-775-7594
Ind	Indianapolis, Scientific Sls. Corp.	317-253-4606
Kans	Olathe, B. Rush Assocs.	913-782-1177
Md	Randallstown, C. L. Malinow & Co.	301-922-2092
Mass	Waltham, McBar Assocs.	617-890-0233
Mich	Detroit, Harvey Teplitz & Co.	313-537-9058
Minn	Bloomington, Scientific Sls. Corp.	612-881-3300
NJ	Haworth, Central Assocs.	201-568-0808
NJ	Pennsauken, Himmelstein Assoc.	609-662-3081
NM	Albuquerque, Trembly Assocs.	505-293-4444
NY	East Syracuse, Ossmann Instrs.	315-437-6666
NY	Plainview, Central Assocs.	516-433-0808
NY	Rochester, Ossman Instrs.	716-328-2230
NY	Vestal, Ossman Instrs.	607-785-9947
NC	Greensboro, Currie, Peak & Frazier	919-273-3040
Ohio	Cleveland, Harvey Teplitz & Co.	216-371-2044
Ohio	Dayton, Harvey Teplitz & Co.	513-277-6531
Tex	Richardson, Lear Assocs.	214-231-5388
Wash	Seattle, Delcom Sls. Co.	206-248-0090

WINCHESTER ELCTRNS., Div. Litton Inds., Main St. & Hillside Ave., Oakville, Conn., 06779, Tel: 203-274-8891

Products manufactured: Connectors

Local Sales Offices & Reps.

Ala	Huntsville, Interep Assocs., Inc.	205-881-3677
Ariz	Tempe, Litton Industries	602-968-2455
Cal	North Hollywood, Litton Industries	213-985-8985
Cal	Palo Alto, Quad Rep, Inc.	415-964-3532
Colo	Littleton, Simpson Assocs.	303-798-8439
Fla	Ormond Beach, Technology Mktg. Assocs.	904-672-2314
Fla	Pompano Beach, Technology Mktg. Assocs.	305-942-0774

Ill	Chicago, L-Tec, Inc.	312-286-1500
Mass	Waltham, Litton Industries	617-890-2207
Minn	Minneapolis, Litton Industries	612-789-8851
Mo	Hazelwood, CenTech, Inc.	314-731-4220
Mo	Raytown, CenTech, Inc.	826-358-8100
NJ	Cherry Hill, Trinkle Sls. Co.	609-667-3500
NJ	Wayne, G. T. Assocs.	201-694-6040
NY	East Syracuse, Fountain, Young & Co.	315-437-7733
NC	Charlotte, Anthom, Inc.	704-527-1515
Ohio	Dayton, Compass Assocs.	513-252-9939
Tex	Dallas, Bouillion Engrg. Sls. Co.	214-376-1929
Wash	Seattle, Arneson Assocs.	206-762-7664

WINEGARD CO., 3000 Kirkwood St., Burlington, Iowa, 52601, Tel: 319-753-0121; Empl.: 300

For info on price: Sls. Dept.; Application info: Sls. Dept.; Customer service: Sls. Dept.; Delivery info: D. Krieger

Free literature available: CP2 catalog, 110 catalog, FF 276 277 284, stuffers WS1-13R-15-16-17

Products manufactured: Amplifiers, Antennas

WIRE CLOTH ENTERPRISES, INC., 130-132 Gamma Dr., R.I.D.C., Pittsburgh, Pa., 15238, Tel: 412-781-1390; Empl.: 8

For info on price: J. Albaker; Customer service: P. Borggila; Delivery info: J. Albaker

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Screens, Printed Circuit, Services, Assembly, Production & Test

Advertisment

Quality materials for printed circuit production. Stainless Steel Wire Cloth and Synthetic Monofilament Fabrics woven to the highest quality standards of accuracy in wire diameter and thread count. Ask about our Screen Star Photo Emulsions. The most efficient "direct" emulsions in use today! Also, special polyurethane squeegee blades, all sizes.

WIREFLEX INCORPORATED, 502 Old Route 30 East, Bourbon, Ind., 46504, Tel: 219-342-5315; Empl.: 20; Minimum order: $1

For info on price: E. C. Evancich; Application info: E. C. Evancich; Customer service: D. Vujnovich; Delivery info: D. Vujnovich

Free literature available: 4 pages on Type Wire We Manufacture.

Products manufactured: Braid, Cable, Cable, Wire

WIREMOLD CO., West Hartford, Conn., 06110, Tel: 203-233-6251, TWX: 710-425-6281; Empl.: 800

Products manufactured: Boxes, Junction, Outlets & Wall Plates, Connector Boxes & Strips, Power Outlet, Ducts, Wiring

Local Sales Offices & Reps.

Cal	Danville, J.R. Griffin	415-433-5744
Cal	Los Angeles, Airey-Thompson	213-264-1533
Colo	Denver, R.B. Schumann	303-534-1058
Conn	Farmington, E.W. Selnau	203-673-4979
Conn	Hartford, Home Office	203-233-6251
DC	Washington, T.J. Pugh	202-296-3669
Fla	Tampa, J.D. Whetsell	813-988-5860
Ga	Decatur, R.L. Pace	404-981-4385
Ill	Des Plaines, R. E. Horn/J. Reisch	312-297-3240
Iowa	Des Moines, W.J. Kelley	515-243-4079
La	New Orleans, United Sls. Assoc.	504-733-8711
Md	Baltimore, A.B. French	301-825-1305
Mass	Boston, R.T. Bennett	617-246-1131
Mich	Detroit, M.F. Frazier Co.	313-535-0840
Minn	Minneapolis, H.G. Schendel	612-722-2226
Mo	Kansas City, V.A. Meier	816-452-9076
Mo	St. Louis, A.F. Tubbesing	314-842-2455
NJ	Jersey City, P.F. McGovern	201-433-5869
NY	Babylon, A.C. Bradbury	516-587-2318
NY	Elmira, R.C. Hill	607-734-5406
NY	New York, P.F. McGovern/J.E. Finley	201-963-3280
NY	North Syracuse, A. Simone	315-471-4201
NC	Charlotte, H.M. Short	704-334-7060
Ohio	Cincinnati, C.J. Wirtz	513-821-3254
Ohio	Cleveland, R. Najda	216-781-5135
Ore	Portland, D.A. King	503-228-1900
Pa	Glenmoore, W.A. Gibson	215-469-6453
Pa	Philadelphia, R.B. French	215-887-0964
Pa	Pittsburgh, W. Simon	412-421-9491
Tex	Dallas, W.R. Moseley	214-637-6432
Tex	Houston, R. LeMaster	713-523-1316

Tex	Salt Lake City, D.E. Blomquist	801-359-7074
Wash	Seattle, Strohecker, Inc.	206-623-0357
Wash	Spokane, W.D. Beach	509-624-2518

WISCO DIV., ESB Inc., 1222 18th St., Racine, Wisc., 53403, Tel: 414-637-9131, TWX: 910-271-2382

For info on price: E. W. Kronberg; Application info: G. P. Cook; Customer service: T. A. Parker; Delivery info: T. A. Parker

Products manufactured: Batteries

WORKMAN ELECTRONIC PRODS., INC., Box 3828, Sarasota, Fla., 33578, Tel: 313-371-4242; Empl.: 150; Minimum order: $25

For info on price: J. Price; Application info: J. Klempka; Customer service: P. Rice; Delivery info: P. Rice

Products manufactured: Adhesives (All Types), Alternators, Antennas, Arresters, Electrical Surge, Lightning, Attenuators, Boards, Printed Circuit, Cable Assemblies & Harnesses, Cable, Calculators, Electrical & Electronic, Caps, Connector, CATV Systems & Equipment, Chargers, Battery, Chokes, Circuit Breakers, Clamps & Clips, Cleaners & Solvents, Coils Including Assemblies & Forms, Connector Adapters, Connectors, Controls/Control Eqpt., Converters, Coolants, Circuit & Components, Cords, Cores, Magnetic, Couplers, Diodes, Dummy Loads, Eliminators, Battery, Filters, Fuses, Heads, Recording Playback, Erase, Insulators & Insulation, Jack Adapters (All Types), Lamp Adapters, Lamps, Lights, Limiters, Lubricants, Meters, Microphones, All Kinds, Networks, Pickups, Telephone (For Recording), Plug Adapters, Plugs, Potentiometers, Protectors, Rectifiers, Refrigerants, Spray, Resistors, Retainers, Services, Assembly, Production & Test, Socket Adapters, Sockets, Solder (All Types), Spacers, Speakers, Splicers, Coaxial Cable, Splices, wire (Including, Butt & Cap Types), Switches, Tape Recording Accessories, Terminal Blocks, Boards & Strips, Terminals, Testers, Thermistors, Timers, Tools, Transformers, Transistors, Wire, Wire & Cable Ties, Wire Strippers

Local Sales Offices & Reps.

Alas	Anchorage, H. Lang & Assocs.	907-279-5741
Ariz	Phoenix, B & G Sls. Co.	602-266-5624
Cal	Mt. View, Sinai-Johnson Inc.	415-967-1788
Cal	N. Hollywood, S. Lewis & Assocs.	213-877-0461
Cal	Redwood City, Sinai-Johnson Inc.	415-365-6263
Cal	San Francisco, Tech. Sls. Assocs.	415-467-1434
Colo	Colorado Springs, Norris & Co.	303-635-9319
Fla	Lakeland, Dixie Elect. Assocs.	813-682-6624
Fla	Miami, Raulson & Co.	305-264-6003
Ill	Hoffman Estates, G. Sangwin	312-884-0186
Ind	Indianapolis, Mid-Central Sls.	317-283-1727
Iowa	Des Moines, Lectro Reps	515-276-6387
Ky	Fern Creek, Mid-Central Sls.	502-239-5614
Md	Baltimore, EKP Assoc.	301-944-6677
Mass	W. Springfield, Larry Cole Inc.	413-781-3040
Mass	Wellesley, Larry Cole Inc.	617-237-1260
Mich	Detroit, R. Butchart Assocs.	313-773-7870
Minn	St. Paul, E.W. Oszman	612-488-1811
Mo	Liberty, Lectro Reps, Inc.	816-781-2522
Mo	St. Charles, Lectro Reps, Inc.	314-723-8736
NH	Manchester, Larry Cole Inc.	
NY	Brooklyn, I. Brown Co.	212-493-1379
NY	Camillus, Callahan-Ferguson Co.	315-487-3870
NY	Manilus, Callahan-Ferguson Co.	315-682-9301
NC	Burlington, E.P. Ester & Co.	919-584-1568
Ohio	Cleveland, H. Miller Sls. Co.	216-321-3900
Ohio	Jamestown, H. Miller Sls. Co.	513-675-2059
Ohio	Wickliffe, H. Miller Sls. Co.	216-585-3278
Pa	Bethlehem, EKP Assocs.	215-691-5250
Pa	Easton, EKP Assocs.	215-258-6484
SC	Rock Hill, Dixie Elect. Assocs.	803-328-3981
Tenn	Gallatin, Dixie Elect. Assocs.	615-452-1744
Tenn	Hendersonville, Dixie Elect. Assocs.	615-824-2923
Tex	Dallas, Techno Assocs.	214-357-9213
Wash	Seattle, D. Smith Sls. Co.	206-633-3160
Wisc	Brookfield, G. Sangwin	414-782-3240
EXP:	Miami Lakes, Fla., Manrep Corp.	305-822-7630
FOR:	Can., Downsview, Ont., L. Finkler LTD	416-630-9103

WORTEK, INC., 5971 Reseda Blvd., Tarzana, Cal., 91356, Tel: 213-881-1644; Empl.: 8

Customer service: W. O. Rumsey

Free literature available: Product brochures on single and multiple-output modular dc power supplies upon request. Includes specifications, package outlines, mounting data and pricing information.

Products manufactured: Power Supplies

WOVEN ELECTRONICS

WOVEN ELCTRNS., Southern Weaving Co., Box 189, Mauldin, S. C., 29662, Tel: 803-963-5131, TWX: 810-287-2091; Empl.: 150; Minimum order: $50

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Customer service: P. Davis

Free literature available: 1. "New Twist in IC Interconnects" Sample with applications info. 2. "Basic Concepts of Woven Cable" 3. & 5. General Products Folder with Samples 4. "Fast Lead Exposure/Woven Cable"

Products manufactured: Cable Assemblies & Harnesses, Cable, Wire

Local Sales Offices & Reps.

Ala	Huntsville, Inco Tech.	205-837-6061
Cal	Mountain View, Reptronics	415-968-5550
Cal	Playa Del Rey, The Rep	213-821-6979
Fla	Alamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-447-2533
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Chicago, Electrical Cable & Access.	312-235-2830
Md	Bethesda, Warren Mount Co.	301-657-9312
Mass	Worcester, United Sls.	617-757-3872
Mich	Detroit, R. P. Urban & Assocs.	313-535-2355
Mich	Grand Rapids, R. P. Urban & Assoc.	616-245-0511
Mo	St. Louis, R. F. Carlson & Co.	314-961-4485
NJ	Hackensack, Trak Sls.	201-487-5075
NY	Manlius, Marden-Taylor Assoc.	315-446-9280
NC	Winston-Salem, Electronic Mktg. Assocs.	919-722-5151
Ohio	Cleveland, D. Steffen & Assoc.	216-461-8333
Ohio	Dayton, D. Steffen & Assocs.	513-293-3145
Pa	Jenkintown, Warren Mount Co.	215-886-0383
Pa	York, Warren Mount Co.	717-757-5823
SC	Greenville, Elctrn. Mktg. Assoc.	803-268-1125
Tex	Dallas, Precision Sls.	214-351-6964
Wisc	Wauwatosa, Larsen Assoc.	414-258-0529

WROUGHT WASHER MFG., INC., 2252 S. Bay St., Milwaukee, Wisc., 53207, Tel: 414-744-0771, TWX: 910-262-3101; Empl.: 400

Products manufactured: Fasteners

WYLE COMPUTER PRODS., INC., 128 Maryland St., El Segundo, Calif., 90245, Tel: 213-973-7571, TWX: 910-348-6283; Empl.: 80

For info on price: T. McEachran; Application info: R. Weyhrich; Customer service: R. Casselman; Delivery info: R. Casselman

Products manufactured: Boards, Plug-In, Boards, Printed Wiring, Universal, Cards, Linear Function, Cards, Logic, Converters, Punched Card Equipment, Terminal Equipment, Digital

X-ACTO, 48-31 Van Dam St., Long Island City, N.Y., 11101, Tel: 212-392-3333; Empl.: 150

Products manufactured: Clamps & Clips, Drills & Accessories, Hand & Power, Heat Sinks, Soldering, Knives & Knife Sets, Lubricants, Pliers, Screwdrivers, Tools, Tweezers, Hand & Vacuum

XCELITE, Div. Cooper Ind's., 170 Bank St., Orchard Park, N.Y., 14127, Tel: 716-662-4461

Customer service: C. Smith

Free literature available: Illustrated full line catalog.

Products manufactured: Cutters, Wire, Hand Operated, Drivers, Nut, Heat Sinks, Soldering, Pliers, Screwdrivers, Tools, Wire Strippers, Wrenches

Local Sales Offices & Reps.

Ala	Gadsden, F.C. Nickerson Co.	205-547-7718
Cal	Fullerton, J. Vombaur	213-733-1163
Cal	San Mateo, J.W. Hand	415-341-5516
Colo	Denver, Connors, Inc.	303-934-5829
Conn	Waterbury, Coakley, Boyd & Abbett	203-756-8766
Fla	Oldsmar, F.C. Nickerson Co.	813-855-4209
Ill	Genoa, B. Drobish	312-253-0057
Ind	Indianapolis, L.M. Devoe Co.	317-257-1227
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470

Mich	Southfield, Aztec Sls. Corp.	313-642-0777
Minn	Minneapolis, R. Swanson Co.	612-789-5636
Mo	Kansas City, K & M Sls. Co.	816-471-1355
Mo	St. Louis, K & M Sls. Co.	314-423-2420
NY	Flushing, Bettan Sls.	212-591-7600
NY	N. Syracuse, Trademark Elctrns.	315-487-3870
NC	Kannapolis, F.C. Nickerson Co.	704-932-6772
Ohio	Cleveland, J.O. Olsen Co.	513-922-2176
Pa	Warminster, Cerf & Hagen	215-343-1339
Tenn	Memphis, A.S. Engelman Co.	901-458-6263
Tex	Dallas, C.W. Cortez Co.	214-747-1031
Va	Richmond, D. Miller & Assoc.	804-353-5324
Wash	Seattle, Fleehart & Sullivan	206-522-1533

XCITON CORP., 5 Hemlock Dr., Latham, N.Y., 12110, Tel: 518-783-7726, TWX: 710-444-9692; FSC No: 53184; Empl.: 100; Minimum order: $100

For info on price: A. Ligorner; Application info: J. Duncan; Customer service: J. Duncan; Delivery info: A. Ligorner

Free literature available: Literature on our comprehensive line of LED lamps and numeric displays.

Products manufactured: Crystals, Diodes, Display Devices/Displays, Semiconductor Wafer Fabrication

XENTEK, INC., 1550 B Linda Vista Dr., San Marcos, Calif., 92069, Tel: 714-744-3346, TWX: 910-322-1155; FSC No: 53279; Empl.: 20; Minimum order: $25

For info on price: L. Kester; Application info: A. Peterson; Customer service: A. Myrwold; Delivery info: L. Kester

Free literature available: Xentek manufactures quality open-frame power supplies with single and multiple outputs. Outputs are available in any voltage from 2-32 volts, .1 amps to 100 amps.

Products manufactured: Power Supplies, Regulators

Local Sales Offices & Reps.

Ariz	Scottsdale, Fryco	602-945-3281
Cal	Cupertino, PM Sls.	408-255-1771
Cal	Santa Monica, Rep Assocs.	213-829-5401
Colo	Littleton, Eissler Sls. & Svcs.	303-794-1779
Ill	Chicago, E. Joyner Co.	312-968-8383
Mass	Natick, Wayland Engrg. Sls.	617-655-6080
Mo	St. Louis, Gordon Fixman Engrg.	314-725-5219
Ohio	Dayton, The Dynel Co.	513-434-6467
Okla	Tulsa, Allied Comps. Inc.	214-238-0408
Tex	Dallas, Allied Components Inc.	214-238-0408
Tex	Houston, Allied Components Inc.	713-691-3961
Wash	Seattle, Underwood/Jensen & Assoc.	206-575-0123

XINCOM CORP., 8944 Mason Ave., Box 648, Chatsworth, Cal., 91311, Tel: 213-341-5040, TWX: 910-494-2769; FSC No: 15237; Empl.: 100; Minimum order: $100

For info on price: J. Coons; Application info: J. Coons; Customer service: D. Moore; Delivery info: B. Sear

Free literature available: Enclosed are short form catalogs on pulse instrumentation & data conversion products along with several data sheets on various semiconductor test systems including options.

Products manufactured: Amplifiers, Comparators, Controllers, Programmable, Converters, Data Acquisition & Reduction Systems, Generators, Pulsers, Logic Test, Testers, Timers

Local Sales Offices & Reps.

Cal	Sunnyvale, R. Bach	408-732-3880

YASKAWA ELECTRIC AMERICA, INC., 4001 Westerly Pl., Newport Beach, Cal., 92660, Tel: 714-833-1436, Telex: 67-8396; Empl.: 4

Customer service: H. Matsuo

Products manufactured: Motors, Switches

YELLOW SPRINGS INSTRUMENT CO., Box 279, Yellow Springs, Ohio, 45387, Tel: 513-767-7241; Empl.: 250

Customer service: R. Heggemann

Free literature available: Pressure tranducers, transmitters and indicators, Platinum temperative probes and transducers, indicators and transmitters, Precision interchangeable thomistors and temperature probes.

Products manufactured: Bolometers, Bridges, Controls/Control Eqpt., Gages, Indicators, Meters, Monitors, Probes, Radiometers, Recorders, Standards, Thermistors, Thermometers, Resistance, Transducers, Transmitters

Local Distributors

Cal	Pasadena, RDX Corp., 110 S. Euclid	213-792-4041
Cal	Sunnyvale, RDX Corp., 1287 Lawrence Sta. Rd.	408-734-4504
Fla	Orlando, Datarep Inc., Box 5929	305-843-5224
Ill	Chicago, Liz Ind'l Sls., 1445 No. State Pkwy	312-943-5122
Ill	Chicago, Newark Elec. Corp., 500 N. Pulaski	312-638-4411
La	Harvey, Gordon Instr. Co., Box 591	504-368-6152
Mass	Norwell, Bordewieck Engr., Box 323	617-659-4915
Mich	Brighton, Cesko Sls. Co., Box 155	313-227-5061
Minn	Minneapolis, Pilot Ind. Corp., 7400 Washington Ave. S.	612-941-7400
NJ	Cinnaminson, Control Equip. Inc., 464 N. Randolph	609-829-1447
NJ	Springfield, RJM Sls., Box 82	201-467-1210
NY	E. Rochester, Thermal Sys. Inc., Box 163	716-377-1970
NY	Syracuse, Thermal Sys., Box 117	315-458-5202
NC	Charlotte, Sloan Assoc., 3230 Piperhane Sect. N	704-523-2122
Ohio	Dayton, Whelan Corp., 4541 Gateway Cir.	513-434-7551
Tenn	Chattanooga, Coleman Assoc., Elder Mtn. Rt. 8	615-821-0235
Tex	Ft. Worth, Southwest Controls, 2416 Ludelle St.	817-268-1569
Va	Richmond, Sloan Assocs., 2120 Staples Mill Rd.	804-359-6051

YEWTEC CORPORATION, Sub Yokogawa Elec. Works, Ltd., 1995 Palmer Ave., Larchmont, N.Y., 10538, Tel: 914-834-3550, TWX: 710-566-1104; Empl.: 47 p. 1•860-862,875

Free literature available: General Catalog. Individual catalogs on each instrument.

Products manufactured: Amplifiers, Analyzers, Bridges, Computers, Converters, Decade Boxes, Meters, Multipliers, Oscillographs, Direct Writing, Potentiometers, Pyrometers, Recorders, Shunts, Meter, Standards, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Incotech, Inc.	205-837-6061
Cal	Palo Alto, Held & Mollard	415-965-9321
Fla	Longwood, Saber Assocs.	305-422-3686
Ill	Chicago, Penn Engrg.	312-338-3835
Ind	Galthersburg, Wright Co.	202-296-0979
Mass	Acton, Applied Meas.	617-263-2766
Minn	Minneapolis, Heimann Co.	612-861-6051
Mo	St. Louis, Hitts & Assocs.	314-426-2322
NY	Great Neck, Industron Assoc.	516-487-2620
NY	Liverpool, Rayelco Elctrn.	315-652-5272
Ohio	Columbus, Meas. Instrs.	614-488-9753
Pa	Oreland, Technical Sls.	215-885-5145
Tex	Richardson, Lear Assoc. Inc.	214-231-5388

YIG-TEK CORP., 1725 De La Cruz Blvd., Santa Clara, Cal., 95050, Tel: 408-244-3240, TWX: 910-338-0293; Empl.: 69

For info on price: T. Clark; Application info: T. Clark; Customer service: M. Jones; Delivery info: M. Jones

Free literature available: 1. Product catalogue which lists our products and gives specifications and outline drawings. 2. Application Note, which explains how YIG-tuned products work and where they can be used.

Products manufactured: Crystals, Discriminators, Filters, Oscillators, Preselector-Mixers

Local Sales Offices & Reps.

Ariz	Scottsdale, Electronic Entprs.	602-946-9860
Cal	Mountain View, Donlay Assocs.	415-968-7500
Cal	Van Nuys, C.W. Swift & Assocs.	213-873-4778
Colo	Denver, Thorson Co.	303-759-0809
Fla	Palm Bay, Spartech Assocs.	305-727-8045
Ga	Smyrna, Spartech Assocs.	404-432-3644
Ill	Park Ridge, R F Specialists	312-698-2044
Kans	Shawnee Mission, EIR Co.	913-363-0919
Md	Silver Springs, Eastern Instrumentation	301-681-6500
Mass	Cochituate, Micronic Assocs.	617-872-6561
NM	Albuquerque, Electronic Entprs.	505-256-3561
NY	Skaneateles, Robtron	315-685-5731
Ohio	Dayton, Comtel Sterling	513-298-7573
Pa	Newton Square, SWR Assocs.	215-356-8550
Tex	Arlington, N & W Sls.	817-461-4443
Wash	Seattle, Rush Drake Assocs.	206-763-2755

ZEHNTEL, INC., 2440 Stanwell Dr., Concord, Cal., 94520, Tel: 415-676-4200; Empl.: 28

Customer service: Mktg. Dept.

Free literature available: Technical Article - Computerized approaches to analog subassembly; Data Sheet - Trouble Shooter II in-circuit test systems; Data Sheet - Testpac III functional test system.

Products manufactured: Switches, Telephone Channel Test & Simulator Equipment, Test Systems, Testers

Local Sales Offices & Reps.

Ala	Huntsville, Gentry Assocs.	205-534-9771
Cal	Woodland Hills, Burtis Instrumentation Sls.	213-887-5863
Conn	Middletown, McBAR Assocs.	203-865-4376
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, Solid State Elctrns.	312-889-8033
Kans	Shawnee Mission, E.I.R. Co.	913-362-0919
Mass	Waltham, McBAR Assocs.	617-890-0233
Mich	Detroit, Group Ten	313-549-3910
Minn	Minneapolis, Engrg. Prods. Assocs.	612-925-1883
Miss	Hazelwood, E.I.R. Co.	314-895-4100
NY	Port Chester, Radiation Elctrns.	914-937-2300
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Dayton, Group Ten	513-277-6531
Okla	Norman, Data Mktg. Assocs.	405-364-8320
Tex	Houston, Data Mktg. Assocs.	713-686-9627

ZELTEX, INC., 1000 Chalomar, Concord, Cal, 94520

ZENITH CONTROLS INC., 830 West 40th St., Chicago, Ill., 60609, Tel: 312-247-6400; Empl.: 125

For info on price: V. Helford; Application info: R. Ellis; Customer service: R. Morris; Delivery info: D. Leri

Free literature available: Zenith Timer Brochure contains a capsule description of the design and function of Zenith's full line of timing controls for original equipment manufacturers.

Products manufactured: Chargers, Battery, Delays, Time (Excluding Delay Lines, Timers, Delay & Relays, Time-Delays), Relays, Switches, Timers

Local Sales Offices & Reps.

Ariz	Phoenix, A. Norton Co.	602-278-6481
Cal	El Cerrito, Saletta Sls.	415-236-9191
Cal	Los Angeles, H.S. Eales Co.	213-776-4410
Colo	Englewood, L.S. Reed & Co.	303-761-6154
Fla	Brandon, J. Meeks & Assoc.	813-689-6137
Ga	Atlanta, Holman-Lobsinger Co. Inc.	404-256-9120
Ill	Westchester, Wasson-Gallagher Inc.	312-344-0690
Ind	Indianapolis, Indiana Electrical Sls.	317-849-3880
La	New Orleans, A. Levin & Assoc. Inc.	504-524-8489
Mass	Bedford, Interact Sls. Co.	617-667-5656
Mich	Livonia, A.J. Riopelle Co.	313-427-9114
Minn	Minneapolis, A.M. Johnson Co.	612-927-8741
Mo	St. Louis, L.E. Brunson Co.	314-522-6006
Neb	Omaha, Electric Equip. Sls. Co.	402-556-4198
NJ	Berkley Heights, R.P. Luce & Co. Inc.	201-464-6440
NY	New Hyde Park, R.P. Luce & Co., Inc.	516-437-4550
NY	New York, NEPA Inc.	212-867-0340
NC	Charlotte, L.P. Spoon Inc.	704-372-3290
Ohio	Cleveland, Loesch Assoc. Inc.	216-241-4581
Pa	Fort Washington, Variable Elec. Prod. Co.	215-TU4-5375
Tenn	Memphis, Vincent Sls. Agency	901-682-4187
Tex	Dallas, Andres & Boruch Co.	214-621-3601
Va	Richmond, Marchant & Field Sls.	804-262-7333
Va	Vienna, Jemco Assoc., Inc.	703-938-0003
Wash	Seattle, Clair Stebbins Co.	206-CH 6-1170
Wisc	Milwaukee, E.M.E. Assoc.	414-354-5115

ZENRAD CONTROLS CO., 529 E. Gutierrez St., Santa Barbara, Ca., 93103, Tel: 805-965-4996; FSC No: 33180; Empl.: 9

Products manufactured: Boards, Printed Circuit, Machines/Machinery, Production, Screens, Printed Circuit, Services, Assembly, Production & Test

ZERO MFG. CO., 777 Front St., Burbank, Cal., 91502; Empl.: 1260 .... p. 1•106-109

For info on price: E. V. Schirmer; Application info: M. S. Huffman

Free literature available: Design and manufacture of electronic and environmental packaging systems for industrial and government applications and cabinets and consoles for the computer and instrumentation industries.

Products manufactured: Air Cleaners & Filters (Shielded & Unshielded), Benches, Consoles, Stools, Tables, Bezels, Shielded & Unshielded, Bins, Part Storage, Blowers & Fans & Accessories, Boxes, Junction, Outlets & Wall Plates, Bus Bars & Systems, Cabinets & Accessories, Cable Assemblies & Harnesses, Cable Retractors, Cans, Capacitor, Relay, Semiconductor, Transformer, etc, Carts & Dollies, Instrument & Equipment, Cases, Equipment, Instrument, Meter, Cases, Transit, Cavities, Microwave, Chassis, Circuit Board Mounting, Chassis, Metal, Connector Boxes & Strips, Power Outlet, Containers, Covers, Protective (Including Dust), Drawers, Sliding, Frames, Cabinet & Rack, Grilles, Handles For Cabinets, Circuit Boards, Racks, etc., Honeycomb Sheets, Panels, etc., Mounts, Panels, Racks, Services, Assembly, Production & Test, Slides, Cabinet & Chassis, Spacers, Stands, Instruments

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe Sls., Inc.	602-264-7971
Cal	Burbank, Zero-West Div.	213-846-4191
Cal	Palo Alto, Northern Cal. Sls. Off.	415-964-7700
Cal	San Diego, Clark & Co.	714-296-6351
Colo	Denver, Grifco	303-722-4674
Fla	Orlando, Datarep, Inc.	305-843-5224
Fla	St. Petersburg, Datarep	813-345-8503
Fla	St. Petersburg, Zero-So. Div.	813-531-8991
Ill	Chicago, Carlson Elctrns. Sls.	312-774-9022
Ind	Indianapolis, L.M. DeVoe Co.	317-257-1227
La	New Orleans, Davies Assocs.	504-522-9027
Md	Baltimore, R. P. Luce & Co.	301-752-8200
Mass	Monson, Zero-East Div.	413-267-5561
Mich	Dearborn, VPI Inc.	313-271-4600
Minn	Minneapolis, S. Clothier Co.	612-888-4666
Mo	St. Louis, Carlson Elctrn. Sls.	314-991-0262
NJ	Berkeley Heights, R.P. Luce & Co.	201-464-6440
NM	Albuquerque, Fry-Gates	505-298-1875
NY	East Syracuse, Fountain Young & Co.	315-437-7733
NY	New Hyde Park, R.P. Luce & Co.	516-437-4550
Ohio	Dayton, N. Bear Corp.	513-299-3566
Ohio	Richfield, N. Bear Corp.	216-659-3131
Pa	Philadelphia, R.P. Luce Co.	215-884-8365
Pa	Pittsburgh, B.E. Gibson Co.	412-823-8310
Tenn	Franklin, Vaughn Sls. Co.	615-794-7557
Tex	Dallas, J. Gibbs & Assocs.	817-430-1861
Tex	Fort Worth, J. Gibbs & Assocs.	817-237-1455
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778
EXP:	Etobicoke, Ontario, Can., C.A. Pipe & Assocs.	416-622-3403

Local Distributors

Ind	Indianapolis, Graham Elctrns., 133 S. Pennsylvania Ave.	317-634-8202
Mass	Woburn, Rush Industries, Inc., 122 Cummings Park Dr.	617-935-2400
Mich	Farmington, Harvey-Michigan Inc., 23461 Industrial Park Dr.	313-477-1650

ZEUS IND'L. PRODS., Foot of Thompson St., Raritan, N.J., 08869, Tel: 201-526-0800, TWX: 710-480-9346; Empl.: 38; Minimum order: $25

Customer service: R. D. Hoyt

Products manufactured: Clamps & Clips, Tubing

ZI-TECH DIV., Aikenwood Co., Box 26, 223 Forest Ave., Palo Alto, Cal., 94302, Tel: 415-326-2151; Empl.: 7

For info on price: L. Erlund; Application info: G. Ziman; Customer service: G. Ziman; Delivery info: L. Erlund

Products manufactured: Calibrators, Comparators, Connectors, Controls/Control Eqpt., Current Sources, Dividers, Indicators, Meters, Potentiometers, Power Supplies, Probes, Recorders, References, D-C Voltage, Standards, Switches, Testers, Transducers, Voltage Sources

ZIERICK MFG. CORP., Radio Circle, Mt. Kisco, N.Y., 10549, Tel: 914-666-2911; Empl.: 90; Minimum order: $15

Customer service: Sls. Dept.

Products manufactured: Clamps & Clips, Connectors, Eyelets, Fasteners, Machines/Machinery, Production, Pointers, Dial, Posts, Services, Assembly, Production & Test, Terminal Blocks, Boards & Strips, Terminals, Tools

Local Sales Offices & Reps.

Ill	Chicago, K. D. Engle Co.	312-539-1820
Ind	Indianapolis, K. D. Engle Co.	317-356-3001

Local Distributors

Cal	Los Angeles, Timco Inc., 5808 Monterey Rd.	213-254-5101
Ill	Chicago, Waldom, Inc., 4625 W. 53rd St.	312-585-1212

ZIPPERTUBING CO., 13000 S. Broadway, Los Angeles, Calif., 90061, Tel: 213-321-3901, TWX: 910-346-6713

Products manufactured: Braid, Cable, Cable, Caps, Connector, Coatings, Conductive Plastic Materials, Conduit, Electrical, Cords, Fabrics, Conductive, Holder & Carriers, Insulators & Insulation, Integrated Circuit Packaging Systems, Jumpers, Kits, Connector, Kits, Marking (Dial, Instrument, Equipment, etc.), Kits, Shielding, Machines/Machinery, Production, Protectors, Seals, Shields, Sound Absorbing Materials, Splices, wire (Including, Butt & Cap Types), Strain Reliefs, Cable & Wire, Strips, Tapes, Films & Foils, Pressure Sensitive, Tubing, Wire, Wire & Cable Ties, Wire Markers, Wire Shielding

Local Sales Offices & Reps.

Ariz	Phoenix	602-967-8888
Fla	Orlando	305-671-7399
Ill	Chicago	312-289-3000
Md	Baltimore	301-675-3365
Mass	Boston	617-429-6780
NJ	Totowa	201-256-4980
Ohio	Cleveland	216-734-3286
Tex	Dallas	214-521-9240

ZIRCONIUM CORP. OF AMER., See Zircoa Div. Corhart Refractories

ZONIC TECHNICAL LABS., 8927 Rossash Ave., Cincinnati, Ohio, 45236, Tel: 513-891-6390, TWX: 810-461-2470; Empl.: 50; Minimum order: $50

For info on price: T. A. Dunlap; Application info: T. A. Dunlap; Customer service: D. W. Parsons; Delivery info: D. W. Parsons

Products manufactured: Recorders, Testers

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Scottsdale, Barnhill Three	
Cal	Belmont, Fisher Assocs.	415-592-5711
Cal	Montebello, Tucul Engrg. Co.	213-728-7397
Colo	Denver, Barnhill Three	
Conn	Hamden, Northeast Engrg.	203-248-4481
Fla	Orlando, BCS Assocs.	305-896-4881
Ga	Decatur, BCS Assocs.	404-321-0980
Md	Silver Springs, K. G. Electrns.	
Mass	Danvers, Northeast Engrg.	617-774-3010
Mo	St. Louis, Adelphi, Inc.	314-821-1232
NM	Albuquerque, Barnhill Three	
NY	Great Neck, Measurement Technology	
NC	Greensboro, BCS Assocs.	919-273-1918
Pa	King of Prussia, Letronix	215-265-1020
Tex	Houston, Barnhill Two	
Tex	Richardson, Barnhill Two	
Wash	Bellevue, Topp Engrg. Sls. Corp.	

Last Page of this Section.

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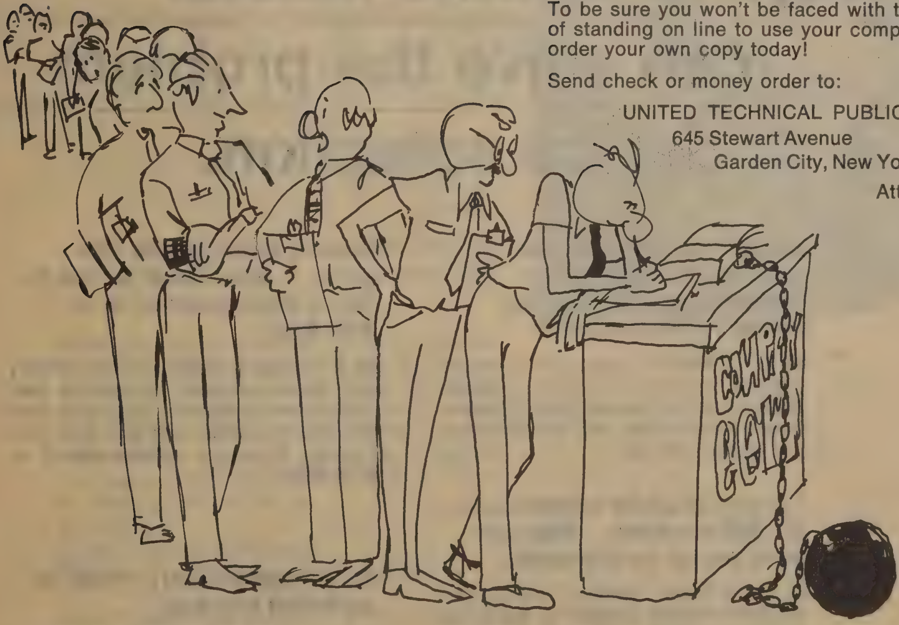

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Go to the Master. Section 7 is a comprehensive telephone directory of the entire IC Industry. Page 7-37 lists Texas Instruments and the extension number for product information on MOS. It also contains a phone listing for TI sales offices and distributors throughout the country.

Motorola makes an MCM 4004 device . . . where would you look to find an alternate source for an MCM 4004?

Go to the Master. Section 3 is an industry wide cross reference. It contains over 14,000 cross references. Page 3-20 lists five other companies and their part numbers for pin-for-pin replacements of an MCM 4004.

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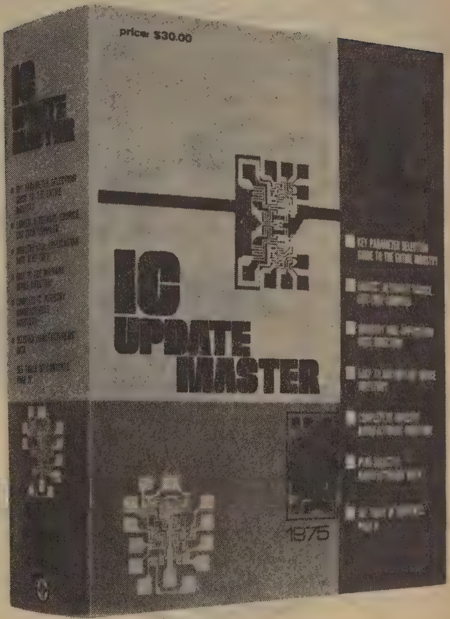
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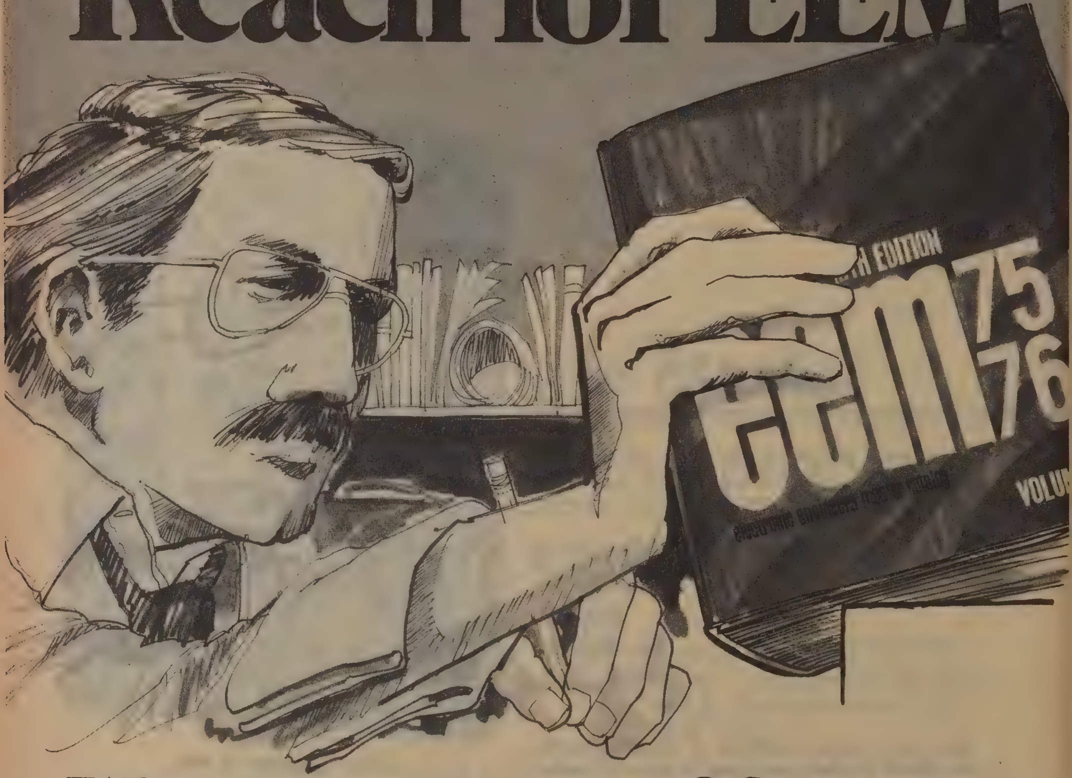
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18TH EDITION

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This issue of EEM is the largest, most complete catalog ever published in the electronics field. The two volumes contain more than 5,000 pages of up-to-date information. New features have been added and you may find it helpful to scan this page as a guide to the easy use of EEM.

1. INDEX OF MANUFACTURERS' CATALOG PAGES

When you need data from particular manufacturers, just look them up alphabetically in the index beginning on page 3 (green pages). More than 700 manufacturers have catalog pages in EEM, and easy reference is given for all these pages in two-number figures. The first number in bold type indicates the volume (1 or 2); the second, the page number. Example: **1**•141 means Vol. 1, page 141.

2. PRODUCT INDEX AND DIRECTORY

All products are indexed by basic type. Each product shows three groups of manufacturers:

1. **Boldface** listings with page references tell you that this manufacturer's catalog pages are right at hand in the white pages.
2. * the asterisk means that this manufacturer has catalog pages in the white section but not on this particular product.
3. Lightface listings, unmarked, means that the manufacturer has submitted a data sheet to verify that they do manufacture this product, but no further data is available in EEM.

New feature You'll find a handy Product Index and Directory in each volume. All product designations are in both volumes, but page references are given only for those products in that volume; you are referred to the other volume when the catalog pages are there.

New feature The letter "D" preceding the listing tells you that the product is available from distributors.

New feature The letter "M" preceding the listing tells you that the product is available in military specifications.

3. TRADE MARK DIRECTORY

If you have just a trade mark, this directory gives you the product it signifies and who makes it. We've black edgemarked the section for easy location. Beginning on page 2•301 (green pages), there are more than 2500 manufacturers' trade marks listed. Once you have the product and manufacturer, look in the Manufacturers and Sales Offices Directory for complete name and address.

4. MANUFACTURERS' CATALOG PAGES

Here is the greatest collection of detailed catalog pages on electronic products available anywhere. The section is indexed by product category, alphabetically. Manufacturers' catalog pages appear in each product category in alphabetical order. There is a handy guide to the product category in each volume of EEM on the page facing page 1. The great number of catalog pages were divided into the two volumes to facilitate handling.

5. MANUFACTURERS/SALES OFFICES DIRECTORY

Here is all the data on where they are — addresses and phone numbers of main offices, branch offices, local representatives, local distributors plus local contact names and phone numbers.

NEW DATA — Additional data included this year:

a. Minimum order accepted
b. Federal Supply Code (FSC) number
c. Qualified Parts List (QPL) number
d. Individual contacts by name for price data, application information, customer service
e. Free literature offerings
f. Summary of categories of products manufactured by each company
h. Corporate logos or trade marks for easy location of manufacturers. Manufacturers with catalog pages in EEM are indicated by **boldface** listings and page number references.

6. DISTRIBUTOR'S DIRECTORY

Yellow pages, black edgemarked for easy location, contain a geographic listing of electronic distributors offering name, address, phone number and sales manager. This section is to be found in Volume 2 following Manufacturers/Sales Offices Directory.

Your enthusiastic response and usage of EEM has helped make this edition the largest ever. Each year, we try to incorporate new features to make EEM better and easier to use. Your comments and ideas are sincerely welcomed. Please write Editorial Director, United Technical Publications, 645 Stewart Avenue, Garden City, N. Y. 11530.

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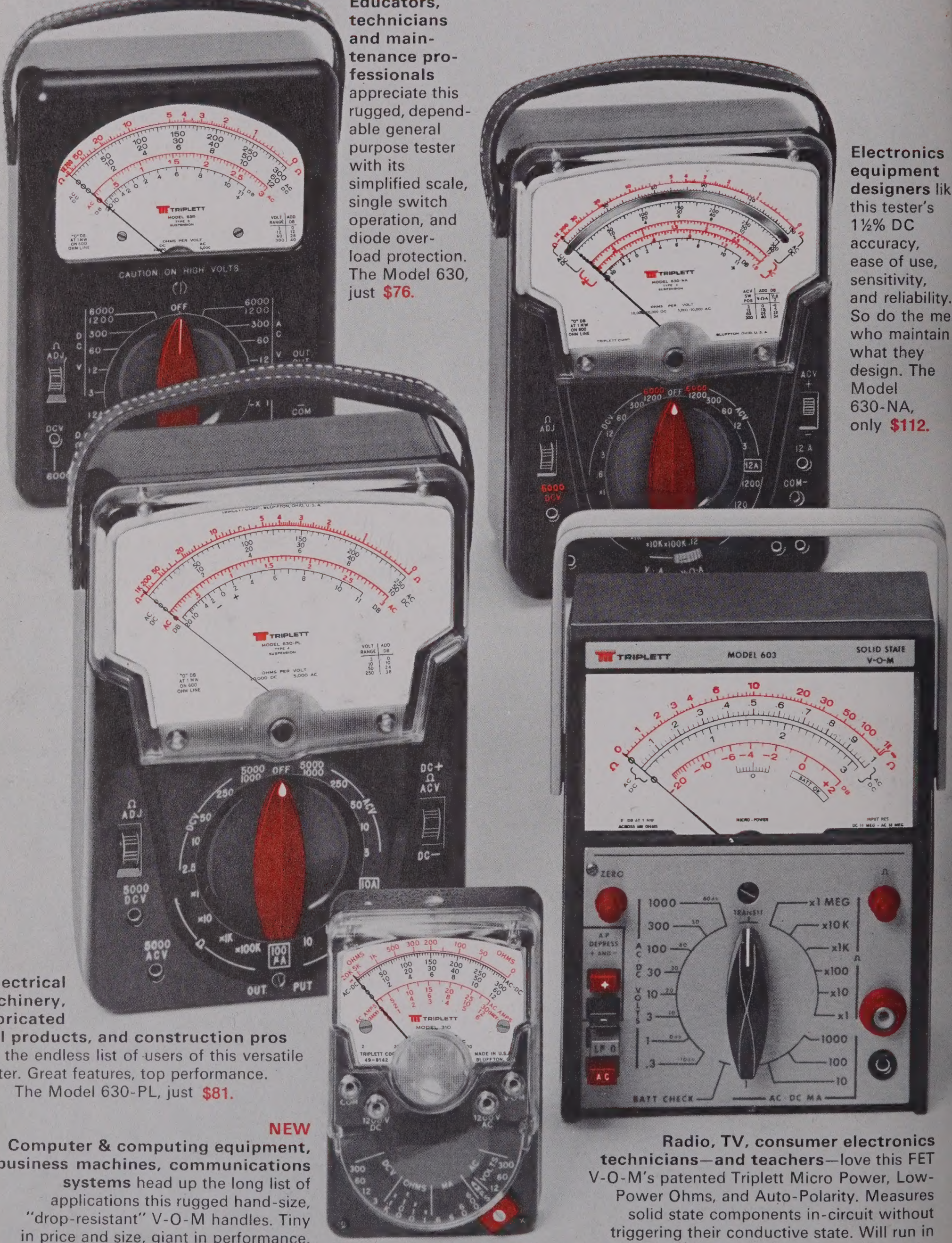

Educators, technicians and maintenance professionals appreciate this rugged, dependable general purpose tester with its simplified scale, single switch operation, and diode overload protection. The Model 630, just **$76.**

Electronics equipment designers like this tester's 1½% DC accuracy, ease of use, sensitivity, and reliability. So do the men who maintain what they design. The Model 630-NA, only **$112.**

Electrical machinery, fabricated metal products, and construction pros lead off the endless list of users of this versatile tester. Great features, top performance. The Model 630-PL, just **$81.**

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Computer & computing equipment, business machines, communications systems head up the long list of applications this rugged hand-size, "drop-resistant" V-O-M handles. Tiny in price and size, giant in performance. The New Model 310, Type 3, Only **$49.**

Radio, TV, consumer electronics technicians—and teachers—love this FET V-O-M's patented Triplett Micro Power, Low-Power Ohms, and Auto-Polarity. Measures solid state components in-circuit without triggering their conductive state. Will run in excess of a year even if left on continuously. The Model 603, **$173.**

See Yellow Section for Local Sales and Distributor's Office.

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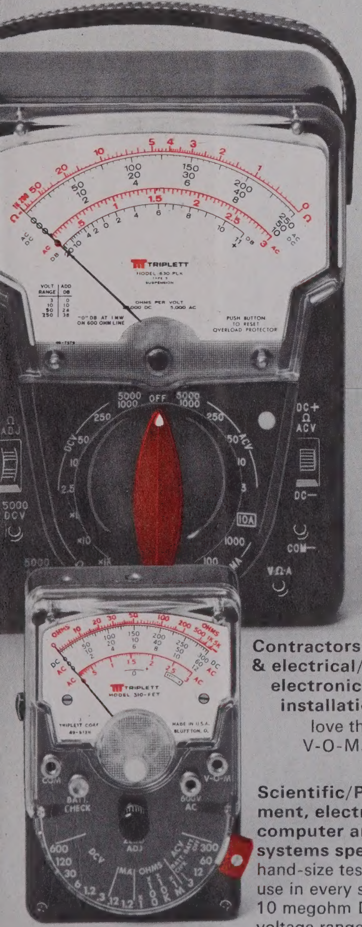

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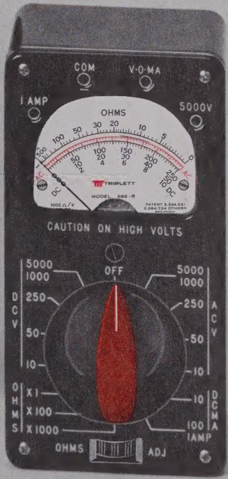

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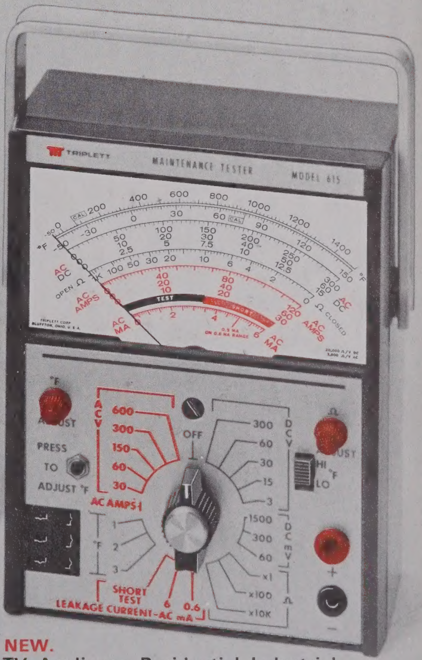

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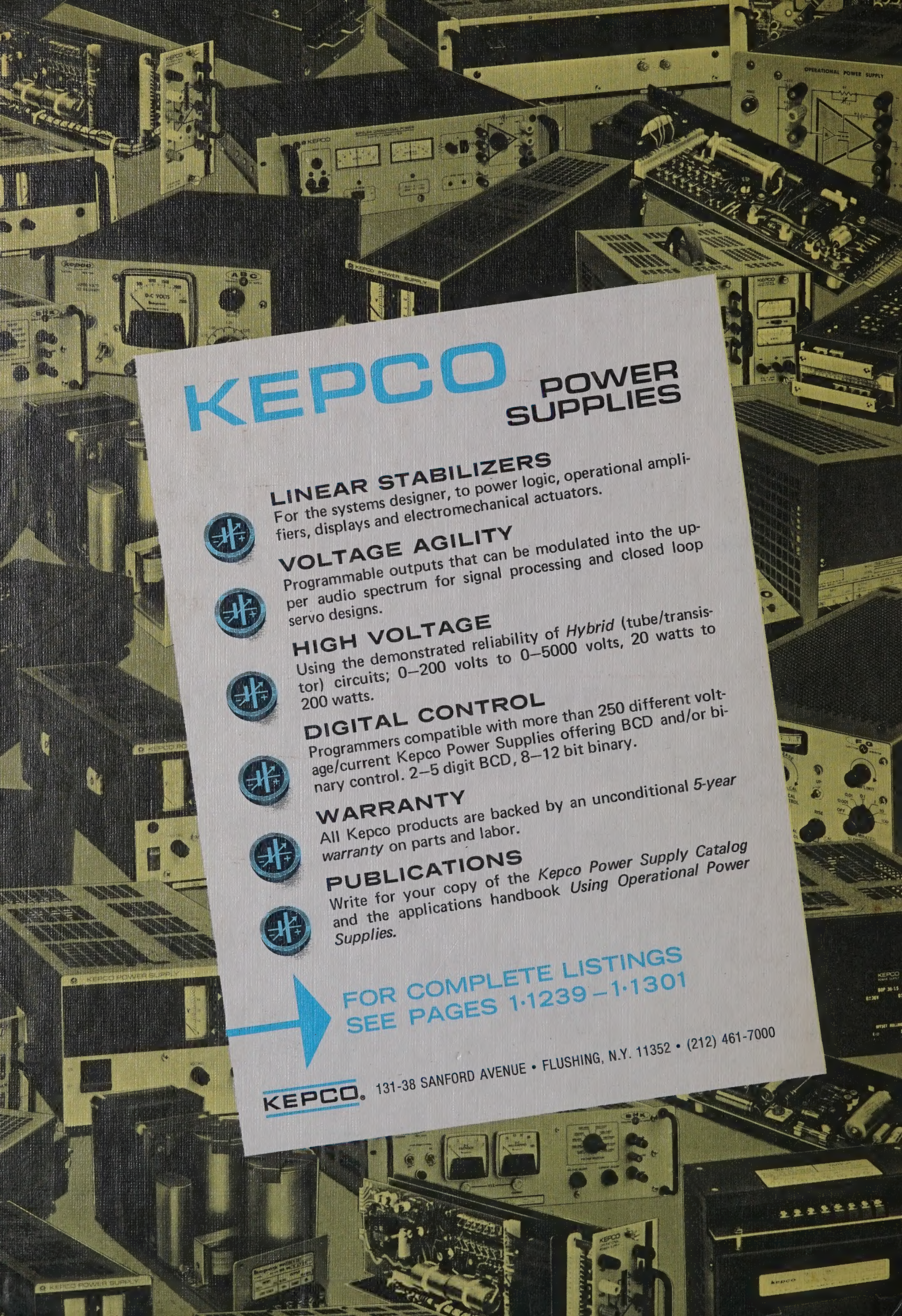

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